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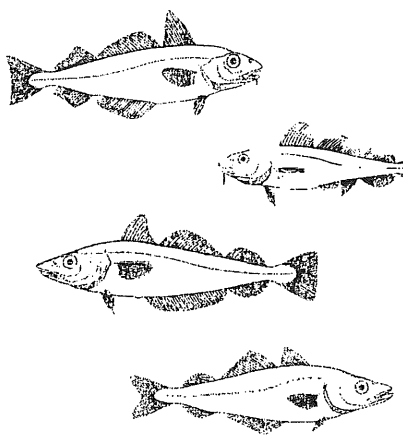
ROUND FISH WORKING GROUP



Aberdeen 11-23 October, 1990

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it should not be quoted without consultation with:

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2 TERMS OF REFERENCE

The terms of reference for this Working Group are given in C.Res.1989/2:4:22:

The Roundfish Working Group (Chairman: D. Armstrong) will meet in Aberdeen from 11-23 October 1990 to:

a) assess the status of and provide catch options for 1991 within safe biological limits for the stocks of cod, haddock, whiting and saithe in Sub-areas IV and VI (including Division IIIa for saithe); cod, haddock and whiting in Divisions VIId,e and Divisions VIIb,c,h-k (including Division VIIg for haddock); and saithe in Sub-area VII;

b) 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 cod, haddock, whiting, and saithe in the North Sea for 1989 as input for the multispecies VPA;

c) assess the effects of the cod box in the German Bight;

d) evaluate by season and area which fisheries for cod, haddock, whiting, and saithe should be considered as separate fisheries;

e) review for cod and whiting the relationship between stocks in the North Sea and in Divisions VIId and VIIe and advise on the appropriate units for assessment and management purposes.

Immediately prior to the start of the meeting, the following terms of reference were added:

f) assess the short-term effects of an increase in the minimum mesh size to 100, 110 and 120 mm in the North Sea roundfish fishery taking into account all available information on the 1990 year classes;

g) describe the seasonal distribution of the 0- and 1-group haddock in the North Sea during recent years and provide information on the expected distribution of 1-group haddock in 1991;

h) consider how it would be possible to maximise the sustainable take of whiting in the North Sea while improving technical measures to conserve cod and haddock stocks.

Agenda items (f) and (g) were requested by the European Commission on 9 October. Agenda item (h) was requested by the Department of Agriculture and Fisheries for Scotland on 2 October and the request was supported by the Danish Ministry of Fisheries in a letter of 5 October.

3 DATA BASE REVISIONS AND PROBLEMS

Preliminary data were prepared for 1989 and data for 1988 were updated to a finalised form, no major changes being necessary.

Problems remain, as described in previous reports, in obtaining sufficiently detailed and accurate landings statistics for the Netherlands.

For the Danish industrial by-catches in 1989, sampling was confined to the estimation of total weights of each species landed, and no biological analyses were carried out. Age compositions were, therefore, estimated from research vessel surveys (IYFS and Danish acoustic surveys) in the same or a neighbouring quarter.

For haddock, catches in 1989 for some fleets were re-allocated from Division VIa to Sub-area IV to correct for misreporting. In addition, estimates were made of quantities not reported in the haddock fishery in Sub-area IV in 1989. The differences between the Working Group estimates and the officially-reported figures are referred to in Section 18.

There is some evidence that in 1989 there was misreporting of cod to the North Sea from stocks not covered by the Roundfish Working Group. It was not possible to quantify the problem at the meeting, but it is not thought that the quantities involved are large enough to affect the assessment.

The data for the Channel stocks continue to be unsatisfactory. The time series of data for cod in Division VIId does not give acceptable results for use in VPA, and data for Division VIId whiting could be improved. Sampling of cod has only recently commenced in Division VIIe, while for whiting there are no age composition data for recent years. A groundfish survey by France has recently been started for Division VIId (1988), and this will be extended to Division VIIe during an English survey in November/December 1990. The usefulness of these surveys in this area can only be assessed when data for more years are available.

4 THE EFFECTS OF THE COD BOX IN THE GERMAN BIGHT

The cod box was introduced in 1986 in order to reduce fishing mortality on the strong 1985 year class, and although subsequent year classes have been weak, the box has been retained. The recommendation from ACFM was for a mesh size of 120 mm within the box, since this is the smallest mesh size which would afford a significant increase in selectivity for 1-year-old cod. However, the regulation adopted was for a minimum mesh size of 100 mm which is unlikely to have had much effect. A positive effect of a technical measure such as the cod box would be expected to show up in the VPA as a reduction in F in 1-year-olds, and as an increased local abundance of this age group. No such effects can be detected in the VPA or from survey data; however, the relevant Fs are as yet unconverged in the VPA. It should be stressed that tagging studies show that any beneficial effects of the cod box would be confined to a radius of around 100 miles, the normal limit of cod migrations.

As noted in last year's report, measures like the cod box as recommended are likely to have a positive effect on the level of spawning biomass. However, the Roundfish Working Group does not have the data necessary to quantify this effect. Such data are currently being assembled by an ad hoc working group of the EC Scientific and Technical Committee for Fisheries and that group should be able to evaluate the effects of the cod box and other technical measures in due course.

The text table below shows the percentage of 1- and 2-year-old cod caught in the cod box during the IYFS in recent years.

	1986	1987	1988	1989	1990
Age 1	38.1	65.0	21.8	6.9	5.2
Age 2	11.8	16.4	8.6	19.4	3.7

This shows that the percentage in the cod box is very variable from year to year, and in some years is very low, as for example in 1990. There is some evidence in these data that the 1-year-olds have become less abundant in the cod box in recent years.

The overall conclusion is that the cod box only seems likely to have a significant effect when there is a good year class, a significant proportion is distributed in the box, and a mesh size of at least 120 mm mesh is enforced. There have been no good year classes since that spawned in 1985, and preliminary indications of the 1990 year-class from the English groundfish survey in 1990 are that it is below average.

5 STOCK UNIT DEFINITIONS

The Group was asked to review for cod and whiting the relationship between stocks in the North Sea and in Divisions VIId and VIIe, and advise on the appropriate units for assessment and management purposes.

Currently there are two management areas for Sub-area VII: Division VIIa (Irish Sea) and Divisions VIIb-k. Assessments are made for cod and whiting in Divisions VIIa and VIIf,g by the Irish Sea and Bristol Channel Working Group, and for cod and whiting in Divisions VIId,e by the Roundfish Working Group.

A working paper on the relationships between cod in Divisions VIId,e and adjacent areas was submitted to the Group at last year's meeting. This summarised tagging data from 1964 and also investigated CPUE correlations between rectangles for English trawlers over the period 1972-1985. No additional tagging data have become available but further analyses of English CPUE data have been made.

5.1 Tagging Data

There have been no tagging experiments for cod in Divisions VIIe or VIIf,g. There have been several releases in Division VIId and in the southern half of Sub-area IV, and these showed that a significant proportion of cod released in Division VIId were recaptured in the North Sea (27%) but there was little movement westwards to Division VIIe (4%). Cod released in the southern North Sea were mostly recaptured there (96%), with a small proportion (3%) from Division VIId.

5.2 Analysis of CPUE Data for Cod

The analysis of CPUE correlations shows that most of the rectangle correlations for Division VIId are with rectangles in Division IVc. For Division VIIe there is no evidence for any relationship with the North Sea stock, but there is some evidence for a link with Division VIId.

5.3 Recruitment Correlation

Values for the correlation coefficient (r) were calculated from log-transformed VPA data, which were available for whiting in Sub-area IV, Division VIId, and Division VIIe (years 1976-1987 only). The correlation matrix is given in Table 5.1; none of the values of r is significant, but it should be noted that the VPA database for the Channel stock is less reliable than that for the North Sea.

5.4 Spawning Areas

Little is known about spawning areas of cod and whiting in the Channel, except for cod in Division VIId. Here, egg surveys by Dutch research vessels have shown that there is a spawning area in the eastern part of Division VIId (Heessen and Rijnsdorp, 1989). However, it is not known whether the eggs and larvae remain in the area or drift into the southern Bight.

5.5 Conclusions

The evidence suggests that cod and whiting in the western Channel (Division VIIe) have little or no relationship with those in the southern North Sea (Division IVc). However, the evidence is conflicting with regard to the relationships between the eastern Channel (Division VIId) and the southern North Sea. There are undoubtedly links between cod in these two areas, as shown by the CPUE data and the tagging data. However, for whiting the recruitment at age 1 is uncorrelated in the two areas, although the reliability of the whiting VPA is less than in the North Sea. The relationships between cod and whiting in the eastern and western Channel are also unclear. The Working Group, therefore, has no basis at present for proposing stock units different from those currently used for assessment purposes.

The present management unit covers all stocks in Divisions VIIb-k, and includes several assessment units and areas, for which precautionary TACs are in place. This has led to problems in management in the recent past, and a more satisfactory arrangement on pragmatic grounds would be for assessment units to have separate TACs.

The attention of ACFM is drawn to the existence of a Study Group set up by France and England to study the fish and fisheries in the Channel. As part of its work, this Group will be investigating the question of stock units in 1991, and ACFM could formally ask the Group for advice.

6 QUARTERLY DATA FOR MULTISPECIES WORKING GROUP

Quarterly data for 1989 were provided for North Sea cod, haddock, whiting, and saithe. The Roundfish Working Group Chairman will work up these data in the near future and pass the results to the Multispecies Working Group for use in its forthcoming meeting.

Some progress has been made in revising the historical quarterly data set. However, some nations have not yet provided the appropriate age composition data. The Roundfish Working Group Chairman will discuss with the ICES Statistician the possibility of obtaining quarterly landings data for those nations which do not provide age compositions.

The Group has been requested to supply quarterly data on the relative distribution of cod, haddock, whiting, and saithe at this meeting and at several previous meetings. It is fortunate that this Group has not yet produced these data since the Multispecies Working Group Chairman has recently informed the Chairman of the Bottom Trawl Survey Working Group that the data are not required.

7 SEPARATE FISHERIES FOR COD, HADDOCK, SAITHE, AND WHITING

7.1 Background

The terms of reference for the Working Group included both to provide an "evaluation by season and area which fisheries for cod, haddock, whiting, and saithe should be considered as separate fisheries", and a request to "consider how it would be possible to maximise the sustainable take of whiting in the North Sea while improving technical measures to conserve cod and haddock stocks".

The Working Group finds it adequate to address both problems in the same way, as a systematic mapping of landings by species, fleet/gear, and statistical rectangle and a scanning of occurrences of separate fisheries. This approach fulfils the first term of reference and partly fulfils the second. It is only possible for this Working Group to consider spatial, temporal and technical separation of fisheries; the Working Group does not have the means to include the multispecies effects which are also implied in the second term of reference.

7.2 Definition of Separate Fisheries

The terms of reference give no specific suggestions as to the definition of separate fisheries. The problem is so multidimensional (fleet, gear, season, area, species compositions) that it is not possible to give any overview without strict *a priori* definitions.

The Working Group has chosen to present the results emerging from a few selected definitions and then to produce a floppy disk containing a data base with the data available at the meeting and associated software (FORTRAN programmes for scanning the data base and mapping fisheries, developed during the meeting) which will allow extraction of corresponding results based on any other definition. Maps covering the commercial landings per rectangle by species, fleet and quarter have been prepared but are not included in the report due to their immense volume. They are similarly available on floppy disk.

The commercial data are biased by the fact that they represent landings rather than catches and discarding practice is known to be variable between the fleets/countries. Survey data have been included in the presentation in order to give an impression of the distribution in the sea which is what is relevant when considering future fisheries.

7.3 Data Available

The data available to the Working Group have been survey data from the IYFS, the German Ground Fish Survey, and the English Ground Fish Survey, and commercial landing data disaggregated on fleet, statistical rectangles, and quarter from Denmark, England, France, and Scotland.

Only data which were available as computer accessible files have been included in the analysis. This means that some large and important data sets have not been considered by the Group.

The years and fleets included in the data base are summarized in Table 7.1.

7.4 Survey Catches

IYFS (1st quarter)

Catches of large gadoids were extracted from the years 1983-1987, "large" size being defined as larger than 35 cm for cod, 30 cm for haddock, 30 cm for whiting, and 35 cm for saithe. The catches have been mapped as percentage (weight) of total catch of large size gadoids for the four species separately (Figures 7.1-7.4, reference is also made to maps presenting catch in numbers by age presented in Section 9). The pattern emerging from these maps is that cod is dominating in the southeastern North Sea, haddock in the northwestern part, and saithe at the edge of the Norwegian Deep. Whiting constitutes a large percentage in some rectangles in the Southern Bight, in the German Bight, off the coast northeast of England and around Shetland. This must be related to the fact that the weight of large gadoids caught in the IYFS in the southernmost of these areas is relatively small. The main distribution of older whiting in the IYFS is more northerly (see Figure 9.9).

German Ground Fish Survey (3rd quarter)

The data from the GGFS are available as catch percentage (weight) of each of the four roundfish species of the total gadoid catch and are presented as the average for 1987-1990 on a rectangle basis (Figures 7.5-7.8). These data are not directly comparable with the IYFS data since they cover another season, another year range and smaller sized fish are included. The major differences are that haddock is found in high percentages as far south as the northern edge of the Dogger Bank and that whiting is dominating south and southeast of Dogger Bank and more consistently in the German Bight than seen in the IYFS data.

English Ground Fish Survey (3rd quarter)

The distribution of 3+ whiting in the English Ground Fish Survey (Figure 9.9) shows a more scattered distribution than seen in the IYFS data. This pattern is in accordance with the German groundfish survey data referred to above.

7.5 Commercial Landings

The by-catches of whiting in the Danish industrial fishery in the period 1982-1984 (Figure 7.9) are mainly taken in two areas: on the plateau of the northern North Sea and in the area southeast and east of Dogger Bank up to the border of Skagerrak. Whiting constituted 65% of gadoid by-catches in the period covered, the remainder being mainly haddock taken in the northern area. The by-catches in the southern area are mainly taken in the 2nd and 3rd quarters. The distribution of whiting by-catches in the area southeast and east of Dogger does conform well with the pattern seen in the GGFS and the EGFS. The present distribution of the industrial by-catches is different as the Norway pout fishery in the northern North Sea has diminished considerably.

The commercial landing data base has been scanned for 'separate' fisheries defined as occurrences by quarter, fleet/gear and rectangle for which at least 75% of the total demersal landings consisted of the species in question. Furthermore, a minimum landing of 30 t was stipulated. For whiting two searches were made: one with a combined criterion of minimum 50% whiting and maximum 10% by-catch of the other roundfish species and one with minimum 50% whiting and 25% by-catch of the other roundfish species. The first is an approximation to a proposal for regulation of a fishery targeting on whiting which has been advanced by the EC. The output of the scans for whiting are presented in Tables 7.2-7.3 while these and the scans for the other species have formed the basis for mapping and the presentation in the next section.

7.6 Separate Fisheries

Maps covering all occurrences of fisheries fulfilling the criteria above have been prepared and are available on floppy disk. A sample is presented as Figure 7.10. These maps plus the survey maps form the basis of the discussion below.

A summary of occurrences of separate fisheries is presented in Table 7.4, and some examples of the distribution of major roundfish fisheries are presented in Figures 7.10-7.17.

The major conclusions which can be drawn are :

The only examples of existing fisheries targetting clearly on a single roundfish species are the saithe fisheries conducted by French fleets. To this can be added the Norwegian saithe fishery which is not covered by the present data base. Several other fleets target mainly on one roundfish species. Examples are the Danish gill net fishery for cod and the French fishery for whiting in the Southern Bight. The major patterns of fisheries with high percentages of single species are:

Cod

Cod is an important target species for the Danish gill net, Danish seine and small trawlers. Cod is generally taken in operations directed for mixed human consumption species, but is so important for the gill net fishery that this fishery may be considered a directed fishery. The overall percentages of cod in the landings of these fisheries are 69%, 43% and 38%, respectively, with cod landings amounting to 8,200 t, 8,100 t and 4,700 t in 1987. These fisheries take place in the eastern North Sea. Most cod landings are recorded from the first two quarters.

The English longline and gill net fisheries are also targeting on cod: 88% of their landings (5,600 t, average for 1983-1986) are cod. Cod is an important species for the English pair trawlers (64%, 17,600 t), the single trawlers (34%, 79,400 t), and the English Danish seiners (47%, 10,700 t).

Haddock

Haddock is a target species for the Scottish seiners, light trawlers and pair trawlers. The landings of haddock constitute 48%, 33%, and 25%, respectively, of the total demersal landings of these fleets, amounting to 7,500 t, 3,200 t and 5,700 t (average for 1983-1986).

Haddock occasionally constitutes a large fraction of the landings of French high sea trawlers in the northern North Sea, but overall constitutes less than 10% of the catches of these fleets.

Another fishery with a large percentage of haddock is undertaken by the English single seiners which caught 4,700 t (average for 1983-1986), haddock amounting to 46% of their overall landings.

Whiting

The French coastal trawlers undertake a directed whiting fishery in the southern North Sea. Whiting is, furthermore, caught by the French high sea trawlers off northeast England on their return from the saithe fishery in the northern North Sea.

The survey data and the distribution of by-catches in the industrial fishery indicate a distribution of whiting east and southeast of Dogger Bank, especially during summer, which is not reflected in the commercial landings. This can be explained by a different discarding practice in the fleets operating in that area.

Saithe

The French high sea trawlers operate a directed fishery for saithe in the northern North Sea, landing 29,200 t/year (average for 1985-1987). Saithe constitutes approximately 70% of the total landings from these fleets.

Catches with a high percentage of saithe are also taken by Scottish motor trawlers.

Some English pair trawlers and English single trawlers are fishing for saithe in the northern North Sea. These catches do not constitute a large percentage of the overall landings of these fleets, but the fishery can be considered as a separate saithe fishery when it occurs.

The commercial data only give information on existing fisheries and are thus biased by present regulations and present discard practices. Furthermore, they only reflect the possibilities with present fishing technology.

The survey data and the by-catches in the Danish industrial fishery indicate that whiting constitutes a higher percentage of gadoid stocks in certain areas than indicated by the commercial human consumption landings data. These areas include the area east and southeast of Dogger, the Southern Bight and the area off northeast England. The two latter areas are also reflected in the French commercial landings data.

This seemingly contradictory evidence on the possibilities for a separate whiting fishery needs further investigation before clear conclusions can be drawn. Discard data from all fleets resolved in the same way as the landings data would clarify much. Experimental fishing could also provide valuable information on the subject.

New techniques to improve the selectivity of fishing gears, for instance separator panels, may provide the means of catching whiting separately. The Working Group is not the most competent body for evaluating results or potentials from such techniques; this should be referred to gear technology specialists.

In conclusion, the Working Group does not consider the information available to be sufficient to draw firm conclusions on the possibilities for separate fisheries except for saithe. More information of the nature listed above is needed in order to arrive at a concerted scientific opinion on the subject.

8 SHORT-TERM EFFECTS OF CHANGES IN SELECTIVITY

The Working Group was requested to "assess the short-term effects of an increase in the minimum mesh size to 100, 110 and 120 mm in the North Sea roundfish fishery taking into account all available information on the 1990 year classes".

The Group decided to respond to this request and to widen considerably the range of options and geographical areas to be included to give a comprehensive review of this topic in the light of recent scientific work and of recent proposals from the European Commission and others for improving selectivity.

Recent scientific work (Armstrong et al., 1989); Robertson and Ferro (1988) indicates that mesh size is not the only feature of gear design which affects selectivity. It is now known that selectivity is also affected by the number of meshes around the mouth of the codend and by the length of the extension piece between the main panels of the net and the codend. The probability of retention of a fish of any specified length is reduced as mesh size is increased and extension length and number of meshes round the codend are decreased. Changes in mesh size have the greatest effect on selectivity and changes in extension length have the least effect.

In the light of these findings it can be appreciated that when proposing technical measures intended to increase the selectivity of towed demersal fishing gears it is not sufficient only to propose an increase in mesh size. The potential gain thereby obtained can be nullified or negated by compensating increases in extension length and/or number of meshes around the codend.

The Group, therefore, decided to consider the effects of changes in both mesh size and number of meshes around the mouth of the codend. No investigation of the effect of changing extension length was carried out since this is the least important aspect of gear design. (If required, however, this possibility can be investigated using the program written to carry out the required calculations.) Extension length was set to 9 m, which is thought to be the average for Scottish seiners and light trawlers.

The effects of all possible combinations of 5 mesh sizes (90, 100, 110, 120 and 130 mm) and 3 numbers of meshes around the mouth of the codend (120, 100, 75) were estimated. Three of the options for mesh size are those requested by the European Commission. The 90 mm mesh option is required to calculate "baseline" estimates (see below). The 130 mm option was included to simulate the effects of the recent proposal by the European Commission to introduce 120 mm minimum mesh size with square-mesh netting in the top half of the codend. The options on numbers of meshes were chosen because 120 is the most usual number currently in use (required for "baseline" calculations), 100 meshes has been suggested as a possibility by the UK, and 75 has been proposed by the EC in conjunction with 120 mm minimum mesh size and square-mesh top half of the codend.

In addition, the Group was aware that the recent EC proposals for improvement of selectivity would also apply to Division VIa north of 56°N. It was, therefore, decided also to estimate the effects of changing selectivity in this area.

8.1 Computational Method and Input Data

Calculations were carried out following the method described in Appendix 1 of this report. The effect of each change in selectivity is measured by comparing predictions of catches in future years (subdivided where possible into landings for human consumption, discards and industrial by-catches) assuming no change in selectivity (the baseline estimates) with corresponding predictions incorporating selectivity changes.

Estimates of the effects of changes in gear design were made for cod, haddock, and whiting. No attempt was made to estimate the effects on saithe since data on selectivity of this species are insufficient. It was assumed that the changes in gear design would occur on 1 January 1991. The starting point for the calculations was the age composition of the stock at the start of 1990. This age composition incorporates current knowledge of the abundance of the 1990 year class for each species and area investigated. Future year classes were assumed to be of geometric mean abundance. The computations were carried out on a fleet- disaggregated basis, and it was assumed that, in future years, each fleet would continue to generate the F-at-age values equal to its average F-at-age for the period 1985-1989 except for modification of the exploitation pattern as a result of changes in gear design (i.e., the Group made no attempt to simulate the effects of changes in fishing effort in addition to changes in selectivity).

Specification of fleets for each species and area

COD IV		HAD IV		WHI IV		COD VIa		HAD VIA		WHI VIa	
Natn	Gear	Natn	Gear	Natn	Gear	Natn	Gear	Natn	Gear	Natn	Gear
DEN	ALL	DEN	ALL	DEN	ALL	ENG	ALL	ENG	ALL	SCO	SEI
FRA	ALL	FRA	ALL	FRA	ALL	SCO	SEI	SCO	SEI	SCO	TRL
FRG	ALL	FRG	ALL	FRG	ALL	SCO	TRL	SCO	TRL	SCO	LTR
NET	ALL	NET	ALL	NET	ALL	SCO	LTR	SCO	LTR	SCO	NTR
NOR	ALL	NOR	ALL	NOR	ALL	SCO	NTR	SCO	NTR	SCO	OTH
ENG	TRL	ENG	ALL	ENG	ALL	SCO	OTH	SCO	OTH	IRE	ALL
ENG	SEI	SCO	SEI	SCO	SEI	IRE	ALL	IRE	ALL	FRA	ALL
ENG	OTH	SCO	TRL	SCO	TRL	FRA	ALL	FRA	ALL	OTH	ALL
SCO	SEI	SCO	LTR	SCO	LTR	OTH	ALL	OTH	ALL		
SCO	TRL	SCO	NTR	SCO	NTR						
SCO	LTR	SCO	OTH	SCO	OTH						
SCO	NTR	OTH	ALL	OTH	ALL						
SCO	OTH										
OTH	ALL										

8.2 **Problems**

It was assumed that only the selectivity of trawls and seines would be altered in future years. However, the available data allow only a very crude definition of some fleets (e.g., Denmark, all gears). Within some of these "fleets" some of the vessels operate trawls and seines and some do not. To simulate this, the proportion of each fleet which would be affected by the proposed changes was specified and taken into account when estimating the effects of each change in selectivity (see Appendix 1 for details).

Some uniquely identified fleets (e.g., Scottish Nephrops trawlers) operate under derogations permitting the use of mesh size smaller than the legal minimum were assumed to be unaffected by changes in gear design. In such cases the proportion of the fleet affected by changes was set to zero and hence their future fishing mortalities remain unchanged in the simulations. Furthermore, no change was made to fishing mortalities by fleets fishing for industrial species. Current mesh size was defined for the trawls and seines in each fleet. If a simulated mesh size was less than the current mesh size, the latter was not altered when carrying out the calculations.

Selectivity models allowing estimation of the effects of changing combinations of mesh size and number of meshes (and extension length) are available only for Scottish seiners and light trawlers and, in general, the selectivity of trawls and seines currently used by other nations is unknown. For the purpose of this exercise it was assumed that any selective demersal fishing gear other than Scottish seiners is equivalent to a Scottish light trawler.

It should be noted that the existing Scottish selectivity model is based on data from hauls using mesh sizes up to 100 mm. Simulation of effects of mesh sizes greater than this involves extrapolation of the results of the model.

The results presented include estimation of landings etc. in 1990 and 1991 assuming no change in selectivity. Conceptually, this is a repetition of the estimation of status quo values provided elsewhere in this report. In principle, the two estimates should be identical. In practice they are somewhat different because of the disaggregated nature of the data on which the computations of the effects of selectivity changes are based. A further point in this context is that the absolute values of predicted catches in 1992 should be treated with due caution. This is particularly relevant in the case of North Sea haddock where a considerable recovery in landings is "forecast" for 1992. This apparent recovery is very dependent on the current high-abundance estimate of the 1990 year class which has yet to be confirmed.

8.3 Results

The Group estimated the effects of changes for 5 mesh sizes, 3 numbers of meshes, 3 species, and 2 areas which required 90 sets of output. It is obviously not possible to present this much material in this report. A copy of the outputs was made available to ACFM and to Working Group members on floppy disk.

A summary of the results is given in Tables 8.1 to 8.6, which show for each species and area considered the percentage change from baseline for the total international fleet in 1991 of human consumption landings and, where possible, discards and industrial by-catch. Also shown are the percentage changes expected in spawning stock biomass at the start of 1992.

It should be noted that the highly aggregated summary provided in this report obscures the fact that in the simulations some fleets experience larger short-term losses than those for the total international fleet while other fleets experience lower losses. Where no change occurs in selectivity for some fleets (e.g., industrial fleets and Scottish Nephrops trawlers), these fleets increase their landings in 1991 (and further into the future) since the other fleets have left young, small fish in the sea as a result of their increase in selectivity. The full results should be examined in detail to gain a full appreciation of the effects of the selectivity changes.

It should be specifically pointed out that the estimated short-term loss of haddock landed for human consumption in the North Sea in 1991 is either zero or very low except for simulations incorporating large changes in selectivity. This is because at present that part of the stock of sizes big enough to be landed consists almost entirely of the survivors of the 1986 year class. These fish will be 5 years old in 1991 and will all be big enough to be retained by gears exhibiting increased selectivities.

9 DISTRIBUTION OF HADDOCK, COD, AND WHITING

The Working Group was asked to describe the seasonal distribution of 0- and 1-group haddock in the North Sea during recent years. Since this may result in a proposal for closed areas, the Working Group considered it necessary to include other age groups of haddock and also cod and whiting in the analysis to find out to what extent a closed area for young haddock might influence the fisheries for older haddock and other gadoid species.

The data used for the analysis were survey results for the years 1986 up to and including 1990. The International Young Fish Survey (IYFS) covers the whole North Sea and represents the distribution of the three species in winter. The Scottish Groundfish Survey (SGFS) covers the northwestern and central North Sea and was used to describe the distribution of haddock in summer. Results from the English Groundfish Survey, which covers the whole North Sea as a coarse grid, were used to indicate the summer distribution of cod and whiting. Data for other quarters were not available.

For age groups 0, 1, 2, and 3+ the catch in numbers per rectangle for each year was expressed as percentage of the total catch of the relevant age group in that year. For whiting the analysis was restricted to the 3+ group (IYFS) or the 3-group (EGFS) since the human consumption fishery for that species heavily depends on 3-year-olds and older fish. Figures 9.1 to 9.9 show how often in the period 1986-1990 the catch in a certain rectangle was 2% or more of the total catch of that age group.

0-group haddock are widely distributed over the northwestern North Sea but are more concentrated at ages 1 and 2 and as 3+ in winter. In the summer, the 3+ group can again be found over a wider area. The distribution of 1-group haddock overlaps to a great extent with the distribution of 2-group haddock and older fish.

Cod is at all ages more widely distributed over the whole North Sea than haddock, but only from age 2 onwards is there an overlap with the main distribution area of haddock.

The main distribution area of older whiting is to the northeast of Scotland, off the northeast coast of England, and in the Southern Bight. The area with the highest concentrations overlaps to a great extent the distribution area of haddock.

10 ESTIMATES OF RECRUITMENT

10.1 Recruitment Indices

Recruitment indices for the North Sea stocks of cod, haddock, and whiting (Tables 10.1-10.3) were available for the first time from the German Groundfish Survey (1983-1990), and as usual from the International Young Fish Survey (1971-1990), the English Groundfish Survey (1977-1990), the Scottish Groundfish Survey (1982-1990), and for cod and whiting from the Dutch Groundfish Survey (1980-1989). Preliminary results for cod and whiting from the 1990 DGFS will become available during the November meeting of ACFM. Abundance indices of cod taken as by-catch in the shrimp fishery by Germany were available for the years 1968-1990.

For the stocks of cod, haddock, and whiting in Division VIa, 1- and 2-group indices were available from surveys by Scotland (1982-1990) (Tables 10.4-10.6).

No research vessel survey data are available for saithe.

Plots of these indices against VPA numbers are shown in Figures 10.1.1.-10.6.2.

10.2 Use of Indices

As last year, RCRTINX2 was used to combine the available abundance indices. The program options chosen were:

a) calibration regression,

b) shrinkage towards the mean,

c) minimum variance of prediction of 0.2 for any estimate,

d) a minimum of 5 data points in regression and

e) tricubic weighting.

To estimate recruitment at age 1 and age 2 for the North Sea stocks of cod, haddock and whiting, various recruitment indices were used together with VPA numbers. The results of the RCRTINX2 runs were used as final values in preference to values from VPA tuning where available. Predicted recruitment and summary statistics are given in tables in the relevant stock sections.

For the stocks of cod, haddock and whiting in Division VIa, at last year's meeting all available abundance indices for Division VIa and the North Sea were used as input values for the RCRTINX2 program. Because this procedure resulted in imprecise estimates of recruitment, it was decided this year to restrict the input to the Scottish West Coast Groundfish Survey, CPUE data for Scottish seiners and light trawlers (cod and haddock), and the North Sea VPA (haddock and whiting). The latter was not included for cod because recruitments in the North Sea and in Division VIa are not correlated. The results of these runs are presented in tables in the relevant stock sections.

11 VPA TUNING METHODS

The Laurec-Shepherd tuning method was used to estimate F at age in the last data year and at the highest age for the stocks indicated in the text table below. The fleets for which effort data are available and which were used in the tuning procedure are also indicated in the text table. For the catch predictions, the tuned F and N values for ages 0, 1, and 2 were replaced by (respectively) average values, and RCRTINX2 values (where available).

A problem was encountered with the tuning program, in that it appears that if a zero catch value occurs in the data file, it is replaced with a small positive value. This led to some anomalous results for some stocks in initial tuning runs, which required editing of the datafiles to ensure that zeros did not occur over the time span for a particular age group. In the case of age 1 for saithe in Sub-area IV and Division VIa, this prevented the use of the tuning program for estimating F at this age.

Country	Fleet	Sub-area IV				Division VIa			
		Cod	Had	Whi	Sai	Cod	Had	Whi	Sai
Scotland	GFS	+	+	+					
	TRL	+	+	+		+	+	+	+
	SEI	+	+	+		+	+	+	+
	LTR	+	+	+		+	+	+	+
	NTR					+	+	+	+
England	GFS	+	+	+					
	TRL	+							
	SEI	+							
France	TRB	+	+	+	+				
	ALL					+	+		+
Germany	GFS	+	+	+					
Netherlands	GFS	+		+					
Norway	TRL				+				
International	GFS	+	+	+					

Full diagnostic statistics for each stock will be made available to ACFM on floppy disc.

Trends in fishing effort (hours fishing) for the commercial fleets used for tuning are shown in Figures 11.1-11.3.

12 COD IN SUB-AREA IV

12.1 Catch Trends

Official landings data are given in Table 12.1. Trends in landings from Working Group estimates are given in Table 12.2 and graphed in Figure 12.1. The Working Group estimate of landings in 1989 is 119,000 t, compared to the TAC of 124,000 t. The landings were 20 % lower than in 1988, and were the smallest since 1964. Landings have declined markedly since 1981.

12.2 Natural Mortality and Maturity at Age

These values are given in Table 12.3. They are unchanged from those used last year.

12.3 Age Compositions

The VPA input data for recent years are given in Table 12.4. They do not include discards or industrial fishery by-catches. Data for 1988 were revised, but changes were only minor. Data for 1989 were provided by England, Scotland, Netherlands, Denmark, France and Germany.

12.4 Mean Weight at Age

Total international mean weights at age for the catch are given in Table 12.5. These were also used as stock weights at age.

12.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates. The fleets used in the tuning are given in the text table in Section 11. The research vessel indices are given in Table 10.1.

12.6 VPA Tuning

The Laurec-Shepherd method was used to tune the VPA. F for the oldest age was set as the mean of ages 7 to 11. A summary of the tuning results for each fleet is given in Table 12.6. F at age and numbers at age resulting from the tuned VPA are given in the Tables 12.7 and 12.8, respectively.

12.7 Abundance Estimates of the 1987-1990 Year Classes

The methods employed for deriving estimates of recruitment are described in Section 10. The results from the RCRTINX2 method, used as final values, are given in Tables 12.9a and b.

12.7.1 The 1987 year class in 1989

The RCRTINX2 estimate is 79 million which compares with the estimate derived from tuning of 52 million. It was decided to accept the RCRTINX2 estimate, which is close to the value of 74 million predicted in last year's assessment.

12.7.2 The 1988 year class in 1989

This was estimated to be 324 million at age 1, which compares with the tuned value of 360 million. Last year's estimate of this year class was 329 million but this was revised to 299 million in the ACFM assessment in November 1989.

12.7.3 The 1989 year class in 1990

This was estimated to be 169 million at age 1. Last year a preliminary value of 315 million was used by the Working Group, and this was subsequently revised to 221 million by ACFM in November 1989. Additional survey data now available indicate a much lower abundance for this year class.

12.7.4 The 1990 year class in 1991

The only survey information available at present is the 0-group estimate from the English Groundfish Survey. The RCRTINX2 estimate, with the survey and the mean receiving approximately equal weights, is 293 million at age 1. Further information on this year class should be available to ACFM from the preliminary results of the Dutch Groundfish Survey in October-November.

12.7.5 The 1991 and later year classes

These were set at the geometric mean for the period 1970-1989, which produced a value of 361 million at age 1.

12.8 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

Historical trends in mean fishing mortality, spawning stock biomass and recruitment are shown in Table 12.10 and Figure 12.1. Fishing mortality peaked in 1982 and appears to have stabilised subsequently. Spawning stock biomass reached an historically low value of 84,000 t in 1988 and is estimated to be 87,000 t at the beginning of 1990. No trend in recruitment is apparent, but all year classes since 1985 have been below average.

12.9 Catch Predictions

The input data for catch prediction are given in Table 12.11. The F value for age 1 (0.140) and the F for age 2 (0.970) are the mean for the period 1985-1989 and replace the tuned values of 0.084 and 1.188 (see Table 12.7).

12.9.1 Status quo prediction

The results of a *status quo* catch prediction are given in Table 12.12 and Figure 12.2. The *status quo* catch in 1990 is 143,000 t compared to 132,000 t predicted by ACFM last year. The same fishing mortality in 1991 results in a catch of 122,000 t. SSB will fall from 87,000 t in 1990 to 78,000 t in 1991, with a further fall to 71,000 t at the beginning of 1992.

12.9.2 Prediction assuming TAC taken in 1990

The results of this catch prediction are given in Table 12.13. The TAC of 105,000 t for 1990 implies a reduction in F of 33% in 1990 compared to 1989. SSB will rise from 87,000 t in 1990 to 105,000 t in 1991.

12.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 12.2.

12.11 Safe Biological Limits

The stock/recruitment scatter diagram is shown in Figure 12.3. Values for F_{med} (0.9) and F_{high} (1.05) are shown in Figure 12.3. The current level of F (0.86) is approximately at the F_{med} level. Spawning biomass at the beginning of 1990 was estimated to be 87,000 t, which is amongst the lowest in the historical series. The minimum spawning biomass advised by ACFM is 150,000 t.

The Group is concerned at the continuing low level of spawning biomass relative to the past historical series, and the fact that there has been no strong recruitment since the year class of 1985.

12.12 Critical Spawning Population Size

As an example of the method proposed by Serebryakov (1990), Figure 12.4 shows the indicator levels of spawning stock size for North Sea cod. A moderate survival (50% of the recruitment values fall either side of the line) and a spawning stock size of 280,000 t (safe level) result in a high recruitment (including 90% of the recruitment values). High survival conditions (10% of the recruitment values are above the line) are necessary to get the same high recruitment level at a spawning stock size of 150,000 t (critical level). The estimated current levels of SSB are far below this level.

13 COD IN DIVISION VIa

13.1 Catch Trends

Official landings data are given in Table 13.1, and trends in landings are shown in Figure 13.1. Working Group estimates of landings are given in Table 13.2, and these show that landings in 1989 were 17,167 t, which is a decrease of 16% on 1988. The agreed TAC for Sub-area VI (VIa+VIb) for 1989 was 18,400 t.

13.2 Natural Mortality and Maturity at Age

These values are given in Table 13.3 and are unchanged from those used last year.

13.3 Age Compositions

The VPA input data for recent years are given in Table 13.4; they do not include discards or industrial by-catch landings. Minor revisions were made to the 1988 data, and data for 1989 were provided by Scotland, England, Ireland, and France. As in 1988, the catch in 1989 was dominated by the 1986 year class.

13.4 Mean Weight at Age

Total international mean weights at age for the catch are given in Table 13.5. These values were also used for the stock weights at age.

13.5 Commercial Catch/Effort Data and Research Vessel Indices

The data from the commercial fleets were used to tune the VPA and, together with research vessel data, to provide recruitment indices. The fleets used in the tuning are given in the text table in Section 11, and the research vessel indices are given in Table 10.4.

13.6 VPA Tuning

The Laurec-Shepherd method was used to tune the VPA. F for the oldest age was set as the mean of ages 4-8. A summary of the tuning results for each fleet is given in Table 13.6. F at age and numbers at age resulting from the tuned VPA are given in Tables 13.7 and 13.8, respectively.

13.7 Abundance Estimates of the 1987-1990 Year Classes

The results from the RCRTINX2 method are given in Table 13.9. Various indices of abundance for Division VIa and Sub-area IV were examined, and the four indices finally included in the analysis are given in Table 10.4.

Difficulties still exist in estimating recruitment for this stock, but it is hoped that the situation will improve as further years are added to the time series of the Scottish West Coast Groundfish Survey.

13.7.1 The 1987 year class in 1989

This was estimated to be 5.0 million at age 2, which compares with the tuned estimate of 2.5 million. The RCRTINX2 estimate was accepted, and it is somewhat lower than the value of 6.3 million predicted in last year's assessment.

13.7.2 The 1988 year class in 1989

The RCRTINX2 estimate for this year class is 15.3 million at age 1.

13.7.3 The 1989 year class in 1990

The preliminary estimate for this year class, based on the SGFS at age 1, is 11.0 million at age 1.

13.7.4 The 1990 year class in 1991

This was set at the geometric mean over the period 1970-1989, the resulting value being 10.5 million at age 1.

13.8 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

Estimates of biomass, fishing mortality rate, and recruitment are given in Table 13.10, and plots are shown in Figure 13.1. Spawning stock biomass declined from 1981 to reach a historically low value in 1986 of 19,000 t but is estimated to have increased in the following three years, to reach 28,000 t in 1990. Mean fishing mortality peaked in 1985 and has subsequently declined. Recruitment in the past decade has been at a higher level than in previous years.

13.9 Catch Predictions

Input data for catch prediction are given in Table 13.11. Stock numbers for ages 3 and older fish are the tuned values from VPA. The values for ages 1 and 2 are estimated as described in Section 13.7 above. The tuned F values for ages 1 and 2 have been replaced by average values. The results of catch predictions are given in Tables 13.12 and 13.13, and in Figure 13.2. The *status quo* catch in 1990 is predicted to be 18,000 t, compared to the TAC for Sub-area VI of 16,000 t. The same F value in 1991 is predicted to result in a catch of 17,000 t. Spawning stock biomass will fall from 28,000 t in 1990 to 27,000 t in 1991, and to 26,000 t in 1992. If the landings are held at the TAC level of 16,000 t in 1990, the implied reduction in F is 16%. This will lead to a slight increase in SSB in 1991 to 30,000 t.

13.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 13.2.

13.11 Safe Biological Limits

The stock recruitment relationship is shown in Figure 13.3. Values for F_{med} (0.7) and F_{high} (1.2) are shown in Figure 13.2. The current level of F is slightly above F_{med}. Spawning stock biomass is currently close to the average level for the past 20 years.

14 COD IN DIVISION VIb

No age composition data are available for this stock. Landings are small and are given in Table 14.1.

15 COD IN DIVISION VIId

15.1 Catch Trends

Recent nominal landings and Working Group estimates are given in Table 15.1. Landings in 1986 and 1987 (13,000-14,000 t) were well above those for previous years, but have fallen in the two subsequent years to 9,400 t and 5,500 t, respectively.

15.2 Natural Mortality and Maturity at Age

The values used for VPA are given in Table 15.2.

15.3 Age Compositions and Mean Weight at Age

The VPA input data are given in Tables 15.3 and 15.4. Data for 1988 were updated, and data for 1989 were provided by France and England. Weight at age in the stock was assumed the same as in the landings.

15.4 VPA

No data are available for tuning the VPA and, therefore, a separable VPA was run. Trial values of F and S were input and final values of F = 1 for age 3 and S = 1 were adopted. The log-catch ratio residuals are given in Table 15.5. They indicate the high variability of the catch-at-age data.

A separable analysis using program RCSEP (Cook) was also run, and the results are given in Table 15.6. The erratic values for year and age effects confirm that the quality of the basic data is poor.

15.5 Estimates of Recruitment

There are as yet no recruitment data for this area. However, a survey was started by France in October 1988, and a groundfish survey by England will take place in November and December 1990.

15.6 Catch Predictions

At last year's meeting, a VPA and a full catch prediction were computed. However, after considering the results from the two separable analyses, this year the Group came to the conclusion that the age composition data are not sufficiently reliable for a valid catch prediction to be made. Moreover, since no recruitment data are available, it was considered that a SHOT forecast would not be useful.

16 COD IN DIVISION VIIe

16.1 Catch Trends

Nominal landings for recent years together with Working Group estimates are given in Table 16.1. The Working Group estimates show that, after a sharp increase to 2,699 in 1987, landings have decreased in the two following years to 2,387 t and 1,679 t, respectively.

16.2 Catch Prediction

No analytical assessment is possible, although sampling of English landings commenced in 1989. It was decided this year not to attempt a SHOT forecast for this area, since data on recruitment are lacking.

17 COD IN OTHER DIVISIONS OF SUB-AREA VII

Cod in Division VIIa, and Divisions VIIf,g are assessed by the Irish Sea and Bristol Channel Working Group.

No age composition data for cod in other areas are available. Landings for recent years are given in Table 17.1.

18 HADDOCK IN SUB-AREA IV

18.1 Catch Trends

Official landings figures are given in Table 18.1. Total international catches and total international discards as estimated by the Working Group are given in Table 18.2. Catch trends are plotted in Figure 18.1. Total human consumption landings in 1989 were estimated by the Working Group to be 76,000 t although the total nominal landings were reported as 64,000 t. The difference is due largely to misreporting in one country. Misreported landings were reallocated to area on the basis of information available to members of the Working Group. The degree of misreporting is such as to invoke some uncertainty about the probable level of catches in 1989 and this has obvious implications for the subsequent analysis.

Total human consumption landings in 1989 were about 70% of those in 1987 and 1988 and about half the average over the fairly stable period 1982-1986. Industrial by-catch remains low at 2,000 t.

The agreed TAC for 1989 was 68,000 t.

18.2 Natural Mortality and Maturity at Age

These values are given in Table 18.3 and are the same as those used last year.

18.3 Age Compositions

Total international catch-at-age data are given in Table 18.4. Age compositions for human consumption landings were supplied for 1989 by Denmark, England, France and Scotland. Age compositions for discards were supplied by Scotland and, for industrial by-catch, by Norway.

18.4 Mean Weights at Age

Total international mean weights at age are given in Table 18.5. These values are also used as stock mean weights at age.

18.5 Commercial Catch-Effort-Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates. The commercial fleet data and survey data used to tune the VPA are indicated in the text table in Section 11. The research vessel indices used to estimate recent recruitment are presented in Table 10.2.

18.6 VPA Tuning

Table 18.6 gives a summary of the VPA tuning statistics. The estimates of F at age and numbers at age resulting from the tuning are given in Tables 18.7 and 18.8, respectively.

18.7 Abundance Estimates of the Year Classes 1987-1990

Methods for estimating recruitment are described in Section 10. RCRTINX2 output summaries are shown in Tables 18.9a and 18.9b for ages 1 and 2, respectively.

18.7.1 1987 year class in 1989

The RCRTINX2 estimate of the 1987 year class at age 2 is 129.5 million. This may be compared with the value of 74.1 million estimated by Laurec-Shepherd tuning. The forecast of the abundance of this year class at age 2 made by last year's Working Group was 93.7 million.

18.7.2 1988 year class in 1989

The RCRTINX2 estimate of the 1988 year class at age 1 is 1348.9 million which compares with the 1219.2 million estimated by Laurec-Shepherd tuning. The forecast of the abundance of this year class at age 1 made by last year's Working Group was 977.5 million.

18.7.3 1989 year class in 1990

The RCRTINX2 estimate of this year class at age 1 is 1646.2 million. This may be compared with the value of 985.3 million estimated by Laurec-Shepherd tuning.

18.7.4 1990 year class in 1991

English and Scottish Groundfish Survey 0-group indices allow RCRTINX2 to predict the abundance of this year class in 1991 as 1-group fish. The estimated abundance is 6946 million, which indicates a rather stronger year class than of late. The approximately equivalent number as 0-group in 1990 is 53956 million (6946 * e**2.05). However, the English and Scottish Groundfish Survey 0-group indices give conflicting impressions of the strength of this year class. The former (least weighted by RCRTINX2 at 11%) indicates a value as 1-group which is less than the VPA 1-group mean (1970-1986), whilst the latter (heavily weighted by RCRTINX2 at 53%) indicates a value in excess of the mean (which has a 36% weighting).

18.7.5 Abundance of the 1991 and 1992 year classes at age 0

The abundance of these year classes was assumed to be 27418 million, the geometric mean value for the period 1970 to 1989.

18.8 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

Trends in biomass, fishing mortality, and recruitment are given in Table 18.10 and plotted in Figure 18.1. Human consumption fishing mortality rate in 1989 does not appear to be much reduced in respect of recent years whilst that due to the industrial by-catch remains relatively low.

The estimate of recruitment in 1989 continues the below-average series of year classes since the 1983 year class (excluding that of 1986). In consequence, the estimate of spawning stock biomass at the start of 1989 (122,000 t) is at its lowest level since 1979. Total stock biomass at the start of 1989, which excludes 0-group, is estimated to be 447,000 t. This figure is only marginally higher than the corresponding value for 1988 which was the lowest value on record. Total stock biomass at the start of 1990 is estimated to be 385,000 t with the spawning stock at 86,000 t.

18.9 Catch and Biomass Predictions

Input data for predictions are given in Table 18.11. Values of F at ages 0, 1, and 2 in 1989, obtained by tuning, were replaced by scaled, mean Fs for the period 1985-1989.

As the agreed TAC of 68,000 t was exceeded by about 11,000 t in 1989, the Working Group considered it likely that the 1990 TAC would also be exceeded. Therefore, the *status quo* prediction given below is considered to be more relevant than that of the TAC constrained prediction.

It must be stressed that spawning biomass predictions for the start of 1992 are largely contingent upon the high Scottish Groundfish Survey 0-group index for 1990.

18.9.1 Status quo prediction

Total landings in 1990 at status quo are expected to be 63,000 t, 59,000 t for the human consumption fishery and 4,000 t as industrial by-catch. Discards would amount to 26,000 t. Results of the prediction are given in Table 18.12 and plotted in Figure 18.2. The total and spawning stock estimates at the start of 1991 amount to 1,182,000 t and 81,000 t, respectively. This level of spawning stock is well below any previously recorded levels although the total stock biomass is forecast to be at the second highest level since 1975.

If the 1989 human consumption fishing mortality rate is maintained in 1991, it is expected that landings in 1991 will be 61,000 t of which about 54,000 t are human consumption landings and about 6,000 t are industrial by-catch. 64,000 t will be discarded. The spawning biomass at the start of 1992 is expected to increase to 150,000 t.

18.9.2 TAC constrained prediction

Results for this prediction are given in Table 18.13. The agreed TAC is 50,000 t. Assuming catches for human consumption and as industrial by-catch do not exceed this value, the human consumption fishing mortality rate will be 69% of its 1989 value. In addition, the total and spawning stock biomasses at the start of 1991 would be 1,202,000 t and 97,000 t, respectively. This spawning stock estimate is below any previous level but the total stock estimate is bolstered by the predicted level of the 1990 year class and would be at the highest value since 1984 and the second highest since 1975.

If F in 1991 is the same as F in 1989, the expected human consumption landings are 65,000 t with the same amount discarded and 7,000 t taken as the industrial by-catch. Spawning stock biomass at the start of 1992 would be 158,000 t on this basis.

18.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 18.2.

18.11 Safe Biological Limits

The stock and recruitment plot is shown in Figure 18.3. In its report of 1987, the Working Group suggested that 100,000 t should be the lowest acceptable level for spawning biomass. Spawning biomass is estimated to be currently below that level (86,000 t at the start of 1990) and is expected to remain below that level at the start of 1991 (97,000 t assuming the 1990 TAC is adhered to and 81,000 t if it is not). However, due to the predicted strength of the 1990 year class, the spawning biomass at the start of 1992 is expected to rise to 150,000 t, assuming the 1989 fishing mortality rate is maintained.

The current value of mean F (0.95) is in excess of F_{med} (0.6). F_{high} is rather indeterminate due to the shallow slope of the SSB/R curve at higher levels of F.

19 HADDOCK IN DIVISION VIa

19.1 Catch Trends

Officially-reported landings are given in Table 19.1. Total international catches and total international discards as estimated by the Working Group are given in Table 19.2. Catch trends are plotted in Figure 19.1. Total human consumption landings in 1989 were estimated by the Working Group to be 17,000 t, although the total nominal landings were reported as 22,000 t. The difference is due largely to misreporting in one country. Misreported landings were reallocated to area on the basis of information available to members of the Working Group. The degree of misreporting is such as to invoke some uncertainty about the probable level of catches in 1989 and this has obvious implications for the subsequent analysis.

There is no TAC explicitly applicable to Division VIa. The agreed TAC for 1989 for the whole of Sub-area VI was 24,000 t.

19.2 Natural Mortality and Maturity at Age

These values are given in Table 19.3 and are the same as those used last year.

19.3 Age Compositions

Total international catch at age data are given in Table 19.4. Age compositions for human consumption landings were supplied for 1989 by England, France, Ireland and Scotland. Age compositions for discards were supplied by Scotland.

19.4 Mean Weights at Age

Total international mean weights at age are given in Table 19.5. These values are also used as stock mean weights at age.

19.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates. The commercial fleet data used to tune the VPA are indicated in the text table in Section 11. The research vessel indices and commercial CPUE data used to estimate recent recruitment are discussed in Section 10.1 and presented in Table 10.5.

19.6 VPA Tuning

Table 19.6 gives a summary of the VPA tuning statistics. The estimates of F at age and numbers at age resulting from the tuning are given in Tables 19.7 and 19.8, respectively.

19.7 Abundance Estimates of the Year Classes 1987-1990

Methods for estimating recruitment are described in Section 10. RCRTINX2 output summaries are shown in Tables 19.9a and 19.9b for ages 1 and 2, respectively.

Plots of recruitment for Division VIa haddock against North Sea haddock for ages 1 and 2 are shown in Figure 19.4.

19.7.1 1987 year class in 1989

The RCRTINX2 estimate of the 1987 year class at age 2 is 21.6 million. This may be compared with the value of 7.6 million estimated by Laurec-Shepherd tuning. The forecast of the abundance of this year class at age 2 made by last year's Working Group was 24.3 million.

19.7.2 1988 year class in 1989

The RCRTINX2 estimate of the 1988 year class at age 1 is 29.3 million which compares with the 17.8 million estimated by Laurec-Shepherd tuning. The forecast of the abundance of this year class at age 1 made by last year's Working Group was 39.6 million (the lower quartile value of the recruitment time series).

19.7.3 1989 year class in 1990

The RCRTINX2 estimate of this year class at age 1 is 49.3 million. This may be compared with the value of 164.6 million estimated by Laurec-Shepherd tuning.

19.7.4 1990 year class in 1991

This could be estimated from RCRTINX2 because the North Sea VPA 1-group series was correlated with 1-group abundance in Division VIa (Figure 19.4), and the North Sea 1-group index for the 1990 year class was available from the RCRTINX2 analysis for the North Sea (Section 18.7.4). The estimated abundance as 1-group fish is 246.8 million making this similar to the 1986 year class.

19.7.5 Abundance of the 1991 and 1992 year classes at age 0

The abundance of these year classes was assumed to be 115.5 million, the geometric mean value for the period 1970 to 1989.

19.8 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

Trends in biomass, fishing mortality, and recruitment are given in Table 19.10 and plotted in Figure 19.1. Fishing mortality in 1989 remained at a high level.

The level of recruitment in 1989 remains at the lower end of the range for the time series. All year classes since 1983, except the 1986 year class, have been of below average abundance. The 1986 year class is now estimated to be the fifth largest since 1970. Total stock biomass at the start of 1989 (46,000 t) is at its lowest level since 1978 whilst the corresponding spawning biomass level (37,000 t) continues the downward trend, apparent since 1985, and is at the lowest level since 1980.

19.9 Catch and Biomass Predictions

Input data for predictions are given in Table 19.11. Values of F at ages 0, 1 and 2 in 1989, obtained by tuning, were replaced by scaled, mean Fs for the period 1985-1989. As no TAC is explicitly applicable to Division VIa, a TAC constrained prediction was not made.

19.9.1 Status quo catch prediction

Table 19.12 and Figure 19.2 give results of predictions assuming that fishing mortality in 1990 will be the same as in 1989. The predicted human consumption landings in 1990 are 12,000 t compared to the 17,000 t predicted by last year's Working Group and the TAC recommended by ACFM for catch in Division VIa of 14,000 t.

Human consumption landings at status quo fishing mortality in 1991 are predicted to be 9,300 t. This will continue the run of diminishing landings, apparent since 1987, and is largely due to a succession of poor year classes entering the stock and the reduced influence of the 1986 year class.

In parallel with this, spawning biomass is expected to decrease to 15,000 t at the start of 1991 from the 22,000 t estimated at the start of 1990. This is lower than any previously recorded level. However, the influence of the apparently strong 1990 year class is expected to push spawning biomass level up to 28,000 t at the start of 1992, assuming status quo fishing mortality.

19.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 19.2.

19.11 Safe Biological Limits

The stock and recruitment plot is shown in Figure 19.3. The value of F_{med} (0.33) is shown in Figure 19.2 and is considerably less than the current mean level of F (0.86). The value of F_{high} is rather indeterminate due to the shallow slope of the SSB/R line at higher values of F.

Spawning biomass at the start of 1991 is expected to be an all time low.

20 HADDOCK IN DIVISION VIb

20.1 Catch Trends

Officially-reported landings for recent years are given in Table 20.1. The nominal landings in 1989 were 6,272 t which is similar to recent years.

20.2 Age Compositions

Age compositions were available from Scotland in 1989 which accounted for most of the catch that year. Total international catch-at-age data are given in Table 20.2. Catch-at-age for 1986 and 1987 has been revised in the light of higher final landings figures. Nearly half of the landings in 1989 are accounted for by the 1984 year class.

20.3 Mean Weight at Age

Mean weights at age are given in Table 20.3.

20.4 Abundance Indices

Indices of abundance from research vessel surveys conducted since 1985 are given in Table 20.4. Only surveys from 1988 onwards have used the same vessel. As in previous years, a linear model has been fitted to the data to obtain year class estimates with the year (or vessel) effect removed. This year, the data for 0-group fish have been omitted since the catches of these fish do not seem to reflect abundance. The results of fitting the model are given in Table 20.5.

20.5 Analysis of Catch at Age Data

There are now five years of catch at age data for this stock. In previous assessments, a separable model (Cook et al., in press) has been fitted to the data. It is clear that this model is not entirely appropriate for this fishery since the separable assumption is almost certainly violated. It was found that the data for 1985 have a substantial effect on the estimated model values due to a much larger than expected catch of 4-year-olds that year. Leaving this year out of the analysis leads to the analysis given in Table 20.6. The estimated year effects follow the relative change in fishing effort by Scottish vessels (Table 20.7).

In addition to the separable analysis, a conventional VPA was run where F in the last year was set to the four-year-mean and F on the oldest age was set the the average of ages 4-8. The results of this analysis are given in Table 20.8. The principal differences are seen in the most recent year at the younger ages. Clearly, with such a short span of years,the analysis is questionable but the degree of similarity with the separable analysis is encouraging and suggests that the catch-at-age data are tolerably accurate.

20.6 Recruitment

Tables 20.5 and 20.6 give estimates of year-class strength obtained from the research vessel data and commercial catch data, respectively. The models permit estimates of yearclass strength for year classes prior to 1985 to be made and hence provide the longest time series available to calibrate recent abundance estimates. The data are plotted in Figure 20.1. Use of calibration regression with shrinkage towards the long-term mean gives the estimated log recruitment values at age 2 in Table 20.9. These values have been used in forecasts.

20.7 State of the Stock

It is difficult with such a short time series to judge recent trends. Table 20.10 gives estimates of SSB and mean F. SSB appears to be at around 12,000 t which is near the recent average. Fishing mortality is high and has increased reflecting rising effort by the Scottish fleet. The analysis suggests that recent recruitment has been fairly stable and near the long-term geometric mean.

20.8 Yield and Biomass per Recruit

Yield and biomass per recruit are plotted in Figure 20.2.

20.9 Status Quo Catch Prediction

A status quo catch forecast was run using the population numbers and F at age estimated from conventional VPA. The input values are given in Table 20.11. The populations at age 1 and 2 have been replaced by the corresponding values emerging from the reruitment calibration line. Predicted status quo catches and SSBs are given in Table 20.12. For 1991, the predicted value is 5,300 t. As a check, a similar forecast was run using the inputs from the separable analysis. Very similar values were obtained and are thus not presented. A sensitivity analysis of the forecast is given in Section 32.

The present forecast is very consistent with the forecast given last year. The predicted catch for 1989 made last year was 5,469 t. The realised catch was 6,272 t but this corresponds to an increase in observed effort over status quo of about 30%. This is encouraging but care still needs to be exercised in using the forecasts. It is clear that the forecast depends heavily on estimates of recruitment and the indices presently available have high estimated variances.

21 HADDOCK IN SUB-AREA VII

Nominal landings from Divisions VII b-e, g-k are given in Tables 21.1a-c.

22 WHITING IN SUB-AREA IV

22.1 Catch Trends

Total nominal landings and total international catches as estimated by the Working Group are given in Tables 22.1 and 22.2, respectively. Total international catches in 1989 amounted to 119,000 t, of which 41,000 t were human consumption landings and 43,000 t were industrial by-catch. The industrial by-catch decreased slightly from 1988, but in 1989 for the first time since 1977 they were at a higher level than the human consumption landings. Total estimated landings were well below the predicted landings for 1989 of 138,000 t given in last year's report and the 1989 TAC of 115,000 t. Catch trends for the last 20 years are shown in Figure 22.1. The declining trend of both catches and landings since the second half of the 1970s appears to continue.

22.2 Natural Mortality and Maturity at Age

Natural mortality coefficients at age and the proportion mature at age used as inputs to the VPA are given in Table 22.3.

22.3 Age Compositions

Age composition data for 1988 were updated and age compositions for 1989 were prepared (Table 22.4). Human consumption landings data were provided by Scotland, the Netherlands, England and France. Only Scotland provided discard data. Denmark and Norway provided industrial by-catch data. The data for Norway are based on direct sampling. Denmark estimated industrial by-catch age compositions as described in Section 3.

22.4 Mean Weight at Age

Total international mean weight at age for the catch (also used as the stock mean weight at age) are given in Table 22.5.

22.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates. The fleets used in the analyses are given in Section 11. The research vessel indices are given in Table 10.3.

22.6 VPA Tuning

The summary statistics of the tuning are given in Table 22.6. Total international fishing mortality rates and stock numbers at age given by the Laurec-Shepherd tuning method are shown in Tables 22.7 and 22.8, respectively. Fs for the oldest age groups (9 and 10) were set at the mean of the F values of the preceding five ages (4-8).

22.7 Recruitment Estimates

The method employed for deriving estimates of recruitment is described in Section 10. The results of RCRTINX2 are given in Tables 22.9a and b.

22.7.1 The 1987 year class in 1989

This was estimated to be 1255 million, compared with a tuned VPA value of 485 million 2-group in 1989.

22.7.2 The 1988 year class in 1989

This was estimated to be 5533 million, compared with the tuned VPA value of 5554 million 1-group in 1989.

22.7.3 The 1989 year class in 1990

This year class was estimated to be 3760 million at age 1 in 1990. The natural mortality at age 0 is 2.55. The number at age 0 in 1989 can then be approximated by exp(2.55) * 3,760 which results in 48155 million.

22.7.4 The 1990 and later year classes

From the 0-group survey data, the 1990 year class was estimated to be 3210 million at age 1 corresponding approximately to 48421 million at age 0. The later year classes were set at the geometric mean recruitment (over the period 1970-1989) at age 0 of 45572 million.

22.8 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

These are tabulated in Table 22.10 and graphed in Figure 22.1. Mean fishing mortality for human consumption catch (ages 2-6) has decreased recently and is currently 0.691, the lowest value since 1982. However, the 20 years' time series shows no obvious trend in human consumption fishing mortality. Industrial by-catch F has increased considerably since 1986 and is now 0.152, the second highest value since the 1981 high value of 0.171. Spawning stock biomass has increased to 365,000 t and is currently at its highest level since 1981, very close to the average of 368,000 t for the period 1970-1989. Recruitment was at the average level in 1989.

22.9 Catch Predictions

The input data for catch predictions are given in Table 22.11. The F values for ages 0-2 have been set to the mean over the period 1985-1989 and differ from the tuned values from the VPA.

22.9.1 Status quo prediction

The results of the status quo prediction are given in Table 22.12 and Figure 22.2. Both the predicted human consumption landings and the industrial by-catch in 1990 are 75,000 t. The high prediction of industrial by-catch is due to the expected large numbers of young fish in the sea due to the strong 1988 year class. In 1991, the human consumption landings are expected to be 82,000 t, and the industrial by-catch 66,000 t. Spawning stock biomass is expected to rise to 474,000 t at the beginning of 1990 and to come down slightly to 437,000 t in 1991 followed by a further fall in 1992 to 375,000 t.

22.9.2 TAC prediction

The results of this prediction are given in Table 22.13. The agreed TAC for North Sea whiting in 1989 is 125,000 t. This TAC has been set on the basis of an average recruitment in 1988. Due to the strong 1988 year class, the catches of the small mesh fisheries are expected to be much higher than were predicted in the 1989 report. In such a situation to take the TAC in 1990 requires a reduction of F in the human consumption fisheries of 40%. In this case the human consumption landings in 1990 would be 49,000 t and the industrial by-catch 79,000 t. In 1991, they would be 95,000 t and 71,000 t, respectively. Under that assumption the spawning stock biomass would rise to 477,000 t in 1991 and then decrease to 392,000 t in 1992.

22.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 22.2.

22.11 Safe Biological Limits

The scatter diagram of recruitment and spawning stock biomass is shown in Figure 22.3. The value for F_{med} (0.75) is shown in Figure 22.2; the current value of F (0.69) is a little below this. F_{high} was considerably higher than the range of F values considered here. The spawning stock is very close to its historical average level and is expected to increase in 1990 and to remain at a higher level than the current one in 1991 and 1992.

23 WHITING IN DIVISION VIa

23.1 Catch Trends

Total nominal landings and total international catches as estimated by the Working Group are given in Tables 23.1 and 23.2, respectively. Total international catches in 1989 amounted to 6,300 t, all of which were landed for human consumption. Landings were well below both the predicted status quo level of landings for 1989 of 11,000 t given in last year's report and the agreed TAC of 16,400 t for Sub-area VI. Catch trends for the last 20 years are shown in Figure 23.1. Landings are at their lowest level on record.

23.2 Natural Mortality and Maturity at Age

Natural mortality coefficients at age and the proportion mature at age used as input to the VPA are given in Table 23.3.

23.3 Age Composition

Age composition data for 1988 were updated, and data for 1989 were compiled (Table 23.4). Age composition data were provided by Scotland and Ireland. Catches were dominated by 3-year-old fish which contributed 49% by number.

23.4 Mean Weight at Age

Total international mean weight at age in the catches (also used as the stock mean weight) are given in Table 23.5.

23.5 Commercial Catch/Effort Data and Research Vessel Indices

These data were used to tune the VPA and to provide recruitment estimates. The fleets used in the analysis are referred to in Section 11. The research vessel indices are given in Table 10.6.

23.6 VPA tuning

The results of the tuning are given in Table 23.6. Total international fishing mortality rates and stock numbers at age provided by the Laurec-Shepherd tuning method are shown in Tables 23.7 and 23.8, respectively.

23.7 Recruitment Estimates

The method used to derive estimates of recruitment is described in Section 10. No discard data are available on this stock. It was, therefore, decided not to use Scottish CPUE on ages 1 and 2 to derive recruitment estimates. The stock numbers at age 1 from VPA in the North Sea and Division VIa are correlated (see Figure 23.4), and recruitment indices are available for ages 1 and 2 from the Scottish Groundfish Survey in the North Sea. These three series of indices have, therefore, been used.The results of RCRTINX2 are given in Tables 23.9a and b.

23.7.1 The 1987 year class in 1989

The abundance of the 1987 year class at age 2 was estimated to be 32 million.

23.7.2 The 1988 year class in 1989

The abundance of this year class was estimated to be 49 million at age 1. The tuned value is 16 million.

23.7.3 The 1989 and 1990 year classes

These were estimated to be 54 million and 69 million at age 1, respectively.

23.7.4 The 1991 and later year classes

These were set at the geometric mean recruitment (over the period 1970-1989) at age 1 of 65 million.

23.8 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

These are tabulated in Table 23.10 and graphed in Figure 23.1. Mean fishing mortality (ages 2-4), which was already at a high level, has increased and is currently 1.04. Spawning stock biomass has decreased and is currently at its lowest level for the last 20 years. Both the 1988 and 1989 year classes are below the historical average.

23.9 Catch Predictions

The input data for catch predictions are given in Table 23.11. The F values for ages 1 and 2 have been set to the mean over the period 1985-1989.

23.9.1 Status quo prediction

The results of the status quo prediction are given in Table 23.12 and Figure 23.2. The predicted landings in 1990 and 1991 are both 10,000 t. Spawning stock biomass is expected to decline further from 17,000 t in 1989 to 15,000 t in 1990, but to rise slightly to 16,000 t in 1991, followed by a further increase to 18,000 t in 1992.

23.9.2 TAC prediction

As the status quo landings in 1990 are not very different from the TAC for 1990 of 11,000 t, no prediction with a TAC constraint was made.

23.10 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 23.2.

23.11 Safe Biological Limits

The scatter diagram of recruitment and spawning stock biomass is shown in Figure 23.3. The values for F_{med} and F_{high} are shown in Figure 23.2; the current value of F (0.86) is above F_{med} (0.70). The spawning stock is currently at its lowest level and is not expected to increase significantely in the near future.

24 WHITING IN DIVISION VIb

Landings of whiting from Division VIb are insignificant (Table 24.1)

25 WHITING IN DIVISION VIId

25.1 Catch Trends

Total nominal landings are given in Table 25.1 together with Working Group estimates (see also Table 25.2). Total landings have been decreasing since 1980 and were 4,148 t in 1989 (Figure 25.1).

25.2 Natural Mortality and Maturity at Age

The values used for VPA are given in Table 25.3. Previously a knife-edge maturity was used. This year, data of proportion mature at age were available from the French Groundfish Survey in the eastern Channel in 1989.

25.3 Age Composition and Mean Weight at Age

The VPA input data are given in Tables 25.4 and 25.5. Further revisions were made for the period 1986-1989 to take account of revised landings data. Data for 1989 were provided by England and France. Weight at age in the stock was assumed to be the same as in the landings.

25.4 VPA

No data are available for tuning the VPA and, therefore, two separable VPAs, using, respectively, the RCSEP program (Cook, et al., in press) and the Lowestoft package, were run. The results of these two runs are not identical, but the parameter estimates from the two methods seem to be plausible. In the absence of any other information, it was decided to use the second run to stay consistent with last year's report. Values of F = 1 for age 3 and S = 1 were adopted. The log catch ratio residuals are given in Table 25.6. They indicate the high variability of the catch-at-age data. The terminal population numbers from the separable VPA were used to initiate a conventional VPA, and the resulting estimates of F and N at age are given in Tables 25.7 and 25.8.

25.5 Recruitment Estimates

There are no recruitment data for this area. The VPA estimates for age 1 do not correlate with any of the survey indices in the North Sea or with VPA estimates from that area.

25.5.1 The 1988 and later year classes

In the absence of other data, these values have been set to the geometric mean of 35 million over the period 1976-1988.

25.6 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

These are tabulated in Table 25.9 and graphed in Figure 25.1. Fishing mortality has decreased since 1986 but remains at a high level and is currently 0.93. Total biomass has increased but the spawning stock biomass is very close to its lowest level.

25.7 Catch Prediction

The input data for the catch prediction are given in Table 25.10 and the results in Table 25.11 and Figure 25.2. The predicted status quo landings are 4,500 t in 1990 and 5,100 t in 1991. Spawning stock biomass is predicted to increase to 7,300 t in 1991 and to 7,600 t in 1992.

25.8 Yield and Biomass per Recruit

Plots of yield and biomass per recruit are shown in Figure 25.2.

25.9 Safe Biological Limits

The stock/recruitment scatter diagram is shown in Figure 25.3. The values for F_{med} (0.73) and F_{high} (1.45) are shown in Figure 25.2. The current value of F (0.93) is well above F_{med}. The spawning stock biomass is very close to its historical minimum.

25.10 Reliability of Assessment

Although there has been some improvement in the data base for some years, it is pointed out that the reliability of the assessment is lower than for the others stocks dealt with by this Working Group. Therefore, the assessment and catch prediction results should be considered with caution.

26 WHITING IN DIVISION VIIe

26.1 Catch Trends

Nominal landings for recent years together with Working Group estimates are given in Table 26.1. The Working Group estimates show that after an increase to 1,921 t in 1987 and 2,294 t in 1988, landings have decreased to 1,541 t in 1989.

26.2 Catch Prediction

Since there has been no catch-at-age data since 1987, no analytical assessment is possible. It was decided this year not to attempt a SHOT forecast for this area, since there are no recruitment data.

27 WHITING IN OTHER DIVISIONS OF SUB-AREA VII

Whiting in Division VIIa and Divisions VIIf,g are assessed by the Irish Sea and Bristol Channel Working Group.

No age composition data are available for other areas. Nominal landings for the period 1980-1989 are given in Table 27.1.

28 SAITHE IN SUB-AREA IV AND DIVISION IIIa

28.1 Catch Trends

Recent nominal landings are given in Table 28.1. Working Group estimates are in Table 28.2 and are plotted in Figure 28.1. Landings were high in the early 1970s, reaching a maximum of 320,000 t in 1976. Subsequently, landings declined to 114,000 t in 1979. After that, the landings followed an increasing trend to reach 200,000 t in 1985. Since then the landings have decreased considerably. In 1988 and 1989, the landings are estimated to be 105,000 t and 92,000 t, respectively. Small amounts of saithe are taken as industrial by-catch. Since 1976, the average industrial by-catch has been 3,000 t (Table 28.2). The agreed TAC in 1989 was 120,000 t. 1989 was the fourth successive year that the TAC was not taken.

28.2 Natural Mortality and Maturity at Age

Values of natural mortality rate and maturity at age are given in Table 28.3.

28.3 Age Compositions

Total international age compositions are given in Table 28.4. Data for 1989 were supplied by Denmark, Germany, France, Norway, UK (England) and UK (Scotland). Discards are not included.

28.4 Mean Weight at Age

The mean weights at age in the landings are given in Table 28.5. These are also used as stock mean weights.

28.5 Commercial Catch/Effort and Research Vessel Indices

Commercial catch and effort data used to tune the VPA are indicated in the text table in Section 11. There are no research vessel indices of abundance for saithe.

28.6 VPA Tuning

Fishing mortality rates in 1989 for ages 2-8 were estimated from the Laurec-Shepherd tuning method (Table 28.6). For reasons mentioned in Section 11, it was not possible to tune the fishing mortality for age 1. Table 28.7 gives the values of fishing mortality rates, and Table 28.8 gives the stock numbers estimated by tuning.

28.7 Recruitment

No data to estimate recent recruitment are available. The Group decided to assume geometric mean recruitment at age 1 for the year classes 1987 onwards (232 million fish). However, the fact that the TACs have not been taken in the last four years indicates that recent recruitment may have been lower than the geometric mean. According to Figure 28.3, the spawning stock now seems to be at a level where good survival of spawning products will mainly result in average year classes while medium survival will result in poor ones. The Group, therefore, decided also to run a prediction with low recruitment (150 million fish).

28.8 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

Table 28.9 gives a summary of trends in fishing mortality, biomass, and recruitment as estimated by VPA. These data are also plotted in Figure 28.1.

In recent years, fishing mortality has increased from 0.31 in 1981 to 0.89 in 1986. Since then the fishing mortality has been steadily decreasing. In 1988 and 1989, the fishing mortalities are estimated to be 0.51 and 0.39, respectively. This reduction is supported by the fact that fishing effort by French and Norwegian vessels has decreased by 30% and 80%, respectively, since 1986. Total biomass has declined from 695,000 t in 1983 to 482,000 t in 1987, and spawning biomass has declined from 453,000 t in 1974 to 99,000 t in 1986 which is the lowest on record. For the years 1988 and 1989, the estimates are 125,000 t and 122,000 t, respectively. The spawning stock biomasses estimated this year are lower than those estimated in last year's report. The reason for this is that only French and Norwegian effort data were used for tuning the fishing mortality this year.

28.9 Catch Predictions

Input data for prediction are given in Table 28.10. Average number at age 1 was input for 1989. Number at age 2 in 1989 was input to produce an average number at age 1 in 1988. The fishing mortality rate at ages 1 and 2 in 1989 is the average of the period 1985 - 1989. Results of the predictions assuming average recruitment are given in Table 28.11 and in Figure 28.2.

28.9.1 Status quo prediction

Maintenance of the 1989 level of fishing mortality in 1990 will lead to landings of 116,000 t in 1990 and 125,000 t in 1991. Spawning stock size is predicted to increase from 122,000 t in 1989 to 233,000 t in 1992. However, this is dependent upon the assumptions about recent and future recrcuitment.

28.9.2 Prediction assuming TAC taken in 1990

The Group felt it unrealistic that the TAC of 120,000 t could be taken in 1990. Therefore, no prediction with a TAC constraint was run.

28.9.3 Prediction assuming low recruitment (Table 28.12)

Maintenance of the 1989 level of fishing mortality in 1990 will lead to landings of 109,000 t in 1990 and 104,000 t in 1991. Spawning stock biomass is predicted to increase from 122,000 t in 1989 to 209,000 t in 1992.

28.10 Yield and Biomass per Recruit

Yield and biomass per recruit are shown in Figure 28.2.

28.11 Safe Biological Limits

The stock/recruitment scatter diagram is shown in Figure 28.3. F_{med} (0.47) and F_{high} (0.70) are shown in Figure 28.2. The current level of F is a little lower than F_{med}. Spawning biomass is predicted to increase both with low and average recruitment.

29 SAITHE IN SUB-AREA VI

29.1 Catch Trends

Recent nominal landings are given in Table 29.1. Working Group estimates are given in Table 29.2 and are plotted in Figure 29.1. Landings increased in the early 1970s reaching 42,000 t in 1976. Landings then declined to 22,000 t in the early 1980s, and then increased to 40,000 t in 1986. Landings were 34,000 t in 1988 and 26,000 t in 1989. The agreed TAC in 1989 was 30,000 t.

29.2 Natural Mortality and Maturity at Age

Values of natural mortality rate and maturity at age are given in Table 29.3.

29.3 Age Compositions

Total international age compositions are given in Table 29.4. Data for 1989 were supplied by Germany, France, England and Scotland.

29.4 Mean Weight at Age

Mean weight at age in the landings are given in Table 29.5. These values were also used as stock mean weights.

29.5 Commercial Catch/Effort and Research Vessel Indices

The commercial catch and effort data used to tune the VPA are indicated in the text table in Section 11. There are no research vessel indices of abundance for saithe.

29.6 VPA Tuning

Fishing mortality rates in 1989 for ages 2-8 were estimated from the Laurec-Shepherd tuning method (Table 29.6). For reasons mentioned in Section 11, it was not possible to tune the fishing mortality for age 1. Table 29.7 gives the fishing mortality rates, and Table 29.8 gives the stock numbers estimated by tuning.

29.7 Recruitment

No data to estimate recent recruitment are available. The Group decided to assume geometric mean recruitment at age 1 for the year classes 1988 onwards.

29.8 Long-Term Trends in Biomass, Fishing Mortality, and Recruitment

Table 29.9 gives a summary of the trends in fishing mortality, biomass, and recruitment as estimated by VPA. These data are also plotted in Figure 29.1.

In recent years, fishing mortality has increased from 0.24 in 1984 to 0.53 in 1989. This increase is supported by the fact that the French vessels have increased their effort considerably (Figure 11.3). Total stock biomass increased from 98,000 t in 1977 to 144,000 t in 1985 and then declined to 99,000 t in 1989. The spawning stock biomass has declined from 94,000 t in 1974 to 28,000 t in 1989 which is the lowest on record.

29.9 Catch and Biomass Predictions

Input data for predictions are given in Table 29.10. The fishing mortality rate at age 1 in 1989 is the average of the period 1985-1989 obtained from tuning. Results of predictions are given in Table 29.11 and Figure 29.2.

29.9.1 Status quo prediction

Maintenance of the 1989 level of fishing mortality in 1990 will lead to landings of 27,000 t in 1990 and 25,000 t in 1991. Assuming geometric average recruitment of the 1988 and later year classes, the spawning biomass remains at the very low level of 29,000 t.

29.9.2 Prediction assuming TAC taken in 1990

The agreed TAC in 1990 is 29,000 t which is close to the predicted *status quo* catch. No prediction with a TAC constraint is, therefore, presented.

29.10 Yield and Biomass per Recruit

Yield and biomass per recruit are shown in Figure 29.2.

29.11 Safe Biological Limits

The stock/recruitment plot is shown in Figure 29.3. F_{med} (0.29) and F_{high} (0.40) are shown in Figure 29.2. The current level of F is well above F_{high}. Spawning biomass is predicted to stay at the lowest level on record even assuming geometric mean recruitment for the year classes of 1988 onwards.

30 SAITHE IN SUB-AREA VII

30.1 Landings

The provisional landings of saithe in Sub-area VII are given in Table 30.1. No data on the age composition of the catch were available.

31 RISK DIAGRAMS

31.1 1990 NAFO Meeting

In September 1990, a Special Session of NAFO was held on the "Management under uncertainties related to biology and assessments". One of the ideas which emerged from the meeting on the presentation of uncertainty to managers was risk diagrams. The preliminary suggestions are contained in the report of the meeting (NAFO SCS doc 90/25). The idea is to quantify the risk associated with "something bad" happening to the stock or fishery (Francis, 1990). As an example, one might wish to calculate the probability that the spawning stock biomass of a stock falls below a critical level. This could be done for a range of levels of exploitation. The risk (or probability) associated with reaching this critical level can then be plotted against the level of exploitation. Such a diagram has a number of advantages. It makes clear the risk associated with any level of exploitation but, perhaps more importantly, it leaves it to the manager to decide the level of risk he or she is willing to take.

The possibility of presenting diagrams of this type has been explored at this meeting using the North Sea cod as an example.

31.2 Risk Diagrams for Cod in Sub-area IV

Two examples of risk diagrams are presented for North Sea cod. These are defined as:

a) the risk, for various values of relative fishing effort, that the spawning stock will fall below a particular level;

b) the risk, for various levels of TAC, that will result in fishing mortality rising above status quo in the forecast year.

The analysis performed considers the risk associated with estimation errors for the forecast and uses the methodology in Cook et al. (in press) based on the estimated variance of the forecast. Figure 31.1 shows the risk associated with (a) where the critical level of SSB has been arbitrarily chosen as 100 thousand t. The diagram shows that for present levels of fishing mortality, the stock is almost certain to remain below this level. To have any expectation of the SSB rising above the set level would require a reduction in fishing mortality by at least 50%. The manager's problem is to weigh this risk against the other constraints in arriving at an appropriate TAC. The diagram avoids the problem encountered in last year's ACFM report which referred to "minimum acceptable level" of spawning stock. Such terminology naturally draws the manager to the conclusion that nothing less than a substantial reduction in effort is required. In this example, if the critical level is chosen carefully (admittedly a big "if") then the risk is made clear. Suitable ways of choosing critical SSB levels are also discussed in the NAFO report using definitions suggested by Serebryakov (1990) (see also Figure 12.4).

For many stocks in the North-East Atlantic, TACs are chosen near the status quo value. Laymen frequently interpret the figure chosen as being error-free. The danger of presenting 95% confidence intervals in any forecast is that there is a temptation to assume that it is equally legitimate to pick a status quo value from the upper limit of the interval. In Figure 31.2 the variance of the estimated status quo forecast is presented as a risk diagram. Here the risk is that F in the forecast year will rise above the desired status quo value. Obviously the 50% risk corresponds to the mean estimated forecast which in this case is a little above 120,000 t. By plotting the data in this way it is clear that a choice of TAC above the mean is increasingly likely to result in the failure to achieve the desired level of F. It is up to the manager to decide the level of risk he is prepared to take.

The two examples shown above could easily be repeated for any target SSB or fishing mortality rate. Equally it would not be difficult to conceive of other risk scenarios which might be of interest to managers. Comments are invited.

32 SENSITIVITY ANALYSIS OF FORECASTS

One of the many difficulties associated with assessments is the accuracy of forecasts, particularly catch forecasts. Since TACs are frequently based on the forecast it is important to achieve the best possible estimate. For most age-based assessments a number of input values are used in the prediction. These do not all make the same contribution to the result. Sensitivity analysis is one way of determining which input values or "parameters" contribute most to the forecast. These input values can then be critically examined to ensure the most approporiate value is chosen. Those parameters which only make a small contribution to the calculation will be of less concern. The sensitivity analysis, therefore, provides a systematic way of revealing the essential elements of the forecast.

Sensitivity analysis has been performed on the major Sub-areas IV and VI stocks as an aid to understanding the quality of the forecasts.

32.1 Methods

The input parameters for the forecast are number at age in 1989, fishing mortality at age, and recruitment. These values are all estimated with a degree of uncertainty. Using the Fourier Amplitude Sensitivity Test (FAST), the parameters can be disturbed in a systematic way according to the level of uncertainty and the effect on the forecast quantified. The details of such an analysis are given in Cook et al. (in press). Essentially the method is able to determine the proportion of the total variability in the forecast that is attributable to each input value or parameter. The forecast is most sensitive to those parameters which account for the greatest proportion of the variability.

The analysis was conducted on the status quo forecast of landings and spawning stock biomass.

32.2 Results

Results from the analysis are given in Figures 32.1-32.9. The parameters are identified in the figures by:

R1 = Recruitment at youngest age in 1989
R2 = Recruitment at youngest age in 1990
R3 etc.

N1 = number at age 1 in 1989
N2 = number at age 2 in 1989
etc.

F1 = fishing mortality in all years at age 1
F2 = fishing mortality in all years at age 2
etc.

32.2.1 Cod in Sub-area IV

Catch is most sensitive to recruiting year classes. There is high sensitivity to recruitment in 1991 at age 1 which is only poorly estimated.

SSB is highly sensitive to recruitment and fishing mortality at ages 2-4. In this year's assessment, the F at age 3 differs markedly from 1989 to 1990-1991. This may have an important effect on the estimate of SSB in 1992.

32.2.2 Cod in Division VIa

The results are very similar to those for Sub-area IV but catch is less sensitive to recruitment in 1990 and 1991. SSB is very sensitive to recruitment in 1990 and 1991.

32.2.3 Haddock in Sub-area IV

Landings are most senitive to numbers at age 0, 1, and 3 in 1989 and fishing mortality at age 4. This reflects the relative strength of the 1986 year class compared to other recent year classes. Recruitment of the 1990 year class, even though it will only be age 1, may be important for the 1991 landings.

SSB is almost entirely dependent on the 1990 year class. This illustrates the vulnerable state of the stock, where the SSB at the start of 1992 will be composed almost entirely of 2-year-olds.

32.2.4 Haddock in Division VIa

The results are similar to those for Sub-area IV but landings are more dependent on the 1986 year class and mortality rates at ages 3 and 4. The dependence on the 1990 year class is also high reflecting the younger age of recruitment to this stock. As for the North Sea stock, SSB is almost entirely dependent on the 1990 year class in 1992.

32.2.5 Haddock in Division VIb

Landings are most dependent on the population at ages 1, 2, and 3 in 1989. SSB is heavily dependent on the 1989 year class.

32.2.6 Whiting in Sub-area IV

Landings are most sensitive to the 1988 year class which is believed to be large. Since the RCRTINX2 value for the variance of this year class estimate is quite large (compared to those for cod, for example), this may have an important influence on the accuracy of the forecast.

The 1990 year class has a large influence in the SSB forecast because it has a very high variance associated with the estimate.

32.2.7 Whiting in Division VIa

Landings are heavily dependent on the 1989 year class which is imprecisely estimated. SSB is dependent on the 1990 and 1991 year classes which are both poorly estimated.

32.2.8 Saithe in Sub-area IV and Division IIIa, and in Sub-area VI

Both these stocks show high sensitivity to numbers at age 1 and 2. These are age groups which cannot be estimated from surveys and are included in the forecast as average year classes. This means that the forecasts depend largely on the natural variablity of recruitment and are correspondingly imprecise.

33 CALIBRATION OF VPA USING THE ADAPT METHOD

The `ADAPT` method, which is used in the calibration of VPA in the assessment of groundfish stocks in Canada, was used to do an illustrative calibration for cod in the North Sea (Sub-area IV).

In summary, the technique makes use of non-linear least squares techniques and VPA equations to minimize the residuals sum of squares described by the following generic equation:

$$\mathrm{SUM}_i\,(\mathrm{SUM}_j\,(\mathrm{SUM}_k\,(\ln(\mathrm{obs}\ I_{i,j,k}) - \ln(\mathrm{pred}\ I_{i,j,k}))))^2$$

where

I = index of abundance (fleet, i.e., catch rate at age)
k = age index
j = year index
i = fleet index

The program is written in the interpreter language APL and runs on a microcomputer. The output includes parameter estimates and their standard errors, tables of residuals by fleet, year and age and correlation matrix of the parameters. In addition, plots of observed and predicted values can be obtained.

Because of memory limitations, not all fleets used in the Laurec-Shepherd tuning could be incorporated in the analysis. The fleets used were ENGTRL (ages 1 to

4), ENGSEI (ages 1 to 7), SCOSEI (ages 1 to 7), and INTGFS (ages 1 and 2). In addition to the catchability at age by fleet, the model estimated population numbers in 1990 for ages 2 to 8. In the analysis, no weighting factors were applied to the various fleets.

For these reasons, the results of this analysis were not comparable to the Laurec-Shepherd tuning, but the estimates of population numbers in 1990 were for the most part comparable except for age 3 where the estimate was approximately double. However, the estimates of population size had very high standard errors except at age 2. Catchabilities for the various fleets were all significantly different from 0. There were no high correlations between parameters. Some high residuals were noted, and the indices for particular fleets and age groups should probably be investigated to determine whether they should be excluded in a model where no weighting is performed.

The Working Group showed interest in the method and generally considered that it could become a valuable tool in VPA calibration. Some drawbacks were noted; specifically that it is in the interpreter APL language which is not used in the ICES community and which requires too long a run time, and that documentation of the method is lacking at present.

34 OTOLITH EXCHANGE PROGRAMME

During the meeting of the Roundfish Working Group in 1988, problems were briefly discussed which are encountered in determining the age from otoliths of whiting and haddock. It was decided to circulate a sample of otoliths of North Sea haddock and whiting (collected by the Lowestoft Laboratory) among otolith readers from different countries.

The otoliths have now been read by readers from England, Netherlands, Denmark, France, Scotland and Norway, and will also be read at the German institute. Preliminary analysis of the results of this exchange indicates that a workshop will be useful and the Working Group, therefore, recommends that such a workshop is organised. The Lowestoft laboratory will be prepared to host it.

35 STANDARDISATION OF ASSESSMENT PROGRAMS

For the assessments done by the Roundfish Working Group several programs, developed in different laboratories, are used:

WG0 (Aberdeen)	To set up source data files with catch data.
WG1 (Aberdeen)	Source data input program.
WG2 (Aberdeen)	To work up catch numbers and mean weight at age data (SOP corrections) to derive total international input data.
WG3 (Aberdeen)	To print the working group data.
GATEWAY (Boulogne)	To change the format of the input files to be used in "Lowestoft" and "Aberdeen" programs.
RCRTINX2 (Lowestoft)	To combine the available abundance indices and estimate recruitment.
Lowestoft VPA Package (Lowestoft)	To be used for tuning, VPA and Separable VPA.

	The VPA results from this package are then used as input for:
WG4 (Aberdeen)	VPA program.
WG6 (Aberdeen)	For short- and long-term catch predictions.

In addition to these programs, several other programs may be used on an ad hoc basis, such as the mesh assessment program.

There are some shortcomings in the above-mentioned programs. The WG0 - WG6 programs, for example, can be run by very few people with a specialized knowledge of these programs, for which no user guide is available.

The Lowestoft VPA Package gives no routinely produced results for the weighting of the different fleets for which data are used in tuning. Also non-zero catchabilities are generated where the catches have been zero. Furthermore, the minimization routine in the Separable VPA does not check for a global minimum.

Although within ICES it is planned to develop a fully integrated assessment package, maintained by the ICES Secretariat, the general opinion of the Working Group is that there is an immediate need to make improvements to the currently used programs. This would serve two purposes. The assessment programs would be accessibe for all members which would greatly improve the possibilities to work up the annual data (by different members of the Working Group) prior to the meeting, and also run preliminary VPAs. The other purpose would be that RCRTINX2 and tuning input can also be updated before the meeting of the Working Group.

36 REFERENCES

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Table 5.1 Correlation matrix of log-transformed recruitment data for whiting. Correlation coefficients and number of observations ( ).

Area	IV	VIID	VIIE
IV	-	-.16(13)	-.14(10)
VIId	-.16(13)	-	-.18(10)
VIIe	-.14(10)	-.18(10)	-

Table 7.1 Fleets/gears and years included in commercial landing data base.

Denmark 1987

DKDASE	Danish seines
DKNEDE	Nets, value of sole < 50%
DKNESO	Nets, value of sole > 50%
DKTR00	Trawlers < 60 BRT
DKTR60	Trawlers > 60 BRT
DKOTHE	Others

England 1983-86

ENGBTR	Beam trawlers
ENGDSE	Danish seines
ENGLGN	Long lines and gill nets
ENGOTH	Other
ENGPTR	Pair trawlers
ENGSSE	Single seiners (fly seiners)
ENGSTR	Single trawlers

France 1985-87

FRANEC	Coastal netters
FRATRB	High sea trawlers > 1500 HP
FRATRC	Coastal trawlers
FRATRF	Freezer trawlers
FRATRM	High sea trawlers 1000-1500 HP
FRATRS	High sea trawlers < 1000 HP
FRAALL	All fleets operating in area 6A

Scotland 1983-86

SCOLTR	Light trawlers
SCONTR	Nephrops trawlers
SCOMTR	Motor trawlers
SCOPTD	Pair trawlers
SCOSEN	Seiners

Table 7.2 Occurrences of whiting constituting more than 50% of total demersal landing while the by-catch of other roundfish species constitute less than 10%. Minimum whiting catch : 10 t.

RECT	FLEET	Q	CCOD	PCOD	CHAD	PHAD	CWHI	PWHI	CSAI	PSAI	CCHS	PCHS
44E9	DKTR60	4	.5	4.2	.1	.6	11.3	89.6	.0	.0	.6	4.9
40E8	FRATRB	3	.6	3.1	.8	4.1	19.2	92.4	.0	.0	1.5	7.2
37F0	FRATRB	4	1.1	1.2	7.1	7.7	81.4	88.7	.0	.0	8.3	9.0
35F3	FRATRM	1	1.4	7.7	.0	.0	16.9	90.3	.0	.0	1.4	7.7
33F2	FRATRM	1	1.5	6.4	.0	.0	20.5	88.8	.0	.0	1.5	6.4
33F3	FRATRM	1	1.3	3.4	.0	.1	36.3	92.8	.0	.0	1.4	3.5
34F2	FRATRC	1	1.0	8.4	.0	.1	11.1	88.9	.0	.0	1.1	8.5
34F3	FRATRC	2	.3	1.5	.0	.0	22.1	92.2	.0	.0	.3	1.5
33F2	FRATRC	1	1.1	3.0	.0	.0	36.1	95.2	.0	.0	1.1	3.0
33F3	FRATRC	1	1.3	6.2	.0	.0	20.0	91.7	.0	.0	1.3	6.2
41E3	SCOLTR	3	.8	2.1	2.5	6.2	27.6	68.2	.0	.0	3.4	8.3

Table 7.3 Occurrences of whiting constituting more than 50% of total demersal landing while the by-catch of other roundfish species constitute less than 25%. Minimum whiting catch 10 t.

RECT	FLEET	Q	CCOD	PCOD	CHAD	PHAD	CWHI	PWHI	CSAI	PSAI	CCHS	PCHS
38F7	DKDASE	4	7.6	14.2	.0	.0	30.0	56.3	.0	.0	7.6	14.3
44E9	DKTR60	4	.5	4.2	.1	.6	11.3	89.6	.0	.0	.6	4.9
40E8	FRATRB	3	.6	3.1	.8	4.1	19.2	92.4	.0	.0	1.5	7.2
40E9	FRATRB	1	.4	2.6	2.4	14.6	12.9	79.5	.0	.0	2.8	17.2
40F0	FRATRB	3	.5	3.1	2.9	16.8	12.9	73.6	.0	.0	3.5	19.9
39E8	FRATRB	4	.4	2.8	1.8	11.7	12.9	84.5	.0	.0	2.2	14.5
39E9	FRATRB	3	5.3	3.0	33.7	19.3	128.2	73.5	2.6	1.5	41.6	23.9
38F1	FRATRB	3	.5	3.1	2.5	16.0	12.3	79.9	.0	.0	2.9	19.1
37F0	FRATRB	4	1.1	1.2	7.1	7.7	81.4	88.7	.0	.0	8.3	9.0
40E9	FRATRM	3	3.1	10.1	4.4	14.3	22.2	72.1	.0	.1	7.6	24.6
35F3	FRATRM	1	1.4	7.7	.0	.0	16.9	90.3	.0	.0	1.4	7.7
35F4	FRATRM	1	9.3	17.6	.3	.6	41.1	77.6	.0	.0	9.7	18.2
34F3	FRATRM	1	6.9	21.2	.3	.9	23.9	73.5	.0	.0	7.2	22.1
33F2	FRATRM	1	1.5	6.4	.0	.0	20.5	88.8	.0	.0	1.5	6.4
33F3	FRATRM	1	1.3	3.4	.0	.1	36.3	92.8	.0	.0	1.4	3.5
34F2	FRATRC	1	1.0	8.4	.0	.1	11.1	88.9	.0	.0	1.1	8.5
34F2	FRATRC	3	58.0	16.5	.1	.0	243.6	69.5	.0	.0	58.1	16.6
34F3	FRATRC	2	.3	1.5	.0	.0	22.1	92.2	.0	.0	.3	1.5
33F2	FRATRC	1	1.1	3.0	.0	.0	36.1	95.2	.0	.0	1.1	3.0
33F2	FRATRC	3	27.5	11.7	2.8	1.2	145.0	61.4	.0	.0	30.3	12.9
33F3	FRATRC	1	1.3	6.2	.0	.0	20.0	91.7	.0	.0	1.3	6.2
46E8	SCONTR	3	.4	1.9	1.8	8.6	11.1	54.4	.0	.1	2.2	10.6
42E3	SCOSEN	3	1.8	1.7	17.1	16.1	60.9	57.3	.8	.7	19.6	18.5
39E4	SCOSEN	4	13.0	11.1	10.2	8.8	58.6	50.2	.7	.6	23.9	20.5
42E3	SCOLTR	3	7.4	4.6	26.5	16.6	85.5	53.5	1.4	.9	35.3	22.1
41E3	SCOLTR	3	.8	2.1	2.5	6.2	27.6	68.2	.0	.0	3.4	8.3
43E3	SCONTR	3	2.4	5.0	8.9	18.2	26.0	53.3	.2	.3	11.5	23.5
42E3	SCONTR	3	5.4	5.1	13.8	12.9	61.0	57.1	.5	.5	19.8	18.5
41E3	SCONTR	3	2.2	4.5	3.0	6.1	30.9	63.2	.0	.1	5.2	10.7
39E4	SCONTR	4	19.8	10.2	3.0	1.6	111.8	57.2	7.2	3.7	30.1	15.4

Table 7.4 Overview of fisheries with high percentage of 1 species.

Species		Fleet	Quarter	Area	Rectangle range
COD	*	DKNEDE	1,2,(3)	E,SE	32F1-43F6
		DKDASE	1,2	E	38F2-42F6
		DKTROO	1,2	E	37F6-39E7
	*	ENGLGN	1,2,3,4	W	39E8-32F2
		ENGPTR	1,2,3,4	W	36F0-42F2
		ENGSTR	1,3	W	40E8-36F1
		ENGDSE	1,2	W	37F1-42F3
HADDOCK		ENGSSE	3,4	W	39F0-44F2
		FRTRB	4	N	43F0-F1
	*	SCOSEN	1,2,3,4	NW	40E7-51F2
	*	SCOPTD	1,3,4	NW	40E7-50F1
WHITING		FRATRF	4	N	51-52F0
		FRATRB	3,4	W	37-40E9
	*	FRATRC	1,3	S	31-34F2
		SCOSEN	3,4	NW	48E8-50E9
SAITHE		ENGPTR	1,2	N	50E7-50F1
		ENGSTR	1,2,3,4	N	48E8-51E9
	*	FRATRF	1,2,3,4	N	48E8-52F1
	*	FRATRB	1,2,3,4	N	48E6-52F2
	*	FRATRM	2	N	50E7-52E9
	*	FRAALL	1,2	NW. Scot	47E2-49E5
		SCOMTR	3	NW	46E6-51E9

* Directed fisheries (Working Group member pers. comm.)

Table 8.1 Percentage Changes compared to Baseline for Total International Fleet, 1991, Cod in area IV

COD IV Landings for Human Consumption

No. Meshes	Mesh Size 90	100	110	120	130
120	0	-1	-5	-12	-20
100	-1	-3	-8	-16	-25
75	-2	-5	-13	-22	-31

COD IV Spawning Biomass (1992)

No. Meshes	Mesh Size 90	100	110	120	130
120	0	0	2	5	10
100	0	1	3	7	14
75	1	2	5	12	21

Table 8.2 Percentage Changes compared to Baseline for Total International Fleet, 1991, Cod in area VIA

COD VIA Landings for Human Consumption

No. Meshes	Mesh Size 90	100	110	120	130
120	0	-1	-3	-7	-13
100	0	-1	-4	-10	-17
75	-1	-3	-7	-15	-23

COD VIA Spawning Biomass (1992)

No. Meshes	Mesh Size 90	100	110	120	130
120	0	1	3	7	14
100	0	1	4	10	19
75	1	3	8	16	27

Table 8.3 Percentage Changes compared to Baseline for Total International Fleet, 1991, Haddock in area IV

HAD IV Landings for Human Consumption

No. Meshes	Mesh Size 90	100	110	120	130
120	0	0	0	-2	-9
100	0	0	-2	-10	-24
75	0	-3	-12	-29	-47

HAD IV Discards

No. Meshes	Mesh Size 90	100	110	120	130
120	0	-15	-40	-65	-81
100	-14	-39	-65	-82	-91
75	-39	-67	-84	-91	-94

HAD IV Industrial By-Catch

No. Meshes	Mesh Size 90	100	110	120	130
120	0	5	2	4	5
100	1	2	4	5	7
75	0	4	6	8	9

HAD IV Spawning Biomass (1992)

No. Meshes	Mesh Size 90	100	110	120	130
120	0	2	6	11	17
100	2	6	11	18	24
75	6	12	19	26	32

Table 8.4 Percentage Changes compared to Baseline for Total International Fleet, 1991, Haddock in area VIA

HAD VIA Landings for Human Consumption

No. Meshes	Mesh Size 90	100	110	120	130
120	0	0	0	-2	-9
100	0	0	-3	-10	-22
75	0	-3	-13	-26	-40

HAD VIA Discards

No. Meshes	Mesh Size 90	100	110	120	130
120	0	-16	-41	-65	-80
100	-14	-41	-66	-82	-89
75	-41	-69	-84	-90	-92

HAD VIA Spawning Biomass (1992)

No. Meshes	Mesh Size 90	100	110	120	130
120	0	6	15	25	33
100	5	15	26	35	41
75	15	27	36	43	48

Table 8.5 Percentage Changes compared to Baseline for Total International Fleet, 1991, Whiting in area IV

WHI IV Landings for Human Consumption

No. Meshes	Mesh Size 90	100	110	120	130
120	0	-8	-25	-44	-60
100	-5	-20	-40	-58	-71
75	-16	-40	-58	-71	-80

WHI IV Discards

No. Meshes	Mesh Size 90	100	110	120	130
120	0	-32	-56	-70	-77
100	-22	-50	-67	-76	-80
75	-45	-65	-76	-80	-82

WHI IV Industrial By-Catch

No. Meshes	Mesh Size 90	100	110	120	130
120	0	3	7	10	13
100	2	6	10	12	14
75	5	9	12	14	15

WHI IV Spawning Biomass (1992)

No. Meshes	Mesh Size 90	100	110	120	130
120	0	7	15	21	26
100	5	13	20	26	29
75	11	19	25	29	32

Table 8.6 Percentage Changes compared to Baseline for Total International Fleet, 1991, Whiting in area VIA

WHI VIA Landings for Human Consumption

No. Meshes	Mesh Size 90	100	110	120	130
120	0	-13	-33	-53	-69
100	-8	-27	-50	-67	-79
75	-23	-47	-67	-79	-85

WHI VIA Spawning Biomass (1992)

No. Meshes	Mesh Size 90	100	110	120	130
120	0	7	17	27	34
100	4	14	25	34	39
75	11	23	33	39	42

Table 10.1 Cod IV RCRTINX2 input values

Year Class	VPA 1	VPA 2	IYFS1	IYFS2	EGFS0	EGFS1	EGFS2	SGFS1	SGFS2	DGFS0	DGFS1	DGFS2	FRGSF	GGFS1	GGFS2
1970	847	353	98.3	34.5	-1	-1	-1	-1	-1	-1	-1	-1	90.4	-1	-1
1971	159	69	4.1	10.6	-1	-1	-1	-1	-1	-1	-1	-1	1.3	-1	-1
1972	289	114	38.0	9.5	-1	-1	-1	-1	-1	-1	-1	-1	1.6	-1	-1
1973	232	95	14.7	6.2	-1	-1	-1	-1	-1	-1	-1	-1	3.6	-1	-1
1974	426	172	40.3	19.9	-1	-1	-1	-1	-1	-1	-1	-1	8.0	-1	-1
1975	196	85	7.9	3.2	-1	-1	4.5	-1	-1	-1	-1	-1	7.8	-1	-1
1976	726	286	36.7	29.3	-1	62.7	12.5	-1	-1	-1	-1	-1	28.2	-1	-1
1977	426	175	12.9	9.3	13.9	22.8	5.8	-1	-1	-1	-1	-1	27.2	-1	-1
1978	449	180	9.9	14.8	12.6	24.2	6.7	-1	-1	-1	-1	4.5	31.1	-1	-1
1979	800	320	16.9	25.5	18.6	50.8	13.9	-1	-1	-1	163.8	11.2	35.5	-1	-1
1980	271	109	2.9	6.7	10.2	11.4	2.9	-1	3.5	43.2	46.9	1.6	14.1	-1	-1
1981	557	208	9.2	16.6	74.2	32.4	11.0	6.1	7.8	176.8	83.0	2.3	23.2	-1	3.5
1982	269	105	3.9	8.0	2.5	15.4	4.7	3.3	3.9	26.9	21.8	1.6	9.0	5.9	2.4
1983	534	199	15.2	17.6	95.1	61.2	11.9	8.2	11.4	121.5	121.3	3.1	43.0	2.6	22.4
1984	108	43	.9	3.6	.4	4.3	1.2	.7	1.0	1.3	3.6	.2	.9	2.3	2.6
1985	581	208	17.0	28.8	8.3	34.4	10.7	8.0	6.9	143.6	111.2	8.0	9.5	15.4	11.4
1986	257	102	8.8	6.1	1.2	14.2	4.1	2.2	2.9	37.0	41.5	1.7	2.3	7.0	9.5
1987	-1	-1	3.6	6.3	.4	8.4	2.5	1.6	1.3	36.2	17.8	2.2	2.1	2.0	7.2
1988	-1	-1	13.1	15.2	16.8	22.8	5.1	5.6	4.9	16.6	16.6	-1	4.2	90.2	14.7
1989	-1	-1	3.4	-1	6.0	6.1	-1	1.1	-1	13.7	-1	-1	.6	11.9	-1
1990	-1	-1	-1	-1	3.9	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Table 10.2 Haddock IV RCRTINX2 input values

Year class	VPA 1	VPA 2	IYFS1	IYFS2	EGFS0	EGFS1	EGFS2	SGFS0	SGFS1	SGFS2	GGFS1	GGFS2
1970	10056	1259	855	299	-1	-1	-1	-1	-1	-1	-1	-1
1971	9425	1550	740	971	-1	-1	-1	-1	-1	-1	-1	-1
1972	2469	337	187	110	-1	-1	-1	-1	-1	-1	-1	-1
1973	8582	1192	1092	385	-1	-1	-1	-1	-1	-1	-1	-1
1974	15559	2197	1168	670	-1	-1	-1	-1	-1	-1	-1	-1
1975	1334	193	177	84	-1	-1	32.1	-1	-1	-1	-1	-1
1976	1864	263	162	108	-1	66.8	26.2	-1	-1	-1	-1	-1
1977	2946	396	385	240	534.8	136.9	54.6	-1	-1	-1	-1	-1
1978	4638	758	480	402	358.3	295.5	167.3	-1	-1	-1	-1	-1
1979	8363	1353	896	675	875.5	623.3	439.1	-1	-1	-1	-1	-1
1980	1755	285	268	252	374	173.2	79.8	-1	-1	99.6	-1	-1
1981	3710	607	526	400	1537.5	315.5	109.5	-1	248.8	161.1	-1	72.8
1982	2372	396	307	219	281.3	218.2	61.6	123.5	181.3	78.8	93.9	47.2
1983	7980	1365	1057	828	831.9	599.3	238.2	220.3	436.7	298.1	272.9	259.6
1984	2046	324	229	244	228.5	186.6	44.7	87.3	197.6	57.4	129.7	38
1985	2875	490	579	326	245.9	149.7	43.1	81.8	232.9	70.4	142.3	154.4
1986	5808	1008	885	688	266	281.9	183.5	174.7	239.3	198	307.4	179.9
1987	-1	-1	92	97	22.4	28.6	14.5	27.7	46.7	21.4	68.6	45.3
1988	-1	-1	210	114	60.7	81.7	20.4	40.6	88.6	24	135	54.7
1989	-1	-1	219	-1	94.3	65.7	-1	43.2	100	-1	180	-1
1990	-1	-1	-1	-1	281.9	-1	-1	313	-1	-1	-1	-1

Table 10.3 Whiting IV RCRTINX2 input values

Year class	VPA 1	VPA 2	IYFS1	IYFS2	EGFS0	EGFS1	EGFS2	SGFS0	SGFS1	SGFS2	DGFS0	DGFS1	DGFS2	GGFS1	GGFS2
1970	2853	743	274	190	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1971	5089	1420	332	763	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1972	6960	2016	1156	496	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1973	3453	897	322	153	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1974	7092	2181	893	535	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	4433	1431	679	219	-1	-1	74	-1	-1	-1	-1	-1	-1	-1	-1
1976	4267	1068	418	293	-1	220	52	-1	-1	-1	-1	-1	-1	-1	-1
1977	4292	1413	513	183	284	247	71	-1	-1	-1	-1	-1	-1	-1	-1
1978	4447	1360	457	391	184	201	125	-1	-1	-1	-1	-1	62	-1	-1
1979	4108	1432	692	485	355	353	288	-1	-1	-1	-1	330	131	-1	-1
1980	1540	500	227	232	199	183	79	-1	-1	97	166	205	105	-1	-1
1981	1735	560	161	126	349	277	109	-1	65	58	1393	640	224	-1	15.3
1982	1595	500	128	179	69	119	108	102	56	37	166	431	141	6.8	12.9
1983	2388	739	436	359	717	506	170	210	108	97	2649	1330	893	5.7	22.8
1984	1829	589	341	261	173	159	66	454	158	45	143	783	75	9.6	24.6
1985	3677	1091	456	544	200	152	130	169	111	115	859	384	252	12.2	70.8
1986	3010	1010	669	862	163	228	132	406	141	161	1784	2004	612	91.0	79.8
1987	-1	-1	394	542	137	188	118	120	97	74	2883	1441	803	15.1	392.3
1988	-1	-1	1465	887	382	295	129	642	404	205	629	1049	-1	603.1	-1
1989	-1	-1	509	-1	1170	194	-1	427	224	-1	1882	-1	-1	-1	-1
1990	-1	-1	-1	-1	882	-1	-1	1943	-1	-1	-1	-1	-1	-1	-1

Table 10.4 Cod VIa RCRTINX2 input values

Year class	VPA 1	VPA 2	SWFS1	SWFS2	SCSEI1	SCLTR1
1969	7820	6172	-1	-1	13	1
1970	10453	8329	-1	-1	6	3
1971	6301	4496	-1	-1	8	19
1972	8520	6061	-1	-1	36	24
1973	8297	6033	-1	-1	16	18
1974	11452	8289	-1	-1	27	38
1975	6541	4481	-1	-1	8	15
1976	9799	6883	-1	-1	29	25
1977	9576	7188	-1	-1	22	11
1978	14978	11425	-1	-1	31	16
1979	20614	15799	-1	.62	66	14
1980	5986	4486	.1	.61	4	2
1981	15071	10693	.1	3.28	56	29
1982	9179	5417	.2	-1	48	24
1983	15058	10399	-1	2.38	56	35
1984	6143	3811	.2	.69	36	16
1985	13358	10222	.2	1.62	54	22
1986	30524	17918	1.1	6.49	561	45
1987	-1	-1	-1	.72	15	5
1988	-1	-1	.5	2.46	60	34
1989	-1	-1	.2	-1	-1	-1

Table 10.5 Haddock VIa RCRTINX2 input values

Year class	VPA 1	VPA 2	NSVPA1	SWFS1	SWFS2	SCSEI1	SCSEI2	SCLTR1	SCLTR2
1969	17870	8971	1418	-1	-1	45	19	4	3
1970	246338	137522	10056	-1	-1	355	253	100	135
1971	76579	44096	9425	-1	-1	114	58	10	12
1972	78647	22316	2469	-1	-1	420	29	6	11
1973	168741	76574	8582	-1	-1	424	135	58	34
1974	438790	198961	15559	-1	-1	1600	364	153	82
1975	37272	8962	1335	-1	-1	207	28	15	3
1976	23189	7327	1864	-1	-1	91	9	8	2
1977	59202	34154	2946	-1	-1	103	83	20	24
1978	179058	83885	4638	-1	-1	317	164	104	32
1979	440562	34091	8363	-1	317.1	193	463	41	90
1980	38511	31304	1755	2.3	9.5	1	33	-1	7
1981	80062	51611	3710	7.9	103.7	78	78	37	51
1982	44452	23370	2372	19.3	-1	55	40	28	17
1983	374545	217750	7980	-1	408.5	294	220	192	114
1984	69919	36781	2046	110.4	166.9	47	86	22	20
1985	53015	36086	2875	62.1	44.6	44	69	16	31
1986	241735	118183	5808	551.8	361.0	527	194	138	110
1987	-1	-1	827	43.6	48.8	51	13	19	7
1988	-1	-1	1349	17.8	8.7	22	-1	10	-1
1989	-1	-1	1546	257.7	-1	-1	-1	-1	-1
1990	-1	-1	6946	-1	-1	-1	-1	-1	-1

Table 10.6 Whiting VIa RCRTINX2 input v

Year class	VPA 1	VPA 2	NSVPA1	SWFS1	SWFS2
1969	22301	17599	1685	-1	-1
1970	30875	23125	2853	-1	-1
1971	93140	61157	5089	-1	-1
1972	195341	147232	6960	-1	-1
1973	67779	47309	3453	-1	-1
1974	151610	110678	7092	-1	-1
1975	51942	34873	4433	-1	-1
1976	81006	51820	4267	-1	-1
1977	112171	75926	4292	-1	-1
1978	78746	58759	4447	-1	-1
1979	191670	146414	4108	-1	246.7
1980	39966	29481	1540	212.4	14.1
1981	35660	26498	1735	35.2	51.9
1982	43085	32191	1595	142.8	-1
1983	67891	49085	2388	-1	179.2
1984	64423	49011	1829	314.0	152.6
1985	50508	38939	3677	145.6	105.4
1986	62110	45019	3010	693.8	346.9
1987	-1	-1	3830	56.7	50.5
1988	-1	-1	5532	91.0	57.2
1989	-1	-1	3660	181.8	-1
1990	-1	-1	3000	-1	-1

Table 12.1 Nominal catch (tonnes) of COD in Sub-area IV, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	9,630	8,744	6,604	6,704	5,804
Denmark	56,404	64,968	61,454	48,828	46,751
Faroe Islands	150	38	65	361	-
France	10,910	11,369	8,399	7,159	8,129
German Dem.Rep.	63	-	-	-	-
Germany, Fed.Rep.	26,343	29,741	18,525	20,333	13,453
Netherlands	45,400	51,281	36,490	34,111	25,460
Norway[2]	4,506	6,766	12,163	6,625	7,005
Poland	28	7	62	75	7
Sweden	293	321	453	422	575
UK (England & Wales)	49,951	59,856	54,277	53,860	35,605
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	45,044	53,921	57,308	58,581	54,359
USSR	-	-	-	-	-
Total	248,722	287,012	255,800	237,059	197,148

Country	1985	1986	1987	1988	1989
Belgium	4,815	6,604	6,693	5,508	3,398
Denmark	42,547	32,892	36,948	34,905	25,782[1]
Faroe Islands	71	15	57	46	25[1]
France	4,834	8,402	8,199	8,323	2,578[1,3]
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	7,675	7,667	8,230	7,707	13,154[1]
Netherlands	30,844	25,082	21,347	n/a	12,028[1]
Norway[2]	5,766	4,864	5,000	3,585	5,166[1]
Poland	-	10	13	19	24
Sweden	748	839	688	367	501
UK (England & Wales)	29,692	25,361	29,960	23,496	18,250
UK (Isle of Man)	-	-	-	-	1
UK (N.Ireland)	-	-	-	-	124
UK (Scotland)	60,931	45,748	49,671	41,382	31,480
Total	187,923	157,484	166,806	125,338	112,511

[1] Preliminary.
[2] Figures do not include cod caught as industrial by-catch.
[3] Includes Division IIa.
n/a = Not available.

Table 12.2 : Annual Weight and Numbers of COD caught in IV between 1963 and 1989

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1963	108	108	0	0	57	57	0	0
1964	116	116	0	0	52	52	0	0
1965	173	173	0	0	94	94	0	0
1966	212	212	0	0	117	117	0	0
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	209	209	0	0	123	123	0	0
1977	182	182	0	0	137	137	0	0
1978	263	263	0	0	210	210	0	0
1979	249	249	0	0	168	168	0	0
1980	265	265	0	0	200	200	0	0
1981	301	301	0	0	236	236	0	0
1982	273	273	0	0	191	191	0	0
1983	234	234	0	0	178	178	0	0
1984	205	205	0	0	158	158	0	0
1985	193	193	0	0	144	144	0	0
1986	163	163	0	0	140	140	0	0
1987	175	175	0	0	145	145	0	0
1988	150	150	0	0	109	109	0	0
1989	119	119	0	0	77	77	0	0

Table 12.3 : Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
0	2.700	0.000
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

Table 12.4 : Total International Catch at Age (1000's) of COD in IV between 1963 and 1989

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Age
0											0
1	2979	4621	15078	17450	10339	5601	2842	52719	42972	3692	1
2	39475	20665	49476	59861	67849	80549	21867	32813	148927	180834	2
3	6516	18478	16825	28578	31289	40916	30453	17886	16507	46369	3
4	3278	3958	8755	5922	10777	11906	13222	12904	6475	5474	4
5	2584	1762	2276	3235	3131	5838	4403	6092	6808	2627	5
6	1124	1670	906	1224	1889	1359	2792	1705	2588	3084	6
7	75	551	627	457	850	836	567	930	856	1618	7
8	456	108	284	354	340	297	407	202	439	589	8
9	13	86	49	121	132	145	142	180	219	376	9
10	5	11	72	54	38	107	45	95	74	108	10
11		4	8	80	16	23	75	39	90	17	11

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Age
0											0
1	24742	14690	30081	5182	62751	24933	34116	60874	19835	64839	1
2	30259	55617	42487	90267	42276	158837	85845	96115	175922	59947	2
3	52342	10765	17073	16172	22918	13094	40459	29562	27563	53239	3
4	13409	14937	4203	6016	4104	8417	3332	10272	7649	7287	4
5	2102	4365	6816	1542	2055	2809	3130	1590	3802	3193	5
6	1057	907	1863	2764	752	941	675	1172	740	1883	6
7	1010	414	405	837	1030	366	365	412	555	355	7
8	466	373	176	119	335	372	129	191	131	218	8
9	76	313	206	61	237	140	145	71	63	72	9
10	55	76	86	57	23	33	39	54	36	25	10
11	154	178	57	39	87	40	16	25	20	15	11

Age	1983	1984	1985	1986	1987	1988	1989	Age
0			2		1		1	0
1	23838	63860	7894	82594	21635	17717	20066	1
2	121828	57774	111120	20828	105618	49802	31665	2
3	17518	27765	15712	28919	6962	35706	15191	3
4	10104	3461	6875	3954	7625	2508	8211	4
5	2501	3119	1150	2584	1348	2227	873	5
6	1167	939	1116	521	955	558	896	6
7	562	415	328	498	209	274	220	7
8	142	233	162	148	188	58	125	8
9	70	57	73	60	46	52	22	9
10	22	43	13	39	31	11	24	10
11	18	19	23	19	11	16	9	11

Table 12.5 : Total International Mean Weight at Age (Kg.) of COD in IV between 1963 and 1989

Age	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Age
0											0
1	0.538	0.496	0.581	0.579	0.590	0.640	0.544	0.626	0.579	0.616	1
2	1.004	0.863	0.965	0.994	1.035	0.973	0.921	0.961	0.941	0.836	2
3	2.657	2.377	2.304	2.442	2.404	2.223	2.133	2.041	2.193	2.086	3
4	4.491	4.528	4.512	4.169	3.153	4.094	3.852	4.001	4.258	3.968	4
5	6.794	6.447	7.274	7.027	6.803	5.341	5.715	6.131	6.528	6.011	5
6	9.409	8.520	9.498	9.599	9.610	8.020	6.722	7.945	8.646	8.246	6
7	11.562	10.606	11.898	11.766	12.033	8.581	9.262	9.953	10.356	9.766	7
8	11.942	10.758	12.041	11.968	12.481	10.162	9.749	10.131	11.219	10.228	8
9	13.383	12.340	13.053	14.060	13.589	10.720	10.384	11.919	12.881	11.875	9
10	13.756	12.540	14.441	14.746	14.271	12.497	12.743	12.554	13.147	12.530	10
11		7.090	15.667	15.672	19.016	11.595	11.176	14.367	15.544	14.350	11

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Age
0											0
1	0.559	0.594	0.619	0.568	0.542	0.568	0.549	0.546	0.725	0.587	1
2	0.869	1.039	0.899	1.027	0.973	0.938	0.940	0.998	0.827	0.948	2
3	1.919	2.217	2.348	2.477	2.161	2.025	2.447	2.002	2.256	1.851	3
4	3.776	4.156	4.226	4.575	4.603	4.242	4.583	4.578	4.759	4.512	4
5	5.488	6.174	6.404	6.505	6.716	6.599	6.687	6.390	7.188	6.848	5
6	7.453	8.333	8.691	8.630	8.832	8.945	8.557	9.156	8.851	8.993	6
7	9.019	9.889	10.107	10.137	10.075	9.972	10.938	9.805	10.059	10.740	7
8	9.810	10.791	10.910	11.341	11.052	11.099	11.550	11.867	11.519	12.500	8
9	11.077	12.175	12.339	12.888	11.824	12.427	13.057	12.782	13.338	13.469	9
10	12.359	12.425	12.976	14.140	13.134	12.778	14.148	14.081	14.895	12.890	10
11	12.886	13.731	14.431	14.371	14.361	13.981	15.478	15.392	18.784	14.608	11

Age	1983	1984	1985	1986	1987	1988	1989	Age
0			0.287		0.328		0.230	0
1	0.634	0.593	0.582	0.570	0.621	0.561	0.668	1
2	0.917	0.996	0.920	0.909	0.937	0.836	1.028	2
3	1.814	2.144	2.126	1.823	1.955	1.912	1.822	3
4	3.960	4.041	4.228	3.890	3.671	3.242	3.577	4
5	6.589	6.255	6.457	6.426	6.017	5.971	5.172	5
6	8.454	8.423	8.475	8.158	8.280	7.864	7.840	6
7	9.919	10.317	10.406	9.956	9.911	9.723	9.498	7
8	11.837	11.352	12.034	11.713	11.413	11.607	11.087	8
9	12.797	13.505	13.033	12.710	12.149	13.489	12.774	9
10	12.562	13.408	13.209	13.566	15.542	14.353	14.067	10
11	14.427	13.471	14.415	13.160	16.430	15.767	14.578	11

Table 12.6 COD in Sub-area IV. Tuning results.

with cpue data from file COD4ZEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 SCOSEI has terminal q estimated as the mean
Fleet 2 SCOTRL has terminal q estimated as the mean
Fleet 3 SCOLTR has terminal q estimated as the mean
Fleet 4 SCOGFS has terminal q estimated as the mean
Fleet 5 ENGTRL has terminal q estimated as the mean
Fleet 6 ENGSEI has terminal q estimated as the mean
Fleet 7 ENGGFS has terminal q estimated as the mean
Fleet 8 FRATRB has terminal q estimated as the mean
Fleet 9 NETGFS has terminal q estimated as the mean
Fleet 10 FRGGFS has terminal q estimated as the mean
Fleet 11 INTGFS has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using Laurec/Shepherd method

	Age 1		Age 2		Age 3		Age 4		Age 5	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.0948	.1245	1.0058	.2315	.5863	.1407	.7085	.1398	.7795	.1253
SCOTRL	.0968	.0517	2.8260	.0484	.4629	.0971	.614	.2013	.7124	.2174
SCOLTR	.1241	.1048	1.8005	.2208	.7705	.3129	.7939	.1839	.6725	.1529
SCOGFS	.0627	.1451	1.4252	.1070	.8103	.0380	1.0735	.0886	.7448	.0985
ENGTRL	.1071	.0423	.8510	.0720	1.2334	.1265	.7981	.2143	1.4118	.1529
ENGSEI	.0953	.1393	.8660	.0736	1.1688	.0916	.8975	.0807	2.3709	.1096
ENGGFS	.0805	.2288	.9595	.1324	.7721	.1210	.6885	.0123	1.0345	.0469
FRATRB	.0470	.0378	.9142	.1003	.8751	.0722	1.0055	.0791	1.7746	.0966
NETGFS	.2168	.0383		.0000		.0000		.0000		.0000
FRGGFS	.0087	.0114	.4736	.0141		.0000		.0000		.0000
INTGFS	.0586	.0761		.0000		.0000		.0000		.0000
		1.0000		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar		Fbar	
	.0840		1.1880		.7870		.7840		1.0100	

	Age 6		Age 7		Age 8		Age 9		Age 10	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.3385	.0675	.3030	.1779	.5635	.3812	.8257	.4190		.0000
SCOTRL	.8300	.0856		.0000		.0000		.0000		.0000
SCOLTR	.5450	.0935	.3673	.1632		.0000		.0000		.0000
SCOGFS	1.5706	.0478		.0000		.0000		.0000		.0000
ENGTRL	.9549	.2069	1.5882	.2981		.0000		.0000		.0000
ENGSEI	.6888	.3261	1.1497	.3608	.6764	.6188	1.0338	.5810	.5932	1.0000
ENGGFS		.0000		.0000		.0000		.0000		.0000
FRATRB	1.2594	.1726		.0000		.0000		.0000		.0000
NETGFS		.0000		.0000		.0000		.0000		.0000
FRGGFS		.0000		.0000		.0000		.0000		.0000
INTGFS		.0000		.0000		.0000		.0000		.0000
		1.0000		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar		Fbar	
	.8060		.8280		.6310		.9410		.5930	

Table 12.7 : Total International Fishing Mortality Rate at Age of COD in IV between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	0.110	0.076	0.034	0.132	0.096	0.107	0.039	0.133	0.088	0.116	1
2	0.583	0.883	0.898	0.709	0.833	0.737	0.931	0.861	1.023	0.838	2
3	0.745	0.774	0.919	0.854	0.693	0.786	0.829	0.763	0.859	0.967	3
4	0.577	0.701	0.670	0.798	0.665	0.674	0.753	0.535	0.753	0.575	4
5	0.580	0.697	0.699	0.595	0.666	0.746	0.566	0.635	0.887	0.715	5
6	0.521	0.524	0.813	0.688	0.560	0.679	0.796	0.604	0.684	0.546	6
7	0.467	0.544	0.743	0.699	0.641	0.527	0.761	0.807	0.678	0.627	7
8	0.271	0.421	0.925	0.494	0.609	0.631	0.287	0.814	0.792	0.541	8
9	0.404	0.527	0.788	0.277	0.736	0.832	0.462	1.583	1.029	0.859	9
10	0.614	0.287	0.545	0.243	0.494	0.456	0.580	0.321	1.088	0.937	10
11	0.301	1.263	0.041	0.909	2.156	0.621	0.199	0.171	0.366	0.179	11
12	0.412	0.608	0.608	0.524	0.928	0.613	0.458	0.739	0.791	0.629	12
13	0.412	0.608	0.608	0.524	0.928	0.613	0.458	0.739	0.791	0.629	13

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	0.116	0.112	0.183	0.137	0.188	0.111	0.227	0.129	0.198	0.084	1
2	0.959	1.003	1.005	1.113	0.998	1.033	0.812	0.883	0.837	1.188	2
3	0.952	0.991	1.235	1.167	1.012	1.008	1.028	0.844	1.054	0.787	3
4	0.739	0.733	0.833	0.882	0.806	0.794	0.806	0.909	0.915	0.784	4
5	0.603	0.684	0.800	0.788	0.766	0.701	0.812	0.727	0.754	1.010	5
6	0.649	0.635	0.896	0.793	0.798	0.700	0.825	0.833	0.776	0.806	6
7	0.778	0.750	0.732	0.753	0.746	0.738	0.803	0.980	0.612	0.828	7
8	0.812	0.614	0.769	0.750	0.841	0.754	0.917	0.840	0.835	0.631	8
9	0.663	0.710	0.832	0.611	0.789	0.708	0.718	0.854	0.585	0.941	9
10	0.951	0.855	0.679	0.660	0.962	0.427	1.100	1.040	0.524	0.593	10
11	2.165	0.882	0.625	0.997	1.135	2.338	1.573	0.485	1.139	0.800	11
12	1.074	0.762	0.725	0.754	0.895	0.993	1.022	0.840	0.739	0.759	12
13	1.074	0.762	0.725	0.754	0.895	0.993	1.022	0.840	0.739	0.759	13

Table 12.8 : Stock Numbers at Age (1000's) of COD in IV between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	729267	846712	159348	289088	231615	426099	196003	725823	425653	449209	1
2	86584	293516	352542	69195	113884	94543	171961	84696	285528	175077	2
3	37911	34065	85548	101219	23998	34894	31880	47761	25233	72343	3
4	32173	14020	12229	26570	33555	9348	12388	10834	17337	8327	4
5	15134	14795	5697	5122	9798	14126	3899	4774	5195	6685	5
6	4592	6940	6034	2318	2313	4122	5484	1812	2072	1753	6
7	2726	2232	3364	2191	954	1082	1711	2025	811	856	7
8	936	1398	1061	1310	892	412	523	654	740	337	8
9	594	584	751	345	655	397	179	322	237	274	9
10	225	324	282	280	214	257	141	92	54	69	10
11	94	100	199	134	180	107	133	65	55	15	11
12	54	57	23	157	44	17	47	89	45	31	12
13				60	8	11	4	72	5		13

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	800149	270958	556968	268947	533663	107921	581380	257351	141577	359816	1
2	179742	320096	108896	208442	105424	198617	43377	208114	101632	52199	2
3	53374	48548	82763	28079	48286	27387	49835	13571	60639	31008	3
4	21424	16047	14032	18747	6808	13665	7780	13884	4546	16462	4
5	3836	8373	6312	4995	6352	2489	5058	2845	4581	1490	5
6	2679	1719	3459	2321	1860	2418	1010	1839	1126	1764	6
7	831	1146	746	1156	860	685	983	363	654	424	7
8	374	313	443	294	446	334	268	360	111	291	8
9	161	136	139	168	114	157	129	88	127	40	9
10	95	68	55	49	75	42	63	51	31	58	10
11	22	30	24	23	21	23	23	17	15	15	11
12	10	2	10	10	7	5	2	4	9	4	12
13		6			3	0	2	6	4	0	13

Table 12.9a

Analysis by RCRT1NX2 of data from file COD4ZR1.CSV
COD IV AGE 1 (1990 WG)

Data for 13 surveys over 21 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass	1987		1988		1989		1990	
Survey/ Series	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight
IYFS1	5.1659	.01954	6.1657	.02312	5.2045	.05156		
EGFS1	5.1982	.12485	5.9438	.13869	4.9654	.22142		
DGFS1	5.3251	.12453	5.2885	.12169				
SGFS1	5.1671	.14569	6.1016	.14460	4.9546	.30184		
EGFS0	4.8104	.01625	6.1720	.01918	5.6770	.03917	5.4924	.52736
DGFS0	5.7033	.14569	5.3949	.14460	5.3216	.30184		
IYFS2	5.3851	.07848	6.1471	.08484				
FRGSF	4.9731	.02793	5.3076	.02893	4.5106	.04500		
EGFS2	5.1670	.14045	5.7372	.14460				
SGFS2	4.8731	.10166	5.8516	.12850				
DGFS2	5.7428	.05106						
CGFS1	4.1935	.00230	10.9282	.00066	7.0577	.00496		
GGFS2	5.9366	.00440	6.8781	.00382				
MEAN	5.8993	.01717	5.8990	.01677	5.8972	.03422	5.8929	.47264

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	5.29	197.92	.08	.08		1.01
1988	5.78	323.84	.08	.10		1.30
1989	5.13	169.33	.11	.12		1.06
1990	5.66	293.44	.41	.20		.48

Table 12.9b

Analysis by RCRTINX2 of data from file CODAZE2.CSV
COD IV AGE 2 (1990 WG)

Data for 13 surveys over 21 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass	1987		1988		1989		1990	
Survey/ Series	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight
IYFS1	4.2789	.02285	5.2219	.02671	4.3055	.05967		
EGFS1	4.2756	.10959	5.0048	.12195	4.0493	.19882		
DGFS1	4.4000	.13648	4.3649	.13343				
SGFS1	4.2453	.14461	5.1258	.14298	4.0451	.30250		
EGFS0	3.8963	.01635	5.2259	.01931	4.7421	.04022	4.5619	.51546
DGFS0	4.7571	.14461	4.4701	.14298	4.4016	.30250		
IYFS2	4.4699	.06905	5.2118	.07233				
FRGSF	4.0939	.03286	4.4086	.03397	3.6504	.05370		
EGFS2	4.2574	.12396	4.8087	.14041				
SGFS2	3.9799	.11667	4.8952	.14298				
DGFS2	4.8055	.05709						
GGFS1	3.3176	.00252	9.7033	.00072	6.0332	.00548		
GGFS2	4.9702	.00492	5.8553	.00426				
MEAN	4.9722	.01844	4.9691	.01795	4.9644	.03712	4.9572	.48454

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	4.37	78.77	.08	.08		.99
1988	4.83	124.98	.08	.10		1.27
1989	4.22	68.11	.11	.11		1.04
1990	4.75	115.98	.40	.20		.49

Table 12.10 : Mean Fishing Mortality , Biomass and Recruitment of COD in IV between 1970 and 1989

Year	Mean Fishing Mortality Ages 2 to 8 H.Con	Disc	Ages 1 to 1 By-cat	Biomass 1000 tonnes Total	Sp St	Recruits Age 1 Y.C.	Million
1970	0.535	0.000	0.000	924	271	69	729
1971	0.649	0.000	0.000	1110	269	70	847
1972	0.810	0.000	0.000	763	225	71	159
1973	0.691	0.000	0.000	606	197	72	289
1974	0.667	0.000	0.000	561	210	73	232
1975	0.683	0.000	0.000	622	189	74	426
1976	0.703	0.000	0.000	527	163	75	196
1977	0.717	0.000	0.000	713	142	76	726
1978	0.811	0.000	0.000	709	143	77	426
1979	0.687	0.000	0.000	705	147	78	449
1980	0.785	0.000	0.000	887	161	79	800
1981	0.773	0.000	0.000	741	173	80	271
1982	0.896	0.000	0.000	737	168	81	557
1983	0.892	0.000	0.000	558	135	82	269
1984	0.852	0.000	0.000	625	116	83	534
1985	0.818	0.000	0.000	412	107	84	108
1986	0.858	0.000	0.000	549	97	85	581
1987	0.859	0.000	0.000	475	89	86	257
1988	0.826	0.000	0.000	375	84	87	201
1989	0.862	0.000	0.000	443	85	88	324
Arit-mean recruits at age 1 for period 1970 to 1989							419
Geom-mean recruits at age 1 for period 1970 to 1989							361

Table 12.11: Input for catch prediction of COD in IV

Age	1989 Stock and Fishing Mortality: Stock Number	Fishing Mortality: H.Con.	Disc	Ind	Values used in Prediction (F at age, Mean Wt. and Propn. Retained by Consumption Fishery) — Scaled mean F 1985 to 1989: H.Con.	Disc	Ind	Mean values for period 1985 to 1989, Mean Weight (Kg.): H.Con.	Disc	Ind	Stock	Prop. Ret.
1	324000	0.140		0.000	0.140		0.000	0.601		0.330	0.600	1.000
2	79000	0.970		0.000	0.970		0.000	0.926		0.808	0.926	1.000
3	31008	0.787		0.000	0.964		0.000	1.928		2.182	1.928	1.000
4	16462	0.784		0.000	0.859		0.000	3.722		4.879	3.722	1.000
5	1490	1.010		0.000	0.817		0.000	6.008		7.051	6.009	1.000
6	1764	0.806		0.000	0.804		0.000	8.123		8.655	8.123	1.000
7	424	0.828		0.000	0.809		0.000	9.899		10.737	9.899	1.000
8	291	0.631			0.812		0.000	11.571		11.000	11.571	1.000
9	40	0.941			0.777		0.000	12.831		12.000	12.831	1.000
10	58	0.593			0.752		0.000	14.147		13.000	14.147	1.000
11	15	0.800			1.293			14.753			14.753	1.000
12	4	0.759			0.888		0.000	15.051		14.000	15.051	1.000
13	0	0.759			0.888		0.000	15.289			15.289	1.000

Mean F	Age 2 to 8	Age 1 1	Age 2 to 8	Age 1 1
Unscaled	0.862	0.000	0.845	0.000
Scaled			0.862	0.000

Recruits at age 1 in 1990 = 169000
Recruits at age 1 in 1991 = 293000
Recruits at age 1 in 1992 = 360755
Recruits at age 1 in 1993 = 360755

M at age and proprtion mature at age are as shown in Table 12.3

Mean F for ages 2 to 8 in 1989 for human consumption landings + discards = 0.862 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1985 to 1989
rescaled to produce a mean value of F for ages 2 to 8 equal to that for 1989

Mean F for ages 1 to 1 in 1989 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1985 to 1989 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1989

Values of N in 1989 from VPA have been overwritten
for the following ages .....

Age 1
Age 2

Values of F for these ages in 1989 from VPA have been overwritten
with scaled mean values used for predictions for 1990 onwards

Table 12.12 : Predicted Catches and Biomasses (1000's of tonnes) of COD in IV 1990 to 1991

	Year 1989	1990	1991	1991	1991	1991	1991	1991	1991	1991	1991
Biomass 1 Jan of Year											
Total	443	351	372	372	372	372	372	372	372	372	372
Spawning	85	87	78	78	78	78	78	78	78	78	78
Mean F Ages											
Human Cons. 2 to 8	0.83	0.86	0.00	0.17	0.34	0.52	0.69	0.86	1.03	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(1989)										F0.1	Fmax
Human Consumption	1.00	1.04	0.00	0.21	0.42	0.62	0.83	1.04	1.25	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	119	143	0	32	60	84	104	122	137	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	119	143	0	32	60	84	104	122	137	0	0
Total catch	119	143	0	32	60	84	104	122	137	0	0
Biomass 1 Jan of Year+1											
Total	351	372	606	557	516	482	453	429	408	0	0
Spawning	87	78	165	139	117	99	84	71	61	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
1	169000	15368	0	1	15369
2	126525	68148	0	1	68149
3	21099	11775	0	0	11775
4	10992	5823	0	0	5823
5	6156	3157	0	0	3158
6	444	225	0	0	225
7	645	328	0	0	328
8	152	77	0	0	77
9	127	63	0	0	63
10	13	6	0	0	6
11	26	18	0	0	18
12	5	3	0	0	3
13	1	1	0	0	1
Wt	351247	142860	0	3	142863

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	293000	26644	0	2	26646
2	65996	35546	0	1	35547
3	33792	18859	0	0	188[illegible]
4	6269	3321	0	0	3321
5	3812	1956	0	0	1956
6	2225	1129	0	0	1129
7	163	83	0	0	83
8	235	120	0	0	120
9	55	27	0	0	27
10	48	23	0	0	23
11	5	3	0	0	3
12	6	3	0	0	3
13	2	1	0	0	1
Wt	372414	121554	0	3	121557

Table 12.13 : Predicted Catches and Biomasses (1000's of tonnes) of COD in IV 1990 to 1991

		Year									
	1989	1990	1991								
Biomass 1 Jan of Year											
Total	443	351	427	427	427	427	427	427	427	427	427
Spawning	85	87	105	105	105	105	105	105	105	105	105
Mean F Ages											
Human Cons. 2 to 8	0.83	0.56	0.00	0.17	0.34	0.52	0.69	0.86	1.03	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(1989)										F0.1	Fmax
Human Consumption	1.00	0.67	0.00	0.21	0.42	0.62	0.83	1.04	1.25	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	119	105	0	40	75	104	129	151	170	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	119	105	0	40	75	104	129	151	170	0	0
Total catch	119	105	0	40	75	104	129	151	170	0	0
Biomass 1 Jan of Year+1											
Total	351	427	679	618	567	524	488	458	432	0	0
Spawning	87	105	218	183	154	130	110	93	79	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
1	169000	10200	0	1	10201
2	126525	50848	0	1	50849
3	21099	8802	0	0	8803
4	10992	4301	0	0	4301
5	6156	2320	0	0	2320
6	444	165	0	0	165
7	645	241	0	0	241
8	152	57	0	0	57
9	127	46	0	0	46
10	13	4	0	0	4
11	26	14	0	0	14
12	5	2	0	0	2
13	1	1	0	0	1
Wt	351247	105405	0	4	105408

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	293000	26644	0	2	26646
2	69318	37335	0	1	37336
3	47455	26485	0	0	26485
4	8783	4653	0	0	4653
5	5149	2641	0	0	2641
6	2962	1503	0	0	1504
7	216	110	0	0	110
8	312	159	0	0	159
9	73	36	0	0	36
10	63	30	0	0	30
11	6	4	0	0	4
12	9	5	0	0	5
13	3	2	0	0	2
Wt	427148	151014	0	4	151018

Table 13.1 Nominal catch (tonnes) of COD in Division VIa, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	57	30	35	21	22
Denmark	27[2]	-	3	-	-
Faroe Islands	3	-	2	-	-
France	5,495	7,601	7,160	8,140	7,637
Germany, Fed. Rep.	1	21	8	205	75
Ireland	2,331	2,725	3,527	2,695	2,316
Netherlands	1	-	-	-	-
Norway	48	40	238	267	231
Spain	-	-	41	52	64
Sweden	-	-	1	-	-
UK (England and Wales)	2,302	3,187[3]	2,948	1,141	692
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	2	7	33	37	32
UK (Scotland)	7,603	10,339	7,969	8,933	9,483
Total	17,870	23,950	21,965	21,491	20,552

Country	1985	1986	1987	1988	1989
Belgium	48	88	33	44	28
Denmark	-	-	4	1	3
Faroe Islands	-	-	-	11	16[1]
France	7,411	5,096	5,044	7,669	3,640[1,4]
Germany, Fed. Rep.	66	53	12	25	546[1,2]
Ireland	2,564	1,704	2,442	2,335	n/a
Netherlands	1	-	-	n/a	-
Norway	204	174	77	186	200[1]
Spain	28	-	-	-	n/a
Sweden	-	-	-	-	-
UK (England & Wales)	243	106	306	184	439
UK (Isle of Man)	-	-	-	-	3
UK (N. Ireland)	17	54	138	46	129
UK (Scotland)	8,032	4,251	11,143	8,465	8,942
Total	18,614	11,526	19,199	18,966	13,946

[1] Preliminary.
[2] Includes Division VIb.
[3] Including 37 tonnes caught in Sub-area VI.
[4] Includes Divisions Vb and VIb.
n/a = Not available.

Table 13.2 : Annual Weight and Numbers of COD caught in VIA between 1966 and 1989

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1966	17	17	0	0	6	6	0	0
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
1987	19	19	0	0	15	15	0	0
1988	20	20	0	0	12	12	0	0
1989	17	17	0	0	8	8	0	0

Table 13.3 : 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 13.4 : Total International Catch at Age (1000's) of COD in VIA between 1966 and 1989

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	Age
1	384	261	333	64	256	254	735	1015	843	1207	1
2	2883	2571	1364	1974	1176	1903	2891	1524	2318	1898	2
3	629	3705	3289	1332	1638	550	1591	1442	778	1187	3
4	999	670	1838	1943	571	841	409	583	1068	533	4
5	825	442	215	759	476	240	501	161	288	325	5
6	78	264	171	149	153	201	108	193	72	90	6
7	43	43	124	94	26	66	70	63	76	12	7
8	5	21	19	65	21	15	24	28	13	13	8
9	1	1	6	12	23	7	12	10	9	9	9
10	3	2	1		4	7	4	3	5	1	10

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	970	1265	723	929	1195	461	1827	2335	2143	1355	1
2	3682	1314	1761	1612	3294	7016	1673	4515	2360	5069	2
3	1467	1639	999	2125	2001	3220	3206	1118	2564	1269	3
4	638	624	695	682	796	904	1189	1400	448	1091	4
5	256	269	286	342	191	182	367	468	555	140	5
6	215	87	97	134	77	29	111	148	185	167	6
7	44	57	47	32	27	16	22	40	40	60	7
8	7	11	18	16	8	3	10	16	14	13	8
9	4	4	8	17	1	1	1	2	5	6	9
10	1	6	2	4	1		1	1		0	10

Age	1986	1987	1988	1989	Age
1	792	7873	1008	2016	1
2	1486	4837	8336	1081	2
3	2055	988	2193	3857	3
4	411	905	278	708	4
5	191	137	210	113	5
6	40	56	39	69	6
7	16	8	14	23	7
8	9	14	5	7	8
9	4	3	1	3	9
10		1		0	10

Table 13.5 : Total International Mean Weight at Age (Kg.) of COD in VIA between 1966 and 1989

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	Age
1	0.730	0.681	0.745	0.860	0.595	0.674	0.609	0.597	0.611	0.603	1
2	1.466	1.470	1.776	1.284	0.955	1.046	1.192	1.181	1.103	1.369	2
3	3.474	2.906	2.766	2.821	2.533	2.536	2.586	2.784	2.834	3.078	3
4	5.240	4.560	4.721	4.259	4.678	4.167	4.417	4.601	4.750	5.302	4
5	4.868	6.116	6.304	6.169	6.016	6.023	6.226	5.625	6.144	6.846	5
6	8.711	7.394	7.510	6.374	7.120	6.835	7.585	7.049	7.729	8.572	6
7	8.809	8.150	8.023	7.529	7.350	7.781	7.968	8.208	8.931	9.769	7
8	11.154	7.751	9.575	8.436	8.826	8.238	9.081	8.526	9.317	10.301	8
9	12.285	10.199	8.065	8.300	8.703	9.029	10.369	9.981	12.206	10.843	9
10	10.984	8.555	13.542		7.400	9.925	9.647	12.878	10.538	13.061	10

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	0.616	0.629	0.630	0.693	0.624	0.550	0.692	0.583	0.735	0.628	1
2	1.397	1.160	1.373	1.373	1.375	1.166	1.468	1.265	1.402	1.183	2
3	3.161	2.605	3.389	2.828	3.002	2.839	2.737	2.995	3.168	2.597	3
4	5.005	4.715	5.262	4.853	5.277	4.923	4.749	4.398	5.375	4.892	4
5	6.290	6.269	7.096	6.433	7.422	7.518	6.113	6.305	6.601	6.872	5
6	8.017	7.525	8.686	7.784	8.251	9.314	7.227	8.084	8.606	8.344	6
7	8.754	9.337	9.932	8.570	9.293	10.176	9.587	9.064	10.461	9.540	7
8	9.676	9.489	10.060	9.452	9.473	10.668	10.264	10.979	10.464	10.061	8
9	9.947	12.812	8.694	11.097	8.500	11.271	11.449	12.467	9.131	11.357	9
10	10.486	8.925	10.657	12.736	10.875		10.306	11.882		13.442	10

Age	1986	1987	1988	1989	Age
1	0.710	0.531	0.806	0.704	1
2	1.211	1.312	1.182	1.298	2
3	2.785	2.783	2.886	2.425	3
4	4.655	4.574	5.145	4.737	4
5	6.336	6.161	6.993	7.027	5
6	8.283	7.989	8.204	7.520	6
7	9.091	9.786	8.754	9.130	7
8	8.742	9.530	12.342	10.638	8
9	12.128	11.299	11.814	10.125	9
10		16.056		13.936	10

Table 13.6 COD in Division VIa. Tuning results.

with cpue data from file COD6AEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 SCOSEI has terminal q estimated as the mean
Fleet 2 SCOTRL has terminal q estimated as the mean
Fleet 3 SCOLTR has terminal q estimated as the mean
Fleet 4 SCONTR has terminal q estimated as the mean
Fleet 5 FRAALL has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using Laurec/Shepherd method

	Age 1		Age 2		Age 3		Age 4		Age 5	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.1428	.2430	.3464	.1598	.9471	.1685	.9281	.0898	.7606	.1616
SCOTRL	.1413	.1108	.7276	.2604	.6329	.2488	.5531	.1264	1.6239	.1002
SCOLTR	.1120	.3954	.6928	.2282	.8889	.3949	.8099	.6719	.5686	.5507
SCONTR	.3092	.1879	.7246	.2525	.8724	.0839	1.3973	.0548	.3294	.0623
FRAALL	.0940	.0629	.7976	.0991	1.4686	.1039	1.4673	.0571	2.1271	.1250
		1.0000		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar		Fbar	
	.146		.644		.869		.833		.755	

	Age 6		Age 7		Age 8	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.7890	.3635		.0000		.0000
SCOTRL		.0000		.0000		.0000
SCOLTR	.6736	.3893		.0000		.0000
SCONTR		.0000		.0000		.0000
FRAALL	2.5288	.2472	3.9986	1.0000	3.3754	1.0000
		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar	
	.989		3.999		3.375	

Table 13.7 : Total International Fishing Mortality Rate at Age of COD in VIA between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	0.037	0.027	0.137	0.141	0.119	0.123	0.178	0.153	0.087	0.071	1
2	0.498	0.412	0.478	0.464	0.542	0.423	0.663	0.388	0.330	0.283	2
3	0.529	0.461	0.731	0.467	0.459	0.596	0.682	0.716	0.577	0.845	3
4	0.631	0.575	0.754	0.659	0.769	0.664	0.763	0.709	0.779	1.040	4
5	0.740	0.603	0.828	0.777	0.824	0.565	0.801	0.888	0.857	1.219	5
6	0.711	0.830	0.603	0.925	1.026	0.671	0.938	0.713	0.992	1.467	6
7	0.408	0.794	0.799	0.877	1.309	0.468	0.838	0.710	1.148	1.158	7
8	0.748	0.430	0.747	0.930	0.426	0.841	0.525	0.528	0.511	2.198	8
9	0.648	0.646	0.746	0.834	0.871	0.642	0.773	0.710	0.857	1.417	9
10	0.648	0.646	0.746	0.834	0.871	0.642	0.773	0.710	0.857	1.417	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	0.066	0.089	0.143	0.327	0.170	0.277	0.068	0.333	0.311	0.146	1
2	0.380	0.663	0.524	0.618	0.646	0.758	0.556	0.725	0.708	0.644	2
3	0.678	0.794	0.743	0.821	0.894	0.899	0.822	0.915	0.888	0.869	3
4	0.933	0.763	0.792	0.883	0.970	1.369	0.860	1.146	0.728	0.833	4
5	0.982	0.567	0.840	0.867	1.150	0.981	0.993	0.808	0.944	0.755	5
6	1.078	0.369	0.830	1.035	1.086	1.559	0.879	0.947	0.563	0.990	6
7	1.703	0.663	0.530	0.864	0.909	1.472	0.607	0.438	0.673	0.800	7
8	1.165	0.936	1.196	0.986	0.848	0.874	0.986	2.014	0.534	0.800	8
9	1.172	0.660	0.838	0.927	0.996	1.264	0.910	1.159	0.861	0.800	9
10	1.172	0.660	0.838	0.927	0.996	1.264	0.910	1.159	0.861	0.800	10

Table 13.8 : Stock Numbers at Age (1000's) of COD in VIA between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	7820	10453	6301	8520	8297	11452	6541	9799	9576	14978	1
2	3280	6172	8329	4496	6061	6033	8289	4481	6883	7188	2
3	4360	1631	3345	4228	2315	2887	3237	3496	2490	4053	3
4	1332	2103	842	1319	2169	1198	1302	1340	1399	1145	4
5	992	580	969	324	558	823	505	497	540	526	5
6	328	388	260	347	122	200	383	186	167	188	6
7	86	132	138	116	112	36	84	123	74	51	7
8	44	47	49	51	40	25	18	30	49	19	8
9	52	17	25	19	16	21	9	9	14	24	9
10	9	15	9	6	9	2	3	13	4	6	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	20614	5986	15071	9179	15058	6143	13358	30524	4143	16348	1
2	11425	15799	4486	10693	5417	10399	3811	10222	17918	2486	2
3	4435	6397	6666	2174	4717	2325	3991	1790	4052	7227	3
4	1426	1844	2366	2597	783	1580	775	1436	587	1364	4
5	331	459	704	878	880	243	329	268	374	232	5
6	127	102	213	249	302	228	75	100	98	119	6
7	35	35	58	76	72	83	39	25	32	46	7
8	13	5	15	28	26	24	16	18	13	13	8
9	2	3	2	4	8	9	8	5	2	6	9
10	1		2	2		0		2		1	10

Table 13.9a

Analysis by RCRTINX2 of data from file COD6AR1.DWA
COD VIa AGE 1 (1990 WG)

Data for 4 surveys over 22 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass	1987		1988		1989	
Survey/ Series	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight
SCOSEI	8.8967	.43243	9.5739	.41645		
SCOLTR	7.9747	.07871	10.0400	.09320		
SCOGFS	8.6434	.14819	9.7988	.15389	9.2092	.44218
SCOCFS	8.8026	.11320	9.7707	.12434		
MEAN	9.3502	.22748	9.3668	.21213	9.3840	.55782

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	8.88	7180.34	.23	.18		.75
1988	9.63	15252.53	.23	.10		.42
1989	9.31	11011.69	.38	.09		.23

Table 13.9b

Analysis by RCRTINX2 of data from file COD6AR2.DWA
COD VIa AGE 2 (1990 WG)

Data for 4 surveys over 22 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Year class	1987		1988		1989	
Survey/ series	Predicted value	Weight	Predicted value	Weight	Predicted value	Weight
SCOSEI	8.4655	.32401	9.2409	.31198		
SCOLTR	7.3324	.07374	9.8058	.08855		
SCOGFS	8.1620	.13567	9.4385	.14154	8.7848	.31792
SCOGFS	8.3604	.11512	9.4326	.12767		
MEAN	8.9887	.35147	9.0016	.33026	9.0149	.68208

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	8.51	4976.95	.29	.22		.77
1988	9.26	10554.91	.29	.12		.41
1989	8.94	7644.74	.43	.11		.25

Table 13.10 : Mean Fishing Mortality , Biomass and Recruitment of COD in VIA between 1970 and 1989

	Mean Fishing Mortality Ages 2 to 5		Ages 1 to 1	Biomass 1000 tonnes		Recruits Age 1	
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1970	0.599	0.000	0.000	35	27	69	8
1971	0.513	0.000	0.000	34	24	70	10
1972	0.698	0.000	0.000	36	26	71	6
1973	0.592	0.000	0.000	34	25	72	9
1974	0.648	0.000	0.000	35	25	73	8
1975	0.562	0.000	0.000	39	27	74	11
1976	0.727	0.000	0.000	40	29	75	7
1977	0.675	0.000	0.000	33	23	76	10
1978	0.636	0.000	0.000	38	26	77	10
1979	0.847	0.000	0.000	43	26	78	15
1980	0.743	0.000	0.000	53	31	79	21
1981	0.697	0.000	0.000	54	39	80	6
1982	0.725	0.000	0.000	53	37	81	15
1983	0.797	0.000	0.000	45	33	82	9
1984	0.915	0.000	0.000	47	31	83	15
1985	1.002	0.000	0.000	35	24	84	6
1986	0.808	0.000	0.000	32	19	85	13
1987	0.899	0.000	0.000	44	21	86	31
1988	0.817	0.000	0.000	46	28	87	7
1989	0.775	0.000	0.000	44	28	88	15
Arit-mean recruits at age 1 for period 1970 to 1989							12
Geom-mean recruits at age 1 for period 1970 to 1989							11

Table 13.11: Input for catch prediction of COD in VIA

Age	1989 Stock and Fishing Mortality: Stock Number	Fishing Mortality H.Con.	Fishing Mortality Disc	Fishing Mortality Ind	Scaled mean F 1985 to 1989 H.Con.	Scaled mean F Disc	Scaled mean F Ind	Mean Weight (Kg.) H.Con.	Mean Weight Disc	Mean Weight Ind	Mean Weight Stock	Prop. Ret.
1	15253	0.179			0.179			0.676			0.676	1.000
2	4977	0.611			0.611			1.237			1.237	1.000
3	7227	0.869			0.792			2.695			2.695	1.000
4	1364	0.833			0.890			4.801			4.801	1.000
5	232	0.755			0.808			6.678			6.678	1.000
6	119	0.990			0.890			8.068			8.068	1.000
7	46	0.800			0.719			9.260			9.260	1.000
8	13	0.800			0.939			10.262			10.262	1.000
9	6	0.800			0.900			11.345			11.345	1.000
10	1	0.800			0.900			14.478			14.478	1.000

Values used in Prediction: F at age, Mean Wt. and Propn. Retained by Consumption Fishery; Mean values for period 1985 to 1989.

Mean F	1989 Age 2 to 5	1989 Age 1 1	Prediction Age 2 to 5	Prediction Age 1 1
Unscaled	0.775	0.000	0.860	0.000
Scaled			0.775	0.000

Recruits at age 1 in 1990 = 11012
Recruits at age 1 in 1991 = 10510
Recruits at age 1 in 1992 = 10510
Recruits at age 1 in 1993 = 10510

M at age and proprtion mature at age are as shown in Table 13.3

Mean F for ages 2 to 5 in 1989 for human consumption landings + discards = 0.775 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1985 to 1989 rescaled to produce a mean value of F for ages 2 to 5 equal to that for 1989

Mean F for ages 1 to 1 in 1989 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1985 to 1989 . rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1989

Values of N in 1989 from VPA have been overwritten for the following ages .....

Age 1
Age 2

Values of F for these ages in 1989 from VPA have been overwritten with scaled mean values used for predictions for 1990 onwards

Table 13.12 : Predicted Catches and Biomasses (1000's of tonnes) of COD in VIA 1990 to 1991

		Year										
		1989	1990	1991								
Biomass 1 Jan of Year												
Total		44	43	40	40	40	40	40	40	40	40	40
Spawning		28	28	27	27	27	27	27	27	27	27	27
Mean F	Ages											
Human Cons.	2 to 5	0.77	0.78	0.00	0.16	0.31	0.47	0.62	0.78	0.93	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(1989)											F0.1	Fmax
Human Consumption		1.00	1.01	0.00	0.20	0.40	0.61	0.81	1.01	1.21	0.00	0.00
Catch weight												
Human Consumption		17	18	0	4	8	12	15	17	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		17	18	0	4	8	12	15	17	19	0	0
Total catch		17	18	0	4	8	12	15	17	19	0	0
Biomass 1 Jan of Year+1												
Total		43	40	64	58	52	47	42	38	35	0	0
Spawning		28	27	50	44	38	33	29	26	23	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
1	11012	1638	0	0	1638
2	10445	4373	0	0	4373
3	2211	1111	0	0	1111
4	2482	1345	0	0	1345
5	486	247	0	0	247
6	89	48	0	0	48
7	36	17	0	0	17
8	17	9	0	0	9
9	5	3	0	0	3
10	2	1	0	0	1
Wt	42801	18312	0	0	18312

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	10510	1563	0	0	1563
2	7541	3157	0	0	3157
3	4641	2331	0	0	2331
4	820	444	0	0	444
5	835	425	0	0	425
6	177	96	0	0	96
7	30	14	0	0	14
8	14	8	0	0	8
9	5	3	0	0	3
10	2	1	0	0	1
Wt	40404	17258	0	0	17258

Table 13.13 : Predicted Catches and Biomasses (1000's of tonnes) of COD in VIA 1990 to 1991

		Year										
		1989	1990	1991								
Biomass 1 Jan of Year												
Total		44	43	44	44	44	44	44	44	44	44	44
Spawning		28	28	30	30	30	30	30	30	30	30	30
Mean F	Ages											
Human Cons.	2 to 5	0.77	0.64	0.00	0.16	0.31	0.47	0.62	0.78	0.93	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(1989)											F0.1	Fmax
Human Consumption		1.00	0.84	0.00	0.20	0.40	0.61	0.81	1.01	1.21	0.00	0.00
Catch weight												
Human Consumption		17	16	0	5	9	13	16	19	21	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		17	16	0	5	9	13	16	19	21	0	0
Total catch		17	16	0	5	9	13	16	19	21	0	0
Biomass 1 Jan of Year+1												
Total		43	44	69	61	55	49	44	40	37	0	0
Spawning		28	30	54	47	41	36	31	28	24	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
1	11012	1379	0	0	1379
2	10445	3798	0	0	3798
3	2211	976	0	0	976
4	2482	1189	0	0	1189
5	486	218	0	0	218
6	89	43	0	0	43
7	36	15	0	0	15
8	17	8	0	0	8
9	5	2	0	0	2
10	2	1	0	0	1
Wt	42801	16034	0	0	16034

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	10510	1563	0	0	1563
2	7773	3254	0	0	3254
3	5149	2587	0	0	2587
4	938	508	0	0	508
5	971	494	0	0	494
6	203	110	0	0	110
7	35	16	0	0	16
8	16	9	0	0	9
9	6	3	0	0	3
10	3	2	0	0	2
Wt	43831	18992	0	0	18992

Table 14.1 Nominal catch (tonnes) of COD in Division VIb, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Faroe Islands	75	2	77	112	18
France	1	4	27	97	9
Germany, Fed. Rep.	136	443	+	195	-
Norway	80	134	51	462	373
Spain	-	70	58	42	241
UK (England and Wales)	1	67	3	163	161
UK (Isle of Man)	-	-	-	-	-
UK (N.Ireland)	-	-	-	-	-
UK (Scotland)	370	143	157	35	221
Total	696	863	373	1,106	1,023

Country	1985	1986	1987	1988	1989
Faroe Islands	-	1	-	31	2[1]
France	17	5	7	2	...[1,2]
Germany, Fed. Rep.	3	-	-	3	...[1,2]
Norway	202	95	130	195	148[1]
Spain	1,200	1,219	808	1,345	n/a
UK (England & Wales)	114	93	69	56	130
UK (Isle of Man)	-	-	-	-	1
UK (N. Ireland)	-	1	-	-	3
UK (Scotland)	437	187	284	254	262
Total	1,973	1,601	1,298	1,886	546

[1] Preliminary.
[2] Included in Division VIa.
n/a = Not available.

Table 15.1 Nominal catch (tonnes) of COD in Division VIId, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	151	329	251	368	331
Denmark	...[1]	-	-	-	-
France	3,203	3,707	2,696	2,802	2,492
Netherlands	-	4	1	4	-
UK (England and Wales)	160	206	306	358	282
Total	3,514	4,246	3,254	3,532	3,105
WG Estimate	5,020	5,336	3,981	3,841	3,524

Country	1985	1986	1987	1988	1989
Belgium	501	650	815	486	173
Denmark	-	4	-	+	+
France	2,589	9,938	7,541	8,795	n/a
Netherlands	...[1]	...[1]	-	n/a	1
UK (England and Wales)	326	830	1,044	867	562
Total	3,416	11,422	9,400	10,148	736
WG Estimate	3,331	12,814	14,220	9,359	5,504

[1]Included in Division VIIe.
n/a = Not available.

Table 15.2 : 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	0.000
3	0.200	0.000
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000

Table 15.3 : Total International Catch at Age (1000's) of COD in VIID between 1976 and 1989

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0										4		2		1	0
1	11	5840	464	292	671	57	860	125	555	14	7779	2837	595	230	1
2	765	4242	5717	1528	2001	2056	904	1786	1588	1210	8941	8320	2517	1702	2
3	745	209	1275	1239	673	1056	520	776	405	453	1734	167	1793	816	3
4	108	64	248	223	296	202	271	187	72	75	545	216	225	279	4
5	40	16	12	63	26	28	41	40	36	5	63	6	6	107	5
6	26	5	1	4	8	1	7	7	10	4	8	1		1	6

Table 15.4 : Total International Mean Weight at Age (Kg.) of COD in VIID between 1976 and 1989

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0										0.000		0.000		0.000	0
1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	1
2	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	2
3	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.001	0.003	0.003	0.002	3
4	0.005	0.005	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.003	0.003	0.004	0.004	4
5	0.006	0.006	0.006	0.005	0.006	0.006	0.006	0.006	0.006	0.007	0.005	0.006	0.007	0.005	5
6	0.007	0.008	0.008	0.006	0.006	0.007	0.007	0.008	0.006	0.008	0.008	0.008		0.008	6

Table 15.5

Title : COD IN THE EASTERN ENGLISH CHANNEL (DIVISION VIId) On 22/10/1990 10:00

Separable analysis
from 1976 to 1989 on ages 1 to 5
with Terminal F = 1.000 on age 3 and Terminal S = 1.000

Initial sum of squared residuals was 223.695
final sum of squared residuals is 55.276 after 46 iterations

Matrix of Residuals

Years	1976/77	1977/78	1978/79
Ages			
1/ 2	-3.987	2.029	.651
2/ 3	.242	.164	.261
3/ 4	1.376	-1.248	.433
4/ 5	.150	-.119	-.681
	.000	.000	.000
WTS	1.000	1.000	1.000

Years	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89		WTS
Ages												
1/ 2	-.010	.743	-.853	1.386	-.770	.493	-3.037	.979	1.614	.969	.205	.252
2/ 3	-.336	-.560	.284	-.720	.155	-.442	.300	.920	-.237	.174	.205	1.000
3/ 4	.243	-.017	.259	.120	1.028	.054	.383	-1.210	-2.117	.902	.205	.454
4/ 5	.250	.417	-.205	.347	-.469	.322	.319	-.087	.868	-.907	.205	.913
	.000	.000	.000	.000	.000	.000	.000	.538	.000	.000	.822	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1976	1977	1978	1979
F-values	1.0544	1.0872	1.2242	1.1405

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
F-values	1.1343	1.0344	.9731	1.2113	.9965	.3910	3.0000	1.5377	.9549	1.0000

Selection-at-age (S)

	1	2	3	4	5
S-values	.0659	.8924	1.0000	1.3610	1.0000

Table 15.6

ANALYSIS BY RCSEP OF COD IN 7D

Coefficient of determination = .9695

	Parameter	s.d.
year effects		
	1.0000	.0000
	4.6004	2.1354
	.5238	.4348
	2.3589	.6445
age effects		
	.1718	.2203
	.6493	.4566
	.4584	.3814
	.9744	.6160
	5.8146	2.5118
	.5000	.0000
y/c effects		
	3.1023	2.0240
	5.1815	1.9405
	4.7292	1.4265
	7.7262	1.3879
	8.5560	1.2714
	10.6126	1.3748
	9.1759	1.2466
	8.4927	1.5472
	6.6289	2.2620

Table 16.1 Nominal catch (tonnes) of COD in Division VIIe, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	12	34	42	21	15
Denmark	660[1]	-	-	-	-
France	798	779	653	567	390
Netherlands	-	-	-	-	-
UK (England and Wales)	205	222	262	292	236
UK (Scotland)	-	-	-	-	-
Total	1,675	1,035	957	880	641
WG Estimate	1,774	1,170	956	906	805

Country	1985	1986	1987	1988	1989
Belgium	12	8	10	12	19
Denmark	-	-	+	+	+
France	359	1,305	1,122	1,758	n/a
Netherlands	1[1]	66[1]	-	n/a	-
UK (England and Wales)	243	406	524	840	734
UK (Scotland)	-	-	-	-	2
Total	615	1,785	1,656	2,610	755
WG Estimate	733	1,028	2,699	2,387	1,679

[1]Includes Division VIId.
n/a = Not available.

Table 17.1 Nominal catch (t) of COD in Divisions VIIb,c,h-k, 1980-1989, based on officially reported figures (where available) and Working Group estimates.

Country	1980	1981	1982	1983	1984
Belgium	-	-	-	-	-
Denmark	-	-	-	-	-
France	983	1,465	587	636	946
Germany, Fed. Rep.	7	-	-	-	-
Ireland	782	1,434	1,764	1,192	1,211
Netherlands	5	-	+	80	325
Norway	-	-	-	4	1
Spain	17	37	29	28	56
UK (England and Wales)	1	171	304	41	408
UK (Scotland)	12	+	-	-	45
Total	1,807	3,107	2,684	1,981	2,991

Country	1985	1986	1987	1988	1989
Belgium	13	3	-	-	-
Denmark	-	-	+[2]	+[2]	-
France	1,115	1,599	1,214	2,551	n/a
Germany, Fed. Rep.	-	-	-	-	-[1]
Ireland	1,176	1,283	1,301	1,256	n/a
Netherlands	208	1	-	n/a	-
Norway	22	106	1	2	22[1,2]
Spain	26	-	-	-	n/a
UK (England and Wales)	546	455	275	127	137
UK (Scotland)	+	17	19	7	33
Total	3,106	3,464	2,810	3,943	192

[1] Preliminary.
[2] Includes Division VIIg.
n/a = Not available.

Table 18.1 Nominal catch (tonnes) of HADDOCK in Sub-area IV, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	1,414	1,217	966	985	494
Denmark	12,928	13,198	22,704	25,653	16,368
Faroe Islands	27	46	6	51	-
France	7,407	11,966	15,988	11,250	8,103
German Dem. Rep.	36	-	-	-	-
Germany, Fed. Rep.	2,354	3,387	4,510	3,654	2,571
Netherlands	1,557	2,279	1,021	1,722	1,052
Norway[2]	1,191	2,283	2,888	3,862	3,959
Poland	59	31	317	150	17
Sweden	1,165	1,301	1,874	1,360	1,518
UK (England and Wales)	12,195	14,570	16,403	15,476	12,340
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	64,058	82,798	107,773	100,390	87,479
Total	104,391	133,076	174,450	164,553	133,901

Country	1985	1986	1987	1988	1989
Belgium	719	317	165	220	145
Denmark	23,821	16,397	7,767	9,174	2,789[1]
Faroe Islands	5	4	23	35	10[1]
France	5,389	4,802	3,889	2,193	1,702[1,3]
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	2,796	1,984	1,231	802	500[1]
Netherlands	3,875	1,627	1,093	n/a	328[1]
Norway[2]	3,498	5,190	2,610	1,590	1,664[1]
Poland	-	1	-	-	-
Sweden	1,942	1,550	937	614	1,051
UK (England & Wales)	13,614	8,137	7,491	5,537	2,704
UK (N. Ireland)	-	-	-	-	137
UK (Scotland)	112,549	126,650	84,063	84,104	53,252
Total	168,208	166,659	109,269	104,269	64,282

[1] Preliminary.
[2] Figures do not include haddock caught as industrial by-catch.
[3] Includes Division IIa.
n/a = Not available.

Table 18.2 : Annual Weight and Numbers of HADDOCK caught in IV between 1960 and 1989

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1960	218	75	130	12	1191	207	842	143
1961	219	75	133	11	2061	189	889	983
1962	453	59	383	11	3108	149	2674	286
1963	271	68	189	14	1683	181	1246	256
1964	379	131	160	89	1594	352	644	599
1965	298	162	62	75	1717	370	254	1093
1966	346	226	74	47	3128	407	490	2232
1967	246	147	78	21	1420	272	448	700
1968	302	105	162	34	1617	221	838	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	1631	396	788	447
1977	217	137	44	35	896	320	226	350
1978	174	86	77	11	1030	192	418	420
1979	141	83	42	16	1461	189	286	985
1980	216	99	95	22	1447	218	541	687
1981	207	130	60	17	1352	274	298	780
1982	226	166	41	19	971	311	181	480
1983	238	159	66	13	1256	293	389	574
1984	213	128	75	10	866	247	412	207
1985	251	159	86	6	971	359	458	154
1986	220	166	52	3	755	371	308	75
1987	172	108	59	4	657	228	334	95
1988	171	105	62	4	644	254	362	29
1989	104	76	26	2	296	168	111	17

Table 18.3 : 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 18.4 : Total International Catch at Age (1000's) of HADDOCK in IV between 1960 and 1989

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Age
0	51506	1006475	26880	1359	139777	649768	1666972	305249	11105	72559	0
1	687709	755531	2949187	1305614	7425	367490	1005889	837010	1096962	20469	1
2	402287	185823	72429	334239	1294531	15136	25640	88979	438696	3574797	2
3	13697	93131	32385	20858	134823	647618	6412	4853	19538	303070	3
4	7521	4035	21229	12952	9039	29385	411562	3576	1940	7584	4
5	23929	1872	1479	5746	5333	4642	9954	177394	2519	2407	5
6	3082	12294	605	499	2398	1963	1043	2437	45804	2512	6
7	1065	936	3839	649	286	450	599	214	324	19099	7
8	435	430	272	562	235	107	164	216	40	200	8
9	49	150	59	58	230	90	89	57	13	24	9
10	33	7	27	18	25	40	23	33	5	7	10
11		1	1				2				11

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	924601	330673	240896	59872	601412	44946	167173	114954	285843	841439	0
1	266147	1809964	675831	364822	1213867	2096827	167599	250138	454092	344756	1
2	218293	70735	584076	567133	174389	632672	1046110	104310	142668	198147	2
3	1906573	47224	40150	237498	326659	57630	204506	376976	28695	39551	3
4	57362	397328	20948	6099	53137	106048	9555	38062	107172	7068	4
5	1176	10288	155922	4399	1832	15320	30044	4087	8153	26742	5
6	1195	458	3516	38829	1320	952	4793	5939	1190	2134	6
7	256	193	188	1237	10672	601	198	1230	1942	250	7
8	5946	146	33	106	236	2628	73	128	377	461	8
9	67	1578	27	28	23	258	728	27	108	145	9
10	11	159	402	108	31	61	58	190	14	52	10
11	19	8	11	53	9	18	3	4	74	23	11

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	374960	646419	278705	639815	95502	139623	56507	9419	10808	10706	0
1	659594	134440	275372	156146	432175	179244	160285	277273	29040	47228	1
2	323151	413156	83827	247634	161719	526391	177699	246818	482791	33550	2
3	68715	138189	287840	71192	118503	75488	320291	46723	87436	179519	3
4	9837	14457	40322	123246	21366	36620	27068	67312	13155	17555	4
5	1784	1883	3198	15955	32134	5271	9504	4628	18433	2541	5
6	7573	374	691	1645	3698	7286	1208	2816	1547	4003	6
7	562	2462	268	286	590	954	1808	530	615	496	7
8	114	123	780	59	76	209	235	768	152	195	8
9	153	63	29	189	37	54	101	130	135	82	9
10	70	23	15	52	110	22	43	32	48	28	10
11	42	38	11	14	21	93	77	111	48	24	11

Table 18.5 : Total International Mean Weight at Age (Kg.) of HADDOCK in IV between 1960 and 1989

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Age
0	0.020	0.013	0.045	0.012	0.011	0.010	0.010	0.011	0.010	0.011	0
1	0.135	0.142	0.135	0.123	0.119	0.069	0.088	0.115	0.126	0.063	1
2	0.236	0.267	0.277	0.253	0.239	0.225	0.247	0.281	0.253	0.216	2
3	0.403	0.372	0.475	0.474	0.403	0.365	0.367	0.461	0.509	0.406	3
4	0.459	0.605	0.569	0.695	0.664	0.648	0.533	0.594	0.731	0.799	4
5	0.635	0.574	0.732	0.806	0.814	0.844	0.949	0.639	0.857	0.891	5
6	0.809	0.756	0.768	1.004	0.908	1.193	1.265	1.057	0.837	1.032	6
7	1.020	0.961	0.932	1.131	1.382	1.173	1.525	1.501	1.606	1.094	7
8	1.311	1.274	1.368	1.173	1.148	1.482	1.938	1.922	2.260	2.040	8
9	1.989	1.412	1.722	1.576	1.470	1.707	1.727	2.069	2.702	3.034	9
10	2.251	1.702	2.277	1.825	1.781	2.239	2.963	2.348	2.073	3.264	10
11		1.849	1.514				2.040				11

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	0.013	0.011	0.024	0.044	0.024	0.021	0.013	0.019	0.012	0.009	0
1	0.073	0.106	0.116	0.112	0.128	0.101	0.125	0.108	0.144	0.095	1
2	0.222	0.247	0.242	0.241	0.226	0.241	0.224	0.241	0.253	0.291	2
3	0.353	0.362	0.388	0.372	0.343	0.356	0.401	0.345	0.418	0.442	3
4	0.735	0.505	0.506	0.585	0.548	0.450	0.512	0.602	0.441	0.637	4
5	0.873	0.887	0.606	0.648	0.891	0.680	0.588	0.613	0.719	0.664	5
6	1.191	1.267	1.000	0.724	0.895	1.245	0.922	0.802	0.742	0.933	6
7	1.361	1.534	1.366	1.044	0.953	1.124	1.933	1.181	0.954	1.187	7
8	1.437	1.337	2.241	1.302	1.513	1.093	1.784	1.943	1.398	1.187	8
9	2.571	1.275	2.006	2.796	2.315	1.720	1.306	2.322	2.124	1.468	9
10	3.950	1.969	1.651	1.726	2.508	2.217	2.425	1.780	2.868	2.679	10
11	3.869	3.848	2.899	2.033	3.019	3.083	2.528	3.499	2.036	1.686	11

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	0.012	0.009	0.011	0.022	0.010	0.013	0.025	0.008	0.024	0.027	0
1	0.104	0.074	0.100	0.135	0.141	0.149	0.124	0.126	0.164	0.198	1
2	0.284	0.262	0.292	0.297	0.300	0.279	0.242	0.265	0.217	0.300	2
3	0.486	0.476	0.461	0.448	0.488	0.479	0.396	0.405	0.417	0.372	3
4	0.732	0.744	0.784	0.651	0.670	0.668	0.612	0.613	0.589	0.605	4
5	1.046	1.147	1.166	0.916	0.805	0.859	0.864	1.029	0.747	0.811	5
6	0.936	1.479	1.441	1.215	1.097	1.054	1.260	1.278	1.283	0.984	6
7	1.394	1.180	1.672	1.162	1.100	1.470	1.202	1.433	1.424	1.375	7
8	1.599	1.634	1.456	1.920	1.868	1.844	1.719	1.530	1.542	1.659	8
9	1.593	1.764	2.634	1.376	2.425	2.137	1.526	1.865	1.612	1.695	9
10	1.726	1.554	2.164	1.395	1.972	2.193	2.482	2.040	1.674	2.240	10
11	2.861	1.821	2.145	2.974	2.456	2.012	2.628	2.246	2.948	2.187	11

Table 18.6 HADDOCK in Sub-area IV. Tuning results.

with cpue data from file HAD4ZEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 SCOSEI has terminal q estimated as the mean
Fleet 2 SCOTRL has terminal q estimated as the mean
Fleet 3 SCOLTR has terminal q estimated as the mean
Fleet 4 SCOGFS has terminal q estimated as the mean
Fleet 5 ENGGFS has terminal q estimated as the mean
Fleet 6 FRATRB has terminal q estimated as the mean
Fleet 7 FRGGFS has terminal q estimated as the mean
Fleet 8 INTGFS has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using Laurec/Shepherd method

	Age 0		Age 1		Age 2		Age 3		Age 4	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.0098	.0945	.0820	.0659	.4979	.1783	.8975	.3810	.9119	.3452
SCOTRL		.0000	.0830	.0182	.9459	.0831	2.0616	.0649	1.1841	.1228
SCOLTR	.0015	.0524	.1130	.0881	1.428	.1695	1.1896	.3019	1.0368	.2713
SCOGFS	.0028	.6044	.0809	.1426	.5724	.2110	.9486	.0991	1.4056	.0907
ENGGFS	.0033	.1912	.0848	.2102	.6651	.1580	1.0645	.0435	1.3889	.0633
FRATRB	.0048	.0575	.1567	.0839	1.1836	.1695	1.7569	.1097	1.5233	.1067
FRGGFS		.0000	.0475	.0439	.2507	.0306		.0000		.0000
INTGFS			.0671	.3472		.0000		.0000		.0000
		1.0000		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar		Fbar	
	.003		.820		.768		1.125		1.100	

	Age 5		Age 6		Age 7		Age 8		Age 9	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.8353	.2899	.7393	.3115	.5635	.4379	.3616	.2060	.3208	.2810
SCOTRL	.6570	.1345	1.3782	.0987	1.0506	.0940	.2691	.1540	.4023	.4244
SCOLTR	.6429	.1403	.7789	.1569	.5435	.1216	.6873	.2760		.0000
SCOGFS	1.3565	.1260	1.3104	.0939	1.0705	.0642	1.1931	.0294		.0000
ENGGFS	1.6869	.1028	1.1614	.0503	.6805	.0537		.0000		.0000
FRATRB	1.2072	.2065	1.0154	.2888	.7218	.2284	.5685	.3346	.6717	.2946
FRGGFS		.0000		.0000		.0000		.0000		.0000
INTGFS		.0000		.0000		.0000		.0000		.0000
		1.0000		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar		Fbar	
	.961		.938		.663		.497		.439	

Table 18.7 : Total International Fishing Mortality Rate at Age of HADDOCK in IV between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	0.027	0.011	0.029	0.002	0.012	0.010	0.027	0.012	0.018	0.030	0
1	0.449	0.427	0.155	0.341	0.324	0.307	0.284	0.306	0.357	0.161	1
2	1.032	0.660	0.795	0.572	0.938	0.978	0.826	1.007	1.009	0.892	2
3	1.153	0.803	1.324	1.163	0.960	1.264	1.381	1.040	1.112	1.133	3
4	1.273	0.876	1.194	0.784	1.004	1.110	0.789	1.249	1.101	1.038	4
5	0.658	0.879	1.165	0.944	0.600	0.988	1.285	1.032	1.117	0.998	5
6	1.287	0.586	0.886	1.114	0.858	0.734	1.032	1.006	1.030	1.072	6
7	0.472	0.737	0.509	0.946	1.161	1.381	0.325	0.840	1.175	0.627	7
8	1.167	0.543	0.262	0.610	0.463	1.080	0.597	0.359	0.679	1.052	8
9	0.258	1.259	0.178	0.371	0.251	1.479	1.074	0.468	0.590	0.615	9
10	0.860	1.787	1.523	2.541	0.936	2.318	2.451	0.953	0.480	0.636	10
11	0.682	0.662	0.562	0.752	0.649	1.088	0.882	0.795	0.947	0.886	11
12	0.682	0.662	0.562	0.752	0.649	1.088	0.882	0.795	0.947	0.886	12

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	0.062	0.051	0.035	0.024	0.014	0.015	0.003	0.006	0.003	0.003	0
1	0.171	0.166	0.161	0.142	0.115	0.192	0.119	0.101	0.141	0.082	1
2	0.704	0.454	0.433	0.663	0.665	0.613	1.030	0.900	0.833	0.768	2
3	1.195	0.940	0.811	1.009	0.984	0.951	1.245	1.095	1.275	1.125	3
4	1.115	0.981	0.880	1.147	1.109	1.087	1.295	1.105	1.260	1.100	4
5	0.871	0.688	0.629	1.199	1.219	0.999	1.030	0.855	1.189	0.962	5
6	0.900	0.443	0.587	0.796	1.070	1.084	0.659	1.055	0.804	0.938	6
7	0.965	0.866	0.667	0.518	0.761	0.929	0.903	0.691	0.697	0.663	7
8	0.659	0.573	0.763	0.296	0.250	0.682	0.620	1.406	0.433	0.497	8
9	1.381	1.004	0.251	0.416	0.306	0.285	0.861	0.863	1.089	0.439	9
10	0.697	0.821	0.721	0.989	0.459	0.295	0.385	0.743	0.953	0.700	10
11	0.948	0.729	0.654	0.736	0.801	0.836	0.832	0.965	0.843	0.700	11
12	0.948	0.729	0.654	0.736	0.801	0.836	0.832	0.965	0.843	0.700	12

Table 18.8 : Stock Numbers at Age (1000's) of HADDOCK in IV between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	80281630	73985890	19742580	66805380	122270700	10474010	14870770	23152950	36695190	66936130	0
1	1418000	10056210	9424575	2468928	8582055	15558670	1334779	1863966	2945838	4637625	1
2	398000	173816	1259537	1550241	337257	1191720	2197822	192993	263689	395712	2
3	3075955	95078	60216	381429	586503	88495	300345	645053	47254	64453	3
4	87762	756072	33159	12482	92867	174816	19468	58808	177493	12107	4
5	2664	19135	245305	7825	4439	26500	44879	6886	13130	45980	5
6	1784	1130	6506	62624	2494	1995	8079	10161	2008	3518	6
7	745	403	515	2196	16825	866	784	2356	3041	587	7
8	9349	381	158	253	698	4314	178	464	833	769	8
9	324	2383	181	100	113	360	1199	80	265	346	9
10	21	205	554	124	56	72	67	335	41	120	10
11	41	7	28	99	8	18	6	5	106	21	11
12		11		10	12	12		2	25	21	12

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	14502900	30330780	19078790	63489080	16116150	22659930	45251650	3470491	9495941	7642161	0
1	8363359	1754574	3710418	2372154	7980199	2045848	2874931	5808359	443923	1219187	1
2	758256	1353217	285371	606828	395454	1365638	324343	490237	1008180	74073	2
3	108710	251445	576064	124080	209698	136390	495836	77627	133666	293675	3
4	16173	25622	76500	199453	35243	61075	41052	111217	20233	29087	4
5	3338	4130	7481	24719	49341	9059	16035	8758	28680	4468	5
6	13878	1144	1699	3266	6102	11936	2733	4685	3048	7148	6
7	986	4622	602	773	1207	1714	3305	1158	1336	1116	7
8	257	307	1591	253	377	461	554	1097	475	545	8
9	220	109	142	607	154	240	191	244	220	252	9
10	153	45	33	90	328	93	148	66	84	61	10
11	52	62	16	13	28	170	57	82	26	27	11
12	22	18	9	17	15	8	92	112	65	25	12

Table 18.9a

Analysis by RCRTINX2 of data from file HAD4ZR1.CSV
HADDOCK IV AGE 1 (1990 WG)

Data for 10 surveys over 21 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass	1987		1988		1989		1990	
Survey/ Series	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight
IYFS1	6.4259	.16626	7.3326	.17999	7.3716	.32457		
EGFS1	5.9446	.07391	7.0133	.09250	6.7498	.13624		
SGFS1	4.9249	.02754	6.1786	.04324	6.4107	.08332		
EGFS0	3.2262	.00609	4.8922	.00750	5.6494	.01562	7.4995	.10975
IYFS2	6.7823	.09211	6.9579	.08412				
SGFS0	5.8827	.04604	6.4620	.05223	6.5622	.09496	9.5786	.52625
EGFS2	6.7409	.17683	6.9871	.14826				
SGFS2	6.3897	.09828	6.5157	.08310				
GGFS1	7.0380	.12194	7.8976	.15224	8.2628	.27181		
GGFS2	7.5898	.14167	7.7338	.11634				
MEAN	8.2267	.04933	8.2126	.04048	8.2008	.07348	8.1927	.36400

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	6.72	827.00	.15	.22		1.48
1988	7.21	1348.94	.13	.18		1.34
1989	7.41	1646.22	.18	.29		1.65
1990	8.85	6946.03	.38	.56		1.48

Table 18.9b

Analysis by RCRTINX2 of data from file HAD4ZK2.CSV
HADDOCK IV AGE 2 (1990 WG)

Data for 10 surveys over 21 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass	1987		1988		1989		1990	
Survey/ Series	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight
IYFS1	4.5857	.21371	5.4929	.23117	5.5345	.41553		
EGFS1	4.0516	.07542	5.1565	.09384	4.8860	.13720		
SGFS1	2.9517	.02139	4.2764	.03392	4.5213	.06624		
EGFS0	.8238	.00434	2.6970	.00542	3.5506	.01150		
IYFS2	4.9855	.13447	5.1500	.12152			5.6144	.09711
SGFS0	3.9847	.03716	4.5924	.04255	4.6972	.07822		
EGFS2	4.8283	.15228	5.0933	.12783			7.8663	.51656
SGFS2	4.5154	.07939	4.6472	.06773				
GGFS1	5.1990	.09882	6.1004	.12463	6.4835	.22543		
GGFS2	5.7865	.13897	5.9345	.11523				
MEAN	6.3833	.04403	6.3756	.03617	6.3707	.06588	6.3696	.38633

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	4.86	129.48	.15	.22		1.52
1988	5.38	215.97	.13	.17		1.34
1989	5.56	259.60	.17	.28		1.64
1990	7.07	1175.44	.41	.60		1.48

Table18.10 : Mean Fishing Mortality , Biomass and Recruitment of HADDOCK in IV between 1970 and 1989

Year	Mean Fishing Mortality Ages 2 to 6 H.Con	Disc	Ages 0 to 3 By-cat	Biomass 1000 tonnes Total	Sp St	Recruits Age 0 Y.C.	Million
1970	0.767	0.123	0.257	1360	875	70	80282
1971	0.613	0.108	0.074	1553	404	71	73986
1972	0.902	0.146	0.049	1594	290	72	19743
1973	0.776	0.128	0.031	852	283	73	66805
1974	0.630	0.143	0.099	1452	246	74	122271
1975	0.746	0.208	0.083	1990	224	75	10474
1976	0.809	0.158	0.120	827	290	76	14871
1977	0.806	0.132	0.165	523	222	77	23153
1978	0.854	0.191	0.057	604	123	78	36695
1979	0.907	0.088	0.053	630	103	79	66936
1980	0.800	0.082	0.082	1169	144	80	14503
1981	0.592	0.089	0.060	636	229	81	30331
1982	0.550	0.069	0.063	796	285	82	19079
1983	0.788	0.148	0.047	716	241	83	63489
1984	0.891	0.094	0.031	1416	190	84	16116
1985	0.847	0.079	0.017	818	231	85	22660
1986	0.867	0.181	0.011	679	213	86	45252
1987	0.852	0.146	0.014	982	150	87	5736
1988	0.890	0.156	0.017	436	149	88	10512
1989	0.798	0.156	0.016	447	122	89	12800
Arit-mean recruits at age 0 for period 1970 to 1989							37785
Geom-mean recruits at age 0 for period 1970 to 1989							27418

Table 18.11: Input for catch prediction of HADDOCK in IV

Age	1989 Stock and Fishing Mortality				Values used in Prediction: F at age, Mean Wt. and Propn. Retained by Consumption Fishery							
	Stock	Fishing Mortality			Scaled mean F 1985 to 1989			Mean values for period 1985 to 1989: Mean Weight (Kg.)				Prop.
	Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
0	12800000	0.000	0.001	0.005	0.000	0.001	0.005	0.001	0.051	0.012	0.019	0.000
1	1350000	0.005	0.089	0.018	0.005	0.089	0.018	0.278	0.162	0.073	0.152	0.058
2	130000	0.312	0.463	0.023	0.312	0.463	0.023	0.353	0.199	0.215	0.261	0.410
3	293675	0.785	0.323	0.017	0.884	0.192	0.018	0.449	0.248	0.362	0.414	0.824
4	29087	1.020	0.051	0.029	1.071	0.030	0.024	0.628	0.324	0.642	0.617	0.972
5	4468	0.940	0.008	0.014	0.950	0.003	0.015	0.865	0.455	0.893	0.862	0.997
6	7148	0.908	0.010	0.020	0.865	0.002	0.005	1.172	0.632	1.061	1.172	0.998
7	1116	0.649		0.014	0.743		0.003	1.380		1.286	1.381	1.000
8	545	0.496	0.001	0.000	0.698	0.000	0.000	1.659	2.572	1.315	1.659	1.000
9	252	0.439			0.679		0.000	1.767		1.319	1.767	1.000
10	61	0.688	0.011	0.000	0.588	0.002	0.000	2.123	3.048	1.400	2.126	0.997
11	27	0.700			0.801			2.361			2.361	1.000
12	25	0.700			0.801			2.531			2.531	1.000

Mean F	Age 2 to 6	Age 0 3	Age 2 to 6	Age 0 3
Unscaled	0.954	0.016	0.994	0.015
Scaled			0.954	0.016

Recruits at age 0 in 1990 = 53956000
Recruits at age 0 in 1991 = 27418470
Recruits at age 0 in 1992 = 27418470
Recruits at age 0 in 1993 = 27418470

M at age and proprtion mature at age are as shown in Table 18.3

Mean F for ages 2 to 6 in 1989 for human consumption landings + discards = 0.954 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1985 to 1989 rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1989

Mean F for ages 0 to 3 in 1989 for small-mesh fisheries = 0.016 .
Industrial fishery F-at-age in the prediction are averages for the period 1985 to 1989 .
rescaled to produce a mean value of F for ages 0 to 3 equal to that for 1989

Values of N in 1989 from VPA have been overwritten
for the following ages .....

Age 0
Age 1
Age 2

Values of F for these ages in 1989 from VPA have been overwritten
with scaled mean values used for predictions for 1990 onwards

Table 18.12 : Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in IV 1990 to 1991

	Year 1989	1990	1991								
Biomass 1 Jan of Year											
Total	447	385	1182	1182	1182	1182	1182	1182	1182	1182	1182
Spawning	122	86	81	81	81	81	81	81	81	81	81
Mean F Ages											
Human Cons. 2 to 6	0.96	0.95	0.00	0.19	0.38	0.57	0.76	0.95	1.15	0.00	0.00
Small-mesh 0 to 3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00
Mean F(Year)/Mean F(1989)										F0.1	Fmax
Human Consumption	1.00	0.99	0.00	0.20	0.40	0.59	0.79	0.99	1.19	0.00	0.00
Small-mesh Fishery	1.00	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	0.00	0.00
Catch weight											
Human Consumption	76	59	0	15	27	37	46	54	61	0	0
Discards	26	26	0	14	28	40	52	64	75	0	0
Small-mesh Fisheries	2	4	7	7	7	7	6	6	6	0	0
Total landings	79	63	7	21	34	44	53	61	67	0	0
Total catch	104	88	7	36	61	84	105	125	142	0	0
Biomass 1 Jan of Year+1											
Total	385	1182	1013	984	959	937	918	901	886	0	0
Spawning	86	81	226	206	188	174	161	150	141	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
0	53956000	0	19518	111275	130793
1	1638417	4207	68272	14215	86693
2	231662	42840	61764	3112	107717
3	39244	19124	4095	395	23613
4	74260	43199	1228	967	45394
5	7541	4228	12	67	4306
6	1398	742	2	4	748
7	2292	1101	0	4	1105
8	471	217	0	0	217
9	271	123	0	0	123
10	133	54	0	0	54
11	25	12	0	0	12
12	11	5	0	0	5
Wt	384838	58778	25823	3837	88437

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	27418470	0	9919	56546	66464
1	6906440	17732	287786	59921	365439
2	281154	51993	74960	3777	130730
3	69933	34079	7296	704	42079
4	10235	5954	169	133	6256
5	18778	10527	29	166	10723
6	2345	1244	3	7	1255
7	479	230	0	1	231
8	890	410	0	0	410
9	192	87	0	0	87
10	113	46	0	0	46
11	60	31	0	0	31
12	13	7	0	0	7
Wt	1181807	54230	64044	6331	124605

Table 18.13 : Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in IV 1990 to 1991

	Year										
	1989	1990	1991								
Biomass 1 Jan of Year											
Total	447	385	1202	1202	1202	1202	1202	1202	1202	1202	1202
Spawning	122	86	97	97	97	97	97	97	97	97	97
Mean F Ages											
Human Cons. 2 to 6	0.96	0.67	0.00	0.19	0.38	0.57	0.76	0.95	1.15	0.00	0.00
Small-mesh 0 to 3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00
Mean F(Year)/Mean F(1989)										F0.1	Fmax
Human Consumption	1.00	0.69	0.00	0.20	0.40	0.59	0.79	0.99	1.19	0.00	0.00
Small-mesh Fishery	1.00	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	0.00	0.00
Catch weight											
Human Consumption	76	46	0	17	32	45	55	65	72	0	0
Discards	26	19	0	14	28	41	53	65	76	0	0
Small-mesh Fisheries	2	4	7	7	7	7	7	7	6	0	0
Total landings	79	50	7	25	39	52	62	71	79	0	0
Total catch	104	69	7	39	67	93	115	136	155	0	0
Biomass 1 Jan of Year+1											
Total	385	1202	1035	1002	974	949	928	909	893	0	0
Spawning	86	97	246	222	202	185	170	158	147	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
0	53956000	0	13664	111284	124948
1	1638417	2975	48280	14361	65616
2	231662	32999	47575	3424	83998
3	39244	15249	3265	450	18964
4	74260	34528	982	1104	36614
5	7541	3333	9	75	3418
6	1398	580	1	5	586
7	2292	848	0	5	853
8	471	166	0	0	166
9	271	94	0	0	94
10	133	41	0	0	41
11	25	10	0	0	10
12	11	4	0	0	4
Wt	384838	46293	19160	4031	69484

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	27418470	0	9919	56546	66464
1	6908207	17737	287860	59936	365533
2	289206	53482	77107	3885	134474
3	88230	42995	9205	888	53089
4	14133	8221	234	184	8639
5	26127	14647	40	232	14919
6	3121	1656	4	9	1670
7	621	298	0	1	299
8	1112	512	0	0	513
9	237	107	0	0	107
10	138	56	0	0	56
11	72	36	0	0	36
12	17	8	0	0	8
Wt	1202131	64568	64985	6516	136068

Table 19.1 Nominal catch (tonnes) of HADDOCK in Division VIa, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	3	1	2	1	6
Denmark	-	-	+	-	-
Faroe Islands	-	-	-	-	-
France	2,808	3,403	3,760	4,520	4,240
Germany, Fed. Rep.	3	7	71	65	83
Ireland	726	1,891	4,402	3,450	3,932
Netherlands	2	3	391	25	-
Norway	16	29	37	68	33
Spain	-	-	97	201	129
UK (England and Wales)	1,279	1,052	2,035	1,376	1,042
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	+	-	1	4	5
UK (Scotland)	8,198	12,051	19,249	21,593	18,472
Total	13,935	18,437	30,045	31,303	27,942

Country	1985	1986	1987	1988	1989
Belgium	7	-	29	8	9
Denmark	-	-	4	+	+
Faroe Islands	-	1	-	-	8[1]
France	5,930	4,956	5,456	3,001	1,335[1,2]
Germany, Fed. Rep.	38	25	21	4	10[1,3]
Ireland	3,512	2,026	2,628	2,731	n/a
Netherlands	-	-	-	n/a	-
Norway	76	45	13	54	74[1]
Spain	166	-	-	-	n/a
UK (England and Wales)	348	222	425	114	476
UK (Isle of Man)	-	-	-	-	4
UK (N. Ireland)	1	155	1	35	73
UK (Scotland)	15,036	12,955	18,503	15,151	19,651
Total	25,114	20,385	27,080	21,098	21,636

[1] Preliminary.
[2] Includes Divisions Vb and VIb.
[3] Includes Division VIb.
n/a = Not available.

Table 19.2 : Annual Weight and Numbers of HADDOCK caught in VIA between 1965 and 1989

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1965	36	32	3	0	83	69	14	0
1966	31	30	1	0	59	50	8	0
1967	28	20	7	0	105	33	72	0
1968	46	20	25	0	187	35	152	0
1969	51	26	25	0	181	61	119	0
1970	40	34	6	0	123	82	40	0
1971	58	46	12	0	166	86	81	0
1972	57	41	16	0	180	86	93	0
1973	40	29	11	0	138	58	81	0
1974	33	18	15	0	173	32	141	0
1975	47	14	33	0	233	27	207	0
1976	34	19	15	0	121	41	80	0
1977	24	19	4	0	65	39	26	0
1978	20	17	2	0	48	31	17	0
1979	29	15	14	0	106	26	81	0
1980	17	13	5	0	55	25	30	0
1981	33	18	15	0	109	39	69	0
1982	40	30	10	0	104	57	47	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
1987	43	27	16	0	147	50	97	0
1988	28	19	9	0	89	40	49	0
1989	20	17	3	0	47	30	17	0

Table 19.3 : 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 19.4 : Total International Catch at Age (1000's) of HADDOCK in VIA between 1965 and 1989

Age	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	Age
0	451	5953	40122	27	2742	17189	6604	14215	19589	63698	0
1	1059	1595	19185	129418	84	6317	71481	20713	47387	68837	1
2	1341	529	19332	38393	160706	519	3915	85141	16907	11562	2
3	72461	1113	951	3079	10260	95114	3328	2718	19477	10757	3
4	6816	47431	265	356	1434	2770	79966	2336	258	6317	4
5	294	1926	24979	681	268	173	545	53823	1222	83	5
6	274	64	400	14063	379	89	127	504	33193	447	6
7	174	32	9	727	4576	145	7	50	150	11463	7
8	11	57	14	43	191	585	20	19	32	104	8
9	13		4	9	9	16	191	67	131	70	9

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Age
0	6849	4227	4552	57	5697	13	764	136	2084	269	0
1	179349	24337	13109	15942	70070	22729	251	15492	14524	98976	1
2	34957	72330	3468	2095	17282	21927	83911	5019	20233	8626	2
3	3339	15224	35948	971	1865	5636	20697	73676	6040	12910	3
4	3350	1588	5705	24357	470	922	1768	8167	36122	6242	4
5	1882	1491	680	2938	9863	143	194	898	3398	22790	5
6	95	868	495	351	833	3082	39	108	597	2449	6
7	98	21	308	247	114	229	822	272	41	371	7
8	3454	7	28	338	145	22	39	288	194	43	8
9	80	1112	276	237	76	32	21	44	250	119	9

Age	1985	1986	1987	1988	1989	Age
0	155	2979	1498	6684	3774	0
1	22820	8127	89021	8399	5012	1
2	78922	11235	16824	52343	3421	2
3	4667	45367	10150	7250	25732	3
4	4184	1823	23857	3765	2756	4
5	1789	916	1452	9104	1556	5
6	11189	449	1116	323	3635	6
7	964	2611	642	183	255	7
8	84	344	1818	147	84	8
9	73	65	385	971	583	9

Table 19.5 : Total International Mean Weight at Age (Kg.) of HADDOCK in VIA between 1965 and 1989

Age	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	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	0.162	0.160	0.159	0.158	0.161	0.160	0.160	0.159	0.159	1
2	0.242	0.251	0.266	0.264	0.243	0.230	0.248	0.249	0.251	0.248	2
3	0.412	0.555	0.569	0.567	0.526	0.368	0.341	0.380	0.384	0.368	3
4	0.692	0.572	0.573	0.823	0.916	0.812	0.546	0.530	0.597	0.527	4
5	0.916	1.041	0.667	0.731	1.042	1.283	1.040	0.546	0.512	0.764	5
6	1.041	1.125	1.177	0.811	1.024	1.262	1.313	0.984	0.571	0.685	6
7	1.249	1.325	1.844	1.430	0.999	1.043	1.651	1.499	1.185	0.798	7
8	1.517	1.522	1.611	1.903	1.569	1.342	1.426	1.538	1.706	1.142	8
9	1.876		2.355	2.516	2.065	1.709	1.515	1.551	1.550	1.244	9

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Age
0	0.040	0.040	0.040	0.068	0.032	0.077	0.082	0.038	0.050	0.059	0
1	0.159	0.159	0.161	0.134	0.182	0.134	0.252	0.157	0.178	0.149	1
2	0.260	0.256	0.274	0.278	0.325	0.319	0.245	0.273	0.282	0.319	2
3	0.428	0.459	0.406	0.388	0.457	0.572	0.467	0.376	0.461	0.456	3
4	0.581	0.592	0.684	0.516	0.730	0.719	0.887	0.746	0.557	0.688	4
5	0.832	0.831	0.800	0.827	0.777	0.998	0.975	1.126	1.002	0.667	5
6	1.027	1.095	1.128	1.045	1.040	0.985	1.376	1.539	1.370	1.087	6
7	1.001	1.585	1.337	1.152	1.491	1.143	1.294	1.549	1.716	1.392	7
8	1.009	1.084	1.117	1.399	1.944	1.565	1.347	1.514	1.558	2.075	8
9	1.317	1.247	1.346	1.251	1.388	1.871	1.441	1.826	1.582	1.596	9

Age	1985	1986	1987	1988	1989	Age
0	0.019	0.064	0.028	0.085	0.052	0
1	0.138	0.182	0.168	0.162	0.226	1
2	0.268	0.270	0.270	0.252	0.301	2
3	0.486	0.362	0.418	0.434	0.402	3
4	0.636	0.637	0.566	0.519	0.625	4
5	0.802	0.903	0.880	0.690	0.749	5
6	0.868	1.115	1.105	0.969	0.894	6
7	1.272	1.043	1.250	1.162	1.115	7
8	1.277	1.418	1.147	1.027	1.465	8
9	2.175	1.698	1.350	0.896	1.058	9

Table 19.6 HADDOCK in Division VIa. Tuning results.

with cpue data from file HAD6AEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 SCOSEI has terminal q estimated as the mean
Fleet 2 SCOTRL has terminal q estimated as the mean
Fleet 3 SCOLTR has terminal q estimated as the mean
Fleet 4 SCONTR has terminal q estimated as the mean
Fleet 5 FRAALL has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using Laurec/Shepherd method

	Age 0		Age 1		Age 2		Age 3		Age 4	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.0424	.3191	.3174	.2639	.6245	.4131	.7348	.3462	.6010	.4166
SCOTRL		.0000		.0000	.6385	.1970	1.3609	.1285	1.1581	.0879
SCOLTR	.0063	.3087	.2054	.2443	.3807	.1335	.5322	.1811	.5322	.1187
SCONTR		.0000	.3684	.2457	.8295	.1340	.698	.2323	1.0208	.2856
FRAALL	.0292	.3722	.7710	.2461	1.469	.1224	1.8441	.1119	1.7668	.0911
		1.0000		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar		Fbar	
	.020		.368		.677		.822		.805	

	Age 5		Age 6		Age 7	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.7607	.2338	.8836	.3556	.9033	.1626
SCOTRL	1.4365	.2744	1.6227	.1735	1.336	.1979
SCOLTR	.5727	.2868	.5699	.3253	.5455	.3493
SCONTR		.0000		.0000		.0000
FRAALL	1.8845	.2051	2.3245	.1457	3.4528	.2902
		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar	
	1.006		.980		1.208	

Table 19.7 : Total International Fishing Mortality Rate at Age of HADDOCK in VIA between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	0.061	0.075	0.151	0.099	0.123	0.158	0.152	0.067	0.000	0.011	0
1	0.493	0.385	0.355	1.055	0.587	0.592	1.304	0.952	0.350	0.560	1
2	0.045	0.655	1.123	0.550	0.820	0.683	0.508	0.639	0.376	0.799	2
3	0.294	0.449	1.492	0.872	0.837	0.598	0.735	0.513	0.367	0.681	3
4	0.827	0.432	0.663	0.519	0.803	0.692	0.644	0.688	0.804	0.304	4
5	0.359	0.374	0.585	0.912	0.311	0.598	0.779	0.641	0.967	0.941	5
6	0.424	0.491	0.711	0.906	1.090	0.713	0.618	0.653	0.832	0.834	6
7	0.275	0.050	0.368	0.474	0.972	0.755	0.335	0.464	0.820	0.728	7
8	0.906	0.056	0.198	0.422	0.715	0.928	0.113	1.000	1.504	2.254	8
9	0.206	0.779		0.085	1.104	2.051	0.909	0.251	0.703	0.452	9
10	0.705	0.405	0.793	0.744	0.835	0.819	0.574	0.559	0.745	0.807	10
11	0.705	0.405	0.793	0.744	0.835	0.819	0.574	0.559	0.745	0.807	11

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	0.000	0.009	0.003	0.005	0.003	0.003	0.011	0.071	0.290	0.021	0
1	0.058	0.007	0.239	0.443	0.342	0.442	0.185	0.516	0.687	0.368	1
2	0.339	0.311	0.193	0.560	0.517	0.505	0.408	0.710	0.660	0.677	2
3	0.670	0.623	0.495	0.374	0.871	0.592	0.617	0.802	0.785	0.822	3
4	0.886	0.457	0.540	0.484	0.839	0.800	0.488	0.792	0.815	0.805	4
5	0.142	0.459	0.445	0.453	0.651	0.619	0.400	0.936	0.826	1.005	5
6	0.907	0.053	0.504	0.605	0.697	0.796	0.307	1.282	0.551	0.980	6
7	0.578	0.661	0.604	0.364	0.988	0.663	0.429	0.969	0.748	1.208	7
8	0.290	0.181	0.513	1.255	0.823	0.631	0.529	0.605	0.619	0.964	8
9	0.475	0.294	0.208	0.801	1.172	0.138	0.676	1.585	0.726	0.950	9
10	0.705	0.441	0.470	0.461	0.826	0.712	0.475	0.973	0.745	0.950	10
11	0.705	0.441	0.470	0.461	0.826	0.712	0.475	0.973	0.745	0.964	11

Table 19.8 . : Stock Numbers at Age (1000's) of HADDOCK in VIA between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	318598	100225	111963	228426	606003	51614	32976	77411	218356	550539	0
1	17770	245335	76099	78859	169353	438731	36087	23190	59271	178724	1
2	12870	8889	136703	43704	22486	77072	198766	8018	7328	34210	2
3	409488	10069	3779	36401	20647	8105	31877	97945	3464	4118	3
4	5356	249760	5260	696	12458	7320	3650	12512	47992	1965	4
5	627	1917	132766	2219	339	4569	3001	1569	5148	17579	5
6	281	359	1080	60547	730	203	2057	1127	677	1602	6
7	659	150	180	435	20029	201	82	908	480	241	7
8	1067	410	117	102	221	6206	77	48	467	173	8
9	79	353	317	79	55	89	2008	56	14	85	9
10	5	53	133	260	59	15	9	662	36	6	10
11					11		12	13	443	88	11

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	47275	98631	54444	459770	85696	64923	298538	24164	29132	205124	0
1	445598	38693	80062	44452	374545	69919	53015	241732	18433	17843	1
2	83613	344312	31453	51611	23370	217750	36781	36086	118180	7590	2
3	12601	48760	206490	21232	24146	11408	107579	20033	14523	49987	3
4	1706	5282	21416	103049	11960	8272	5165	47512	7353	5426	4
5	1186	576	2739	10223	51999	4230	3043	2596	17627	2664	5
6	5618	843	298	1437	5322	22207	1864	1670	834	6319	6
7	570	1857	654	147	642	2170	8205	1123	379	393	7
8	95	262	785	293	84	196	915	4375	349	147	8
9	15	58	179	385	68	30	85	442	1956	154	9
10	44	8	36	119	141	17	21	36	74	775	10
11	14	15	3	45	5	131	57	67	19	103	11

Table 19.9a

Analysis by RCRT1NX2 of data from file HAD6AR1.DWA
HADDOCK VIa AGE 1 (1990 WG)

Data for 7 surveys over 22 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass	1987		1988		1989		1990	
Survey/ Series	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight
VPAIV1	9.1561	.16408	9.9222	.38008	10.1388	.61264	12.5913	.83608
SGFS1	11.2467	.12073	10.8338	.20760	12.0621	.24546		
SGFS2	10.9461	.11065	9.5318	.13358				
SCSEI1	10.7997	.03650	10.1049	.06327				
SCSEI2	9.6253	.30376						
SCLTR1	11.1494	.06781	10.6113	.11383				
SCLTR2	10.2494	.13996						
MEAN	11.5086	.05652	11.5132	.10163	11.5176	.14189	11.5229	.16392

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	10.23	27728.69	.23	.30		1.31
1988	10.31	30061.31	.31	.27		.86
1989	10.81	49343.93	.36	.60		1.66
1990	12.42	246762.70	.39	.40		1.01

Table 19.9b

Analysis by RCRTINX2 of data from file HADSAR2.DWA
HADDOCK VIa AGE 2 (1990 WG)

Data for 7 surveys over 22 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass	1987		1988		1989		1990	
Survey/ Series	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight
VPAIV1	8.0702	.11920	8.9325	.22625	9.1882	.34061	11.9676	.51847
SGFS1	10.7388	.16386	10.3176	.26483	11.5564	.33928		
SGFS2	10.1465	.08562	8.6779	.09806				
SCSEI1	9.7059	.02623	8.7704	.04352				
SCSEI2	8.5166	.13019						
SCLTR1	10.3274	.09939	9.7776	.15826				
SCLTR2	9.4595	.25336						
MEAN	10.7082	.12214	10.7240	.20907	10.7430	.32011	10.7661	.48153

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	9.68	16071.49	.33	.35		1.07
1988	9.78	17599.44	.43	.34		.81
1989	10.49	35932.79	.52	.70		1.35
1990	11.39	88350.21	.63	.60		.96

Table 19.10: Mean Fishing Mortality , Biomass and Recruitment of HADDOCK in VIA between 1970 and 1989

	Mean Fishing Mortality Ages 2 to 6		Ages 1 to 1	Biomass 1000 tonnes		Recruits Age 0	
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1970	0.372	0.018	0.000	164	160	70	319
1971	0.369	0.112	0.000	185	145	71	100
1972	0.705	0.210	0.000	125	98	72	112
1973	0.646	0.106	0.000	75	58	73	228
1974	0.621	0.152	0.000	64	34	74	606
1975	0.538	0.118	0.000	108	30	75	52
1976	0.558	0.099	0.000	81	53	76	33
1977	0.527	0.099	0.000	59	54	77	77
1978	0.608	0.061	0.000	43	34	78	218
1979	0.640	0.072	0.000	63	26	79	551
1980	0.552	0.036	0.000	103	31	80	47
1981	0.303	0.077	0.000	126	80	81	99
1982	0.368	0.067	0.000	121	105	82	54
1983	0.388	0.107	0.000	103	89	83	460
1984	0.614	0.101	0.000	124	65	84	86
1985	0.575	0.087	0.000	105	70	85	65
1986	0.347	0.097	0.000	77	63	86	299
1987	0.808	0.097	0.000	97	52	87	45
1988	0.625	0.102	0.000	61	43	88	43
1989	0.731	0.127	0.000	46	37	89	61
Arit-mean recruits at age 0 for period 1970 to 1989							178
Geom-mean recruits at age 0 for period 1970 to 1989							116

Table 19.11 : Input for catch prediction of HADDOCK in VIA

Age	1989 Stock and Fishing Mortality: Stock Number	Fishing Mortality H.Con.	Fishing Mortality Disc	Fishing Mortality Ind	Values used in Prediction (F at age , Mean Wt. and Propn. Retained by Consumption Fishery): Scaled mean F 1985 to 1989 H.Con.	Scaled mean F Disc	Scaled mean F Ind	Mean values for period 1985 to 1989: Mean Weight (Kg.) H.Con.	Mean Weight Disc	Mean Weight Ind	Mean Weight Stock	Prop. Ret.
0	60875		0.062			0.062			0.050		0.050	
1	29299	0.033	0.399		0.033	0.399		0.301	0.164		0.175	0.077
2	21584	0.270	0.436		0.270	0.436		0.358	0.217		0.272	0.378
3	49987	0.588	0.233		0.706	0.157		0.458	0.267		0.420	0.815
4	5426	0.802	0.003		0.872	0.011		0.599	0.366		0.596	0.989
5	2664	1.005	0.000		0.902	0.002		0.806	0.575		0.805	0.998
6	6319	0.980	0.000		0.931	0.003		0.992	0.888		0.990	0.997
7	393	1.208			0.958			1.168			1.168	1.000
8	147	0.961	0.003		0.798	0.001		1.266	2.572		1.267	0.999
9	154	0.950			0.972			1.315			1.315	1.000
10	775	0.950	0.000		0.920	0.000		1.605	3.048		1.605	1.000
11	104	0.950	0.000		0.920	0.000		2.285			2.285	1.000

Mean F	Age 2 to 6	Age 1 1	Age 2 to 6	Age 1 1
Unscaled	0.858	0.000	0.719	0.000
Scaled			0.858	0.000

Recruits at age 0 in 1990 = 304426
Recruits at age 0 in 1991 = 115549
Recruits at age 0 in 1992 = 115549
Recruits at age 0 in 1993 = 115549

M at age and proprtion mature at age are as shown in Table 19.3

Mean F for ages 2 to 6 in 1989 for human consumption landings + discards = 0.858 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1985 to 1989
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1989

Mean F for ages 1 to 1 in 1989 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1985 to 1989 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1989

Values of N in 1989 from VPA have been overwritten
for the following ages .....

Age 0
Age 1
Age 2

Values of F for these ages in 1989 from VPA have been overwritten
with scaled mean values used for predictions for 1990 onwards

Table 19.12 : Predicted Catches and Biomasses (1000's of tonnes) of HADDOCK in VIA 1990 to 1991

	1989	1990	1991								
Biomass 1 Jan of Year											
Total	46	32	59	59	59	59	59	59	59	59	59
Spawning	37	22	15	15	15	15	15	15	15	15	15
Mean F Ages											
Human Cons. 2 to 6	0.86	0.86	0.00	0.17	0.34	0.51	0.69	0.86	1.03	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(1989)										F0.1	Fmax
Human Consumption	1.00	0.99	0.00	0.20	0.40	0.60	0.79	0.99	1.19	0.00	0.00
Catch weight											
Human Consumption	17	12	0	2	5	6	8	9	10	0	0
Discards	3	4	0	3	6	9	11	13	15	0	0
Small-mesh Fisheries	0	0	0	0	0	0	0	0	0	0	0
Total landings	17	12	0	2	5	6	8	9	10	0	0
Total catch	20	16	0	6	11	15	19	23	26	0	0
Biomass 1 Jan of Year+1											
Total	32	59	89	81	75	69	63	59	54	0	0
Spawning	22	15	50	44	40	35	32	28	25	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
0	304426	0	16507	0	16507
1	46861	1161	13845	0	15006
2	15573	2736	4496	0	7233
3	8721	3778	857	0	4635
4	17993	9593	109	0	9701
5	1985	1084	2	0	1086
6	798	444	1	0	446
7	1942	1102	0	0	1102
8	96	49	0	0	49
9	46	26	0	0	26
10	49	27	0	0	27
11	245	136	0	0	136
Wt	32329	11857	4333	0	16190

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	115549	0	6266	0	6266
1	234347	5805	69236	0	75041
2	24909	4376	7192	0	11568
3	6292	2726	618	0	3345
4	3012	1606	18	0	1624
5	6093	3328	6	0	3334
6	659	367	1	0	368
7	257	146	0	0	146
8	610	308	0	0	308
9	35	20	0	0	20
10	14	8	0	0	8
11	96	53	0	0	53
Wt	59214	9292	13377	0	22670

Table 20.1 Nominal catch (tonnes) of HADDOCK in Division VIb, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Faroe Islands	5	1	21	3	3
France	1	10	32	48	12
Germany, Fed. Rep.	17	-	4	1	-
Norway	2	10	3	20	45
Spain	6	88	121	79	128
UK (England & Wales)	6,261	9,005	3,736	113	788
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	1,051	27	5	136	1,654
Total	7,343	9,141	3,992	400	2,630

Country	1985	1986	1987	1988	1989
Faroe Islands	1	-	-	5	-[1]
France	116	103	99	5	...[1,2]
Germany, Fed. Rep.	4	-	-	4	...[1,2]
Norway	31	83	33	20	47[1]
Spain	892	756	371	245	n/a
UK (England & Wales)	1,876	703	1,271	753	1,007
UK (Isle of Man)	-	-	-	-	+
UK (N. Ireland)	-	157	-	-	8
UK (Scotland)	6,397	2,961	6,221	6,542	5,210
Total	9,317	4,763	7,995	7,574	6,272

[1] Preliminary.
[2] Included in Division VIa.
n/a = Not available.

Table 20.2. Total international catch at age ('000) of haddock in Division VIb between 1985 and 1989.

Age	1985	1986	1987	1988	1989
1	0.	0.	77.	256.	59.
2	65.	717.	747.	2284.	2586.
3	758.	467.	17330.	2114.	4439.
4	12971.	1021.	278.	11991.	1474.
5	3699.	3948.	353.	100.	5472.
6	124.	1233.	1506.	121.	115.
7	6.	73.	579.	256.	24.
8	70.	34.	36.	128.	59.
9	220.	84.	4.	5.	21.
10+	1.	106.	55.	8.	6.

Table 20.3. Total international mean weight at age (Kg.) of haddock in Division VIb between 1985 and 1989.

Age	1985	1986	1987	1988	1989	mean(85-89)
1	-	-	0.154	0.233	0.271	0.219
2	0.348	0.305	0.276	0.335	0.358	0.324
3	0.479	0.477	0.339	0.377	0.378	0.410
4	0.507	0.624	0.466	0.461	0.424	0.496
5	0.543	0.646	0.601	0.724	0.526	0.608
6	0.668	0.697	0.715	0.582	0.617	0.656
7	1.208	0.868	0.688	1.017	0.705	0.897
8	0.778	0.825	0.865	0.745	1.045	0.852
9	0.879	0.841	0.852	1.797	1.023	1.078
10+	1.370	1.133	0.823	2.191	1.022	1.308

Table 20.4. Abundance indices for haddock in Division VIb obtained by research vessel surveys conducted in August since 1985.

age	1985	1986	1987	1988	1989	1990
0	489	3577	698	8640	23580	16388
1	51284	17309	11672	8170	10799	10612
2	214	62196	2917	5799	3531	1231
3	31	85	8530	810	1889	388
4	4218	139	105	2107	268	307
5	676	2568	267	5	765	39
6	1	225	249	2	2	140
7	2	0	71	91	7	2
R.V	C	R	D	S	S	S

C=Clarkwood
R=G.A.Reay
D=Dawn Sky
S=Scotia

Table 20.5. Results from fitting the linear model to the abundance indices for haddock in Division VIb.

RESIDUAL SUM OF SQUARES= 0.103E+02

NUMBER OF OBSERVATIONS = 41

NUMBER OF PARAMETERS = 22

		PARAMETER	S.D.
Year effects	1	0-input	
	2	1.1167	0.4416
	3	1.1621	0.4032
	4	0.5507	0.3704
	5	0.9491	0.3130
Age effects	1	0-input	
	2	-1.0775	0.4521
	3	-2.8280	0.4758
	4	-3.2924	0.4993
	5	-4.4203	0.5242
	6	-6.5733	0.5583
	7	-6.9415	0.6074
Y/C effects			
	1	7.6347	0.9539
	2	6.5733	0.9235
	3	10.6323	0.7035
	4	11.0032	0.6561
	5	7.4540	0.6152
	6	6.3106	0.5717
	7	10.7265	0.5151
	8	8.2611	0.5455
	9	8.9035	0.5428
	10	8.4405	0.5534
	11	8.1542	0.5988
	12	9.0469	0.7700

FITTED CATCH AT AGE

	1985	1986	1987	1988	1989	1990
1	45548.1	11823.3	23521.6	8032.1	8984.6	10612.0
2	187.4	47366.7	4212.1	4344.7	4072.5	1479.6
3	102.1	99.4	8609.9	397.0	1124.0	342.2
4	2232.5	196.0	65.4	2936.2	371.6	341.7
5	498.7	2207.4	66.4	11.5	1415.5	58.2
6	1.0	176.9	268.3	4.2	2.0	79.5
7	2.0	2.1	128.1	100.7	4.3	0.7

Table 20.6. Results of fitting separable model to catch at ag
data for haddock in Division VIb.

ANALYSIS BY RCSEP OF ROCKALL CATCH DATA

Gradient for year effects set to 0.1000

Number of observations= 32
Number of parameters = 20
Residual mean square = 0.2942

Coefficient of determination = 0.9753
Adj. coeff. of determination = 0.9362

	Parameter	s.d.
year effects		
	1.0000	0.0000
	1.3508	0.3388
	1.2392	0.2621
	1.3705	0.1031
age effects		
	0.0438	0.0188
	0.3402	0.1176
	0.6128	0.1860
	0.7546	0.2221
	1.1492	0.2912
	0.9291	0.2537
	1.3077	0.3054
	1.0000	0.0000
y/c effects		
	4.9715	0.5424
	3.5947	0.4054
	4.9906	0.3425
	7.9342	0.3284
	8.6756	0.3138
	7.3665	0.2965
	7.2129	0.2828
	10.7375	0.2923
	9.1671	0.3453
	10.2664	0.4550
	10.7498	0.6831

Table 20.6 cont.

F-at-age

Age	1986	1987	1988	1989
2	0.0438	0.0592	0.0543	0.0600
3	0.3402	0.4596	0.4216	0.4663
4	0.6128	0.8278	0.7594	0.8399
5	0.7546	1.0192	0.9351	1.0341
6	1.1492	1.5523	1.4241	1.5750
7	0.9291	1.2550	1.1514	1.2734
8	1.3077	1.7664	1.6205	1.7923
9	1.0000	1.3508	1.2392	1.3705

Fitted N-at-age

Age	1986	1987	1988	1989
2	46048.8	9577.0	28751.0	46620.9
3	1356.9	36086.1	7390.6	22295.9
4	1582.0	790.5	18659.2	3969.3
5	5858.1	701.8	282.9	7148.6
6	2791.0	2255.3	207.3	90.9
7	147.0	724.1	391.0	40.9
8	36.4	47.5	169.0	101.2
9	144.2	8.1	6.7	27.4

Log catch residuals

Age	1986	1987	1988	1989
2	-0.9147	0.4033	0.5055	0.0000
3	0.2695	0.3557	-0.0932	-0.5055
4	0.4308	-0.3858	0.2747	-0.3101
5	0.3266	-0.1578	-0.4582	0.2843
6	-0.3561	-0.0922	-0.1877	0.5745
7	-0.1147	0.1900	0.0362	-0.0853
8	0.3242	-0.0199	0.0151	-0.2706
9	0.0000	-0.3242	0.1346	0.1510

Table 20.6 cont.

Standardised log recruitment at age 2

Year	log R	s.d.
1979	12.4652	0.7965
1980	9.8884	0.7103
1981	9.7766	0.6035
1982	11.5910	0.5389
1983	10.9832	0.4430
1984	8.7195	0.3693
1985	7.7532	0.3063
1986	10.7375	0.2923
1987	9.1671	0.3453
1988	10.2664	0.4550
1989	10.7498	0.6831

Table 20.7. Relative effort by Scottish vessels in Division VIb.

1985	1.00
1986	0.97
1987	1.48
1988	1.43
1989	1.91

Table 20.8. Total international fishing mortality at age and number at age of haddock in Division VIb between 1985 and 1989.

F at age

Age	1985	1986	1987	1988	1989
1	0.0000	0.0000	0.0036	0.0058	0.0100
2	0.0411	0.0126	0.1077	0.1385	0.0750
3	0.3130	0.4552	0.4653	0.4952	0.4322
4	0.9879	0.9132	0.5422	0.6909	0.7835
5	0.8696	0.9852	0.9926	0.3814	0.8072
6	0.5867	0.8315	1.4955	1.2321	1.0364
7	0.1170	0.8474	1.3390	1.2767	0.8950
8	0.3818	1.8123	1.5811	1.4236	1.2997
9	0.4888	1.1191	1.3520	1.0784	1.0096
10	0.4888	1.1191	1.3520	1.0784	1.0096

Number at age ('000)

Age	1985	1986	1987	1988	1989
1	77053.	9842.	23830.	48468.	6541.
2	1780.	63085.	8058.	19441.	39450.
3	3096.	1399.	51001.	5924.	13858.
4	22438.	1854.	726.	26221.	2956.
5	6927.	6841.	609.	346.	10757.
6	305.	2377.	2091.	185.	193.
7	60.	139.	847.	384.	44.
8	242.	44.	49.	182.	88.
9	623.	135.	6.	8.	36.
10	3.	171.	80.	13.	10.

Table 20.9. Haddock in VIb. Calibration regression of estimated abundance index on separable VPA estimate. Fitted values for age 2 are given.

Slope	se	intercept	Residual var.	n	D	R^2
1.2960	0.3271	-4.1562	1.2056	8	0.8245	0.723

year	Fitted value	variance
1980	9.4268	0.4025
1981	9.0066	0.4364
1982	10.6566	0.4387
1983	10.7924	0.4559
1984	9.3530	0.4067
1985	8.9099	0.4480
1986	10.6939	0.4432
1987	9.6895	0.3936
1988	9.9593	0.3937
1989	9.7653	0.3927
1990	9.6432	0.3946
1991	10.0223	0.3951
mean	9.8265	0.3984

Table 20.10. Estimated mean fishing mortality and spawning stock biomass (tonnes) for haddock in VIb from VPA.

Year	F(1-10)	SSB
1985	0.4275	17635
1986	0.8095	8363
1987	0.9231	20185
1988	0.7801	15248
1989	0.7358	12438

Table 20.11. Haddock in VIb. Input values of population size fishing mortality and recruitment used in prediction.

age	N(1989)	F	wt
1	18918	0.0047	0.219
2	17326	0.0750	0.324
3	13858	0.4322	0.410
4	2956	0.7835	0.496
5	10757	0.8072	0.608
6	193	1.0364	0.656
7	44	0.8950	0.897
8	88	1.2997	0.852
9	36	1.0096	1.078
10	10	1.0096	1.308

Recruits at age 1 in 1990 = 27575
Recruits at age 1 in 1991 = 18518
Recruits at age 1 in 1992 = 18518

Table 20.12. Forecast catch and spawning stock biomass for haddock in Division VIb.

year	Landings	Spawning stock biomass
1990	5,840	12,400
1991	5,350	11,300
1992	5,600	12,800

Table 21.1a Nominal landings (tonnes) of HADDOCK in Divisions VIIb,c, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
France	523	658	750	1,443	1,840
Ireland	150	335	464	450	277
Netherlands	-	-	1	-	-
Norway	-	-	-	54	17
Spain	5	85	129	58	240
UK (England & Wales)	1	-	3	-	275
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	56	-	-	-	63
Total	735	1,078	1,347	2,005	2,712

Country	1985	1986	1987	1988	1989
France	1,183	1,243	1,079	487	n/a
Ireland	388	202	156	101	n/a
Netherlands	-	-	-	-	-
Norway	4	77	-	+	26[1]
Spain	291	-	-	-	n/a
UK (England & Wales)	35	58	30	33	3
UK (N. Ireland)	-	-	-	+	-
UK (Scotland)	7	51	79	3	17
Total	1,908	1,631	1,344	624	46

[1] Preliminary.
[2] Included in Divisions VIIg-k.
n/a = Not available.

Table 21.1b Nominal landings (tonnes) of HADDOCK in Divisions VIId,e, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	+	2	1	1	-
Denmark	15	-	-	-	-
France	298	421	344	232	273
Ireland	+	-	-	-	-
Netherlands	-	-	94	1	-
UK (England & Wales)	59	119	60	41	26
UK (Scotland)	-	-	-	-	-
Total	372	542	499	275	299

Country	1985	1986	1987	1988	1989
Belgium	2	1	+	1	1
Denmark	-	-	-	-	-
France	138	249	268	411	n/a
Ireland	-	-	-	-	n/a
Netherlands	-	-	-	n/a	-
UK (England & Wales)	27	21	43	102	70
UK (Scotland)	-	-	-	-	1
Total	167	271	311	514	72

n/a = Not available.

Table 21.1c Nominal landings (tonnes) of HADDOCK in Divisions VIIg-k, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	2	3	3	1	-
France	1,696	1,913	1,255	1,145	1,161
Ireland	124	344	440	491	369
Netherlands	-	-	6	-	-
Norway	-	-	-	3	-
Spain	-	192	119	109	292
UK (England & Wales)	49	92	179	23	34
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	-	4	-	-	-
Total	1,871	2,548	2,002	1,772	1,856

Country	1985	1986	1987	1988	1989
Belgium	2	-	8	11	18
France	1,075	824	928	1,960	n/a
Ireland	406	115	158	174	n/a
Netherlands	-	-	-	n/a	-
Norway	-	9	-	-	1[1]
Spain	270	-	-	-	n/a
UK (England & Wales)	100	100	98	184	100
UK (N. Ireland)	-	-	-	+	1
UK (Scotland)	-	6	-	1	-
Total	1,853	1,054	1,192	2,330	120

[1]Preliminary.
n/a = Not available.

C.M. 1991/Assess: 4

Table 22.1 Nominal catch (tonnes) of WHITING in Sub-area IV, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	3,153	2,623	2,272	2,864	2,798
Denmark	17,916	16,430	27,043	18,054	19,771
Faroe Islands	21	12	57	18	-
France	23,626	24,744	23,780	21,263	19,209
Germany, Fed. Rep.	1,267	601	223	317	286
Netherlands	14,389	14,600	12,218	10,935	8,767
Norway	27	27	17	39	88
Poland	1	-	-	1	2
Sweden	16	9	11	44	53
UK (England and Wales)	6,778	5,964	4,743	4,366	5,017
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	42,218	31,399	29,640	41,248	42,967
Total	109,412	96,409	100,004	99,149	98,958

Country	1985	1986	1987	1988	1989
Belgium	2,177	2,275	1,404	1,984	1,271
Denmark	16,152	9,076	2,047	12,112	803[1]
Faroe Islands	6	-	12	222	1[1,2]
France	10,853	8,250	10,493	10,569	5,277[1]
Germany, Fed. Rep.	226	313	274	454	686[1]
Netherlands	6,973	13,741	8,542	n/a	3,860[1]
Norway	103	103	74	52	34[1]
Poland	-	-	-	-	-
Sweden	22	33	17	5	17
UK (England & Wales)	5,024	3,805	4,485	4,007	1,896
UK (N. Ireland)	-	-	-	1	61
UK (Scotland)	30,398	29,113	37,630	31,804	26,491
Total	71,934	66,709	64,978	61,210	40,397

[1]Preliminary.
[2]Includes Division IIa.
n/a = Not available.

Table 22.2 : Annual Weight and Numbers of WHITING caught in IV between 1960 and 1989

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1960	180	48	122	11	1063	191	763	109
1961	325	68	241	16	2168	290	1646	232
1962	221	56	157	8	1508	222	1185	100
1963	258	58	154	45	1549	215	854	480
1964	147	60	59	28	931	221	341	369
1965	185	86	77	22	964	313	490	161
1966	240	105	84	51	1334	366	546	422
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	361	75	136	150	2285	248	641	1396
1977	342	73	163	106	2470	259	547	1663
1978	178	88	35	55	1727	322	240	1165
1979	233	98	77	59	1869	344	640	886
1980	212	91	76	46	1411	301	466	645
1981	181	79	35	67	1396	257	210	929
1982	129	71	26	33	733	231	168	333
1983	151	79	48	24	1310	253	360	697
1984	135	77	39	19	858	245	317	297
1985	97	54	28	15	686	180	226	280
1986	154	58	78	18	1173	202	572	399
1987	132	62	53	16	917	224	408	285
1988	127	51	28	49	1370	191	227	952
1989	119	41	35	43	862	154	277	431

Table 22.3 : 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 22.4 : Total International Catch at Age (1000's) of WHITING in IV between 1960 and 1989

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Age
0	60827	215700	76256	105982	234479	63912	84279	177436	104751	1206087	0
1	482294	1078401	1021577	549043	137315	342410	516853	971232	828855	374122	1
2	257330	617301	218127	745486	364670	147628	342260	213111	516865	1019744	2
3	212115	218122	154305	93558	159602	326417	92701	119813	108548	154798	3
4	20948	32172	31151	43791	21861	71183	250807	23128	47737	27811	4
5	22431	1331	5846	8947	10413	7873	36933	65886	7170	12712	5
6	3498	4019	269	1653	2646	3498	8347	7520	29652	1664	6
7	858	377	396	8	414	752	1486	809	1845	5658	7
8	2053	118	109	120	2	122	333	122	93	621	8
9	229	225	13	13	39	2	128	31	23	34	9
10	7	19		1	12	9		3	5	1	10

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	1187095	1232837	553711	175647	571415	238839	425081	666975	687017	476345	0
1	606631	620700	938136	1153018	755217	954765	479081	1004731	417292	611121	1
2	82358	106187	314926	660398	976000	403599	1119601	474222	305020	457585	2
3	563090	18145	44793	131353	226168	295629	163420	268897	222079	202924	3
4	50200	123135	7445	18039	31516	53896	79425	29031	79704	89752	4
5	11023	13021	56265	5404	4660	8792	14188	20033	6935	26698	5
6	3577	2191	7933	17226	1163	7524	2733	5225	6864	2988	6
7	1162	693	3284	2375	5496	109	488	505	1707	1528	7
8	1302	162	243	345	325	1303	18	228	247	250	8
9	131	408	67	118	47	132	527	17	11	33	9
10	16	26	641	50	20	2	28	159	13	5	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	332172	516852	100512	666558	157321	186585	225026	84650	416511	87191	0
1	263938	160949	187614	197608	313029	200262	563912	260597	425292	325004	1
2	406641	334230	102148	168127	159701	143659	161516	355267	296398	169718	2
3	266938	253428	226317	107271	108562	83358	159440	120294	174813	184001	3
4	82466	92315	82807	124479	45938	37180	42550	78955	38549	76651	4
5	47604	24065	24577	35013	57100	13531	12526	10892	15476	14132	5
6	9858	10819	6293	8290	13142	17769	3376	4205	1937	4469	6
7	1003	2770	1956	1669	2832	3098	3935	822	417	406	7
8	653	238	385	760	376	831	530	818	60	287	8
9	58	43	49	96	176	94	72	101	73	37	9
10	20	37	30	33	21	9	1	7	38	6	10

Table 22.5 : Total International Mean Weight at Age (Kg.) of WHITING in IV between 1960 and 1989

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Age
0	0.058	0.042	0.055	0.049	0.042	0.058	0.072	0.062	0.038	0.043	0
1	0.117	0.118	0.119	0.112	0.124	0.124	0.109	0.118	0.112	0.097	1
2	0.190	0.193	0.187	0.195	0.174	0.209	0.187	0.198	0.187	0.173	2
3	0.256	0.259	0.266	0.272	0.267	0.242	0.249	0.268	0.294	0.261	3
4	0.315	0.303	0.334	0.352	0.354	0.332	0.288	0.331	0.358	0.362	4
5	0.344	0.412	0.400	0.411	0.443	0.421	0.368	0.340	0.484	0.414	5
6	0.383	0.420	0.521	0.472	0.488	0.499	0.434	0.426	0.447	0.416	6
7	0.501	0.493	0.519	0.820	0.535	0.542	0.473	0.495	0.620	0.535	7
8	0.457	0.386	0.539	0.626	0.601	0.635	0.697	0.625	0.730	0.670	8
9	0.383	0.468	0.585	0.499	0.764	1.256	0.694	0.621	0.779	0.787	9
10	0.398	0.475		0.610	0.692	0.614		0.486	0.842	1.236	10

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	0.020	0.036	0.022	0.027	0.026	0.030	0.019	0.022	0.010	0.009	0
1	0.110	0.116	0.071	0.084	0.070	0.100	0.107	0.116	0.074	0.098	1
2	0.203	0.219	0.200	0.166	0.149	0.215	0.194	0.211	0.181	0.166	2
3	0.240	0.285	0.282	0.277	0.257	0.277	0.294	0.322	0.235	0.260	3
4	0.348	0.318	0.388	0.371	0.381	0.376	0.352	0.401	0.327	0.304	4
5	0.455	0.433	0.418	0.439	0.469	0.470	0.443	0.450	0.436	0.419	5
6	0.452	0.531	0.520	0.462	0.519	0.356	0.519	0.468	0.438	0.457	6
7	0.512	0.637	0.575	0.550	0.541	0.817	0.514	0.551	0.477	0.502	7
8	0.628	0.560	0.748	0.738	0.786	0.596	0.554	0.440	0.613	0.584	8
9	0.785	0.728	0.801	0.860	1.032	0.712	0.740	0.734	0.702	0.618	9
10	0.802	0.729	0.822	0.846	0.966	1.022	0.893	0.500	1.247	0.559	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	0.013	0.011	0.029	0.014	0.020	0.014	0.015	0.012	0.013	0.023	0
1	0.075	0.082	0.059	0.105	0.088	0.094	0.105	0.076	0.054	0.068	1
2	0.176	0.166	0.182	0.189	0.188	0.186	0.182	0.146	0.143	0.156	2
3	0.253	0.241	0.252	0.275	0.275	0.265	0.252	0.246	0.222	0.224	3
4	0.332	0.326	0.314	0.326	0.338	0.324	0.315	0.293	0.298	0.264	4
5	0.340	0.394	0.378	0.387	0.384	0.391	0.373	0.371	0.335	0.316	5
6	0.466	0.423	0.484	0.427	0.393	0.429	0.462	0.368	0.413	0.383	6
7	0.479	0.473	0.506	0.457	0.464	0.469	0.465	0.492	0.428	0.438	7
8	0.573	0.649	0.703	0.520	0.586	0.424	0.525	0.458	0.834	0.347	8
9	0.539	0.828	0.783	0.670	0.514	0.497	1.194	0.852	0.588	0.512	9
10	0.812	1.032	1.101	0.502	0.871	0.789	0.528	0.602	0.642	0.828	10

Table 22.6 WHITING in Sub-area IV. Tuning results.

with cpue data from file WHI4ZEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 SCOSEI has terminal q estimated as the mean
Fleet 2 SCOTRL has terminal q estimated as the mean
Fleet 3 SCOLTR has terminal q estimated as the mean
Fleet 4 SCOGFS has terminal q estimated as the mean
Fleet 5 ENGGFS has terminal q estimated as the mean
Fleet 6 FRATRB has terminal q estimated as the mean
Fleet 7 NETGFS has terminal q estimated as the mean
Fleet 8 FRGGFS has terminal q estimated as the mean
Fleet 9 INTGFS has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using Laurec/Shepherd method

	Age 0		Age 1		Age 2		Age 3		Age 4	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.1384	.0764	.4160	.0588	.5516	.2360	.6037	.1745	.6412	.2042
SCOTRL		.0000	.0823	.0513	1.0161	.1118	1.0345	.1343	.9217	.1281
SCOLTR	.0148	.0587	.2216	.0517	.7621	.2215	.9358	.1961	1.0702	.2142
SCOGFS	.0031	.1420	.0498	.0401	.3088	.0554	.3444	.0135	.5816	.0196
ENGGFS	.0015	.4341	.1520	.1716	.293	.1053	.3733	.0211	.6147	.0417
FRATRB	.0091	.1478	.1618	.1223	.6708	.2319	.6832	.4537	.8755	.3922
NETGFS	.0031	.1409	.1497	.0586	.0968	.0219	.163	.0068		.0000
FRGGFS		.0000	.0085	.0192	.0419	.0161		.0000		.0000
INTGFS		.0000	.0554	.4264		.0000		.0000		.0000
		1.0000		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar		Fbar	
	.004		.094		.555		.728		.844	

	Age 5		Age 6		Age 7		Age 8	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.6669	.1264	.9675	.1087	.9766	.1458		.0000
SCOTRL	.8554	.0846	2.5607	.0820	.5242	.0971		.0000
SCOLTR	1.0099	.2011	2.1440	.1568	2.716	.1506	1.42	.3303
SCOGFS	1.5072	.0165	.9956	.0614		.0000		.0000
ENGGFS	.4865	.0350	2.6243	.0568		.0000		.0000
FRATRB	1.0948	.5364	1.4483	.5343	1.4294	.6066	1.5021	.6697
NETGFS		.0000		.0000		.0000		.0000
FRGGFS		.0000		.0000		.0000		.0000
INTGFS		.0000		.0000		.0000		.0000
		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar	
	.968		1.561		1.351		1.474	

Table 22.7 : Total International Fishing Mortality Rate at Age of WHITING in IV between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	0.085	0.051	0.017	0.011	0.017	0.012	0.021	0.033	0.033	0.025	0
1	0.749	0.396	0.326	0.289	0.398	0.229	0.180	0.435	0.161	0.235	1
2	0.837	0.544	0.719	0.822	0.873	0.783	0.956	0.517	0.429	0.502	2
3	0.974	0.577	0.611	1.064	1.059	1.005	1.257	0.872	0.644	0.757	3
4	0.855	0.702	0.588	0.636	1.007	0.984	1.041	0.985	0.853	0.707	4
5	0.806	0.626	0.947	1.407	0.365	1.025	0.879	0.949	0.761	0.905	5
6	1.188	0.384	1.122	0.968	1.866	2.136	1.238	1.087	1.183	0.989	6
7	1.459	0.820	1.966	1.497	1.063	1.063	0.972	0.852	1.619	1.012	7
8	0.824	0.839	0.788	1.570	0.881	0.800	0.489	2.524	1.575	1.302	8
9	1.026	0.675	1.082	1.216	1.036	1.201	0.927	1.279	1.198	0.983	9
10	1.026	0.675	1.082	1.216	1.036	1.201	0.927	1.279	1.198	0.983	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	0.045	0.062	0.013	0.058	0.018	0.011	0.016	0.010	0.016	0.004	0
1	0.104	0.174	0.181	0.209	0.223	0.183	0.265	0.142	0.412	0.094	1
2	0.454	0.337	0.289	0.456	0.493	0.273	0.408	0.506	0.444	0.555	2
3	0.836	0.763	0.520	0.735	0.811	0.688	0.725	0.816	0.662	0.728	3
4	1.008	0.984	0.734	0.731	1.027	0.901	1.182	1.287	0.826	0.844	4
5	1.248	1.111	0.894	0.924	1.047	1.194	1.049	1.440	1.147	0.968	5
6	1.185	1.286	1.152	0.979	1.297	1.326	1.327	1.567	1.336	1.562	6
7	1.238	1.601	0.916	1.278	1.242	1.547	1.470	1.852	0.657	1.351	7
8	2.274	1.236	1.132	1.234	1.251	2.058	1.487	1.867	0.671	1.475	8
9	1.390	1.244	0.966	1.029	1.173	1.405	1.303	1.603	0.927	1.240	9
10	1.390	1.244	0.966	1.029	1.173	1.405	1.303	1.603	0.927	1.240	10

Table 22.8 : Stock Numbers at Age (1000's) of WHITING in IV between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
0	39766470	68557110	90667310	44711120	92400800	57429950	55823590	56804510	58844370	53918270	0
1	1684692	2852782	5089366	6960260	3453263	7091808	4432759	4267368	4292249	4447217	1
2	174885	308203	742604	1420226	2016317	896748	2180769	1431304	1068254	1413097	2
3	1043128	48267	114111	230649	398166	537116	261266	534359	544255	443442	3
4	99041	277630	19108	43654	56087	97273	138539	52358	157494	201455	4
5	22146	31218	101897	7864	17113	15181	26942	36230	14485	49743	5
6	5678	7704	12998	30781	1500	9256	4244	8716	10920	5271	6
7	1632	1348	4086	3297	9106	181	852	959	2290	2606	7
8	2524	311	486	469	604	2576	51	264	335	371	8
9	222	906	110	181	80	205	947	26	17	57	9
10	27	58	1050	77	33	2	51	237	20	9	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
0	20635210	23635270	20700650	32409180	23860720	47608340	39166460	24452480	72275960	63539700	0
1	4107638	1540111	1735168	1594690	2388196	1829227	3677126	3009732	1891043	5553750	1
2	1360393	1431740	500494	560225	500252	739287	589152	1091116	1009580	484508	2
3	545377	550813	651565	239110	226322	194808	358788	249692	419634	412876	3
4	146642	166637	181064	272948	80775	70894	69020	122413	77804	152462	4
5	73608	39638	46165	64400	97368	21422	21334	15674	25048	25246	5
6	15670	16465	10159	14712	19912	26627	5057	5822	2891	6198	6
7	1527	3732	3543	2500	4305	4237	5508	1045	946	592	7
8	776	363	616	1160	570	1018	738	1037	134	402	8
9	83	65	86	163	277	134	106	137	131	56	9
10	28	56	53	56	33	13	2	9	67	10	10

Table 22.9a

Analysis by RCRTINX2 of data from file WHI4ZR1.CSV
WHITING IV AGE 1 (1990 WG)

Data for 13 surveys over 21 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass	1987		1988		1989		1990	
Survey/ Series	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight
IYFS1	8.0043	.18992	9.2727	.24751	8.2253	.43688		
EGFS1	7.2197	.00678	9.0772	.01230	7.3579	.01528		
DGFS1	10.8780	.00217	9.6482	.00477				
SGFS1	7.6793	.05770	9.8839	.03571	8.9828	.07600		
EGFS0	6.4560	.00604	9.3339	.01135	12.4345	.00834	11.6244	.03171
DGFS0	8.3686	.07556	7.7060	.17672	8.1878	.19003		
IYFS2	8.9117	.02777	9.6528	.04567				
SGFS0	5.5187	.00279	11.3652	.00393	10.0048	.00571	16.0865	.00575
EGFS2	8.4108	.00288	8.7337	.00745				
SGFS2	7.6322	.17131	8.5152	.22369				
DGFS2	17.3553	.00040						
GGFS1	7.8385	.04098	10.2161	.02184				
GGFS2	8.9562	.30926						
MEAN	7.9956	.10645	7.9684	.20907	7.9392	.26776	7.9091	.96254

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	8.25	3830.25	.16	.17		1.08
1988	8.62	5529.15	.22	.22		1.03
1989	8.23	3756.05	.24	.20		.84
1990	8.07	3209.75	.45	.63		1.42

Table 22.9b

Analysis by RCRTINX2 of data from file WH14ZR2.CSV
WHITING IV AGE 1 (1990 WG)

Data for 13 surveys over 21 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass	1987		1988		1989		1990	
Survey/ Series	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight	Predicted Value	Weight
IYFS1	6.8375	.18276	8.0170	.27430	7.0482	.48305		
EGFS1	6.1745	.00650	7.7333	.01373	6.2857	.01724		
DGFS1	9.7435	.00142	8.4823	.00380				
SGFS1	6.5346	.05035	8.5082	.03677	7.7001	.08022		
EGFS0	5.3561	.00420	8.1595	.00924	11.2004	.00688	10.4226	.03098
DGFS0	7.1793	.05815	6.5580	.16021	7.0098	.17618		
IYFS2	7.6629	.02298	8.3474	.04395				
SGFS0	5.2312	.00501	8.8066	.00855	7.9539	.01319	11.4469	.01674
EGFS2	7.0848	.00464	7.3269	.01246				
SGFS2	6.4897	.15221	7.2979	.23452				
DGFS2	16.7691	.00023						
GGFS1	6.6733	.04894	8.5827	.03080				
GGFS2	7.7307	.38802						
MEAN	6.8294	.07459	6.8065	.17169	6.7815	.22324	6.7552	.95228

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	7.14	1255.24	.13	.16		1.26
1988	7.45	1726.97	.19	.20		1.05
1989	7.06	1166.27	.21	.18		.83
1990	6.95	1040.39	.43	.61		1.41

Table 22.10: Mean Fishing Mortality , Biomass and Recruitment of WHITING in IV between 1970 and 1989

	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.	Million
1970	0.606	0.231	0.238	521	353	70	39766
1971	0.411	0.134	0.061	520	220	71	68557
1972	0.578	0.141	0.116	603	269	72	90667
1973	0.671	0.169	0.159	921	381	73	44711
1974	0.581	0.136	0.294	682	441	74	92401
1975	0.838	0.220	0.142	1102	453	75	57430
1976	0.640	0.169	0.272	1036	581	76	55824
1977	0.565	0.118	0.217	1013	547	77	56805
1978	0.604	0.078	0.103	701	404	78	58844
1979	0.595	0.073	0.105	871	465	79	53918
1980	0.651	0.219	0.093	768	474	80	20635
1981	0.649	0.083	0.171	575	444	81	23635
1982	0.491	0.103	0.100	440	341	82	20701
1983	0.561	0.145	0.068	462	303	83	32409
1984	0.742	0.129	0.068	441	247	84	23861
1985	0.734	0.082	0.055	406	242	85	47608
1986	0.732	0.146	0.055	618	266	86	39166
1987	0.914	0.153	0.067	494	278	87	50113
1988	0.680	0.103	0.127	480	283	88	72010
1989	0.521	0.170	0.152	718	365	89	48155
Arit-mean recruits at age 0 for period 1970 to 1989							49861
Geom-mean recruits at age 0 for period 1970 to 1989							45572

Table 22.11: Input for catch prediction of WHITING in IV

Age	1989 Stock and Fishing Mortality: Stock Number	Fishing Mortality: H.Con.	Fishing Mortality: Disc	Fishing Mortality: Ind	Values used in Prediction (F at age, Mean Wt. and Propn. Retained by Consumption Fishery) — Scaled mean F 1985 to 1989: H.Con.	Scaled mean F: Disc	Scaled mean F: Ind	Mean values for period 1985 to 1989 — Mean Weight (Kg.): H.Con.	Mean Weight: Disc	Mean Weight: Ind	Mean Weight: Stock	Prop. Ret.
0	48155000	0.000	0.000	0.016	0.000	0.000	0.016	0.136	0.026	0.015	0.015	0.001
1	5533000	0.002	0.078	0.125	0.002	0.078	0.125	0.191	0.093	0.051	0.079	0.032
2	1255000	0.074	0.150	0.271	0.074	0.150	0.271	0.228	0.159	0.127	0.163	0.363
3	412876	0.276	0.240	0.212	0.332	0.160	0.203	0.269	0.196	0.224	0.242	0.670
4	152462	0.471	0.231	0.142	0.632	0.118	0.147	0.313	0.215	0.311	0.299	0.832
5	25246	0.620	0.222	0.126	0.812	0.078	0.115	0.365	0.236	0.407	0.357	0.903
6	6198	1.156	0.035	0.370	1.070	0.027	0.131	0.409	0.236	0.497	0.411	0.975
7	592	1.031	0.025	0.295	1.058	0.013	0.103	0.463	0.274	0.556	0.458	0.988
8	402	1.049	0.063	0.363	1.141	0.033	0.122	0.525	0.277	0.717	0.517	0.966
9	56	1.186		0.054	1.048		0.018	0.730		0.800	0.729	1.000
10	10	1.186		0.054	1.048		0.018	0.678			0.678	1.000

Mean F	Age 2 to 6 (1989)	Age 0 4 (1989)	Age 2 to 6 (Prediction)	Age 0 4 (Prediction)
Unscaled	0.690	0.152	0.847	0.091
Scaled			0.690	0.152

Recruits at age 0 in 1990 = 38421000
Recruits at age 0 in 1991 = 45572070
Recruits at age 0 in 1992 = 45572070
Recruits at age 0 in 1993 = 45572070

M at age and proprtion mature at age are as shown in Table 22.3

Mean F for ages 2 to 6 in 1989 for human consumption landings + discards = 0.690 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1985 to 1989
rescaled to produce a mean value of F for ages 2 to 6 equal to that for 1989

Mean F for ages 0 to 4 in 1989 for small-mesh fisheries = 0.152 .
Industrial fishery F-at-age in the prediction are averages for the period 1985 to 1989 .
rescaled to produce a mean value of F for ages 0 to 4 equal to that for 1989

Values of N in 1989 from VPA have been overwritten
for the following ages .....

Age 0
Age 1
Age 2

Values of F for these ages in 1989 from VPA have been overwritten
with scaled mean values used for predictions for 1990 onwards

Table 22.12 : Predicted Catches and Biomasses (1000's of tonnes) of WHITING in IV 1990 to 1991

	Year 1989	1990	1991								
Biomass 1 Jan of Year											
Total	718	758	660	660	660	660	660	660	660	660	660
Spawning	365	474	437	437	437	437	437	437	437	437	437
Mean F Ages											
Human Cons. 2 to 6	0.70	0.69	0.00	0.14	0.28	0.41	0.55	0.69	0.83	0.00	0.00
Small-mesh 0 to 4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.00	0.00
Mean F(Year)/Mean F(1989)										F0.1	Fmax
Human Consumption	1.00	0.99	0.00	0.20	0.40	0.60	0.79	0.99	1.19	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	41	75	0	20	38	54	69	82	95	0	0
Discards	35	54	0	10	20	29	38	47	54	0	0
Small-mesh Fisheries	43	75	77	74	72	70	68	66	65	0	0
Total landings	83	150	77	94	110	125	137	149	159	0	0
Total catch	119	204	77	105	130	154	176	195	214	0	0
Biomass 1 Jan of Year+1											
Total	758	660	751	723	698	675	654	635	617	0	0
Spawning	474	437	491	463	438	415	394	375	358	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
0	38421000	8	6050	224916	230974
1	3697702	5701	170463	274205	450370
2	1742485	91888	160935	305456	558280
3	487624	99640	49055	61390	210085
4	140449	51084	10332	12053	73470
5	48566	22219	2385	3196	27800
6	7466	4170	108	510	4788
7	1013	583	7	57	646
8	125	74	3	8	84
9	75	45	0	1	46
10	13	8	0	0	8
Wt	757688	74991	53998	75287	204276

Stock at start of and catch during 1991 for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	45572070	9	7176	266779	273964
1	2950252	4549	136006	218778	359332
2	1164502	61409	107553	204136	373098
3	677033	138343	68110	85236	291689
4	171624	62423	12626	14729	89778
5	42416	19406	2083	2791	24280
6	13848	7735	199	947	8881
7	1703	980	12	95	1087
8	256	151	5	16	172
9	28	17	0	0	17
10	25	15	0	0	15
Wt	660271	82439	46537	66430	195405

Table 22.13 : Predicted Catches and Biomasses (1000's of tonnes) of WHITING in IV 1990 to 1991

	Year										
	1989	1990	1991								
Biomass 1 Jan of Year											
Total	718	758	701	701	701	701	701	701	701	701	701
Spawning	365	474	477	477	477	477	477	477	477	477	477
Mean F Ages											
Human Cons. 2 to 6	0.70	0.41	0.00	0.14	0.28	0.41	0.55	0.69	0.83	0.00	0.00
Small-mesh 0 to 4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.00	0.00
Mean F(Year)/Mean F(1989)										F0.1	Fmax
Human Consumption	1.00	0.60	0.00	0.20	0.40	0.60	0.79	0.99	1.19	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	41	49	0	23	44	63	80	95	109	0	0
Discards	35	34	0	11	21	31	40	49	57	0	0
Small-mesh Fisheries	43	79	82	80	77	75	73	71	69	0	0
Total landings	83	128	82	103	121	138	152	165	177	0	0
Total catch	119	162	82	114	142	169	193	215	235	0	0
Biomass 1 Jan of Year+1											
Total	758	701	782	750	722	696	673	651	632	0	0
Spawning	474	477	521	490	462	436	413	392	373	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
0	38421000	5	3630	224928	228563
1	3697702	3466	103625	277816	384907
2	1742485	57281	100323	317357	474961
3	487624	64958	31981	66703	163642
4	140449	34708	7020	13649	55377
5	48566	15436	1657	3700	20793
6	7466	2980	77	608	3664
7	1013	416	5	67	488
8	125	53	2	10	65
9	75	32	0	1	33
10	13	6	0	0	6
Wt	757688	49159	33854	78933	161946

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
0	45572070	9	7176	266779	273964
1	2950769	4550	136030	218816	359395
2	1202537	63415	111066	210804	385284
3	740592	151331	74504	93238	319073
4	208900	75981	15368	17928	109277
5	57258	26196	2812	3768	32776
6	19764	11040	285	1351	12675
7	2641	1520	19	148	1686
8	393	231	8	25	264
9	45	27	0	0	27
10	38	23	0	0	23
Wt	701265	94772	49136	70701	214608

Table 23.1 Nominal catch (tonnes) of WHITING in Division VIa, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	+	-	2	-	-
Denmark	32	-	+	-	-
France	2,609	1,637	1,798	2,029	1,887
Germany, Fed.Rep.	1	49	53	43	6
Ireland	4,407	8,148	3,406	3,578	3,454
Netherlands	2	6	285	811	-
Spain	-	-	99	76	40
UK (England & Wales)	227	145	166	157	162
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	-	-	-	52	40
UK (Scotland)	7,386	8,519	8,419	10,019	11,270
Total	14,664	18,504	14,235	16,765	16,859

Country	1985	1986	1987	1988	1989
Belgium	3	-	4	3	1
Denmark	-	-	5	-	1
France	1,502	829	1,644	1,249	199[1,2]
Germany, Fed. Rep.	9	1	+	4	4[1]
Ireland	1,917	1,683	2,868	2,640	n/a[1]
Netherlands	14	-	-	n/a	-[1]
Spain	61	-	-	-	n/a
UK (England & Wales	63	26	62	30	83
UK (Isle of Man)	-	-	-	-	2
UK (N. Ireland)	17	5	13	89	18
UK (Scotland)	9,051	5,848	7,803	7,864	6,047
Total	12,637	8,392	12,399	11,879	6,355

[1] Preliminary.
[2] Includes Divisions Vb and VIb.
n/a = Not available.

Table 23.2 Annual Weight and Numbers of WHITING caught in VIA between 1970 and 1989

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
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
1987	12	12	0	0	41	41	0	0
1988	11	11	0	0	41	41	0	0
1989	8	8	0	0	27	27	0	0

Table 23.3 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 23.4 Total International Catch at Age (1000's) of WHITING in VIA between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	730	2387	16777	14078	9083	14917	8500	16120	17670	6334	1
2	6423	8617	12028	36142	51036	16778	46421	13376	18175	34221	2
3	28065	4122	4013	5592	10049	36318	15757	25144	6682	13282	3
4	3241	34784	1363	1461	1166	2819	17423	3127	9400	3407	4
5	670	1338	14796	357	180	281	1508	4719	941	3488	5
6	214	240	793	4292	52	57	66	292	1433	376	6
7	16	70	77	277	817	7	13	13	63	374	7
8	534	153	71	34	31	238	44	11	4	10	8

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	11650	3593	2991	3418	7209	4139	2674	6470	1842	2529	1
2	11378	24395	5783	7094	12765	19520	14826	14023	20587	5887	2
3	14860	11297	29094	8040	8221	8574	9771	14076	9638	11889	3
4	4155	4611	6821	22757	4387	3351	2653	5476	6168	4767	4
5	1244	1518	2043	6070	14825	1997	532	842	1949	1266	5
6	1085	452	803	1439	1953	4764	291	332	290	468	6
7	84	197	254	399	723	748	474	125	115	46	7
8	106	5	95	141	135	74	55	135	92	25	8

Table 23.5 Total International Mean Weight at Age (Kg.) of WHITING in VIA between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	0.205	0.209	0.211	0.196	0.193	0.209	0.201	0.200	0.199	0.218	1
2	0.203	0.247	0.258	0.235	0.215	0.245	0.242	0.244	0.235	0.232	2
3	0.274	0.276	0.345	0.362	0.317	0.305	0.309	0.296	0.286	0.306	3
4	0.382	0.316	0.368	0.479	0.444	0.471	0.361	0.392	0.389	0.404	4
5	0.519	0.426	0.426	0.485	0.591	0.651	0.497	0.431	0.516	0.536	5
6	0.619	0.551	0.494	0.532	0.641	0.615	0.687	0.629	0.549	0.678	6
7	0.664	0.696	0.603	0.654	0.574	0.841	1.050	0.848	0.602	0.694	7
8	0.683	0.720	0.675	0.763	0.843	0.713	0.800	0.784	0.750	0.644	8

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	0.172	0.192	0.184	0.216	0.216	0.185	0.174	0.188	0.176	0.171	1
2	0.242	0.228	0.220	0.249	0.259	0.238	0.236	0.237	0.215	0.220	2
3	0.330	0.289	0.276	0.280	0.313	0.306	0.294	0.304	0.301	0.279	3
4	0.420	0.382	0.352	0.340	0.371	0.402	0.365	0.373	0.400	0.348	4
5	0.492	0.409	0.505	0.409	0.412	0.430	0.468	0.511	0.483	0.459	5
6	0.595	0.409	0.513	0.494	0.458	0.461	0.482	0.520	0.567	0.425	6
7	0.722	0.542	0.503	0.526	0.438	0.531	0.496	0.575	0.595	0.479	7
8	0.894	0.751	0.585	0.466	0.566	0.615	0.530	0.578	0.606	0.698	8

Table 23.6 Whiting in Division VIa. Tuning results.

VPA Version 2.1 - May 1988
WHITING VIA
with cpue data from file WHI6AEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 ,SCOSEI , has terminal q estimated as the mean
Fleet 2 ,SCOTRL , has terminal q estimated as the mean
Fleet 3 ,SCOLTR , has terminal q estimated as the mean
Fleet 4 ,SCONTR , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using Laurec/Shepherd method
Regression weights

Age 1

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-14.41	0.442	0.0218	0.1655	0.000E+00	0.000E+00	-14.406	0.122
2	No data for this fleet at this age							
3	-15.82	0.516	0.0293	0.1762	0.000E+00	0.000E+00	-15.818	0.143
4	-16.66	0.527	0.0221	0.1924	0.000E+00	0.000E+00	-16.660	0.146

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.176	0.283	0.439E-01	0.283	0.024

Age 2

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.86	0.485	0.1022	0.5146	0.000E+00	0.000E+00	-12.861	0.134
2	-14.52	0.575	0.0026	2.1904	0.000E+00	0.000E+00	-14.523	0.159
3	-14.10	0.333	0.1628	0.9204	0.000E+00	0.000E+00	-14.105	0.092
4	-16.00	0.396	0.0426	0.7644	0.000E+00	0.000E+00	-16.001	0.110

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.879	0.210	0.239	0.239	1.295

Age 3

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.45	0.320	0.1544	0.6164	0.000E+00	0.000E+00	-12.448	0.089
2	-13.15	0.328	0.0103	2.2119	0.000E+00	0.000E+00	-13.146	0.091
3	-13.58	0.200	0.2761	0.8957	0.000E+00	0.000E+00	-13.577	0.055
4	-15.83	0.300	0.0505	1.4177	0.000E+00	0.000E+00	-15.832	0.083

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.071	0.135	0.240	0.240	3.175

Age 4

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.46	0.430	0.1523	0.6393	0.000E+00	0.000E+00	-12.462	0.119
2	-12.60	0.351	0.0179	2.0025	0.000E+00	0.000E+00	-12.597	0.097
3	-13.53	0.256	0.2899	0.9864	0.000E+00	0.000E+00	-13.528	0.071
4	-15.79	0.462	0.0528	1.6884	0.000E+00	0.000E+00	-15.787	0.128

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.177	0.173	0.232	0.232	1.796

Table 23.6 (Cont'd)

Age 5

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.52	0.349	0.1444	0.7656	0.000E+00	0.000E+00	-12.516	0.097
2	-12.60	0.674	0.0179	2.1284	0.000E+00	0.000E+00	-12.595	[illegible]
3	-13.62	0.420	0.2649	0.8356	0.000E+00	0.000E+00	-13.618	0.116
4	-15.90	0.689	0.0471	0.8302	0.000E+00	0.000E+00	-15.900	0.191

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.893	0.235	0.182	0.235	0.599

Age 6

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.69	0.475	0.1217	0.3049	0.000E+00	0.000E+00	-12.686	0.131
2	-12.57	0.704	0.0183	3.0907	0.000E+00	0.000E+00	-12.573	0.195
3	-13.66	0.351	0.2532	0.9125	0.000E+00	0.000E+00	-13.663	0.097
4	-16.02	0.897	0.0417	1.4497	0.000E+00	0.000E+00	-16.024	[illegible]

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
0.813	0.252	0.421	0.421	2.795

Table 23.7 Total International Fishing Mortality Rate at Age of WHITING in VIA between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	0.037	0.089	0.221	0.083	0.160	0.115	0.198	0.247	0.190	0.093	1
2	0.601	0.762	0.835	1.025	0.477	0.491	0.613	0.544	0.484	0.677	2
3	0.320	1.025	1.043	1.328	0.936	0.753	1.268	0.815	0.581	0.806	3
4	0.659	0.835	1.269	1.659	1.230	0.760	1.065	0.973	0.855	0.673	4
5	0.887	0.637	1.125	1.672	1.043	1.246	1.338	0.992	0.930	0.947	5
6	0.890	0.982	1.022	1.326	1.505	1.223	1.228	1.102	0.991	0.801	6
7	0.672	0.848	1.059	1.402	1.038	0.895	1.102	0.885	0.768	0.781	7
8	0.672	0.848	1.059	1.402	1.038	0.895	1.102	0.885	0.768	0.781	8

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	0.069	0.104	0.097	0.091	0.124	0.073	0.060	0.118	0.141	0.176	1
2	0.239	0.202	0.243	0.348	0.568	0.570	0.401	0.495	0.662	0.880	2
3	0.719	0.396	0.394	0.623	0.875	0.976	0.633	0.840	0.767	1.071	3
4	0.643	0.511	0.443	0.616	0.853	1.182	0.980	0.919	1.208	1.177	4
5	0.560	0.517	0.449	0.920	1.114	1.359	0.585	1.036	1.061	0.893	5
6	0.914	0.406	0.574	0.665	0.899	1.599	0.735	0.924	1.429	0.813	6
7	0.615	0.406	0.421	0.634	0.862	1.137	0.667	0.843	1.025	0.967	7
8	0.615	0.406	0.421	0.634	0.862	1.137	0.667	0.843	1.025	0.967	8

Table 23.8 Stock Numbers at Age (1000's) of WHITING in VIA between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	22301	30875	93140	195341	67779	151610	51942	81006	112173	78749	1
2	15537	17599	23125	61157	147232	47309	110678	34873	51820	75928	2
3	112455	6975	6722	8216	17963	74804	23700	49104	16577	26140	3
4	7326	66852	2049	1939	1782	5767	28840	5459	17791	7594	4
5	1238	3102	23740	472	302	427	2207	8144	1689	6193	5
6	395	417	1344	6312	73	87	100	474	2473	545	6
7	35	133	128	396	1373	13	21	24	129	751	7
8	1191	291	118	48	53	437	72	19	9	21	8

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	191679	39971	35669	43099	67948	64605	50946	63819	15394	17229	1
2	58762	146421	29485	26506	32203	49132	49160	39298	46417	10944	2
3	31594	37872	97917	18937	15330	14943	22759	26945	19610	19608	3
4	9562	12602	20869	54057	8316	5231	4611	9899	9519	7458	4
5	3173	4115	6188	10969	23909	2901	1313	1417	3231	2330	5
6	1967	1484	2009	3234	3580	6423	610	599	412	916	6
7	200	646	810	927	1362	1193	1063	239	195	81	7
8	251	15	302	328	255	118	124	258	156	43	8

Table 23.9a Whiting in Division VIa. Results of RCRTINX2 analysis for Age 1.

Analysis by RCRTINX2 of data from file WHI6AR1.DWA
WHITING VIa AGE 1 (1990 WG)

Data for 3 surveys over 22 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
VPAIV1	15.1584	1.462	-10.657	.5431	18	11.5046	.49683	.52326	.12523
SGFS1	4.0553	.302	9.219	.6935	6	10.4439	.18492	.22308	.68899
SGFS2	3.9416	.782	7.346	.4176	7	10.4301	.69383	.77350	.05731
MEAN						11.1274	.51660	.51660	.12848

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
VPAIV1	15.5261	1.462	-10.630	.5323	18	12.0653	.49873	.56385	.09903
SGFS1	4.5218	.301	9.224	.6966	6	10.5862	.18439	.20862	.72342
SGFS2	4.0639	.778	7.358	.4146	7	10.5178	.68995	.76317	.05406
MEAN						11.1134	.50492	.50492	.12349

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
VPAIV1	15.1130	1.474	-10.795	.5178	18	11.4881	.50480	.53792	.10613
SGFS1	5.2084	.300	9.230	.7005	6	10.7941	.18391	.19972	.76772
SGFS2									
MEAN						11.0950	.49339	.49339	.12615

Yearclass = 1990

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
VPAIV1	14.9141	1.503	-11.200	.4980	18	11.2198	.51669	.54581	.43786
SGFS1									
SGFS2									
MEAN						11.0731	.48171	.48171	.56214

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	10.66	42777.18	.19	.23		1.22
1988	10.79	48731.12	.18	.26		1.48
1989	10.91	54485.57	.18	.16		.90
1990	11.14	68687.36	.36	.07		.20

Table 23.9b Whiting in Division VIb. Results of RCRTINX2 analysis for Age 2.

Analysis by RCRTINX2 of data from file WHI6AR2.DWA
WHITING VIa AGE 2 (1990 WG)

Data for 3 surveys over 22 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
VPAIV1	15.1584	1.515	-11.768	.4989	18	11.2017	.53929	.56797	.13104
SGFS1	4.0553	.319	8.838	.6380	6	10.1333	.21259	.25646	.64269
SGFS2	3.9416	.804	6.954	.4068	7	10.1212	.71918	.80176	.06576
MEAN						10.8107	.51317	.51317	.16052

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
VPAIV1	15.5261	1.514	-11.723	.4896	18	11.7848	.53963	.61010	.10499
SGFS1	4.5218	.319	8.843	.6404	6	10.2838	.21230	.24019	.67735
SGFS2	4.0639	.799	6.965	.4033	7	10.2111	.71565	.79159	.06236
MEAN						10.7989	.50163	.50163	.15530

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
VPAIV1	15.1130	1.524	-11.838	.4781	18	11.1892	.54268	.57828	.11505
SGFS1	5.2084	.318	8.850	.6434	6	10.5035	.21217	.23041	.72470
SGFS2									
MEAN						10.7830	.48998	.48998	.16025

Yearclass = 1990

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
VPAIV1	14.9141	1.547	-12.159	.4631	18	10.9150	.54997	.58097	.40375
SGFS1									
SGFS2									
MEAN						10.7640	.47808	.47808	.59625

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	10.38	32248.83	.21	.23		1.13
1988	10.52	36931.53	.20	.27		1.38
1989	10.63	41241.22	.20	.16		.82
1990	10.82	50259.65	.37	.07		.20

Table 23.10 Mean Fishing Mortality , Biomass and Recruitment of WHITING in VIA between 1970 and 1989

	Mean Fishing Mortality Ages 2 to 4		Ages 1 to 1	Biomass 1000 tonnes		Recruits Age 1	
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1970	0.527	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	0.881	0.000	0.000	52	39	73	68
1975	0.668	0.000	0.000	70	38	74	152
1976	0.982	0.000	0.000	56	46	75	52
1977	0.777	0.000	0.000	45	29	76	81
1978	0.640	0.000	0.000	49	26	77	112
1979	0.718	0.000	0.000	50	33	78	79
1980	0.534	0.000	0.000	65	32	79	192
1981	0.370	0.000	0.000	60	52	80	40
1982	0.360	0.000	0.000	52	46	81	36
1983	0.529	0.000	0.000	46	37	82	43
1984	0.765	0.000	0.000	43	28	83	68
1985	0.909	0.000	0.000	35	23	84	65
1986	0.671	0.000	0.000	30	21	85	51
1987	0.752	0.000	0.000	35	23	86	64
1988	0.879	0.000	0.000	29	22	87	41
1989	1.043	0.000	0.000	25	17	88	49
Arit-mean recruits at age 1 for period 1970 to 1989							77
Geom-mean recruits at age 1 for period 1970 to 1989							65

Table 23.11 Input for catch prediction of WHITING in VIA

	1989 Stock and Fishing Mortality				Values used in Prediction F at age , Mean Wt. and Propn. Retained by Consumption Fishery							
		Fishing Mortality			Scaled mean F 1985 to 1989			Mean values for period 1985 to 1989 Mean Weight (Kg.)				Prop.
Age	Stock Number	H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	48731	0.117			0.117			0.179			0.179	1.000
2	32249	0.737			0.737			0.229			0.229	1.000
3	19611	1.071			1.051			0.297			0.297	1.000
4	7459	1.177			1.340			0.378			0.378	1.000
5	2330	0.893			1.210			0.470			0.470	1.000
6	916	0.813			1.348			0.491			0.491	1.000
7	81	0.967			1.137			0.535			0.535	1.000
8	43	0.967			1.137			0.605			0.605	1.000

Mean F	Age 2 to 4	Age 1 1	Age 2 to 4	Age 1 1
Unscaled	1.043	0.000	0.851	0.000
Scaled			1.043	0.000

Recruits at age 1 in 1990 = 54485
Recruits at age 1 in 1991 = 68687
Recruits at age 1 in 1992 = 64643
Recruits at age 1 in 1993 = 64643

M at age and proprtion mature at age are as shown in Table 23.3

Mean F for ages 2 to 4 in 1989 for human consumption landings + discards = 1.043 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1985 to 1989
rescaled to produce a mean value of F for ages 2 to 4 equal to that for 1989

Mean F for ages 1 to 1 in 1989 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1985 to 1989 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1989

Values of N in 1989 from VPA have been overwritten
for the following ages .....

Age 1
Age 2

Values of F for these ages in 1989 from VPA have been overwritten
with scaled mean values used for predictions for 1990 onwards

Table 23.12 Predicted Catches and Biomasses (1000's of tonnes) of WHITING in VIA 1990 to 1991

		Year									
	1989	1990	1991								
Biomass 1 Jan of Year											
Total	25	25	28	28	28	28	28	28	28	28	28
Spawning	17	15	16	16	16	16	16	16	16	16	16
Mean F Ages											
Human Cons. 2 to 4	1.00	1.04	0.00	0.21	0.42	0.63	0.83	1.04	1.25	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(1989)										F0.1	Fmax
Human Consumption	1.00	1.05	0.00	0.21	0.42	0.63	0.84	1.05	1.26	0.00	0.00
Catch weight											
Human Consumption	8	10	0	3	5	7	8	10	11	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	8	10	0	3	5	7	8	10	11	0	0
Total catch	8	10	0	3	5	7	8	10	11	0	0
Biomass 1 Jan of Year+1											
Total	25	28	41	38	35	33	31	30	28	0	0
Spawning	15	16	29	26	24	21	20	18	17	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
1	54485	5465	0	0	5465
2	35491	16983	0	0	16983
3	12632	7574	0	0	7574
4	5502	3761	0	0	3761
5	1882	1221	0	0	1221
6	781	536	0	0	536
7	333	209	0	0	209
8	25	16	0	0	16
Wt	25180	9500	0	0	9500

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	68687	6889	0	0	6889
2	39682	18988	0	0	18988
3	13901	8335	0	0	8335
4	3616	2472	0	0	2472
5	1180	765	0	0	765
6	460	315	0	0	315
7	166	104	0	0	104
8	94	59	0	0	59
Wt	27812	9602	0	0	9602

Table 24.1 Nominal catch (tonnes) of WHITING in Division VIb, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	...[2]	-	-	-	-	-	-	-	-	-
France	3	-	-	-	3	2	-	-	-	...[1,2]
Spain	-	196	112	88	16	123	-	-	-	n/a
UK(Engl. & Wales)	+	-	-	+	2	+	5	4	-	2
UK (N. Ireland)	-	-	-	-	-	-	-	-	-	15
UK(Scotland)	59	+	-	5	25	6	13	108	23	18
Total	62	196	112	93	46	131	18	112	23	35

[1]Provisional.
[2]Included in Division VIa.
n/a = Not available.

Table 25.1 Nominal catch (tonnes) of WHITING in Division VIId, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	52	88	93	84	79
Denmark	-	2	-	-	-
France	7,110	8,145	7,012	5,057	6,914
Netherlands	-	1	2	1	-
UK(England and Wales)	122	120	170	198	88
Total	7,284	8,356	7,277	5,340	7,081
WG Estimate	9,167	8,932	7,911	6,936	7,373

Country	1985	1986	1987	1988	1989
Belgium	82	65	136	69	38
Denmark	-	-	-	-	-
France	7,563	4,551	6,730	7,501	n/a
Netherlands	-	...[1]	-	n/a	-
UK(England and Wales)	186	180	287	251	231
Total	7,831	4,796	7,153	7,821	269
WG Estimate	7,339	5,678	5,518	5,203	4,148

[1]Included in Division VIIe.
n/a = Not available.

Table 25.2 : Annual Weight and Numbers of WHITING caught in VIID between 1976 and 1989

	Weight (1000 tonnes)				Number (millions)			
Year	Total	H.Con	Disc	By-cat	Total	H.Con	Disc	By-cat
1976	7.72	7.72	0.00	0.00	27	27	0	0
1977	4.95	4.95	0.00	0.00	21	21	0	0
1978	9.11	9.11	0.00	0.00	38	38	0	0
1979	8.91	8.91	0.00	0.00	36	36	0	0
1980	9.17	9.17	0.00	0.00	36	36	0	0
1981	8.93	8.93	0.00	0.00	34	34	0	0
1982	7.91	7.91	0.00	0.00	33	33	0	0
1983	6.94	6.94	0.00	0.00	29	29	0	0
1984	7.37	7.37	0.00	0.00	33	33	0	0
1985	7.34	7.34	0.00	0.00	34	34	0	0
1986	5.50	5.50	0.00	0.00	23	23	0	0
1987	4.69	4.69	0.00	0.00	18	18	0	0
1988	4.43	4.43	0.00	0.00	18	18	0	0
1989	4.15	4.15	0.00	0.00	16	16	0	0

Table 25.3 : Values of Natural Mortality Rate and Proportion Mature at age

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	0.530
3	0.200	0.840
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 25.4 : Total International Catch at Age (1000's) of WHITING in VIID between 1976 and 1989

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	529	1351	1105	413	163	952	3199	3441	4105	493	1
2	9774	6717	6763	8072	5742	9204	10391	12546	12308	14184	2
3	6190	10329	18945	14018	16492	10274	14132	8486	13266	15979	3
4	8590	1099	9770	10512	7365	8548	3151	3537	2274	2494	4
5	1800	1301	579	2358	4806	3308	1553	1229	1075	578	5
6	430	336	650	98	776	1275	453	154	317	203	6
7	7	26	130	116	138	717	68	63	45	29	7
8	101	15	4	14	28	2	5	14	22	36	8

Age	1986	1987	1988	1989	Age
1	228	2160	1753	1191	1
2	3661	6132	10713	6326	2
3	11455	1667	4058	7339	3
4	6774	7442	572	1128	4
5	1015	493	807	42	5
6	274	248	35	129	6
7	61	43	10	10	7
8	18	11			8

Table 25.5 : Total International Mean Weight at Age (Kg.) of WHITING in VIID between 1976 and 1989

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	0.220	0.191	0.280	0.189	0.157	0.150	0.146	0.174	0.172	0.137	1
2	0.225	0.179	0.215	0.205	0.211	0.229	0.197	0.211	0.194	0.167	2
3	0.284	0.242	0.223	0.247	0.243	0.278	0.257	0.258	0.239	0.242	3
4	0.312	0.352	0.275	0.272	0.286	0.272	0.318	0.296	0.310	0.301	4
5	0.414	0.357	0.328	0.325	0.312	0.264	0.346	0.307	0.261	0.318	5
6	0.381	0.378	0.319	0.398	0.347	0.305	0.410	0.376	0.305	0.290	6
7	0.467	0.475	0.328	0.357	0.309	0.331	0.436	0.324	0.379	0.477	7
8	0.481	0.468	0.721	0.458	0.444	1.046	0.575	0.602	0.388	0.388	8

Age	1986	1987	1988	1989	Age
1	0.131	0.192	0.183	0.176	1
2	0.164	0.219	0.215	0.210	2
3	0.228	0.256	0.319	0.287	3
4	0.268	0.298	0.356	0.371	4
5	0.310	0.369	0.355	0.405	5
6	0.335	0.322	0.466	0.484	6
7	0.415	0.369	0.458	0.530	7
8	0.451	0.759			8

Table 25.6

Title : WHITING IN THE EASTERN ENGLISH CHANNEL (DIVISION VIId) On 22/10/1990 10:04

Separable analysis
from 1976 to 1989 on ages 0 to 6
with Terminal F = 1.000 on age 3 and Terminal S = 1.000

Initial sum of squared residuals was1325.658
final sum of squared residuals is 360.276 after 72 iterations

Matrix of Residuals

Years	1976/77	1977/78	1978/79
Ages			
0/ 1	-6.050	-4.960	-4.485
1/ 2	-.707	1.092	.212
2/ 3	.009	-.112	-.320
3/ 4	.825	.068	.036
4/ 5	.560	.276	.457
5/ 6	.175	.167	.648
	.000	.000	.000
WTS	1.000	1.000	1.000

Years	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89		WTS
Ages												
0/ 1	-3.264	-4.706	-6.307	-6.603	-6.554	-4.624	1.625	-5.747	-3.654	-5.629	-60.957	.170
1/ 2	-.154	-1.286	-.052	.763	1.065	.919	.346	-.850	.442	.735	2.526	.480
2/ 3	-.041	.259	-.084	.344	.287	-.102	.545	1.105	.306	.329	2.526	1.000
3/ 4	.363	.473	.362	.331	.492	.628	-.000	-.527	-.442	-.082	2.526	.925
4/ 5	.104	.205	.401	-.623	-.119	-.187	-.454	1.139	.099	.669	2.526	.774
5/ 6	.276	.614	.584	.642	-.054	.009	-.696	-.128	.474	-.185	2.526	.913
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-48.326	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1976	1977	1978	1979
F-values	.5434	.3302	.4891	.4354

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
F-values	.5185	.8572	.9616	.8625	.9698	.9014	1.0380	1.3850	1.2139	1.0000

Selection-at-age (S)

	0	1	2	3	4	5	6
S-values	.0009	.0268	.3604	1.0000	1.3419	1.3017	1.0000

Table 25.7 : Total International Fishing Mortality Rate at Age of WHITING in VIID between 1976 and 1989

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	0.008	0.026	0.021	0.013	0.004	0.030	0.073	0.065	0.080	0.060	1
2	0.233	0.126	0.176	0.204	0.252	0.315	0.515	0.450	0.343	0.427	2
3	1.022	0.411	0.611	0.659	0.818	0.963	1.158	1.095	1.286	1.026	3
4	1.198	0.493	0.876	0.842	0.908	1.572	0.933	1.102	1.055	0.927	4
5	1.012	0.566	0.526	0.536	1.318	1.624	1.853	1.310	1.360	0.875	5
6	1.502	0.515	0.623	0.156	0.337	2.093	1.161	1.074	1.874	1.114	6
7	0.540	0.307	0.386	0.211	0.340	0.599	0.639	0.470	1.186	0.996	7
8	0.540	0.307	0.386	0.211	0.340	0.599	0.639	0.470	1.186	0.996	8

Age	1986	1987	1988	1989	Age
1	0.014	0.071	0.076	0.171	1
2	0.800	0.615	0.585	0.426	2
3	0.740	1.133	1.143	1.078	3
4	2.390	1.924	2.048	1.285	4
5	1.403	2.152	1.510	0.969	5
6	1.612	2.328	1.080	1.182	6
7	1.361	1.452	0.645	1.182	7
8	1.361	1.452	0.645	1.182	8

Table 25.8 : Stock Numbers at Age (1000's) of WHITING in VIID between 1976 and 1989

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	77107	57849	59996	35093	45804	35551	49865	60609	59131	9385	1
2	51740	62653	46143	48123	28359	37354	28247	37939	46518	44709	2
3	10494	33566	45241	31687	32133	18053	22312	13820	19813	27030	3
4	13313	3093	18215	20098	13417	11609	5645	5740	3785	4484	4
5	3069	3290	1547	6214	7089	4430	1974	1818	1560	1079	5
6	596	913	1529	748	2976	1554	715	253	402	328	6
7	19	109	447	671	524	1739	157	183	71	50	7
8	266	63	14	82	107	5	12	41	35	63	8

Age	1986	1987	1988	1989	Age
1	18060	34676	26344	8331	1
2	7239	14580	26442	19987	2
3	23882	2663	6454	12064	3
4	7936	9330	702	1686	4
5	1452	595	1115	74	5
6	368	292	57	202	6
7	88	60	23	16	7
8	26	15			8

Table 25.9 : Mean Fishing Mortality , Biomass and Recruitment of WHITING in VIID between 1976 and 1989

	Mean Fishing Mortality			Biomass		Recruits	
	Ages 2 to 4		Ages 1 to 1	1000 tonnes		Age 1	
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1976	0.817	0.000	0.000	37	14	75	77
1977	0.343	0.000	0.000	33	15	76	58
1978	0.554	0.000	0.000	43	20	77	60
1979	0.568	0.000	0.000	32	20	78	35
1980	0.659	0.000	0.000	28	17	79	46
1981	0.950	0.000	0.000	24	14	80	36
1982	0.868	0.000	0.000	21	11	81	50
1983	0.882	0.000	0.000	25	10	82	61
1984	0.895	0.000	0.000	26	11	83	59
1985	0.793	0.000	0.000	17	11	84	9
1986	1.310	0.000	0.000	12	8	85	18
1987	1.224	0.000	0.000	14	5	86	35
1988	1.258	0.000	0.000	13	5	87	26
1989	0.930	0.000	0.000	15	6	88	35
Arit-mean recruits at age 1 for period 1976 to 1989							43
Geom-mean recruits at age 1 for period 1976 to 1989							38

Table 25.10 : Input for catch prediction of WHITING in VIID

Age	1989 Stock Number	1989 Fishing Mortality H.Con.	1989 Fishing Mortality Disc	1989 Fishing Mortality Ind	Scaled mean F 1985 to 1989 H.Con.	Scaled mean F Disc	Scaled mean F Ind	Mean Weight (Kg.) 1985 to 1989 H.Con.	Mean Weight Disc	Mean Weight Ind	Mean Weight Stock	Prop. Ret.
1	35000	0.066			0.066			0.164			0.164	1.000
2	19979	0.426			0.481			0.195			0.195	1.000
3	12061	1.078			0.863			0.266			0.266	1.000
4	1686	1.285			1.445			0.319			0.319	1.000
5	74	0.969			1.165			0.351			0.351	1.000
6	202	1.182			1.233			0.379			0.379	1.000
7	16	1.182			0.950			0.450			0.450	1.000
8		1.182			0.950			0.533			0.533	1.000

Mean F	1989 Age 2 to 4	1989 Age 1 1	Prediction Age 2 to 4	Prediction Age 1 1
Unscaled	0.930	0.000	1.103	0.000
Scaled			0.930	0.000

Recruits at age 1 in 1990 = 35000
Recruits at age 1 in 1991 = 35000
Recruits at age 1 in 1992 = 35000
Recruits at age 1 in 1993 = 35000

M at age and proprtion mature at age are as shown in Table 25.3

Mean F for ages 2 to 4 in 1989 for human consumption landings + discards = 0.930 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1985 to 1989 rescaled to produce a mean value of F for ages 2 to 4 equal to that for 1989

Mean F for ages 1 to 1 in 1989 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1985 to 1989 . rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1989

Values of N in 1989 from VPA have been overwritten
for the following ages .....

Age 1

Values of F for these ages in 1989 from VPA have been overwritten
with scaled mean values used for predictions for 1990 onwards

Table 25.11 : Predicted Catches and Biomasses (1000's of tonnes) of WHITING in VIID 1990 to 1991

	Year										
	1989	1990	1991								
Biomass 1 Jan of Year											
Total	15	15	16	16	16	16	16	16	16	16	16
Spawning	6	6	7	7	7	7	7	7	7	7	7
Mean F Ages											
Human Cons. 2 to 4	0.93	0.93	0.00	0.19	0.37	0.56	0.74	0.93	1.12	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(1989)										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	4.1	4.5	0.0	1.3	2.5	3.5	4.3	5.1	5.7	0.0	0.0
Discards	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Small-mesh Fisheries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total landings	4.1	4.5	0.0	1.3	2.5	3.5	4.3	5.1	5.7	0.0	0.0
Total catch	4.1	4.5	0.0	1.3	2.5	3.5	4.3	5.1	5.7	0.0	0.0
Biomass 1 Jan of Year+1											
Total	15.0	16.0	22.0	20.5	19.3	18.2	17.2	16.4	15.7	0.0	0.0
Spawning	6.4	7.3	12.7	11.4	10.2	9.2	8.4	7.6	7.0	0.0	0.0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
1	35000	2030	0	0	2030
2	26824	9355	0	0	9355
3	10684	5677	0	0	5677
4	3360	2382	0	0	2382
5	382	243	0	0	243
6	23	15	0	0	15
7	51	29	0	0	29
8	4	2	0	0	2
Wt	15049	4534	0	0	4534

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	35000	2030	0	0	2030
2	26824	9355	0	0	9355
3	13578	7215	0	0	7215
4	3691	2616	0	0	2616
5	648	412	0	0	412
6	98	64	0	0	64
7	5	3	0	0	3
8	17	10	0	0	10
Wt	16034	5089	0	0	5089

Table 26.1 Nominal catch (tonnes) of WHITING in Division VIIe, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	33	14	8	10	4
Denmark	6	-	-	-	-
France	580	697	1,039	651	325
Netherlands	2	1	68	398	-
UK (England and Wales)	717	1,016	1,052	1,012	723
UK (Scotland)	-	-	-	-	-
Total	1,338	1,728	2,167	2,071	1,052
WG Estimate	1,487	1,681	1,649	2,075	1,369

Country	1985	1986	1987	1988	1989
Belgium	2	2	2	4	3
Denmark	-	-	-	-	-
France	544	788	1,486	1,439	n/a
Netherlands	-	124[1]	-	n/a	-
UK (England and Wales)	418	629	753	1,183	917
UK (Scotland)	-	-	-	-	5
Total	964	1,543	2,241	2,626	925
WG Estimate	1,942	1,282	1,921	2,294	1,541

[1] Includes Division VIId.
n/a = Not available.

Table 27.1 Nominal catch (tonnes) of WHITING in Divisions VIIb,c,h-k, 1980-1989, based on officially reported figures (where available) and Working Group estimates.

Country	1980	1981	1982	1983	1984
Belgium	-	-	-	-	-
France	656	516	204	356	398
Germany, Fed. Rep.	+	-	-	-	-
Ireland	3,499	3,550	4,011	2,590	1,872
Netherlands	1	21	78	363	169
Spain	-	-	85	91	57
UK (England and Wales)	-	67	49	18	58
UK (Scotland)	80	1	-	-	4
Total	4,236	4,155	4,427	3,418	2,558

Country	1985	1986	1987	1988	1989
Belgium	75[2]	33[2]	29[2]	19[2]	39[2]
France	583	614	487	890	n/a[1]
Germany, Fed. Rep.	-	-	-	+	1[1]
Ireland	2,719	2,165	2,421	2,693	n/a
Netherlands	90	7	-	n/a	-
Spain	76	-	-	-	n/a
UK (England and Wales)	165	168	95	121	117
UK (Scotland)	-	-	7	1	32
Total	3,708	2,987	3,039	3,724	189

[1]Preliminary.
[2]Includes Division VIIg.
n/a = Not available.

Table 28.1 Nominal catch (tonnes) of SAITHE in Sub-area IV and Division IIIa, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	13	12	4	7	32
Denmark	10,370	6,454	10,114	10,530	8,526
Faroe Islands	1,020	614	746	806	-
France	37,306	42,649	47,064	38,782	43,592
German Dem. Rep.	925	-	-	-	-
Germany, Fed. Rep.	11,095	8,246	13,517	13,649	25,262
Netherlands	245	123	36	89	181
Norway	47,959	55,882	72,669	81,330	88,420
Poland	2,404	698	793	415	413
Sweden	342	156	372	548	522
UK (England and Wales)	4,879	4,309	5,627	6,845	8,183
UK (N. Ireland)	-	-	-	-	-
UK (Scotland)	6,525	6,529	8,136	6,321	6,970

Country	1985	1986	1987	1988	1989
Belgium	31	16	4	60	13
Denmark	9,033	10,343	7,928	6,868	6,550[1]
Faroe Islands	895	224	691	276	392[1]
France	42,200	43,958	38,356	28,913	30,761[1,2]
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	22,551	22,277	22,400	18,528	13,095[1]
Netherlands	233	134	334	n/a	257[1]
Norway	101,808	67,341	66,400	40,021	25,941[1]
Poland	-	495	832	1,016	809
Sweden	1,764	1,987	1,732	2,064	797
UK (England & Wales)	5,455	4,480	3,233	3,790	4,441
UK (N. Ireland)	-	-	-	-	24
UK (Scotland)	9,932	15,520	11,911	10,850	8,726
Total	193,902	166,775	153,821	112,386	91,806

[1] Preliminary.
[2] Includes Divisions IIa, and IIIa,d(EC).
n/a = Not available.

Table 28.2 : Annual Weight and Numbers of SAITHE caught in IV between 1960 and 1989

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1960	32	32	0	0	17	17	0	0
1961	33	33	0	0	17	17	0	0
1962	24	24	0	0	13	13	0	0
1963	30	30	0	0	13	13	0	0
1964	58	58	0	0	33	33	0	0
1965	73	73	0	0	39	39	0	0
1966	96	96	0	0	62	62	0	0
1967	78	78	0	0	54	54	0	0
1968	104	104	0	0	62	62	0	0
1969	115	115	0	0	66	66	0	0
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	135	132	0	3	97	96	0	2
1979	114	113	0	2	68	67	0	1
1980	120	120	0	0	72	72	0	0
1981	123	121	0	1	70	68	0	2
1982	166	161	0	5	115	110	0	5
1983	169	167	0	1	112	111	0	1
1984	198	192	0	6	167	161	0	6
1985	200	192	0	8	206	195	0	11
1986	164	163	0	1	158	156	0	2
1987	149	145	0	4	167	159	0	8
1988	105	104	0	1	93	92	0	1
1989	92	90	0	2	79	76	0	3

Table 28.3 : 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	0.150
5	0.200	0.700
6	0.200	0.900
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

Table 28.4 : Total International Catch at Age (1000's) of SAITHE in IV between 1960 and 1989

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Age
1									172	36	1
2	1185	563	132	859	9568	81	14017	8494	3783	1764	2
3	6956	4076	3563	1341	9785	14712	12105	15277	20788	28252	3
4	3639	6710	5161	4803	5654	14037	27528	13335	18944	13063	4
5	3001	2079	2456	4626	4581	8368	3777	13597	11987	9559	5
6	1585	1614	770	972	1566	1174	3492	2035	5402	7103	6
7	300	815	213	289	725	378	427	1141	281	5170	7
8	77	277	88	96	435	81	126	200	116	685	8
9	8	253	51	96	290	54	79	154	94	547	9
10	8	130	73	32	58	40	16	46	29	72	10
11	8	57	29	72	58	40	32	15	22	3	11
12	8	106	51	129	130	108	63	46	36	3	12

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	234	594	379	4416	3947	312	235	2015	1215	907	1
2	2228	10773	20189	31275	16150	71766	31335	12891	16503	16787	2
3	34392	68424	40162	47388	61201	50672	199669	22890	30972	14504	3
4	74326	53348	62290	32955	31387	23406	50339	52270	24935	13022	4
5	13194	30846	23108	24967	12123	9005	9902	13082	16771	10031	5
6	11529	3650	20779	15228	20080	6706	5137	4753	2616	7991	6
7	3654	3783	3363	7998	13734	12650	3317	3218	849	2437	7
8	1596	2481	2790	1689	4308	8650	4845	3062	790	577	8
9	278	1574	1550	1165	988	3304	3003	3522	607	349	9
10	80	322	993	977	473	1097	1066	1930	807	310	10
11	24	187	229	569	281	619	414	903	669	419	11
12	40	26	223	380	341	632	648	946	689	603	12

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	1276	5309	1932	270	59	214	104	780	11	5336	1
2	23095	18195	28263	32798	34455	6622	6078	28876	4886	9728	2
3	14159	22267	27405	23363	75449	124122	47110	29029	27389	14304	3
4	11399	6362	38946	17980	29769	54405	85116	90577	23186	25835	4
5	8338	6151	7934	25161	12081	13039	12197	12429	32283	11699	5
6	6086	3265	5410	4903	12330	4045	4269	1942	2910	9903	6
7	5189	2994	1761	4380	1357	2524	1592	1120	1132	1144	7
8	956	3173	1210	1333	1113	461	1044	813	451	474	8
9	418	504	846	929	279	267	265	689	492	270	9
10	409	277	274	319	184	70	158	229	208	119	10
11	322	373	80	198	100	53	99	120	46	72	11
12	754	1214	440	303	203	131	230	149	145	111	12

Table 28.5 : Total International Mean Weight at Age (Kg.) of SAITHE in IV between 1960 and 1989

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Age
1									0.501	0.451	1
2	0.447	0.390	0.773	1.189	0.550	0.536	0.532	0.679	0.772	0.578	2
3	1.101	0.962	1.237	1.327	1.334	1.291	1.300	0.892	1.291	0.962	3
4	1.683	1.471	1.655	1.842	2.026	1.846	1.723	1.307	1.652	1.608	4
5	2.929	2.561	2.355	2.288	2.698	2.353	2.698	2.077	1.972	2.263	5
6	3.926	3.432	3.783	3.645	3.889	3.484	3.240	3.130	3.017	2.699	6
7	4.861	4.249	4.329	4.467	4.867	4.646	4.796	3.718	4.069	3.569	7
8	6.128	5.357	4.847	6.240	5.885	6.165	5.613	5.288	4.459	4.335	8
9	6.107	5.339	6.284	6.240	6.435	6.552	6.096	5.835	6.426	5.157	9
10	7.654	6.692	5.666	6.487	7.575	7.406	5.869	7.132	6.813	5.950	10
11	8.651	7.564	6.139	8.350	7.972	7.475	7.327	7.932	7.220	8.286	11
12	9.950	8.164	7.801	8.560	8.369	11.303	9.826	8.760	8.211	7.959	12

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	0.434	1
2	0.697	0.609	0.510	0.392	0.494	0.494	0.501	0.416	0.520	0.389	2
3	0.931	0.838	0.743	0.780	0.849	0.887	0.690	0.753	0.781	1.080	3
4	1.442	1.357	1.158	1.407	1.556	1.497	1.302	1.251	1.294	1.590	4
5	2.073	2.203	1.897	1.575	2.489	2.478	2.175	1.900	2.120	2.219	5
6	2.708	3.007	2.364	2.543	2.729	3.275	3.036	3.097	3.210	3.071	6
7	3.598	3.804	3.869	3.339	3.353	3.684	4.007	4.146	4.466	3.966	7
8	4.420	4.635	4.184	4.657	4.386	4.190	4.325	4.551	4.784	5.128	8
9	5.615	5.168	4.543	4.502	5.538	5.481	4.981	4.779	5.309	5.947	9
10	5.826	5.629	5.538	5.601	6.407	6.827	6.008	5.168	5.945	6.428	10
11	6.698	5.476	7.319	5.788	7.640	7.347	6.901	6.460	6.640	6.733	11
12	8.289	7.957	7.477	7.574	8.980	8.517	7.933	8.285	7.792	7.855	12

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	0.253	0.274	0.249	0.418	0.181	0.142	0.481	0.360	0.417	0.416	1
2	0.411	0.585	0.498	0.455	0.482	0.481	0.481	0.387	0.545	0.655	2
3	0.905	0.937	1.087	0.982	0.772	0.649	0.648	0.641	0.698	0.831	3
4	1.812	1.859	1.566	1.701	1.600	1.244	1.000	0.838	0.902	0.981	4
5	2.370	2.694	2.497	2.118	2.270	1.889	1.674	1.770	1.324	1.372	5
6	2.975	3.529	3.144	3.058	2.645	2.603	2.294	2.921	2.641	1.888	6
7	4.047	4.470	3.958	3.533	3.715	3.141	3.559	3.782	3.684	3.852	7
8	5.044	5.424	4.908	4.432	4.524	4.521	4.245	4.902	4.649	4.842	8
9	5.812	6.907	5.606	5.336	5.897	5.094	5.779	5.491	5.672	6.279	9
10	6.265	7.643	6.362	6.161	7.289	6.502	7.240	6.788	6.209	6.916	10
11	7.024	7.601	7.623	5.750	7.687	6.947	7.130	6.239	7.488	7.658	11
12	8.023	8.740	8.634	8.560	8.126	7.709	8.684	8.075	8.512	10.639	12

Table 28.6 SAITHE in Sub-area VI. Tuning results.

with cpue data from file SAI4ZEF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 FRATRB has terminal q estimated as the mean
Fleet 2 NORTRL has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using Laurec/Shepherd method

	Age 2		Age 3		Age 4		Age 5		Age 6	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
FRATRB	.0528	1.0000	.1017	.9415	.4350	.6658	.6271	.5840	.3969	.7881
NORTRL			.1562	.0585	.4323	.3342	.6148	.4160	.6248	.2119
		1.0000		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar		Fbar	
	.053		.104		.434		.622		.437	

	Age 7		Age 8	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT
FRATRB	.5210	.8197	.5510	.9133
NORTRL	.2201	.1803	.1631	.0867
		1.0000		1.0000
	Fbar		Fbar	
	.446		.496	

Table 28.7 : Total International Fishing Mortality Rate at Age of SAITHE in IV between 1970 and 1989

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	0.013	0.004	1
2	0.007	0.065	0.129	0.195	0.086	0.165	0.241	0.133	0.198	0.251	2
3	0.157	0.280	0.363	0.498	0.711	0.419	0.926	0.278	0.538	0.268	3
4	0.505	0.388	0.444	0.575	0.735	0.663	0.982	0.671	0.553	0.457	4
5	0.547	0.406	0.289	0.320	0.431	0.481	0.666	0.760	0.472	0.452	5
6	0.567	0.284	0.529	0.314	0.462	0.453	0.561	0.806	0.328	0.433	6
7	0.327	0.366	0.460	0.399	0.520	0.600	0.425	0.852	0.318	0.581	7
8	0.227	0.387	0.507	0.443	0.389	0.740	0.486	0.898	0.519	0.372	8
9	0.435	0.366	0.446	0.411	0.508	0.587	0.626	0.806	0.438	0.459	9
10	0.435	0.366	0.446	0.411	0.508	0.587	0.626	0.806	0.438	0.459	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	0.009	0.030	0.007	0.001	0.000	0.001	0.000	0.004	0.000		1
2	0.125	0.164	0.224	0.149	0.105	0.021	0.051	0.185	0.027	0.053	2
3	0.347	0.170	0.394	0.291	0.593	0.657	0.204	0.366	0.267	0.104	3
4	0.349	0.258	0.501	0.488	0.739	1.223	1.464	0.748	0.561	0.434	4
5	0.601	0.323	0.592	0.717	0.722	0.877	1.074	0.912	0.663	0.622	5
6	0.549	0.502	0.524	0.930	0.981	0.570	0.824	0.475	0.559	0.437	6
7	0.560	0.578	0.561	1.123	0.735	0.545	0.462	0.531	0.567	0.446	7
8	0.474	0.817	0.489	1.167	1.034	0.601	0.456	0.455	0.424	0.496	8
9	0.507	0.496	0.533	0.885	0.842	0.763	0.856	0.624	0.555	0.487	9
10	0.507	0.496	0.533	0.885	0.842	0.763	0.856	0.624	0.555	0.487	10

Table 28.8 : Stock Numbers at Age (1000's) of SAITHE in IV between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	230466	224980	238012	268624	637031	196870	138972	125404	102982	265530	1
2	378161	188478	183661	194525	215943	517992	160902	113568	100852	83218	2
3	260054	307599	144591	132171	131104	162232	359445	103543	81363	67712	3
4	205095	181928	190319	82320	65757	52697	87367	116630	64191	38884	4
5	34228	101335	101068	99963	37910	25825	22231	26780	48791	30235	5
6	29130	16212	55289	61973	59409	20165	13074	9354	10255	24915	6
7	14370	13532	9991	26660	37054	30639	10497	6107	3421	6046	7
8	8632	8483	7682	5165	14650	18038	13770	5619	2133	2039	8
9	862	5631	4718	3790	2714	8128	7049	6933	1875	1039	9
10	449	1917	4399	6270	3007	5774	4995	7441	6684	3966	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	163516	195255	321139	466183	427853	163496	230221	244746	254699		1
2	216578	132723	155068	261181	381434	350243	133666	188395	199677	208520	2
3	53032	156500	92273	101523	184282	281222	280775	103951	128240	159070	3
4	42394	30701	108074	50952	62117	83386	119329	187467	59043	80362	4
5	20161	24472	19414	53593	25605	24291	20087	22589	72664	27589	5
6	15761	9049	14509	8798	21416	10179	8277	5618	7433	30647	6
7	13232	7455	4484	7034	2841	6573	4714	2972	2859	3481	7
8	2770	6189	3425	2095	1873	1115	3122	2433	1431	1328	8
9	1151	1411	2239	1720	534	546	501	1620	1263	767	9
10	4090	5218	2102	1517	931	519	921	1171	1026	858	10

Table 28.9 : Mean Fishing Mortality , Biomass and Recruitment of SAITHE in IV between 1970 and 1989

	Mean Fishing Mortality Ages 3 to 6		Ages 1 to 4	Biomass 1000 tonnes		Recruits Age 1	
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1970	0.373	0.000	0.071	1149	263	69	230
1971	0.296	0.000	0.045	1134	368	70	225
1972	0.364	0.000	0.044	935	404	71	238
1973	0.332	0.000	0.096	819	437	72	269
1974	0.428	0.000	0.161	974	453	73	637
1975	0.404	0.000	0.111	923	392	74	197
1976	0.683	0.000	0.121	765	257	75	139
1977	0.614	0.000	0.013	535	214	76	125
1978	0.464	0.000	0.006	452	195	77	103
1979	0.394	0.000	0.007	495	194	78	266
1980	0.459	0.000	0.002	454	191	79	164
1981	0.310	0.000	0.004	553	204	80	195
1982	0.486	0.000	0.017	584	164	81	321
1983	0.601	0.000	0.004	695	171	82	466
1984	0.738	0.000	0.019	647	136	83	428
1985	0.794	0.000	0.031	582	104	84	163
1986	0.887	0.000	0.004	569	99	85	230
1987	0.605	0.000	0.017	482	107	86	245
1988	0.509	0.000	0.002	497	125	87	235
1989	0.385	0.000	0.008	560	122	88	230
Arit-mean recruits at age 1 for period 1970 to 1989							255
Geom-mean recruits at age 1 for period 1970 to 1989							232

Table 28.10 : Input for catch prediction of SAITHE in IV

	1989 Stock and Fishing Mortality				Values used in Prediction F at age , Mean Wt. and Propn. Retained by Consumption Fishery							
					Scaled mean F 1985 to 1989			Mean values for period 1985 to 1989 Mean Weight (Kg.)				Prop.
Age	Stock Number	Fishing Mortality H.Con.	Disc	Ind	H.Con.	Disc	Ind	H.Con.	Disc	Ind	Stock	Ret.
1	230000	0.002			0.002			0.363			0.363	1.000
2	192000	0.040		0.000	0.040		0.000	0.512		0.398	0.510	1.000
3	159070	0.100		0.004	0.186		0.008	0.700		0.524	0.693	1.000
4	80362	0.408		0.026	0.515		0.023	1.009		0.731	0.993	1.000
5	27589	0.601		0.020	0.495		0.008	1.615		1.156	1.606	1.000
6	30647	0.432		0.005	0.346		0.001	2.471		1.819	2.470	1.000
7	3481	0.446			0.309		0.000	3.603		3.590	3.604	1.000
8	1328	0.496			0.294		0.000	4.632		4.200	4.632	1.000
9	767	0.487			0.398			5.663			5.663	1.000
10	858	0.487			0.398			7.562			7.562	1.000

Mean F	Age 3 to 6	Age 1 4	Age 3 to 6	Age 1 4
Unscaled	0.385	0.008	0.636	0.013
Scaled			0.385	0.008

Recruits at age 1 in 1990 = 231844
Recruits at age 1 in 1991 = 231844
Recruits at age 1 in 1992 = 231844
Recruits at age 1 in 1993 = 231844

M at age and proprtion mature at age are as shown in Table 28.3

Mean F for ages 3 to 6 in 1989 for human consumption landings + discards = 0.385 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1985 to 1989
rescaled to produce a mean value of F for ages 3 to 6 equal to that for 1989

Mean F for ages 1 to 4 in 1989 for small-mesh fisheries = 0.008 .
Industrial fishery F-at-age in the prediction are averages for the period 1985 to 1989 .
rescaled to produce a mean value of F for ages 1 to 4 equal to that for 1989

Values of N in 1989 from VPA have been overwritten
for the following ages .....

Age 1
Age 2

Values of F for these ages in 1989 from VPA have been overwritten
with scaled mean values used for predictions for 1990 onwards

Table 28.11 : Predicted Catches and Biomasses (1000's of tonnes) of SAITHE in IV 1990 to 1991

	1989	1990	1991								
Biomass 1 Jan of Year											
Total	560	573	608	608	608	608	608	608	608	608	608
Spawning	122	166	206	206	206	206	206	206	206	206	206
Mean F Ages											
Human Cons. 3 to 6	0.39	0.39	0.00	0.08	0.15	0.23	0.31	0.39	0.46	0.00	0.00
Small-mesh 1 to 4	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(1989)										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
Small-mesh Fishery	1.00	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	0.00	0.00
Catch weight											
Human Consumption	90	113	0	28	55	79	102	123	142	0	0
Discards	0	0	0	0	0	0	0	0	0	0	0
Small-mesh Fisheries	2	2	3	3	2	2	2	2	2	0	0
Total landings	92	116	3	31	57	82	104	125	144	0	0
Total catch	92	116	3	31	57	82	104	125	144	0	0
Biomass 1 Jan of Year+1											
Total	573	608	792	754	720	688	659	632	607	0	0
Spawning	166	206	352	324	298	274	253	233	215	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
1	231844	382	0	0	382
2	187966	6762	0	66	6828
3	150900	23175	0	1019	24195
4	117336	42704	0	1921	44625
5	42625	15152	0	241	15393
6	12128	3233	0	9	3242
7	16210	3922	0	2	3925
8	1825	423	0	1	424
9	662	198	0	0	198
10	386	116	0	0	116
Wt	573083	113447	0	2271	115719

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	231844	382	0	0	382
2	189473	6816	0	67	6883
3	147730	22688	0	998	23686
4	101761	37036	0	1666	38702
5	56112	19946	0	317	20263
6	21109	5627	0	15	5643
7	7018	1698	0	1	1699
8	9744	2261	0	4	2265
9	1113	333	0	0	333
10	576	173	0	0	173
Wt	607574	122768	0	2182	124950

Table 28.12 : Predicted Catches and Biomasses (1000's of tonnes) of SAITHE in IV 1990 to 1991

	Year 1989	1990	1991								
Biomass 1 Jan of Year											
Total	482	473	472	472	472	472	472	472	472	472	472
Spawning	122	166	201	201	201	201	201	201	201	201	201
Mean F Ages											
Human Cons. 3 to 6	0.39	0.39	0.00	0.08	0.15	0.23	0.31	0.39	0.46	0.00	0.00
Small-mesh 1 to 4	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(1989)										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
Small-mesh Fishery	1.00	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	0.00	0.00
Catch weight											
Human Consumption	90	106	0	24	46	66	85	103	119	0	0
Discards	0	0	0	0	0	0	0	0	0	0	0
Small-mesh Fisheries	2	2	2	2	2	2	2	2	1	0	0
Total landings	92	109	2	26	48	68	87	104	120	0	0
Total catch	92	109	2	26	48	68	87	104	120	0	0
Biomass 1 Jan of Year+1											
Total	473	472	602	571	542	516	492	469	449	0	0
Spawning	166	201	313	288	266	245	226	209	193	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
1	150000	140	0	0	140
2	122683	4414	0	43	4457
3	96670	14842	0	653	15495
4	117693	42831	0	1926	44757
5	42637	15155	0	241	15396
6	12125	3232	0	9	3241
7	16206	3921	0	2	3923
8	1825	424	0	1	424
9	662	198	0	0	198
10	386	115	0	0	115
Wt	472830	106449	0	2074	108523

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	150000	140	0	0	140
2	122683	4414	0	43	4457
3	96420	14804	0	651	15455
4	65195	23725	0	1067	24792
5	56287	20007	0	318	20325
6	21116	5629	0	15	5644
7	7016	1698	0	1	1699
8	9742	2261	0	4	2265
9	1113	333	0	0	333
10	576	173	0	0	173
Wt	472203	102602	0	1554	104155

Table 29.1 Nominal catch (tonnes) of SAITHE in Sub-area VI, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	2	2	-	-	-
Denmark	-	-	4	-	-
Faroe Islands	4	3	5	-	-
France	15,427	16,654	17,102	13,470	19,706
Germany, Fed. Rep.	49	581	441	179	713
Ireland	295	250	322	698	599
Netherlands	91	-	-	32	-
Norway	62	25	19	55	66
Spain	-	120	243	330	882
UK (England and Wales)	1,594	1,364	1,966	2,760	1,800
UK (Isle of Man)	-	-	-	-	-
UK (N. Ireland)	9	10	7	12	49
UK (Scotland)	2,902	3,117	2,141	2,642	3,170
Total	20,435	22,126	22,250	26,178	26,985

Country	1985	1986	1987	1988	1989
Belgium	2	-	12	14	15
Denmark	-	-	7	+	2
Faroe Islands	-	-	-	8	-[1]
France	19,120	26,521	24,581	24,656	17,106[1,2]
Germany, Fed. Rep.	838	2,345	1,486	1,584	1,988
Ireland	670	660	704	544	n/a
Netherlands	-	-	-	n/a	-
Norway	51	72	38	50	72[1]
Spain	624	824	533	857	n/a
UK (England and Wales)	1,349	1,259	1,708	1,193	555
UK (Isle of Man)	-	-	-	-	+
UK (N. Ireland)	15	21	26	13	21
UK (Scotland)	3,118	3,697	3,442	3,925	2,851
Total	25,787	35,399	32,537	32,844	22,610

[1] Preliminary.
[2] Includes Division Vb.
n/a = Not available.

Table 29.2 : Annual Weight and Numbers of SAITHE caught in VI between 1965 and 1989

Year	Weight (1000 tonnes) Total	H.Con	Disc	By-cat	Number (millions) Total	H.Con	Disc	By-cat
1965	18	18	0	0	9	9	0	0
1966	19	19	0	0	10	10	0	0
1967	16	16	0	0	8	8	0	0
1968	13	13	0	0	7	7	0	0
1969	17	17	0	0	10	10	0	0
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	31	31	0	0	15	15	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	40	40	0	0	23	23	0	0
1987	31	31	0	0	16	16	0	0
1988	34	34	0	0	19	19	0	0
1989	26	26	0	0	18	18	0	0

Table 29.3 : 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

Table 29.4 : Total International Catch at Age (1000's) of SAITHE in VI between 1965 and 1989

Age	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	Age
1				2				51	292	806	1
2	231	68	385	49	335	33	382	3644	6557	3056	2
3	3327	2838	2053	2435	1983	2857	1385	7913	6944	5737	3
4	3060	4909	2885	2287	4618	2335	4444	3805	4743	2353	4
5	1757	1220	1934	1197	1498	1805	1891	2209	1882	2000	5
6	512	693	268	621	507	599	1085	428	833	608	6
7	271	135	454	148	568	240	465	309	430	932	7
8	92	39	91	126	106	196	362	154	311	891	8
9	69	27	44	29	79	41	300	91	192	489	9
10	137	48	75	58	71	122	238	162	454	861	10

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Age
1	23	35	157	38	9	45	148	38	42	147	1
2	2465	2776	1234	4048	969	1005	2449	1307	4026	2932	2
3	6315	8154	4571	4087	1828	3335	3911	4490	4879	5484	3
4	2458	2721	2697	2334	1194	942	1977	1641	2624	2403	4
5	1314	1794	1673	1291	1151	677	588	1240	852	876	5
6	860	1116	737	696	708	632	410	568	775	681	6
7	1007	659	559	289	368	469	341	384	513	300	7
8	707	517	385	243	156	194	223	244	161	139	8
9	197	583	290	161	191	91	153	136	107	56	9
10	340	1362	921	1319	756	816	673	460	508	159	10

Age	1985	1986	1987	1988	1989	Age
1	5	233	1	22	22	1
2	2224	750	1874	3604	745	2
3	4982	6918	2314	5713	7249	3
4	2992	8380	7156	3521	5681	4
5	1454	3764	1953	2630	2250	5
6	1222	1395	1369	1051	1398	6
7	608	1054	780	892	375	7
8	186	469	454	698	257	8
9	104	185	261	330	156	9
10	223	345	217	329	183	10

Table 29.5 : Total International Mean Weight at Age (Kg.) of SAITHE in VI between 1965 and 1989

Age	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	Age
1				0.472				0.507	0.311	0.309	1
2	0.728	0.647	1.094	0.620	0.770	0.592	0.640	0.764	0.621	0.590	2
3	1.141	1.085	1.217	1.171	1.027	1.066	0.935	1.139	1.102	0.987	3
4	1.653	1.732	1.616	1.653	1.412	1.401	1.240	1.815	1.400	1.622	4
5	2.430	2.727	2.290	2.155	2.251	1.954	1.762	2.631	2.516	1.743	5
6	3.788	3.213	3.609	2.942	2.913	2.911	2.697	2.598	3.080	3.534	6
7	4.408	4.597	3.845	3.986	3.466	3.622	3.454	2.979	3.694	4.542	7
8	5.343	5.781	5.378	4.399	4.868	4.816	4.626	5.018	4.833	5.038	8
9	6.681	6.517	6.084	5.196	5.657	6.178	5.196	6.118	6.705	6.066	9
10	7.383	8.029	7.394	7.269	7.481	7.065	7.227	8.166	8.138	8.279	10

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Age
1	0.460	0.444	0.383	0.412	0.513	0.417	0.400	0.432	0.378	0.472	1
2	0.737	0.681	0.577	0.502	0.700	0.650	0.676	0.717	0.665	0.723	2
3	0.939	1.005	0.794	1.128	1.323	1.165	1.096	1.078	1.246	1.109	3
4	1.504	1.442	1.353	1.676	1.980	1.932	1.699	1.779	1.833	1.786	4
5	2.575	2.732	2.207	2.603	2.405	2.651	2.963	2.736	3.074	2.663	5
6	3.497	3.230	3.199	3.829	3.366	3.560	4.047	3.946	3.642	3.503	6
7	4.779	4.174	4.253	4.687	4.609	4.560	5.115	5.348	5.036	4.714	7
8	5.589	4.930	5.030	5.279	5.815	5.531	6.240	6.202	6.285	5.791	8
9	6.522	5.785	5.829	5.979	6.967	6.524	7.222	7.765	6.975	7.609	9
10	8.549	7.739	7.711	8.470	9.339	9.651	9.761	10.680	10.880	10.781	10

Age	1985	1986	1987	1988	1989	Age
1	0.405	0.672	0.453	0.557	0.500	1
2	0.707	0.746	0.607	0.675	0.718	2
3	1.056	0.872	0.960	1.003	0.886	3
4	1.677	1.335	1.183	1.306	1.099	4
5	2.613	2.172	2.043	1.683	1.511	5
6	3.237	2.896	3.248	3.210	2.445	6
7	4.316	3.614	4.725	4.428	4.175	7
8	6.002	4.145	6.130	5.619	5.381	8
9	7.377	5.505	7.731	7.226	6.625	9
10	11.097	8.592	12.082	10.193	8.394	10

Table 29.6 SAITHE in Sub-area VI. Tuning results.

with cpue data from file SAI6EF.DAT
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 SCOSEI has terminal q estimated as the mean
Fleet 2 SCOTRL has terminal q estimated as the mean
Fleet 3 SCOLTR has terminal q estimated as the mean
Fleet 4 SCONTR has terminal q estimated as the mean
Fleet 5 FRAALL has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **
Terminal Fs estimated using Laurec/Shepherd method

	Age 2		Age 3		Age 4		Age 5		Age 6	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI	.0763	.1321	.2832	.1519	.4292	.0713	1.1802	.0865		.0000
SCOTRL	.2071	.2183	.1781	.1727	.2647	.0993	.1797	.0531	.1878	.0671
SCOLTR	.1517	.1746	.5084	.1493	.9979	.1471	1.1822	.1218	.6990	.0749
SCONTR	.4381	.1921	.5513	.0391	1.8486	.0347		.0000		.0000
FRAALL	.0684	.2829	.4161	.4869	.5568	.6476	.5223	.7387	.6514	.8580
		1.0000		1.0000		1.0000		1.0000		1.0000
	Fbar		Fbar		Fbar		Fbar		Fbar	
	.145		.353		.577		.585		.602	

	Age 7		Age 8	
Fleet	Raised F	WEIGHT	Raised F	WEIGHT
SCOSEI		.0000		
SCOTRL		.0000		
SCOLTR	.5541	.1925		
SCONTR		.0000		
FRAALL	.9093	.8075	.8207	1.0000
		1.0000		1.0000
	Fbar		Fbar	
	.8260		.8210	

Table 29.7 : Total International Fishing Mortality Rate at Age of SAITHE in VI between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1			0.002	0.010	0.027	0.001	0.002	0.010	0.002	0.000	1
2	0.002	0.014	0.154	0.307	0.141	0.108	0.164	0.102	0.357	0.067	2
3	0.136	0.089	0.431	0.488	0.483	0.476	0.614	0.440	0.565	0.271	3
4	0.270	0.322	0.372	0.500	0.302	0.394	0.388	0.421	0.422	0.318	4
5	0.268	0.365	0.262	0.318	0.408	0.276	0.561	0.440	0.366	0.380	5
6	0.229	0.255	0.130	0.149	0.160	0.308	0.399	0.475	0.330	0.351	6
7	0.186	0.280	0.107	0.187	0.247	0.430	0.411	0.357	0.345	0.291	7
8	0.144	0.467	0.141	0.150	0.725	0.301	0.411	0.450	0.258	0.317	8
9	0.220	0.340	0.202	0.261	0.369	0.342	0.434	0.429	0.344	0.331	9
10	0.220	0.340	0.202	0.261	0.369	0.342	0.434	0.429	0.344	0.331	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	0.002	0.005	0.001	0.001	0.004	0.000	0.007	0.000	0.003	0.003	1
2	0.061	0.113	0.061	0.150	0.107	0.070	0.043	0.069	0.115	0.145	2
3	0.342	0.355	0.310	0.334	0.313	0.265	0.322	0.179	0.309	0.353	3
4	0.218	0.351	0.247	0.300	0.273	0.281	0.961	0.649	0.450	0.577	4
5	0.300	0.206	0.388	0.196	0.155	0.264	0.684	0.620	0.529	0.585	5
6	0.372	0.299	0.313	0.448	0.237	0.334	0.436	0.574	0.829	0.602	6
7	0.415	0.353	0.506	0.518	0.312	0.344	0.538	0.467	0.951	0.827	7
8	0.245	0.355	0.461	0.413	0.256	0.325	0.487	0.471	1.032	0.821	8
9	0.310	0.313	0.383	0.375	0.247	0.310	0.621	0.556	0.758	0.682	9
10	0.310	0.313	0.383	0.375	0.247	0.310	0.621	0.556	0.758	0.682	10

Table 29.8 : Stock Numbers at Age (1000's) of SAITHE in VI between 1970 and 1989

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Age
1	37464	34272	33285	31645	33156	24758	17138	18219	20169	22781	1
2	21951	30673	28059	27205	25645	26418	20249	14000	14775	16479	2
3	24800	17942	24768	19690	16381	18242	19407	14078	10350	8462	3
4	10854	17730	13441	13181	9898	8270	9276	8598	7426	4816	4
5	8443	6787	10523	7588	6543	5989	4566	5152	4620	3987	5
6	3212	5289	3859	6629	4521	3562	3722	2132	2718	2623	6
7	1562	2091	3354	2774	4677	3154	2144	2045	1085	1600	7
8	1609	1062	1293	2468	1883	2991	1679	1164	1172	629	8
9	227	1141	545	920	1740	747	1813	911	608	741	9
10	681	905	973	2175	3062	1290	4239	2896	4969	2942	10

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Age
1	30927	30033	38866	39005	44288	24191	37948	44724	7430	8735	1
2	18643	25280	24456	31787	31896	36127	19802	30858	36616	6063	2
3	12618	14357	18490	18843	22397	23471	27572	15535	23574	26729	3
4	5284	7335	8243	11103	11044	13409	14736	16358	10635	14167	4
5	2870	3478	4230	5272	6732	6881	8288	4613	6998	5551	5
6	2231	1741	2318	2350	3549	4722	4326	3424	2031	3374	6
7	1512	1259	1057	1388	1229	2293	2768	2291	1578	726	7
8	979	818	725	522	677	737	1331	1323	1176	499	8
9	375	628	469	374	283	429	436	669	676	343	9
10	3361	2752	1585	1782	799	920	815	555	674	405	10

Table 29.9 : Mean Fishing Mortality , Biomass and Recruitment of SAITHE in VI between 1970 and 1989

	Mean Fishing Mortality			Biomass 1000 tonnes		Recruits Age 1	
	Ages 3 to 6		Ages 1 to 1				
Year	H.Con	Disc	By-cat	Total	Sp St	Y.C.	Million
1970	0.226	0.000	0.000	100	45	69	37
1971	0.258	0.000	0.000	109	51	70	34
1972	0.299	0.000	0.000	156	65	71	33
1973	0.364	0.000	0.000	152	86	72	32
1974	0.339	0.000	0.000	152	94	73	33
1975	0.363	0.000	0.000	136	76	74	25
1976	0.491	0.000	0.000	139	85	75	17
1977	0.444	0.000	0.000	98	60	76	18
1978	0.421	0.000	0.000	119	79	77	20
1979	0.330	0.000	0.000	106	62	78	23
1980	0.308	0.000	0.000	113	63	79	31
1981	0.302	0.000	0.000	118	60	80	30
1982	0.314	0.000	0.000	120	51	81	39
1983	0.320	0.000	0.000	137	57	82	39
1984	0.244	0.000	0.000	139	51	83	44
1985	0.286	0.000	0.000	144	61	84	24
1986	0.601	0.000	0.000	139	55	85	38
1987	0.506	0.000	0.000	125	51	86	45
1988	0.529	0.000	0.000	122	44	87	29
1989	0.529	0.000	0.000	99	28	88	29
Arit-mean recruits at age 1 for period 1970 to 1989							31
Geom-mean recruits at age 1 for period 1970 to 1989							30

Table 29.10 : Input for catch prediction of SAITHE in VI

Age	1989 Stock and Fishing Mortality: Stock Number	Fishing Mortality: H.Con.	Disc	Ind	Values used in Prediction (F at age, Mean Wt. and Propn. Retained by Consumption Fishery) — Scaled mean F 1985 to 1989: H.Con.	Disc	Ind	Mean values for period 1985 to 1989 — Mean Weight (Kg.): H.Con.	Disc	Ind	Stock	Prop. Ret.
1	29000	0.002			0.002			0.518			0.518	1.000
2	24000	0.095			0.095			0.691			0.691	1.000
3	26729	0.353			0.308			0.955			0.955	1.000
4	14167	0.577			0.630			1.320			1.320	1.000
5	5551	0.585			0.579			2.004			2.004	1.000
6	3374	0.602			0.599			3.007			3.007	1.000
7	726	0.826			0.675			4.252			4.252	1.000
8	499	0.821			0.677			5.456			5.456	1.000
9	343	0.682			0.632			6.893			6.893	1.000
10	405	0.682			0.632			10.071			10.071	1.000

Mean F	Age 3 to 6	Age 1 1	Age 3 to 6	Age 1 1
Unscaled	0.529	0.000	0.490	0.000
Scaled			0.529	0.000

Recruits at age 1 in 1990 = 29993
Recruits at age 1 in 1991 = 29993
Recruits at age 1 in 1992 = 29993
Recruits at age 1 in 1993 = 29993

M at age and proprtion mature at age are as shown in Table 29.3

Mean F for ages 3 to 6 in 1989 for human consumption landings + discards = 0.529 .
Human consumption + discard F-at-age values in prediction are mean values for the period 1985 to 1989
rescaled to produce a mean value of F for ages 3 to 6 equal to that for 1989

Mean F for ages 1 to 1 in 1989 for small-mesh fisheries = 0.000 .
Industrial fishery F-at-age in the prediction are averages for the period 1985 to 1989 .
rescaled to produce a mean value of F for ages 1 to 1 equal to that for 1989

Values of N in 1989 from VPA have been overwritten
for the following ages .....

Age 1
Age 2

Values of F for these ages in 1989 from VPA have been overwritten
with scaled mean values used for predictions for 1990 onwards

Table 29.11 : Predicted Catches and Biomasses (1000's of tonnes) of SAITHE in VI 1990 to 1991

	Year 1989	1990	1991								
Biomass 1 Jan of Year											
Total	99	100	96	96	96	96	96	96	96	96	96
Spawning	28	31	33	33	33	33	33	33	33	33	33
Mean F Ages											
Human Cons. 3 to 6	0.53	0.53	0.00	0.11	0.21	0.32	0.42	0.53	0.64	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(1989)										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	26	27	0	6	12	17	21	25	29	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	26	27	0	6	12	17	21	25	29	0	0
Total catch	26	27	0	6	12	17	21	25	29	0	0
Biomass 1 Jan of Year+1											
Total	100	96	125	117	110	104	98	93	89	0	0
Spawning	31	33	54	48	42	37	33	29	26	0	0

Stock at start of and catch during 1990

Age	Stock No	H.Cons	Discards	By-catch	Total
1	29993	63	0	0	63
2	23689	1958	0	0	1958
3	17861	4319	0	0	4319
4	15373	6582	0	0	6582
5	6515	2622	0	0	2622
6	2531	1045	0	0	1045
7	1512	680	0	0	680
8	260	117	0	0	117
9	180	77	0	0	77
10	142	61	0	0	61
Wt	100433	27274	0	0	27274

Stock at start of and catch during 1991
for F(1991) = F(1990)

Age	Stock No	H.Cons	Discards	By-catch	Total
1	29993	63	0	0	63
2	24499	2025	0	0	2025
3	17629	4263	0	0	4263
4	10741	4599	0	0	4599
5	6703	2697	0	0	2697
6	2989	1233	0	0	1233
7	1138	512	0	0	512
8	630	284	0	0	284
9	108	46	0	0	46
10	140	60	0	0	60
Wt	96324	25342	0	0	25342

Table 30.1 Nominal catch (tonnes) of SAITHE in Sub-area VII, 1980-1989, as officially reported to ICES.

Country	1980	1981	1982	1983	1984
Belgium	19	12	13	6	10
Denmark	6	-	-	-	-
France	2,317	4,563	4,061	4,760	3,697
Germany, Fed. Rep.	46	-	-	11	5
Ireland	2,220	2,197	2,367	2,383	2,374
Netherlands	84	100	22	7	5
Norway	-	-	-	3	-
Spain	-	266	179	70	118
UK (England and Wales)	109	236	526	235	974
UK (Isle of Man)	19	36	34	16	27
UK (N. Ireland)	301	577	872	668	411
UK (Scotland)	56	94	119	138	140
Total	5,177	8,081	8,193	8,297	7,756

Country	1985	1986	1987	1988	1989
Belgium	31	25	20	23	15
Denmark	-	-	-	+	-
France	6,101	8,256	6,210	6,185	8,278[1,2]
Germany, Fed. Rep.	-	-	-	124	29[1]
Ireland	2,177	1,739	1,624	1,400	n/a
Netherlands	-	-	-	n/a	-
Norway	3	40	2	1	16[1]
Spain	118	-	-	-	n/a
UK (England and Wales)	722	648	375	762	699
UK (Isle of Man)	9	6	3	4	2
UK (N. Ireland)	665	635	571	491	524
UK (Scotland)	477	488	1,064	142	66
Total	10,303	11,837	9,869	9,132	9,629

[1] Preliminary.
[2] Includes Division Vb.
n/a = Not available.

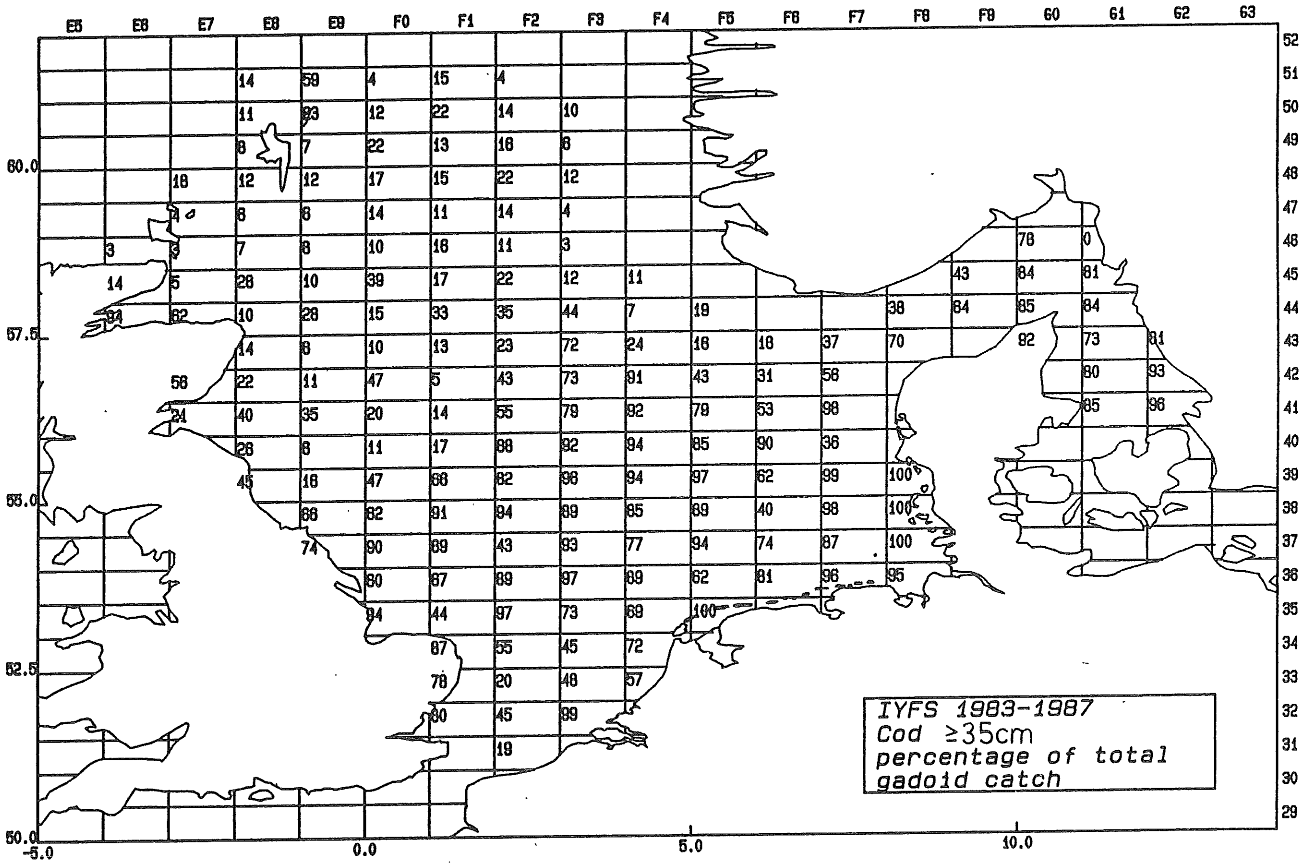


Figure 7.1 Distribution of large cod in IYFS catches. Numbers represent the weight percentage of the species of the total catch of large gadoids. Rectangles with catch >50% are marked.

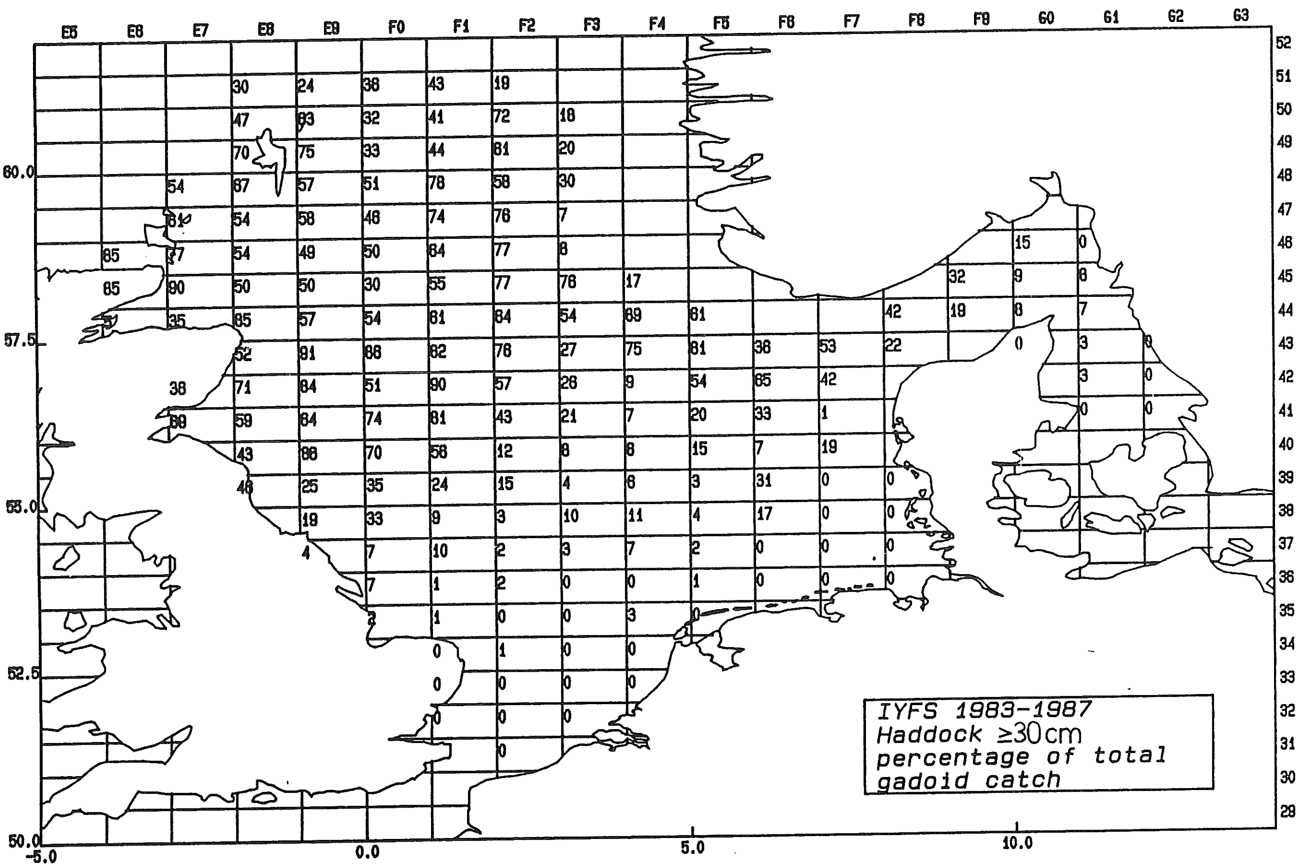


Figure 7.2 Distribution of large haddock in IYFS catches. Numbers represent the weight percentage of the species of the total catch of large gadoids. Rectangles with catch >50% are marked.

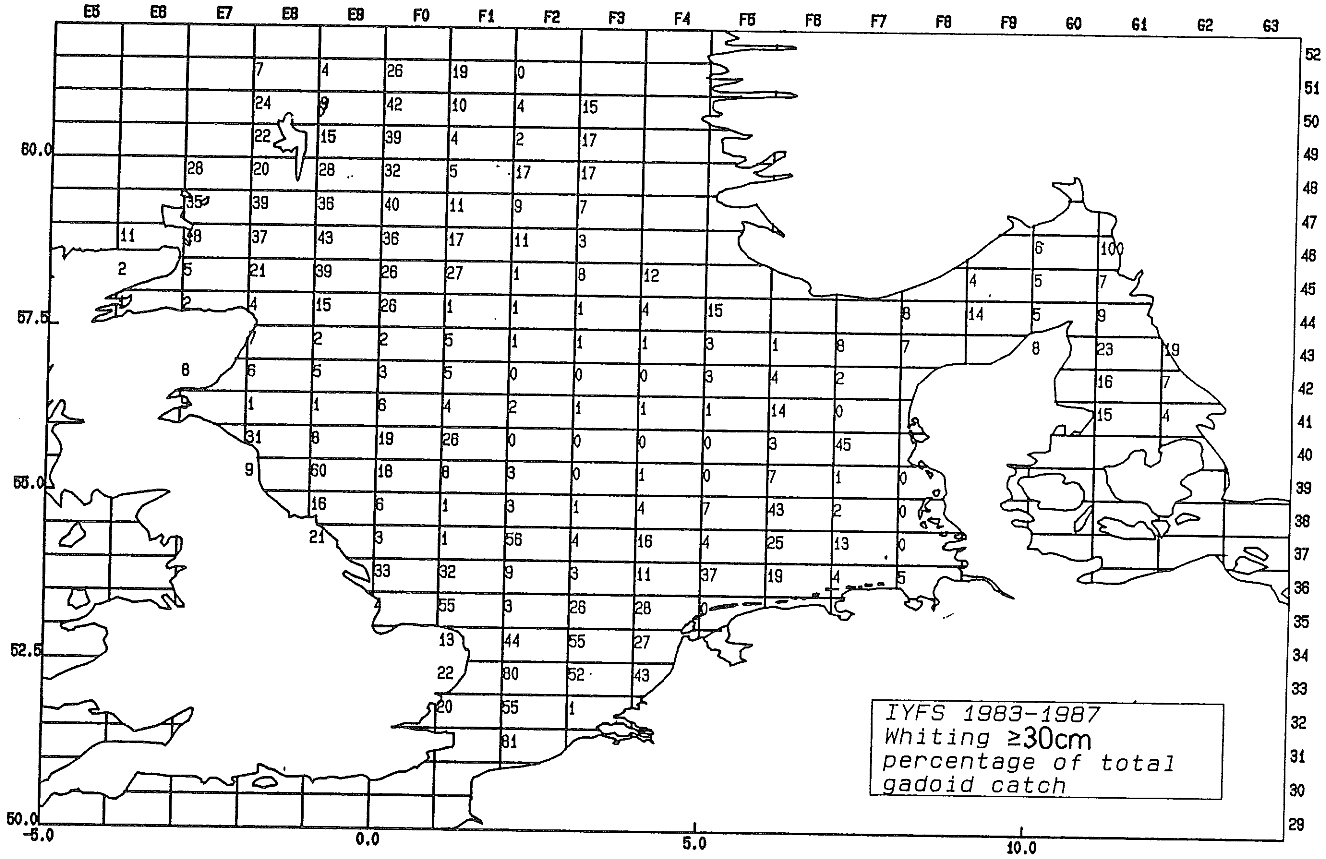


Figure 7.3 Distribution of large whiting in IYFS catches. Numbers represent the weight percentage of the species of the total catch of large gadoids. Rectangles with catch >50% are marked.

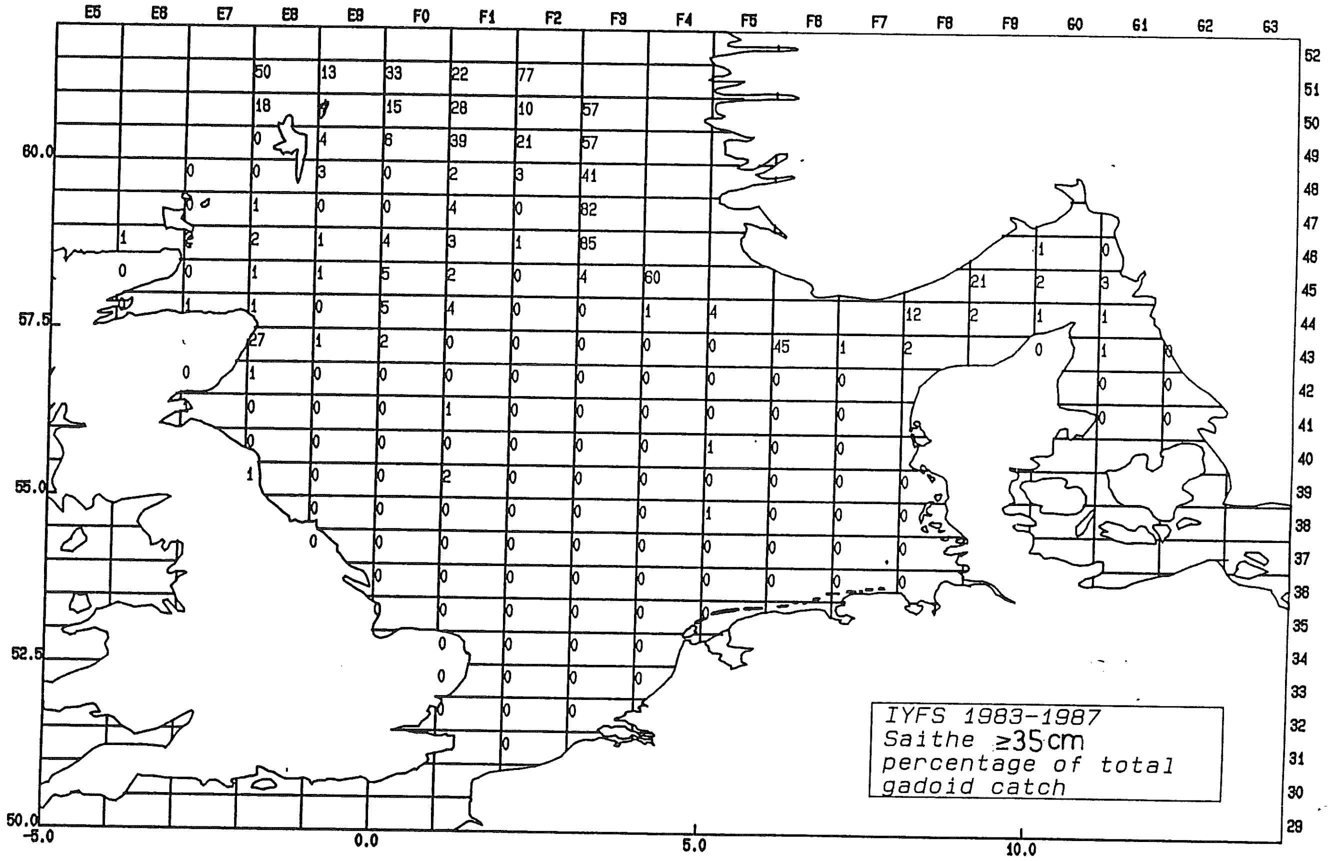


Figure 7.4 Distribution of large saithe in IYFS catches. Numbers represent the weight percentage of the species of the total catch of large gadoids. Rectangles with catch >50% are marked.

GGFSCOD.XLS

	E5	E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9
52															
51															
50															
49						42	33	15							
48						34	17	34							
47						23	16	14							
46						7	14	12							
45				3	1	48	26	10							
44					3	26	18	18							
43						8	42	26	13	15	27	33			
42						11	61	52	16	2	19	17			
41						5	38	19	13	47	6				
40					6	77	5								
39					3	22									
38						1	2		2	4	8	7	7		
37							4	1	4	18	7	3	15		
36															
35															

GGFS, 1987 - 1990. Cod catch as percentage of total gadoid catch

Figure 7.5 Distribution of cod in the German ground fish survey. Numbers represent weight percentage of species of total gadoid catch. Rectangles with catch >50% are marked.

GGFSHAD.XLS

	E5	E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9
52															
51															
50															
49						11	48	78							
48						45	57	51							
47						38	60	54							
46						2	61	65							
45				69	62	9	42	59							
44					67	51	55	32							
43						52	43	50	16	70	60	51			
42						70	30	37	47	33	15	15			
41						71	52	66	40	13	1				
40					45	15	54								
39					11	57									
38						1	0		0	1	7	0	1		
37							3	0	0	0	1	0	0		
36															
35															

GGFS, 1987 - 1990. Haddock catch as percentage of total gadoid catch

Figure 7.6 Distribution of haddock in the German ground fish survey. Numbers represent weight percentage of species of total gadoid catch. Rectangles with catch >50% are marked.

GGFSWHI.XLS

	E5	E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9
52															
51															
50															
49						23	14	4							
48						16	22	14							
47						20	17	22							
46						3	24	18							
45				28	38	17	30	30							
44					29	20	3	50							
43						40	15	24	71	16	11	13			
42						19	6	9	38	65	65	68			
41						24	10	15	47	40	92				
40					50	8	41								
39					86	21									
38						98	99		98	95	85	93	92		
37							93	99	96	82	92	97	85		
36															
35															

GGFS, 1987 - 1990. Whiting catch as percentage of total gadoid catch

Figure 7.7 Distribution of whiting in the German ground fish survey. Numbers represent weight percentage of species of total gadoid catch. Rectangles with catch >50% are marked.

GGFSSAI.XLS

	E5	E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9
52															
51															
50															
49						24	5	3							
48						5	4	2							
47						20	6	10							
46						89	1	5							
45				0	0	26	2	2							
44					1	4	24	0							
43						0	0	0	0	0	3	4			
42						1	3	2	0	0	1	0			
41						0	1	0	0	0	0				
40					0	1	0								
39					0	0									
38						0	0		0	0	0	0	0		
37							0	0	0	0	0	0	0		
36															
35															

GGFS, 1987 - 1990. Saithe catch as percentage of total gadoid catch

Figure 7.8 Distribution of saithe in the German ground fish survey. Numbers represent weight percentage of species of total gadoid catch. Rectangles with catch >50% are marked.

WHIBYFIG.XLS

	E5	E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9
52															
51				1	0	6	67	0							
50				0	112	135	491	1	24						
49				31	25	1087	1421	71	89						
48			0	0	1	50	556	84	41						
47			0	19	158	592	1456	250	141						
46			0	2	136	918	766	519	20						
45		0	0	4	69	1296	594	137	51	58					
44		0	0	0	28	205	70	30	23	9	152				
43				0	0	95	2	89	0	0	28	85	163		
42			0	0	0	9	3	29	0	1	15	74	274		
41			0	0	0	0	2	42	15	68	523	218	415		
40				0	0	3	3	12	39	430	530	72	718		
39				0	0	24	93	44	61	702	750	546	92	27	
38					0	9	287	58	46	223	990	1091	171	8	
37						15	466	102	240	296	83	281	201	9	
36						4	222	66	26	0	0	0	1	1	
35						0	0	17	1	0	0				
34							0	3	2	0					
33							0	1	0	0					
32							0	0	0						
31								0							
30															

Bycatch of whiting by the Danish industrial fishery in tonnes (mean 1982-198

Figure 7.9 Distribution of whiting by-catch in the Danish industrial fishery, average for the years 1982-1984 (tonnes). The Danish industrial fishery in the northern area in these years averages 400,000 t Norway pout and 100,000 t blue whiting. In recent years, these catches have been reduced to 150,000 and 30-40,000 t respectively. The map does not represent the present situation. (Data provided by Working Group members.)

Figure 7.10 Danish gill net fishery for cod, 1st quarter.

CATCH OF SPECIES (T) AND PCT OF TOT CATCH
* INDICATES CRITERIA FULFILLED

COD DKNEDE QUARTER 1

	E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8
48	9.0 68.79	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
47	31.6 64.61	— —	— —	— —	— —	— —	— —	— —	— —	3.7 83.98	— —	— —	— —
46	— —	— —	— —	— —	— —	.4 45.00	— —	— —	— —	— —	— —	— —	— —
45	— —	— —	— —	— —	— —	— —	.1 42.33	— —	2.7 53.98	— —	— —	— —	— —
44	— —	— —	— —	— —	— —	— —	— —	— —	— —	1.4 61.37	— —	— —	— —
43	— —	— —	— —	— —	1.2 99.37	— —	5.3 97.57	— —	29.9 88.44	15.5 76.78	16.0 71.51	* 56.4 87.43	* 109.9 82.44
42	— —	— —	— —	— —	3.7 90.95	— —	1.4 97.39	24.1 87.94	* 81.2 83.31	* 85.1 78.11	135.2 68.46	* 204.8 83.58	19.0 91.50
41	— —	— —	— —	— —	— —	.0 100.00	12.2 86.13	* 145.5 94.59	* 184.6 83.45	* 178.6 85.88	42.0 24.57	86.3 52.14	1.7 72.22
40	— —	— —	— —	— —	— —	— —	* 73.8 95.81	* 162.3 93.96	* 209.5 95.05	* 186.8 93.53	45.0 33.60	* 79.3 96.68	2.5 98.77
39	— —	— —	— —	— —	1.2 100.74	1.2 94.13	* 77.4 94.65	* 123.4 92.97	* 180.5 88.20	* 78.1 91.37	* 162.4 92.25	* 67.1 87.79	— —
38	— —	— —	— —	— —	— —	— —	6.0 98.41	* 113.3 88.57	* 95.0 96.89	* 47.9 94.96	* 149.6 91.92	* 56.5 95.72	— —
37	— —	— —	— —	— —	— —	.0 .00	23.8 97.36	* 184.9 93.55	* 97.3 98.86	* 93.9 98.29	* 79.3 98.40	15.4 90.12	— —
36	— —	— —	— —	— —	— —	— —	19.1 97.85	* 41.2 97.22	28.5 98.47	* 34.8 94.84	6.8 100.04	— —	— —
35	— —	— —	— —	— —	— —	— —	24.0 97.53	* 58.3 95.77	* 38.9 99.19	— —	— —	— —	— —
34	— —	— —	— —	— —	— —	— —	— —	* 223.1 98.97	14.0 99.57	— —	— —	— —	— —
33	— —	— —	— —	— —	— —	— —	* 85.7 98.82	* 354.7 99.90	* 122.4 99.85	— —	— —	— —	— —
32	— —	— —	— —	— —	— —	— —	* 207.0 99.84	* 300.5 99.33	— —	— —	— —	— —	— —

Figure 7.11 Danish small trawlers, cod 2nd quarter.

CATCH OF SPECIES (T) AND PCT OF TOT CATCH
* INDICATES CRITERIA FULLFILLED

COD DKTR00 QUARTER 2

	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8
50	—	—	—	—	—	.3	—	—	—	—	—	—
	—	—	—	—	—	16.06	—	—	—	—	—	—
49	8.7	—	—	—	—	7.1	—	—	—	—	—	—
	65.62	—	—	—	—	13.58	—	—	—	—	—	—
48	62.3	—	—	—	—	.3	.4	—	—	—	—	—
	61.74	—	—	—	—	10.96	17.67	—	—	—	—	—
47	—	—	—	—	—	—	.7	.0	—	—	—	—
	—	—	—	—	—	—	13.09	20.00	—	—	—	—
46	—	—	—	1.0	.0	—	8.5	.8	.1	—	—	—
	—	—	—	35.48	.00	—	17.37	15.28	23.75	—	—	—
45	—	.8	—	10.1	7.2	.7	15.1	12.2	5.3	—	—	—
	—	13.04	—	34.90	24.07	31.94	18.42	14.80	14.89	—	—	—
44	—	—	—	.8	.1	—	.8	7.0	21.4	4.4	19.1	—
	—	—	—	24.61	30.85	—	62.46	12.73	12.27	13.16	21.03	—
43	—	—	—	1.1	—	—	9.8	15.9	22.6	8.3	109.3	126.3
	—	—	—	40.62	—	—	67.89	28.44	25.98	13.04	60.91	50.76
42	—	.0	.8	.1	—	—	7.2	6.4	54.1	21.7	395.1	22.1
	—	.00	2.87	10.47	—	—	100.04	14.91	39.48	36.55	64.60	58.89
41	—	—	.0	—	.5	.0	1.2	3.6	3.7	106.8	260.8	6.5
	—	—	.00	—	8.35	2.15	9.62	4.59	4.39	27.45	38.05	35.33
40	—	—	—	.8	1.6	.1	.5	.0	2.7	39.7	87.2	.0
	—	—	—	6.13	42.31	3.36	3.99	.74	8.76	27.84	40.56	.00
39	—	—	—	.0	4.4	—	.5	.3	1.4	113.1	* 148.3	.0
	—	—	—	.00	12.23	—	23.30	2.31	2.49	74.88	88.40	.00
38	—	—	—	—	.2	.9	.7	.0	.0	* 57.7	* 106.4	—
	—	—	—	—	3.44	96.79	21.52	.39	.78	89.12	89.61	—
37	—	—	—	.6	2.7	4.7	.1	.0	—	.0	3.6	—
	—	—	—	9.62	24.53	73.22	8.22	1.60	—	.00	55.53	—
36	—	—	—	—	—	11.7	.2	—	7.7	.0	—	—
	—	—	—	—	—	98.11	12.72	—	65.89	.00	—	—
35	—	—	—	—	—	—	—	3.6	—	—	—	—
	—	—	—	—	—	—	—	43.11	—	—	—	—
34	—	—	—	—	—	—	13.5	—	—	—	—	—
	—	—	—	—	—	—	37.35	—	—	—	—	—
33	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—
32	—	—	—	—	—	.5	—	—	—	—	—	—
	—	—	—	—	—	74.23	—	—	—	—	—	—

Figure 7.12 English long line and gill net fishery fishing for cod, 1st quarter.

CATCH OF SPECIES (T) AND PCT OF TOT CATCH
* INDICATES CRITERIA FULFILLED

COD ENGLGN QUARTER 1

	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8
43	6.2	—	—	—	—	—	—	—	—	—	—
	97.33	—	—	—	—	—	—	—	—	—	—
42	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
41	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
40	—	—	—	—	—	15.6	—	—	—	—	—
	—	—	—	—	—	97.02	—	—	—	—	—
39	23.6	.1	—	9.0	—	* 31.3	—	—	—	—	—
	94.14	100.00	—	99.78	—	90.19	—	—	—	—	—
38	* 89.7	* 198.8	26.5	29.8	9.1	—	* 47.4	—	—	—	—
	92.52	97.32	98.63	89.74	97.04	—	90.43	—	—	—	—
37	—	* 595.5	* 148.4	* 170.7	24.0	1.1	—	—	—	—	—
	—	98.43	97.85	96.96	95.74	96.90	—	—	—	—	—
36	—	.4	* 177.4	* 62.0	* 53.5	10.1	.0	—	—	—	—
	—	100.00	96.90	93.74	99.06	97.86	.00	—	—	—	—
35	—	—	19.9	5.7	12.9	.0	.5	—	—	—	—
	—	—	98.76	94.03	99.03	.00	100.00	—	—	—	—
34	—	—	—	24.0	27.1	—	—	—	—	—	—
	—	—	—	34.57	50.62	—	—	—	—	—	—
33	—	—	—	* 224.4	186.0	.1	—	—	—	—	—
	—	—	—	85.18	53.27	3.32	—	—	—	—	—
32	—	—	.0	338.0	* 99.4	—	—	—	—	—	—
	—	—	.00	65.48	81.97	—	—	—	—	—	—
31	—	—	.0	87.6	—	—	—	—	—	—	—
	—	—	.00	73.05	—	—	—	—	—	—	—

Figure 7.13 English single seiner fishery, haddock 4th quarter.

CATCH OF SPECIES (T) AND PCT OF TOT CATCH
* INDICATES CRITERIA FULFILLED

HAD ENGSSE QUARTER 4

	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8
50	— —	— —	— —	— —	15.5 88.58	— —	— —	— —	— —	— —	— —
49	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —
48	— —	— —	.0 .00	— —	— —	— —	— —	— —	— —	— —	— —
47	— —	— —	.0 .00	.0 .00	— —	— —	— —	— —	— —	— —	— —
46	— —	— —	11.1 85.68	* 33.1 81.38	— —	— —	— —	— —	— —	— —	— —
45	— —	— —	.0 .00	25.2 82.83	39.1 70.54	— —	— —	— —	— —	— —	— —
44	— —	— —	13.1 75.86	23.2 64.24	— —	— —	— —	— —	— —	— —	— —
43	— —	— —	11.8 72.02	52.2 69.51	41.6 66.67	— —	— —	— —	— —	— —	— —
42	— —	1.0 95.00	* 274.0 78.26	* 75.1 78.11	* 49.4 75.30	.0 .00	— —	— —	— —	— —	— —
41	.2 5.11	6.6 71.80	* 32.9 78.98	* 116.7 79.65	122.4 58.80	— —	— —	— —	3.9 73.27	— —	— —
40	3.3 73.25	14.3 41.40	100.8 71.15	66.0 68.05	70.0 72.03	1.1 73.30	— —	— —	.0 .00	— —	— —
39	.4 15.81	3.1 33.64	20.9 63.56	72.7 52.18	37.8 55.99	19.6 43.68	— —	— —	— —	— —	— —
38	1.0 9.66	1.3 6.00	3.1 32.05	6.5 72.10	10.0 41.34	6.1 87.32	— —	— —	— —	— —	— —
37	— —	— —	2.6 76.15	.0 .00	10.3 28.30	7.0 13.95	— —	— —	— —	7.0 33.29	— —
36	— —	— —	— —	— —	— —	— —	— —	— —	.6 44.44	— —	— —

Figure 7.14 French whiting fishery in the Southern Bight, 3rd quarter.

CATCH OF SPECIES (T) AND PCT OF TOT CATCH
* INDICATES CRITERIA FULFILLED

WHI FRATRC QUARTER 3

	F1	F2	F3	F4	F5	F6	F7	F8
37	2.2	4.7	—	—	—	—	—	—
	72.32	40.56	—	—	—	—	—	—
36	3.1	2.4	3.1	—	—	—	18.6	—
	43.58	28.63	54.22	—	—	—	87.96	—
35	.4	12.0	2.2	—	—	.6	—	—
	22.47	37.07	63.14	—	—	44.44	—	—
34	—	* 243.5	6.6	—	—	—	—	—
	—	69.48	38.88	—	—	—	—	—
33	1.7	* 145.0	—	—	—	—	—	—
	51.10	61.42	—	—	—	—	—	—
32	22.5	25.9	—	—	—	—	—	—
	39.80	59.07	—	—	—	—	—	—
31	90.4	18.7	—	—	—	—	—	—
	25.53	9.42	—	—	—	—	—	—

Figure 7.15 French saithe fishery in the northern North Sea, large high sea trawlers, 1st quarter.

CATCH OF SPECIES (T) AND PCT OF TOT CATCH
* INDICATES CRITERIA FULFILLED

SAI FRATRB QUARTER 1

		E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8
52					*	*	*							
		—	.3	29.6	315.1	549.4	307.3	—	—	—	—	—	—	—
		—	35.77	96.44	91.35	94.86	90.13	—	—	—	—	—	—	—
51			*	*	*	*	*	*						
		—	77.6	406.2	464.0	480.9	427.7	76.4	—	—	—	—	—	—
		—	77.83	82.31	82.03	82.64	82.30	92.21	—	—	—	—	—	—
50		*	*	*		*								
		51.6	816.5	265.0	7.2	281.8	260.0	1.3	—	—	—	—	—	—
		75.40	75.28	75.04	58.13	81.49	72.26	62.52	—	—	—	—	—	—
49						*	*							
		380.8	51.9	.0	28.5	196.0	46.1	2.7	—	—	—	—	—	—
		64.77	41.84	.00	66.65	83.25	85.34	99.75	—	—	—	—	—	—
48							*							
		13.9	—	2.2	14.6	15.0	63.9	13.2	—	—	—	—	—	—
		52.94	—	12.43	15.49	27.19	86.21	99.66	—	—	—	—	—	—
47														
		1.3	—	3.4	24.1	4.4	25.6	—	—	—	—	—	—	—
		45.45	—	2.28	23.81	22.99	78.92	—	—	—	—	—	—	—
46														
		—	—	—	.0	—	.4	—	—	—	—	—	—	—
		—	—	—	.00	—	16.36	—	—	—	—	—	—	—
45														
		—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—
44														
		—	—	—	—	.0	.0	—	—	—	—	—	—	—
		—	—	—	—	.00	.00	—	—	—	—	—	—	—
43														
		—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—
42														
		—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7.16 Scottish seiner fishery for haddock, 1st quarter, North Sea.

CATCH OF SPECIES (T) AND PCT OF TOT CATCH
* INDICATES CRITERIA FULFILLED

HAD SCOSEN QUARTER 1

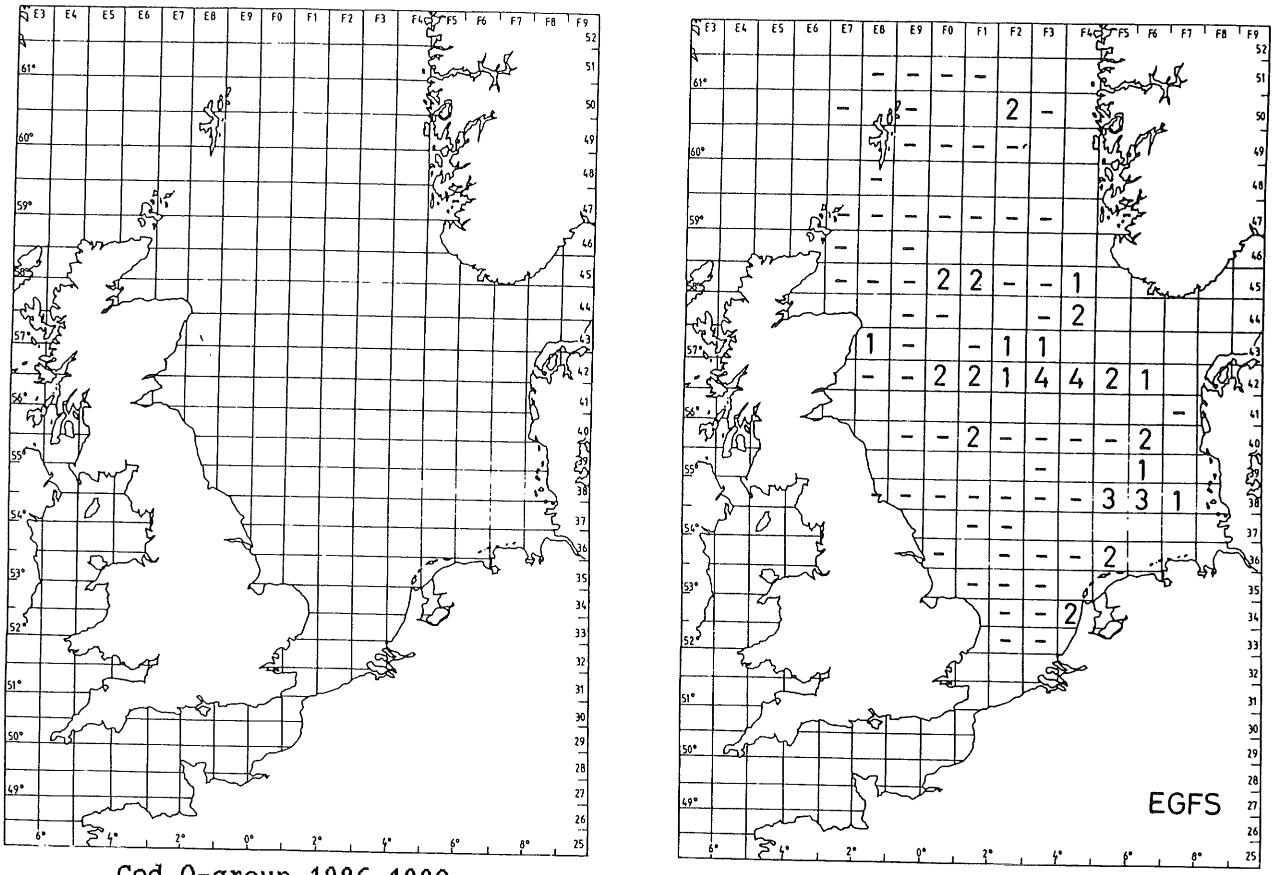
	E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	G0
52	—	—	—	—	5.0	—	—	—	—	—	—	—	—		
	—	—	—	—	50.58	—	—	—	—	—	—	—	—		
51	—	—	8.1	34.5	70.1	110.7	5.2	—	—	—	—	—	—		
	—	—	27.85	26.88	42.13	45.73	45.08	—	—	—	—	—	—		
50	—	21.1	22.2	142.9	156.6	129.3	186.8	4.6	—	—	—	—	—	2.0	147.5
	—	35.02	50.87	38.59	40.31	47.99	49.68	43.44	—	—	—	—	—	69.20	59.32
49	3.9	95.6	216.1	645.6	877.5	493.2	834.0	9.3	—	—	—	—	—	314.2	72.0
	59.45	41.79	39.45	53.84	50.89	54.81	53.91	62.07	—	—	—	—	—	47.07	53.86
48	3.4	9.8	332.9	993.0	770.6	487.3	124.2	9.2	—	—	—	—	—	46.1	3.6
	51.33	33.97	48.01	48.61	53.08	56.19	58.79	47.85	—	—	—	—	—	61.00	63.25
47	11.6	8.0	313.7	280.6	1167.9	314.9	347.6	39.9	—	—	—	—	—	1.9	—
	48.54	71.07	53.90	52.24	56.47	61.31	64.32	68.29	—	—	—	—	—	79.12	—
46	27.0	56.3	289.4	431.2	435.5	181.5	381.7	50.4	4.5	—	—	—	—	—	—
	29.30	63.07	60.54	61.84	59.11	68.79	71.22	62.59	73.24	—	—	—	—	—	—
45	32.8	217.5	299.6	360.7	210.9	426.6	314.5	68.4	27.5	—	.0	—	—	—	—
	18.53	51.37	68.04	67.25	60.15	66.98	70.03	64.80	64.55	—	13.63	—	—	—	—
44	3.4	119.0	114.1	487.0	452.7	364.0	86.7	44.9	74.8	11.5	—	—	—	—	—
	12.23	44.24	68.59	72.93	70.21	69.53	71.88	69.33	67.04	64.55	—	—	—	—	—
43	—	.7	35.5	58.0	* 103.4	* 163.5	* 45.1	.3	10.8	—	—	—	—	—	—
	—	23.12	51.43	66.73	78.50	75.40	78.98	54.43	38.65	—	—	—	—	—	—
42	—	7.8	8.1	6.5	108.2	25.4	43.8	.8	—	—	—	—	—	—	—
	—	22.79	45.52	50.80	66.11	54.88	64.38	29.74	—	—	—	—	—	—	—
41	—	12.9	7.6	8.4	7.4	8.2	13.4	1.0	—	—	—	—	—	16.4	—
	—	26.23	35.22	50.11	84.49	82.70	57.23	70.97	—	—	—	—	—	83.98	—
40	—	18.0	12.6	47.1	3.2	2.3	15.6	3.4	3.3	—	—	—	—	.2	—
	—	35.89	38.91	63.05	39.90	79.82	60.20	66.21	60.36	—	—	—	—	16.73	—
39	—	—	.2	.0	4.4	8.4	.8	—	—	—	—	—	—	—	—
	—	—	43.07	25.98	69.50	42.38	32.92	—	—	—	—	—	—	—	—
38	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
37	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
36	—	—	—	—	—	—	—	—	—	.5	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	78.77	—	—	—	—	—

Figure 7.17 Landings of whiting in the Scottish seiner fishery, 3rd quarter, North Sea.

CATCH OF SPECIES (T) AND PCT OF TOT CATCH
* INDICATES CRITERIA FULLFILLED

WHI SCOSEN QUARTER 3

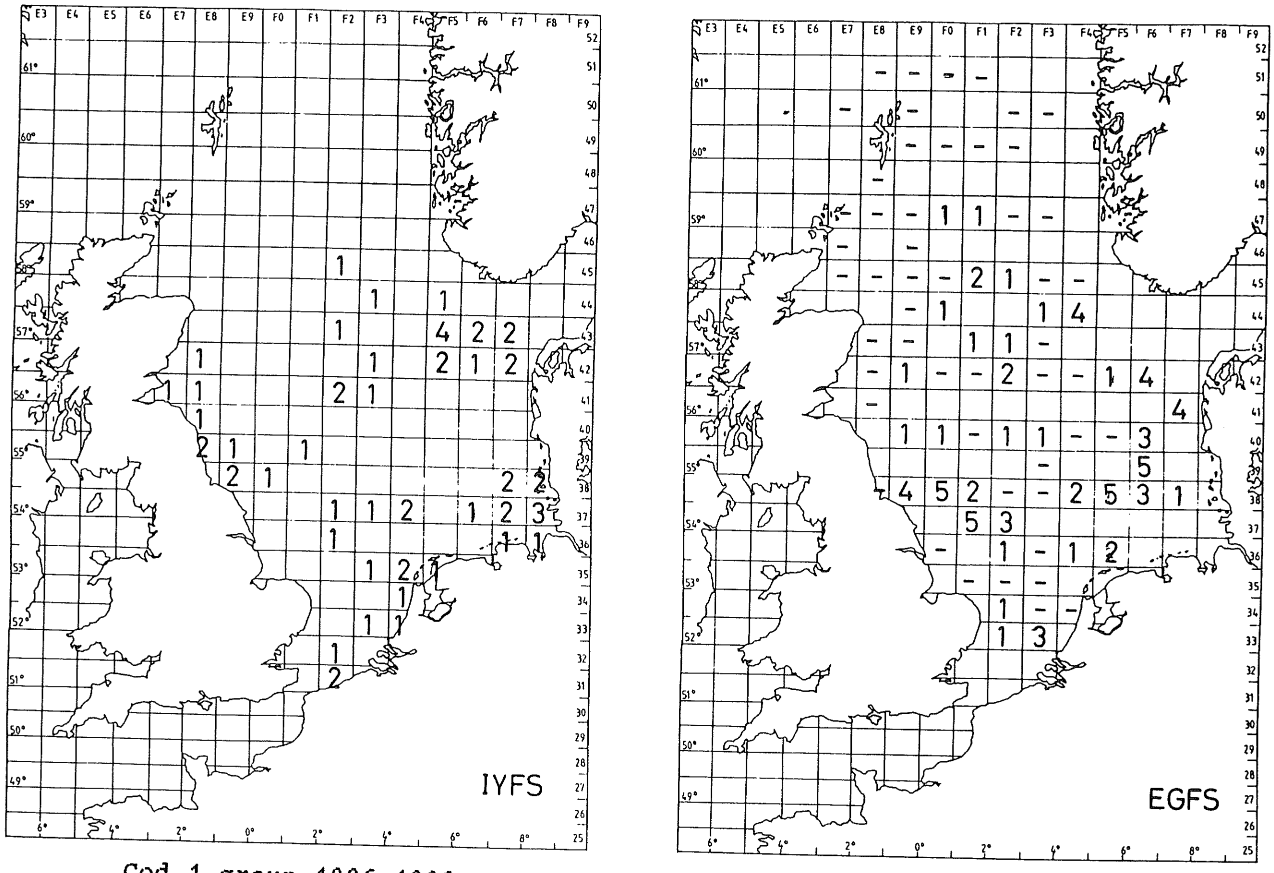
	E6	E7	E8	E9	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	G0
52	—	—	—	—	—	.4	.0	—	—	—	—	—	—		
	—	—	—	—	—	5.70	.46	—	—	—	—	—	—		
51	—	—	2.4	4.7	3.1	1.5	.7	—	—	—	—	—	—		
	—	—	22.23	66.36	15.52	3.86	4.80	—	—	—	—	—	—		
50	—	.0	8.2	* 103.5	5.0	7.2	25.2	.5	—	—	—	—	—	2.0	147.5
	—	3.92	29.00	51.63	15.81	8.08	7.53	3.90	—	—	—	—	—	69.20	59.32
49	—	22.8	* 367.9	108.7	68.2	55.0	186.8	1.0	.1	—	—	—	—	314.2	72.0
	—	45.77	57.48	35.85	15.96	11.87	7.35	6.59	4.57	—	—	—	—	47.07	53.86
48	5.0	6.8	126.0	97.2	65.6	65.7	20.0	.5	—	—	—	—	—	46.1	3.6
	24.57	28.47	33.88	32.49	17.00	10.61	9.09	12.00	—	—	—	—	—	61.00	63.25
47	4.4	1.9	285.7	66.4	119.9	29.9	29.2	.9	—	—	—	—	—	1.9	—
	17.67	12.82	47.31	32.76	19.69	11.50	7.57	5.50	—	—	—	—	—	79.12	—
46	8.0	23.9	159.2	85.3	17.0	8.3	19.6	2.8	—	—	—	—	—	—	—
	7.01	21.75	47.64	32.41	15.50	6.14	2.92	2.63	—	—	—	—	—	—	—
45	10.2	72.2	99.3	129.9	3.7	33.8	42.6	6.4	1.2	—	—	—	—	—	—
	4.45	13.52	49.35	42.62	5.73	5.09	1.76	1.48	1.67	—	—	—	—	—	—
44	1.2	22.8	22.6	55.9	95.8	104.2	20.7	16.4	10.0	.6	.0	—	—	—	—
	2.03	7.11	26.85	20.35	13.30	6.78	2.33	1.78	1.18	.89	.00	—	—	—	—
43	—	.0	9.8	8.9	47.7	51.3	8.0	4.2	6.9	1.5	.0	—	—	—	—
	—	.80	14.28	10.84	7.23	4.02	1.52	1.40	.86	1.27	.00	—	—	—	—
42	—	1.9	16.5	6.2	9.7	9.4	3.5	.7	.1	.0	.0	—	—	—	—
	—	2.28	12.77	5.24	4.26	3.54	1.12	.55	6.20	2.09	.46	—	—	—	—
41	—	5.4	11.7	3.3	1.6	2.3	4.3	.3	.2	.0	.1	—	—	16.4	—
	—	5.33	9.50	2.83	2.54	1.74	2.50	1.42	1.58	.00	2.40	—	—	83.98	—
40	—	.6	6.1	7.2	13.3	4.4	6.4	—	—	—	—	—	—	.2	—
	—	1.26	12.74	7.50	5.52	4.92	6.08	—	—	—	—	—	—	16.73	—
39	—	—	—	2.4	.7	4.5	1.2	.0	—	.0	—	—	—	—	—
	—	—	—	87.28	3.31	8.13	7.80	.00	—	.14	—	—	—	—	—
38	—	—	—	—	—	.1	.4	—	—	—	—	—	—	—	—
	—	—	—	—	—	7.80	6.75	—	—	—	—	—	—	—	—
37	—	—	—	—	—	1.5	—	—	.0	—	—	—	—	—	—
	—	—	—	—	—	21.08	—	—	.72	—	—	—	—	—	—
36	—	—	—	—	—	—	—	—	—	—	—	.0	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	1.26	—	—	—



Cod 0-group 1986-1990.

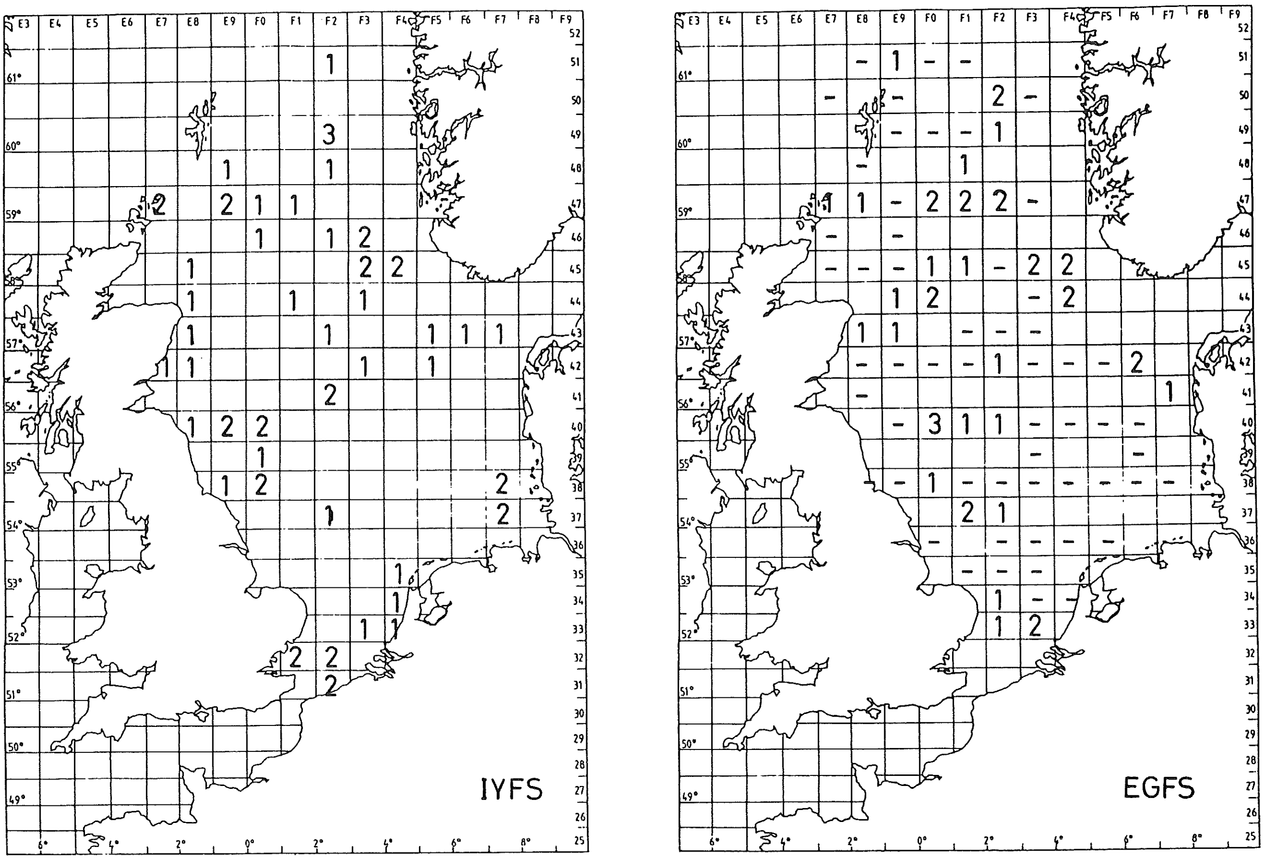
- rectangle fished but no catch ≥ 2%.

Figure 9.1 Number of years in which the catch in a certain rectangle comprised 2% or more of the total catch of that age group.



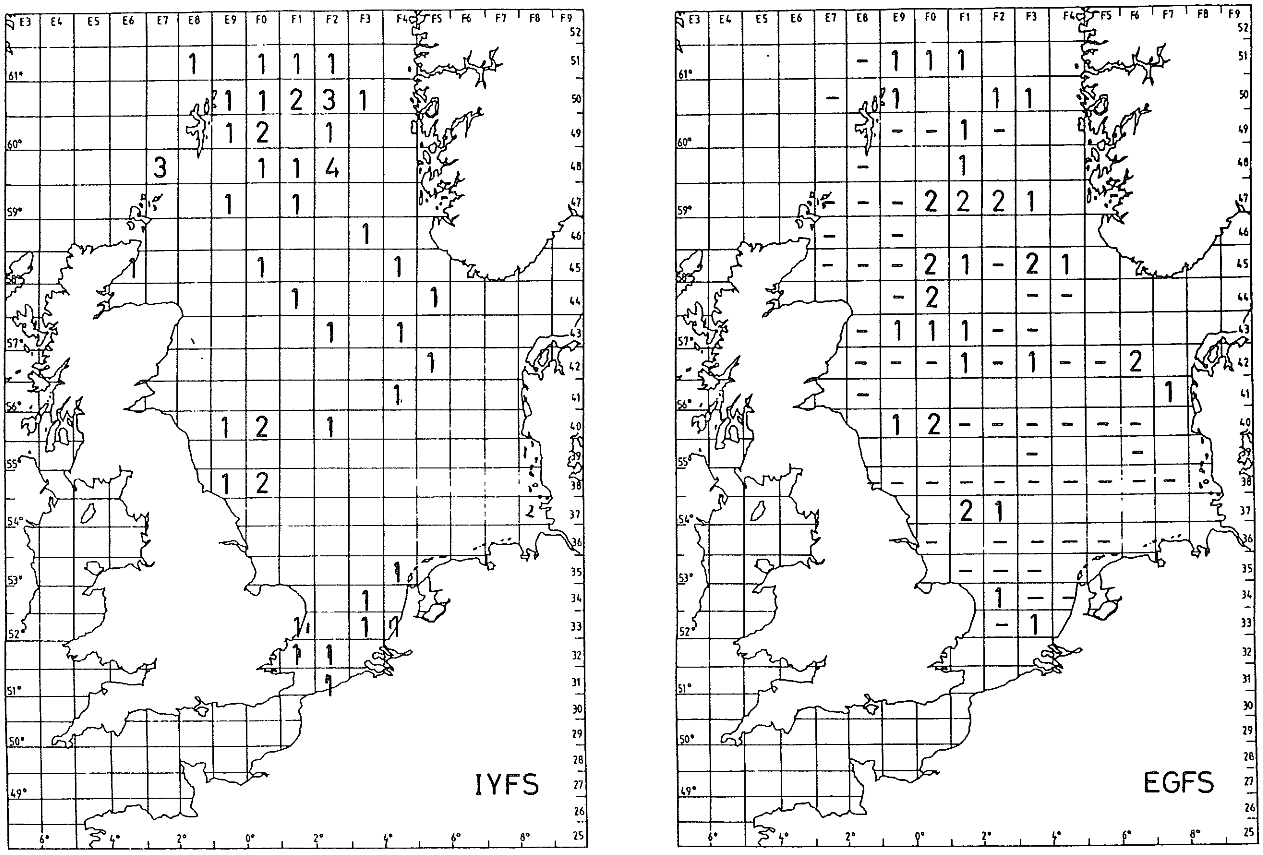
Cod 1-group 1986-1990.

Figure 9.2 Number of years in which the catch in a certain rectangle comprised 2% or more of the total catch of that age group.



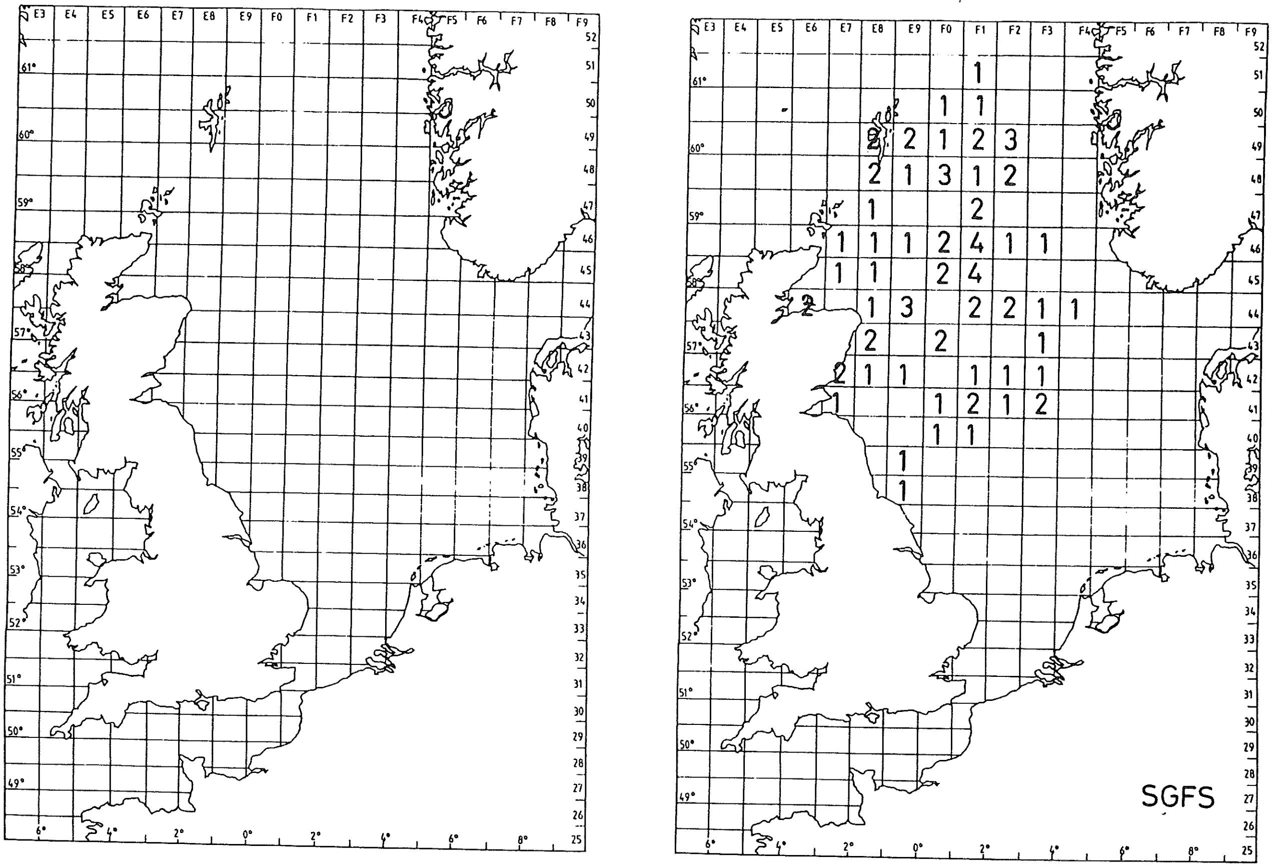
Cod 2-group 1986-1990.

Figure 9.3 Number of years in which the catch in a certain rectangle comprised 2% or more of the total catch of that age group.



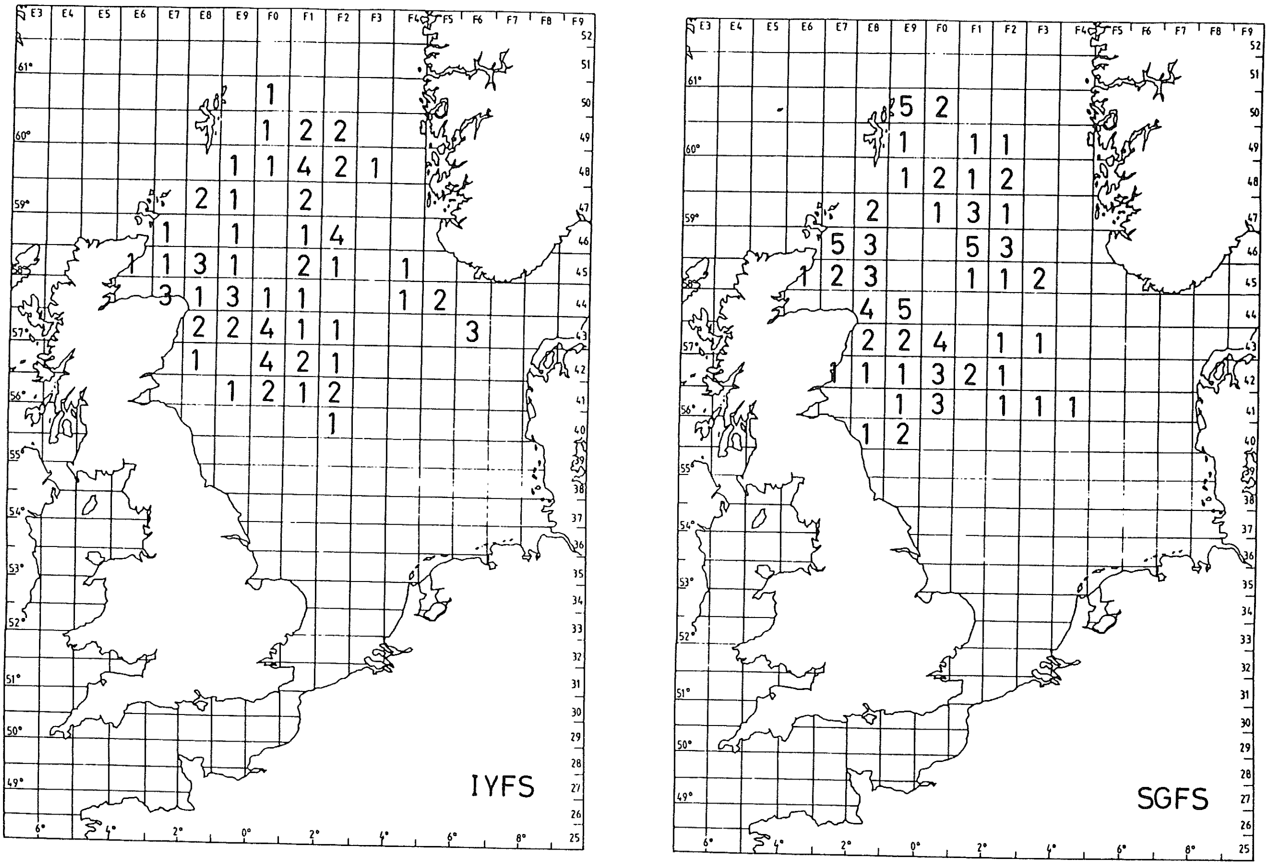
Cod 3⁺-group IYFS and 3-group EGFS 1986-1990.

Figure 9.4 Number of years in which the catch in a certain rectangle comprised 2% or more of the total catch of that age group.



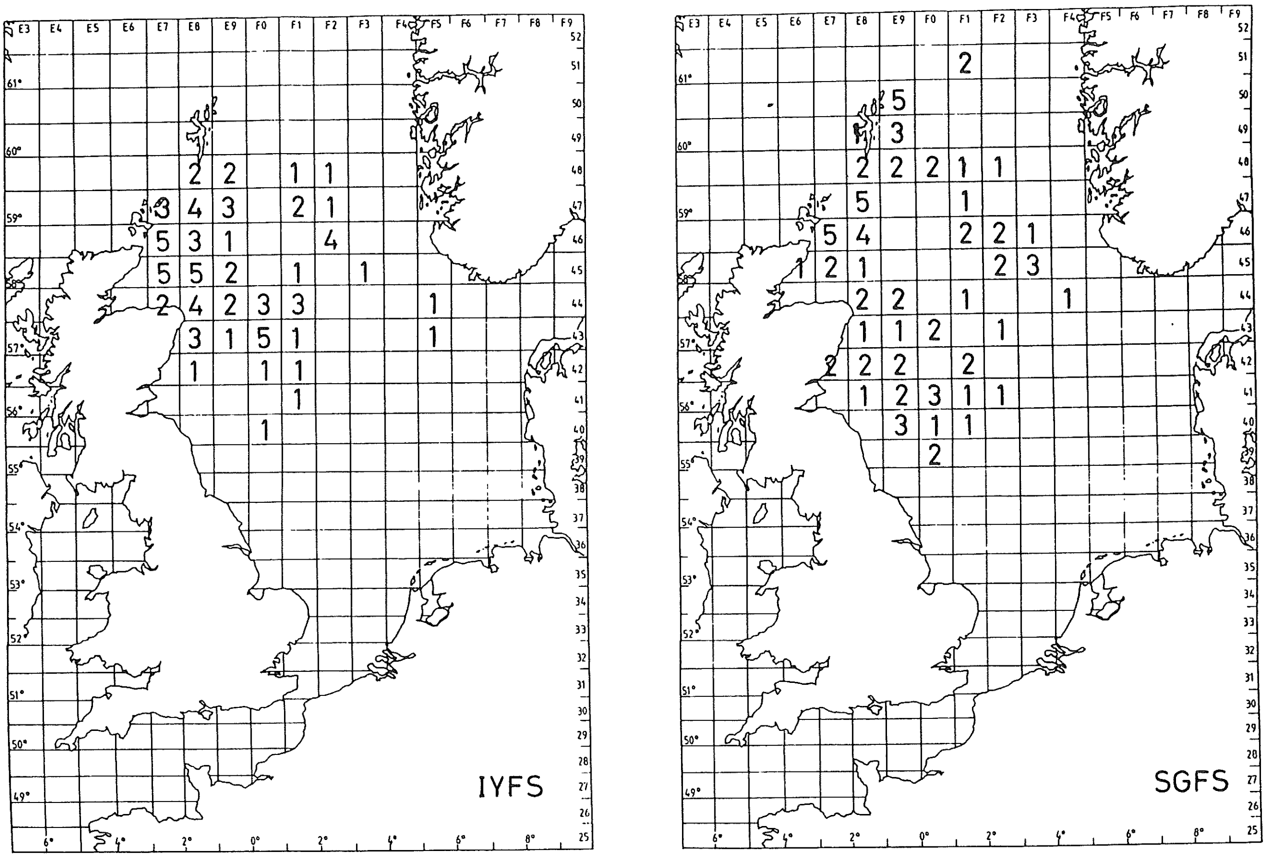
Haddock 0-group 1986-1990.

Figure 9.5 Number of years in which the catch in a certain rectangle comprised 2% or more of the total catch of that age group.



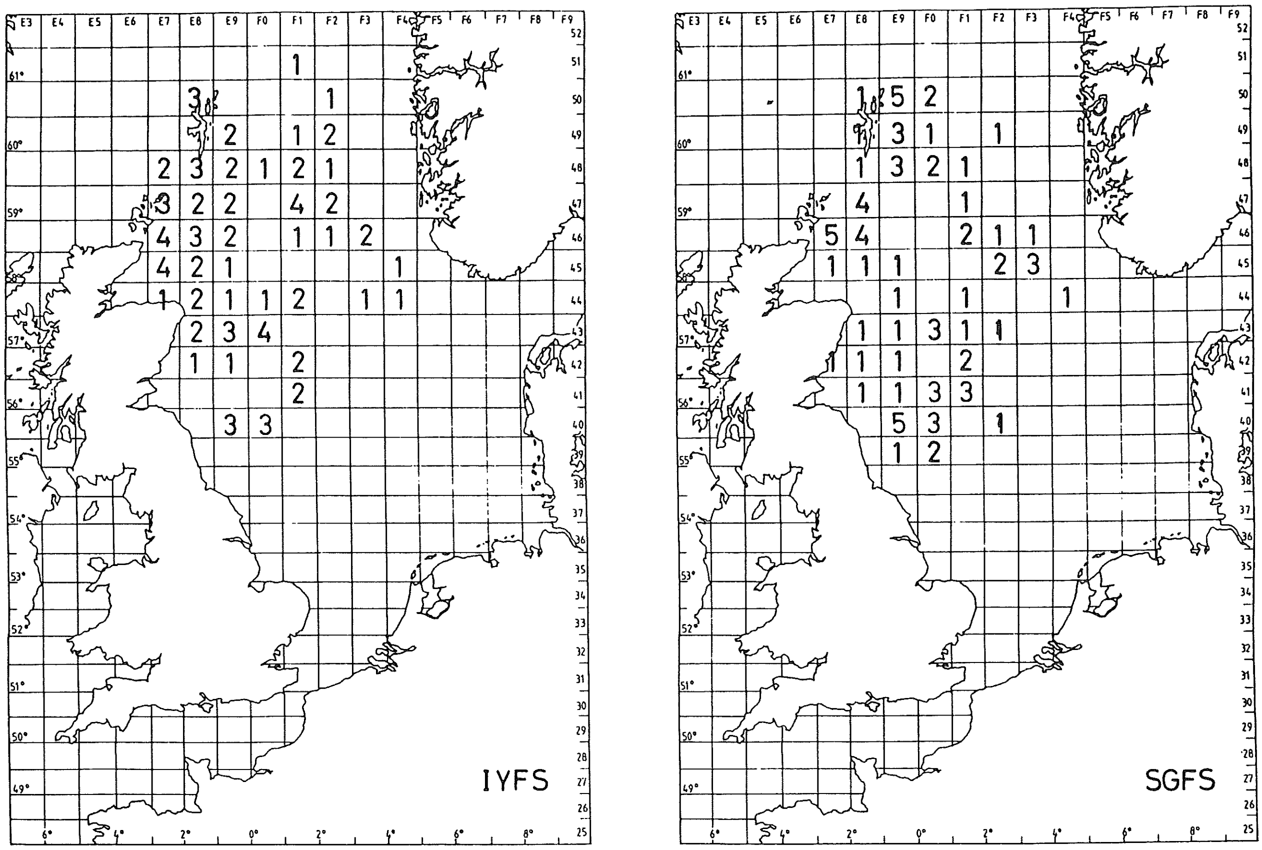
Haddock 1-group 1986-1990.

Figure 9.6 Number of years in which the catch in a certain rectangle comprised 2% or more of the total catch of that age group



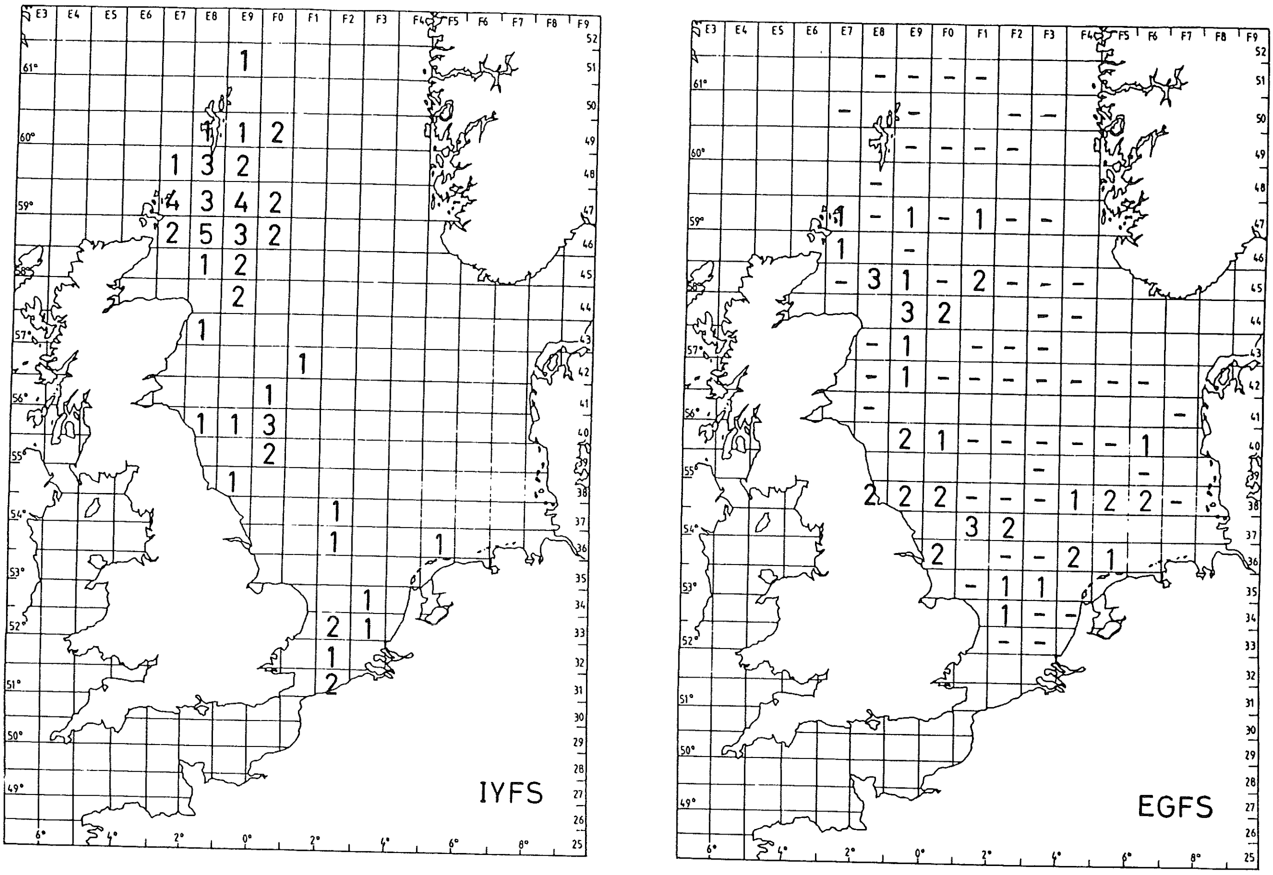
Haddock 2-group 1986-1990.

Figure 9.7 Number of years in which the catch in a certain rectangle comprised 2% or more of the total catch of that age group.



Haddock 3^{+}-group 1986-1990.

Figure 9.8 Number of years in which the catch in a certain rectangle comprised 2% or more of the total catch of that age group.



Whiting 3^{+}-group IYFS and 3-group EGFS.

Figure 9.9 Number of years in which the catch in a certain rectangle comprised 2% or more of the total catch of that age group

Figure 10.1.1

1-gp COD in IV. Abundance Indices vs VPA (log values)

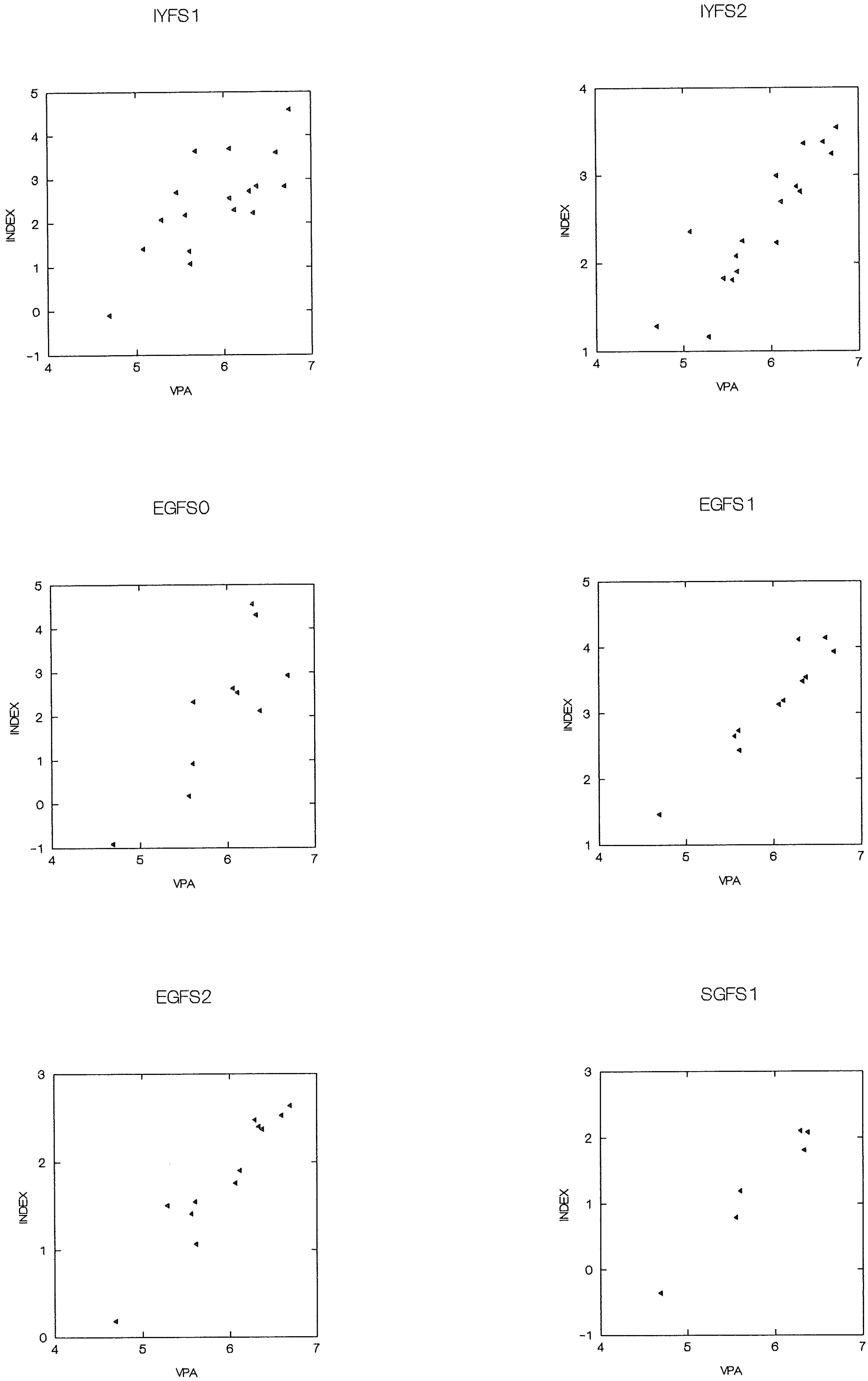


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Figure 10.1.1 cont'd.

1-gp COD in IV. Research Vessel Indices vs VPA (log values)

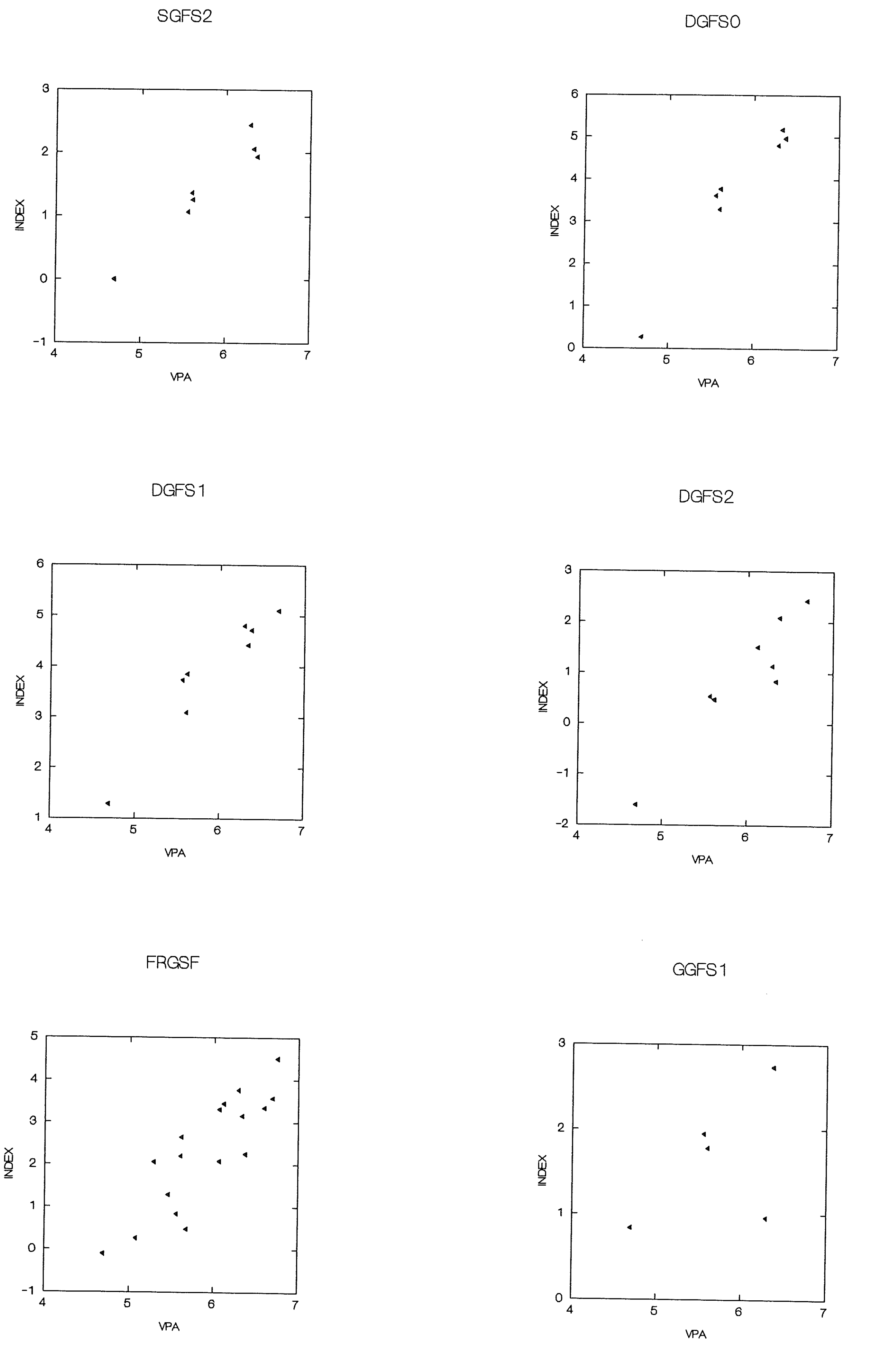

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Figure 10.1.1 cont'd.

1-gp COD in IV. Research Vessel Indices vs VPA (log values)

GGFS2

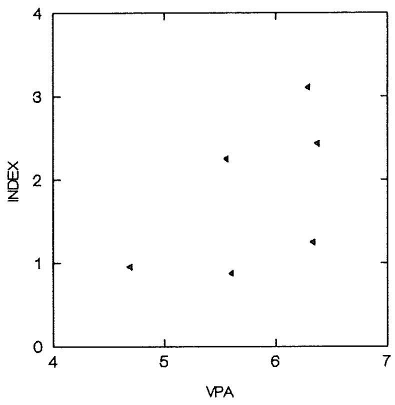

Figure 10.1.2

2-gp COD in IV. Research Vessel Indices vs VPA (log values)

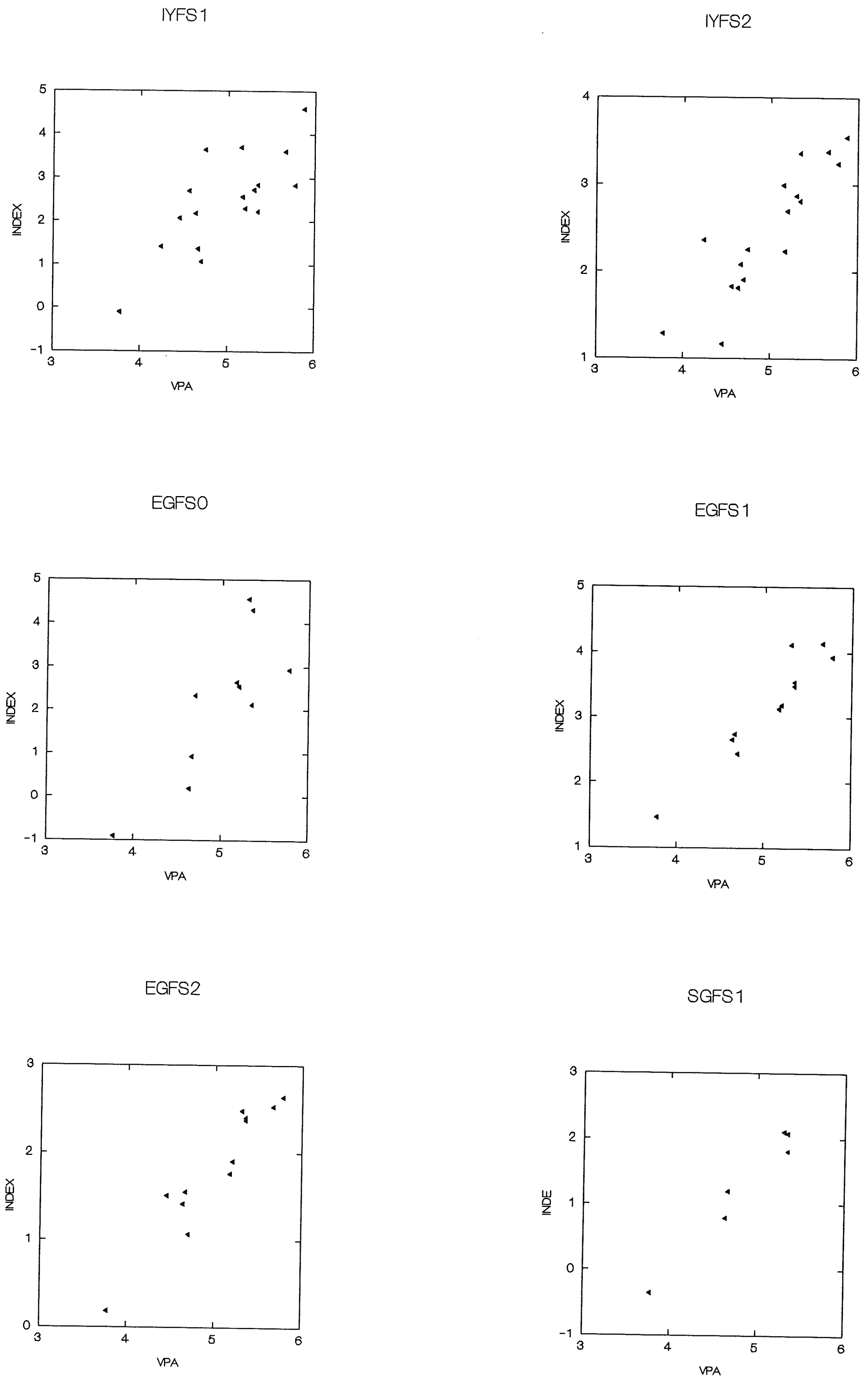

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Figure 10.1.2 cont'd.

2-gp COD in IV. Research Vessel Indices vs VPA (log values)

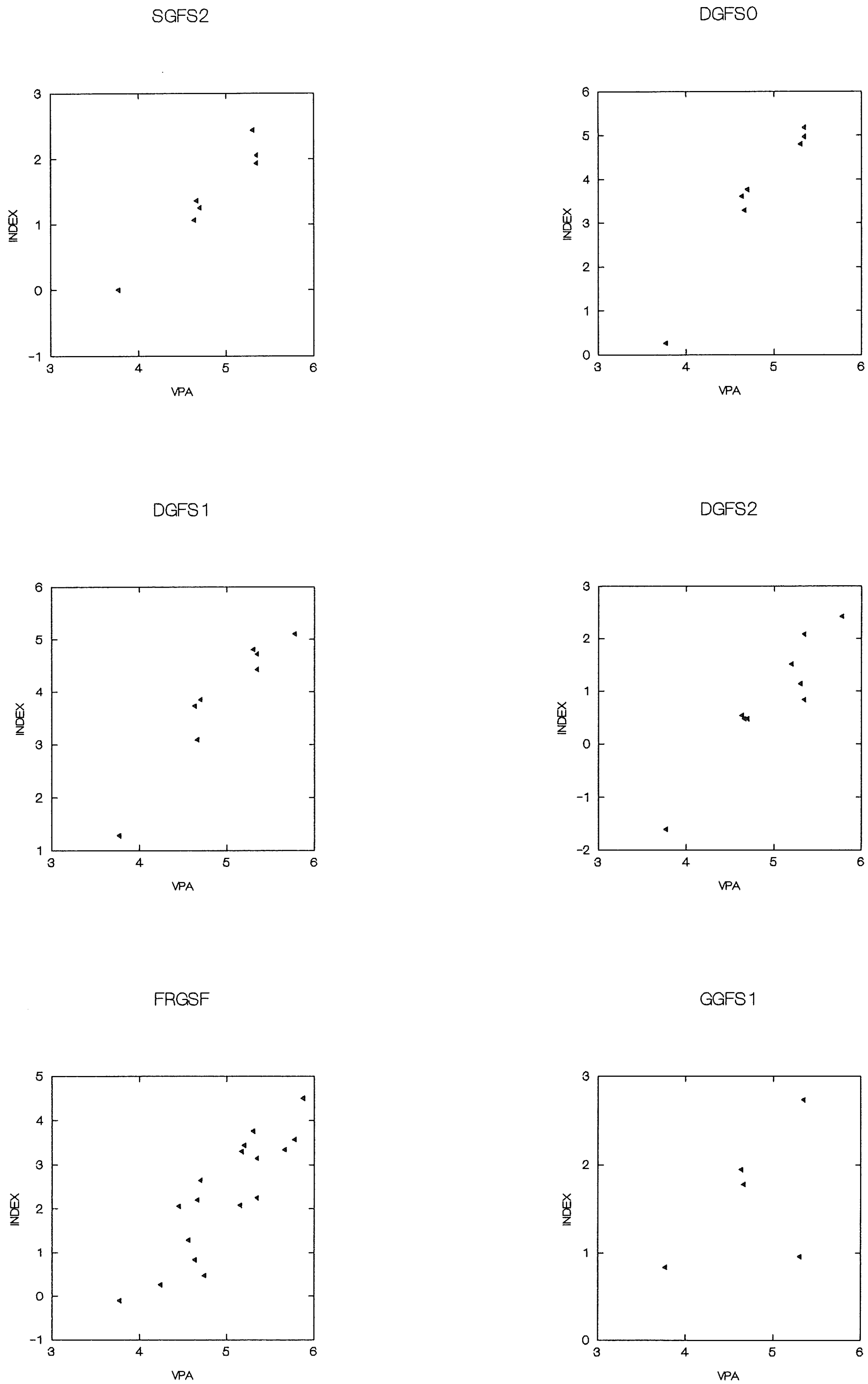

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Figure 10.1.2 cont'd.

2-gp COD in IV. Research Vessel Indices vs VPA (log values)

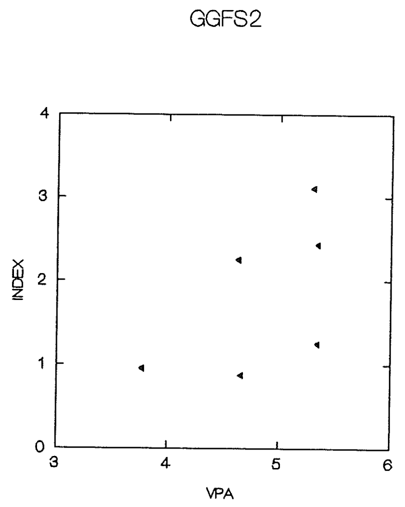

Figure 10.2.1

1-gp HADDOCK in IV. Research Vessel Indices vs VPA (log values)

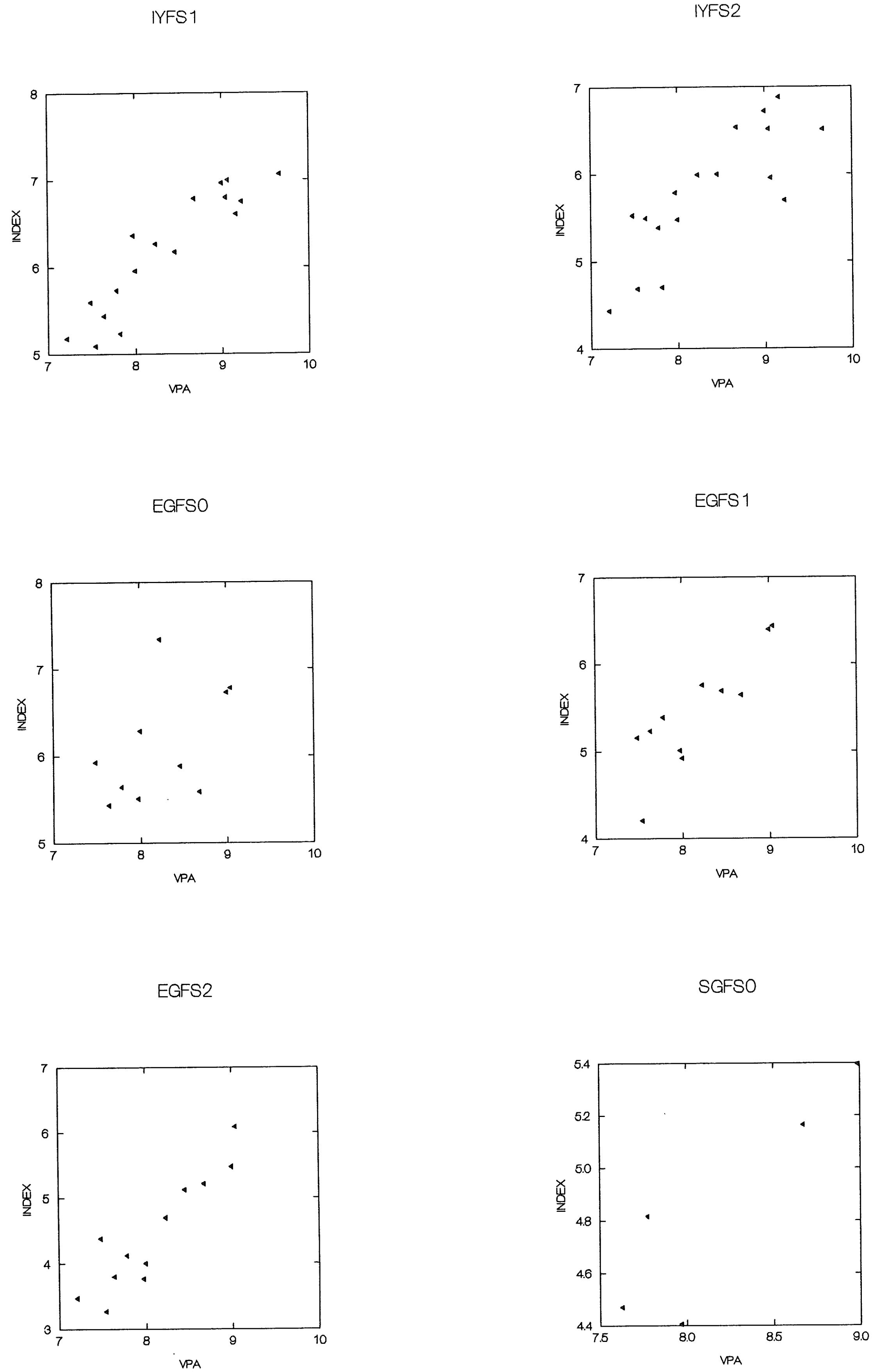

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Figure 10.2.1 cont'd.

1-gp HADDOCK in IV. Research Vessel Indices vs VPA (log values)

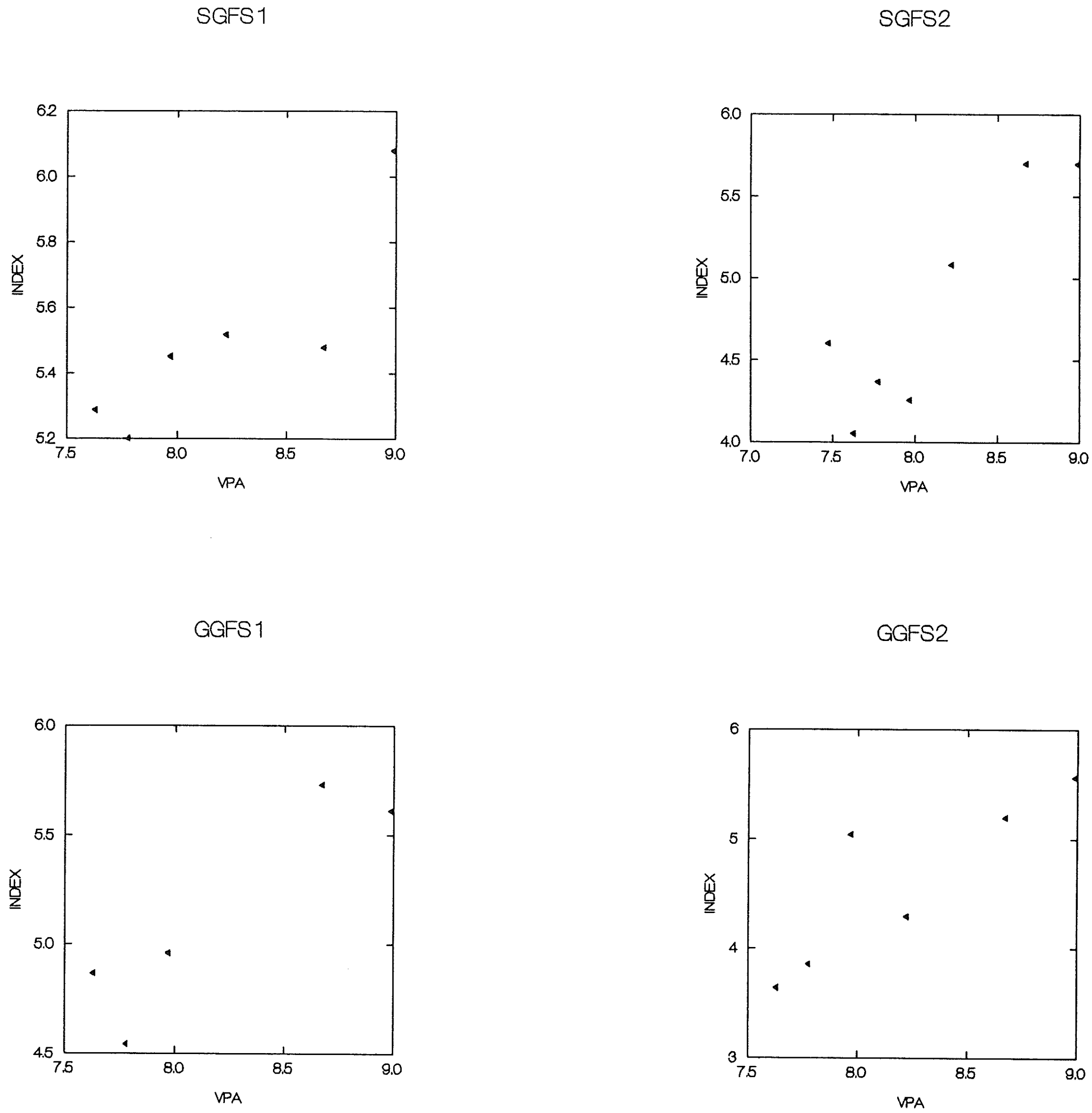

Figure 10.2.2

2-gp HADDOCK in IV. Research Vessel Indices vs VPA (log values)

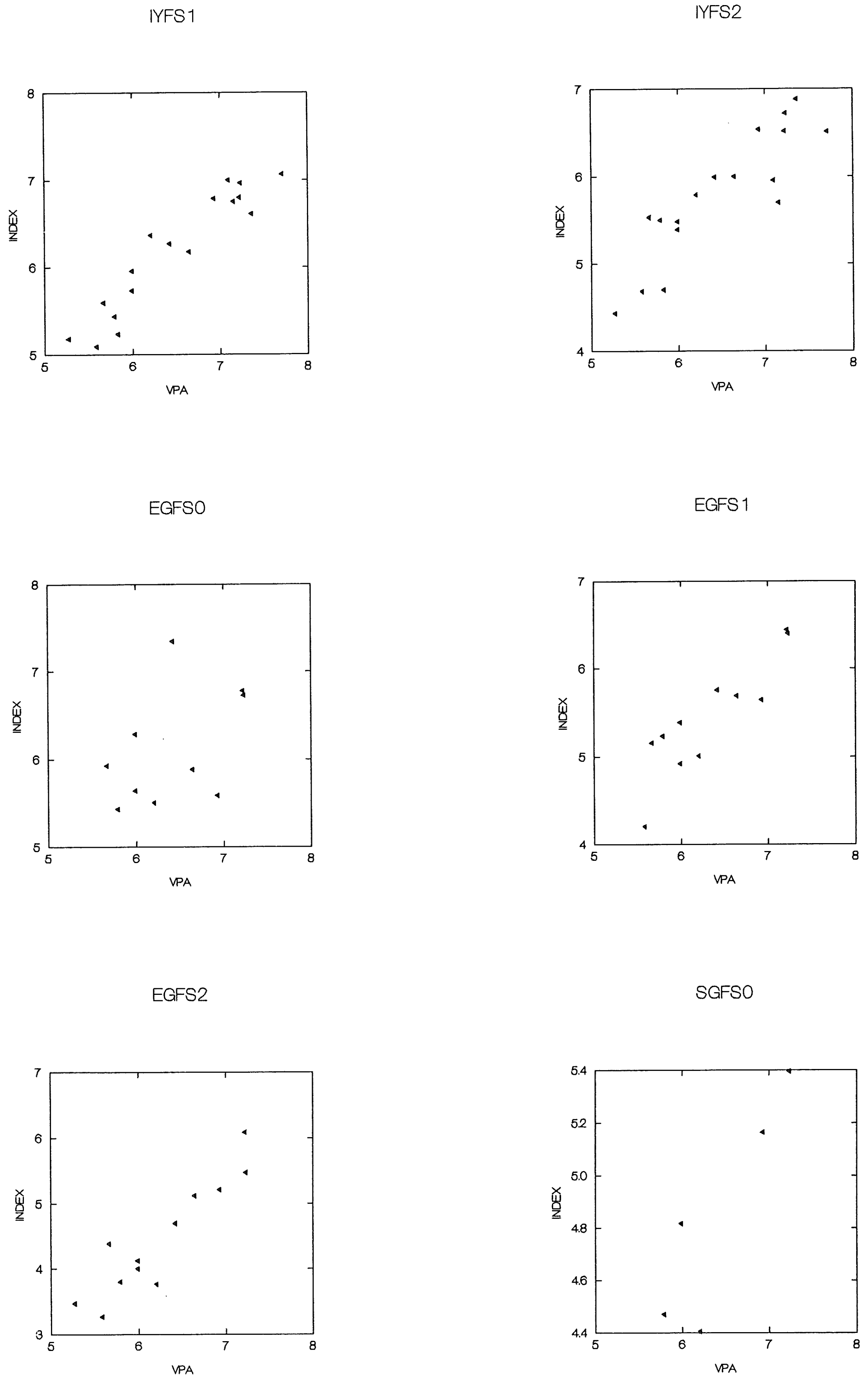

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Figure 10.2.2. cont'd.

2-gp HADDOCK in IV. Research Vessel Indices vs VPA (log values)

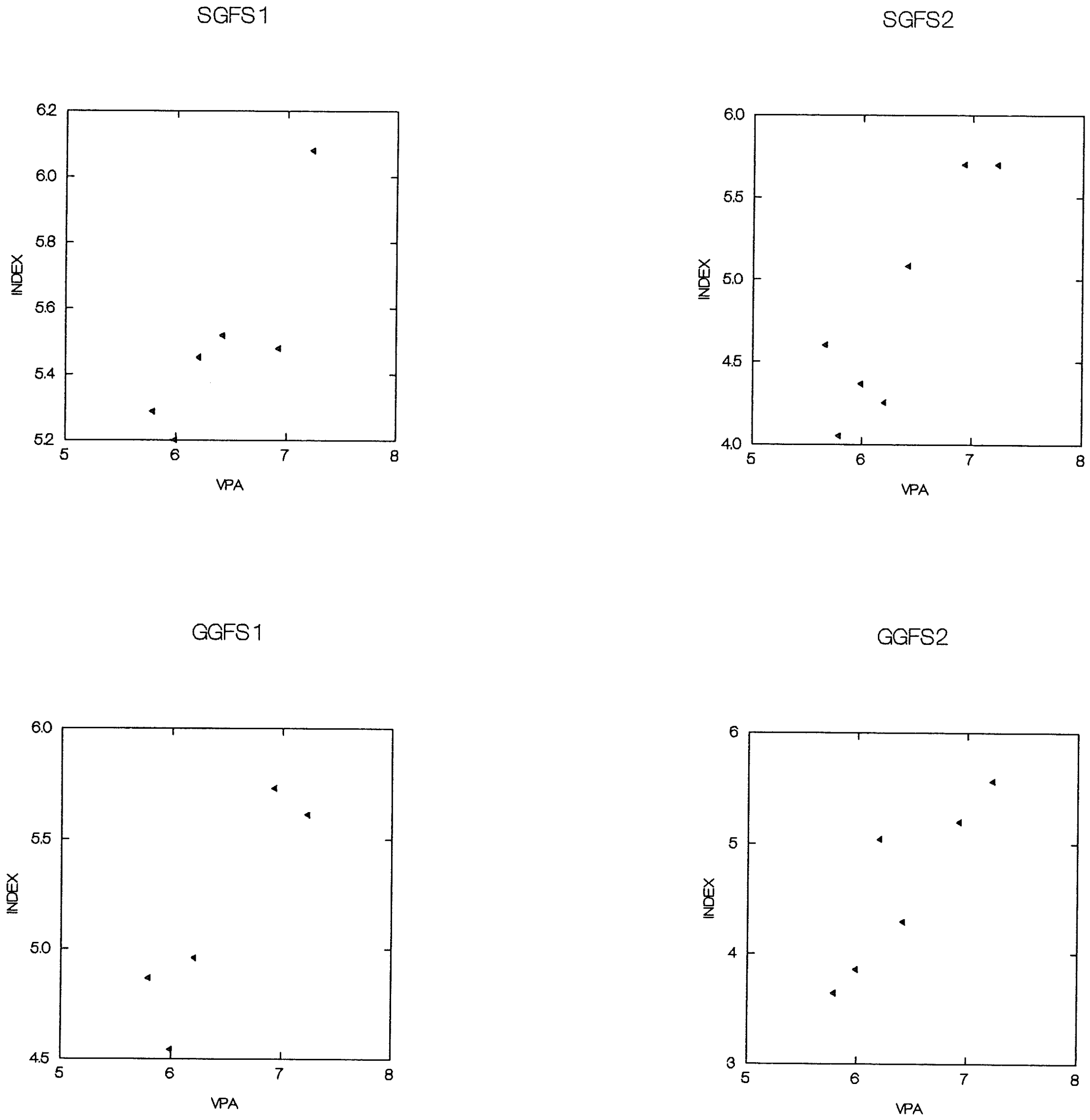
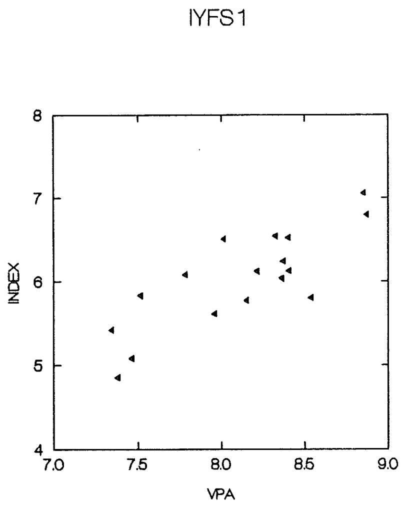
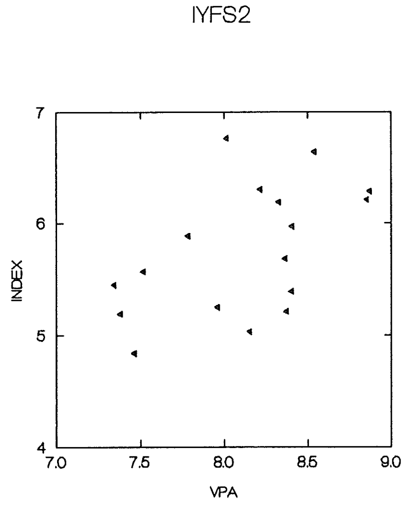
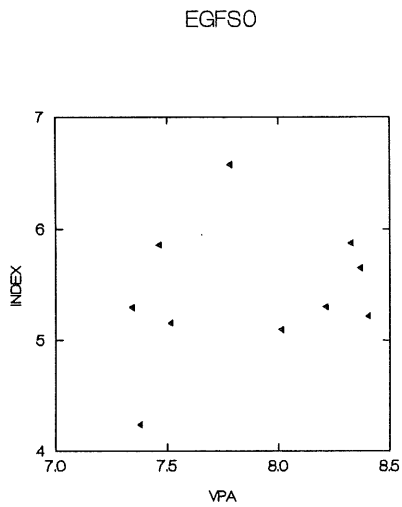


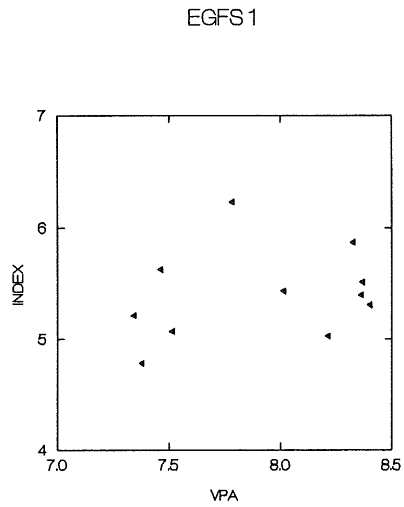
Figure 10.3.1

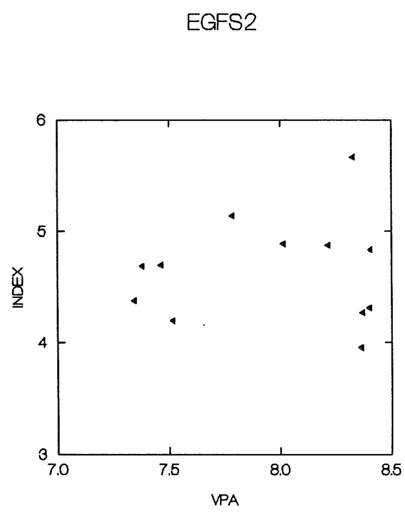
1-gp WHITING in IV. Research Vessel Indices vs VPA (log values)











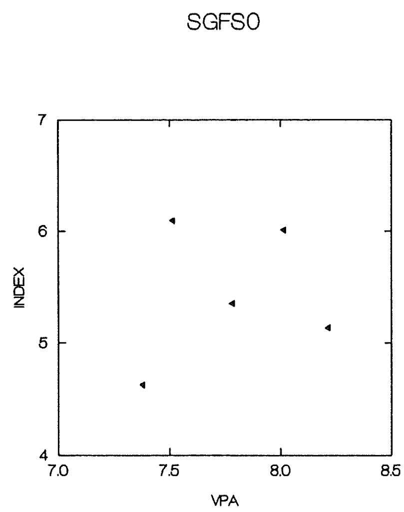


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Figure 10.3.1 cont'd.

1-gp WHITING in IV. Research Vessel Indices vs VPA (log values)

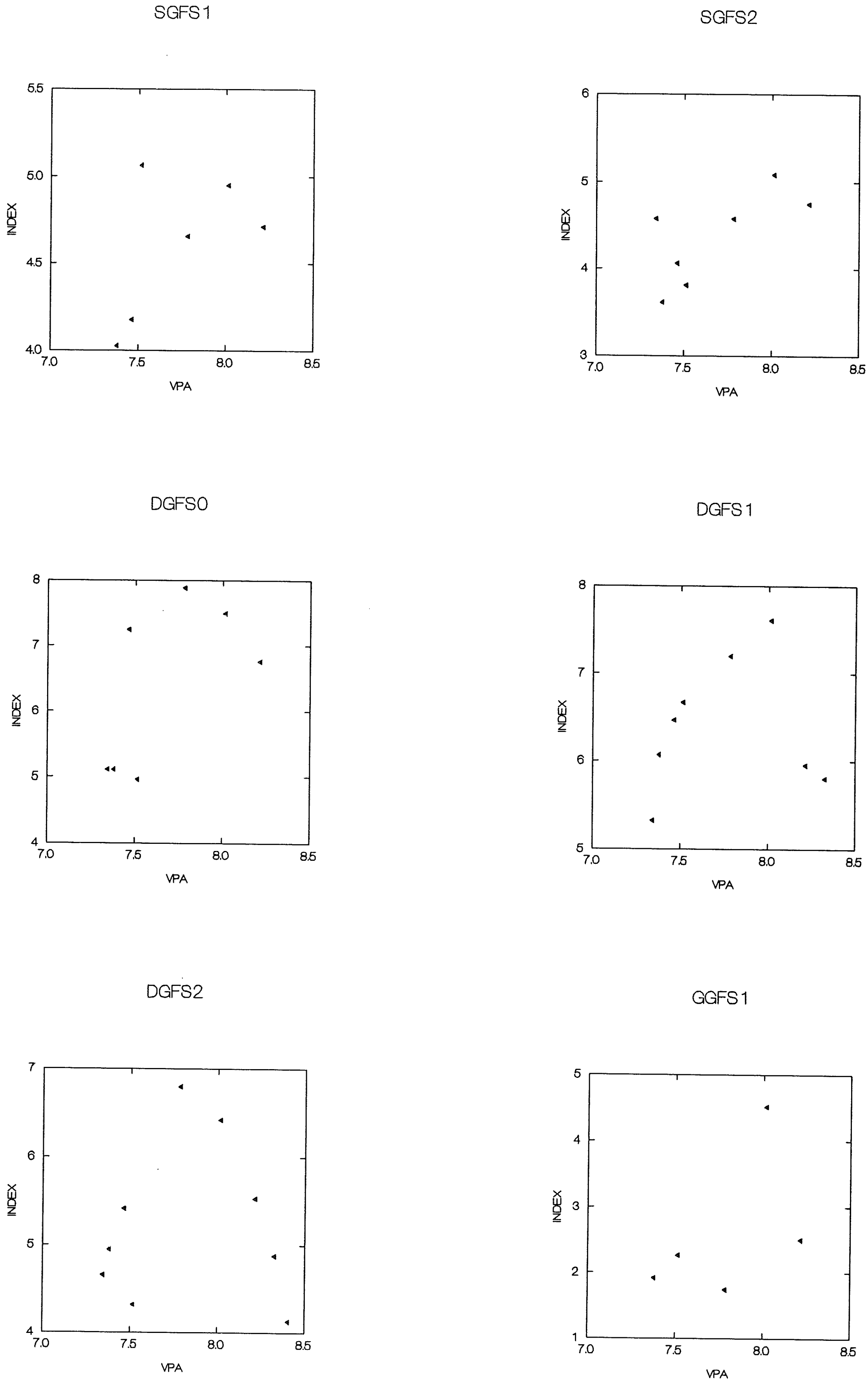

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Figure 10.3.1 cont'd.

1-gp WHITING in IV. Research Vessel Indices vs VPA (log values)

GGFS2

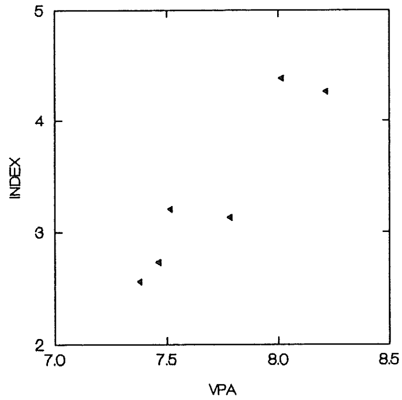

Figure 10.3.2

2-gp WHITING in IV. Research Vessel Indices vs VPA (log values)

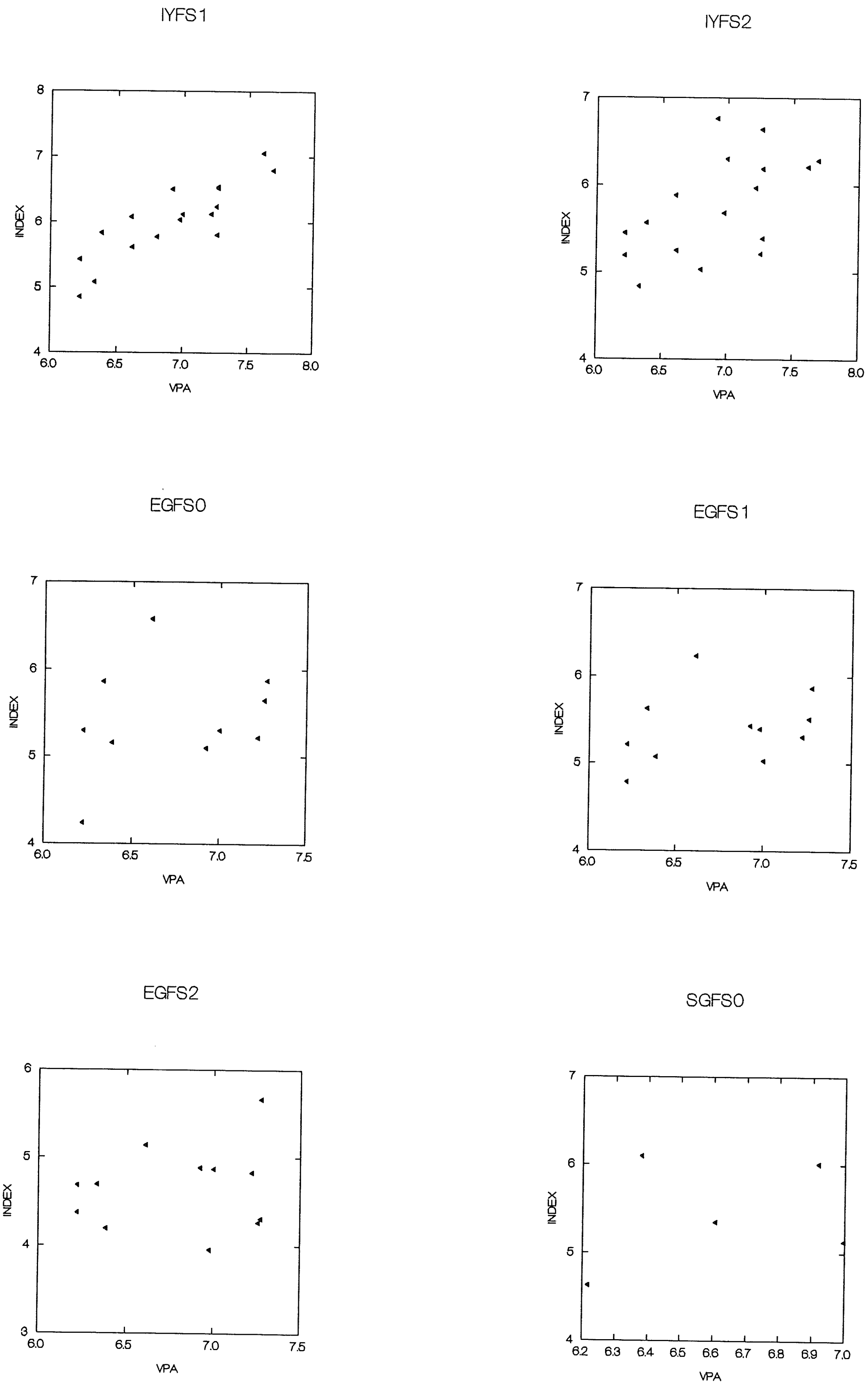

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Figure 10.3.2 cont'd.

2-gp WHITING in IV. Research Vessel Indices vs VPA (log values)

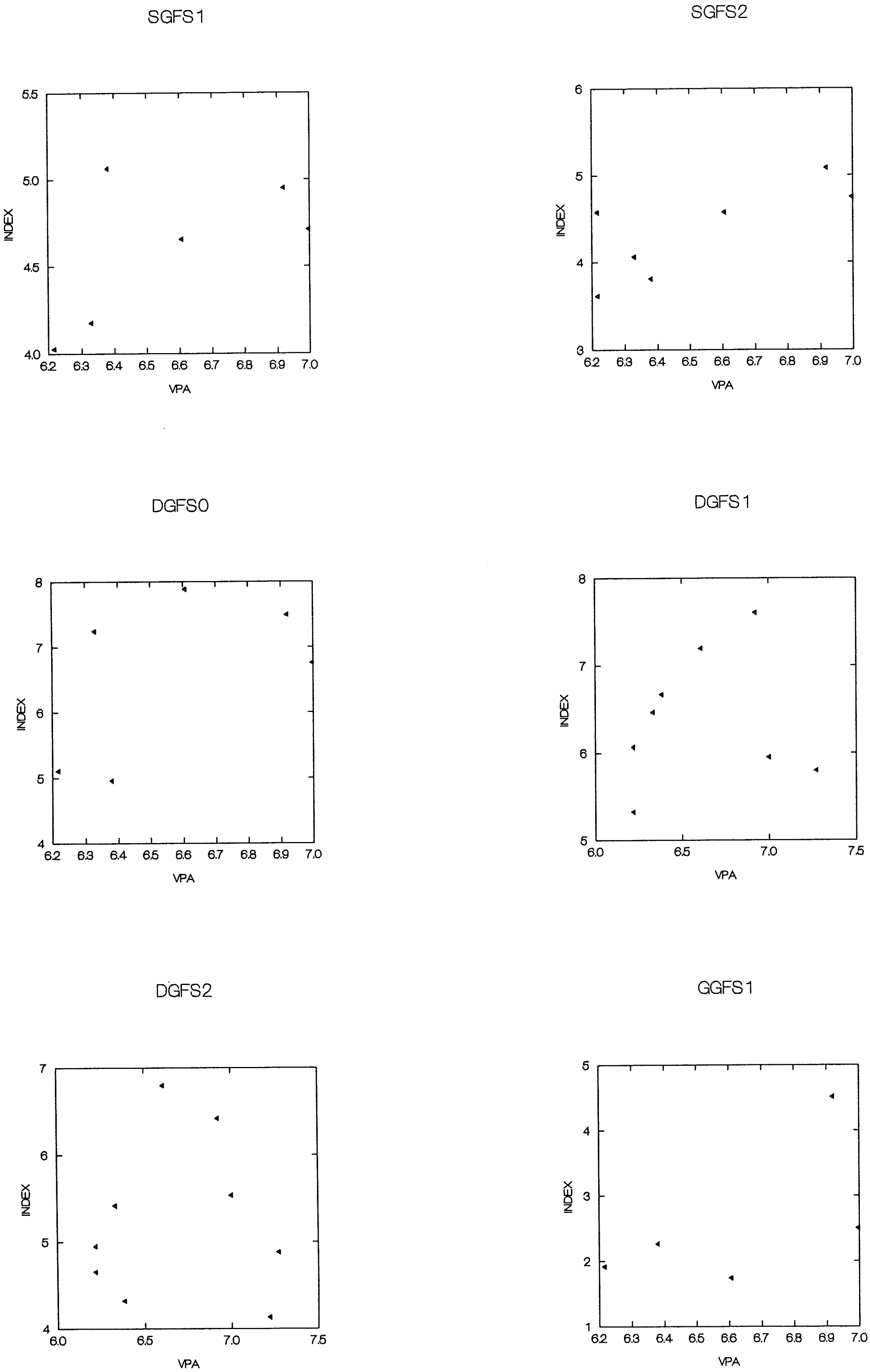

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Figure 10.3.2 cont'd.

2-gp WHITING in IV. Research Vessel Indices vs VPA (log values)

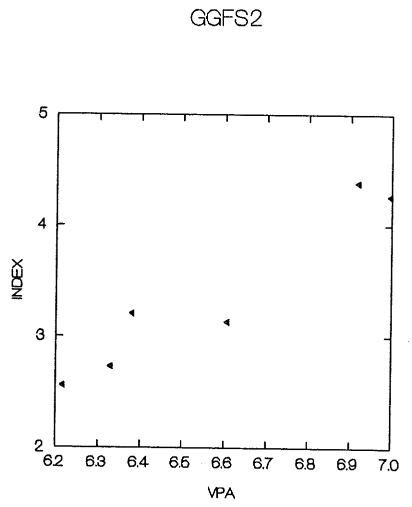


Figure 10.4.1

1-gp COD in VIa. Abundance Indices vs VPA (log values)

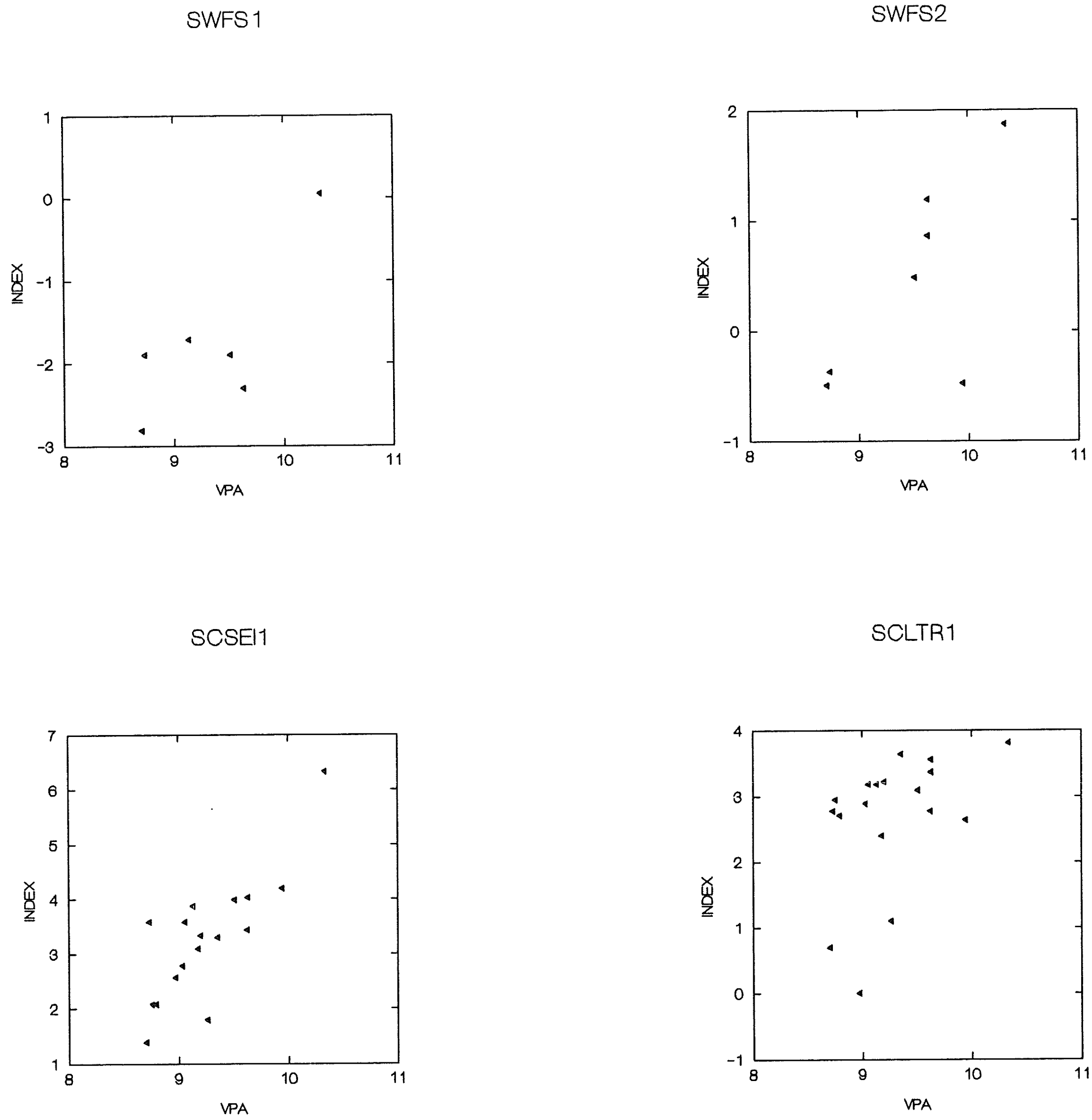


Figure 10.4.2

2-gp COD in VIa. Research Vessel Indices vs VPA (log values)

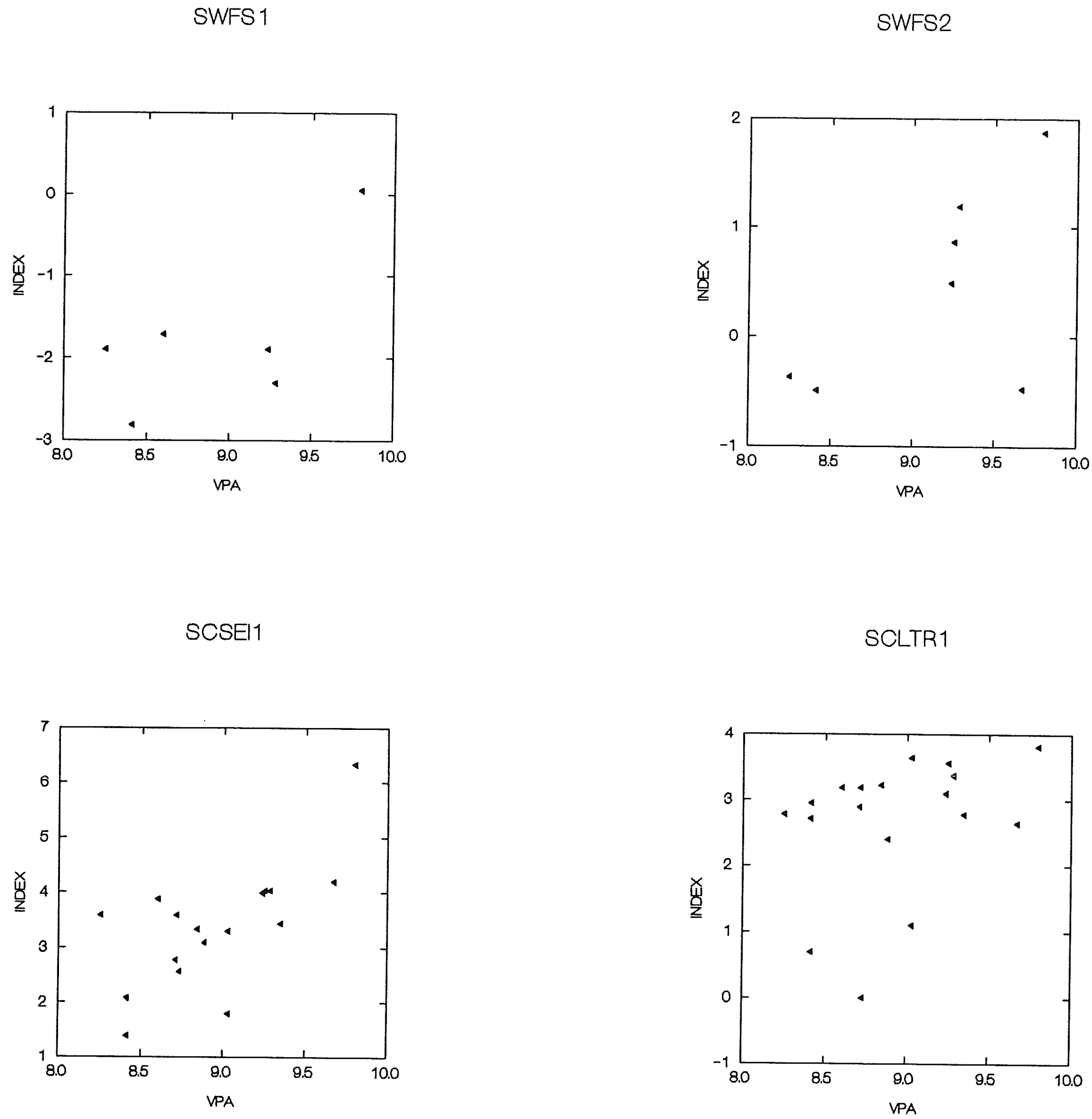
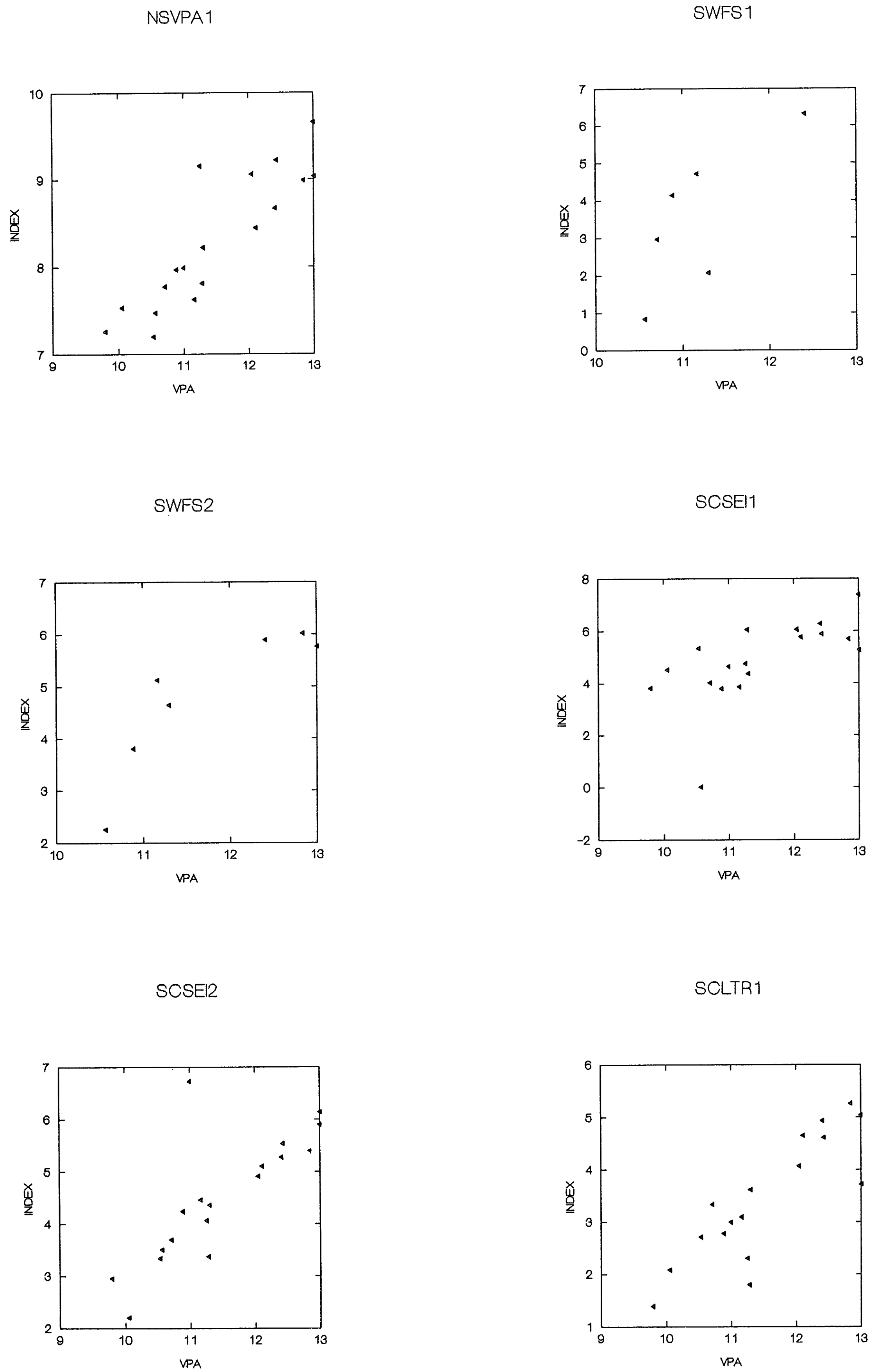


Figure 10.5.1

1-gp HADDOCK in VIa. Research Vessel Indices vs VPA (log values)



cont'd.

Figure 10.5.1 cont'd.

1-gp HADDOCK in VIa. Research Vessel Indices vs VPA (log values)

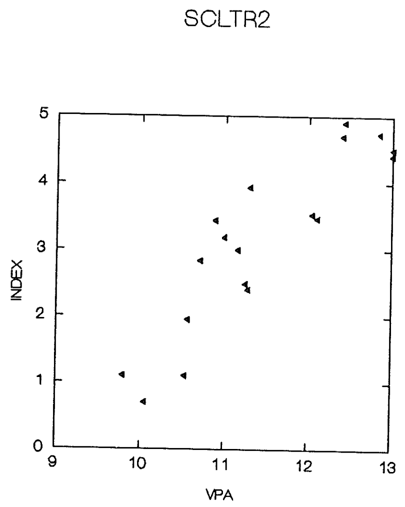
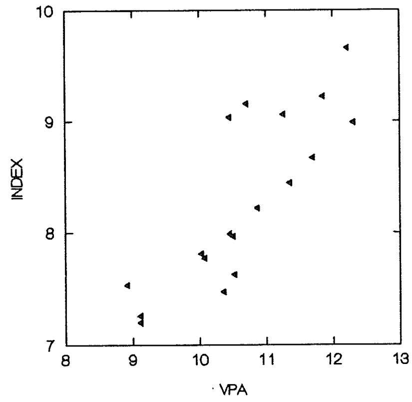


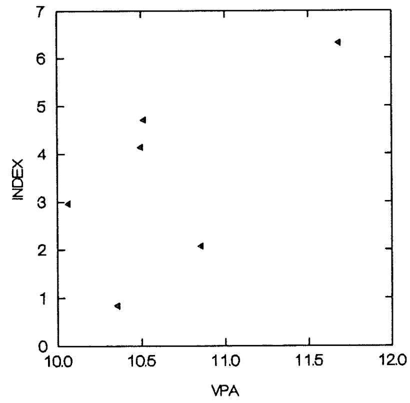
Figure 10.5.2

2-gp HADDOCK in VIa. Research Vessel Indices vs VPA (log values)

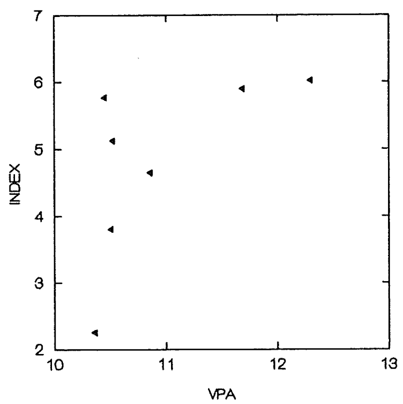
NSVPA1



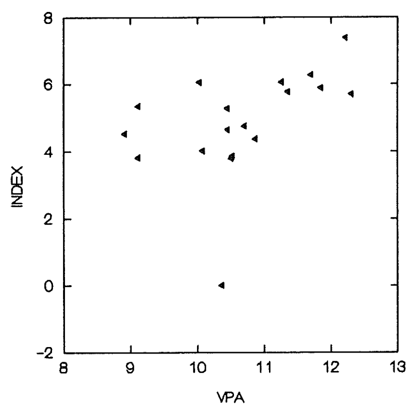
SWFS1



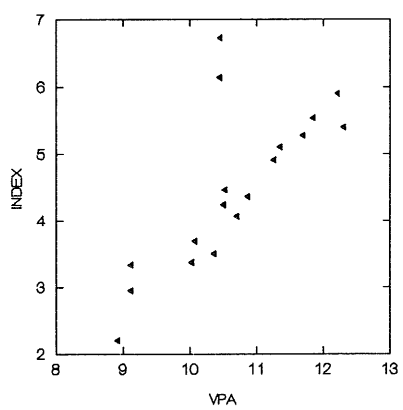
SWFS2



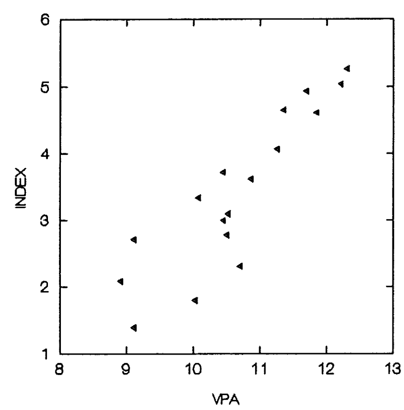
SCSEI1



SCSEI2



SCLTR1



cont'd.

Figure 10.5.2 cont'd.

2-gp HADDOCK in VIa. Research Vessel Indices vs VPA (log values)

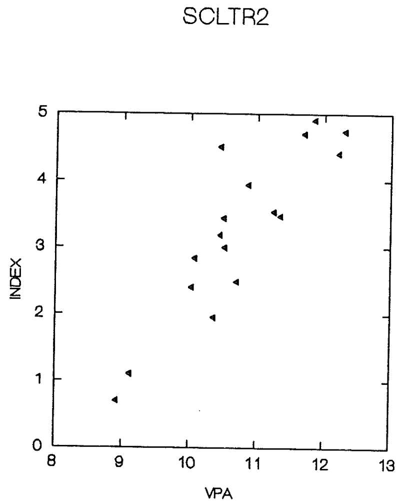
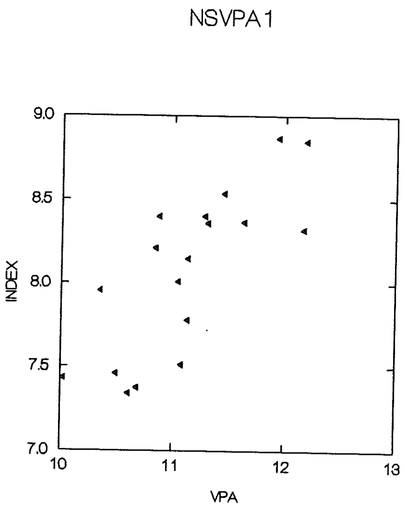
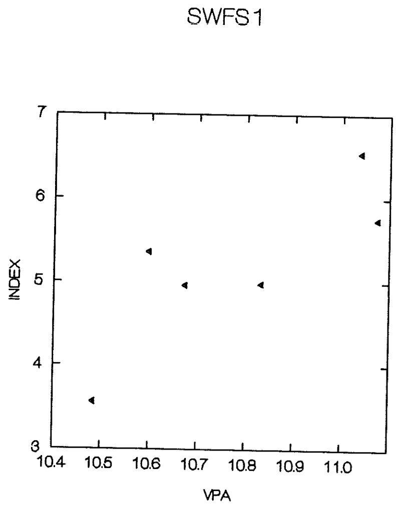


Figure 10.6.1

1-gp WHITING in VIa. Research Vessel Indices vs VPA (log values)





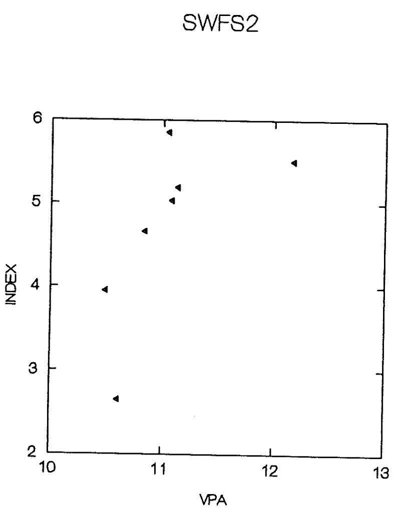
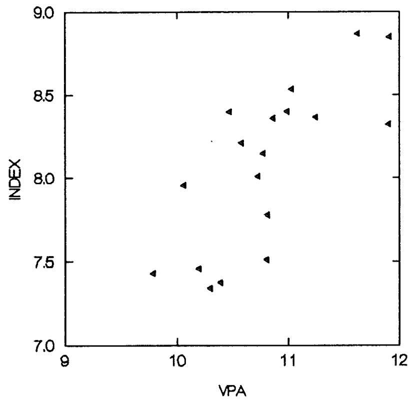


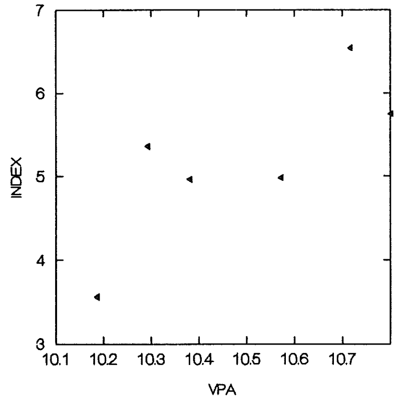
Figure 10.6.2

2-gp WHITING in VIa. Research Vessel Indices vs VPA (log values)

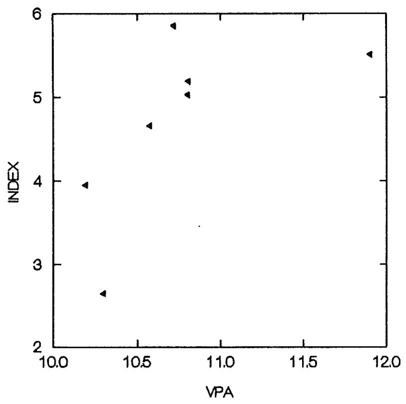
NSVPA1



SWFS1



SWFS2



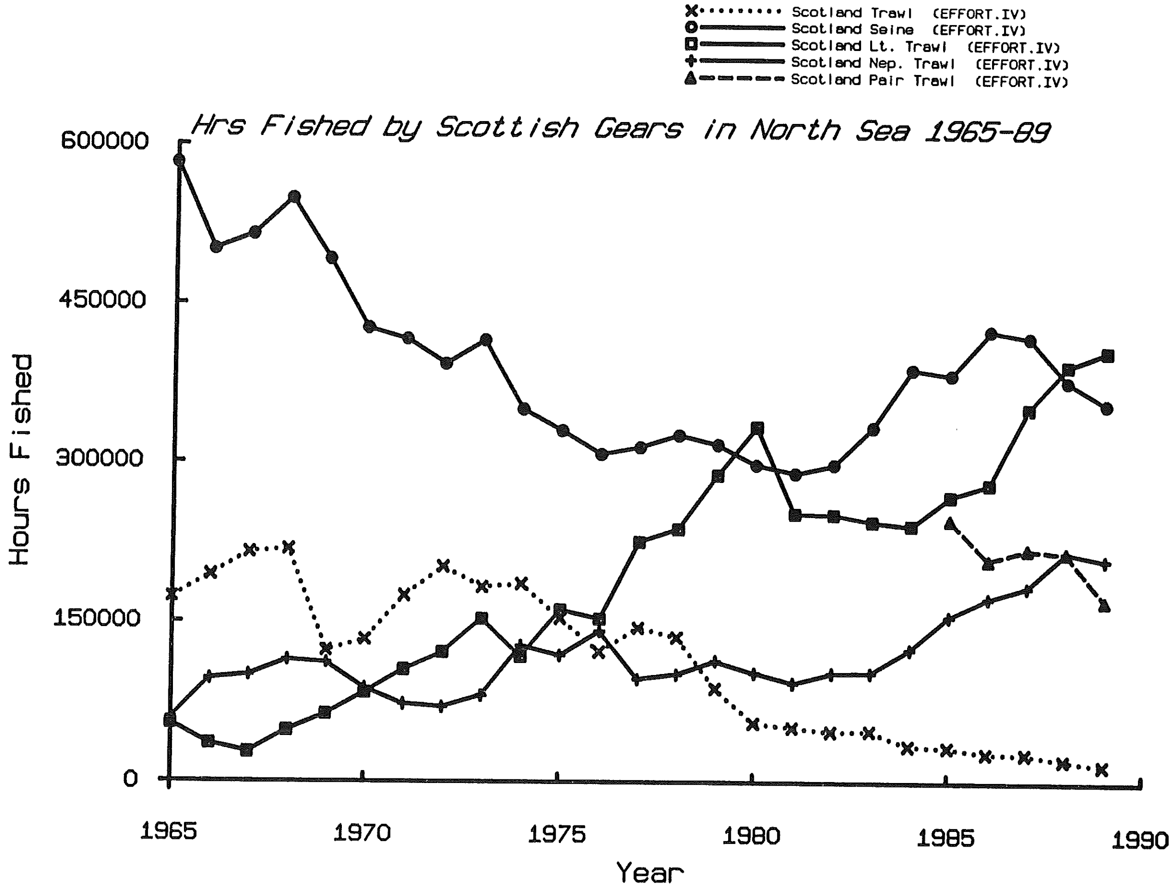


Figure 11.1

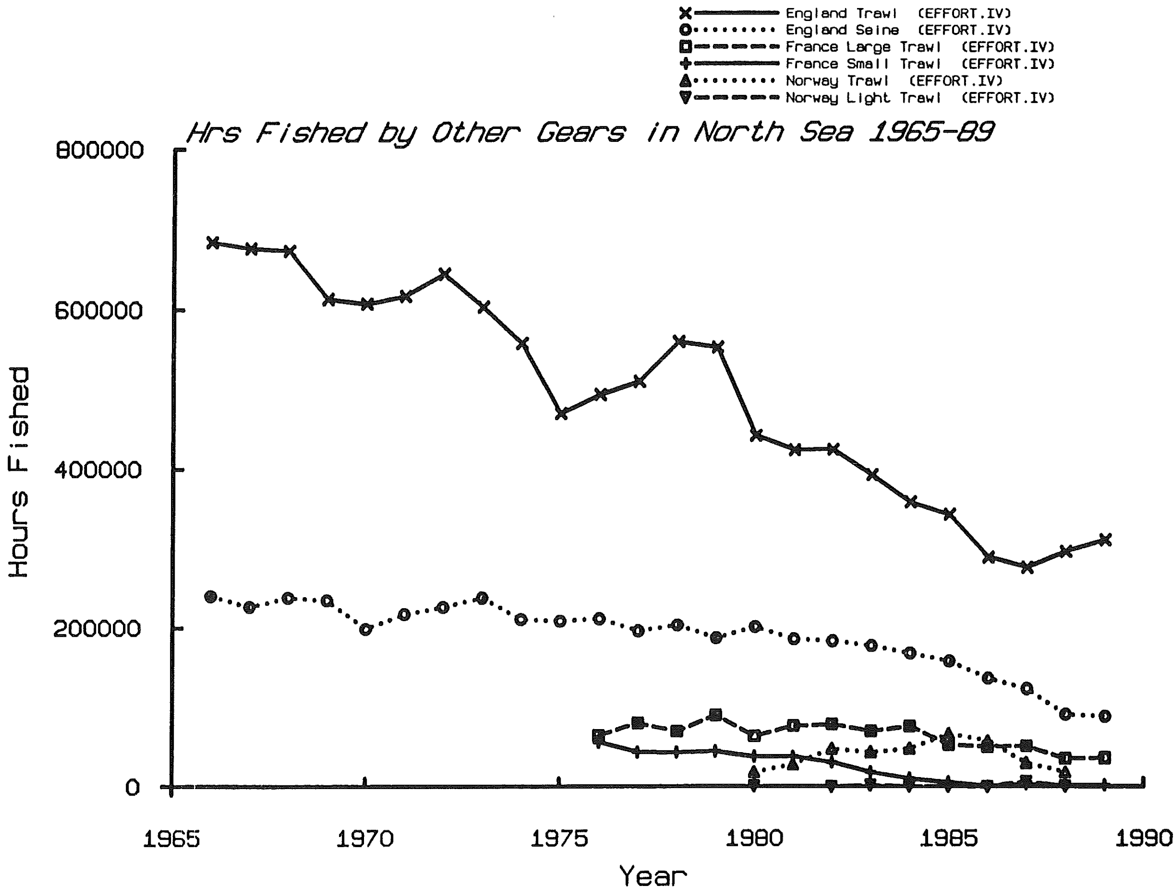
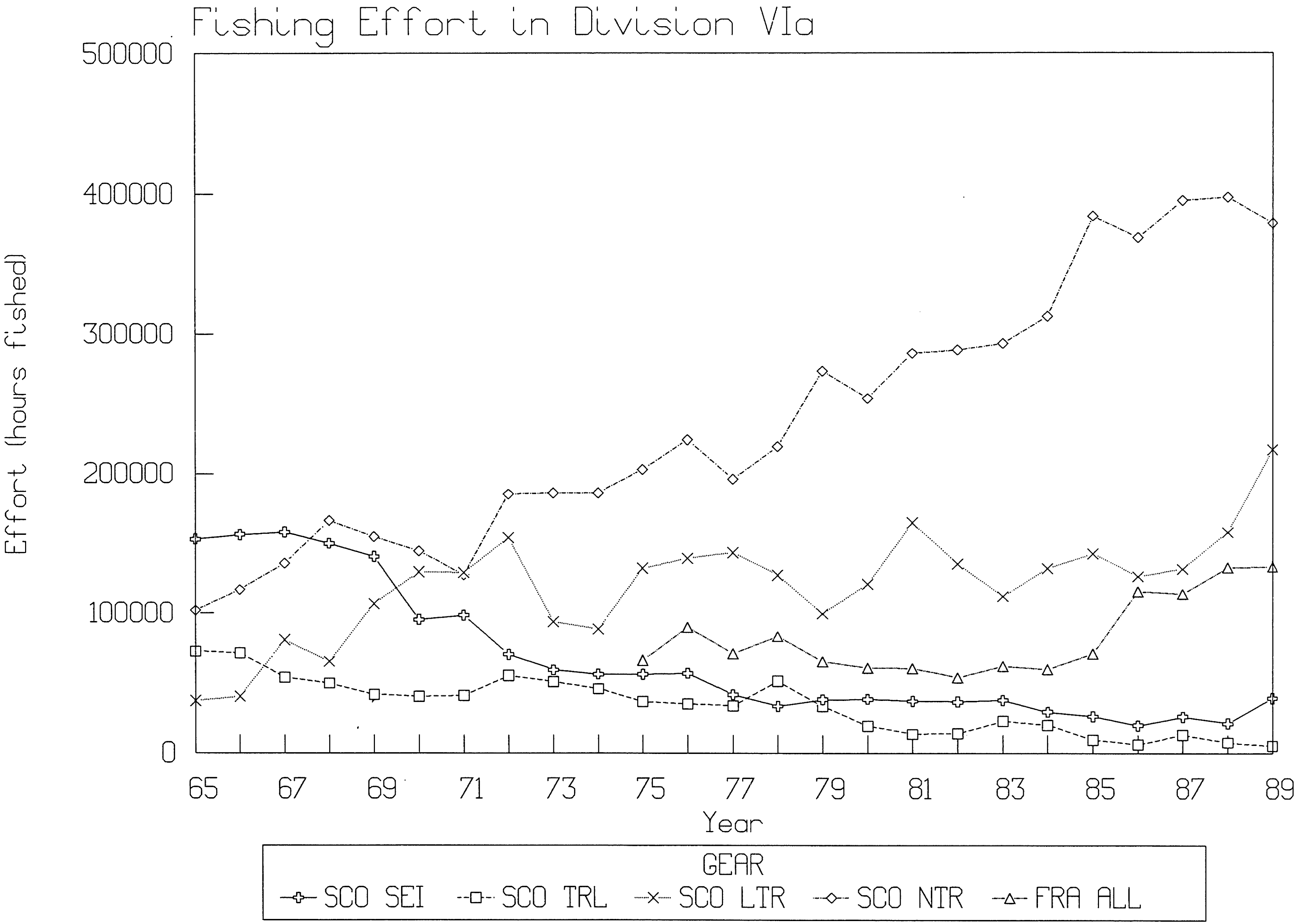


Figure 11.2

Figure 11.3



Fishing Effort in Division VIa
Effort (hours fished)
500000
400000
300000
200000
100000
0
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
GEAR
SCO SEI
SCO TRL
SCO LTR
SCO NTR
FRA ALL

Figure 12.1

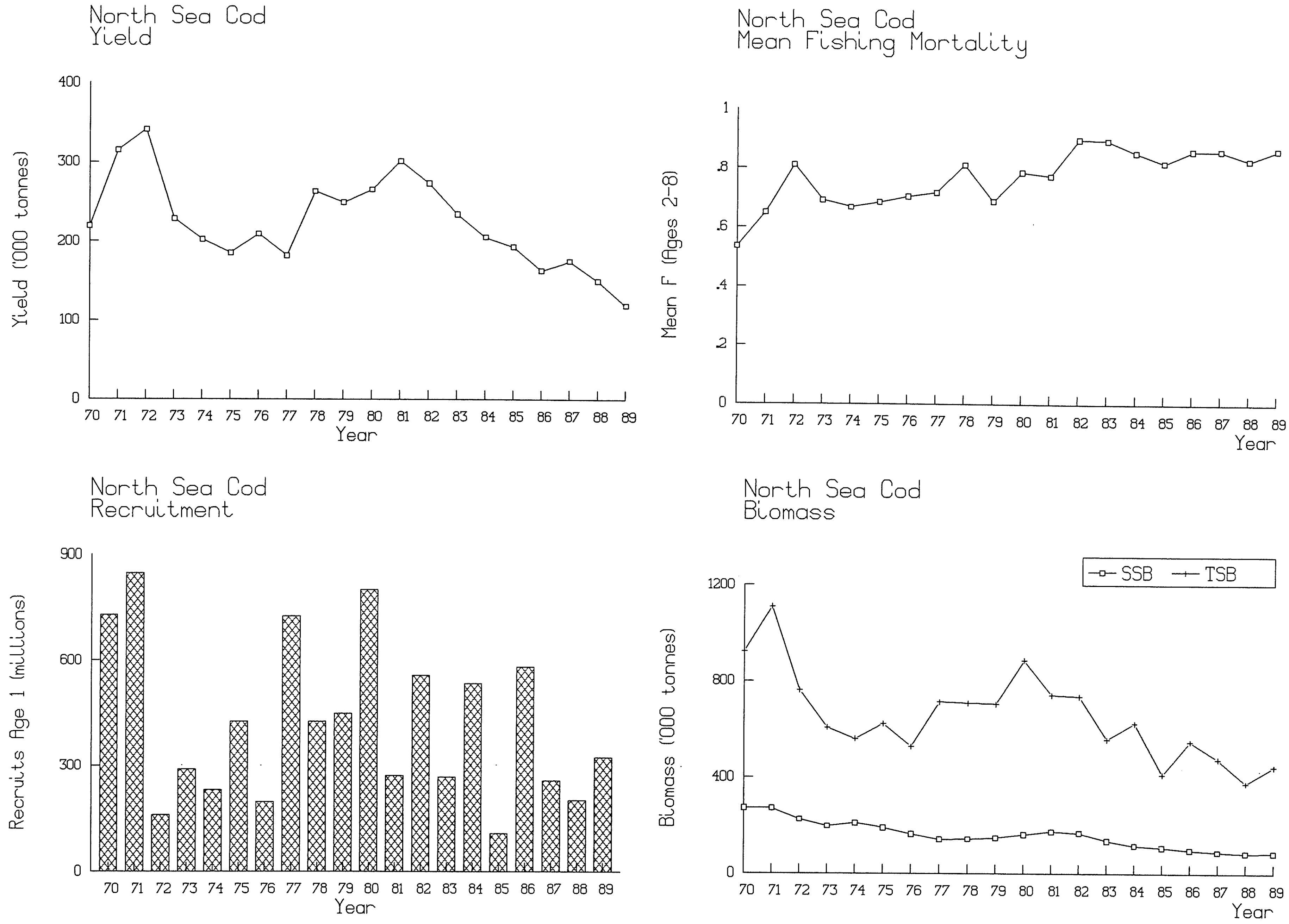
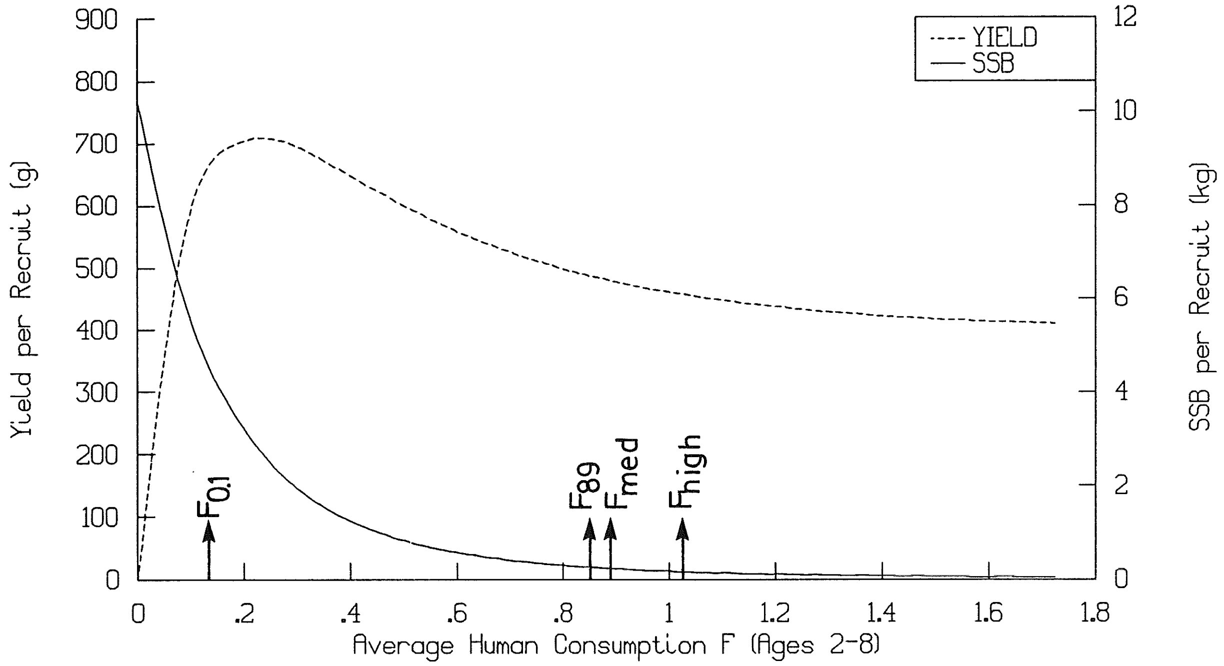

North Sea Cod
Yield
Yield ('000 tonnes)
400
300
200
100
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
North Sea Cod
Mean Fishing Mortality
Mean F (Ages 2-8)
1
.8
.6
.4
.2
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
North Sea Cod
Recruitment
Recruits Age 1 (millions)
900
600
300
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
North Sea Cod
Biomass
SSB
TSB
Biomass ('000 tonnes)
1200
800
400
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year

Figure 12.2 NORTH SEA COD.

a) Long Term Total Landings and Spawning Biomass



b) Short Term Total Landings and Spawning Biomass

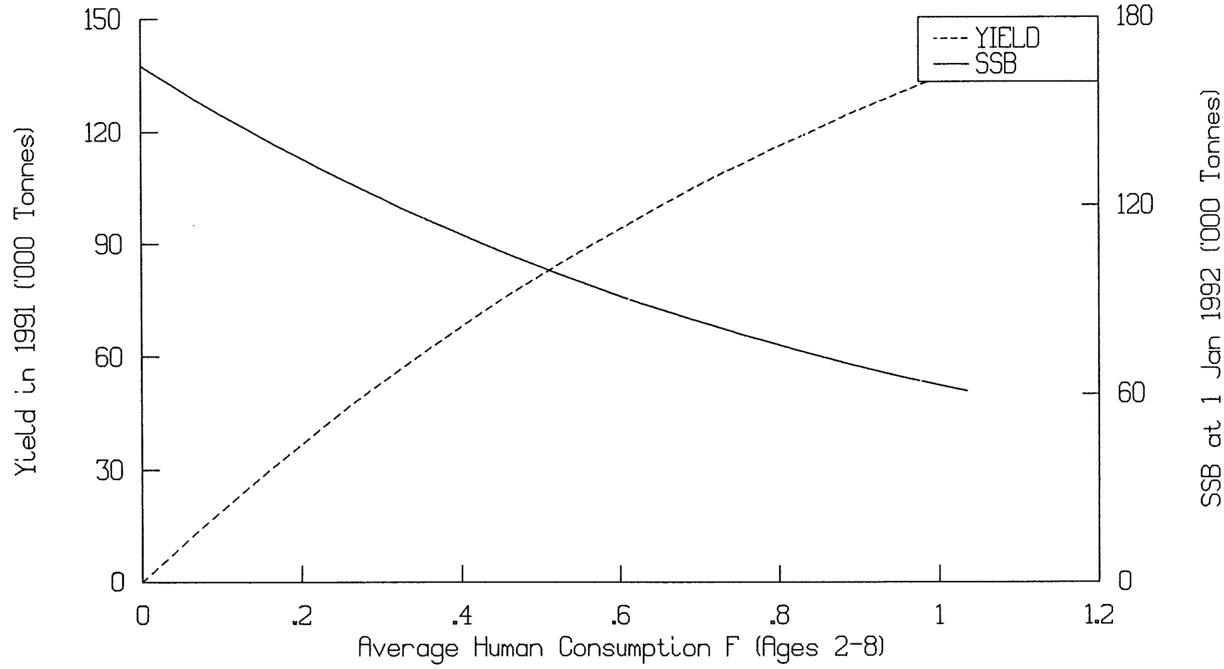


Figure 12.3

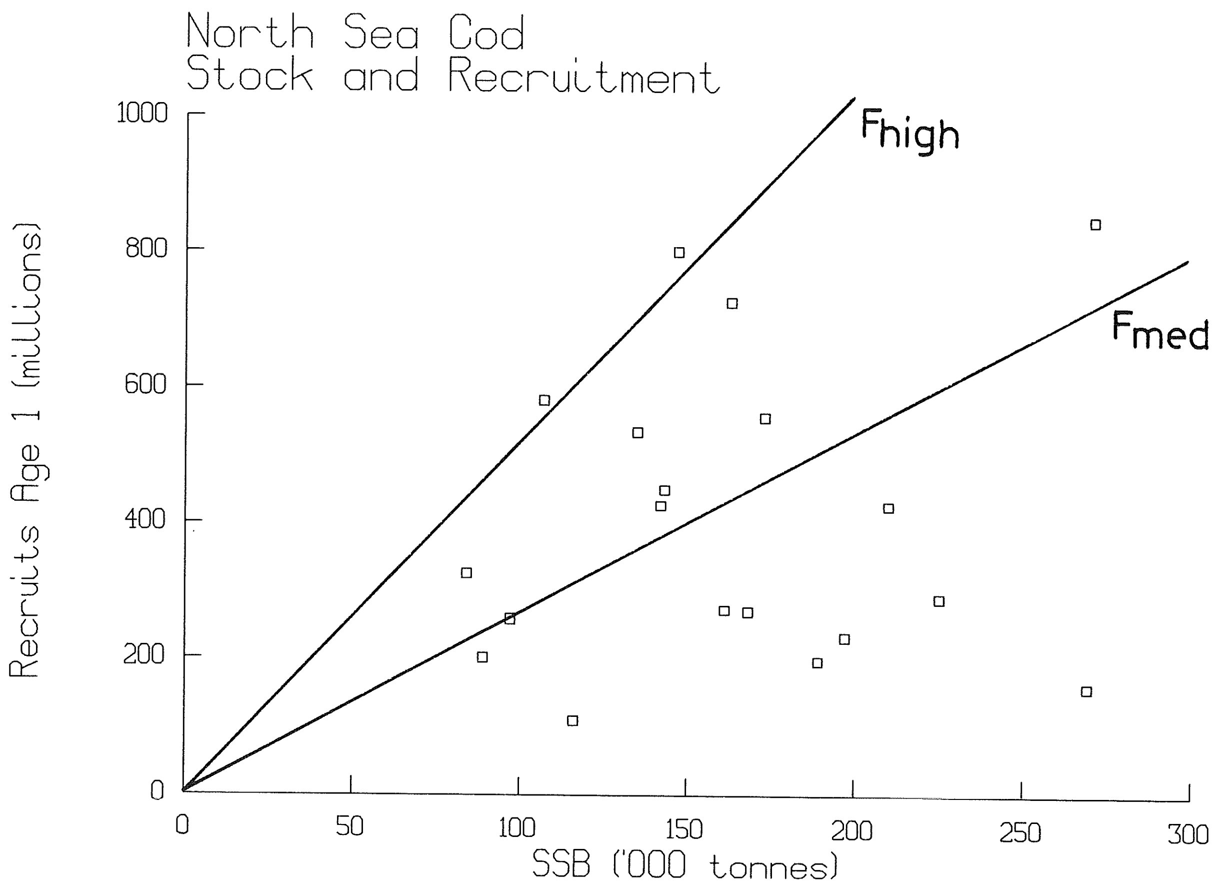
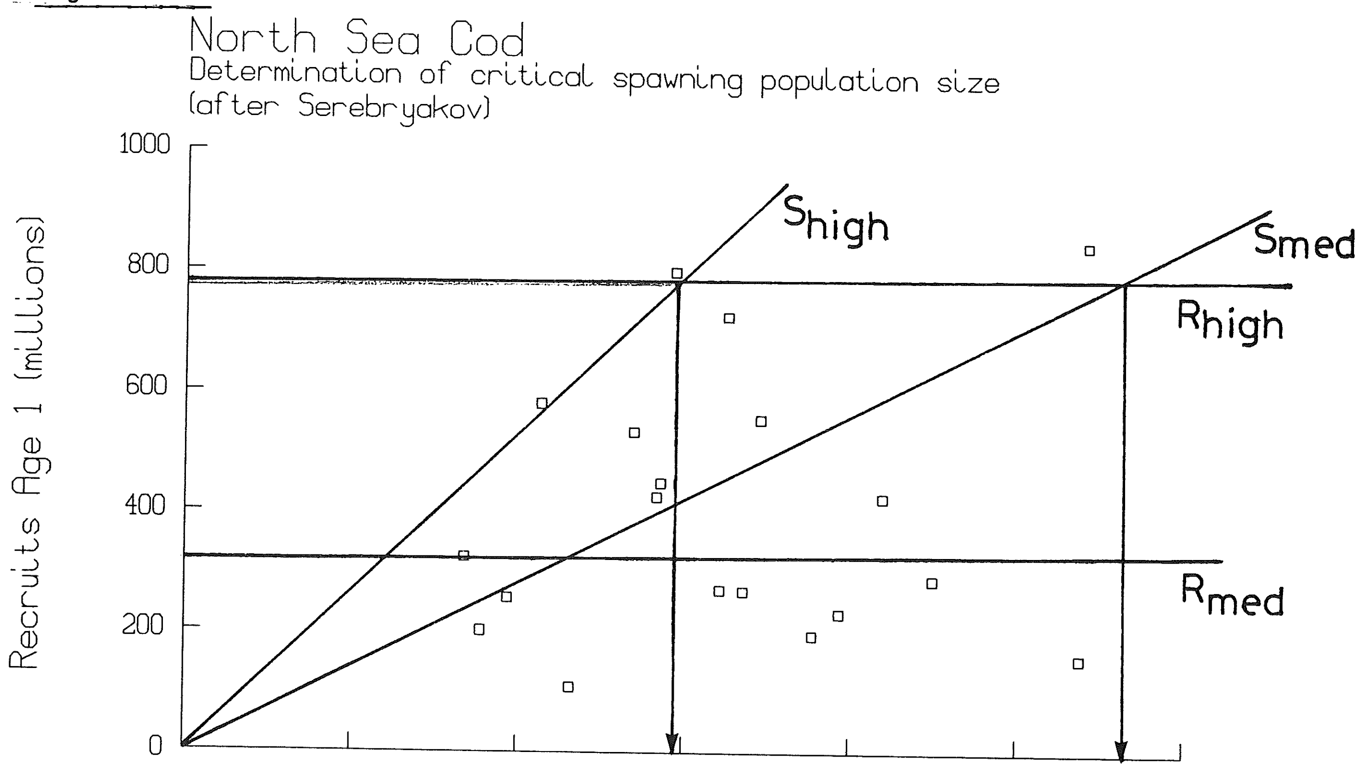
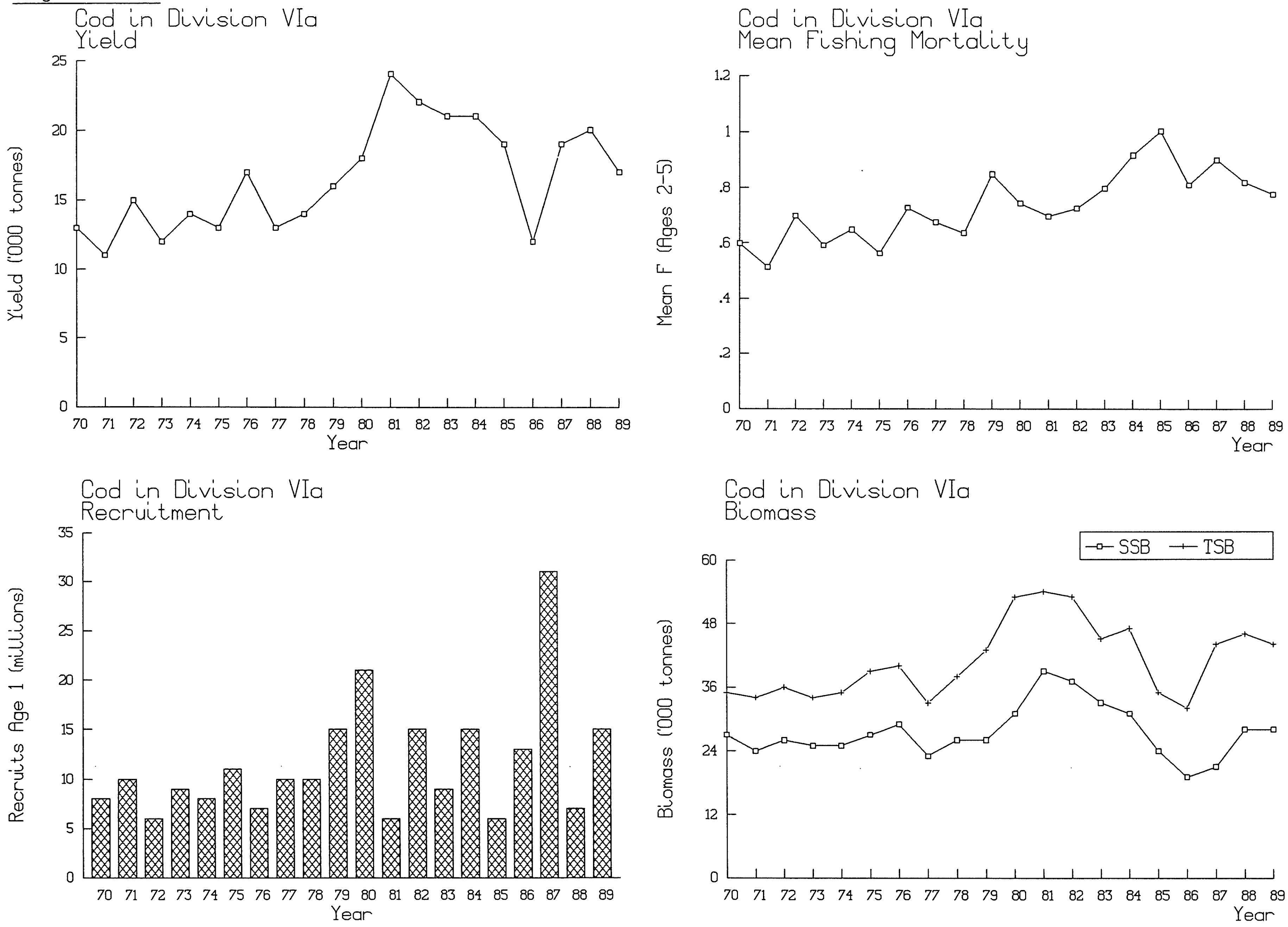


Figure 12.4



SSB at a 'safe' level: 280,000t
SSB at a 'critical' level: 150,000t

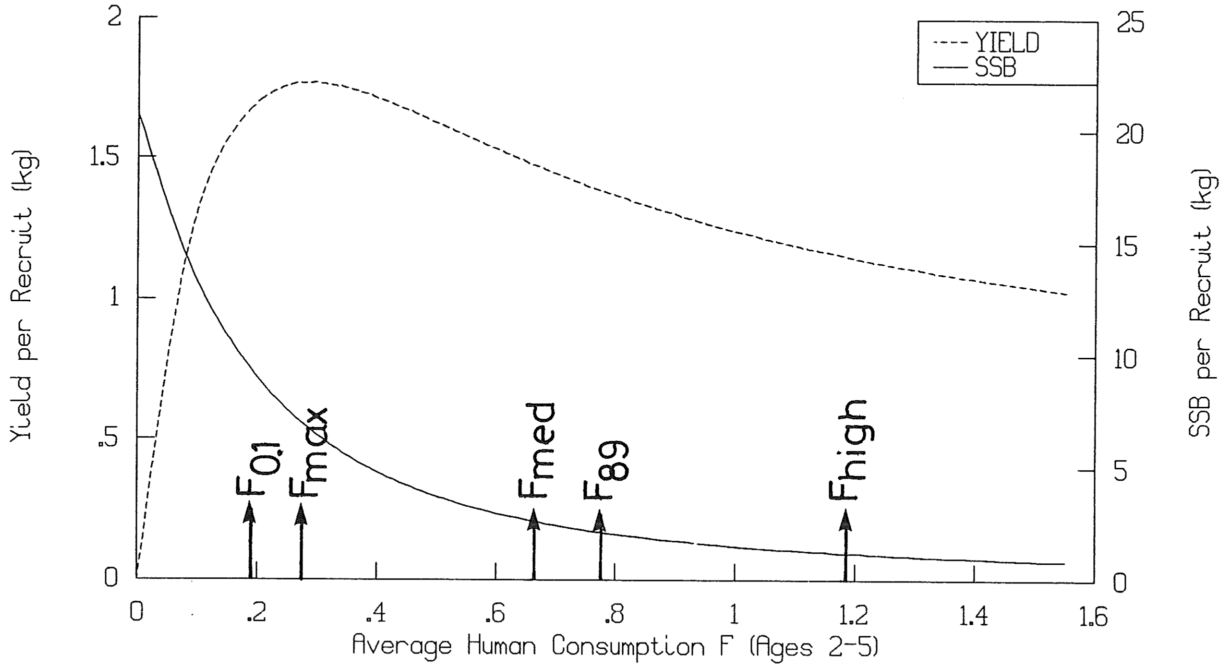
Figure 13.1



Cod in Division VIa
Yield
Yield ('000 tonnes)
Year
Cod in Division VIa
Mean Fishing Mortality
Mean F (Ages 2-5)
Year
Cod in Division VIa
Recruitment
Recruits Age 1 (millions)
Year
Cod in Division VIa
Biomass
SSB
TSB
Biomass ('000 tonnes)
Year

Figure 13.2 COD in Division VIa.

a) Long Term Total Landings and Spawning Biomass



b) Short Term Total Landings and Spawning Biomass

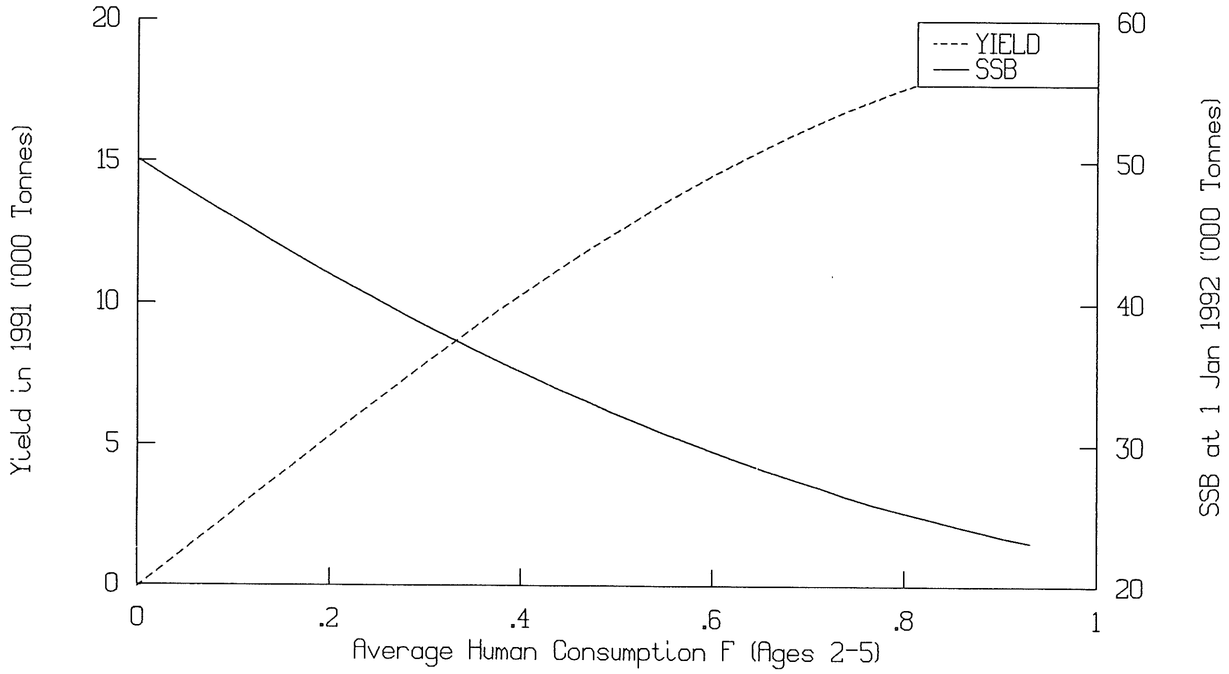


Figure 13.3

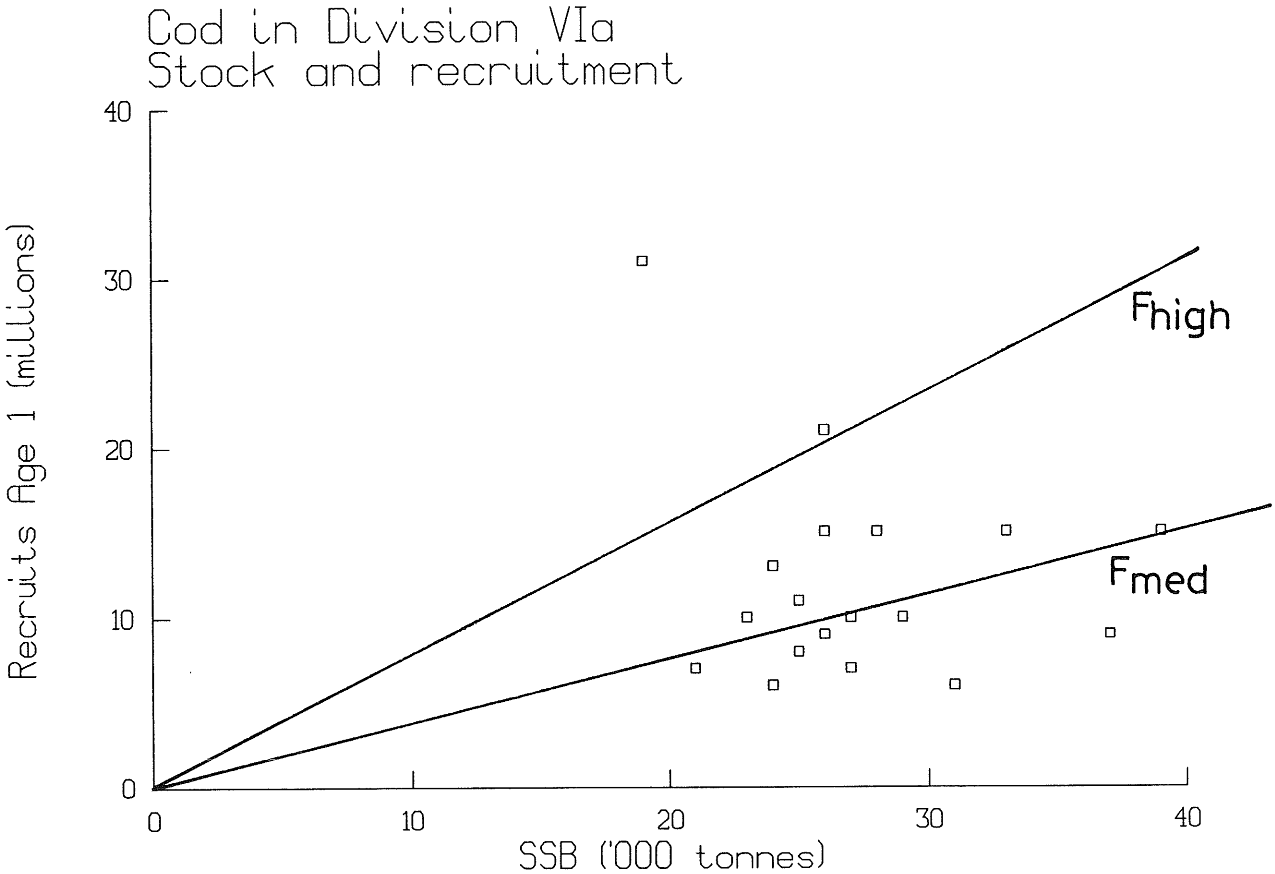

Cod in Division VIa
Stock and recruitment
Recruits Age 1 (millions)
40
30
20
10
0
0
10
20
30
40
SSB ('000 tonnes)
Fhigh
Fmed

Figure 18.1

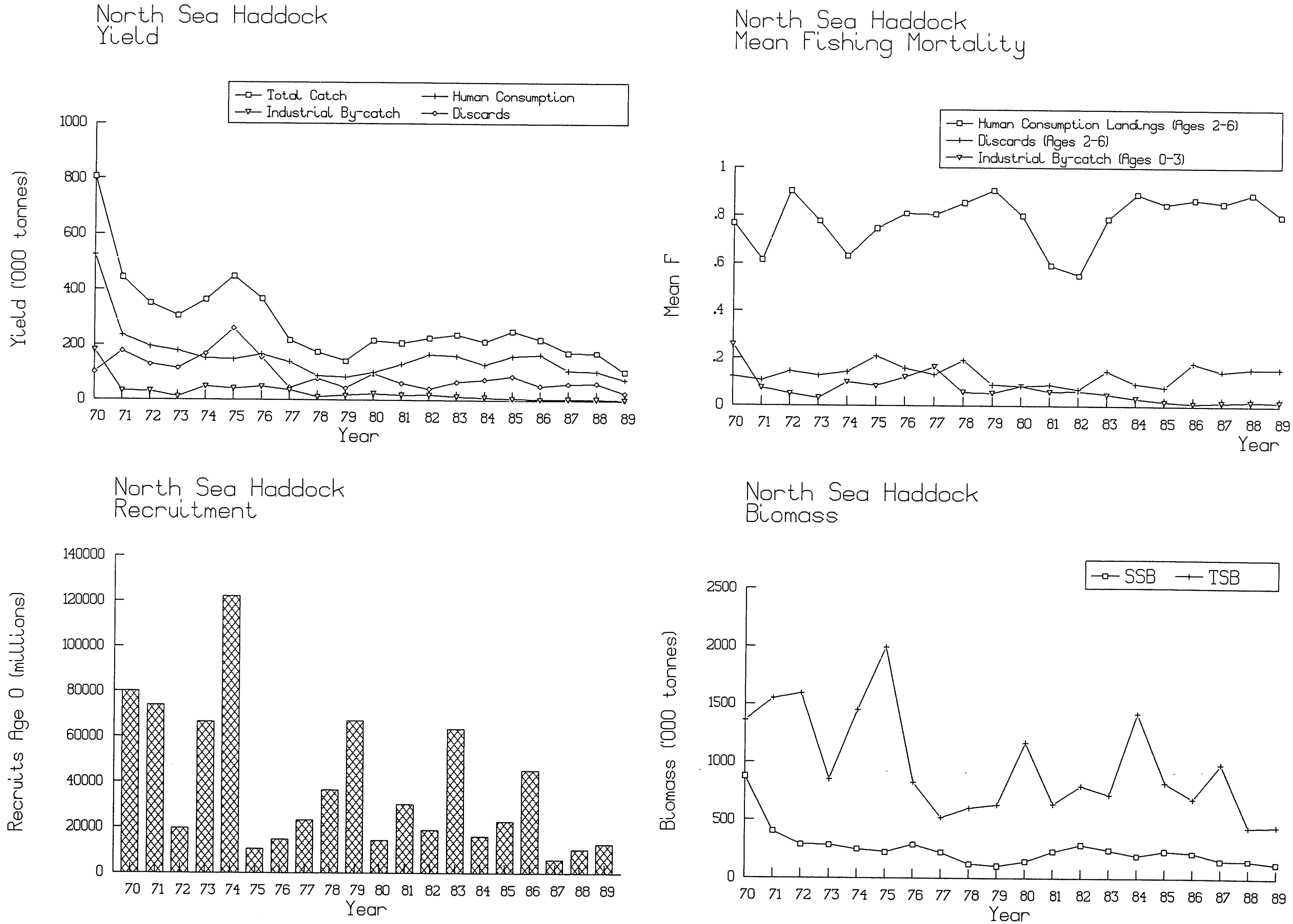
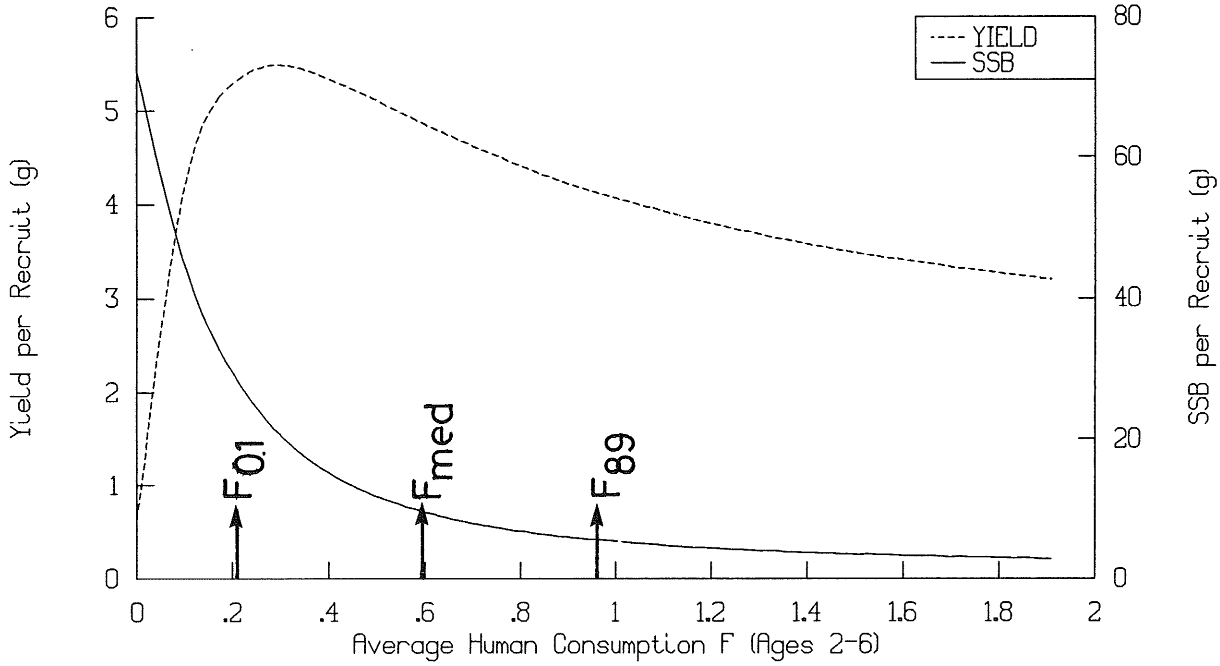

North Sea Haddock
Yield
Total Catch
Human Consumption
Industrial By-catch
Discards
Yield ('000 tonnes)
Year
North Sea Haddock
Mean Fishing Mortality
Human Consumption Landings (Ages 2-6)
Discards (Ages 2-6)
Industrial By-catch (Ages 0-3)
Mean F
Year
North Sea Haddock
Recruitment
Recruits Age 0 (millions)
Year
North Sea Haddock
Biomass
SSB
TSB
Biomass ('000 tonnes)
Year

Figure 18.2 North Sea HADDOCK.

a) Long Term Total Landings and Spawning Biomass



b) Short Term Total Landings and Spawning Biomass

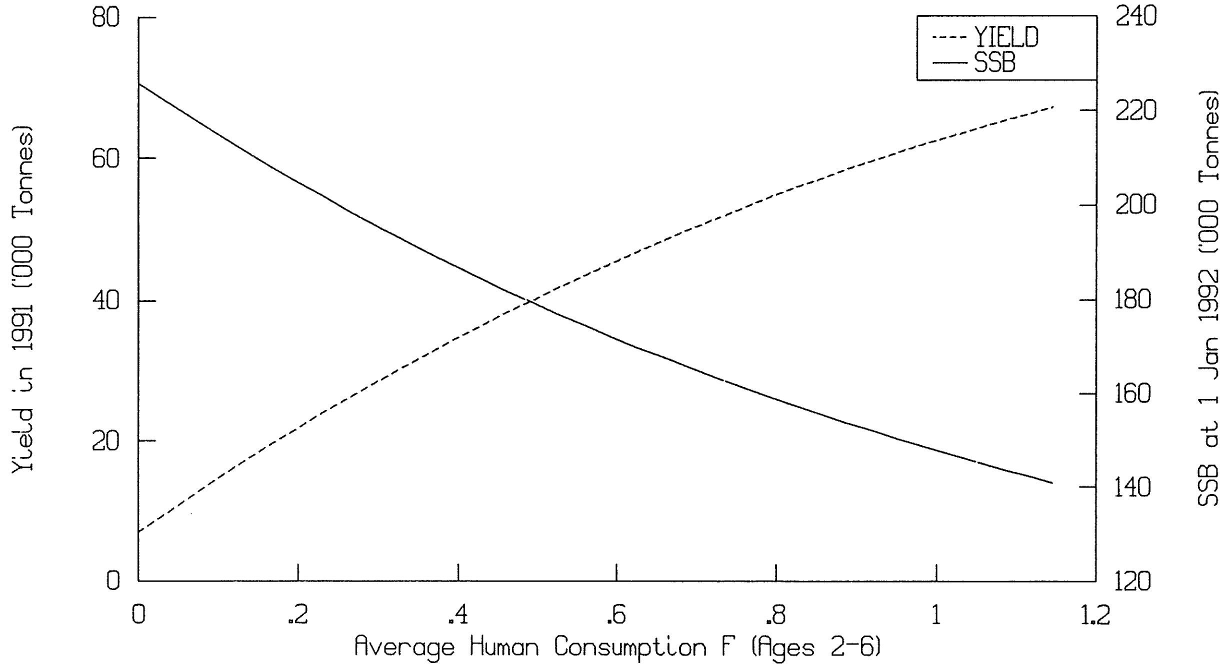


Figure 18.3

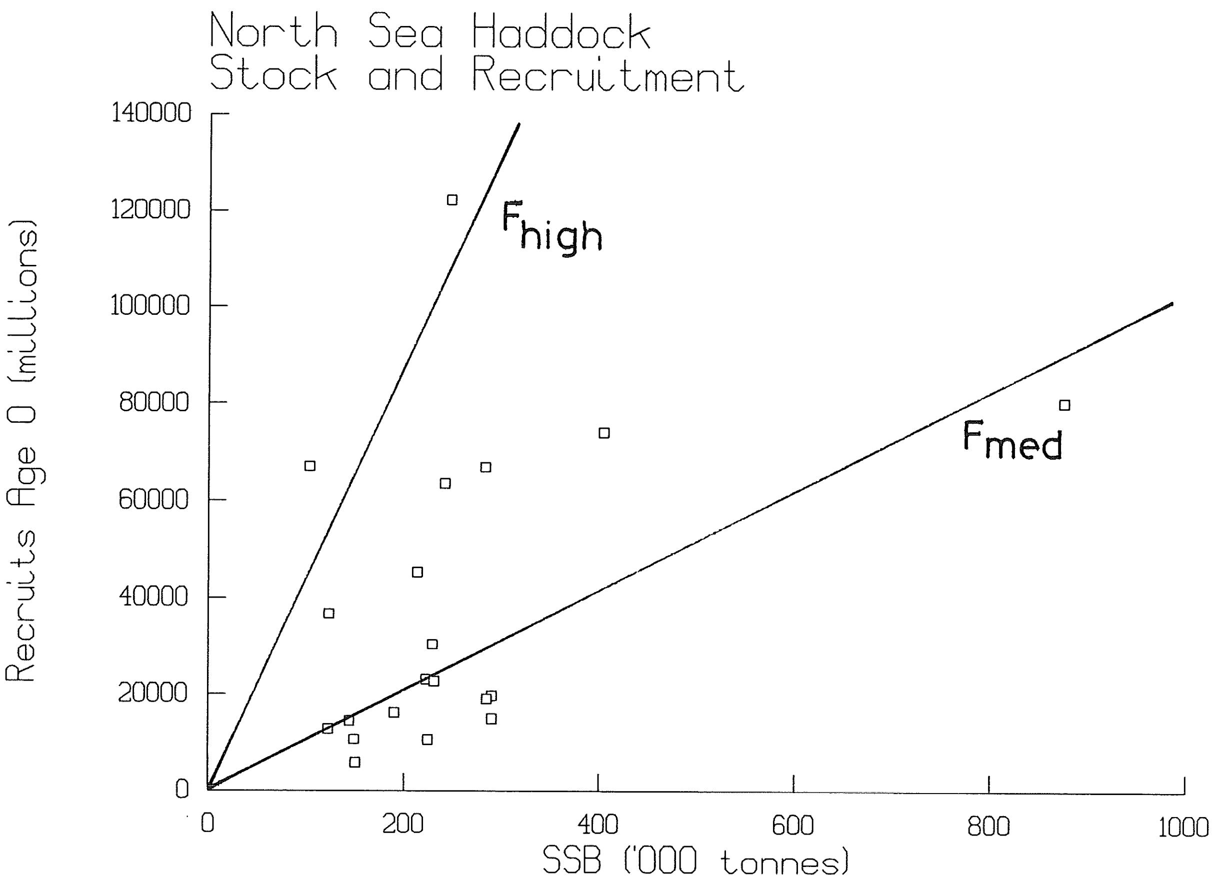

North Sea Haddock
Stock and Recruitment
140000
120000
100000
80000
60000
40000
20000
0
Recruits Age 0 (millions)
0
200
400
600
800
1000
SSB ('000 tonnes)
F_{high}
F_{med}

Figure 19.1

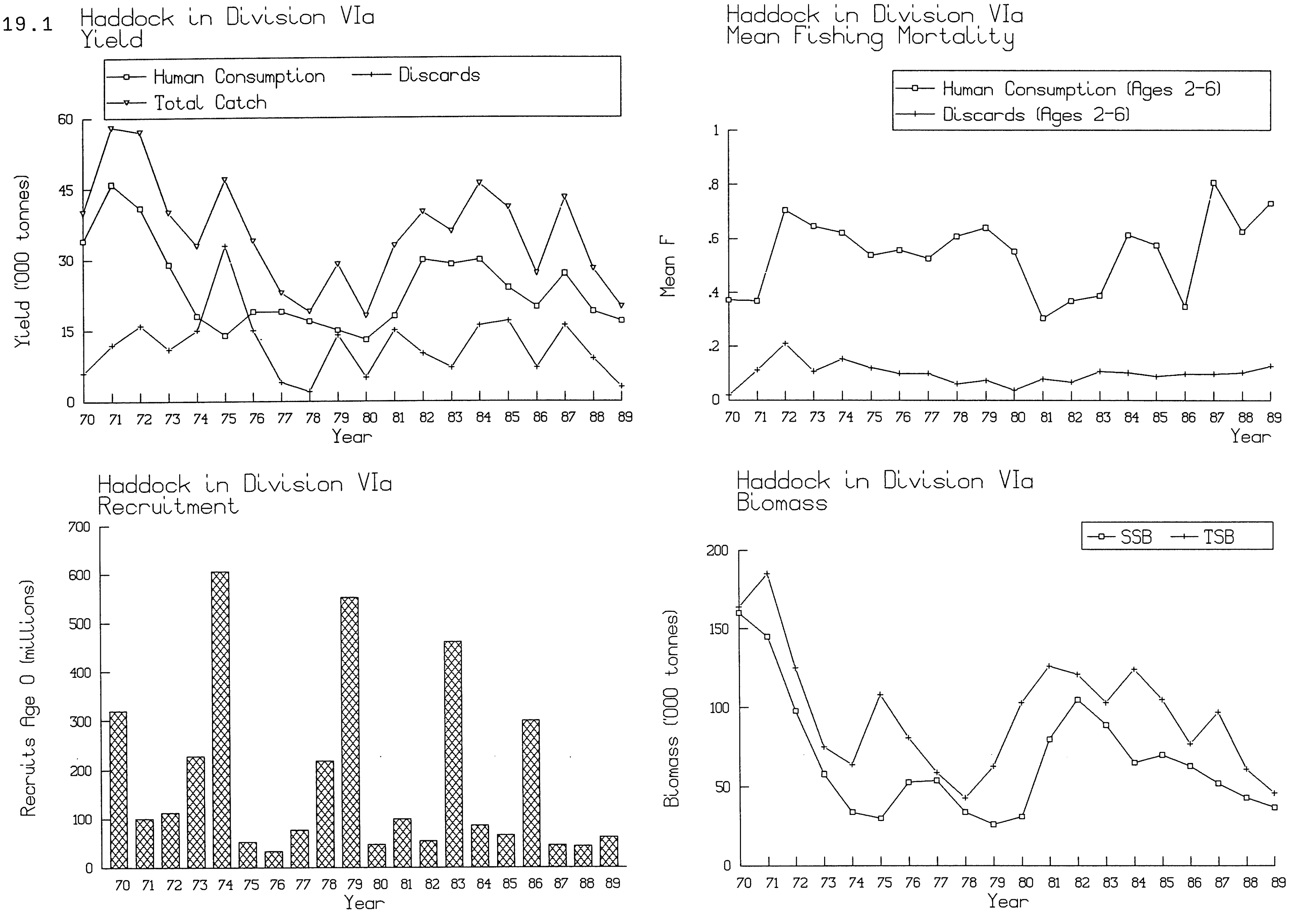
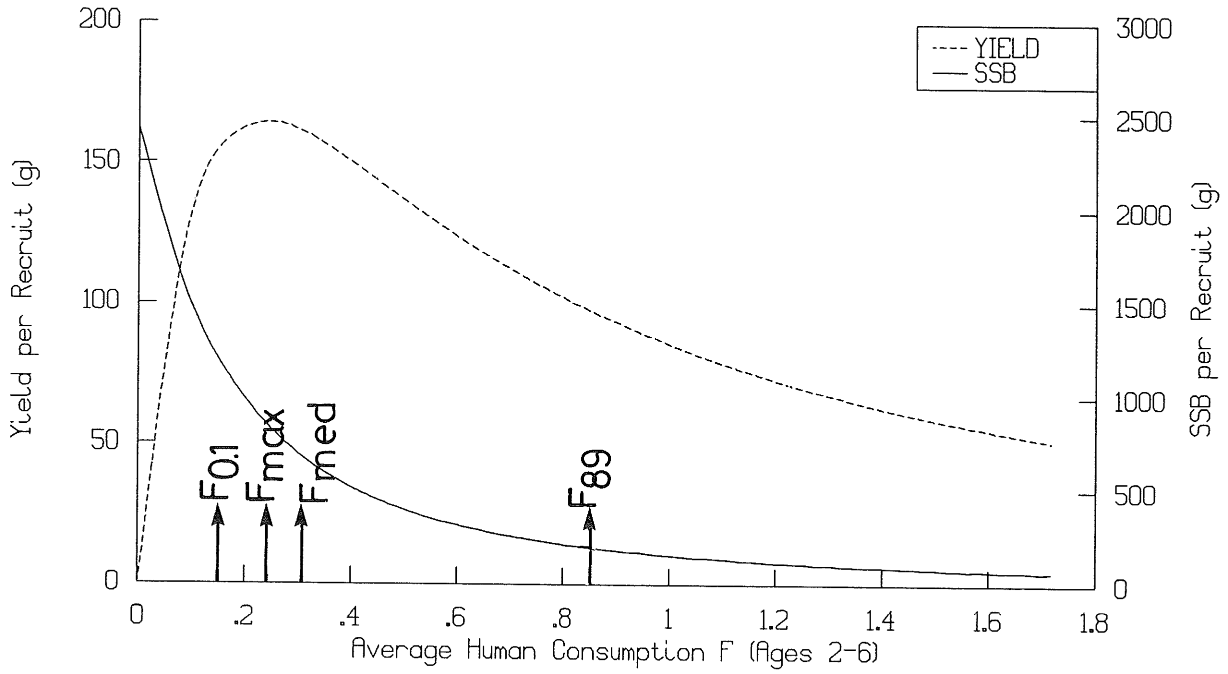

Haddock in Division VIa
Yield
Human Consumption
Discards
Total Catch
Yield ('000 tonnes)
Year
Haddock in Division VIa
Mean Fishing Mortality
Human Consumption (Ages 2-6)
Discards (Ages 2-6)
Mean F
Year
Haddock in Division VIa
Recruitment
Recruits Age 0 (millions)
Year
Haddock in Division VIa
Biomass
SSB
TSB
Biomass ('000 tonnes)
Year

Figure 19.2 HADDOCK in Division VIa.

a) Long Term Total Landings and Spawning Biomass



b) Short Term Total Landings and Spawning Biomass

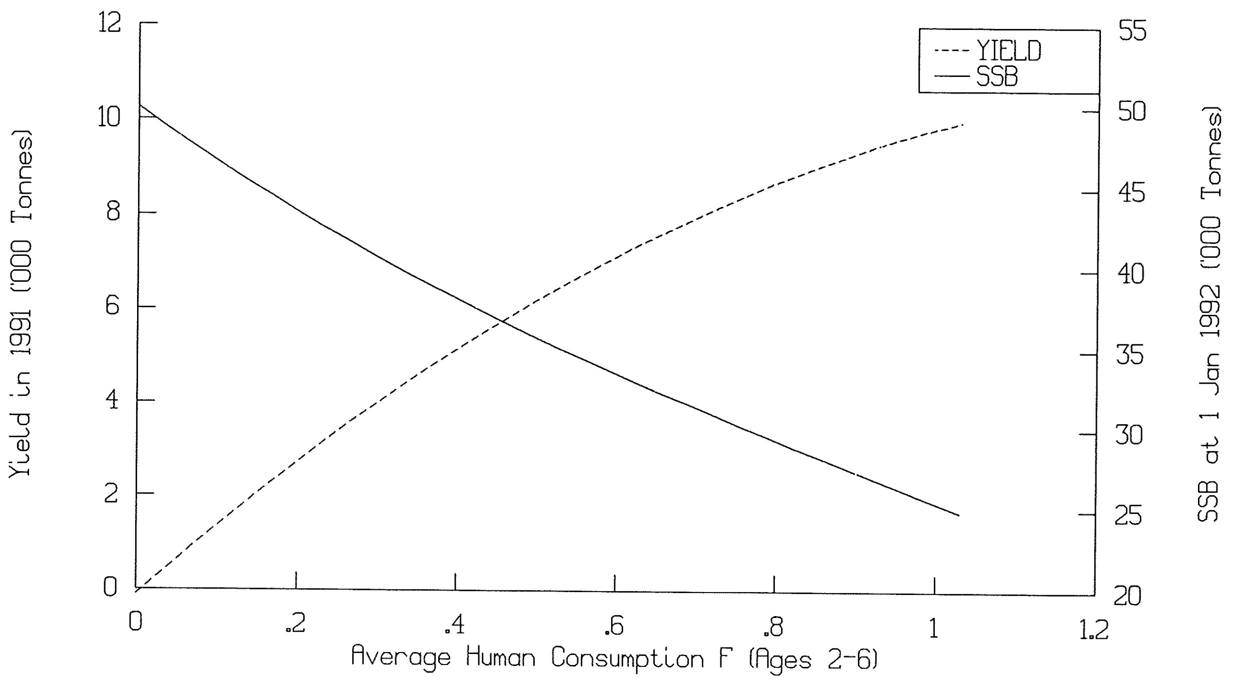
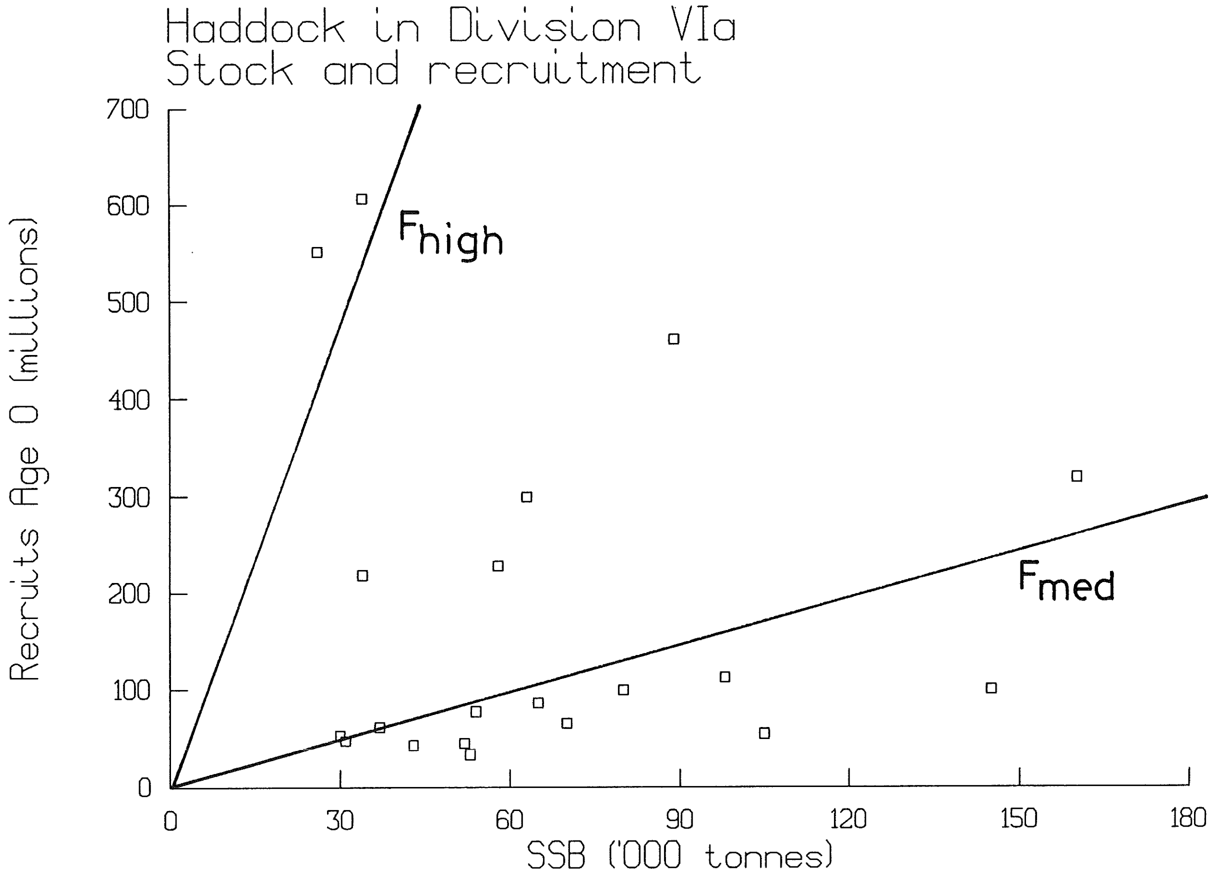
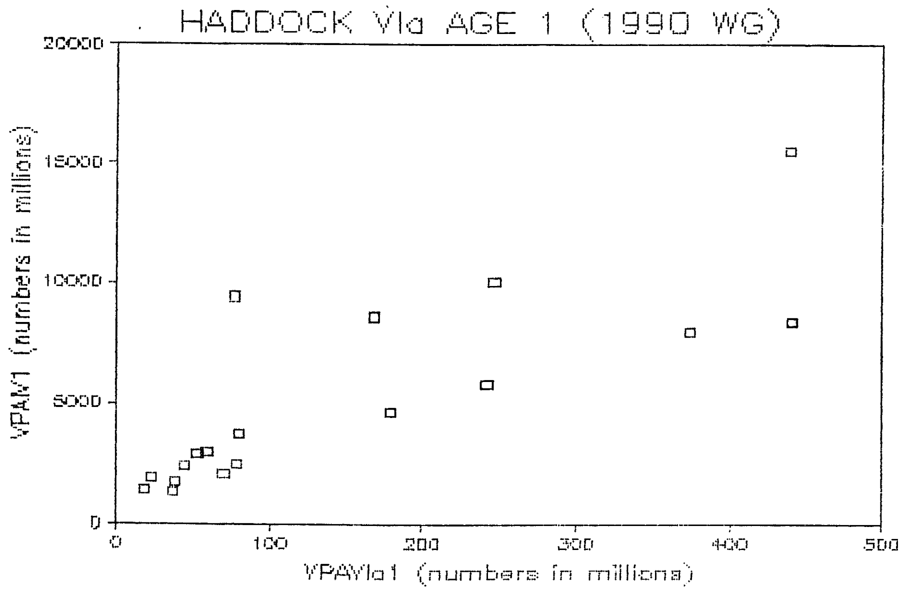


Figure 19.3


Haddock in Division VIa
Stock and recruitment
Recruits Age 0 (millions)
0
100
200
300
400
500
600
700
SSB ('000 tonnes)
0
30
60
90
120
150
180
Fhigh
Fmed



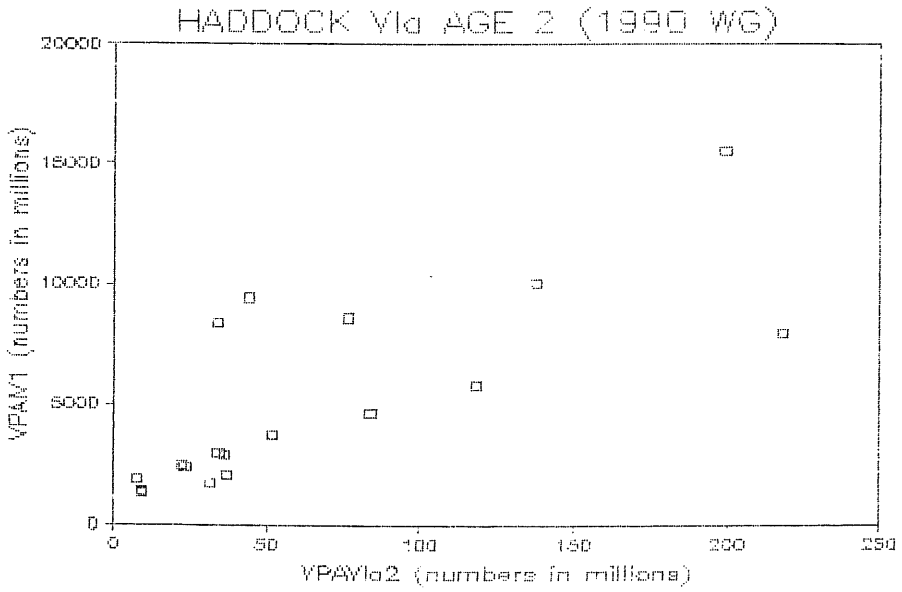


Figure 19.4 Plots of recruitment for haddock in Division VIa against the North Sea for ages 1 and 2.

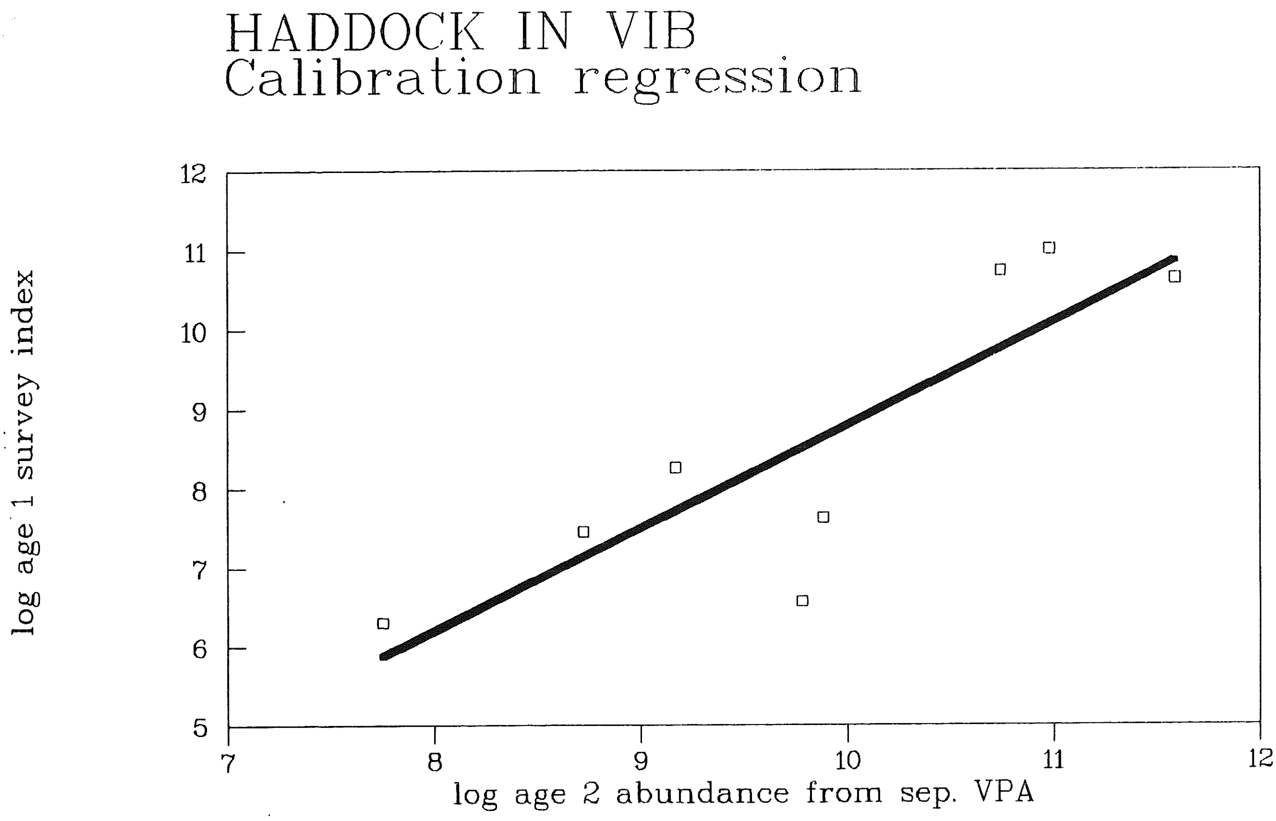


Figure 20.1

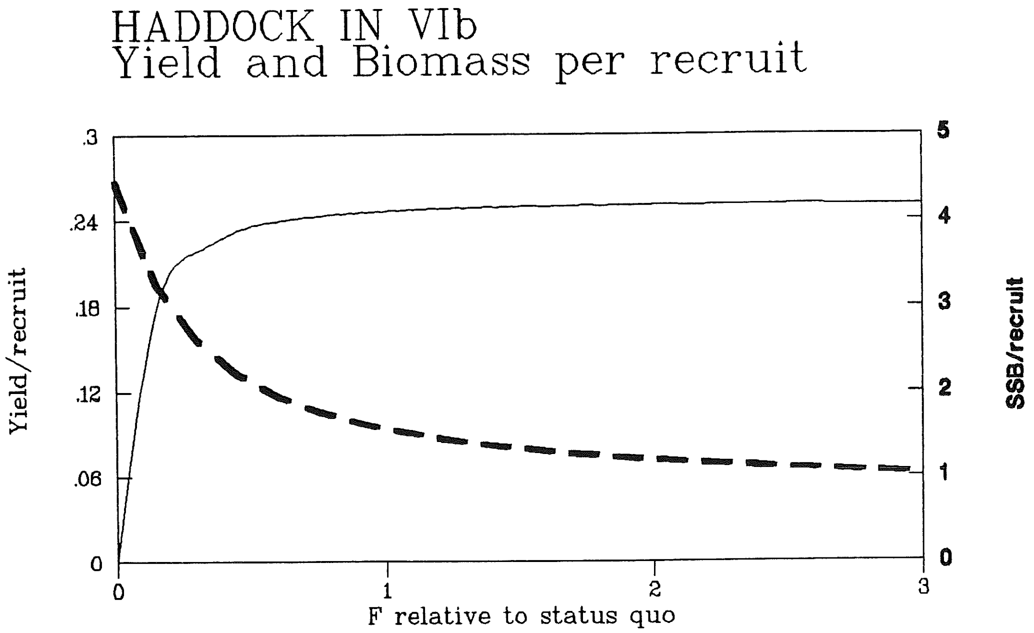
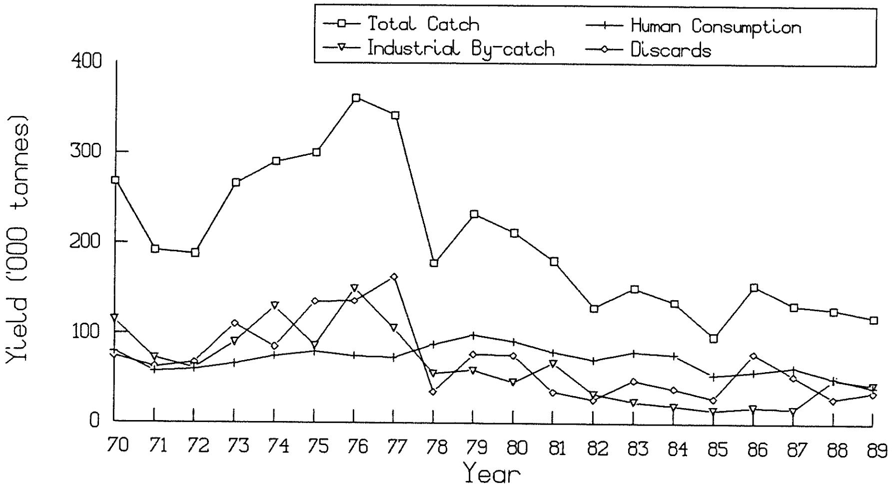


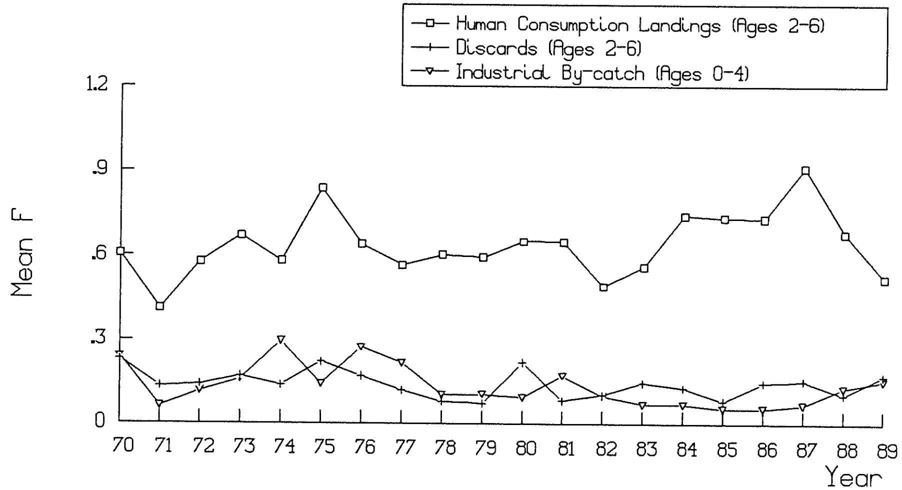
Figure 20.2

Figure 22.1

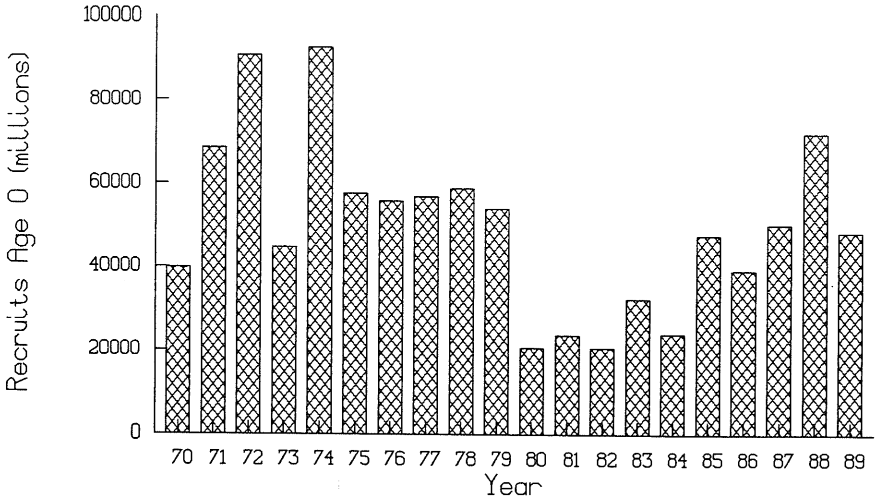
North Sea Whiting
Yield



North Sea Whiting
Mean Fishing Mortality



North Sea Whiting
Recruitment



North Sea Whiting
Biomass

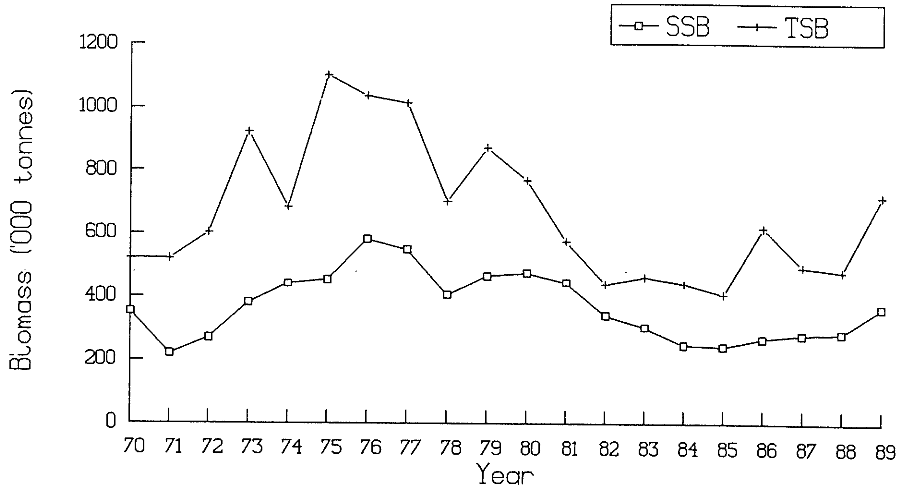
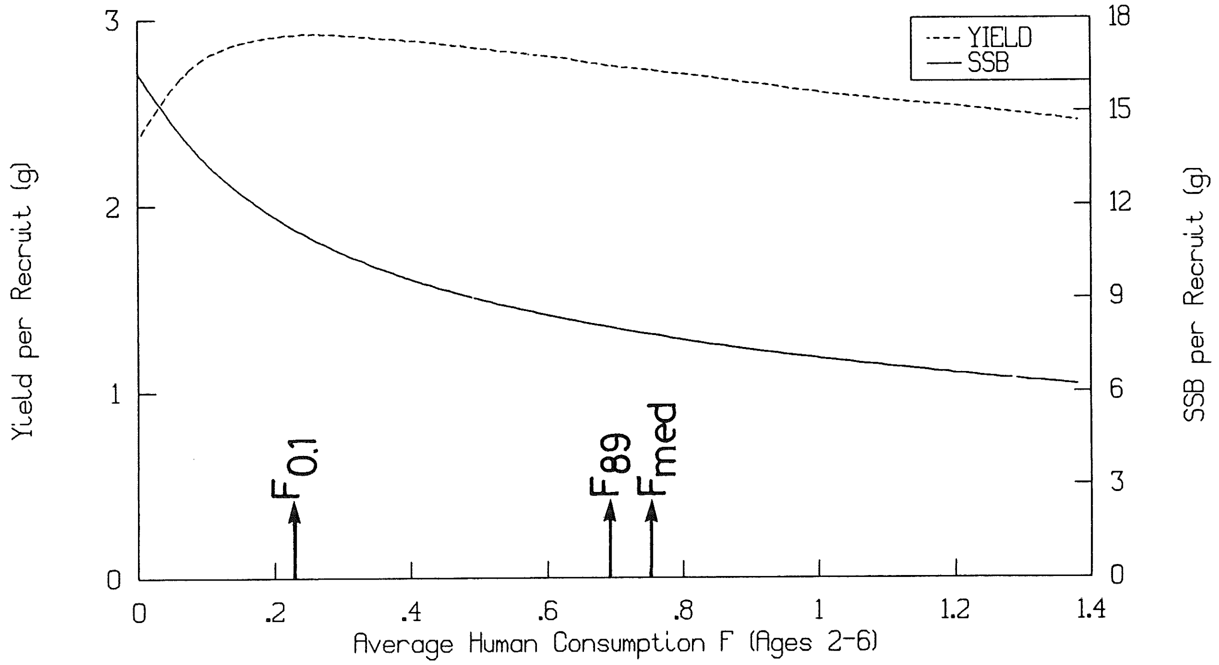


Figure 22.2 North Sea WHITING.

a) Long Term Total Landings and Spawning Biomass



b) Short Term Total Landings and Spawning Biomass

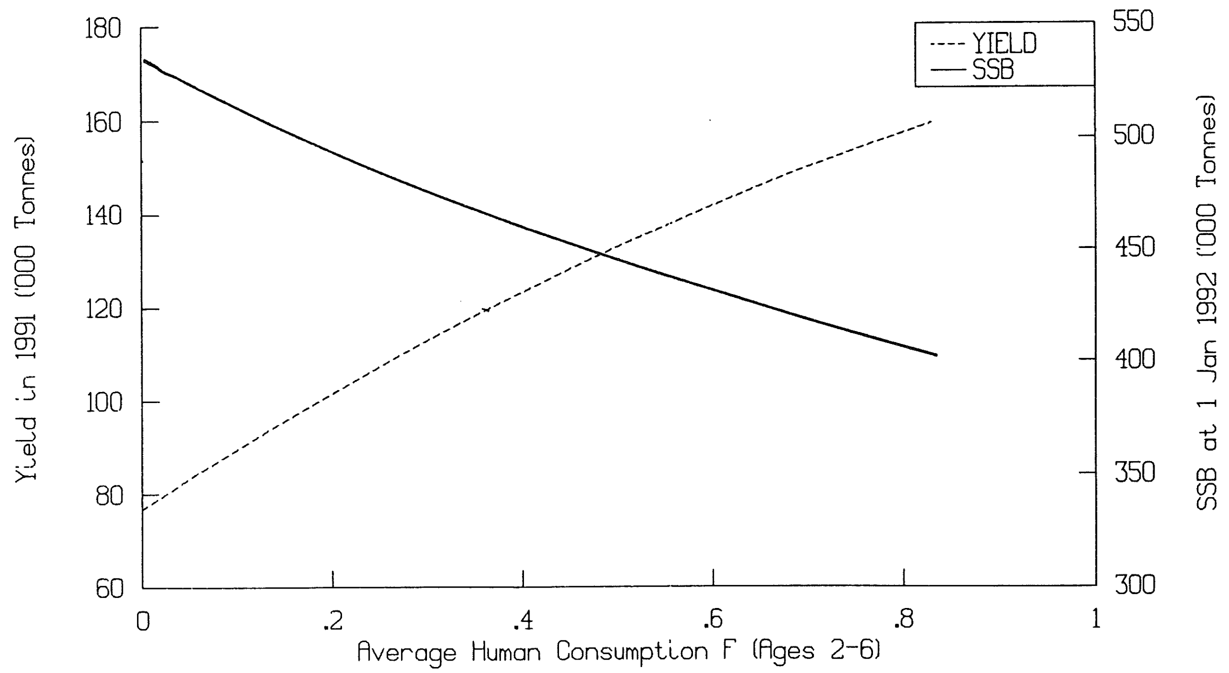


Figure 22.3

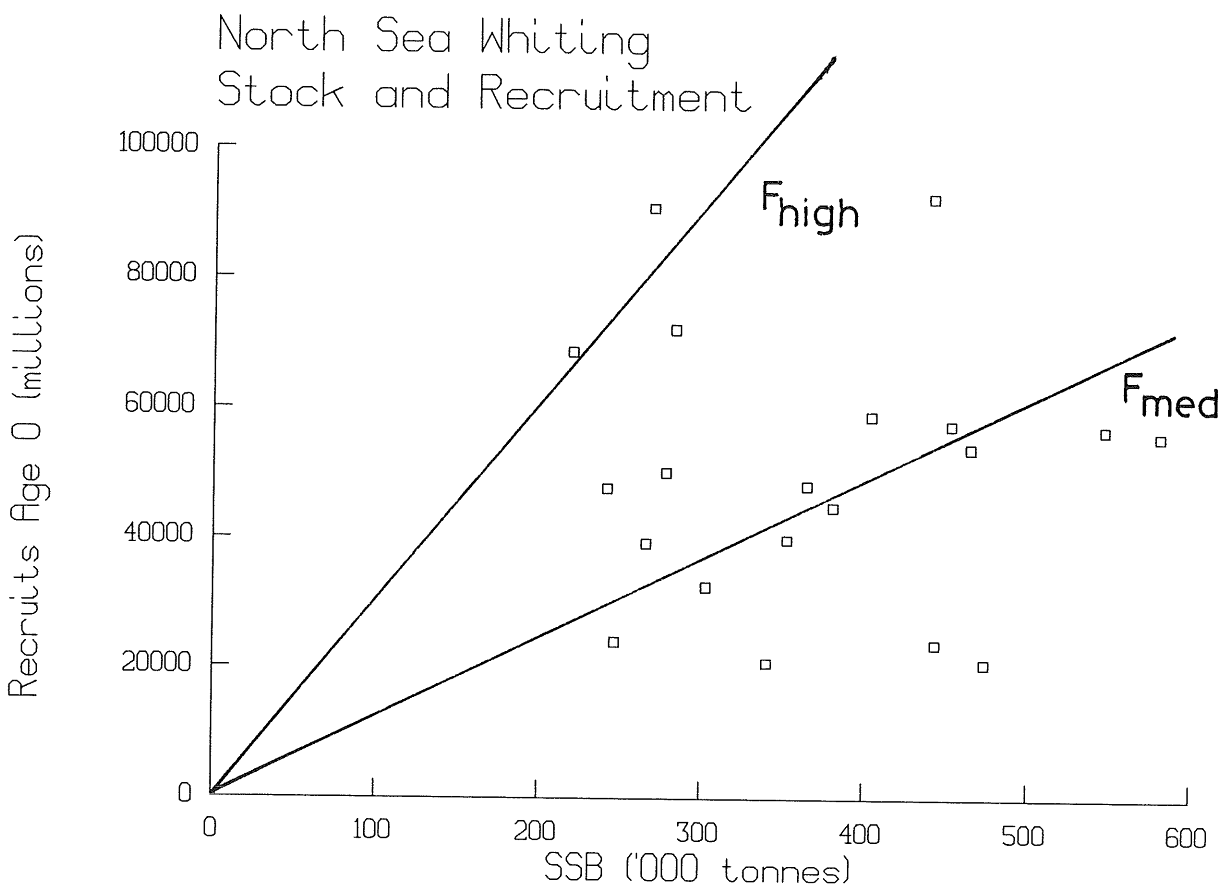

North Sea Whiting
Stock and Recruitment
Recruits Age 0 (millions)
100000
80000
60000
40000
20000
0
Fhigh
Fmed
0
100
200
300
400
500
600
SSB ('000 tonnes)

Figure 23.1

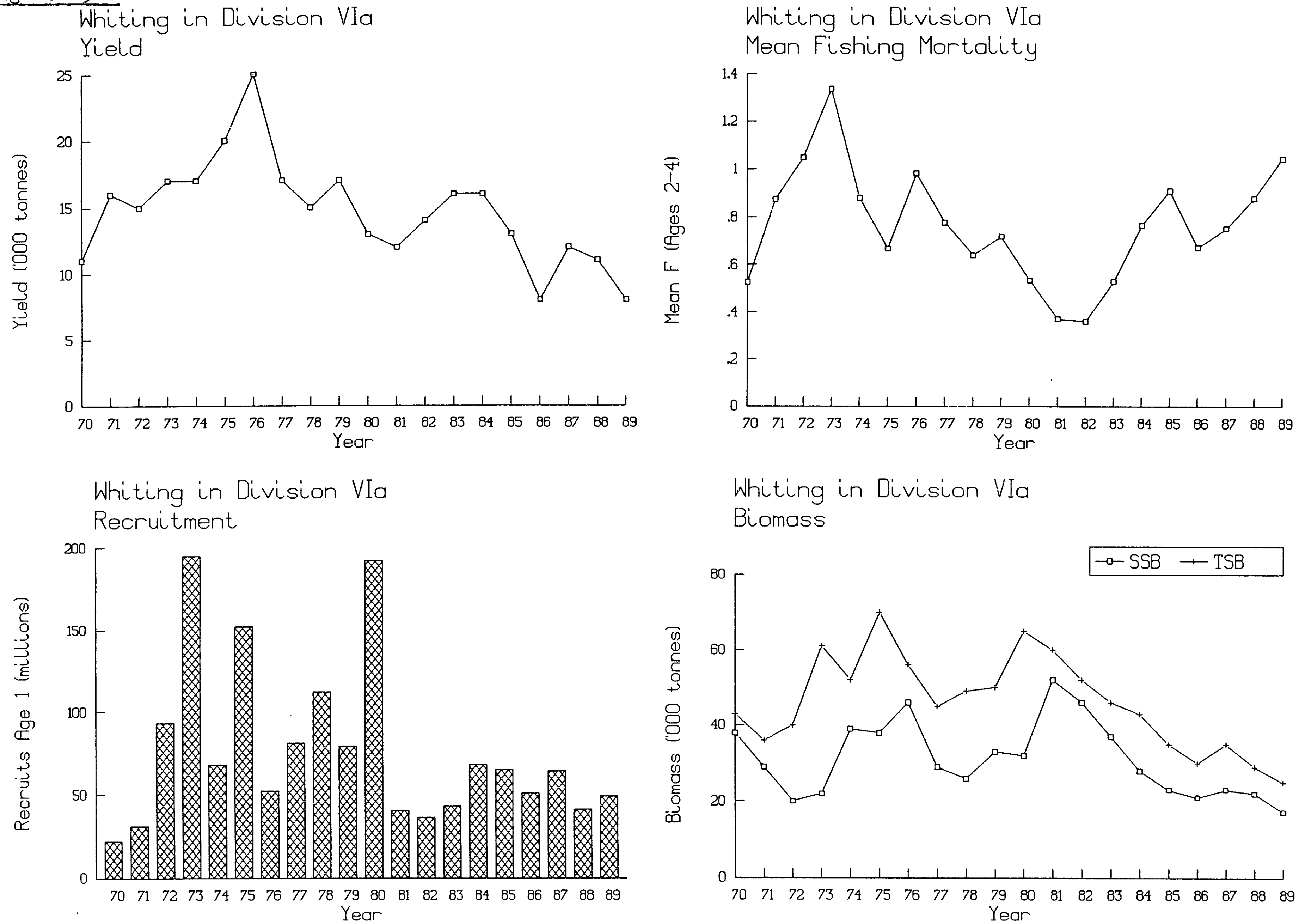
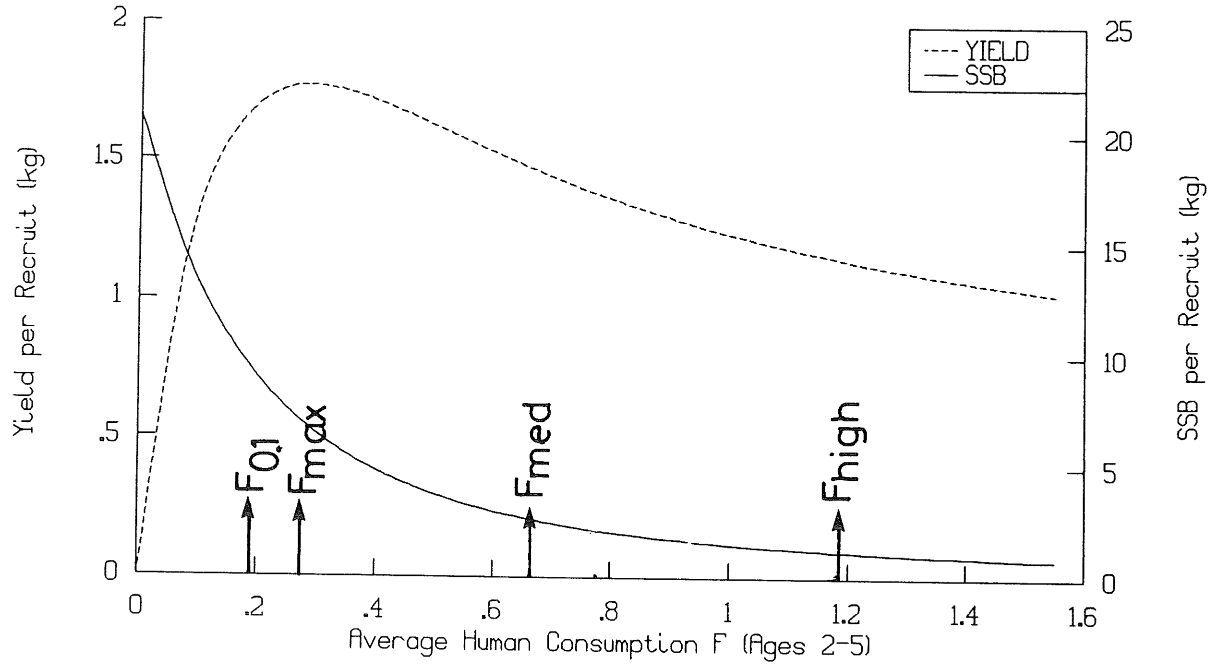

Whiting in Division VIa
Yield
Yield ('000 tonnes)
Year
Whiting in Division VIa
Mean Fishing Mortality
Mean F (Ages 2-4)
Year
Whiting in Division VIa
Recruitment
Recruits Age 1 (millions)
Year
Whiting in Division VIa
Biomass
SSB
TSB
Biomass ('000 tonnes)
Year

Figure 23.2 COD in Division VIa.

a) Long Term Total Landings and Spawning Biomass



b) Short Term Total Landings and Spawning Biomass

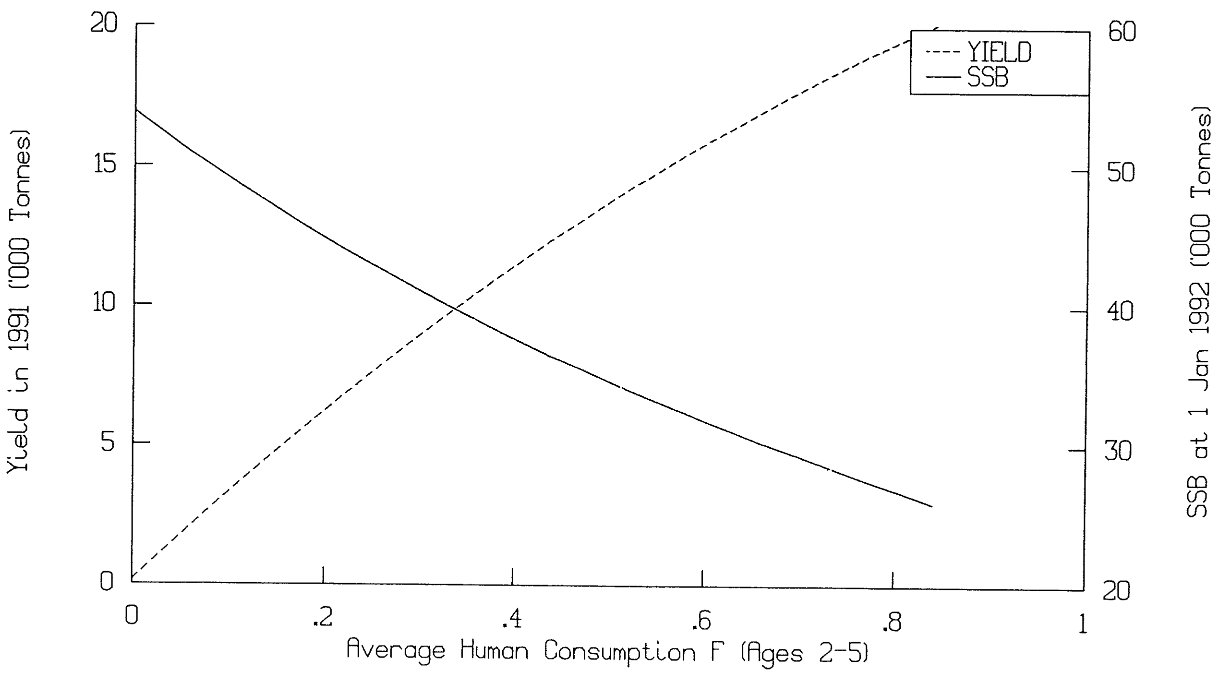
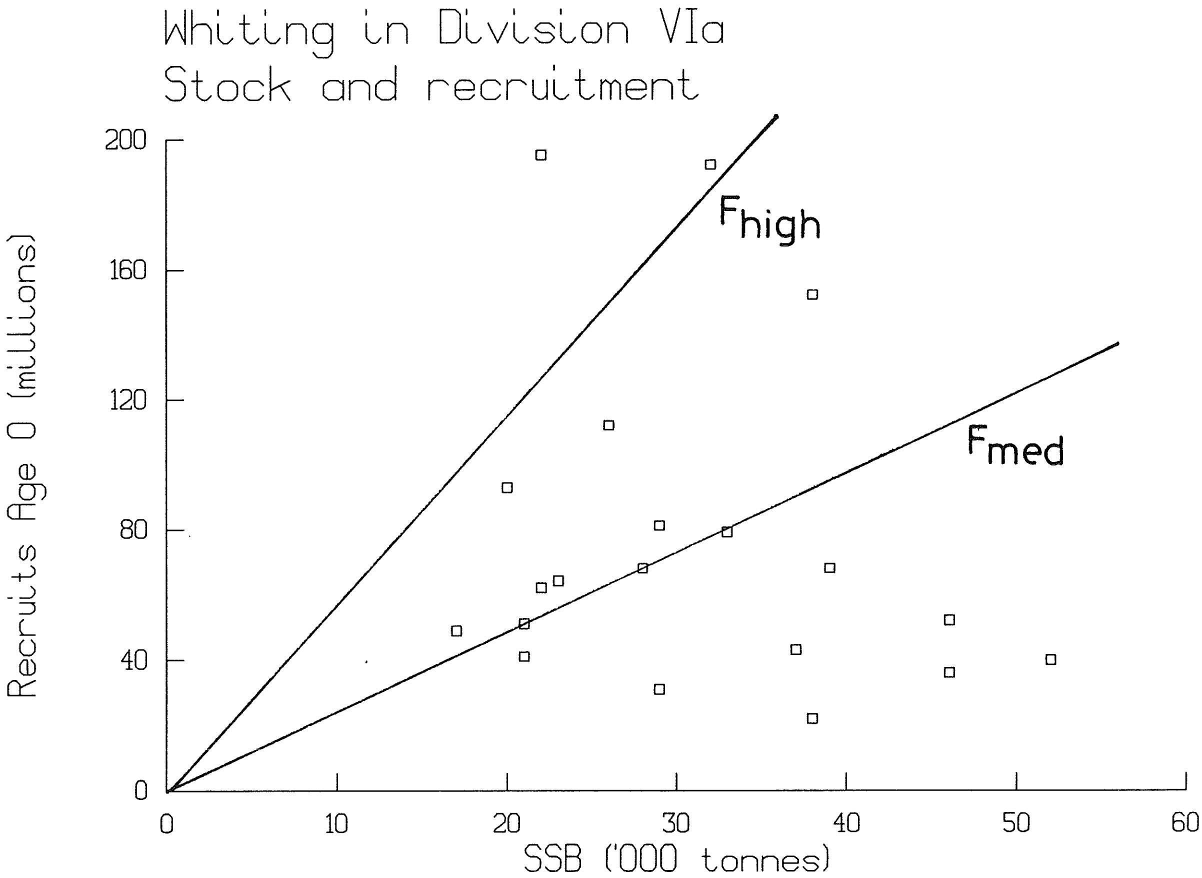
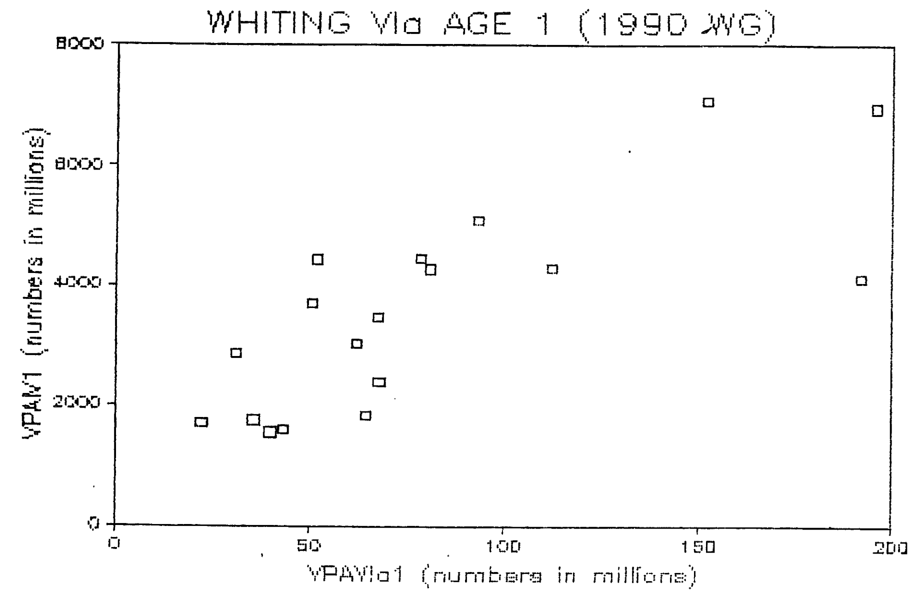


Figure 23.3


Whiting in Division VIa
Stock and recruitment
Recruits Age 0 (millions)
200
160
120
80
40
0
Fhigh
Fmed
0
10
20
30
40
50
60
SSB ('000 tonnes)



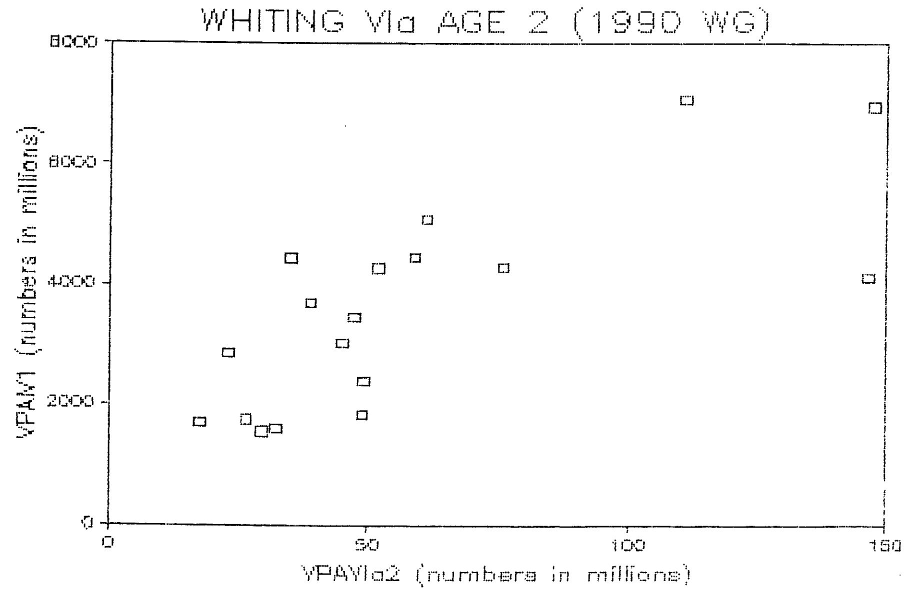


Figure 23.4 Plots of recruitment for whiting in Division VIa against the North Sea for ages 1 and 2.

Figure 25.1

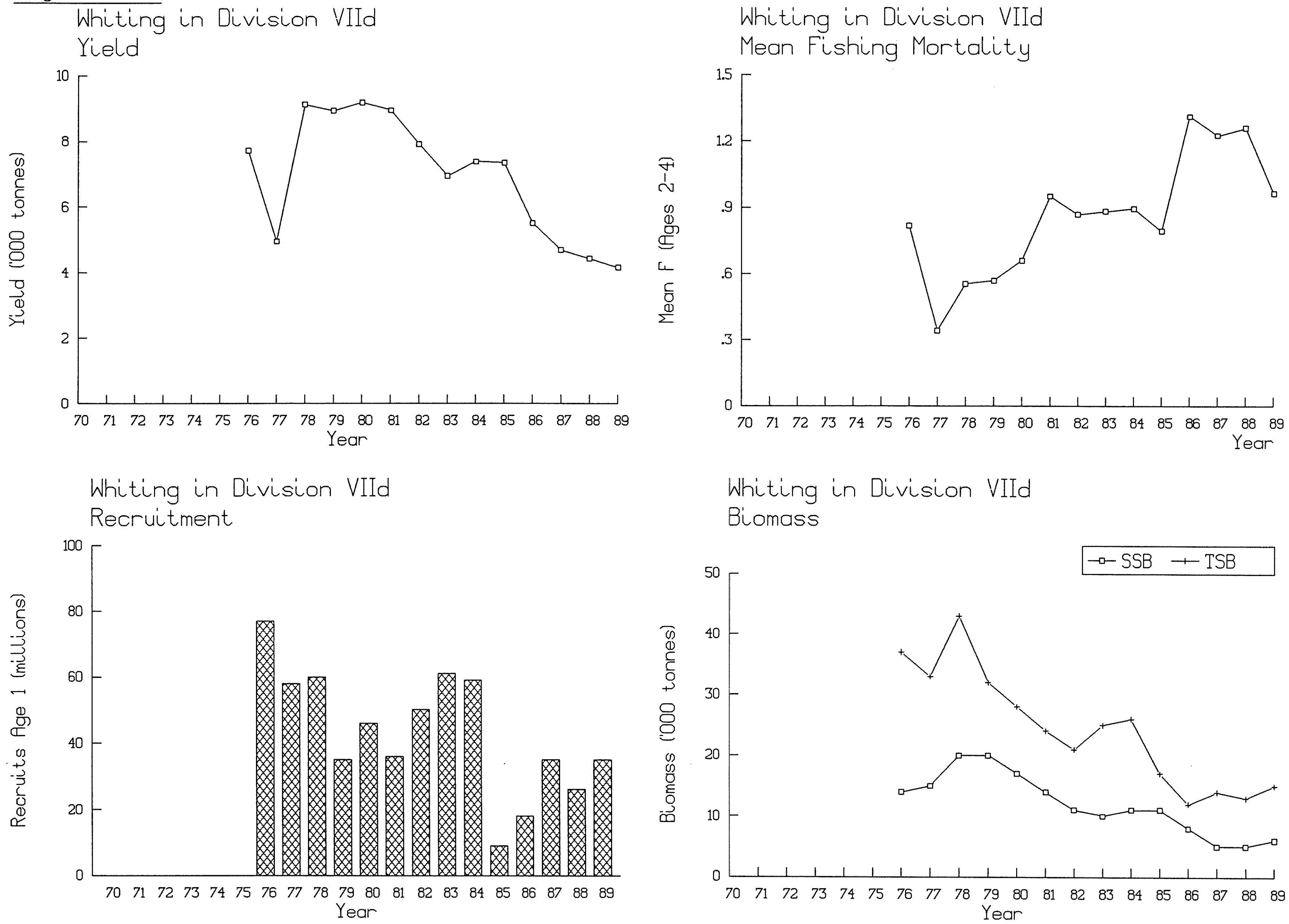
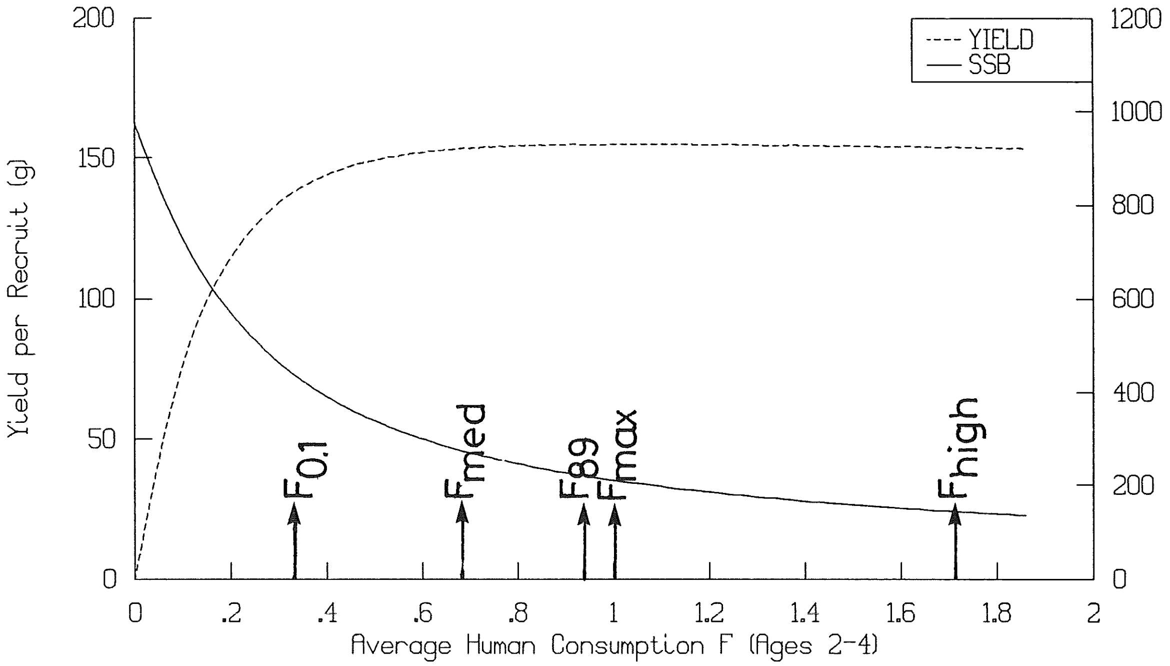

Whiting in Division VIId
Yield
Yield ('000 tonnes)
10
8
6
4
2
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
Whiting in Division VIId
Mean Fishing Mortality
Mean F (Ages 2-4)
1.5
1.2
.9
.6
.3
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
Whiting in Division VIId
Recruitment
Recruits Age 1 (millions)
100
80
60
40
20
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
Whiting in Division VIId
Biomass
SSB
TSB
Biomass ('000 tonnes)
50
40
30
20
10
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year

Figure 25.2 WHITING in Division VIId.

a) Long Term Total Landings and Spawning Biomass



b) Short Term Landings and Spawning biomass

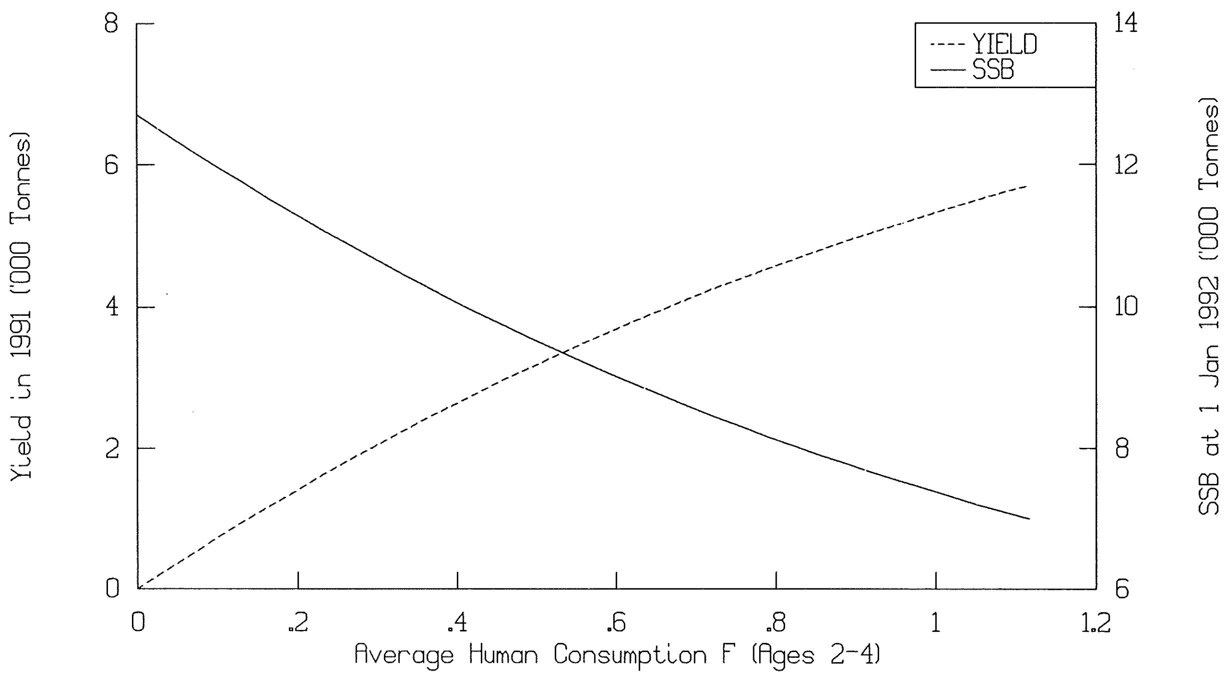


Figure 25.3

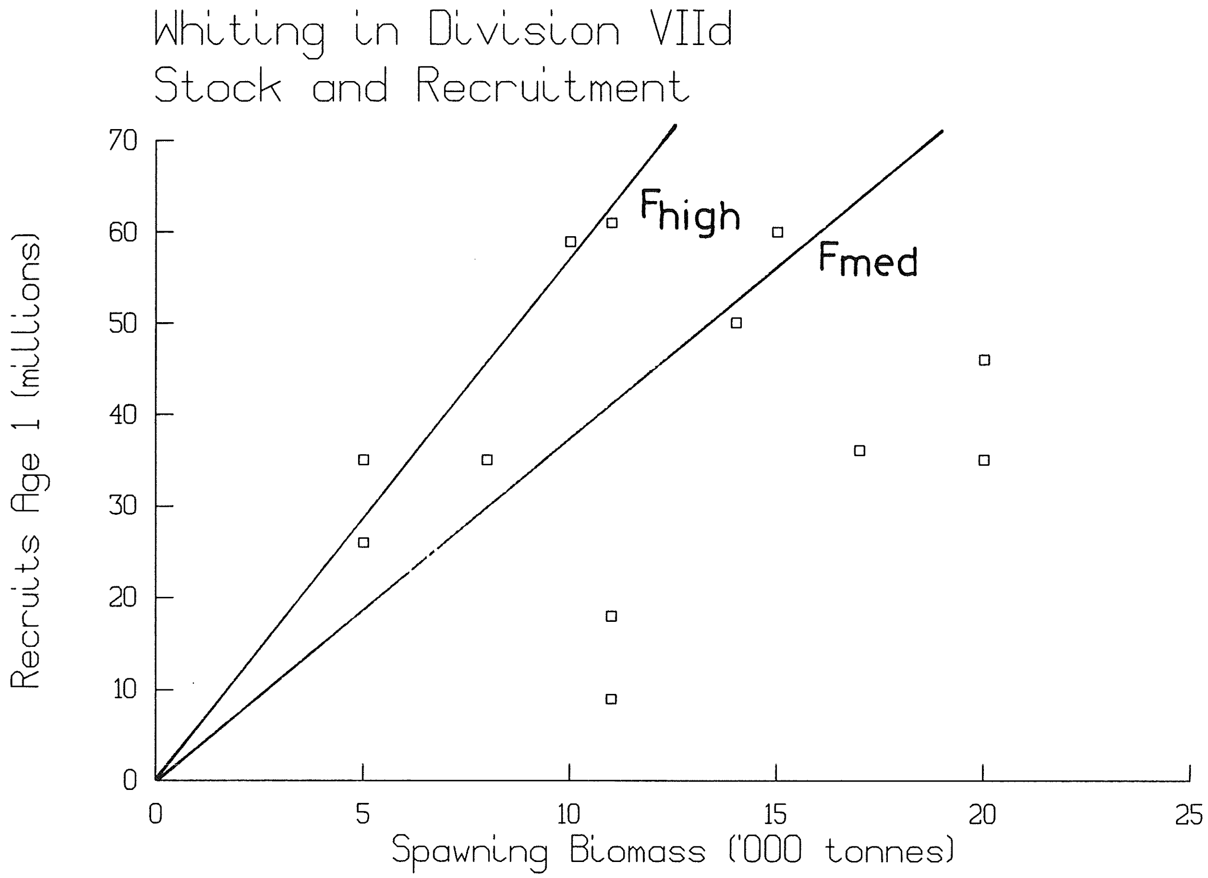

Whiting in Division VIId
Stock and Recruitment
Fhigh
Fmed
Recruits Age 1 (millions)
0
10
20
30
40
50
60
70
0
5
10
15
20
25
Spawning Biomass ('000 tonnes)

Figure 28.1

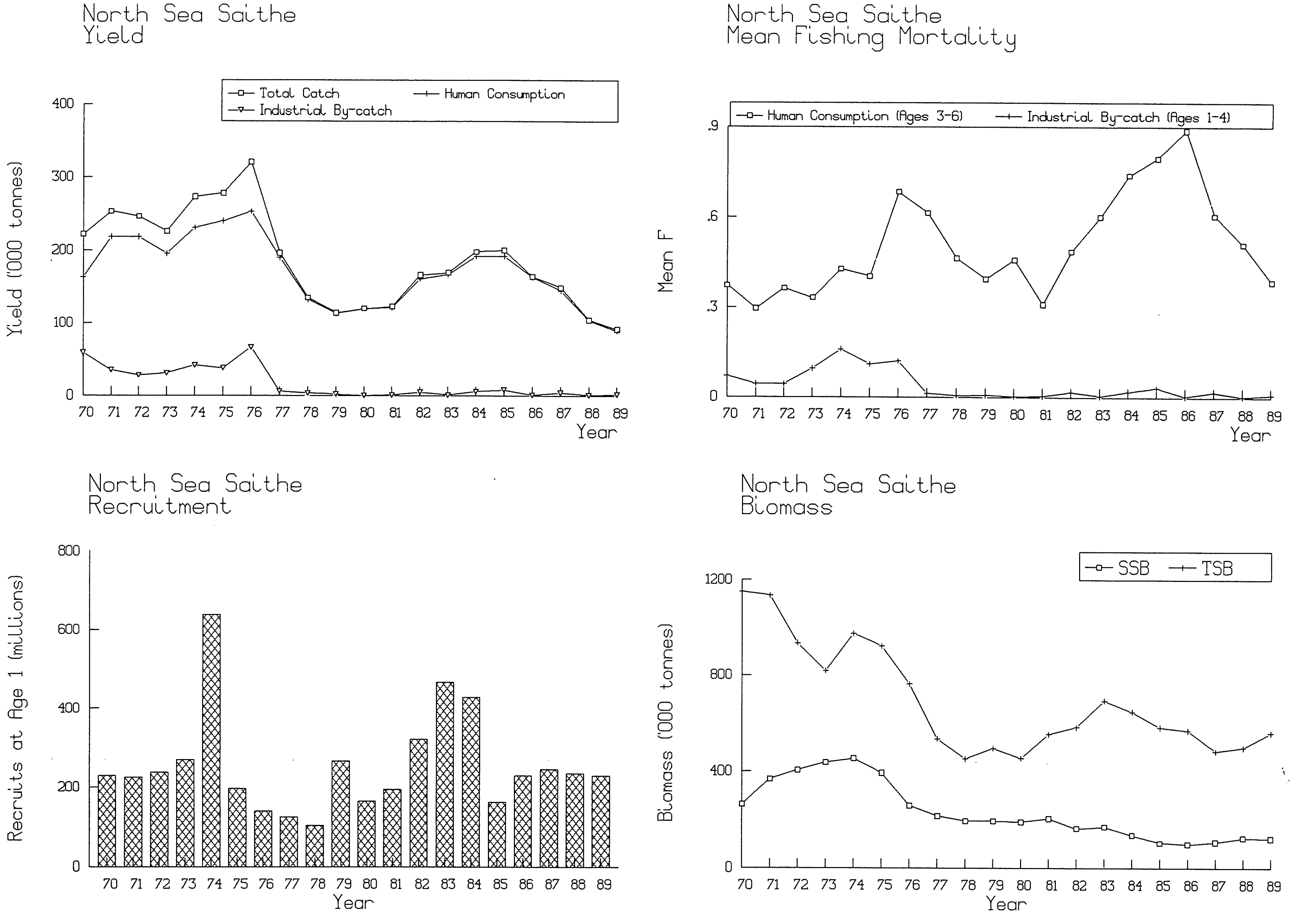
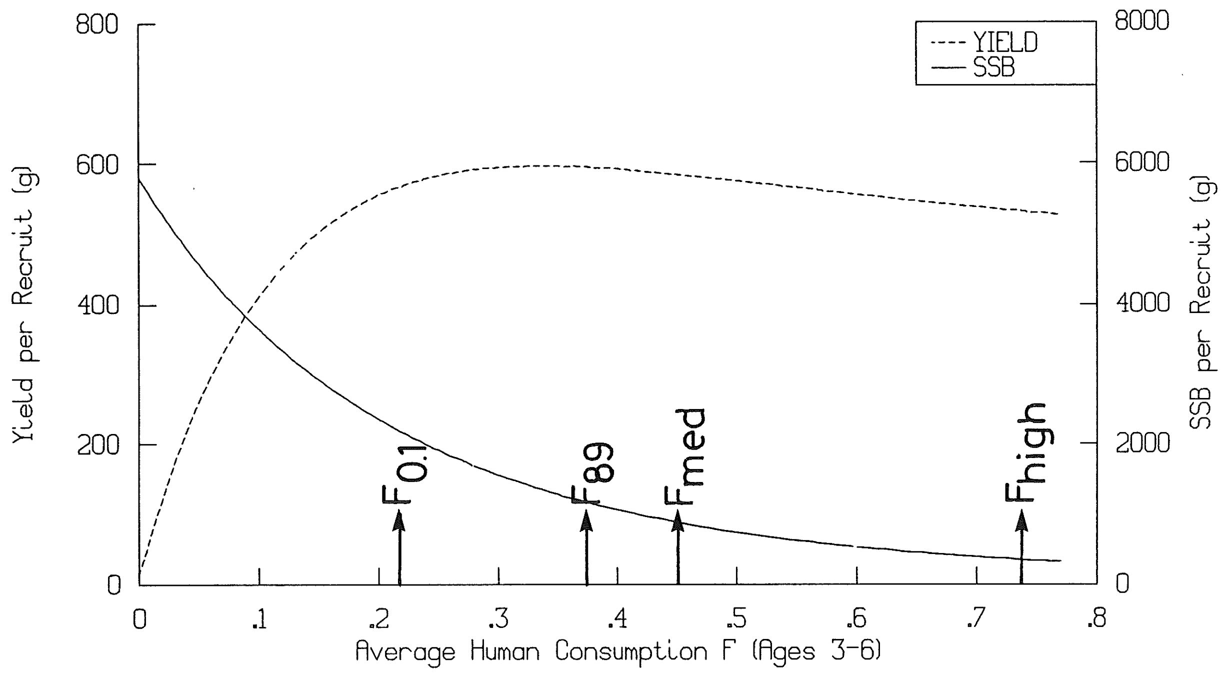

North Sea Saithe
Yield
Total Catch
Human Consumption
Industrial By-catch
Yield ('000 tonnes)
400
300
200
100
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
North Sea Saithe
Mean Fishing Mortality
Human Consumption (Ages 3-6)
Industrial By-catch (Ages 1-4)
Mean F
.9
.6
.3
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
North Sea Saithe
Recruitment
Recruits at Age 1 (millions)
800
600
400
200
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
North Sea Saithe
Biomass
SSB
TSB
Biomass ('000 tonnes)
1200
800
400
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year

Figure 28.2 North Sea SAITHE.

a) Long Term Total Landings and Spawning Biomass



b) Short Term Total Landings and Spawning Biomass

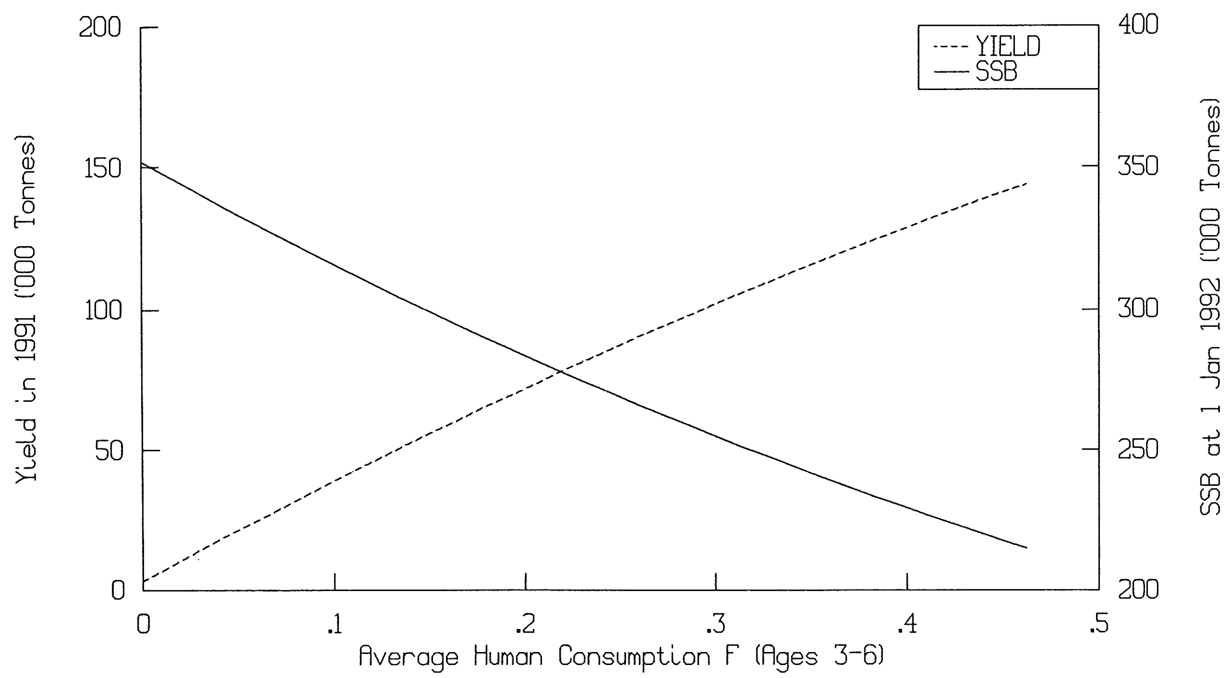


Figure 28.3

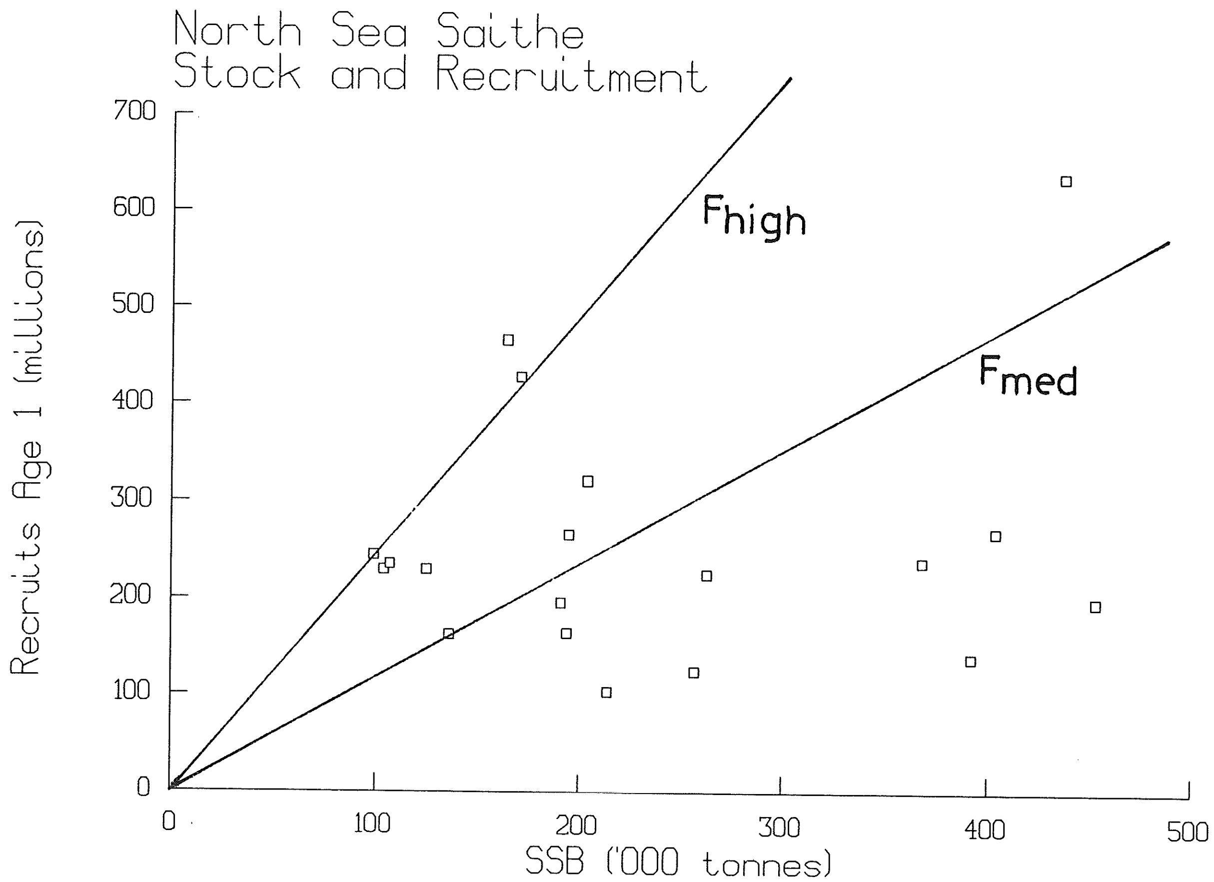
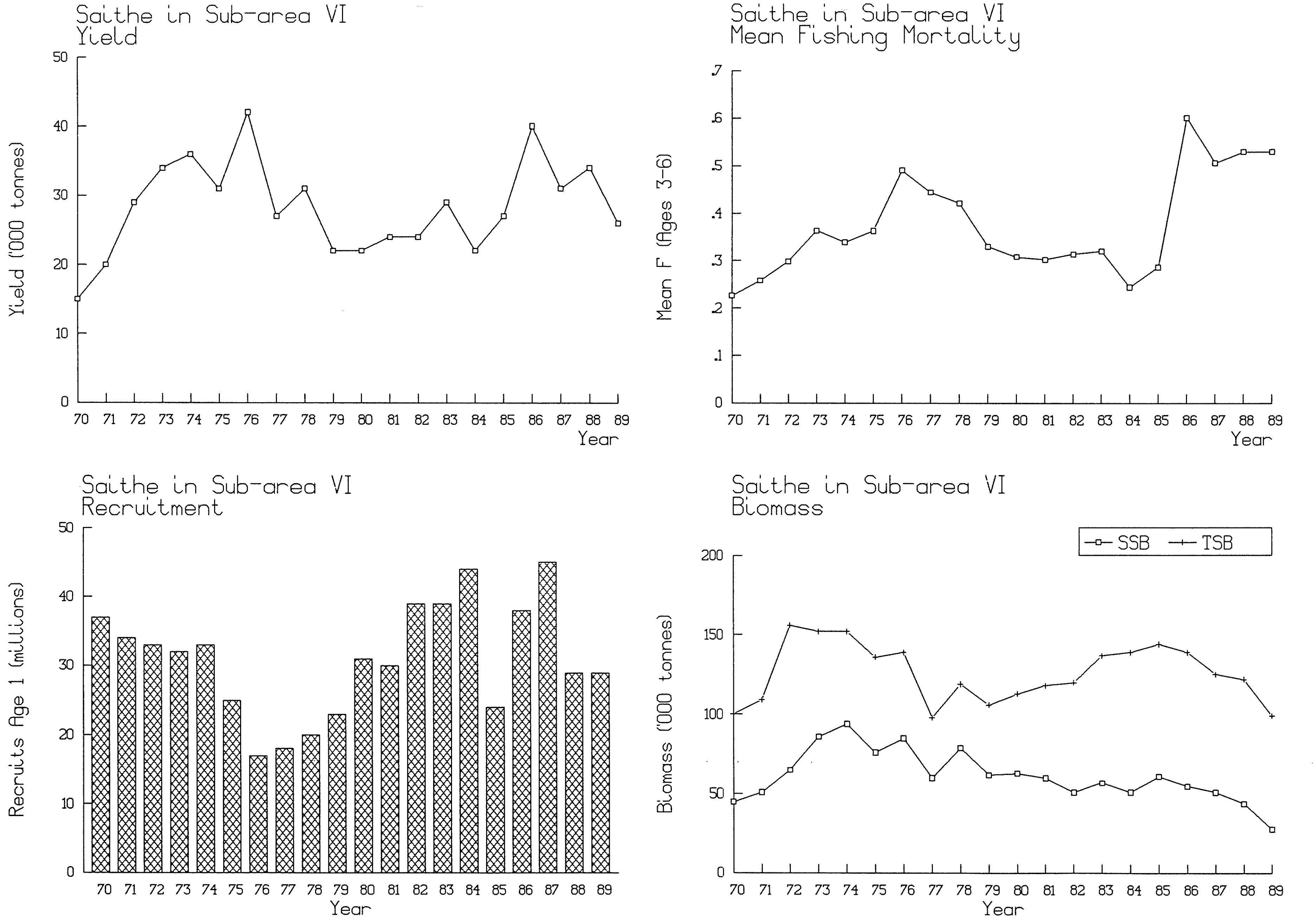

North Sea Saithe
Stock and Recruitment
Recruits Age 1 (millions)
700
600
500
400
300
200
100
0
Fhigh
Fmed
0
100
200
300
400
500
SSB ('000 tonnes)

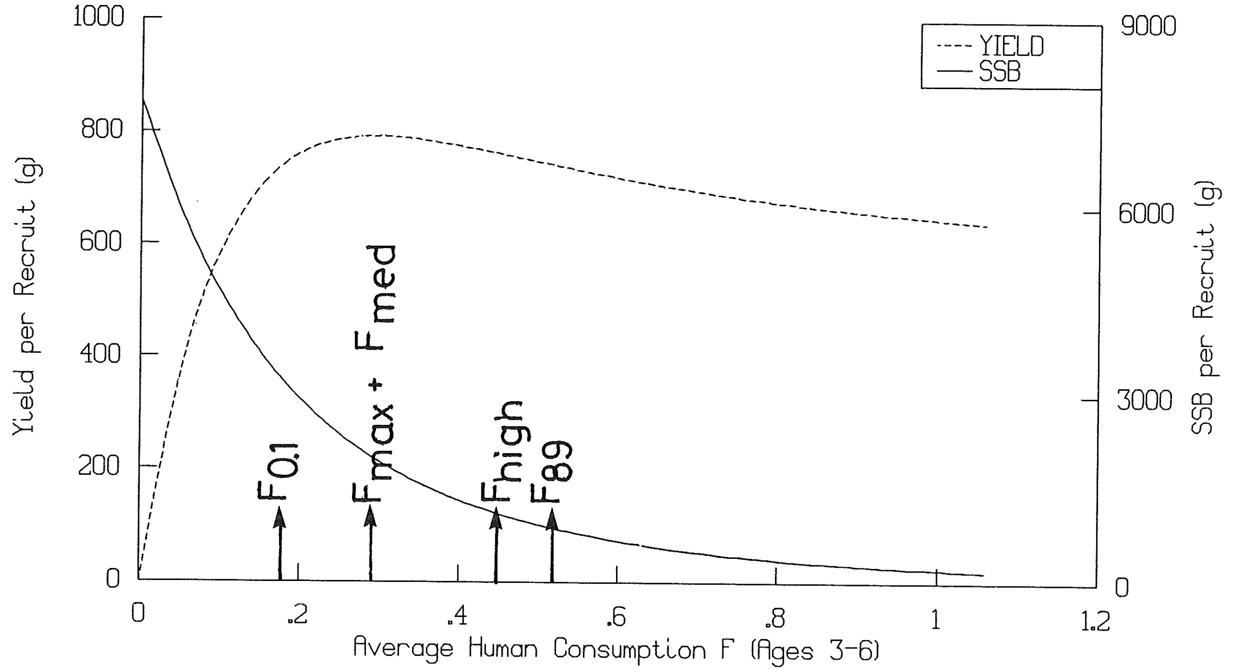
Figure 29.1



Saithe in Sub-area VI
Yield
Yield ('000 tonnes)
0
10
20
30
40
50
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
Saithe in Sub-area VI
Mean Fishing Mortality
Mean F (Ages 3-6)
0
.1
.2
.3
.4
.5
.6
.7
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
Saithe in Sub-area VI
Recruitment
Recruits Age 1 (millions)
0
10
20
30
40
50
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year
Saithe in Sub-area VI
Biomass
SSB
TSB
Biomass ('000 tonnes)
0
50
100
150
200
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89
Year

Figure 29.2 SAITHE in Sub-area VI.

a) Long Term Total Landings and Spawning Biomass



b) Short Term Total Landings and Spawning Biomass

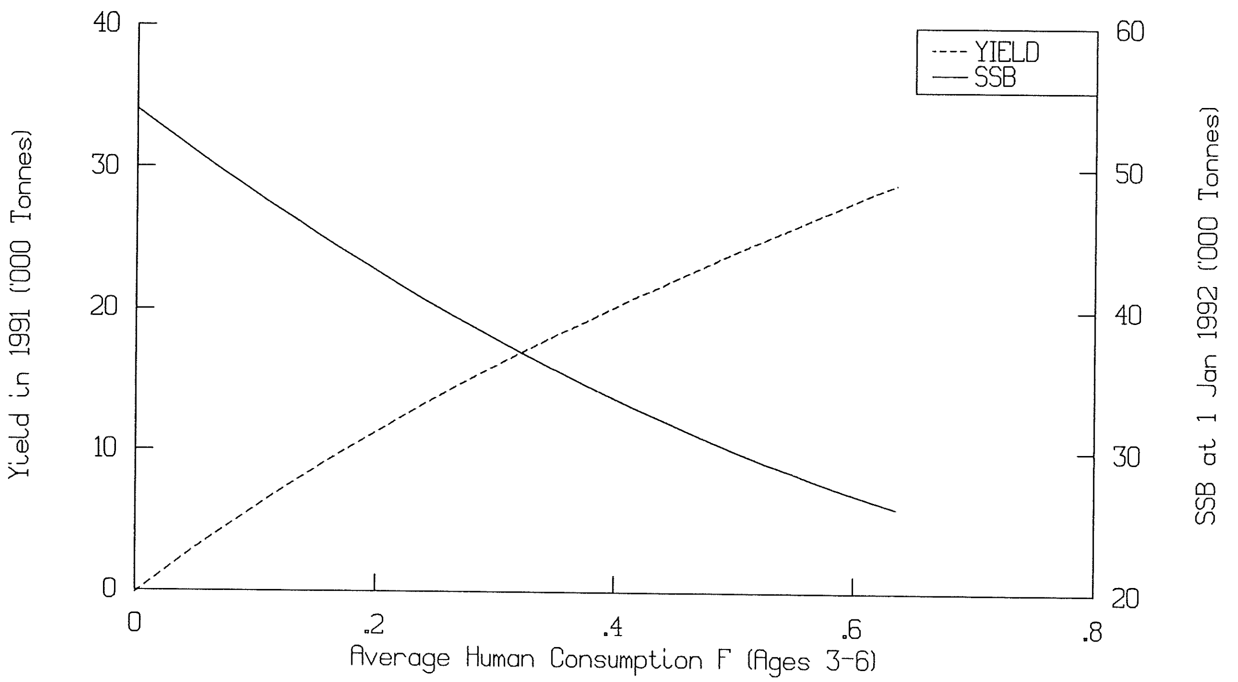


Figure 29.3

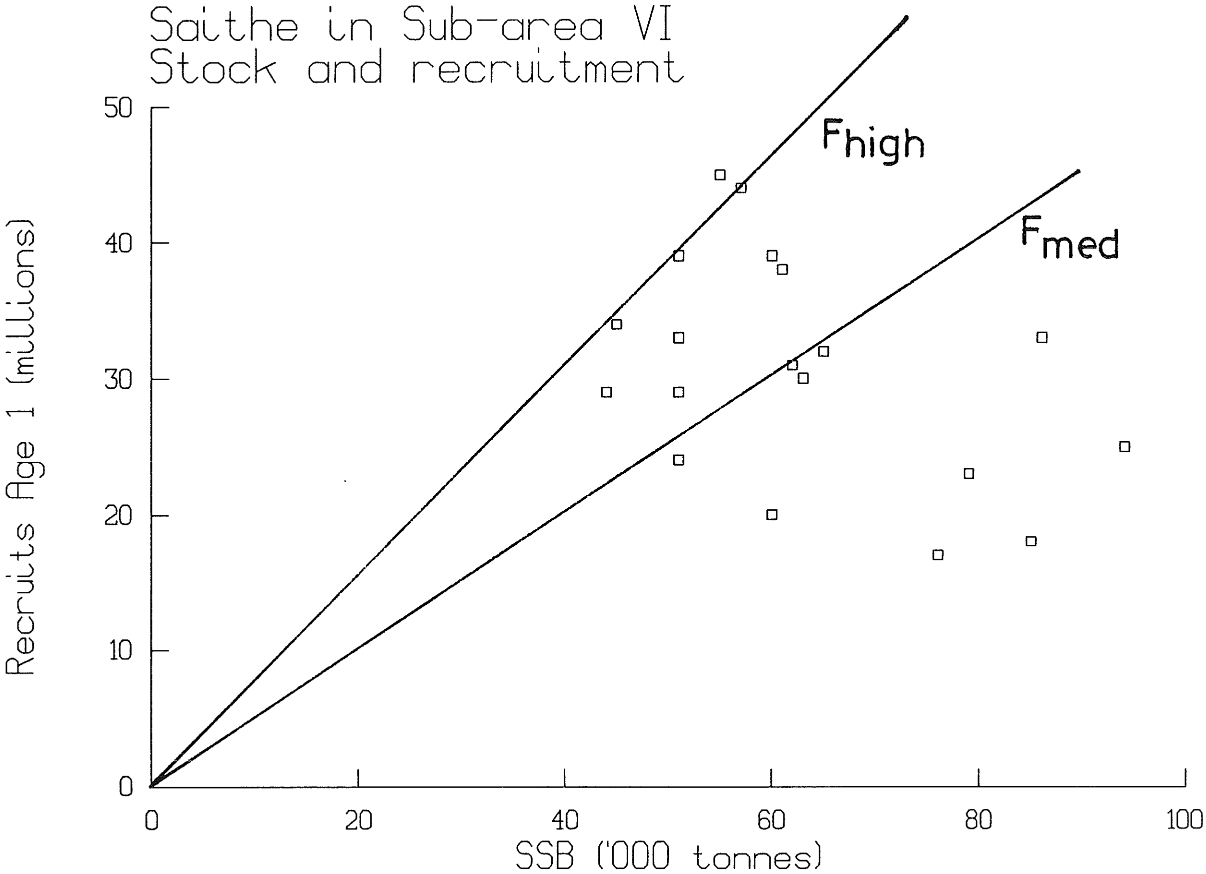

Saithe in Sub-area VI
Stock and recruitment
Fhigh
Fmed
Recruits Age 1 (millions)
SSB ('000 tonnes)
0
10
20
30
40
50
0
20
40
60
80
100

Figure 31.1

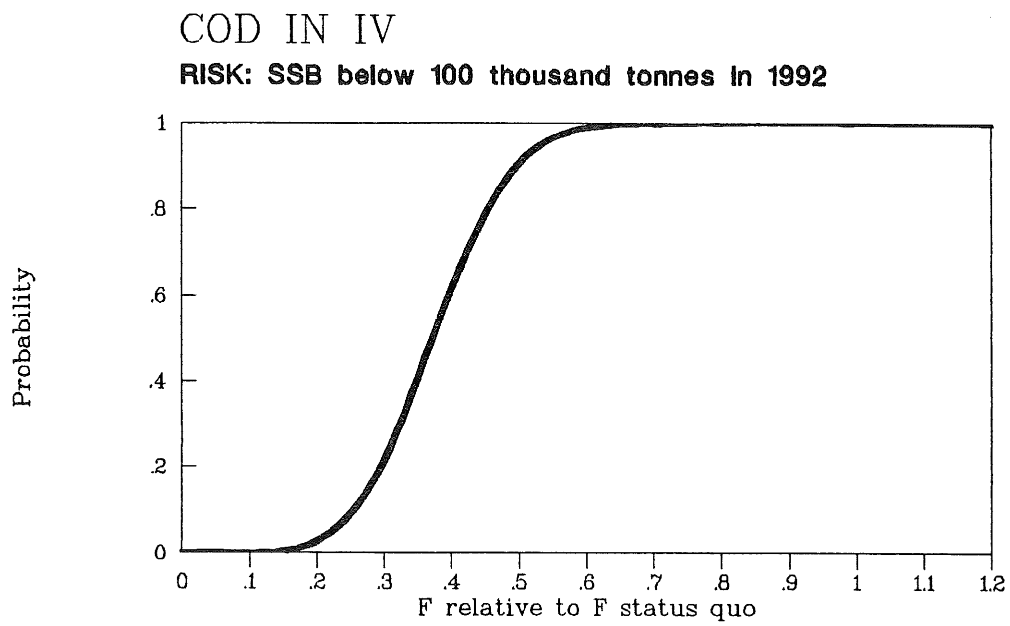


Figure 31.2

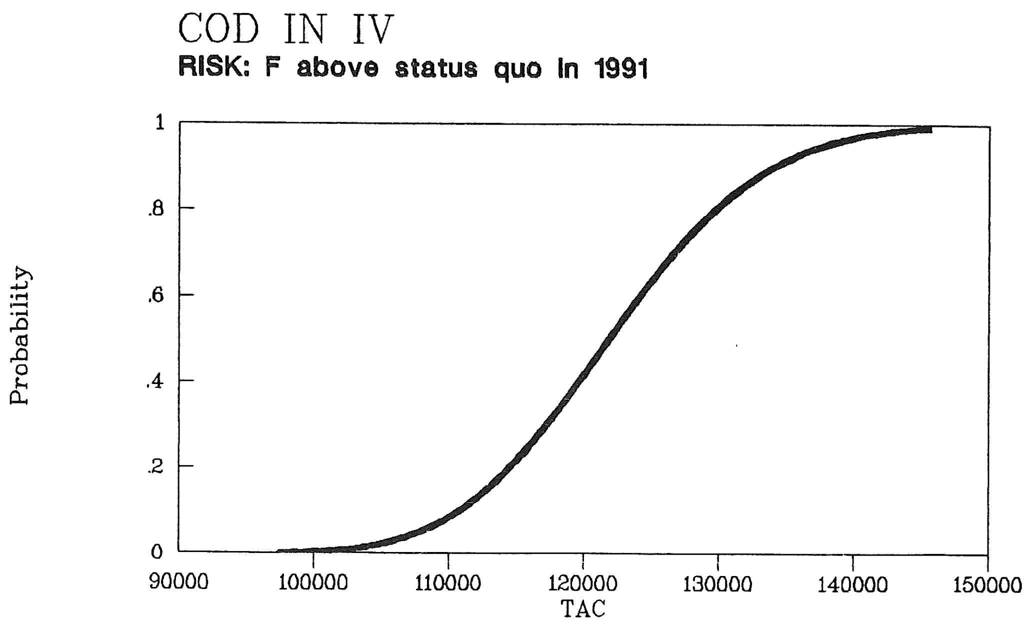
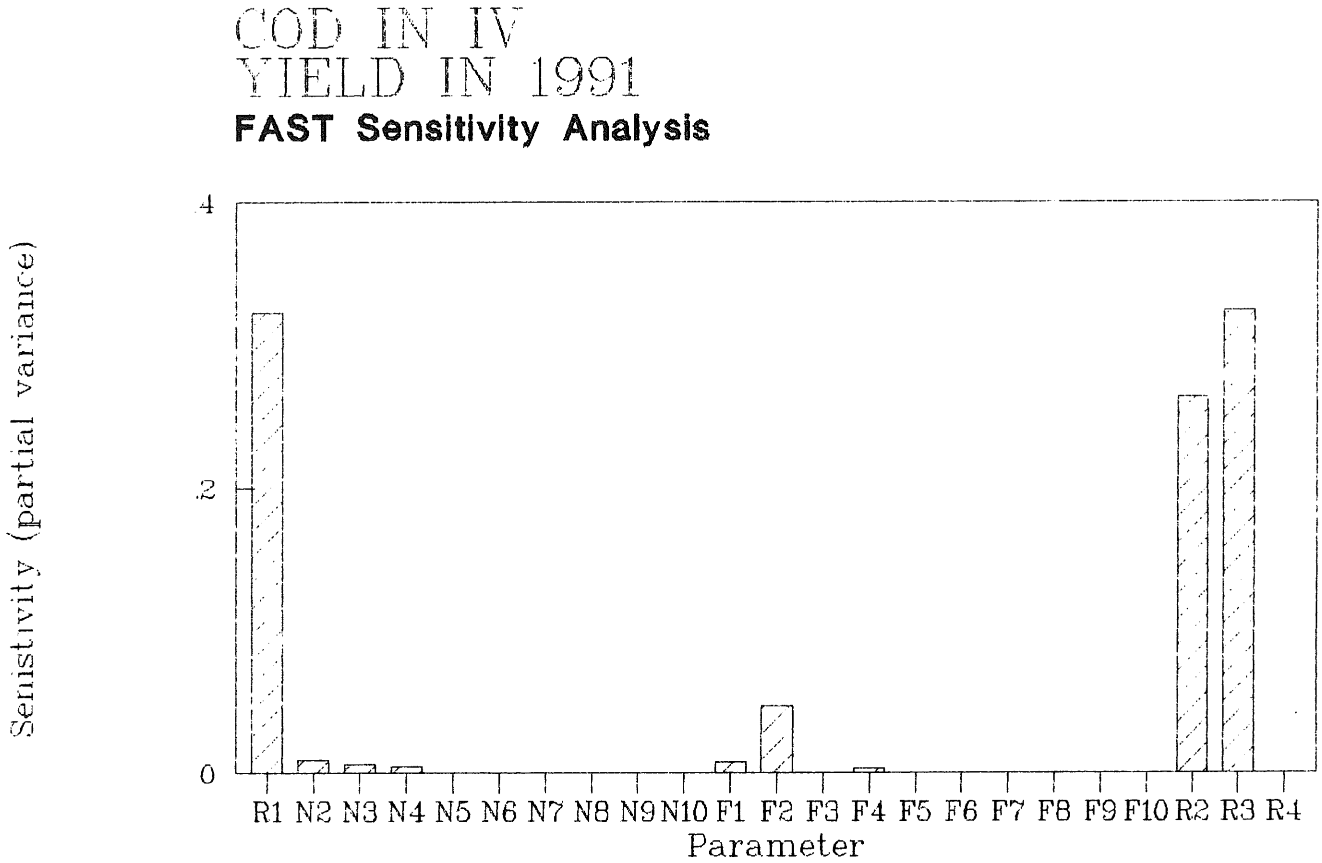


Figure 32.1


COD IN IV
YIELD IN 1991
FAST Sensitivity Analysis
Senistivity (partial variance)
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter

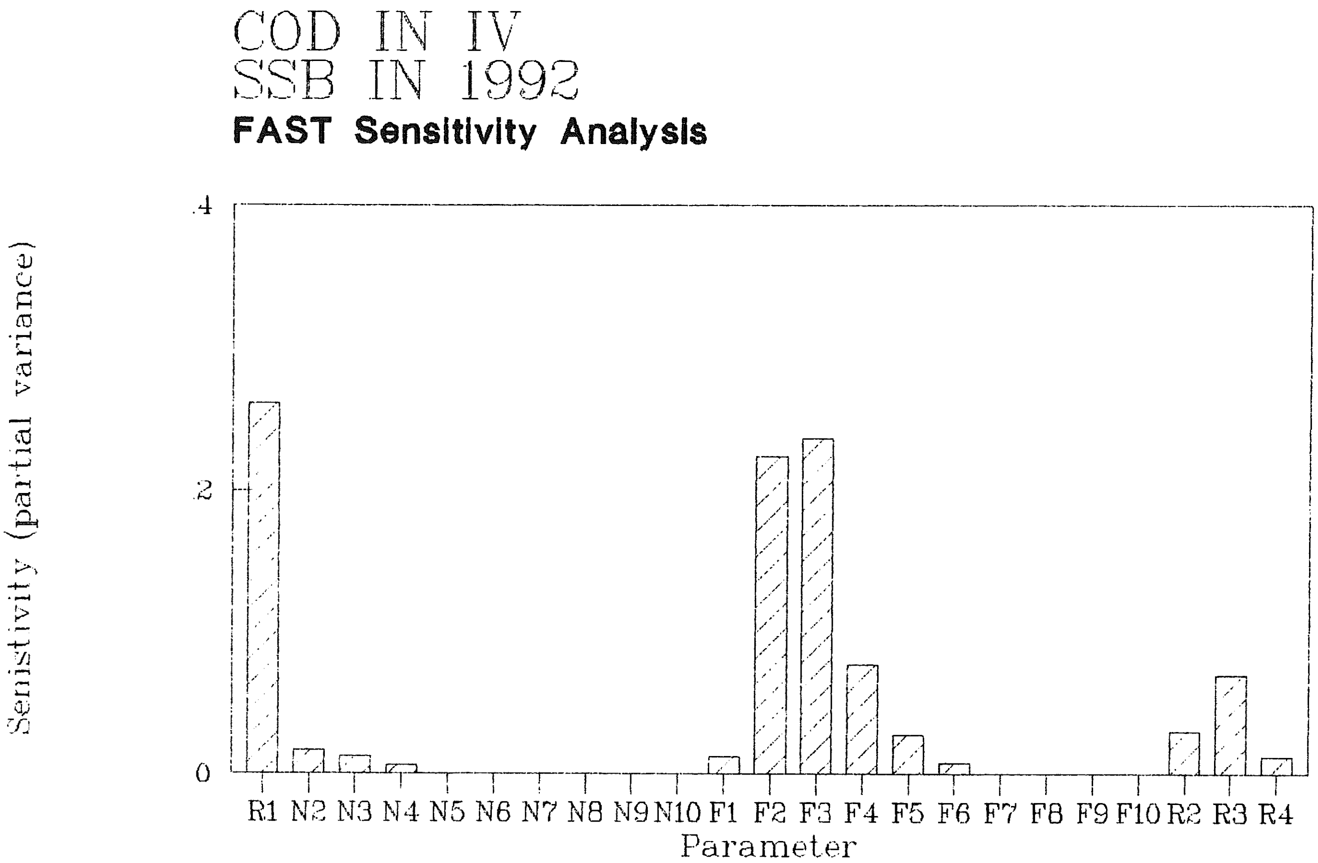
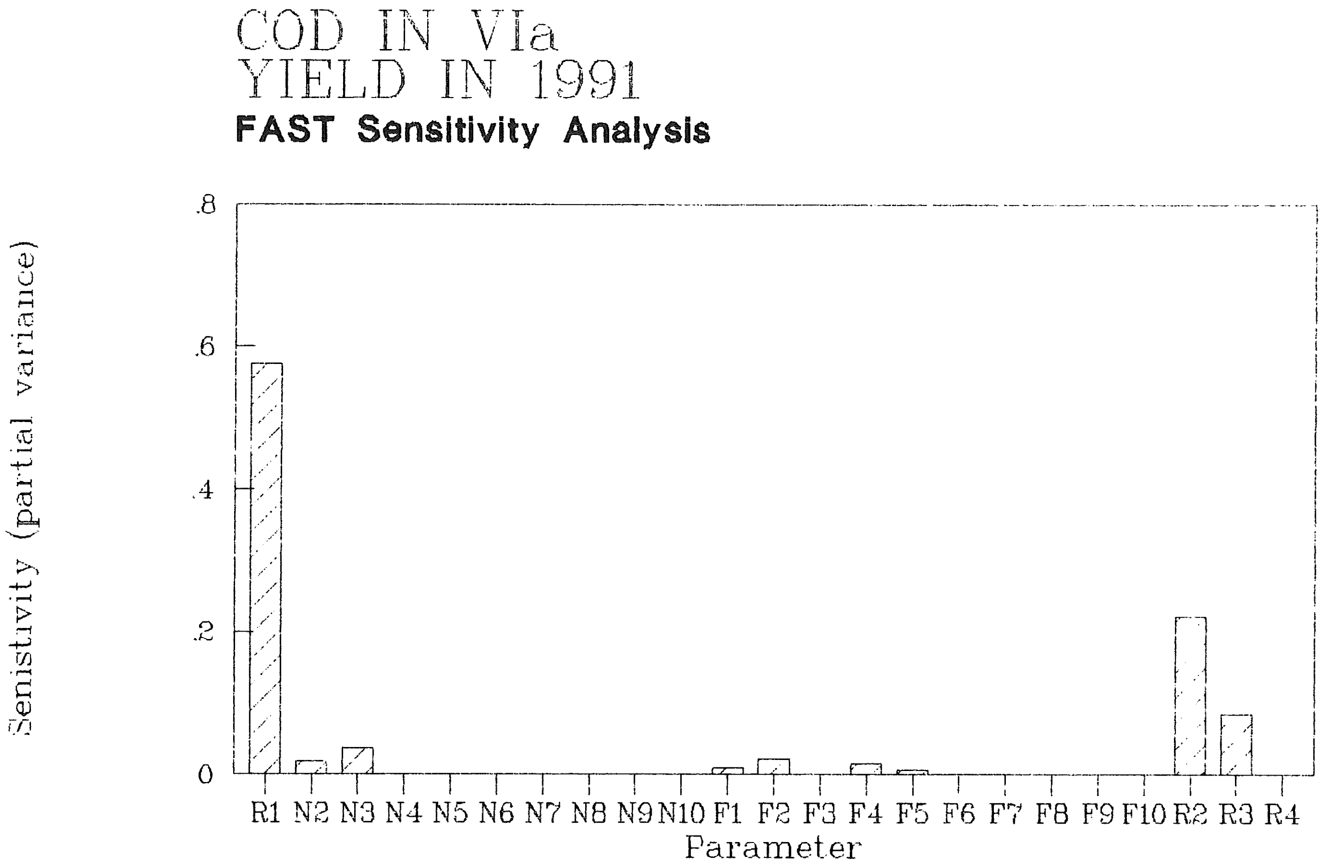

COD IN IV
SSB IN 1992
FAST Sensitivity Analysis
Senistivity (partial variance)
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter

Figure 32.2


COD IN VIa
YIELD IN 1991
FAST Sensitivity Analysis
Senistivity (partial variance)
.8
.6
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter

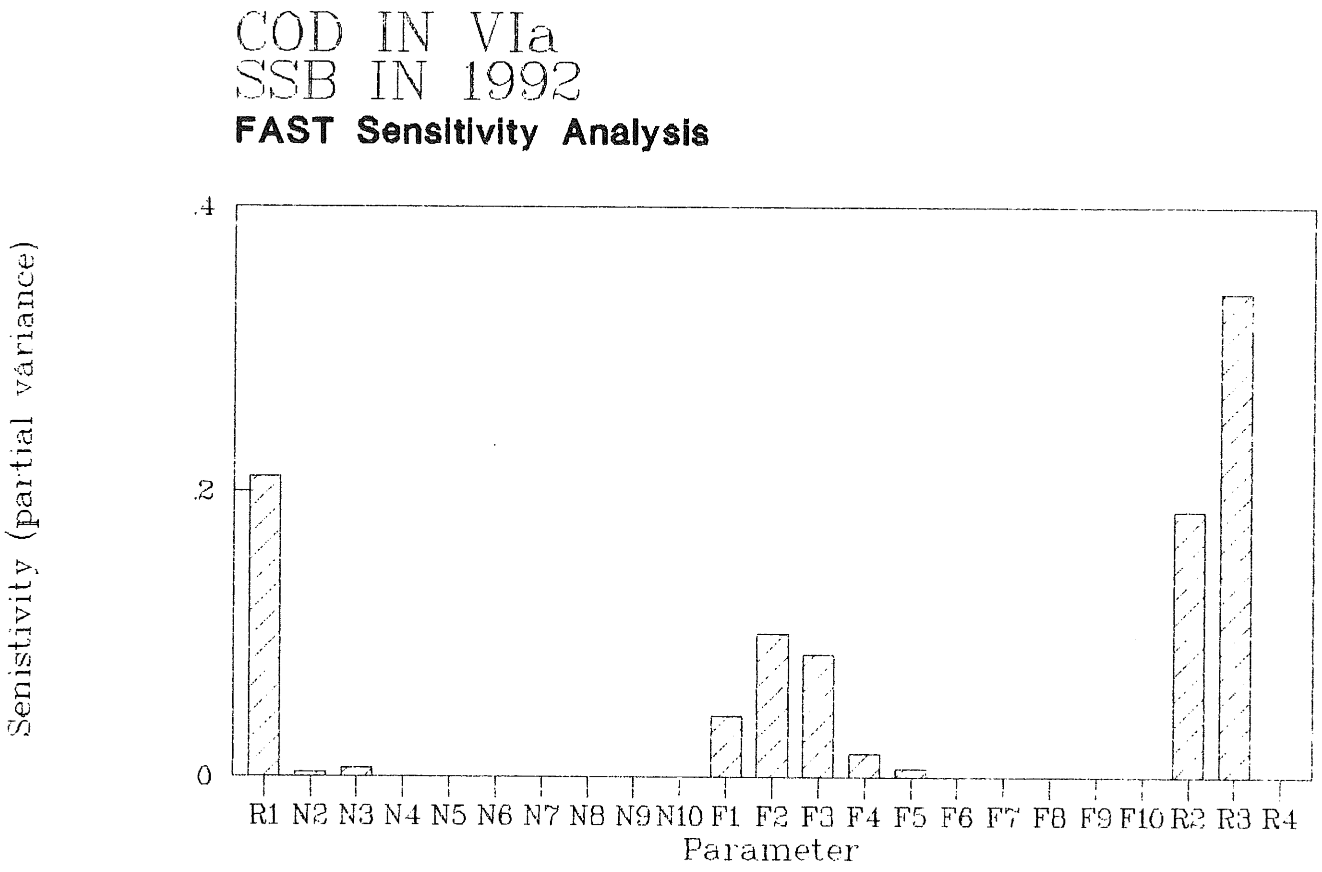
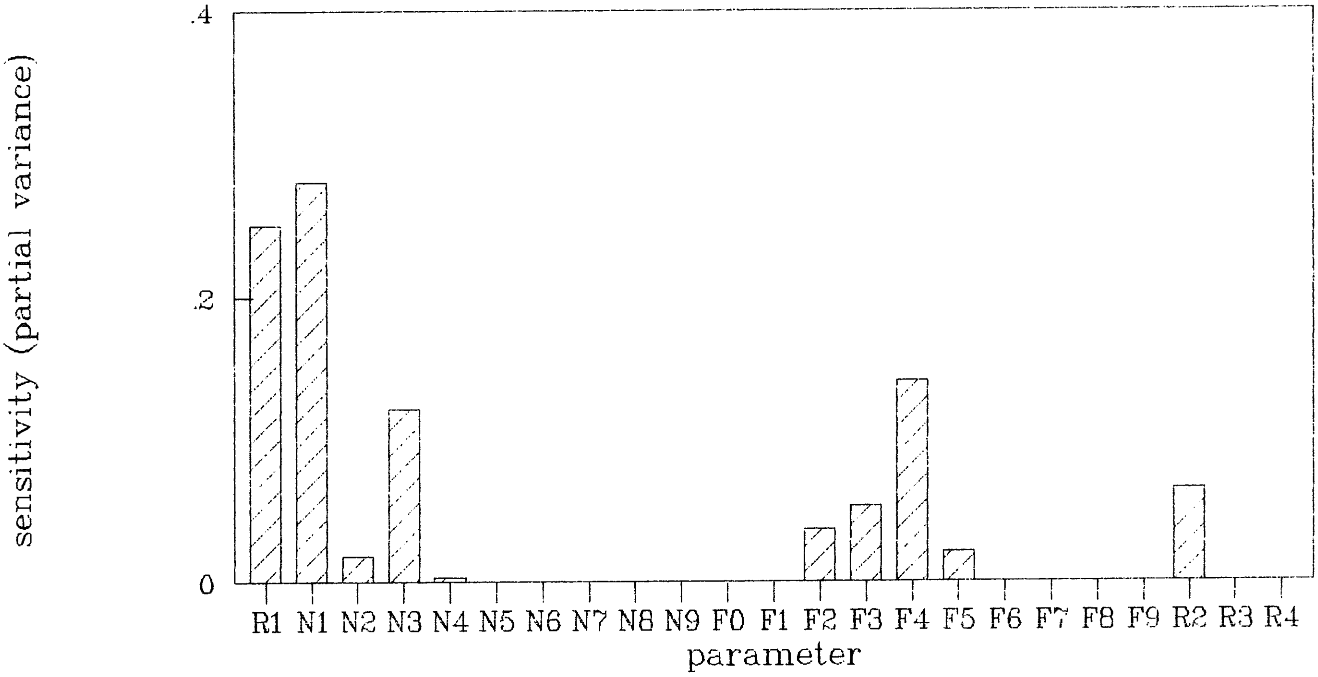

COD IN VIa
SSB IN 1992
FAST Sensitivity Analysis
Senistivity (partial variance)
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter

Figure 32.3

HADDOCK IN IV
Human consumption landings in 1991
FAST sensitivity analysis



HADDOCK IN IV
SSB at start of 1992
FAST sensitivity analysis

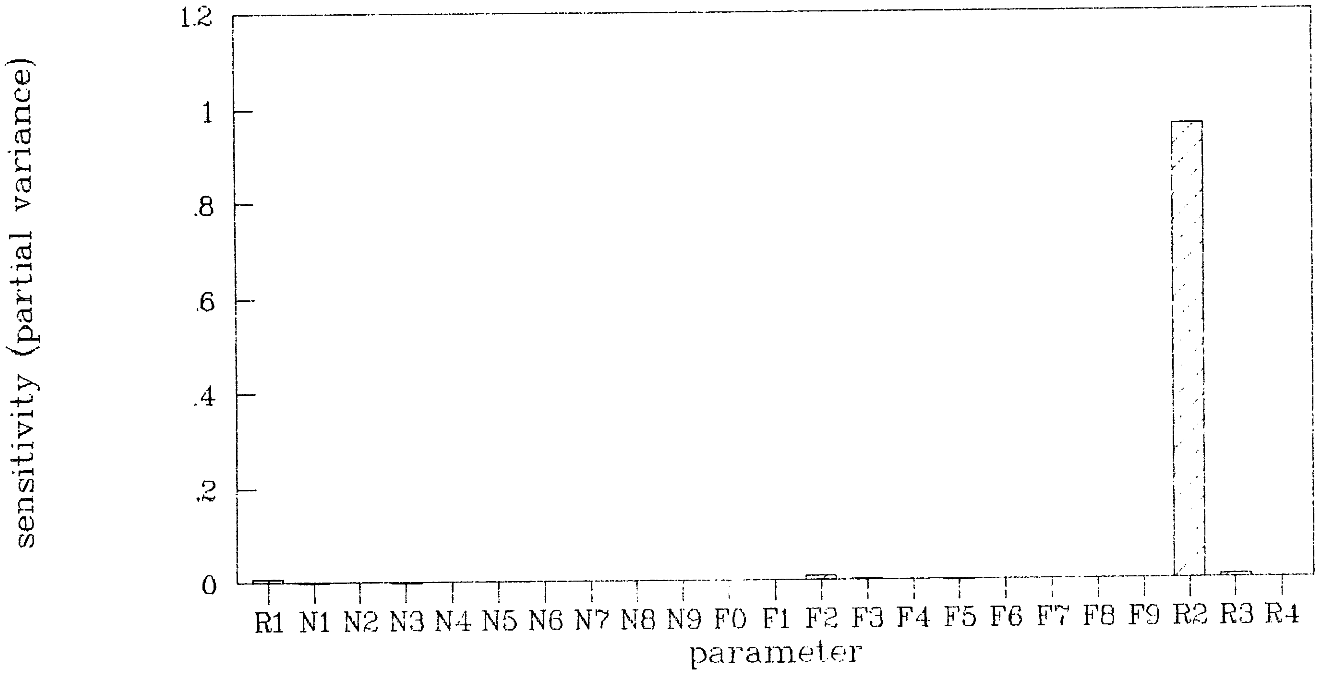
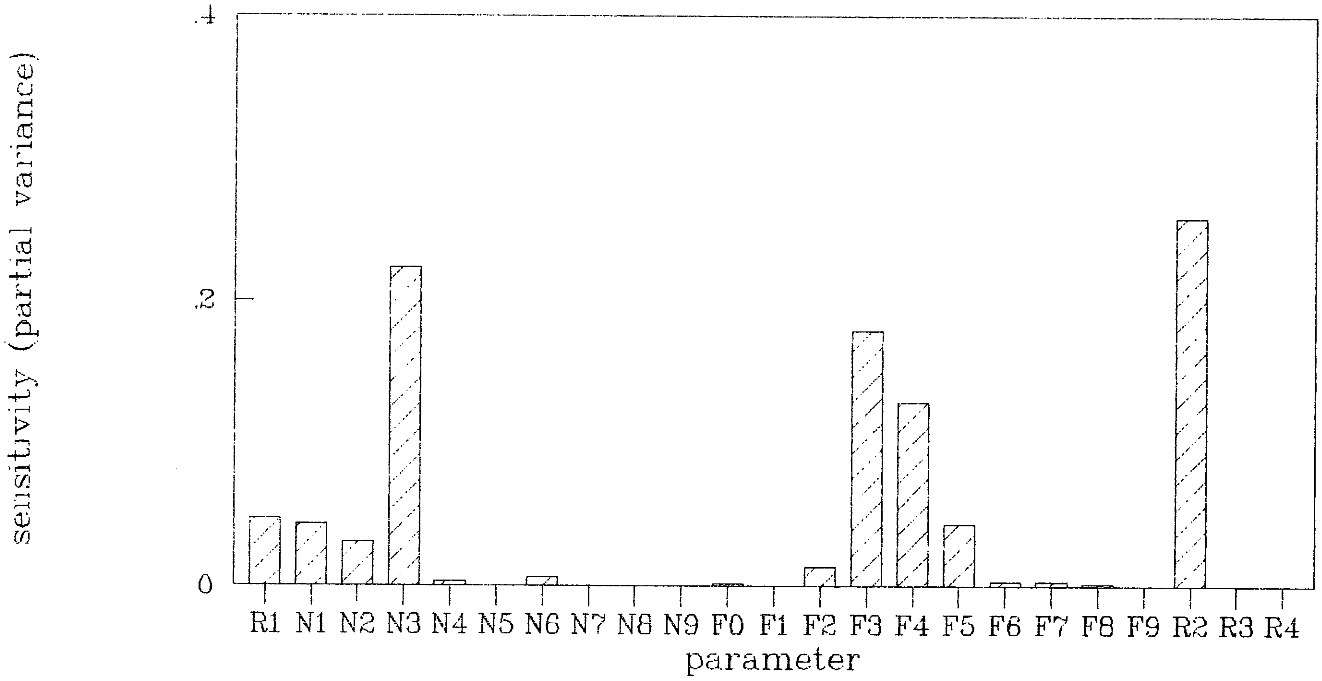


Figure 32.4

HADDOCK IN VIa
Human consumption landings in 1991
FAST sensitivity analysis



HADDOCK IN VIa
SSB at start of 1992
FAST sensitivity analysis

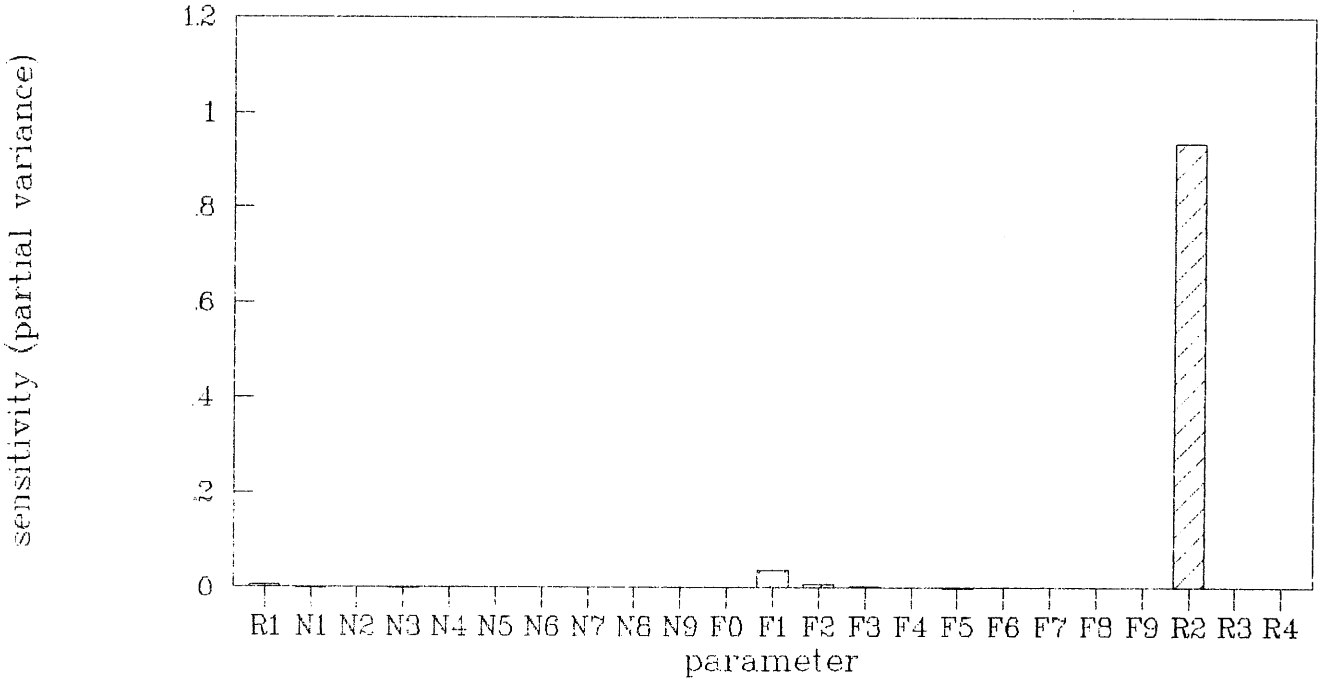
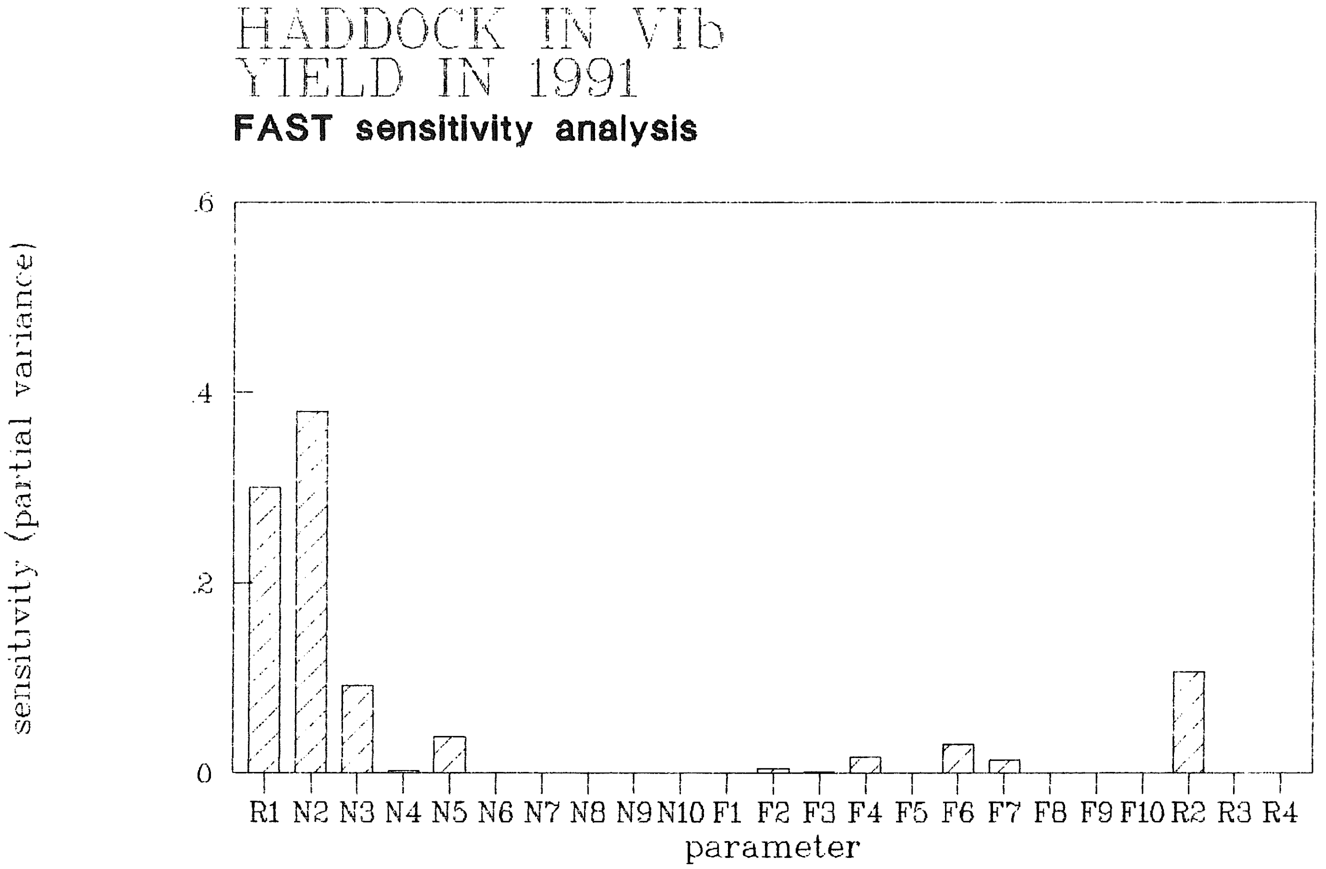


Figure 32.5


HADDOCK IN VIb
YIELD IN 1991
FAST sensitivity analysis
sensitivity (partial variance)
.6
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
parameter

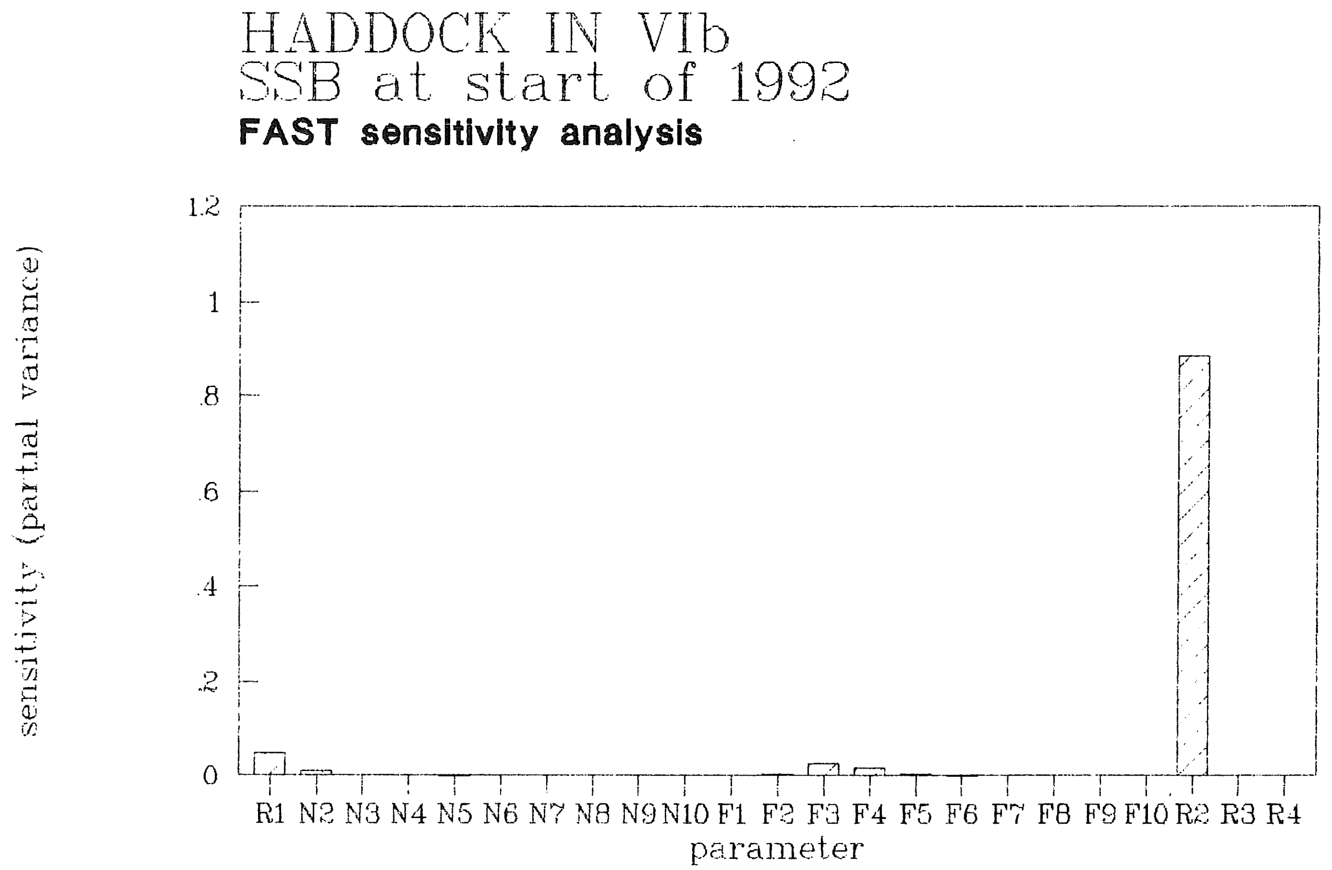
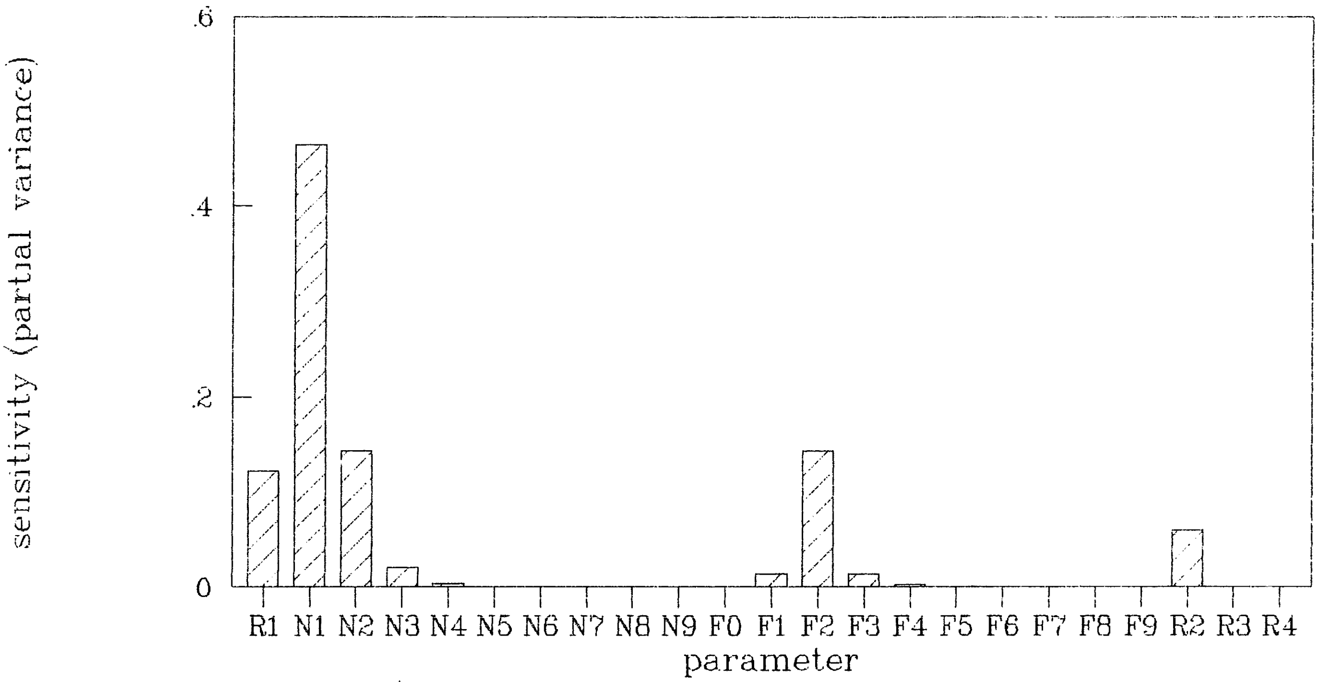

HADDOCK IN VIb
SSB at start of 1992
FAST sensitivity analysis
sensitivity (partial variance)
1.2
1
.8
.6
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
parameter

Figure 32.6

WHITING IN IV
Human consumption landings in 1991
FAST sensitivity analysis



WHITING IN IV
SSB at start of 1992
FAST sensitivity analysis

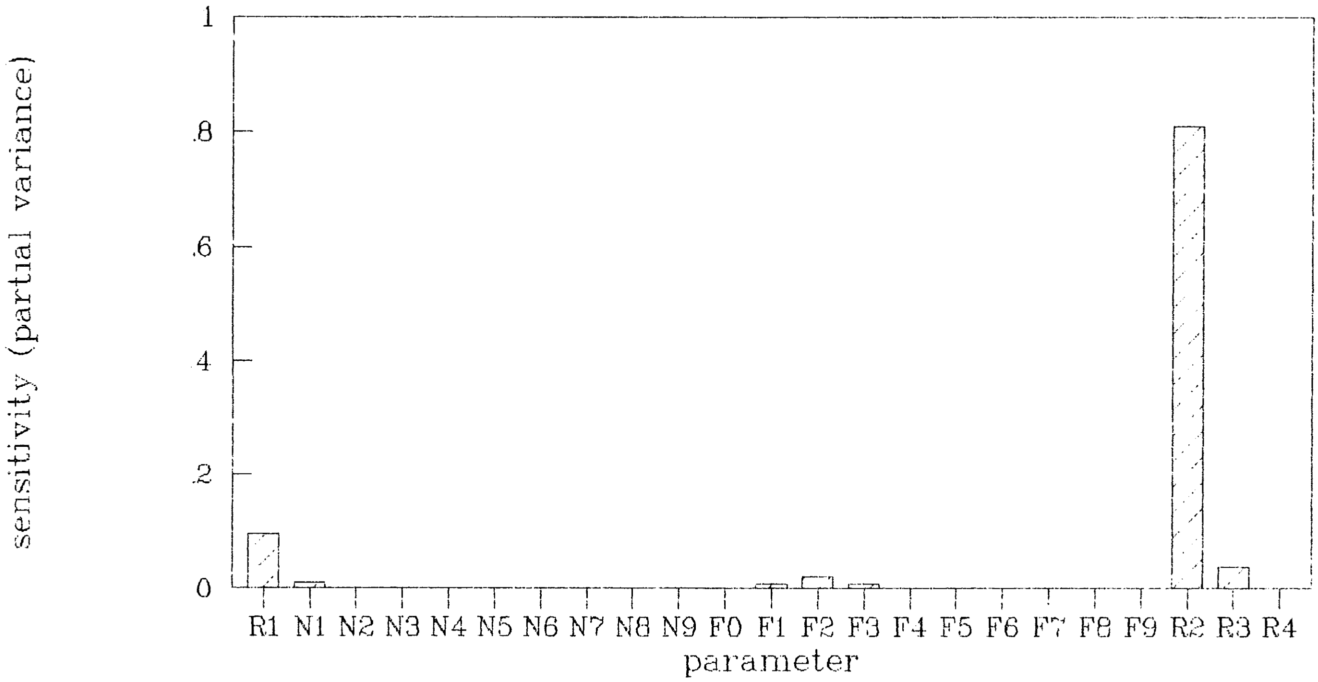
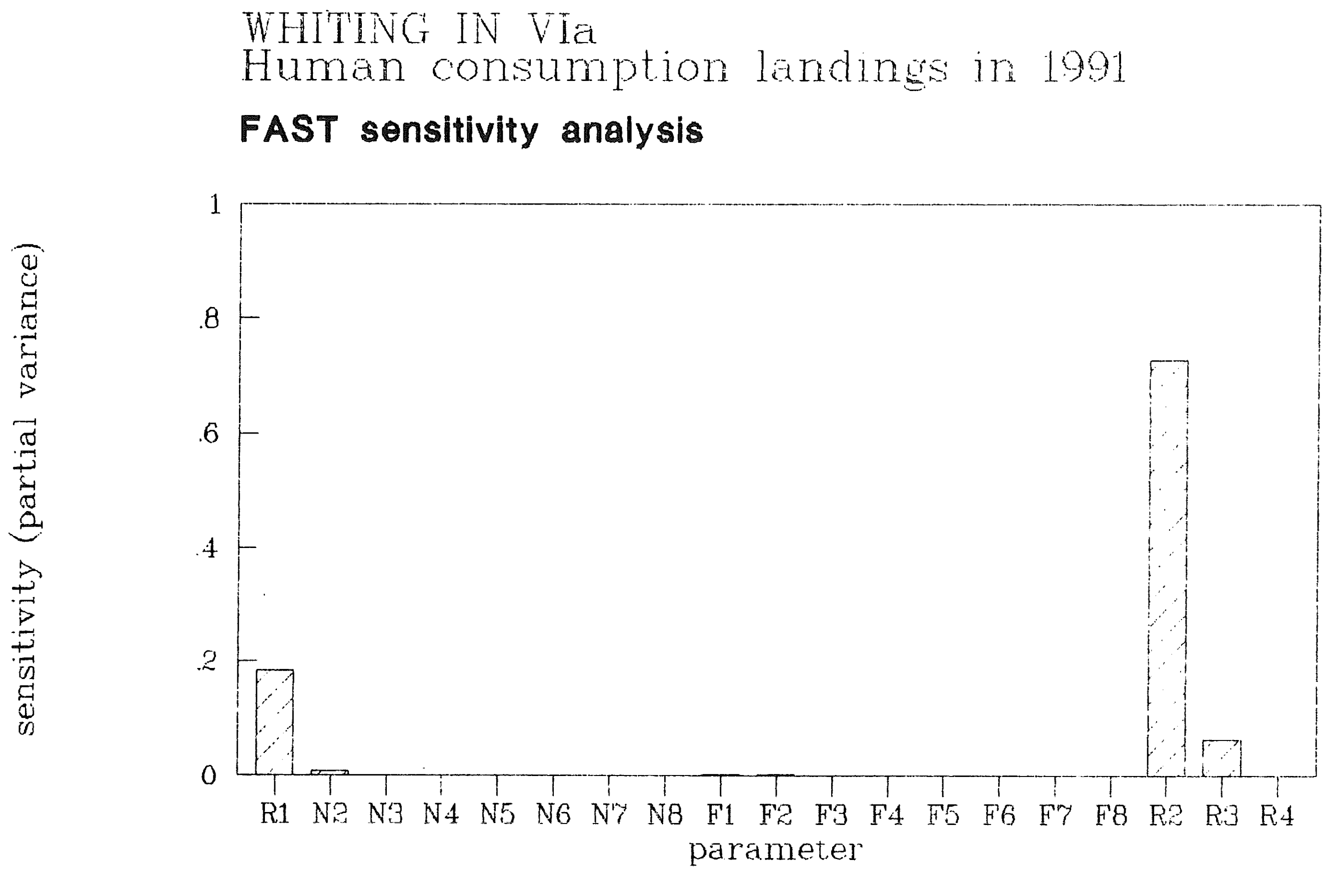


Figure 32.7


WHITING IN VIa
Human consumption landings in 1991
FAST sensitivity analysis
sensitivity (partial variance)
1
.8
.6
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 F1 F2 F3 F4 F5 F6 F7 F8 R2 R3 R4
parameter

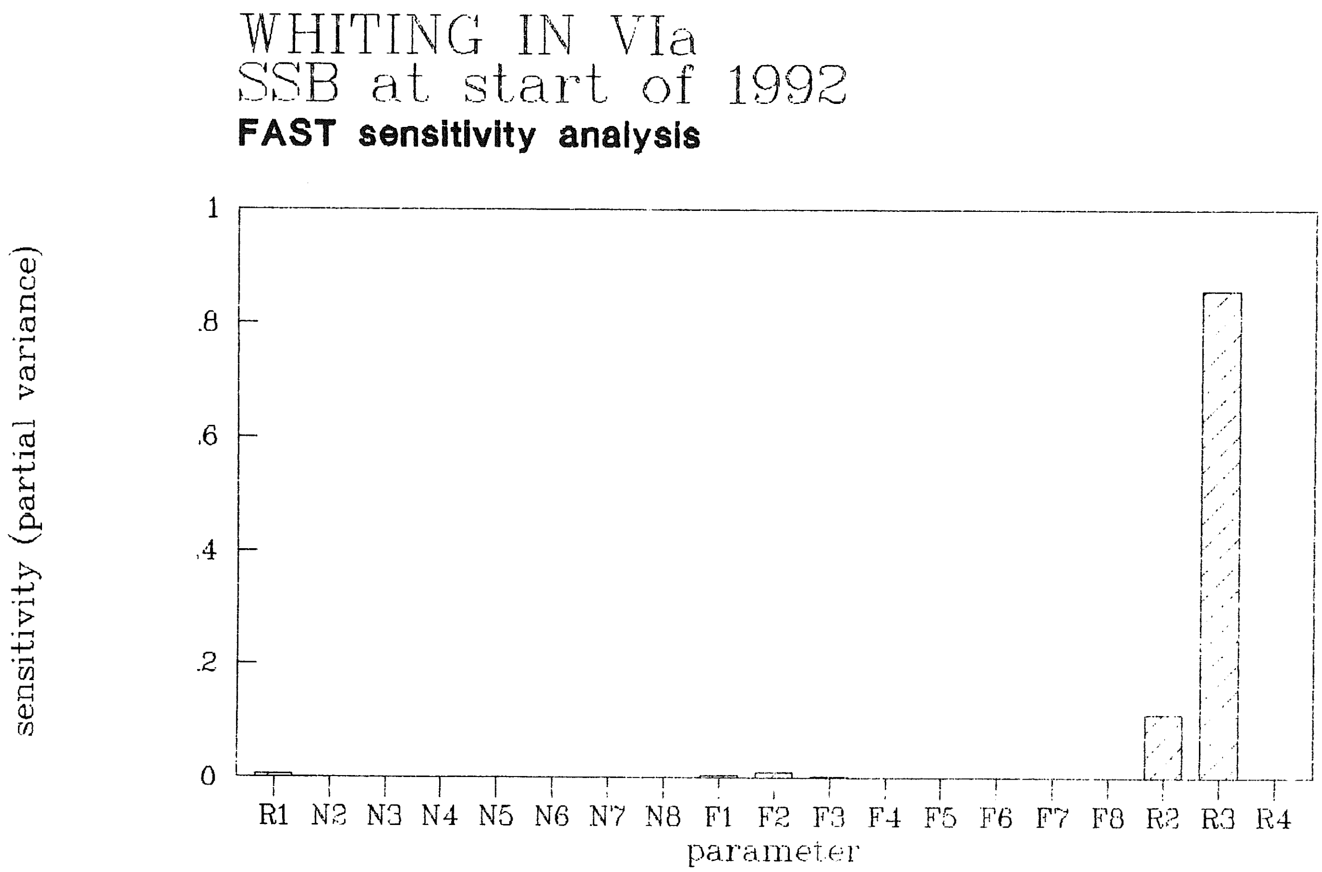
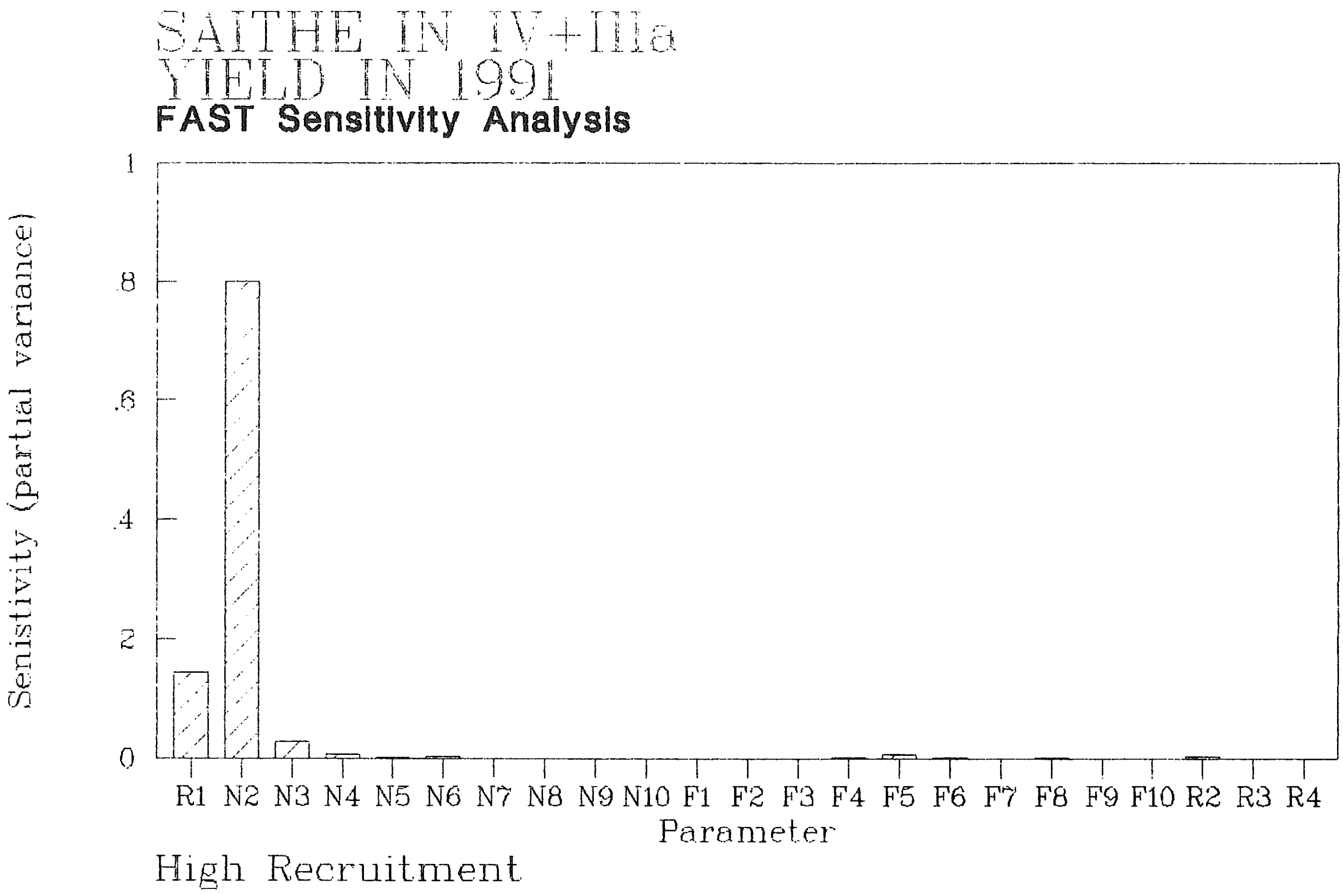

WHITING IN VIa
SSB at start of 1992
FAST sensitivity analysis
sensitivity (partial variance)
1
.8
.6
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 F1 F2 F3 F4 F5 F6 F7 F8 R2 R3 R4
parameter

Figure 32.8


SAITHE IN IV+IIIa
YIELD IN 1991
FAST Sensitivity Analysis
Senistivity (partial variance)
1
.8
.6
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter
High Recruitment

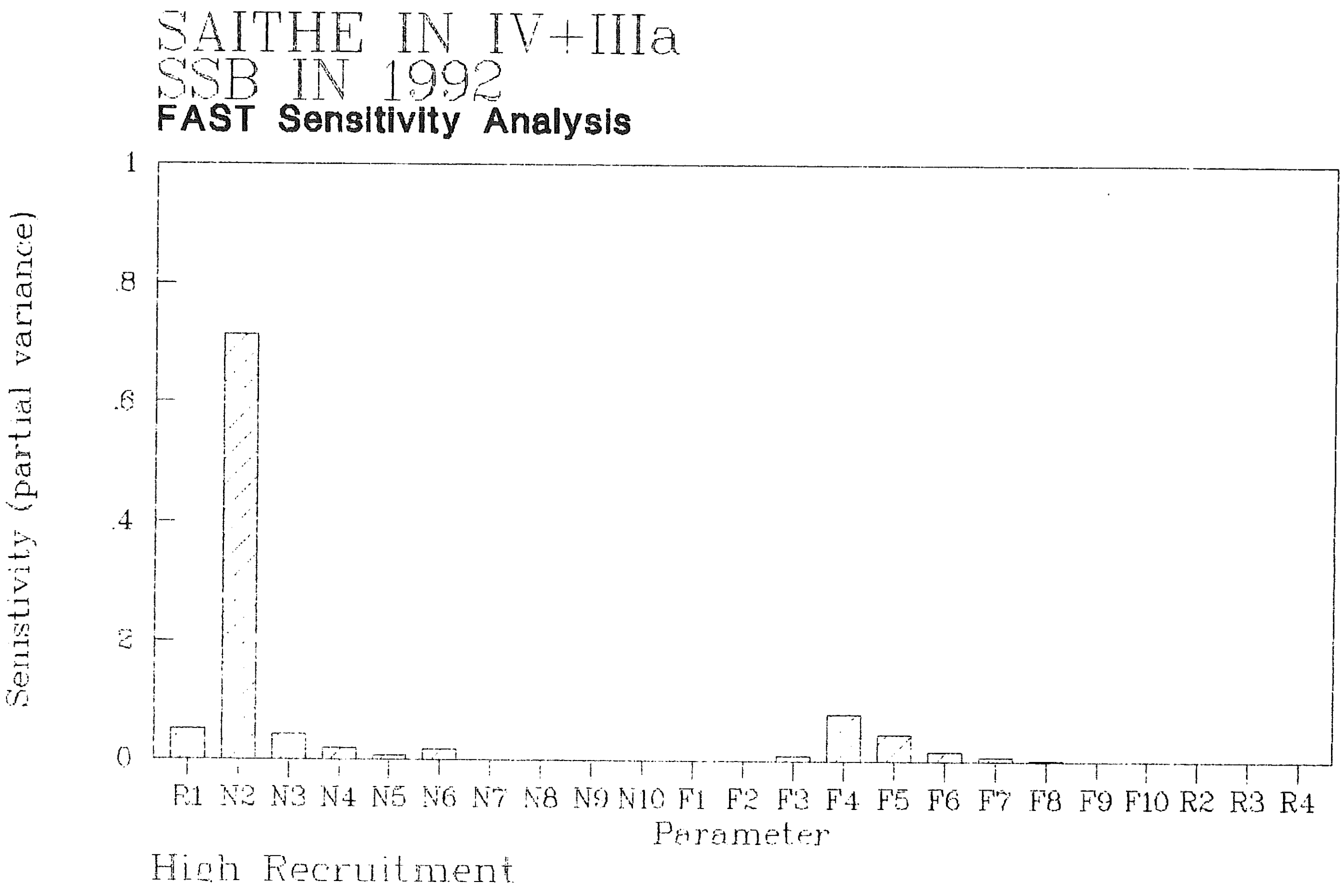
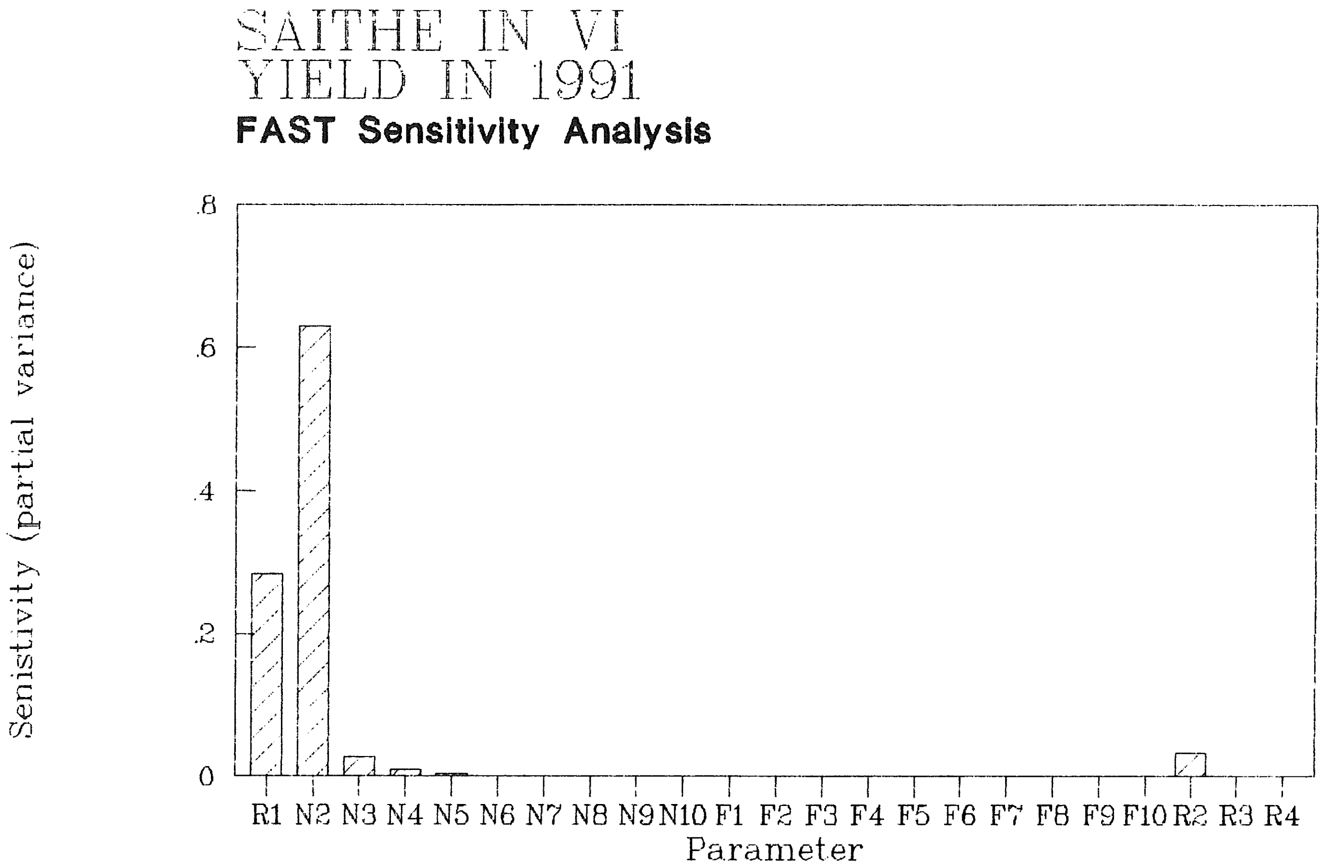
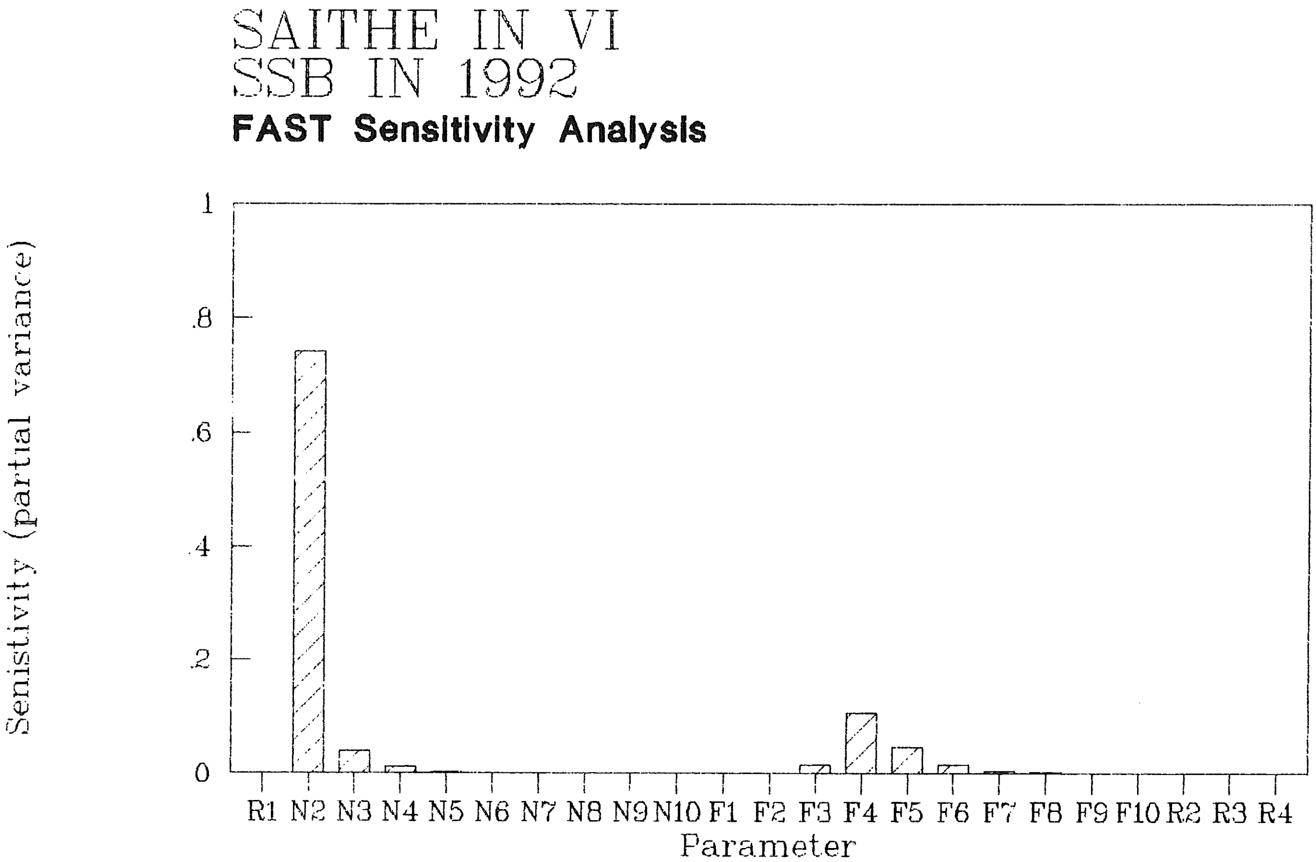

SAITHE IN IV+IIIa
SSB IN 1992
FAST Sensitivity Analysis
Senistivity (partial variance)
1
.8
.6
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter
High Recruitment

Figure 32.9


SAITHE IN VI
YIELD IN 1991
FAST Sensitivity Analysis
Senistivity (partial variance)
.8
.6
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter


SAITHE IN VI
SSB IN 1992
FAST Sensitivity Analysis
Senistivity (partial variance)
1
.8
.6
.4
.2
0
R1 N2 N3 N4 N5 N6 N7 N8 N9 N10 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 R2 R3 R4
Parameter

APPENDIX 1

ESTIMATION OF EFFECTS OF CHANGES IN SELECTIVITY

A very extensive text would be required to explain fully the program used to estimate the effects of selectivity changes. This text describes the main features of the program, a listing of which can be obtained from the Working Group Chairman.

1. Selectivity Models

Recent work has demonstrated that the proportion of fish of specified length retained in the codend depends on the length, the mesh size of the codend, the length of the extension piece and the number of meshes around the mouth of the codend. Armstrong et al. (1989) propose the following model for selectivity:

$$\log(p/(1-p)) = a0 + a1*L + a2*M + a3*E + a4*D \quad \ldots\ldots\ldots\ldots \quad (1)$$

where p = proportion of fish retained
L = fish length (cm)
M = stretched mesh size (mm)
E = extension length (m)
D = diameter (m)

(Note that diameter = N*M/3141.6 where N = number of meshes around the mouth of the codend.)

From (1) we have for any specified combination of mesh, extension and diameter:

$$\left.\begin{aligned} L50 &= (-a0 - a2*M - a3xE - a4*D)/a1 \\ L25 &= (\log(1/3) - a0 - a2*M - a3*E - a4*D)/a1 \end{aligned}\right] \quad \ldots\ldots\ldots\ldots \quad (2)$$

where L50 = 50% retention length
L25 = 25% retention length

L50 and L25 for the specified gear design are used to calculate the probability of retention of fish of each length using a logistic model:

$$p(L) = \frac{1}{\left[3^{((L50-L)/(L50-L25))} + 1\right]} \quad \ldots\ldots\ldots\ldots \quad (3)$$

2. Estimation of the Effects of Changing Selectivity

2.1 General Principles

It is expected that fishing mortality rates will change on those length groups of fish which are affected by the specified changes in selectivity. Conventionally, the amount by which the mortality rates change is estimated by:

$$S = p(L|new)/p(L|old) \quad \ldots\ldots\ldots\ldots \quad (4)$$

where p(L|old) = proportion of fish of length L retained by "old" gear
p(L|new) = proportion of fish of length L retained by "new" gear

$$\text{i.e., } F(L|new) = S*F(L|old) \quad \ldots\ldots\ldots\ldots \quad (5)$$

To estimate the effects of a change in selectivity, predictions are made of future catches

(a) assuming no change in fishing mortality rates (the "baseline" estimates), and

(b) assuming that fishing mortality rates are changed according to equation (5).

Comparison of the predictions under changed mortality rates (equivalent to changed selectivity) with baseline estimates (usually as percentage changes from baseline) indicates the effect of the change.

2.2 Technical Details

The data available to the Working Group are age-based rather than length-based and some means had to be found to convert from age to length. Catch-at-age data are available for several fleets and appropriate use of these data allowed estimation of the effect of selectivity change on each fleet. The catch of each fleet may be subdivided according to its ultimate use, i.e., human consumption, industrial by-catch or discards. The effect of selectivity change on each of these components of the catch of each fleet was investigated.

2.2.1 Estimation of F-at-age for each fleet and for each use

F-at-age for each fleet was calculated for each year in the period 1985-1989.

$$F(a,u,f,y) = F(a,*,*,y).C(a,u,f,y)/C(a,*,*,y)$$

where F = fishing mortality rate
C = catch in numbers
a = age (0-15)
u = use (human consumption landings, discards, ind. by-catch)
f = fleet
y = year
* = summation over all subscripts
e.g., F(a,*,*,y) = total international F-at-age in year y from VPA

C(a,*,*,y) = total international catch at age in year y from Working Group data base

For the catch predictions the average of F(a,u,f,y) over the five-year period was used:

$$F'(a,u,f) = (1/5) \sum_{y=1985}^{1989} F(a,u,f,y)$$

2.2.2 Mean weight at age for each fleet and use

These values are available in the roundfish data base, and average values for the period 1985 to 1989 were used when making predictions.

$$W'(a,u,f) = (1/5) \sum_{y=1985}^{1989} W(a,u,f,y) \quad \text{where } W = \text{mean weight}$$

2.2.3 Estimation of F-at-age by fleet and use following change in selectivity, revision of total international F-at-age

Mean length at age was estimated from the values of mean weight at age defined in 2.2.2.

$$L'(a,u,f) = (W'(a,u,f)/w1)\hat{}(1/w2)$$

where w1 = constant of conventional weight/length relationship
w2 = exponent

For each age, use and fleet the proportion retained at this mean length by the old gear and the new gear was estimated by the methods indicated in Section 1. Fishing mortality rates-at-age for the new gear were estimated as:

$$F'(a,u,f)new = F(a,u,f)old.S(a,u,f)$$

where $S(a,u,f) = p(L'(a,u,f)|new)/p(L'(a,u,f)|old)$

Total international F-at-age for the new selectivity was calculated by summation over fleet and use:

$$F'(a,*,*) = \sum_{u,f} F(a,u,f)$$

Hence, $Z'(a,*,*) = F'(a,*,*) + M(a)$ where $M(a)$ = natural mortality rate.

2.2.4 Catch and biomass prediction

Catch and biomass predictions were initiated using the expected stock age composition at 1 January 1990. This age composition incorporates estimates of the most recent recruitments. Future recruitments were assumed to be of geometric mean abundance. Catch and biomass predictions were then made by conventional methods for the period 1990-2001, assuming that selectivity changes were applied to fishing mortalities arising from industrial by-catch.

Catch in number by age, use, fleet in future year Y is given by:

$$C(a,u,f,Y) - N(a,Y).F'(a,u,f)new.(1-exp(Z'(a,*,*))/Z'(a,*,*)$$

Hence, we may estimate:

$T(a,u,f,Y) = C(a,u,f,Y)*W'(a,u,f)$ - Total weight caught at age by fleet and use in future year

$Yield(*,u,f,Y) = \sum T(a,u,f,Y)$ - Total yield to fleet by use in future year

$Yield(*,u,*,Y) = \sum Yield(*,u,f,Y)$ - Total international yield by use and future year

Total and spawning biomass at 1 January of each future year is given by:

$$Btot(Y) = \sum_{a} (N(a,Y) \cdot w(a) \qquad Bspawn\ (Y) = \sum_{a} N(a,y).w(a).r(a)$$

where N = stock number, w = stock mean weight, r = propn. mature

$N(a+1,Y+1) = N(a,Y)*exp(-Z'(a,*,*))$ - Stock for next future year

$N(0,Y)$ = historical geometric mean no.