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~~Working Group on Roundfish~~

## REPORT OF THE NORTH SEA ROUND FISH WORKING GROUP

Copenhagen, 12-24 March 1984

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TABLE OF CONTENTS

	<u>Page</u>
1. PARTICIPANTS .....	1
2. TERMS OF REFERENCE .....	1
3. DETERMINATION OF FISHING MORTALITY IN THE LAST DATA YEAR..	1
4. ESTIMATION OF RECRUITMENT .....	2
5. NORTH SEA COD .....	3
5.1 Catch Trends .....	3
5.2 Age Composition .....	3
5.3 Recruitment .....	3
5.4 Weight at Age .....	4
5.5 Fishing Mortalities in 1983 .....	4
5.6 VPA Results .....	4
5.7 Equilibrium Yield and Spawning Stock Biomass for Average Recruitment .....	4
5.8 Catch Predictions .....	5
6. COD IN DIVISION VIa .....	5
6.1 Catch Trends .....	5
6.2 Age Composition .....	5
6.3 Recruitment .....	6
6.4 Weight at Age .....	6
6.5 Fishing Mortalities in 1983 .....	6
6.6 VPA Results .....	7
6.7 Equilibrium Yield and Spawning Stock Biomass for Average Recruitment .....	7
6.8 Catch Predictions .....	7
7. COD IN DIVISION VIb .....	7
8. COD IN SUB-AREA VII .....	7
8.1 Cod in Divisions VII <sup>d</sup> and e .....	7
8.2 Cod in Divisions VII <sup>b,c</sup> and VII <sup>g-k</sup> .....	8
9. NORTH SEA HADDOCK .....	8
9.1 Catch Trends .....	8
9.2 Age Composition .....	8
9.3 Weight at Age .....	8
9.4 Recruitment .....	8
9.5 Fishing Mortality Rates in 1983 for Age Groups 0-10	9
9.6 VPA Results .....	9
9.7 Equilibrium Yield and Spawning Stock Biomass for Average Recruitment .....	9
9.8 Catch Predictions .....	9
10. HADDOCK IN DIVISION VIa .....	10
10.1 Catch Trends .....	10
10.2 Age Composition .....	10
10.3 Weight at Age .....	11
10.4 Recruitment .....	11
10.5 Fishing Mortality Rates in 1983 for Ages 0-10 .....	11

continued...

Table of Contents (ctd)

		<u>Page</u>
10.	HADDOCK IN DIVISION VIIa (ctd)	
10.6	VPA Results .....	11
10.7	Equilibrium Yield and Spawning Stock Biomass for Average Recruitment .....	11
10.8	Catch Predictions .....	11
11.	HADDOCK IN DIVISION VIIb .....	12
11.1	Catch Trends .....	12
11.2	Stock Assessment .....	12
12.	HADDOCK IN SUB-AREA VII .....	13
13.	NORTH SEA WHITING .....	13
13.1	Catch Trends .....	13
13.2	Age Composition .....	13
13.3	Mean Weight at Age .....	14
13.4	Recruitment .....	14
13.5	Fishing Mortalities in 1983 .....	14
13.6	VPA Results .....	14
13.7	Equilibrium Yield and Spawning Stock Biomass for Average Recruitment .....	14
13.8	Catch Predictions .....	15
14.	WHITING IN DIVISION VIIa .....	15
14.1	Catch Trends .....	15
14.2	Age Composition .....	15
14.3	Recruitment .....	15
14.4	Weight at Age .....	16
14.5	Fishing Mortalities .....	16
14.6	VPA Results .....	16
14.7	Equilibrium Yield and Spawning Stock Biomass for Average Recruitment .....	16
14.8	Catch Predictions .....	16
15.	WHITING IN DIVISION VIIb .....	17
16.	WHITING IN SUB-AREA VII .....	17
16.1	Whiting in Divisions VIIId,e .....	17
16.2	Whiting in Divisions VIIb,c and VIIg-k .....	17
17.	EFFECTS OF CHANGES IN THE DATA SETS OF WEIGHT AT AGE AND MATURITY AT AGE ON STOCK AND SPAWNING STOCK BIOMASS .....	17
17.1	Weight at Age Data .....	17
17.2	Maturity at Age Data .....	17
18.	IMPLICATIONS OF RESULTS OF STOMACH SAMPLING PROJECT ON STOCK ASSESSMENTS .....	18
18.1	Introduction .....	18
18.2	Estimation of Natural Mortality on the Younger Age Groups .....	18
18.3	Implications for Stock Assessments .....	18

continued...

Table of Contents (ctd)

	<u>Page</u>
19. GROWTH PARAMETERS AND SELECTION LENGTHS .....	19
19.1 Growth Parameters .....	19
19.2 Selection Lengths .....	19
20. EFFECTS ON WHITING OF A MESH SIZE INCREASE TO 90 mm IN THE NORTH SEA .....	20
20.1 Introduction .....	20
20.2 Data Base .....	20
20.3 Computation .....	21
20.4 Results .....	22
20.5 Comments .....	23
TABLES 1.1 - 20.26 .....	24-115
FIGURES 3.1 - 19.1 .....	116-138

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REPORT OF THE NORTH SEA ROUND FISH WORKING GROUP

1. PARTICIPANTS

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H J L Heessen	Netherlands
B W Jones (Chairman)	U.K. (England)
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J B Pérodon	France
O M Smedstad	Norway
A Souplet	France
G Wagner	Federal Republic of Germany

K Hoydal, ICES Statistician, also attended the meeting.

2. TERMS OF REFERENCE

At the 1983 Statutory Meeting of ICES it was decided (C.Res.1983/2:8:9) that the North Sea Roundfish Working Group should meet from 13-22 March 1984 at ICES headquarters to:

- (i) assess catch options for 1985 inside safe biological limits for cod, haddock and whiting in Sub-areas IV and VI and whiting in Divisions VIId,e;
- (ii) take into account the levels of predation mortality implied by the results of the stomach sampling project;
- (iii) analyse the effect of changes in the data sets of weight at age and age at first maturity on the time series of stock and spawning stock biomass.

Subsequently, the Working Group was asked, in addition, to estimate the effects on whiting of an increase in mesh size to 90 mm in Sub-area IV. As a result of this addition to the terms of reference, the period of the meeting was changed to 12-24 March 1984.

3. DETERMINATION OF FISHING MORTALITY IN THE LAST DATA YEAR

For the North Sea stocks, two methods were employed: the Rho method and the Armstrong-Cook method. For technical reasons, it was not possible to use the Lewy method. For the stocks in Division VIa, it was possible to use only the Rho method. The individual fleet data used are given in the text table below.

Fleet	North Sea			West of Scotland		
	Cod	Haddock	Whiting	Cod	Haddock	Whiting
Scottish trawl		+	+	+	+	+
Scottish seine	x	x	x	+	+	+
Scottish light trawl	+	+	+	+	+	+
Netherlands beam trawl	+					

Key: + used in Rho method.

x used in Rho method and in Armstrong-Cook method.

These were the same fleet data sets as used last year except that English data could not be used since the 1983 data were not available.

The input catch and effort data, and the resultant estimates of Rho and terminal Fs in 1983, are given in Tables 3.1 - 3.12. Trends in Rho with time are plotted by age group in Figures 3.1 - 3.6.

Table 3.13 gives a comparison of Fs as estimated by the Rho and Armstrong-Cook methods. For cod and haddock, the two methods give comparable results, but in whiting the Rho method produced higher values. It was considered preferable to use the results as estimated by the Rho method, on the grounds of consistency with previous years, and also because the Armstrong-Cook method is not at present implemented in the ICES computer.

The decision as to whether to accept the Rho-estimated Fs or not was based on their magnitude in relation to recently observed Fs in the VPA and on an inspection of the degree of scatter in the Rho plots. On this basis, the Rho-estimated Fs were accepted for all stocks except haddock and whiting in Division VIa. In these latter stocks, the input Fs were based on recent average values. Where possible, Fs on the youngest age groups were adjusted to correspond to abundances as estimated from the IYFS data. Further details are given in the relevant sections for each stock.

At last year's meeting, both methods gave unacceptably high estimates of F for some age groups in North Sea haddock. During the course of the year, it was discovered that the problem was due to inconsistencies between estimates of year class strength in the Rho data and in the VPA. Revisions to the VPA data base were, therefore, made, and the Fs estimated by the Rho method are now considered to be acceptable. Further details are given in Section 9.

#### 4.

##### ESTIMATION OF RECRUITMENT

Only some of the participating countries have so far provided exchange data tapes containing the 1983 IYFS data. Therefore, the indices for the 1983 IYFS are still preliminary.

Because the 1984 IYFS ended shortly before the meeting of the Working Group, only preliminary indices for the 1983 year classes were available. No indices were available for the 2-group fish.

The IYFS indices are tabulated together with English groundfish survey indices and VPA year class strength estimates in Tables 4.1 - 4.3. As far as the index for cod is concerned it must be taken into account that last year the International Gadoid Survey Working Group revised the standard area for the calculation of the abundance index. Four coastal rectangles in the German Bight were excluded because of irregularly high catches of young cod (Doc. C.M.1983/G:62).

Plots of IYFS indices against VPA year class strength estimates, and for the North Sea/West of Scotland relationship for VPA year class estimates are given in Figures 4.1 to 4.6.

The indications from the IYFS are that the 1983 year classes for cod and whiting are at least of intermediate strength, whereas the 1983 year class of haddock is a strong one.

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 1983 were 232 328 tonnes, compared to 258 102 tonnes in 1982. The TACs agreed between EEC and Norway were 235 000 tonnes in 1982 and 240 000 tonnes in 1983.

5.2 Age Composition

VPA input data are given in Table 5.2; they do not include discards or industrial fishery by-catches. Details of countries supplying age composition data are given in the text table below. For 1982, there were only minor changes to the data provided at last year's meeting. The same countries supplied data for 1983, with the exception of England, for whom computing difficulties prevented submission of data in time for the meeting.

Year	Category	Nations supplying age composition data	Weight represented by age compositions	Total weight caught	Percentage represented by age compositions
1982	Industrial by-catch	-	-	Not known	-
	Human consumption landings	France, Denmark, Netherlands, Federal Republic of Germany, England, Scotland, Belgium	245 974	257 825	95
	Discards	Scotland	4 212	Not known	-
1983	Industrial by-catch	Norway	774	Not known	-
	Human consumption landings	France, Denmark, Netherlands, Federal Republic of Germany, Scotland, Belgium	173 309	232 546	75
	Discards	Scotland	550	Not known	-

5.3 Recruitment

Revised estimates of abundance indices at ages 1 and 2 from the IYTS were provided by the International Young Gadoid Survey Working Group. A preliminary index at age 1 was available for the 1983 year class from the 1984 survey but, in contrast to last year's meeting, not for age 2.

#### 1982 year class

Two estimates of abundance are potentially available from the IYFS: at age 1 in 1983 and at age 2 in 1984. Although the correlation at age 2 between VPA and IYFS is quite good (Figure 4.2.A), as stated above the IYFS estimate was not available. At age 1, the VPA/IYFS plot (Figure 4.1.A) shows a wide scatter of points such that it cannot be used for prediction. The IYFS does, however, indicate that this year class is below average, of similar magnitude as the 1980 year class, and this is supported by the English Groundfish Survey. The value of 131 millions for the 1982 year class, which results from the F produced by the Rho method and the catch, compares with a VPA estimate of 154 millions for the 1980 year class. These abundance estimates are not inconsistent with those indicated by the research vessel surveys, and the value of 131 millions was, therefore, accepted for the 1982 year class at age 1.

#### 1983 year class

Estimates of abundance were available at age 1 (IYFS 1984) and at age 0 from English and Dutch groundfish surveys. Both the latter sources indicate an abundance similar to the 1981 year class (currently estimated at 290 millions from VPA), but the efficiency of sampling at age 0 on these surveys is uncertain. Problems with the IYFS data are explained above and so it was decided to set the abundance of the 1983 year class to 214 millions at age 1, which is the mean recruitment for the period 1963-80.

#### 1984 year class

Average recruitment of 214 millions was also assumed for this year class.

#### 5.4 Weight at Age

Mean weight at age in the stock (Table 5.3) was assumed to be the same as that in the landings. For predictions of catch in 1984 and 1985, mean weights were calculated as arithmetic means for the period 1978-83.

#### 5.5 Fishing Mortalities in 1983

##### F at age 1

The estimate of 0.27 as derived from the Rho method was adopted for this age group, since it results in a recruitment estimate which corresponds to that indicated by research vessel surveys (see Section 5.3). This value is higher than the mean of recent years but is similar to that in 1982.

##### F at other ages

These were estimated using the Rho method, as described in Section 3. Values from the Armstrong-Cook method were broadly similar to the Rho estimates. Data from two Scottish fleets and Dutch beam trawlers were included in the Rho analysis, English data being unavailable. The F values estimated are similar to those seen in recent years, with the exception of F at age 3 which is somewhat larger.

#### 5.6 VPA Results

Fishing mortalities are given in Table 5.4 and mean F at ages 3 to 8 are graphed in Figure 5.1.A. Mean F increased sharply in the early 1970s and then stabilised. However, a further sharp increase appears to

have occurred between 1979 and 1982. Historical SSB was calculated using a maturity ogive and not, as in previous years, assuming knife-edge maturity (see Section 17). A comparison of results from the two methods is shown in Figure 17.1.A. Stock numbers and biomasses are given in Table 5.5, while recruitment at age 1 and spawning stock biomass (SSB) are graphed in Figure 5.1.B. Recruitment has fluctuated between about 100 and 400 millions over the period shown, but no marked trend is apparent. SSB appears to have stabilised at a historically low level in recent years, but is expected to show a further decline in 1984 and 1985.

#### 5.7 Equilibrium Yield and Spawning Stock Biomass for Average Recruitment

These are shown in Figure 5.1.C. Values averaged over the period 1978-83 were used for stock weights and fishing mortalities. Mean recruitment of 214 millions (1963-80) was used in the calculations.

#### 5.8 Catch Predictions

Input data are given in Table 5.6. The mean weights and exploitation pattern are the averages for the period 1978-83. The results are given in Tables 5.7 and 5.8 and graphed in Figure 5.1.D (Assumption 1).

##### 1984

Two assumptions were considered:

$$\text{Assumption 1: } F_{84} = F_{83}$$

In this case, landings in 1984 of 196 000 tonnes are predicted at a mean  $F$  of 0.91. This compares with a prediction of 183 000 tonnes at a mean  $F$  of 0.73 made at last year's meeting.

$$\text{Assumption 2: } \text{Catch}_{84} = \text{TAC} = 215 000 \text{ tonnes}$$

In this case,  $F$  in 1984 is predicted to increase by 17% over  $F$  in 1983, to reach a mean  $F$  of 1.07.

##### 1985

Catches and spawning biomasses were calculated for a range of  $F$ s. If  $F_{85} = F_{84}$ , landings of 188 000 tonnes ( $F = 0.91$ ) are expected under Assumption 1 (Table 5.7), and the corresponding figure under Assumption 2 (Table 5.8) is also 188 000 tonnes but at a higher  $F$  of 1.07.

Attention is drawn to the decline in spawning biomass in 1985 and 1986 under the catch assumptions made. Under Assumption 1, it is expected to fall to 86 000 tonnes in 1986, well below any previously recorded value.

#### 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. Provisional nominal landings in 1983 were 22 005 tonnes, similar to the 1982 figure of 21 924 tonnes.

##### 6.2 Age Composition

VPA input data are given in Table 6.2; these do not include discards or industrial fishery by-catches. Details of data supplied for the past 2 years are given in the text table below.

Year	Category	Nations supplying age composition data	Weight represented by age composition	Total weight caught	Percentage represented by age compositions
1982	Human consumption landings	Ireland, England, France, Scotland	21 485	21 795	99
	Discards	Scotland	424	Not known	-
1983	Human consumption landings	Ireland, France, Scotland	20 268	21 661	94
	Discards	Scotland	57	Not known	-

#### 6.3 Recruitment

##### 1982 year class

Since there is no correlation between VPA estimates at age 1 in the North Sea and in Division VIa (Figure 4.1.B), at last year's meeting this age group was estimated using an average F value. However, using the current data this procedure results in an estimate of about 30 million fish at age 1, which would be the largest year class yet seen. Scottish cpue data (Table 3.2) do not support such a high abundance, and it was, therefore, decided to adopt the value of 16.1 million fish at age 1 inferred by the Rho-estimated F value of 0.18. This is consistent with Scottish cpue data which suggest that the year class is above average but smaller than the 1981 year class.

##### 1983 and later year classes

In the absence of other information these year classes were assumed to be of average strength. To take account of an apparent upward trend in recruitment (Figure 6.1.B), the average was calculated for the recent period 1976-80. This produced a value of 12.5 million fish at age 1.

#### 6.4 Weight at Age

The stock weights (Table 6.3) were assumed to be the same as the catch weights. Unfortunately no revision of the values for the period 1967-78 (a nominal constant series set at the 1978 level) was possible at the meeting. Biomass estimates for this period should therefore be treated with caution.

#### 6.5 Fishing Mortalities in 1983

For all age groups these were estimated using the Rho method as described in Section 3. Data from the same three Scottish fleets as used at last year's meeting were included. The estimated values are in reasonable agreement with recent Fs although F at age 1 is rather higher.

6.6

VPA Results

Fishing mortalities are given in Table 6.4 and mean F at ages 3 and 4 are graphed in Figure 6.1.A. Mean F has shown considerable fluctuations and also an upward trend, although in recent years F seems to have stabilised. Stock numbers and biomasses are given in Table 6.5, while recruitment and spawning stock biomass are graphed in Figure 6.1.B.

Recruitment shows considerable fluctuations, and an upward trend is apparent. The SSB data were calculated using a maturity ogive and a comparison with results using knife-edge maturity (as used previously) is shown in Figure 17.1.B. The SSB data for years prior to 1978 should be treated with caution (see Section 6.4).

A sharp increase in SSB is predicted for 1984 due to the recruitment to the spawning stock of the 1981 year class.

6.7

Equilibrium Yield and Spawning Stock Biomass at Average Recruitment

These are shown in Figure 6.1.C. An average recruitment of 12.5 millions (1976-80) was used. For stock weights and fishing mortalities, values averaged over the period 1978-83 were used.

6.8

Catch Predictions

Input data are given in Table 6.6. The mean weights and exploitation pattern are the averages for the period 1978-83. The results are given in Tables 6.7 and 6.8 and graphed in Figure 6.1.D (Assumption 1).

1984

Two assumptions were considered:

$$\text{Assumption 1: } F_{84} = F_{83}$$

In this case, landings in 1984 of 29 000 tonnes at a mean F of 0.76 are predicted. This compares with 23 200 tonnes at a mean F of 0.84 as predicted at last year's assessment. The increase is largely due to revised estimates of the 1981 and 1982 year classes.

$$\text{Assumption 2: } \text{Catch}_{84} = \text{TAC} = 24\ 500 \text{ tonnes.}$$

In this case a 20% reduction in F to a value of 0.60 is predicted.

1985

Catches and spawning biomasses were calculated for a range of Fs. If  $F_{85} = F_{84}$ , landings of 29 000 tonnes are expected under Assumption 1 (Table 6.7), and the corresponding value under Assumption 2 (Table 6.8) is 27 000 tonnes.

7.

COD IN DIVISION VIb

No age compositions from commercial landings are available for 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 VIIId and e

Age composition data were supplied by France for 1982 and 1983, and by England for 1982. Due to the lack of sufficiently long time series of age composition data, no analytical assessment was attempted. 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 for these areas. 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 1.2 and in Figure 9.1.A for the period 1960-83.

The TAC for 1983 was 181 000 tonnes, and provisional nominal landings for that year were 168 247 tonnes. The Working Group's estimate of total landings for 1983 is 174 163 tonnes. Discards for 1983 were estimated at 65 179 tonnes.

9.2 Age Composition

Details of the data supplied to the Working Group by various nations for 1983 (provisional) are summarised in the text table below. No amendments were made to the data set for 1982 prepared at last year's Working Group meeting.

Year	Category	Nations supplying age compositions	Weight represented by age compositions	Total weight caught	Percentage represented by age compositions
1983	Industrial	Denmark, Norway	15 382	16 032	96
	Human consumption	Belgium, Denmark, France, Federal Republic of Germany, Netherlands, U.K., Scotland	138 695	157 531	88
	Discards	U.K. Scotland	41 420	65 179	64

Prior to the meeting some anomalies in the French and Danish human consumption landings' age frequencies were noted. Preliminary corrections were made of these data sets, and the total international data sets were modified accordingly (Table 9.2).

9.3 Weight at Age

Mean weight at age data for the total catch (used as stock weights) are given in Table 9.3.

9.4 Recruitment

1983 year class in 1984

A preliminary recruitment index for the 1983 year class at age 1 in 1984 was available from the IYFS. Inspection of the scatter diagram of VPA stock number at age 1 vs IYFS index (Figure 4.3.A) indicated that the 1983 year class in 1984 has an abundance of about 3000 million at age 1 (4419 millions at age 0) and this value was adopted by the Working Group.

1982 year class in 1983

At last year's Working Group the abundance of this year class was estimated by inspection of the VPA/IYFS scatter diagram as 760 millions. This estimate was confirmed at the current meeting. The Rho method and the Armstrong-Cook tuning method both produced estimates of F on this year class at age 1 such that the stock number at age 1 was in good agreement with the IYFS results. For the reasons given in Section 3, it was decided to accept the Rho method estimate of F at age 1 in 1983 and hence the estimate of the abundance of the 1982 year class in 1983 has been slightly adjusted to 740 millions at age 1 (1297 millions at age 0).

Average recruitment at age 0 of 2543 millions (excluding the very abundant 1967 year class) was assumed for the year classes 1984, 1985 and 1986 in the prediction runs.

9.5 Fishing Mortality Rates in 1983 for Age Groups 0 to 10

As explained in Section 3 it was decided to accept the Rho method estimates of fishing mortality rates in 1983 for ages 1 to 10.

Fishing mortality at age 0 in 1983 was calculated to produce the abundance levels of the 1983 year class in 1984 referred to above.

9.6 VPA Results

Estimated fishing mortalities for the period 1974 to 1983 are shown in Table 9.4, and the corresponding stock numbers and stock biomasses are given in Table 9.5.

For the first time at this Working Group, data were available on the proportion of haddock mature at each age. These data are presented in Table 17.1 and were used to estimate spawning stock biomass. A parallel series of estimates of spawning stock biomass assuming knife-edge maturity at age 2, as assumed at previous meetings, was also calculated. The results can be compared in Figure 17.2.A.

The historical spawning stock biomass values plotted in Figure 9.1.B were calculated using the maturity ogive.

9.7 Equilibrium Yield and Spawning Stock Biomass for Average Recruitment

Equilibrium yield and spawning stock biomass are shown in Figure 9.1.C for average recruitment of 2543 millions at age 0.

Because of programming difficulties, it was not possible to calculate equilibrium values of spawning stock biomass for multi-category stocks using a maturity ogive, and knife-edge maturity at age 2 was therefore assumed.

9.8 Catch Predictions

Input data for catch prediction are shown in Table 9.6.

Catch predictions were calculated for two assumptions:

- (1) Fishing mortality in 1984 equal to that in 1983.
- (2) Agreed TAC of 170 000 tonnes taken in 1984.

The results of these assumptions are presented in Tables 9.7 and 9.8, respectively. It should be noted that to take the TAC in 1984 it is estimated that fishing mortality will have to increase by 25% from the estimated 1983 level. In recent years, the Working Group's estimates of the landings in the year following the last data year have been within 5% of the subsequently realised value. These estimates have

been made assuming that fishing mortality remains unchanged. For this reason, the Group believes that the prediction of the 1984 landings (455 000 tonnes) made under Assumption 1 is the more realistic. Graphs for landings in 1985 and spawning stock biomass in 1986 under Assumption 1 are shown in Figure 9.1.b.

Irrespective of the assumption about F in 1984, the predicted spawning stock biomass values at the start of 1986 are higher than those estimated at the start of 1984. It should be noted that because of restrictions in the program handling predictions by fleet categories, predicted spawning stock biomasses all assume knife-edge maturity at age 2.

10. HADDOCK IN DIVISION VIA

10.1 Catch Trends (Table 10.1)

Nominal landings in 1983 were 29 439 tonnes, and the Working Group's estimated total (29 397 tonnes) did not differ appreciably from this.

Figure 10.1.A shows weight landed and discarded since 1965.

10.2 Age Composition (Table 10.2)

Details of the data supplied to the Working Group by various nations for 1983 are summarised in the text table below. No revision was made of the 1982 age compositions.

Year	Category	Nations supplying age compositions	Weight represented by age compositions	Total weight caught	Percentage represented by age compositions
1983	Human consumption	France, Ireland, Scotland	27 941	29 397	95
	Discards	Scotland	4 148	6 890	60

10.2.1 Inclusion of data on discards into the historical catch at age array

Subsequent to last year's meeting, some concern was expressed that inclusion of estimates of discarded fish into the data base might have led to difficulties in the estimation of TACs. At this meeting, the whole process of assessment and prediction was carried out on data sets including and excluding discards. Inclusion of discards produced predictions for 1985 which are only slightly higher than those if discards are excluded, whereas the corresponding predictions for 1984 made last year differed more widely.

At last year's meeting the predicted catch for 1984, assuming constant fishing mortality, was 27 000 tonnes. A subsequent prediction, which excluded discards, predicted a 1984 catch for constant fishing mortality of 13 500 tonnes. The 1982 and 1983 landings were both about 29 000 tonnes and these are the highest values since 1972. Given also that the 1979 year class has been confirmed as being of considerably higher than average abundance, it appears that last year's Working Group prediction for 1984 (including discards) was the more realistic one.

The Working Group is therefore now reasonably confident that inclusion of discards will not lead to serious problems in prediction.

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

1983 year class in 1984

The abundance of this year class was estimated by inspection of the VIa/IV scatter diagram shown in Figure 4.3.B as 250 millions at age 1 (308 millions at age 0). This year class is of above average abundance.

1982 year class in 1982

The abundance of this year class was estimated at last year's meeting (using data including discards) as 48 millions. The current estimate is 38 millions and is based on an averaged fishing mortality rate being input to VPA at age 1 in 1983 (see Section 10.5). The revised value is not inconsistent with the other values plotted in Figure 4.3.B.

Average recruitment (excluding the very abundant 1967 year class) of 165 millions at age 0 was assumed in the predictions for the years 1984, 1985 and 1986.

10.5 Fishing Mortality Rates in 1983 for Ages 0 to 10

Attempts were made to estimate these values by the Rho method from data sets including and excluding discards. No satisfactory results were obtained due to the high degree of scatter on the Rho plots.

It was, therefore, decided to iteratively re-input the average values of fishing mortality rates for the period 1978-80 until stability of input was achieved. The values obtained by this process, using the data set including discards, are shown in Table 10.4.

10.6 VPA Results

Estimated fishing mortality rates for the period 1974 to 1983 are shown in Table 10.4, and estimates of the historical total and spawning stock sizes are shown in Table 10.5. Historical spawning stock sizes were estimated using knife-edge maturity at age 2 and the maturity ogive shown in Table 17.1. The two series of spawning stock biomass estimates may be compared in Figure 17.2.B.

Spawning stock biomass in the last three years has been greater than at any time since 1972.

10.7 Equilibrium Yield and Spawning Stock Biomass for Average Recruitment

Equilibrium yield and spawning stock biomass are shown in Figure 10.1.C for an average recruitment at age of 165 millions. Because of difficulties with currently available programs to deal with multi-category stocks, it was not possible at this meeting to calculate equilibrium spawning stock biomass using a maturity ogive. Knife-edge maturity at age 2 was therefore assumed. However, in the case of Division VIa haddock it can be seen from Figure 17.2.B that the use of an ogive makes very little difference to estimates of spawning stock biomass.

10.8 Catch Predictions

Input data for catch predictions are shown in Table 10.6. For the reasons given in Section 10.7, prediction of spawning stock biomass assumed knife-edge maturity at age 2.

The only option considered for 1984 was that fishing mortality in that year would be equal to F in 1983. No consideration could be given to the possibility that the TAC for Division VIa in 1984 would be taken, since the only information available on TACs was for Divisions VIa and VIb combined (40 000 tonnes).

The predicted catch for 1984 on this basis is 27 000 tonnes. A range of predictions for 1985 is given in Table 10.7 and Figure 10.1.D.

11. HADDOCK IN DIVISION VIb

11.1 Catch Trends (Table 11.1)

The fishery for haddock on Rockall Bank declined markedly in 1983 when landings amounted to only 302 tonnes compared with 3801 tonnes in 1982. The lack of fishing by English freezer trawlers was the reason for the reduced landings.

11.2 Stock Assessment

Data for 1983 are again limited to those available from an English research vessel survey. This survey repeated a standardised grid of 45 trawl stations, which had also been worked in the previous two years. The catch age compositions were as follows:

Age	Number per 45 hauls		
	1981	1982	1983
0	353 962	0	45
1	95 650	96 767	28
2	323	69 808	83 435
3	164	1 844	35 824
4	5 496	1 555	1 050
5	25 692	6 575	110
6	0	22 804	870
7	417	0	5 444
8	551	1 999	0
9	59	1 148	256
10+	3	16	206
TOTAL N	482 317	202 520	127 268
TOTAL WEIGHT kg	36 148	48 490	27 972
TOTAL N Ages 1-10+	128 355	202 520	127 223
TOTAL WEIGHT kg Ages 1-10+	30 596	48 490	27 971

Recruitment of the 1980 and 1981 year classes is confirmed as very good. Last year, there was some doubt about the 1982 year class because the 1982 survey had been conducted in July rather than in August as in 1981 and may therefore have been too early to sample 0-group fish. The 1983 survey (in August) has confirmed that the 1982 year class is a virtual failure as the 1983 year class also appears to be.

Total stock biomass in September 1981 was estimated to be 70 000 tonnes (Jones, 1982). A year later, on the basis of relative survey catch rates, total biomasses increased to about 94 000 tonnes but with the failure of the 1982 and 1983 year classes declined in 1983 to 54 000 tonnes. Provided fishing mortality in the year 1983-84 does not exceed about  $F = 0.2$ , the total stock biomass in the summer of 1984 would be expected to remain at or slightly above the 1983 level as gains from growth of the abundant year classes would balance the losses from mortality. A fishing mortality of  $F = 0.2$  would be expected to yield 9 000 tonnes in 1984 and 8 000 tonnes in 1985.

In view of the fact that the haddock stocks in Division VIIa and at Rockall (Division VIIb) are separate, and because of the very variable stock abundance at Rockall, the Working Group recommends that consideration should be given to setting TACs for the two Divisions separately.

12. HADDOCK IN SUB-AREA VII

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

13. NORTH SEA WHITING

13.1 Catch Trends (Table 13.1, Figure 13.1.A)

The provisional nominal landings for 1983 amount to 98 000 tonnes, which is close to the catch officially reported for 1982 (100 000 tonnes) and below the agreed TAC for 1983 of 170 000 tonnes. However, the Working Group estimates of total catches (including discards) amount to 143 000 tonnes and 150 000 tonnes respectively for 1982 and 1983.

13.2 Age Composition (Table 13.2)

The age composition data for 1982 were updated and provisional estimates for 1983 were prepared. Details of the data supplied to the Working Group by various nations for 1982 and 1983 are summarised in the text table below.

Year	Category	Nations suppl. age comp. data	Weight repr. by age compositions	Total weight caught	% repres. by age comp.
1982	Industrial by-catch	Denmark, Norway	31 970	32 990	97
	Human consumption	Belgium, England, France, Nether- lands, Scotland	72 635	72 942	100
	Discards	Netherlands, Scotland	18 835	37 095	51
1983	Industrial by-catch	Denmark, Norway	22 752	23 637	96
	Human consumption	Belgium, France, Netherlands, Scotland	72 003	76 841	94
	Discards	Netherlands, Scotland	29 594	49 125	60

13.3 Mean Weight at Age

Mean weight at age data for total catches (used as stock weights) are given in Table 13.3.

13.4 Recruitment

By inspection of the VPA/IYFS scatter diagram (Figure 4.5.A), the abundance of the 1982 year class and the 1983 year class at 1 year old were estimated at 740 million fish and 2000 million fish respectively (1017 and 3170 million at age 0). No index was available for the abundance of the 1982 year class at 2 years old.

The F values implied by these recruitment values on 0- and 1-year old whiting in 1983 are consistent with the average values upon the five past years.

Average recruitment of 2700 millions at age 0 (mean value for 1960-80) is assumed for the years 1984, 1985 and 1986.

13.5 Fishing Mortalities in 1983 (Table 13.4)

F at ages 0 and 1

These values were estimated from the IYFS abundance indices (see Section 13.4).

F at age 2

The scatter diagram of Rho versus year for age 2 (Figure 3.5) shows that the year 1974 seems to be anomalous. So the F value for this age has been recalculated by averaging Rho values over the time series excluding 1974.

F at age 3-6

These were estimated using the Rho method as described in Section 3.

F at age 7-10

Since the Rho method gave unrealistically high values for these ages, fishing mortalities were set at 1.0.

13.6 VPA Results

Estimated fishing mortalities are shown in Table 13.4 and in Figure 13.1.A. The corresponding stock numbers and stock biomass are shown in Table 13.5 and in Figure 13.1.B.

The average F value over the age groups 2-6 in recent years has fluctuated about a level of about  $\bar{F}_{2-6} = 0.9$ . The downward trend in spawning stock biomass observed since 1980 is continuing and spawning stock biomass in 1983 is close to the lowest values on record. Spawning stock biomass was calculated using a maturity ogive rather than knife-edge age at first maturity as in previous years. However, since the ogive itself is virtually knife edge, Figure 17.3 indicates this change makes very little difference to the spawning stock biomass estimates.

13.7 Equilibrium Yields and Spawning Stock Biomass for Average Recruitment

long-term equilibrium yields for human consumption and total landings and spawning stock size are shown in Figure 13.1.C. Input data were those used for catch predictions (Table 13.6).

13.8

Catch Prediction

Input data for catch predictions are given in Table 13.6. The mean weights at age and exploitation patterns are the averages for the period 1978-83. The discarding rates at age are averages for the same reference period.

No catch prediction was made for the assumption that the catch in 1984 would equal the agreed TAC of 145 000 tonnes because this would require an unrealistically high fishing mortality. Therefore only the assumption with  $\bar{F}_{84} = \bar{F}_{83}$  (in the human consumption fishery) was considered.

Results are given in Table 13.7. Predicted total landings for 1984 are 102 000 tonnes (human consumption landings: 64 000 tonnes, industrial by-catch: 38 000 tonnes).

The option  $\bar{F}_{85} = \bar{F}_{84}$  produces total landings in 1985 of 118 000 tonnes (human consumption landings: 69 000 tonnes, industrial by-catch: 49 000 tonnes).

For the assumption of unchanged fishing mortality, stock biomass and spawning stock biomass increase from 1984 to 1986 respectively from 405 000 tonnes to 525 000 tonnes and from 191 000 tonnes to 342 000 tonnes.

14.

WHITING IN DIVISION VIa

14.1

Catch Trends (Table 14.1)

The revised reported landings of 13 770 tonnes taken in 1982 are close to the provisional figure of 13 540 tonnes reported in 1983. The provisional landings in 1983 were 14 968 tonnes. However, the Working Group estimate of 15 844 tonnes was used in the assessment. The estimated total catch including discards was 19 000 tonnes in 1982 and 21 000 tonnes in 1983.

14.2

Age Composition (Table 14.2)

The age composition data for 1982 were revised. Provisional age compositions for 1983 were compiled. Discard data were provided by Scotland. These are available for the last six years but they have not been used in the assessment. Details of the data supplied to the Group are summarised in the text table below.

Year	Category	Nations supplying age composition data	Weight represented by age compositions	Total weight caught	% represented by age comp.
1982	Human consumption landings	France, Ireland, Scotland	13 260	13 773	96.3
	Discards	Scotland	3 253	5 319	61.2
1983	Human consumption landings	France, Ireland, Scotland	15 638	15 844	98.7
	Discards	Scotland	3 822	5 399	70.8

14.3

Recruitment

Abundance figures of the 1982 and 1983 year classes at 1 year old were estimated to  $30 \times 10^6$  and  $80 \times 10^6$ , respectively, by inspection of the scatter diagram of VPA recruitment indices for Division VIa versus VPA recruitment indices for Sub-area IV (Figure 4.5.B).

The number of recruits of age 1 entering the fishery in 1985 and 1986 was assumed to be  $95 \times 10^6$ , which is the average number of 1-group whiting during the period 1963-80.

14.4 Weight at Age

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

14.5 Fishing Mortalities

The Rho method was tried. However, the output from the Rho method gave very scattered plots, and the presence of outliers in the scatter plots produced rather high F values. The Working Group, therefore, decided to use mean values of fishing mortalities for the period 1978 through 1980. This gave lower fishing mortality levels for the recent years than were used in last year's report. With the Rho method as used last year the fishing level determined then was probably too high.

Fishing mortality for age 1 was chosen to produce a 1982 year class of  $30 \times 10^6$  fish in 1983.

14.6 VPA Results

Estimated fishing mortalities for the period 1963-83 are shown in Table 14.4 and Figure 14.1.A, and the corresponding stock numbers and stock biomasses are shown in Table 14.5 and Figure 14.1.B. The lower terminal F values used this year produce larger stock sizes in the recent years than those calculated in last year's report.

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 1978-83 (Table 14.6). The curve (Figure 14.1.C) has no clear maximum. The  $F_{0.1} = 0.166$  is indicated in the figure. Spawning stock biomass was calculated using knife-edge age at first maturity as this was unchanged by the new maturity at age data (Table 17.1).

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 1978-83.

No catch prediction was made for the agreed TAC of 15 400 tonnes, because this would result in unrealistically high fishing mortalities ( $\bar{F}_{84} = 0.93$ ). Therefore, only the assumption with  $\bar{F}_{84} = \bar{F}_{83} = 0.68$  was pursued, which gives landings in 1984 of 13 000 tonnes.

The results of the prediction runs are shown in Table 14.7 and are also given in Figure 14.1.D.

The spawning stock estimated for 1984 is one of the lowest on record. However, in all prediction options for 1985 the spawning stock is expected to increase.

15. WHITING IN DIVISION VIIb

Landings of whiting in Division VIIb are insignificant (Table 15.1).

16. WHITING IN SUB-AREA VII

16.1 Whiting in Divisions VIIId,e

Landings figures for 1982 have been revised from last year's provisional figure of 8 640 tonnes to 9 444 tonnes. Provisional landings in 1983 are 5 743 tonnes (Table 16.1). The age composition of the human consumption catch in 1982 has been revised. For 1983, age composition data have been submitted by France only, covering 77% of the provisional landings. The French age composition was not raised to total landings because the age composition of English landings are known to be different from those of France.

Catch and mean weight at age are given in Tables 16.2 and 16.3.

In the absence of English data, it was impossible to produce any assessment for this stock.

16.2 Whiting in Divisions VIIb,c and VIIg-k

Landings in 1982-83 are at the same level as in the earlier period 1974-79 (Table 16.4).

17. EFFECTS OF CHANGES IN THE DATA SETS OF WEIGHT AT AGE AND MATURITY AT AGE ON STOCK AND SPAWNING STOCK BIOMASS

17.1 Weight at Age Data

For the North Sea cod, haddock and whiting stocks and for the West of Scotland haddock and whiting stocks, weight at age data have been determined separately for each year in the data series. The majority of these data were revised at the special Data Base meeting of the Group in 1981 and have been used in the assessments since then. For West of Scotland cod, a constant set of weight at age data have been used for the period 1967-78 and annually determined values have been used for more recent years. The annual data for 1967-78 are in the course of preparation and will replace the data currently being used as soon as they are available. When this is done, a comparison of the effects on biomass estimates of using the old and the new sets of data will be presented.

17.2 Maturity at Age Data

In previous reports, knife-edge ages at first maturity have been used for calculating spawning stock biomass for all stocks. This year, for the first time maturity ogives have been used in the assessments. For the North Sea stock, maturity at age data were available from 1981 and 1982 IYFS. The proportions mature at each age were averaged for the two years. The resultant maturity ogives were considered preferable to knife-edge age at first maturity and have been used in the assessments. The new maturity ogives (Table 17.1) have been applied to all years in the historic series.

For the West of Scotland stocks, maturity at age data were available from French research vessel survey made in 1983. These data were also accepted by the Working Group as being preferable to knife-edge age at first maturity and have been incorporated in the data base as described above for the North Sea stocks.

Spawning stock biomass estimates for the whole time series have been calculated using both the new maturity ogives and also the old knife-edge age at first maturity. For West of Scotland whiting, the new maturity ogive was identical to the knife-edge age at first maturity and spawning stock biomass estimates are unchanged. For the other stocks, spawning stock biomass estimates have been plotted in Figures 17.1 - 17.3. For North Sea whiting, the results are virtually identical. For the cod and haddock stocks the new ogives give lower estimates of spawning stock biomass but the trends with time for the two curves are similar.

18. IMPLICATIONS OF RESULTS OF STOMACH SAMPLING PROJECT ON STOCK ASSESSMENTS

18.1 Introduction

Results of the 1981 Stomach Sampling Project have been communicated in various contributions to the Statutory Meeting of ICES and a preliminary review paper was prepared by Daan (NAFO, SCR.Doc.83/IX/93. Mimeo.). Updated estimates of the numbers at each age of cod, haddock and whiting eaten by the predators examined in the project have been communicated to the Working Group by Daan (Table 18.1). For age groups 0 and 1, the numbers of each species estimated to have been consumed by predators in 1981 exceed the estimates of the numbers in the stock at the beginning of that year as derived from VPA using a coefficient of natural mortality,  $M = 0.2$ , for all age groups. One of the implications of these results is that the value of  $M = 0.2$  used in the stock assessments is likely to be too low for the younger age groups.

18.2 Estimation of Natural Mortality on the Younger Age Groups

The Working Group considered whether revised estimates of natural mortality on age groups 0 and 1 could be calculated. As an estimate of a minimum value of  $M$ , it could be assumed that  $M$  on age groups 0 and 1 was due to predation mortality only. However, even making this assumption, it was concluded that  $M$  could only be properly estimated using a multi-species model involving cod, haddock, whiting and saithe. This is because the estimates of numbers of prey eaten (Table 18.1) are based on stock sizes of predators calculated using a value of  $M = 0.2$ . Even within a single species, re-estimation of  $M$  will result in revised estimates of stock size which will in turn affect the estimates of numbers of prey consumed.

As the Working Group did not have the facilities or the data to recalculate  $M$  using a multispecies model, the Group is unable to re-estimate  $M$  on the age groups subject to predation.

18.3 Implications for Stock Assessments

It seems probable that, when the predation data are taken into account, estimates of  $M$  on the younger age groups will be revised upwards. As far as short-term, single species catch predictions are concerned, a change in the values of  $M$  is not expected to have any significant effect. For long-term management considerations, a change in  $M$  on the younger age groups could be of much greater significance. Again, to properly assess the effects of such a change would require a multi-species model. Management policy determined on the basis of such a

model would have to consider not only the yields for each species in relation to different levels of fishing mortality, but also how to optimise the relative stock biomasses for the various prey and predator species in relation to specified biological and economic objectives.

19. GROWTH PARAMETERS AND SELECTION LENGTHS

19.1 Growth Parameters

Growth parameters have been calculated for the North Sea stocks of cod, haddock and whiting. These have been derived from recent (1978-83) average weights at age in the stock, as used in the catch predictions, converted into length, using the length/weight relationship given below.

Von Bertalanffy growth parameters were calculated using the ICES computer program. Observed mean length at age and fitted growth curves are shown in Figure 19.1. The results are summarised below:

<u>Length (cm)</u>	<u>Weight (kg) relationships</u>	(age group 1 excluded from the analysis)
Cod	$W = l^3 \times 0.0000104$	
Haddock	$W = l^3 \times 0.0000090$	
Whiting	$W = l^3 \times 0.0000083$	

Von Bertalanffy growth parameters

	<u><math>L_{\infty}</math></u>	<u>K</u>	<u><math>t_0</math></u>
Cod	117.5	0.279	0.87
Haddock	66.0	0.201	-0.50
Whiting	48.7	0.224	-0.96

19.2 Selection Lengths

Selection factors, 50%, selection lengths and selection ranges for the North Sea stocks taken from the report of the 1974 meeting of the North Sea Roundfish Working Group (ICES, Doc. C.M.1974/F:5) are given below. Those given for whiting have been used for calculating selection ratios in the mesh change assessment (see Section 20.).

	<u>Cod</u>	<u>Haddock</u>	<u>Whiting</u>
Selection factor	3.6	3.4	3.8
50% retention length ± 25%:	80 mm	28.8 ± 2.6	27.2 ± 2.3
	90 mm	32.4 ± 2.9	30.6 ± 2.5
			34.2 ± 3.3

20. EFFECTS ON WHITING OF A MESH SIZE INCREASE TO 90 mm IN THE NORTH SEA

20.1 Introduction

The Group was requested to carry out a mesh assessment only for North Sea whiting. However, in the northern North Sea this species is taken in a mixed fishery together with mainly cod and haddock. Previous mesh assessments have shown that an increase from 80 mm to 90 mm will have negligible effects in cod, but in haddock the assessments have indicated more significant effects, and it was, therefore, thought useful to perform an updated assessment for haddock. In this area it is considered that the effects of a mesh increase in whiting cannot be considered in isolation from those in haddock. In the southern North Sea, the effects of a mesh increase on the sole fishery would have to be considered.

The Working Group tried to use the Hoydal, Rørvik and Sparre method (see DANA, Vol.2, 1982), available on the ICES computer, for estimating effective mesh sizes. The Working Group did not produce results which were convincing, probably for the following reasons: (1) Only Scottish discard data were available for haddock and only Scottish and Netherlands data for whiting, which means that estimated discards for other fleets are likely to be poorly determined; (2) The calculations are based on age compositions converted to length compositions within the model, using the same von Bertalanffy length growth curve for all fleets, which may not be valid at least for industrial and human consumption fisheries; (3) Lack of experience in using this rather complex model on age-structured data rather than working with length composition data.

As a result of failing to obtain successful results for estimates of effective mesh size, the Working Group had to revert to another method to carry out the assessment. This method is described below.

20.2 Data Base

Age frequency data for the landings and discards of each fleet reporting landings of haddock and whiting from the North Sea in the period 1980 to 1982 were prepared in advance of the meeting and were presented to the Working Group. These data were used to partition the total international values of F at age obtained from VPA for each year 1980-82 into landings and discard Fs at age for each fleet.

An average of these values was then obtained and these values are shown in Tables 20.1 and 20.2 and 20.14 and 20.15 for whiting and haddock respectively.

Values of mean weight at age for the landings and discards of each fleet were averaged over the period 1980-82 and are presented in Tables 20.3 and 20.4 and 20.16 and 20.17 for whiting and haddock respectively.

The maturity ogive data presented in Tables 20.5 and 20.18 and the stock mean weight data in Tables 20.5 and 20.18 were used in the calculation of predicted spawning stock biomasses.

It was assumed that  $M = 0.2$  at all ages.

The expected stock size of the two species at the start of 1985 was computed on the assumption that fishing mortality in 1984 would be the same as that for the reference period indicated in Tables 20.5 and 20.18 respectively.

Selection factors and selection ranges for appropriate mesh sizes were taken from the 1974 report of this Working Group and are shown in the text table below.

	<u>Selection factor</u>	<u>Mesh size (mm)</u>	<u>Selection range (mm)</u>
Whiting	3.8	80	26
		90	33
Haddock	3.4	80	21
		90	25

It was assumed for the assessment that the mesh sizes in the industrial fisheries would remain unchanged.

20.3 Computation

The mesh change assessment was made as to catch predictions, one using F at age arrays corresponding to the existing mesh and a second with F at age arrays adjusted for the increased mesh size.

Catch predictions were run for a period of 13 years, since with 12 age groups in the stock (0 to 11+) and assuming constant recruitment (whiting:  $2\ 700 \times 10^6$ , haddock:  $2\ 543 \times 10^6$ ) this period is required for the stock to reach its new equilibrium state.

Total weights of discards and landings were computed for each predicted year for each fleet by means of the following functions:

$$L = \sum_g \sum_a N(a) * (F(l,a,g)/Z(a)) * (1-exp(-Z(a))) * W(l,a,g)$$

$$D = \sum_f \sum_a N(a) * (F(d,a,g)/Z(a)) * (1-exp(-Z(a))) * W(d,a,g)$$

where a denotes age

d " discards  
l " landings  
g " fleet  
N " number of fish in the stock  
F " fishing mortality  
Z " total mortality  
W " mean weight of fish caught  
L " total weight landed  
D " total weight discarded

Total and stock biomasses for each predicted year were computed using the following functions:

$$T = \sum_a N(a) * SW(a)$$

$$S = \sum_a N(a) * SW(a) * P(a)$$

where SW denotes stock mean weight

P " proportion mature in the stock  
T " total stock biomass  
S " spawning stock biomass.

In the first prediction run it was assumed that all human consumption fisheries are currently employing an effective mesh size of 80 mm and will continue to do so for the next 13 years. In the second run, it was assumed that the effective mesh size will change to 90 mm on 1 January 1985 and will remain at this value thereafter.

The effects of the mesh change on F at age values were simulated for each fleet by means of the following logistic function:

$$R(e) = \frac{1}{3^{l/r} (m^*s-1) + 1}$$

where R denotes proportion retained  
l " length  
r " selection range  
m " mesh size  
s " selection factor.

The mean length at age of discards and landings for each fleet was estimated by conversion of the input mean weight values using the following weight/length relationship:

$$\text{(weight in gm, length in cm)} \\ \text{Haddock } W = .009 l^3 \quad \text{Whiting } W = .008 l^3$$

The proportion of fish retained at each of these lengths for the 80 mm mesh and for the 90 mm mesh was calculated. Values of F at age were then modified by multiplication by the ratio:

$$R2/R1$$

where R2 denotes proportion retained by new mesh  
R1 denotes proportion retained by old mesh.

The modified F at age arrays are given in Tables 20.6 and 20.7 for whiting and in Tables 20.19 and 20.20 for the new mesh.

The assumption of the universal use at present of an effective mesh size of 80 mm by the human consumption fisheries is almost certainly invalid. However, data indicating how far each fishery departs from this idealized picture are not generally available. For this reason, the Working Group concluded that it was not able to realistically investigate other scenarios.

#### 20.4

##### Results

Tables 20.8-20.9 and 20.21-20.22 show the predicted catches of whiting and haddock respectively by each fleet assuming no mesh change while Tables 20.10-20.11 and 20.23-20.24 show corresponding values assuming a mesh change as defined above. Tables 20.12 and 20.25 show the corresponding spawning stock and total stock biomasses. The percentage changes immediately after the mesh change and the long-term changes are summarised in Tables 20.13 and 20.26.

For whiting the human consumption landings will experience an immediate loss of 38% while the industrial fleets will have a 7% gain. The long-term results are gains of 10% and 29% in the human consumption landings and industrial fisheries, respectively. Discards will be much reduced. For haddock, the immediate effect is a 17% reduction in human consumption landings, which will be converted into a 7% gain after

one year and a 21% gain in the long term. The industrial fishery will have an immediate gain of 4% which will increase to a 12% gain.

20.5

Comments

The following points should be noted in relation to the assessments:

- (1) Whiting predicted landings for old mesh increase from 1985 to 1997, because this stock is currently at a low level and will increase under conditions of constant average recruitment.  
Haddock predicted landings show the reverse trend for old mesh, because the stock currently contains two abundant year classes.
- (2) Data on the age composition of discards are lacking for all fleets except for the Scottish for haddock and the Scottish and Dutch for whiting. For this reason, all other nations' discards had to be estimated from the existing data. The method employed was such that each nation except those providing data was assumed to have discarded fish of the same percentage age frequency within any of the years considered. It is not possible to determine what effect this procedure has had on the assessment.
- (3) The computer program used in the assessment had to be written during the meeting, and it could not be checked to the required extent. It cannot, therefore, be guaranteed that the results presented in this report are correct and final.

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Table 1.1 North Sea COD. Numbers ('000) and weight (tonnes) in each category.  
Working Group Data.

Year	Human consumption		Discards		Total	
	Number	Weight	Number	Weight	Number	Weight
1963	56 495	107 936	5 659	1 708	62 154	109 644
1964	51 729	115 435	6 571	1 857	58 300	117 292
1965	94 349	172 619	19 798	5 204	114 147	177 823
1966	115 024	211 937	22 578	6 010	137 602	217 947
1967	124 779	242 108	15 724	4 481	140 503	246 589
1968	146 039	277 062	6 372	2 150	152 411	279 212
1969	76 286	193 612	7 443	2 027	83 729	195 639
1970	124 517	218 763	63 759	11 002	188 276	229 765
1971	226 093	314 544	53 707	13 374	279 800	327 918
1972	243 478	341 051	21 573	8 831	265 051	349 882
1973	125 133	227 787	46 620	8 196	171 753	235 983
1974	102 367	202 269	4 588	950	106 955	203 219
1975	109 863	184 974	35 390	6 045	145 253	191 019
1976	128 536	209 914	8 201	2 050	136 737	211 964
1977	140 359	181 121	99 474	16 573	239 833	197 694
1978	212 729	260 890	100 786	27 874	313 515	288 764
1979	170 706	248 051	236 295	67 490	407 001	315 541
1980	192 691	250 766	660 066	170 675	852 757	421 441
1981	249 276	310 599	164 776	47 132	414 052	357 731
1982	185 388	257 825	xx)	xx)		
1983 <sup>x)</sup>	171 762	232 546	xx)	xx)		

xx) Insufficient data

x) Preliminary

Table 1.2 North Sea HADDOCK. Numbers ('000) and weight (tonnes) in each category. Working Group data.

Year	Industrial		Human consumption		Discards		Total	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
1960	142 567	12 200	208 753	75 242	853 264	131 791	1 204 584	219 233
1961	982 786	11 100	189 763	74 862	888 867	132 991	2 061 416	218 953
1962	285 824	11 200	148 967	58 677	2 673 394	383 153	3 108 185	453 030
1963	255 844	13 700	180 624	68 364	1 245 890	188 969	1 682 358	271 033
1964	598 840	88 600	351 422	130 509	643 595	160 319	1 593 857	379 428
1965	1 092 756	74 600	369 998	161 613	253 860	62 236	1 716 614	298 449
1966	2 232 098	46 700	406 399	225 760	489 695	73 573	3 128 192	346 033
1967	699 516	20 700	272 201	147 391	448 264	78 059	1 419 981	246 150
1968	557 995	34 200	220 977	105 440	837 979	161 882	1 616 951	301 522
1969	1 889 659	338 353	909 208	330 897	1 203 447	260 231	4 002 314	929 481
1970	1 621 762	179 729	1 244 162	524 622	515 018	101 376	3 380 942	805 727
1971	913 516	31 546	473 069	235 358	1 282 184	177 485	2 668 769	444 389
1972	531 113	29 585	427 890	192 901	760 224	128 130	1 719 227	350 616
1973	170 412	11 267	449 107	178 610	659 515	114 719	1 279 034	304 596
1974	936 218	47 777	357 011	149 617	1 000 667	166 782	2 383 896	364 176
1975	734 412	41 380	362 239	146 616	1 862 031	260 427	2 958 681	448 423
1976	446 767	48 204	397 743	165 624	788 037	154 289	1 632 547	368 117
1977	350 521	34 993	319 991	137 372	225 974	44 369	896 486	216 734
1978	425 714	9 659	192 021	85 981	422 631	77 681	1 040 366	173 321
1979	1 107 027	17 414	190 326	83 249	286 969	41 834	1 584 322	142 497
1980	768 645	25 154	217 435	98 860	541 782	94 910	1 527 862	218 924
1981	828 555	17 615	273 542	130 009	298 115	60 290	1 400 212	207 914
1982	578 186	20 988	309 117	165 475	180 852	41 308	1 068 155	227 771
1983*	696 941	16 032	301 673	157 531	383 931	65 179	1 382 545	238 742

\* Preliminary

Table 1.3 North Sea WHITING. Numbers ('000) and weight (tonnes) in each category. Working Group data.

Year	Industrial		Human consumption		Discards		Total	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
1960	141 183	11 639	190 513	47 566	763 229	121 600	1 094 925	180 805
1961	271 885	16 177	289 708	67 828	1 645 728	241 122	2 207 321	325 127
1962	112 954	8 347	222 274	55 952	1 185 487	156 713	1 520 715	221 012
1963	499 847	45 431	214 477	58 205	853 608	154 401	1 567 932	258 037
1964	393 794	28 124	220 682	60 064	341 223	58 784	955 699	146 972
1965	182 171	22 259	313 057	85 978	490 073	77 184	985 301	185 421
1966	431 635	51 176	351 953	105 229	545 116	83 356	1 328 704	239 761
1967	280 275	22 840	245 396	68 215	1 102 690	142 703	1 628 361	233 758
1968	592 395	57 506	298 807	88 281	596 827	90 898	1 488 029	236 685
1969	1 980 444	152 364	203 640	57 149	625 916	114 566	2 810 000	324 079
1970	1 855 953	114 504	271 813	79 274	347 540	67 814	2 475 306	261 592
1971	1 477 350	71 699	185 690	58 005	458 746	62 589	2 121 786	192 293
1972	1 351 090	61 166	178 908	59 868	398 294	66 598	1 928 292	187 632
1973	1 273 007	89 614	234 405	66 479	658 852	110 128	2 166 264	266 221
1974	1 841 153	130 293	254 114	74 561	477 271	84 753	2 572 538	289 607
1975	1 019 586	86 376	251 761	78 722	698 963	134 698	1 970 310	299 796
1976	1 395 318	149 759	243 201	74 231	633 359	134 176	2 271 878	358 166
1977	1 657 167	106 104	267 023	74 374	555 515	107 186	2 479 705	287 664
1978	1 163 125	55 274	322 834	88 475	241 670	35 442	1 727 629	179 191
1979	887 889	59 021	351 613	99 321	651 877	78 371	1 891 379	236 713
1980	644 159	45 747	313 565	92 534	547 726	86 940	1 505 450	225 221
1981	932 530	66 595	258 430	80 018	293 714	45 560	1 484 674	192 173
1982	333 574	32 990	242 572	72 942	277 531	37 095	853 677	143 027
1983*	688 250	23 637	247 236	76 841	369 839	49 125	1 305 325	149 603

\* Preliminary

Table 3.1. North Sea COD.

Effort (hours fished) and catch at age ( $N \times 10^{-3}$ ). Input data for the estimation of terminal F's.

YEAR	EFFORT	AGE	1	2	3	4	5	6	7	8	9	10	SCOTISH SEA
1963	548.642	896.	8740.	4593.	969.	241.	142.	74.	25.	13.	9.		
1969	491.435	64.	3755.	2716.	1308.	467.	111.	75.	33.	17.	11.		
1970	428.365	1201.	2890.	3014.	1035.	470.	113.	22.	25.	12.	7.		
1971	416.144	4542.	3553.	644.	705.	587.	203.	71.	16.	9.	9.		
1972	392.132	938.	19054.	3501.	390.	339.	120.	57.	27.	5.	8.		
1973	414.398	2657.	7445.	6165.	870.	137.	98.	42.	31.	12.	4.		
1974	349.604	3858.	6283.	1610.	1085.	252.	54.	38.	22.	15.	7.		
1975	329.432	1829.	8673.	1783.	550.	471.	79.	9.	5.	13.	4.		
1976	307.165	537.	14244.	2891.	370.	179.	113.	37.	10.	4.	9.		
1977	313.913	2742.	4316.	3069.	714.	177.	51.	35.	24.	6.	2.		
1978	325.246	1704.	14710.	1380.	651.	202.	46.	25.	21.	8.	5.		
1979	316.419	2523.	8026.	3258.	583.	345.	67.	44.	19.	12.	4.		
1980	297.227	1068.	5961.	2342.	829.	144.	911.	33.	15.	9.	4.		
1981	289.072	853.	13281.	2348.	692.	204.	26.	11.	12.	3.	0.		
1982	297.730	4070.	4794.	6024.	822.	291.	151.	25.	21.	12.	1.		
1983	333.168	1343.	13320.	1814.	1290.	227.	98.	39.	19.	15.	3.		
1968	48.234	33.	301.	140.	35.	9.	4.	3.	1.	0.	0.		
1969	62.050	20.	494.	245.	87.	23.	6.	4.	2.	1.	2.		
1970	83.329	334.	302.	397.	93.	33.	10.	2.	2.	0.	0.		
1971	104.901	992.	1764.	207.	150.	41.	74.	6.	2.	2.	1.		
1972	121.031	204.	3927.	705.	111.	50.	0.	2.	0.	0.	0.		
1973	152.422	760.	1255.	1894.	202.	20.	23.	12.	1.	4.	0.		
1974	116.982	459.	1185.	458.	570.	40.	5.	8.	3.	1.	2.		
1975	161.009	965.	1559.	770.	120.	113.	6.	1.	2.	1.	0.		
1976	152.419	263.	5274.	412.	101.	38.	39.	10.	1.	1.	0.		
1977	224.424	2068.	1807.	770.	118.	75.	24.	13.	8.	2.	1.		
1978	236.929	2256.	5380.	671.	270.	51.	26.	7.	8.	5.	0.		
1979	287.494	1973.	5845.	1804.	178.	61.	15.	3.	4.	2.	0.		
1980	333.197	1798.	5207.	2042.	534.	69.	56.	15.	4.	3.	1.		
1981	251.504	691.	5237.	1475.	294.	82.	11.	6.	0.	0.	0.		
1982	250.671	4704.	2940.	2302.	377.	110.	59.	8.	6.	4.	2.		
1983	244.549	1321.	6292.	1020.	460.	111.	31.	14.	5.	3.	1.		
1968	526.713	637.	3040.	568.	109.	47.	1.	7.	2.	0.	0.		
1969	514.675	179.	317.	484.	224.	56.	65.	6.	3.	0.	0.		
1970	721.045	4108.	592.	94.	269.	93.	27.	45.	0.	2.	0.		
1971	824.939	7227.	7759.	169.	93.	289.	101.	19.	21.	1.	19.		
1972	828.995	622.	8468.	1037.	152.	31.	84.	32.	14.	8.	4.		
1973	941.423	6468.	464.	1527.	451.	32.	13.	25.	10.	1.	1.		
1974	894.920	949.	2596.	532.	085.	216.	42.	21.	25.	3.	5.		
1975	880.061	4118.	2677.	790.	133.	227.	78.	14.	5.	4.	2.		
1976	769.105	667.	3209.	4601.	272.	34.	57.	29.	4.	4.	2.		
1977	698.531	11511.	1579.	779.	155.	57.	14.	22.	4.	3.	4.		
1978	595.259	3513.	8730.	307.	219.	29.	15.	5.	2.	5.	2.		
1979	639.184	5308.	3716.	1508.	65.	71.	12.	10.	5.	6.	2.		
1980	638.868	5354.	5338.	649.	384.	15.	20.	4.	3.	1.	1.		
1981	606.136	1240.	7301.	747.	263.	135.	9.	11.	1.	2.	2.		
1982	609.181	5925.	1110.	1151.	178.	73.	14.	7.	7.	1.	1.		
1983	544.000	2131.	3363.	245.	302.	41.	26.	19.	1.	2.	0.		

**Table 3.2.** West of Scotland COD.  
Effort (hours fished) and catch at age ( $N \times 10^{-3}$ ). Input data for the estimation  
of terminal F's.

YEAR	EFFORT	AGE	1	2	3	4	5	6	7	8	
1968	50.001	23.	257.	554.	555.	34.	31.	19.	2.		
1969	42.058	6.	153.	217.	413.	154.	18.	17.	7.		
1970	40.572	38.	38.	205.	135.	128.	45.	6.	6.		
1971	41.234	71.	204.	26.	160.	57.	37.	16.	7.		
1972	55.536	49.	527.	168.	34.	94.	12.	10.	1.		
1973	51.153	14.	58.	202.	79.	15.	32.	13.	5.		
1974	45.899	73.	199.	103.	236.	30.	10.	12.	5.		
1975	37.080	22.	171.	80.	39.	58.	13.	3.	4.		
1976	35.307	43.	216.	158.	92.	41.	43.	7.	1.		
1977	23.948	99.	69.	75.	27.	12.	9.	6.	2.		
1978	51.582	37.	267.	79.	112.	55.	21.	9.	5.		
1979	33.373	16.	109.	103.	34.	29.	15.	4.	2.		
1980	19.660	167.	147.	78.	38.	7.	6.	2.	3.		
1981	13.755	1.	175.	85.	16.	2.	0.	0.	0.		
1982	14.194	159.	34.	121.	27.	3.	0.	1.	0.		
1983	23.056	61.	228.	28.	48.	16.	14.	3.	0.		
											SCOTTISH TRAWL
1968	150.094	163.	212.	798.	401.	37.	26.	19.	4.		
1969	140.718	13.	788.	358.	482.	131.	30.	14.	4.		
1970	95.629	131.	471.	454.	82.	51.	10.	3.	3.		
1971	98.748	66.	287.	123.	110.	28.	21.	2.	1.		
1972	70.741	59.	256.	187.	52.	32.	3.	2.	1.		
1973	59.596	224.	247.	153.	35.	10.	12.	16.	1.		
1974	56.448	90.	204.	69.	49.	17.	6.	2.	0.		
1975	56.420	145.	231.	99.	54.	12.	5.	0.	0.		
1976	57.090	48.	224.	69.	61.	10.	10.	0.	0.		
1977	41.920	121.	122.	112.	22.	11.	5.	2.	0.		
1978	33.617	81.	145.	69.	45.	14.	4.	2.	2.		
1979	38.465	120.	114.	196.	25.	12.	5.	0.	1.		
1980	38.640	245.	216.	73.	36.	13.	4.	0.	0.		
1981	37.208	16.	664.	147.	48.	9.	1.	1.	0.		
1982	36.689	217.	147.	146.	34.	15.	4.	0.	0.		
1983	38.030	183.	412.	65.	58.	15.	5.	2.	0.		
											SCOTTISH SPRING
1968	65.348	39.	43.	175.	97.	9.	7.	4.	1.		
1969	106.850	9.	150.	154.	229.	70.	12.	4.	2.		
1970	118.881	14.	242.	298.	87.	62.	9.	2.	2.		
1971	129.187	41.	296.	140.	174.	39.	7.	6.	1.		
1972	142.244	302.	406.	346.	97.	62.	20.	6.	3.		
1973	91.151	270.	167.	252.	139.	33.	25.	1.	3.		
1974	88.651	159.	296.	137.	123.	37.	6.	7.	1.		
1975	132.353	453.	296.	203.	90.	37.	9.	1.	1.		
1976	139.225	202.	446.	305.	101.	43.	30.	11.	0.		
1977	143.574	363.	190.	398.	161.	61.	9.	3.	1.		
1978	127.387	139.	405.	187.	135.	33.	8.	3.	1.		
1979	99.803	161.	187.	484.	57.	31.	6.	0.	0.		
1980	121.211	177.	735.	345.	130.	36.	11.	5.	1.		
1981	165.092	34.	1160.	540.	189.	52.	4.	3.	0.		
1982	135.280	401.	375.	626.	167.	47.	6.	2.	1.		
1983	112.532	275.	1160.	196.	164.	51.	18.	6.	6.		
											SCOTTISH LIGHT TRawl

Table 3.3. North Sea HADDOCK.

Effort (hours fished) and catch at age ( $N \times 10^{-3}$ ). Input data for the estimation of terminal F's.

YEAR	EFFORT	AGE	1	2	3	4	5	6	7	8	9	10
1964	197,623	0	94916	11013	854	642	572	22	22	44	1	
1965	172,992	3118	548	55569	2055	158	109	32	10	3	2	
1966	194,012	32137	1544	1143	55854	752	66	31	10	2	0	
1967	215,319	112299	13358	838	767	43192	512	9	21	4	1	
1968	218,141	21758	75527	3650	372	518	12809	49	10	2	1	
1969	123,010	76	56896	14066	519	225	323	1486	20	1	0	
1970	133,445	843	4771	92679	2917	153	83	20	431	3	0	
1971	174,559	47647	5343	7806	63059	1808	122	34	43	432	27	
1972	201,493	4598	76452	4199	4120	31677	755	32	10	44	20	
1973	182,541	5014	51520	37305	632	851	6405	1409	18	2	0	
1974	175,432	24707	12502	34250	7336	166	207	1562	33	4	7	
1975	152,977	3964	51399	5715	14221	1923	73	57	383	12	1	
1976	121,841	520	26812	20097	1311	3065	596	16	0	90	10	
1977	144,348	4750	3538	3698	7624	451	1006	179	20	2	55	
1978	135,220	9364	9910	2194	17291	1781	169	332	61	16	2	
1979	87,467	6138	13902	4106	760	4608	337	58	73	29	9	
1980	55,475	5779	20663	5687	1065	193	1159	104	11	18	4	
1981	51,553	709	23581	12373	1122	100	12	320	0	2	2	
1982	47,889	1101	2865	20239	3249	147	58	49	106	1	1	
1983	48,339	2377	6805	2302	7603	1143	170	21	50	20	2	
1964	639,177	1621	315569	17856	1213	761	417	23	39	33	1	
1965	582,364	69774	3568	173131	5856	481	300	70	17	8	13	
1966	500,663	149827	6223	1158	85923	1082	87	35	25	5	0	
1967	514,858	866273	28190	1180	862	45338	300	43	32	10	13	
1968	548,642	188256	153075	5926	515	409	17787	71	15	2	1	
1969	491,433	1111	322694	30588	1069	272	215	3495	23	3	1	
1970	426,563	20187	20402	205835	6994	85	154	36	777	4	3	
1971	416,144	543516	21374	15554	108820	2462	82	36	31	249	44	
1972	392,432	178579	167637	9213	4995	39759	911	53	7	3	110	
1973	414,898	98804	193251	69360	1972	1043	9872	351	42	7	59	
1974	349,604	351800	48432	86495	13184	441	234	2390	48	3	8	
1975	329,432	480815	161720	15612	25856	3708	151	110	530	22	11	
1976	307,105	35831	329386	57468	2529	8069	1026	54	13	146	10	
1977	313,914	33009	37092	130190	12895	1644	1400	347	24	7	04	
1978	325,246	160841	69033	14340	44152	2366	442	673	86	29	3	
1979	316,419	83633	78617	17215	3040	8073	646	70	115	24	4	
1980	297,227	131314	128304	26206	3395	501	2415	123	20	56	23	
1981	289,672	10357	134264	55729	5181	702	102	579	15	22	1	
1982	297,730	31144	30969	118899	14297	682	145	39	230	1	9	
1983	335,164	29056	77409	30466	50204	6406	584	119	15	69	26	
1964	24,655	0	3150	117	10	5	2	0	0	0	0	
1965	54,799	1759	85	3851	58	7	4	1	0	0	0	
1966	35,841	3112	121	36	1248	17	1	1	0	0	0	
1967	28,022	13286	441	20	16	469	2	0	0	0	0	
1968	48,238	216	3150	121	21	38	235	1	0	0	0	
1969	63,666	189	20609	1002	34	10	8	87	1	0	0	
1970	83,529	812	934	18154	368	4	5	1	83	0	0	
1971	104,901	67866	3052	1553	16024	347	12	18	6	45	12	
1972	121,031	28413	20279	2495	1083	7920	137	13	1	1	28	
1973	152,422	20457	34299	9429	242	203	1591	48	5	1	6	
1974	116,982	45501	8695	14945	2336	31	21	283	6	0	1	
1975	161,009	128502	26965	2450	5213	520	13	14	77	3	1	
1976	152,419	3355	59426	11342	637	1757	328	7	5	45	1	
1977	224,824	10102	6461	41122	3492	590	787	99	15	2	5	
1978	236,929	45734	11471	2914	12280	774	110	167	24	4	0	
1979	287,494	44659	23157	4111	714	3646	205	20	57	20	0	
1980	533,197	92522	66285	8063	755	197	1015	61	18	8	5	
1981	251,504	7979	58165	13653	1518	161	20	320	12	0	7	
1982	250,870	25257	10170	33462	3927	135	67	7	58	0	0	
1983	244,349	19627	44664	6953	11805	1258	124	27	4	25	7	

SCHOOLING STAGES

SEASIDE STAGES

TAXONIC STAGES

Table 3.4. West of Scotland HADDOCK.  
Effort (hours fished) and catch at age ( $N \times 10^{-3}$ ). Input data for the estimation of terminal F's.

YEAR	EFFORT	AGE	1	2	3	4	5	6	7	8	9	10	SOCIAL FISHING HOURS	TAXES
1966	71.525	789.	249.	146.	20569.	921.	36.	17.	24.	0.	0.			
1967	54.231	5922.	2987.	182.	102.	12814.	55.	1.	5.	2.	0.			
1968	50.001	6486.	13331.	644.	138.	398.	8402.	310.	15.	2.	0.			
1969	42.056	0.	30459.	3585.	252.	117.	174.	2264.	81.	2.	0.			
1970	40.572	0.	113.	26460.	1376.	43.	34.	72.	242.	3.	0.			
1971	41.236	842.	475.	449.	16258.	142.	8.	1.	0.	16.	2.			
1972	55.536	3284.	18408.	903.	1041.	23671.	198.	5.	2.	16.	0.			
1973	51.153	1711.	5191.	6261.	90.	641.	17059.	61.	0.	1.	61.			
1974	45.399	6484.	3795.	5154.	1909.	28.	215.	4366.	8.	1.	13.			
1975	37.080	5986.	11545.	1404.	1095.	660.	20.	51.	1523.	40.	2.			
1976	35.507	66.	13426.	5902.	714.	595.	183.	4.	1.	217.	1.			
1977	33.946	2534.	237.	12304.	2059.	129.	171.	52.	/.	1.	27.			
1978	51.582	1376.	698.	192.	10559.	1542.	156.	122.	99.	1.	10.			
1979	33.373	6018.	2235.	611.	74.	3166.	3119.	31.	24.	5.	2.			
1980	19.660	465.	3664.	1346.	274.	27.	875.	47.	2.	1.	1.			
1981	13.755	3.	14272.	5735.	169.	32.	2.	131.	2.	5.	0.			
1982	14.194	86.	479.	7212.	1405.	37.	2.	12.	39.	0.	0.			
1983	23.056	2821.	3836.	1155.	5536.	801.	30.	1.	2.	34.	0.			
1966	156.511	491.	165.	2.	18628.	538.	4.	2.	0.	0.	0.			
1967	158.208	8256.	10693.	516.	103.	6640.	170.	4.	3.	2.	0.			
1968	150.094	88598.	16469.	1655.	117.	143.	2124.	239.	8.	6.	0.			
1969	140.718	67.	90695.	3738.	701.	63.	81.	754.	41.	5.	0.			
1970	95.629	4332.	183.	45402.	444.	65.	16.	19.	114.	7.	0.			
1971	98.748	35005.	1870.	1554.	32274.	139.	50.	2.	2.	79.	7.			
1972	70.741	8052.	17913.	585.	344.	8341.	74.	10.	1.	0.	20.			
1973	59.596	25035.	3433.	3691.	29.	31.	1630.	8.	14.	2.	5.			
1974	56.443	23940.	1637.	885.	681.	8.	31.	652.	10.	5.	4.			
1975	56.420	90247.	7636.	467.	324.	143.	3.	4.	130.	1.	1.			
1976	57.099	11262.	20806.	3050.	212.	223.	133.	3.	2.	109.	1.			
1977	41.929	3812.	1159.	6791.	803.	161.	69.	48.	4.	2.	23.			
1978	33.617	3470.	296.	157.	1946.	130.	16.	6.	5.	0.	1.			
1979	38.465	12198.	3181.	207.	84.	780.	50.	7.	4.	2.	0.			
1980	38.640	7436.	6320.	785.	94.	25.	358.	21.	2.	1.	2.			
1981	37.208	35.	17244.	4960.	518.	49.	4.	126.	4.	1.	0.			
1982	36.699	2883.	1213.	15227.	1323.	27.	5.	1.	14.	1.	0.			
1983	38.060	2099.	2976.	1308.	7600.	474.	20.	1.	2.	10.	1.			
1966	40.538	0.	3.	0.	703.	21.	0.	0.	0.	0.	0.			
1967	80.916	429.	1328.	73.	7.	149.	7.	0.	0.	0.	0.			
1968	65.348	2446.	514.	132.	9.	13.	82.	9.	0.	0.	0.			
1969	106.856	0.	6105.	274.	82.	5.	8.	53.	0.	1.	0.			
1970	118.881	558.	61.	7190.	94.	18.	4.	4.	24.	2.	0.			
1971	129.187	12856.	427.	324.	7717.	30.	21.	1.	0.	31.	3.			
1972	142.244	1479.	20885.	447.	197.	4635.	45.	15.	1.	0.	20.			
1973	91.151	559.	1171.	1396.	9.	19.	726.	7.	5.	1.	5.			
1974	88.651	5161.	950.	706.	425.	4.	13.	421.	9.	2.	4.			
1975	132.353	20271.	4525.	398.	360.	320.	8.	6.	235.	2.	2.			
1976	139.225	2067.	11485.	2004.	172.	219.	119.	3.	5.	93.	1.			
1977	145.574	1151.	363.	3582.	661.	95.	66.	49.	9.	1.	50.			
1978	127.387	2565.	206.	157.	1412.	215.	33.	19.	13.	1.	1.			
1979	99.803	10349.	2420.	165.	35.	803.	59.	17.	5.	4.	0.			
1980	121.211	4939.	3970.	1035.	184.	38.	500.	52.	7.	1.	2.			
1981	165.002	28.	14863.	4466.	423.	60.	8.	176.	12.	3.	1.			
1982	135.240	4962.	960.	17389.	1722.	71.	10.	15.	18.	1.	1.			
1983	112.332	3168.	5746.	1345.	10272.	662.	62.	3.	5.	22.	0.			

Table 3.5. North Sea WHITING.  
Effort (hours fished) and catch at age ( $N \times 10^{-3}$ ). Input data for the estimation of terminal F<sub>1</sub>.

YEAR	EFFORT	ARE	1	2	3	4	5	6	7	8	9	10
1964	197,623	204.	12553.	11005.	2101.	1056.	246.	77.	1.	11.	4.	
1965	172,992	691.	276.	13599.	2904.	484.	155.	49.	18.	1.	1.	
1966	194,012	1777.	2793.	867.	13469.	1430.	138.	54.	13.	8.	0.	
1967	215,319	8255.	1704.	5071.	702.	1032.	817.	118.	25.	12.	0.	
1968	218,141	7211.	21140.	6637.	3078.	267.	4229.	287.	26.	10.	3.	
1969	133,010	74.	1112.	6575.	1453.	564.	45.	93.	65.	2.	0.	
1970	133,465	394.	274.	14388.	2377.	347.	114.	4.	212.	10.	1.	
1971	174,259	4798.	2519.	455.	13095.	1484.	179.	52.	0.	81.	3.	
1972	201,493	8830.	7643.	2427.	307.	7895.	868.	95.	38.	10.	22.	
1973	182,561	9833.	16094.	1110.	74.	82.	170.	216.	25.	10.	5.	
1974	185,432	1726.	17908.	7426.	987.	207.	35.	535.	37.	2.	0.	
1975	152,977	1677.	5948.	13289.	2166.	279.	42.	7.	121.	12.	1.	
1976	121,861	280.	8121.	2958.	9282.	691.	121.	14.	0.	29.	2.	
1977	144,344	885.	6342.	13050.	132.	2352.	211.	26.	2.	2.	12.	
1978	135,220	2270.	12979.	15501.	8632.	859.	752.	71.	9.	0.	0.	
1979	87,467	2856.	1484.	11108.	7628.	2945.	166.	212.	25.	1.	0.	
1980	55,475	626.	1003.	10096.	3439.	2395.	875.	30.	21.	3.	3.	
1981	51,553	234.	9534.	8047.	3470.	546.	537.	104.	2.	4.	0.	
1982	47,899	271.	877.	6532.	2668.	916.	191.	69.	14.	2.	0.	
1983	48,359	293.	1090.	3125.	7240.	1341.	539.	50.	102.	15.	0.	
1984	639,177	18627.	112530.	46095.	5487.	2358.	647.	142.	0.	14.	3.	
1985	582,364	101782.	110848.	17446.	2061.	844.	159.	46.	0.	0.	4.	
1986	500,668	94342.	47443.	8605.	82295.	7236.	293.	22.	15.	0.	0.	
1987	514,854	453102.	56306.	21660.	2880.	24524.	2040.	235.	53.	9.	2.	
1988	534,432	168236.	121615.	17163.	6304.	694.	6853.	570.	31.	5.	0.	
1989	691,435	6932.	70980.	25683.	4178.	1599.	110.	1742.	126.	13.	1.	
1990	426,263.	21905.	3477.	50805.	8738.	1086.	553.	58.	387.	44.	6.	
1991	164,144	161744.	22242.	3650.	3740.	3860.	520.	172.	13.	164.	11.	
1992	392,432	46775.	27827.	4850.	84.	14987.	2587.	1780.	33.	10.	367.	
1993	414,398	27179.	49676.	12692.	2514.	245.	4100.	487.	77.	25.	19.	
1994	349,064	69434.	557205.	25595.	4326.	720.	102.	1175.	79.	15.	8.	
1995	329,432	54357.	31190.	39771.	10131.	855.	103.	19.	292.	34.	0.	
1996	307,163	22193.	67582.	12457.	10086.	1890.	264.	43.	0.	73.	1.	
1997	313,913	22193.	50859.	37035.	3356.	2528.	371.	31.	10.	1.	6.	
1998	325,244	14994.	29309.	43713.	15391.	1058.	1409.	201.	36.	0.	7.	
1999	316,419	90732.	41123.	26104.	14606.	6093.	59.	16.	3.	0.	0.	
2000	297,227	27033.	73706.	37658.	11915.	9368.	2556.	240.	229.	27.	7.	
2001	289,072	4753.	22671.	26215.	11223.	2555.	2222.	400.	44.	4.	1.	
2002	297,730	3761.	7160.	26980.	13595.	2827.	561.	290.	85.	5.	0.	
2003	533,163	11621.	15212.	22230.	35421.	10215.	2249.	425.	165.	17.	0.	
2004	24,653	446.	2895.	460.	58.	22.	6.	2.	0.	0.	0.	
2005	54,799	481.	563.	5484.	454.	49.	22.	3.	1.	0.	0.	
2006	35,841	2678.	1254.	162.	1066.	125.	11.	5.	0.	0.	0.	
2007	28,022	7614.	1156.	410.	66.	419.	46.	4.	1.	0.	0.	
2008	48,238	4514.	3278.	542.	196.	35.	181.	14.	1.	0.	0.	
2009	63,366	794.	5074.	1678.	267.	88.	7.	102.	0.	1.	0.	
2010	83,529	2381.	1350.	4914.	1089.	127.	87.	4.	125.	8.	3.	
2011	104,901	25395.	3085.	510.	6129.	769.	124.	67.	4.	29.	4.	
2012	121,031	21378.	10224.	1780.	355.	4156.	504.	80.	18.	4.	13.	
2013	152,442	54373.	15192.	3207.	710.	73.	1430.	185.	39.	6.	3.	
2014	116,932	18997.	16613.	5208.	774.	148.	15.	423.	35.	7.	2.	
2015	161,009	26423.	15360.	18384.	3497.	424.	34.	5.	180.	21.	0.	
2016	152,419	5755.	30125.	5298.	5244.	876.	195.	18.	1.	44.	5.	
2017	224,324	24596.	29945.	24841.	1664.	2419.	460.	34.	1d.	0.	4.	
2018	236,944	8785.	19909.	30721.	14472.	956.	1612.	635.	72.	6.	0.	
2019	287,494	171149.	42911.	23153.	17990.	4058.	377.	284.	57.	5.	0.	
2020	323,197	20806.	58382.	34363.	9525.	9430.	1864.	144.	145.	5.	0.	
2021	251,504	6577.	19035.	21463.	9662.	1770.	1446.	309.	9.	1.	0.	
2022	250,870	5222.	8270.	27044.	13131.	3385.	659.	346.	75.	16.	3.	
2023	244,349	37408.	17900.	12354.	19247.	6128.	1238.	143.	143.	1.	0.	
2024	24,653	446.	2895.	460.	58.	22.	6.	2.	0.	0.	0.	
2025	54,799	481.	563.	5484.	454.	49.	22.	3.	1.	0.	0.	
2026	35,841	2678.	1254.	162.	1066.	125.	11.	5.	0.	0.	0.	
2027	28,022	7614.	1156.	410.	66.	419.	46.	4.	1.	0.	0.	
2028	48,238	4514.	3278.	542.	196.	35.	181.	14.	1.	0.	0.	
2029	63,366	794.	5074.	1678.	267.	88.	7.	102.	0.	1.	0.	
2030	83,529	2381.	1350.	4914.	1089.	127.	87.	4.	125.	8.	3.	
2031	104,901	25395.	3085.	510.	6129.	769.	124.	67.	4.	29.	4.	
2032	121,031	21378.	10224.	1780.	355.	4156.	504.	80.	18.	4.	13.	
2033	152,442	54373.	15192.	3207.	710.	73.	1430.	185.	39.	6.	3.	
2034	116,932	18997.	16613.	5208.	774.	148.	15.	423.	35.	7.	2.	
2035	161,009	26423.	15360.	18384.	3497.	424.	34.	5.	180.	21.	0.	
2036	152,419	5755.	30125.	5298.	5244.	876.	195.	18.	1.	44.	5.	
2037	224,324	24596.	29945.	24841.	1664.	2419.	460.	34.	1d.	0.	4.	
2038	236,944	8785.	19909.	30721.	14472.	956.	1612.	635.	72.	6.	0.	
2039	287,494	171149.	42911.	23153.	17990.	4058.	377.	284.	57.	5.	0.	
2040	323,197	20806.	58382.	34363.	9525.	9430.	1864.	144.	145.	5.	0.	
2041	251,504	6577.	19035.	21463.	9662.	1770.	1446.	309.	9.	1.	0.	
2042	250,870	5222.	8270.	27044.	13131.	3385.	659.	346.	75.	16.	3.	
2043	244,349	37408.	17900.	12354.	19247.	6128.	1238.	143.	143.	1.	0.	

Table 3.6. West of Scotland WHITING.  
Effort (hours fished) and catch at age ( $N \times 10^{-3}$ ). Input data for the estimation  
of terminal F's.

YEAR	EFFORT	AGE	1	2	3	4	5	6	7	8	SCOTISH TRAWL
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	194.	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.	1800.	432.	60.	26.	1.	27.		
1971	41,234	15.	154.	114.	3515.	193.	42.	4.	0.		
1972	55,536	317.	456.	220.	54.	1226.	82.	5.	2.		
1973	51,155	292.	946.	595.	212.	45.	743.	37.	4.		
1974	45,499	68.	1740.	867.	184.	54.	5.	131.	7.		
1975	37,080	125.	321.	1506.	214.	31.	6.	0.	27.		
1976	35,507	51.	1705.	794.	1152.	165.	13.	3.	0.		
1977	33,448	312.	367.	1984.	225.	439.	17.	0.	0.		
1978	51,582	45.	626.	704.	2400.	241.	405.	25.	1.		
1979	33,373	143.	2030.	1799.	386.	703.	36.	75.	1.		
1980	19,661	22.	446.	1369.	561.	354.	237.	53.	23.		
1981	13,753	10.	973.	1124.	493.	151.	102.	22.	0.		
1982	14,194	36.	150.	1400.	654.	112.	131.	23.	3.		
1983	23,056	18.	426.	555.	2390.	543.	127.	13.	5.		
1965	153,103	2971.	2772.	17100.	1588.	67.	17.	1.	1.		
1966	156,511	993.	7710.	1302.	12702.	784.	75.	13.	3.		
1967	158,208	2392.	15869.	4622.	535.	5543.	315.	55.	2.		
1968	150,094	3984.	8227.	4017.	1282.	133.	1679.	125.	8.		
1969	140,718	450.	11467.	3450.	960.	435.	48.	824.	86.		
1970	95,629	340.	1266.	801.	805.	191.	57.	6.	174.		
1971	98,448	1117.	5626.	2073.	13834.	492.	77.	25.	0.		
1972	70,741	6861.	4168.	915.	521.	3000.	111.	15.	7.		
1973	59,396	5346.	9255.	1565.	523.	91.	855.	56.	6.		
1974	56,448	3007.	10864.	3065.	270.	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.	2357.	5562.	531.	1022.	44.	2.	1.		
1978	33,599	5427.	3320.	809.	1187.	73.	168.	7.	0.		
1979	38,465	2761.	10731.	3416.	520.	592.	17.	32.	0.		
1980	38,640	1837.	2579.	3845.	994.	258.	124.	4.	14.		
1981	37,208	653.	5810.	2480.	1015.	405.	92.	57.	1.		
1982	36,689	333.	881.	5771.	1072.	247.	74.	58.	13.		
1983	38,080	578.	1411.	1444.	4603.	1243.	139.	76.	51.		
1965	37,387	519.	282.	3745.	400.	16.	6.	1.	0.		
1966	40,538	269.	565.	154.	541.	567.	57.	7.	4.		
1967	80,916	647.	2899.	1446.	98.	2501.	140.	13.	1.		
1968	65,548	489.	1960.	1617.	641.	51.	861.	60.	4.		
1969	106,856	12.	5202.	1984.	565.	289.	30.	549.	63.		
1970	118,881	26.	3663.	9914.	938.	202.	52.	5.	133.		
1971	129,187	394.	2535.	868.	905.	327.	63.	25.	1.		
1972	142,244	3398.	2655.	1475.	514.	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.	628.	83.	13.	3.	87.		
1976	139,223	2784.	9170.	5208.	5440.	731.	14.	5.	0.		
1977	143,574	6043.	2497.	5289.	749.	1148.	74.	2.	1.		
1978	127,337	3559.	3791.	1542.	1912.	136.	259.	4.	0.		
1979	99,403	1239.	7803.	2304.	517.	297.	33.	59.	0.		
1980	121,211	1525.	5193.	3957.	970.	151.	149.	12.	19.		
1981	165,002	570.	6980.	4045.	1366.	498.	161.	66.	1.		
1982	135,280	783.	1557.	8587.	1765.	328.	76.	65.	10.		
1983	112,332	1024.	2183.	2395.	802.	1815.	265.	59.	54.		

SCOTISH DRAFTRAWL

Table 3.7. North Sea COD.  
Rho values and regression analysis for the estimation of terminal F's.

YEAR/AGE	1	2	3	4	5	6	7	8	9	
1968	1	0.468	0.492	0.471	0.570	0.286	0.858	1.031	0.141	0.839
1969	2	0.084	0.302	0.353	0.615	0.732	0.964	1.256	0.230	0.480
1970	3	0.418	0.324	0.884	0.589	0.562	0.688	1.009	0.134	0.570
1971	4	0.667	0.760	0.276	1.113	1.146	1.000	1.167	0.954	0.375
1972	5	0.609	0.915	0.652	0.828	1.294	1.155	0.889	1.026	1.897
1973	6	1.391	1.182	0.802	0.916	0.490	1.703	1.024	0.297	0.869
1974	7	2.026	0.824	0.967	1.149	1.228	1.157	2.732	1.768	1.201
1975	8	0.690	1.197	0.898	1.392	1.169	1.371	0.642	0.540	1.278
1976	9	0.323	1.490	1.379	1.023	1.097	1.327	1.569	0.249	2.733
1977	10	1.236	0.877	0.982	1.343	1.032	1.299	1.213	0.501	1.426
1978	11	0.461	1.428	0.973	1.390	1.207	1.580	1.533	0.488	2.786
1979	12	0.347	0.963	1.167	1.114	1.468	1.451	2.763	0.701	2.018
1980	13	0.536	0.395	0.962	1.454	0.930	1.577	2.987	0.583	1.414
1981	14	0.483	1.075	1.204	1.469	1.302	0.861	1.120	0.594	1.448
1982	15	1.494	0.747	1.003	1.901	1.504	3.389	2.551	1.545	8.421
1983	16	1.078	1.225	1.456	1.727	1.460	2.014	2.344	0.951	3.993
FREDIC. I.	130695.	179525.	35671.	19503.	4931.	2154.	930.	217.	101.	
FREDIC. F	0.270	1.006	1.476	0.745	0.907	0.755	0.688	0.894	0.871	
COR.COEFF.	0.291	0.524	0.818	0.890	0.697	0.590	0.556	0.344	0.611	
SLOPE	0.034	0.040	0.068	0.075	0.056	0.084	0.097	0.038	0.268	
INTERCEPT	0.536	0.578	0.569	0.521	0.579	0.677	0.787	0.349	-0.292	

Table 3.8. West of Scotland COD.  
Rho values and regression analysis for the estimation of  
terminal F's.

YEAR/AGE	1	2	3	4	5	6	7
1968 1	0.275	0.716	1.018	0.737	0.287	0.756	0.704
1969 2	0.082	0.761	1.078	1.251	1.108	1.345	0.891
1970 3	0.419	1.149	0.841	0.751	0.870	1.002	0.529
1971 4	0.301	0.662	0.495	0.589	0.742	1.059	0.810
1972 5	1.286	0.890	0.826	0.553	0.754	0.901	0.442
1973 6	1.110	0.663	0.644	0.712	0.661	2.045	3.092
1974 7	0.597	0.759	0.545	0.971	0.658	1.380	1.869
1975 8	0.755	0.580	0.505	0.344	0.560	0.910	0.580
1976 9	0.709	0.638	0.792	0.500	0.701	2.146	2.567
1977 10	0.840	0.409	0.618	0.468	0.641	0.856	0.759
1978 11	0.374	0.528	0.505	0.631	0.740	1.772	1.396
1979 12	0.343	0.299	1.099	0.515	0.950	2.473	2.588
1980 13	0.622	0.519	0.530	0.662	0.913	1.949	2.903
1981 14	0.107	0.674	0.573	0.413	0.291	0.476	0.718
1982 15	0.565	0.646	0.624	0.410	0.375	1.129	0.604
1983 16	0.565	0.450	0.554	0.376	0.590	1.592	1.827
PREDIC. N	15367.	19367.	2482.	2852.	784.	281.	66.
PREDIC. F	0.183	0.294	0.704	0.806	1.063	0.369	0.901
COR.COEFF.	0.009	-0.589	-0.383	-0.614	-0.223	0.226	0.267
SLOPE	0.001	-0.026	-0.019	-0.033	-0.012	0.030	0.058
INTERCEPT	0.553	0.369	0.860	0.898	0.777	1.117	0.903

Table 3.9. North Sea HADDOCK.

Rho values and regression analysis for the estimation of terminal F's.

YEAR/AGE	1	2	3	4	5	6	7	8	9	
1964	1	0.271	1.033	1.239	0.344	0.392	1.431	0.236	0.567	0.864
1965	2	11.705	0.316	0.501	0.553	0.365	0.492	0.590	0.243	0.216
1966	3	10.035	2.597	0.570	0.595	0.432	0.498	0.447	0.937	0.069
1967	4	7.464	0.189	0.017	0.265	0.978	0.313	0.906	2.030	1.331
1968	5	0.206	2.714	1.700	0.818	0.271	1.000	0.247	0.665	0.237
1969	6	0.032	0.701	1.420	0.847	0.361	1.132	1.000	0.199	0.205
1970	7	1.431	1.639	1.117	0.779	0.381	0.876	0.285	1.000	0.926
1971	8	5.191	2.693	1.707	1.235	0.797	0.527	1.581	0.567	1.000
1972	9	1.523	4.011	3.176	1.830	1.438	1.045	0.634	0.245	0.077
1973	10	3.477	2.406	2.902	0.915	0.934	1.453	8.480	0.767	0.179
1974	11	4.073	4.072	1.384	1.316	0.416	2.757	2.018	0.438	0.065
1975	12	3.316	5.025	5.007	1.571	0.994	0.559	2.291	1.879	0.449
1976	13	3.054	4.733	4.125	1.146	1.904	1.783	0.465	0.281	1.139
1977	14	1.870	7.108	2.877	2.767	1.586	2.113	1.733	0.617	0.354
1978	15	5.704	9.250	4.059	2.450	1.798	1.701	3.222	1.180	0.580
1979	16	1.023	6.402	4.125	2.614	1.569	1.975	0.971	2.464	0.734
1980	17	1.593	4.790	4.282	2.696	1.810	1.942	2.834	0.612	3.093
1981	18	0.718	2.503	3.036	1.951	1.103	0.945	2.353	0.656	0.344
1982	19	1.215	2.491	2.482	1.377	0.431	0.990	4.863	2.058	0.038
1983	20	1.026	5.319	4.234	2.559	1.591	1.027	2.500	1.333	0.852
PREDIC. F		743.910	412.191	1145.111	20195.87	21368.	3735.	653.	724.	585.
PREDIC. F		0.412	0.937	1.373	1.134	1.062	1.008	1.453	0.896	0.983
COR.COFF.		-0.402	0.494	0.626	0.312	0.615	0.494	0.459	0.270	0.212
SLOPE		-0.237	0.204	0.180	0.122	0.104	0.047	0.165	0.035	0.027
INTERCEPT		5.764	1.743	0.511	0.126	0.312	0.696	0.202	0.626	0.304

Table 3.10. West of Scotland HADDOCK.  
Rho values and regression analysis for the estimation of terminal F's.

YEAR/AGE	1	2	3	4	5	6	7	8	9	
1966	1	0.077	0.412	0.253	1.390	0.965	0.293	0.254	0.095	0.000
1967	2	0.365	6.626	1.382	0.204	1.288	0.094	0.040	0.054	0.048
1968	3	0.417	3.621	2.433	1.005	0.791	1.271	1.146	0.652	0.742
1969	4	0.018	1.000	2.274	3.131	1.100	0.264	2.676	0.993	2.839
1970	5	2.391	0.104	1.000	1.599	0.613	0.214	0.237	0.515	0.602
1971	6	1.157	2.830	1.218	1.000	0.125	0.229	0.014	0.005	1.959
1972	7	0.954	4.297	7.801	1.809	1.000	0.053	0.113	0.034	0.000
1973	8	8.905	1.714	3.225	1.549	1.522	1.000	0.030	0.244	0.163
1974	9	2.109	3.034	4.840	2.453	0.395	0.410	1.000	0.115	1.943
1975	10	3.390	2.920	2.996	4.140	1.165	0.276	0.218	1.000	11.033
1976	11	12.095	1.912	3.822	3.416	1.920	0.265	0.119	0.037	1.309
1977	12	4.480	4.514	2.312	3.077	1.604	0.468	0.207	0.482	0.410
1978	13	1.046	1.220	1.057	3.670	2.755	0.682	0.902	1.022	0.626
1979	14	1.468	3.485	3.547	0.749	2.258	0.856	0.606	2.544	0.591
1980	15	0.253	1.842	4.227	7.155	0.361	0.958	0.493	0.113	2.222
1981	16	0.016	1.668	3.970	1.614	2.053	0.015	0.539	0.052	0.747
1982	17	0.071	1.510	3.154	2.050	0.504	0.204	0.155	0.250	0.125
1983	18	3.002	2.063	4.096	3.827	1.528	0.491	0.336	0.703	1.764
PREDIC. N		27330.	56406.	12370.	08110.	7601.	832.	55.	211.	307.
PREDIC. F		0.859	0.501	0.774	0.916	0.658	1.495	1.598	3.433	1.156
COR. COEF.		0.110	-0.147	0.368	0.484	0.320	0.070	-0.153	0.192	0.058
SLOPE		0.073	-0.049	0.132	0.159	0.047	0.005	-0.020	0.024	0.030
INTERCEPT		1.682	2.958	1.720	0.950	0.774	0.390	0.694	0.263	1.228

Table 3.11. North Sea WHITING.

Rho values and regression analysis for the estimation of terminal F's.

YEAR/AGE	1	2	3	4	5	6	7	8	9	
1964	1	0.209	0.119	0.912	0.265	0.481	0.393	0.476	0.307	0.910
1965	2	0.772	0.064	1.000	0.345	0.207	0.303	0.156	0.492	0.713
1966	3	1.046	0.243	0.910	1.000	0.968	0.860	1.419	0.705	3.670
1967	4	2.635	0.351	1.212	0.335	1.000	0.329	1.177	2.745	1.280
1968	5	0.345	0.431	1.276	0.451	0.283	1.007	0.565	0.547	4.054
1969	6	0.265	0.096	1.339	0.329	0.575	0.096	1.000	0.964	0.660
1970	7	0.532	0.145	1.029	0.523	0.266	0.070	0.094	1.000	1.406
1971	8	1.474	0.311	1.512	0.086	0.423	0.192	0.434	0.184	1.000
1972	9	0.253	0.197	0.866	0.367	1.153	1.290	4.312	0.428	0.190
1973	10	0.238	0.204	1.284	0.275	0.327	0.853	0.962	2.613	1.104
1974	11	0.358	1.933	1.713	0.604	0.170	0.975	0.753	0.869	7.104
1975	12	0.182	0.207	2.363	0.991	0.590	0.249	0.503	1.198	1.624
1976	13	0.147	0.255	1.776	1.007	0.755	0.991	0.349	0.273	0.627
1977	14	0.143	0.133	2.263	0.569	1.300	0.689	0.260	4.997	0.185
1978	15	0.089	0.153	2.015	1.220	0.716	2.194	3.953	4.143	6.106
1979	16	0.454	0.179	1.797	0.955	1.647	1.029	1.128	0.995	0.281
1980	17	0.140	0.248	2.236	0.977	2.116	2.442	0.762	6.714	1.055
1981	18	0.133	0.098	1.504	0.943	0.877	1.972	1.395	0.743	0.263
1982	19	0.076	0.067	1.110	0.736	1.074	1.057	0.893	1.911	0.285
1983	20	-0.047	0.282	2.021	1.007	1.288	1.000	1.438	3.121	1.372
PREDIC. N	-2144903.	300909.	206328.	248290.	64667.	11712.	1934.	821.	124.	
PREDIC. F	-0.098	0.923	0.786	0.823	0.904	1.153	1.436	1.522	1.149	
COR.CUEF.	-0.487	-0.009	0.622	0.650	0.538	0.010	0.173	0.449	-0.094	
SLOPE	-0.055	-0.001	0.054	0.034	0.049	0.071	0.035	0.145	-0.034	
INTERCEPT	1.046	0.295	0.941	0.317	0.309	0.238	0.734	0.229	2.051	

Table 3.12. West of Scotland WHITING.  
Rho values and regression analysis for the estimation of  
terminal F's.

YEAR/AGE	1	2	3	4	5	6	7
1965 1	0.804	2.075	0.731	0.528	0.420	0.066	0.659
1966 2	0.219	1.170	2.219	0.951	0.726	0.968	0.882
1967 3	0.546	2.637	2.101	0.762	0.769	0.608	0.748
1968 4	0.348	1.474	2.944	1.383	1.122	1.000	0.341
1969 5	0.280	0.579	1.065	1.307	1.718	4.176	1.000
1970 6	0.270	3.374	0.718	0.791	0.982	1.082	4.022
1971 7	0.595	2.735	3.604	1.104	0.642	1.277	0.659
1972 8	1.829	2.874	3.251	2.551	1.481	1.722	0.858
1973 9	0.764	4.127	5.015	3.162	3.485	1.947	2.006
1974 10	1.400	1.676	3.191	2.199	1.985	2.770	0.962
1975 11	0.938	1.009	2.317	0.965	1.943	1.093	3.292
1976 12	1.618	2.491	5.442	1.828	3.249	3.807	2.268
1977 13	2.484	1.528	2.349	1.333	1.385	2.308	1.923
1978 14	2.225	1.409	1.291	1.453	1.728	1.895	5.288
1979 15	1.408	3.551	3.440	1.582	1.784	1.431	2.175
1980 16	0.366	0.764	3.205	1.420	1.866	3.152	31.356
1981 17	0.653	0.514	1.345	1.074	1.051	1.111	1.042
1982 18	0.650	0.061	1.197	0.747	0.550	2.076	0.618
1983 19	1.454	1.501	2.823	1.592	1.930	2.512	7.829
PREDIC. R	22391.	23337.	16115.	45731.	9799.	1380.	417.
PREDIC. F	0.214	0.455	0.874	0.859	1.098	1.485	3.015
COR. COEFF.	0.590	-0.230	0.111	0.159	0.288	0.348	0.354
SLOPE	0.051	-0.047	0.028	0.020	0.046	0.067	0.473
INTERCEPT	0.485	2.402	2.293	1.207	1.058	1.231	-1.151

**Table 3.13** Comparison of results of VPA tuning methods for North Sea stocks (A/C = Armstrong-Cook method).

Table 4.1 North Sea COD. Estimates of recruitment at age 1 and 2.

Year Class	Age 1				Age 2			
	IYFS <sup>1)</sup>	EGFS <sup>2)</sup>	VPA number x 10 <sup>-6</sup> IV	VIA	IYFS	EGFS	VPA number x 10 <sup>-6</sup> IV	VIA
1968					4.9		76	2.3
1969	42.2		379	5.2	25.9		263	4.2
1970	98.3		429	8.7	34.5		312	6.8
1971	4.1		78	4.3	10.6		60	3.3
1972	38.0		154	6.9	9.5		104	5.5
1973	14.7		128	8.2	6.2		92	6.1
1974	40.3		225	12.7	19.9		157	9.3
1975	7.9		109	7.4	3.2	459	84	4.3
1976	36.7	6 818	375	9.8	29.3	1 249	252	6.9
1977	12.9	2 372	223	9.5	9.3	592	157	7.2
1978	9.9	2 265	233	14.6	14.8	697	158	11.2
1979	16.8	5 150	428	21.0	25.5	1 411	300	16.1
1980	2.9	1 232	154	6.4	6.7	289	106	4.9
1981	9.2	3 234	290	26.6	21.2 <sup>3)</sup>	1 095	(179)	(20.1)
1982	4.3 <sup>3)</sup>	1 541	(131)	(16.1)				
1983	15.5 <sup>3)</sup>							

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

Table 4.2 North Sea HADDOCK. Estimates of recruitment at age 1 and 2.

Year Class	Age 1				Age 2			
	IYFS <sup>1)</sup>	EGFS <sup>2)</sup>	VPA number x 10 <sup>-6</sup>		IYFS	EGFS	VPA number x 10 <sup>-6</sup>	
			IV	VIIa			IV	VIIa
1968					45		347	14
1969	28		470	18	32		148	9
1970	855		3 290	245	299		1 083	137
1971	740		2 335	76	971		1 306	44
1972	187		756	79	110		294	22
1973	1 072		2 603	169	385		1 047	77
1974	1 168		4 607	438	670		1 898	198
1975	177		387	36	84	3 119	167	8
1976	162	6 634	554	23	108	3 105	230	7
1977	385	12 605	925	57	240	6 053	348	32
1978	480	29 691	1 190	167	402	15 755	661	78
1979	896	62 392	2 174	399	675	43 835	1 128	306
1980	268	17 036	436	28	252	7 955	230	23
1981	526	31 501	829	83	330 <sup>3)</sup>	10 945	(412)	(54)
1982	301 <sup>3)</sup>	21 762	(743)	(56)				
1983	989 <sup>3)</sup>							

1) International Young Fish Survey: Aritmetic 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

Table 4.3 North Sea WHITING. Estimates of recruitment at age 1 and 2.

Year Class	Age 1				Age 2			
	IYFS <sup>1)</sup>	EGFS <sup>2)</sup>	VPA number x 10 <sup>-6</sup>		IYFS	EGFS	VPA number x 10 <sup>-6</sup>	
			IV	VIIa			IV	VIIa
1968					77		126	16
1969	69		926	22	31		227	17
1970	274		1 408	31	190		598	23
1971	332		2 438	93	763		1 156	61
1972	1 156		3 258	194	496		1 632	147
1973	322		1 711	67	153		726	47
1974	893		3 175	150	535		1 741	110
1975	679		1 799	51	219	6 531	1 043	34
1976	418	21 969	2 144	80	293	5 482	847	51
1977	513	24 632	1 814	110	183	7 441	1 109	74
1978	457	20 019	1 994	79	391	15 040	1 077	59
1979	692	30 044	1 660	183	485	30 646	1 069	140
1980	227	26 603	694	39	232	7 928	391	28
1981	161	27 704	759	30	149 <sup>3)</sup>	10 855	(384)	(22)
1982	130 <sup>3)</sup>	11 813	(737)	(30)				
1983	397 <sup>3)</sup>							

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

**Table 5.1** Nominal catch (in tonnes) of COD in Sub-area IV, 1974-83. (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	10 253	7 566	7 483	10 346	17 473	12 576	9 630	8 744	6 604	6 645
Denmark	54 207	46 344	53 277	42 582	41 858	48 509	56 404	64 968	64 648	50 436
Faroe Islands	416	732	448	260	56	113	150	38	65	81
France	7 275	8 667	8 079	7 511	11 944	12 559	10 910	11 369	8 399	6 314
German Dem. Rep.	132	223	69	21	75	84	63	-	-	-
Germany, Fed. Rep.	17 089	16 457	24 445	22 663	37 040	20 411	26 343	29 741	18 525	20 246
Ireland	-	-	98	136	174	1	-	-	-	-
Netherlands	24 029	23 263	21 835	29 903	48 817	34 752	45 400	51 281	36 490	31 590
Norway <sup>a)</sup>	324	1 528	1 877	1 449	2 747	3 575	4 506	6 766	11 271	5 392
Poland	4 750	2 991	2 961	381	115	142	28	7	62	75
Spain	80	63	14	-	-	-	-	-	-	-
Sweden	2 071	900	597	36	...	298	293	321	453	337
UK (England & Wales)	39 857	33 615	46 475	35 424	59 127	54 923	49 951	59 856	54 277	53 352
UK (Scotland)	39 887	37 308	39 597	34 406	41 984	42 811	45 044	53 921	57 308	57 860
USSR	2 667	6 796	6 187	-	17	17	-	-	-	-
Total IV	203 037	186 453	213 442	185 118	261 427	230 771	248 722	287 012	258 102	232 328
Total IVa	64 152	58 343	68 352	55 623	43 357	41 118	48 467	55 109	60 024	56 713
Total IVb	114 087	107 227	126 218	100 191	164 388	147 313	161 767	194 283	171 365	167 424
Total IVc	24 798	20 883	18 872	29 304	53 682	42 340	38 488	37 620	26 713	8 191

<sup>x)</sup>Provisional

<sup>a)</sup>Figures from Norway do not include cod caught in Rec. 2 fisheries

<sup>b)</sup>Included in Division IIIa

Table 5.2. VIRTUAL POPULATION ANALYSIS

NORTH SEA COD (FISHING AREA IV)

CATCH IN NUMBERS      UNIT: THOUSANDS

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	14677	30305	6238	60267	28358	36314	55522	21829	64659	28193
2	55431	48051	93083	48281	156890	86741	94284	187169	57307	105022
3	10716	18232	17584	23082	14231	39700	29942	27318	51770	25680
4	14869	4220	6608	4307	8469	3596	9702	7627	6424	9443
5	4392	6484	1589	2190	2884	3061	1523	3777	2939	2705
6	920	1732	2439	675	961	660	1037	757	1662	1053
7	417	377	770	926	371	342	384	546	321	424
8	373	149	98	307	364	113	159	136	197	118
9	318	180	49	223	131	127	69	62	62	54
10	75	80	49	20	32	34	46	33	24	8
11+	179	53	29	81	38	18	23	22	23	9
TOTAL	102367	109863	128536	140359	212729	170706	192691	249270	185388	172709

Table 5.3. VIRTUAL POPULATION ANALYSIS

NORTH SEA COD (FISHING AREA IV)

MEAN WEIGHT AT AGE OF THE STOCK      UNIT: KILOGRAM

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.504	0.373	0.373	0.306	0.369	0.302	0.534	0.642	0.592	0.641
2	1.032	0.871	1.000	0.905	0.744	0.836	0.974	0.891	0.939	0.949
3	2.213	2.310	2.372	2.091	1.919	2.369	1.972	2.052	1.850	1.639
4	4.152	4.162	4.328	4.412	4.130	4.475	4.512	4.275	4.491	4.163
5	6.242	6.282	6.372	6.639	6.425	6.678	6.295	6.867	6.795	6.322
6	8.341	8.434	8.560	8.750	8.615	8.657	9.084	8.787	8.914	8.880
7	9.878	9.801	10.078	9.980	9.578	10.672	9.683	9.843	10.622	10.519
8	10.762	10.320	11.017	10.897	10.787	11.460	11.736	11.387	12.437	12.347
9	12.226	11.933	12.690	12.018	12.153	13.017	12.666	13.097	13.242	13.241
10	12.413	12.671	13.912	12.830	12.560	13.849	13.866	14.131	12.944	12.477
11+	13.629	13.641	14.452	13.814	13.830	15.849	15.972	15.630	14.302	13.537

Table 5.4. VIRTUAL POPULATION ANALYSIS

NORTH SEA COD (FISHING AREA IV)

	FISHING MORTALITY COEFFICIENT				UNIT: Year-1				NATURAL MORTALITY COEFFICIENT = 0.20			
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1978-83	
1	0.13	0.16	0.07	0.19	0.15	0.19	0.15	0.17	0.28	0.27	0.20	
2	0.87	0.84	1.03	0.98	1.12	0.92	1.04	1.12	0.89	1.01	1.02	
3	0.71	0.81	0.89	0.80	0.93	1.02	1.00	1.05	1.21	1.48	1.11	
4	0.70	0.69	0.80	0.56	0.80	0.64	0.75	0.77	0.77	0.75	0.75	
5	0.71	0.78	0.61	0.68	0.95	0.77	0.62	0.76	0.80	0.91	0.80	
6	0.59	0.68	0.77	0.57	0.75	0.59	0.65	0.74	0.95	0.76	0.74	
7	0.83	0.52	0.76	0.78	0.72	0.66	0.86	0.89	0.84	0.69	0.78	
8	0.71	0.82	0.24	0.80	0.83	0.50	0.76	0.88	1.00	0.89	0.81	
9	1.00	0.95	0.72	1.38	1.00	0.81	0.67	0.77	1.49	0.87	0.94	
10	0.75	0.75	0.75	0.75	0.75	0.80	0.80	0.80	0.80	0.80	0.79	
11+	0.75	0.75	0.75	0.75	0.75	0.80	0.80	0.80	0.80	0.80	0.79	
( 3- 8)U	0.71	0.72	0.68	0.70	0.83	0.70	0.77	0.85	0.93	0.91		

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

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1974-80
1	128476	224839	109119	374590	222972	232767	427862	153583	289980	130872*****	245803	
2	104069	91958	156779	83710	252422	157001	157872	300279	106080	179279	81795	143402
3	22994	35833	32477	45677	25615	67492	51352	45519	79835	35828	53460	40206
4	32207	9258	13084	10935	16818	8310	19984	15434	13010	19504	6677	15799
5	9458	13091	3811	4821	5098	6218	3589	7705	5833	4921	7543	6584
6	2255	3822	4935	1699	1990	1609	2360	1577	2939	2155	1622	2667
7	807	1023	1582	1865	787	772	727	1006	615	928	825	1080
8	797	289	500	608	701	313	327	253	357	218	381	505
9	547	319	104	321	224	249	155	126	86	101	73	274
10	155	165	101	41	66	67	91	65	47	16	35	98
11+	370	109	60	167	78	36	45	44	45	18	12	124
TOTAL NO	302134	389708	322551	524433	526772	474834	604364	525589	498808	373640		
SPS NO	44810	37814	35071	34064	39400	39246	43165	46284	43719	38274		
TOT.BIOM	464801	420147	422712	412945	458331	470641	632533	608323	554770	458421		
SPS BIOM	200406	171138	149242	131141	129636	133301	144859	152136	149944	133317		

Table 5.6.

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

NORTH SEA COD

FIRST YEAR: 1984

LAST YEAR: 1936

YEAR	RECRUITMENT
	thousands

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1964	214000.
1935	214000.
1986	214000.

AGE	STOCK SIZE thousands	F AT AGE 1)	M	MATURITY OGIVE	WEIGHT IN	WEIGHT IN
					2) THE CATCH	2) THE STOCK
1	214000.0	0.220	0.20	0.010	0.536	0.536
2	31795.7	1.120	0.20	0.050	0.939	0.939
3	53460.0	1.220	0.20	0.230	1.975	1.975
4	6077.0	0.820	0.20	0.620	4.341	4.341
5	7243.0	0.600	0.20	0.800	6.564	6.564
6	1322.0	0.310	0.20	1.000	8.823	8.823
7	325.0	0.500	0.20	1.000	10.153	10.153
8	381.0	0.390	0.20	1.000	11.692	11.692
9	73.0	1.030	0.20	1.000	12.903	12.903
10	35.0	0.270	0.20	1.000	13.305	13.305
11+	12.0	0.070	0.20	1.000	14.127	14.127

1) Average F 1978-83 rescaled to  $\bar{F}_{av} = \bar{F}_{83}$

2) Mean values 1978-83.

Table 5.7 Management options: COD in Sub-area IV.

ASSUMPTION 1:  $F_{84} = F_{83}$ 

1984				Management option for 1985	1985			1986		
Stock biomass	Spawn. stock biom.	$\bar{F}_{(3-8)}$ H.C.	Total landings		Stock biom.	Spawn. stock biom.	$\bar{F}_{(3-8)}$ H.C.	Total landings	Stock biomass	Spawn. stock biom.
415	119	0.91	196	$F_{0.1}$	407	100	0.13	38	650	191
				$F_{max}$			0.20	57	618	177
				$F_{85} = 0$			0	0	714	219
				$F_{85}=0.6 F_{84}$			0.55	132	495	124
				$F_{85}=0.8 F_{84}$			0.73	162	446	104
				$F_{85}=F_{84}$			0.91	188	406	86
				$F_{85}=1.2F_{84}$			1.10	209	373	72
				$F_{85}=1.4 F_{84}$			1.28	228	345	61

Weights in '000 tonnes.

Stock biomass = fish of age 1 and older.

Spawning stock biomass based on ogive.

Exploitation pattern 1984-85 based on 1978-83 average.

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

Table 5.8 Management options: COD in Sub-area IV.

ASSUMPTION 2: 1984 TAC taken.

1984				Management option for 1985	1985			1986		
Stock biomass	Spawn. stock biom.	$\bar{F}_{(3-8)}$ H.C.	Total landings		Stock biom.	Spawn. stock biom.	$\bar{F}_{(3-8)}$ H.C.	Total landings	Stock biomass	Spawn. stock biom.
415	119	1.07	215	$F_{0.1}$	376	85	0.13	34	614	166
				$F_{max}$			0.20	52	584	154
				$F_{85} = 0$			0	0	671	190
				$F_{85} = 0.6F_{84}$			0.64	134	449	99
				$F_{85} = 0.8F_{84}$			0.86	164	401	80
				$F_{85} = F_{84}$			1.07	188	364	65
				$F_{85} = 1.2F_{84}$			1.28	207	334	53
				$F_{85} = 1.4F_{84}$			1.50	224	309	43

Weights in '000 tonnes.

Stock biomass = fish at age 1 and older.

Spawning stock biomass based on ogive.

Exploitation pattern 1984-85 based on 1978-83 average.

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

Table 6.1 Nominal catch (in tonnes) of COD in Division VIa, 1974-83. (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	174	49	71	-	-	4	57	30	35	21
Denmark	-	7	-	-	-	-	27 <sup>a)</sup>	-	3	-
Faroe Islands	13	3	39	43	-	40	3	-	2	-
France	3 678	3 546	5 611	3 583	4 499	4 590	5 495	7 601	7 160	8 760
German Dem. Rep.	-	2	-	-	-	-	-	-	-	-
Germany, Fed. Rep.	6	12	1	3	31	40	1	21	8	421
Ireland	883	1 141	1 341	984	1 214	2 237	2 331	2 725	3 527	2 616
Netherlands	5	5	11	5	3	20	1	-	-	-
Norway	14	17	22	29	40	32	48	40	238	274
Poland	175	68	18	-	-	-	-	-	-	-
Spain	137	180	15	20 <sup>a)</sup>	108 <sup>a)</sup>	-	-	-	-	-
Sweden	-	-	-	-	-	-	-	-	1	-
U.K. (England & Wales)	2 467	2 217	2 742	2 434	2 082	2 348	2 302	3 187	2 948	1 068
U.K. (Scotland)	6 084	5 806	7 475	5 513	5 539	6 929	7 603	10 339	7 969	8 815
U.K. (Northern Ireland)	3	3	13	5	5	2	2	7	33	30
USSR	13	107	46	-	-	-	-	-	-	-
Total VIa	13 652	13 163	17 405	12 619	13 521	16 242	17 870	23 950	21 924	22 005

x)  
Provisional

a)  
Includes IVb

Table 6.2. VIRTUAL POPULATION ANALYSIS

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

CATCH IN NUMBERS		UNIT: THOUSANDS									
		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	727	1260	1988	1179	680	846	1206	447	1829	2411	
2	1841	2043	4753	1183	1792	1500	3250	6947	1664	4612	
3	752	1217	1362	1497	1035	2150	1997	3232	3202	1150	
4	874	506	585	590	728	666	794	917	1186	1450	
5	235	269	255	245	289	340	190	189	306	473	
6	53	60	185	81	96	140	78	31	112	150	
7	52	11	58	49	49	34	28	18	20	37	
8+	22	19	18	13	30	38	9	6	12	19	
TOTAL	4556	5385	9214	4837	4699	5714	7552	11787	8391	10302	

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									
		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.606	0.606	0.606	0.606	0.606	0.721	0.627	0.544	0.708	0.579	
2	1.372	1.372	1.372	1.372	1.372	1.412	1.385	1.163	1.508	1.254	
3	2.988	2.988	2.988	2.988	2.988	2.858	3.008	2.830	2.777	2.994	
4	5.052	5.052	5.052	5.052	5.052	5.052	4.902	5.289	4.930	4.808	
5	6.573	6.573	6.573	6.573	6.573	6.573	6.689	7.433	7.481	6.177	
6	7.966	7.966	7.966	7.966	7.966	7.824	8.319	9.307	7.277	6.300	
7	8.807	8.807	8.807	8.807	8.807	9.150	9.262	10.235	9.655	8.115	
8+	9.664	9.664	9.664	9.664	9.664	10.039	9.595	11.055	10.502	10.993	

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 = 0.20				
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1978-83
1	0.10	0.12	0.35	0.14	0.08	0.07	0.07	0.08	0.08	0.18	0.09
2	0.46	0.46	0.81	0.36	0.33	0.26	0.38	0.64	0.47	0.29	0.40
3	0.45	0.63	0.64	0.66	0.61	0.85	0.66	0.82	0.70	0.70	0.72
4	0.77	0.63	0.73	0.65	0.81	1.08	0.94	0.74	0.85	0.81	0.87
5	0.70	0.57	0.76	0.79	0.79	1.23	1.14	0.60	0.77	1.06	0.93
6	1.15	0.38	1.04	0.59	0.86	1.23	1.13	0.56	0.90	0.87	0.93
7	0.70	0.80	0.80	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
8+	0.70	0.80	0.80	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
( 3- 4)U	0.61	0.63	0.69	0.66	0.71	0.97	0.80	0.78	0.77	0.76	

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													
		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1974-80
1	8207	12747	7439	9777	9485	14631	20985	6435	26586	16100*****	11896		
2	5478	6064	9300	4305	6942	7152	11215	16093	4805	20117	11010	7208	
3	2274	2835	3133	3378	2463	4074	4507	6265	6966	2492	12324	3238	
4	1774	1188	1233	1348	1428	1091	1420	1905	2249	2844	1013	1354	
5	508	673	520	487	576	520	302	456	742	785	1036	512	
6	84	206	310	198	181	214	125	79	205	281	223	188	
7	113	22	115	90	90	62	51	33	37	68	96	77	
8+	48	38	36	24	55	70	16	11	22	35	34	41	
TOTAL NO	18486	23772	22086	19607	21219	27814	38622	31277	41671	42721			
SPS NO	3460	3434	3670	3715	3410	3922	4059	5475	6501	4910			
TOT.BIOM	33707	37132	40102	34530	36392	44060	53673	53945	62972	62591			
SPS BIOM	16701	16182	17468	16907	16578	17075	17424	21903	26013	22722			

Table 6.6.

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

VIA COD

FIRST YEAR: 1984

LAST YEAR: 1986

YEAR RECRUITMENT  
thousands

1984 12500.  
1985 12500.  
1986 12500.

AGE	STOCK SIZE thousands	F AT AGE 1)	Maturity		WEIGHT IN THE CATCH mtfge	WEIGHT IN THE STOCK mtfge
			0	1		
1	12501.0	0.090	0.20	0.110	0.630	0.630
2	11010.0	0.350	0.20	0.100	1.349	1.349
3	12324.0	0.030	0.20	0.520	2.909	2.909
4	10134.0	0.031	0.20	0.600	4.892	4.892
5	1136.0	0.500	0.20	1.000	6.776	6.776
6	225.0	0.500	0.20	1.000	3.135	3.135
7	90.0	0.550	0.20	1.000	9.202	9.202
8+	34.0	0.350	0.20	1.000	10.523	10.523

1) Average F 1978-83 rescaled to  $\bar{F}_{av} = \bar{F}_{83}$

2) Mean values 1978-83.

Table 6.7 Management options: COD in Division VIa.

ASSUMPTION 1:  $F_{84} = F_{83}$ 

1984				Management option for 1985	1985			1986		
Stock biomass	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 biomass	Spawn. stock biom.
74	33	0.76	29	$F_{0.1}$	70	37	0.17	8	92	58
				$F_{max}$			0.30	14	84	51
				$F_{85} = 0$			0	0	103	67
				$F_{85} = 0.6F_{84}$			0.45	20	76	44
				$F_{85} = 0.8F_{84}$			0.60	25	69	39
				$F_{85} = F_{84}$			0.76	29	63	34
				$F_{85} = 1.2 F_{84}$			0.91	33	58	29
				$F_{85} = 1.4F_{84}$			1.06	36	53	26

Weights in '000 tonnes.

Stock biomass = fish at age 1 and older.

Spawning stock biomass based on ogive.

Exploitation pattern 1984-85 based on 1978-83 average.

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

Table 6.8 Management options: COD in Division VIIa.

ASSUMPTION 2: 1984 TAC taken.

1984				Management option for 1985	1985			1986	
Stock biomass	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 biomass
74	33	0.60	24.5	$F_{0.1}$	77	43	0.17	9	98
				$F_{max}$			0.40	16	90
				$F_{85} = 0$			0	0	111
				$F_{85} = 0.6 F_{84}$			0.35	18	86
				$F_{85} = 0.8 F_{84}$			0.48	23	80
				$F_{85} = F_{84}$			0.60	27	74
				$F_{85} = 1.2 F_{84}$			0.72	31	68
				$F_{85} = 1.4 F_{84}$			0.84	35	64
									34

Weights in '000 tonnes.

Stock biomass = fish at age 1 and older.

Spawning stock biomass based on ogive.

Exploitation pattern 1984-85 based on 1978-83 average.

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

Table 7.1. Nominal catch (in tonnes) of COD in Division VIb, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	-	-	1	-	-	-	-	-	-	-
Denmark	-	-	-	-	-	-	a)	-	-	-
Faroe Islands	5	3	22	40	10	92	75	2	77	87
France	1 128	4	4	3	1	2	1	4	27	27
Germany, Fed. Rep.	-	-	-	-	-	111	136	443	+	a)
Ireland	-	-	-	-	3	-	-	-	-	-
Norway	3	-	8	3	69	138	80	134	51	462
Spain	-	-	-	a)	a)	-	33	-	-	-
U.K. (England & Wales)	-	28	77	89	285	129	1	67	3	163
U.K. (Scotland)	39	98	61	33	384	198	370	143	157	35
USSR	--	110	1 398	-	-	-	-	-	-	-
Total	175	243	1 571	168	752	670	696	793	315	774

<sup>x)</sup> Provisional

<sup>a)</sup> Included in Division VIa

Table 8.1. Nominal catch (in tonnes) of COD in Divisions VIId and VIIe, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	67	59	65	53	435	699	163	363	293	389
Denmark	-	2 718	1 506	1 120	2 160	2 052	660 <sup>a)</sup>	-	-	-
France	3 099	2 143	1 646	5 185	8 044	4 848	4 001	4 486	3 349	3 011
Netherlands	4	+	2	1	+	-	-	4	1	-
Poland	6	-	-	-	-	-	-	-	-	-
U.K. (England & Wales)	260	159	142	581	654	485	365	428	568	641
U.K. (Scotland)	-	-	-	-	-	+	-	-	-	-
USSR	-	3	4	-	-	-	-	-	-	-
Total VIId,e	3 436	5 082	3 365	6 940	11 293	8 084	5 189	5 281	4 211	4 041

<sup>x)</sup> Provisional

<sup>a)</sup> Includes Divisions VIIb, c

Table 8.2. Nominal catch (in tonnes) of COD in Divisions VIIb, c and VIIg-k, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	167	116	159	85	52	51	110	198	97	112
Denmark	-	-	-	-	-	18	...	-	-	-
France	2 302	2 877	3 196	1 972	2 192	2 918	4 475	6 803	5 041	4 381
Germany, Fed. Rep.	-	-	-	-	3 <sup>a)</sup>	-	7	-	-	-
Ireland	283	474	506	315	323	552	1 028	1 542	1 906	945 <sup>c)</sup>
Netherlands	9	54	46	291	279	-	5	-	+	-
Norway	-	1	-	+	-	-	-	-	-	-
Poland	39	19	40	6	-	2	-	-	-	-
Spain	232	588	1 140	51	11	-	17	37	-	-
U.K. (England & Wales)	26	73	44	33	28	33	83	288	419	85
U.K. (Scotland)	-	-	-	-	2	1	12	+	-	-
USSR	72	134	203	-	-	-	-	-	-	-
Total VIIb, c, g-k	3 130	4 336	5 234	2 753	2 890	3 575	5 737	8 868	7 463	5 523

<sup>x)</sup>Provisional

<sup>a)</sup>Catch in Division VIIg only

<sup>b)</sup>Included in Division VIIe

<sup>c)</sup>Catch in Divisions VIIb,c only.

Table 9.1. Nominal catch (in tonnes) of HADDOCK in Sub-area IV, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	1 137	2 209	2 166	2 293	1 295	732	1 414	1 217	966	947
Denmark	44 342	32 930	46 899	20 069	8 093	8 248	12 928	13 198	32 159	32 770
Faroe Islands	435	267	183	385	12	7	27	46	6	43
France	4 020	4 646	5 500	6 914	5 122	7 208	7 407	11 966	15 988	11 557
German Dem. Rep.	8	44	20	8	37	12	36	-	-	-
Germany, Fed. Rep.	3 478	2 396	3 433	3 744	2 589	2 549	2 354	3 387	4 510	3 503
Ireland	-	-	31	53	101	-	-	-	-	-
Netherlands	3 035	1 901	1 728	1 598	857	955	1 557	2 279	1 021	1 163
Norway <sup>a)</sup>	324	331	367	374	609	968	1 191	2 283	2 853	2 525
Poland	3 001	1 485	1 155	485	62	106	59	31	317	150
Spain	210	-	-	-	-	-	-	-	-	-
Sweden <sup>b)</sup>	3 098	2 083	2 455	113	d)	907	1 165	1 301	1 874	1 020
U.K. (England & Wales)	10 798	11 499	17 238	17 167	12 200	10 774	12 195	14 570	16 403	15 097
U.K. (Scotland)	71 679	64 686	80 576	89 465	58 406	54 119	64 058	82 798	107 773	99 472
USSR	42 234	49 686	42 852	8 010	54	18	-	-	-	-
Total IV	187 799	174 163	204 603	150 678	89 437	86 603	104 391	133 076	183 870	168 247
Total IVa	122 977	110 848	138 591	116 577	57 886	51 741	64 886	82 996	109 306	97 727
Total IVb	63 695	62 761	65 594	34 030	31 457	34 361	39 072	49 197	74 288	70 386
Total IVc	1 127	554	418	71	94	501	433	833	276	134
WG total catch <sup>c)</sup>	307 689	401 053	334 888	219 953	170 804	140 635	218 924	207 914	227 771	238 742

x) Provisional

a) Figures from Norway do not include haddock caught in Rec. 2 fisheries. For 1974 Rec. 2 fisheries were officially reported but have been deducted in the figures given here to make a consistent data series.

b) 1974 includes Division IIIa.

c) Includes discards.

d) Included in Division IIIa.

Table 9.2. VIRTUAL POPULATION ANALYSIS

NORTH SEA HADDOCK (FISHING AREA IV)

CATCH IN NUMBERS UNIT: THOUSANDS

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	601454	44913	167010	115080	289807	960092	388200	688754	355133	685230
1	1213968	2097418	167563	250416	458727	348597	726409	141833	297376	229031
2	174438	632852	1045329	103734	141915	198797	321523	408901	82207	238103
3	326841	57628	206721	376518	28439	39750	70544	140766	287181	79279
4	55159	106044	9624	39348	109212	7131	10117	14892	41185	128610
5	1834	15315	30523	3949	8583	26908	1826	1835	3160	19136
6	1320	953	4786	6000	1186	2136	8228	342	659	2215
7	19583	599	187	1136	1911	249	601	2631	187	465
8	237	2625	67	115	386	451	123	127	945	57
9	22	255	662	24	112	136	182	67	21	337
10	32	61	52	163	24	52	71	22	78	74
11+	8	18	3	3	64	23	38	42	23	8
TOTAL	2383896	2958681	1632547	896486	1040366	1584322	1527862	1400212	1068155	1382545

Table 9.3. VIRTUAL POPULATION ANALYSIS

NORTH SEA HADDOCK (FISHING AREA IV)

MEAN WEIGHT AT AGE OF THE STOCK UNIT: KILOGRAM

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.024	0.020	0.013	0.019	0.010	0.009	0.012	0.009	0.012	0.021
1	0.128	0.101	0.125	0.108	0.143	0.094	0.097	0.072	0.095	0.101
2	0.226	0.241	0.224	0.240	0.250	0.290	0.282	0.259	0.289	0.279
3	0.343	0.356	0.400	0.346	0.415	0.441	0.466	0.477	0.460	0.431
4	0.548	0.450	0.509	0.599	0.444	0.635	0.728	0.755	0.799	0.607
5	0.890	0.680	0.580	0.609	0.695	0.658	0.978	1.109	1.126	0.855
6	0.895	1.245	0.893	0.753	0.709	0.921	0.949	1.364	1.353	1.127
7	0.953	1.124	1.876	1.096	0.924	1.169	1.385	1.205	1.513	1.005
8	1.512	1.093	1.746	1.708	1.301	1.164	1.589	1.564	1.536	1.609
9	2.301	1.724	1.235	1.973	1.814	1.450	1.724	1.733	1.984	1.215
10	2.507	2.219	2.330	1.604	1.913	2.636	1.710	1.532	2.885	1.483
11+	4.148	2.856	2.527	3.190	1.800	1.628	2.790	1.887	1.640	2.067

Table 9.4. VIRTUAL POPULATION ANALYSIS

NORTH SEA HADDOCK (FISHING AREA IV)

FISHING MORTALITY COEFFICIENT      UNIT: Year-1      NATURAL MORTALITY COEFFICIENT = 0.20

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	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1978-83
0	0.11	0.10	0.24	0.11	0.20	0.33	0.59	0.56	0.36	0.19	0.37
1	0.71	0.69	0.64	0.68	0.78	0.39	0.40	0.44	0.50	0.41	0.50
2	1.03	1.07	0.91	1.12	1.11	0.97	0.75	0.50	0.50	0.99	0.80
3	0.99	1.30	1.40	1.00	1.17	1.18	1.22	0.92	0.82	1.38	1.11
4	1.03	1.12	0.79	1.20	1.11	1.14	1.20	0.97	0.77	1.18	1.06
5	0.62	1.00	1.29	0.93	1.12	0.95	1.10	0.75	0.56	1.08	0.92
6	0.87	0.78	1.07	1.01	0.84	1.00	0.90	0.62	0.44	1.01	0.84
7	1.17	1.41	0.34	0.82	1.15	0.41	0.90	0.85	0.85	1.46	0.94
8	0.43	1.13	0.56	0.36	0.75	0.97	0.37	0.47	0.89	0.70	0.69
9	0.16	1.22	1.11	0.40	0.72	0.66	1.60	0.35	0.13	0.98	0.74
10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
11+	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
( 2- 7)U	0.95	1.11	0.97	1.04	1.08	0.94	1.01	0.77	0.69	1.18	

Table 9.5. 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

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1974-81
0	6288858	521910	859910	1250160	1772157	3708528	956818	1765212	1297322	4419000	*****	2141192
1	2602835	4606577	386801	553710	924035	1189964	2173787	436070	826747	743249	3000903	1609311
2	293833	1047171	1898214	166917	229699	347946	661367	1178482	229831	412096	403038	721704
3	562954	85619	295510	623853	44644	62149	106114	254614	557623	114516	125745	254682
4	89750	170415	19120	59369	176482	11344	15655	26040	83195	200670	23706	71022
5	4337	26258	45461	7073	13779	47600	2965	3854	8078	31381	50265	18910
6	2480	1911	7887	10216	2277	3668	15040	807	1517	3786	8708	5536
7	10576	855	715	2209	5053	806	1105	4990	555	653	1131	5786
8	739	4192	171	417	796	789	438	370	1742	124	124	989
9	161	392	1104	80	233	307	245	248	189	585	51	347
10	59	112	95	299	44	95	130	40	143	136	179	109
11+	15	33	5	5	117	42	70	77	42	15	50	46
TOTAL NO	9862597	6465444	3514993	2680368	3167932	5373241	3935732	3620804	3008764	5926139		
SPS NO	621934	622651	890708	573483	287583	228167	343599	579098	561767	430241		
TOT.BIOM	816350	862033	649314	390933	320013	318070	493022	493274	498815	486857		
SPS BIOM	227846	199672	264270	213185	1163112	94896	129103	209565	276654	210074		

Table 9.6. North Sea HADDOCK.  
Input for catch prediction.

Age	Stock $\bar{W}$ (kg)	H.C. landings 1983			Discards 1983			Ind. landings 1983			Total F 1983	Reference Period: 1978 - 1983					
		Nx10 <sup>-3</sup>	$\bar{W}$ (kg)	F	Nx10 <sup>-3</sup>	$\bar{W}$ (kg)	F	Nx10 <sup>-3</sup>	$\bar{W}$ (kg)	F		H.C. catch	$\bar{W}$	Prop. ret.	Discards	$\bar{W}$	Ind. catch
0	.012	-	-	-	149 252	.067	.041	535 978	.009	.146	.187	.010	-	0.000	.057	.361	.010
1	.100	6 063	.278	.011	84 356	.187	.151	138 612	.041	.248	.410	.298	.298	0.051	.154	.248	.038
2	.275	96 605	.350	.402	126 681	.237	.527	14 816	.168	.062	.990	.885	.362	0.456	.216	.069	.176
3	.448	58 250	.455	1.014	15 794	.347	.275	5 235	.424	.091	1.380	1.267	.469	0.857	.269	.063	.323
4	.661	119 277	.615	1.094	7 035	.476	.065	2 298	.575	.021	1.180	1.227	.678	0.962	.366	.045	.553
5	.904	18 426	.861	1.040	708	.711	.040	2	.957	.000	1.08	1.085	.919	0.992	.511	.024	.696
6	1.067	2 111	1.142	.963	104	.792	.047				1.01	1.002	1.077	0.977	.538	.003	.927
7	1.167	465	1.005	1.46							1.46	1.127	1.167	1.000		.001	.644
8	1.461	57	1.609	.70							.70	.854	1.461	1.000			
9	1.653	357	1.215	.98							.98	.892	1.653	1.000			
10	2.027	74	1.483	.90							.90	1.084	2.027	1.000			
11+	1.969	8	3.476	.90							.90	1.084	2.204	1.000			
Weight tonnes		157 531			65 179			16 032									

$$\begin{aligned}1984 &= 2.543 \times 10^6 \\ \text{Recruitment } R_0 & \\ 1985 &= 2.543 \times 10^6 \\ 1986 &= 2.543 \times 10^6\end{aligned}$$

Table 9.7 Management options: HADDOCK in the North Sea. ASSUMPTION 1:  $\bar{F}_{84} = \bar{F}_{83}$

1984				1985								1986	
Stock Biom.	Spawning stock 1) biomass	$\bar{F}$ (2-6) H.C.	Total landings	Management Option for 1985	Stock Biom.	Spawning stock 1) biomass	$\bar{F}$ (2-6) H.C.	Total landings	H.C. landings	Indust. landings	Discards	Stock Biom.	Spawning stock biom. 1)
571	240	1.093	155 <sup>2)</sup>	$\bar{F}_{85} = 0 \bar{F}_{84}$	664	490	0	36	0	36	0	1 021	845
				$\bar{F}_{85} = 0.2\bar{F}_{84}$			.219	86	52	34	35	904	729
				$\bar{F}_{85} = 0.5\bar{F}_{84}$			.547	147	115	32	79	763	588
				$\bar{F}_{85} = 1.0\bar{F}_{84}$			1.093	217	188	29	137	594	420
				$\bar{F}_{85} = 1.5\bar{F}_{84}$			1.640	260	234	26	179	481	308
				$\bar{F}_{85} = 2.0\bar{F}_{84}$			2.186	289	265	24	211	404	232

Weights in '000 tonnes.

Stock biomass = fish of age 0 and older.

Spawning stock biomass = fish at age 2 and older.

Exploitation pattern 1984-85 based on 1978-83 average.

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

1) Using knife-edge age at first maturity.

2) Includes industrial landings = 32.

Table 9.8 Management options: HADDOCK in the North Sea. ASSUMPTION 2: Landings in 1984=TAC=170 000 t.

1984				1985								1986	
Stock Biom.	Spawning stock 1) biomass	$\bar{F}$ (2-6) H.C.	Total landings	Management Option for 1985	Stock Biom.	Spawning stock 1) biomass	$\bar{F}$ (2-6) H.C.	Total landings	H.C. landings	Indust. landings	Discards	Stock Biom.	Spawning stock biom. 1)
571	240	1.365	170 <sup>2)</sup>	$\bar{F}_{85} = 0 \bar{F}_{84}$	614	440	0	34	0	34	0	962	787
				$\bar{F}_{85} = 0.2\bar{F}_{84}$			.273	88	56	32	41	833	657
				$\bar{F}_{85} = 0.5\bar{F}_{84}$			.683	150	120	30	90	683	508
				$\bar{F}_{85} = 1.0\bar{F}_{84}$			1.365	214	188	26	151	515	342
				$\bar{F}_{85} = 1.5\bar{F}_{84}$			2.048	252	228	24	194	412	239
				$\bar{F}_{85} = 2.0\bar{F}_{84}$			2.730	274	252	22	224	345	173

Weights in '000 tonnes.

Stock biomass = fish of age 0 and older.

Spawning stock biomass = fish of age 2 and older.

Exploitation pattern 1984-85 based on 1978-83 average.

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

1) Using knife-edge at first maturity.

2) Includes industrial landings = 31

Table 10.1. Nominal catch (in tonnes) of HADDOCK in Division VIa, 1974-83.  
 (Data for 1974-82 as officially reported to ICES).

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	98	23	45	-	-	2	3	1	2	1
Denmark	-	-	13	-	-	37	-	-	+	-
Faroe Islands	1	-	-	-	-	2	-	-	-	-
France	3 979	2 328	3 026	3 401	4 255	4 786	2 808	3 403	3 760	4 577
German Dem. Rep.	-	9	-	-	-	-	-	-	-	-
Germany, Fed. Rep.	18	3	30	+	20	2	3	7	71	78 <sup>a)</sup>
Ireland	1 715	599	1 115	616	441	877	726	1 891	3 983	2 976
Netherlands	63	19	30	28	13	2	2	3	391	-
Norway	-	-	3	7	13	9	16	29	37	72
Poland	97	20	-	-	-	-	-	-	-	-
Spain	540	-	-	-	-	-	-	-	-	-
U.K. (England & Wales)	1 512	1 214	1 971	3 827	2 805	1 654	1 279	1 052	2 035	1 305
U.K. (Scotland)	9 583	8 973	11 992	11 422	9 629	7 459	8 198	12 051	19 249	20 430
U.K. (Northern Ireland)	-	-	-	-	-	-	+	-	1	-
USSR	364	495	533	-	-	-	-	-	-	-
Total VIa	17 970	13 683	18 758	19 301	17 176	14 830	13 935	18 437	29 529	29 439
WG Total incl. discards	33 342	46 635	34 071	23 657	19 510	27 147	17 470	33 278	39 439	36 287

<sup>x)</sup>Provisional

<sup>a)</sup>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

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	63680	6849	4226	4549	56	5362	13	765	133	2085
1	6831	179360	24212	13107	15948	65945	22728	251	15249	14477
2	11565	34966	72353	3467	2096	16262	21918	83792	4944	20338
3	10770	3341	15228	35946	969	1753	5631	20686	72646	6117
4	6323	3352	1587	5704	24359	441	922	1768	8060	37582
5	43	1884	1490	681	2959	9282	142	194	887	3384
6	449	96	867	496	352	784	5081	59	106	599
7	9496	98	21	307	247	107	228	822	268	41
8	2086	5457	280	28	558	157	22	39	264	194
9	34	73	831	11	7	26	5	14	30	194
10	32	8	4	259	18	3	20	2	12	43
11+	5	0	5	5	214	41	0	3	1	17
TOTAL	173363	233484	121064	64560	47543	100143	54716	108373	102620	85071

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

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.040	0.040	0.040	0.040	0.006	0.032	0.077	0.082	0.038	0.050
1	0.159	0.159	0.160	0.161	0.133	0.183	0.134	0.253	0.157	0.172
2	0.246	0.260	0.256	0.274	0.278	0.324	0.519	0.245	0.273	0.276
3	0.368	0.428	0.459	0.406	0.389	0.457	0.571	0.468	0.376	0.435
4	0.526	0.581	0.593	0.685	0.516	0.731	0.719	0.886	0.746	0.553
5	0.779	0.832	0.830	0.800	0.827	0.771	0.998	0.975	1.126	0.920
6	0.679	1.023	1.095	1.126	1.045	1.040	0.985	1.375	1.539	1.313
7	0.775	1.000	1.548	1.337	1.152	1.490	1.143	1.293	1.548	1.652
8	0.905	1.007	1.487	1.115	1.400	1.943	1.570	1.343	1.514	1.579
9	1.323	1.186	1.160	1.393	2.125	1.738	1.628	1.367	1.738	1.461
10	1.279	2.516	1.827	1.340	1.372	1.569	1.874	1.215	2.068	1.522
11+	0.000	0.000	0.000	1.593	1.203	1.781	2.959	1.783	1.543	1.917

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 = 0.20					
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1973-83	
0	0.12	0.16	0.15	0.07	0.00	0.01	0.00	0.01	0.00	0.0075	0.01	
1	0.59	0.59	1.31	0.98	0.37	0.56	0.00	0.01	0.23	0.54	0.30	
2	0.33	0.69	0.51	0.66	0.40	0.80	0.37	0.36	0.27	0.53	0.45	
3	0.84	0.61	0.74	0.52	0.38	0.69	0.72	0.71	0.60	0.63	0.62	
4	0.81	0.70	0.66	0.71	0.42	0.50	1.00	0.52	0.68	0.74	0.68	
5	0.31	0.60	0.79	0.67	1.03	0.90	0.15	0.54	0.55	0.70	0.65	
6	0.54	0.71	0.65	0.67	0.92	0.88	0.89	0.06	0.77	0.91	0.74	
7	0.92	0.21	0.33	0.47	0.67	0.22	0.70	0.63	0.64	0.80	0.74	
8	3.06	1.10	1.69	0.98	1.62	2.57	0.38	0.24	0.46	1.52	1.13	
9	1.01	2.12	0.89	0.25	0.72	0.49	0.80	0.45	0.29	0.57	0.57	
10	0.70	0.70	0.70	0.80	0.80	0.80	0.90	0.90	0.90	0.90	0.87	
11+	0.70	0.70	0.70	0.80	0.80	0.80	0.90	0.90	0.90	0.90	0.87	
( 2- 6)0	0.67	0.60	0.67	0.64	0.71	0.71	0.63	0.45	0.58	0.70		

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

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1974-80
0	604567	51219	52461	74541	204568	492569	34492	101976	40488	307839	*****	213488
1	168949	437562	55764	22769	56924	167435	393439	24228	82802	37941	250154	183978
2	22494	76748	197801	7868	6991	52266	76105	305705	22884	54069	18102	60309
3	20620	3036	31605	97154	3543	3842	11934	44235	175045	14290	26056	25219
4	12431	7280	3591	12287	47348	1807	1580	4744	17743	78342	6231	12342
5	342	4541	2972	1522	4967	17055	1153	474	2301	7332	30602	4647
6	1173	205	2033	1104	638	1456	5701	799	215	1091	2981	1758
7	17179	558	82	289	461	209	494	1924	619	81	359	2839
8	2311	5614	369	49	453	158	70	201	640	267	30	1290
9	53	89	1529	56	15	73	10	42	129	434	48	261
10	62	17	4	512	36	6	57	4	22	79	182	98
11+	11	0	11	10	423	81	11	5	2	31	37	78
TOTAL NO	850114	591876	308227	216761	326105	717038	531970	488338	349196	501795		
SPS NO	66963	70093	154947	118068	61068	43150	65471	226681	209966	132765		
TOT.BIOM	87361	109597	81452	61150	55279	75544	96445	119697	105496	95925		
SPS BIOM	33926	29395	52657	53570	53371	24643	29091	71938	88043	67591		

Table 10.6. West of Scotland HADDOCK.  
Input data for catch predictions.

Age	Stock $\bar{w}$ (kg) 1978-83	H.C. landings 1983			Discards 1983			Ind. landings 1983			Total F 1983	Reference Period: 1978 - 1983									
		Nx10 <sup>-3</sup>	$\bar{w}$ (kg)	F	Nx10 <sup>-3</sup>	$\bar{w}$ (kg)	F	Nx10 <sup>-3</sup>	$\bar{w}$ (kg)	F		H.C. catch	Discards	Ind. catch	F	$\bar{w}$	Prop. ret.	$\bar{w}$	F	$\bar{w}$	
0	0.058	0	-	-	2 085	.050	.0075				.0075	0.006	0.443	.003	0.056						
1	0.172	518	.362	.019	13 959	.165	.521				.54	0.329	0.285	.176	0.142						
2	0.286	5 027	.395	.131	15 311	.237	.399				.53	0.506	0.372	.405	0.228						
3	0.449	4 662	.482	.480	1 455	.263	.150				.63	0.695	0.485	.813	0.280						
4	0.692	36 119	.563	.711	1 463	.298	.029				.74	0.758	0.697	.983	0.304						
5	0.936	3 372	.921	.698	12	.536	.002				.70	0.728	0.958	.997	0.368						
6	1.216	599	1.313	.91							.91	0.823	1.219	.997	0.308						
7	1.380	41	1.652	.80							.80	0.829	1.380	1.000							
8	1.558	194	1.579	1.52							1.52	1.263	1.558	1.000							
9	1.676	194	1.461	.67							.67	0.637	1.676	1.000							
10	1.603	43	1.522	.9							.9	0.968	1.603	1.000							
11+	1.865	17	1.917	.9							.9	0.968	1.865	1.000							
Weight tonnes		29 397			6 890																

$$1984 = 165 \times 10^6$$

Recruitment  $R_0$

$$1985 = 165 \times 10^6$$

$$1986 = 165 \times 10^6$$

Table 10.7 Management options: HADDOCK in Division VIIa.

1984				1985							1986		
Stock Biom.	Spawning stock biomass	$\bar{F}$ (2-6) H.C.	Total landings	Management Option for 1985	Stock Biom.	Spawning stock biomass	$\bar{F}$ (2-6) H.C.	Total landings	H.C. landings	Indust. landings	Discards	Stock Biom.	Spawning stock biom.
107	54	0.702	27.0	$\bar{F}_{85} = 0 \bar{F}_{84}$	105	72	0	0	0	0	0	150	117
				$\bar{F}_{85} = .2 \bar{F}_{84}$			.140	6.3	6.3	0	2.7	138	105
				$\bar{F}_{85} = .5 \bar{F}_{84}$			.351	14.2	14.2	0	6.4	123	90
				$\bar{F}_{85} = 1.0 \bar{F}_{84}$			.702	24.6	24.6	0	11.6	102	70
				$\bar{F}_{85} = 1.5 \bar{F}_{84}$			1.053	32.3	32.2	0	15.8	87	54
				$\bar{F}_{85} = 2.0 \bar{F}_{84}$			1.404	37.8	37.8	0	19.2	75	43

Weights in '000 tonnes.

Stock biomass = fish of age 0 and older.

Spawning stock biomass = fish of age 2 and older.

Exploitation pattern 1984-85 based on 1978-83 average.

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

Table 11.1. Nominal catch (in tonnes) of HADDOCK in Division VIb, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	-	-	33	-	-	-	-	-	-	-
Faroe Islands	2	1	8	3	11	20	5	1	21	19
France	353	21	4	4	3	4	1	10	32	14 a)
Germany, Fed. Rep.	-	-	-	-	-	-	17	-	4	...
Ireland	-	-	-	-	61	-	-	-	-	-
Norway	-	-	-	+	4	16	2	10	3	20
Poland	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	6	88	-	-
U.K. (England & Wales)	-	5	2 111	2 694	2 365	1 654	6 261	9 005	3 736	113
U.K. (Scotland)	22	71	640	297	2 060	548	1 051	27	5	136
USSR	48 911	49 830	40 474	-	-	-	-	-	-	-
Total VIb	49 288	49 928	43 243	2 998	4 504	2 242	7 343	9 141	3 801	302

x) Provisional

a) Included in Division VIa

Table 12.1. Nominal catch (in tonnes) of HADDOCK in Divisions VIIId and VIIe, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	+	+	+	1	-	1	+	2	1	1
Denmark	-	-	-	2	22	21	15	-	-	-
France	487	868	405	438	356	333	298	421	344	61
Germany, Fed. Rep.	-	+	-	-	-	-	-	-	-	-
Ireland	-	-	-	4	-	-	+	-	-	-
Netherlands	-	1	-	-	-	-	-	-	94	-
Poland	-	-	-	-	-	-	-	-	-	-
U.K. (England & Wales)	113	99	45	29	22	51	59	119	60	41
USSR	33	3	-	-	-	-	-	-	-	-
Total VIIId and VIIe	633	971	450	474	400	406	372	542	499	103

<sup>x)</sup>Provisional

Table 12.2. Nominal catch (in tonnes) of HADDOCK in Divisions VIIb,c and VIIg-k, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	35	33	19	13	5	2	2	3	3	-
Denmark	-	-	-	-	-	1	-	-	-	-
Faroe Islands	-	-	-	-	-	-	-	-	-	-
France	6 057	4 583	3 726	2 244	1 479	1 931	2 219	2 571	2 005	1 973
Germany, Fed. Rep.	-	+	3	-	-	-	-	-	-	-
Ireland	829	507	287	153	111	155	274	679	905	405 <sup>a)</sup>
Netherlands	2	4	14	1	-	16	-	-	6	-
Poland	143	-	-	-	-	-	-	-	-	-
Spain	1 100	-	-	294	-	-	5	277	-	-
U.K. (England & Wales)	39	46	24	18	13	19	50	92	182	21
U.K. (Scotland)	-	-	-	-	8	22	56	4	-	-
USSR	456	1 290	183	-	-	-	-	-	-	-
Total VIIb,c and VIIg-k	8 661	6 463	4 256	2 273	1 616	2 146	2 606	3 626	3 130	2 399

<sup>x)</sup>Provisional

<sup>a)</sup>Divisions VIIb,c only

Table 13.1. Nominal catch (in tonnes) of WHITING in Sub-area IV, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	3 156	3 279	2 640	3 275	3 304	3 941	3 153	2 623	2 272	2 860
Denmark	109 654	61 941	116 973	46 479	15 741	41 965	17 916	16 430	27 043	22 132
Faroe Islands	1 126	764	1 262	472	42	581	21	12	57	35
France	19 825	20 079	19 557	17 592	22 525	27 590	23 626	24 744	23 790	16 978
German Dem. Rep.	-	3	18	-	22	5	-	-	-	-
Germany, Fed. Rep.	454	446	302	461	348	1 280	1 267	601	223	422
Ireland	-	-	4	9	38	-	-	-	-	-
Netherlands	12 057	14 078	12 274	9 406	11 030	13 417	14 389	14 600	12 218	10 925
Norway <sup>a)</sup>	58	55	71	33	64	49	27	27	16	27
Poland	1 002	888	509	445	8	3	1	-	-	1
Spain	110	65	18	-	-	-	-	-	-	-
Sweden <sup>b)</sup>	2 440	255	153	341	...	31	16	9	11	28
U.K. (England & Wales)	5 519	5 246	5 112	6 185	7 542	7 581	6 778	5 964	4 743	4 326
U.K. (Scotland)	25 274	27 969	26 167	33 017	42 779	44 841	42 218	31 399	29 640	40 936
USSR	2 978	5 098	5 612	2 413	-	-	-	-	-	-
Total Sub-area IV	183 653	140 166	190 672	120 128	103 443	141 284	109 412	96 409	100 003	98 670
Total Division IVa	76 761	75 444	100 001	61 499	42 837	48 554	42 529	33 799	35 664	44 929
Total Division IVb	87 842	41 930	69 908	42 911	40 943	68 775	41 156	40 145	45 311	46 293
Total Division IVc	19 050	22 792	20 763	15 718	19 663	23 955	25 727	22 465	19 028	7 448
WG total catch <sup>c)</sup>	351 266	290 589	345 951	294 635	178 773	234 947	225 221	192 173	143 027	149 603

<sup>x)</sup>Provisional figures

<sup>a)</sup>Figures from Norway do not include whiting caught in Rec.2 fisheries. For 1974 Rec.2 fisheries were officially reported, but have been deducted from the figures given here to make a consistent time series.

<sup>b)</sup>1974 includes Division IIIa, 1978 included in Division IIIa.

<sup>c)</sup>Includes discards.

Table 13.2. VIRTUAL POPULATION ANALYSIS

NORTH SEA WHITING (FISHING AREA IV)

CATCH IN NUMBERS      UNIT: THOUSANDS

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	570112	239142	424539	664985	686282	477685	332373	543293	104919	661477
1	754672	956417	478651	1017151	418282	619543	321704	198342	264612	200540
2	974691	401312	1114173	480400	355745	466684	437785	354910	126627	167394
3	228625	299652	161154	261985	203499	211648	282591	261111	232550	103070
4	32094	54982	76447	51540	69135	86230	33419	93063	82116	127966
5	4876	9173	13317	18292	7618	25082	38185	21701	24209	35390
6	1223	7987	2716	4637	5387	3115	8027	10186	6279	7402
7	5822	116	545	406	1422	1179	755	1761	1712	1367
8	352	1385	22	167	245	194	548	240	365	596
9	52	142	291	4	7	15	45	30	58	78
10	19	2	23	135	7	1	13	36	23	45
11+	0	0	0	3	0	3	5	1	7	0
TOTAL	2572538	1970310	2271878	2479705	1727629	1891379	1505450	1484674	843077	1305325

1  
76  
1

Table 13.3. VIRTUAL POPULATION ANALYSIS

NORTH SEA WHITING (FISHING AREA IV)

MEAN WEIGHT AT AGE OF THE STOCK      UNIT: KILOGRAM

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0.026	0.030	0.019	0.019	0.010	0.009	0.013	0.014	0.031	0.015
1	0.071	0.100	0.107	0.190	0.074	0.098	0.082	0.091	0.073	0.105
2	0.149	0.214	0.194	0.176	0.185	0.165	0.178	0.105	0.172	0.180
3	0.253	0.275	0.294	0.288	0.259	0.259	0.255	0.241	0.252	0.277
4	0.376	0.369	0.359	0.375	0.357	0.313	0.337	0.330	0.314	0.322
5	0.463	0.465	0.440	0.449	0.460	0.434	0.346	0.411	0.386	0.381
6	0.521	0.353	0.512	0.483	0.462	0.492	0.480	0.433	0.493	0.434
7	0.543	0.818	0.440	0.532	0.514	0.541	0.472	0.574	0.527	0.461
8	0.767	0.590	0.457	0.332	0.689	0.617	0.620	0.662	0.711	0.526
9	1.033	0.716	0.692	0.932	0.741	0.669	0.580	0.714	0.728	0.708
10	0.958	1.022	0.917	0.440	1.628	0.738	0.795	1.051	1.142	0.488
11+	0.000	0.000	0.000	0.941	0.000	0.521	0.717	0.695	0.775	0.000

Table 13.4. VIRTUAL POPULATION ANALYSIS

NORTH SEA WHITING (FISHING AREA IV)

FISHING MORTALITY COEFFICIENT		UNIT: Year-1		NATURAL MORTALITY COEFFICIENT = 0.20							
		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 .1978-83
0	0.15	0.11	0.16	0.28	0.27	0.23	0.36	0.49	0.12	0.26	0.29
1	0.06	0.40	0.35	0.73	0.29	0.42	0.24	0.38	0.48	0.35	0.36
2	1.04	0.92	1.18	0.70	0.57	0.62	0.59	0.45	0.44	0.64	0.55
3	1.19	1.17	1.32	1.05	0.74	0.88	0.98	0.87	0.61	0.79	0.81
4	1.08	1.12	1.18	1.08	0.91	0.83	1.13	1.11	0.76	0.82	0.93
5	0.38	1.12	0.95	1.07	0.85	1.06	1.19	1.10	1.04	0.90	1.02
6	1.92	2.25	1.36	1.13	1.18	1.10	1.32	1.36	1.21	1.15	1.22
7	1.20	1.16	1.27	0.76	1.49	0.93	0.91	1.33	0.91	1.00	1.10
8	0.94	1.11	0.71	2.77	1.78	0.87	1.94	0.86	1.23	1.00	1.28
9	2.65	1.43	0.75	0.26	1.52	0.47	0.50	0.52	0.51	1.00	0.76
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
( 2- 6)U	1.12	1.32	1.20	1.00	0.85	0.90	1.04	0.98	0.81	0.86	

Table 13-5. VIRTUAL POPULATION ANALYSIS

## NORTH SEA WHITING (FISHING AREA IV)

STOCK SIZE IN NUMBERS UNIT: THOUSANDS

BIOMASS TOTALS UNIT: TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1974-80
0	4505207	2460955	3085451	2945481	3189535	2553589	1211928	1525100	1025365	3173999	*****	2850307
1	1710644	3174842	1799236	2143711	1813681	1994201	1660837	693775	761858	744910	2003694	2042450
2	1631805	726168	1741106	1045169	847265	1108888	1076908	1070321	389959	386607	429776	1167901
3	355324	470398	237414	438091	425068	393232	490566	490050	558087	205536	166902	401442
4	52816	88333	119534	51862	126019	166405	133504	150423	168074	248946	76372	105496
5	16969	14755	23550	30116	14464	41644	59399	35319	40589	64837	89769	28699
6	1534	9516	3944	7437	8419	5056	11626	14796	9660	11730	21582	6819
7	9029	183	820	829	1976	2119	1375	2584	3111	2347	3041	2333
8	628	2234	47	189	316	363	686	454	558	1023	707	638
9	59	201	600	19	10	44	125	81	158	134	308	151
10	53	3	39	232	12	2	22	62	59	77	40	49
11+	n	0	0	5	n	5	9	2	12	n	23	3
TOTAL NO	8284047	6947589	7011741	6661139	6426764	6265547	4647182	3982965	2958072	4840147		
SPS NO	2125823	1612932	2185681	1724302	1555272	1848408	1870958	1754780	1223456	972249		
TOT.BIOM	605631	7210517	714844	595856	478717	577277	541188	451676	370712	366375		
SPS BIOM	360949	351695	457657	353493	314833	365723	368890	360007	284062	243401		

Table 13.6. North Sea WHITING. Input data used for stock predictions

Age	Stock $\bar{w}$ (kg) 1978-83	H.C. landings 1983			Discards 1983			Ind. landings 1983			Total F 1983	Reference period: 1978 - 1983					
		Nx10 <sup>-3</sup>	$\bar{w}$ (kg)	F	Nx10 <sup>-3</sup>	$\bar{w}$ (kg)	F	Nx10 <sup>-3</sup>	$\bar{w}$ (kg)	F		H.C. catch	Discards	Ind. catch			
		$F^{(1)}$	$\bar{w}^{(2)}$	Prop. ret.	$\bar{w}$	F	$\bar{w}$										
0	.015	-	-	-	71 371	.037	.03	590 106	.012	.23	.26	.016	.129	.000	.051	.273	.013
1	.087	6 163	.216	.01	152	.114	.27	42 003	.058	.07	.35	.203	.204	.069	.116	.158	.055
2	.175	49 593	.246	.19	87 455	.166	.33	30 346	.148	.12	.64	.369	.238	.384	.162	.184	.147
3	.254	53 566	.292	.41	31 997	.234	.25	17 507	.311	.13	.79	.618	.282	.686	.203	.195	.252
4	.326	99 072	.328	.64	22 308	.263	.14	6 586	.432	.04	.82	.835	.340	.844	.227	.095	.368
5	.403	29 744	.378	.76	4 027	.290	.10	1 619	.653	.04	.90	.957	.415	.887	.255	.072	.475
6	.467	7 067	.437	1.10	276	.317	.04	59	.567	.01	1.15	1.180	.470	.963	.264	.047	.508
7	.515	1 320	.462	.96	23	.277	.02	24	.602	.02	1.00	1.088	.516	.994	.276	.013	.495
8	.638	588	.528	.99	8	.365	.01	-	-	-	1.00	1.273	.639	.998	.365	.010	.503
9	.723	78	.708	1.00	-	-	-	-	-	-	1.00	.759	.723	1.000	-	-	-
10	1.007	45	.488	1.00	-	-	-	-	-	-	1.00	1.005	1.007	1.000	-	-	-
11+	.677	-	-	1.00	-	-	-	-	-	-	1.00	1.005	.677	1.000	-	-	-
Weight tonnes		76 841			49 125			23 637									

Recruitment  $R_o$  1984  
 1985  $2 700 000 \times 10^3$   
 1986

(1) Rescaled to  $F_{av} = F_{83}$   
 (2) Human consumption landings

Table 13.7 Management options: WHITING in the North Sea.

1984				1985								1986	
Stock Biom.	Spawning stock biomass	$\bar{F}$ (2-6) H.C.	Total landings	Management Option for 1985	Stock Biom.	Spawning stock biomass	$\bar{F}$ (2-6) H.C.	Total landings	H.C. landings	Indust. landings	Discards	Stock Biom.	Spawning stock biom.
405	191	.792	102 <sup>*)</sup>	$\bar{F}_{85} = 0$	481	297	0	57	0	57	0	673	486
				$\bar{F}_{85} = 0.2\bar{F}_{84}$			.158	72	17	55	15	638	451
				$\bar{F}_{85} = 0.5\bar{F}_{84}$			.396	92	40	52	35	591	405
				$\bar{F}_{85} = \bar{F}_{84}$			.792	118	69	49	66	526	342
				$\bar{F}_{85} = 1.5\bar{F}_{84}$			1.188	137	92	45	92	474	290
				$\bar{F}_{85} = 2.0\bar{F}_{84}$			1.584	152	109	43	115	431	249

\*) Includes industrial landings = 38

Weights in '000 tonnes.

Stock biomass = fish of age 0 and older.

Spawning stock biomass = fish of age 2 and older.

Exploitation pattern 1984-85 based on 1978-83 average.

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

Table 14.1. Nominal catch (in tonnes) of WHITING in Division VIIa, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	10	1	14	-	-	-	+ 32 <sup>a)</sup>	-	2	-
Denmark	-	-	-	-	119	92	-	-	+	-
Faroe Islands	1	30	2	-	-	770	-	-	-	-
France	2 983	2 763	3 655	3 395	3 610	2 779	2 609	1 637	1 798	1 216
German Dem. Rep.	-	-	31	-	-	-	-	-	-	-
Germany, Fed. Rep.	80	62	1	1	2	4	1	49	53	58 <sup>a)</sup>
Ireland	2 431	2 429	3 255	2 752	2 080	2 791	4 407	8 148	3 040	3 207
Netherlands	23	85	255	78	23	17	2	6	285	-
Norway	-	-	1	-	-	-	-	-	-	-
Poland	9	-	-	-	-	-	-	-	-	-
Spain	1 479	1 871	821	763 <sup>a)</sup>	-	-	-	-	-	-
U.K. (England & Wales)	112	132	244	520	669	320	227	118	166	148
U.K. (Scotland)	9 929	12 668	16 658	9 873	8 174	10 613	7 386	8 519	8 419	10 339
U.K. (Northern Ireland)	-	-	-	-	-	-	-	-	7	-
Total VIIa	17 057	20 041	24 937	17 382	14 677	17 386	14 664	18 477	13 770	14 968

<sup>x)</sup>Provisional

<sup>a)</sup>Includes Division VIIb

Table 14.2. VIRTUAL POPULATION ANALYSIS

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

CATCH IN NUMBERS UNIT: THOUSANDS

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	11203	2214	6900	1688	5543	7241	607	664	2355	10068	15715	9031
2	23897	32114	6070	10477	26858	16452	25146	6773	8533	11973	56395	50779
3	3126	11047	43492	2219	10949	9232	8626	23090	4032	4022	5583	10018
4	753	1421	4600	26202	719	3659	2564	3237	33660	1357	1471	1165
5	252	431	389	1862	13598	325	1204	664	1300	14132	359	182
6	56	149	103	187	813	5057	116	211	234	797	4330	42
7	0	56	16	34	116	322	2106	17	67	79	278	830
8+	4	4	5	18	33	39	219	519	151	70	36	31
TOTAL	39324	47436	61776	44687	58429	42313	40874	40175	50372	49792	62167	72078
	1975	1976	1977	1978	1979	1980	1981	1982	1983			
1	14931	8520	16037	17712	9322	11651	3791	3129	3919			
2	16762	46222	13325	18177	34232	11479	25362	5944	7602			
3	30244	15711	25070	5670	13272	15216	11501	30153	8035			
4	2811	17435	3125	9389	3392	4307	4753	7007	23853			
5	279	1515	4711	931	3492	1205	1540	2076	6027			
6	57	65	292	1429	264	1120	450	812	1350			
7	9	14	13	64	374	85	197	263	575			
8+	237	45	10	5	4	64	5	97	153			
TOTAL	71350	89525	52583	54377	61558	45127	46105	49481	52110			

Table 14.3. VIRTUAL POPULATION ANALYSIS

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

MEAN WEIGHT AT AGE OF THE STOCK UNIT: KILOGRAM

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.196	0.192	0.212	0.238	0.204	0.206	0.178	0.206	0.209	0.211	0.197	0.194
2	0.276	0.213	0.255	0.244	0.240	0.263	0.225	0.200	0.247	0.258	0.234	0.216
3	0.380	0.382	0.312	0.325	0.319	0.306	0.355	0.273	0.277	0.346	0.362	0.318
4	0.412	0.551	0.465	0.374	0.424	0.444	0.500	0.381	0.316	0.369	0.479	0.445
5	0.440	0.629	0.620	0.609	0.412	0.554	0.571	0.517	0.426	0.426	0.485	0.592
6	0.675	0.740	0.769	0.720	0.639	0.539	0.649	0.619	0.551	0.495	0.533	0.640
7	0.000	0.672	0.342	0.816	0.824	0.711	0.616	0.670	0.696	0.604	0.654	0.574
3+	0.710	0.468	0.753	0.871	0.878	0.854	0.725	0.667	1.006	0.713	0.750	0.843

	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.209	0.201	0.200	0.199	0.218	0.172	0.190	0.175	0.203
2	0.245	0.243	0.240	0.235	0.232	0.232	0.226	0.213	0.238
3	0.306	0.311	0.293	0.285	0.306	0.324	0.288	0.264	0.269
4	0.472	0.363	0.388	0.388	0.405	0.419	0.382	0.341	0.321
5	0.652	0.510	0.429	0.515	0.536	0.486	0.407	0.493	0.563
6	0.612	0.691	0.623	0.549	0.691	0.499	0.531	0.572	0.488
7	0.853	1.045	0.853	0.611	0.695	0.652	0.540	0.433	0.446
3+	0.713	1.169	1.065	0.973	0.651	0.786	0.665	0.524	0.397

Table 14.4. VIRTUAL POPULATION ANALYSIS

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

	FISHING MORTALITY COEFFICIENT					UNIT: Year-1		NATURAL MORTALITY COEFFICIENT = 0.20				
	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	0.05	0.10	0.16	0.05	0.11	0.04	0.05	0.03	0.09	0.22	0.08	0.16
2	0.63	0.21	0.33	0.40	0.34	0.59	0.18	0.63	0.75	0.83	1.03	0.48
3	0.70	0.68	0.43	0.36	0.95	1.07	0.71	0.32	1.02	1.04	1.33	0.94
4	0.04	0.33	0.73	0.66	0.77	1.05	1.05	0.65	0.82	1.28	1.65	1.24
5	0.77	1.20	0.58	0.72	0.80	1.02	1.56	0.38	0.59	1.12	1.78	1.02
6	0.29	1.75	0.94	0.61	0.33	0.81	1.52	0.97	0.93	0.91	1.30	1.23
7	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8+	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
( 2 - 4 ) 0	0.66	0.58	0.68	0.64	0.89	0.90	0.85	0.53	0.86	1.05	1.34	0.88
	1975	1976	1977	1978	1979	1980	1981	1982	1983	1978-83		
1	0.12	0.21	0.25	0.20	0.09	0.07	0.11	0.12	0.155	0.12		
2	0.49	0.62	0.57	0.49	0.70	0.24	0.23	0.26	0.49	0.40		
3	0.76	1.28	0.83	0.63	0.82	0.80	0.40	0.45	0.76	0.64		
4	0.76	1.08	1.01	0.90	0.77	0.71	0.63	0.46	0.79	0.71		
5	1.26	1.38	1.03	1.02	1.07	0.71	0.60	0.64	0.93	0.83		
6	1.13	1.27	1.21	1.09	0.96	1.37	0.64	0.75	1.22	1.00		
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
8+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
( 2 - 4 ) 0	0.07	0.99	0.80	0.67	0.77	0.58	0.42	0.39	0.68			

Table 14.5. VIRTUAL POPULATION ANALYSIS

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

STOCK SIZE IN NUMBERS UNIT: THOUSANDS

BIOASS TOTALS UNIT: TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
1	242523	16762	50491	60253	55419	208126	20242	21982	30714	93225	194078	67364
2	55813	188390	11729	35123	47607	40550	103671	15772	17398	23041	61325	146525
3	6748	24338	125235	4193	19354	15250	11485	111519	6359	6755	8196	17881
4	1731	2753	10059	63637	1457	6108	4290	7431	66166	2033	1958	1774
5	511	744	972	3951	26901	551	1751	1235	3191	23911	464	399
6	157	193	183	446	1573	9201	163	370	420	1449	6419	64
7	0	96	27	58	199	563	3616	29	115	136	477	1425
8+	0	7	9	31	57	87	370	891	259	120	62	53
TOTAL NO	307463	233269	198305	167094	152767	221133	212795	159230	125022	150670	272978	235395
SFS NO	64960	216506	148314	107441	97347	72957	7192552	137248	94507	57445	78901	168032
TOT.BIO1	66547	54829	58555	50876	41673	67936	521197	42440	35425	39773	60493	52280
SPS BIO1	19013	51611	47546	36536	30567	25054	43494	37912	291106	20103	22260	39212

1  
85

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1963-80
1	150246	50524	61532	109935	79233	103490	36516	303500	31057	444444444	95275
2	47016	109549	33090	51343	74059	59166	139735	23118	221142	21061	65677
3	74456	23476	48360	15656	25749	30165	36115	91131	17675	11056	32371
4	5722	28623	5319	17253	6356	9253	11049	20885	47576	6768	13462
5	421	2135	7961	1576	5763	2506	3730	4797	10613	17678	4722
6	91	98	450	2333	405	1622	1043	1671	2072	3494	1467
7	15	24	22	110	642	146	538	452	644	501	428
8+	407	77	17	9	75	144	9	167	263	273	145
TOTAL NO	278380	214553	176152	198219	192787	280477	232537	177590	131127		
SFS NO	128135	164029	95819	88284	113554	102987	194019	147222	101090		
TOT.BIO1	69041	55741	44118	47268	46987	61536	56357	46004	36907		
SPS BIO1	37640	45536	28052	25397	31707	29976	49030	40689	30809		

Table 14.6.

LIST OF INPUT VARIABLES FOR THE ICES PREDICTION PROGRAM

WHITING IN FISHING AREA VIA

FIRST YEAR: 1984

LAST YEAR: 1986

YEAR	RECRUITMENT
	thousands

---

1984	80000.
1985	95000.
1986	95000.

AGE	STOCK SIZE	F AT AGE	#)	MATURITY	WEIGHT IN	WEIGHT IN
	thousands			O GIVE	THE CATCH	THE STOCK
1	30100.0	0.140	0.20	0.000	0.193	0.193
2	21161.0	0.470	0.20	1.000	0.250	0.250
3	11056.0	0.750	0.20	1.000	0.289	0.289
4	6730.0	0.650	0.20	1.000	0.376	0.376
5	17073.0	0.970	0.20	1.000	0.470	0.470
6	3494.0	1.170	0.20	1.000	0.540	0.540
7	501.0	1.000	0.20	1.000	0.576	0.576
8+	273.0	1.000	0.20	1.000	0.670	0.670

#)  $\bar{F}_{av}$  rescaled to  $\bar{F}_{83}$

Table 14.7 Management options: WHITING in Division VIa.

1984				Management option for 1985	1985			1986		
Stock biomass	Spawn. stock biom.	$\bar{F}(2-4)$	Total landings		Stock biom.	Spawn. stock biom.	$\bar{F}(2-4)$	Total landings	Stock biomass	Spawn. stock biom.
37	21	0.68	13	$\bar{F}_{85} = 0 \bar{F}_{84}$	41	23	0.0	0	59	41
				$\bar{F}_{85} = \bar{F}_{84} 0.1$			0.17	4	55	37
				$\bar{F}_{85} = 0.4\bar{F}_{84}$			0.27	6	53	34
				$\bar{F}_{85} = 0.6\bar{F}_{84}$			0.41	8	50	32
				$\bar{F}_{85} = 0.8\bar{F}_{84}$			0.55	10	48	30
				$\bar{F}_{85} = \bar{F}_{84}$			0.68	12	46	28
				$\bar{F}_{85} = 1.2\bar{F}_{84}$			0.82	14	44	26
				$\bar{F}_{85} = 1.6\bar{F}_{84}$			1.09	16	41	23

Weights in '000 tonnes.

Stock biomass: fish of age 1 and older.

Spawning stock biomass: fish of age 2 and older.

Exploitation pattern 1984-85 based on 1978-83 average.

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

Table 15.1. Nominal catch (in tonnes) of WHITING in Division VIb, 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Denmark	-	-	-	-	-	-	...	-	-	-
Faroe Islands	1	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	3	-	-	-
Germany. Fed. Rep.	-	-	-	-	-	-	-	-	-	...
Ireland	-	-	-	-	1	-	-	-	-	-
Spain	-	-	-	...	-	-	-	196	-	-
U.K. (England & Wales)	-	-	3	2	5	1	+	-	-	-
U.K. (Scotland)	+	12	15	5	24	2	59	+	-	5
Total VIb	1	12	18	7	30	3	62	196	-	5

<sup>x)</sup>Provisional

<sup>a)</sup>Included in Division VIa

Table 16.1. Nominal catch (in tonnes) of WHITING in Division VIIId and VIIle in 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	39	70	103	36	85	92	85	102	101	93
Denmark	-	-	18	-	1	2 585	6	2	-	-
France	7 917	10 060	8 390	8 886	8 010	5 352	7 690	8 842	8 051	4 443
Germany, Fed. Rep.	25	1	-	-	-	-	-	-	-	-
Ireland	-	-	-	11	12	-	13	-	-	-
Netherlands	12	14	5	1	2	1	2	2	70	-
U.K. (England & Wales)	579	1 255	1 504	1 342	1 038	930	839	1 136	1 222	1 207
Total VIIId,e	8 572	11 400	10 020	10 276	9 148	8 960	8 635	10 084	9 444	5 743

<sup>x)</sup>Provisional

I  
90

**Table 16.2. VIRTUAL POPULATION ANALYSIS**

**WHITING IN THE ENGLISH CHANNEL (FISHING AREAS VIIIE AND VIID)**

CATCH IN NUMBERS      UNIT: THOUSANDS

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	1976	1977	1978	1979	1980	1981	1982	1983 <sup>(a)</sup>
0	140	0	150	0	33	0	0	0
1	12727	13347	19249	1555	4375	2764	7759	3035
2	7313	13004	9201	7582	11628	10670	1262	8901
3	5074	2835	4649	4542	5103	10651	15437	4642
4	1410	143	1556	2472	2027	3200	2639	1639
5	521	253	435	639	573	5217	1103	442
6	74	49	88	93	53	1044	387	64
7+	0	0	0	10	0	660	114	27
TOTAL	27259	30236	36026	23081	23765	37414	33232	18750

**Table 16.3. VIRTUAL POPULATION ANALYSIS**

**WHITING IN THE ENGLISH CHANNEL (FISHING AREAS VIIIE AND VIID)**

MEAN WEIGHT AT AGE OF THE STOCK      UNIT: KILOGRAM

---

	1976	1977	1978	1979	1980	1981	1982	1983 <sup>(a)</sup>
0	0.218	0.200	0.130	0.170	0.195	0.200	0.200	0.200
1	0.230	0.256	0.207	0.289	0.262	0.157	0.173	0.180
2	0.374	0.347	0.260	0.379	0.336	0.232	0.202	0.209
3	0.470	0.490	0.346	0.455	0.430	0.259	0.282	0.267
4	0.594	0.642	0.412	0.513	0.461	0.297	0.344	0.319
5	0.695	0.749	0.603	0.594	0.538	0.370	0.407	0.342
6	0.742	0.850	0.711	1.052	0.637	0.455	0.417	0.416
7+	0.740	0.955	0.711	0.479	0.701	0.362	0.415	0.447

<sup>(a)</sup> France or

Table 16.4. Nominal catch (in tonnes) of WHITING in Divisions VIIb,c and VIIg-k in 1974-83.  
 (Data for 1974-82 as officially reported to ICES)

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 <sup>x)</sup>
Belgium	75	83	97	60	37	26	31	61	28	47
France	4 331	3 637	4 731	3 962	3 868	4 127	5 603	5 922	4 767	6 203
Germany, Fed. Rep.	-	2	-	1	45	-	+	-	-	-
Ireland	1 641	2 562	1 980	1 201	1 172	2 674	3 710	3 612	4 073	1 113 <sup>a)</sup>
Netherlands	915	66	112	86	63	3	4	21	78	-
Spain	1 367	2 974	2 772	-	-	-	-	-	-	-
U.K. (England & Wales)	15	61	21	26	38	23	60	257	153	42
U.K. (Scotland)	-	-	-	2	1	1	80	1	-	-
USSR	-	64	2	-	-	-	-	-	-	-
Total VIIb,c and g-k	8 344	9 449	9 715	5 338	5 224	6 854	9 488	9 874	9 099	7 405

x) Provisional

a) Divisions VIIb,c only

Table 17.1. Maturity data used for the estimation  
of spawning stock biomass

NORTH SEA                            WEST OF SCOTLAND

COD

<u>Age</u>	<u>Proportion Mature</u>	<u>Age</u>	<u>Proportion Mature</u>
1	0.01	1	0.00
2	0.05	2	0.00
3	0.23	3	0.52
4	0.62	4	0.86
5	0.86	5	1.00
6	1.00	6+	1.00
7	1.00		
8	1.00		
9	1.00		
10	1.00		
11+	1.00		

HADDOCK

1	0.01	1	0.00
2	0.32	2	0.57
3	0.71	3	1.00
4	0.87	4	1.00
5	0.95	5	1.00
6	1.00	6+	1.00
7	1.00		
8	1.00		
9	1.00		
10	1.00		
11+	1.00		

WHITING

1	0.11	1	0.00
2	0.92	2	1.00
3	1.00	3	1.00
4	1.00	4	1.00
5	1.00	5	1.00
6	1.00	6+	1.00
7	1.00		
8	1.00		
9	1.00		
10	1.00		
11+	1.00		

Table 18.1. Estimated numbers of COD, HADDOCK and WHITING estimated to have been consumed by predators in comparison with VPA estimates of stock numbers

Age group	COD		HADDOCK		WHITING	
	*Stock $N \times 10^{-3}$ at 1.1.1981	$N \times 10^{-3}$ consumed	*Stock $N \times 10^{-3}$ at 1.1.1981	$N \times 10^{-3}$ consumed	*Stock $N \times 10^{-3}$ at 1.1.1981	$N \times 10^{-3}$ consumed
0		10 135	2 278	57 051	1 604	8 138
1	131	157	341	2 438	498	1 075
2	313	18	1 018	243	893	303
3	47	2	255	10	465	47
4+	28	-	40	1	197	11

\*Stock numbers from 1983 Working Group Report based on  $M = 0.2$  for all age groups.

Table 20.1. North Sea WHITING mesh assessment.  
Fat age by fleet for landings with existing mesh.

FLEETS

		BEL	BELGIUM HUMAN CONSUMPTION
		ENG	ENGLAND " "
		FRA	FRANCE " "
		NET	NETHERLANDS " "
DEN	IND	DENMARK INDUSTRIAL	
NOR	IND	NORWAY "	
FAR	IND	FAROE "	
SCO	TRA	SCOTLAND TRAWL	
SCO	SNI	" INSHORE SEINE	
SCO	SNO	" OFFSHORE SEINE	
SCO	LTR	" LIGHT TRAWL	
SCO	NTR	" NEPHROPS TRAWL	
SCO	OTH	" OTHER	
FAR		FAROE HUMAN CONSUMPTION	
FRG		FEDERAL REPUBLIC OF GERMANY H.C.	
NOR		NORWAY H.C.	
SWE		SWEDEN H.C.	
GDR		GERMAN DEMOCRATIC REPUBLIC H.C.,	
POL		POLAND H.C.	

Table 20.2. North Sea WHITING mesh assessment.  
 F at age by fleet for discards with existing mesh.  
 (For definition of fleets, see Table 20.1)

Table 20.3. North Sea WHITING mesh assessment.  
Mean weight at age for landings.  
(For definition of fleets, see Table 20.1)

Table 20.4. North Sea WHITING mesh assessment.  
Mean weight at age for discards.  
(For definition of fleets, see Table 20.1.)

1	BEL	ENG	FRA	NET	DEN	NOR	FAR	SCO	SCO	SCO	
2	ALL	ALL	ALL	ALL	IND	IND	IND	TRA	SNI	SNO	
0	0.049	0.059	0.049	0.049				0.052	0.057	0.024	
1	0.110	0.110	0.110	0.110				0.140	0.138	0.140	
2	0.171	0.171	0.171	0.171				0.171	0.168	0.201	
3	0.203	0.203	0.203	0.203				0.211	0.197	0.234	
4	0.233	0.233	0.233	0.233				0.229	0.216	0.266	
5	0.261	0.261	0.261	0.261				0.264	0.239	0.289	
6	0.253	0.253	0.253	0.253				0.283	0.221	0.313	
7	0.261	0.265	0.265	0.265				0.311	0.212	0.263	
8											
9											
10											
11											
1	SCO	SCO	SCO	FAR	FRG	NOR	SHE	GDR	POL		
2	LTFR	NIR	OTP	ALL	ALL	ALL	ALL	ALL	ALL		
0	0.050	0.047	0.049	0.049	0.049	0.049	0.049	0.049	0.049		
1	0.128	0.109	0.110	0.110	0.110	0.110	0.110	0.110	0.107		
2	0.169	0.146	0.171	0.171	0.171	0.171	0.171	0.171	0.166		
3	0.197	0.190	0.203	0.203	0.203	0.203	0.203	0.203	0.202		
4	0.220	0.199	0.225	0.233	0.233	0.233	0.233	0.233	0.233		
5	0.264	0.255	0.262	0.253	0.261	0.261	0.253	0.253	0.253		
6	0.223	0.274	0.253		0.253						
7	0.268		0.265								
8											
9											
10											
11											

Table 20.5. North Sea WHITING mesh assessment.  
Mean weight at age in the stock, stock age composition 1985 and  
maturity at age.

Age	Stock mean weights, stock in 1985, maturity at age			
	0	1	2	
0	0.015	2700000	0.00	
1	0.087	1655746	0.11	
2	0.175	1143584	0.91	
3	0.254	202404	0.99	
4	0.326	60007	0.99	
5	0.403	24671	1.00	
6	0.467	26265	1.00	
7	0.515	5180	1.00	
8	0.638	828	1.00	
9	0.723	160	1.00	
10	1.007	113	1.00	
11	0.677	23	1.00	

Mean recruits at age 0= 2.7E+06      n= 0.2 all ages

Table 20.6. North Sea WHITING mesh assessment.  
 F at age by fleet for landings with new mesh.  
 (For definition of fleets, see Table 20.1)

**Table 20.7.** North Sea WHITING mesh assessment.  
 F at age by fleet for discards for new mesh.  
 (For definition of fleets, see Table 20.1)

**Table 20.8.** North Sea WHITING mesh assessment.  
 Predicted landings 1985-97 by fleet with old mesh N x 10<sup>-3</sup>.  
 (For definition of fleets, see Table 20.1)

PER	ENG	FRA	NET	DEN	NOR	FAR	SCO	SCO	SCO	
ALL	ALL	ALL	ALL	IMP	IMP	IND	TRA	SHI	SHO	
1951	2232	4157	13628	11677	51956	9241	30531	22071	8351	2024
1961	2758	4935	23748	14295	5906	10691	35221	23801	10310	2665
1971	5171	5921	26316	16449	58950	12311	34921	33241	117151	5198
1981	5205	6307	26317	16270	57102	12991	34321	34261	11280	3346
1991	5221	6368	26237	16050	50027	12601	34231	34611	120071	3353
1990	5192	6272	26164	15956	57932	12691	34191	34281	11961	3308
1991	5190	6257	26127	15962	57921	12671	34191	34171	12002	3300
1992	5189	6244	26121	15958	57921	12671	34191	34141	11975	3298
1993	5188	6268	26110	15957	57921	12671	34191	34161	11966	3303
1994	5171	6267	26117	15957	57921	12671	34191	34161	11965	3301
1995	5166	6265	26117	15957	57921	12671	34191	34161	11965	3301
1996	5181	6265	26117	15957	57921	12671	34191	34161	11965	3301
1997	5168	6265	26117	15957	57921	12671	34191	34161	11965	3301

SCO	SCO	SCO	FAR	FRG	FOR	ISME	FDR	POL	
LTR	LTR	LTR	DTM	ALL	ALL	ALL	ALL	ALL	
1951	3265	561	2707	11	5601	16	91	01	01
1961	11112	463	3435	16	7811	23	121	01	01
1971	12177	486	3979	10	8361	20	141	01	01
1981	12114	492	4014	10	8901	27	14	01	01
1991	12455	488	4037	10	8361	27	141	01	01
1990	12396	485	4024	10	8341	26	14	01	01
1991	12405	486	4022	10	8341	26	141	01	01
1992	12365	485	4017	10	8331	26	14	01	01
1993	12362	482	4017	10	8031	26	141	01	01
1994	12331	485	4016	10	8331	26	14	01	01
1995	12361	485	4016	10	8831	26	141	01	01
1996	12331	485	4016	10	8831	26	141	01	01
1997	12361	485	4016	10	8331	26	141	01	01

**Table 20.9.** North Sea WHITING mesh assessment.  
 Predicted discards 1985-97 by fleet with old mesh N x 10<sup>-3</sup>.  
 (For definition of fleets, see Table 20.1)

TREL	FNG	FRA	MET	DEG	BOR	FAR	SCO		SCO		SCO	
							ALL	ALL	IND	IND	TRA	SRI
185	2096	5569	15636	12606	0	0	0	1440	6168	3482		
186	2262	4136	17938	13217	0	0	0	1706	6504	3654		
187	2232	4532	17752	13130	0	0	0	1733	6297	3492		
188	2224	4526	17668	13052	0	0	0	1700	6270	3457		
189	2212	4258	17575	12976	0	0	0	1718	6247	3450		
190	2209	4249	17554	12966	0	0	0	1708	6242	3449		
191	2209	4242	17553	12965	0	0	0	1706	6242	3449		
192	2209	4243	17553	12965	0	0	0	1716	6242	3449		
193	2209	4243	17553	12965	0	0	0	1706	6242	3449		
194	2209	4243	17553	12965	0	0	0	1706	6242	3449		
195	2209	4243	17553	12965	0	0	0	1706	6242	3449		
196	2209	4243	17553	12965	0	0	0	1706	6242	3449		
197	2209	4243	17553	12965	0	0	0	1706	6242	3449		
SCO		SCO		SCO		FAR		FAR		FAR		
LTR	FTR	OTR	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	
185	3114	2001	17321	111	615	19	19	0	0	0	0	
186	3303	1942	1947	121	603	26	10	0	0	0	0	
187	3417	1927	1997	121	651	19	10	0	0	0	0	
188	3469	1933	1932	121	648	19	10	0	0	0	0	
189	3436	1923	1975	121	646	19	10	0	0	0	0	
190	3397	1927	1973	121	645	19	19	0	0	0	0	
191	3392	1927	1972	121	645	19	10	0	0	0	0	
192	3397	1927	1972	121	645	19	10	0	0	0	0	
193	3392	1927	1972	121	645	19	10	0	0	0	0	
194	3392	1927	1972	121	645	19	19	0	0	0	0	
195	3392	1927	1972	121	645	19	10	0	0	0	0	
196	3392	1927	1972	121	645	19	10	0	0	0	0	
197	3392	1927	1972	121	645	19	19	0	0	0	0	

Table 20.10. North Sea WHITING mesh assessment.

Predicted landings 1985-97 by fleet with new mesh N x 10<sup>-3</sup>.  
(For definition of fleets, see Table 20.1)

FEL	FAL	FRA	NET	DEN	NOR	FEAR	SCO	SCO	SCO	
ALL	ALL	ALL	ALL	IND	IND	TIL	SFI	SFI	SFI	
1985	1595	27061	109251	64751	553721	9991	32501	14621	506671	15631
1986	1771	25611	160551	95401	709181	13691	41351	21491	79091	23151
1987	2346	52101	217721	130511	742911	18231	43971	30741	711991	36711
1988	3735	50751	244451	148021	742261	21491	43561	37171	153231	44431
1989	3506	74671	253461	147991	745341	21661	43651	40471	147661	47931
1990	3551	72431	259751	147481	743241	21491	43571	41211	151611	47341
1991	2569	76301	259921	147551	742371	21411	43561	41201	154671	47801
1992	3904	76301	260061	147431	742371	21411	43561	41211	153551	47821
1993	3601	77601	259921	147471	742371	21411	43561	41321	153021	48051
1994	3557	77711	259931	147471	742871	21411	43561	41351	153591	43001
1995	2607	77701	260001	147471	742871	21411	43561	41371	153591	47991
1996	3567	77701	260001	147471	742871	21411	43561	41371	153591	47991
1997	3567	77701	250001	147471	742871	21411	43561	41371	153591	47991

FEC	SCO	SCO	FEAR	FRG	NOR	SWE	GDR	IPOL	ALL	
ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	
1985	5162	1791	17321	61	3051	111	61	91	0	0
1986	7577	2761	26921	191	5701	161	81	91	0	0
1987	11112	3771	36941	141	7961	231	121	91	0	0
1988	12577	5761	43051	161	9211	261	141	91	0	0
1989	12522	3451	46321	171	9771	281	151	91	0	0
1990	13347	3761	47311	171	9321	291	141	91	0	0
1991	13370	3901	48721	171	9391	281	141	91	0	0
1992	13232	5391	43151	171	9851	261	141	91	0	0
1993	13375	3271	41151	171	9341	231	141	91	0	0
1994	13767	5831	48151	171	9841	231	141	91	0	0
1995	13762	3781	48131	171	9841	261	141	91	0	0
1996	13767	3461	43151	171	9841	261	141	91	0	0
1997	13772	3281	48121	171	9341	231	141	91	0	0

Table 20.11. North Sea WHITING mesh assessment.

Predicted discards 1985-97 by fleet with new mesh N x 10<sup>-3</sup>.  
(For definition of fleets, see Table 20.1)

FLEET	TEG	TFRA	TET	TDE	TADK	TFAR	TSCL	TSCL	TSCL	TSCL
ALL	ALL	ALL	ALL	IPB	IPB	IPB	TRA	SRI	SRI	SRI
1851	1772	1750	1469	6434	0	0	743	2957	1695	
1861	1502	2425	1019	7506	0	0	1056	3527	2072	
1871	1595	2385	10902	6074	0	0	1152	5617	2090	
1881	1541	2075	11243	8204	0	0	7210	3705	2073	
1891	1454	3014	11137	8150	0	0	1259	3507	2062	
1901	1423	2190	11150	3138	0	0	1273	3670	2079	
1911	1426	2499	11146	3157	0	0	1268	3677	2079	
1921	1423	2499	11146	3157	0	0	1263	3677	2079	
1931	1423	2499	11146	3157	0	0	1263	3677	2079	
1941	1423	2499	11146	3157	0	0	1263	3677	2079	
1951	1423	2499	11146	3157	0	0	1263	3677	2079	
1961	1423	2499	11146	3157	0	0	1263	3677	2079	
1971	1528	2499	11146	3157	0	0	1263	3677	2079	

TCN	SCN	SCN	TFAR	TFB	TADK	TSRE	SGR	PGC
ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL
1851	4521	1452	941	61	516	9	5	0
1861	4527	1105	1117	71	382	11	6	0
1871	4529	1105	11053	71	406	12	6	0
1881	4529	1105	11053	71	423	12	6	0
1891	5231	1105	11053	71	423	12	6	0
1901	5231	1105	11053	71	423	12	6	0
1911	5231	1105	11053	71	419	12	6	0
1921	5231	1105	11053	71	416	12	6	0
1931	5231	1105	11053	71	416	12	6	0
1941	5231	1105	11053	71	416	12	6	0
1951	5231	1105	11053	71	416	12	6	0
1961	5231	1105	11053	71	416	12	6	0
1971	5231	1105	11053	71	416	12	6	0

Table 20.12. North Sea WHITING mesh assessment.

Predicted total stock biomass and spawning stock biomass 1985-97 with old and new mesh. Tonnes.

	OLD MESH		NEW MESH	
	Total st	Spawn st	Total st	Spawn st
15	4814051	2940401	4814051	2940401
86	5272891	3463371	5824131	4001001
37	5373871	3573071	6382291	4556941
88	5367231	3568071	6626101	430421
39	5351601	3552041	6701701	4630451
90	5341521	3542561	6709061	4888471
91	5359861	5540911	6714921	4893071
92	5339101	3540141	6715131	4893881
93	5359311	3540351	6717041	4895791
94	5339201	3540251	6716991	4895741
95	5339171	3540211	6716951	4895701
96	5339161	3540211	6716951	4895711
97	5339161	3540201	6716961	4895711

Table 20.13. NORTH SEA WHITING. Mesh change assessment. Summary % changes in yields ('000 tonnes).

		1985		1986		1987		1997	
		Landings	Discards	Landings	Discards	Landings	Discards	Landings	Discards
TOTAL HUMAN CONSUMPTION	Old New %CH	61.2 37.7 -38	58.3 29.4 -50	77.3 54.7 -29	62.7 35.5 -43	87.7 86.0 -2	61.9 37.8 -40	88.0 96.4 +10	61.2 58.6 -37
INDUSTRIAL	Old New %CH	55.9 59.6 +7		64.2 76.5 +19		63.7 80.5 +26		62.6 80.8 +29	
INDUSTRIAL + HUMAN CONSUMPTION	Old New %CH	117.1 97.3 -17	58.3 29.4 -50	141.5 131.2 -7	62.7 35.5 -43	151.4 166.5 +10	61.9 37.8 -40	150.6 177.2 +18	61.2 38.6 -37
Belgium	%CH	-37	-49					+12	-35
England	%CH	-35	-48					+24	-29
France	%CH	-41	-49					0	-37
Netherlands	%CH	-44	-48					-8	-37
Scotland	%CH	-34	-51					+22	-38
Federal Republic of Germany	%CH	-37	-49					+11	-35
OTHER Human consumption	%CH	-39	-49					+5	-39

**Table 20.14.** North Sea HADDOCK mesh assessment.  
 F at age by fleet for landings with old mesh.  
 (For definition of fleets, see Table 20.1)

FSEL	IDEN	IENG	IFRA	IFRG	IRET	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO
ALL	ALL	ALL	ALL	ALL	ALL	TR-ABL	TR-SH	TR-INS	SH-OFF	LE	TR
0											
1			0.00181		0.00010	0.024	0.00010	0.0012	0.0002	0.0009	
2	0.0014	0.0046	0.0233	0.00810	0.0046	0.0039	0.0010	0.0029	0.0042	0.0024	
3	0.0034	0.0439	0.0826	0.050610	0.017610	0.001610	0.0019	0.0062	0.01795	0.00717	
4	0.0091	0.0701	0.0893	0.157810	0.0191	0.0012	0.0017	0.0030	0.01816	0.01624	0.00745
5	0.0157	0.0716	0.0960	0.176410	0.0175	0.0002	0.00536	0.0060	0.1201	0.06221	
6	0.0076	0.0539	0.1360	0.130110	0.0226	0.0012	0.003	0.01222	0.00558	0.06571	
7	0.0205	0.0599	0.1106	0.139410	0.0155	0.0015	0.0015	0.0076	0.0276	0.07321	
8	0.0046	0.0715	0.1394	0.061710	0.0008	0.0017	0.0017	0.0066	0.0046	0.0737	0.05031
9	0.0162	0.0791	0.0561	0.172710	0.0152		0.00536	0.01639	0.0002	0.03231	
10	0.0237	0.2447	0.1100	0.141010	0.0032		0.0493	0.1051	0.0553	0.11971	
11		0.1501	0.1493	0.124510	0.0071		0.0216	0.1742	0.0706	0.06691	
ISCO	ISCO	IDEN	IWOR	IFAR	IFAR	IOP	IPOL	ISWE	OTHER		
ALL	TR	FORMER	IM	TR	IM	TR	IM	TR	ALL	ALL	ALL
0			0.3734	0.0953	0.0307						
1			0.0012	0.219710	0.054210	0.0175		0.0001			
2	0.0009	0.0156	0.0435	0.043	0.0035	0.0010	0.0028	0.0002	0.0023		
3	0.0011	0.0597	0.0532	0.0589	0.0049	0.0021	0.0010	0.0007	0.0043	0.0001	
4	0.0016	0.0475	0.0457	0.012010	0.0046	0.0027	0.0010	0.0005	0.0035	0.0001	
5	0.0002	0.0321	0.0092	0.0152	0.0006	0.0001	0.0006	0.0003	0.0267	0.0002	
6	0.0015	0.0301	0.0053		0.0001	0.0023	0.0004	0.0007	0.0081		
7	0.0009	0.0425			0.0001	0.0110	0.0011	0.0009	0.0069		
8		0.0253				0.0066	0.0007	0.0001	0.0000		
9		0.0224				0.1072		0.0072			
10		0.0404				0.0059		0.0029			
11		0.0247				0.0071		0.0146			

Table 20.15. North Sea HADDOCK mesh assessment.  
 Fat age by fleet for discards with old mesh.  
 (For definition of fleets, see Table 20.1)

**Table 20.16.** North Sea HADDOCK mesh assessment.  
Mean weight at age for landings.  
(For definition of fleets, see Table 20.1)

FLE	IDEN	1ENG	1FRA	1FRG	1LET	1SCO	1SCO	1SCO	1SCO
ALL	ALL	ALL	ALL	ALL	ALL	TPAWL	SILKS	SURFF	LTR
1	0.391	0.3471	0.3121	0.3201	0.3031	0.3391	0.2511	0.2421	0.2531
2	0.505	0.3661	0.3291	0.3961	0.3581	0.5031	0.3621	0.3271	0.4051
3	0.755	0.3021	0.5801	0.5041	0.6011	0.7971	0.4901	0.4321	0.5051
4	0.119	0.1751	0.0541	0.7761	0.8521	1.3711	0.7541	0.6041	0.3481
5	0.490	1.4901	1.1631	1.0301	1.1271	2.4071	1.0171	0.6751	1.1181
6	0.577	1.7951	1.3201	1.2221	1.2001	1.4561	1.1681	0.9621	1.2331
7	1.331	2.2101	1.5421	1.3211	1.4041	1.5131	1.0101	1.0991	1.4751
8	1.532	1.6361	1.6391	1.5091	1.6421	1.5931	1.3281	1.4071	1.1641
9	1.307	2.4311	1.9351	1.6371	1.7541	1.9341	1.4571	1.0101	1.2331
10	1.710	3.0521	2.7461	1.8061	1.7101	1.6641	1.6011	1.5301	1.3291
11	1	2.5641	3.4651	1.9571	1.6551	1	2.1901	1.6641	2.5301
									1.1221
1SCO	1SCD	IDEN	1MOR	1EAR	1FOR	1AOA	1POL	1Sec	1OTHER
LTR	1014ER	1IP TR	1IN TR	1IM TR	1ALL	1ALL	1ALL	1ALL	1ALL
1	0	0.0101	0.0121	0.0101	0.0101	0	0	0	0.2701
2	0.237	0.2481	0.0401	0.0321	0.0401	0.2151	0.3021	0.2651	0.3321
3	0.301	0.3511	0.1841	0.2041	0.1841	0.3171	0.3671	0.3071	0.3601
4	0.300	0.4851	0.3281	0.4281	0.3281	0.4701	0.5191	0.5191	0.5251
5	0.626	0.7511	0.5321	0.6491	0.5651	0.7191	0.7301	0.7001	0.7431
6	0.315	1.9301	0.6011	0.9791	0.6011	0.8571	1.0971	1.0921	1.0911
7	0.755	1.0401	1.5511	1	1.2141	1.1411	1.2141	0.8491	1
8	0.950	1.1131	1	1.2051	1.3011	1.2051	1.2051	1	1
9	1	1.4001	1	1.5651	1.5561	1.5651	1	1	1
10	1	1.5121	1	1.7291	1.7291	1	1.7291	1	1
11	1	1.5561	1	1.7101	1.7101	1	1.7101	1	1
	1	2.1501	1	1.6591	1	1.6591	1	1	1

Table 20.17. North Sea HADDOCK mesh assessment.  
Mean weight at age for discards.  
(For definition of fleets, see Table 20.1)

ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO
ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL
0	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065
1	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
2	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226
3	0.278	0.278	0.278	0.278	0.278	0.278	0.278	0.278	0.278	0.278	0.278
4	0.413	0.413	0.413	0.413	0.413	0.413	0.413	0.413	0.413	0.413	0.413
5											
6											
7											
8											
9											
10											
11											
ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO	ISCO
ALL	OTHER	IM TR									
0	0.159	0.065									
1	0.152	0.169									
2	0.101	0.226									
3	0.201	0.278									
4	0.413										
5											
6											
7											
8											
9											
10											
11											

Table 20.18. North Sea HADDOCK mesh assessment.  
Mean weight at age in the stock, stock age composition 1985  
and maturity at age.

Age	Stock mean weights		Stock in 1985	Maturity at age
	0	1		
0	1.912		2543000	0.00
1	0.199		1435094	0.00
2	0.275		1423208	1.54
3	0.443		127666	0.75
4	0.661		27097	0.90
5	0.904		5403	0.90
6	1.067		13656	1.99
7	1.167		2613	1.00
8	1.461		299	1.00
9	1.653		44	1.00
10	2.027		17	1.00
11	1.969		65	1.00

mean recruits at age  $n = 2.543E+00$        $n = 0.2$  all ages

Table 20.19. North Sea HADDOCK mesh assessment.  
F at age by fleet for landings with new mesh.  
(For definition of fleets, see Table 20.1)

ReL	PER	FMS	FEA	FRS	FRI	SCD	SCD	SCD	SCD	SCD	SCD
ALL	ALL	ALL	ALL	ALL	ALL	TRawl	SA	INS	SA	OFF	TR
0		{0, 200}				{0, 0013}	{0, 100}	{0, 0004}	{0, 0001}	{0, 0003}	
1		{0, 200}				{0, 0013}	{0, 100}	{0, 0004}	{0, 0001}	{0, 0003}	
2	0, 0029	{0, 0167}	{0, 0058}	{0, 0026}	{0, 0023}	{0, 100}	{0, 0470}	{0, 0540}	{0, 0274}		
3	0, 0052	{0, 0437}	{0, 0014}	{0, 0007}	{0, 0173}	{0, 0017}	{0, 0546}	{0, 1393}	{0, 1758}	{0, 0351}	
4	0, 0091	{0, 0699}	{0, 0092}	{0, 0074}	{0, 0191}	{0, 0012}	{0, 0734}	{0, 1804}	{0, 1622}	{0, 0741}	
5	0, 0157	{0, 0716}	{0, 0080}	{0, 1764}	{0, 0079}	{0, 0012}	{0, 0210}	{0, 1530}	{0, 0060}	{0, 1200}	{0, 0621}
6	0, 0276	{0, 0539}	{0, 1360}	{0, 1301}	{0, 0226}	{0, 0012}	{0, 0638}	{0, 1321}	{0, 0552}	{0, 0656}	
7	0, 0209	{0, 0599}	{0, 1758}	{0, 1924}	{0, 0155}	{0, 0012}	{0, 0470}	{0, 1214}	{0, 0570}	{0, 0732}	
8	0, 0446	{0, 0715}	{0, 1294}	{0, 1067}	{0, 0069}	{0, 0017}	{0, 0566}	{0, 0646}	{0, 0737}	{0, 0503}	
9	0, 0182	{0, 0701}	{0, 0551}	{0, 1727}	{0, 0152}		{0, 0550}	{0, 1639}	{0, 0062}	{0, 0323}	
10	0, 0237	{0, 2447}	{0, 1100}	{0, 1419}	{0, 0039}		{0, 0643}	{0, 1051}	{0, 0553}	{0, 1197}	
11	{0, 1801}	{0, 1943}	{0, 1745}	{0, 2071}			{0, 0213}	{0, 1742}	{0, 0760}	{0, 0666}	
SCD	SCD	FEA	FEA	FRS	FRI	FCR	SCD	SCD	SCD	SCD	SCD
TR	OTHER	TR	TR	TR	TR	ALL	ALL	ALL	ALL	ALL	ALL
0		{0, 3724}	{0, 0935}	{0, 0597}							
1		{0, 0001}	{0, 2197}	{0, 0545}	{0, 0193}						
2	0, 0105	{0, 0105}	{0, 0635}	{0, 0043}	{0, 0051}		{0, 0020}	{0, 0001}	{0, 0017}		
3	0, 0111	{0, 0442}	{0, 0532}	{0, 0059}	{0, 0049}		{0, 0022}	{0, 0006}	{0, 0020}	{0, 0001}	
4	0, 0108	{0, 0473}	{0, 0457}	{0, 0120}	{0, 0046}		{0, 0002}	{0, 0006}	{0, 0005}	{0, 0004}	{0, 0001}
5	0, 0102	{0, 0321}	{0, 0023}	{0, 0154}	{0, 0036}		{0, 0001}	{0, 1890}	{0, 0003}	{0, 0262}	{0, 0002}
6	0, 0305	{0, 0310}		{0, 0155}			{0, 0002}	{0, 1891}	{0, 0004}	{0, 0077}	{0, 0001}
7	0, 0109	{0, 0425}					{0, 0001}	{0, 0310}	{0, 0001}	{0, 0059}	
8		{0, 0253}						{0, 0001}	{0, 0007}	{0, 0001}	
9		{0, 0224}						{0, 0072}		{0, 0072}	
10		{0, 0404}						{0, 0059}		{0, 0039}	
11		{0, 0237}						{0, 0071}		{0, 0320}	

Table 20.20. North Sea HADDOCK mesh assessment.  
 Fat age by fleet for discards for new mesh.  
 (For definition of fleets, see Table 20.1)

**Table 20.21.** North Sea HADDOCK mesh assessment.  
 Predicted landings 1985-97 by fleet with old mesh N x 10<sup>-3</sup>.  
 (For definition of fleets, see Table 20.1)

FEL	IDF	TEN	TFR	TFR	REI	SCO	SCO	SCO	SCO	SCO
ALL	ALL	ALL	ALL	ALL	ALL	TRAWL	SL	INFS	SL	OFFIL
1851	14401	75841	151011	93501	29571	29291	7681	344601	287401	187201
1861	23001	173061	226311	104491	54941	23201	156231	507351	5210241	245751
1871	25271	189641	224891	230721	49741	20951	147151	429941	454691	217511
1881	25951	163971	205561	216051	44511	19341	126861	374681	523751	167621
1891	21561	154261	203711	199111	42861	19651	121521	366491	360581	162751
1901	22541	151341	198231	165111	41531	19751	121611	361021	362581	160591
1911	21451	143191	193491	178911	40691	19741	111301	256451	361891	173921
1921	21541	147951	191341	179141	40701	19711	117601	356834	361141	173561
1931	21201	149921	191341	178401	40581	19711	117441	356071	361072	171951
1941	21471	146161	191461	176351	40561	19711	117291	357981	361041	178351
1951	21471	147301	191221	177911	40561	19711	117261	357371	360571	171271
1961	21671	147771	191111	177371	40561	19711	117251	357821	360541	178201
1971	21811	147731	191191	177361	40561	19711	117251	357891	360531	178201

SCO	SCO	TFR	TFR	TFR	TFR	TFR	TFR	TFR	TFR	TFR
ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL
1851	1351	132091	269561	51051	23261	261	17621	11131	15621	191
1861	13671	134291	271061	52761	24511	451	26671	1371	2494	51
1871	1331	131291	255351	53271	23421	411	26361	1601	2214	21
1881	13501	135251	239671	54961	21761	551	23461	1351	2754	21
1891	1352	93871	236801	52111	21491	521	22291	1361	2261	20
1901	1352	27551	235661	51451	21661	521	21921	1311	2161	23
1911	1350	26421	231061	51391	21481	521	21621	1321	2156	23
1921	1350	26151	234661	51391	21461	521	21561	1311	2154	23
1931	1351	26151	236661	51371	21451	521	21501	1301	2147	23
1941	1350	26151	234661	51391	21461	521	21501	1311	2147	23
1951	1350	26031	236661	51391	21481	521	21491	1301	2147	23
1961	1351	96021	236661	51391	21481	521	21491	1301	2147	23
1971	1350	96021	236661	51391	21481	521	21491	1301	2147	23

**Table 20.22.** North Sea HADDOCK mesh assessment.  
 Predicted discards 1985-97 by fleet with old mesh  $N \times 10^{-3}$ .  
 (For definition of fleet, see Table 20.1)

PER	DEN	ENG	FRA	FRG	IRI	SCO	SCO	SCO	SCO
ALL	ALL	ALL	ALL	ALL	ALL	IRAWL	IR	IRS	OFF
1.5	795	7410	10621	6280	4145	1408	5193	21279	16/50
80	724	5593	7365	4610	3285	1039	4003	17505	11/50
87	655	4630	6335	3989	2615	897	3065	14901	9255
88	640	4751	6725	3926	2769	882	2943	14545	9137
89	626	4743	6721	3927	2746	882	2941	14532	9137
90	626	4743	6721	3927	2746	882	2941	14532	9137
91	626	4743	6721	3927	2746	882	2941	14532	9137
92	626	4743	6721	3927	2746	882	2941	14532	9137
93	626	4743	6721	3927	2746	882	2941	14532	9137
94	626	4743	6721	3927	2746	882	2941	14532	9137
95	626	4743	6721	3927	2746	882	2941	14532	9137
96	626	4743	6721	3927	2746	882	2941	14532	9137
97	626	4743	6721	3927	2746	882	2941	14532	9137

Table 20.23. North Sea HADDOCK mesh assessment.  
Predicted landings 1985-97 by fleet with new mesh N x 10<sup>-3</sup>.  
(For definition of fleets, see Table 20.1)

REL	DEN	ENG	FRA	FRG	NET	SCO	SCO	SCO	SCO	
ALL	ALL	ALL	ALL	ALL	TRAWL	SN INS	SN OFF	L TR		
85	1282	7230	13618	3767	2414	2426	6729	26239	25682	14209
86	2641	20327	24241	17761	5974	2155	16940	51034	53427	24719
87	3056	23459	26069	27609	5879	1958	17535	48555	55120	22927
88	3252	21699	24875	27211	5388	1834	15566	41751	48333	20886
89	2869	20229	24609	24534	5245	1834	15053	40908	45785	20181
90	2382	19788	23880	24084	5084	1823	15160	40447	45300	19979
91	2791	19576	23616	23407	5011	1825	14607	40102	45261	19803
92	2797	19569	23378	23450	5014	1821	14754	40168	45189	19740
93	2796	19723	23395	23382	5007	1821	14717	40089	45145	19767
94	2786	19626	23414	23340	4999	1821	14700	40082	45137	19744
95	2784	19593	23391	23327	4996	1821	14696	40070	45150	19737
96	2784	19585	23379	23323	4998	1821	14695	40065	45127	19736
97	2784	19582	23375	23321	4996	1821	14695	40063	45126	19736

SCO	SCO	DEN	INR	FAIR	FAIR	INR	POL	SWE	OTHER	
ALL	ALL	IN TR	IN TR	IN TR	ALL	ALL	ALL	ALL	ALL	
85	213	6762	28143	5271	2460	19	1454	97	1502	14
86	311	14269	29816	5658	2695	47	5078	201	2670	32
87	276	13765	28719	6039	2026	47	5076	166	2075	31
88	242	12167	26893	6156	2436	41	2801	162	3320	32
89	238	11631	26529	5821	2404	37	2683	158	2602	29
90	239	11549	26510	5726	2404	37	2649	154	2697	28
91	236	11451	26510	5730	2404	37	2616	156	2673	27
92	236	11423	26510	5730	2404	37	2611	154	2669	27
93	236	11422	26510	5730	2404	37	2605	154	2664	27
94	236	11415	26510	5730	2404	37	2604	154	2662	27
95	236	11412	26510	5730	2404	37	2604	154	2661	27
96	236	11411	26510	5730	2404	37	2604	154	2661	27
97	236	11411	26510	5730	2404	37	2604	154	2661	27

\*20.23.1

**Table 20.24.** North Sea HADDOCK mesh assessment.  
Predicted discards 1985-97 by fleet with new mesh N x 10<sup>-3</sup>.  
(For definition of fleets, see Table 20.1)

REL	IDEN	ENG	FRA	IFRG	IMEI	SCO	SCO	SCO	SCO
ALL	ALL	ALL	ALL	ALL	ALL	TRAWL	SN INS	SN OFF	TR
185	5791	45361	69631	38581	23261	11581	30541	122471	130641
186	5421	39781	58031	32251	22471	9501	35411	119851	97481
187	4551	32751	48231	26661	18271	7921	26941	97051	80151
188	4441	31641	46951	25991	17471	7741	25681	92861	73611
189	4421	31601	46901	25881	17441	7731	25651	92691	78601
190	4431	31611	46901	25881	17441	7731	25651	92691	78601
191	4431	31601	46901	25881	17441	7731	25651	92691	78601
192	4431	31601	46901	25881	17441	7731	25651	92691	78601
193	4421	31671	46901	25881	17441	7731	25651	92691	78601
194	4431	31601	46901	25881	17441	7731	25651	92691	78601
195	4431	31601	46901	25881	17441	7731	25651	92691	78601
196	4431	31601	46901	25881	17441	7731	25651	92691	78601
197	4421	31601	46901	25881	17441	7731	25651	92691	78601

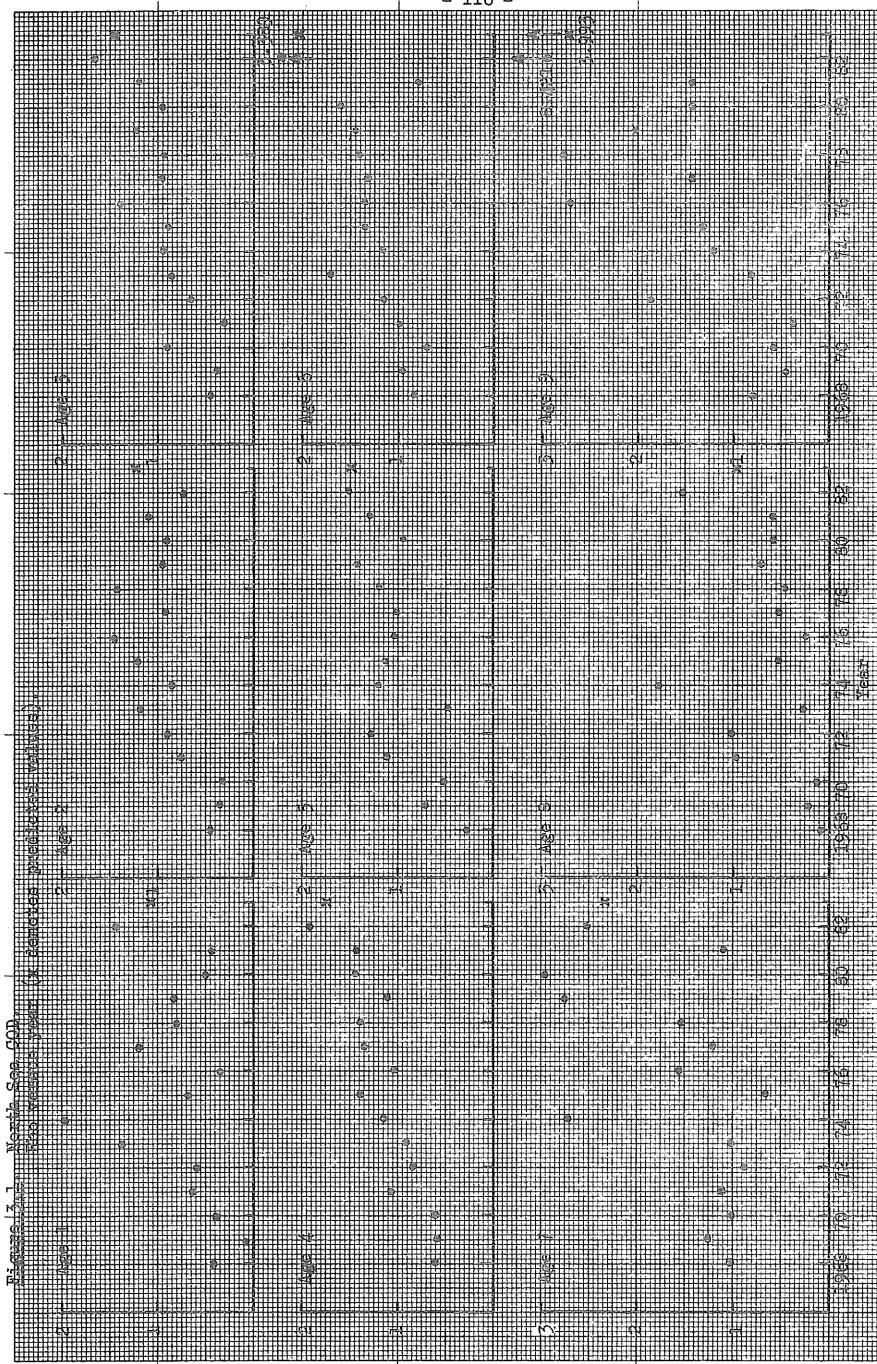
1800	1801	1802	1803	1804	1805	1806	1807	1808	1809
IN TR	OTHER	DEM	NOR	EAR	EAR	HOR	POL	SWE	OTHER
IN TR	ALL	ALL	ALL	ALL					
1851	1251	33941	01	01	01	131	7931	571	6571
1861	791	30571	01	01	01	121	6851	451	5581
1871	971	24851	01	01	01	91	5631	371	4031
1881	911	23951	01	01	01	91	5451	361	4491
1891	911	23921	01	01	01	91	5441	361	4491
1901	911	23921	01	01	01	91	5441	361	4491
1911	911	23921	01	01	01	91	5441	361	4491
1921	911	23921	01	01	01	91	5441	361	4491
1931	911	23921	01	01	01	91	5441	361	4491
1941	911	23921	01	01	01	91	5441	361	4491
1951	911	23921	01	01	01	91	5441	361	4491
1961	911	23921	01	01	01	91	5441	361	4491
1971	911	23921	01	01	01	91	5441	361	4491

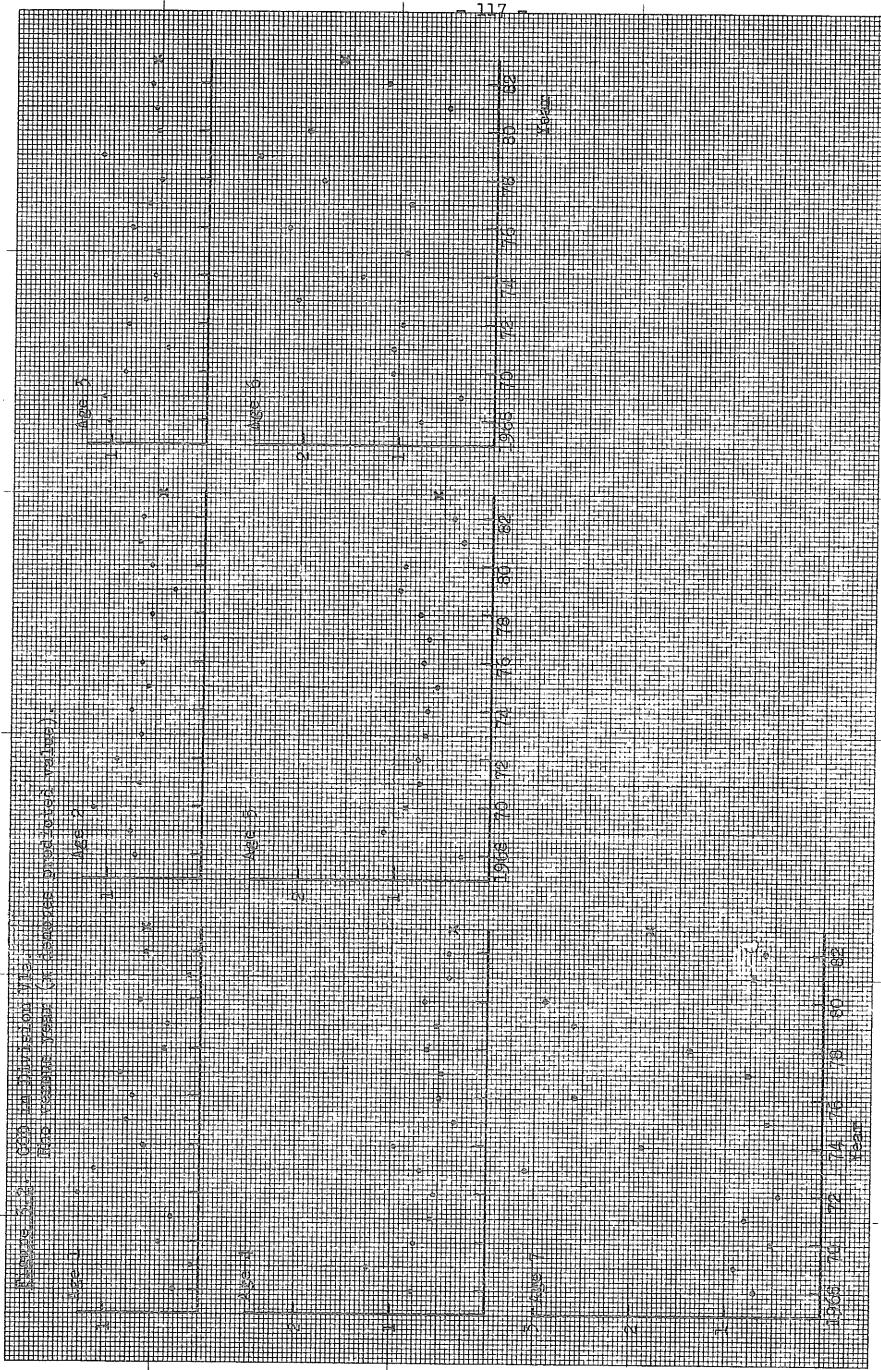
**Table 20.25.** North Sea HADDOCK mesh assessment.  
Predicted total stock biomass and spawning stock biomass  
1985-97 with old and new mesh. Tonnes.

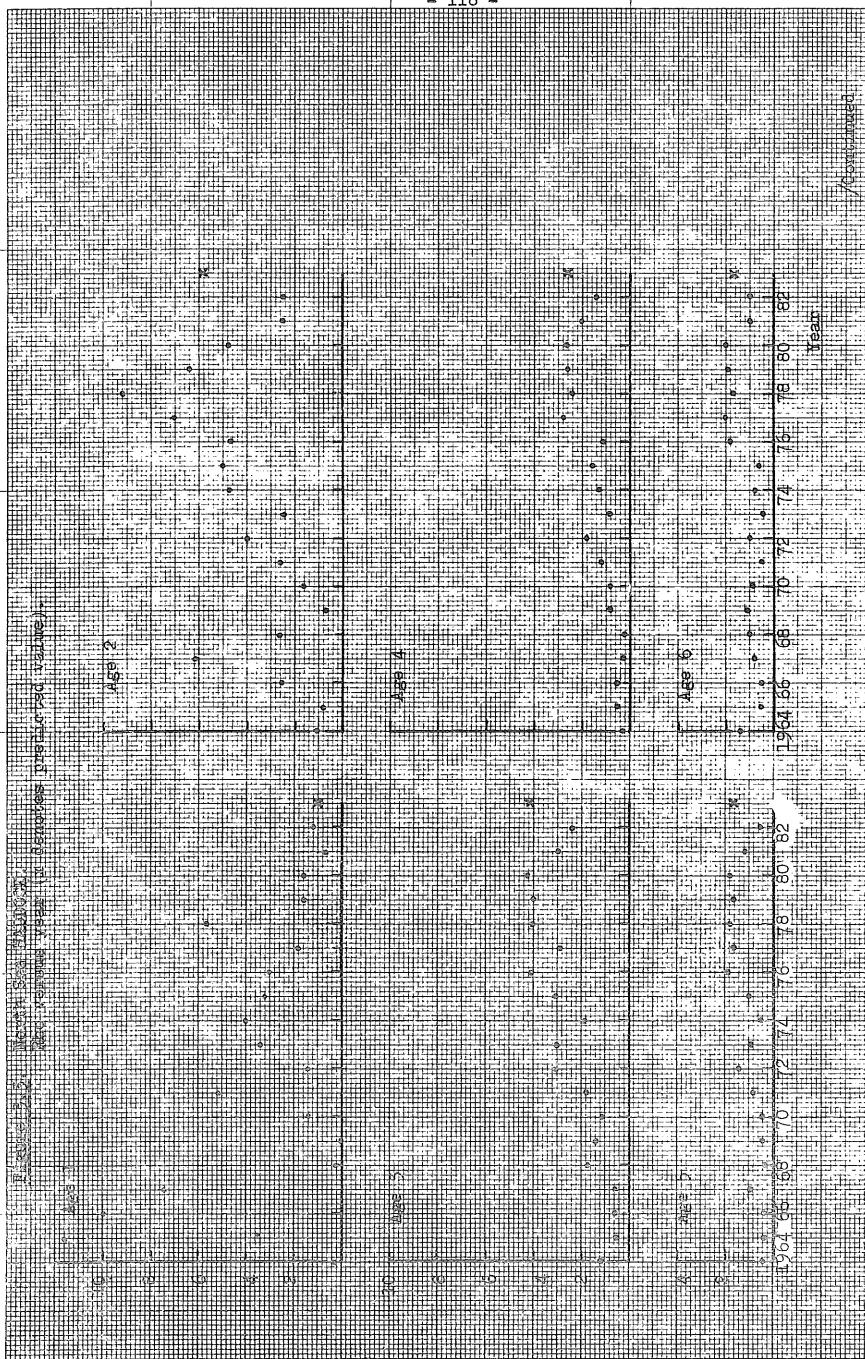
	OLD MESH	NEW MESH
Total St	Spawning St	Total St
35	6039421	2164281
36	6939071	3292411
37	6348651	3111321
38	5978401	2833161
39	5822301	2694211
40	5754481	2628961
41	5725341	2599981
42	5716141	2590781
43	5711521	2586161
44	5707441	2582081
45	5705881	2580521
46	5705571	2580011
47	5705201	2579841

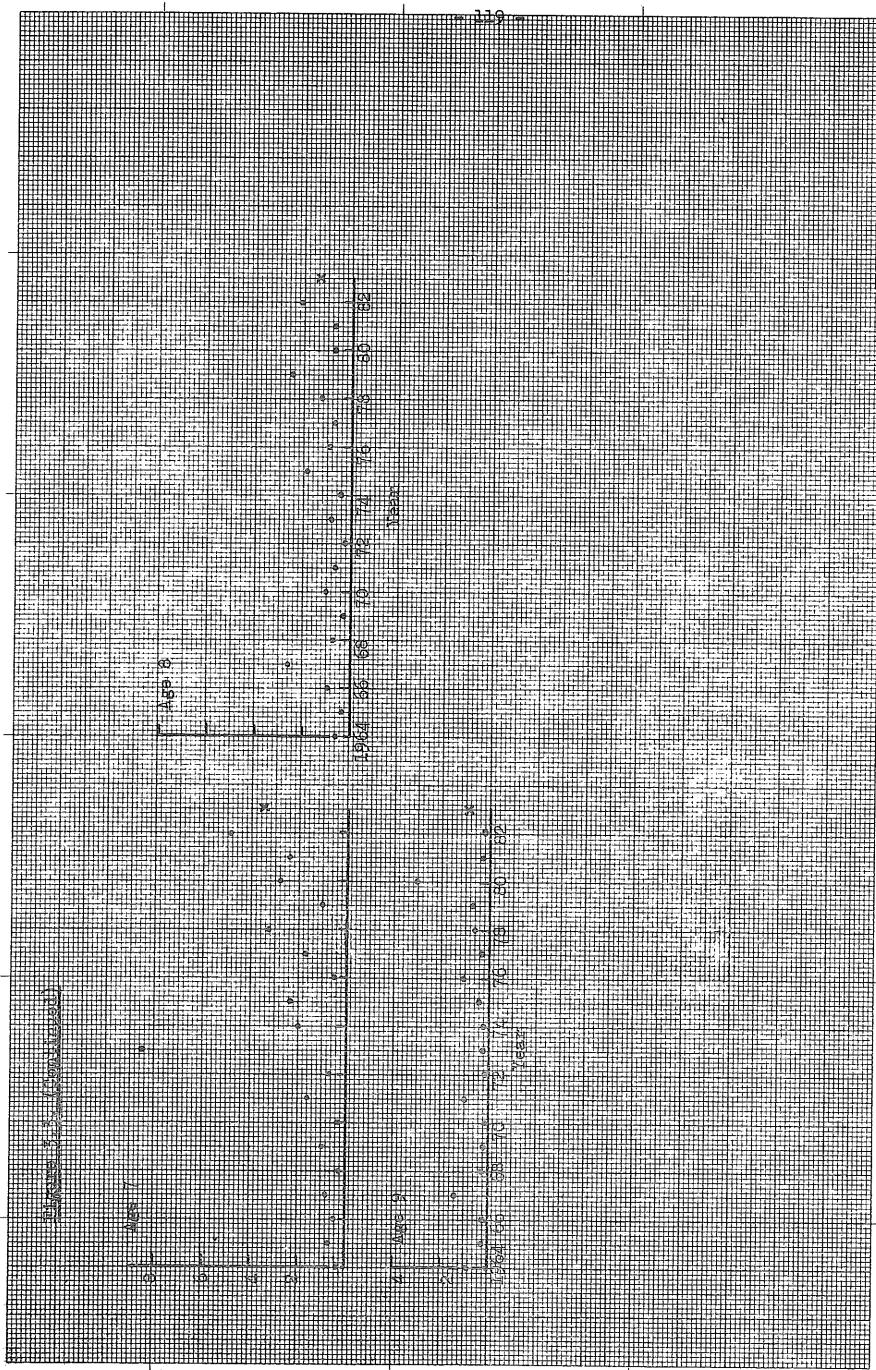
Table 20.26 NORTH SEA HADDOCK. Mesh change assessment for summary % changes in yields ('000 tonnes)

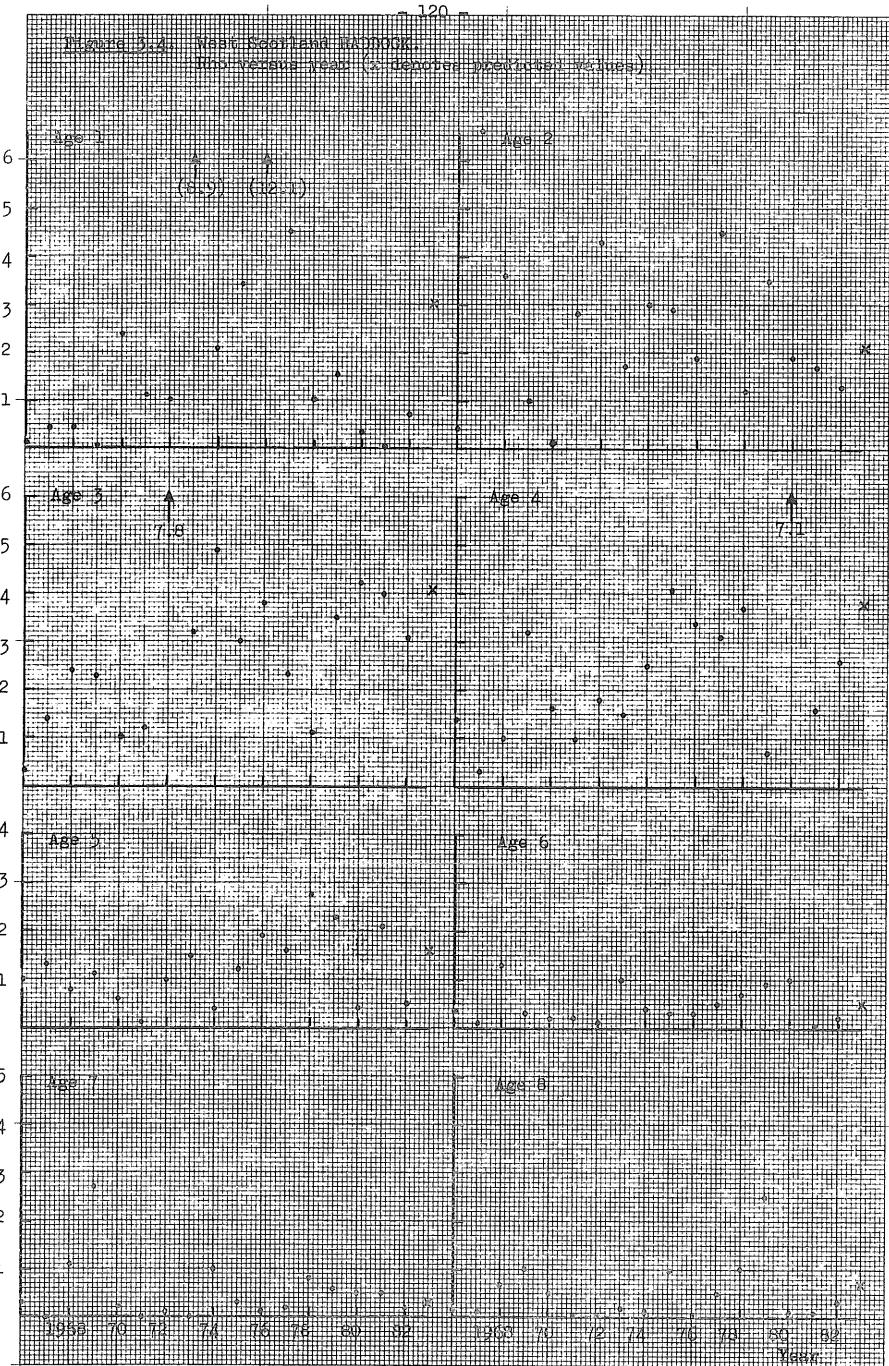
		1985		1986		1987		1997		
		Landings	Discards	Landings	Discards	Landings	Discards	Landings	Discards	
TOTAL HUMAN CONSUMPTION		Old New %CH	143.1 118.5 -17	96.4 61.2 -37	229.5 244.8 +7	72.7 52.7 -27	216.7 252.2 +16	62.5 43.4 -31	175.5 212.6 +21	61.3 42.0 -32
INDUSTRIAL		Old New %CH	34.4 35.9 +4		34.8 38.2 +10		33.4 37.4 +12		30.9 34.6 +12	
INDUSTRIAL + HUMAN CONSUMPTION		Old New %CH	177.5 154.4 -13	96.4 61.2 -37	264.3 283.0 +7	72.7 52.7 -27	250.1 289.6 +16	62.5 43.4 -31	206.4 247.2 +20	61.3 42.0 -32
Belgium	%HC	-9	-47						+30	-29
Denmark	%HC	-8	-37						+33	-33
England	%HC	-15	-49						+22	-30
France	%HC	-11	-56						+31	-34
Netherlands	%HC	-17	-52						-8	-12
Scotland	%HC	-19	-56						+18	-31
Federal Republic of Germany	%HC	-19	-44						+23	-36
OTHER human consumption	%HC	-17	-37						+22	-32

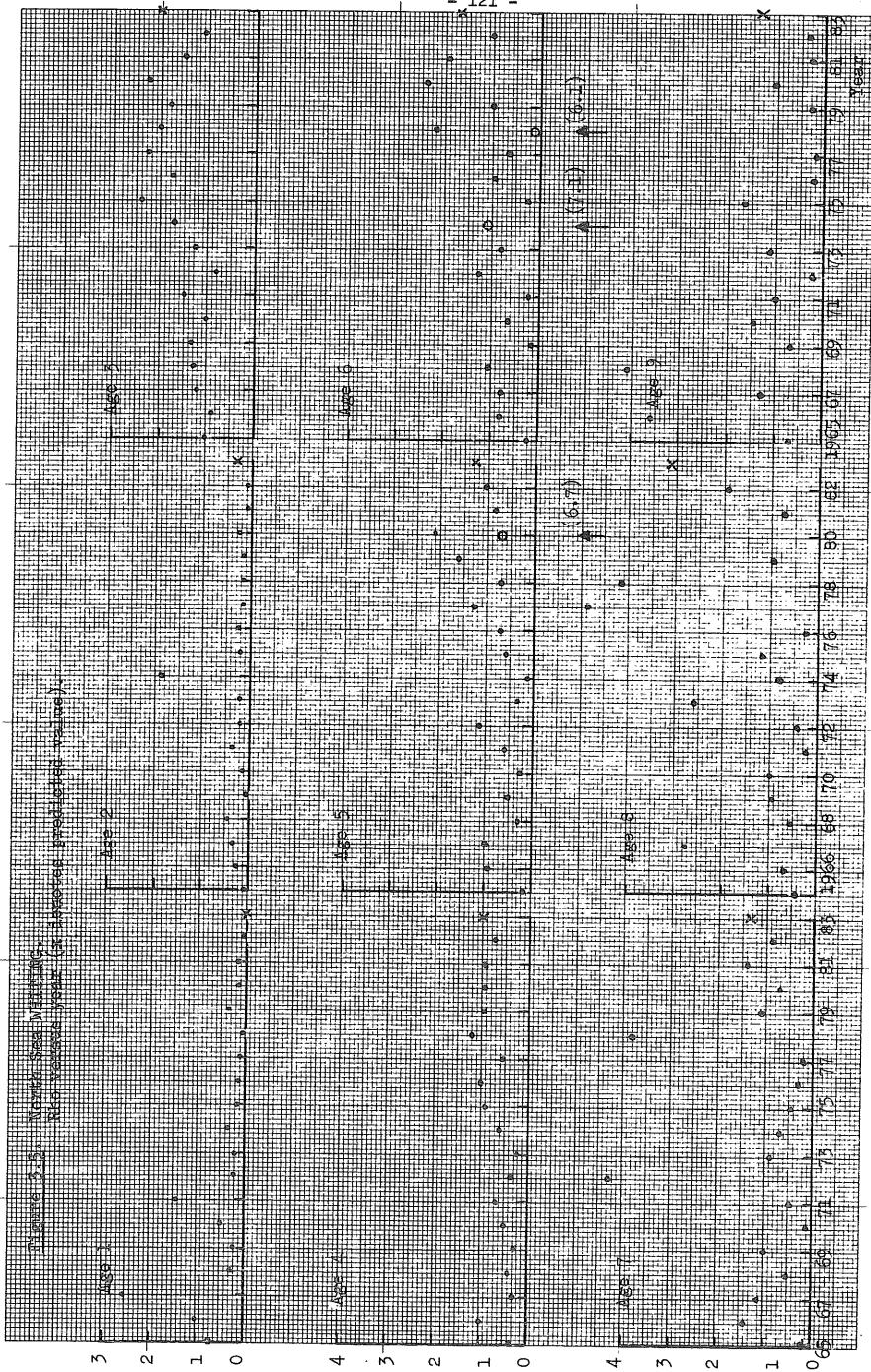


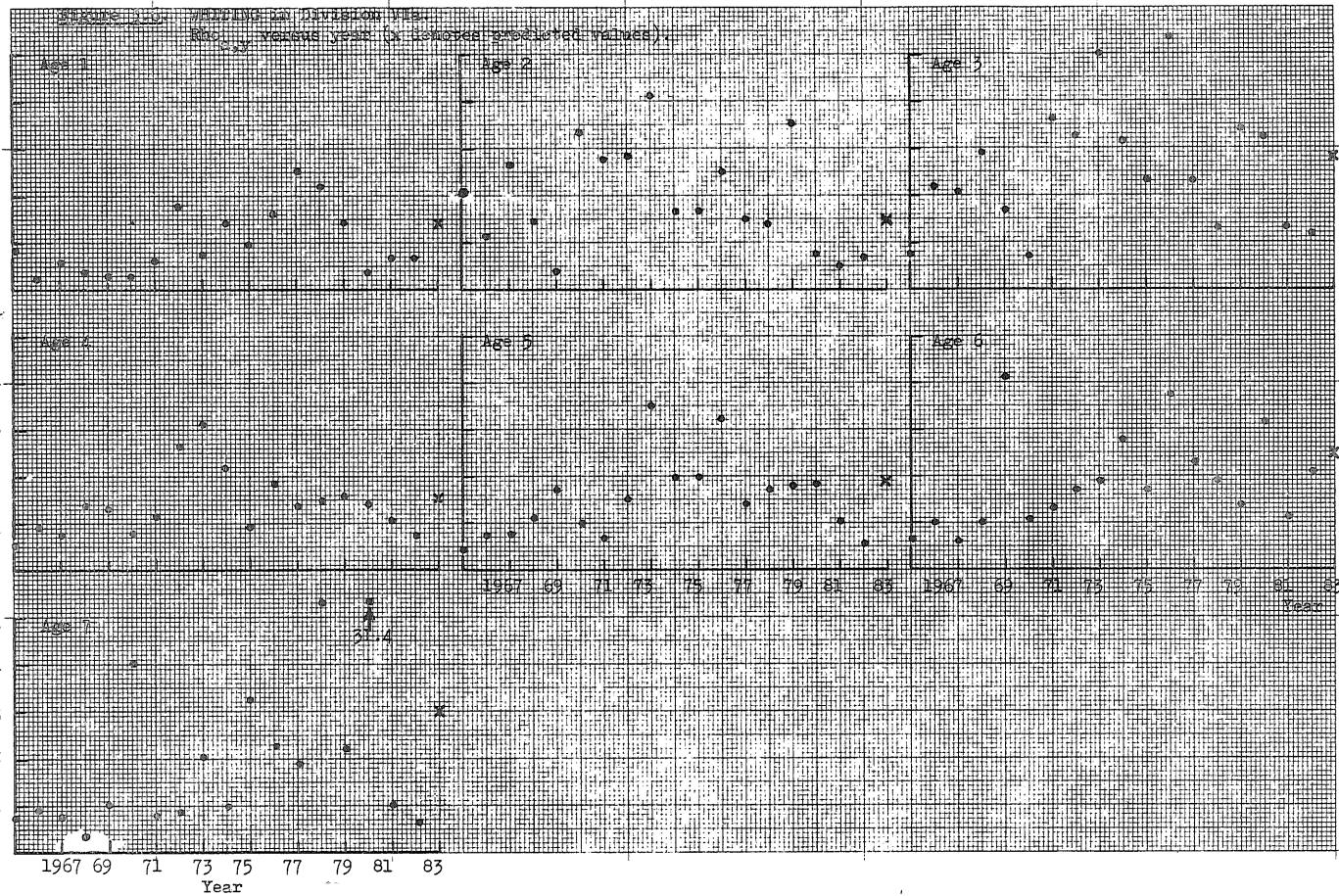












Plots (4,5) COD recruitment at age 1.

VPA

No. x 10<sup>-6</sup>

500

400

300

200

100

0

VPA

W. Scotland

No. x 10<sup>-6</sup>

25

20

15

10

5

79

76 69

81

78

77

74

60  
52 73

72  
75

83  
71

81

79

62

78

74

73

72

75 70

70 69

71 68

70 69

68 67

50

70

A. North Sea COD, relation between IVTS recruitment indices and VPA numbers at age 1.

Year classes indicated.

100 IVTS index

B. Relation between VPA numbers at age 1 in the North Sea (sum-area) and West of Scotland (Division VPA).

100 VPA = 1000000000 No. x 10<sup>-6</sup>

200

300

400

500

Figure 1-2 (b) (i). Recruitement at age 2.

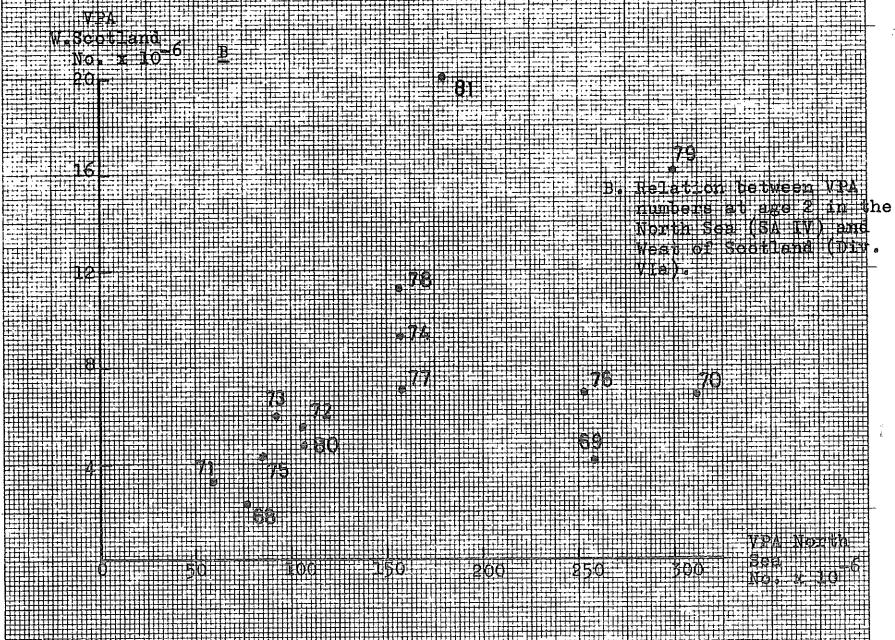


Figure 4-3 HADDOCK Recruitment at age 1

125

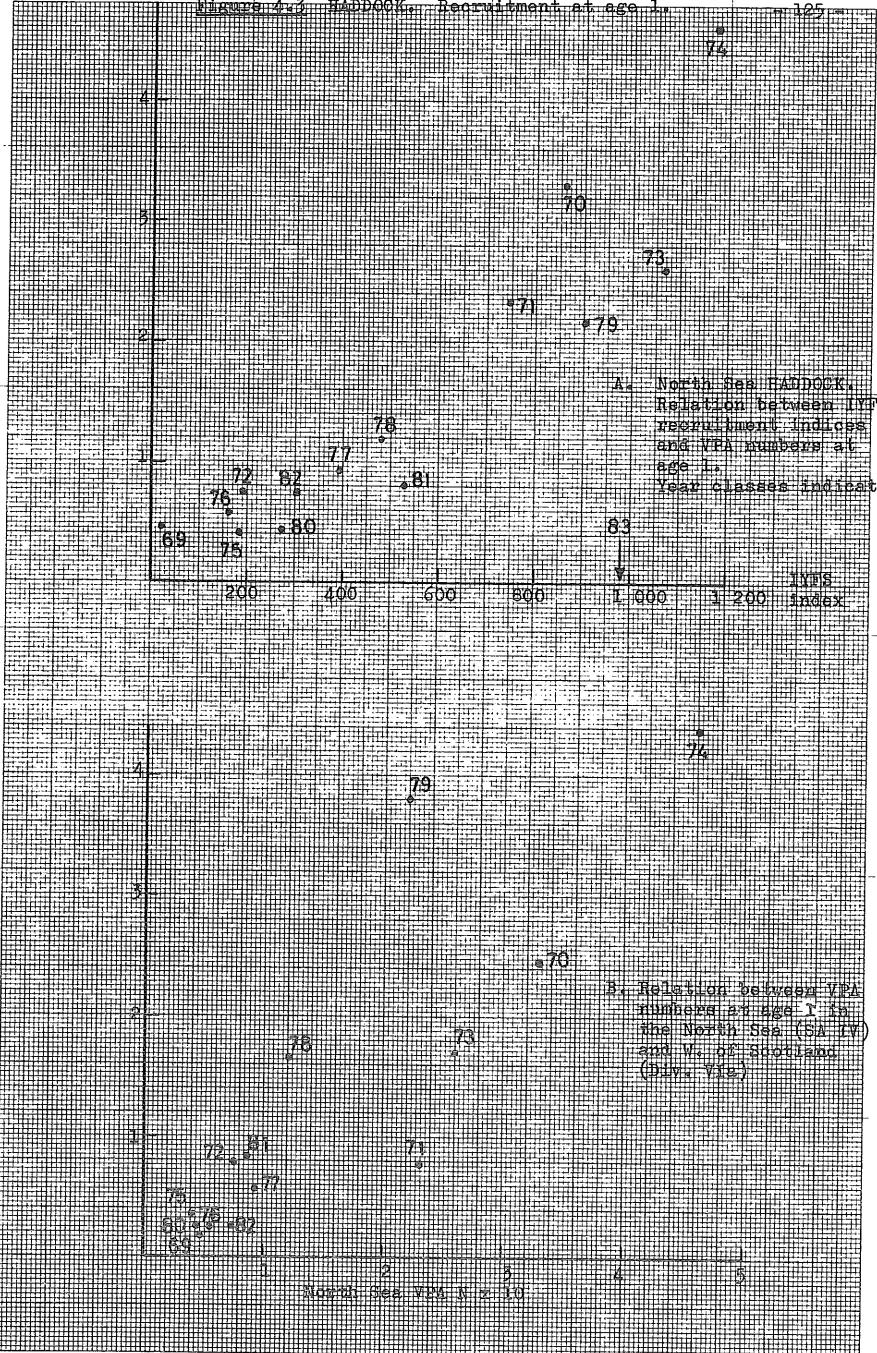
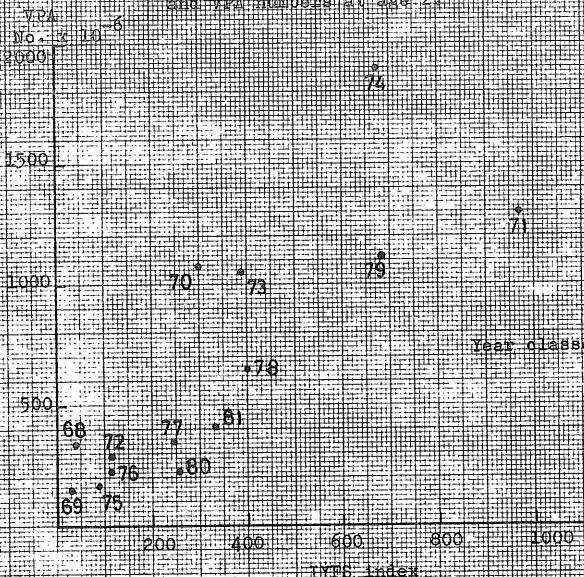
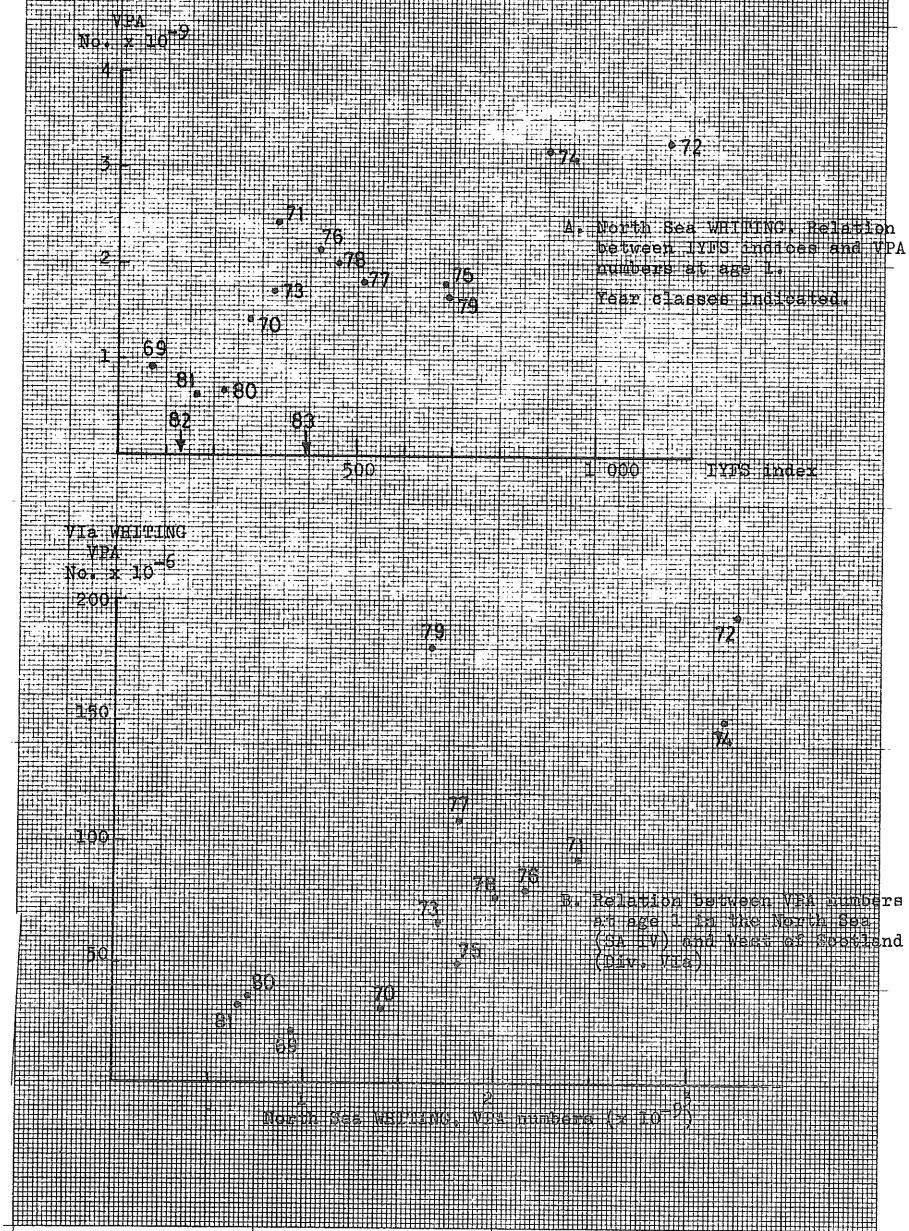


Figure 4.4. North Sea haddock  
Relation between 1978 recruitment index  
and VPA numbers at age 2.



Year classes indicated.

Figure 4.5 North Sea WHITING  
Recruitment at age 1.



Plots for Area NPA 21 (Nord-Nord-Ost) = Norwegian Sea - 21, 900-12, 000 m.

VPA  
No.  $\times 10^{-9}$

200  
100  
0

\*74  
\*72

77 78 79

\*76

73

70

81 \*80

69

\*58

500

a. North Sea WHITING Relation  
between LYTS recruitment  
Indices and VPA numbers at  
age 2+

Year classes indicated

LYTS

1.000 Index

Inv. VPA WHITING  
VPA No.  $\times 10^{-6}$

800

100

0

b. Relation between VPA numbers  
at age 2 in the North Sea  
(SA IV) and west of  
Scotland (Dovey VPA)

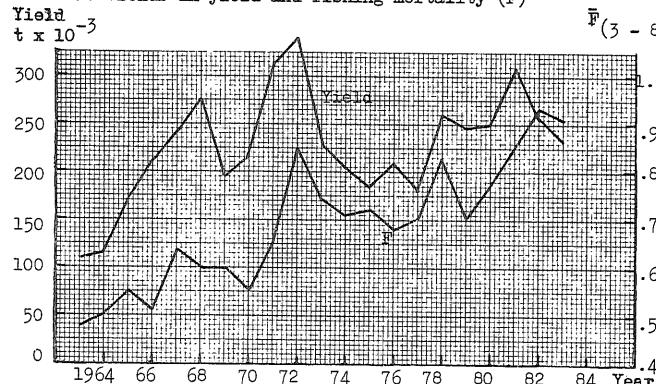
79  
\*78  
77  
76  
75  
74  
73  
72  
71  
70  
69  
68  
67  
66  
65  
64

b. VPA 100  $\times 10^{-6}$

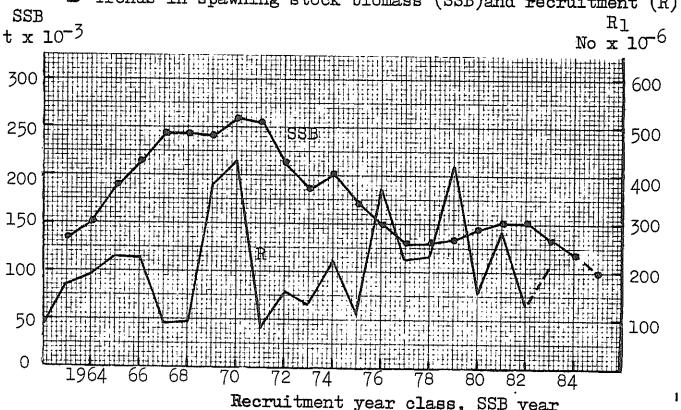
Figure 5.1.

## F I S H   S T O C K   S U M M A R Y

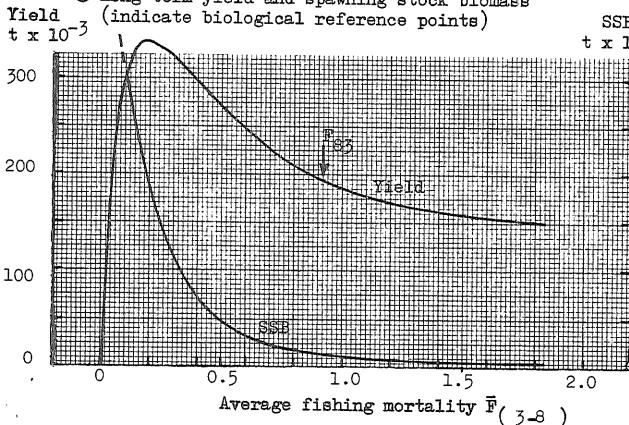
(uk) North Sea COD (Sub-area IV)

A Trends in yield and fishing mortality ( $\bar{F}$ )

B Trends in spawning stock biomass (SSB) and recruitment (R)



C Long-term yield and spawning stock biomass (indicate biological reference points)



D Short-term yield and spawning stock biomass in 1985 (indicate biological reference points)

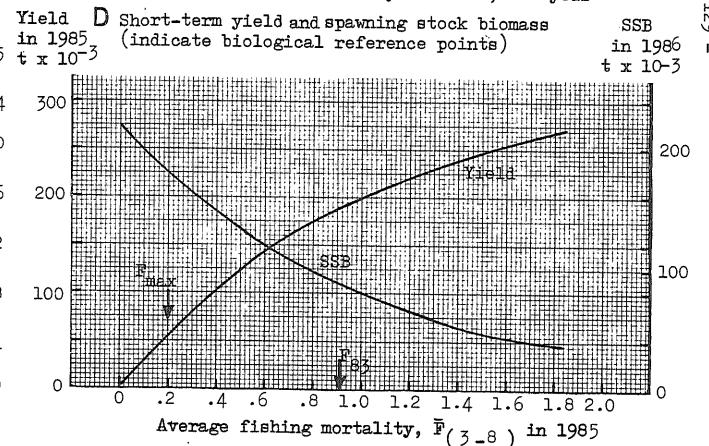
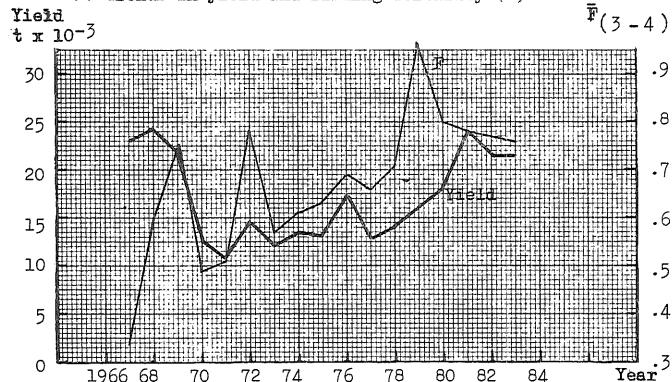


Figure 6.1.

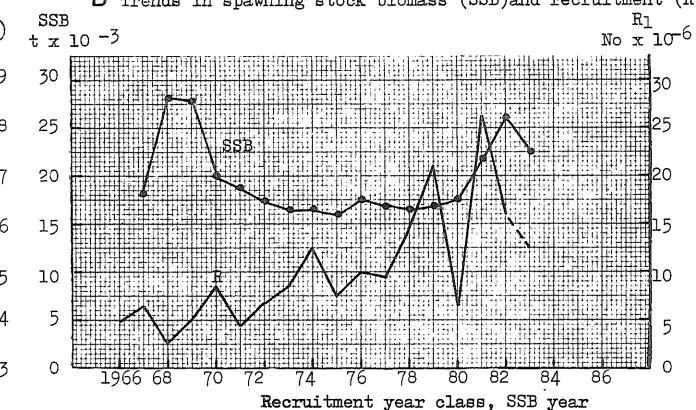
F I S H   S T O C K   S U M M A R Y

(Stock) West of Scotland COD (Div. VIIa)

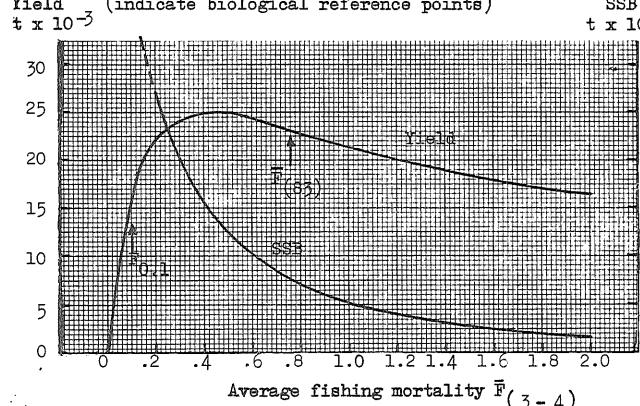
A Trends in yield and fishing mortality ( $\bar{F}$ )



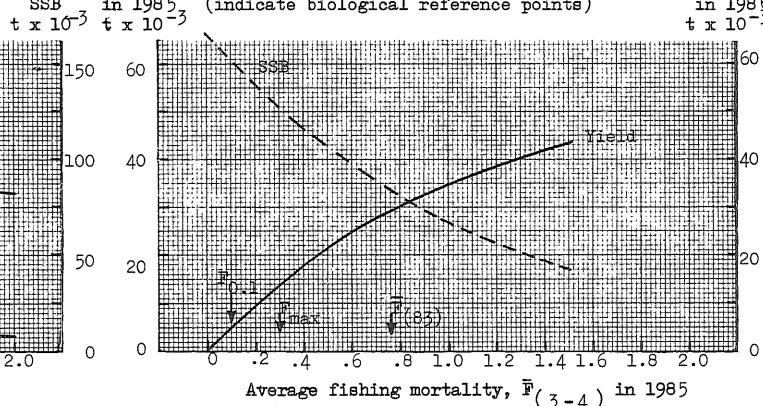
B Trends in spawning stock biomass (SSB) and recruitment (R)



C Long-term yield and spawning stock biomass  
(indicate biological reference points)



D Short-term yield and spawning stock biomass  
(indicate biological reference points)



**Figure 9.1. FISH STOCK SUMMARY**

(Stock) North Sea HADDOCK

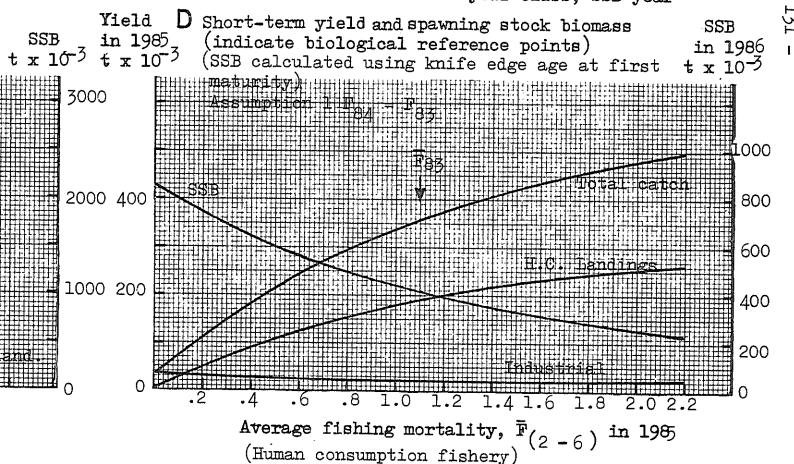
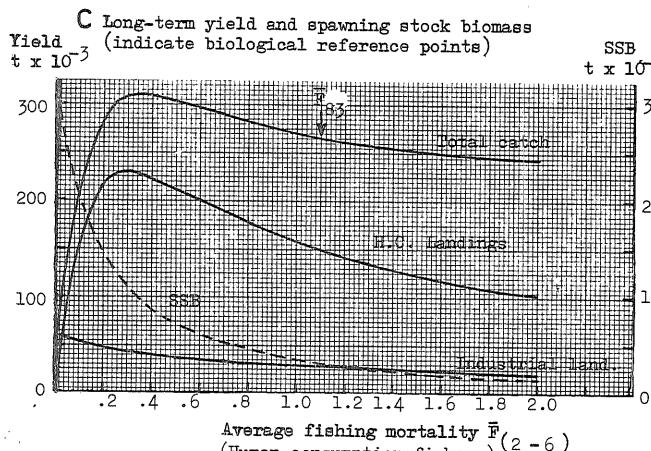
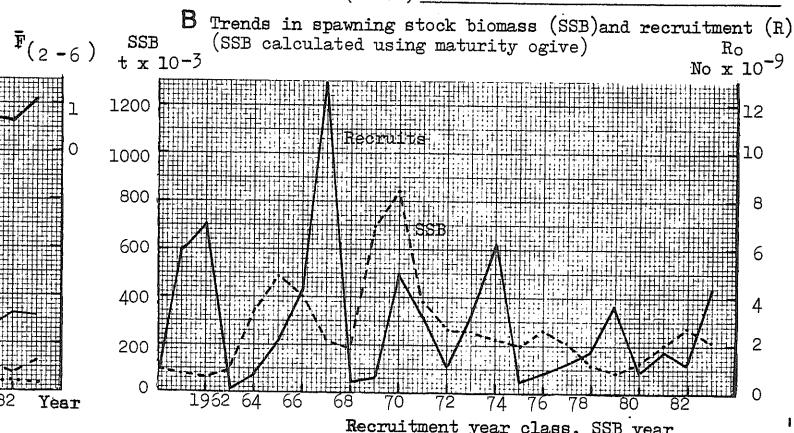
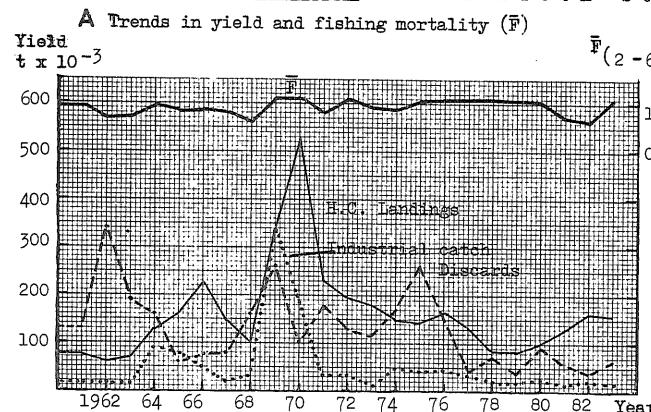
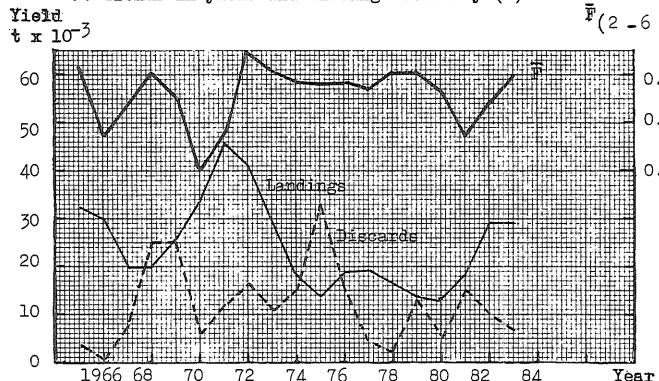


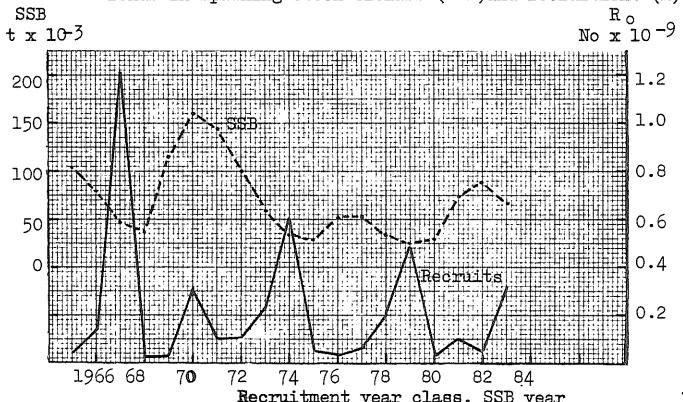
Figure 10.1. F I S H S T O C K S U M M A R Y

(Stock) HADDOCK in Division VIIa

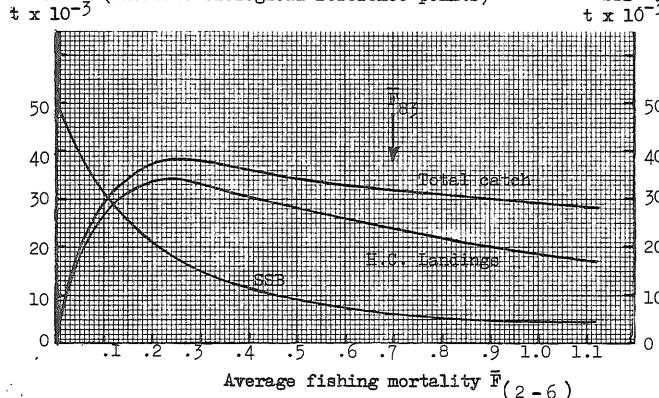
A Trends in yield and fishing mortality ( $\bar{F}$ )



B Trends in spawning stock biomass (SSB) and recruitment (R)



C Long-term yield and spawning stock biomass  
(indicate biological reference points)



D Short-term yield and spawning stock biomass  
(indicate biological reference points)

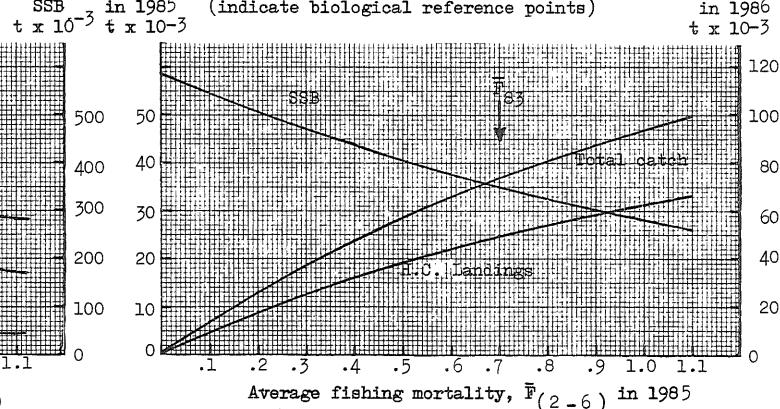
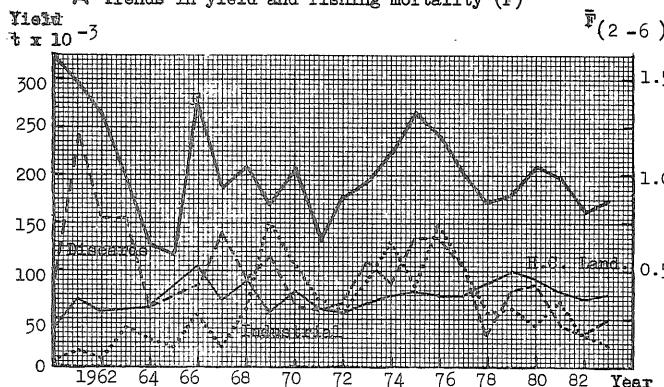


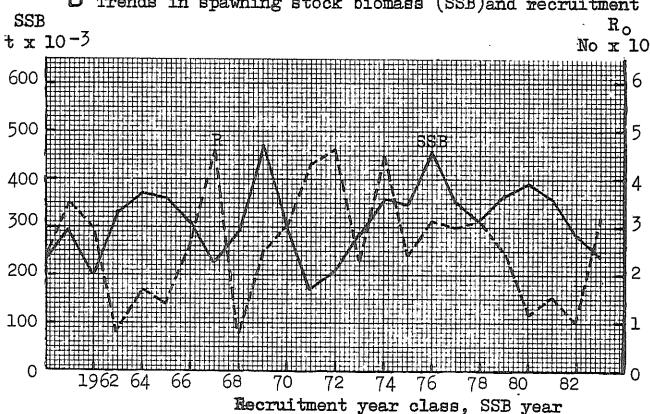
Figure 13.1.

## FISH STOCK SUMMARY

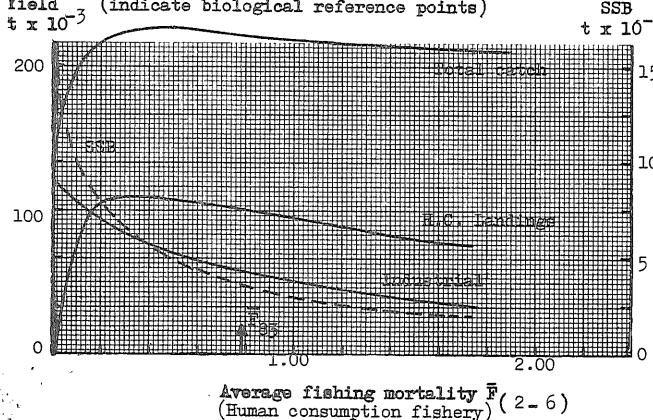
(Lk) North Sea WHITING

A Trends in yield and fishing mortality ( $\bar{F}$ )

B Trends in spawning stock biomass (SSB) and recruitment (R)



C Long-term yield and spawning stock biomass (indicate biological reference points)



D Short-term yield and spawning stock biomass (indicate biological reference points)

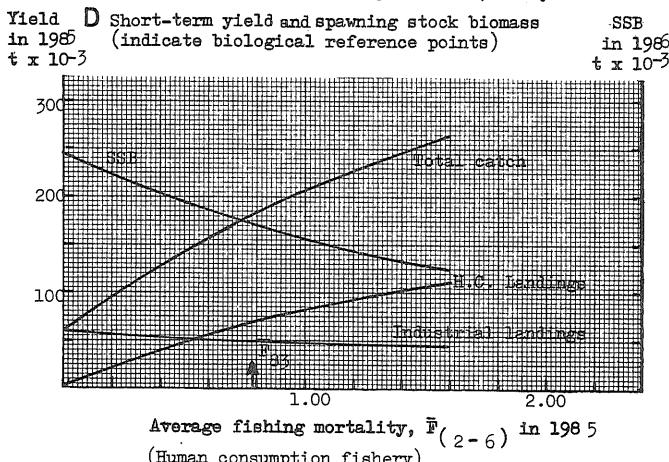
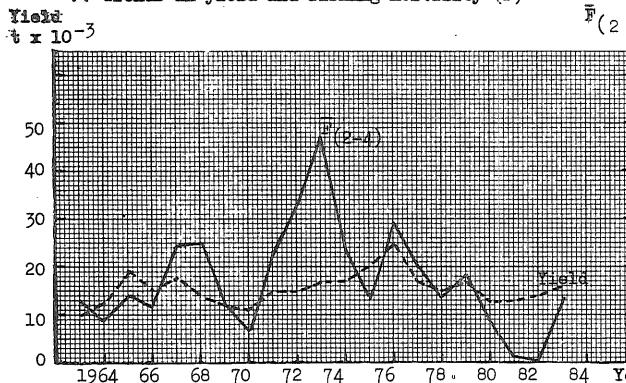


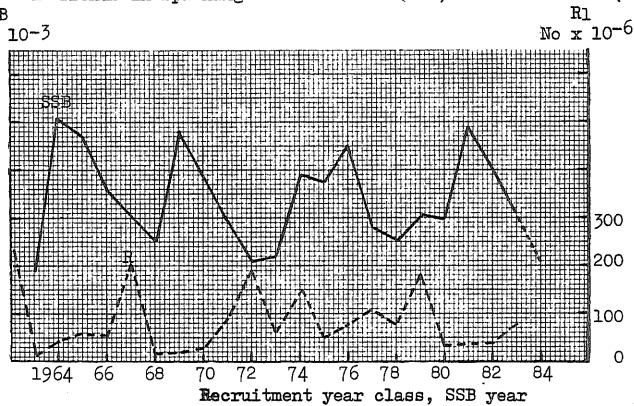
Figure 14.1. FISH STOCK SUMMARY

(Stock) WHITING in Division VIa

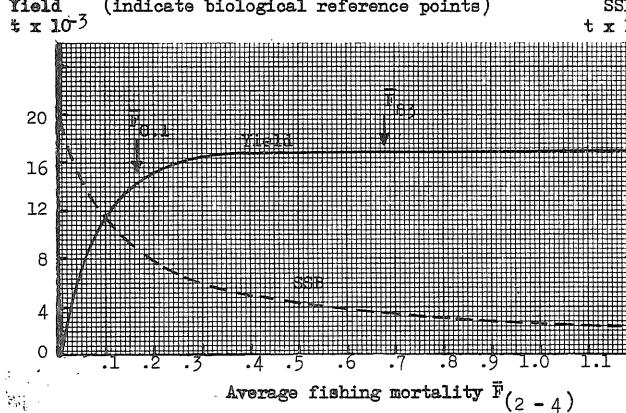
A Trends in yield and fishing mortality ( $\bar{F}$ )



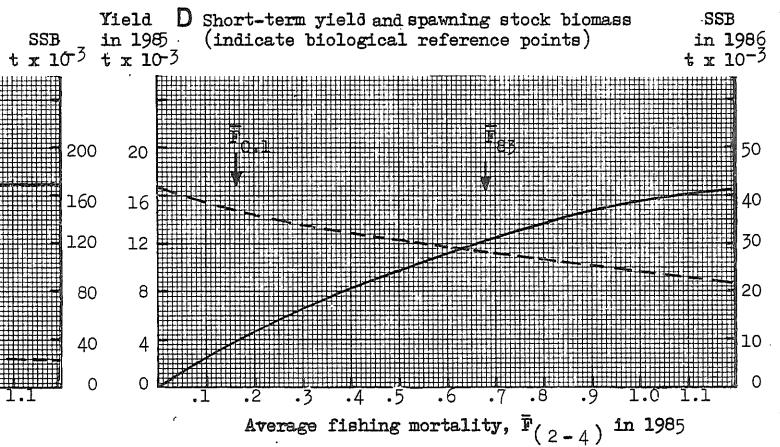
B Trends in spawning stock biomass (SSB) and recruitment (R)

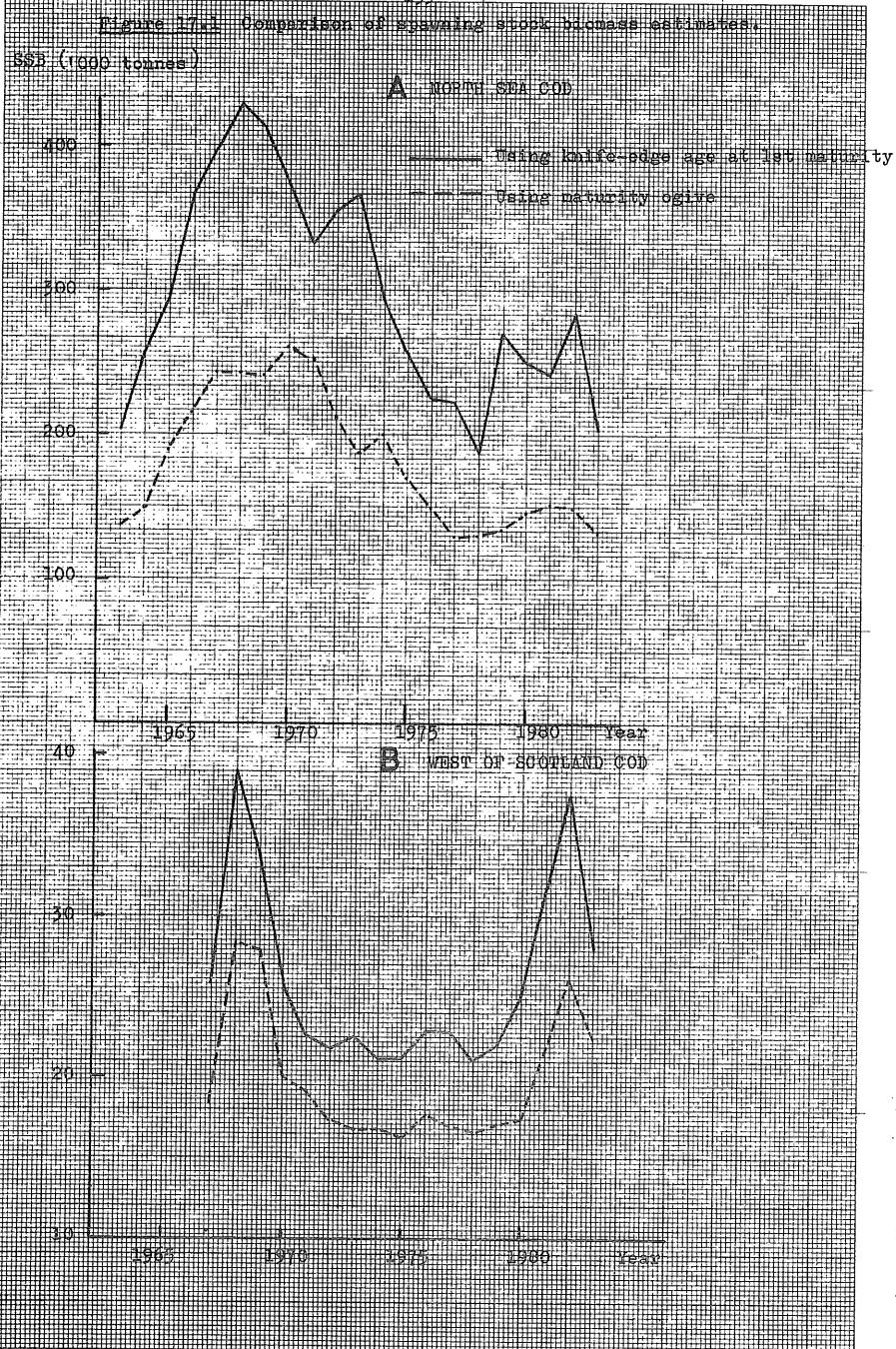


C Long-term yield and spawning stock biomass  
Yield (indicate biological reference points)  
 $t \times 10^{-3}$



D Short-term yield and spawning stock biomass  
Yield in 1985 (indicate biological reference points)  
 $t \times 10^{-3}$





FIGURES 17 & 18 Comparison of spawning stock biomass estimates

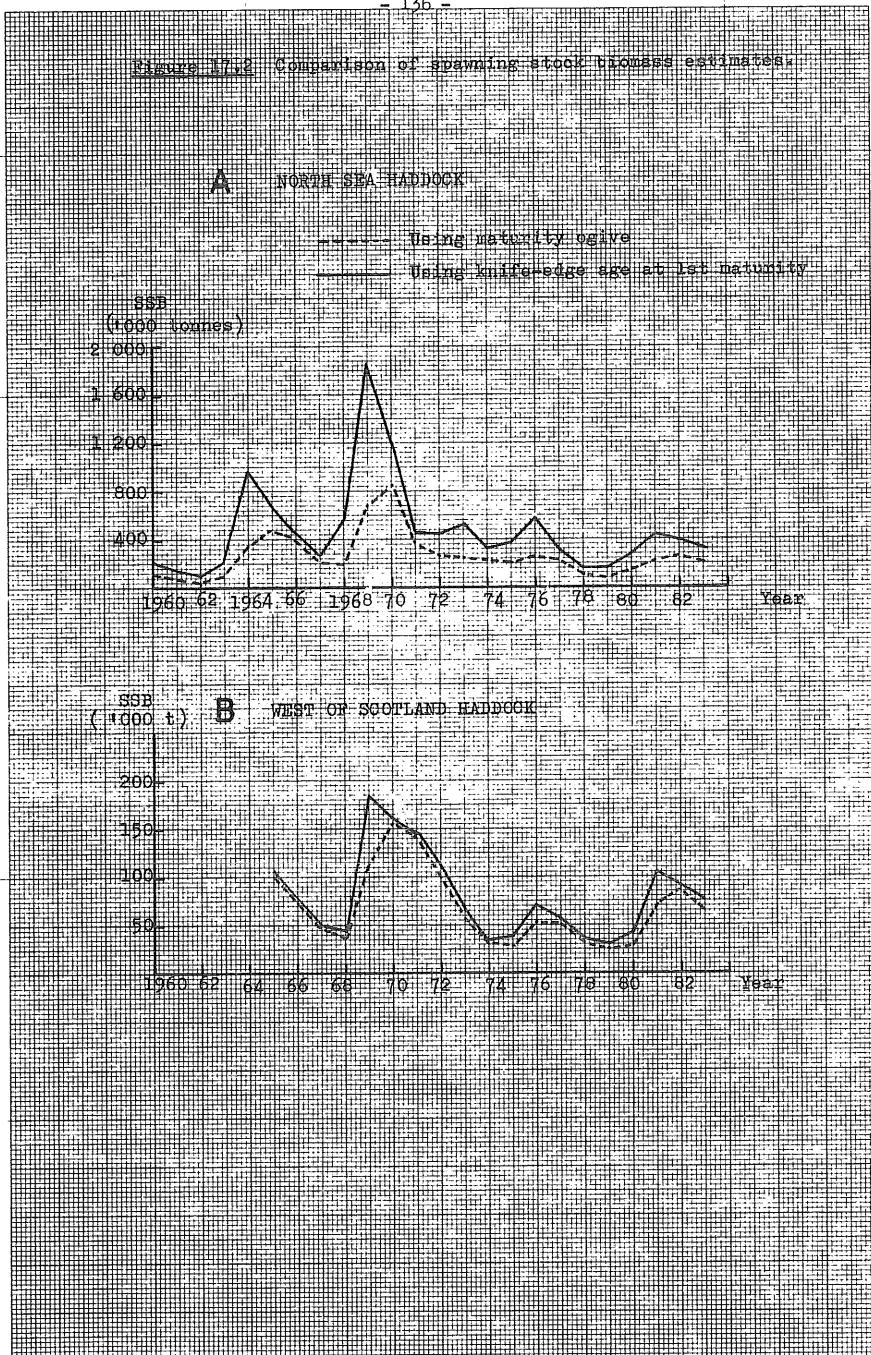


Figure 17.3 North Sea WHITING  
Comparison of spawning stock biomass estimates.

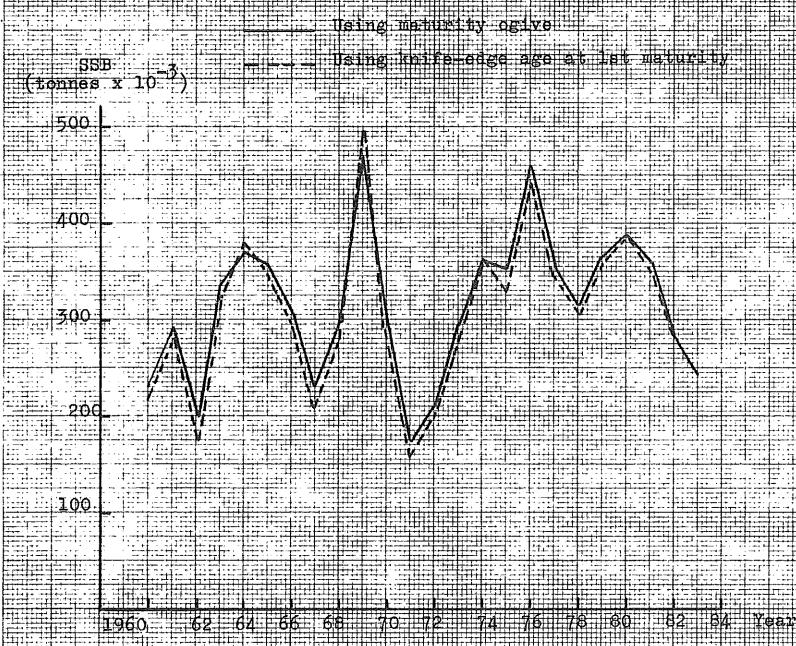


Figure 19.1 Von Bertalanffy growth curves.

