Advisory Committee on Fishery Management

ICES CM 1996/Assess:6

REPORT OF THE WORKING GROUP ON THE ASSESSMENT OF DEMERSAL STOCKS IN THE NORTH SEA AND SKAGERRAK

ICES Headquarters, Copenhagen, Denmark

2–10 October 1995

PART III

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK-1261 Copenhagen K Denmark

3.9 Sandeel in the North Sea

3.9.1 Sandeel in the North Sea proper

3.9.1.1 Catch trends

Overall landings of sandeel amounted to 769,000 t in 1994, 78.5% of this being landed by the Danish fishery. Total landings are close to the mean value of the previous 10 years (784,000t; Tables. 3.9.1.1.1, and 3.9.1.1.2 and Figure. 3.9.1.1.1), but the contribution of the northern and southern North Sea to the total has changed. Landings from the traditionally important subarea 1A which includes the north eastern part of the Dogger bank and the grounds in the Firth of Forth area continued to decline in 1994, and as a consequence the landings from the Southern Area were the lowest since 1976. Increased landings from subareas 1B and 3 lifted the landings from the Northern area to 490,000t which is very close to the highest value on record (Table 3.9.1.1.4). The fishing season was generally shorter than in the 1993, the majority of landings were taken between April and the end of July (Table 3.9.1.1.3).

3.9.1.2 Natural mortality, maturity, age composition and mean weight at age

As in previous years the catch and weight at age data for the southern and northern North Sea were worked up separately.

The data from the Northern North Sea show an outstanding high contribution of age classes 3 and 4 in the first half of the year. Both figures are the highest on record (Table 3.9.1.2.1a,b). The number of 4 year old fish is more than twice as high as the so far maximum in 1980. The large number of three and four year old fish were mainly taken by the Danish fleet in subarea 1B and stem from rectangles 43F0 and 43E9 where a new fishery developed in 1994, see Figure 3.9.1.1.2b. Norwegian data from the same area seems to confirm this high proportion of 3 and 4 year olds in the catches.

Weight at age data show a large amount of interannual variability. The weights of the ages 3 and 4 for the first half of the year in the northern North Sea are well below the respective values in the last three years (15.1 (age 3) and 18.2g (age 4), compared to 21.9 and 25.0g (mean values 1991-93). In the second half of the year the reverse is the case, here the 1994 weights in ages 1 to 5 exceed the values observed in the previous three years by a factor of up to three. The weight at age data from the Southern North Sea are generally more in line with previous observations (Table. 3.9.1.2.2.a,b).

Natural mortality values and maturity ogives were the same as in previous assessments

3.9.1.3 Catch effort and research vessel data

Calculation of the total international effort in the Sandeel fishery

The calculation is to some extent different from that for the Norway pout fishery, because here the data from the Southern North Sea and the Northern North Sea have been treated as two independent fleets, the Southern North Sea fleet being only Danish vessels and the Northern North Sea fleet being a mixture of Danish and Norwegian vessels.

- **Danish data**

The Danish data for the Southern North Sea are treated in the same way as for Norway Pout (steps 1) to 3)). See section 3.8.3.

The Danish data for the Northern North Sea are also treated in the same way as the Norway Pout data (steps 1) to 3)). Subsequently the mean 175 GRT-CPUE is calculated by dividing the total sandeel landings by the sum of the standardized 175 GRT-fishing days. This procedure was changed this year to be in line with the respective procedure used so far for the Norwegian data. The CPUE values of the different size classes were adjusted to the 175 GRT vessel size using the same regression equations that are applied to correct the Norwegian CPUE data (see next paragraph).

- **Norwegian data**

As described in section 1.4.2.2 two linear regression was used to convert catches by trips into catches by days. One regression for each half year:

$fd_1 = 23.255 + 5.3713*Trips - 13.459*Catch('000\ t)$
$fd_2 = 67.626 + 4.1068*Trips + 9.955*Catch('000\ t)$

The modelling showed significant effects of number of trips, catch and season while the effect of mean GRT was not significant.

In the Sandeel fishery catches are homogeneous, so it is not necessary to correct the fishing days according to the share of the target species in the total catch. The mean-CPUE value (t/fd) can be calculated directly based on the landings and the fishing days. The mean GRT (GTR_{avN}) value is estimated in the same way as for Norway pout.

Instead of adjusting the number of fishing days to the 175 GRT-class here the CPUE value is adjusted to the vessel size 175 GRT. This is again based on a regression model based on *Danish* data. The regression model used is a power function of the type $CPUE=a*(GRT)^b$. The adjustment factor is the defined as $(GRT_{avN}/175)^b$, the mean-CPUE is multiplied with this factor give the Norwegian standardized 175 GRT-CPUE for Sandeel.

- **Combination of Danish and Norwegian data (only Northern North Sea)**

The combination of the Data of Denmark and Norway for the Northern North Sea is here done by calculating the mean international standardized 175 GRT-CPUE of both fleets rather than adding standardized fishing days. The contribution of the national 175 GRT-CPUE values are weighted by the amount of landings, that was sampled for the estimation of the national CPUE data. From the international mean standardized 175 GRT-CPUE the overall standardized 175 GRT-fishing days are derived by dividing the international catch of Sandeel through the international mean standardized 175 GRT-CPUE figure.

More details and the coefficients of the different regression models used can be found in the two previous reports of the then Working Group on the Assessment of Norway Pout and Sandeel (C.M.1994/Assess:7, C.M.1995/Assess:5). The regression models that relate sandeel CPUE in the Danish fleet with GRT had to be corrected during this meeting and the revised coefficients are given in Table 3.9.1.3.2.

Research vessel data

There are no appropriate survey data available for this species.

3.9.1.4 Catch at age analysis

At the last meeting of the WG on Norway pout and Sandeel it was attempted to produce a combined assessment of the sandeel in the northern and southern North Sea. The stock size estimated by the combined assessment was generally close to the results obtained by adding the separate stock size estimates from the northern and southern together. For this reason the present Working Group decided only to present the results from a combined assessment. However, in order not to disrupt the timeseries of catch and effort from the northern and southern areas, it was decided to retain the same basic tables of input data as presented in last years report, and to treat the northern and southern North Sea fisheries as two different fleets in the tuning procedure.

The SXSA was used to estimate fishing mortalities and stock numbers at age. Half yearly manual weighting factors were applied to the catchabilities in order to downweight the influence of older fish and data from the second half of the year. This is in accordance with the catch at age analysis from last year. The downweighting of the older fish can be justified from the very high variability of these year classes proportion in the catches (see also section 3.9.1.2 for the discussion on older fish in subarea 1B). The catches (especially of 0-group fish) in the second half year are in addition very varying. This could also be due to misreported catches. The most extreme 0-group value in the time series are the reported landings from the southern part of the North Sea in 1991 (which also stands out in the retrospective analysis).

The catchability was assumed to remain constant over the time period considered (1983-1994) and used to estimate the missing catch at age data for 1990 under the constraint the that the SOP in 1990 should equal the observed landings. Plot of log catchability residuals reveal no apparent trend in catchability with time, Figure 3.9.1.4.2

Compared to the period from 1983 to 1991 fishing mortality appears to have declined somewhat in the most recent years. The spawning stock biomass has fluctuated around a level of 1 million tonnes. After having declined to 500.000 tonnes in 1991 it has been increasing in recent years and is presently estimated to be close to the long term average. It is likely that it will increase further in the near future due to the strong 1993 year class.

As last years assessment the results indicate a low F level in the most recent years. The previous estimates of F for 1992 and 1993 were revised downward by 20 and 30% respectively (Table 3.9.1.4.1). Recruitment (age 1) in 1994 came out as the second highest since 1983. The estimates of the year class strength of year classes 1991 and 1992 given in the previous assessment have been corrected upward by 26 and 19% respectively. Total spawning stock biomass is estimated to be 962,000t in 1994. The previous estimates for the years 1992 and 1993 have been revised upward by 15 and 41%, respectively. The revision of previous F and SSB estimates is mainly a consequence of the untypically large numbers of age group 3 and 4 fish caught in 1994 at a comparatively low effort level.

When the biomass figures for the total North Sea assessment (Figure 10.2.1 and Figure 10.2.2 in Report on the WG of Assessment of Norway Pout and Sandeel, C.M.1995/Assess:5) were compared to this years values some errors were discovered. These errors do *not* occur in the basic data of the respective run given in Table 10.2.1 of the previous report but only in the figures. For clarification the revised Figure 10.2.2 (old report) is included here as Figure 3.9.1.4.3. The values for the total North Sea run are based on this years run and thus includes the 1994 data. The basic conclusion drawn last year has not changed. The differences between the sum of the separate and the combined assessments are even lower than they appeared previously. Further information with regard to the stock identity problem is included in section 3.9.1.12.

It is not clear, to what extent the observed changes in the assessment will reflect true changes in the overall North Sea population. The untypical high numbers of older fish in the Danish catches are originating from a restricted fishing ground that was previously only lightly exploited. A basic problem in the assessment of the sandeel stock in the North Sea is the lack of information on the abundance of sandeel outside the fishing areas. The catch at age data will only represent the exploited part of the population and methods based on analysis of catch at age data are therefore likely to underestimate the total stock size.

The very high total stock biomass estimate for 1994 (4,103,000t), which is the highest since 1983, is a consequence of a high CPUE. The CPUE values in the northern North Sea were the highest on record since 1976 in both the Danish and the Norwegian fleet.

Retrospective analysis indicates that the SXSA has a moderate tendency to underestimate SSB, but generally the estimates converge rapidly. Recruitment (0-group) is over- or underestimated, most extreme for the 1991 year class. This extreme deviation is, however, related to the very high catches of 0-group in the southern North Sea that year. Except from the 1991 year class estimates of the year class strength vary only little, once data on the 1-group have been entered.

3.9.1.5 Recruitment estimates

No further analysis of recruitment.

3.9.1.6 Historical stock trends

The total landing of Sandeel in the period 1974-1994 are shown in Table 3.9.1.1.1. In addition the estimated average Fishing mortality for 1- and 2-group, the trends in the Spawning Stock Biomass (SSB) and the recruitment trends for the period 1976-1994 are shown in Table 3.9.1.6.1. These data are also presented in Figure 3.9.1.1.1.

The pre. 1982 tuning data are not complete for all tuning series and the 1976-1994 trend presented differ slightly from the keyrun (1983-1994), but the conclusions in section 3.9.1.4 should not be altered.

3.9.1.7 Biological reference points

A half-yearly SSB per recruit analysis and data on stock and recruitment for the period 1976-1993 were used to calculate F_{med} and F_{high} (Figure 3.9.1.7.1). Values of natural mortality and proportion mature at age were taken from Tables 3.9.1.2.3 and 3.9.1.2.4. Weight at age in the stock was calculated from the average weight at age in the southern and northern area (weighted by the catch in numbers in each area) over the period from 1992 to 1994. The average fishing mortality by halfyear over the same period was used as representing the present level of fishing mortality. F_{med} was found to be 0.63 (average annual fishing mortality for ages 1 and 2) which is approximately two times the present level of average fishing mortality, but which is lower than the average fishing mortalities for the period 1989-1991. F_{high} is estimated to be at 1.60, which is 4-5 times the present level of effort.

(Figures 3.9.1.7.1 Recruitment/SSB plot used to calculate F_{med} and F_{high}).

3.9.1.8 Comments on the assessment

It has been pointed out earlier that the interpretation of the age of sandeel otoliths is problematic. The main difficulty is the occurrence of secondary rings and the determination of the translucent winter rings. This lead to a workshop on the analysis of sandeel otoliths, which was held in August 1995. The results from the workshop were presented at the ICES annual science conference (C.M.1995/G:4). The first intercalibration exercise indicated substantial problems in the identification of 0-group otoliths. These problems are, however, likely to be less serious in the age determinations used by WG-data, since only one of the 7 readers who read the otoliths during the intercalibration exercise was experienced in sandeel otolith reading. This probably explains why 80% of the otoliths which the experienced reader classified as belonging to the 0-group were classified to age group 1 or older by the unexperienced readers. A second intercalibration exercise during the workshop showed considerable improvement with more than 95% agreement in ageing of 1 and 2 group otoliths. It was, however, considered impossible to produce guidelines giving sufficient precision in the age readings, especially for older ages, and this merits further attention to the problems involved in age determination of sandeel otoliths.

This problems in age determination raised the suspicion that the untypically high proportion of old fish in Danish samples in the northern North Sea were due to problems in the age determination. A comparison with independent Norwegian age readings from samples of taken at the same location (43F0 and 43E9) confirmed largely the Danish age readings.

The SOP of the catch and weight at age does not conform with the total reported landings except for the most recent years. This is due to the use of a smoothed mean weight at age in the catch in the historic time series.

The comments on methodology, data preparation and standardisation of procedures given in Section 3.8.8 also applies to the sandeel assessment.

Table 3.9.1.1.1 Landings ('000 t) of sandeel from the North Sea, 1952-1994. (Data provided by Working Group members.)

Year	Denmark	Germany	Faroes	Netherlands	Norway	Sweden	UK	Total
1952	1.6	-	-	-	-	-	-	1.6
1953	4.5	+	-	-	-	-	-	4.5
1954	10.8	+	-	-	-	-	-	10.8
1955	37.6	+	-	-	-	-	-	37.6
1956	81.9	5.3	-	+	1.5	-	-	88.7
1957	73.3	25.5	-	3.7	3.2	-	-	105.7
1958	74.4	20.2	-	1.5	4.8	-	-	100.9
1959	77.1	17.4	-	5.1	8.0	-	-	107.6
1960	100.8	7.7	-	+	12.1	-	-	120.6
1961	73.6	4.5	-	+	5.1	-	-	83.2
1962	97.4	1.4	-	-	10.5	-	-	109.3
1963	134.4	16.4	-	-	11.5	-	-	162.3
1964	104.7	12.9	-	-	10.4	-	-	128.0
1965	123.6	2.1	-	-	4.9	-	-	130.6
1966	138.5	4.4	-	-	0.2	-	-	143.1
1967	187.4	0.3	-	-	1.0	-	-	188.7
1968	193.6	+	-	-	0.1	-	-	193.7
1969	112.8	+	-	-	-	-	0.5	113.3
1970	187.8	+	-	-	+	-	3.6	191.4
1971	371.6	0.1	-	-	2.1	-	8.3	382.1
1972	329.0	+	-	-	18.6	8.8	2.1	358.5
1973	273.0	-	1.4	-	17.2	1.1	4.2	296.9
1974	424.1	-	6.4	-	78.6	0.2	15.5	524.8
1975	355.6	-	4.9	-	54.0	0.1	13.6	428.2
1976	424.7	-	-	-	44.2	-	18.7	487.6
1977	664.3	-	11.4	-	78.7	5.7	25.5	785.6
1978	647.5	-	12.1	-	93.5	1.2	32.5	786.8
1979	449.8	-	13.2	-	101.4	-	13.4	577.8
1980	542.2	-	7.2	-	144.8	-	34.3	728.5
1981	464.4	-	4.9	-	52.6	-	46.7	568.6
1982	506.9	-	4.9	-	46.5	0.4	52.2	610.9
1983	485.1	-	2.0	-	12.2	0.2	37.0	536.5
1984	596.3	-	11.3	-	28.3	-	32.6	668.6
1985	587.6	-	3.9	-	13.1	-	17.2	621.8
1986	752.5	-	1.2	-	82.1	-	12.0	847.8
1987	605.4	-	18.6	-	193.4	-	7.2	824.6
1988	686.4	-	15.5	-	185.1	-	5.8	892.8
1989	824.4	-	16.6	-	186.8	-	11.5	1039.1
1990	496.0	-	2.2	0.3	88.9	-	3.9	591.3
1991	701.4	-	11.2	-	128.8	-	1.2	842.6
1992	751.1	-	9.1	-	89.3	0.5	4.9	855.0
1993	482.2	-	-	-	95.5	-	1.5	579.2
1994	603.5	-	10.3	-	165.8	-	5.9	765.5

+ = less than half unit.
- = no information or no catch.

Table 3.9.1.1.2 Sandeel North Sea. Monthly landings (t) by country, 1988-1994. (Data provided by Working Group members.

Year	Month	Denmark	Faroes	Norway	Scotland	Total[1]
1988	Mar	48,766		21,582	4	70,352
	Apr	147,839		27,181	1,518	186,538
	May	246,852		65,160	2,481	314,493
	Jun	169,526		32,995	744	203,265
	Jul	33,120	n/a	104	633	33,857
	Aug	21,155		5,212	198	26,565
	Sep	9,224		9,111	181	18,516
	Oct	9,885		13,709	36	23,630
	Nov	-		-	-	-
	Dec	-		-	-	-
	Total	686,367	15,531	185,054	5,795	877,216[1]
1989	Mar	62,927		23,117	106	86,150
	Apr	164,296		27,953	1,345	193,594
	May	300,524		61,764	4,912	376,200
	Jun	235,779	n/a	59,079	5,124	299,982
	Jul	31,670		187	-	31,857
	Aug	6,533		9,581	-	16,114
	Sep	22,705		5,086	-	27,791
	Oct	-		65	-	65
	Nov	-		-	-	-
	Dec	-		-	-	-
	Total	824,434	16,612	186,832	11,487	1,022,753[1]
1990	Mar	24,700		11,542	-	36,242
	Apr	94,670		13,673	906	109,249
	May	181,582		35,394	2,184	219,160
	Jun	121,981	n/a	6,660	797	129,438
	Jul	17,307		1,101	-	18,408
	Aug	48,992		17,519	-	66,511
	Sep	6,793		2,541	-	9,334
	Oct	-		474	-	474
	Nov	-		-	-	-
	Total	496,025	2,230	88,904	3,887	588,816[1]
1991	Mar	23,454		7,349	-	30,803
	Apr	78,374		12,582	30	90,986
	May	204,894	n/a	50,110	1,124	256,519
	Jun	217,334		13,176	-	230,509
	Jul	129,548		8,267	-	137,815
	Aug	43,024		16,955	-	59,979
	Sep	4,801		16,153	-	20,955
	Oct	-		4,242	-	4,242
	Nov	-		-	-	-
	Total	701,429		128,834	1,154	831,808[1]

[1]Excluding the Faroes.

Table 8.1.2 (cont'd)

Table 3.9.1.2 Continued

Year	Month	Denmark	Faroes	Norway	Scotland	Total[1]
1992	Mar	22,686		3,490	392	26,269
	Apr	148,866		10,998	2,975	160,256
	May	242,170		29,149	1,469	274,294
	Jun	265,879		44,197	-	311,545
	Jul	64,910	n/a	1,464	-	66,374
	Aug	6,574		-	-	6,574
	Sep	1		-	-	1
	Oct	16		-	-	16
	Nov	-		-	-	-
	Dec	-		-	-	-
	Total	751,102	9,139	89,298	4,836	854,462
1993	Mar	18,374		8,006	0	26,830
	Apr	49,794		22,169	0	71,963
	May	134,695		19,213	0	153,908
	Jun	186,936		17,242	204	204,382
	Jul	56,049		2,883	0	58,932
	Aug	10,552		8,017	0	18,569
	Sep	4,474		6,421	0	10,895
	Oct	13,145		9,392	0	22,537
	Nov	8,163		2,150	0	10,313
	Total	482,182		95,463	204	577,869
1994	Mar	79		1,919	0	1,998
	Apr	98,123		18,887	0	117,010
	May	243,826		69,048	607	313,481
	Jun	222,409		48,228	4,755	275,392
	Jul	84,191		22,060	559	106,810
	Aug	2,320		7,922	0	10,242
	Sep	7,425		5,137	0	12,562
	Oct	9		599	0	608
	Nov	0		0	0	0
	Total	658,381		173,800	5,921	838,103

[1]Excluding the Faroes.

Table 3.9.1.1.3 Monthly landings of sandeels (t) from each area in Figure 8.1.1, 1990–1994.

Month	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland
1991											
Mar	902	494	-	1,582	26,528	737	548	-	4	8	-
Apr	8,443	356	680	27,611	34,413	418	18,032	138	-	892	3
May	86,975	4,631	-	9,615	106,294	615	39,939	4,038	660	3,144	-
Jun	91,485	1,005	-	26,522	12,671	-	34,263	10,261	115	54,187	-
Jul	30,976	411	-	43,619	15,253	-	13,174	8,195	215	25,972	-
Aug	4,624	223	-	4,631	37,052	-	4,567	-	-	8,882	-
Sep	4,789	-	-	391	15,762	-	13	-	-	-	-
Oct	-	-	-	-	4,242	-	-	-	-	-	-
Nov	-	-	-	-	-	-	-	-	-	-	-
Total	228,194	7,120	680	113,971	252,215	1,320	110,596	22,632	993	93,086	3
1992											
Mar	3,900	30	653	10,778	8,480	92	1,619	-	-	717	-
Apr	70,224	403	828	35,672	20,817	-	28,568	1,539	-	2,204	-
May	111,120	760	85	94,723	27,301	3	24,752	488	167	14,875	-
Jun	218,335	2,574	2,030	17,870	9,406	108	22,712	10,291	1,712	26,507	-
Jul	18,802	180	622	9,711	1,070	68	18,128	7,771	935	9,087	-
Aug	-	-	-	162	10	-	5,416	-	-	986	-
Sep	-	-	-	-	-	-	-	-	-	1	-
Oct	-	-	-	-	-	-	-	-	-	7	-
Nov	-	-	-	-	-	-	-	-	-	-	-
	422,381	3,948	4,218	168,916	67,083	271	101,204	20,089	2,834	54,381	
1993											
Mar	222	131	0	0	25,069	0	928	30	0	0	0
Apr	14,927	11,121	0	2,287	38,170	0	4,496	747	55	160	0
May	47,453	1,490	0	7,546	35,118	0	34,186	17,192	685	10,238	0
Jun	125,991	3,038	23	7,550	21,544	148	13,509	5,018	1,879	25,682	0
Jul	7,942	4,494	65	6,894	18,563	116	6,871	3,608	1,258	9,121	0
Aug	0	1,573	0	703	7,863	0	5,744	0	0	2,686	0
Sept	0	0	0	186	7,127	0	3,501	0	0	81	0
Oct	0	0	0	899	9,296	0	11,807	0	0	535	0
Nov	0	20	0	112	2,150	0	7,803	0	0	228	0
Total	196,535	21,867	88	26,177	164,900	264	88,845	26,595	3,877	48,731	0
1994											
Mar	79	0	21	168	1730	0	0	0	0	0	0
Apr	10512	41080	0	9700	33383	2249	17145	318	0	113	0
May	47346	36777	6	21386	78640	281	83588	1064	10	2314	0
Jun	85405	29250	0	23947	47986	38	41184	10087	2572	16450	0
Jul	13679	1483	0	4966	27474	0	27813	4521	267	23164	0
Aug	0	0	0	1	7794	128	174	0	0	5	0
Sep	0	0	0	1487	5845	0	5048	0	0	0	0
Oct	0	0	0	0	522	0	79	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0
Total	157,021	108,590	,021	61,655	203,374	2,696	175,031	15,990	2,849	42,046	0

Table 3.9.1.1.4 Annual landings ('000 t) of Sandeels by area of the North Sea [Denmark, Norway and UK (Scotland)]. (Data provided by Working Group members)(Figure 8.1.1).

	Area											Assessment areas[1]	
Year	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland	Northern	Southern
1972	98.8	28.1	3.9	24.5	85.1	0.0	13.5	58.3	6.7	28.0	0.0	130.6	216.3
1973	59.3	37.1	1.2	16.4	60.6	0.0	8.7	37.4	9.6	59.7	0.0	107.6	182.4
1974	50.4	178.0	1.7	2.2	177.9	0.0	29.0	27.4	11.7	25.4	7.4	386.6	117.1
1975	70.0	38.2	17.8	12.2	154.7	4.8	38.2	42.8	12.3	19.2	12.9	253.7	156.5
1976	154.0	3.5	39.7	71.8	38.5	3.1	50.2	59.2	8.9	36.7	20.2	135.0	330.6
1977	171.9	34.0	62.0	154.1	179.7	1.3	71.4	28.0	13.0	25.3	21.5	348.4	392.3
1978	159.7	50.2		346.5	70.3		42.5	37.4	6.4	27.2	28.1	163.0	577.2
1979	194.5	0.9	61.0	32.3	27.0	72.3	34.1	79.4	5.4	44.3	13.4	195.3	355.9
1980	215.1	3.3	119.3	89.5	52.4	27.0	90.0	30.8	8.7	57.1	25.4	292.0	401.2
1981	105.2	0.1	42.8	151.9	11.7	23.9	59.6	63.4	13.3	45.1	46.7	138.1	378.9
1982	189.8	5.4	4.4	132.1	24.9	2.3	37.4	75.7	6.9	74.7	52.0	74.4	479.2
1983	197.4	-	2.8	59.4	17.7	-	57.7	87.6	8.0	66.0	37.0	78.2	419.0
1984	337.8	4.1	5.9	74.9	30.4	0.1	51.3	56.0	3.9	60.2	32.6	91.8	532.8
1985	281.4	46.9	2.8	82.3	7.1	0.1	29.9	46.6	18.7	84.5	17.2	79.7	513.5
1986	295.2	35.7	8.5	55.3	244.1	2.0	84.8	22.5	4.0	80.3	14.0	375.1	457.4
1987	275.1	63.6	1.1	53.5	325.2	0.4	5.6	21.4	7.7	45.1	7.2	395.9	402.8
1988	291.1	58.4	2.0	47.0	256.5	0.3	37.6	35.3	12.0	102.2	4.7	384.8	487.6
1989	228.3	31.0	0.5	167.9	334.1	1.5	125.3	30.5	4.5	95.1	3.5	492.4	526.3
1990	141.4	1.4	0.1	80.4	156.4	0.6	61.0	45.5	13.8	85.5	2.3	219.5	366.7
1991	228.2	7.1	0.7	114.0	252.8	1.8	110.5	22.6	1.0	93.1	+	372.9	458.9
1992	422.4	3.9	4.2	168.9	67.1	0.3	101.2	20.1	2.8	54.4	0	176.7	668.6
1993	196.5	21.9	0.1	26.2	164.9	0.3	88.0	26.6	3.9	48.7	0	276.0	301.9
1994	157.0	108.6	-	61.7	203.4	2.7	175.0	16.0	2.8	42.0	0	489.7	279.5

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

Table 3.9.1.2.1 a Sandeels in the northern North Sea. Catch in numbers, half-year (millions).

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

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

Age group	1987		1988		1989		1990[1]		1991	
	1	2	1	2	1	2	1	2	1	2
0	-	455	2,453	13,196	6,163	3,380	1,599	18,293	-	13,616
1	26,236	5,768	9,855	1,283	57,002	4,038	10,551	-	41,855	866
2	10,855	198	25,922	340	2,233	274	1,481	-	2,342	28
3	350	-	1,319	119	3,406	-	232	-	908	8
4	107	-	26	17	-	-	-	-	225	3
5+	48	-	-	-	-	-	-	-	93	-

Age group	1992		1993		1994	
	1	2	1	2	1	2
0	137	6,797	-	26,960	398	456
1	9,871	48	15,768	1,004	28,490	829
2	4,056	3	2,635	112	7,225	1,211
3	486	-	1,023	34	5,954	396
4	195	-	207	8	1,579	12
5+	110	-	439	14	577	12

[1]Based on Norwegian data only.
Note: 1 = Jan-Jun.
2 = Jul-Dec.

Table 3.9.1.2.1 b SANDEELS in the Southern North Sea. Catch in numbers, half-year (millions)

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

Age groups	1983		1984		1985		1986		1987		1988		1989	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
0	955	9,298	20	-	6,573	11,940	-	112	-	298	1,420	-	29	1
1	2,232	240	62,517	9,423	7,790	1,896	43,629	5,350	4,351	3,095	2,349	-	44,444	1,619
2	35,029	2,806	2,257	92	39,301	3,229	7,333	293	22,771	6,664	10,074	234	405	165
3	934	513	13,272	577	2,490	2,234	1,604	241	1,158	196	17,914	2,084	957	35
4	234	2	267	44	233	163	30	9	141	45	1,920	63	3,350	122
5	122	-	109	-	18	77	-	9	24	6	617	5	18	1
6	25	-	66	-	7	30	-	-	-	-	146	-	-	-
7+	6	-	-	-	7	28	-	-	-	-	86	-	-	-

Age groups	1990		1991		1992		1993		1994	
	1	2	1	2	1	2	1	2	1	2
0			-	12,115	2	134	-	838	24.697	4.093
1			20,058	11,411	60,337	3,903	3,581	1,037	2.594	322
2			9,224	344	10,021	382	14,659	953	2.654	198
3			1,320	111	1,002	157	3,707	266	447	116
4			454	-	427	25	451	60	268	21
5+			-	-	69	2	375	17	61	-
6					103	5	186	10	31	-
7+					22	2				

Note: 1 = January-June
2 = July-December

Table 3.9.1.2.2 a SANDEEL North Sea. Northern area. Mean weight at age (g) in the catch for 1991 (revised), 1992, 1993 and 1994. Data from Denmark and Norway.

1991	Half-year	
Age	1	2
0	2.87	3.42
1	7.43	9.57
2	14.23	14.99
3	22.40	16.20
4	29.93	-
5+	33.15	-
1992		
Age	1	2
0	-	5.48
1	5.45	18.03
2	10.86	25.40
3	18.49	21.56
4	25.28	39.33
5+	38.15	-
1993		
Age	1	2
0	0.92	2.71
1	5.97	10.37
2	20.62	19.22
3	24.92	20.28
4	19.65	20.27
5 +	23.31	22.00
1994		
Age	1	2
0	1.10	6.58
1	6.43	22.75
2	13.70	30.20
3	15.08	58.07
4	18.18	59.30
5+	21.47	85.00

Table 3.9.1.2.2 b SANDEEL, North Sea. Southern area. Mean weight at age (g) in the catch for 1993 and 1994.

1993	Half-year	
Age	1	2
0	-	3.08
1	6.08	10.13
2	11.54	15.66
3	15.09	17.04
4	19.18	21.84
5	20.02	22.43
6	22.46	23.10
7+	23.63	21.89

1994	Half-year	
Age	1	2
0		
1	6.07	8.56
2	11.01	17.16
3	13.46	19.50
4	16.17	23.29
5	17.90	26.25
6	18.49	
7	19.15	

Table 3.9.1.2.4 SANDEEL, North Sea. Southern area. Mean weight at age (g) in the catch for 1993 and 1994.

1993	Half-year	
Age	1	2
0	-	3.08
1	6.08	10.13
2	11.54	15.66
3	15.09	17.04
4	19.18	21.84
5	20.02	22.43
6	22.46	23.10
7+	23.63	21.89
1994	Half-year	
Age	1	2
0		
1	6.07	8.56
2	11.01	17.16
3	13.46	19.50
4	16.17	23.29
5	17.90	26.25
6	18.49	
7	19.15	

Table 3.9.1.2.5 VPA: Weighting factor for catchabilities (*100)

All years			
Season		1	2
Age	Fleet		
0	1	20	2
1	1	100	10
2	1	100	10
3	1	100	10
4	1	20	2
5	1	20	2
6	1	20	2

Table 3.9.1.3.1.a Sandeel. Southern North Sea. Danish CPUE data.

Year	Vessel size (GRT)						
	5-50	50-100	100-150	150-200	200-250	250-300	>300
			First half year				
1982	16.1	26.9	43.1	47.2	59.2	53/2	59.6
1983	17.0	20.6	36.3	44.4	49.1	51.2	50.9
1984	19.9	26.3	42.6	50.4	60.9	56.4	60.1
1985	13.8	21.2	35.5	43.4	49.8	49.1	56.3
1986	23.2	31.4	41.1	49.8	58.9	58.4	69.4
1987	23.9	33.9	53.9	67.4	76.1	76.4	115.5
1988	19.2	26.8	42.9	52.3	60.0	56.6	82.8
1989	19.4	24.5	43.3	52.3	58.9	55.2	74.3
1990	20.0	20.8	30.4	33.7	39.8	35.7	49.1
1991	27.0	30.0	49.5	50.3	62.8	60.7	92.8
1992	18.4	23.4	53.1	63.2	83.8	82.4	115.9
1993	17.2	18.1	38.1	40.2	58.6	60.9	89.5
1994	24.6	29.0	59.1	59.5	75.2	78.9	96.6
			Second half year				
1982	-	20.3	37.5	40.5	-	27.9	-
1983	15.1	21.3	25.1	32.4	45.4	34.0	34.7
1984	12.7	16.4	26.9	34.2	36.5	40.2	40.9
1985	13.2	19.5	26.0	35.8	36.2	38.2	39.4
1986	18.4	25.2	32.5	44.5	45.8	51.8	55.5
1987	16.2	22.6	41.4	45.8	49.3	45.6	75.4
1988	18.8	29.3	29.9	31.1	38.6	31.1	44.0
1989	26.7	26.2	27.0	38.3	38.0	29.3	40.4
1990	27.9	32.8	36.4	41.3	48.3	45.2	42.7
1991	21.4	26.8	41.8	49.4	65.1	53.7	98.3
1992	21.3	28.7	36.7	42.6	44.8	39.1	58.3
1993	20.2	22.7	30.8	35.6	45.3	39.3	51.8
1994	28.6	38.9	50.4	54.3	60.7	56.9	65.2

Table 3.9.1.3.1.b Sandeel Northern North Sea. Danish CPUE data.

Year	Vessel size (GRT)						
	5-50	50-100	100-150	150-200	200-250	250-300	>300
			First half year				
1982	11.2	17.2	31.8	26.7	47.6	40.8	25.8
1983	11.1	17.1	23.6	23.9	31.6	36.4	41.3
1984	14.6	24.8	33.4	32.1	44.4	55.5	19.7
1985	12.1	17.2	35.7	51.2	57.9	67.2	55.8
1986	21.0	32.0	45.5	50.2	63.9	57.4	71.8
1987	23.7	37.8	67.0	66.5	78.6	79.9	113.0
1988	19.0	25.6	34.4	42.5	48.0	47.8	75.3
1989	16.3	25.2	36.7	41.0	49.6	51.4	76.2
1990	14.5	21.6	27.3	27.8	29.5	27.4	39.7
1991	16.7	25.5	38.4	42.5	47.6	47.5	72.2
1992	16.6	24.6	36.3	34.7	60.6	46.9	76.9
1993	14.9	19.3	33.6	36.5	47.2	51.1	51.8
1994	26.9	32.0	53.9	61.8	75.0	87.9	102.5
			Second half year				
1982	-	17.7	33.6	46.7	19.9	-	-
1983	17.9	25.7	31.0	32.9	44.5	34.3	57.1
1984	113.2	22.0	21.5	35.2	-	28.3	24.0
1985	21.6	23.5	25.8	39.6	60.7	33.3	-
1986	17.1	27.5	50.2	50.0	77.9	74.0	80.7
1987	21.3	31.8	23.9	24.3	42.6	25.4	46.3
1988	16.8	21.3	30.0	32.4	38.0	33.1	43.9
1989	16.6	22.3	23.6	27.3	28.3	35.6	25.0
1990	17.6	32.5	29.4	34.1	40.4	32.6	53.3
1991	15.1	26.3	40.8	44.8	54.4	51.3	72.5
1992	20.4	25.4	35.2	38.2	53.6	50.9	52.1
1993	18.5	21.4	26.5	27.5	38.8	47.9	59.0
1994	24.3	31.5	42.7	53.5	59.8	65.8	74.6

Table 3.9.1.3.2. Danish CPUE data. parameter estimates from regressions of ln(CPUE) versus ln(av. GRT).

Northern North Sea										
		Jan-Jul					Jul-Dec			
	Year	Slope	Intercept	R-square	Std. CPUE		Slope	Intercept	R-square	Std. CPUE
	1987	0.57	3.60	0.98	75.2		0.20	11.22	0.58	31.9
	1988	0.48	3.58	0.95	46.4		0.36	5.06	0.96	33.9
	1989	0.55	2.54	0.98	47.5		0.23	8.11	0.87	27.3
	1990	0.33	5.13	0.95	29.4		0.33	6.37	0.89	37.3
	1991	0.52	2.99	0.97	46.5		0.58	2.31	0.99	49.4
	1992	0.55	2.55	0.94	47.0		0.41	5.05	0.96	43.7
	1993	0.53	2.40	0.97	40.8		0.43	3.86	0.90	37.4
	1994	0.54	4.02	0.96	70.3		0.45	5.20	0.98	56.1
Southern North Sea										
		Jan-Jul					Jul-Dec			
	Year	Slope	Intercept		Std. CPUE		Slope	Intercept		Std. CPUE
	1987	0.58	3.28	0.97	71.7		0.55	2.54	0.95	47.4
	1988	0.55	3.00	0.97	54.7		0.27	8.17	0.91	34.4
	1989	0.53	3.18	0.96	52.6		0.15	15.33	0.69	33.7
	1990	0.34	5.93	0.92	35.8		0.20	14.18	0.94	41.8
	1991	0.45	5.54	0.93	58.8		0.54	3.23	0.93	56.3
	1992	0.74	1.41	0.96	70.6		0.34	6.85	0.95	42.5

Table 3.9.1.3.3 Sandeel northern North Sea. Norwegian effort data.

Year	Fishing days		Mean gross register tonnage (GRT)	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
1976	595	-	198.8	-
1977	2,212	457	172.3	184.9
1978	1,747	806	203.4	203.7
1979	1,407	1,720	213.8	188.9
1980	2,642	1,099	215.5	210.3
1981	1,740	404	216.6	190.9
1982	1,206	-	209.1	-
1983	304	66	254.6	191.1
1984	145	-	182.6	-
1985	366	-	219.5	-
1986	1,562	567	201.1	187.4
1987	2,123	1,584	218.8	200.9
1988	3,571	925	203.3	198.2
1989	4,292	588	192.3	202.1
1990	2,275	731	207.9	189.2
1991	1,749	958	199.7	194.1
1992	1,202	23	204.5	212.7
1993[1]	1,411	716	224.7	198.6
1994[1]	1,547	434	216.3	224.2

[1]Av. GRT pr. trip

Table 3.9.1.3.4.a SANDEEL Southern North Sea. Standardized CPUE, based on Danish data. (Revised)

Year	Half-year	CPUE (t/day)	Total international ('000 t)	Total Int'l fishing effort ('000 days) Half-year
1982	1	48.2	426.5	8.9
	2	35.7	52.6	1.5
1983	1	42.8	359.8	8.4
	2	33.9	59.3	1.8
1984	1	50.5	461.1	9.1
	2	32.9	71.1	2.2
1985	1	41.9	417.1	10.0
	2	33.6	110.6	3.3
1986	1	53.7	386.4	7.2
	2	44.1	75.5	1.7
1987	1	71.7	297.7	4.2
	2	47.4	105.1	2.2
1988	1	54.7	462.0	8.5
	2	34.4	33.4	1.0
1989	1	52.6	506.1	9.6
	2	33.7	18.5	0.5
1990	1	35.8	341.7	9.5
	2	41.8	24.0	0.6
1991	1	58.8	326.6	5.6
	2	56.3	132.3	2.4
1992	1	70.6	621.1	8.8
	2	42.5	73.0	1.7
1993	1	51.0	267.7	5.3
	2	38.5	34.2	0.9
1994	1	67.8	226.4	3.3
	2	55.6	47.6	0.9

Table 3.9.1.3.4.b Fishing effort indices for SANDEEL in the Northern North Sea (days fishing multiplied by scaling factors for each vessel category to represent days fishing for a vessel of 200 GRT)

Year	Norwegian			Danish		Mean CPUE (t/day)	Total Intnat. catch ('000 t)	Derived Intnat. effort ('000 days)
	Standardized fishing days	Catch sampled for fishing effort (;000 t)	CPUE (t/day)	Catch sampled for fishing effort ('000 t)	CPUE (t/day)			
			First half of year					
1976	593	11.1	18.7	-	-	18.7	110.3	5.9
1977	2,061	50.4	24.4	-	-	24.5	276.0	11.2
1978	1,761	44.9	25.5	-	-	25.5	109.7	4.3
1979	1,451	29.6	20.4	-	-	20.4	47.7	2.3
1980	2,733	112.8	41.3	-	-	41.3	220.9	5.4
1981	1,804	42.8	23.7	-	-	23.7	93.3	3.9
1982	1,231	26.9	21.9	13.5	34.9	26.2	62.3	2.4
1983	338	8.7	25.7	17.4	28.9	27.8	54.5	2.0
1984	139	3.5	25.2	54.1	41.2	40.2	74.1	1.8
1985	382	8.7	22.8	47.4	46.7	43.0	69.9	1.6
1986	1,565	60.4	38.6	154.1	54.7	50.2	221.3	4.4
1987	2,235	122.9	55.0	213.2	75.2	67.8	360.9	5.3
1988	3,599	143.8	40.0	158.1	46.4	43.3	332.0	7.7
1989	4,200	146.9	35.0	267.3	47.5	43.1	435.2	10.1
1990	2,304	58.6	25.4	94.9	29.4	27.9	148.7	5.3
1991	1,748	67.7	38.7	210.6	46.5	44.6	282.2	6.3
1992	1,217	53.7	44.1	124.0	47.0	46.1	151.2	3.3
1993	1,502	70.7	47.1	133.8	40.8	43.0	189.0	4.4
1994	1,616	130.1	80.5	299.6	70.3	73.4	413.4	5.6
			Second half of year					
1976	108	2.0	18.5	-	-	18.5	44.9	2.4
1977	445	11.8	26.5	-	-	26.5	110.0	4.2
1978	811	22.5	27.6	-	-	27.8	53.3	1.9
1979	1,688	52.2	30.9	-	-	30.9	147.7	4.8
1980	1,117	33.1	29.6	-	-	29.5	71.1	2.4
1981	398	7.9	19.6	-	-	19.9	44.9	2.3
1982	-	-	-	1.8	32.3	33.0	12.0	0.4
1983	65	2.4	36.9	12.3	36.6	37.3	23.7	0.6
1984	-	-	-	10.7	29.6	30.2	17.7	0.6
1985	-	-	-	16.4	38.0	38.8	16.8	0.4
1986	555	21.8	39.3	96.1	60.2	57.4	153.8	2.7
1987	1,585	68.1	43.0	5.5	31.9	42.1	76.9	1.8
1988	922	26.9	29.2	41.5	33.9	32.0	71.4	2.2
1989	589	11.5	19.5	44.9	27.3	25.7	57.2	2.2
1990	718	22.8	31.8	65.8	37.3	35.9	70.8	2.0
1991	942	30.3	32.2	96.0	49.4	45.3	90.7	2.0
1992	24	1.5	63.6	48.0	43.7	44.3	25.5	0.6
1993	714	30.7	43.0	59.4	37.4	39.3	87.0	2.2
1994	457	35.7	78.1	90.8	56.1	62.3	76.4	1.2

Table 3.9.1.4.1 Survivors analysis results (keyrun table 1983-1994)

SURVIVORS ANALYSIS OF:

Sandeel in the Total North Sea

The following parameters were used:

Year range: **1983 - 1994**
Seasons per year: 2
The last season in the last year is season : 2
Youngest age: 0; Oldest age: 4; (Plus age: 5)
Recruitment in season: 2
Spawning in season: 1

The following fleets were included:
Fleet 1: Fishery in the Northern North Sea
Fleet 2: Fishery in the Southern North Sea

The following options were used:

1: Inv. catchability: 2
(1: Linear; 2: Log; 3: Cos. filter)
2: Indiv. shats: 2
(1: Direct; 2: Using z)
3: Comb. shats: 2
(1: Linear; 2: Log.)
4: Fit catches: 0
(0: No fit; 1: No SOP corr; 2: SOP corr.)
5: Est. unknown catches: 2
(0: No; 1: No SOP corr; 2: SOP corr; 3: Sep. F)
6: Weighting of rhats: 0
(0: Manual)
7: Weighting of shats: 0
(0: Manual; 1: Linear; 2: Log.)
8: Handling of the plus group: 1
(1: Dynamic; 2: Extra age group)

Data were input from the following files:
Catch in numbers: **canum5.hyr**
Weight in catch: **weca5.hyr**
Weight in stock: **west5.hyr**
Natural mortalities: **natmor.hyr**
Maturity ogive: **matprop.hyr**
Tuning data (CPUE): **tuning5.xsa**
Weighting for rhats: **tweq.new**
Weighting for shats: **twred.xsa**
Unknown catches: **uc5.90**

Stock numbers (at start of season)

****

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	862962.	*	244779.	*	1245926.	*	646034.	*	264678.	*	751505.
1	82405.	25514.	376218.	93393.	109986.	34106.	551593.	161941.	285444.	86457.	118423.	36163.
2	89045.	30014.	20398.	10477.	66845.	9936.	26110.	9369.	121341.	53807.	62766.	12602.
3	3110.	1247.	21749.	3588.	8386.	2762.	4997.	1872.	6978.	3443.	37844.	9621.
4	427.	88.	540.	139.	2376.	1094.	159.	82.	1315.	678.	2641.	177.
5+	192.	0.	70.	0.	74.	0.	741.	497.	458.	248.	712.	0.
SSN	92774.		42757.		77682.		32007.		130092.		103964.	
SSB	1215375.		648054.		1062873.		449822.		1705509.		1593266.	
TSN	175179.	919826.	418975.	352375.	187668.	1293824.	583601.	819796.	415537.	409312.	222387.	810068.
TSB	1629873.	1727845.	2190550.	1526242.	1523715.	2077180.	2755481.	3023935.	3047097.	2194287.	2114327.	1869839.

Table 3.9.1.4.1 C continued

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	329549.	*	671184.	*	844492.	*	366292.	*	1158108.	*	61473.
1	328827.	59439.	145810.	34474.	291766.	69783.	362207.	90665.	159940.	47103.	501738.	152319.
2	28447.	13536.	43546.	9264.	25329.	7509.	46024.	19326.	70655.	33202.	36718.	16573.
3	9798.	2996.	10685.	2169.	6982.	2856.	5811.	2677.	15474.	6500.	26220.	10528.
4	5884.	1201.	2421.	492.	1443.	411.	2230.	986.	2050.	835.	5050.	1727.
5+	73.	34.	900.	0.	327.	143.	451.	53.	820.	0.	622.	0.
SSN	44202.		57552.		34080.		54517.		88999.		68611.	
SSB	684961.		829249.		490327.		755019.		1209300.		961936.	
TSN	373029.	406755.	203361.	717583.	325846.	925193.	416724.	479999.	248939.	1245749.	570349.	242621.
TSB	2131801.	1350601.	1450398.	1477429.	1742003.	1852319.	2232821.	1879653.	1929028.	2785625.	4102816.	3050008.

Catch in numbers for fleet: 1

Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	7911.	*	0.	*	349.	*	7105.	*	455.	*	13196.
1	5684.	303.	11692.	1207.	2688.	109.	23934.	7077.	26236.	5768.	9855.	1283.
2	1215.	316.	1647.	121.	3292.	239.	2600.	473.	10855.	198.	25922.	340.
3	89.	19.	153.	43.	1002.	89.	200.	0.	350.	0.	1319.	119.
4	8.	0.	5.	0.	377.	7.	0.	0.	107.	0.	26.	17.
5+	4.	0.	0.	0.	103.	4.	0.	0.	48.	0.	0.	0.
SOP	50871.	37464.	91792.	20871.	106277.	12946.	174378.	128325.	305979.	83202.	430970.	71479.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	3380.	*	13928.	*	13616.	*	6797.	*	26960.	*	457.
1	57002.	4038.	13737.	1528.	41855.	866.	9871.	48.	15768.	1004.	28490.	829.
2	2233.	274.	4532.	220.	2342.	28.	4056.	3.	2635.	112.	7225.	1211.
3	3406.	0.	884.	91.	908.	8.	486.	0.	1023.	34.	5954.	396.
4	0.	0.	200.	21.	225.	3.	195.	0.	207.	8.	1579.	12.
5+	0.	0.	0.	0.	93.	0.	110.	0.	439.	14.	577.	12.
SOP	440192.	57222.	169212.	72756.	374466.	55404.	115957.	38189.	188262.	86785.	413543.	83223.

Catch in numbers for fleet: 2

Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	9298.	*	0.	*	11940.	*	112.	*	298.	*	0.
1	2232.	240.	62517.	9423.	7790.	1896.	43629.	5350.	4351.	3095.	2349.	0.
2	35029.	2806.	2257.	92.	39301.	3229.	7333.	293.	22771.	6664.	10074.	234.
3	934.	513.	13272.	577.	2490.	2234.	1604.	241.	1158.	196.	17914.	2084.
4	234.	2.	267.	44.	233.	163.	30.	9.	141.	45.	1920.	63.
5+	153.	0.	175.	0.	32.	135.	0.	9.	24.	6.	849.	5.
SOP	380559.	61745.	556795.	80581.	472950.	114930.	335960.	47286.	296759.	105111.	464842.	40004.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	1.	*	717.	*	12115.	*	134.	*	838.	*	0.
1	44444.	1619.	17862.	1673.	20058.	11411.	60337.	3903.	3581.	1037.	24697.	4093.
2	4525.	165.	19805.	446.	9224.	344.	10021.	382.	14659.	953.	2594.	322.
3	957.	35.	5215.	277.	1320.	111.	1002.	157.	3707.	266.	2654.	198.
4	3350.	122.	1182.	63.	454.	0.	427.	25.	451.	60.	447.	116.
5+	18.	1.	2098.	117.	0.	0.	194.	9.	561.	27.	268.	21.
SOP	309832.	22244.	463067.	32826.	345866.	123092.	618474.	47520.	267431.	34453.	226320.	47671.

Table 3.9.1.4.1 Continued

Partial fishing mortality for fleet: 1

Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.013	*	0.000	*	0.000	*	0.016	*	0.003	*	0.026
1	0.116	0.013	0.056	0.015	0.041	0.004	0.074	0.050	0.156	0.078	0.141	0.040
2	0.021	0.012	0.109	0.013	0.092	0.032	0.153	0.058	0.128	0.004	0.732	0.030
3	0.042	0.022	0.013	0.014	0.188	0.064	0.061	0.000	0.069	0.000	0.059	0.016
4	0.033	0.000	0.014	0.000	0.224	0.008	0.000	0.000	0.110	0.000	0.020	0.139
5+	0.046	*	*	*	*	*	0.000	0.000	0.139	0.000	*	*
F (1- 2)	0.069	0.013	0.083	0.014	0.067	0.018	0.114	0.054	0.142	0.041	0.436	0.035

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.015	*	0.031	*	0.024	*	0.027	*	0.034	*	0.011
1	0.339	0.079	0.172	0.051	0.261	0.015	0.049	0.001	0.169	0.024	0.096	0.006
2	0.110	0.023	0.182	0.027	0.150	0.004	0.129	0.000	0.052	0.004	0.280	0.085
3	0.559	0.000	0.146	0.051	0.191	0.003	0.118	0.000	0.096	0.006	0.336	0.043
4	0.000	0.000	0.146	0.051	0.255	0.008	0.125	0.000	0.149	0.011	0.487	0.008
5+	0.000	0.000	*	*	0.409	0.000	0.470	0.000	*	*	*	*
F (1- 2)	0.224	0.051	0.177	0.039	0.206	0.010	0.089	0.000	0.110	0.014	0.188	0.045

Partial fishing mortality for fleet: 2

Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.016	*	0.000	*	0.014	*	0.000	*	0.002	*	0.000
1	0.046	0.010	0.300	0.118	0.119	0.063	0.135	0.038	0.026	0.042	0.034	0.000
2	0.615	0.109	0.150	0.010	1.098	0.439	0.431	0.036	0.269	0.146	0.284	0.021
3	0.445	0.585	1.121	0.195	0.467	1.598	0.486	0.152	0.228	0.065	0.797	0.272
4	0.967	0.025	0.831	0.416	0.139	0.179	0.255	0.128	0.145	0.076	1.482	0.514
5+	1.761	*	*	*	*	*	0.000	0.020	0.070	0.027	*	*
F (1- 2)	0.330	0.060	0.225	0.064	0.609	0.251	0.283	0.037	0.147	0.094	0.159	0.010

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.000	*	0.002	*	0.021	*	0.001	*	0.001	*	0.000
1	0.265	0.032	0.224	0.056	0.125	0.199	0.300	0.049	0.038	0.025	0.083	0.030
2	0.222	0.014	0.797	0.055	0.590	0.052	0.318	0.022	0.291	0.032	0.101	0.023
3	0.157	0.013	0.863	0.155	0.278	0.044	0.243	0.067	0.349	0.046	0.150	0.021
4	1.006	0.118	0.863	0.155	0.515	0.000	0.274	0.028	0.324	0.083	0.138	0.077
5+	0.347	0.033	*	*	0.000	0.000	0.829	0.204	*	*	*	*
F (1- 2)	0.243	0.023	0.510	0.056	0.358	0.125	0.309	0.035	0.165	0.029	0.092	0.026

Log inverse catchabilities, fleet no: 1

Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	4.786	*	*	*	4.786	*	4.786	*	4.786	*	4.786
1	3.591	4.266	3.591	4.266	3.591	4.266	3.591	4.266	3.591	4.266	3.591	4.266
2	3.535	4.899	3.535	4.899	3.535	4.899	3.535	4.899	3.535	4.899	3.535	4.899
3	3.755	4.277	3.755	4.277	3.755	4.277	3.755	*	3.755	*	3.755	4.277
4	3.755	*	3.755	*	3.755	4.277	*	*	3.755	*	3.755	4.277

Table 3.9.1.4.1 Continued

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	4.786	*	4.786	*	4.786	*	4.786	*	4.786	*	4.786
1	3.591	4.266	3.591	4.266	3.591	4.266	3.591	4.266	3.591	4.266	3.591	4.266
2	3.535	4.899	3.535	4.899	3.535	4.899	3.535	4.899	3.535	4.899	3.535	4.899
3	3.755	*	3.755	4.277	3.755	4.277	3.755	*	3.755	4.277	3.755	4.277
4	*	*	3.755	4.277	3.755	4.277	3.755	*	3.755	4.277	3.755	4.277

Log inverse catchabilities, fleet no: 2

Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	7.011	*	*	*	7.011	*	7.011	*	7.011	*	*
1	4.275	3.434	4.275	3.434	4.275	3.434	4.275	3.434	4.275	3.434	4.275	*
2	3.007	3.452	3.007	3.452	3.007	3.452	3.007	3.452	3.007	3.452	3.007	3.452
3	2.927	2.423	2.927	2.423	2.927	2.423	2.927	2.423	2.927	2.423	2.927	2.423
4	2.927	2.423	2.927	2.423	2.927	2.423	2.927	2.423	2.927	2.423	2.927	2.423

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	7.011	*	7.011	*	7.011	*	7.011	*	7.011	*	*
1	4.275	3.434	4.275	3.434	4.275	3.434	4.275	3.434	4.275	3.434	4.275	3.434
2	3.007	3.452	3.007	3.452	3.007	3.452	3.007	3.452	3.007	3.452	3.007	3.452
3	2.927	2.423	2.927	2.423	2.927	2.423	2.927	2.423	2.927	2.423	2.927	2.423
4	2.927	2.423	2.927	2.423	2.927	*	2.927	2.423	2.927	2.423	2.927	2.423

Log residual stocknr. (nhat/n), fleet no: 1

Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.990	*	*	*	-2.098	*	-0.337	*	-1.792	*	0.295
1	0.744	0.453	0.122	0.588	-0.070	-0.434	-0.490	0.281	0.046	1.124	-0.424	0.211
2	-1.006	1.011	0.735	1.055	0.679	2.389	0.174	1.062	-0.207	-1.126	1.169	0.576
3	-0.099	0.955	-1.184	0.547	1.614	2.439	-0.530	*	-0.604	*	-1.135	-0.723
4	-0.348	*	-1.103	*	1.789	0.325	*	*	-0.137	*	-2.208	1.468

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	-0.247	*	0.605	*	0.309	*	1.695	*	0.581	*	0.000
1	0.163	0.893	0.146	0.605	0.378	-0.670	-0.677	-2.646	0.307	-0.294	-0.491	-1.095
2	-1.025	0.282	0.146	0.605	-0.236	-1.310	0.231	-3.252	-0.920	-1.510	0.521	2.169
3	0.824	*	0.146	0.605	0.229	-2.223	0.366	*	-0.088	-1.687	0.924	0.863
4	*	*	0.146	0.605	0.517	-1.284	0.425	*	0.345	-1.063	1.294	-0.787

Log residual stocknr. (nhat/n), fleet no: 2

Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	2.278	*	*	*	1.549	*	-1.799	*	-0.236	*	*
1	-0.941	-1.711	0.862	0.511	-0.155	-0.520	0.302	-0.368	-0.839	-0.575	-1.295	*
2	0.392	0.649	-1.098	-1.967	0.798	1.435	0.191	-0.401	0.234	0.698	-0.425	-0.412
3	-0.012	1.298	0.832	0.001	-0.137	1.698	0.231	0.010	-0.008	-1.147	0.525	1.120
4	0.765	-1.838	0.533	0.756	-1.353	-0.491	-0.416	-0.164	-0.462	-0.989	1.146	1.757

Table 3.9.1.4.1 Continued

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	-4.804	*	1.067	*	2.283	*	-0.613	*	0.273	*	*
1	0.643	0.491	0.507	1.067	0.458	0.943	0.851	0.314	-0.692	-0.156	0.597	0.038
2	-0.801	-0.329	0.507	1.067	0.739	-0.382	-0.360	-0.458	0.067	0.122	-0.485	-0.234
3	-1.228	-1.411	0.507	1.067	-0.093	-1.580	-0.705	-0.379	0.170	-0.545	-0.165	-1.319
4	0.630	0.800	0.507	1.067	0.523	*	-0.586	-1.235	0.095	0.037	-0.250	-0.035

Weighting factors for computing survivors:

Fleet no: 1

Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.020	*	*	*	0.020	*	0.020	*	0.020	*	0.020
1	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100
2	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100
3	1.000	0.100	1.000	0.100	1.000	0.100	1.000	*	1.000	*	1.000	0.100
4	0.200	*	0.200	*	0.200	0.020	*	*	0.200	*	0.200	0.020

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.020	*	0.020	*	0.020	*	0.020	*	0.020	*	0.020
1	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100
2	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100
3	1.000	*	1.000	0.100	1.000	0.100	1.000	*	1.000	0.100	1.000	0.100
4	*	*	0.200	0.020	0.200	0.020	0.200	*	0.200	0.020	0.200	0.020

Weighting factors for computing survivors:

Fleet no: 2

Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.020	*	*	*	0.020	*	0.020	*	0.020	*	*
1	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	*
2	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100
3	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100
4	0.200	0.020	0.200	0.020	0.200	0.020	0.200	0.020	0.200	0.020	0.200	0.020

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.020	*	0.020	*	0.020	*	0.020	*	0.020	*	*
1	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100
2	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100
3	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100	1.000	0.100
4	0.200	0.020	0.200	0.020	0.200	*	0.200	0.020	0.200	0.020	0.200	0.020

Tab. 3.9.1.4.2 Sandeel in the total North Sea

a) **Assessment Quality Control Diagram 1**

Average F(1-2,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989[1]								
1990[2]								
1991[3]								
1992[3]								
1993[4]								
1994[4] b	0.44	0.66	0.52	0.83	0.36	0.54	0.46	
1995 b	0.42	0.64	0.54	0.78	0.70	0.43	0.32	0.35

[1]Half yearly 'hand' tuned VPA. [2]Half yearly *ad hoc* tuned VPA. [3]No assessment. [4]Half yearly modif. XSA.
b) combined total North Sea assessment

Remarks:

b) **Assessment Quality Control Diagram 2**

Recruitment (age 1) Unit: '000 million								
Date of assessment	Year class							
	1987	1988	1989	1990	1991	1992	1993	1994
1989 a	46							
1990 a	228	611	298					
1991								
1992								
1993 a	77	283	102	238	587	306		
1994 a	93	321	128	287	385	111		
b	125	332	138	273	287	134		
1995 b	118	329	146	292	362	160	502	

Remarks:
a) sum of separate assessments for the Northern North Sea and the Southern North Sea
b) combined assessment total North Sea

Table 3.9.1.4.2 Continued Stock: Sandeel in the northern North Sea

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989 a	2266		[1]	[1]						
1990 a	1909	655	1913	[1]	[1]					
1991					[1]	[1]				
1992						[1]	[1]			
1993 a	1786	711	804	498	647	2020	[1]	[1]		
1994 a	1170	687	789	524	755	1299		[1]	[1]	
b	1538	677	844	452	657	859				
1995 b	1593	685	829	490	755	1209	962		[1]	[1]

[1]Forecast.

Remarks:

a) sum of separate assessments for the Northern North Sea and Southern North Sea

b) combined assessment total North Sea

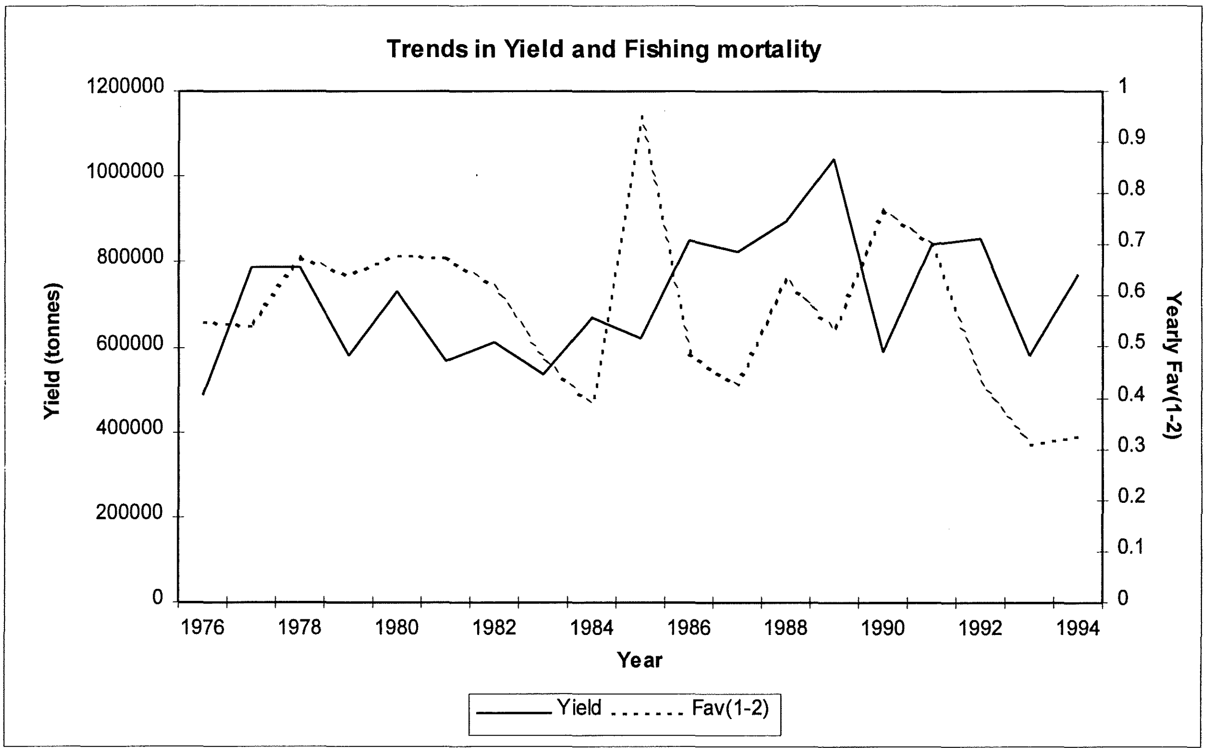
Table 3.9.1.6.1 **Trend in Yield, Average fishing mortality for 1- and 2-group, SSB and Recruitment**

Year	Yield (tonnes)	$F_{av(1-2)}$	SSB (tonnes)	Recruitm. (millions)
1976	488000	0.548	779648	486725
1977	786000	0.543	546180	657469
1978	787000	0.677	700563	532024
1979	578000	0.641	881161	543000
1980	729000	0.679	841003	212902
1981	569000	0.677	706025	984959
1982	611000	0.621	426748	200596
1983	537000	0.475	1237303	861497
1984	669000	0.386	658335	244862
1985	622000	0.951	1065663	1246158
1986	848000	0.487	445654	646777
1987	825000	0.424	1703491	274811
1988	893000	0.635	1593860	753232
1989	1039000	0.53	704770	314077
1990	591000	0.767	846271	675384
1991	843000	0.702	488701	849074
1992	854000	0.43	755001	378917
1993	578000	0.31	1217140	1288619
1994	769000	0.326	988995	50941

NOTE: This table with data from a longer SXSA run will not be exactly equal to the shorter keyrun presented in table 3.9.1.4.1

Figure: 3.9.1.1.1 **Trend in Yield, Average fishing mortality for 1- and 2-group, SSB and Recruitment**

Sandeel in the North Sea



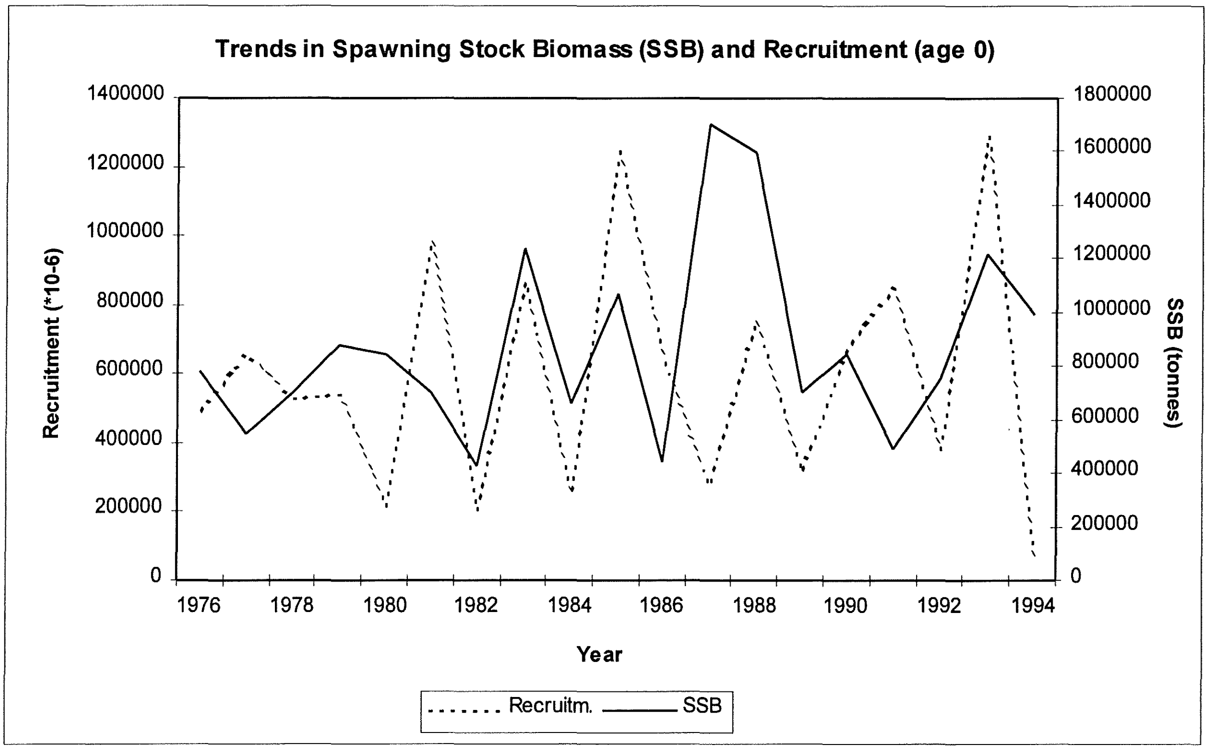
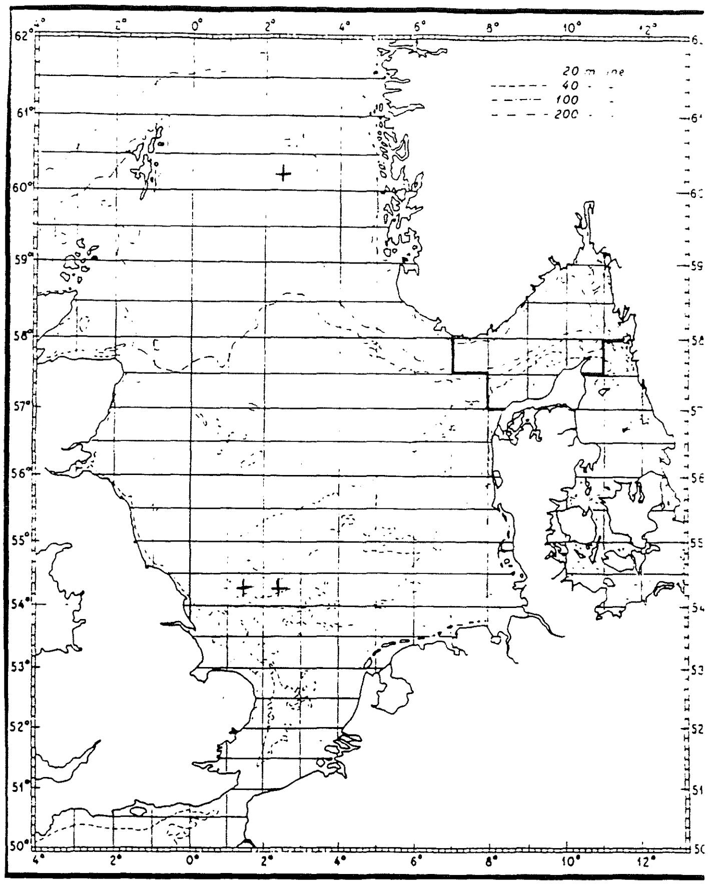
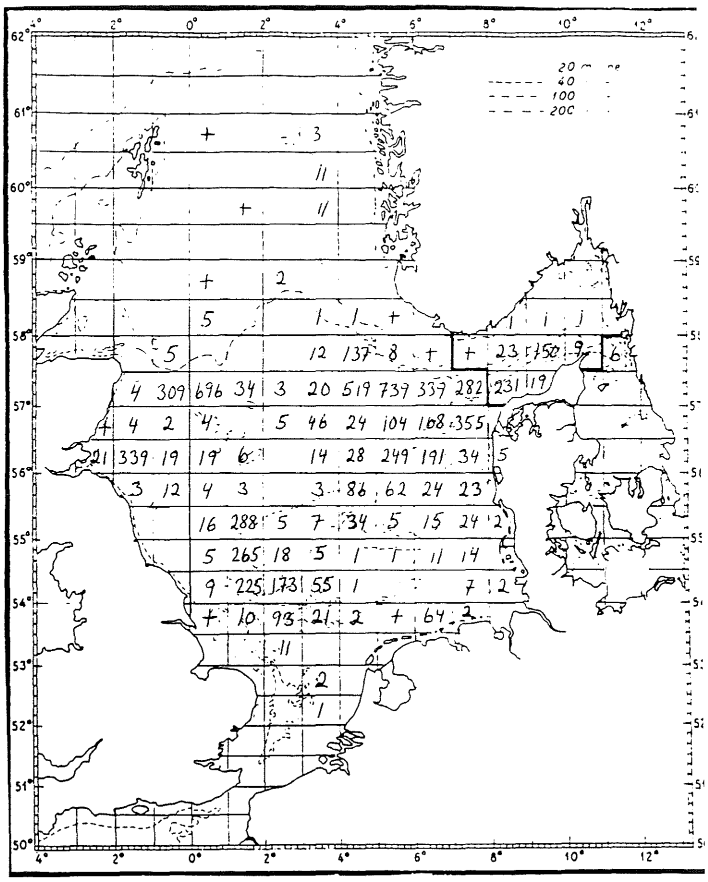


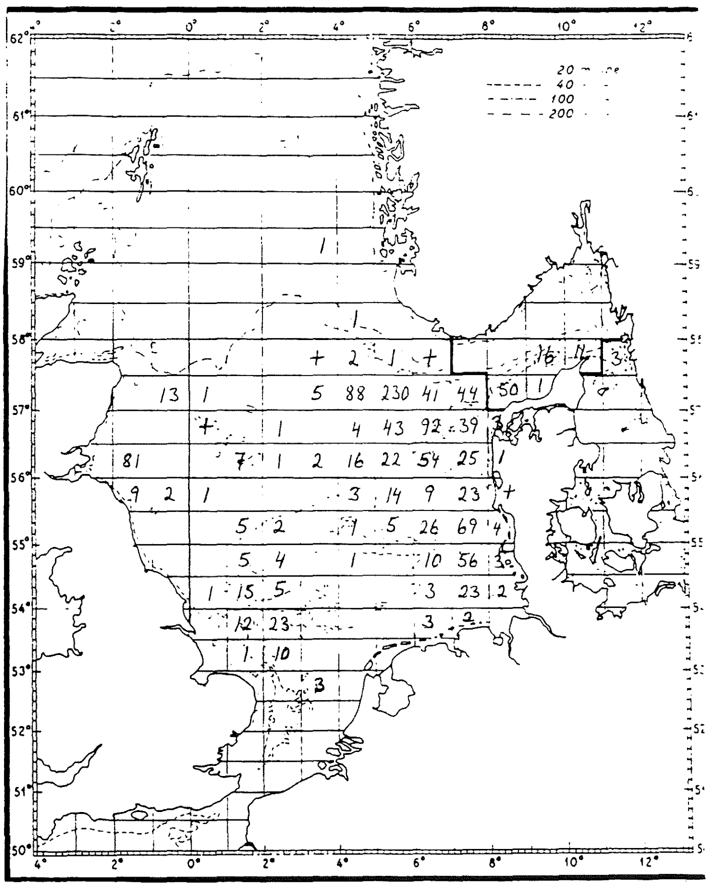
Figure 3.9.1.1.2 Sandeel landings (tonnes x 10^2) in 1994 by Denmark and Norway
a) 1st Quarter b) 2nd Quarter c) 3rd Quarter d) 4th Quarter



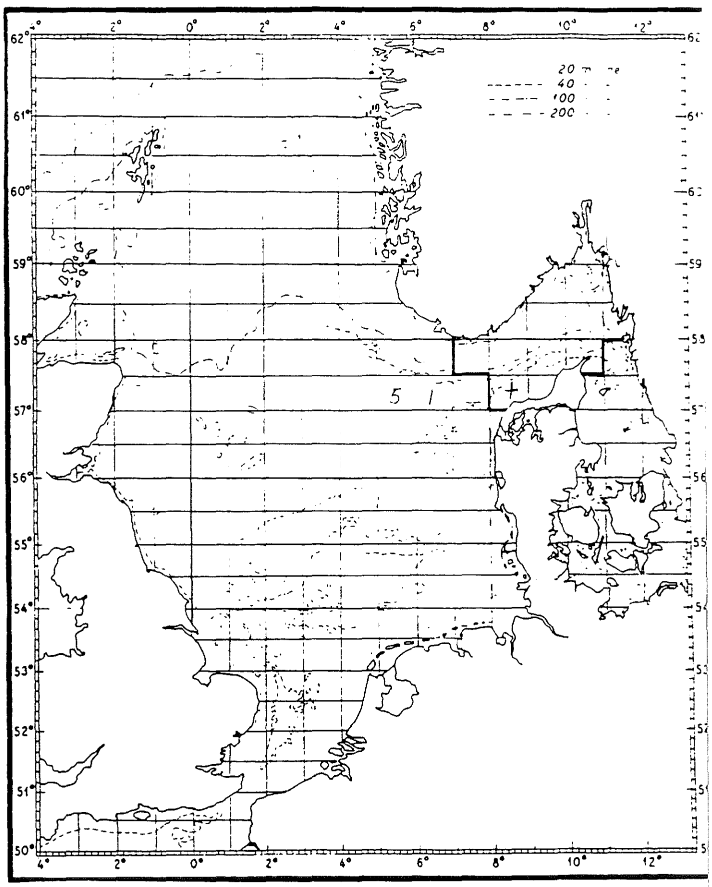
a)



b)



c)



d)

Figure: 3.9.1.2.1 Mean weight at age in the stock

Sandeel in the North Sea

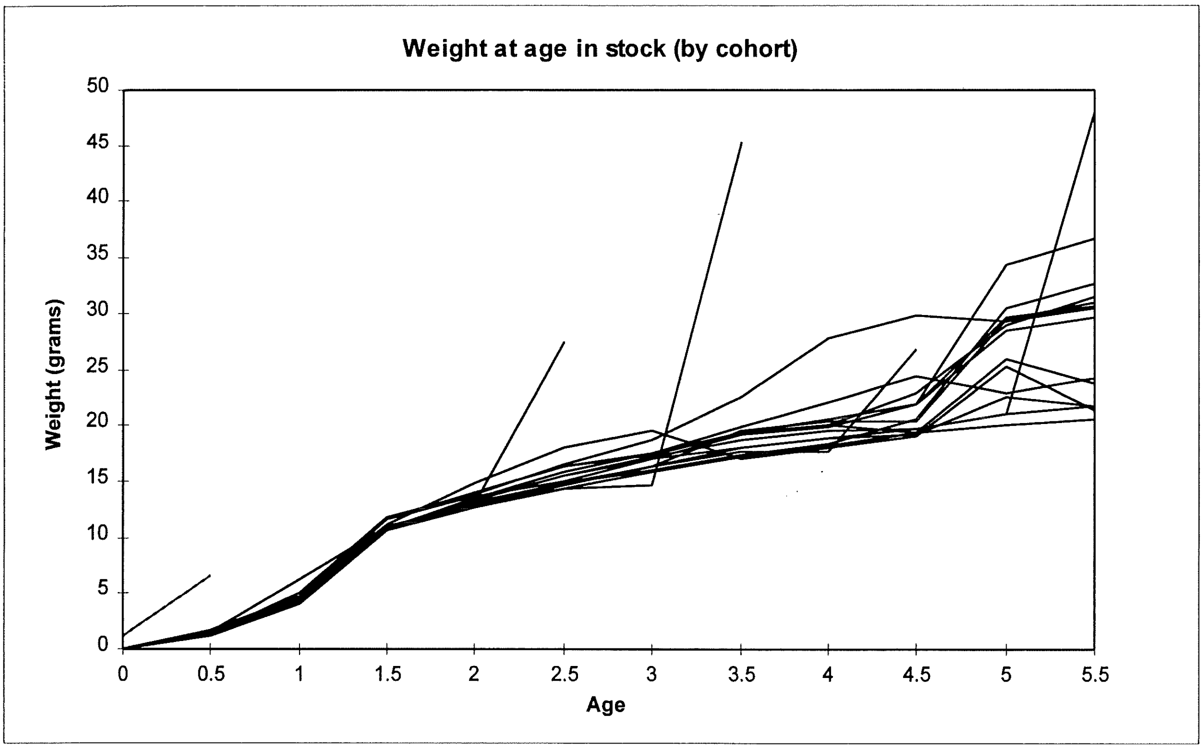


Figure: 3.9.1.4.1 Retrospective analysis of SSB and Recruitment

SXSA - Sandeel in the North Sea

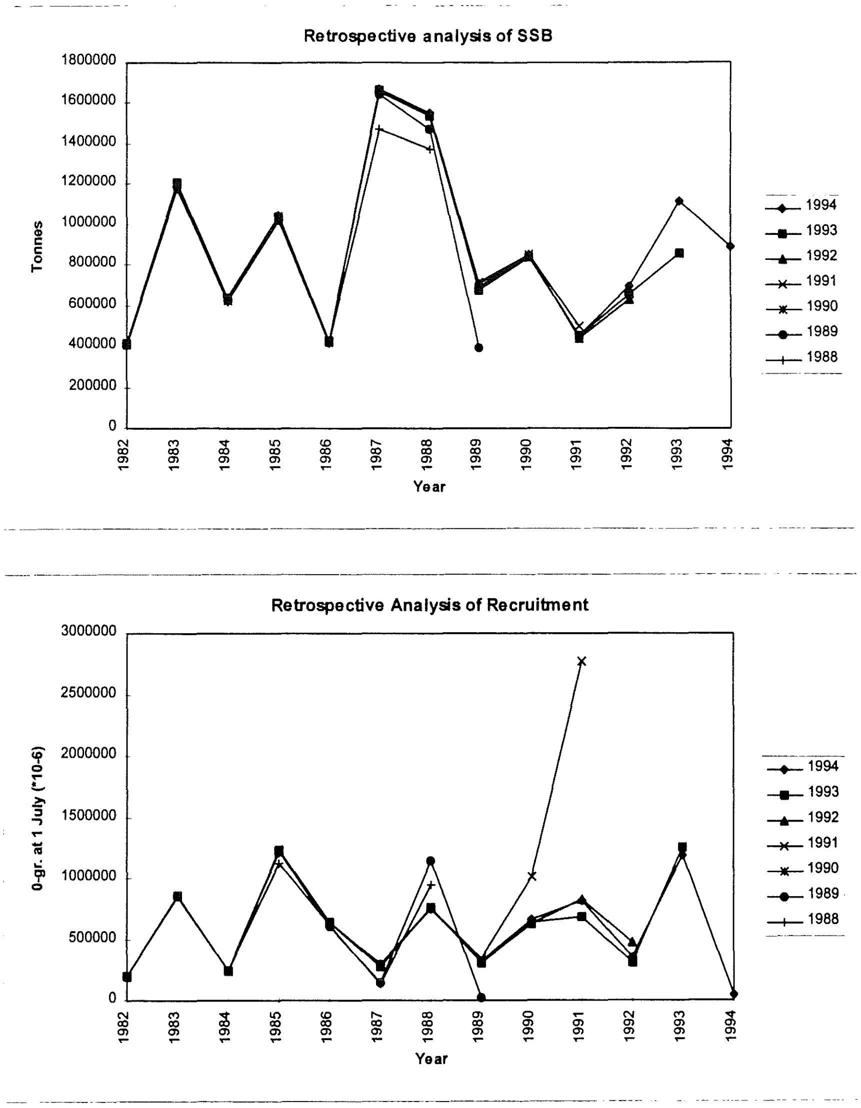


Figure: 3.9.1.4.2 Log catchability residuals by fleet and season

SXSA - Sandeel in the North Sea

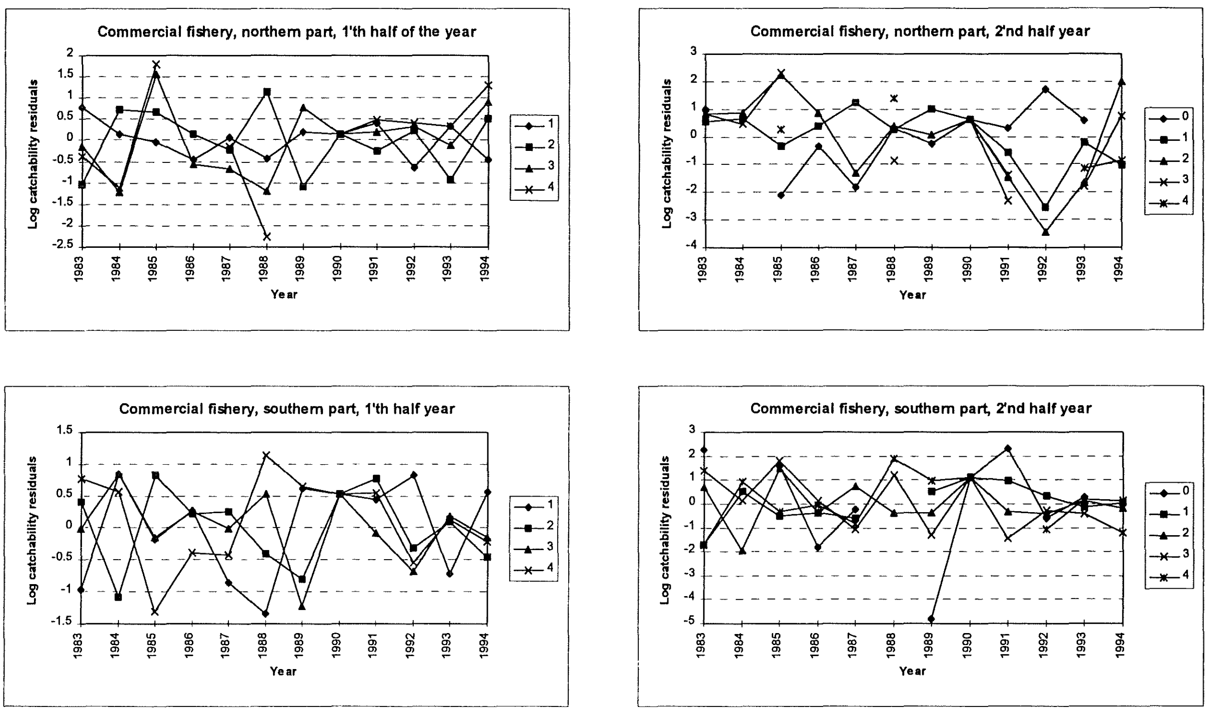


Figure: 3.9.1.4.3 **Trends in Spawning Stock Biomass (SSB) and Recruitment of North Sea Sandeel**

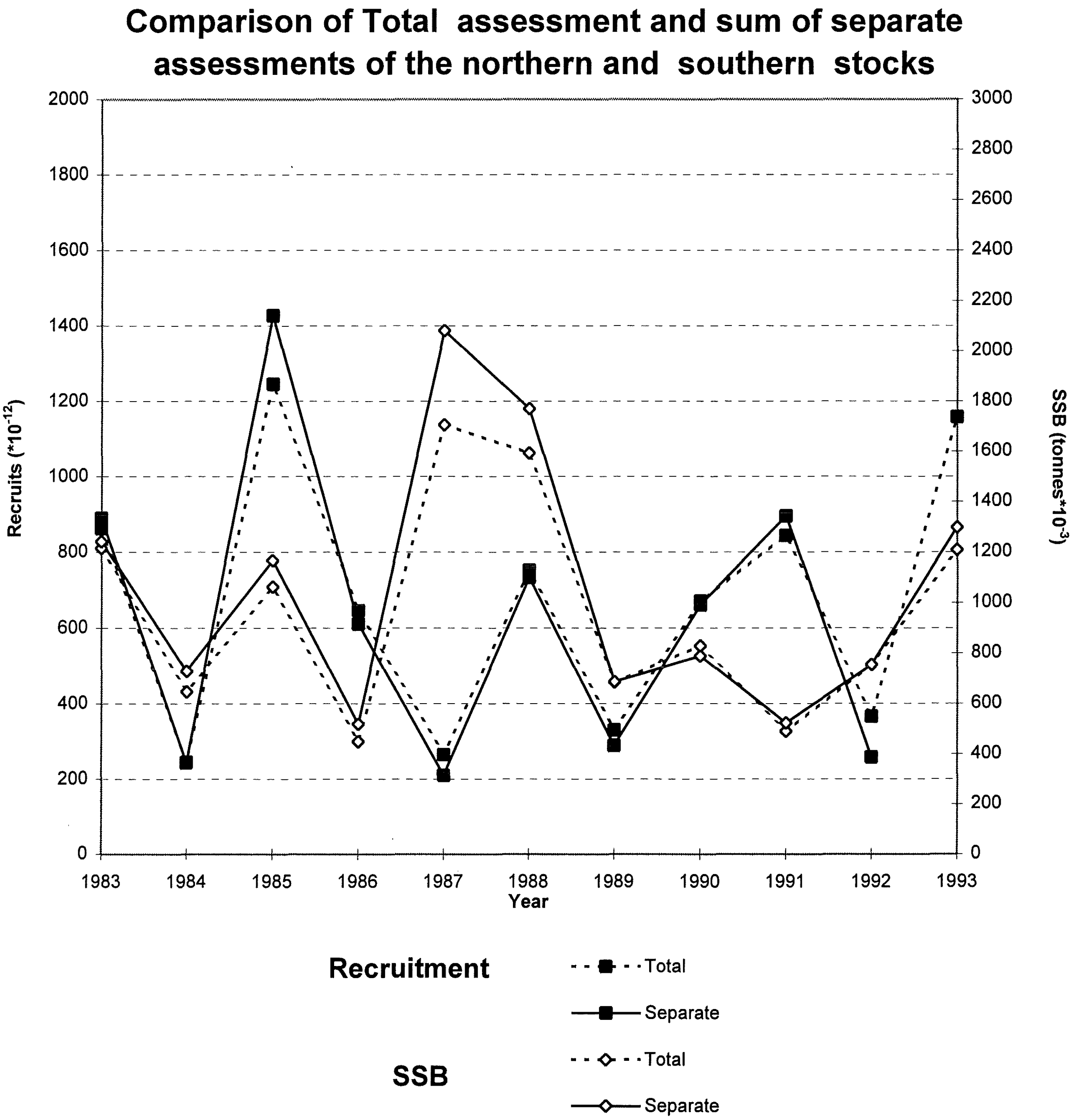
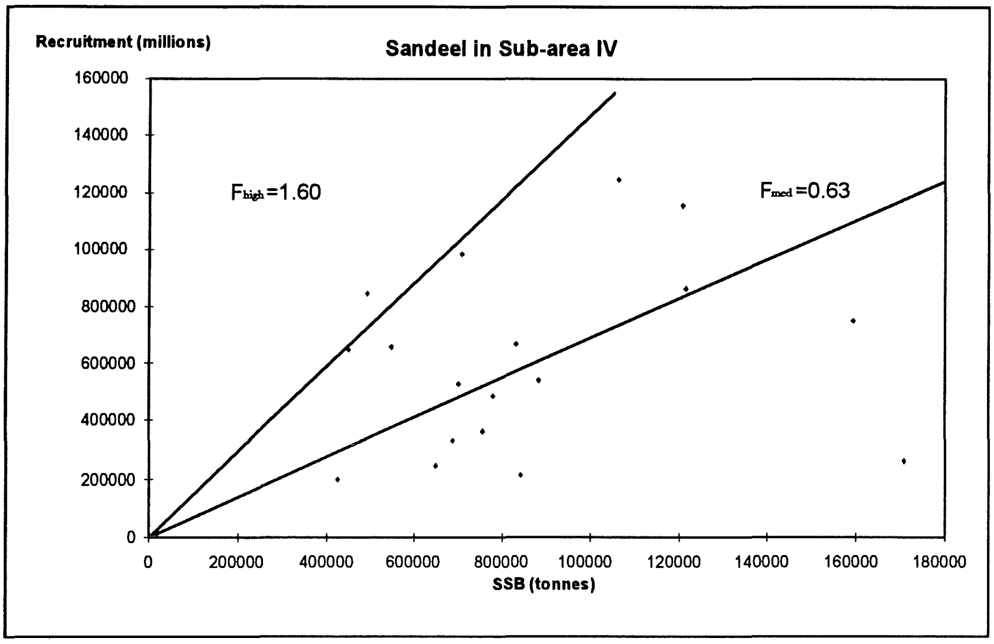


Figure: 3.9.1.7.1 Recruitment/SSB plot used to calculate F_{med} and F_{high}



4. EASTERN CHANNEL (DIVISION VIID)

4.1 Overview

Analytical assessments were carried out on all four stocks, cod, whiting, sole and plaice in VIId.

Data
Only single commercial fleets were available for tuning cod and whiting but both commercial and survey fleets were used for sole and plaice. There were no independent recruit estimates available for either of the roundfish stocks but research vessel surveys covering most of VIId were available for sole and plaice. The data base on all four stocks has steadily improved over the past 5 years but there remain uncertainties about the level of discards for whiting and plaice. The level of sampling is poor for age in cod, whiting and plaice, particularly at older ages. The possibility of combining samples across countries to develop improved ALKs should be considered.

Effort
Trends in fishing effort for the main fleets are shown in Figures 4.4.10 and Tables 4.4.16. Effort on flatfish has increased consistently since 1975 and reached a peak during 1989-1990, followed by a decline in the early 1990's.

Stock impressions
Landings for cod and whiting and plaice are all relatively low compared with the historical series while sole is at an historically high level. Fishing mortalities for cod and whiting in 1994 are close to historically high levels and both are well above F_{med}. In sole and plaice, F_{med} is estimated to be close to the current level of F. Spawning stock biomass for cod and whiting are at the lowest level in the available series but are predicted to rise under assumptions of mean recruitment in the next two years. In plaice the spawning stock has declined from a peak in 1989 and is forecast to remain stable in the short-term. Sole spawning stock has increased following recruitment of three above average year classes and despite the high level of F is expected to increase slightly.

4.2 Cod in Division VIId

4.2.1 Catch trends

Total nominal landings by country and total international landings as estimated by the Working Group are given in Table 4.2.1 and graphed in Figure 4.2.1. Landings reached a peak of 14,000 t in 1987, and then declined continuously to 1,900 t in 1991. Since then they slowly increase, up to 2,800 t in 1994. Annual weight and numbers caught between 1976 and 1994 are given in Table 4.2.2. There is no separately TAC for this species in division VIId but it is a part of VII excluded VIIa.

Cod are caught by the offshore trawlers and gill netters in the east Channel. The trawlers take a mixture of species, whereas the netters have a fishing mainly towards cod.

4.2.2 Natural mortality, maturity at age, age composition and mean weight at age

Natural mortality estimates and values for maturity at age are given in Table 4.2.3. This year, for the first time, the same values as for the North Sea cod have been used. Human consumption landings data were supplied by England, Belgium, Scotland and France. The age compositions were provided by England and France accounting for more than 90% of the catches. The age composition and mean weight at age in the catch are given in Tables 4.2.4 and 4.2.5. Fish of 5-year-old and older are very scarce in Division VIId. Catch numbers in 1994 were dominated by 1-year-old fish.

No SOP correction has been applied to the weight at age data. Weight at age in the stock was assumed to be the same as in the landings.

4.2.3 Catch, effort and research vessel data

Only one fleet, the French artisanal trawlers (FRATRC), is used to tune the VPA and the tuning data are given in Table 4.2.6. The year range used is 1985-1994. As it has already been said in the previous report, 1985 year was suspect, so it has not been taken into account in the tuning.

4.2.4 Catch at age analysis

The catch-at-age analysis for this stock used XSA with age 1 treated as recruits, and the q-plateau was set at age 3. Tuning was performed over a 10 year period, with shrinkage of 0.5 and a tricubic time taper. The previous assessment of this stock treated age 6 as the plus group. Age 5 has been treated as the plus group this year, based on an analysis of the age length keys. Only age groups 1 to 4 are adequately sampled. Survivor estimates shrunk towards the mean F of the final 5 years or the 2 ages groups (2 and 3). The default values were accepted for all other settings. The diagnostics from the final run are given in Table 4.2.7, and plots of the log catchability residuals for the commercial fleet from this run are given in Figure 4.2.2.

The log catchability residuals show a downward trend between 1988 and 1992.

The relative weighting of the French fleet and the F-shrinkage mean are similar at age 2 and the survivor estimates as well. At ages 3 and 4, the relative weighting of the F-shrinkage mean is the most important (2/3) but the survivor estimates are very close.

Tuned Fs at age from the current XSA are given in Table 4.2.8, and stock numbers at age are given in Table 4.2.9. Retrospective trends in mean F are shown in Figure 4.2.3. The retrospective analysis indicates that mean F is underestimated in 1993 and overestimated in 1994.

4.2.5 Recruitment estimates

No recruitment indices are available, so it has been decided to use for the estimates of 1 year old in 1995-1997 mean geometric over the years 1976-1992. This value has a CV of 0.88. The VPA estimate and the geometric mean of the stock number for age 2 in 1995 are very close. Therefore, the VPA estimate has been kept.

	VPA estimates			GMST 76-92
Ages	1993	1994	1995	
1	725	11510	0	8864
2	1645	283	3537	3350
3	245	283	64	994
4	41	15	42	256
5	12	6	4	

4.2.6 Historical stock trends

Trends in fishing mortality, biomass and recruitment since 1976 are given in Table 4.2.10 and plotted in Figure 4.2.1. Fishing mortality is at a very high level. The 1985 value of F seems to be abnormal and the 1993 value is very high. The current mean F is equal to 1.4. This value is higher than Fmed (0.996). The spawning stock biomass is currently at its historical minimum of 416 t. This value is very close to the 1993 value. Recruitment has fluctuated over the whole period and the last strong year class was that of 1985 (48 million). The 1993 year class appears to be better than the previous ones. Total biomass shows peaks corresponding to the recruitment of the occasional strong year classes (one in 75-76 and an other one in 84-85). These two peaks have had an impact on SSB which then decreased slowly in the first case and drastically in the second.

4.2.7 Biological reference points

The stock recruitment scatter plot is given in Figure 4.2.4. F_{med} (0.996) and F_{94} (1.41) are indicated on the yield and biomass-per-recruit curves in Figure 4.2.5. F_{high} is greater than 2.

4.2.8 Short term forecast

Input data for short-term catch predictions are given in Tables 4.2.11. and 4.2.12 with coefficient of variation of all the parameters. The input data are based on averages over the years 1990-1994. Details of the Fs at age for each age used are given in Table 4.2.12.

Only the *status quo* prediction has been run. The catch options table is given in Table 4.2.13. Assuming *status quo* F in 1995 and 1996, the forecast indicates human consumption landings of 4,370 t in 1995 and 5,530 t in 1996. SSB is predicted to increase from its 1994 level of 416 t to 500 t at the start of 1995, 920 t at the start of 1996 and 1,120 t at the start of 1997. Under these assumptions, the estimate of human consumption landings in 1996 has a CV of 52%.

Detailed forecast tables for the *status quo* option are given in Table 4.2.14.

The results of a sensitivity analysis with *status quo* forecast is presented in Figures 4.2.7. The estimate of human consumption yield in 1995 is particularly sensitive to the level of F in 1995, and also to the weights and population numbers at age 2. The estimate of human consumption yield in 1996 is also sensitive to the levels of F in both 1995 and 1996 and the population numbers at age 1. The estimate of SSB in 1996 and 1997 is dependent upon the level of F and on the selectivity at age 2. Furthermore, in 1996, the estimate of SSB depends on the proportion of mature fish at age 3 and population numbers at age 2.

The partial variances of the sensitivity analysis are shown in Figure 4.2.8. The uncertainty associated with the estimate of the 1994 (N1) and 1993 (N2) year classes associated with the estimate of human consumption F in 1995, accounts for over 80% of the variance of the estimate of human consumption yield in 1995. Year class 1995 contributes for more than 50% to the variance in the estimate of the 1996 yield. The scheme for the 1996 SSB is similar to that for the 1996 yield.

Cumulative probability distributions from the sensitivity analysis of the short-term forecast are given in Figure 4.2.9. The probability of the SSB falling below the current level of 416 t is small both in 1995 and 1996.

4.2.9 Medium term projections

Input parameters for medium term projections are given in Table 4.2.15. A Shepherd curve was fitted to the stock-recruitment data as the basis for the medium-term projections. The projections were run for *status quo* F and the results are shown in Figure 4.2.10.

4.2.10 Comments on the assessment

There is no recruitment index available for cod in VIId. The tuning process used only a single commercial fleet. F levels are very high and very variable. One reason could be the migration of fish. The SSB is at an extremely low level and even if there is good recruitment, an increase of the biomass does not last. The main problem for this assessment is that the stock is probably a part of the North Sea cod stock. Because of this, the assessment should be considered with caution.

Table. 4.2.1 : COD in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, 1976 to 1994.

Year	Belgium	France	Denmark	Netherlands	UK (E+W)	UK (S)	Total	Unreported landings	Total as used by Working Group
1982	251	2696	-	1	306	-	3254	726	3980
1983	368	2802	-	4	358	-	3532	308	3840
1984	331	2492	-	-	282	-	3105	415	3520
1985	501	2589	-	-	326	-	3416	- 86	3330
1986	650	9938	4	-	830	-	11422	1398	12820
1987	815	7541	-	-	1044	-	9400	4820	14220
1988	486	8795	+	1	867	-	10149	- 789	9360
1989	173	n/a	+	1	562	-	n/a	-	5540
1990	237	n/a	-	-	420	7	n/a	-	2730
1991	182	n/a	-	-*	340	2	n/a	-	1920
1992	187	2079*	1	2	441	22	2733	-	2680
1993*	157	n/a	1[1]	-	530	2	n/a	-	2430
1994*	228	n/a	9	-	312	+	n/a	-	2850

* Preliminary; 1 Includes VIIe.

Table 4.2.2 : Cod, Eastern Channel
Annual weight and numbers caught, 1976 to 1994.

Year	Wt.('000 t)	Nos.(millions)
1976	4	2
1977	7	10
1978	10	8
1979	6	3
1980	5	4
1981	5	3
1982	4	3
1983	4	3
1984	4	3
1985	3	2
1986	13	19
1987	14	12
1988	9	5
1989	6	3
1990	3	1
1991	2	1
1992	3	3
1993	2	1
1994	3	3

Table 4.2.3 : Cod, Eastern Channel
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.800	.010
2	.350	.050
3	.250	.230
4	.200	.620
5	.200	.860
6	.200	1.000

Table 4.2.4 : Cod, Eastern Channel
International catch at age ('000), Total , 1976 to 1994.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	11	5840	464	292	671	57	860	125	555	14
2	765	4242	5717	1528	2001	2056	904	1786	1588	1210
3	745	209	1275	1239	673	1056	520	776	405	452
4	108	64	248	223	296	202	271	187	72	77
5+	66	21	13	67	34	29	48	47	46	8

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	11133	2330	1059	729	165	126	2118	64	2438
2	6187	8108	1922	1411	776	221	440	1045	161
3	1477	611	2024	605	321	295	74	199	202
4	193	482	133	501	105	73	33	32	11
5+	78	19	101	36	71	40	13	10	4

Table 4.2.5 : Cod, Eastern Channel
International mean weight at age (kg), Total catch, 1976 to 1994.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.613	.536	.559	.625	.578	.586	.645	.752	.690	.617
2	1.310	.671	1.065	.950	.777	.956	.692	.748	.853	1.357
3	2.301	2.010	1.987	2.455	2.282	2.139	2.424	1.745	2.795	2.721
4	4.666	4.850	2.901	4.029	4.440	4.398	4.333	4.113	4.228	5.140
5+	6.549	6.688	6.152	4.755	5.699	5.873	5.777	5.975	5.901	7.567

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.547	.682	.762	.657	.941	.742	.711	.815	.732
2	.589	1.231	1.149	1.197	1.184	1.534	1.033	1.641	1.533
3	1.404	1.996	2.669	2.156	2.551	2.773	3.340	2.440	3.522
4	3.193	2.788	3.785	3.762	4.033	4.886	5.349	3.881	5.046
5+	5.081	4.949	4.367	5.240	5.220	6.501	7.376	5.252	6.496

Table. 4.2.6 : COD in Division VIId.
Effort and catch data used for VPA tuning.

COD IN VIID (EASTERN CHANNEL) : 1976-1994
101
FRATRC
1985 1994
1 1 .00 1.00
1 6

456831.000	11.000	870.000	344.000	55.000	3.000	1.000
353839.000	9094.000	5015.000	1202.000	154.000	55.000	4.000
309988.000	1307.000	5041.000	420.000	325.000	10.000	3.000
260919.000	791.000	1487.000	1471.000	102.000	75.000	4.000
329640.000	572.000	913.000	455.000	378.000	18.000	7.000
268831.000	74.000	362.000	151.000	49.000	31.000	2.000
361439.000	61.000	106.000	148.000	35.000	12.000	7.000
346545.000	1426.793	267.854	33.346	12.142	3.654	.497
351004.000	27.323	435.461	104.908	15.794	4.543	.310
357798.000	1634.389	83.161	90.591	5.587	.971	.152

Table. 4.2.7 : COD in Division VIId.
XSA tuning diagnostics.

Lowestoft VPA Version 3.1

3/10/1995 9:28

Extended Survivors Analysis

COD IN VIID (EASTERN CHANNEL) : 1976-1994

CPUE data from file COD7DEF.DAT

Catch data for 19 years. 1976 to 1994. Ages 1 to 5.

Fleet,		First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FRATRC	,	1986,	1994,	1,	4,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 10 years

Catchability analysis :

Catchability dependent on stock size for ages < 2

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 2

Catchability independent of age for ages >= 3

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 2 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 15 iterations

Regression weights
, .116, .284, .482, .670, .820, .921, .976, .997, 1.000

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
1,	.420,	.363,	.260,	.283,	.217,	.093,	.622,	.141,	.380
2,	1.840,	1.123,	1.026,	1.214,	.964,	.858,	.920,	1.412,	1.132
3,	.992,	1.225,	1.200,	1.429,	1.297,	1.782,	.956,	2.527,	1.656
4,	1.422,	1.180,	1.063,	1.269,	1.172,	1.412,	1.188,	2.017,	1.446

Table. 4.2.7 : COD in Division VIId.
XSA tuning diagnostics. (Continued.)

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4
1986	4.85E+04	8.76E+03	2.66E+03	2.81E+02
1987	1.14E+04	1.43E+04	9.81E+02	7.68E+02
1988	6.90E+03	3.57E+03	3.28E+03	2.24E+02
1989	4.41E+03	2.39E+03	9.02E+02	7.70E+02
1990	1.26E+03	1.50E+03	5.00E+02	1.68E+02
1991	2.13E+03	4.57E+02	4.02E+02	1.07E+02
1992	6.82E+03	8.71E+02	1.36E+02	5.27E+01
1993	7.25E+02	1.65E+03	2.45E+02	4.08E+01
1994	1.15E+04	2.83E+02	2.83E+02	1.52E+01

Estimated population abundance at 1st Jan 1995

, 0.00E+00, 3.54E+03, 6.42E+01, 4.20E+01,

Taper weighted geometric mean of the VPA populations:

, 3.58E+03, 1.16E+03, 4.23E+02, 9.31E+01,

Standard error of the weighted Log(VPA populations) :

, 1.1439, 1.0931, .9477, 1.3304,

1

Log catchability residuals.

Fleet : FRATRC

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	-.47	-.18	.09	.19	.27	-.59	.39	.01	-.13
2	.86	.25	.55	.30	-.05	-.43	-.08	-.06	-.07
3	-.05	.12	.33	.30	-.06	.02	-.66	.44	-.15
4	.29	.07	.27	.20	-.16	-.25	-.64	.16	-.11

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	2	3	4
Mean Log q	-13.2876	-12.9658	-12.9658
S.E(Log q)	.3061	.3784	.3346

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.63	2.553	12.28	.92	9	.38	-14.69

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.83	2.205	12.23	.98	9	.19	-13.29
3	.82	1.354	11.72	.93	9	.29	-12.97
4	.92	.786	12.40	.96	9	.30	-13.07

1

Table. 4.2.7 : COD in Division VIId.
XSA tuning diagnostics. (Continued.)

Fleet disaggregated estimates of survivors :

Age 1 Catchability dependent on age and year class strength

Year class = 1993

FRATRC

Age,	1,
Survivors,	3111.,
Raw Weights,	3.647,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FRATRC ,	3111.,	.433,	.000,	.00,	1,	.430,	.422
P shrinkage mean ,	1162.,	1.09,,,,				.099,	.878
F shrinkage mean ,	5020.,	.50,,,,				.471,	.282

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3537.,	.32,	.32,	3,	1.000,	.380

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1992

FRATRC

Age,	2,	1,
Survivors,	60.,	65.,
Raw Weights,	2.966,	1.299,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FRATRC ,	61.,	.269,	.036,	.14,	2,	.516,	1.166
F shrinkage mean ,	68.,	.50,,,,				.484,	1.097

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
64.,	.28,	.05,	3,	.190,	1.132

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

FRATRC

Age,	3,	2,	1,
Survivors,	36.,	40.,	62.,
Raw Weights,	1.150,	.427,	.130,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FRATRC ,	38.,	.289,	.101,	.35,	3,	.299,	1.727
F shrinkage mean ,	44.,	.50,,,,				.701,	1.626

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
42.,	.36,	.08,	4,	.209,	1.656

Table. 4.2.7 : COD in Division VIId.
XSA tuning diagnostics. (Continued.)

Age 4 Catchability constant w.r.t. time and age (fixed at the value for age) 3

Year class = 1990

FRATRC

Age,	4,	3,	2,	1,
Survivors,	3.,	5.,	3.,	2.,
Raw Weights,	1.814,	.113,	.067,	.033,

Fleet,		Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,		Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FRATRC	,	3.,	.323,	.082,	.25,	4,	.336,	1.513
F shrinkage mean	,	3.,	.50,,,,				.664,	1.412

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
3.,	.35,	.07,	5,	.193,	1.446

Table 4.2.8 : Cod, Eastern Channel
International F at age, Total , 1976 to 1994.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.001	.334	.084	.038	.113	.015	.170	.026	.069	.001
2	.632	1.030	1.173	.724	.633	1.051	.548	1.148	.927	.323
3	1.751	.393	1.310	1.057	.999	.990	1.007	1.872	1.074	.884
4	1.206	.718	1.257	.900	.825	1.032	.786	1.530	1.012	.609
5+	1.206	.718	1.257	.900	.825	1.032	.786	1.530	1.012	.609

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.420	.363	.260	.283	.217	.093	.622	.141	.380
2	1.840	1.123	1.026	1.214	.964	.858	.920	1.412	1.132
3	.992	1.224	1.200	1.429	1.297	1.782	.956	2.527	1.656
4	1.422	1.180	1.063	1.269	1.172	1.412	1.188	2.017	1.446
5+	1.422	1.180	1.063	1.269	1.172	1.412	1.188	2.017	1.446

Table 4.2.9 : Cod, Eastern Channel
Tuned Stock Numbers at age (10-3), 1976 to 1995, (numbers in 1995 are VPA survivors)**

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	17512	30665	8555	11754	9384	5764	8220	7153	12436	19520
2	1946	7861	9864	3533	5085	3767	2552	3117	3130	5216
3	1021	729	1979	2152	1207	1904	928	1039	697	873
4	170	138	383	416	582	346	551	264	125	185
5+	102	44	20	122	66	49	96	64	79	20

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	48469	11418	6902	4415	1263	2126	6822	725	11510	0
2	8761	14316	3569	2391	1495	457	871	1645	283	3537
3	2660	981	3282	902	500	402	136	245	283	64
4	281	768	224	770	168	107	53	41	15	42
5+	111	30	168	54	112	57	21	12	6	4

Table 4.2.10 : Cod, Eastern Channel
Mean fishing mortality, biomass and recruitment, 1976 - 1994.

	Mean F	Stock Biomass ('000 tonnes)		Recruits Age 1	
Year	Ages 2 to 4	Total	Spawning	Yclass	Million
1976	1.196	17	1.877	1975	18
1977	.714	24	1.447	1976	31
1978	1.246	20	2.275	1977	9
1979	.894	18	3.000	1978	12
1980	.819	15	2.825	1979	9
1981	1.024	13	2.341	1980	6
1982	.780	12	2.628	1981	8
1983	1.516	11	1.597	1982	7
1984	1.005	14	1.409	1983	12
1985	.606	23	1.748	1984	20
1986	1.418	37	2.430	1985	48
1987	1.176	30	2.869	1986	11
1988	1.096	20	3.435	1987	7
1989	1.304	11	2.672	1988	4
1990	1.144	5	1.320	1989	1
1991	1.351	4	.966	1990	2
1992	1.022	7	.507	1991	7
1993	1.986	4	.434	1992	1
1994	1.411	10	.416	1993	12
Arithmetic mean recruits, age 1, 1976 to 1992:					12
Geometric mean recruits, age 1, 1976 to 1992:					9

Table 4.2.11 : Cod, Eastern Channel
Input for Catch Prediction

Age	1995 Stock Numbers (10**-3)	F and mean Wt at age used in prediction: Scaled Mean F 1990 - 1994	Mean Wt. at age (kg) 1990 - 1994: Stock	Catch	M and maturity: M	P. mat
1	8864	.297	.788	.788	.800	.010
2	3537	1.079	1.385	1.385	.350	.050
3	64	1.678	2.925	2.925	.250	.230
4	42	1.477	4.639	4.639	.200	.620
5	4	1.477	6.064	6.169	.200	.860

Mean F	(2 - 4)
Unscaled	1.383
Scaled	1.411

Recruits at age 1 in 1996 = 8864
Recruits at age 1 in 1997 = 8864
Stock numbers in 1995 are VPA survivors.

Table 4.2.12 :.Cod Eastern Channel
Input data for catch forecast and linear sensitivity analysis.

Populations in 1995			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	8864	.88	WS1	.79	.15	M1	.80	.10	MT1	.01	.10
N2	3536	.32	WS2	1.38	.29	M2	.35	.10	MT2	.05	.10
N3	64	.28	WS3	2.93	.21	M3	.25	.10	MT3	.23	.10
N4	42	.36	WS4	4.64	.17	M4	.20	.10	MT4	.62	.10
N5	4	.35	WS5	6.06	.14	M5	.20	.10	MT5	.86	.10

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.30	.96	WH1	.79	.15
sH2	1.08	.26	WH2	1.38	.29
sH3	1.68	.20	WH3	2.93	.21
sH4	1.48	.04	WH4	4.64	.17
sH5	1.48	.04	WH5	6.17	.15

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K95	1.00	.10	HF95	1.00	.28
K96	1.00	.10	HF96	1.00	.28
K97	1.00	.10	HF97	1.00	.28

Recruitment		
Labl	Value	CV
R96	8864	.88
R97	8864	.88

Stock numbers in 1995 are VPA survivors exept for age 1 (Geometric Mean).

Table 4.2.13 :Cod Eastern Channel
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 1995	Year 1996						
Mean F Ages H.cons 2 to 4	1.41	.00	.28	.56	.85	1.13	1.41	1.69
Effort relative to 1994 H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Biomass at start of year								
Total	12.29	13.66	13.66	13.66	13.66	13.66	13.66	13.66
Spawning	.50	.92	.92	.92	.92	.92	.92	.92
Catch weight (,000t) H.cons	4.37	.00	1.61	2.90	3.95	4.81	5.53	6.13
Biomass at start of 1997								
Total		21.75	19.35	17.46	15.95	14.73	13.75	12.94
Spawning		3.72	2.87	2.24	1.76	1.40	1.12	.91

	Year 1995	Year 1996						
Effort relative to 1994 H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.54	.56	.56	.56	.56	.56	.56	.56
Spawning	.27	.45	.45	.45	.45	.45	.45	.45
Catch weight H.cons	.50	.00	1.34	.74	.59	.54	.52	.51
Biomass at start of 1997								
Total		.47	.51	.52	.54	.56	.58	.59
Spawning		.49	.61	.62	.62	.62	.63	.63

Table 4.2.14 :.Cod Eastern Channel
Detailed forecast tables.

Forecast for year 1995
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Total
1	8864	1599	1599
2	3537	2031	2031
3	64	48	48
4	42	30	30
5	4	3	3
Wt	12	4	4

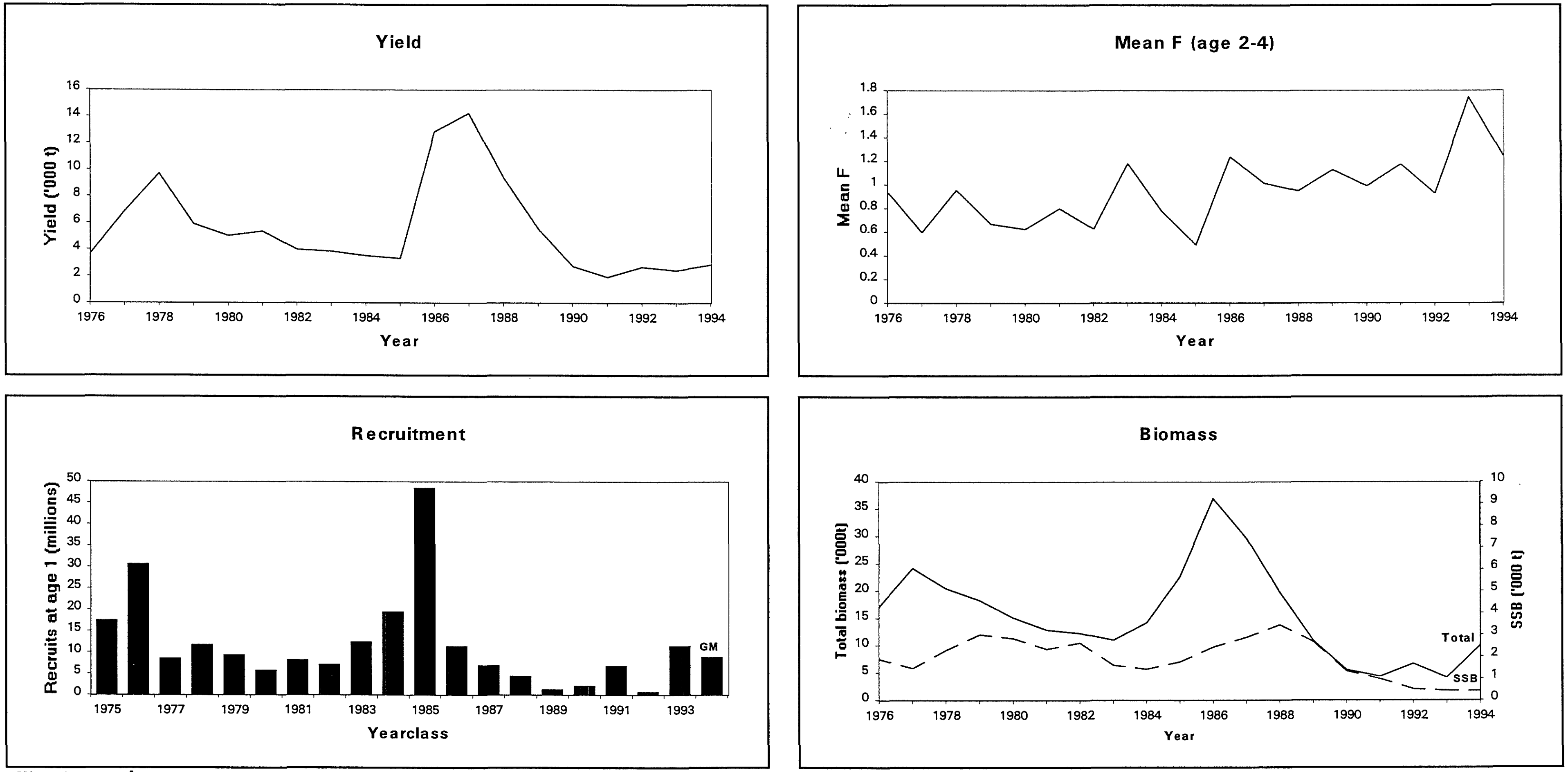
Forecast for year 1996
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Total
1	8864	1599	1599
2	2959	1699	1699
3	847	630	630
4	9	7	7
5	9	6	6
Wt	14	6	6

Table. 4.2.15 : COD in Division VIId.
Model parameters for stock-recruitment.

```
Shepherd curve
Moving average term NOT fitted

IFAIL on exit from E04FDF =         0
Residual sum of squares=     12.1434
Number of observations=           17
Number of parameters  =            3
Residual mean square  =        .8674
Coefficient of determination = .3118
Adj. coeff. of determination = .2135
IFAIL from E04YCF=                 0

Parameter  Correlation matrix
,  1.0000,
,  -.8084,  1.0000,
,  -.5193,   .7562,  1.0000,


 Parameter,s.d.
   6.4798,    2.5607,
 256.1858,   50.2780,
   6.0831,    4.7628,
```

Fig. 4.2.1 : COD in Division VIId.
Historical trends in estimated landings, Fbase, SSB and recruitment.



GM : Geometric mean

Fig. 4.2.2 : COD in Division VIId.
Log catchability residuals at age by fleet.

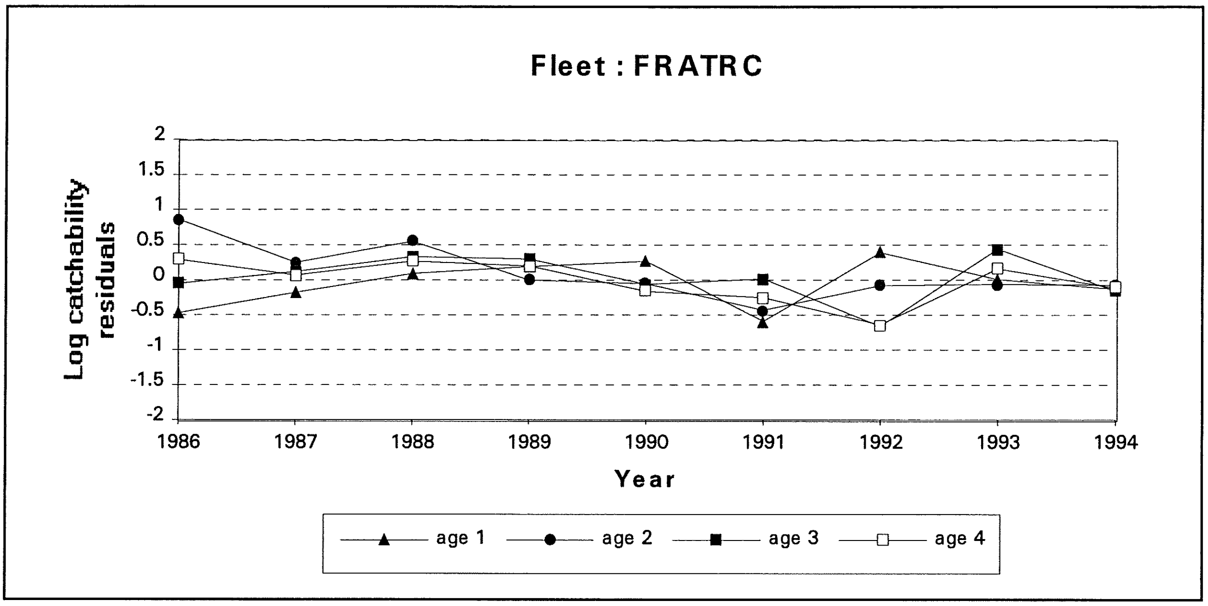


Fig. 4.2.3 : COD in Division VIId.
Retrospective VPA, XSA tuning : reference F(ave.2-4) by year.

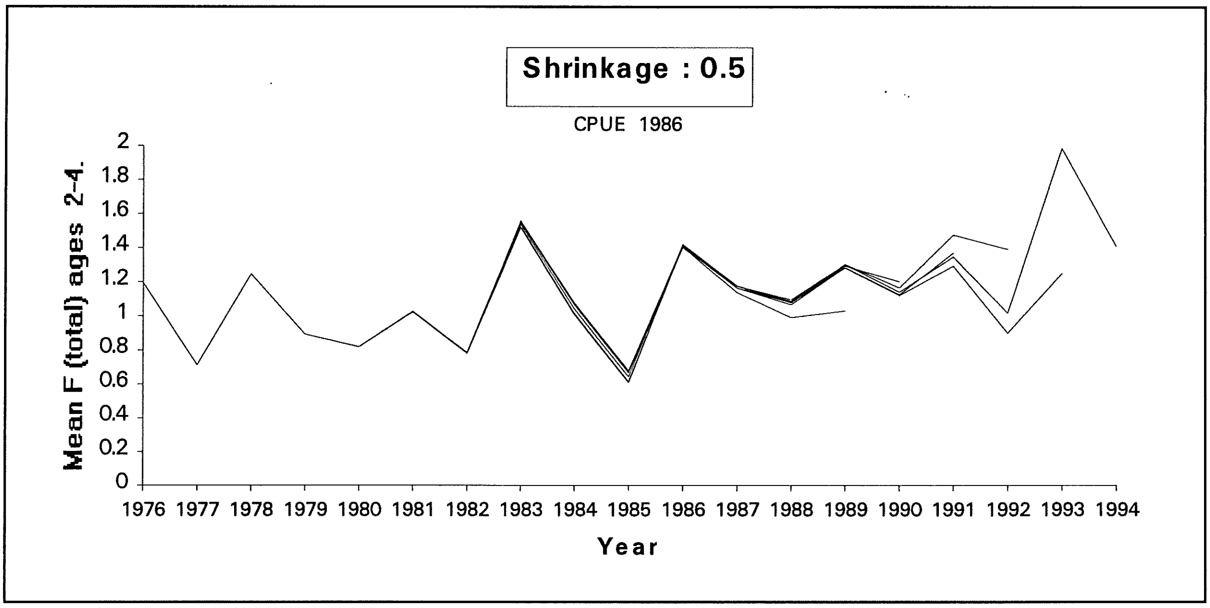


Fig. 4.2.4 : COD in Division VIId.
Recruitment and spawning stock biomass.

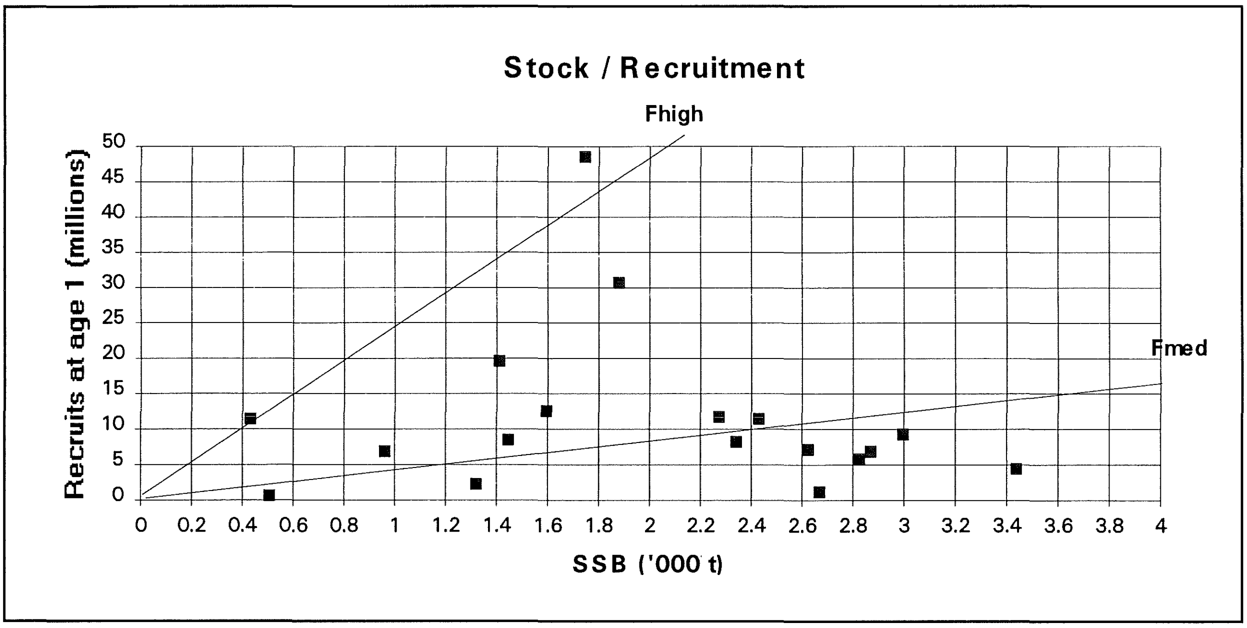


Fig. 4.2.5 : COD in Division VIId.
Yield per recruit-Long term yield and spawning biomass.

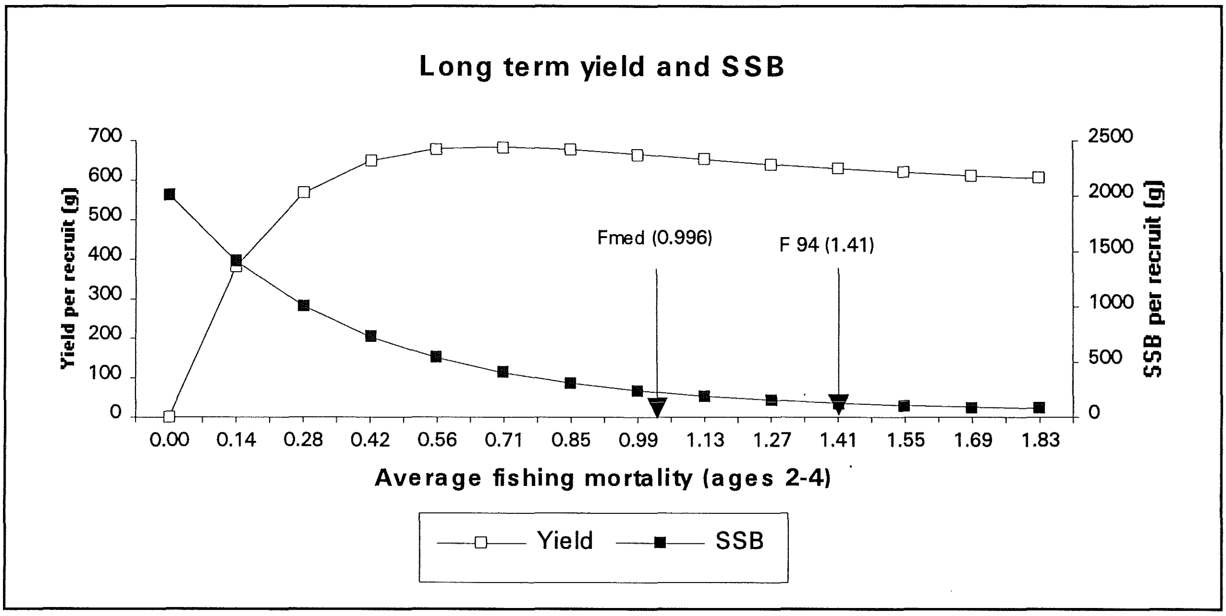


Fig. 4.2.6 : COD in Division VIId.
Short term landings and spawning biomass.

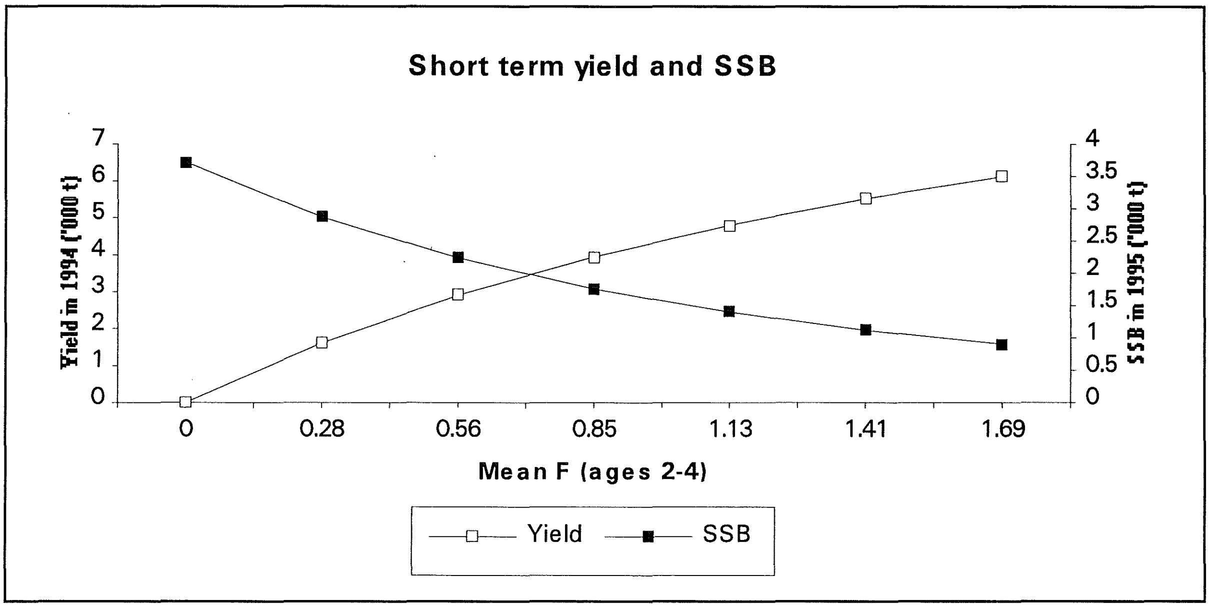


Fig. 4.2.7 : COD in Division VIId.
Linear sensitivity coefficients (elasticities)
Key to lebels is in Table 4.2.12.

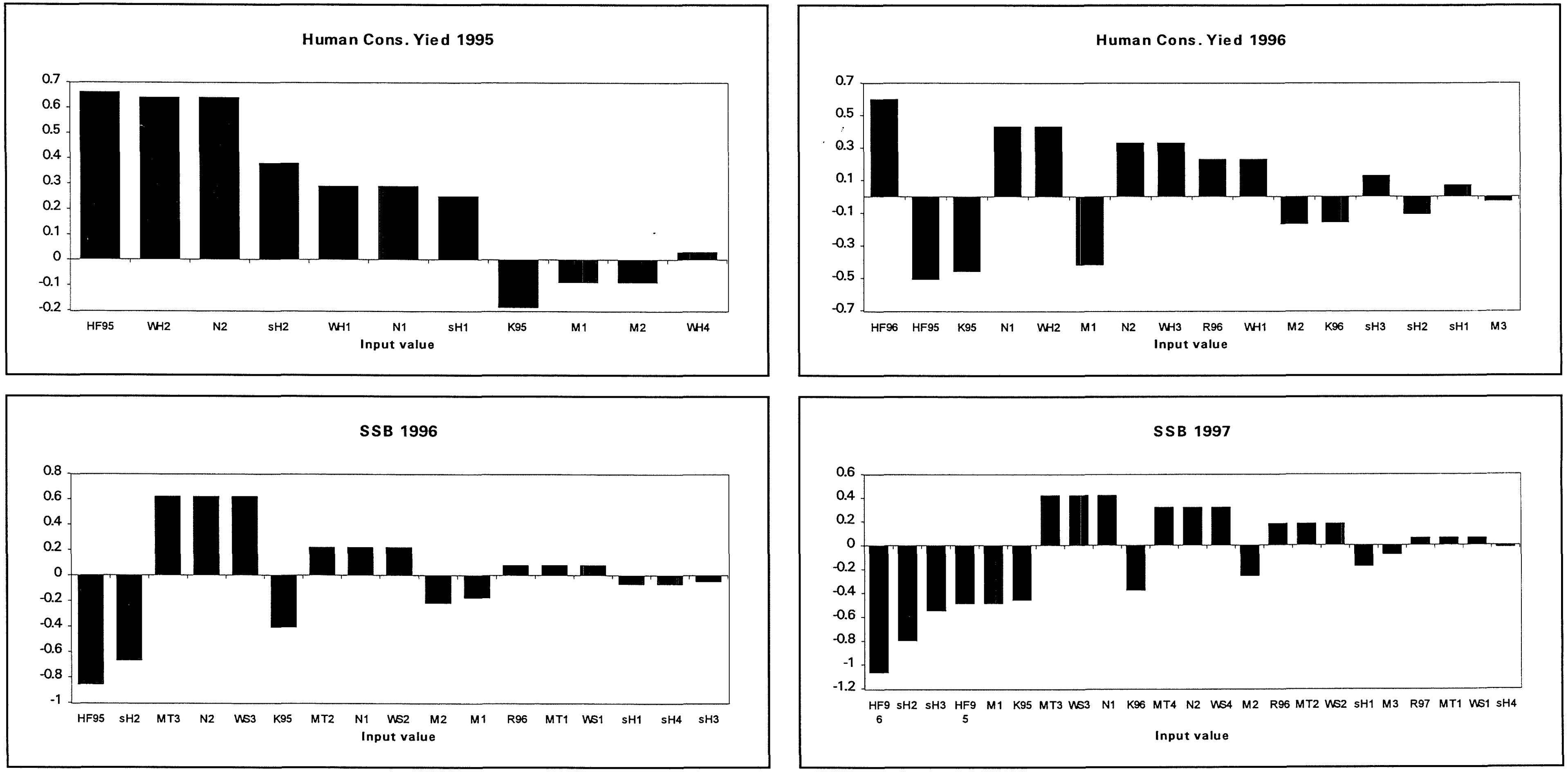


Fig. 4.2.8 : COD in Division VIId.
Proportion of total variance contributed by each input value.
Key to lebels is in Table 4.2.12..

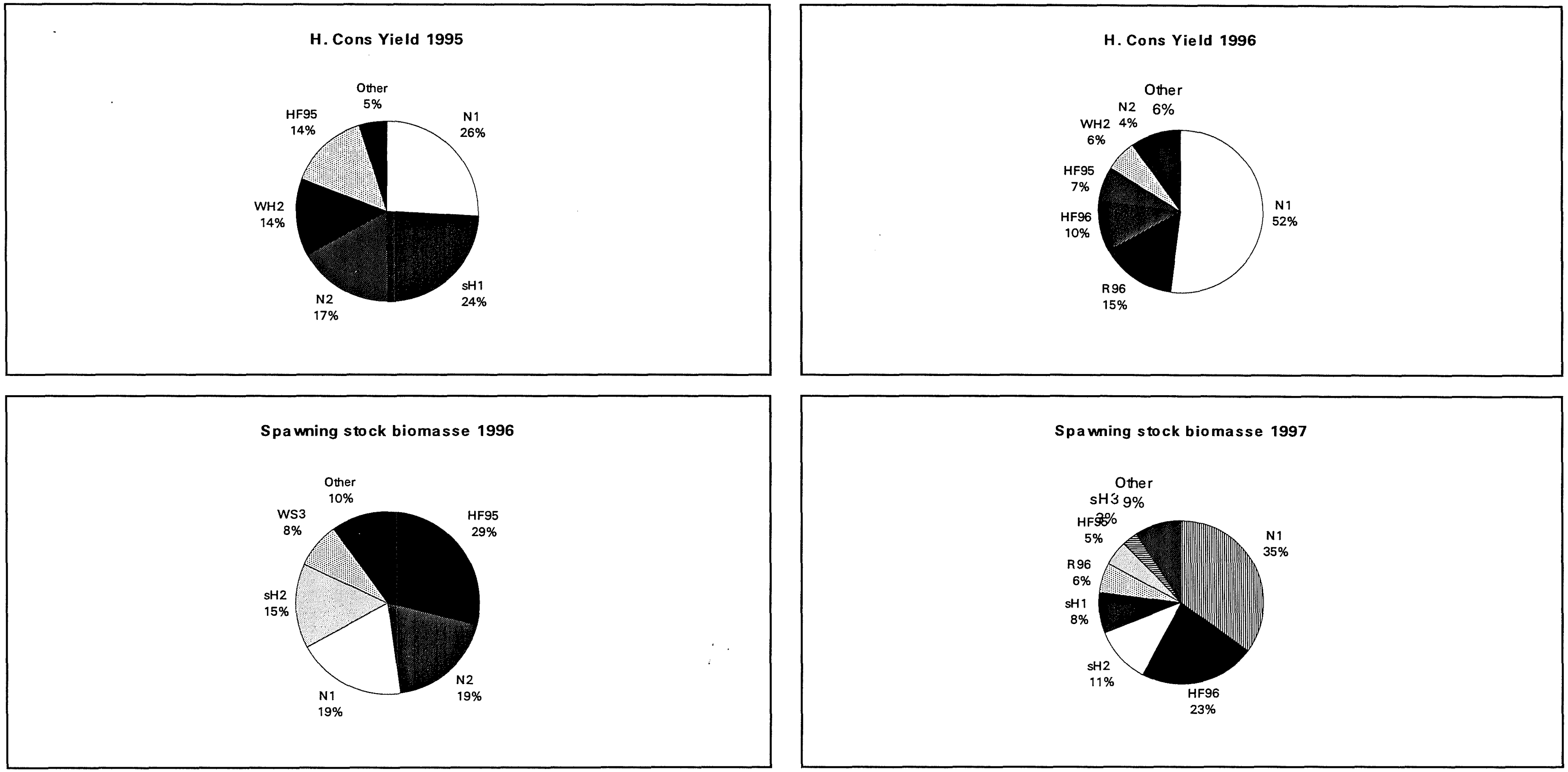


Fig. 4.2.9 : COD in Division VIId.
Cumulative probability distributions.

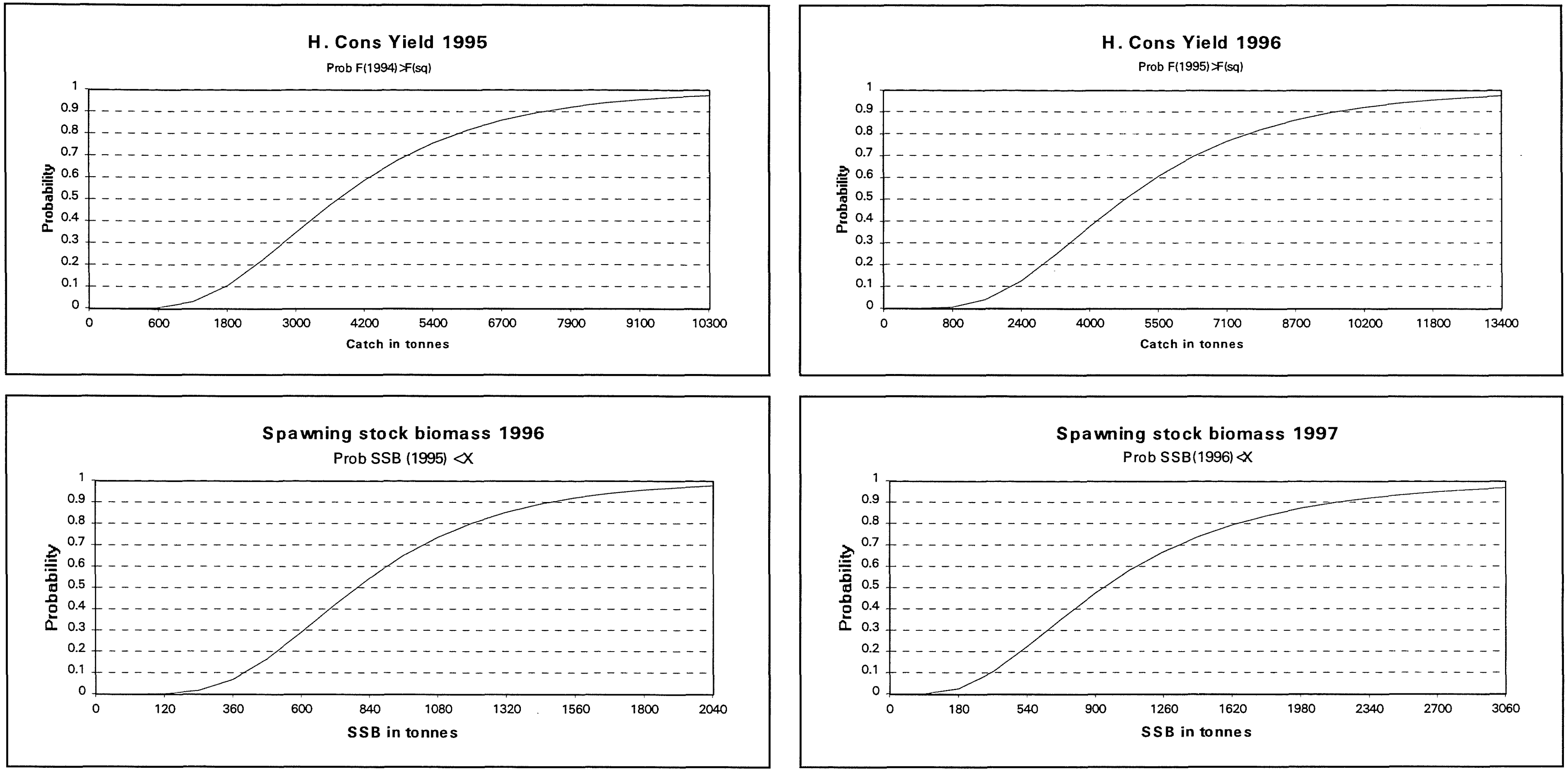
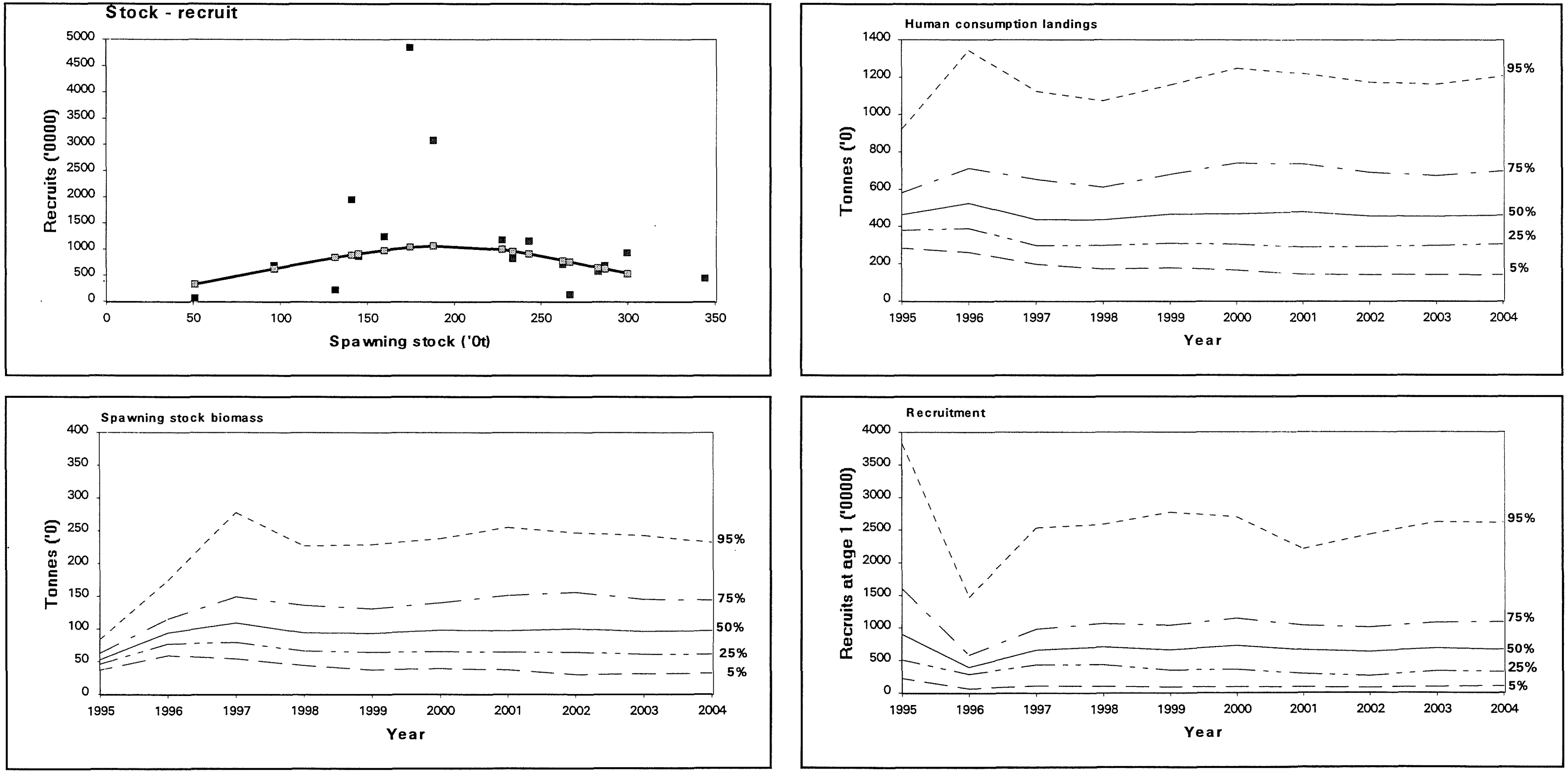


Fig. 4.2.10 : COD in Division VIId.
Results of medium-term predictions (Shepherd).



4.3 Whiting in Division VIId

4.3.1 Catch trends

Landings data from human consumption fisheries for recent years as officially reported as well as those estimated by the Working Group are given in Table 4.3.1. A longer time series of landings from Working Group estimates is given in Table 4.3.2. and graphed in Figure 4.3.1. The Working Group estimate for landings in 1994 was 6,623 t, which is 1,400 t more than previous year. Landings decreased more or less continuously from 9,000 t to 3,500 t between 1978 and 1990. The period 1991 to 1994 is marked by a progressive increase reaching more than 6,000 t. There is no separately TAC for this species in Division VIId but it is a part of VII excluded VIIa.

Whiting are caught by the inshore and offshore trawlers in the Channel. It is a mixed fisheries.

4.3.2 Natural mortality, maturity at age, age composition and mean weight at age

Values for natural mortality and maturity are given in Table 4.3.3. The maturity estimates are unchanged from those used last year but the natural mortality values have been changed. This year, for the first time, the same values as for the North Sea whiting stock have been used. The source of the natural mortality is multispecies VPA as performed by the Multispecies Working Group and the source of the maturity is the French groundfish survey in VIId. The VPA catch input data are given in Table 4.3.4.

The age composition were supplied by England and France. Mean weight at age data for landings are given in Table 4.3.5. The mean weight at age in the catch is assumed to be the same in the stock. The 1986 and 1993 mean weight at age seem to be under estimated. A particular attention has been done on 1994 age length key and this suggest to make some revisions of previous age length keys for the next Working Group. SOP corrections have not been applied.

4.3.3 Catch, effort and research vessel data

The fleets available for tuning the VPA are given in Table 4.3.6. But only the commercial fleet, the French artisanal trawlers (FRATRC), has been used because there is only 4 years available for the survey. The year range is 1985-1994.

4.3.4 Catch at age analysis

The method used to tune the VPA was XSA. Tuning was performed over a 10 year period, with shrinkage of 0.5 and a tricubic time taper. The age range used for VPA was 1 to 5 (the plus-group) instead of 1 to 6 used last year. This change is based on an analysis of age length keys. Only 1 to 4 ages are adequately sampled. Several runs have been done with the two ages, and the final run has been done with age 5 as plus-group. The recruiting age was set at age 1, and catchability was fixed for ages 3 and above. Survivor estimates shrunk towards the mean F of the final 5 years of the 2 oldest ages. The default values were accepted for all other settings.

The tuning results are given in Table 4.3.7. The fleet residuals are plotted in Figure 4.3.2. No obvious trend appears in the results for any ages. The commercial fleet contribute strongly (around 65 % for age 2, 3, and 4) with a low standard error (around 0.25) to the weighted estimates of survivors.

The estimates of fishing mortality rates and population numbers resulting from the tuning procedure and VPA are given in Tables 4.3.8 and 4.3.9. It is quite interesting to compare these results obtain with a 5 age group plus with the results get with a 6 age group plus. The high and irregular values of F obtained with a 6 age group plus disappear with a 5 age group plus.

The results from a retrospective analysis using XSA with the same options used in the tuning are shown in Figure 4.3.3. In 1993 and 1991 there is a tendency for F values to be underestimated.

4.3.5 Recruitment estimates

The set of research vessel recruitment indices is too short to be used in RCT3 program (4 years). A geometric mean recruitment at age 1 in 1995 and onwards calculated over the period 1976-1992 has been used. This estimate is 129 million at age 1 and has a coefficient of variation of 68%. At the older ages the XSA survivors estimates have been chosen.

	VPA estimates			GMST76-92
Ages	1993	1994	1995	
1	85479	163136	0	129355
2	21364	32311	54311	55751
3	21764	8899	13711	27929
4	6466	4738	3316	13575
5	3828	1035	2362	

4.3.6 Historical stock trends

Historical trends in mean fishing mortality (ages 2-4), recruitment and spawning stock biomass are shown in Table 4.3.10 and Figure 4.3.1. Mean fishing mortality shows a stable situation between 1981 and 1990 with values contained between 0.37 and 0.56. Then the values increase with a peak of 0.8 in 1993. Spawning stock biomass decreased from a peak of 62,000 t in 1976 to a historical low level of 10,000 t in 1987 then the values have been becoming stable for 8 years. The most of recruitments over the period 1984-1993 have been smaller than the previous period and except 3 values

(1986, 1990, 1993) have been below the geometric mean (129 million).

4.3.7 Biological reference points

A stock-recruitment scatter plot is shown in Figure 4.3.4 which also shows Fmed and Fhigh replacement lines. The F *status quo* (0.55) is drawn in the yield per recruit and spawning stock biomass per recruit graph plotted in Figure 4.3.5. The current F is above F_{med} (0.17). The value of F_{high} is 1.025.

4.3.8 Short term forecast

Input data for catch predictions are given in Tables 4.3.11 and 4.3.12. This table includes estimated CVs and parameter labels for the sensitivity plots. Input predictions are based on averages over the years 1990-1994.

The catch options table is given in Tables 4.3.13 and detailed forecast tables for the *status quo* option are given in Tables 4.3.14. The results of a *status quo* landings prediction for 1995 is shown in a graph in Figure 4.3.6. Assuming *status quo* in 1995, and 1996, the landings prediction for 1995 would be of 6,130 t and 6,940 t in 1996. The spawning stock biomass is predicted to increase from its 1994 level of 9,000 t to 10,660 t at the start of 1995, 12,400t at the start of 1996 and 13,000 t at the start of 1997. Under these assumptions, the estimate of human consumption landings in 1996 has a CV of 52%.

The results of sensitivity analyses of the *status quo* catch prediction are shown in Figure 4.3.7 which shows the sensitivity of the predictions to the various parameters used, 4.3.8 which shows the proportion of the total variance of the estimated yields and SSB contributed by the input parameters, and 4.3.9 which shows probability profiles for yields and biomasses in 1995 and 1996. The input data are included in Table 4.3.12.

The estimate of human consumption yield in 1995 is particularly sensitive to the level of F in 1995, and also to main parameters of 1993 year class (population numbers, weights and selectivity). The estimate of human consumption yield in 1996 is sensitive to the population numbers and weight at age for age 1 and 2.

The estimate of SSB in 1996 is dependent upon the population number at age 1 and 2 and on the weight at age and proportion of mature at age 2 and 3. In 1997, the estimate of SSB depend on recruitment, and proportion of mature and stock weight at age 2.

The relative effort and the 1993 year class contribute for 74% of the variance in the estimate of human consumption yield in 1995. In 1996, the contribution of relative effort and population numbers at age 1 and 2 is over 80%. Population numbers at age 1 and 2 account for 80% of the variance in the estimate of SSB. The contribution of recruitment and population number at age 1 of the variance in the estimate of 1997 SSB is more than 60%.

The probability of the landings falling below the current level of 6,600 t negligible. The probability of the SSB falling below the current level of 9,000 t is of the order of 35% both in 1995 and 1996.

4.3.9 Medium term projections

Input parameters for medium term projections are given in Table 4.3.15. A Shepherd curve was fitted to the stock-recruitment data as the basis of the medium-term projections. The projections were run for *status quo* F and the results are shown in Figure 4.3.10.

4.3.10 Comments on the assessment

There is no recruitment index available for whiting in VIId yet. It will be available next year. The tuning process used only a single commercial fleet. There is no estimate of discards, which might be significant for this stock. The result of the assessment seems more realistic with a 5 age plus-group than with a 6 age plus-group. In previous assessment the mean F appeared irregular. Otherwise it suggests a larger SSB and recruits at age 1. For next year a particular attention could be done to the 1993 database (weight at age). Because of these considerations this assessment should be considered with caution.

Table. 4.3.1 : WHITING in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, 1976 to 1994.

Year	Belgium	France	Netherlands	UK (E+W)	UK (S)	Total	Unreported landings	Total as used by Working Group
1982	93	7012	2	170	-	7277	633	7910
1983	84	5057	1	198	-	5340	1600	6940
1984	79	6914	-	88	-	7081	289	7370
1985	82	7563	-	186	-	7831	- 491	7340
1986	65	4551	-	180	-	4796	704	5500
1987	136	6730	-	287	-	7153	- 2463	4690
1988	69	7501	-	251	-	7821	- 3391	4430
1989	38	n/a	-	231	-	n/a	-	4160
1990	83	n/a	-	237	1	n/a	-	3480
1991	83	n/a	-	292	1	n/a	-	5780
1992	66	5414	-	417	24	5921	-	5760
1993	74	n/a	-	321	2	n/a	-	5200
1994*	61	n/a	-	293	+	n/a	-	6623

* Preliminary

Table 4.3.2 : Whiting, Eastern Channel
Annual weight and numbers caught, 1976 to 1994.

Year	Wt.('000 t)	Nos.(millions)
1976	7.715	27
1977	4.954	21
1978	9.113	37
1979	8.910	35
1980	9.167	35
1981	8.932	32
1982	7.911	32
1983	6.936	29
1984	7.373	33
1985	7.336	34
1986	5.503	23
1987	4.688	18
1988	4.426	18
1989	4.155	16
1990	3.476	15
1991	5.777	25
1992	5.762	26
1993	5.204	24
1994	6.623	28

Table 4.3.3 : Whiting, Eastern Channel
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.950	.000
2	.450	.530
3	.350	.840
4	.300	1.000
5+	.250	1.000

Table 4.3.4 : Whiting, Eastern Channel
International catch at age ('000), Total , 1976 to 1994.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	529	1351	1105	413	163	952	3199	3441	4105	491
2	9774	6717	6763	8072	5742	9204	10391	12546	12308	14177
3	6190	10329	18945	14018	16492	10274	14132	8486	13266	15972
4	8590	1099	9770	10512	7365	8548	3151	3537	2274	2493
5+	2339	1678	1363	2586	5749	5302	2079	1460	1460	847

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	229	2160	1753	1194	237	4059	5924	1202	14120
2	3665	6133	10713	6340	8951	8753	11816	5915	8630
3	11457	1667	4058	7349	3049	5336	5666	12625	3520
4	6773	7442	572	1131	2131	3998	1489	3021	1846
5+	1365	794	850	182	311	3344	1246	1868	420

Table 4.3.5 : Whiting, Eastern Channel
International mean weight at age (kg), Total catch, 1976 to 1994.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.220	.191	.280	.189	.157	.150	.146	.174	.172	.137
2	.225	.179	.215	.205	.211	.229	.197	.211	.194	.167
3	.284	.242	.223	.247	.243	.278	.257	.258	.239	.243
4	.312	.352	.275	.272	.286	.272	.318	.296	.310	.301
5+	.411	.364	.325	.330	.317	.283	.363	.318	.276	.320

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.131	.192	.183	.176	.152	.164	.159	.155	.188
2	.164	.219	.214	.210	.205	.200	.205	.178	.231
3	.228	.256	.319	.287	.265	.238	.267	.204	.309
4	.268	.298	.357	.371	.319	.267	.312	.272	.389
5+	.321	.361	.361	.468	.372	.304	.336	.303	.396

Table. 4.3.6 : WHITING in Division VIId.
Effort and catch data used for VPA tuning.

WHITING IN VIID (EASTERN CHANNEL) : 1976-1994 : 30/8/94
101

FRATRC
1985 1994
1 1 .00 1.00
1 6

456831.000	474.000	13903.000	15351.000	2385.000	527.000	197.000
353839.000	217.000	3457.000	10828.000	6419.000	960.000	258.000
309988.000	1939.000	5352.000	1467.000	6436.000	425.000	216.000
260919.000	1718.000	10289.000	3766.000	488.000	708.000	28.000
329640.000	1163.000	6156.000	6885.000	1036.000	25.000	71.000
268831.000	209.000	8351.000	2713.000	1820.000	273.000	2.000
361439.000	3730.000	7904.000	4784.000	3640.000	2524.000	495.000
346545.000	5796.459	10983.330	4990.140	1279.827	736.783	269.777
351004.000	1156.499	5431.472	11886.660	2795.877	1126.540	384.810
357798.000	13816.050	8155.700	3199.448	1566.889	303.335	35.495

**Table. 4.3.7 : WHITING in Division VIId.
XSA tuning diagnostics.**

Lowestoft VPA Version 3.1

2/10/1995 15:49

Extended Survivors Analysis

WHITING IN VIID (EASTERN CHANNEL) : 1976-1994 : 30/8/94

CPUE data from file WHI7DEF.DAT
Catch data for 19 years. 1976 to 1994. Ages 1 to 5.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FRATRC ,	1985,	1994,	1,	4,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 10 years

Catchability analysis :

Catchability dependent on stock size for ages < 2

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 2

Catchability independent of age for ages >= 3

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 2 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 18 iterations

Regression weights
, .020, .116, .284, .482, .670, .820, .921, .976, .997, 1.000

Fishing mortalities

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
1,	.027,	.006,	.031,	.032,	.024,	.004,	.050,	.159,	.023,	.150
2,	.237,	.522,	.414,	.375,	.268,	.460,	.364,	.360,	.426,	.407
3,	.502,	.389,	.625,	.706,	.627,	.249,	.733,	.551,	1.175,	.637
4,	.382,	.483,	.558,	.531,	.504,	.431,	.721,	.540,	.782,	.603

Table. 4.3.7 : Continued.

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4
1985	3.00E+04	8.41E+04	4.82E+04	9.11E+03
1986	5.89E+04	1.13E+04	4.23E+04	2.06E+04
1987	1.14E+05	2.26E+04	4.27E+03	2.02E+04
1988	9.01E+04	4.29E+04	9.54E+03	1.61E+03
1989	8.05E+04	3.38E+04	1.88E+04	3.32E+03
1990	9.33E+04	3.04E+04	1.65E+04	7.07E+03
1991	1.33E+05	3.59E+04	1.22E+04	9.04E+03
1992	6.48E+04	4.89E+04	1.59E+04	4.15E+03
1993	8.55E+04	2.14E+04	2.18E+04	6.47E+03
1994	1.63E+05	3.23E+04	8.90E+03	4.74E+03

Estimated population abundance at 1st Jan 1995

, 0.00E+00, 5.43E+04, 1.37E+04, 3.32E+03,

Taper weighted geometric mean of the VPA populations:

, 9.80E+04, 3.23E+04, 1.39E+04, 5.50E+03,

Standard error of the weighted Log(VPA populations) :

, .3446, .3297, .4672, .6135,

1

Log catchability residuals.

Fleet : FRATRC

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.13	-.85	-.18	.08	-.16	-1.17	-.05	.98	-.26	.53
2	-.75	.24	.07	.24	-.31	.38	-.18	-.11	.03	-.01
3	-.47	-.49	.04	.39	.05	-.71	.06	-.19	.60	-.05
4	-.74	-.27	-.08	.03	-.19	-.21	.07	-.23	.19	-.17

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	2	3	4
Mean Log q	-13.7575	-13.3074	-13.3074
S.E(Log q)	.2285	.4184	.1963

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.57	.445	14.10	.20	10	.77	-16.07

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.27	-.658	14.65	.59	10	.31	-13.76
3	.99	.020	13.27	.56	10	.46	-13.31
4	.96	.282	13.21	.93	10	.19	-13.39

Table. 4.3.7 : Continued.

Fleet disaggregated estimates of survivors :

Age 1 Catchability dependent on age and year class strength

Year class = 1993

FRATRC

Age,	1,
Survivors,	91852.,
Raw Weights,	.977,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRC ,	91852.,	.938,	.000,	.00,	1,	.069,	.091
P shrinkage mean ,	32324.,	.33,,,,				.649,	.240
F shrinkage mean ,	157550.,	.50,,,,				.282,	.054

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
54311.,	.26,	.63,	3,	2.378,	.150

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1992

FRATRC

Age,	2,	1,
Survivors,	13591.,	10579.,
Raw Weights,	7.394,	.913,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRC ,	13222.,	.283,	.078,	.28,	2,	.675,	.420
F shrinkage mean ,	14785.,	.50,,,,				.325,	.383

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
13711.,	.25,	.06,	3,	.256,	.407

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

FRATRC

Age,	3,	2,	1,
Survivors,	3154.,	3402.,	8793.,
Raw Weights,	2.607,	3.827,	.389,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRC ,	3489.,	.246,	.163,	.66,	3,	.630,	.614
F shrinkage mean ,	3041.,	.50,,,,				.370,	.679

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3316.,	.24,	.12,	4,	.481,	.637

Table. 4.3.7 : Continued.

Age 4 Catchability constant w.r.t. time and age (fixed at the value for age) 3

Year class = 1990

FRATRC

Age,	4,	3,	2,	1,
Survivors,	1622.,	3505.,	1713.,	1836.,
Raw Weights,	6.081,	.831,	1.279,	.149,

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRC	,	1770.,	.229,	.132,	.58,	4,	.676,	.641
F shrinkage mean	,	2279.,	.50,,,,				.324,	.529

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1921.,	.22,	.12,	5,	.528,	.603

Table 4.3.8. :Whiting, Eastern Channel
International F at age, Total , 1976 to 1994

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.002	.008	.007	.006	.002	.013	.032	.023	.030	.027
2	.059	.045	.081	.106	.174	.211	.352	.299	.186	.237
3	.254	.101	.217	.303	.417	.705	.772	.722	.798	.502
4	.158	.074	.150	.206	.298	.463	.570	.517	.498	.382
5+	.158	.074	.150	.206	.298	.463	.570	.517	.498	.382

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.006	.031	.032	.024	.004	.050	.159	.023	.150
2	.522	.414	.375	.268	.460	.364	.360	.426	.407
3	.389	.625	.706	.627	.249	.733	.551	1.175	.637
4	.483	.558	.531	.504	.431	.721	.540	.782	.603
5+	.483	.558	.531	.504	.431	.721	.540	.782	.603

Table 4.3.9 : Whiting, Eastern Channel
Tuned Stock Numbers at age (10-3), 1976 to 1995, (numbers in 1995 are VPA survivors)**

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	491127	282878	261665	117379	156920	114923	162298	240819	224140	29993
2	212535	189610	108560	100509	45138	60586	43854	60778	90994	84131
3	32872	127714	115537	63820	57642	24197	31282	19665	28736	48193
4	68372	17968	81328	65514	33206	26776	8427	10181	6734	9113
5+	18049	26642	11001	15610	25058	16002	5346	4044	4161	2990

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	58926	114368	90094	80537	93308	133045	64766	85479	163136	0
2	11294	22646	42888	33753	30404	35939	48930	21364	32311	54311
3	42324	4274	9543	18792	16459	12239	15926	21764	8899	13711
4	20553	20207	1613	3318	7073	9039	4146	6466	4738	3316
5+	3989	2074	2307	513	997	7246	3339	3828	1035	2362

Table 4.3.10 :Whiting, Eastern Channel
Mean fishing mortality, biomass and recruitment, 1976 - 1994.

	Mean F	Stock Biomass ('000 tonnes)		Recruits Age 1	
Year	Ages 2 to 4	Total	Spawning	Yclass	Million
1976	.157	194	62	1975	491
1977	.073	135	60	1976	283
1978	.150	148	60	1977	262
1979	.205	81	47	1978	117
1980	.296	65	34	1979	157
1981	.460	49	25	1980	115
1982	.565	45	16	1981	162
1983	.513	64	15	1982	241
1984	.494	66	18	1983	224
1985	.374	34	21	1984	30
1986	.464	26	16	1985	59
1987	.532	35	10	1986	114
1988	.538	30	9	1987	90
1989	.467	28	10	1988	81
1990	.380	27	10	1989	93
1991	.606	36	11	1990	133
1992	.484	27	11	1991	65
1993	.794	24	9	1992	85
1994	.549	43	9	1993	163
Arithmetic mean recruits, age 1, 1976 to 1992:					160
Geometric mean recruits, age 1, 1976 to 1992:					129

Table 4.3.11 : Whiting, Eastern Channel
Input for Catch Prediction

Age	1995 Stock Numbers (10**-3)	F and mean Wt at age used in prediction: Scaled Mean F 1990 - 1994	Mean Wt. at age (kg) 1990 - 1994: Stock	Catch	M and maturity: M	P. mat
1	129355	.075	.164	.164	.950	.000
2	54311	.394	.204	.204	.450	.530
3	13711	.653	.257	.257	.350	.840
4	3316	.601	.312	.312	.300	1.000
5	2362	.601	.334	.342	.250	1.000

Mean F	(2 - 4)
Unscaled	.563
Scaled	.549

Recruits at age 1 in 1996 = 129355
Recruits at age 1 in 1997 = 129355

Stock numbers in 1995 are VPA survivors.

Table 4.3.12 :.Whiting Eastern Channel
Input data for catch forecast and linear sensitivity analysis.

Populations in 1995: Labl	Value	CV	Stock weights: Labl	Value	CV	Nat.Mortality: Labl	Value	CV	Prop.mature: Labl	Value	CV
N1	129354	.68	WS1	.16	.19	M1	.95	.10	MT1	.00	.10
N2	54310	.63	WS2	.20	.10	M2	.45	.10	MT2	.53	.10
N3	13710	.25	WS3	.26	.11	M3	.35	.10	MT3	.84	.10
N4	3315	.24	WS4	.31	.12	M4	.30	.10	MT4	1.00	.10
N5	2362	.22	WS5	.33	.13	M5	.25	.10	MT5	1.00	.00

HC selectivity: Labl	Value	CV	HC.catch wt: Labl	Value	CV
sH1	.07	1.19	WH1	.16	.19
sH2	.39	.33	WH2	.20	.10
sH3	.65	.19	WH3	.26	.11
sH4	.60	.05	WH4	.31	.12
sH5	.60	.05	WH5	.34	.14

Year effect M: Labl	Value	CV	HC relative eff: Labl	Value	CV
K95	1.00	.10	HF95	1.00	.42
K96	1.00	.10	HF96	1.00	.42
K97	1.00	.10	HF97	1.00	.42

Recruitment: Labl	Value	CV
R96	129354	.68
R97	129354	.68

Stock numbers in 1995 are VPA survivors exept for age 1 (Geometric Mean).

Table 4.3.13 : .Whiting Eastern Channel
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 1995	1996						
Mean F Ages								
H.cons 2 to 4	.55	.00	.11	.22	.33	.44	.55	.66
Effort relative to 1994								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Biomass at start of year								
Total	37.64	39.04	39.04	39.04	39.04	39.04	39.04	39.04
Spawning	10.66	12.42	12.42	12.42	12.42	12.42	12.42	12.42
Catch weight (,000t)								
H.cons	6.13	.00	1.64	3.14	4.52	5.78	6.94	8.00
Biomass at start of 1997								
Total		46.02	44.45	43.03	41.74	40.57	39.50	38.53
Spawning		18.79	17.39	16.12	14.98	13.95	13.02	12.17

	Year 1995	1996						
Effort relative to 1994								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.44	.44	.44	.44	.44	.44	.44	.44
Spawning	.37	.42	.42	.42	.42	.42	.42	.42
Catch weight								
H.cons	.53	.00	2.05	1.04	.73	.60	.53	.49
Biomass at start of 1997								
Total		.39	.40	.41	.42	.43	.43	.44
Spawning		.38	.42	.42	.42	.43	.43	.44

Table 4.3.14 : Whiting Eastern Channel
Detailed forecast tables.

Forecast for year 1995
F multiplier H.cons=1.00

	Populations	Catch number	
Age	Stock No.	H.Cons	Total
1	129355	6069	6069
2	54310	14452	14452
3	13710	5652	5652
4	3316	1314	1314
5	2362	956	956
Wt	38	6	6

Forecast for year 1996
F multiplier H.cons=1.00

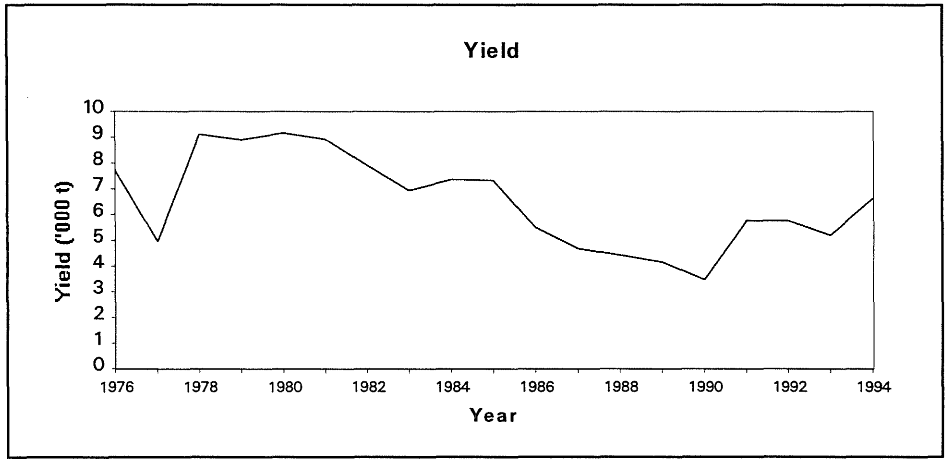
	Populations	Catch number	
Age	Stock No.	H.Cons	Total
1	129355	6069	6069
2	46412	12350	12350
3	23353	9627	9627
4	5029	1992	1992
5	2355	953	953
Wt	39	7	7

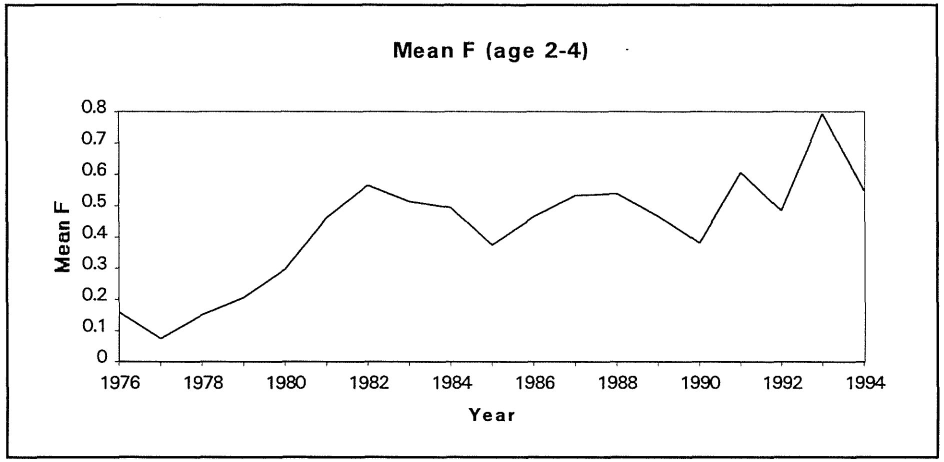
Table. 4.3.15 : WHITING in Division VIId.
Model parameters for stock-recruitment.

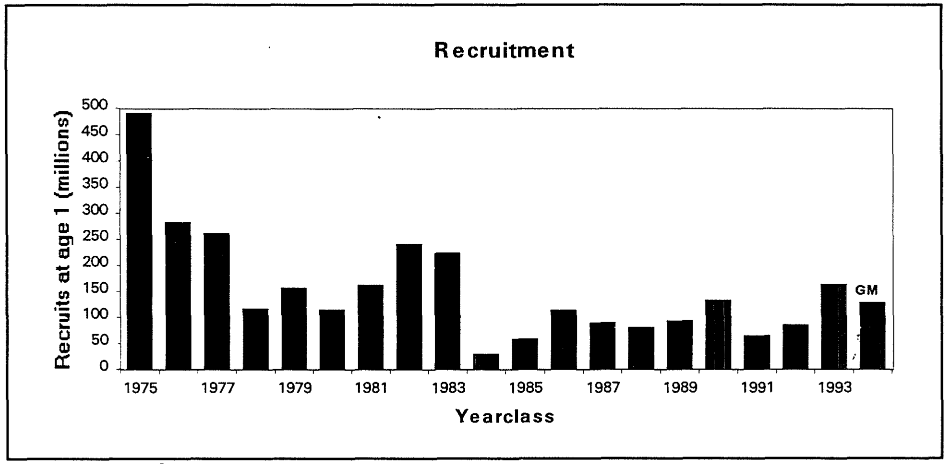
Shepherd curve
Moving average term NOT fitted

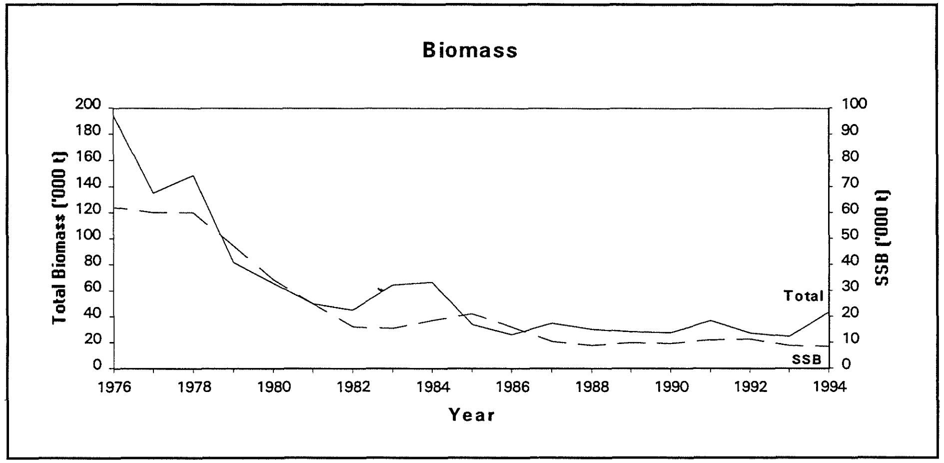
```
IFAIL on exit from E04FDF =         2
Residual sum of squares=       4.3989
Number of observations=            17
Number of parameters  =             3
Residual mean square  =         .3142
Coefficient of determination = .2149
Adj. coeff. of determination = .1027
IFAIL from E04YCF=                  0

Parameter  Correlation matrix
,  1.0000,
, -1.0000,  1.0000,
,  -.9882,   .9894,  1.0000,

 Parameter,s.d.
 444.1504,76965.4517,
    .0173,    5.2292,
    .6127,    1.3327,
```

Fig. 4.3.1 : WHITING in Division VIId.
Historical trends in estimated landings, Fbase, SSB and recruitment.









GM : Geometric mean

Fig. 4.3.2 : WHITING in Division VIId.
Log catchability residuals at age by fleet.

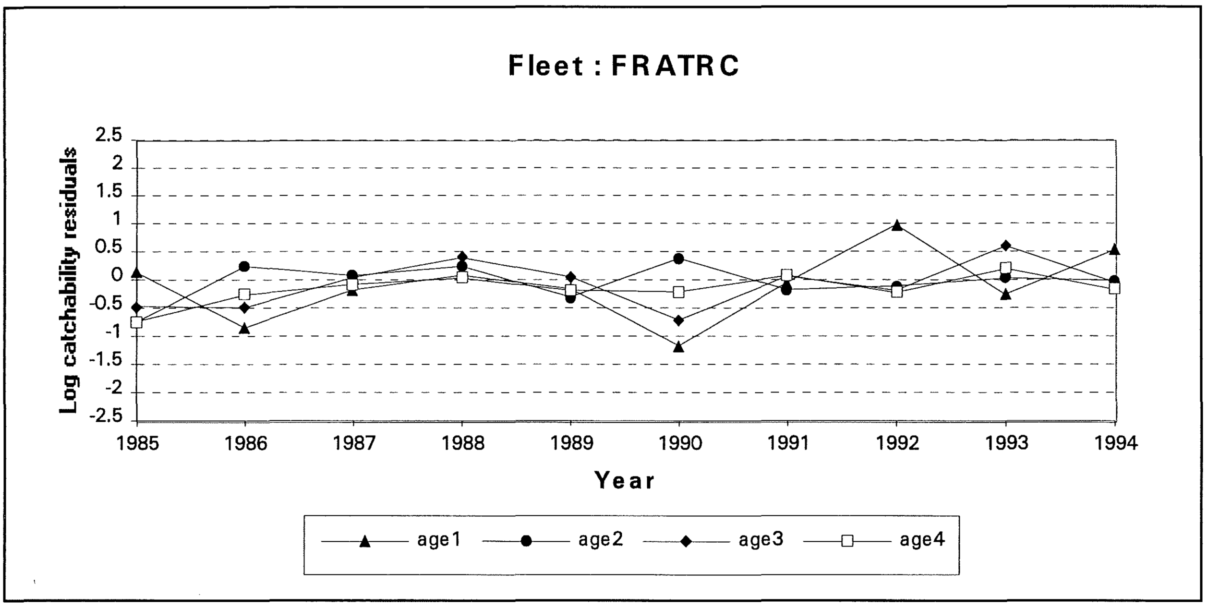


Fig. 4.3.3 : WHITING in Division VIId.
Retrospective VPA, XSA tuning : reference F(ave.2-4) by year.

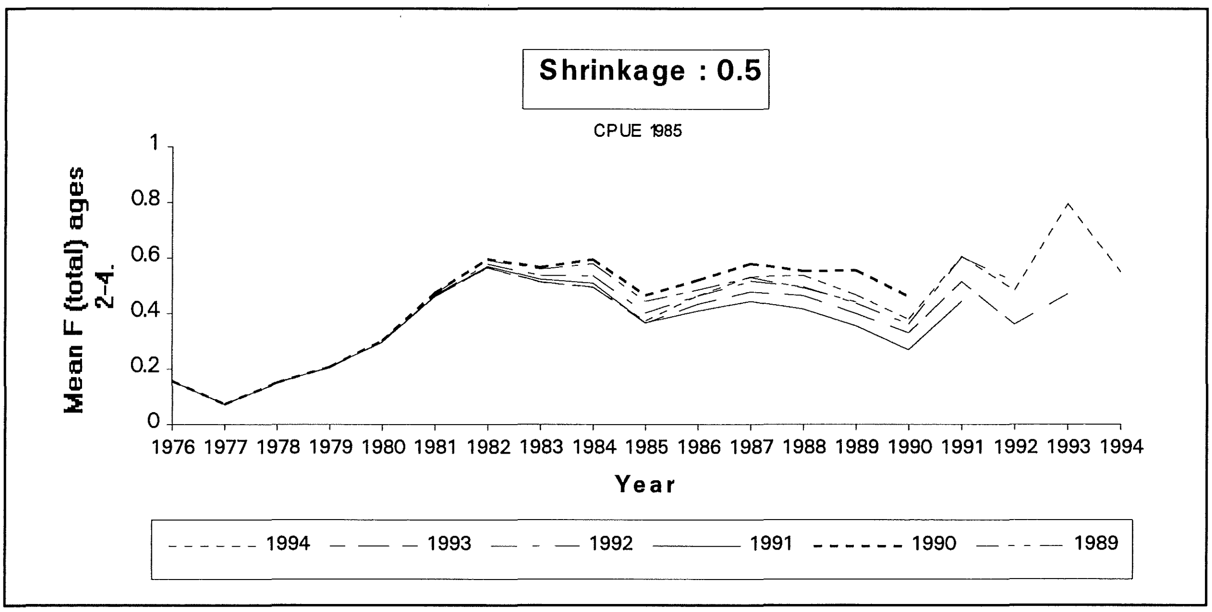
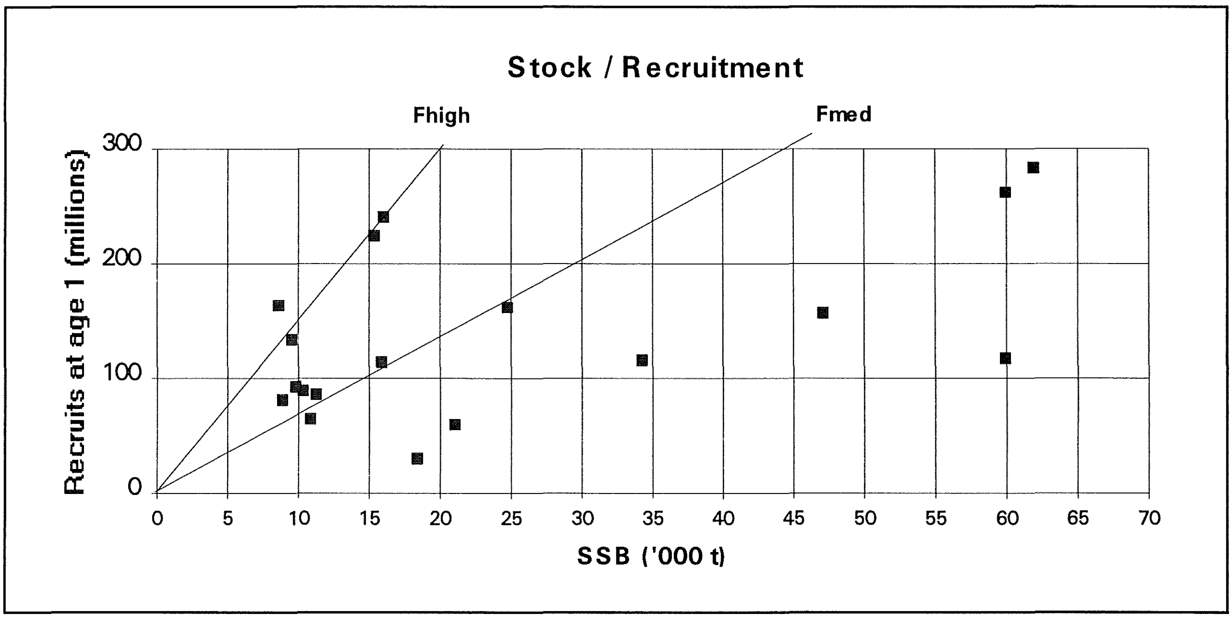


Fig. 4.3.4 : WHITING in Division VIId.
Recruitment and spawning stock biomass.



 E:\ACFM\WGNSSK96\WHG_ECHE\FIG95W7.DOC 02/11/95 10:47

Fig. 4.3.5 : WHITING in Division VIId.
Yield per recruit-Long term yield and spawning biomass.

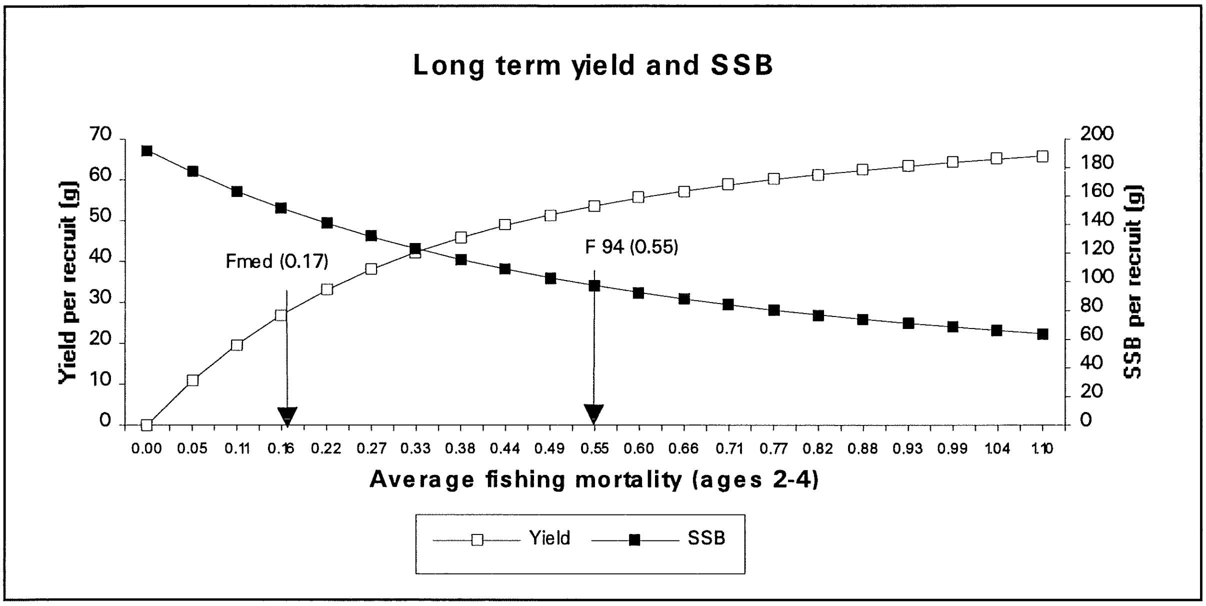


Fig. 4.3.6 : WHITING in Division VIId.
Short term yield and spawning biomass.

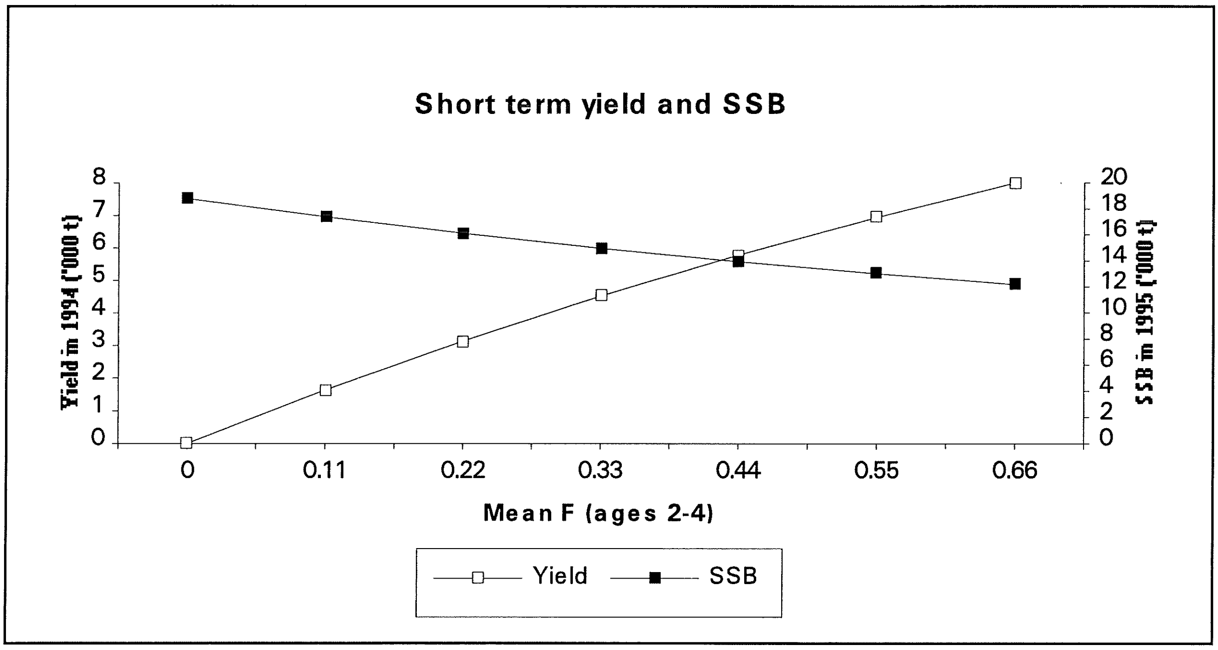


Fig. 4.3.7 : WHITING in Division VIId.
Linear sensitivity coefficients (elasticities)
Key to lebels is in Table 4.3.12.

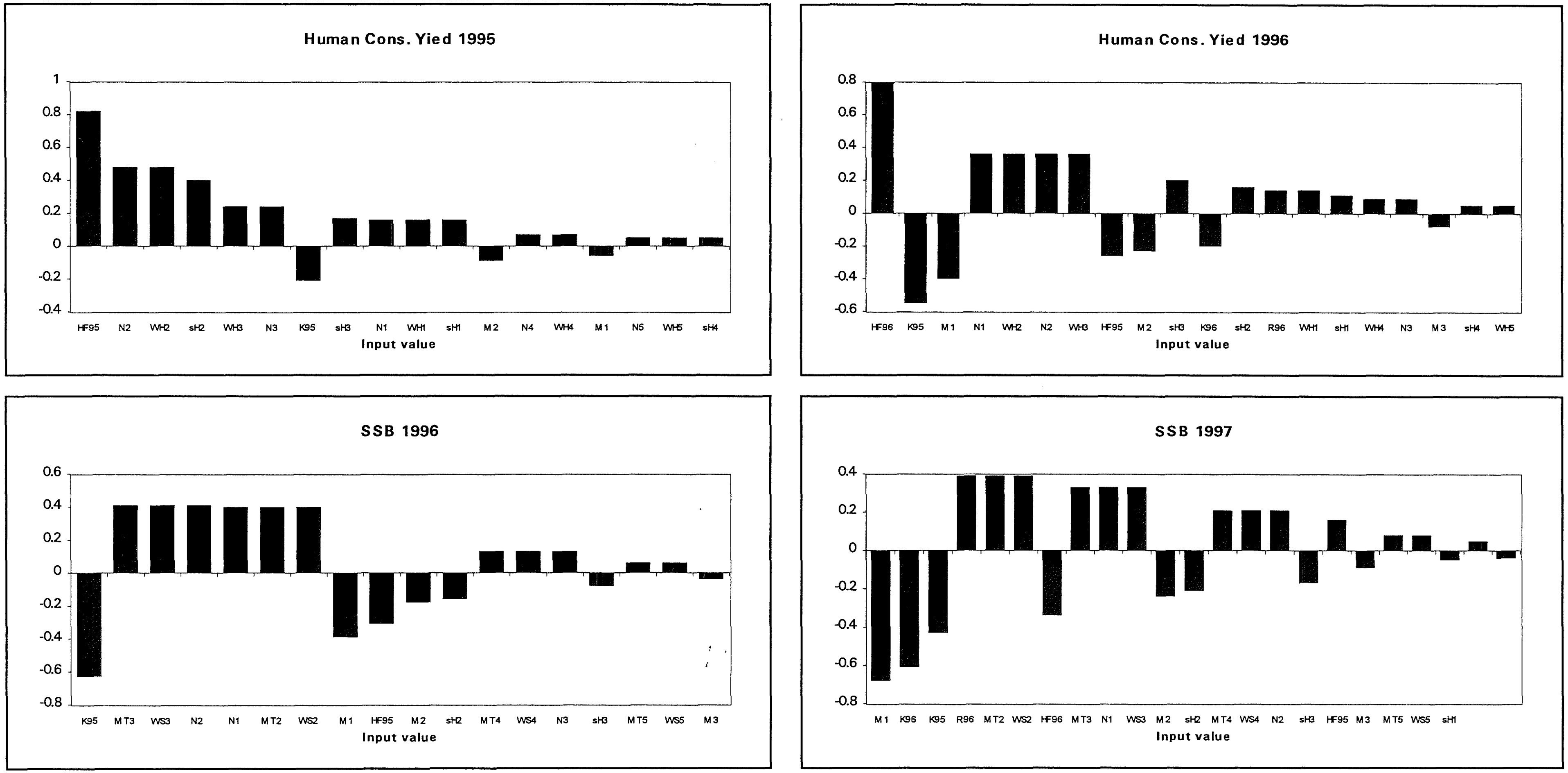
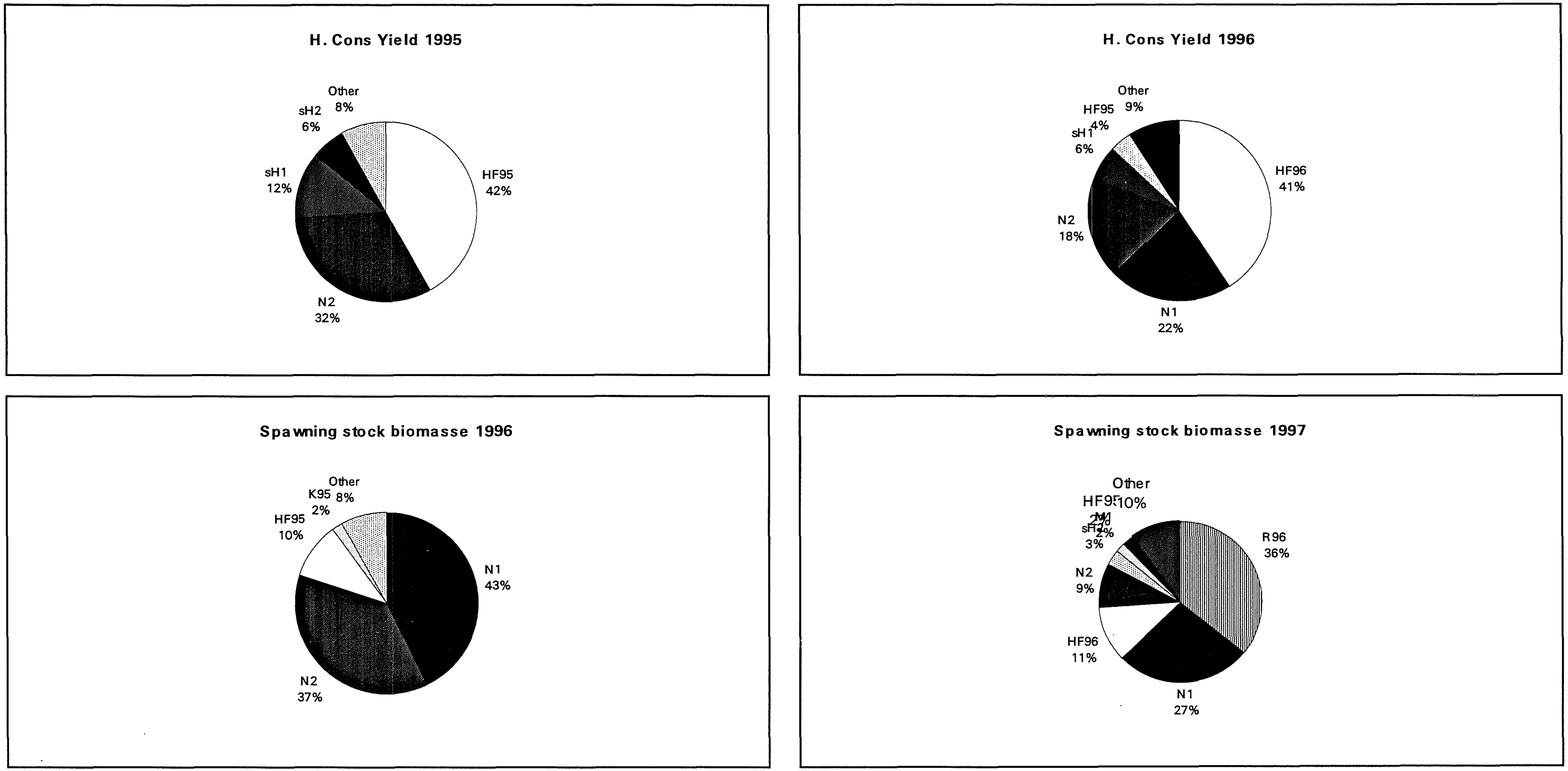


Fig. 4.3.8 : WHITING in Division VIId.
Proportion of total variance contributed by each input value.
Key to lebels is in Table 4.2.12.



E:\ACFM\WGNSSK96\WHG_ECHE\FIG95W7.DOC 02/11/95 10:52

Fig. 4.3.9 : WHITING in Division VIId.
Cumulative probability distributions.

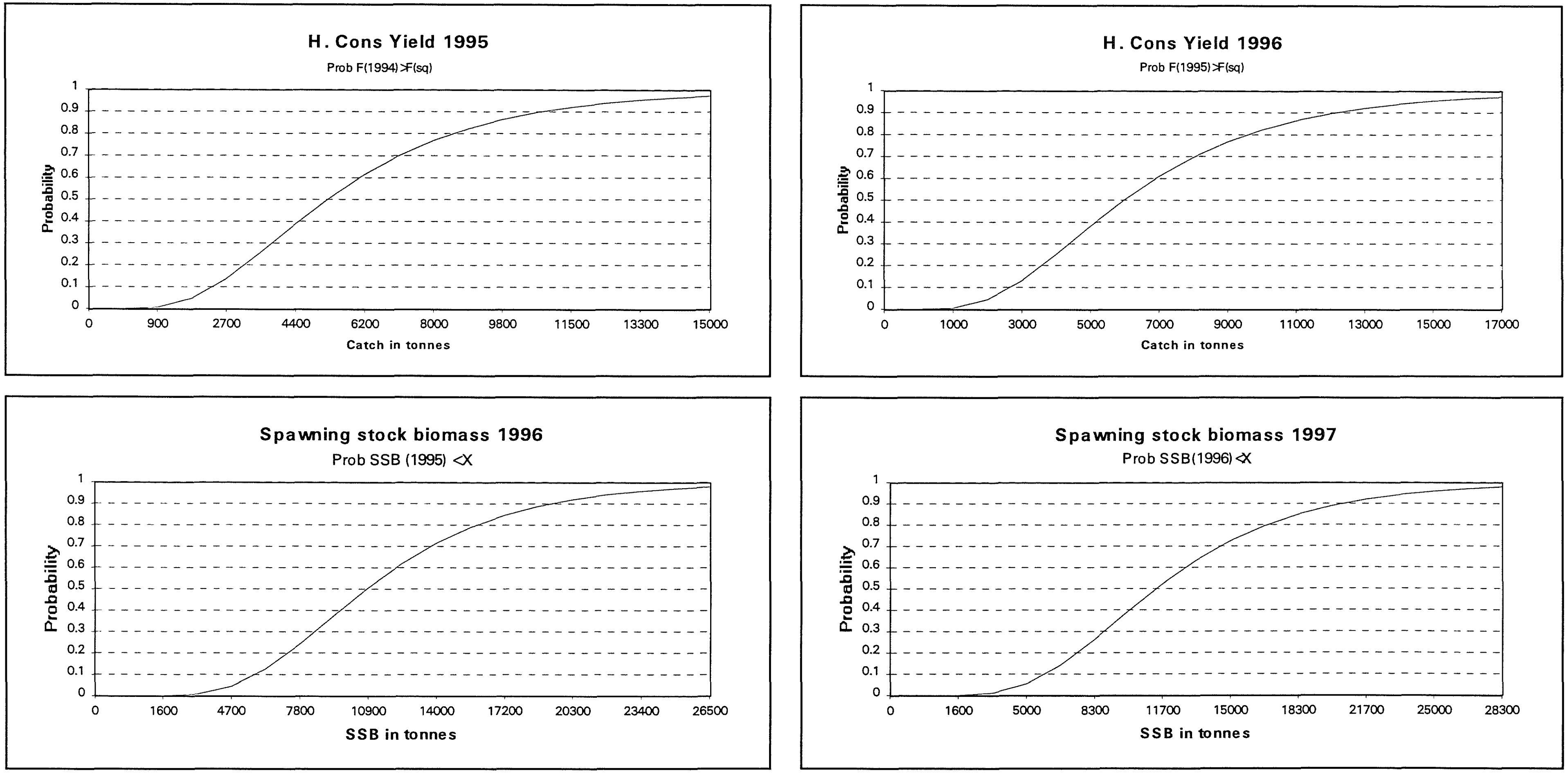
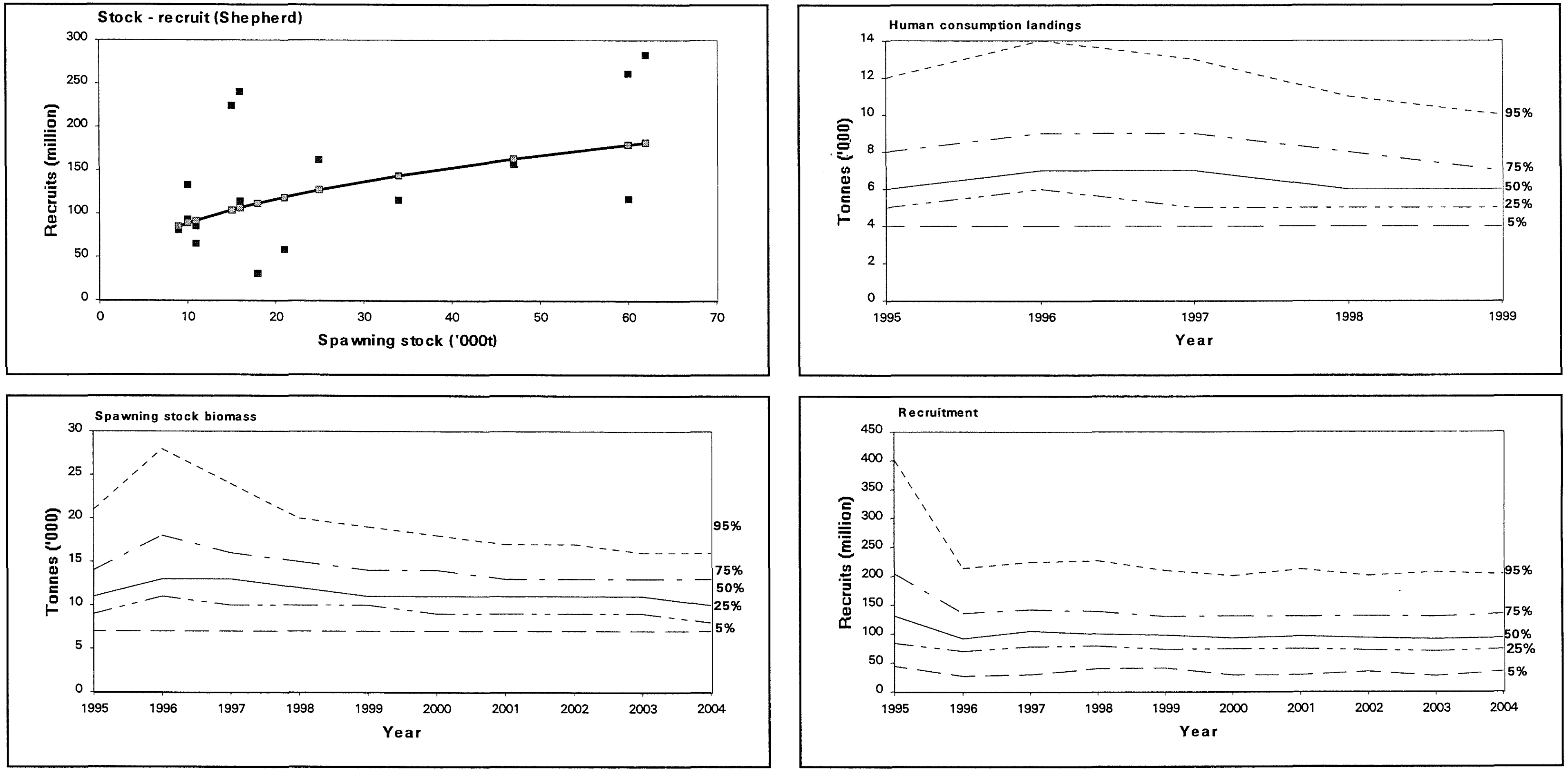


Fig. 4.3.10 : WHITING in Division VIId.
Results of medium-term predictions (Shepherd).



4.4 Sole

4.4.1 Catch trends

Landings data reported to ICES are shown in Table 4.4.1 together with the total landings estimated by the Working Group. Landed weights were changed to correct for SOP discrepancies, and the factors used are shown in Table 4.4.1. The Channel sole fishery comprises five main commercial fleets, these are Belgian and English offshore beam trawl fleets, both inshore and offshore French fleets, and an inshore English fixed net fleet. The Belgian beam trawlers fish in the North Sea and western waters in 1994 have reduced their effort in VIId. The French fishery mainly comprises small inshore vessels fishing for sole with trammel nets and trawls. Fishing effort in this sector has more than doubled since 1985/86 but appears to have decreased in recent years as some vessels have been decommissioned. The French offshore fleet is a mixed demersal fishery which takes sole only as a by-catch. The UK inshore fishery consists of small vessels which target sole in the spring and autumn using mainly trammel nets, and effort in this fishery appears to be relatively stable. UK beam trawl effort has increased considerably and has more than doubled since 1985. Part of this fleet fishes regularly in VIId and part consists of mobile beam trawlers from the southwest which fish only occasionally in the area.

The trend in total landings (Figure 4.4.1) has been relatively stable since reaching a peak of about 4900t in 1987. The 1994 landings were reported as 4641 tonnes which is close to the figure predicted at *status quo* fishing mortality in 1994 (4300 t) but about 18 % above the agreed TAC of 3800 t. In 1994 about one third of the unallocated catch was due to SOP corrections, a third was a soft estimate of misreported catch and the rest was based on estimates from partial data.

Trends in commercial effort of the most important fleets have increased consistently since 1975 and reached a peak during 1989-1990, followed by a decline in the early 1990s (Figure 4.4.10; Table 4.4.16). All fleets show a decline in CPUE between 1988 and 1991, followed by a more recent increase (Figure 4.4.11; Table 4.4.16).

4.4.2 Natural mortality, maturity, age compositions and mean weight at age

As in previous assessments natural mortality was assumed constant over ages and years at 0.1, and the maturity ogive used was knife-edged with sole regarded as fully mature at age 3 and older (Table 4.4.9, input to prediction). Age data for the period before 1980 was poor, but between 1981 and 1984 quarterly samples were provided by both Belgium and England. Since 1985, quarterly catch and weight at age compositions were available from Belgium, France and England. The age composition data and the mean weight at age in the catch and stock are shown in Table 4.4.2.

Stock weights were calculated from a smoothed curve of the catch weights interpolated to 1st January. The data for 1992-1993 were updated with minor revisions. The data do not include discards which are not sampled for this stock but are expected to be relatively low.

4.4.3 Catch, effort and research vessel data

Catch and effort data were available for 8 fleets, 5 commercial and 3 survey fleets. The French offshore fleet, which was used in tuning last year, was not included in XSA tuning runs because it used the same age composition as the inshore fleet.

Recruit survey estimates for 0 and 1-group fish were available from English and French Young Fish Surveys in coastal waters of VIId (Table 4.4.6). Survey age compositions for fish of age 1 to 6 were also available since 1988 from the English beam trawl survey, carried out in August throughout the Eastern Channel (Table 4.4.15).

Table 4.4.3a summarises the range of ages and years in each fleet used in the initial tuning analysis.

4.4.4 Catch at age analysis

Analysis was carried out on ages 1-10+ because the older age-groups showed high levels of variance. A number of trial runs were made with XSA to select the most appropriate model for the data.

A tricubic time weighting over 10 years was applied so that poor quality data in the early 1980s was down weighted. All seven fleets were used in the first XSA run to select the most appropriate ages for which stock size was proportional to CPUE. Selection of recruits as 1-group and 2-group fish improved the regression se's of the slope of q, and also the stability of the terminal survivors estimate. This did not occur when 3-group fish were also included as recruits. This provided evidence that both 1 and 2-group fish should be considered as recruits, but not 3-group fish. Constant catchability was assumed for fish older than 7 years, based on the trends in mean log q of each fleet. The model also included an F shrinkage to the most recent four years, and for the four oldest ages. Only four ages were used because the plus group had already been reduced to 10+.

In order to select the appropriate level of shrinkage, a weaker shrinkage of the mean (s.e. = 0.800 rather than 0.500) was used to increase the weighting on F values determined by each fleet. This run reduced the range in the values of estimated survivors from all fleets, and produced smaller internal s.e's for the younger ages in all commercial fleets. The results of a retrospective analysis comparing different levels of shrinkage are given in Figure 4.4.2. In each case there had been a tendency to over estimate F in previous years, while the level of shrinkage had very little effect on the over estimation and a weaker shrinkage of 0.8 was selected for the final run. The UK inshore fixed net fleet was removed in the final run because of low scaled weights (0.03-0.10) for all ages, and a survivors estimate for 2-group fish of more than twice the weighted prediction.

There was no consistent trend in catchability with time for any of the three commercial fleets, although the UK beam trawl fleet showed slightly higher values for 3- and 4-group fish at the start of the time-series (Figure 4.4.3).

The input effort and catch at age for each fleet are shown in Table 4.4.3b and the results of the final XSA run using these parameters are given in Table 4.4.4, with tables of fishing mortality and stock number at age in Table 4.4.5.

4.4.5 Recruitment estimates

Recruit indices were available from English and French young fish surveys for 0- and 1-group, and the English beam trawl survey in VIId for ages up to 10+-group. The relationship between these series and the VPA is shown in Figure 4.4.4a. The indices were used with RCT3 to estimate the 1994 year class abundance. Indices with values close to one should be scaled to avoid problems when the data are logged in RCT3. This was not done in the run used for estimation of the 1994 year class, but a later comparison showed that scaling improved the SE's of the indices but had an insignificant effect on the final weighted estimate of the year class. The input files to RCT3 are given in Table 4.4.6 and the results in Table 4.4.7.

The geometric mean recruitment for the period 1982-1992 was 21.7 million and the arithmetic mean was 23.8 million at age 1.

1992 year class at age 3 in 1995: This year class was the lowest on record for the UK beam trawl survey (Table 4.4.15). The XSA estimated this year class as 6.3 million at age 3 (in 1995) which was the lowest recorded since 1982, and this compares with a GM of 14.0 million for that age group (Table 4.4.5). The XSA value for this year class was accepted because all the relevant recruit surveys had been included in tuning.

1993 year class at age 2 in 1995: As 1-group and 2-group this year class was close to the survey average recorded by the UK beam trawl survey. It was strongest since 1990 for the UK surveys, but for the French YFS it was weak as 0-group but strongest since 1980 as 1-group (Table 4.4.16). At age 2, this was estimated at 31.7 million by XSA, compared with GM of 18.7 million. The XSA value of this year class, as for the 1992 year class, has been used in the prediction.

1994 year class at age 1 in 1995: The UK beam trawl survey recorded this year class as close to the survey average as 1-groups. As 0-groups, it was the strongest since 1989 on the French coast, but average on the English coast. It was estimated by RCT3 at 28.2 million, which is above the GM of 21.7 million, and this survey estimate was used in preference to the GM as it included a weighting of 20% from the English beam trawl survey and 11% from the French inshore survey. A later estimate using scaled indices gave a value of 28.7 million but the original value of 28.2 was used in the prediction.

The 1995 year class: There were no survey estimates of this year class, so the GM was used.

4.4.6 Historical stock trends

Trends in yield, fishing mortality, SSB and recruitment are shown in Table 4.4.8 and Figure 4.4.1. Fishing mortality has increased since 1982 to peak in the period 1987-1989. Since then it has stabilised at around 0.45. The yield peaked in 1987 and has been relatively stable above 4000 t since then. Recruitment has shown alternate weak and strong year classes with one particularly strong recruitment in 1989. The spawning stock has shown a decline since 1986 but some recovery is evident since 1992 as the strong 1989, 1990 and 1991 year classes recruit to the stock.

4.4.7 Biological reference points

The stock recruitment scatter plot (Figure 4.4.4b) shows no clear pattern of stock recruitment trend. Only a short time series is available and it is not clear what level of SSB should be used to determine the minimum biologically acceptable level. The value of F_{med} from the plot corresponds to that of the *status quo* F of 0.42, while F_{high} is estimated at 0.76. The biological reference points are similar to last year and are summarised below:

$F_{0.1}$	F_{max}	F_{med}	F_{94}	F_{high}
0.11	0.24	0.42	0.42	0.76

The yield per recruit input values are shown in Table 4.4.9 and the output summary in Table 4.4.10. YPR and SSB/R curves are shown in Figure 4.4.5. Assuming AM recruitment of 23.8 million the equilibrium yield at *status quo* F will average 4110t with a corresponding SSB of 9200t.

4.4.8 Short term forecast

The input data for the catch forecasts are given in Table 4.4.9. Stock numbers in 1994 were taken from the XSA output adjusted for recruitment at age 1. The GM recruitment of 21.8 million was used for age 1 in 1996 to 1997. The exploitation pattern was the mean for the period 1992-94, scaled to the 1994 $F_{(3-8)}$ value of 0.423.

Catch and stock weights at age were the mean for the period 1992-94 and proportions of M and F before spawning were set to zero. The results of the *status quo* catch prediction are given in Tables 4.4.11 and 4.4.12 and Figure 4.4.5. The predicted catch in 1995 is 4452t from a SSB of 9478t. Continuing with the same level of F implies a catch of 4658t in 1996. Spawning stock biomass is expected to increase to 10,600t in 1996 and 10,800t in 1997 following recruitment of the 1993 and 1994 year classes.

Input data for the sensitivity analysis of the catch predictions using the programme INSENS are given in Table 4.4.13 and the results shown in Figures 4.4.6 - 4.4.8. For yield, the prediction in 1995 and 1996 is most sensitive to the variability in the estimate of the level of F (HF 95, 96), and about equally sensitive to a range of other parameters such as the catch weight (WH 1-n) and number of the 2, 4,and 5 year olds (N2,4,5). The SSB in 1996 is affected mainly by variability in natural mortality at age 3 (MT3), stock weight at age 3 (WS3) and numbers of 2 year olds (N2). Figure 4.4.7 indicates the proportion of the variance contributed by each input. For the yield in 1995 and 1996, the relative level of F (HF 95,96) contributes more than 25% of the variance. The figures indicate that errors in the estimate of the 1993 and 94 year classes will have only a small influence on the estimate of the yield in 1995. The estimate of the 1993 year class is important for the SSB in 1996 and in 1997 the SSB estimate is dominated by the variance of the 1994 year class which contributes over 50%.

Figure 4.4.8 gives cumulative probability distributions for achieving selected yield or SSB within the constraints of *status quo* F. The 95% confidence intervals of the expected *status quo* yield in 1995 are 3200t to 5200t. The probability that SSB will fall below the lowest observed level of 7000t is below 5%, under the current assumptions.

4.4.9 Medium term predictions

Medium term projections were made for yield, spawning stock biomass and recruitment for a period of 10 years. The projections were run for *status quo* F and a random bootstrap model was used which assumes that recruitment was independent of spawning stock size. The results are shown in Figure 4.4.9 and indicate that on the assumptions of this model, yield and SSB are expected to fall initially before levelling off and fluctuating around the equilibrium level in the near term.

4.4.10 Long-term considerations

The current level of F is close to F_{med}, based on the short time series available, and at this level the equilibrium SSB is predicted to fall to 9200t which is above the minimum level observed. Apart from the poor 1992 year class, recent recruitments have been at or above average, suggesting that there is no indication of recruitment failure at the present stock level.

4.4.11 Comments on the assessment

Quality control diagrams are given in Table 4.4.14a and 14b. The main changes to the assessment are the continued overestimation of F in previous years. This has resulted in a substantial increase in SSB compared with last years' assessment. Whilst the level of F appears uncertain, the decreasing trend since 1991 appears to match trends in effort of the major fleets such as the Belgian beam trawl and French inshore fleet (Figure 4.4.10). Similarly, the increase in SSB resulting from the recruitment of the 1990 and 1991 year classes corresponds to increases in CPUE seen in Figure 4.4.11.

The use of F_{med} should be treated with some caution since it is determined from a scatter plot with relatively few data points. Consequently assumptions about the long term stability of the stock which assume current F is close to F_{med} may also be subject to some uncertainty.

4.4.12 Evaluation of the usefulness of quarterly International Bottom trawl surveys.

Sole is not sampled by the IBTS and no indices were consequently available on a quarterly basis.

Table 4.4.1 Sole in VIId Nominal landings (tonnes)
as officially reported to ICES and used by the WG.

Year	Belgium	France	UK (E&W)	others	Total reported	Unallocated [1]	SOP corr. factor	Total used by WG
1974	159	469	309	3	940	-56	1.06	884
1975	132	464	244	1	841	41	1.01	882
1976	203	599	404	.	1206	99	0.99	1305
1977	225	737	315	.	1277	58	1.01	1335
1978	241	782	366	.	1389	200	0.91	1589
1979	311	1129	402	.	1842	473	0.85	2215
1980	302	1075	159	.	1536	387	0.88	1923
1981	464	1513	160	.	2137	340	0.90	2477
1982	525	1828	317	4	2674	516	0.84	3190
1983	502	1120	419	.	2041	1417	0.89	3458
1984	592	1309	505	.	2406	1169	0.90	3575
1985	568	2545	520	.	3633	204	1.00	3837
1986	858	1528	551	.	2937	1087	0.99	4024
1987	1100	2086	655	.	3841	1133	1.00	4974
1988	667	2057	578	.	3302	680	1.00	3982
1989	646	1610	689	.	2945	1242	1.00	4187
1990	996	1255	742	.	2993	1067	0.99	4060
1991	904	2054	825	.	3783	599	0.98	4382
1992	891	2187	706	10	3794	348	0.98	4142
1993	917	1907	610	13	3447	1064	0.98	4511
1994	940	2001	701	15	3657	984	0.98	4641

[1] Includes landings corrected for SOP discrepancies
and unreported landings estimated by the WG

Table 4.4.2 Sole in VIId

SOL-ECHE: Sole in the Eastern English Channel (Fishing Area VIId)

CANUM: Catch in Numbers (Thousands)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
1971	0.0	90.7	802.9	52.5	41.1	11.4	82.1	744.7	35.4	17.7	94.2	99.9	152.3	187.7	246.0
1972	0.0	37.7	545.1	226.5	0.0	48.3	0.0	48.3	875.7	24.1	0.0	43.8	57.3	61.9	303.5
1973	0.0	487.3	317.5	756.4	257.9	45.3	77.0	62.7	172.2	282.6	65.9	84.1	115.9	31.8	125.4
1974	0.0	539.7	551.0	318.1	483.6	75.1	99.3	10.1	40.8	55.6	158.4	44.9	8.3	52.6	157.2
1975	0.0	23.0	811.0	443.0	143.0	432.0	120.0	54.0	17.0	28.0	28.0	182.0	23.0	32.0	195.0
1976	36.0	651.0	1298.0	765.0	258.0	69.0	292.0	67.0	39.0	13.0	9.0	27.0	215.0	6.0	166.0
1977	47.0	1772.0	803.0	882.0	247.0	111.0	49.0	101.0	48.0	29.0	23.0	12.0	33.0	121.0	113.0
1978	391.0	1911.0	2490.0	580.0	335.0	315.0	95.0	57.0	60.0	38.0	29.0	20.0	13.0	35.0	135.0
1979	331.0	936.0	3841.0	1650.0	424.0	228.0	186.0	51.0	29.0	62.0	20.0	26.0	9.0	29.0	148.0
1980	45.0	688.0	1752.0	1739.0	710.0	416.0	306.0	142.0	86.0	43.0	37.0	20.0	10.0	10.0	72.0
1981	0.0	2889.0	2580.0	1109.0	905.0	704.0	307.0	191.0	101.0	46.0	29.0	38.0	18.0	8.0	95.0
1982	155.0	2625.0	5256.0	1727.0	570.0	653.0	549.0	240.0	122.0	83.0	44.0	25.0	24.0	12.0	97.0
1983	0.0	852.0	3452.0	3930.0	897.0	735.0	627.0	333.0	108.0	89.0	56.0	26.0	7.0	32.0	72.0
1984	24.0	1977.0	3157.0	2610.0	1900.0	742.0	457.0	317.0	136.0	99.0	56.0	51.0	19.0	18.0	94.0
1985	49.0	3693.0	5211.0	1646.0	1027.0	1860.0	144.0	158.0	156.0	69.0	27.0	31.0	18.0	16.0	36.0
1986	49.0	1264.0	5377.0	3273.0	925.0	790.0	1087.0	156.0	192.0	216.0	128.0	47.0	19.0	64.0	123.0
1987	9.0	3284.0	3827.0	3417.0	2166.0	1064.0	1110.0	828.0	114.0	163.0	101.0	88.0	94.0	31.0	155.0
1988	95.0	2227.0	7393.0	1648.0	1219.0	910.0	400.0	268.0	280.0	84.0	53.0	78.0	76.0	16.0	61.0
1989	163.0	3704.0	3424.0	4842.0	1530.0	943.0	651.0	218.0	181.0	270.0	38.0	34.0	48.0	46.0	163.0
1990	1271.0	3092.0	6326.0	1257.0	1654.0	329.0	432.0	293.0	138.0	139.0	238.0	85.0	52.0	70.0	111.0
1991	383.0	7381.0	3796.0	4316.0	585.0	1003.0	256.0	257.0	272.0	95.0	88.0	159.0	13.0	15.0	120.0
1992	106.0	4082.0	8967.0	1886.0	2065.0	295.0	382.0	140.0	184.0	98.0	91.0	34.0	44.0	9.0	59.0
1993	85.0	5225.0	6716.0	5735.0	1057.0	645.0	171.0	206.0	123.0	67.0	45.0	24.0	15.0	22.0	39.0
1994	244.0	738.0	6555.0	6122.0	3491.0	612.0	612.0	112.0	154.0	94.0	57.0	41.0	37.0	30.0	113.0

WECA: Mean Weight in Catch (Kilograms)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
1971	0.119	0.190	0.245	0.302	0.355	0.410	0.455	0.493	0.525	0.550	0.565	0.578	0.590	0.595	0.620
1972	0.119	0.190	0.245	0.302	0.355	0.410	0.455	0.493	0.525	0.550	0.565	0.578	0.590	0.595	0.620
1973	0.119	0.190	0.245	0.302	0.355	0.410	0.455	0.493	0.525	0.550	0.565	0.578	0.590	0.595	0.620
1974	0.119	0.190	0.245	0.302	0.355	0.410	0.455	0.493	0.525	0.550	0.565	0.578	0.590	0.595	0.620
1975	-1.000	0.142	0.193	0.301	0.358	0.428	0.345	0.375	0.509	0.389	0.550	0.521	0.576	0.402	0.695
1976	0.199	0.181	0.235	0.299	0.466	0.523	0.503	0.590	0.492	0.665	0.419	0.436	0.668	0.378	0.687
1977	0.198	0.192	0.262	0.358	0.404	0.522	0.433	0.539	0.650	0.545	0.607	0.439	0.587	0.542	0.661
1978	-1.000	0.177	0.237	0.293	0.342	0.418	0.548	0.384	0.494	0.477	0.656	0.534	0.633	0.644	0.548
1979	0.130	0.168	0.245	0.319	0.389	0.459	0.480	0.601	0.596	0.683	0.602	0.707	0.689	0.515	0.659
1980	0.121	0.174	0.235	0.326	0.399	0.439	0.452	0.552	0.455	0.602	0.574	0.598	0.774	0.540	0.743
1981	-1.000	0.171	0.229	0.316	0.380	0.415	0.427	0.542	0.546	0.533	0.605	0.569	0.614	0.586	0.642
1982	0.102	0.171	0.225	0.312	0.386	0.428	0.439	0.509	0.502	0.463	0.522	0.614	0.805	0.534	0.741
1983	0.000	0.173	0.230	0.302	0.404	0.436	0.435	0.524	0.537	0.583	0.552	0.631	0.838	0.548	0.702
1984	0.100	0.178	0.234	0.314	0.380	0.436	0.417	0.538	0.529	0.565	0.662	0.726	0.749	0.694	0.734
1985	0.090	0.182	0.230	0.281	0.368	0.394	0.516	0.543	0.594	0.595	0.632	0.714	0.804	0.813	0.994
1986	0.135	0.179	0.212	0.306	0.362	0.385	0.435	0.519	0.501	0.524	0.556	0.592	0.756	0.438	0.718
1987	0.095	0.176	0.236	0.295	0.353	0.407	0.412	0.479	0.463	0.538	0.616	0.566	0.604	0.648	0.655
1988	0.102	0.152	0.226	0.278	0.358	0.407	0.458	0.509	0.551	0.559	0.753	0.630	0.595	0.634	0.734
1989	0.106	0.156	0.193	0.274	0.295	0.357	0.391	0.469	0.516	0.538	0.531	0.713	0.692	0.617	0.772
1990	0.121	0.180	0.240	0.291	0.351	0.343	0.469	0.463	0.489	0.519	0.543	0.538	0.449	0.633	0.653
1991	0.114	0.161	0.211	0.267	0.349	0.390	0.415	0.426	0.433	0.477	0.601	0.473	0.789	0.696	0.600
1992	0.103	0.153	0.202	0.267	0.291	0.399	0.386	0.455	0.445	0.461	0.494	0.579	0.546	0.754	0.622
1993	0.085	0.148	0.197	0.245	0.331	0.374	0.528	0.540	0.505	0.742	0.566	0.638	0.709	0.688	0.698
1994	0.146	0.159	0.188	0.236	0.290	0.354	0.380	0.505	0.492	0.496	0.597	0.591	0.538	0.691	0.639

WEST: Mean Weight in Stock (Kilograms)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
1971	0.070	0.115	0.217	0.275	0.329	0.382	0.432	0.476	0.508	0.534	0.558	0.572	0.583	0.592	0.620
1972	0.070	0.115	0.217	0.275	0.329	0.382	0.432	0.476	0.508	0.534	0.558	0.572	0.583	0.592	0.620
1973	0.070	0.115	0.217	0.275	0.329	0.382	0.432	0.476	0.508	0.534	0.558	0.572	0.583	0.592	0.620
1974	0.070	0.115	0.217	0.275	0.329	0.382	0.432	0.476	0.508	0.534	0.558	0.572	0.583	0.592	0.620
1975	0.075	0.141	0.203	0.272	0.328	0.384	0.432	0.480	0.515	0.549	0.576	0.603	0.629	0.651	0.669
1976	0.075	0.141	0.203	0.272	0.328	0.384	0.432	0.480	0.515	0.549	0.576	0.603	0.629	0.651	0.669
1977	0.075	0.141	0.203	0.272	0.328	0.384	0.432	0.480	0.515	0.549	0.576	0.603	0.629	0.651	0.669
1978	0.075	0.141	0.203	0.272	0.328	0.384	0.432	0.480	0.515	0.549	0.576	0.603	0.629	0.651	0.669
1979	0.075	0.141	0.203	0.272	0.328	0.384	0.432	0.480	0.515	0.549	0.576	0.603	0.629	0.651	0.669
1980	0.075	0.141	0.203	0.272	0.328	0.384	0.432	0.480	0.515	0.549	0.576	0.603	0.629	0.651	0.669
1981	0.075	0.141	0.203	0.272	0.328	0.384	0.432	0.480	0.515	0.549	0.576	0.603	0.629	0.651	0.669
1982	0.059	0.114	0.167	0.217	0.263	0.306	0.347	0.384	0.418	0.450	0.478	0.503	0.525	0.544	0.560
1983	0.070	0.135	0.197	0.255	0.309	0.359	0.406	0.448	0.487	0.522	0.552	0.579	0.603	0.622	0.637
1984	0.067	0.131	0.192	0.249	0.304	0.355	0.403	0.448	0.490	0.529	0.564	0.597	0.626	0.652	0.675
1985	0.065	0.129	0.192	0.254	0.315	0.376	0.436	0.495	0.554	0.611	0.668	0.724	0.779	0.834	0.888
1986	0.070	0.136	0.198	0.256	0.309	0.358	0.403	0.443	0.480	0.512	0.539	0.563	0.582	0.597	0.608
1987	0.072	0.139	0.203	0.262	0.318	0.370	0.417	0.461	0.500	0.536	0.567	0.595	0.618	0.638	0.653
1988	0.073	0.141	0.206	0.267	0.324	0.377	0.426	0.471	0.512	0.549	0.582	0.612	0.637	0.659	0.677
1989	0.060	0.119	0.175	0.230	0.283	0.335	0.385	0.433	0.479	0.523	0.566	0.607	0.647	0.685	0.720
1990	0.070	0.135	0.196	0.253	0.305	0.353	0.396	0.435	0.470	0.500	0.525	0.547	0.563	0.576	0.584
1991	0.061	0.119	0.175	0.228	0.278	0.326	0.371	0.413	0.453	0.490	0.524	0.556	0.585	0.611	0.635
1992	0.084	0.132	0.178	0.223	0.267	0.309	0.349	0.388	0.425	0.461	0.496	0.528	0.559	0.589	0.617
1993	0.067	0.087	0.161	0.230	0.293	0.352	0.405	0.454	0.497	0.535	0.568	0.596	0.619	0.637	0.649
1994	0.068	0.118	0.165	0.211	0.254	0.296	0.335	0.372	0.407	0.440	0.471	0.499	0.526	0.550	0.572

Table 4.4.3a Sole in VIId Fleets available for tuning.

fleet	first year	last year	first age	last age
Belgian beam trawl,	1982	1994	2	9
UK >40ft beam trawl,	1982	1994	2	9
French inshore otter trawl,	1985	1994	2	9
UK inshore fixed net,	1985	1994	2	9
UK beam trawl survey,	1988	1994	1	6
English young fish survey,	1985	1994	1	1
French young fish survey,	1987	1994	1	1

Table 4.4.3b Sole in VIId Tuning input data

SOL-ECHE: Sole in the Eastern English Channel (Fishing Area VIId)

FLT01: BELGIAN BT (HP CORRECTED EFFORT - ALL GEARS AGE COMP)

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1980	12.8	69.3	46.1	298.7	189.6	57.4	24.7	10.3	5.1	8.6	3.1	5.5	2.4	2.6	37.9
1981	19.0	640.7	161.4	82.1	312.8	229.6	44.7	32.9	33.1	6.9	9.0	18.4	9.3	0.8	51.9
1982	23.9	148.7	980.9	128.0	93.4	155.9	112.6	38.8	60.1	15.2	14.0	7.4	12.5	5.9	54.3
1983	23.6	190.4	373.0	818.9	65.5	54.0	81.7	73.2	23.5	20.2	27.0	5.0	1.0	7.1	33.0
1984	28.0	603.8	347.2	311.2	436.0	53.7	38.5	104.9	59.9	25.4	23.2	25.3	9.0	8.2	42.4
1985	25.3	382.9	612.1	213.0	209.1	260.2	58.2	34.1	48.0	31.0	16.9	19.6	9.2	7.7	21.3
1986	23.4	215.0	1522.3	675.0	233.7	170.6	194.0	30.1	53.1	64.2	32.6	12.7	2.6	43.0	29.3
1987	27.1	843.6	451.0	739.3	724.4	344.5	232.4	152.7	25.3	86.5	56.0	56.1	54.5	9.3	109.0
1988	38.5	131.6	990.4	243.3	362.9	216.7	111.8	41.8	73.8	47.0	9.8	22.3	35.8	8.6	25.3
1989	35.7	47.5	512.6	543.6	748.0	276.6	225.0	53.1	36.4	12.7	4.7	0.0	0.0	4.7	27.0
1990	30.3	1011.4	1375.2	218.1	366.2	85.3	198.2	65.5	39.0	22.4	22.2	25.4	2.8	24.0	18.2
1991	24.3	320.2	1358.6	710.1	125.6	283.9	60.6	56.2	21.0	19.8	22.2	18.0	5.6	0.3	21.4
1992	22.0	499.3	1613.7	523.3	477.7	36.9	67.9	28.2	31.7	11.2	11.4	6.0	5.7	3.2	16.7
1993	20.0	1654.5	1520.4	889.5	215.5	78.5	38.9	40.8	37.8	11.3	8.7	13.3	1.5	3.0	22.4
1994	22.2	196.9	1183.2	1598.5	912.9	201.0	160.0	39.5	33.8	46.2	16.0	10.2	14.9	8.8	18.6

FLT03: UK. >40FT.BEAM TRAWL(FLEET EFFORT - ALL TRAWL AGE COMPS DE-RAISED)

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1981	2.27	41.5	31.2	6.7	25.7	8.5	1.9	2.3	1.6	0.3	0.4	0.8	0.1	0.0	2.8
1982	4.17	17.2	137.2	10.1	3.3	14.1	1.8	1.8	1.9	4.5	1.1	0.0	0.1	0.1	2.3
1983	2.66	18.5	38.4	118.6	2.0	2.8	6.9	4.4	0.3	0.0	0.0	0.0	0.0	1.7	1.3
1984	2.88	42.6	34.8	26.1	30.1	2.6	1.1	0.7	0.6	0.4	0.1	0.1	0.1	0.3	1.5
1985	9.11	12.8	295.0	43.8	21.9	79.8	0.3	0.1	4.9	0.0	0.1	0.5	1.8	0.5	0.5
1986	12.92	38.4	185.4	128.7	35.9	36.9	50.5	1.5	3.1	6.7	3.3	3.6	2.0	2.2	6.8
1987	24.27	362.0	152.3	206.4	142.6	26.8	21.0	54.1	2.1	0.6	4.8	1.5	2.2	4.7	3.5
1988	18.98	145.2	402.6	81.8	94.4	61.4	13.4	17.6	25.6	2.6	0.4	6.7	7.1	0.0	0.3
1989	33.29	310.0	186.9	369.7	44.0	81.7	60.5	12.7	10.8	42.6	2.5	1.1	5.0	6.8	34.5
1990	33.39	199.8	662.3	97.2	146.7	29.1	34.2	34.7	8.7	15.0	48.6	4.1	1.1	6.8	17.7
1991	30.38	488.9	200.3	287.8	12.3	45.9	7.5	11.0	16.3	4.1	2.7	12.7	0.4	0.0	7.4
1992	37.10	332.3	684.6	105.6	215.2	15.0	26.1	8.2	19.0	6.6	3.0	1.9	4.2	0.1	3.3
1993	29.32	272.1	358.5	357.3	56.9	86.8	8.6	17.7	7.4	5.0	5.5	1.9	2.1	3.5	4.6
1994	28.13	65.6	419.0	226.9	174.7	44.0	73.3	6.7	15.7	5.1	6.1	5.7	4.0	2.3	15.0

FLT05: FR INSHORE OT,MANCHE EST (all fleets age comp)eff=all fleet lands/

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1985	228.87	98.6	95.6	35.4	20.6	34.4	2.5	3.6	2.3	1.1	0.2	0.3	0.0	0.2	0.4
1986	411.20	47.2	156.0	92.2	24.1	20.0	28.8	6.0	6.3	5.6	4.0	0.7	0.3	0.4	2.9
1987	573.20	146.8	273.7	181.0	79.6	57.4	74.0	41.9	7.2	7.0	2.7	2.2	3.0	0.9	3.2
1988	942.10	238.1	712.8	158.3	69.0	54.0	30.7	20.8	8.3	4.2	4.9	3.1	2.7	1.0	4.9
1989	1039.00	417.9	332.0	427.1	88.7	57.4	32.3	17.1	14.8	17.0	3.6	4.1	4.4	2.8	6.9
1990	909.10	138.9	244.4	64.1	72.3	14.3	11.9	11.0	6.6	6.8	7.1	4.2	4.0	2.5	4.0
1991	967.00	548.3	151.8	194.9	39.5	44.7	15.4	13.4	15.8	5.2	5.3	6.7	0.6	1.5	6.2
1992	505.22	270.6	510.5	95.1	61.1	19.1	18.1	6.8	6.5	5.5	6.5	1.6	1.6	0.5	2.5
1993	544.60	260.4	371.7	325.4	58.3	19.6	8.9	8.4	5.3	3.2	1.3	0.4	0.4	0.4	0.1
1994	643.00	27.6	315.1	310.5	164.3	22.2	16.3	4.4	5.4	3.0	1.7	1.0	0.9	1.2	3.5

FLT09: UK FIX TRAM E (U5.4) (Fleet effort & UK Trammel & Gill age comps) (Catch: Thousands)

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1985	6190	1.9	382.0	91.1	48.3	154.7	1.1	1.5	12.3	0.6	1.0	0.8	1.4	0.8	0.8
1986	5863	16.9	177.4	257.4	70.5	71.9	109.5	3.8	5.3	13.9	4.4	4.5	2.8	4.1	10.2
1987	7215	46.1	107.7	193.7	173.3	36.6	36.0	69.3	5.6	1.7	4.0	3.1	2.5	1.1	2.8
1988	6943	2.9	228.4	47.7	90.1	121.1	30.2	25.1	68.5	0.1	6.0	13.2	0.6	0.0	0.0
1989	8378	30.8	101.1	334.0	37.5	63.0	51.1	11.8	11.1	35.3	1.7	1.5	4.1	4.6	11.6
1990	13540	72.9	597.2	78.2	112.7	15.7	20.0	21.4	3.9	6.4	26.6	2.0	0.5	2.4	7.2
1991	12169	294.8	275.2	599.4	25.1	102.2	15.7	25.4	34.1	8.4	4.4	27.0	0.5	0.0	12.0
1992	8496	48.8	396.6	98.2	303.5	17.4	43.4	14.7	27.7	9.9	3.6	4.6	8.0	0.5	5.6
1993	9043	116.0	176.8	215.6	40.2	79.8	9.1	18.6	7.4	4.8	5.7	2.1	2.3	3.9	4.7
1994	10797	43.6	353.0	207.0	149.1	37.7	59.7	4.9	12.2	3.9	4.4	3.3	2.6	1.1	10.8

Table 4.4.3b cont.

SOL-ECHE: Sole in the Eastern English Channel (Fishing Area VIId)

FLT06: UK BEAM TRAWL SURVEY

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1988	1	8.2	14.2	9.9	0.8	1.3	1.2
1989	1	2.6	15.4	3.4	1.7	0.6	1.1
1990	1	12.1	3.7	3.4	0.7	0.8	0.5
1991	1	8.9	22.8	2.2	2.3	0.3	1.0
1992	1	1.4	12.0	10.0	0.7	1.1	1.8
1993	1	0.5	17.5	8.4	7.0	0.8	1.9
1994	1	4.7	3.2	8.3	3.3	3.3	0.2

FLT08: FRENCH YFS

Year	Fishing effort	Catch, age 1
1987	1	0.04
1988	1	0.08
1989	1	0.08
1990	1	0.25
1991	1	0.21
1992	1	0.13
1993	1	0.02
1994	1	0.89

FLT07: ENGLISH YFS

Year	Fishing effort	Catch, age 1
1985	1	0.9
1986	1	1.4
1987	1	1.0
1988	1	1.8
1989	1	0.8
1990	1	2.3
1991	1	5.4
1992	1	2.2
1993	1	1.1
1994	1	2.9

Table 4.4.4 Sole in VIId Tuning diagnostics

Extended Survivors Analysis

Sole in VIId (run: FINAL05/005)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/sol_eche/FLEET.005

Catch data for 13 years. 1982 to 1994. Ages 1 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT01: BELGIAN BT (H,	1982,	1994,	2,	9,	.000,	1.000
FLT03: UK. >40FT.BEA,	1982,	1994,	2,	9,	.000,	1.000
FLT05: FR INSHORE OT,	1985,	1994,	2,	9,	.000,	1.000
FLT06: UK BEAM TRAWL,	1988,	1994,	1,	6,	.500,	.750
FLT07: ENGLISH YFS (,	1985,	1994,	1,	1,	.500,	.750
FLT08: FRENCH YFS (C,	1987,	1994,	1,	1,	.500,	.750

Time series weights :

Tapered time weighting applied
Power = 3 over 10 years

Catchability analysis :

Catchability dependent on stock size for ages < 3

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 3

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 4 years or the 4 oldest ages.

S.E. of the mean to which the estimates are shrunk = .800

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00310

Final year F values

Age ,	1,	2,	3,	4,	5,	6,	7,	8,	9
Iteration 29,	.0073,	.1063,	.4446,	.5550,	.3946,	.3908,	.3738,	.3791,	.3895
Iteration 30,	.0073,	.1063,	.4445,	.5547,	.3943,	.3904,	.3733,	.3785,	.3887

Regression weights

, .020,	.116,	.284,	.482,	.670,	.820,	.921,	.976,	.997,	1.000

Fishing mortalities

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
1,	.004,	.002,	.001,	.004,	.011,	.029,	.012,	.004,	.010,	.007
2,	.214,	.117,	.154,	.261,	.176,	.253,	.211,	.151,	.230,	.106
3,	.417,	.486,	.535,	.533,	.705,	.451,	.495,	.380,	.352,	.444
4,	.358,	.445,	.579,	.411,	.712,	.537,	.562,	.433,	.395,	.555
5,	.268,	.311,	.528,	.370,	.736,	.497,	.455,	.509,	.409,	.394
6,	.436,	.302,	.623,	.390,	.482,	.299,	.565,	.388,	.260,	.390
7,	.250,	.435,	.795,	.445,	.474,	.376,	.356,	.386,	.361,	.373
8,	.220,	.415,	.614,	.392,	.412,	.359,	.356,	.299,	.329,	.379
9,	.297,	.401,	.538,	.381,	.443,	.441,	.585,	.414,	.414,	.389

Log catchability residuals.

Fleet : FLT01: BELGIAN BT (H

Age	1982	1983	1984
1	No data for this fleet at this age		
2	99.99	99.99	99.99
3	99.99	99.99	99.99
4	99.99	99.99	99.99
5	99.99	99.99	99.99
6	99.99	99.99	99.99
7	99.99	99.99	99.99
8	99.99	99.99	99.99
9	99.99	99.99	99.99

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	No data for this fleet at this age									
2	.04	-.41	1.07	-1.86	-4.45	1.79	-.91	.28	2.75	-.03
3	-.62	.49	-.44	-.66	-.20	-.11	.71	-.15	.10	.01
4	-.69	.07	.23	-.84	-.49	-.18	.04	.40	-.18	.58
5	-.77	-.33	.33	-.49	.77	-.25	-.15	.14	-.11	.00
6	-.32	-.17	.81	-.32	.18	-.26	.68	-.41	-.74	.55
7	-.02	-.21	.41	-.23	.12	.33	-.16	-.27	.01	.07
8	-.78	-.17	.02	-.94	-.37	-.43	-.24	-.40	-.22	.39
9	-.12	.15	.08	-.45	-.49	.01	-.79	-.23	.44	-.06

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	-5.6321	-5.6135	-5.3725	-5.7117	-5.5054	-5.5054	-5.5054
S.E(Log q)	.3957	.4517	.3557	.5772	.2295	.4561	.4534

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	1.76	-.433	4.91	.07	10	2.48	-7.06

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.23	-.490	4.70	.52	10	.52	-5.63
4	.86	.480	6.10	.73	10	.42	-5.61
5	.98	.084	5.44	.75	10	.39	-5.37
6	.83	.326	6.03	.46	10	.53	-5.71
7	.86	.739	5.73	.87	10	.21	-5.51
8	1.81	-1.228	5.08	.35	10	.64	-5.75
9	-33.78	-2.245	25.21	.00	10	10.52	-5.68

Table 4.4.4 cont.

Fleet : FLT03: UK. >40FT.BEA

Age	1982	1983	1984
1	No data for this fleet at this age		
2	99.99	99.99	99.99
3	99.99	99.99	99.99
4	99.99	99.99	99.99
5	99.99	99.99	99.99
6	99.99	99.99	99.99
7	99.99	99.99	99.99
8	99.99	99.99	99.99
9	99.99	99.99	99.99

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	No data for this fleet at this age									
2	-1.72	-.48	.50	.73	.03	.12	.08	-.26	-.05	-.29
3	.99	.29	-.10	.46	.18	.38	-.12	-.21	-.41	.04
4	.05	.31	.37	.08	.49	.22	.21	-.42	-.17	-.31
5	-.28	.12	.54	.59	-.27	.46	-.97	.54	-.10	-.17
6	.81	.18	-.35	.42	.32	-.14	-.07	-.54	.27	.09
7	-2.62	.69	-.24	.00	.52	.12	-.83	-.10	-.24	.70
8	-3.94	-.94	.74	.54	-.09	.48	-.45	-.51	.20	.02
9	.26	-.45	-.66	.85	.01	.05	.38	.38	.07	.58

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	-6.9462	-6.9170	-7.0947	-7.0025	-7.1495	-7.1495	-7.1495
S.E(Log q)	.3071	.3356	.5630	.3340	.5492	.5117	.4586

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	1.03	-.110	7.69	.78	10	.37	-7.75

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.23	-.655	6.30	.65	10	.40	-6.95
4	1.13	-.465	6.63	.74	10	.41	-6.92
5	.68	1.231	7.50	.77	10	.36	-7.09
6	.60	3.487	7.24	.95	10	.11	-7.00
7	.55	2.131	7.14	.84	10	.23	-7.15
8	.68	.886	6.97	.64	10	.35	-7.16
9	.52	2.280	6.58	.84	10	.14	-6.90

Fleet : FLT05: FR INSHORE OT

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	No data for this fleet at this age									
2	.33	-.07	-.22	.67	.09	-.03	-.19	.04	.12	-.29
3	-.04	-.02	.65	.44	.63	-.60	-.54	.20	.02	-.05
4	-.16	-.26	.30	.06	.42	-.27	-.41	.09	.04	.10
5	-.27	-.45	.09	-.33	.28	-.26	.03	-.04	.29	-.07
6	.36	-.27	.87	.00	.14	-.54	.06	.71	-.52	-.11
7	-.27	.12	1.31	.38	-.09	-.78	-.11	.38	.33	-.47
8	-.12	.45	.78	.26	.23	-.51	-.25	.15	.00	-.07
9	-.26	.26	.87	-.72	.34	-.06	.35	.16	.28	-.15

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	-10.2652	-10.1442	-10.3885	-10.6213	-10.6104	-10.6104	-10.6104
S.E(Log q)	.4527	.2719	.2299	.4866	.5410	.3278	.3880

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	.67	1.576	10.71	.84	10	.29	-11.10

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.10	-.213	10.32	.50	10	.55	-10.27
4	.90	.517	10.04	.87	10	.27	-10.14
5	1.13	-.655	10.65	.86	10	.27	-10.39
6	1.81	-.911	13.06	.23	10	.89	-10.62
7	1.43	-.569	12.09	.29	10	.83	-10.61
8	.98	.052	10.54	.63	10	.36	-10.61
9	3.09	-1.333	19.40	.09	10	1.06	-10.50

Fleet : FLT07: ENGLISH YFS (

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	-.43	-.57	-.13	-.24	-.77	-.46	.92	-.09	.27	.09
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	1.27	-.646	9.12	.57	10	.59	-9.33

Table 4.4.4 cont.

Fleet : FLT06: UK BEAM TRAWL

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	99.99	99.99	99.99	.48	.30	.17	.29	-.68	-.05	-.13
2	99.99	99.99	99.99	1.03	.20	-.59	.06	-.29	.25	-.17
3	99.99	99.99	99.99	.52	.53	-.58	-.40	-.03	.01	.26
4	99.99	99.99	99.99	-.35	-.07	.08	.09	-.56	.53	.08
5	99.99	99.99	99.99	.28	.03	-.19	-.23	-.07	.05	.23
6	99.99	99.99	99.99	-.09	.01	-.23	.03	1.43	.29	-1.49
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6
Mean Log q	-7.6716	-8.1038	-8.0574	-7.4136
S.E(Log q)	.4071	.3707	.1906	.9448

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.60	1.241	9.38	.71	7	.44	-8.88
2	.94	.176	7.57	.66	7	.51	-7.41

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.10	-.226	7.46	.55	7	.50	-7.67
4	.74	1.503	8.36	.90	7	.25	-8.10
5	.84	1.635	8.10	.96	7	.14	-8.06
6	7.76	-.882	6.27	.00	7	7.51	-7.41

Fleet : FLT08: FRENCH YFS (C

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	99.99	99.99	.08	-.40	.11	-.30	-.09	-.22	-.04	.68
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.56	1.519	11.18	.74	8	.41	-12.04

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: BELGIAN BT (H,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: UK. >40FT.BEA,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: FR INSHORE OT,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: UK BEAM TRAWL,	27930.,	.476,	.000,	.00,	1,	.298,	.008
FLT07: ENGLISH YFS (,	34698.,	.656,	.000,	.00,	1,	.157,	.007
FLT08: FRENCH YFS (C,	62818.,	.512,	.000,	.00,	1,	.258,	.004
P shrinkage mean ,	19808.,	.62,,,,				.180,	.012
F shrinkage mean ,	16659.,	.80,,,,				.106,	.014

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
31704.,	.26,	.25,	5,	.973,	.007

Age 2 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: BELGIAN BT (H,	6085.,	2.703,	.000,	.00,	1,	.005,	.109
FLT03: UK. >40FT.BEA,	4694.,	.487,	.000,	.00,	1,	.148,	.139
FLT05: FR INSHORE OT,	4687.,	.396,	.000,	.00,	1,	.224,	.140
FLT06: UK BEAM TRAWL,	5641.,	.423,	.060,	.14,	2,	.195,	.117
FLT07: ENGLISH YFS (,	8225.,	.683,	.000,	.00,	1,	.074,	.082
FLT08: FRENCH YFS (C,	6032.,	.512,	.000,	.00,	1,	.132,	.110
P shrinkage mean ,	16696.,	.49,,,,				.161,	.041
F shrinkage mean ,	2976.,	.80,,,,				.061,	.212

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
6260.,	.19,	.18,	9,	.932,	.106

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: BELGIAN BT (H,	11685.,	.422,	.340,	.80,	2,	.111,	.428
FLT03: UK. >40FT.BEA,	11263.,	.257,	.045,	.18,	2,	.280,	.441
FLT05: FR INSHORE OT,	11842.,	.274,	.085,	.31,	2,	.230,	.423
FLT06: UK BEAM TRAWL,	10939.,	.288,	.302,	1.05,	3,	.214,	.451
FLT07: ENGLISH YFS (,	10191.,	.647,	.000,	.00,	1,	.037,	.477
FLT08: FRENCH YFS (C,	8899.,	.443,	.000,	.00,	1,	.080,	.531
F shrinkage mean ,	11917.,	.80,,,,				.048,	.421

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
11145.,	.14,	.07,	12,	.543,	.444

Table 4.4.4 cont.

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: BELGIAN BT (H,	11152.,	.324,	.166,	.51,	3,	.124,	.420
FLT03: UK. >40FT.BEA,	5620.,	.213,	.041,	.19,	3,	.270,	.711
FLT05: FR INSHORE OT,	8455.,	.208,	.024,	.11,	3,	.295,	.524
FLT06: UK BEAM TRAWL,	8205.,	.240,	.092,	.39,	4,	.212,	.536
FLT07: ENGLISH YFS (,	19643.,	.786,	.000,	.00,	1,	.015,	.260
FLT08: FRENCH YFS (C,	7146.,	.461,	.000,	.00,	1,	.043,	.596
F shrinkage mean ,	9367.,	.80,,,,				.041,	.483

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7861.,	.11,	.07,	16,	.622,	.555

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: BELGIAN BT (H,	6363.,	.258,	.055,	.21,	4,	.165,	.420
FLT03: UK. >40FT.BEA,	5916.,	.215,	.053,	.25,	4,	.187,	.446
FLT05: FR INSHORE OT,	6685.,	.181,	.058,	.32,	4,	.320,	.403
FLT06: UK BEAM TRAWL,	8845.,	.202,	.085,	.42,	5,	.267,	.319
FLT07: ENGLISH YFS (,	4338.,	.709,	.000,	.00,	1,	.010,	.568
FLT08: FRENCH YFS (C,	5113.,	.493,	.000,	.00,	1,	.020,	.500
F shrinkage mean ,	5546.,	.80,,,,				.031,	.469

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6876.,	.10,	.05,	20,	.458,	.394

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: BELGIAN BT (H,	1575.,	.253,	.171,	.68,	5,	.168,	.315
FLT03: UK. >40FT.BEA,	1146.,	.208,	.099,	.48,	5,	.263,	.411
FLT05: FR INSHORE OT,	1331.,	.182,	.109,	.60,	5,	.300,	.363
FLT06: UK BEAM TRAWL,	962.,	.207,	.199,	.96,	6,	.217,	.473
FLT07: ENGLISH YFS (,	565.,	.901,	.000,	.00,	1,	.004,	.708
FLT08: FRENCH YFS (C,	1354.,	.542,	.000,	.00,	1,	.011,	.358
F shrinkage mean ,	1263.,	.80,,,,				.038,	.379

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1220.,	.10,	.07,	24,	.685,	.390

Table 4.4.4 cont.

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: BELGIAN BT (H,	1265.,	.212,	.124,	.59,	6,	.310,	.378
FLT03: UK. >40FT.BEA,	1873.,	.216,	.087,	.40,	6,	.237,	.271
FLT05: FR INSHORE OT,	959.,	.193,	.103,	.53,	6,	.258,	.475
FLT06: UK BEAM TRAWL,	1253.,	.218,	.097,	.44,	6,	.147,	.382
FLT07: ENGLISH YFS (,	1009.,	.922,	.000,	.00,	1,	.003,	.455
FLT08: FRENCH YFS (C,	866.,	.639,	.000,	.00,	1,	.006,	.514
F shrinkage mean ,	1297.,	.80,,,,				.039,	.371

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1288.,	.11,	.07,	27,	.610,	.373

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: BELGIAN BT (H,	242.,	.207,	.096,	.46,	7,	.308,	.364
FLT03: UK. >40FT.BEA,	185.,	.229,	.146,	.64,	7,	.222,	.455
FLT05: FR INSHORE OT,	251.,	.200,	.115,	.58,	7,	.330,	.354
FLT06: UK BEAM TRAWL,	245.,	.239,	.255,	1.07,	5,	.093,	.361
FLT07: ENGLISH YFS (,	204.,	1.310,	.000,	.00,	1,	.001,	.421
FLT08: FRENCH YFS (C,	250.,	.881,	.000,	.00,	1,	.002,	.355
F shrinkage mean ,	266.,	.80,,,,				.044,	.337

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
232.,	.11,	.06,	29,	.559,	.379

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: BELGIAN BT (H,	262.,	.211,	.081,	.38,	8,	.313,	.443
FLT03: UK. >40FT.BEA,	410.,	.245,	.107,	.44,	8,	.236,	.306
FLT05: FR INSHORE OT,	300.,	.206,	.071,	.34,	8,	.351,	.397
FLT06: UK BEAM TRAWL,	276.,	.268,	.096,	.36,	4,	.049,	.426
FLT07: ENGLISH YFS (,	175.,	1.921,	.000,	.00,	1,	.000,	.608
FLT08: FRENCH YFS (C,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	312.,	.80,,,,				.050,	.385

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
309.,	.12,	.05,	30,	.419,	.389

Table 4.4.5 Sole in VIId

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 92-94
AGE														
1,	.0126,	.0000,	.0011,	.0039,	.0019,	.0008,	.0037,	.0106,	.0292,	.0119,	.0038,	.0105,	.0073,	.0072,
2,	.1852,	.0804,	.1107,	.2144,	.1168,	.1536,	.2607,	.1760,	.2528,	.2113,	.1513,	.2302,	.1063,	.1626,
3,	.3233,	.3504,	.4201,	.4172,	.4858,	.5351,	.5328,	.7052,	.4512,	.4947,	.3796,	.3525,	.4445,	.3922,
4,	.4837,	.3789,	.4319,	.3579,	.4453,	.5786,	.4106,	.7120,	.5371,	.5621,	.4330,	.3950,	.5547,	.4609,
5,	.2091,	.4417,	.2826,	.2677,	.3110,	.5282,	.3695,	.7360,	.4974,	.4552,	.5089,	.4089,	.3943,	.4374,
6,	.2953,	.4026,	.7086,	.4359,	.3024,	.6231,	.3902,	.4816,	.2990,	.5655,	.3876,	.2601,	.3904,	.3461,
7,	.5095,	.4534,	.4165,	.2499,	.4352,	.7949,	.4451,	.4737,	.3758,	.3563,	.3857,	.3614,	.3733,	.3735,
8,	.5644,	.5895,	.3865,	.2199,	.4155,	.6145,	.3916,	.4120,	.3587,	.3565,	.2993,	.3292,	.3785,	.3357,
9,	.3958,	.4735,	.4502,	.2965,	.4010,	.5379,	.3815,	.4428,	.4411,	.5846,	.4138,	.4137,	.3887,	.4054,
+gp,	.3958,	.4735,	.4502,	.2965,	.4010,	.5379,	.3815,	.4428,	.4411,	.5846,	.4138,	.4137,	.3887,	
FBAR 3- 8,	.3976,	.4361,	.4410,	.3248,	.3992,	.6124,	.4233,	.5868,	.4199,	.4650,	.3990,	.3512,	.4226,	

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	GMST 82-92	AMST 82-92
AGE																
1,	12970,	21912,	22257,	13379,	26850,	11286,	26770,	16254,	46367,	34175,	29638,	8592,	35285,	0,	21783,	23805,
2,	16326,	11588,	19826,	20116,	12059,	24248,	10203,	24132,	14552,	40746,	30558,	26716,	7693,	31704,	18711,	20396,
3,	20002,	12276,	9675,	16059,	14689,	9709,	18817,	7114,	18312,	10226,	29847,	23767,	19204,	6260,	14007,	15157,
4,	4734,	13099,	7824,	5751,	9574,	8176,	5145,	9994,	3180,	10552,	5642,	18477,	15117,	11145,	7046,	7606,
5,	3176,	2641,	8114,	4597,	3638,	5550,	4148,	3087,	4437,	1682,	5443,	3311,	11264,	7861,	3912,	4228,
6,	2685,	2331,	1537,	5534,	3182,	2412,	2961,	2594,	1338,	2441,	965,	2960,	1990,	6876,	2308,	2544,
7,	1446,	1808,	1410,	684,	3238,	2128,	1171,	1814,	1450,	898,	1255,	593,	2065,	1220,	1452,	1573,
8,	585,	786,	1040,	841,	482,	1896,	870,	679,	1022,	901,	569,	772,	374,	1288,	821,	879,
9,	392,	301,	394,	639,	611,	288,	928,	532,	407,	646,	571,	382,	503,	232,	490,	519,
+gp,	913,	783,	973,	805,	1893,	1589,	1215,	1753,	2040,	1158,	1035,	655,	1210,	1051,		
TOTAL,	63229,	67524,	73050,	68406,	76217,	67283,	72228,	67952,	93105,	103424,	105522,	86226,	94704,	67638,		

Table 4.4.6 Sole in VIId RCT3 Input

Year class	VPA 1 gp	enyfs0	enfys1	frbds0	frbds1	enbts1
1981	12970	2.6	1.27	2	0.03	-11
1982	21912	3.31	2.04	0.46	0.02	-11
1983	22257	13.86	3.76	0.38	-11	-11
1984	13379	2.2	0.9	-11	-11	-11
1985	26850	4.97	1.41	-11	-11	-11
1986	11286	4.2	0.96	-11	0.04	-11
1987	26770	8.23	1.8	0.36	0.08	8.2
1988	16254	2.9	0.82	0.02	0.08	2.6
1989	46367	5.3	2.29	7.7	0.25	12.1
1990	34175	4.47	5.4	0.25	0.21	8.9
1991	29638	1.6	2.2	0.46	0.13	1.4
1992	-11	2.7	0.91	0.21	0.02	0.5
1993	-11	8.8	2.87	0.12	0.89	4.8
1994	-11	4.63	-11	5.35	-11	5.2

Table 4.4.7 Recruitment analysis Age1

Analysis by RCT3 ver3.1 of data from file :
s7drec94.dat

7d Sole (1 year olds)
Data for 5 surveys over 14 years : 1981 - 1994

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
enyfs0	3.44	4.35	1.73	.071	11	1.31	8.84	2.077	.016
enyfs1	1.67	8.26	.52	.456	11	.65	9.34	.646	.168
frbds0	1.16	9.44	.82	.224	8	.19	9.66	1.051	.063
frbds1	7.67	9.26	.33	.727	8	.02	9.41	.448	.350
enbts1	.85	8.70	.57	.380	5	.41	9.05	1.084	.060
					VPA Mean =		10.01	.452	.343

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
enyfs0	3.57	4.15	1.80	.067	11	2.28	12.29	2.307	.018
enyfs1	1.66	8.27	.53	.458	11	1.35	10.51	.640	.228
frbds0	1.09	9.49	.77	.248	8	.11	9.62	1.005	.093
frbds1	7.65	9.25	.33	.732	8	.64	14.12	1.176	.068
enbts1	.85	8.71	.57	.380	5	1.76	10.20	.812	.142
					VPA Mean =		10.02	.455	.453

Yearclass = 1994

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
enyfs0	3.73	3.89	1.89	.063	11	1.73	10.34	2.260	.027
enyfs1									
frbds0	1.01	9.56	.71	.277	8	1.85	11.42	1.097	.114
frbds1									
enbts1	.85	8.71	.57	.378	5	1.82	10.26	.823	.203
					VPA Mean =		10.03	.458	.656

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	14605	9.59	.26	.15	.31		
1993	34182	10.44	.31	.48	2.41		
1994	28178	10.25	.37	.25	.46		

Table 4.4.8 Sole in VIId. VPA Summary table

Terminal F's derived using XSA (with F shrinkage)

Year	Recruits Age 1 thousands	TotBiomass tonnes	SSB tonnes	Yield tonnes	Yield/SSB	FBAR 3-8
1982	12970	9716	7166	3190	0.45	0.398
1983	21912	12083	9013	3458	0.38	0.436
1984	22257	12568	8527	3575	0.42	0.441
1985	13379	13160	9703	3837	0.40	0.325
1986	26850	14064	10529	4024	0.38	0.399
1987	11286	13809	9625	4974	0.52	0.612
1988	26770	13189	9806	3982	0.41	0.423
1989	16254	11412	7575	4187	0.55	0.587
1990	46367	13672	8488	4060	0.48	0.420
1991	34175	14043	7107	4382	0.62	0.465
1992	29638	16297	9770	4142	0.42	0.399
1993	8592	14166	11263	4511	0.40	0.351
1994	35285	14765	11458	4641	0.41	0.423
1995	28178 (1)					

Arith. mean (1982-92)	23805
Geom. mean (1982-92)	21783

(1) Adjusted by recruitment surveys

Table 4.4.9 Sole in VIId

Sole in the Eastern English Channel (Fishing Area VIId)

Prediction with management option table: Input data

Year: 1995								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	28178.000	0.1000	0.0000	0.0000	0.0000	0.073	0.0080	0.111
2	31704.000	0.1000	0.0000	0.0000	0.0000	0.112	0.1760	0.153
3	6260.000	0.1000	1.0000	0.0000	0.0000	0.168	0.4240	0.196
4	11145.000	0.1000	1.0000	0.0000	0.0000	0.221	0.4980	0.249
5	7861.000	0.1000	1.0000	0.0000	0.0000	0.271	0.4730	0.304
6	6876.000	0.1000	1.0000	0.0000	0.0000	0.319	0.3740	0.376
7	1220.000	0.1000	1.0000	0.0000	0.0000	0.363	0.4040	0.431
8	1288.000	0.1000	1.0000	0.0000	0.0000	0.405	0.3630	0.500
9	232.000	0.1000	1.0000	0.0000	0.0000	0.443	0.4380	0.481
10+	1051.000	0.1000	1.0000	0.0000	0.0000	0.539	0.4380	0.597
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1996								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	21800.000	0.1000	0.0000	0.0000	0.0000	0.073	0.0080	0.111
2	.	0.1000	0.0000	0.0000	0.0000	0.112	0.1760	0.153
3	.	0.1000	1.0000	0.0000	0.0000	0.168	0.4240	0.196
4	.	0.1000	1.0000	0.0000	0.0000	0.221	0.4980	0.249
5	.	0.1000	1.0000	0.0000	0.0000	0.271	0.4730	0.304
6	.	0.1000	1.0000	0.0000	0.0000	0.319	0.3740	0.376
7	.	0.1000	1.0000	0.0000	0.0000	0.363	0.4040	0.431
8	.	0.1000	1.0000	0.0000	0.0000	0.405	0.3630	0.500
9	.	0.1000	1.0000	0.0000	0.0000	0.443	0.4380	0.481
10+	.	0.1000	1.0000	0.0000	0.0000	0.539	0.4380	0.597
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	21800.000	0.1000	0.0000	0.0000	0.0000	0.073	0.0080	0.111
2	.	0.1000	0.0000	0.0000	0.0000	0.112	0.1760	0.153
3	.	0.1000	1.0000	0.0000	0.0000	0.168	0.4240	0.196
4	.	0.1000	1.0000	0.0000	0.0000	0.221	0.4980	0.249
5	.	0.1000	1.0000	0.0000	0.0000	0.271	0.4730	0.304
6	.	0.1000	1.0000	0.0000	0.0000	0.319	0.3740	0.376
7	.	0.1000	1.0000	0.0000	0.0000	0.363	0.4040	0.431
8	.	0.1000	1.0000	0.0000	0.0000	0.405	0.3630	0.500
9	.	0.1000	1.0000	0.0000	0.0000	0.443	0.4380	0.481
10+	.	0.1000	1.0000	0.0000	0.0000	0.539	0.4380	0.597
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : S7DPRED
Date and time: 04OCT95:14:08

Table 4.4.10 Sole in VIId

Sole in the Eastern English Channel (Fishing Area VIId)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	3752.522	8.603	3577.878	8.603	3577.878
0.1000	0.0423	0.259	106.097	7.923	2458.773	6.019	2284.210	6.019	2284.210
0.2000	0.0845	0.398	149.365	6.534	1795.804	4.631	1621.323	4.631	1621.323
0.3000	0.1268	0.485	168.425	5.666	1401.328	3.763	1226.928	3.763	1226.928
0.4000	0.1691	0.545	176.614	5.071	1144.401	3.169	970.082	3.169	970.082
0.5000	0.2113	0.589	179.516	4.637	966.473	2.736	792.235	2.736	792.235
0.6000	0.2536	0.622	179.748	4.308	837.596	2.407	663.440	2.407	663.440
0.7000	0.2959	0.648	178.631	4.049	740.958	2.149	566.882	2.149	566.882
0.8000	0.3381	0.669	176.857	3.840	666.452	1.941	492.457	1.941	492.457
0.9000	0.3804	0.687	174.802	3.669	607.672	1.770	433.758	1.770	433.758
1.0000	0.4227	0.701	172.669	3.525	560.388	1.627	386.555	1.627	386.555
1.1000	0.4649	0.714	170.569	3.403	521.709	1.506	347.957	1.506	347.957
1.2000	0.5072	0.724	168.560	3.298	489.602	1.402	315.929	1.402	315.929
1.3000	0.5495	0.734	166.667	3.206	462.601	1.311	289.009	1.311	289.009
1.4000	0.5917	0.742	164.901	3.126	439.630	1.232	266.119	1.232	266.119
1.5000	0.6340	0.749	163.263	3.055	419.885	1.161	246.454	1.161	246.454
1.6000	0.6763	0.756	161.746	2.992	402.751	1.099	229.400	1.099	229.400
1.7000	0.7185	0.762	160.345	2.935	387.756	1.043	214.485	1.043	214.485
1.8000	0.7608	0.767	159.050	2.884	374.530	0.992	201.340	0.992	201.340
1.9000	0.8031	0.772	157.852	2.837	362.782	0.946	189.672	0.946	189.672
2.0000	0.8453	0.776	156.742	2.795	352.278	0.904	179.248	0.904	179.248
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : S7DYPR
Date and time : 04OCT95:14:28
Computation of ref. F: Simple mean, age 3 - 8
F-0.1 factor : 0.2623
F-max factor : 0.5602
F-0.1 reference F : 0.1109
F-max reference F : 0.2368
Recruitment : Single recruit

Table 4.4.11 Sole in VIId

Sole in the Eastern English Channel (Fishing Area VIId)

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4227	15096	9478	4452	0.0000	0.0000	14986	10554	0	19228	15421
.	.	.	.	.	0.1000	0.0423	.	10554	551	18675	14869
.	.	.	.	.	0.2000	0.0845	.	10554	1082	18143	14339
.	.	.	.	.	0.3000	0.1268	.	10554	1592	17632	13830
.	.	.	.	.	0.4000	0.1691	.	10554	2082	17141	13340
.	.	.	.	.	0.5000	0.2113	.	10554	2554	16668	12870
.	.	.	.	.	0.6000	0.2536	.	10554	3008	16214	12418
.	.	.	.	.	0.7000	0.2959	.	10554	3444	15778	11983
.	.	.	.	.	0.8000	0.3381	.	10554	3865	15358	11565
.	.	.	.	.	0.9000	0.3804	.	10554	4269	14955	11163
.	.	.	.	.	1.0000	0.4227	.	10554	4658	14567	10777
.	.	.	.	.	1.1000	0.4649	.	10554	5033	14193	10406
.	.	.	.	.	1.2000	0.5072	.	10554	5393	13834	10048
.	.	.	.	.	1.3000	0.5495	.	10554	5740	13489	9705
.	.	.	.	.	1.4000	0.5917	.	10554	6075	13157	9374
.	.	.	.	.	1.5000	0.6340	.	10554	6396	12837	9056
.	.	.	.	.	1.6000	0.6763	.	10554	6706	12529	8750
.	.	.	.	.	1.7000	0.7185	.	10554	7005	12233	8456
.	.	.	.	.	1.8000	0.7608	.	10554	7292	11948	817[illegible]
.	.	.	.	.	1.9000	0.8031	.	10554	7569	11674	7900
.	.	.	.	.	2.0000	0.8453	.	10554	7836	11410	7638
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : S7DPRED
Date and time : 04OCT95:14:08
Computation of ref. F: Simple mean, age 3 - 8
Basis for 1995 : F factors

Table 4.4.12 Sole in VIId

Sole in the Eastern English Channel (Fishing Area VIId)

Single option prediction: Detailed tables

Year: 1995	F-factor: 1.0000		Reference F: 0.4227			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0080	214	24	28178	2057	0	0	0	0
2	0.1760	4876	748	31704	3561	0	0	0	0
3	0.4240	2066	404	6260	1052	6260	1052	6260	1052
4	0.4980	4177	1042	11145	2467	11145	2467	11145	2467
5	0.4730	2830	860	7861	2133	7861	2133	7861	2133
6	0.3740	2048	769	6876	2193	6876	2193	6876	2193
7	0.4040	387	167	1220	443	1220	443	1220	443
8	0.3630	374	187	1288	521	1288	521	1288	521
9	0.4380	79	38	232	103	232	103	232	103
10+	0.4380	356	213	1051	566	1051	566	1051	566
Total		17407	4452	95815	15096	35933	9478	35933	9478
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1996	F-factor: 1.0000		Reference F: 0.4227			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0080	165	18	21800	1591	0	0	0	0
2	0.1760	3890	596	25293	2841	0	0	0	0
3	0.4240	7939	1553	24057	4042	24057	4042	24057	4042
4	0.4980	1389	346	3707	820	3707	820	3707	820
5	0.4730	2207	671	6129	1663	6129	1663	6129	1663
6	0.3740	1320	496	4432	1414	4432	1414	4432	1414
7	0.4040	1358	586	4280	1554	4280	1554	4280	1554
8	0.3630	214	107	737	298	737	298	737	298
9	0.4380	275	132	811	359	811	359	811	359
10+	0.4380	254	152	749	404	749	404	749	404
Total		19012	4658	91996	14986	44902	10554	44902	10554
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1997	F-factor: 1.0000		Reference F: 0.4227			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0080	165	18	21800	1591	0	0	0	0
2	0.1760	3010	461	19568	2198	0	0	0	0
3	0.4240	6334	1239	19193	3224	19193	3224	19193	3224
4	0.4980	5340	1331	14246	3153	14246	3153	14246	3153
5	0.4730	734	223	2038	553	2038	553	2038	553
6	0.3740	1029	387	3456	1102	3456	1102	3456	1102
7	0.4040	876	378	2759	1002	2759	1002	2759	1002
8	0.3630	751	376	2586	1046	2586	1046	2586	1046
9	0.4380	157	76	464	205	464	205	464	205
10+	0.4380	309	184	911	491	911	491	911	491
Total		18704	4673	87020	14567	45652	10777	45652	10777
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : S7DSOPRD
Date and time : 04OCT95:14:25
Computation of ref. F: Simple mean, age 3 - 8
Prediction basis : F factors

Table 4.4.13 SOLE E Channel
Input data for catch forecast and linear sensitivity analysis.

Populations in 1995			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	28177	.44	WS1	.07	.13	M1	.10	.10	MT1	.00	.00
N2	31704	.20	WS2	.11	.21	M2	.10	.10	MT2	.00	.10
N3	6259	.20	WS3	.17	.05	M3	.10	.10	MT3	1.00	.10
N4	11143	.20	WS4	.22	.04	M4	.10	.10	MT4	1.00	.00
N5	7861	.20	WS5	.27	.07	M5	.10	.10	MT5	1.00	.00
N6	6876	.20	WS6	.32	.09	M6	.10	.10	MT6	1.00	.00
N7	1218	.20	WS7	.36	.10	M7	.10	.10	MT7	1.00	.00
N8	1287	.20	WS8	.41	.11	M8	.10	.10	MT8	1.00	.00
N9	230	.20	WS9	.44	.11	M9	.10	.10	MT9	1.00	.00
N10	1050	.20	WS10	.48	.10	M10	.10	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.01	.54	WH1	.11	.28
sH2	.18	.48	WH2	.15	.04
sH3	.42	.05	WH3	.20	.04
sH4	.50	.10	WH4	.25	.06
sH5	.47	.16	WH5	.30	.08
sH6	.37	.14	WH6	.38	.06
sH7	.40	.08	WH7	.43	.19
sH8	.36	.11	WH8	.50	.09
sH9	.44	.12	WH9	.48	.07
sH10	.44	.12	WH10	.60	.12

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K95	1.00	.10	HF95	1.00	.09
K96	1.00	.10	HF96	1.00	.09
K97	1.00	.10	HF97	1.00	.09

Recruitment		
Labl	Value	CV
R96	21782	.44
R97	21782	.44

Stock numbers in 1995 are VPA survivors.
These are overwritten at Age 1

Table 4.4.14a Stock: Sole in Division VIId (Eastern English Channel)

Assessment Quality Control Diagram 1

Average F(3-8,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	0.560	0.424						
1990	0.576	0.400	0.471					
1991	0.643	0.479	0.725	0.625				
1992	0.565	0.401	0.572	0.425	0.553			
1993	0.634	0.455	0.634	0.466	0.560	0.559		
1994	0.621	0.436	0.610	0.448	0.519	0.477	0.463	
1995	0.612	0.423	0.587	0.420	0.465	0.399	0.351	0.423

Remarks: XSA first banned with commercial and survey fleets.

Assessment Quality Control Diagram 2

Recruitment (age 1) Unit: thousands								
Date of assessment	Year class							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	(14000)	(20000)						
1990	(14600)	(21000)	(17400)					
1991	(14245)	(17864)	16873	16873				
1992	13122	(19682)	(20357)	18206[1]	18206[1]			
1993	13838	36371	26318	12228	19800[1]	19800[1]		
1994	15291	41773	26851	28132	(12000)	(21000)		
1995	1654	46367	34175	29638	8592	35285	(281780	21800[1]

[1]Geometric Mean 1982-1992.

Remarks: Figures in brackets are estimated from recruit surveys.

Table 4.4.14b Stock: Sole in Division VIId (Eastern English Channel)

b) **Assessment Quality Control Diagram 3**

Spawning stock biomass (tonnes)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989	9539	8774	8968[1]	8409[1]						
1990	9111	8214	7944	7187[1]	7455[1]					
1991	7859	6645	6669	5258	5124[1]	4919[1]				
1992	8839	7767	8613	6460	6356	6093[1]	5666[1]			
1993	9624	7047	7903	6209	7093	7774	5981[1]	5654[1]		
1994	9700	7370	8052	6522	8085	9561	9200	7500[1]	7400[1]	
1995	9806	7575	8488	7107	9770	11263	11458	9478	10554[1]	10800[1]

[1]Forecast at SQF.

Remarks: Corrected for SOP in 1995..

Table 4.4.15 Sole in VIId beam trawl survey recruit indices

Sole in division VIId. English beam trawl survey numbers per hr raised to 8m beam trawl equivalent (mean no/rectangle, averaged across rectangles).

	AGE-GROUP											
YEAR	1	2	3	4	5	6	7	8	9	10+	1+	3+
1988	8.2	14.2	9.9	0.8	1.3	0.6	0.1	0.1	0.2	0.2	35.7	13.2
1989	2.6	15.4	3.4	1.7	0.6	0.2	0.2	0.0	0.0	0.7	25.1	6.8
1990	12.1	3.7	3.4	0.7	0.8	0.2	0.1	0.2	0.0	0.0	21.4	5.4
1991	8.9	22.8	2.2	2.3	0.3	0.5	0.1	0.2	0.1	0.1	37.6	5.8
1992	1.4	12.0	10.0	0.7	1.1	0.3	0.5	0.1	0.2	0.6	27.1	13.7
1993	0.5	17.5	8.4	7.0	0.8	1.0	0.3	0.2	0.0	0.4	36.1	18.2
1994	4.75	3.17	8.33	3.34	3.34	0.20	0.57	0.08	0.29	0.29	24.40	16.48
1995	5.17	16.90	2.06	3.80	2.22	2.43	0.20	0.32	0.15	0.21	33.40	11.40
mean	5.4	13.2	6.0	2.5	1.3	0.7	0.3	0.2	0.1	0.3	30.1	11.4

E:\ACFM\WGNSSK96\SOL_ECHE\TAB4415.XLS 02/11/95 15:46

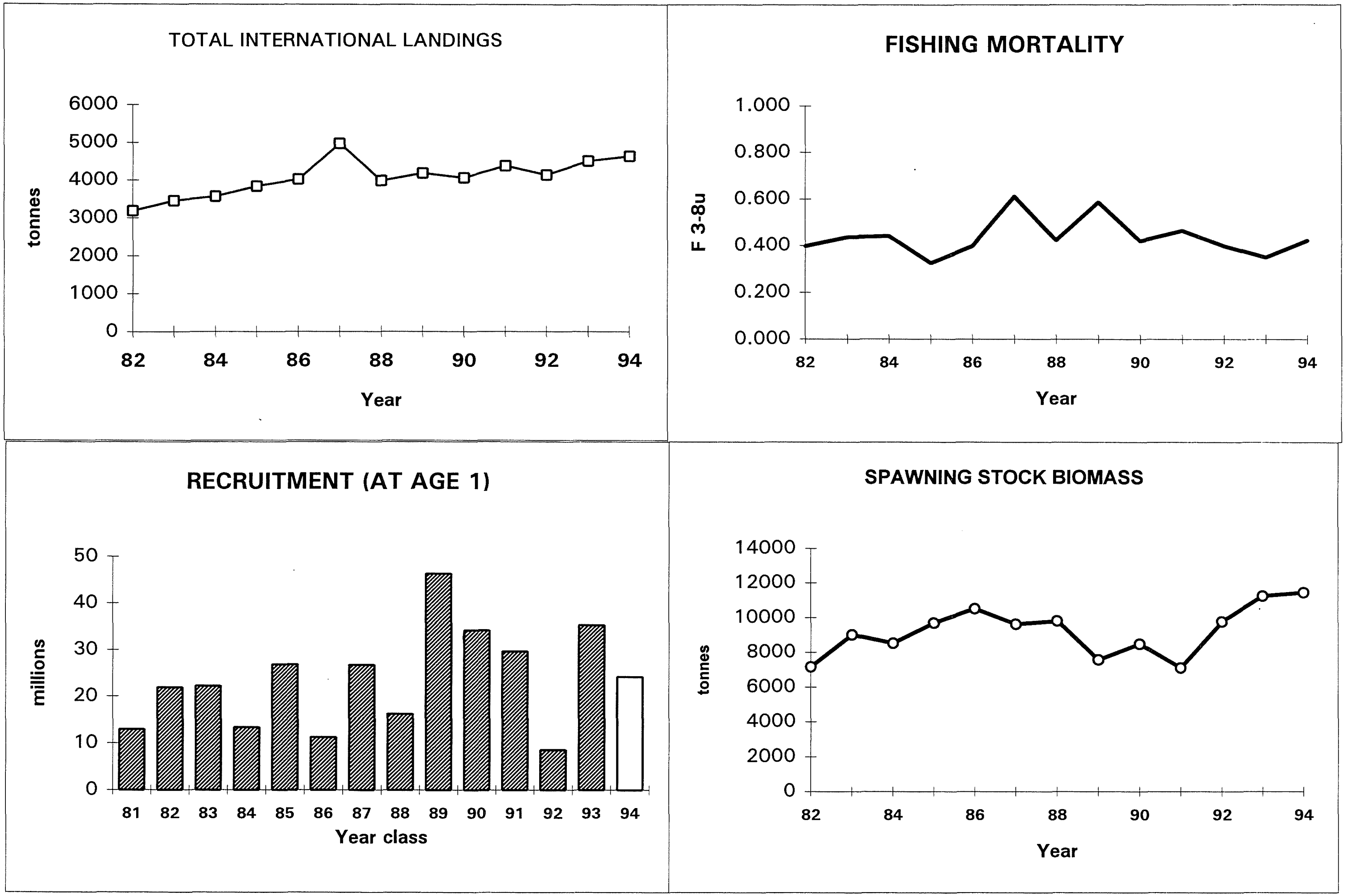
Table 4.4.16 Sole in VIId effort data

	Belgium	UK vessels < 12 m	UK vessels > 12 m		France	
Year	Beam trawl	UK FIX TRAM E	Beam trawl	Otter trawl	Offshore trawl	Inshore trawl
	('000 hr) HP corr	(days at sea)	('000 hr)	('000 hr)	(h*kw*10-4)	(h*kw*10-4)
1975	5.02					
1976	6.56					
1977	6.87					
1978	8.22					
1979	7.30					
1980	12.81		6.8	96.7		
1981	19.00		6.7	96.7		
1982	23.94		16.0	110.4		
1983	23.64		12.6	143.1	1816.7	
1984	28.00		21.8	139.8	2801.3	
1985	25.29	6190	21.5	163.2	6771.5	228.8
1986	23.54	5863	25.8	68.8	8067.3	411.2
1987	27.11	7215	37.8	128.0	6036.7	573.2
1988	38.52	6943	29.0	213.6	6065.9	942.1
1989	35.67	8378	41.4	187.2	5815.4	1039.0
1990	30.33	13540	40.8	316.6	7485.7	909.1
1991	24.29	12169	53.1	205.2	9540.3	967.0
1992	21.99	8496	53.7	168.7	9261.4	505.2
1993	20.02	9043	50.1	182.5	8979.5	442.5
1994	22.17	10797	48.4	138.7	9375.64	643.04

Sole in VIId catch per unit effort data

	Belgium	UK vessels inshore	UK vessels > 12 m		France	
Year	HP corr	UK FIX TRAM E	Beam trawl	Otter trawl	Offshore trawl	Inshore trawl
	(kg/10hr)	(kg/day)	(kg/hr) GRT corr	(kg/hr) GRT corr	(kg/h*kw*10-4)	(kg/h*kw*10-4)
1972			15.2	4.8		
1973			12.1	2.1		
1974			11.6	3.3		
1975	24.1		11.5	2.6		
1976	27.3		10.5	3.7		
1977	30.0		11.0	3.2		
1978	26.3		9.1	2.2		
1979	37.4		8.3	2.1		
1980	23.3		15.2	1.1		
1981	24.5		13.7	1.0		
1982	23.6		11.2	1.6		
1983	22.4		21.4	1.9	25.5	
1984	21.6		13.3	2.1	22.5	
1985	22.9	34.1	12.8	1.7	37.9	345.3
1986	33.5	38.9	10.9	4.1	23.3	290.0
1987	36.6	31.5	11.0	3.2	28.6	478.5
1988	15.9	33.8	11.3	1.5	15.4	362.8
1989	16.8	28.2	10.6	2.4	16.5	332.0
1990	25.9	20.2	11.9	1.5	12.5	173.2
1991	22.6	31.8	8.1	2.1	16.4	250.5
1992	29.1	30.2	8.0	2.5	12.5	444.4
1993	34.8	18.8	8.4	2.3	21.0	544.6
1994	31.7	21.1	9.2	3.2	13.1	314.0

Figure 4.4.1 Sole in Division VIId Fish stock summary



E:\ACFM\WGNSSK96\SOL_ECHE\FIG441.XLS 3/11/95 9:28

Figure 4.4.2 Sole in VIId Retrospective analysis

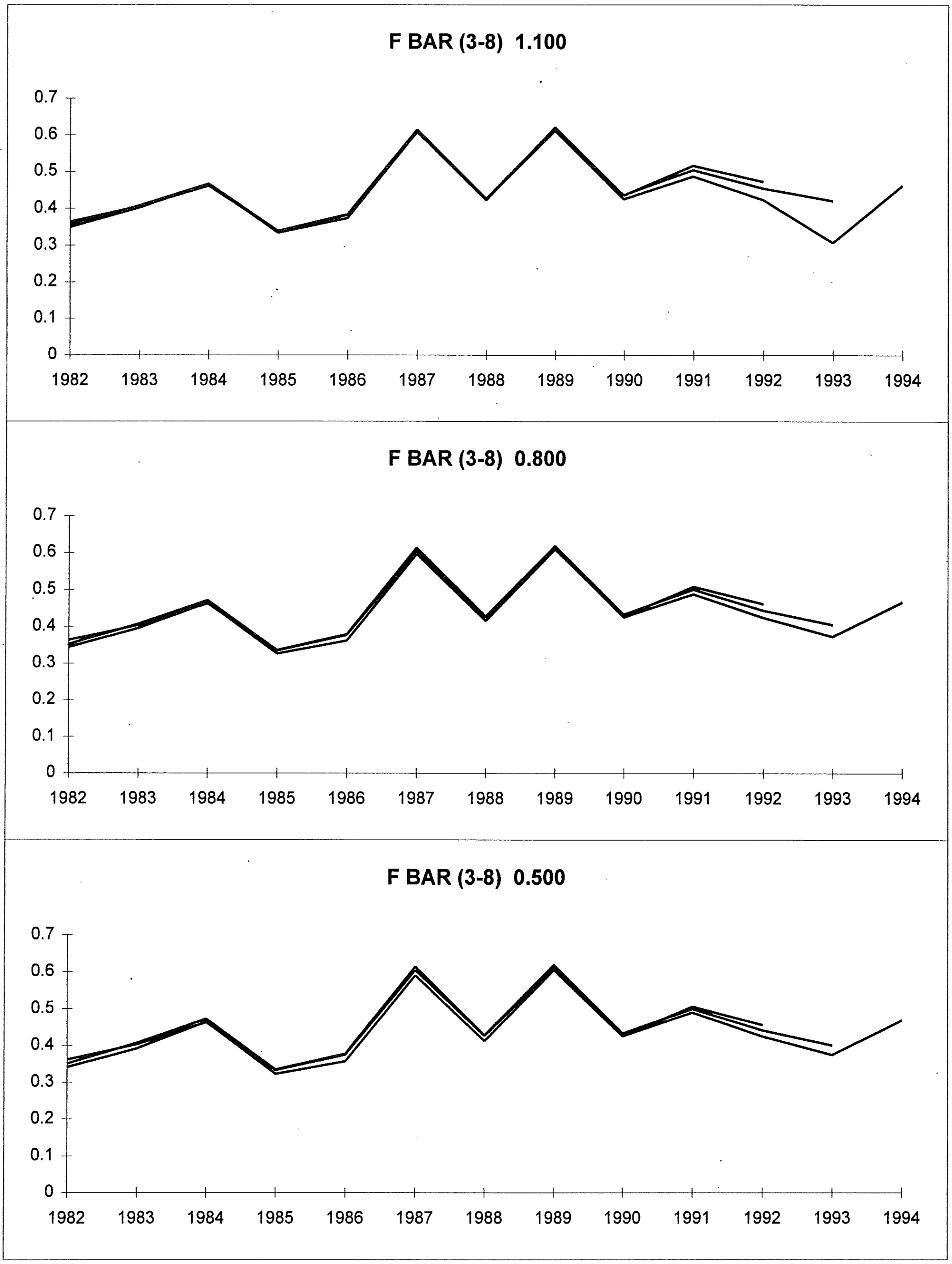
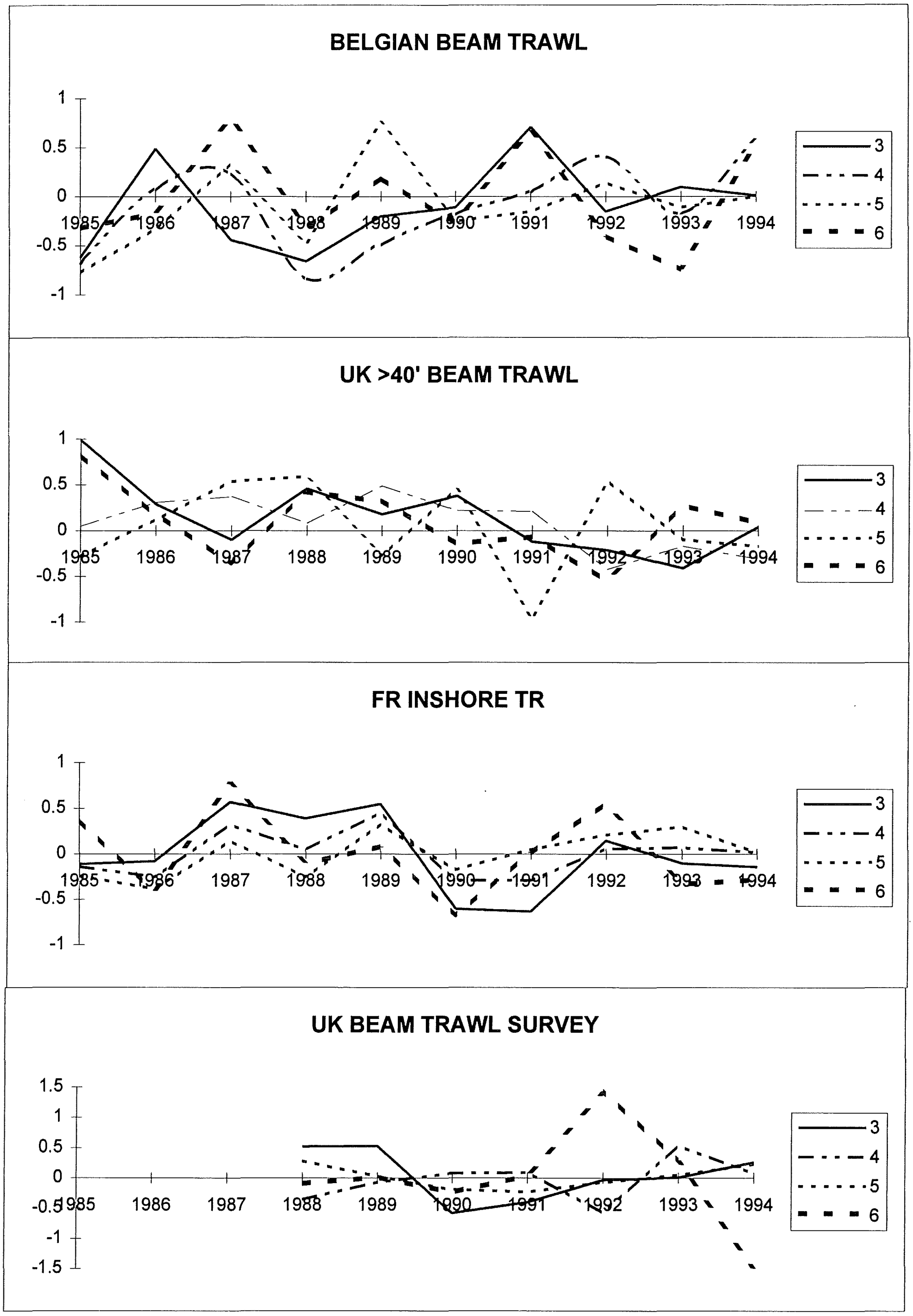
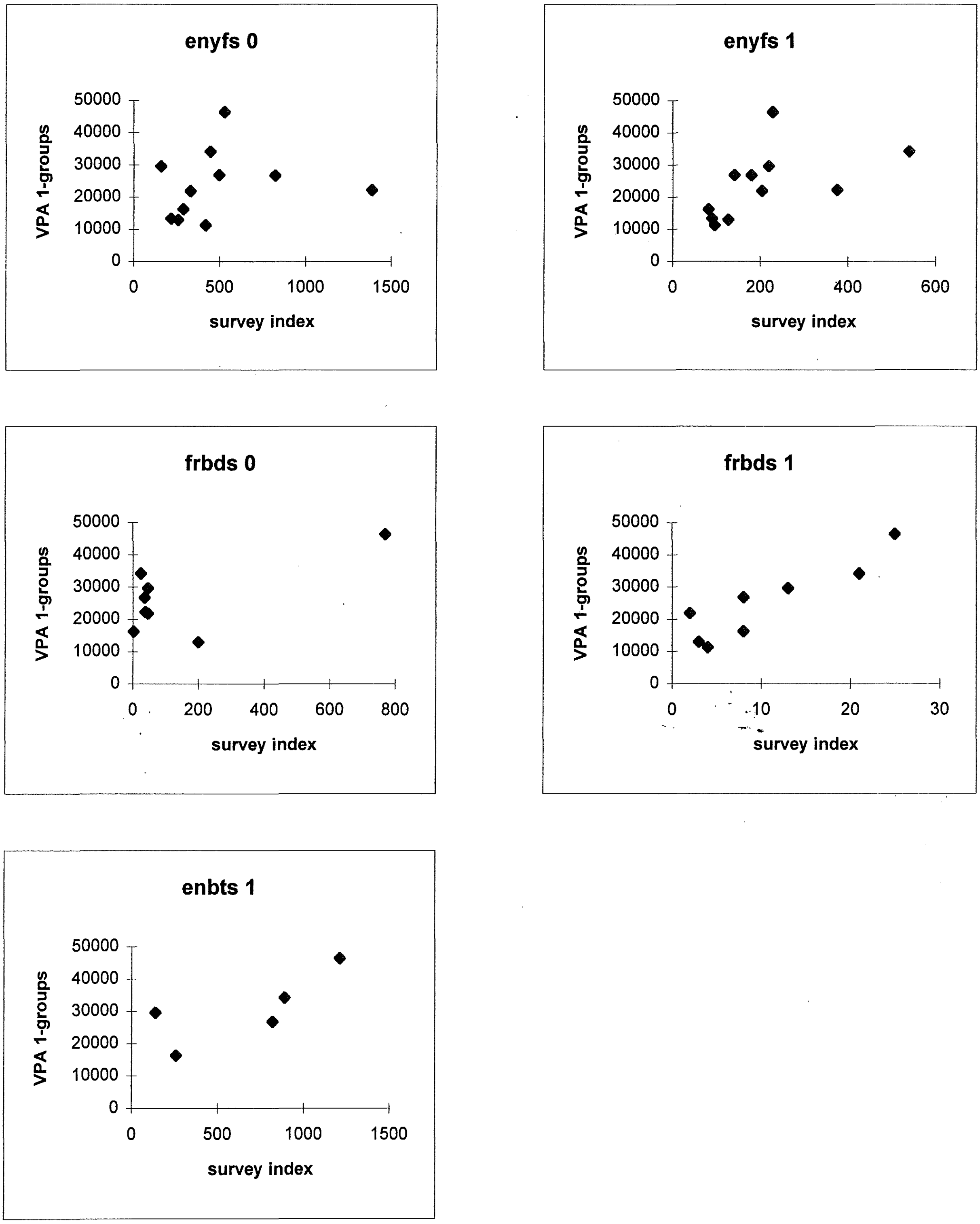


Figure 4.4.3   Sole in VIId   Log q residuals



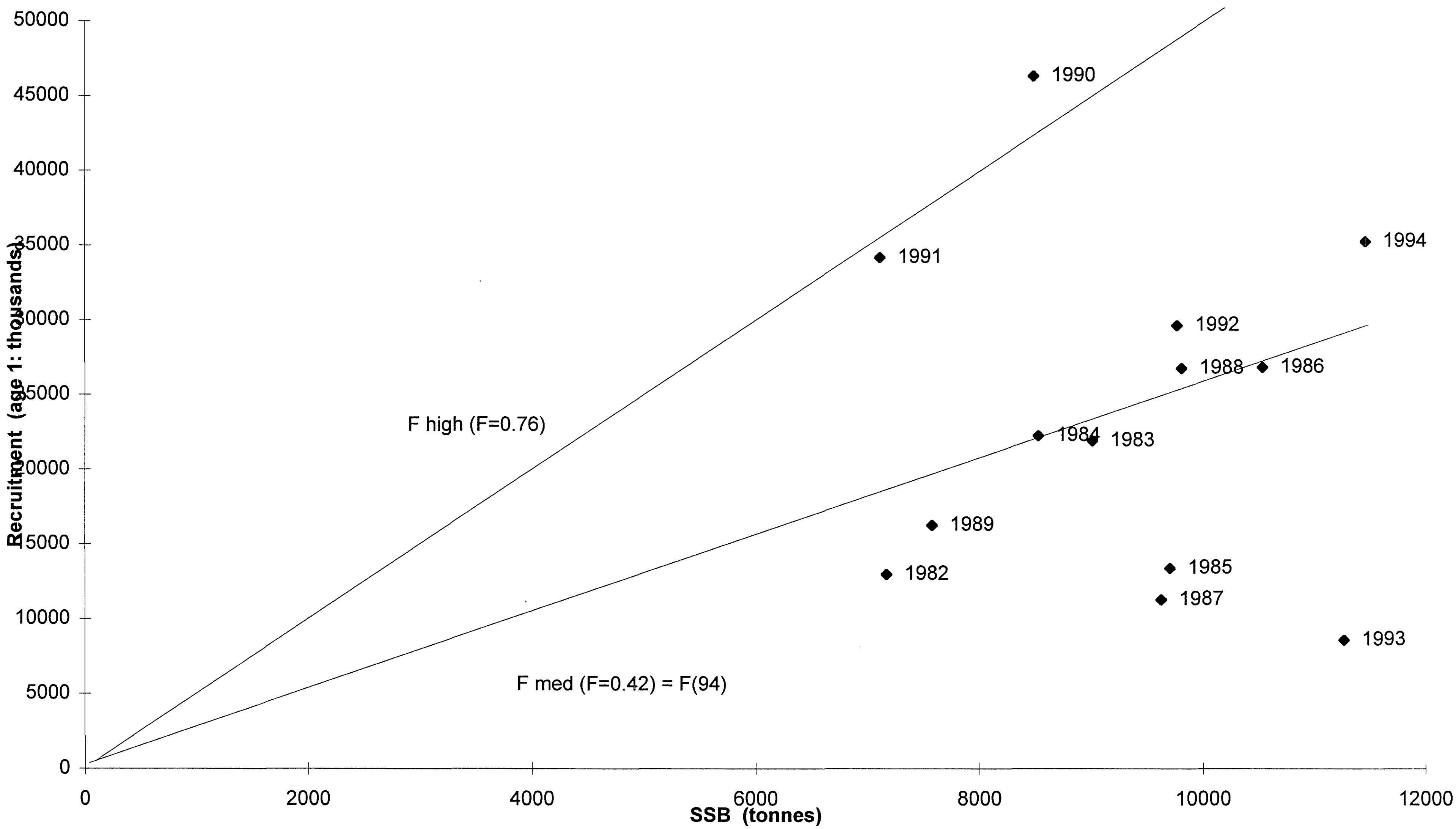
E:\ACFM\WGNSSK96\SOL_ECHEFIG443.XLS   3/11/95   9:43

Figure 4.4.4a   Sole in VIId



 E:\ACFM\WGNSSK96SOL_ECHE\FIG444A.XLS 3/11/95 9:48

Figure 4.4.4b Sole in VIId Stock recruitment plot

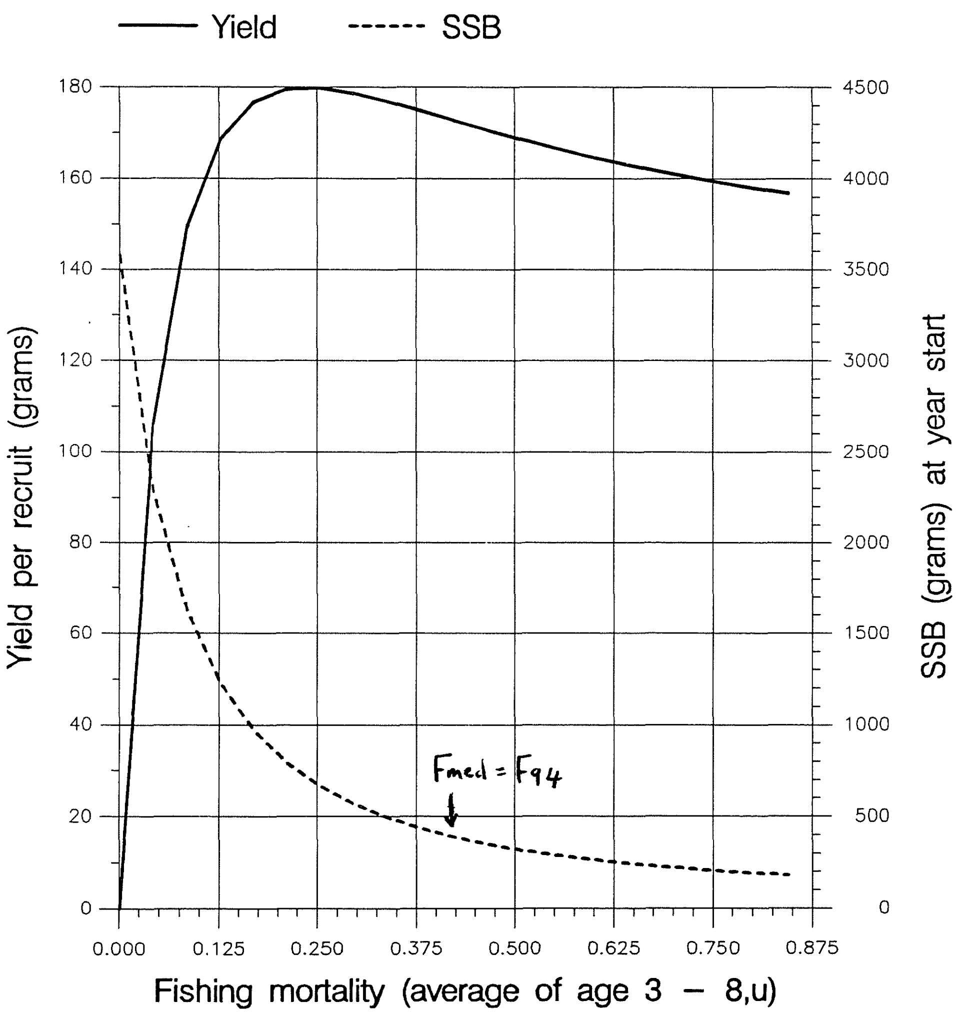


E:\ACFM\WGNSSK96\SOL_ECHE\FIG444B.XLW 3/11/95 9:37

Figure 4.4.5

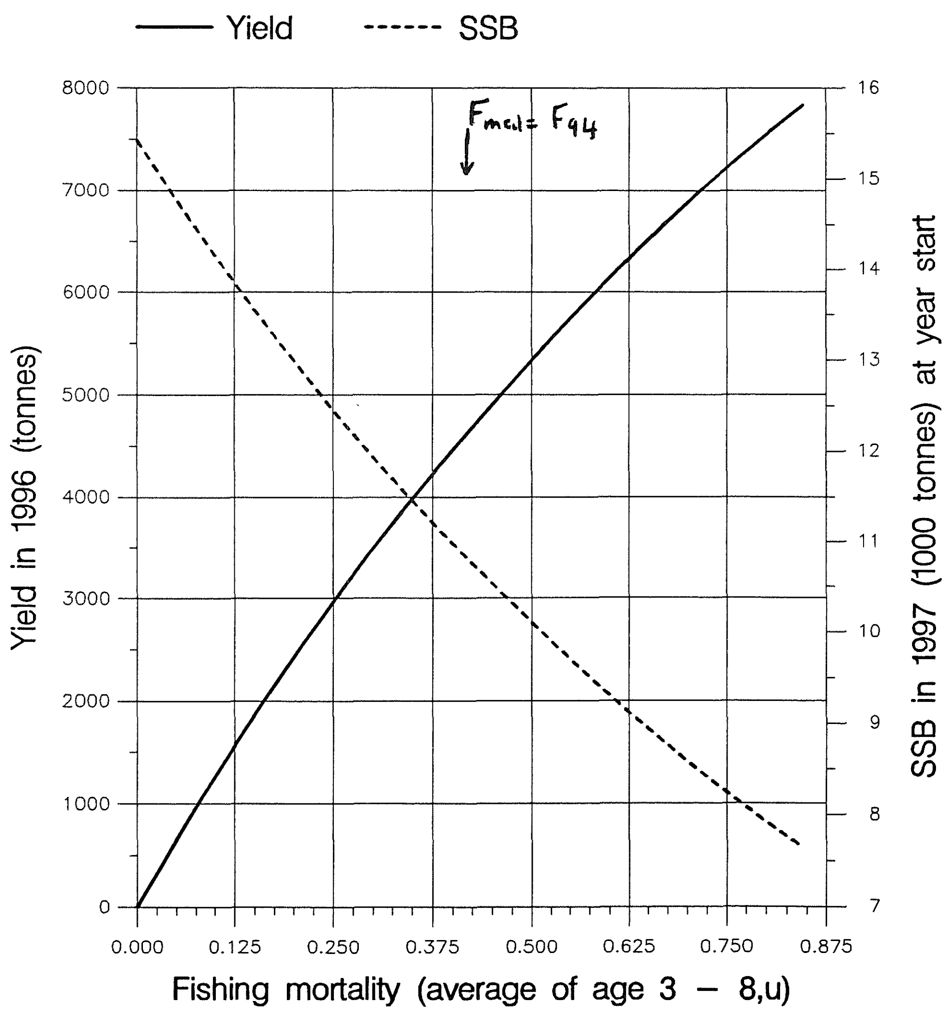
Fish Stock Summary
Sole in the Eastern English Channel (Fishing Area VIId)
4–10–1995

Long term yield and spawning stock biomass



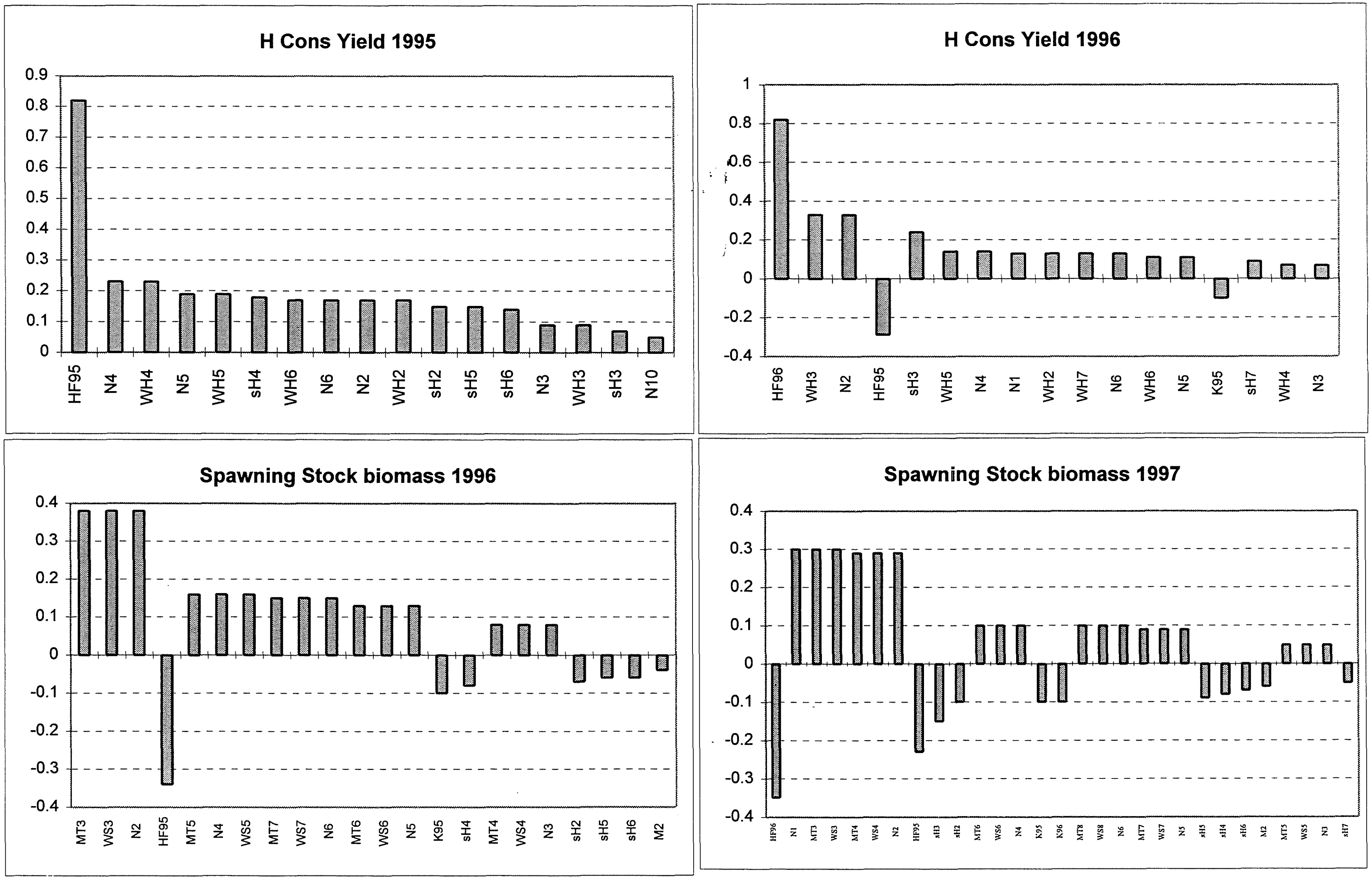
(run: S7DYPR) C

Short term yield and spawning stock biomass



(run: S7DPRED) D

Fig 4.4.6 Sole V11d. Sensitivity analysis of short term forecast.
Linear sensitivity coefficients (elasticities).
Key to labels is in Table 4.4.13.



E:\ACFM\WGNSSK96\SOLECHE\FIG446.XLS 3/11/95 9:54

Fig.4.4.7 Sole V11d. Sensitivity analysis of short term forecast.
Proportion of total variance contributed by each input.
Key to labels in Table 4.4.13.

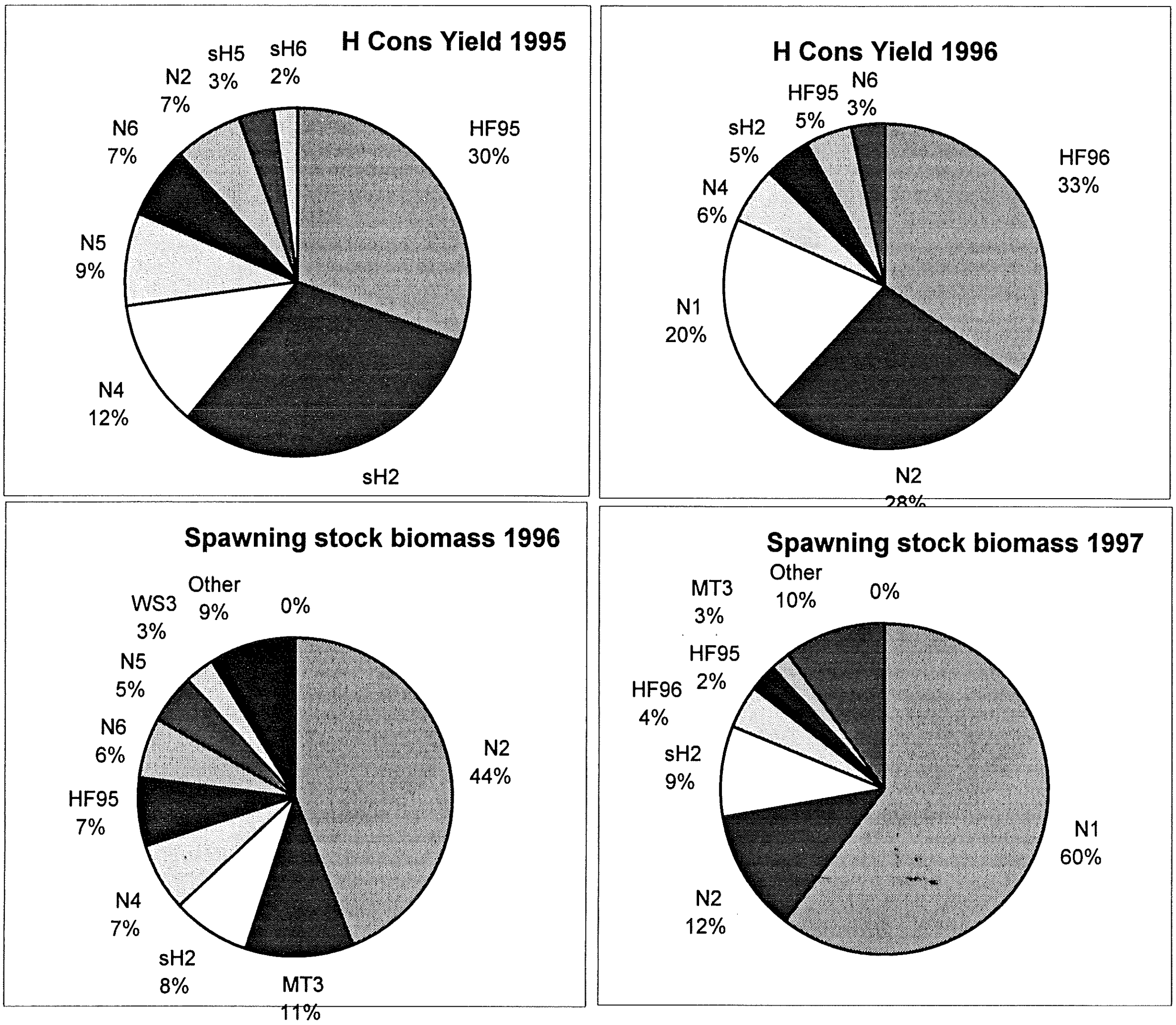


Fig 4.4.8 Sole V11d. Sensitivity analysis of short term forecast.
Cumulative probability distributions.

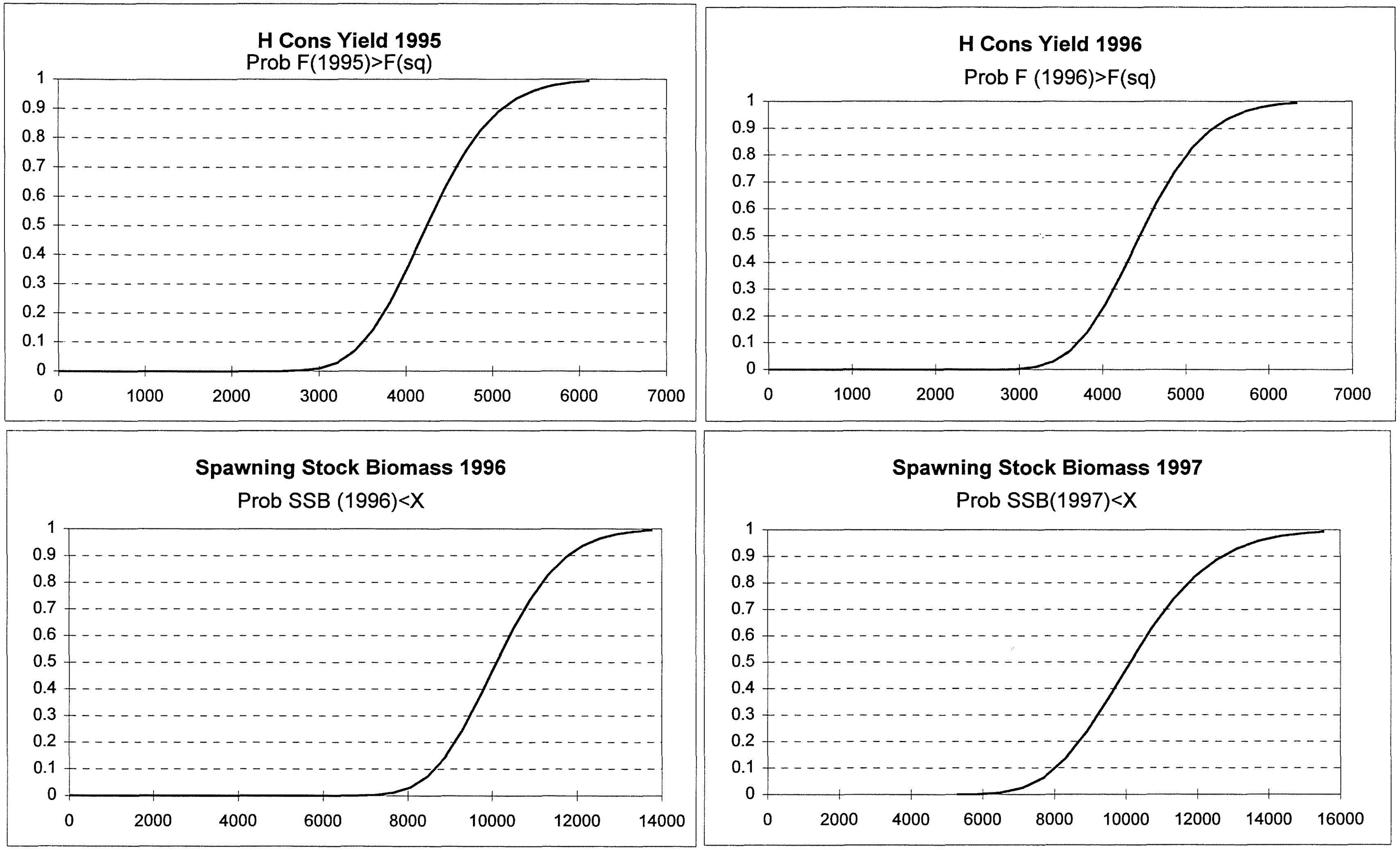


Figure 4.4.9 Sole in V11d. Medium term projections, showing 5, 25, 50, 75 and 95 percentiles from random boot strap stock recruit model

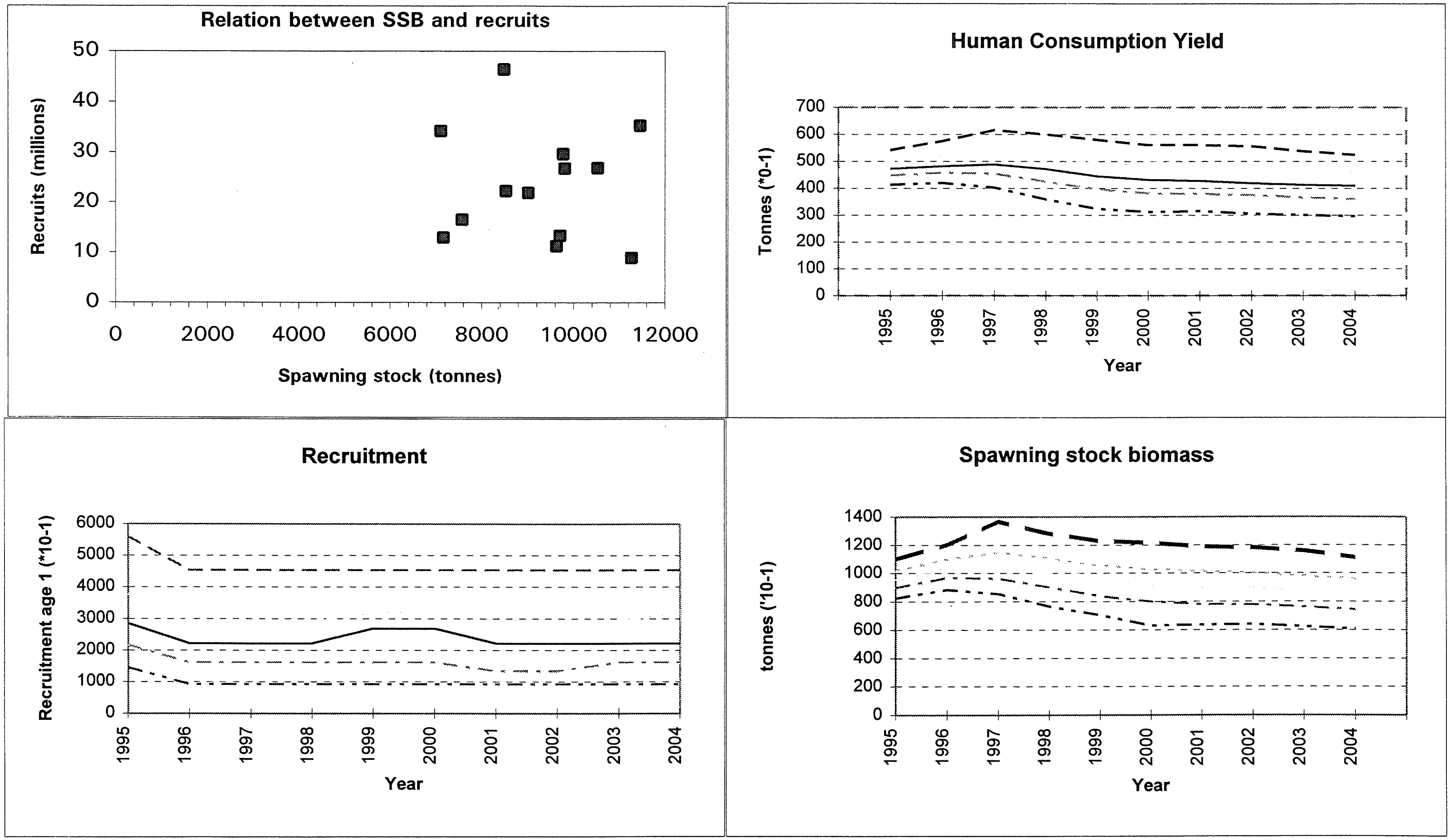
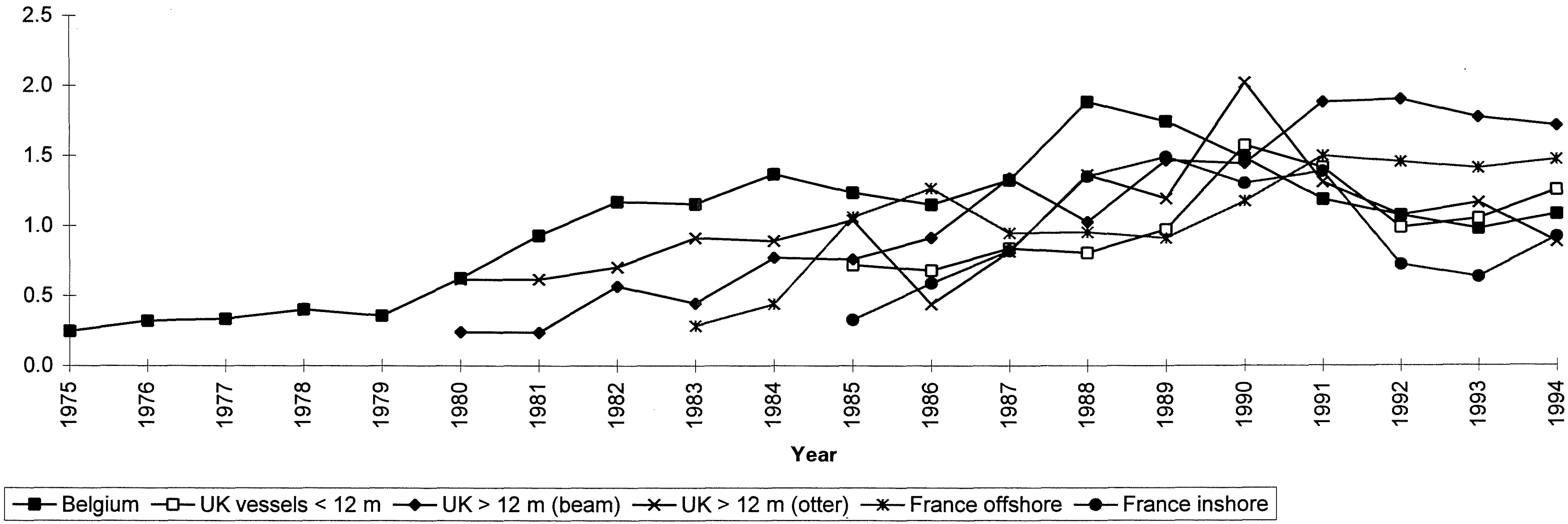
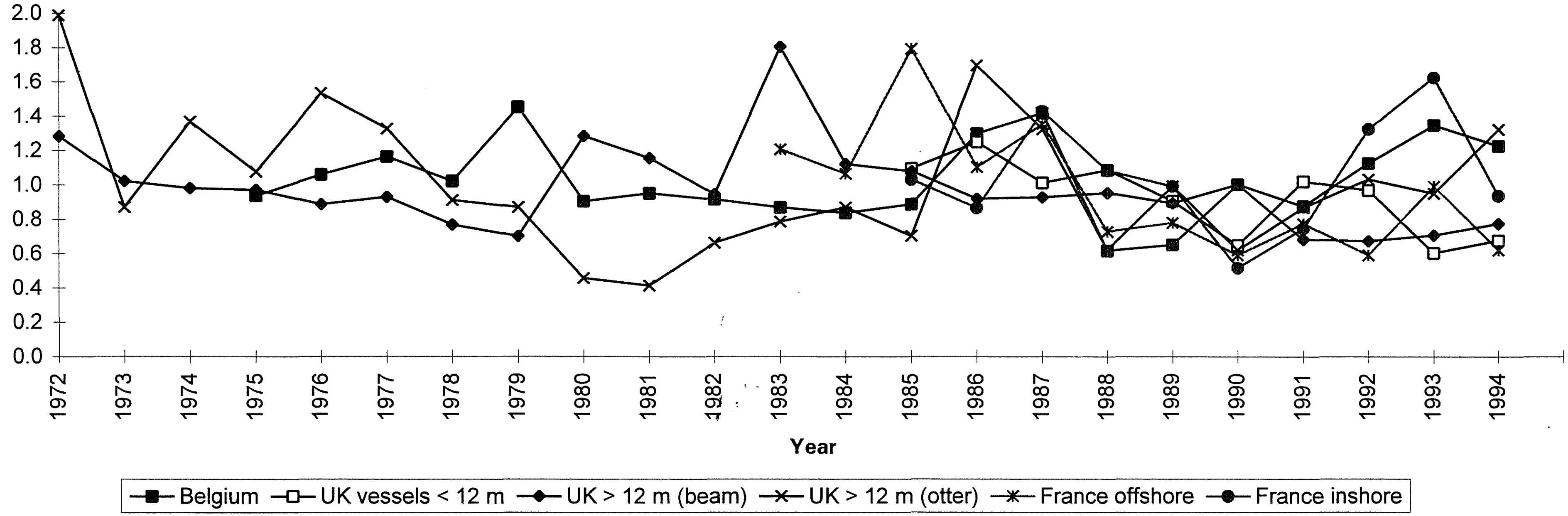


Figure 4.4.10 Sole in VIId EFFORT residuals



E:\ACFM\WGNSSK96\SOL_ECHE\FIG4410.XLS 3/11/95 10:40

Figure 4.4.11 Sole in VIId, CPUE residuals



4.5 PLAICE in Division VIId

4.5.1 Catch trends

Landings data reported to ICES are shown in Table 4.5.1 together with the total landings estimated by the Working Group. The unallocated landings are mainly due to discrepancies between the officially reported figures and those available to WG members. No correction was made for SOP discrepancies. The trend in landings is shown in Figure 4.5.1. Landings peaked at 10,400 t in 1988 and have declined by nearly half since then to 5822 t in 1994 which was just below the catch estimate of 6000 t predicted in last years assessment. France contribute mainly to the landings (53%) followed by Belgium (24%) and UK (19%). Plaice is a seasonal target in winter for French offshore otter trawl trawlers and catched all year with sole by Belgian and UK offshore beam trawlers. There is no separate TAC for VIId plaice which at present is managed together with area VIIe.

4.5.2 Natural mortality, maturity, age compositions and mean weight at age

As in previous assessments natural mortality was assumed constant over ages and years at 0.12. The maturity ogive used is similar to that for VIIe plaice and shown in Table 4.5.9 (input to YPR). Age compositions for 1980-1994 were available for the UK and for 1981-1994 for Belgium. However, levels of sampling prior to 1985 were poor and those data are considered to be less reliable. Age compositions were available for France since 1989.

Quarterly catch weights were available from the UK since 1980 and from Belgium since 1986. French catch weights have been collected since 1989.

The age-composition data and the mean weight at age in the catch and stock are shown in Table 4.5.2. Stock weights at the beginning of the year were calculated from a smoothed curve of catch weights. Data for 1980-1994 were updated with minor revisions. The data do not include discards which are not sampled for this stock although they seem not negligible.

4.5.3 Catch, effort and research vessel data

Commercial effort and CPUE data were available from five commercial fleets covering inshore and offshore trawlers. All fleets show a steep decline in CPUE from 1988/89 to 1994. Effort has increased in all fleets since 1983 to 1989 and despite a decrease in 1992 remains at a high level. Trends in CPUE are shown in Tables 4.5.14 and Figures 4.5.11 and effort in the VIId overview (section 4.1).

Effort and age composition were available for three commercial fleets. A new one, FR TRAWL INSHORE was added this year (a second one, the FRENCH TRAWL OFFSHORE, was also used in a first step but remove after because it uses also de-raised age composition and was a little lower correlated). The UK RYE TRAWL was replaced by a new fleet named UK INSHORE FLEET. Surveys data were obtained since 1988 from two trawl surveys covering most of VIId. These were the English beam trawl survey in August (Table 4.5.16) and French otter trawl ground fish survey in October. Recruit survey estimates for 0 and 1-group fish were also available from smaller scale surveys in VIId, the English and French YFS.

All these data (including age 1) were used to tune the VPA. The range of ages and years used in each fleet is shown in the input file (Table 4.5.3).

4.5.4 Catch at age analysis

As for last year the analysis was carried out with XSA.

Ages 1-10^{+} were selected because the older age groups showed high levels of variance. A number of trial runs were made to select the most appropriate model for the data and a 5 stage process was used to select the final tuning options.

1. Choice of age to be treated as recruits. A trial run was made with all ages below 8 (default) treated as recruits (all other options accepted also by defaults). Examination of the regression statistics showed that for age 1 the slopes were significantly different from 1.0 for UK BEAM TRAWL SURVEY (t value 4.5, high RSquare) and nearly for FR YFS (t value 2.1, high RSquare). Slope is also different from 1.0 for age 2 in the FR GFS (t value 4.0, high RSquare. Problem were also detected for age 7 in FR TRAWL INSHORE and nearly for age 5 in FR TRAWL OFFSHORE and age 3 in FR GFS. The two options <2 and <3 concerning the age to be treated as recruits were explored and the latest gave always lower standard error. Catchabilities were therefore set to be dependent on year class strength for ages<3 (<2 in 94WG).

2. Choice of age for which catchability can be assumed to be constant. From the previous trial run where catchability depend on year class strength for ages <3 and not dependent of age until 8 (default). The patterns of q with age is examined for each fleet. In most fleets, q showed a slight decline with age from a peak at age 4 and catchability become constant at age 7. Age 7 was therefore taken as an acceptable value (as in 94WG).

3. Trends in catchability were examined for fleet problems. Trends were examined from runs using XSA where each fleet were weighted separately to 1 (Figure 4.5.2). Because the data were relatively poor and also we noticed a change in the trend for the UK

fleet before 1990 in later runs this earlier period was therefore down weighted using a tricubic weight over 10 years (as in 94WG). As result a tapered time weight were applied with a power of 3 over 10 years.

4. A shrinkage towards the mean F over 3 age (8 to 6) was used in final run (as in 94WG).

5. Retrospective analysis was carried out initially using all fleets and shrinking to SEs of 0.3, 0.5 and 0.7 was examined (Figure 4.5.3). There was a tendency to over estimate F by 20 % in the previous year. We noticed that there is no important effect of the shrinkage. To have more years another analysis was made using a shrinkage of 0.5 on each fleet separately (Figure 4.5.4). The overestimation of F in the previous year was confirmed (underestimation in 94WG) and the shrinkage of 0.5 accepted (as in 94WG).

The tuning fleets, input parameters and output from the final run are shown in Tables 4.5.3 and 4.5.4. Fishing mortality and stock numbers are in Tables 4.5.5.

4.5.5 Recruit estimates

Research vessel survey indices of 0, 1 and 2 year olds were available and are shown in Table 4.5.16. These indices except 0 group were used in XSA with those of the three commercial fleets.

RCT3 was used to predict recruitment at age 1, and the input file is presented in Table 4.5.6. Results are shown in Table 4.5.7 and can be compared to those of XSA.

	RCT3		XSA
Year class	Weighted average at age 1	Var Ratio	(age 1)
1992	21,383	.99	20,072
1993	23,124	1.10	24,276
1994	26,992	1.06	-

The estimation of the 1992 and 1993 year-class is very similar with the two methods and the XSA estimation was accepted. The RCT3 value of 27 million at age 1 was used for the 1994 year-class and because the 1995 year class is not estimated by RCT3 the GM_{80-92} of 26.5 millions was used.

4.5.6 Historical Stock Trends

Trends in fishing mortality, SSB and recruitment are shown in Table 4.5.8 and Figure 4.5.4. Fishing mortality shows changes in recent years, increasing steeply in 1991, decreasing in 1992 and 1993 and going up in 1994. It appears that F has decreased in recent years and this recent trend is connected with the decrease of the effort made by FR INSHORE TRAWL, B BEAM TRAWL and UK INSHORE TRAWL (see overview section 4.1). SSB increased rapidly in 1988 following recruitment of the strong 1985 year class. Since 1990 it has declined steadily until 1992 and is now beginning to increase. However, the level remains at an historically low. Apart from one above average year class (1991), recruitment has been close to the GM level of 26.5 million 1 year olds since 1989.

4.5.7 Biological reference points

A stock-recruitment scatter plot is shown in Figure 4.5.5. The value of Fmed from the plot is 0.47 (0.39 kg/recruit) and is at the same level as current F (0.46). The yield per recruit input values are given in Table 4.5.9 and the output summary in Table 4.5.10. The YPR and SSB/R curves are shown in Figure 4.5.6. Assuming recruitment of 26.5 million, the equilibrium yield at *status quo* F will average 6300 t with a corresponding SSB of 10,300 t, slightly above current levels of biomass. Since recruitment has been very stable at levels of SSB ranging from 6000 to 14,000 t it is not clear what level MBAL should be set at from the relatively short time series available.

The relevant biological reference points are shown below:

F0.1	Fmax	Fmed	F94	Fhigh
0.13	0.26	0.47	0.46	0.75

4.5.8 Short term forecast

The input data for the catch forecasts are given in Table 4.5.9. Stock numbers in 1994 were taken from the VPA output adjusted for recruitment at age 1 and the GM of 26.5 million was used for age 1 in 1995 and 96. The exploitation pattern was the mean of the period 1992-1994, scaled to the 1994 $F_{(2-6)}$ value of 0.46. Catch and stock weights at age were the mean for the period 1992-94 and proportions of M and F before spawning were set to zero. The results of the *status quo* catch prediction are given in Table 4.5.11 and Figure 4.5.6. The predicted catch in 1995 will be 6500 t from a SSB of 10,500 t. This compares with a figure of 5600 t forecast for the catch made last year. Continuing with the same level of F implies an stabilisation in catch to 6500 t and an prediction of SSB to 10,200 t in 1996 and 1997.

The results of sensitivity analysis of the *status quo* catch prediction are shown in Figures 4.5.7, 4.5.8 and 4.5.9. The input data are included in Table 4.5.12.

Figure 4.5.7 shows the sensitivity of the prediction to the various input parameters used. It shows for example that the yield in 1996 is very dependent of the fishing mortality in 1996.

Figure 4.5.8 shows the proportion of total variance of the estimated yields and spawning biomass contributed by the input parameters. For yield in 1996, most of the variance is contributed by the estimates of fishing mortality in 1996.

Figure 4.5.9 shows probability profiles for yields and spawning biomass in 1995, 1996 and 1997.

4.5.9 Medium term predictions

A medium term prediction (10 years) was carried out assuming that recruitment is independent of spawning stock size (random bootstrapped model). One run of 500 simulations was carried out for the *status quo* (F=1.0*F94). Results in Figure 4.5.10 show the 5, 25, 50, 75 and 95 percentiles for yield, recruitment and SSB. These figures indicate a stability of all of these parameters for the medium-term period. Hence with a 90 % probability, the yield will be between 5500 t and 9500 t and the corresponding SSB between 9000 t and 14,000 t.

4.5.10 Long term considerations

The current level of F is equal to F_{med} and at this level, the SSB should sustain itself. The stock is being fished down from an historically high level following the strong recruitment in 1985 and at average levels of recruitment, SSB is likely to be relatively stable.

4.5.11 Comments on the assessment

The methodology used this year was very similar to last year and XSA was used again.

If methodology remained the same the database was extended by improving the tuning data. A new commercial fleet was added and an other one completely revised. The problem of the age composition for the French fleets has not be resolved this year but we hope to do in the future.

If we compare the situation of the VIId plaice stock from this assessment and from the previous one some changes appear in recent years : reducing in F (-10 % for 1991) with the consequence of an increasing of the SSB (+15 % for 1992) and confirmation that the 1991 year class was above the average.

The level of F_{med} calculated from the stock-recruitment scatter plot appears to be close to current F. In this situation, the SSB will be expected to be relatively stable at average levels of recruitment. However, the calculation of F_{med} is not very precise because of the small number of data points available and thus conclusions about the long term stability of this stock should be treated with caution.

Quality Control Diagram are presented in Table 4.5.13.

Table 4.5.1 PLAICE in Division VIId. Nominal landings (tonnes) as officially reported to ICES, 1976–1994.

Year	Belgium	Denmark	France	UK (E+W)	Others	Total reported	Un-allocated[1]	Total as used by WG
1976	147	1[1]	1,439	376	-	1,963	-	1,963
1977	149	81[2]	1,714	302	-	2,246	-	2,246
1978	161	156[2]	1,810	349	-	2,476	-	2,476
1979	217	28[2]	2,094	278	-	2,617	-	2,617
1980	435	112[2]	2,905	304	-	3,756	-1,106	2,650
1981	815	-	3,431	489	-	4,735	34	4,769
1982	738	-	3,504	541	22	4,805	60	4,865
1983	1,013	-	3,119	548	-	4,680	363	5,043
1984	947	-	2,844	640	-	4,431	730	5,161
1985	1,148	-	3,943	866	-	5,957	65	6,022
1986	1,158	-	3,288	828	488[2]	5,762	1,072	6,834
1987	1,807	-	4,768	1,292	-	7,867	499	8,366
1988	2,165	-	5,688[2]	1,250	-	9,103	1,317	10,420
1989	2,019	+	3,265[1]	1,382	-	6,666	2,092	8,758
1990	2,149	-	4,170	1,404	-	7,725	1,322	9,047
1991	2,265	-	3,606[1]	1,565	-	7,436	377	7,813
1992[3]	1,560	1	2,762[1]	1,545	26	5,865	472	6,337
1993[3]	0,877	+[2]	2,408[1]	1,075	27	4,387	944	5,331
1994	1,418	+[3]	2,740[1]	993	23	5,174	648	5,822

[1]Estimated by the Working Group.
[2]Includes Division VIIe.
[3]Provisional.

E:\ACFM\WGNSSK96\T451.REPE:\ACFM\WGNSSK96\T451.REP

TABLE 4.5.2.- Plaice in Division VIId.

International catch at age ('000), Total , 1980 to 1994.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	53	16	265	92	350	142	679	25	16	826
2	2644	2446	1393	3030	1871	5714	4884	8499	5011	3638
3	1451	6795	6909	3199	7310	6195	7034	7508	18813	7227
4	540	2398	3302	5908	2814	4883	3663	3472	4900	9453
5	490	290	762	931	1874	413	1458	1257	1118	2672
6	75	159	206	226	533	612	562	430	541	588
7	45	51	96	92	236	164	254	442	439	288
8	44	42	62	122	101	99	69	154	127	179
9	4	56	21	4	34	139	19	105	105	81
10+	103	200	88	101	100	50	34	77	174	197

Age	1990	1991	1992	1993	1994
1	1632	1542	1665	740	1242
2	2627	5860	6193	7606	3544
3	8746	5445	4450	3817	6703
4	5983	4524	1725	1259	2811
5	3603	2437	1187	542	794
6	801	1681	1044	468	391
7	243	286	698	334	288
8	203	120	200	287	251
9	178	113	116	102	256
10+	231	125	118	152	288

International mean weight at age (kg), Total catch, 1980 to 1994.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.309	.239	.245	.266	.233	.254	.226	.251	.292	.201
2	.312	.299	.271	.296	.295	.278	.306	.282	.268	.268
3	.499	.373	.353	.349	.336	.301	.331	.360	.321	.321
4	.627	.464	.431	.420	.402	.427	.406	.477	.432	.370
5	.787	.712	.640	.542	.508	.502	.546	.577	.560	.473
6	1.139	.870	.795	.822	.689	.570	.486	.783	.657	.648
7	1.179	.863	1.153	.953	.703	.557	.629	.735	.770	.837
8	1.293	.897	1.067	1.144	.945	1.081	.871	1.142	.908	.907
9	1.475	.992	1.504	.943	1.028	.849	1.446	1.268	1.218	1.204
10+	1.557	1.174	1.355	1.591	1.427	1.421	1.579	1.515	1.328	1.519

Age	1990	1991	1992	1993	1994
1	.201	.225	.182	.220	.243
2	.256	.277	.277	.272	.272
3	.326	.311	.352	.336	.288
4	.378	.390	.429	.432	.357
5	.483	.454	.509	.507	.469
6	.610	.556	.585	.591	.580
7	.781	.745	.701	.741	.693
8	.963	1.087	.837	.820	.938
9	1.159	.924	.850	.934	.979
10+	1.310	1.602	1.195	1.156	1.305

Table 4.5.2 Continued

Stock mean weight at age (kg), 1980 to 1994.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.171	.110	.105	.097	.082	.084	.101	.122	.084	.079
2	.332	.216	.208	.192	.164	.171	.205	.242	.168	.162
3	.482	.317	.308	.286	.248	.259	.311	.361	.254	.250
4	.622	.414	.406	.379	.333	.348	.420	.479	.340	.342
5	.751	.506	.502	.470	.420	.440	.532	.596	.427	.439
6	.870	.594	.596	.560	.507	.533	.646	.712	.514	.541
7	.977	.677	.687	.648	.596	.628	.763	.826	.603	.648
8	1.074	.756	.776	.735	.686	.725	.882	.939	.692	.759
9	1.161	.830	.862	.821	.777	.824	1.004	1.051	.783	.874
10+	1.237	.899	.947	.905	.869	.924	1.128	1.162	.874	.995

Age	1990	1991	1992	1993	1994
1	.085	.065	.088	.108	.160
2	.172	.141	.177	.214	.213
3	.262	.227	.268	.315	.275
4	.355	.324	.361	.414	.347
5	.451	.432	.456	.509	.428
6	.549	.550	.552	.601	.518
7	.651	.679	.651	.690	.617
8	.755	.819	.751	.776	.726
9	.862	.969	.853	.858	.844
10+	.971	1.130	.957	.937	.971

pt452_94.wri

Table 4.5.3.- Plaice in Division VIId. Tuning file input.

```
VIID PLAICE,BEL,UK+FRANCE  80-94   [rev: 3/10/95-AT]
107
UK INSHORE TRAWL METIER <40 trawl lands, all trawl age comps fleet effort [rev: 12/9/95-RM]
1985 1994
1 1 0 1
1 15
2708 0.0 638.6 433.4 228.4 19.4 0.0 0.0 0.0 19.6 0.0 0.0 0.0 0.0 0.0 0.0
1919 17.9 257.2 324.5 143.7 55.7 7.0 5.1 3.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0
2679 3.5 485.6 458.1 163.2 51.2 26.7 5.4 6.7 4.6 0.0 0.0 0.0 0.0 0.6 0.0
2479 2.2 379.6 849.8 140.7 57.4 29.8 14.0 2.7 4.0 5.2 0.8 1.1 0.1 0.3 0.3
2491 1.2 45.5 212.9 447.0 93.2 39.6 18.3 5.2 1.2 6.0 0.0 0.3 0.1 0.0 2.3
968 1.1 28.7 77.2 44.1 47.7 15.1 6.3 4.6 3.0 2.6 1.9 0.9 0.4 0.3 1.1
2049 44.6 197.2 188.6 136.8 62.9 53.3 8.8 3.5 1.7 1.1 0.3 0.6 0.8 0.0 1.2
2291 9.0 243.6 184.4 114.8 63.6 45.2 36.1 12.0 2.4 1.9 1.2 0.9 1.3 1.4 0.8
2285 14.9 263.2 154.4 56.7 34.5 25.6 18.3 21.3 7.2 3.2 2.5 2.1 1.0 1.0 2.0
1891 25.4 141.1 192.6 79.9 30.3 16.8 13.6 7.1 14.4 2.8 3.1 1.4 1.5 0.6 1.9
BELGIAN BEAM TRAWL( HP corr), all gears age comp
1981 1994
1 1 0 1
2 15
24.4 285.9 1126.5 593.3 67.3 21.6 8.3 7.1 13.3 14.1 3.0 11.7 1.3 13.4 10.3
29.8 147.8 1065.4 688.2 187.2 55.1 21.1 6.5 4.6 4.0 5.8 2.4 1.8 1.5 4.7
26.4 476.7 654.3 1384.5 165.0 52.2 23.0 31.6 1.3 1.4 3.6 3.1 0.4 1.4 12.2
35.4 92.0 1570.4 712.1 467.5 134.3 61.0 28.2 5.4 6.8 5.0 4.6 2.4 6.1 3.1
33.4 557.2 1125.3 1115.1 93.9 197.2 52.9 31.9 5.3 6.1 0.7 0.1 0.1 4.3 5.0
30.8 700.6 1141.8 667.8 269.9 145.9 60.3 11.3 5.6 6.4 0.1 0.1 0.1 3.6 0.1
49.3 1944.8 1639.7 889.0 343.1 92.7 154.5 41.1 28.0 14.1 1.1 10.1 0.7 0.1 2.0
48.9 773.0 4264.6 1301.8 237.1 109.9 113.2 35.8 25.4 24.0 10.4 0.3 0.1 0.1 4.8
43.8 73.6 1733.7 2950.5 973.4 212.8 113.1 61.1 21.7 0.1 9.8 14.6 9.0 0.1 0.1
38.5 372.1 2687.5 1942.8 1007.0 184.8 43.9 50.5 13.1 14.0 11.1 10.0 0.1 4.0 0.1
32.8 595.4 1689.2 1149.4 1089.5 698.4 86.9 36.0 58.9 1.7 3.3 2.4 1.5 0.0 1.5
30.9 889.8 1031.7 403.8 277.6 282.1 159.7 58.2 60.7 6.7 4.7 1.4 0.0 0.0 1.0
28.2 488.8 684.2 274.3 197.6 121.6 74.7 62.8 10.6 19.3 27.9 0.0 0.0 0.0 0.0
30.1 424.6 1259.2 1426.5 268.0 132.6 109.5 75.5 90.0 37.6 33.4 20.6 7.5 0.0 12.5
FR INSHORE TRAWL - F1.4 crts
1989 1994
1 1 0 1
1 15
1044.1 117.3 482.7 663.5 666.5 189.1 29.8 13.9 13.8 7.8 6.5 2.8 4.0 2.2 0.5 2.2
909.1 99.5 114.5 307.7 211.5 119.5 25.2 7.0 5.4 7.6 2.4 2.1 0.3 0.4 0.5 0.2
967.0 109.3 348.5 219.8 207.7 75.4 48.2 10.7 4.5 3.3 3.6 1.4 0.9 0.3 0.1 0.7
505.2 109.6 270.4 162.3 44.0 36.2 33.4 21.8 4.5 2.7 2.0 0.9 0.4 0.2 0.2 0.2
544.6 43.4 382.3 155.7 45.7 11.4 13.9 10.7 7.4 3.1 1.1 0.7 0.4 0.1 0.1 0.1
643.0 82.3 185.3 347.9 93.7 31.4 14.7 9.8 11.4 8.4 6.5 1.8 1.0 0.7 0.2 0.6
UK BEAM TRAWL SURVEY
1988 1995
1 1 .5 .75
1 6
1.0 26.5 31.3 43.8 7.0 4.6 4.8
1.0 2.3 12.1 16.6 19.9 3.3 5.3
1.0 5.2 4.9 5.8 6.7 7.5 4.5
1.0 11.7 9.1 7.0 5.3 5.4 6.7
1.0 16.5 12.5 4.2 4.2 5.6 10.2
1.0 3.2 13.4 5.0 1.7 1.9 7.3
1.0 8.3 7.5 9.2 5.6 2.0 5.6
1.0 11.3 4.1 3.0 3.7 1.5 4.1
French GFS [option 2]
1988 1994
1 1 .75 1
1 6
1.0 8.0 17.6 9.9 1.7 0.6 0.7
1.0 3.5 7.4 2.7 1.1 0.1 0.2
1.0 3.3 0.9 2.3 1.4 1.3 0.5
1.0 1.6 0.6 0.4 0.2 0.2 0.3
1.0 37.7 3.2 0.5 0.2 0.1 0.4
1.0 10.0 5.4 2.0 0.4 0.2 0.6
1.0 6.3 2.4 0.9 0.3 0.2 0.3
English YFS
1985 1994
1 1 .5 .75
1 1
1.0 0.9
1.0 1.2
1.0 1.6
1.0 1.2
1.0 0.7
1.0 0.4
1.0 0.3
1.0 0.9
1.0 0.4
1.0 0.3
French YFS
1987 1994
1 1 .5 .75
1 1
1.0 0.9
1.0 0.8
1.0 0.2
1.0 0.4
1.0 0.4
1.0 1.4
1.0 0.4
1.0 1.1
```

pt453_94.wri

Table 4.5.4.- Plaice in VIId. Tuning output.

Lowestoft VPA Version 3.1

3/10/1995 19:23

Extended Survivors Analysis

107D PLAICE 1995 WG,1-15+,80-94,SEXES COMB [rev: 19/9/95-AT]

CPUE data from file P7DTUN94.VPA

Catch data for 15 years. 1980 to 1994. Ages 1 to 10.

Fleet, ,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
UK INSHORE TRAWL MET,	1985,	1994,	1,	9,	.000,	1.000
BELGIAN BEAM TRAWL(,	1981,	1994,	2,	9,	.000,	1.000
FR INSHORE TRAWL - F,	1989,	1994,	1,	9,	.000,	1.000
UK BEAM TRAWL SURVEY,	1988,	1994,	1,	6,	.500,	.750
French GFS [option 2,	1988,	1994,	1,	6,	.750,	1.000
English YFS ,	1985,	1994,	1,	1,	.500,	.750
French YFS ,	1987,	1994,	1,	1,	.500,	.750

Time series weights :

Tapered time weighting applied
Power = 3 over 10 years

Catchability analysis :

Catchability dependent on stock size for ages < 3

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 3

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning had not converged after 60 iterations

Total absolute residual between iterations
59 and 60 = .00090

Final year F values

Age ,	1,	2,	3,	4,	5,	6,	7,	8,	9
Iteration 59,	.0558,	.2485,	.5717,	.6072,	.5060,	.3820,	.2864,	.2952,	.3545
Iteration 60,	.0559,	.2485,	.5721,	.6074,	.5060,	.3820,	.2864,	.2952,	.3545

Regression weights

,	.020,	.116,	.284,	.482,	.670,	.820,	.921,	.976,	.997,	1.000

Log catchability residuals.

pt454_94.wri

Table 4.5.4.- Plaice in VIId. Tuning output (continued).

Fleet : UK INSHORE TRAWL MET

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.94,	.028,	15.20,	.04,	9,	1.42,	-15.55,
2,	1.35,	-.256,	13.18,	.11,	10,	1.09,	-12.35,

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3,	1.50,	-.924,	12.60,	.44,	10,	.59,	-11.60,
4,	1.23,	-.600,	12.10,	.61,	10,	.52,	-11.50,
5,	1.17,	-1.065,	12.15,	.90,	10,	.20,	-11.58,
6,	1.08,	-.233,	11.95,	.67,	9,	.32,	-11.64,
7,	.91,	.221,	11.43,	.57,	9,	.34,	-11.87,
8,	.77,	.584,	10.79,	.61,	9,	.38,	-12.02,
9,	.53,	2.067,	9.21,	.82,	9,	.23,	-12.01,

1

Fleet : BELGIAN BEAM TRAWL(

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2,	8.24,	-.701,	-13.28,	.00,	10,	8.32,	-7.14,

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3,	2.04,	-1.305,	1.29,	.27,	10,	.85,	-5.53,
4,	.87,	.468,	5.73,	.76,	10,	.37,	-5.26,
5,	.83,	.586,	5.85,	.74,	10,	.35,	-5.38,
6,	.65,	1.116,	6.32,	.71,	10,	.30,	-5.62,
7,	.95,	.119,	5.94,	.62,	10,	.31,	-5.89,
8,	1.09,	-.325,	5.89,	.74,	10,	.28,	-5.95,
9,	1.25,	-.245,	5.79,	.19,	10,	1.19,	-5.83,

1

Fleet : FR INSHORE TRAWL - F

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.72,	.798,	11.48,	.70,	6,	.16,	-12.05,
2,	.48,	1.223,	10.25,	.62,	6,	.21,	-10.65,

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3,	1.43,	-.792,	10.48,	.50,	6,	.40,	-10.19,
4,	.85,	1.208,	10.12,	.95,	6,	.16,	-10.34,
5,	.88,	.321,	10.35,	.67,	6,	.47,	-10.64,
6,	1.15,	-.404,	11.25,	.67,	6,	.35,	-10.78,
7,	.62,	2.972,	9.58,	.95,	6,	.10,	-11.05,
8,	.87,	.390,	10.52,	.74,	6,	.26,	-11.08,
9,	1.47,	-.791,	13.06,	.45,	6,	.58,	-10.81,

1

pt454_94.wri

Table 4.5.4.- Plaice in VIId. *Tuning output (continued)*.

Fleet : UK BEAM TRAWL SURVEY

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	.28,	3.328,	9.47,	.85,	7,	.10,	-7.94,
2,	.61,	1.139,	8.30,	.69,	7,	.20,	-7.29,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
3,	.80,	.677,	7.58,	.74,	7,	.32,	-7.07,
4,	.86,	.550,	7.09,	.81,	7,	.33,	-6.80,
5,	1.06,	-.225,	6.38,	.77,	7,	.35,	-6.49,
6,	2.52,	-2.136,	2.11,	.34,	7,	.67,	-5.45,

1

Fleet : French GFS [option 2

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	.32,	1.029,	9.41,	.37,	7,	.30,	-8.04,
2,	.27,	3.673,	9.53,	.87,	7,	.12,	-8.53,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
3,	.58,	1.455,	9.08,	.76,	7,	.31,	-8.70,
4,	.88,	.284,	9.03,	.59,	7,	.57,	-9.05,
5,	1.18,	-.213,	9.26,	.27,	7,	1.05,	-9.10,
6,	11.18,	-2.023,	12.63,	.01,	7,	4.75,	-8.10,

1

Fleet : English YFS

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	.84,	.219,	10.54,	.30,	10,	.45,	-10.63,

1

Fleet : French YFS

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	.38,	2.146,	10.23,	.74;	8,	.15,	-10.50,

1

Table 4.5.4.- Plaice in VIId. Tuning output (continued).

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
UK INSHORE TRAWL MET,	64273.,	1.622,	.000,	.00,	1,	.006,	.018
BELGIAN BEAM TRAWL(,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR INSHORE TRAWL - F,	19834.,	.300,	.000,	.00,	1,	.187,	.057
UK BEAM TRAWL SURVEY,	20079.,	.300,	.000,	.00,	1,	.187,	.057
French GFS [option 2,	19335.,	.330,	.000,	.00,	1,	.155,	.059
English YFS ,	12728.,	.521,	.000,	.00,	1,	.062,	.088
French YFS ,	25199.,	.300,	.000,	.00,	1,	.187,	.045
P shrinkage mean ,	21135.,	.35,,,,				.145,	.054
F shrinkage mean ,	18176.,	.50,,,,				.071,	.062

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
20359.,	.13,	.07,	8,	.521,	.056

1

Age 2 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
UK INSHORE TRAWL MET,	16749.,	.934,	.230,	.25,	2,	.013,	.182
BELGIAN BEAM TRAWL(,	15305.,	8.954,	.000,	.00,	1,	.000,	.197
FR INSHORE TRAWL - F,	10743.,	.212,	.082,	.39,	2,	.242,	.271
UK BEAM TRAWL SURVEY,	10949.,	.212,	.011,	.05,	2,	.242,	.266
French GFS [option 2,	14232.,	.223,	.085,	.38,	2,	.219,	.211
English YFS ,	11289.,	.496,	.000,	.00,	1,	.043,	.259
French YFS ,	12037.,	.300,	.000,	.00,	1,	.118,	.245
P shrinkage mean ,	15056.,	.47,,,,				.065,	.200
F shrinkage mean ,	8597.,	.50,,,,				.057,	.328

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
11835.,	.11,	.05,	13,	.441,	.248

pt454_94.wri

Table 4.5.4.- Plaice in VIId. Tuning output (continued).

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
UK INSHORE TRAWL MET,	7896.,	.383,	.090,	.23,	3,	.074,	.587
BELGIAN BEAM TRAWL(,	7339.,	.480,	.092,	.19,	2,	.049,	.621
FR INSHORE TRAWL - F,	9144.,	.177,	.060,	.34,	3,	.293,	.525
UK BEAM TRAWL SURVEY,	7676.,	.192,	.038,	.20,	3,	.236,	.600
French GFS [option 2,	7689.,	.228,	.177,	.78,	3,	.160,	.599
English YFS ,	9850.,	.527,	.000,	.00,	1,	.027,	.495
French YFS ,	8509.,	.304,	.000,	.00,	1,	.080,	.555
F shrinkage mean ,	7329.,	.50,,,,				.080,	.621

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
8173.,	.10,	.04,	17,	.377,	.572

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
UK INSHORE TRAWL MET,	2900.,	.294,	.138,	.47,	4,	.109,	.649
BELGIAN BEAM TRAWL(,	4423.,	.323,	.359,	1.11,	3,	.095,	.469
FR INSHORE TRAWL - F,	3069.,	.163,	.063,	.39,	4,	.304,	.622
UK BEAM TRAWL SURVEY,	3392.,	.185,	.113,	.61,	4,	.218,	.577
French GFS [option 2,	2986.,	.225,	.192,	.85,	4,	.128,	.635
English YFS ,	2054.,	.542,	.000,	.00,	1,	.015,	.828
French YFS ,	2761.,	.313,	.000,	.00,	1,	.046,	.672
F shrinkage mean ,	2898.,	.50,,,,				.083,	.649

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
3166.,	.09,	.06,	22,	.632,	.607

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
UK INSHORE TRAWL MET,	1215.,	.226,	.083,	.37,	5,	.208,	.480
BELGIAN BEAM TRAWL(,	1139.,	.276,	.183,	.66,	4,	.130,	.505
FR INSHORE TRAWL - F,	1267.,	.179,	.094,	.52,	5,	.222,	.464
UK BEAM TRAWL SURVEY,	981.,	.191,	.113,	.59,	5,	.244,	.567
French GFS [option 2,	1226.,	.261,	.140,	.54,	5,	.086,	.476
English YFS ,	1110.,	.545,	.000,	.00,	1,	.007,	.515
French YFS ,	1167.,	.331,	.000,	.00,	1,	.020,	.495
F shrinkage mean ,	1008.,	.50,,,,				.084,	.555

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
1136.,	.10,	.05,	27,	.477,	.506

1

pt454_94.wri

Table 4.5.4.- Plaice in VIId. Tuning output (continued).

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK INSHORE TRAWL MET,	826.,	.190,	.086,	.45,	6,	.248,	.369
BELGIAN BEAM TRAWL(,	825.,	.258,	.106,	.41,	5,	.121,	.369
FR INSHORE TRAWL - F,	732.,	.176,	.104,	.59,	6,	.248,	.408
UK BEAM TRAWL SURVEY,	860.,	.185,	.116,	.63,	6,	.222,	.356
French GFS [option 2,	818.,	.283,	.104,	.37,	6,	.082,	.372
English YFS ,	1408.,	.606,	.000,	.00,	1,	.004,	.232
French YFS ,	720.,	.367,	.000,	.00,	1,	.011,	.413
F shrinkage mean ,	598.,	.50,,,,				.065,	.480

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
792.,	.09,	.04,	32,	.473,	.382

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK INSHORE TRAWL MET,	791.,	.180,	.071,	.39,	7,	.256,	.295
BELGIAN BEAM TRAWL(,	899.,	.217,	.114,	.53,	6,	.198,	.264
FR INSHORE TRAWL - F,	748.,	.174,	.063,	.36,	6,	.284,	.309
UK BEAM TRAWL SURVEY,	1000.,	.200,	.108,	.54,	6,	.143,	.240
French GFS [option 2,	826.,	.321,	.225,	.70,	6,	.051,	.284
English YFS ,	1350.,	.802,	.000,	.00,	1,	.002,	.183
French YFS ,	754.,	.432,	.000,	.00,	1,	.005,	.307
F shrinkage mean ,	644.,	.50,,,,				.061,	.352

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
818.,	.09,	.04,	34,	.471,	.286

1

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK INSHORE TRAWL MET,	576.,	.185,	.081,	.44,	8,	.217,	.344
BELGIAN BEAM TRAWL(,	670.,	.187,	.093,	.50,	7,	.276,	.302
FR INSHORE TRAWL - F,	809.,	.165,	.088,	.53,	6,	.328,	.256
UK BEAM TRAWL SURVEY,	744.,	.215,	.082,	.38,	5,	.083,	.276
French GFS [option 2,	618.,	.362,	.158,	.44,	5,	.029,	.324
English YFS ,	1205.,	1.146,	.000,	.00,	1,	.001,	.179
French YFS ,	553.,	.563,	.000,	.00,	1,	.003,	.356
F shrinkage mean ,	591.,	.50,,,,				.064,	.337

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
688.,	.09,	.04,	34,	.461,	.295

pt454_94.wri

Table 4.5.4.- Plaice in VIId. Tuning output (continued).

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1985

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
UK INSHORE TRAWL MET,	661.,	.197,	.069,	.35,	9,	.222,	.311
BELGIAN BEAM TRAWL(,	524.,	.192,	.109,	.57,	8,	.266,	.379
FR INSHORE TRAWL - F,	570.,	.171,	.136,	.80,	6,	.346,	.353
UK BEAM TRAWL SURVEY,	424.,	.243,	.216,	.89,	4,	.059,	.450
French GFS [option 2,	369.,	.454,	.425,	.94,	4,	.018,	.502
English YFS ,	415.,	1.636,	.000,	.00,	1,	.000,	.458
French YFS ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	634.,	.50,,,,				.088,	.322

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
567.,	.10,	.06,	33,	.545,	.354

pt454_94.wri

TABLE 4.5.5.- Plaice in Division VIId.

International F at age, Total , 1980 to 1994.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.002	.001	.010	.005	.014	.005	.011	.001	.001	.052
2	.161	.113	.127	.145	.111	.301	.203	.173	.193	.166
3	.269	.708	.481	.433	.552	.573	.668	.495	.638	.424
4	.314	.859	.831	.905	.770	.808	.726	.753	.637	.705
5	.593	.253	.668	.531	.748	.213	.543	.532	.525	.793
6	.402	.351	.262	.383	.602	.527	.453	.274	.417	.526
7	.386	.477	.337	.163	.796	.337	.393	.711	.451	.372
8	.244	.685	1.815	.854	.248	.857	.211	.399	.409	.304
9	.345	.507	.809	.468	.551	.574	.347	.516	.473	.451
10+	.345	.507	.809	.468	.551	.574	.347	.516	.473	.451

Age	1990	1991	1992	1993	1994
1	.090	.072	.058	.040	.056
2	.212	.481	.412	.364	.249
3	.671	.805	.753	.437	.572
4	.680	.815	.584	.444	.607
5	.580	.593	.466	.329	.506
6	.525	.534	.496	.307	.382
7	.389	.326	.401	.264	.286
8	.443	.308	.362	.260	.295
9	.508	.431	.499	.289	.354
10+	.508	.431	.499	.289	.354

Tuned Stock Numbers at age (10-3), 1980 to 1995, (numbers in 1995 are VPA survivors)**

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	27408	13977	27179	21501	26692	31968	64721	34233	28529	17310
2	18840	24259	12382	23856	18983	23344	28219	56762	30338	25288
3	6522	14220	19212	9670	18305	15075	15323	20428	42340	22189
4	2128	4418	6212	10533	5564	9351	7536	6966	11048	19835
5	1164	1379	1660	2400	3778	2284	3695	3234	2909	5184
6	241	571	950	755	1252	1586	1637	1904	1685	1527
7	149	143	356	648	457	608	830	923	1284	985
8	215	90	79	226	488	183	385	497	402	725
9	15	150	40	11	85	338	69	277	296	237
10+	373	531	167	285	249	121	123	202	488	573

Age	1990	1991	1992	1993	1994	1995
1	20103	23602	31643	20072	24276	0
2	14575	16293	19480	26497	17106	20359
3	19002	10453	8932	11445	16337	11835
4	12873	8616	4143	3731	6556	8173
5	8689	5783	3382	2050	2123	3166
6	2081	4313	2834	1881	1308	1136
7	800	1091	2243	1530	1228	792
8	602	481	699	1332	1043	818
9	474	343	314	431	911	688
10+	612	377	317	640	1020	1202

pt455_94.wri

Table 4.5.6.- Plaice in Division VIId. RCT3 input file.

7D PLAICE - AGE 1_ indices all * per 100

7	14	2						
YCL	VPA	eyfs0	eyfs1	fyfs0	fyfs1	ebt1	fbt0	fbt1
1981	27179	180	37	531	25	-11	-11	-11
1982	21501	140	62	149	4	-11	-11	-11
1983	26692	820	58	242	-11	-11	-11	-11
1984	31968	400	92	-11	-11	-11	-11	-11
1985	64721	590	125	-11	-11	-11	-11	-11
1986	34233	1080	161	-11	94	-11	-11	-11
1987	28529	1553	123	444	82	2647	-11	1033
1988	17310	642	73	111	22	231	19	408
1989	20103	227	38	238	40	516	16	395
1990	23602	237	34	104	39	1175	16	195
1991	31643	174	86	302	136	1653	15	3361
1992	-11	180	38	219	45	322	98	1168
1993	-11	350	34	88	112	833	241	902
1994	-11	620	-11	395	-11	1132	739	-11

pt456_94.wri

Table 4.5.7.- Plaice in Division VIId. RCT3 output.

Analysis by RCT3 ver3.1 of data from file : pt456_94.csv

7D PLAICE - AGE 1_ indices all * per 100,,,,,,,,

Data for 7 surveys over 14 years : 1981 - 1994

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 4 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	I		I-----------	Prediction	---------	I
eyfs0	1.73	-.19	1.45	.064	11	5.20	8.79	1.793	.005
eyfs1	1.13	5.39	.51	.358	11	3.66	9.52	.637	.040
fyfs0	.51	7.36	.24	.476	8	5.39	10.08	.301	.180
fyfs1	.35	8.80	.28	.464	8	3.83	10.15	.355	.129
ebt1	.27	8.21	.11	.870	5	5.78	9.79	.174	.407
fbt0	-3.15	19.02	.19	.736	4	4.60	4.56	2.837	.002
fbt1	.31	8.09	.27	.536	5	7.06	10.25	.388	.108
					VPA Mean =		10.24	.357	.128

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	I		I-----------	Prediction	---------	I
eyfs0	1.77	-.47	1.50	.061	11	5.86	9.91	1.776	.006
eyfs1	1.12	5.41	.51	.360	11	3.56	9.40	.661	.040
fyfs0	.51	7.31	.25	.473	8	4.49	9.62	.360	.135
fyfs1	.36	8.77	.28	.476	8	4.73	10.47	.378	.123
ebt1	.27	8.20	.11	.869	5	6.73	10.05	.158	.439
fbt0	-3.15	19.04	.19	.736	4	5.49	1.73	4.334	.001
fbt1	.31	8.10	.27	.537	5	6.81	10.18	.383	.120
					VPA Mean =		10.24	.358	.137

Yearclass = 1994

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	I		I-----------	Prediction	---------	I
eyfs0	1.83	-.81	1.56	.058	11	6.43	10.94	1.882	.007
eyfs1									
fyfs0	.52	7.26	.25	.468	8	5.98	10.40	.350	.198
fyfs1									
ebt1	.28	8.19	.11	.868	5	7.03	10.13	.162	.607
fbt0	-3.17	19.07	.19	.736	4	6.61	-1.84	6.301	.001
fbt1									
					VPA Mean =		10.23	.360	.188

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	21383	9.97	.13	.13	.99		
1993	23124	10.05	.13	.14	1.10		
1994	26992	10.20	.16	.16	1.06		

pt457_94.wri

Table 4.5.8.- Plaice in Division VIId. VPA summary.

At 3/10/1995 19:26

Table 16 Summary (without SOP correction)

,	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 6,	FBAR 3- 6,
1980,	27408,	17386,	5852,	2650,	.4529,	.3479,	.3945,
1981,	13977,	14993,	6810,	4769,	.7003,	.4567,	.5426,
1982,	27179,	15795,	7870,	4865,	.6181,	.4739,	.5605,
1983,	21501,	15903,	8465,	5043,	.5958,	.4793,	.5629,
1984,	26692,	14860,	7817,	5161,	.6602,	.5564,	.6679,
1985,	31968,	16625,	8581,	6022,	.7018,	.4846,	.5305,
1986,	64721,	24479,	10658,	6834,	.6412,	.5187,	.5977,
1987,	34233,	33691,	14238,	8366,	.5876,	.4455,	.5136,
1988,	28529,	25860,	13927,	10420,	.7482,	.4819,	.5541,
1989,	17310,	22986,	15258,	8758,	.5740,	.5228,	.6121,
1990,	20103,	20899,	14536,	9047,	.6224,	.5339,	.6142,
1991,	23602,	15863,	11150,	7813,	.7007,	.6459,	.6870,
1992,	31643,	15834,	8934,	6337,	.7093,	.5422,	.5748,
1993,	20072,	18286,	9543,	5331,	.5586,	.3761,	.3793,
1994,	24276,	19343,	10159,	5822,	.5731,	.4632,	.5169,
1995	26992 (1)						
Arith. Mean	27548,	19520,	10253,	6483,	.6296,	.4886,	.5539,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

(1) recruit estimate

Table 4.5.9

Plaice in the Eastern English Channel (Fishing Area VIId)

Prediction with management option table: Input data

Year: 1995								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	26992.000	0.1200	0.0000	0.0000	0.0000	0.119	0.0514	0.215
2	20359.000	0.1200	0.1500	0.0000	0.0000	0.201	0.3433	0.274
3	11835.000	0.1200	0.5300	0.0000	0.0000	0.286	0.5908	0.325
4	8173.000	0.1200	0.9600	0.0000	0.0000	0.374	0.5481	0.406
5	3166.000	0.1200	1.0000	0.0000	0.0000	0.464	0.4365	0.495
6	1136.000	0.1200	1.0000	0.0000	0.0000	0.557	0.3973	0.585
7	792.000	0.1200	1.0000	0.0000	0.0000	0.653	0.3189	0.712
8	818.000	0.1200	1.0000	0.0000	0.0000	0.751	0.3076	0.865
9	688.000	0.1200	1.0000	0.0000	0.0000	0.852	0.3831	0.921
10+	1202.000	0.1200	1.0000	0.0000	0.0000	1.103	0.3831	1.218
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1996								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	26474.000	0.1200	0.0000	0.0000	0.0000	0.119	0.0514	0.215
2	.	0.1200	0.1500	0.0000	0.0000	0.201	0.3433	0.274
3	.	0.1200	0.5300	0.0000	0.0000	0.286	0.5908	0.325
4	.	0.1200	0.9600	0.0000	0.0000	0.374	0.5481	0.406
5	.	0.1200	1.0000	0.0000	0.0000	0.464	0.4365	0.495
6	.	0.1200	1.0000	0.0000	0.0000	0.557	0.3973	0.585
7	.	0.1200	1.0000	0.0000	0.0000	0.653	0.3189	0.712
8	.	0.1200	1.0000	0.0000	0.0000	0.751	0.3076	0.865
9	.	0.1200	1.0000	0.0000	0.0000	0.852	0.3831	0.921
10+	.	0.1200	1.0000	0.0000	0.0000	1.103	0.3831	1.218
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	26474.000	0.1200	0.0000	0.0000	0.0000	0.119	0.0514	0.215
2	.	0.1200	0.1500	0.0000	0.0000	0.201	0.3433	0.274
3	.	0.1200	0.5300	0.0000	0.0000	0.286	0.5908	0.325
4	.	0.1200	0.9600	0.0000	0.0000	0.374	0.5481	0.406
5	.	0.1200	1.0000	0.0000	0.0000	0.464	0.4365	0.495
6	.	0.1200	1.0000	0.0000	0.0000	0.557	0.3973	0.585
7	.	0.1200	1.0000	0.0000	0.0000	0.653	0.3189	0.712
8	.	0.1200	1.0000	0.0000	0.0000	0.751	0.3076	0.865
9	.	0.1200	1.0000	0.0000	0.0000	0.852	0.3831	0.921
10+	.	0.1200	1.0000	0.0000	0.0000	1.103	0.3831	1.218
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : AT94
Date and time: 05OCT95:09:43

Table 4.5.10.

Plaice in the Eastern English Channel (Fishing Area VIId)

09:40 Thursday, October 5, 1995

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	8.843	5656.618	6.692	5269.994	6.692	5269.994
0.2000	0.0926	0.374	218.511	5.737	2769.654	3.626	2394.475	3.626	2394.475
0.4000	0.1853	0.533	260.703	4.415	1694.449	2.342	1329.757	2.342	1329.757
0.6000	0.2779	0.620	265.177	3.701	1184.846	1.663	829.787	1.663	829.787
0.8000	0.3706	0.673	260.997	3.261	907.891	1.255	561.705	1.255	561.705
1.0000	0.4632	0.709	255.540	2.967	742.459	0.991	404.465	0.991	404.465
1.2000	0.5558	0.735	250.661	2.757	636.210	0.809	305.795	0.809	305.795
1.4000	0.6485	0.754	246.682	2.600	563.826	0.679	240.441	0.679	240.441
1.6000	0.7411	0.770	243.515	2.479	512.021	0.582	195.169	0.582	195.169
1.8000	0.8338	0.782	240.997	2.382	473.365	0.508	162.597	0.508	162.597
2.0000	0.9264	0.792	238.973	2.302	443.482	0.450	138.390	0.450	138.390
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : AT_YR94
Date and time : 05OCT95:10:17
Computation of ref. F: Simple mean, age 2 - 6
F-0.1 factor : 0.2785
F-max factor : 0.5551
F-0.1 reference F : 0.1290
F-max reference F : 0.2571
Recruitment : Single recruit

Table 4.5.11

Plaice in the Eastern English Channel (Fishing Area VIId)

09:40 Thursday, October 5, 1995

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4632	18889	10489	6445	0.0000	0.0000	19055	10213	0	25878	15837
.	.	.	.	.	0.1000	0.0463	.	10213	786	25071	15152
.	.	.	.	.	0.2000	0.0926	.	10213	1538	24299	14498
.	.	.	.	.	0.3000	0.1390	.	10213	2257	23562	13876
.	.	.	.	.	0.4000	0.1853	.	10213	2946	22858	13[illegible]
.	.	.	.	.	0.5000	0.2316	.	10213	3606	22185	12[illegible]
.	.	.	.	.	0.6000	0.2779	.	10213	4238	21541	12178
.	.	.	.	.	0.7000	0.3242	.	10213	4843	20926	11663
.	.	.	.	.	0.8000	0.3706	.	10213	5423	20337	11173
.	.	.	.	.	0.9000	0.4169	.	10213	5978	19774	10705
.	.	.	.	.	1.0000	0.4632	.	10213	6511	19235	10259
.	.	.	.	.	1.1000	0.5095	.	10213	7021	18720	9834
.	.	.	.	.	1.2000	0.5558	.	10213	7510	18226	9427
.	.	.	.	.	1.3000	0.6022	.	10213	7980	17754	9040
.	.	.	.	.	1.4000	0.6485	.	10213	8430	17302	8670
.	.	.	.	.	1.5000	0.6948	.	10213	8862	16869	8317
.	.	.	.	.	1.6000	0.7411	.	10213	9276	16454	7980
.	.	.	.	.	1.7000	0.7874	.	10213	9674	16057	7659
.	.	.	.	.	1.8000	0.8338	.	10213	10056	15676	7352
.	.	.	.	.	1.9000	0.8801	.	10213	10422	15312	7058
.	.	.	.	.	2.0000	0.9264	.	10213	10774	14962	6778
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : AT94
Date and time : 05OCT95:09:43
Computation of ref. F: Simple mean, age 2 - 6
Basis for 1995 : F factors

Table 4.5.12.- Plaice in Division VIId. Input data for catch forecast and linear sensitivity analysis.

Populations in 1995			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	26992	.16	WS1	.10	.36	M1	.12	.10	MT1	.00	.10
N2	20358	.20	WS2	.18	.17	M2	.12	.10	MT2	.15	.10
N3	11835	.20	WS3	.27	.12	M3	.12	.10	MT3	.53	.10
N4	8172	.20	WS4	.36	.09	M4	.12	.10	MT4	.96	.10
N5	3164	.20	WS5	.46	.07	M5	.12	.10	MT5	1.00	.10
N6	1134	.20	WS6	.55	.05	M6	.12	.10	MT6	1.00	.00
N7	791	.20	WS7	.66	.04	M7	.12	.10	MT7	1.00	.00
N8	817	.20	WS8	.77	.05	M8	.12	.10	MT8	1.00	.00
N9	687	.20	WS9	.88	.06	M9	.12	.10	MT9	1.00	.00
N10	1200	.20	WS10	.99	.08	M10	.12	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.06	.22	WH1	.21	.11
sH2	.31	.32	WH2	.27	.03
sH3	.59	.07	WH3	.32	.08
sH4	.57	.08	WH4	.40	.08
sH5	.45	.12	WH5	.48	.05
sH6	.41	.08	WH6	.58	.03
sH7	.30	.15	WH7	.73	.05
sH8	.30	.19	WH8	.93	.12
sH9	.38	.15	WH9	.97	.12
sH10	.38	.15	WH10	1.31	.13

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K95	1.00	.10	HF95	1.00	.20
K96	1.00	.10	HF96	1.00	.20
K97	1.00	.10	HF97	1.00	.20

Recruitment		
Labl	Value	CV
R96	26473	.37
R97	26473	.37

pt451294.wri

Table 4.5.13 Stock: Plaice in Division VIId (Eastern English Channel)

Assessment Quality Control Diagram 1

Average F(2-6,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989								
1990[1]	0.384	0.344	0.299					
1991	0.500	0.548	0.564	0.514				
1992	0.512	0.566	0.607	0.580	0.531			
1993	0.468	0.476	0.507	0.525	0.577	0.420		
1994	0.453	0.492	0.544	0.566	0.713	0.656	0.484	
1995	0 .446	0.482	0.523	0.534	0.646	0.542	0.376	0.463

[1]Average F(3-6,u).

Remarks:

Assessment Quality Control Diagram 2

Recruitment (age 1) Unit: thousands								
Date of assessment	Year class							
	1988	1989	1990	1991	1992	1993	1994	1995
1989								
1990	(49700)	(35600)	(27500)					
1991	(22009)	(23216)	28854[1]	28854[1]				
1992	23395	(23095)	(21107)	27244[2]	27244[2]			
1993	18782	22986	30926	33556	29192[3]	29192[3]		
1994	16713	18707	20097	33502	19660	(19354)	25334[4]	
1995	17310	20103	23602	31643	20072	24276	(26992)	26474[5]

[1]Geometric mean 1980-1987. [2]Geometric mean 1980-1989. [3]Geometric mean 1983-1990. [4]Geometric mean 1980-1991.

Remarks: Figures in brackets are estimated from recruit surveys.

Table 4.5.13 Continued Stock: Plaice in Division VIId (Eastern English Channel)

Assessment Quality Control Diagram 3

Spawning stock biomass (tonnes)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989			[1]	[1]						
1990	16528	20265	23462	24255[1]	24057[1]					
1991	11163	12025	12433	11127	9793[1]	9468[1]				
1992	10911	11627	11557	9669	10052	9541[1]	9466[1]			
1993	17788	17744	17993	12670	11263	9511	10453[1]	11032[1]		
1994	13604	14712	13788	10370	7757	7671	7868	8181[1]	7931[1]	
1995	13927	15258	14536	11150	8934	9543	10159	10500	10200[1]	10200[1]

[1]Forecast.

Remarks: Not corrected for SOP.

Table 4.5.14.- Plaice in Division VIId. Catch per unit effort

Year	United Kingdom Beam trawl (kg/hr)	United Kingdom Inshore trawl (kg/day)	Belgium Beam trawl (kg/hr)	France Offshore trawl (kg/(hr*kw*10-4))	France Inshore trawl (kg/(hr*kw*10-4))
1980			24.4		
1981			31.2		
1982			24.5		
1983	21.6		36.2	187.9	
1984	18.5		25.9	301.5	
1985	19.9	158.9	31.8	224.9	527.2
1986	27.7	149.7	34.9	221.1	701.4
1987	15.5	181.5	33.7	318.0	843.0
1988	8.9	213.0	40.7	316.8	1258.5
1989	17.6	129.3	42.8	190.5	739.5
1990	17.4	111.1	48.8	224.0	362.0
1991	18.3	115.8	45.5	173.4	382.9
1992	14.2	117.0	34.9	148.9	485.0
1993	11.9	97.9	24.2	117.2	417.1
1994	11.1	109.7	35.3	131.7	421.5

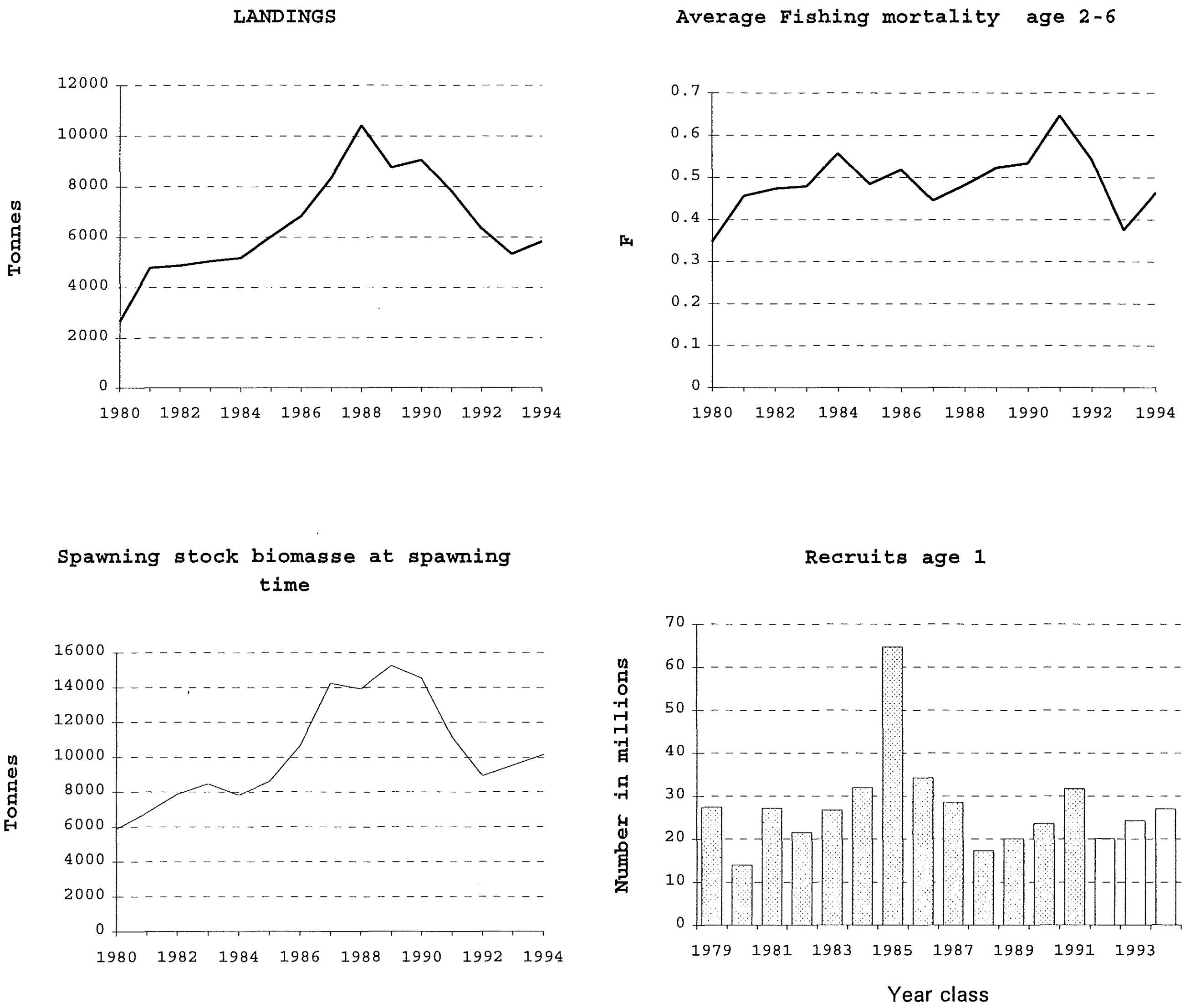
Table 4.5.15.- Plaice in Division VIId. English beam trawl survey numbers per hr raised to 8m beam trawl equivalent (mean no/rectangle, average across rectangles).

Age	1	2	3	4	5	6	7	8	9	10+	1+	3+
1988	26.47	31.33	43.75	6.96	4.64	1.51	0.77	0.70	0.60	1.21	117.94	60.14
1989	2.31	12.13	16.63	19.94	3.30	1.48	1.32	0.54	0.30	1.65	59.60	45.16
1990	5.16	4.86	5.76	6.70	7.53	1.76	0.65	0.97	0.75	0.37	34.51	24.49
1991	11.75	9.06	6.98	5.30	5.43	3.20	1.22	0.99	0.06	1.24	45.23	24.42
1992	16.53	12.54	4.19	4.17	5.57	4.88	3.44	0.66	0.49	0.72	53.18	24.12
1993	3.22	13.40	4.96	1.75	1.89	1.57	2.05	2.78	0.39	0.57	32.57	15.95
1994	8.33	7.46	9.17	5.56	1.95	0.77	0.90	1.83	1.24	0.81	38.03	22.23
1995	11.32	4.06	3.00	3.67	1.49	0.58	0.59	1.32	0.82	0.78	27.63	12.25

Table 4.5.16.- Plaice in division VIId. Survey indices of recruitment

	English YFS		English BTS			French YFS		French CGFS		
Year class	0 gp	1 gp	1 gp	2 gp	3 gp	0 gp	1 gp	0 gp	1 gp	2 gp
1980		0.14				1.12	0.04	-		
1981	1.8	0.37				5.31	0.25	-		
1982	1.4	0.62				1.49	0.04	-		
1983	8.2	0.58				2.42	-	-		
1984	4.0	0.92				-	-	-		
1985	5.9	1.25			43.75	-	-	-		
1986	10.8	1.61		31.33	16.63	-	0.94	-	-	26.46
1987	15.5	1.23	26.47	12.13	5.76	4.44	0.82	-	10.33	8.79
1988	6.4	0.73	2.31	4.86	6.98	1.11	0.22	0.19	4.08	1.27
1989	2.3	0.38	5.16	9.06	4.19	2.38	0.4	0.16	3.95	0.91
1990	2.4	0.34	11.75	12.54	4.96	1.04	0.39	0.16	1.95	6.05
1991	1.7	0.86	16.53	13.4	9.17	3.02	1.36	0.15	33.61	6.79
1992	1.8	0.38	3.22	7.46	3.00	2.19	0.45	0.98	11.68	3.45
1993	3.5	0.34	8.33	4.06		0.88	1.12	2.41	9.02	
1994	6.2		11.32			3.95		7.39		

Figure 4.5.1.- Plaice in Division VIId. Fish stock summary.



E:\acfm\wgnssk96\ple_eche\FIG451.XLS09/11/95 15:03

Figure 4.5.2.- Plaice in Division VIId. Catchability residual plot per age (XSA, each fleet separatly).

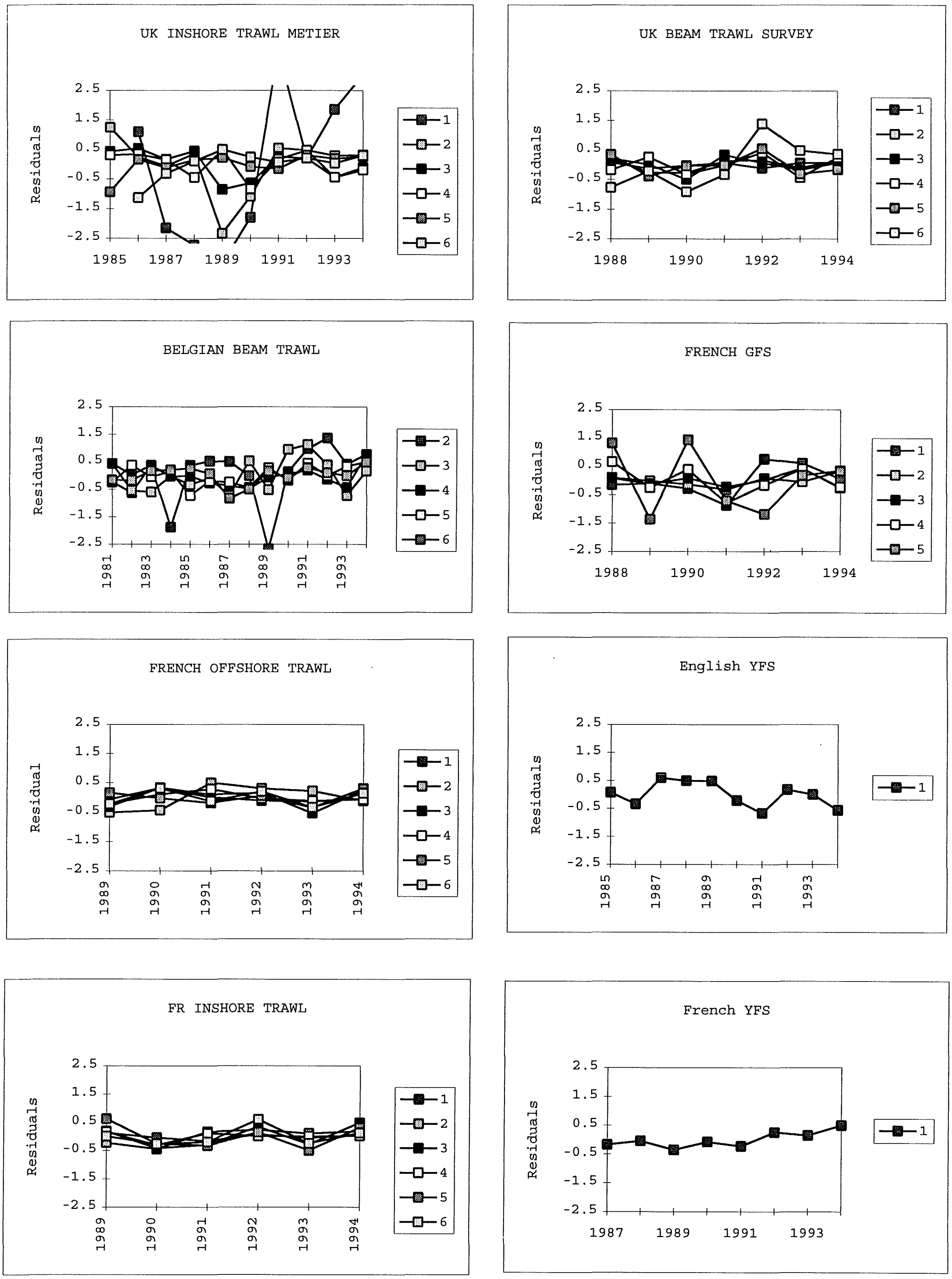
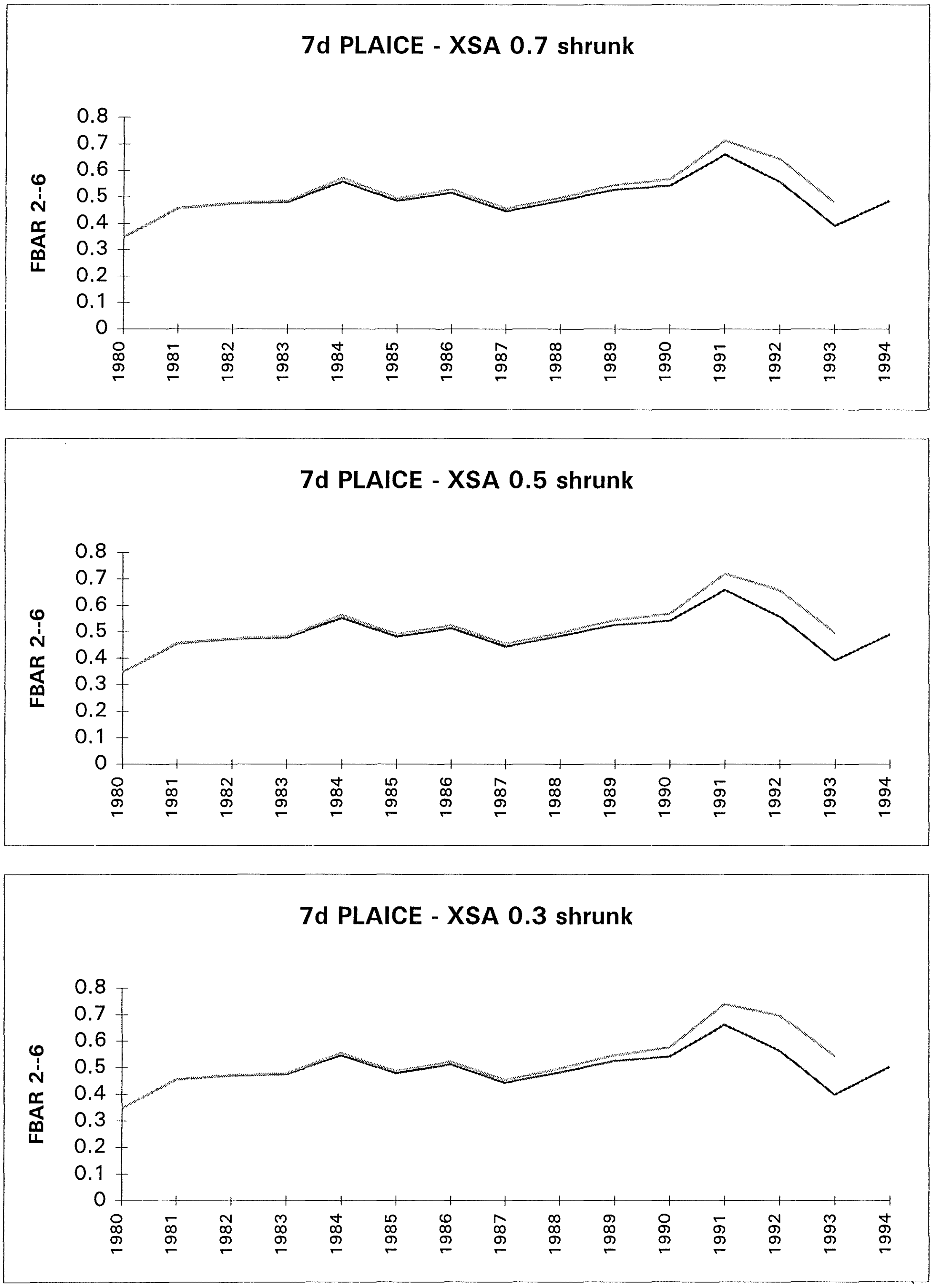


Figure 4.5.3.- Plaice in Division VIId - Retrospective analysis with the all fleets.



 E:\acfm\wgnssk96\ple_eche\PF453_94.XLS 09/11/95 14:52

Figure 4.5.4.- Plaice in Division VIId - Retrospective analysis for each commercial fleet individualy using a shrinkage of 0.5.

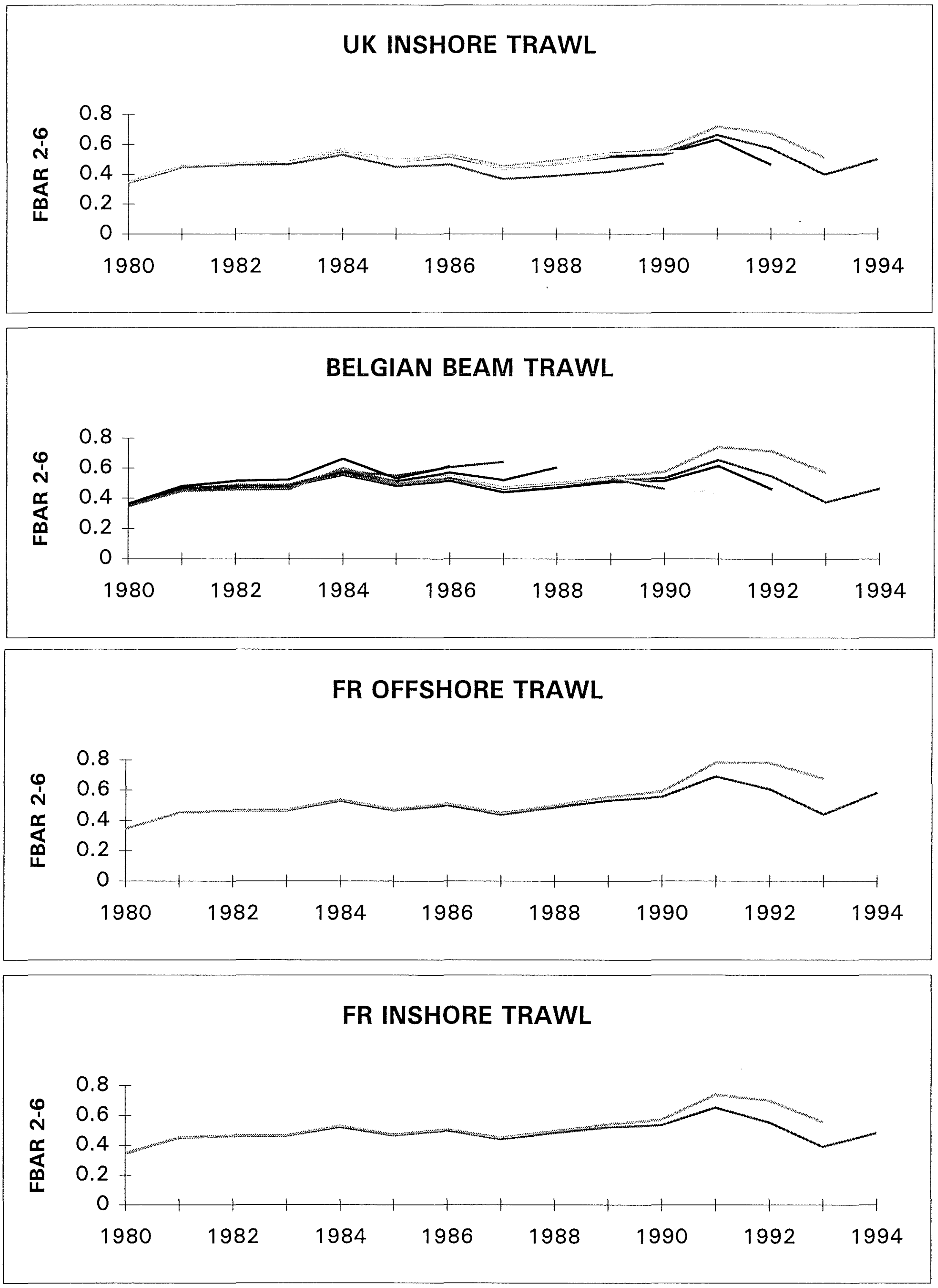
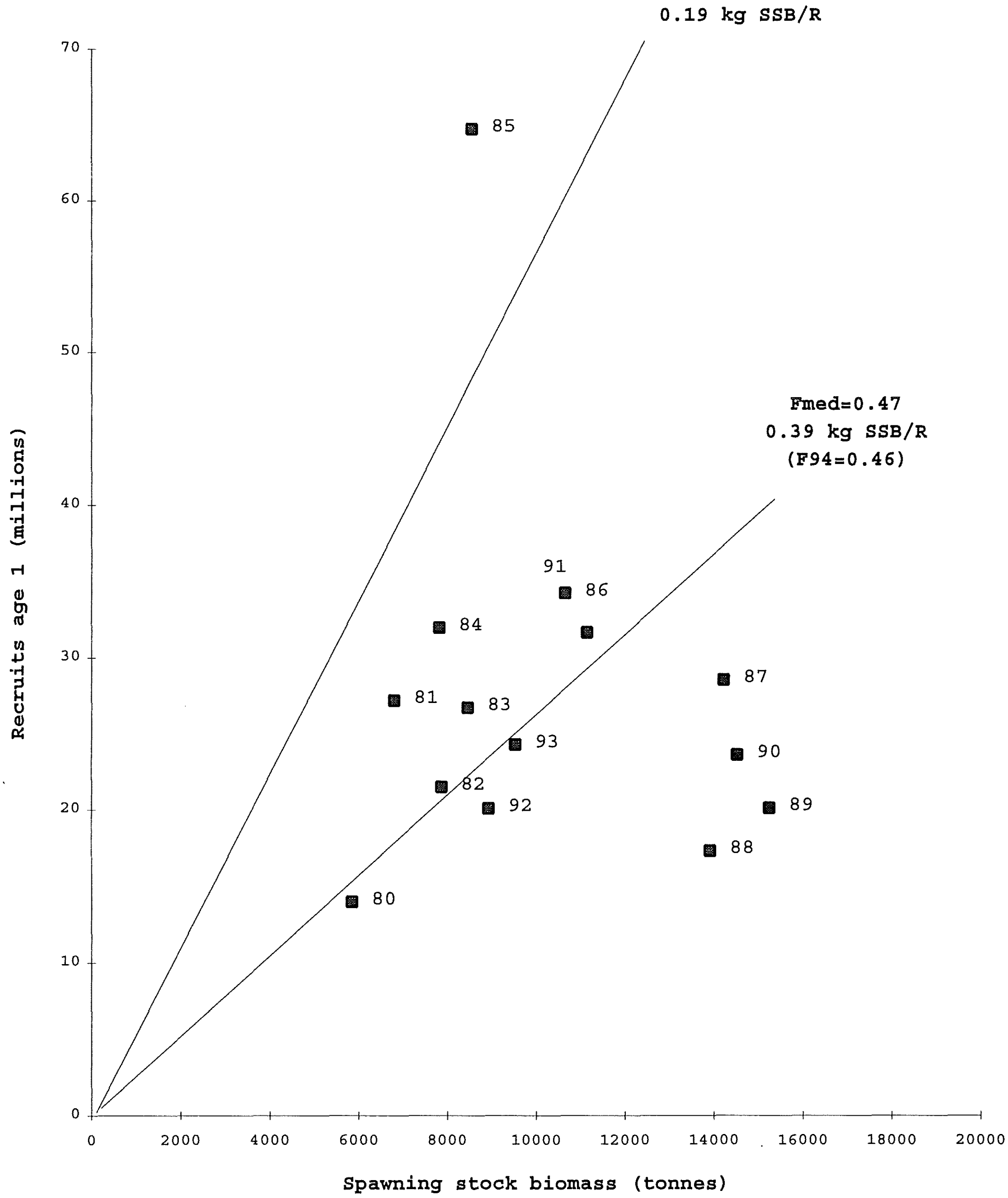
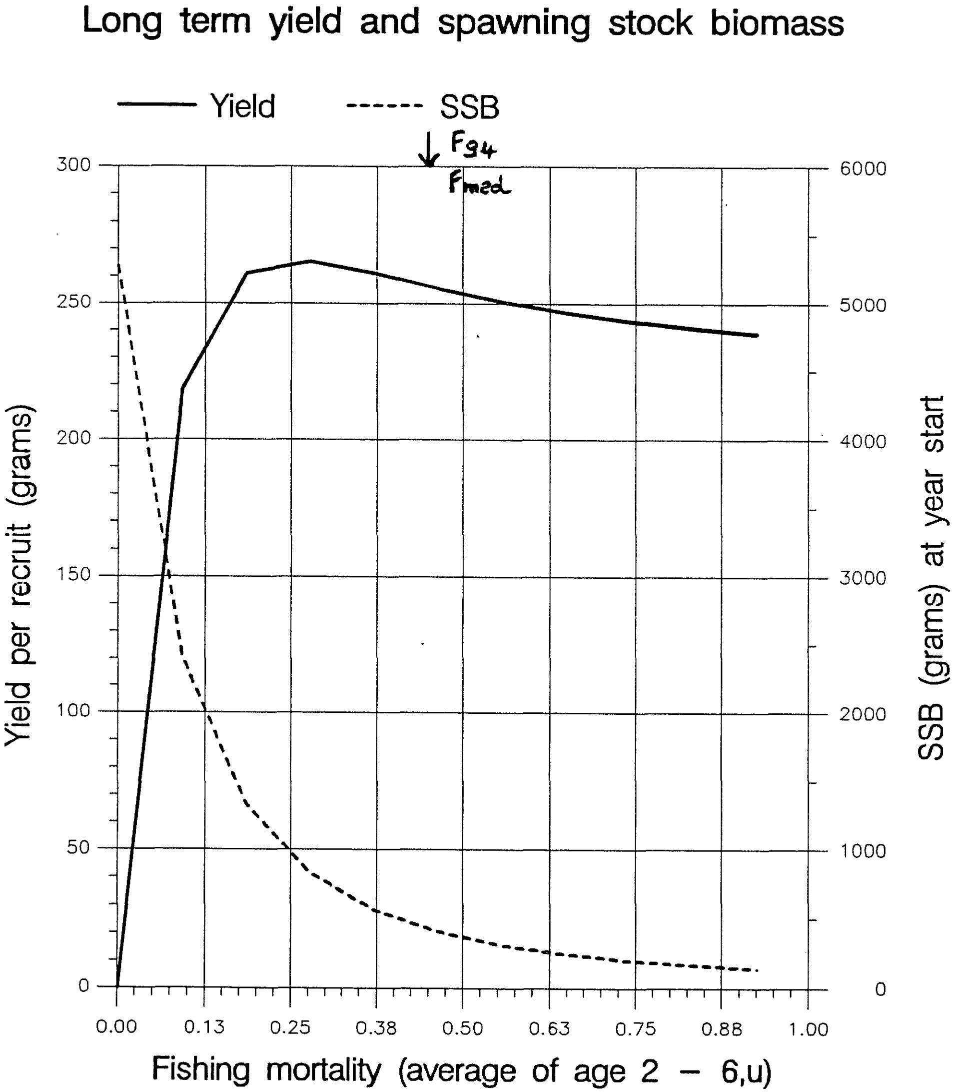


Figure 4.5.5. Plaice in Division VIId. Stock recruitment.

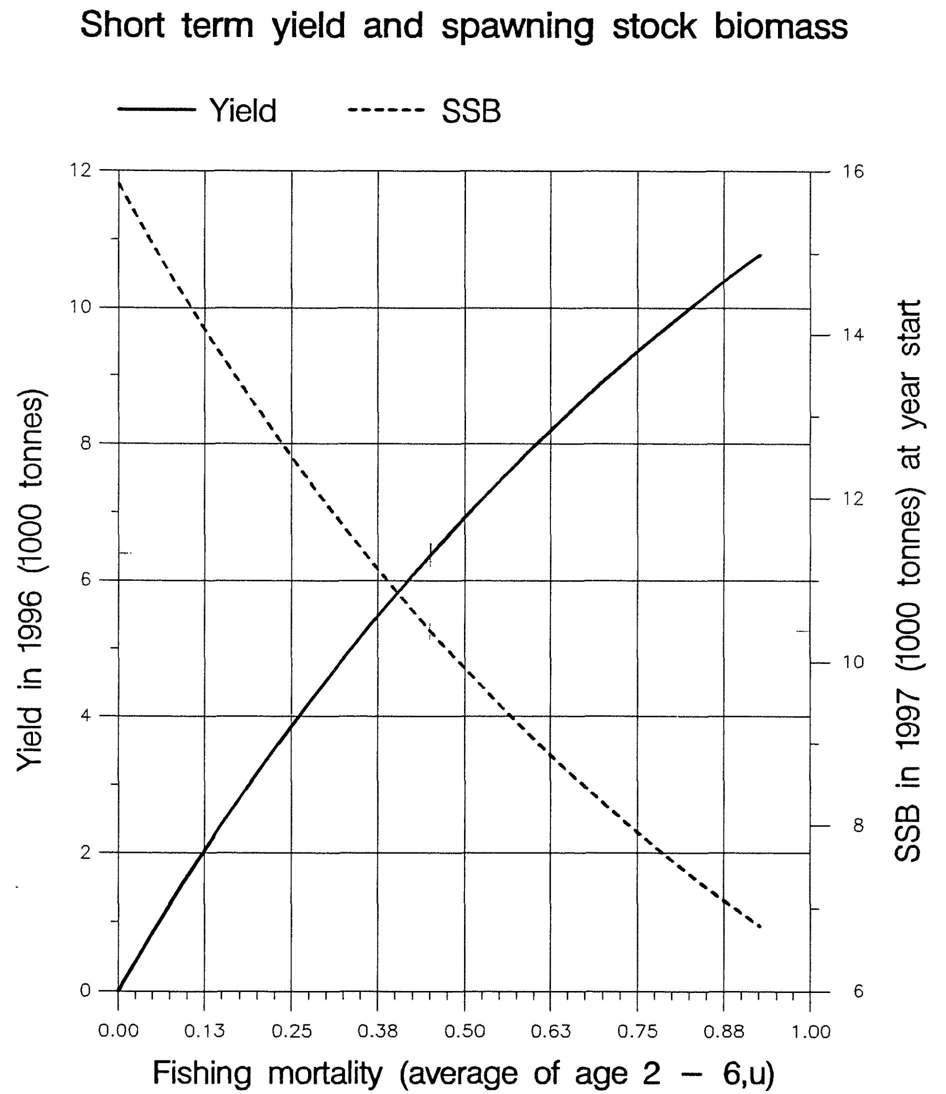


E:\acfm\wgnssk96\ple_eche\FIG455.XLS 09/11/95 14:56

Fish Stock Summary
Plaice in the Eastern English Channel (Fishing Area VIId)
5–10–1995



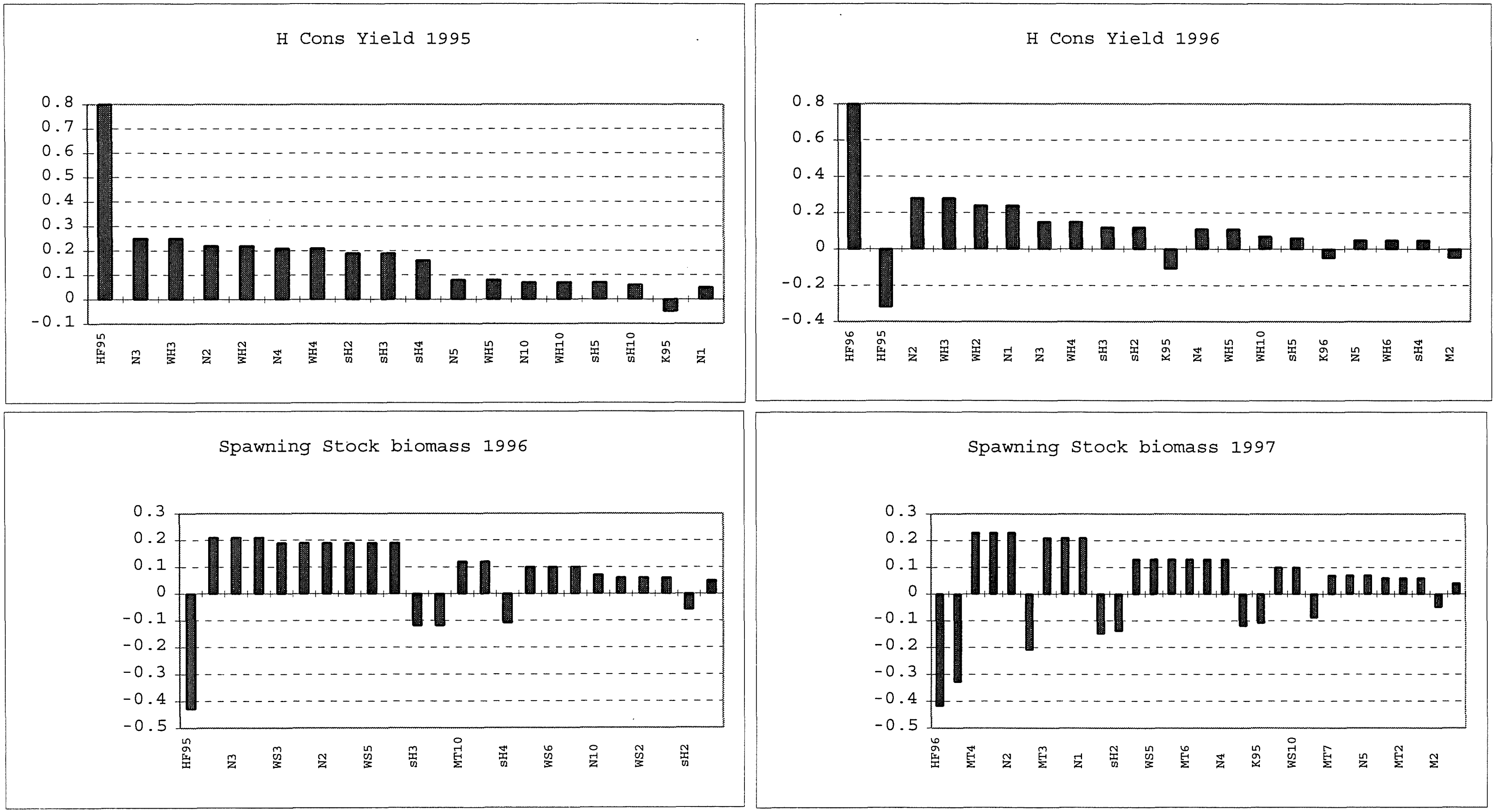
(run: AT_YR94) C



(run: AT94) D

Figure 4.5.6. - Plaice in Division VIId. Yield per recruit and short term forecast.

Figure 4.5.7.- Plaice in Division VIId. Sensitivity analysis of short term forecast.
Linear sensitivity coefficients (elasticities).
Key to labels is in Table .



E:\acfm\wgnssk96\ple_eche\FIG457.XLS 09/11/95 15:39

Figure 4.5.8.- Plaice in Division VIId. Sensitivity analysis of short term forecast.

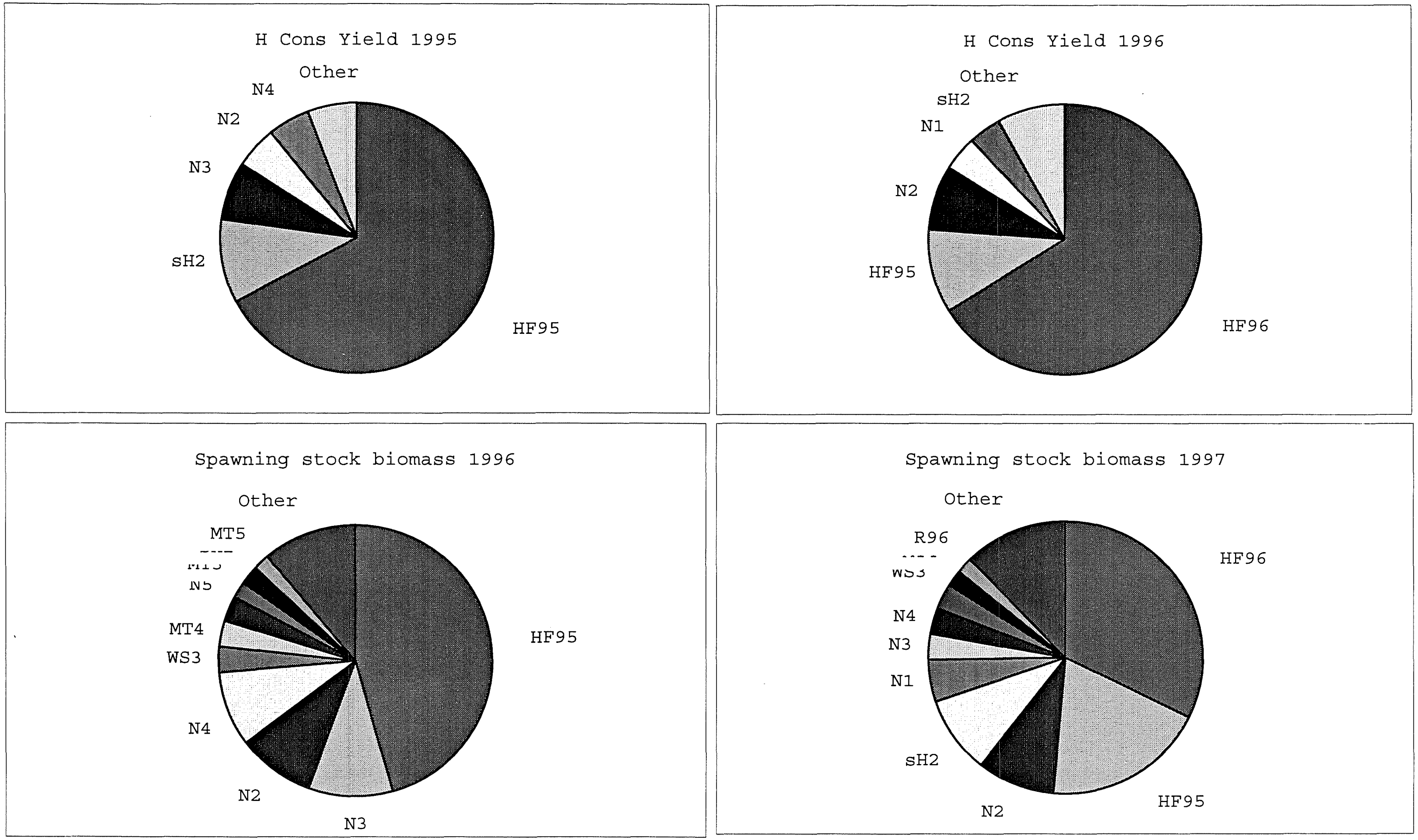


Figure 4.5.9.- Plaice in Division VIId. Sensitivity analysis of short term forecast.

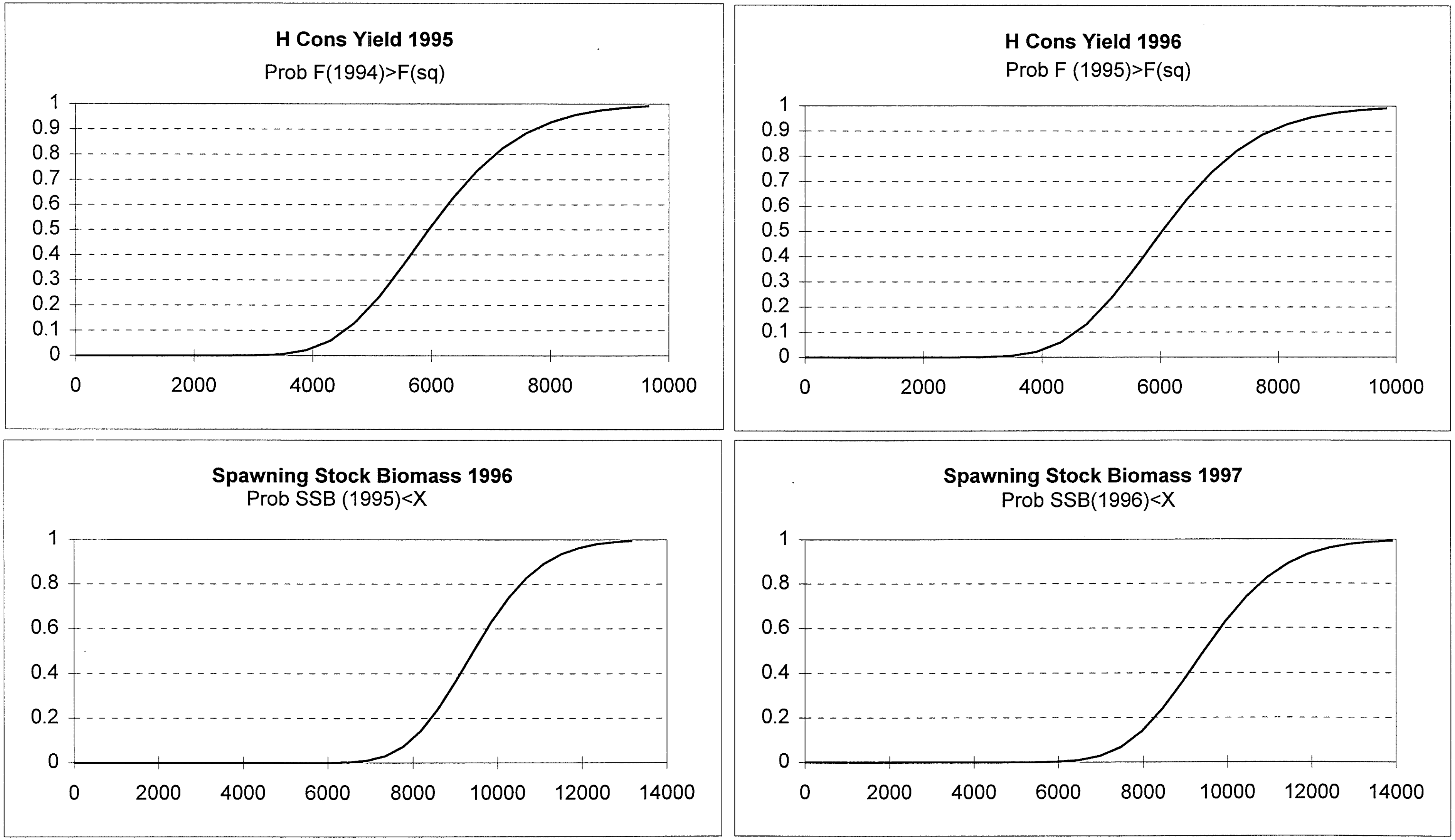
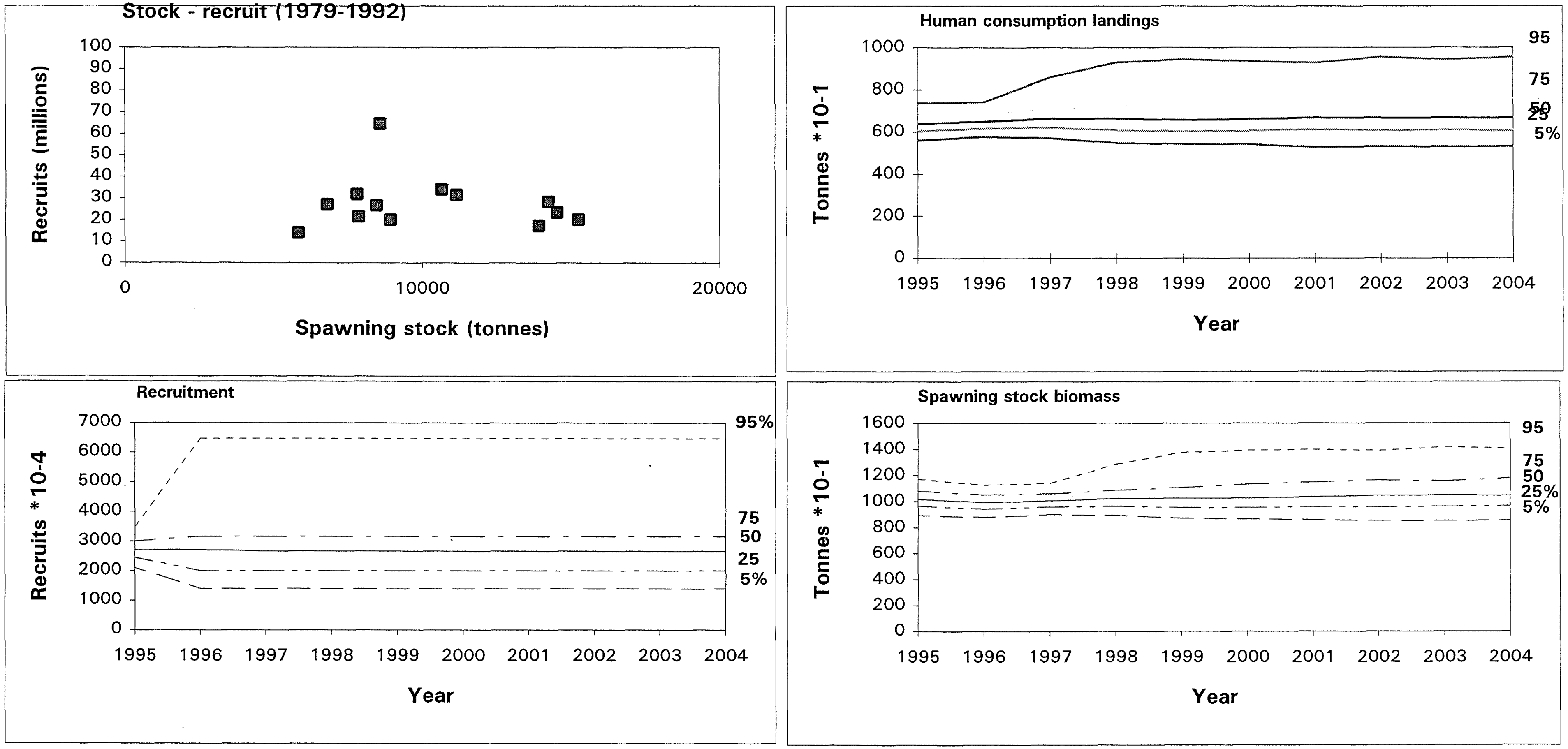
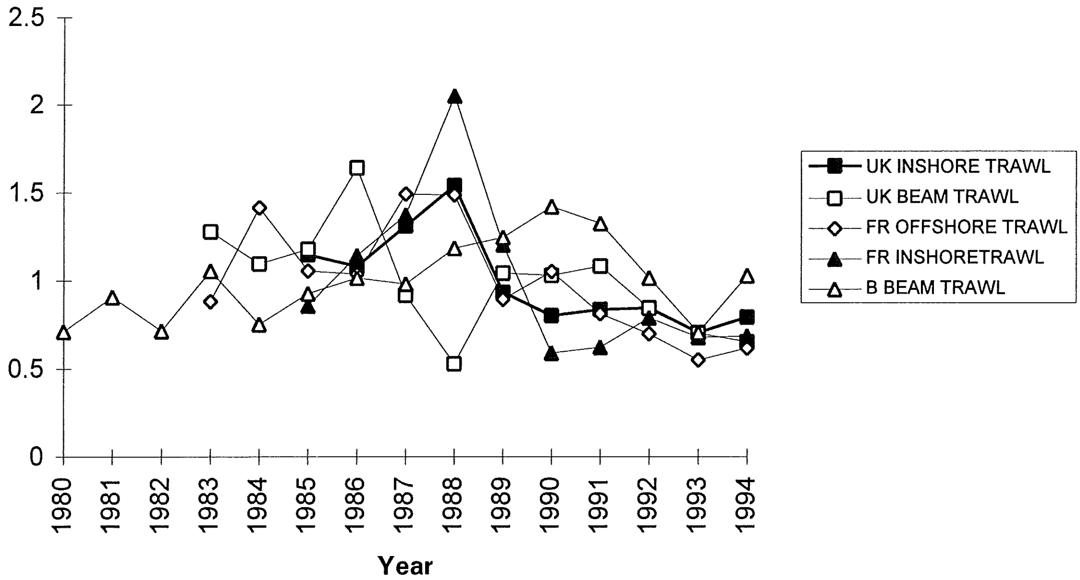


Figure 4.5.10 - Plaice in VIID. Medium term projections showing 5, 25 ,50, 75 and 95 percentiles from random bootstrapped model..



E:\acfm\wgnssk96\ple_eche\FIG4510.XLS 09/11/95 15:46

Figure 4.5.11.- Plaice in Division VIId. Standardised CPUE.



E:\acfm\wgnssk96\ple_eche\FIG4511.XLS 09/11/95 15:43

5. NORWAY POUT AND SANDEEL IN DIVISION VIA

5.1 Overview of industrial fisheries in Division VIa

There are two distinct industrial fisheries operating in Division VIa; a Norway Pout fishery and a sandeel fishery. The Norway Pout fishery is predominately Danish, whereas the sandeel fishery is almost exclusively Scottish and operates in more inshore areas. No information is available on bycatches in the Norway Pout fishery. The sandeel fishery has a small bycatch of other species; bycatch information for 1994 are given in the text table below. Landings from both fisheries are small compared to the fisheries in the North Sea.

Catch composition in the Division VIa Sandeel fishery, 1994. (Landings into UK only)

Species	Weight (t)	Percentage
Lesser Sandeel, *A. marinus*	6334.7	96.6
Smooth Sandeel, G. *semisquamatus*	0.9	0.1
Greater Sandeel, *H. lanceolatus*	65.5	1.0
Whiting	7.5	0.1
Herring	0.2	+
Others	143	2.2

5.2 Norway Pout in Division VIa

Landings of Norway Pout from Division VIa as reported to ICES are given in Table 5.2.1 and Figure 5.2.1. Landings in 1994 were 14,812 t, which is the highest figure since 1989, and is above the series average of 12,120 t. No data are available on bycatches in this fishery. In addition, no age composition date are available so there are insufficient data available to assess this stock.

Table 5.2.1 Norway Pout. Annual landings (t) in Division VIa. (Data officially reported to ICES).

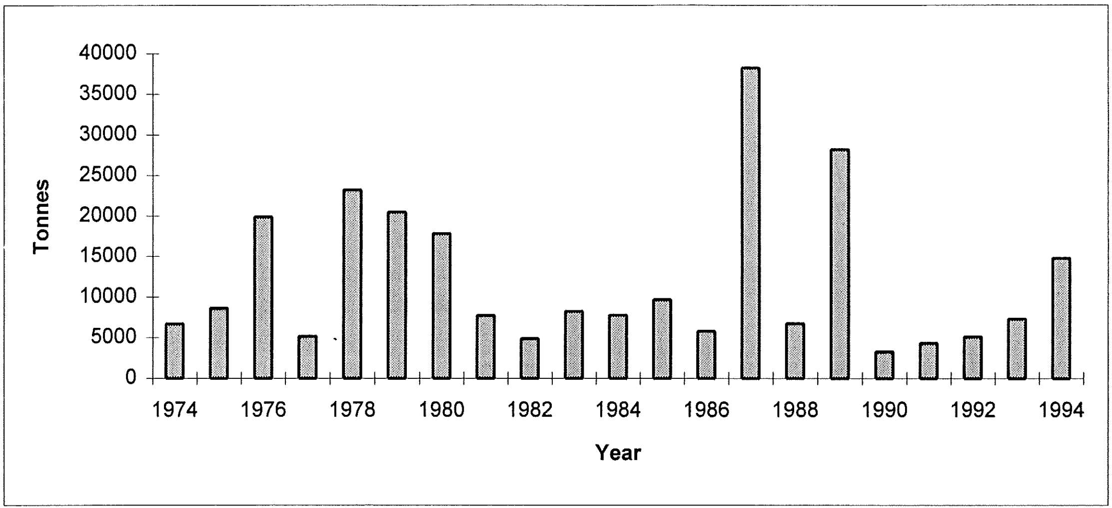
Country	1974	1975	1976	1977	1978	1979	1980	1981
Denmark	-	193	-	-	4,443	15,609	13,070	2,877
Faroes	1,581	1,524	6,203	2,177	18,484	4,772	3,530	3,540
Germany	179	-	8	-	-	-	-	-
Netherlands	-	322	147	230	21	98	68	182
Norway	144[3]	-	82[3]	-	-	-	-	-
Poland	75	-	-	-	-	-	-	-
UK (Scotland)[2]	4,702	6,614	6,346	2,799	302	23	1,202	1,158
Russia	40	2	7,147	-	-	-	-	-
Total	6,721	8,655	19,933	5,206	23,250	20,502	17,870	7,757

Country	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	751	530	4,301	8,547	5,832[4]	37,714[5]	5,849[5]	28,180[5]
Faroes	3,026	6,261	3,400	998	-	-	376	11
Germany	-	-	70	-	-	-	-	-
Netherlands	548	1,534	-	139	-	-	-	-
Norway	-		-	-	-	-	-	-
Poland	-	-	-	-	-	-	-	-
UK (Scotland)[2]	586	-	23	13	-	553	517	5
Russia	-	-	-	-	-	-	-	-
Total	4,911	8,325	7,794	9,697	5,832	38,267	6,742	28,196

Country	1990	1991	1992	1993	1994
Denmark	3,316[5]	4,348	5,147	7,338	14,811
Faroes	-	-	-	-	-
Germany	-	-	-	-	-
Netherlands	-	-	10	-	-
Norway	-	-	-	-	-
Poland	-		-	-	-
UK (Engl.& Wales)	-	-	2	-	1
UK (Scotland)	+	-	-	-	+
Russia	-	-	-	-	-
Total	3,316	4,348	5,159	7,338	14,812

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

Figure 5.2.1 Norway Pout in Division VIa
Catch trends



E:\acfm\wgnssk96\npo_scow\FIG521.XLS09/11/95 15:57

5.3 Sandeel in Division VIa

5.3.1 Catch trends

Landings from the sandeel fishery in Division VIa in 1994 amounted to 10,630 tonnes. This represents an increase relative to 1993, but is still below the landings recorded at the height of the fishery in the mid-eighties. All landings were taken in the months from June to August, from grounds at North Rona and in the North Minch. The increase in landings corresponded to a slight increase in fishing effort. Landings figures for 1981 to 1994 are given in Table 5.3.1. Trends in catch and effort are indicated in Figure 5.3.1

Samples from the catch indicate that bycatch levels are very low, with sandeel constituting in excess of 97% of the landings in 1994.

5.3.2 Commercial catch-effort data and research vessel surveys.

Effort data are available for vessels which land their catch into Scottish ports. In 1994 62 % of the total catch was landed into Scotland, with the remainder being landed into Faroe. To obtain an estimate of total fishing effort, the nominal effort figures obtained from boats landing into Scotland have been raised to the total landings. Effort data by month for boats landing into Scotland are given in Table 5.3.2. Estimates of total effort by half-year are given in Table 5.3.3. The latter figures were used in the catch-at-age analysis.

Research vessel surveys have been conducted in this area during August of 1992 to 1994. The series was not continued in 1995.

5.3.3 Age compositions and mean weights at age

During 1994, samples for age determination were obtained from all month/ground combinations, although fewer samples were obtained during July and August when a higher proportion of the catch was landed into Faroe. Catch at age data by half-year are given in Table 5.3.4. The 1991 year-class was the most abundant cohort in the 1994 catches.

Long term mean weights-at-age in the catch were used to calculate biomass totals. These are given in Table 5.3.5.

5.3.4 Natural mortality and maturity at age

The natural mortality values used in this assessment are the same as those used in the assessment of the North Sea stocks. The values originate from MSVPA. The values are given, along with the maturity ogive, in Table 5.3.6.

5.3.5 Catch-at-Age Analysis

As in recent years, the assessment of this stock used a semi-annual separable VPA (SSV; Cook, 1992; Cook and Reeves, 1993). Equal weight was given to the catch and the effort data. Catches at age 0 were given a weight of 0.5 relative to catches at older ages. This reduces the influence of this age class, where large residuals indicate noisy data. The diagnostics from the SSV run are given in Table 5.3.7

The diagnostics show some large residuals in the year/season effects and the fitted catches for the most recent years. This may be due to deterioration in the quality of catch and effort data for recent years due to a higher proportion being landed into foreign ports. In addition, the assessment is prone to changes in level with the addition of successive years of data. This is likely to be a consequence of the very low level of fishing mortality being swamped by high and variable natural mortality.

Estimates of fishing morality from the final SSV run are given in Table 5.3.8, and fitted populations are given in Table 5.3.9.

5.3.6 Long-term trends

Trends in spawning stock, recruitment and fishing mortality are given in Table 5.3.10 and Figure 5.3.1. The fishery started in the early 1980s . Catches increased in line with effort, with almost 25 thousand tonnes being landed in 1986. This peak was equalled in 1988, but subsequently, catches declined, reaching a low of 4,900 tonnes in 1992. Since then catches have increased again. Trends in catch have always closely followed trends in effort, and the trend in mean F has also followed a similar trend. Mean F has always been low, never exceeding 0.25; but is currently less than 0.05.

Recruitment is highly variable, but the strongest recorded year-class (1991) has been followed by two further above-average year-classes, leading to an increase in SSB to its highest recorded level. The relative strength of the 1994 year-class is uncertain; the SSV estimate of recruitment is subject to high uncertainty, so has been set aside.

5.3.7 Quality of assessment

The level of exploitation of this stock is low relative to natural mortality. This means that this assessment is best taken as an indication of broad trends in the stock, rather than absolute stock levels. There may also be some problems with the quality of catch and effort data for recent years, which may be exacerbated by the low level of exploitation.

5.3.8 Safe biological limits.

The present assessment indicates that the spawning stock is at its highest recorded level, whereas fishing mortality is at a very low level. Notwithstanding the limitations of the assessment, this stock would appear to be within safe biological limits.

Table 5.3.1 Sandeel, Division VIa. Landings (tonnes), 1981–1994, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994*
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	80	-
Scotland	5,972	10,786	13,051	14,166	18,586	24,469	14,479	24,465	18,785	16,515	8,532	4,935	6,156	10,627
Total	5,972	10,786	13,051	14,166	18,586	24,469	14,479	24,465	18,785	16,515	8,532	4,935	6,236	10,627

* Preliminary

Table 5.3.2 Fishing effort (days absent) by month and year in the Division VIa Sandeel fishery 1981–1994, UK (Scotland) data.

Month	1981	1982	1983	1984	1985	1986	1987	1988	1989*	1990*	1991*	1992*	1993*	1994*
Jan	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr	4	54	21	11	7	7	3	26	13	-	-	-	-	-
May	4	121	112	119	131	104	22	87	50	29	5	-	-	-
Jun	-	168	112	128	124	117	79	139	99	138	54	24	31	14
Total	8	343	245	258	262	228	104	252	162	167	59	24	31	14
Jul	90	118	126	125	101	126	93	108	110	75	31	32	45	51
Aug	132	89	76	63	76	94	67	59	22	5	18	13	19	33
Sep	70	34	-	-	28	67	26	28	3	-	-	-	-	-
Oct	3	4	-	-	8	15	-	8	-	-	-	-	-	-
Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	295	245	202	188	213	302	186	203	135	80	49	45	64	84
Annual Total	303	588	447	446	475	530	290	455	297	247	108	69	95	98

* Vessels landings into Scotland only

Table 5.3.3 Sandeel, Division VIa . Nominal effort (days absent) by half-year, 1983–1994. UK (Scotland) data. (Figures for 1989 to 1994 are raised to total landings.

Year	I	II	Total
1983	245	202	447
1984	258	188	446
1985	262	213	475
1986	228	302	530
1987	104	186	290
1988	252	203	455
1989	173	142	315
1990	187	94	281
1991	67	49	116
1992	24	59	83
1993	55	79	134
1994	14	148	162

Table 5.3.4 Sandeel, Division VIa. Catch at age (millions) 1983–1994

Age		1983		1984		1985		1986
	1	2	1	2	1	2	1	2
0	391	2253	186	1751	53	3207	368	2702
1	521	106	863	99	139	13	859	996
2	136	29	226	67	437	163	140	68
3	86	21	138	115	181	117	171	219
4	111	18	67	38	139	73	58	103
5	29	3	28	26	55	28	38	40
6	12	3	8	8	27	12	9	12
7+	2	1	1	3	7	1	6	6

		1987		1988		1989		1990
	1	2	1	2	1	2	1	2
0	105	595	795	173	185	284	21	588
1	521	676	187	72	211	21	602	158
2	97	232	1216	548	136	64	229	6
3	17	37	235	131	569	294	122	11
4	45	31	41	28	135	76	324	52
5	23	20	52	45	228	23	75	19
6	4	7	21	24	19	12	18	1
7+	1	4	3	8	6	8	2	1

		1991		1992		1993		1994
	1	2	1	2	1	2	1	2
0	673	94	122	578	552	814	0	309
1	423	52	226	177	134	76	38	54
2	158	66	29	26	186	67	60	105
3	10	39	8	22	31	5	31	363
4	15	23	5	10	21	16	2	61
5	27	37	1	5	8	2	2	18
6	10	12	4	7	5	1	0	2
7+	1	0	1	3	5	1	0	3

Table 5.3.5 Sandeel, Division VIa. Mean weight at age (g) in catch 1981–1994.

Age	1	2
0	1.43	1.64
1	4.41	5.68
2	8.33	9.18
3	11.58	12.77
4	14.1	15.21
5	16.98	17.15
6	18.61	17.88
7+	20.62	21.97

Table 5.3.6 Sandeel, Division VIa. Natural Mortality and proportion mature.

Age	Natural mortality		Proportion Mature
	1	2	
0	0	0.8	0
1	1	0.2	0
2	0.4	0.2	1
3	0.4	0.2	1
4	0.4	0.2	1
5	0.4	0.2	1
6	0.4	0.2	1
7+	0.4	0.2	1

Table 5.3.7 Sandeel in Division VIa. Diagnostics from SSV.

weight for effort data = 1.0000

RMS for catch data = 0.4555
RMS for effort data = 0.4278

Initial sum of squares = 582.6163
Final sum of squares = 52.3324
Residual mean square = 0.3355

Coefficient of determination = 0.9102
Adj. Coeff. of determination = 0.8779

Number of observations = 213
Number of parameters = 57

IFAIL on exit from E04FDF = 5
IFAIL on exit from E04YCF = 0

No.	parameter	s.d.				Age
1	-0.1321	0.2798	Year/season effect	1983	1	
2	-0.9654	0.2896		1983	2	
3	-0.3541	0.279		1984	1	
4	-0.2554	0.2834		1984	2	
5	0.0442	0.2745		1985	1	
6	-0.3069	0.2808		1985	2	
7	-0.2277	0.273		1986	1	
8	0.46	0.2725		1986	2	
9	-1.1606	0.2698		1987	1	
10	-0.2253	0.2702		1987	2	
11	-0.0475	0.2629		1988	1	
12	0.1518	0.2615		1988	2	
13	0.3313	0.2542		1989	1	
14	0.0864	0.2554		1989	2	
15	0.2897	0.2573		1990	1	
16	-0.96	0.2697		1990	2	
17	-0.9436	0.2742		1991	1	
18	-0.6762	0.2828		1991	2	
19	-2.3955	0.2867		1992	1	
20	-1.3054	0.2855		1992	2	
21	-1.4693	0.2985		1993	1	
22	-2.0566	0.2979		1993	2	
23	-3.3105	0.3344		1994	1	
24	-0.9717	0.3165		1994	2	
25	-5.2844	0.4291	Selectivity at age	0	1	
26	-3.1817	0.4258		0	2	
27	-2.9359	0.293		1	1	
28	-3.3725	0.2961		1	2	
29	-1.9932	0.2782		2	1	
30	-2.6678	0.2851		2	2	
31	-2.0015	0.2713		3	1	
32	-1.9481	0.2752		3	2	
33	-1.7271	0.2641		4	1	
34	-1.4936	0.2759		4	2	
35	-1.2415	0.2628		5	1	
36	-1.2224	0.2762		5	2	
37	-1.113	0.2819		6	1	
38	-1.1094	0.2891		6	2	
39	8.9123	0.9471	Est. Population	1994	2	0
40	9.421	0.5333		1994	2	1
41	8.6405	0.4425		1994	2	2
42	8.3881	0.3961		1994	2	3
43	6.0751	0.367		1994	2	4
44	5.4991	0.3515		1994	2	5
45	3.5706	0.3561		1994	2	6
46	4.2036	0.3651		1994	2	7
47	2.4035	0.4402		1983	2	7
48	2.7389	0.302		1984	2	7
49	2.693	0.2704		1985	2	7
50	3.1938	0.2679		1986	2	7
51	2.9291	0.2849		1987	2	7
52	3.0691	0.2746		1988	2	7
53	3.0379	0.3127		1989	2	7
54	2.8927	0.3811		1990	2	7
55	2.6703	0.4058		1991	2	7
56	3.6537	0.3878		1992	2	7
57	4.5301	0.368		1993	2	7

Year/season effects

year	1	2
1983	0.8763	0.3808
1984	0.7018	0.7746
1985	1.0452	0.7358
1986	0.7964	1.5841
1987	0.3133	0.7983
1988	0.9536	1.1639
1989	1.3928	1.0902
1990	1.336	0.3829
1991	0.3892	0.5085
1992	0.0911	0.2711
1993	0.2301	0.1279
1994	0.0365	0.3785

Residuals

1	2
0.1321	0.7724
0.4058	-0.0094
0.0229	0.1669
0.1558	-0.2509
0.3037	-0.0503
0.0757	-0.3398
-0.6793	-0.6318
-0.5598	0.002
-0.3529	-0.9332
0.0723	-0.1184
-0.0246	0.9248
0.4483	0.4676

Selectivities at age

age	1	2
0	0.0051	0.0415
1	0.0531	0.0343
2	0.1363	0.0694
3	0.1351	0.1425
4	0.1778	0.2246
5	0.2889	0.2945
6	0.3286	0.3298
7	0.1778	0.2246

Log catch residuals

	1983		1984		1985		1986		1987		1988	
	1	2	1	2	1	2	1	2	1	2	1	2
0	0.1527	0.6683	0.3228	0.6209	-1.0908	0.3626	-0.1991	-0.3129	0.523	0.1487	1.1254	-0.5069
1	-0.0852	0.4245	0.5782	-0.4165	-0.7612	-1.5006	0.1521	0.8964	0.1823	0.7654	-0.2092	-0.0803
2	-0.693	-0.3546	-0.1838	-0.4478	0.0441	0.4832	0.0557	-0.2704	-0.5674	0.3925	0.4448	0.53
3	-0.1564	-0.3979	0.2864	0.354	-0.0252	0.2604	0.1633	0.1317	-0.324	-0.1593	-0.0489	-0.44
4	0.3511	-0.4451	0.3172	-0.1346	0.4683	0.4181	-0.3195	-0.1276	0.3959	-0.7324	-0.0156	-0.3183
5	0.236	-0.7301	-0.4268	-0.1044	0.2158	0.4358	-0.071	-0.0909	0.2764	-0.3606	-0.1217	0.121
6	0.1971	0.154	-0.0032	0.4363	0.1046	0.239	-0.3505	-0.0771	-0.2798	-0.1825	-0.0283	0.547
7	-0.0877	0.2421	-0.8776	0.3363	0.6832	-0.6689	0.3238	-0.0585	-0.2246	0.4061	-0.4398	0.6198

	1989		1990		1991		1992		1993		1994	
	1	2	1	2	1	2	1	2	1	2	1	2
0	-0.289	-0.7224	-1.2401	0.2747	0.2851	-1.6091	0.3552	-0.1907	0.8192	0.5275	-0.7607	0.7607
1	-0.1471	-0.9146	-0.0521	1.1426	1.009	-0.0986	0.1801	0.0889	-0.8803	0.3854	0.0353	-0.7087
2	-0.3191	0.2835	0.5711	-0.7371	0.3522	0.2311	0.246	0.0366	-0.4839	0.0776	0.6011	-0.1884
3	0.1524	0.1567	0.4835	-0.3045	-0.5701	0.832	-0.5016	-0.3089	0.0348	-0.9308	0.2015	0.5978
4	-0.3071	-0.3239	0.3227	-0.023	0.1298	0.4465	0.6222	0.3289	-0.0727	0.3443	-0.5016	0.6873
5	1.9717	0.5699	-0.1842	0.2351	-0.5485	-0.0903	-0.8488	0.0029	0.3812	-0.0841	-0.4132	-0.216
6	-0.3366	0.1595	0.6856	-0.3611	-0.1126	0.2449	-0.3112	-0.4875	0.4354	-0.2306	0	-0.5915
7	-0.1367	0.7088	-1.0429	-0.2523	-0.1898	0	0.3066	0.4188	0.1005	-0.82	0	-0.4534

Table 5.3.8 Sandeel in Division VIa. Total fishing Mortality.

	1983		1984		1985		1986	
	1	2	1	2	1	2	1	2
0	0.004	0.016	0.004	0.032	0.005	0.031	0.004	0.066
1	0.047	0.013	0.037	0.027	0.055	0.025	0.042	0.054
2	0.119	0.026	0.096	0.054	0.142	0.051	0.109	0.110
3	0.118	0.054	0.095	0.110	0.141	0.105	0.108	0.226
4	0.156	0.086	0.125	0.174	0.186	0.165	0.142	0.356
5	0.253	0.112	0.203	0.228	0.302	0.217	0.230	0.467
6	0.288	0.126	0.231	0.255	0.343	0.243	0.262	0.522
7	0.156	0.086	0.125	0.174	0.186	0.165	0.142	0.356
Mean F (1-3)	0.095	0.031	0.076	0.064	0.113	0.060	0.086	0.130

	1987		1988		1989		1990	
	1	2	1	2	1	2	1	2
0	0.002	0.033	0.005	0.048	0.007	0.045	0.007	0.016
1	0.017	0.027	0.051	0.040	0.074	0.037	0.071	0.013
2	0.043	0.055	0.130	0.081	0.190	0.076	0.182	0.027
3	0.042	0.114	0.129	0.166	0.188	0.155	0.181	0.055
4	0.056	0.179	0.170	0.261	0.248	0.245	0.238	0.086
5	0.091	0.235	0.276	0.343	0.402	0.321	0.386	0.113
6	0.103	0.263	0.313	0.384	0.458	0.360	0.439	0.126
7	0.056	0.179	0.170	0.261	0.248	0.245	0.238	0.086
Mean F (1-3)	0.034	0.065	0.103	0.096	0.151	0.089	0.145	0.032

	1991		1992		1993		1994	
	1	2	1	2	1	2	1	2
0	0.002	0.021	0.000	0.011	0.001	0.005	0.000	0.016
1	0.021	0.017	0.005	0.009	0.012	0.004	0.002	0.013
2	0.053	0.035	0.012	0.019	0.031	0.009	0.005	0.026
3	0.053	0.072	0.012	0.039	0.031	0.018	0.005	0.054
4	0.069	0.114	0.016	0.061	0.041	0.029	0.006	0.085
5	0.112	0.150	0.026	0.080	0.066	0.038	0.011	0.111
6	0.128	0.168	0.030	0.089	0.076	0.042	0.012	0.125
7	0.069	0.114	0.016	0.061	0.041	0.029	0.006	0.085
0								
Mean F (1-3)	0.042	0.041	0.010	0.022	0.025	0.010	0.004	0.031

Table 5.3.9 Sandeel in Division VIa. Fitted Populations (millions).

Age	1983		1984		1985		1986	
	1	2	1	2	1	2	1	2
0	0	64704	0	27363	0	88392	0	135446
1	18079	7754	19183	8304	7981	3392	25822	11122
2	2789	1833	3439	2315	3633	2334	1486	988
3	1039	684	1323	891	1625	1046	1643	1093
4	624	396	480	314	591	364	697	448
5	118	68	269	163	195	107	228	134
6	45	25	45	26	96	50	64	36
7+	17	11	24	15	24	15	38	24
SSB (tonnes)	47254		56635		63006		47078	

Age	1987		1988		1989		1990	
	1	2	1	2	1	2	1	2
0	0	23207	0	17278	0	46530	0	36908
1	38199	16881	6762	2888	4959	2069	13394	5606
2	4733	3360	7380	4801	1247	764	896	553
3	656	466	2355	1534	3281	2013	525	325
4	646	453	308	192	962	557	1277	746
5	233	158	280	158	110	54	323	163
6	62	42	92	50	83	39	29	14
7+	27	19	34	22	36	21	31	18
SSB (tonnes)	61798		100257		66100		38212	

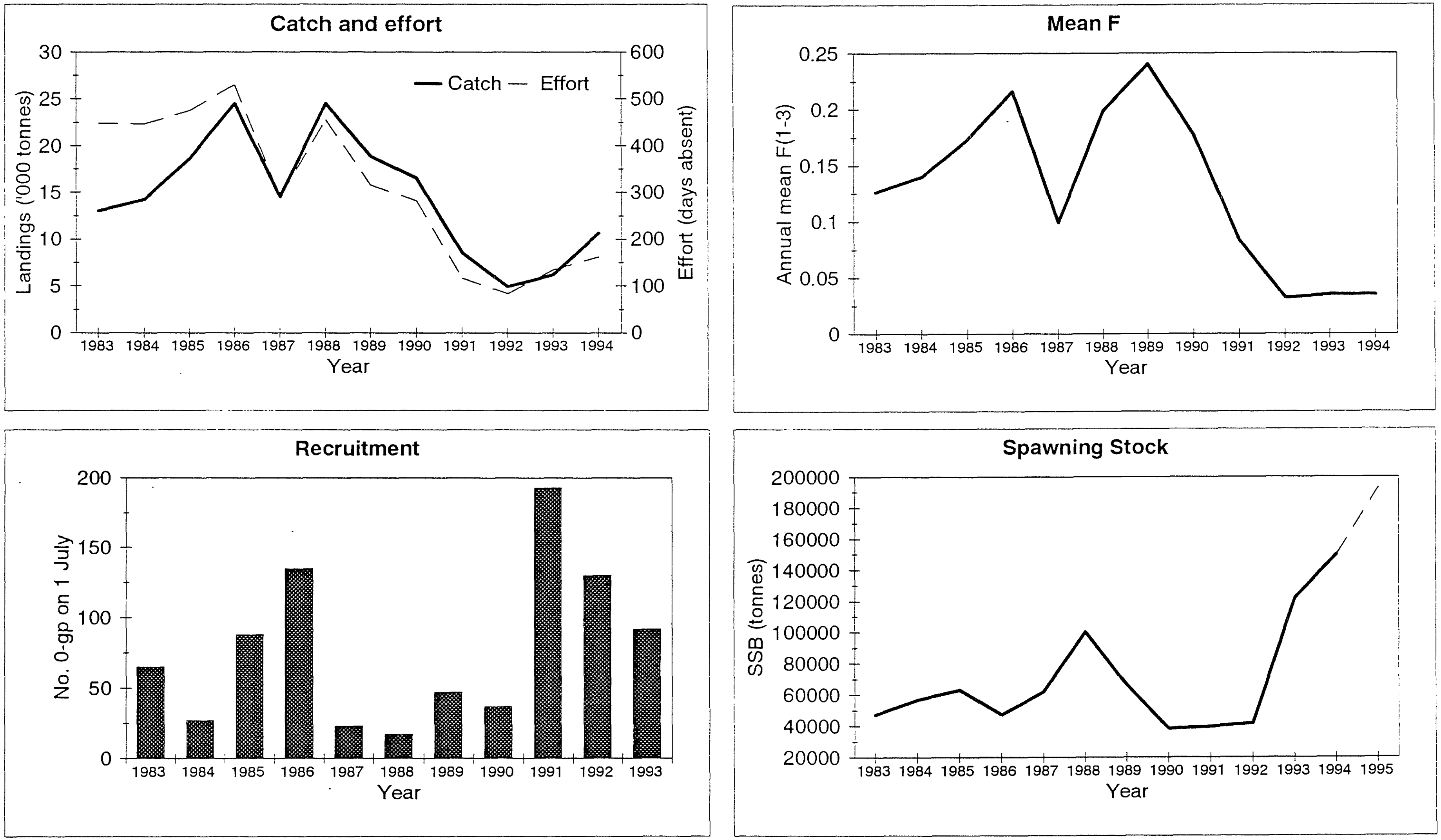
Age	1991		1992		1993		1994		*1995*
	1	2	1	2	1	2	1	2	*1*
0	0	192632	0	129748	0	91878	0	7423	*0*
1	10941	4816	56807	25402	38642	17152	27527	12345	*3282*
2	2486	1747	2126	1556	11308	8119	7673	5656	*9977*
3	399	280	1249	914	1131	812	5961	4395	*4512*
4	228	157	193	141	651	463	591	435	*3409*
5	507	336	104	75	98	68	333	244	*327*
6	108	70	214	154	51	35	49	36	*179*
7+	21	14	53	39	130	93	91	67	*26*
SSB (tonnes)	39595		41736		121765		149720		*192841*

Table 5.3.10 Sandeel in Division VIa. Stock Summary.

Year	SSB (tonnes)	Recruits (billions)	Mean F (1-3)	Landings ('000 t)
1983	47254	65	0.126	13
1984	56635	27	0.140	14.2
1985	63006	88	0.173	18.6
1986	47078	135	0.216	24.5
1987	61798	23	0.099	14.5
1988	100257	17	0.199	24.5
1989	66100	47	0.240	18.8
1990	38212	37	0.177	16.5
1991	39595	193	0.083	8.5
1992	41736	130	0.032	4.9
1993	121765	92	0.035	6.2
1994	149720	7*	0.035	10.6
1995	*192841*			
Mean	69430	78	0.130	14.6

* Value set aside

Figure 5.3.1 Sandeel in Division VIa. Stock Summary.



6. SUMMARIES OF EVALUATIONS

6.1 Stock units used in assessments

In response to the Terms of Reference to investigate the identity of stock units reviews have been made for the stocks assessed by the present working group.

6.1.1 Stock identity: cod

In the area covered by the Working Group cod are assessed and managed as three different units: the North Sea, the Skagerrak and the eastern Channel. It is uncertain whether cod in these areas represent separate stocks.

The question of the validity of the present stock unit definitions used for assessment and management purposes has been considered on several occasions by predecessors of the present Working Group in meetings in 1970 and 1971 (North Sea), 1986 (North Sea/West of Scotland), 1989 (Sub-area VII) and 1990 (North Sea/Divisions VIId and e).

North Sea

On the basis of a review of extensive tagging data (Anon., 1970 and 1971), it was concluded that cod do not disperse uniformly throughout the North Sea but remain more or less within one region. As an approximation the following regional grouping was suggested:

a) the Norwegian side of the Skagerrak,
b) the Danish side of the Skagerrak,
c) one or possibly several coastal regions, from Flamborough to the Scottish east and north coasts,
d) the central North Sea,
e) the Southern Bight, from the Straits of Dover to latitude 54 degrees N,
f) the English Channel, south and west of the Straits of Dover.

North Sea cod is certainly not a homogeneous stock (Jamieson and Birley, 1989), but on the basis of genetically studies, substocks with clear boundaries cannot be discriminated.

Relation between North Sea and West of Scotland

There appears to be a continuous distribution of gadoid eggs, larvae and pelagic O-group fish extending from the Hebrides to the North Sea.

From what is known of the hydrography of the area, it seems likely that a proportion of the spawning products from west of 4 degrees W (the Sub-area IV/VI boundary) is carried into the North Sea. However, the extent of this passive transport is not known. Transport in the opposite direction is unlikely to occur.

Recaptures of tagged fish suggest a net westerly migration but this appears to be on a rather small scale.

There is no significant correlation between recruitment west of Scotland and the North Sea.

It may be concluded that there is interchange between Divisions IVa and VIa, but the extent to which this interchange occurs is uncertain.

Relation between North Sea and Eastern Channel

There have been several tagging experiments in Division VIId and the southern North Sea (Working Document by W. Parnell). A significant proportion of cod released in Division VIId were recaptured in the North Sea (40 %) but there was little movement westward to Division VIIe (4%). Cod released in the southern North Sea were mostly recaptured there (98%), with a small proportion (2%) recaptured in Division VIId, and only 0.2% in the western Channel. The general picture of the tagging experiments is therefore the movement of cod from the eastern Channel into the North Sea, but relatively little movement from the North Sea into the Channel.

An analysis of CPUE correlations shows that catch rates in Division VIId were most highly correlated with catch rates in Division IVc.

Egg surveys have shown the existence of spawning areas in the Eastern Channel (Heessen and Rijnsdorp, 1989). Juvenile cod in the eastern Channel probably originate from eggs spawned in the same area. Tagging studies suggest that the eastern Channel contains semi-resident adult cod which move into the Southern Bight less frequently than the juvenile fish (Symonds, unpublished data). However, as the juvenile cod grow, they filter into the North Sea and, as such, the eastern Channel cod clearly have close links with the North Sea stock (Anon., 1993).

All evidence suggests that cod in the eastern Channel (Division VIId) have strong links with those in the southern North Sea and that there is little interchange with the western Channel (Division VIIe).

Relation between North Sea and Skagerrak

The identity of cod in Division IIIa has been discussed by the Division IIIa Demersal Stocks Working Group on several occasions (e.g. Anon., 1986; Anon., 1990). From a review of available information in Anon. (1990) it was concluded that a separate stock exists in the Kattegat, spawning in the southern part of that area. Also, there was good evidence for a coastal (fjord) stock(s), spawning in the fjords along the Norwegian coast. This is the case also along the Swedish Skagerrak coast (Hallbäck *et al.*, 1974). Results of taggings, information on distribution of larvae and (lack of) spawning indicated a connection between the cod in the eastern North Sea and the Skagerrak, but Anon. (1990) felt that more information would be required before conclusions can be drawn about the mixing of the cod in these areas.

Hagström *et al.* (1990), after reviewing the results of the February IBTS 1981 - 1990, supported this idea. In February, cod were spawning in the Norwegian and Swedish fjords and in the Kattegat, while offshore in the Skagerrak almost no mature or close to mature cod were found, indicating an emigration of those fish to remote spawning grounds.

During 1992 - 1994 investigations were performed aimed at finding the distribution of juvenile pelagic cod in the Skagerrak and adjacent areas in the North Sea and the Kattegat. The results are reported by Munk *et al.* (1993), Larsson *et al.* (1994), Munk (1993), Munk (1995) and Munk *et al.* (1995). The distribution pattern was consistent throughout the three years, and showed a more or less continuous distribution of cod larvae, from the north-eastern North Sea into the Skagerrak. Major concentrations were found at the border between Skagerrak and Kattegat. The main conclusion is that the Skagerrak cod (except the coastal stock(s)) and cod in the northern Kattegat are recruited from spawning in the North Sea.

In May 1992, 1993 and 1994 the north-eastern North Sea, the Skagerrak and the northern part of the Kattegat were covered by extensive surveys, to study the distribution of cod larvae and early juveniles in relation with hydrographical parameters (Larsson, 1995). The observed pattern supports the hypothesis that the Skagerrak cod, excluding coastal cod from the fjords, are recruited from spawning grounds in the North Sea.

Conclusion

It may be concluded that the cod in the North Sea, the Skagerrak and the eastern Channel could be considered to be a single stock for assessment purposes. However current data problems, especially in Division VIId, should be clarified before combining the data. Furthermore, it should be noted that the stock structure in the eastern Channel rather differs from that in the central and northern North Sea, but has much more resemblance with the cod in the southern North Sea. Management of such a large area may however be difficult, due to local differences in abundance, which may change over time.

6.1.2 Stock identity : Haddock

Within the area covered by this Working Group, there is a large fishery for haddock in the North Sea, and smaller fisheries in adjacent areas to the west of Scotland (ICES Division VIa) and in the Skaggerak (Division IIIa). Easey (1986) reviewed the data on interchange of haddock between the North Sea and Division VIa. He noted that there was some movement from the North Sea into VIa, but that this was on a relatively small scale. More recently, Hall, *et al.* (1995) reviewed past Scottish tagging data, covering areas IVa, IVb, Vb and VIa, and found that between area movements are generally low. An electrophoretic analysis of transferring alleles in samples of haddock caught throughout the species range in the North Sea and to the west of Scotland (Jamieson and Birley, 1989), indicated that there is a genetically homogeneous population extending from around the Hebrides into the North Sea on the east coast of Scotland. A distinct race of haddock was, however, observed along the eastern margins of the North Sea. Thus the biological information on the stock identity of haddock in the North Sea and west of Scotland is limited and rather inconclusive. From the assessments of the respective 'stocks' it is clear that recruitment in the two areas is well correlated.

The relationship between haddock stocks in the North Sea and Division VIa has previously been reviewed by the ICES Roundfish WG. In 1986 they noted (Anon. 1986) that although there is clearly some interchange between the two areas, the extent of this is uncertain, so it was felt that it would not be appropriate to combine the assessments of the two areas. This view was reiterated at the 1989 WG meeting (Anon. 1990) where it was also noted that more data on the interchange between the two areas would be necessary before a combined assessment could be considered.

With regard to haddock in the Skaggerak, the situation is even less clear. A preliminary analysis (Anon, 1993b) indicates that recruitment trends in the Skaggerak are similar to those in the North Sea. A recent review of literature concerning fisheries in the Skaggerak and Kattegat (Anon, 1993a) concluded that not much is known about haddock in the Skaggerak, but that it appears to be related to the North Sea stock.

In view of the problems with catch data in the assessment of haddock in IIIa, it would seem inadvisable to consider a combined North Sea/IIIa assessment until these problems have been fully resolved.

6.1.3 Stock identity : Whiting

The question of the validity of the current stock unit used by the Working Group was several times reviewed (Anon. 1986, Anon. 1989, Anon. 1990). The main problem is whether or not the whiting in the Skagerrak and the eastern Channel are part of the North Sea stock, and what the relation is between the west of Scotland whiting and the North Sea stock.

A Study Group, set up by France and England, investigated the question of stock units in 1991 (Anon., 1993) in the Channel and the two adjacent areas. This report refers to different studies which could be summarised as follows:

Katerinas (1986) summarised data on the distribution and abundance of whiting eggs from a series of surveys during 1971, 1976 and 1984 in the Channel and the southern North Sea. Whiting were found to spawn throughout the area but egg abundance was slightly higher in the southern North Sea. O-group whiting appear to show an affinity with the estuaries in the area. 1-Group whiting are regularly caught throughout the Channel at sites where also adult fish are caught (English and French survey data).

The spatial and temporal distribution of tag returns from releases in the North Sea (Rout, 1962) indicates that whiting moved into the eastern Channel and southern North Sea during the first quarter and returned to the southern central North Sea in summer. Riley (unpublished data) reviewed all tagging experiments with whiting in southern North Sea in the period 1950-1988. Most returns were from the eastern Channel.

Child (1988) sampled 1-year-old whiting from different regions of the North Sea and analysed allele frequency data at two loci. His data suggest that there is no genetically-based division between whiting from the southern and northern North Sea. He hypothesised that mixing of larvae from different regions maintained genetic homogeneity.

Kabata (1963) studied the infection of whiting with parasites in order to see if they can be used as tags for studying subdivisions of the populations around the British coasts. The results of parasites analysis suggested that in the North Sea there are two stocks of whiting. The northern stock is infested with *Ceratomyxa* and the southern stock with *Myxidium*. The limit of the two stock could pass through the Dogger Bank. In contrast to the whiting of the northern North Sea, the population in the Faroes is infected with *Myxidium*. That means there is no exchanges between the populations of whiting off the Faroes and in the waters over the continental shelf.

Tagging data (Rout, 1962) and parasite studies (Noble, 1957; Kabata, 1963) suggest that whiting from the southern North Sea are closely related to those in the Channel, more than to whiting in the northern North Sea.

There are very few data which support a relation between whiting in the eastern and western Channel. It is likely that a stronger relationship exists between whiting in IVc and VIId, than between whiting in VIId and VIIe.

<u>Conclusion</u>

According to the relevant reference, it seems that the whiting population in the eastern Channel, North Sea and Faroes is composed of three stocks, a small one around the Faroes, a second one in the northern part of the North Sea (VIa and VIb) and a third including the southern part of the North Sea and the eastern Channel.

6.1.4 Stock identity : saithe

This problem was discussed in the Saithe Study Group in Aberdeen this summer (C.M.1995/G:2). This group found that the saithe in Divisions IVa and VIa had similar recruitment pattern, and spawning areas in these Divisions are not separated. Furthermore, it is known that some saithe migrate from Division IIa to IVa, and that some saithe larvae drift the opposite direction.

6.1.5 Stock identity : plaice

Plaice is distributed throughout the continental shelf of the north-eastern Atlantic and occurs in depths down to 100 m. Spawning takes place in all offshore waters from the English Channel (VIIe and VIId), the southern and south-eastern North Sea into the Skagerrak and along the English and Scottish east coast (Harding *et al.*, 1978), but major centres of egg production occur in the eastern Channel and the Southern Bight. Minor local centres occur along the English east coast and in the Moray Firth. The spawning areas in the Kattegat and Baltic are less well described. Pelagic eggs and larvae are transported by the residual current. Juveniles are distributed over sandy substrates in shallow coastal waters and estuaries.

Adult tagging experiments in the North Sea were analysed o.a. by de Veen (1962) and Rijnsdorp & Pastoors (1994). Experiments in the Channel were analysed by Houghton & Harding (1976). The results showed that adult fish showed an annual migration cycle between the spawning areas in winter and the feeding areas in summer. Adults were shown to return to their spawning areas in successive years. In the North Sea, the feeding areas are generally located north of the spawning areas. The migration patterns in the Channel are less clear. The tagging data suggest that in the Channel two sub-groups may be distinguished (Anon., 1993). The Channel plaice appear to migrate over shorter distances and stay in the Channel, whereas the North Sea fish appear to enter the Channel only to spawn. The movements of plaice between the Channel and Irish Sea are insignificant (Anon., 1993).

The extensive tagging experiments carried out in Danish waters and off Scotland have not yet been analysed in the context of the stock identity.

Tagging data from juvenile experiments, conducted in the North Sea, Channel and Skagerrak, were analysed by Anon. (1992). Results showed that juveniles migrated against the direction of the residual current to the spawning areas. Juveniles from the English east coast migrated northward to the spawning areas along the English and Scottish coast. Juveniles from the nursery grounds on the continental coast migrated in a south-westerly direction: those from the Skagerrak mainly recruited to spawning areas in the eastern North Sea; those from the Wadden Sea to the German Bight and Southern Bight; juveniles from the Scheldt estuary and off the Belgian coast to the spawning areas in the Southern Bight and the eastern Channel. The spawning areas in the eastern and western Channel receive a substantial (30-50%) number of recruits from nursery grounds of the southern North Sea.

The underlying stock structure of adult plaice may be represented by a continuum of overlapping sub-groups. During the spawning period fish separate in sub-groups whereas during the feeding season they mix with other sub-groups on the feeding grounds. Because of the continuous distribution of eggs, the delineation of sub-groups has a arbitrary character. De Veen (1962) distinguished four sub groups spawning in the North Sea (Southern Bight, area south of the Dogger, the German Bight and Flamborough Head area). Other sub-groups may be defined on the basis of the discrete centres of egg production in the western and eastern English Channel, along the English east coast and in the Moray Firth and the Firth of Forth. The distinction of sub-groups is supported by difference in maturation, fecundity, meristic characters and parasitic infection rates.

Conclusion

Available data suggest that the plaice population in the Channel, North Sea, Skagerrak and Kattegat is composed of several sub-groups which separate during the spawning season but partly overlap during the feeding season. Tagging data clearly indicate substantial movement between the southern North Sea and the eastern and western Channel, and between the North Sea and Skagerrak. A comprehensive and quantitative analysis of the available tagging data in conjunction with data on the distribution of juveniles and adults and hydrographic data is needed as a basis to evaluate management units, management measures and biological and technical interactions.

6.1.6 Stock Identity: Sole

Sole are distributed throughout the southern North Sea, south of 56^0 N and in the eastern Channel. Data on the distribution of sole by age (Anon., 1995) show that there is a consistent pattern of movement offshore into deeper water from the main nursery areas until about age three. Superimposed on the offshore movement is a well defined seasonal movement (Anon., 1989). This results in the rapid inshore movement to spawn in the spring as water temperature rises above 7°C and peaks at about a temperature of 10°C. Spawning occurs in spawning areas on both sides of the North Sea and Eastern English Channel (Riley *et al.* 1986; van Beek, 1988). The position of the spawning areas must be defined by current systems which ensure that the larvae reach appropriate nursery grounds within the 30 days or less required for development from eggs to metamorphosing larvae. Following spawning there is a slower diffusion of fish away from the spawning areas but the rate and extent of this movement is restricted and results in limited mixing of sole compared with other species such as cod and plaice (ICES, 1965,89,92). The distribution of sole nursery areas has been described for the North Sea and VIId (van Beek *et al.* 1989) and indicates that the main nurseries are located in shallow productive coastal areas with the most important occurring on the eastern North Sea coast. Nursery grounds in estuaries and shallow bays on the English and French coasts of VIId have also been identified (Mesnil, 1983; Peronnet and Tetard, 1984; Riley *et al.*, 1986; Millner & Whiting, 1990). Analysis from different survey areas (Rijnsdorp *et al.* 1992) indicate that there is some correlation of recruitment patterns between adjacent grounds but that this breaks down over a wider geographical spread.

Published data from tagging exercises which described the movements of sole within and between the eastern Channel and the North Sea (ICES, 1989), suggested that there was a permanent emigration from age 1 to 3-4 years of around 10% to the southern North Sea and up to 30% to the western Channel. There was no evidence of a significant immigration to the eastern Channel by sole tagged in the southern North Sea.

Information on growth, fecundity and maturation of sole in both regions shows that although there are gradual differences in populations coinciding with their relative geographical positions, there are no clear stock differences (Millner & Whiting, 1990 Rijnsdorp & Vingerhoed, 1995; Witthames & Greer Walker 1995; Ramsay, 1993).

Conclusion

There is insufficient evidence to make firm conclusions about the level of separation between North Sea and VIId stocks. However, the available evidence suggests that there are loosely defined sub-stocks in both the North Sea and VIId which have separate spawning and associated nursery areas. Although there is emigration of juvenile sole from VIId to VIIe, the growth, age composition, recruitment and fishery of VIIe stocks are completely different from VIId. There would appear to be little support for managing these stocks together.

6.1.7 Stock identity : Norway pout

In last years report from the WG on the assessment of Norway pout and sandeel the separation of the stock of Norway pout in areas IV and IIIa was considered. It was concluded that the justification for a separate stock assessment in IIIa is highly questionable and a preliminary run was made last year including the IIIa fishery as an additional fleet in the North Sea assessment. The combined assessment produced results which were very close to the results produced by the North Sea assessment. However, since the main use of the assessment of Norway pout in the North Sea is to provide stock estimates for Multispecies considerations it was decided not to include the IIIa landings in the North Sea assessment.

6.1.8 Stock identity : sandeel

Sandeel in the North Sea has been assessed separately as a northern and southern component in the past. One of the major reasons, why the assessments were done separately, was the existence of pronounced growth differences observed in earlier years, which have been diminishing later. An inspection of 1994 weight at age data gives some additional insight into this question. Data from the second half of the year, in which the smaller share of the catch is taken, the weight at age data from the SNS and the NNS differ by a factor of two. Data for the more important first half of the year, however are much more in line with each other. In addition, a comparison of the Norwegian and Danish data from the NNS in the 1st half of the year are extremely different from each other, weight at age in the Norwegian data being between 1.5 and 3.3 times higher than the respective values in the Danish samples. These results indicate that 1) the overall conclusion of only minor growth differences between the two subareas is valid for the majority of the catch data 2) The variability within the Subareas can be quite considerable and exceeds the observed differences between the two subareas in the second quarter. These observations are in line with the general understanding of the biology of the sandeel (see C.M.1995/Assess:5 and C.M.1995/G:4), which is considered to be stationary to a large extent, which will most likely lead to pronounced local differences in population parameters. It would seem adequate thus, to split the stock rather into smaller subareas than the previously two large subareas NNS and SNS. This would, however, require a sampling effort of the biological sampling of catches, which seems at present unrealistic to achieve.

6.1.9 Interlinkages between species units

The considerations on stock units to be used in assessments should not be made entirely on a species base. Assessments including species interactions will not be consistent if for instance major predator and prey stock units do not refer to the same geographical area. Whiting and sandeel in IIIa should therefore only be merged with the North Sea stocks if this would apply to both species. It would similarly create problems for multispecies assessments if the VIa saithe were to be included in the North Sea.

6.2 The potential usefulness of quarterly surveys in the North Sea and Division IIIa assessments

Quarterly surveys may provide useful data for the assessment of demersal stocks in the North Sea :

1) to tune the VPA and predict future recruitment;

2) to analyse technical and biological interactions.

With respect to tuning and recruitment prediction the usefulness of quarterly surveys for assessments has been evaluated separately for each stock, reference is made to the subsection on this subject for each stock.

The overall picture concerning tuning and recruitment prediction is, that

- Quarterly surveys have been found to provide useful contributions to the assessments for several stocks as indicated by the weights assigned to these data in trial VPA tunings and recruitment estimations.

- The data series are however so short that the Working Group is hesitant to use the data yet in order not to put large weight on something which may prove to be spurious correlations. There have been bad experiences for some stocks earlier when picking up new survey indices too early.

The surveys are therefore found to be potentially very useful in assessments, but it is too early to provide firm conclusions.

With regard to the analysis of technical and biological interactions quarterly distribution data may potentially provide relevant data. The usefulness, however, will depend on the progress made at the area based working group to actually address technical and biological interactions. Survey data may furthermore provide relevant data on weights and maturity ogives.

7. MEDIUM TERM MANAGEMENT OBJECTIVES

Management objectives for the medium term are understood to refer to a time period of 5-10 years. An appropriate management objective for the medium term is MBAL, which is defined as the lowest level of spawning stock from which the stock has been seen to recover in the VPA series. Application of this definition is not always straightforward and clear criteria should be formulated to define MBAL consistently for various stocks.

MBAL is a relative measure conditional on the level of natural mortality assumed and on the time series of data available. It may be necessary to revise the value for

MBAL as more data are added to the historical series. In using SSB as a biological reference point, it should also be borne in mind that the egg production from a given level of SSB can vary due to changes in the maturity ogive, changes in fecundity, egg quality and sex ratios.

Medium term catch projections have been included in this report for the main demersal stocks, resulting from the use of program WGMTERM. (see Section 1.3). The projections show the probability of various trajectories of yield and spawning biomass over the next 10 years, given estimates for the CVs of the population parameters and assumptions about the stock-recruitment relationship. In applying the medium term projections, criteria are needed for the acceptable probability that the SSB may fall below MBAL in the medium term. It is not directly obvious whether a single probability can be applied for all stocks or whether different levels should be applied for stocks in relation to the width of the probability bands.

A further point is that a strong year class can result in SSB levels above MBAL in the short term, whereas medium term projections may indicate a low level of probability that this will remain the case. This emphasizes the point that MBAL should not be used as a short term objective.

Medium term objectives in terms of mortality can - in relation to objectives related to the ability of the stock to reproduce itself - be defined on basis of F_{med} or the maximum F level which should be allowed if the probability of SSB to fall below MBAL is to be less than a specific value in a medium term projection.

F_{med} has been estimated for all stocks for which analytic assessments have been made in the present report, but the time series available is for some stocks so short that the Fmed estimates must be treated as preliminary estimates. This has been noted in each case.

The maximum F levels allowed if the probability of SSB falling below MBAL is to be less than a certain level has not been estimated for any stocks. The reason for this is, that the probability distributions emerging from medium term projections are very sensitive to the recruitment models used and to appropriate estimates of Cvs of input parameters. The medium term projections available are considered to illustrate the problems for the various stocks on medium term reasonably, but rigid quantitative conclusions based on the medium term probability distributions should not be made before further investigations into the properties of these distributions and especially their dependence on recruitment models have been made.

7.1 Catch and effort controls

The appropriateness of catch and effort controls for North Sea fisheries is discussed in the previous Working Group report. Since nothing new can be added to the discussion, the Working Group repeat the conclusions reached last year.

1. Catch control in mixed fisheries designed to restrict fishing mortality are unlikely to be effective due to imprecision in assessments and problems of enforcement.

2. Effort control appears to be more likely to be effective in the short term provided effort is genuinely restricted and an appropriate measure of effort exists for a particular fleet.

3. Any measure which does not address the underlying problem of over-capacity is unlikely to be successful in the long run.

7.2 The potential use for multispecies and multiannual catch options

The topic of multispecies and multi-annual catch options was briefly discussed in last years Working Group report. It was concluded that multispecies TAC's were not appropriate for the North Sea roundfish and flatfish stocks, since they are heavily fished and an over-capacity in the fleets fishing for these species exists.

Multi-annual TAC's can not be used either. The level of exploitation of the North Sea demersal stocks and problems in predicting recruitment prevent any useful forecast on which a TAC could be based for more than two years ahead of the data. Multi-annual TAC's could only be considered if the fishing mortality was reduced to a level where the risks of the stock were considerably lower.

8. DATA FOR THE MULTISPECIES ASSESSMENT GROUP

Quarterly catch at age and mean weight at age data for the North Sea stocks of roundfish are being provided directly to the multispecies data base co-ordinator. The quarterly data for Norway pout and sandeel are included in this report. The data have been compiled as totals for the North Sea for 1993 and 1994. Data for 1993 were not provided from last years meeting as the data were requested on a 'subdivision' basis and it was not possible for the Working Group to deliver the data with this resolution. It was furthermore not clear what was actually meant by subdivision and it was noted by the working group that the majority of data were not sampled on sampling strata as fine as rectangles or even roundfish areas. The Working Group recommended last year that a request for better spatial resolution should be based on an *ad hoc* workshop to specify the exact data needs, exchange protocols and work organisation. This workshop has not been held and the Working Group assumes that the request this year, which does not specifically state the spatial resolution needed, concerns totals for the North Sea.

9. THE FUTURE OF THE ASSESSMENTS OF DEMERSAL STOCKS AND FISHERIES IN SUB-AREA IV AND DIVISION IIIA

9.1 Integration of technical and species interactions

One of the major objectives behind the changes from a species based to an area based set up of the ICES Assessment Working Groups was the need for including both technical and species interaction in the assessments.

It is, however, necessary for appropriate tools and databases to exist and be available if such interactions are to be analysed. The present section describes the present state of the art and models available and the needs to be fulfilled before it will be possible to include interactions in the assessments made by this Working Group.

Technical interactions occur when several species are caught by the same fleet. If technical interactions are not taken into account it is difficult to foresee the effect of management measures aimed at protection a particular stock on other stocks and fisheries.

Within ICES a number of different Working Groups have considered and to some extent included technical interactions in their assessment. Outside ICES the EC STECF Working Group on Improvements of the Exploitation Pattern of the North Sea Fisheries has created the so-called STCF database which contains catch at age data from the North Sea by ICES statistical rectangle, quarter and fleet for 1989 and 1991. In connection with the database software has been developed to allow multi-fleet multi-area catch predictions. At present, however, there is no collection of data to the database, and although the database has been taken over by ICES it has not yet been used by ICES Assessment Working Groups. It is furthermore a major shortcoming of this database that it only includes landings but no information on discards. Discard data are crucial if the effects of for instance closed areas are to be evaluated.

The fleets available in the STCF database are national fleets defined by gear and vessel size. About 50 fleets are included. It may be possible to obtain annual updated fleet data for fleets defined by nation and gear only.

The Multispecies Assessment Working Groups have over the years developed the methods and software for taking *species interactions* into account in fish stock assessment. To assess historic stock sizes and fishing mortality and to estimate food selection parameters they have used multispecies VPA (MSVPA). MSVPA is a quarterly VPA in which changes in natural mortality due to predation are accounted for. The predictive counterpart of MSVPA, the multispecies Forecast model (MSFOR) has been the main multispecies tool for making multispecies predictions, but other more simple models have also been used.

The general experience has been that the inclusion of species interaction in the assessments does not change the results of retrospective reconstructions of population sizes provided the levels of natural mortality in single species and multispecies runs are identical. The same conclusion has also been reached with regard to short term predictions, while the impact of species interactions on medium term predictions and in particular on long term predictions has been found to be profound.

In 1989 the MSAWG compared medium term multispecies and single species predictions and found that the effect of species interaction was to introduce damped oscillations in the forecast. Short term losses following a reduction in fishing mortality, could turn into medium term gains above those found in the single species case and continue into damped oscillations around the long term equilibrium values. Figure 9.1.1, which has been taken from the 1989 report of the MSAWG (ICES 1989) shows an example of the difference between single and multispecies predictions of haddock spawning stock biomass. Starting in 1989 and predicting 9 years ahead with stochastic recruitment the multispecies prediction resulted in a decrease in the spawning stock biomass of haddock to less than 100 thousand tonnes in 1991 and 1992. In contrast the single species run predicted the spawning stock to be maintained at a level of 200 thousand tonnes throughout the period.

In the long term there are also large differences between single and multispecies predictions. The general conclusion from single species predictions is that most stocks are fished at levels of fishing mortality far above F_{max} while the outcome of multispecies predictions is that the level of fishing is close to $F_{0.1}$ (ICES, 1989). Multispecies predictions would thus tend to give relative more importance to recruitment overfishing in management considerations at the expense of considerations pertaining to of growth overfishing.

The needs for multispecies software in the area-based working groups were investigated in 1993 by the Planning Group for the Development of Multispecies Multifleet Assessment Tools (ICES,1993). The general conclusion from the Planning Group was that there were no immediate needs for transfer of analytical software from the Multispecies Assessment Working Group to the area-based working groups. This conclusion was reached because it was believed that the main task of the area-based working groups was to perform retrospective analysis of historical stock sizes and short-term TAC predictions. The idea was that the long-term strategic predictions should be the responsibility of the Working Group on Long-Term Management Measures (LTMWG) and not be included among the tasks of the area-based assessment groups. With the recent disbanding of the LTMWG and the increased importance of medium-term predictions this conclusion appears no longer to be valid.

Recently a new multi-species, multi-fleet area-disaggregated assessment package, 4M, has been created. The intention has been to develop a user-friendly and easily adaptable model. The 4M model is build around a flexible database-management system written in SAS and containing standard record formats for the exchange of data. The computations are at the moment the same as in the old MSVPA/MSFOR model, but with an index for area added to the equations. It has been attempted to make the computational modules, such as the VPA and forecast modules, easily interchangeable in order to allow the model to change as assessment methods develop into more statistically advanced tools.

At the recent meeting of the Working Group on Multispecies Assessment of Baltic Fish (WGMABF) the 4M model was used to assess the stocks of cod, sprat and herring in the Baltic. The report from the meeting suggests that a number of improvements should be made to the model. The major drawback of the present version of the model is the lack of tuning possibilities and the limited possibilities for making sensitivity analysis and for estimating the confidence intervals of the predictions. However, such modules could be added if sufficient man-power was allocated to their creation. The design of the additional modules had to be carried out in close cooperation with the members of the present Working Group. Furthermore, ICES would need to consider how to maintain the software and database on the ICES system.

When the modules had been developed it should be possible for the present Working Group to use the 4M model in its regular assessments provided that quarterly data was made available. Prior to the meeting Working Group members would be asked to prepare preliminary single species assessments in order to identify outstanding problems in the data and methods. During the first days of the Working Group meeting a first multispecies retrospective assessment would be performed and discussed, and the rest of the meeting would be based on an adopted keyrun. One outstanding problem would be the lack of an updated assessment for herring, sprat and mackerel in the most recent year. It should, however, be possible to use the predicted catches of these species in the most recent year in the assessment of the demersal species. This would attach an additional but, at least in principle, quantifiable uncertainty to the assessment.

The assessments of interaction effects may not have to be carried out on an annual basis, at least not for the purpose of updating short term predictions.

It should be obvious that major work is required both in terms of modelling and data bases before this Working Group can include interaction aspects in routine assessments. It cannot be expected that it will be possible include such aspects on a short term.

9.2 Tuning methods and stochastic models

The present tuning models used by this Working Group cannot be truly described as real stochastic models and it is therefore difficult or impossible to apply standard statistical methods for parameter estimation. Use of truly stochastic assessment models have some clear advantages. The variance of e.g. estimated biomass, predicted catches and other biological parameters can directly be calculated from the stochastic analyses. Finally, it is possible to test hypotheses on a proper statistical basis. For instance the validity of one specific stock recruitment relationship can be tested against another relationship. Instead of shrinkage to e.g. F one can test if F is constant for a specified range of year, etc.

Several authors have been dealing with stochastic or integrated models. These models are rather different, but they are all based on least square or maximum likelihood method for estimating stock size , fishing mortality etc.

The stochastic assessments models focus on the errors in catch and effort data. If stochastic models should be used in assessments, this error information either must be estimated by the model or provided elsewhere. Using this approach at least the sampling errors in catches may be valuable and ought to be provided together with the usual input to VPA.

Probably all stochastic assessment models have been dealing with single species assessment. If multispecies effects and fleet based technical interactions should be included in the assessment (section 9.1) one of the problems are the estimation of terminal F's. There are three possibilities for doing this: 1) To do what the MSAWG does today, that is to use single species terminal F's, 2) to implement a multispecies tuning method or 3) to develop a stochastic, multifleet and multispecies model. This also includes a stochastic submodel for the estimation of predation mortality.

There is a movement within some assessment working groups away from the standard XSA-based tuning method towards more integrated statistical approaches such as the CAGEAN-type model (Deriso *et al.*, 1985) and Time Series analysis (Gudmundson, 1987). The characteristics and performance of these, and other, approaches have been explored by the Methods Working Group at its meetings and workshops) and are not considered here in further detail. However, it is appropriate to discuss these methods with regard to the incorporation of biological and fleet-based technical interactions within this Group's assessments procedures for the North Sea stocks (Section 9.1)

The Methods Working Group (CM 1993/Assess:12) made the following general observations: "Many analyses of catch-at-age data involve the fitting of a statistical model with an explicit objective function. The assumptions about the error structure of the data and the fitting procedure generally permit the estimation of the parameter covariance matrix. Examples of existing methods in which this is in principle possible are ADAPT (Gavaris, 1988), CAGEAN (Deriso et al, 1985) Time Series analysis (Gudmundsson (1987) and XSA (Shepherd, 1991). Given this matrix it is possible to estimate the variance of any quantity derived from the parameters". Therefore, it appears that *in principle* any of these methods could be used to produce variance estimates of fitted or derived quantities, either through single species estimation, stochastic multispecies estimation or stochastic multispecies multifleet estimation. In practice, their use is governed more by their availabilty to users and the familiarity of the users with the methods.

For this Working Group, availability/familiarity has meant the adoption of the current XSA program (version 3.1) as the *de facto* standard for single species tuning, although an implementation of the CAGEAN-type approach is now available (Patterson and Melvin, 1995) and will be evaluated for some North Sea demersal stocks prior to the next meeting of this Group. The incorporation of a stochastic model within the multispecies or multifleet/multispecies approach will require considerable development work.

9.3 Working procedures and data base management

Working procedures

The present working group is in effect an aggregate of four earlier working groups - the industrial, the flatfish, the roundfish and the IIIa Working Groups. These groups where last separate in 1991 in which year a total of 305 persondays were put at disposal for the Working Groups. The present meeting had at its disposal 175 persondays for basically the same work .

It has been necessary to change working procedures considerably to keep up with the work to be done with this limitation of resources. The most important changes are the preparation of assessments before the Working Group meeting and assessment reviews in sub-groups.

It was possible for this meeting to have appr. 9 out of 15 formal assessments ready at the start at the meeting and the major stocks could be reviewed on the second day of the meeting. However, as the pre-meeting assessments had been made on stand alone machines and the Working Group wanted to follow the ICES policy to ensure documentation and availability of the assessments on the IFAP system, considerable time was used simply to try to repeat the assessments on the IFAP system and ensure that the results were identical. With the present work schedule of the Working Group this repetition of work which has already been done is a luxury which the Group cannot afford.

There are only two options if assessments are to be made before the meeting without this duplication of work : the whole assessment including predictions is made on stand alone machines both before and during the meeting or pre-meeting assessments are made using IFAD/IFAP on the ICES server through Internet connections. The Working Group does still consider it important to document the assessments and make them available to revisions and has therefore opted for the Internet solution for the preparation of the next Working Group meeting. The procedure for the 1996 meeting will therefore be that input data are made available in IFAD on the ICES server well in advance of the meeting and that assessments will be run directly on IFAP through Internet connections to the various laboratories. *This does however require that IFAP is revised to accommodate the specific needs of the stocks (split of catch categories for predictions) and that the problems encountered at the present meeting are corrected. If these conditions are not met the Working Group sees no other option available to it than to run the whole assessment and predictions on stand alone machines independently of IFAD/IFAP both before and during the meeting.*

It should be noted that these needs are not unique to the present Working Group. The Northern Shelf Working Group is for instance also working with category disaggregated data.

Another consequence of the relative diminishment of the resources available for the Working Group is that the peer review process is becoming less thorough and the participation in all aspects of the report by all Working Group members is no longer possible. The peer review can no longer be made in plenary sessions and even the final revisions of the stock sections of the report does to a large extent take place in a plenary which is incomplete in terms of participation. This means that the individual assessments are receiving considerably less time for scrutinization.

Database management

The data for the present Working Group are prepared through what is in effect a continuation of the preparatory set-up of the four working groups which have merged into the present group. National data are collected by four different co-ordinators in four different formats. The primary data are then compiled to produce tuning files and total international data for VPAs. This is done through four different sets of procedures/software by the four co-ordinators.

This set-up has served its purpose and it has been possible for the Working Group to do its work. It has, however, been difficult to ensure that various derived data bases, which should be consistent, are updated in a consistent way. Data are stored in both the scattered primary data bases held by the co-ordinators, in the IFAD system and in the multispecies data base and consistency between the three is not guaranteed. The Working Group is furthermore completely dependent on large inputs in terms of manpower before the meeting from the co-ordinators. This set-up does finally not ensure complete documentation of the compilation procedures used in each case, it is difficult to ensure that the procedures are standardised and it is not possible for other than the co-ordinators to reproduce the data used in assessments from primary data.

All these drawbacks could to a large extent be avoided if the primary data were kept as a part of the database system on the ICES server and the procedures leading from primary data to the various derived bases including assessment input data could be performed through standard procedures on the server locally and via Internet.

It is understood that the IFAD base is prepared for storage of fleet-disaggregated data. It has been agreed that the secretariat will receive a sample set of primary data and the source code of programs presently used for data compilation of roundfish data in order to investigate the extent of modifications and additions needed to the IFAD system to include this level of the data flow. It is recognised that a major revision of the ICES data base structure may be necessary on a longer term to accommodate for instance spatial information and that this revision should include primary data to be stored in the data base. It is therefore understood that the modifications to be made to accommodate primary data in the present data structure should be limited in terms of manpower demands.

10. RECOMMENDATIONS

The Working Group has noted several points were initiatives are needed if assessments are to be improved in the future or if the Working Group is to live up to the expectation that an area based working group should be able to provide assessments which integrates species and technical interactions. Some of these points are basically just notes for the next Working Group meeting while others would require follow up by ACFM.

Points for improvements at the next Working Group meeting :

1) IBTS data on saithe should be retrieved and investigated as potential sources for recruitment information or tuning data. It has been assumed that IBTS data may be poor indicators of saithe recruitment since the survey does not cover the coastal areas which are known to be important nursery areas and poor indicators of the abundance of larger saithe since the deeper areas in the North Sea including the pelagic zone. However, a test of these assumptions would be worthwhile considering the lack of recruitment estimates for this stock.

2) The Norway pout and sandeel data bases need to be sorted out by a separate meeting/correspondence before the meeting. There are too many inconsistencies or unclear intermediate steps presently for the bases to serve as a satisfactory basis for work by the present working group

3) An overview of the fleets exploiting the stocks assessed by this Group should be reproduced and included in next year's report

Points which would need support from ACFM :

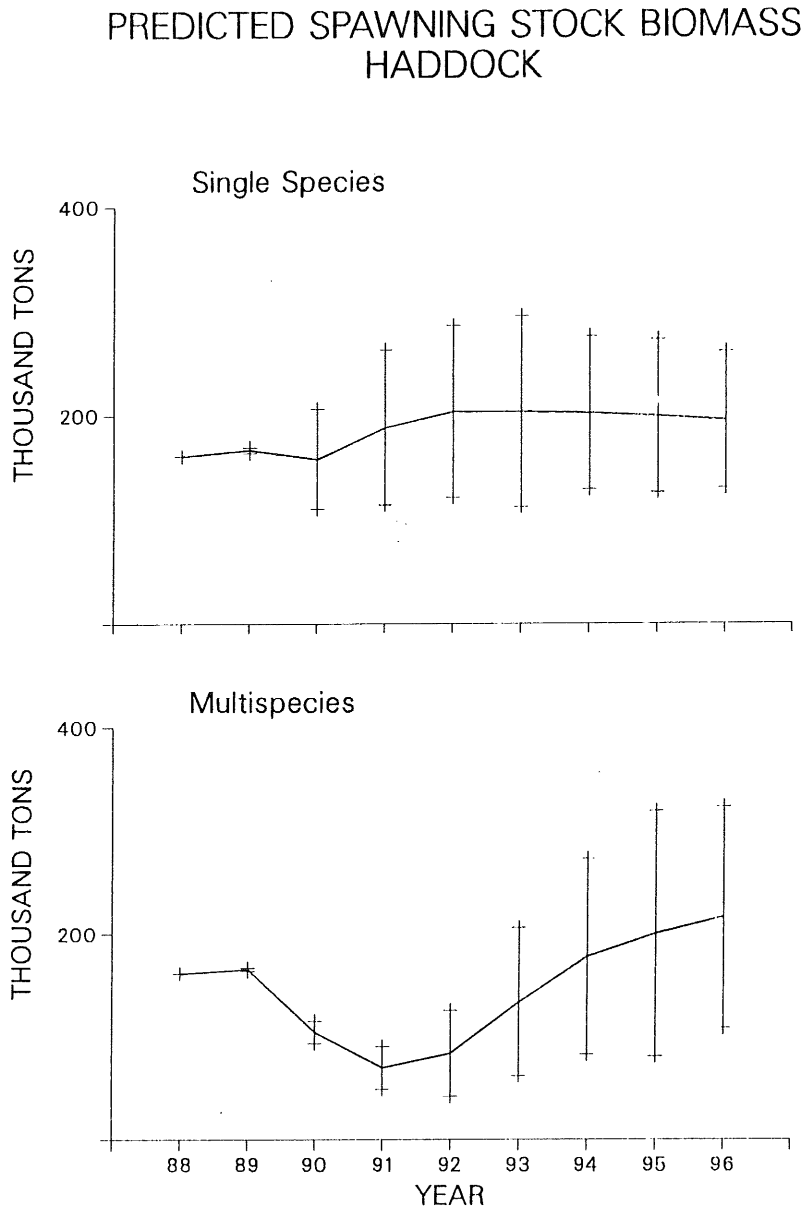
1) It has been understood that the establishment of area based working groups should enable the working groups to take a more systems oriented approach including species- and technical interactions. The models and data bases needed for a more integrated approach are not available and the Working Group does not have the time to work on methodological developments. If the Working Group is to be able to respond to request beyond the simple single species assessments in the future a major action is needed for the development of models and data bases outside the realm of the Working Group. Reference is made to section 9 for a discussion of the needs and possibilities.

2) The tools available for standard single species assessments on the ICES system are not adequate for the Working Group The resources available to the Working Groups in terms of manpower have diminished, for the present Working Group from 305 to 175 persondays over 4 years. The IFAP system has not been modified yet to accommodate the catch categories used for some stocks and the IFAP system is cumbersome to use. The work to be done by the Working Group can simply not be done with the very low productivity involved in using IFAP. Serious

thoughts must be given to streamlining the system to improve functionality.

3) Ageing of whiting has created problems. It is suggested that an ageing workshop on whiting is held to improve the situation.

Figure 9.1.1 Predicted haddock spawning stock biomass (mean, +/- 1 SD) under stochastic simulations with MSFOR, in single and multispecies modes. Simulations are based on lognormal recruitment distributions, using MSVPA results from 1974-1986. A total of 60 9-year simulations were run, assuming the current exploitation pattern (85 mm for cod).



1. REFERENCES

Anon., 1965. Report of the Working Group on sole. Coop. Res. Rep. ICES No.5, 126p. (mimeo).

Anon., 1970. Interim report of the North Sea Cod Working Group. ICES, Doc. C.M. 1970/F:15.

Anon., 1971. Report by the North Sea Roundfish Working Group on North Sea Cod. ICES, Doc. C.M. 1971/F:5.

Anon., 1979. Report of the Flatfish Working Group. ICES, Doc. C.M. 1979/G:7.

Anon., 1986. Report of the ad hoc Working Group on the 1984/85 sole egg surveys. ICES, Doc. C.M. 1986/G:95, 93pp. (mimeo).

Anon., (1986) Report of the 1986 Roundfish Working Group. ICES, Doc. C..M. 1986/Assess:16, pp.

Anon., 1986. Report of the Division IIIa Demersal Stocks Working Group. ICES, Doc. C.M. 1986/Assess:18.

Anon., 1989. Report of the *ad hoc* study group on juvenile sole tagging. ICES, Doc. C.M.1989/G:21, 34pp. . (mimeo).

Anon., 1989. Report of the Roundfish Working Group. ICES, Doc. C.M. 1989/Assess:7, pp.

Anon., 1990. Report of the Roundfish Working Group. ICES, Doc. C.M. 1990/Assess:7, 93pp.

Anon., 1990. Report of the Division IIIa Demersal Stocks Working Group. ICES, Doc. C.M. 1990/Assess:10.

Anon., 1991. Report of Division IIIa Demersal Stocks Cook, R.M. and Reeves, S.A. 1993. Assessment of North Sea industrial fish stocks with incomplete catch-at-age data. ICES J. Mar. Sci., 50:425-434.

Anon., 1991. Report of Division IIIa Demersal Stocks Working Group. ICES, Doc. C.M.1991/Assess:18.

Anon., 1991. ICES, Doc. C.M.1991/Assess:4. Report of the Roundfish Assessment Working Group.

Anon 1992. Report of the ICES Study Group on Tagging Experiments for juvenile plaice. ICES, Doc. C.M. 1992/G:10.

Anon 1992. Report of the ICES Study Group on tagging experiments for juvenile plaice. ICES, Doc. C.M. 1992/G: 73pp. (mimeo).

Anon., 1993. Biogeographical identification of English Channel fish and shellfish stocks. E.C. Contract, D.G. XIV, N° : 91/1211416/BMF : 256 pp.

Anon. 1993. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES, Doc. C.M. 1993/Assess:5.

Anon., 1993. Identification biogeographique des principaux stocks exploites en Manche, relations avec ceux des regions voisines. IFREMER, RI DRV 93-028.

Anon., (1993a) Forvaltning af fiskeriressourcene i Skaggerak og Kattegat. Nordiske Seminar og Arbejds-rapporter 1993:550.

Anon., (1993b) Report of the Working Group on the assessment of demersal stocks in the North Sea and Skaggerak. ICES, Doc. C.M.1993/Assess:5.

Anon, 1994. Report of the Study Group on the North Sea plaice box. ICES, Doc. C.M./Assess 14. 52 pp.

Anon. 1994. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES, Doc. C.M. 1994/Assess:6.

Anon. 1994. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES, Doc. C.M. 1995/Assess:8.

Anon, 1995. Report of the Beam Trawl Study Group. ICES, Doc. C.M. 1995/G:5.

Anon, 1995. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES, C.M./Assess 8.

Anon., (1996) Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks. ICES, Doc. C.M. 1996/Assess:1.

Beek, F. A. van. 1988. Egg production of North Sea sole in 1988. ICES, Doc. C.M. 1989/G:45, 18pp. (mimeo).

Beek, F.A. van *et al.* 1989.

Beek, F.A. van, 1994. The "one and only" Management Objective of fishery Biologists. ICES, Doc. C.M. 1994(G:43).

Child, A.R.,1988. Population genetics of cod (*Gadus morhua* (L.)), haddock (*Melano-grammus* aeglefinus (L.)), whiting (*Merlangius merlangus* (L.)) and saithe (*Pollachius virens* (L.)). Fish. Res. Tech. Rep., MAFF Direct. Fish; Res., Lowestoft, 87:27pp.

Cook, R.M. 1992. Partially Separable VPA. Appendix in ICES, Doc. C.M. 1992/Assess:9.

Cook, R.M. (1993) The use of sensitivity analysis to quantify uncertainty in stock projections. ICES, Doc. C.M. 1993/D:66.

de Veen, J.F. 1962. On the sub-populations of plaice in the southern North Sea. ICES, Doc. C.M. 1962/F:94.

Deriso, R.B., T.J.Quinn II & P.R. Neal. 1985. Catch-age analysis with auxilliary information. Can. J. Fish. Aq. Sci. 42: 815-824.

Easey, M.W. (1986) Interchange between the North Sea and West of Scotland: A literature review. Working paper to 1986 ICES roundfish Working Group.

Gamble, R., 1959. Investigations of the subdivisions of North Sea whiting population. I: Further observations on the vertebral counts of whiting in the North Sea area. Int. Coun. Explor. Sea, Near Northern Seas Committee, Paper 36, 3pp.

Gavaris, S. 1988. An adaptive framework for the estimation of population size. CAFSAC Res. Doc. 88/29. 12p.

Greer Walker, M & Emerson, L., 1990. The seasonal migration of soles (*Solea solea*) through the Dover Strait. Neth. J. Sea Res., 25: 417:422.

Gudmundsson, G. 1987. Time series models of fishing mortality rates. ICES, Doc CM 1987/D:6.

Hagström, O., Larsson, P-O. and Ulmestrand, M. 1990. Swedish cod data from the International Young Fish Surveys 1981-1990. ICES, Doc. C.M. 1990/G:65.

Hall, S.J, Fryer, R.J. and Bell, M (1995) Movements of Haddock: An analysis of tagging data. ICES, Doc. C.M. 1995/G:30.

Hallbäck, H., Hagström, O. and Winström, K. 1974. Fiskeribiologiska undersökningar i Brofjorden 1972-74. (In Swedish) Meddelande från Havsfiskelaboratoriet, Lysekil, nr 175.

Harding, D., Nichols, J.H. & Tungate, D.S. 1978. The spawning of plaice in the southern North Sea and Englsih Channel. Rapp. P. -v. Reun. Cons. int. Explor. Mer 172: 102-113.

Heessen, H.J.L. and A.D. Rijnsdorp, 1989. Investigations on egg production and mortality of cod (*Gadus morhua* L.) and plaice (*Pleuronectes platessa* L.) in the southern and eastern North Sea in 1987 and 1988. Rapp. P.-v. Reun. Cons. int. Explor. Mer, 191: 15-20.

Houghton, R.G. & Harding, D. 1976. The plaice of the English Channel: spawning and migration. J. Cons. int. Explor. Mer 36: 229-239.

Hovgaard, H. 1995. Estimating IBTS (February) indices for cod in Skagerrak and Kattegat by use of modal separation techniques. ICES Annual Science Conference 1995/G:24

Hovgaard, H. 1995. Estimating IBTS (February) indices for cod in Skagerrak and Kattegat by use of modal separation techniques. ICES Annual Science Conference 1995/G:24

ICES, 1989. Report of the Multispecies Assessment Working. ICES, Doc. C.M.1989/Assess:20.

ICES, 1993. Report of the Planning Group for the Development of Multispecies Multifleet Assessment Tools. ICES C.M.1993/Assess:8

Jamieson, A. and A.J. Birley, 1989. The demography of a haemoglobin polymorphism in the Atlantic cod, Gadus morhua L. Journal of Fish Biology 35(A): 193-204.

Jamieson, A. and Birley, A.J. (1989). The distribution of transferring alleles in haddock stocks. J. Cons. Int Explor. Mer, 45:248-262.

Kabata, Z., 1963. Parasites as biological tags. Spec. Publs int. Commn. NW Atlant. Fish., 4: 31-37.

Katerinas, A., 1986. Flounder and whiting distribution as shown by planktonic eggs in relation to Lernaeocera branchialis cross infection. Sandwich Student's Report, University of Bath.

Larsson, P-O, Danielssen, D. S., Moksness, E., Munk, P., Nielsen, E. och Rudolphi, A-C. 1994. Rekrytering till torskbestånden i Kattegat och Skagerrak - rapport om fältundersökningarna i nordöstra Nordsjön, Skagerrak och Kattegat. TemaNord 1994:636, 13 pp.

Larsson, P-O. 1995. Distribution of juvenile gadoids in the NE North Sea and the Skagerrak. Working paper.

Larsson, P-O. 1995. Distribution of juvenile gadoids in the NE North Sea and the Skagerrak. Working paper.

Llewellyn, J., 1956. The host specificity, micro-ecology, adhesive attitudes and comparative morphology of some trematode gill parasites. J. Mar. Biol. Ass. U.K., 35:113-127.

Mesnil, B. 1983. Indices d'abondance des juveniles de poisson plats devant les cotes francaises de Manche-est et Mer du Nord. Resultats des campagnes DYFS. 1977-1982. ICES, Doc. C.M. 1983/G:55, 8pp. (mimeo).

Millner, R & Whiting, C.L. 1990. Distribution and abundance of juvenile plaice and sole in the eastern English Channel from young fish surveys. ICES, Doc. C.M. 1990/G:38, 7pp. (mimeo).

Millner, R in press. Comparison of long term trends in growth of sole and plaice populations ICES J man Sci.

Munk, P. 1993. Describing the distribution and abundance of small 0-group cod using ring-net sampling and echo-integration. ICES, Doc. C.M. 1993/G:40.

Munk, P. 1995. The concentration of larval cod and its prey in the zone of a hydrographic front. ICES Doc. Annual Science Conference 1995/Q:23.

Munk, P., Danielssen, D.S., Larsson, P-O. och Moksnes, E. 1993. Distribution of larval and juvenile cod in relation to hydrographic characteristics in the areas of northwestern North Sea, Skagerrak and Kattegat. Symposium on Cod and Climate Change, Reykjavik, 23 - 27 August 1993. Poster No. 25.

Munk, P., Larsson, P-O., Danielsen, D. and Moksnes, E. 1995. Larval and juvenile cod (*Gadus morhua*) concentrated in the highly productive areas of a shelf break front. Marine Ecology Progress Series. In print.

Munk, P., Larsson, P-O., Danielsen, D. and Moksnes, E. 1995. Larval and juvenile cod (*Gadus morhua*) concentrated in the highly productive areas of a shelf break front. Marine Ecology Progress Series. In print.

Munk, P., Larsson, P-O., Danielsen, D. and Moksnes, E. 1995. Larval and juvenile cod (*Gadus morhua*) concentrated in the highly productive areas of a shelf break front. Marine Ecology Progress Series. In print.

Noble, E.R., 1957. Seasonal variations in host-parasite relations between fish and their protozoa. J. Mar. Biol. Ass. U.K., 36 : 143-155.

Patterson, K.R. & G.D. Melvin. 1995. Integrated catch at age analysis. User's manual, Version 1.2. (copy lodged with ICES).

Peronnet, I. & Tetard, A., 1984. Evolution pluriannuelle des nourriceries de poissons plats dans le secteur de la Baie de Somme. ICES, Doc. C.M. 1984/G;22, 16pp. (mimeo).

Pilcher, M.W., Whitfield, P.J. and Riley, J.D., 1989. Seasonal and regional infestation characteristics of three ectoparasites of whiting *Merlangius merlangus* L. in the North Sea. J. Fish Biol., 35 : 97-110.

Potter, I.C., Gardner, D.C. and Clardge, P.N., 1988. Age composition, movements, meristics and parasites of the whiting (Merlangius merlangus) in the Severn Estuary and Bristol Channel. J. Mar. Biol. Assess. U.K., 68 : 295-313.

Ramsay, K. 1993. Factors influencing first time maturity in female sole (*Solea solea*) (L.)). ICES, Doc. C.M. 1993/G:25, 5pp (mimeo).

Reeves, S. and Cook, R (1994) Demersal assessment programs, September 1994. Working Document to 1994 meeting of the North Sea Demersal Working Group.

Rijnsdorp, A. D and Vingerhoed, B. 1995. Ecological significance of. Neth J Sea Res., 32: xxpp.

Rijnsdorp, A. D *et al.* 1992. Recruitment in sole stocks in the Northeast Atlantic. Neth J Sea Res., 27,xxpp.

Rijnsdorp, A.D. & Pastoors, M. 1994. A simulation model of the spatial dynamics of plaice based on tagging data. ICES, Doc. C.M. 1994/G:XX.

Rijnsdorp, A.D. & van Leeuwen, P.I. 1994. Changes in growth of North Sea plaice since 1950 and its relation to density, eutrophication, beam trawl effort and temperature. ICES, Doc. C.M.1994/G:9. 31 pp.

Riley, J. D., Symonds, D.J and Woolner, L.E.(1986). Determination of the distribution of the planktonic and small demersal stages of fish in the coastal waters of England, Wales and adjacent waters between 1970 and 1984. Fish. Res. Tech. Rep., MAFF, Lowestoft, 84, 23pp.

Riley, J.D., Sydmonds, D.J. and Woolner, L.E., 1986. Determination of the distribution of the planktonic and small demersal stages of fish in the coastal waters of England, Wales and adjacent areas between 1970 and 1984. Fish. Res. Tech. Rep., MAFF Direct. Fish; Res., Lowestoft, 84, 23 pp.

Roessingh, M., 1957. Observations on the whiting made by the Netherlands Institute for Fishery Investigations. ICES, Doc. C.M. 1957/Doc. 82, 6pp.

Rout, D.W.R., 1962. Some observations on the whiting (*Gadus merlangus* L.) in the inshore winter fishery off Lowestoft. J. Cons. int. Explor. Mer, 27 : 316-324.

Shepherd, J.G. 1991. Extended Survivor's Analysis: an improved method for analysis of catch-at-age data and catch-per-unit-effort data. Working Paper to Methods WG, 1991. see ICES, Doc. C.M. 1991/Assess:25.

Skagen, D.W. 1993. A seasonal extended survivors analysis (SXSA) with optional estimation of unknown catches at age. Appendix 1 in ICES, Doc. C.M. 1994/Assess:7.

Skagen, D.W. 1994. Revision and extension of the Seasonal Extended Survivors Analysis (SXSA). Working Paper to the 1994 meeting of the Working Group on the Assessment of Norway Pout and Sandeel.

Sproston, N.G. and Hartley, P.H.T., 1939. The ecology of some parasitic copepods of gadoids and other fishes. J. Mar. Biol. Assess. U.K., 25 : 361-392.

van Beek, F.A. 1994. The 'one and only' management objective of fishery biologists. ICES, Doc. C.M. 1994/G:43.

van Beek, F.A., Rijnsdorp, A.D. & de Clerck, R. 1989. Monitoring juvenile plaice and sole in the Wadden Sea and coastal areas of the southeastern North Sea. Helgolander Meeresunters.

Van den Broek, W.L.F., 1979. Copepod parasites of *Merlangius merlangius* and Platichthys flesus. J. Fish Biol., 14 : 371-380.

Veen, J.F. de, 1976. On Changes in some biological parameters in the North Sea Sole. J. Cons. int. Explor. Mer, 37(1):60-90.

Witthames, P and Greer Walker, M. 1995. Geographical variation in fecundity Neth J Sea Res., 32:xxpp.

Working Group. ICES, Doc. C.M.1991/Assess:18.