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REPORT OF THE NORTH SEA ROUNDFISH WORKING GROUP

Copenhagen, 12-21 March 1985

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K Hoydal, ICES Statistician, also attended the meeting.

2 TERMS OF REFERENCE

At the 1984 Statutory Meeting of ICES it was decided (C.Res. 1984/2:4:5) that the North Sea Roundfish Working Group should meet from 12-21 March 1985 at ICES headquarters to:

"assess catch options for 1985 inside safe biological limits for cod, haddock and whiting in Sub-areas IV and VI, and for cod and whiting in Divisions VII d-e"

In addition the Working Group was also requested to

i) provide quarterly catch at age and mean weight at age data as input for the Multispecies VPA for the period 1974 to 1984 and, as far as possible, for earlier years back to 1963 for the North Sea stocks,

ii) evaluate the evidence of natural mortality for the oldest age groups,

iii) assess the effects of applying the estimates of total natural mortality calculated by the Multispecies Working Group.

2.1 Data Base Revisions

Amendments:

Prior to this meeting, the whole of the data bases for the North Sea and Division VIa stocks of cod, haddock and whiting had been reconstructed and checked. As a result of this reconstruction the new data base was slightly different from that used previously. The reasons for these small differences are

a) In reconstructing the data base, the Scottish gears (seine, trawl, light trawl, Nephrops trawl and other gears) were processed individually. This was not the case when the roundfish data base was first constructed in its present form at the ad hoc meeting in Aberdeen (ICES Doc. C.M.1981/G:3). On that occasion Scottish data were processed and all other Scottish gears combined.

b) A few mistakes were discovered in the original data base.

c) Some of the landings data had been revised since the data base was created in 1981 and these revisions had not been incorporated into the data base.

Changes:

Age composition data for Norwegian industrial by-catch of haddock
in the North Sea had been revised in advance of this meeting, and
the new data were incorporated into the data base. Age composition
data for Danish human consumption landings of haddock from the
North Sea for the period 1980-83 had also been revised and were
incorporated into the data base.

Problems:

The Working Group was informed that the   official   landing
statistics from the Netherlands for 1984 consisted only of the
total year's catch by species. Furthermore, effort data were not
available for 1984. This means that the Working Group has been
unable to maintain its data series on catches of cod by the Dutch
beam trawlers. This data set had previously formed an important
input to various tuning methods.

3 VPA TUNING METHODS (Tables 3.1-3.6 and Figures 3.1-3.6)

Two new methods for tuning VPAs were presented to the Working
Group. These methods are described in Appendices 1   and   2,
respectively, and will be referred to as the Integrated Stochastic
VPA (ISVPA) and the catchability analysis method. The ISVPA is
currently implemented on the Danish Fisheries Research Institute's
computer, while the catchability analysis is implemented on a
micro-computer which was brought to the meeting. In addition to
these new methods, the Rho method used at previous meetings was
available on ICES computer.

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The results obtained using each of these methods are shown in the
text table below. It should be noted that the results of the ISVPA
were presented to the Working Group purely as information on the
state of development of Lewy's new model.

				North Sea				
		COD			HADDOCK			WHITING
Age	Rho	Cat	--	Rho	Cat	ISVPA	Rho	Cat --
1	.24	.19		.14		.27	.46	
2	1.33	1.25		.71	.69	.46	.31	.44
3	1.16	1.23		1.12	.96	.81	.68	.73
4	.88	.81		1.18	.90	.97	.77	.85
5	.76	.80		.86	.82	.83	.95	1.06
6	.89	.79		.88	.84	.73	1.19	1.14
7	.84	.75		1.50	.77	.88	1.29	1.11
8	.69	.72		.84	.86	.88	2.27	
9	1.10	.76		1.54		.88	.97	

WEST SCOTLAND								
	COD			HADDOCK			WHITING	
	Rho	Cat	--	Rho	Cat	--	Rho	Cat	--
Age								
1	.18	.08		?	.41		.19	
2	.73	.43		.17	.25		.51	.16
3	.77	.78		.33	.35		.84	.36
4	.73	.84		.43	.41		1.09	.40
5	.69	.83		.16	.44		1.03	.62
6	.68	.88		.75	.62		1.15	.77
7	.81	.99		1.82			2.26	

The fleet input data for each method are shown in the text table
below.

		NORTH SEA			WEST SCOTLAND	
FLEET	COD	HADDOCK	WHITING	COD	HADDOCK	WHITING
Scottish seine	RC	RCL	RC	RC	RC	RC
Scottish trawl	RC	RCL	RC	RC	RC	RC
Scottish light tr.	RC	RCL	RC	RC	RC	RC
Scottish Nephrops trawl	RC	RC	RC	RC	RC	C
English trawl	RC					
English seine	RC					

R = used in Rho method.
C = used in catchability analysis method.
L = used in ISVPA.

For the North Sea stocks the Working Group felt that the tuning methods all produced results which were in reasonably good agreement with each other and with recent historical values of fishing mortality.As indicated above, it was not intended that the results from the ISVPA should be used at this meeting. It was decided to use the results of catchability analysis as input to VPA rather than those from the Rho method. The reason for this decision was that the catchability analysis has the capacity to detect and follow any recent trend in catchability, and it was

this kind of consideration that created some problems last year. In addition, the catchability analysis is a fleet-disaggregated model of the type requested by ACFM in their report of May 1984.

In the case of the Division VIa stocks, it was felt that none of the methods gave satisfactory results. Inspection of various outputs from the Rho and catchability analyses indicated that the data for this area are probably of poor quality. In such a case it cannot reasonably be expected that tuning methods will function effectively. For the Division VIa stocks it was, therefore, decided to use mean fishing mortality rates for the period 1978-81 as input to VPA.

In the case of the haddock and whiting stocks in the North Sea, fishing mortality rates at ages 0 and 1 in 1984 were tuned using the IYFS results. For these two species in Division VIa, a corresponding tuning was carried out using the VIa/IV recruitment relationship.

The full results of the catchability analysis for each stock were printed out during the meeting. Because this amounts to about 200 tables and associated graphs it is not possible to include these results in the report, but an example of the output is included in Appendix 2. A copy of the results has been deposited with ICES Statistician for inspection by ACFM.

4 ESTIMATION OF RECRUITMENT

International Young Fish Survey: although all countries have provided ICES with exchange tapes holding the data for the 1983 and 1984 IYFS, it is not so far possible to calculate indices from the IYFS data base.

The final indices for the 1983 IYFS were made available from the IJmuiden Laboratory. The indices for the 1984 survey are still preliminary.

For the 1985 survey, which ended shortly before the meeting of the Working Group, preliminary data were available for the 1-group. Four countries had provided ICES with exchange tapes holding their 1985 length distributions and the length distributions of cod were made available by Mr H Sparholt. An attempt was made from examination of these distributions to calculate an index for the 2-group (year class 1983), but it was found that this could not be reliably achieved.

For cod, the indices from the IYFS, the English Groundfish Survey (EGFS) and the Dutch Groundfish Survey (DGFS) are tabulated together with by-catch data from shrimp fisheries by the Federal Republic of Germany and VPA year class estimates (Table 4.1). For haddock and whiting, the indices from IYFS and EGFS are tabulated with the VPA estimates (Tables 4.2 and 4.3).

Plots of different indices against VPA estimates of year class strength, and for the North Sea/West of Scotland relationship for VPA year class estimates are given in Figures 4.1 to 4.3.

Interpretation of the recruitment data is discussed for each stock in the appropriate section.

5 NORTH SEA COD

5.1 Catch Trends

Recent nominal landings are given in Table 5.1 and graphed in Figure 5.1.A. Provisional nominal landings in 1984 were 184,600 tonnes, considerably less than the 1983 landings of 231,512 tonnes. Working Group totals for the two years are 196,944 tonnes and 229,499 tonnes respectively. The TACs agreed between EEC and Norway for 1983 and 1984 were 240,000 tonnes and 215,000 tonnes respectively.

5.2 Age Composition

The VPA input data for recent years are given in Table 5.2; they do not include discards or industrial fishery by-catches. Subsequent to last year's meeting, the whole of the age composition data base back to the earliest year of 1963 was reconstituted. (See Section 2.1). The following countries provided age composition data for 1983 (updated) and for 1984 (provisional): Scotland, France, Denmark, Federal Republic of Germany, Netherlands, Belgium, England. Norway provided age composition data for industrial fishery by-catches.

5.3 Recruitment

5.3.1 1983 year class in 1984

Estimates of the abundance of this year class at age 1 are
available from the Federal Republic of Germany shrimp by-catch
data, IYFS,English Groundfish Survey (EGFS), and Dutch Groundfish
Survey(DGFS).With regard to the IYFS, two estimates were
potentially available: the arithmetic mean (AM) of the retangle
abundance and the log transformed mean (LM) of the rectangle
abundance.The 1985 report of the IYFS Working Group showed that of
these two indices, only the LM index is significantly correlated
with the abundance from VPA (Figure 4.1.A). A preliminary LM index
became available during the meeting and this indicates a year
class size of 252 millions at age 1. However, data from other
sources suggest that this estimate is too low. Although the data
series is relatively short, both the EGFS (Figure 4.1.B) and DGFS
(Figure 4.1.C) indices appear to correlate well with VPA. Both
surveys indicate that the 1983 year class is a strong one.

The EGFS estimate is about 400 millions and the DGFS estimate is
about 300 millions.A working paper presented to the Group (data
from Schumacher,1985) showed that there is a good correlation
between VPA number at age 1 and by-catches of 0 and 1 year old cod
in the shrimp fishery conducted by the Federal Republic of
Germany. From these data two estimates of the 1983 year class were
made, namely 462 millions and 492 millions (Figure 4.1.D). The
recruitment value of 393 millions which is implied by the F value
calculated for age 1 in 1984 by the catchability analysis is not
inconsistent with the values obtained from the sources described
above.It was therefore decided to accept this F value, which

results in a recruitment value for the 1983 year class at 1 of 393
millions.

5.3.2 1984 year class in 1985

The LM index of abundance (preliminary value) from the 1985 IYFS
was available, and this indicates an abundance of 164 millions at
age 1.(Figure 4.1.A). Catches at age 0 in 1984 were very low on
both the EGFS and theDGFS (Figure 4.1.B and C) which also suggests
that this year class is a poor one.

It was therefore decided to accept the IYFS derived figure as a
preliminary estimate, although the two groundfish surveys suggest
that the strength of this may be lower than the estimate derived
from IYFS.

5.3.3 1985 and 1986 year classes

These year classes were assumed as the average from VPA for the
period 1963-81. This produced a value of 209 millions at age 1.

5.4 Weight at Age

The mean weight at age in the stock is given in Table 5.3 and it
was assumed to be the same as that in the landings. For
predictions of catch in 1985 and 1986, mean weights were
calculated as the average for the period 1979-84.

5.5 Fishing Mortalities in 1984

The values adopted were those which resulted from the catchability
analysis method (see Section 3). For most age groups the F values
are consistent with recent values as shown by VPA (Table 5.4) but
they are somewhat higher at ages 2 and 3. As explained above, F at
age 1 was not adjusted, since the implied recruitment was accepted
as being consistent with groundfish survey data and shrimp by-
catch data.

5.6 VPA Results

Fishing mortalities in recent years are given in Table 5.4 and
mean F at ages 3 to 8 is graphed in Figure 5.1.A. Mean F increased
sharply in the early 1970s and a further increase appears to have
taken place in the most recent years. Stock numbers and biomasses
are given in Table 5.5, and recruitment at age 1 and spawning
stock biomass (SSB) are graphed in Figure 5.1.B. Recruitment has
fluctuated between about 100 millions and 450 millions over the
period shown but no marked trend is apparent. SSB has declined
since 1971,is currently at the lowest recorded level, and is
predicted to fall to even lower levels (just over 90,000 tonnes)
by 1987.

5.7 Equilibrium Yield and Spawning Stock Biomass for Average
    Recruitment

Yield and SSB curves are shown in Figure 5.1.C. The input stock
weights, and exploitation pattern are averages for the period
1979-84. Mean recruitment of 209 millions, averaged over the
period 1963-81, was used in the calculations.

5.8 Catch Predictions

The input data used for catch predictions are given in Table 5.6. The mean weights and exploitation pattern are the averages for the period 1979-84.

Two assumptions were made about F in 1985: (1) that it would be the same as in 1984, or (2) that it would correspond to the TAC of 250,000 tonnes. In fact, predicted F in 1985 is virtually identical for the two assumptions, since Assumption 1 results in a catch of 248,000 tonnes, which is very close to the TAC. Therefore only the results from Assumption 1 are presented.

For 1986, catches and biomasses were calculated for a range of F options, and the results are presented in Table 5.7 and Figure 5.1.D. If F remains constant in 1986, a catch of 210,000 tonnes is predicted, and spawning stock biomass in 1987 will remain at a historically low level of 95,000 tonnes.

6 COD IN DIVISION VIa

6.1 Catch Trends

Recent nominal landings are given in Table 6.1 and graphed in Figure 6.1.A. The provisional value of 21 107 tonnes in 1984 is very similar to the landings of 21 498 in 1983; the Working Group figures do not differ significantly from the officially reported data.

6.2 Age Composition

VPA input data are given in Table 6.2; they do not include discards or industrial fishery by-catches. Subsequent to last year's meeting, the data base was revised by further disaggregation of Scottish data (See Section 2.1). Age composition data for 1983 (updated) and 1984 (provisional) were provided by England, Scotland, and Ireland.

6.3 Recruitment

6.3.1 1983 year class in 1984

There is no recruitment survey in Division VIa and, for cod, there is no correlation between recruitment in Division VIa and that in the North Sea (Figure 4.1.E). Because both the Rho plot and the catchability analysis plot showed a wide scatter of points for age 1 (and other ages), the resultant estimates of F were not accepted. However, examination of Scottish cpue data indicates that the 1983 year class is a strong one. The most reliable data are considered to be those relating to Scottish seiners, since catchability at age 1 for that fleet shows the least variance and no trend over recent years. Therefore for this fleet a plot was made for age 1 of cpue against VPA (Figure 6.2). The data are well correlated, although it is recognised that there is a degree of forced correlation, since Scottish seine data are included in both data sets. The 1983 cpue value predicts a VPA stock size of about 19 million fish at age 1, and this value was adopted for the size of the 1983 year class.

6.3.2 1984 and later year classes

These year classes were assumed to be of average strength. To take account of higher levels of recruitment in recent years (Figure 6.1.B), an average was calculated for the recent period 1977-81. This resulted in a value of 12.5 million fish at age 1.

6.4 Weight at Age

In the 1984 report of this Working Group, it was pointed out that the weight at age data base for earlier years consisted of a constant set of values. This has now been rectified. Weight at age in the stock is assumed to be the same as that in the catch (Table 6.3).

6.5 Fishing Mortalities in 1984

As mentioned above, Scottish catch and effort data were examined using the Rho analysis and catchability analysis. In general the plots showed a wide scatter of points and no consistency in trends. It was therefore decided to revert to the use of an average F. A 4-year average of reasonably converged F values was adopted as a standard procedure for all Division VIa stocks, and Fs in 1984 are thus mean values for the period 1978-81 (except at age 1, as explained above). The Fs resulting from this procedure are given in Table 6.4 together with past values in recent years. It will be noted that the years chosen for the averaging procedure (1978-81) include some F values which appear to be somewhat erratic, in particular including some high values in 1979 and 1980. Various alternative procedures were considered, such as the use of different years for the reference period or scaling the Fs in 1984 to correspond to the apparently decreasing trend in average F in the most recent years. However, each of these options

was perceived to have some drawbacks and it was decided to use
1978-81 as the reference period, whilst recognising that there may
be other equally valid methods of proceeding.

6.6 VPA Results

Fishing mortalities for recent years are given in Table 6.4 and
mean F for ages 3 and 4 are graphed in Figure 6.1.A. Mean F has
fluctuated considerably over the period and an upward trend can be
detected in the 1970s, but in recent years F has become reduced.
Stock numbers and biomasses are given in Table 6.5, while
recruitment and SSB are graphed in Figure 6.1.B. Recruitment has
fluctuated between about 5 millions and 21 millions,with the
higher levels being recorded in recent years. SSB showed a
declining trend in the 1970s but this has been reversed in the
early 1980s and, assuming constant F, is predicted to remain at
levels higher than those in the 1970s in the immediate future.

6.7 Equilibrium Yield and Spawning Stock Biomass at Average
Recruitment

These are shown in Figure 6.1.C. The stock weights and exloitation
pattern used in the calculations are average values based on years
1979-84. An average recruitment of 12,5 millions at age 1 was
also used.

6.8 Catch Predictions

The input data used for catch predictions are given in Table 6.6.
The mean weights and exploitation pattern are averages for the
period 1979-84.

The assumption that $\bar{F}_{85}=\bar{F}_{84}$ results in a catch in 1985 of 25,670 tonnes, which is close to the portion of the TAC for Sub-area VI which is attributable to Division VIa, namely 24,500 tonnes. The results for predictions in 1986 are therefore based on the assumption of unchanged F in 1985, and a catch of 25,670 tonnes in that year. Results are given in Table 6.7 and shown graphically in Figure 6.1.D.

Catches and biomasses were calculated for a range of Fs in 1986. If F remains at the 1985 level, a catch of 25,290 tonnes is predicted in 1986 and SSB at the beginning of 1987 will remain at the same level as at the beginning of 1985.

7 COD IN DIVISION VIb

No age composition data are available from commercial landings from this stock. Nominal landings are quite small and are given in Table 7.1.

8 COD IN SUB-AREA VII

8.1 Cod in Divisions VIId,e

The age composition data base continues to be built up with data for 1983 and 1984 being supplied by France and England. However, due to the lack of sufficiently long time series of such data, no analytical assessment is yet possible. It is planned to make some improvements to the data base by correspondence before the next meeting. Historical landings data are given in Table 8.1.

8.2 Cod in Divisions VIIb,c and VIIg-k

No age composition data are available. Landings data are given in Table 8.2.

9 NORTH SEA HADDOCK

9.1 Catch Trends

Total international landings and total international catches as estimated by the Working Group are given in Table 9.1 and Figure 9.1.A for the period 1960 to 1984. The TAC for 1984 was 170,000 tonnes and provisional nominal landings (Table 9.1) were 131,498 tonnes. Discards were estimated at 72,473 tonnes.

9.2 Age Composition (Table 9.3)

Age compositions for human consumption landings were provided by Denmark, France, Federal Republic of Germany, England, Netherlands and Scotland. Age compositions for industrial by-catch were provided by Denmark and Norway, and for discards by Scotland.

Incomplete sampling of the Danish industrial catches means that there is some doubt about the 0- and 1-group catch numbers in 1984.

Revisions were made to the historic data base as described in Section 2.1.

9.3 Weights at Age

The revised mean weight at age data for the total catch (taken as stock weights) is given in Table 9.4.

9.4 Recruitment

1984 year class in 1985

A preliminary IYFS index for the 1984 year class at age 1 was available. Table 4.2 gives the indices and corresponding estimated numbers at age 1 estimated from the current VPA and a plot of these is shown in Figure 4.2.A. Recruitment of the 1984 year class at age in 1985 was estimated using a predictive linear regression of VPA numbers at age 1 and on IYFS indices for the years 1970 to 1983, and the estimated number is 580 million (767 million at age 0).

1983 year class in 1984

At last year's meeting of the Working Group the abundance of this year class was estimated to be 3000 million at age 1. The value estimated by the same regression as that used for the 1984 year class estimation is 3,027 million (4397 million at age 0). This is the strongest year class since that of 1974. It is encouraging to note that EGFS results (Table 4.2) confirm that the 1983 year class is of high abundance.

9.5 Fishing Mortality Rates in 1984

As explained in Section 3, it was decided to adopt estimates of F for ages 2 to 10 in 1984 from the catchability analysis and for ages 0 and 1 from recruitment predicted by the IYFS indices and

catch numbers.

9.6 VPA Results

Estimates of fishing mortalities for the period 1975 to 1984 are
given in Table 9.5 and corresponding stock numbers and biomasses
in Table 9.6.The spawning stock biomasses were derived using the
maturity ogive given in Table 9.7.

Historical trends in fishing mortality, spawning stock biomass and
recruitment can be seen in Figures 9.1.A and 9.1.B.

9.7 Equilibrium Yield and Spawning Stock Biomass for Average Recruitment

The input for this analysis was the same as for the prediction
(Table 9.7) and average recruitment of 2,455 million at age 0 was
assumed; this was calculated for the period 1960 to 1981 omitting
the outstanding 1967 year class. Results are shown in Figure
9.1.C.

9.8 Catch Predictions

An initial catch prediction run was carried out using the catch at
age data shown in Table 9.3 and assuming the $\bar{F}_{85} = \bar{F}_{84}$. This
produced a predicted catch in 1985 of 263,000 tonnes which is 27%
greater than the TAC agreed between EEC and Norway (Table 9.8).
The Working Group is, however, of the opinion that this is a
spurious result brought about largely as a result of the poor
estimates of catch at age 0 and 1 in 1984 in the Danish industrial
fishery.

The Working Group's reasons for believing this are as follows:

   a) The IYFS gives reliable estimates of abundance at age 1;

   b) If the IYFS estimate of abundance of the 1983 year class at
      age 1 in 1984 is correct then the catch at age 1 reported in
      Table 9.3 implies that F at age 1 in 1984 was 0.16, which is
      approximately 50% lower than average F for the period 1978-
      81;

   c) If this is the case, then the expected stock number of 2-
      year old haddock at the start of 1985 is 2101 millions, and
      it is mainly because of this that the predicted 'status quo'
      catch in 1985 exceedes the TAC.

   d) The Working Group, therefore, concludes that the catch at
      age data for 1-group fish in 1984 are unacceptable and
      further extends this conclusion to the 0-group fish which
      were also poorly sampled in the Danish industrial by-catch.

To resolve this difficulty, the Working Group decided on the
following approach:

   i) Accept the IYFS estimate of abundance of the 1983 and 1984
      year classes at age 1;

  ii) Assume that the mean F for the period 1978-81 at ages 0 and
      1 is a reasonable estimator of F at those ages in 1984;

 iii) Reject the catch values at ages 0 and 1 in 1984 shown in
      Table 9.3 and replace them with catches calculated using the
      Fs referred to in (ii) above and the stock number estimates
      referred to in (i) above. This implies that the weight of
      the industrial by-catch in 1984 is not 10,000 tonnes as

reported to the Working Group but 40,000 tonnes.

This means that the VPA input and results for 1984 for ages 0 and
1 now become as shown in the text table below.

	1984	1984	1984	1984
Age	Catch	F	Stock	Stock
0	311123	0.393	1049453	
1	1080099	0.495	3027401	579999
2				1510900

The Working Group is of the opinion that this prediction is much
more realistic than the one using the inadequate catch data.
Options for catches under the assumptions just discussed are shown
in Table 9.10 and input data for these predictions are shown in
Table 9.9.

The prediction based on the revised catch figures in Fs implies
that if $\bar{F}_{85}=\bar{F}_{84}$, the expected landings in 1985 are 216,000 tonnes
which is close to the 1985 TAC. Expected landings in 1986,
assuming av.F_{86}=av.F_{85}=av.F_{84} are 239,000 tonnes.

10 HADDOCK IN DIVISION VIa

10.1 Catch Trends

Nominal landings in 1984 were 29,979 tonnes compared to 27,000
tonnes predicted by the Working Group last year. The estimate of
discarded catch in 1984 is 16,201 tonnes. Figure 10.1.A shows the
historic trends in landings. The nominal landings by country for
the last 10 years are given in Table 10.1.

10.2 Age Composition (Table 10.2)

1984 age composition data were provided as follows:

Category	Nations suppl. age comp.
Human consumption landings	UK (England), France, Ireland, UK (Scotland)
Discards	UK (Scotland)

10.3 Weight at Age

Mean weight at age data for the total catch (used as stock mean
weights) are given in Table 10.3.

10.4 Recruitment

Estimates of the 1983 and 1984 year classes at age 1 were derived
from a regression of numbers at age 1 in Division VIa on numbers
at age 1 in Sub-area IV using VPA results for the years 1965-83
(Figure 4.2.B). The regression equation is $N_{VIa}=0.0932\ N_{IV}-12.527$
$(r = 0.94)$.

1984 year class in 1985

The estimated value is 42 millions at age 1 in 1985 (51 millions
at age 0).

1983 year class in 1984

The estimated value is 270 millions at age 1 in 1984 (332 millions
at age 0). Last year the Working Group estimated this year class
as 250 millions at age 1.

10.5 Fishing Mortality Rates in 1984

As explained in Section 3 the tuning methods did not provide
satisfactory estimates of fishing mortality rates in 1984 for this
stock and so mean values for the period 1978-81 were adopted for
1984 for ages 2-7 and 0.9 for older ages. Estimates for F at ages
0 and 1 were derived from the recruit number estimates in
association with the appropriate catch numbers.

Fishing mortality at age for 1975 to 1984 is given in Table 10.4.

10.6 VPA Results

Estimated fishing mortalities, stock numbers and biomasses from VPA are shown in Tables 10.4 and 10.5. The maturity ogive is given in Table 10.6. The decline of spawning stock biomass from the very high level in 1982 continued to 1984.

10.7 Equilibrium Yield and Spawning Stock Biomass for Average Recruitment

The input data for this analysis were the same as for the catch prediction (Table 10.6). Average recruitment was calculated for the period 1965 to 1981, omitting the 1967 year class, as 169 millions at age 0. The maturity ogive as used in the VPA was used to calculate spawning stock biomass. Results from this analysis for various levels of fishing mortality are given in Figure 10.1.C.

10.8 Catch Predictions

Input data for the predictions are shown in Table 10.6. The only option considered was that the mean fishing mortality in 1985 equalled that in 1984. The assumption that the TAC would be taken in 1985 could not be made because the TAC is for catches in Divisions VIa and VIb combined. The predicted landings for 1985 assuming no change in fishing mortality is 32,000 tonnes. Results from the prediction are given in Table 10.7 and Figure 10.1.D.

11 HADDOCK IN DIVISION VIb

11.1 Catch Trends

Landings of haddock from Rockall (Table 11.1) increased during the years 1980-82 when English freezer-trawlers participated in the fishery. This fishery ended and in 1983 landings of only 400 tonnes were reported from this area. Reported landings for 1984 increased to 2,400 tonnes as a result of renewed interest by both English and Scottish conventional vessels.

11.2 Stock Assessment

In previous years it has been possible to estimate the stock size using data obtained on English trawl surveys. In 1984, the vessel used for these surveys was no longer available and no survey was made. Some sampling of commercial landings was undertaken in England and Ireland but at present these data are inadequate for an assessment to be made. The available data show no indication of any significant recruitment after the 1981 year class. Until there is recruitment of a sizeable year class, the stock biomass will decline and the fishery will continue to be dependent on the existing large year classes of 1976, 1980 and 1981. In the absence of an analytical assessment, a TAC of about 5,000 tonnes is suggested for 1986.

12 HADDOCK IN SUB-AREA VII

Haddock landings from Divisions VIIb-c and VIIg-k are given in Tables 12.1 and 12.2.

13 NORTH SEA WHITING

13.1 Catch Trends

Total international landings and total international catches as estimated by the Working Group are given in Tables 13.1 and 13.2 and Figure 13.1.A. The provisional nominal landings for 1984 amount to 93,000 tonnes which is close to the catch officially reported for 1983 (98,000 tonnes) and well below the agreed TAC for 1984 of 145,000 tonnes. The Working Group estimates of total catch (including discards) amount to 154,000 tonnes and 133,000 tonnes respectively for 1983 and 1984.

13.2 Age Composition (Table 13.3)

The age composition data for 1983 were updated and provisional estimates for 1984 were prepared.

Age composition data were supplied as follows:

For human conmsumption landings:
    Belgium, England, France, Netherlands and Scotland.
For discards:
    Netherlands and Scotland.
For industrial by-catch:
    Denmark and Norway.

Incomplete sampling of the Danish industrial by-catches means that there is some doubt about the 0- and 1-group catch numbers in 1984.

13.3 Mean Weight at Age

Mean weight at age data for total catches (used as stock weights)
are given in Table 13.4.

13.4 Recruitment

The relationship between stock numbers from VPA at age 1 and IYFS
indices (Table 4.3). Figure 4.3.A provides estimates of abundance
at age 1 of the 1983 and 1984 year classes of 1631 and 1392
million fish respectively (2724 and 1871 million at age O). No
IYFS index was available for the abundance of the 1983 year class
at age 2. An average recruitment of 2672 million fish at age O
(mean value for 1960-81) is assumed for 1985, 1986, and 1987.

13.5 Fishing Mortalities in 1984 (Table 13.5)

F at ages O and 1

The F values implied by these recruitment values at age O and 1 in
1984 are rather lower than in the previous years and may be
suspect due to sampling problems in the industrial landings
referred to above.

F at ages 2-7

These were estimated using the "catchability analysis" (See
Section 3).

F at ages 8-10

At these ages, fishing mortalities were set at 1.0.

13.6 VPA Results

Estimated fishing mortalities are shown in Table 13.5 and Figure
13.1A.   The corresponding stock numbers and stock biomass are
shown in Table 13.6 and Figure 13.1.B.

The average F value over the age groups 2-6 in recent years has
fluctuated above a level of about 0.9. The downward trend in
spawning stock biomass observed since 1980 is continuing and
spawning stock biomass in 1984 is at its lowest level since 1972.

13.7 Equilibrium Yields and Spawning Stock Biomass for Average
Recruitment

Long-term equilibrium yields for human consumption and total
landings and spawning stock biomass are shown in Figure 13.1C.
Input data were those used for catch predictions (Table 13.7).

13.8 Catch Prediction

Input data for catch predictions are given in Table 13.7. The mean
weights at age and exploitation patterns are the average for the
period 1979-84.

The assumption that the catch in 1985 would equal the agreed TAC
of 160,000 tonnes requiring an unrealistically high fishing
mortality ($\bar{F}_{84}$ should be raised by a factor 2.4), it has not been
taken into account. Then only the "status quo" assumption ($\bar{F}_{85}$ =

$\bar{F}_{84}$ in the human consumption fishery) was considered.

Results are given in Table 13.8. Predicted total landings for 1985 are 117,000 (human consumption: 72,000 tonnes, industrial by-catch: 45,000 tonnes). The last year prediction produced total landings in 1985 of 118 000 tonnes, assuming average F_{85}= average F_{84}.

For 1986, the "status quo" option produces total landings of 135,000 tonnes (human consumption: 85,000 tonnes, industrial by-catches: 50,000 tonnes).

Under this assumption, total stock biomass and spawning stock biomass increase from 1985 to 1987 respectively from 470,000 tonnes to 553,000 tonnes and from 308,000 tonnes to 370,000 tonnes.

As for the North Sea haddock, the Working Group has reservations about the validity of the estimates of F in 1984 on the younger age groups due to deficiencies in the sampling of the industrial by-catches. In the case of haddock, the 1983 year class is a particularly large one which exacerbates the problem. The 1983 year class of whiting is only of average size. The catches of whiting predicted for 1985 from the present assessment are in good agreement with those expected from last year's assessment, and the Working Group is of the opinion that any errors resulting from poor industrial by-catch sampling are unlikely to be as serious as in the case of haddock.

14 WHITING IN DIVISION VIa

14.1 Catch Trends (Table 14.1)

The revised reported landings for 1983 were 15,594 tonnes and the provisional landings for 1984 were 16,191 tonnes. However, the Working Group estimate of 15,902 tonnes was used in the assessment. The TAC for 1984 was 16,400 tonnes.

14.2 Age Compositions (Table 14.2)

The age composition data for 1983 were revised. Provisional age compositions for 1984 were compiled from Irish and Scottish data. Small revisions of the data base from 1965 to 1982 were also done (See Section 2.1).

14.3 Recruitment

Abundance figures of the 1983 and 1984 year classes at 1 year old were estimated to 78 million and 66 million respectively by correlating the VPA recruitment values for Division VIa versus VPA recruitment values for Sub-area IV (Figure 4.3.B).

The number of recruits of age 1 entering the fishery in 1986 and 1987 was assumed to be 90 million, which is the average number of 1-group whiting during the period 1965-81.

14.4 Weight at Age

Mean weight at age data for the landings (also used as stock weights) are given in Table 14.3.

14.5 Fishing Mortalities in 1984

Both the Rho method and the catchability analysis were tried. However, the data from this area do not seem to be good enough for any of the methods to give satisfactory results. The Working Group therefore decided to use mean values of fishing mortalities for the period 1978 through 1981 for input to VPA (See Section 3).

Fishing mortality for age 1 was chosen to produce a 1983 year class of 78 million in 1984.

14.6 VPA Results

Estimated fishing mortalities for the period 1975-84 are shown in Table 14.4 and Figure 14.1 and the corresponding stock numbers and stock biomasses are shown in Table 14.5 and Figure 14.1.

14.7 Equilibrium Yield and Spawning Stock Biomass for Average Recruitment

The yield was calculated using an exploitation pattern and mean weights at age equal to the averages 1979-84 (Table 14.6). The curve (Figure 14.1) has no clear maximum. The $F_{0.1} = 0.16$ is indicated in the figure.

14.8 Catch Prediction

The input data for catch predictions are given in Table 14.6. The exploitation pattern and the mean weights at age used were averages for the period 1979-84.

The catch prediction assuming average F_{85} = average F_{84} gave landings of 14,000 tonnes in 1985. To take the 1985 TAC of 16,400 tonnes, fishing mortality would need to increase to 0.75, and this is considered to be unrealistic and no alternative prediction was made on this basis. The results of the prediction runs are shown in Table 14.7 and are also given in Figure 14.1.

The spawning stock has decreased since 1981 and the predicted spawning stock of 1985 is at a low level. However, the predictions for 1987 show that the spawning stock will stabilise.

15 WHITING IN DIVISION VIb

Landings of whiting from Division VIb are insignificant (Table 15.1).

16 WHITING IN SUB-AREA VII

16.1 Whiting in Divisions VIId,e

Landing figures for 1983 have been revised from 5,743 tonnes to 7,012 tonnes. Provisional landings in 1984 are 7,229 tonnes (Table 16.1). The age composition of the human consumption landings in 1983 has been revised, and provisional estimates for 1984 were prepared. The age composition data have been submitted

by England and France for 1983 and 1984, covering 99% of the
landings for these two years.

A VPA was made to give some indications about the level of
exploitation. The input catch data are given in Tables 16.2 and
16.3. Both catch at age and weight at age data reveal an obvious
discontinuity at 1981: the numbers landed of the older age groups
have been increasing since that year whereas the weights at age
have been decreasing. Before the 1986 meeting, a revision of the
database should be tried, as well as for cod in this division. The
fishing mortalities are given in Table 16.4. In the absence of
effort data the input values for the last data year were adjusted
to correspond with the average over the period 1976-81. The stock
estimates are shown in Table 16.5.

16.2 Whiting in Divisions VIIb, c and VII g-k (Table 16.6)

Landings in 1980-83 fluctuated around 9,000 tonnes as in the
earlier period of 1975-76. The provisional figure for 1984 is
6,179 tonnes, at the same low level as in the period 1977-79.

17 PROVISION OF QUARTERLY CATCH AT AGE AND WEIGHT AT AGE DATA FOR
   INPUT TO MULTISPECIES WORKING GROUP

None of the participants was able to provide complete sets of
quarterly data at the time of the meeting. Table 17 indicates
which data, for the last ten years, are available or will be
shortly. For some countries the data are sub-divided on a
fleet/gear basis.

No progress was made in processing the quarterly data during the course of the meeting but participants undertook to send their complete data sets to a coordinator (D W Armstrong) before the end of June. Mr Armstrong offered the facilities of the Aberdeen Laboratory to assist with the computer-processing of the data. In view of the large volume of data it is hoped that some Working Group members would be able to visit Aberdeen in the autumn and assist with the data processing and to advise the coordinator on any problems arising.

The Working Group identified a number of potential problems which may arise in processing the quarterly data. It was considered that the present method for estimating annual discards for countries not sampling this category could apply equally well to quarterly data.

The Group also discussed whether the North Sea Roundfish data for future years should be prepared quarterly and then the quarters summed to give annual age compositions required by the Roundfish Working Group. It was considered, however, that it would be preferable to maintain a consistent set of annual data and these would be prepared as at present. Quarterly data will be requested from members and would be processed in addition to the annual data. In the longer term the way the data are processed will depend on developments which may take place in the ICES Standard Assessments Package and Database and the ability of the ICES system in the future to handle data at a more disaggregated level than at present.

18 PROCEDURE FOR CALCULATING CATCH PREDICTIONS FOR THE NORTH SEA HADDOCK AND WHITING STOCKS

The present procedure is as follows:

1) Weight at age arrays for each category (human consumption landings, discards and industrial by-catch) and for the total used for the prediction period are determined as averages of the last 6 data years (the reference period).

2) Fishing mortality at each age in the last six data years as determined from VPA is split into the fishing mortality in each category on the basis of numbers of fish in the catch of each category. Six years' averages of F at each age are obtained for each category. a)

3) Average F is calculated for the human consumption fishery (landings and discards). A scaling factor is calculated for the human consumption fishery as av. F for the last data year divided by av.F for the reference period. This factor is then used to re-scale the reference period exploitation patterns for the human consumption fishery to the same level of F as in the last data year. For the industrial by-catch the reference period exploitation pattern is not rescaled and is added to the rescaled values for the human consumption fishery to give the F at age array for the total fishery for the status quo prediction option.

4) Catch predictions are made and the catches in each category are determined separately. For catch predictions other than the status quo situation a range of factors is applied to the human consumption fishery F values to provide a range of catch options for the TAC year corresponding to different levels of fishing mortality. These factors are not applied to the industrial by-catch F values and the industrial

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a)   to give the smoothed exploitation patterns for the
        prediction period.

fisheries are assumed to continue at a constant level of fishing mortality.

The object of this description is to draw attention to the way the industrial by-catch is treated in catch predictions. This procedure dates from earlier years when conservation regulations had their main effect on the human consumption fishery and the industrial fishery was expected to continue with more or less constant effort. Alternative treatments would be possible but as they would require amendments to the software, some notice of any proposed change would be required.

The Working Group would, however, like ACFM to advise it whether the present procedure is considered satisfactory or whether a different procedure would be preferable such as, for example, applying factors for the different catch options to the industrial fishery as well as to the human consumption fishery. Consideration could also be given to rescaling (stage 3) the reference period exploitation for the industrial fishery as is done for the human consumption fishery although for the industrial fishery a different range of ages would need to be used for the calculation of average F.

19 EVALUATION OF EVIDENCE OF NATURAL MORTALITY FOR THE OLDEST AGE GROUPS

The Working Group considered this subject and concluded that no information was currently available on rates of natural mortality on the older age-groups. It was suggested that some models now available might be able to estimate M from commercial catch data and groundfish survey data.

20 **ON THE ASSESSMENT OF NATURAL MORTALITIES ESTIMATED BY THE**
   MULTISPECIES WORKING GROUP

In its report (Anon., 1984) the Multispecies Working Group
presented estimates of predation mortalities in Table 2.9.1 for
six alternative assumptions. Run no.6 (Table 2.9.1 in Anon., 1984)
tries to take into account the fact that mean weights at age of
prey in the predator stomachs were different from the mean weights
at age in the population in the sea.

The results obtained from Run no.6, therefore, should represent
the most realistic estimates of predation mortality. However, the
fact that the mean prey weight in stomachs deviates from that in
the sea was realized during the meeting of the Multispecies
Working Group, and the necessary modifications of the MSVPA-
program were made in the course of that meeting.

Whether these modifications of the MSVPA-program were done
correctly still remains to be decided by the Multispecies Working
Group at its next meeting. Some members of the Multispecies
Working Group expressed their doubts as to whether the MSVPA-
program in fact did what it was supposed to do (Sparre,
pers.comm.) and a new alternative version has been developed
(Gislason and Sparre, 1985).

Bearing in mind the above described state of the art in
multispecies assessment, the Working Group on North Sea Roundfish
did not consider it worthwhile to assess the effect of predation
mortality estimates given in Anon., 1984, but rather to wait for
the next report of the Multispecies Working Group.

21 DISCUSSION ON FUTURE DEVELOPMENTS OF THE ICES STANDARD
   ASSESSMENT PROGRAMME SUITE AND DATABASE

A discussion paper on the above subject was introduced by ICES Statistician.

On the subject of the structure of the database, the Working Group suggested that files could be maintained of national source data, where available, consisting of:

    Numbers at each age
    Weight at each age (kg)
    Landed weight (tonnes) (mandatory)
    Fishing effort

For each stock, these data would be by country with sub-division by fleets by quarter year. Within each stock, files would need to be maintained for each category (e.g., human consumption landings, discards, industrial by-catch).

These source data would need to be processed to correct for SOP discrepancies (if required) and to prepare estimates of age compositions for unsampled countries or categories, and suitable programs should be provided for doing this.

Further programs would be needed to aggregate the data to the stage of aggregation required as input into the assessment programs. Requirements will differ for different Working Groups.

A standard procedure for each stock stored as a macro could be a possibility for processing and aggregating source data or another possibility might be an interactive programme allowing the user to vary procedures according to the availability of data. The latter approach would require the program to keep careful documentation of the procedure used in each year.

It was suggested that intermediate files should be maintained of
the   processed   and   aggregated source data which would be
immediately available for stock assessment.

On the question of requirements for ICES standard assessment
programs, the Working Group favoured an approach whereby it would
be possible to transfer data and results from one program to
another. Programs should be able to print tables in the format
required for inclusion in reports. It was suggested that menu
options might be reduced, but if it was considered necessary to
maintain a full range of options, thought could be given to
enabling users to define control files which would specify a
preferred route through the options. The Working Group would like
a standard ICES prediction program which would handle multi-
category catch predictions.

22 RECOMMENDATIONS

In order to make it possible to evaluate sampling errors of catch
in number of the various national fleets which may be essential to
the results of the Integrated Stochastic VPA, the Working Group
recommends that each country provides information on

    a) the variance of catch in number

    b) the corresponding covariances.

23 REFERENCES

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Table 3.1.   NORTH SEA COD.
Effort data (hours x 10^{-3}) and catch at age

YEAR	EFFORT	AGE 1	2	3	4	5	6	7	8	9	10
1968	218.141	333.	1830.	1598.	584.	73.	65.	41.	6.	3.	1.
1969	123.010	23.	1258.	836.	562.	172.	29.	26.	9.	2.	1.
1970	133.445	300.	303.	1025.	485.	270.	101.	15.	15.	7.	3.
1971	174.559	735.	2150.	320.	579.	160.	64.	37.	9.	5.	0.
1972	201.493	200.	5089.	1633.	183.	317.	76.	43.	15.	4.	2.
1973	185.241	323.	1405.	2629.	471.	61.	67.	28.	14.	6.	0.
1974	185.432	565.	1179.	926.	820.	144.	34.	49.	14.	8.	3.
1975	152.977	351.	1597.	431.	265.	272.	38.	9.	16.	7.	1.
1976	121.841	129.	1301.	677.	152.	85.	87.	11.	4.	3.	2.
1977	144.348	420.	570.	840.	228.	70.	31.	31.	6.	5.	2.
1978	135.220	304.	1425.	286.	182.	64.	16.	12.	7.	3.	1.
1979	87.467	216.	910.	448.	74.	47.	23.	12.	4.	3.	1.
1980	55.475	154.	850.	380.	127.	20.	20.	8.	7.	1.	2.
1981	51.553	96.	928.	388.	114.	51.	14.	6.	2.	1.	1.
1982	47.889	522.	306.	389.	73.	17.	6.	3.	1.	1.	0.
1983	48.339	178.	1428.	206.	112.	23.	10.	2.	0.	0.	0.
1984	34.574	316.	772.	346.	33.	17.	7.	1.	1.	0.	0.
1968	548.642	896.	8746.	4593.	969.	241.	142.	74.	25.	13.	9.
1969	491.435	64.	3755.	2716.	1308.	467.	111.	75.	33.	17.	11.
1970	426.650	1201.	2890.	3014.	1055.	470.	113.	22.	25.	12.	7.
1971	416.144	4542.	8553.	644.	705.	587.	203.	71.	16.	9.	9.
1972	392.432	938.	19054.	3501.	396.	339.	120.	57.	27.	5.	8.
1973	414.898	2657.	7445.	6165.	870.	137.	98.	42.	31.	12.	4.
1974	349.604	3858.	6233.	1610.	1045.	252.	54.	38.	22.	15.	7.
1975	329.452	1820.	8673.	1783.	556.	471.	79.	9.	5.	13.	4.
1976	307.165	537.	14244.	2891.	570.	179.	113.	37.	10.	4.	9.
1977	313.913	2742.	4316.	3069.	714.	177.	51.	35.	24.	6.	2.
1978	325.246	1704.	14716.	1386.	651.	202.	48.	23.	21.	8.	3.
1979	316.419	2523.	8024.	3258.	583.	345.	67.	44.	19.	12.	4.
1980	297.227	1068.	5960.	2342.	829.	144.	90.	33.	15.	9.	4.
1981	289.672	853.	13281.	2348.	692.	204.	26.	11.	12.	3.	0.
1982	207.730	4070.	4794.	6024.	822.	291.	151.	25.	21.	12.	1.
1983	333.168	1343.	13321.	1814.	1290.	227.	98.	39.	19.	15.	3.
1984	388.035	4839.	9956.	3784.	454.	381.	108.	47.	26.	6.	7.

SCOTTISH TRAWL

SCOTTISH SEINE

(cont'd)

Table 3.1. (cont'd)

1968	48.238	33.	301.	140.	35.	9.	4.	3.	1.	0.	0.	
1969	62.666	20.	494.	243.	87.	23.	0.	4.	2.	1.	2.	
1970	83.529	334.	302.	397.	95.	33.	10.	2.	2.	0.	0.	
1971	104.901	992.	1768.	207.	150.	41.	14.	2.	2.	0.	0.	
1972	121.031	204.	3927.	705.	111.	50.	6.	2.	0.	0.	0.	
1973	152.422	760.	1255.	1896.	202.	20.	23.	12.	1.	4.	0.	S
1974	116.982	459.	1185.	438.	376.	40.	5.	8.	5.	1.	2.	C
1975	161.009	965.	1559.	776.	120.	113.	6.	1.	2.	1.	0.	O T
1976	152.419	263.	3274.	415.	101.	38.	39.	10.	1.	1.	0.	T I
1977	224.824	2068.	1607.	774.	118.	75.	24.	13.	8.	2.	1.	S H
1978	236.929	2256.	5380.	671.	270.	51.	28.	7.	8.	5.	0.	L I G H T
1979	207.494	1973.	5845.	1808.	178.	61.	15.	3.	4.	2.	0.	T R A W L
1980	333.197	1798.	5207.	2042.	534.	69.	38.	15.	4.	3.	1.	
1981	251.504	691.	5237.	1475.	294.	82.	11.	6.	0.	0.	0.	
1982	250.870	4704.	2940.	2302.	377.	110.	39.	8.	6.	4.	5.	
1983	244.349	1321.	6294.	1020.	460.	111.	31.	14.	5.	3.	1.	
1984	240.781	2876.	2993.	1529.	179.	85.	36.	10.	7.	3.	0.	
1968	673.249	82.	10093.	6140.	1489.	775.	236.	91.	45.	14.	14.	
1969	613.445	99.	2164.	4549.	1475.	486.	230.	70.	35.	12.	1.	
1970	607.370	667.	2157.	1261.	1530.	829.	236.	151.	29.	12.	1.	
1971	616.967	1695.	13787.	1569.	629.	976.	430.	163.	70.	27.	5.	
1972	644.260	104.	14630.	4926.	612.	288.	503.	244.	75.	56.	12.	
1973	603.481	1289.	2361.	5481.	1626.	461.	190.	133.	59.	16.	10.	
1974	557.947	821.	4129.	792.	1925.	617.	157.	68.	65.	40.	7.	E
1975	469.958	1866.	2623.	1156.	303.	738.	267.	44.	42.	31.	9.	N G
1976	493.436	480.	6058.	1508.	727.	163.	395.	100.	27.	10.	12.	L I S H
1977	509.862	2570.	1905.	2013.	616.	320.	98.	127.	48.	14.	5.	
1978	559.930	2029.	10576.	1093.	987.	338.	117.	57.	60.	22.	4.	T R A W L
1979	553.020	1329.	7698.	3341.	393.	403.	99.	54.	15.	30.	7.	
1980	442.036	1881.	3786.	2106.	865.	122.	114.	38.	16.	6.	8.	
1981	423.653	615.	12703.	1886.	535.	250.	38.	48.	8.	6.	4.	
1982	474.272	4074.	3063.	3802.	587.	298.	179.	35.	24.	11.	2.	
1983	370.646	659.	13444.	1024.	939.	132.	38.	48.	10.	3.	1.	
1984	358.387	3469.	3459.	2650.	267.	217.	42.	32.	16.	3.	3.	

Table 3.1. (cont'd)

1968	238.150	2.	4157.	3680.	1157.	695.	226.	82.	35.	15.	15.
1969	234.905	16.	906.	2683.	1214.	536.	286.	76.	37.	17.	5.
1970	198.731	267.	781.	783.	1147.	662.	202.	112.	15.	17.	16.
1971	217.199	694.	5763.	825.	334.	690.	299.	118.	43.	14.	1.
1972	226.241	67.	8388.	3039.	410.	207.	455.	228.	66.	51.	7.
1973	237.907	831.	1966.	3952.	1225.	174.	127.	102.	40.	5.	1.
1974	210.623	597.	2764.	411.	1085.	487.	116.	40.	32.	45.	4.
1975	208.506	2585.	2437.	764.	127.	350.	145.	14.	13.	27.	8.
1976	211.284	281.	8523.	895.	479.	116.	290.	84.	17.	6.	5.
1977	196.103	2630.	2453.	1577.	245.	182.	60.	103.	31.	8.	3.
1978	203.382	898.	12831.	746.	547.	131.	78.	21.	37.	9.	1.
1979	187.180	1718.	7004.	2458.	162.	280.	76.	35.	14.	18.	4.
1980	201.169	2111.	7760.	1370.	611.	146.	210.	54.	29.	9.	12.
1981	185.423	343.	12689.	1053.	398.	359.	67.	74.	12.	8.	6.
1982	183.209	1486.	3191.	2473.	530.	294.	189.	38.	31.	9.	3.
1983	171.334	586.	4564.	603.	563.	209.	152.	94.	19.	20.	6.
1984	167.699	1232.	1513.	1215.	147.	290.	72.	50.	32.	6.	5.

ENGLISH SEINE

Table 3.2.   WEST OF SCOTLAND COD.
             Effort data (hours x 10^{-3}) and catch at age.

YEAR	EFFORT	AGE 1	2	3	4	5	6	7	8	
1968	50.001	21.	237.	511.	328.	22.	29.	18.	2.	
1969	42.058	5.	135.	191.	564.	136.	16.	15.	6.	
1970	40.572	35.	35.	190.	123.	119.	42.	7.	6.	
1971	41.234	62.	179.	23.	141.	50.	33.	14.	6.	
1972	55.536	45.	486.	155.	31.	87.	11.	9.	1.	
1973	51.153	12.	52.	180.	70.	13.	29.	12.	4.	
1974	45.899	71.	192.	100.	228.	29.	10.	12.	3.	SCOTTISH TRAWL
1975	37.080	22.	171.	82.	40.	59.	13.	3.	4.	
1976	35.507	41.	204.	149.	49.	39.	41.	7.	1.	
1977	33.948	98.	69.	75.	27.	12.	9.	6.	2.	
1978	51.582	36.	256.	76.	108.	53.	20.	9.	5.	
1979	33.373	16.	107.	101.	53.	28.	15.	4.	1.	
1980	19.660	160.	141.	75.	36.	7.	6.	2.	3.	
1981	13.753	1.	170.	83.	16.	2.	0.	0.	0.	
1982	14.194	146.	31.	111.	25.	3.	0.	1.	0.	
1983	23.056	60.	222.	27.	46.	15.	14.	3.	0.	
1984	20.061	218.	93.	95.	14.	20.	9.	2.	1.	
1968	150.094	150.	195.	734.	369.	34.	24.	17.	4.	
1969	140.718	11.	692.	314.	423.	115.	26.	12.	4.	
1970	95.629	124.	444.	426.	77.	48.	9.	3.	3.	
1971	98.743	61.	265.	114.	102.	26.	19.	2.	1.	
1972	70.741	59.	255.	186.	52.	32.	3.	2.	1.	
1973	59.596	215.	237.	147.	34.	10.	11.	15.	1.	
1974	56.443	90.	204.	69.	49.	17.	6.	2.	0.	
1975	56.420	150.	239.	102.	35.	12.	5.	0.	0.	SCOTTISH SEINE
1976	57.090	48.	225.	90.	61.	10.	10.	0.	0.	
1977	41.920	120.	121.	111.	22.	11.	5.	2.	0.	
1978	33.617	75.	135.	64.	42.	13.	4.	2.	2.	
1979	38.465	121.	115.	197.	25.	19.	5.	0.	1.	
1980	38.040	253.	223.	75.	37.	13.	4.	0.	0.	
1981	37.208	14.	410.	130.	42.	8.	1.	1.	0.	
1982	36.089	204.	136.	157.	32.	14.	4.	0.	0.	
1983	38.080	183.	413.	65.	59.	15.	5.	2.	0.	
1984	29.561	174.	54.	79.	23.	18.	10.	0.	0.	

(cont'd)

Table 3.2. (cont'd)

1968	65.348	37.	40.	164.	91.	8.	7.	4.	1.
1969	106.856	8.	130.	116.	198.	61.	10.	3.	2.
1970	118.381	14.	242.	298.	87.	62.	9.	2.	2.
1971	129.187	75.	185.	86.	107.	24.	4.	4.	1.
1972	142.244	288.	387.	350.	92.	59.	19.	6.	3.
1973	91.151	230.	142.	214.	118.	28.	21.	1.	3.
1974	88.651	162.	372.	140.	125.	38.	6.	7.	1.
1975	132.353	499.	326.	224.	99.	41.	10.	1.	1.
1976	139.225	210.	464.	317.	105.	45.	31.	11.	0.
1977	143.574	355.	186.	389.	157.	60.	9.	3.	1.
1978	127.387	138.	402.	185.	134.	33.	8.	3.	1.
1979	99.803	161.	187.	485.	57.	31.	6.	0.	1.
1980	121.211	168.	699.	328.	129.	34.	10.	5.	1.
1981	165.002	33.	1125.	524.	183.	31.	4.	3.	0.
1982	135.280	393.	368.	616.	164.	46.	6.	2.	1.
1983	112.532	275.	1161.	196.	164.	51.	18.	6.	6.
1984	132.217	469.	593.	419.	85.	94.	31.	7.	2.

SCOTTISH LIGHT TRAWL

1968	166.713	29.	35.	134.	67.	7.	4.	4.	1.
1969	155.131	4.	146.	69.	65.	20.	4.	2.	1.
1970	134.891	14.	93.	160.	30.	17.	4.	1.	1.
1971	127.638	12.	552.	57.	44.	9.	24.	1.	0.
1972	184.997	80.	462.	214.	40.	14.	6.	2.	0.
1973	215.031	36.	242.	141.	61.	20.	16.	1.	2.
1974	186.342	127.	448.	85.	58.	19.	4.	2.	0.
1975	203.053	87.	250.	125.	34.	11.	9.	0.	0.
1976	224.347	36.	336.	124.	48.	14.	8.	1.	2.
1977	196.403	27.	200.	251.	42.	16.	2.	2.	1.
1978	219.562	131.	171.	61.	45.	13.	3.	2.	0.
1979	273.713	61.	184.	165.	34.	18.	3.	1.	1.
1980	254.147	150.	328.	123.	36.	6.	2.	1.	0.
1981	286.461	101.	415.	180.	31.	6.	1.	0.	0.
1982	288.902	126.	124.	163.	39.	6.	2.	0.	1.
1983	293.396	123.	419.	55.	25.	7.	1.	0.	0.
1984	315.418	86.	192.	95.	16.	11.	5.	0.	0.

SCOTTISH NEPHROPS TRAWL

Table 3.3. NORTH SEA HADDOCK.
Effort and catch at age. Effort in hours x 10^{-3}.

YEAR	EFFORT	AGE 1	2	3	4	5	6	7	8	9	10	
1965	172.992	691.	276.	13599.	2904.	484.	155.	49.	18.	1.	1.	
1966	194.012	1777.	2793.	867.	13469.	1430.	138.	54.	15.	8.	0.	
1967	215.319	8255.	7704.	5071.	702.	10632.	817.	118.	23.	12.	9.	
1968	218.141	7211.	21140.	6657.	3078.	267.	4229.	287.	26.	10.	3.	
1969	123.010	74.	11622.	6575.	1455.	564.	45.	935.	65.	2.	0.	
1970	133.445	394.	274.	14538.	2377.	347.	114.	4.	212.	10.	1.	
1971	174.559	4798.	2519.	453.	13095.	1484.	179.	52.	0.	81.	3.	
1972	201.493	8830.	7643.	2421.	307.	7895.	868.	95.	38.	10.	22.	SCOTTISH TRAWL
1973	185.241	9833.	16099.	4608.	794.	82.	2170.	216.	25.	10.	3.	
1974	185.432	1726.	17080.	7424.	987.	207.	35.	533.	37.	5.	2.	
1975	152.977	1677.	5988.	13289.	2166.	279.	42.	7.	121.	12.	1.	
1976	121.841	280.	8121.	2848.	3928.	691.	121.	14.	0.	29.	2.	
1977	144.348	885.	6342.	13056.	1521.	2332.	211.	26.	2.	2.	12.	
1978	135.220	2270.	12979.	15501.	8632.	550.	752.	71.	9.	0.	0.	
1979	87.467	2856.	14814.	11068.	7828.	2945.	166.	212.	25.	1.	0.	
1980	55.475	626.	10603.	10096.	3439.	2395.	875.	30.	21.	3.	3.	
1981	51.555	238.	6656.	8102.	3501.	552.	544.	105.	2.	4.	0.	
1982	47.889	273.	886.	6626.	2714.	932.	195.	70.	14.	2.	0.	
1983	48.539	296.	1114.	3203.	7485.	1597.	558.	52.	106.	15.	0.	
1984	34.574	344.	1561.	1502.	1157.	2429.	487.	80.	29.	14.	0.	
1965	582.364	108732.	10197.	110384.	17446.	2061.	844.	159.	46.	0.	4.	
1966	500.668	94342.	47443.	8605.	82293.	7236.	723.	293.	22.	15.	0.	
1967	514.854	453102.	56306.	21666.	2880.	24824.	2040.	233.	53.	9.	2.	
1968	548.642	168236.	112615.	17163.	6304.	698.	6853.	570.	31.	5.	0.	
1969	491.435	6952.	70969.	25683.	4178.	1599.	110.	1742.	126.	13.	1.	
1970	426.563	21905.	3377.	50805.	8758.	1086.	553.	38.	387.	44.	6.	
1971	416.144	161744.	22242.	3630.	37940.	3860.	520.	172.	15.	164.	11.	
1972	392.432	46775.	27827.	4850.	846.	14387.	2587.	1780.	33.	10.	307.	
1973	414.898	72079.	49676.	12692.	2514.	245.	4100.	487.	77.	25.	19.	SCOTTISH SEINE
1974	349.604	44934.	55720.	25559.	4326.	720.	102.	1175.	79.	15.	8.	
1975	329.432	54357.	31190.	39771.	10131.	835.	103.	19.	292.	34.	0.	
1976	307.165	22193.	67582.	12457.	10886.	1890.	264.	43.	0.	73.	1.	
1977	313.913	22193.	50659.	37035.	3336.	2528.	371.	31.	10.	1.	6.	
1978	325.246	14994.	29309.	43713.	15391.	1058.	1409.	201.	36.	0.	7.	
1979	316.419	90752.	41092.	28124.	14745.	6084.	678.	156.	5.	0.	0.	
1980	297.227	27033.	73706.	37658.	11915.	9368.	2556.	260.	229.	27.	7.	
1981	289.672	8727.	22244.	25048.	10552.	2402.	2064.	374.	41.	4.	1.	
1982	297.730	3721.	7032.	26194.	13117.	2713.	539.	277.	81.	5.	0.	
1983	333.168	11565.	14957.	21690.	34199.	9831.	2155.	407.	158.	16.	5.	
1984	388.035	4923.	24016.	20670.	14986.	21269.	4715.	960.	87.	50.	7.	

(cont')

Table 3.3. (cont'd)

1965	54.799	481.	363.	3484.	454.	49.	22.	3.	1.	0.	0.
1966	35.841	2678.	1254.	162.	1666.	125.	11.	5.	0.	0.	0.
1967	28.022	7614.	1156.	410.	66.	409.	46.	4.	1.	0.	0.
1968	48.238	4514.	3278.	542.	196.	35.	181.	14.	1.	0.	0.
1969	63.606	794.	5074.	1678.	267.	88.	7.	102.	6.	1.	0.
1970	83.529	2381.	1350.	4914.	1089.	127.	87.	4.	125.	8.	3.
1971	104.901	25395.	3085.	610.	6129.	769.	124.	61.	4.	29.	4.
1972	121.031	21378.	10224.	1786.	535.	4156.	508.	30.	18.	4.	13.
1973	152.422	34373.	15192.	3507.	710.	73.	1430.	183.	39.	6.	3.
1974	116.982	18997.	16615.	5208.	774.	148.	15.	423.	35.	7.	2.
1975	161.009	26423.	13340.	18384.	3497.	424.	34.	5.	186.	21.	0.
1976	152.419	5575.	30123.	5298.	5248.	876.	195.	18.	1.	44.	5.
1977	224.824	24596.	29945.	24841.	1004.	2419.	460.	34.	18.	0.	4.
1978	236.944	8785.	19909.	30721.	14472.	956.	1612.	635.	72.	6.	0.
1979	287.494	171149.	42911.	25155.	17990.	4058.	377.	264.	57.	5.	0.
1980	333.197	20806.	58382.	38436.	9525.	9430.	1864.	144.	145.	3.	0.
1981	251.504	6576.	19069.	21550.	9706.	1777.	1455.	310.	9.	1.	0.
1982	250.870	5214.	8197.	26681.	12945.	3334.	647.	339.	74.	16.	3.
1983	244.349	37496.	17920.	12535.	19234.	6124.	1217.	183.	141.	20.	1.
1984	240.775	38267.	16048.	10784.	6307.	9019.	2371.	479.	13.	30.	5.

1965	60.036	1130.	78.	1346.	111.	12.	3.	1.	0.	0.	0.
1966	96.261	3940.	1207.	345.	2127.	162.	19.	7.	1.	0.	0.
1967	99.959	16457.	1299.	440.	53.	503.	49.	2.	1.	0.	0.
1968	114.054	4518.	5434.	603.	255.	37.	238.	16.	1.	0.	0.
1969	111.707	672.	3392.	1009.	157.	66.	4.	68.	4.	1.	0.
1970	62.579	1273.	632.	1382.	204.	48.	20.	1.	13.	3.	0.
1971	72.909	5079.	465.	94.	783.	60.	10.	5.	0.	1.	0.
1972	70.077	1588.	303.	60.	13.	154.	15.	1.	1.	0.	0.
1973	80.369	2403.	798.	176.	41.	4.	70.	6.	2.	0.	0.
1974	127.264	1561.	876.	447.	69.	19.	1.	39.	1.	0.	0.
1975	118.506	2102.	574.	601.	199.	32.	2.	0.	11.	1.	0.
1976	140.776	4220.	2378.	392.	559.	99.	17.	0.	0.	5.	1.
1977	96.190	1796.	1539.	923.	103.	148.	56.	3.	4.	0.	1.
1978	100.636	440.	985.	1196.	544.	17.	34.	27.	2.	1.	0.
1979	113.250	6599.	1652.	558.	527.	63.	5.	2.	1.	1.	0.
1980	102.023	1372.	3637.	1930.	385.	477.	58.	1.	5.	0.	0.
1981	92.791	1570.	1616.	1012.	277.	28.	26.	6.	0.	0.	0.
1982	102.171	12296.	1045.	797.	384.	66.	18.	3.	0.	0.	0.
1983	102.485	6193.	1573.	352.	782.	200.	15.	6.	0.	0.	0.
1984	124.534	31660.	1733.	715.	228.	207.	110.	23.	0.	0.	0.

Table 3.4. WEST OF SCOTLAND   DOCK.
Effort and catch at age. Effort in hours x 10^{-3}.

YEAR	EFFORT	AGE 1	2	3	4	5	6	7	8	
1966	71.525	789.	249.	146.	20569.	921.	36.	17.	24.	
1967	54.231	5922.	2987.	182.	102.	12814.	85.	1.	3.	
1968	50.001	6886.	13331.	644.	138.	398.	8402.	310.	15.	
1969	42.058	0.	30459.	3585.	252.	117.	174.	2264.	81.	
1970	40.572	0.	113.	26460.	1376.	43.	34.	72.	242.	
1971	41.234	842.	475.	449.	16258.	142.	3.	1.	0.	S
1972	55.536	3284.	18408.	903.	1041.	23671.	196.	5.	5.	C
1973	51.153	1711.	5191.	6261.	96.	641.	17059.	61.	0.	O
1974	45.899	6484.	3795.	5154.	1909.	28.	215.	4366.	8.	T
1975	37.080	5986.	11545.	1404.	1695.	666.	20.	51.	1523.	T
1976	35.307	66.	13426.	5902.	716.	595.	183.	4.	1.	I
1977	33.948	2534.	237.	12304.	2059.	129.	171.	52.	7.	S
1978	51.582	1376.	688.	192.	10859.	1542.	156.	122.	99.	H
1979	33.375	8618.	2235.	611.	74.	3186.	309.	31.	24.	
1980	19.660	465.	3664.	1346.	274.	27.	873.	47.	2.	T
1981	13.753	3.	14272.	3733.	169.	23.	2.	131.	2.	R
1982	14.194	86.	479.	7212.	1405.	37.	2.	12.	39.	A
1983	23.056	2821.	3836.	1153.	5536.	801.	30.	1.	2.	W
1984	20.061	4188.	1141.	1795.	303.	2672.	243.	9.	0.	L
1966	156.511	491.	165.	2.	18628.	538.	4.	2.	6.	
1967	158.208	8256.	10693.	516.	103.	6640.	170.	4.	3.	
1968	150.094	88598.	16469.	1653.	117.	143.	2124.	239.	8.	
1969	140.713	67.	90695.	3738.	701.	63.	81.	754.	41.	
1970	95.629	4332.	183.	45402.	444.	65.	16.	19.	114.	
1971	98.748	35005.	1870.	1554.	32278.	139.	50.	2.	2.	S
1972	70.741	8052.	17913.	585.	344.	9341.	74.	10.	1.	C
1973	59.596	25035.	3433.	3691.	29.	31.	1030.	8.	14.	O
1974	56.448	23940.	1637.	885.	681.	8.	31.	652.	10.	T
1975	56.429	90247.	7636.	467.	324.	183.	3.	4.	130.	T
1976	57.090	11826.	20806.	3050.	212.	223.	133.	3.	2.	I
1977	41.920	3812.	1159.	6791.	803.	161.	69.	48.	4.	S
1978	33.617	3470.	296.	137.	1946.	130.	16.	6.	5.	H
1979	38.465	12198.	3181.	207.	84.	780.	50.	7.	4.	
1980	38.640	7436.	6320.	785.	94.	25.	338.	21.	2.	S
1981	37.208	35.	17244.	4960.	518.	49.	4.	126.	4.	E
1982	36.689	2883.	1213.	15227.	1523.	27.	5.	1.	14.	I
1983	38.080	2099.	2976.	1300.	7600.	474.	26.	1.	2.	N
1984	29.561	8690.	1193.	1716.	370.	1971.	142.	12.	0.	E

(cont'd)

Table 3.4. (cont'd)

SCOTTISH LIGHT TRAWL

1966	40.538	0.	3.	0.	703.	21.	0.	0.	0.
1967	80.916	429.	1328.	73.	7.	189.	7.	0.	0.
1968	65.348	2444.	514.	132.	9.	13.	82.	9.	0.
1969	106.856	0.	6105.	274.	82.	5.	8.	53.	6.
1970	118.881	558.	61.	7190.	94.	18.	4.	4.	24.
1971	129.187	12856.	427.	324.	7717.	30.	21.	1.	0.
1972	142.244	1479.	20885.	447.	197.	4635.	45.	15.	1.
1973	91.151	559.	1171.	1396.	9.	19.	726.	7.	5.
1974	88.651	5161.	950.	706.	425.	4.	13.	421.	9.
1975	132.353	20271.	4525.	398.	360.	320.	3.	8.	233.
1976	139.225	2067.	11485.	2004.	172.	209.	119.	3.	3.
1977	143.574	1151.	363.	3582.	661.	95.	68.	49.	9.
1978	127.387	2563.	206.	157.	1412.	205.	33.	19.	13.
1979	99.803	10349.	2420.	163.	33.	803.	59.	17.	5.
1980	121.211	4939.	3870.	1035.	184.	38.	500.	52.	7.
1981	165.002	28.	14863.	4468.	423.	40.	8.	176.	12.
1982	135.280	4962.	960.	17389.	1722.	71.	10.	15.	18.
1983	112.332	3168.	5746.	1345.	10272.	662.	62.	3.	5.
1984	132.217	25482.	2213.	3689.	810.	6083.	366.	57.	0.

SCOTTISH NEPHROPS TRAWL

1966	116.972	0.	3.	0.	198.	8.	0.	0.	0.
1967	135.811	163.	297.	19.	4.	93.	3.	0.	0.
1968	166.713	1553.	293.	76.	6.	6.	36.	4.	0.
1969	155.131	0.	4387.	106.	34.	2.	3.	20.	0.
1970	134.891	394.	73.	2485.	19.	4.	1.	5.	0.
1971	127.038	1909.	3.	43.	750.	10.	11.	1.	0.
1972	184.997	1187.	1249.	14.	0.	254.	3.	4.	0.
1973	215.031	66.	209.	286.	2.	4.	186.	2.	0.
1974	186.342	430.	104.	86.	82.	0.	1.	42.	0.
1975	203.053	1122.	256.	38.	28.	37.	0.	0.	0.
1976	224.347	1578.	1603.	139.	16.	13.	17.	0.	0.
1977	196.403	198.	135.	380.	29.	7.	6.	15.	0.
1978	219.562	1603.	38.	22.	181.	22.	6.	5.	0.
1979	273.713	1960.	894.	19.	11.	124.	11.	4.	0.
1980	254.147	674.	516.	160.	8.	2.	41.	3.	0.
1981	286.461	12.	3709.	740.	60.	1.	0.	20.	0.
1982	288.902	1097.	137.	2725.	147.	10.	3.	5.	0.
1983	293.396	683.	179.	79.	610.	20.	4.	0.	0.
1984	312.930	5362.	227.	146.	40.	286.	9.	1.	0.

Table 3.5.   NORTH SEA WHITING.
             Effort (hours x 10^{-3}) and catch age.

YEAR	EFFORT	AGE 1	2	3	4	5	6	7	8	9	10	
1975	152.977	1677.	5988.	13289.	2166.	279.	42.	7.	121.	12.	1.	SCOTTISH TRAWL
1976	121.841	280.	8121.	2848.	3928.	691.	121.	14.	0.	29.	2.	
1977	144.348	885.	6342.	13056.	1521.	2532.	211.	26.	2.	2.	12.	
1978	135.220	2270.	12979.	15501.	8632.	550.	752.	71.	9.	0.	0.	
1979	87.467	2856.	14814.	11008.	7826.	2945.	166.	212.	25.	1.	0.	
1980	55.475	626.	10603.	10096.	3439.	2395.	875.	30.	21.	3.	3.	
1981	51.553	238.	6650.	8102.	3501.	552.	544.	105.	2.	4.	0.	
1982	47.889	273.	886.	6626.	2714.	932.	195.	70.	14.	2.	0.	
1983	48.539	296.	1114.	5203.	7485.	1597.	558.	52.	100.	15.	0.	
1984	34.574	344.	1561.	1502.	1157.	2429.	487.	80.	29.	14.	0.	
1975	329.432	54357.	31190.	39771.	10131.	835.	103.	19.	292.	34.	0.	SCOTTISH SEINE
1976	307.165	22193.	67582.	12457.	10886.	1890.	264.	43.	0.	73.	1.	
1977	313.913	22193.	50659.	37035.	3336.	2528.	371.	31.	10.	1.	6.	
1978	325.246	14994.	29309.	43713.	15391.	1058.	1409.	201.	36.	1.	7.	
1979	316.419	90752.	41092.	28124.	14745.	6084.	678.	156.	0.	0.	7.	
1980	297.227	27033.	73706.	37658.	11915.	9368.	2556.	260.	3.	0.	0.	
1981	289.072	8727.	22244.	25048.	10552.	2402.	2064.	374.	229.	27.	7.	
1982	297.730	3721.	7032.	26194.	13117.	2713.	277.	41.	4.	1.		
1983	533.168	11565.	14957.	21690.	34199.	9831.	2155.	407.	158.	16.	5.	
1984	388.035	4923.	24016.	20670.	14986.	21269.	4715.	960.	87.	50.	7.	

(cont'd)

Table 3.5. (cont'd)

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------------------------------------------------------------------------------
1975   161.009  26423.  13340.  18384.   3497.   424.    34.     5.   186.   21.   0.
1976   152.419   5575.  30123.   5298.   5248.   876.   195.    18.     1.   44.   5.
1977   224.824  24596.  29945.  24841.   1664.  2419.   460.    34.    18.    0.   4.
1978   236.944   8785.  19909.  30721.  14472.   956.  1612.   635.    72.    6.   0.
1979   287.494 171149.  42911.  23155.  17996.  4058.   377.   284.    57.    5.   0.
1980   333.197  20806.  58382.  38436.   9525.  9430.  1864.   144.   145.    3.   0.
1981   251.504   6576.  19069.  21550.   9706.  1777.  1455.   310.     9.    1.   0.
1982   250.870   5214.   8197.  26681.  12945.  3334.   647.   339.    74.   16.   3.
1983   244.349  37496.  17920.  12535.  19234.  6124.  1217.   185.   141.   26.   1.
1984   240.775  38267.  16048.  10784.   6307.  9019.  2371.   479.    13.   30.   5.
------------------------------------------------------------------------------
1975   113.308   2102.    574.    601.    199.    32.     2.     0.    11.    1.   0.
1976   140.776   4220.   2378.    392.    359.    99.    17.     0.     0.    1.   0.
1977    96.190   1796.   1539.    923.    103.   148.    56.     3.     4.    5.   1.
1978   100.036    440.    985.   1196.    344.    17.    34.    27.     2.    0.   1.
1979   113.256   6599.   1652.    588.    527.    63.     5.     2.     1.    1.   0.
1980   102.023   1372.   3637.   1930.    383.   477.    33.     1.     3.    0.   0.
1981    92.791   1570.   1813.   1012.    277.    28.    26.     6.     0.    0.   0.
1982   102.171  12296.   1045.    797.    384.    66.    18.     3.     0.    0.   0.
1983   102.485   6193.   1573.    852.    782.   200.    15.     6.     0.    0.   0.
1984   124.534  31660.   1733.    715.    228.   207.   110.    23.     0.    0.   0.
```

Table 3.6. WEST OF SCOTLAND WHITING.
        Effort (hours x 10^-3) and catch per effort data.

YEAR	EFFORT	AGE 1	2	3	4	5	6	7	8
1965	72.614	1.	33.	3189.	655.	86.	23.	5.	2.
1966	71.525	32.	385.	93.	4741.	306.	27.	7.	1.
1967	54.231	104.	868.	1164.	53.	2142.	75.	8.	2.
1968	50.001	472.	1206.	749.	578.	38.	841.	38.	2.
1969	42.058	1.	1915.	1043.	295.	157.	10.	201.	7.
1970	40.572	3.	12.	1886.	432.	60.	26.	1.	27.
1971	41.234	15.	154.	114.	3515.	193.	42.	4.	0.
1972	55.536	317.	456.	226.	54.	1226.	82.	5.	2.
1973	51.153	292.	946.	595.	212.	45.	748.	37.	4.
1974	45.899	68.	1740.	867.	184.	54.	5.	131.	7.
1975	37.080	125.	521.	1508.	214.	31.	6.	0.	27.
1976	35.307	51.	1703.	794.	1152.	165.	13.	3.	0.
1977	33.948	302.	367.	1984.	223.	439.	17.	0.	0.
1978	51.582	45.	628.	704.	2400.	241.	405.	25.	1.
1979	33.373	143.	2080.	1799.	886.	703.	38.	75.	1.
1980	19.660	22.	446.	1389.	580.	354.	237.	53.	25.
1981	13.753	10.	973.	1124.	493.	151.	102.	22.	0.
1982	14.194	36.	130.	1400.	834.	112.	131.	23.	3.
1983	23.056	18.	435.	545.	2443.	555.	130.	13.	5.
1984	20.061	40.	419.	507.	266.	1426.	182.	42.	13.

YEAR	EFFORT	AGE 1	2	3	4	5	6	7	8
1965	153.103	2971.	2772.	17100.	1388.	67.	17.	1.	1.
1966	156.511	993.	7710.	1302.	12702.	784.	75.	13.	3.
1967	158.208	2392.	13869.	4822.	335.	5543.	315.	55.	5.
1968	150.094	3984.	8227.	4017.	1282.	133.	1679.	125.	8.
1969	140.718	450.	11467.	3430.	980.	435.	48.	824.	86.
1970	95.629	340.	1266.	8101.	305.	191.	57.	6.	174.
1971	98.748	1117.	3826.	2073.	13834.	492.	77.	25.	0.
1972	70.741	6861.	4168.	915.	521.	3008.	111.	13.	7.
1973	59.596	5346.	9255.	1565.	323.	91.	853.	58.	6.
1974	56.448	3007.	16864.	3065.	276.	23.	10.	251.	8.
1975	56.420	5502.	5564.	11402.	569.	40.	10.	0.	16.
1976	57.090	2576.	18225.	5244.	4578.	289.	19.	1.	0.
1977	41.920	4895.	2837.	5562.	531.	1022.	44.	2.	1.
1978	33.599	5427.	3320.	809.	1187.	73.	168.	7.	0.
1979	38.465	2760.	10731.	3416.	326.	392.	17.	32.	0.
1980	38.640	1837.	2579.	3843.	994.	258.	124.	4.	14.
1981	37.208	653.	3818.	2488.	1015.	405.	92.	57.	1.
1982	36.689	333.	881.	5771.	1072.	247.	74.	58.	15.
1983	38.080	534.	1305.	1335.	4496.	1149.	129.	70.	47.
1984	29.561	1293.	1444.	1019.	327.	1912.	218.	113.	10.

(cont'd)

Table 3.6. (cont'd)

1965	37.387	519.	282.	3245.	400.	16.	6.	1.	0.
1966	40.538	269.	565.	154.	5741.	367.	37.	7.	4.
1967	80.916	647.	2699.	1446.	98.	2501.	140.	13.	1.
1968	65.348	489.	1960.	1617.	641.	51.	861.	60.	4.
1969	106.856	12.	5202.	1984.	569.	289.	30.	549.	63.
1970	118.881	26.	3665.	9914.	938.	202.	52.	5.	133.
1971	129.187	394.	2535.	868.	9059.	327.	63.	25.	1.
1972	142.244	3398.	2655.	1473.	314.	5353.	313.	30.	7.
1973	91.151	1177.	7482.	604.	145.	44.	503.	41.	5.
1974	88.651	1914.	9464.	1612.	159.	18.	7.	85.	3.
1975	132.353	2715.	3952.	9397.	828.	83.	13.	3.	87.
1976	139.225	2784.	9170.	3208.	5440.	731.	14.	5.	0.
1977	143.574	4643.	2497.	5289.	749.	1148.	78.	2.	1.
1978	127.387	3559.	3791.	1542.	1913.	136.	259.	4.	0.
1979	99.805	1239.	7805.	2304.	317.	297.	33.	59.	0.
1980	121.211	1525.	3193.	3952.	974.	151.	188.	12.	19.
1981	165.002	570.	6986.	4045.	1366.	498.	161.	66.	1.
1982	135.280	783.	1537.	8587.	1785.	328.	78.	65.	10.
1983	112.332	945.	2016.	2209.	7388.	1076.	245.	55.	50.
1984	132.217	1169.	2900.	2320.	987.	4699.	577.	220.	13.

Table 4.1. NORTH SEA COD
Estimates of recruitment at age 0, 1 and 2

Year class	Age 0		Age 1						
	EGFS[1]	DGFS[2]	IYFS[3]	IYFS[4] in transf.	EGFS	DGFS	FRG shrimp fishery[5]	VPA number x 10^{-6} IV	VIa
1968							6.1	96	3.9
1969							34.1	379	7.7
1970			98.3	2,938			(90.4)	433	10.4
1971			4.1	0,258			1.3	79	6.3
1972			38.0	1,470			1.6	153	8.6
1973			14.7	1,120			3.6	120	8.3
1974			40.3	1,621			8.0	222	11.4
1975			7.9	0,540			7.8	104	6.5
1976			36.7	1,775	6,018		28.2	374	9.8
1977	1,559		12.9	1,112	2,372		27.2	219	9,6
1978	1,679		9.9	0,786	2,265		31.1	235	15.3
1979	1,856		16.8	1,365	5,150	180.8	35.5	412	21.1
1980	1,006	45.6	2.9	0,309	1,232	65.0	14.1	136	6.6
1981	7,963	176.9	9.2	1,072	3,234	83.2	21.1[6]	283	17.9
1982	254	26.8	3.7	n.a.	1,541	24.8	3.8[6]	129	17.3
1983	9,595	138.9	15.5[6]	1,652[6]	6,122	122.4	48.0[6]	393	19.0
1984	45	3.7	4.4[6]	0,919[6]					

Year class	Age 2			
	IYFS[3]	EGFS	VPA number x 10^{-6} IV	VIa
1968			76	3.2
1969	25.9		263	6.0
1970	34.5		316	8.3
1971	10.6		62	4.5
1972	9.5		103	6.1
1973	6.2		85	6.1
1974	19.9		154	8.3
1975	3.2	459	80	4.4
1976	29.3	1,249	253	6.9
1977	9.3	592	155	7.2
1978	14.8	697	161	11.7
1979	25.5	1,411	285	16.2
1980	6.7	289	93	5.0
1981	16.4	1,095	176	13.0
1982		477	85	12.0

[1] English Groundfish Survey: Number per 100 hrs trawling
[2] Dutch Groundfish Survey: Arithmetic mean number per hour trawling per rectangle in Roundfish Area 6
[3] International Young Fish Survey: Arithmetic mean number per hour trawling per rectangle in the standard area (ICES C.M.1985/H:2)
[4] IYFS: mean ln (mean catch per rectangle +1) (ICES C.M.1985/H:2)
[5] By-catch indices of 0- and 1-group in the shrimp fishery of Federal Republic of Germany (Schumacher, 1985)
[6] Preliminary figure

Table 4.2. NORTH SEA HADDOCK
Estimates of recruitment at age 1 and 2

Year class	Age 1				Age 2		
	IYFS[1]	EGFS[2]	VPA number x 10⁻⁶ IV	VIa	IYFS	EGFS	VPA number IV
1969	28		470	18	32		148
1970	855		3,310	245	299		1,098
1971	740		2,373	76	971		1,336
1972	187		767	79	110		293
1973	1,072		2,607	169	385		1,044
1974	1,168		4,562	439	670		1,866
1975	177		380	36	84	3,119	162
1976	162	6,634	538	24	108	3,105	221
1977	385	12,605	902	60	240	6,053	345
1978	480	29,691	1,173	186	402	15,755	650
1979	896	62 392	2,103	452	675	43,835	1,128
1980	268	17,036	441	47	252	7,955	241
1981	526	31,501	909	95	386	10,945	497
1982	313	21,762	586	49		6,199	342
1983	989[3]	60,008	3,027	270			
1984	230[3]						

[1] International Young Fish Survey: Arithmetic mean number per hour tr per rectangle in the standard area

[2] English Groundfish Survey: Number per 100 hrs trawling

[3] Preliminary figure

Age 1: IYFS against VPA (1969-82)
        $r = 0.92$ $a = -162.337$ $b = 3.224$

        VPA IV against VPA VIa (1969-82)
        $r = 0.79$ $a = 7.411$ $b = 0.089$

Table 4.3. NORTH SEA WHITING
Estimates of recruitment at age 1 and 2

Year class	Age 1				Age 2			
	IYFS[1]	EGFS[2]	VPA number x 10^{-6} IV	VIa	IYFS	EGFS	VPA number x 10^{-6} IV	VIa
1968					77		131	16
1969	69		934	22	31		227	18
1970	274		1,408	31	190		598	23
1971	332		2,437	93	763		1,155	61
1972	1,156		3,258	195	496		1,632	147
1973	322		1,712	68	153		726	47
1974	893		3,174	151	535		1,741	110
1975	679		1,850	51	219	6,531	1,085	34
1976	418	21,969	2,141	80	293	5,482	843	51
1977	513	24,632	1,800	112	183	7,441	1,097	75
1978	457	20,019	1,988	78	391	15,040	1,073	58
1979	692	30,044	1,598	199	485	30,646	1,066	153
1980	227	26,603	652	41	232	7,928	389	31
1981	161	27,704	773	40	129	10,855	461	30
1982	129	11,813	810	54		10,790	(483)	(41)
1983	397[3]	50,319	(1,630)	(78)				
1984	290[3]							

[1] International Young Fish Survey: Arithmetic mean number per hour trawling per rectangle in the standard area (ICES C.M.1983/G:62)

[2] English Groundfish survey: Number per 100 hrs trawling

[3] Preliminary figure

Age 1: VPA versus IYFS: VPA = 744.59 + IYFS x 2.232 (1969-82)
r = 0.84

VIa versus IV: VIa = -6.709 + IV x 0.059 (1969-82)
r = 0.78

Table 5.1. Nominal catch (in tonnes) of COD in Sub-area IV, 1975-84 (Data for 1975-83 as officially reported to ICES)

Country	1975	1976	1977	1978	1979
Belgium	7,566	7,483	10,346	17,473	12,576
Denmark	46,344	53,277	42,582	41,858	48,509
Faroe Islands	732	448	260	56	113
France	8,667	8,079	7,511	11,944	12,559
German Dem.Rep.	223	69	21	75	84
Germany, Fed.Rep.	16,457	24,445	22,663	37,040	20,411
Ireland	-	98	136	174	1
Netherlands	23,263	21,835	29,903	48,817	34,752
Norway[1])	1,528	1,877	1,449	2,747	3,575
Poland	2,991	2,961	381	115	142
Spain	63	14	-	-	-
Sweden	900	597	36	...^{2})	298
UK (England & Wales)	33,615	46,475	35,424	59,127	54,923
UK (Scotland)	37,308	39,597	34,406	41,984	42,811
USSR	6,796	6,187	-	17	17
Total IV	186,453	213,442	185,118	261,427	230,771
Total IVa	58,343	68,352	55,623	43,357	41,118
Total IVb	107,227	126,218	100,191	164,388	147,313
Total IVc	20,883	18,872	29,304	53,682	42,340
W.G. Total	184,974	209,914	181,121	260,890	248,051

Country	1980	1981	1982	1983	1984*)
Belgium	9,630	8,744	6,604	6,704	5,792
Denmark	56,404	64,968	61,454	48,828*)	37,528
Faroe Islands	150	38	65	361	73
France	10,910	11,369	8,399	7,159	6,355
German Dem.Rep.	63	-	-	-	-
Germany, Fed.Rep.	26,343	29,741	18,525	20,333	14,220
Ireland	-	-	-	-	-
Netherlands	45,400	51,281	36,490	28,651*)	25,679
Norway[1])	4,506	6,766	12,163	6,537*)	6,419
Poland	28	7	62	75	7
Spain	-	-	-	-	-
Sweden	293	321	453	423	491
UK (England & Wales)	49,951	59,856	54,277	53,860	33,938
UK (Scotland)	45,044	53,921	57,308	58,581	54,098
USSR	-	-	-	-	-
Total IV	248,722	287,012	255,800	231,512	184,600
Total IVa	48,467	55,109	60,917	63,858	57,115
Total IVb	161,767	194,283	168,170	161,304	119,462
Total IVc	38,488	37,620	26,713	6,350	8,023
W.G. Total	260,278	300,599	255,934	229,499	196,944

*)Provisional
[1])Figures from Norway do not include cod caught in Rec.2 fisheries
[2])Included in Division IIIa

Table 5.2.   VIRTUAL POPULATION ANALYSIS

NORTH SEA COD (FISHING AREA IV)

CATCH IN NUMBERS   UNIT: thousands

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	30081	5145	58279	26368	55319	58518	20416	61191	23395	61878
2	42467	90265	45947	156479	86133	97412	177309	56340	118145	55919
3	17073	16485	22823	13358	59843	29132	26739	50002	16932	26148
4	4203	6721	4300	8386	3584	9840	7352	6639	9869	3254
5	6816	1661	2099	2850	3188	1571	3829	3002	2584	2903
6	1863	2746	757	980	713	1172	757	1769	1235	876
7	405	836	1029	383	371	417	571	334	575	391
8	176	120	335	376	131	190	135	205	142	221
9	206	59	238	141	145	73	65	68	83	55
10	86	57	23	33	39	54	37	23	22	41
11+	57	39	87	39	15	24	21	15	18	19
TOTAL	103453	124132	135917	209393	169461	198403	237231	179586	173000	151705

Table 5.3.   VIRTUAL POPULATION ANALYSIS

NORTH SEA COD (FISHING AREA IV)

MEAN WEIGHT AT AGE OF THE STOCK   UNIT: kilogram

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	.619	.572	.541	.567	.548	.546	.723	.590	.629	.592
2	.899	1.019	.926	.937	.945	.985	.834	.942	.909	.903
3	2.348	2.389	2.132	1.967	2.452	1.995	2.261	1.853	1.854	2.178
4	4.226	4.364	4.484	4.201	4.506	4.577	4.606	4.535	3.953	4.137
5	6.404	6.402	6.061	6.536	6.558	6.371	7.253	6.851	6.016	6.592
6	8.691	8.625	8.804	8.766	8.277	9.150	8.903	9.002	8.600	8.627
7	10.107	10.120	10.076	9.794	10.658	9.852	10.139	10.721	10.264	10.527
8	10.910	11.278	11.048	11.053	11.490	11.878	11.570	12.508	12.013	11.600
9	12.339	12.899	11.824	12.427	13.057	12.819	13.428	13.459	13.961	13.832
10	12.976	14.140	13.134	12.778	14.143	14.026	15.018	12.852	12.782	13.722
11+	13.851	14.705	14.417	13.847	15.932	16.436	17.000	13.991	14.867	13.162

Table 5.4.   VIRTUAL POPULATION ANALYSIS

NORTH SEA COD (FISHING AREA IV)

FISHING MORTALITY COEFFICIENT   UNIT: Year-1   NATURAL MORTALITY COEFFICIENT = .20

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1979-84
1	.16	.06	.19	.14	.18	.17	.18	.27	.22	.19	.20
2	.79	1.01	.97	1.10	.92	1.07	1.12	1.07	1.29	1.25	1.12
3	.77	.84	.77	.87	.99	.98	1.03	1.25	1.21	1.23	1.12
4	.65	.80	.55	.74	.61	.72	.73	.79	.93	.81	.76
5	.75	.59	.64	.86	.72	.60	.70	.77	.84	.80	.74
6	.68	.79	.59	.71	.57	.64	.66	.84	.86	.79	.73
7	.51	.75	.79	.68	.65	.60	.75	.70	.74	.75	.73
8	.83	.28	.79	.77	.53	.85	.67	.68	.75	.72	.70
9	.94	.75	1.41	.97	.79	.64	.82	.87	.65	.76	.76
10	.75	.75	.75	.75	.80	.80	.80	.80	.80	.80	.80
11+	.75	.75	.75	.75	.80	.80	.80	.80	.80	.80	.80
(3- 8)U	.70	.67	.69	.78	.68	.77	.76	.84	.89	.85	.80

Table 5.5.   VIRTUAL POPULATION ANALYSIS

NORTH SEA COD (FISHING AREA IV)

STOCK SIZE IN NUMBERS   UNIT: thousands

BIOMASS TOTALS   UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1975-81
1	221629	103887	373814	218764	235328	411981	136029	282775	129225	393298	164000	243062
2	84820	154355	80412	253572	155346	160861	284591	92985	176490	84745	266285	167708
3	34789	31559	46167	24981	68768	50545	45223	75729	26114	39963	19879	43147
4	9578	13253	11150	17442	8557	20889	15436	13272	17736	6382	9564	13765
5	14142	4086	4859	5280	6797	3801	8318	6117	4946	5741	2524	6755
6	4140	5496	1859	2102	1785	2719	1707	3391	2330	1747	2112	2830
7	1111	1726	2051	845	846	824	1178	721	1200	808	649	1226
8	341	547	667	762	350	361	303	455	292	469	312	476
9	368	122	340	247	288	169	126	127	190	113	187	237
10	178	118	48	68	77	107	73	45	44	81	43	95
11+	118	81	180	81	30	47	42	30	36	58	44	82

TOTAL NO	371213	315228	521546	524144	478173	652305	493076	475646	358602	533383		
SPS NO	38815	35835	34614	40071	40464	44235	46175	43153	35464	29511		
TOT.BIOM	485573	451563	509125	558750	557740	645887	603754	543509	432560	499301		
SPS BIOM	186359	159618	138856	139720	141536	155302	166624	158340	131179	106663		

Table 5.6. NORTH SEA COD
List of input variables for the ICES program
(The reference F is the mean F for the age group range 3-8)

The number of recruits per year is as follows:

Year	Recruitment
1985	164,000.0
1986	208,710.0
1987	208,710.0

Age	Stock size	Fishing[1]) pattern	Natural mortality	Maturity ogive	Weight in[2]) the catch	Weight in the stock
1	164,000.0	.21	.20	.01	.605	.605
2	266,285.0	1.19	.20	.05	.935	.935
3	19,879.0	1.19	.20	.23	2.096	2.096
4	9,564.0	.81	.20	.62	4.352	4.352
5	2,324.0	.79	.20	.86	6.673	6.673
6	2,112.0	.78	.20	1.00	8.767	8.767
7	649.0	.78	.20	1.00	10.394	10.394
8	312.0	.74	.20	1.00	11.844	11.844
9	187.0	.81	.20	1.00	13.426	13.426
10	43.0	.85	.20	1.00	13.758	13.758
11+	44.0	.85	.20	1.00	15.240	15.240

[1])Average F 1979-84 rescaled to $F_{av} = F_{84}$ for ages 3-8

[2])Mean values 1979-84

Table 5.7. NORTH SEA COD (Sub-area IV)
           Assumption $\bar{F}_{85} = \bar{F}_{84}$

Management Options

1 9 8 5				Management option for 1986	1 9 8 6				1 9 8 7	
Stock biom.	Spawn. stock biom.	$\bar{F}_{(3-8)}$ H.C.	Total landing		Stock biom.	Spawn. stock biom.	$\bar{F}_{(3-8)}$ H.C.	Total landings	Stock biom.	Spawn. stock biom.
				$F_{0.1}$			0.12	37	708	231
				F_{max}			0.19	57	673	215
				$F_{86}=0$			0	0	773	262
478	94	0.85	248	$F_{86}=0.6F_{85}$	433	93	0.51	149	515	141
				$F_{86}=0.8F_{85}$			0.68	182	460	116
				$F_{86}=F_{85}$			0.85	210	415	95
				$F_{86}=1.2F_{85}$			1.02	233	378	78
				$F_{86}=1.4F_{85}$			1.19	252	348	65

Weight in '000 tonnes

Stock biomass = fish of age 1 and older

Spawning stock biomass based on ogive

Exploitation pattern 1985-86 based on 1979-84 average

Table 6.1. Nominal catch (in tonnes) of COD in Division VIa, 1975-84.
(Data for 1975-83 as officially reported to ICES)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Belgium	49	71	-	-	4	57	30	35	21	22
Denmark	7	-	-	-	-	27[1]	-	3	-	-
Faroe Islands	3	39	43	-	40	3	-	2	-	-
France	3,546	5,611	3,583	4,499	4,590	5,495	7,601	7,160	8,140	8,397
German Dem.Rep.	2	-	-	-	-	-	-	-	-	-
ɪrmany, Fed.Rep.	12	1	3	31	40	1	21	8	205	36[1]
Ireland	1,141	1,341	984	1,214	2,237	2,331	2,725	3,527	2,695	2,326
Netherlands	5	11	5	3	20	1	-	-	-	
Norway	17	22	29	40	32	48	40	238	274*	273
Poland	68	18	-	-	-	-	-	-	-	-
Spain	180	15	20[1]	108[1]	-	-	-	41	52	
Sweden	-	-	-	-	-	-	-	1	-	
UK (England & Wales)	2,217	2,742	2,434	2,082	2,348	2,302	3,187	2,948	1,141	569
UK (Scotland)	5,806	7,475	5,513	5,539	6,929	7,603	10,339	7,969	8,933	9,452
UK (Northern Ireland)	3	13	5	5	2	2	7	33	37	32
USSR	107	46	-	-	-	-	-	-	-	
Total Division VIa	13,163	17,405	12,619	13,521	16,242	17,870	23,950	21,965	21,498	21,107

*Provisional

[1] Includes Division VIb

Table 6.2.   VIRTUAL POPULATION ANALYSIS

COD IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

CATCH IN NUMBERS   UNIT: thousands

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	1207	970	1262	723	929	1195	460	1827	2329	2101
2	1898	3682	1311	1761	1613	3294	7015	1673	4498	3692
3	1187	1467	1630	999	2125	2001	3221	3206	1119	3111
4	533	638	622	695	682	796	905	1189	1404	605
5	325	256	268	280	343	191	182	367	470	613
6	90	215	87	97	133	77	30	111	149	225
7	12	44	57	47	33	27	17	22	40	44
8+	23	12	21	28	36	10	4	12	19	22
TOTAL	5275	7284	5264	4630	5894	7591	11834	8407	10028	10413

Table 6.3. VIRTUAL POPULATION ANALYSIS

COD IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

MEAN WEIGHT AT AGE OF THE STOCK   UNIT: kilogram

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	.603	.616	.629	.630	.693	.624	.548	.692	.580	.731
2	1.369	1.397	1.160	1.373	1.374	1.375	1.164	1.468	1.261	1.194
3	3.078	3.161	2.605	3.589	2.829	3.002	2.834	2.737	2.997	2.421
4	5.302	5.005	4.715	5.262	4.856	5.277	4.917	4.749	4.400	3.999
5	6.846	6.290	6.269	7.096	6.437	7.422	7.503	6.113	6.313	5.154
6	8.572	8.017	7.525	8.686	7.788	8.251	9.300	7.227	8.091	6.857
7	9.769	8.754	9.337	9.932	8.571	9.293	10.146	9.587	9.068	7.837
8+	10.301	9.676	9.489	10.060	9.465	9.473	10.886	10.264	10.979	8.614

Table 6.4. VIRTUAL POPULATION ANALYSIS

COD IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

FISHING MORTALITY COEFFICIENT   UNIT: Year-1   NATURAL MORTALITY COEFFICIENT = .20

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1979-84
1	.12	.18	.15	.09	.07	.06	.08	.12	.16	.13	.10
2	.42	.67	.59	.33	.28	.37	.64	.46	.48	.41	.44
3	.59	.67	.72	.59	.85	.67	.76	.69	.64	.72	.72
4	.65	.75	.69	.79	1.09	.94	.75	.72	.76	.89	.86
5	.59	.76	.85	.81	1.25	1.12	.57	.81	.72	.94	.90
6	.65	1.04	.64	.89	1.22	1.16	.51	.85	.97	.94	.94
7	.80	.80	.90	.90	.90	.90	.90	.90	.90	.90	.90
8+	.80	.80	.90	.90	.90	.90	.90	.90	.90	.90	.90
(3- 4)U	.62	.71	.70	.69	.97	.81	.76	.71	.70	.80	

Table 6.5.   VIRTUAL POPULATION ANALYSIS

COD IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

STOCK SIZE IN NUMBERS   UNIT: thousands

BIOMASS TOTALS   UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1975-83
1	11453	6481	9789	9611	15265	21108	6601	17885	17255	18975	0	12825
2	6069	8272	4433	6677	7217	11659	16204	4989	12996	12029	13641	8746
3	2908	3266	3483	2453	4049	4458	6589	6996	2585	6609	6536	4087
4	1221	1319	1564	1391	1114	1422	1802	2521	2865	1116	2634	1075
5	796	523	511	561	519	307	456	717	1002	1093	375	599
6	205	361	200	179	204	121	82	210	260	401	350	203
7	24	87	104	86	60	49	31	40	73	81	128	62
8+	45	24	36	51	66	18	7	22	35	40	40	34
TOTAL NO	22700	20334	19922	21210	28494	39144	31332	33381	37072	40344		
SPS NO	3632	3828	3838	3349	3914	4037	5604	6796	5179	6012		
TOT.BIOM	38529	39651	32849	38039	43435	54003	54387	57338	56229	58060		
SPS BIOM	18124	18222	16295	17527	16685	17326	22164	26770	24350	21522		

Table 6.6 West of Scotland COD.List of input variables for the
ICES prediction programme. Reference F is the mean F
for the age group range from 3-4.

The number of recruits per year is as follows

Year	Recruitment
1985	12,500.0
1986	12,500.0
1987	12,500.0

Age	Stock size	Fishing[1]) pattern	Natural mortality	Maturity ogive	Weight in[2]) the catch	Weight in[2]) the stock
1	12,500.0	.10	.20	.00	.645	.645
2	13,641.0	.45	.20	.00	1.306	1.306
3	6,536.0	.73	.20	.52	2.803	2.803
4	2,634.0	.87	.20	.86	4.700	4.700
5	375.0	.91	.20	1.00	6.490	6.490
6	350.0	.95	.20	1.00	7.919	7.919
7	128.0	.91	.20	1.00	9.084	9.084
8+	40.0	.91	.20	1.00	9.946	9.946

1) Average F 1979-84 rescaled to $\bar{F}_{av}=\bar{F}_{84}$ for ages 3-4

2) Mean values 1979-84

Table 6.7   West of Scotland COD (Sub-area VIa)
            Assumption: $F_{85} = F_{84}$

Management Options

1 9 8 5				Management option for 1986	1 9 8 6				1 9 8 7	
Stock biom.	Spawn. stock biom.	$\bar{F}_{(3-4)}$ H.C.	Total landings		Stock biom.	Spawn. stock biom.	$\bar{F}_{(3-4)}$ H.C.	Total landings	Stock biom.	Spawn. stock biom.
				$F_{0.1}$			0.17	6	84	50
				F_{max}			0.30	10	79	46
				$F_{86} = 0$			0	0	92	56
				$F_{86} = 0.6\ F_{85}$			0.48	17	67	36
63	27	.80	26	$F_{86} = 0.8\ F_{85}$	61	29	0.64	22	61	32
				$F_{86} = F_{85}$			0.80	25	56	27
				$F_{86} = 1.2\ F_{85}$			0.96	29	51	24
				$F_{86} = 1.4\ F_{85}$			1.12	31	47	21

Weight in '000 tonnes

Stock biomass = fish of age 1 and older

Spawning stock biomass based on ogive

Exploitation pattern 1985-86 based on 1979-84 average

Table 7.1 Nominal catch (in tonnes) of COD in Division VIb,
1975-84. (Data for 1975-83 as officially
reported to ICES)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Belgium	-	1	-	-	-	-	-	-	-	-
Denmark	-	-	-	-	-	..a)	-	-	-	-
Faroe Islands	3	22	40	10	92	75	2	77	112	18
France	4	4	3	1	2	1	4	27	97	5
Germany, Fed.Rep.	-	-	-	-	111	136	443	+	195	..a)
Ireland	-	-	-	3	-	-	-	-	-	-
Norway	-	8	3	69	138	80	134	51	462*	341
Spain	-	-	..a)	..a)	-	33	70	58	42	
UK (England & Wales)	28	77	89	285	129	1	67	3	163	160
UK (Scotland)	98	61	33	384	198	370	143	157	35	221
USSR	110	1,398	-	-	-	-	-	-	-	-
Total	243	1,571	168	752	670	696	863	373	1,106	745

* Provisional

a) Included in Division VIa

Table 8.1. Nominal catch (in tonnes) of COD in Divisions VIId and VIIe, 1975-84.
            (Data for 1975-83 as officially reported to ICES)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Belgium	59	65	53	435	699	163	363	293	389	345
Denmark	2,718	1,506	1,120	2,160	2,052	660[1]	-	-	-	-
France	2,143	1,646	5,185	8,044	4,848	4,001	4,486	3,349	3,369	3,209
Netherlands	+	2	1	+	-	-	4	1	-	
UK (England & Wales)	159	142	581	654	485	365	428	568	650	498
'. (Scotland)	-	-	-	-	+	-	-	-	-	-
USSR	3	4	-	-	-	-	-	-	-	-
Total Div. VIId,e	5,082	3,365	6,940	11,293	8,084	5,189	5,281	4,211	4,408	4,052

*Provisional

[1]Includes Divisions VIIb,c

Table 8.2. Nominal catch (in tonnes) of COD in Divisions VIIb,c and VIIg-k, 1975-84.
(Data for 1975-83 as officially reported to ICES)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Belgium	116	159	85	52	51	110	198	97	113	144
Denmark	-	-	-	-	18	...b)	-	-	-	-
France	2,877	3,196	1,972	2,192	2,918	4,475	6,803	5,041	4,668	3,704
Germany,Fed.Rep.	-	-	-	3a)	-	7	-	-	-	-
Ireland	474	506	315	323	552	1,028	1,542	1,906	1,466	1,419
Netherlands	54	46	291	279	-	5	-	+	304*	
Norway	1	-	+	-	-	-	-	-	1*	-
Poland	19	40	6	-	2	-	-	-	-	-
Spain	588	1,140	51	11	-	17	37	29	28	
U.K. (England & Wales)	73	44	33	28	33	83	288	419	103	372
U.K. Scotland	-	-	-	2	1	12	+	-	-	45
USSR	134	203	-	-	-	-	-	-	-	-
Total Divs.VIIb,c,g-k	4,336	5,234	2,753	2,890	3,575	5,737	8,868	7,492	6,683	5,684

* Provisional

a)Catch in Division VIIg only

b)Included in Division VIIe

Table 9.1. Nominal catch (in tonnes) of HADDOCK in Sub-area IV, 1975-84
(Data for 1975-83 as officially reported to ICES)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Belgium	2,209	2,166	2,293	1,295	732	1,414	1,217	966	985	508
Denmark	32,930	46,899	20,069	8,093	8,248	12,928	13,198	22,704	25,653*	16,320
Faroe Isl.	267	183	385	12	7	27	46	6	51	23
France	4,646	5,500	6,914	5,122	7,208	7,407	11,966	15,988	11,250	7,111
German Dem.Rep.	44	20	8	37	12	36	-	-	-	-
Germany Fed.Rep.	2,396	3,433	3,744	2,589	2,549	2,354	3,387	4,510	3,654	2,573
Ireland	-	31	53	101	-	-	-	-	-	-
Netherlands	1,901	1,728	1,598	857	955	1,557	2,279	1,021	1,213*	1,060
Norway a)	331	367	374	609	968	1,191	2,283	2,888	3,718*	3,405
Poland	1,485	1,155	485	62	106	59	31	317	150	17
Sweden	2,083	2,455	113	-b)	907	1,165	1,301	1,874	1,360*	1,515
UK (England & Wales)	11,499	17,238	17,167	12,200	10,774	12,195	14,570	16,403	15,476	11,725
UK (Scotland)	64,686	80,576	89,465	58,406	54,119	64,058	82,798	107,773	100,390	87,241
USSR	49,686	42,852	8,010	54	18	-	-	-	-	-
TOTAL Sub-area IV	174,163	204,603	150,678	89,437	86,603	104,391	133,076	174,450	163,900	131,498
Division IVa	110,848	138,591	116,577	57,886	51,741	64,886	82,996	109,341	101,918	87,250
Division IVb	62,761	65,594	34,030	31,457	34,361	39,072	49,197	64,833	61,852	44,210
Division IVc	554	418	71	94	501	433	833	276	130	38
Working Group Total incl. Discards	448,582	368,327	207,788	163,890	141,858	217,107	206,930	225,789	232,203	205,854

* Provisional
a) Figures from Norway do not include haddock caught in Rec.2 fisheries
b) Included in Division IIIa

Table 9.2 North Sea HADDOCK. Numbers('OOO.OOO) and weight
('OOO tonnes) in each category. Working Group
data.

	Industrial		HC		Discards		Total	
Year	Number	Weight	Number	Weight	Number	Weight	Number	Weight
1960	143	12	197	72	805	124	1,145	208
1961	983	11	170	67	797	119	1,950	197
1962	286	11	129	51	2,321	333	2,736	395
1963	256	14	146	55	1,005	152	1,407	221
1964	599	89	360	134	658	164	1,617	387
1965	1,093	75	377	165	259	63	1,729	303
1966	2,232	47	413	229	497	75	3,142	351
1967	700	21	272	147	448	78	1,420	246
1968	558	34	224	107	850	164	1,632	305
1969	1,890	338	910	331	1,203	260	4,003	929
1970	1,622	180	1,245	525	515	101	3,382	806
1971	914	32	474	236	1,284	178	2,672	446
1972	534	30	429	193	761	128	1,724	351
1973	171	11	469	186	688	120	1,328	317
1974	936	48	360	151	1,100	168	2,396	367
1975	734	41	365	148	1,856	260	2,955	449
1976	447	48	398	166	789	154	1,634	368
1977	350	35	304	131	215	42	869	208
1978	433	10	182	81	397	73	1,112	164
1979	985	16	190	84	288	42	1,463	142
1980	687	22	219	99	545	95	1,451	216
1981	779	17	275	130	299	60	1,353	207
1982	480	19	310	166	181	41	971	226
1983	574	13	286	155	378	64	1,238	232
1984*	173	10	355	123	470	72	809	205

HC = Human Consumption

* Preliminary

Table 9.3.   VIRTUAL POPULATION ANALYSIS

NORTH SEA HADDOCK (FISHING AREA IV)

CATCH IN NUMBERS   UNIT: thousands

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	44945	167175	114326	294618	841409	374946	646339	278692	635669	52362
1	2092533	167706	245095	440567	345899	662217	134459	275374	153450	418508
2	633927	1046224	99930	134443	198970	323179	413329	83700	238228	155725
3	57006	206799	361275	27039	39620	69878	139259	286750	72253	109959
4	106938	9635	37505	103275	7139	10021	14663	40511	119535	20594
5	15391	30548	3762	8117	26932	1818	1902	3229	16401	30223
6	670	4795	5730	1123	2134	7842	375	700	1691	3424
7	454	186	1080	1809	248	580	2478	273	266	540
8	2631	67	109	365	451	116	130	799	64	65
9	248	683	23	107	136	154	63	29	176	44
10	47	51	155	22	52	71	22	15	47	85
11+	19	3	3	60	23	36	39	12	14	25
TOTAL	2954809	1633872	868993	1011545	1463213	1450858	1353058	970084	1237794	792054

Table 9.4.   VIRTUAL POPULATION ANALYSIS

NORTH SEA HADDOCK (FISHING AREA IV)

MEAN WEIGHT AT AGE OF THE STOCK   UNIT: kilogram

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	.021	.013	.019	.009	.009	.012	.009	.011	.022	.010
1	.101	.125	.106	.140	.095	.104	.074	.100	.134	.141
2	.242	.224	.239	.250	.291	.284	.262	.292	.294	.311
3	.357	.400	.346	.414	.443	.487	.474	.461	.446	.495
4	.451	.508	.599	.444	.635	.730	.735	.786	.649	.679
5	.681	.580	.608	.694	.659	1.038	1.131	1.168	.911	.808
6	1.310	.893	.753	.709	.924	.925	1.456	1.456	1.278	1.105
7	1.152	1.877	1.096	.924	1.173	1.377	1.148	1.678	1.215	1.127
8	1.097	1.736	1.708	1.302	1.167	1.621	1.583	1.452	1.951	1.873
9	1.743	1.235	1.977	1.806	1.455	1.597	1.690	2.624	1.429	2.413
10	2.286	2.335	1.608	1.923	2.639	1.710	1.531	2.173	1.486	1.885
11+	2.854	2.528	3.189	1.800	1.618	3.269	1.464	1.870	1.843	2.519

Table 9.5.   VIRTUAL POPULATION ANALYSIS

NORTH SEA HADDOCK (FISHING AREA IV)

FISHING MORTALITY COEFFICIENT   UNIT: Year-1   NATURAL MORTALITY COEFFICIENT =   .20

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1979-82
0	.10	.25	.11	.20	.31	.57	.49	.36	.17	.08	.43
1	.09	.66	.69	.76	.39	.42	.41	.40	.34	.16	.41
2	1.07	.94	1.11	1.08	.98	.78	.51	.48	.74	.69	.69
3	1.52	1.44	1.07	1.12	1.19	1.25	.97	.83	1.03	.95	1.06
4	1.14	.85	1.26	1.09	1.09	1.23	1.02	.87	1.07	.98	1.05
5	1.01	1.33	1.01	1.11	1.01	.95	.83	.66	1.16	.89	.86
6	.62	1.10	1.02	1.00	1.06	.96	.51	.37	.90	.82	.85
7	1.24	.35	.81	1.14	.63	.98	.96	.89	1.03	.84	.87
8	1.15	.59	.35	.72	1.05	.70	.61	1.05	.53	.78	.85
9	1.21	1.14	.41	.69	.66	1.48	1.11	.26	.70	.87	.88
10	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90
11+	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90
(2- 6)U	1.03	1.13	1.09	1.08	1.07	1.03	.77	.74	.98	.87	

Table 9.6.   VIRTUAL POPULATION ANALYSIS

NORTH SEA HADDOCK (FISHING AREA IV)

STOCK SIZE IN NUMBERS   UNIT: thousands

BIOMASS TOTALS   UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1975-82
0	514006	840340	1227501	1756283	3493148	949021	1318268	1019759	4397022	766819	0	1452291
1	4561794	380301	537615	901905	1172066	2103743	441441	909555	584638	3027404	580129	1376130
2	1044046	1866144	161501	221254	345584	649670	1128376	240775	497584	340824	2101614	707144
3	83975	292068	597199	43568	61806	105900	243087	553612	122118	194784	139961	247727
4	170644	18341	56579	168215	11684	15320	24342	75691	197730	35796	61676	67665
5	20214	44879	6433	13126	46078	3230	5669	7312	25895	55763	10999	18868
6	1584	7737	9733	1924	3545	13793	1027	1309	3101	6661	18749	5088
7	691	698	2120	2878	577	1008	4319	505	448	1034	2402	1600
8	4177	164	404	773	752	251	309	1333	171	131	365	1020
9	382	1087	74	233	307	215	102	137	362	82	49	317
10	36	93	284	40	95	130	40	27	86	156	28	100
11+	35	5	5	110	42	66	71	22	26	46	67	45

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
TOTAL NO	6407634	3451906	2599448	3110310	5136104	3842346	3666153	2810039	5829202	4429500
SPS NO	619654	876763	549024	275529	225390	335981	569480	555340	452616	369862
TOT.BIOM	857402	638774	374306	304947	314112	496128	489864	500879	533310	715687
SPS BIOM	199074	260144	203794	111128	93615	126097	204050	269633	225884	179972

Table 9.7.
NORTH SEA HADDOCK.
Assumption 1. No adjustment for industrial by-catch data.

INPUT DATA FOR PREDICTION
***** **** *** *********

Stock numbers are for year 1985
Fishing mortality and weight at age are averages for
the reference period 1979 to 1984
Fishing mortality has been rescaled so that for the
Human Consumption FISHERY (landings + discards) F(bar)
for the reference period = F(bar) 1984 = .848

AGE	STOCK NUMBER	AV. WT. STOCK	AV. WT. HC. LAND	AV. WT. DISC.	AV. WT. INDUST.	FISHING TOTAL	MORTALITY HC. LAND	DISC.	INDUST.	PROPORTION MATURE	NATURAL MORTALITY
0	2455000.	.013	.000	.061	.009	.330	.000	.009	.321	.000	.200
1	580129.	.108	.501	.162	.043	.349	.009	.164	.176	.010	.200
2	2101614.	.289	.379	.230	.186	.680	.296	.323	.061	.320	.200
3	141100.	.468	.503	.290	.392	1.011	.823	.129	.059	.710	.200
4	61171.	.703	.716	.379	.592	1.017	.952	.022	.044	.870	.200
5	11017.	.952	.969	.523	.750	.893	.858	.010	.025	.950	.200
6	18589.	1.191	1.196	.792	1.012	.831	.819	.009	.004	1.000	.200
7	2402.	1.286	1.286	.000	1.592	.868	.866	.000	.002	1.000	.200
8	368.	1.608	1.608	.000	.000	.766	.766	.000	.000	1.000	.200
9	49.	1.868	1.868	.000	1.796	.824	.823	.000	.002	1.000	.200
10	28.	1.904	1.904	.000	.000	.876	.876	.000	.000	1.000	.200
11	67.	2.097	2.097	.000	.000	.876	.876	.000	.000	1.000	.200

YEAR	RECRUITMENT
1985	2455000
1986	2455000
1987	2455000

<u>Table 9.8</u>. Management Options: North Sea HADDOCK.

Assumption 1. $F_{85} = F_{84}$

No adjustment for industrial by-catch data.

1 9 8 5			
Stock biomass	Spawning stock biomass	$\overline{F}_{2-6}$ H.C.	Total landings
846	315	.848	263

Management option for 1986	Stock biom.	SSB	$\overline{F}_{2-6}$ H.C.	Total landings	H.C. landings	Industr. landings	Discards
1 9 8 6							
$F_{86} = 0 \quad F_{85}$	753	379	0	37	0	37	0
$F_{86} = 0.2F_{85}$			.170	110	74	35	16
$F_{86} = 0.5F_{85}$			.424	197	164	33	37
$F_{86} = 1.0F_{85}$			.848	300	271	29	66
$F_{86} = 1.5F_{85}$			1.272	367	341	27	90
$F_{86} = 2.0F_{85}$			1.696	412	387	24	110

1 9 8 7		
Management option for 1986	Stock biomass	Spawning stock biomass
$F_{86} = 0 \quad F_{85}$	1,131	651
$F_{86} = 0.2F_{85}$	1,015	557
$F_{86} = 0.5F_{85}$	873	443
$F_{86} = 1.0F_{85}$	701	308
$F_{86} = 1.5F_{85}$	585	220
$F_{86} = 2.0F_{85}$	504	162

Weights in '000 tonnes.
Stock biomass = fish age 0 and older.
Exploitation pattern 1985-86 based on 1979-84 average.
F values related to human consumption fishery
  (landings and discards) only.
Maturity ogive used for spawning stock biomass.
Average recruitment at age 0 = 2,455 million.

Table 9.9. NORTH SEA HADDOCK.
            Assumption 2. Revised catch and F at ages 0 and 1 in 1984.

INPUT DATA FOR PREDICTION
***** **** *** **********

     Stock numbers are for year 1985
     Fishing mortality and weight at age are averages for
     the reference period 1979 to 1984
     Fishing mortality has been rescaled so that for the
     Human Consumption FISHERY (landings + discards) F(bar)
     for the reference period = F(bar) 1984 = .848

AGE	STOCK NUMBER	AV. WT. STOCK	AV. WT. HC. LAND	AV. WT. DISC.	AV. WT. INDUST.	FISHING MORTALITY TOTAL	HC. LAND	DISC.	INDUST.	PROPORTION MATURE	NATURAL MORTALITY
0	2455000.	.012	.000	.061	.009	.382	.000	.009	.373	.000	.200
1	579999.	.099	.301	.162	.043	.404	.010	.167	.228	.010	.200
2	1510900.	.289	.379	.230	.186	.680	.296	.323	.061	.320	.200
3	141100.	.468	.503	.290	.392	1.011	.823	.129	.059	.710	.200
4	61171.	.703	.716	.379	.592	1.017	.952	.022	.044	.870	.200
5	11017.	.952	.969	.523	.750	.893	.858	.010	.025	.950	.200
6	18589.	1.191	1.196	.792	1.012	.831	.819	.009	.004	1.000	.200
7	2402.	1.286	1.286	.000	1.592	.868	.866	.000	.002	1.000	.200
8	368.	1.608	1.608	.000	.000	.766	.766	.000	.000	1.000	.200
9	49.	1.868	1.868	.000	1.796	.824	.823	.000	.002	1.000	.200
10	28.	1.904	1.904	.000	.000	.876	.876	.000	.000	1.000	.200
11	67.	2.097	2.097	.000	.000	.876	.876	.000	.000	1.000	.200

YEAR	RECRUITMENT
1985	2455000
1986	2455000
1987	2455000

<u>Table 9.10</u>. Management Options: North Sea HADDOCK.
Assumption 2. Revised catch and F at ages O and 1 in 1984
(means based on the 84 figures)

	1 9 8 5		
Stock biomass	Spawning stock biomass	$\overline{F}_{(2-6)}$ H.C.	Total landings
669	261	.848	216

Management option for 1986	Stock biom.	SSB	$\overline{F}_{(2-6)}$ H.C.	Total landings	H.C. landings	Industr. landings	Discards
				1 9 8 6			
F_{86} = O F_{85}	612	295	O	35	O	35	O
F_{86} = 0.2F_{85}			.170	91	58	33	14
F_{86} = 0.5F_{85}			.424	158	127	31	32
F_{86} = F_{85}			.848	239	210	28	58
F_{86} = 1.5F_{85}			1.272	291	265	26	80
F_{86} = 2.OF_{85}			1.096	326	302	24	98

1 9 8 7		
Management option for 1986	Stock biomass	Spawning stock biomass
F_{86} = O F_{85}	942	522
F_{86} = 0.2F_{85}	850	448
F_{86} = 0.5F_{85}	737	359
F_{86} = F_{85}	600	253
F_{86} = 1.5F_{85}	506	183
F_{86} = 2.OF_{85}	440	137

Weights in 'OOO tonnes.
Recruitment R_0 = 2,455 million in 1985-86.
Stock biomass = fish of age O and older
Spawning stock biomass using maturity ogive.
Exploitation pattern 1985-86 based on 1979-84 average.
F-values relate to human consumption fishery (landings + discards) only.

Table 10.1   Nominal catch (in tonnes) of HADDOCK in Division VIa,
             1975-84. (Data for 1975-83 as officially reported
             to ICES).

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Belgium	23	45	-	-	2	3	1	2	1	6
Denmark	-	13	-	-	37	-	-	+	-	-
Faroe Isl.	-	-	-	-	2	-	-	-	-	-
France	2,328	3,026	3,401	4,255	4,786	2,808	3,403	3,760	4,520	6,948
German Dem.Rep.	9	-	-	-	-	-	-	-	-	-
.many Fed.Rep.	3	30	+	20	2	3	7	71	65	15a)
Ireland	599	1,115	616	441	877	726	1,891	4,402	3,450	3,704
Netherlands	19	30	28	13	2	2	3	391	-*	
Norway	-	3	7	13	9	16	29	37	72*	49
Poland	20	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	97	201	
UK (England & Wales)	1,214	1,971	3,827	2,805	1,654	1,279	1,052	2,035	1,376	840
UK (Scotland)	8,973	11,992	11,422	9,629	7,459	8,198	12,051	19,249	21,593	18,412
UK (N Ireland)	-	-	-	-	-	+	-	1	4	5
USSR	495	533	-	-	-	-	-	-	-	
Total Div.VIa	13,683	18,758	19,301	17,176	14,830	13,935	18,437	30,045	31,282	29,979
WG Total incl. discards	46,635	34,071	23,657	19,510	28,847	17,478	33,306	39,681	37,630	45,956

* Provisional
a) Includes Division VIb

Table 10.2.   VIRTUAL POPULATION ANALYSIS

HADDOCK IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

CATCH IN NUMBERS   UNIT: thousands

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	6849	4227	4552	56	5697	13	764	136	2161	267
1	179350	24338	13109	15941	70070	22729	251	15491	14979	98221
2	34957	72330	3469	2096	17281	21928	83912	5020	20408	8583
3	3359	15224	35948	970	1865	5636	20697	73676	6123	12923
4	3350	1588	5704	24358	470	922	1766	8167	35573	6508
5	1882	1491	680	2939	9863	143	194	898	6566	23089
6	95	868	495	351	833	3082	39	108	847	2426
7	98	21	308	247	114	229	822	272	148	370
8	3454	7	28	336	145	22	39	286	228	50
9	72	1103	11	7	28	5	14	31	193	47
10	8	4	259	17	3	21	2	12	34	70
11+	0	5	5	214	44	7	4	1	44	2
TOTAL	233454	121206	64568	47534	106413	54737	108506	104109	87504	152556

Table 10.3.   VIRTUAL POPULATION ANALYSIS

HADDOCK IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

MEAN WEIGHT AT AGE OF THE STOCK   UNIT: kilogram

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	.040	.040	.040	.068	.032	.077	.082	.038	.050	.059
1	.159	.159	.161	.134	.182	.134	.252	.157	.172	.149
2	.260	.256	.274	.278	.325	.319	.245	.273	.275	.319
3	.428	.459	.406	.388	.457	.572	.467	.376	.428	.453
4	.581	.592	.684	.516	.730	.719	.887	.746	.554	.660
5	.852	.831	.800	.827	.777	.998	.975	1.126	.763	.653
6	1.027	1.095	1.128	1.045	1.040	.985	1.376	1.539	1.165	1.047
7	1.001	1.585	1.337	1.152	1.491	1.143	1.294	1.549	1.408	1.335
8	1.009	1.084	1.117	1.399	1.944	1.565	1.347	1.514	1.581	1.909
9	1.190	1.243	1.394	2.126	1.735	1.632	1.366	1.738	1.493	1.882
10	2.523	1.806	1.339	1.376	1.569	1.879	1.314	2.068	1.545	1.401
11+	.000	.000	1.593	1.208	1.781	2.862	1.785	1.543	1.541	1.624

Table 10.4.   VIRTUAL POPULATION ANALYSIS

HADDOCK IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

FISHING MORTALITY COEFFICIENT   UNIT: Year-1   NATURAL MORTALITY COEFFICIENT =   .20

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1978-81
0	.157	.149	.066	.000	.011	.000	.007	.003	.007	.006	.005
1	.592	1.287	.924	.342	.530	.057	.006	.197	.408	.508	.234
2	.687	.508	.618	.356	.769	.312	.305	.154	.429	.435	.435
3	.604	.743	.514	.347	.621	.620	.546	.481	.265	.533	.533
4	.694	.656	.703	.806	.282	.731	.401	.432	.454	.555	.555
5	.601	.784	.663	1.019	.944	.130	.326	.365	.750	.605	.605
6	.708	.623	.662	.894	.952	.916	.047	.304	.703	.702	.702
7	.790	.328	.471	.844	.851	.767	.674	.526	.891	.784	.784
8	.938	.112	.983	1.576	2.617	.384	.277	.533	1.208	.900	1.213
9	2.112	1.069	.258	.719	.502	.796	.452	.369	.850	.900	.617
10	.700	.700	.800	.800	.800	.900	.900	.900	.900	.900	.850
11+	.700	.700	.800	.800	.800	.900	.900	.900	.900	.900	.850
(1- 6)U	.647	.767	.681	.627	.683	.461	.272	.322	.505	.556	

Table 10.5.   VIRTUAL POPULATION ANALYSIS

HADDOCK IN FISHING AREA VIA (NW. COAST OF SCOTLAND, N. IRELAND)

STOCK SIZE IN NUMBERS   UNIT: thousands

BIOMASS TOTALS   UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1975-81
0	51921	33510	78744	227585	558980	58022	117335	59963	331923	50934	0	160871
1	438635	36339	23627	60362	186230	452509	47493	95375	48971	269804	41460	177892
2	76774	198687	8218	7680	35102	89769	349971	38657	64139	26654	132913	109457
3	8049	31635	97880	3626	4405	13325	53791	211115	27127	34208	14125	30387
4	7303	3603	12315	47939	2098	1939	5370	25512	106820	16705	16436	11581
5	4552	2987	1531	4990	17535	1295	755	3219	13563	55564	7851	4808
6	204	2044	1116	646	1474	5583	951	452	1830	5246	24842	1714
7	195	82	897	472	216	466	1829	727	273	742	2128	594
8	5975	73	49	459	166	76	177	763	552	92	277	996
9	87	1822	53	15	78	10	42	110	367	86	30	301
10	17	9	512	34	6	38	4	22	62	128	29	89
11+	0	11	10	423	87	13	7	2	81	4	44	79
TOTAL NO	593713	310801	224952	354230	806428	623046	578214	435918	595507	460165		
SPS NO	70144	155517	119048	62980	46073	73914	262899	263957	187053	127966		
TOT.BIOM	109838	81845	61882	58418	32845	110324	142367	133059	127054	121517		
SPS BIOM	29435	52855	53960	33936	26149	32907	85908	111268	95051	74655		

Table 10.6. WEST OF SCOTLAND HADDOCK.

INPUT DATA FOR PREDICTION
***** **** *** **********

    Stock numbers are for year 1985
    Fishing mortality and weight at age are averages for
    the reference period 1979 to 1984
    Fishing mortality has been rescaled so that for the
    Human Consumption FISHERY (landings + discards) F(bar)
    for the reference period = F(bar) 1984 = .566

AGE	STOCK NUMBER	AV. WT. STOCK	AV. WT. HC. LAND	AV. WT. DISC.	AV. WT. INDUST.	FISHING MORTALITY TOTAL	HC. LAND	DISC.	INDUST.	PROPORTION MATURE	NATURAL MORTALITY
0	169000.	.056	.000	.056	.000	.007	.000	.007	.000	.000	.200
1	41460.	.175	.289	.145	.000	.322	.012	.310	.000	.000	.200
2	132913.	.293	.380	.234	.000	.451	.203	.249	.000	.570	.200
3	14125.	.459	.494	.292	.000	.579	.478	.101	.000	1.000	.200
4	16436.	.716	.723	.319	.000	.534	.523	.011	.000	1.000	.200
5	7851.	.882	.890	.372	.000	.586	.573	.013	.000	1.000	.200
6	24842.	1.192	1.192	.000	.000	.680	.680	.000	.000	1.000	.200
7	2128.	1.370	1.370	.000	.000	.843	.843	.000	.000	1.000	.200
8	277.	1.643	1.643	.000	.000	1.111	1.111	.000	.000	1.000	.200
9	30.	1.641	1.641	.000	.000	.726	.726	.000	.000	1.000	.200
10	29.	1.629	1.629	.000	.000	.995	.995	.000	.000	1.000	.200
11	44.	1.856	1.856	.000	.000	.995	.995	.000	.000	1.000	.200

YEAR	RECRUITMENT
1985	169000
1986	169000
1987	169000

Table 10.7. Management Options: North Sea HADDOCK in Division VIa.

1 9 8 5			
Stock biomass	Spawning stock biomass	$\overline{F}(_2-_6)$ H.C.	Total landings
114	80	.566	32

1 9 8 6					
Management option for 1986	Stock biom.	Spawning stock biomass.	$\overline{F}(_2-_6)$ H.C.	H.C. landings	Discards
$F_{86} = 0 \quad F_{85}$	104	67	0	0	0
$F_{86} = .2 \; F_{85}$			.113	7	2
$F_{86} = .5 \; F_{85}$			.283	16	4
$F_{86} = F_{85}$			.566	28	7
$F_{86} = 1.5F_{85}$			.849	36	10
$F_{86} = 2 \quad F_{85}$			1.132	43	13

1987		
Management option for 1986	Stock biomass	Spawning stock biomass
$F_{86} = 0 \quad F_{85}$	148	100
$F_{86} = .2 \; F_{85}$	136	89
$F_{86} = .5 \; F_{85}$	121	76
$F_{86} = F_{85}$	101	58
$F_{86} = 1.5F_{85}$	86	44
$F_{86} = 2 \quad F_{85}$	75	34

Weights in '000 tonnes.

Recruitment R_0 = 169 million in 1985-86.

Stock biomass = fish at age 0 and older.

Spawning stock biomass using maturity ogive.

Exploitation pattern 1985-86 based on 1979-84 average.

F values relate to human consumption fishery (landings + discards) only.

Table 11.1   Nominal catch (in tonnes) of HADDOCK in Division VIb,
             1975-84. (Data for 1975-83 as officially reported to ICES).

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Belgium	-	33	-	-	-	-	-	-	-	
Faroe Isl.	1	8	3	11	20	5	1	21	3	3
France	21	4	4	3	4	1	10	32	48	10
Germany										
Fed.Rep.	-	-	-	-	-	17	-	4	1	..a)
Ireland	-	-	-	61	-	-	-	-	-	-
Norway	-	-	+	4	16	2	10	3	20	42
Spain	-	-	-	-	-	6	88	121	79	
UK (Eng-										
land &	5	2,111	2,694	2,365	1,654	6,261	9,005	3,736	113	719
Wales)										
UK										
(Scotland)	71	640	297	2,060	548	1,051	27	5	136	1,654
USSR	49,830	40,474	-	-	-	-	-	-	-	-
Total										
Div.VIb	49,928	43,243	2,998	4,504	2,242	7,343	9,141	3,922	400	2,428

* Provisional
a) Included in Division VIa

Table 12.1   Nominal catch (in tonnes) of HADDOCK in Divisions VIId and
              VIIe, 1975-84. (Data for 1975-83 as officially reported
              to ICES)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Belgium	+	+	1	–	1	+	2	1	1	–
Denmark	–	–	2	22	21	15	–	–	–	–
France	868	405	438	356	333	298	421	344	231	–
Germany Fed.Rep.	+	–	–	–	–	–	–	–	–	–
Ireland	–	–	4	–	–	+	–	–	–	–
Netherlands	1	–	–	–	–	–	–	94	–*	
UK (England & Wales)	99	45	29	22	51	59	119	60	41	26
USSR	3	–	–	–	–	–	–	–	–	–
Total Divs.VIId & VIIe	971	450	474	400	406	372	542	499	273	26

* Provisional

Table 12.2 Nominal catch (in tonnes) of HADDOCK in Divisions VIIb,c & VIIg-k, 1975-84. (Data for 1985-83 as officially reported to ICES).

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Belgium	33	19	13	5	2	2	3	3	1	-
Denmark	-	-	-	-	1	-	-	-	-	-
France	4,583	3,726	2,244	1,479	1,931	2,219	2,571	2,005	2,588	1,594
Germany Fed.Rep.	+	3	-	-	-	-	-	-	-	-
Ireland	507	287	153	111	155	274	679	904	941	647
Netherlands	4	14	1	-	16	-	-	7	- *	
Norway	-	-	-	-	-	-	-	-	54*	-
Spain	-	-	294	-	-	5	277	248	167	
UK (England & Wales)	46	24	18	13	19	50	92	182	23	300
UK (Scotland)	-	-	-	8	22	56	4	-	-	63
USSR	1,290	183	-	-	-	-	-	-	-	-
Total Divs.VIIb,c & VIIg-k	6,463	4,256	2,273	1,616	2,146	2,606	3,626	3,349	3,774	2,604

* Provisional

Table 13.1. Nominal catch (in tonnes) of WHITING in Sub-area IV, 1975-84.
(Data for 1975-83 as officially reported to ICES)

Country	1975	1976	1977	1978	1979
Belgium	3,279	2,640	3,275	3,304	3,941
Denmark	61,941	116,973	46,479	15,741	41,965
Faroe Islands	764	1,262	472	42	581
France	20,079	19,557	17,592	22,525	27,590
German Dem.Rep.	3	18	-	22	5
Germany, Fed.Rep.	446	302	461	348	1,280
Ireland	-	4	9	38	-
Netherlands	14,078	12,274	9,406	11,030	13,417
Norway[1]	55	71	33	64	49
Poland	888	509	445	8	3
Spain	65	18	-	-	-
Sweden	255	153	341	...[2]	31
U.K. (England & Wales)	5,246	5,112	6,185	7,542	7,581
U.K. (Scotland)	27,969	26,167	33,017	42,779	44,841
USSR	5,098	5,612	2,413	-	-
Total Sub-area IV	140,166	190,672	120,128	103,443	141,284
Total Division IVa	75,444	100,001	61,499	42,837	48,554
Total Division IVb	41,930	69,908	42,911	40,943	68,775
Total Division IVc	22,792	20,763	15,718	19,663	23,955
WG total incl.discards	299,798	358,161	345,537	179,192	236,712

Country	1980	1981	1982	1983	1984*
Belgium	3,153	2,623	2,272	2,864	2,779
Denmark	17,916	16,430	27,043	18,054*	19,735
Faroe Islands	21	12	57	18	8
France	23,626	24,744	23,780	21,263	13,775
German Dem.Rep.	-	-	-	-	-
Germany, Fed.Rep.	1,267	601	223	317	291
Ireland	-	-	-	-	-
Netherlands	14,389	14,600	12,218	10,372*	8,770
Norway[1]	27	27	17	40*	77
Poland	1	-	-	1	2
Spain	-	-	-	-	
Sweden	16	9	11	44*	52
U.K. (England & Wales)	6,778	5,964	4,743	4,366	4,853
U.K. (Scotland)	42,218	31,399	29,640	41,248	42,918
USSR	-	-	-	-	-
Total Sub-area IV	109,412	96,409	100,004	98,587	93,260
Total Division IVa	42,529	33,799	35,665	46,992	44,839
Total Division IVb	41,156	40,145	45,311	41,947	40,062
Total Division IVc	25,727	22,465	19,028	9,648	8,359
WG total incl.discards	215,979	182,272	131,881	154,236	132,883

*Provisional figures
[1] Figures from Norway do not include whiting caught in Rec.2 fisheries
[2] Included in Division IIIa

Table 13.2.   North Sea WHITING.
               Numbers ('000,000) and weight ('000 tonnes) in each
               category.   Working Group data.

Year	Industrial Number	Industrial Weight	Human consumption Number	Human consumption Weight	Discards Number	Discards Weight	Total Number	Total Weight
1960	109	11	191	48	763	122	1,063	181
1961	232	16	290	68	1,646	241	2,168	325
1962	100	8	222	56	1,185	157	1,507	221
1963	480	45	215	58	854	154	1,549	257
1964	369	28	221	60	341	59	931	147
1965	161	22	313	86	490	77	964	185
1966	422	51	366	105	546	84	1,334	240
1967	231	23	246	68	1,103	143	1,580	234
1968	593	58	299	88	754	115	1,646	261
1969	1,974	152	204	57	626	115	2,804	324
1970	1,854	115	272	79	381	74	2,507	268
1971	1,475	72	185	58	458	63	2,118	193
1972	1,352	61	179	60	398	67	1,929	188
1973	1,273	90	234	66	659	110	2,166	266
1974	1,846	130	252	75	477	85	2,575	290
1975	1,018	86	252	79	699	135	1,969	300
1976	1,396	150	243	74	633	134	2,272	358
1977	1,663	106	267	74	555	165	2,485	346
1978	1,165	55	323	88	242	35	1,730	178
1979	886	59	352	99	652	78	1,890	236
1980	644	46	328	93	476	78	1,448	217
1981	929	67	258	80	212	34	1,399	181
1982	333	33	238	72	173	27	744	132
1983	697	24	261	81	370	50	1,328	155
1984*	296	19	241	75	312	39	849	133

*Preliminary

Table 13.3.   VIRTUAL POPULATION ANALYSIS

NORTH SEA WHITING (FISHING AREA IV)

CATCH IN NUMBERS   UNIT: thousands

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	238840	424725	667359	687251	476390	332222	516826	100982	668570	157012
1	955579	478793	1019668	418867	618984	269163	161118	191347	201525	308195
2	401161	1114465	480968	335950	465908	428185	333868	103342	168470	156000
3	299671	161202	262129	203682	211672	270624	263065	231457	107974	107420
4	55070	76470	31567	69085	86510	80234	91501	83856	133591	46460
5	9171	13319	18243	7617	25174	58209	21356	24517	37121	57597
6	7989	2719	4634	5371	3120	7855	10212	6307	8054	13102
7	117	545	406	1408	1183	734	1763	1692	1716	2672
8	1385	22	167	245	194	526	240	360	698	579
9	141	287	4	7	15	44	30	58	81	148
10	2	24	155	7	1	13	36	58	81	148
11+	0	0	3	0	3	5	1	7	0	0
TOTAL	1969126	2272571	2485323	1729490	1889154	1447814	1400016	743948	1328033	849005

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Table_13.4.   VIRTUAL POPULATION ANALYSIS

NORTH SEA WHITING (FISHING AREA IV)

MEAN WEIGHT AT AGE OF THE STOCK   UNIT: kilogram

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	.030	.019	.022	.010	.009	.013	.011	.029	.014	.020
1	.100	.107	.117	.074	.098	.076	.082	.061	.105	.087
2	.214	.194	.212	.185	.165	.176	.165	.181	.188	.188
3	.276	.294	.326	.239	.258	.245	.241	.253	.275	.276
4	.368	.358	.394	.337	.313	.322	.332	.313	.323	.335
5	.465	.440	.463	.460	.433	.331	.413	.385	.380	.378
6	.353	.511	.489	.461	.492	.473	.433	.494	.424	.389
7	.817	.441	.532	.515	.541	.459	.573	.532	.459	.463
8	.596	.460	.335	.689	.615	.593	.655	.712	.532	.582
9	.713	.693	.916	.742	.668	.570	.913	.734	.700	.528
10	1.022	.912	.441	1.828	.737	.795	1.051	1.153	.513	.861
11+	.000	.000	.941	.000	.521	.717	.695	.781	.000	.000