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REPORT OF THE NORTH SEA ROUNDFISH WORKING GROUP

Copenhagen, 9-20 March 1987

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2 TERMS OF REFERENCE

At the 1985 Statutory Meeting of ICES, it was decided (C.Res. 1986/2:5:7) that the North Sea Roundfish Working Group should meet from 9-20 March 1987 at ICES Headquarters to:

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

b) examine the evidence for changes in catchability in both commercial fisheries and research surveys and evaluate the consequences;

c) assess the status of and provide catch options for 1988 within safe biological limits for the stocks of cod, haddock, whiting, and saithe in Sub-areas IV and VI (also including Division IIIa for saithe); cod, haddock, and whiting in Divisions VIId, e and VIIb,c,h-k (also including Division VIIg for haddock); and saithe in Sub-area VII;

d) provide quarterly catch-at-age and catch and stock mean weight-at-age data and information on the relative distribution at different ages by quarter for North Sea cod, haddock, whiting, and saithe for 1986 as input for the Multispecies VPA.

2.1 Data Base Revisions

Preliminary data were prepared for 1986 and amendments were made to the 1985 data.

The Group's data base and programs were transferred to the IBM microcomputer recently installed at ICES. No attempt was made to update the data base on the NORD computer.

2.2 Problems in Maintaining a Valid Data Base

Problems with the Dutch landings statistics are still in evidence. Official Dutch landings data consist only of the total weight landed of each species by quarter. No information is available on the weight landed by gear or the composition in market categories, and this leads to problems and possible errors in the derivation of catch-at-age data. Furthermore, no effort data are available

Estimates based on only very limited biological sampling were available of the number at age of whiting and haddock in the Danish industrial by-catch in 1986, although an estimate was available of the total weight caught of each of these species. Especially when taken in conjunction with the poor Danish data on by-catch age composition for 1984 and 1985 (also brought about by the refusal of Danish fishermen to allow sampling by the Danish Institute), this has caused a serious further reduction in the validity of the international catch-at-age data base. The fact that the Danish Institute is currently being prevented from obtaining biological samples is, in effect, reducing the value of other nations' data.

It must be stressed, therefore, that the Group possesses very poor estimates of the age composition of the Danish by-catch of haddock and whiting in the North Sea in 1984, 1985, and 1986 and any work on these species presented in this report must be interpreted with this fact in mind.

It should also be noted that no material improvement in this situation has occurred in the first quarter of 1987, so it is likely that the Group will experience the same problems at its next meeting.

3 OTHER MATTERS

3.1 Data on Maturity

In 1984, the Working Group started to use maturity ogives for North Sea cod, haddock, and whiting based on the results from the International Young Fish Survey in 1981 and 1982. Before that time, knife-edge maturity ogives were used.

Maturity data have now become available for the years 1983-1985. Maturity data for the period 1981-1985 are presented in Table 3.1. Except for the value of 1% mature cod at age 1, which seems to be an exceptional value, there are no great discrepancies between the average percentage mature fish at age over the period 1981-1985 and the values used by the Working Group in the last years. The Group, therefore, decided not to change the maturity ogives for North Sea cod, haddock, and whiting.

For North Sea saithe, new data for the proportion mature at each age were provided by Norway, derived from observations made on a research vessel survey (Table 21.4).

3.2 Natural Mortality Rates

For all roundfish species in the North Sea except saithe, new estimates of natural mortality rates, resulting from MSVPA, were available from the report of the ad hoc Multispecies Assessment Working Group (Anon., 1987, Table 2.8.2). For North Sea cod, the new estimates were virtually identical to those used in last year's assessment, and, therefore, they were not changed. For North Sea haddock and whiting, there were slight differences and, therefore, minor adjustments to some values have been made, as shown below.

	Haddock		Whiting	
Age	Old	New	Old	New
0[1]	2.05	2.05	2.25	2.55
1	1.45	1.65	0.95	0.95
2	0.35	0.40	0.45	0.45
3	0.25	0.25	0.35	0.35
4	0.25	0.25	0.30	0.30
5	0.20	0.20	0.25	0.25
6	0.20	0.20	0.25	0.25
7	0.20	0.20	0.20	0.20
8+	0.20	0.20	0.20	0.20

[1] Values refer to the period July-December.

3.3 Yield per Recruit

At the request of ACFM, yield-per-recruit curves have been included in the report. However, the Group wishes to restate its view that single-species yield-per-recruit curves may be misleading in terms of formulating long-term management objectives. This view is supported by the work of the ad hoc Multispecies Assessment Working Group.

3.4 Catch Prediction Methods

Shortly before last year's meeting, the Working Group was informed of the recommendation of the Methods Working Group on the use of Fs in catch prediction when N had been estimated from a survey index. Since then, more work on the problem has been done by the Multispecies Working Group, and the recommendation was endorsed. The Working Group, therefore, decided to implement the recommendation. The catch prediction procedure is as follows:

a) Where an F in the last data year is estimated from a tuning method, then this same F is used to calculate N at the start of the first prediction year.

b) Where an F in the last data year in VPA is calculated to be consistent with a year-class estimate in the same year, the F is not used to carry the N forward into prediction. Instead, a recent average F is used. This procedure is followed to reduce the sensitivity of the prediction to arbitrary changes in M at age or revisions to survey indices.

In this year's assessment, the Fs for 1986 which differ in the VPA table and the input to catch prediction table are as follows:

Stock	Age 1	Age 2
Cod IV	+	-
Cod VIa	+	-
Haddock IV	+	-
Haddock VIa	+	-
Whiting IV	+	-
Whiting VIa	+	-
Saithe IV	+	+
Saithe VI	+	+

Further background to this topic can be found in Anon. (1986a, 1986b, and 1987).

3.5 Changes in Catchability in Commercial Fleets and Research Vessel Surveys

This Working Group introduced the "Rho method" in 1983 and "catchability analysis" in 1985. For each of these methods, graphs and tables of catchability by year and by fleet have been presented to ACFM. These graphs constitute the evidence that catchability has changed within the various commercial fleets for which effort data are available. (The graphs and tables were not included in the report for the last few years because there were too many of them.)

Similarly, last year, the Group presented graphs and tables of research vessel catchabilities for various research vessel surveys. These are again presented in the sections relating to each stock and constitute the evidence for changes in research vessel catchability.

The consequence of our knowledge of these changes in catchability is that methods for estimation of fishing mortality rate or number of fish in the sea must accommodate the possibility that the data on which they operate may be affected by catchability changes. Some methods with this property are now available (Annex 1) and extensions of these methods and/or other methods are being investigated.

The requirement for estimation methods which accommodate changes in catchability can be demonstrated with reference to the estimation of the abundance of the 1986 year class of haddock. Using methods described later in this report, the Group estimated the abundance of this year class at age 1 as 7,500 million. Had the Group adhered to the "traditional" regression of VPA on IYFS in-

dex (which assumes constant catchability), the estimate would have been 9,368 million.

3.6 Calculation of Biomass Values at 1 January

As pointed out by Dr E. Ursin in a letter to the Group's chairman, O-group fish do not exist on 1 January and to include them in biomass calculations for that date is illogical. Accordingly, O-group fish have been excluded from biomass calculations in this report.

4 VPA TUNING METHODS

The Group again employed the catchability analysis described in Appendix 2 of the 1985 report of the North Sea Roundfish Working Group (Anon., 1985) to estimate mortality rates of fish of ages 2 and older.

Effort data and associated age compositions exist for the fleets indicated in the text table below. The data and associated programs are available in the ICES data base and can be accessed on the IBM microcomputer. Tables of the data have not been presented in this report.

		Cod		Haddock		Whiting		Saithe	
Nation	Gear	IV	VIa	IV	VIa	IV	VIa	IV	VI
England	Trawl	+	-	-	-	-	-	+	-
England	Seine	+	-	-	-	-	-	-	-
France	Trawl	-	-	-	-	-	-	+	+
Scotland	Trawl	+	+	+	+	+	+	+	+
Scotland	Seine	+	+	+	+	+	+	+	+
Scotland	Light trawl	+	+	+	+	+	+	+	+
Scotland	Nephrops trawl	+	+	+	+	+	+	+	+

Graphs of fishing effort for the gears and areas in the text table above are shown in Figures 4.1 and 4.2.

5 ESTIMATES OF RECRUITMENT

5.1 Indices Available

International Young Fish Survey (IYFS) indices for 1- and 2-group cod, haddock, and whiting were available for the period 1970-1985 (Anon., 1986c).

For the survey in 1986, indices were calculated by the IJmuiden Laboratory, using a data set provided by ICES. However, this data set is still not complete, so the 1986 indices should be regarded as provisional.

For the survey in 1987, preliminary 1-group estimates were available. These indices are based on a split of the length

distributions of 530 hauls. The number of 1-group fish is assumed to be equivalent to the number of cod <25 cm, haddock <20 cm, and whiting <20 cm. Tapes with length distribution by haul for the 1987 survey were sent to ICES immediately after the end of the survey by most of the participating countries. Age-length keys by roundfish area for cod, haddock, and whiting were brought to the Working Group meeting by England, Netherlands, and Scotland.

The Working Group wishes to stress here that their use of the results of the International Young Fish Survey is impeded by the fact that 1) not all nations had, at the beginning of the Working Group meeting, provided ICES with data for the 1987 survey, and one country had not yet provided final data for the 1986 survey, and 2) the ICES Secretariat is still not capable of producing indices from the IYFS data base.

Programs developed by the Danish Institute were used, therefore, to derive mean numbers per age group per roundfish area using the data on length distributions from the ICES IYFS data base and the age-length keys available, and from these, 2-group ind ices were calculated.

It should be stressed that these 2-group indices are to be considered as provisional because 1) they were calculated on an incomplete set of data, 2) only hauls which were positive for a certain species were used to calculate the mean number of fish per haul, and 3) in the analysis, all hauls in the different roundfish areas were included, although not all these hauls were made within the standard area for the different species.

In the course of the meeting, output from a program developed at ICES became available which also gave length distributions by roundfish area. For cod, the output was compared with the results of the analysis done at the Danish Institute, and both gave comparable figures. The length distributions produced at ICES were based on data from one more country.

Indices from the English (EGFS) and Dutch Groundfish Surveys (DGFS) were updated, and data from the Scottish Groundfish Survey (SGFS) were included in the different tables giving the survey indices. The 1986 by-catch data of young cod in the shrimp fishery by the Federal Republic of Germany (FRGSF) became available too late to be included in the analysis of survey indices.

5.2 Use of Indices

During past meetings of the Working Group, input values for VPA for the youngest age groups in the most recent year were derived from inspection of the regression plots of survey index against VPA.

Last year, the Working Group pointed out that there had been changes in the catchability in the different surveys and decided to take these changes into account. Mean catchabilities over a recent period were used to predict the number of 1- and 2-group fish.

This year, a number of new methods were available, referred to as the "Shepherd method", the "Cook method", and the "catchability tuning". These methods are concerned with using all available indices simultaneously to arrive at the recruitment estimates for recent years. The Working Group adopted the methods which take into account changes in catchability. The different methods are described in Annex 1.

6 SAFE BIOLOGICAL LIMITS

In a letter to assessment working group chairmen (12 January 1987), ACFM requested that working groups should again "try to define safe biological limits for the stocks which they assess and to indicate whether sufficient data exist on which to base a definition."

In referring to this problem last year, the Group indicated that the approach taken to this problem by the Irish Sea and Bristol Channel Working Group is a reasonable one and it has been used in commenting (wherever possible) on this topic throughout the text.

In addition to this, ACFM is offered (again wherever possible) levels of spawning stock biomass for consideration as "minimum acceptable" levels. In each case, the value chosen is the minimum spawning stock level from which the stock is known to have recovered since the early 1960s.

ACFM will, of course, be aware that if it adopts these (or other) values, they will be subject to amendment if further changes are made to values of natural mortality rate and/or maturity ogives.

The Group feels that, in the absence of discernable stock/recruitment relationships for any of the stocks dealt with in this report, it is not advisable to extrapolate beyond the range of the historical data, and the approach adopted is the best available at present.

7 RECENT MESH CHANGE IN THE NORTH SEA DEMERSAL FISHERIES

From 1 January 1987, the legal minimum mesh size to be used when fishing for roundfish species in the European Economic Zone of the North Sea was increased from 80 to 85 mm. In principle, this change should be incorporated into any catch predictions made for 1987 and 1988 and into any long-term calculations. In practice, incorporating the effects of this change raises a number of problems.

The true mesh size used by some fleets is not known and may be below the previous legal minimum, and it is by no means certain that such fleets will be affected by the change in the regulations. Conversely, it is known that some vessels voluntarily or as a result of enforcement of the 100 mm legal minimum in the Norwegian sector use mesh sizes well in excess 80 mm, and these vessels will not be affected by the change. The number of vessels using mesh sizes greater than the legal minimum is not known. Furthermore, recent work (as yet unpublished) carried out in Scotland indicates that legally acceptable gear used by some

seiners has selection factors far lower than those previously thought to be the case.

The best that can be done at present is to assume that all vessels fishing for human consumption were using 80 mm mesh in 1986 and started to use 85 mm on 1 January 1987. Estimation of the effect of the mesh change can then be carried out using methods and parameter values described in the 1984 report of this Working Group (Anon., 1984). This was done for haddock and whiting during the course of this meeting, and the results (assuming constant fishing effort in 1986, 1987, and 1988) are summarized below. The catch predictions for cod and saithe will not be significantly affected by an increase in mesh size to 85 mm.

Year	Category	Predicted catch ('000 t)			
		Haddock		Whiting	
		80 mm	85 mm	80 mm	85 mm
1987	Human consumption	159	151	80	64
	Discards	99	75	78	69
	Industrial by-catch	5	5	27	27
1988	Human consumption	188	185	104	91
	Discards	113	94	82	71
	Industrial by-catch	5	6	30	32

For haddock, the short-term loss occurs almost entirely in discards. For whiting, however, short-term losses of 20% and 8% are predicted for 1987 and 1988, respectively. It should be noted that these short-term losses are relative to predicted catches assuming no mesh change. Even if a mesh change is assumed, the predicted status quo catches for 1987 and 1988 are considerably bigger than the catch in recent years.

The Group stresses that, because of the problems related to carrying out this mesh assessment, the results indicated above should be treated with extreme caution. Furthermore, the Group incorporates would like to remind ACFM that this assessment incorporates age-variable values of natural mortality rate, whereas the most recent previous mesh assessment incorporated constant (0.2) M at age.

8 QUARTERLY-CATCH-AT-AGE DATA

Countries supplying annual age composition data for 1985 and 1986 also provided quarterly age compostions for North Sea stocks. There was insufficient time at the meeting to work up these data. The Working Group notes that the Multispecies Working Group will not meet until 1988, by which time the 1986 age compositions will, in any case, have to be revised since current data are provisional. Since the compilation of the data is an arduous, time-

consuming, irritating, and thankless job, there seems little purpose in compiling the data at present.

To date, all the spade work in setting up the roundfish data base for the Multispecies Working Group has been done at the Scottish Laboratory. The overworked Scots would be extremely appreciative of offers of assistance in the maintenance of the data. The Working Group points out that software for working up the data now exist at ICES headquarters and invites the Multispecies Working Group to make use of these facilities.

9 NORTH SEA COD

9.1 Catch Trends

Recent nominal landings are given in Table 9.1. Provisional landings in 1986 were 148,700 t, a fall of 20% compared with 1985. The Working Group estimate of landings (Table 9.2, Figure 9.2A) in 1986 was 157,000 t and 192,000 t in 1985. The agreed TAC for 1986 was 170,000 t and the Working Group status quo catch prediction was 167,000 t, revised by ACFM to 147,000 t.

9.2 Age Compositions

The VPA input data for recent years are given in Table 9.5. The data do not include discards or industrial fishery by-catches. Data for 1985 were revised and provisional data for 1986 were provided by Scotland, France, Denmark, Federal Republic of Germany, Netherlands, and England.

9.3 Recruitment

The methods employed for deriving estimates of recruitment are described in Section 5 and Annex 1. The recruitment indices given by the various surveys are shown in Tables 9.9, 9.10, and 9.11, and the estimates derived from various methods for combining the indices are given in Table 9.12.

9.3.1 1984 year class in 1986

The catchability-tuned F at age 2 in 1986 implies a year-class strength of 37 million and this value is consistent with those derived from surveys.

9.3.2 1985 year class in 1986 and in 1987

Abundance indices were available from IYFS, EGFS, DGFS, and SGFS. The surveys produced estimates of numbers in the sea which ranged between 537 and 1,011 million (Table 9.10). A value of 730 million at age 1 was estimated for this year class, reflecting results obtained from methods which take account of changes in catchability. This value is similar to the value of 790 million estimated by the Group last year.

The IYFS estimate of 400 million for this year class at age 2 in 1987 implies a value at age 1 in 1986 of about 1,000 million,

assuming average F in 1986, and this value is well in excess of any previously recorded. In view of this and the provisional nature of the data (see Section 5), the estimate was not accepted.

At its November 1986 meeting, ACFM estimated a value of 500 million for the 1985 year class at age 1, based on EGFS and preliminary DGFS data. This value, together with the catch at age 1 in 1986, implies an F of 0.25 on 1-year-olds in 1986, which is well above any value previously recorded in the VPA. The Working Group estimate of 730 million implies an F of 0.17, which is consistent with recent values. The Group, therefore, adopted a value of 730 million at age 1 in 1986.

9.3.3 1986 year class in 1987

The preliminary estimate for this year class from IYFS is 410 million, which implies that it is of average strength. The indications at age 0 last year were that it was below average, and ACFM accordingly adopted a conservative estimate of 100 million in November last year. The Group adopted a value of 410 million at age 1 in 1987.

9.3.4 1987 and later year classes

These were set at 432.5 million at age 1, the mean value for the period 1967-1984.

9.4 Weight at Age

The mean weight at age in the stock was assumed to be the same as in the catch, and the data are given in Table 9.6.

9.5 Fishing Mortality in 1986

For ages 2-7, F values were determined using the catchability analysis method (Table 9.3). For ages 8 and older, a smoothed value of 0.9 was adopted. The input Fs for 1986 are slightly lower than those estimated last year for 1985 (mean F = 0.91 compared with 1.003).

9.6 Fishing Mortality at the Oldest Age

Smoothed values were determined from inspection of Fs averaged over ages 5-7, and are the same as those used last year.

9.7 VPA Results

Fishing mortalities for recent years are given in Table 9.7, and mean F for ages 2-8 is graphed in Figure 9.2B. Mean F continues to show an upward trend, with the 1986 value the highest yet recorded.

Stock numbers and biomasses are given in Tables 9.8 and 9.13. Recruitment at age 1 is shown in Figure 9.2C. The sequence of alternate high and low recruitment, remarked upon last year, seems to have been broken by the 1986 year class which appears on preliminary assessment to be of average strength. Spawning biomass continues to decline, with the 1986 level the lowest on record. Due to slightly lower input Fs estimated this year, stock sizes for recent years are slightly higher than those estimated last year, but the trend is unaltered.

9.8 Catch Predictions

The input data for the catch prediction are given in Table 9.14. For reasons given in Section 4, F for age 1 in 1986 is different from that used as input F for VPA. The results of the catch prediction are given in Tables 9.15 and 9.16.

The status quo catch prediction (Table 9.15) is 253,000 t for 1987, and 233,000 t in 1988. Spawning biomass is predicted to increase slightly from 95,000 t in 1986 to 104,000 t in 1989, assuming average recruitment in 1988.

The TAC for 1987 is 125,000 t and the current assessment indicates that such a TAC implies a 60% reduction in F, whereas in the ACFM assessment in November last year, a 30% reduction was implied. Under the current assessment, a 30% reduction in F (Table 9.16) in 1987 yields a catch of 198,000 t, and a catch of 220,000 t in 1988 if this level of F is maintained. Spawning biomass would rise to 135,000 t in 1988 and to 175,000 t in 1989.

The current status quo catch prediction for 1987 of 253,000 t compares with the prediction of 243,000 t made by the Working Group last year, but it differs significantly from the ACFM prediction of 157,000 t made in November 1986. The difference between the Working Group and ACFM predictions is mainly due to the higher levels of recruitment estimated by the Working Group for the 1985 and 1986 year classes, as explained in Section 9.3.

The Group notes that an additional technical measure to protect young cod in the German Bight was introduced on 1 January 1987. Under this regulation, fishing in the first and fourth quarters is banned in certain rectangles except when using 100-mm mesh size, excluding shrimp fisheries. The effect of this regulation on catch predictions could not be assessed by the Group, but any such measure will assist in improving the exploitation pattern.

9.9 Yield and Biomass per Recruit

Yield- and biomass-per-recruit curves are shown in Figure 9.3A.

9.10 Safe Biological Limits

A stock-recruitment plot is shown in Figure 9.4, and no obvious relationship is apparent. However, fishing mortality continues to increase and, despite some good year classes in recent years, spawning biomass continues to decline. The fact that relatively

few fish survive to recruit to the spawning stock is due to the high F and to the relatively slow rate of maturation. Although the recent low levels of spawning stock have produced some strong year classes, the effect on recruitment of lower levels of spawning biomass is unpredictable. Based on the criteria stated in Section 6, the level of spawning biomass in 1977, currently estimated at 140,0000 t, could be considered as a safe minimum level.

10 COD IN DIVISION VIa

10.1 Catch Trends

Recent nominal landings are given in Table 10.1. Provisional nominal landings in 1986 were 14,000 t, compared with 18,500 t in 1985. The TAC for Sub-area VI in 1986 was 25,000 t, while the Working Group estimate of landings in Division VIa (Table 10.2, Figure 10.2A) in 1986 is 12,000 t. The latter value is considerably smaller than the status quo catch prediction of 21,000 t for 1986, made at last year's meeting.

10.2 Age Compositions

The VPA input data for the past 20 years are given in Table 10.6. They do not include discards or industrial fishery by-catches. Revised data for 1985 and provisional data for 1986 were provided by Scotland, France, Ireland, and England.

10.3 Recruitment

10.3.1 1985 year class in 1986

Since there are as yet no recruitment surveys in Division VIa, North Sea indices of recruitment from survey data were analyzed, but none of them were found to be well correlated with VPA estimates. The abundance of this year class was, therefore, estimated from a plot of CPUE for Scottish seiners against VPA (Table 10.4, Figure 10.1B). The CPUE value for age 1 in 1986 gives a predicted VPA value of 14.8 million, similar to the recent mean of 13 million.

10.3.2 1986 and later year classes

These year classes were assumed to be of average strength. To take account of higher levels of recruitment in recent years, the average was calculated for the period 1979-1983, resulting in a value of 13 million.

10.4 Weight at Age

Mean weight at age in the stock (Table 10.7) was assumed to be the same as in the landings.

10.5 Fishing Mortality in 1986

Plots of catchability against year for Scottish fleets showed a high degree of scatter, and it was decided not to use them for estimating F in 1986. Therefore, mean F values for the period 1981-1984 were used as input for 1986, except for age 1, where the F value was adjusted to correspond to the estimated recruitment. In fact, the mean F values input for 1986 are similar to the values estimated from catchability analysis (Table 10.3).

In last year's assessment, F values estimated for 1985 (based on a recent mean) were lower, so that stock numbers were estimated higher. In addition, it now appears that the 1984 year class is only 50% of the strength previously estimated from CPUE data for Scottish seiners.

10.6 Fishing Mortality at the Oldest Age

These estimates are smoothed values determined from inspection of Fs averaged over ages 5-7, and are the same as those used last year.

10.7 VPA Results

Fishing mortalities for recent years are given in Table 10.8, and mean F for ages 2-5 is graphed in Figure 10.2B. There is a trend of increasing F since about 1975. Stock numbers and biomasses are given in Tables 10.9 and 10.10, and biomasses are graphed in Figure 10.2D. Spawning biomass appears to have declined since 1981 to an historically low level, but this conclusion is dependent upon the assumption of a recent mean F in 1986. An upward trend in recruitment is apparent (Figure 10.2C) and the amplitude of fluctuations appears to have increased in recent years.

10.8 Catch Predictions

The input data for the catch prediction are given in Table 10.11. F for age 1 is different from that input for VPA, for reasons given in Section 4. The results of the catch prediction are given in Table 10.12. The status quo catch prediction for 1987 is 15,000 t and 16,000 t for 1988. Spawning biomass is predicted to increase during 1987 to reach 24,000 t by 1 January 1988. The TAC for Sub-area VI (also including the Division Vb EEC zone, Sub-area XII, and Sub-area XIV) in 1987 is 22,000 t. However, it is considered unlikely that this quantity will be taken and, therefore, no corresponding set of catch options for 1988 has been included.

10.9 Yield and Biomass per Recruit

Yield- and biomass-per-recruit curves are shown in Figure 10.3A.

10.10 Safe Biological Limits

a) A stock-recruitment plot is shown in Figure 10.4 . No obvious relationship can be discerned.

b) The spawning biomass has declined since 1981 and is estimated to have been at its lowest historical level in 1986, given the assumption of average F input to the VPA.

c) Under the criteria stated in Section 6, the level of spawning biomass in 1977, currently estimated at 23,000 t, could be considered as a safe minimum spawning biomass.

11 COD IN DIVISION VIb

No age composition data are available from commercial landings from this stock. Nominal landings are small and are given in Table 11.1.

12 COD IN SUB-AREA VII

12.1 Cod in Divisions VIId,e

12.1.1 Catch trends

Nominal landings by nation are given in Table 12.1. Provisional nominal landings in 1986 were 13,800 t and the Working Group estimate was 10,650 t (Table 12.2). The difference is accounted for by landings from some other divisions of Sub-area VII and from Sub-area VIII being included in the nominal landings data for France. The 1986 landings were considerably higher than those recorded in recent years.

12.1.2 Age compositions

Prior to the meeting, the whole data base was revised. During this revision, it became apparent that the sampling intensity between fleets was very variable. French age composition data were available for the period 1974-1986 and English data for the period 1980-1985. VPA input data are given in Figure 12.2.

12.1.3 Recruitment

There are, at present, no recruitment surveys for cod in Divisions VIId,e. Historical numbers at ages 1 and 2 from VPA were examined in relation to estimates of recruitment in the North Sea from surveys, including subsets of IYFS and EGFS data relating to the southern North Sea, and from VPA. However, none of the North Sea recruitment indices showed a significant correlation with the Divisions VIId,e data (Figure 12.1).

12.1.4 Weight at age

The mean weight at age in the stock was assumed to be the same as in the catch (Table 12.3).

12.1.5 Fishing mortality in 1986

Mean values for the period 1979-1983 were used as input for the VPA.

12.1.6 Fishing mortality on the oldest age

A value of 1.0 was adopted for all years, based on inspection of trial VPA data.

12.1.7 VPA results

Historical values for F are given in Table 12.4, and population numbers and biomasses are given in Table 12.5. F values appear to be high and somewhat variable between years and ages. There is apparently no trend in F. Recruitment (age 1) has been fairly constant apart from strong year classes spawned in 1975, 1976, 1984, and 1985.

12.1.8 Catch predictions

It was decided not to perform a catch prediction since a) the reliability of estimates of stock sizes for 1986 is unknown, and b) no estimates of recruitment are available for the fishery for which 1- and 2-year-old fish are an important part of the catch. In particular, the estimate (derived from the catch and average F) of 41.5 million for the 1985 year class seems open to doubt. This value is 6 times greater than the long- term mean, whereas in the North Sea and Division VIa cod stocks, the best year class was twice the average strength.

However,it does appear that there are two strong year classes (1984 and 1985) in the fishery at present and, therefore, TACs in 1987 and 1988 based solely on past catch data will be inappropriate.

12.2 Cod in Divisions VIIb,c and VIIh-k

No age composition data are available. Recruitment data are also lacking. Landings data are given in Table 12.6.

13 NORTH SEA HADDOCK

13.1 Catch Trends

Total international catches and total international discards estimated by the Working Group are given in Tables 13.1 and 13.2. Catch trends are plotted in Figure 13.2A for the period 1967-1986. Total human consumption landings have remained fairly stable since 1981 in the range 130,000-165,000 t. The industrial by-catch has decreased in recent years to well below 10,000 t due to decreased effort in the Danish industrial fishery for Norway pout and increased enforcement of regulations.

The TAC for 1986 was 230,000 t, while preliminary data indicate that landings were 169,000 t.

13.2 Age Compositions

Total international catch-at-age data are given in Table 13.5.

Age compositions for human consumption landings were provided by France, Federal Republic of Germany, England, Denmark, Netherlands, and Scotland. Age compositions for discards were provided by Scotland and for industrial by-catch by Norway and Denmark. The number of samples used to derive the Danish industrial by-catch age compositions was very low and the data are not considered reliable (see Section 2).

13.3 Weights at Age

Total international mean weights at age for the catch are shown in Table 13.6. These were also used as stock weights at age.

13.4 Recruitment

Various methods for estimating recruitment from survey indices were available to the Working Group. These are described in Section 5. The indices used to estimate recruitment are shown in Tables 13.9 and 13.10 and the estimates of year-class abundance derived from these are shown in Table 13.11.

13.4.1 1984 year class in 1985

The estimated size of the 1984 year class at age 1 is in the range 2,000-2,500 million. The catchability-tuned value of F for 2-year-olds in 1986 produces a population of 2,624 million for this year class at age 1. This value was accepted since it is close to the index-predicted values.

13.4.2 1985 year class in 1986

The estimated size of the 1985 year class at age 1 from survey indices is in the range 3,000-4,000 million. The higher value of 4,000 million was adopted, as this value was predicted from methods which take account of catchability changes in research vessel surveys.

13.4.3 1985 year class in 1987

Provisional indices from the 1987 IYFS for 2-year-old haddock were available for the first time at this Working Group. These indices gave an estimate of the 1985 year class at age 2 in 1987 in the range 500-700 million. This is in agreement with the value of 664 million estimated by applying an average F (1981-1985) to the population at age 1 in 1986. The latter figure was, therefore, adopted.

13.4.4 1986 year class in 1987

The estimated size of this 1986 year class at age 1 from survey indices is in the range 7,000-9,000 million. A figure of 7,500 million was adopted reflecting the values predicted from methods which take account of changes in catchability in research vessel surveys.

13.4.5 1987 and subsequent year classes

These were assumed to be of average abundance for the period 1968-1984 (40,731 million at age 0).

13.5 Fishing Mortality Rates

Fishing mortality rates in 1986 for ages 2-7 were estimated from catchability analysis of Scottish seiners and light trawlers (Table 13.3). The F at age 1 in the VPA was adjusted to give a population in 1986 of 4,000 million. The F at age 0 in the VPA was adjusted to give a population at age 1 in 1987 of 7,500 million. F for fish of ages 8 and older was set at 0.9, the same as the value for the oldest fish in all other years.

13.6 VPA Results

Estimates of fishing mortality rates and corresponding stock numbers and biomasses are given in Tables 13.7, 13.8, and 13.12. Historical trends in fishing mortality, spawning stock biomass, and recruitment can be seen in Figure 13.2.

Fishing mortality rates appear to have continued their upward trend noted in last year's report. A further increase in F is consistent with the increase in effort by Scottish seiners and light trawlers (see Figure 4.1) which take about half of the human consumption catch.

13.7 Catch Prediction

Input data for catch prediction are shown in Table 13.13.

The input F in the catch prediction table on age 1 in 1986 is the mean value for 1981-1985 and differs from that in the VPA table. This is in line with the recommendation of the Methods Working Group (see Section 3).

At last year's meeting, the estimate of the abundance of the 1983 year class was substantially revised and this resulted in substantially revised catch predictions of 141,000 t for 1986 compared to the earlier estimate of 238,000 t. The realized catch in 1986 was 169,000 t. Thus, while last year's catch prediction was pessimistic, the downward revision of the 1983 year class appears justified. The fact that the catch in 1986 exceeded the 141,000 t predicted may be because two major Scottish fleets (seiners and light trawlers) increased their fishing effort in 1986.

The foregoing serves to emphasize the sensitivity of catch predictions to estimates of recent year-class size. The current estimate of the 1986 year class indicates that it is above average and it will, therefore, dominate the prediction for 1988. Since the estimate of this year class is based largely on the provisional index from the IYFS, some care in interpretation is necessary.

The status quo landings forecast (Table 13.14) 164,000 t (159,000 human consumption, 5,000 industrial by-catch) which is higher than the agreed TAC of 140,000 t. If the landings in 1987 are restricted to the agreed TAC (Table 13.15), then the predicted landings in 1988 are 218,000 t if F in 1988 = F in 1986. The prediction for status quo landings in 1988 given status quo landings in 1987 is 194,000 t. In either case, the spawning stock biomass is expected to increase by the beginning of 1989. Predicted catches incorporating the recent mesh increase are shown in Table 13.16 (see also Section 7).

13.8 Yield and Spawning Stock Biomass per Recruit

These are shown in Figure 13.3A.

13.9 Safe Biological Limits

1) There is no evidence at present that recruitment to this stock is reduced at the lowest levels of spawning stock which have been observed (Figure 13.4).

2) The spawning stock is not currently at a lower level than previously observed and has remained above 200,000 t since 1981. It is expected to rise in the near future as the 1983 year class matures and should be further augmented by the 1986 year class by 1989. A level of 100,000 t (1979 level) may be considered as the basis for a minimum acceptable level.

3) Levels of F well in excess of those presently estimated would be required to reduce spawning stock biomass to below minimum acceptable levels.

14 HADDOCK IN DIVISION VIa

14.1 Catch Trends

Nominal landings are given in Table 14.1. Landings for human consumption have decreased from 25,068 t in 1985 to 18,243 t in 1986. Discards were estimated to amount to 7,000 t in 1986. The historical development of landings and discards is shown in Table 14.2 and Figure 14.2A. The TAC for 1986 is 34,500 t for Divisions VIa,b, Division Vb (EEC zone), Sub-area XII, and Sub-area XIV.

14.2 Age Compositions

Age compositions of landings were provided by England, France, Ireland, and Scotland. Age compositions of discards were provided by Scotland. International catch-at-age values are shown in Table 14.5.

14.3 Mean Weight at Age

Mean weights at age are given in Table 14.6. The weights are also used as stock weights at age.

14.4 Recruitment

As recruitment is correlated with North Sea VPA results and North Sea IYFS indices (Figures 14.1A and 14.1B), estimation of the 1985 and 1986 year classes at age 1 was obtained using methods and data sources as described in Annex 1. Output is given in Table 14.9. The estimates of year-class size adopted from the method, taking account of the changes in catchability, are:

1985 in 1986:	111 million
1986 in 1987:	199 million

The average recruitment at age 0 for the period 1968-1986 is estimated to be 181 million, and this value has been used for the years 1987 and 1988 in the predictions.

14.5 Fishing Mortality

For the oldest age groups in all years and for age groups 6-9 in 1986, a fishing mortality of 0.9 was assumed. Fishing mortalities for ages 2-5 in 1986 were obtained from catchability analysis. The output of the catchability analysis is given in Table 14.3. Fishing mortalities for ages 0 and 1 in 1986 were calculated on the basis of the age 1 recruitment estimates for 1986 and 1987, respectively. Estimated fishing mortalities in 1986 are in agreement with recent historical values except for age 1, for which the estimated fishing mortality in 1986 is lower than the historical values.

14.6 VPA Results

Estimated fishing mortalities and associated stock sizes are shown in Tables 14.7 and 14.8. Average fishing mortality over ages 2-6, biomass, and recruitment are given in Table 14.10 and Figure 14.2. Fishing mortality in 1986 is estimated to be lower than in the two preceding years. This is in agreement with a reduction in effort (Figure 4.2).

14.7 Catch Predictions

Input data for the catch predictions are given in Table 14.11. Predictions are given in Table 14.12. Fishing mortality at age 1 was set at the average for 1981-1985 for the prediction. The status quo landing prediction is 31,000 t in 1987 and 25,000 t in 1988. This represents an increase compared to landings in 1986, which is largely due to the large 1983 and 1986 year classes.

14.8 Yield and Biomass per Recruit

These are given in Figure 14.3.

14.9 Safe Biological Limits

Spawning stock biomass is at present approximately at an average level for the period 1972 onwards compared to recent levels and is estimated to stay at this level under status quo fishing mortality conditions.

Fishing mortalities in 1986 are at historically intermediate values. A level of 25,000 t spawning stock biomass (1979) may be considered as the basis for a minimum acceptable level.

15 HADDOCK IN DIVISION VIb

15.1 Catch Trends

Nominal catch in 1986 amounted to 3,647 t following catches of 9,177 t in 1985 and 2,630 t in 1984 (Table 15.1). This is in line with the historically high variability of catches from this stock.

15.2 Age Composition and Mean Weights

Age compositions and mean weights at age for 1986 are available for the Irish, English, and Scottish fisheries. Catches are still dominated by the 1980-1981 year classes. Catch-at-age data and mean weights are presented in Table 15.2. The apparently strong 1984 class has not yet influenced landings significantly.

15.3 Abundance Indices

Abundance indices from the Federal Republic of Germany, England, and Scotland are summarized in Table 15.3. These survey indices are not directly comparable from year to year due to variations in gear, positions, and time of year. The indication of a large 1984 year class from the 1985 survey is confirmed by the 1986 survey.

15.4 Fishing Prospects

It is not possible to provide an analytical assessment on the basis of only two years of catch-at-age data. The 1980 and 1981 year classes will be contributing to the catches in 1987 and the large 1984 year class is expected to contribute significantly.

16 HADDOCK IN SUB-AREA VII

Nominal landings in Divisions VIId,e are shown in Table 16.1, and landings in Divisions VIIb,c,g-k in Table 16.2.

17 NORTH SEA WHITING

17.1 Catch Trends

Total nominal landings and total international catches as estimated by the Working Group are given in Tables 17.1 and 17.2, respectively. The provisional nominal landings for 1986 amount to 78,600 t which is well below the predicted landings for 1986 of 114,000 t given in the last year's report and is considerably lower than the 1986 TAC of 135,000 t.

17.2 Age Compositions

Age composition data for 1985 were updated and provisional age composition data for 1986 were prepared (Table 17.5). Human consumption landings data have been provided by England, France, the Netherlands, and Scotland. Only Scotland provided discard data. Denmark and Norway provided industrial by-catch data, but the Danish data for 1986 are unreliable (see Section 2).

17.3 Mean Weight at Age

Mean weight-at-age data in the catch (also used as stock mean weight) are given in Table 17.6.

17.4 Recruitment

The use of survey indices (Tables 17.9, 17.10, and 17.11, Figure 17.2) to estimate recruitment is discussed in Section 5 and Annex 1. The number of 1-year-old fish in 1986 and 1987 were estimated as follows:

1985 year class in 1986: 3,200 million
1986 year class in 1987: 5,700 million

These values provide 1985 and 1986 year-class strengths at age 0 of 41,515 million and 73,355 million, respectively.

An average recruitment at age 0 of 46,600 million fish for the period 1968-1984 was assumed for 1987 and 1988.

17.5 Fishing Mortality

For the oldest age group used in the VPA (age 10), the same value of F as last year (1.2) was used as input.

Values of F for ages 2-7 (Table 17.3) were obtained by the catchability analysis method referred to in Section 4. For ages 5 and 6, however, the catchability analysis provided unrealistically high values. It was, therefore, decided to choose values for these ages which are consistent with the values at ages 4 and 7 and the values at ages 5 and 6 in recent years.

17.6 VPA Results

Fishing mortalities and corresponding stock sizes are shown in Tables 17.7 and 17.8. Trends in fishing mortality rate, stock biomass, and spawning stock biomass are shown in Table 17.12. and Figure 17.3. The decline in the industrial by-catch F stopped in 1986, but it stays at a very low level. There is apparently no sustained trend in the human consumption F.

There appears to be an increase in both total stock and spawning stock biomass. Nevertheless, these biomasses are still at a low level compared to earlier years.

In the last two reports, the 1983 year class was regarded as a good year class, much better than the 1984 one. This was supported by the IYFS recruitment indices for age 1 for these two year classes. This year, it appears from catchability analysis that the 1983 year class is lower than the 1984 year class or at a comparable level. To generate a 1983 year class better than the 1984, one needs a very low F at age 3 in the VPA. This value is inconsistent with the values observed at this age in the past.

By examining the IYFS indices at age 1 disaggregated by "roundfish area", it became obvious that the indices could be split into a northern area and a southern area. In the case of the 1983 and 1984 year classes, the indices from the northern roundfish area indicated that the 1984 year class was stronger than the 1983 year class an the indices from the southern roundfish areas indicated the opposite. The Group decided, therefore, to calculate a northern index and a southern index using the same method as for the calculation of the standard IYFS index. The northern and southern areas are shown in Figure 17.1. and the text table below gives the historical series of the two indices compared with the standard index.

Year class	Index north	Index south	Index standard
1970	134	441	274
1971	378	307	332
1972	1,474	790	1,156
1973	295	339	322
1974	823	946	893
1975	404	990	679
1976	269	634	418
1977	492	477	513
1978	575	216	457
1979	791	453	692
1980	240	186	227
1981	122	191	161
1982	202	114	128
1983	246	617	436
1984	408	177	341
1985	601	155	455
1986	726	570	704

These northern and southern indices were used as input to Cook's method (see Annex 1). The fitted values for the 1983 and 1984 year classes at age 1 were consistent with the catchability-tuned VPA. It was, therefore, decided to use the results of the catchability analysis.

17.7 Catch Prediction

Inputs for catch prediction are given in Table 17.13 and results in Tables 17.14-17.17 and Figure 17.4. The fishing mortality at age 1 is the average for the period 1981-1985. The status quo landings for 1987 are expected to be 106,000 t (human consumption: 80,000; industrial by-catch: 27,000) which is lower than last year's prediction of 127,000 t and the agreed TAC of 135,000 t. However, the human consumption component of this catch is now estimated to be only 80,000 t compared to the previous prediction of 101,000 t.

The status quo landings for 1988 are expected to be 134,000 t (human consumption: 104,000 t; industrial: 30,000 t).

Assuming an average recruitment in 1987 and 1988, the predicted spawning stock biomass should increase from 294,000 t in 1986 to 368,000 t in 1987 and 490,000 t in 1988

17.8 Yield per Recruit and Biomass per Recruit

Yield per recruit and spawning stock biomass per recruit are shown in Figure 17.4.

17.9 Safe Biological Limits

The spawning stock biomass is currently at a low level but is above the historical minimum. An increase can be expected in 1987 and 1988, in relation with the increase of recruitment since 1982.

Because there is no apparent stock-recruitment relationship (Figure 17.5), there is no indication that the spawning stock biomass has entered a range where low recruitment can be expected.

The level of F seems to be relatively stable and it seems unlikely that it could reduce the spawning stock biomass to the historical minimum in the immediate future.

This historical minimum, which can be considered as a minimum acceptable spawning stock biomass, was 219,000 t in 1971.

18 WHITING IN DIVISION VIa

18.1 Catch Trends

The reported total landings have declined since 1984. The provisional figure for 1986 was about 9,500 t (Tables 18.1 and 18.2, Figure 18.2), which is well below the TAC of 16,400 t.

18.2 Age Compositions

Age compositions for 1985 were revised. Provisional age compositions for 1986 (Table 18.5) were compiled from Irish and Scottish data.

18.3 Weight at Age

Weight-at-age data for landings, which were also used as weights, stock are given in Table 18.6.

18.4 Fishing Mortalities

A value of F on the oldest age group (age 7) of 1.0 was obtained, as described in last year's report.

Catchability analysis was used to tune F on ages 2-5 in 1986 (Table 18.3). The annual catchability values when plotted against year showed some scatter. However, the tuned values of F appeared consistent with historical values and it was felt that these provided estimates of input Fs as good as any other method and were adopted.

F at age 1 in 1986 was adjusted in accordance with estimated recruitment (see below).

18.5 Recruitment

Estimates of recruitment (age 1) in 1986 and 1987 were obtained, as explained in Annex 1, using the survey indices for Sub-area IV and the VPA estimates for Sub-area IV together with the VPA estimates for Division VIa (Table 18.9, Figure 18.1). The estimated recruitment at age 1 in 1986 and 1987 was:

1985 year class in 1986:	84 million
1986 year class in 1987:	143 million

Recruitment at age 1 in 1987 and later was calculated as the average for 1967-1984, excluding the 1968 figure.

18.6 VPA Results

Estimated fishing mortalities and corresponding stock sizes are shown in Tables 18.7 and 18.8. The resulting spawning stock and total stock biomasses are given in Table 18.10 and Figure 18.2. Fishing mortality appears to be at a lower level than in the 1970s, while estimated stock biomasses have fluctuated with no obvious trend.

18.7 Catch Prediction

Input data for short-term catch predictions are shown in Table 18.11. Input F on age 1 in 1986 was adjusted to the average value for1981-1985 (see Section 3.4)

Results of the catch predictions are shown in Table 18.12 and Figure 18.3. The forecast status quo landings for 1987 are estimated to be 11,000 t which is less than the agreed TAC of 16,400 t. The status quo forecast for 1988 is 15,000 t corresponding to a spawning biomass stock of 46,000 t in 1989.

18.8 Yield and Biomass per Recruit

These are shown in Figure 18.3.

18.9 Safe Biological Limits

Long-term trends in catch, fishing mortality, stock biomass, and spawning stock biomass are shown in Figure 18.2. Fishing mortality appears to be lower than in the 1970s, while stock biomass has fluctuated with no obvious trend. At present, it seems to be somewhat lower than the long-term average.

Recruitment at age 1 plotted against spawning stock biomass is shown in Figure 18.4. For the range of stock sizes observed, no obvious recruitment relationship is seen.

The lowest recorded level of SSB is 20,000 t (1972), and this level may be considered as a basis for defining a minimum acceptable level of SSB.

19 WHITING IN DIVISION VIb

Landings of whiting from Division VIb are insignificant (Table 19.1).

20 WHITING IN SUB-AREA VII

20.1 Whiting in Divisions VIId,e

20.1.1 Catch trends

Nominal landings for 1985 have been revised to 8,795 t (Table 20.1). Provisional nominal landings in 1986 were 12,514 t and the Working Group estimate was 7,528 t. This discrepancy is mainly due to the fact that French nominal landings, as shown in Table 20.1, include landings for Sub-areas VII (excluding Division VIIa) and VIII. The 1986 landings were a little higher than in 1985, but they were at almost the lowest level since 1977.

20.1.2 Age compositions

In advance of the meeting, the existing data base was revised. It became obvious that the sampling intensity between fleets was very variable. For the period 1977-1980, the age compositions are based mainly on English samples. France provided only length frequencies on which English age-length keys have been applied. These age-length conversions appeared to be unreliable and, since France landed the majority of the catch in those years, the international data for the period 1977-1980 have not been included in the VPA. From 1981, both English and French samples are available. VPA input data are given in Table 20.2

20.1.3 Weight at age

The mean weights at age in the catch are given in Table 20.3. The mean weights at age in the stock were assumed to be the same.

20.1.4 Recruitment

There are no recruitment surveys at present in Divisions VIId,e. Numbers at ages 1 and 2 from VPA were examined in relation to estimates of recruitment in the North Sea from surveys (IYFS, subset of IYFS data, and EGFS) and from VPA. No significant relationship appeared between recruitment in the North Sea and in the Channel.

20.1.5 Fishing mortality in 1986

Mean values for the period 1981-1984 were used as input for the VPA.

20.1.6 Fishing mortality at the oldest age

A value of 1.0 has been adopted for all years.

20.1.7 VPA results

Values of F are given in Table 20.4 and stock numbers and biomasses are given in Table 20.5. F values are high and variable between years and ages, but they do not show any trend. Recruitment at age 1 has been quite constant around an average of 52 million fish.

20.1.8 Catch predictions

Because of the poor reliability of estimates of stock size in 1986 and because no estimates of recruitment are available, it was decided not to perform a catch prediction. However, considering the stability of the spawning stock biomass from 1981-1985, a TAC at the present level of catch could be considered.

20.2 Whiting in Divisions VIIb,c,h-k

Landings from 1977-1985 have fluctuated between 1,500 t and 4,500 t (Table 20.6). The provisional figure for 1986 is 2,235 t, but it does not include landings by France, which are included in the data for Divisions VIId,e.

21 SAITHE IN THE NORTH SEA (Sub-area IV and Division IIIa)

21.1 Catch Trends

Recent nominal landings are given in Table 21.1. Working Group estimates are given in Table 21.2 and are plotted in Figure 21.1A Landings were high in the early 1970s reaching a maximum of 320,000 t in 1976. Subsequently, landings declined to a minimum of 116,000 t in 1979. Since then, landings have followed an increasing trend to reach 190,000 t in 1984. In 1985 and 1986, the reported catches were 188,000 t and 170,000 t, respectively. Some saithe are taken as by-catches in the industrial fisheries. Since 1976, this quantity has averaged 3,500 t (Table 21.2). The agreed TAC for this stock in 1986 was 240,000 t.

21.2 Age Compositions

Total international age compositions used as input to the VPA are given in Table 21.6. Data for 1985 were updated and new data were added for 1986. Data are currently being supplied by the following countries: Denmark, Federal Republic of Germany, France, Norway, UK (England), and UK (Scotland). Discards are not included.

21.3 Recruitment

Recruitment indices obtained by observers along the Norwegian coast for the years 1980-1986 (Table 21.5) and information from a Norwegian 0-group survey in 1986 was provided. Because of the subjectivity of the indices and the short time series, the Group decided to use average recruitment for the prediction. However, the data indicate that the 1985 year class may be well above the average, while the 1986 year class seems to be a very poor one.

21.4 Weight at Age

The mean weights at age in the landings are given in Table 21.7. These weights are also used as stock weights.

21.5 Fishing Mortality

The Group attempted to implement catchability analysis for ages 3-12 using various combinations of fleets. However, all of these analyses resulted in unrealistically high fishing mortalities (Table 21.3). The Group, therefore, decided to use average fishing mortalities from the years 1983 and 1984 for age groups 3-12. The fishing mortalities for age groups 1 and 2 were adjusted to give average recruitment. For the oldest age groups, last year's value of 0.3 was used.

21.6 VPA Results

Table 21.8 gives the values of fishing mortality estimated by VPA, and estimates of numbers of fish in the stock are given in Table 21.9. Table 21.10 gives a summary of the trends in fishing mortality, biomass, and recruitment as estimated by VPA.

The results indicate that, in recent years, fishing mortality has been increasing from a low value of F = 0.35 in 1981 to 0.9 in 1985. Total stock biomass has remained relatively stable in the last decade, but spawning stock biomass has been declining. These trends are illustrated in Figure 21.1, and stock-recruitment plot is given in Figure 21.3. The 1982 year class is now estimated to be 554 million at age 1, while last year, the estimate was 399 million.

21.7 Catch Predictions

Input data used for the catch predictions are given in Table 21.11. The Fs on ages 1 and 2 in the catch prediction table are the mean Fs for the years 1981-1985 and are different from those in the VPA table (see Section 3). The results of the catch predictions are given in Tables 23.12 and 23.13.

If fishing mortality in 1987 is assumed to remain at the 1986 level, a total catch of 223,000 t is predicted, whereas a TAC of 173,000 t is agreed. The status quo landings predicted for 1988 are 198,000 t.

If the prediction is constrained to the TAC of 173,000 t, the fishing mortality has to be reduced by about 30% from 1986 to 1987. The status quo prediction for the 1988 catch at the 1987 level of F will then give about 180,000 t.

21.8 Yield and Biomass per Recruit

Yield and biomass per recruit are shown in Figure 21.2.

21.9 Safe Biological Limits

Spawning stock biomass has been declining since 1974, and in 19851986, reached the lowest level recorded since 1970. Lower levels of spawning stock biomass have been estimated in the 1960s, but the data for this period are considered to be less reliable than more recent data. No clear relationship of recruitment with spawning stock size can be discerned from Figure 21.3. The prediction for the immediate future is that year classes recruiting to the spawning stock will increase the spawning stock biomass above the 1986 level in 1987 and 1988. This prediction assumes average recruitment for five years. As we have not seen the spawning stock recover since 1974, we cannot define the lower limit of the spawning stock.

22 SAITHE IN SUB-AREA VI

22.1 Catch Trends

The nominal landings of saithe reported for 1986 were 25,000 t compared with 25,000 t in 1985 and 27,000 t in 1984 (Table 22.1). The Working Group estimate of landings in 1986 was 39,000 t. (Table 22.2 and Figure 22.1A). The agreed TAC in 1986 was 27,800 t.

The nominal landings followed an increasing trend in the 1960s to a level of 30,000-40,000 t in the mid-1970s, after which they dropped to between 20,000 and 27,000 t (Table 22.1).

22.2 Age Compositions

New age composition data for 1986 and revisions to the data set for 1985 were available from the Federal Republic of Germany, France, England, and Scotland. The resulting total age composition is shown in Table 22.5.

22.3 Weight at Age

The average weights at age in the landings are shown in Table 22.6. Weight at age in the stock was assumed to be the same as in the landings.

22.4 Virtual Population Analysis

22.4.1 Fishing mortality in 1986

Data on fishing effort and associated age compositions were available for French and Scottish trawlers and for Scottish light trawl, seine, and Nephrops trawl (Figure 4.2). The total effort of French trawlers increased by 40% from 1985 to 1986.

As the Scottish data cover only approximately 12% of the landings while the French represent approximately 70%, it was decided to use only French data in the catchability analysis. The fishing mortality at ages 13-15 was set to 0.3, as in previous assessments. The results of the analysis, in terms of fishing mortalities for ages 2-12 are given in Table 22.3. Except for ages 2-5, the plots of catchability versus time showed a reasonable agreement between predicted and observed values.

22.4.2 Results

A VPA was run using the fishing mortalities estimated by the catchability analysis as input for 1986 for ages 3-12. For ages 1 and 2, the fishing mortality was tuned to produce a stock in numbers at age 1 equal to the average for the period 1970-1983. The resulting fishing mortalities and stock sizes are shown in Tables 22.7 and 22.8.

Compared to the VPA presented in last year' report, the abundance of the 1981-1983 year classes has more than doubled. In order to examine whether this was a result of using the catchability analysis for ages 3-5, it was also decided to estimate the stock size by separable VPA. As the separable VPA, however, did not change the abundance of the 1981-1983 year classes very much, it was decided to retain the catchability-tuned fishing mortalities for ages 3-5 in the VPA.

Table 22.9 and Figures 22.1B-D show a summary of mean fishing mortality, biomass, and recruitment as estimated by VPA. If the catchability analysis is reliable, it implies that the 40% increase in the French effort from 1985 to 1986 resulted in a 58% increase in mean fishing mortality.

22.5 Catch Prediction

The input data used for the catch prediction are given in Tables 22.4 and 22.10. The 1987 and 1988 year classes were both assumed to be of average abundance. The average fishing mortality from 1981-1985 was used as input for ages 1 and 2 in 1986.

The results of the catch predictions are given in Table 22.11 and Figure 22.2. The predicted catch in 1987 is 46,000 t. The agreed TAC for 1987 is 27,800 t and the catch predicted in last year's report was 24,000 t. This discrepancy is mainly due to the revised estimates of the abundance of the 1981-1983 year classes and to the implicit assumption that the increased French effort will be maintained in 1987. In 1988, the status quo catch is expected to be 42,000 t.

22.6 Yield and Biomass per Recruit

The yield- and biomass-per-recruit curves are presented in Figure 22.2.

22.7 Safe Biological Limits

1) If anything, there seems to be an inverse relationship between the size of the spawning stock and recruitment (Figure 22.3). Recruitment seems, however, to be closely linked to the recruitment of the North Sea saithe stock (Figure 22.4).

2) The high level of spawning stock biomass in the 1970s resulted from a succession of abundant year classes. Due to the increased level of fishing mortality, the equally abundant 1981-1983 year classes will not result in a similar increase in the spawning stock.

3) As in the North Sea, the spawning stock biomass has shown a continuous decline from 1974 onwards. At present, no lower limit of spawning stock biomass, from which the stock is known to have recovered, can be given.

23 SAITHE IN SUB-AREA VII

23.1 Landings

The provisional landings of saithe in Sub-area VII are given in Table 23.1. No data on the age composition of the catch were available.

24 REFERENCES

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Table 3.1 Maturity data from IYFS for the years 1981-1985 (% mature, sexes combined). Mean for the period 1981-1985 and values used by the Working Group.

Species	Age	1981	1982	1983	1984	1985	1981-1985	WG
Cod	1	1	-	-	-	-	-	1
	2	4	5	3	3	3	4	5
	3	22	23	20	29	21	23	23
	4	60	63	53	49	56	56	62
	5	87	84	93	84	69	83	86
	6+	97	98	100	98	96	98	100
Haddock	1	2	-	-	1	1	1	1
	2	36	28	36	36	40	35	32
	3	62	79	70	85	74	74	71
	4	79	94	93	93	85	89	87
	5	90	100	100	100	98	98	95
	6+	99	100	100	100	95	99	100
Whiting	1	13	8	13	8	4	9	11
	2	90	94	97	89	94	93	92
	3	98	99	98	99	99	99	100
	4	99	100	99	96	100	99	100
	5	99	100	100	99	100	100	100
	6+	100	97	100	100	99	99	100

Table 9.1 Nominal catch (in tonnes) of COD in Sub-area IV, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	10,346	17,473	12,576	9,630	8,744
Denmark	42,582	41,858	48,509	56,404	64,968
Faroe Islands	260	56	113	150	38
France	7,511	11,944	12,559	10,910	11,369
German Dem.Rep.	21	75	84	63	-
Germany, Fed.Rep.	22,663	37,040	20,411	26,343	29,741
Ireland	136	174	1	-	-
Netherlands	29,903	48,817	34,752	45,400	51,281
Norway[2]	1,449	2,747	3,575	4,506	6,766
Poland	381	115	142	28	7
Sweden	36	...[3]	298	293	321
UK (England & Wales)	35,424	59,127	54,923	49,951	59,856
UK (Scotland)	34,406	41,984	42,811	45,044	53,921
USSR	-	17	17	-	-
Total IV	185,118	261,427	230,771	248,722	287,012
WG total	181,121	260,890	248,051	260,278	300,599

Country	1982	1983	1984	1985	1986[1]
Belgium	6,604	6,704	5,804	4,815	6,707
Denmark	61,454	48,828	46,751	41,737	28,646
Faroe Islands	65	361	-	71	58
France	8,399	7,159	8,129	4,834	7,024[4]
German Dem.Rep.	-	-	-	-	-
Germany, Fed.Rep.	18,525	20,333	13,453	7,679	5,468
Ireland	-	-	-	-	-
Netherlands	36,490	34,111	25,460	30,844	24,500
Norway[2]	12,163	6,625	7,005	5,022	5,850
Poland	62	75	7	-	10
Sweden	453	422	575	748	511[5]
UK (England & Wales)	54,277	53,860	35,605	60,931	24,287
UK (Scotland)	57,308	58,581	54,359	60,554	45,654
USSR	-	-	-	-	-
Total IV	255,800	237,059	197,148	186,004	148,715
WG total	255,934	229,499	206,014	192,253	157,000

[1] Provisional.
[2] Figures from Norway do not include cod caught in Rec. 2 fisheries.
[3] Included in Division IIIa.
[4] Includes Division IIa.
[5] Jan-Nov.

Table 9.2 : Annual Weight and Numbers of COD caught in IV between 1967 and 1986

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1967	242	242	0	0	127	127	0	0
1968	277	277	0	0	148	148	0	0
1969	194	194	0	0	77	77	0	0
1970	219	219	0	0	126	126	0	0
1971	315	315	0	0	226	226	0	0
1972	341	341	0	0	245	245	0	0
1973	228	228	0	0	126	126	0	0
1974	202	202	0	0	103	103	0	0
1975	185	185	0	0	103	103	0	0
1976	210	210	0	0	124	124	0	0
1977	181	181	0	0	136	136	0	0
1978	261	261	0	0	209	209	0	0
1979	248	248	0	0	169	169	0	0
1980	264	264	0	0	201	201	0	0
1981	301	301	0	0	237	237	0	0
1982	273	273	0	0	192	192	0	0
1983	233	233	0	0	177	177	0	0
1984	206	206	0	0	159	159	0	0
1985	192	192	0	0	144	144	0	0
1986	157	157	0	0	135	135	0	0

Table 9.3 : Results of analysis of catchability coefficients for COD in IV

F for named gears and total international F

Gear	Estimate	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
	F(gear)	0.154	0.175	0.135	0.104	0.095	0.083
SCO SEI	Var F(gear)	0.00033	0.00022	0.00009	0.00006	0.00009	0.00013
	Propn(gear)	0.13137	0.23747	0.21303	0.11487	0.08602	0.07967
	F(gear)	0.058	0.068	0.046	0.031	0.024	0.016
SCO LTR	Var F(gear)	0.00002	0.00003	0.00001	0.00001	0.00002	0.00001
	Propn(gear)	0.05770	0.06391	0.06481	0.03844	0.02473	0.01779
	F(gear)	0.063	0.067	0.053	0.038	0.032	0.042
ENG TRL	Var F(gear)	0.00006	0.00002	0.00001	0.00002	0.00003	0.00001
	Propn(gear)	0.10411	0.08253	0.05398	0.06471	0.03013	0.02505
	F(gear)	0.036	0.032	0.029	0.054	0.068	0.088
ENG SEI	Var F(gear)	0.00004	0.00001	0.00001	0.00002	0.00005	0.00006
	Propn(gear)	0.01543	0.01975	0.01679	0.05586	0.06830	0.10853
	F(gear)	0.311	0.341	0.264	0.227	0.218	0.228
All above	Var F(gear)	0.00046	0.00028	0.00013	0.00011	0.00018	0.00022
	Propn(gear)	0.30861	0.40366	0.34860	0.27388	0.20918	0.23103
Total	F	1.007	0.846	0.757	0.828	1.043	0.989
Internatl	Var F	0.00478	0.00172	0.00106	0.00147	0.00409	0.00406

Table 9.4 : Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.800	0.010
2	0.350	0.050
3	0.250	0.230
4	0.200	0.620
5	0.200	0.860
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000
11	0.200	1.000
12	0.200	1.000
13	0.200	1.000

Table 9.5 : Total International Catch at Age (1000's) of COD in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	10339	5601	2842	52719	42972	3692	24742	14690	30081	5145	1
2	67849	80549	21867	32813	148927	180833	30259	55617	42487	90263	2
3	31289	40916	30453	17886	16507	46369	52342	10765	17073	16485	3
4	10777	11906	13222	12904	6475	5474	13409	14937	4203	6721	4
5	3131	5838	4403	6092	6808	2627	2102	4365	6816	1661	5
6	1889	1359	2792	1705	2588	3084	1057	907	1863	2746	6
7	850	836	567	930	856	1618	1010	414	405	836	7
8	340	297	407	202	439	589	466	373	176	120	8
9	132	145	142	180	219	376	76	313	206	59	9
10	38	107	45	95	74	108	55	76	86	57	10
11	3	17	61	22	66	7	74	149	45	22	11
12	14	6	10	17	24	10	58	25	7	16	12
13			5				22	5	5	1	13

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	58279	26368	35319	59344	20416	65348	23877	62720	7752	78013	1
2	45947	156479	86133	98856	177309	60167	121789	60215	110680	20219	2
3	22823	13358	39843	29578	26739	53398	17279	27801	15649	28910	3
4	4300	8386	3584	9988	7352	7090	9890	3493	6816	3872	4
5	2099	2850	3188	1595	3829	3206	2507	3126	1167	2488	5
6	757	980	713	1164	757	1889	1177	956	1116	498	6
7	1029	383	371	411	571	355	563	413	326	479	7
8	335	376	131	191	135	218	142	233	162	143	8
9	238	141	145	71	65	72	70	57	73	58	9
10	23	33	39	54	37	25	22	43	13	39	10
11	9	15	2	18	17	10	13	13	20	16	11
12	43	22	13	6	1	5	5	4	3	1	12
13	35	2			3				0	1	13

Table 9.6 : Total International Mean Weight at Age (Kg.) of COD in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	0.590	0.640	0.544	0.626	0.579	0.616	0.559	0.594	0.619	0.572	1
2	1.035	0.973	0.921	0.961	0.941	0.836	0.869	1.039	0.899	1.019	2
3	2.404	2.223	2.133	2.041	2.193	2.086	1.919	2.217	2.348	2.389	3
4	3.153	4.094	3.852	4.001	4.258	3.968	3.776	4.156	4.226	4.364	4
5	6.803	5.341	5.715	6.131	6.528	6.011	5.488	6.174	6.404	6.402	5
6	9.610	8.020	6.722	7.945	8.646	8.246	7.453	8.333	8.691	8.625	6
7	12.033	8.581	9.262	9.953	10.356	9.766	9.019	9.889	10.107	10.120	7
8	12.481	10.162	9.749	10.131	11.219	10.228	9.810	10.791	10.910	11.278	8
9	13.589	10.720	10.384	11.919	12.881	11.875	11.077	12.175	12.339	12.899	9
10	14.271	12.497	12.743	12.554	13.147	12.530	12.359	12.425	12.976	14.140	10
11	18.583	11.518	11.017	14.473	15.676	14.455	12.892	13.660	13.831	14.705	11
12	19.103	11.807	13.718	14.225	15.176	14.272	12.899	14.049	17.410	14.376	12
13			8.095				12.832	14.309	15.662	8.311	13

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	0.541	0.567	0.548	0.546	0.722	0.585	0.630	0.592	0.584	0.571	1
2	0.926	0.937	0.945	0.985	0.830	0.948	0.916	0.982	0.917	0.899	2
3	2.132	1.967	2.432	1.996	2.252	1.857	1.857	2.142	2.118	1.779	3
4	4.484	4.201	4.306	4.576	4.773	4.514	3.954	4.044	4.221	3.869	4
5	6.661	6.538	6.558	6.373	7.214	6.820	6.592	6.251	6.403	6.442	5
6	8.804	8.766	8.277	9.173	8.861	8.981	8.439	8.396	8.468	8.144	6
7	10.076	9.794	10.858	9.815	10.060	10.707	9.920	10.316	10.410	9.945	7
8	11.048	11.053	11.490	11.874	11.513	12.499	11.825	11.357	12.034	11.719	8
9	11.824	12.427	13.057	12.782	13.324	13.452	12.747	13.505	13.033	12.745	9
10	13.134	12.778	14.148	14.081	14.876	12.852	12.562	13.408	13.209	13.593	10
11	14.417	13.847	15.982	16.475	16.867	13.991	14.117	12.886	14.425	13.243	11
12	14.513	13.739	15.394	12.166	18.129	15.879	15.238	14.086	14.348	13.234	12
13	14.160	17.148			28.496				15.568	10.461	13

Table 9.7 : Total International Fishing Mortality Rate at Age of COD in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	0.033	0.045	0.021	0.110	0.076	0.034	0.130	0.095	0.107	0.037	1
2	0.492	0.630	0.390	0.583	0.883	0.898	0.703	0.815	0.725	0.931	2
3	0.721	0.731	0.600	0.746	0.774	0.919	0.855	0.682	0.748	0.823	3
4	0.520	0.705	0.578	0.577	0.703	0.669	0.798	0.666	0.654	0.800	4
5	0.565	0.598	0.622	0.581	0.697	0.703	0.593	0.666	0.748	0.591	5
6	0.551	0.515	0.650	0.526	0.526	0.813	0.696	0.557	0.679	0.792	6
7	0.638	0.506	0.421	0.467	0.552	0.747	0.699	0.656	0.522	0.760	7
8	0.593	0.480	0.498	0.260	0.421	0.954	0.499	0.610	0.658	0.286	8
9	0.366	0.550	0.448	0.429	0.495	0.787	0.293	0.750	0.834	0.485	9
10	0.516	0.576	0.323	0.613	0.312	0.492	0.243	0.537	0.471	0.582	10
11	0.136	0.448	0.772	0.265	1.256	0.045	0.743	2.142	0.722	0.208	11
12	0.500	0.500	0.500	0.500	0.500	0.600	0.600	0.600	0.600	0.600	12
13	0.500	0.500	0.500	0.500	0.500	0.600	0.600	0.600	0.600	0.600	13

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	0.126	0.093	0.119	0.113	0.115	0.185	0.133	0.178	0.128	0.167	1
2	0.892	1.022	0.844	0.991	1.011	1.020	1.118	1.020	0.955	1.007	2
3	0.759	0.848	0.964	0.966	0.981	1.257	1.179	1.030	0.993	0.846	3
4	0.546	0.745	0.602	0.721	0.715	0.816	0.891	0.858	0.817	0.757	4
5	0.633	0.879	0.721	0.595	0.684	0.811	0.788	0.811	0.810	0.828	5
6	0.596	0.698	0.566	0.638	0.637	0.890	0.820	0.815	0.789	1.043	6
7	0.804	0.698	0.630	0.766	0.765	0.713	0.740	0.789	0.746	0.989	7
8	0.815	0.800	0.549	0.802	0.624	0.768	0.711	0.806	0.852	0.900	8
9	1.540	1.031	0.864	0.667	0.723	0.830	0.610	0.706	0.646	0.900	9
10	0.354	0.989	0.940	0.963	0.903	0.686	0.651	0.958	0.351	0.900	10
11	0.172	0.421	0.151	2.193	1.006	0.685	1.000	1.097	2.262	0.900	11
12	0.800	0.800	0.800	0.800	0.800	0.900	0.900	0.900	0.900	0.900	12
13	0.800	0.800	0.800	0.800	0.800	0.900	0.900	0.900	0.900	0.900	13

Table 9.8 : Stock Numbers at Age (1000's) of COD in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	461461	184755	196880	729266	846609	160201	292873	234149	426021	207584	1
2	203891	200614	79371	86611	293516	352495	69578	115583	95681	171925	2
3	67794	87812	75304	37873	34085	85548	101187	24264	36068	32670	3
4	29094	25663	32911	32171	13992	12244	26569	33531	9554	13291	4
5	7932	14168	10379	15114	14793	5674	5134	9798	14107	4066	5
6	4878	3693	6378	4562	6924	6032	2300	2323	4122	5467	6
7	1968	2303	1806	2727	2208	3351	2190	939	1090	1711	7
8	830	851	1137	970	1399	1041	1300	891	399	530	8
9	470	375	431	566	613	752	328	646	396	169	9
10	104	267	177	226	302	306	280	200	250	141	10
11	24	51	123	105	100	181	153	180	96	128	11
12	38	17	27	46	66	23	142	60	17	38	12
13			13				54	11	12	31	13

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	710308	427010	454088	799804	270589	556128	275649	551829	92829	730000	1
2	89923	281432	174761	181160	320924	108357	207742	108407	207487	36693	2
3	47739	25958	71367	52929	47389	82255	27540	47840	27537	56253	3
4	11176	17401	8660	21194	15694	13837	18233	6597	13295	7947	4
5	4889	5300	6764	3885	8436	6285	5009	6123	2290	4810	5
6	1843	2127	1802	2692	1754	3486	2288	1866	2227	834	6
7	2028	832	866	837	1164	760	1173	825	676	828	7
8	655	743	339	378	318	444	305	458	307	262	8
9	326	237	274	160	139	140	168	122	167	107	9
10	85	57	69	94	67	55	50	75	49	72	10
11	64	49	17	22	30	22	23	21	24	29	11
12	85	44	26	12	2	9	9	7	6	2	12
13	69	5			6				0	2	13

Table 9.9 VPA at age 1 (million) and Survey indices at age 0 for North Sea cod.

Year	Year class	VPA	EGFS	DGFS
1977	1977	427	1,559	-
1978	1978	454	1,679	-
1979	1979	800	1,856	-
1980	1980	271	1,006	43.2
1981	1981	556	7,963	176.8
1982	1982	276	254	26.9
1983	1983	552	9,595	121.5
1984	1984	93	45	1.3
1985	1985	730	798	143.6
1987	1986	-	96	37.0

Table 9.10 COD in IV Age 1 : Abundance indices and catchability coefficients

YC1	Yr.	VPA	IYFS		EGFS		DGFS		FRGSF		SGFS	
			Index	Q	Index	Q	Index	Q	Index	Q	Index	Q
68	in 69	197							6.1	0.031		
69	in 70	729							34.1	0.047		
70	in 71	847	98.3	0.116								
71	in 72	160	4.1	0.026					1.3	0.008		
72	in 73	293	38.0	0.130					1.6	0.005		
73	in 74	234	14.7	0.063					3.6	0.015		
74	in 75	426	40.3	0.095					8.0	0.019		
75	in 76	208	7.9	0.038					7.8	0.038		
76	in 77	710	36.7	0.052	6818.0	9.599			28.2	0.040		
77	in 78	427	12.9	0.030	2372.0	5.555			27.2	0.064		
78	in 79	454	9.9	0.022	2265.0	4.988			31.1	0.068		
79	in 80	800	16.8	0.021	5150.0	6.439	163.8	0.205	35.5	0.044		
80	in 81	271	2.9	0.011	1232.0	4.553	46.9	0.173	14.1	0.052		
81	in 82	556	9.2	0.017	3234.0	5.815	83.0	0.149	23.2	0.042	53.8	0.097
82	in 83	276	3.9	0.014	1541.0	5.590	21.8	0.079	9.0	0.033	23.3	0.085
83	in 84	552	15.2	0.028	6122.0	11.094	121.3	0.220	43.0	0.078	63.1	0.114
84	in 85	93	0.9	0.010	419.0	4.514	3.6	0.039	0.9	0.010	6.0	0.065
85	in 86	730	17.2	0.024	3464.0	6.448	111.2	0.119			86.0	0.085
		input	=> VPA=	705	=> VPA=	537	=> VPA=	938			=> VPA=	1011
86	in 87	410	9.6	0.024	.							
		input	=> VPA=	402								

Table 9.11 COD in IV Age 2 : Abundance indices and catchability coefficients

YC1	Yr.	VPA	IYFS		EGFS		DGFS		FRGSF		SGFS	
			Index	Q	Index	Q	Index	Q	Index	Q	Index	Q
69	in 71	294	25.9	0.088								
70	in 72	352	34.5	0.098								
71	in 73	70	10.6	0.151								
72	in 74	116	9.5	0.082								
73	in 75	98	6.2	0.065								
74	in 76	172	19.9	0.116								
75	in 77	90	3.2	0.036	459.0	5.100						
76	in 78	281	29.3	0.104	1249.0	4.445						
77	in 79	175	9.3	0.053	592.0	3.383						
78	in 80	181	14.8	0.082	696.0	3.845	4.5	0.025				
79	in 81	321	25.5	0.079	1411.0	4.396	11.2	0.035				
80	in 82	108	6.7	0.062	289.0	2.676	1.6	0.015			53.8	0.498
81	in 83	208	16.6	0.080	1095.0	5.264	2.3	0.011			23.3	0.112
82	in 84	108	8.0	0.074	477.0	4.417	1.6	0.015			63.1	0.584
83	in 85	207	17.6	0.085	1168.0	5.643	3.1	0.015			6.0	0.029
84	in 86	0	3.1	0.076	115.0	4.479	0.2	0.015			86.0	0.242
		input	=> VPA=	41	=> VPA=	26	=> VPA=	14			=> VPA=	355
85	in 87	0	32.4	0.076								
		input	=> VPA=	425								

Table 9.12 Estimates of recruitment at ages 1 and 2 for North Sea cod using various methods.

Method	1986		1987	
	Age 1	Age 2	Age 1	Age 2
Commercial Q	-	37	-	-
Shepherd	565	45	269	240
Cook (weighted)	730	33	423	425
Res. Vessel Q (weighted mean)	728	37	400	426
Value adopted	730	37	410	400

Table 9.13: Mean Fishing Mortality , Biomass and Recruitment of COD in IV between 1967 and 1986

	Mean Fishing Mortality			Biomass		Recruits	
	Ages 2 to 8		Ages 1 to 1	1000 tonnes		Age 1	
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1967	0.583	0.000	0.000	882	244	66	461
1968	0.595	0.000	0.000	755	252	67	185
1969	0.537	0.000	0.000	606	251	68	197
1970	0.534	0.000	0.000	924	271	69	729
1971	0.651	0.000	0.000	1110	269	70	847
1972	0.815	0.000	0.000	763	225	71	160
1973	0.692	0.000	0.000	608	197	72	293
1974	0.664	0.000	0.000	565	210	73	234
1975	0.676	0.000	0.000	626	190	74	426
1976	0.712	0.000	0.000	533	163	75	208
1977	0.721	0.000	0.000	704	142	76	710
1978	0.813	0.000	0.000	705	143	77	427
1979	0.697	0.000	0.000	702	145	78	454
1980	0.783	0.000	0.000	884	160	79	800
1981	0.774	0.000	0.000	739	173	80	271
1982	0.896	0.000	0.000	734	167	81	556
1983	0.893	0.000	0.000	558	134	82	276
1984	0.876	0.000	0.000	633	114	83	552
1985	0.852	0.000	0.000	406	104	84	93
1986	0.910	0.000	0.000	632	95	85	730
Mean recruits at age 1 for period 1967 to 1984							433

Table 9.14 Input for catch prediction of COD in IV

		Values used in Prediction									
		F at age , Mean Wt. and Propn. Retained by Consumption Fishery									
	1986		1987	Scaled mean F			Mean values for period 1981 to 1985				
Age	Fishing Mortality		Stock	1981 to 1985			Mean Weight (Kg.)				Prop.
	H.Con.	Disc Ind	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	0.148		410000	0.157			0.623			0.623	1.000
2	1.007		282886	1.087			0.918			0.918	1.000
3	0.846		9446	1.154			2.045			2.045	1.000
4	0.757		18800	0.869			4.301			4.301	1.000
5	0.828		3052	0.828			6.656			6.656	1.000
6	1.043		1721	0.838			8.629			8.629	1.000
7	0.989		241	0.796			10.283			10.283	1.000
8	0.900		252	0.798			11.846			11.846	1.000
9	0.900		87	0.746			13.212			13.212	1.000
10	0.900		36	0.753			13.381			13.381	1.000
11	0.900		24	1.283			14.457			14.457	1.000
12	0.900		9	0.933			15.536			15.536	1.000
13	0.900		1	0.933			22.032			22.032	1.000

Age 2 to 8	Age 1 1	Mean F	Age 2 to 8	Age 1 1
0.910	0.000	Unscaled	0.858	0.000
		Scaled	0.910	0.000

Recruits at age 1 in 1988 = 433000
Recruits at age 1 in 1989 = 433000

M at age and proprtion mature at age are as shown in Table 9.4

Mean F for ages 2 to 8 in 1986 for human consumption landings + discards = 0.910 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1981 to 1985
rescaled to produce a mean value of F for ages 2 to 8 equal to that for 1986

Mean F for ages 1 to 1 in 1986 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1981 to 1985 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1986

Table 9.15: Predicted Catches and Biomasses (1000's of tonnes) of COD in IV 1987 to 1988

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	632	658	623	623	623	623	623	623	623	623	623	623
Spawning	95	110	103	103	103	103	103	103	103	103	103	103
Mean F Ages												
Human Cons. 2 to 8	0.91	0.91	0.00	0.18	0.36	0.55	0.73	0.91	1.09	0.15	0.23	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1986)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.17	0.25	
Catch weight												
Human Consumption	157	253	0	65	119	164	201	233	260	55	79	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	157	253	0	65	119	164	201	233	260	55	79	
Total catch	157	253	0	65	119	164	201	233	260	55	79	
Biomass 1 Jan of Year+1												
Total	658	623	976	869	781	709	651	603	564	885	845	
Spawning	110	103	278	227	186	153	126	104	87	235	216	

Table 9.16: Predicted Catches and Biomasses (1000's of tonnes) of COD in IV 1987 to 1988

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	632	658	706	706	706	706	706	706	706	706	706	706
Spawning	95	110	135	135	135	135	135	135	135	135	135	135
Mean F Ages												
Human Cons. 2 to 8	0.91	0.64	0.00	0.18	0.36	0.55	0.73	0.91	1.09	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1986)										F0.1	Fmax	
Human Consumption	1.00	0.70	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	157	198	0	79	144	198	244	281	313	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	157	198	0	79	144	198	244	281	313	0	0	
Total catch	157	198	0	79	144	198	244	281	313	0	0	
Biomass 1 Jan of Year+1												
Total	658	706	1098	966	860	773	702	644	597	0	0	
Spawning	110	135	357	291	238	195	160	132	109	0	0	

Table 10.1 Nominal catch (in tonnes) of COD in Division VIa, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	-	-	4	57	30
Denmark	-	-	-	27[2]	-
Faroe Islands	43	-	40	3	-
France	3,583	4,499	4,590	5,495	7,601
Germany, Fed. Rep.	3	31	40	1	21
Ireland	984	1,214	2,237	2,331	2,725
Netherlands	5	3	20	1	-
Norway	29	40	32	48	40
Spain	20[2]	108[2]	-	-	-
Sweden	-	-	-	-	-
UK (England and Wales)	2,434	2,082	2,348	2,302	3,187[3]
UK (Scotland)	5,513	5,539	6,929	7,603	10,339
UK (Northern Ireland)	5	5	2	2	7
Total	12,619	13,521	16,242	17,870	23,950

Country	1982	1983	1984	1985	1986[1]
Belgium	35	21	22	48	94
Denmark	3	-	-[1]	-	-
Faroe Islands	2	-	-[1]	-	-
France	7,160	8,140	7,637	7,411	8,386[4]
Germany, Fed. Rep.	8	205	75	66	76[5]
Ireland	3,527	2,695	2,316	2,564	970
Netherlands	-	-	-	1	-
Norway	238	267[1]	231	204	171
Spain	41	52	64	28	-
Sweden	1	-	-	-	-
UK (England and Wales)	2,948	1,141	692	170[6]	61
UK (Scotland)	7,969	8,933	9,483	8,032	4,246
UK (Northern Ireland)	33	37	32	17	63
Total	21,965	21,491	20,552	18,541	14,067

[1] Provisional.

[2] Includes Division VIb.

[3] Including 37 tonnes caught in Sub-area VI and landed abroad.

[4] Includes Divisions VIb and Vb.

[5] Includes Division VIb.

[6] Foreign landings not included.

Table 10.2: Annual Weight and Numbers of COD caught in VIA between 1967 and 1986

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1967	23	23	0	0	8	8	0	0
1968	24	24	0	0	7	7	0	0
1969	22	22	0	0	6	6	0	0
1970	13	13	0	0	4	4	0	0
1971	11	11	0	0	4	4	0	0
1972	15	15	0	0	6	6	0	0
1973	12	12	0	0	5	5	0	0
1974	14	14	0	0	5	5	0	0
1975	13	13	0	0	5	5	0	0
1976	17	17	0	0	7	7	0	0
1977	13	13	0	0	5	5	0	0
1978	14	14	0	0	5	5	0	0
1979	16	16	0	0	6	6	0	0
1980	18	18	0	0	8	8	0	0
1981	24	24	0	0	12	12	0	0
1982	22	22	0	0	8	8	0	0
1983	21	21	0	0	10	10	0	0
1984	21	21	0	0	8	8	0	0
1985	19	19	0	0	9	9	0	0
1986	12	12	0	0	5	5	0	0

Table 10.3: Results of analysis of catchability coefficients for COD in VIA

F for named gears and total international F

Gear	Estimate	Age 2	Age 3	Age 4	Age 5	Age 6
	F(gear)	0.159	0.151	0.142	0.147	0.149
SCO LTR	Var F(gear)	0.00024	0.00032	0.00018	0.00040	0.00056
	Propn(gear)	0.24979	0.18543	0.16255	0.15833	0.08098
	F(gear)	0.159	0.151	0.142	0.147	0.149
All above	Var F(gear)	0.00024	0.00032	0.00018	0.00040	0.00056
	Propn(gear)	0.24979	0.18543	0.16255	0.15833	0.08098
Total	F	0.635	0.814	0.876	0.930	1.844
Internatl	Var F	0.00392	0.00945	0.00687	0.01610	0.08575

Table 10.4 Cod in Division VIa. Scottish seiner data.

Year	Effort (hours)	Catch at age 1 (millions)	CPUE	VPA (millions)
1975	56,420	150	2,659	11
1976	57,090	48	0.841	7
1977	41,920	120	2.863	10
1978	33,617	75	2.231	10
1979	38,465	121	3.146	15
1980	38,640	253	6.548	21
1981	37,208	14	0.376	6
1982	36,689	204	5.560	15
1983	38,080	183	4.806	9
1984	29,561	167	5.649	15
1985	26,365	96	3.641	6
1986	19,960	108	5.411	(15)

Table 10.5 : Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	0.520
3	0.200	0.860
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000

Table 10.6 : Total International Catch at Age (1000's) of COD in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	261	333	64	256	235	735	1015	843	1207	970	1
2	2571	1364	1974	1176	1771	2891	1524	2318	1898	3682	2
3	3705	3289	1332	1638	487	1591	1442	778	1187	1467	3
4	670	1838	1943	571	763	409	583	1068	533	638	4
5	442	215	759	476	223	501	161	288	325	256	5
6	264	171	149	153	198	108	193	72	90	215	6
7	43	124	94	26	64	70	63	76	12	44	7
8	21	19	65	21	15	24	28	13	13	7	8
9	1	6	12	23	7	12	10	9	9	4	9
10	2	1		4	4	4	3	5	1	1	10

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	1262	723	929	1195	460	1827	2335	2143	1355	796	1
2	1311	1761	1613	3294	7015	1673	4515	2360	5069	1500	2
3	1636	999	2125	2001	3221	3206	1118	2564	1269	2073	3
4	622	695	682	796	905	1189	1400	448	1091	413	4
5	268	286	343	191	182	367	468	555	140	191	5
6	87	97	133	77	30	111	148	185	167	40	6
7	57	47	33	27	17	22	40	40	60	16	7
8	11	18	16	8	3	10	16	14	13	9	8
9	4	8	16	1	1	1	2	5	6	4	9
10	5	1	4	1	0	1	1		0		10

Table 10.7 : Total International Mean Weight at Age (Kg.) of COD in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	0.681	0.745	0.860	0.595	0.758	0.609	0.597	0.611	0.603	0.616	1
2	1.470	1.776	1.284	0.955	1.183	1.192	1.181	1.103	1.369	1.397	2
3	2.906	2.766	2.821	2.533	2.745	2.586	2.784	2.834	3.078	3.161	3
4	4.560	4.721	4.259	4.678	4.668	4.417	4.601	4.750	5.302	5.005	4
5	6.116	6.304	6.169	6.016	6.163	6.226	5.625	6.144	6.846	6.290	5
6	7.394	7.510	6.374	7.120	6.841	7.585	7.049	7.729	8.572	8.017	6
7	8.150	8.023	7.529	7.350	7.945	7.968	8.208	8.931	9.769	8.754	7
8	7.751	9.575	8.436	8.826	8.259	9.081	8.526	9.317	10.301	9.676	8
9	10.199	8.065	8.300	8.703	9.022	10.369	9.981	12.206	10.843	9.947	9
10	8.555	13.542		7.400	10.815	9.647	12.878	10.426	13.046	10.486	10

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	0.629	0.630	0.693	0.624	0.548	0.692	0.583	0.735	0.628	0.711	1
2	1.160	1.373	1.374	1.375	1.164	1.468	1.265	1.402	1.183	1.214	2
3	2.605	3.389	2.829	3.002	2.834	2.737	2.995	3.168	2.597	2.780	3
4	4.715	5.262	4.856	5.277	4.917	4.749	4.398	5.375	4.892	4.657	4
5	6.269	7.096	6.437	7.422	7.503	6.113	6.305	6.601	6.872	6.340	5
6	7.525	8.686	7.788	8.251	9.300	7.227	8.084	8.606	8.344	8.288	6
7	9.337	9.932	8.571	9.293	10.146	9.587	9.064	10.461	9.540	9.092	7
8	9.489	10.060	9.465	9.473	10.886	10.264	10.979	10.464	10.061	8.742	8
9	12.812	8.694	11.039	8.500	11.237	11.449	12.467	9.131	11.357	12.128	9
10	8.461	10.548	12.736	10.875	10.509	10.404	11.882		13.442		10

Table 10.8 : Total International Fishing Mortality Rate at Age of COD in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	0.044	0.040	0.018	0.038	0.025	0.137	0.141	0.119	0.123	0.178	1
2	0.264	0.338	0.348	0.515	0.389	0.476	0.464	0.542	0.423	0.663	2
3	0.666	0.634	0.648	0.546	0.418	0.731	0.464	0.459	0.597	0.682	3
4	0.724	0.849	1.007	0.649	0.533	0.754	0.660	0.759	0.663	0.765	4
5	0.723	0.540	1.115	0.737	0.574	0.826	0.777	0.827	0.551	0.799	5
6	0.575	0.697	0.921	0.709	0.805	0.611	0.920	1.024	0.675	0.889	6
7	0.520	0.591	1.101	0.401	0.741	0.766	0.900	1.287	0.466	0.848	7
8	0.831	0.477	0.717	0.812	0.404	0.687	0.844	0.448	0.803	0.521	8
9	0.600	0.600	0.600	0.600	0.700	0.700	0.700	0.700	0.700	0.700	9
10	0.600	0.600	0.600	0.600	0.700	0.700	0.700	0.700	0.700	0.700	10

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	0.153	0.087	0.071	0.066	0.088	0.142	0.327	0.169	0.293	0.061	1
2	0.388	0.329	0.283	0.380	0.664	0.523	0.614	0.643	0.748	0.611	2
3	0.716	0.577	0.843	0.677	0.794	0.745	0.818	0.879	0.892	0.809	3
4	0.709	0.778	1.038	0.927	0.763	0.792	0.888	0.960	1.301	0.851	4
5	0.893	0.858	1.218	0.976	0.559	0.839	0.866	1.169	0.957	0.859	5
6	0.710	1.005	1.470	1.076	0.365	0.808	1.034	1.085	1.665	0.826	6
7	0.633	1.134	1.201	1.718	0.661	0.520	0.813	0.908	1.467	0.732	7
8	0.541	0.418	2.063	1.312	0.964	1.184	0.948	0.742	0.870	0.975	8
9	0.700	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	9
10	0.700	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	10

Table 10.9 : Stock Numbers at Age (1000's) of COD in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	6661	9364	3974	7642	10468	6302	8517	8297	11453	6544	1
2	12167	5218	7366	3196	6025	8358	4498	6058	6033	8289	2
3	8313	7649	3047	4258	1563	3344	4252	2316	2885	3237	3
4	1418	3495	3323	1305	2020	842	1317	2189	1199	1300	4
5	937	563	1224	994	558	971	325	557	839	506	5
6	660	372	269	329	389	258	348	122	200	396	6
7	116	304	152	88	133	142	114	113	36	83	7
8	41	56	138	41	48	52	54	38	26	18	8
9	2	15	29	55	15	26	21	19	20	9	9
10	4	4		9	8	10	7	11	2	3	10

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	9810	9576	14978	20596	5995	15147	9196	15175	5864	14824	1
2	4484	6892	7188	11425	15784	4493	10755	5431	10494	3583	2
3	3497	2492	4060	4435	6397	6654	2180	4768	2337	4069	3
4	1339	1399	1146	1431	1844	2367	2588	788	1621	784	4
5	496	540	526	332	464	704	878	872	247	361	5
6	186	166	187	127	103	217	249	302	222	78	6
7	133	75	50	35	36	58	79	72	84	34	7
8	29	58	20	12	5	15	28	29	24	16	8
9	9	14	31	2	3	2	4	9	11	8	9
10	11	2	7	1		2	2		0		10

Table 10.10 Mean Fishing Mortality , Biomass and Recruitment of COD in VIA between 1967 and 1986

	Mean Fishing Mortality			Biomass		Recruits
	Ages		Ages	1000 tonnes		Age 1
	2 to 5		1 to 1			
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1967	0.594	0.000	0.000	65	48	66	7
1968	0.590	0.000	0.000	63	49	67	9
1969	0.779	0.000	0.000	47	38	68	4
1970	0.612	0.000	0.000	34	27	69	8
1971	0.478	0.000	0.000	37	25	70	10
1972	0.697	0.000	0.000	36	26	71	6
1973	0.591	0.000	0.000	34	25	72	9
1974	0.647	0.000	0.000	35	26	73	8
1975	0.558	0.000	0.000	39	27	74	11
1976	0.727	0.000	0.000	40	29	75	7
1977	0.676	0.000	0.000	33	23	76	10
1978	0.635	0.000	0.000	38	26	77	10
1979	0.845	0.000	0.000	43	26	78	15
1980	0.740	0.000	0.000	53	31	79	21
1981	0.695	0.000	0.000	54	39	80	6
1982	0.725	0.000	0.000	53	37	81	15
1983	0.796	0.000	0.000	46	33	82	9
1984	0.913	0.000	0.000	48	31	83	15
1985	0.974	0.000	0.000	35	24	84	6
1986	0.783	0.000	0.000	33	19	85	15
Mean recruits at age 1 for period 1967 to 1986							9983

Table 10.11 Input for catch prediction of COD in VIA

					Values used in Prediction						
					F at age , Mean Wt. and Propn. Retained by Consumption Fishery						
	1986			1987	Scaled mean F			Mean values for period 1981 to 1985			
Age	Fishing Mortality			Stock	1981 to 1985			Mean Weight (Kg.)			Prop.
	H.Con.	Disc	Ind	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	0.204			13000	0.194			0.638			0.638	1.000
2	0.611			9897	0.609			1.297			1.297	1.000
3	0.809			1592	0.787			2.867			2.867	1.000
4	0.851			1483	0.897			4.867			4.867	1.000
5	0.859			274	0.837			6.682			6.682	1.000
6	0.826			125	0.945			8.315			8.315	1.000
7	0.732			28	0.833			9.766			9.766	1.000
8	0.975			14	0.898			10.487			10.487	1.000
9	0.900			5	0.858			11.135			11.135	1.000
10	0.900			3	0.858			11.909			11.909	1.000

Age 2 to 5	Age 1 1	Mean F	Age 2 to 5	Age 1 1
0.783	0.000	Unscaled	0.821	0.000
		Scaled	0.783	0.000

Recruits at age 1 in 1988 = 13000
Recruits at age 1 in 1989 = 13000

M at age and proprtion mature at age are as shown in Table 10.5

Mean F for ages 2 to 5 in 1986 for human consumption landings + discards = 0.783 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1981 to 1985 rescaled to produce a mean value of F for ages 2 to 5 equal to that for 1986

Mean F for ages 1 to 1 in 1986 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1981 to 1985 , rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1986

Table 10.12: Predicted Catches and Biomasses (1000's of tonnes) of COD in VIA 1987 to 1988

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	33	36	40	40	40	40	40	40	40	40	40	40
Spawning	19	21	24	24	24	24	24	24	24	24	24	24
Mean F Ages												
Human Cons. 2 to 5	0.78	0.78	0.00	0.16	0.31	0.47	0.63	0.78	0.94	0.00	0.00	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1986)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.00	0.00	
Catch weight												
Human Consumption	12	15	0	4	8	11	14	16	19	0	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	12	15	0	4	8	11	14	16	19	0	0	
Total catch	12	15	0	4	8	11	14	16	19	0	0	
Biomass 1 Jan of Year+1												
Total	36	40	68	61	56	50	46	42	39	0	0	
Spawning	21	24	50	44	39	34	30	27	24	0	0	

Table 11.1 Nominal catch (in tonnes) of COD in Division VIb, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Denmark	-	-	-	-[2]	2
Faroe Islands	40	10	92	75	4
France	3	1	2	1	443
Germany, Fed. Rep.	-	-	111	136	-
Ireland	-	3	-	-	134
Norway	3	69	138	80	70
UK (England and Wales)	89	285	129	1	67
UK (Scotland)	33	384	198	370	143
Total	168	752	670	696	863

Country	1982	1983	1984	1985	1986[1]
Denmark	-	-	-	-	-
Faroe Islands	77	112	18	-	-
France	27	97	9	17	-
Germany, Fed. Rep.	+	195	-	3	...[2]
Ireland	-	-	-	-	...[2]
Norway	51	462[1]	373[1]	204	-
Spain	58	42	241	1,200	98
UK (England and Wales)	3	163	161	111[3]	65
UK (Scotland)	157	35	221	437	169
Total	373	1,106	1,023	1,972	332

[1] Provisional.

[2] Included in Division VIa.

[3] Foreign landings not included.

Table 12.1 Nominal catch (in tonnes) of COD in Divisions VIId and VIIe, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	53	435	699	163	363
Denmark	1,120	2,160	2,052	660[2]	-
France	5,185	8,044	4,848	4,001	4,486
Netherlands	1	+	-	-	4
UK (England and Wales)	581	654	485	365	428
Total	6,940	11,293	8,084	5,189	5,281

Country	1982	1983	1984	1985	1986[1]
Belgium	293	389	346	513	568
Denmark	-	-	-	-	-
France	3,349	3,369	2,882	2,948	12,335[3]
Netherlands	1	4	-	1	-
UK (England and Wales)	568	650	518	569[4]	902
Total	4,211	4,412	3,746	4,031	13,805

[1] Provisional.

[2] Includes Divisions VIIb,c.

[3] Includes all of Sub-areas VII (except Division VIIa) and VIII.

[4] Foreign landings not included.

Table 12.2

COD IN FISHING AREA VIID AND VIIE (ENGLISH CHANNEL)
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: thousands

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	0	0	0	0	0	0	0	0	0	0	0	1
1	21	683	47	3320	922	627	922	75	1063	217	225	6
2	466	1454	642	5287	5769	2148	2067	2456	926	1922	2361	367
3	523	406	562	304	2229	1376	651	924	656	854	427	355
4	257	254	215	43	423	490	288	207	197	218	93	85
5	88	126	80	17	76	145	76	35	49	48	52	19
6	37	55	20	8	7	48	32	2	10	8	18	4
7	8	14	6	1	1	5	6	0	1	2	0	3
8+	2	5	2	0	1	0	1	0	0	0	0	0
TOTAL	1400	2997	1574	10980	9428	4887	4043	3699	2901	3269	3176	1340
WG weight (tonnes)	3436	5082	3365	6940	11293	8064	5189	5281	4210	4412	3746	2475

19.6

0	0
1	4921
2	3306
3	1775
4	573
5	22
6	2
7	0
8+	0
TOTAL	10599
WG weight (tonnes)	10658

Table 12.3

COD IN FISHING AREA VIID AND VIIE (ENGLISH CHANNEL)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.268
1	.858	.686	.816	.537	.024	.617	.591	.471	.601	.791	.494	.535
2	1.352	.822	1.347	.636	1.022	1.021	.774	.937	.696	.776	.707	1.284
3	2.344	2.712	2.220	1.262	1.641	2.345	2.303	2.015	2.663	1.735	2.681	2.472
4	3.572	4.627	3.205	4.501	2.076	3.099	3.672	4.171	4.303	4.178	4.115	4.027
5	4.667	5.680	4.478	5.194	2.979	3.443	3.932	5.752	5.208	5.704	6.205	5.168
6	5.278	5.511	5.537	5.215	5.584	3.958	4.631	6.878	7.776	7.353	6.692	8.607
7	5.849	6.714	6.626	6.625	6.592	5.394	5.466	.000	6.500	10.329	.000	4.177
8+	6.614	7.408	7.104	.000	7.854	.000	6.411	.000	.000	.000	.000	.000

	1986
0	.000
1	.417
2	.651
3	1.170
4	2.496
5	5.206
6	7.555
7	.000
8+	.000

Table 12.4 VIRTUAL POPULATION ANALYSIS

COD IN FISHING AREA VIID AND VIIE (ENGLISH CHANNEL)

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

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.11	.25	.00	.44	.20	.13	.19	.03	.29	.05	.05	.00
2	.43	.87	.38	.91	1.29	1.03	.84	1.10	.57	1.32	1.11	.26
3	.78	.85	1.04	.32	1.42	1.43	1.06	1.26	1.05	1.91	1.57	.47
4	.35	1.16	1.93	.19	.99	1.81	1.67	1.30	1.08	1.39	1.47	1.24
5	.61	1.44	1.81	.32	.60	1.21	3.00	1.03	1.41	.87	2.03	1.77
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
(2- 4)U	.58	.96	1.11	.47	1.23	1.42	1.19	1.22	.90	1.54	1.31	.66
(2- 4)U	.58	.96	1.11	.47	1.23	1.42	1.19	1.22	.90	1.54	1.31	.66

	1986	1979-83
1	.14	.14
2	.97	.97
3	1.34	1.34
4	1.45	1.45
5	1.50	1.50
6	1.00	1.00
7+	1.00	1.00
(2- 4)U	1.25	
(2- 4)U	1.25	

Table 12.5 VIRTUAL POPULATION ANALYSIS

COD IN FISHING AREA VIID AND VIIE (ENGLISH CHANNEL)

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	1985
1	3359	3443	11804	10351	5540	5517	5898	2921	4626	4911	5235	17879
2	1454	2732	2205	9622	6616	5706	5952	5999	2524	2832	3817	4124
3	1754	775	941	1229	3172	1950	1081	1594	1094	1074	619	1050
4	497	499	271	272	733	629	361	307	323	313	130	129
5	211	178	105	55	184	224	84	59	69	90	64	25
6	52	94	54	14	17	82	55	3	17	14	31	7
7+	17	35	14	2	3	5	12	0	2	3	0	5
TOTAL NO	9655	7655	15372	27522	18260	12113	11464	8883	8454	9227	9946	23199
SPS NO	777	705	421	520	952	940	535	370	411	421	225	156
TOT.BIOM	10428	10304	16500	17929	19626	14835	11068	9573	9205	9896	8108	18135
SPS BIOM	3158	3602	1609	1478	2158	3074	2053	1645	1894	1959	1140	728

	1986	1987	1974-83
1	41463	0	6456
2	14652	29512	4144
3	2597	4541	1377
4	525	557	413
5	51	101	125
6	3	6	38
7+	0	1	9
TOTAL NO	59252		
SPS NO	559		
TOT.BIOM	31373		
SPS BIOM	1496		

Table 12.6 Nominal catch (in tonnes) of COD in Divisions VIIb,c and VIIh,j,k, 1977-1986. (Data for 1977-1985 as offically reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	1	-	-	-	-
Denmark	-	-	18	-	-
France	321	443	546	983	1,465
Germany, Fed. Rep.	-	-	-	7	-
Ireland	298	293	480	782	1,434
Netherlands	291	279	-	5	-
Norway	+	-	-	-	-
Poland	6	-	2	-	-
Spain	51	11	-	17	37
UK (England and Wales)	3	-	1	1	171
UK (Scotland)	-	2	1	12	+
Total	971	1,028	1,048	1,807	3,107

Country	1982	1983	1984	1985	1986[1]
Belgium	-	-	-	-	8
Denmark	-	-	-	-	-
France	587	636	946	1,115	...[2]
Germany, Fed. Rep.	-	-	-	-	-
Ireland	1,764	1,192	1,211	1,176	786
Netherlands	+	80	-	-	-
Norway	-	4	1	25[1]	102
Poland	-	-	-	-	-
Spain	29	28	-	-	-
UK (England and Wales)	304	41	408	135[3]	103
UK (Scotland)	-	-	45	-	9
Total	2,684	1,981	2,611	2,451	1,008

[1] Provisional.

[2] Included in Divisions VIId,e.

[3] Foreign landings not included.

Table 13.1 Nominal catch (in tonnes) of HADDOCK in Sub-area IV, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	2,293	1,295	732	1,414	1,217
Denmark	20,069	8,093	8,248	12,928	13,198
Faroe Islands	385	12	7	27	46
France	6,914	5,122	7,208	7,407	11,966
German Dem. Rep.	8	37	12	36	-
Germany, Fed. Rep.	3,744	2,589	2,549	2,354	3,387
Ireland	53	101	-	-	-
Netherlands	1,598	857	955	1,557	2,279
Norway[2]	374	609	968	1,191	2,283
Poland	485	62[3]	106	59	31
Sweden	113	-[3]	907	1,165	1,301
UK (England and Wales)	17,167	12,200	10,774	12,195	14,570
UK (Scotland)	89,465	58,406	54,119	64,058	82,798
USSR	8,010	54	18	-	-
Total IV	150,678	89,437	86,603	104,391	133,076
WG total incl.discards	207,788	163,890	141,858	217,107	206,930

Country	1982	1983	1984	1985	1986[1]
Belgium	966	985	494	719	329
Denmark	22,704	25,653	16,368	23,619	17,650
Faroe Islands	6	51	-	5	20
France	15,988	11,250	8,103	5,389	7,060[4]
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	4,510	3,654	2,571	2,796	1,945
Ireland	-	-	-	-	-
Netherlands	1,021	1,722	1,052	3,875	1,614
Norway[2]	2,888	3,862	3,959	3,256	4,300
Poland	317	150	17	-	-
Sweden	1,874	1,360	1,518	1,942	1,703[5]
UK (England and Wales)	16,403	15,476	12,340	13,274[6]	7,745
UK (Scotland)	107,773	100,390	87,479	112,549	126,475
USSR	-	-	-	-	-
Total	174,450	164,553	133,901	167,424	168,841
WG total incl.discards	225,789	232,203	213,252	250,000	220,000

[1] Provisional.
[2] Figures from Norway do not include haddock caught in Rec. 2 fisheries.
[3] Included in Division IIIa.
[4] Includes Division IIa.
[5] Jan-Nov.
[6] Foreign landings not included.

Table 13.2 Annual Weight and Numbers of HADDOCK caught in IV between 1967 and 1986

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1967	246	147	78	21	1420	272	448	700
1968	302	105	162	34	1617	221	833	558
1969	929	331	260	338	4003	910	1203	1890
1970	806	525	101	180	3382	1245	515	1622
1971	444	235	177	32	2669	473	1282	914
1972	351	193	128	30	1722	428	760	534
1973	305	179	115	11	1280	449	660	171
1974	364	150	167	48	2384	357	1091	936
1975	448	147	260	41	2958	362	1862	734
1976	368	166	154	48	1633	398	788	447
1977	217	137	44	35	896	320	226	356
1978	174	86	77	11	1031	192	419	420
1979	142	84	42	16	1463	190	288	985
1980	217	99	95	22	1451	219	545	687
1981	207	130	60	17	1353	275	299	779
1982	226	166	41	19	970	310	181	490
1983	238	159	66	13	1254	292	387	574
1984	213	128	75	10	865	246	412	207
1985	250	159	86	6	971	359	457	154
1986	220	165	52	3	756	372	308	75

Table 13.3 Results of analysis of catchability coefficients for HADDOCK in IV

F for named gears and total international F

Gear	Estimate	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
SCO SEI	F(gear)	0.271	0.572	0.639	0.585	0.466	0.376
	Var F(gear)	0.00359	0.00291	0.00160	0.00383	0.00326	0.00228
	Propn(gear)	0.41010	0.48312	0.48030	0.45363	0.41866	0.36853
SCO LTR	F(gear)	0.098	0.103	0.115	0.109	0.118	0.125
	Var F(gear)	0.00016	0.00014	0.00014	0.00034	0.00042	0.00042
	Propn(gear)	0.14996	0.10026	0.10417	0.11031	0.10585	0.10235
All above	F(gear)	0.370	0.675	0.754	0.691	0.584	0.500
	Var F(gear)	0.00375	0.00305	0.00173	0.00417	0.00369	0.00270
	Propn(gear)	0.56007	0.58337	0.58447	0.56394	0.52451	0.55088
Total Internatl	F	0.660	1.157	1.290	1.226	1.114	0.908
	Var F	0.01195	0.00876	0.00508	0.01311	0.01341	0.00883

Table 13.4 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
0	2.050	0.000
1	1.650	0.010
2	0.400	0.320
3	0.250	0.710
4	0.250	0.870
5	0.200	0.950
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000
11	0.200	1.000

Table 13.5 Total International Catch at Age (1000's) of HADDOCK in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	305249	111054	725594	9246014	3306744	2408964	598734	6914124	449474	1671744	0
1	837010	1096962	204694	2661474	1809634	6758314	3648244	1213864	2096824	1676424	1
2	88777	439894	3574774	218294	707354	5840764	5671314	1743894	632674	1045674	2
3	4853	19534	303074	1906574	47224	401504	2374984	326594	57634	206684	3
4	3574	1940	7584	57364	397324	209484	60994	53134	106044	9624	4
5	177394	2514	2404	1174	10284	1559224	4394	1834	15324	30534	5
6	2434	45804	2514	1194	454	3514	38824	1324	954	4794	6
7	214	324	19094	254	194	184	1234	10674	604	184	7
8	214	404	204	5944	144	334	104	234	2624	674	8
9	54	134	24	64	1574	274	284	234	254	6834	9
10	334	54	74	114	154	404	104	314	614	514	10
11				194	34	114	484	34	114	34	11

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	114904	285824	8413914	3749464	6463404	2786924	6393334	954844	1395934	564714	0
1	250174	454384	345754	6622164	1344594	2753734	1557234	4315134	1791144	1601124	1
2	103584	141134	1989394	3231794	4133294	834994	2434804	1598114	5269144	1770374	2
3	376474	28444	39814	69874	1392594	2867504	74124	1196814	75144	3225654	3
4	39324	109114	7134	10024	14634	405114	1222914	22204	36314	26844	4
5	3944	8574	26934	1814	1904	3224	16684	32004	5234	9194	5
6	6014	1184	2134	7844	374	704	1674	3634	7154	1174	6
7	1134	1914	244	574	2474	274	274	584	924	1684	7
8	114	384	454	114	134	794	64	74	194	224	8
9	24	114	134	154	64	24	174	34	54	94	9
10	164	24	54	74	24	154	44	94	24	434	10
11	24	54	14	24	34	84	64	174	74	294	11

Table 13.6 Total International Mean Weight at Age (Kg.) of HADDOCK in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	0.011	0.010	0.011	0.013	0.011	0.024	0.044	0.024	0.021	0.013	0
1	0.115	0.126	0.063	0.073	0.106	0.116	0.112	0.128	0.101	0.125	1
2	0.281	0.253	0.216	0.222	0.247	0.242	0.241	0.226	0.241	0.224	2
3	0.461	0.509	0.406	0.353	0.362	0.388	0.372	0.343	0.356	0.400	3
4	0.594	0.731	0.799	0.735	0.505	0.506	0.585	0.548	0.450	0.508	4
5	0.639	0.857	0.891	0.873	0.887	0.606	0.648	0.891	0.680	0.580	5
6	1.057	0.837	1.032	1.191	1.267	1.000	0.724	0.895	1.245	0.893	6
7	1.501	1.606	1.094	1.361	1.534	1.366	1.044	0.953	1.124	1.877	7
8	1.922	2.260	2.040	1.437	1.337	2.241	1.302	1.513	1.093	1.736	8
9	2.069	2.702	3.034	2.571	1.275	2.006	2.796	2.315	1.720	1.235	9
10	2.348	2.073	3.264	3.950	1.969	1.651	1.726	2.508	2.217	2.335	10
11				3.869	4.306	2.899	2.020	4.152	2.854	2.528	11

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	0.019	0.012	0.009	0.012	0.009	0.011	0.022	0.010	0.013	0.025	0
1	0.108	0.144	0.095	0.104	0.074	0.100	0.135	0.141	0.149	0.124	1
2	0.240	0.252	0.291	0.284	0.262	0.292	0.295	0.298	0.280	0.241	2
3	0.345	0.416	0.443	0.487	0.474	0.461	0.447	0.486	0.480	0.396	3
4	0.599	0.444	0.635	0.730	0.735	0.786	0.649	0.673	0.669	0.615	4
5	0.609	0.694	0.659	1.038	1.131	1.168	0.912	0.804	0.862	0.872	5
6	0.753	0.709	0.924	0.925	1.456	1.456	1.225	1.100	1.061	1.279	6
7	1.096	0.924	1.173	1.377	1.148	1.678	1.220	1.128	1.466	1.204	7
8	1.706	1.302	1.167	1.621	1.583	1.452	1.937	1.929	1.817	1.691	8
9	1.977	1.806	1.455	1.597	1.690	2.624	1.425	2.462	2.103	1.471	9
10	1.608	1.923	2.639	1.710	1.531	2.173	1.484	1.871	2.129	2.338	10
11	3.189	1.890	1.618	3.269	1.464	1.870	1.846	2.454	1.912	2.782	11

Table 13.7 Total International Fishing Mortality Rate at Age of HADDOCK in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	0.002	0.002	0.015	0.027	0.011	0.029	0.002	0.012	0.010	0.027	0
1	0.237	0.047	0.020	0.450	0.428	0.155	0.341	0.323	0.307	0.286	1
2	1.061	0.579	0.655	1.032	0.662	0.795	0.571	0.939	0.968	0.824	2
3	0.410	0.882	1.375	1.154	0.804	1.332	1.165	0.958	1.269	1.363	3
4	0.353	0.302	1.209	1.270	0.876	1.196	0.797	1.009	1.102	0.807	4
5	1.015	0.467	0.789	0.622	0.873	1.167	0.947	0.620	1.002	1.296	5
6	0.998	0.814	1.261	1.282	0.530	0.873	1.120	0.865	0.784	1.073	6
7	1.027	0.330	1.016	0.384	0.730	0.431	0.912	1.180	1.420	0.337	7
8	2.007	0.534	0.350	1.105	0.395	0.258	0.463	0.431	1.134	0.573	8
9	1.834	0.658	0.710	0.189	1.065	0.116	0.363	0.169	1.237	1.106	9
10	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	10
11	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	11

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	0.012	0.018	0.030	0.061	0.052	0.035	0.023	0.011	0.010	0.002	0
1	0.307	0.355	0.161	0.173	0.164	0.163	0.142	0.112	0.147	0.084	1
2	1.008	1.000	0.886	0.700	0.457	0.425	0.660	0.661	0.593	0.660	2
3	1.031	1.110	1.139	1.200	0.939	0.814	1.044	1.020	0.952	1.157	3
4	1.246	1.110	1.066	1.159	0.989	0.874	1.151	1.222	1.169	1.290	4
5	1.014	1.145	1.004	0.947	0.746	0.635	1.269	1.243	1.240	1.226	5
6	1.025	1.037	1.056	0.957	0.512	0.691	0.823	1.146	1.122	1.114	6
7	0.820	1.179	0.631	0.975	0.964	0.889	0.643	0.790	1.101	0.908	7
8	0.358	0.748	1.048	0.694	0.607	1.017	0.535	0.375	0.681	0.900	8
9	0.408	0.722	0.658	1.470	1.099	0.257	0.665	0.605	0.452	0.900	9
10	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	10
11	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	11

Table 13.8 Stock Numbers at Age (1000's) of HADDOCK in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	375295400	164460600	111735400	80256740	74042800	19730910	67125370	122405400	10417890	14813110	0
1	78413811	48221180	21138200	14165010	10053010	9431901	2467426	8623249	15576020	1327554	1
2	159520	1187659	8833303	3979521	1735351	1258936	1551644	336972	1199530	2201114	2
3	16157	37002	446051	3075562	950471	600301	381034	587435	88309	305421	3
4	13497	8348	11926	87864	755774	33135	12343	92568	175528	19328	4
5	301895	7387	4805	2773	19212	245076	7807	4332	26272	45420	5
6	4189	89555	3789	1788	1219	6568	62441	2479	1908	7895	6
7	362	1264	32494	879	406	588	2247	16679	854	714	7
8	267	106	744	9635	490	160	313	739	4197	169	8
9	73	29	51	430	2612	270	101	161	393	1105	9
10	61	9	12	20	291	737	197	58	111	93	10
11				34	6	20	88	6	20	6	11

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	23294870	36838590	66756050	14649680	29977510	18938270	64948220	20608610	31399500	58392080	0
1	1856544	2964123	4656089	8340192	1773462	3664981	2354072	8168170	2624176	4000001	1
2	191604	262267	399065	761416	1347802	288979	598131	392150	1401929	435062	2
3	647549	46896	64678	110301	253507	572323	126585	207159	135680	519470	3
4	60839	179808	12040	16122	25868	77181	197501	34709	58155	40796	4
5	6716	13626	46127	3228	3940	7497	25082	48650	7966	14070	5
6	10177	1994	3549	13832	1026	1529	3251	5771	11496	1887	6
7	2210	2989	579	1010	4351	503	627	1169	1502	3066	7
8	417	797	753	252	312	1359	169	270	435	409	8
9	78	239	309	216	103	139	402	81	152	180	9
10	299	42	95	131	41	28	88	169	36	79	10
11	4	95	25	46	58	15	11	31	141	54	11

Table 13.9 HAD in IV Age 1 : Abundance indices and catchability coefficients

YCl Yr.	VPA	IYFS		EGFS		DGFS		FRGSF		SGFS	
		Index	Q	Index	Q	Index	Q	Index	Q	Index	Q
69 in 70	1417	28.0	0.020								
70 in 71	10053	835.0	0.083								
71 in 72	9432	740.0	0.078								
72 in 73	2467	187.0	0.076								
73 in 74	8623	1072.0	0.124								
74 in 75	15576	1168.0	0.075								
75 in 76	1328	177.0	0.133								
76 in 77	1857	162.0	0.087	6634.0	3.573						
77 in 78	2964	385.0	0.130	12605.0	4.253						
78 in 79	4656	480.0	0.103	29691.0	6.377						
79 in 80	8340	896.0	0.107	62392.0	7.481						
80 in 81	1773	268.0	0.151	17036.0	9.606						
81 in 82	3665	526.0	0.144	31501.0	8.595					3197.0	0.872
82 in 83	2354	307.0	0.130	21762.0	9.244					2314.0	0.983
83 in 84	8168	1057.0	0.129	60008.0	7.347					4611.0	0.565
84 in 85	2624	229.0	0.087	18216.0	6.942					2497.0	0.952
85 in 86	4000	584.0	0.119	14892.0	8.057					2710.0	0.812
	input	=> VPA=	4918	=> VPA=	1848					=> VPA=	3337
86 in 87	7500	926.0	0.119								
	input	=> VPA=	7785								

Table 13.10 HAD in IV Age 2 : Abundance indices and catchability coefficients

YCl	Yr.	VPA	IYFS		EGFS		DGFS		FRGSF		SGFS	
			Index	Q	Index	Q	Index	Q	Index	Q	Index	Q
68	in 70	398										
69	in 71	174	32.0	0.184								
70	in 72	1259	299.0	0.237								
71	in 73	1552	971.0	0.626								
72	in 74	337	110.0	0.326								
73	in 75	1200	385.0	0.321								
74	in 76	2201	670.0	0.304								
75	in 77	192	84.0	0.438	3119.0	16.245						
76	in 78	262	108.0	0.412	3105.0	11.851						
77	in 79	399	240.0	0.602	6053.0	15.170						
78	in 80	761	402.0	0.528	15755.0	20.703						
79	in 81	1348	675.0	0.501	43835.0	32.519						
80	in 82	289	252.0	0.872	7955.0	27.526					884.0	3.059
81	in 83	598	400.0	0.669	10945.0	18.303					1576.0	2.635
82	in 84	392	219.0	0.559	6199.0	15.814					669.0	1.707
83	in 85	1402	828.0	0.591	23543.0	16.792					2556.0	1.823
84	in 86	0	257.0	0.568	4757.0	20.719					619.0	1.867
		input	=> VPA=	453	=> VPA=	230					=> VPA=	332
85	in 87	0	306.0	0.571								
		input	=> VPA=	536								

Table 13.11 Estimates of recruitment at ages 1 and 2 for North Sea haddock using various methods.

Method	1986		1987	
	Age 1	Age 2	Age 1	Age 2
Commercial Q	-	435	-	-
Shepherd	2,994	323	8,842	692
Cook (weighted)	4,031	400	7,168	529
Res. Vessel Q (weighted mean)	4,054	390	7,782	536
Value adopted	4,000	435	7,500	530

Table 13.12 Mean Fishing Mortality , Biomass and Recruitment of HADDOCK in IV between 1967 and 1986

	Mean Fishing Mortality			Biomass		Recruits
	Ages 2 to 6		Ages 0 to 3	1000 tonnes		Age 0
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1967	0.608	0.140	0.048	1163	225	67	375295
1968	0.475	0.089	0.055	6471	259	68	16446
1969	0.756	0.092	0.197	2278	794	69	11174
1970	0.760	0.123	0.257	1361	876	70	80257
1971	0.601	0.109	0.074	1554	404	71	74043
1972	0.902	0.146	0.049	1595	290	72	19731
1973	0.781	0.128	0.031	852	283	73	67125
1974	0.635	0.143	0.099	1458	246	74	122405
1975	0.757	0.207	0.083	1994	225	75	10418
1976	0.822	0.157	0.119	827	290	76	14813
1977	0.803	0.132	0.165	523	223	77	23295
1978	0.860	0.192	0.057	607	124	78	36839
1979	0.911	0.088	0.053	633	103	79	66756
1980	0.835	0.082	0.081	1169	145	80	14650
1981	0.620	0.089	0.059	635	228	81	29978
1982	0.571	0.068	0.063	791	285	82	18938
1983	0.814	0.149	0.047	708	239	83	64948
1984	0.938	0.095	0.030	1437	187	84	20609
1985	0.915	0.077	0.015	911	232	85	31400
1986	0.956	0.130	0.008	850	225	86	58392
Mean recruits at age 0 for period 1967 to 1984							59318
" - 1968- 1984							40731

Table 13.13 Input for catch prediction of HADDOCK in IV

		Values used in Prediction										
		F at age , Mean Wt. and Propn. Retained by Consumption Fishery										
	1986			1987	Scaled mean F			Mean values for period 1981 to 1985				
Age	Fishing Mortality			Stock	1981 to 1985			Mean Weight (Kg.)				Prop.
	H.Con.	Disc	Ind	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
0		0.001	0.001	40731000		0.002	0.007		0.059	0.009	0.013	
1	0.011	0.099	0.036	7500001	0.005	0.098	0.018	0.301	0.172	0.043	0.120	0.053
2	0.226	0.427	0.007	663846	0.295	0.352	0.012	0.374	0.229	0.190	0.285	0.458
3	0.933	0.221	0.003	150730	0.960	0.183	0.011	0.505	0.298	0.393	0.470	0.839
4	1.284	0.001	0.005	127206	1.288	0.034	0.007	0.715	0.405	0.572	0.703	0.974
5	1.223	0.002	0.001	8746	1.228	0.017	0.009	0.995	0.544	0.775	0.975	0.989
6	1.114			3381	1.061	0.013	0.000	1.266	0.606	0.878	1.269	0.987
7	0.908			507	1.099			1.328			1.328	1.000
8	0.900			1013	0.806			1.744			1.744	1.000
9	0.900			136	0.771			2.061			2.061	1.000
10	0.900			60	1.127			1.838			1.838	1.000
11	0.900			26	1.127			1.909			1.909	1.000

Age 2 to 6	Age 0 3	Mean F	Age 2 to 6	Age 0 3
1.086	0.012	Unscaled	0.867	0.043
		Scaled	1.086	0.012

Recruits at age 0 in 1988 = 40731000
Recruits at age 0 in 1989 = 40731000

M at age and proprtion mature at age are as shown in Table 13.4

Mean F for ages 2 to 6 in 1986 for human consumption landings + discards = 1.086 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1981 to 1985
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1986

Mean F for ages 0 to 3 in 1986 for small-mesh fisheries = 0.012 .
Industrial fishery F-at-age in the prediction are averages for the period 1981 to 1985 .
rescaled to produce a mean value of F for ages 0 to 3 equal to that for 1986

Table 13.14 Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in IV 1987 to 1988

	Year										
	1986	1987	1988								
Biomass 1 Jan of Year											
Total	850	1265	1152	1152	1152	1152	1152	1152	1152	1152	1152
Spawning	225	213	251	251	251	251	251	251	251	251	251
Mean F Ages											
Human Cons. 2 to 6	1.09	1.09	0.00	0.22	0.43	0.65	0.87	1.09	1.30	0.22	0.36
Small-mesh 0 to 3	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mean F(Year)/Mean F(1986)										F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.20	0.33
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Catch weight											
Human Consumption	165	159	0	52	95	131	162	188	210	51	81
Discards	52	99	0	27	51	74	94	113	131	27	43
Small-mesh Fisheries	3	5	7	6	6	6	6	5	5	6	6
Total landings	168	164	7	58	101	137	168	194	216	58	87
Total catch	220	264	7	85	152	211	262	307	347	84	130
Biomass 1 Jan of Year+1											
Total	1265	1152	1485	1393	1314	1247	1189	1140	1098	1393	1340
Spawning	213	251	544	473	413	363	321	286	255	473	433

Status quo F

Table 13.15 Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in IV 1987 to 1988

	Year										
	1986	1987	1988								
Biomass 1 Jan of Year											
Total	850	1265	1197	1197	1197	1197	1197	1197	1197	1197	1197
Spawning	225	213	284	284	284	284	284	284	284	284	284
Mean F Ages											
Human Cons. 2 to 6	1.09	0.84	0.00	0.22	0.43	0.65	0.87	1.09	1.30	0.22	0.36
Small-mesh 0 to 3	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mean F(Year)/Mean F(1986)										F0.1	Fmax
Human Consumption	1.00	0.77	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.20	0.33
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Catch weight											
Human Consumption	165	135	0	59	108	148	183	212	237	58	92
Discards	52	79	0	27	53	75	97	116	134	27	44
Small-mesh Fisheries	3	5	7	7	6	6	6	6	5	7	6
Total landings	168	140	7	65	114	154	189	218	242	65	98
Total catch	220	219	7	93	166	230	285	333	376	92	142
Biomass 1 Jan of Year+1											
Total	1265	1197	1534	1432	1346	1272	1210	1157	1112	1432	1374
Spawning	213	284	587	507	441	386	339	300	267	508	463

TAC in 1987 = 140,000 tonnes.

Table 13.16 Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in IV 1987 to 1988

	Year										
	1986	1987	1988								
Biomass 1 Jan of Year											
Total	850	1265	1178	1178	1178	1178	1178	1178	1178	1178	1178
Spawning	225	213	264	264	264	264	264	264	264	264	264
Mean F Ages											
Human Cons. 2 to 6	1.09	1.06	0.00	0.21	0.42	0.64	0.85	1.06	1.27	0.00	0.00
Small-mesh 0 to 3	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
Mean F(Year)/Mean F(1986)										F0.1	Fmax
Human Consumption	1.00	0.98	0.00	0.20	0.39	0.59	0.78	0.98	1.17	0.00	0.00
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00
Catch weight											
Human Consumption	165	151	0	51	93	129	159	185	208	0	0
Discards	32	75	0	22	42	61	78	94	109	0	0
Small-mesh Fisheries	3	5	7	6	6	6	6	6	5	0	0
Total Landings	168	157	7	57	99	135	165	191	213	0	0
Total catch	220	231	7	79	142	196	244	285	322	0	0
Biomass 1 Jan of Year+1											
Total	1265	1178	1514	1426	1351	1287	1232	1185	1144	0	0
Spawning	213	264	566	498	440	391	350	314	284	0	0

Including mesh increase to 85mm.

Table 14.1 Nominal catch (in tonnes) of HADDOCK in Division VIa, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	-	-	2	3	1
Denmark	-	-	37	-	-
Faroe Islands	-	-	2	-	-
France	3,401	4,255	4,786	2,808	3,403
Germany, Fed. Rep.	+	20	2	3	7
Ireland	616	441	877	726	1,891
Netherlands	28	13	2	2	3
Norway	7	13	9	16	29
Spain	-	-	-	-	-
UK (England & Wales)	3,827	2,805	1,654	1,279	1,052
UK (Scotland)	11,422	9,629	7,459	8,198	12,051
UK (Northern Ireland)	-	-	-	+	-
Total	19,301	17,176	14,830	13,935	18,437
WG total incl.discards	23,657	19,510	28,847	17,478	33,306

Country	1982	1983	1984	1985	1986[1]
Belgium	2	1	6	7	-
Denmark	+	-	-[1]	-	-
Faroe Islands	-	-	-	-	-
France	3,760	4,520	4,240	5,930	3,553[2]
Germany, Fed. Rep.	71	65	83	38	27
Ireland	4,402	3,450	3,932	3,512	1,427
Netherlands	391	25	-[1]	-	-
Norway	37	68	32[1]	75	55
Spain	97	201	-	166	-
UK (England & Wales)	2,035	1,376	1,042	303	188
UK (Scotland)	19,249	21,593	18,472	15,036	12,953
UK (Northern Ireland)	1	4	5	1	40
Total	30,045	31,303	27,942	25,068	18,243
WG total incl.discards	39,681	37,630	46,364	41,737	27,000

[1] Provisional.

[2] Includes Divisions VIb and Vb.

Table 14.2 Annual Weight and Numbers of HADDOCK caught in VIA between 1967 and 1986

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1967	28	20	7	0	133	53	79	0
1968	46	20	25	0	233	55	178	0
1969	51	26	25	0	232	88	144	0
1970	40	34	6	0	163	117	47	0
1971	58	46	12	0	225	132	93	0
1972	57	41	16	0	237	127	110	0
1973	40	29	11	0	179	86	92	0
1974	33	18	15	0	207	50	157	0
1975	47	14	33	0	280	41	240	0
1976	34	19	15	0	155	59	96	0
1977	24	19	4	0	88	58	30	0
1978	20	17	2	0	67	48	19	0
1979	29	15	14	0	135	41	95	0
1980	17	13	5	0	72	38	34	0
1981	33	18	15	0	142	58	84	0
1982	40	30	10	0	144	87	57	0
1983	36	29	7	0	83	49	34	0
1984	46	30	16	0	153	48	105	0
1985	42	24	17	0	125	43	82	0
1986	27	20	7	0	74	38	36	0

Table 14.3 Results of analysis of catchability coefficients for HADDOCK in VIA

F for named gears and total international F

Gear	Estimate	Age 2	Age 3	Age 4	Age 5
	F(gear)	0.108	0.162	0.160	0.126
SCO LTR	Var F(gear)	0.00064	0.00061	0.00033	0.00035
	Propn(gear)	0.22820	0.29268	0.22415	0.17835
	F(gear)	0.108	0.162	0.160	0.126
All above	Var F(gear)	0.00064	0.00061	0.00033	0.00035
	Propn(gear)	0.22820	0.29268	0.22415	0.17835
Total	F	0.471	0.552	0.714	0.706
Internatl	Var F	0.01224	0.00710	0.00648	0.01112

Table 14.4 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
0	0.200	0.000
1	0.200	0.000
2	0.200	0.570
3	0.200	1.000
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000

Table 14.5 Total International Catch at Age (1000's) of HADDOCK in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	40122	27	2742	17189	6604	14215	19589	63698	6849	4227	0
1	19185	129418	84	6317	71481	20713	47387	68837	179349	24337	1
2	19332	38393	160706	519	3915	85141	16907	11562	34957	72330	2
3	951	3079	10260	95114	3328	2718	19477	10757	3339	15224	3
4	265	356	1434	2770	79966	2336	258	6317	3350	1588	4
5	24979	681	268	173	545	53823	1222	83	1892	1491	5
6	400	14063	379	89	127	504	33193	447	95	868	6
7	9	727	4576	145	7	50	150	11463	98	21	7
8	14	43	191	585	20	19	32	104	3454	7	8
9	4	9	9	13	175		6	34	72	1103	9

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	4552	57	5697	13	764	136	2084	269	155	2982	0
1	13109	15942	70070	22729	251	15492	14524	98976	22820	8136	1
2	3468	2095	17282	21927	83911	5019	20233	8626	78922	11244	2
3	35948	971	1865	5636	20697	73676	6040	12910	4667	45418	3
4	5705	24357	470	922	1768	8167	36122	6242	4184	1824	4
5	680	2938	9863	143	194	898	3398	22790	1789	916	5
6	495	351	833	3082	39	108	597	2449	11189	452	6
7	308	247	114	229	822	272	41	371	964	2624	7
8	28	338	145	22	39	288	194	43	84	345	8
9	11	7	28	5	14	31	195	44	4	39	9

Table 14.6 Total International Mean Weight at Age (Kg.) of HADDOCK in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0
1	0.160	0.159	0.158	0.161	0.160	0.160	0.159	0.159	0.159	0.159	1
2	0.266	0.264	0.243	0.230	0.248	0.249	0.251	0.248	0.260	0.256	2
3	0.569	0.567	0.526	0.368	0.341	0.380	0.384	0.368	0.428	0.459	3
4	0.573	0.823	0.916	0.812	0.546	0.530	0.597	0.527	0.581	0.592	4
5	0.667	0.731	1.042	1.283	1.040	0.546	0.512	0.764	0.832	0.831	5
6	1.177	0.811	1.024	1.262	1.313	0.984	0.571	0.685	1.027	1.095	6
7	1.844	1.430	0.999	1.043	1.651	1.499	1.185	0.798	1.001	1.585	7
8	1.611	1.903	1.569	1.342	1.426	1.538	1.706	1.142	1.009	1.084	8
9	2.355	2.516	2.065	1.791	1.466		2.202	1.319	1.190	1.243	9

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	0.040	0.068	0.032	0.077	0.082	0.038	0.050	0.059	0.019	0.064	0
1	0.161	0.134	0.182	0.134	0.252	0.157	0.178	0.149	0.138	0.182	1
2	0.274	0.278	0.325	0.319	0.245	0.273	0.282	0.319	0.268	0.270	2
3	0.406	0.388	0.457	0.572	0.467	0.376	0.461	0.456	0.486	0.361	3
4	0.684	0.516	0.730	0.719	0.887	0.746	0.557	0.668	0.636	0.636	4
5	0.830	0.827	0.777	0.998	0.975	1.126	1.002	0.667	0.802	0.902	5
6	1.128	1.045	1.040	0.985	1.376	1.539	1.370	1.087	0.868	1.133	6
7	1.337	1.152	1.491	1.143	1.294	1.549	1.716	1.392	1.272	1.044	7
8	1.117	1.399	1.944	1.565	1.347	1.514	1.558	2.075	1.277	1.414	8
9	1.394	2.126	1.735	1.632	1.366	1.738	1.556	1.882	1.695	1.526	9

Table 14.7 Total International Fishing Mortality Rate at Age of HADDOCK in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	0.037	0.002	0.130	0.061	0.075	0.151	0.100	0.123	0.157	0.152	0
1	0.242	0.159	0.006	0.492	0.384	0.352	1.060	0.591	0.594	1.286	1
2	1.340	1.078	0.302	0.046	0.654	1.115	0.545	0.831	0.691	0.511	2
3	0.625	0.805	1.003	0.294	0.460	1.484	0.857	0.821	0.614	0.754	3
4	0.144	0.507	1.200	0.845	0.431	0.691	0.512	0.771	0.664	0.677	4
5	0.681	0.656	0.922	0.423	0.388	0.584	1.002	0.305	0.553	0.718	5
6	0.259	1.099	0.985	0.945	0.640	0.759	0.902	1.448	0.690	0.537	6
7	0.095	1.045	1.561	1.496	0.159	0.571	0.534	0.960	1.982	0.317	7
8	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	8
9	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	9

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	0.067	0.000	0.012	0.000	0.009	0.003	0.005	0.004	0.001	0.013	0
1	0.953	0.351	0.565	0.059	0.008	0.248	0.474	0.328	0.485	0.085	1
2	0.617	0.377	0.804	0.344	0.322	0.210	0.590	0.579	0.473	0.471	2
3	0.518	0.347	0.684	0.678	0.637	0.520	0.420	0.975	0.727	0.552	3
4	0.725	0.820	0.281	0.895	0.467	0.562	0.525	1.057	1.059	0.714	4
5	0.706	1.095	0.985	0.129	0.468	0.462	0.484	0.756	1.071	0.706	5
6	0.556	1.033	1.164	1.022	0.048	0.520	0.645	0.788	1.120	0.900	6
7	0.369	0.603	1.261	1.334	0.871	0.522	0.382	1.145	0.859	0.900	7
8	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	8
9	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	9

Table 14.8 Stock Numbers at Age (1000's) of HADDOCK in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	1228143	190031	247411	319392	100710	111665	227411	604639	51935	32952	0
1	98165	969297	155331	177841	245985	76497	78616	168522	437614	36350	1
2	28284	63110	676995	126411	89011	137234	44028	22291	76396	197857	2
3	2236	6066	17591	409832	98821	3788	36827	20911	7947	31328	3
4	2179	980	2221	5285	250041	5107	704	12802	7534	3521	4
5	55168	1545	483	548	1859	132995	2096	345	4947	3175	5
6	1925	22855	657	157	294	1033	60734	630	208	2284	6
7	107	1216	6234	201	50	127	396	20180	121	85	7
8	26	79	350	1071	37	35	59	190	6328	14	8
9	8	16	16	25	321		11	62	132	2021	9

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	771911	2168921	5362991	437301	956181	515791	4771381	796921	1345221	2471111	0
1	231701	590911	1775251	4339391	357911	775951	421071	3089651	650041	1099981	1
2	82271	73121	340631	826371	3347681	290771	495931	214571	2293711	327711	2
3	972041	36341	41051	124821	479621	1986891	192881	225031	98491	1170561	3
4	120661	473881	21031	16951	51851	207681	966891	103731	69461	38981	4
5	14641	47871	170901	13001	5671	26601	96941	468141	29501	19731	5
6	12681	5921	13111	52241	9361	2911	13731	48911	179961	8271	6
7	10931	5951	1721	3351	15391	7301	1421	5901	18201	48081	7
8	511	6181	2671	401	721	5271	3551	791	1541	6321	8
9	211	121	521	91	251	561	3571	801	61	711	9

Table 14.9 Estimates of recruitment at age 1 for haddock in Division VIa from two estimation procedures.

Method	1986	1987
Shepherd	56	1,304
Cook	111[1]	199[1]

[1] Value adopted.

Table 14.10 Mean Fishing Mortality , Biomass and Recruitment of HADDOCK in VIA between 1967 and 1986

	Mean Fishing Mortality			Biomass			Recruits
	Ages		Ages	1000 tonnes			Age 0
	2 to 6		1 to 1				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1967	0.404	0.205	0.000	114	46	67	1228
1968	0.656	0.173	0.000	197	35	68	19
1969	0.808	0.074	0.000	187	113	69	25
1970	0.493	0.018	0.000	176	159	70	319
1971	0.403	0.112	0.000	188	144	71	101
1972	0.718	0.208	0.000	129	97	72	112
1973	0.658	0.105	0.000	84	57	73	227
1974	0.683	0.152	0.000	88	35	74	605
1975	0.522	0.120	0.000	110	30	75	52
1976	0.539	0.100	0.000	82	53	76	33
1977	0.528	0.097	0.000	61	53	77	77
1978	0.673	0.062	0.000	57	33	78	217
1979	0.711	0.073	0.000	79	25	79	536
1980	0.577	0.037	0.000	103	30	80	44
1981	0.309	0.079	0.000	130	78	81	96
1982	0.383	0.072	0.000	118	100	82	52
1983	0.419	0.114	0.000	121	84	83	477
1984	0.716	0.115	0.000	125	59	84	80
1985	0.804	0.086	0.000	103	65	85	135
1986	0.569	0.099	0.000	98	59	86	247
Mean recruits at age 0 for period 1967 to 1984							239
" - 1968-1984							181

Table 14.11 Input for catch prediction of HADDOCK in VIA

		Values used in Prediction									
		F at age , Mean Wt. and Propn. Retained by Consumption Fishery									
	1986			1987	Scaled mean F 1981 to 1985			Mean values for period 1981 to 1985 Mean Weight (Kg.)				Prop.
Age	Fishing Mortality H.Con.	Disc	Ind	Stock Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
0		0.013		181000		0.005			0.050		0.050	
1	0.023	0.286		199625	0.013	0.320		0.322	0.141		0.175	0.185
2	0.202	0.269		66119	0.149	0.320		0.377	0.235		0.277	0.302
3	0.326	0.226		16752	0.568	0.140		0.490	0.304		0.449	0.786
4	0.714			55183	0.771	0.021		0.711	0.339		0.703	0.975
5	0.706			1563	0.681	0.019		0.924	0.412		0.914	0.977
6	0.900			797	0.670	0.003		1.249	0.353		1.248	0.997
7	0.900			275	0.816			1.444			1.444	1.000
8	0.900			1600	0.971			1.554			1.554	1.000
9	0.900			210	0.971			1.648			1.648	1.000

Age 2 to 6	Age 1 1!	Mean F	Age 2 to 6	Age 1 1!
0.669	0.000	Unscaled	0.619	0.000
		Scaled	0.669	0.000

Recruits at age 0 in 1988 = 181000
Recruits at age 0 in 1989 = 181000

M at age and proprtion mature at age are as shown in Table 14.4

Mean F for ages 2 to 6 in 1986 for human consumption landings + discards = 0.669 .
human consumption + discard F-at-age values in prediction are mean values for the period 1981 to 1985
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1986

Mean F for ages 1 to 1 in 1986 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1981 to 1985 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1986

Table 14.12 Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in VIA 1987 to 1700

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	82	105	99	99	99	99	99	99	99	99	99	99
Spawning	59	62	60	60	60	60	60	60	60	60	60	60
Mean F Ages												
Human Cons. 2 to 6	0.67	0.67	0.00	0.13	0.27	0.40	0.53	0.67	0.80	0.18	0.27	
Small-mesh 1 to 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										F0.1	Fmax	
Mean F(Year)/Mean F(1986)												
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.27	0.40	
Catch weight												
Human Consumption	20	31	0	6	12	17	21	25	28	8	12	
Discards	7	10	0	3	5	8	10	12	14	4	5	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	20	31	0	6	12	17	21	25	28	8	12	
Total catch	27	41	0	9	17	25	31	37	42	12	17	
Biomass 1 Jan of Year+1												
Total	105	99	149	137	126	116	107	100	93	133	126	
Spawning	62	60	109	98	88	79	71	64	57	94	88	

Table 15.1 Nominal catch (in tonnes) of HADDOCK in Division VIb, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Faroe Islands	3	11	20	5	1
France	4	3	4	1	10
Germany, Fed. Rep.	-	-	-	17	-
Ireland	-	61	-	-	-
Norway	+	4	16	2	10
Spain	-	-	-	6	88
UK (England & Wales)	2,694	2,365	1,654	6,261	9,005
UK (Scotland)	297	2,060	548	1,051	27
Total	42,998	4,504	2,242	7,343	9,141

Country	1982	1983	1984	1985	1986[1]
Faroe Islands	21	3	3	1	-[2]
France	32	48	12	116	...[2]
Germany, Fed. Rep.	4	1	-	4	...
Ireland	-	-	-	-	-
Norway	3	20	45	29	90
Spain	121	79	128	892	-
UK (England & Wales)	3,736	113	788	1,738	604
UK (Scotland)	5	136	1,654	6,397	2,869
UK (Northern Ireland)	-	-	-	-	84
Total	3,922	400	2,630	9,177	3,647

[1] Provisional.

[2] Included in Division VIa.

Table 15.2

HADDOCK VIB 1985 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
1			1331	0.100			1331	0.100
2	65	0.348	668	0.220			734	0.231
3	758	0.479	61	0.280			819	0.464
4	12971	0.507	4292	0.320			17263	0.461
5	3699	0.543	715	0.370			4414	0.515
6	124	0.668					124	0.668
7	6	1.208					6	1.208
8	70	0.778					70	0.778
9	220	0.879	154	0.320			374	0.648
10	1	1.231					1	1.231
11	3	1.408					3	1.408
12	1	1.370					1	1.370
13								
No.	17917		7222		0		25139	
Wt.	9315		1985		0		11300	

HADDOCK VIB 1986 Total International Data

	Human Consumption				Small Mesh		International	
	Landings		Discards		By-catch		Catch	
Age	Number	Weight	Number	Weight	Number	Weight	Number	Weight
1								
2	588	0.305					588	0.305
3	383	0.477					383	0.477
4	837	0.624					837	0.624
5	3236	0.646					3236	0.646
6	1101	0.697					1101	0.697
7	60	0.868					60	0.868
8	28	0.825					28	0.825
9	69	0.841					69	0.841
10	87	0.918					87	0.918
11	12	1.133					12	1.133
12	1	1.336					1	1.336
13								
No.	6403		0		0		6403	
Wt.	3970		0		0		3970	

Table 15.3 HADDOCK. Division VIb (Rockall) Scottish and German trawl surveys. Numbers per 10 hours fishing (weighted average of surveys).

Survey year	Vessel	Age									Hauls
		0	1	2	3	4	5	6	7	8+	
1967	E	9	11	153	115	124	150	174	168	215	38
1968	E	21,302	69	11	76	66	66	60	50	58	51
1969	E	-	7,431	78	8	28	25	13	19	29	24
1970	E	[-]	11	9,746	68	25	27	22	20	34	23
1971	-	-	-	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-
1974	H	42,250	5,410	400	180	20	50	-	20	-	1
1975	-	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	-	-	-
1977	H	-	6,117	13,581	2,587	4,366	54	-	80	163	5
1978	-	-	-	-	-	-	-	-	-	-	-
1979	EH	-	212	819	6,110	686	843	119	-	3	16
1980	?	-	-	75	1,309	15,357	82	1,583	604	428	?
1981	RH	39,329	32,098	16,596	613	1,675	17,320	-	236	808	45+
1982	SH	[-]	30,094	20,923	136	104	737	3,306	176	280	30
1983	-	-	-	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	-	-	-
1985	C	489	51,284	214	31	4,218	676	1	2	145	23
1986	R	3,577	17,309	62,196	85	139	2,568	225	-	52	?

[ ] Indicates surveys early in year before 0-group are available.

Vessel Key

E = "Explorer"

H = "Walter Herwig"

R = "G.A. Reay"

S = "Scotia"

C = "Clarkwood"

Table 16.1 Nominal catch (in tonnes) of HADDOCK in Divisions VIId and VIIe, 1977-1986. (Data for 1977-1985 as officially reported to ICES).

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986[1]
Belgium	1	-	1	+	2	1	1	-	3	2
Denmark	2	22	21	15	-	-	-	-	-	-
France	438	356	333	298	421	344	232	273	138	3,222[2]
Ireland	4	-	-	+	-	-	-	-	-	-
Netherlands	-	-	-	-	-	94	1	-	-	-
UK (Engl.& Wales)	29	22	51	59	119	60	41	26	27[3]	20
Total	474	400	406	372	542	499	275	299	168	3,244

[1] Provisional.

[2] Includes all of Sub-areas VII and VIII.

[3] Foreign landings not included.

Table 16.2 Nominal catch (in tonnes) of HADDOCK in Divisions VIIb,c and VIIg-k, 1977-1986. (Data for 1977-1985 as officially reported to ICES).

Country	1977	1978	1979	1980	1981
Belgium	13	5	2	2	3
Denmark	-	-	1	-	-
France	2,244	1,479	1,931	2,219	2,571
Ireland	153	111	155	274	679
Netherlands	1	-	16	-	-
Norway	-	-	-	-	-
Spain	294	-	-	5	277
UK (England and Wales)	18	13	19	50	92
UK (Scotland)	-	8	22	56	4
Total	2,273	1,616	2,146	2,606	3,626

Country	1982	1983	1984	1985	1986[1]
Belgium	3	1	-	2	2
Denmark	-	-	-	-	-
France	2,005	2,588	3,001	2,258	...[2]
Ireland	904	941	646	794[1]	332
Netherlands	7	-	-	-[1]	-
Norway	-	57	17	46[1]	70
Spain	248	167	532	561[3]	-
UK (England and Wales)	182	23	309	45	636
UK (Scotland)	-	-	63	7	2,875
UK (Northern Ireland)	-	-	-	-	84
Total	3,349	3,777	4,568	3,713	3,999

[1] Provisional.
[2] Included in Divisions VIId,e.
[3] Foreign landings not included.

Table 17.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	3,275	3,304	3,941	3,153	2,623
Denmark	46,479	15,741	41,965	17,916	16,430
Faroe Islands	472	42	581	21	12
France	17,592	22,525	27,590	23,626	24,744
German Dem. Rep.	-	22	5	-	-
Germany, Fed. Rep.	461	348	1,280	1,267	601
Ireland	9	38	-	-	-
Netherlands	9,406	11,030	13,417	14,389	14,600
Norway	33	64	49	27	27
Poland	445	8	3	1	-
Sweden	341	...[2]	31	16	9
UK (England and Wales)	6,185	7,542	7,581	6,778	5,964
UK (Scotland)	33,017	42,779	44,841	42,218	31,399
USSR	2,413	-	-	-	-
Total Sub-area IV	120,128	103.443	141,284	109,412	96,409
WG total incl.discards	345,539	179,192	236,712	215,979	182,272

Country	1982	1983	1984	1985	1986[1]
Belgium	2,272	2,864	2,798	2,177	2,282
Denmark	27,043	18,054	19,771	16,142[1]	17,762
Faroe Islands	57	18	-	6	-[2]
France	23,780	21,263	19,209	10,853	11,840[4]
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	223	317	286	226	283
Ireland	-	-	-	-	-
Netherlands	12,218	10,935	8,767	6,973	13,670
Norway	17	39	88	90[1]	81
Poland	-	1	2	-	-
Sweden	11	44	53	22	29[3]
UK (England and Wales)	4,743	4,366	5,017	4,967[5]	3,598
UK (Scotland)	29,640	41,248	42,967	30,398	29,092
USSR	-	-	-	-	-
Total Sub-area IV	100,004	99,149	98,958	71,854	78,639
WG total incl.discards	131,881	154,236	139,000	97,000	151,000

[1] Provisional.
[2] Included in Division IIIa.
[3] Jan-Nov.
[4] Includes Division IIa.
[5] Foreign landings not included.

Table 17.2 Annual Weight and Numbers of WHITING caught in IV between 1967 and 1986

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1967	234	68	143	23	1579	246	1103	231
1968	261	88	115	58	1646	299	754	593
1969	324	57	115	152	2803	204	626	1974
1970	268	79	74	115	2507	272	381	1854
1971	192	58	63	72	2118	184	458	1475
1972	188	60	67	61	1927	177	398	1352
1973	266	66	110	90	2164	232	659	1273
1974	290	75	85	130	2572	249	477	1846
1975	300	79	135	86	1965	247	699	1018
1976	358	74	134	150	2269	240	633	1396
1977	346	74	165	106	2485	266	555	1663
1978	179	88	35	55	1729	323	242	1165
1979	237	99	78	59	1885	348	652	886
1980	213	93	75	46	1440	325	471	644
1981	189	80	43	67	1473	257	287	929
1982	141	73	35	33	833	243	257	333
1983	155	81	50	24	1328	260	371	697
1984	139	78	40	21	855	250	322	283
1985	97	53	28	15	681	178	224	279
1986	151	56	77	18	1165	205	562	398

Table 17.3 Results of analysis of catchability coefficients for WHITING in IV

F for named gears and total international F

Gear	Estimate	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
	F(gear)	0.052	0.170	0.292	0.414	0.520	0.497
SCO_SEI	Var F(gear)	0.00013	0.00030	0.00094	0.00221	0.00503	0.00949
	Propn(gear)	0.29489	0.21907	0.28103	0.22234	0.36502	0.48378
	F(gear)	0.038	0.088	0.139	0.176	0.260	0.247
SCO_LTR	Var F(gear)	0.00004	0.00009	0.00035	0.00038	0.00179	0.00913
	Propn(gear)	0.05190	0.06080	0.10182	0.06502	0.14144	0.16624
	F(gear)	0.090	0.258	0.432	0.590	0.779	0.743
All above	Var F(gear)	0.00018	0.00040	0.00129	0.00259	0.00682	0.01862
	Propn(gear)	0.34679	0.27987	0.38285	0.28736	0.50646	0.65002
Total	F	0.258	0.920	1.128	2.053	1.539	1.144
Internatl	Var F	0.00148	0.00507	0.00878	0.03133	0.02660	0.04408

Table 17.4 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
0	2.550	0.000
1	0.950	0.110
2	0.450	0.920
3	0.350	1.000
4	0.300	1.000
5	0.250	1.000
6	0.250	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000

Table 17.5 Total International Catch at Age (1000's) of WHITING in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	177436	104751	1206087	1187095	1232837	553711	175647	571415	238839	424725	0
1	971232	828855	374122	606631	620700	938136	1153017	755217	954764	478364	1
2	213111	516865	1019744	82358	106187	314925	660397	975999	403599	1111503	2
3	119813	108548	154798	563090	18145	44793	131353	226168	295629	162626	3
4	23128	47737	27811	50200	123135	7445	18039	31516	53896	75259	4
5	6588	7170	12712	11023	13021	56265	5404	4660	8792	13000	5
6	7520	29652	1664	3577	2191	7933	17226	1163	7524	2651	6
7	809	1845	5658	1162	693	3284	2375	5496	109	556	7
8	122	93	621	1302	162	243	345	325	1303	21	8
9	31	23	34	131	408	67	118	47	132	271	9
10	3	5	1	16	26	641	50	20	2	23	10

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	667358	687251	476388	334006	550702	95742	668726	114979	186059	224837	0
1	1019667	418866	618700	298266	186941	187374	201679	333409	198894	557841	1
2	480805	335869	463937	395342	348400	179613	168488	167913	145158	165165	2
3	261890	203546	210759	266225	259741	245696	108055	118946	78246	157525	3
4	31459	69034	86158	82124	93004	89726	133330	46103	37097	40355	4
5	18273	7601	24995	55066	21742	26422	37105	56834	13323	11804	5
6	4628	5369	3089	7809	10484	6552	8506	13815	18419	3007	6
7	405	1409	1147	808	1746	1693	1667	2750	3015	3661	7
8	167	245	187	517	238	360	658	379	870	477	8
9	4	7	14	42	41	58	87	159	94	68	9
10	135	7	1	12	35	23	35	22	15		10

Table 17.6 Total International Mean Weight at Age (Kg.) of WHITING in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	0.062	0.038	0.043	0.020	0.036	0.022	0.027	0.026	0.030	0.019	0
1	0.118	0.112	0.097	0.110	0.116	0.071	0.084	0.070	0.100	0.107	1
2	0.198	0.187	0.173	0.203	0.219	0.200	0.166	0.149	0.215	0.194	2
3	0.268	0.294	0.261	0.240	0.285	0.282	0.277	0.257	0.277	0.297	3
4	0.331	0.358	0.362	0.348	0.318	0.388	0.371	0.381	0.376	0.363	4
5	0.340	0.484	0.414	0.455	0.433	0.418	0.439	0.469	0.470	0.446	5
6	0.426	0.447	0.416	0.452	0.531	0.520	0.462	0.519	0.356	0.524	6
7	0.495	0.620	0.535	0.512	0.637	0.575	0.550	0.541	0.817	0.481	7
8	0.625	0.730	0.670	0.628	0.560	0.748	0.738	0.786	0.596	0.460	8
9	0.621	0.779	0.787	0.785	0.728	0.801	0.860	1.032	0.712	0.693	9
10	0.486	0.842	1.236	0.802	0.729	0.822	0.846	0.966	1.022	0.911	10

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	0.022	0.010	0.009	0.014	0.014	0.028	0.014	0.017	0.014	0.014	0
1	0.117	0.074	0.098	0.078	0.084	0.061	0.105	0.086	0.094	0.105	1
2	0.212	0.185	0.165	0.176	0.165	0.141	0.188	0.183	0.187	0.180	2
3	0.326	0.240	0.260	0.247	0.242	0.244	0.275	0.273	0.269	0.250	3
4	0.397	0.338	0.318	0.324	0.331	0.303	0.324	0.342	0.325	0.314	4
5	0.466	0.462	0.436	0.336	0.415	0.376	0.383	0.384	0.395	0.374	5
6	0.495	0.462	0.496	0.480	0.432	0.488	0.429	0.397	0.431	0.475	6
7	0.534	0.515	0.544	0.492	0.573	0.532	0.462	0.473	0.475	0.467	7
8	0.341	0.689	0.614	0.594	0.654	0.717	0.525	0.570	0.423	0.538	8
9	0.916	0.742	0.668	0.570	0.835	0.734	0.692	0.536	0.487	1.234	9
10	0.441	1.828	0.737	0.795	1.051	1.153	0.512	0.850	0.636		10

Table 17.7 Total International Fishing Mortality Rate at Age of WHITING in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	0.004	0.022	0.140	0.085	0.051	0.017	0.011	0.018	0.012	0.021	0
1	0.406	0.158	0.792	0.749	0.396	0.328	0.292	0.396	0.236	0.182	1
2	0.575	0.808	0.565	0.838	0.544	0.721	0.830	0.891	0.775	0.998	2
3	0.781	0.891	0.822	0.978	0.578	0.611	1.070	1.087	1.061	1.210	3
4	0.913	1.054	0.722	0.855	0.709	0.591	0.637	1.024	1.055	1.104	4
5	0.832	0.945	1.074	0.807	0.626	0.969	1.425	0.365	1.073	0.916	5
6	1.122	1.358	0.637	1.187	0.385	1.122	1.027	1.994	2.154	1.352	6
7	1.668	1.024	1.193	1.477	0.819	1.980	1.496	1.262	1.421	1.276	7
8	1.383	0.941	1.309	1.041	0.872	0.784	1.635	0.881	1.320	1.332	8
9	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	9
10	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	10

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	0.033	0.032	0.023	0.039	0.064	0.013	0.063	0.009	0.012	0.009	0
1	0.426	0.160	0.233	0.111	0.170	0.177	0.215	0.262	0.124	0.306	1
2	0.533	0.460	0.504	0.429	0.333	0.460	0.446	0.530	0.319	0.258	2
3	0.941	0.593	0.789	0.821	0.742	0.537	0.742	0.888	0.670	0.920	3
4	1.013	0.855	0.644	1.040	0.959	0.751	0.760	1.044	0.967	1.128	4
5	1.047	0.827	1.034	1.397	1.026	0.929	0.940	1.017	1.211	1.150	5
6	1.145	1.190	1.101	1.285	1.366	1.174	1.000	1.349	1.312	1.150	6
7	0.814	1.686	0.962	1.082	1.330	0.911	1.256	1.195	1.525	1.144	7
8	2.652	2.363	1.263	2.087	1.205	1.212	1.213	1.199	2.112	1.200	8
9	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	9
10	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	10

Table 17.8 Stock Numbers at Age (1000's) of WHITING in IV between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
0	1118326001	130646001	248203701	397221101	682411201	897478301	449364901	899849101	569522401	575701701	0
1	43660311	8693786	997580	1684420	2849324	5064705	6888469	3470877	6903182	4395460	1
2	592647	1124600	2871722	174735	308102	741282	1410765	1988729	903481	2108119	2
3	256186	212688	319750	1040330	48174	114047	229822	392281	520017	265465	3
4	43736	82677	61494	99041	275712	19043	43610	55524	93261	126852	4
5	129575	13006	21351	22129	31218	100493	7816	17080	14774	24046	5
6	12321	43900	3939	5681	7691	12998	29708	1464	9231	3934	6
7	1071	3125	8790	1622	1350	4076	3297	8288	155	834	7
8	175	165	919	2183	303	487	461	604	1921	311	8
9	49	36	53	203	631	104	182	74	205	420	9
10	5	7	2	25	41	992	77	311	2	36	10

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
0	573432501	598255301	571880601	242663801	241130601	206476001	299116501	338080101	415145901	733550101	0
1	4403808	4334224	4523763	4362911	1823155	1765313	1591573	2192862	2614999	3201441	1
2	1417332	1111980	1428379	1385503	1510161	594565	571995	496694	652342	893314	2
3	495465	530449	447578	550209	575336	690441	239295	233496	186333	302368	3
4	55793	136203	206678	143309	170537	193064	204494	80281	67684	67202	4
5	31147	15014	42933	80396	37506	48433	67495	98546	20933	19073	5
6	7496	8512	5115	11893	15480	10468	14899	20525	27747	4858	6
7	792	1857	2016	1325	2564	3077	2520	4267	4150	5818	7
8	191	287	282	630	368	555	1013	588	1057	739	8
9	7	11	22	65	64	90	135	247	145	105	9
10	209	11	2	19	55	36	54	34	22		10

Table 17.9 WHI in IV Age 1 : Abundance indices and catchability coefficients

YC1	Yr.	VPA	IYFS		EGFS		DGFS		FRGSF		SGFS	
			Index	Q	Index	Q	Index	Q	Index	Q	Index	Q
69	in 70	1684	69.0	0.041								
70	in 71	2849	274.0	0.096								
71	in 72	5065	332.0	0.066								
72	in 73	6888	1156.0	0.168								
73	in 74	3471	322.0	0.093								
74	in 75	6903	893.0	0.129								
75	in 76	4395	679.0	0.154								
76	in 77	4404	418.0	0.095	21969.0	4.988						
77	in 78	4334	513.0	0.118	24632.0	5.683						
78	in 79	4524	457.0	0.101	20019.0	4.425						
79	in 80	4363	692.0	0.159	30044.0	6.886						
80	in 81	1823	227.0	0.125	26603.0	14.593						
81	in 82	1765	161.0	0.091	27704.0	15.696					887.0	0.503
82	in 83	1592	128.0	0.080	11813.0	7.420					771.0	0.484
83	in 84	2193	436.0	0.199	50319.0	22.945					1348.0	0.615
84	in 85	2615	341.0	0.130	15739.0	6.019					1994.0	0.763
85	in 86	0	455.0	0.125	15184.0	12.372					1660.0	0.678
		input	=> VPA=	3636	=> VPA=	1227					=> VPA=	2447
86	in 87	0	704.0	0.125								
		input	=> VPA=	5617								

Table 17.10 WHI in IV Age 2 : Abundance indices and catchability coefficients

YC1	Yr.	VPA	IYFS		EGFS		DGFS		FRGSF		SGFS	
			Index	Q	Index	Q	Index	Q	Index	Q	Index	Q
68	in 70	175	77.0	0.440								
69	in 71	308	31.0	0.101								
70	in 72	741	190.0	0.256								
71	in 73	1411	763.0	0.541								
72	in 74	1989	496.0	0.249								
73	in 75	903	153.0	0.169								
74	in 76	2108	535.0	0.254								
75	in 77	1417	219.0	0.155	6531.0	4.609						
76	in 78	1112	293.0	0.263	5482.0	4.930						
77	in 79	1428	183.0	0.128	7441.0	5.211						
78	in 80	1386	391.0	0.282	15040.0	10.851						
79	in 81	1510	485.0	0.321	30646.0	20.295						
80	in 82	595	232.0	0.390	7928.0	13.324					881.0	1.481
81	in 83	572	126.0	0.220	10855.0	18.977					580.0	1.014
82	in 84	497	179.0	0.360	10790.0	21.710					380.0	0.765
83	in 85	652	359.0	0.551	16879.0	25.888					937.0	1.437
84	in 86	0	257.0	0.304	6617.0	19.134					473.0	1.144
		input	=> VPA=	845	=> VPA=	346					=> VPA=	413
85	in 87	0	540.0	0.307								
		input	=> VPA=	1760								

Table 17.11 Estimates of recruitment at ages 1 and 2 for North Sea whiting using various methods.

Method	1986		1987	
	Age 1	Age 2	Age 1	Age 2
Commercial Q	-	893	-	-
Shepherd	2,491	530	5,652	2,194
Cook (weighted)	3,349	764	5,793	1,830
Res. Vessel Q (weighted mean)	2,967	706	5,632	1,776
Value adopted	3,200	893	5,700	1,800

Table 17.12 Mean Fishing Mortality , Biomass and Recruitment of WHITING in IV between 1967 and 1986

	Mean Fishing Mortality			Biomass			Recruits
	Ages 2 to 6		Ages 0 to 4	1000 tonnes			Age 0
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Millions
1967	0.614	0.203	0.033	765	298	67	111833
1968	0.727	0.226	0.072	1307	421	68	13065
1969	0.409	0.195	0.278	715	589	69	24820
1970	0.606	0.231	0.238	520	352	70	39722
1971	0.413	0.135	0.061	519	219	71	68241
1972	0.582	0.141	0.116	600	268	72	89748
1973	0.685	0.170	0.161	912	378	73	44937
1974	0.606	0.139	0.299	677	435	74	89985
1975	0.864	0.227	0.146	1077	446	75	56952
1976	0.670	0.373	0.277	1016	566	76	57570
1977	0.596	0.127	0.218	1020	536	77	57343
1978	0.608	0.082	0.104	712	410	78	59826
1979	0.633	0.075	0.104	883	470	79	57188
1980	0.711	0.207	0.090	799	478	80	24266
1981	0.631	0.096	0.161	621	465	81	24113
1982	0.487	0.166	0.095	464	342	82	20648
1983	0.573	0.147	0.069	467	309	83	29912
1984	0.758	0.132	0.083	419	244	84	33808
1985	0.746	0.086	0.056	463	234	85	41515
1986	0.720	0.133	0.059	605	294	86	73355
Mean recruits at age 0 for period 1967 to 1984							50221
" - "							1968-1984 46597

Table 17.13 Input for catch prediction of WHITING in IV

						Values used in Prediction							
						F at age , Mean Wt. and Propn. Retained by Consumption Fishery							
		1986			1987	Scaled mean F			Mean values for period 1981 to 1985				
Age	Fishing Mortality				Stock	1981 to 1985			Mean Weight (kg.)				Prop.
	H.Con.	Disc	Ind		Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
0		0.001	0.017		46600000	0.000	0.003	0.017	0.138	0.040	0.015	0.018	0.002
1	0.003	0.133	0.054		5626631	0.007	0.117	0.046	0.198	0.105	0.052	0.086	0.073
2	0.073	0.181	0.003		1024291	0.124	0.215	0.066	0.237	0.155	0.145	0.173	0.376
3	0.590	0.245	0.085		440072	0.453	0.173	0.091	0.286	0.210	0.260	0.261	0.709
4	0.875	0.141	0.111		84914	0.769	0.135	0.050	0.339	0.239	0.372	0.325	0.841
5	0.949	0.059	0.142		16114	0.961	0.103	0.042	0.401	0.260	0.476	0.391	0.900
6	1.110	0.040			4703	1.258	0.073	0.028	0.438	0.268	0.572	0.436	0.945
7	1.125	0.019			1198	1.352	0.029	0.004	0.507	0.268	0.477	0.503	0.979
8	1.171	0.029			1517	1.546	0.004		0.578	0.312		0.578	0.997
9	1.200				182	1.340			0.657			0.657	1.000
10	1.200				26	1.340			0.840			0.840	1.000

Age 2 to 6	Age 0 4	Mean F	Age 2 to 6	Age 0 4
0.853	0.054	Unscaled	0.764	0.093
		Scaled	0.853	0.054

Recruits at age 0 in 1988 = 46600000
Recruits at age 0 in 1989 = 46600000

M at age and proprtion mature at age are as shown in Table 17.4

Mean F for ages 2 to 6 in 1986 for human consumption landings + discards = 0.853 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1981 to 1985
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1986

Mean F for ages 0 to 4 in 1986 for small-mesh fisheries = 0.054 .
Industrial fishery F-at-age in the prediction are averages for the period 1981 to 1985 .
rescaled to produce a mean value of F for ages 0 to 4 equal to that for 1986

Table17.14 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in IV 1987 to 1988

	Year										
	1986	1987	1988								
Biomass 1 Jan of Year											
Total	605	813	798	798	798	798	798	798	798	798	798
Spawning	294	368	500	500	500	500	500	500	500	500	500
Mean F Ages											
Human Cons. 2 to 6	0.85	0.85	0.00	0.17	0.34	0.51	0.68	0.85	1.02	0.22	0.74
Small-mesh 0 to 4	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Mean F(Year)/Mean F(1986)										F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.26	0.86
Small-mesh Fishery	1.00	1.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Catch weight											
Human Consumption	56	80	0	26	49	70	89	106	121	34	94
Discards	77	78	0	19	36	53	68	83	97	24	73
Small-mesh Fisheries	18	27	18	17	16	16	15	15	15	17	15
Total landings	74	106	18	43	66	86	104	121	135	51	110
Total catch	151	184	18	62	102	139	173	204	233	75	183
Biomass 1 Jan of Year+1											
Total	813	798	986	941	899	862	826	796	768	927	818
Spawning	368	500	671	646	606	569	535	505	477	633	525

Industrial by-catch F = 0.5 x recent average.

Table 17.15 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in IV 1987 to 1988

	Year										
	1986	1987	1988								
Biomass 1 Jan of Year											
Total	605	813	798	798	798	798	798	798	798	798	798
Spawning	294	368	500	500	500	500	500	500	500	500	500
Mean F Ages											
Human Cons. 2 to 6	0.85	0.85	0.00	0.17	0.34	0.51	0.68	0.85	1.02	0.22	0.64
Small-mesh 0 to 4	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Mean F(Year)/Mean F(1986)										F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.26	0.75
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Catch weight											
Human Consumption	56	80	0	26	49	69	88	104	119	33	83
Discards	77	78	0	18	36	52	68	82	96	24	64
Small-mesh Fisheries	18	27	35	24	33	31	31	30	29	33	31
Total landings	74	106	35	59	81	101	118	134	148	67	114
Total catch	151	184	35	78	117	153	186	216	244	91	177
Biomass 1 Jan of Year+1											
Total	813	798	963	919	879	843	810	779	752	906	818
Spawning	368	500	671	628	588	552	520	490	463	615	528

Industrial by-catch F = recent average.

Table 17.16 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in IV 1987 to 1988

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	605	813	798	798	798	798	798	798	798	798	798	
Spawning	294	368	500	500	500	500	500	500	500	500	500	
Mean F Ages												
Human Cons. 2 to 6	0.85	0.85	0.00	0.17	0.34	0.51	0.68	0.85	1.02	0.22	0.58	
Small-mesh 0 to 4	0.05	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	
Mean F(Year)/Mean F(1986)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.26	0.68	
Small-mesh Fishery	1.00	1.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	
Catch Weight												
Human Consumption	56	80	0	25	48	68	86	103	118	33	75	
Discards	77	78	0	18	35	51	67	81	95	24	57	
Small-mesh Fisheries	18	27	51	50	48	47	45	44	43	49	46	
Total landings	74	106	51	75	96	115	132	147	160	82	122	
Total catch	151	184	51	93	131	166	198	228	255	106	179	
Biomass 1 Jan of Year+1												
Total	813	798	941	898	859	824	792	763	736	885	811	
Spawning	368	500	651	609	571	537	505	477	450	597	524	

Industrial by-catch F = 1.5 x recent average.

Table 17.17 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in IV 1987 to 1988

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	605	813	823	823	823	823	823	823	823	823	823	
Spawning	294	368	525	525	525	525	525	525	525	525	525	
Mean F Ages												
Human Cons. 2 to 6	0.85	0.70	0.00	0.14	0.28	0.42	0.56	0.70	0.84	0.20	0.50	
Small-mesh 0 to 4	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Mean F(Year)/Mean F(1986)										F0.1	Fmax	
Human Consumption	1.00	0.82	0.00	0.16	0.33	0.49	0.66	0.82	0.99	0.23	0.58	
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Catch Weight												
Human Consumption	56	64	0	22	41	59	76	91	105	30	68	
Discards	77	69	0	15	30	44	58	71	84	22	52	
Small-mesh Fisheries	18	27	36	35	34	34	33	32	31	35	33	
Total landings	74	91	36	57	76	93	108	123	136	65	101	
Total catch	151	161	36	72	106	137	166	194	219	87	153	
Biomass 1 Jan of Year+1												
Total	813	823	983	947	913	882	852	825	800	932	865	
Spawning	368	525	692	656	622	592	563	537	512	642	576	

Including mesh changes.

Table 18.1 Nominal catch (in tonnes) of WHITING in Division VIa, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	-	-	-	+	-
Denmark	-	119	92	32	-
Faroe Islands	-	-	770	-	-
France	3,395	3,610	2,779	2,609	1,637
Germany, Fed.Rep.	1	2	4	1	49
Ireland	2,752	2,080	2,791	4,407	8,148
Netherlands	78	23	17	2	6
Spain	763[2]	-	-	-	-
UK (England & Wales)	520	669	320	227	145
UK (Scotland)	9,873	8,174	10,613	7,386	8,519
UK (N. Ireland)	-	-	-	-	-
Total	17,382	14,677	17,386	14,664	18,504
WG total	17,411	14,677	17,081	12,816	12,203

Country	1982	1983	1984	1985	1986[1]
Belgium	2	-	-	3	-
Denmark	+	-	-	-	-
Faroe Islands	-	-	-	-	-
France	1,798	2,029	1,887	1,502	1,998[3]
Germany, Fed.Rep.	53	43	6	9	3[2]
Ireland	3,406	3,578	3,454	1,917	1,569
Netherlands	285	811	-	14	-
Spain	99	76	40	61	50
UK (England & Wales)	166	157	162	50[4]	38
UK (Scotland)	8,419	10,019	11,270	9,051	5,847
UK (N. Ireland)	7	52	40	17	13
Total	14,235	16,765	16,859	12,624	9,518
WG total	13,871	15,971	15,902	13,000	8,000

[1] Provisional.

[2] Includes Division VIb.

[3] Includes Divisions VIb and Vb.

[4] Foreign landings not included.

Table 18.2 Annual Weight and Numbers of WHITING caught in VIA between 1967 and 1986

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1967	18	18	0	0	58	58	0	0
1968	14	14	0	0	42	42	0	0
1969	12	12	0	0	41	41	0	0
1970	11	11	0	0	40	40	0	0
1971	16	16	0	0	52	52	0	0
1972	15	15	0	0	50	50	0	0
1973	17	17	0	0	62	62	0	0
1974	17	17	0	0	72	72	0	0
1975	20	20	0	0	71	71	0	0
1976	25	25	0	0	90	90	0	0
1977	17	17	0	0	63	63	0	0
1978	15	15	0	0	54	54	0	0
1979	17	17	0	0	61	61	0	0
1980	13	13	0	0	45	45	0	0
1981	12	12	0	0	46	46	0	0
1982	14	14	0	0	48	48	0	0
1983	16	16	0	0	49	49	0	0
1984	16	16	0	0	50	50	0	0
1985	13	13	0	0	43	43	0	0
1986	8	8	0	0	31	31	0	0

Table 18.3 Results of analysis of catchability coefficients for WHITING in VIA

F for named gears and total international F

Gear	Estimate	Age 2	Age 3	Age 4	Age 5
SCO SEI	F(gear)	0.035	0.053	0.053	0.082
	Var F(gear)	0.00015	0.00016	0.00013	0.00016
	Propn(gear)	0.18127	0.15882	0.12715	0.09943
SCO LTR	F(gear)	0.084	0.157	0.155	0.202
	Var F(gear)	0.00057	0.00058	0.00063	0.00223
	Propn(gear)	0.17111	0.22674	0.22132	0.17924
SCO NTR	F(gear)	0.017	0.025	0.020	0.022
	Var F(gear)	0.00012	0.00007	0.00037	0.00065
	Propn(gear)	0.05174	0.06744	0.09254	0.01660
All above	F(gear)	0.137	0.235	0.228	0.306
	Var F(gear)	0.00084	0.00082	0.00113	0.00305
	Propn(gear)	0.40412	0.45301	0.44101	0.29527
Total	F	0.338	0.519	0.517	1.037
Internatl	Var F	0.00515	0.00399	0.00580	0.03495

Table 18.4 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	1.000
3	0.200	1.000
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000

Table 18.5 Total International Catch at Age (1000's) of WHITING in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	5169	7265	873	730	2387	16777	14078	9083	14917	8500	1
2	26023	16484	25174	6423	8617	12028	36142	51036	16778	46421	2
3	10619	9239	8644	28065	4122	4013	5592	10049	36318	15757	3
4	697	3656	2566	3241	34784	1363	1461	1166	2819	17423	4
5	14574	324	1206	670	1338	14796	357	180	261	1508	5
6	789	5036	118	214	240	793	4292	52	57	66	6
7	113	328	2113	16	70	77	277	817	7	13	7
8	13	22	210	472	1	28	26	31	235		8

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	16120	17670	6334	11650	3593	2991	3418	7209	4139	2674	1
2	13376	18175	34221	11378	24395	5783	7094	12765	19520	14825	2
3	25144	6682	13282	14860	11297	29094	8040	8221	8574	9770	3
4	3127	9400	3407	4155	4611	6821	22757	4387	3351	2653	4
5	4719	941	3488	1244	1518	2043	6070	14825	1997	532	5
6	292	1433	276	1085	452	803	1439	1953	4764	291	6
7	13	63	374	84	197	254	399	723	748	474	7
8	3	1	10	101	5	77	131	94	56	47	8

Table 18.6 Total International Mean Weight at Age (Kg.) of WHITING in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	0.204	0.206	0.178	0.205	0.209	0.211	0.196	0.193	0.209	0.201	1
2	0.240	0.263	0.223	0.203	0.247	0.258	0.235	0.215	0.245	0.242	2
3	0.319	0.366	0.335	0.274	0.276	0.345	0.362	0.317	0.305	0.309	3
4	0.424	0.444	0.500	0.382	0.316	0.368	0.479	0.444	0.471	0.361	4
5	0.412	0.554	0.570	0.519	0.426	0.426	0.485	0.591	0.651	0.497	5
6	0.639	0.538	0.649	0.619	0.551	0.494	0.532	0.641	0.615	0.687	6
7	0.822	0.701	0.618	0.664	0.696	0.603	0.654	0.574	0.841	1.050	7
8	0.878	0.853	0.725	0.666	1.028	0.717	0.748	0.843	0.713		8

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	0.200	0.199	0.218	0.172	0.192	0.184	0.216	0.216	0.185	0.175	1
2	0.244	0.235	0.232	0.242	0.228	0.220	0.249	0.259	0.238	0.236	2
3	0.296	0.286	0.306	0.330	0.289	0.276	0.280	0.313	0.306	0.294	3
4	0.392	0.389	0.404	0.420	0.382	0.352	0.340	0.371	0.402	0.365	4
5	0.431	0.516	0.536	0.492	0.409	0.505	0.409	0.412	0.430	0.468	5
6	0.629	0.549	0.678	0.595	0.409	0.513	0.494	0.458	0.461	0.482	6
7	0.848	0.602	0.694	0.722	0.542	0.503	0.526	0.438	0.531	0.496	7
8	1.160	0.973	0.644	0.876	0.751	0.603	0.441	0.601	0.604	0.522	8

Table 18.7 Total International Fishing Mortality Rate at Age of WHITING in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	0.108	0.039	0.049	0.037	0.089	0.221	0.083	0.160	0.116	0.204	1
2	0.923	0.585	0.184	0.601	0.762	0.835	1.027	0.478	0.493	0.620	2
3	0.933	1.067	0.709	0.320	1.025	1.042	1.330	0.940	0.757	1.282	3
4	0.759	1.044	1.041	0.641	0.834	1.271	1.654	1.234	0.768	1.078	4
5	0.837	1.028	1.339	0.880	0.604	1.121	1.684	1.032	1.261	1.378	5
6	0.810	0.805	1.578	0.951	0.962	0.910	1.310	1.558	1.184	1.281	6
7	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	7
8	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	8

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	0.250	0.191	0.092	0.070	0.105	0.100	0.082	0.114	0.064	0.036	1
2	0.566	0.493	0.681	0.238	0.203	0.245	0.360	0.489	0.508	0.338	2
3	0.834	0.624	0.832	0.728	0.393	0.397	0.633	0.938	0.725	0.519	3
4	1.006	0.902	0.772	0.688	0.523	0.439	0.624	0.881	1.460	0.517	4
5	1.027	1.013	1.084	0.734	0.584	0.466	0.901	1.149	1.508	1.037	5
6	1.217	1.092	0.991	1.345	0.656	0.716	0.710	0.856	1.815	1.000	6
7	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	7
8	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	8

Table 18.8 Stock Numbers at Age (1000's) of WHITING in VIA between 1967 and 1986

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Age
1	553741	209704	199361	223051	308681	930671	1949511	675801	1505151	506601	1
2	469391	406751	165133	155341	176031	231201	610971	146913	471461	109782	2
3	190161	152741	185551	112528	69731	67251	82121	179151	74544	23567	3
4	14281	61221	43031	74741	669121	20481	19421	17791	57281	28630	4
5	279721	5481	17651	12441	32221	237891	4701	3041	4241	21761	5
6	15471	99151	1601	3791	4231	14421	63511	721	891	981	6
7	1941	5631	36281	271	1201	1321	4751	14041	121	221	7
8	231	381	3601	8101	21	481	441	541	4031		8

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Age
1	801731	111761	790641	1907821	396561	346951	478751	734031	738281	840681	1
2	338241	511391	755911	590191	1456881	292271	257081	361131	535971	567111	2
3	483751	157231	255841	313201	380831	973171	187261	146781	181291	263971	3
4	53521	172011	68981	91121	123801	210411	535671	81441	47051	71891	4
5	79751	16031	57161	26081	37491	60071	111101	235101	27621	8951	5
6	4491	23371	4771	15841	10251	17121	30861	36931	61031	5001	6
7	221	1091	6421	1451	3381	4361	6851	12421	12841	8141	7
8	51	31	181	1731	81	1321	2251	1611	961	811	8

Table 18.9 Estimates of recruitment at age 1 for whiting in Division VIa from two estimation procedures.

Method	1986	1987
Shepherd	92	140
Cook	84[1]	143[1]

[1] Value adopted.

Table 18.10 Mean Fishing Mortality , Biomass and Recruitment of WHITING in VIA between 1967 and 1986

	Mean Fishing Mortality			Biomass		Recruits	
	Ages		Ages	1000 tonnes		Age 1	
	2 to 4		1 to 4				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1967	0.872	0.000	0.000	42	31	66	55
1968	0.859	0.000	0.000	68	25	67	210
1969	0.645	0.000	0.000	52	49	68	20
1970	0.521	0.000	0.000	43	38	69	22
1971	0.874	0.000	0.000	36	29	70	31
1972	1.049	0.000	0.000	40	20	71	93
1973	1.337	0.000	0.000	61	22	72	195
1974	0.884	0.000	0.000	52	39	73	68
1975	0.673	0.000	0.000	69	38	74	151
1976	0.993	0.000	0.000	56	45	75	51
1977	0.802	0.000	0.000	44	28	76	80
1978	0.673	0.000	0.000	48	25	77	112
1979	0.762	0.000	0.000	49	32	78	79
1980	0.551	0.000	0.000	64	31	79	191
1981	0.373	0.000	0.000	59	51	80	40
1982	0.360	0.000	0.000	51	45	81	35
1983	0.539	0.000	0.000	47	36	82	48
1984	0.769	0.000	0.000	45	29	83	73
1985	0.898	0.000	0.000	39	25	84	74
1986	0.458	0.000	0.000	40	25	85	84
Mean recruits at age 1 for period 1967 to 1984							86

Table 18.11 Input for catch prediction of WHITING in VIA

	1986			1987	Values used in Prediction: F at age , Mean Wt. and Propn. Retained by Consumption Fishery							
	Fishing Mortality			Stock	Scaled mean F 1981 to 1985			Mean values for period 1981 to 1985: Mean Weight (Kg.)				Prop.
Age	H.Con.	Disc	Ind	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	0.093			143000	0.073			0.199			0.199	1.000
2	0.339			62203	0.282			0.239			0.239	1.000
3	0.519			32999	0.481			0.293			0.293	1.000
4	0.517			12861	0.612			0.370			0.370	1.000
5	1.037			3510	0.719			0.433			0.433	1.000
6	1.000			260	0.741			0.467			0.467	1.000
7	1.000			151	0.780			0.508			0.508	1.000
8	1.000			245	0.780			0.600			0.600	1.000

Age 2 to 4	Age 0 0	Mean F	Age 2 to 4	Age 0 0
0.458	0.000	Unscaled	0.588	0.000
		Scaled	0.458	0.000

Recruits at age 1 in 1988 = 78963
Recruits at age 1 in 1989 = 78963

M at age and proprtion mature at age are as shown in Table 18.4

Mean F for ages 2 to 4 in 1986 for human consumption landings + discards = 0.458 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1981 to 1985 rescaled to produce a mean value of F for ages 2 to 4 equal to that for 1986

Mean F for ages 0 to 0 in 1986 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1981 to 1985 , rescaled to produce a mean value of F for ages 0 to 0 equal to that for 1986

Table 18.12 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in VIA 1987 to 1988

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	39	60	62	62	62	62	62	62	62	62	62	62
Spawning	25	31	47	47	47	47	47	47	47	47	47	47
Mean F Ages												
Human Cons. 2 to 4	0.46	0.46	0.00	0.09	0.18	0.27	0.37	0.46	0.55	0.27	0.00	
Small-mesh 0 to 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1986)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.58	0.00	
Catch weight												
Human Consumption	8	11	0	3	7	10	12	15	17	9	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	8	11	0	3	7	10	12	15	17	9	0	
Total catch	8	11	0	3	7	10	12	15	17	9	0	
Biomass 1 Jan of Year+1												
Total	60	62	78	74	70	67	64	62	59	67	0	
Spawning	31	47	62	58	55	51	49	46	43	52	0	

Table 19.1 Nominal catch (in tonnes) of WHITING in Division VIb, 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986[1]
Denmark	-	-	-	-	...[2]	-	-	-	-	-	...[2]
France	-	-	-	-	3	-	-	-	3	2	...[2]
Germany, Fed.Rep.	-	-	-	-	-	-	-	-	-	-	-
Ireland	-	-[2]	1	-	-	-	-	-	-	-	-
Spain	-	...	-	-	-	196	112	88	16	123[3]	-
UK (Engl.& Wales)	3	2	5	1	+	-	-	+	2	+	-
UK (Scotland)	15	5	24	2	59	+	-	5	25	6	5
Total	18	7	30	3	62	196	112	93	46	131	5

[1] Provisional.
[2] Included in Division VIa.
[3] Foreign landings not included.

Table 20.1 Nominal catch (in tonnes) of WHITING in Divisions VIId and VIIe in 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	36	85	92	85	102
Denmark	-	1	2,585	6	2
France	8,886	8,010	5,352	7,690	8,842
Ireland	11	12	-	13	-
Netherlands	1	2	1	2	2
UK (England & Wales)	1,342	1,038	930	839	1,136
Total	10,276	9,148	8,960	8,635	10,084
Country	1982	1983	1984	1985	1986[1]
Belgium	101	94	83	84	67
Denmark	-	-	-	-	-
France	8,051	5,708	7,239	8,107	11,706[2]
Ireland	-	-	-	-	-
Netherlands	70	399	-	-	-
UK (England & Wales)	1,222	1,210	811	604[3]	741
Total	9,444	7,411	8,133	8,795	12,514

[1] Provisional.
[2] Includes all of Sub-areas VII (except Division VIIa) and VIII.
[3] Foreign landings not included.

Table 20.2 SUM OF PRODUCTS CHECK

WHITING IN THE ENGLISH CHANNEL (FISHING AREAS VIIE AND VIID)
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: thousands

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	0	96	0	0	14	0	2	3	141	0
1	19291	19882	16254	8839	3096	7791	4360	3642	1560	1725
2	16022	11976	12217	17649	12090	13022	14131	15539	15468	13616
3	5001	4541	5305	4555	11265	13632	6984	11584	12074	13938
4	553	713	2006	659	7967	2652	2479	2402	1848	5737
5	123	66	225	94	2702	1085	647	1368	661	733
6	8	13	13	4	808	375	110	384	100	140
7	1	0	1	0	658	104	45	24	17	26
8	0	0	0	2	1	7	5	13	38	10
9	0	0	1	0	0	2	1	0	0	1
10+	0	0	0	0	0	0	1	0	0	0
TOTAL	40999	37287	36020	31800	38601	38670	29241	34759	31907	35976

Table 20.3 SUM OF PRODUC CHECK

WHITING IN THE ENGLISH CHANNEL (FISHING AREAS VIIE AND VIID)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	.000	.210	.000	.000	.180	.000	.332	.156	.137	.000
1	.200	.218	.215	.232	.171	.171	.197	.157	.170	.141
2	.277	.258	.279	.273	.242	.208	.232	.203	.182	.175
3	.365	.394	.351	.320	.264	.281	.287	.265	.270	.216
4	.442	.434	.366	.390	.287	.347	.346	.353	.338	.270
5	.561	.736	.515	.536	.301	.407	.380	.285	.319	.334
6	.823	1.039	1.068	1.184	.391	.421	.445	.314	.380	.419
7	.938	.000	.496	.000	.363	.415	.448	.450	.578	.564
8	.000	.000	.000	.952	1.053	.797	.709	.429	.416	.430
9	.000	.000	.716	.000	.000	.485	1.067	.000	.000	.653
10+	.000	.000	.000	.000	.000	.000	1.116	.000	.000	.000

Table 20.4 VIRTUAL POPULATION ANALYSIS

WHITING IN THE ENGLISH CHANNEL (FISHING AREAS VIIE AND VIID)

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

	1981	1982	1983	1984	1985	1986	1981-84
1	.091	.131	.090	.075	.038	.109	.109
2	.424	.668	.576	.456	.493	.531	.531
3	1.156	1.266	.961	1.411	.788	1.193	1.193
4	1.735	.940	.842	1.135	.964	1.178	1.178
5	1.547	1.799	.630	2.076	1.234	1.515	1.515
6	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7+	1.000	1.000	1.000	1.000	1.000	1.000	1.000
(2- 4)0	1.118	.958	.795	1.001	.749	.967	

Table 20.5 VIRTUAL POPULATION ANALYSIS

WHITING IN THE ENGLISH CHANNEL (FISHING AREAS VIIE AND VIID)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1981	1982	1983	1984	1985	1986	1987	1981-84
1	59036	51661	62105	57104	45869	18396	0	52477
2	33515	29168	35280	46464	43467	36146	13500	37507
3	17977	20525	12246	16241	24110	21729	17402	16747
4	10250	4728	4759	5834	5244	8973	5596	5888
5	5695	1395	1512	1672	1009	1012	2262	2068
6	1538	644	189	659	172	240	183	720
7+	1152	194	82	64	94	64	92	368
TOTAL NO	111793	108315	116154	126037	117965	86561		
SPS NO	72756	56653	54049	68933	72095	68165		
TOT.BIOM	25701	23228	26270	24767	23756	16510		
SPS BIOM	19025	14394	14055	15801	15959	13916		

Table 20.6 Nominal catch (in tonnes) of WHITING in Divisions VIIb,c and VIIh-k, in 1977-1986. (Data for 1977-1985 as officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	8	-	-	-	-
France	336	419	444	656	516
Germany, Fed. Rep.	1	45	-	+	-
Ireland	1,191	1,160	2,589	3,499	3,550
Netherlands	25	-	1	1	21
Spain	-	-	-	-	-
UK (England and Wales)	1	-	-	-	67
UK (Scotland)	2	1	1	80	1
Total	1,564	1,625	3,035	4,236	4,155

Country	1982	1983	1984	1985	1986[1]
Belgium	-	-	-	-	1
France	204	356	398	583	...[2]
Germany, Fed. Rep.	-	-	-	-	-
Ireland	4,011	2,590	1,872	2,719	2,198
Netherlands	78	363	169	90	-
Spain	85	91	57	76	-
UK (England and Wales)	49	18	58	71	36
UK (Scotland)	-	-	4	-	-
Total	4,427	3,418	2,558	3,539	2,235

[1] Provisional.
[2] Included in Divisions VIId,e.

Table 21.1 Nominal catch (tonnes) of SAITHE in Sub-area IV and Division IIIa, 1977-1986. (Data for 1977-1985 from Bulletin Statistique).

Country	1977	1978	1979	1980	1981
Belgium	107	44	14	13	12
Denmark	17,334	10,372	10,461	10,370	6,454
Faroe Islands	318	213	407	1,020	614
France	41,022	38,122	40,983	37,306	42,649
German Dem. Rep.	2,430	2,404	1,504	925	-
Germany, Fed. Rep.	26,860	25,982	18,780	11,095	8,246
Ireland	126	88	-	-	-
Netherlands	7,270	5,135	1,466	245	123
Norway	14,949	17,627	17,575	47,959	55,882
Poland	12,378	5,661	6,104	2,404	698
Sweden	1,275	990	211	342	156
UK (England and Wales)	6,822	8,382	6,256	4,879	4,309
UK (Scotland)	11,366	14,330	6,257	6,525	6,529
USSR	46,385	10,161	2,015	-	-
Sub-total	288,642	139,511	114,033	123,083	125,672
By catch from industrial fisheries:					
Denmark[2]	1,805	72	493	-	-
Norway[2]	4,392	2,494	1,142	363	1,280
Total	394,839	142,077	115,668	123,446	126,952

Country	1982	1983	1984	1985	1986[1]
Belgium	4	7	32	31	17
Denmark	10,114	10,530	8,526	8,431	10,262
Faroe Islands	746	806	-	895	435
France	47,064	38,782	43,592	42,200	56,826[4]
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	13,517	13,649	25,262	22,551	20,872
Ireland	-	-	-	-	-
Netherlands	36	89	181	233	134
Norway	70,464	78,135	90,497	93,406	62,000
Poland	793	415	413	-	495
Sweden	372	548	522	1,764	1,737[5]
UK (England and Wales)	5,627	6,845	8,183	981[3]	821
UK (Scotland)	8,136	6,321	6,970	9,932	14,936
USSR	-	-	-	-	-
Sub-total	156,873	156,127	184,178	180,424[1]	168,535
By catch from industrial fisheries:					
Denmark[2]	-	-	-	-	-
Norway[2]	5,003	1,445	5,616	7,895	1,126
Total	161,876	157,572	189,794	188,319[1]	169,661

[1] Preliminary.
[2] Data from national labs.
[3] Foreign landings not included.
[4] Includes Division IIa.
[5] Jan-Nov.

Table 21.2 Annual Weight and Numbers of SAITHE caught in IV between 1970 and 1986

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1970	222	163	0	59	142	95	0	47
1971	253	218	0	35	176	143	0	33
1972	246	218	0	28	176	153	0	23
1973	226	195	0	31	169	142	0	27
1974	273	231	0	42	165	120	0	45
1975	278	240	0	38	189	142	0	47
1976	320	253	0	67	310	223	0	87
1977	196	190	0	6	121	117	0	4
1978	142	140	0	3	100	98	0	2
1979	116	114	0	2	68	67	0	1
1980	123	123	0	0	65	64	0	0
1981	127	126	0	1	72	71	0	2
1982	169	164	0	5	110	105	0	5
1983	173	171	0	1	115	114	0	1
1984	198	192	0	6	170	164	0	6
1985	193	185	0	8	197	185	0	11
1986	162	161	0	1	159	157	0	2

Table 21.3 Results of analysis of catchability coefficients for SAITHE in IV

F for named gears and total international F

Gear	Estimate	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
	F(gear)	0.002	0.005	0.004	0.004	0.005	0.008	0.011	0.016	0.010	0.012	0.014
SCD LTR	Var F(gear)	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.00001	0.00000	0.00000	0.00000
	Propn(gear)	0.08173	0.11253	0.18302	0.31262	0.15599	0.07699	0.09003	0.09610	0.10217	0.1355	0.15165
	F(gear)	0.002	0.047	0.343	0.460	0.394	0.120	0.039	0.017	0.074	0.066	0.066
FRA ALL	Var F(gear)	0.00003	0.00010	0.00167	0.00210	0.00286	0.00056	0.00052	0.00034	0.00013	0.0003	0.00035
	Propn(gear)	0.08173	0.11253	0.18302	0.31262	0.15599	0.07699	0.09003	0.09610	0.10217	0.1355	0.15165
	F(gear)	0.004	0.052	0.348	0.464	0.399	0.127	0.050	0.034	0.084	0.078	0.080
All above	Var F(gear)	0.00004	0.00010	0.00167	0.00210	0.00286	0.00057	0.00053	0.00035	0.00013	0.0003	0.00035
	Propn(gear)	0.08173	0.11253	0.18302	0.31262	0.15599	0.07699	0.09003	0.09610	0.10217	0.1355	0.15165
Total	F	0.051	0.463	1.899	1.483	2.559	1.651	0.560	0.352	0.818	0.576	0.526
Internat	Var F	0.00561	0.00781	0.04998	0.02149	0.11773	0.09544	0.06554	0.03778	0.01263	0.0209	0.01526

Table 21.4 Values of natural mortality rate and proportion mature at age.

Age	Natural mortality	Mature	Mature 1987
1	0.200	0.000	0.000
2	0.200	0.000	0.000
3	0.200	0.000	0.020
4	0.200	0.150	0.200
5	0.200	0.700	0.850
6	0.200	0.900	0.970
7	0.200	1.000	1.000
8	0.200	1.000	1.000
9	0.200	1.000	1.000
10	0.200	1.000	1.000
11	0.200	1.000	1.000
12	0.200	1.000	1.000
13	0.200	1.000	1.000
14	0.200	1.000	1.000
15	0.200	1.000	1.000

Table 21.5 Recruitment indice obtained by observers along the Norwegian coast (given on a scale of 0-10 where 5 is average abundance).

Year	Index
1980	7.4
1981	4.7
1982	7.1
1983	2.7
1984	5.4
1985	7.0
1986	2.7

Table 21.6 Total International Catch at Age (1000's) of SAITHE in IV between 1970 and 1986

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	234	594	379	4416	3947	312	235	2015	1204	870	1
2	2228	10773	20189	31275	16150	71766	31335	12708	16244	16968	2
3	34392	68424	40162	47388	61201	50672	199869	22740	29341	10196	3
4	74326	53349	62290	32955	31387	23406	50339	52143	27118	14818	4
5	13194	30846	23108	24967	12123	9005	9302	13066	17062	12864	5
6	11529	3650	20779	15228	20080	6706	5137	4738	3755	7393	6
7	3654	3783	3363	7998	13734	12650	3317	3215	1133	2640	7
8	1596	2481	2790	1689	4308	8650	4845	3059	1046	873	8
9	278	1574	1550	1165	988	3304	3003	3517	689	470	9
10	80	322	993	977	473	1097	1066	1926	692	282	10
11	24	187	229	569	281	619	414	900	604	404	11
12	15	9	117	256	175	254	249	347	398	344	12
13	4	6	26	77	106	276	124	344	196	157	13
14	4	2	41	28	30	77	164	123	90	54	14
15	18	9	39	19	30	25	111	131	95	99	15

Age	1980	1981	1982	1983	1984	1985	1986	Age
1	997	5591	1615	265	74	342	233	1
2	18625	17892	24805	34191	32760	6679	5100	2
3	11082	19277	25015	23571	78416	115060	53838	3
4	10954	9079	35590	18793	31752	53874	82275	4
5	9507	7072	10888	26032	11808	12609	11718	5
6	6298	4393	6776	4673	12356	4616	3014	6
7	4455	3185	1900	4444	1318	2622	1403	7
8	974	3252	1432	1262	1063	415	881	8
9	499	667	1045	895	255	213	252	9
10	399	291	311	303	180	90	174	10
11	307	388	112	205	97	69	102	11
12	190	343	134	76	71	59	124	12
13	214	292	102	89	28	23	35	13
14	143	249	147	38	40	15	39	14
15	92	330	147	102	56	36	37	15

Table 21.7 Total International Mean Weight at Age (Kg.) of SAITHE in IV between 1970 and 1986

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	0.434	0.495	0.304	0.154	0.268	0.198	0.461	0.429	0.353	0.437	1
2	0.697	0.609	0.510	0.392	0.494	0.494	0.501	0.424	0.513	0.387	2
3	0.931	0.838	0.743	0.780	0.849	0.887	0.690	0.759	0.752	0.910	3
4	1.442	1.357	1.158	1.407	1.556	1.497	1.302	1.254	1.262	1.469	4
5	2.073	2.203	1.897	1.575	2.489	2.478	2.175	1.903	2.051	2.189	5
6	2.708	3.007	2.364	2.543	2.729	3.275	3.036	3.110	3.347	3.026	6
7	3.598	3.804	3.869	3.339	3.353	3.684	4.007	4.151	4.660	3.904	7
8	4.420	4.635	4.184	4.657	4.386	4.190	4.325	4.556	5.292	5.030	8
9	5.615	5.168	4.543	4.502	5.538	5.481	4.981	4.787	5.727	5.885	9
10	5.826	5.629	5.538	5.601	6.407	6.827	6.008	5.181	6.069	6.258	10
11	6.698	5.476	7.319	5.788	7.640	7.347	6.901	6.494	6.726	6.774	11
12	7.212	6.555	6.693	7.468	8.500	7.719	7.422	7.400	7.674	7.617	12
13	9.170	7.680	9.258	7.264	9.098	8.495	8.017	8.696	8.601	8.081	13
14	8.874	9.350	7.931	8.593	11.841	10.668	8.105	8.948	9.699	8.200	14
15	8.854	9.260	8.170	8.744	8.521	10.198	8.732	8.979	9.104	8.699	15

Age	1980	1981	1982	1983	1984	1985	1986	Age
1	0.297	0.285	0.273	0.422	0.185	0.162	0.264	1
2	0.463	0.556	0.542	0.460	0.491	0.475	0.448	2
3	0.963	0.897	1.089	0.966	0.711	0.659	0.651	3
4	1.798	1.625	1.516	1.703	1.610	1.154	0.982	4
5	2.447	2.489	2.292	2.126	2.234	1.953	1.781	5
6	3.274	3.356	3.004	3.076	2.701	2.779	2.778	6
7	4.690	4.418	3.983	3.569	3.857	3.372	3.856	7
8	5.620	5.354	4.891	4.567	4.542	4.632	4.511	8
9	6.302	6.338	5.765	5.383	5.961	5.351	6.034	9
10	7.436	7.233	6.513	6.223	7.147	6.631	7.242	10
11	7.835	7.525	7.510	6.913	7.758	7.272	7.353	11
12	7.912	7.996	7.848	7.693	7.427	7.995	8.270	12
13	8.442	8.664	8.102	9.236	8.189	8.297	8.263	13
14	8.946	8.267	8.407	7.805	8.401	8.696	8.730	14
15	9.609	8.829	9.304	10.035	9.339	9.687	10.056	15

Table 21.8 Total International Fishing Mortality Rate at Age of SAITHE in IV between 1970 and 1986

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	0.001	0.003	0.002	0.018	0.007	0.002	0.002	0.018	0.012	0.004	1
2	0.006	0.063	0.124	0.191	0.083	0.167	0.221	0.123	0.195	0.233	2
3	0.149	0.276	0.352	0.470	0.690	0.403	0.938	0.248	0.457	0.180	3
4	0.495	0.362	0.434	0.548	0.661	0.625	0.908	0.689	0.524	0.442	4
5	0.457	0.393	0.263	0.310	0.398	0.400	0.596	0.637	0.507	0.509	5
6	0.503	0.219	0.503	0.277	0.440	0.401	0.420	0.646	0.377	0.430	6
7	0.292	0.305	0.321	0.368	0.432	0.553	0.354	0.508	0.310	0.497	7
8	0.189	0.330	0.387	0.264	0.347	0.535	0.425	0.648	0.306	0.418	8
9	0.117	0.288	0.354	0.277	0.244	0.490	0.358	0.630	0.291	0.219	9
10	0.096	0.193	0.298	0.396	0.172	0.467	0.287	0.411	0.239	0.185	10
11	0.091	0.338	0.204	0.278	0.188	0.356	0.321	0.419	0.217	0.214	11
12	0.058	0.046	0.365	0.370	0.128	0.258	0.237	0.488	0.331	0.186	12
13	0.387	0.033	0.176	0.435	0.257	0.305	0.194	0.593	0.569	0.210	13
14	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	14
15	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	15

Age	1980	1981	1982	1983	1984	1985	1986	Age
1	0.007	0.034	0.005	0.001	0.000	0.002	0.001	1
2	0.108	0.170	0.206	0.149	0.083	0.036	0.029	2
3	0.234	0.156	0.379	0.307	0.593	0.460	0.450	3
4	0.299	0.306	0.476	0.547	0.882	1.119	0.710	4
5	0.570	0.322	0.746	0.781	0.814	1.151	0.800	5
6	0.505	0.568	0.583	0.856	1.147	0.914	1.000	6
7	0.503	0.521	0.518	0.993	0.632	0.821	0.810	7
8	0.344	0.865	0.471	0.793	0.691	0.416	0.740	8
9	0.449	0.420	0.778	0.613	0.359	0.282	0.480	9
10	0.292	0.515	0.354	0.542	0.234	0.205	0.390	10
11	0.314	0.514	0.383	0.416	0.333	0.133	0.380	11
12	0.147	0.694	0.336	0.486	0.250	0.345	0.370	12
13	0.168	0.352	0.455	0.388	0.338	0.118	0.360	13
14	0.300	0.300	0.300	0.300	0.300	0.300	0.300	14
15	0.300	0.300	0.300	0.300	0.300	0.300	0.300	15

Table 21.9 Stock Numbers at Age (1000's) of SAITHE in IV between 1970 and 1986

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	236173	234227	242227	276578	632618	212282	148108	125576	111107	245060	1
2	383454	193150	191232	197976	222455	514379	173520	121048	100993	89880	2
3	273174	311933	148416	138368	133927	167563	356489	113864	87650	68060	3
4	208442	192665	193862	85445	70811	54990	91719	114245	72767	45457	4
5	39408	104064	109838	102855	40455	29930	24096	30291	46965	35291	5
6	31899	20435	57517	69145	61773	22243	16424	10870	13120	23168	6
7	15837	15789	13445	28476	42918	32568	12193	8839	4665	7371	7
8	10184	9682	9526	7986	16133	22821	15341	7004	4356	2801	8
9	2772	6901	5698	5295	5020	9340	10939	8214	3001	2627	9
10	964	2019	4235	3274	3288	3221	4686	6260	3581	1837	10
11	299	717	1363	2575	1803	2266	1654	2878	3397	2309	11
12	286	223	419	910	1596	1223	1300	982	1549	2237	12
13	13	221	175	238	515	1149	773	840	493	911	13
14	16	71	175	120	126	326	693	521	380	229	14
15	77	39	165	81	127	108	470	557	401	421	15

Age	1980	1981	1982	1983	1984	1985	1986	Age
1	154886	185457	333490	553922	251805	242351	242163	1
2	199853	125910	146791	271579	453274	206093	198111	2
3	58319	146831	86969	97852	191541	341557	162706	3
4	46540	37776	102847	48749	58930	86674	176495	4
5	23929	28257	22769	52306	23089	19976	23173	5
6	17371	11084	16763	8837	19609	8378	5176	6
7	12337	8580	5144	7663	3073	5098	2751	7
8	3670	6110	4173	2510	2324	1337	1837	8
9	1510	2129	2106	2133	930	953	723	9
10	1727	789	1145	792	946	532	589	10
11	1250	1056	386	658	377	613	355	11
12	1527	748	517	215	355	222	439	12
13	1522	1079	306	303	108	227	128	13
14	605	1053	621	159	168	63	165	14
15	348	1400	624	434	235	151	158	15

Table 21.10 Mean Fishing Mortality , Biomass and Recruitment of SAITHE in IV between 1970 and 1986

	Mean Fishing Mortality			Biomass		Recruits	
	Ages 3 to 6		Ages 1 to 4	1000 tonnes		Age 1	
Year	H.Com	Disc	By-cat	Total	Sp St	Y.C.	Million
1970	0.332	0.000	0.069	1221	308	69	236
1971	0.271	0.000	0.043	1207	414	70	234
1972	0.346	0.000	0.042	1009	460	71	242
1973	0.310	0.000	0.091	886	489	72	277
1974	0.401	0.000	0.151	1071	537	73	633
1975	0.362	0.000	0.106	1003	459	74	212
1976	0.615	0.000	0.119	858	334	75	148
1977	0.540	0.000	0.013	610	276	76	126
1978	0.458	0.000	0.006	519	251	77	111
1979	0.382	0.000	0.006	533	243	78	245
1980	0.400	0.000	0.002	538	249	79	155
1981	0.335	0.000	0.004	558	226	80	185
1982	0.529	0.000	0.018	605	186	81	333
1983	0.616	0.000	0.004	745	185	82	554
1984	0.836	0.000	0.020	650	143	83	252
1985	0.875	0.000	0.027	567	105	84	242
1986	0.736	0.000	0.004	526	106	85	242
Mean recruits at age 1 for period 1977 to 1983							242

Table 21.11 Input for catch prediction of SAITHE in IV

		Values used in Prediction									
		F at age , Mean Wt. and Propn. Retained by Consumption Fishery									
	1986			1987	Scaled mean F			Mean values for period 1981 to 1985			
Age	Fishing Mortality			Stock	1981 to 1985			Mean Weight (Kg.)			Prop.
	H.Con.	Disc	Ind	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	0.001			242000	0.010		0.000	0.267		0.198	0.265	1.000
2	0.118		0.002	198056	0.145		0.001	0.506		0.462	0.505	1.000
3	0.440		0.010	143858	0.410		0.007	0.874		0.730	0.865	1.000
4	0.704		0.006	84940	0.731		0.010	1.530		1.318	1.521	1.000
5	0.799		0.001	71044	0.867		0.003	2.223		2.074	2.219	1.000
6	1.000			8525	0.935		0.001	2.983		2.752	2.983	1.000
7	0.810			1559	0.802		0.000	3.840		3.370	3.840	1.000
8	0.740			1002	0.745		0.000	4.797		5.085	4.797	1.000
9	0.480			718	0.564		0.000	5.759		5.970	5.760	1.000
10	0.390			366	0.426		0.000	6.750		5.970	6.750	1.000
11	0.380			326	0.410			7.396			7.396	1.000
12	0.370			199	0.486			7.792			7.792	1.000
13	0.360			249	0.381			8.498			8.498	1.000
14	0.300			73	0.346			8.315			8.315	1.000
15	0.300			100	0.346			9.438			9.438	1.000

Age 3 to 6	Age 1 4	Mean F	Age 3 to 6	Age 1 4
0.736	0.004	Unscaled	0.638	0.015
		Scaled	0.736	0.004

Recruits at age 1 in 1988 = 242000
Recruits at age 1 in 1989 = 242000

M at age and proprtion mature at age are as shown in Table 21.4

Mean F for ages 3 to 6 in 1986 for human consumption landings + discards = 0.736 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1981 to 1985 rescaled to produce a mean value of F for ages 3 to 6 equal to that for 1986

Mean F for ages 1 to 4 in 1986 for small-mesh fisheries = 0.004 .
Industrial fishery F-at-age in the prediction are averages for the period 1981 to 1985 , rescaled to produce a mean value of F for ages 1 to 4 equal to that for 1986

Table 21.12 Predicted Catches and Biomasses (1000's of tonnes) of SAITHE in IV 1987 to 1988

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	526	626	572	572	572	572	572	572	572	572	572	
Spawning	106	178	158	158	158	158	158	158	158	158	158	
Mean F Ages												
Human Cons. 3 to 6	0.74	0.74	0.00	0.15	0.29	0.44	0.59	0.74	0.88	0.20	0.33	
Small-mesh 1 to 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1986)										F0.1	Fmax	
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.27	0.44	
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Catch weight												
Human Consumption	161	221	0	50	94	133	167	196	222	67	103	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	1	2	2	2	2	2	1	1	1	2	2	
Total landings	162	223	2	52	96	135	168	198	224	69	105	
Total catch	162	223	2	52	96	135	168	198	224	69	105	
Biomass 1 Jan of Year+1												
Total	626	572	795	730	673	623	579	541	507	709	661	
Spawning	178	158	295	252	216	185	159	136	117	239	209	

Status quo fishing mortality.

Table 21.13 Predicted Catches and Biomasses (1000's of tonnes) of SAITHE in IV 1987 to 1988

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	526	626	634	634	634	634	634	634	634	634	634	634
Spawning	106	178	195	195	195	195	195	195	195	195	195	195
Mean F Ages												
Human Cons. 3 to 6	0.74	0.53	0.00	0.15	0.29	0.44	0.59	0.74	0.88	0.20	0.33	
Small-mesh 1 to 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1986)											F0.1	Fmax
Human Consumption	1.00	0.72	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.27	0.44	
Small-mesh Fishery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Catch weight												
Human Consumption	161	173	0	59	110	154	193	227	257	78	120	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	1	2	2	2	2	2	2	2	1	2	2	
Total landings	162	175	2	61	112	156	195	229	259	80	122	
Total catch	162	175	2	61	112	156	195	229	259	80	122	
Biomass 1 Jan of Year+1												
Total	626	634	864	789	723	666	616	573	535	764	710	
Spawning	178	195	351	299	256	219	187	161	138	283	247	

TAC taken in 1987.

Table 22.1 Nominal catch (tonnes) of SAITHE in Sub-area VI from 1977-1986. (Data for 1977-1985 from Bulletin Statistique.)

Country	1977	1978	1979	1980	1981
Belgium	-	-	1	2	2
Denmark	-	-	-	-	-
Faroe Islands	11	-	14	4	3
France	19,686	21,519	15,662	15,427	16,654
Germany, Fed. Rep.	254	604	131	49	581
Ireland	240	266	246	295	250
Netherlands	531	623	256	91	-
Norway	91	122	20	62	25
Spain	346	-	-	-	120
UK (England and Wales)	2,758	3,193	1,765	1,594	1,364
UK (Northern Ireland)	9	27	11	9	10
UK (Scotland)	4,628	5,181	3,602	2,902	3,117
Total	28,554	31,535	21,708	20,435	22,126

Country	1982	1983	1984	1985	1986[1]
Belgium	-	-	-	2	-
Denmark	4	-	-	-	-
Faroe Islands	5	-	-	-	-
France	17,102	13,470	19,706	19,120	18,363[2]
Germany, Fed. Rep.	441	179	713	838	3,239
Ireland	322	698	599	670	582
Netherlands	-	32	-	-	-
Norway	19	55	66	22	79
Spain	243	330	882	624	-
UK (England and Wales)	1,966	2,760	1,800	435[3]	323
UK (Northern Ireland)	7	12	49	15	21
UK (Scotland)	2,141	2,642	3,170	3,118	2,862
Total	22,250	26,178	26,985	24,844	25,469

[1] Preliminary.
[2] Includes Division Vb.
[3] Foreign landings not included.

Table 22.2 Annual Weight and Numbers of SAITHE caught in VI between 1970 and 1986

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1970	15	15	0	0	8	8	0	0
1971	20	20	0	0	11	11	0	0
1972	29	29	0	0	19	19	0	0
1973	34	34	0	0	23	23	0	0
1974	36	36	0	0	18	18	0	0
1975	31	31	0	0	16	16	0	0
1976	42	42	0	0	20	20	0	0
1977	27	27	0	0	13	13	0	0
1978	33	33	0	0	16	16	0	0
1979	22	22	0	0	7	7	0	0
1980	22	22	0	0	8	8	0	0
1981	24	24	0	0	11	11	0	0
1982	24	24	0	0	11	11	0	0
1983	29	29	0	0	14	14	0	0
1984	22	22	0	0	13	13	0	0
1985	27	27	0	0	14	14	0	0
1986	39	39	0	0	23	23	0	0

Table 22.3 Results of analysis of catchability coefficients for SAITHE in VI

F for named gears and total international F

Gear	Estimate	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
	F(gear)	0.034	0.224	0.396	0.399	0.560	0.630	0.419
FRA ALL	Var F(gear)	0.00008	0.00407	0.00519	0.00587	0.00218	0.01068	0.00535
	Propn(gear)	0.24718	0.73185	0.88147	0.86034	0.79701	0.72861	0.58784
	F(gear)	0.034	0.224	0.396	0.399	0.560	0.630	0.419
All above	Var F(gear)	0.00008	0.00407	0.00519	0.00587	0.00218	0.01068	0.00535
	Propn(gear)	0.24718	0.73185	0.88147	0.86034	0.79701	0.72861	0.58784
Total	F	0.138	0.306	0.449	0.463	0.703	0.865	0.712
Internatl	Var F	0.00135	0.00759	0.00668	0.00792	0.00343	0.02011	0.01550

Gear	Estimate	Age 9	Age 10	Age 11	Age 12
	F(gear)	0.319	0.277	0.086	0.119
FRA ALL	Var F(gear)	0.00158	0.00360	0.00557	0.01486
	Propn(gear)	0.67327	0.69381	0.42904	0.62095
	F(gear)	0.319	0.277	0.086	0.119
All above	Var F(gear)	0.00158	0.00360	0.00557	0.01486
	Propn(gear)	0.67327	0.69381	0.42904	0.62095
Total	F	0.474	0.400	0.201	0.192
Internatl	Var F	0.00348	0.00749	0.03026	0.03853

Table22.4 Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	0.000
3	0.200	0.000
4	0.200	0.000
5	0.200	1.000
6	0.200	1.000
7	0.200	1.000
8	0.200	1.000
9	0.200	1.000
10	0.200	1.000
11	0.200	1.000
12	0.200	1.000
13	0.200	1.000
14	0.200	1.000
15	0.200	1.000

Table 22.5 Total International Catch at Age (1000's) of SAITHE in VI between 1970 and 1986

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1			51	292	806	23	35	157	38	9	1
2	33	382	3644	6557	3056	2465	2776	1234	5047	969	2
3	2857	1385	7913	6944	5737	6315	8154	4571	4634	1828	3
4	2335	4444	3805	4743	2353	2458	2721	2697	2411	1194	4
5	1805	1891	2299	1882	2000	1314	1794	1673	1350	1151	5
6	599	1085	428	833	608	860	1116	737	715	708	6
7	240	465	309	430	932	1607	659	559	309	368	7
8	196	362	154	311	891	707	517	385	263	156	8
9	41	300	91	192	489	197	583	290	161	191	9
10	57	52	81	201	418	87	323	290	301	152	10
11	20	93	24	125	190	86	397	273	377	164	11
12	20	21	21	73	126	85	178	99	264	137	12
13	12	31	10	19	35	45	177	52	207	131	13
14	4	18	9	21	36	13	186	102	83	110	14
15	8	31	18	15	56	25	161	106	84	62	15

Age	1980	1981	1982	1983	1984	1985	1986	Age
1	45	148	38	42	147	5	234	1
2	1005	2449	1306	4026	2932	2234	752	2
3	3335	3911	4491	4879	5484	4982	6907	3
4	942	1977	1641	2624	2403	2992	8396	4
5	677	588	1240	852	876	1454	3732	5
6	632	410	568	775	681	1222	1312	6
7	469	341	384	513	300	608	958	7
8	194	223	244	161	139	186	400	8
9	91	153	136	107	56	104	166	9
10	113	120	72	94	46	49	97	10
11	172	127	50	56	16	23	21	11
12	140	115	63	65	7	12	31	12
13	188	129	67	62	12	19	57	13
14	84	91	76	95	24	24	36	14
15	119	91	132	136	54	96	77	15

Table 22.6 Total International Mean Weight at Age (Kg.) of SAITHE in VI between 1970 and 1986

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1			0.507	0.311	0.309	0.460	0.444	0.383	0.412	0.513	1
2	0.592	0.640	0.764	0.621	0.590	0.737	0.681	0.577	0.490	0.700	2
3	1.066	0.935	1.139	1.102	0.987	0.939	1.005	0.794	1.091	1.323	3
4	1.401	1.240	1.815	1.400	1.622	1.504	1.442	1.353	1.674	1.980	4
5	1.954	1.762	2.631	2.516	1.743	2.575	2.732	2.207	2.583	2.405	5
6	2.911	2.697	2.598	3.080	3.534	3.497	3.230	3.199	3.813	3.366	6
7	3.622	3.454	2.979	3.694	4.542	4.779	4.174	4.253	4.657	4.609	7
8	4.816	4.626	5.018	4.833	5.038	5.589	4.930	5.030	5.278	5.815	8
9	6.178	5.196	6.118	6.705	6.066	6.522	5.785	5.829	5.979	6.967	9
10	6.425	5.816	7.320	7.329	7.370	7.119	6.405	6.518	6.853	7.559	10
11	6.770	6.948	7.709	7.951	8.011	8.002	6.944	6.884	7.692	8.387	11
12	7.510	7.755	7.662	8.986	8.981	9.030	7.823	7.931	9.072	9.187	12
13	8.309	8.287	9.522	9.274	9.830	8.995	8.592	8.736	10.030	10.154	13
14	8.290	8.267	10.488	10.550	10.567	10.638	9.477	9.604	10.941	11.091	14
15	8.684	8.661	11.377	11.550	11.969	11.883	10.296	10.590	9.548	11.734	15

Age	1980	1981	1982	1983	1984	1985	1986	Age
1	0.417	0.400	0.432	0.378	0.472	0.405	0.672	1
2	0.650	0.676	0.717	0.665	0.723	0.707	0.746	2
3	1.165	1.096	1.078	1.246	1.109	1.056	0.873	3
4	1.932	1.699	1.779	1.833	1.786	1.677	1.336	4
5	2.651	2.983	2.736	3.074	2.663	2.613	2.183	5
6	3.560	4.047	3.946	3.642	3.503	3.237	3.000	6
7	4.560	5.115	5.348	5.036	4.714	4.316	3.727	7
8	5.531	6.240	6.197	6.285	5.791	6.002	4.381	8
9	6.524	7.222	7.765	6.975	7.609	7.377	5.757	9
10	7.902	8.304	9.148	8.160	9.028	8.940	6.760	10
11	8.680	8.473	9.374	8.802	8.832	9.717	7.553	11
12	9.482	9.311	10.411	9.827	9.998	9.419	8.319	12
13	9.753	10.121	10.580	11.254	11.291	10.377	8.798	13
14	10.774	10.978	10.779	12.055	11.597	12.092	9.244	14
15	11.957	12.314	12.130	13.153	12.452	12.634	12.906	15

Table 22.7 Total International Fishing Mortality Rate at Age of SAITHE in VI between 1970 and 1986

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1			0.002	0.010	0.026	0.001	0.002	0.009	0.002	0.000	1
2	0.001	0.011	0.145	0.286	0.136	0.101	0.156	0.096	0.418	0.066	2
3	0.110	0.068	0.342	0.449	0.435	0.453	0.559	0.412	0.612	0.262	3
4	0.166	0.249	0.270	0.355	0.268	0.336	0.360	0.361	0.398	0.310	4
5	0.183	0.197	0.189	0.207	0.248	0.235	0.440	0.363	0.310	0.336	5
6	0.120	0.160	0.062	0.101	0.096	0.160	0.322	0.326	0.291	0.265	6
7	0.062	0.129	0.062	0.082	0.156	0.226	0.178	0.264	0.220	0.238	7
8	0.054	0.125	0.057	0.082	0.243	0.170	0.173	0.149	0.191	0.164	8
9	0.087	0.111	0.042	0.094	0.179	0.077	0.207	0.139	0.086	0.206	9
10	0.112	0.152	0.039	0.122	0.303	0.044	0.176	0.150	0.209	0.110	10
11	0.104	0.267	0.098	0.079	0.162	0.093	0.284	0.220	0.297	0.168	11
12	0.208	0.145	0.088	0.476	0.107	0.101	0.284	0.106	0.344	0.167	12
13	0.224	0.558	0.095	0.106	0.436	0.050	0.315	0.125	0.336	0.286	13
14	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	14
15	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	15

Age	1980	1981	1982	1983	1984	1985	1986	Age
1	0.002	0.006	0.001	0.001	0.004	0.000	0.008	1
2	0.067	0.127	0.071	0.128	0.070	0.067	0.033	2
3	0.337	0.398	0.359	0.403	0.258	0.163	0.306	3
4	0.209	0.343	0.289	0.369	0.355	0.218	0.449	4
5	0.291	0.195	0.376	0.239	0.201	0.379	0.463	5
6	0.313	0.287	0.292	0.428	0.306	0.475	0.703	6
7	0.282	0.277	0.476	0.467	0.293	0.493	0.864	7
8	0.190	0.210	0.328	0.376	0.221	0.298	0.712	8
9	0.137	0.226	0.191	0.272	0.217	0.256	0.474	9
10	0.181	0.268	0.157	0.195	0.146	0.301	0.400	10
11	0.174	0.317	0.171	0.182	0.045	0.100	0.201	11
12	0.213	0.169	0.259	0.346	0.032	0.043	0.192	12
13	0.363	0.308	0.139	0.431	0.102	0.108	0.300	13
14	0.300	0.300	0.300	0.300	0.300	0.300	0.300	14
15	0.300	0.300	0.300	0.300	0.300	0.300	0.300	15

Table 22.8 Stock Numbers at Age (1000's) of SAITHE in VI between 1970 and 1986

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	45188	36276	35425	32731	35268	25878	18195	19938	20403	20838	1
2	28266	36997	29700	28957	26534	28147	21166	14865	16182	16670	2
3	30200	23113	29945	21033	17813	18970	20822	14828	11058	8721	3
4	16775	22150	17674	17410	10994	9439	9869	9749	8039	4910	4
5	11875	11630	14137	11048	9995	6885	5520	5637	5561	4419	5
6	5828	8097	7819	9586	7351	6383	4454	2911	3114	3240	6
7	4414	4231	5652	6016	7097	5470	4452	2644	1721	1906	7
8	4068	3397	3045	4349	4537	4971	3572	3051	1662	1131	8
9	538	3154	2455	2354	3279	2914	3433	2459	2151	1124	9
10	595	404	2312	1928	1754	2245	2208	2286	1752	1616	10
11	228	436	284	1820	1397	1060	1759	1516	1610	1164	11
12	119	168	273	211	1377	972	791	1084	996	980	12
13	67	79	119	205	107	1014	720	487	798	578	13
14	17	44	37	89	151	57	789	430	352	467	14
15	35	131	74	66	238	104	426	448	356	262	15

Age	1980	1981	1982	1983	1984	1985	1986	Age
1	27696	25958	44976	58488	46065	31228	32376	1
2	17053	22635	21119	36789	47848	37582	25563	2
3	12774	13055	16325	16111	26491	36529	28763	3
4	5496	7463	7179	9333	8812	16756	25420	4
5	2947	3651	4334	4402	5285	5057	11026	5
6	2584	1804	2460	2435	2837	3538	2835	6
7	2098	1548	1109	1504	1299	1711	1801	7
8	1230	1296	960	564	772	794	856	8
9	786	833	860	567	317	507	482	9
10	749	561	544	582	368	209	321	10
11	1186	511	351	381	392	260	127	11
12	805	816	305	242	260	367	193	12
13	679	533	564	193	140	206	241	13
14	356	387	321	402	103	104	151	14
15	503	387	560	574	228	405	328	15

Table 22.9 Mean Fishing Mortality , Biomass and Recruitment of SAITHE in VI between 1970 and 1986

	Mean Fishing Mortality			Biomass			Recruits
	Ages 3 to 6		Ages 0 to 0	1000 tonnes			Age 1
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1970	0.145	0.000	0.000	159	86	69	45
1971	0.168	0.000	0.000	171	98	70	36
1972	0.216	0.000	0.000	235	128	71	35
1973	0.278	0.000	0.000	226	150	72	33
1974	0.262	0.000	0.000	222	160	73	35
1975	0.296	0.000	0.000	222	157	74	26
1976	0.420	0.000	0.000	194	136	75	18
1977	0.373	0.000	0.000	151	110	76	20
1978	0.403	0.000	0.000	146	105	77	20
1979	0.293	0.000	0.000	134	90	78	21
1980	0.287	0.000	0.000	127	79	79	28
1981	0.306	0.000	0.000	124	71	80	26
1982	0.329	0.000	0.000	133	68	81	45
1983	0.360	0.000	0.000	146	63	82	58
1984	0.280	0.000	0.000	153	52	83	46
1985	0.309	0.000	0.000	162	56	84	31
1986	0.480	0.000	0.000	158	58	85	32
Mean recruits at age 1 for period 1970 to 1984							33

Table 22.10 Input for catch prediction of SAITHE in VI

		Values used in Prediction								
		F at age , Mean Wt. and Propn. Retained by Consumption Fisherv								
	1986		1987	Scaled mean F			Mean values for period 1981 to 1985			
Age	Fishing Mortality			Stock	1981 to 1985			Mean Weight (Kg.)				Prop.
	H.Con.	Disc	Ind	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	0.003			32888	0.004			0.417			0.417	1.000
2	0.120			26428	0.140			0.698			0.696	1.000
3	0.306			18562	0.479			1.117			1.117	1.000
4	0.449			17341	0.478			1.755			1.755	1.000
5	0.463			13284	0.422			2.810			2.810	1.000
6	0.703			5682	0.542			3.675			3.675	1.000
7	0.864			1149	0.608			4.906			4.906	1.000
8	0.712			622	0.434			6.103			6.103	1.000
9	0.474			344	0.340			7.389			7.389	1.000
10	0.400			246	0.324			8.716			8.716	1.000
11	0.201			176	0.247			9.040			9.040	1.000
12	0.192			85	0.258			9.791			9.791	1.000
13	0.300			130	0.330			10.725			10.725	1.000
14	0.300			146	0.455			11.500			11.500	1.000
15	0.300			92	0.455			12.537			12.537	1.000

Age 3 to 6	Age 0 0	Mean F	Age 3 to 6	Age 0 0
0.480	0.000	Unscaled	0.317	0.000
		Scaled	0.480	0.000

Recruits at age 1 in 1988 = 32888
Recruits at age 1 in 1989 = 32888

M at age and proprtion mature at age are as shown in Table 22.4

Mean F for ages 3 to 6 in 1986 for human consumption landings + discards = 0.480 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1981 to 1985
rescaled to produce a mean value of F for ages 3 to 6 equal to that for 1986

Mean F for ages 0 to 0 in 1986 for small-mesh fisheries = 0.000 .
Industrial fisherv F-at-age in the prediction are averages for the period 1981 to 1985 .
rescaled to produce a mean value of F for ages 0 to 0 equal to that for 1986

Table 22.11 Predicted Catches and Biomasses (1000's of tonnes) of SAITHE in VI 1987 to 1988

	Year											
	1986	1987	1988									
Biomass 1 Jan of Year												
Total	158	162	147	147	147	147	147	147	147	147	147	147
Spawning	58	79	77	77	77	77	77	77	77	77	77	77
Mean F Ages												
Human Cons. 3 to 6	0.48	0.48	0.00	0.10	0.19	0.29	0.38	0.48	0.58	0.18	0.28	
Small-mesh 0 to 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean F(Year)/Mean F(1986)											F0.1	Fmax
Human Consumption	1.00	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20	0.37	0.59	
Catch weight												
Human Consumption	39	46	0	10	19	28	35	42	49	18	27	
Discards	0	0	0	0	0	0	0	0	0	0	0	
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0	
Total landings	39	46	0	10	19	28	35	42	49	18	27	
Total catch	39	46	0	10	19	28	35	42	49	18	27	
Biomass 1 Jan of Year+1												
Total	162	147	185	172	161	151	141	133	125	162	151	
Spawning	79	77	101	91	83	75	68	62	56	84	76	

Table 23.1 Nominal catch (in tonnes) of SAITHE in Sub-area VII for 1977-1986. (Data for 1977-1985 from Bulletin Statistique.)

Country	1977	1978	1979	1980	1981
Belgium	10	9	9	19	12
Denmark	1	19	7	6	-
France	2,591	2,105	1,699	2,317	4,563
Germany, Fed. Rep.	15	16	3	46	-
Ireland	1,083	1,451	1,632	2,220	2,197
Netherlands	52	44	35	84	100
Norway	-	-	-	-	-
Poland	1	-	-	-	-
Spain	632	-	-	-	266
UK (England & Wales)	144	89	61	109	236
UK (Isle of Man)	-	-	41	19	36
UK (N. Ireland)	423	343	276	301	577
UK (Scotland)	10	106	34	56	94
Total	4,962	4,182	3,797	5,177	8,081

Country	1982	1983	1984	1985	1986[1]
Belgium	13	6	10	31[1]	22
Denmark	-	-	-	-	-
France	4,061	4,760	3,697	6,101	4,979[3]
Germany, Fed. Rep.	-	11	5	-	-
Ireland	2,367	2,383	2,374	2,177	1,079
Netherlands	22	7	-	-	-
Norway	-	3	+	3[1]	35
Poland	-	-	-	-	-
Spain	179	70	118	118	-
UK (England & Wales)	526	235	974	250[2]	206
UK (Isle of Man)	34	16	27	9	6
UK (N. Ireland)	872	668	411	665	643
UK (Scotland)	119	138	140	477	355
Total	8,193	8,297	7,756	9,831	7,325

[1] Preliminary.
[2] Foreign landings not included.
[3] Includes Sub-area VIII.

Figure 4.1 Trends in effort for various fleets in the North Sea.

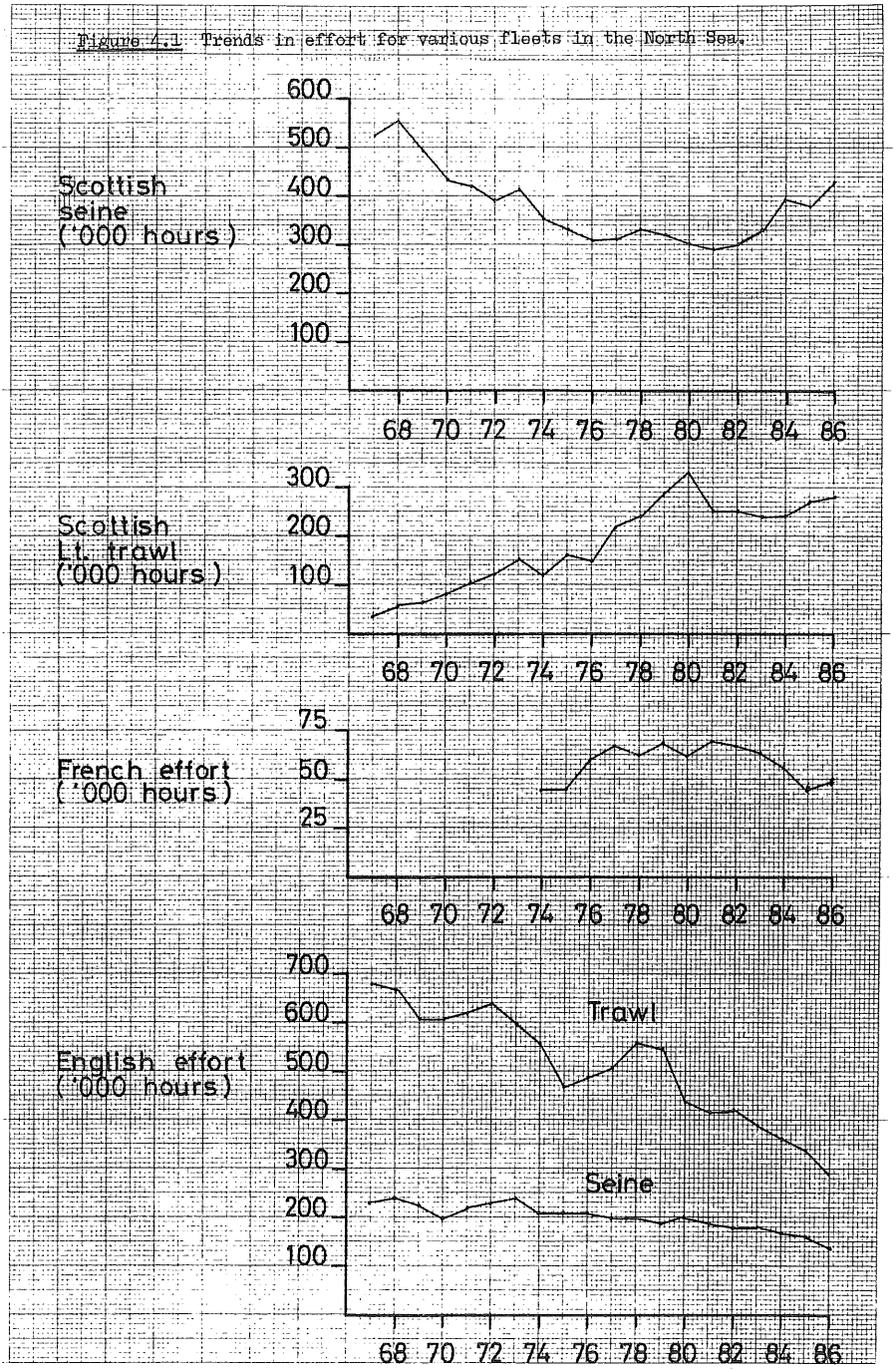


Figure 4.2 Trends in effort for various fleets in Division VIa.

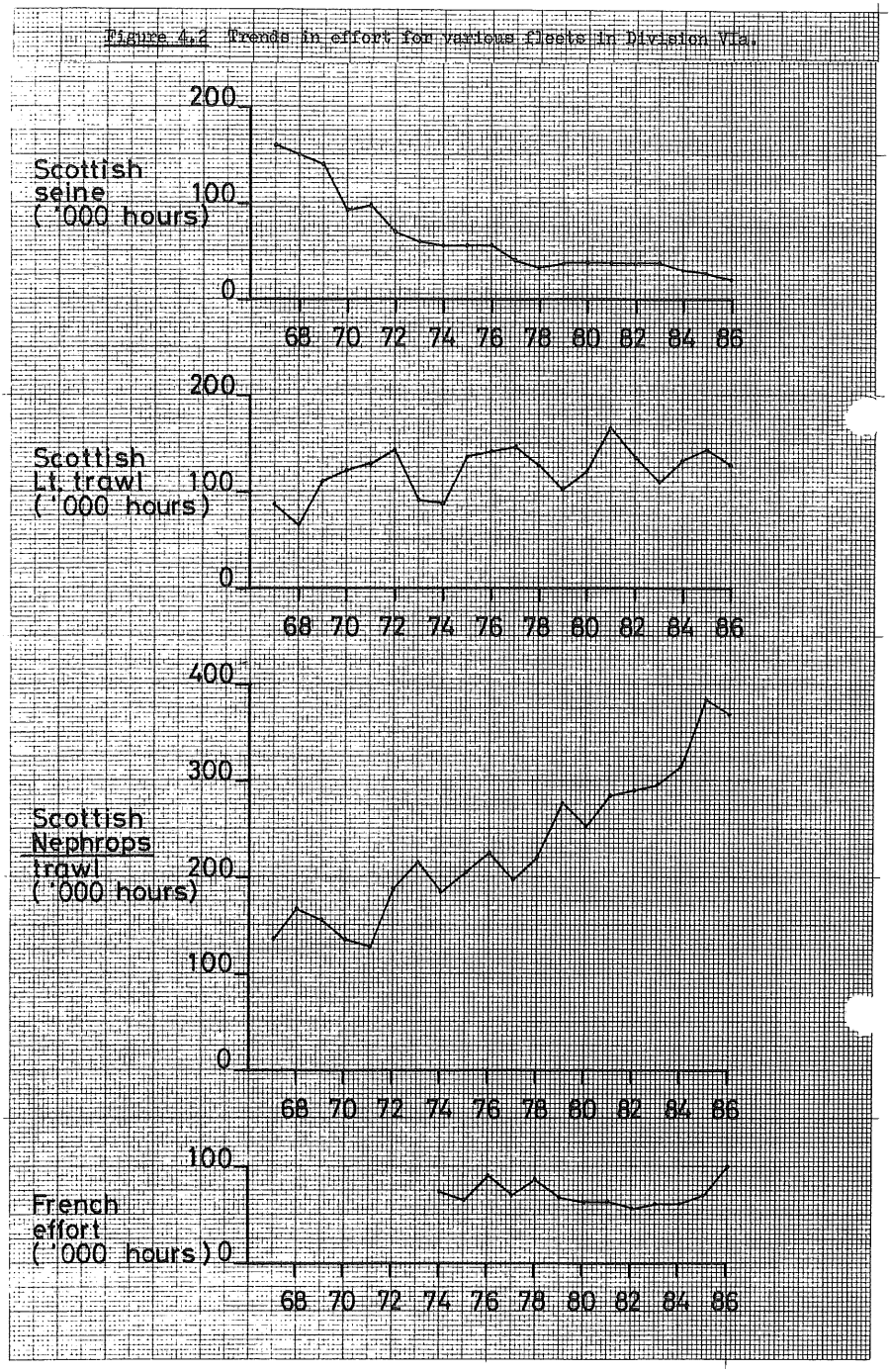
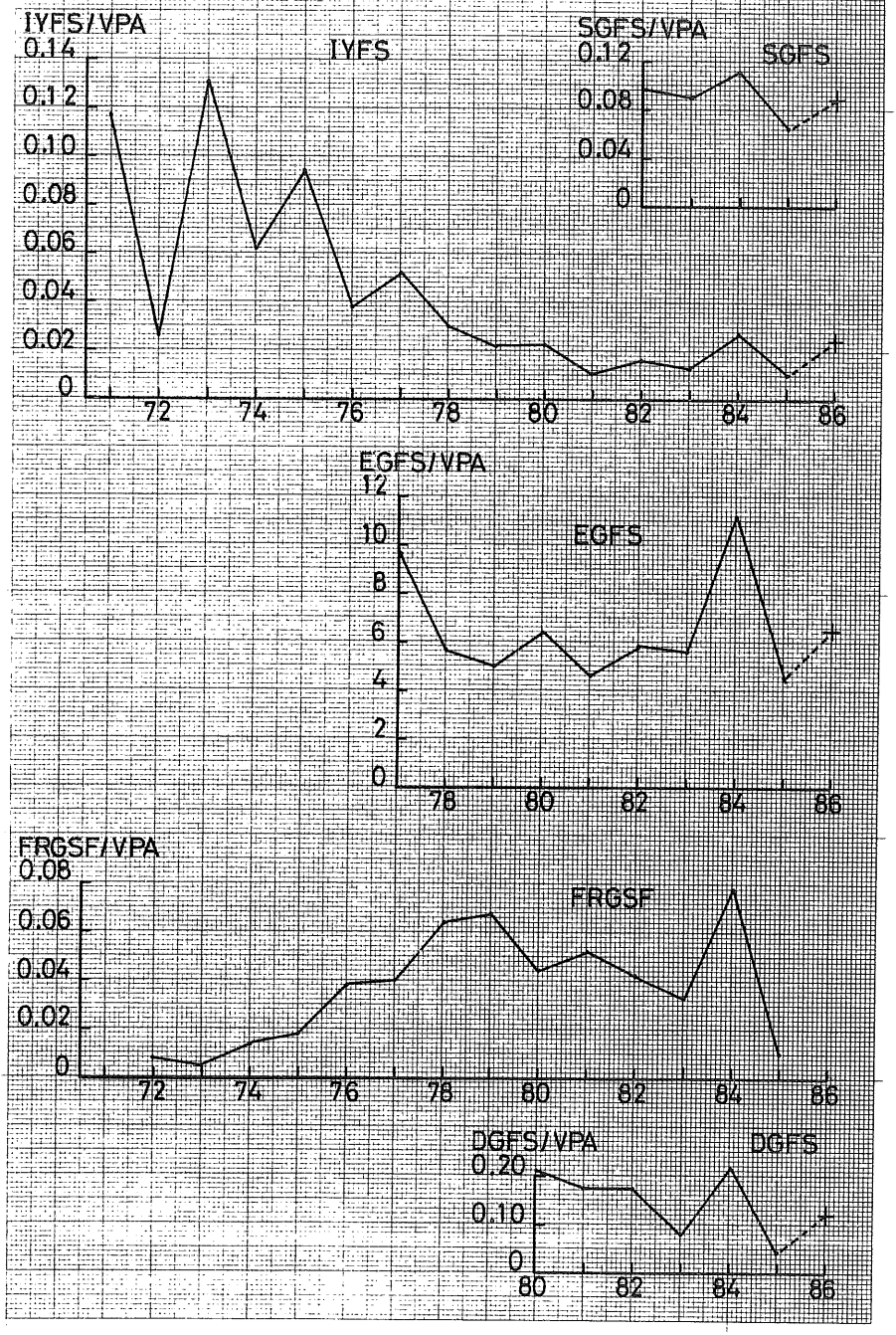


Figure 9.1A Catchability of North Sea cod at age 1.



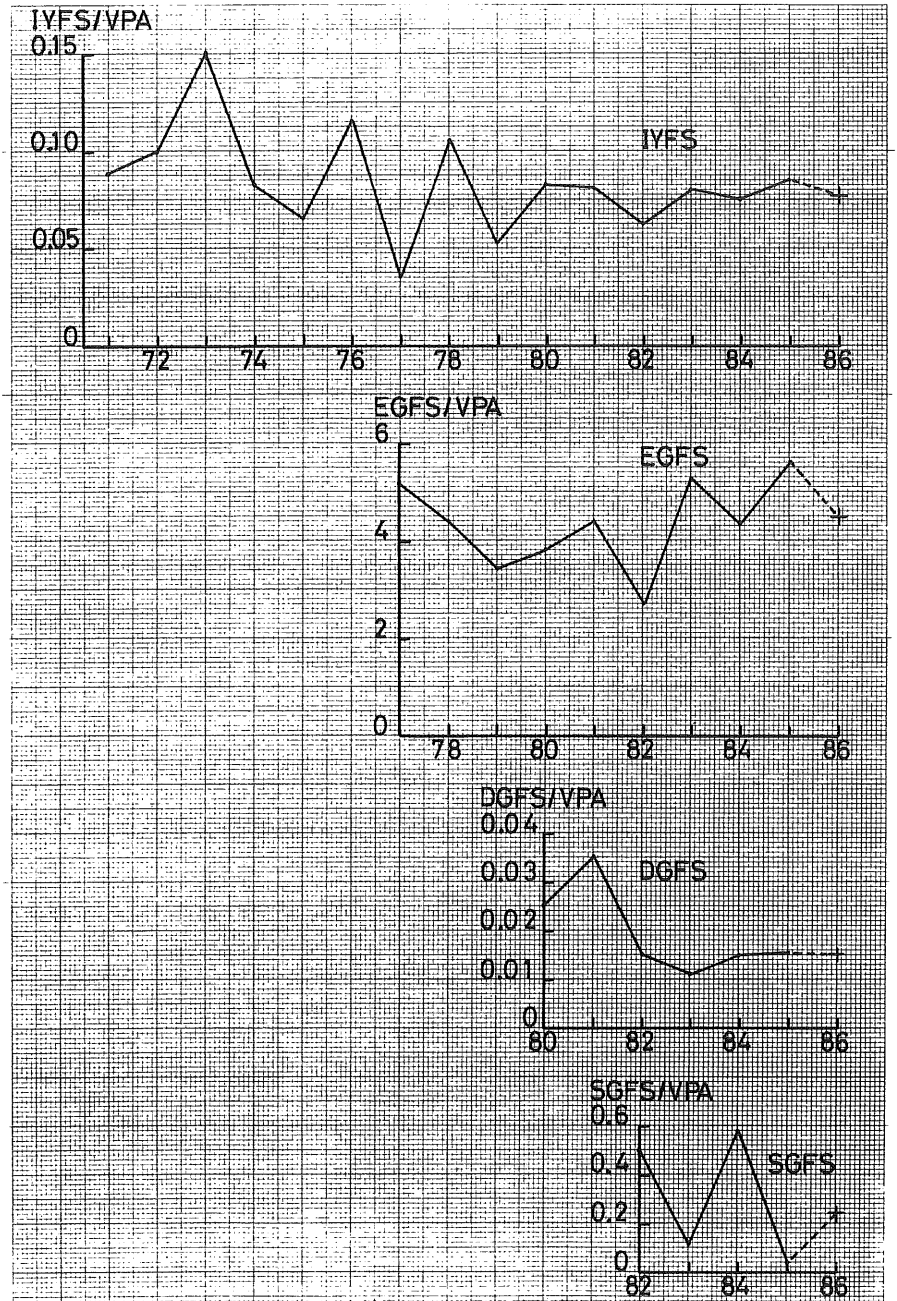


Figure 9.1B Catchability of North Sea Cod at age 2.

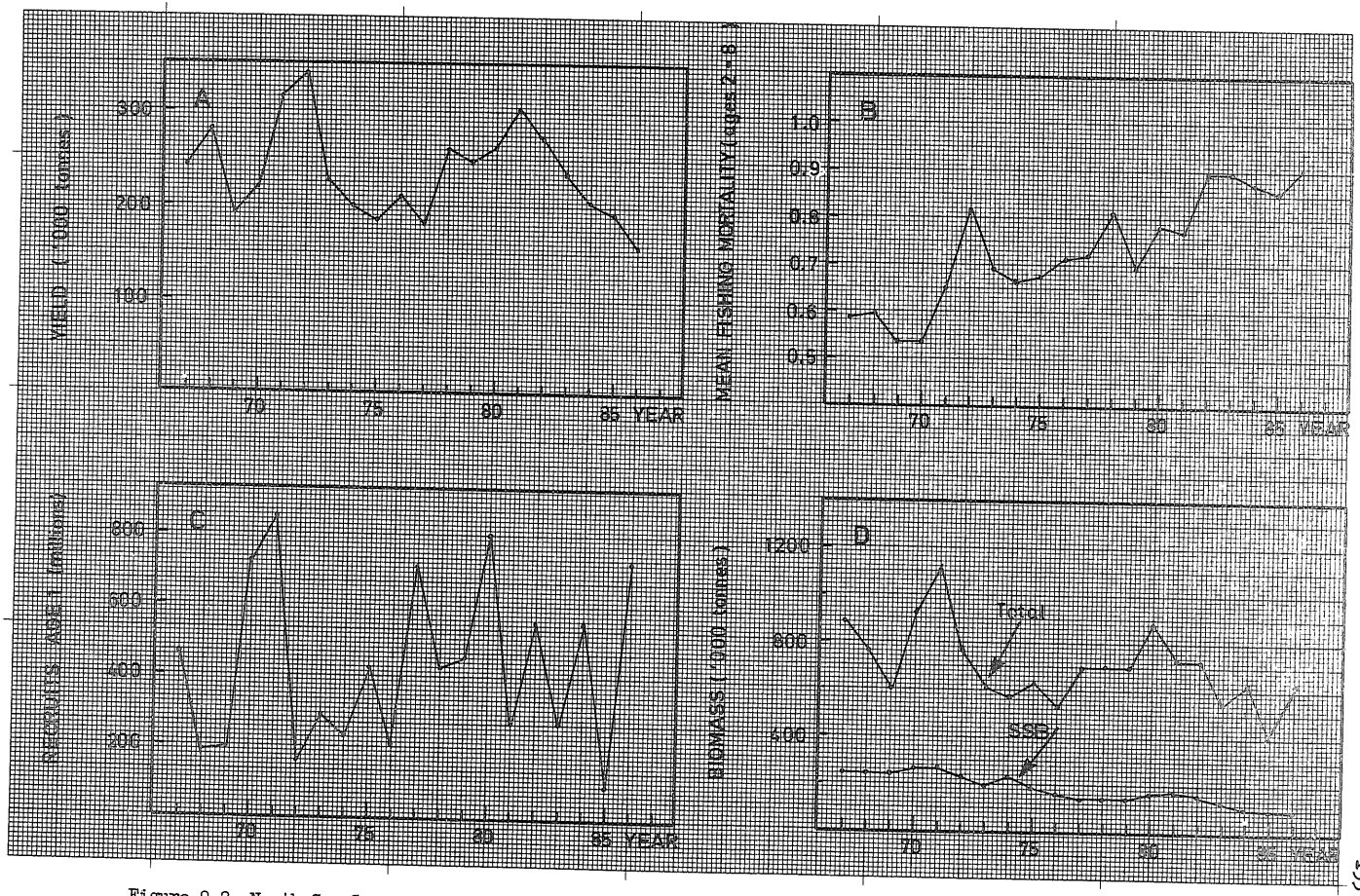


Figure 9.2 North Sea Cod.

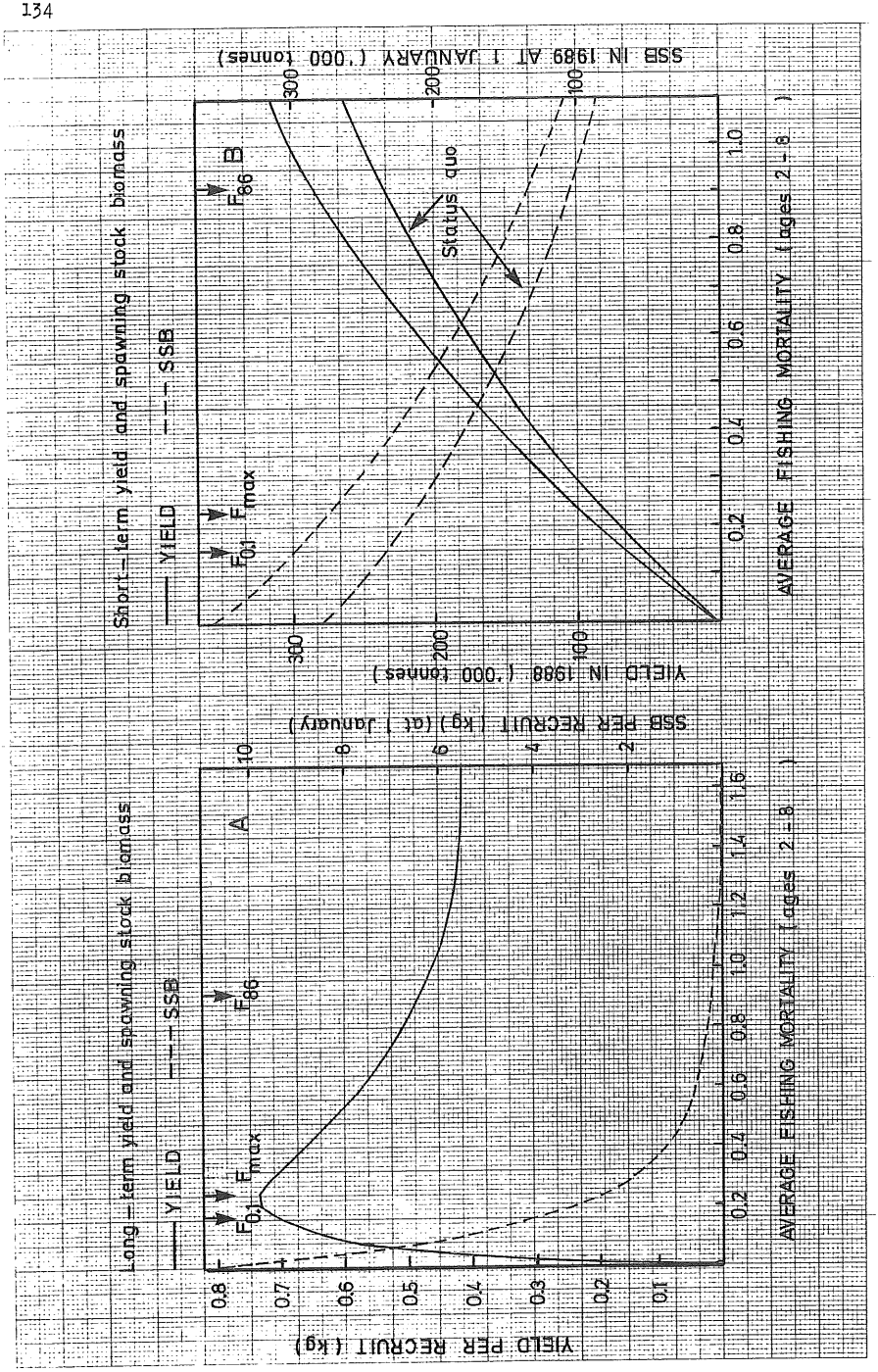


Figure 9.3 North Sea Cod.

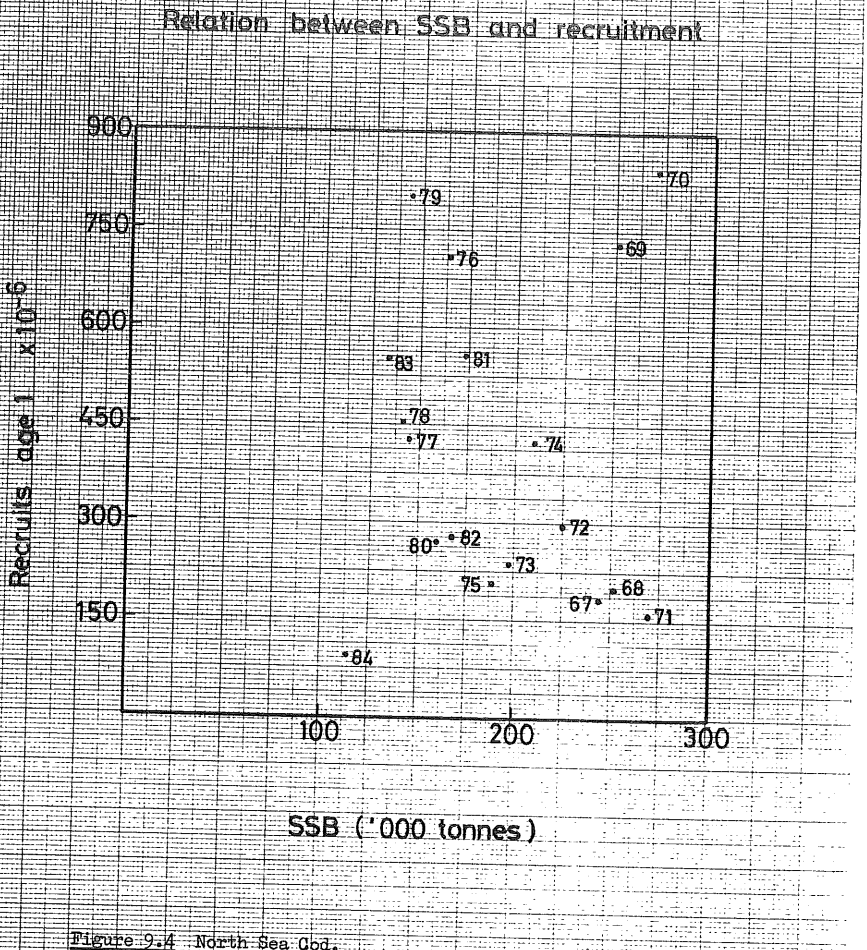


Figure 9.4 North Sea Cod.

Figure 10.1A Relation between VPA numbers for Cod in the North Sea and to the West of Scotland at age 1.

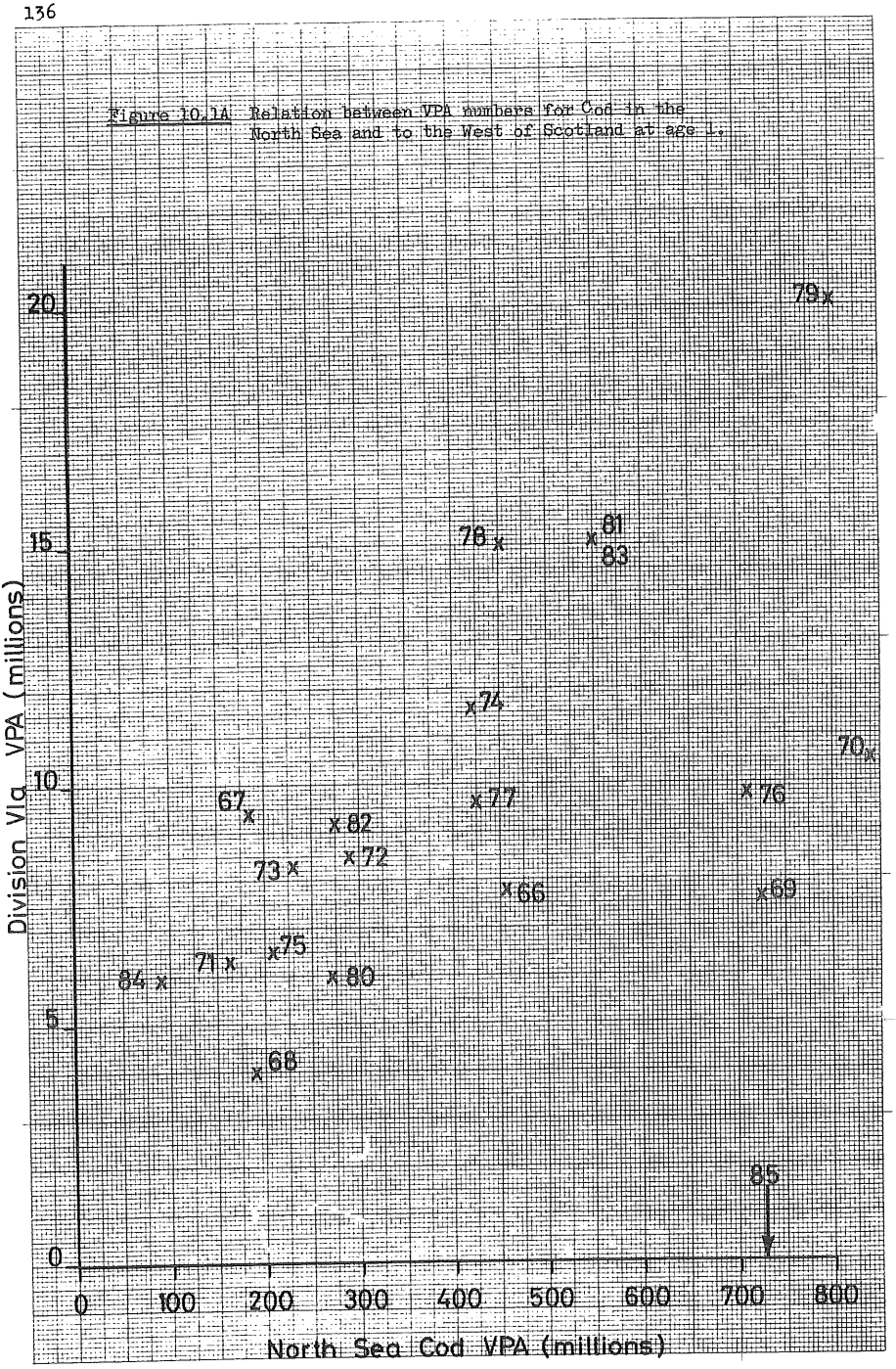
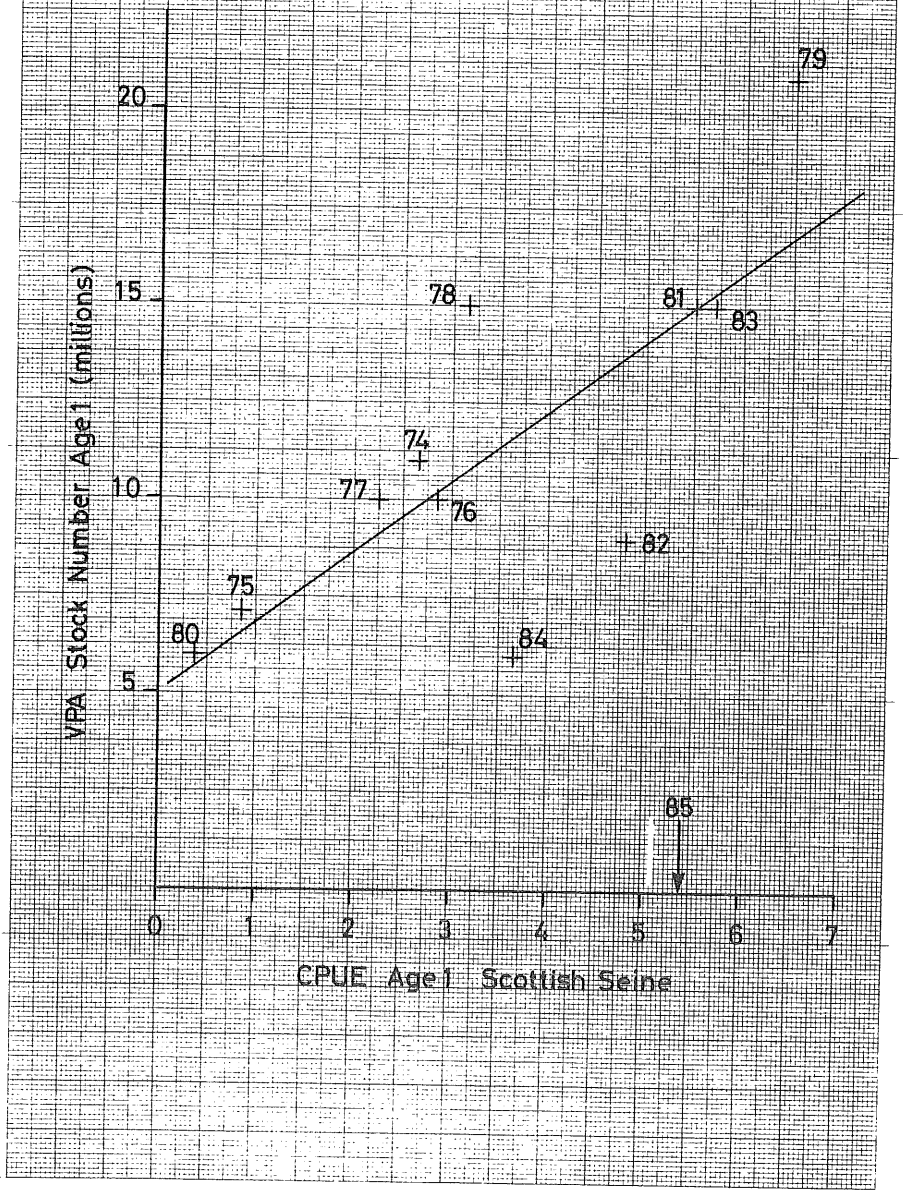


Figure 10.1B Relation between CPUE at age 1 for Scottish Seiners and VPA numbers at age 1 for West of Scotland Cod.



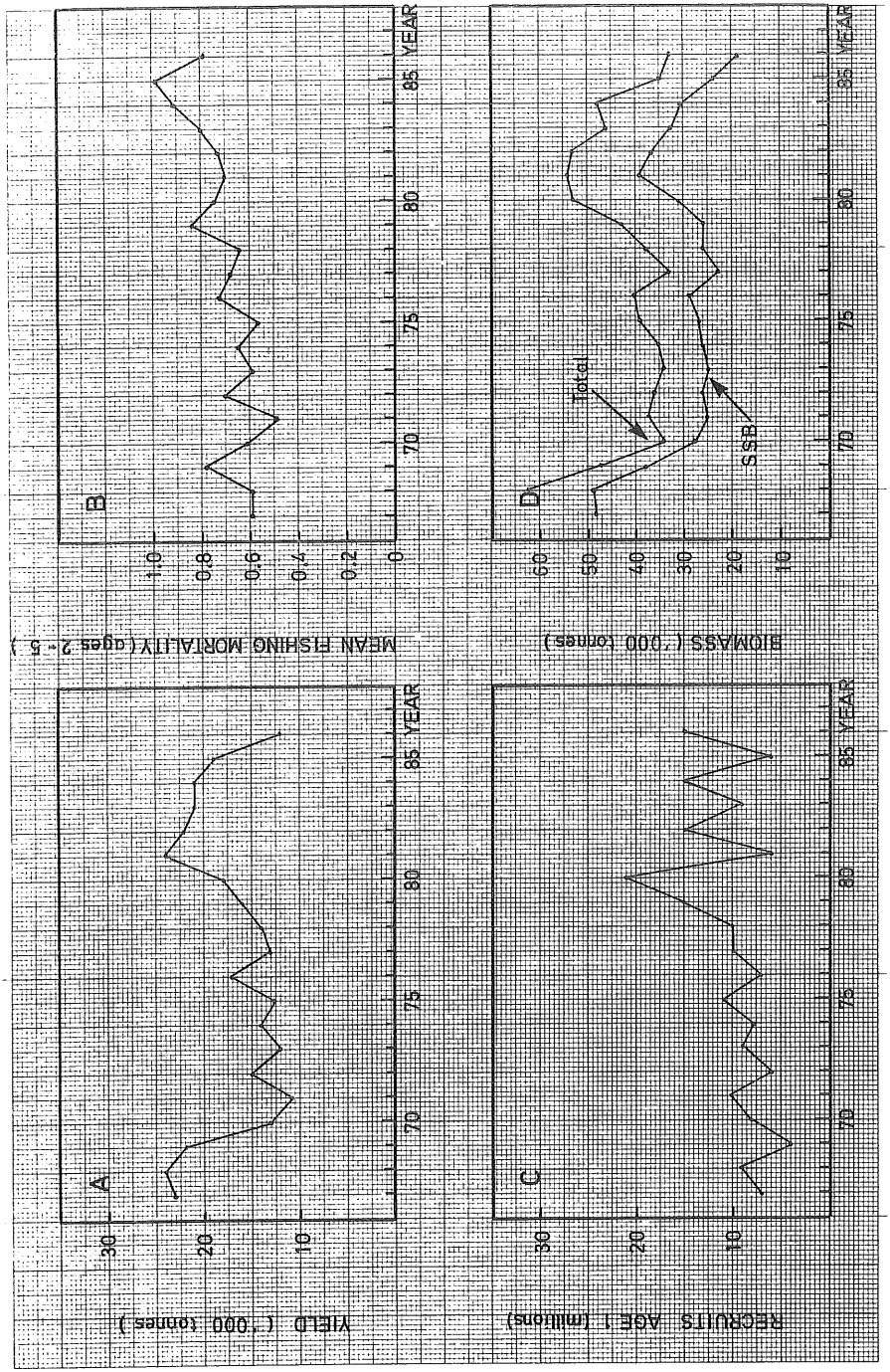


Figure 10.2 Cod in Division VIa (West of Scotland).

Figure 10.3 Cod in Division VIa (West of Scotland).

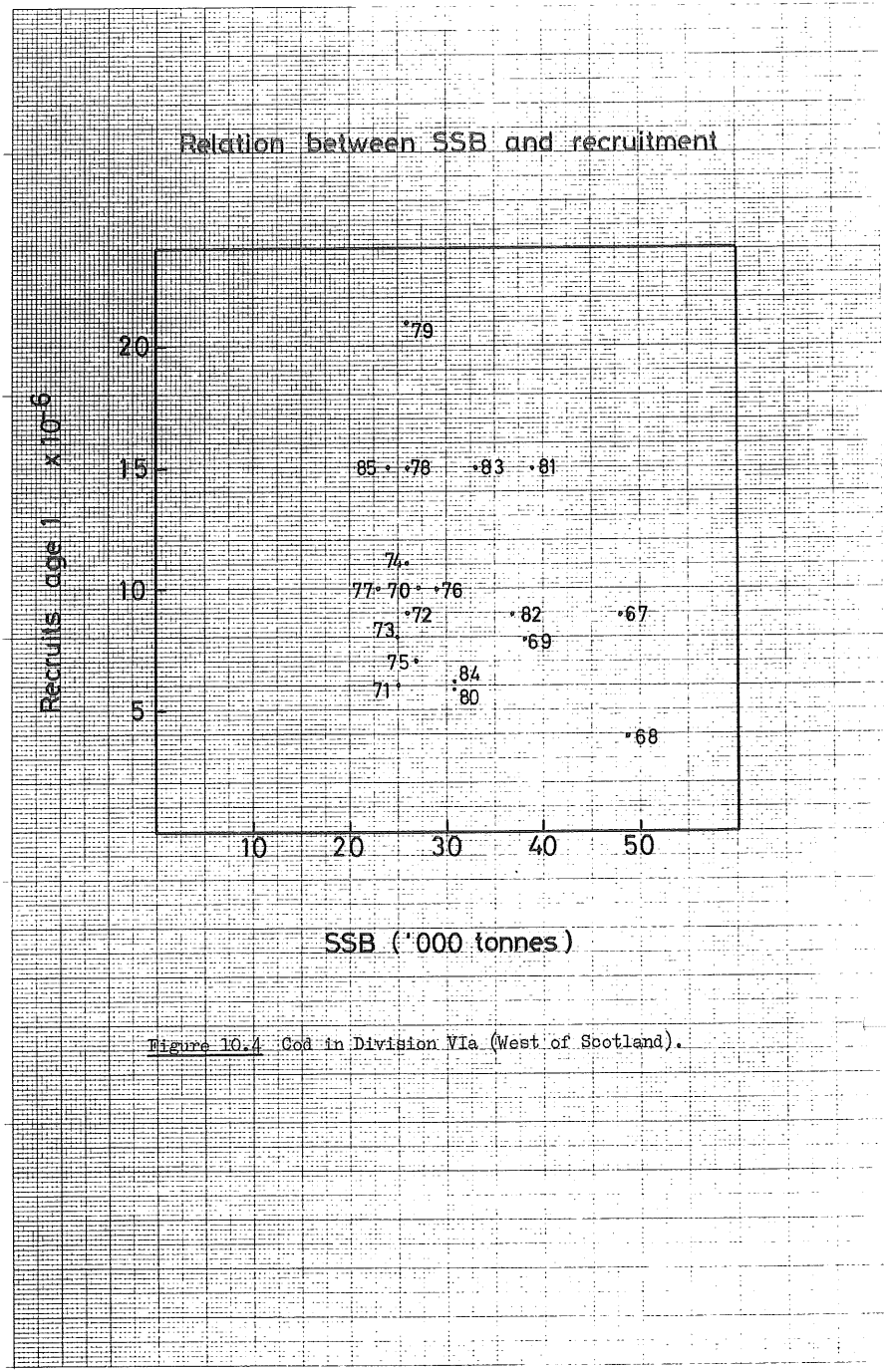


Figure 10.4 Cod in Division VIa (West of Scotland).

Figure 12.1 The relation for Cod between VPA numbers at age 1 in the North Sea and VPA numbers at age 1 in Divisions VIId,e.

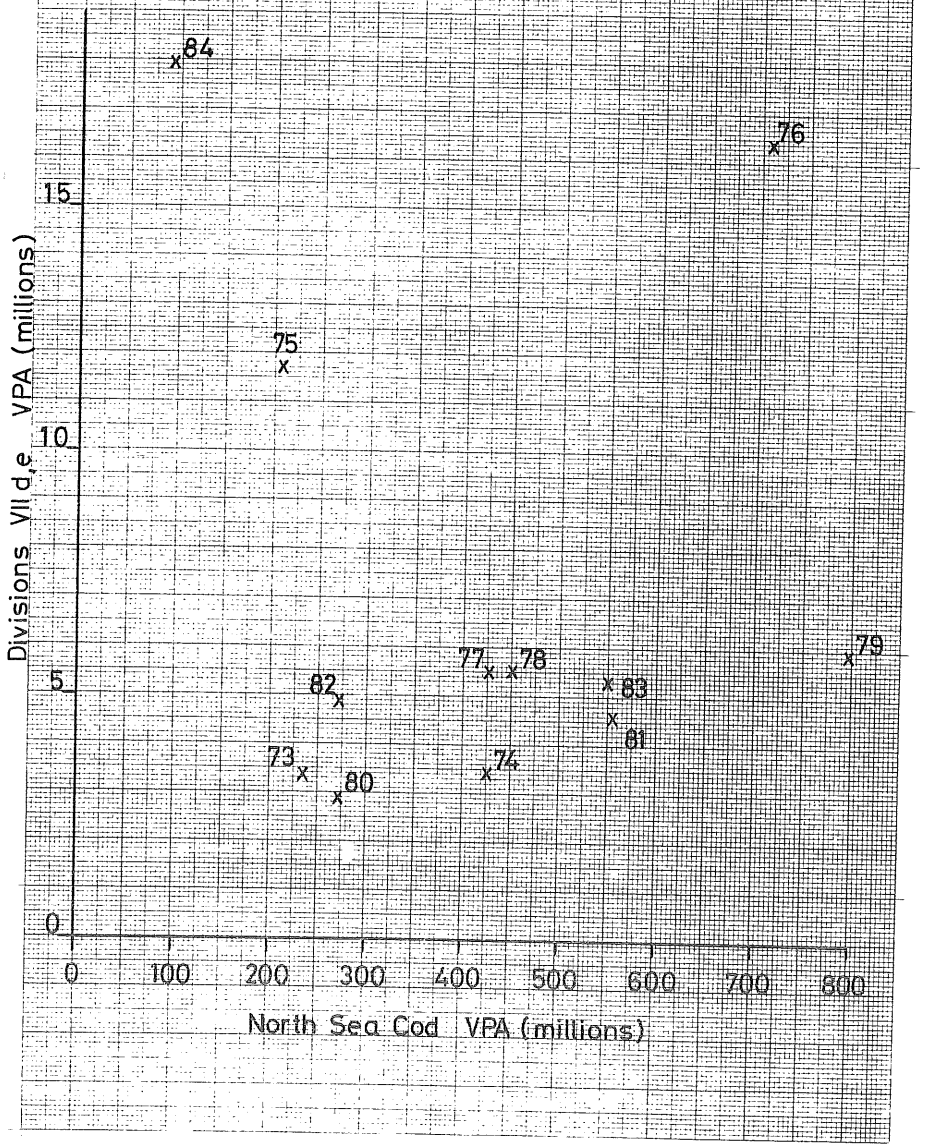


Figure 13.1A Catchability of North Sea Haddock at age 1.

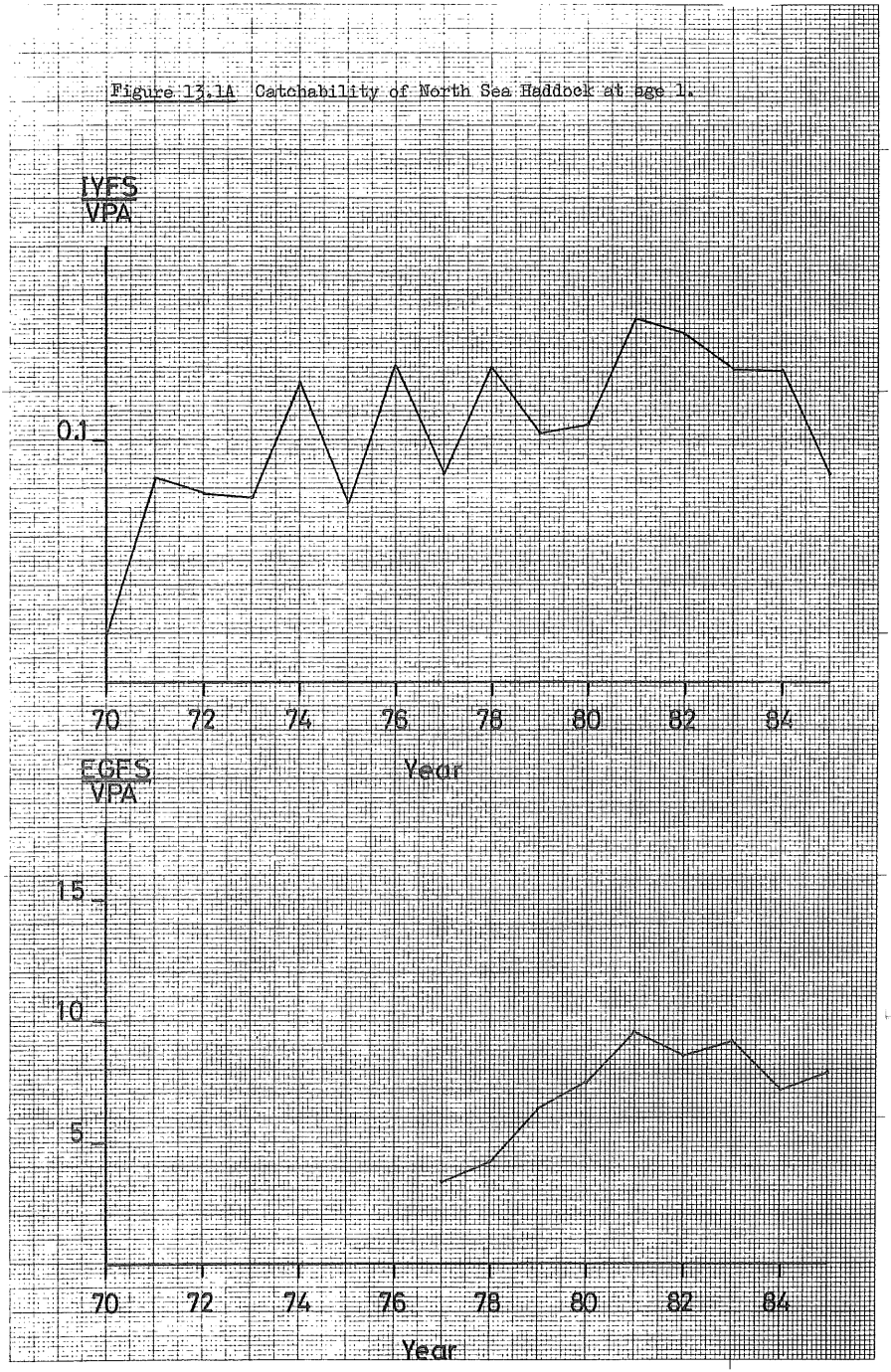
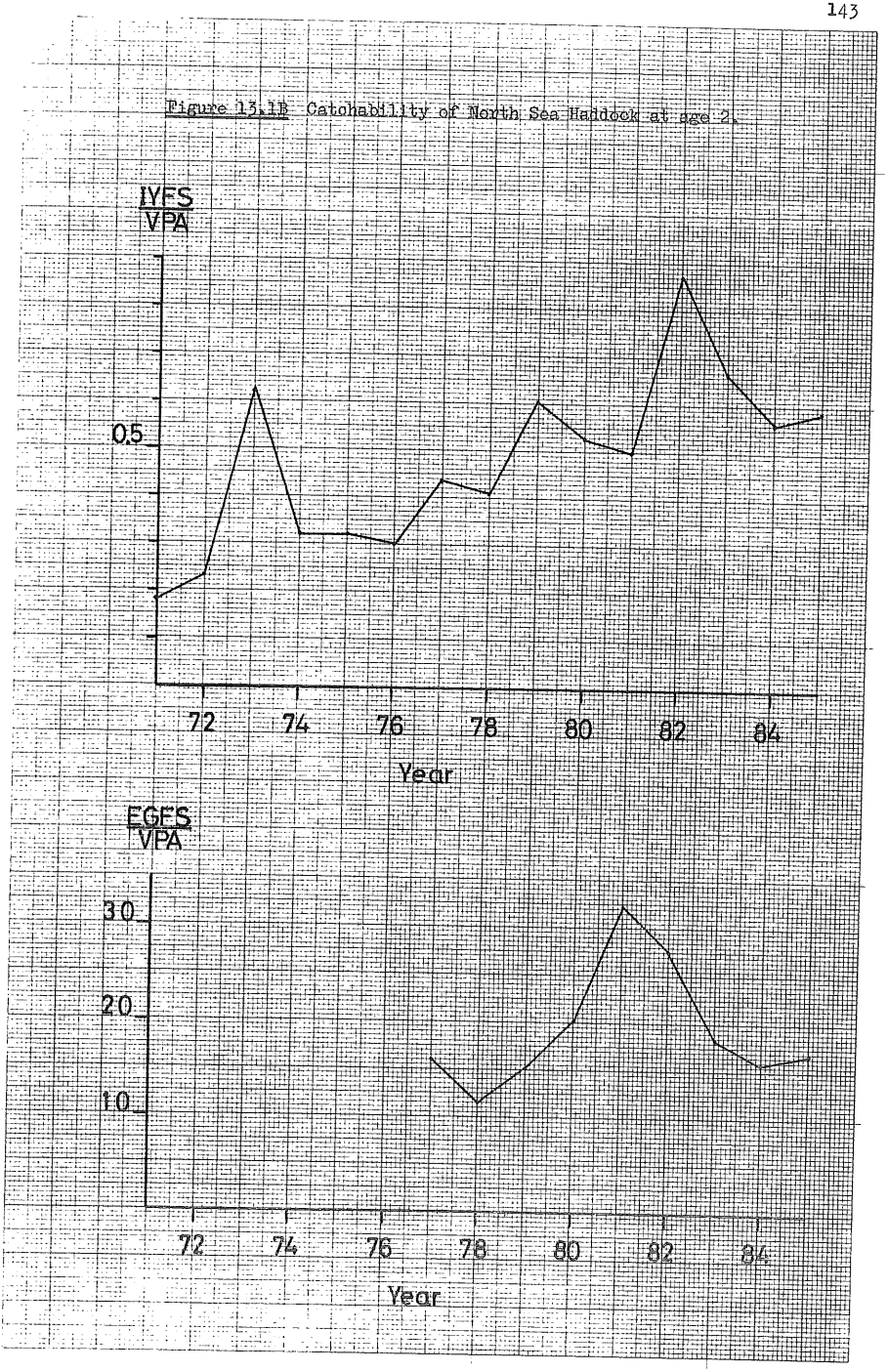


Figure 13.1B Catchability of North Sea Haddock at age 2.



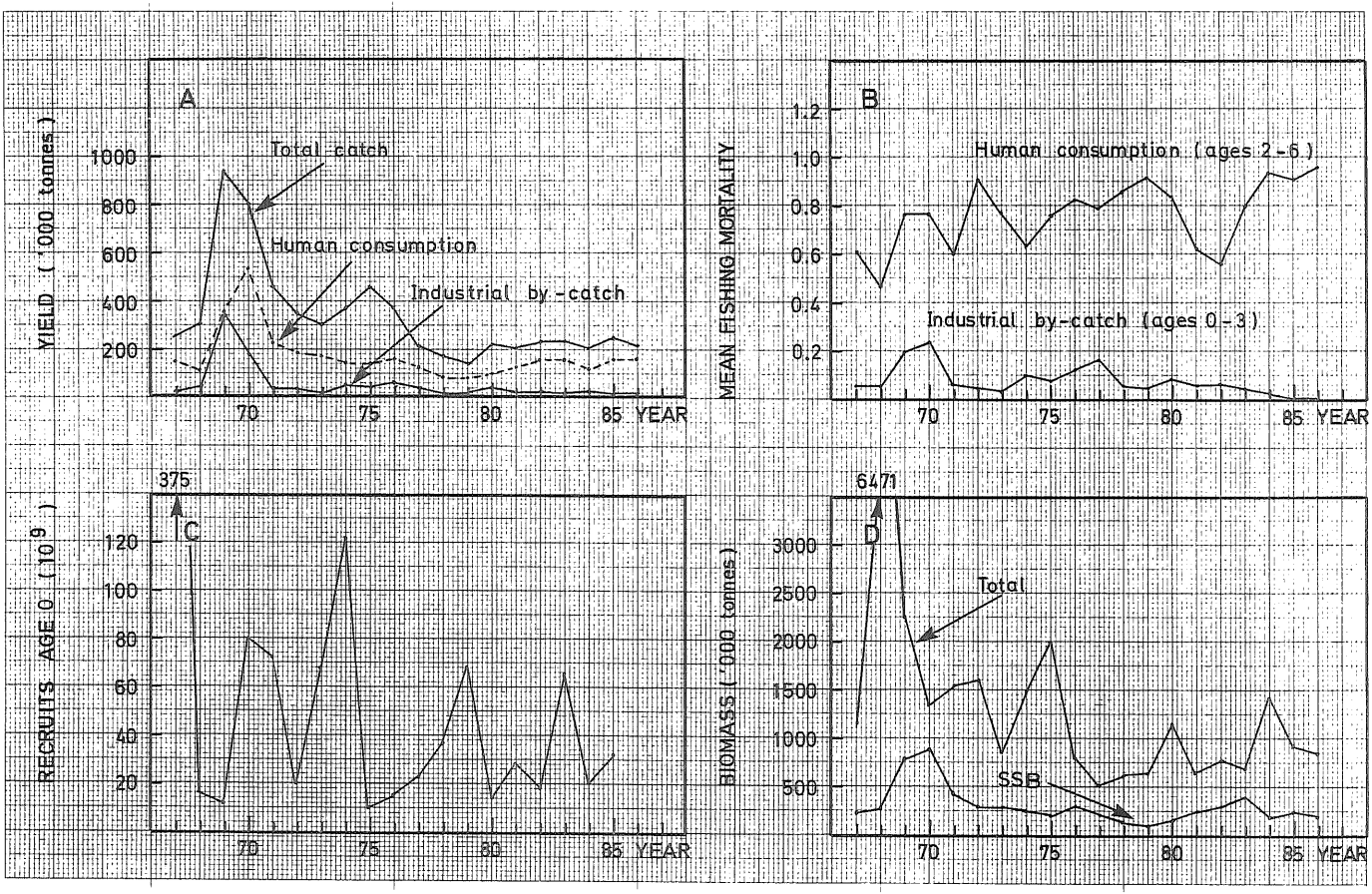


Figure 13.2 North Sea Haddock.

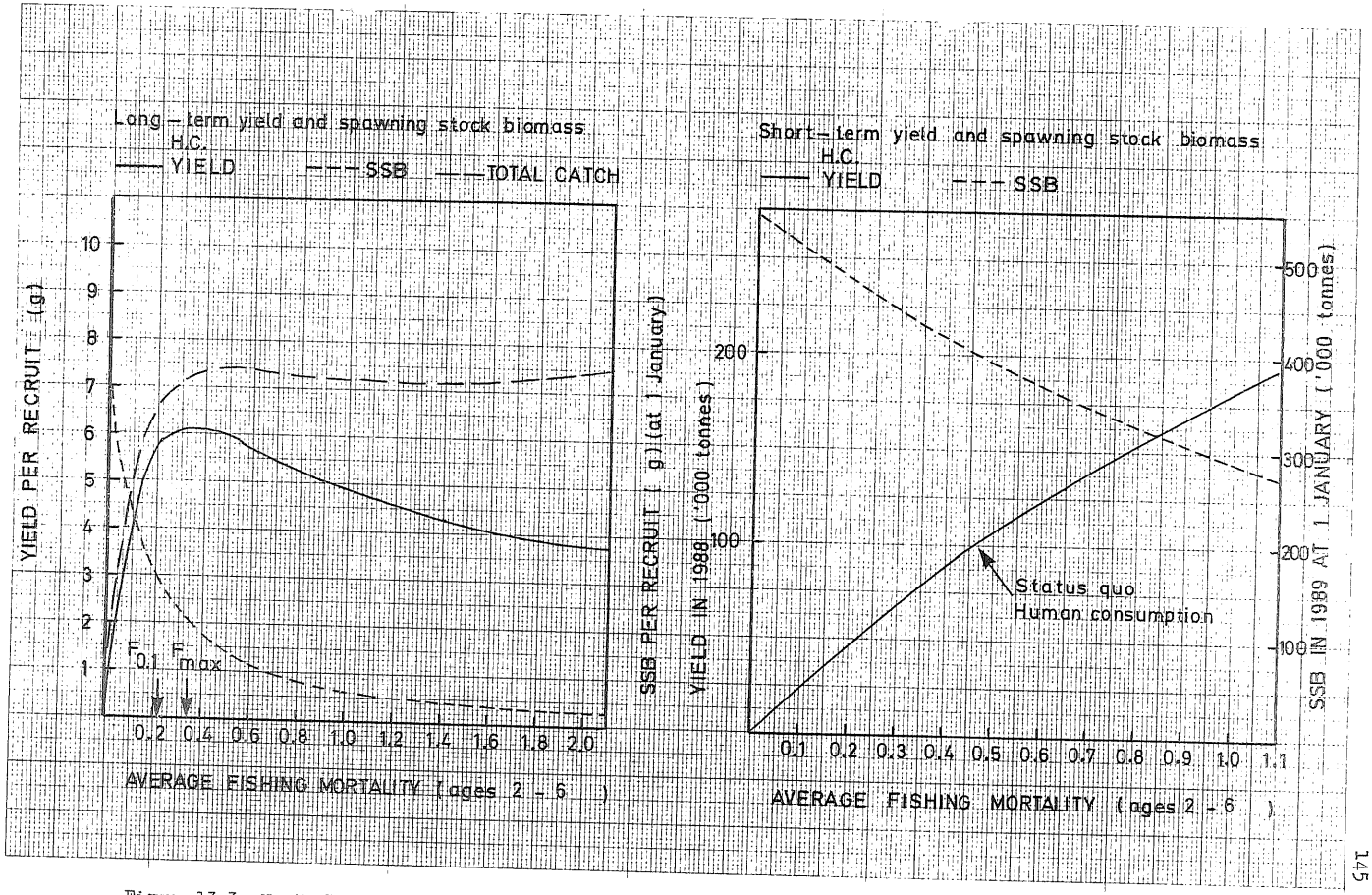


Figure 13.3 North Sea Haddock.

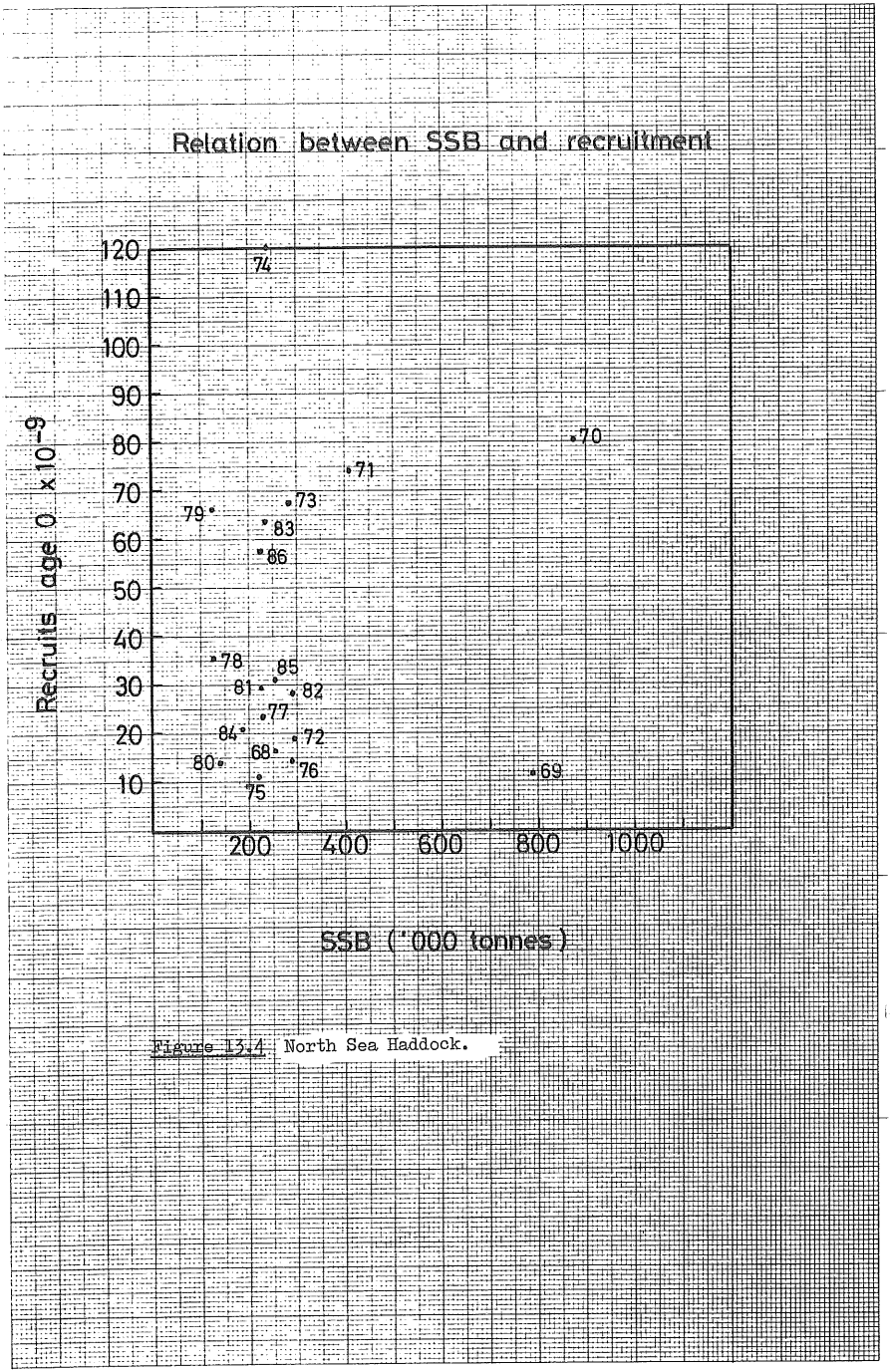


Figure 13.4 North Sea Haddock.

Figure 14.1A Relationship between IYFS index of age 1 Haddock and VPA at age 1 in Division VIa.

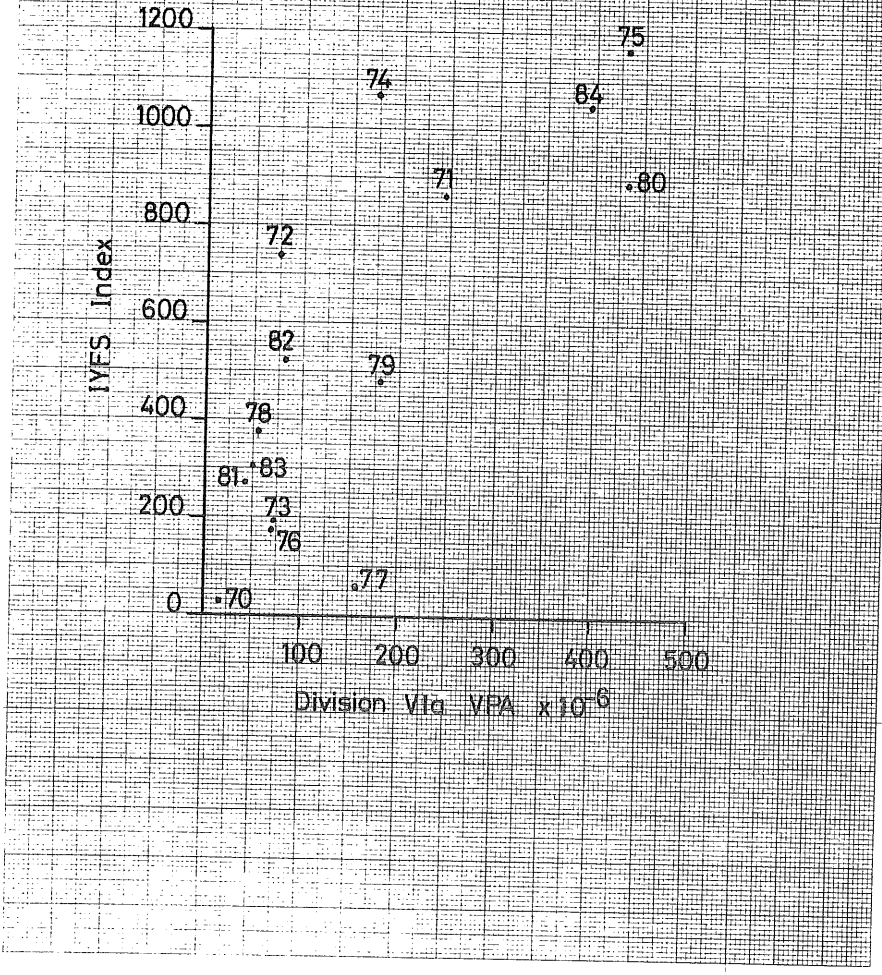
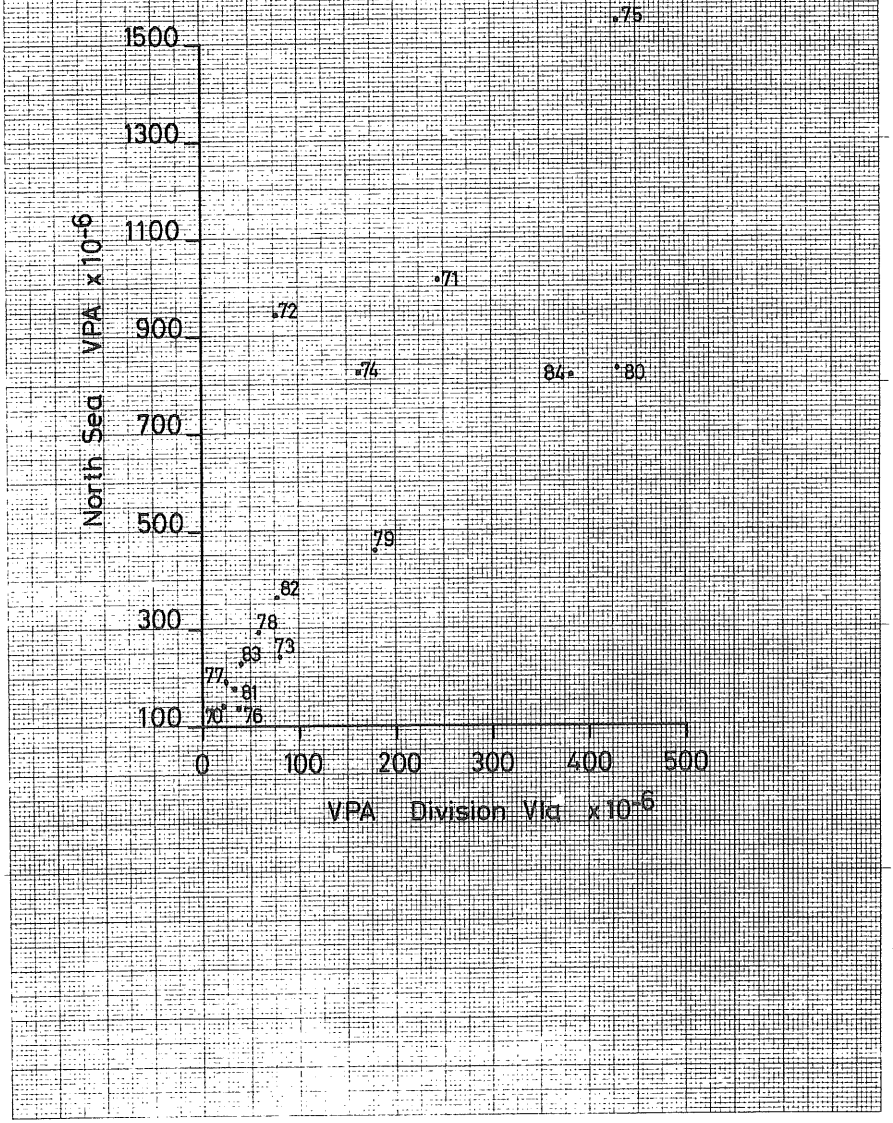


Figure 14.1B Relationship between North Sea Haddock VPA at age 1 and VPA at age 1 in Division VIa.



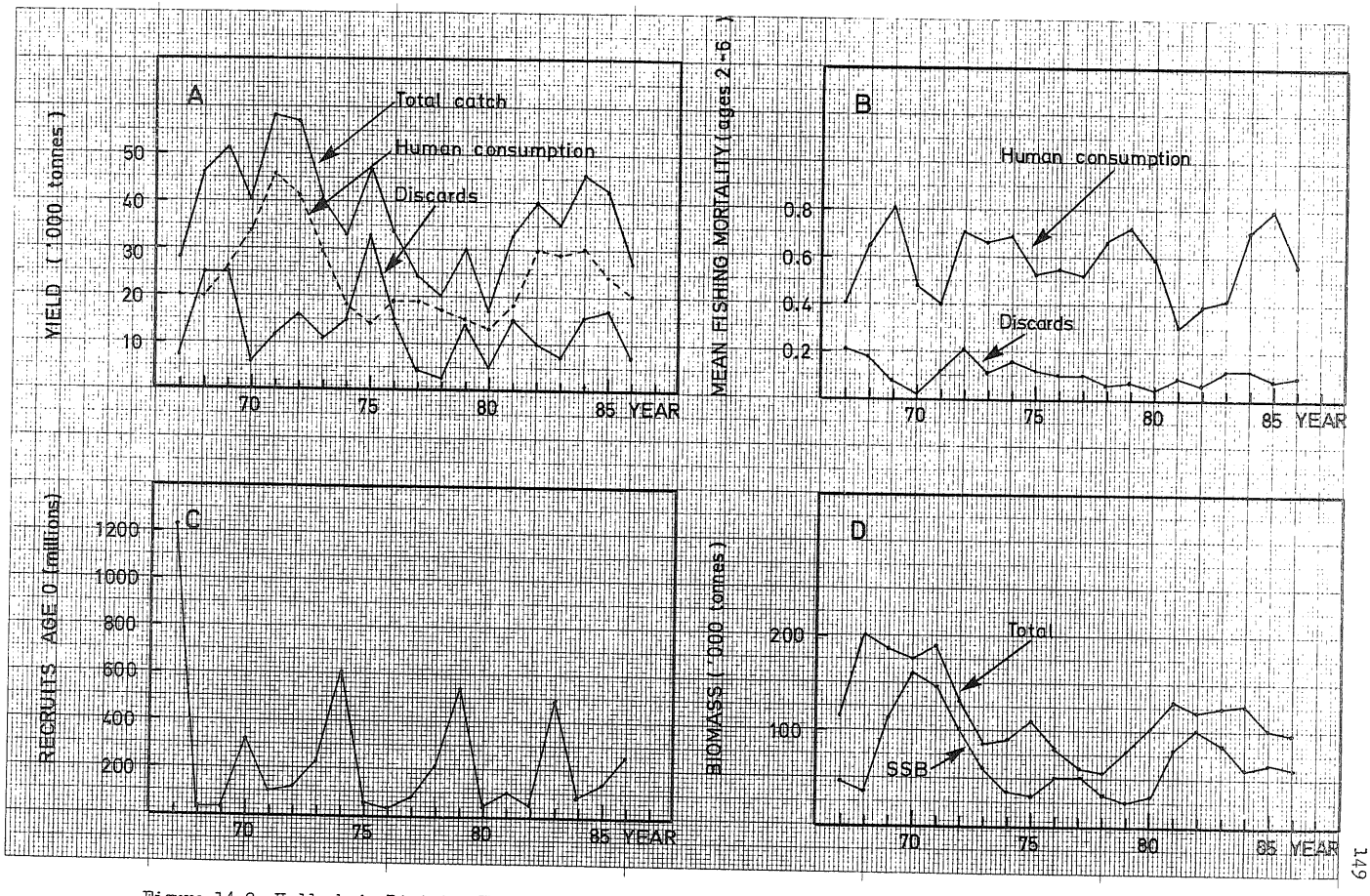


Figure 14.2 Haddock in Division VIa.

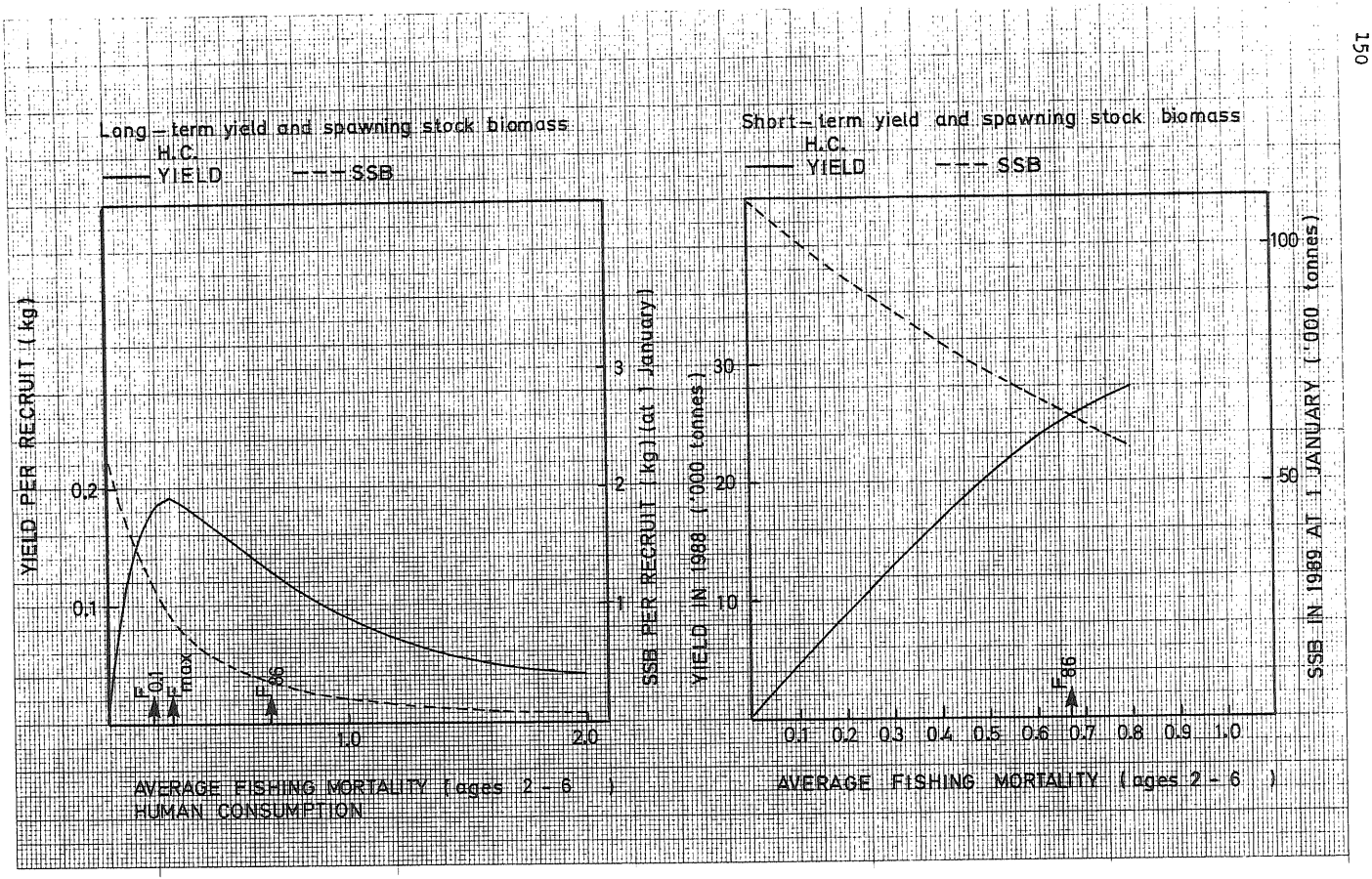


Figure 14.3 Haddock in Division VIa.

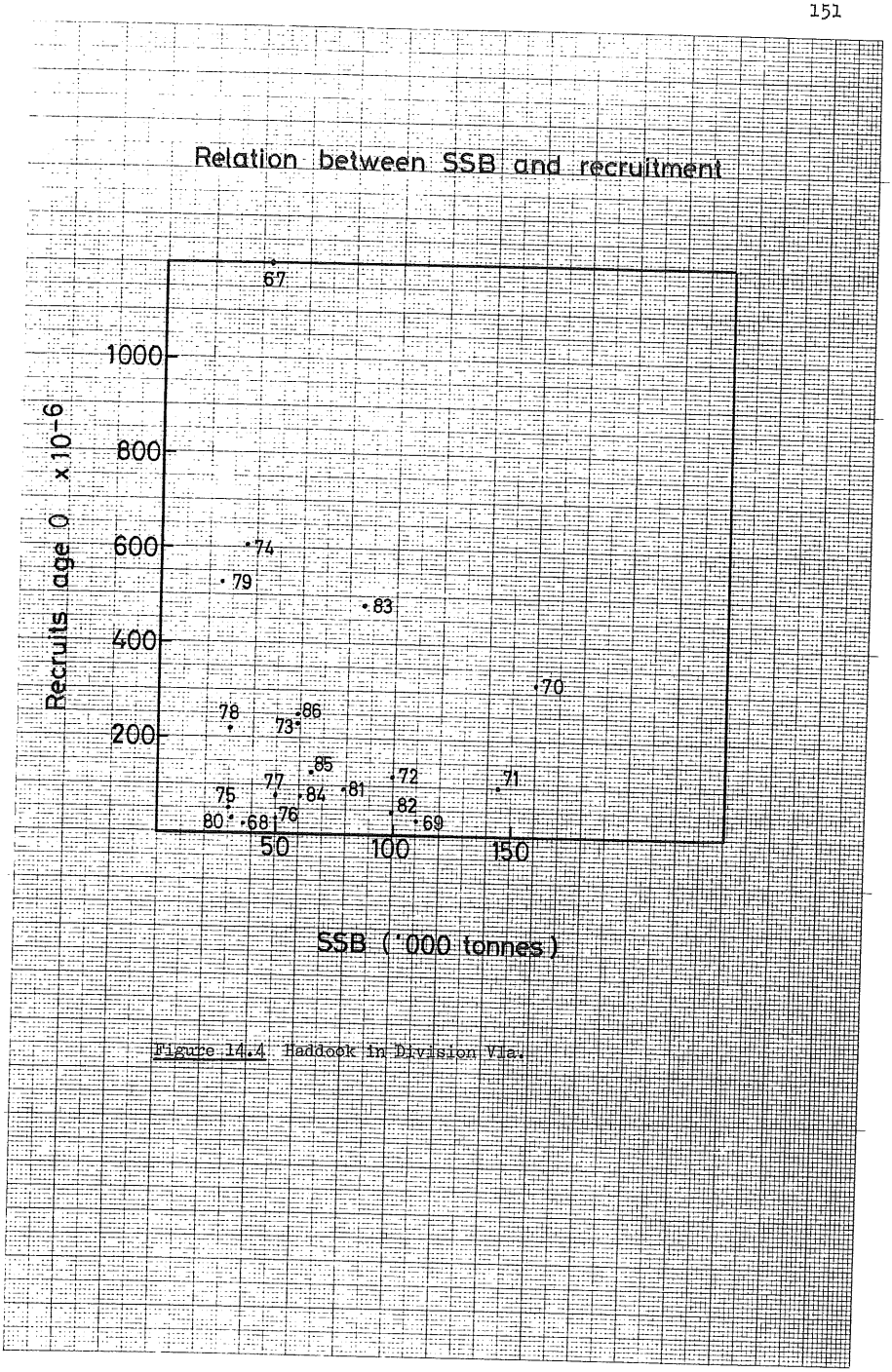
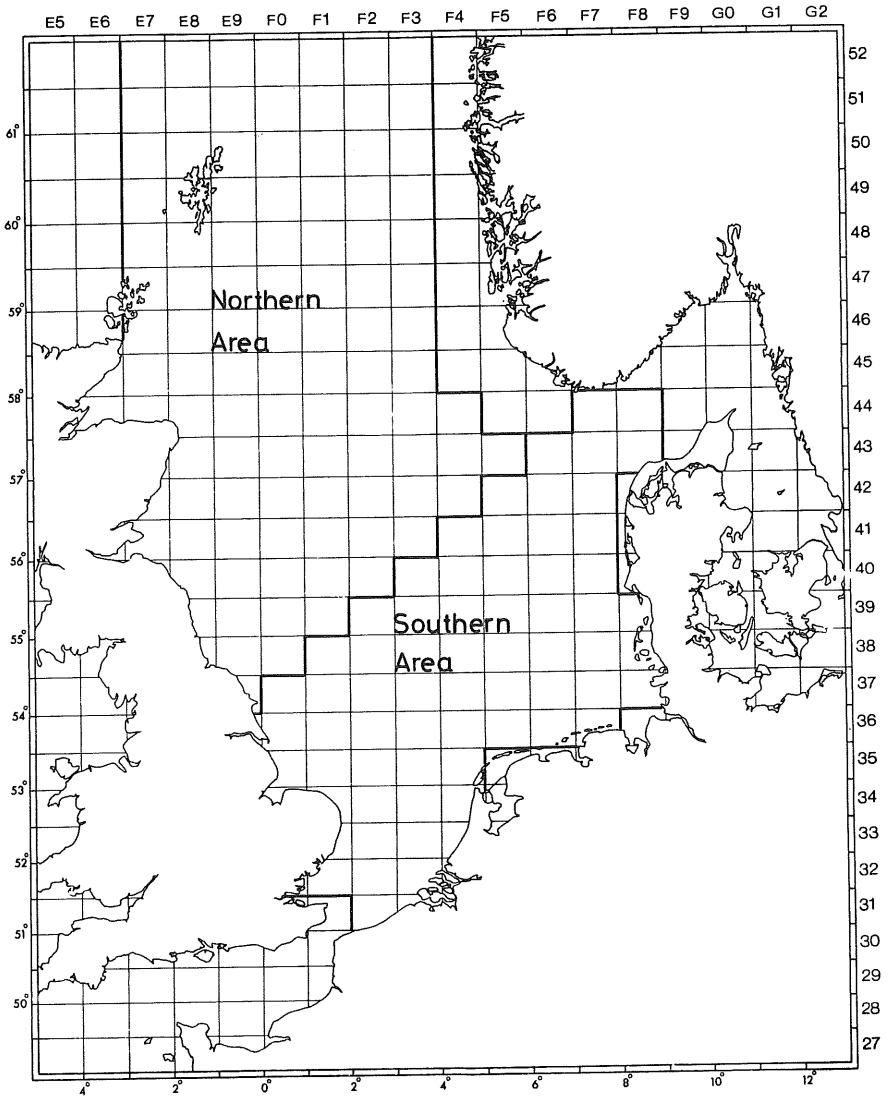


Figure 14.4 Haddock in Division VIa.

Figure 17.1 Areas used to calculate Northern and Southern recruitment indices for Whiting at age 1.



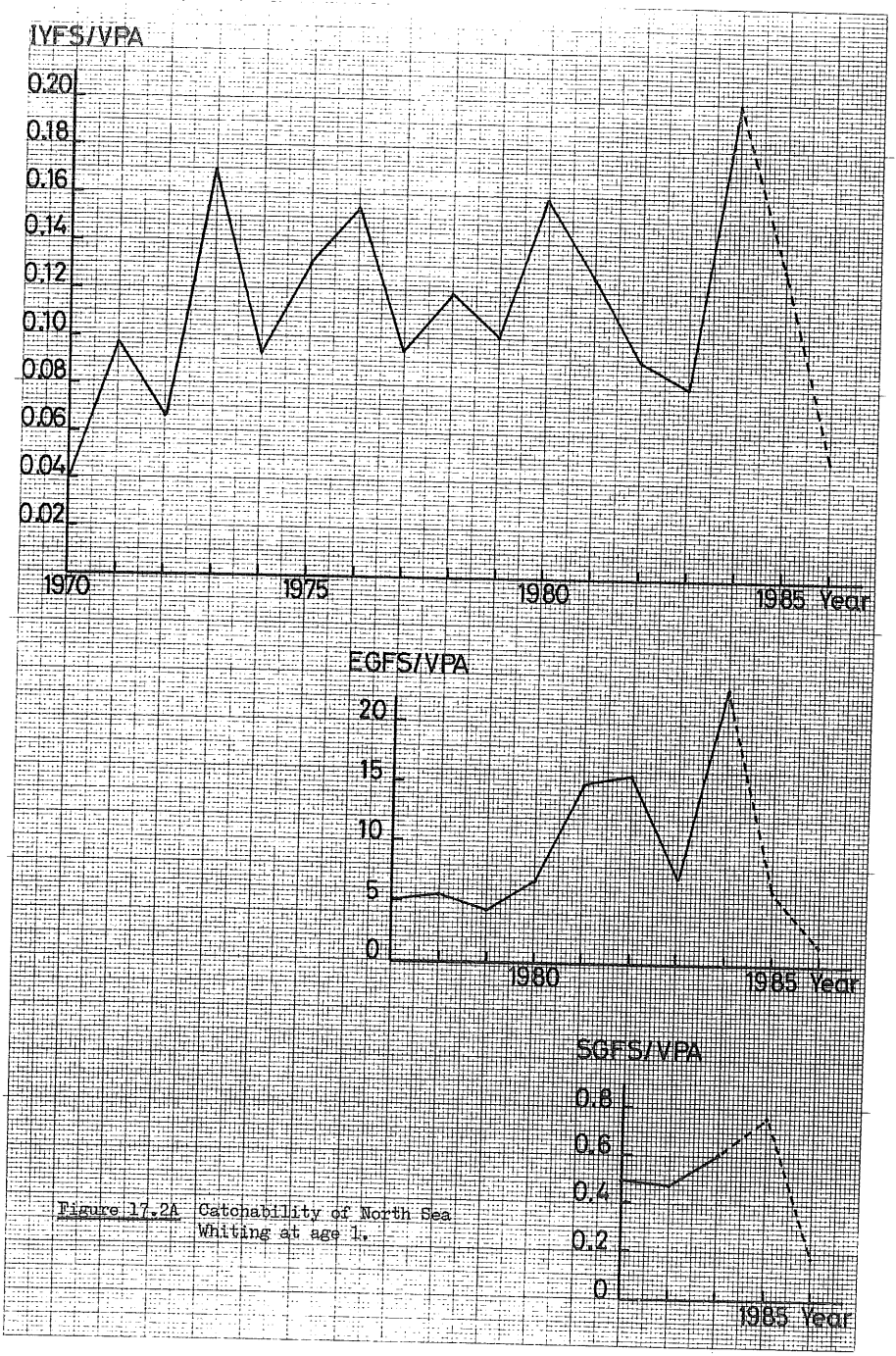
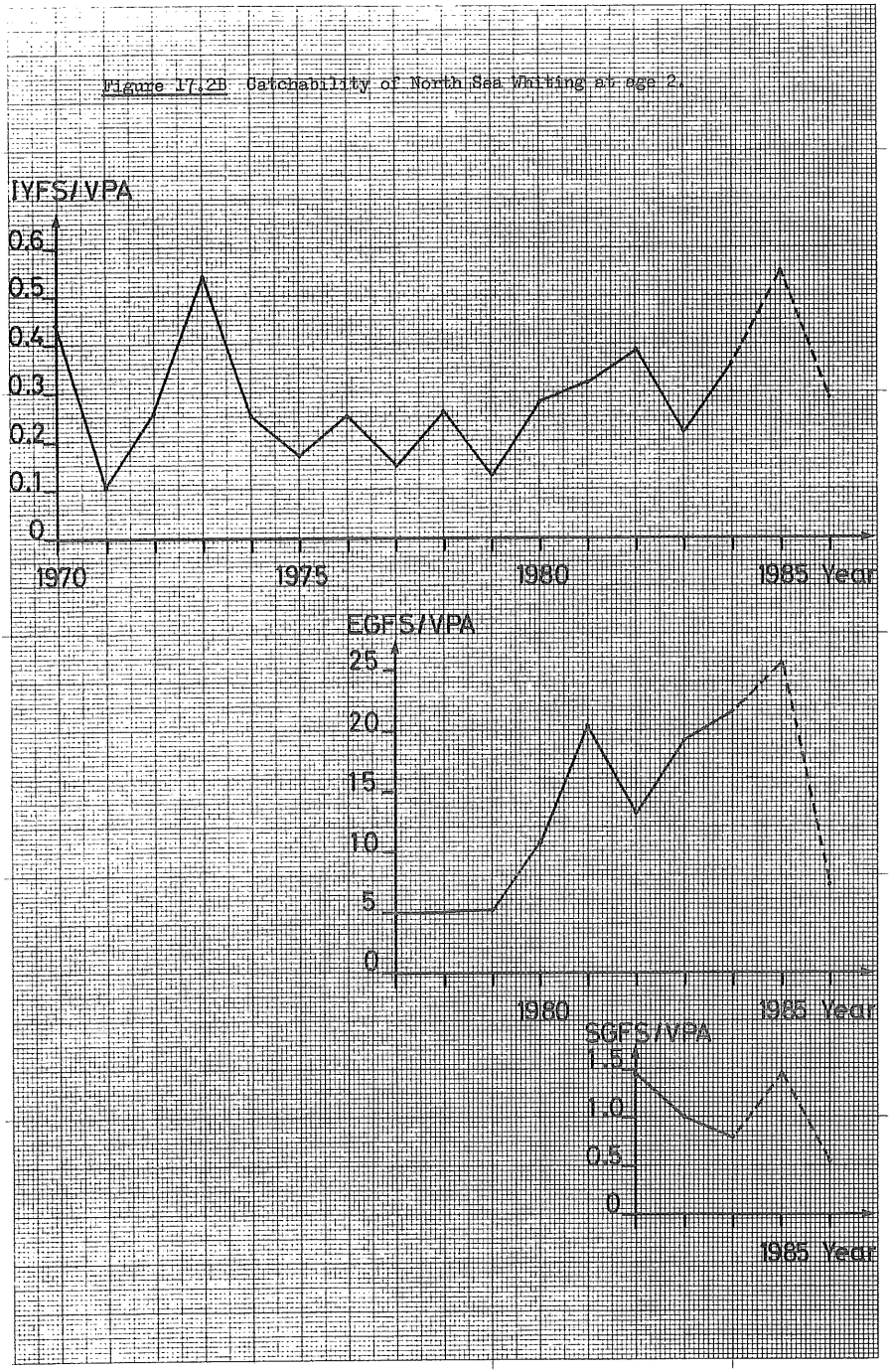


Figure 17.2A Catchability of North Sea Whiting at age 1.

Figure 17.2b Catchability of North Sea Whiting at age 2.



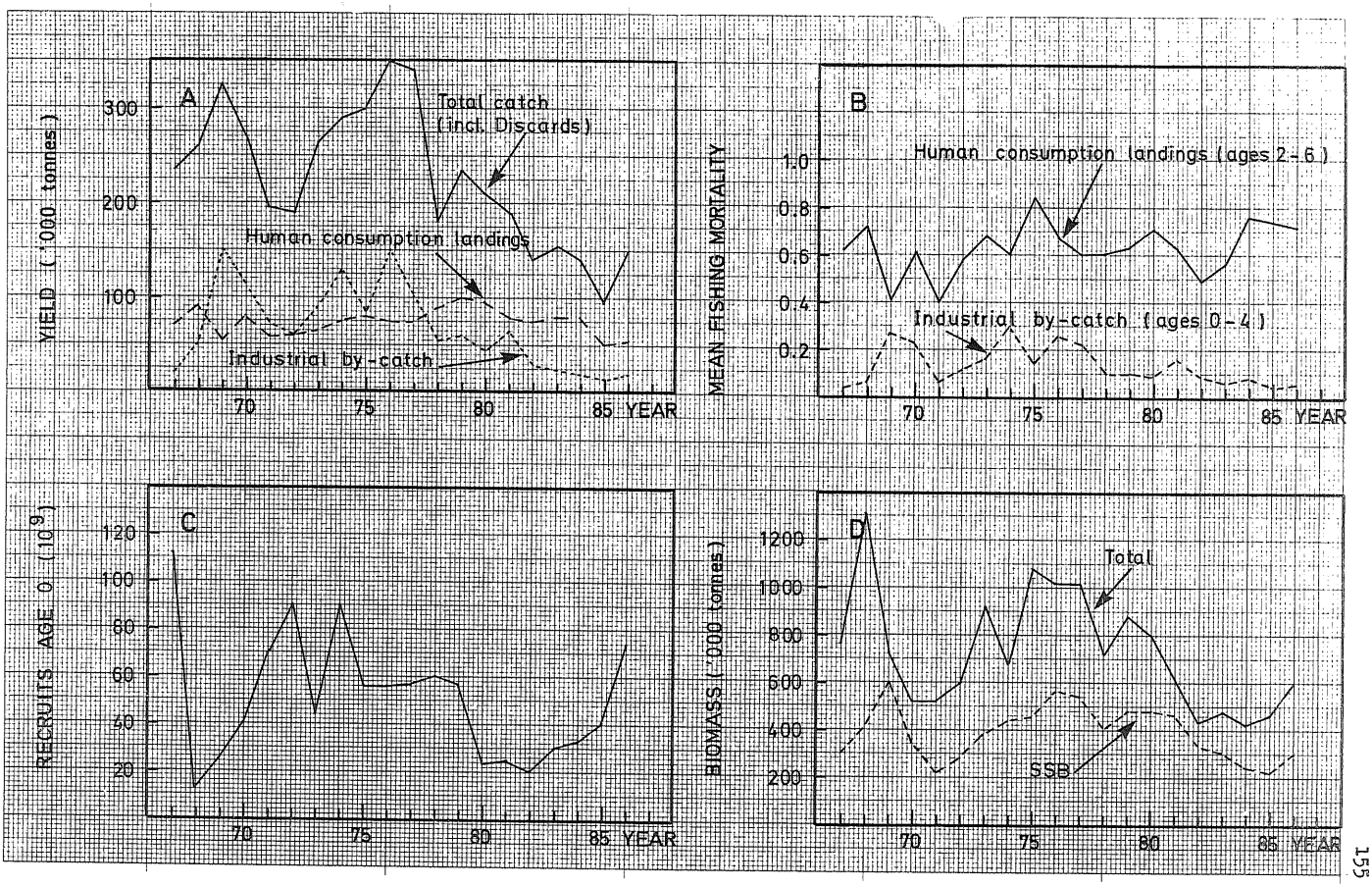


Figure 17.3 North Sea Whiting.

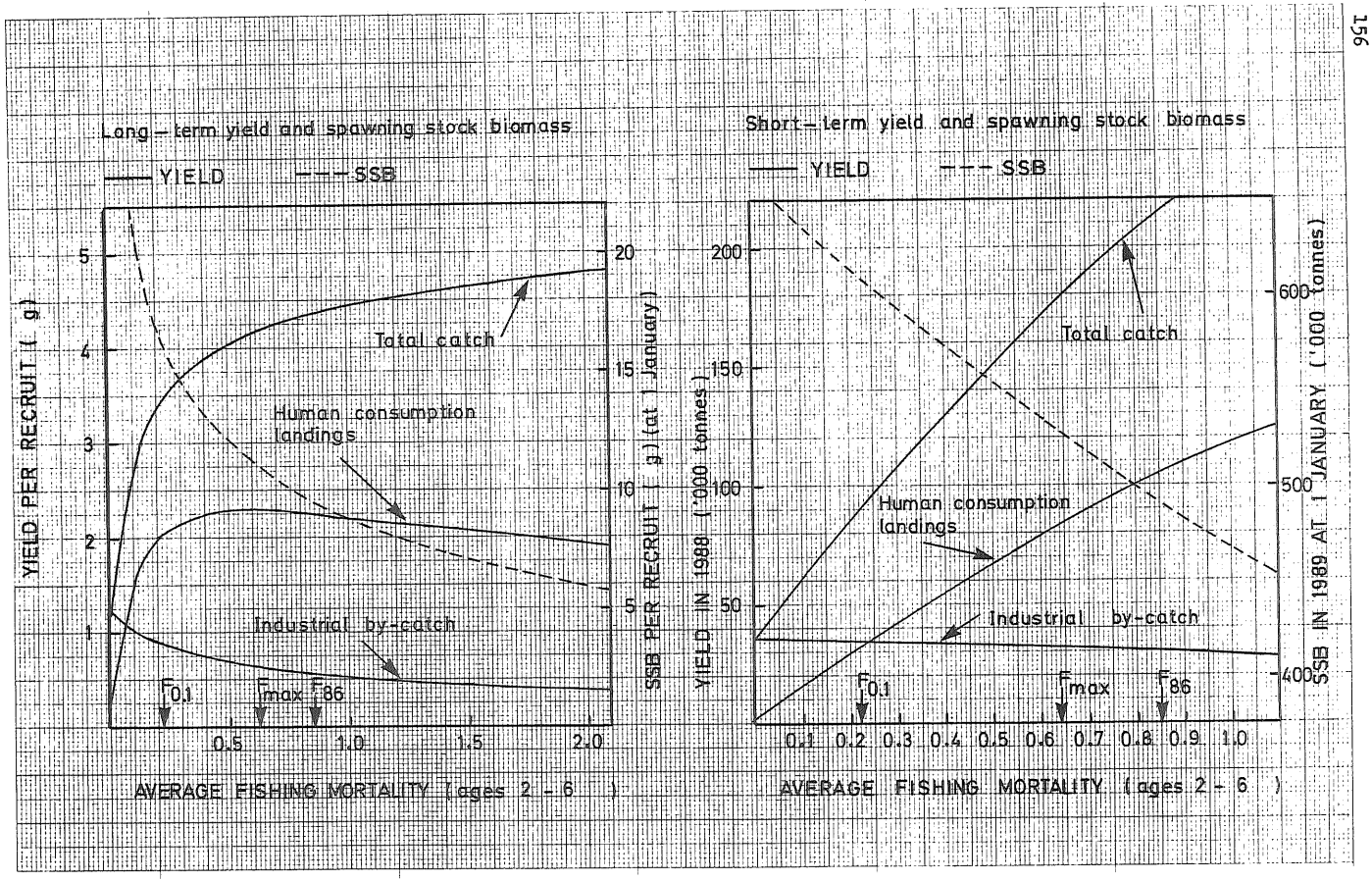


Figure 17.4 North Sea Whiting

Figure 17.5 North Sea Whiting.

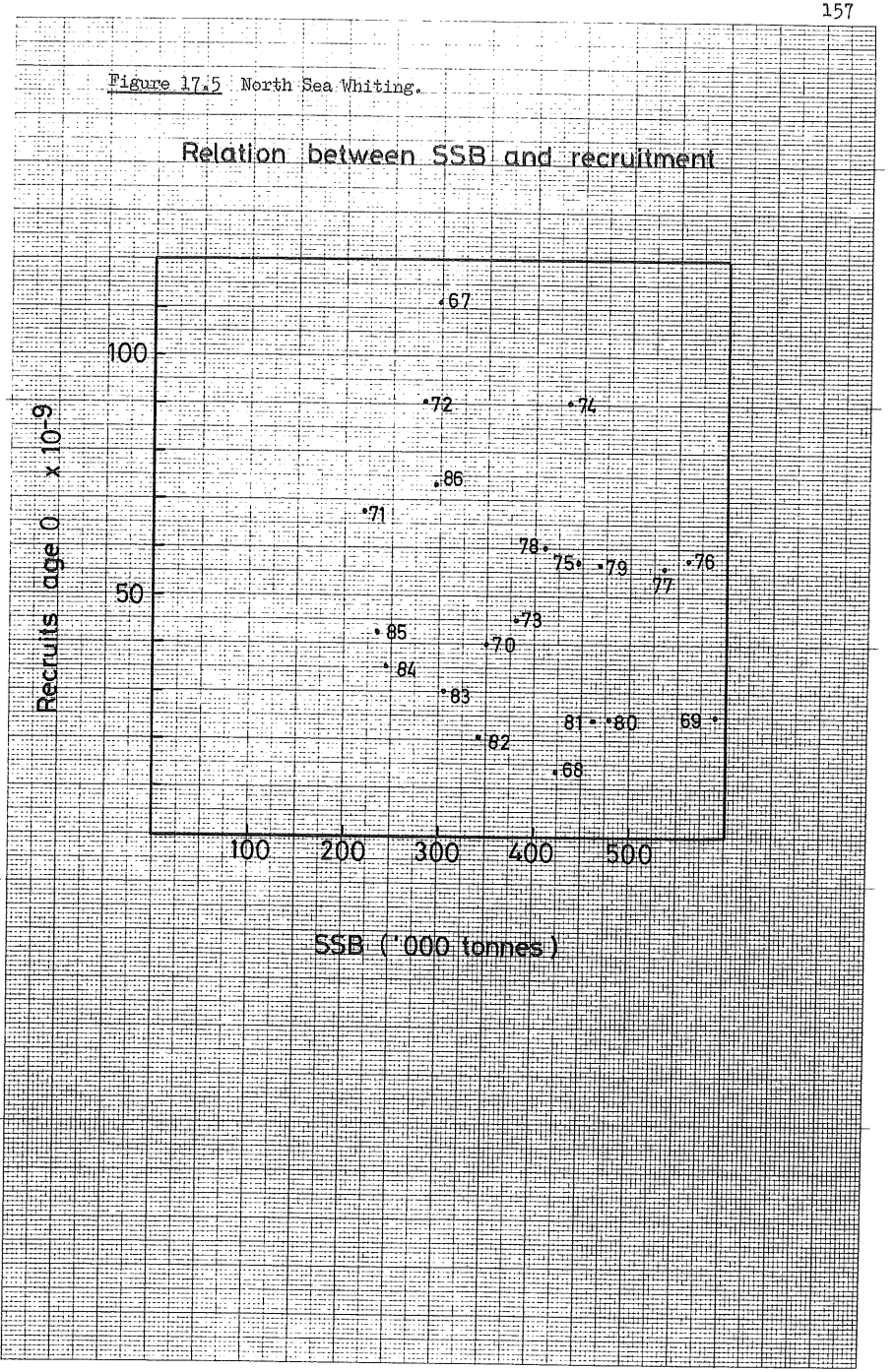
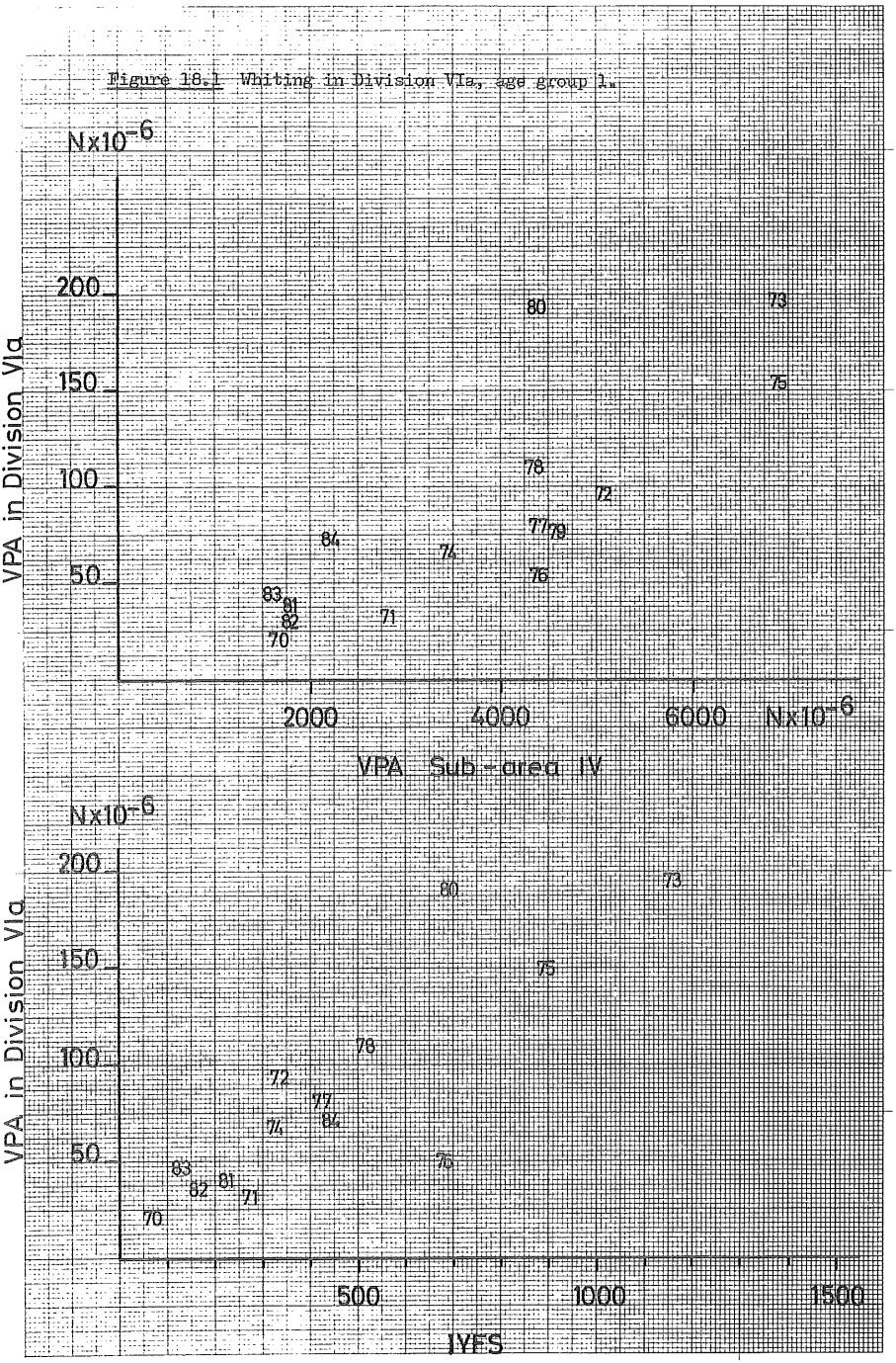


Figure 18.1 Whiting in Division VIa, age group 1.



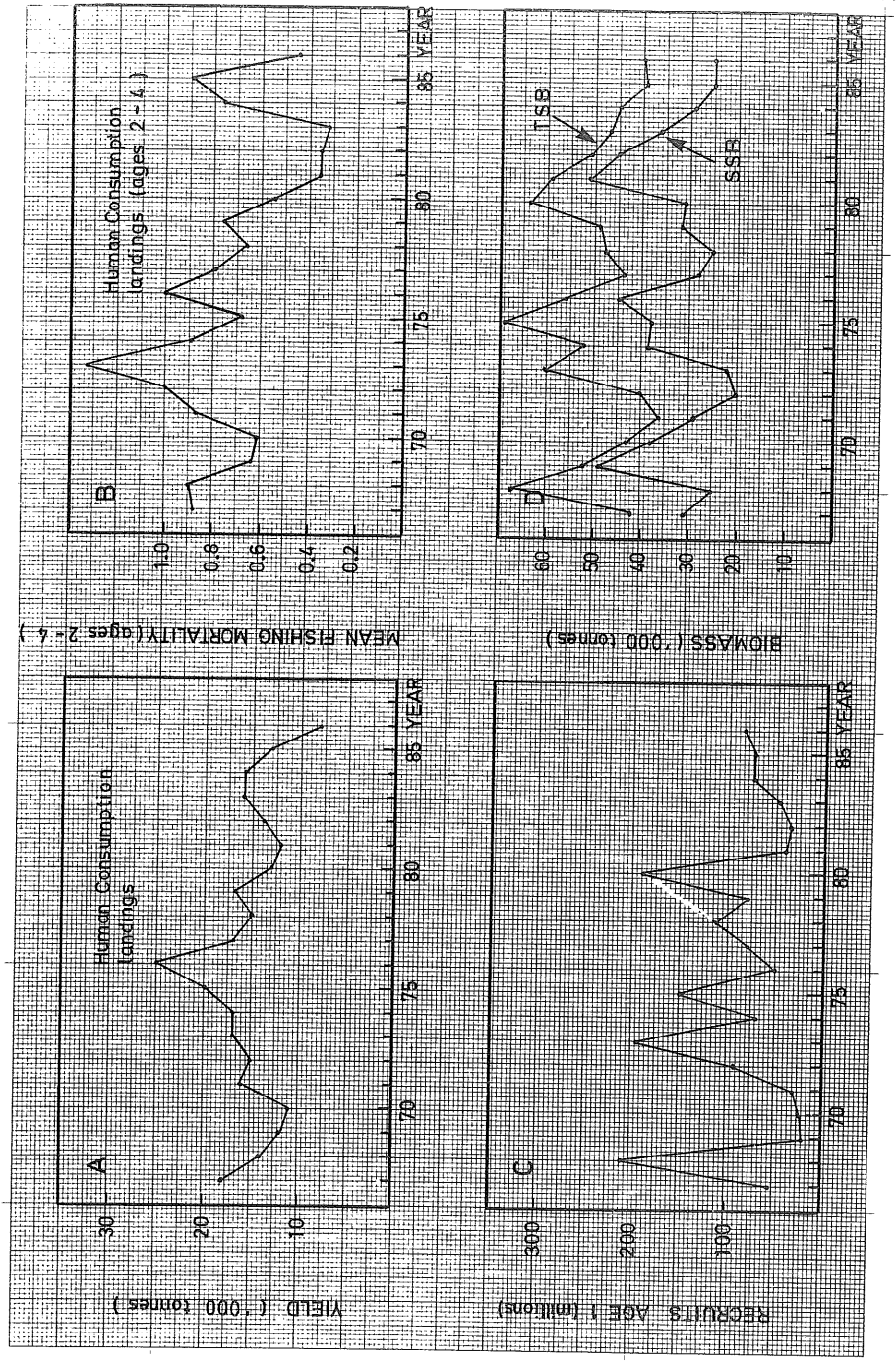


Figure 18.2 Whiting in Division VIa (West of Scotland).

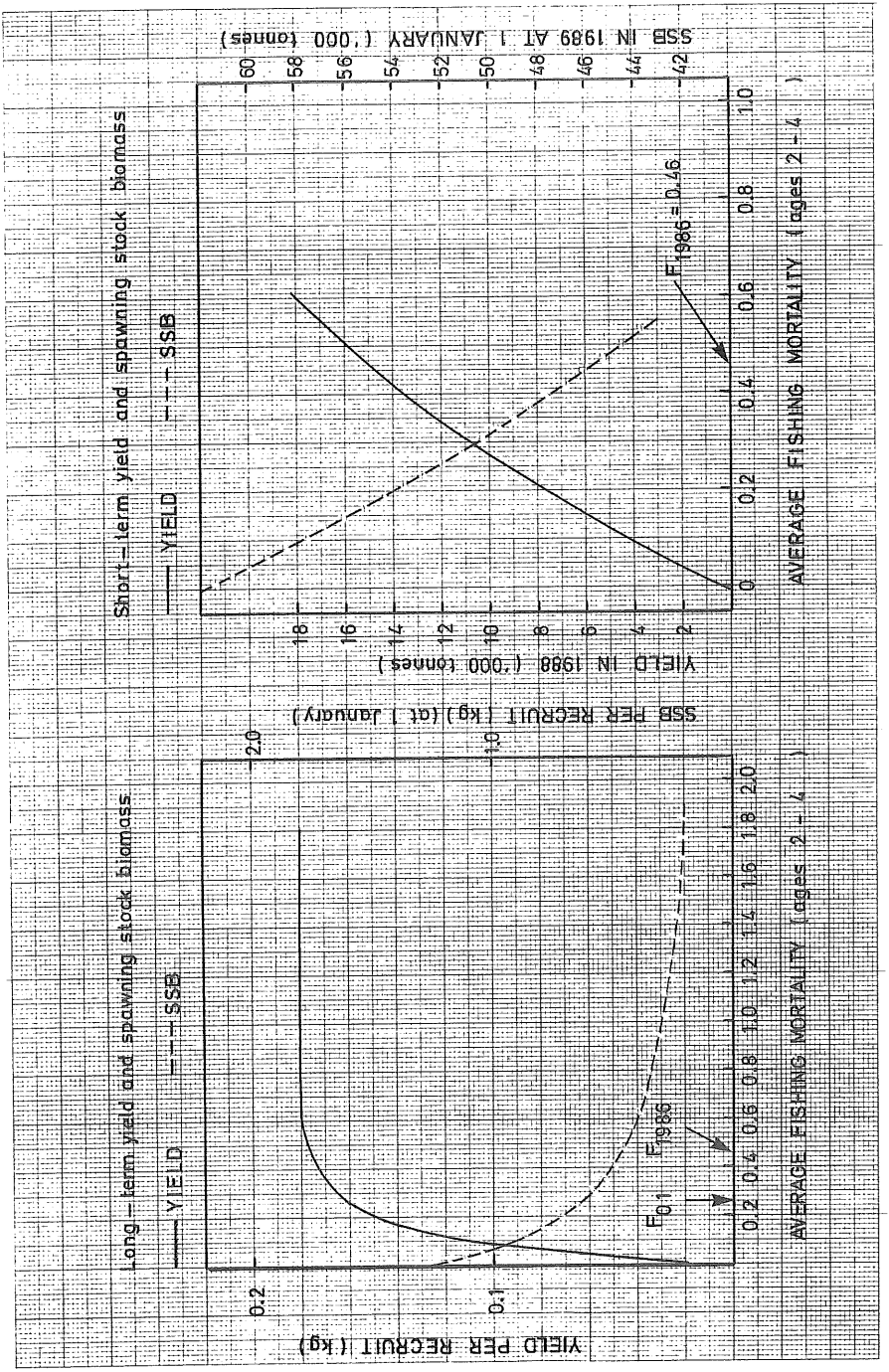
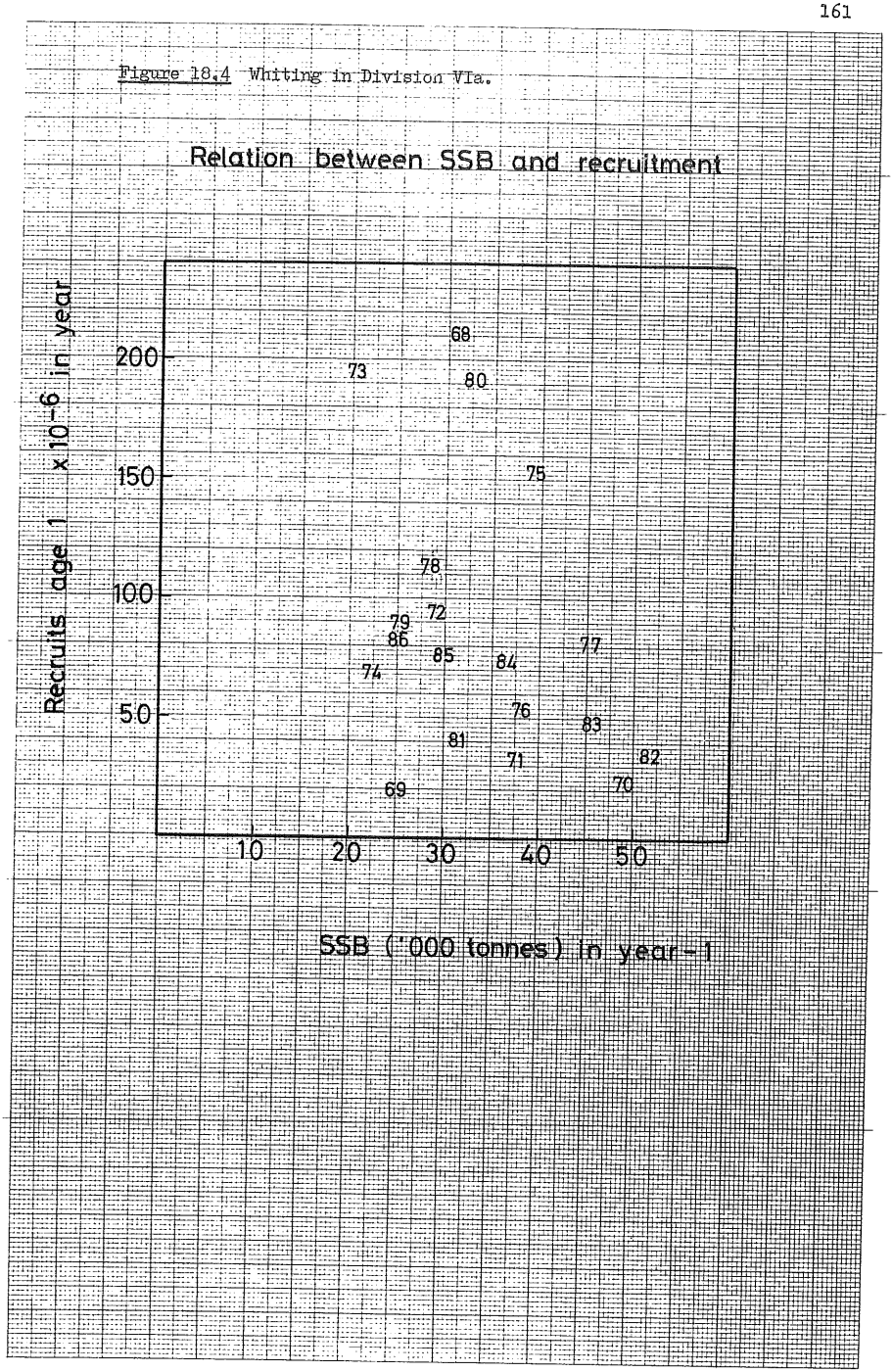


Figure 18.3 Whiting in Division VIa.

Figure 18.4 Whiting in Division VIa.



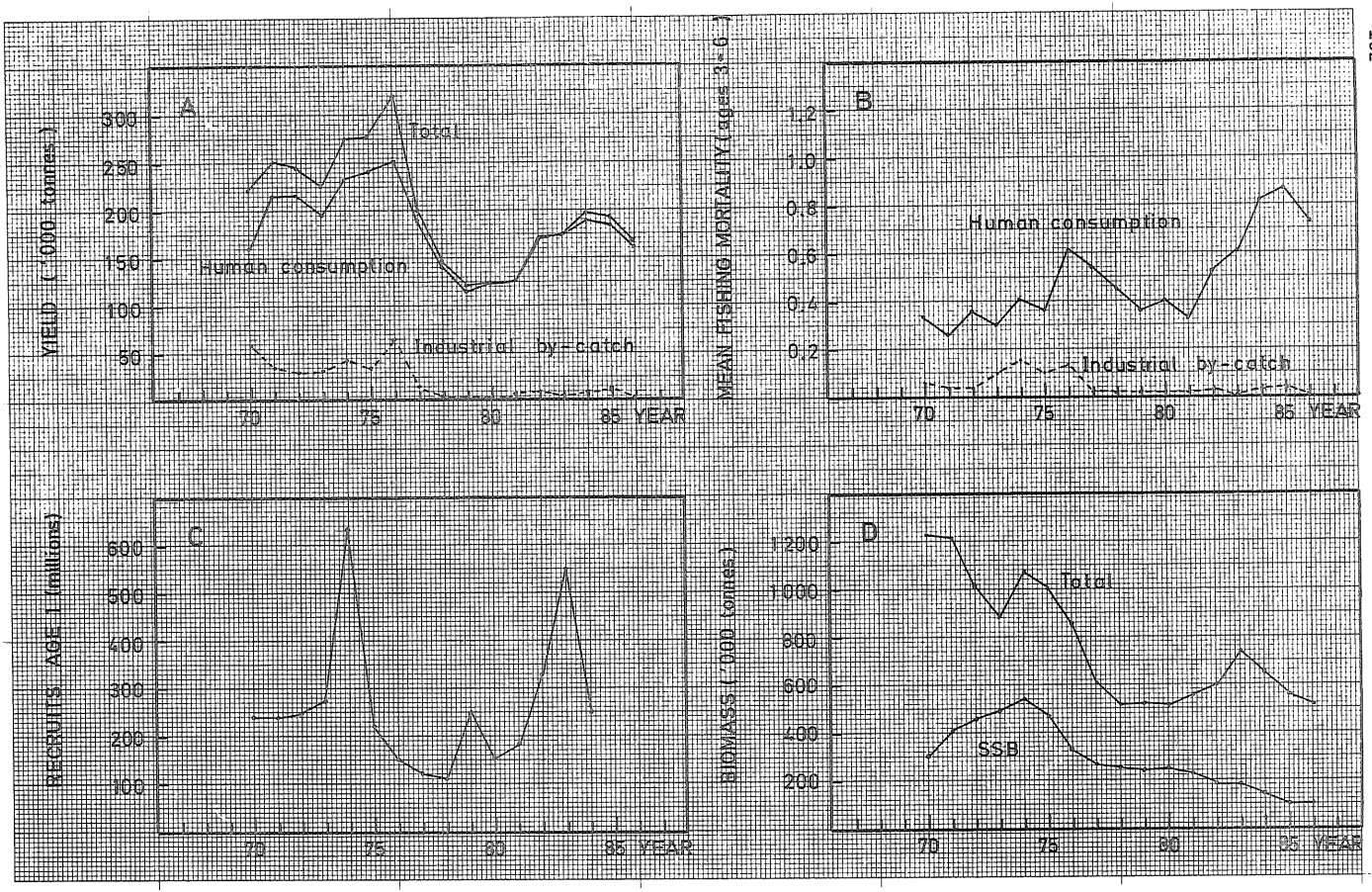


Figure 21.1 North Sea Saithe.

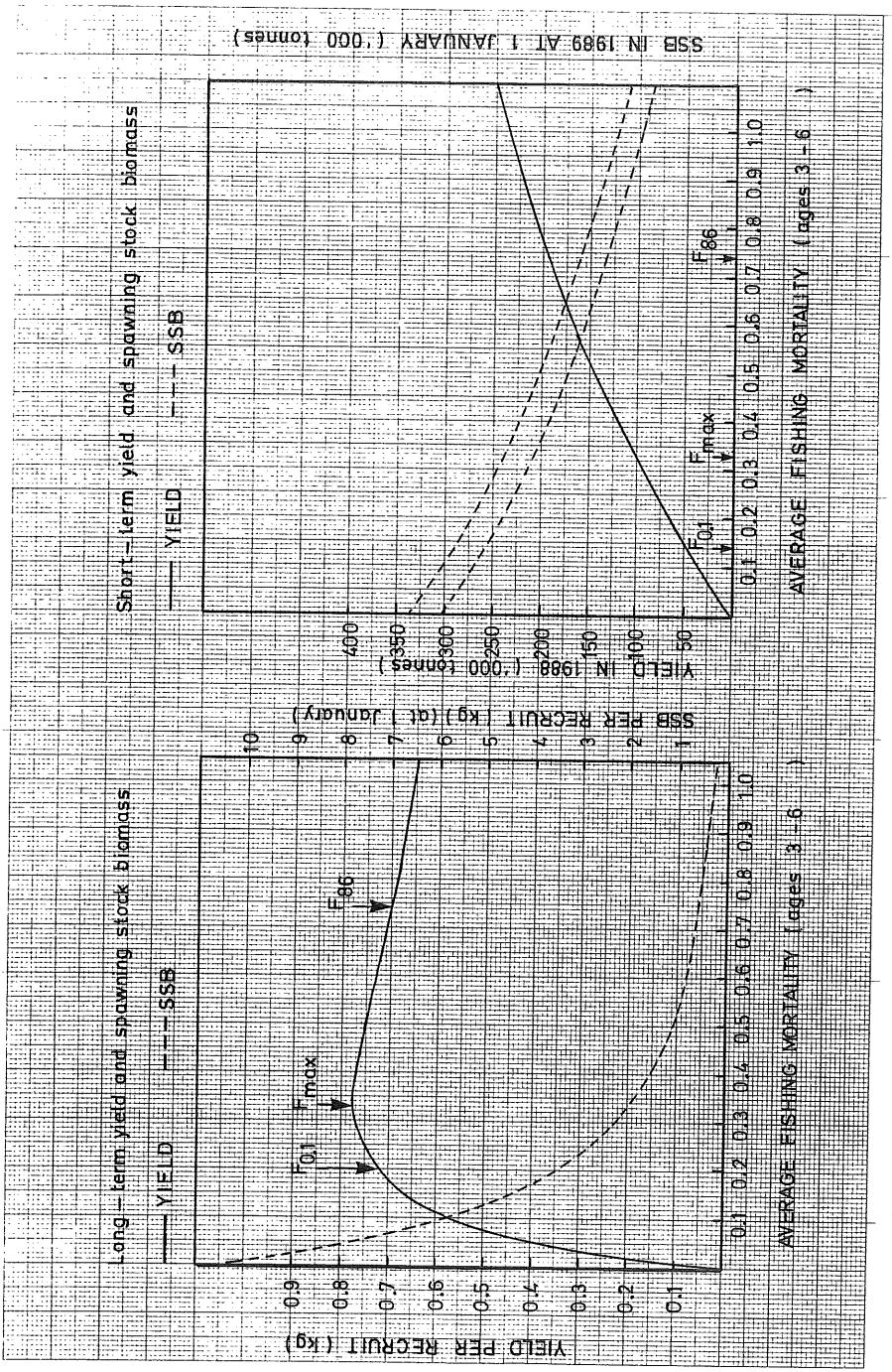
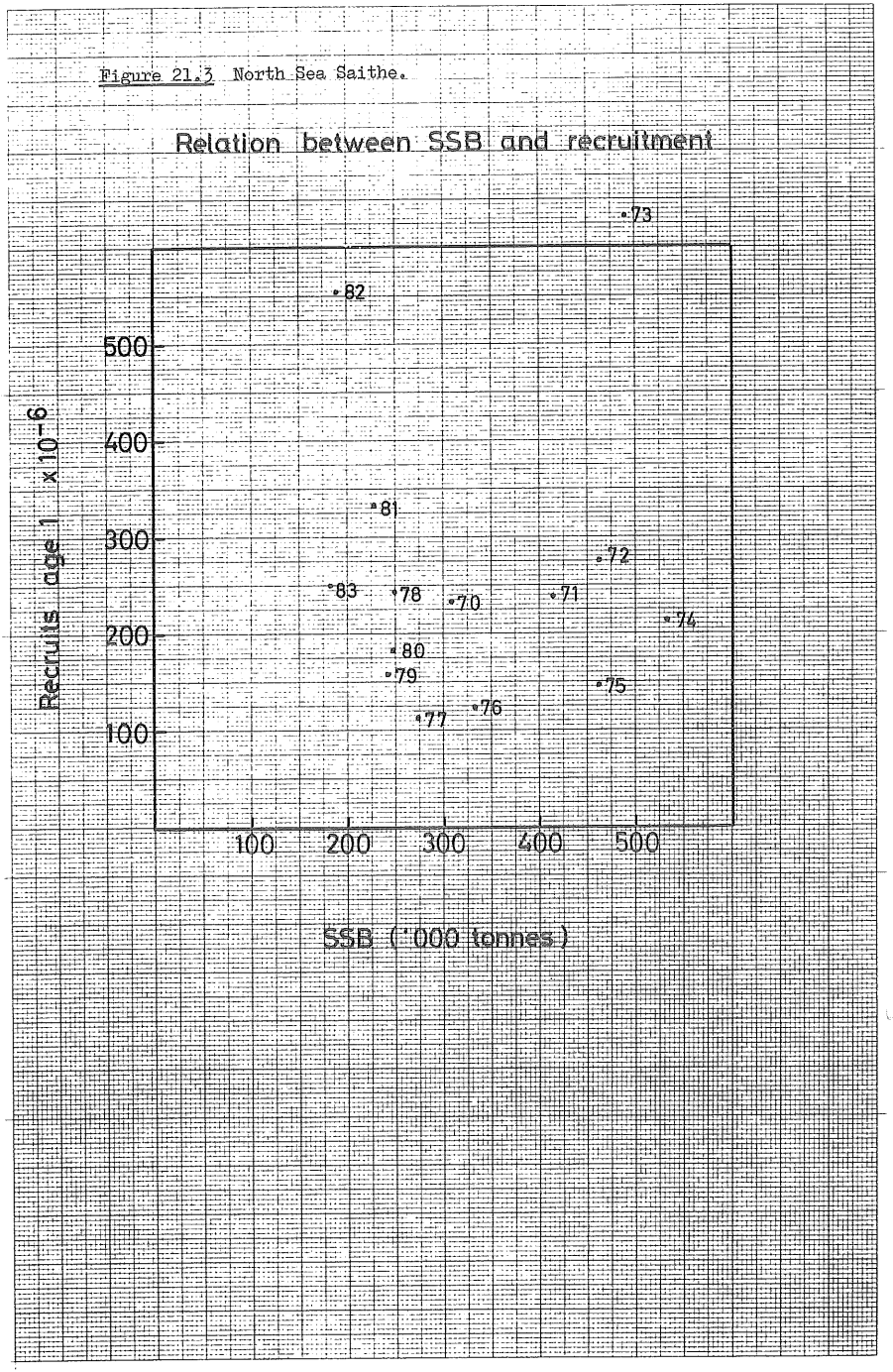


Figure 21.2 North Sea Saithe.

Figure 21.3 North Sea Saithe.



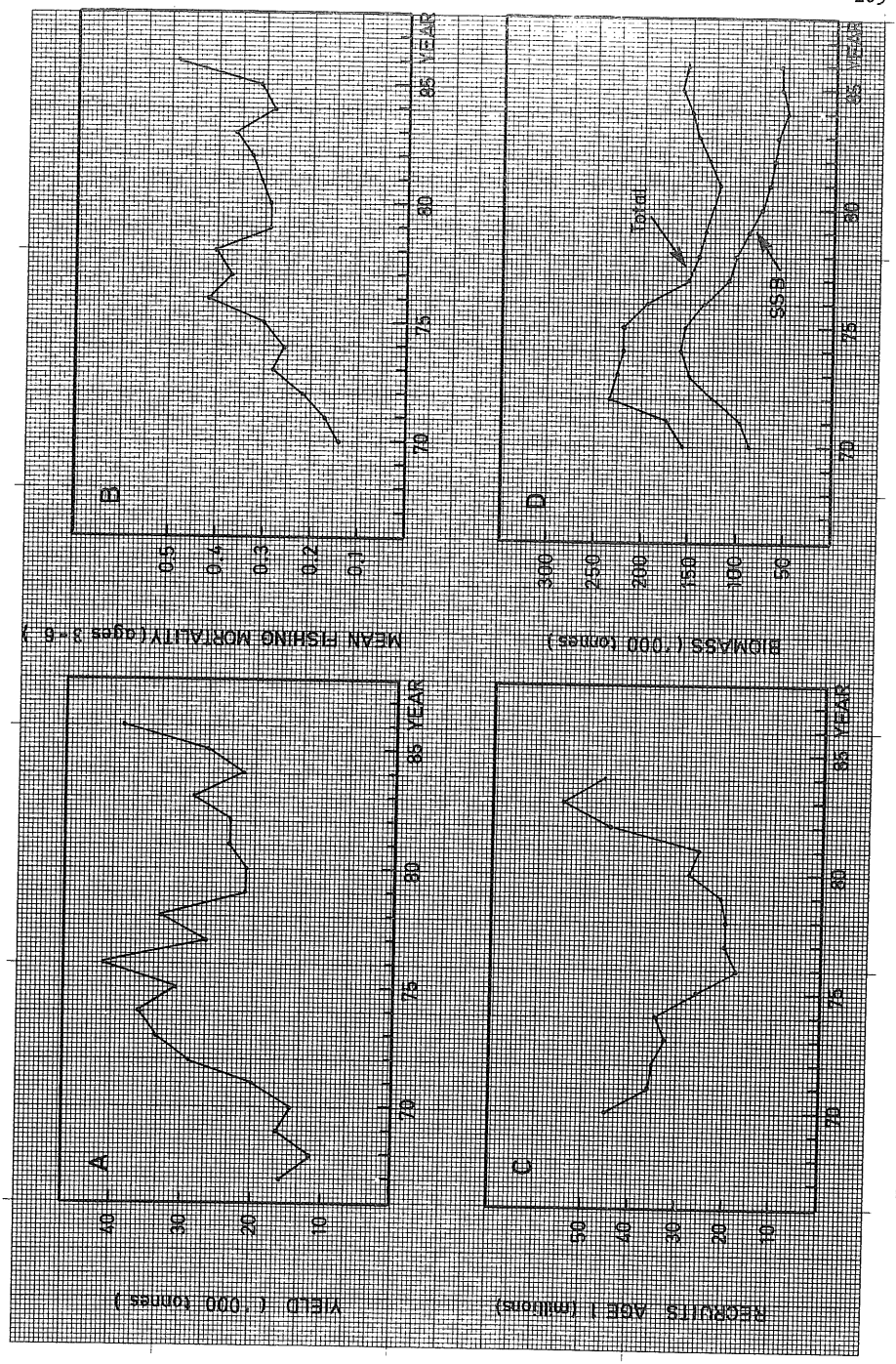


Figure 22.1 Saithe in Sub-area VI.

Figure 22.2 Saithe in Sub-area VI.

Figure 22.3 Saithe in Sub-area VI.

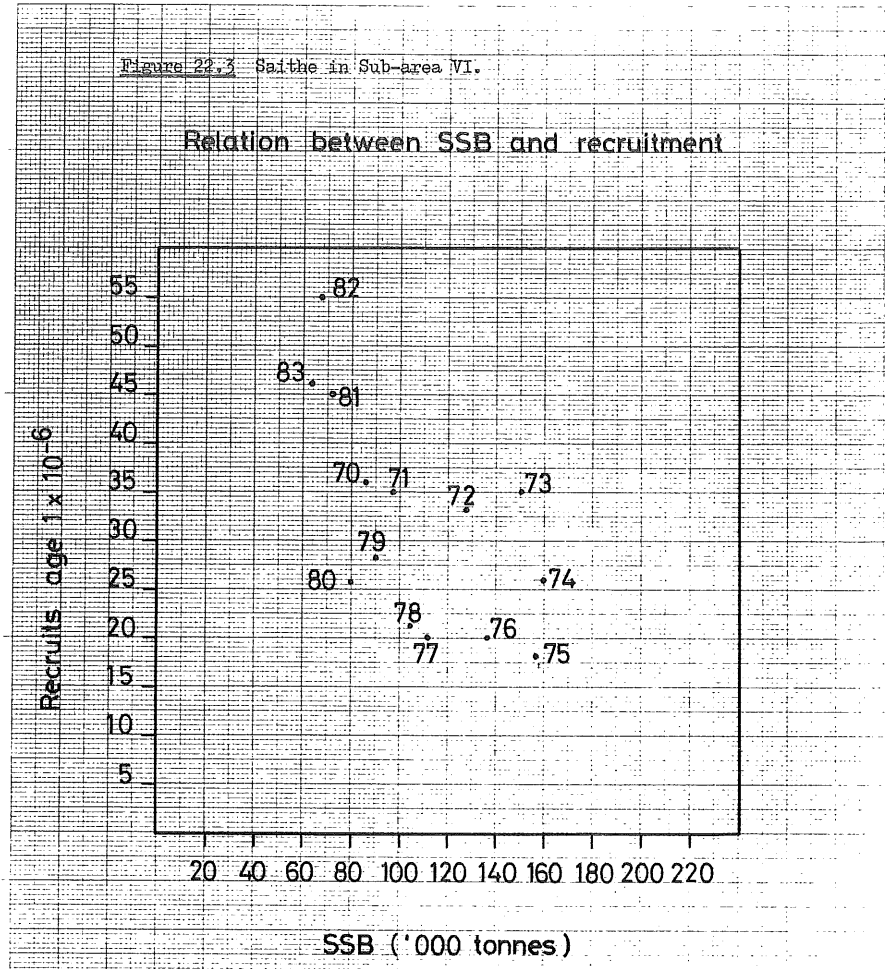
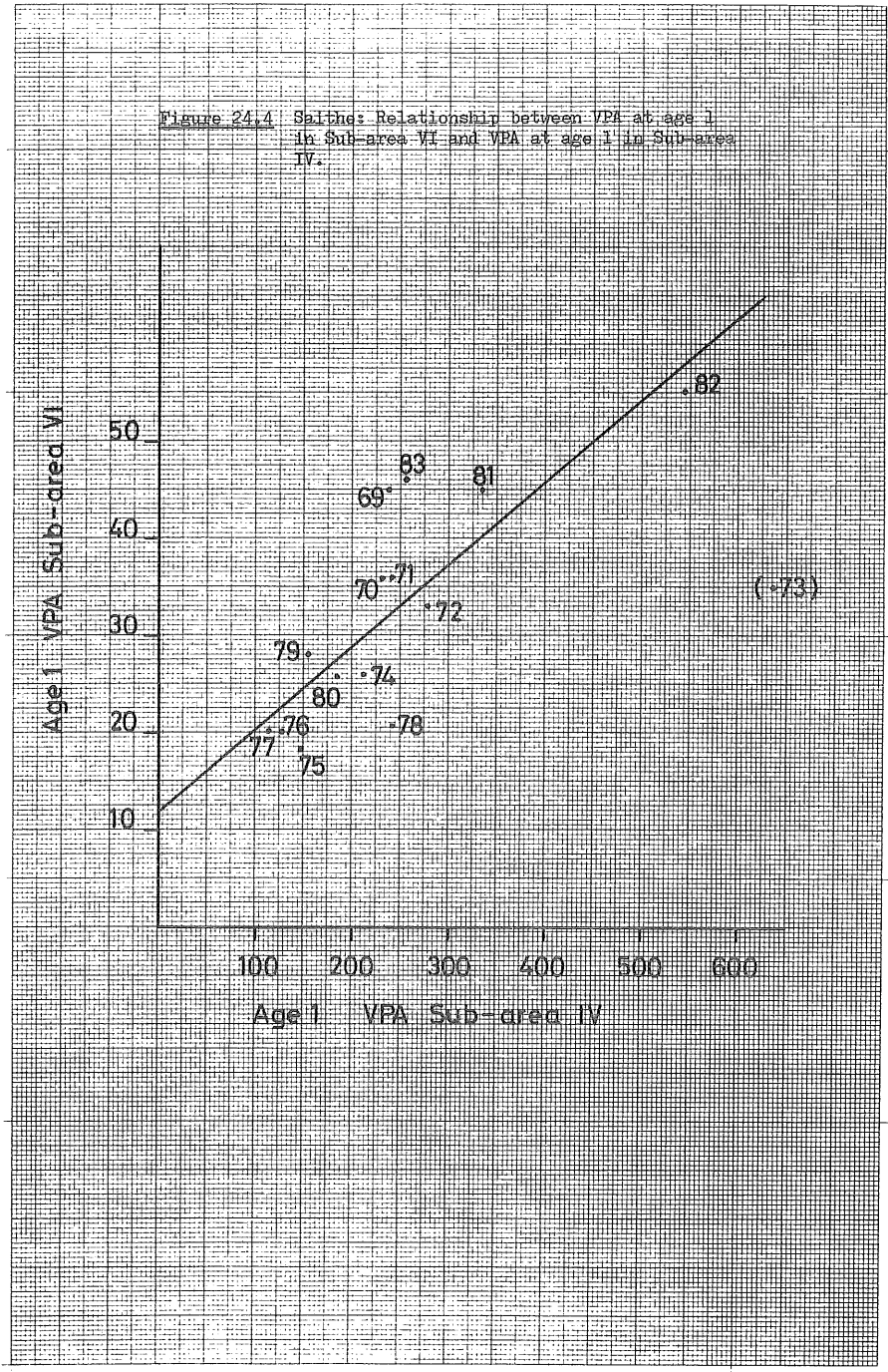


Figure 24.4 Saithe: Relationship between VPA at age 1 in Sub-area VI and VPA at age 1 in Sub-area IV.



ANNEX 1

METHODS OF ESTIMATING RECRUITMENT

1 Introduction

In recent years, a number of abundance indices have been made available to the Working Group in addition to the IYFS. Consideration was given at last year's meeting to the handling of these data and the question was further discussed at the Methods Working Group (Anon., 1986). As a result, three methods were available at the meeting to utilize abundance indices for recruitment estimation.

2 Catchability Analysis

Catchability analysis has been used to tune input F to VPA using commercial catch and effort data. The same principle can be applied to survey indices. The ratio R(y)/N(y) is calculated for each year where:

R(y) = survey index for yth year class
and N(y) = VPA estimate of the same year class

This ratio can be interpreted as catchability Q(y). An average value of the Q(y)s for each year is then obtained using a Cleveland weighted mean, where the years farther back in time receive progressively lower weight. Thus, the mean value of Q (i.e., $\hat{Q}$) is a value reflecting recent Q(y)s. The required recruitment estimate is then calculated from:

$$N(t) = R(t)/\hat{Q}$$

where t is the year for which the year class is being estimated.

The method is implemented on the ICES IBM microcomputer and will give a separate estimate of N(t) for each survey. The Working Group decided to combine these estimates by a weighted mean using the weighting factors described in Annex Section 5.

3 Shepherd Method

Shepherd's method is briefly outlined in Section 5.3 of the report of the Working Group on Methods of Fish Stock Assessments (Anon., 1986) and was made available to the Group in the form of Program RCRTINX implemented on an Apricot microcomputer. The method consists of calculating a log-log regression of survey index vs VPA, with VPA as the independent variate. For each survey, a predicted recruitment value and its associated variance can be calculated. The predicted values can then be combined by taking a weighted average, where the weights are the inverse of the variances of the individual estimates.

4 Cook Method

A working paper by Cook (1987) was presented to the Working Group describing a multiplicative model for the analysis of survey indices. The method consists of fitting the model:

$$r(f,y) = a(f) + P(y) \qquad (1)$$

where $r(f,y)$ = log recruitment index for survey f in year y

$a(f)$ = log catchability of survey f

$P(y)$ = log population of fish in year y

The model treats VPA as a survey subject to a(VPA) = 0. This normalization allows the estimate P(t) in the last data year to be an estimate of recruitment scaled to the VPA.

The model is implemented on the ICES ND 500 computer as Program INDEX05. The program offers various options allowing a number of different models to be fitted accommodating non-linearity in the relationship between survey index and the number of fish in the sea and changes of a(f) with time. Only option 1 which fits equation 1 was used in conjunction with weighting factors described below. Although the other options were tried, they either fitted the data badly or gave unrealistic estimates of recruitment.

5 Weighting Factors

In its current form, Shepherd's method is self contained, since weighting factors are an integral part of the method. Cook's method, as implemented, offers the opportunity to weight residuals. Thus, more weight can be given to particular surveys or years, but this must be specified by the user. The method, as run by the Working Group, used Cleveland weighting (see Cook, 1987) to give less weight to historical data and hence bias the estimates of a(f) to recent data. Additionally, the weight given to each survey was the square root of the number of hauls in each survey. These were chosen to reflect the precision expected from each survey on the basis of its sample size. Very low weight was given to the 0-group indices because their precision is uncertain. In the absence of a logical weighting for the shrimp trawl index, it was given the same weight as the smaller surveys. The weight given to the VPA was then the sum of the weights for each survey in the analysis. The factors used are given in Annex Table 1. The same weights were used for Division VIa stocks, except that the North Sea VPA values were included as "surveys" and given the same weight as the Division VIa VPA.

6 References

Anon.1986. Report of the Working Group on Methods of Fish Stock Assessments. ICES, Doc. C.M.1986/Assess:10.

Cook, R.M. 1987. A multiplicative model for estimating year class strength from research vessel surveys. Working paper submitted to 1987 meeting of North Sea Roundfish Working Group.

Annex Table 1 Surveys and weighting factors used for estimating year-class strength by Cook's method.

Survey	Weighting factor	Cod		Haddock		Whiting	
		Age 1	Age 2	Age 1	Age 2	Age 1	Age 2
IYFS	23.0	+	+	+	+	+	+
EGFS	8.9	+	+	+	+	+	+
DGFS	9.5	+	+	+	+	+	+
SGFS	9.5	+	+	+	+	+	+
FRGSF	9.5	+	-	-	-	-	-
EGFSO	0.1	+	-	-	-	-	-
DGFSO	0.1	+	-	-	-	-	-