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International Council for the Exploration of the Sea

C.M.1995/Assess:8

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

Copenhagen, 6 - 14 October 1994

PART 2

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3.6 Sole in Sub-area IV

3.6.1 Catch trends

The total nominal landings in 1993 reported to ICES were 29,069 t. The estimate of the Working Group of the 1993 landings was 31,170 t compared to 29,349 t in the previous year (Table 3.6.1). The agreed TAC for 1993 was 32,000 t. The estimates of the unreported landings have decreased considerable in recent years. Historical trends in landings are given in Figure 3.6.3. In the last four years the landings have been at a high level and dominated by year classes 1987 and 1991.

3.6.2 Natural mortality, maturity, age compositions, mean weight at age

Age compositions, weight and length at age were available for the 1993 landings on a quarterly basis from Belgium, Denmark, the Netherlands and UK (England and Wales), accounting for 93% of the total international landings. The SOP of the combined 1993 age composition was 1% higher than the total landings. Revisions were made to the 1991 and 1992 data as a consequence of revisions in the national landings and in the unreported landings. The revisions for 1992 were minor, but the 1991 catch was estimated to be 12% lower than previously. No estimates of discards are available to the Working Group.

Weights at age in the stock are measured as second quarter weights of the catch. The age compositions and weights at age in the catch and in the stock are given in Tables 3.6.2, 3.6.3 and 3.6.4.

A knife-edged maturity-ogive was used in all years, assuming full maturation at age 3. Natural mortality has been assumed constant over ages and years at a level of 0.1, except for 1963, when a value of 0.9 was used to take account of the effects of a severe winter (Anon., 1980).

3.6.3 Catch, effort and research vessel data

Catch and effort data were available for four fleets. Three fleets were used in the tuning of last year's assessment. The BTS has been included for the first time. The tuning data are presented in Table 3.6.5. The "Netherlands all Fleets" is a beam trawl fleet, whose effort is measured in million Horse Power days. The other three fleets are surveys. The SNS (Sole Net Survey) is a coastal survey carried out by the Netherlands with a 6-m beam trawl in October. The German SOLEA survey is carried out in May in the south-eastern North Sea with a 7-m beam trawl. The BTS (Beam Trawl Survey) is carried out by the Netherlands in the southern and south-eastern North Sea in August and September using a 8-m beam trawl.

3.6.4 Catch at age analysis

The tuning procedure used in the assessment is XSA with shrinkage. The tuning was performed using data over a 10 year period. Retrospective runs were carried out over a period of 5 years in order to inspect the performance of the tuning configuration. A trial configuration, using last year's options which gives equal weight to all observations in years used in the tuning, indicates a consistent over-estimation of mean fishing mortality in the last data year (Figure 3.6.1).

The observed retrospective patterns are related to a decline in catchability in the Dutch fleet, which gives considerable weight to the estimate of fishing mortality. The decline in catchability appears in most age groups in the last 5-7 years. The surveys do not show these trends. The fishing mortality in the terminal year is consistently over-estimated by the assumption of constant catchability in the model and the weight given to the older data. Excluding the first three data years from the tuning, or weighting the influence of these years down, the retrospective behaviour in the last three years disappears (Figure 3.6.1). Both runs gave almost identical results. For the final assessment a run with a tricubic taper over 10 years has been chosen.

Table 3.6.6 specifies the configuration of the method and gives the diagnostics of the tuning. Figure 3.6.2 shows the trend in log catchability residuals in the tuning fleet. The diagnostics of the tuning indicate that the tuning fleets give almost no information about the 1 year old survivors. Except for the 1 and 2 year olds, most weight has been given to the Dutch beam trawl fleet and to a lesser extent to the BTS survey in the estimation of the survivors. The SNS and SOLEA surveys give most weight to the age 2 estimates. In age groups older than 10, the influence of the shrinker on the combined estimate is increasing.

Compared to last year's assessment, the estimates of F(2-8) in 1991 and 1992 have been revised downwards by 14 and 18% respectively. This is caused by taking account of the observed decrease in catchability in the Dutch beam trawl fleet in the present assessment. The trend in the catchability of this fleet observed this year differs from the assessment made last year, where it increased in 1991 and 1992. This increase, observed last year, has disappeared by the inclusion of the 1993 data and the revision of the 1991 data. Consequently, estimates of the strength of the 1988 and 1989 year classes have been revised upwards by 21 and 35% respectively and the SSB in 1991 and 1992 has been revised upwards by 9 and 32%.

The results of the VPA are presented in Tables 3.6.7 and 3.6.8.

3.6.5 Recruitment estimates

Average recruitment in the period 1957–1991 was 134 million (arithmetic mean) or 97 million (geometric mean) 1-year-old fish.

No independent indices of recruitment were available from pre-recruit surveys carried out in 1994 since the surveys were not complete at the time of the meeting. Like last year, it is expected that these indices will become available after the meeting of the present Working Group and will be made available to ACFM in November 1994.

Preliminary estimates of recent year classes were made using the log regressions between the indices available from surveys carried out in previous years with the 1-year-olds from the VPA using RCT3. These series are the same which were available to last year's meeting plus the 1 and 2 year old indices of the Dutch BTS. The indices are given in Table 3.6.9. The options used in RCT3 were the same as those used last year and are listed in Table 3.6.10. The results are given in the same table.

1991 year class: The available indices indicate that this year class appears to be a very good one. On the UK coast it was around average strength as 0-group. The estimate provided to ACFM last year was 274 million 1-year-olds. The weighted estimate of RCT3 is 332 million compared with 326 million estimated by the VPA. The estimate from the VPA has been used in the prediction

1992 year class: This year class was virtually absent as 0- and 1-group in the continental surveys. In the UK nursery areas it was, however, average as 0-group and good as 1-group. The year class was absent in the age composition of the 1993 landings. The BTS estimates it to be average at age 1 but poor at age 2. RCT3 estimates it at 71 million. The estimate of RCT3 has been used in the prediction.

1993 year class: This year class was also virtually absent as 0-group in the continental surveys. In the UK nursery areas it was about average strength as 0- and 1-group. Also the BTS estimates it as average. The RCT3 estimate is 86 million and has been used in the prediction.

3.6.6 Historical stock trends

Trends in landings, recruitment, fishing mortality and SSB are shown in Figure 3.6.3 and in the assessment summary table (Table 3.6.11).

Average fishing mortality F(2–8)u has increased since 1957 from 0.14 to around 0.50 in the mid-eighties. In the last five years it has been reduced and is fluctuating at around a level of 0.42.

The recruitment of North Sea sole shows considerable variation from year to year. In recent years two outstanding year classes appeared (born in 1987 and 1991) which are dominating in the landings. Year classes 1988 and 1989 were above GM average but year classes born in 1990, and 1992 were below average.

Trends in SSB are associated with the occurrence of strong year classes. It was at a historically high level near 150,000 t in the years 1961–1963 but decreased sharply thereafter due to high natural mortality in the cold 1963 winter. The 1963 year class built it up again to 105,000 t in 1966. Thereafter it decreased due to an increase in fishing mortality and the absence of a very strong year class. In the period 1973–1989 it has fluctuated between 25,000 t and 45,000 t. In 1990, it increased sharply to 96,000 t when the 1987 year class recruited to the SSB and remained high in 1991 and 1992. Last year it decreased to 61,000 t but is expected to increase again in 1994 when the 1991 year class recruits to the SSB.

3.6.7 Biological reference points

Figure 3.6.4 shows the SSB/recruitment scatter plot. At the observed levels of biomass there are no indications that recruitment has declined. Most historical observations of recruitment are made at SSB levels higher that 35,000 t. Only two observations are available at levels of SSB below 35,000 t, in both cases associated with above average recruitment. The plot does not indicate a particular level of MBAL based on biological arguments. Since recruitment is uncertain at SSB levels below 35,000 t, caution should be exercised when the SSB enters this region.

The SSB recruitment plot also shows the position of Fmed and F93. F93 is higher than Fmed but the difference is not significant.

The input parameters for the yield and biomass-per-recruit calculations are given in Table 3.6.12. The weights at age used were the averages of the last three years in the catch and in the stock. The exploitation pattern used was the average of the last three years in the VPA scaled to the 1993 level. The results of the calculations are given in Table 3.6.13 and Figure 3.6.5.

The biological reference points are almost at the same position as last year and are as follows:

$F_{0.1}$	F_{low}	F_{max}	F_{med}	F_{93}	F_{high}
0.09	0.10	0.23	0.34	0.46	>0.91

3.6.8 Short-term forecast

Catch forecasts for 1994 and 1995 are obtained using program WGFRANS that also performs a sensitivity analysis. The input parameters for the forecast and the sensitivity analysis are given in Table 3.6.12. The stock numbers for ages 1 and 2 in 1994 were estimated from recruitment surveys and may have to be changed by ACFM when new information on the recruitment of recent year classes becomes available from the 1994 recruitment surveys.

The management options are presented in Table 3.6.14 and Figure 3.6.6. Table 3.6.14 also presents the CV' of the predicted values. A *status quo* level of fishing mortality has been assumed for 1994 in the prediction. The expected catch in 1994 is 35,000 t. The spawning stock biomass will increase to 85,000 t in 1994 when the strong 1991 year class recruits to the SSB. At a *status quo* level of fishing mortality in 1995, the expected catch is 27,000 t leaving a SSB of 67,000 t in 1996.

Probability profiles of the expected yield in 1994 and the SSB in 1995 are given in Figure 3.6.7 a–d. The 95% confidence intervals of the expected *status quo* yield in 1994 are 26,000 and 46,000 t respectively. The expected *status quo* yield in 1994 of 36,000 t is higher than the agreed TAC of 32,000 t. The 95% confidence intervals of the expected *status quo* yield in 1995 are 16,000 and 38,000 t respectively. The TAC is within the 95% confidence intervals.

Figure 3.6.8 shows the sensitivity of the forecast of the predicted yields in 1994 and 1995 and the predicted biomasses in 1995 and 1996 to the input parameters. The most important factors seem to be the level of assumed fishing mortality in 1994 and 1995 and the estimate of the 1991 year class.

Figure 3.6.9 shows the partial variances (proportions), estimated from a linear analysis for the forecast. They show how the variability in the input parameters contributes to the variance of the predicted yields and biomasses. The measurement error of the 1992 year class contributes most to the variance of predicted yield in 1995 and SSB in 1995. The variance of the yield in 1994 is mostly determined by the 1991 year class estimate and the assumed level of fishing mortality in 1994. The measurement error of the 1992 year class and the level contributes most to variance in the yield in 1995 and the SSBs in 1995 and 1996.

3.6.9 Medium-term projections

Medium-term predictions were made for a period of 10 years to estimate 95% confidence intervals of the predicted yields, SSB and recruitment at a *status quo* level of fishing mortality and for a level of 0.8 $F_{status\ quo}$ assuming no stock-recruitment relationship. The results are presented in Figures 3.6.10 and 3.6.11. The model was run with 500 simulations. The estimates of the 95% confidence intervals of the predicted yield and SSB increase with time and stabilize after 1997, indicating that from this year onwards the prediction of yield and SSB is unreliable. The estimate of recruitment is uncertain from 1995 onwards.

3.6.10 Long-term considerations

The SPLIR model has been used to estimate the probability that SSB will decrease below this level in the long term. This model is described in ICES C.M.1994/G:43. Basically the model estimates the variability on the yield- and biomass-per-recruit curves due to the observed variability in recruitment. The model was run over 500 years.

The results are shown in Figure 3.6.12. At the present level of fishing mortality ($F_{(2-8)}$=0.457) the probability that the spawning stock will be below the level of 35,000 t in any year in the long term is 0.2. If the fishing mortality is reduced to 80% of the present level, the probability that this happens will decrease to about 0.05. The distribution of expected yields is almost the same for all levels of fishing mortality. This corresponds to the flat-topped yield/recruit curve, which is typical for this stock (Figure 3.6.5).

3.6.11 Comments on the assessment

The consistency of this assessment and previous assessments is shown in the quality control diagrams (Table 3.6.15). The quality control diagrams show there is a tendency to revise F downwards. This has been taken into account in the present assessment.

The 1994 assessment is not consistent with the 1993 assessment with regard to the estimated fishing mortality in 1991 and 1992. An explanation of this and the consequences for the estimates of recruitment and SSB is discussed in paragraph 3.6.4.

In general there is a lack of reliable effort and cpue data. The effort of the only commercial fleet used in the tuning is from a mixed fishery on plaice and sole and contains a certain proportion of effort exclusively directed to plaice. Changes in the directivity of this fishery towards one of these species or other species have been observed depending on the availability of the species (catch rates, catch restrictions) but cannot be quantified. The decreasing trend in catchability in the last 5–7 years can be explained by a change in the distribution of this fleet induced by the plaice box. The plaice box covers significant spawning areas for sole in the second quarter, where these fish aggregate. These spawning areas were important fishing areas for the beam trawl fleet of vessels >300 HP, the largest component in the sole fishery. Since the introduction of the plaice box the area is prohibited for these vessels and their effort has been directed elsewhere.

Other CPUE and effort series (Table 3.6.16) could not be used either because they were biased by national restrictions on the amount of sole allowed to be landed by trip or because they were based on estimates in localized areas. The historical trends in these series do not correspond at all with the converged trends in the assessment.

In the past, weights at age of sole have shown significant trends. In the mid–sixties and early seventies a significant increase in weight at age (about 40%) was observed. This increase in weight at age has been explained by an increase in growth. In last year's report it was demonstrated that in recent years a relatively small, but probably significant, decrease in weight at age has been observed in sole as well as in plaice. The decrease in weight at age has continued in 1993. The reasons for these changes are not yet fully understood. The short–term forecasts take account of the change in weight at age by assuming an extrapolation of the mean weight at age of the last three years. The medium– and long–term models used by the Working Group do not take account of a possible further decrease.

3.6.12 Management advice

Apart from changes in technical measures, such as changes in the minimum mesh size, closed areas and closed seasons, which are directed to changing the exploitation pattern or the protection of certain stock components, most management advice given by ACFM relates to changes in the level of fishing mortality. Many heavily exploited commercial stocks require a reduction in the level of fishing mortality, either to maintain these within historically observed safe levels or to improve the expected yields. The most obvious way to achieve a reduction in fishing mortality is by reducing the fishing effort.

In the case of North Sea sole the relationship between the level of fishing mortality and various indices of international fishing effort are, however, rather poor. Fishing mortality is rather constant over a wide range of effort. Last year's report shows the relationship between mean F and international effort derived from Dutch and Belgian CPUE indices. Similar poor relationships have been demonstrated in other flatfish and roundfish stocks by various Assessment Working Groups in the past.

In the case of sole it is obvious that total effort has increased significantly in the last 20 years and while the fishing mortality shows only a minor increase. The problem clearly needs to be investigated in much more detail. Studies on this problem should be encouraged. In the meantime, the observed lack of a relationship between F and effort should be kept in mind when attempts are made to achieve a reduction in fishing mortality by means of a reduction in effort.

Table 3.6.1 Nominal catch (tonnes) of SOLE in Sub-area IV and landings as estimated by the Working Group, 1982-1993

Year	Belgium	Denmark	France	Germany Fed. Rep.	Netherlands	UK (Engl. & Wales)	Other countries	Total reported	Unreported landings	Grand Total
1982	1,927	522	686	290	17,749	403		21,577	2	21,579
1983	1,740	730	332	619	16,101	435		19,957	4,970	24,927
1984	1,771	818	400	1,034	14,330	586	1	18,940	7,899	26,839
1985	2,390	692	875	303	14,897	774	3	19,934	4,313	24,247
1986	1,833	443	296	155	9,558	647	2	12,934	5,267	18,201
1987	1,644	342	318	210	10,635	676	4	13,829	3,539	17,368
1988	1,199	616	487	452	9,841	740	28	13,363	8,227	21,590
1989	1,596	1,020	312	864	9,620	966	65	14,443	7,378	21,821
1990	2,389	1,428	352	2,296	18,202	1,484	276	26,427	8,706	35,133
1991	2,977	1,307	465	2,107	18,758	1,605	361	27,580	5,955	33,535
1992	2,058	1,359	548	1,880	18,601	1,237	321	26,004	3,345	29,349
1993	2,783	1,661	484	1,378	22,015	688	60	29,069	2,101	31,170

all landings reported to ICES
unreported landings estimated by the Working Group
1993 data are provisional
No data on discards available

TABLE 3.6.2; SOLE, North Sea
International catch at age ('000), Total , 1984 to 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	191	165	373	92	10	115	837	117	968	1
2	30734	16618	9351	29208	13187	46140	12023	13217	6875	49240
3	43931	43213	18494	21703	47140	18211	103898	25468	44442	16032
4	22554	20286	17703	9210	15248	22583	9779	77535	16211	30944
5	8791	9403	7745	6623	4400	4700	9360	6666	37758	13866
6	741	3556	5522	3133	3890	1695	3824	3842	2472	24159
7	854	209	2272	1527	1554	1455	1164	1829	3064	1483
8	1043	379	110	892	898	655	1273	760	790	1206
9	524	637	282	94	526	467	604	743	428	483
10	242	200	620	114	38	240	268	325	478	187
11	209	192	355	176	34	45	324	329	175	305
12	146	189	173	142	86	36	59	386	242	109
13	30	94	126	69	42	49	28	18	143	84
14	24	33	105	56	10	27	63	16	7	115
15+	243	267	305	167	111	95	215	169	255	110

TABLE 3.6.3; SOLE, North Sea
International mean weight at age (kg), Total catch, 1984 to 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	.153	.122	.135	.139	.127	.118	.124	.127	.146	.125
2	.171	.187	.179	.186	.175	.173	.182	.185	.177	.167
3	.221	.216	.213	.205	.217	.216	.226	.209	.213	.196
4	.286	.288	.299	.271	.270	.288	.290	.263	.259	.239
5	.361	.357	.357	.353	.353	.335	.368	.314	.299	.263
6	.386	.427	.407	.374	.428	.374	.390	.428	.380	.300
7	.465	.447	.485	.428	.483	.456	.401	.434	.410	.334
8	.555	.544	.543	.480	.519	.490	.497	.455	.459	.438
9	.575	.612	.568	.380	.558	.472	.457	.505	.484	.489
10	.512	.634	.536	.577	.594	.509	.564	.548	.527	.608
11	.655	.509	.575	.637	.807	.681	.622	.513	.590	.559
12	.631	.656	.633	.612	.714	.630	.517	.508	.471	.583
13	.722	.767	.631	.659	.754	.711	.571	.819	.610	.632
14	.845	.801	.788	.726	.771	.636	.461	.742	.776	.597
15+	.707	.680	.715	.698	.694	.729	.630	.552	.639	.637

TABLE 3.6.4; SOLE, North Sea
Stock mean weight at age (kg), 1984 to 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	.050	.050	.050	.050	.050	.050	.050	.050	.050	.050
2	.133	.127	.133	.154	.133	.133	.148	.138	.156	.128
3	.203	.185	.191	.192	.193	.195	.203	.183	.195	.182
4	.268	.267	.278	.259	.260	.290	.292	.253	.259	.227
5	.348	.324	.344	.349	.335	.348	.356	.300	.308	.262
6	.386	.381	.423	.381	.408	.339	.438	.406	.399	.293
7	.488	.380	.494	.405	.417	.410	.391	.437	.406	.339
8	.591	.626	.487	.457	.472	.475	.486	.501	.470	.472
9	.567	.554	.587	.308	.485	.418	.471	.551	.495	.420
10	.559	.589	.546	.512	.455	.462	.496	.430	.544	.534
11	.632	.517	.681	.624	.829	.704	.682	.640	.488	.559
12	.731	.734	.645	.580	.655	.787	.550	.640	.442	.505
13	.873	.740	.737	.572	.535	.716	.789	.430	.578	.676
14	.952	.642	.939	.690	.847	.616	.458	1.109	.672	.574
15+	.700	.673	.887	.681	.687	.730	.749	.650	.628	.662

TABLE 3.6.5 North Sea Sole Tuning input fleets

```
NS SOLE Tuning data  <<NETH>> <<TRI>> <<GER>>  VBEEK (5/10/94) RSOLEF.DAT
104
>>NETHERLANDS ALL FLEETS<<
79, 93
1, 1, 0, 1
1, 15
44.9,    1.00,  7721.2, 35400.6, 12904.4,  2096.5,  2657.4, 1490.0,  641.6, 177.2, 323.3, 104.9,  85.5,  77.0,  53.7, 476.1
45.0,  462.1,   938.3, 11061.0, 14294.5,  4914.8,   938.1, 1731.7, 1133.1, 214.3,  17.0, 347.8,  16.5,  32.5,  23.7, 432.2
46.3,  391.2, 26036.0,  2756.0,  5720.5,  6094.5,  2265.5,  586.6,  531.3, 439.4 , 98.9,  15.3, 102.4,  56.9,   4.4, 173.2
57.3, 2572.0, 24290.1, 38683.0,  1085.1,  2638.3,  3214.2,  961.1,  234.8, 352.9, 287.6,  80.2,  41.7, 157.3,   7.9, 141.1
65.6,  381.0, 31274.7, 36706.2, 16386.3,   375.1,   768.9, 1117.8,  531.2, 237.5, 168.1, 338.6,  15.0,   2.0, 157.6, 143.2
70.8,  186.7, 26976.3, 37398.3, 18212.1,  6529.0,   301.2,  492.0,  633.5, 321.8, 123.7, 130.9,  90.3,   6.4,  14.5, 155.4
70.3,  126.2, 12923.7, 34685.4, 16979.4,  7239.6,  2536.8,  146.5,  285.1, 426.8,  84.9,  68.7, 113.3,  61.9,   9.1, 134.5
68.2,  354.6,  8027.0, 13755.0, 13809.8,  6353.7,  4342.4, 1712.2,   71.8, 223.4, 405.6, 211.1, 124.6,  73.4,  88.5, 247.6
68.5,   73.7, 23918.9, 18282.7,  7081.1,  5313.1,  2608.3, 1095.7,  566.4,  57.0,  78.0,  79.7,  80.1,  36.4,  32.0, 123.4
76.3,   1.00, 12191.9, 40595.2, 12448.9,  2982.9,  2955.6, 1274.8,  652.4, 384.5,  30.4,  25.4,  42.7,  26.1,   3.2,  60.9
61.6,   1.00, 40284.3, 13165.6, 17489.4,  2688.9,  1099.4, 1134.4,  409.4, 333.9, 161.6,   8.9,  22.7,  16.2,  10.0,  40.0
71.4,  119.3,  9071.1, 84629.7,  7242.0,  6586.7,  1965.0,  634.6,  819.2, 375.9, 137.6, 134.1,  42.5,  10.1,  12.6, 138.2
68.5,   40.0,  7336.6, 17182.4, 59754.0,  4638.3,  2137.6,  682.7,  312.1, 392.3, 156.6,  98.4, 180.5,   6.3,   6.0,  48.1
71.1,  833.9,  5055.0, 34088.9, 11138.4, 29622.1,  1458.1, 2063.2,  447.7, 216.0, 272.3,  74.5, 170.3,  74.4,   3.9, 107.5
76.8,   1.00, 39284.5, 10948.0, 24132.0,  9625.4, 18624.0,  887.1,  811.5, 236.1,  66.4, 186.3,  50.2,  41.6,  59.1,  21.8
>>Tridens sns survey<<
70, 93
1, 1, 0.666, 0.750
1, 4
1,  4938,   745,  204,  31
1,   613,  1961,   99,   7
1,  1410,   341,  161,  0.1
1,  4686,   905,   73,  35
1,  1924,   397,   69,   0.1
1,   597,   887,  174,  44
1,  1413,    79,  187,  70
1,  3724,   762,   77,  85
1,  1552,  1379,  267,  27
1,   104,   388,  325,  60
1,  4483,    80,   99,  45
1,  3739,  1411,   51,  13
1,  5098,  1124,  231,   7
1,  2640,  1137,  107,  43
1,  2359,  1081,  307, 102
1,  2151,   709,  159,  59
1,  3791,   465,   67,  30
1,  1890,   955,   59,  15
1, 11227,   594,  284,  81
1,  3052,  5369,  248,  50
1,  2900,  1078,  907, 100
1,  1265,  2515,  527, 607
1, 11081,   114,  319, 194
1,  1351,  3489,   46, 166
>>Solea survey<<
80,93
1, 1, 0.333, 0.417
2, 10
1,   3.8,  27.6,  26.1,  15.0,   1.3,  3.5,  1.8,  0.5,  0.1
1,  43.6,   2.7,   7.6,   4.6,   2.2,  0.4,  0.6,  0.5,  0.2
1,  17.1,  48.4,   1.4,   5.3,   2.9,  2.1,  0.4,  1.0,  0.4
1,  74.0,  50.0,  23.3,   0.8,   1.8,  1.1,  0.9,  0.1,  0.2
1,  13.1,  84.4,  34.4,  14.9,   0.5,  1.5,  1.5,  0.8,  0.2
1,   4.9,  32.8,  40.4,   9.0,   3.0,  0.2,  0.3,  0.2,  0.1
1,   7.1,   9.5,   8.4,   7.1,   2.3,  0.6,  0.0,  0.2,  0.1
1,  11.8,  17.3,   7.4,   3.4,   1.8,  0.5,  0.2,  0.0,  0.0
1,   4.2,  16.3,   7.9,   1.5,   1.1,  0.9,  0.2,  0.1,  0.0
1,  24.4,  24.9,  21.4,   4.6,   1.2,  1.0,  0.9,  0.2,  0.1
1,   7.0,  52.6,   7.8,   2.8,   0.8,  0.2,  0.1,  0.1,  0.0
1,   9.5,  34.1,  87.2,  10.0,   6.9,  1.1,  0.4,  0.2,  0.4
1,   1.2,  25.8,  11.2,  25.6,   3.6,  0.8,  0.7,  0.0,  0.1
1,  15.47,  8.92, 82.47, 29.36, 33.83, 2.58, 0.88, 0.56, 0.06
>>BTS survey<<
85, 93
1, 1, 0.666, 0.750
1, 7
1,    2.372  6.021  3.959  1.612  0.593  0.216  0.019
1,    5.935  4.883  1.555  1.037  0.458  0.225  0.109
1,    6.101  9.842  2.497  0.768  0.551  0.192  0.148
1,   70.609 11.138  3.060  0.802  0.160  0.157  0.088
1,    8.021 60.486  3.199  4.089  0.530  0.189  0.144
1,   18.991 19.400 19.486  0.950  0.693  0.229  0.084
1,    3.328 17.372  4.597  9.119  0.260  0.481  0.132
1,   67.816 24.403  9.134  2.484  3.442  0.115  0.174
1,    4.954 24.505  2.652  3.930  1.670  3.266  0.029
```

Table 3.6.6 North Sea Sole TUNING options and diagnostics

VPA Version 3.1 (MSDOS)

7/10/1994 10:29

Extended Survivors Analysis

North Sea Sole, sexes combined *** reduced data set *** RSOLIND.DAT

CPUE data from file RSOLEF.DAT

Catch data for 10 years. 1984 to 1993. Ages 1 to 15.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
>>NETHERLANDS ALL FL	1984	1993	1	14,	.000,	1.000
>>Tridens sns survey	1984	1993	1	4,	.666,	.750
>>Solea survey<<	1984	1993	2	10,	.333,	.417
>>BTS survey<<	1985	1993	1	7,	.666,	.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 5 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 30 iterations

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

Continued

table 3.6.6 continued

Regression statistics :

Fleet : >>NETHERLANDS ALL FL

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	1.32,	-.348,	12.84,	.22,	10,	3.71,	-12.47,
2,	1.08,	-.252,	6.00,	.70,	10,	.57,	-6.43,

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3,	1.14,	-.853,	4.42,	.89,	10,	.30,	-5.29,
4,	1.10,	-.517,	4.59,	.85,	10,	.35,	-5.18,
5,	1.09,	-.727,	4.83,	.94,	10,	.24,	-5.27,
6,	1.00,	-.028,	5.42,	.94,	10,	.26,	-5.43,
7,	.79,	1.260,	6.10,	.90,	10,	.15,	-5.49,
8,	.92,	.791,	5.85,	.96,	10,	.12,	-5.67,
9,	1.17,	-.733,	5.35,	.81,	10,	.31,	-5.62,
10,	1.06,	-.195,	5.86,	.70,	10,	.53,	-5.91,
11,	.83,	.717,	6.04,	.81,	10,	.43,	-6.00,
12,	1.15,	-.458,	5.24,	.69,	10,	.58,	-5.29,
13,	1.06,	-.256,	5.78,	.80,	10,	.48,	-5.73,
14,	.94,	.246,	5.66,	.82,	10,	.52,	-5.75,

Fleet : >>Tridens sns survey

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	2.57,	-3.800,	-9.57,	.58,	10,	1.68,	-3.18,
2,	.62,	2.185,	7.33,	.89,	10,	.31,	-4.60,

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3,	.89,	.321,	6.19,	.67,	10,	.60,	-5.56,
4,	.87,	.426,	6.40,	.72,	10,	.54,	-5.72,

Fleet : >>Solea survey<<

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2,	.84,	.793,	10.07,	.86,	10,	.36,	-9.74,

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3,	1.62,	-1.705,	6.00,	.64,	10,	.65,	-8.07,
4,	.80,	.731,	8.31,	.75,	10,	.49,	-7.65,
5,	1.06,	-.128,	7.72,	.50,	10,	.93,	-7.86,
6,	.79,	.700,	8.29,	.72,	10,	.62,	-8.00,
7,	2.09,	-.525,	8.43,	.05,	10,	1.91,	-8.43,
8,	-1.06,	-1.570,	7.15,	.13,	9,	.97,	-8.66,
9,	-1.12,	-1.965,	5.83,	.23,	8,	.83,	-8.84,
10,	11.95,	-.859,	29.58,	.00,	7,	11.49,	-8.80,

Fleet : >>ISIS BTS survey<<

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	2.05,	-2.025,	6.02,	.47,	9,	2.11,	-8.73,
2,	2.14,	-1.641,	5.07,	.33,	9,	1.26,	-8.67,

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3,	1.10,	-.550,	9.22,	.87,	9,	.33,	-9.42,
4,	.91,	.437,	9.73,	.85,	9,	.36,	-9.62,
5,	.87,	.757,	10.05,	.89,	9,	.32,	-10.04,
6,	.80,	1.501,	9.95,	.93,	9,	.28,	-10.10,
7,	.81,	.430,	9.99,	.53,	9,	.41,	-10.37,

Continued

table 3.6.6 continued

```
Terminal year survivor and F summaries :

Age  1   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
>>NETHERLANDS ALL FL,          1202.,    4.359,        .000,     .00,    1,  .009,      .001
>>Tridens sns survey,          8299.,    1.935,        .000,     .00,    1,  .044,      .000
>>Solea survey<<     ,            1.,     .000,        .000,     .00,    0,  .000,      .000
>>BTS survey<<       ,        11438.,    2.366,        .000,     .00,    1,  .029,      .000

  P shrinkage mean   ,       136354.,      .79,,,,                            .264,      .000
  F shrinkage mean   ,          426.,      .50,,,,                            .655,      .002

Weighted prediction :
Survivors,          Int,      Ext,     N,    Var,      F
at end of year,     s.e,      s.e,      ,   Ratio,
   2465.,           .40,      1.38,    5,   3.423,    .000


Age  2   Catchability dependent on age and year class strength

Year class = 1991

Fleet,                      Estimated,    Int,         Ext,     Var,     N, Scaled,  Estimated
     ,                      Survivors,    s.e,         s.e,    Ratio,     , Weights,    F
>>NETHERLANDS ALL FL,        314889.,     .665,        .462,     .69,    2,  .094,      .139
>>Tridens sns survey,        219108.,     .351,        .315,     .90,    2,  .337,      .194
>>Solea survey<<     ,       194208.,     .403,        .000,     .00,    1,  .255,      .216
>>BTS survey<<       ,       289335.,    1.212,        .971,     .80,    2,  .028,      .150

  P shrinkage mean   ,        89432.,      .77,,,,                            .084,      .421
  F shrinkage mean   ,       302758.,      .50,,,,                            .201,      .144

Weighted prediction :
Survivors,          Int,      Ext,     N,    Var,      F
at end of year,     s.e,      s.e,      ,   Ratio,
 219267.,           .21,      .15,     9,   .729,     .194


Age  3   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
>>NETHERLANDS ALL FL,         19556.,     .274,        .061,     .22,    3,  .276,      .577
>>Tridens sns survey,         11235.,     .343,        .191,     .56,    3,  .161,      .858
>>Solea survey<<     ,        14863.,     .347,        .236,     .68,    2,  .164,      .706
>>BTS survey<<       ,        27147.,     .291,        .256,     .88,    3,  .248,      .446

  F shrinkage mean   ,        25918.,      .50,,,,                            .151,      .463

Weighted prediction :
Survivors,          Int,      Ext,     N,    Var,      F
at end of year,     s.e,      s.e,      ,   Ratio,
  19352.,           .15,      .12,    12,   .793,     .581


Age  4   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
>>NETHERLANDS ALL FL,         38205.,     .212,        .125,     .59,    4,  .320,      .571
>>Tridens sns survey,         49155.,     .279,        .136,     .49,    4,  .161,      .469
>>Solea survey<<     ,        54312.,     .284,        .359,    1.27,    3,  .156,      .433
>>BTS survey<<       ,        50712.,     .238,        .062,     .26,    4,  .249,      .458

  F shrinkage mean   ,        41223.,      .50,,,,                            .113,      .539

Weighted prediction :
Survivors,          Int,      Ext,     N,    Var,      F
at end of year,     s.e,      s.e,      ,   Ratio,
  45498.,           .12,      .08,    16,   .615,     .499
```


Continued

table 3.6.6 continued

Age 5 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
>>NETHERLANDS ALL FL,	14441.,	.179,	.105,	.59,	5,	.389,	.649
>>Tridens sns survey,	25539.,	.280,	.139,	.50,	4,	.105,	.416
>>Solea survey<< ,	22249.,	.281,	.320,	1.14,	4,	.123,	.466
>>BTS survey<< ,	21765.,	.210,	.162,	.77,	5,	.274,	.474
F shrinkage mean ,	19252.,	.50,,,,				.110,	.522

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
18671.,	.11,	.09,	19,	.756,	.534

Age 6 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
>>NETHERLANDS ALL FL,	39241.,	.167,	.057,	.34,	6,	.455,	.461
>>Tridens sns survey,	42299.,	.311,	.153,	.49,	4,	.057,	.434
>>Solea survey<< ,	40785.,	.315,	.201,	.64,	5,	.100,	.447
>>BTS survey<< ,	49037.,	.206,	.119,	.58,	6,	.280,	.384
F shrinkage mean ,	37302.,	.50,,,,				.110,	.480

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
41871.,	.12,	.05,	22,	.454,	.438

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLANDS ALL FL,	1989.,	.169,	.050,	.29,	7,	.506,	.536
>>Tridens sns survey,	3101.,	.331,	.133,	.40,	4,	.025,	.375
>>Solea survey<< ,	4232.,	.382,	.236,	.62,	6,	.079,	.288
>>BTS survey<< ,	1164.,	.227,	.143,	.63,	7,	.244,	.794
F shrinkage mean ,	2287.,	.50,,,,				.146,	.480

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1912.,	.13,	.09,	25,	.676,	.552

Age 8 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
>>NETHERLANDS ALL FL,	2235.,	.163,	.085,	.52,	8,	.610,	.414
>>Tridens sns survey,	1677.,	.382,	.184,	.48,	4,	.013,	.521
>>Solea survey<< ,	2344.,	.427,	.213,	.50,	7,	.068,	.398
>>BTS survey<< ,	2822.,	.231,	.110,	.48,	7,	.164,	.341
F shrinkage mean ,	2124.,	.50,,,,				.145,	.432

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2304.,	.13,	.05,	27,	.400,	.404

Continued

table 3.6.6 continued

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

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLANDS ALL FL,	553.,	.165,	.036,	.22,	9,	.657,	.604
>>Tridens sns survey,	630.,	.455,	.259,	.57,	4,	.006,	.547
>>Solea survey<< ,	951.,	.496,	.242,	.49,	8,	.060,	.394
>>BTS survey<< ,	763.,	.249,	.116,	.47,	7,	.093,	.471
F shrinkage mean ,	885.,	.50,,,,				.184,	.418

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
643.,	.15,	.06,	29,	.387,	.539

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLANDS ALL FL,	241.,	.171,	.069,	.41,	10,	.605,	.552
>>Tridens sns survey,	152.,	.624,	.354,	.57,	4,	.003,	.774
>>Solea survey<< ,	193.,	.610,	.141,	.23,	8,	.062,	.652
>>BTS survey<< ,	282.,	.269,	.136,	.50,	6,	.076,	.488
F shrinkage mean ,	470.,	.50,,,,				.253,	.320

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
285.,	.17,	.08,	29,	.452,	.485

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLANDS ALL FL,	372.,	.178,	.041,	.23,	10,	.574,	.577
>>Tridens sns survey,	193.,	.965,	.238,	.25,	3,	.002,	.917
>>Solea survey<< ,	176.,	.533,	.183,	.34,	9,	.061,	.976
>>BTS survey<< ,	344.,	.313,	.148,	.47,	5,	.064,	.612
F shrinkage mean ,	618.,	.50,,,,				.300,	.385

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
411.,	.19,	.08,	28,	.420,	.534

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1981

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLANDS ALL FL,	112.,	.234,	.055,	.23,	10,	.522,	.652
>>Tridens sns survey,	101.,	1.705,	.161,	.09,	2,	.000,	.702
>>Solea survey<< ,	165.,	.608,	.299,	.49,	8,	.035,	.486
>>BTS survey<< ,	114.,	.394,	.031,	.08,	4,	.026,	.645
F shrinkage mean ,	122.,	.50,,,,				.417,	.612

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
118.,	.24,	.04,	25,	.174,	.629

Continued

table 3.6.6 continued

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1980

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLANDS ALL FL,	104.,	.250,	.120,	.48,	10,	.552,	.565
>>Tridens sns survey,	127.,	4.344,	.000,	.00,	1,	.000,	.487
>>Solea survey<< ,	60.,	.747,	.121,	.16,	6,	.014,	.848
>>BTS survey<< ,	133.,	.530,	.140,	.26,	3,	.014,	.468
F shrinkage mean ,	129.,	.50,,,,				.421,	.480

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
114.,	.25,	.07,	21,	.278,	.530

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1979

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLANDS ALL FL,	93.,	.250,	.098,	.39,	10,	.519,	.776
>>Tridens sns survey,	1.,	.000,	.000,	.00,	0,	.000,	.000
>>Solea survey<< ,	34.,	.757,	.151,	.20,	6,	.018,	1.437
>>BTS survey<< ,	89.,	.768,	.064,	.08,	2,	.007,	.800
F shrinkage mean ,	151.,	.50,,,,				.457,	.545

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
114.,	.26,	.10,	19,	.385,	.672

TABLE 3.6.7; SOLE, North Sea
International F at age, Total , 1984 to 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	.003	.002	.002	.001	.000	.001	.005	.002	.003	.000
2	.285	.312	.142	.236	.232	.120	.121	.087	.158	.194
3	.713	.718	.598	.495	.644	.508	.381	.360	.412	.581
4	.673	.757	.646	.599	.688	.652	.499	.483	.363	.499
5	.573	.584	.650	.470	.567	.411	.546	.669	.406	.534
6	.655	.425	.723	.526	.494	.393	.610	.400	.495	.438
7	.557	.340	.468	.392	.477	.306	.455	.587	.568	.553
8	.399	.455	.269	.300	.373	.335	.426	.538	.481	.404
9	.405	.403	.643	.345	.259	.301	.519	.418	.586	.539
10	.356	.237	.761	.516	.203	.161	.253	.519	.461	.485
11	.331	.469	.743	.443	.252	.352	.302	.495	.520	.534
12	.344	.497	.906	.667	.358	.404	.932	.625	.731	.629
13	.245	.345	.642	1.048	.371	.314	.556	.710	.438	.530
14	.338	.412	.712	.584	.352	.388	.749	.621	.548	.673
15+	.338	.412	.712	.584	.352	.388	.749	.621	.548	.673

TABLE 3.6.8; SOLE, North Sea
Tuned Stock Numbers at age (10**-3), 1984 to 1994,
(numbers in 1994 are VPA survivors)

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	72258	82429	161790	74107	474434	122326	185086	54819	326037	2725	0
2	130304	65200	74428	146039	66967	429276	110576	166676	49491	294090	2465
3	90571	88669	43188	58450	104358	48051	344536	88616	138243	38242	219267
4	48411	40164	39125	21486	32243	49586	26155	212918	55957	82813	19352
5	21178	22350	17045	18562	10681	14671	23386	14364	118902	35212	45498
6	1621	10801	11279	8056	10496	5479	8804	12257	6657	71671	18671
7	2102	762	6390	4953	4309	5797	3345	4328	7436	3672	41871
8	3330	1089	490	3621	3029	2421	3861	1920	2176	3814	1912
9	1653	2021	625	339	2428	1886	1567	2283	1014	1218	2304
10	850	997	1223	297	217	1696	1263	844	1359	511	643
11	781	539	712	517	161	161	1307	888	454	775	285
12	527	508	305	307	300	113	102	874	490	244	411
13	145	338	279	112	142	190	68	36	423	213	118
14	88	103	217	133	35	89	125	35	16	247	114
15+	888	828	625	395	392	311	425	381	631	235	223

Table : 3.6.9

SOLE NORTH SEA (IV) - Indices of recruitment (input data for RCT3)

Year class	VPA	INT-0	TR1S	INT-1	TR2S	TR3S	SOL3	NBTS1	NBTS2
1968	50587	-11	-11	-11	745	99	-11	-11	-11
1969	141484	-11	4938	-11	1961	161	-11	-11	-11
1970	41933	-11	613	-11	341	73	-11	-11	-11
1971	76940	-11	1410	-11	905	69	-11	-11	-11
1972	106445	-11	4686	-11	397	174	-11	-11	-11
1973	110801	-11	1924	-11	887	187	31.5	-11	-11
1974	41917	-11	597	1.49	79	77	16.3	-11	-11
1975	114191	167.88	1413	5.93	762	267	34.4	-11	-11
1976	140653	81.91	3724	6.97	1379	325	-11	-11	-11
1977	47101	32.31	1552	0.87	388	99	41.5	-11	-11
1978	11865	95.38	104	2.27	80	51	1.9	-11	-11
1979	155017	391.51	4483	-11	1411	231	76.1	-11	-11
1980	149646	401.63	3739	12.10	1124	107	77.1	-11	-11
1981	153396	293.04	5098	14.58	1137	307	147.1	-11	-11
1982	144417	340.58	2640	21.81	1081	159	77.8	-11	-11
1983	72258	109.4	2359	11.23	709	67	10.8	-11	6.021
1984	82429	194.2	2151	3.29	465	59	29.8	2.372	4.883
1985	161790	300.66	3791	11.62	955	284	24.6	5.935	9.842
1986	74107	72.36	1890	5.16	594	248	20.3	6.101	11.138
1987	474434	534.21	11227	17.08	5369	907	66.9	70.609	60.486
1988	122326	61.73	3052	6.50	1078	527	86.4	8.021	19.4
1989	185086	83	2900	8.72	2515	319	54.1	18.991	17.372
1990	54819	62.56	1265	11.21	114	46	11.3	3.328	24.403
1991	-11	369.69	11081	11.87	3489	-11	180.7	67.816	24.505
1992	-11	32.81	1351	8.76	-11	-11	-11	4.954	5.648
1993	-11	29.94	-11	-11	-11	-11	-11	6.537	-11
1994	-11	-11	-11	-11	-11	-11	-11	-11	-11

INT-0	INT-1		International DFS survey
TR1S	TR2S	TR3S	"TRIDENS" SNS coastal beam trawl survey
SOL3			"SOLEA" beam trawl survey
NBTS1	NBTS2		"ISIS" Beam Trawl Survey

Table 3.6.10 NORTH SEA SOLE (IV)
Analysis by RCT3 ver3.1 of data from file : rcrtsol.csv

Data for 8 surveys over 27 years : 1968 - 1994
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression
Forecast/Hindcast variance correction used.

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Prediction
	I-----------Regression			----------I	I-----------Prediction					----------------------I
Yearclass = 1991										
"INT-0	1.63	3.40	1.14	.344	16	5.92	13.04	1.304	.027	460469
"TR1S"	.81	5.24	.29	.871	22	9.31	12.81	.330	.423	365857
"INT-1	1.62	8.12	.86	.496	16	2.55	12.25	.957	.050	208981
"TR2S"	.82	6.10	.41	.766	23	8.16	12.76	.463	.215	348014
"TR3S"	estimate available to ACFM in November 94									
"NBTS1	.76	10.03	.34	.841	7	4.23	13.23	.534	.162	556821
"NBTS2	1.44	7.74	.91	.409	8	3.24	12.42	1.141	.035	247706
					VPA Mean =		11.45	.728	.087	93901
Yearclass = 1992										
"INT-0	1.63	3.40	1.14	.344	16	3.52	9.13	1.377	.027	9228
"TR1S"	.81	5.24	.29	.871	22	7.21	11.10	.312	.524	66171
"INT-1	1.62	8.12	.86	.496	16	2.28	11.80	.947	.057	133252
"TR2S"	estimate available to ACFM in November 94									
"NBTS1	.76	10.03	.34	.841	7	1.78	11.38	.442	.261	87553
"NBTS2	1.44	7.74	.91	.409	8	1.89	10.48	1.194	.036	35596
					VPA Mean =		11.45	.728	.096	93901
Yearclass = 1993										
"INT-0	1.63	3.40	1.14	.344	16	3.43	8.99	1.391	.068	8022
"TR1S"	estimate available to ACFM in November 94									
"INT-1	estimate available to ACFM in November 94									
"NBTS1	.76	10.03	.34	.841	7	2.02	11.56	.437	.685	104820
					VPA Mean =		11.45	.728	.247	93901
Yearclass = 1994										
"INT-0	estimate available to ACFM in November 94									

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1991	331737	12.71	.21	.18	.74		
1992	71019	11.17	.23	.19	.68		
1993	85610	11.36	.36	.45	1.56		
1994	No valid surveys						

TABLE 3.6.11 North Sea Sole Assesment summary table (without SOP correction)

	RECRUITS AGE 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFAC	FBAR 2- 8	FBAR 3-10
1957	165501	88541	78902	12067	0.15	1.0402	0.1369	0.1428
1958	144951	99675	85569	14287	0.17	1.0050	0.1599	0.1806
1959	559002	116346	93190	13832	0.15	1.0095	0.1324	0.1503
1960	66858	138322	101244	18620	0.18	0.9936	0.1669	0.1794
1961	115732	156081	148953	23566	0.16	1.0137	0.1599	0.1646
1962	28345	156823	148784	26877	0.18	0.9940	0.1807	0.1932
1963	23007	150771	148401	26164	0.18	0.9918	0.2612	0.2855
1964	554347	68096	53582	11342	0.21	0.9661	0.2277	0.2439
1965	121485	122205	48952	17043	0.35	0.9592	0.2464	0.2400
1966	41180	113508	104783	33340	0.32	0.9892	0.2398	0.2226
1967	75331	109350	100872	33439	0.33	1.0225	0.3081	0.2985
1968	100099	99737	88919	33179	0.37	0.9968	0.3726	0.3425
1969	50587	83908	70370	27559	0.39	1.0202	0.4229	0.3833
1970	141484	72695	62939	19685	0.31	1.0001	0.3506	0.3206
1971	41933	72564	52374	23652	0.45	1.0119	0.4440	0.4013
1972	76940	64473	55730	21086	0.38	0.9890	0.3930	0.3681
1973	106445	56337	41864	19309	0.46	1.0189	0.4519	0.4708
1974	110801	60116	42273	17989	0.43	0.9864	0.4625	0.4851
1975	41917	59308	43017	20773	0.48	1.0104	0.4618	0.4617
1976	114191	52820	43474	17326	0.40	1.0216	0.4047	0.4317
1977	140653	56008	36042	18003	0.50	1.0188	0.3818	0.3827
1978	47101	57669	38561	20280	0.53	0.9956	0.4938	0.4788
1979	11865	53018	46181	22598	0.49	1.0124	0.4613	0.4525
1980	155017	43764	36034	15807	0.44	1.0201	0.4426	0.4455
1981	149646	51355	24739	15403	0.62	1.0262	0.4479	0.4570
1982	153396	60040	34820	21579	0.62	1.0138	0.4953	0.5040
1983	144417	68530	42231	24927	0.59	1.0040	0.4655	0.4526
1984	72258	66416	45473	26839	0.59	1.0034	0.5509	0.5415
1985	82429	55089	42687	24248	0.57	0.9898	0.5131	0.4899
1986	161790	53825	35836	18200	0.51	0.9936	0.4993	0.5947
1987	74107	57372	31177	17367	0.56	0.9932	0.4310	0.4552
1988	474434	74221	41593	21590	0.52	0.9990	0.4964	0.4631
1989	122326	99641	36431	21821	0.60	0.9855	0.3892	0.3833
1990	185086	121306	95686	35133	0.37	0.9901	0.4341	0.4611
1991	54819	111017	85275	33535	0.39	0.9837	0.4463	0.4968
1992	326037	111124	87102	29349	0.34	0.9848	0.4119	0.4715
1993	*(2725)	** (98591)	60811	31170	0.51	0.9910	0.4575	0.5040
1994	*** 85610	**** 98580	**** 85261					
Arith Mean	134557	85964	65807	22405	0.40		0.3730	0.3784
Geom Mean	96739							
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)				
period	57-91	57-93	57-93	57-93	57-93		57-93	57-93

* Replaced by 71019 estimated by RCT3
** Replaced by 102005 adjusted for recruitment revision
*** Estimated by RCT3
**** Adjusted for recruitment revision

TABLE 3.6.12 SOLE North Sea
Input data for catch forecast and linear sensitivity analysis.

Populations in 1994			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	85610	.70	WS1	.05	.00	M1	.10	.10	MT1	.00	.00
N2	64243	1.38	WS2	.14	.08	M2	.10	.10	MT2	.00	.10
N3	219267	.21	WS3	.19	.04	M3	.10	.10	MT3	1.00	.10
N4	19352	.15	WS4	.25	.07	M4	.10	.10	MT4	1.00	.00
N5	45498	.12	WS5	.29	.09	M5	.10	.10	MT5	1.00	.00
N6	18671	.11	WS6	.37	.11	M6	.10	.10	MT6	1.00	.00
N7	41871	.12	WS7	.39	.11	M7	.10	.10	MT7	1.00	.00
N8	1912	.13	WS8	.48	.11	M8	.10	.10	MT8	1.00	.00
N9	2304	.13	WS9	.49	.18	M9	.10	.10	MT9	1.00	.00
N10	643	.15	WS10	.50	.10	M10	.10	.10	MT10	1.00	.00
N11	285	.17	WS11	.56	.16	M11	.10	.10	MT11	1.00	.00
N12	411	.19	WS12	.53	.17	M12	.10	.10	MT12	1.00	.00
N13	118	.24	WS13	.56	.20	M13	.10	.10	MT13	1.00	.00
N14	114	.25	WS14	.79	.27	M14	.10	.10	MT14	1.00	.00
N15	223	.26	WS15	.65	.10	M15	.10	.10	MT15	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.00	.73	WH1	.13	.09
sH2	.15	.33	WH2	.18	.04
sH3	.47	.17	WH3	.21	.04
sH4	.47	.18	WH4	.25	.07
sH5	.56	.13	WH5	.29	.10
sH6	.46	.19	WH6	.37	.10
sH7	.59	.22	WH7	.39	.10
sH8	.50	.24	WH8	.45	.08
sH9	.54	.30	WH9	.49	.13
sH10	.51	.47	WH10	.56	.08
sH11	.54	.32	WH11	.55	.14
sH12	.69	.37	WH12	.52	.13
sH13	.58	.49	WH13	.69	.12
sH14	.64	.32	WH14	.71	.16
sH15	.64	.32	WH15	.61	.08

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K94	1.00	.10	HF94	1.00	.11
K95	1.00	.10	HF95	1.00	.11
K96	1.00	.10	HF96	1.00	.11

Recruitment		
Labl	Value	CV
R95	97000	.70
R96	97000	.70

Table 3.6.13

Sole in the North Sea (Fishing Area IV)

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	4215.842	8.603	4038.531	8.603	4038.531
0.1000	0.0457	0.296	123.501	7.554	2498.241	5.649	2320.956	5.649	2320.956
0.2000	0.0915	0.433	162.665	6.187	1765.898	4.283	1588.639	4.283	1588.639
0.3000	0.1372	0.514	176.954	5.383	1366.653	3.478	1189.419	3.478	1189.419
0.4000	0.1830	0.568	181.931	4.847	1118.523	2.942	941.314	2.942	941.314
0.5000	0.2287	0.606	183.027	4.461	951.045	2.558	773.862	2.558	773.862
0.6000	0.2745	0.636	182.442	4.171	831.352	2.267	654.194	2.267	654.194
0.7000	0.3202	0.659	181.145	3.942	742.117	2.039	564.984	2.039	564.984
0.8000	0.3659	0.678	179.583	3.759	673.377	1.855	496.269	1.855	496.269
0.9000	0.4117	0.693	177.971	3.607	619.018	1.704	441.936	1.704	441.936
1.0000	0.4574	0.706	176.407	3.480	575.095	1.577	398.038	1.577	398.038
1.1000	0.5032	0.717	174.936	3.371	538.953	1.469	361.922	1.469	361.922
1.2000	0.5489	0.727	173.576	3.278	508.750	1.375	331.745	1.375	331.745
1.3000	0.5947	0.735	172.327	3.196	483.169	1.294	306.189	1.294	306.189
1.4000	0.6404	0.743	171.187	3.124	461.247	1.222	284.292	1.222	284.292
1.5000	0.6861	0.749	170.148	3.060	442.264	1.158	265.335	1.158	265.335
1.6000	0.7319	0.755	169.201	3.003	425.674	1.101	248.770	1.101	248.770
1.7000	0.7776	0.760	168.337	2.952	411.056	1.050	234.178	1.050	234.178
1.8000	0.8234	0.765	167.549	2.905	398.080	1.003	221.227	1.003	221.227
1.9000	0.8691	0.770	166.828	2.862	386.485	0.961	209.657	0.961	209.657
2.0000	0.9149	0.774	166.167	2.823	376.060	0.922	199.257	0.922	199.257
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YIELD3
Date and time : 08OCT94:14:14
Computation of ref. F: Simple mean, age 2 - 8
F-0.1 factor : 0.2003
F-max factor : 0.5017
F-0.1 reference F : 0.0916
F-max reference F : 0.2295
Recruitment : Single recruit

TABLE 3.6.14 SOLE North Sea
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 1994	1995						
Mean F Ages 2 to 8								
H.cons	.46	.00	.09	.18	.27	.37	.46	.55
Effort relative to 1993								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Biomass at start of year								
Total	99	83	83	83	83	83	83	83
Spawning	85	67	67	67	67	67	67	67
Catch weight (,000t)								
H.cons	36	0	6	12	18	23	27	31
Biomass at start of 1996								
Total		101	94	88	82	77	72	67
Spawning		84	77	70	65	59	55	50

	Year 1994	1995						
Effort relative to 1993								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.16	.21	.21	.21	.21	.21	.21	.21
Spawning	.12	.23	.23	.23	.23	.23	.23	.23
Catch weight								
H.cons	.17	.00	.57	.34	.28	.26	.25	.24
Biomass at start of 1996								
Total		.22	.22	.23	.23	.23	.24	.24
Spawning		.24	.25	.25	.25	.26	.26	.26

Continued

TABLE 3.6.14 continued SOLE North Sea
Detailed forecast tables.

Forecast for year 1994
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Total
1	85610	163	163
2	64243	8632	8632
3	219267	78684	78684
4	19352	6910	6910
5	45498	18652	18652
6	18671	6610	6610
7	41871	17934	17934
8	1912	713	713
9	2304	914	914
10	643	245	245
11	285	114	114
12	411	196	196
13	118	50	50
14	114	52	52
15	223	101	101
Wt	99	36	36

Forecast for year 1995
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Catch number: Total
1	97000	184	184
2	77308	10387	10387
3	49933	17918	17918
4	123877	44230	44230
5	10966	4495	4495
6	23516	8325	8325
7	10633	4554	4554
8	20918	7804	7804
9	1055	418	418
10	1220	466	466
11	349	139	139
12	150	72	72
13	187	79	79
14	60	27	27
15	161	73	73
Wt	83	27	27

Table 3.6.15
Stock: North Sea sole

Assessment Quality Control Diagram 1

Average F(2-8,u)							
Date of assessment	Year						
	1987	1988	1989	1990	1991	1992	1993
1989	0.51	0.55					
1990	0.48	0.58	0.53				
1991	0.45	0.52	0.42	0.55			
1992	0.41	0.46	0.36	0.40	0.47		
1993	0.43	0.49	0.38	0.43	0.52	0.50	
1994	0.43	0.50	0.39	0.43	0.45	0.41	0.46

Remarks:

Assessment Quality Control Diagram 2

Estimated total landings ('000 t) at *status quo* F								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	17.6	24.0	29.0					
1990		23.2	38.0	31.0				
1991			28.8	32.0	25.0			
1992				33.6	32.4	28.9		
1993				33.0	30.0	27.5	30.2	
1994					31.3	28.7	35.6	27.2
				\ SQC[1]	\ SQC[2]	\ Current	\ Forecast	

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\{F(y-2)-F(y-1)\}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\{F(y-1)-F(y)\}\right]$$

where F(y), F(y - 1) and F(y - 2) are as estimated in the assessment made in year (y + 1).

Remarks:

Continued

Table 3.6.15 Continued

Stock: North Sea sole

Assessment Quality Control Diagram 3

Recruitment (age 1) Unit: millions							
Date of assessment	Year class						
	1988	1989	1990	1991	1992	1993	1994
1989	101[1]	52[1]					
1990	106[1]	99[1]	15[1]				
1991	117[1]	125[1]	70[1]	137[1]			
1992	105	147[1]	51[1]	275[1]	55[1]		
1993	101	137	49[1]	275[1]	56[1]	97[2]	
1994	122	185	55	326	71[1]	86[1]	97[2]

[1]Predicted from surveys. [2]GM.

Remarks:

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)									
Date of assessment	Year								
	1988	1989	1990	1991	1992	1993	1994	1995	1996
1989	32.2	27.1	n/a[1]	n/a[1]					
1990	37.8	29.8	69.9	58.0[1]	46.0[1]				
1991	40.5	34.1	67.6	56.0	47.0[1]	37.0[1]			
1992	42.9	38.2	94.2	80.2	73.7	54.4[1]	69.8[1]		
1993	41.9	37.2	92.7	78.3	66.2	50.1	65.9[1]	51.2[1]	
1994	41.6	36.4	95.7	85.3	87.1	60.8	85.3	67.5[1]	72.2[1]

[1]Forecast.

Remarks:

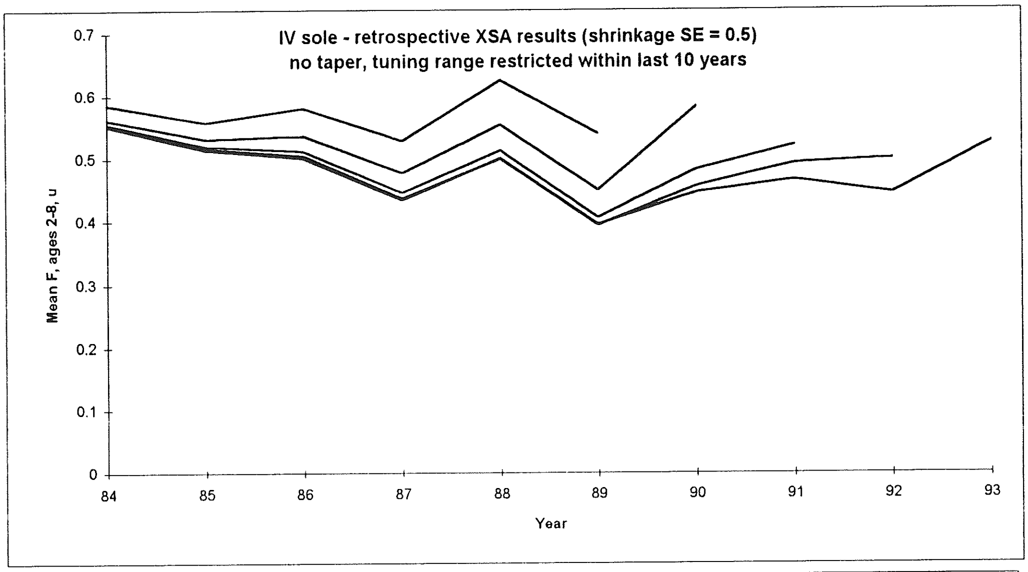
Table 3.6.16 North Sea sole Indices of effort and cpue

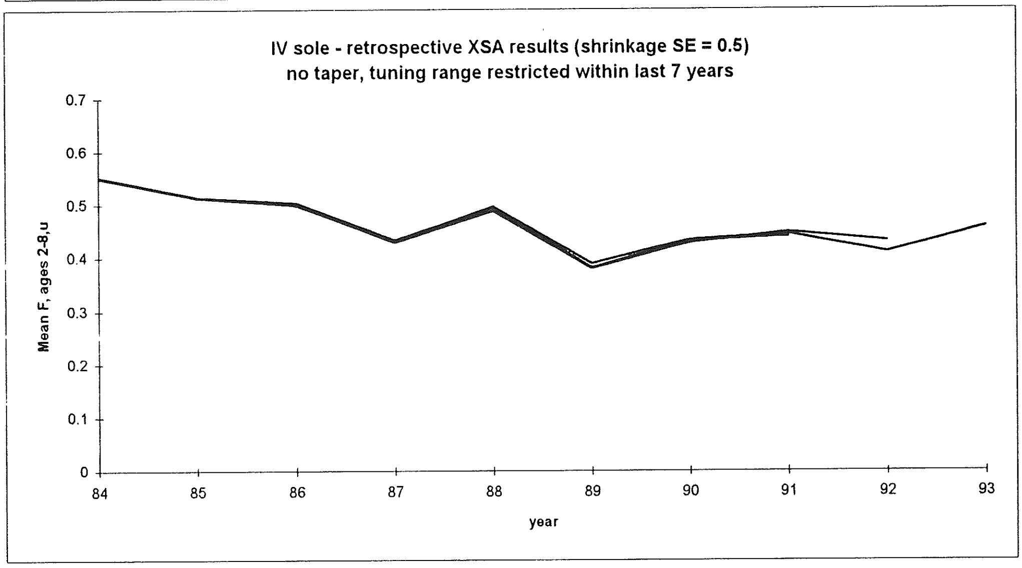
	effort						cpue					
	1 Belgium	2 UK-ot	3 UK-bt	4 Netherlands	5 France-bt	6 Denmark	7 Belgium	8 UK-ot	9 UK-bt	10 Netherlands	11 France-bt	12 Denmark
1971												
1972	29.8						33.5					
1973	29.4						33.1					
1974	32.2						23.7					
1975	39.2						26.2					
1976	44.7						24.5					
1977	47.6						27.2					
1978	50.3			44.3			25.9			335.7		
1979	40.0			44.9			38.7			370.8		
1980	35.2	166.8	36.5	45.0			30.9	2.71	12.39	422.2		
1981	31.1	160.1	35.7	46.3			35.2	2.38	10.68	274.2		
1982	34.9	156.9	35.3	57.3			44.7	2.57	11.44	216.4		
1983	35.4	160.1	24.4	65.6		3301	42.8	2.70	17.71	270.6		133
1984	42.8	146.7	34.6	70.8		1203	35.2	3.84	16.27	296.4		301
1985	51.4	170.5	65.5	70.3	12791	488	40.8	4.79	12.46	309.5	25.0	821
1986	42.5	243.6	49.2	68.2	9665	1425	38.8	2.66	13.16	284.8	18.5	174
1987	50.7	257.4	78.3	68.5	8162	1515	28.9	2.63	8.65	212.4	18.0	161
1988	53.0	250.9	87.3	76.3	9150	2539	19.2	2.95	8.48	183.6	15.4	206
1989	54.3	263.9	123.2	61.6	10485	2001	22.7	3.80	8.14	292.2	11.4	207
1990	64.7	819.4	180.4	71.4	11787	2011	24.8	2.16	9.81	235.3	12.4	759
1991	74.3	577.7	210.9	68.5	12116	2712	33.5	2.87	7.86	394.1	16.4	791
1992	67.7	644.7	195.7	71.1	10939	n.a	22.5*	1.94	6.38	338.1	14.6	n.a.
1993	71.1	532.1	166.6	76.8	n.a.	n.a	27.2*	2.12	6.77	284.3	n.a.	n.a.

1	fishing hours in 1000 HP beam trawl units *10E3	measured
2	otter trawl units *10E2 (areas 3+4)	derived
3	beam trawl units *10E2 (areas 3+4)	derived
4	million HP days beam trawl	measured
5	hours beam trawl	measured
6	fishing days gill net 2nd quarter	measured
7	Kg/FH 1000 HP beam trawl	derived
8	otter trawl kg/FH (areas 3+4)	measured
9	beam trawl kg/FH (areas 3+4)	measured
10	kg/1000 HP day	derived
11	kg/hour	derived
12	kg/fishing day, 2nd quarter	derived

* biased by national indiviual restrictions in landings per day and per HP

Figure 3.6.1 North Sea Sole Retrospective Analyses





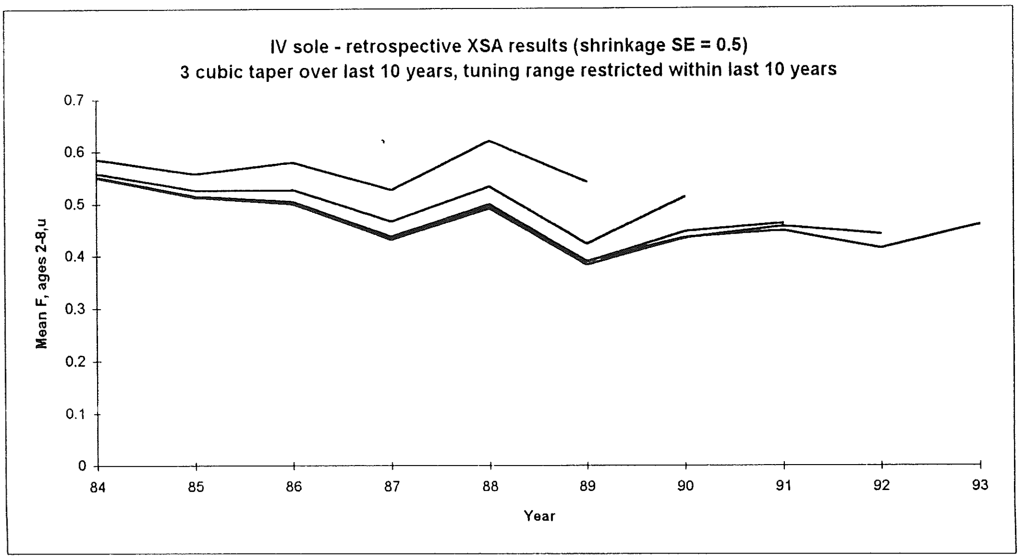
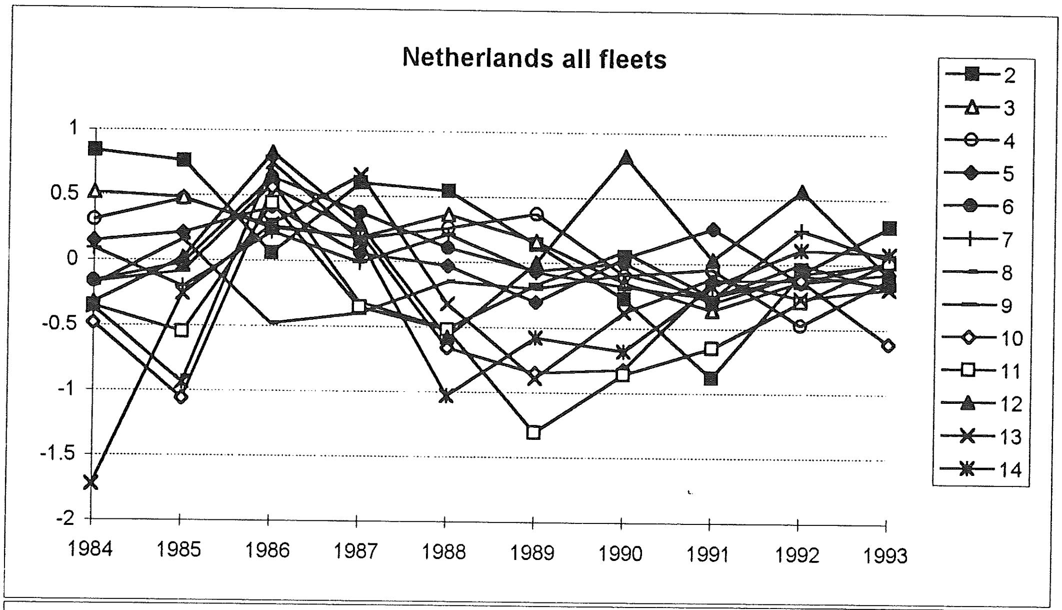
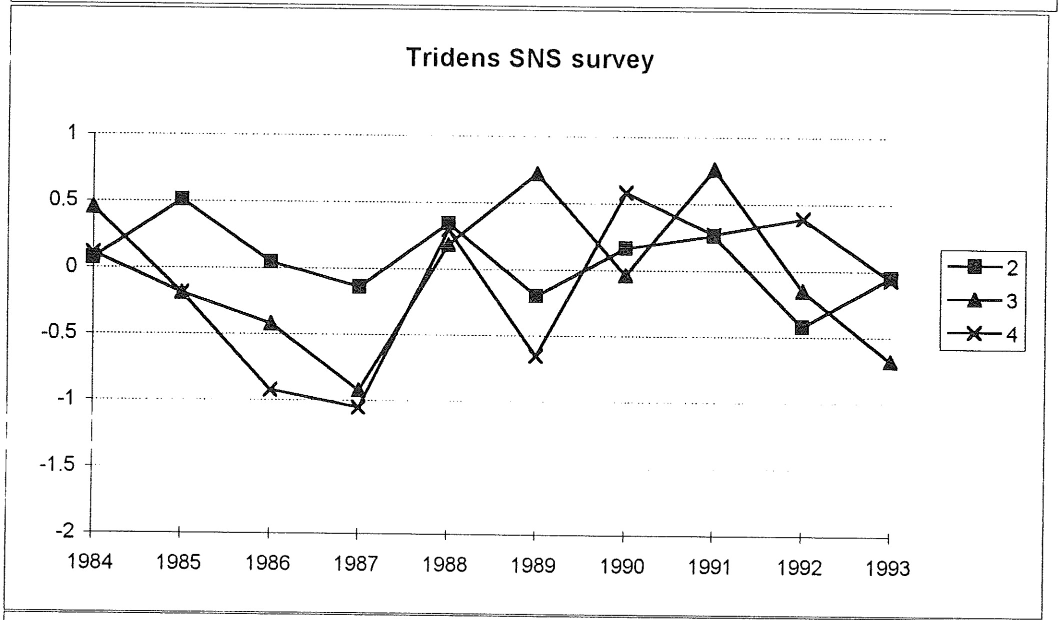


Figure 3.6.2 North Sea Sole Trends in Catchability





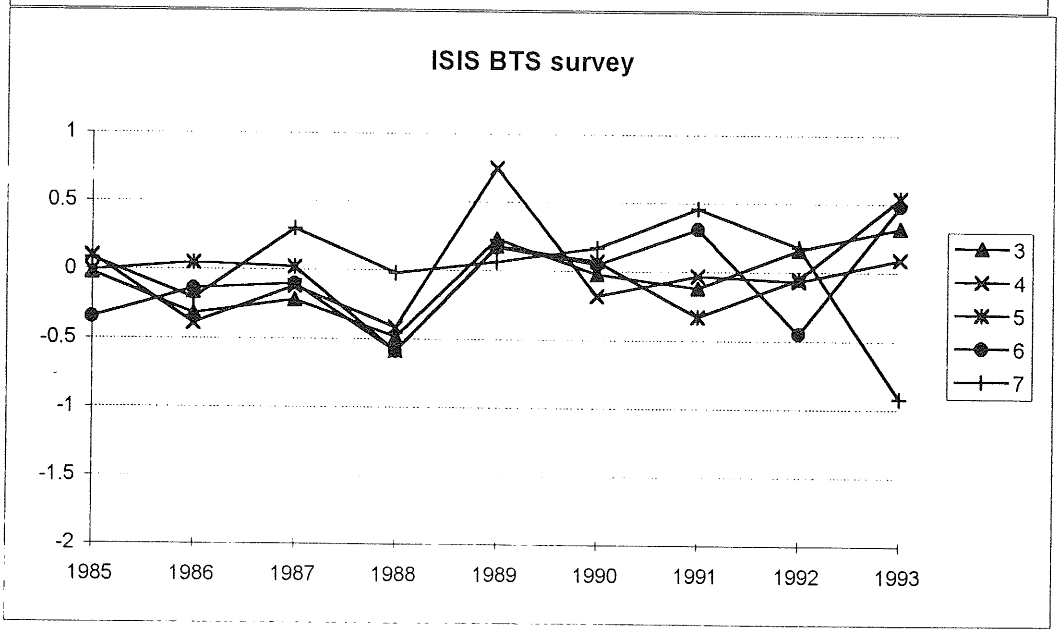


Figure 3.6.3 North Sea sole Historical trends in the stock

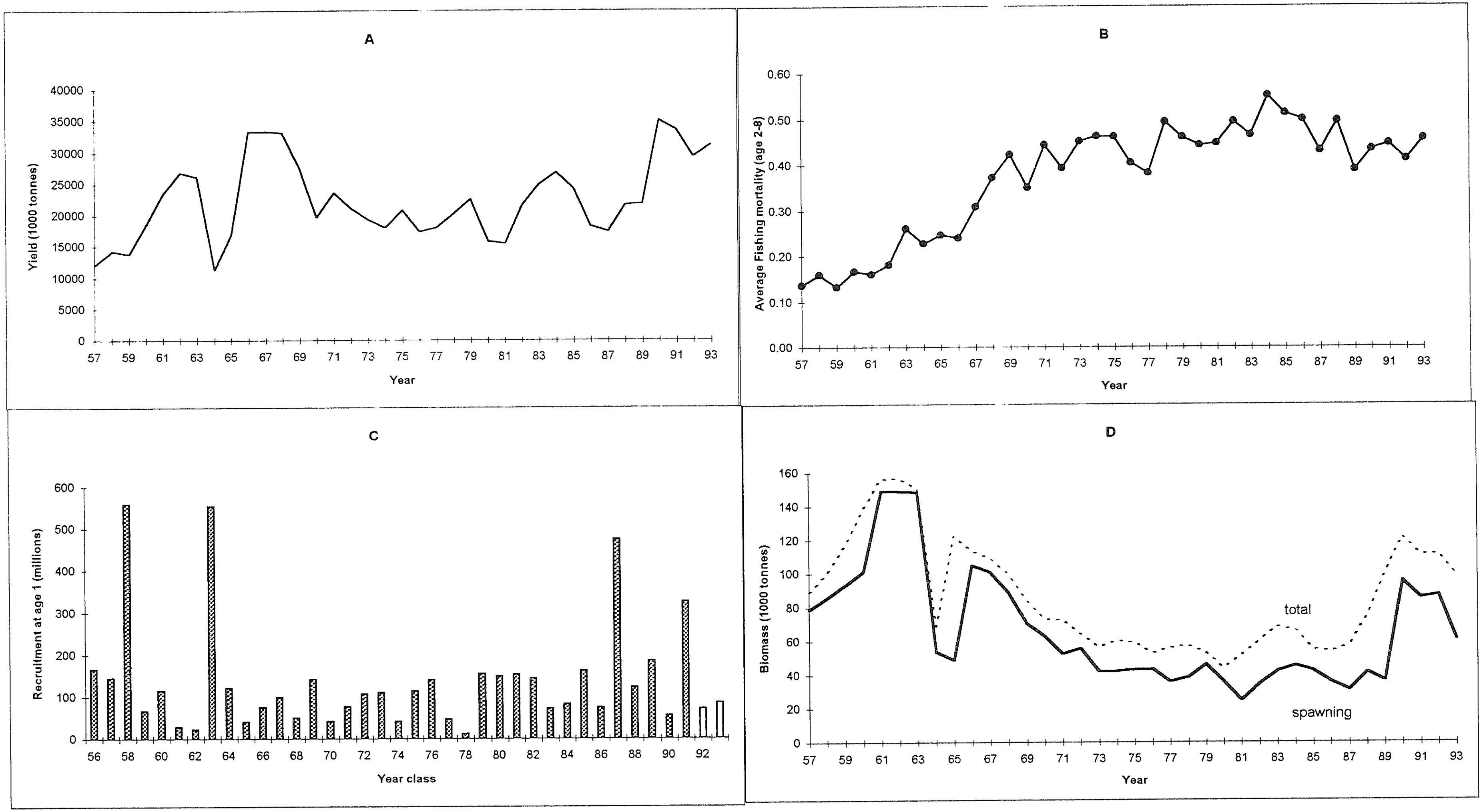


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Figure 3.6.4

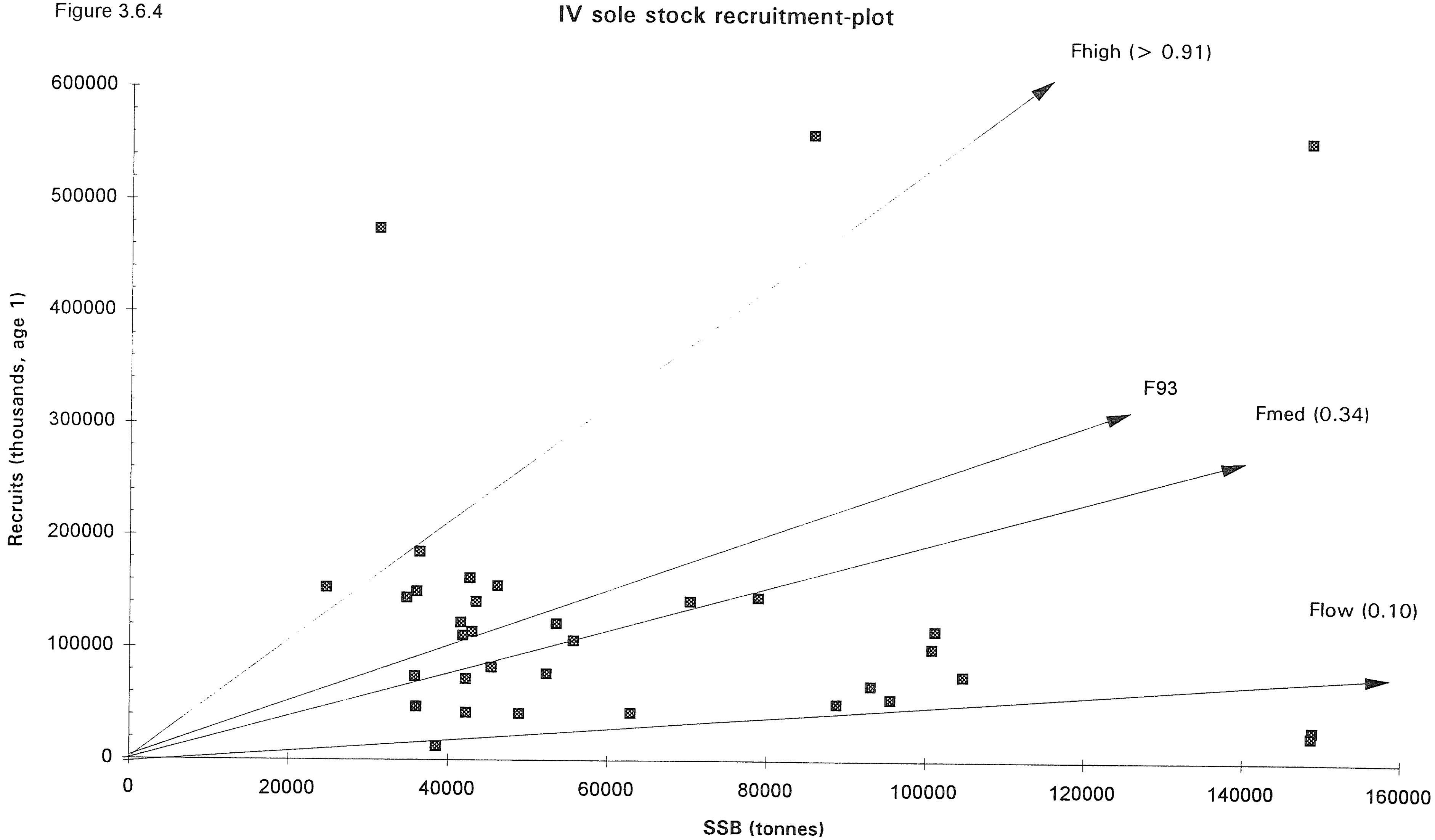
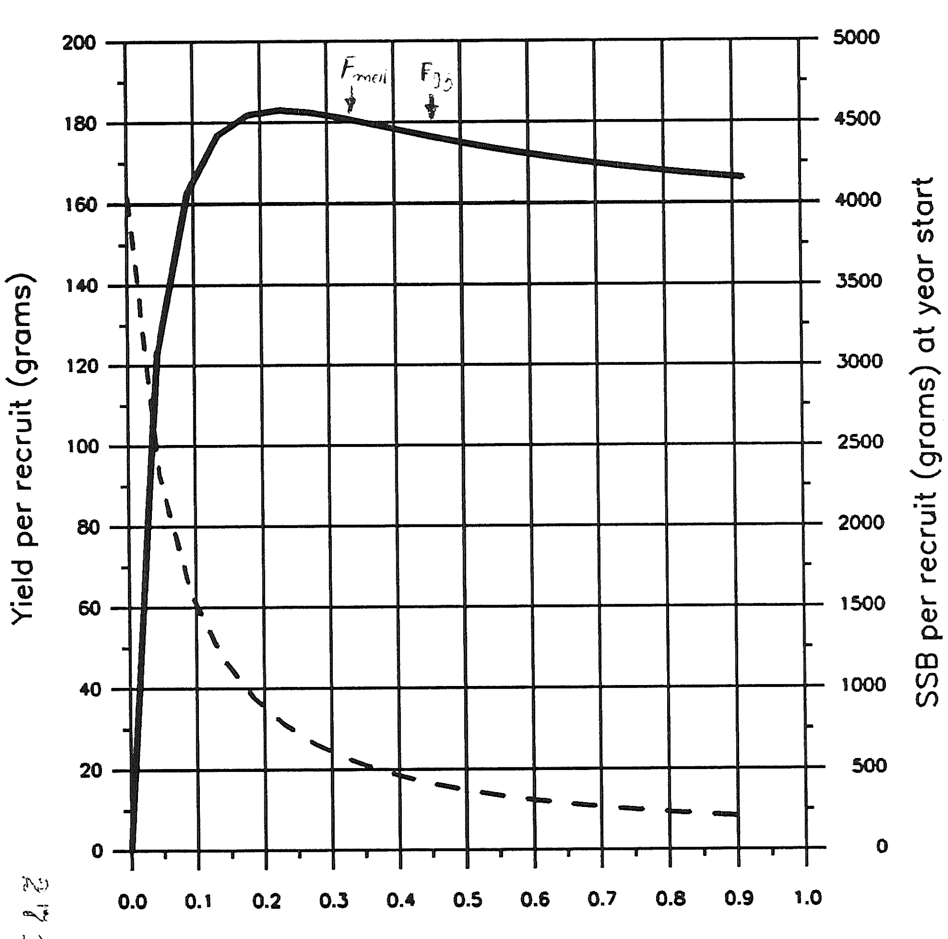


Figure 3.6.5

FISH STOCK SUMMARY
STOCK: Sole in the North Sea (Fishing Area IV)
8-10-1994

Figure 3.6.6

Long term yield and spawning stock biomass

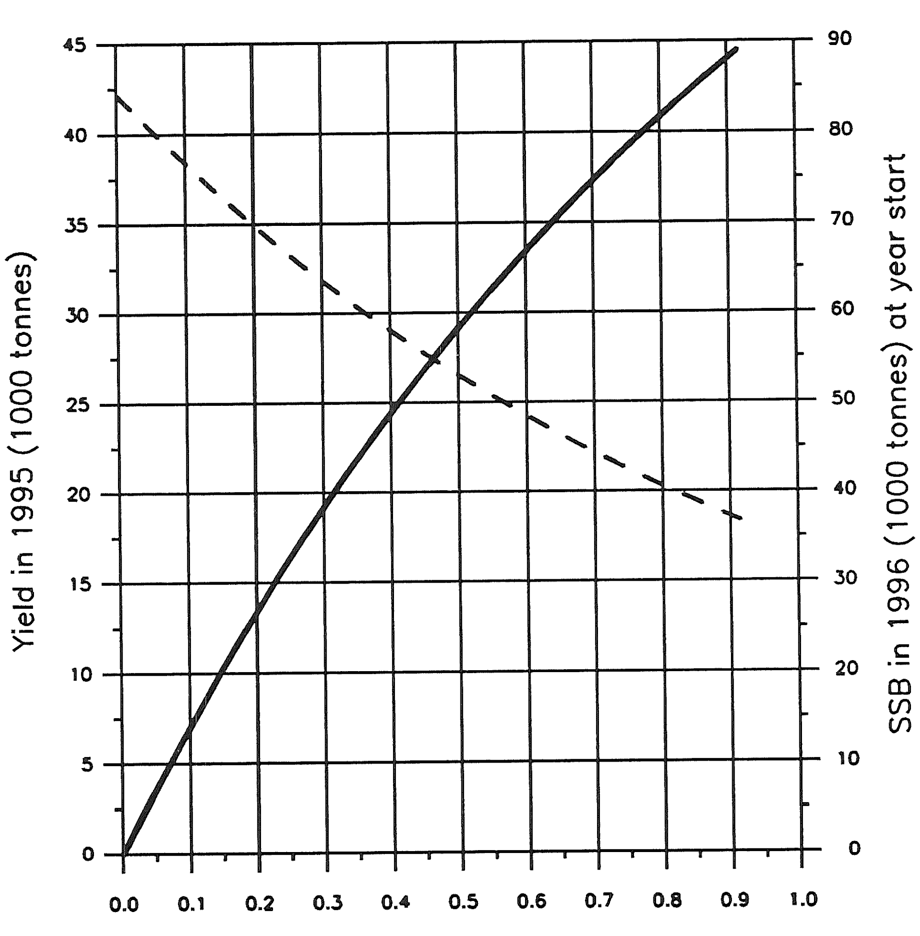


Average fishing mortality (ages 2-8,u)

(run: YIELD3)

C

Short-term yield and spawning stock biomass



Average fishing mortality (ages 2-8,u)

(run: PRED5)

D

Figure 3.6.7.a-d North Sea Sole Sensitivity analysis of short term forecast

Cumulative probability distributions

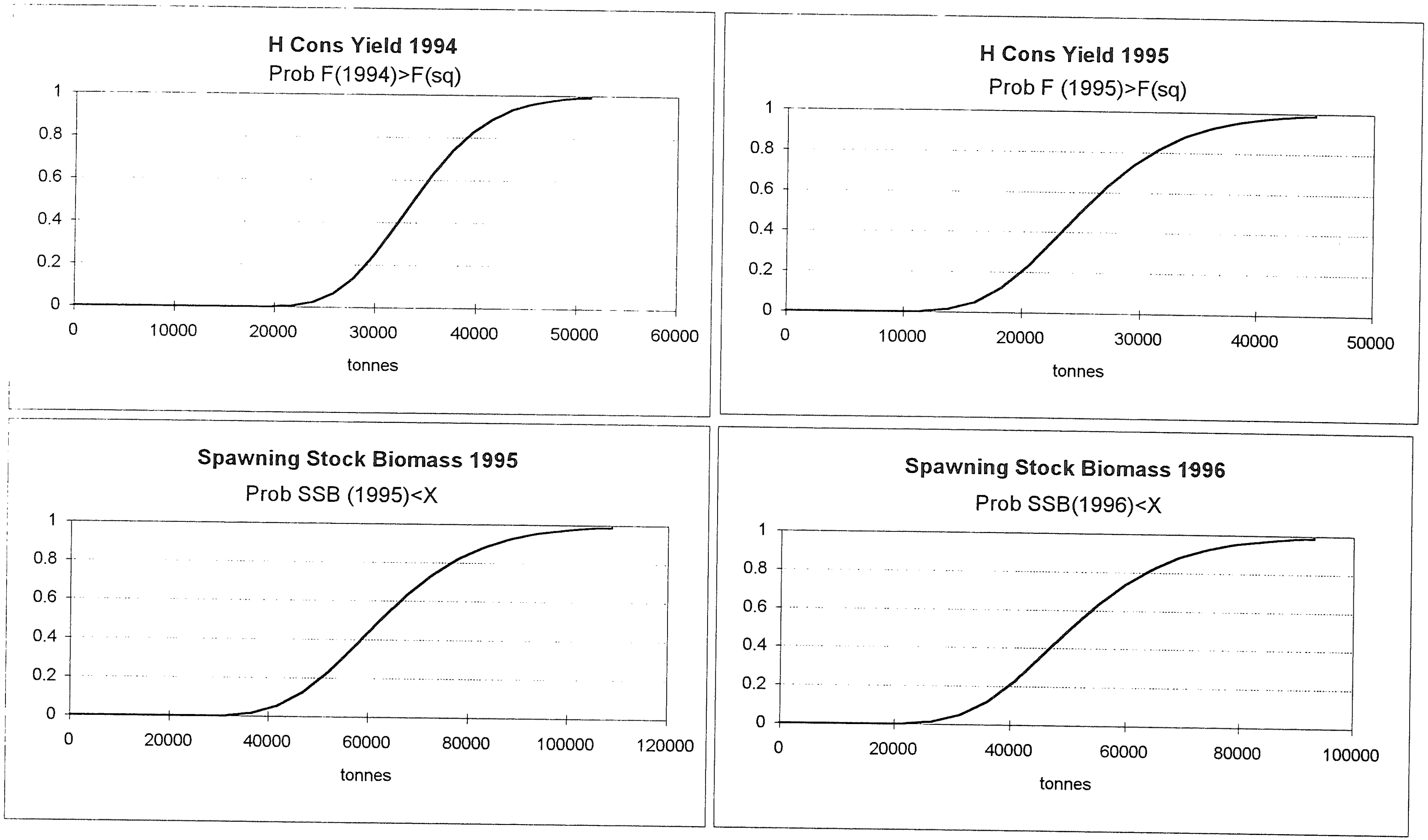


Figure 3.6.8 North Sea sole. Sensitivity analysis of short term forecast.
Linear sensitivity coefficients (elasticities)

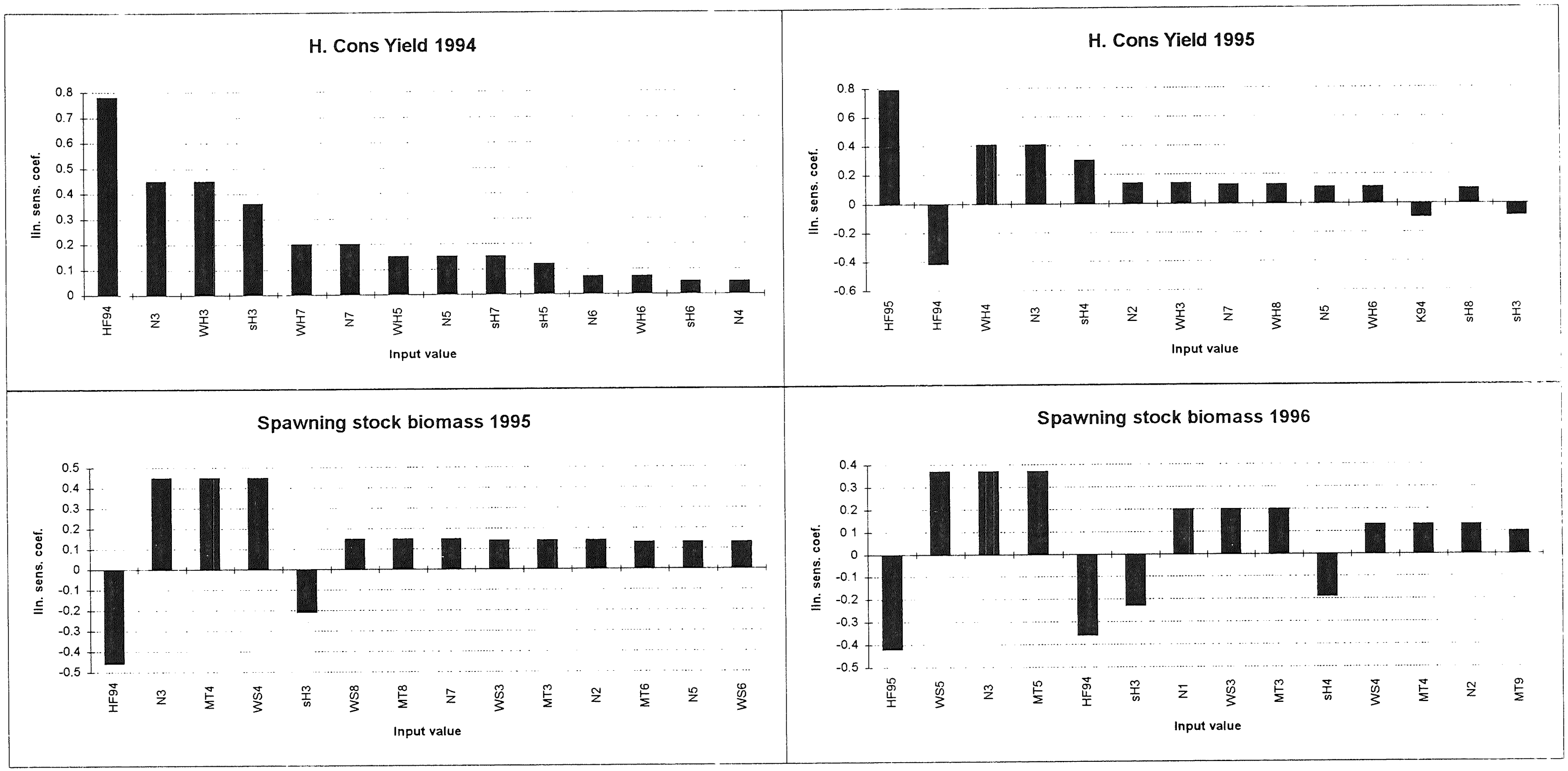


Figure 3.6.9 North Sea Sole Sensitivity analysis of short term forecast
Proportion of total variance contributed by each input value

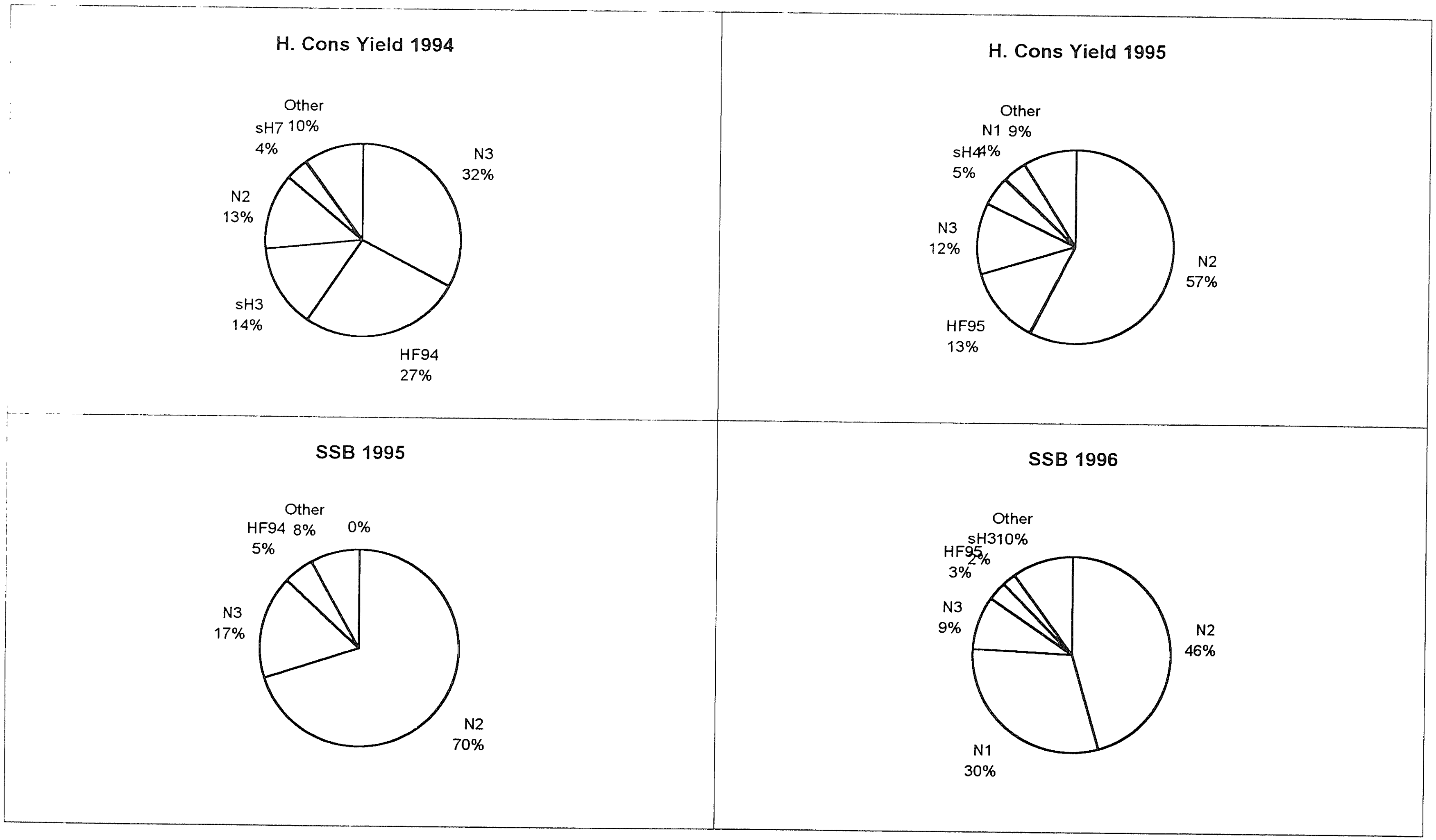
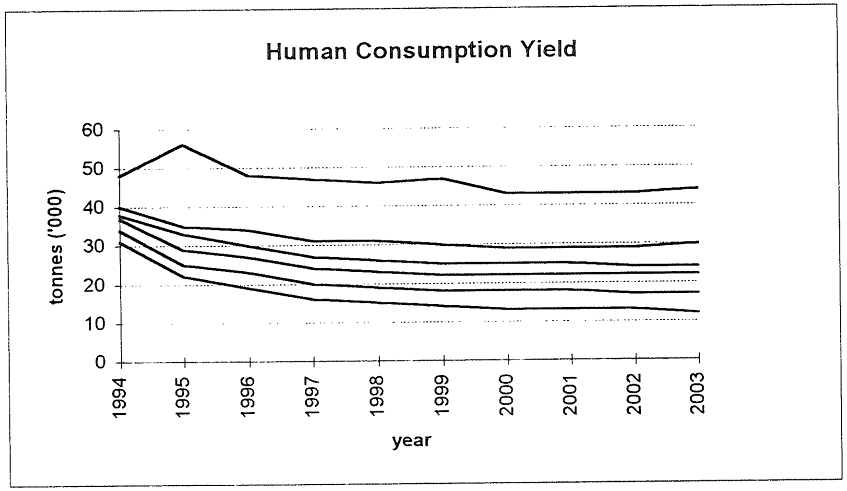
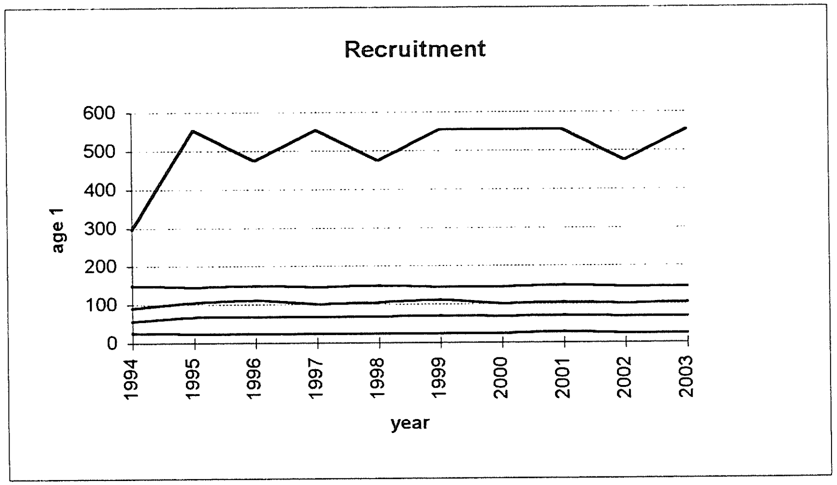


Fig 3.6.10 **North Sea sole. Medium term projections. Solid lines show 5, 25, 50, and 95 percentiles**

no stock-recruitment relationship

Number of simulations 500 Relaltive H. Cons effort = 1.00





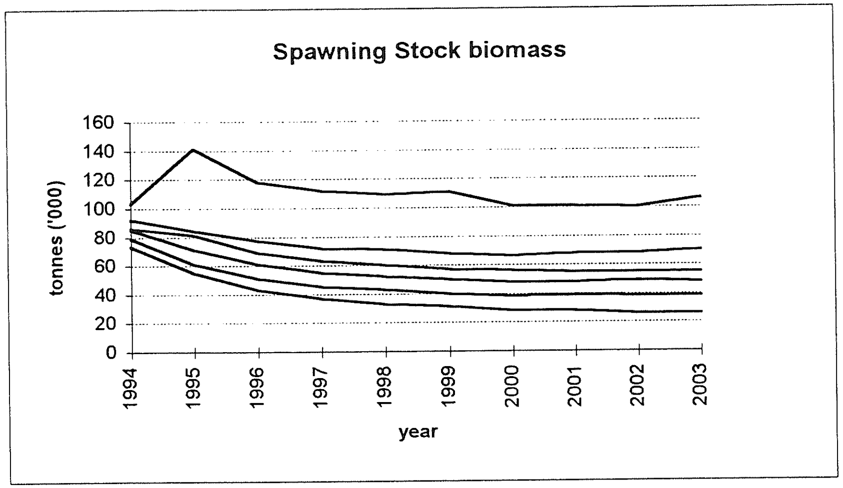


Fig 3.6.11 **North Sea sole. Medium term projections. Solid lines show 5, 25, 50, and 95 percentiles**

no stock-recruitment relationship

Number of simulations 500

Relaltive H. Cons effort = 0.80

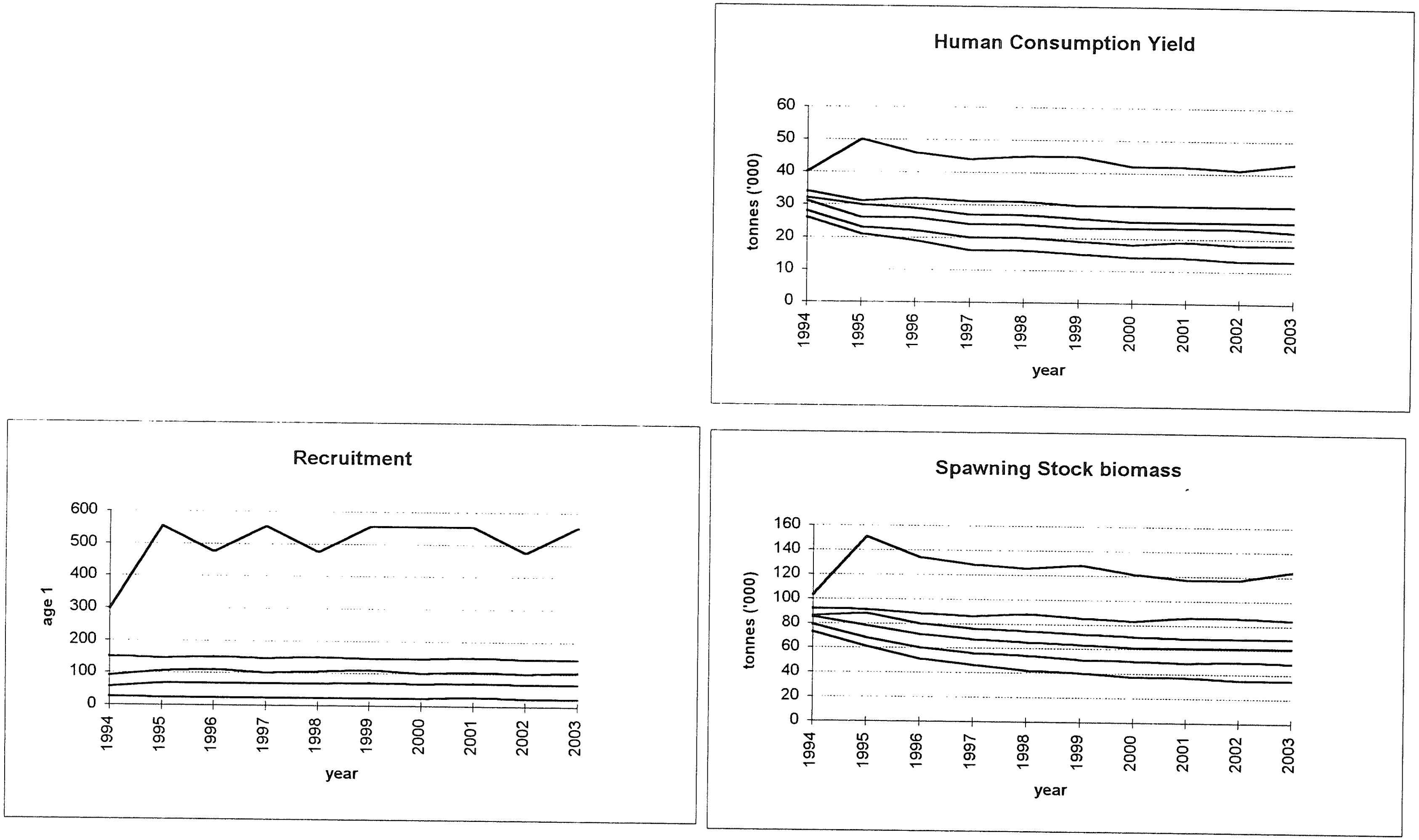
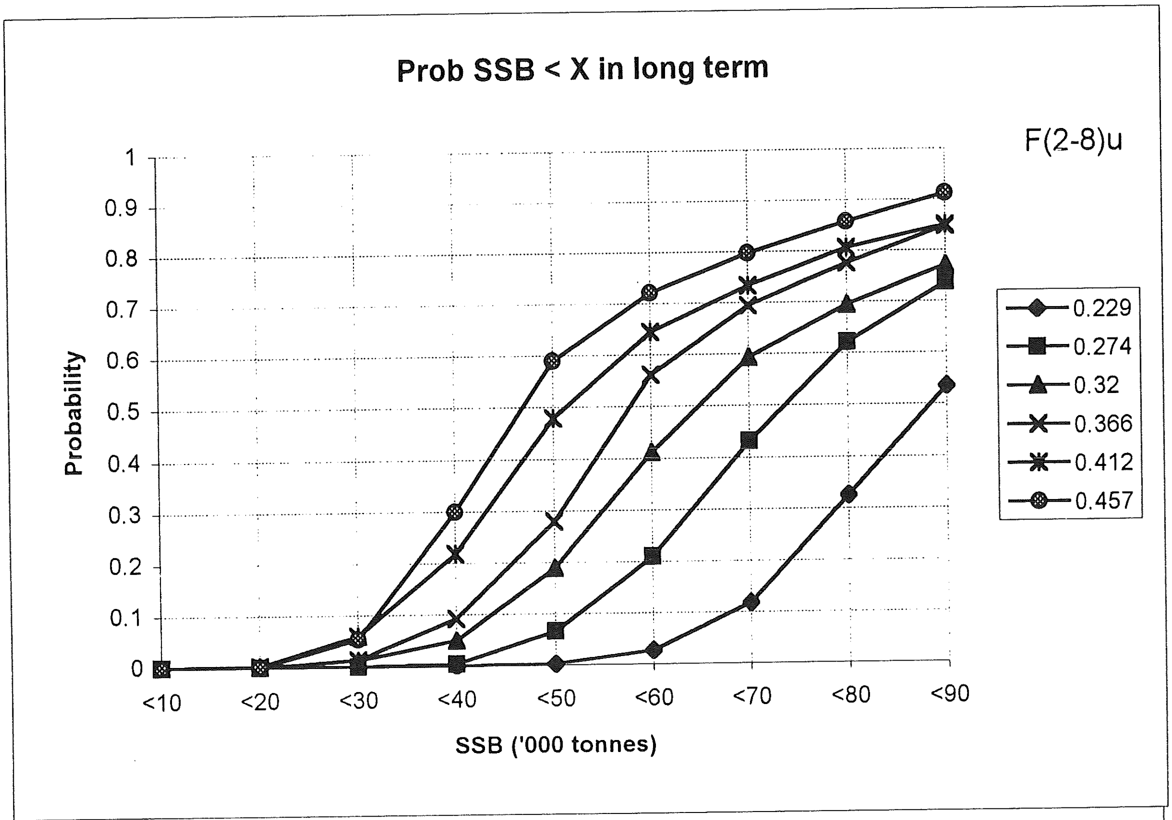
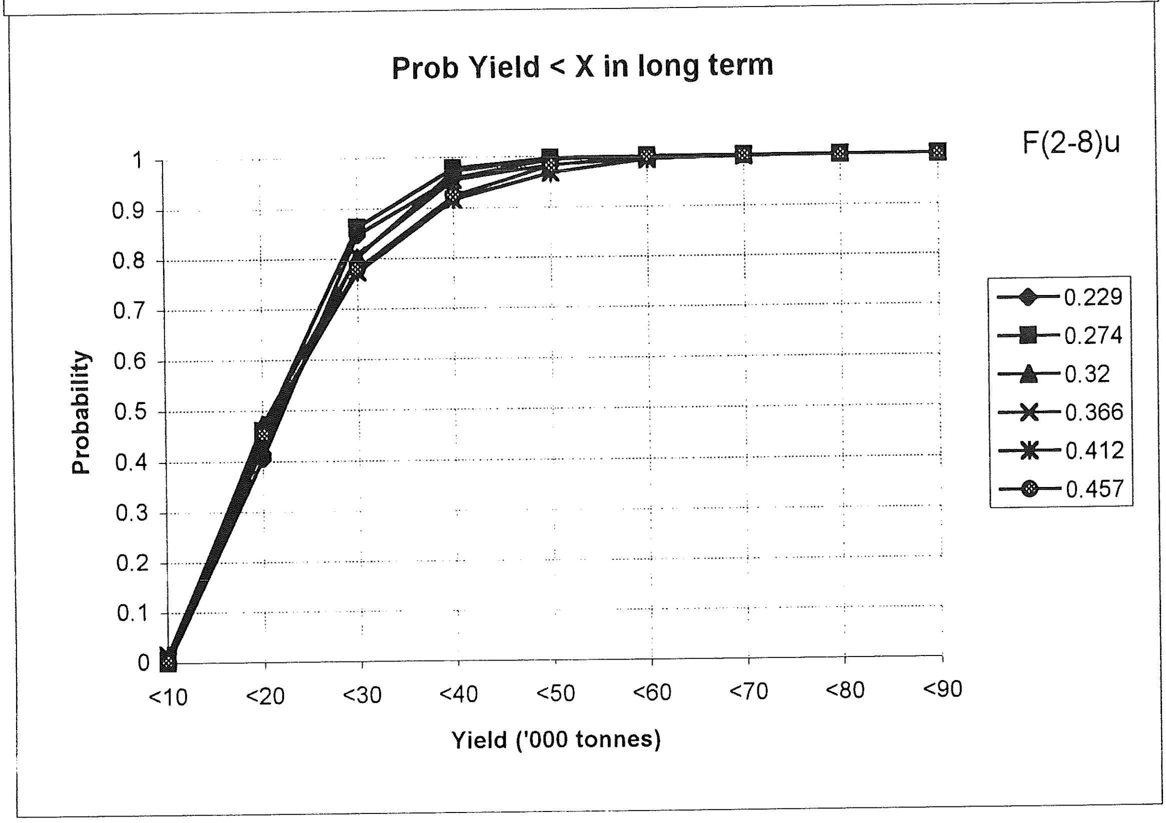


Figure 3.6.12 **North Sea Sole**

Long term probability profiles of SSB and Yield for ranges of F between 0.5 - 1.0 times F93





3.7 North Sea plaice

3.7.1 Catch trends

After a period of record high landings between 1979 - 1991 of around 150,000 t, the total international landings declined to 110,000 t in 1993 (Table 3.7.1, Figure 3.7.1), which compares to an agreed TAC of 165,000 t. The 1993 landings were the lowest since 1975 (Figure 3.7.1). None of the major fisheries exhausted their quotas; underreporting is therefore assumed to be of little importance in 1993. Due to an update of the official landings that only became available during the working group meeting, the catch used by the Working Group was slightly lower than the officially reported landings. This was reflected in the negative value of unreported landings. Estimates of unreported landings were revised downwards for 1988, 1990 and 1991.

3.7.2 Natural mortality, maturity, age composition and weight at age

Natural mortality and maturity were the conventional values used in previous years (Table 3.7.2). The values are assumed to be constant over the years. The age compositions of the landings (Table 3.7.3) were not corrected for SOP-discrepancies and were based on a sampling coverage of about 90% of the total landings. The SOP-discrepancy for 1993 was 0.98. SOP-discrepancies since 1957 are given in Table 3.7.12. No discard data were available. Mean weights at age in the catch (Table 3.7.4) were estimated from market sampling data. Mean weight at age in the stock (Table 3.7.5) refers to the first quarter only, but values for age groups that are not yet fully recruited were extrapolated graphically.

The data on age composition, weight at age in the catch and weight at age in the stock have been revised for 1988, 1990 and 1991 due to revision of the estimates of the level of unreported landings in those years, and for 1987 because of a revision of the allocation of landings over quarters. Inspection of Tables 3.7.4 and 3.7.5 shows that growth rate has decreased considerably over the last 10 years.

3.7.3 Catch, effort, and research vessel data

The input data for the tuning are given in Table 3.7.6 and include two commercial cpue series (Netherlands all fleets = beam trawl and English seine) and two research survey series (ISIS Beam Trawl Survey, Netherlands and Tridens SNS survey, Netherlands). The ISIS Beam Trawl Survey targets pre-recruit and recruited age groups (age group ≥ = 1). It is conducted in August-September and covers the southern and southeastern North Sea. The Tridens SNS survey is targeted at pre-recruits (age groups 1, 2 and 3). Commercial cpue and survey data indicate a decrease in plaice since 1990 (Table 3.7.19; Figure 3.7.14).

3.7.4 Catch at age analysis

Tuning was done by the XSA (with shrinkage) model. The model specifications are given in Table 3.7.7. A tricubic tapered time weighting was applied over 10 years only because of the trend in q observed in the Netherlands commercial beam trawl (Figure 3.7.5). Trial runs of XSA showed that there was no significant relationship between q and year class strength, hence catchability was set independent of stock size for all ages. The trial runs further showed that q was about constant from age 10 onwards. Terminal Fs of the youngest age groups 1 and 2 were mainly determined by the research vessel surveys, whereas those of the older age groups were determined mainly by the commercial fleets.

Log catchability residual plots against time are given in Figure 3.7.5 and show a decrease for the Netherlands beam trawl fleet around 1989. The other fleets used in the tuning do not suggest a change in catchability. The reduction in the Netherlands fleet may be related to a change in the directivity of the fleet. Although the timing of the decrease in catchability of this fleet coincides with the installation of the plaice box in 1989, it is difficult to envisage how the plaice box may have reduced the catchability for the older age groups which are not exclusively distributed in the plaice box.

A retrospective analysis showed that the terminal F tended to be overestimated in the recent four years, although the tuning results were virtually similar when data were included up to 1992 or 1993 (Figure 3.7.6). The overestimation of terminal F in the analysis with 1989, 1990 and 1991 as the terminal year is probably due to the observed decrease in catchability in the Netherlands commercial beam trawl fleet.

Results of the final VPA are given in Tables 3.7.8 and 3.7.9, and in Figures 3.7.1 - 3.7.4. The present analysis shows that the mean F2-10u has varied without a clear trend since 1979, although the values in the last three years (0.46-0.47) were slightly higher than before (Figure 3.7.2). The exploitation pattern shows a peak in fishing mortality at age 5. A shift in the exploitation pattern was observed from a peak at age 3 between 1980-1982 to a peak at age 5 between 1986-1993.

3.7.5 Recruitment estimates

For the forecast, the number of age-1 (year class 1993) in 1994 was estimated from the recruitment surveys. The input data for RCT3 are given in Table 3.7.10 and include pre-recruit surveys covering all the major nursery areas of North Sea plaice at both the continental and the UK coast of the North Sea. In contrast to last year the ISIS BTS survey results (Netherlands) of age groups 1, 2 and 3 were included in the analysis. The combined indices are an average of the Netherlands/Belgian, German and UK-survey results for 0- and 1-group weighted over the surface area of the strata (Table 3.7.21). Results of the RCT3 are given in Table 3.7.11 and include recruitment predictions for year classes born since 1985.

Year class	RCT3 prediction	XSA estimate	% difference
1985	978	1270[1]	-23
1986	622	539[1]	+15
1987	714	556[1]	+28
1988	549	382[1]	+44
1989	506	392[1]	+29
1990	542	453	+20
1991	525	476	+10
1992	353[2]	377	-6
1993	456[2]	-	
1994	-[2]	-	
AM 1957-1990		465	
GM 1957-1990		429	

[1]XSA estimates considered to be converged.
[2]estimate will be updated when results from autumn surveys will become available in November 1994.

The 1993 year class is estimated at 456 million at age 1 at about the AM recruitment over the period 1957-1990. The estimates of the 1993 and 1994 year classes will be updated and made available to ACFM in November 1994 when the results of the pre-recruit surveys presently being carried out become available.

Comparison of the predicted recruitment from the surveys and the XSA indicates a substantial overestimate of recruitment of the year classes born between 1986 and 1991. In Section 3.7.13. these discrepancies will be further explored. The main result of these explorations is that there is some evidence that the accuracy of the recruitment estimates from surveys may have been affected by changes in the discard mortality level of cohorts due to changes in pre-recruit growth that affected the time period of exposure to discard mortality. The situation is even more complicated because of the installation of the plaice box in 1989 which has given the undersized plaice some protection from discard mortality. Although the effects of varying levels and periods of discard mortality cannot be quantified at the moment, these processes should nevertheless be taken into account when interpreting the results of the assessment and the forecast of future yield and spawning stock biomass.

3.7.6 Historical stock trends

Table 3.7.12 and Figures 3.7.1 - 3.7.4 show the trends in yield, mean F, SSB and recruitment from 1957-1992. The yield of the stock has increased continuously from about 80,000 t in the late 1980s to a record level of about 150,000 t in the 1980s. Since 1990, a sharp decrease in the landings can be observed. Fishing mortality increased in the 1970s and remained stable in the 1980s, but increased slightly to about 0.47 in 1991-1993. SSB has shown two peaks in the 1960s and 1980s, due to the recruitment of exceptionally strong year classes born in 1963 and in 1981 and 1985, respectively. Since 1990, SSB shows a sharp decline from 414,000 t in 1989 to a historical low value of 271,000 t in 1994. Recruitment is rather constant but varies periodically with low recruitment around 1970 and high recruitment between 1980-1988. Superimposed on this trend, three strong year classes occurred which are related to low winter temperatures during the spawning season. There is a suggestion that recruitment in most recent years has declined from the level of around 500-600 million in the mid 1980s to a level of around 400 million in the early 1990s.

3.7.7 Biological reference points

The stock recruitment plot is shown in Figure 3.7.7 with lines indicating F*status quo* and Fmed. The current value of F (0.46) is above Fmed = 0.30 and at about Fhigh. To maintain SSB at the current level, above-average recruitment is needed. The stock-recruitment plot (S-R plot) suggests a dome-shaped pattern with highest recruitment occurring at SSB levels around 300,000 t. The S-R relationship, however, has to be interpreted with caution because it may be coincidental that the low R-values in the 1960s occurred at high levels of SSB. The dome-shaped S-R relationship may reflect either density dependent population processes, a change in environmental conditions affecting pre-recruit survival, and/or a change in the discard mortality until the age of recruitment to the fisheries (age 2-5).

Input data for the yield per recruit are given in Table 3.7.13. Weights at age in the catch and stock were taken as the mean weights over the last three years to take account of the observed decrease in growth rate. The yield per recruit is flat topped and shows that the present level of F is about double that of Fmax (Table 3.7.14; Figure 3.7.8).

3.7.8 Short-term forecast

A short-term forecast was carried out using the data in Table 3.7.15. The exploitation pattern taken was the mean over the last three years scaled to the level of F2-10u in 1993. Weights at age in the catch and stock were taken as the mean weights over the last three years to take account of the observed decrease in growth rate. The predicted *status quo* catch for 1994 is 114,000 t (Table 3.7.17), well below the agreed TAC of 165,000

t. The *status quo* catch forecast is close to the expected landings in 1994 of 107,700 t (provisional data for EU fleets). The *status quo* catch for 1995 is 109,000 t. At *status quo* fishing mortality, the SSB will decline from 257,000 t in 1994 to 252,000 t in 1995 and 237,000 t in 1996.

An analysis was conducted to determine the sensitivity of the short-term forecast to uncertainties in the input parameters. The input to this analysis is given in Table 3.7.16. Figure 3.7.9 indicates that the level of F in 1995 (HF95) is responsible for 29% of the variance in yield in 1995. Population numbers at ages 1, 2, and 3 contribute 11, 26 and 9% of the variance in yield, respectively. Recruitment and population numbers at ages 1 and 2 contribute 23-25% of the variance in SSB.

Sensitivity coefficients illustrating the effect of a relative change in input parameters on the yield or SSB are shown in Figure 3.7.10. Yield in 1995 is most heavily affected by a change in the fishing mortality in 1995. For SSB, an increase in F95 and F94 will result in a decrease in SSB. Other input parameters have a relatively modest effect.

3.7.9 Medium-term predictions

A medium-term prediction (10 year) was carried out assuming that recruitment is independent of spawning stock size and by random sampling from the observed distribution between 1957 and 1990. The other input parameters were similar to the yield per recruit analysis. Two runs of 500 simulations each were carried out for *status quo* (F = 1.0 x F93) and reduced fishing mortality (F = 0.8 x F93). Results in Figure 3.7.11 show the 5, 25, 50, 75 and 95 percentiles for SSB and yield together with the trajectories of five individual simulations. The *status quo* prediction indicates that the range of the predicted yield and SSB increase over the first five years and then stabilize. The 50% percentile for the stabilized period reflects the equilibrium situation. The range in yield and SSB indicates the effect of the variability in recruitment on the variability in yield and SSB. Hence, with a 90% probability, the *status quo* yield will be between 85,000 and 160,000 t. The corresponding SSB will be between 195,000 and 350,000 t. At an F level of 0.8 x F93 the yield will be between 85,000 t and 155,000 t, and the SSB between 240,000 and 410,000 t. An important inference that can be drawn from both runs is that at *status quo* F the probability that SSB will further decline is >75%, whereas at F=0.8 x F93 SSB is likely to increase.

3.7.10 Long-term considerations

For the lowest level of SSB calculated for this stock (around 300,000 t between 1978-1992) there was no indication of a decline in recruitment (Figure 3.7.7). The level of the SSB in this period has been proposed as the acceptable minimum SSB (Anon, 1993). The current level of SSB is below this level.

Similar to last year, the SPLIR model was used to estimate the probability that SSB will fall below a certain level in the long term assuming random recruitment (van Beek, 1994). The results (Figure 3.7.12), which assume that recruitment is independent of stock size, show that at the current level of F (0.46), there is a 60% probability that SSB will fall below 250,000 t, and an 80% probability that SSB will fall below 300,000 t. A reduction in F by 20% to F=0.37 would reduce this probability to 50%. The distribution of the expected yield is about the same for all levels of F in the simulation, corresponding to the flat topped yield-per-recruit curve for this stock.

3.7.11 Comments on the assessment

Since 1991 the Working Group has observed an increasing discrepancy between the *status quo* catch forecast and the realized catch, suggesting that the assessment has overestimated the size of the plaice stock. The downward revision of the estimates of unreported landings in three years between 1985 - 1991 had a major impact on the results of the assessment (Figure 3.7.13), in particular with regard to the estimates of recruitment and SSB in the most recent years. The estimate of fishing mortality was hardly affected. The close agreement between the predicted 1994 catch (114,000 t) and the EC-catch expectation (107,700 t) suggests that the major discrepancy between the VPA results and the realized catch may have been resolved. The quality control diagrams are given in Table 3.7.18.

TAC levels in recent years have not restricted the fisheries; hence the level of unreported landings was reduced substantially. However, in the near future, the problem may become pertinent again if restrictive TACs are set.

With regard to the future evolution of the stock, there is concern about the recruitment. As the forecast level of SSB in 1994 and 1995 is at a historically low value, there is a risk of a reduction in recruitment in the future at the current low levels of SSB. Although pre-recruit surveys have not provided evidence for recruitment failure in recent years (Table 3.7.21), there is evidence that the surveys of pre-recruits (ages 0-2) tend to overestimate recruitment to the fisheries at ages 2-4. This may suggest that the cumulative mortality of pre-recruit fish increased in spite of the installation of the plaice box in 1989. This box was installed to reduce the level of discarding in areas with high concentrations of undersized fish by excluding trawlers exceeding 300 HP (Anon, 1994). The inferred increase in pre-recruit mortality may be related to the observed decrease in pre-recruit growth in the 1980s as discussed in Section 3.7.13. These considerations highlight the need for a better understanding of the nature of the stock-recruitment relationship in this stock, and the underlying processes such as the interplay of growth and discarding. Research on the factors affecting the observed changes in growth and its effect on discard mortality and recruitment, taking account of the effect of the plaice box, is urgently needed.

3.7.12 Other CPUE and survey data

Table 3.7.19 shows CPUE trends for five fleets, two of which are used in the tuning (UK seine, NL beam trawl). All fleets show a steep decline since 1990 and are at a historical low level (Figure 3.7.14). The results of the ISIS Netherlands beam trawl survey indicate that the decline in CPUE in numbers has come to a stop in 1994, although the 10 plus group continues to decline (Figure 3.7.15, Table 3.7.20). Recruitment data used to calculate the combined index for 0- and 1-group plaice that was used for estimating recruitment are given in Table 3.7.21.

3.7.13 Growth, recruitment and the plaice box

Over the last 30 years there have been major changes in the growth rate of plaice. In the 1960s and early 1970s, growth rate increased, while in the 1980s growth rate declined again (Figure 3.7.16). The growth rate of pre-recruit plaice appeared to be positively correlated with eutrophication and the level of beam trawling and negatively correlated to the density of plaice (Rijnsdorp & van Leeuwen, 1994). A change in growth rate will affect the apparent recruitment to the fisheries (R) by increasing the time until recruitment (t): $R = No \exp(-Zt)$. Hence, a reduction in pre-recruit growth rate that results in a delay in recruitment by 1 year will reduce the potential number of recruits by $\exp(-Z)$. With a total mortality rate of pre-recruits of about $Z= 0.3$ (Anon, 1994), the number of recruits may be reduced by almost 25%. This hypothetical calculation clearly shows that a change in growth rate may substantially affect the recruitment to the fisheries and may be (partly) responsible for the changes in time of the level of recruitment estimated by the VPA.

In an exploratory exercise, pre-recruit survey indices of 0- and 1-group plaice were analysed to test whether there was a relationship between the pre-recruit growth and pre-recruit discard mortality. Pre-recruit growth was estimated as the length of females at the age of 4 years (L4 from Dutch 1st quarter market samples). Discard mortality was estimated as the log residual of the predicted recruitment from surveys and the observed recruitment from the VPA. Recruitment of cohorts born between 1974 and 1989 was predicted using RCT3 employing four 0- and 1-group survey indices (T-0-autumn, T-1-autumn, Comb-0 and Comb-1) using no time tapering, calibrative regression, without shrinkage. The time series of ln-residuals do not clearly suggest a trend that coincides with the decrease in L4, although the two largest negative residuals for year classes 1988 and 1989 coincide with a relatively small L4 (Figure 3.7.17a). The scatter plot of the residuals against L4 also does not provide firm evidence for a relationship between recruitment residual and pre-recruit growth (Figure 3.7.17b). However, the measures of pre-recruit growth and especially discard mortality are rather imprecise and may have obscured an underlying relationship. Further investigations into this problem are needed.

Accepting for the moment that a reduced growth rate during the pre-recruit phase will increase the cumulative mortality of discards, technical measures to reduce the level of discard mortality rate (Z), such as the plaice box, will be even more important compared to a situation with a high pre-recruit growth rate, and underpins the conclusions of the Study Group on the Plaice Box (Anon., 1994).

Table 3.7.1 North Sea PLAICE. Nominal landings (tonnes) in Sub-area IV as officially reported to ICES, 1983-1993.

Country	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	8,916	10,220	9,965	7,232	8,554	11,527	10,939	13,940	14,328	12,006	10,814
Denmark	19,114	23,361	28,236	26,332	21,597	20,259	23,481	26,474	24,356	20,891	16,452
Faroe Islands	-	-	-	-	-	43	-	-	-	-	-
France	1,185	1,145	1,010	751	1,580	1,773	2,037[1]	1,339	508[1]	537[1]	593[1]
Germany	2,397	2,485	2,197	1,809	1,794	2,566	5,341	8,747	7,926	6,818	6,896[1]
Netherlands	53,608	61,478	90,950	74,447	76,612	77,724	84,173	78,204	67,945	51,064	48,552
Norway	17	17	23	21	12	21	321	1,756	560	843[1]	753
Sweden	22	14	18	16	7	2	12	169	103	53	7
UK (Engl. & Wales)	13,248	12,988	11,335	12,428	14,891	17,613	19,735	17,563	17,672	20,191	19,238
UK (N.Ireland)	-	-	-	-	-	-	540	176	992	1,268	1,384
UK (Scotland)	4,159	4,195	4,577	4,866	5,747	6,884	5,516	6,789	9,047	9,743	10,541
UK (Isle of Man)	-	-	-	-	-	-	-	-	-	64	-
Total reported	102,666	115,903	148,311	127,902	130,794	138,412	152,095	155,157	143,437	123,478	115,230
Unreported landings[2]	41,369	40,244	11,526	37,445	22,876	16,063	17,548	1,050	4,041	1,234	-5,279
Landings as used by WG	144,035	156,147	159,837	165,347	153,670	154,475	169,643	156,207	147,478	124,712	109,951

[1]Provisional.
[2]Estimated by the Working Group.

TABLE 3.7.2 North sea plaice
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.100	.000
2	.100	.500
3	.100	.500
4	.100	1.000
5	.100	1.000
6	.100	1.000
7	.100	1.000
8	.100	1.000
9	.100	1.000
10	.100	1.000
11	.100	1.000
12	.100	1.000
13	.100	1.000
14	.100	1.000
15+	.100	1.000

TABLE 3.7.3 North sea plaice
International catch at age ('000), Total , 1984 to 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	108	121	1674	0	0	1260	1511	1411	3097	2787
2	63252	73552	67125	85123	15146	46709	31759	41876	40163	45360
3	274209	144316	163717	115951	250675	105820	96046	81192	79291	87526
4	53549	185203	93801	111239	74335	231176	109536	113577	68348	66799
5	37468	32520	84479	64758	47380	52854	160253	72215	69610	48229
6	13661	15544	24049	34728	25091	19227	26889	78212	32641	28127
7	6465	6871	9299	11452	16774	10556	8429	15059	29733	13024
8	5544	3650	4490	4341	5381	7553	4409	5490	7028	11992
9	2720	2698	2733	2154	3162	2118	3717	3256	3343	3894
10	2088	1543	2026	1743	1671	1691	1176	2556	2420	2109
11	1307	1030	1178	1033	932	926	767	1035	1731	1498
12	1143	1070	1084	663	932	630	487	667	975	1106
13	455	727	806	529	505	446	325	394	605	812
14	310	371	628	296	516	327	235	331	609	292
15+	1262	1057	1228	1214	1677	1555	1221	1292	1597	1246

TABLE 3.7.4 North sea plaice
International mean weight at age (kg), Total catch, 1984 to 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	.233	.247	.221	.221	.221	.236	.271	.227	.251	.251
2	.263	.264	.269	.249	.254	.280	.285	.286	.263	.273
3	.283	.290	.304	.300	.278	.308	.298	.295	.291	.290
4	.375	.337	.347	.351	.352	.331	.318	.306	.320	.327
5	.491	.462	.425	.402	.453	.390	.368	.367	.344	.358
6	.613	.577	.488	.504	.512	.532	.448	.456	.427	.424
7	.684	.678	.675	.583	.608	.600	.596	.529	.531	.519
8	.725	.729	.751	.728	.699	.667	.687	.664	.603	.618
9	.837	.804	.853	.829	.813	.790	.752	.738	.704	.693
10	.916	.900	.921	.826	.936	.819	.817	.822	.737	.755
11	.981	1.001	.948	.996	.964	.917	1.025	.902	.809	.770
12	1.026	.950	1.063	1.015	1.041	.948	1.077	.917	.924	.873
13	1.112	1.071	1.078	1.045	1.137	1.139	1.096	.979	.969	.825
14	1.250	1.139	1.074	1.127	1.115	1.080	.968	.944	.879	.869
15+	1.214	1.215	1.110	1.150	1.038	.993	1.075	1.004	1.059	1.036

TABLE 3.7.5 North sea plaice
Stock mean weight at age (kg), 1984 to 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	.150	.150	.150	.150	.150	.150	.150	.131	.131	.131
2	.203	.208	.195	.194	.212	.215	.245	.208	.263	.259
3	.242	.243	.253	.265	.238	.251	.272	.263	.291	.264
4	.338	.310	.336	.330	.315	.281	.282	.276	.320	.302
5	.464	.452	.440	.401	.426	.359	.343	.342	.344	.330
6	.571	.536	.533	.503	.467	.484	.422	.401	.427	.391
7	.649	.635	.692	.573	.547	.551	.555	.463	.531	.490
8	.692	.656	.779	.711	.644	.612	.647	.633	.603	.587
9	.787	.764	.888	.747	.706	.759	.701	.652	.704	.633
10	.898	.869	.971	.817	.897	.837	.760	.744	.737	.723
11	.932	.955	.953	1.009	.937	.787	1.017	.824	.809	.764
12	1.042	.906	1.107	1.018	1.009	.968	1.144	.960	.924	.913
13	1.235	1.068	1.153	1.019	1.065	1.215	.996	.951	.969	.798
14	1.127	1.108	1.126	1.214	1.135	.899	1.046	.825	.879	.822
15+	1.235	1.308	1.354	1.114	.972	.857	1.068	.891	1.059	.969

Table 3.7.6

```
Plaice in the North Sea (Fishing Area IV) (run name: NSPLAICE)
104
>>NETHERLAND BTS<<
1985, 1993
1, 1, 0.75, 1.0
1, 10,
     1,    105.67,  185.895,    39.49,  13.33,  1.500, 1.024,  0.524,  0.157,  0.195,  0.453
     1,    634.26,  125.847,    50.38,  10.18,  4.688,  0.912,  0.485,  0.253,  0.065,  0.243
     1,    207.67,  707.449,    32.12,  9.455,  2.669,  1.541,  0.326,  0.178,  0.097,  0.251
     1,    541.24,  151.097,  207.993,  6.782,  3.053,  0.742,  0.570,  0.129,  0.136,  0.255
     1,    397.995,  337.866,  56.082,  51.097,  7.886,  1.132,  0.421,  0.246,  0.070,  0.318
     1,    123.152,  122.127,  67.359,  22.315,  10.203,  1.128,  0.281,  0.230,  0.071,  0.121
     1,    187.159,  125.537,  30.112,  21.642,  5.364,  4.582,  0.588,  0.171,  0.082,  0.213
     1,    179.561,  117.197,  20.615,  6.104,  4.971,  2.878,  1.414,  0.389,  0.042,  0.090
     1,     124.924,  164.107,  36.885,  7.261,  1.769,  1.538,  0.514,  0.466,  0.154,  0.130
>>NETHERLANDS ALL FLEETS<<
1979, 1993
1, 1, 0, 1
1, 14
44.9, 1267.5, 44268.9,  65005.3,  18310.6, 18066.6, 13360.2, 9189.9, 2410.3, 1539.7,  961.2,  691.6,  488.4, 429.3, 308.5, 811.4
45.0,  943.7, 50726.9,  77105.9,  35404.3,  8928.9,  8739.5, 5909.8, 3245.6, 1004.0,  794.8,  365.1,  200.9, 169.5, 142.8, 366.4
46.3,  122.0, 74461.7,  79996.2,  25008.9, 19061.8,  6615.2, 5223.6, 4203.2, 2372.4,  974.6,  688.7,  356.3, 276.9, 207.9, 455.3
57.3, 3199.6, 39899.6, 137177.0,  36203.3, 14979.8,  9577.3, 5399.5, 3713.5, 2034.8, 1924.7,  760.2,  450.6, 313.9, 141.3, 676.0
65.6, 1134.4, 96297.5,  78330.5,  55221.0, 15280.3,  7432.7, 5033.9, 2798.9, 2025.0, 1702.1, 1257.6, 1008.0, 365.2, 213.3, 385.5
70.8,     9.9, 53837.3, 180607.0,  30489.5, 22212.2,  7308.2, 3717.4, 3363.3, 1791.5, 1323.1,  768.1,  649.4, 248.6, 179.8, 465.1
70.3,  732.0, 66003.4, 105584.0, 102925.0, 17163.2,  9669.2, 4187.8, 2329.9, 1681.1,  940.6,  679.0,  599.6, 450.1, 274.9, 383.4
68.1, 1615.0, 59619.2, 112586.0,  57103.8, 46190.2, 12357.8, 5803.6, 2609.8, 1724.7, 1385.8,  828.3,  696.8, 528.4, 317.3, 415.8
68.4,     9.9, 65506.6,  76847.5,  75946.0, 39780.8, 16774.8, 6229.6, 2327.4, 1027.5,  963.0,  572.6,  358.1, 238.1, 150.4, 364.4
76.2,     9.9, 10932,   158030,    37783,   26927,    14288,   8817,   3253,   1898,    999,    444,    370,   242,   205,   347
72.5, 1151.3, 40443.3,  73696.3, 131915.1, 23063.6,  9633.8, 5239.6, 2714.5,  947.4,  630.6,  304.1,  168.4, 149.0,  68.7, 143.5
71.4,  173.7, 21956.4,  60038.4,  49861.6, 76520.9, 12186.9, 3682.3, 1790.2, 1160.8,  491.5,  250.8,  171.3, 101.8,  63.7, 118.4
68.5,  426.9, 27501.1,  42376.4,  53151.7, 30697.4, 34092.3, 6878.9, 1954.4, 1137.4,  652.1,  285.8,  122.4,  66.9,  73.0, 111.6
71.1, 1810.1, 24270.5,  44306.1,  31854.1, 27165.2, 12219.3, 9485.1, 2463.9,  992.8,  508.2,  312.9,  262.8,  95.2,  75.3, 129.3
76.8, 2456.7, 27551.7, 46535.8, 31333.2, 19704.6, 10983.9, 6039.9, 3611.1, 1024.9, 534.7, 252.6, 174.0, 93.1, 35.1, 61.0
>>TRIDENS SNS September survey<<
1982 1993
1 1 0.75 1.0
1 3
     1   70108    8503    1146
     1   34884   14708     308
     1   44667   10413    2480
     1   27832   13789    1584
     1   93573    7558    1155
     1   33426   33021    1232
     1   36672   14430   13140
     1   37238   14952    3709
     1   24903    7287    3248
     1   57349   11148    1507
     1   48223   13742    2257
     1    22184   9484      988


nglish seine<<
 1993
1  0  1
15
160.6     44.4   3887.4   3202.2   1996.9    985.3   332.2   132.2   371.6   427.1    85.4    45.4    36.4    37.1   244.8
156.0   1539.7   2602.1   5926.2   1993.0    911.9   536.5   122.0    68.9   184.8   117.3    10.4    30.6    12.7   142.5
144.7    400.0   5372.1   2497.3   2169.5    679.8   378.2   283.3   120.9    74.6    65.3   104.4    71.0    37.0   222.1
138.9   1168.0   2968.5   5471.5    663.2    622.2   284.0   175.1   104.1    25.6    38.9    36.1    30.3    20.8   136.4
121.0    282.5   4316.2   2631.9   1953.4    270.5   206.3   169.4   205.9   106.4    56.5    31.7    46.3    26.3   272.6
112.7    792.7   1896.1   2729.0   2078.0   1085.3   362.0   188.6    58.6    67.2    30.6    15.1    33.9     9.7    65.4
 78.8    129.0   3071.8   1508.6   1048.7    819.5   402.0    91.1    78.4    37.8    23.9    13.4   104.8    20.8   117.3
 83.6     48.2    625.2   4324.9   1915.1    898.0   385.9   515.6    73.1   108.0    71.9    56.5    26.2    16.4   129.6
 73.1    120.2   1227.3   1673.6   4296.7    495.0   332.1   169.9   146.8    45.8    25.8    19.0    14.5    14.3    90.5
 67.0    130.0    504.1   1078.5   1002.9   1517.4   246.9   116.6    64.1    87.7    33.8    26.2    18.1    17.4    69.0
 60.0    177.4   1039.2   1015.8   1145.5    549.2   497.3   140.6    56.9    39.3    52.5    12.3    14.7    10.4    44.6
 52.8     66.3    898.0   1140.3    837.7    566.3   151.1   228.5    72.2    36.1    30.7    20.5     8.7     4.9    23.9
```

Table 3.7.7. North Sea plaice: XSA tuning input and results

VPA Version 3.1 (MSDOS)

8/10/1994 10:38

Extended Survivors Analysis

North Sea PLA4e, sexes combined *** full data set ***

CPUE data from file P4EF.57

Catch data for 37 years. 1957 to 1993. Ages 1 to 15.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
>>NETHERLAND BTS<<	1985	1993	1	10,	.750,	1.000
>>NETHERLANDS ALL FL	1984	1993	1	14,	.000,	1.000
>>TRIDENS SNS Septem	1984	1993	1	3,	.750,	1.000
>>English seine<<	1984	1993	2	14,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 10 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 10

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 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 48 iterations

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

Fleet : >>NETHERLAND BTS<<

Regression statistics :

Ages with q constant w.r.t. time

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
1,	.84,	.223,	8.44,	.32,	9,	.46,	-7.58,
2,	.67,	1.269,	9.47,	.77,	9,	.20,	-7.69,
3,	.58,	3.279,	10.42,	.93,	9,	.11,	-8.66,
4,	.59,	1.896,	10.61,	.84,	9,	.21,	-9.34,
5,	.85,	.490,	10.08,	.70,	9,	.31,	-9.74,
6,	.70,	.839,	10.43,	.65,	9,	.32,	-10.10,
7,	.67,	1.903,	10.58,	.89,	9,	.14,	-10.61,
8,	.84,	.542,	10.71,	.73,	9,	.22,	-10.87,
9,	1.16,	-.101,	11.67,	.09,	9,	.57,	-11.35,
10,	-26.58,	-.719,	-26.44,	.00,	9,	14.05,	-10.11,

Continued

Table 3.7.7. North Sea plaice XSA tuning cntd.

Fleet : >>NETHERLANDS ALL FL

Ages with q constant w.r.t. time

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
1,	-.61,	-.765,	14.07,	.05,	10,	1.39,	-11.33,
2,	1.20,	-.241,	5.75,	.26,	10,	.63,	-6.35,
3,	.96,	.145,	6.15,	.76,	10,	.24,	-5.87,
4,	.88,	.490,	6.41,	.81,	10,	.24,	-5.62,
5,	.95,	.257,	5.80,	.85,	10,	.20,	-5.47,
6,	.84,	1.135,	6.49,	.92,	10,	.13,	-5.61,
7,	1.20,	-.687,	4.81,	.73,	10,	.24,	-5.77,
8,	2.26,	-2.051,	1.34,	.38,	10,	.47,	-6.12,
9,	-5.56,	-1.608,	25.96,	.01,	10,	1.51,	-6.28,
10,	2.08,	-.539,	3.73,	.06,	10,	.73,	-6.35,
11,	.93,	.081,	6.76,	.21,	10,	.33,	-6.63,
12,	.36,	1.469,	7.52,	.56,	10,	.14,	-6.68,
13,	.64,	.380,	7.09,	.20,	10,	.38,	-6.80,
14,	.63,	.813,	6.99,	.53,	10,	.32,	-6.86,

Fleet : >>TRIDENS SNS Septem

Ages with q constant w.r.t. time

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
1,	1.02,	-.041,	2.20,	.45,	10,	.35,	-2.43,
2,	.96,	.123,	3.80,	.71,	10,	.23,	-3.44,
3,	.59,	1.210,	8.03,	.67,	10,	.30,	-4.73,

Fleet : >>English seine<<

Ages with q constant w.r.t. time

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	1.13,	-.118,	12.24,	.17,	10,	.81,	-12.32,
3,	1.13,	-.196,	9.54,	.35,	10,	.59,	-9.92,
4,	1.33,	-.999,	7.93,	.68,	10,	.33,	-9.05,
5,	.93,	.255,	8.80,	.73,	10,	.29,	-8.55,
6,	1.03,	-.060,	8.51,	.47,	10,	.47,	-8.59,
7,	1.04,	-.101,	8.73,	.63,	10,	.31,	-8.80,
8,	.74,	.655,	9.07,	.60,	10,	.30,	-8.78,
9,	.51,	1.321,	9.12,	.63,	10,	.14,	-8.97,
10,	1.25,	-.155,	8.85,	.08,	10,	.59,	-8.83,
11,	.88,	.104,	8.77,	.14,	10,	.43,	-8.83,
12,	-1.31,	-1.021,	6.67,	.04,	10,	.72,	-9.02,
13,	1.36,	-.158,	8.97,	.04,	10,	.90,	-8.61,
14,	.86,	.530,	8.53,	.77,	10,	.18,	-8.75,

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	242232.,	.535,	.000,	.00,	1,	.208,	.011
>>NETHERLANDS ALL FL,	2532677.,	2.368,	.000,	.00,	1,	.011,	.001
>>TRIDENS SNS Septem,	248591.,	.332,	.000,	.00,	1,	.541,	.011
>>English seine<< ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	747489.,	.50,,,,				.240,	.004

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
330040.,	.24,	.33,	4,	1.367,	.008

Continued

Table 3.7.7. North Sea plaice XSA tuning cntd.

Age 2 Catchability constant w.r.t. time and dependent on age
Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	327129.,	.288,	.099,	.34,	2,	.281,	.124
>>NETHERLANDS ALL FL,	359717.,	.500,	.323,	.65,	2,	.094,	.113
>>TRIDENS SNS Septem,	345934.,	.223,	.205,	.92,	2,	.471,	.118
>>English seine<< ,	252421.,	.695,	.000,	.00,	1,	.048,	.158
F shrinkage mean ,	426868.,	.50,,,,				.105,	.096

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
344149.,	.15,	.08,	8,	.512,	.118

Age 3 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
>>NETHERLAND BTS<< ,	183066.,	.225,	.070,	.31,	3,	.284,	.375
>>NETHERLANDS ALL FL,	181377.,	.258,	.064,	.25,	3,	.224,	.378
>>TRIDENS SNS Septem,	258131.,	.209,	.272,	1.30,	3,	.320,	.280
>>English seine<< ,	310329.,	.413,	.159,	.39,	2,	.087,	.238
F shrinkage mean ,	216156.,	.50,,,,				.085,	.326

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
216504.,	.12,	.09,	12,	.741,	.325

Age 4 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
>>NETHERLAND BTS<< ,	73944.,	.209,	.097,	.46,	4,	.231,	.620
>>NETHERLANDS ALL FL,	90694.,	.200,	.085,	.42,	4,	.288,	.531
>>TRIDENS SNS Septem,	101948.,	.212,	.156,	.74,	3,	.188,	.484
>>English seine<< ,	137402.,	.247,	.034,	.14,	3,	.203,	.380
F shrinkage mean ,	97108.,	.50,,,,				.090,	.503

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
96824.,	.11,	.07,	15,	.633,	.505

Age 5 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
>>NETHERLAND BTS<< ,	32512.,	.199,	.150,	.75,	5,	.225,	.880
>>NETHERLANDS ALL FL,	38494.,	.177,	.034,	.19,	5,	.308,	.785
>>TRIDENS SNS Septem,	37521.,	.220,	.139,	.63,	3,	.102,	.799
>>English seine<< ,	46260.,	.203,	.100,	.49,	4,	.252,	.689
F shrinkage mean ,	50492.,	.50,,,,				.112,	.646

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
39911.,	.11,	.06,	18,	.541,	.765

Continued

Table 3.7.7. North Sea plaice XSA tuning cntd.

Age 6 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
>>NETHERLAND BTS<< ,	40548.,	.213,	.085,	.40,	6,	.209,	.507
>>NETHERLANDS ALL FL,	28514.,	.174,	.069,	.40,	6,	.371,	.662
>>TRIDENS SNS Septem,	32771.,	.236,	.115,	.49,	3,	.058,	.597
>>English seine<< ,	30814.,	.205,	.145,	.71,	5,	.240,	.625
F shrinkage mean ,	32631.,	.50,,,,				.121,	.599

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
32043.,	.11,	.05,	21,	.471,	.607

Age 7 Catchability constant w.r.t. time and dependent on age
Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	20616.,	.207,	.086,	.42,	7,	.260,	.471
>>NETHERLANDS ALL FL,	16872.,	.173,	.063,	.36,	7,	.336,	.551
>>TRIDENS SNS Septem,	17060.,	.264,	.144,	.55,	3,	.024,	.546
>>English seine<< ,	13817.,	.198,	.059,	.30,	6,	.276,	.640
F shrinkage mean ,	19303.,	.50,,,,				.103,	.496

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17060.,	.11,	.05,	24,	.421,	.546

Age 8 Catchability constant w.r.t. time and dependent on age
Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	26160.,	.190,	.065,	.34,	8,	.309,	.362
>>NETHERLANDS ALL FL,	18586.,	.171,	.068,	.40,	8,	.350,	.479
>>TRIDENS SNS Septem,	26551.,	.317,	.238,	.75,	3,	.009,	.357
>>English seine<< ,	22811.,	.199,	.032,	.16,	7,	.241,	.406
F shrinkage mean ,	22465.,	.50,,,,				.091,	.411

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
22149.,	.11,	.04,	27,	.379,	.415

Age 9 Catchability constant w.r.t. time and dependent on age
Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	10138.,	.182,	.099,	.54,	9,	.256,	.311
>>NETHERLANDS ALL FL,	6674.,	.159,	.062,	.39,	9,	.354,	.441
>>TRIDENS SNS Septem,	4737.,	.420,	.029,	.07,	3,	.004,	.578
>>English seine<< ,	7536.,	.179,	.053,	.30,	8,	.304,	.400
F shrinkage mean ,	8125.,	.50,,,,				.082,	.376

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7820.,	.10,	.05,	30,	.472,	.388

Continued

Table 3.7.7. North Sea plaice XSA tuning cntd.

Age 10 Catchability constant w.r.t. time and dependent on age
Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	2415.,	.192,	.068,	.36,	9,	.233,	.605
>>NETHERLANDS ALL FL,	2950.,	.162,	.040,	.24,	10,	.373,	.519
>>TRIDENS SNS Septem,	2285.,	.655,	.216,	.33,	3,	.001,	.630
>>English seine<< ,	3333.,	.181,	.058,	.32,	9,	.289,	.471
F shrinkage mean ,	4724.,	.50,,,,				.105,	.354

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3064.,	.11,	.04,	32,	.416,	.504

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 10
Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	1786.,	.197,	.105,	.53,	8,	.184,	.586
>>NETHERLANDS ALL FL,	1789.,	.168,	.067,	.40,	10,	.376,	.586
>>TRIDENS SNS Septem,	1500.,	1.317,	.045,	.03,	2,	.000,	.668
>>English seine<< ,	2277.,	.188,	.071,	.38,	10,	.311,	.486
F shrinkage mean ,	4091.,	.50,,,,				.128,	.299

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2143.,	.11,	.06,	31,	.571,	.510

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 10
Year class = 1981

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	1617.,	.218,	.055,	.25,	7,	.147,	.501
>>NETHERLANDS ALL FL,	1407.,	.181,	.084,	.46,	10,	.382,	.558
>>TRIDENS SNS Septem,	1262.,	4.042,	.000,	.00,	1,	.000,	.606
>>English seine<< ,	2549.,	.201,	.071,	.36,	10,	.320,	.346
F shrinkage mean ,	2785.,	.50,,,,				.152,	.320

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1927.,	.13,	.07,	29,	.552,	.436

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 10
Year class = 1980

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	667.,	.242,	.065,	.27,	6,	.122,	.770
>>NETHERLANDS ALL FL,	757.,	.188,	.106,	.57,	10,	.358,	.703
>>TRIDENS SNS Septem,	1.,	.000,	.000,	.00,	0,	.000,	.000
>>English seine<< ,	733.,	.207,	.067,	.33,	10,	.320,	.719
F shrinkage mean ,	2182.,	.50,,,,				.199,	.303

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
911.,	.14,	.11,	27,	.752,	.614

Continued

Table 3.7.7. North Sea plaice XSA tuning cntd.

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 10
Year class = 1979

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
>>NETHERLAND BTS<< ,	682.,	.287,	.184,	.64,	5,	.053,	.342
>>NETHERLANDS ALL FL,	350.,	.234,	.156,	.67,	10,	.241,	.584
>>TRIDENS SNS Septem,	1.,	.000,	.000,	.00,	0,	.000,	.000
>>English seine<< ,	494.,	.213,	.068,	.32,	10,	.511,	.446
F shrinkage mean ,	437.,	.50,,,,				.195,	.492

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
452.,	.16,	.07,	26,	.421,	.479

TABLE 3.7.8 North sea plaice
International F at age, Total , 1984 to 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	.000	.000	.001	.000	.000	.004	.004	.003	.007	.008
2	.133	.151	.158	.081	.033	.103	.102	.133	.109	.118
3	.507	.443	.511	.395	.322	.303	.283	.363	.355	.325
4	.419	.678	.512	.696	.421	.490	.518	.557	.522	.505
5	.578	.429	.671	.713	.641	.530	.663	.682	.703	.765
6	.438	.444	.576	.571	.590	.516	.499	.708	.670	.607
7	.345	.365	.462	.527	.529	.468	.396	.511	.567	.546
8	.402	.298	.383	.361	.447	.426	.322	.431	.422	.415
9	.323	.309	.338	.284	.431	.281	.340	.371	.449	.388
10	.299	.273	.358	.333	.331	.383	.222	.368	.460	.504
11	.313	.211	.308	.278	.266	.275	.266	.277	.406	.510
12	.303	.404	.319	.254	.384	.258	.203	.347	.404	.436
13	.254	.286	.535	.226	.278	.285	.184	.225	.539	.614
14	.293	.302	.380	.338	.319	.261	.213	.258	.564	.479
15+	.293	.302	.380	.338	.319	.261	.213	.258	.564	.479

TABLE 3.7.9 North sea plaice
Tuned Stock Numbers at age (10**-3), 1984 to 1994, (numbers in 1994 are VPA survivors)

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	610644	534051	1269110	538045	555074	380906	391289	452781	476301	367694	0
2	534852	552430	483114	1146745	486843	502252	343459	352616	408351	428029	330040
3	725274	423787	429895	373289	956647	426107	410025	280565	279226	331287	344149
4	164620	395419	246181	233253	227469	627160	284898	279644	176633	177230	216504
5	89718	98017	181619	133527	105242	135113	347577	153593	144995	94810	96824
6	40462	45540	57755	83977	59221	50157	71979	162063	70283	64982	39911
7	23277	23617	26420	29383	42951	29718	27095	39552	72243	32546	32043
8	17609	14912	14834	15061	15693	22908	16849	16499	21463	37085	17060
9	10366	10660	10021	9151	9498	9081	13543	11051	9706	12736	22149
10	8493	6792	7079	6468	6231	5586	6202	8719	6902	5603	7820
11	5116	5699	4678	4478	4194	4049	3446	4494	5458	3944	3064
12	4596	3386	4177	3112	3069	2908	2783	2389	3081	3292	2143
13	2132	3072	2046	2748	2185	1891	2032	2055	1527	1861	1927
14	1282	1496	2088	1085	1983	1497	1287	1530	1484	806	911
15+	5205	4249	4068	4435	6426	7100	6670	5956	3872	3425	2371

Table 3.7.10 Input for RCT3.

Plaice North Sea - 1-Y-Rcr.												
11	27	2										
1967	246	-11	-11	-11	-11	-11	2813	-11	-11	-11	-11	-11
1968	328	-11	-11	-11	7708	9450	1008	-11	-11	-11	-11	-11
1969	371	-11	8641	8032	-11	23848	4484	-11	-11	-11	-11	-11
1970	276	3678	-11	18101	14840	9584	1631	-11	-11	-11	-11	-11
1971	235	6708	9799	6437	8738	4191	1261	-11	-11	-11	-11	-11
1972	542	9242	32980	57238	43774	17985	10744	-11	-11	-11	-11	-11
1973	452	5451	5835	15648	15583	9171	791	-11	-11	-11	-11	-11
1974	337	2193	3903	9781	4610	2274	1720	105.73	69.34	-11	-11	-11
1975	326	1151	1739	9037	3424	2900	435	68.29	77.88	-11	-11	-11
1976	473	11544	8344	19119	15364	12714	1577	226.29	128.65	-11	-11	-11
1977	432	4378	5054	13924	7041	9540	456	158.38	66.25	-11	-11	-11
1978	445	3252	6922	21681	10778	12084	785	213.62	153.28	-11	-11	-11
1979	661	27835	16425	58049	37468	16106	1146	355.51	197.67	-11	-11	-11
1980	426	4039	2594	19611	11132	8503	308	136.2	131.45	-11	-11	-11
1981	1028	31542	20251	70108	45588	14708	2480	616.99	263.58	-11	-11	-11
1982	592	23987	7615	34884	17459	10413	1584	476.36	148.97	-11	-11	39.488
1983	611	36722	11869	44667	37339	13788	1155	398.7	113.91	-11	185.895	50.377
1984	534	7958	16557	27832	16277	7557	1232	260.99	103.51	105.674	125.847	32.122
1985	1269	47385	56559	93573	62290	33021	13140	721.87	260	634.259	707.449	207.993
1986	538	8818	8523	33426	16213	14429	3709	357.8	188.31	207.673	151.097	56.082
1987	555	21270	12835	36672	34218	14952	3248	473.62	98.16	541.243	337.866	67.359
1988	381	15598	10387	37238	16677	7287	1507	341.71	128.37	397.995	122.127	30.112
1989	391	24198	10235	24903	-11	11148	2257	469.64	121.31	123.152	125.537	20.615
1990	-11	9559	-11	57349	-11	13742	988	465.84	136.88	187.159	117.197	36.885
1991	-11	17120	-11	48223	-11	9484	-11	497.11	114.16	179.561	164.107	33.759
1992	-11	5398	-11	22184	-11	-11	-11	365.17	67.95	124.924	62.378	-11
1993	-11	9226	-11	-11	-11	-11	-11	265.11	-11	153.118	-11	-11
T-0												
T-1april												
T-1october												
T-2april												
T-2october												
T-3october												
com-0												
com-1												
ISIS-1												
ISIS-2												
ISIS-3												

Table 3.7.11

Analysis by RCT3 ver3.1 of data from file :

pla4recl.csv

Plaice North Sea - 1-Y-Rcr.,,,,,,,,,,,,

Data for 11 surveys over 27 years : 1967 - 1993

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 = 1985

	Regression					Prediction			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,,	.40	2.63	.27	.644	15	10.77	6.89	.341	.088
T-1apr	.63	.56	.38	.458	15	10.94	7.45	.545	.034
T-1oct	.54	.78	.16	.829	16	11.45	6.93	.215	.221
T-2apr	.53	1.07	.26	.668	16	11.04	6.95	.331	.094
T-2oct	.90	-2.02	.42	.426	17	10.40	7.33	.565	.032
T-3oct	1.26	-2.63	.99	.120	18	9.48	9.28	1.505	.005
com-0	.53	3.32	.14	.861	11	6.58	6.84	.184	.256
com-1	.94	1.69	.24	.665	11	5.56	6.94	.327	.096
ISIS-3	.34	5.10	.04	.885	3	5.34	6.92	.334	.091
					VPA Mean =		6.20	.349	.084

Yearclass = 1986

	Regression					Prediction			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,,	.44	2.29	.29	.701	16	9.08	6.24	.329	.061
T-1apr	.54	1.36	.31	.664	16	9.05	6.25	.354	.053
T-1oct	.59	.24	.17	.866	17	10.42	6.41	.199	.165
T-2apr	.57	.75	.26	.748	17	9.69	6.26	.293	.077
T-2oct	.82	-1.30	.35	.609	18	9.58	6.56	.407	.040
T-3oct	.62	1.85	.50	.440	19	8.22	6.92	.591	.019
com-0	.63	2.79	.18	.855	12	5.88	6.52	.209	.151
com-1	1.06	1.16	.26	.728	12	5.24	6.69	.315	.067
ISIS-2	.52	3.75	.05	.995	3	5.02	6.35	.100	.165
ISIS-3	.48	4.59	.05	.991	4	4.04	6.52	.073	.165
					VPA Mean =		6.30	.422	.037

Yearclass = 1987

	Regression					Prediction			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,,	.43	2.36	.27	.709	17	9.97	6.63	.311	.066
T-1apr	.52	1.53	.27	.697	17	9.46	6.48	.313	.065
T-1oct	.60	.18	.16	.869	18	10.51	6.45	.186	.159
T-2apr	.56	.86	.23	.769	18	10.44	6.68	.269	.088
T-2oct	.81	-1.25	.33	.620	19	9.61	6.57	.377	.045
T-3oct	.57	2.17	.45	.460	20	8.09	6.77	.530	.023
com-0	.65	2.69	.19	.826	13	6.16	6.68	.223	.127
com-1	1.08	.99	.29	.671	13	4.60	5.96	.343	.054
ISIS-1	.59	3.32	.28	.867	3	6.30	7.05	.631	.016
ISIS-2	.53	3.66	.05	.991	4	5.83	6.75	.078	.159
ISIS-3	.53	4.34	.13	.911	5	4.22	6.57	.188	.159
					VPA Mean =		6.32	.400	.040

Continued

Table 3.7.11 Continued

Yearclass = 1988

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
T-0,,,	.43	2.36	.27	.687	18	9.65	6.47	.305	.082
T-1apr	.51	1.66	.24	.721	18	9.25	6.36	.279	.099
T-1oct	.60	.09	.15	.868	19	10.53	6.45	.176	.192
T-2apr	.55	.87	.23	.742	19	9.72	6.26	.266	.108
T-2oct	.82	-1.28	.31	.623	20	8.89	5.97	.360	.059
T-3oct	.53	2.43	.41	.483	21	7.32	6.32	.466	.035
com-0	.67	2.54	.22	.764	14	5.84	6.44	.250	.123
com-1	1.09	1.00	.30	.634	14	4.86	6.28	.341	.066
ISIS-1	.80	1.97	.63	.404	4	5.99	6.75	1.019	.007
ISIS-2	.61	3.12	.25	.741	5	4.81	6.07	.394	.049
ISIS-3	.57	4.13	.17	.830	6	3.44	6.08	.248	.125
					VPA Mean =		6.35	.377	.054

Yearclass = 1989

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
T-0,,,	.49	1.70	.34	.577	19	10.09	6.65	.390	.072
T-1apr	.56	1.20	.28	.669	19	9.23	6.32	.315	.110
T-1oct	.70	-.99	.23	.743	20	10.12	6.13	.266	.154
T-2oct	.83	-1.44	.29	.654	21	9.32	6.31	.326	.103
T-3oct	.55	2.24	.41	.478	22	7.72	6.52	.471	.049
com-0	.79	1.78	.29	.643	15	6.15	6.65	.341	.094
com-1	1.21	.37	.33	.584	15	4.81	6.18	.382	.075
ISIS-1	1.47	-2.06	1.14	.170	5	4.82	5.03	1.871	.003
ISIS-2	.66	2.84	.24	.774	6	4.84	6.04	.340	.094
ISIS-3	.61	3.92	.17	.845	7	3.07	5.81	.254	.169
					VPA Mean =		6.33	.375	.077

Yearclass = 1990

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
T-0,,,	.60	.58	.45	.426	20	9.17	6.08	.521	.044
T-1oct	.76	-1.61	.24	.733	21	10.96	6.73	.279	.155
T-2oct	.92	-2.33	.31	.619	22	9.53	6.47	.351	.098
T-3oct	.61	1.74	.46	.417	23	6.90	5.98	.535	.042
com-0	.99	.58	.41	.473	16	6.15	6.63	.480	.052
com-1	1.30	-.09	.34	.564	16	4.93	6.30	.394	.078
ISIS-1	1.09	.24	.79	.277	6	5.24	5.93	1.067	.011
ISIS-2	.68	2.73	.22	.793	7	4.77	5.97	.300	.134
ISIS-3	.58	4.08	.16	.868	8	3.63	6.18	.197	.301
					VPA Mean =		6.32	.373	.086

Yearclass = 1991

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
T-0,,,	.65	.08	.49	.399	20	9.75	6.42	.561	.041
T-1oct	.80	-2.05	.24	.732	21	10.78	6.60	.280	.163
T-2oct	.96	-2.68	.30	.629	22	9.16	6.11	.354	.102
com-0	1.07	.07	.44	.450	16	6.21	6.70	.516	.048
com-1	1.34	-.30	.36	.554	16	4.75	6.05	.416	.074
ISIS-1	1.09	.22	.79	.276	6	5.20	5.88	1.082	.011
ISIS-2	.68	2.72	.23	.793	7	5.11	6.20	.291	.151
ISIS-3	.58	4.08	.16	.869	8	3.55	6.13	.201	.318
					VPA Mean =		6.33	.375	.091

Continued

Table 3.7.11 Continued

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			
T-0,,,	.71	-.58	.52	.370	20	8.59	5.57	.658	.063
T-1oct	.85	-2.53	.24	.735	21	10.01	5.94	.293	.316
com-0	1.17	-.58	.47	.426	16	5.90	6.34	.546	.091
com-1	1.38	-.53	.37	.544	16	4.23	5.33	.508	.105
ISIS-1	1.09	.19	.80	.274	6	4.84	5.48	1.166	.020
ISIS-2	.68	2.72	.23	.793	7	4.15	5.54	.356	.215
					VPA Mean =		6.34	.378	.190

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			
T-0,,,	.79	-1.39	.57	.342	20	9.13	5.87	.695	.168
com-0	1.30	-1.37	.49	.405	16	5.58	5.88	.610	.218
ISIS-1	1.10	.16	.81	.272	6	5.04	5.69	1.150	.061
					VPA Mean =		6.34	.382	.554

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1985	978	6.89	.10	.10	.92	1270	7.15
1986	622	6.43	.08	.05	.31	539	6.29
1987	714	6.57	.08	.06	.54	556	6.32
1988	549	6.31	.09	.05	.31	382	5.95
1989	506	6.23	.10	.09	.69	392	5.97
1990	542	6.30	.11	.08	.59		
1991	525	6.26	.11	.07	.41		
1992	353	5.87	.16	.14	.77		
1993	456	6.12	.28	.14	.25		

Run title : North Sea PLA4e, sexes combined *** full data set *** At 8/10/1994 10:43

Table 3.7.12 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

0, 0	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2-10,	FBARC,	FBARP,	SOP
1957,	296169,	457378,	354628,	70563,	.1990,	.1973,	.2317,	.1376,	1.1105
1958,	429989,	443684,	340640,	73354,	.2153,	.2118,	.2500,	.1413,	1.0634
1959,	433448,	457574,	345192,	79300,	.2297,	.2266,	.2434,	.1430,	1.0217
1960,	405335,	497704,	368318,	87541,	.2377,	.2469,	.2815,	.1535,	1.0067
1961,	359395,	461937,	352886,	85984,	.2437,	.2331,	.2822,	.1396,	1.0156
1962,	318820,	564476,	446584,	87472,	.1959,	.2345,	.2839,	.1407,	0.9665
1963,	315192,	547178,	439993,	107118,	.2435,	.2644,	.3224,	.1479,	1.0193
1964,	1021966,	624858,	422955,	110540,	.2614,	.2732,	.3038,	.1653,	1.0075
1965,	309585,	580525,	414382,	97143,	.2344,	.2761,	.3025,	.1571,	1.0057
1966,	305416,	588018,	416421,	101834,	.2445,	.2594,	.3091,	.1462,	1.0182
1967,	277260,	590893,	493058,	108819,	.2207,	.2427,	.2927,	.1424,	1.0198
1968,	245564,	548249,	456159,	111534,	.2445,	.2209,	.2342,	.1422,	1.0291
1969,	327530,	526337,	418346,	121651,	.2908,	.2538,	.2572,	.1604,	1.0582
1970,	370503,	525914,	399658,	130342,	.3261,	.3329,	.3804,	.1984,	0.9744
1971,	275686,	500652,	372460,	113944,	.3059,	.3154,	.2988,	.1796,	1.0331
1972,	234710,	495360,	375955,	122843,	.3267,	.3408,	.3058,	.2025,	1.0283
1973,	542176,	488275,	334898,	130429,	.3895,	.3804,	.3859,	.2292,	1.0508
1974,	451685,	467430,	309058,	112540,	.3641,	.3911,	.4349,	.2153,	1.0369
1975,	336924,	495338,	320296,	108536,	.3389,	.3651,	.3806,	.1886,	1.0624
1976,	325850,	451229,	314928,	113670,	.3609,	.3145,	.2970,	.1913,	1.0254
1977,	472649,	479474,	329786,	119188,	.3614,	.3340,	.3309,	.2095,	1.0016
1978,	431817,	474970,	323512,	113984,	.3523,	.3278,	.3405,	.2126,	0.9643
1979,	445267,	474272,	310665,	145347,	.4679,	.4559,	.4525,	.2490,	0.9983
1980,	661100,	487608,	296811,	139951,	.4715,	.3961,	.4976,	.2607,	1.0136
1981,	425694,	488503,	307455,	139747,	.4545,	.3981,	.4566,	.2540,	1.0175
1982,	1028422,	560142,	300415,	154547,	.5144,	.4375,	.5454,	.2623,	1.0062
1983,	592379,	548437,	324186,	144038,	.4443,	.4158,	.4927,	.2501,	0.9938
1984,	610644,	559202,	325560,	156147,	.4796,	.3826,	.4268,	.2314,	0.9844
1985,	534051,	547118,	358068,	159838,	.4464,	.3767,	.4478,	.2374,	0.9799
1986,	1269109,	651661,	359809,	165347,	.4595,	.4410,	.4679,	.2494,	0.9877
1987,	538046,	631264,	389862,	153670,	.3942,	.4402,	.5169,	.2338,	0.9875
1988,	555075,	622043,	373336,	154475,	.4138,	.4161,	.4394,	.2023,	0.9848
1989,	380906,	578779,	414175,	169643,	.4096,	.3887,	.3898,	.2110,	0.9885
1990,	391289,	541631,	385101,	156207,	.4056,	.3717,	.4152,	.2122,	0.9827
1991,	452782,	458112,	325231,	147478,	.4535,	.4582,	.4567,	.2354,	0.9650
1992,	476301,	464830,	308109,	124712,	.4048,	.4729,	.4560,	.2306,	1.0103
1993,	367680,	418018,	270692,	109951,	.4062,	.4637,	.4527,	.2292,	0.9791
Arith. Mean ,	465308,	521597,	362151,	122417,	.3463,	.3394,	.0000,	.1971,	
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),					

Table 3.7.13

Plaice in the North Sea (Fishing Area IV)

Plaice in the North Sea (Fishing Area IV)

Yield per recruit: Input data

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	1.000	0.1000	0.0000	0.0000	0.0000	0.131	0.0061	0.243
2	.	0.1000	0.5000	0.0000	0.0000	0.243	0.1202	0.274
3	.	0.1000	0.5000	0.0000	0.0000	0.273	0.3476	0.292
4	.	0.1000	1.0000	0.0000	0.0000	0.299	0.5279	0.318
5	.	0.1000	1.0000	0.0000	0.0000	0.339	0.7165	0.356
6	.	0.1000	1.0000	0.0000	0.0000	0.406	0.6616	0.436
7	.	0.1000	1.0000	0.0000	0.0000	0.495	0.5413	0.526
8	.	0.1000	1.0000	0.0000	0.0000	0.608	0.4226	0.628
9	.	0.1000	1.0000	0.0000	0.0000	0.663	0.4027	0.712
10	.	0.1000	1.0000	0.0000	0.0000	0.735	0.4440	0.771
11	.	0.1000	1.0000	0.0000	0.0000	0.799	0.3975	0.827
12	.	0.1000	1.0000	0.0000	0.0000	0.932	0.3959	0.905
13	.	0.1000	1.0000	0.0000	0.0000	0.906	0.4593	0.924
14	.	0.1000	1.0000	0.0000	0.0000	0.842	0.4340	0.897
15+	.	0.1000	1.0000	0.0000	0.0000	0.973	0.4340	1.003
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : AR2
Date and time: 10OCT94:20:22

Table 3.7.14. NS plaice: yield per recruit analysis.

alpha,	Tot F,	Tot Y/R,	HC F,	HC Y/R,	Ind F,	Ind Y/R
.00,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000
.10,	.0464,	114.2594,	.0000,	121.3041,	.0000,	.0000
.20,	.0928,	173.5541,	.0000,	184.9882,	.0000,	.0000
.30,	.1391,	203.2308,	.0000,	217.4930,	.0000,	.0000
.40,	.1855,	217.1321,	.0000,	233.2888,	.0000,	.0000
.50,	.2319,	222.7850,	.0000,	240.2682,	.0000,	.0000
.60,	.2783,	224.2544,	.0000,	242.7123,	.0000,	.0000
.70,	.3246,	223.7127,	.0000,	242.9232,	.0000,	.0000
.80,	.3710,	222.3020,	.0000,	242.1220,	.0000,	.0000
.90,	.4174,	220.6070,	.0000,	240.9421,	.0000,	.0000
1.00,	.4638,	218.9133,	.0000,	239.6999,	.0000,	.0000
1.10,	.5102,	217.3492,	.0000,	238.5428,	.0000,	.0000
1.20,	.5565,	215.9616,	.0000,	237.5300,	.0000,	.0000
1.30,	.6029,	214.7570,	.0000,	236.6761,	.0000,	.0000
1.40,	.6493,	213.7236,	.0000,	235.9745,	.0000,	.0000
1.50,	.6957,	212.8423,	.0000,	235.4096,	.0000,	.0000
1.60,	.7420,	212.0925,	.0000,	234.9630,	.0000,	.0000
1.70,	.7884,	211.4544,	.0000,	234.6167,	.0000,	.0000
1.80,	.8348,	210.9104,	.0000,	234.3542,	.0000,	.0000
1.90,	.8812,	210.4455,	.0000,	234.1612,	.0000,	.0000
2.00,	.9276,	210.0466,	.0000,	234.0256,	.0000,	.0000

alpha,	Tot F,	Tot SSB/R,	HC F,	HC SSB/R,	Ind F,	Ind SSB/R
.00,	.0000,	3546.7525,	.0000,	3546.7525,	.0000,	536.3570
.10,	.0464,	2602.7076,	.0000,	2602.7076,	.0000,	536.3570
.20,	.0928,	1967.2671,	.0000,	1967.2671,	.0000,	536.3570
.30,	.1391,	1532.3924,	.0000,	1532.3924,	.0000,	536.3570
.40,	.1855,	1229.4102,	.0000,	1229.4102,	.0000,	536.3570
.50,	.2319,	1014.2654,	.0000,	1014.2654,	.0000,	536.3570
.60,	.2783,	858.4161,	.0000,	858.4161,	.0000,	536.3570
.70,	.3246,	743.1747,	.0000,	743.1747,	.0000,	536.3570
.80,	.3710,	656.1672,	.0000,	656.1672,	.0000,	536.3570
.90,	.4174,	589.1029,	.0000,	589.1029,	.0000,	536.3570
1.00,	.4638,	536.3570,	.0000,	536.3570,	.0000,	536.3570
1.10,	.5102,	494.0635,	.0000,	494.0635,	.0000,	536.3570
1.20,	.5565,	459.5294,	.0000,	459.5294,	.0000,	536.3570
1.30,	.6029,	430.8524,	.0000,	430.8524,	.0000,	536.3570
1.40,	.6493,	406.6700,	.0000,	406.6700,	.0000,	536.3570
1.50,	.6957,	385.9922,	.0000,	385.9922,	.0000,	536.3570
1.60,	.7420,	368.0894,	.0000,	368.0894,	.0000,	536.3570
1.70,	.7884,	352.4165,	.0000,	352.4165,	.0000,	536.3570
1.80,	.8348,	338.5601,	.0000,	338.5601,	.0000,	536.3570
1.90,	.8812,	326.2028,	.0000,	326.2028,	.0000,	536.3570
2.00,	.9276,	315.0976,	.0000,	315.0976,	.0000,	536.3570

TABLE 3.7.15 North sea plaice
Input for Catch Prediction

Age	1994 Stock Numbers (10**-3)	F and mean Wt at age used in prediction: Scaled Mean F 1989 - 1993	Mean Wt. at age (kg) 1989 - 1993 Stock	Mean Wt. at age (kg) 1989 - 1993 Catch	M and maturity: M	P. mat
1	456000	.006	.139	.247	.100	.000
2	330040	.122	.238	.277	.100	.500
3	344149	.350	.268	.296	.100	.500
4	216504	.558	.292	.320	.100	1.000
5	96824	.719	.344	.365	.100	1.000
6	39911	.645	.425	.457	.100	1.000
7	32043	.535	.518	.555	.100	1.000
8	17060	.434	.616	.648	.100	1.000
9	22149	.394	.690	.735	.100	1.000
10	7820	.417	.760	.790	.100	1.000
11	3064	.373	.840	.885	.100	1.000
12	2143	.355	.982	.948	.100	1.000
13	1927	.397	.986	1.002	.100	1.000
14	911	.382	.894	.948	.100	1.000
15	2371	.382	.969	1.033	.100	1.000

Mean F	(2 -10)
Unscaled	.431
Scaled	.464

Recruits at age 1 in 1995 = 400000
Recruits at age 1 in 1996 = 400000

Stock numbers in 1994 are VPA survivors (Age 1 from RCT3).

Table 3.7.16. North Sea plaice:
Input data for catch forecast and linear sensitivity analysis.

Populations in 1994			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	456000	.38	WS1	.14	.06	M1	.10	.00	MT1	.00	.00
N2	330040	.33	WS2	.24	.12	M2	.10	.00	MT2	.50	.00
N3	344149	.15	WS3	.27	.06	M3	.10	.00	MT3	.50	.00
N4	216504	.12	WS4	.29	.07	M4	.10	.00	MT4	1.00	.00
N5	96824	.11	WS5	.34	.13	M5	.10	.00	MT5	1.00	.00
N6	39911	.11	WS6	.43	.13	M6	.10	.00	MT6	1.00	.00
N7	32043	.11	WS7	.52	.13	M7	.10	.00	MT7	1.00	.00
N8	17060	.11	WS8	.62	.09	M8	.10	.00	MT8	1.00	.00
N9	22149	.11	WS9	.69	.10	M9	.10	.00	MT9	1.00	.00
N10	7820	.10	WS10	.76	.10	M10	.10	.00	MT10	1.00	.00
N11	3064	.11	WS11	.84	.10	M11	.10	.00	MT11	1.00	.00
N12	2143	.11	WS12	.98	.08	M12	.10	.00	MT12	1.00	.00
N13	1927	.13	WS13	.99	.13	M13	.10	.00	MT13	1.00	.00
N14	911	.14	WS14	.89	.14	M14	.10	.00	MT14	1.00	.00
N15	2371	.16	WS15	.97	.16	M15	.10	.00	MT15	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.01	1.02	WH1	.25	.07
sH2	.12	.34	WH2	.28	.05
sH3	.35	.24	WH3	.30	.03
sH4	.56	.20	WH4	.32	.06
sH5	.72	.11	WH5	.37	.12
sH6	.65	.09	WH6	.46	.13
sH7	.54	.10	WH7	.56	.10
sH8	.43	.12	WH8	.65	.07
sH9	.39	.13	WH9	.74	.07
sH10	.42	.17	WH10	.79	.08
sH11	.37	.22	WH11	.89	.09
sH12	.36	.21	WH12	.95	.07
sH13	.40	.39	WH13	1.00	.09
sH14	.38	.24	WH14	.95	.12
sH15	.38	.24	WH15	1.03	.07

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K94	1.00	.00	HF94	1.00	.09
K95	1.00	.00	HF95	1.00	.09
K96	1.00	.00	HF96	1.00	.09

Recruitment		
Labl	Value	CV
R95	400000	.38
R96	400000	.38

Stock numbers in 1994 are VPA survivors.

Table 3.7.17. North Sea plaice: Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	1994	1995						
Mean F Ages H.cons 2 to10	.46	.00	.19	.28	.32	.37	.46	.56
Effort relative to 1993 H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Biomass at start of year								
Total	406	392	392	392	392	392	392	392
Spawning	257	252	252	252	252	252	252	252
Catch weight (,000t) H.cons	114	0	50	72	82	91	109	126
Biomass at start of 1996								
Total		490	439	417	407	398	380	363
Spawning		342	293	273	263	254	237	222

	1994	1995						
Effort relative to 1993 H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.10	.14	.14	.14	.14	.14	.14	.14
Spawning	.08	.11	.11	.11	.11	.11	.11	.11
Catch weight H.cons	.12	.00	.23	.17	.15	.14	.13	.12
Biomass at start of 1996								
Total		.13	.14	.14	.15	.15	.15	.16
Spawning		.12	.13	.13	.14	.14	.14	.15

Table 3.7.18
Stock: North Sea plaice

Assessment Quality Control Diagram 1

Average F(2-10,u)							
Date of assessment	Year						
	1987	1988	1989	1990	1991	1992	1993
1989	0.39	0.44					
1990	0.48	0.60	0.55				
1991	0.48	0.56	0.53	0.56			
1992	0.43	0.44	0.38	0.39	0.46		
1993	0.40	0.42	0.37	0.38	0.47	0.46	
1994	0.44	0.42	0.39	0.37	0.46	0.47	0.46

Remarks:

Assessment Quality Control Diagram 2

Estimated total landings ('000 t) at *status quo* F								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	172.6	182.0	171.0					
1990	172.6	180.5	189.0	169.0				
1991		169.6	167.7	164.0	160.0			
1992			167.7	153.7	170.6	170.2		
1993				165.8	123.6	143.0	147.0	
1994					122	112	114	109
					\ SQC[1]	\ SQC[2]	\ Current	\ Forecast

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\right]$$

where F(y), F(y−1) ∧ F(y−2) are as estimated ∈ the assessment made ∈ year (y+1).

Remarks:

Continued

Table 3.7.18 Continued

Stock: North Sea plaice

Assessment Quality Control Diagram 3

Recruitment (age 1) Unit: millions							
Date of assessment	Year class						
	1988	1989	1990	1991	1992	1993	1994
1989	612	750					
1990[1]	574	584	588				
1991[1]	594	617	696	690			
1992[1]	581	598	750	687	567		
1993	404	471	676[1]	699[1]	529[1]	n/a	
1994	381	391	453	476	368	456[1]	-[1]

[1]Prediction from recruitment surveys.

Remarks: Predictions for 1993 and 1994 will be updated for ACFM meeting (autumn 1994) based on recruitment survey data currently collected.

Assessment Quality Control Diagram 4

Spawning stock biomass ('000 t)									
Date of assessment	Year								
	1988	1989	1990	1991	1992	1993	1994	1995	1996
1989	361	385	364[1]	361[1]					
1990	348	382	377	345[1]	326[1]				
1991	341	383	376	355	354[1]	357[1]			
1992	377	433	402	346	385	378[1]	369[1]		
1993	386	429	406	345	325	388	336[1]	329[1]	
1994	373*	414	385	325	308	270	257	252[1]	237[1]

[1]Forecast.

Remarks: * SOP corrected.

Table 3.7.19 North Sea plaice. Commercial catch rate indices.

Year	Belgium beam trawl	UK beam trawl	UK otter trawl	UK seine	Netherlands beam trawl
	1)	kg/hr	kg/hr	kg/hr	kg/hpd
1972	50.8	-	-	-	-
1973	61.8	-	-	-	-
1974	60.9	-	-	-	-
1975	43.4	-	-	-	-
1976	34.3	-	-	-	-
1977	43.8	-	-	-	-
1978	39.8	-	-	-	-
1979	45.4	-	-	-	1.67
1980	50.9	76.7	31.3	23.7	1.73
1981	58.4	81.4	29.5	29.4	1.85
1982	62.9	98.7	32.8	38.2	1.71
1983	70.1	60.4	22.6	37.3	1.44
1984	67.5	52.7	29.7	34.9	1.44
1985	60.8	42.2	25.1	29.0	1.51
1986	55.8	48.6	25.8	34.3	1.65
1987	66.0	59.0	21.1	32.3	1.44
1988	78.0	58.4	22.6	36.0	1.19
1989	74.5	53.2	23.0	43.7	1.38
1990	83.1	49.4	23.0	47.8	1.10
1991	74.6	41.5	15.0	32.0	1.02
1992	60.1	39.4	12.0	28.1	0.74
1993	52.6	33.9	12.3	26.0	0.66

1) CPUE index based on hours fishing, corrected for HP.

Table 3.7.20 North Sea PLAICE. Results of trawl surveys in August-September in the southeastern North Sea.

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9	Age-10+
NETHERLANDS BTS (8 M BEAM TRAWL)										
1985	105.67	185.90	39.49	13.33	1.50	1.02	0.52	0.16	0.20	0.45
1986	634.26	125.85	50.38	10.18	4.69	0.91	0.48	0.25	0.07	0.24
1987	207.67	707.45	32.12	9.46	2.67	1.54	0.33	0.18	0.10	0.25
1988	541.24	151.10	207.99	6.78	3.05	0.74	0.57	0.13	0.14	0.26
1989	398.00	337.87	56.08	51.10	7.89	1.13	0.42	0.25	0.07	0.32
1990	123.15	122.13	67.36	22.32	10.20	1.13	0.28	0.23	0.07	0.12
1991	187.16	125.54	30.11	21.64	5.36	4.58	0.59	0.17	0.08	0.21
1992	179.56	117.20	20.61	6.10	4.97	2.88	1.41	0.39	0.04	0.09
1993	124.92	164.11	36.88	7.26	1.77	1.54	0.51	0.47	0.15	0.13
1994	153.12	62.38	33.76	10.62	2.76	0.55	0.76	1.32	0.38	0.04
BELGIUM BTS (8 M BEAM TRAWL 1989-1992, 4 m beam trawl since 1993										
1989	3.6	3.4	6.7	6.7	0.8	0.2	0.1	0.2	-	0.1
1990	2.8	4.8	4.4	5.2	7.5	0.9	0.5	-	-	-
1991	0.5	7.0	3.5	0.8	1.0	0.2	-	-	-	-
1992	8.0	5.0	5.0	3.0	-	1.0	-	-	-	-
1993*	10.8	67.4	1.8	0.2	0.2	-	-	-	-	-
1994*	2.3	2.3	3.1	1.8	0.2	-	-	-	-	-

*Values corrected by a factor of 2 in order to standardize from 4 m to 8 m beam length.

Table 3.7.21 North Sea PLAICE recruitment indices.

Year class	1-group VPA	Autumn surveys				Spring survey	
		Tridens O-group	Tridens 1-group	Tridens 2-group	Tridens 3-group	Tridens 1-group	Tridens 2-group
1967	246	-	-	-	2,813	-	-
1968	328	-	-	9,450	1,008	-	7,708
1969	371	-	8,032	23,848	4,484	8,641	-
1970	276	3,678	18,101	9,584	1,631	-	14,840
1971	235	6,708	6,437	4,191	1,261	9,799	8,738
1972	542	9,242	57,238	17,985	10,744	32,980	43,774
1973	452	5,451	15,648	9,171	791	5,835	15,583
1974	337	2,193	9,781	2,274	1,720	3,903	4,610
1975	326	1,151	9,037	2,900	435	1,739	3,424
1976	473	11,544	19,119	12,714	1,577	8,344	15,364
1977	432	4,378	13,924	9,540	456	5,054	7,041
1978	445	3,252	21,681	12,984	785	6,425	10,778
1979	661	27,835	58,049	16,106	1,146	16,567	37,468
1980	426	4,039	19,611	8,503	308	3,694	11,131
1981	1,028	31,542	70,108	14,708	2,480	20,151	45,588
1982	592	23,987	34,884	10,413	1,584	7,615	17,459
1983	611	36,722	44,667	13,788	1,155	11,869	37,339
1984	534	7,958	27,832	7,557	1,232	16,557	16,277
1985	1,269	47,385	93,573	33,021	13,140	56,559	62,290
1986	538	8,818	33,426	14,429	3,709	8,523	16,213
1987	555	21,270	36,672	14,952	3,248	12,835	34,218
1988	381	15,598	37,238	7,287	1,507	10,387	16,677
1989	391	24,198	24,903	11,149	2,257	10,235	-
1990	-	9,559	57,349	13,742	988	-	-
1991	-	17,120	48,223	9,484	-	-	-
1992	-	5,398	22,184	-	-	-	-
1993		9,226					

Continued

Table 3.7.21 Continued

Year class	Coastal surveys					Combined	
	Netherlands/Belgium		Germany	UK			
	0-group	1-group	0-group	0-group	1-group	0-group	1-group
1969	-	2.87	-	-	-	-	-
1970	-	0.93	-	-	-	-	-
1971	4.59	2.63	-	-	-	-	-
1972	2.46	6.79	-	-	-	-	-
1973	2.58	1.96	-	43.48	-	-	-
1974	2.29	3.03	11.3	56.91	14.36	105.73	69.34
1975	2.17	4.03	6.9	21.06	4.76	68.29	77.88
1976	7.03	6.59	28.3	59.87	9.08	226.29	128.65
1977	3.70	3.00	24.7	59.02	11.82	158.38	66.25
1978	8.18	7.91	22.0	31.14	9.75	213.62	153.28
1979	17.07	10.53	17.1	17.67	6.60	355.51	197.67
1980	5.02	6.92	15.3	21.35	5.89	136.20	131.45
1981	28.87	13.83	28.0	53.19	12.64	616.99	263.58
1982	24.01	7.82	14.8	16.74	7.08	476.36	148.97
1983	18.00	5.74	13.3	62.39	9.76	398.70	113.91
1984	10.72	4.65	7.1	70.63	19.14	260.99	103.51
1985	36.98	13.41	6.0	52.61	16.68	721.87	260.00
1986	17.69	9.98	3.6	39.96	7.22	357.80	188.31
1987	23.38	4.97	12.6	33.90	7.98	473.62	98.16
1988	15.50	6.31	12.6	48.67	13.88	341.71	128.37
1989	22.35	6.25	21.2	31.71	7.90	469.64	121.31
1990	22.02	6.88	20.3	34.37	12.04	465.84	136.88
1991	24.47	5.88	20.9	17.80	7.47	497.11	151.17
1992	18.09	3.41	5.4	35.55	8.90	365.17	114.16
1993	12.31	-	4.2	42.50	7.30	265.11	67.95
1994			7.0	35.2			

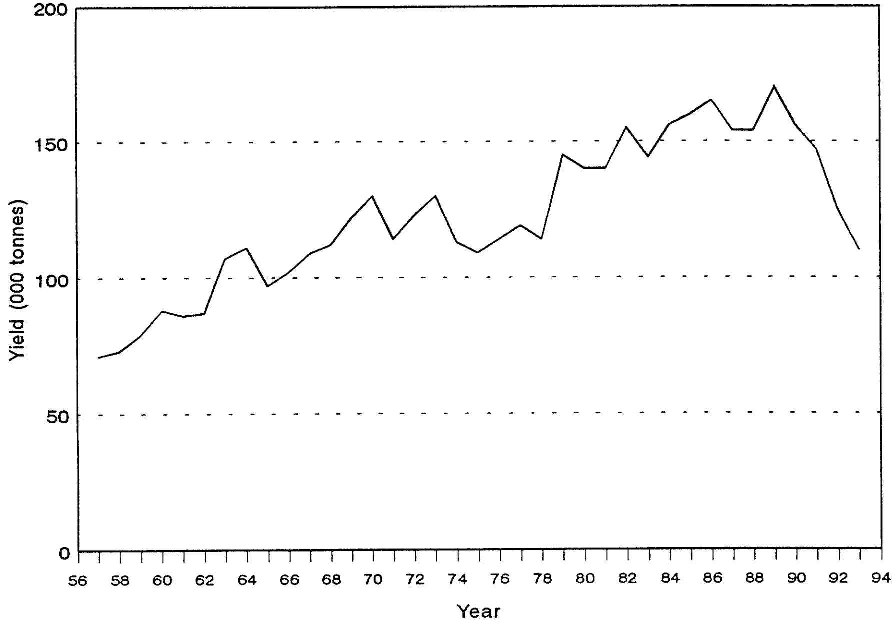


Fig. 3.7.1. North Sea plaice: trends in yield (000 tonnes) from 1957-1993.

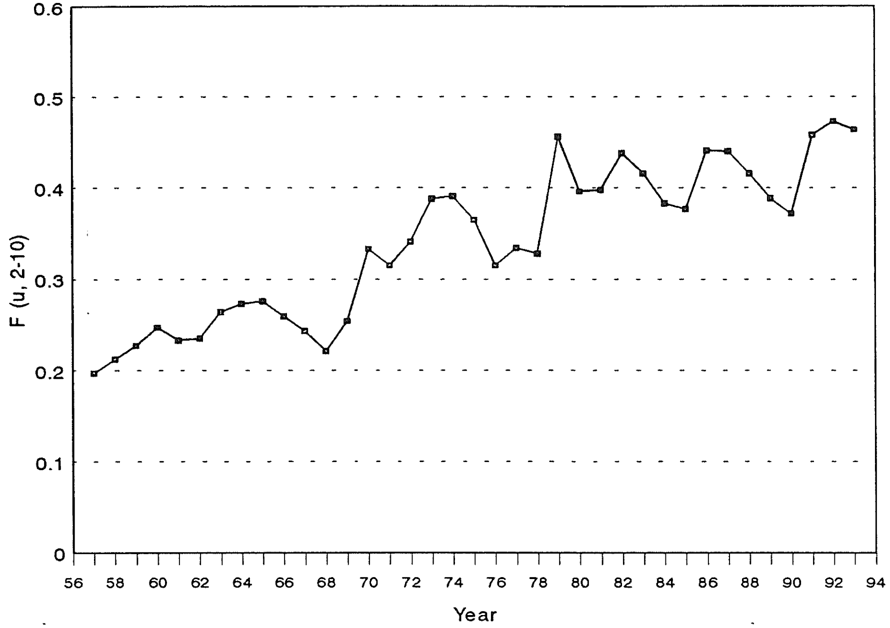


Fig. 3.7.2. North Sea plaice: trends in mean F (u, 2-10) from 1957-1993.

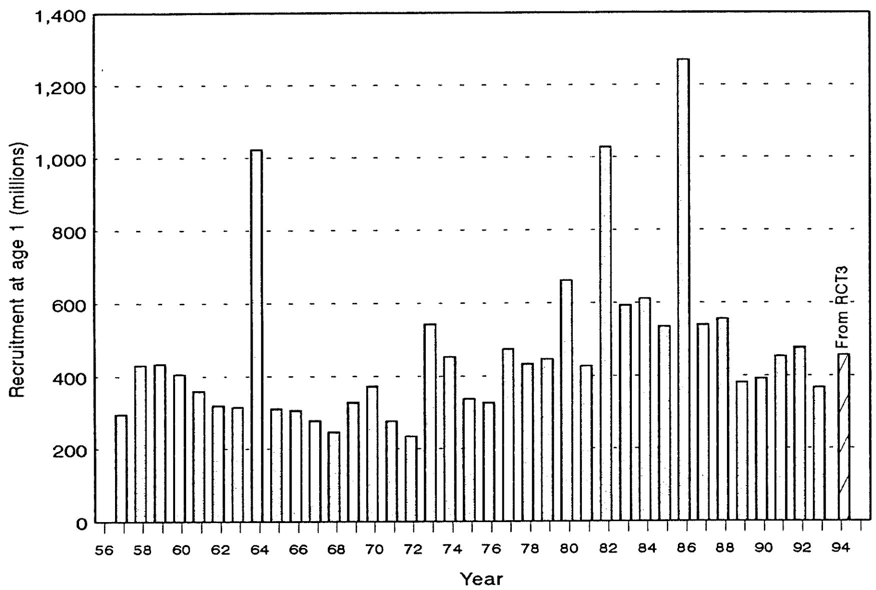


Fig. 3.7.3. North Sea plaice: trends in recruitment at age 1 from 1957-1993.

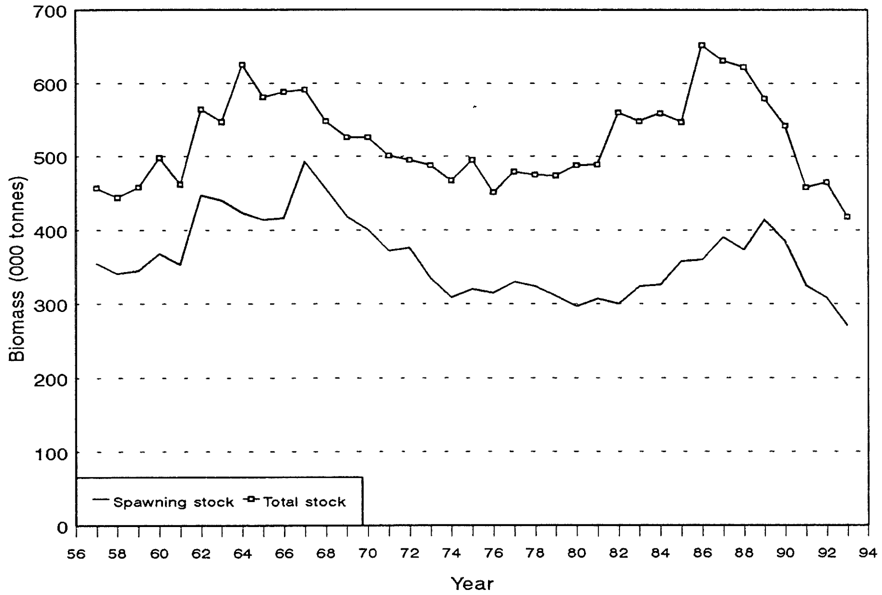


Fig. 3.7.4. North Sea plaice: trends in biomass (Total and SSB) from 1957-1993.

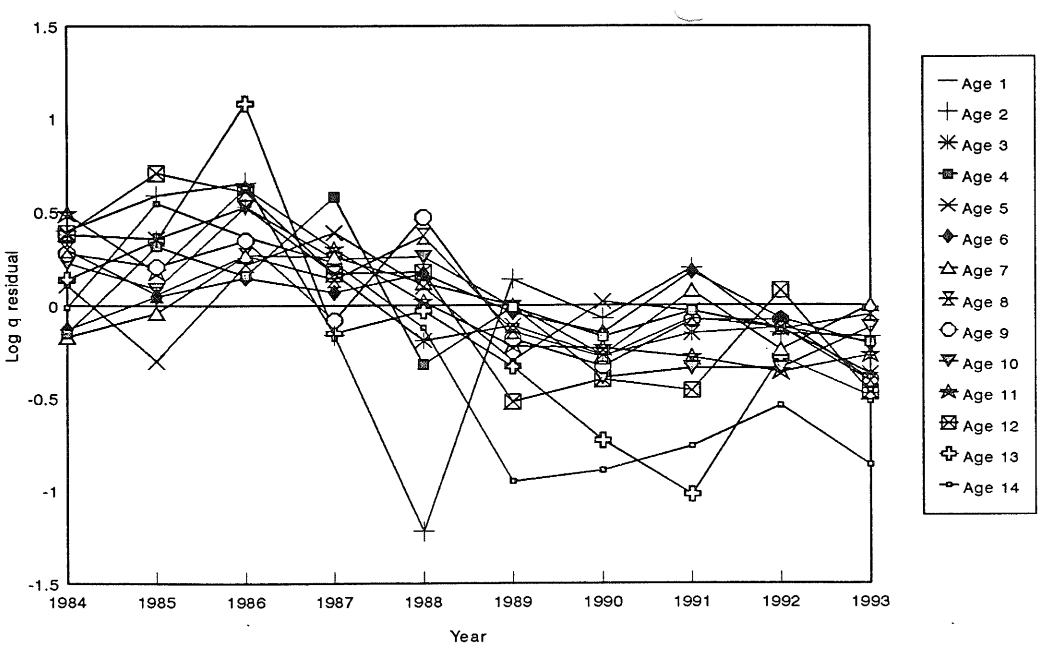


Fig. 3.7.5. N.Sea plaice: Log q residuals.
(Netherlands beam trawl fleet)

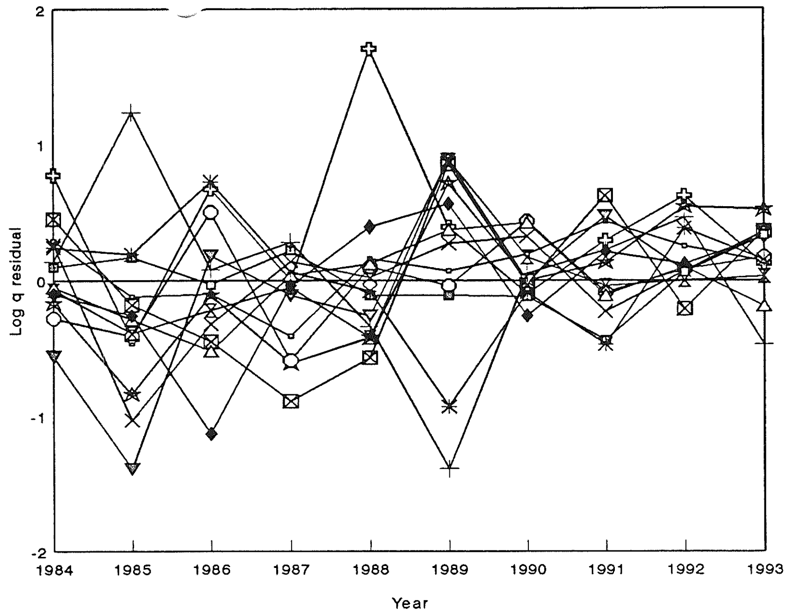


Fig. 3.7.5. N.Sea plaice: Log q residuals.
(English seine fleet)

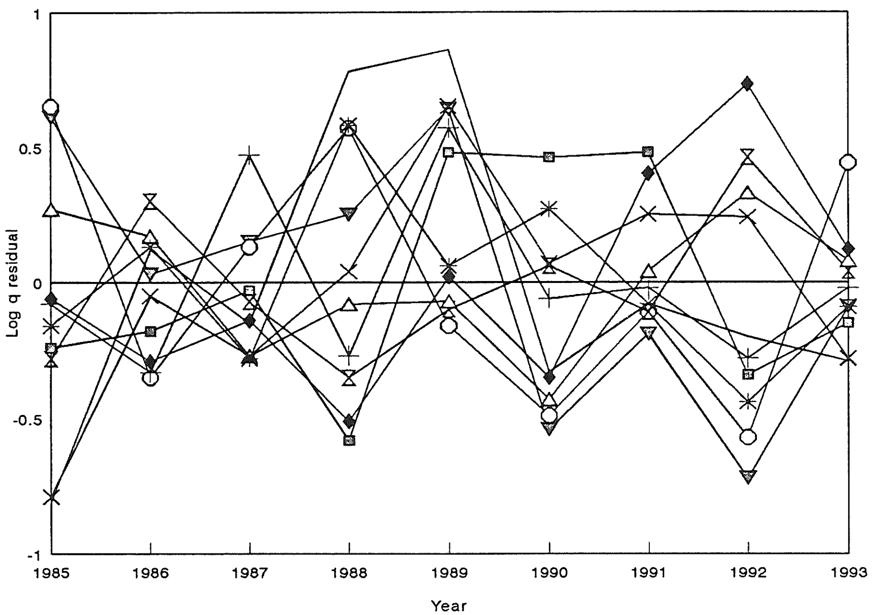


Fig. 3.7.5. N.Sea plaice: Log q residuals.
(Netherlands beam trawl survey)

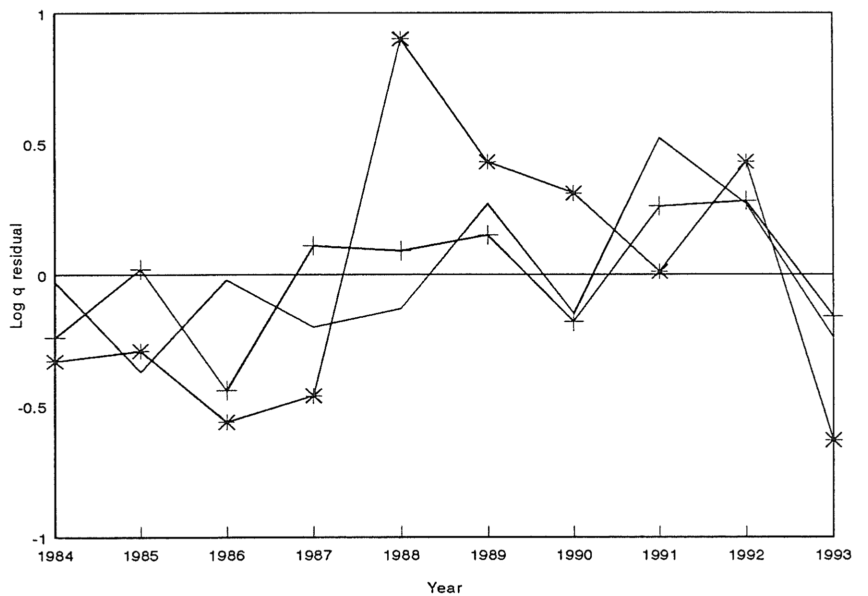


Fig. 3.7.5. N.Sea plaice: Log q residuals.
(Tridens survey)

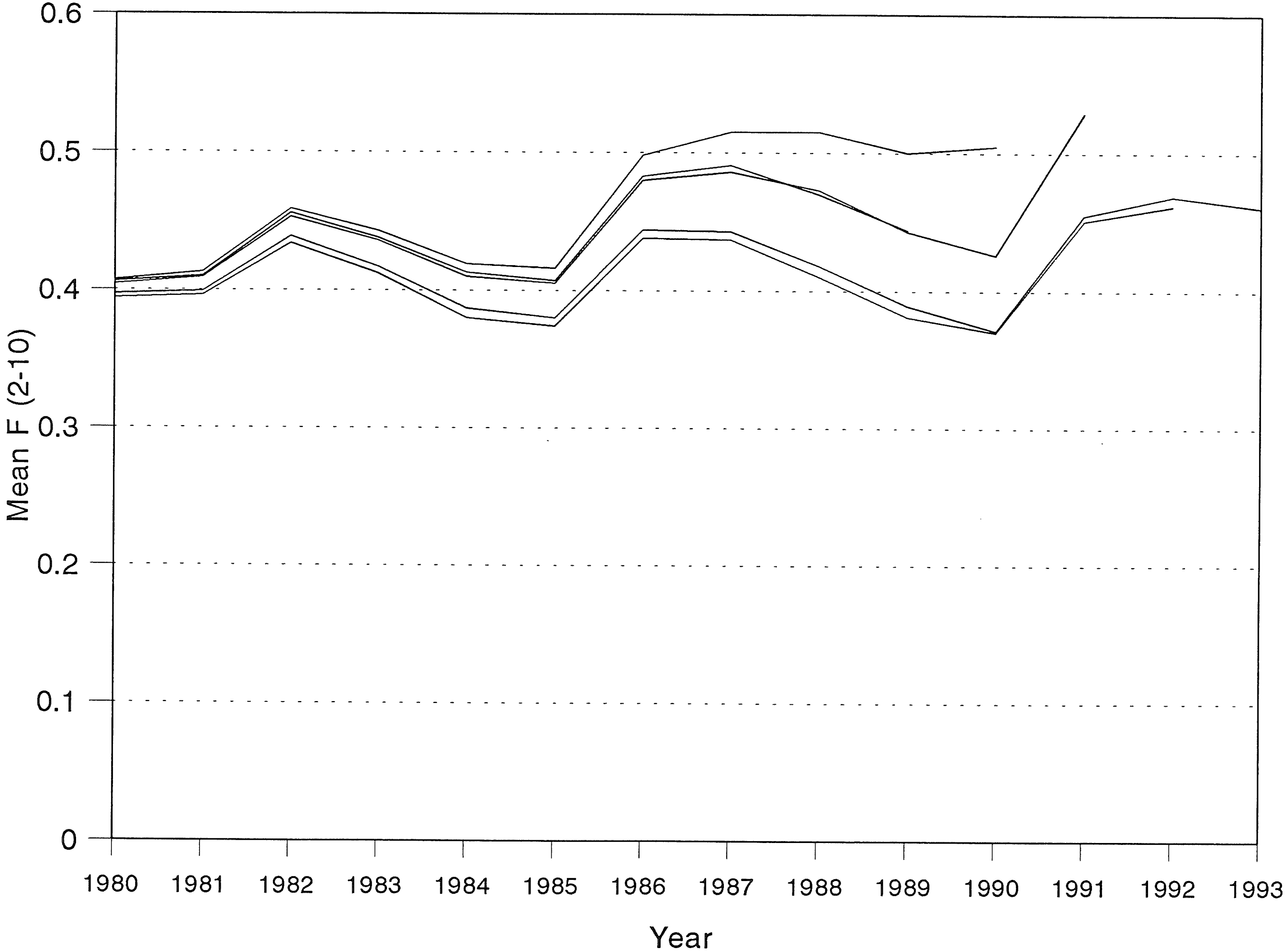


Fig.3.7.6. North Sea plaice: Retrospective analysis
(XSA with 10 yr taper, 10 yr tuning window, F 2-10 unweighted)

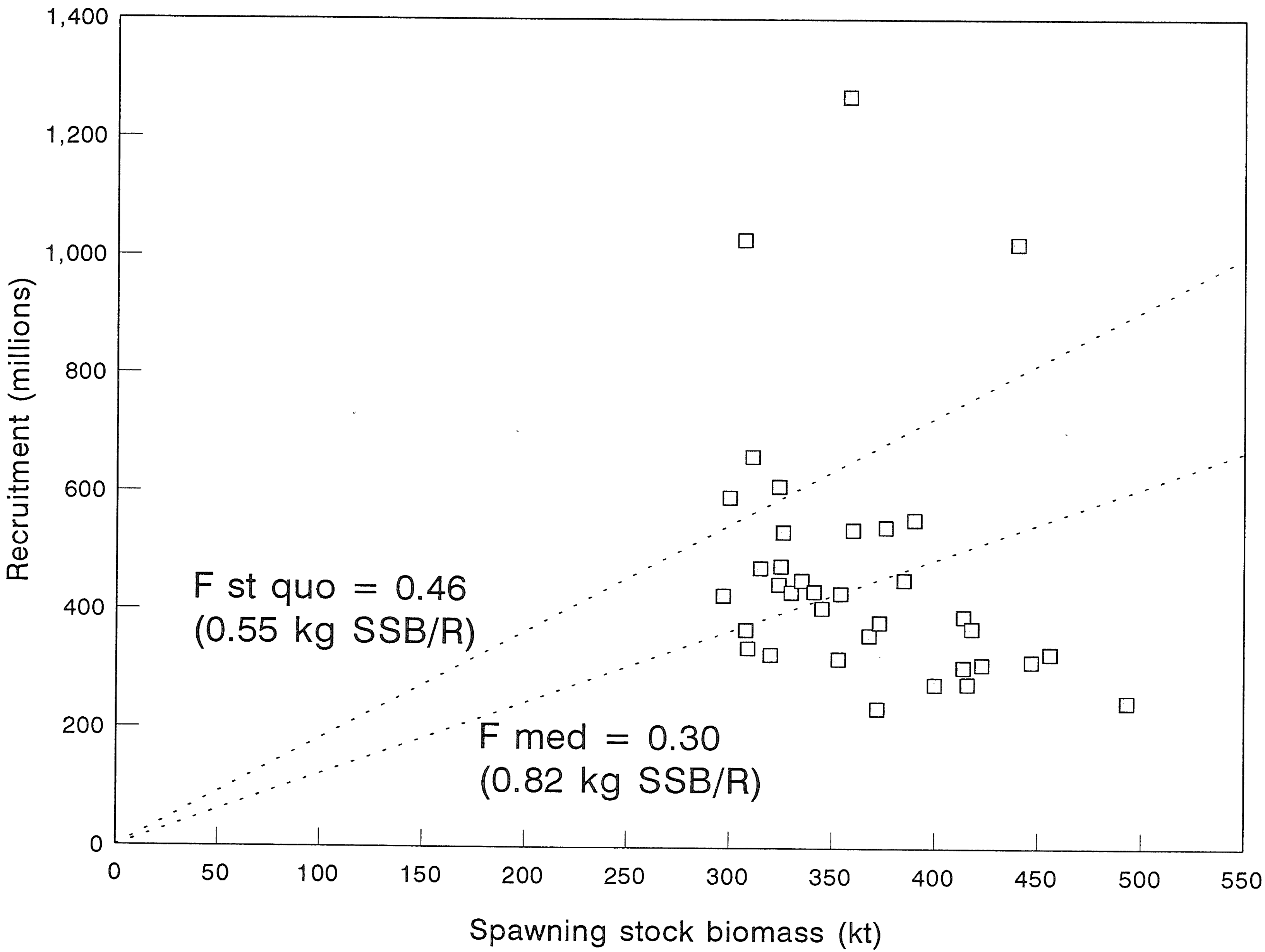
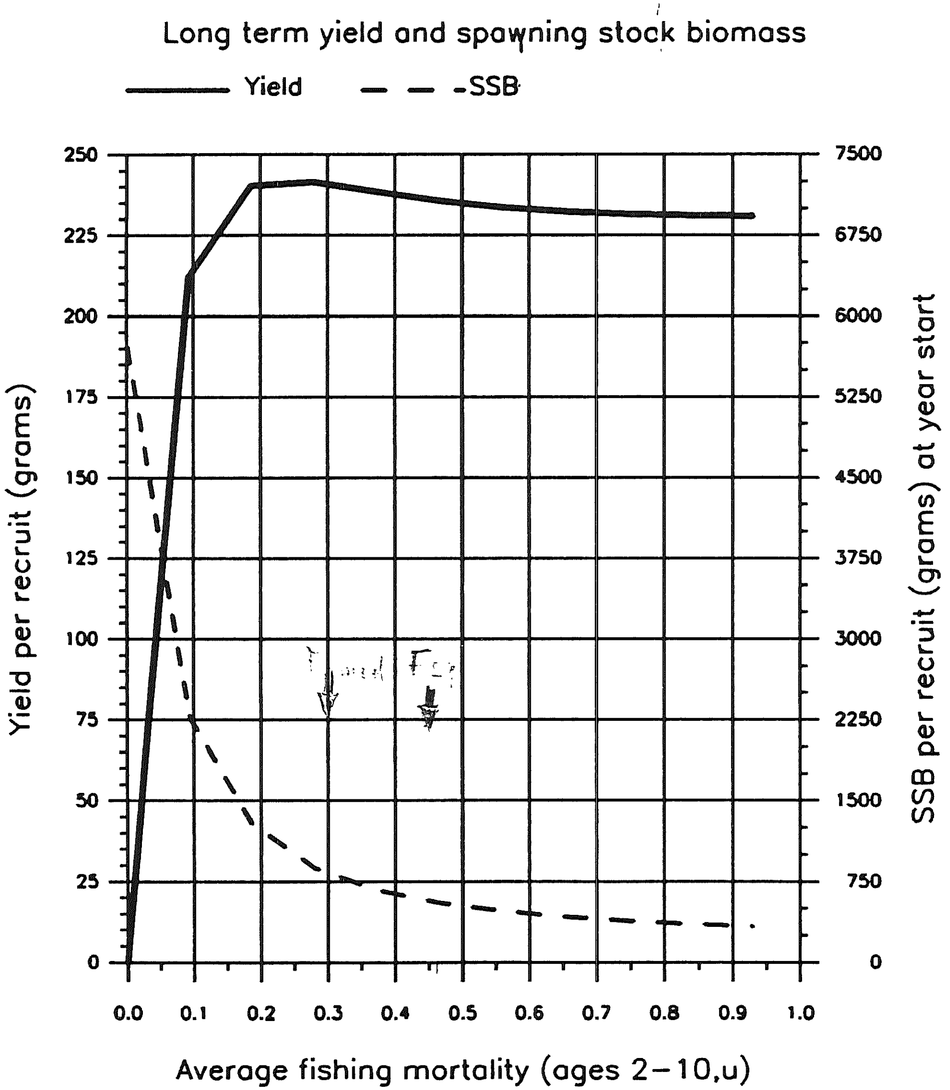


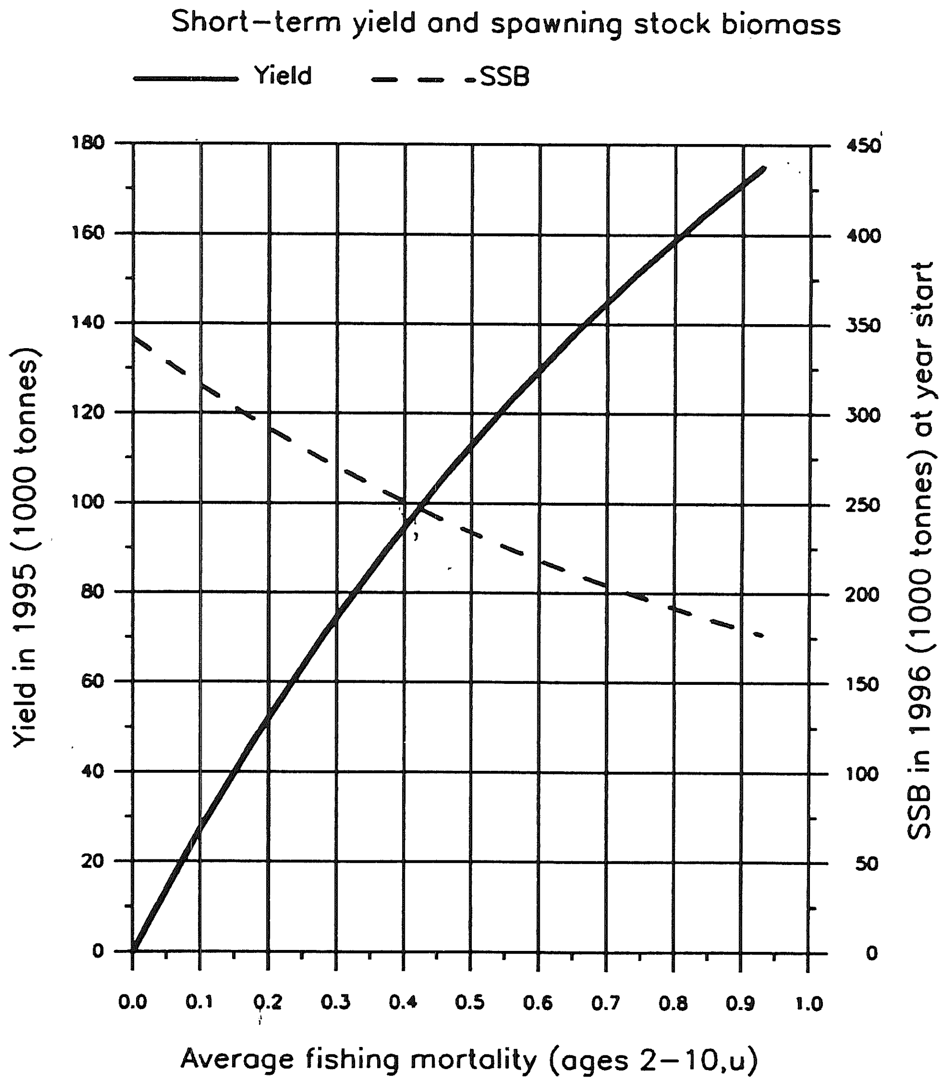
Fig. 3.7.7. NS plaice: stock recruitment plot with dashed lines indicating the levels of F status quo and F med.

Figure 3.7.8

FISH STOCK SUMMARY
STOCK: Plaice in the North Sea (Fishing Area IV)
10–10–1994



(run: AR2) **C**



(run: AR1) **D**

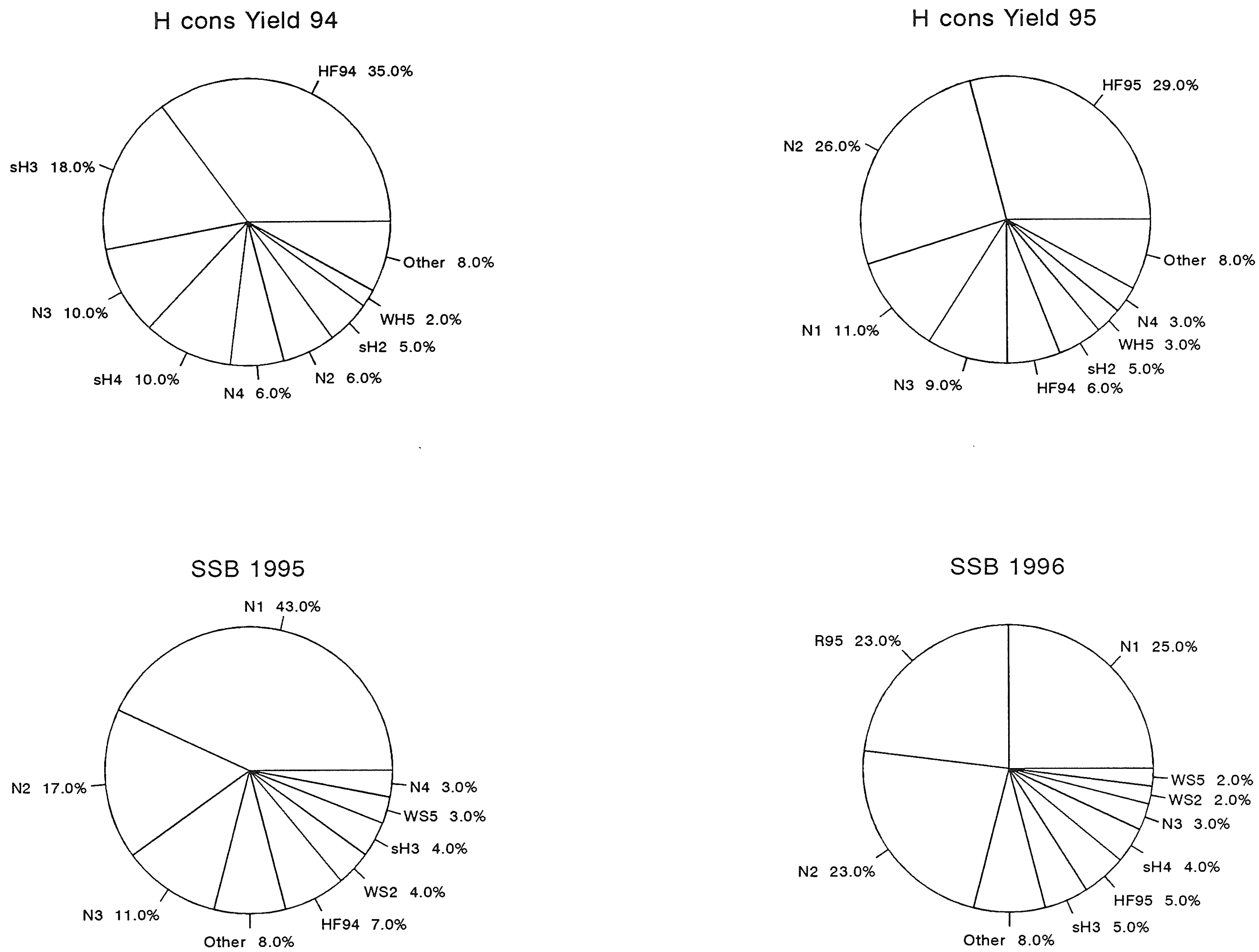


Fig.3.7.9. NS plaice: Sensitivity analysis of short term forecast.

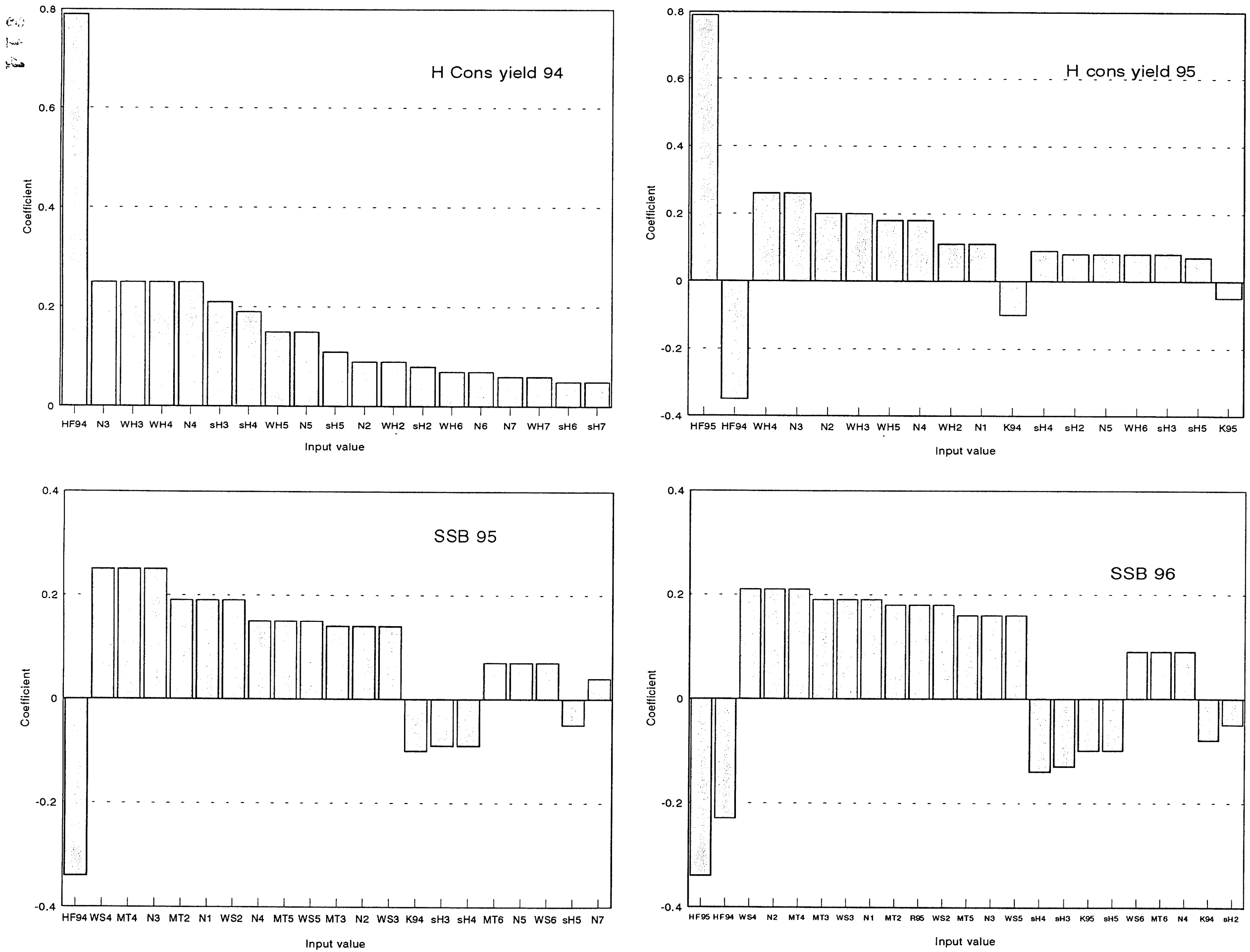


Fig. 3.7.10. I aice: Linear sensitivity coefficients.

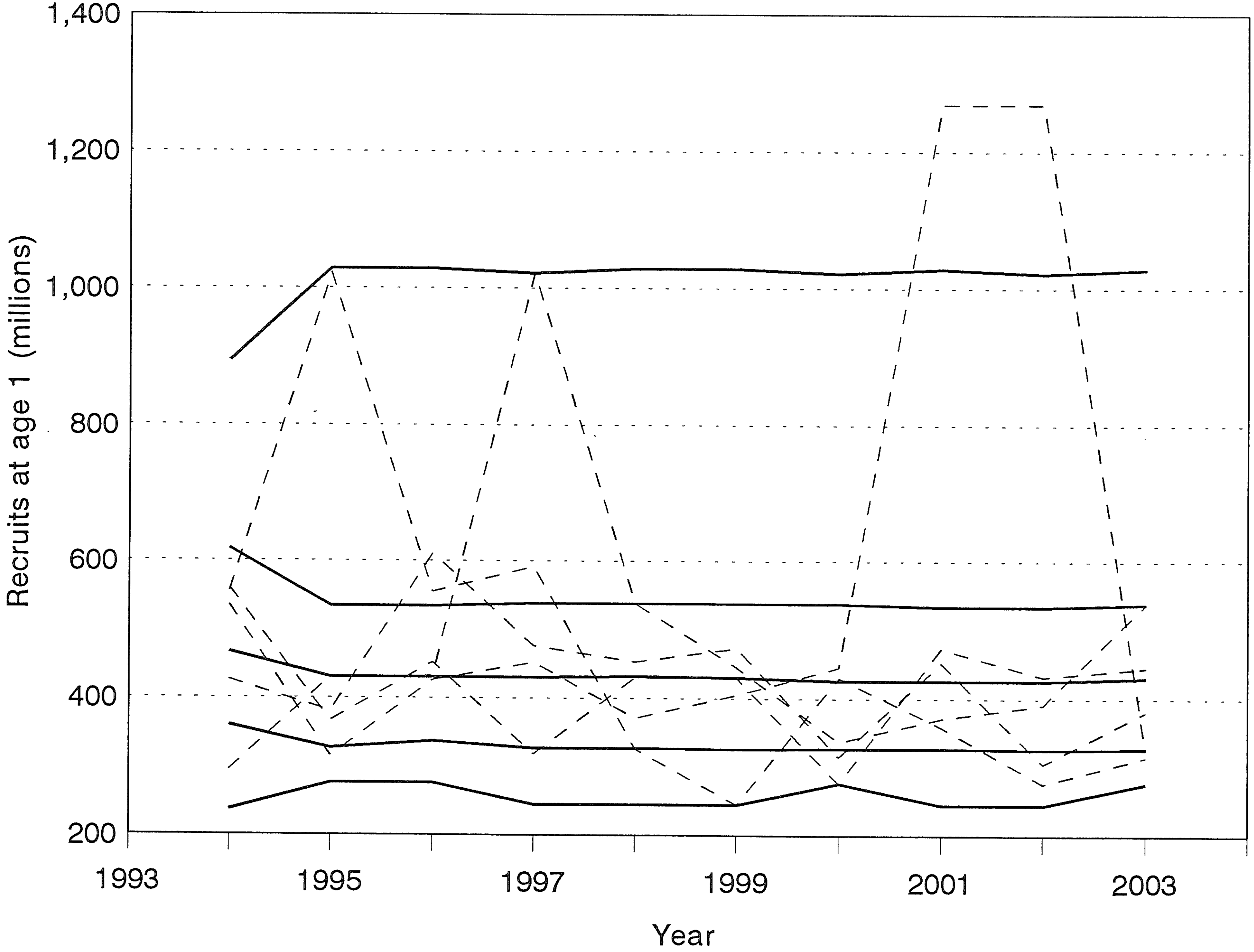


Fig. 3.7.11a. NS plaice. Bootstrapped recruitment simulation. Solid lines show 5, 25, 50, 75, and 95 percentiles. Dashed lines show trajectories of 5 out of 500 simulations.

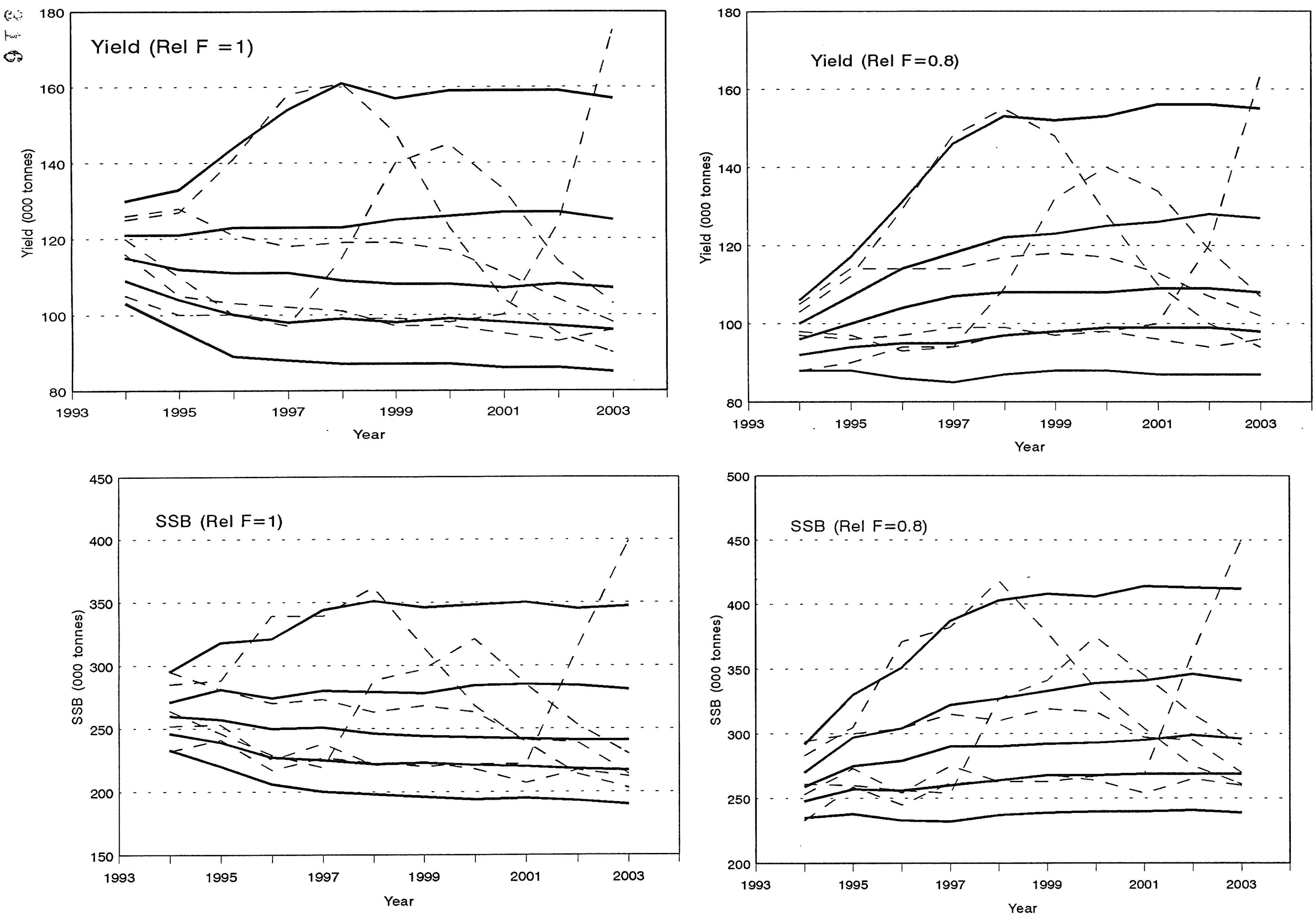
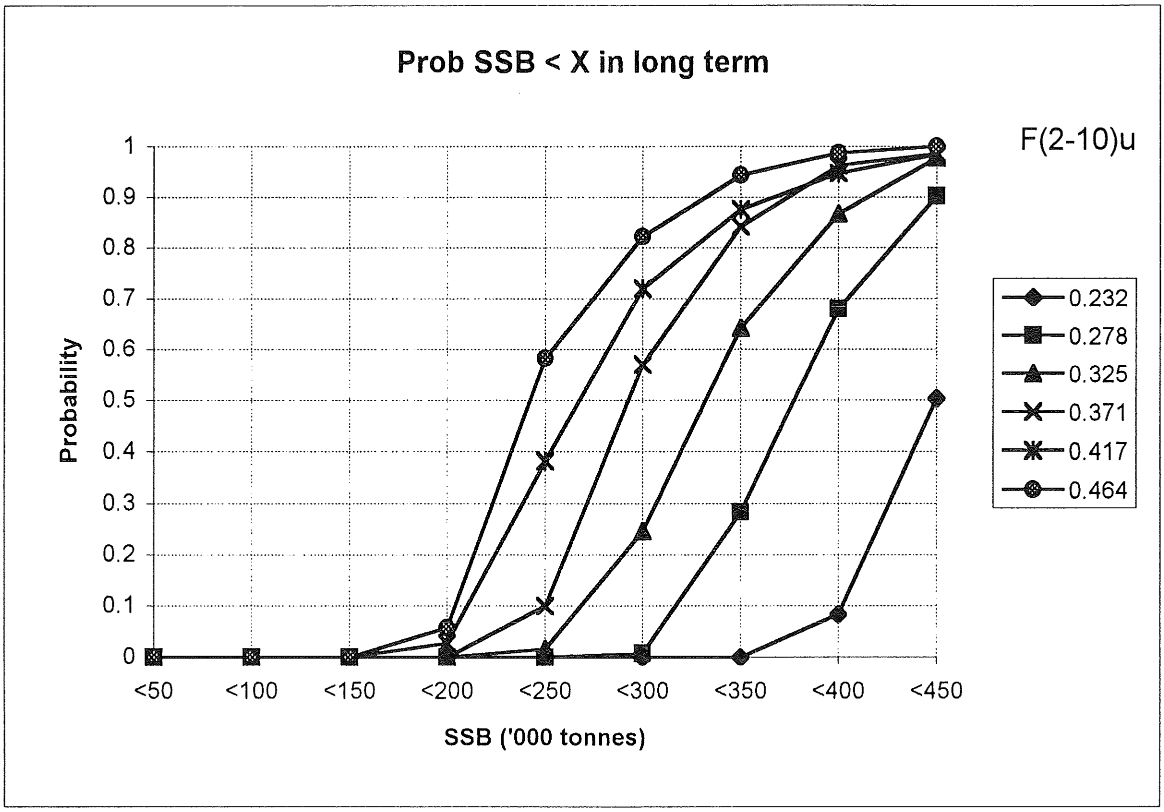
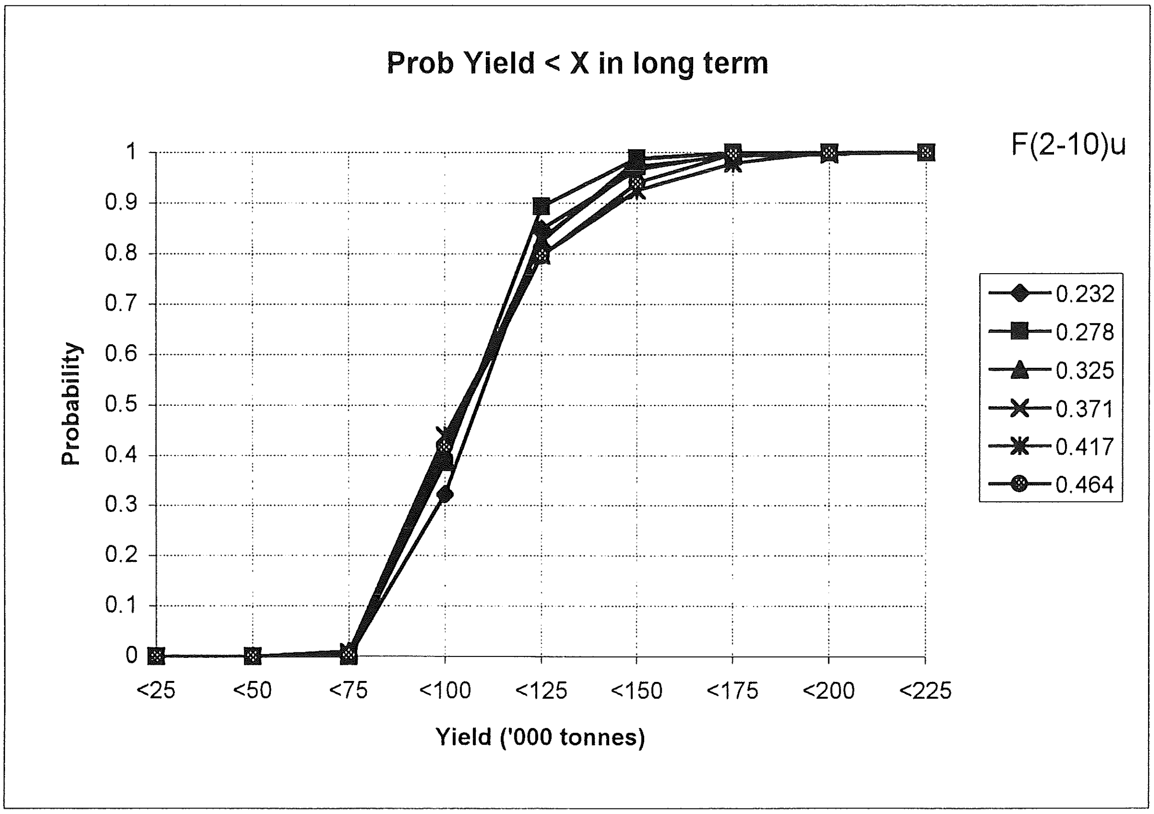
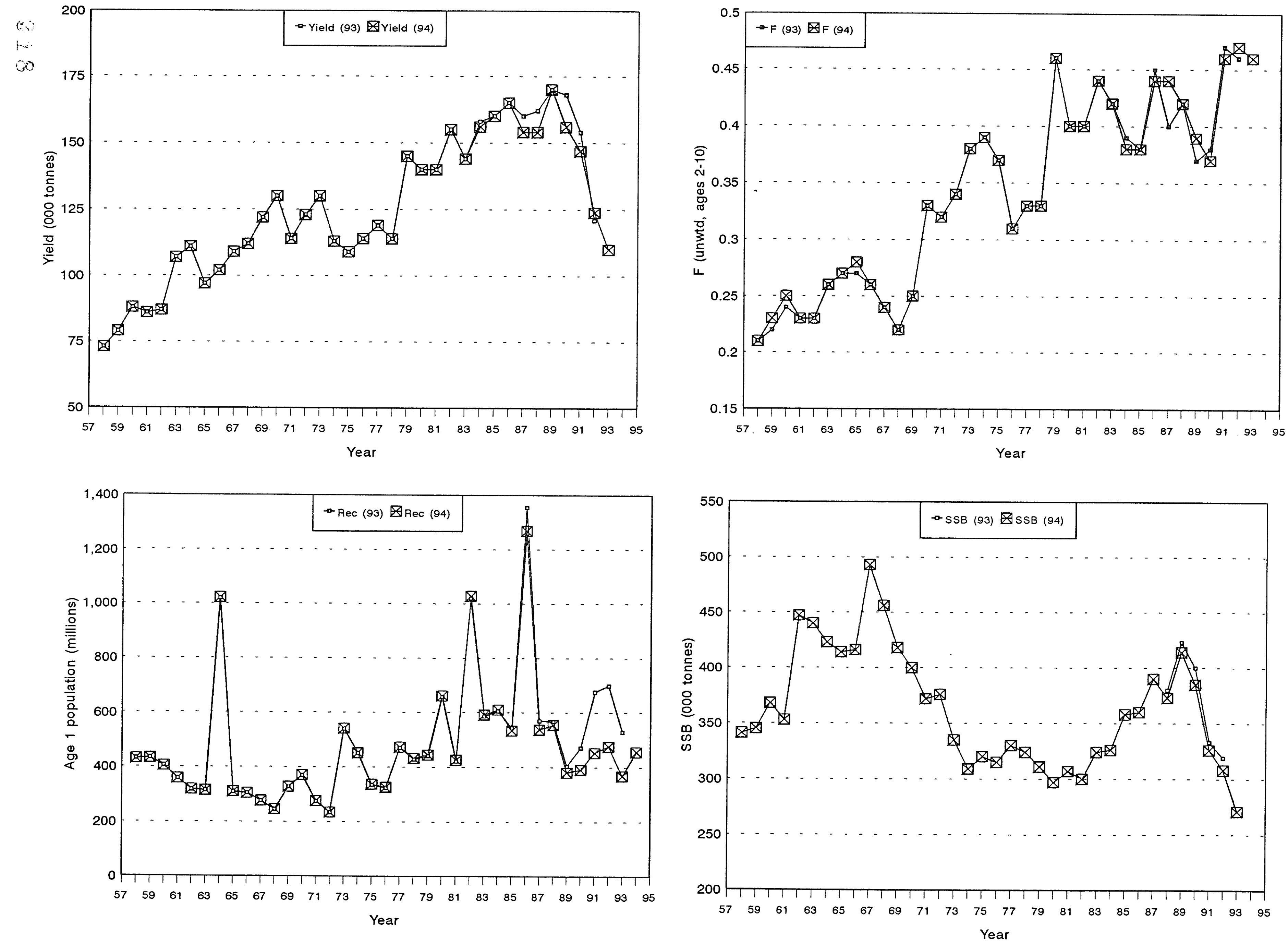


Fig. 3.7.11b. NS plaice: Comparison of medium term simulations using relative F multipliers of 1 (LHS) and 0.8 (RHS). Solid lines are percentiles and dashed lines are 5 simulations out of 500.

Figure 3.7.12 North Sea Plaice







RCT3 estimates were used for the last 3 pts in 93 and the last pt in 94.

Fig.3.7.13. N.S. plaice: Comparison of Yield, F, Recruitment and SSB from the 93 and 94 assessments.

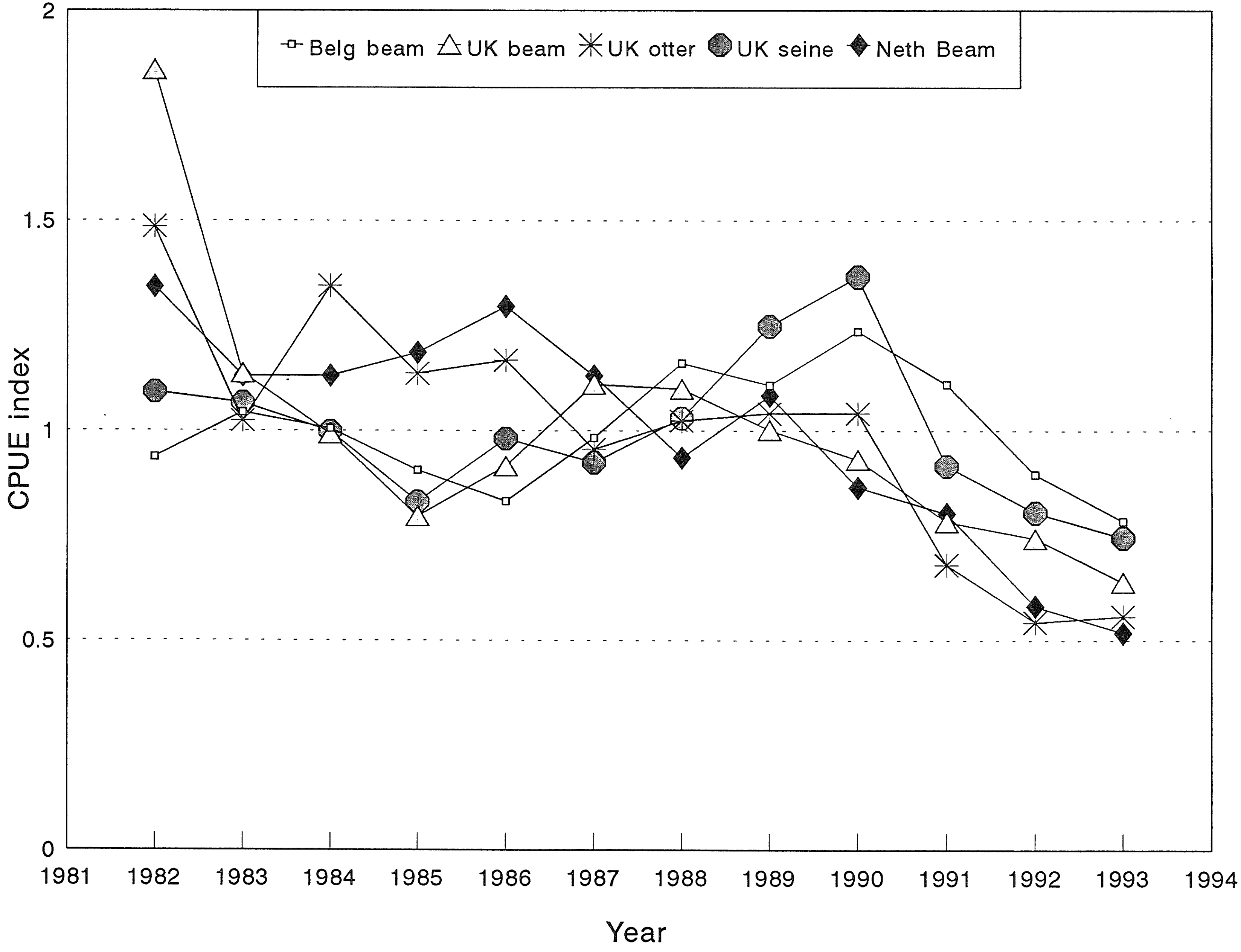


Figure 3.7.14 NS plaice CPUE indices, standardized to their mean.

Figure 3.7.15 North Sea plaice. Trends in CPUE (numbers) of plaice in the "ISIS" BTS survey for age groups 3 and older, 4 plus, 5 plus, 6 plus and 10 plus.

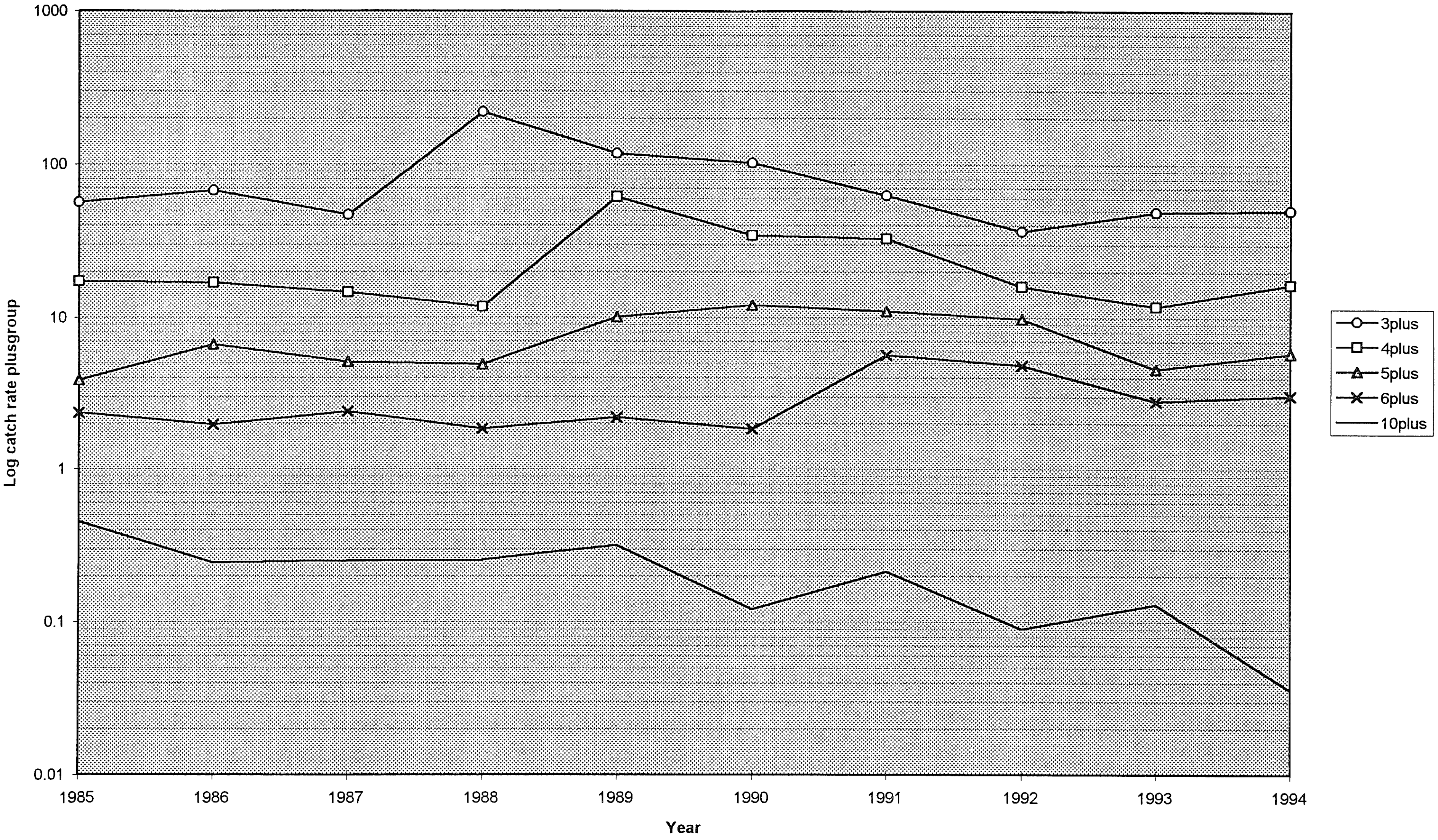


Figure 3.7.16 North Sea plaice. Trends in growth as reflected in the weight-at-age in the catch of the first second quarter.

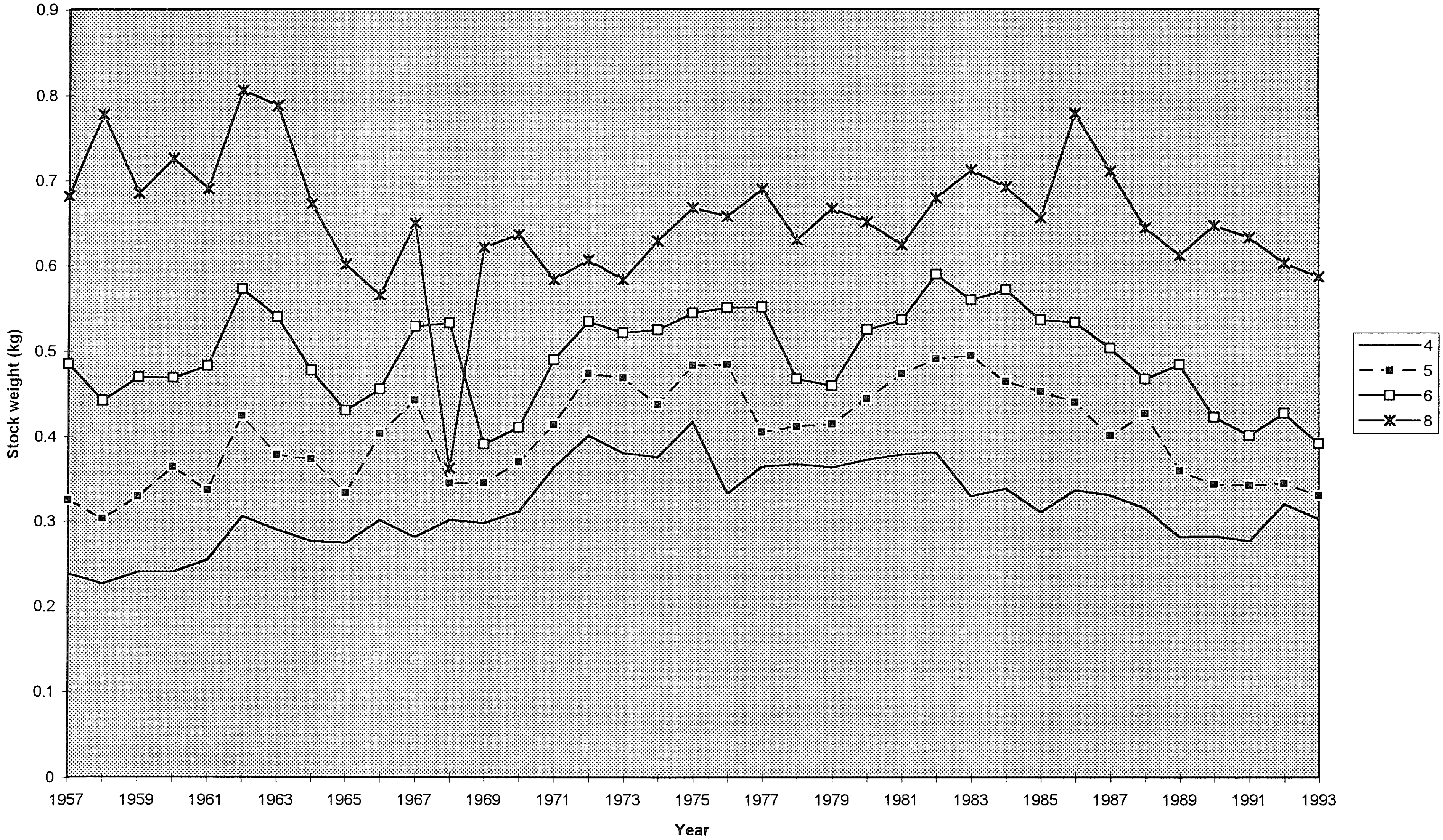


Figure 3.7.17a North Sea plaice. Trends in length of 4 year old females in Dutch catch (14 cm) in first quarter and the log residuale of survey predicted and VPA estimated recruitment

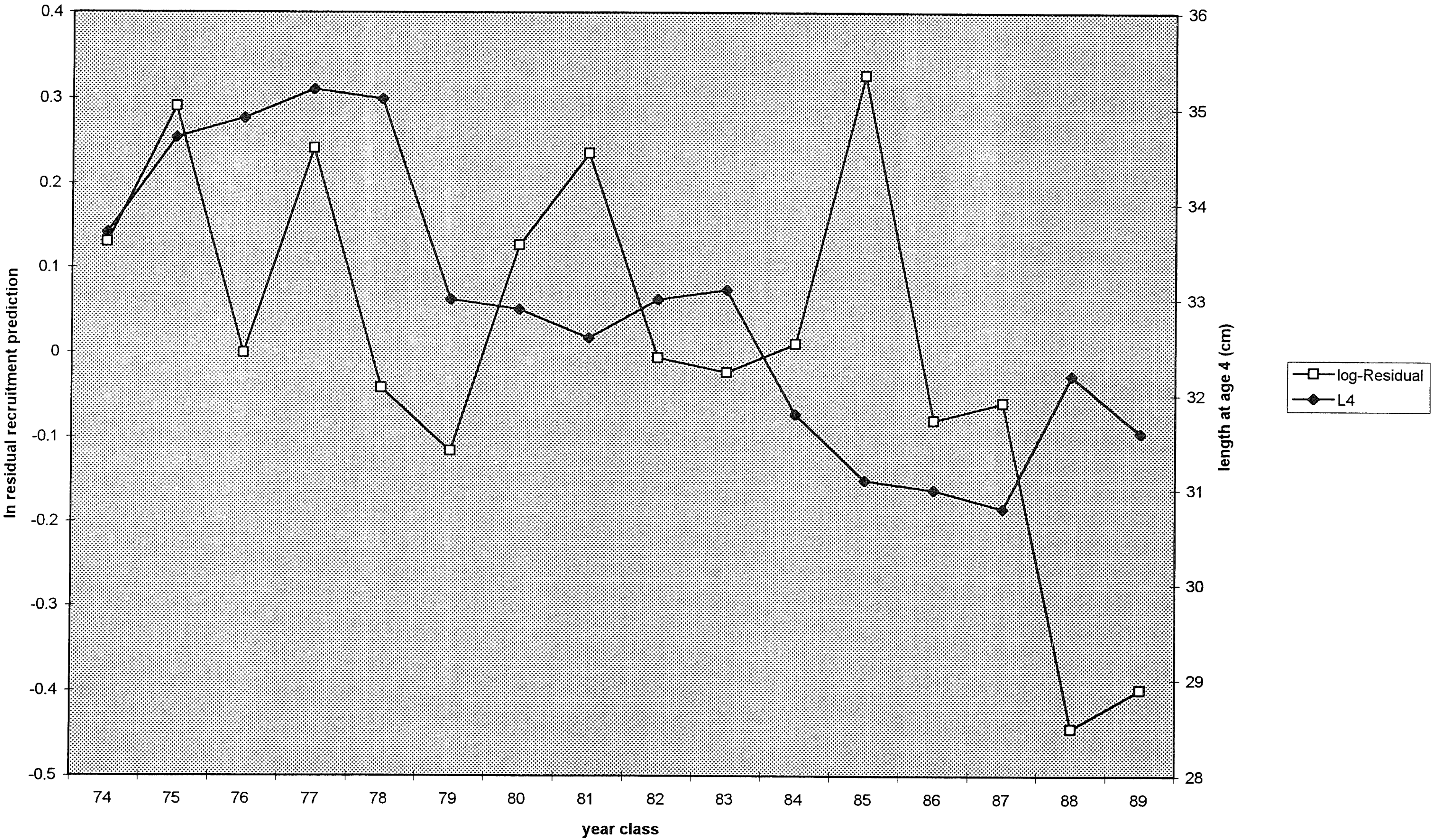
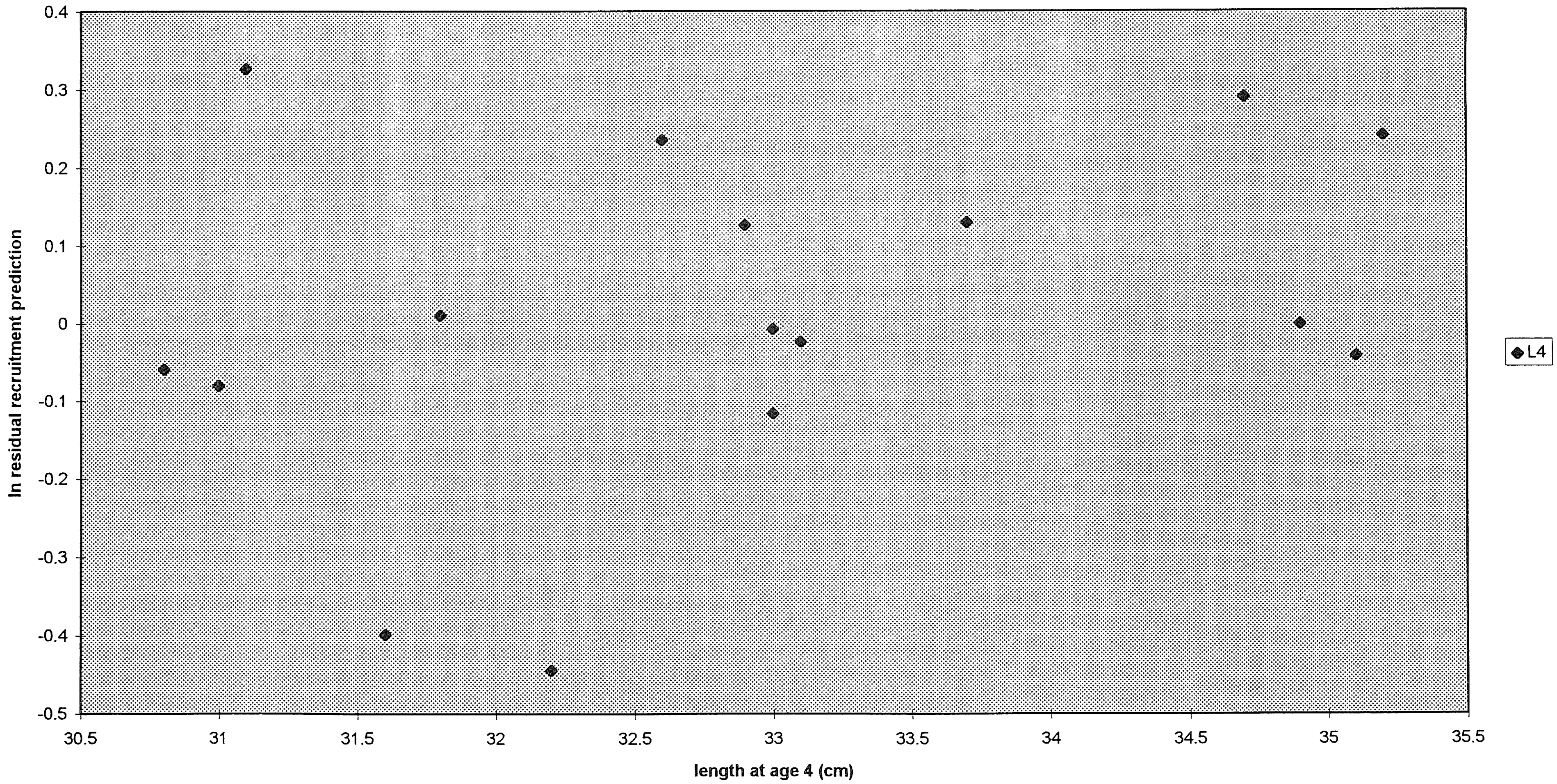


Figure 3.7.17b North Sea plaice. Scatter plot of the log residual of survey predicted and VPA estimated recruitment.



3.8 Controls on Catch and/or Effort

The second term of reference asks for information necessary to give advice on the appropriateness of catch controls or effort restrictions in the North Sea demersal fisheries. This subject overlaps with the responsibilities of managers and the Working Group can only give advice on the scientific aspects of the issue.

3.8.1 Catch controls

TACs have been the principal tool used by mangers to try to control the exploitation rate of North Sea fisheries. In recent years, TACs for the demersal species have been set at levels corresponding to a reduction in fishing mortality rate. The intention, therefore, is to prevent fishing on a stock once a catch limit has been reached. Because catch controls are output controls, they are an indirect control of fishing mortality. In order to be effective they must satisfy the following conditions:

i) The catch prediction on which the TAC is based must be very accurate. Clearly if fishing mortality is to be reduced by, say, 10% then the catch prediction must be of at least this precision.

ii) When a catch limit is reached, the fishery on the stock concerned must be closed almost completely.

iii) The measure needs to be enforceable.

As can be seen in the stock assessment sections, estimates of the precision of forecasts are rarely less than 15% and many are substantially more than this. This arises because it is very difficult to gather data of high enough precision (quite independently of mis-reporting etc). For a number of stocks estimates of recruitment are difficult or impossible to obtain. This is particularly true for North Sea whiting and saithe and since forecasts are highly dependent on recruitment estimates, it means the precision of the forecasts is low. In these conditions, it is virtually impossible to control accurately the exploitation rate through the use of TACs. Imprecision in the forecasts can lead either to the unnecessary premature closure of fisheries or unrestricted fishing.

Both the North Sea roundfish fisheries and flatfish fisheries are mainly mixed fisheries. Thus in protecting one species component of the fishery, it is necessary to set TACs which are exhausted simultaneously so that unwanted by-catch does not occur. Given the problem of precision described above, it is simply not possible in reality to calculate TACs which will all run out at the same time. This means the quota for one stock is likely to lead to a closure while fishing for other species continues. Given that there is an inescapable by-catch of all species in the fishery, and discarding is permitted, this means that no real constraint on fishing mortality can be expected. In most cases the only solution to this is to close the whole fishery once the TAC for one species is taken.

In recent years, North Sea TACs have been set at levels which lead to quota exhaustion before the year end. It is apparent that the nature of enforcement is such that, despite the closure of the fishery, little or no real constraint is placed on the fishery. Fish continue to be caught and are either discarded legally or, more often, landed illegally. Even if enforcement can be improved considerably, it does not appear that TACs will be effective in controlling exploitation rate because they control landings not actual catch which includes discards.

3.8.2 Effort control

Although not precise, fishing effort (as quantified in days fishing for example) is related to fishing mortality in many demersal fleets. Indeed, this relationship underpins much of the analysis in XSA. Hence a control on fishing effort can be regarded as a direct control on fishing mortality. The nature of demersal fisheries is such that they do not change radically from one year to the next. This means that it is easier to obtain adequately precise estimates of the typical exploitation rate needed for management purposes than it is for catch limits. Controlling fishing mortality directly through restrictions on effort is therefore potentially attractive. If effort control is to be effective, the following conditions need to be satisfied:

i) An appropriate measure of effort which is related to fishing mortality needs to be identified. This may be problematic for static gears which take a significant part of the North sea cod catch and even with towed gear the relationship may not be easily defined.

ii) Increases in fishing power or catchability should not compensate for the reduction in effort.

iii) Any restriction must be enforceable.

Some attempts were made in the early 1990s to restrict effort on roundfish by limiting the number of days a fishing vessel could spend at sea. These schemes proved ineffective because, rather than limiting the number of days typically spent at sea, it was the potential number of days that was restricted. Since most vessels spend substantially less than 365 days at sea anyway, the measure proved to be of very limited value. However, if the days at sea limit had been set at a more appropriate level, the measure may have been more successful because it appeared to be enforceable.

A complication worth noting is that the advice to "reduce effort" was interpreted by some managers as an increase in mesh size. The latter of course reduces catchability on certain size classes which may produce a similar reduction in fishing mortality but it is difficult to enforce and can be circumvented by technological innovation.

Restrictions on effort will not have any effect on reducing capacity and may well give a stimulus to increasing effective capacity. Thus effort control cannot be seen as a solution to the problem of over-capacity.

3.8.3 Conclusions

Catch controls in mixed fisheries designed to restrict fishing mortality are unlikely to be effective due to imprecision in assessments and problems of enforcement.

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.

Any measure which does not address the underlying problem of over-capacity is unlikely to be successful in the long run.

3.9 Multispecies and Multi-annual Catch Options

The topic of multispecies and multi-annual catch options has been under discussion for a number of years recently. In particular, it has been discussed in some detail by STCF (Anon, 1992). The Working Group has nothing new to add to that report and what follows simply highlights some of the main points from the report.

3.9.1 Multispecies TACs

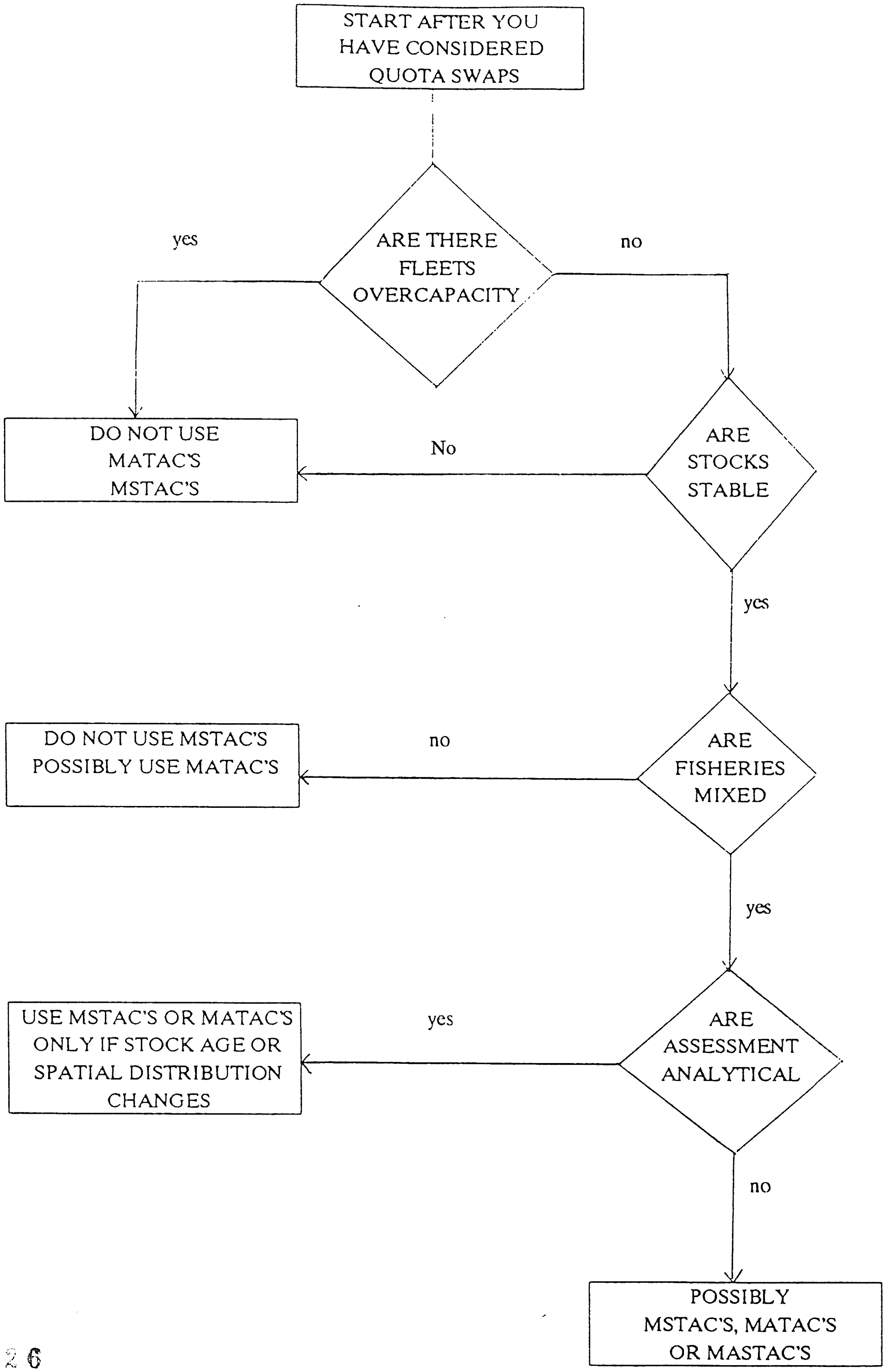
The principal problem with the roundfish and flatfish stocks in the North Sea is that they are already heavily fished and some are seriously depleted. It is generally agreed that there is over-capacity in the fleets and in these circumstances multispecies TACs are inappropriate. This is because individual stocks need to be protected, notably North Sea cod, and multispecies TACs suffer much the same problems as single species TACs as discussed in Section 3.8.1. Aggregating single species TACs without species constraints is potentially dangerous since it offers no direct protection of vulnerable stocks. The STCF report gives a simple decision flow chart for multispecies TACs. The North Sea demersal fisheries clearly are inappropriate for this type of TAC if the flowchart is followed (Figure 3.9.1).

3.9.2 Multi-annual TACs

There are broadly two views on the interpretation of multi-annual TACs. Either one may seek to set in advance a specific figure for a TAC or one may simply decide to set a TAC corresponding to a predetermined rule but based on the latest assessment. It is obvious that for the North sea demersal stocks the level of exploitation and ability to predict recruitment prevents any useful forecast on which a TAC could be based for more than two years ahead of the data. Thus only the second option, basing the TAC on a decision rule, is a viable option and this could clearly be done if the rule can be specified.

The argument above tends to assume that TACs would remain the principal tool used to regulate fishing mortality rate. If an effective control was placed on fishing effort or fishing capacity to the extent that fishing mortality was reduced to a level where the risks to the stock were lower, then the use of multi-annual TACs could be quite different and they might be a useful way of allocating resources to fleets. However, that is a very different view of the use of TACs from that currently in operation.

Figure 3.9.1


START AFTER YOU HAVE CONSIDERED QUOTA SWAPS
ARE THERE FLEETS OVERCAPACITY
yes
no
DO NOT USE MATAC'S MSTAC'S
No
ARE STOCKS STABLE
yes
DO NOT USE MSTAC'S POSSIBLY USE MATAC'S
no
ARE FISHERIES MIXED
yes
USE MSTAC'S OR MATAC'S ONLY IF STOCK AGE OR SPATIAL DISTRIBUTION CHANGES
yes
ARE ASSESSMENT ANALYTICAL
no
POSSIBLY MSTAC'S, MATAC'S OR MASTAC'S

3.10 Analysis of Survey Data for North Sea Roundfish

3.10.1 Introduction

In recent years there has been an increasing problem of mis-reporting and non-reporting of catches to the extent that it is problematic to judge the validity of many assessments. This is particularly true of the North Sea roundfish. It is desirable to make an assessment which is independent of the catch data to see if the conventional assessments are reliable. In order to do this survey data have been analyzed to estimate recent trends in spawning stock biomass and fishing mortality.

3.10.2 Analytical method

The method used to analyze the survey data is a variant on the well known separable model. This was used to try to remove some of the noise in the survey data which is known to be large. The model assumes that fishing mortality is a simple multiple of a year effect and an age effect ie;

$$F_{a,y}=s_a f_y \qquad (1)$$

where s is the selectivity at age a and f is the year effect in year y. The population N at time $t+1$ can then be written as;

$$N_{a,+1,t+1}=N_{a,t}e^{-(F_{a,t}+M_a)} \qquad (2)$$

If survey catchability is constant with age then the populations in (2) can be replaced by a survey index I. Recruitment at the youngest age, the selectivities and year effects can then be estimated by minimising the sum;

$$\Sigma\left(\log(\overline{I}_{a,y})-\log(I_{a,y})\right)^2 \qquad (3)$$

Where catchability is not constant with age it is easy to show that the effect is to lead to bias in the estimated selectivity. This does not matter if the main purpose of the analysis is to estimate relative changes in spawning stock size or fishing mortality from year to year.

The model was used to analyze data from the International Young Fish Survey (IYFS) the Scottish Groundfish Survey (SGFS) and the English Groundfish Survey (EGFS) using the program RCCPUE. After fitting the model, the fitted indices were used to estimate SSB using the maturity ogives and weights at age given in the main assessment of each species. In order to plot the results from each survey on the same scale, each time series was scaled to the mean of the series.

3.10.3 North Sea cod

Results of fitting the model to the years 1983-1994 are shown in Figure 3.10.1. It can be seen that the trend in SSB from the surveys follows very closely the trend obtained from the conventional VPA. This indicates that for the period up to 1993, estimates of SSB do not appear to be distorted by problems in the catch data. For the estimates of mean F there is little apparent trend though the surveys possibly suggest a decrease in F. The estimates of F from the surveys are clearly very noisy and not precise enough to determine anything but gross trends.

3.10.4 North Sea haddock

The results for haddock are shown in Figure 3.10.2. Like the cod, the results for trends in SSB are encouraging with a close agreement between the surveys and the VPA. The estimates of mean F are very variable but are not inconsistent with the VPA.

3.10.5 North Sea whiting

For whiting the results are more disturbing. Figure 3.10.3 Shows the trends for the SSB and mean F. The IYFS and SGFS show a similar trend of increasing SSB up to the early 1990s and then a recent decrease. The VPA on the other hand, suggests the SSB has been more or less constant. The EGFS is intermediate between the other two surveys and the VPA. Clearly there is an inconsistency between the survey data and VPA. This is not surprising in view of the very low correlations between the survey indices and the VPA seen in the RCT3 analysis (Section 3.4).

The analysis of whiting was extended further to see if it was possible to get a complete assessment based on survey data. RCCPUE is programmed to accept only one survey. Consequently, the three survey indices were combined using factor analysis using the program MLFACT. This calculates the underlying common factor between the survey indices by maximum likelihood. The combined indices are given in Table 3.10.1. These data were then analysed using RCCPUE. The complete set of input data is given in Table 3.10.1. When fitting the model, low weight was given to the youngest age group as these are not sampled well by all the surveys. The results of fitting the model are shown in Table 3.10.2. Although the coefficient of determination is high the estimated standard deviations of the parameters are high.

Table 3.10.3 shows the estimated fishing mortalities and stock sizes estimated from the model. A negative F is estimated for the one year olds because these fish clearly have a lower catchability than older fish. Using these estimates, and the maturity and weight at age data in Table 3.10.1, indices of fitted catch, and SSB were calculated. These along with mean F and recruitment are plotted in Figure 3.10.4. In all cases the values have been scaled to the mean of the period 1983-1993. The comparable VPA values have been shown. By combining the indices some of the noise seen in Figure 3.10.3 is removed. The differing trends between the surveys and the VPA are retained, however. Despite the obvious differences, there are also some similarities, especially in the period 1987-1991. It appears that the total catch data in the early period are discrepant because the pattern of recruitment is consistent but the Fs and SSB arising from the analysis are not. The very large divergence between the survey Fs and the VPA Fs is particularly notable. Unfortunately it is not possible to determine which trend is more realistic.

Table 3.10.1. North Sea Whiting. Input data used in RCCPUE analysis of survey indices.

Source data

Age	M	Prop.mat.	wt
1	.95	.11	.8000
2	.45	.92	1.6000
3	.35	1.00	2.3000
4	.30	1.00	2.7000
5	.25	1.00	3.1000

Combined survey indices

Age	1983	1984	1985	1986	1987	1988
1	12943.0	20968.0	19046.0	21089.0	24548.0	19988.0
2	9844.0	8951.0	11244.0	9377.0	11719.0	12705.0
3	2508.0	2265.0	1915.0	3347.0	2241.0	4223.0
4	2100.0	877.0	788.0	518.0	1295.0	774.0
5	505.0	490.0	290.0	138.0	220.0	239.0

Age	1989	1990	1991	1992	1993	1994
1	33209.0	22125.0	28485.0	27771.0	29590.0	25523.0
2	10607.0	13429.0	11219.0	12023.0	11731.0	11234.0
3	5028.0	3380.0	5269.0	3854.0	3743.0	3110.0
4	1706.0	2080.0	1018.0	2974.0	1332.0	1026.0
5	218.0	354.0	358.0	361.0	664.0	302.0

Relative weight applied by age

Age	Rel.wt
1	.1000
2	1.0000
3	1.0000
4	1.0000
5	1.0000

Table 3.10.2. North Sea Whiting. Fitted parameter estimates from RCCPUE analysis.

Number of observations= 60

Number of parameters = 30

Coefficient of determination = .9927

	Parameter	s.d.
year effects		
	1.0000	.0000
	.9051	.1915
	1.1911	.1934
	.7570	.1493
	1.0663	.1812
	.7197	.1495
	.9289	.1666
	.9584	.1698
	.5425	.1364
	.8800	.1629
	1.1025	.1855
age effects		
	-.2436	.1639
	.7916	.1207
	.7936	.1232
	1.1873	.1579
y/c effects		
	6.2246	.1516
	7.6657	.1331
	7.9785	.1158
	9.0230	.1122
	9.6004	.1884
	10.1574	.1776
	9.5649	.2117
	10.2961	.1607
	10.2284	.1962
	10.0048	.1563
	10.4972	.1798
	9.9263	.1836
	10.1784	.1412
	10.1093	.1805
	10.0343	.2191
	10.1473	.4795

Table 3.10.3. North Sea whiting. Estimated fishing mortality and numbers at age from RCCPUE analysis.

F-at-age

Age	1983	1984	1985	1986	1987	1988
1	-.2436	-.2204	-.2901	-.1844	-.2597	-.1753
2	.7916	.7164	.9428	.5992	.8441	.5697
3	.7936	.7183	.9453	.6007	.8463	.5712
4	1.1873	1.0746	1.4142	.8987	1.2660	.8544

Age	1989	1990	1991	1992	1993
1	-.2262	-.2334	-.1321	-.2143	-.2685
2	.7353	.7586	.4294	.6966	.8727
3	.7372	.7606	.4305	.6984	.8750
4	1.1029	1.1379	.6441	1.0448	1.3090

Std. Dev of F-at-age

Age	1983	1984	1985	1986	1987	1988
1	.1207	.1443	.1796	.1143	.1615	.1101
2	.1232	.1067	.1227	.1006	.1183	.1007
3	.1579	.1057	.1270	.1130	.1196	.1087
4	.1516	.2656	.2922	.2112	.2692	.2083

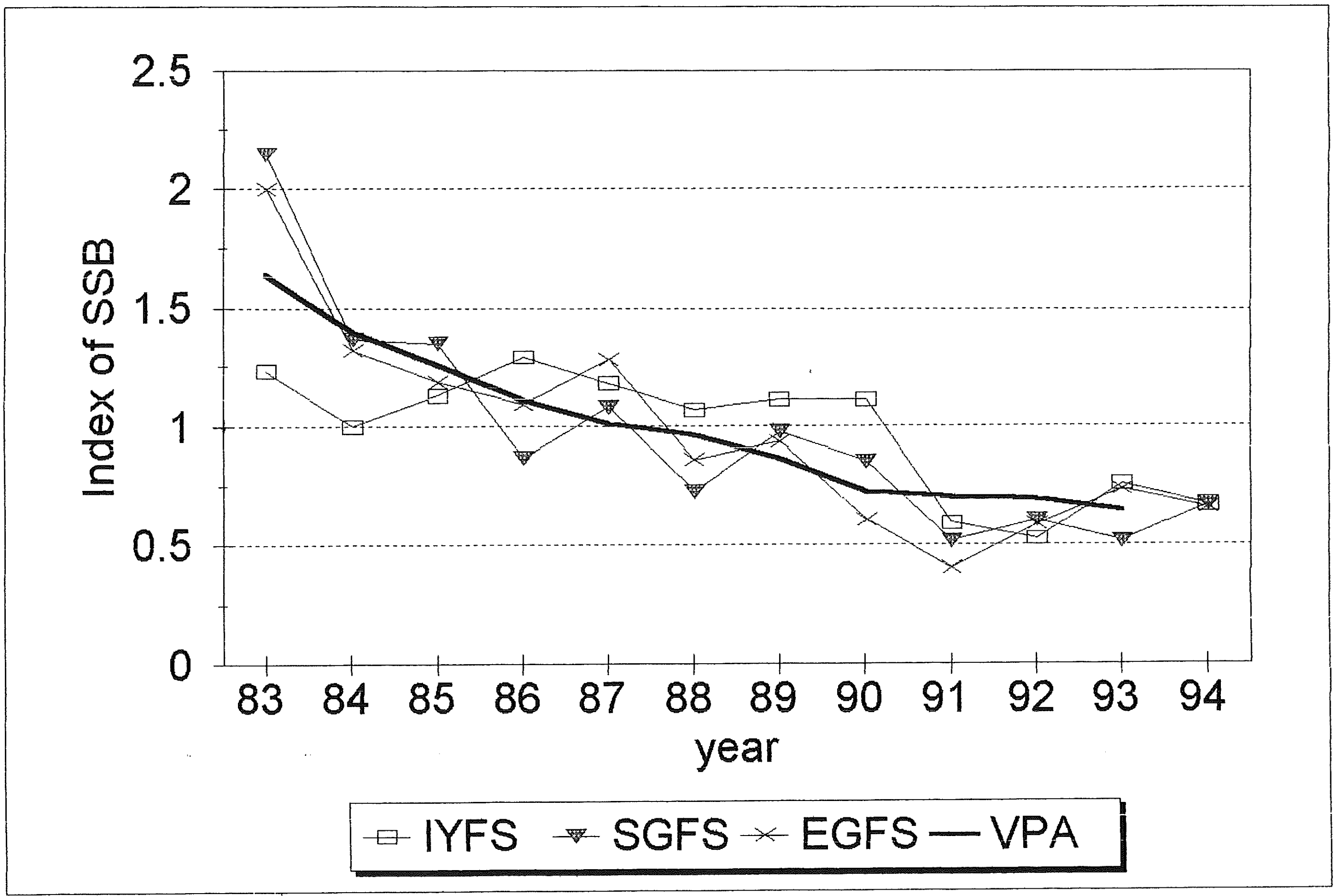
Age	1989	1990	1991	1992	1993
1	.1406	.1451	.0853	.1333	.1661
2	.1100	.1106	.0977	.1094	.1179
3	.1153	.1174	.1022	.1128	.1259
4	.2428	.2485	.1817	.2349	.2765

Fitted N-at-age

Age	1983	1984	1985	1986	1987	1988
1	14771.3	25782.0	14256.2	29616.9	27678.2	22132.5
2	8292.0	7288.1	12430.1	7369.1	13773.0	13878.8
3	2917.5	2395.8	2270.1	3087.2	2580.9	3775.9
4	2133.9	929.7	823.2	621.6	1193.1	780.2
5	505.0	482.2	235.2	148.3	187.5	249.2

Age	1989	1990	1991	1992	1993	1994
1	36214.4	20461.5	26329.5	24570.9	22794.2	25523.0
2	10199.4	17561.4	9993.9	11621.0	11774.1	11531.0
3	5006.3	3117.5	5243.9	4147.8	3692.2	3136.8
4	1503.1	1687.9	1026.8	2402.6	1453.8	1084.6
5	246.0	369.6	400.8	399.5	626.1	290.9

Figure 3.10.1 Cod North Sea. Estimated trends in spawning stock biomass and mean F from surveys.



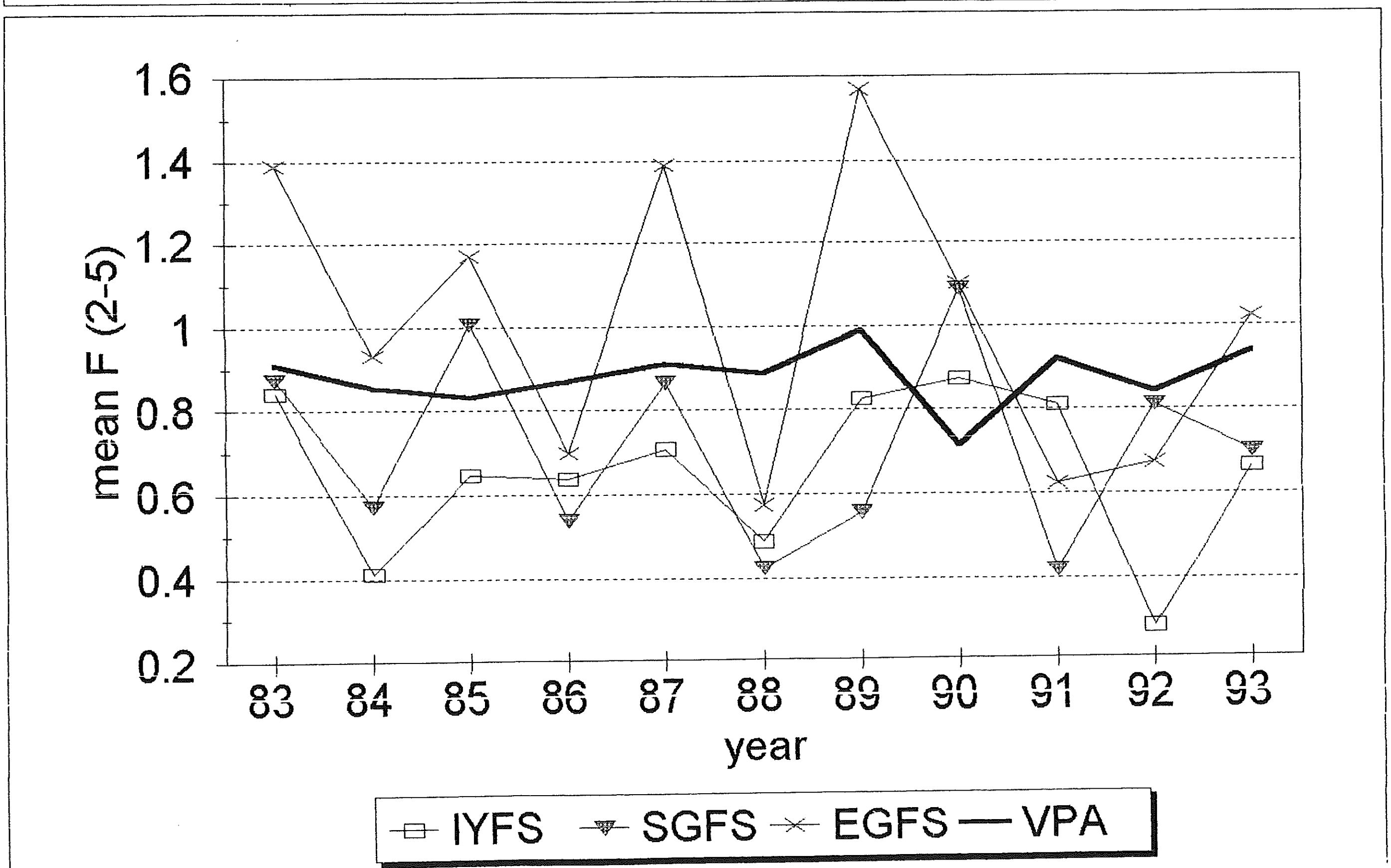
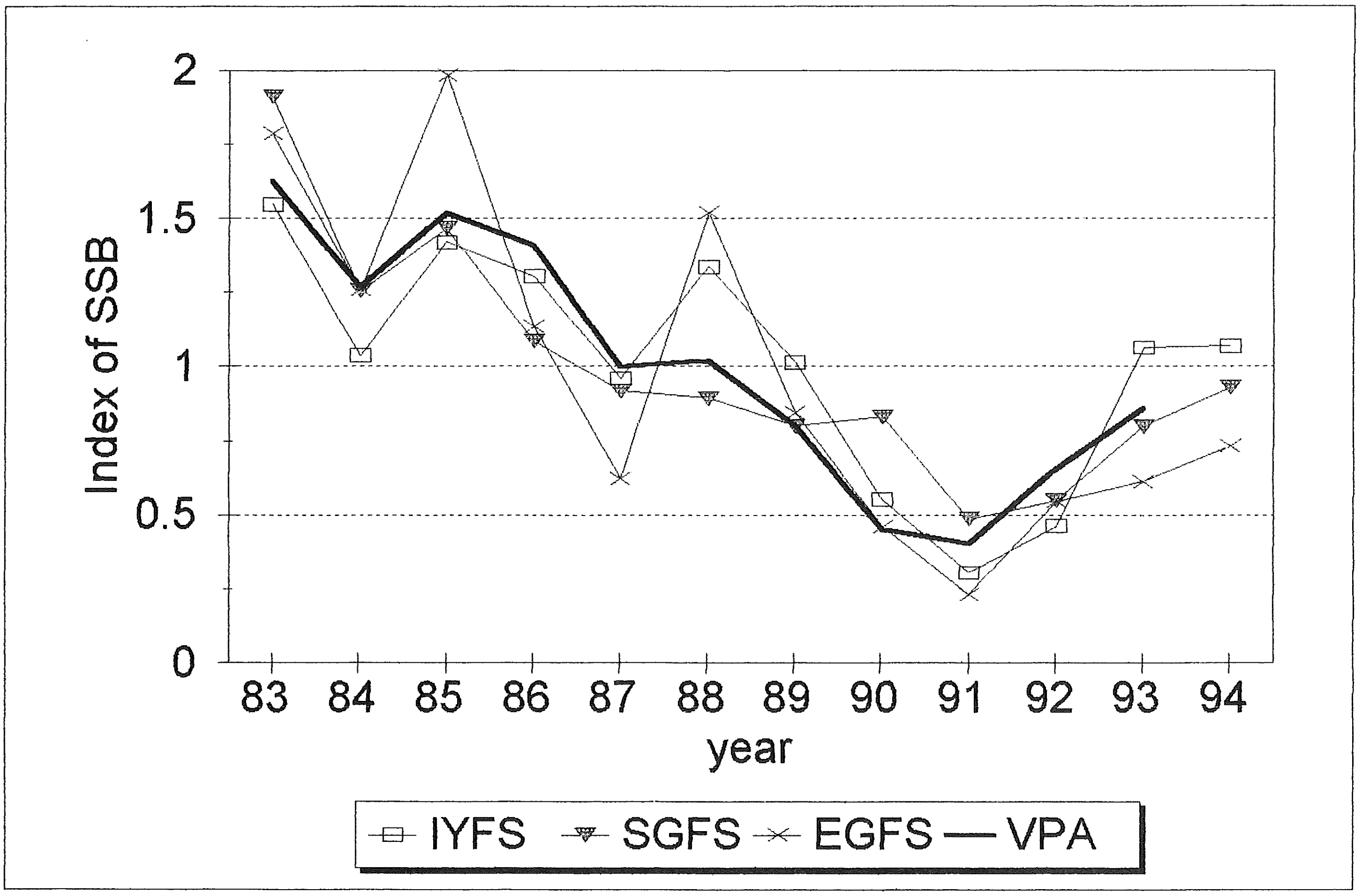


Figure 3.10.2 Haddock North Sea. Estimated trends in spawning stock biomass and mean F from surveys.



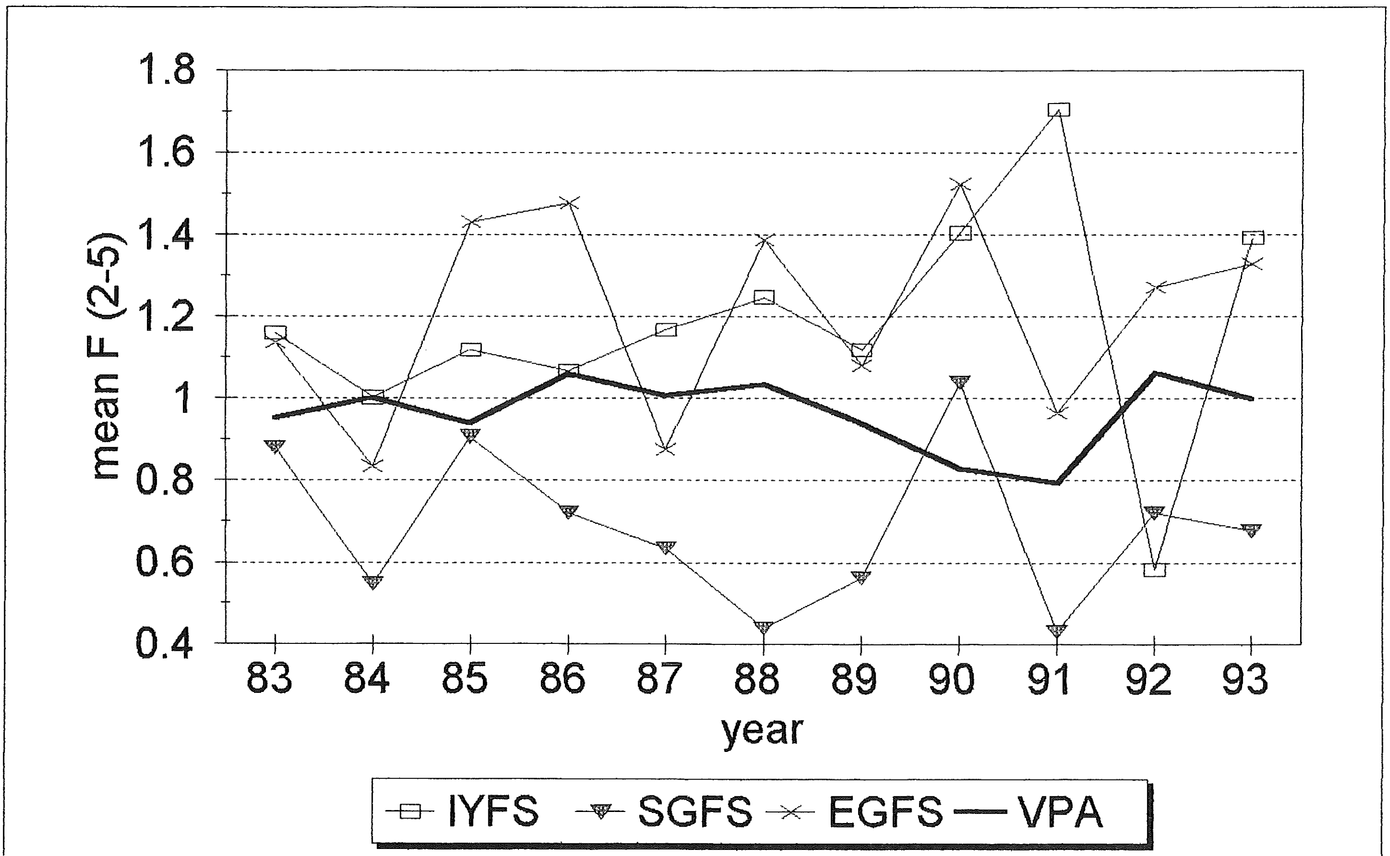


Figure 3.10.3 Whiting North Sea. Estimated trends in spawning stock biomass and mean F from surveys.

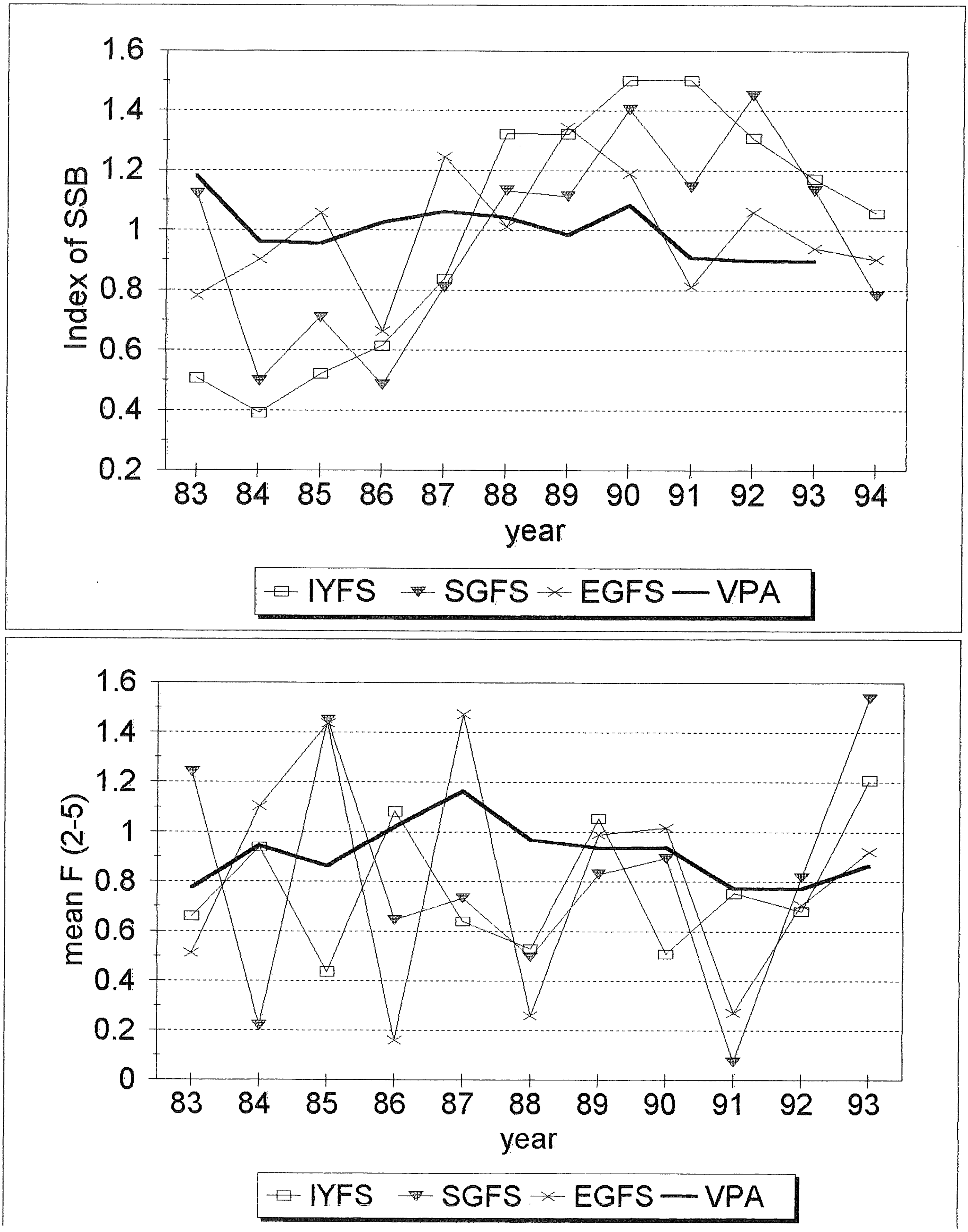
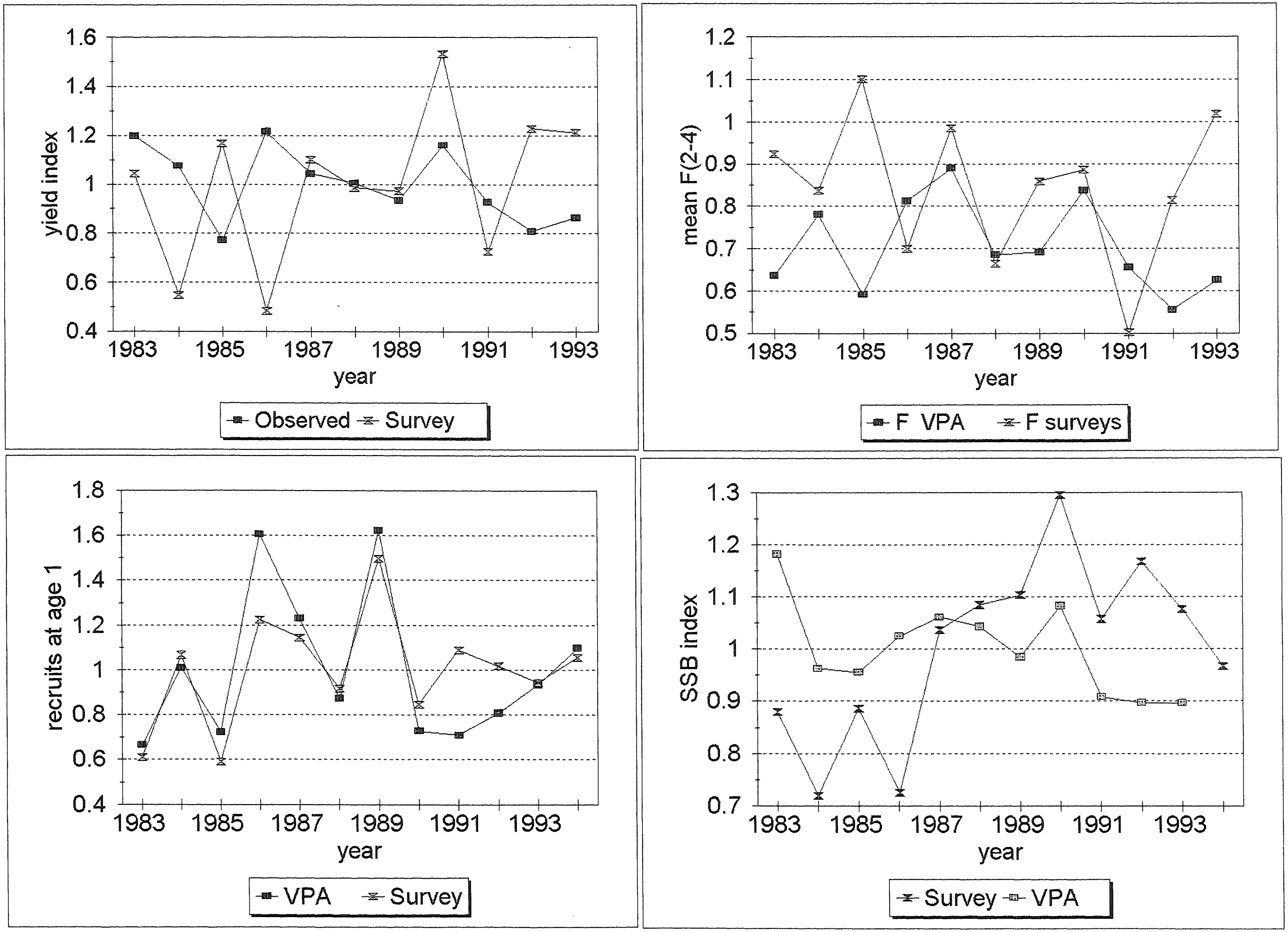


Figure 3.10.4 Whiting North Sea. Stock trends estimated from surveys. All values are scaled to the long term mean.



4 DEMERSAL STOCKS IN DIVISION VIID

4.1 Overview

The database for both cod and whiting remains poor with uncertainties over the level of landings and no information on discards. Data on sole and plaice has improved since 1986 for sole and 1989 for plaice with landings from all countries being sampled for age. However, no discard data is available for either of the flatfish stocks.

Analytical assessments were carried out on all four stocks. In the case of both cod and whiting, tuning was based on only one commercial fleet and the there were large SEs on population regression indicating problems with the database for both stocks. There was no recruitment estimate for cod and only a 3-year index available for whiting from the French groundfish survey in VIId. Survey indices were available for 0,-1- and 2-group sole and plaice.

The SSB of cod remains near its historical minimum and recruitment since 1985 has been poor although there are indications from inshore fisherman that the 1993 year class may be relatively abundant. Fishing mortality has fluctuated with no trend in time but remains above Fmed. The SSB of whiting is also at historically low levels but appears to have been stable since 1987.

The sole SSB remains close to historically low levels but with relatively strong recruitment in 4 out of the 5 recent years it is likely to show a recovery in the short term.

Plaice is caught mainly as a by-catch in the sole fishery in VIId although in the second half of the year there is a directed fishery by inshore vessels. The stock trends are similar to those in the North Sea with an even stronger decline in SSB since 1988. The quota was not taken by any country and fishermen have noted the scarcity of plaice. Recruitment in recent years has been around average and the stock is expected to decline further in the near future.

Effort trends in the major demersal fleets are shown in Figure 4.1.1. There has been an overall increase in effort by trawlers since 1980s. The main English trawl fleets have shown a large increase since 1988 while the main fixed net fleets have declined or remained stable since 1990-1991. The French offshore trawler fleet effort has been relatively stable since 1991 while the inshore fleet effort has decreased.increase in mesh size. The latter of course reduces catchability on certain size classes which may produce a similar reduction in fishing mortality but it is difficult to enforce and can be circumvented by technological innovation.

Restrictions on effort will not have any effect on reducing capacity and may well give a stimulus to increasing effective capacity. Thus effort control cannot be seen as a solution to the problem of over-capacity.

4.1.1 Conclusions

Catch controls in mixed fisheries designed to restrict fishing mortality are unlikely to be effective due to imprecision in assessments and problems of enforcement.

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.

Any measure which does not address the underlying problem of over-capacity is unlikely to be successful in the long run.

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 less than 3,000 t in 1990 where they remained more or less stable. Annual weight and numbers caught between 1976 and 1993 are given in Table 4.2.2. There is no TAC for this species in Division VIId.

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

The conventional natural mortality and maturity at age values are given in Table 4.2.3. Human consumption landings data were supplied by England, Belgium, Scotland and France. The age compositions were provided by England and France accounting for 93% 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. No SOP correction to the age composition has been carried out on 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 is used to tune the VPA (Table 4.2.6). The French groundfish survey has been eliminated from the tuning because the catches were too low. Commercial catch and effort data used to tune the VPA were nearly the same as last year. It appears that the 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 as recruits and catchability was fixed for ages 3 and above. The age range used for VPA was 1 to 6 and this was a change from last year's assessment when a 7 plus-group was used. Preliminary VPA runs indicated that 6 would be a better plus-group age because the catch numbers at the older ages are very small. The default values were accepted for all other settings except for tricubic weight which has been tapered over 10 years instead of 20 years.

The tuning results are given in Table 4.2.7 and the log catchability residuals for each fleet are plotted in Figure 4.2.2. There is a strong year effect of log catchability residuals for the commercial fleet in the 1992. The F-shrinker receives most weight in the estimate of survivors in all ages, although the French commercial fleet is also important but represents half of the F-shrinker.

The estimates of population numbers and fishing mortality rates resulting from the tuning procedure and VPA are given in Tables 4.2.8 and 4.2.9.

A retrospective analysis of XSA with a shrinkage value of 0.5 has been done. The results have been plotted in Figure 4.2.3. The estimates in 1992 show a discrepancy.

4.2.5 Recruitment estimates

No indices are available so it has been decided to assume mean geometric recruitment at age 1 over the years 1976-1991 for the year class 1992 onwards (5 million fish). This value has a CV of 0.91. At the oldest ages the XSA estimates of survivors have been chosen.

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. The fishing mortality fluctuates but shows no trend in time. The 1985 value of F seems to be completely abnormal. The spawning stock biomass is currently at its historical minimum of 260 t. Recruitment has fluctuated over all the period and the last very high value was in 1985 (28 million). During 5 years out of 6, the year classes spawned have been below the geometric mean since 1985.

4.2.7 Biological reference points

F_{med} (1.18) and F *status quo* (1.36) are indicated on the yield and biomass-per-recruit curves in Figure 4.2.5. and on the stock-recruitment plot in Figure 4.2.4.

4.2.8 Short-term forecast

The input data for catch predictions are given in Tables 4.2.11. and 4.2.12, the latter including coefficients of variation of all the parameters.

For prediction, values of F at age are the mean values over 1989 to 1993 scaled to give a mean value of F over ages 2 to 4 as in 1993. Only the *status quo* prediction has been run. The results of this prediction for 1994 are given in Tables 4.2.13. and 4.2.14., and presented in Figure 4.2.6.

Landings of 2,400 t are predicted for 1994. The *status quo* landings for 1995 are predicted to be 3,700 t. All the estimates of human consumption landings in 1995 have a CV higher than 60%.

The results of a sensitivity analysis of the *status quo* forecast are presented in Figures 4.2.7, 4.2.8 and 4.2.9.

The sensitivity of the predictions to the various parameters is shown in Figure 4.2.7. For instance, the estimate of human consumption yield in 1994 is particularly sensitive to the level of F in 1994 and also to the population numbers and weights at age 1 and 2, and selectivities at age 1, and to a lesser extent, 3.

The proportion of the total variance of the estimated yields and SSB contributed by the input parameters is represented in Figure 4.2.8. The population numbers at age 1 contributed the most in human consumption yield estimates in 1994 and 1995. The estimate of human consumption F in 1994 associated with the estimate of population numbers and selectivity at age 3 accounts for 98% of the variance of the estimate of SSB in 1995.

The probability of the SSB falling below the current level of 260 t is nil both in 1995 and 1996 (Figure 4.2.9).

4.2.9 Medium-term projections

The method used for these projections is explained in Section 1.3 and the 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 of the medium-term projections. The projections were run for *status quo* F and the results are shown in Figure 4.2.10.

On average, under the current level of exploitation, yield will tend to increase very slowly and the spawning stock biomass and recruitment will tend to be stable.

4.2.10 Comments on the assessment

There is no recruitment index. The tuning process is based on data from only one commercial fleet. These considerations indicate the need to consider this assessment with caution.

Table.4.2 1 : COD in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, 1976 to 1993.

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	-	-	530	2	n/a		2430

* Preliminary

Table 4.2.2 : COD in Division VIId.
Annual Weight and Numbers caught, 1976 to 1993.

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

Table 4.2.3 : COD in Division VIId.
Natural Mortality Rate and Proportion Mature at age.

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

Table 4.2.4 : COD in Division VIId.
International Catch at Age (1000's), Total, 1976 to 1993.

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	40	16	12	63	26	28	41	40	36	5
6+	26	5	1	4	8	1	7	7	10	4

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	11133	2330	1059	729	165	126	2118	64
2	6187	8108	1922	1411	776	221	440	1045
3	1477	611	2024	605	321	295	74	199
4	193	482	133	501	105	73	33	32
5	72	15	96	25	68	25	11	8
6+	7	4	5	11	3	14	2	2

Table 4.2.5 : COD in Division VIId.
International Mean Weight at Age (kg), Total, 1976 to 1993.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.615	.537	.560	.626	.585	.599	.660	.780	.701	.617
2	1.315	.672	1.067	.951	.780	.963	.707	.750	.870	1.355
3	2.309	2.014	1.991	2.457	2.297	2.142	2.493	1.744	2.883	2.718
4	4.683	4.860	2.907	4.032	4.484	4.407	4.383	4.123	4.293	5.132
5	6.046	6.332	6.003	4.682	5.655	5.934	5.827	5.705	5.882	7.355
6+	7.399	7.812	7.934	6.092	5.830	6.847	6.976	7.705	6.425	7.748

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	.547	.681	.761	.656	.952	.750	.759	.816
2	.589	1.230	1.149	1.194	1.208	1.603	1.112	1.642
3	1.403	1.996	2.668	2.153	2.587	2.836	3.745	2.440
4	3.193	2.788	3.785	3.760	4.102	5.011	6.017	3.883
5	4.955	4.711	4.343	4.939	5.342	6.541	7.981	5.082
6+	6.445	5.779	4.793	5.879	4.653	6.959	9.774	6.081

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

```
Cod in VIId.
101
FRATRC
 1985 1993
 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

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

Lowestoft VPA Version 3.1

19/09/1994 12:56

Extended Survivors Analysis

Cod in VIId.

CPUE data from file COD7DEF.DAT

Catch data for 18 years. 1976 to 1993. Ages 1 to 6.

Fleet,		First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FRATRC	,	1986,	1993,	1,	5,	.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 4 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 14 iterations

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

Continued

Table 4.2.7 : Continued.

Fleet : FRATRC

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,	.67,	2.257,	12.10,	.92,	8,	.41,	-14.33,

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,	.76,	2.453,	11.83,	.96,	8,	.23,	-13.21,
3,	.77,	3.136,	11.41,	.98,	8,	.17,	-12.99,
4,	.78,	2.103,	11.20,	.96,	8,	.26,	-12.98,
5,	.84,	1.234,	11.65,	.93,	8,	.29,	-13.21,

Fleet disaggregated estimates of survivors :

Age 1 Catchability dependent on age and year class strength

Year class = 1992

FRATRC

Age,	1,
Survivors,	228.,
Raw Weights,	3.151,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FRATRC ,	228.,	.499,	.000,	.00,	1,	.389,	.226
P shrinkage mean ,	1657.,	1.03,,,,				.117,	.034
F shrinkage mean ,	120.,	.50,,,,				.494,	.394

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
209.,	.34,	.58,	3,	1.716,	.244

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

Year class = 1991

FRATRC

Age,	2,	1,
Survivors,	329.,	624.,
Raw Weights,	1.647,	.689,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FRATRC ,	397.,	.345,	.293,	.85,	2,	.369,	1.218
F shrinkage mean ,	508.,	.50,,,,				.631,	1.051

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
464.,	.34,	.19,	3,	.549,	1.111

Continued

Table 4.2.7 : Continued.

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

Year class = 1990

FRATRC

Age,	3,	2,	1,
Survivors,	51.,	45.,	27.,
Raw Weights,	1.418,	.483,	.373,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRC ,	45.,	.281,	.161,	.57,	3,	.362,	1.616
F shrinkage mean ,	61.,	.50,,,,				.638,	1.378

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
54.,	.33,	.16,	4,	.485,	1.462

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

Year class = 1989

FRATRC

Age,	4,	3,	2,	1,
Survivors,	7.,	4.,	5.,	10.,
Raw Weights,	1.050,	.548,	.179,	.119,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRC ,	6.,	.285,	.165,	.58,	4,	.322,	1.733
F shrinkage mean ,	9.,	.50,,,,				.678,	1.400

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
8.,	.35,	.19,	5,	.545,	1.504

Age 5 Catchability constant w.r.t. time and age (fixed at the value for age) 3

Year class = 1988

FRATRC

Age,	5,	4,	3,	2,	1,
Survivors,	3.,	2.,	3.,	3.,	4.,
Raw Weights,	1.401,	.436,	.091,	.025,	.015,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRC ,	2.,	.347,	.094,	.27,	5,	.330,	1.412
F shrinkage mean ,	4.,	.50,,,,				.670,	1.093

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3.,	.35,	.17,	6,	.482,	1.193

Table 4.2.8 : COD in Division VIId.
Tuned Stock Numbers at age (1000's), 1976 to 1993
(numbers in 1994 are VPA survivors).

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	8393	16925	4264	5453	4895	2738	4416	3470	6026	9731
2	1739	6862	8572	3071	4200	3400	2191	2837	2728	4431
3	941	732	1779	1845	1132	1628	923	975	707	797
4	156	96	410	303	390	318	378	286	96	212
5	68	30	21	111	46	51	78	64	64	14
6+	43	10	2	6	14	2	14	10	17	10

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	27854	6467	3791	2436	686	1159	4443	326	0
2	7954	12731	3187	2146	1335	412	835	1721	209
3	2533	914	3087	871	480	390	138	286	464
4	243	738	196	696	165	103	53	46	54
5	104	25	168	40	117	40	18	13	8
6+	9	7	9	18	6	22	3	3	4

Table 4.2.9 : COD in Division VIId.
International Fishing Mortality at Age, Total, 1976
to 1993.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.001	.480	.128	.061	.164	.023	.243	.041	.107	.002
2	.666	1.150	1.336	.798	.748	1.104	.609	1.190	1.031	.359
3	2.080	.379	1.570	1.355	1.071	1.261	.974	2.115	1.004	.987
4	1.438	1.329	1.104	1.684	1.827	1.208	1.578	1.288	1.733	.509
5	1.058	.843	1.046	.985	.963	.909	.860	1.173	.980	.468
6+	1.058	.843	1.046	.985	.963	.909	.860	1.173	.980	.468

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	.583	.508	.369	.401	.310	.128	.748	.244
2	1.963	1.217	1.098	1.298	1.029	.898	.873	1.111
3	1.034	1.342	1.290	1.461	1.342	1.802	.906	1.462
4	2.086	1.279	1.389	1.585	1.213	1.537	1.185	1.503
5	1.419	1.091	.997	1.156	1.029	1.197	1.130	1.193
6+	1.419	1.091	.997	1.156	1.029	1.197	1.130	1.193

Table 4.2.10 : COD in Division VIId.
Mean Fishing Mortality, Biomass and Recruitment, 1976 to 1993.

Year	Mean F Ages 2 to 4	Stock Biomass ('000 tonnes) Total	Spawning	Recruits Age 1 Yclass	Million
1976	1.395	11	1.46	1975	8
1977	.953	16	0.74	1976	17
1978	1.337	16	1.33	1977	4
1979	1.279	13	1.78	1978	5
1980	1.215	11	2.09	1979	5
1981	1.191	10	1.72	1980	3
1982	1.054	9	2.21	1981	4
1983	1.531	8	1.62	1982	3
1984	1.256	10	0.90	1983	6
1985	.618	15	1.27	1984	10
1986	1.694	25	1.35	1985	28
1987	1.279	24	2.21	1986	6
1988	1.259	16	1.51	1987	4
1989	1.448	9	2.92	1988	2
1990	1.195	5	1.33	1989	1
1991	1.412	4	0.93	1990	1
1992	.988	5	0.50	1991	4
1993	1.359	4	0.26	1992	0
Arithmetic mean recruits, age 1, 1976 to 1991:					7
Geometric mean recruits, age 1, 1976 to 1991:					5

Table 4.2.11 : COD in Division VIId.
Input for catch prediction.

Age	1994 Stock Numbers (10**-3)	F and mean Wt at age used in prediction: Scaled Mean F 1989 - 1993	Mean Wt. at age (kg) 1989 - 1993: Stock	Catch	M and maturity: M	P. mat
1	4678	.389	.787	.787	.200	.000
2	209	1.105	1.352	1.352	.200	.000
3	464	1.480	2.752	2.752	.200	.000
4	54	1.491	4.555	4.555	.200	1.000
5	8	1.211	5.977	5.977	.200	1.000
6	4	1.211	6.600	6.669	.200	1.000

Mean F	(2 - 4)
Unscaled	1.280
Scaled	1.359

Recruits at age 1 in 1995 = 4678
Recruits at age 1 in 1996 = 4678

Stock numbers in 1994 are VPA survivors.

Table 4.2.12 : COD in Division VIId.
Input data for catch forecast and linear sensitivity analysis.

Populations in 1994			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	4677	.91	WS1	.79	.16	M1	.20	.10	MT1	.00	.00
N2	208	.58	WS2	1.35	.29	M2	.20	.10	MT2	.00	.00
N3	462	.34	WS3	2.75	.22	M3	.20	.10	MT3	.00	.10
N4	52	.33	WS4	4.55	.19	M4	.20	.10	MT4	1.00	.10
N5	8	.35	WS5	5.98	.16	M5	.20	.10	MT5	1.00	.00
N6	4	.35	WS6	6.60	.20	M6	.20	.10	MT6	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.39	.98	WH1	.79	.16
sH2	1.10	.27	WH2	1.35	.29
sH3	1.47	.22	WH3	2.75	.22
sH4	1.48	.31	WH4	4.55	.19
sH5	1.21	.17	WH5	5.98	.16
sH6	1.21	.17	WH6	6.67	.18

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K94	1.00	.10	HF94	1.00	.24
K95	1.00	.10	HF95	1.00	.24
K96	1.00	.10	HF96	1.00	.24

Recruitment		
Labl	Value	CV
R95	4677	.91
R96	4677	.91

Table 4.2.13 : COD in Division VIId.
Catch Prediction output ; Assuming Status quo in 1994.

	Year 1994	1995						
Mean F Ages								
H.cons 2 to 4	1.36	.00	.54	.82	.95	1.09	1.36	1.63
Effort relative to 1993								
H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Biomass at start of year								
Total	5.6	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Spawning	.3	.5	.5	.5	.5	.5	.5	.5
Catch weight (,000t)								
H.cons	2.4	.0	1.9	2.6	2.9	3.2	3.7	4.1
Biomass at start of 1996								
Total		15.4	12.3	11.1	10.6	10.1	9.3	8.6
Spawning		.7	.4	.3	.3	.2	.2	.1

	Year 1994	1995						
Effort relative to 1993								
H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.62	.64	.64	.64	.64	.64	.64	.64
Spawning	.31	.56	.56	.56	.56	.56	.56	.56
Catch weight								
H.cons	.59	.00	.76	.68	.67	.66	.64	.64
Biomass at start of 1996								
Total		.55	.57	.57	.58	.59	.60	.62
Spawning		.48	.58	.60	.61	.62	.64	.66

Table 4.2.14 : COD in Division VIId.
Detail forecast tables.

Forecast for year 1994
F multiplier H.cons=1.00

	Populations	Catch number	
Age	Stock No.	H.Cons	Total
1	4678	1375	1375
2	208	128	128
3	463	332	332
4	53	38	38
5	8	5	5
6	4	3	3
Wt	6	2	2

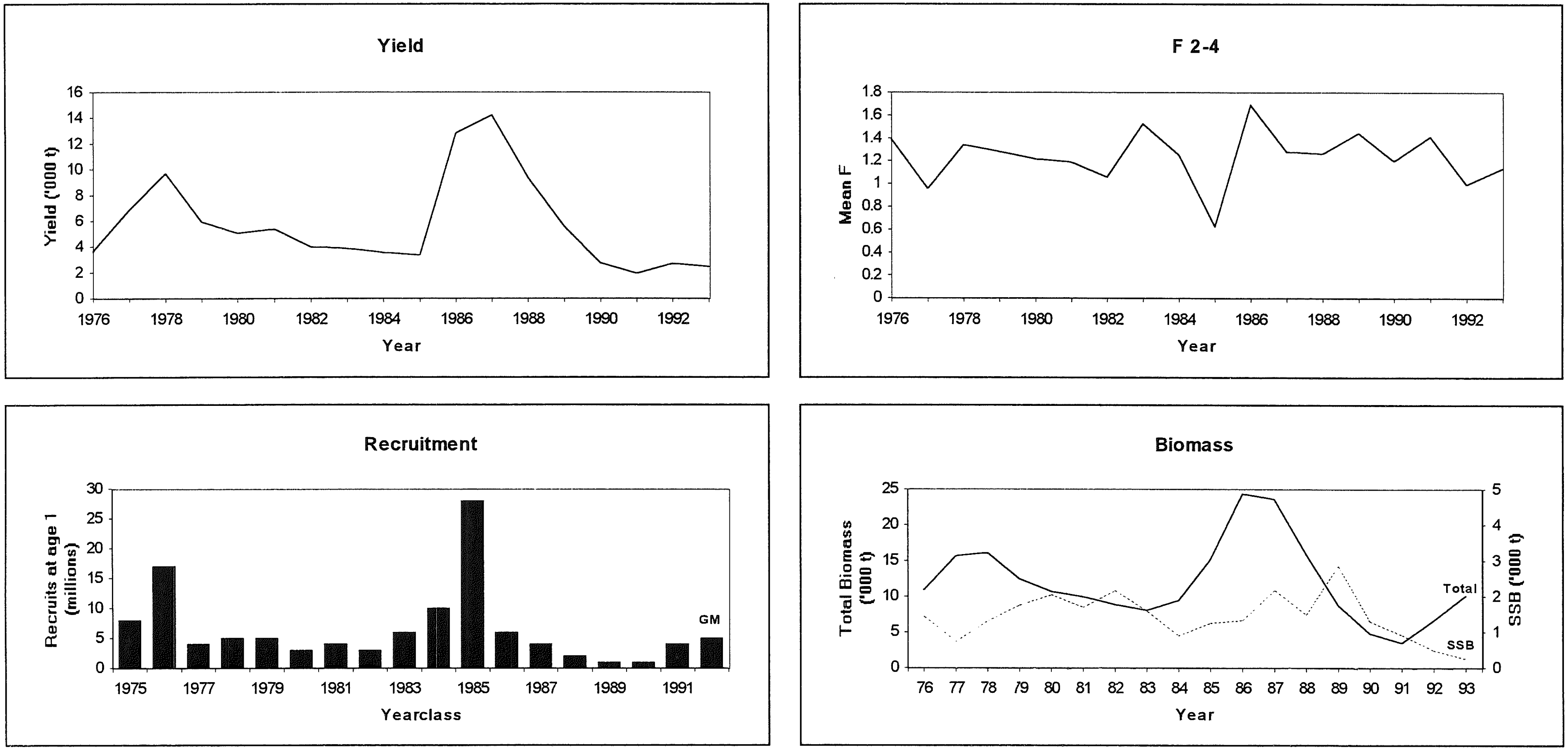
Forecast for year 1995
F multiplier H.cons=1.00

	Populations	Catch number	
Age	Stock No.	H.Cons	Total
1	4678	1375	1375
2	2596	1602	1602
3	56	40	40
4	86	62	62
5	10	6	6
6	3	2	2
Wt	8	4	4

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=        7.6662
Number of observations=             16
Number of parameters   =             3
Residual mean square   =         .5897
Coefficient of determination = .3630
Adj. coeff. of determination = .2650
IFAIL from E04YCF=                   0

Parameter  Correlation matrix
              1
          -.8853       1
          -.6456   .8271       1

 Parameter,s.d.
          6.4911    2.8409
          1.6603     .3637
          5.3038    2.1622
```

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.

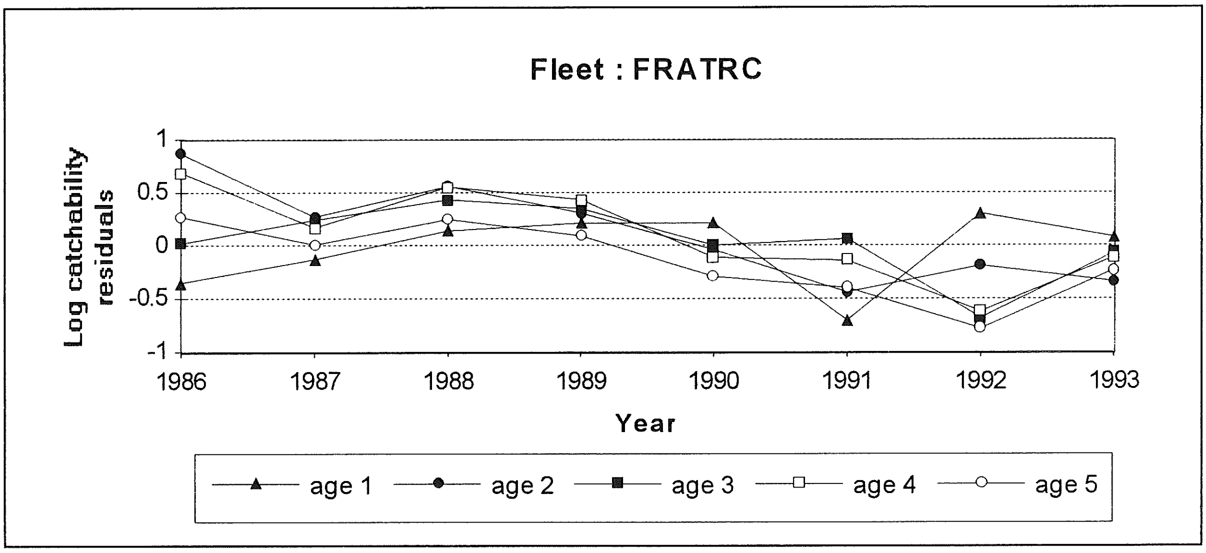


Fig. 4.2.3 : COD in Division VIId.
Retrospective VPA, XSA tuning : reference F(ave.2-4) by year.

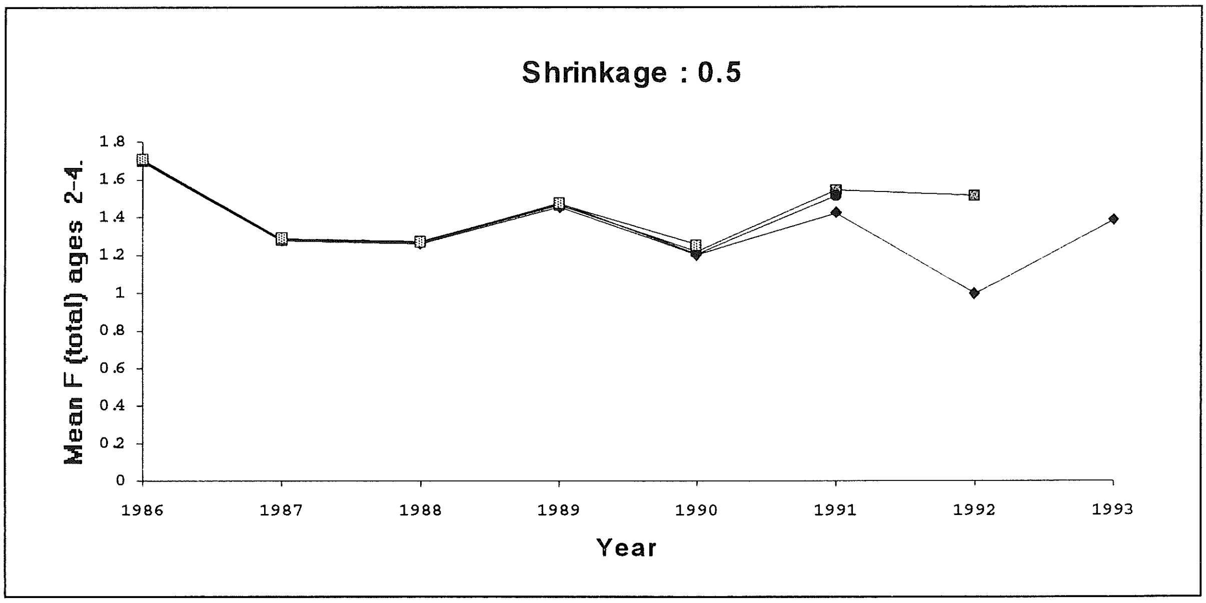


Fig. 4.2.4 : COD in Division VIId.
Recruitment and spawning stock biomass.

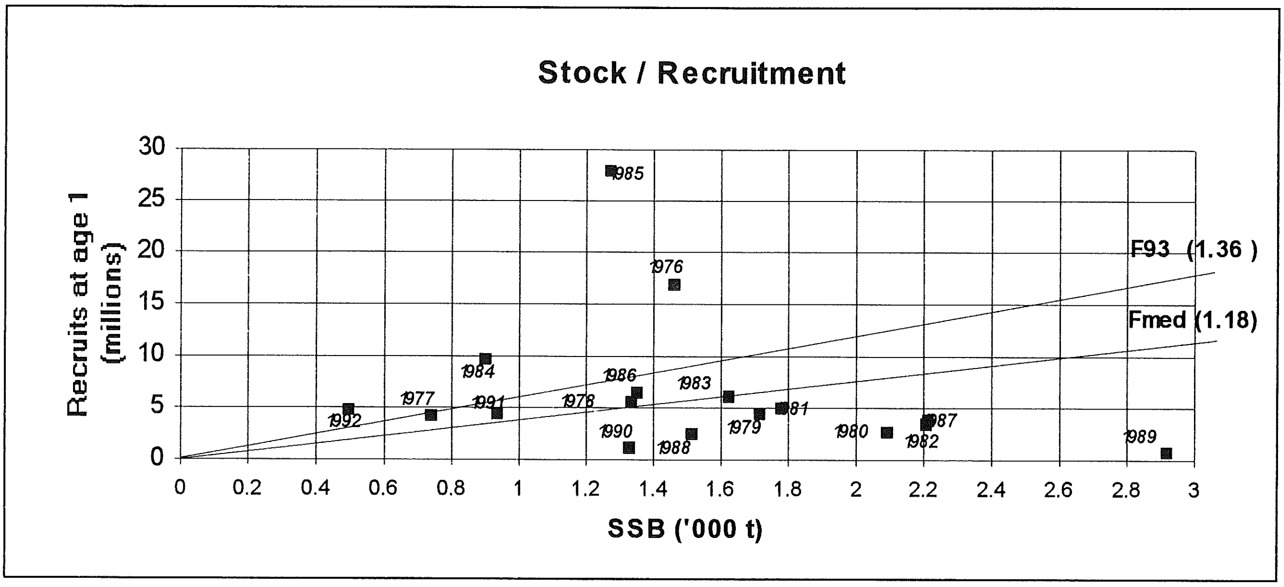


Fig. 4.2.5 : COD in Division VIId.
Yield per recruit-Long term yield and spawning biomass.

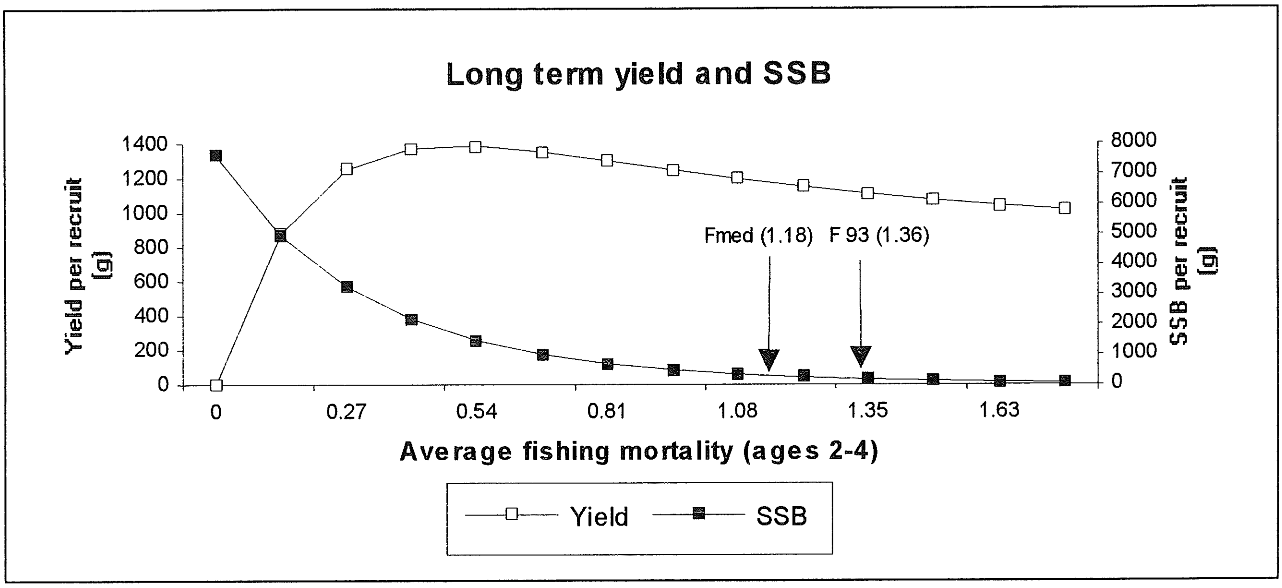


Fig. 4.2.6 : COD in Division VIId.
Short term landings ans spawning biomass.

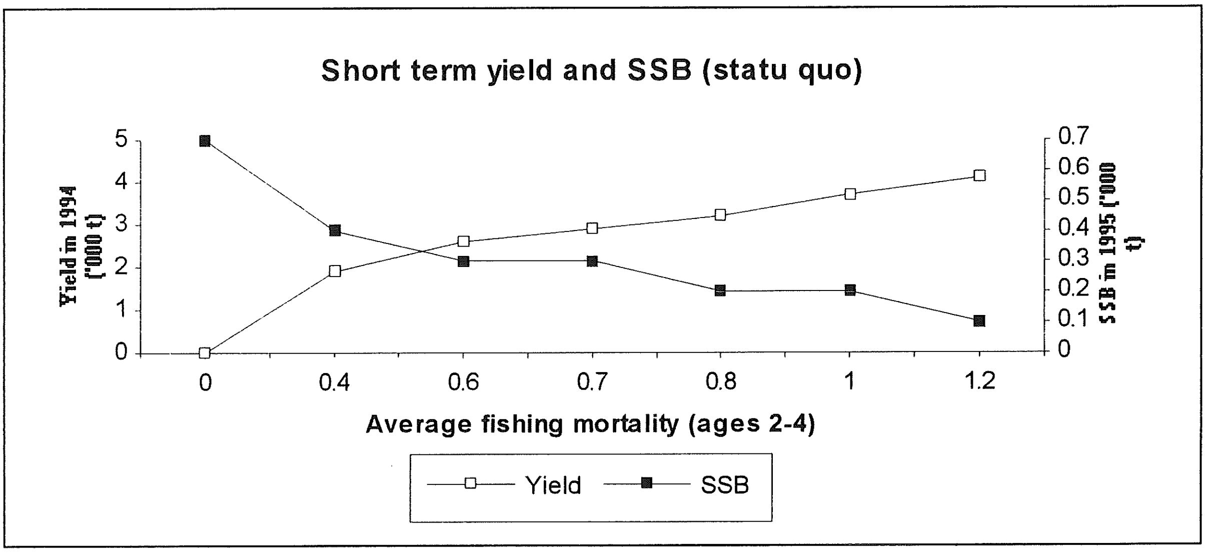


Fig. 4.2.7 : COD in Division VIId.
Linear sensitivity coefficients (elasticities).
Key to lebels is in Table 4.3.12

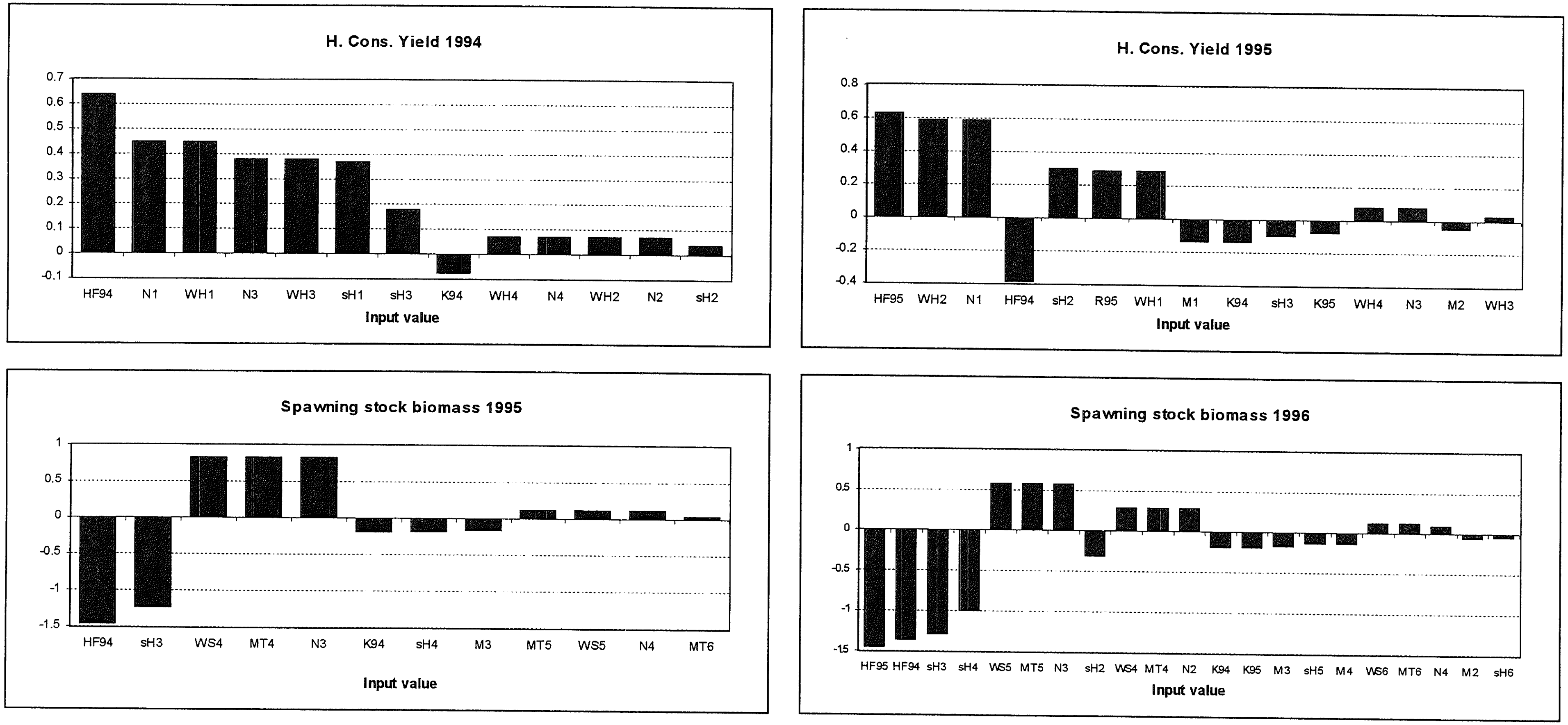


Fig. 4.2.8 : COD in Division VIId.
Proportion of total variance contributed by each input value.
Key to lebels is in Table 4.3.12

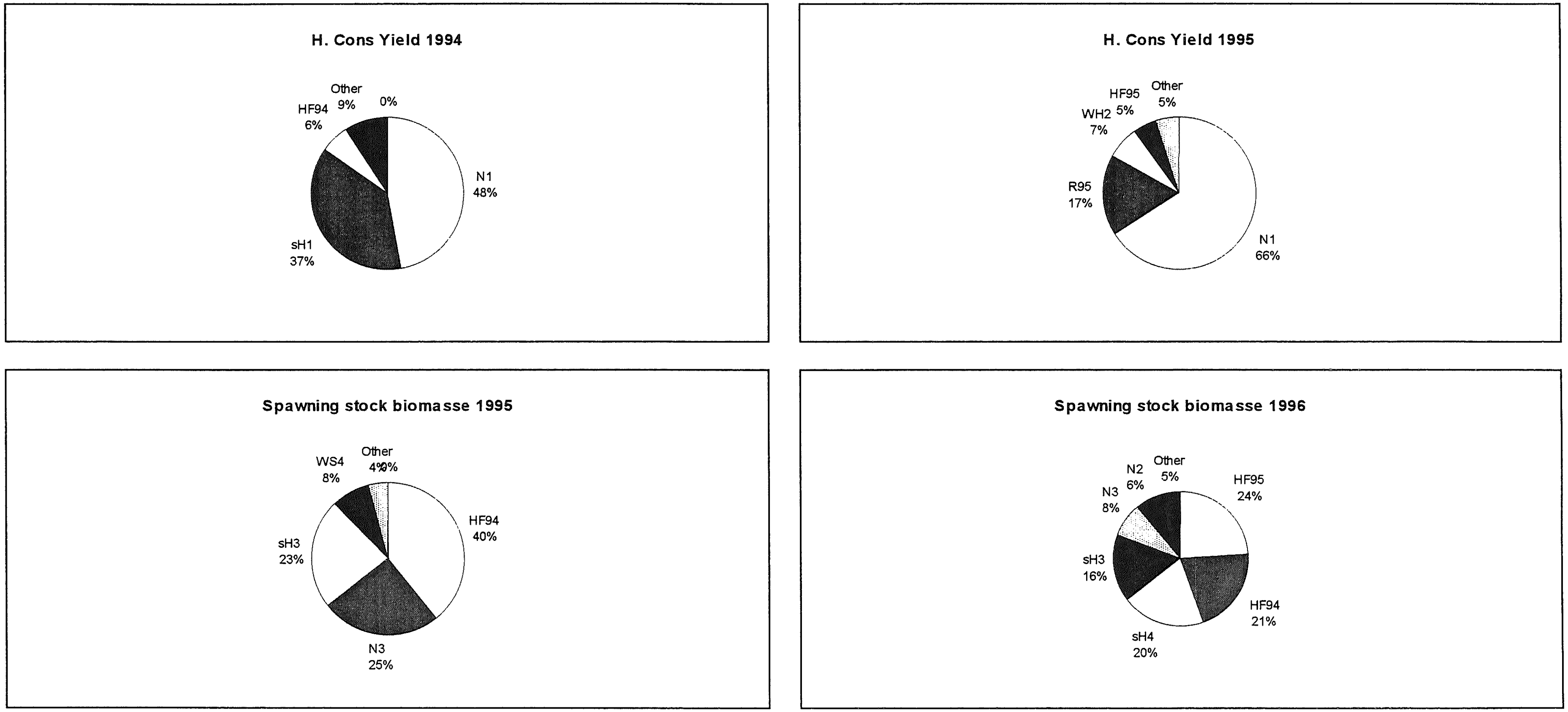


Fig. 4.2.9 : COD in Division VIId.
Cumulative probability distributions.

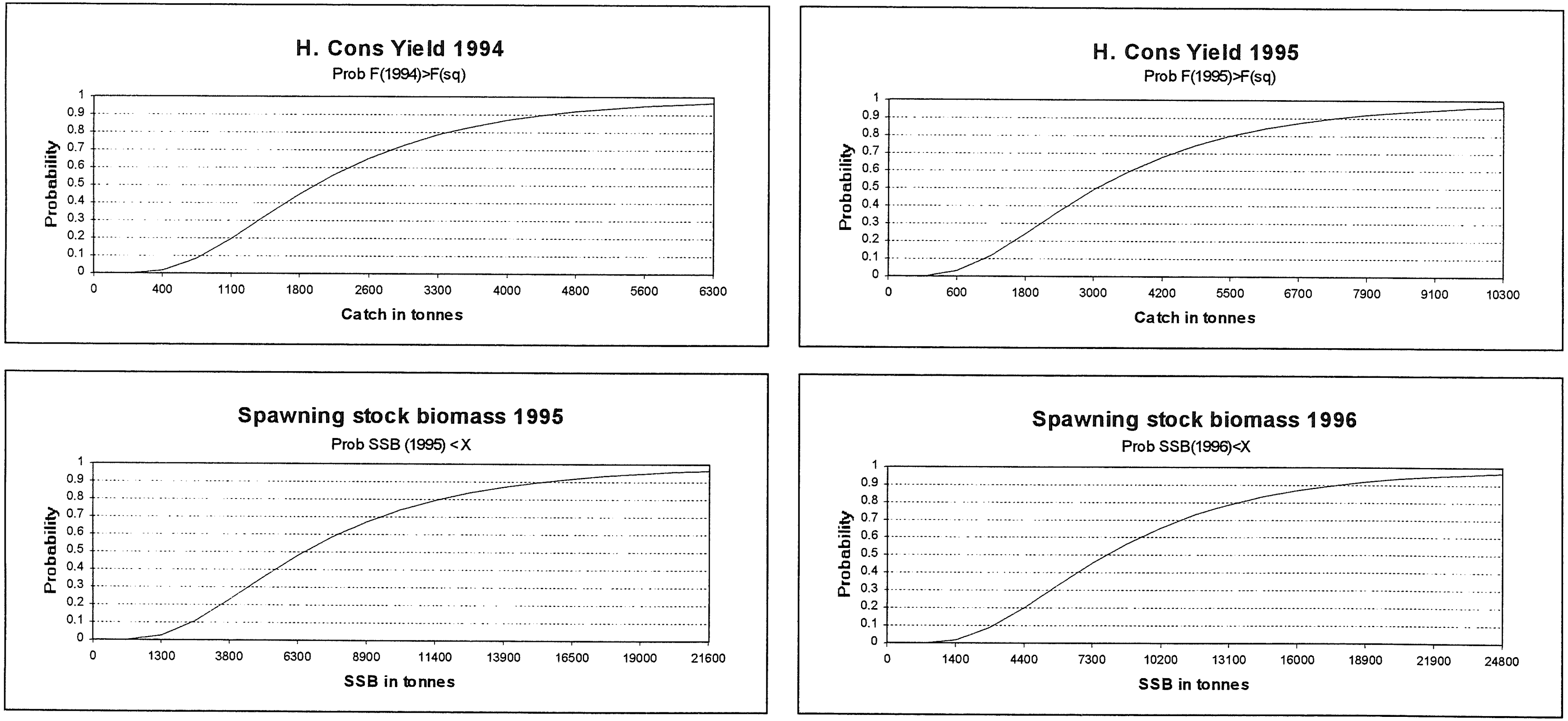
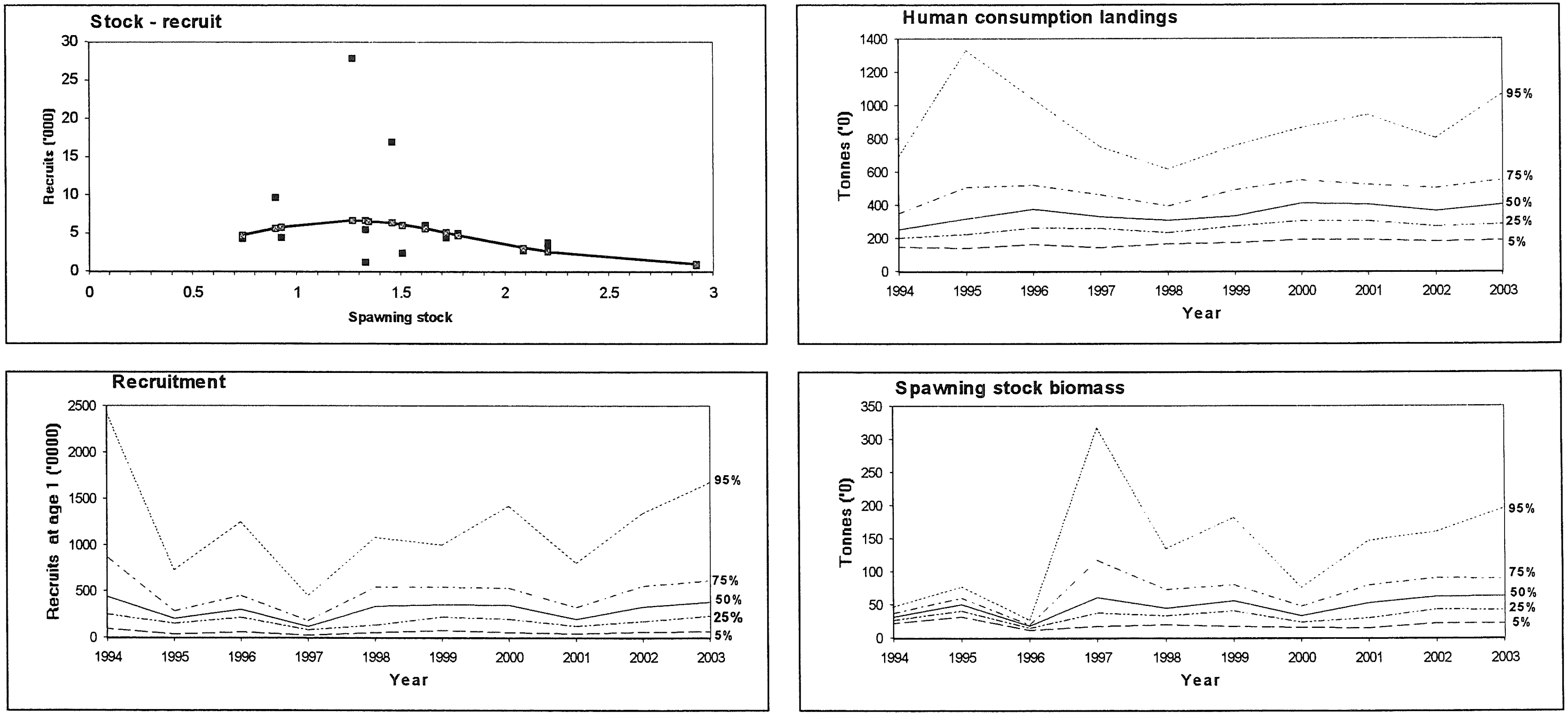


Fig. 4.2.10 : COD in Division VIId.
Results of medium-term predictions (Shepherd).



4.3 Whiting in Division VIId

4.3.1 Catch trends

The Working Group estimate of the landings during 1993 is 5,070 t. (Table 4.3.1). Historical trends in landings are given in Figure 4.3.1. From a small increase in 1991, the total international landings slowly decreased again. Annual weight and numbers caught between 1976 and 1993 are given in Table 4.3.2. There is no separate TAC for this species in Division VIId.

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

Natural mortality estimates are given in Table 4.3.3 along with the maturity ogive. Both are as used previously. Human consumption landings data were supplied by England, Belgium, Scotland and France. The age compositions were provided by England and France accounting for 99% of the catches. Total international catch at age and mean weight at age in the catch are presented in Tables 4.3.4 and 4.3.5. The mean weight at age in the catch was also used as the stock mean weight at age. The 1993 mean weights at ages 3, 4 and 5 seem to be underestimated. This year, no SOP correction has been applied.

4.3.3 Catch, effort and research vessel data

Commercial catch and effort data used to tune the VPA were the same series as used in last year's assessment. Concerning the Channel Groundfish survey, the data have been revised because of the poor French age length keys from 1988 to 1990. These years have therefore been eliminated from the Channel French survey database. The data used to tune the VPA are given in Table 4.3.6.

4.3.4 Catch at age analysis

The method used to tune the VPA was XSA. The age range used for VPA was 1 to 6 and this was a change from last year's assessment when a 7 plus-group was used. Preliminary VPA runs indicated that 6 would be a better plus-group age because the catch numbers at the older ages are very small.

Tuning was performed over a 9 year period, with shrinkage of 0.5 and a tricubic time taper over 10 years instead of 20 years last year. The recruiting age was set at age 1, and catchability was fixed for ages 4 and above. The tuning results are given in Table 4.3.7 and the residuals of the log catchability are plotted in Figure 4.3.2. No obvious trend appears in most age groups in the commercial fleet.

The French groundfish survey and the shrinker receive most of the weight in the estimates of survivors from the 1992 year class at the start of 1994. At older ages the survey and the commercial fleet contribute similarly to the weighted estimates of survivors.

The stock numbers and fishing mortalities at age estimated by the tuning are presented in Tables 4.3.8 and 4.3.9. The variability of F observed in Table 4.3.9 seems to indicate a problem concerning the database. Trends in mean total F from a retrospective analysis are plotted in Figure 4.3.3. The retrospective analysis indicates that there was a tendency for F values to be overestimated.

The database used in this assessment was not the last revised database so another run has been done to check the VPA results. The differences observed between the two sets were not important.

4.3.5 Recruitment estimates

There exist some 0-group indices from a French groundfish survey, but the time series is too short for use in the RCT3 program (3 years). A geometric mean recruitment at age 1 over the years 1976-1991 for the year class 1992 (42 million fish) has been used. At the oldest ages the XSA estimates of survivors have been chosen. This value has a CV of 0.56.

4.3.6 Historical stock trends

Trends in fishing mortality, recruitment and biomass since 1976 are given in Table 4.3.10 and Figure 4.3.1. Mean fishing mortality appears to be quite variable between 0.26 and more than 1.1 over all the period. Spawning biomass decreased from a peak of 26,000 t in 1978 and 1979 to a value around 9,000 t. This level has remained stable since 1986. Recruitment has fluctuated considerably over the period but the frequency of good year classes has decreased since 1984.

4.3.7 Biological reference points

The stock-recruitment plot is shown in Figure 4.3.4. and the F_{med} is indicated. A yield per recruit and spawning stock biomass per recruit plot is shown in Figure 4.3.5 with F_{med} (0.45) and F_{93}(0.67).

4.3.8 Short-term forecast

The population numbers, fishing mortality, stock and catch weights at age and natural mortalities and the maturity ogive used in the short-term catch forecast are given in Tables 4.3.11 and 4.3.12 and the results are shown in Figure 4.3.6. The predicted *status quo* landings for 1994 (Table 4.3.13) are 5,000 t. This value would be the same in 1995 with the same level of F (0.67). Detailed forecast tables are given in Table

4.3.14.

The input data for the linear sensitivity analysis are given in Table 4.3.12 and the results are shown in Figures 4.3.7 and 4.3.8. The table shows the coefficient of variation of the various parameters. Figure 4.3.7 shows the sensitivity of the predictions to the various parameters. Figure 4.3.8 shows the contribution to the variance of prediction for the main parameters.

The estimate of human consumption yield in 1994 is particularly sensitive to the level of F in 1994 and to a lesser extent to the population numbers, weight at age and selectivities at ages 2, 3 and 4. The estimates of SSB in 1994 and 1995 are both sensitive to the proportion of mature at ages 2 and 3, and to the level of F and weight at age 3. Moreover, the 1994 SSB is sensitive to the number at age 1 and the 1995 SSB is sensitive to recruitment.

Human consumption F in 1994 and selectivity at age 1 account for 81% of the variance of the estimate of the human consumption yield estimates in 1994. Human consumption F in 1995 and the population numbers at age 1 contributed the most (76%) to human consumption yield estimates in 1995. The estimate of human consumption F in 1994 associated with the estimate of population numbers at age 1 accounts for 88% of the variance of the estimate of SSB in 1995. In 1995, recruitment in 1995, population numbers at age 1 and human consumption F in 1995 represent 75% of the estimate of SSB in 1996.

Figure 4.3.9 shows probability profiles for landings in 1994 and 1995 and SSB in 1995 and 1996. The probability of F exceeding *status quo* F is quite similar in 1994 and 1995 for all levels of human consumption catch. The probability of the SSB falling below the current level of 9,000 t is high both in 1995 and 1996.

4.3.9 Medium-term projections

A Shepherd curve was fitted to the stock-recruitment data as the basis of the medium-term projections. Projections were run assuming *status quo*. The input parameters for medium-term projections are given in Tables 4.3.12 and 4.3.15 and the results are presented in Figure 4.3.10.

On average, under the current level of exploitation, yield, spawning stock biomass and recruitment will tend to be stable.

4.3.10 Comments on the assessment

The tuning process is based on data from only one commercial fleet and one survey vessel with only three years of available data. The Fs at age fluctuate over the time series which is indicative of a potentially large problem with the assessment. The cause of this feature is not known. These considerations indicate the need to consider this assessment with caution.

Table 4.3.1 : WHITING in Division VIId.
Nominal landings (tonnes) as officially reported to ICES, 1976 to 1993.

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	-	5070

* Preliminary

Table 4.3.2 : WHITING in Division VIId.
Annual Weight and Numbers caught, 1976 to 1993.

Year	Wt.('000 t)	Nos.(millions)
1976	8	27
1977	5	21
1978	9	38
1979	9	35
1980	9	35
1981	9	34
1982	8	33
1983	7	29
1984	7	33
1985	7	34
1986	6	23
1987	5	18
1988	4	18
1989	4	16
1990	3	15
1991	6	25
1992	6	26
1993	5	24

Table 4.3.3 : WHITING in Division VIId.
Natural Mortality Rate and Proportion Mature at age.

Age	Nat Mor	Mat.
1	0.200	0.000
2	0.200	0.530
3	0.200	0.840
4	0.200	1.000
5	0.200	1.000
6	0.200	1.000

Table 4.3.4 : WHITING in Division VIId.
International Catch at Age (1000's), Total, 1976 to 1993.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Age
1	529	1351	1105	413	163	952	3199	3441	4105	491	1
2	9774	6717	6763	8072	5742	9204	10391	12546	12308	14177	2
3	6190	10329	18945	14018	16492	10274	14132	8486	13266	15972	3
4	8590	1099	9770	10512	7365	8548	3151	3537	2274	2493	4
5	1800	1301	579	2358	4806	3308	1553	1229	1075	578	5
6	539	378	784	228	942	1994	526	231	385	269	6

Age	1986	1987	1988	1989	1990	1991	1992	1993	Age
1	229	2160	1753	1194	237	4060	5925	1132	1
2	3665	6133	10713	6340	8951	8753	11816	5718	2
3	11457	1667	4058	7349	3049	5336	5666	12419	3
4	6773	7442	572	1131	2131	3999	1489	2969	4
5	1014	493	806	42	301	2720	893	1152	5
6	351	301	45	139	10	624	353	681	6

Table 4.3.5 : WHITING in Division VIId.
International Mean Weight at Age (kg), Total, 1976 to 1993.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	0.220	0.191	0.280	0.189	0.157	0.150	0.146	0.174	0.172	0.137
2	0.225	0.179	0.215	0.205	0.211	0.229	0.197	0.211	0.194	0.167
3	0.284	0.242	0.223	0.247	0.243	0.278	0.257	0.258	0.239	0.243
4	0.312	0.352	0.275	0.272	0.286	0.272	0.318	0.296	0.310	0.301
5	0.414	0.357	0.328	0.325	0.312	0.264	0.346	0.307	0.261	0.318
6	0.401	0.389	0.323	0.381	0.345	0.315	0.415	0.375	0.319	0.324

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	0.131	0.192	0.183	0.176	0.152	0.164	0.159	0.155
2	0.164	0.219	0.214	0.210	0.205	0.200	0.205	0.178
3	0.228	0.256	0.319	0.287	0.265	0.238	0.267	0.203
4	0.268	0.298	0.357	0.371	0.319	0.268	0.312	0.272
5	0.310	0.370	0.355	0.405	0.370	0.297	0.318	0.289
6	0.353	0.345	0.464	0.487	0.433	0.333	0.382	0.325

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

Whiting in VIId
102
FRATRC
1985 1993
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
345214.000	1086.398	5236.142	11679.640	2744.369	1103.230	377.078

FRAGFS
1991 1993
1 1 .83 .92
1 7

26.660	1233	153	23	12	14	20	9
22.500	1168	334	29	13	1	14	10
24.960	484	164	19	10	4	14	4

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

Lowestoft VPA Version 3.1

7/10/1994 20:39

Extended Survivors Analysis

Whiting in VIId

CPUE data from file WHI7DEF.DAT

Catch data for 18 years. 1976 to 1993. Ages 1 to 6.

Fleet,	,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FRATRC	,	1985,	1993,	1,	5,	.000,	1.000
FRAGFS	,	1991,	1993,	1,	5,	.830,	.920

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 >= 4

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 4 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 29 iterations

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

Continued

Table 4.3.7 : Continued

Fleet : FRATRC

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,	.74,	.279,	14.30,	.21,	9,	.86,	-15.70,

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,	1.44,	-1.230,	15.15,	.64,	9,	.37,	-13.61,
3,	1.31,	-.992,	14.40,	.71,	9,	.46,	-13.24,
4,	1.54,	-.958,	15.61,	.43,	9,	1.06,	-13.12,
5,	.87,	1.503,	12.60,	.97,	9,	.25,	-13.38,

Fleet : FRAGFS
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,	1.34,	-.271,	5.26,	.40,	3,	.89,	-6.57,

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,	.92,	.204,	7.83,	.87,	3,	.22,	-7.62,
3,	-3.56,	-2.554,	12.26,	.24,	3,	1.04,	-8.96,
4,	1.22,	-1.771,	8.60,	.99,	3,	.03,	-8.61,
5,	.44,	1.864,	8.63,	.92,	3,	.23,	-9.27,

Fleet disaggregated estimates of survivors :

Age 1 Catchability dependent on age and year class strength

Year class = 1992

FRATRC

Age,	1,
Survivors,	19644.,
Raw Weights,	1.096,

FRAGFS

Age,	1,
Survivors,	13351.,
Raw Weights,	3.005,

Continued

Table 4.3.7 : Continued

Fleet, Estimated		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	F
FRATRC	,	19644.,	.927,	.000,	.00,	1,	.083,	.051
FRAGFS	,	13351.,	.560,	.000,	.00,	1,	.229,	.074
P shrinkage mean	,	25185.,	.45,,,,				.383,	.040
F shrinkage mean	,	11178.,	.50,,,,				.305,	.088

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
16653.,	.27,	.22,	4,	.793,	.060

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

Year class = 1991

FRATRC

Age,	2,	1,
Survivors,	9086.,	33742.,
Raw Weights,	7.625,	.509,

FRAGFS

Age,	2,	1,
Survivors,	12498.,	19644.,
Raw Weights,	7.625,	1.724,

Fleet, Estimated		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	F
FRATRC	,	9864.,	.289,	.318,	1.10,	2,	.379,	.422
FRAGFS	,	13585.,	.266,	.175,	.66,	2,	.435,	.323
F shrinkage mean	,	9764.,	.50,,,,				.186,	.425

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
11317.,	.18,	.14,	5,	.760,	.376

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

Year class = 1990

FRATRC

Age,	3,	2,	1,
Survivors,	11353.,	7370.,	10295.,
Raw Weights,	3.299,	3.652,	.320,

Continued

Table 4.3.7 : Continued

FRAGFS

Age,	3,	2,	1,
Survivors,	5257.,	10828.,	7020.,
Raw Weights,	1.084,	3.652,	.948,

Fleet, Estimated	Estimated,	Int,	Ext,	Var,	N,	Scaled,	
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FRATRC ,	9099.,	.232,	.150,	.65,	3,	.429,	.804
FRAGFS ,	8776.,	.249,	.208,	.84,	3,	.335,	.824
F shrinkage mean ,	13306.,	.50,,,,				.236,	.612

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
9833.,	.18,	.12,	7,	.681,	.762

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

Year class = 1989

FRATRC

Age,	4,	3,	2,	1,
Survivors,	2224.,	1780.,	1841.,	548.,
Raw Weights,	.768,	1.556,	1.496,	.109,

FRAGFS

Age,	4,	3,	2,	1,
Survivors,	1928.,	3111.,	1596.,	0.,
Raw Weights,	4.673,	.511,	1.496,	.000,

Fleet, Estimated	Estimated,	Int,	Ext,	Var,	N,	Scaled,	
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FRATRC ,	1822.,	.240,	.127,	.53,	4,	.269,	.906
FRAGFS ,	1917.,	.226,	.113,	.50,	3,	.457,	.876
F shrinkage mean ,	2145.,	.50,,,,				.274,	.812

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
1950.,	.18,	.07,	8,	.356,	.866

Continued

Table 4.3.7 : Continued

Age 5 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1988

FRATRC

Age,	5,	4,	3,	2,	1,
Survivors,	1046.,	613.,	1180.,	1827.,	1123.,
Raw Weights,	2.655,	.682,	1.330,	1.184,	.106,

FRAGFS

Age,	5,	4,	3,	2,	1,
Survivors,	798.,	1335.,	1515.,	0.,	0.,
Raw Weights,	.331,	4.150,	.437,	.000,	.000,

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FRATRC	,	1131.,	.245,	.152,	.62,	5,	.400,	.653
FRAGFS	,	1304.,	.274,	.097,	.35,	3,	.331,	.587
F shrinkage mean	,	1528.,	.50,,,,				.269,	.520

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1285.,	.19,	.09,	9,	.463,	.594

Table 4.3.8 : WHITING in Division VIId.
Tuned Stock Numbers at age (1000's), 1976 to 1993
(numbers in 1994 are VPA survivors).

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99062	67427	65297	38278	48679	36885	51664	62575	61377	9640
2	59439	80627	53982	52461	30965	39708	29338	39404	48118	46537
3	11933	39821	59934	38077	35648	20157	24182	14618	20909	28259
4	19125	4169	23257	31928	18491	14264	7207	7012	4290	5115
5	5597	7886	2418	10201	16629	8475	3943	3050	2540	1454
6+	1660	2277	3253	981	3234	5054	1322	566	899	669

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	19949	46944	28462	31524	31739	58830	31148	21590	0
2	7448	16126	36480	21716	24729	25771	44491	20141	16653
3	25273	2781	7654	20173	12043	12147	13180	25735	11317
4	8685	10325	769	2594	9867	7101	5118	5664	9833
5	1932	983	1720	112	1100	6150	2196	2843	1950
6+	658	592	94	364	37	1393	858	1661	2036

Table 4.3.9 : WHITING in Division VIId.
International Fishing Mortality at Age, Total, 1976 to 1993.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.006	.022	.019	.012	.004	.029	.071	.063	.077	.058
2	.201	.097	.149	.186	.229	.296	.497	.434	.332	.410
3	.852	.338	.430	.522	.716	.828	1.038	1.026	1.208	.980
4	.686	.345	.624	.452	.580	1.086	.660	.816	.882	.774
5	.439	.201	.307	.295	.385	.564	.571	.590	.630	.579
6+	.439	.201	.307	.295	.385	.564	.571	.590	.630	.579

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	.013	.052	.071	.043	.008	.079	.236	.060
2	.785	.545	.392	.390	.511	.471	.347	.377
3	.695	1.086	.882	.515	.328	.664	.645	.762
4	1.979	1.592	1.727	.658	.273	.974	.388	.866
5	.868	.808	.729	.542	.360	.671	.597	.594
6+	.868	.808	.729	.542	.360	.671	.597	.594

Table 4.3.10 : WHITING in Division VIId.
Mean Fishing Mortality, Biomass and Recruitment, 1976 to 1993.

Year	Mean F Ages 2 to 4	Stock Biomass ('000 tonnes) Total	Spawning	Recruits Age 1 Yclass	Million
1976	.579	47	19	1975	99
1977	.260	42	21	1976	67
1978	.401	51	26	1977	65
1979	.387	40	26	1978	38
1980	.508	34	22	1979	49
1981	.737	28	17	1980	37
1982	.732	24	12	1981	52
1983	.758	26	11	1982	63
1984	.807	27	11	1983	61
1985	.721	18	12	1984	10
1986	1.153	13	9	1985	20
1987	1.074	17	6	1986	47
1988	1.000	16	7	1987	28
1989	.521	17	8	1988	32
1990	.371	17	9	1989	32
1991	.703	22	9	1990	59
1992	.460	20	10	1991	31
1993	.668	15	9	1992	
Arithmetic mean recruits, age 1, 1976 to 1991:					47
Geometric mean recruits, age 1, 1976 to 1991:					42

Table 4.3.11 : WHITING in Division VIId.
Input for catch prediction.

Age	1994 Stock Numbers (10**-3)	F and mean Wt at age used in prediction: Scaled Mean F 1989 - 1993	Mean Wt. at age (kg) 1989 - 1993 Stock	Catch	M and maturity: M	P. mat
1	41892	.105	.161	.161	.200	.000
2	16653	.514	.200	.200	.200	.530
3	11317	.715	.252	.252	.200	.840
4	9833	.775	.308	.308	.200	1.000
5	1950	.678	.336	.336	.200	1.000
6	2036	.678	.389	.392	.200	1.000

Mean F	(2 - 4)
Unscaled	.544
Scaled	.668

Recruits at age 1 in 1995 = 41892
Recruits at age 1 in 1996 = 41892

Stock numbers in 1994 are VPA survivors.

Table 4.3.12 : WHITING in Division VIId.
Input data for catch forecast and linear sensitivity analysis.

Populations in 1994			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	41891	.56	WS1	.16	.20	M1	.20	.10	MT1	.00	.10
N2	16651	.27	WS2	.20	.09	M2	.20	.10	MT2	.53	.10
N3	11315	.18	WS3	.25	.11	M3	.20	.10	MT3	.84	.10
N4	9832	.18	WS4	.31	.10	M4	.20	.10	MT4	1.00	.10
N5	1948	.18	WS5	.34	.13	M5	.20	.10	MT5	1.00	.00
N6	2035	.19	WS6	.39	.15	M6	.20	.10	MT6	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.11	1.32	WH1	.16	.20
sH2	.51	.42	WH2	.20	.09
sH3	.71	.22	WH3	.25	.11
sH4	.77	.22	WH4	.31	.10
sH5	.68	.17	WH5	.34	.13
sH6	.68	.17	WH6	.39	.14

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K94	1.00	.10	HF94	1.00	.38
K95	1.00	.10	HF95	1.00	.38
K96	1.00	.10	HF96	1.00	.38

Recruitment		
Labl	Value	CV
R95	41892	.56
R96	41892	.56

Stock numbers in 1994 are VPA survivors.

Table 4.3.13; Whiting eastern channel
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	1994	1995						
Mean F Ages H.cons 2 to 4	.67	.00	.27	.40	.47	.53	.67	.80
Effort relative to 1993 H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Biomass at start of year								
Total	17.40	18.26	18.26	18.26	18.26	18.26	18.26	18.26
Spawning	8.64	8.29	8.29	8.29	8.29	8.29	8.29	8.29
Catch weight (,000t) H.cons	5.32	.00	2.51	3.57	4.06	4.53	5.39	6.16
Biomass at start of 1996								
Total		24.99	22.27	21.13	20.60	20.10	19.18	18.35
Spawning		14.00	11.60	10.60	10.15	9.71	8.92	8.21

	1994	1995						
Effort relative to 1993 H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.24	.31	.31	.31	.31	.31	.31	.31
Spawning	.12	.31	.31	.31	.31	.31	.31	.31
Catch weight H.cons	.35	.00	.91	.62	.55	.50	.43	.39
Biomass at start of 1996								
Total		.28	.31	.32	.32	.32	.33	.34
Spawning		.30	.36	.36	.37	.37	.38	.39

Table 4.3.14 : WHITING in Division VIId.
Detail forecast tables.

Forecast for year 1994
F multiplier H.cons=1.00

Populations		Catch number	
Age	Stock No.	H.Cons	Total
1	41891	3791	3791
2	16652	6117	6117
3	11316	5301	5301
4	9832	4867	4867
5	1949	880	880
6	2035	918	918
Wt	17	5	5

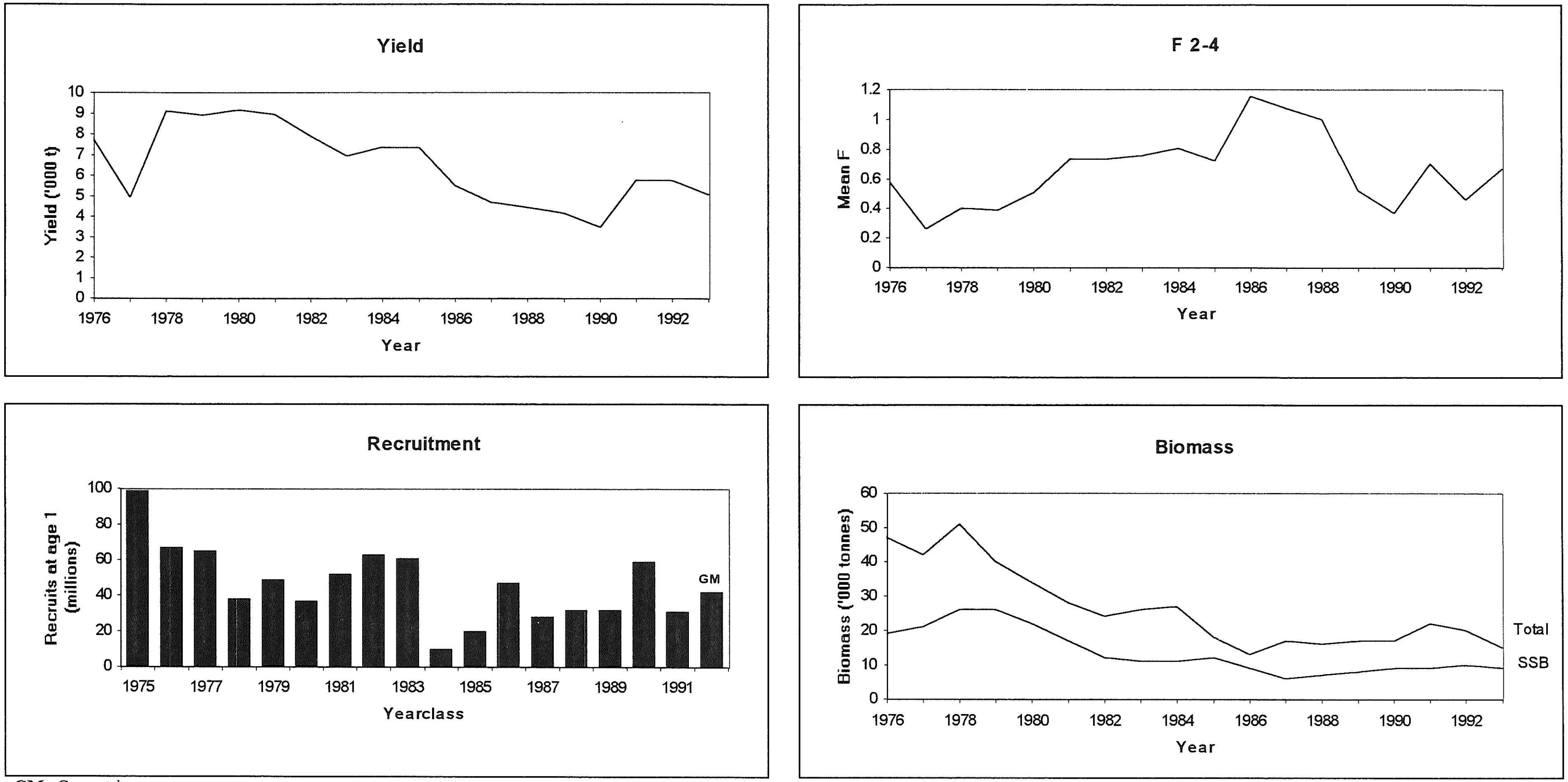
Forecast for year 1995
F multiplier H.cons=1.00

Populations		Catch number	
Age	Stock No.	H.Cons	Total
1	41892	3791	3791
2	30879	11344	11344
3	8154	3820	3820
4	4532	2244	2244
5	3709	1674	1674
6	1656	747	747
Wt	18	5	5

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

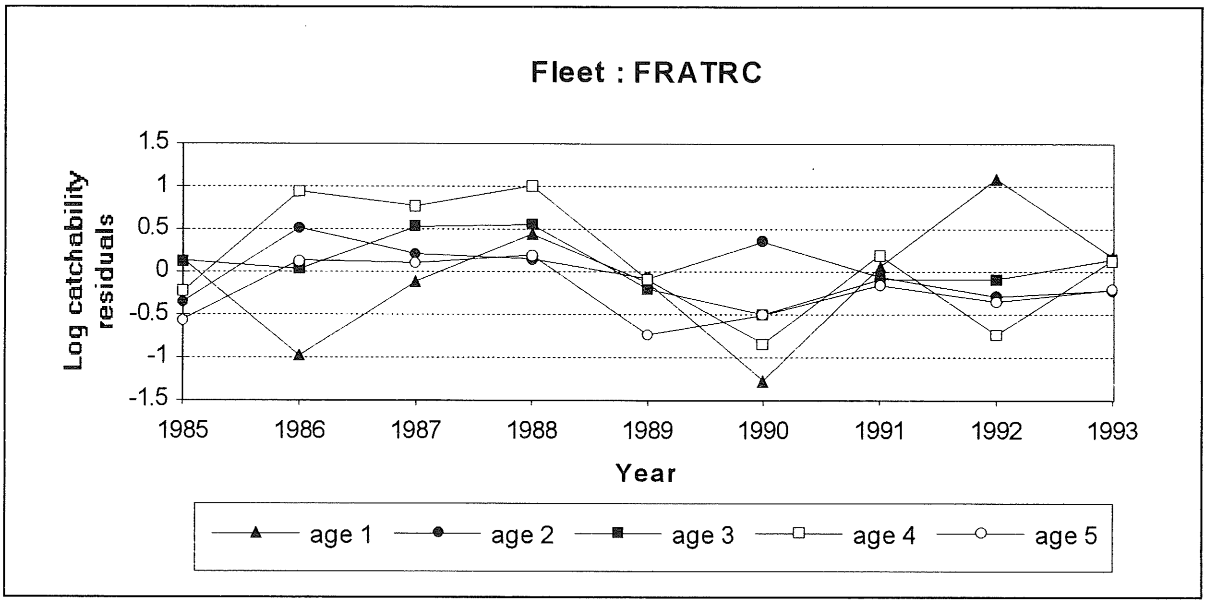
```
 Shepherd curve
 Moving average term NOT fitted

 IFAIL on exit from E04FDF =        0
 Residual sum of squares=       .5768
 Number of observations=           16
 Number of parameters  =            3
 Residual mean square  =        .0444
 Coefficient of determination   .6359
 Adj. coeff. of determination = .5799
 IFAIL from E04YCF=                 0

 Parameter  Correlation matrix
     1.
-.8080        1
-.6016    .7011       1

  Parameter,s.d.
 4.9123     .4707
21.6312    1.6673
 4.0766    1.4077
```

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.



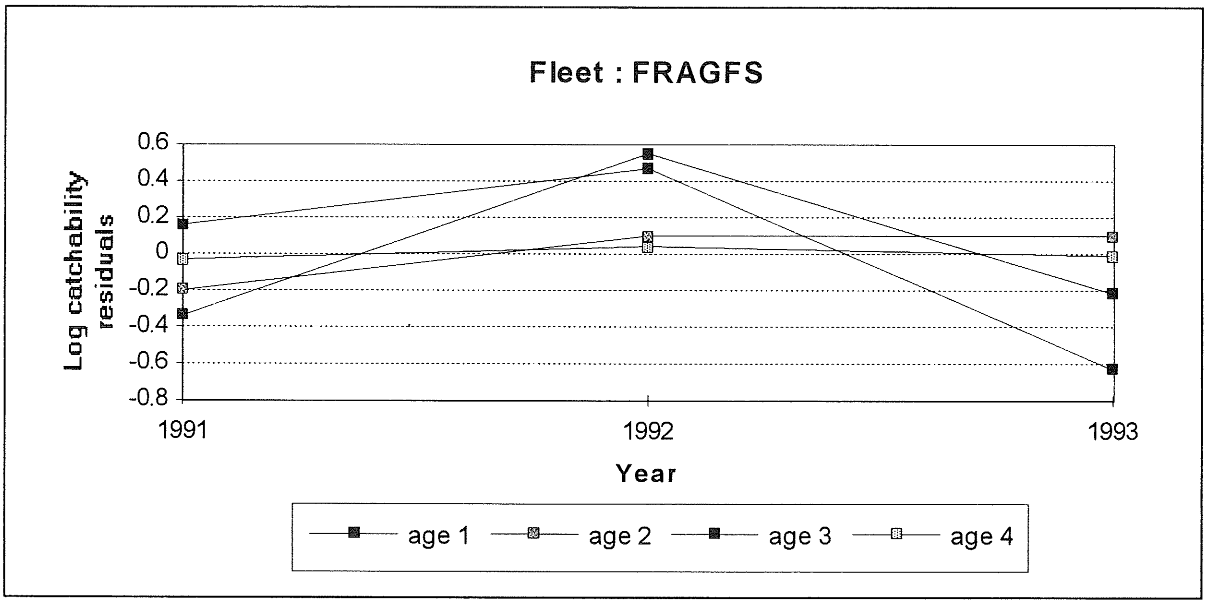


Fig. 4.3.3 : WHITING in Division VIId.
Retrospective VPA, XSA tuning : reference F(ave.2-4) by year.

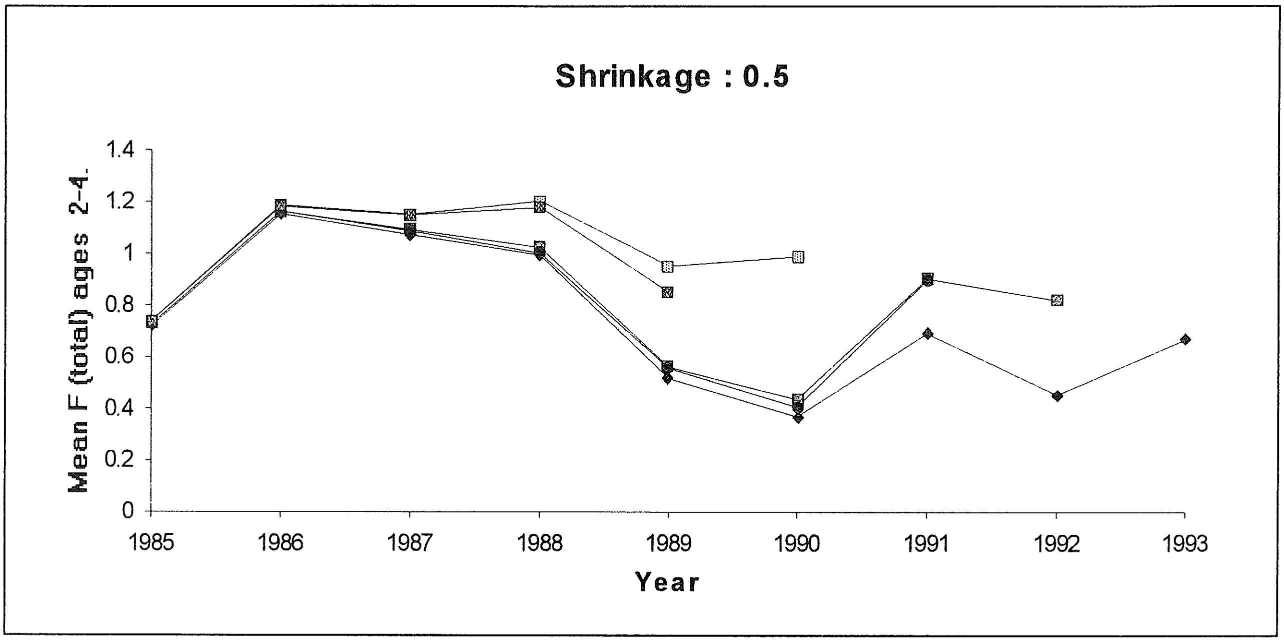


Fig. 4.3.4 : WHITING in Division VIId.
Recruitment and spawning stock biomass.

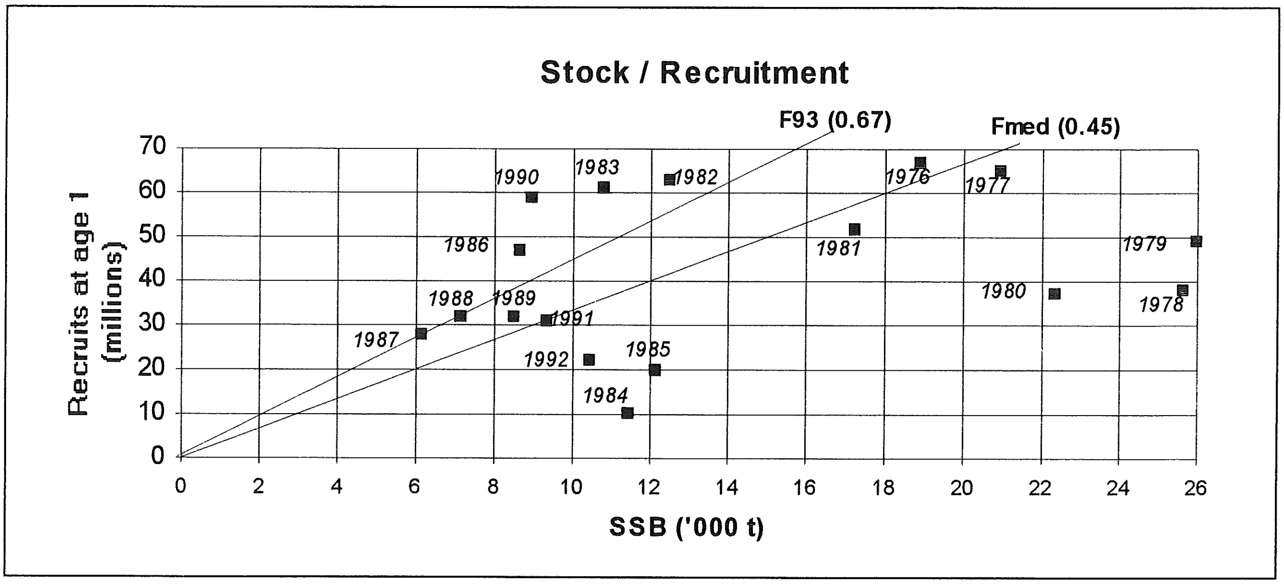


Fig. 4.3.5 : WHITING in Division VIId.
Yield per recruit-Long term yield and spawning biomass.

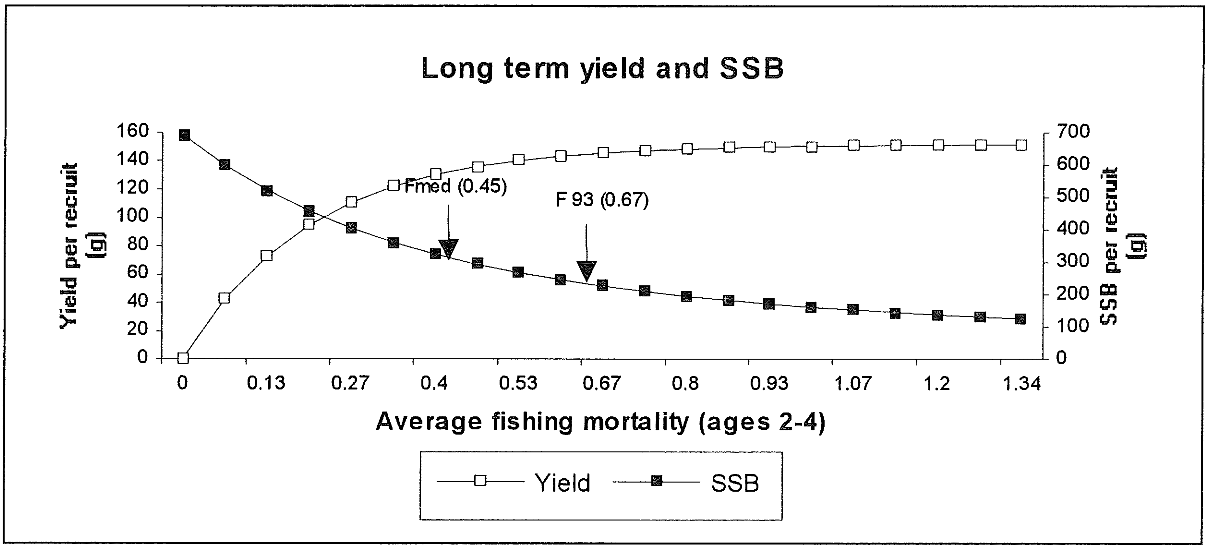


Fig. 4.3.6 : WHITING in Division VIId.
Short term yield and spawning biomass.

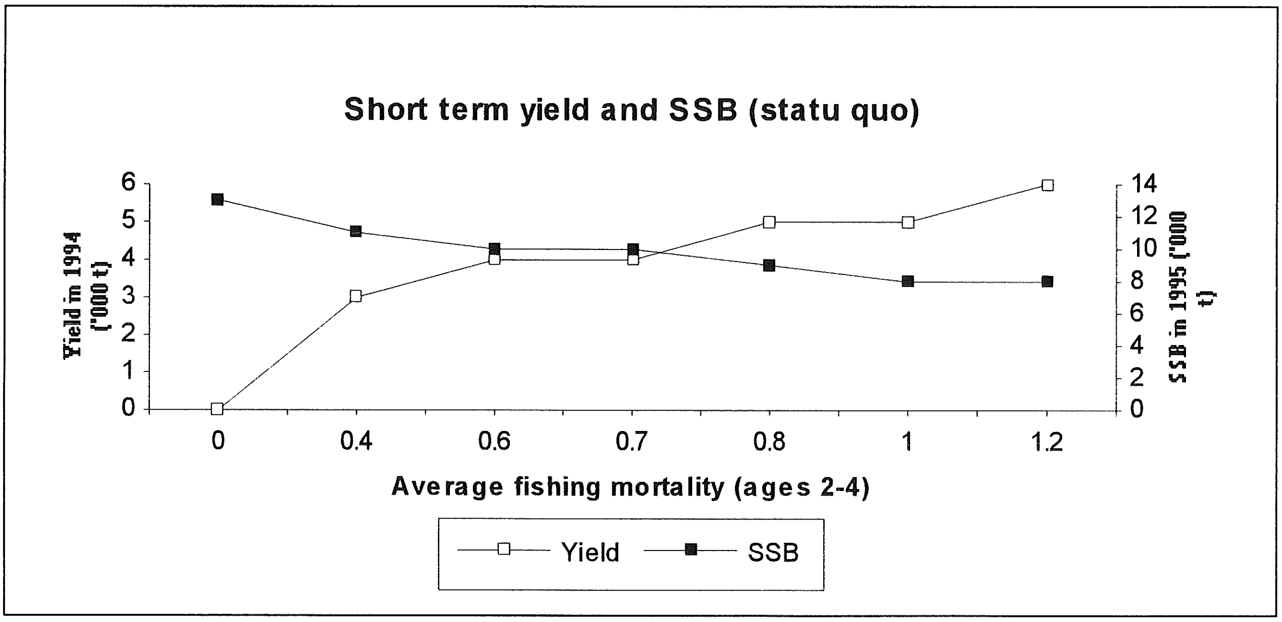


Fig. 4.3.7 : WHITING in Division VIId.
Linear sensitivity coefficients (elasticities).
Key to lebels is in Table 4.3.12

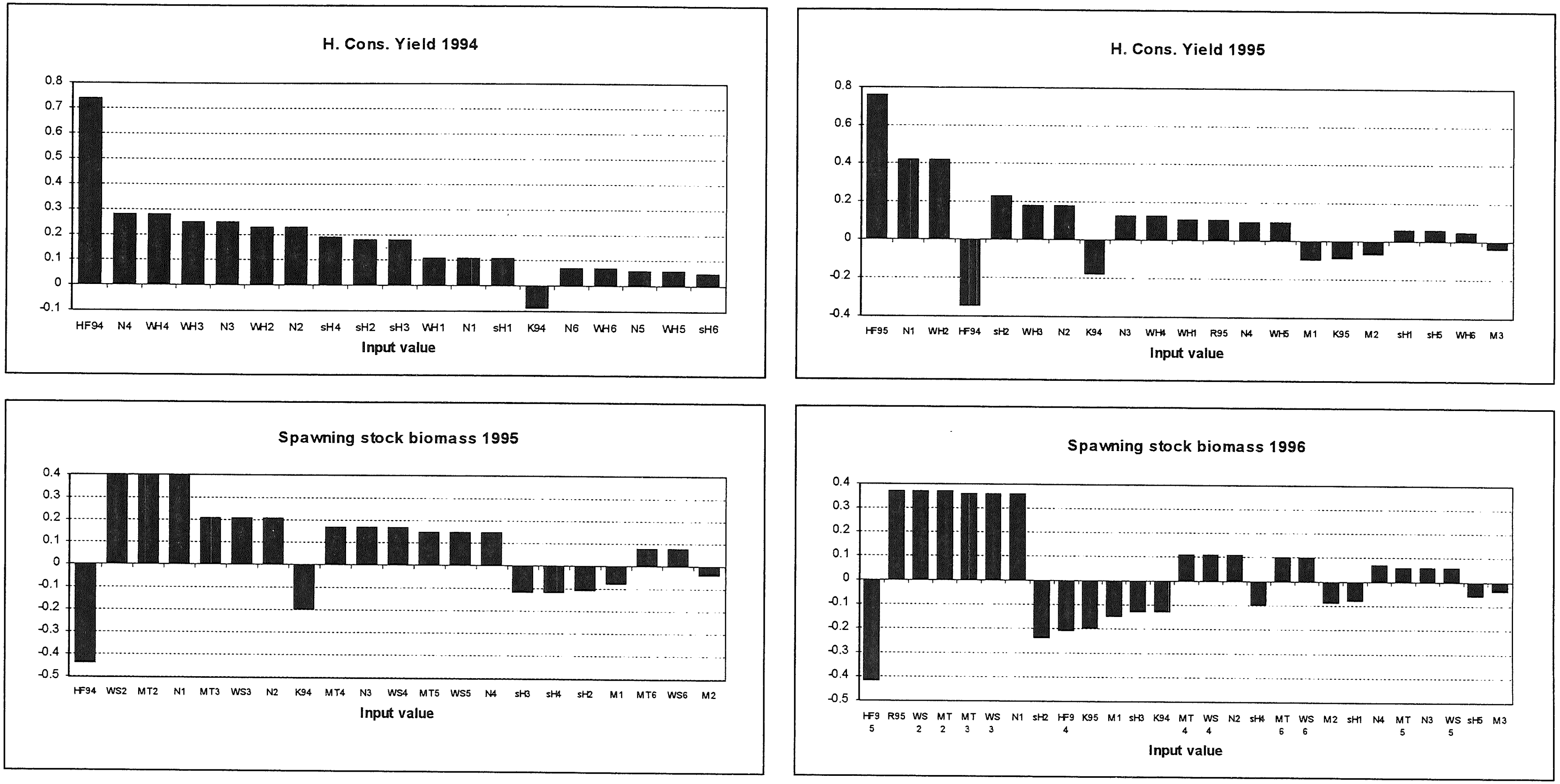


Fig. 4.3.8 : **WHITING in Division VIId.**
Proportion of total variance contributed by each input value.
Key to lebels is in Table 4.3.12

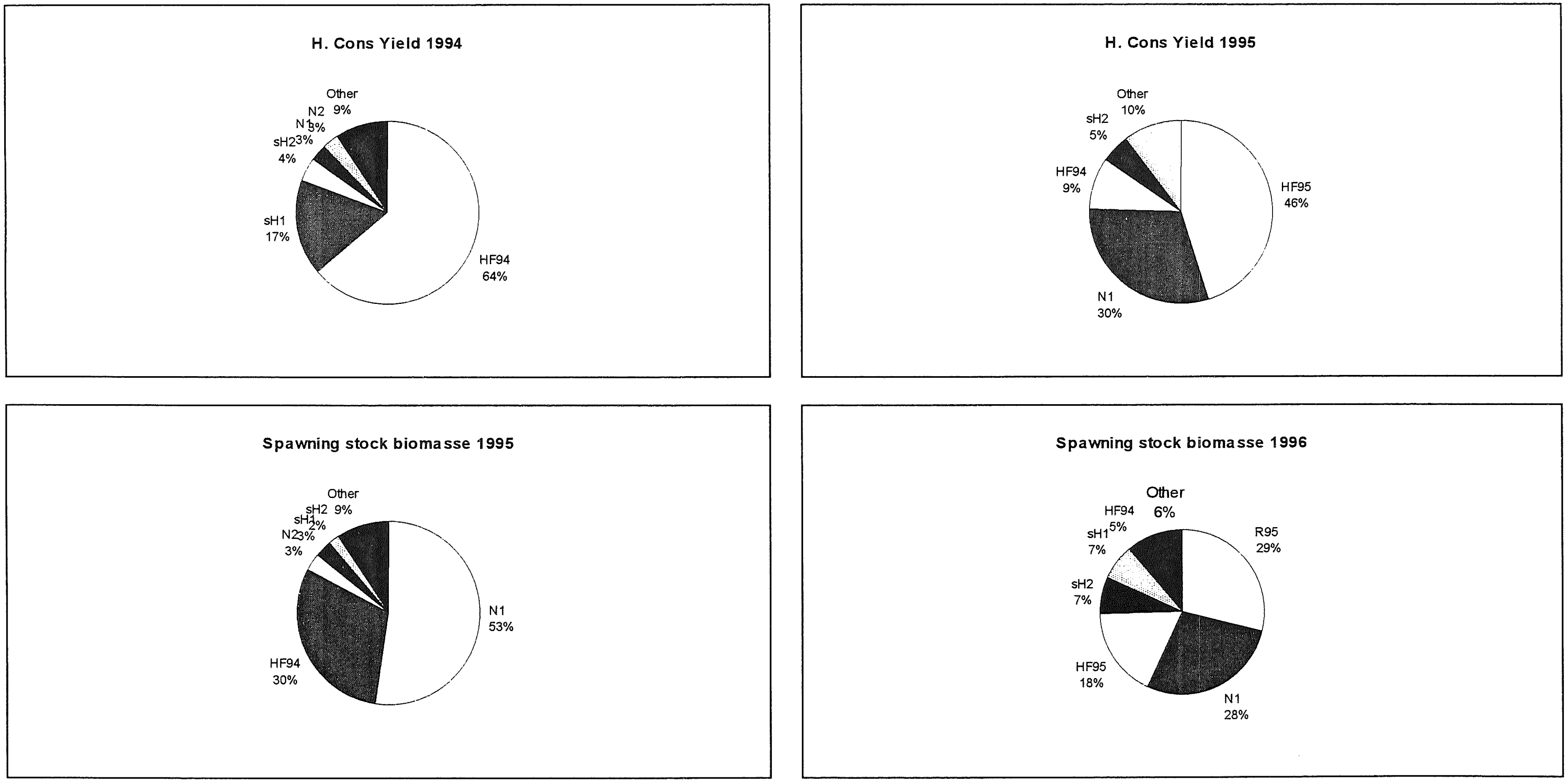


Fig. 4.3.9 : WHITING in Division VIId.
Cumulative probability distributions.

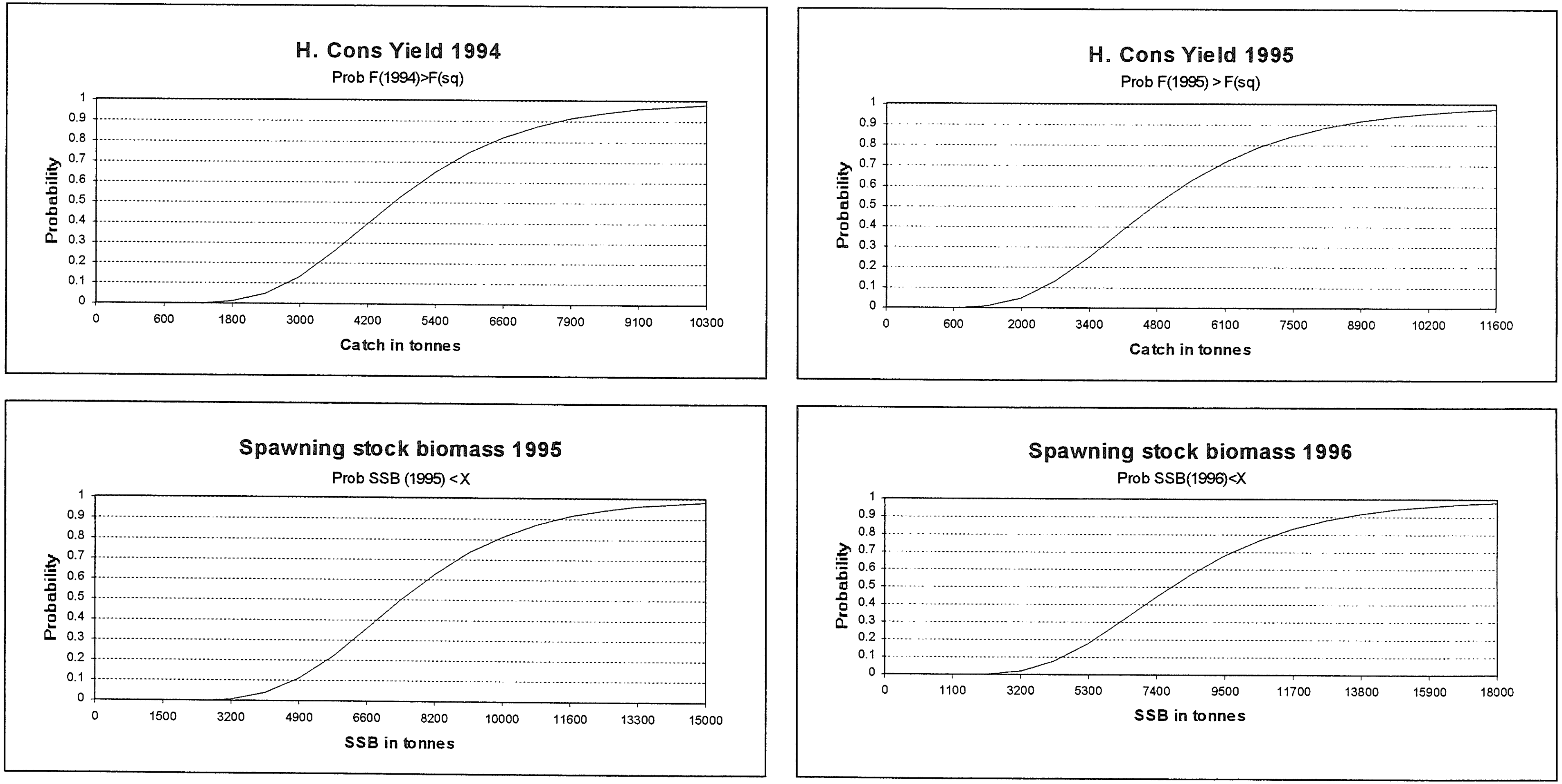
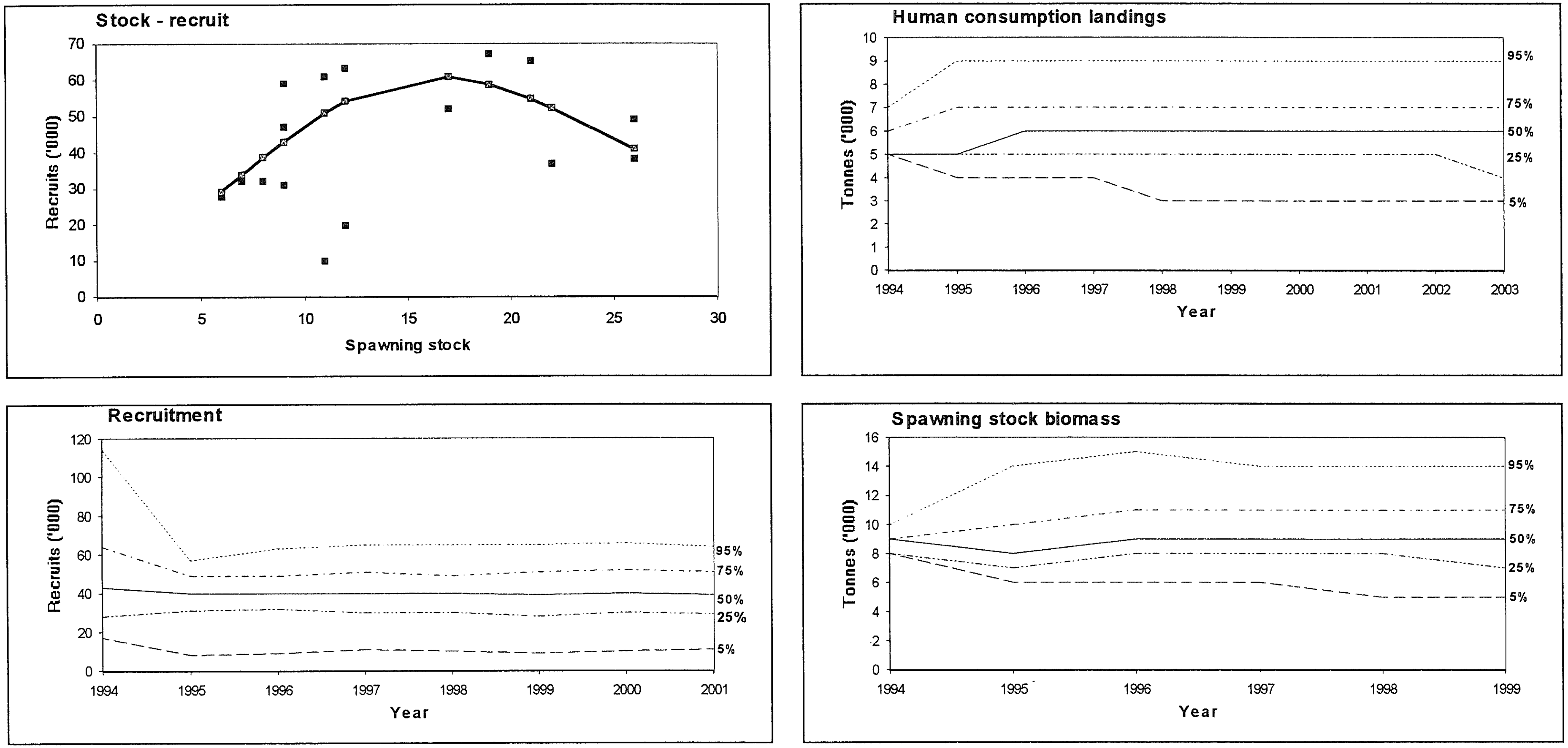


Fig. 4.3.10 : WHITING in Division VIId.
Results of medium-term predictions (Shepherd).



4.4 Sole in Division VIId

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. The trend in landings is shown in Figure 4.4.1. Landings have been stable over the past 6 years since peaking at about 4,900 t in 1987. The landings in 1993 were estimated to have been 4,423 t which is close to the figure predicted at *status quo* fishing mortality (4,488 t) but about 28% above the agreed TAC.

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). Quarterly catch and weight at age compositions for 1985-93 were available from Belgium, France and England. Prior to this, age data were provided from Belgium and England only and the database prior to 1980 was considered unreliable due to poor sampling for age. The age composition data and the mean weights 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 1 January. The data for 1982-1991 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

Commercial effort and CPUE data were available from three commercial fleets covering inshore and offshore trawlers and fixed net vessels. Trends in CPUE and effort are shown in Tables 4.4.14 and 4.4.15 and Figures 4.4.10 and 4.4.11.

Survey age compositions were available since 1988 from the English beam trawl survey in August in the eastern Channel (Table 4.4.16). Recruit survey estimates for 0 and 1-group fish were also available from the English and French YFS in Division VIId.

Both commercial and survey data were used to tune the VPA. The range of ages and years used in each fleet is shown in the input file in Table 4.4.3.

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.

All eight fleets were used in the first XSA run to determine whether catchability was dependent on year class strength for any age groups as indicated by slopes deviating significantly from 1. The regression statistics for the slope of catchability in this model were not significantly different from 1 for any age for both French trawl fleets and the Belgian beam trawl fleet but the Hastings Trammel and the UK Beam Trawl fleets showed significantly different slopes of q for ages 4 to 7 (t values up to 4.6, and high correlation coefficients r^2). A run was tried with the two English commercial fleets, comparing a constant q model with one in which catchability was allowed to trend with stock abundance at all ages below 8. The latter model gave abnormally low F levels (0.2-0.3) for ages 6 to 9 and was rejected.

In an attempt to explain the significantly different slopes of q for the two UK fleets, plots of the variation in catchability with time for each separate fleet (for ages 4-6) were produced from the output of separate Laurec-Shepherd tuning runs (Figure 4.4.2). There was no consistent trend in catchability with time, except for the two UK fleets and the French offshore fleet which showed slightly higher values at the start of the time-series. A down-weighting over 10 years was applied to the time-series to reduce the influence of these earlier years.

There was some evidence that q was influenced by stock size for 1-group fish in the French YFS and these age groups were consequently treated as recruits and the catchabilities set as dependent on year class strength for ages <2 in all subsequent runs.

Catchability was set as constant above age 7 as there appeared to be only a small decrease in q in all fleets above this age. F for the oldest true age was set at the mean of the four younger ages and the results of a retrospective analysis comparing different levels of shrinkage are given in Figure 4.4.3. Only one backward step was possible because the survey fleets were then excluded but comparisons with a run including only the commercial fleets showed a similar trend. In all cases there has been a tendency to overestimate F in previous years. The level of shrinkage had little effect on the overestimation and a moderate shrinkage of 0.5 was selected for the final run.

The results of the XSA run are given in Table 4.4.4 and tables of fishing mortality and stock size in Table 4.4.5.

4.4.5 Recruitment estimates

Research vessel survey indices of 0-, 1-, and 2-year olds were available for Division VIId and are shown in Table 4.4.16 and 4.4.17. These indices were used with RCT3 to estimate the 1991-94 year class abundance. The input files to RCT3 are given in Table 4.4.6 and the results in

4.4.7.

Geometric mean recruitment for the period 1980-91 was 20 million and arithmetic mean 21 million at age 1.

1991 year class: The XSA estimated this year class as 28 million at age 1 and this compares with 14 million at age 1 from the RCT3 run and GM 20 million. Since this year class already appears in the catch at age 1 and 2 and the same survey data have already been used in the XSA, the XSA value of 28 million at age 1 in 1992 (18 million at age 3 in 1994) was accepted.

1992 year class: At age 1, this was estimated to be below average by XSA (10.2 million) and RCT3 (12.2 million) compared with GM of 20 million. The RCT3 value was preferred because of the high residuals around the commercial catch at age of one year olds and was adjusted for mortality at age 1 to give 10.97 at age 2 in 1994.

1993 year class: This year class was estimated by RCT3 at 20.8 million close to the GM of 20 million and this survey estimate was used.

The GM was used in preference to the RCT3 estimate of the 1994 year class.

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 1987-89. Since then it has stabilised at around 0.45. The yield peaked in 1987 and has been relatively stable above 4,000 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 in 1992 and 1993 as the strong 1989 and 1990 year classes recruit to the stock.

4.4.7 Biological reference points

A stock recruitment scatter plot is shown in Figure 4.4.4. The points show no clear pattern of stock recruitment trend. The value of Fmed from the plot corresponds to the SQ F of 0.46 while Fhigh is estimated at 0.83. The yield per recruit input values are shown in Table 4.4.9 and the output summary in Table 4.4.9a. Yield/R and SSB/R curves are shown in Figure 4.4.5. Assuming AM recruitment of 22 million the equilibrium yield will average 3,800 t with a corresponding SSB of 7,700 t. Since the data are unreliable before 1982, it is not clear what level of SSB should be used to determine the minimum biologically acceptable level.

4.4.8 Short-term forecast

The input data for the catch forecasts and sensitivity analysis are given in Table 4.4.9. Stock numbers in 1994 were taken from the XSA output adjusted for recruitment at age 1 and 2. The GM recruitment of 20 million was used for age 1 in 1995 to 1996. The exploitation pattern was the mean for the period 1991-93, scaled to the 1993 F(3-8) value of 0.463. Catch and stock weights at age were the mean for the period 1991-93 and proportions of M and F before spawning were set to zero. The results of the *status quo* catch prediction are given in Tables 4.4.10 and 4.4.11 and Figure 4.4.5. The predicted catch in 1994 is 4300 t from a SSB of 9,200 t. This compares with a figure of 3,800 t forecast last year. Continuing with the same level of F implies a drop in catch to 3,800 t in 1995 and a fall in SSB to 7,500 t in 1995 and 7,400 t in 1996.

The results of the sensitivity analysis of the catch predictions are given in Figures 4.4.6 - 4.4.8. For yield, the prediction in 1994 is most sensitive to the variability in the estimate of F in 1994 and about equally sensitive to a range of other parameters such as the catch weight and number of the 3,4 and 5 year olds. The yield in 1995 is also most sensitive to the F in 1995. Figure 4.4.7 indicates the proportion of the variance contributed by each input. For the yield in 1994 and 1995, the F in the corresponding year contributes more than 50% of the variance. The figures indicate that errors in the estimate of the 1992 and 1993 year classes will have only a small influence on the estimate of the yield in 1995. The estimates of the 1991 and 1992 year classes are important for the SSB in 1995 but in 1996 the SSB estimate is dominated by the variance of the 1993 year class which contributes over 50%.

Figure 4.4.8 gives cumulative probability distributions for achieving selected yield or SSB within the constraints of SQ F. There is a high probability that SSB at the start of 1995 will be less than the value of 10,000 t estimated for 1993.

4.4.9 Medium-term predictions

The input parameters for the medium-term projections (10 years) for yield, spawning stock biomass and recruitment are given in Table 4.4.12. The projections were run for *status quo* F and an autocorrelation model was used. 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 Fmed and at this level the equilibrium SSB is predicted to fall to 7,700 t which is slightly above the minimum level observed in the short time series. Apart from the 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 4.4.13. The main change to the assessment compared with last year is the addition of the 1-group recruit series in the XSA tuning. This has had little effect on the results as the high standard errors at this age resulted in the 1 year olds receiving a low weighting in the analysis. Fishing mortality continues to show a fluctuating pattern from year to year which is regarded as a feature of the data rather than any real switching of effort in the fishery. In last year's report, is was noted that the 1991 year class had possibly been underestimated and the results of the current assessment suggest that this was the case. As a result the year class has been increased from the estimate of 12 million last year to 28 million. As the sensitivity analysis shows, this has a relatively small effect on the 1994 and 1995 yields but a larger effect on the 1995 spawning stock. It also explains the discrepancy between the 1994 SSB predicted last year and the current estimate.

4.4.12 Trends in effort and CPUE

Indices of cpue and effort from Belgian, French and UK fleets are given in Tables 4.4.14 and 4.4.15 and shown in Figures 4.4.10 and 4.4.11. All fleets show a decline in CPUE from 1988/89 to 1991 but some improvement since then. Effort has increased in all fleets since 1980 and despite a decrease in 1992 or 1993 remains at a high level.

4.4.13 Recruit indices

Recruit indices were available from English and French young fish surveys at 0- and 1-group and the English beam trawl survey in VIId. The results are shown in Tables 4.4.16 and 4.4.17. The 1993 year class was the strongest in the English series as 0-group since 1987 and the strongest as 1-group since 1990 in both the YFS and beam trawl indices. The 1993 year class was relatively weak in the French YFS. Only one estimate of the 1994 year class was available from the English YFS and this indicated an average size.

Table 4.4.1 SOLE in Division VIId. Nominal landings (tonnes) as officially reported to ICES, 1974-1993.

Year	Belgium	France	UK (E+W)	Others	Total reported	Unreported[1]	Total as used by WG
1974	159	469	309	3	940	-	940
1975	132	464	244	1	841	52	893
1976	203	599	404	-	1,206	90	1,296
1977	225	737	315	-	1,277	69	1,346
1978	241	782	366	-	1,389	75	1,464
1979	311	1,129	402	-	1,842	83	1,925
1980	302	1,075	159	-	1,536	183	1,719
1981	464	1,513	160	-	2,137	120	2,257
1982	525	1,828	317	4	2,674	145	2,819
1983	502	1,120	419	-	2,041	1,131	3,172
1984	592	1,309	505	-	2,406	880	3,286
1985	568	2,545	520	-	3,633	237	3,870
1986	858	1,528	551	-	2,937	991	3,928
1987	1,100	2,086	655	-	3,841	1,026	4,867
1988	667	2,057	578	-	3,302	644	3,946
1989	646	1,610[2]	689	-	2,945	1,212	4,157
1990	996	1,255[2]	742	-	2,993	964	3,957
1991	904	2,054[2]	825	-	3,783	513	4,296
1992[2]	891	2,187[2]	706	10	3,794	267	4,061
1993[2]	917	1,907[2]	610	13	3,447	976	4,423

[1]Estimated by the Working Group.
[2]Provisional.

Table 4.4.2 Sole in V11d

International catch at age ('000), Total , 1982 to 1993.

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	155	0	24	49	49	9	95	163	1271	383
2	2625	852	1977	3693	1264	3284	2227	3704	3092	7381
3	5256	3452	3157	5211	5377	3827	7393	3424	6326	3796
4	1727	3930	2610	1646	3273	3417	1648	4842	1257	4316
5	570	897	1900	1027	925	2166	1219	1530	1654	585
6	653	735	742	1860	790	1064	910	943	329	1003
7	549	627	457	144	1087	1110	400	651	432	256
8	240	333	317	158	156	828	268	218	293	257
9	122	108	136	156	192	114	280	181	138	272
10+	285	282	337	197	597	632	368	599	695	490

Age	1992	1993
1	106	85
2	4082	5225
3	8967	6716
4	1886	5735
5	2065	1057
6	295	645
7	382	171
8	140	206
9	184	123
10+	335	212

International mean weight at age (kg), Total catch, 1982 to 1993.

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	.102	.000	.100	.090	.135	.095	.102	.106	.121	.114
2	.171	.173	.178	.182	.179	.176	.152	.156	.180	.161
3	.225	.230	.234	.230	.212	.236	.226	.193	.240	.211
4	.312	.302	.314	.281	.306	.295	.278	.274	.291	.267
5	.386	.404	.380	.368	.362	.353	.358	.295	.351	.349
6	.428	.436	.436	.394	.385	.407	.407	.357	.343	.390
7	.439	.435	.417	.516	.435	.412	.458	.391	.469	.415
8	.509	.524	.538	.543	.519	.479	.509	.469	.463	.426
9	.502	.537	.529	.594	.501	.463	.551	.516	.489	.433
10+	.612	.614	.670	.729	.574	.598	.642	.630	.557	.543

Age	1992	1993
1	.103	.085
2	.153	.148
3	.202	.197
4	.267	.245
5	.291	.331
6	.399	.374
7	.386	.528
8	.455	.540
9	.445	.505
10+	.529	.677

Stock mean weight at age (kg), 1982 to 1993.

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	.059	.070	.067	.065	.070	.072	.073	.060	.070	.061
2	.114	.135	.131	.129	.136	.139	.141	.119	.135	.119
3	.167	.197	.192	.192	.198	.203	.206	.175	.196	.175
4	.217	.255	.249	.254	.256	.262	.267	.230	.253	.228
5	.263	.309	.304	.315	.309	.318	.324	.283	.305	.278
6	.306	.359	.355	.376	.358	.370	.377	.335	.353	.326
7	.347	.406	.403	.436	.403	.417	.426	.385	.396	.371
8	.384	.448	.448	.495	.443	.461	.471	.433	.435	.413
9	.418	.487	.490	.554	.480	.500	.512	.479	.470	.453
10+	.450	.522	.529	.611	.512	.536	.549	.523	.500	.490

Age	1992	1993
1	.057	.067
2	.113	.130
3	.165	.190
4	.216	.246
5	.264	.300
6	.310	.350
7	.353	.397
8	.394	.441
9	.433	.481
10+	.469	.518

Table 4.4.3 Sole in V11d Tuning input data

```
V11D SOLE,TUNING FILE,UK,BELG,FRANCE [rev:9/9/94]
108
BELGIAN BT (HP CORRECTED EFFORT & ALL GEARS AGE COMP)
1980 1993
1 1 0 1
2 15
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
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
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
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
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
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
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 29.3
27.1 843.6 451 739.3 724.4 344.5 232.4 152.7 25.3 86.5 56 56.1 54.5 9.3 109.0
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
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
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
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
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
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
HASTINGS TRAMMEL (FLEET EFFORT & UK TRAMMEL AGE COMPS)
1981 1993
1 1 0 1
2 15
2.1 8.9 18.0 19.0 58.2 27.7 8.9 10.8 6.2 0.4 0.9 1.1 0.5 0.6 7.7
5.9 33.5 301.7 24.5 13.8 50.8 11.8 8.1 10.0 16.1 6.1 0.0 1.9 1.1 12.3
3.3 24.1 109.7 325.9 3.1 5.2 14.0 9.1 2.1 0.0 0.0 0.0 0.0 6.0 3.8
4.4 23.8 128.0 168.6 262.6 7.5 4.9 9.6 6.3 4.7 2.1 1.4 2.4 1.0 6.2
3.8 2.0 396.5 94.6 50.1 160.6 1.1 1.6 12.8 0.6 1.0 0.8 1.5 0.8 0.8
3.7 17.6 184.4 267.6 73.3 74.8 113.8 3.9 5.5 14.5 4.6 4.7 2.9 4.3 10.6
4.2 48.4 113.1 203.5 182.0 38.5 37.8 72.8 5.9 1.8 4.2 3.3 2.6 1.2 2.9
6.1 3.1 241.6 50.5 95.3 128.1 32.0 26.6 72.5 0.1 6.4 14.0 0.6 0.0 0.0
5.7 31.9 104.7 345.9 38.8 65.2 52.9 12.2 11.5 36.6 1.8 1.6 4.2 4.8 12.0
9.8 78.8 645.7 84.5 121.8 17.0 21.6 23.1 4.2 6.9 28.8 2.2 0.5 2.6 7.8
14.6 300.1 280.2 610.2 25.6 104.0 16.0 25.9 34.7 8.6 4.5 27.5 0.5 0.0 12.2
7.2 51.8 421.2 104.3 322.3 18.5 46.1 15.6 29.4 10.5 3.8 4.9 8.5 0.5 5.9
7.6 120.6 183.8 224.1 41.8 83.0 9.5 19.3 7.7 5.0 5.9 2.2 2.4 4.1 4.9
UK. >40FT.BEAM TRAWL(FLEET EFFORT & ALL TRAWL AGE COMPS DE-RAISED)
1981 1993
1 1 0 1
2 15
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
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
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
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
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
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
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
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
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
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
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
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
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
```

Continued

Table 4.4.3 cont

FRENCH OFFSHORE TRAWLERS,PORT EN BESSIN,FLEET EFFORT(Kg metier/cpue metier)
1983 1993
1 1 0 1
2 15
1816.7 11.6 60.5 44.6 18.2 14.7 10.8 4.9 1.8 1.5 0.6 0.5 0.1 0.2 0.6
2801.3 32.7 75.2 58.7 26.1 21.1 12.9 6.1 2.0 2.0 0.9 0.7 0.1 0.2 1.0
6771.5 320.5 310.7 115.0 67.1 111.9 8.1 11.9 7.5 3.7 0.8 0.9 0.1 0.6 1.3
8067.3 74.5 246.1 145.5 38.0 31.6 45.5 9.5 9.9 8.9 6.4 1.2 0.4 0.6 4.6
6036.7 92.4 172.3 113.9 50.1 36.1 46.6 26.4 4.5 4.4 1.7 1.4 1.9 0.5 2.0
6065.9 64.9 194.4 43.2 18.8 14.7 8.4 5.7 2.3 1.2 1.3 0.8 0.7 0.3 1.3
5815.4 116.1 92.2 118.7 24.6 15.9 9.0 4.7 4.1 4.7 1.0 1.1 1.2 0.8 1.9
7485.7 82.3 144.8 37.9 42.8 8.4 7.1 6.5 3.9 4.0 4.2 2.5 2.4 1.5 2.4
9540.3 354.0 98.0 125.8 25.5 28.9 9.9 8.7 10.2 3.4 3.4 4.3 0.4 1.0 4.0
9261.4 139.0 262.1 48.9 31.4 9.8 9.3 3.5 3.3 2.8 3.4 0.8 0.8 0.2 1.3
8981.0 203.4 290.4 254.2 45.5 15.4 6.9 6.5 4.2 2.5 1.0 0.3 0.3 0.3 0.1
FR INSHORE OT,MANCHE EST (all fleets age comp)eff=all fleet lands/metier cpue)
1985 1993
1 1 0 1
2 15
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
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
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
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
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
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
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
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
544.6 260.4 371.7 325.4 58.3 19.6 8.9 8.4 5.3 3.2 1.3 0.4 0.4 0.4 0.1
UK BEAM TRAWL SURVEY
1988 1993
1 1 .5 .75
1 6
1.0 8.2 14.2 9.9 0.8 1.3 1.2
1.0 2.6 15.4 3.4 1.7 0.6 1.1
1.0 12.1 3.7 3.4 0.7 0.8 0.5
1.0 8.9 22.8 2.2 2.3 0.3 1.0
1.0 1.4 12.0 10.0 0.7 1.1 1.8
1.0 0.5 17.5 8.4 7.0 0.8 1.9
ENGLISH YFS
1985 1993
1 1 .5 .75
1 1
1.0 0.9
1.0 1.4
1.0 1.0
1.0 1.8
1.0 0.8
1.0 2.3
1.0 5.4
1.0 2.2
1.0 1.1
FRENCH YFS
1987 1993
1 1 .5 .75
1 1
1.0 0.04
1.0 0.08
1.0 0.08
1.0 0.25
1.0 0.21
1.0 0.13
1.0 0.02

Table 4.4.4 Sole in V11d Tuning diagnostics

Lowestoft VPA Version 3.1

8/10/1994 17:49

Extended Survivors Analysis

107D SOLE 1994 WG,1-15+,80-93,SEXES COMB,MILLNER

CPUE data from file s7dtun93.vpa

Catch data for 12 years. 1982 to 1993. Ages 1 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
BELGIAN BT (HP CORRE,	1982,	1993,	2,	9,	.000,	1.000
HASTINGS TRAMMEL (FL,	1982,	1993,	2,	9,	.000,	1.000
UK. >40FT.BEAM TRAWL,	1982,	1993,	2,	9,	.000,	1.000
FRENCH OFFSHORE TRAW,	1983,	1993,	2,	9,	.000,	1.000
FR INSHORE OT,MANCHE,	1985,	1993,	2,	9,	.000,	1.000
ENGLISH BTS,	1988,	1993,	1,	6,	.500,	.750
ENGLISH YFS ,	1985,	1993,	1,	1,	.500,	.750
FRENCH YFS ,	1987,	1993,	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 < 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 >= 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 = .500

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 = .00097

Final year F values

Age ,	1,	2,	3,	4,	5,	6,	7,	8,	9
Iteration 29,	.0088,	.2442,	.5064,	.5108,	.5394,	.3955,	.4246,	.4020,	.5406
Iteration 30,	.0088,	.2442,	.5063,	.5108,	.5393,	.3953,	.4245,	.4018,	.5403

Regression weights

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

Continued

Table 4.4.4 cont

Fleet : BELGIAN BT (HP CORRE

Regression statistics :

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,	1.48,	-.212,	5.71,	.04,	10,	2.25,	-7.08,
3,	1.15,	-.250,	4.95,	.40,	10,	.64,	-5.55,
4,	.94,	.169,	5.84,	.63,	10,	.47,	-5.64,
5,	1.00,	.008,	5.28,	.47,	10,	.49,	-5.27,
6,	.75,	.728,	6.14,	.66,	10,	.38,	-5.67,
7,	.96,	.193,	5.50,	.82,	10,	.27,	-5.43,
8,	1.00,	-.004,	5.77,	.64,	10,	.32,	-5.77,
9,	82.90,	-2.411,	-41.76,	.00,	10,	29.50,	-5.58,

Fleet : HASTINGS TRAMMEL (FL

Regression statistics :

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,	.48,	1.270,	8.94,	.58,	10,	.41,	-7.85,
3,	1.20,	-.435,	4.99,	.53,	10,	.49,	-5.74,
4,	.84,	.416,	5.96,	.60,	10,	.50,	-5.38,
5,	.38,	3.380,	7.09,	.87,	10,	.17,	-5.44,
6,	.54,	2.179,	6.36,	.84,	10,	.23,	-5.35,
7,	.55,	1.455,	6.20,	.71,	10,	.37,	-5.53,
8,	.71,	.609,	5.78,	.52,	10,	.41,	-5.44,
9,	.49,	1.267,	5.70,	.59,	10,	.35,	-5.22,

Fleet : UK. >40FT.BEAM TRAWL

Regression statistics :

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,	1.28,	-.507,	6.97,	.44,	10,	.54,	-7.61,
3,	.97,	.122,	6.88,	.76,	10,	.29,	-6.79,
4,	.89,	.581,	6.96,	.86,	10,	.25,	-6.72,
5,	.43,	4.313,	7.60,	.93,	10,	.13,	-6.92,
6,	.63,	1.881,	7.13,	.86,	10,	.22,	-6.87,
7,	.64,	1.250,	7.14,	.74,	10,	.35,	-7.20,
8,	.55,	.940,	6.89,	.50,	10,	.43,	-7.11,
9,	.61,	1.467,	6.60,	.77,	10,	.23,	-6.88,

Continued

Table 4.4.4 cont

Fleet : FRENCH OFFSHORE TRAW

Regression statistics :

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,	1.04,	-.135,	13.98,	.72,	10,	.30,	-13.82,
3,	1.75,	-1.186,	15.70,	.37,	10,	.68,	-13.07,
4,	.82,	.982,	12.27,	.87,	10,	.24,	-13.02,
5,	1.93,	-1.322,	18.04,	.32,	10,	.67,	-13.25,
6,	.85,	.429,	12.57,	.67,	10,	.37,	-13.43,
7,	.93,	.168,	12.91,	.56,	10,	.52,	-13.37,
8,	.68,	1.127,	11.26,	.74,	10,	.25,	-13.43,
9,	18.84,	-1.608,	140.89,	.00,	10,	9.64,	-13.31,

Fleet : FR INSHORE OT,MANCHE

Regression statistics :

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,	.97,	.085,	10.83,	.65,	9,	.36,	-10.85,
3,	1.03,	-.059,	10.12,	.46,	9,	.56,	-10.10,
4,	.83,	.848,	9.85,	.86,	9,	.25,	-10.05,
5,	1.35,	-.705,	11.04,	.49,	9,	.47,	-10.28,
6,	1.29,	-.489,	11.31,	.39,	9,	.66,	-10.46,
7,	1.05,	-.086,	10.57,	.44,	9,	.66,	-10.41,
8,	1.02,	-.048,	10.55,	.52,	9,	.41,	-10.47,
9,	7.48,	-2.146,	37.45,	.03,	9,	2.62,	-10.35,

Fleet : ENGLISH BTS

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,	.50,	1.198,	9.39,	.63,	6,	.45,	-8.77,

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,	1.12,	-.172,	6.90,	.39,	6,	.64,	-7.22,
3,	1.04,	-.076,	7.48,	.54,	6,	.52,	-7.56,
4,	.67,	1.644,	8.28,	.88,	6,	.25,	-8.00,
5,	.84,	.686,	7.96,	.84,	6,	.20,	-7.95,
6,	15.21,	-1.547,	.05,	.00,	6,	8.94,	-6.99,

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,	1.15,	-.297,	9.21,	.47,	9,	.62,	-9.31,

Continued

Table 4.4.4 cont

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,	.61,	1.974,	11.36,	.87,	7,	.24,	-12.28,

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
BELGIAN BT (HP CORRE,	1.,	.000,	.000,	.00,	0,	.000,	.000
HASTINGS TRAMMEL (FL,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK. >40FT.BEAM TRAWL,	1.,	.000,	.000,	.00,	0,	.000,	.000
FRENCH OFFSHORE TRAW,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR INSHORE OT,MANCHE,	1.,	.000,	.000,	.00,	0,	.000,	.000
ENGLISH BTS,	7812.,	.582,	.000,	.00,	1,	.118,	.010
ENGLISH YFS ,	10869.,	.691,	.000,	.00,	1,	.084,	.007
FRENCH YFS ,	7520.,	.308,	.000,	.00,	1,	.421,	.011
P shrinkage mean ,	20799.,	.43,,,,				.216,	.004
F shrinkage mean ,	5102.,	.50,,,,				.161,	.016

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
9114.,	.20,	.25,	5,	1.224,	.009

1

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
BELGIAN BT (HP CORRE,	82534.,	1.483,	.000,	.00,	1,	.009,	.058
HASTINGS TRAMMEL (FL,	34280.,	.966,	.000,	.00,	1,	.021,	.135
UK. >40FT.BEAM TRAWL,	15716.,	.424,	.000,	.00,	1,	.108,	.275
FRENCH OFFSHORE TRAW,	19135.,	.300,	.000,	.00,	1,	.216,	.231
FR INSHORE OT,MANCHE,	20700.,	.356,	.000,	.00,	1,	.153,	.215
ENGLISH BTS,	13617.,	.376,	.406,	1.08,	2,	.137,	.311
ENGLISH YFS ,	17143.,	.670,	.000,	.00,	1,	.043,	.255
FRENCH YFS ,	16595.,	.300,	.000,	.00,	1,	.214,	.262
F shrinkage mean ,	19790.,	.50,,,,				.099,	.224

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17972.,	.14,	.09,	10,	.628,	.244

Continued

Table 4.4.4 cont

Age 3 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
BELGIAN BT (HP CORRE,	14022.,	.509,	.034,	.07,	2,	.049,	.375
HASTINGS TRAMMEL (FL,	5816.,	.374,	.152,	.41,	2,	.090,	.741
UK. >40FT.BEAM TRAWL,	8070.,	.246,	.031,	.13,	2,	.202,	.583
FRENCH OFFSHORE TRAW,	8389.,	.248,	.220,	.89,	2,	.186,	.566
FR INSHORE OT,MANCHE,	12653.,	.296,	.032,	.11,	2,	.130,	.409
ENGLISH BTS,	11446.,	.300,	.153,	.51,	3,	.129,	.444
ENGLISH YFS ,	27470.,	.813,	.000,	.00,	1,	.016,	.209
FRENCH YFS ,	12586.,	.304,	.000,	.00,	1,	.113,	.410
F shrinkage mean ,	8613.,	.50,,,,				.086,	.555

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
9692.,	.11,	.08,	16,	.721,	.506

1

Age 4 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
BELGIAN BT (HP CORRE,	8365.,	.363,	.109,	.30,	3,	.071,	.502
HASTINGS TRAMMEL (FL,	6488.,	.325,	.218,	.67,	3,	.078,	.610
UK. >40FT.BEAM TRAWL,	7260.,	.197,	.055,	.28,	3,	.225,	.560
FRENCH OFFSHORE TRAW,	8593.,	.203,	.148,	.73,	3,	.208,	.492
FR INSHORE OT,MANCHE,	9426.,	.227,	.079,	.35,	3,	.173,	.457
ENGLISH BTS,	11233.,	.271,	.190,	.70,	4,	.109,	.396
ENGLISH YFS ,	5649.,	.701,	.000,	.00,	1,	.011,	.676
FRENCH YFS ,	7642.,	.313,	.000,	.00,	1,	.054,	.539
F shrinkage mean ,	6395.,	.50,,,,				.072,	.617

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
8185.,	.10,	.05,	22,	.572,	.511

Age 5 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
BELGIAN BT (HP CORRE,	1960.,	.308,	.178,	.58,	4,	.093,	.414
HASTINGS TRAMMEL (FL,	1164.,	.330,	.126,	.38,	4,	.061,	.622
UK. >40FT.BEAM TRAWL,	1096.,	.201,	.113,	.56,	4,	.159,	.651
FRENCH OFFSHORE TRAW,	1324.,	.198,	.211,	1.06,	4,	.193,	.565
FR INSHORE OT,MANCHE,	1702.,	.207,	.195,	.94,	4,	.193,	.464
ENGLISH BTS,	1447.,	.220,	.170,	.77,	5,	.191,	.528
ENGLISH YFS ,	774.,	.815,	.000,	.00,	1,	.004,	.833
FRENCH YFS ,	1786.,	.331,	.000,	.00,	1,	.027,	.447
F shrinkage mean ,	1182.,	.50,,,,				.078,	.615

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1407.,	.09,	.07,	28,	.726,	.539

Continued

Table 4.4.4 cont

1

Age 6 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
BELGIAN BT (HP CORRE,	1170.,	.300,	.183,	.61,	5,	.114,	.422
HASTINGS TRAMMEL (FL,	1999.,	.355,	.155,	.44,	5,	.079,	.268
UK. >40FT.BEAM TRAWL,	1877.,	.229,	.104,	.45,	5,	.168,	.283
FRENCH OFFSHORE TRAW,	941.,	.212,	.079,	.37,	5,	.201,	.502
FR INSHORE OT,MANCHE,	1091.,	.219,	.117,	.53,	5,	.180,	.446
ENGLISH BTS,	1419.,	.229,	.092,	.40,	6,	.150,	.359
ENGLISH YFS ,	1065.,	.811,	.000,	.00,	1,	.003,	.455
FRENCH YFS ,	968.,	.367,	.000,	.00,	1,	.015,	.491
F shrinkage mean ,	1016.,	.50,,,,				.089,	.472

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1266.,	.10,	.06,	34,	.613,	.395

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
BELGIAN BT (HP CORRE,	301.,	.224,	.075,	.34,	6,	.237,	.432
HASTINGS TRAMMEL (FL,	228.,	.347,	.158,	.45,	6,	.074,	.538
UK. >40FT.BEAM TRAWL,	244.,	.231,	.176,	.76,	6,	.149,	.511
FRENCH OFFSHORE TRAW,	355.,	.213,	.050,	.23,	6,	.182,	.377
FR INSHORE OT,MANCHE,	371.,	.221,	.152,	.69,	6,	.161,	.364
ENGLISH BTS,	334.,	.238,	.267,	1.12,	5,	.101,	.396
ENGLISH YFS ,	298.,	1.014,	.000,	.00,	1,	.001,	.436
FRENCH YFS ,	351.,	.432,	.000,	.00,	1,	.007,	.381
F shrinkage mean ,	296.,	.50,,,,				.088,	.438

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
308.,	.10,	.06,	38,	.555,	.424

1

Age 8 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
BELGIAN BT (HP CORRE,	354.,	.223,	.115,	.52,	7,	.227,	.440
HASTINGS TRAMMEL (FL,	499.,	.356,	.104,	.29,	7,	.093,	.331
UK. >40FT.BEAM TRAWL,	475.,	.272,	.088,	.32,	7,	.112,	.345
FRENCH OFFSHORE TRAW,	378.,	.232,	.076,	.33,	7,	.209,	.418
FR INSHORE OT,MANCHE,	404.,	.240,	.081,	.34,	7,	.202,	.395
ENGLISH BTS,	320.,	.257,	.089,	.35,	4,	.055,	.477
ENGLISH YFS ,	237.,	1.260,	.000,	.00,	1,	.001,	.603
FRENCH YFS ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	404.,	.50,,,,				.101,	.395

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
396.,	.11,	.04,	41,	.354,	.402

Continued

Table 4.4.4 cont

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

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
BELGIAN BT (HP CORRE,	170.,	.216,	.152,	.70,	8,	.216,	.524
HASTINGS TRAMMEL (FL,	140.,	.339,	.208,	.61,	8,	.090,	.609
UK. >40FT.BEAM TRAWL,	153.,	.273,	.143,	.52,	8,	.134,	.568
FRENCH OFFSHORE TRAW,	142.,	.225,	.120,	.53,	8,	.194,	.600
FR INSHORE OT,MANCHE,	179.,	.226,	.108,	.48,	8,	.214,	.503
ENGLISH BTS,	133.,	.292,	.173,	.59,	3,	.038,	.631
ENGLISH YFS ,	118.,	2.109,	.000,	.00,	1,	.000,	.687
FRENCH YFS ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	211.,	.50,,,,				.114,	.442

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
163.,	.11,	.06,	45,	.512,	.540

TABLE 4.4.5 Sole in V11d

International F at age, Total , 1982 to 1993.

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	.013	.000	.001	.004	.002	.001	.004	.011	.032	.015
2	.186	.081	.111	.216	.118	.155	.264	.187	.271	.238
3	.323	.352	.423	.419	.493	.545	.540	.721	.492	.550
4	.484	.378	.435	.361	.449	.592	.423	.731	.560	.652
5	.212	.442	.282	.271	.315	.535	.384	.776	.522	.488
6	.296	.411	.711	.434	.307	.635	.398	.511	.327	.614
7	.510	.454	.429	.251	.432	.815	.460	.489	.412	.404
8	.566	.590	.387	.229	.418	.606	.409	.433	.377	.408
9	.397	.476	.451	.298	.425	.544	.373	.474	.477	.634
10+	.397	.476	.451	.298	.425	.544	.373	.474	.477	.634

Age	1992	1993
1	.004	.009
2	.198	.244
3	.448	.506
4	.515	.511
5	.666	.539
6	.432	.395
7	.442	.424
8	.358	.402
9	.508	.540
10+	.508	.540

Tuned Stock Numbers at age (10**-3), 1982 to 1994, (numbers in 1994 are VPA survivors)

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	12915	21829	22067	13219	26613	11153	25313	15291	41773	26851
2	16271	11539	19752	19944	11914	24034	10083	22814	13681	36589
3	20033	12225	9630	15991	14533	9578	18623	7005	17119	9438
4	4730	13127	7778	5711	9513	8036	5026	9818	3082	9473
5	3134	2638	8139	4555	3602	5494	4021	2980	4278	1593
6	2682	2294	1533	5558	3145	2379	2911	2478	1241	2298
7	1445	1806	1376	682	3259	2094	1141	1768	1346	810
8	584	785	1037	811	480	1915	839	651	981	807
9	391	300	394	637	583	286	945	504	382	609
10+	911	779	972	802	1806	1576	1238	1662	1916	1090

Age	1992	1993	1994
1	28132	10161	0
2	23931	25354	9114
3	26086	17771	17972
4	4929	15074	9692
5	4466	2666	8185
6	885	2077	1407
7	1125	520	1266
8	490	654	308
9	485	310	396
10+	880	531	443

Table 4.4.6 Sole in V11d. RCT3 Input

Year Class	VPA 1 gp	enyfs0	enyfs1	frbds0	frbds1	enbts1
1980	17982	-11	4.08	1.07	0.77	-11
1981	12915	2.6	1.27	2	0.03	-11
1982	21829	3.31	2.04	0.46	0.02	-11
1983	22067	13.86	3.76	0.38	-11	-11
1984	13219	2.2	0.9	-11	-11	-11
1985	26613	4.97	1.41	-11	-11	-11
1986	11153	4.2	0.96	-11	0.04	-11
1987	25313	8.23	1.8	0.36	0.08	8.2
1988	15291	2.9	0.82	0.02	0.08	2.6
1989	41773	5.3	2.29	7.7	0.25	12.1
1990	26851	4.47	5.4	0.25	0.21	8.9
1991	-11	1.6	2.2	0.46	0.13	1.4
1992	-11	2.7	0.91	0.21	0.02	0.5
1993	-11	7.38	2.78	0.12	-11	4.8
1994	-11	4.77	-11	-11	-11	-11

Table 4.4.7 Recruitment analysis Age 1

Analysis by RCT3 ver3.1 of data from file :

c:\nsdwg94\s7prep94\s7drec93.dat

7d Sole

Data for 5 surveys over 15 years : 1980 - 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 = 1991

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	1.91	6.63	.81	.236	10	.96	8.45	1.103	.047
enyfs1	1.73	8.05	.67	.297	11	1.16	10.06	.782	.094
frbds0	.96	9.39	.66	.277	8	.38	9.75	.834	.083
frbds1	9.40	8.58	1.64	.082	8	.12	9.73	2.062	.014
enbts1	.77	8.55	.16	.912	4	.88	9.22	.374	.414
					VPA Mean =		9.91	.408	.347

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	1.94	6.57	.82	.234	10	1.31	9.11	1.032	.064
enyfs1	1.72	8.07	.67	.303	11	.65	9.18	.826	.100
frbds0	.91	9.43	.62	.303	8	.19	9.60	.819	.102
frbds1	9.19	8.64	1.55	.094	8	.02	8.82	2.041	.016
enbts1	.77	8.55	.16	.912	4	.41	8.86	.464	.317
					VPA Mean =		9.92	.412	.401

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	1.99	6.50	.84	.232	10	2.13	10.72	1.061	.037
enyfs1	1.71	8.09	.67	.310	11	1.33	10.36	.811	.064
frbds0	.85	9.48	.59	.334	8	.11	9.57	.796	.066
frbds1									
enbts1	.77	8.55	.16	.912	4	1.76	9.90	.266	.592
					VPA Mean =		9.92	.418	.241

Continued

Table 4.4.7 cont

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	2.04	6.41	.86	.229	10	1.75	9.98	1.052	.140
enyfs1									
frbds0									
frbds1									
enbts1									
					VPA Mean =		9.93	.424	.860

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1991	14097	9.55	.24	.19	.61		
1992	12168	9.41	.26	.21	.64		
1993	20799	9.94	.20	.10	.26		
1994	20748	9.94	.39	.02	.00		

Table 4.4.8 Sole in V11d. VPA summary table

Terminal Fs derived using XSA (With F shrinkage)

Year	Recruits Age1 thousands	TotBiomass tonnes	SSB tonnes	Yield tonnes	SOP	Yield/SSB	FBAR 3- 8
1980	27872	9496	6067	1719	0.88	0.28	0.327
1981	17982	11352	6453	2257	0.90	0.35	0.359
1982	12915	9984	7368	2750	0.84	0.37	0.399
1983	21829	12160	9074	3115	0.89	0.34	0.438
1984	22067	12664	8598	3250	0.90	0.38	0.445
1985	13219	13107	9675	3837	1.00	0.40	0.328
1986	26613	13840	10356	3984	0.99	0.38	0.402
1987	11153	13658	9514	4974	1.00	0.52	0.621
1988	25313	12970	9700	3982	1.00	0.41	0.436
1989	15291	11002	7370	4187	1.00	0.57	0.61
1990	41773	12823	8052	4020	0.99	0.50	0.448
1991	26851	12514	6522	4296	0.98	0.66	0.519
1992	28132	12393	8085	4061	0.98	0.50	0.477
1993	12200(1)	13538	9561	4423	0.98	0.46	0.463
1994	20800(1)						
Arith. Mean	21276	12554	8656	3907		0.4583	0.4654

Geometric mean recruitment 1980-91: 20 million
Arithmetic mean recruitment 1980-91 21 million

1. Adjusted by recruitment surveys

Table 4.4.9. Sole Eastern Channel
Input data for catch forecast and linear sensitivity analysis.

Populations in 1994			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	20799	.42	WS1	.06	.08	M1	.10	.10	MT1	.00	.00
N2	10965	.25	WS2	.12	.08	M2	.10	.10	MT2	.00	.10
N3	17971	.14	WS3	.18	.07	M3	.10	.10	MT3	1.00	.10
N4	9690	.11	WS4	.23	.07	M4	.10	.10	MT4	1.00	.00
N5	8184	.10	WS5	.28	.07	M5	.10	.10	MT5	1.00	.00
N6	1405	.09	WS6	.33	.07	M6	.10	.10	MT6	1.00	.00
N7	1265	.10	WS7	.37	.07	M7	.10	.10	MT7	1.00	.00
N8	307	.10	WS8	.42	.07	M8	.10	.10	MT8	1.00	.00
N9	396	.11	WS9	.46	.07	M9	.10	.10	MT9	1.00	.00
N10	441	.11	WS10	.49	.08	M10	.10	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.01	1.16	WH1	.10	.34
sH2	.22	.38	WH2	.15	.07
sH3	.48	.16	WH3	.20	.07
sH4	.53	.12	WH4	.26	.07
sH5	.54	.27	WH5	.32	.10
sH6	.46	.27	WH6	.39	.07
sH7	.40	.18	WH7	.44	.10
sH8	.37	.25	WH8	.47	.08
sH9	.53	.13	WH9	.46	.09
sH10	.53	.13	WH10	.58	.10

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K94	1.00	.10	HF94	1.00	.18
K95	1.00	.10	HF95	1.00	.18
K96	1.00	.10	HF96	1.00	.18

Recruitment		
Labl	Value	CV
R95	20438	.42
R96	20438	.42

Stock numbers in 1994 are VPA survivors.
These are overwritten at Age 1 Age 2

Table 4.4.9a

Sole in the Eastern English Channel (Fishing Area VIId)

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	3593.190	8.603	3422.340	8.603	3422.340
0.2000	0.0926	0.427	155.690	6.242	1637.325	4.339	1466.671	4.339	1466.671
0.4000	0.1853	0.571	179.922	4.816	1042.371	2.915	871.913	2.915	871.913
0.6000	0.2779	0.644	181.830	4.092	766.743	2.192	596.481	2.192	596.481
0.8000	0.3705	0.688	178.553	3.652	613.151	1.754	443.083	1.754	443.083
1.0000	0.4632	0.718	174.256	3.357	517.706	1.461	347.834	1.461	347.834
1.2000	0.5558	0.740	170.102	3.145	453.782	1.250	284.105	1.250	284.105
1.4000	0.6484	0.756	166.393	2.986	408.488	1.092	239.005	1.092	239.005
1.6000	0.7411	0.769	163.168	2.861	374.932	0.969	205.643	0.969	205.643
1.8000	0.8337	0.780	160.383	2.760	349.151	0.870	180.056	0.870	180.056
2.0000	0.9263	0.789	157.976	2.677	328.739	0.788	159.837	0.788	159.837
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : S7YPR94
Date and time : 08OCT94:15:59
Computation of ref. F: Simple mean, age 3 - 8
F-0.1 factor : 0.2349
F-max factor : 0.5341
F-0.1 reference F : 0.1088
F-max reference F : 0.2474
Recruitment : Single recruit

Table 4.4.10 Sole Eastern Channel

Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year							
	1994	1995						
Mean F Ages								
H.cons 3 to 8	.46	.00	.19	.28	.32	.37	.46	.56
Effort relative to 1993								
H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Biomass at start of year								
Total	11.8	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Spawning	9.2	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Catch weight (,000t)								
H.cons	4.3	.0	1.7	2.5	2.8	3.2	3.8	4.4
Biomass at start of 1996								
Total		14.6	12.9	12.2	11.8	11.5	10.8	10.3
Spawning		11.1	9.4	8.7	8.3	8.0	7.4	6.8

	Year							
	1994	1995						
Effort relative to 1993								
H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.08	.13	.13	.13	.13	.13	.13	.13
Spawning	.08	.12	.12	.12	.12	.12	.12	.12
Catch weight								
H.cons	.17	.00	.43	.29	.25	.23	.19	.17
Biomass at start of 1996								
Total		.13	.15	.16	.16	.16	.16	.17
Spawning		.15	.17	.18	.18	.18	.19	.20

Table 4.4.11 Sole Eastern Channel
Detailed forecast tables.

Forecast for year 1994
F multiplier H.cons=1.00

Populations		Catch number	
Age	Stock No.	H.Cons	Total
1	20799	177	177
2	10966	2031	2031
3	17971	6513	6513
4	9691	3822	3822
5	8185	3251	3251
6	1406	493	493
7	1265	401	401
8	308	91	91
9	396	157	157
10	442	175	175
Wt	12	4	4

Forecast for year 1995
F multiplier H.cons=1.00

Populations		Catch number	
Age	Stock No.	H.Cons	Total
1	20438	174	174
2	18651	3454	3454
3	7995	2898	2898
4	10092	3980	3980
5	5151	2046	2046
6	4329	1517	1517
7	806	255	255
8	765	226	226
9	193	76	76
10	445	176	176
Wt	11	4	4

Table 4.4.12 Sole in V11d. Model parameters for stock-recruitment model
medium term prediction

Data read from file s7recin.wgm

Autocorrelated recruitment
Moving average term NOT fitted

IFAIL on exit from E04FDF =	0
Residual sum of squares=	1.6964
Number of observations=	14
Number of parameters =	2
Residual mean square =	0.1414
Coefficient of determination =	0.0241
Adj. coeff. of determination =	-0.0572
IFAIL from E04YCF=	0

Parameter Correlation matrix

1	
-0.9306	1

Parameter	s.d.
-0.1136	0.26
22.924	6.2382

Table 4.4.13

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
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

Remarks: XSA used in 1993, previously L-S.

Assessment Quality Control Diagram 2

Estimated total landings (tonnes) at *status quo* F								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	4869	3402	3369					
1990		3310	3552	3415				
1991			4366	3214	3210			
1992				3520	3764	3500		
1993				3747	4066	4488	3780	
1994					4312	4569	4423	3800
				\ SQC[1]	\ SQC[2]	\ Current	\ Forecast	

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\right]$$

where F(y), F(y - 1) and F(y - 2) are as estimated in the assessment made in year (y + 1).

Continued

Remarks: Landings in 1989 from 1988 Working Group by SHOT forecast.

Table 4.4.13 Continued

Stock: Sole in Division VIId (Eastern English Channel)

Assessment Quality Control Diagram 3

Recruitment (age 1) Unit: thousands							
Date of assessment	Year class						
	1988	1989	1990	1991	1992	1993	1994
1989	(14000)	(20000)					
1990	(14600)	(21000)	(17400)				
1991	(14245)	(17864)	16873	16873			
1992	13122	(19682)	(20357)	18206[1]	18206		
1993	13838	36371	26318	12228	19800[1]	19800[1]	
1994	15291	41773	26851	28132[2]	(12000)	(21000)	

[1]Geometric Mean 1983-1990.

Remarks: Figures in brackets are estimated from recruit surveys.

Assessment Quality Control Diagram 4

Spawning stock biomass (tonnes)									
Date of assessment	Year								
	1988	1989	1990	1991	1992	1993	1994	1995	1996
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]

[1]Forecast.

Remarks: Not corrected for SOP.

Table4.4.14 Sole in Division VIId. Catch per unit effort, 1972-1993

Year	Belgium	UK vessels < 12 m	UK vessels > 12 m		France	
	HP corr (kg/hr)	Hastings trammel (kg/day)	Beam trawl (kg/hr) GRT corr	Otter trawl (kg/hr) GRT corr	Offshore trawl (kg/100 h/HP)	Inshore trawl (kg/100 h/HP)
1972	33.0		15.2	4.8		
1973	40.0		12.1	2.1		
1974	34.5		11.6	3.3		
1975	24.1	35.0	11.5	2.6		
1976	27.3	35.2	10.5	3.7		
1977	30.0	19.9	11.0	3.2		
1978	26.3	50.4	9.1	2.2		
1979	37.4	46.5	8.3	2.1		
1980	23.3	19.0	15.2	1.1		
1981	24.5	30.3	13.7	1.0		
1982	23.7	23.0	11.2	1.6		
1983	22.4	45.1	21.4	1.9	25.5	
1984	21.6	48.7	13.3	2.1	22.5	
1985	22.9	57.4	12.8	1.7	37.9	345.3
1986	33.5	64.0	10.9	4.1	23.3	290.0
1987	36.6	56.8	11.0	3.2	28.6	478.5
1988	15.9	40.7	11.3	1.5	15.4	362.8
1989	16.8	43.0	10.6	2.4	16.5	332.0
1990	25.9	30.3	11.9	1.5	12.5	173.2
1991	22.6	27.0	8.1	2.1	16.4	250.5
1992	29.1	37.9	8.0	2.5	12.5	444.4
1993	34.8	23.6	8.4	2.3	21.0	544.6

Table 4.4.15 Sole in Division VIId. Effort data, 1975-1993

Year	Belgium	UK vessels < 12 m	UK vessels > 12 m		France	
	Beam trawl ('000 hr) HP corr	Hastings trammel ('000 nets)	Beam trawl ('000 hr)	Otter trawl ('000 hr)	Offshore trawl (hr*HP*10**-6)	Inshore trawl (hr*HP*10**-6)
1975	5.0					
1976	6.6					
1977	6.9					
1978	8.2					
1979	7.3					
1980	12.8	2.8	6.8	96.7		
1981	19.0	2.1	6.7	96.7		
1982	24.0	5.9	16.0	110.4		
1983	23.6	3.3	12.6	143.1	1816.7	
1984	28.0	4.4	21.8	139.8	2801.3	
1985	25.3	3.8	21.5	163.2	6771.5	228.8
1986	23.5	3.7	25.8	68.8	8067.3	411.2
1987	27.1	4.2	37.8	128.0	6036.7	573.2
1988	38.5	6.1	29.0	213.6	6065.9	942.1
1989	35.7	5.7	41.4	187.2	5815.4	1039.0
1990	30.3	9.8	40.8	316.6	7485.7	909.1
1991	24.3	14.6	53.1	205.2	9540.3	967.0
1992	22.0	7.2	53.7	168.7	9261.4	505.2
1993	20.0	7.6	50.1	182.5	8979.5	442.5

Table 4.4.16 Sole in VIId. English beam trawl survey numbers per hr raised to 8m beam trawl equivalent (mean no/rectangle, averaged across rectangles).

Age	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

Table 4.4.17 Division V11d Sole. Survey indices of recruitment

	VPA	English YFS		English BTS			French YFS	
Year class	('000)	0 gp	1 gp	1 gp	2 gp	3 gp	0 gp	1 gp
1980			4.08				1.07	0.77
1981		2.60	1.27				2.00	0.03
1982		3.31	2.04				0.46	0.02
1983		13.86	3.76				0.38	-
1984		2.20	0.90				-	-
1985		4.97	1.41			9.9	-	-
1986		4.20	0.96		14.2	3.4	-	0.04
1987		8.23	1.80	8.2	15.4	3.4	0.36	0.08
1988		2.90	0.82	2.6	3.7	2.2	0.02	0.08
1989		5.30	2.29	12.1	22.8	10.0	7.70	0.25
1990		4.47	5.40	8.9	12.0	8.4	0.25	0.21
1991		1.60	2.20	1.4	17.5	8.3	0.46	0.13
1992		2.70	0.91	0.5	3.2		0.21	0.02
1993		7.38	2.78	4.8			0.12	
1994		4.77						

Fig.- 4.4.1.- Sole in Division VIId. Fish stock summary.

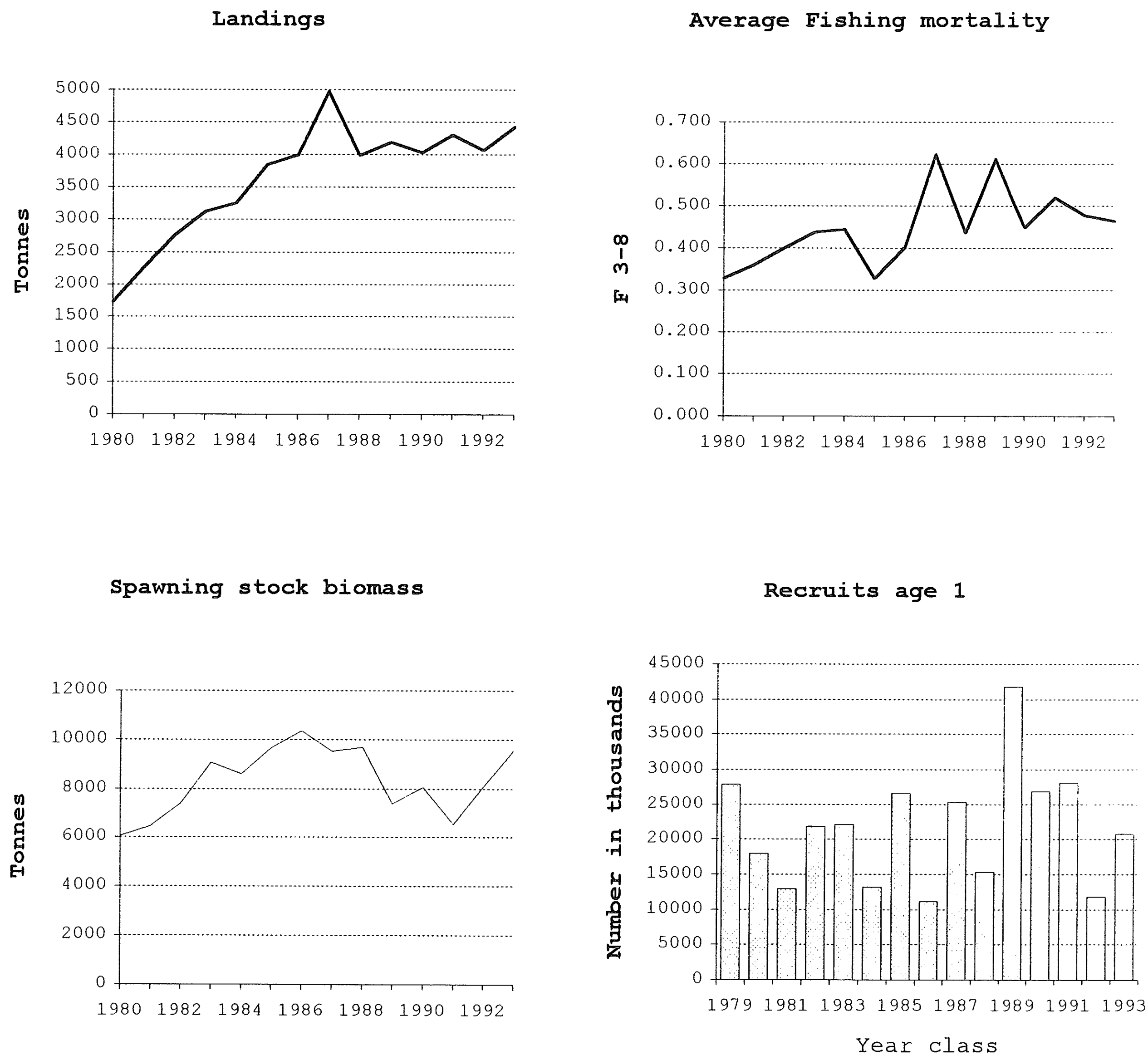
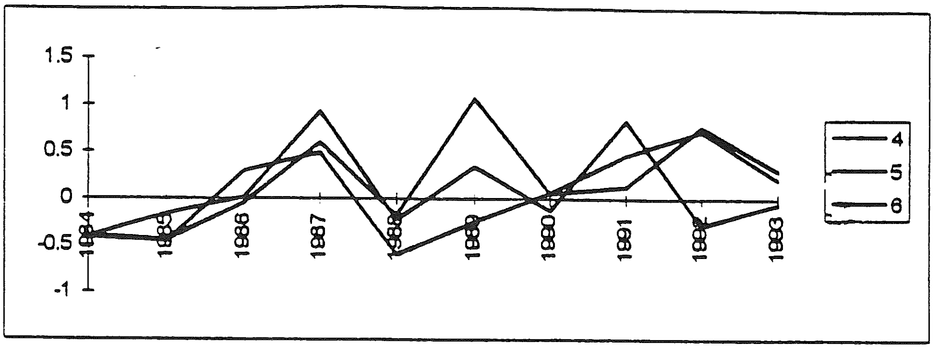
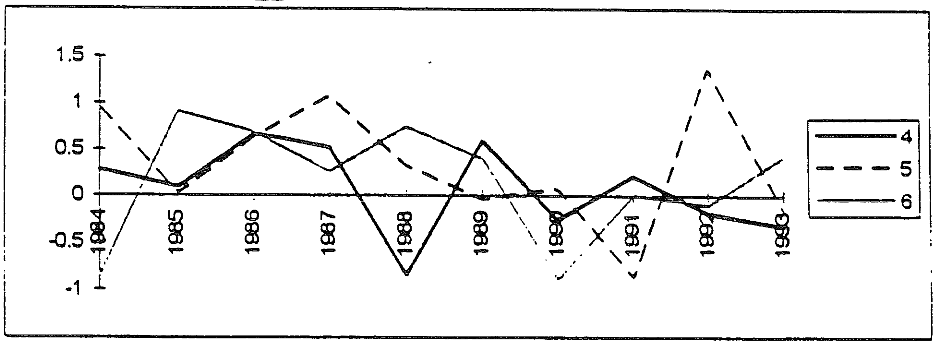


Figure 4.4.2 Sole in V11d. Log q residuals

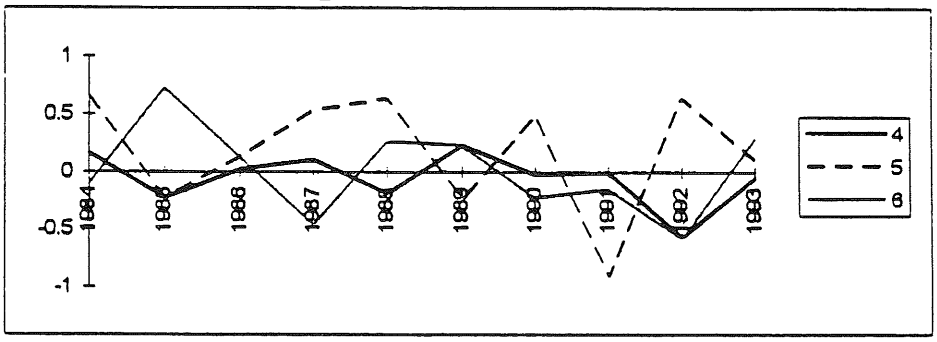
BELGIAN BT



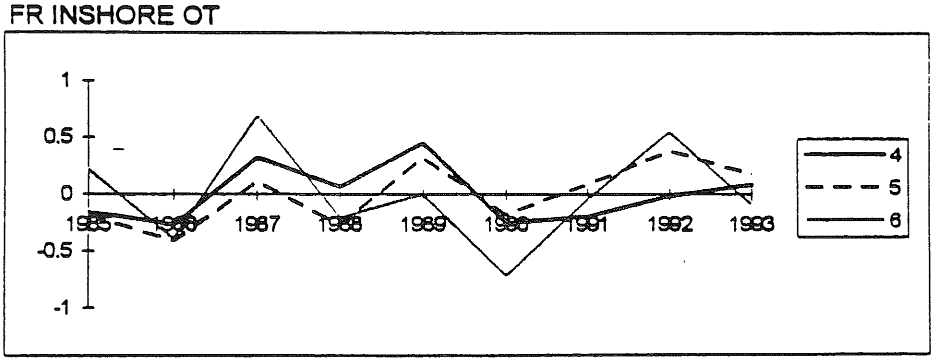
HASTINGS TRAMMEL



UK > 4OFT BEAM TRAWL



FR INSHORE OT



FRENCH OFFSHORE TR

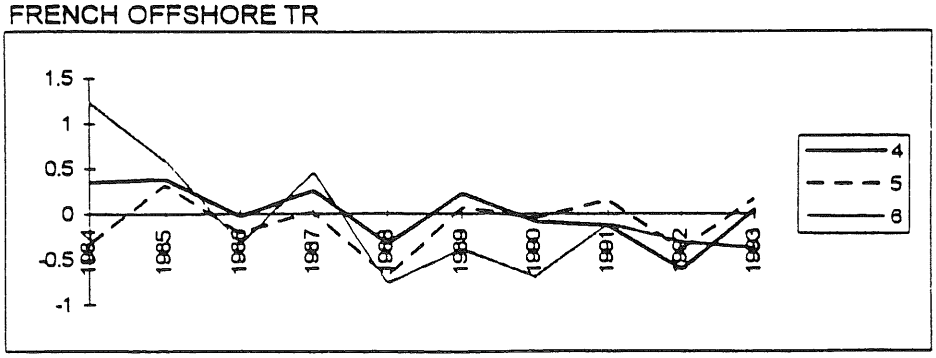
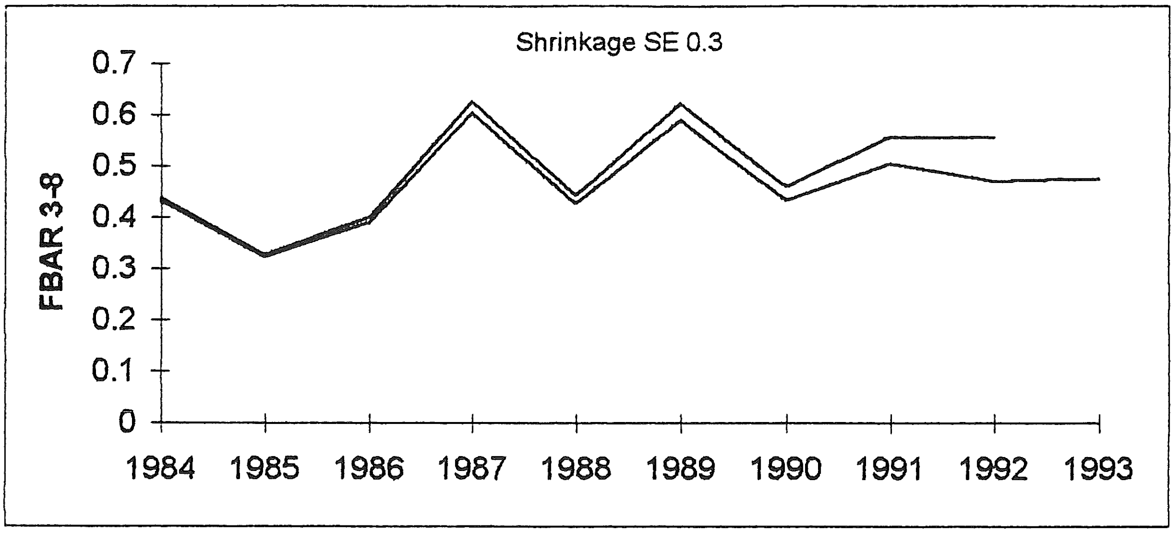
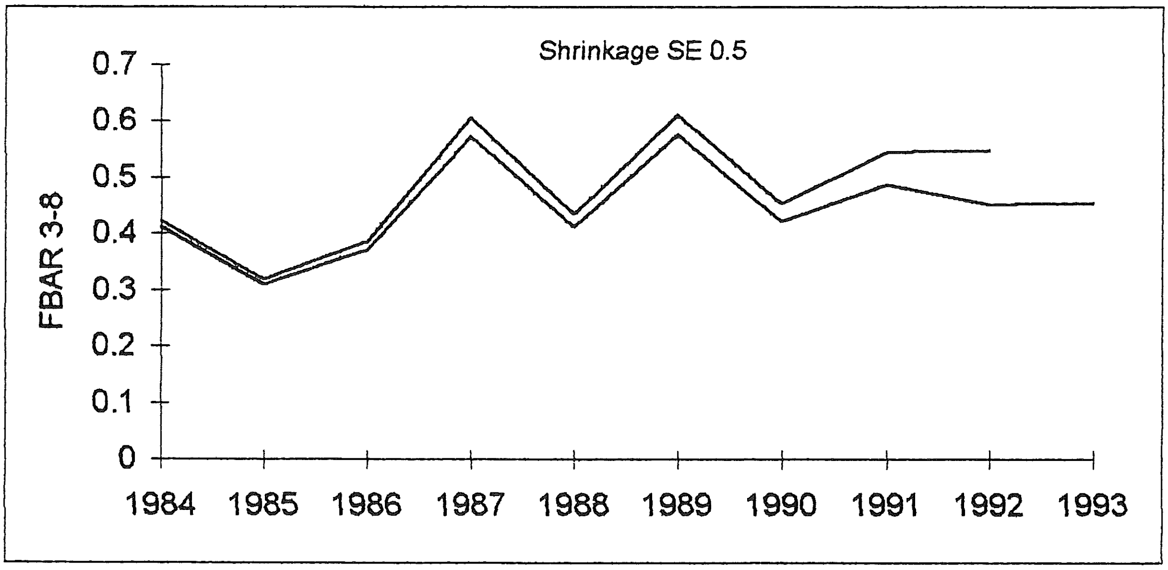


Figure 4.4.3 Sole in V11d. Retrospective analysis





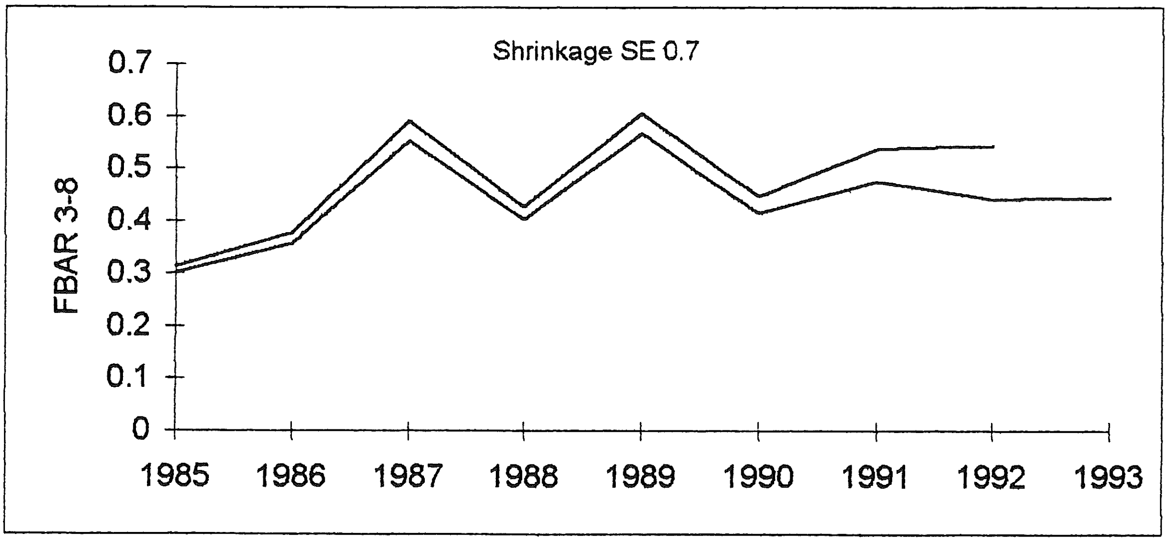


Figure 4.4.4 Sole in V11d Stock recruitment plot

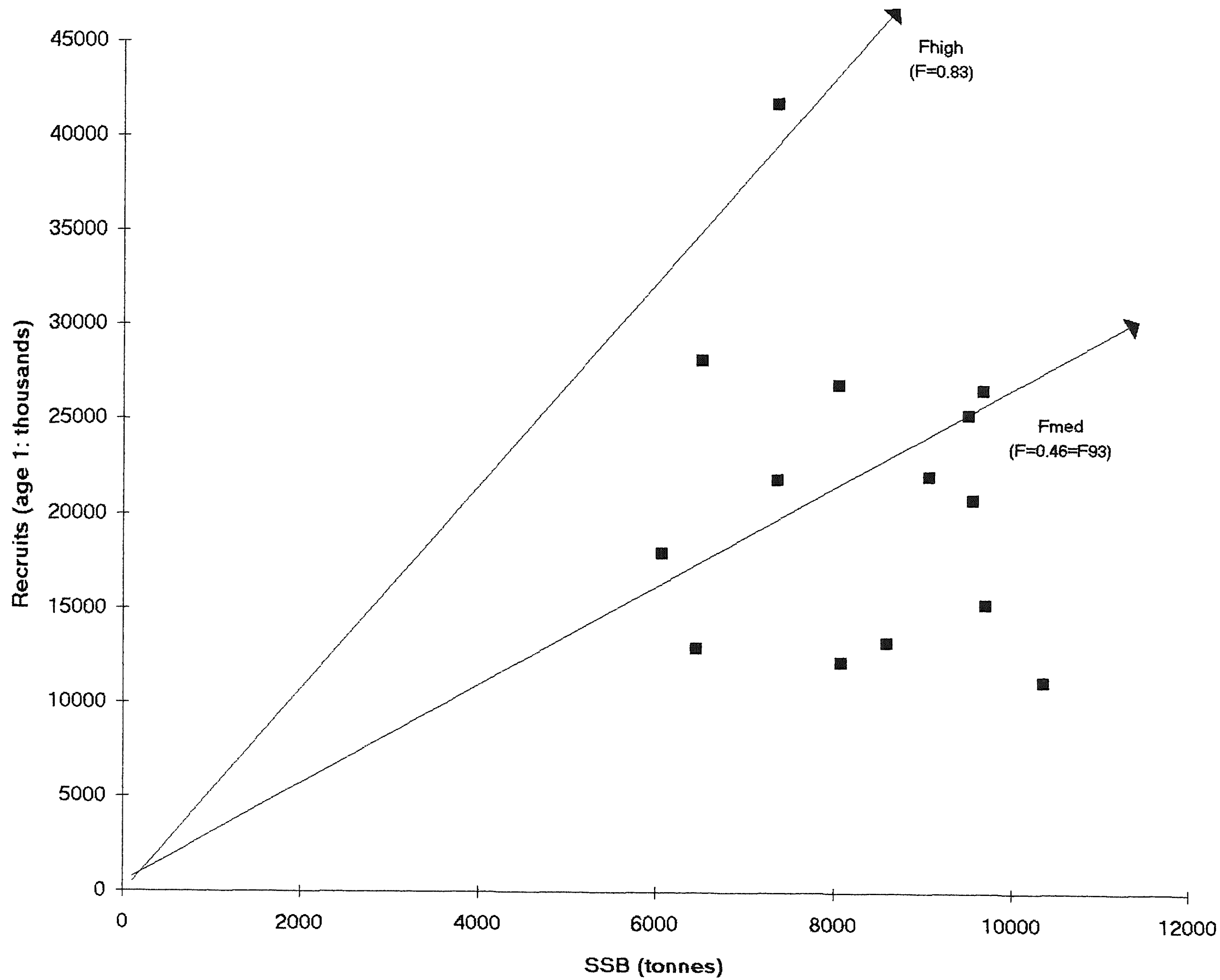
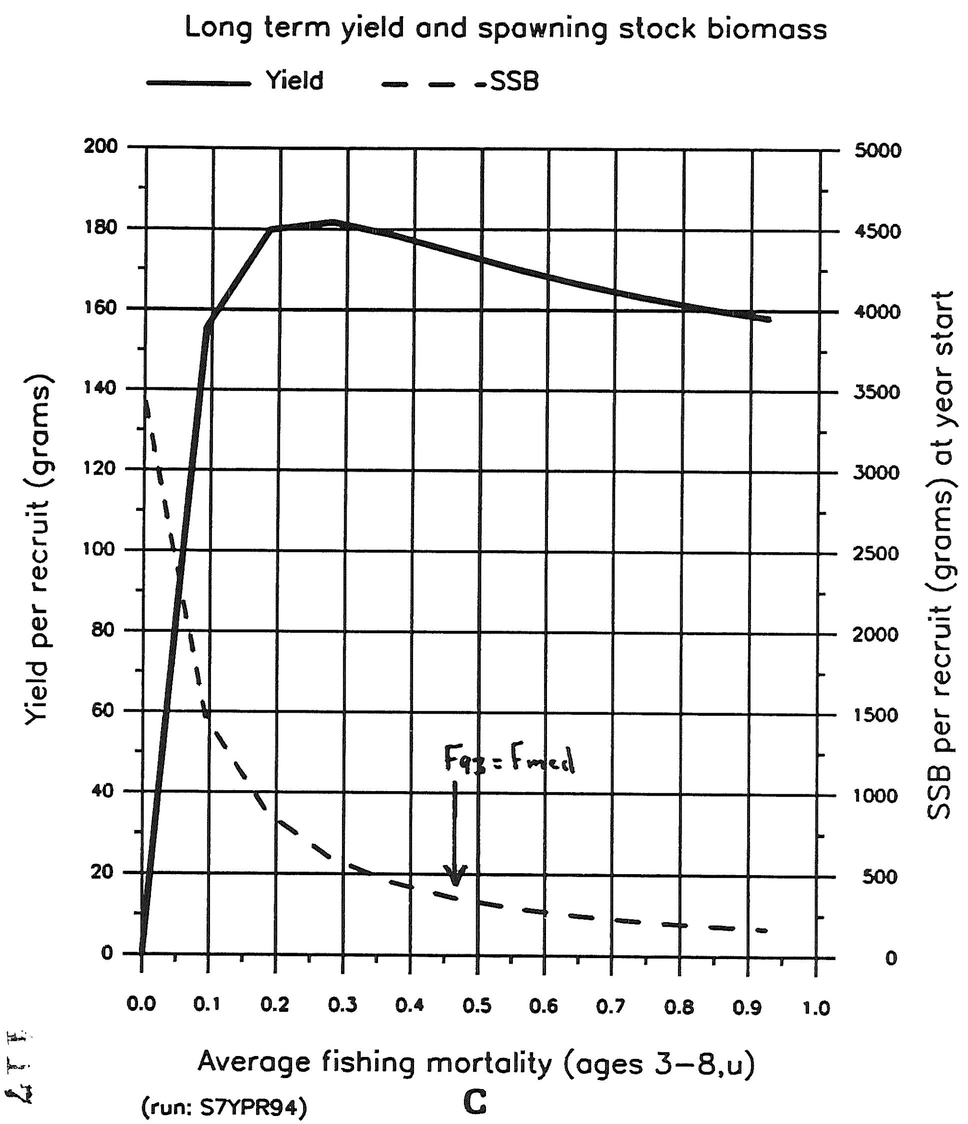


Figure 4.4.5

FISH STOCK SUMMARY
STOCK: Sole in the Eastern English Channel (Fishing Area VIId)
8–10–1994



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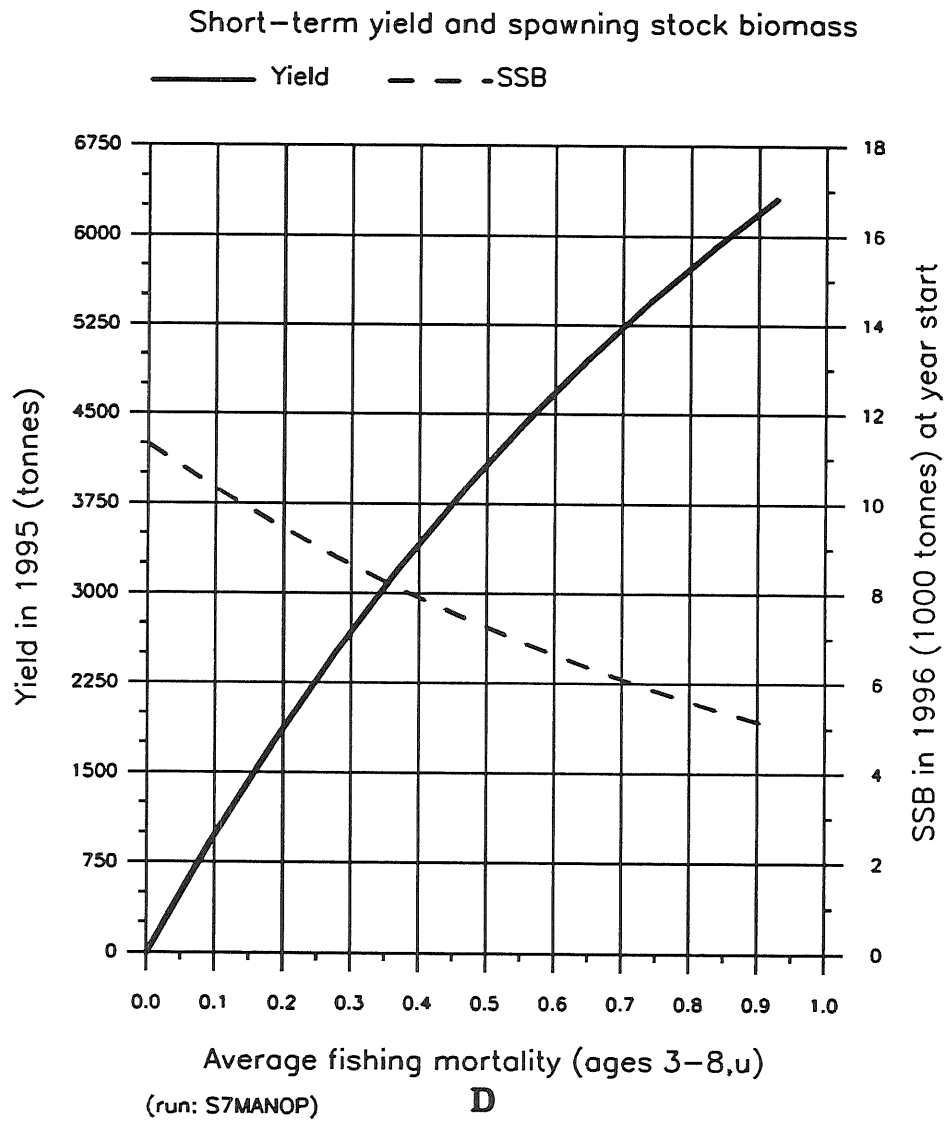

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Fig 4.4.6 Sole V11d. Sensitivity analysis of short term forecast.
Linear sensitivity coefficients (elasticities).
Key to labels is in Table

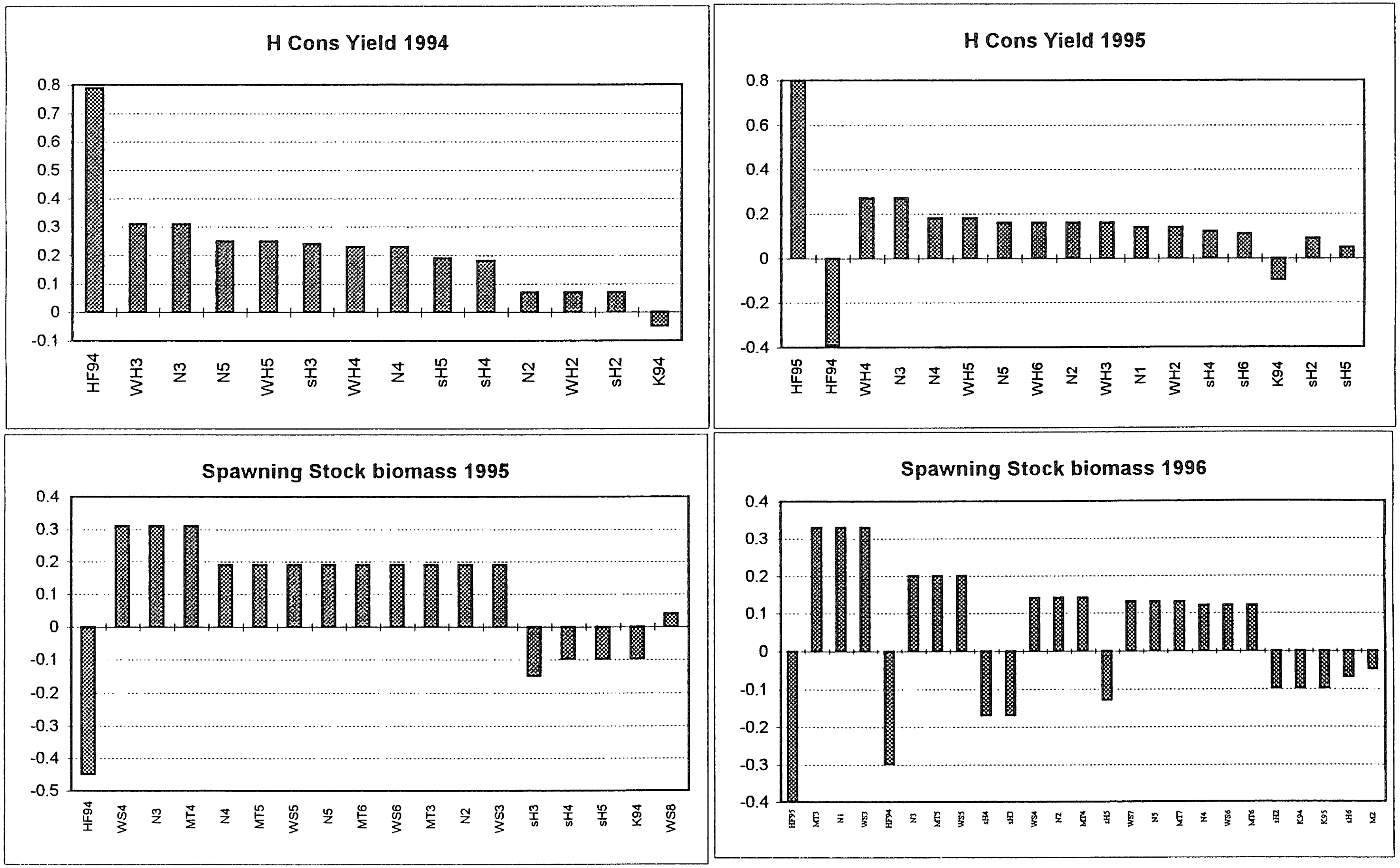

Figure 4.4.7 Sole in Division VIId. Sensitivity analysis of short term forecast. Proportion of total variance contributed by each input.

Key to labels in Table

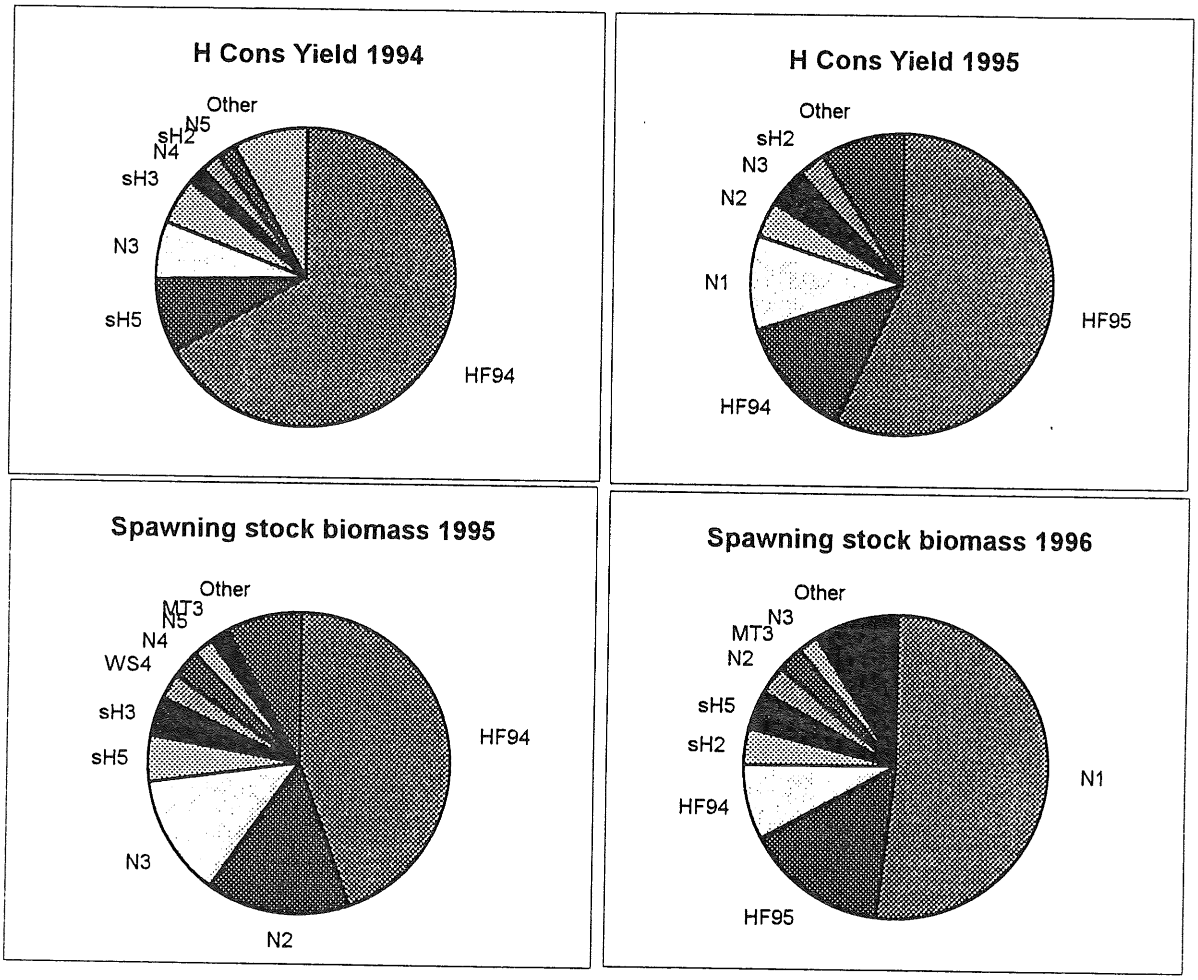

Figure 4.4.8 Sole V11d. Sensitivity analysis of short term forecast. Cumulative probability distributions.

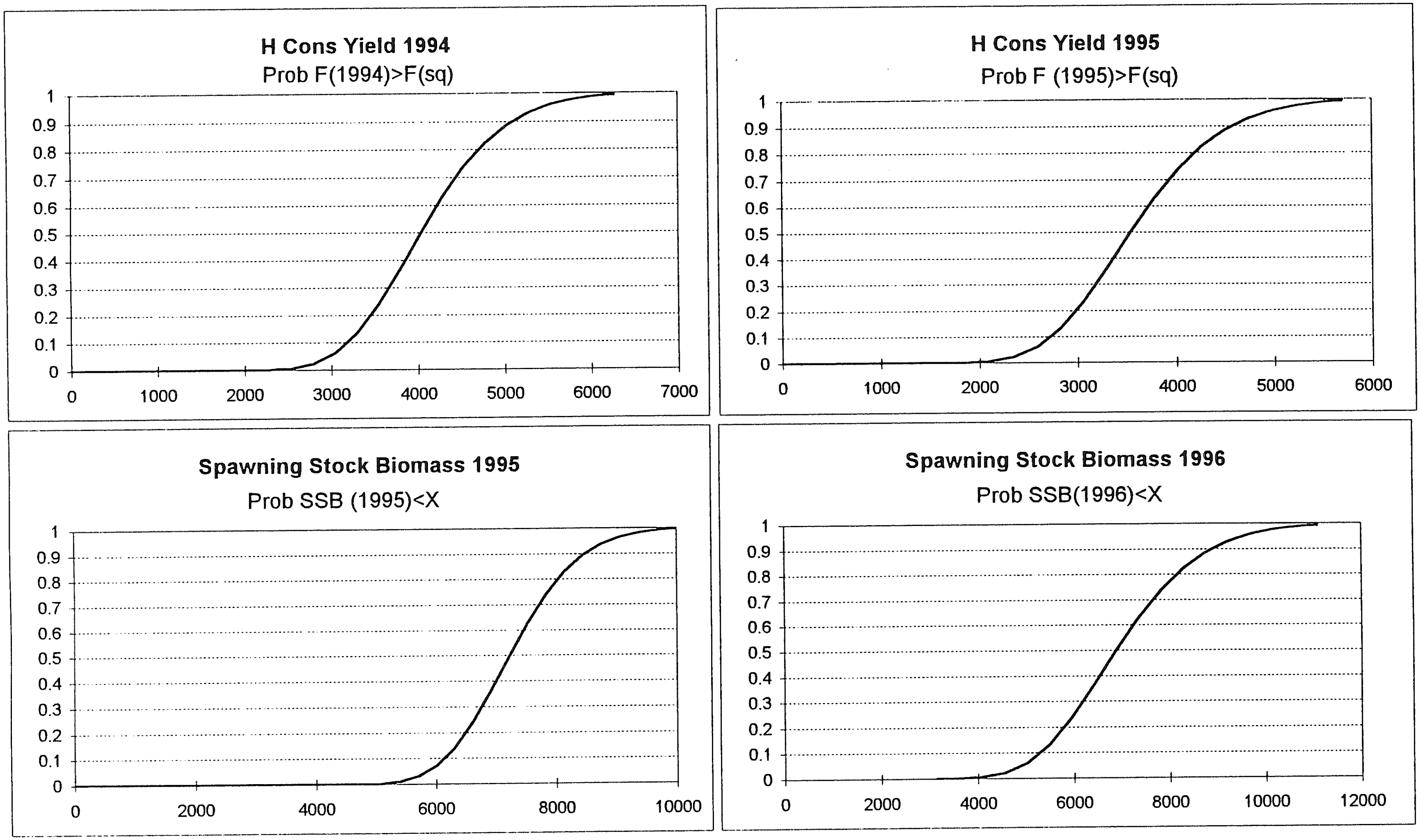

Figure 4.4.9 Sole in V11d. Medium term projections, showing 5,25, 50, 75 and 95 percentiles from auto-correlation stock recruit model

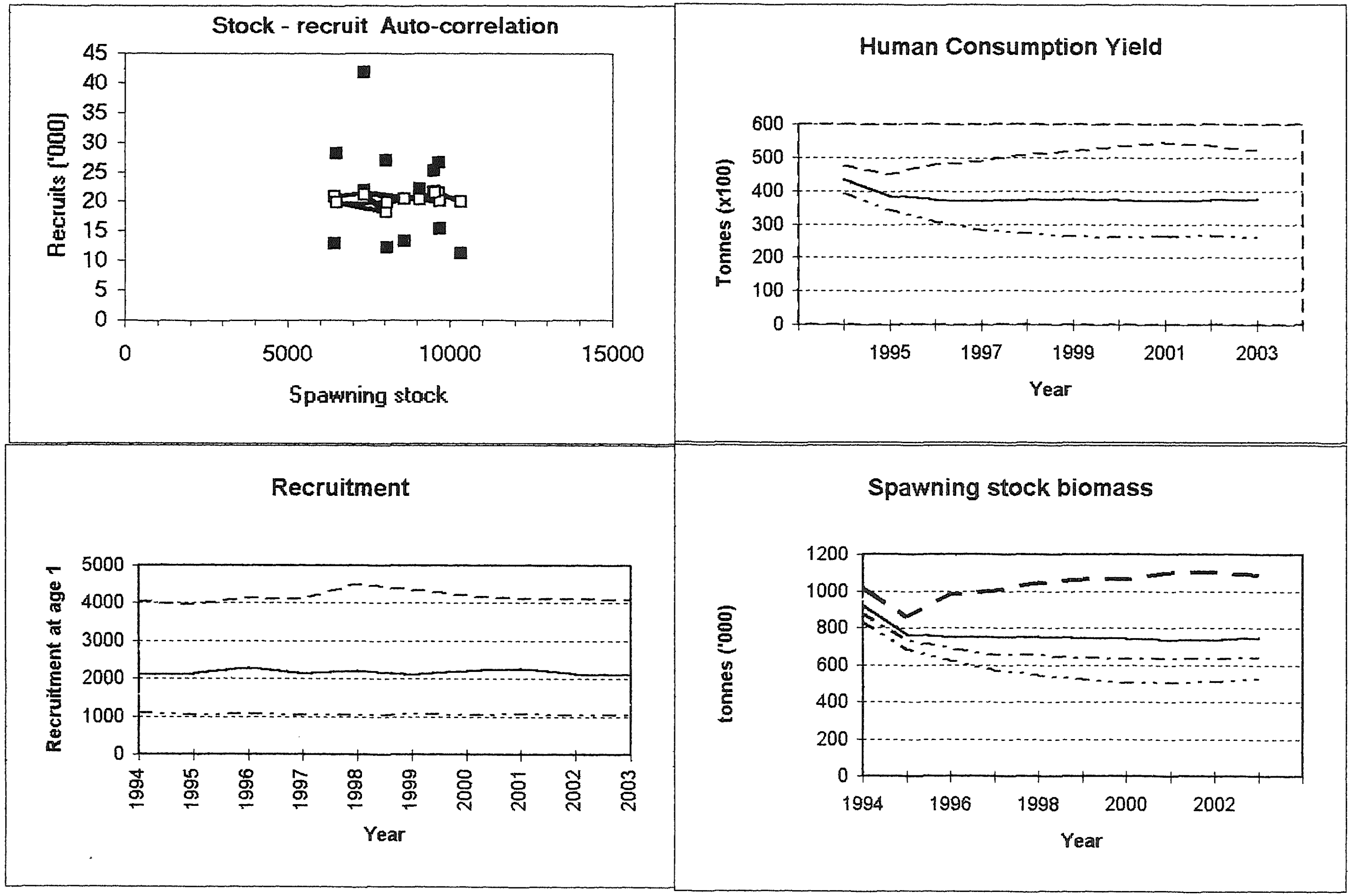

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Figure 4.4.10 Sole in V11d Standardised CPUE

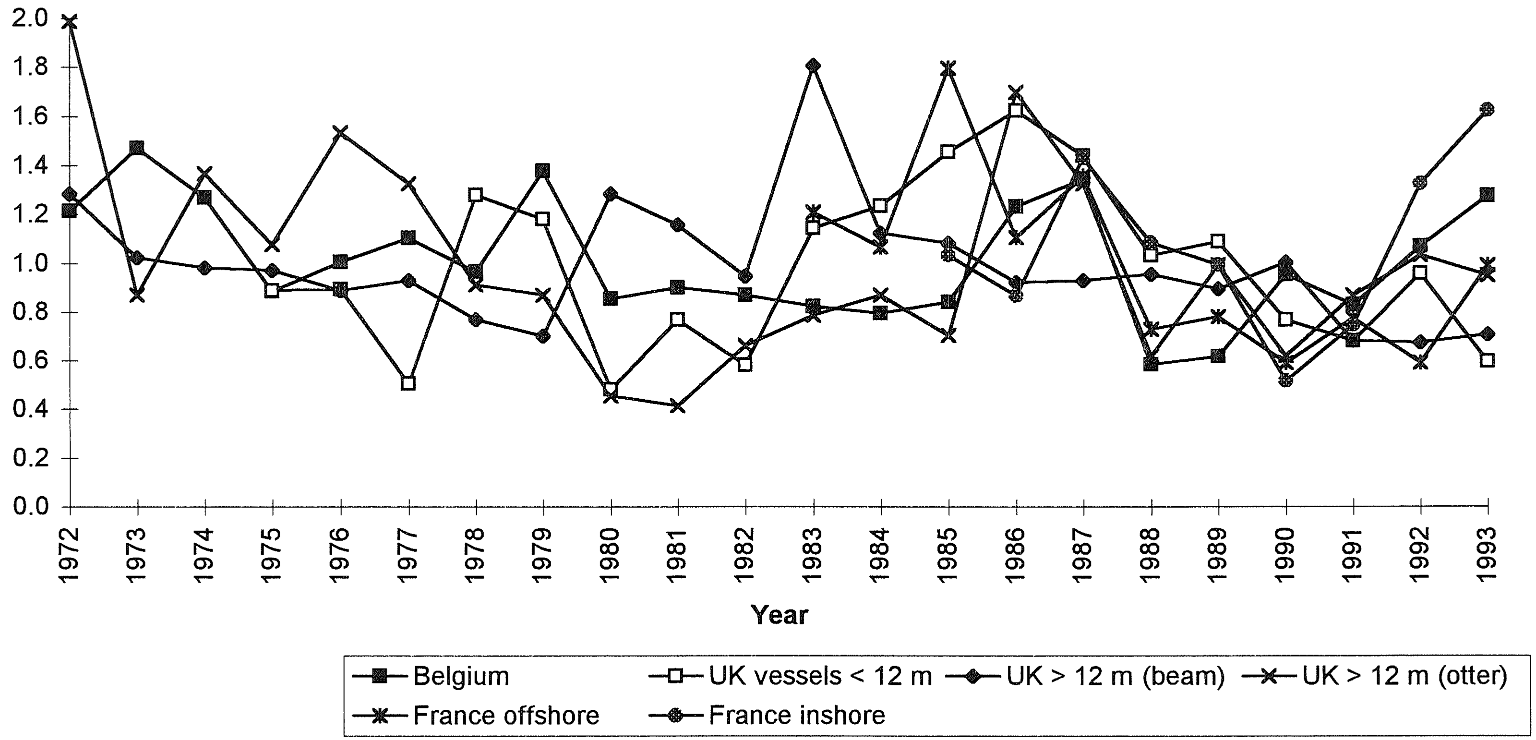
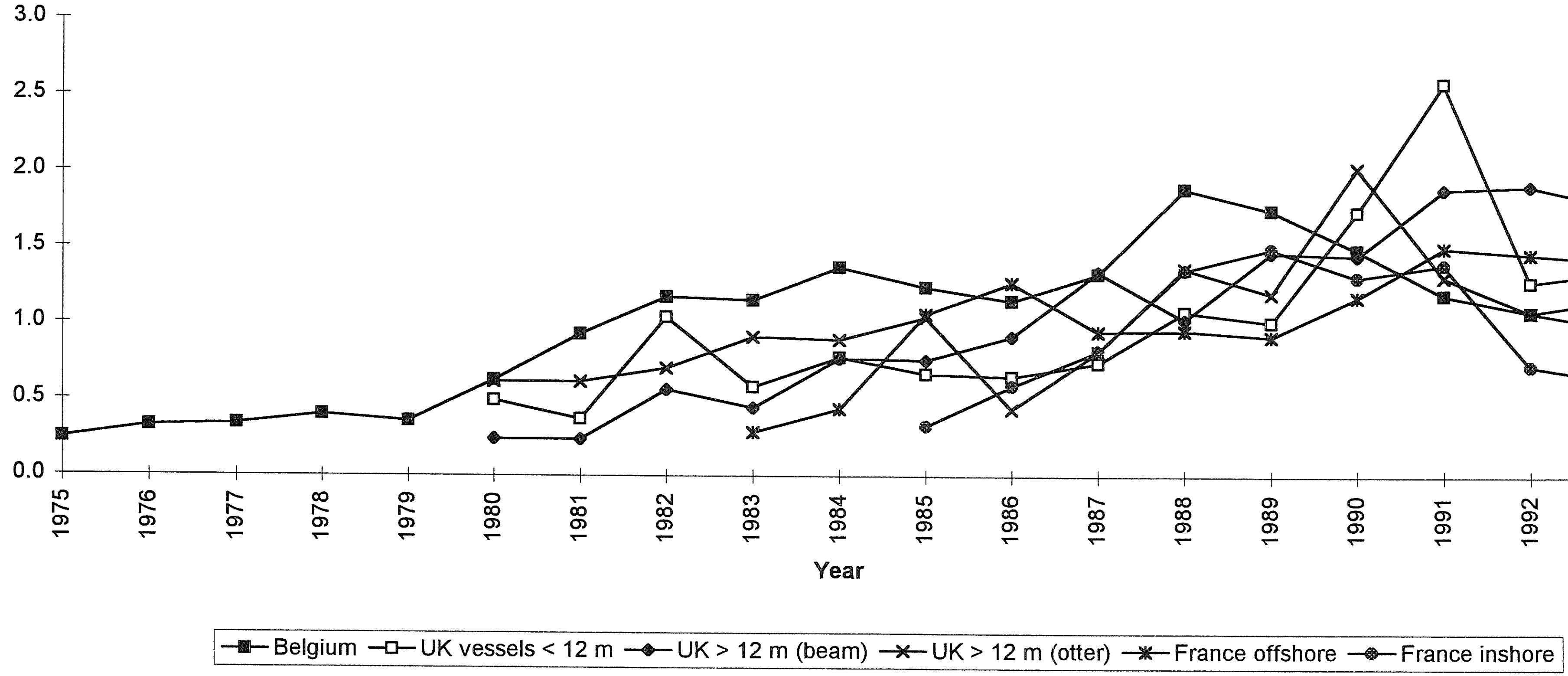


Figure 4.4.11 Sole in V11d Standardised effort



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 trend in landings is shown in Figure 4.5.4. Landings peaked at 10,400 t in 1988 and have declined by nearly half since then to 5,331 t in 1993 which was 20% below the catch estimate of 6,600 t predicted in last year's assessment. There is no separate TAC for Division VIId plaice which at present is managed together with plaice in Division 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 shown in Table 4.5.9. Age compositions for 1980-1993 were available for the UK and for 1981-1993 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 but, for the 1993 data, only three ALKs were available and Q4 ALKs were used for the 3rd and 4th quarters.

The age-composition data and the mean weight at age in the catch and stock are shown in Table 4.5.2. Stock weights were calculated from a smoothed curve of catch weights. Data for 1980-1993 were updated with minor revisions. The data do not include discards which are not sampled for this stock.

4.5.3 Catch, effort and research vessel data

Commercial effort and CPUE data were available from six commercial fleets covering inshore and offshore trawlers and fixed net vessels. All fleets show a steep decline in CPUE from 1988/89 to 1993. Effort has increased in all fleets since 1983 and despite a decrease in 1992 or 1993, remains at a high level. Trends in CPUE and effort are shown in Tables 4.5.14 and 4.5.15 and Figures 4.5.10 and 4.5.11.

Effort and age composition data were available for two commercial fleets and since 1988 from two trawl surveys covering most of Division VIId. These were the English beam trawl survey in August (Table 4.5.16) and the French otter trawl ground fish survey in October. Recruit survey estimates for 0 and 1-group fish were also available from the English and French YFS in Division VIId.

All these data were used to tune the VPA (including age 1 which was not used for tuning in the 1993 Working Group report). 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 four stage process was used to select the final tuning options.

1. Trial runs were made to select the age to be treated as recruits and the age for which catchability can be assumed to be constant. The catchability was therefore set to be independent of year class strength above age 1 and independent of age from age 7.

2. Trends in catchability were examined for fleet problems. As a result a tapered time weight was applied with a power of 3 over 10 years (Figure 4.5.1).

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

4. Using several retrospective analyses a moderate shrinkage was preferred (Figures 4.5.2 and 4.5.3).

The tuning fleets, input parameters and output from the final run are shown in Tables 4.5.4. Fishing mortality and stock numbers are in Table 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 4.5.17. These indices except 0-group and the 1994 survey values were used in XSA with those of the two commercial fleets (see Section 4.5.3) and the estimates of the 1991 and 1992 year classes are shown below with relative weighting shown in brackets.

Fleet	1992 year class (Age 2 in 1994)		1991 year class (Age 3 in 1994)	
UK Rye Trawl, <40 tra	1	(.000)	18829	(.044)
Belgian Beam Trawl	1	(.000)	17865	(.015)
UK Beam Trawl Survey	13886	(.232)	15341	(.312)
French GFS	21458	(.232)	20298	(.206)
English YFS	13743	(.102)	17627	(.097)
French YFS	17186	(.232)	18917	(.213)
P shrinkage mean	21961	(.117)		
F shrinkage mean	11619	(.087)	18438	(.114)
Weighted prediction:	**16738**		**17787**	

RCT3 was used to predict recruitment at age 1; the input file is presented in Table 4.5.6. Although data from the 1-group were already used in XSA this option is preferred here (a trial run with only the 0-group gave very close results, see Table 4.5.18).

Results are shown in Table 4.5.7 and are compared to those of XSA in the text table below.

	RCT3		XSA
Year Class	Weighted average at age 1	Var Ratio	(Age 1)
1991	26,187	.50	33,502
1992	20,521	.49	19,660
1993	19,354	.40	-
1994	27,001	.05	-

The estimation of the 1991 year class is slightly different with the two methods and the XSA estimates, which use relevant catch data (age 2 in the catches in 1993) are preferred. For the 1992 year class the results are very similar and the XSA was accepted. The RCT3 value of 19.3 million at age 1 was used for the 1993 year class and because the 1994 year class is poorly estimated by RCT3 (Var Ratio only 0.05), the GM_{80-91} of 25.3 million 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 increased steeply in 1991 and remained high in 1992 with an apparent decrease in 1993. In view of the likely underestimate of F in the current year (see retrospective analysis, Figures 4.5.2 and 4.5.3), it is probable that F in 1993 has remained closer to the 1991/92 peak. Spawning stock biomass increased rapidly in 1988 following recruitment of the strong 1985 year class. Since 1990 it has declined steadily and is now close to the historical low. Apart from one above–average year class (1991), recruitment has been close to the GM level of 25 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 0.37 kg/-recruit which is equivalent to a reference F_{2-6} of 0.48 and is at the same level as current F (0.48). The yield per recruit input values are given in Table 4.5.9 and the output summary in Table 4.5.10. The Yield/R and SSB/R curves are shown in Figure 4.5.6. Assuming recruitment of 25 million, the equilibrium yield will average 6,500 t with a corresponding SSB of 9,300 t, slightly above current levels of biomass. Since recruitment has been very stable at levels of SSB ranging from 6,000 to 14,000 t it is not clear what level MBAL should be set at from the relatively short time series available.

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 25.3 million was used for age 1 in 1995 and 1996. The exploitation pattern was the mean of the period 1991-1993, scaled to the 1993 $F_{(2-6)}$ value of 0.48. Catch and stock weights at age were the mean for the period 1991-1993 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 1994 will be 6,000 t with a SSB of 7,900 t. This compares with a figure of 7,200 t forecast for the catch for last year. Continuing with the same level of F implies a decrease in catch to 5,600 t and a prediction of SSB of 8,200 t in 1995 and 7,900 t in 1996.

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 given 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 1995 is very dependent on the fishing mortality in 1994 and 1995.

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 1995, most of the variance is contributed by the estimates of fishing mortality in 1995 and by the estimate of the recruits at age 1.

Figure 4.5.9 shows probability profiles for yields and biomass in 1994 and 1995.

4.5.9 Medium–term predictions

No simulation was carried out on this stock.

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, the decline will continue if fishing mortality increases.

4.5.11 Comments on the assessment

The methodology used this year was very similar to last year and XSA was used for the second time. Nevertheless we can notice that we use for the first time one year old survey indices in the tuning to take advantage of the XSA method and only the estimate of age 1 in 1994 was obtained from RCT3.

Even if the methodology remained the same, however we observed an important change this year in the estimation of the fishing effort. Indeed, since the last assessment the F values have notably increased for the last 5 years and this figure looks more realistic knowing the actual high level of effort. The fact that the recent F values were underestimated has already been noticed when we used retrospective analysis. As a consequence of the increase in F the SSB estimates have clearly decreased but recruitment remains very close to the previous assessment. Quality control diagrams are presented in Table 4.5.13.

4.5.12 Catch at age analysis

a) Selection of ages to be treated as recruits (i.e. catchability likely to be influenced by year class strength). A trial run was made with all ages below 8 treated as recruits (all other options accepted as defaults, tuning report output available in WG files). Examination of the regression statistics showed that for most ages and fleets the slopes were not significantly different from 1.0 and a satisfactory model for these ages would be catchability constant with respect to time. Except for this at age 1 we notice that the slope differs statistically from 1 for French YFS with a high r^2 (for 5 df $t=2.6$ and the value of $t=3.7$) and for English BTS (for 4 df $t=2.5$ and the value of $t=2.5$). For age 2 the t is test only significant for the French GFS ($t=3.9$ for 4 df) and not for the other three fleets. It was accepted that the 1-group only should be treated as recruits and the catchabilities were therefore set to be dependent on year class strength for ages 0 and 1.

b) Selection of ages above which catchability is constant. Catchability was set constant above age 7 in trial runs and the patterns of q with age were examined for each fleet (Figure 4.5.12). In most fleets, q showed a slight decline with age from a peak at age 4 and there was no consistent age at which it appeared to level off. Setting q constant at age 6 slightly overestimated q on the older ages and age 8 it was likely to be underestimated slightly. The default age 7 was therefore taken as an acceptable compromise.

c) Trends in catchability in the commercial fleets were examined from runs with each fleet separately (Figure 4.5.1). There were strong trends in catchability residuals in all three commercial fleets before 1988 and examination of the ln catchability residuals showed blocks of negative residuals before 1988 switching to positive after 1988. In later runs the years before 1988 were therefore downweighted using a tricubic weight over 10 years, to remove the effect of the earlier period.

d) An upturn in F on the older ages was noted in early runs in which shrinkage to the mean over 5 ages was used. In view of the shortened age range being used, this had the effect of shrinking to the average F on ages 4-8. A shrinkage over 3 ages (6-8) was used in later runs.

e) Retrospective analysis was carried out initially using the two commercial fleets only as the time series for the survey fleets was too short. Shrinking to SEs of 0.3, 0.5 and 0.7 was examined (Figure 4.5.2). There was a tendency to underestimate F in previous years and this was particularly marked since 1990. In 1991 and 1992, F appeared to be under estimated by between 20-30%. There was also a steep decrease in F in 1993. A retrospective run was also carried out with all tuning fleets although it was only possible to step back one year before the survey fleets were excluded (Figure 4.5.3). The results gave a similar pattern with a large underestimate of F in 1992 compared with the current assessment and a steep decline in F in 1993. The level of shrinkage had only a minor effect on these discrepancies. A strong shrinkage (0.3) increased the difference between the F in 1992 in the two runs but reduced the downturn in the most recent year. With weak shrinkage (1.0) the F in 1992 appeared to be the lowest on record which was not thought to be realistic. A moderate shrinkage (0.5) giving an intermediate result was therefore preferred.

Table 4.5.1 PLAICE in Division VIId. Nominal landings (tonnes) as officially reported to ICES, 1976-1993.

Year	Belgium	Denmark	France	UK (E+W)	Others	Total reported	Un-reported[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]	1,541	1	5,865	472	6,337
1993[3]	0,877	+[2]	2,408[1]	1,075	27	4,387	944	5,331

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

Table 4.5.2 - Plaice in Division VIId. Catch numbers, catch weights and stock weights at age.

Run title : 107D PLAICE 1994 WG,1-15+,80-93,SEXES COMB

At 7/10/1994 19:42

Table 1 Catch numbers at age (numbers*10**-3)

YEAR,	1980,	1981,	1982,	1983,
AGE				
1,	53,	16,	265,	92,
2,	2644,	2446,	1393,	3030,
3,	1451,	6795,	6909,	3199,
4,	540,	2398,	3302,	5908,
5,	490,	290,	762,	931,
6,	75,	159,	206,	226,
7,	45,	51,	96,	92,
8,	44,	42,	62,	122,
9,	4,	56,	21,	4,
+gp,	103,	200,	88,	101,
0 TOTALNUM,	5449,	12453,	13104,	13705,
TONSLAND,	2650,	4769,	4865,	5043,
SOPCOF %,	100,	94,	92,	90,

Table 1 Catch numbers at age (numbers*10**-3)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	350,	142,	679,	25,	16,	826,	1632,	1542,	1665,	740,
2,	1871,	5714,	4884,	8499,	5011,	3638,	2627,	5860,	6193,	7606,
3,	7310,	6195,	7034,	7508,	18813,	7227,	8746,	5445,	4450,	3817,
4,	2814,	4883,	3663,	3472,	4900,	9453,	5983,	4524,	1725,	1259,
5,	1874,	413,	1458,	1257,	1118,	2672,	3603,	2437,	1187,	542,
6,	533,	612,	562,	430,	541,	588,	801,	1681,	1044,	468,
7,	236,	164,	254,	442,	439,	288,	243,	286,	698,	334,
8,	101,	99,	69,	154,	127,	179,	203,	120,	200,	287,
9,	34,	139,	19,	105,	105,	81,	178,	113,	116,	102,
+gp,	100,	50,	34,	77,	174,	197,	231,	125,	118,	152,
0 TOTALNUM,	15223,	18411,	18656,	21969,	31244,	25149,	24247,	22133,	17396,	15307,
TONSLAND,	5161,	6022,	6834,	8366,	10420,	8758,	9047,	7813,	6337,	5331,
SOPCOF %,	86,	92,	100,	98,	92,	93,	98,	96,	98,	99,

1

Run title : 107D PLAICE 1994 WG,1-15+,80-93,SEXES COMB

At 7/10/1994 19:42

Table 2 Catch weights at age (kg)

YEAR,	1980,	1981,	1982,	1983,
AGE				
1,	.3090,	.2390,	.2450,	.2660,
2,	.3120,	.2990,	.2710,	.2960,
3,	.4990,	.3730,	.3530,	.3490,
4,	.6270,	.4640,	.4310,	.4200,
5,	.7870,	.7120,	.6400,	.5420,
6,	1.1390,	.8700,	.7950,	.8220,
7,	1.1790,	.8630,	1.1530,	.9530,
8,	1.2930,	.8970,	1.0670,	1.1440,
9,	1.4750,	.9920,	1.5040,	.9430,
+gp,	1.5572,	1.1736,	1.3552,	1.5907,
0 SOPCOFAC,	.9995,	.9353,	.9208,	.9003,

Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	.2330,	.2540,	.2260,	.2510,	.2920,	.2010,	.2010,	.2250,	.1820,	.2200,
2,	.2950,	.2780,	.3060,	.2820,	.2680,	.2680,	.2560,	.2770,	.2770,	.2720,
3,	.3360,	.3010,	.3310,	.3600,	.3210,	.3210,	.3260,	.3110,	.3520,	.3360,
4,	.4020,	.4270,	.4060,	.4770,	.4320,	.3700,	.3780,	.3900,	.4290,	.4320,
5,	.5080,	.5020,	.5460,	.5770,	.5600,	.4730,	.4830,	.4540,	.5090,	.5070,
6,	.6890,	.5700,	.4860,	.7830,	.6570,	.6480,	.6100,	.5560,	.5850,	.5910,
7,	.7030,	.5570,	.6290,	.7350,	.7700,	.8370,	.7810,	.7450,	.7010,	.7410,
8,	.9450,	1.0810,	.8710,	1.1420,	.9080,	.9070,	.9630,	1.0870,	.8370,	.8200,
9,	1.0280,	.8490,	1.4460,	1.2680,	1.2180,	1.2040,	1.1590,	.9240,	.8500,	.9340,
+gp,	1.4269,	1.4209,	1.5789,	1.5148,	1.3280,	1.5195,	1.3099,	1.6015,	1.1947,	1.1555,
0 SOPCOFAC,	.8632,	.9239,	1.0001,	.9757,	.9224,	.9313,	.9795,	.9625,	.9846,	.9940,

1

Continued

Table 4.5.2 . - (continued)

Run title : 107D PLAICE 1994 WG,1-15+,80-93,SEXES COMB

At 7/10/1994 19:42

Table 3 Stock weights at age (kg)

YEAR,	1980,	1981,	1982,	1983,
AGE				
1,	.1710,	.1100,	.1050,	.0970,
2,	.3320,	.2160,	.2080,	.1920,
3,	.4820,	.3170,	.3080,	.2860,
4,	.6220,	.4140,	.4060,	.3790,
5,	.7510,	.5060,	.5020,	.4700,
6,	.8700,	.5940,	.5960,	.5600,
7,	.9770,	.6770,	.6870,	.6480,
8,	1.0740,	.7560,	.7760,	.7350,
9,	1.1610,	.8300,	.8620,	.8210,
+gp,	1.3392,	1.0419,	1.1184,	1.1688,

Table 3 Stock weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
1,	.0820,	.0840,	.1010,	.1220,	.0840,	.0790,	.0850,	.0650,	.0880,	.1080,
2,	.1640,	.1710,	.2050,	.2420,	.1680,	.1620,	.1720,	.1410,	.1770,	.2140,
3,	.2480,	.2590,	.3110,	.3610,	.2540,	.2500,	.2620,	.2270,	.2680,	.3150,
4,	.3330,	.3480,	.4200,	.4790,	.3400,	.3420,	.3550,	.3240,	.3610,	.4140,
5,	.4200,	.4400,	.5320,	.5960,	.4270,	.4390,	.4510,	.4320,	.4560,	.5090,
6,	.5070,	.5330,	.6460,	.7120,	.5140,	.5410,	.5490,	.5500,	.5520,	.6010,
7,	.5960,	.6280,	.7630,	.8260,	.6030,	.6480,	.6510,	.6790,	.6510,	.6900,
8,	.6860,	.7250,	.8820,	.9390,	.6920,	.7590,	.7550,	.8190,	.7510,	.7760,
9,	.7770,	.8240,	1.0040,	1.0510,	.7830,	.8740,	.8620,	.9690,	.8530,	.8580,
+gp,	1.0858,	1.2060,	1.3126,	1.3055,	.9519,	1.2112,	1.1247,	1.4036,	1.1158,	1.0384,

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

```
VIID PLAICE,BEL,UK+FRANCE  80-93      [rev: 6/10/94 rm/at]
106
UK RYE TRAWL,<40 trawl lands,all trawl age comps  fleet effort
1984 1993
1 1 0 1
2 15
7.4 428.9 640.6 154.7 108.7 29.8 11.9 3.2 4.6 0.8 0.4 0.3 0.2 0.3 1.5
6.4 1118.4 759.1 399.9 34.0 0.0 0.0 0.0 34.4 0.0 0.0 0.0 0.0 0.0 0.0
5.9 641.5 809.4 358.4 139.0 17.4 12.8 7.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0
7.4 1061.0 1001.0 356.6 111.8 58.4 11.7 14.6 9.9 0.0 0.0 0.0 0.0 1.2 0.0
4.8 661.3 1480.5 245.1 99.9 52.0 24.4 4.8 7.0 9.0 1.4 2.0 0.1 0.4 0.4
5.6 135.7 634.4 1332.0 277.8 118.1 54.5 15.6 3.5 17.8 0.1 0.8 0.3 0.0 6.7
4.3 219.7 590.2 337.0 364.8 115.4 47.9 35.4 22.9 19.7 14.8 6.7 2.8 1.9 8.1
12.0 917.2 877.1 636.2 292.4 247.8 40.9 16.3 8.0 5.0 1.2 2.7 3.6 0.2 5.4
11.8 1014.8 768.0 478.1 264.9 188.3 150.5 49.8 9.9 8.1 5.2 3.9 5.6 5.7 3.4
9.7 994.9 583.7 214.3 130.3 96.8 69.3 80.6 27.4 12.1 9.6 7.9 3.7 3.6 7.6
BELGIAN BEAM TRAWL( HP corr, 5/9/93),all gears age comp
1981 1993
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
UK BEAM TRAWL SURVEY
1988 1993
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
French GFS
1988 1993
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
English YFS
1985 1993
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
French YFS
1987 1993
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
```

Table 4.5.4.- Plaice in VIId. Tuning output.

Lowestoft VPA Version 3.1

7/10/1994 19:37

Extended Survivors Analysis

107D PLAICE 1994 WG,1-15+,80-93,SEXES COMB,MILLNER/AT

CPUE data from file p7def93.vpa

Catch data for 14 years. 1980 to 1993. Ages 1 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
UK RYE TRAWL,<40 tra,	1984,	1993,	2,	9,	.000,	1.000
BELGIAN BEAM TRAWL(,	1981,	1993,	2,	9,	.000,	1.000
UK BEAM TRAWL SURVEY,	1988,	1993,	1,	6,	.500,	.750
French GFS ,	1988,	1993,	1,	6,	.750,	1.000
English YFS ,	1985,	1993,	1,	1,	.500,	.750
French YFS ,	1987,	1993,	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 < 2

Regression type = C
Minimum of 4 points used for regression
Survivor estimates shrunk to the population mean for ages < 2

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 = .00092

Final year F values

Age ,	1,	2,	3,	4,	5,	6,	7,	8,	9
Iteration 59,	.0408,	.3378,	.6280,	.6635,	.4194,	.3728,	.3842,	.3656,	.3563
Iteration 60,	.0408,	.3382,	.6283,	.6635,	.4194,	.3729,	.3842,	.3656,	.3563

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

Fleet : UK RYE TRAWL,<40 tra

Regression statistics :

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,	2.30,	-.862,	-.45,	.09,	10,	1.49,	-5.45,
3,	1.20,	-1.045,	3.55,	.86,	10,	.26,	-4.57,
4,	1.04,	-.168,	4.30,	.82,	10,	.37,	-4.47,
5,	.82,	.691,	5.26,	.78,	10,	.32,	-4.62,
6,	1.35,	-.332,	3.61,	.18,	9,	.84,	-4.65,
7,	1.12,	-.108,	4.61,	.16,	9,	.80,	-4.87,
8,	.47,	1.697,	5.69,	.71,	9,	.25,	-4.96,
9,	.43,	1.062,	5.41,	.46,	9,	.30,	-5.03,

1

Continued

Table 4.5.4.- Continued.

Fleet : BELGIAN BEAM TRAWL(

Regression statistics :

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,	7.92,	-.767,	-12.35,	.00,	10,	8.95,	-7.18,
3,	2.24,	-1.778,	.29,	.32,	10,	.93,	-5.43,
4,	.98,	.111,	5.33,	.92,	10,	.23,	-5.27,
5,	.78,	.711,	6.01,	.70,	10,	.39,	-5.36,
6,	.50,	1.604,	6.59,	.71,	10,	.25,	-5.57,
7,	.78,	.715,	6.03,	.71,	10,	.23,	-5.77,
8,	.98,	.043,	5.85,	.63,	10,	.32,	-5.84,
9,	2.23,	-.570,	5.94,	.05,	10,	2.06,	-5.77,

1

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,	.36,	1.646,	9.25,	.66,	6,	.22,	-7.89,

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,	.85,	.258,	7.58,	.47,	6,	.40,	-7.18,
3,	.90,	.329,	7.17,	.76,	6,	.39,	-6.91,
4,	.99,	.036,	6.70,	.86,	6,	.34,	-6.68,
5,	1.27,	-.772,	5.82,	.70,	6,	.43,	-6.34,
6,	2.56,	-1.355,	1.87,	.18,	6,	.89,	-5.38,

1

Fleet : French GFS

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,	.30,	1.627,	9.40,	.62,	6,	.24,	-8.01,

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,	.32,	2.343,	9.43,	.78,	6,	.20,	-8.42,
3,	.71,	.826,	8.73,	.71,	6,	.46,	-8.40,
4,	1.13,	-.237,	8.77,	.50,	6,	.86,	-8.78,
5,	1.12,	-.129,	9.10,	.26,	6,	1.12,	-9.01,
6,	-7.81,	-1.944,	5.12,	.01,	6,	3.51,	-7.96,

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,	.88,	.251,	10.41,	.50,	9,	.40,	-10.45,

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,	.45,	3.631,	10.28,	.92,	7,	.10,	-10.58,

1

Continued

Table 4.5.4.- Continued.

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK RYE TRAWL,<40 tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
BELGIAN BEAM TRAWL(,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK BEAM TRAWL SURVEY,	13866.,	.300,	.000,	.00,	1,	.232,	.049
French GFS ,	21458.,	.300,	.000,	.00,	1,	.232,	.032
English YFS ,	13743.,	.453,	.000,	.00,	1,	.102,	.049
French YFS ,	17186.,	.300,	.000,	.00,	1,	.232,	.040
P shrinkage mean ,	21961.,	.43,,,,				.117,	.031
F shrinkage mean ,	11619.,	.50,,,,				.087,	.058

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
16738.,	.14,	.10,	6,	.667,	.041

1

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK RYE TRAWL,<40 tra,	18829.,	.682,	.000,	.00,	1,	.044,	.322
BELGIAN BEAM TRAWL(,	17865.,	1.168,	.000,	.00,	1,	.015,	.337
UK BEAM TRAWL SURVEY,	15341.,	.251,	.024,	.09,	2,	.312,	.383
French GFS ,	20298.,	.307,	.042,	.14,	2,	.206,	.302
English YFS ,	17627.,	.446,	.000,	.00,	1,	.097,	.341
French YFS ,	18917.,	.300,	.000,	.00,	1,	.213,	.321
F shrinkage mean ,	18438.,	.50,,,,				.114,	.328

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17787.,	.14,	.04,	9,	.271,	.338

Age 3 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
UK RYE TRAWL,<40 tra,	4125.,	.278,	.169,	.61,	2,	.224,	.627
BELGIAN BEAM TRAWL(,	4274.,	.488,	.383,	.78,	2,	.072,	.610
UK BEAM TRAWL SURVEY,	4798.,	.226,	.141,	.62,	3,	.260,	.559
French GFS ,	4057.,	.276,	.311,	1.13,	3,	.158,	.635
English YFS ,	2627.,	.488,	.000,	.00,	1,	.042,	.862
French YFS ,	4181.,	.304,	.000,	.00,	1,	.108,	.620
F shrinkage mean ,	3417.,	.50,,,,				.136,	.719

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4110.,	.13,	.08,	13,	.627,	.628

1

Continued

Table 4.5.4.- Continued.

Age 4 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
UK RYE TRAWL,<40 tra,	1400.,	.241,	.096,	.40,	3,	.236,	.613
BELGIAN BEAM TRAWL(,	1331.,	.270,	.117,	.44,	3,	.224,	.637
UK BEAM TRAWL SURVEY,	1125.,	.224,	.082,	.36,	4,	.257,	.720
French GFS ,	1404.,	.322,	.266,	.83,	4,	.090,	.612
English YFS ,	1121.,	.468,	.000,	.00,	1,	.017,	.722
French YFS ,	1380.,	.313,	.000,	.00,	1,	.038,	.620
F shrinkage mean ,	1090.,	.50,,,,				.137,	.736

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1259.,	.13,	.05,	17,	.426,	.664

Age 5 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 RYE TRAWL,<40 tra,	1129.,	.227,	.072,	.32,	4,	.255,	.373
BELGIAN BEAM TRAWL(,	1077.,	.254,	.094,	.37,	4,	.197,	.388
UK BEAM TRAWL SURVEY,	1016.,	.206,	.132,	.64,	5,	.311,	.407
French GFS ,	922.,	.337,	.222,	.66,	5,	.079,	.441
English YFS ,	1559.,	.478,	.000,	.00,	1,	.014,	.283
French YFS ,	869.,	.331,	.000,	.00,	1,	.028,	.462
F shrinkage mean ,	566.,	.50,,,,				.117,	.643

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
980.,	.12,	.07,	21,	.587,	.419

1

Age 6 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 RYE TRAWL,<40 tra,	887.,	.238,	.097,	.41,	5,	.224,	.403
BELGIAN BEAM TRAWL(,	980.,	.270,	.139,	.52,	5,	.182,	.371
UK BEAM TRAWL SURVEY,	1232.,	.209,	.118,	.56,	6,	.331,	.306
French GFS ,	1042.,	.375,	.249,	.66,	6,	.107,	.353
English YFS ,	1445.,	.575,	.000,	.00,	1,	.007,	.266
French YFS ,	949.,	.367,	.000,	.00,	1,	.017,	.381
F shrinkage mean ,	588.,	.50,,,,				.131,	.559

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
975.,	.13,	.08,	25,	.603,	.373

Continued

Table 4.5.4.- Continued.

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

Year class = 1986

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
UK RYE TRAWL,<40 tra,	584.,	.265,	.090,	.34,	6,	.188,	.431
BELGIAN BEAM TRAWL(,	714.,	.232,	.098,	.42,	6,	.403,	.365
UK BEAM TRAWL SURVEY,	775.,	.224,	.139,	.62,	5,	.185,	.341
French GFS ,	647.,	.446,	.150,	.34,	5,	.055,	.396
English YFS ,	1075.,	.736,	.000,	.00,	1,	.003,	.257
French YFS ,	578.,	.432,	.000,	.00,	1,	.010,	.434
F shrinkage mean ,	579.,	.50,,,,				.156,	.434

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
671.,	.14,	.05,	25,	.358,	.384

1

Age 8 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 RYE TRAWL,<40 tra,	764.,	.297,	.089,	.30,	7,	.179,	.303
BELGIAN BEAM TRAWL(,	640.,	.203,	.081,	.40,	7,	.513,	.352
UK BEAM TRAWL SURVEY,	485.,	.239,	.196,	.82,	4,	.111,	.443
French GFS ,	391.,	.472,	.397,	.84,	4,	.033,	.526
English YFS ,	400.,	.885,	.000,	.00,	1,	.001,	.517
French YFS ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	539.,	.50,,,,				.163,	.406

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
612.,	.15,	.06,	24,	.413,	.366

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

Year class = 1984

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
UK RYE TRAWL,<40 tra,	245.,	.310,	.148,	.48,	8,	.204,	.330
BELGIAN BEAM TRAWL(,	233.,	.202,	.119,	.59,	8,	.479,	.346
UK BEAM TRAWL SURVEY,	165.,	.272,	.053,	.20,	3,	.089,	.458
French GFS ,	260.,	.531,	.325,	.61,	3,	.028,	.315
English YFS ,	228.,	1.301,	.000,	.00,	1,	.001,	.352
French YFS ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	211.,	.50,,,,				.200,	.376

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
224.,	.16,	.07,	24,	.419,	.356

1
1

Table 4.5.5.- Plaice in Division VIId. VPA fishing mortality (F) and stock number at age.

Run title : 107D PLAICE 1994 WG,1-15+,80-93,SEXES COMB,MILLNER/AT

At 7/10/1994 19:42

Table 8 Fishing mortality (F) at age

YEAR,	1980,	1981,	1982,	1983,
AGE				
1,	.0021,	.0012,	.0105,	.0046,
2,	.1621,	.1136,	.1280,	.1459,
3,	.2695,	.7131,	.4829,	.4364,
4,	.3177,	.8590,	.8439,	.9126,
5,	.5944,	.2568,	.6686,	.5471,
6,	.4021,	.3525,	.2672,	.3830,
7,	.3868,	.4773,	.3393,	.1675,
8,	.2449,	.6872,	1.8224,	.8645,
9,	.3458,	.5079,	.8144,	.4737,
+gp,	.3458,	.5079,	.8144,	.4737,
0 FBAR 2- 6,	.3492,	.4590,	.4781,	.4850,
FBAR 3- 6,	.3960,	.5454,	.5657,	.5698,

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	FBAR 91-93
AGE											
1,	.0141,	.0048,	.0113,	.0008,	.0006,	.0539,	.0972,	.0850,	.0542,	.0408,	.0600,
2,	.1107,	.3024,	.2044,	.1755,	.1983,	.1691,	.2214,	.5333,	.5136,	.3382,	.4617,
3,	.5575,	.5742,	.6735,	.4993,	.6515,	.4412,	.6921,	.8655,	.9244,	.6283,	.8061,
4,	.7822,	.8256,	.7281,	.7656,	.6471,	.7346,	.7290,	.8722,	.6765,	.6635,	.7374,
5,	.7618,	.2186,	.5657,	.5352,	.5406,	.8200,	.6277,	.6789,	.5307,	.4194,	.5430,
6,	.6350,	.5457,	.4697,	.2916,	.4208,	.5537,	.5610,	.6150,	.6336,	.3729,	.5405,
7,	.7973,	.3678,	.4150,	.7583,	.4938,	.3769,	.4226,	.3609,	.5071,	.3842,	.4174,
8,	.2559,	.8600,	.2368,	.4333,	.4583,	.3475,	.4523,	.3465,	.4196,	.3656,	.3772,
9,	.5651,	.6023,	.3495,	.6134,	.5393,	.5413,	.6272,	.4446,	.6003,	.3563,	.4671,
+gp,	.5651,	.6023,	.3495,	.6134,	.5393,	.5413,	.6272,	.4446,	.6003,	.3563,	
0 FBAR 2- 6,	.5694,	.4933,	.5283,	.4534,	.4917,	.5437,	.5662,	.7130,	.6558,	.4844,	
FBAR 3- 6,	.6841,	.5410,	.6093,	.5229,	.5650,	.6374,	.6525,	.7579,	.6913,	.5210,	

Run title : 107D PLAICE 1994 WG,1-15+,80-93,SEXES COMB,MILLNER/AT

At 7/10/1994 19:42

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

YEAR,	1980,	1981,	1982,	1983,
AGE				
1,	27334,	13896,	26999,	21479,
2,	18763,	24193,	12309,	23697,
3,	6521,	14151,	19154,	9606,
4,	2106,	4417,	6151,	10481,
5,	1161,	1360,	1659,	2346,
6,	241,	568,	933,	754,
7,	149,	143,	354,	633,
8,	215,	90,	79,	224,
9,	15,	149,	40,	11,
+gp,	373,	530,	166,	283,
0 TOTAL,	56877,	59497,	67845,	69514,

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	GMST 80-91	AMST 80-91
AGE													
1,	26586,	31785,	63941,	33373,	28010,	16713,	18707,	20097,	33502,	19660,	0,	25334,	27410,
2,	18964,	23250,	28057,	56071,	29576,	24827,	14045,	15054,	16372,	28146,	16738,	22191,	24067,
3,	18164,	15057,	15240,	20285,	41727,	21512,	18594,	9983,	7833,	8688,	17787,	15784,	17499,
4,	5507,	9225,	7520,	6892,	10920,	19291,	12273,	8255,	3726,	2757,	4110,	7539,	8587,
5,	3732,	2234,	3584,	3220,	2843,	5071,	8207,	5251,	3061,	1680,	1259,	2909,	3389,
6,	1204,	1545,	1592,	1805,	1672,	1468,	1981,	3886,	2362,	1597,	980,	1209,	1471,
7,	456,	566,	794,	883,	1196,	974,	749,	1002,	1863,	1112,	975,	549,	658,
8,	475,	182,	347,	465,	367,	647,	592,	435,	620,	995,	671,	285,	343,
9,	84,	326,	68,	243,	267,	206,	406,	334,	273,	361,	612,	110,	179,
+gp,	244,	117,	122,	177,	441,	497,	523,	368,	276,	536,	557,		
0 TOTAL,	75415,	84287,	121266,	123415,	117018,	91206,	76076,	64665,	69888,	65532,	43689,		

Table 4.5.6 .- Plaice VIId. RCT3 file input.

7D PLAICE - AGE 1- all indices *10 - WG94

7	14	2						
'YEAR'	'VPA'	'eyfs0'	'eyfs1'	'fyfs0'	'fyfs1'	'ebt1'	'fbt0'	'fbt1'
1981	26999	18	3.7	53.1	2.5	-11	-11	-11
1982	21479	14	6.2	14.9	0.4	-11	-11	-11
1983	26586	82	5.8	24.2	-11	-11	-11	-11
1984	31785	40	9.2	-11	-11	-11	-11	-11
1985	63941	59	12.5	-11	-11	-11	-11	-11
1986	33373	108	16.1	-11	9.4	-11	-11	-11
1987	28010	155.3	12.3	44.4	8.2	264.7	-11	79.5
1988	16713	64.2	7.3	11.1	2.2	23.1	1.6	34.9
1989	18707	22.7	3.8	23.8	4	51.6	1.4	32.7
1990	20097	23.7	3.4	10.4	3.9	117.5	1.5	15.8
1991	-11	17.4	8.6	30.2	13.6	165.3	1.3	376.6
1992	-11	18	6.4	21.9	4.5	32.2	11.9	100.3
1993	-11	27	4.5	8.8	-11	83.3	22.1	-11
1994	-11	60	-11	-11	-11	-11	-11	-11

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

Analysis by RCT3 ver3.1 of data from file : p7drc293.csv
7D PLAICE - AGE 1 - all indices*10 - WG94
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 = 1991

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	1.43	4.69	1.13	.121	10	2.91	8.85	1.439	.008
eyfs1	1.25	7.55	.50	.406	10	2.26	10.38	.603	.048
fyfs0	.42	8.68	.17	.631	7	3.44	10.14	.231	.328
fyfs1	.65	9.04	.39	.346	7	2.68	10.78	.601	.048
ebt1	.23	8.93	.10	.890	4	5.11	10.10	.161	.438
fbt0									
fbt1	.54	7.99	.33	.406	4	5.93	11.21	1.120	.014
					VPA Mean =		10.19	.392	.114

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	1.44	4.65	1.13	.122	10	2.94	8.87	1.455	.008
eyfs1	1.25	7.55	.51	.411	10	2.00	10.05	.606	.046
fyfs0	.43	8.67	.18	.629	7	3.13	10.01	.232	.313
fyfs1	.65	9.03	.38	.359	7	1.70	10.13	.498	.068
ebt1	.23	8.93	.10	.889	4	3.50	9.73	.166	.421
fbt0									
fbt1	.54	7.98	.33	.403	4	4.62	10.49	.689	.035
					VPA Mean =		10.19	.395	.108

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	1.44	4.62	1.14	.123	10	3.33	9.41	1.412	.011
eyfs1	1.24	7.57	.51	.416	10	1.70	9.68	.635	.052
fyfs0	.43	8.66	.18	.626	7	2.28	9.64	.274	.279
fyfs1									
ebt1	.23	8.93	.10	.888	4	4.43	9.94	.155	.525
fbt0									
fbt1									
					VPA Mean =		10.18	.398	.133

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	1.44	4.60	1.14	.126	10	4.11	10.51	1.405	.076
eyfs1									
fyfs0									
fyfs1									
ebt1									
fbt0									
fbt1									
					VPA Mean =		10.18	.402	.924

Year Class	Weighted Average Prediction (age 1)	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1991	**26187**	10.17	.13	.09	.50		
1992	**20521**	9.93	.13	.09	.49		
1993	**19354**	9.87	.14	.09	.40		
1994	**27001**	10.20	.39	.09	.05		

Table 4.5.8 - Plaice in Division VIId. VPA summary.

Run title : 107D PLAICE 1994 WG,1-15+,80-93,SEXES COMB

At 7/10/1994 19:42

Table 16 Summary (without SOP correction)

	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 6,	FBAR 3- 6,
1980,	27334,	17330,	5832,	2650,	.4544,	.3492,	.3960,
1981,	13896,	14935,	6783,	4769,	.7030,	.4590,	.5454,
1982,	26999,	15706,	7822,	4865,	.6220,	.4781,	.5657,
1983,	21479,	15792,	8392,	5043,	.6010,	.4850,	.5698,
1984,	26586,	14734,	7720,	5161,	.6685,	.5694,	.6841,
1985,	31785,	16459,	8449,	6022,	.7128,	.4933,	.5410,
1986,	63941,	24184,	10483,	6834,	.6519,	.5283,	.6093,
1987,	33373,	33122,	13943,	8366,	.6000,	.4534,	.5229,
1988,	28010,	25310,	13604,	10420,	.7659,	.4917,	.5650,
1989,	16713,	22243,	14712,	8758,	.5953,	.5437,	.6374,
1990,	18707,	19896,	13788,	9047,	.6561,	.5662,	.6525,
1991,	20097,	14652,	10370,	7813,	.7534,	.7130,	.7579,
1992,	33502,	14209,	7757,	6337,	.8169,	.6558,	.6913,
1993,	19660,	16246,	7671,	5331,	.6950,	.4844,	.5210,
1994,	19300 (1)						
Arith.Mean,	27292,	18916,	9809,	6530,	.6640,	.5193,	.5899,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

(1) recruits estimate

Table 4.5.9 - Plaice in Division VIId. Yield per recruit input table.

Plaice in the English Channel, Eastern (Fishing Area VIId)

Plaice in the English Channel, Eastern (Fishing Area VIId)

Prediction with management option table: Input data

Year: 1994								
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	19354.000	0.1200	0.0000	0.0000	0.0000	0.087	0.0471	0.209
2	16738.000	0.1200	0.1500	0.0000	0.0000	0.177	0.3621	0.275
3	17787.000	0.1200	0.5300	0.0000	0.0000	0.270	0.6321	0.333
4	4110.000	0.1200	0.9600	0.0000	0.0000	0.366	0.5783	0.417
5	1259.000	0.1200	1.0000	0.0000	0.0000	0.466	0.4258	0.490
6	980.000	0.1200	1.0000	0.0000	0.0000	0.568	0.4239	0.577
7	975.000	0.1200	1.0000	0.0000	0.0000	0.673	0.3273	0.729
8	671.000	0.1200	1.0000	0.0000	0.0000	0.782	0.2958	0.915
9	612.000	0.1200	1.0000	0.0000	0.0000	0.893	0.3663	0.903
10+	557.000	0.1200	1.0000	0.0000	0.0000	1.008	0.4844	1.171
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1995								
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	25334.000	0.1200	0.0000	0.0000	0.0000	0.087	0.0471	0.209
2	.	0.1200	0.1500	0.0000	0.0000	0.177	0.3621	0.275
3	.	0.1200	0.5300	0.0000	0.0000	0.270	0.6321	0.333
4	.	0.1200	0.9600	0.0000	0.0000	0.366	0.5783	0.417
5	.	0.1200	1.0000	0.0000	0.0000	0.466	0.4258	0.490
6	.	0.1200	1.0000	0.0000	0.0000	0.568	0.4239	0.577
7	.	0.1200	1.0000	0.0000	0.0000	0.673	0.3273	0.729
8	.	0.1200	1.0000	0.0000	0.0000	0.782	0.2958	0.915
9	.	0.1200	1.0000	0.0000	0.0000	0.893	0.3663	0.903
10+	.	0.1200	1.0000	0.0000	0.0000	1.008	0.4844	1.171
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	25334.000	0.1200	0.0000	0.0000	0.0000	0.087	0.0471	0.209
2	.	0.1200	0.1500	0.0000	0.0000	0.177	0.3621	0.275
3	.	0.1200	0.5300	0.0000	0.0000	0.270	0.6321	0.333
4	.	0.1200	0.9600	0.0000	0.0000	0.366	0.5783	0.417
5	.	0.1200	1.0000	0.0000	0.0000	0.466	0.4258	0.490
6	.	0.1200	1.0000	0.0000	0.0000	0.568	0.4239	0.577
7	.	0.1200	1.0000	0.0000	0.0000	0.673	0.3273	0.729
8	.	0.1200	1.0000	0.0000	0.0000	0.782	0.2958	0.915
9	.	0.1200	1.0000	0.0000	0.0000	0.893	0.3663	0.903
10+	.	0.1200	1.0000	0.0000	0.0000	1.008	0.4844	1.171
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : AT93
Date and time: 10OCT94:15:40

Table 4.5.10.- Plaice in Division VIId. Yield per recruit summary table.

Plaice in the English Channel, Eastern (Fishing Area VIId)

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	8.843	5346.517	6.692	5015.782	6.692	5015.782
0.2000	0.0969	0.390	228.702	5.604	2517.748	3.494	2198.033	3.494	2198.033
0.4000	0.1938	0.545	265.909	4.314	1528.715	2.242	1219.030	2.242	1219.030
0.6000	0.2907	0.629	268.071	3.624	1061.858	1.587	761.330	1.587	761.330
0.8000	0.3876	0.681	263.109	3.200	806.565	1.196	514.421	1.196	514.421
1.0000	0.4844	0.715	257.470	2.917	653.284	0.942	368.837	0.942	368.837
1.2000	0.5813	0.740	252.606	2.716	554.673	0.769	277.310	0.769	277.310
1.4000	0.6782	0.759	248.685	2.566	487.600	0.645	216.773	0.645	216.773
1.6000	0.7751	0.774	245.563	2.450	439.784	0.553	175.001	0.553	175.001
1.8000	0.8720	0.785	243.062	2.357	404.290	0.483	145.108	0.483	145.108
2.0000	0.9689	0.795	241.027	2.281	377.007	0.428	123.027	0.428	123.027
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : AT_YR93
Date and time : 10OCT94:15:56
Computation of ref. F: Simple mean, age 2 - 6
F-0.1 factor : 0.2502
F-max factor : 0.5207
F-0.1 reference F : 0.1212
F-max reference F : 0.2522
Recruitment : Single recruit

Table 4.5.11.- Plaice in Division VIId. Prediction with management option table.

Plaice in the English Channel, Eastern (Fishing Area VIId)

Plaice in the English Channel, Eastern (Fishing Area VIId)

Prediction with management option table

Year: 1994 F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Year: 1995 F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Year: 1996 Stock biomass	Sp.stock biomass
1.0000	0.4844	14392	7868	5965	0.0000	0.0000	14288	8181	0	20289	12720
.	.	.	.	.	0.2000	0.0969	.	8181	1351	18943	11552
.	.	.	.	.	0.4000	0.1938	.	8181	2577	17726	10500
.	.	.	.	.	0.6000	0.2907	.	8181	3692	16625	9553
.	.	.	.	.	0.8000	0.3876	.	8181	4706	15626	8700
.	.	.	.	.	1.0000	0.4844	.	8181	5629	14721	7931
.	.	.	.	.	1.2000	0.5813	.	8181	6470	13899	7238
.	.	.	.	.	1.4000	0.6782	.	8181	7238	13153	6613
.	.	.	.	.	1.6000	0.7751	.	8181	7939	12474	6048
.	.	.	.	.	1.8000	0.8720	.	8181	8579	11857	5538
.	.	.	.	.	2.0000	0.9689	.	8181	9166	11294	5077
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : AT93
Date and time : 10OCT94:15:40
Computation of ref. F: Simple mean, age 2 - 6
Basis for 1994 : F factors

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

Populations in 1994			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	25333	.39	WS1	.08	.26	M1	.12	.10	MT1	.00	.10
N2	16738	.14	WS2	.17	.24	M2	.12	.10	MT2	.15	.10
N3	17785	.14	WS3	.26	.22	M3	.12	.10	MT3	.53	.10
N4	4109	.13	WS4	.36	.20	M4	.12	.10	MT4	.96	.10
N5	1258	.13	WS5	.46	.18	M5	.12	.10	MT5	1.00	.10
N6	979	.12	WS6	.56	.16	M6	.12	.10	MT6	1.00	.00
N7	974	.13	WS7	.66	.15	M7	.12	.10	MT7	1.00	.00
N8	670	.14	WS8	.77	.13	M8	.12	.10	MT8	1.00	.00
N9	612	.15	WS9	.88	.12	M9	.12	.10	MT9	1.00	.00
N10	556	.16	WS10	1.00	.12	M10	.12	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.05	1.16	WH1	.21	.15
sH2	.29	.44	WH2	.27	.06
sH3	.58	.20	WH3	.33	.14
sH4	.60	.21	WH4	.40	.14
sH5	.50	.32	WH5	.49	.17
sH6	.45	.20	WH6	.60	.24
sH7	.34	.39	WH7	.76	.22
sH8	.32	.80	WH8	.92	.14
sH9	.42	.27	WH9	1.01	.20
sH10	.42	.27	WH10	1.36	.11

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K94	1.00	.10	HF94	1.00	.17
K95	1.00	.10	HF95	1.00	.17
K96	1.00	.10	HF96	1.00	.17

Recruitment		
Labl	Value	CV
R95	25333	.39
R96	25333	.39

Stock numbers in 1994 are VPA survivors.

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
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

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

Remarks:

Assessment Quality Control Diagram 2

Estimated total landings (tonnes) at *status quo* F								
Date of assessment	Year							
	1988	1989	1990	1991	1992	1993	1994	1995
1989								
1990		9851	9904	9703				
1991			9597	8223	7558			
1992				8327	6594	6406		
1993				7296	8049	6635	7162	
1994					6695	6625	5965	5629
					SQC[1]	SQC[2]	Current	Forecast

$$^{1}SQC = Landings(y-1) * \frac{F(y-2)}{F(y-1)} * \exp\left[-\frac{1}{2}\right]$$

$$^{2}SQC = Landings(y) * \frac{F(y-1)}{F(y)} * \exp\left[-\frac{1}{2}\right]$$

where $F(y)$, $F(y-1)$ $\wedge$ $F(y-2)$ *are as estimated* $\in$ *the assessment made* $\in$ *year* $(y+1)$.

Remarks:

Continued

Table 4.5.13 Continued

Stock: Plaice in Division VIId (Eastern English Channel)

Assessment Quality Control Diagram 3

Recruitment (age 1) Unit: thousands							
Date of assessment	Year class						
	1988	1989	1990	1991	1992	1993	1994
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	(19364)	25334[4]

[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.

Assessment Quality Control Diagram 4

Spawning stock biomass (tonnes)									
Date of assessment	Year								
	1988	1989	1990	1991	1992	1993	1994	1995	1996
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]

[1]Forecast.

Remarks: Not corrected for SOP.

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

Year	United Kingdom			Belgium	France	
	Beam trawl (kg/hr)	Hastings trammel (kg/days)	Rye trawl (kg/day)	Beam trawl (kg/hr)	Offshore trawl (kg/hr)	Inshore trawl (kg/hr)
1978		15.5		12.4		
1979		8.2		16.5		
1980		12.0		24.4		
1981		16.0		31.2		
1982		13.3		24.5		
1983	21.6	14.8		36.2	187.9	
1984	18.5	12.9	73.4	25.9	301.5	
1985	19.9	17.1	117.0	31.8	224.9	527.2
1986	27.7	17.5	121.2	34.9	221.1	701.4
1987	15.5	36.6	144.0	33.7	318.0	843.0
1988	8.9	44.2	189.9	40.7	316.8	1258.5
1989	17.6	46.9	171.7	42.8	190.5	739.5
1990	17.4	35.6	193.4	48.8	224.0	362.0
1991	18.3	41.3	91.6	45.5	173.4	382.9
1992	14.2	24.2	94.5	34.9	148.9	485.0
1993	11.9	16.1	86.6	24.2	117.2	417.1

Table 4.5.15.- Plaice in Division VIId. Effort data

Year	United Kingdom			Belgium	France	
	Beam trawl(1) ('000 hr)	Hastings trammel ('000 days)	Rye trawl ('000 days)	Beam trawl(1) ('000 hr)	Offshore trawl(1) ('000 hr)	Inshore trawl(1) ('000 hr)
1980				29.8		
1981				24.4		
1982				29.8		
1983	2.9			26.4	1816.8	
1984	2.3	7.1	7.4	35.4	2801.7	
1985	7.9	5.7	6.4	33.4	6768.4	228.8
1986	7.3	5.6	5.9	30.8	8069.0	411.2
1987	24.3	6.2	7.4	49.3	6035.8	573.2
1988	19.7	7.4	4.8	48.9	6064.3	942.2
1989	24.6	8.3	5.6	43.8	5939.3	1044.1
1990	32.8	18.4	4.3	38.5	7485.7	909.1
1991	29.5	11.1	12.0	32.8	9537.7	967.0
1992	35.0	18.0	11.8	30.9	9260.6	505.2
1993	29.2	13.6	9.8	28.2	8981.0	544.6

1. Corrected for HP

Table 4.5.16.- 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

Table 4.5.17.- Plaice in division VIId. Survey indices of recruitment

	VPA	English YFS		English BTS			French YFS		French CGFS		
Year class	('000)	*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	-	-	17.6
1987		15.5	1.23	26.47	12.13	5.76	4.44	0.82	-	7.95	7.41
1988		6.4	0.73	2.31	4.86	6.98	1.11	0.22	0.16	3.49	0.87
1989		2.3	0.38	5.16	9.06	4.19	2.38	0.4	0.14	3.27	0.59
1990		2.4	0.34	11.75	12.54	4.96	1.04	0.39	0.15	1.58	3.17
1991		1.7	0.86	16.53	13.4	9.17	3.02	1.36	0.13	37.66	5.4
1992		1.8	0.64	3.22	7.46		2.19	0.45	1.19	10.03	
1993		2.7	0.45	8.33			0.88		2.21		
1994		6.0									

Table 4.5.18.- Plaice in VIId. Trial RCT3 with age 0.

Analysis by RCT3 ver3.1 of data from file :

p7drcc93.csv
7D PLAICE - AGE 0 - all indices*10 - WG94
Data for 3 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 = 1991

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	1.43	4.69	1.13	.121	10	2.91	8.85	1.439	.019
fyfs0	.42	8.68	.17	.631	7	3.44	10.14	.231	.728
fbt0									
					VPA Mean =		10.19	.392	.253

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	1.44	4.65	1.13	.122	10	2.94	8.87	1.455	.019
fyfs0	.43	8.67	.18	.629	7	3.13	10.01	.232	.729
fbt0									
					VPA Mean =		10.19	.395	.252

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	1.44	4.62	1.14	.123	10	3.33	9.41	1.412	.025
fyfs0	.43	8.66	.18	.626	7	2.28	9.64	.274	.661
fbt0									
					VPA Mean =		10.18	.398	.314

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	1.44	4.60	1.14	.126	10	4.11	10.51	1.405	.076
fyfs0									
fbt0									
					VPA Mean =		10.18	.402	.924

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1991	25076	10.13	.20	.13	.41		
1992	22788	10.03	.20	.13	.40		
1993	18182	9.81	.22	.18	.66		
1994	27001	10.20	.39	.09	.05		

Figure 4.5.1.- Plaice in Division VIId. Catchability residual plot per age (L/S).

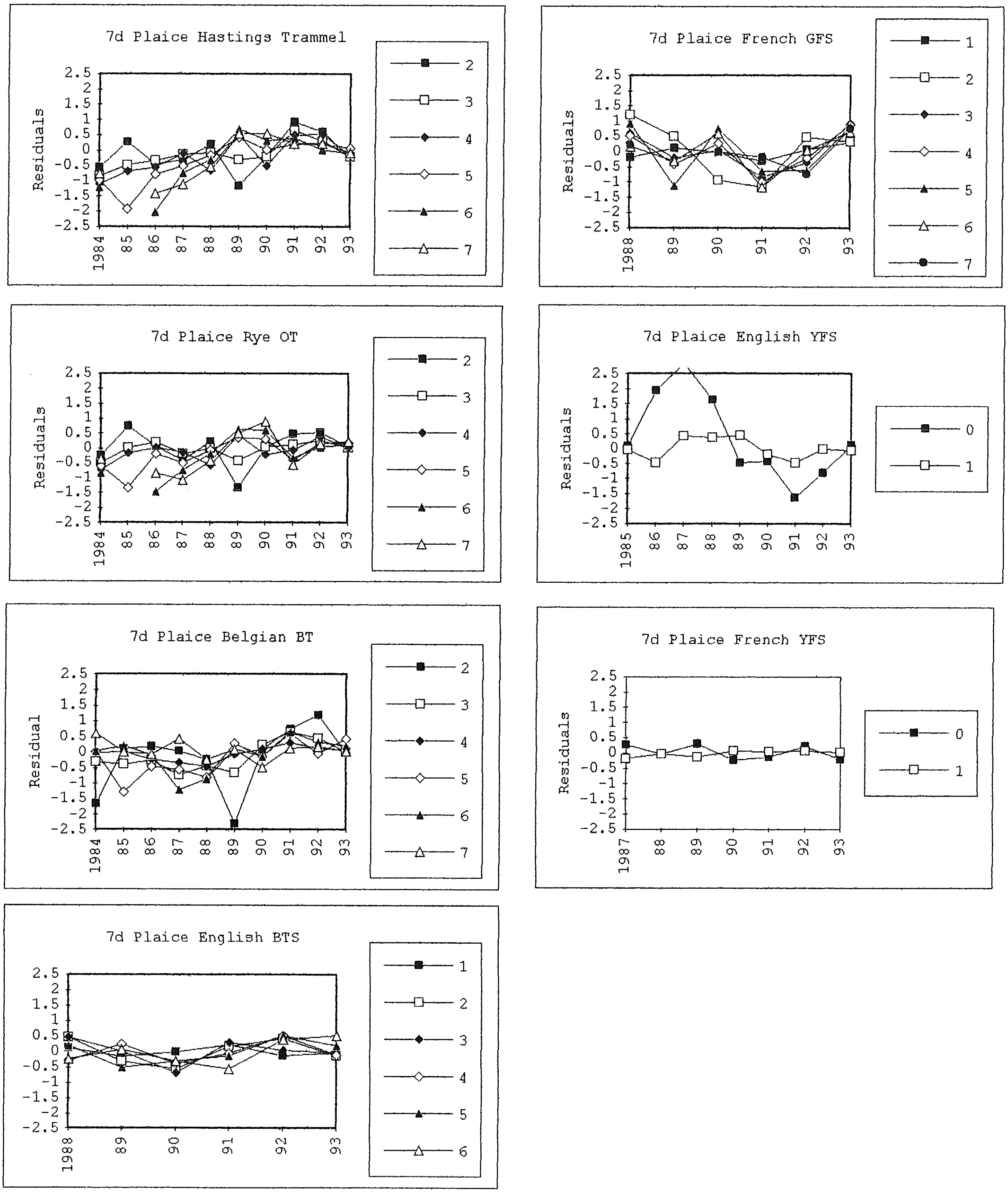


Figure 4.5.2.- Plaice in Division VIId - Retrospective analysis with the 2 commercial fleets.

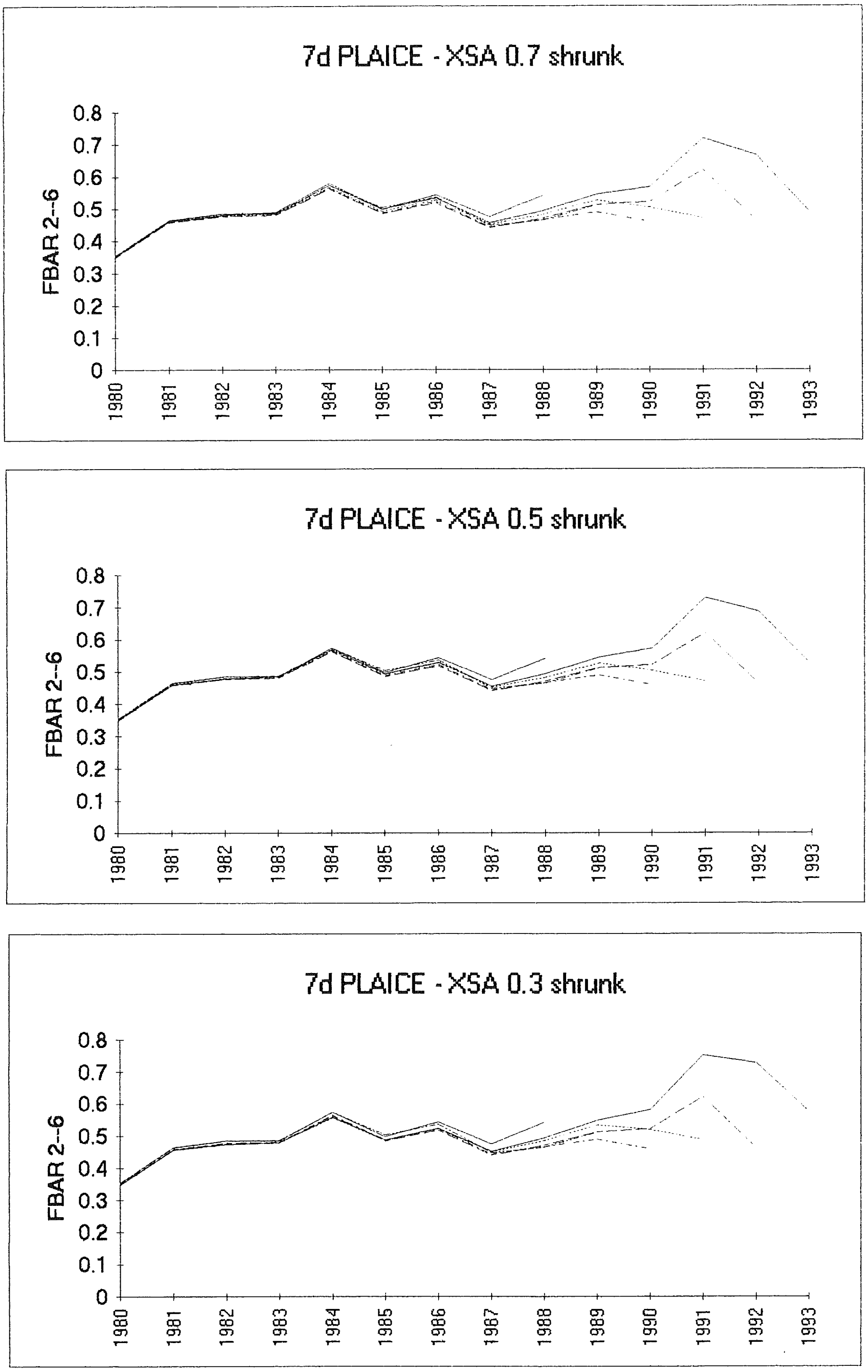
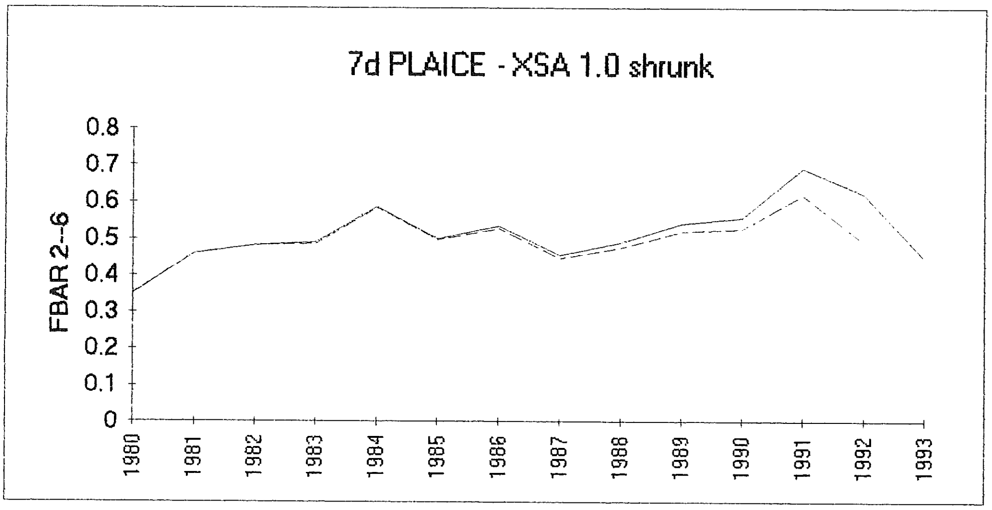
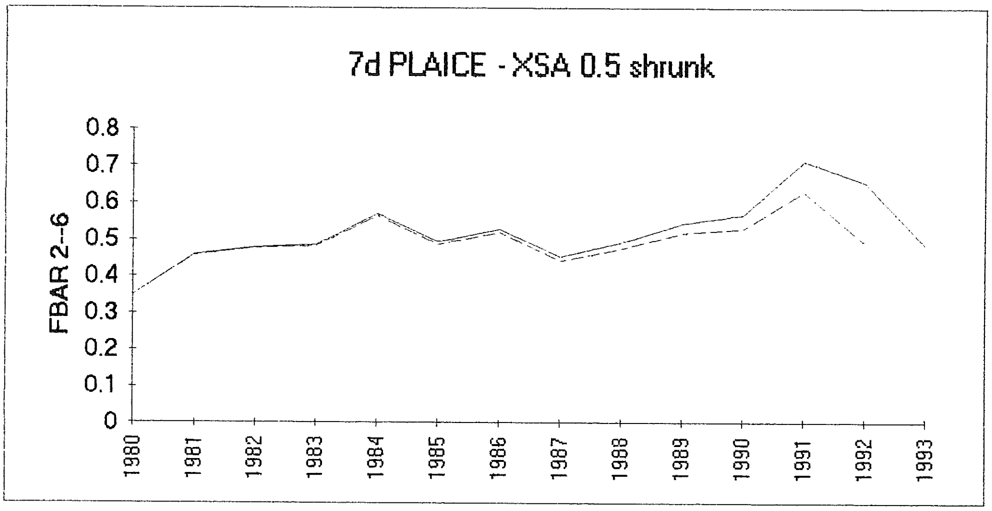


Figure 4.5.3.- Plaice in Division VIId - Retrospective analysis with the 6 fleets.





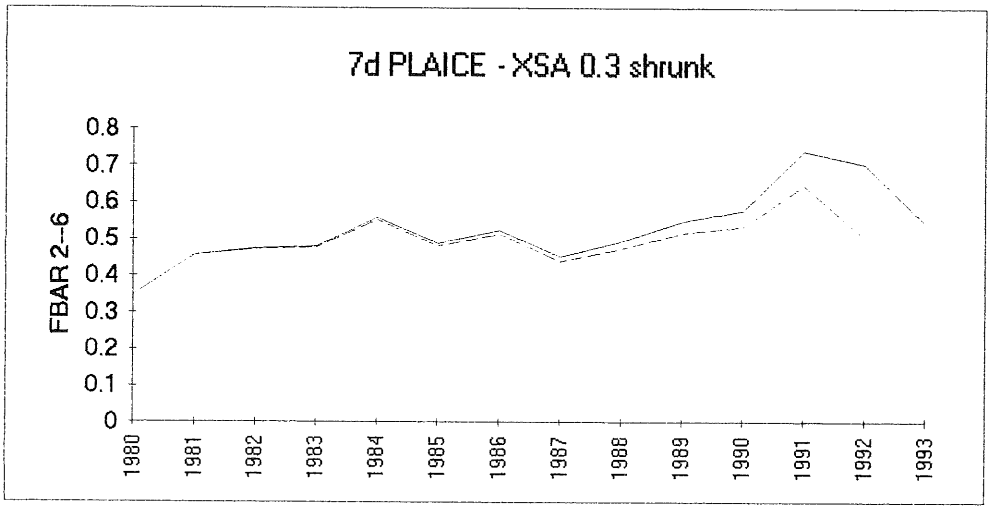


Fig.- 4.5.4.- Plaice in Division VIId. Fish stock summary.

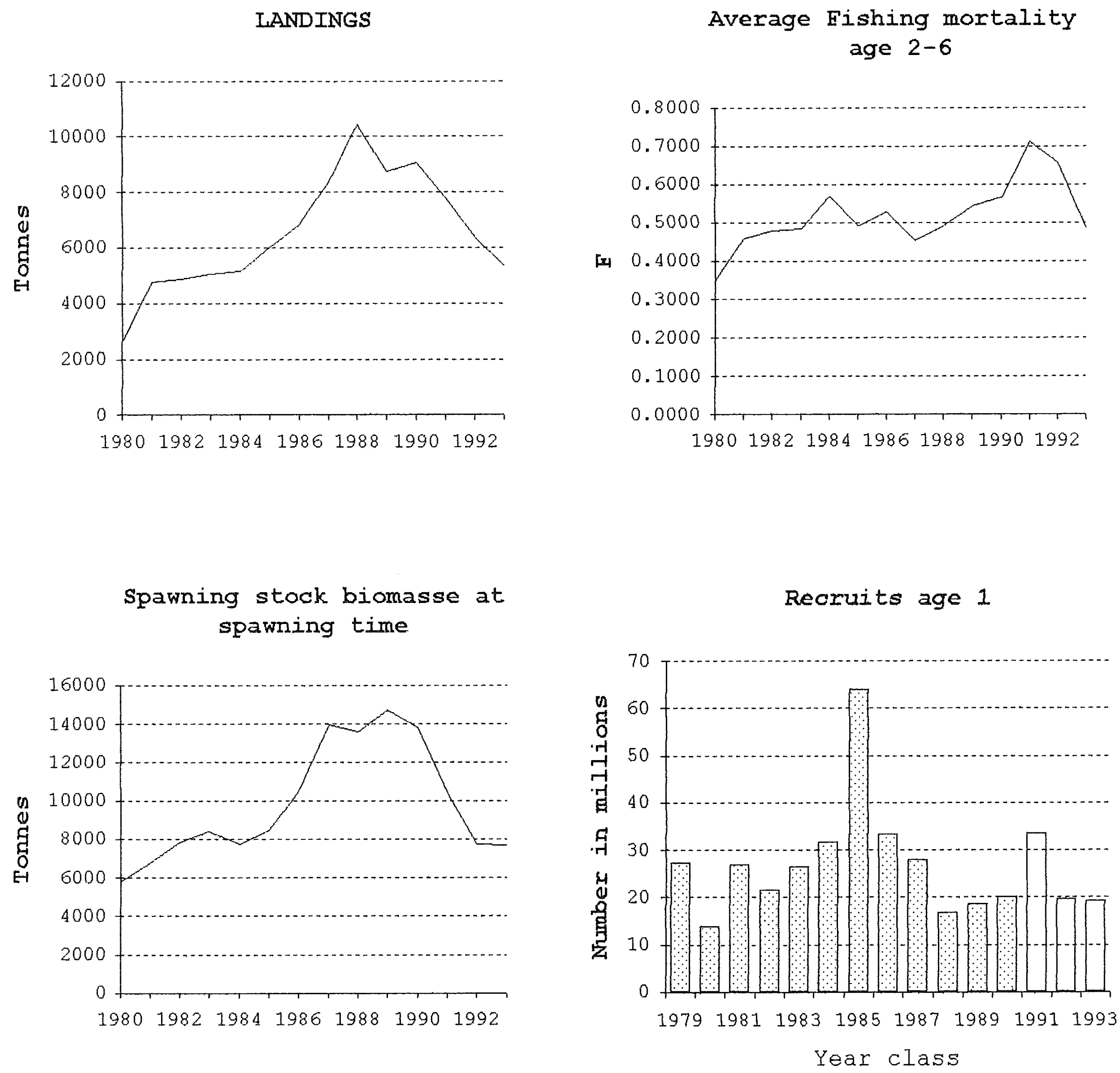
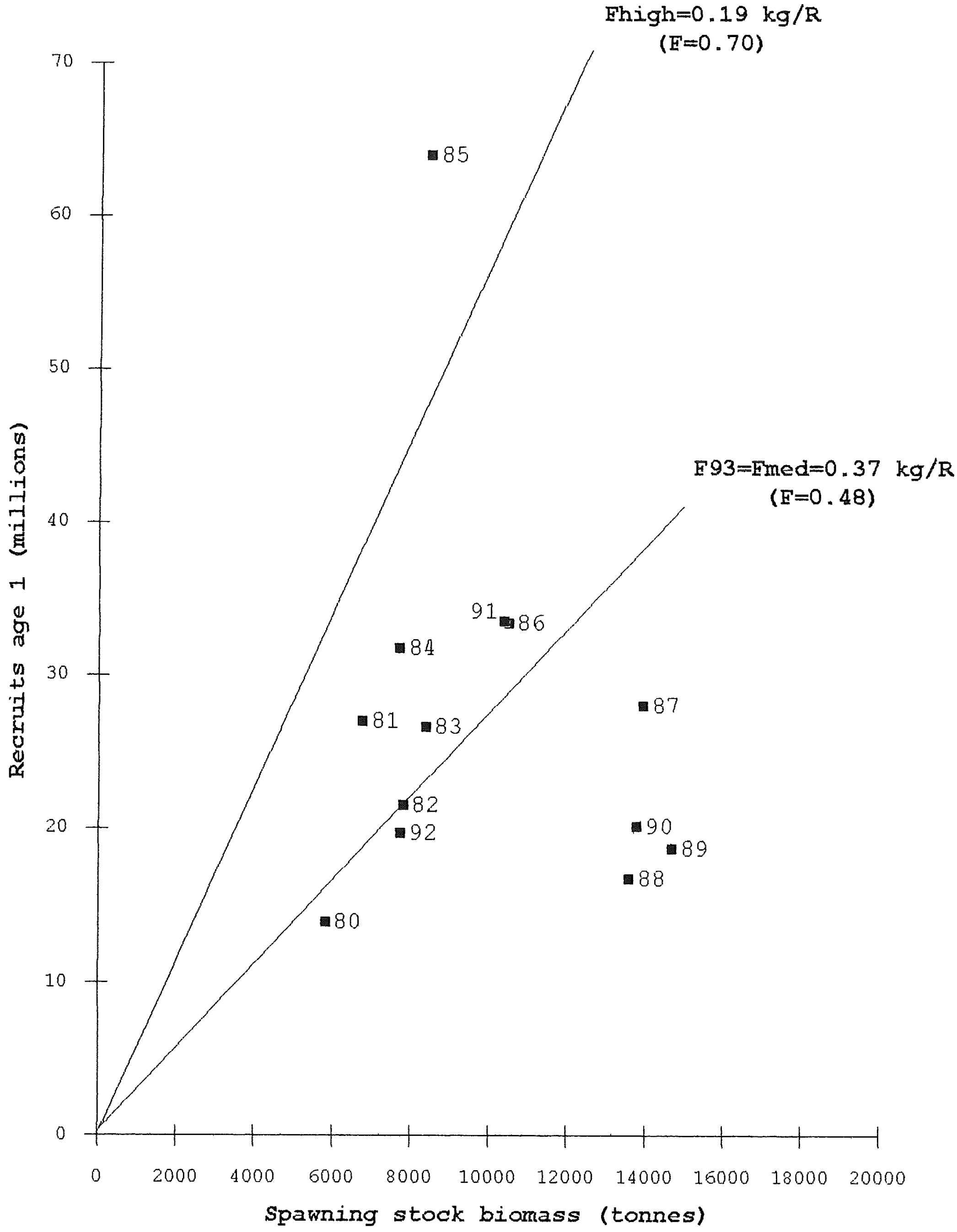
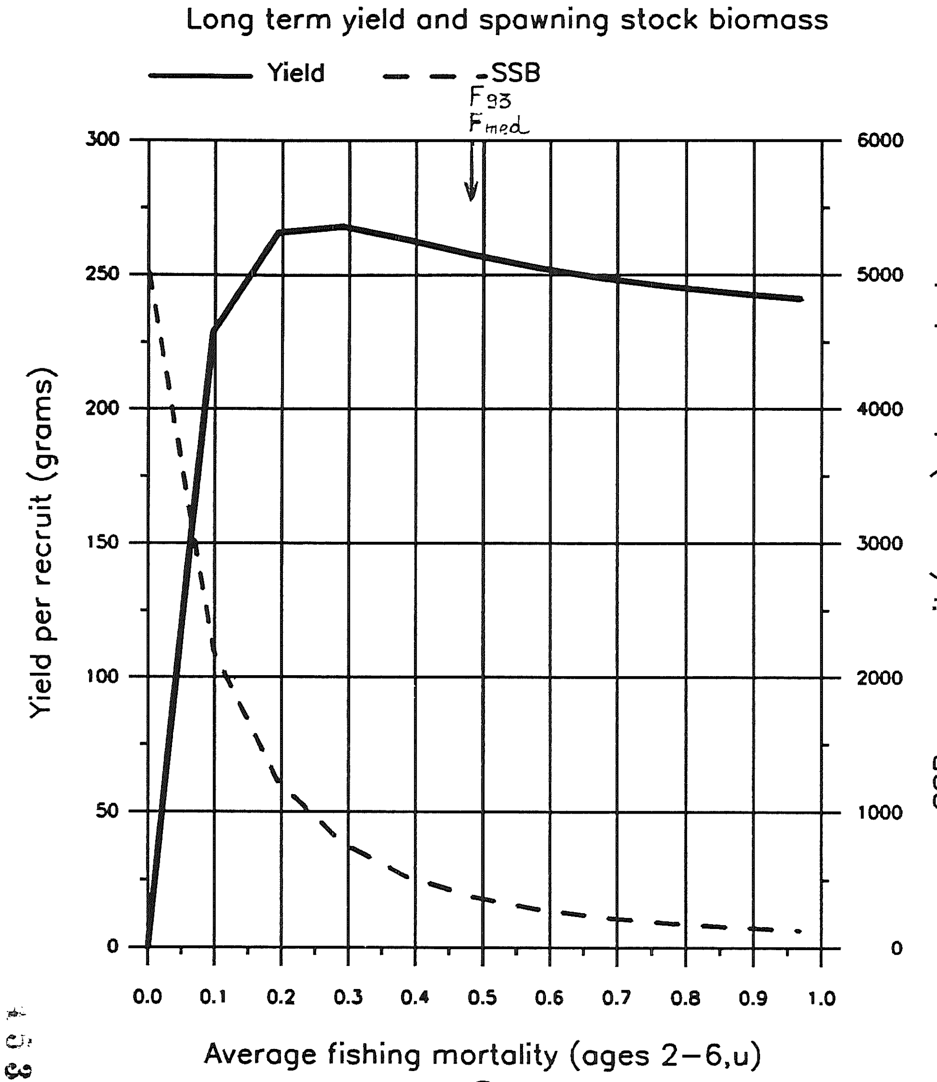


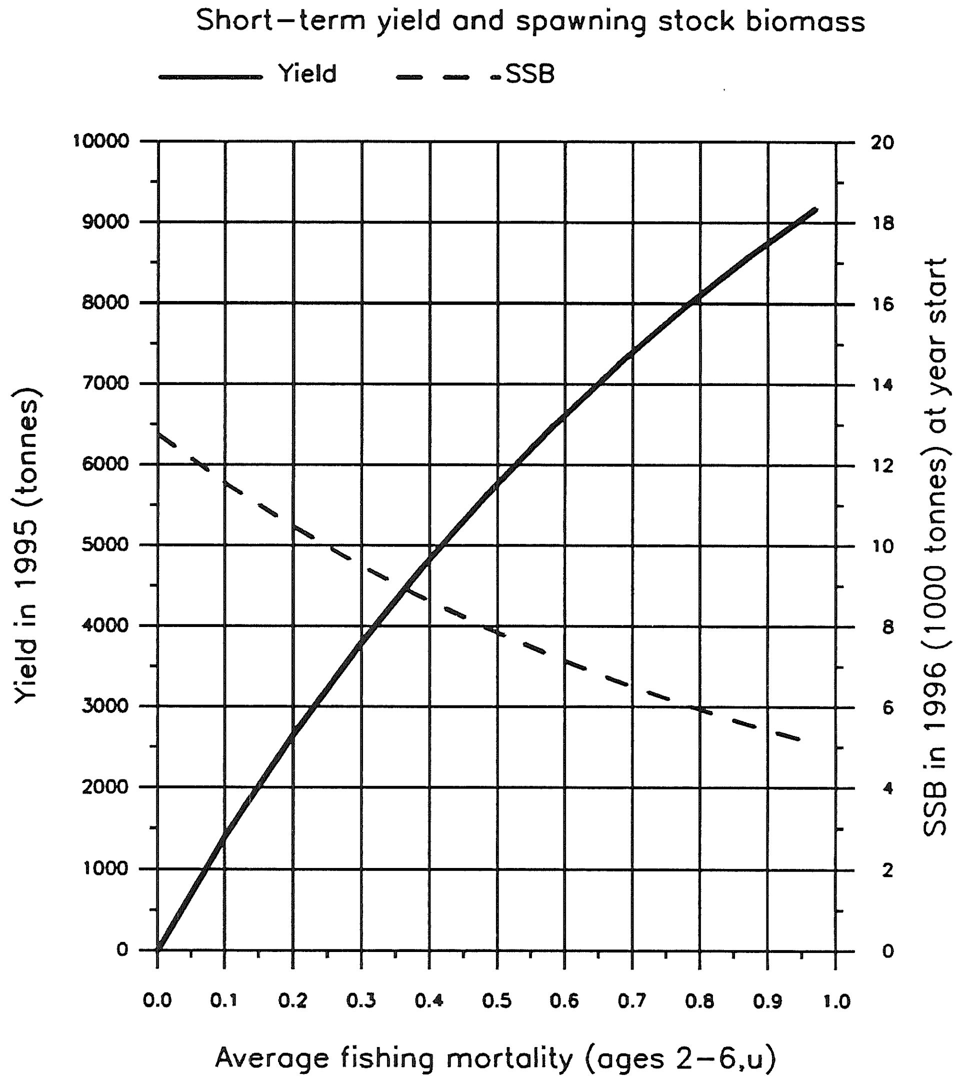
Fig.- 4.5.5.- Plaice in Division VIId. Stock recruitment



FISH STOCK SUMMARY
STOCK: Plaice in the English Channel, Eastern (Fishing Area VIId)
10–10–1994



(run: AT_YR93) **C**



(run: AT93) **D**

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

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

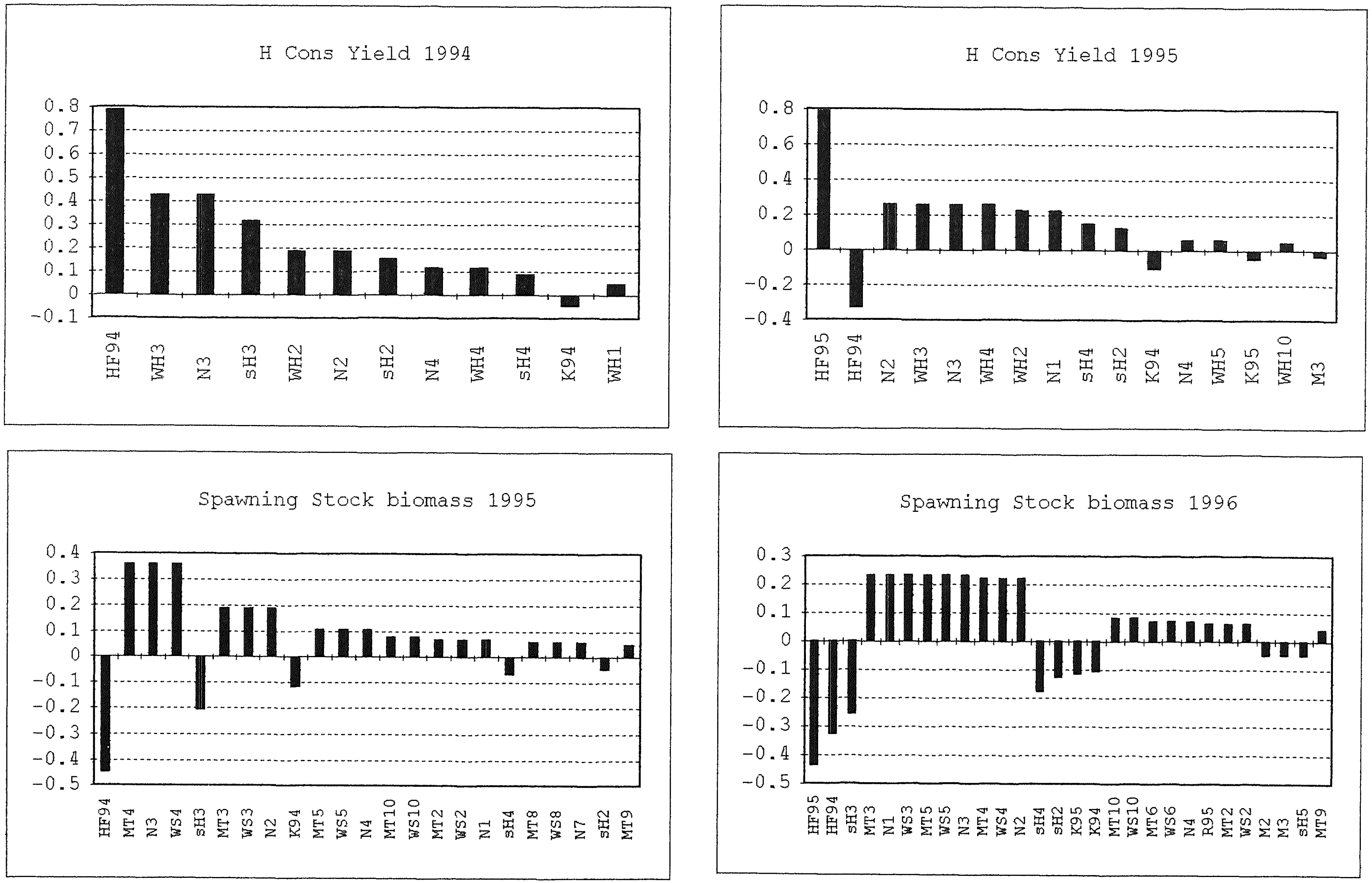


Fig.4.5.8.- Plaice in Division VIId. Sensitivity analysis of short term forecast.
Proportion of total variance contributed by each input.
Key to labels in Table .

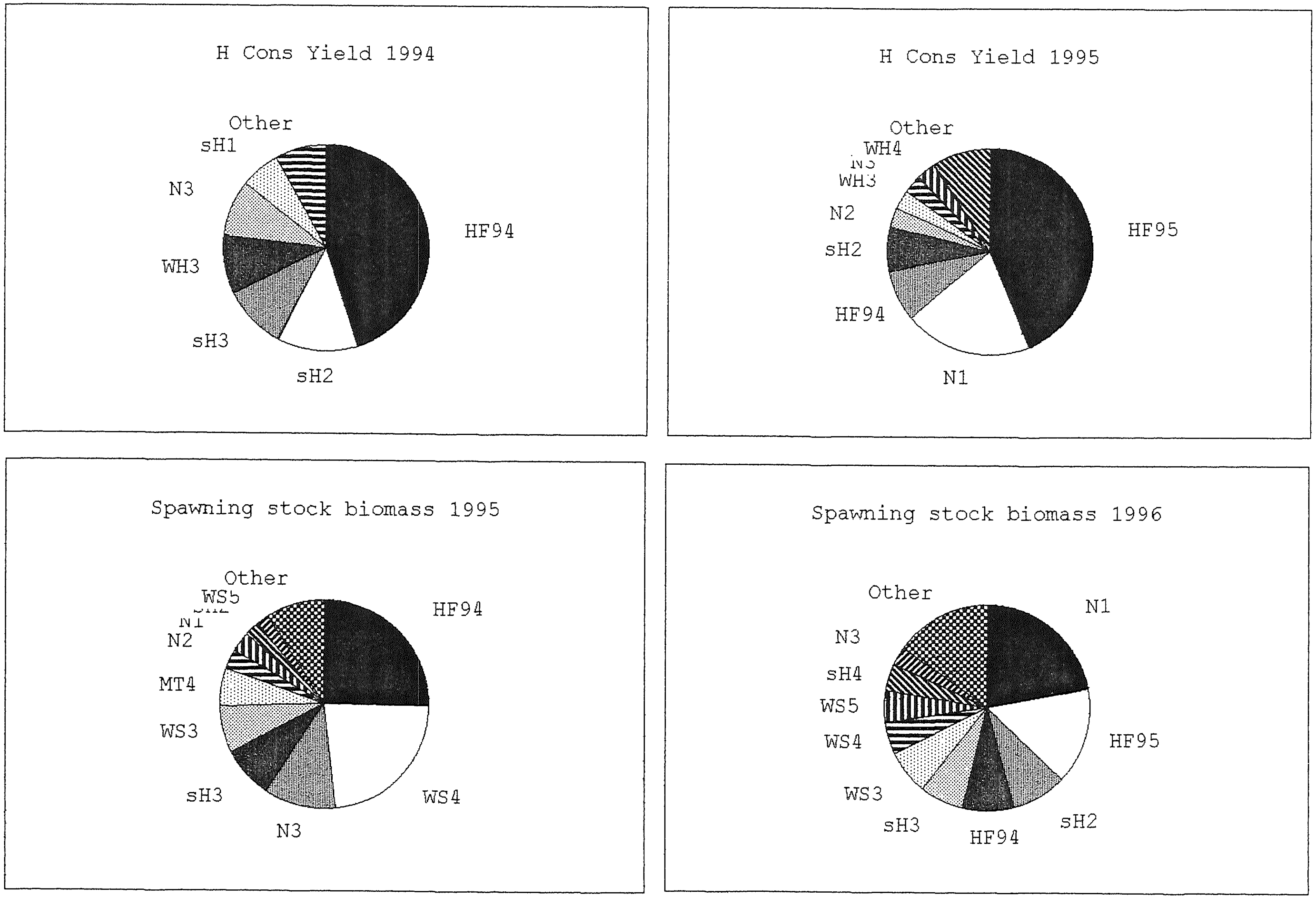


Fig 4.5.9.- Plaice in Division VIId. Sensitivity analysis of short term forecast.
Cumulative probability distributions.

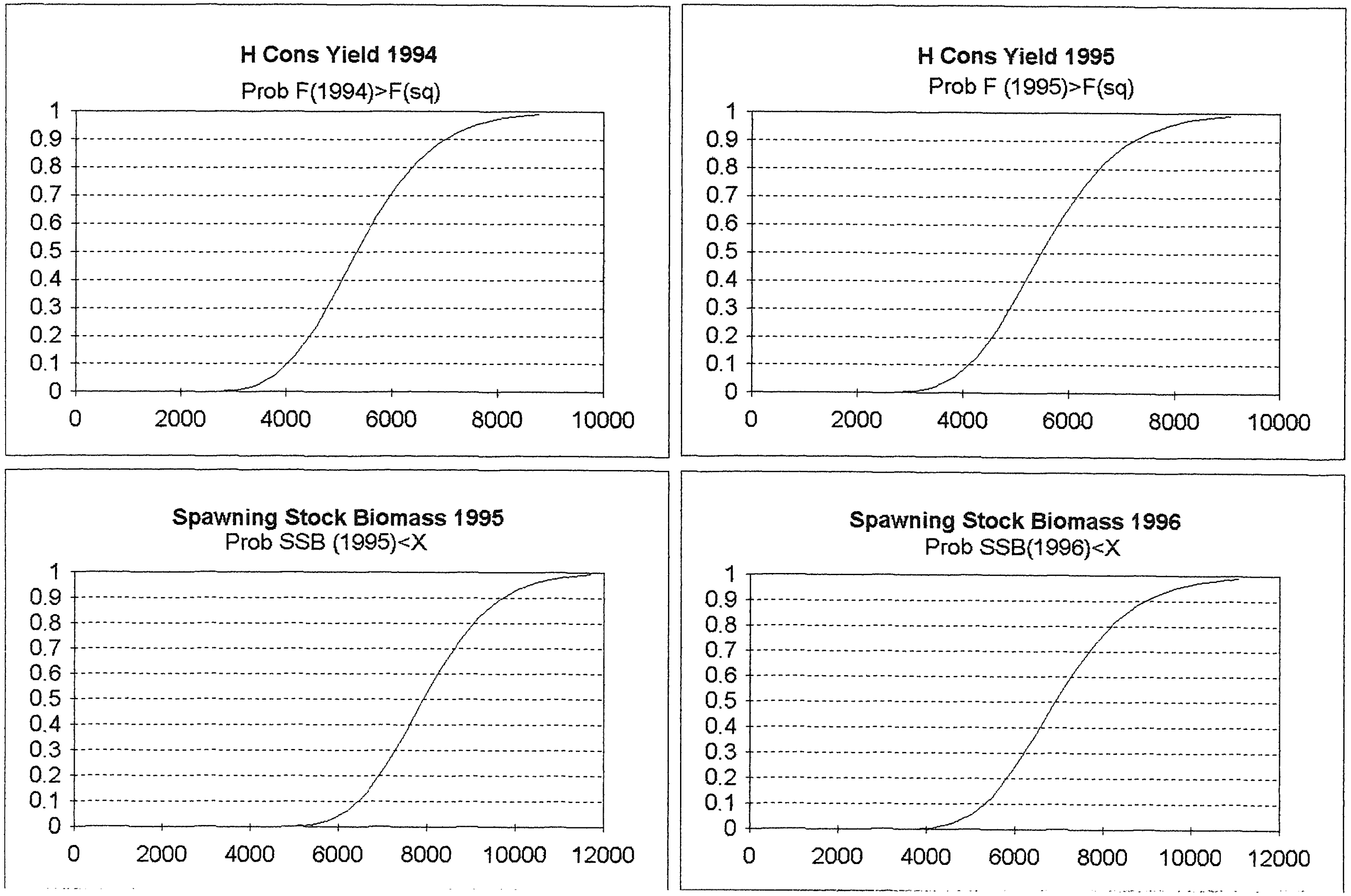


Figure 4.5.10.- Plaice in Division VIId. Standardised CPUE.

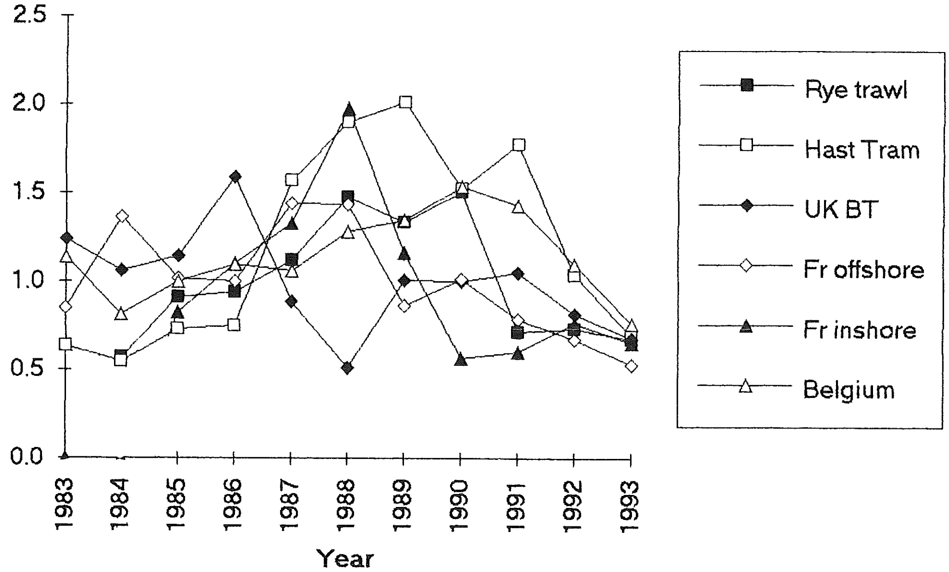


Figure 4.5.11.- Plaice in Division VIId. Standardised effort.

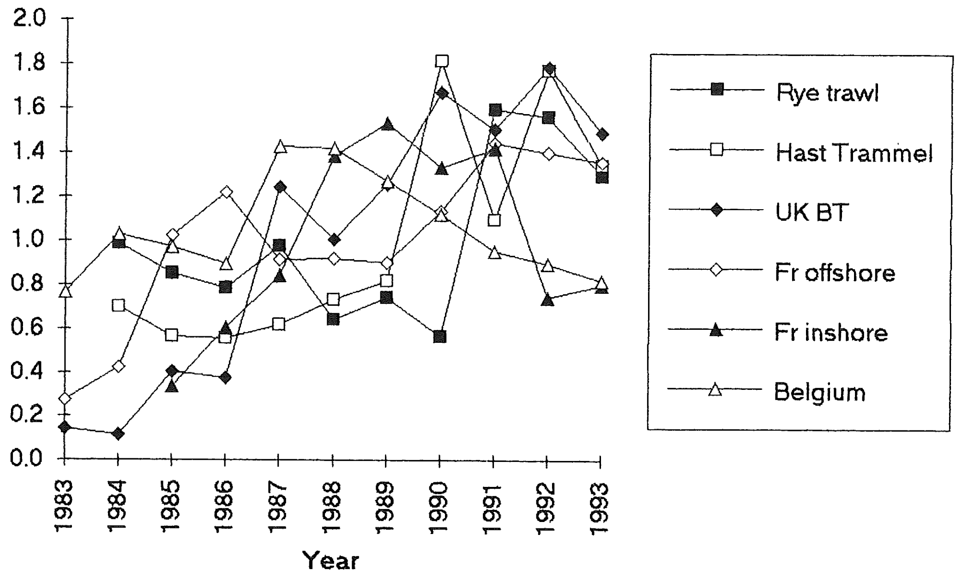
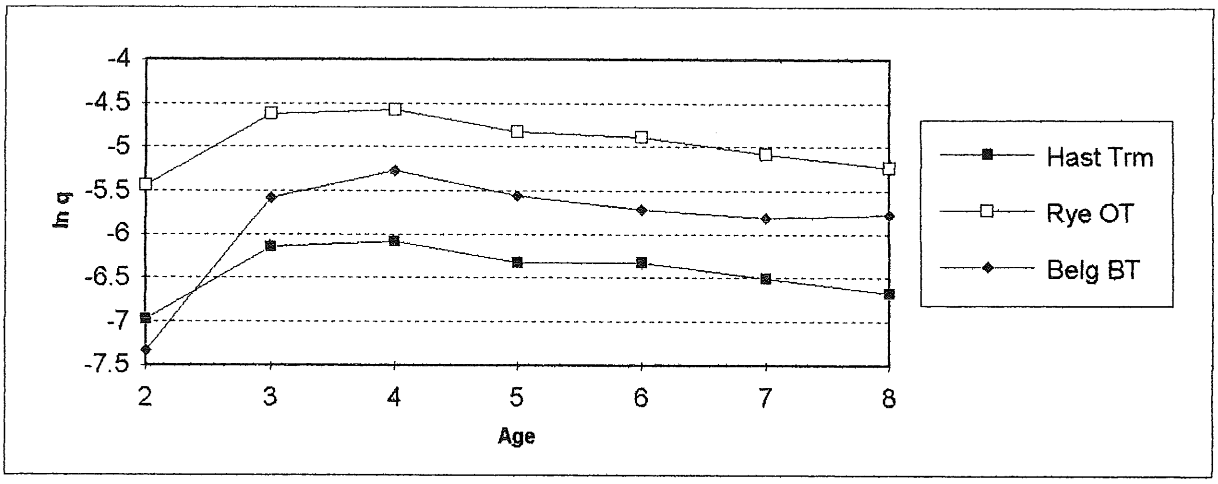


Figure 4 5.12.- Plaice in Division VIId. Mean Ln Q per age.



5 DATA FOR THE MULTISPECIES ASSESSMENT WORKING GROUP

For a number of years there has been a standing request to the Working Group to provide quarterly catch at age and associated mean weights at age for the Multispecies Assessment Working Group. This year the request is for the same data by "sub-division of the North Sea". The actual sub-divisions are not specified and informal approaches to members of the Multispecies Assessment Working Group elicited a variety of answers ranging from ICES Divisions to statistical rectangles. In order to proceed in this matter a clear definition of the areal need should be specified.

Clearly if the spatial resolution is statistical rectangle the task of retrieving the relevant data is significant. It should be remembered that a similar requirement was made for the STCF database and this was only achieved after the exercise was funded by the EC Commission. Although the data required for that database was even more detailed, it highlights a number of issues which need to be resolved. Some of these are:

i) Most biological sampling schemes are based on sampling strata much larger than statistical rectangles and the only way to obtain rectangle data is to derive artificial samples.

ii) Not all sampling schemes are area based. Some, for example, are based on sampling vessels at particular landing sites regardless of where they have fished. This means careful thought would have to be given to allocating age compositions appropriately to each rectangle.

iii) Many official statistics do not allocate catches to quarters of the year. Rules have been defined for dealing with this problem on a total area basis but the problem becomes much more severe when this has to be on a fine spatial scale as well.

iv) Clearly the quantity of data records produced on a country/quarter/species/rectangle basis will be very large and can only be handled efficiently using electronic media. Given that the same problem faces other working groups, it is important that common exchange formats be agreed so that the data recipients are able to process the information without substantial extra work.

v) Fine scale data are a potentially valuable resource and issues of confidentiality and ownership need to be defined and made explicit for any new database. Certain catch categories, such as discards and industrial catches, when available on a fine scale, are particularly politically sensitive.

Many members of the Working Group felt that it was unlikely that it would be possible to produce fine scale data from their country easily. In view of the magnitude of the task, the need to specify exactly what is required and the points discussed above, the Working Group recommends that an *ad hoc* data workshop should be set up with a chairman from the Multispecies Assessment Working Group who, as customer, would be in a position to specify data needs. This *ad hoc* group could specify exchange protocols and organise the work in such a way that the task would not have to be repeated unnecessarily.

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