Advisory Committee on Fishery Management ICES CM 1999/ACFM:8

REPORT OF THE

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

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PART 3 OF 3

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PART 3

10 PLAICE IN DIVISION IIIA

10.1 The fishery

10.1.1 ACFM advice applicable to 1998

ACFM recommended that fishing mortality should not be allowed to increase above the present level in order to maintain a high probability of keeping SSB above the historical level.

10.1.2 Management applicable to 1997 and 1998

The 1996 and 1997 TACs were 14,000 tonnes (11,200 t in Skattegat and 2,800 t in Kattegat). The same TAC has been implemented since 1992.

10.1.3 Landings in 1997

A directed plaice fishery is carried out by otter trawl, seine and gill-net with some beam trawlers being introduced in recent years. However, most of the catches are taken in mixed human consumption fisheries. A considerable number of vessels have been taken out of the fisheries in recent years (ICES CM 1996/Assess:6). The landing of plaice amounted to 10,149 tons in 1997 as compared to 10,121 tons in 1996. The fishery is dominated by Denmark with Danish catches accounting for more than 90% of the total. The annual landings, available since 1972, are given by country and separated on Kattegat and Skagerrak in Table 10.1.3 and Figure 10.7.1. In the start of this period, catches were mostly provided by Kattegat but from the mid-1970s, Skagerrak have supplied the major proportion of the catch. In 1997, about 75% of the catches were taken in Skagerrak (Figure 10.6.1.).

The landing data for 1983–1988 are considered uncertain and have been adjusted on the assumption that mis-reporting was a serious source of bias (ICES CM 1991/Assess: 9). In recent years no strong incentive has existed to omit the reporting of plaice catches and these are therefore considered reliable.

10.2 Natural mortality, Maturity, Age Compositions and Mean Weight at Age

As in previous years catch at age and mean weight at age information are provided by Denmark only. The total international catch was therefore broken down by quarter and landing harbours for Kattegat and Skagerrak separately. On the basis of a new perception of the sorting process in landings at the fish market, a different key has been used to derive the distribution of fish length from market size categories. The age-length key used in this year's assessment is the same as in last year's assessment. The catch-at-age and the mean weight at age are presented in Figure 10.2.1 and in Tables 10.2.1 and 10.2.2. Weight at age in the stock was assumed equal to that of the catch.

A natural mortality of 0.1 per year was assumed for all years and ages. A knife-edge maturity distribution was employed: age group 2 was assumed to be immature whereas all age 3 and older plaice were assumed mature.

10.3 Catch, Effort and Research Vessel Data

Three Danish fleets, i.e., trawl, gill-net and seine, are available for tuning. The age dis-aggregated indices were derived by merging logbook statistics supplying catch weight per market category with the age distribution within these categories available from the market sampling. In last year's assessment, the tuning fleets were designed with regards to two selection criteria. First, only fishing trips where plaice was the most valuable component of the catch were retained. Second, the tuning fleets only included the vessels ranging between 10 and 20 GRT. However, these two selection criteria dramatically shorten the set of data available, and may in addition potentially bias the CPUE estimates (ICES 1998). As a result, new criteria were used this year to configure the tuning fleets. Thus, all the fishing trips during which plaice was caught were included, while the effect of size determined differences in fishing power was reduced by standardising fishing effort in each vessel. The following multiplicative model was used:

$$E = E_0\left(\frac{L}{15}\right)^{\alpha}$$

where E, E_0 and L respectively refer to as standardised fishing effort, number of days fishing and vessel length. The parameter a is estimated for all the commercial fleets as the slope of the regression between the log-$CPUE_0$ (calculated as the ratio between landings and the number of days fishing) and the log-vessel length. a has been estimated to –1.63, -1.09, -0.69 for gill-netters, trawlers and seiners respectively. These negative values indicate that, within the present fleet configuration, the biggest fishing vessels are the less efficient, with regards to plaice landings. The tuning information is provided in Table 10.3.1.

IBTS survey data for Kattegat and Skagerrak for the first quarter were provided by Sweden for the period 1992 to 1998, as numbers-per-age on a haul by haul basis. Stock abundance indices and their associated CVs are given in Table 10.3.2. The highest precision of the estimates are found for the ages 4–6 which are estimated with a precision of approximately 30%.

10.4 Catch at Age Analysis

Tuning was carried out by using the CPUE information from the three commercial fleets and the survey indices. The survey indices were shifted from February to the preceding December to allow for a full use of the available data. The catch information used for the VPA were restricted to the ages 2–11+ as age 1 plaice never accounted for more than 1% of the total catch number. Very few plaices aged 7–9 were caught during the survey and these ages were removed from the IBTS tuning fleet before running the VPA. The tuning settings used last year were maintained but no tapered time was applied over the 10 year tuning period. The tuning settings and diagnostics are given in Table 10.4.1. The VPA results are given in Tables 10.4.2.-10.4.3.

Since new definitions have been made of the tuning fleets, a first exploratory run has been carried out to compare the outcomes of last year's and this year's assessments for the period 1987–1996. Figure 10.4.1. indicates that only little difference could be found between these two assessments.

Consider this year's assessment. Plots of the log catchability residuals (Figure 10.4.2.) show little trend over time, except for the Argos survey and the gill-net fleet at the oldest ages. These apparent trends are essentially generated by a strong year effect in 1996 for both fleets. Retrospective VPA runs are carried back to 1995 (Figure 10.4.3.). Only small differences are observed in the retrospective pattern of recruitment and SSB. However, there are differences in the F estimated in 1996. This observation bears out some of the results of the log-residuals analysis, which suggest that a strong year effect may exist in 1996.

This feature is not due to the new configuration of the tuning fleets, since Figure 10.4.1. indicates that both of the assessments carried out this year and last year are consistent. Figure 10.2.1. shows that in most years, including 1992–1995 and 1997, the peak of the catch at age distribution is reached at age 5. However, in 1996, the peak of this distribution is achieved at age 4. The fraction of catch at age 5–7 is lower in 1996 than in 1993–1995 and 1997.

The year effect in 1996 may then be interpreted as follows. Consider the retrospective analysis backdating from 1996. In 1996, the catches at age 5–7 are relatively low (peak of the distribution at age 4) and high fishing mortality levels are associated to these ages. Consider the retrospective analysis backdating from 1997. In 1997, the catch at age distribution peaks at age 5 like in previous years (except 1996). This different distribution affects the calculation of fishing mortality in 1997, but also in the previous years including 1996. Thus, the fishing mortality in 1996 is decreased to better fit the model. However, the high residuals calculated for 1996 indicate that this new estimation is uncertain (Figure 10.4.2.).

Despite the year effect in 1996, which is documented above, the overall assessment appears reasonable, for four reasons. First, the coefficients of variation (C.V.) on the catchabilities of the commercial fleets are all lower than 50% for the age range 4–9 for the commercial fleets, even if C.Vs. are somewhat higher for the IBTS survey (Table 10.4.1.). Second, for all ages, the estimation of survivors differed only slightly between fleets, including the Argos survey. Third, Figure 10.4.4. indicates that a linear regression describes reasonably well the variations of the log CPUE against the log VPA. Fourth and finally, Figure 10.4.3. shows that the uncertainty on fishing mortality in 1996 does not affect much the estimation of SSB.

The fishing mortality (age 4–8) estimated for 1997 in found at 0.74, which is above the value in 1996 (0.51). The exploitation pattern increases up to age 8 from where on F remains at a constant level.

10.5 Recruitment estimates

The abundance indices from the IBTS surveys in Kattegat and Skagerrak are given in Table 10.3.2. The time series is short but may indicate that the 1997 year class is well above average. However, the coefficients of variation calculated in 1998 were much higher than in previous years, making estimations uncertain. Due to the short time span available, no RCT3 analysis was carried out. Recruitment estimates are provided by the XSA for the period 1987–1995. Recruitment in 1996 and 1997 were replaced by the geometric mean of 47,176, calculated over the period 1987–1995.

10.6 Long-term trends

The long-term trends in the fisheries are presented in Table 10.6.1. and Figure 10.6.1.

In the 1970s, catches fluctuated between 14,000 and 27,000 t. Since then the catches have declined to the present range of 9,000–12,000 t. The fishing mortality has remained at a rather stable level of 0.7–0.9 over the period of assessment, with extreme values only observed in 1988 and 1996. SSB has decreased between 1987 and 1989 and has remained stable in the range 35,000–55,000 t since 1990. Recruitment has fluctuated between 30 and 75 million per year without notable trend.

10.7 Short-term forecast

The inputs used for the predictions are given in Table 10.7.1. Stock sizes for age 3 and above are taken from the estimated number of survivors from the XSA. The age 2 recruitment in 1998, 1999 and 2000 is taken as the geometric average over the 1987–1995 period. The mean weight at age are taken as the average for the years 1987–1997. The exploitation pattern in the prognosis are based on the non-scaled average exploitation pattern over the period 1995–1997.

The *status quo* predictions result in catches of 10,900 and 11,000 t in 1998 and 1999, respectively (Table 10.7.2.). The *status quo* estimate of SSB remains in the range 36,000–37,000 t over the 1998–2000 period. The short- and long-term yield and SSB are shown in Figure 10.9.1.

The inputs of the sensitivity analysis are given in Table 10.7.3. Figure 10.7.2. shows the sensitivity and the sources of variations connected to the various input parameters for the *status quo* catch predictions. The 1999 yield is found most sensitive to the fishing mortalities in 1999 and 1998. These fishing mortalities also contribute to 82% of the variance of the yield. The SSB at the start of 2000 is essentially shared between recruitment in 1999 (37%), the abundance of the age 2 class (25%) and fishing mortality in 1999 (22%). The contribution of recent year classes to the yield in 1999 and SSB in 2000 for *status quo* short-term forecast are shown in Table 10.7.4.

Figure 10.7.3. shows the probability profiles for 1999 yield and the 1999 SSB under the *status quo* projection. The plots show that a catch level similar to that of 1997 may be achieved with a fishing mortality below $F_{status\ quo}$ and that it is unlikely (probability lower than 5%) that the SSB fall below the historical minimum SSB found at 23,000 t.

10.8 Medium-term projections

Several density-dependent functions (recruitment autocorrelation, Beverton and Holt, Ricker and Shepherd) were fitted to the stock and recruitment data (Figure 10.8.1.). There were only few data, particularly at low levels of SSB, to justify the selection of one or the other curve. Moreover, no clear trend could be identified at high SSB levels. As a result, it has been decided to describe the stock and recruitment data with the Butterworth and Berg model (Figure 10.8.2.a). In this model, recruitment increases linearly from the origin to the minimum historical SSB value, where it reaches the geometric mean calculated over 1987–1995, and then remains constant to that level.

A medium term projection, using *status quo* fishing mortality, has been run over the period 1998–2007, by using the program $WGTermB_{pa}$, which is adapted from the WGTERMA program. The outcomes of the medium-term projection have been reported in Figures 10.8.2.c-d. Results suggest that SSB, recruitment and yield would be stable if the stock was exploited with the *status quo* exploitation pattern over the next 10 years.

10.9 Long-term considerations

The input data are given in Table 10.9.1. and the outputs are summarised in Table 10.9.2. and Figure 10.9.1. Figure 10.9.2 gives the stock recruitment plot.

10.10 Biological Reference Points

Biological references were computed with the PA software provided by the CEFAS laboratory. All the reference points have been represented in Figure 10.10.1. The stock and recruitment data were examined, to define candidates for B_{lim}, B_{pa}, $\mathbf{F}_{lim}$, and $\mathbf{F}_{pa}$. All the historical SSB values are grouped in a narrow window of observation (23,000–40,000 t) and no clear pattern in recruitment could be detected.

As a result of (i) the stock not being currently at a low level and, (ii) the moderate inter-annual variability in SSB, B_{pa} has been calculated by rounding up B_{loss}, so that $B_{pa} = 24{,}000$ tonnes, and no B_{lim} was determined. Table 10.8.1. does not allow the selection of a particular $\mathbf{F}_{lim}$, since the probability of the biomass to fall below B_{pa} is very low (< 1%) for a wide range of F (0.0–0.8). The WG recommended that $\mathbf{F}_{lim}$ should be set to $\mathbf{F}_{med} = 0.80$. $\mathbf{F}_{pa}$ is then derived from the standard equation:

$\mathbf{F}_{pa} = \mathbf{F}_{lim}\, e^{-1.645\,CV}$, where CV = 0.2.

The value of $\mathbf{F}_{pa}$ recommended by the WG is then 0.58. Figure 10.10.2. indicates that in the historical times series, fishing mortality has been above $\mathbf{F}_{pa}$ in all but one year, whereas the SSB has, by construction, been under B_{pa} only once.

10.11 Comments on the assessment

Compared to last year's assessment, a new selection criterion was used this year to configure the tuning fleets (i.e., trips are included when plaice is caught) and fishing effort has been standardised in relation to the vessel length. However, only little difference could be identified between this year's and last year's assessments, over the period 1987–1996. It is suggested that the present tuning fleet configuration and effort standardisation procedure should be used next year.

Like last year, the estimated fishing mortality of c.a. 0.70 calculated in IIIa is higher than the one estimated in division IV (c.a. 0.40). The difference may be caused by older, mature, plaice emigrating from the Skagerrak to the North Sea for spawning (Ulmestrand 1989; Stæhr and Støttrup 1991). When not specifically accounting for migrations (by adding the rate of migration to the natural mortality) the VPA calculation will overestimate the fishing mortality. Inter-annual variability in the migration rate might be one explanation for the low level of adults in 1996, which caused a year effect in some of the log residuals and in the retrospective analysis (see Section 10.4). The existence of spawning migrations may also contribute the apparent absence of density-dependence for this stock.

Table 10.1.3. Plaice landings from the Kattegat and Skagerrak (tonnes) 1972-1996. Official figures, excluding misreported landings in the period 1983-1988

Year	Denmark		Sweden		Germany		Belgium	Norway	Total		
	Kattegat	Skagerrak	Kattegat	Skagerrak	Kattegat	Skagerrak	Skagerrak	Skagerrak	Kattegat	Skagerrak	Div. IIIa
1972	15,504	5,095	348	70					15,852	5,165	21,017
1973	10,021	3,871	231	80					10,252	3,951	14,203
1974	11,401	3,429	255	70					11,656	3,499	15,155
1975	10,158	4,888	369	77					10,527	4,965	15,492
1976	9,487	9,251	271	81					9,758	9,332	19,090
1977	11,611	12,855	300	142					11,911	12,997	24,908
1978	12,685	13,383	368	94					13,053	13,477	26,530
1979	9,721	11,045	281	105					10,002	11,150	21,152
1980	5,582	9,514	289	92					5,871	9,606	15,477
1981	3,803	8,115	232	123					4,035	8,238	12,273
1982	2,717	7,789	201	140					2,918	7,929	10,847
1983	3,280	6,828	291	170			133	14	3,571	7,145	10,716
1984	3,252	7,560	323	356	32		27	22	3,607	7,965	11,572
1985	2,979	9,646	403	296	4		136	18	3,386	10,096	13,482
1986	2,468	10,653	170	215			505	24	2,638	11,397	14,035
1987	2,868	11,370	283	222	104		907	25	3,255	12,524	15,779
1988	1,818	9,781	210	281	3		716	41	2,031	10,819	12,850
1989	1,596	5,387	135	320	4	0	230	33	1,735	5,970	7,705
1990	1,831	8,726	201	777	2	1	471	69	2,034	10,044	12,078
1991	1,756	5,849	267	472	6	4	315	68	2,029	6,708	8,737
1992	2,071	8,522	208	381			537	107	2,279	9,547	11,826
1993	1,289	9,128	287	175			339	78	1,576	9,720	11,296
1994	1,553	8,790	315	227	4	33	325	65	1,872	9,440	11,312
1995	1,555	8,479	132	338	6	42	302	76	1,693	9,237	10,930
1996	2,336	7,256	195	198	11	19	0	105	2,542	7,578	10,120
1997	2,198	7,307	261	251	25	15	0	93	2,484	7,665	10,149

Table 10.2.1. Catch in numbers ('000)

	2	3	4	5	6	7	8	9	10	11+
1987	673	4405	12594	17644	10129	2076	376	247	130	200
1988	101	3059	12038	13776	6855	2743	946	322	136	157
1989	1009	3829	7068	6225	2695	1165	547	253	135	235
1990	3189	8773	8601	9676	3208	978	480	348	155	273
1991	2316	8648	9637	4692	2911	897	307	157	87	137
1992	887	3802	11652	17302	4269	1025	294	113	27	113
1993	1003	3465	10091	13252	6893	1650	374	103	46	66
1994	1382	6894	8019	9877	8013	2772	445	111	38	54
1995	455	2318	6717	11718	6730	5009	867	139	66	52
1996	4399	5197	7736	5126	4610	1758	1314	146	22	44
1997	501	4511	6281	9417	5085	3063	1365	847	113	35

Table 10.2.2. Mean weight in Catch (kg)

	2	3	4	5	6	7	8	9	10	11+
1987	0.322	0.281	0.282	0.293	0.363	0.528	0.709	0.904	1.03	1.084
1988	0.252	0.267	0.269	0.29	0.35	0.475	0.567	0.756	0.833	1.192
1989	0.274	0.263	0.282	0.32	0.376	0.466	0.635	0.741	0.825	1.003
1990	0.292	0.289	0.294	0.337	0.397	0.499	0.685	0.776	0.951	1.15
1991	0.263	0.27	0.259	0.274	0.365	0.492	0.584	0.67	0.882	1.08
1992	0.309	0.31	0.272	0.28	0.336	0.501	0.646	0.817	0.804	0.976
1993	0.267	0.271	0.271	0.294	0.338	0.441	0.567	0.711	0.801	1.167
1994	0.275	0.263	0.272	0.289	0.33	0.381	0.517	0.658	0.767	0.977
1995	0.263	0.301	0.303	0.289	0.328	0.368	0.499	0.737	0.752	1.022
1996	0.266	0.268	0.294	0.384	0.399	0.436	0.43	0.561	0.87	0.957
1997	0.3	0.294	0.282	0.299	0.341	0.41	0.465	0.445	0.53	0.752

Table 10.3.1. Tuning fleets used for the plaice in IIIa

```
Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)
104

ARGOS: Argos, 1st Q (IBTS)
1991 1997
1 1 0.99 1
1 6
1 4.17 9.29 6.44 1.62 0.38 0.08
1 6.5 6.02 5.78 5.11 2.03 0.22
1 8.5 6.48 1.89 1.09 1.19 0.25
1 4.48 10.4 4.2 1.13 0.85 0.4
1 17.05 13.35 4.9 1.54 0.46 0.13
1 6.86 12.9 3.26 1.14 0.12 0.04
1 8.06 8 4.24 1.48 0.32 0.12

FLT07: Danish gill-netters
1987 1997
1 1 0 1
2 11
7951 20592.3 169059.2 650915.7 1071313 803164.5 286784.3 58777.3 33990.7 18818.4 24876.8
5840 27481.4 168503.6 529771.3 606818.1 410015.6 309311.4 133999.9 55392.7 19491.5 23976.7
5498 19018.4 63446.8 175205.5 186617.2 129660.6 111414.7 85514 44763.5 24563.5 43810.2
6356 64640.5 246879.5 272983.5 362431.8 157274.3 62093.7 42382.9 38229.8 20604.3 41000.9
4956 43901.1 181507.1 242270.8 148621.9 168825.7 68492 32399.3 14923.2 11663.1 17808.8
6539 67456.2 350854.7 854331.1 1065380 260668.7 108795.4 39020.5 18754.9 5675.4 21064
7438 4845.8 80410.5 339540 652443.1 591403.6 199281.6 42122.4 12860 3774.2 2596.8
17152 93331.6 788950.1 992743.9 1280086 1145581 443000.3 78442.7 26304.2 7858.6 14155.4
14671 98335.2 320239 744931.3 1661991 911911.5 979461.7 185417.9 30434.1 13975.7 10309.3
13869 456628.1 632570.9 858288.4 762350.3 711939.5 291166.6 215021.6 22193.1 3298.1 8388.2
11050 67268.4 468036.5 544401.2 912160.6 684170.5 509591 271093.8 101873.8 19323.2 7745.1

FLT08: Danish trawlers
1987 1997
1 1 0 1
2 11
51099 255914.6 1177661 2468347 2379126 1046122 215077.7 50415 32514 24419.7 37437.7
39570 109743.1 839066.1 1906117 1819047 700988.1 226895.2 75480.6 23885.3 20953 22426.2
43495 434755.3 927354.5 1291748 1026225 456677.9 165557 71803 37576.1 18120.9 35818.8
49039 1192734 2311097 2020630 2065160 631904.4 200415.8 85590.4 45586.3 22634 42974.6
46159 678539.1 2459249 2424238 1085399 580774.1 151469.9 52785.8 31364.1 18474.6 27440.7
42806 324053.8 1244765 2463167 3594631 910595.2 232057.5 62318.1 14226.3 3014.4 12454
36726 172192 866648 2265364 2200206 1312213 455227.1 82231.2 15921.3 12070.9 15308.8
35880 506609 1815439 1886714 2177012 1785146 732728.8 113302.5 17908.9 12336.2 11983.1
32014 290272.8 791717.7 1217689 2119319 1052643 706431.7 144495.7 23084.1 11096.1 8823
34013 1130523 1432920 1503021 1053244 772862 329651.2 235696.1 24500.8 4352 9874.4
31484 166014.2 1234787 1637715 1843447 841072.5 352323.7 143468.1 96236.5 15808.9 6255.1
FLT12: Danish seiners
1987 1997
1 1 0 1
2 11
12972 97425.8 1157332 4050596 5227390 2536790 426009.3 72397.8 40924.6 20943.5 22943.2
9858 467266.8 1343996 3116463 3368983 1446989 521282.5 158464.1 47106.1 16430.8 19005.8
12387 336976.6 1483241 3030013 2733969 1193297 477611.7 171227.1 76748.9 33562.5 39868.4
11935 1117969 3542256 3431384 3748325 1097119 299715.7 116327.5 81119 32921.9 60674.3
10467 522163.3 2426848 3289407 1838074 1057052 265605.5 88516.4 42174.3 17972.1 28586.9
10157 106266.7 791895.1 4199036 6819566 1725235 324760.3 77399.8 27069.6 4686.3 17868.1
8479 139121 509252.6 1721085 2800822 1649545 413535.4 89600.8 21957.5 5718.1 3978.3
8128 336892.3 1620907 1883228 2514844 1977352 552285.4 69992.5 19936.8 4536.3 4288.3
7682 209822 569870.6 1348638 2282155 1664669 1118605 153080.6 23915.4 11390.9 8384.1
7054 997065.7 1363113 1878662 980781.5 913660.5 327088.5 230807 22761.6 3018.6 6501.7
6306 165538.1 1193786 1794123 2572264 1359436 909633.7 392850.4 278160.3 26735.9 5420.2
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Table 10.3.2. Mean nos. per haul and CVs for Argos IBTS survey in first quarter

Abundance indices provided as the mean number per haul

Year	#hauls	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10+	Total
1992	45	0.00	4.17	9.29	6.44	1.62	0.38	0.08	0.02	0.00	0.00	22.00
1993	45	0.35	6.50	6.02	5.78	5.11	2.03	0.22	0.04	0.00	0.05	26.10
1994	48	0.33	8.50	6.48	1.89	1.09	1.19	0.25	0.04	0.02	0.03	19.82
1995	48	0.29	4.48	10.40	4.20	1.13	0.85	0.40	0.00	0.00	0.00	21.75
1996	48	0.00	17.05	13.35	4.90	1.54	0.46	0.13	0.08	0.00	0.01	37.52
1997	46	0.13	6.86	12.90	3.26	1.14	0.12	0.04	0.10	0.02	0.08	24.65
1998	45	0.63	8.06	8.00	4.24	1.48	0.32	0.12	0.02	0.07	0.00	22.93

CV of the survey abundance

Year	#hauls	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10+	Total
1992	45		74	27	14	16	20	38	100			28
1993	45	49	33	14	14	17	40	346	1663		1439	12
1994	48	28	24	14	13	17	19	23	54	69	29	14
1995	48	56	40	24	20	17	20	21				21
1996	48		39	30	24	22	22	24	29		46	32
1997	46	86	25	34	23	22	33	65	26	35	45	27
1998	45	303	163	150	138	116	123	152	495	305		121
Mean	45	104	57	42	35	32	40	96	395	136	390	36

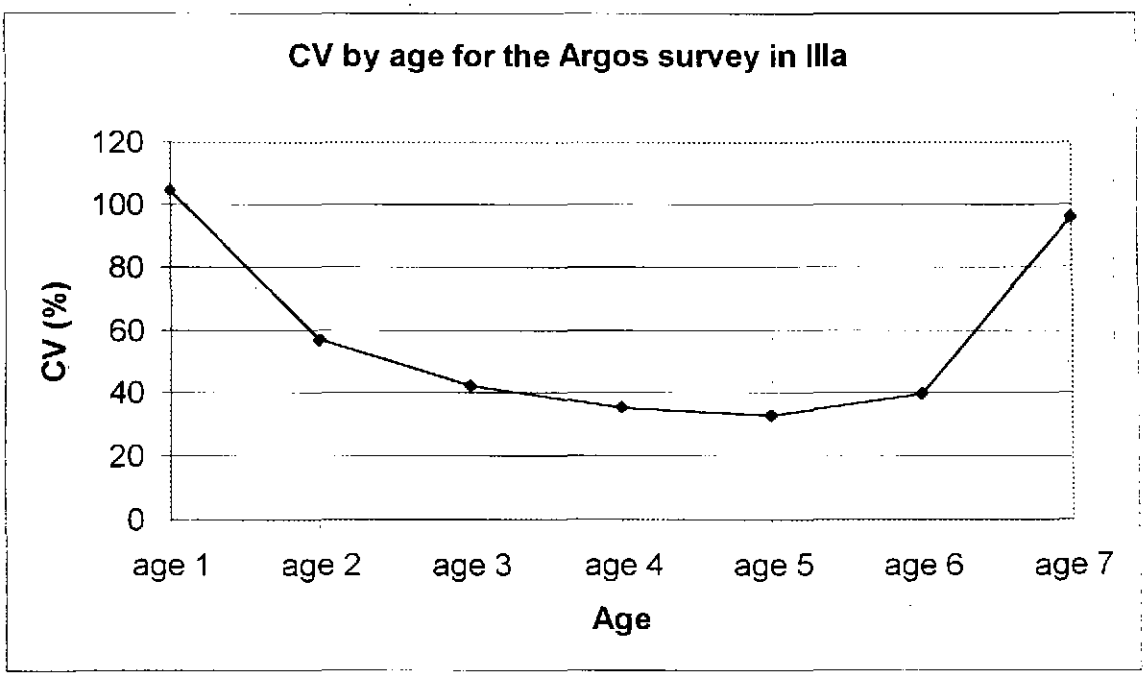


Table 10.4.1. Plaice in IIIa, Diagnostics from the XSA run

Lowestoft VPA Version 3.1

9/10/1998 15:28

Extended Survivors Analysis

Plaice IIIa VPA data 1998 WG ANON COMBSE PLUSGROUP

CPUE data from file C:\Paul\Input\PLE3AFL.TXT

Catch data for 11 years. 1987 to 1997. Ages 2 to 11.

Fleet	First year	Last year	First age	Last age	Alpha	Beta	
ARGOS Argos	1st Q	1991	1997	1	6	0.99	1
FLT07: Danish gill-n	1987	1997	2	10	0	1	
FLT08: Danish trawle	1987	1997	2	10	0	1	
FLT12: Danish seiner	1987	1997	2	10	0	1	

Time series weights

Tapered time weighting applied
Power = 0 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 >= 8

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 28 iterations

Regression weights

	1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.003	0.016	0.047	0.048	0.02	0.027	0.033	0.01	0 069	0 013
3	0.111	0.145	0.17	0.154	0.094	0.091	0.235	0 065	0.132	0.085
4	0.665	0 355	0.49	0.255	0.286	0.342	0 281	0 335	0.285	0.21
5	1.341	0 777	1.038	0.48	0.86	0.537	0.582	0 741	0.409	0.585
6	1.432	0 942	1.104	0.931	0.967	0.917	0 644	0.904	0 649	0 807
7	1.176	0 913	0.988	0.977	0.912	1 192	1 1	0 981	0.552	1.112
8	0.995	0.682	1.138	0.88	0.916	0.918	1 152	1 181	0.66	0 999
9	0 844	0.701	1 162	1.454	0 853	0.868	0 68	1 374	0 545	1 098
10	1 15	0.953	1.164	0.934	0.976	0 931	0.83	1 023	0 726	0.966

Table 10.4.1 (Cont'd)

XSA population numbers (Thousands)

YEAR \ AGE	2	3	4	5	6	7	8	9	10
1988	3.31E+04	3.07E+04	2.60E+04	1.96E+04	9 47E+03	4.17E+03	1.58E+03	5.94E+02	2.09E+02
1989	6.62E+04	2.98E+04	2.48E+04	1.21E+04	4 64E+03	2.05E+03	1 16E+03	5.28E+02	2.31E+02
1990	7 36E+04	5.89E+04	2.33E+04	1.58E+04	5.04E+03	1 64E+03	7.43E+02	5.32E+02	2.37E+02
1991	5 16E+04	6 36E+04	4 50E+04	1.29E+04	5.05E+03	1 51E+03	5.52E+02	2.15E+02	1.51E+02
1992	4 70E+04	4 45E+04	4.93E+04	3.15E+04	7.24E+03	1 80E+03	5 15E+02	2.07E+02	4.56E+01
1993	3.94E+04	4 17E+04	3.66E+04	3 35E+04	1.21E+04	2.49E+03	6.54E+02	1.87E+02	7 98E+01
1994	4 42E+04	3.47E+04	3.44E+04	2.35E+04	1.77E+04	4.37E+03	6.84E+02	2.36E+02	7 08E+01
1995	4.92E+04	3 87E+04	2.48E+04	2.35E+04	1.19E+04	8 42E+03	1.32E+03	1 96E+02	1.08E+02
1996	6.93E+04	4 41E+04	3.28E+04	1.61E+04	1.01E+04	4 36E+03	2 86E+03	3 65E+02	4.48E+01
1997	4.01E+04	5.85E+04	3 49E+04	2 23E+04	9 65E+03	4.80E+03	2 27E+03	1.34E+03	1 92E+02

Estimated population abundance at 1st Jan 1998

0.00E+00	3 58E+04	4.86E+04	2 56E+04	1.13E+04	3 90E+03	1.43E+03	7.57E+02	4.03E+02

Taper weighted geometric mean of the VPA populations.

4.97E+04	4 31E+04	3.22E+04	2.00E+04	8.52E+03	3 06E+03	1 04E+03	3.54E+02	1.15E+02

Standard error of the weighted Log(VPA populations)

0 265	0.2699	0 2593	0 3474	0 4436	0.5724	0 603	0 6513	0.6514

Log catchability residuals

Fleet ARGOS Argos 1st Q

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	99.99	99.99	99 99	-0.04	-0.36	-0 11	0.2	0 3	-0.03	0 05
3	99.99	99 99	99.99	0.15	0.34	-0.72	0 41	0.28	-0 19	-0 26
4	99.99	99 99	99 99	-0.24	0 85	-0 34	-0 3	0 39	-0.24	-0.12
5	99.99	99 99	99 99	0.07	1 23	0.31	0.38	-0 08	-1.37	-0.54
6	99.99	99.99	99 99	0.2	0 89	0 46	0.27	-0 19	-1.47	-0 16
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	3	4	5	6
Mean Log q	-9 0908	-9 6425	-9 9273	-10.2307
S.E(Log q)	0.408	0 4494	0 8108	0.7458

Regression statistics

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	0.89	0.214	8.69	0.44	7	0.23	-8.44

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

Table 10.4.1 (Cont'd)

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1 63	-0.473	8.05	0.1	7	0.71	-9.09
4	0 74	0.394	9 86	0.32	7	0.36	-9.64
5	0.41	1.645	9.98	0.61	7	0.3	-9.93
6	1.32	-0 295	10.56	0.14	7	1.07	-10 23

Fleet : FLT07: Danish gill-n

Age	1987
2	99 99
3	99.99
4	99 99
5	99 99
6	99.99
7	99.99
8	99.99
9	99 99
10	99.99

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.27	-0.58	-0.13	0.16	0 32	-0 91	0.06	0 05	0 54	0.21
3	0 3	-0 57	-0 02	-0.17	0.54	-1	0.71	-0.23	0.41	0.03
4	0 83	-0.31	0.11	-0 52	0.39	-0.34	-0 07	0 15	0 04	-0 28
5	0.65	-0.22	0.15	-0.54	0 43	-0.39	-0 18	0.31	-0.18	-0.02
6	0 49	-0 09	-0.05	0 19	0 01	0 16	-0.51	-0 07	-0 21	0.09
7	0.51	0.15	-0.33	0.1	0 08	0 35	-0 29	-0.04	-0 73	0 2
8	0 42	0 2	-0.01	0 17	0 16	-0 13	-0.3	0 08	-0.71	0 12
9	0.45	0 35	0.23	0.56	0 31	-0 08	-0.52	0 25	-0.97	-0.29
10	0 57	0 69	0.43	0 46	0.68	-0.44	-0 46	-0.07	-0 7	-0.06

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

Age	3	4	5	6	7	8	9	10
Mean Log q	-7.1678	-6.1318	-5 2529	-4.7206	-4.3014	-4 1508	-4.1508	-4 1508
S E(Log q)	0 5218	0.4003	0.3765	0 2652	0.3613	0.3158	0 4905	0 5338

Regression statistics .

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	0 51	0.841	9.86	0.27	10	0 46	-8 94

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.04	-0 062	7.01	0 2	10	0 58	-7.17
4	1.72	-0.795	3 08	0 13	10	0 7	-6.13
5	0.76	0.873	6.38	0.62	10	0.29	-5.25
6	1.24	-0 956	3.7	0.67	10	0.33	-4.72
7	1.07	-0.3	4.04	0.69	10	0.41	-4.3
8	1.15	-0.743	3.72	0.75	10	0 37	-4 15
9	1 08	-0.268	3.99	0.61	10	0.56	-4.12
10	0 7	1.801	4.25	0.82	10	0 33	-4.04

Table 10.4.1 (Cont'd)

Fleet : FLT08 Danish trawle

Age	1987
2	99.99
3	99.99
4	99.99
5	99.99
6	99.99
7	99.99
8	99.99
9	99.99
10	99.99

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	-0.1	-0.28	-0 03	0.13	-0 05	-0.06	0 26	-0.02	0 16	-0.03
3	-0.12	-0.07	0 06	0.1	-0.18	-0 33	0 69	-0.22	0.22	-0.16
4	0.38	-0.19	0.26	-0.26	-0.25	0.14	0.02	0.05	-0.11	-0.04
5	0.28	-0.14	0.29	-0 34	0.21	-0.33	0.06	0.21	-0 31	0.07
6	-0 11	-0.11	0.08	-0.02	0 16	0.15	-0.02	0 08	-0.24	0 04
7	-0.55	-0.36	-0.03	-0.18	0.12	0.74	0 64	0 01	-0 34	-0.05
8	-0.66	-0 64	0.06	-0 17	0.15	0.34	0.74	0 45	-0 11	-0.16
9	-0.9	-0 49	-0.23	0 47	-0.44	-0.06	-0.24	0 6	-0 37	0.01
10	0.14	-0.28	-0.12	0.1	-0.43	0.53	0.66	0 32	0.08	0.1

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

Age	3	4	5	6	7	8	9	10
Mean Log q	-7.0572	-6 3177	-5.696	-5 5056	-5 4642	-5.555	-5.555	-5 555
S.E(Log q)	0 2918	0.2156	0 2573	0 1271	0.4155	0 4485	0.4805	0.3556

Regression statistics .

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	0.4	2 972	9.88	0 75	10	0 16	-8 47

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.08	-0 185	6 78	0 43	10	0 33	-7 06
4	2 03	-2 173	2 15	0 36	10	0 37	-6.32
5	0 85	0.683	6 32	0 73	10	0 23	-5 7
6	0 99	0 112	5 55	0 93	10	0 13	-5.51
7	1	0	5 46	0 65	10	0 44	-5.46
8	1 42	-1 216	4 98	0 52	10	0 62	-5 56
9	1.34	-1 111	5 67	0.58	10	0 59	-5 72
10	1.1	-0.498	5 51	0.76	10	0 39	-5.45

Fleet : FLT12: Danish seiner

Age	1987
2	99 99
3	99.99

Table 10.4.1 (Cont'd)

4	99.99
5	99 99
6	99 99
7	99 99
8	99.99
9	99.99
10	99.99

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	0.57	-0 48	0.22	0.17	-0.76	-0.29	0.2	-0.19	0 56	-0.01
3	0.31	0 22	0.46	0.13	-0.63	-0 83	0.62	-0 56	0 3	-0.02
4	0 53	0.18	0 46	-0.21	-0.02	-0 4	-0 24	-0.16	-0 05	-0 08
5	0 42	0.23	0.43	-0.19	0.43	-0.48	-0.18	-0.15	-0.67	0 15
6	0 06	0.16	0 1	0 12	0 29	-0.1	-0.38	0.02	-0.45	0.18
7	-0.21	0.08	-0.09	-0.01	0.02	0.23	-0.03	0 02	-0.65	0.63
8	-0 32	-0.3	-0.01	0.04	0.02	0.11	-0.04	0 15	-0 34	0 67
9	-0 62	-0.3	-0.02	0 47	-0 14	-0 06	-0.43	0.28	-0.65	0.9
10	-0.5	-0.19	-0.12	-0.23	-0.33	-0.53	-0.64	-0.01	-0.49	0.45

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

Age	3	4	5	6	7	8	9	10
Mean Log q	-5.6187	-4 5785	-3 8339	-3.5604	-3 5888	-3 771	-3.771	-3 771
S E(Log q)	0 5001	0.3022	0.3942	0.2425	0 3214	0 2982	0.4963	0.4222

Regression statistics

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s e	Mean Log q
2	0 65	0.604	8 43	0.27	10	0.46	-7 15

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1 1	-0 141	5 1	0.19	10	0 58	-5 62
4	3.22	-2 075	-8.29	0.1	10	0 83	-4.58
5	1 09	-0.209	3 28	0.4	10	0.46	-3 63
6	1 54	-2 346	0.62	0.71	10	0.3	-3.56
7	1 01	-0 045	3.55	0.76	10	0.34	-3.59
8	1 01	-0.042	3 75	0.8	10	0.32	-3.77
9	0 86	0 62	4 11	0 71	10	0 44	-3.83
10	0 8	1 617	4.17	0 89	10	0 24	-4.03

Terminal year survivor and F summaries

Age 2 Catchability dependent on age and year class strength

Year class = 1995

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
ARGOS: Argos	1st Q	37466	0.3	0	0	1	0.228	0.013
FLT07: Danish gill-n	44184	0.486	0	0	1	0.087	0.011	
FLT08: Danish trawle	34678	0.3	0	0	1	0.226	0.014	
FLT12: Danish seiner	35592	0.486	0	0	1	0.087	0.013	
P shrinkage mean	43072	0.27				0.286	0 011	

Table 10.4.1 (Cont'd)

F shrinkage mean	14698	0.5			0.083	0 032

Weighted prediction :

Survivors at end of year	Int s.e	Ext s e	N	Var Ratio	F
35787	0.14	0 13	6	0 888	0 013

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

Year class = 1994

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
ARGOS: Argos	1st Q	43859	0.247	0.11	0 44	2	0 289	0.093
FLT07 Danish gill-n	63848	0 389	0 255	0.66	2	0 118	0 065	
FLT08 Danish trawle	48608	0 214	0.161	0 75	2	0 389	0.085	
FLT12: Danish seiner	62051	0.38	0.291	0.77	2	0.124	0.067	
F shrinkage mean	32592	0.5				0 08	0 124	

Weighted prediction :

Survivors at end of year	Int s e	Ext s.e	N	Var Ratio	F
48639	0.13	0 09	9	0.672	0.085

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

Year class = 1993

Fleet		Int s e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
ARGOS. Argos	1st Q	27724	0 22	0.16	0.73	3	0.225	0.195
FLT07: Danish gill-n	25212	0.275	0.196	0 71	3	0 148	0.213	
FLT08: Danish trawle	26832	0 175	0 082	0.47	3	0 364	0 201	
FLT12: Danish seiner	24843	0 237	0 118	0.5	3	0 203	0 216	
F shrinkage mean	16663	0.5				0 06	0.306	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s e	N	Var Ratio	F
25626	0 11	0 06	13	0.591	0 21

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

Year class = 1992

Fleet		Int s e	Ext s e	Var Ratio	N	Scaled Weights	Estimated F	
ARGOS: Argos	1st Q	12015	0 214	0.153	0 71	4	0 172	0 557
FLT07 Danish gill-n	11019	0.229	0 054	0 24	4	0.172	0 595	
FLT08 Danish trawle	11360	0.153	0 1	0.66	4	0.374	0.581	
FLT12. Danish seiner	11072	0.208	0 137	0 66	4	0 204	0 593	
F shrinkage mean	10241	0.5				0.078	0 628	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
11259	0 1	0 05	17	0.501	0.585

Table 10.4.1 (Cont'd)

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

Year class = 1991

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
ARGOS: Argos	1st Q	3779	0.219	0.237	1.08	5	0.112	0.824
FLT07: Danish gill-n	4012	0.197	0.146	0.74	5	0.216	0.791	
FLT08: Danish trawle	4005	0.146	0.144	0.99	5	0.338	0.792	
FLT12: Danish seiner	3734	0.183	0.178	0.97	5	0.239	0.831	
F shrinkage mean	3806	0.5				0.095	0.82	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3896	0.09	0.07	21	0.756	0.807

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

Year class = 1990

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
ARGOS: Argos	1st Q	790	0.225	0.218	0.97	5	0.065	1.545
FLT07: Danish gill-n	1448	0.197	0.127	0.64	6	0.231	1.103	
FLT08: Danish trawle	1307	0.161	0.074	0.46	6	0.271	1.172	
FLT12: Danish seiner	1530	0.187	0.239	1.28	6	0.264	1.066	
F shrinkage mean	1830	0.5				0.168	0.952	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1428	0.12	0.08	24	0.698	1.112

Age 8 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
ARGOS: Argos	1st Q	747	0.222	0.122	0.55	5	0.035	1.007
FLT07: Danish gill-n	672	0.198	0.144	0.73	7	0.27	1.076	
FLT08: Danish trawle	690	0.187	0.069	0.37	7	0.22	1.059	
FLT12: Danish seiner	879	0.185	0.234	1.26	7	0.309	0.907	
F shrinkage mean	792	0.5				0.166	0.971	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
757	0.12	0.08	27	0.638	0.999

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1988

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
ARGOS: Argos	1st Q	610	0.305	0.171	0.56	4	0.013	0.842
FLT07: Danish gill-n	261	0.217	0.101	0.47	8	0.249	1.407	
FLT08: Danish trawle	383	0.227	0.039	0.17	8	0.218	1.132	

Table 10.4.1 (Cont'd)

FLT12: Danish seiner	436	0.204	0.205	1	8	0.269	1.047
F shrinkage mean	582	0.5				0.251	0.869

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
403	0.16	0.08	29	0.545	1.098

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1987

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
ARGOS: Argos	1st Q	89	0.424	0.363	0.85	3	0.002	0.79
FLT07: Danish gill-n	49	0.279	0.155	0.56	9	0.198	1.157	
FLT08: Danish trawle	69	0.263	0.087	0.33	9	0.282	0.942	
FLT12: Danish seiner	74	0.258	0.153	0.59	9	0.253	0.899	
F shrinkage mean	71	0.5				0.265	0.925	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
66	0.17	0.06	31	0.371	0.966

Table 10.4.2. Plaice in IIIa. Fishing mortalities from the VPA

Run title : Plaice IIIa VPA data 1998 WG ANON COMBSEX PLUSGROUP

At 11/10/1998 23:22

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

	1987
2	0.0207
3	0.1492
4	0.4767
5	1.0199
6	1.1972
7	0.8116
8	0.4715
9	0.7529
10	0.8549
	0.8549
0 FBAR 4- 8	0.7954

Table 8 Fishing mortality (F) at age

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	FBAR 95-
2	0.0032	0.0182	0.0466	0.0484	0.02	0.0272	0.0334	0.0098	0.0691	0 0132	0.0307
3	0.1108	0.145	0.1702	0.1543	0.0942	0.0914	0.2346	0.065	0.1324	0 0845	0.094
4	0 6652	0.3554	0.4901	0.2552	0.2858	0.3422	0.2807	0.335	0.2847	0.2096	0.2764
5	1 3408	0.7765	1.0376	0.4802	0.86	0.537	0.5822	0.7411	0.4089	0.5853	0.5785
6	1.4322	0.9421	1.1045	0.9312	0.9672	0.9168	0.6444	0.9036	0.6491	0.8072	0.7867
7	1.1764	0.9132	0.9883	0.9768	0.9122	1.1923	1.1002	0.9811	0 5516	1.111	0.8815
8	0.9951	0.6818	1.1378	0.8799	0.9159	0.9183	1.1518	1.1808	0.6604	0.9985	0.9466
9	0.8442	0.7011	1.1621	1.4536	0.8529	0 8685	0 6805	1.3742	0.5448	1.0982	1.0057
10	1.1504	0.9532	1.1645	0.9338	0.9758	0.9309	0.8302	1.0233	0.7264	0.9663	0.9053
	1.1504	0.9532	1.1645	0.9338	0.9758	0 9309	0.8302	1.0233	0.7264	0.9663	
0 FBAR 4- 8	1.122	0.7338	0.9517	0.7047	0.7882	0.7813	0.7519	0.8283	0.511	0.7425	

Table 10.4.3. Plaice in IIIa. Estimated population abundance from the VPA

Run title : Plaice 1998 WG ANON COMBSED PLUSGROUP

At 11/10/1998 23:23

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR		1997
AGE		
	2	34602
	3	33419
	4	34916
	5	29011
	6	15256
	7	3926
	8	1051
	9	491
	10	238
	+gp	363
0	TOTAL	153274

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

YEAR		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	GMST 87-95	AMST 87-95
AGE														
	2	33058	66192	73623	51567	47025	39361	44240	49173	(69273)	(40078)	(0)	47176	48760
	3	30689	29816	59933	63583	44457	41706	34661	38715	44061	(58497)	(35787)	40372	41773
	4	26048	24841	23337	44980	49306	36610	34441	24805	32826	34925	(48639)	32139	33254
	5	19614	12119	15754	12934	31532	33531	23527	23536	16065	22343	25626	21082	22395
	6	9457	4643	5044	9050	7240	12074	17734	11893	10150	9651	11259	8795	9822
	7	4169	2045	1638	1512	1801	2491	4368	8424	4359	4799	3996	2881	3375
	8	1578	1163	743	552	515	664	684	1315	2958	2272	1428	853	917
	9	594	528	532	215	207	187	236	196	365	1336	757	316	354
	10	209	231	237	151	46	80	71	108	45	192	403	131	152
	+gp	239	399	413	235	189	114	100	85	89	59	86		
0	TOTAL	125646	141977	180253	180780	182318	166805	160061	158250	180081	174151	127882		

( ) Overwritten by GM mean

Table 10.6.1. Plaice in IIIa. Historical trends in SSB, recruitment and F-bar

Run title : 1998 WG ANON COMBSEX

At 9/10/1998 15:30

Table 16 Summary (without SOP correction)

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4-8
1987	34602	48318	37176	15779	0.4244	0.7954
1988	33058	36311	27980	12850	0.4592	1.122
1989	66192	41281	23144	7705	0.3329	0.7338
1990	73623	55141	33644	12078	0.359	0.9517
1991	51567	49365	35802	8737	0.244	0.7047
1992	47025	54611	40080	11826	0.2951	0.7882
1993	39361	47470	36961	11296	0.3056	0.7813
1994	44240	45626	33461	11312	0.3381	0.7519
1995	49173	46873	33940	10930	0.322	0.8283
1996	69273*	53559	35132	10121	0.2881	0.511
1997	40078*	52806	40783	10149	0.2489	0.7425
Arith. Mean	49836	48306	34373	11162	0.3289	0.7919
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

(*) replaced by the geometric mean of 47176, calculated over 1987-1995

Table 10.7.1

Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)

Prediction with management option table: Input data

Year: 1998								
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
2	47176.000	0.1000	0.0000	0.0000	0.0000	0.280	0.0307	0.280
3	42127.000	0.1000	1.0000	0.0000	0.0000	0.280	0.0940	0.280
4	33125.000	0.1000	1.0000	0.0000	0.0000	0.280	0.2764	0.280
5	25625.000	0.1000	1.0000	0.0000	0.0000	0.304	0.5785	0.304
6	11260.000	0.1000	1.0000	0.0000	0.0000	0.357	0.7867	0.357
7	3896.000	0.1000	1.0000	0.0000	0.0000	0.454	0.8815	0.454
8	1428.000	0.1000	1.0000	0.0000	0.0000	0.573	0.9466	0.573
9	757.000	0.1000	1.0000	0.0000	0.0000	0.707	1.0057	0.707
10	403.000	0.1000	1.0000	0.0000	0.0000	0.822	0.9053	0.822
11+	86.000	0.1000	1.0000	0.0000	0.0000	1.033	0.9053	1.033
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
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
2	47176.000	0.1000	0.0000	0.0000	0.0000	0.280	0.0307	0.280
3	.	0.1000	1.0000	0.0000	0.0000	0.280	0.0940	0.280
4	.	0.1000	1.0000	0.0000	0.0000	0.280	0.2764	0.280
5	.	0.1000	1.0000	0.0000	0.0000	0.304	0.5785	0.304
6	.	0.1000	1.0000	0.0000	0.0000	0.357	0.7867	0.357
7	.	0.1000	1.0000	0.0000	0.0000	0.454	0.8815	0.454
8	.	0.1000	1.0000	0.0000	0.0000	0.573	0.9466	0.573
9	.	0.1000	1.0000	0.0000	0.0000	0.707	1.0057	0.707
10	.	0.1000	1.0000	0.0000	0.0000	0.822	0.9053	0.822
11+	.	0.1000	1.0000	0.0000	0.0000	1.033	0.9053	1.033
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000								
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
2	47176.000	0.1000	0.0000	0.0000	0.0000	0.280	0.0307	0.280
3	.	0.1000	1.0000	0.0000	0.0000	0.280	0.0940	0.280
4	.	0.1000	1.0000	0.0000	0.0000	0.280	0.2764	0.280
5	.	0.1000	1.0000	0.0000	0.0000	0.304	0.5785	0.304
6	.	0.1000	1.0000	0.0000	0.0000	0.357	0.7867	0.357
7	.	0.1000	1.0000	0.0000	0.0000	0.454	0.8815	0.454
8	.	0.1000	1.0000	0.0000	0.0000	0.573	0.9466	0.573
9	.	0.1000	1.0000	0.0000	0.0000	0.707	1.0057	0.707
10	.	0.1000	1.0000	0.0000	0.0000	0.822	0.9053	0.822
11+	.	0.1000	1.0000	0.0000	0.0000	1.033	0.9053	1.033
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANPAM02
Date and time: 13OCT98:13:40

Table 10.7.2

...S System 13:38 Tuesday, October 13, 1998

Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)

Prediction with management option table

Year: 1998					Year: 1999					Year: 2000	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.6939	49642	36420	10935	0.0000	0.0000	49765	36543	0	62004	48782
.	.	.	.	.	0.1000	0.0694	.	36543	1404	60434	47212
.	.	.	.	.	0.2000	0.1388	.	36543	2729	58958	45735
.	.	.	.	.	0.3000	0.2082	.	36543	3980	57567	44345
.	.	.	.	.	0.4000	0.2776	.	36543	5162	56258	43036
.	.	.	.	.	0.5000	0.3470	.	36543	6279	55023	41801
.	.	.	.	.	0.6000	0.4164	.	36543	7337	53858	40636
.	.	.	.	.	0.7000	0.4858	.	36543	8340	52758	39535
.	.	.	.	.	0.8000	0.5552	.	36543	9290	51718	38496
.	.	.	.	.	0.9000	0.6245	.	36543	10191	50735	37512
.	.	.	.	.	1.0000	0.6939	.	36543	11047	49804	36582
.	.	.	.	.	1.1000	0.7633	.	36543	11861	48922	35700
.	.	.	.	.	1.2000	0.8327	.	36543	12635	48086	34864
.	.	.	.	.	1.3000	0.9021	.	36543	13372	47293	34071
.	.	.	.	.	1.4000	0.9715	.	36543	14074	46540	33318
.	.	.	.	.	1.5000	1.0409	.	36543	14743	45824	32602
.	.	.	.	.	1.6000	1.1103	.	36543	15382	45143	31921
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANPAM02
Date and time : 13OCT98:13:40
Computation of ref. F: Simple mean, age 4 - 8
Basis for 1998 : F factors

Table 10.7.3. Input to sensitivity analysis, Plaice in IIIa

```
         1         11       1998          3
         1          0          0
'N1'          47176          0          'M1'          0          0
'N2'          47176       0.27          'M2'        0.1        0.1
'N3'          35787       0.14          'M3'        0.1        0.1
'N4'          48639       0.13          'M4'        0.1        0.1
'N5'          25626       0.11          'M5'        0.1        0.1
'N6'          11259        0.1          'M6'        0.1        0.1
'N7'           3895       0.09          'M7'        0.1        0.1
'N8'           1428       0.12          'M8'        0.1        0.1
'N9'            756       0.12          'M9'        0.1        0.1
'N10'           403       0.16          'M10'       0.1        0.1
'N11'            85       0.17          'M11'       0.1        0.1
'sH1'             0          0          'MT1'         0          0
'sH2'         0.031       1.27          'MT2'         0        0.1
'sH3'         0.094       0.64          'MT3'         1        0.1
'sH4'         0.276       0.33          'MT4'         1          0
'sH5'         0.578       0.07          'MT5'         1          0
'sH6'         0.787       0.09          'MT6'         1          0
'sH7'         0.882       0.17          'MT7'         1          0
'sH8'         0.947       0.05          'MT8'         1          0
'sH9'         1.006       0.22          'MT9'         1          0
'sH10'        0.905       0.07          'MT10'        1          0
'sH11'        0.905       0.07          'MT11'        1          0
'WH1'             0          0          'R99'     47176       0.27
'WH2'         0.276       0.07          'R**'     47176       0.27
'WH3'          0.28       0.06          'HF98'        1       0.24
'WH4'          0.28       0.05          'HF99'        1       0.24
'WH5'         0.306       0.11          'HF**'        1       0.24
'WH6'         0.356       0.08          'K98'         1        0.1
'WH7'         0.447       0.11          'K99'         1        0.1
'WH8'         0.559       0.15          'K**'         1        0.1
'WH9'         0.687       0.16
'WH10'        0.802       0.14
'WH11'        1.028       0.13
'WS1'             0          0
'WS2'         0.276       0.07
'WS3'          0.28       0.06
'WS4'          0.28       0.05
'WS5'         0.306       0.11
'WS6'         0.356       0.08
'WS7'         0.447       0.11
'WS8'         0.559       0.15
'WS9'         0.687       0.16
'WS10'        0.802       0.14
'WS11'        1.028       0.13

plaice
Kattegat and Skagerr
         1
 1 11  1
         1
H.cons.
 4  8
 1987     1997
 Stock numbers in 1998 are VPA survivors.
         -1
```

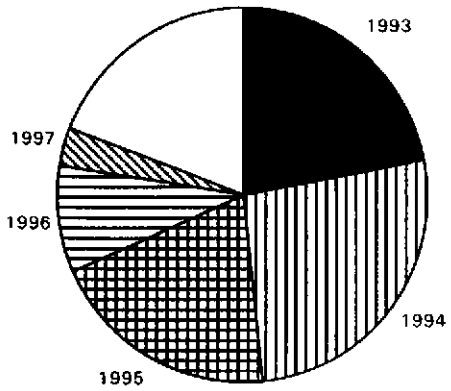
Table 10.7.4. **Plaice (IIIa)**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			1993	1994	1995	1996	1997
Stock No. (thousands) of 2 year-olds			49173	47176	47176	47176	47176
Source			VPA	GM	GM	GM	GM
Status Quo F:							
% in	1998	landings	29.9	19.5	9.2	3.5	-
% in	1999		21.9	26.3	20.3	9.0	3.4
% in	1998	SSB	21.4	25.5	32.4	0.0	-
% in	1999	SSB	12.7	18.9	26.6	31.7	0.0
% in	2000	SSB	6.6	11.3	19.8	26.1	31.7

GM : geometric mean recruitment

Plaice (IIIa) : Year-class % contribution to

a) **1999 landings**



b) **2000 SSB**

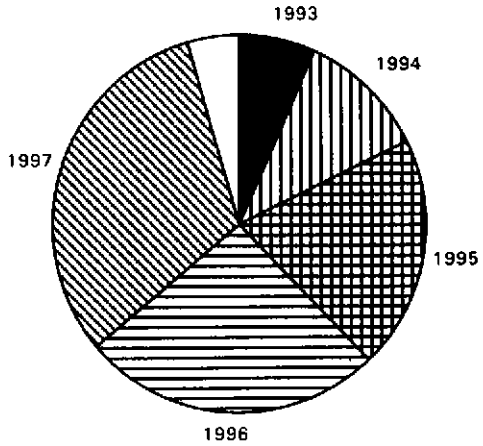


Table 10.8.1. Kattegat and Skagerr plaice : precautionary reference points

BIOMASS

WGNSSK

B_{loss} (lowest observed SSB)	=	23,144 t	
B_{lim}	=		
Bpa	=	23,144 t	
MBAL	=		

SGPAFM

B_{lim}	=		
B_{pa}	=	24,000 t	Lowest observed SSB

Special comments regarding SSB

FISHING MORTALITY

Status quo Fbar (4-8) = 0.69 (Average 95-97)

	Estimate	Probability SSB<Bpa in 2007	% of historical F above precautionary F	Long-term SSB (t) at GM rec	
F_{loss} x 5th %ile	0.00	0%	100%	318616	
$F_{0.1\ 5th\ \%ile}$	0.07	0%	100%	155859	
$F_{0.1}$	0.09	0%	100%	138411	
$F_{35\%SPR\ 5th\ \%ile}$	0.09	0%	100%	131107	
	0.10	0%	100%	126392	
$F_{35\%SPR}$	0.12	0%	100%	111515	
$F_{max\ 5th\ \%ile}$	0.14	0%	100%	103340	
F_{max}	0.18	0%	100%	87244	
	0.20	0%	100%	79866	
	0.30	0%	100%	60609	
	0.40	0%	100%	50475	
	0.50	0%	100%	44288	
$F_{med\ 5th\ \%ile}$	0.51	0%	91%	43604	
	0.60	0%	91%	40102	
	0.70	0%	91%	37054	
F_{med}	0.80	0%	27%	34700	
F_{loss} x exp(-1.645*SE)	3.48	98%	0%	17883	
F_{loss} **	4.84	100%	0%	15124	
SGPAFM F_{lim}	0.63		91%	39094	= Floss
SGPAFM F_{pa}	0.40		100%	50475	=Flim $e^{-1.645*SE}$

F range from the historic series	0.51	to	1.12
SSB range from the historical series	23144	to	40080

** A LOWESS smoother with a span of 0,5 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.

Special comments regarding F

Table 10.9.1

Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)

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
2	1.000	0.1000	0.0000	0.0000	0.0000	0.280	0.0307	0.280
3	.	0.1000	1.0000	0.0000	0.0000	0.280	0.0940	0.280
4	.	0.1000	1.0000	0.0000	0.0000	0.280	0.2764	0.280
5	.	0.1000	1.0000	0.0000	0.0000	0.304	0.5785	0.304
6	.	0.1000	1.0000	0.0000	0.0000	0.357	0.7867	0.357
7	.	0.1000	1.0000	0.0000	0.0000	0.454	0.8815	0.454
8	.	0.1000	1.0000	0.0000	0.0000	0.573	0.9466	0.573
9	.	0.1000	1.0000	0.0000	0.0000	0.707	1.0057	0.707
10	.	0.1000	1.0000	0.0000	0.0000	0.822	0.9053	0.822
11+	.	0.1000	1.0000	0.0000	0.0000	1.033	0.9053	1.033
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDPAM03
Date and time: 14OCT98:18:33

Table 10.9.2

Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)

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	6949.984	9.508	6669.711	9.508	6669.711
0.0500	0.0347	0.234	166.762	8.173	4682.284	7.173	4402.011	7.173	4402.011
0.1000	0.0694	0.357	232.063	6.941	3538.652	5.941	3258.380	5.941	3258.380
0.1500	0.1041	0.434	259.201	6.177	2864.124	5.177	2583.852	5.177	2583.852
0.2000	0.1388	0.486	269.616	5.655	2426.966	4.655	2146.693	4.655	2146.693
0.2500	0.1735	0.525	272.168	5.273	2124.906	4.273	1844.633	4.273	1844.633
0.3000	0.2082	0.554	270.955	4.980	1906.126	3.980	1625.853	3.980	1625.853
0.3500	0.2429	0.578	268.005	4.747	1741.751	3.747	1461.478	3.747	1461.478
0.4000	0.2776	0.597	264.358	4.557	1614.536	3.557	1334.263	3.557	1334.263
0.4500	0.3123	0.613	260.552	4.398	1513.616	3.398	1233.344	3.398	1233.344
0.5000	0.3470	0.627	256.862	4.262	1431.854	3.262	1151.581	3.262	1151.581
0.5500	0.3817	0.639	253.421	4.145	1364.395	3.145	1084.122	3.145	1084.122
0.6000	0.4164	0.649	250.284	4.042	1307.844	3.042	1027.571	3.042	1027.571
0.6500	0.4511	0.658	247.462	3.951	1259.766	2.951	979.493	2.951	979.493
0.7000	0.4858	0.667	244.946	3.870	1218.378	2.870	938.105	2.870	938.105
0.7500	0.5205	0.674	242.715	3.796	1182.351	2.796	902.078	2.796	902.078
0.8000	0.5552	0.681	240.745	3.729	1150.677	2.729	870.404	2.729	870.404
0.8500	0.5898	0.687	239.008	3.668	1122.579	2.668	842.307	2.668	842.307
0.9000	0.6245	0.693	237.480	3.612	1097.454	2.612	817.181	2.612	817.181
0.9500	0.6592	0.698	236.136	3.560	1074.822	2.560	794.549	2.560	794.549
1.0000	0.6939	0.703	234.956	3.511	1054.303	2.511	774.030	2.511	774.030
1.0500	0.7286	0.708	233.921	3.466	1035.588	2.466	755.315	2.466	755.315
1.1000	0.7633	0.712	233.012	3.424	1018.426	2.424	738.154	2.424	738.154
1.1500	0.7980	0.716	232.216	3.384	1002.613	2.384	722.340	2.384	722.340
1.2000	0.8327	0.720	231.518	3.347	987.975	2.347	707.702	2.347	707.702
1.2500	0.8674	0.724	230.909	3.311	974.371	2.311	694.098	2.311	694.098
1.3000	0.9021	0.727	230.376	3.278	961.680	2.278	681.407	2.278	681.407
1.3500	0.9368	0.730	229.913	3.246	949.800	2.246	669.528	2.246	669.528
1.4000	0.9715	0.734	229.510	3.216	938.645	2.216	658.372	2.216	658.372
1.4500	1.0062	0.737	229.162	3.187	928.139	2.187	647.866	2.187	647.866
1.5000	1.0409	0.739	228.862	3.159	918.218	2.159	637.946	2.159	637.946
1.5500	1.0756	0.742	228.606	3.133	908.827	2.133	628.554	2.133	628.554
1.6000	1.1103	0.745	228.388	3.108	899.916	2.108	619.643	2.108	619.643
1.6500	1.1450	0.747	228.204	3.083	891.443	2.083	611.170	2.083	611.170
1.7000	1.1797	0.750	228.051	3.060	883.370	2.060	603.097	2.060	603.097
1.7500	1.2144	0.752	227.926	3.038	875.664	2.038	595.392	2.038	595.392
1.8000	1.2491	0.754	227.826	3.016	868.296	2.016	588.023	2.016	588.023
1.8500	1.2838	0.756	227.748	2.995	861.239	1.995	580.966	1.995	580.966
1.9000	1.3185	0.758	227.690	2.975	854.470	1.975	574.197	1.975	574.197
1.9500	1.3532	0.760	227.651	2.955	847.967	1.955	567.695	1.955	567.695
2.0000	1.3879	0.762	227.628	2.937	841.713	1.937	561.440	1.937	561.440
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDPAM03
Date and time : 14OCT98:18:33
Computation of ref. F: Simple mean, age 4 - 8
F-0.1 factor : 0.1240
F-max factor : 0.2530
F-0.1 reference F : 0.0860
F-max reference F : 0.1756
Recruitment : Single recruit

Figure 10.2.1. Distribution of catch in numbers (%) by age and by year

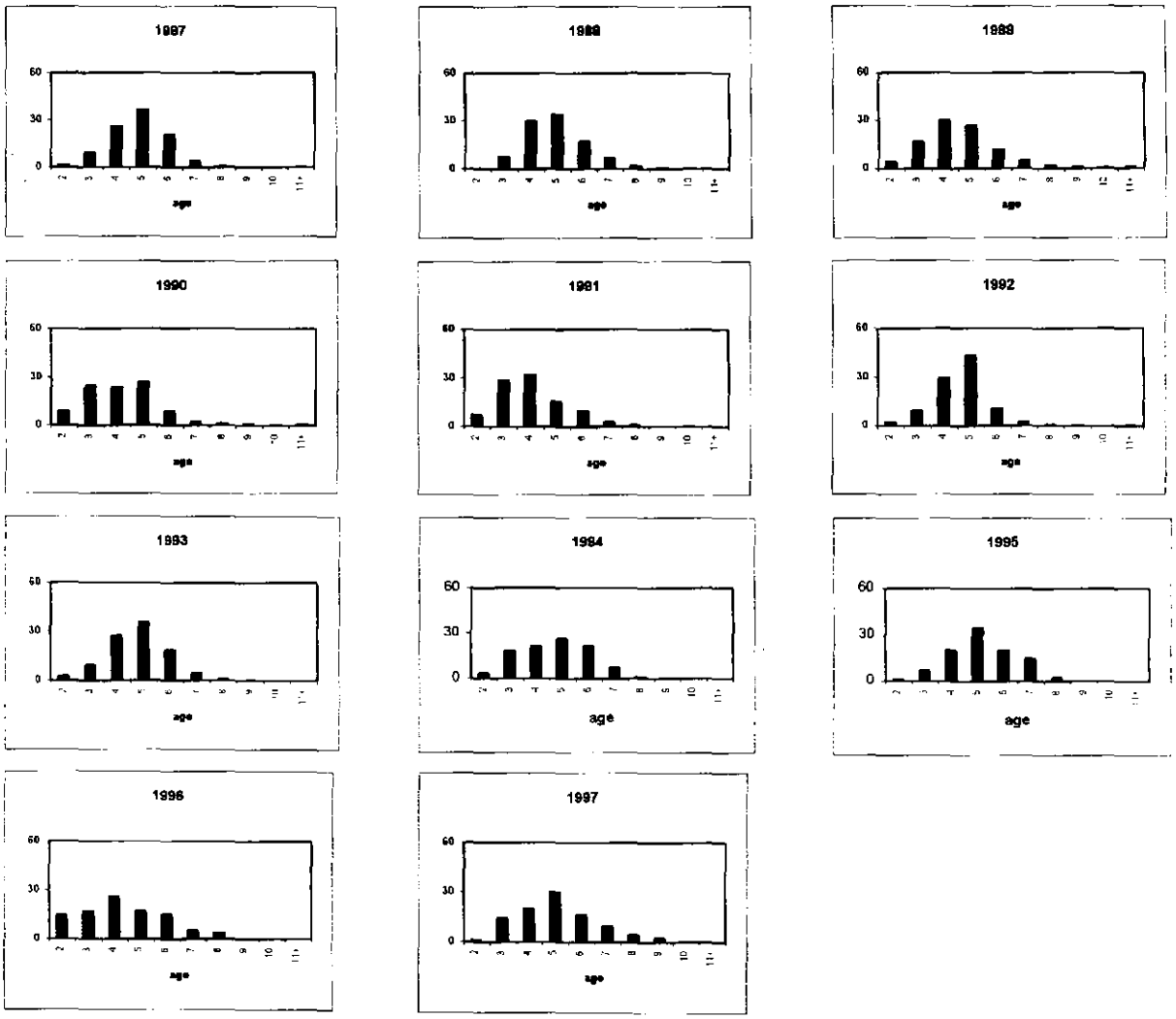
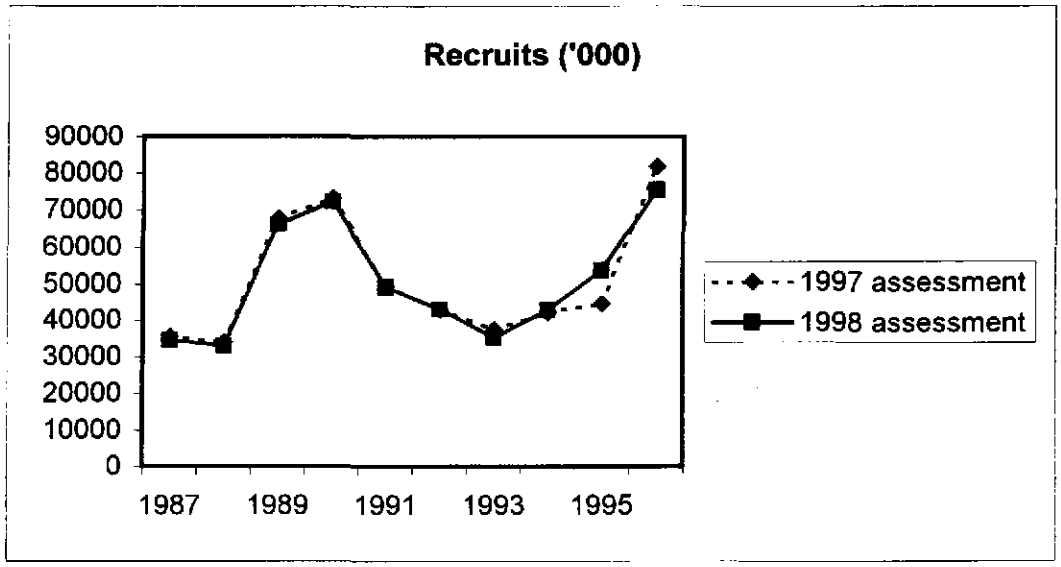
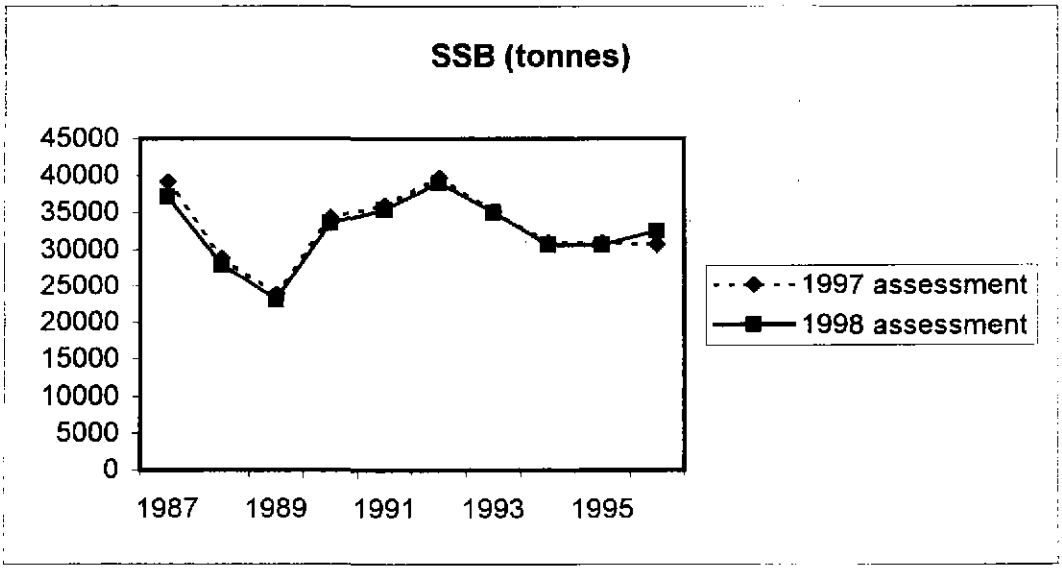


Figure 10.4.1. Assessments carried out in 1997 and 1998 on period 1987-1996





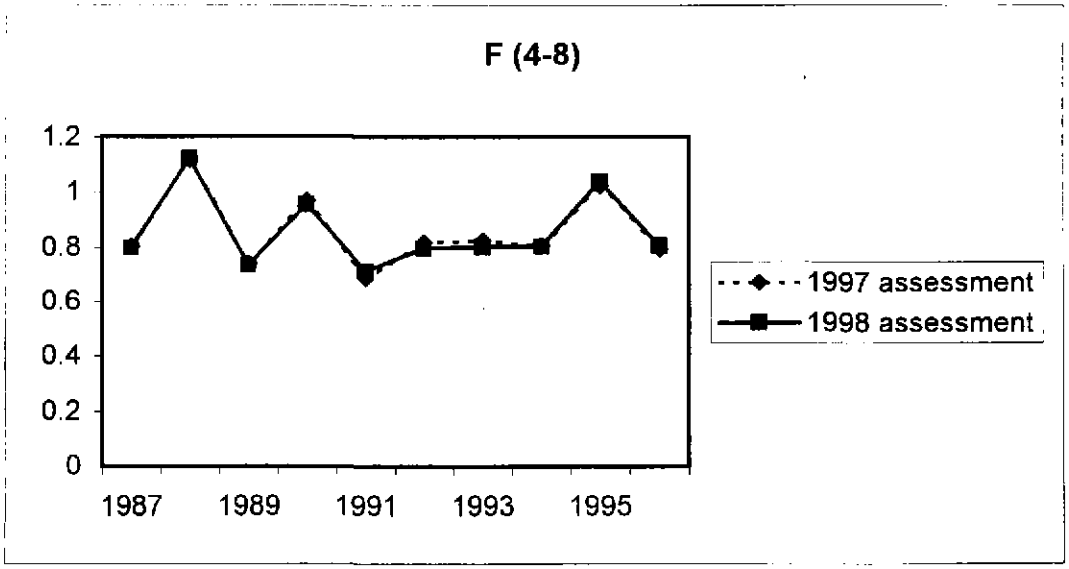
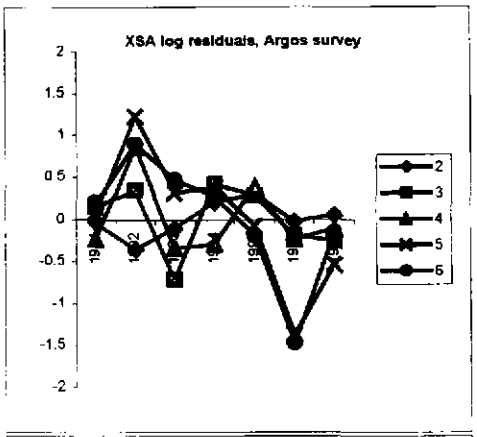
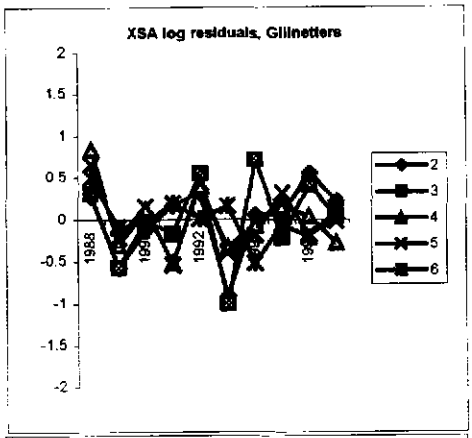
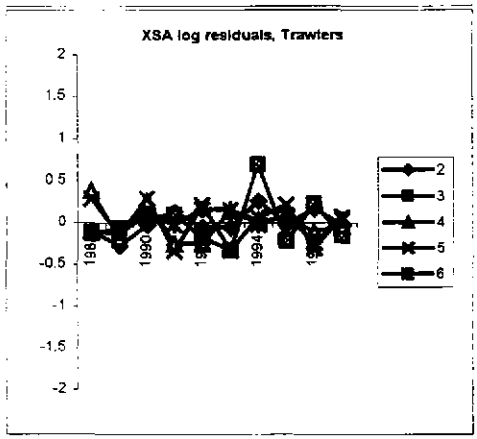
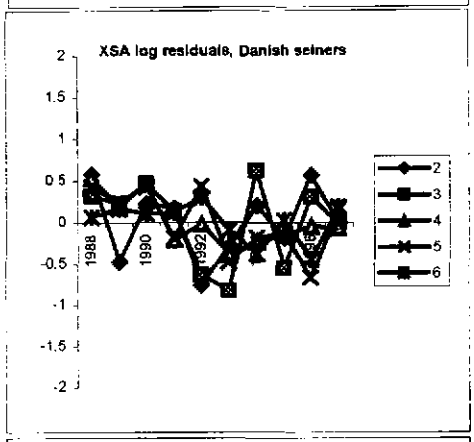


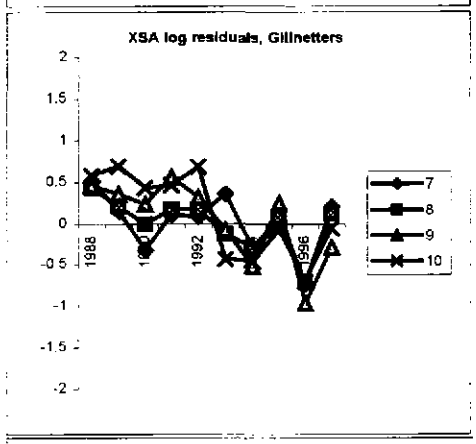
Figure 10.4.2. XSA log residuals by fleet and age

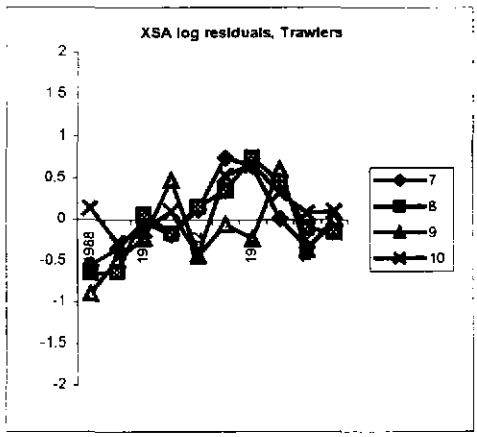












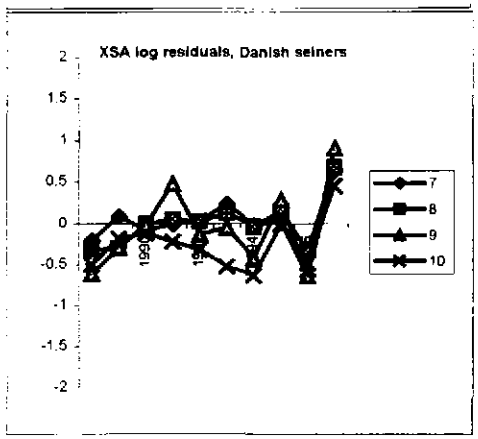
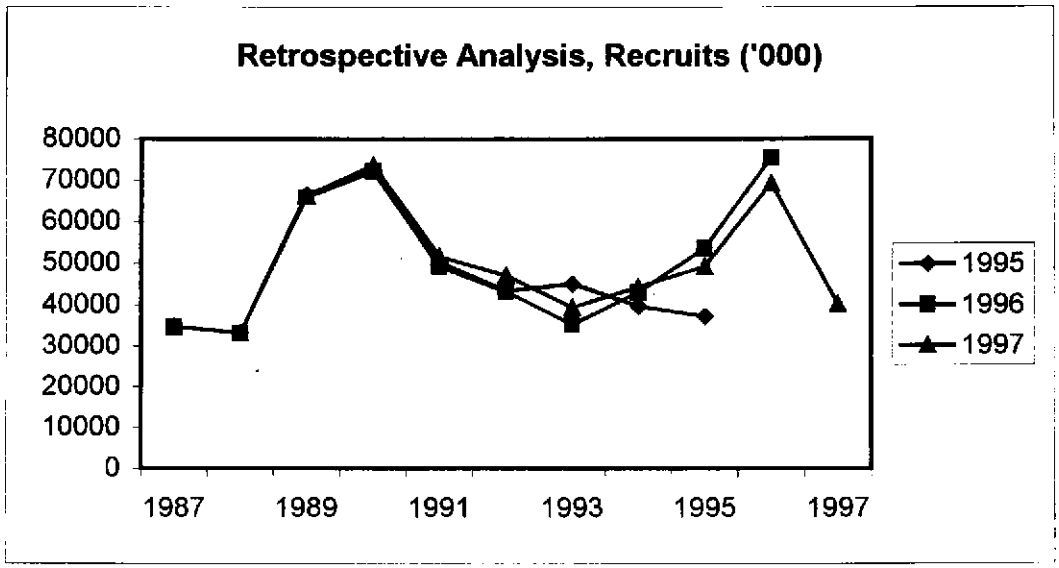
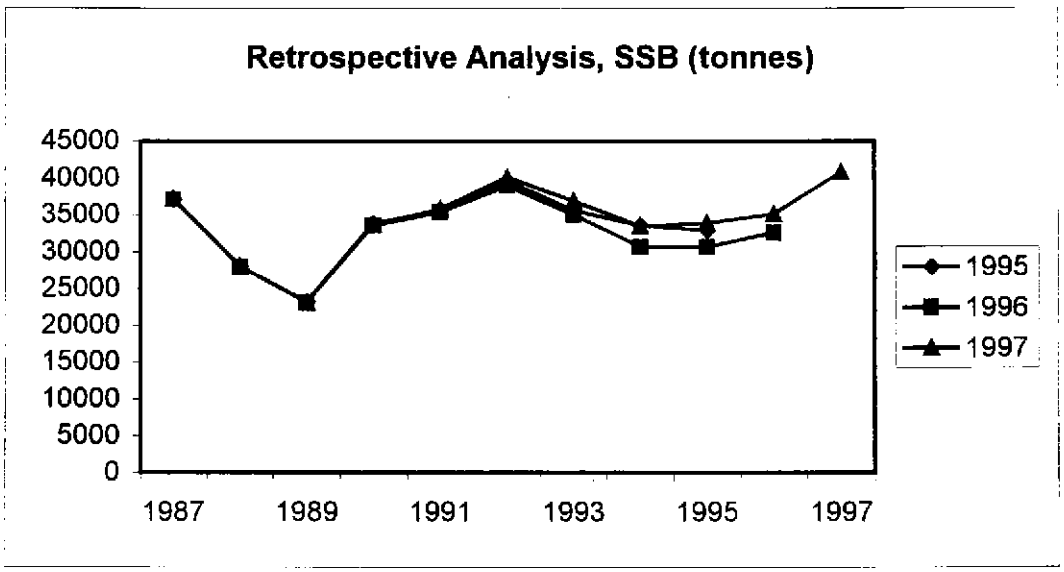


Figure 10.4.3. Retrospective analysis





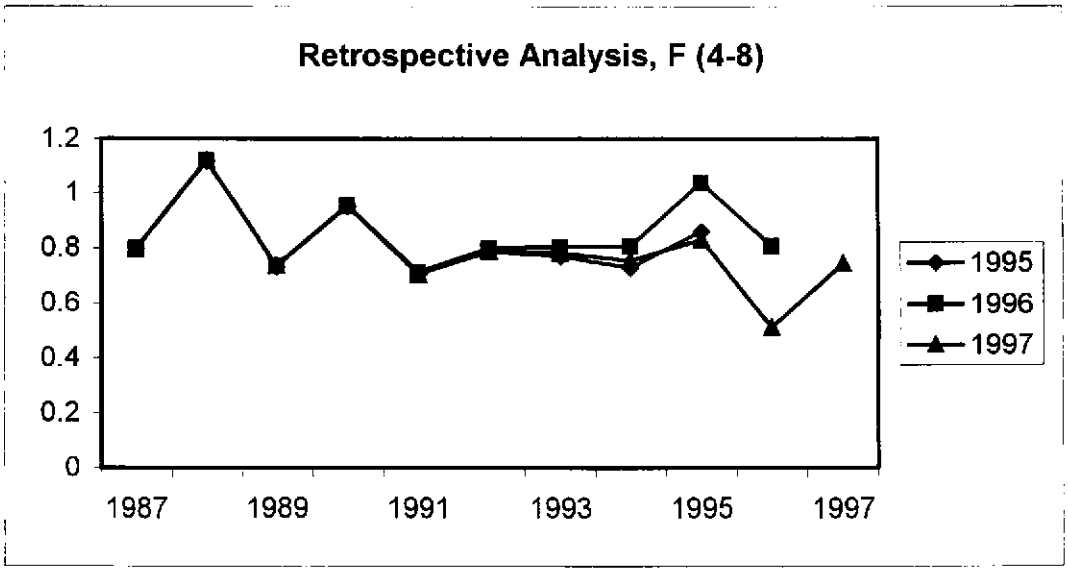


Figure 10.4.4. Log-CPUE versus Log-VPA by age for ARGOS survey

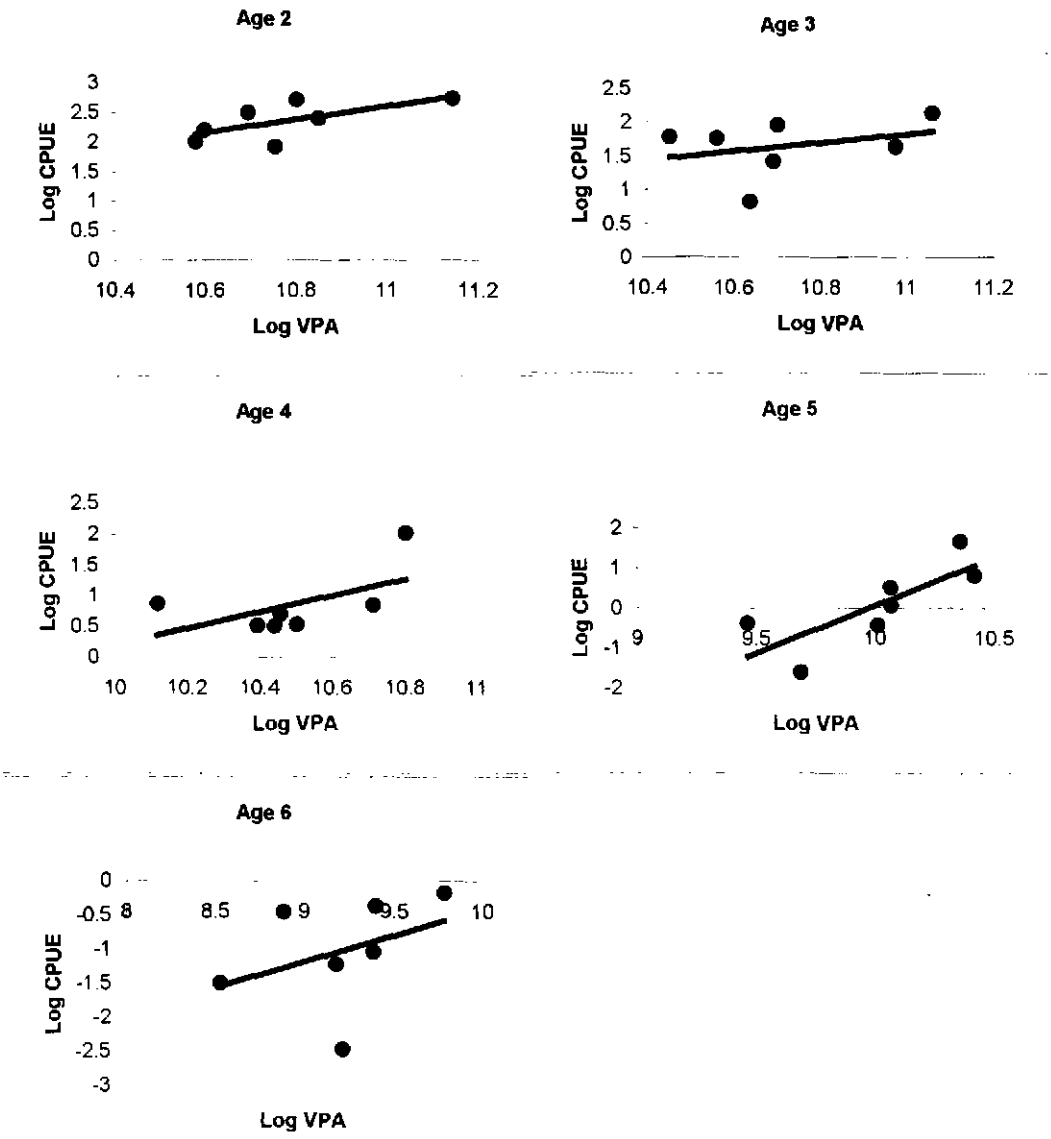


Figure 10.4.4. (cont.) Log-CPUE versus Log-VPA by age for the seine fleet

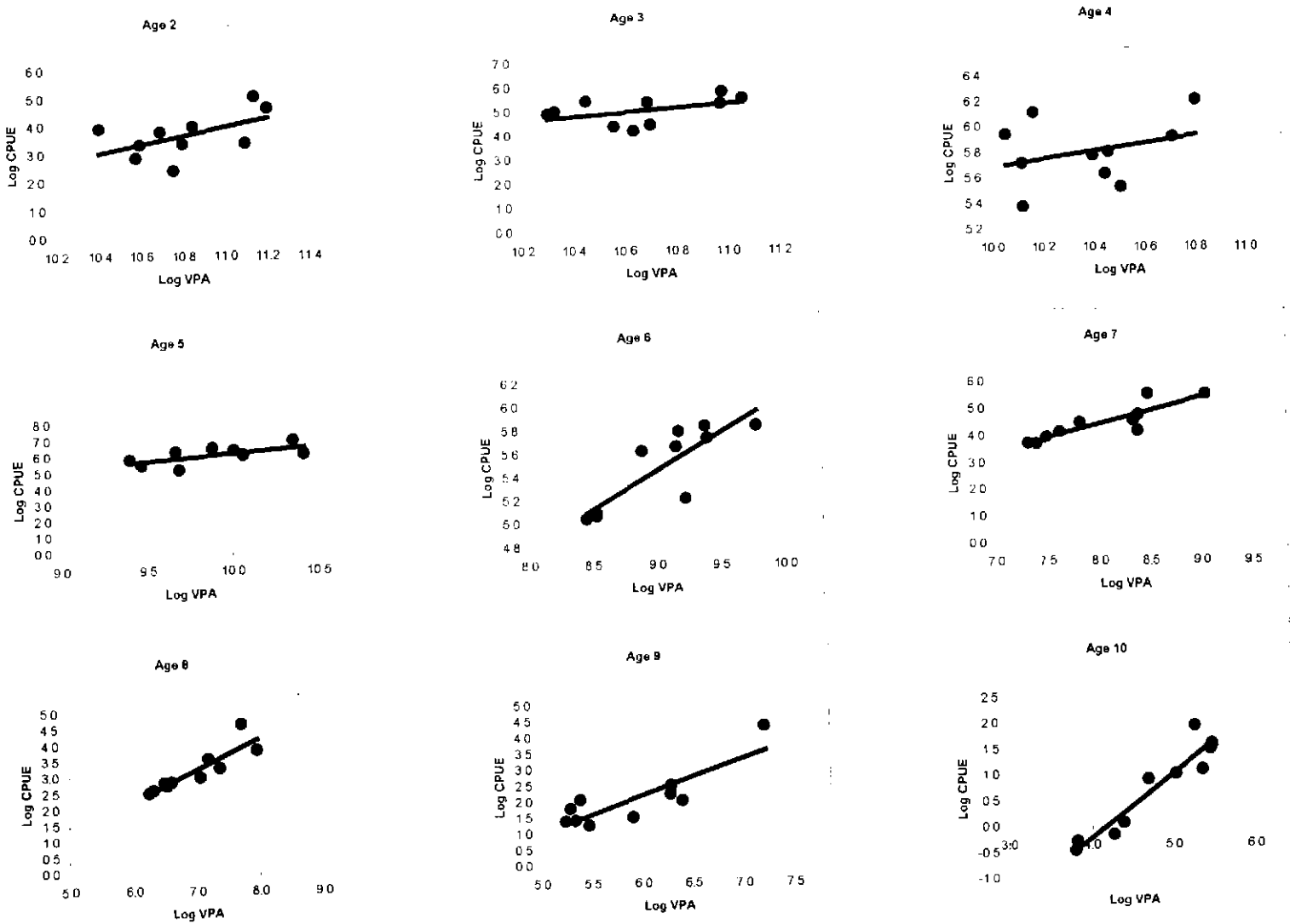


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Figure 10.4.4. (cont.) Log-CPUE versus Log-VPA by age for the gill-net fleet

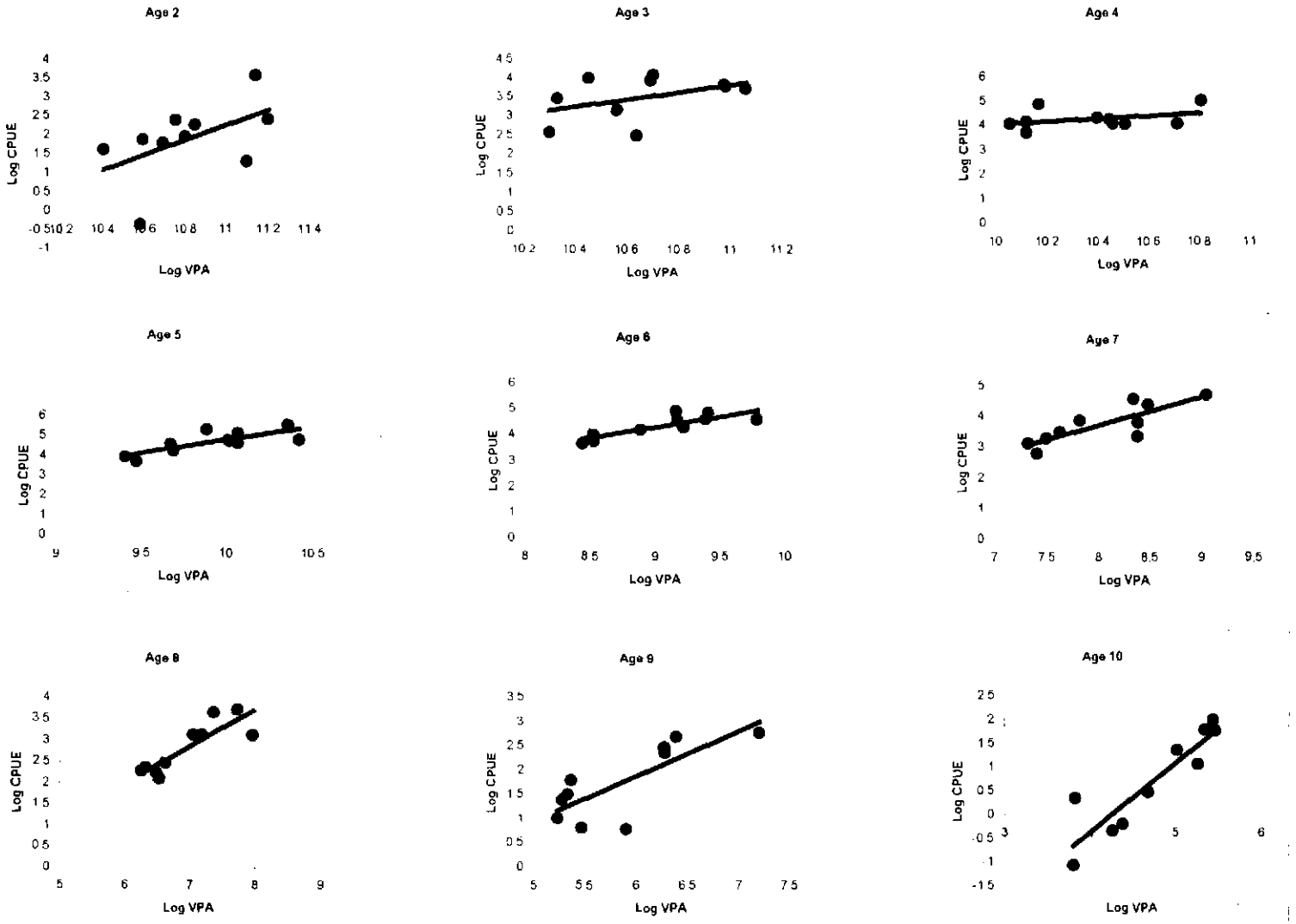

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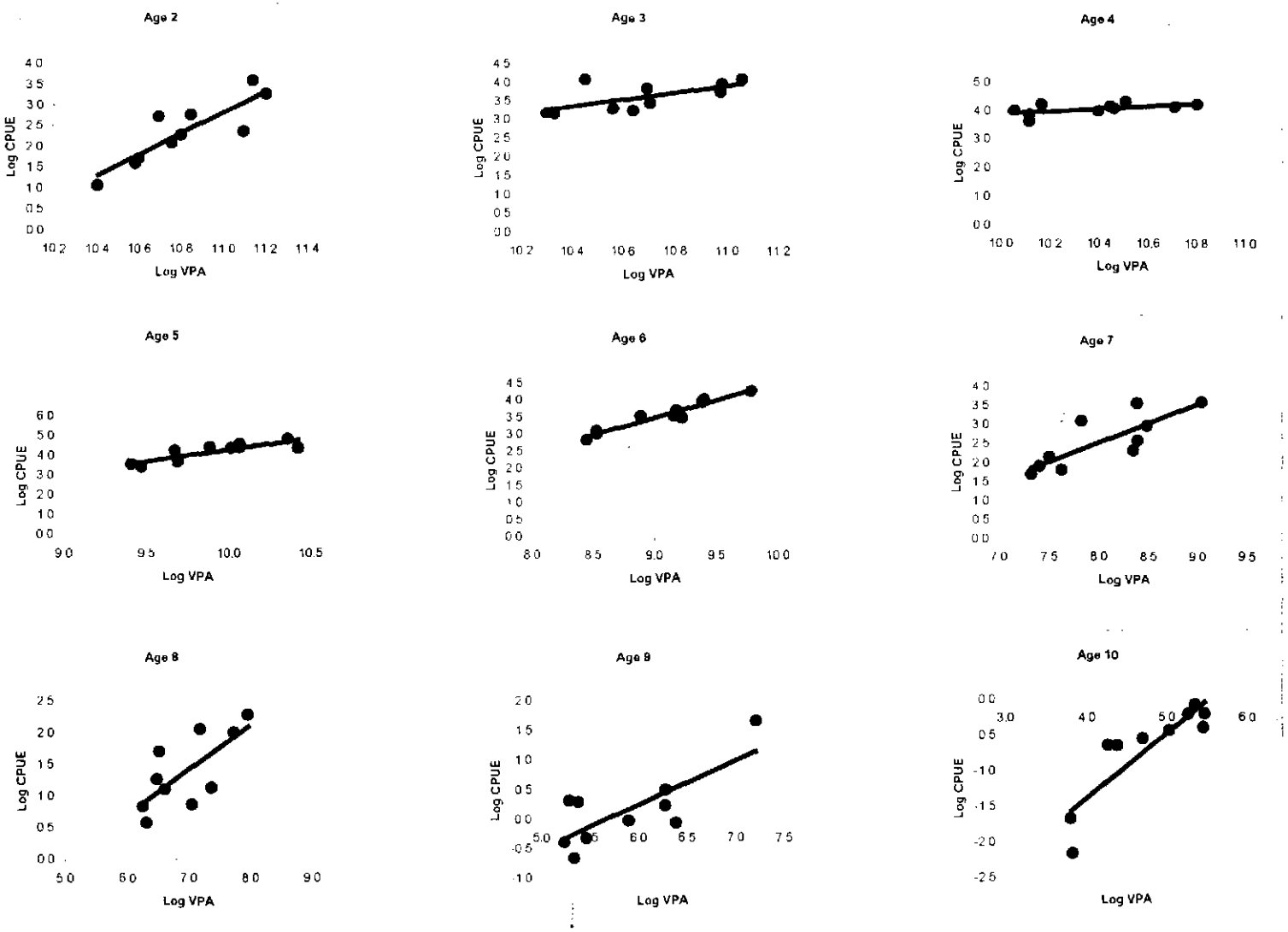
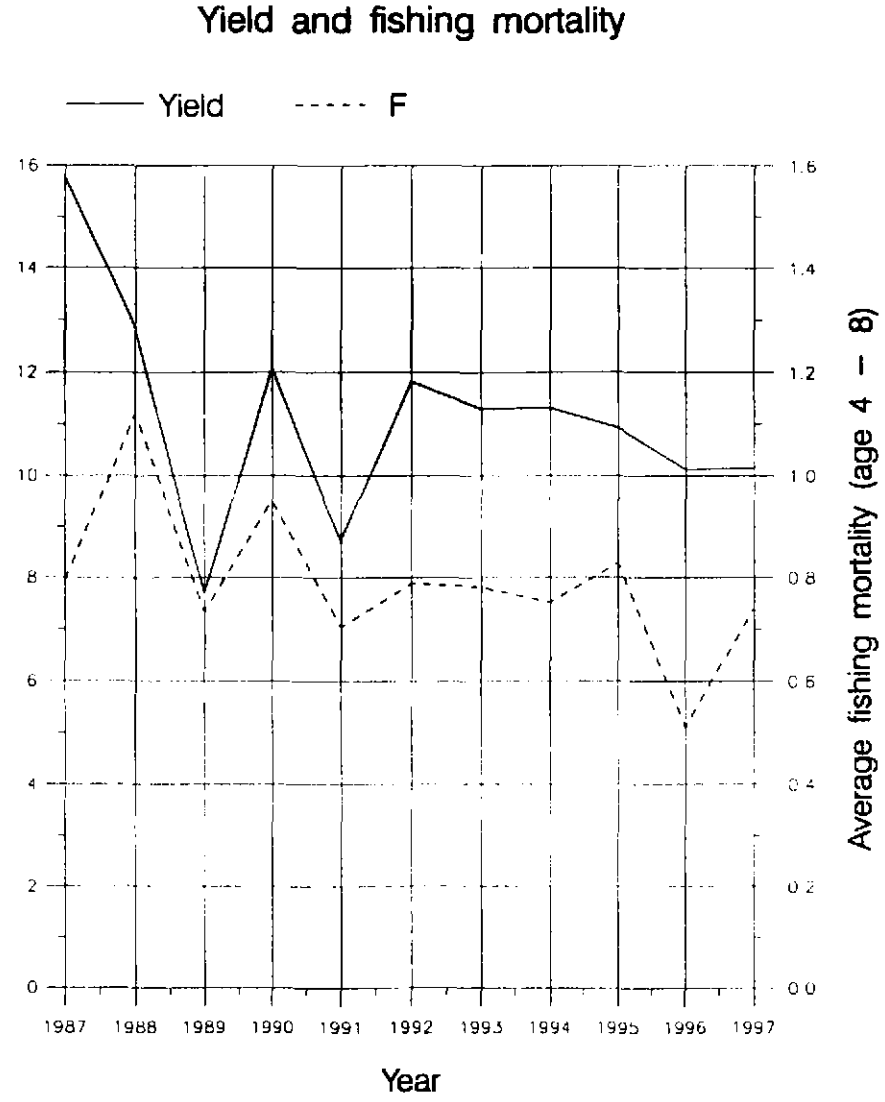
Figure 10.4.4. (cont.) Log-CPUE versus Log-VPA by age for the trawl fleet



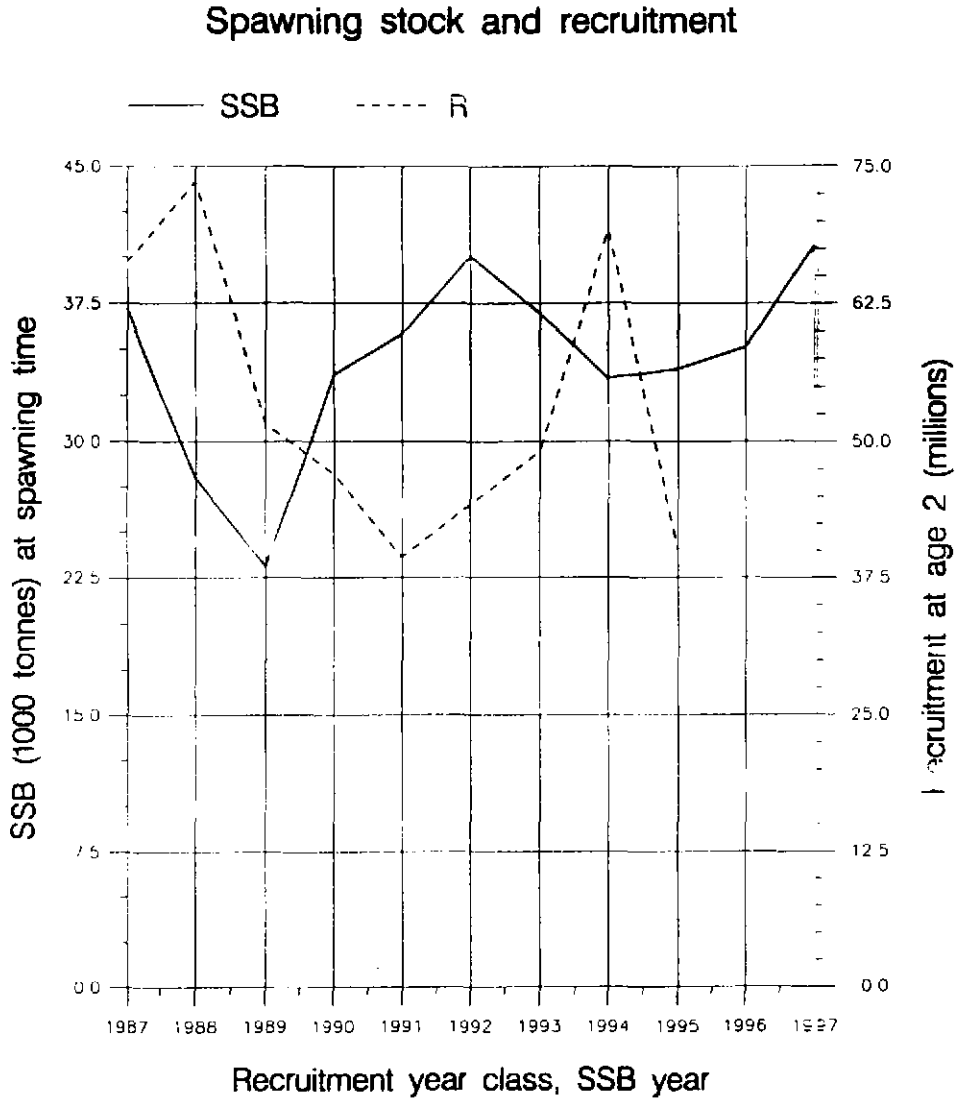
W:\Acfm\Wgnssk\98\Ple_3a\Figures\f10_4_4.xls

Figure 10.6.1

Fish Stock Summary
Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)
13 – 10 – 1998



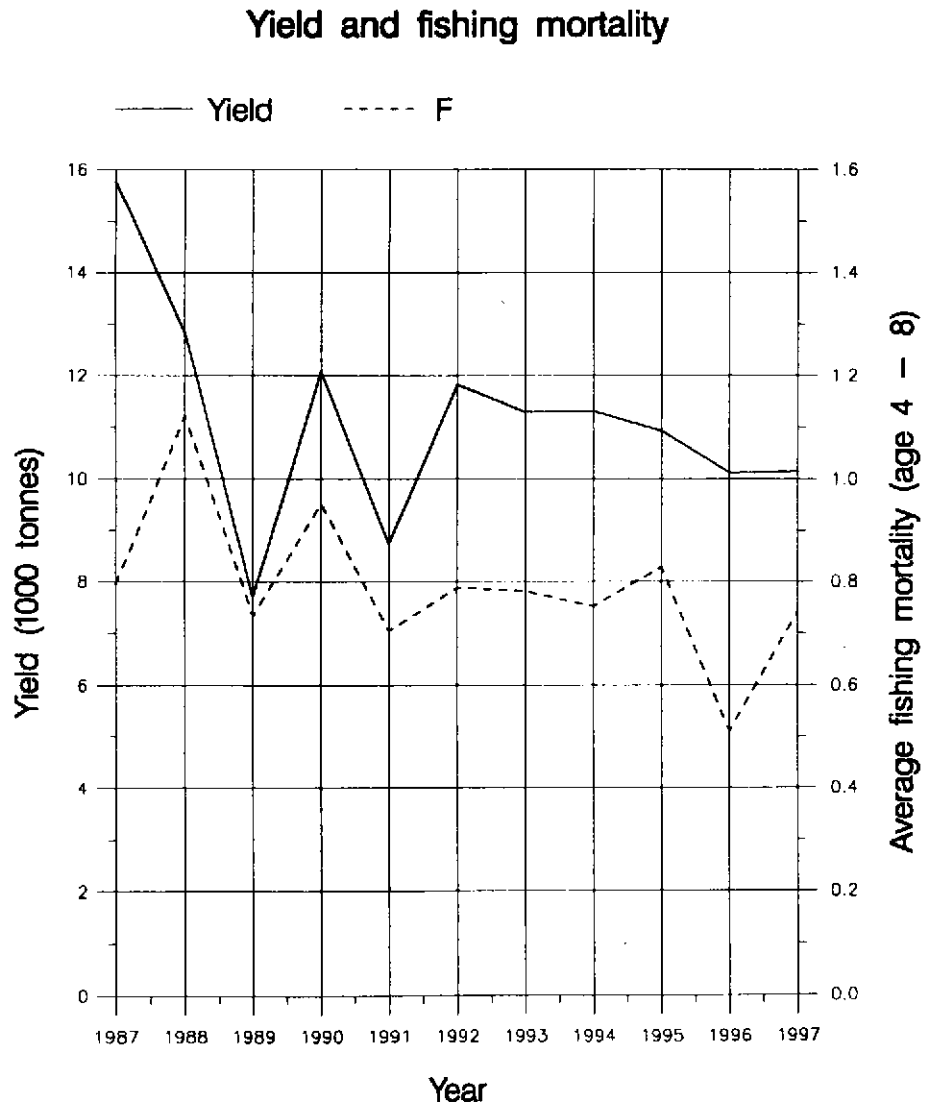
(run: XSAPAM05) A



(run: XSAPAM05) B

Figure 10.7.1

Fish Stock Summary
Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)
13 – 10 – 1998



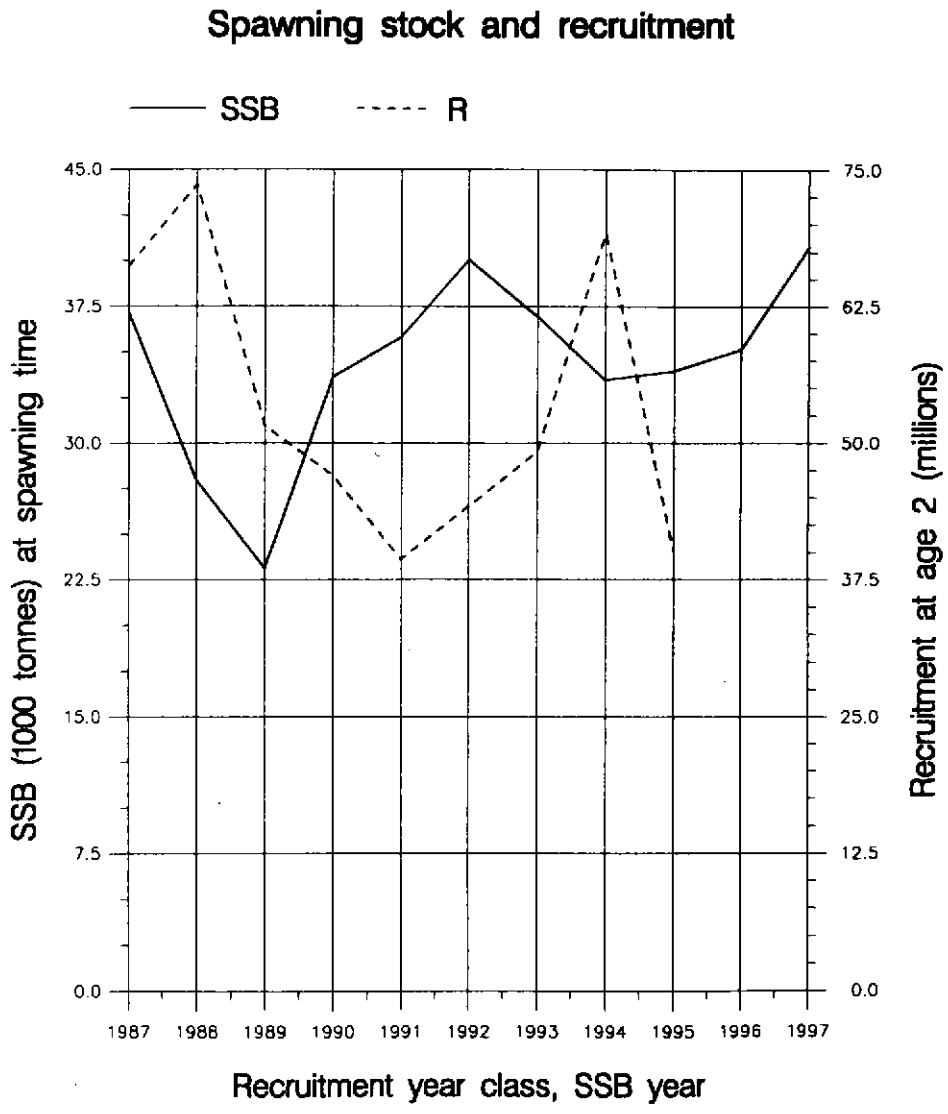


Figure 10.7.2 plaice,Kattegat and Skagerr. Sensitivity analysis of short term forecast.

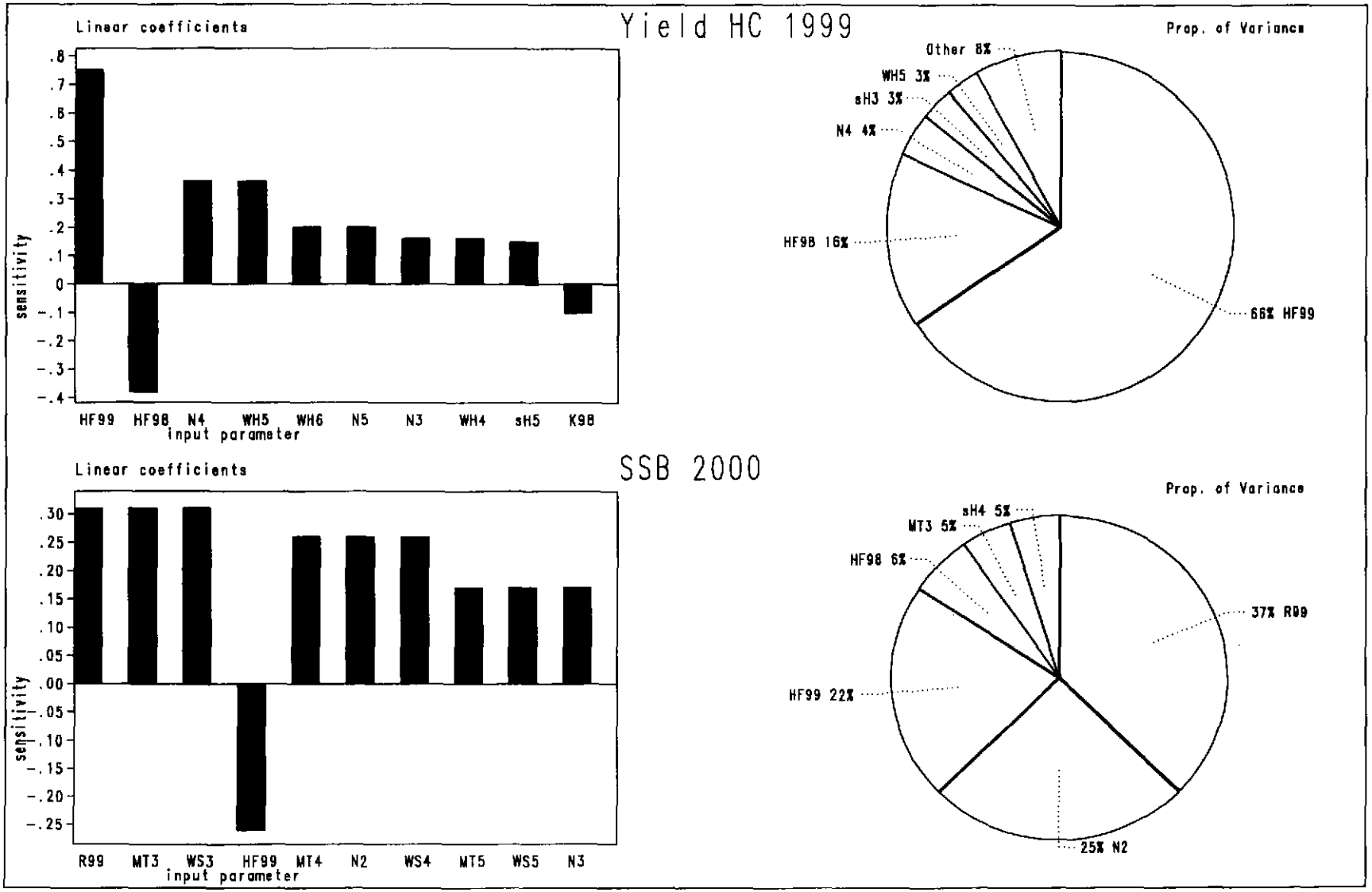
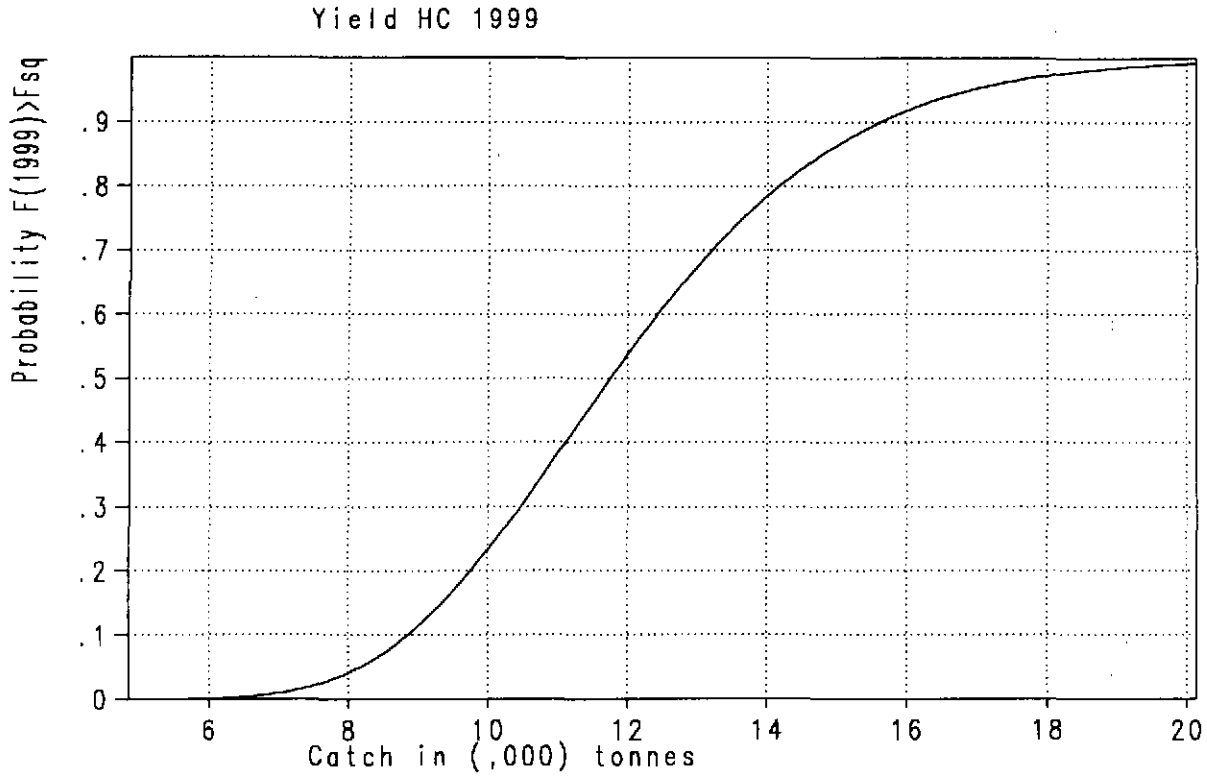


Figure 10.7.3 plaice,Kattegat and Skagerr. Probability profiles for short term forecast.



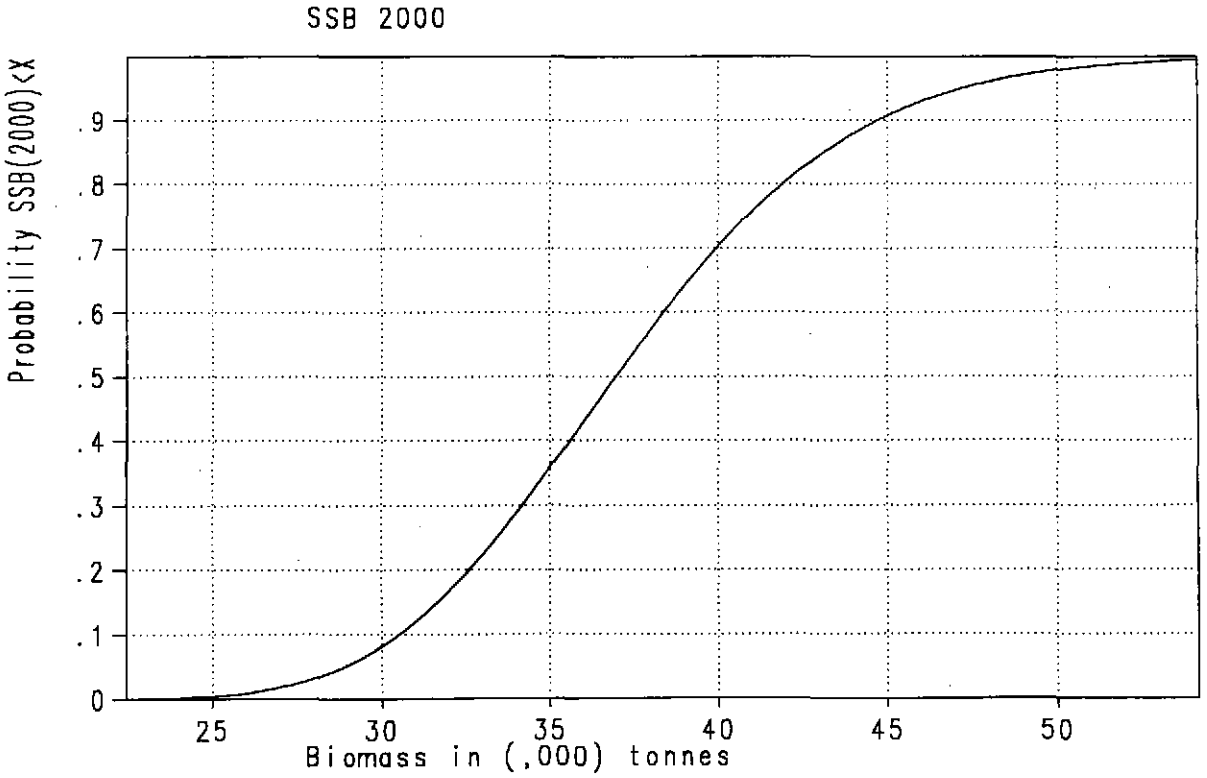


Figure 10.8.1. Description of the stock and recruitment (Plaice IIIa) with 4 traditional density-dependent functions

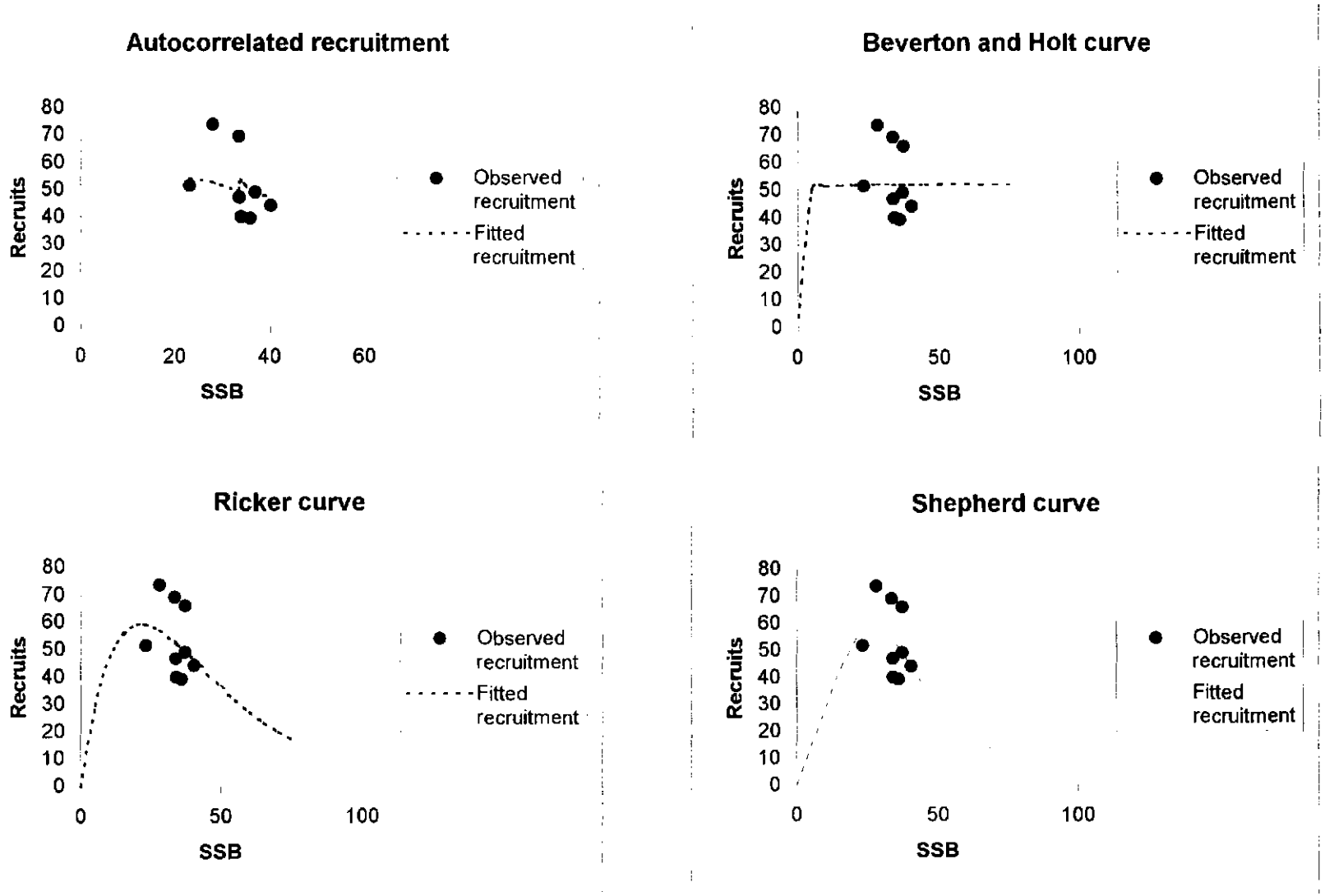


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Figure 10.8.2. Stock recruitment relationship (a) and outcomes of the medium-term projections (yield (b); recruitment (c); SSB (d)). (Butterworth and Berg).

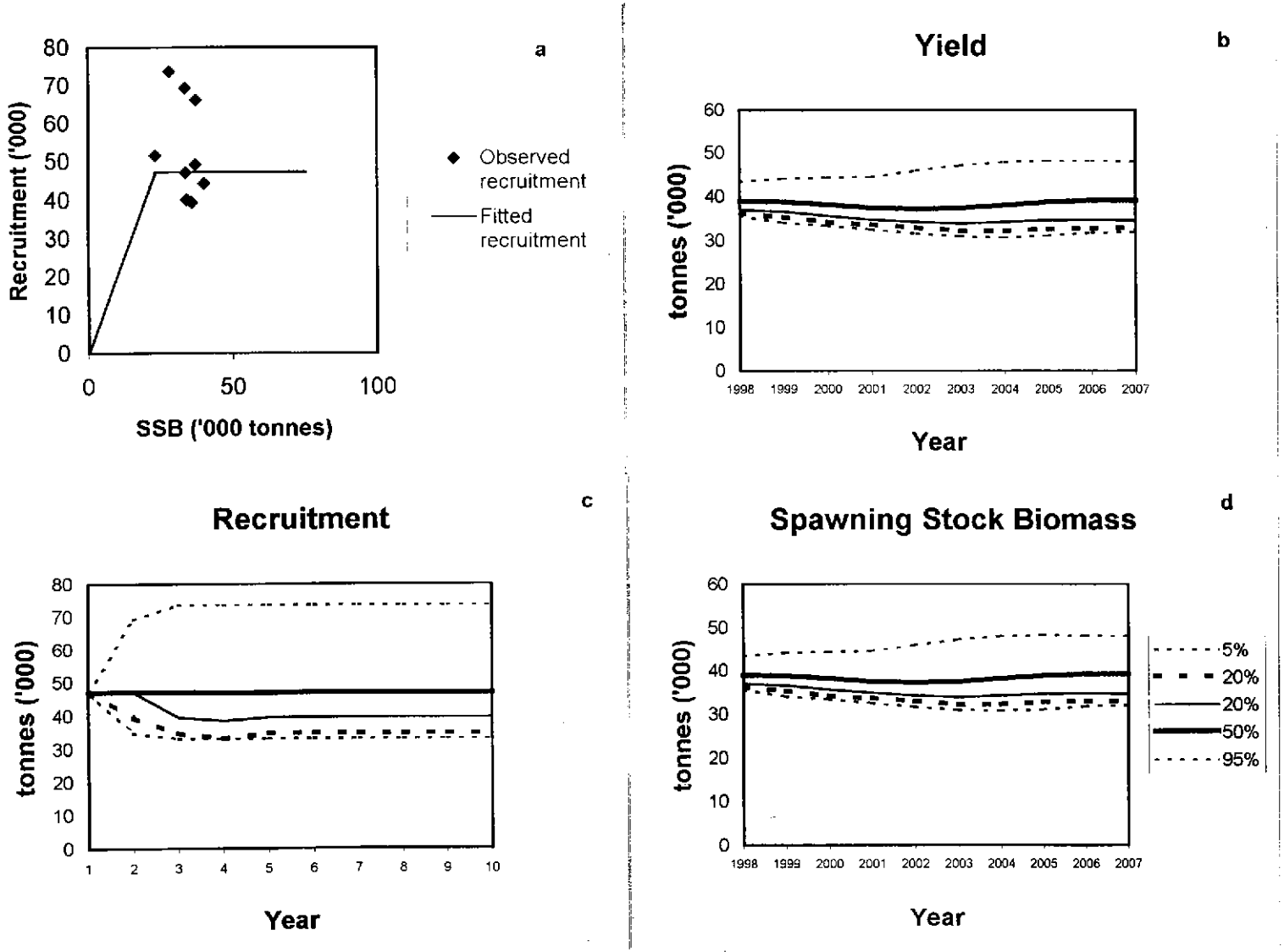

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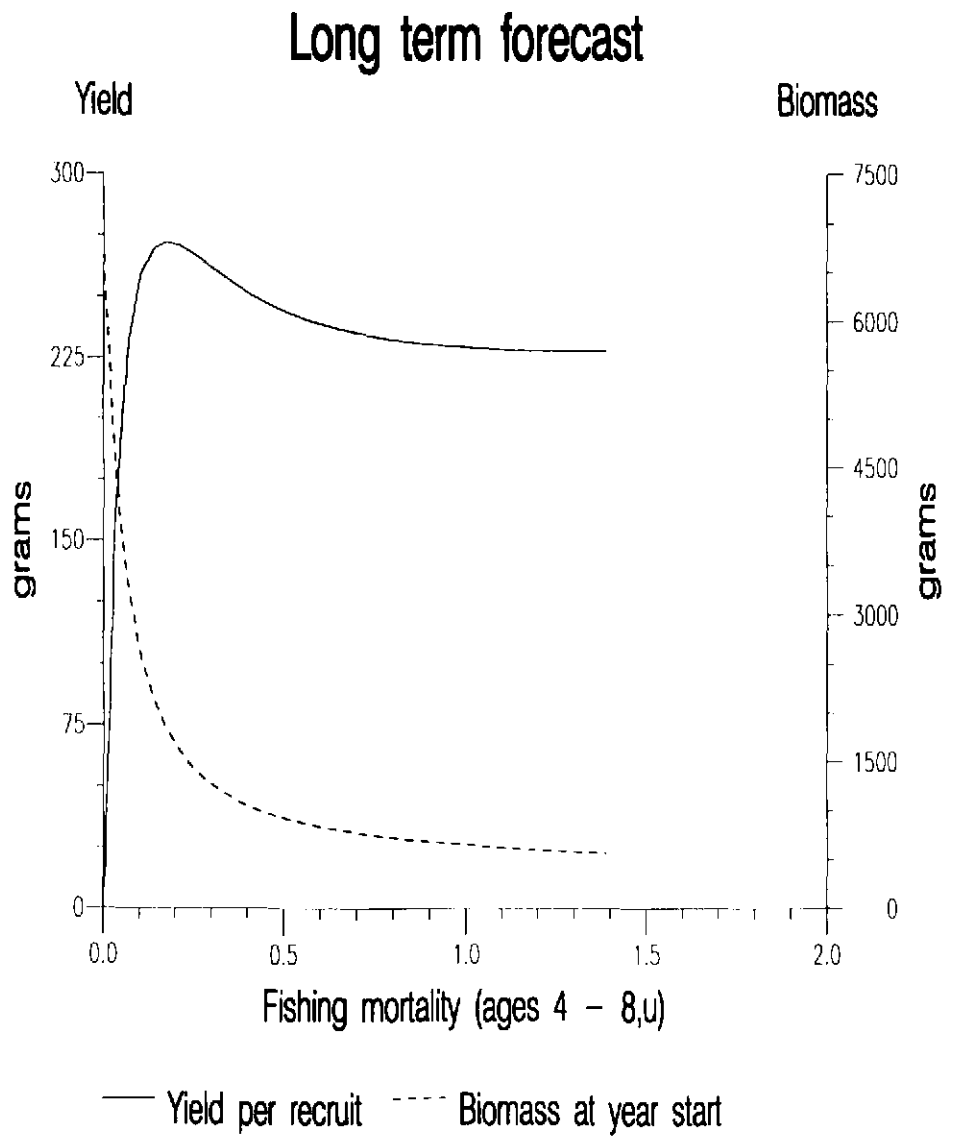
Figure 10.9.1

Fish Stock Summary
Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)
13 – 10 – 1998



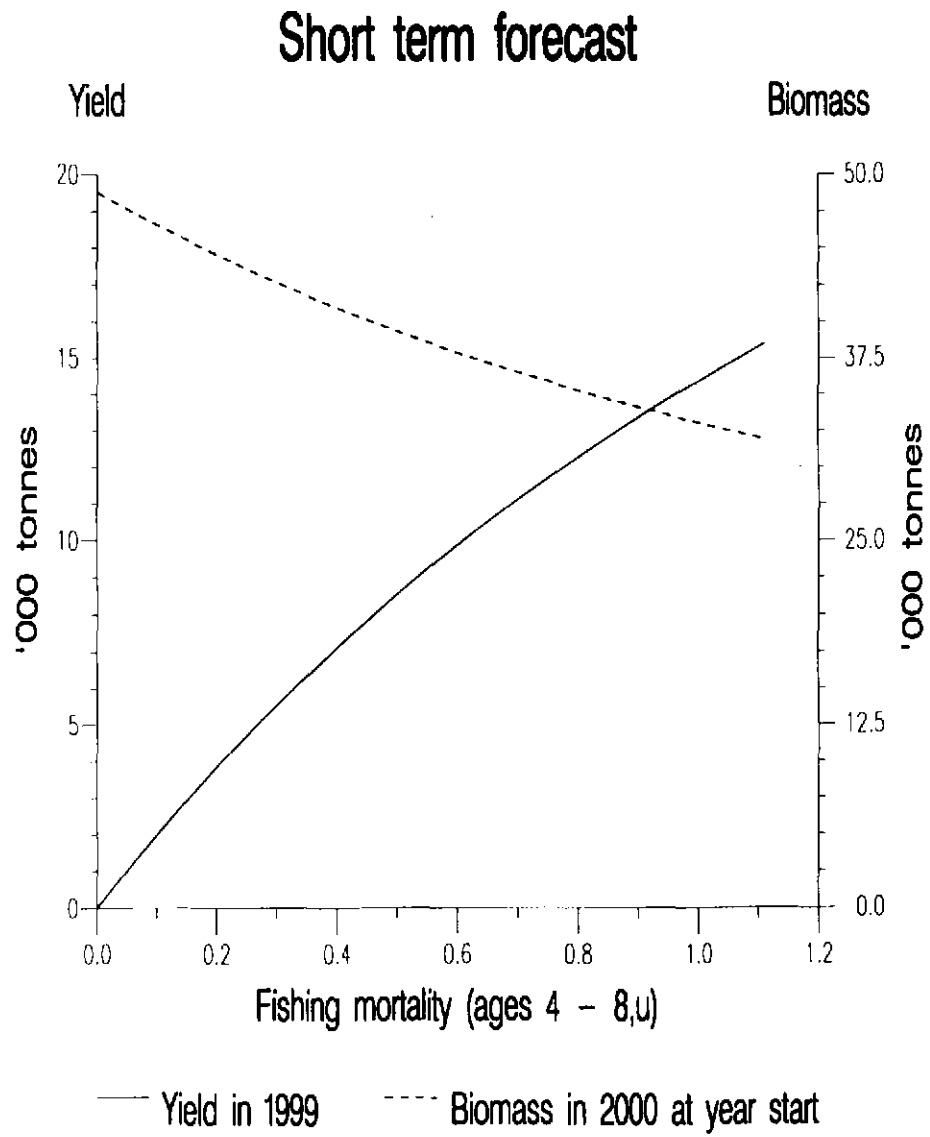
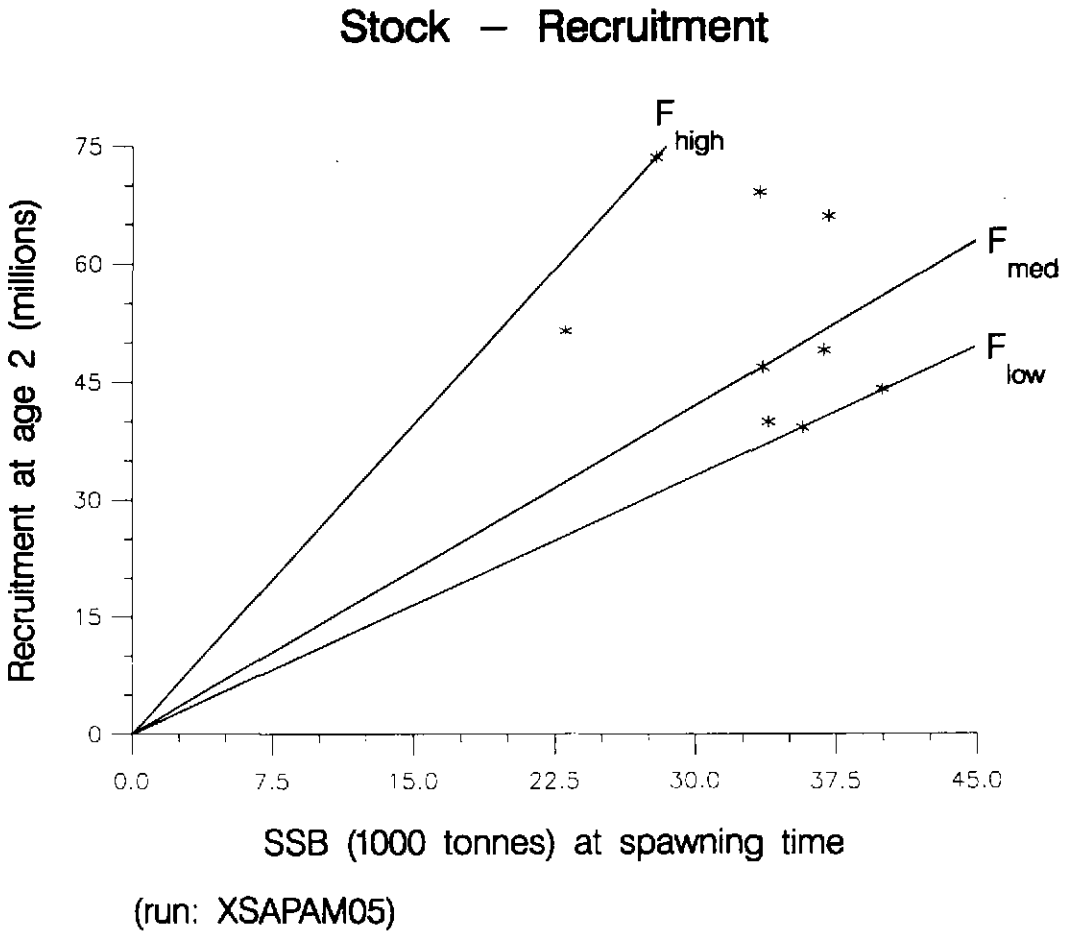


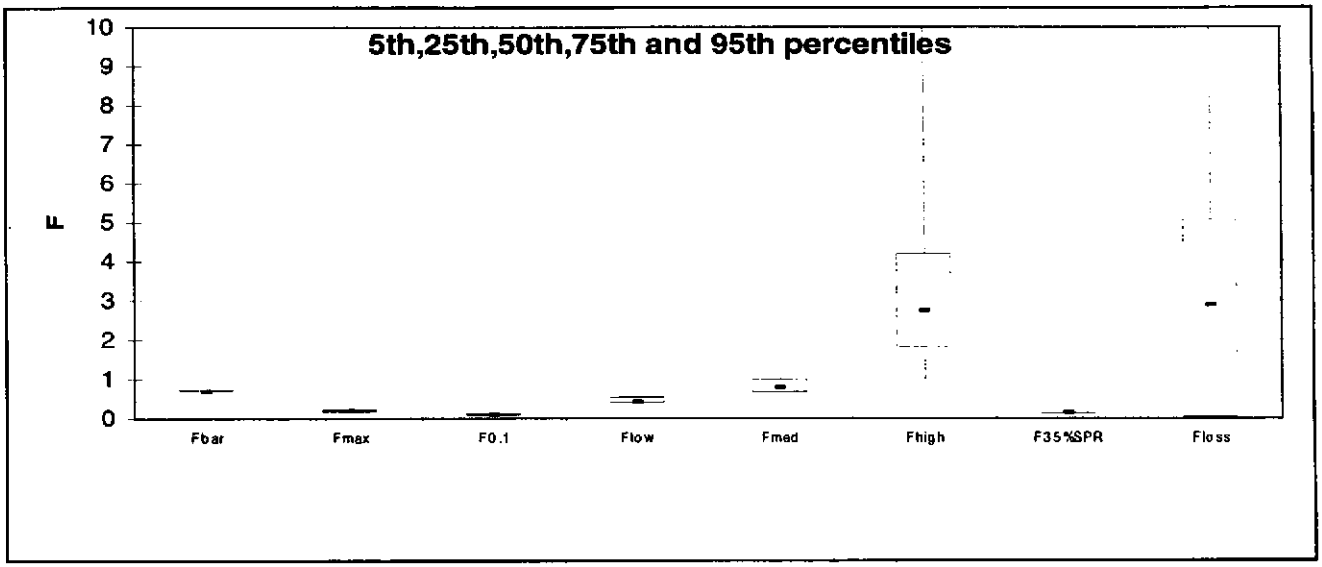
Figure 10.9.2

Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)
13 – 10 – 1998



(run: XSAPAM05)

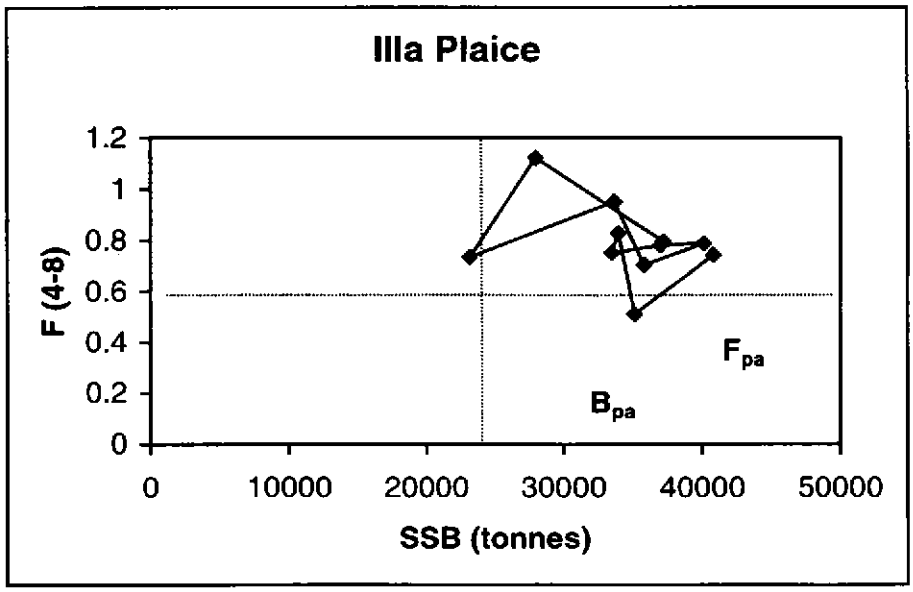
Figure 10.10.1. Representation of the potential biological reference points and of their associated percentiles.



Reference point	Deterministic	Median	95th percentile	80th percentile
MedianRecruits	47025	47025	51567	49173
MBAL	0			
Bloss	23144			
SSB90%R90%Surv	28711	28711	33932	33235
SPR%ofVirgin	11.68	11.66	15.42	13.52
VirginSPR	6.62	6.57	8.80	7.59
SPRloss	0.31	0.42	27980.10	23144.10

	Deterministic	Median	5th percentile	20th percentile
FBar	0.69	0.70	0.63	0.66
Fmax	0.18	0.18	0.14	0.16
F0.1	0.09	0.09	0.07	0.08
Flow	0.41	0.43	0.32	0.36
Fmed	0.80	0.77	0.51	0.61
Fhigh	2.80	2.71	0.93	1.60
F35%SPR	0.12	0.12	0.09	0.11
Floss	4.84	2.87	0.00	0.00

Figure 10.10.2. IIIa Plaice. Relationship between precautionary reference points and the historical pattern of SSB anf fishing mortality.



11 PLAICE IN DIVISION VIID

11.1 The fishery

Plaice is caught all year in mixed fishery with sole by Belgian and UK offshore beam trawlers and French inshore trawlers. It's also a seasonal target in winter for some French offshore otter trawlers

11.1.1 ICES advice applicable to 1998

ACFM considered the stock was outside safe biological limits taking in account the record level of the fishing mortality and the fact that the SSB was expected to fall in the medium term below the lowest observed. A reduction by 30% of the F was advised corresponding to a landing of 4,300 t in VIId.

11.1.2 Management applicable to 1998

There is no separate TAC for VIId plaice which at present is managed together with area VIIe. The TAC was set to 5,700 t in 1998 (TAC_{97} = 7,000 t, of which VIId contributed to 4,300 t). Technical conservation measures including minimum mesh size of 80 mm and minimal landing size of 25 cm are in force.

11.1.3 Trends in landings

Landings data reported to ICES are shown in Table 11.1.1 together with the total landings estimated by the Working Group. The unallocated landings are mainly due to discrepancies between the officially reported figures and those available to WG members. No correction was made for SOP discrepancies which are very low since 1992. The trend in landings is shown in Figure 11.1.1. Landings peaked at 10,400 t in 1988 and have declined by nearly half since then to 6,307 t in 1997 witch is a little over the 5,600 t predicted in last year's assessment. France contributes 57.3% of the official landings in 1997 followed by Belgium (22.2%) and UK (20.6%).

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

The natural mortality was assumed constant over ages and years at 0.10 as for the North Sea (Table 11.2.1). The maturity ogive used is similar to that for VIIe plaice and is the same for all years, it is shown in Table 11.2.1. Age compositions for 1980–97 were available for the UK and for 1981–97 for Belgium. France provided age compositions since 1989 however, levels of sampling prior to 1985 were poor and those data are considered to be less reliable.

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

The age-composition data and the mean weight at age in the catch are shown in Tables 11.2.2 and 11.2.3. In 1997 international landings covered by sampling schemes represented 96% of the total landings. Stock weights at the 1st of January were calculated from a smoothed curve of catch weights (Table 11.2.4). Data before 1997 were not revised. The data do not include discards that are not sampled for this stock although they are probably quite substantial.

11.3 Catch, effort and research vessel data

Commercial effort and CPUE data were available from four commercial fleets covering inshore and offshore trawlers. The two French fleets INSHORE TRAWL and OFFSHORE TRAWL used in previous assessments were grouped this year into FRENCH TRAWLERS because it was not possible to continue to distinguish them on the same basis due to a new statistical database. All fleets show a steep decline in CPUE from 1988/89 to 1995/96 and an increase in 1997. Effort has increased in all fleets since 1983 to 1989 and remained thereafter at a high level. Trends in effort and CPUE are shown in Table 11.3.2 and Figure 11.3.1 (see also overview Section 2.3).

Effort and age compositions were available for three commercial fleets. For FRENCH TRAWLERS we calculated the fleet age composition since 1993 (before this date the age compositions were derived from the total French age composition). Survey data were obtained since 1988 from two trawl surveys covering most of VIId. These were the English beam trawl survey in August (Table 11.3.3) and French otter trawl ground fish survey in October. Recruit survey estimates for 0 and 1-gp fish were also available from coastal research surveys in VIId, the English and French YFS (Table 11.3.4).

All these data (including age 1) were used to tune the VPA. The range of ages and years used in each fleet is shown in the input file for tuning (Table 11.3.1).

11.4 Catch at age analysis

As for last year the analysis was carried out with XSA. A number of trial runs were made to select the most appropriate model for the data and a multi stage process was used to select the final tuning options:

1. Input data: a separable VPA was made to check the input data (Table 11.4.1). Residuals are lower since 1989 when France began to provide age compositions. High residuals in the recent years occur only for the recruits (age 1/2) and for ages above 10. Age 10 and above were combined as a plus group.

2. Trends in catchability were examined for residual trends by fleet. As in 97WG the English BTS was limited to age 6 and French GFS to age 5. Trends were examined from exploratory runs using XSA where each fleet was weighted separately to 1. We noticed big residuals and a change in the trend for age 1 in the UK INSHORE TRAWL METIER before 1990 and big residual for age 1 in French GFS so these ages were therefore removed.

3. Choice of age to be treated as recruits: an exploratory run was made with all ages below 8 (default) treated as recruits (all other options accepted also by defaults). Examination of the regression statistics showed that for all fleets no slopes were significantly different from 1.0. Nevertheless for the youngest ages high t-values were noticed for age 1 in UK BTS and for age 2 in French GFS.

   Because we have surveys data in the tuning file it's recommended that the first age (age 1) is treated as recruit to improve the model even if t-values are not significant. For age 2 the two options age 1 and age $< = 2$ treated as recruit were tested. The results were conflicting, age 1 giving better results for commercial fleets and age $< = 2$ for the surveys but the differences were very low. There was no clear statistical reasons to treat age 2 as recruit and the simpler linear model was chosen for this age. This was different from last year where age 2 was also treated as recruits.

   As the data were relatively poor before 1989 (as shown in the separable VPA) this period was down weighted using a tricubic weight over 15 years over the whole time period (as in 97WG).

4. Choice of age for which catchability can be assumed to be constant: from the previous trial run where catchability depends on year class strength for ages 1 and is not dependant of age until 8 (default), the patterns of q with age were examined for each fleet. In most fleets, q showed a slight decline with age from a peak at age 3 or 4 and catchability become constant at age 7. Age 7 was therefore taken as an acceptable value (as in 97WG).

5. Survival estimates were shrunk towards the mean F of the final 5 years or the 3 oldest ages in the final run (as in 97WG).

6. Finally age 1 and 2 in BELGIAN BEAM TRAWL were also removed because they showed high value of S.E. in mean Log Q.

7. Retrospective analysis was carried out using final XSA options and shrinking to SEs of 0.3, 0.5 and 0.7 were examined (Figure 11.4.2). A general pattern of overestimating the F in the terminal years was noted. Level of shrinkage does not have a big effect and as last year a value of 0.5 was chosen.

8. Catchability residuals of the fleets from final XSA are presented in Figure 11.4.1. The relationship between Ln CPUE index at each age for all fleets and the VPA are shown in figures 11.4.3.a-g.

The following table summarise the changes from last year assessment, others parameters are the same:

	97WG	98WG
Tuning fleets	FRENCH INSHORE TRAWL	Replaced by a new fleet FRENCH TRAWL Including inshore and offshore boats
Excluding ages/fleets	Age 1 in UK INSHORE TRAWL	Age 1 in UK INSHORE TRAWL Age 1 in FRENCH GFS Ages 1 and 2 in BELGIAN BEAM TRAWL
Recruit age	1 and 2	1

The tuning fleets, input parameters and output from the final run are shown in Tables 11.4.2. Fishing mortality and stock numbers are given in Tables 11.4.3 and 11.4.4 respectively. The weights of tuning fleets and shrinkers are presented in Figure 11.4.4.

11.5 Recruit estimates

Research vessel survey indices of 0, 1 and 2 year olds were available and are shown in Table 11.3.4. These survey data were already used in XSA together with those of the three commercial fleets but additional data was available for O groups and for 1998 surveys.

RCT3 was used to predict recruitment at age 1 and age 2 in 1998, and the input file using 0 and 1 group indices is presented in Table 11.5.1. Figure 11.5.1 presents the survey indices compared with the VPA numbers (year class 1981 to 1994). RTC3 results are shown in Table 11.5.2 and Table 11.5.3 and can be compared to those of XSA in the table below:

		RCT3		XSA
Year-Class	Age in 1998	Weighted average (age*10–3)	Var Ratio	(age*10–3)
1995	3			12978
1996	2	25642	1.27	13022
1997	1	22612	.87	-

For the 1995 year class the XSA estimation was accepted. For the 1996 year class results show big differences between XSA and RCT3 and the higher estimate from the surveys was preferred to XSA which is mainly driven by the FRENCH TRAWL. This choice is guided by indications of an over average year class given by four of the six surveys indices and information coming from a small scale survey in the Bay of Seine and from fishermen. For the 1997 year class the estimate of RCT3 was used and for 1999 and 2000 the GM_{80-95} of 24 millions.

11.6 Historical Stock Trends

Trends in fishing mortality, SSB and recruitment are shown in Table 11.6.1 and Figure 11.1.1. Fishing mortality shows big variations in recent years, increasing steeply in 1991 and fluctuates after. This recent trend in F can be explained by the evolution of the effort made by the various fleets (see overview Section 2.3). SSB increased rapidly in 1987 following recruitment of the strong 1985 year class. Since 1990 it has declined steeply until 1992 and now is at a plateau near 9,000 t. Apart from three slightly above average year classes (1991, 1994 and 1996), recruitment has been close to the GM level of 24 million of 1 yr olds since 1989. This pattern looks different from last year assessment where for the last period estimation of F were higher and the trend of the SSB declining rapidly (see part 11.11).

11.7 Short term forecast

The input data for the catch forecasts are given in Table 11.7.1. Stock numbers in 1998 were taken from the VPA for age 3 and older, RCT3 at age 1 and 2 and the GM of 24 million was used for age 1 in 1999 and 2000. The exploitation

pattern was the mean of the period 1994–96. Catch and stock weights at age were the mean for the period 1995–97 and proportions of M and F before spawning were set to zero. The results of the *status quo* catch prediction are given in Table 11.7.3 and Figure 11.7.1. The predicted catch in 1998 is estimated to be 6,500 t with a SSB of 10,100 t for the same year. This compares with a figure of 5,600 t forecast for the catch and 6,200 t for the SSB made last year. Continuing with the same level of F implies a stability in catch with 6,500 t in 1999 and a predicted SSB to 10,500 t in 1999 and 10,800 t in 2000. A detailed prediction output by age is shown in Table 11.7.4.

Figure 11.7.2 shows the contribution of different year classes to landings in 1999 and SSB in 2000 under *status quo* assumptions.

The results of sensitivity analysis of the *status quo* catch prediction are shown in Figures 11.7.3 and 11.7.4. The input data are included in Table 11.7.2.

Figure 11.7.3 shows that the yield in 1999 and the SSB in 2000 are very dependant of the fishing mortality in 1999 and 1998. In the same Figure is shown the proportion of total variance of the estimated yields and spawning biomass contributed by the input parameters. For yield in 1999 and SSB 2000, most of the variance is contributed by the level of fishing mortality in 1998 and 1999.

Figure 11.7.4 shows probability profiles for yields in 1999 and spawning biomass in 2000. For SSB there is a very low probability that the SSB fall below the lowest observed value by 2000.

11.8 Medium term predictions

Figure 11.8.1 presents the results of several models used to fit SSB and recruitment. Because there is no clear evidence to choose one of these models, the Butterworth Berg model was therefore chosen by the Working Group like for most others flatfish stocks.

A medium term prediction (10 years) was carried out assuming that recruitment is fitted with a Butterworth Berg model. One run of 500 simulations was carried out for the *status quo* (F = 1.0*F97). Results in Figure 11.8.2 show the 5, 10, 20, 50 and 95 percentiles for yield, recruitment and SSB. These figures indicate a stability in all these parameters for the medium-term period. Hence with a 95% probability, the yield will be between 5,000 t and 9,000 t and the corresponding SSB between 9,000 t and 15,000 t.

11.9 Long term considerations

A stock-recruitment scatter plot is shown in Figure 11.10.1. The current F (0.47) is below the value of $\mathbf{F}_{med}$ (0.52). The yield per recruit input values are given in Table 11.9.1 and the output summary in Table 11.9.2. The YPR and SSB/R curves are shown in Figure 11.7.1.

11.10 Biological reference points

There is no clear pattern in stock recruitment data but lowest recruitment was observed at lowest biomass and B_{lim} was defined as B_{loss} = 5,600 t.

The proposed B_{pa} was derived as $B_{pa} = B_{lim}\, e^{1.645*\delta}$ where $\delta = 0.2$ and B_{pa} was set to 7,800 t.

Table 11.10.3 presents candidates for the precautionary reference points and the probability SSB< B_{pa} in 2007 resulting from the PA software.

The probability of SSB < B_{pa} rises sharply between F values of 0.5 and 0.6. Therefore the Working Group suggest F = 0.5 as a candidate for $\mathbf{F}_{pa}$.

11.11 Comments on the assessment

The methodology used this year was very similar to last year and XSA was used again. As said before (part 11.3) the major difference appears this year in the tuning fleets where it was necessary to merge INSHORE and OFFSHORE FRENCH TRAWL in a new trawl fleet.

If we compare with last year's assessment some important changes appear in the trend of this stock. The lower estimation of the F in recent years give a more optimistic view of the situation of this stock, the current F is now estimated to be below F_{med}. and the SSB will be expected to increase slightly on the short term until 11,000 t in 2000. The above average 1996 year class will also contribute to maintain the SSB. However, the calculation of F_{med} is not very precise because of the small number of data points available and the result should be treated with caution. The reasons of the changing in the view of this stock since last year are not clear and are related to the tendency of a big overestimation of the F in the final years as shown by retrospective.

Table 11.1.1.- Plaice in Division VIId. Nominal landings (tonnes) as officially reported to ICES, 1976–1997.

Year	Belgium	Denmark	France	UK (E+W)	Others	Total reported	Un-allocated	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[13]	1,383	-	6,667	2,091	8,758
1990	2,149	-	4,170[13]	1,479	-	7,798	1,249	9,047
1991	2,265	-	3,606[13]	1,566	-	7,437	376	7,813
1992	1,560	1	3,099[3]	1,553	19	6,232	105	6,337
1993	0,877	+[2]	2,792[3]	1,075	27	4,771	560	5,331
1994	1,418	+	3,199[3]	993	23	5,633	488	6,121
1995	1,157	-	2,598[3]	796	18	4,569	561	5,130
1996	1,112	-	2,631[3]	856	+	4,599	794	5,393
1997	1,161	-	3,002[13]	1,078	+	5,241	1,066	6,307

[1]Estimated by the Working Group from combined Division VIId+e.
[2]Includes Division VIIe.
[3]Provisional.

Table 11.2.1.- Plaice in Division VIId. Natural mortality and proportion mature.

Age	Nat Mor	Mat.
1	.100	.000
2	.100	.150
3	.100	.530
4	.100	.960
5	.100	1.000
6	.100	1.000
7	.100	1.000
8	.100	1.000
9	.100	1.000
10+	.100	1.000

Table 11.2.2.- Plaice in Division VIId. Catch numbers at age.

	Table 1	Catch numbers at age Numbers*10**-3									
	YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,		
	AGE										
	1,	53,	16,	265,	92,	350,	142,	679,	25,		
	2,	2644,	2446,	1393,	3030,	1871,	5714,	4884,	8499,		
	3,	1451,	6795,	6909,	3199,	7310,	6195,	7034,	7508,		
	4,	540,	2398,	3302,	5908,	2814,	4883,	3663,	3472,		
	5,	490,	290,	762,	931,	1874,	413,	1458,	1257,		
	6,	75,	159,	206,	226,	533,	612,	562,	430,		
	7,	45,	51,	96,	92,	236,	164,	254,	442,		
	8,	44,	42,	62,	122,	101,	99,	69,	154,		
	9,	4,	56,	21,	4,	34,	139,	19,	105,		
	+gp,	103,	200,	88,	101,	100,	50,	34,	77,		
0	TOTALNUM,	5449,	12453,	13104,	13705,	15223,	18411,	18656,	21969,		
	TONSLAND,	2650,	4769,	4865,	5043,	5161,	6022,	6834,	8366,		
	SOPCOF %,	100,	94,	92,	90,	86,	92,	100,	98,		

	Table 1	Catch numbers at age Numbers*10**-3									
	YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
	AGE										
	1,	16,	826,	1632,	1542,	1665,	740,	1242,	2592,	1119,	550,
	2,	5011,	3638,	2627,	5860,	6193,	7606,	3633,	4340,	4847,	4246,
	3,	18813,	7227,	8746,	5445,	4450,	3817,	6968,	2933,	3606,	7189,
	4,	4900,	9453,	5983,	4524,	1725,	1259,	3111,	2928,	1547,	3434,
	5,	1118,	2672,	3603,	2437,	1187,	542,	850,	922,	1436,	1080,
	6,	541,	588,	801,	1681,	1044,	468,	419,	228,	488,	752,
	7,	439,	288,	243,	286,	698,	334,	312,	277,	179,	464,
	8,	127,	179,	203,	120,	200,	287,	267,	225,	176,	199,
	9,	105,	81,	178,	113,	116,	102,	275,	122,	165,	114,
	+gp,	174,	197,	231,	125,	118,	152,	312,	258,	347,	306,
0	TOTALNUM,	31244,	25149,	24247,	22133,	17396,	15307,	17389,	14825,	13910,	18334,
	TONSLAND,	10420,	8758,	9047,	7813,	6337,	5331,	6121,	5130,	5393,	6307,
	SOPCOF %,	92,	93,	98,	96,	98,	99,	99,	98,	102,	97,

Table 11.2.3.- Plaice in Division VIId. Catch weights at age.

	Table 2	Catch weights at age (kg)								
	YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	
	AGE									
	1,	.3090,	.2390,	.2450,	.2660,	.2330,	.2540,	.2260,	.2510,	
	2,	.3120,	.2990,	.2710,	.2960,	.2950,	.2780,	.3060,	.2820,	
	3,	.4990,	.3730,	.3530,	.3490,	.3360,	.3010,	.3310,	.3600,	
	4,	.6270,	.4640,	.4310,	.4200,	.4020,	.4270,	.4060,	.4770,	
	5,	.7870,	.7120,	.6400,	.5420,	.5080,	.5020,	.5460,	.5770,	
	6,	1.1390,	.8700,	.7950,	.8220,	.6890,	.5700,	.4860,	.7830,	
	7,	1.1790,	.8630,	1.1530,	.9530,	.7030,	.5570,	.6290,	.7350,	
	8,	1.2930,	.8970,	1.0670,	1.1440,	.9450,	1.0810,	.8710,	1.1420,	
	9,	1.4750,	.9920,	1.5040,	.9430,	1.0280,	.8490,	1.4460,	1.2680,	
	+gp,	1.5572,	1.1736,	1.3552,	1.5907,	1.4269,	1.4209,	1.5789,	1.5148,	
0	SOPCOFAC,	.9995,	.9353,	.9208,	.9003,	.8632,	.9239,	1.0001,	.9757,	

	Table 2	Catch weights at age (kg)									
	YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
	AGE										
	1,	.2920,	.2010,	.2010,	.2250,	.1820,	.2200,	.2430,	.2180,	.2210,	.1990,
	2,	.2680,	.2680,	.2560,	.2770,	.2770,	.2720,	.2700,	.2710,	.3000,	.2520,
	3,	.3210,	.3210,	.3260,	.3110,	.3520,	.3360,	.2880,	.3130,	.2900,	.2980,
	4,	.4320,	.3700,	.3780,	.3900,	.4290,	.4320,	.3560,	.3900,	.3960,	.3320,
	5,	.5600,	.4730,	.4830,	.4540,	.5090,	.5070,	.4660,	.4850,	.4750,	.4420,
	6,	.6570,	.6480,	.6100,	.5560,	.5850,	.5910,	.5760,	.6880,	.6430,	.5770,
	7,	.7700,	.8370,	.7810,	.7450,	.7010,	.7410,	.6860,	.6120,	.7640,	.8010,
	8,	.9080,	.9070,	.9630,	1.0870,	.8370,	.8200,	.9280,	.8060,	.9340,	.8940,
	9,	1.2180,	1.2040,	1.1590,	.9240,	.8500,	.9340,	.9690,	1.1500,	1.0570,	1.0550,
	+gp,	1.3280,	1.5195,	1.3099,	1.6015,	1.1947,	1.1555,	1.2866,	1.2977,	1.3124,	1.3948,
0	SOPCOFAC,	.9224,	.9313,	.9795,	.9625,	.9846,	.9940,	.9930,	.9807,	1.0201,	.9748,

Table 11.2.4.- Plaice in Division VIId. Stock weights at age.

Table 3	Stock weights at age (kg)								
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	
AGE									
1,	.1710,	.1100,	.1050,	.0970,	.0820,	.0840,	.1010,	.1220,	
2,	.3320,	.2160,	.2080,	.1920,	.1640,	.1710,	.2050,	.2420,	
3,	.4820,	.3170,	.3080,	.2860,	.2480,	.2590,	.3110,	.3610,	
4,	.6220,	.4140,	.4060,	.3790,	.3330,	.3480,	.4200,	.4790,	
5,	.7510,	.5060,	.5020,	.4700,	.4200,	.4400,	.5320,	.5960,	
6,	.8700,	.5940,	.5960,	.5600,	.5070,	.5330,	.6460,	.7120,	
7,	.9770,	.6770,	.6870,	.6480,	.5960,	.6280,	.7630,	.8260,	
8,	1.0740,	.7560,	.7760,	.7350,	.6860,	.7250,	.8820,	.9390,	
9,	1.1610,	.8300,	.8620,	.8210,	.7770,	.8240,	1.0040,	1.0510,	
+gp,	1.3392,	1.0419,	1.1184,	1.1688,	1.0858,	1.2060,	1.3126,	1.3055,	

Table 3	Stock weights at age (kg)									
YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
1,	.0840,	.0790,	.0850,	.0650,	.0880,	.1080,	.1650,	.0580,	.1780,	.1020,
2,	.1680,	.1620,	.1720,	.1410,	.1770,	.2140,	.2150,	.1720,	.2380,	.1810,
3,	.2540,	.2500,	.2620,	.2270,	.2680,	.3150,	.2740,	.2840,	.3070,	.2610,
4,	.3400,	.3420,	.3550,	.3240,	.3610,	.4140,	.3440,	.3960,	.3850,	.3430,
5,	.4270,	.4390,	.4510,	.4320,	.4560,	.5090,	.4220,	.5060,	.4730,	.4280,
6,	.5140,	.5410,	.5490,	.5500,	.5520,	.6010,	.5110,	.6150,	.5690,	.5140,
7,	.6030,	.6480,	.6510,	.6790,	.6510,	.6900,	.6090,	.7230,	.6750,	.6030,
8,	.6920,	.7590,	.7550,	.8190,	.7510,	.7760,	.7160,	.8300,	.7900,	.6930,
9,	.7830,	.8740,	.8620,	.9690,	.8530,	.8580,	.8340,	.9350,	.9150,	.7850,
+gp,	.9519,	1.2112,	1.1247,	1.4036,	1.1158,	1.0384,	1.1472,	1.1891,	1.2233,	1.0245,

Table 11.3.1.- Plaice in VIId. Tuning input file.

```
VIID PLAICE,BEL,UK+FRANCE  80-97   [rev: 23/9/98-AT]
107
UK INSHORE TRAWL METIER <40 trawl lands, all trawl age compn fleet effort [rev: 23/7/98-SR]
1985 1997
1 1 0 1
2 15
2520 618.3 419.7 221.1 18.8 0.0 0.0 0.0 19.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1804 237.9 300.2 132.9 51.6 6.5 4.7 2.9 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
2556 456.0 430.2 153.2 48.0 25.1 5.0 6.3 4.3 0.0 0.0 0.0 0.0 0.5 0.0
2500 382.4 856.1 141.7 57.8 30.1 14.1 2.8 4.0 5.2 0.8 1.1 0.1 0.3 0.3
2131 47.4 221.7 465.4 97.1 41.3 19.0 5.5 1.2 6.2 0.0 0.3 0.1 0.0 2.4
1094 34.3 92.1 52.6 56.9 18.0 7.5 5.5 3.6 3.1 2.3 1.1 0.4 0.3 1.3
2349 240.2 229.7 166.6 76.6 64.9 10.7 4.3 2.1 1.3 0.3 0.7 0.9 0.1 1.4
2527 298.0 225.5 140.4 77.8 55.3 44.2 14.6 2.9 2.4 1.5 1.1 1.6 1.7 1.0
2503 309.3 181.4 66.6 40.5 30.1 21.5 25.1 8.5 3.8 3.0 2.5 1.2 1.1 2.4
2635 176.0 240.2 99.7 37.8 21.0 17.0 8.9 17.9 3.5 3.8 1.8 1.9 0.8 2.3
1531 124.1 70.7 54.6 23.5 8.5 5.0 5.5 3.9 6.8 1.5 1.0 0.9 1.0 0.6
1659 274.4 63.8 16.9 19.1 10.0 2.5 3.1 2.5 2.5 3.5 1.1 0.4 0.4 0.8
2024 317.1 223.8 20.4 7.7 10.2 8.0 4.9 2.8 4.0 3.8 4.1 1.2 0.3 3.2
BELGIAN BEAM TRAWL( HP corr), all gears age comp [rev: 14/9/98-WV]
1981 1997
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
32.8 424.6 1259.2 1426.5 268.0 132.6 109.5 75.5 90.0 37.6 33.4 20.6 7.5 0.0 12.5
31.7 39.8 591.9 925.2 396.5 82.0 140.1 82.6 26.1 0.7 0.0 0.0 4.2 0.0 9.5
32.6 259.3 689.3 541.5 503.7 137.6 46.4 49.9 38.4 44.4 22.7 10.6 0.0 0.2 4.5
39.7 0.0 287.3 931.8 570.2 295.7 143.7 37.3 27.7 11.2 8.7 3.2 8.1 9.1 1.1
FRENCH TRAWLERS (EFFORT H*KW*10-4), 1989-92 DERAISED, 1993-97 TRUE AGE COMPOSITION [rev: 9/9/98-AT]
1989 1997
1 1 0 1
1 15
6983 289.2 1190.1 1635.9 1643.2 466.2 73.5 34.3 34.1 19.3 16.1 7.0 9.9 5.5 1.2 5.4
8395 606.6 698.2 1876.1 1289.5 728.3 153.7 42.6 33.1 46.5 14.4 12.9 1.8 2.7 2.9 1.0
10505 597.6 1905.6 1201.8 1135.5 412.3 263.3 58.6 24.6 18.0 19.6 7.7 4.9 1.6 0.4 3.8
9766 726.5 1792.2 1075.5 291.8 239.7 221.4 144.6 30.1 18.2 13.1 6.0 2.8 1.2 1.1 1.4
10331 225.0 2243.6 1134.2 278.3 58.3 76.3 51.6 34.5 15.0 5.0 2.6 1.8 0.7 0.4 0.4
10685 410.6 1139.0 2455.4 536.6 190.7 76.1 50.9 50.1 32.7 25.7 6.5 4.2 2.7 0.4 2.9
10300 862.4 1399.2 717.8 583.7 91.6 18.4 17.6 25.0 20.1 25.2 7.5 8.3 4.6 4.7 3.9
12084 433.8 1195.4 1311.9 360.7 322.2 99.1 43.3 33.5 34.4 36.1 17.7 2.5 1.6 9.5 4.5
10915 180.1 1418.3 3571.0 1162.8 138.4 167.7 85.3 49.6 21.6 27.5 16.1 9.1 2.4 0.8 2.6
UK BEAM TRAWL SURVEY, true age 6 [rev: 23/7/98-SR]
1988 1997
1 1 .5 .75
1 6
1.0 26.5 31.3 43.8 7.0 4.6 1.5
1.0 2.3 12.1 16.6 19.9 3.3 1.5
1.0 5.2 4.9 5.8 6.7 7.5 1.8
1.0 11.8 9.1 7.0 5.3 5.4 3.2
1.0 16.5 12.5 4.2 4.2 5.6 4.9
1.0 3.2 13.4 5.0 1.7 1.9 1.6
1.0 8.3 7.5 9.2 5.6 1.9 0.8
1.0 11.3 4.1 3.0 3.7 1.5 0.6
1.0 13.2 11.9 1.3 0.7 1.3 0.9
1.0 33.1 13.5 4.2 0.6 0.3 0.3
French GFS [option 2], true age 5 [rev: 21/9/98-AT]
1988 1997
1 1 .75 1
2 5
1.0 17.6 9.9 1.7 0.6
1.0 7.4 2.7 1.1 0.1
1.0 0.9 2.3 1.4 1.3
1.0 0.6 0.4 0.2 0.2
1.0 3.2 0.5 0.2 0.1
1.0 5.4 2.0 0.4 0.2
1.0 2.4 0.9 0.3 0.2
1.0 3.7 1.5 0.9 0.2
1.0 3.3 0.4 0.2 0.2
1.0 7.4 4.6 0.3 0.1
English YFS [new indices] [rev: 23/7/98-SR]
1981 1997
1 1 .5 .75
1 1
1.0 0.4
1.0 0.5
1.0 1.1
1.0 0.7
1.0 1.7
1.0 2.1
1.0 2.4
1.0 1.6
1.0 1.5
1.0 0.8
1.0 0.6
1.0 1.5
1.0 0.9
1.0 0.8
1.0 3.3
1.0 1.4
1.0 0.4
French YFS [rev: 9/9/98-AT]
1987 1997
1 1 .5 .75
1 1
1.0 0.9
1.0 0.8
1.0 0.2
1.0 0.4
1.0 0.4
1.0 1.4
1.0 0.4
1.0 1.1
1.0 1.0
1.0 0.3
1.0 0.9
```

Table 11.3.2

Plaice in Division VIId. Catch per unit effort

Year	United Kingdom		Belgium	France
	Beam trawl (kg/hr)	Inshore trawl (kg/day)	Beam trawl (kg/hr)	Otter trawl (kg/(hr*kw*10-4))
1980			24.4	
1981			31.2	
1982			24.5	
1983	21.6		36.2	
1984	18.5		25.9	
1985	19.9	165.3	31.8	
1986	27.7	147.4	34.9	
1987	15.5	178.7	33.7	
1988	8.9	212.8	40.7	
1989	17.6	157.4	42.8	272.6
1990	17.4	117.4	48.8	239.0
1991	18.3	123.0	45.5	192.7
1992	14.2	129.7	34.9	166.3
1993	11.9	105.0	24.2	129.8
1994	11.1	98.2	32.4	146.7
1995	9.3	76.4	25.7	117.7
1996	10.0	86.8	26.2	119.7
1997	13.9	103.2	21.2	183.8

Plaice in Division VIId. Effort data

Year	United Kingdom		Belgium	France
	Beam trawl(1) ('000 hr)	Inshore trawl ('000 days)	Beam trawl(1) ('000 hr)	Otter trawl(1) hr*kw*10-4
1980			29.8	
1981			24.4	
1982			29.8	
1983	2.9		26.4	
1984	2.3		35.4	
1985	7.9	2.520	33.4	6997
1986	7.3	1.804	30.8	8480
1987	24.3	2.556	49.3	6609
1988	19.7	2.500	48.9	7006
1989	24.6	2.131	43.8	6983
1990	32.8	1.094	38.5	8395
1991	29.5	2.349	32.8	10505
1992	35.0	2.527	30.9	9766
1993	29.2	2.503	28.2	10331
1994	26.8	2.635	32.8	10685
1995	28.1	1.531	31.7	10300
1996	37.1	1.659	32.6	12084
1997	36.0	2.024	39.7	10915

1. Corrected for HP

Table 11.3.3.- 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	26.5	31.3	43.8	7.0	4.6	1.5	0.8	0.7	0.6	1.2	117.9	60.1
1989	2.3	12.1	16.6	19.9	3.3	1.5	1.3	0.5	0.3	1.7	59.6	45.2
1990	5.2	4.9	5.8	6.7	7.5	1.8	0.7	1.0	0.8	0.4	34.5	24.5
1991	11.8	9.1	7.0	5.3	5.4	3.2	1.2	1.0	0.1	1.2	45.2	24.4
1992	16.5	12.5	4.2	4.2	5.6	4.9	3.4	0.7	0.5	0.7	53.2	24.1
1993	3.2	13.4	5.0	1.7	1.9	1.6	2.0	2.8	0.4	0.6	32.6	15.9
1994	8.3	7.5	9.2	5.6	1.9	0.8	0.9	1.8	1.2	0.8	38.0	22.2
1995	11.3	4.1	3.0	3.7	1.5	0.6	0.6	1.3	0.8	0.8	27.6	12.3
1996	13.2	11.9	1.3	0.7	1.3	0.9	0.4	0.3	0.4	2.8	33.3	8.1
1997	33.1	13.5	4.2	0.6	0.3	0.3	0.2	0.2	0.2	1.9	54.6	8.0
1998	11.4	27.3	7.0	3.1	0.3	0.2	0.2	0.1	1.0	1.0	51.6	11.9

Table 11.3.4.- Plaice in division VIId. Survey indices of recruitment

	English YFS		English BTS			French YFS		French CGFS		
Year class	0 gp	1 gp	1 gp	2 gp	3 gp	0 gp	1 gp	0 gp	1 gp	2 gp
1980		0.36				1.12	0.04	-		
1981	3.4	0.45				5.31	0.25	-		
1982	2.5	1.14				1.49	0.04	-		
1983	14.5	0.73				2.42	-	-		
1984	6.3	1.71				-	-	-		
1985	10.9	2.08			43.75	-	-	-		
1986	20.1	2.38		31.33	16.63	-	0.94	-	-	26.46
1987	22.3	1.61	26.47	12.13	5.76	4.44	0.82	-	10.33	8.79
1988	13.0	1.47	2.31	4.86	6.98	1.11	0.22	0.19	4.08	1.27
1989	3.7	0.76	5.16	9.06	4.19	2.38	0.40	0.16	3.95	0.91
1990	6.5	0.64	11.75	12.54	4.96	1.04	0.39	0.16	1.95	6.05
1991	2.7	1.45	16.53	13.4	9.17	3.02	1.36	0.15	33.61	6.79
1992	4.3	0.85	3.22	7.46	3.00	2.19	0.45	0.98	11.68	3.45
1993	7.6	0.83	8.33	4.06	1.3	0.88	1.12	2.41	9.02	4.32
1994	17.2	3.27	11.32	11.9	4.2	3.95	0.95	7.39	5.07	4.59
1995	12.0	1.42	13.2	13.5	7.0	6.72	0.33	0.77	6.84	8.57
1996	2.5	0.42	33.1	27.3		2.95	0.91	21.13	37.56	
1997	2.4		11.4			1.36		9.83		
1998										

Table 11.4.1.- Plaice in Division VIId. Separable VPA.

```
Title : 107D PLAICE 1998 WG,1-15+,80-97,SEXES COMB [rev: 9/9/98-AT]
At 10/09/1998  12:07
Separable analysis
from 1980 to 1997 on ages  1 to 14
with Terminal F of  .500 on age  3 and Terminal S of  .700
Initial sum of squared residuals was    515.959 and
final sum of squared residuals is     287.199 after  79 iterations

Matrix of Residuals
  Years,    1980/81,1981/82,1982/83,1983/84,1984/85,1985/86,1986/87,
  Ages
  1/ 2,    -2.030, -3.092, -1.252, -1.304, -1.931, -2.499,  -.899,
  2/ 3,     -.471, -1.048, -1.034,  -.580, -1.789,  -.535,  -.153,
  3/ 4,     -.486,   .225,  -.541,  -.053,  -.722,  -.292,   .515,
  4/ 5,      .472,   .490,   .404,   .824,   .634,   .218,   .716,
  5/ 6,      .967,  -.300,   .367,   .265,  -.124, -1.296,   .869,
  6/ 7,      .515,   .170,   .269,  -.027,   .272,   .197,   .182,
  7/ 8,      .288,  -.437,  -.682,   .015,   .061,   .278,   .534,
  8/ 9,     -.112,   .361,  2.206,  1.299, -1.220,   .970,  -.476,
  9/10,    -2.338,   .690,   .288, -1.602,  -.139,  1.341,  -.551,
 10/11,     1.447,   .674,  -.104,  -.392,  1.607,  4.593,  1.962,
 11/12,    -1.473,  -.168,  -.013,  -.014,  4.198,  2.276, -5.655,
 12/13,     .460,  1.640,   .278,   .435,  4.185,  -.683, -3.054,
 13/14,    -.262,   .211,  -.390, -1.065,  -.826, -4.912, -3.208,
  TOT ,     .015,   .011,   .010,   .008,   .007,   .005,   .003,
  WTS ,     .001,   .001,   .001,   .001,   .001,   .001,   .001,

  Years,    1987/88,1988/89,1989/90,1990/91,1991/92,1992/93,1993/94,1994/95,1995/96,1996/97,       TOT,        WTS,
  Ages
  1/ 2,    -3.887, -3.979,   .189,  -.206,  -.325,  -.606,  -.059,  -.218,   .659,   .236,      -.010,      .172,
  2/ 3,     -.780,  -.356, -1.025, -1.177,  -.138,  -.022,   .241,  -.147,   .116,  -.192,      -.013,      .458,
  3/ 4,     -.049,   .195,  -.487,  -.343,   .200,   .240,  -.121,   .004,   .091,  -.223,      -.012,      .735,
  4/ 5,      .502,  -.030,   .158,  -.240,   .242,  -.030,  -.090,   .186,  -.006,  -.072,      -.007,      .788,
  5/ 6,      .235,   .050,   .469,  -.297,  -.191,  -.231,  -.212,   .302,  -.083,   .224,       .000,      .480,
  6/ 7,     -.318,   .359,   .488,   .325,   .181,   .302,   .239,  -.286,  -.178,  -.073,       .008,     1.000,
  7/ 8,     1.043,   .720,   .050,   .100,  -.242,   .148,   .150,  -.277,   .127,  -.137,       .013,      .597,
  8/ 9,      .090,   .185,  -.381,  -.109,  -.656,  -.160,  -.120,   .087,  -.109,   .313,       .013,      .316,
 9/10,      -.158,   .298,  -.298,   .656,   .364,   .148,  -.308,   .270,  -.557,   .457,       .009,      .285,
10/11,      -.269,  1.047,  -.382,   .710,   .042,  -.910,  -.464,   .774,  -.128,   .718,       .002,      .190,
11/12,     -1.428,  -.450,  -.314,   .658,  -.273,  -.466,   .038,   .246,  -.219,   .399,      -.005,      .128,
12/13,      2.970, -1.275,   .911,   .225,  -.087,  -.135,  -.449,  -.239,   .928,  -.121,      -.010,      .155,
13/14,      .246, -1.119,   .654,  2.335,  -.141,  -.370,   .710,   .092,   .092,  -.529,      -.013,      .156,
  TOT ,     .000,  -.001,  -.002,  -.002,  -.002,  -.001,  -.001,  -.001,  -.001,   .000,    -15.886,
  WTS ,     .001,   .001,   .001,   .001,   .001,  1.000,  1.000,  1.000,  1.000,  1.000,

Fishing Mortalities (F)
          ,    1980,   1981,   1982,   1983,   1984,   1985,   1986,   1987,
  F-values,   .2731,  .4445,  .4833,  .4283,  .6931,  .4555,  .3387,  .4691,

          ,    1988,   1989,   1990,   1991,   1992,   1993,   1994,   1995,   1996,   1997,
  F-values,   .5412,  .6771,  .8036,  .7116,  .6006,  .4062,  .5219,  .3945,  .3781,  .5000,

  Selection-at-age (S)
          ,      1,      2,      3,      4,      5,      6,      7,      8,      9,     10,     11,     12,     13,
14,
  S-values,   .1395,  .6762, 1.0000,  .9772,  .7737,  .5647,  .5290,  .5410,  .5024,  .5572,  .5368,  .4770,  .4301,
.7000,

Run title : 107D PLAICE 1998 WG,1-15+,80-97,SEXES COMB [rev: 9/9/98-AT]

 At 10/09/1998  12:07

              Traditional vpa  Terminal populations from weighted Separable populations

  Fishing mortality residuals
  YEAR,     1980,    1981,    1982,    1983,    1984,    1985,    1986,    1987,
  AGE
    1,    -.0359,  -.0607,  -.0563,  -.0550,  -.0821,  -.0586,  -.0354,  -.0646,
    2,    -.0190,  -.1833,  -.1944,  -.1382,  -.3554,   .0002,  -.0195,  -.1379,
    3,    -.0097,   .2679,   .0062,   .0155,  -.1230,   .1196,   .3340,   .0337,
    4,     .0788,   .3602,   .3429,   .4847,   .1027,   .3900,   .3773,   .2821,
    5,     .3464,  -.0626,   .1828,   .1687,   .1877,  -.1386,   .3029,   .1338,
    6,     .1541,   .0614,   .0215,   .0388,   .1369,   .2277,   .2518,   .0202,
    7,     .1329,   .0816,   .0250,  -.0413,   .1008,   .0298,   .1585,   .4128,
    8,     .0570,   .1592,   .4298,   .3732,  -.0917,   .0773,  -.0269,   .0599,
    9,    -.1133,   .1612,   .0742,  -.1411,  -.0517,   .4573,  -.0854,   .0987,
   10,     .2101,   .2201,  -.0179,   .0047,   .3214,  -.0139,   .0015,  -.0505,
   11,    -.0654,  -.0959,   .0250,   .0066,   .2613,  -.1444,  -.1818,  -.2197,
   12,     .0690,   .3765,  -.0813,   .0287,   .0184,  -.2173,  -.1615,   .3774,
   13,    -.0173,   .0002,  -.0754,  -.1018,  -.0832,  -.1959,  -.1457,  -.0641,
   14,    -.0001,   .0362,  -.0732,  -.0326,   .1544,   .2419,   .2445,   .0022,

Fishing mortality residuals
  YEAR,     1988,    1989,    1990,    1991,    1992,    1993,    1994,    1995,    1996,    1997,
  AGE
    1,    -.0749,  -.0425,  -.0209,  -.0294,  -.0275,  -.0070,  -.0135,   .0339,   .0098,   .0000,
    2,    -.1672,  -.2897,  -.3361,  -.0066,  -.0203,   .0703,  -.0301,   .0020,  -.0426,  -.0235,
    3,     .1098,  -.2468,  -.1408,   .0339,   .1102,  -.0194,   .0168,   .0206,  -.0455,  -.0083,
    4,     .1073,   .0500,  -.1098,   .0748,  -.0951,  -.0044,   .0431,   .0178,  -.0127,   .0469,
    5,     .0775,   .2424,  -.0464,   .0200,  -.0531,  -.0645,   .0403,  -.0275,   .0214,   .0146,
    6,     .0601,   .0853,   .0283,   .1110,   .1141,   .0218,  -.0171,  -.0412,  -.0060,  -.0421,
    7,     .1785,  -.0572,  -.1067,  -.0956,   .0502,   .0122,  -.0398,   .0576,  -.0103,   .0128,
    8,     .0612,  -.0558,  -.1152,  -.1559,  -.0365,   .0063,  -.0272,   .0254,   .0366,   .0258,
    9,     .0533,   .0156,   .1063,  -.0939,   .0196,   .0048,   .0504,  -.0393,   .0567,  -.0339,
   10,     .3046,  -.0389,   .2690,  -.1381,  -.1853,  -.0182,   .1428,  -.0158,   .0907,  -.0477,
   11,     .0097,  -.0702,   .1673,  -.0389,  -.1479,   .0012,   .1561,  -.0589,   .0103,  -.0791,
   12,    -.1436,   .2723,   .0300,  -.0818,   .0529,  -.0424,  -.0086,   .0693,  -.0251,  -.0753,
   13,    -.1969,   .1728,  -.0559,  -.0437,  -.0593,   .0782,   .0507,   .0416,  -.0746,  -.0098,
   14,    -.2009,  -.2983,  -.0659,  -.4666,  -.0183,   .0270,  -.1077,   .0482,   .0497,  -.0476,
```

Table 11.4.2.- Plaice in Division VIId. Tuning diagnostics.

```
Lowestoft VPA Version 3.1

    8-Oct-98  15:00:49

 Extended Survivors Analysis

 Plaice in VIId (run: XSAATT03/X03)

 CPUE data from file /users/fish/ifad/ifapwork/wgnssk/ple_eche/FLEET.X03

 Catch data for  18 years. 1980 to 1997. Ages  1 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                ,        year, year,  age ,  age
 FLT01: UK INSHORE TR,   1985, 1997,   2,     9,   .000,  1.000
 FLT02: BELGIAN BEAM ,   1981, 1997,   4,     9,   .000,  1.000
 FLT03: FRENCH TRAWLE,   1989, 1997,   1,     9,   .000,  1.000
 FLT04: UK BEAM TRAWL,   1988, 1997,   1,     6,   .500,   .750
 FLT05: French GFS (o,   1988, 1997,   2,     5,   .750,  1.000
 FLT06: English YFS [,   1981, 1997,   1,     1,   .500,   .750
 FLT07: French YFS (r,   1987, 1997,   1,     1,   .500,   .750

Time series weights :

      Tapered time weighting applied
      Power =    3 over  15 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   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   30 iterations

Total absolute residual between iterations
 29 and  30 =     .00115

 Final year F values
 Age          ,     1,      2,      3,      4,      5,      6,      7,      8,      9
 Iteration 29,  .0394,  .2710,  .5252,  .9090,  .7564,  .5001,  .4708,  .5168,  .4760
 Iteration 30,  .0394,  .2710,  .5251,  .9089,  .7562,  .5000,  .4706,  .5165,  .4757

 Regression weights
       ,  .482,  .610,  .725,  .820,  .893,  .944,  .976,  .993,  .999, 1.000

 Fishing mortalities
    Age,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997

      1,  .001,  .054,  .094,  .074,  .062,  .057,  .071,  .092,  .055,  .039
      2,  .204,  .172,  .217,  .496,  .415,  .388,  .379,  .332,  .223,  .271
      3,  .652,  .446,  .689,  .807,  .773,  .432,  .653,  .530,  .449,  .525
      4,  .645,  .714,  .722,  .836,  .570,  .453,  .667,  .558,  .523,  .909
      5,  .527,  .790,  .578,  .648,  .477,  .311,  .558,  .372,  .519,  .756
      6,  .401,  .517,  .508,  .516,  .565,  .309,  .373,  .251,  .305,  .500
      7,  .446,  .343,  .370,  .303,  .371,  .313,  .311,  .401,  .284,  .471
      8,  .423,  .292,  .384,  .280,  .319,  .229,  .392,  .343,  .425,  .517
      9,  .447,  .463,  .467,  .340,  .423,  .238,  .318,  .278,  .403,  .476
```

Table 11.4.2.cont. Plaice in Division VIId. Tuning diagnostics.

XSA population numbers (Thousands)

	AGE								
YEAR ,	1,	2,	3,	4,	5,	6,	7,	8,	9,
1988 ,	2.68E+04,	2.86E+04,	4.13E+04,	1.08E+04,	2.87E+03,	1.72E+03,	1.28E+03,	3.87E+02,	3.06E+02,
1989 ,	1.65E+04,	2.42E+04,	2.11E+04,	1.95E+04,	5.15E+03,	1.53E+03,	1.04E+03,	7.42E+02,	2.30E+02,
1990 ,	1.91E+04,	1.42E+04,	1.85E+04,	1.22E+04,	8.63E+03,	2.11E+03,	8.27E+02,	6.69E+02,	5.01E+02,
1991 ,	2.28E+04,	1.58E+04,	1.03E+04,	8.39E+03,	5.37E+03,	4.38E+03,	1.15E+03,	5.17E+02,	4.12E+02,
1992 ,	2.93E+04,	1.92E+04,	8.69E+03,	4.17E+03,	3.29E+03,	2.54E+03,	2.37E+03,	7.69E+02,	3.54E+02,
1993 ,	1.42E+04,	2.49E+04,	1.14E+04,	3.63E+03,	2.13E+03,	1.85E+03,	1.31E+03,	1.48E+03,	5.06E+02,
1994 ,	1.91E+04,	1.21E+04,	1.53E+04,	6.72E+03,	2.09E+03,	1.42E+03,	1.23E+03,	8.65E+02,	1.06E+03,
1995 ,	3.10E+04,	1.61E+04,	7.49E+03,	7.20E+03,	3.12E+03,	1.08E+03,	8.82E+02,	8.14E+02,	5.29E+02,
1996 ,	2.20E+04,	2.55E+04,	1.05E+04,	3.99E+03,	3.73E+03,	1.95E+03,	7.61E+02,	5.35E+02,	5.23E+02,
1997 ,	1.50E+04,	1.88E+04,	1.85E+04,	6.05E+03,	2.14E+03,	2.01E+03,	1.30E+03,	5.19E+02,	3.17E+02,

Estimated population abundance at 1st Jan 1998

,	.00E+00,	1.30E+04,	1.30E+04,	9.90E+03,	2.20E+03,	9.09E+02,	1.10E+03,	7.35E+02,	2.80E+02,

Taper weighted geometric mean of the VPA populations:

,	2.18E+04,	1.98E+04,	1.36E+04,	6.71E+03,	3.31E+03,	1.89E+03,	1.12E+03,	6.71E+02,	4.21E+02,

Standard error of the weighted Log(VPA populations) :

,	.3338,	.3482,	.4471,	.4902,	.4433,	.3703,	.3432,	.4061,	.5374,

Log catchability residuals.

Fleet : FLT01: UK INSHORE TR

Age ,	1981,	1982,	1983,	1984,	1985,	1986,	1987
1 ,	No data for this fleet at this age						
2 ,	99.99,	99.99,	99.99,	99.99,	.82,	-.03,	-.44
3 ,	99.99,	99.99,	99.99,	99.99,	.57,	.60,	.24
4 ,	99.99,	99.99,	99.99,	99.99,	.64,	.63,	.53
5 ,	99.99,	99.99,	99.99,	99.99,	-.60,	.39,	.07
6 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.84,	-.10
7 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.33,	-.55
8 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.11,	.11
9 ,	99.99,	99.99,	99.99,	99.99,	1.68,	99.99,	.39

Age ,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
1 ,	No data for this fleet at this age									
2 ,	.06,	-1.72,	-.82,	.39,	.30,	.07,	.17,	.06,	.26,	.54
3 ,	.29,	-.33,	-.30,	.49,	.55,	-.08,	-.04,	-.06,	-.62,	-.10
4 ,	-.05,	.75,	-.30,	.52,	.86,	.21,	.04,	-.14,	-.82,	-1.08
5 ,	.39,	.60,	.13,	.16,	.52,	.23,	.25,	-.17,	-.57,	-1.02
6 ,	.24,	.89,	.40,	.19,	.53,	.13,	.01,	-.14,	-.62,	-.74
7 ,	.02,	.64,	.62,	-.15,	.50,	.36,	.13,	-.18,	-.86,	-.34
8 ,	-.41,	-.29,	.52,	-.28,	.49,	.35,	-.13,	-.03,	-.22,	.11
9 ,	.19,	-.56,	.43,	-.74,	-.30,	.34,	.33,	.03,	-.42,	.02

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-12.0512,	-11.6340,	-11.7653,	-11.8258,	-11.8738,	-12.0913,	-12.0913,	-12.0913,
S.E(Log q),	.6105,	.3801,	.6465,	.5142,	.5023,	.4887,	.3188,	.4571,

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,	1.38,	-.426,	12.87,	.15,	13,	.89,	-12.05,
3,	1.07,	-.198,	11.78,	.55,	13,	.43,	-11.63,
4,	.79,	.554,	11.14,	.49,	13,	.53,	-11.77,
5,	.76,	.743,	10.94,	.58,	13,	.40,	-11.83,
6,	.84,	.390,	11.16,	.44,	12,	.44,	-11.87,
7,	.58,	1.450,	9.99,	.63,	12,	.27,	-12.09,
8,	.71,	1.435,	10.47,	.78,	12,	.21,	-12.06,
9,	.75,	.845,	10.62,	.63,	12,	.35,	-12.11,

Table 11.4.2.cont. Plaice in Division VIId. Tuning diagnostics.

Fleet : FLT02: BELGIAN BEAM

Age	1981	1982	1983	1984	1985	1986	1987
1	No data for this fleet at this age						
2	No data for this fleet at this age						
3	No data for this fleet at this age						
4	99.99	99.99	.42	.06	.05	-.22	-.30
5	99.99	99.99	-.31	.06	-1.20	-.42	-.55
6	99.99	99.99	-.01	.25	.40	.13	-1.05
7	99.99	99.99	-.66	.65	.10	-.01	.53
8	99.99	99.99	1.02	-.45	.99	-.98	-.37
9	99.99	99.99	.65	-.20	-1.57	.06	-.08

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	-.43	-.06	.12	.18	-.22	-.43	.55	.03	.04	.14
5	-.79	.26	-.19	.56	-.34	-.23	.06	.00	.10	.69
6	-.73	.21	-.13	.64	.36	-.19	.04	-.19	-.27	.36
7	-.26	.00	-.57	-.09	-.11	-.21	.08	.74	-.30	.18
8	-.23	-.30	-.21	-.18	-.02	-.54	.10	.26	.19	-.23
9	-.33	-.08	-1.23	.57	.85	-1.25	.03	-.49	-.06	-.05

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

Age	4	5	6	7	8	9
Mean Log q	-5.2293	-5.2922	-5.6709	-5.7918	-5.7918	-5.7918
S.E(Log q)	.2939	.4383	.4172	.3691	.3444	.7061

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
4	.89	.592	5.64	.79	15	.27	-5.23
5	.97	.093	5.39	.52	15	.45	-5.29
6	.64	1.534	6.34	.72	15	.25	-5.67
7	1.10	-.236	5.66	.42	15	.43	-5.79
8	1.20	-.567	5.79	.54	15	.40	-5.91
9	1.26	-.448	5.98	.29	15	.89	-5.99

Fleet : FLT03: FRENCH TRAWLE

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	99.99	.20	.38	.06	-.04	-.01	.01	-.02	-.17	-.23
2	99.99	-.14	-.30	.50	.28	.18	.18	.12	-.71	-.11
3	99.99	-.13	.06	.02	.14	-.28	.26	-.27	-.20	.37
4	99.99	.26	.30	.37	-.33	-.35	-.24	-.24	-.31	.72
5	99.99	.85	.51	.22	.16	-.95	.34	-.85	.14	.06
6	99.99	.34	.57	.16	.62	-.29	-.03	-1.20	-.24	.44
7	99.99	.07	.34	.08	.36	-.16	-.14	-.80	.04	.37
8	99.99	.38	.31	.00	-.11	-.72	.23	-.39	.20	.77
9	99.99	1.06	.97	-.06	.21	-.48	-.44	-.21	.24	.41

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-11.5923	-11.0155	-11.2022	-11.6949	-11.9382	-12.1179	-12.1179	-12.1179
S.E(Log q)	.3695	.2473	.4071	.5864	.5941	.3830	.4620	.5477

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.56	1.742	11.66	.73	9	.19	-13.01

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	2.45	-1.159	14.17	.10	9	.88	-11.59
3	.74	1.443	10.61	.84	9	.17	-11.02
4	.70	1.537	10.48	.82	9	.26	-11.20
5	.62	1.375	10.35	.69	9	.34	-11.69

Table 11.4.2.cont. Plaice in Division VIId. Tuning diagnostics.

```
 6,      .53,    1.832,      9.86,      .71,      9,      .27,  -11.94,
 7,      .70,    1.038,     10.58,      .66,      9,      .27,  -12.12,
 8,  ******,   -2.796,    ******,      .00,      9,  ******,  -12.06,
 9,     5.21,   -2.055,     36.56,      .04,      9,     2.28,  -11.99,

Fleet : FLT04: UK BEAM TRAWL

 Age  ,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997
    1 ,   .62, -1.15,  -.51,   .06,   .12,  -.69,  -.09,  -.27,   .20,  1.43
    2 ,   .67,  -.14,  -.48,   .21,   .28,   .07,   .21,  -.71,  -.17,   .29
    3 ,  1.01,   .58,  -.19,   .65,   .30,  -.02,   .44,  -.04, -1.26,  -.61
    4 ,   .34,   .84,   .22,   .44,   .74,  -.10,   .61,   .06, -1.04, -1.37
    5 ,   .89,   .14,   .31,   .50,   .92,   .17,   .34,  -.41,  -.64, -1.40
    6 ,   .31,   .49,   .35,   .20,  1.20,   .24,  -.15,  -.24,  -.39, -1.40
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age

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

   Age ,        2,         3,         4,         5,         6
Mean Log q,  -7.2963,   -7.3874,   -7.2204,   -6.9345,   -7.0381,
S.E(Log q),    .3954,     .6673,     .7770,     .7433,     .7183,

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,      .93,     .067,      7.69,      .13,      10,      .77,   -7.53,

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

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 2,      .78,     .533,      7.87,      .47,      10,      .32,   -7.30,
 3,      .72,     .700,      7.97,      .50,      10,      .50,   -7.39,
 4,      .61,    1.167,      7.84,      .58,      10,      .46,   -7.22,
 5,      .69,     .746,      7.30,      .47,      10,      .53,   -6.93,
 6,      .70,     .610,      7.20,      .38,      10,      .52,   -7.04,

Fleet : FLT05: French GFS [o

 Age  ,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997
    1 , No data for this fleet at this age
    2 ,  1.15,   .43, -1.11, -1.37,   .04,   .27,   .18,   .28,  -.39,   .77
    3 ,   .92,   .11,   .29,  -.77,  -.41,   .41,  -.49,   .63, -1.10,   .84
    4 ,   .88,  -.08,   .64,  -.83,  -.37,   .36,  -.35,   .58,  -.36,  -.04
    5 ,  1.22,  -.93,   .93,  -.41,  -.76,   .22,   .46,  -.10,  -.15,  -.08
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age

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

   Age ,        2,         3,         4,         5
Mean Log q,  -8.2821,   -8.5951,   -8.9934,   -9.1395,
S.E(Log q),    .7427,     .7150,     .5286,     .6150,

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,      .51,     .980,      9.04,      .39,      10,      .38,   -8.28,
 3,      .62,    1.098,      8.94,      .56,      10,      .44,   -8.60,
 4,      .81,     .589,      8.96,      .60,      10,      .45,   -8.99,
 5,     1.08,    -.145,      9.22,      .32,      10,      .71,   -9.14,
```

Table 11.4.2.cont. Plaice in Division VIId. Tuning diagnostics.

```
Fleet : FLT06: English YFS [

 Age  ,  1981,  1982,  1983,  1984,  1985,  1986,  1987
    1 , 99.99, 99.99,   .03,  -.52,  -.04,  -.58,   .17
    2 , No data for this fleet at this age
    3 , No data for this fleet at this age
    4 , No data for this fleet at this age
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age

 Age  ,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997
    1 ,   .03,   .49,  -.11,  -.51,  -.08,   .26,  -.12,   .47,   .15,  -.41
    2 , No data for this fleet at this age
    3 , No data for this fleet at this age
    4 , No data for this fleet at this age
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age

Regression statistics :

Ages with q dependent on year class strength

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

 1,     .75,     .659,      9.83,     .49,     15,     .37,   -9.77,

Fleet : FLT07: French YFS [r

 Age  ,  1981,  1982,  1983,  1984,  1985,  1986,  1987
    1 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.04
    2 , No data for this fleet at this age
    3 , No data for this fleet at this age
    4 , No data for this fleet at this age
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age

 Age  ,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997
    1 ,   .00,  -.92,  -.32,  -.51,   .53,  -.04,   .71,   .15,  -.78,   .73
    2 , No data for this fleet at this age
    3 , No data for this fleet at this age
    4 , No data for this fleet at this age
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age

Regression statistics :

Ages with q dependent on year class strength

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

 1,    1.04,    -.049,     10.36,     .19,     11,     .63,  -10.35,
```

Table 11.4.2.cont. Plaice in Division VIId. Tuning diagnostics.

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT02: BELGIAN BEAM ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: FRENCH TRAWLE,	10397.,	.300,	.000,	.00,	1,	.342,	.049
FLT04: UK BEAM TRAWL,	54305.,	.907,	.000,	.00,	1,	.037,	.010
FLT05: French GFS [o,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: English YFS [,	8675.,	.437,	.000,	.00,	1,	.161,	.059
FLT07: French YFS [r,	27041.,	.682,	.000,	.00,	1,	.066,	.019
P shrinkage mean ,	19828.,	.35,,,,				.264,	.026
F shrinkage mean ,	7517.,	.50,,,,				.128,	.067

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
13022.,	.18,	.22,	6,	1.253,	.039

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	22167.,	.643,	.000,	.00,	1,	.058,	.167
FLT02: BELGIAN BEAM ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: FRENCH TRAWLE,	11227.,	.238,	.027,	.11,	2,	.409,	.307
FLT04: UK BEAM TRAWL,	17004.,	.372,	.037,	.10,	2,	.171,	.213
FLT05: French GFS [o,	27913.,	.785,	.000,	.00,	1,	.039,	.135
FLT06: English YFS [,	15149.,	.387,	.000,	.00,	1,	.152,	.236
FLT07: French YFS [r,	5932.,	.716,	.000,	.00,	1,	.044,	.519
F shrinkage mean ,	9692.,	.50,,,,				.126,	.348

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
12978.,	.16,	.11,	9,	.732,	.271

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

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	9777.,	.341,	.152,	.45,	2,	.148,	.530
FLT02: BELGIAN BEAM ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: FRENCH TRAWLE,	9989.,	.189,	.292,	1.55,	3,	.441,	.522
FLT04: UK BEAM TRAWL,	7315.,	.331,	.133,	.40,	3,	.139,	.660
FLT05: French GFS [o,	13598.,	.548,	.609,	1.11,	2,	.055,	.407
FLT06: English YFS [,	15841.,	.444,	.000,	.00,	1,	.067,	.359
FLT07: French YFS [r,	11479.,	.696,	.000,	.00,	1,	.027,	.467
F shrinkage mean ,	8911.,	.50,,,,				.122,	.570

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
9902.,	.13,	.11,	13,	.814,	.525

Table 11.4.2.cont. Plaice in Division VIId. Tuning diagnostics.

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

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	1148.,	.315,	.256,	.81,	3,	.116,	1.347
FLT02: BELGIAN BEAM ,	2537.,	.309,	.000,	.00,	1,	.168,	.828
FLT03: FRENCH TRAWLE,	2541.,	.181,	.211,	1.16,	4,	.322,	.827
FLT04: UK BEAM TRAWL,	872.,	.324,	.235,	.73,	4,	.096,	1.557
FLT05: French GFS [o,	1760.,	.408,	.337,	.83,	3,	.081,	1.050
FLT06: English YFS [,	1957.,	.395,	.000,	.00,	1,	.044,	.982
FLT07: French YFS [r,	4500.,	.710,	.000,	.00,	1,	.014,	.546
F shrinkage mean ,	4389.,	.50,,,,				.159,	.556

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2205.,	.13,	.14,	18,	1.107,	.909

Age 5 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
FLT01: UK INSHORE TR,	492.,	.303,	.269,	.89,	4,	.142,	1.128
FLT02: BELGIAN BEAM ,	1252.,	.266,	.318,	1.20,	2,	.208,	.599
FLT03: FRENCH TRAWLE,	807.,	.192,	.091,	.47,	5,	.258,	.821
FLT04: UK BEAM TRAWL,	474.,	.347,	.346,	1.00,	5,	.092,	1.153
FLT05: French GFS [o,	836.,	.371,	.175,	.47,	4,	.100,	.802
FLT06: English YFS [,	1184.,	.398,	.000,	.00,	1,	.027,	.625
FLT07: French YFS [r,	870.,	.706,	.000,	.00,	1,	.009,	.780
F shrinkage mean ,	1814.,	.50,,,,				.163,	.449

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
909.,	.13,	.12,	23,	.951,	.756

Age 6 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
FLT01: UK INSHORE TR,	663.,	.298,	.142,	.48,	5,	.176,	.732
FLT02: BELGIAN BEAM ,	1341.,	.247,	.106,	.43,	3,	.264,	.428
FLT03: FRENCH TRAWLE,	1286.,	.222,	.107,	.48,	6,	.221,	.442
FLT04: UK BEAM TRAWL,	580.,	.374,	.308,	.82,	6,	.100,	.804
FLT05: French GFS [o,	1226.,	.380,	.225,	.59,	4,	.068,	.460
FLT06: English YFS [,	1021.,	.411,	.000,	.00,	1,	.015,	.531
FLT07: French YFS [r,	1881.,	.774,	.000,	.00,	1,	.004,	.322
F shrinkage mean ,	1642.,	.50,,,,				.151,	.362

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1103.,	.13,	.09,	27,	.706,	.500

Table 11.4.2.cont. Plaice in Division VIId. Tuning diagnostics.

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	533.,	.266,	.100,	.37,	6,	.189,	.604
FLT02: BELGIAN BEAM ,	816.,	.218,	.155,	.71,	4,	.295,	.432
FLT03: FRENCH TRAWLE,	738.,	.214,	.160,	.75,	7,	.266,	.469
FLT04: UK BEAM TRAWL,	647.,	.361,	.163,	.45,	6,	.067,	.520
FLT05: French GFS [o,	651.,	.384,	.131,	.34,	4,	.047,	.517
FLT06: English YFS [,	442.,	.446,	.000,	.00,	1,	.010,	.692
FLT07: French YFS [r,	441.,	.757,	.000,	.00,	1,	.003,	.693
F shrinkage mean ,	1102.,	.50,,,,				.122,	.337

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
735.,	.12,	.07,	30,	.564,	.471

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	263.,	.223,	.159,	.71,	7,	.266,	.543
FLT02: BELGIAN BEAM ,	220.,	.195,	.056,	.29,	5,	.320,	.621
FLT03: FRENCH TRAWLE,	323.,	.218,	.220,	1.01,	8,	.230,	.462
FLT04: UK BEAM TRAWL,	279.,	.397,	.119,	.30,	6,	.039,	.518
FLT05: French GFS [o,	361.,	.391,	.254,	.65,	4,	.027,	.422
FLT06: English YFS [,	251.,	.458,	.000,	.00,	1,	.004,	.562
FLT07: French YFS [r,	203.,	.804,	.000,	.00,	1,	.001,	.659
F shrinkage mean ,	463.,	.50,,,,				.112,	.342

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
280.,	.12,	.08,	33,	.664,	.517

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: UK INSHORE TR,	166.,	.217,	.078,	.36,	8,	.296,	.503
FLT02: BELGIAN BEAM ,	215.,	.200,	.143,	.71,	6,	.280,	.408
FLT03: FRENCH TRAWLE,	162.,	.225,	.175,	.78,	9,	.235,	.513
FLT04: UK BEAM TRAWL,	184.,	.389,	.186,	.48,	6,	.028,	.464
FLT05: French GFS [o,	154.,	.408,	.236,	.58,	4,	.021,	.533
FLT06: English YFS [,	290.,	.497,	.000,	.00,	1,	.004,	.317
FLT07: French YFS [r,	71.,	.998,	.000,	.00,	1,	.001,	.928
F shrinkage mean ,	168.,	.50,,,,				.135,	.497

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
178.,	.12,	.06,	36,	.488,	.476

Table 11.4.3.- Plaice in Division VIId. F at age.

Run title : Plaice in VIId (run: XSAATT03/X03)

At 8-Oct-98 14:51:23

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age							
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE								
1,	.0022,	.0013,	.0110,	.0048,	.0147,	.0050,	.0118,	.0008,
2,	.1674,	.1177,	.1333,	.1504,	.1142,	.3104,	.2101,	.1788,
3,	.2783,	.7288,	.4942,	.4493,	.5672,	.5850,	.6837,	.5062,
4,	.3299,	.8821,	.8582,	.9267,	.8017,	.8289,	.7329,	.7662,
5,	.6158,	.2639,	.6877,	.5506,	.7657,	.2224,	.5551,	.5276,
6,	.4139,	.3642,	.2706,	.3919,	.6248,	.5366,	.4693,	.2769,
7,	.3979,	.4866,	.3470,	.1665,	.8068,	.3497,	.3941,	.7350,
8,	.2531,	.7015,	1.8459,	.8736,	.2482,	.8561,	.2165,	.3911,
9,	.3560,	.5193,	.8252,	.4785,	.5618,	.5595,	.3385,	.5218,
+gp,	.3560,	.5193,	.8252,	.4785,	.5618,	.5595,	.3385,	.5218,
0 FBAR 2- 6,	.3611,	.4713,	.4888,	.4938,	.5747,	.4967,	.5302,	.4511,
FBAR 3- 6,	.4095,	.5598,	.5777,	.5796,	.6898,	.5432,	.6102,	.5192,

Table 8	Fishing mortality (F) at age										
YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	FBAR 95-97
AGE											
1,	.0006,	.0539,	.0939,	.0738,	.0617,	.0565,	.0707,	.0922,	.0551,	.0394,	.0622,
2,	.2036,	.1717,	.2165,	.4955,	.4153,	.3876,	.3792,	.3323,	.2225,	.2710,	.2753,
3,	.6518,	.4461,	.6887,	.8071,	.7727,	.4319,	.6526,	.5300,	.4493,	.5251,	.5015,
4,	.6450,	.7139,	.7224,	.8361,	.5703,	.4533,	.6665,	.5577,	.5233,	.9089,	.6633,
5,	.5273,	.7896,	.5779,	.6480,	.4766,	.3106,	.5584,	.3715,	.5187,	.7562,	.5488,
6,	.4013,	.5168,	.5081,	.5165,	.5650,	.3093,	.3727,	.2507,	.3054,	.5000,	.3520,
7,	.4463,	.3432,	.3696,	.3029,	.3714,	.3127,	.3107,	.4005,	.2839,	.4706,	.3850,
8,	.4226,	.2923,	.3841,	.2798,	.3193,	.2287,	.3921,	.3431,	.4245,	.5165,	.4280,
9,	.4472,	.4632,	.4671,	.3398,	.4230,	.2383,	.3175,	.2776,	.4030,	.4757,	.3855,
+gp,	.4472,	.4632,	.4671,	.3398,	.4230,	.2383,	.3175,	.2776,	.4030,	.4757,	
0 FBAR 2- 6,	.4858,	.5276,	.5427,	.6606,	.5600,	.3785,	.5259,	.4084,	.4039,	.5922,	
FBAR 3- 6,	.5563,	.6166,	.6243,	.7019,	.5962,	.3763,	.5626,	.4275,	.4492,	.6726,	

Table 11.4.4.- Plaice in Division VIId. N at age.

Run title : Plaice in VIId (run: XSAATT03/X03)

At 8-Oct-98 14:51:23

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)						Numbers*10**-3	
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE								
1,	25646,	12985,	25482,	20231,	25244,	30093,	61033,	31632,
2,	18034,	23155,	11734,	22805,	18218,	22509,	27094,	54579,
3,	6279,	13803,	18625,	9292,	17753,	14705,	14932,	19870,
4,	2020,	4301,	6026,	10281,	5365,	9110,	7413,	6820,
5,	1120,	1314,	1611,	2312,	3682,	2178,	3598,	3223,
6,	233,	548,	913,	733,	1206,	1549,	1577,	1869,
7,	144,	139,	344,	631,	448,	584,	820,	893,
8,	207,	88,	77,	220,	483,	181,	373,	500,
9,	14,	145,	39,	11,	83,	341,	70,	272,
+gp,	360,	517,	163,	278,	243,	122,	124,	198,
TOTAL,	54058,	56995,	65016,	66793,	72726,	81372,	117033,	119856,

Table 10	Stock number at age (start of year)						Numbers*10**-3						
YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST 80-95	AMST 80-95
AGE													
1,	26804,	16544,	19140,	22792,	29254,	14153,	19140,	30952,	21960,	14969*,	0**,	23979,	25695,
2,	28598,	24238,	14184,	15766,	19156,	24887,	12102,	16137,	25541,	18806,	13022***,	20507,	22075,
3,	41301,	21110,	18471,	10335,	8692,	11442,	15283,	7494,	10473,	18500,	12978,	14010,	15587,
4,	10837,	19475,	12227,	8394,	4172,	3632,	6722,	7201,	3991,	6047,	9902,	6805,	7750,
5,	2868,	5145,	8630,	5372,	3292,	2134,	2088,	3123,	3730,	2140,	2205,	2820,	3231,
6,	1721,	1532,	2114,	4381,	2543,	1849,	1416,	1081,	1949,	2009,	909,	1318,	1579,
7,	1282,	1042,	827,	1151,	2365,	1308,	1228,	882,	761,	1300,	1103,	703,	880,
8,	387,	742,	669,	517,	769,	1476,	865,	814,	535,	519,	735,	398,	523,
9,	306,	230,	501,	412,	354,	506,	1063,	529,	523,	317,	280,	174,	305,
+gp,	505,	556,	648,	455,	358,	752,	1202,	1116,	1096,	846,	654,		
TOTAL,	114609,	90614,	77410,	69574,	70954,	62138,	61110,	69331,	70560,	65451,	41788,		

* replaced by RCT3 (28979)
** replaced by RCT3 (22612)
*** replaced by RCT3 (25642)

Table 11.5.1.- Plaice in Division VIId. RCT3 input files.

7D PLAICE - VPA AGE 1 / indices all * per 100

7	17	2						
'YEARCLASS'	'VPA'	'eyfs0'	'eyfs1'	'fyfs0'	'fyfs1'	'ebt1'	'fbt0'	'fbt1'
1981	25482	340	45	531	25	-11	-11	-11
1982	20231	250	114	149	4	-11	-11	-11
1983	25244	1450	73	242	-11	-11	-11	-11
1984	30093	630	171	-11	-11	-11	-11	-11
1985	61033	1090	208	-11	-11	-11	-11	-11
1986	31632	2010	238	-11	94	-11	-11	-11
1987	26804	2230	161	444	82	2647	-11	1033
1988	16544	1300	147	111	22	231	19	408
1989	19140	370	76	238	40	516	16	395
1990	22792	650	64	104	39	1175	16	195
1991	29254	270	145	302	136	1653	15	3361
1992	14153	430	85	219	45	322	98	1168
1993	19140	760	83	88	112	833	241	902
1994	30952	1720	327	395	95	1132	739	507
1995	-11	1200	142	672	33	1320	77	684
1996	-11	250	42	295	91	3310	2113	3756
1997	-11	240	-11	136	-11	1140	983	-11

7D PLAICE - VPA AGE 2 / indices all * per 100

7	17	2						
'YEARCLASS'	'VPA'	'eyfs0'	'eyfs1'	'fyfs0'	'fyfs1'	'ebt1'	'fbt0'	'fbt1'
1981	22805	340	45	531	25	-11	-11	-11
1982	18218	250	114	149	4	-11	-11	-11
1983	22509	1450	73	242	-11	-11	-11	-11
1984	27094	630	171	-11	-11	-11	-11	-11
1985	54579	1090	208	-11	-11	-11	-11	-11
1986	28598	2010	238	-11	94	-11	-11	-11
1987	24238	2230	161	444	82	2647	-11	1033
1988	14184	1300	147	111	22	231	19	408
1989	15766	370	76	238	40	516	16	395
1990	19156	650	64	104	39	1175	16	195
1991	24887	270	145	302	136	1653	15	3361
1992	12102	430	85	219	45	322	98	1168
1993	16137	760	83	88	112	833	241	902
1994	25541	1720	327	395	95	1132	739	507
1995	-11	1200	142	672	33	1320	77	684
1996	-11	250	42	295	91	3310	2113	3756
1997	-11	240	-11	136	-11	1140	983	-11

Table 11.5.2.- Plaice in Division VIId. RCT3 output.

```
Analysis by RCT3 ver3.1 of data from file : rct_1_01.csv
7D PLAICE - VPA AGE 1 / indices all * per 100,,,,,,,,
Data for    7 surveys over   17 years :  1981 - 1997
Regression type = C
 Tapered time weighting applied
 power =    0 over  20 years
 Survey weighting not applied
Final estimates shrunk towards mean
 Minimum S.E. for any survey taken as     .20
 Minimum of   5 points used for regression
Forecast/Hindcast variance correction used.

 Yearclass =   1994

          I----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept    Error         Pts  Value   Value    Error   Weights

 eyfs0     1.70  -1.03   1.27   .083     13   7.45   11.62   1.509    .010
 eyfs1     1.43   3.35    .64   .261     13   5.79   11.65    .845    .033
 fyfs0      .71   6.18    .39   .283     10   5.98   10.43    .480    .103
 fyfs1      .68   7.41    .65   .149     10   4.56   10.52    .790    .038
 ebt1       .32   7.79    .13   .834      7   7.03   10.05    .162    .593
 fbt0      -.46  11.53    .53   .223      6   6.61    8.50   1.022    .023
 fbt1       .85   4.33    .81   .108      7   6.23    9.62   1.041    .022

                                          VPA Mean =  10.11    .365    .178

Yearclass =   1995

          I----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept    Error         Pts  Value   Value    Error   Weights

 eyfs0     1.45    .49   1.08   .105     14   7.09   10.81   1.228    .018
 eyfs1     1.22   4.26    .61   .272     14   4.96   10.33    .681    .058
 fyfs0      .68   6.36    .35   .354     11   6.51   10.76    .461    .127
 fyfs1      .63   7.59    .57   .194     11   3.53    9.82    .663    .061
 ebt1       .40   7.32    .18   .731      8   7.19   10.17    .230    .510
 fbt0      1.03   5.82   1.73   .032      7   4.36   10.30   2.191    .006
 fbt1      1.61   -.59   1.48   .040      8   6.53    9.94   1.015    .008

                                          VPA Mean =  10.12    .356    .212

Yearclass =   1996

          I----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept    Error         Pts  Value   Value    Error   Weights

 eyfs0     1.45    .49   1.08   .105     14   5.53    8.53   1.299    .018
 eyfs1     1.22   4.26    .61   .272     14   3.76    8.86    .758    .052
 fyfs0      .68   6.36    .35   .354     11   5.69   10.21    .407    .182
 fyfs1      .63   7.59    .57   .194     11   4.52   10.44    .674    .066
 ebt1       .40   7.32    .18   .731      8   8.11   10.54    .263    .435
 fbt0      1.03   5.82   1.73   .032      7   7.66   13.69   2.924    .004
 fbt1      1.61   -.59   1.48   .040      8   8.23   12.68   2.203    .006

                                          VPA Mean =  10.12    .356    .237

Yearclass =   1997

          I----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept    Error         Pts  Value   Value    Error   Weights

 eyfs0     1.45    .49   1.08   .105     14   5.48    8.47   1.306    .017
 eyfs1
 fyfs0      .68   6.36    .35   .354     11   4.92    9.69    .414    .173
 fyfs1
 ebt1       .40   7.32    .18   .731      8   7.04   10.12    .227    .573
 fbt0      1.03   5.82   1.73   .032      7   6.89   12.90   2.669    .004
 fbt1

                                          VPA Mean =  10.12    .356    .233

 Year     Weighted       Log      Int      Ext      Var      VPA       Log
 Class     Average       WAP      Std      Std     Ratio              VPA
          Prediction             Error    Error

 1994       25425      10.14      .15      .16      1.11   30953    10.34
 1995       27862      10.24      .16      .09       .30
 1996       28979      10.27      .17      .20      1.30
 1997       22612      10.03      .17      .16       .87
```

Table 11.5.3.- Plaice in Division VIId. RCT3 output.

```
 Analysis by RCT3 ver3.1 of data from file :rct_2_01.csv
7D PLAICE - VPA AGE 2 / indices all * per 100,,,,,,,,
Data for    7 surveys over   17 years :  1981 - 1997
Regression type = C
 Tapered time weighting applied
 power =     0 over  20 years
 Survey weighting not applied
Final estimates shrunk towards mean
 Minimum S.E. for any survey taken as     .20
 Minimum of   5 points used for regression
Forecast/Hindcast variance correction used.

 Yearclass =   1994
          I----------Regression---------I  I----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept    Error         Pts  Value   Value     Error   Weights

 eyfs0     1.68  -1.02   1.24   .094    13   7.45   11.47    1.480    .011
 eyfs1     1.47   3.04    .65   .274    13   5.79   11.55     .859    .033
 fyfs0      .71   6.04    .38   .322    10   5.98   10.29     .467    .112
 fyfs1      .86   6.61    .84   .108    10   4.56   10.52    1.016    .024
 ebt1       .33   7.57    .12   .856     7   7.03    9.90     .155    .608
 fbt0      -.46  11.37    .53   .217     6   6.61    8.32    1.031    .023
 fbt1       .83   4.31    .79   .123     7   6.23    9.46    1.007    .024

                                        VPA Mean =   9.97     .384    .165

Yearclass =   1995
          I----------Regression---------I  I----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept    Error         Pts  Value   Value     Error   Weights

 eyfs0     1.50    .08   1.11   .108    14   7.09   10.69    1.261    .015
 eyfs1     1.30   3.74    .65   .260    14   4.96   10.21     .732    .046
 fyfs0      .67   6.26    .34   .384    11   6.51   10.60     .445    .124
 fyfs1      .76   6.95    .71   .145    11   3.53    9.63     .821    .036
 ebt1       .39   7.22    .16   .778     8   7.19   10.01     .204    .587
 fbt0      1.08   5.46   1.81   .028     7   4.36   10.14    2.299    .005
 fbt1      1.39    .74   1.26   .055     8   6.53    9.78    1.547    .010

                                        VPA Mean =   9.98     .372    .177

Yearclass =   1996
          I----------Regression---------I  I----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept    Error         Pts  Value   Value     Error   Weights

 eyfs0     1.50    .08   1.11   .108    14   5.53    8.34    1.334    .016
 eyfs1     1.30   3.74    .65   .260    14   3.76    8.64     .814    .042
 fyfs0      .67   6.26    .34   .384    11   5.69   10.05     .393    .181
 fyfs1      .76   6.95    .71   .145    11   4.52   10.38     .834    .040
 ebt1       .39   7.22    .16   .778     8   8.11   10.36     .234    .509
 fbt0      1.08   5.46   1.81   .028     7   7.66   13.69    3.068    .003
 fbt1      1.39    .74   1.26   .055     8   8.23   12.14    1.878    .008

                                        VPA Mean =   9.98     .372    .202

Yearclass =   1997
          I----------Regression---------I  I----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept    Error         Pts  Value   Value     Error   Weights

 eyfs0     1.50    .08   1.11   .108    14   5.48    8.28    1.341    .014
 eyfs1
 fyfs0      .67   6.26    .34   .384    11   4.92    9.54     .399    .162
 fyfs1
 ebt1       .39   7.22    .16   .778     8   7.04    9.95     .202    .633
 fbt0      1.08   5.46   1.81   .028     7   6.89   12.87    2.801    .003
 fbt1

                                        VPA Mean =   9.98     .372    .187

 Year     Weighted      Log      Int      Ext      Var      VPA      Log
 Class     Average      WAP      Std      Std     Ratio              VPA
          Prediction            Error    Error

 1994       21873      9.99      .16      .17     1.16   25542    10.15
 1995       23881     10.08      .16      .09      .31
 1996       25642     10.15      .17      .19     1.27
 1997       19451      9.88      .16      .15      .87
```

Table 11.6.1.- Plaice in Division VIId. Historical stock data.

Run title : Plaice in VIId (run: XSAATT03/X03)

At 8-Oct-98 14:51:23

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2- 6,	FBAR 3- 6,
1980,	25646,	16562,	5614,	2650,	.4720,	.3611,	.4095,
1981,	12985,	14396,	6588,	4769,	.7238,	.4713,	.5598,
1982,	25482,	15166,	7621,	4865,	.6383,	.4888,	.5777,
1983,	20231,	15296,	8207,	5043,	.6145,	.4938,	.5796,
1984,	25244,	14332,	7582,	5161,	.6807,	.5747,	.6898,
1985,	30093,	16066,	8350,	6022,	.7212,	.4967,	.5432,
1986,	61033,	23596,	10403,	6834,	.6569,	.5302,	.6102,
1987,	31632,	32510,	13922,	8366,	.6009,	.4511,	.5192,
1988,	26804,	25102,	13689,	10420,	.7612,	.4858,	.5563,
1989,	16544,	22372,	14981,	8758,	.5846,	.5276,	.6166,
1990,	19140,	20503,	14355,	9047,	.6302,	.5427,	.6243,
1991,	22792,	15743,	11160,	7813,	.7001,	.6606,	.7019,
1992,	29254,	15524,	8912,	6337,	.7110,	.5600,	.5962,
1993,	14153,	17422,	9612,	5331,	.5546,	.3785,	.3763,
1994,	19140,	17497,	10067,	6121,	.6080,	.5259,	.5626,
1995,	30952,	14931,	9662,	5130,	.5309,	.4084,	.4275,
1996,	21960,	20368,	9719,	5393,	.5549,	.4039,	.4492,
1997,	28979(*),	16040,	9267,	6307,	.6806,	.5922,	.6726,
Arith. Mean	24892,	18524,	9984,	6354,	.6347,	.4974,	.5596,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

(*) rct3 estimate

Table 11.7.1.- Plaice in Division VIId. Inputs for predicti

The SAS System 16:50 Saturday, October 10, 1998

Plaice in the Eastern English Channel (Fishing Area VIId)

Prediction with management option table: Input data

Year: 1998								
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	22612.000	0.1000	0.0000	0.0000	0.0000	0.113	0.0622	0.213
2	25642.000	0.1000	0.1500	0.0000	0.0000	0.197	0.2753	0.274
3	12978.000	0.1000	0.5300	0.0000	0.0000	0.284	0.5015	0.300
4	9902.000	0.1000	0.9600	0.0000	0.0000	0.375	0.6633	0.373
5	2205.000	0.1000	1.0000	0.0000	0.0000	0.469	0.5488	0.467
6	909.000	0.1000	1.0000	0.0000	0.0000	0.566	0.3520	0.636
7	1103.000	0.1000	1.0000	0.0000	0.0000	0.667	0.3850	0.726
8	735.000	0.1000	1.0000	0.0000	0.0000	0.771	0.4280	0.878
9	280.000	0.1000	1.0000	0.0000	0.0000	0.878	0.3855	1.087
10+	654.000	0.1000	1.0000	0.0000	0.0000	1.146	0.3855	1.335
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
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	23979.000	0.1000	0.0000	0.0000	0.0000	0.113	0.0622	0.213
2	.	0.1000	0.1500	0.0000	0.0000	0.197	0.2753	0.274
3	.	0.1000	0.5300	0.0000	0.0000	0.284	0.5015	0.300
4	.	0.1000	0.9600	0.0000	0.0000	0.375	0.6633	0.373
5	.	0.1000	1.0000	0.0000	0.0000	0.469	0.5488	0.467
6	.	0.1000	1.0000	0.0000	0.0000	0.566	0.3520	0.636
7	.	0.1000	1.0000	0.0000	0.0000	0.667	0.3850	0.726
8	.	0.1000	1.0000	0.0000	0.0000	0.771	0.4280	0.878
9	.	0.1000	1.0000	0.0000	0.0000	0.878	0.3855	1.087
10+	.	0.1000	1.0000	0.0000	0.0000	1.146	0.3855	1.335
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000								
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	23979.000	0.1000	0.0000	0.0000	0.0000	0.113	0.0622	0.213
2	.	0.1000	0.1500	0.0000	0.0000	0.197	0.2753	0.274
3	.	0.1000	0.5300	0.0000	0.0000	0.284	0.5015	0.300
4	.	0.1000	0.9600	0.0000	0.0000	0.375	0.6633	0.373
5	.	0.1000	1.0000	0.0000	0.0000	0.469	0.5488	0.467
6	.	0.1000	1.0000	0.0000	0.0000	0.566	0.3520	0.636
7	.	0.1000	1.0000	0.0000	0.0000	0.667	0.3850	0.726
8	.	0.1000	1.0000	0.0000	0.0000	0.771	0.4280	0.878
9	.	0.1000	1.0000	0.0000	0.0000	0.878	0.3855	1.087
10+	.	0.1000	1.0000	0.0000	0.0000	1.146	0.3855	1.335
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANATT02
Date and time: 10OCT98:17:15

Table 11.7.2.- Plaice in Division VIId.
Input data for catch forecast and linear sensitivity analysis.

Populations in 1998			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	22612	.17	WS1	.11	.54	M1	.10	.10	MT1	.00	.10
N2	25642	.19	WS2	.20	.18	M2	.10	.10	MT2	.15	.10
N3	12977	.20	WS3	.28	.08	M3	.10	.10	MT3	.53	.10
N4	9901	.20	WS4	.38	.07	M4	.10	.10	MT4	.96	.10
N5	2205	.20	WS5	.47	.08	M5	.10	.10	MT5	1.00	.10
N6	908	.20	WS6	.57	.09	M6	.10	.10	MT6	1.00	.00
N7	1101	.20	WS7	.67	.09	M7	.10	.10	MT7	1.00	.00
N8	733	.20	WS8	.77	.09	M8	.10	.10	MT8	1.00	.00
N9	278	.20	WS9	.88	.09	M9	.10	.10	MT9	1.00	.00
N10	653	.20	WS10	1.15	.09	M10	.10	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.06	.56	WH1	.21	.06
sH2	.28	.30	WH2	.27	.09
sH3	.50	.19	WH3	.30	.04
sH4	.66	.09	WH4	.37	.09
sH5	.55	.19	WH5	.47	.05
sH6	.35	.16	WH6	.64	.09
sH7	.38	.17	WH7	.73	.14
sH8	.43	.12	WH8	.88	.07
sH9	.38	.19	WH9	1.09	.05
sH10	.38	.19	WH10	1.33	.04

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K98	1.00	.10	HF98	1.00	.23
K99	1.00	.10	HF99	1.00	.23
K**	1.00	.10	HF**	1.00	.23

Recruitment		
Labl	Value	CV
R99	23979	.37
R**	23979	.37

Proportion F before spawning= .00
Proportion M before spawning= .00

Stock numbers in 1998 are VPA survivors.
These are overwritten at Age 1 Age 2

Table 11.7.3.- Plaice in Division VIId. Prediction with management options table

The SAS System 16:50 Saturday, October 10, 1998

Plaice in the Eastern English Channel (Fishing Area VIId)

Prediction with management option table

Year: 1998					Year: 1999					Year: 2000	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4682	18841	10119	6470	0.0000	0.0000	18923	10544	0	25955	17059
.	.	.	.	.	0.1000	0.0468	.	10544	792	25081	16283
.	.	.	.	.	0.2000	0.0936	.	10544	1548	24248	15544
.	.	.	.	.	0.3000	0.1405	.	10544	2271	23454	14843
.	.	.	.	.	0.4000	0.1873	.	10544	2961	22697	14176
.	.	.	.	.	0.5000	0.2341	.	10544	3621	21975	13542
.	.	.	.	.	0.6000	0.2809	.	10544	4251	21287	12939
.	.	.	.	.	0.7000	0.3277	.	10544	4854	20630	12366
.	.	.	.	.	0.8000	0.3745	.	10544	5431	20003	11821
.	.	.	.	.	0.9000	0.4214	.	10544	5982	19405	11303
.	.	.	.	.	1.0000	0.4682	.	10544	6510	18834	10810
.	.	.	.	.	1.1000	0.5150	.	10544	7015	18288	10341
.	.	.	.	.	1.2000	0.5618	.	10544	7499	17768	9894
.	.	.	.	.	1.3000	0.6086	.	10544	7962	17270	9469
.	.	.	.	.	1.4000	0.6555	.	10544	8406	16794	9065
.	.	.	.	.	1.5000	0.7023	.	10544	8831	16340	8680
.	.	.	.	.	1.6000	0.7491	.	10544	9238	15906	8313
.	.	.	.	.	1.7000	0.7959	.	10544	9629	15490	7964
.	.	.	.	.	1.8000	0.8427	.	10544	10003	15093	7631
.	.	.	.	.	1.9000	0.8895	.	10544	10363	14713	7314
.	.	.	.	.	2.0000	0.9364	.	10544	10707	14349	7012
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANATT02
Date and time : 10OCT98:17:15
Computation of ref. F: Simple mean, age 2 - 6
Basis for 1998 : F factors

Table 11.7.4

16:50 Saturday, October 10, 1998

Plaice in the Eastern English Channel (Fishing Area VIId)

Single option prediction: Detailed tables

Year: 1998 F-factor: 1.0000 Reference F: 0.4682

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0622	1298	276	22612	2548	0	0	0	0
2	0.2753	5886	1615	25642	5051	3846	758	3846	758
3	0.5015	4891	1469	12978	3686	6878	1953	6878	1953
4	0.6633	4594	1712	9902	3710	9506	3562	9506	3562
5	0.5488	890	416	2205	1034	2205	1034	2205	1034
6	0.3520	257	164	909	514	909	514	909	514
7	0.3850	336	244	1103	736	1103	736	1103	736
8	0.4280	244	215	735	567	735	567	735	567
9	0.3855	86	93	280	246	280	246	280	246
10+	0.3855	200	267	654	749	654	749	654	749
Total		18683	6470	77020	18841	26117	10119	26117	10119
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1999 F-factor: 1.0000 Reference F: 0.4682

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0622	1377	293	23979	2702	0	0	0	0
2	0.2753	4413	1211	19226	3788	2884	568	2884	568
3	0.5015	6640	1994	17618	5004	9338	2652	9338	2652
4	0.6633	3299	1230	7112	2665	6827	2558	6827	2558
5	0.5488	1864	871	4616	2165	4616	2165	4616	2165
6	0.3520	326	208	1152	652	1152	652	1152	652
7	0.3850	176	128	578	386	578	386	578	386
8	0.4280	226	198	679	524	679	524	679	524
9	0.3855	132	144	433	381	433	381	433	381
10+	0.3855	176	234	575	658	575	658	575	658
Total		18629	6510	75969	18923	27083	10544	27083	10544
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000 F-factor: 1.0000 Reference F: 0.4682

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0622	1377	293	23979	2702	0	0	0	0
2	0.2753	4680	1284	20389	4017	3058	602	3058	602
3	0.5015	4978	1495	13210	3752	7001	1988	7001	1988
4	0.6633	4479	1669	9655	3617	9268	3473	9268	3473
5	0.5488	1338	626	3315	1555	3315	1555	3315	1555
6	0.3520	683	435	2412	1365	2412	1365	2412	1365
7	0.3850	224	162	733	489	733	489	733	489
8	0.4280	118	104	356	275	356	275	356	275
9	0.3855	122	133	401	352	401	352	401	352
10+	0.3855	189	253	620	711	620	711	620	711
Total		18190	6453	75070	18834	27166	10810	27166	10810
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRATT01
Date and time : 10OCT98:18:47
Computation of ref. F: Simple mean, age 2 - 6
Prediction basis : F factors

Table 11.9.1

16:50 Saturday, October 10, 1998

Plaice in the Eastern English Channel (Fishing Area VIId)

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	0.113	0.0622	0.213
2	.	0.1000	0.1500	0.0000	0.0000	0.197	0.2753	0.274
3	.	0.1000	0.5300	0.0000	0.0000	0.284	0.5015	0.300
4	.	0.1000	0.9600	0.0000	0.0000	0.375	0.6633	0.373
5	.	0.1000	1.0000	0.0000	0.0000	0.469	0.5488	0.467
6	.	0.1000	1.0000	0.0000	0.0000	0.566	0.3520	0.636
7	.	0.1000	1.0000	0.0000	0.0000	0.667	0.3850	0.726
8	.	0.1000	1.0000	0.0000	0.0000	0.771	0.4280	0.878
9	.	0.1000	1.0000	0.0000	0.0000	0.878	0.3855	1.087
10+	.	0.1000	1.0000	0.0000	0.0000	1.146	0.3855	1.335
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDATT02
Date and time: 10OCT98:18:20

Table 11.9.2

16:50 Saturday, October 10, 1998

Plaice in the Eastern English Channel (Fishing Area VIId)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	7496.766	8.325	7112.198	8.325	7112.198
0.2000	0.0936	0.425	273.066	6.263	3250.748	4.119	2876.902	4.119	2876.902
0.4000	0.1873	0.583	302.118	4.688	1877.489	2.580	1513.610	2.580	1513.610
0.6000	0.2809	0.664	292.533	3.892	1276.011	1.819	921.417	1.819	921.417
0.8000	0.3745	0.712	278.683	3.420	965.360	1.379	619.433	1.379	619.433
1.0000	0.4682	0.743	267.081	3.109	785.696	1.099	447.873	1.099	447.873
1.2000	0.5618	0.766	258.370	2.889	672.368	0.908	342.137	0.908	342.137
1.4000	0.6555	0.783	252.003	2.724	595.699	0.770	272.591	0.770	272.591
1.6000	0.7491	0.796	247.343	2.596	540.759	0.667	224.345	0.667	224.345
1.8000	0.8427	0.807	243.888	2.492	499.477	0.588	189.363	0.588	189.363
2.0000	0.9364	0.816	241.277	2.405	467.223	0.524	163.049	0.524	163.049
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDATT02
Date and time : 10OCT98:18:20
Computation of ref. F: Simple mean, age 2 - 6
F-0.1 factor : 0.2212
F-max factor : 0.3939
F-0.1 reference F : 0.1036
F-max reference F : 0.1844
Recruitment : Single recruit

Table 11.10.3 Plaice in Division VIId. Pa Software output.
Introduction to PA Add-in outputs

Four sheets of results are included in this workbook:

RefPts - provides stochastic output in the form of a table of reference points and a chart summarising the distributions of some reference points.

Plots - provides 5 plots:
A stock recruitment plot with a LOWESS smoother as a possible stock recruitment relationship. Some reference points are also indicated.
A plot of YPR and SPR curves with some reference points indicated.
A plot of historical SSB against Fbar with an equilibrium curve based on the LOWESS stock recruitment relationship.
A plot of historical yield against Fbar with an equilibrium curve based on the LOWESS stock recruitment relationship.
A plot of the time series of stock and recruitment with expected recruits based on the LOWESS stock recruitment relationship.

PD - gives the value of the reference points during each iteration of the simulation and the percentiles plotted on the chart on RefPts.

SV - contains the steady state vectors and stock recruitment series used. These can be used as the basis for further runs.

For estimation of Gloss and Floss:
A LOWESS smoother with a span of 0.5 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.

For estimation of the stock recruitment relationship used in equilibrium calculations:
A LOWESS smoother with a span of 1 was used.
Stock recruit data were un-transformed
No point representing the origin was included in the stock recruit data.

English Channel East Plaice

Steady state selection averaged over 0 years.
FBar averaged from age 2 to 6

Number of iterations = 1000

Data source:
D:\North Sea Demersal WG 98\PA\FlatFish\Plaice VIId\PLEVIID.SEN
D:\North Sea Demersal WG 98\PA\FlatFish\Plaice VIId\PLEVIID.SUM

FishLab DLL used
FLVB32.DLL built on Aug 18 1998 at 08:57:43

10/12/98 11:47

Table 11.10.3 Continued English Channel East Plaice : precautionary reference points

BIOMASS

WGNSSK

B_{loss} (lowest observed SSB)	=	5 614 t	B_{loss}
B_{lim}	=	5 614 t	
Bpa	=	7 800 t	$B_{loss}\, e^{1.645\ SE}$
MBAL	=		

SGPAFM

B_{lim}	=	5 600 t	Lowest observed SSB
B_{pa}	=	8 000 t	

Special comments regarding SSB

FISHING MORTALITY

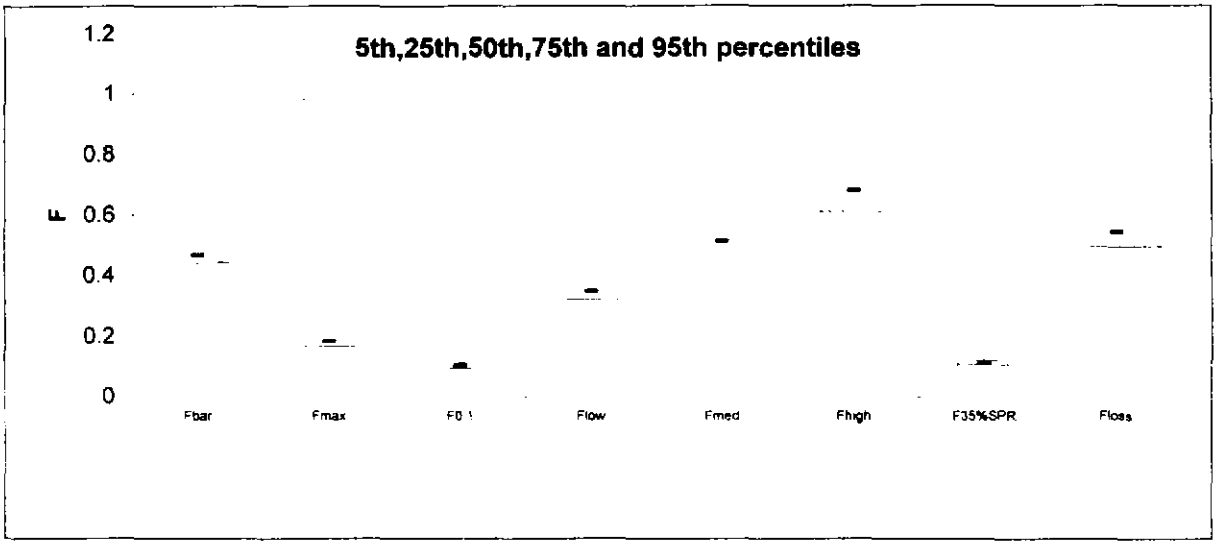
Status quo Fbar (2-6) = 0.47 (Average 95-97)

	Estimate	Probability SSB<Bpa in 2007	% of historical F above precautionary F	Long-term SSB (t) at GM rec	
$F_{0.1\ 5th\ \%ile}$	0.08	0%	100%	76767	
$F_{35\%SPR\ 5th\ \%ile}$	0.09	0%	100%	70218	
	0.10	0%	100%	66027	
$F_{0.1}$	0.10	0%	100%	64208	
$F_{35\%SPR}$	0.11	0%	100%	60042	
F_{max}	0.18	0%	100%	37137	
$F_{max\ 5th\ \%ile}$	0.15	0%	100%	47123	
	0.20	0%	100%	33890	
	0.30	0%	100%	20359	
F_{loss} x exp(-1.645*SE)	0.39	0%	89%	14197	
	0.40	0%	89%	13599	
$F_{med\ 5th\ \%ile}$	0.42	0%	78%	12657	
F_{loss} x 5th %ile	0.45	0%	72%	11340	
	0.50	2%	44%	9810	
F_{med}	0.52	6%	44%	9200	
F_{loss} **	0.54	11%	28%	8767	
	0.60	52%	6%	7493	
	0.70	90%	0%	5976	
SGPAFM F_{lim}	0.63	0%	6%	6974	F_{loss}
SGPAFM F_{pa}	0.40	0%	89%	13599	F_{lpg}

F range from the historic series	0.36	to	0.66
SSB range from the historical series	5614	to	14980

** A LOWESS smoother with a span of 0,5 was used.
Stock recruit data were log-transformed
A point representing the origin was included in the stock recruit data.
Butterworth Berg Stock recruitment model Geo Mean recruitment above Bloss
Special comments regarding F

Table 11.10.3 Continued



Reference point	Deterministic	Median	95th percentile	80th percentile
MedianRecruits	25363	25363	28029	26143
MBAL	0			
Bloss	5614			
SSB90%R90%Surv	7991	8742	10155	9411
SPR%ofVirgin	6.30	6.30	8.45	7.39
VirginSPR	7.11	7.11	9.63	8.29
SPRloss	0.36	0.37	0.43	0.42

	Deterministic	Median	5th percentile	20th percentile
FBar	0.47	0.47	0.41	0.44
Fmax	0.18	0.18	0.15	0.16
F0.1	0.10	0.10	0.08	0.09
Flow	0.35	0.35	0.29	0.32
Fmed	0.52	0.51	0.42	0.46
Fhigh	0.68	0.68	0.55	0.60
F35%SPR	0.11	0.11	0.09	0.10
Floss	0.54	0.54	0.45	0.48

Table 11.10.3 Continued

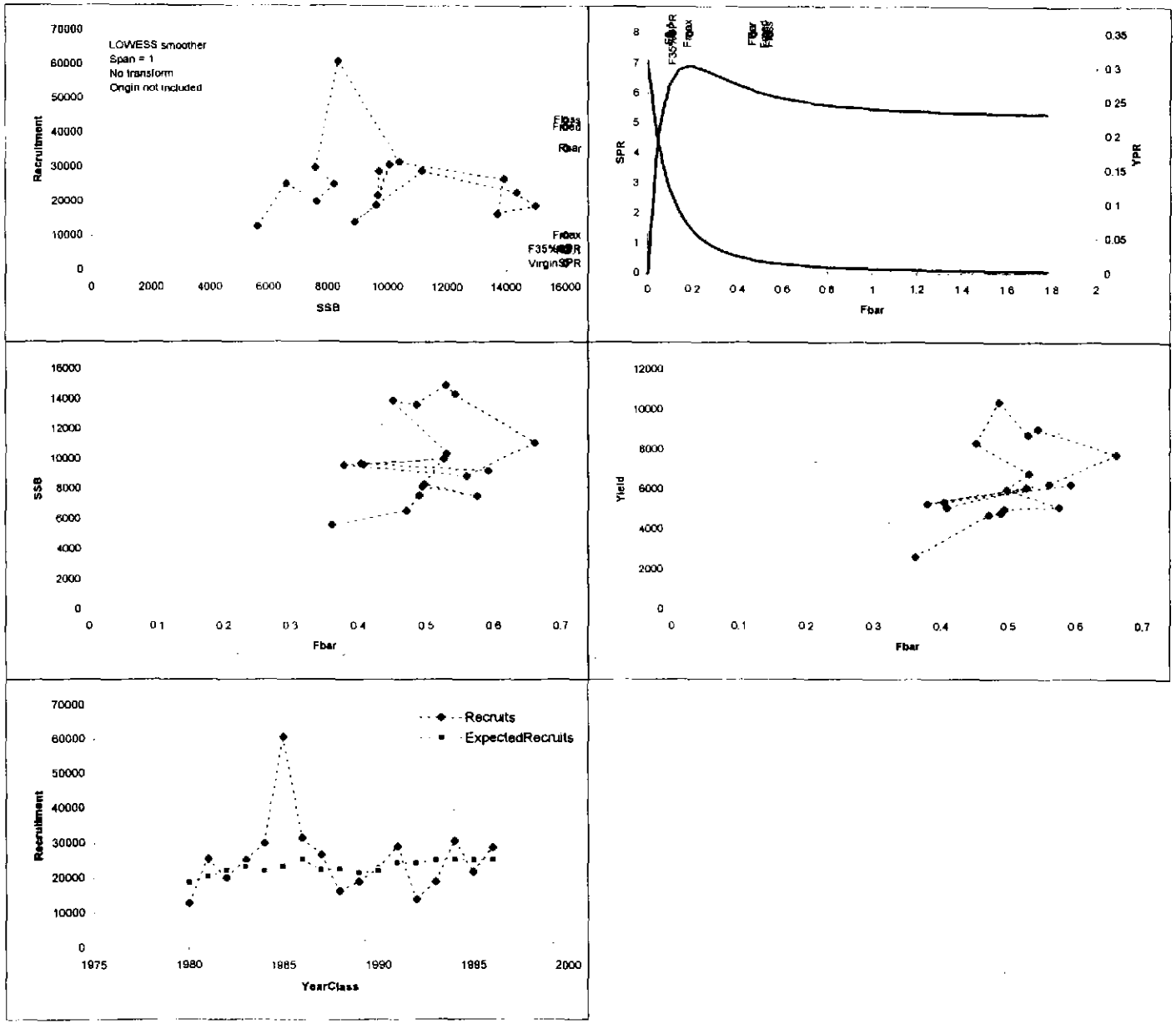


Figure 11.1.1 Stock summary, Plaice ,English Channel

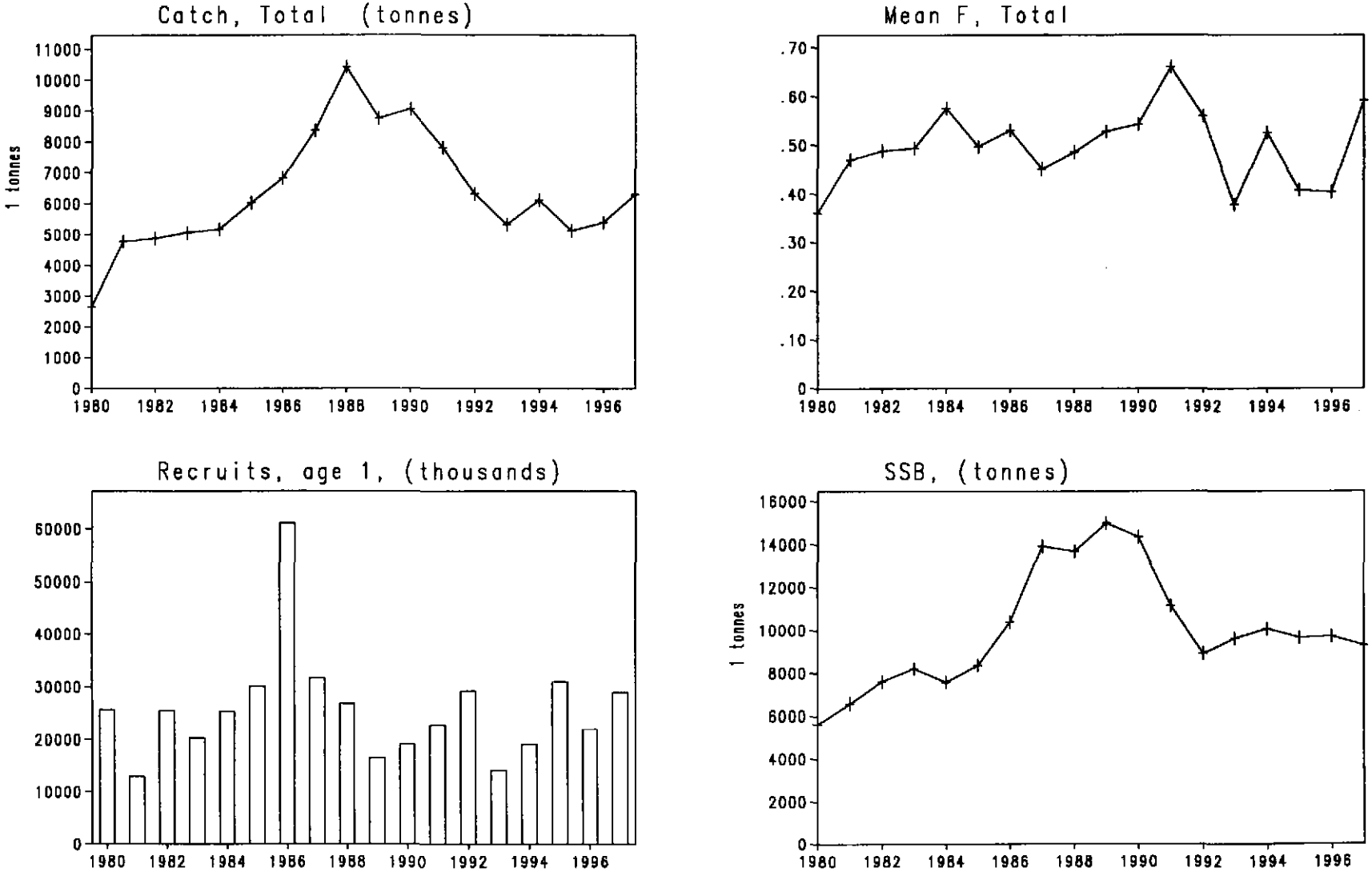
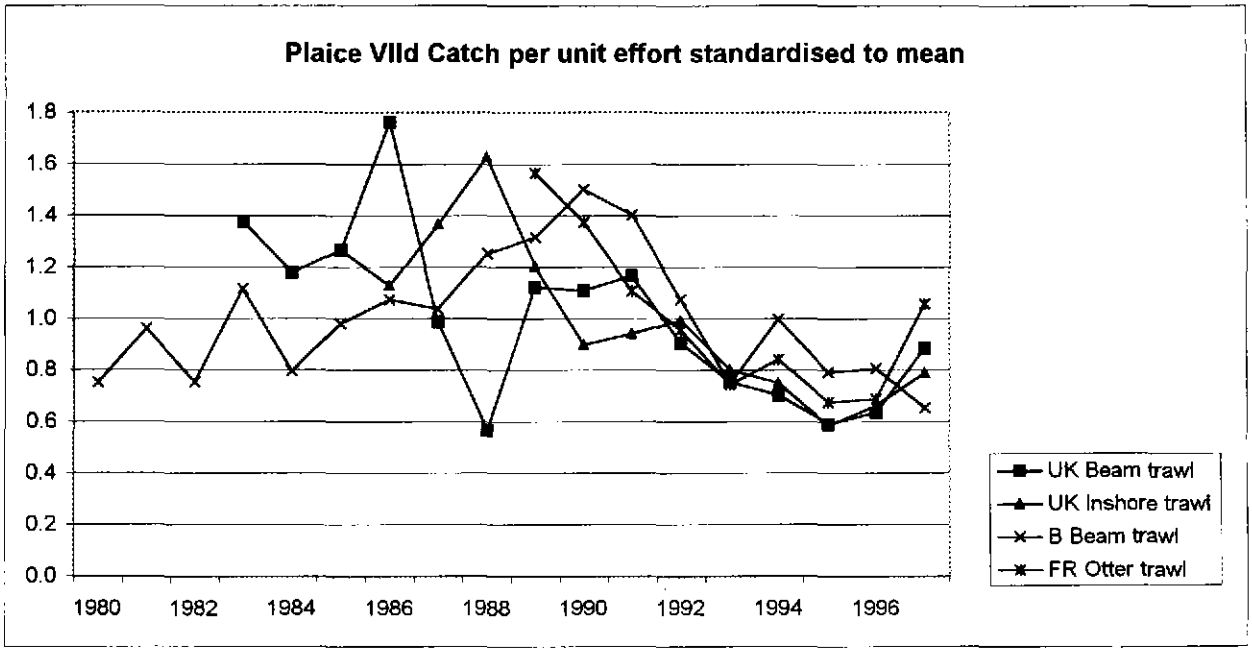


Figure 11.3.1


Plaice VIId Catch per unit effort standardised to mean
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1980
1982
1984
1986
1988
1990
1992
1994
1996
UK Beam trawl
UK Inshore trawl
B Beam trawl
FR Otter trawl

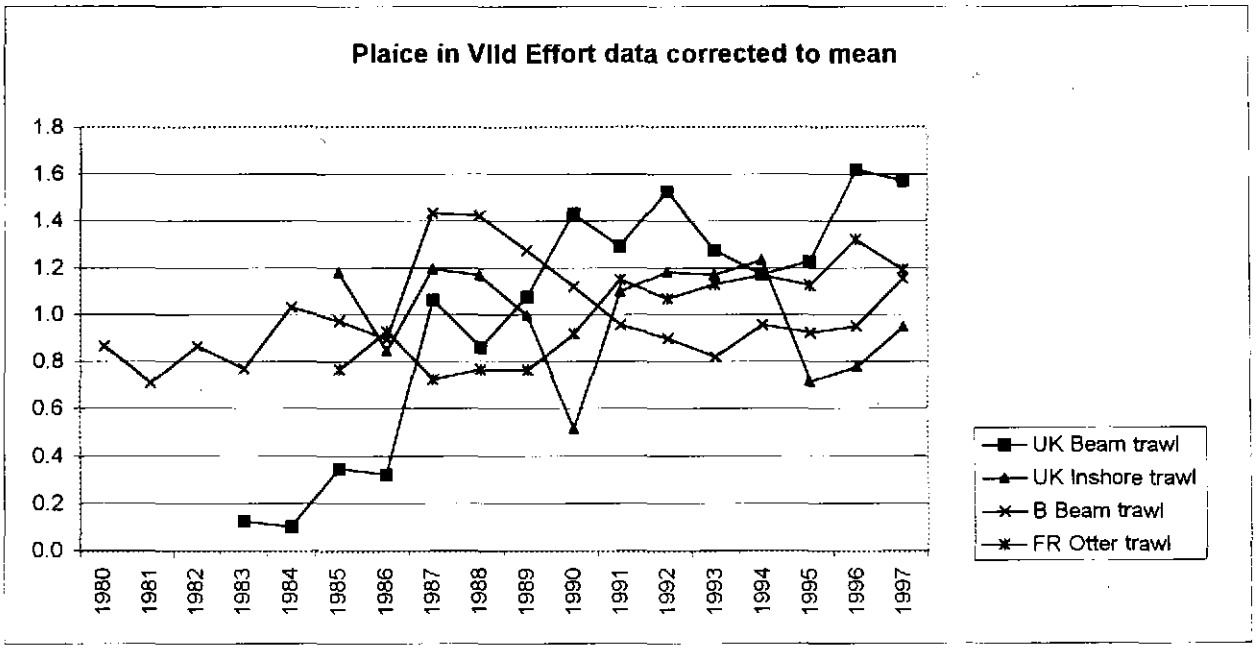

Plaice in VIId Effort data corrected to mean
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
UK Beam trawl
UK Inshore trawl
B Beam trawl
FR Otter trawl

Figure 11.4.1.- Plaice in Division VIId. Log q residual per fleet and age (XSA, final Run).

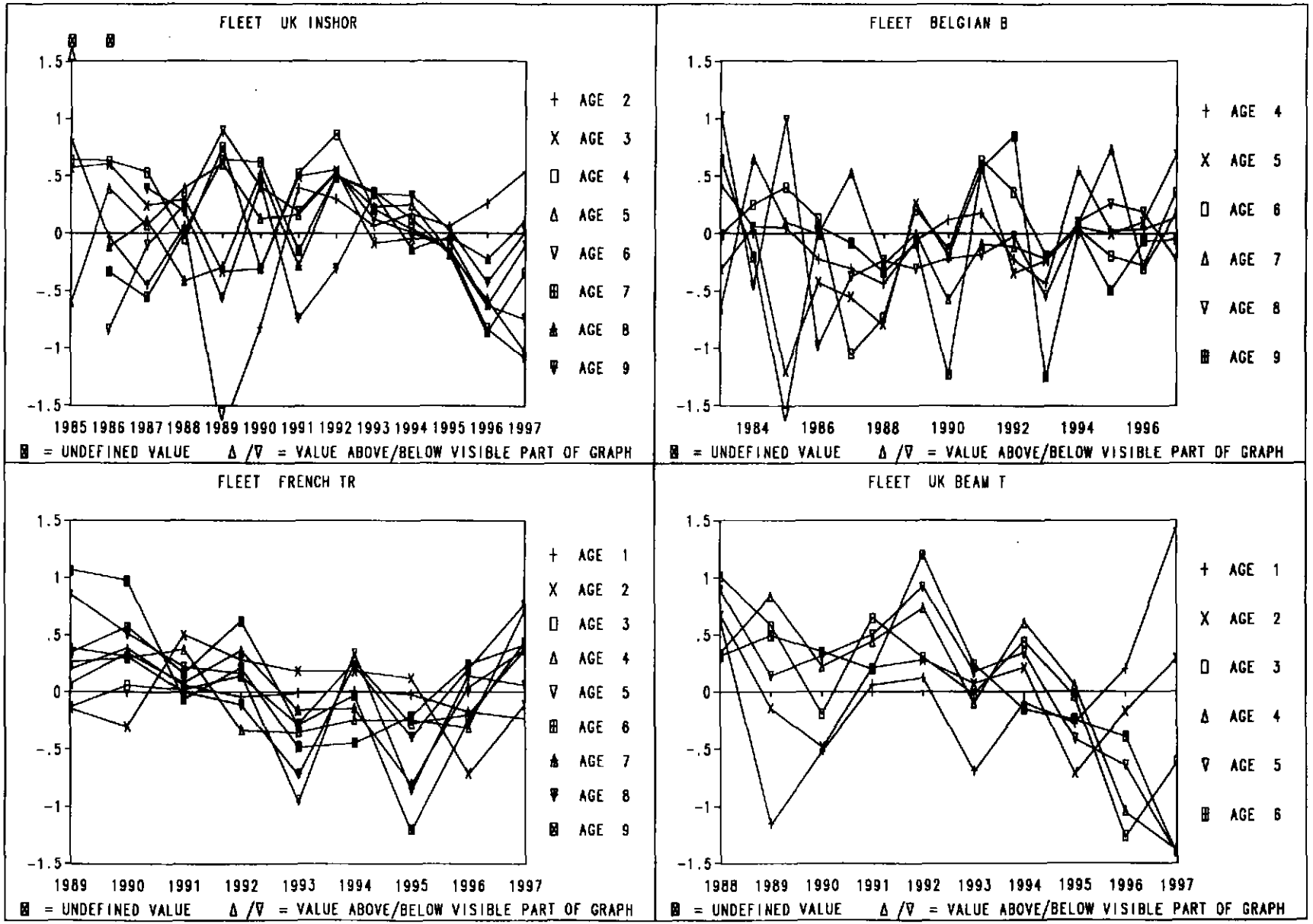


Figure 11.4.1.- Plaice in Division VIId. Log q residual per fleet and age (XSA, final Run). (cont)

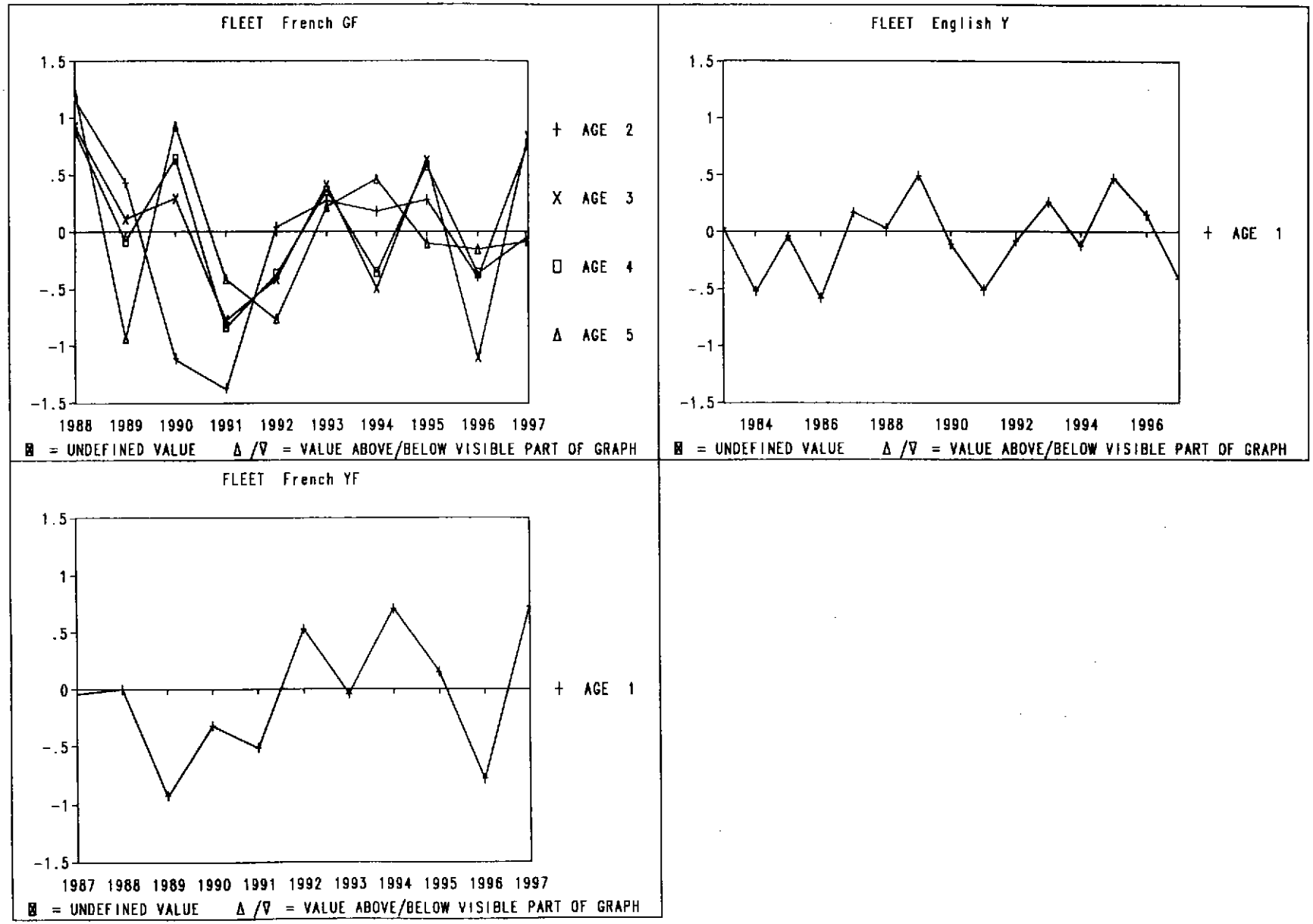
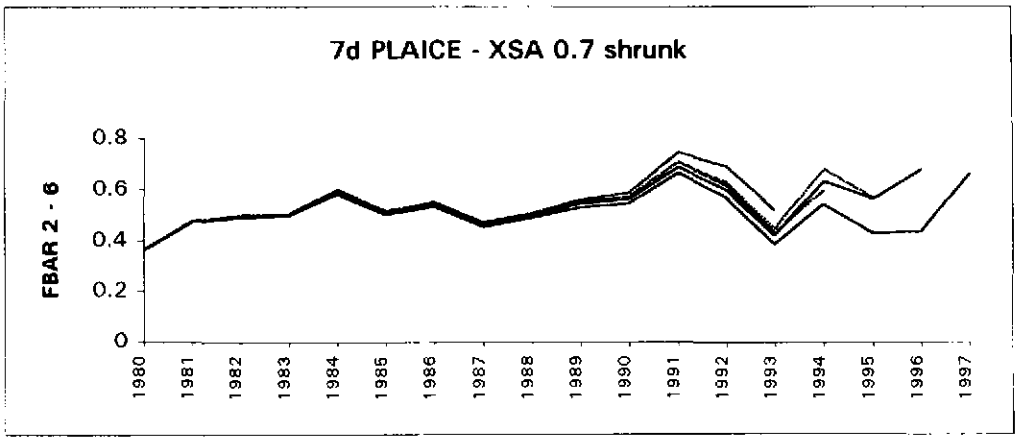
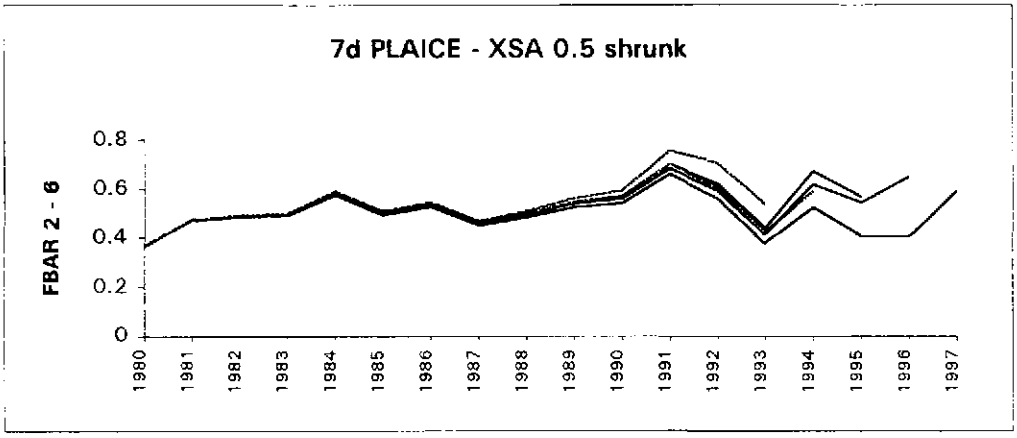


Figure 11.4.2.- Plaice in Division VIId. Retrospective analysis with final Run.





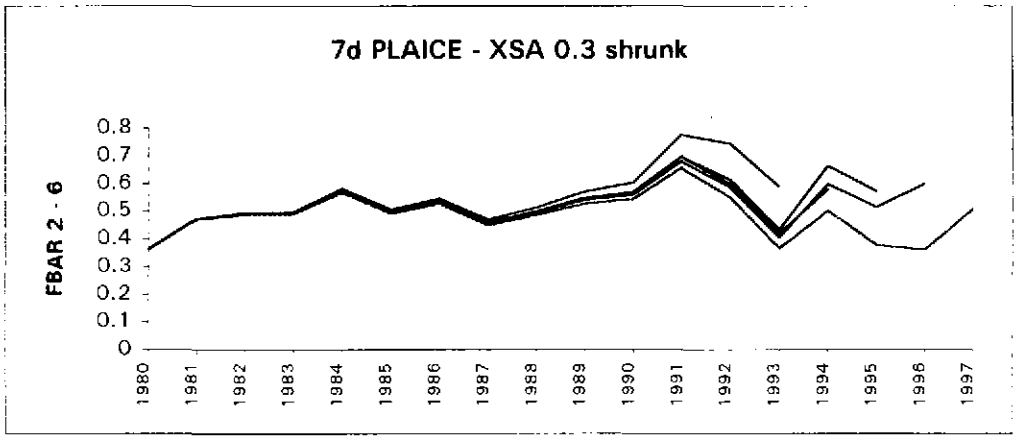


Figure : 11.4.3a
PLAICE VIId
Log VPA vs. log Index
UK INSHORE TRAWL
Yearrange : 1988-1997

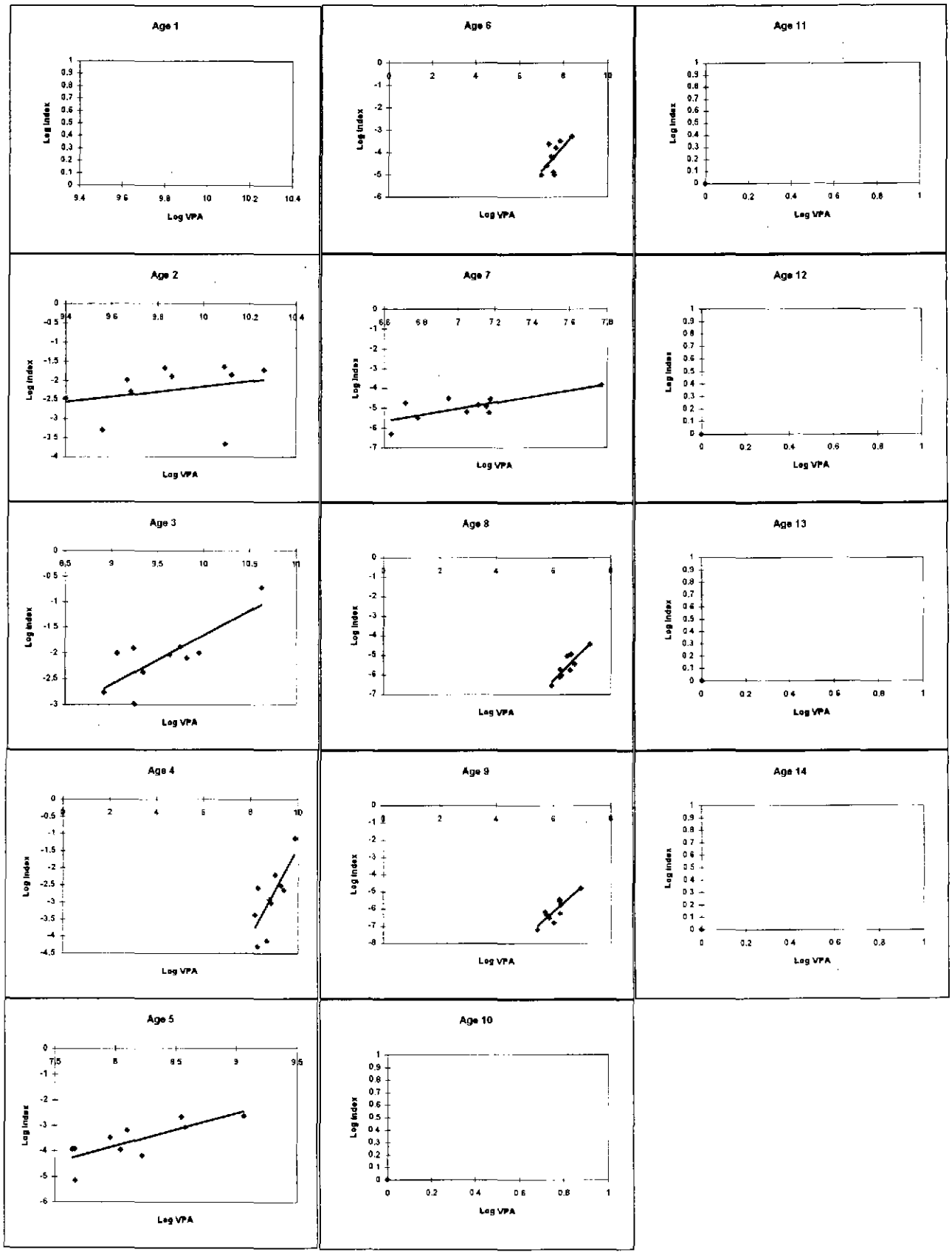


Figure : 11.4.3b
PLAICE VIId
Log VPA vs. log Index
FRENCH YFS
Yearrange : 1988-1997

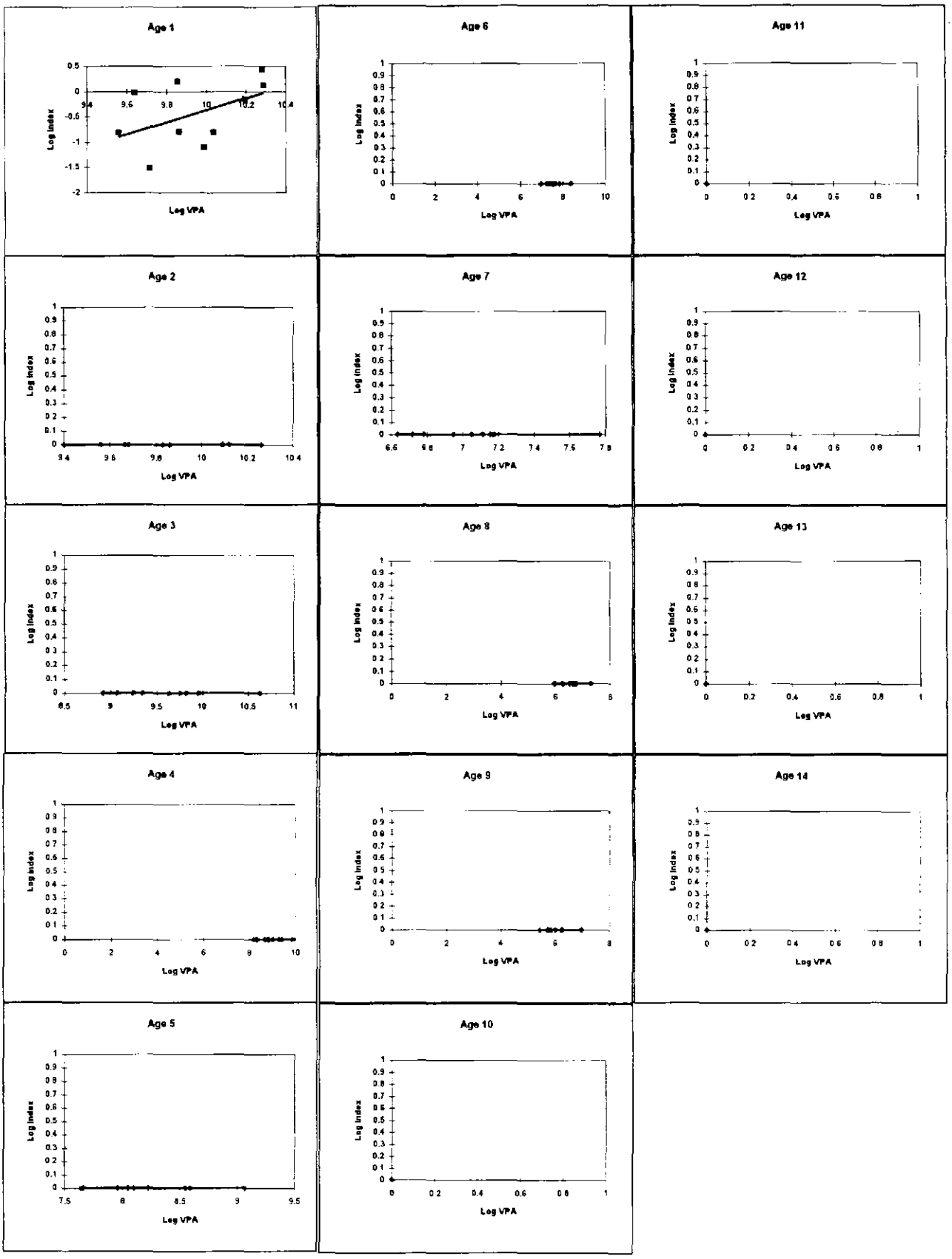


Figure : 11.4.3c
PLAICE VIId
Log VPA vs. log Index
ENGLISH YFS
Yearrange : 1988-1997

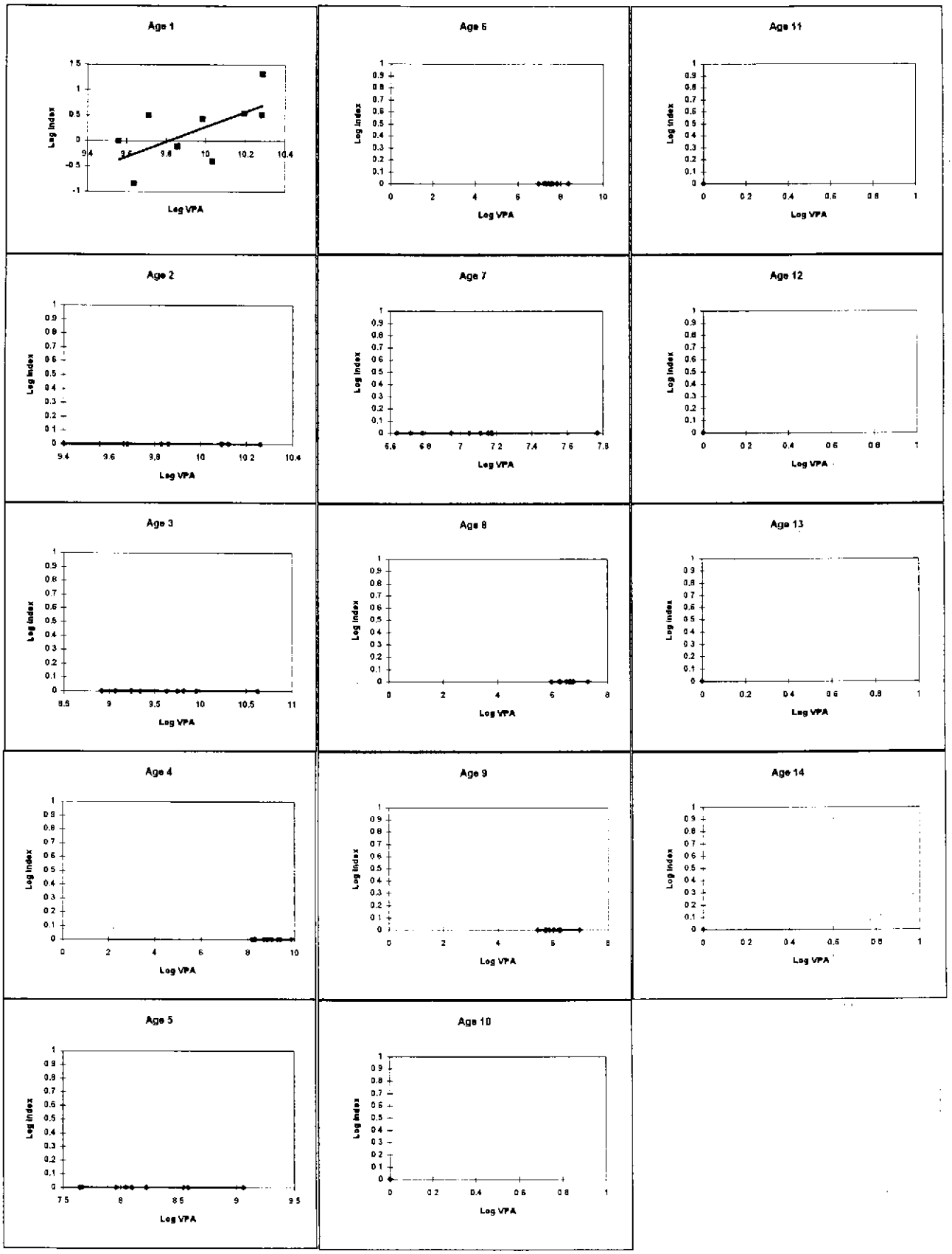


Figure : 11.4.3d
PLAICE VIId
Log VPA vs. log Index
ENGLISH BEAM TRAWL SURVEY
Yearrange : 1988-1997

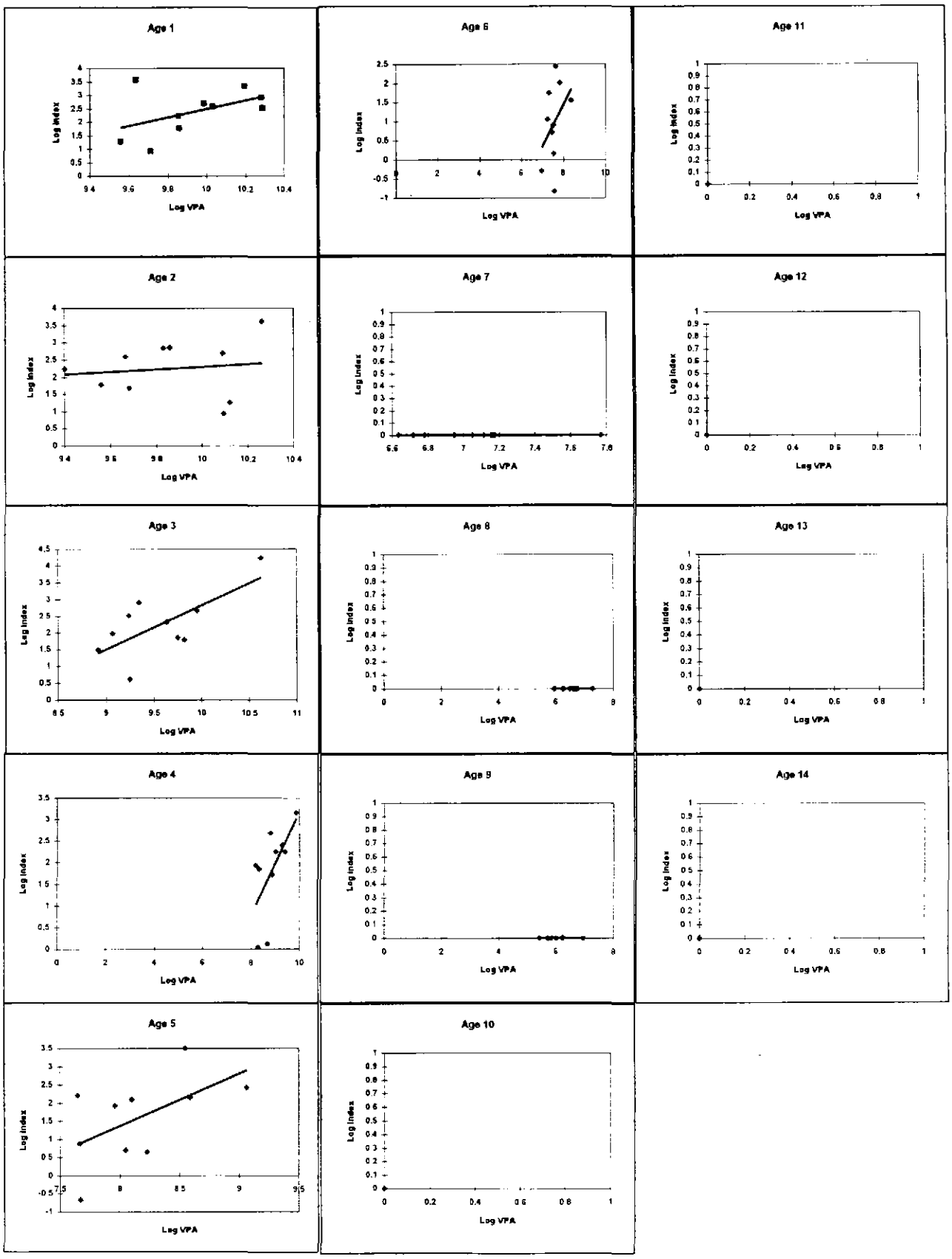


Figure : 11.4.3e
PLAICE VIId
Log VPA vs. log Index
FRENCH GFS
Yearrange : 1988-1997

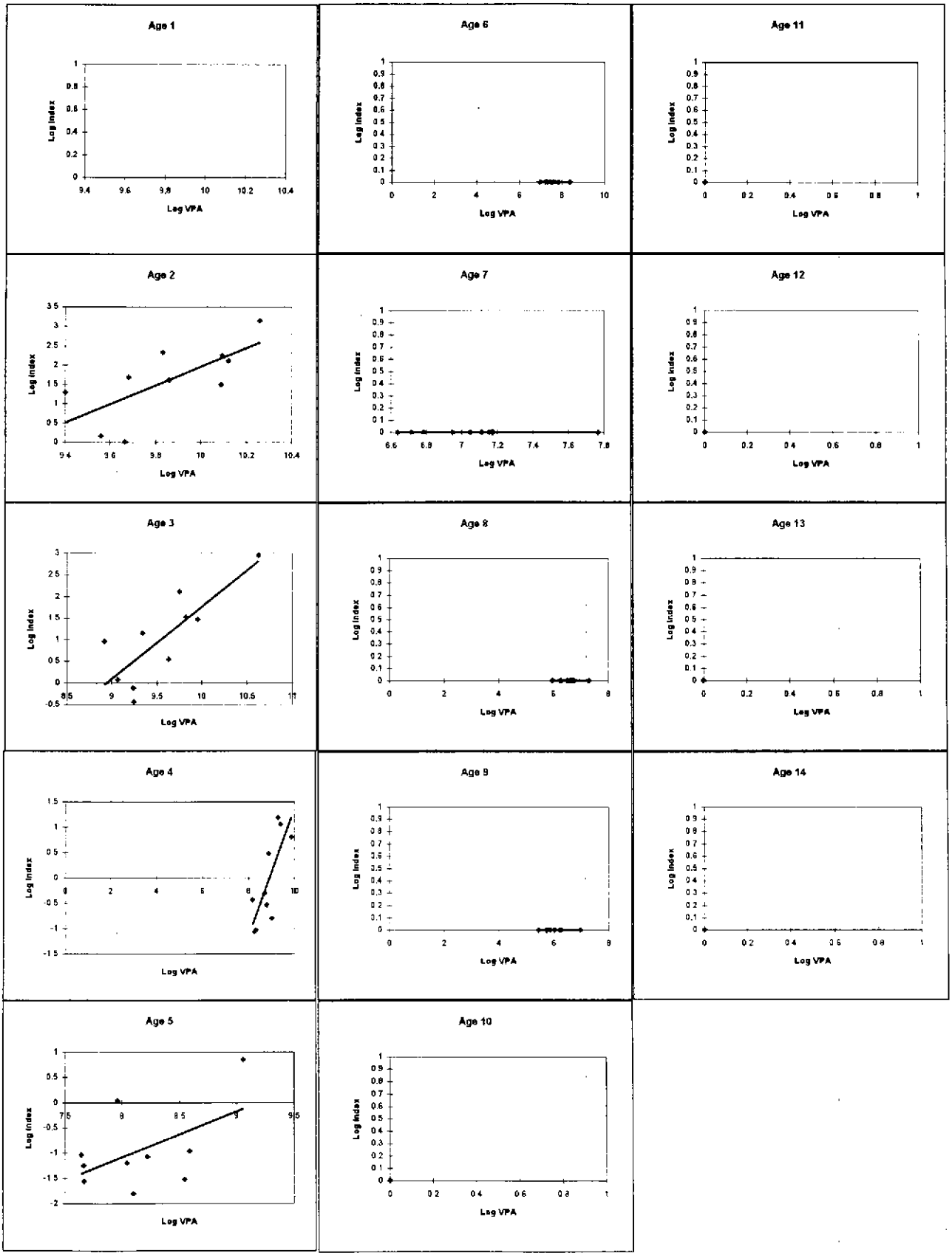


Figure : 11.4.3f
PLAICE VIId
Log VPA vs. log Index
FRENCH TRAWL
Yearrange : 1988-1997

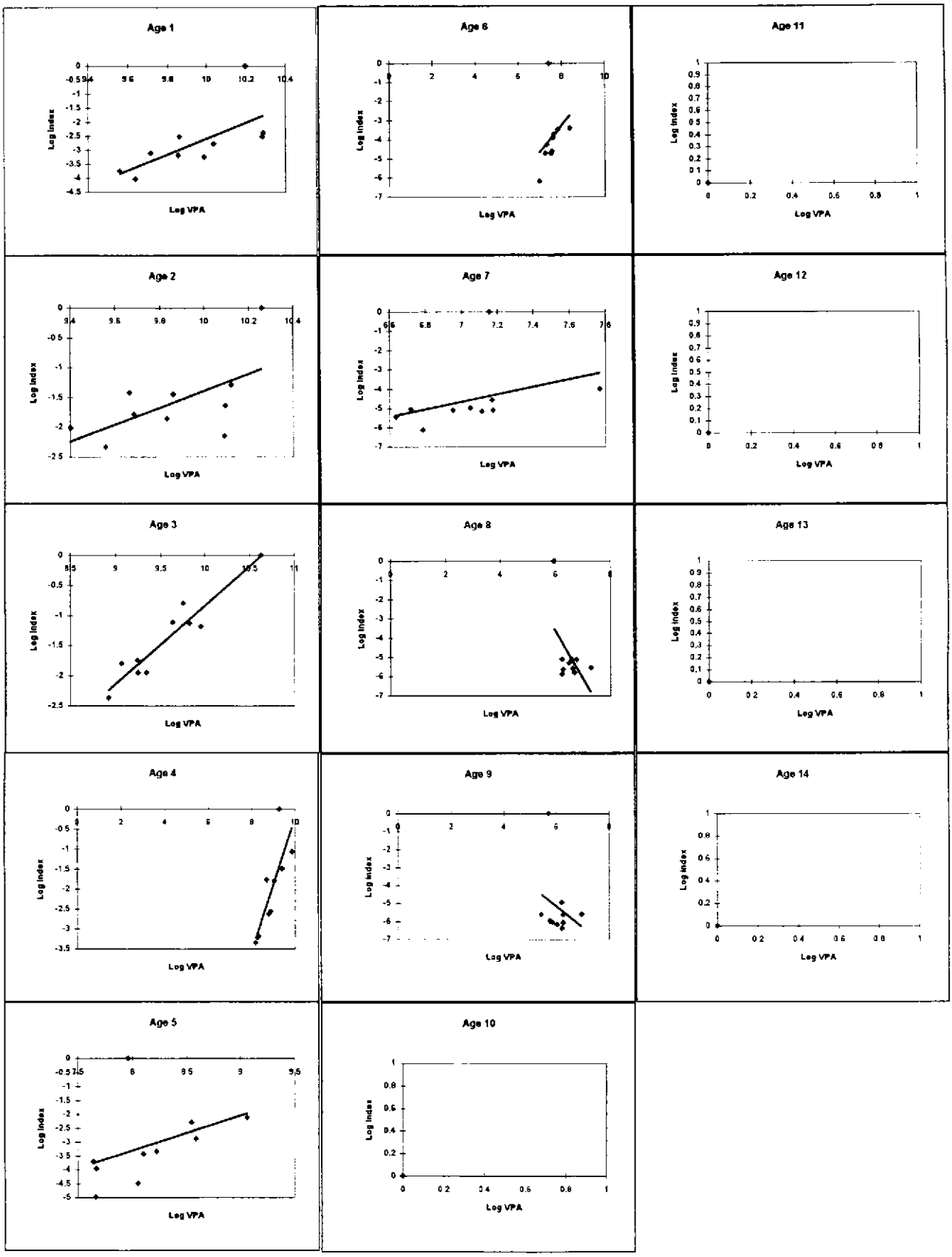


Figure : 11.4.3g
PLAICE VIId
Log VPA vs. log Index
BELGIAN BEAM TRAWL
Yearrange : 1988-1997

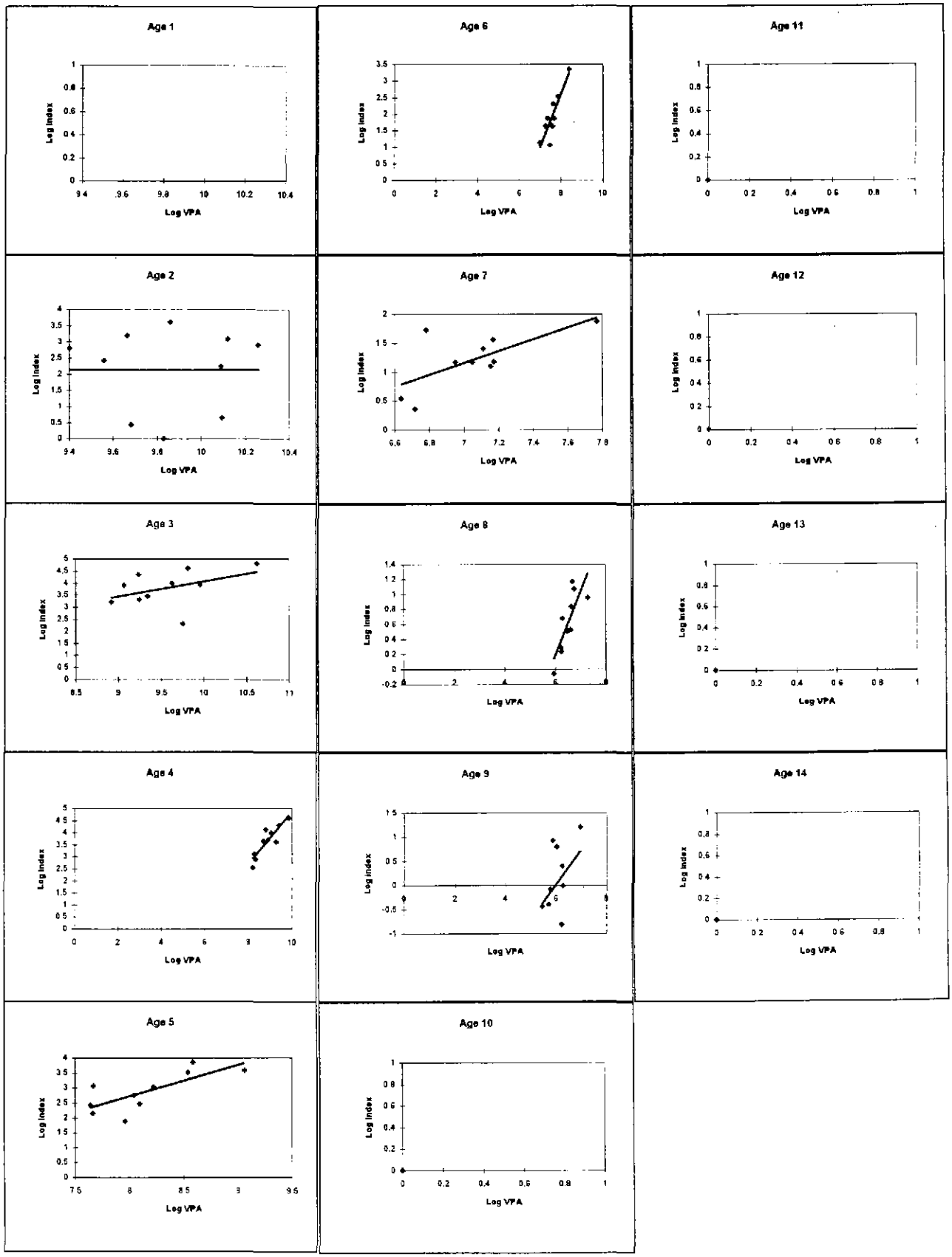


Figure 11.4.4.- Plaice in Division VIId. Weights of tuning categories in final assessment.

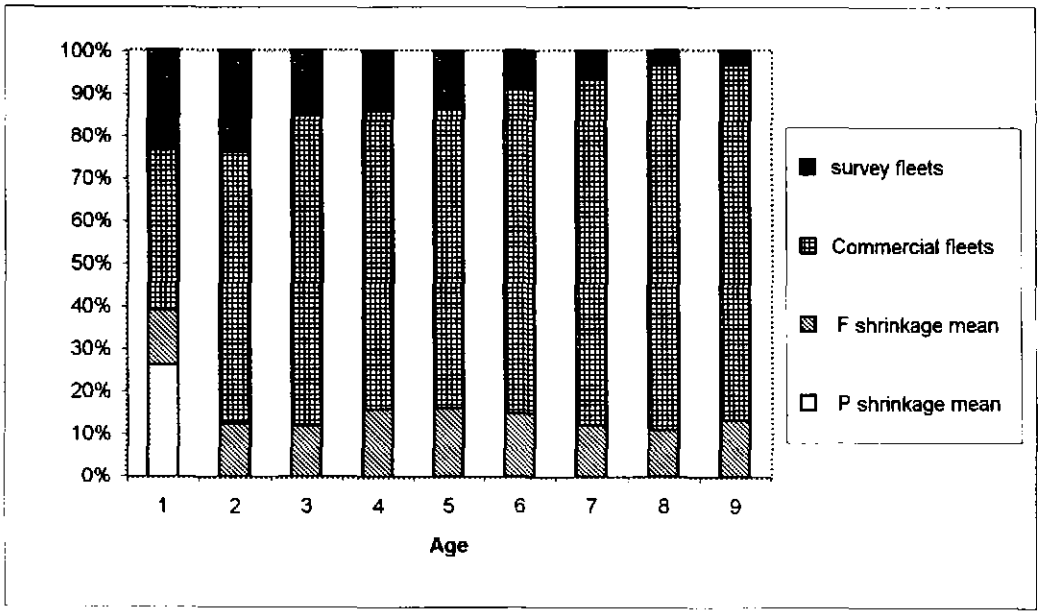


Figure 11.5.1.- Plaice in Division VIId. LN (Survey index) versus LN (VPA-N)

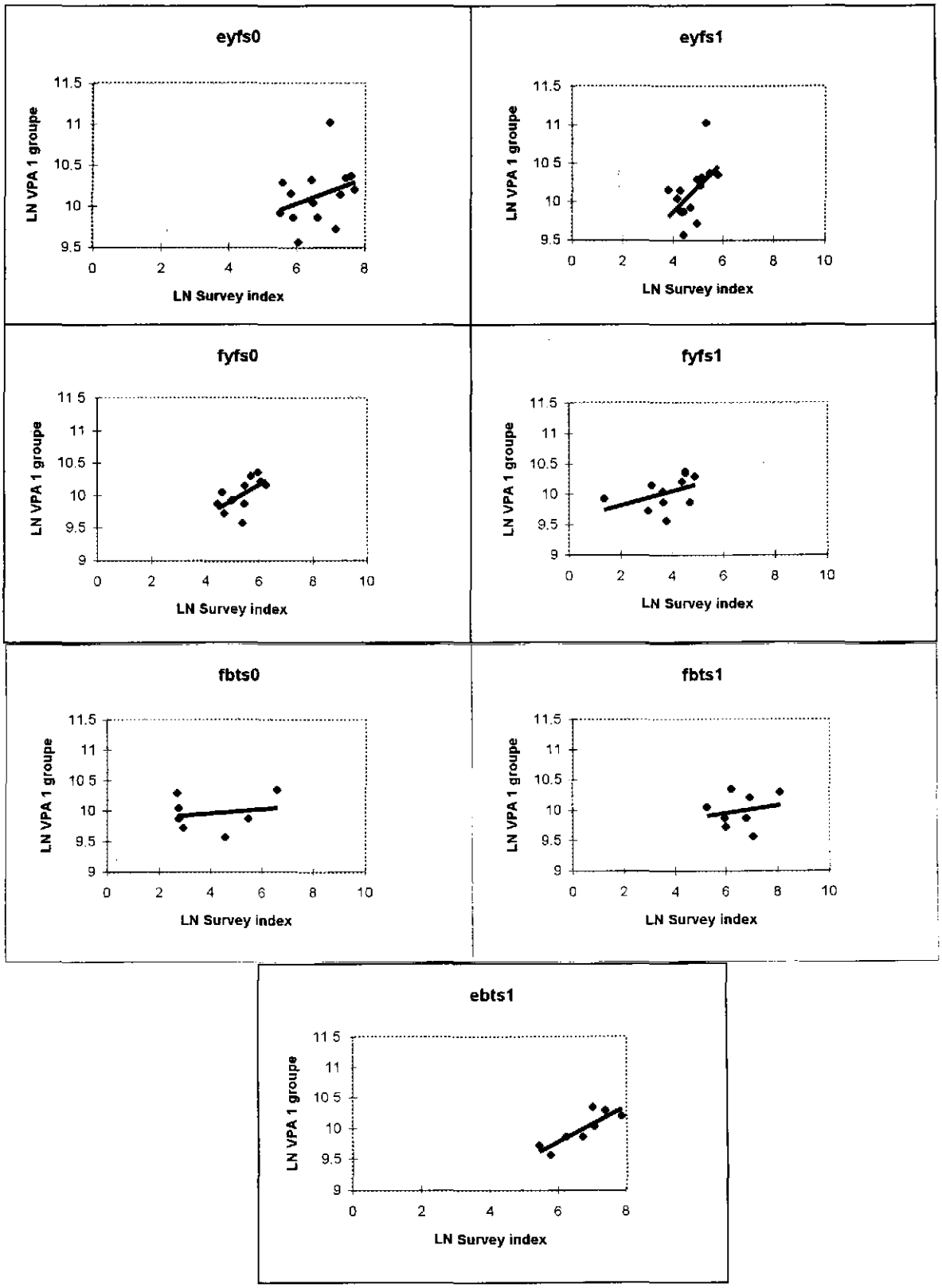
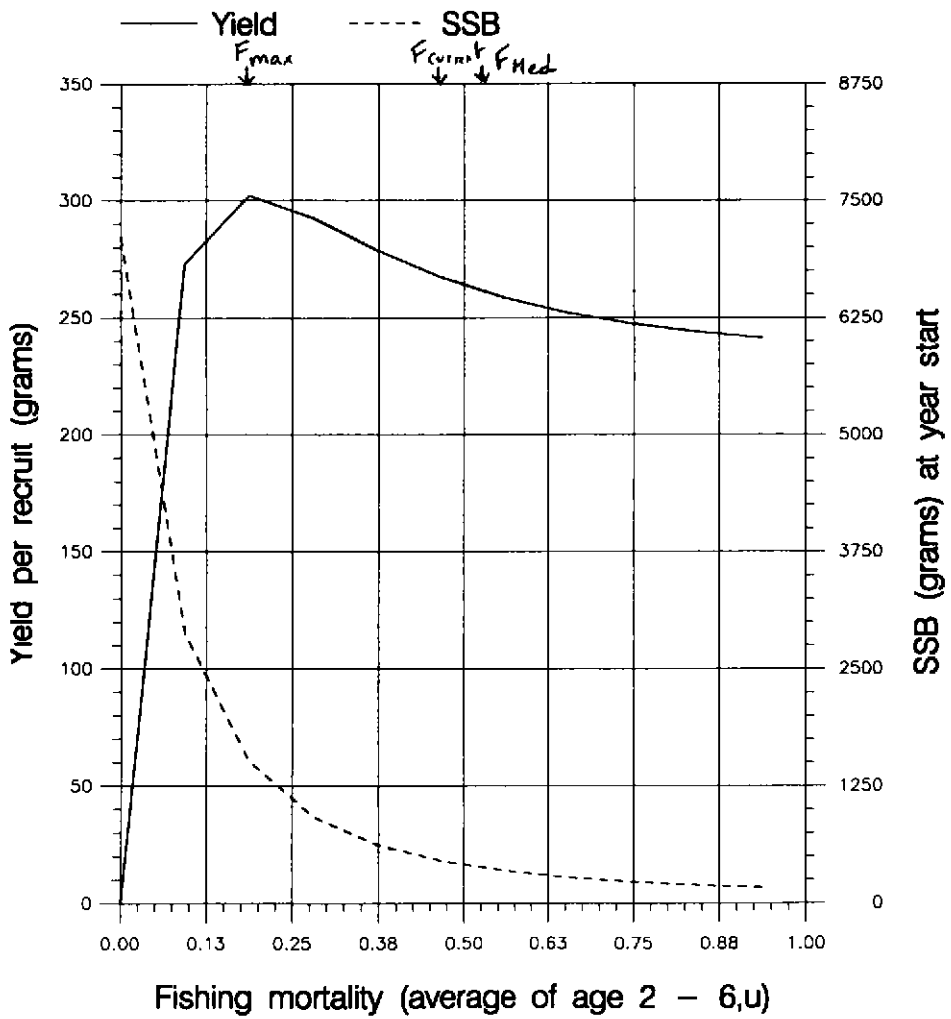


Figure 11.7.1.- Plaice in Division VIId

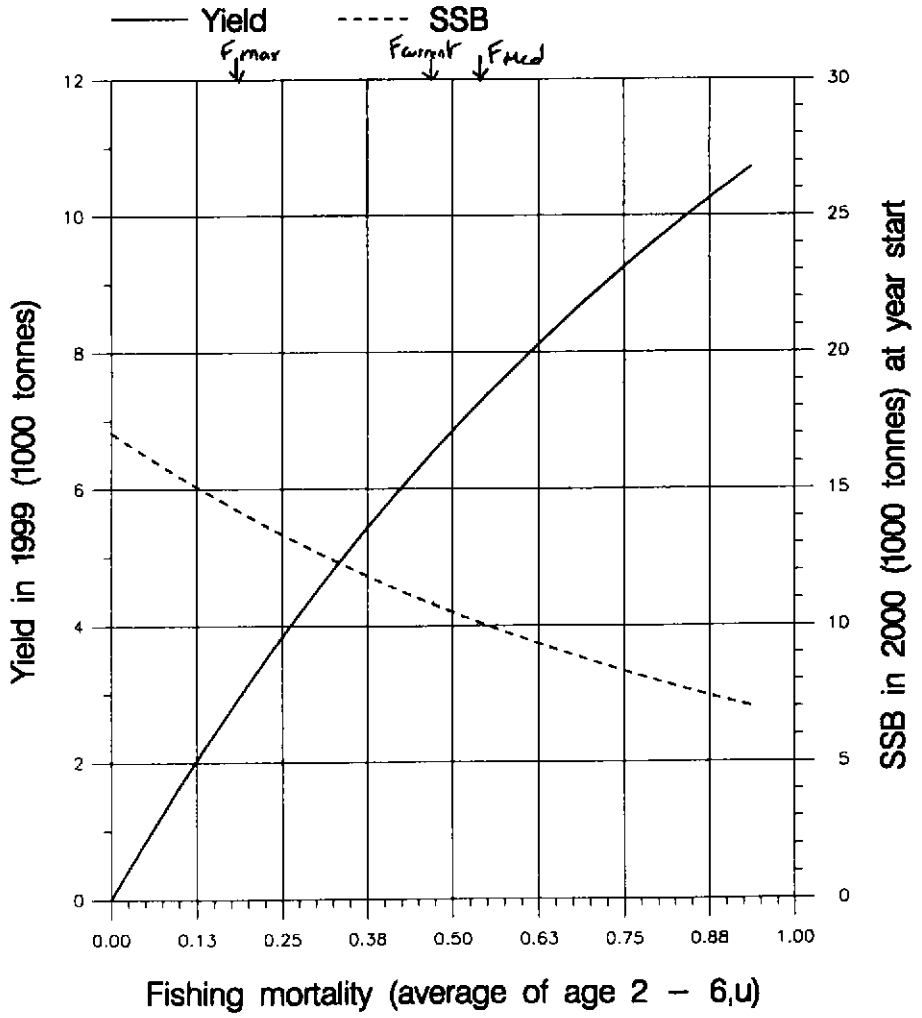
Fish Stock Summary
Plaice in the Eastern English Channel (Fishing Area VIId)
10 – 10 – 1998

Long term yield and spawning stock biomass



(run: YLDATT02) C

Short term yield and spawning stock biomass



(run: MANATT02) D

Table 11.7.2 **Plaice in VIId**

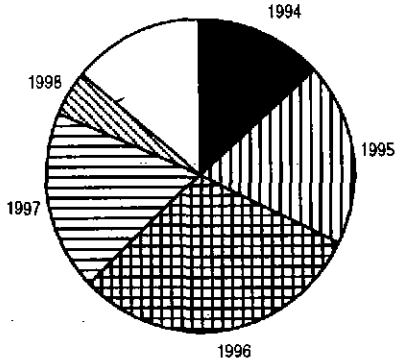
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	1994	1995	1996	1997	1998
Stock No. (thousands) of 1 year-olds	30952	21960	28979	22612	23979
Source	VPA	VPA	RCT3	RCT3	GM
Status Quo F:					
% in 1998 landings	26.5	22.7	25.0	4.3	-
% in 1999	13.4	18.9	30.6	18.6	4.5
% in 1998 SSB	35.2	19.3	7.5	0.0	-
% in 1999 SSB	20.5	24.3	25.2	5.4	0.0
% in 2000 SSB	12.6	14.4	32.1	18.4	5.6

GM : geometric mean recruitment

Plaice in VIId : Year-class % contribution to

a) **1999 landings**



b) **2000 SSB**

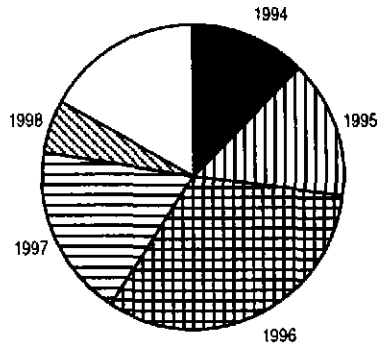


Figure 11.7.3 Plaice,English Channel East. Sensitivity analysis of short term forecast.

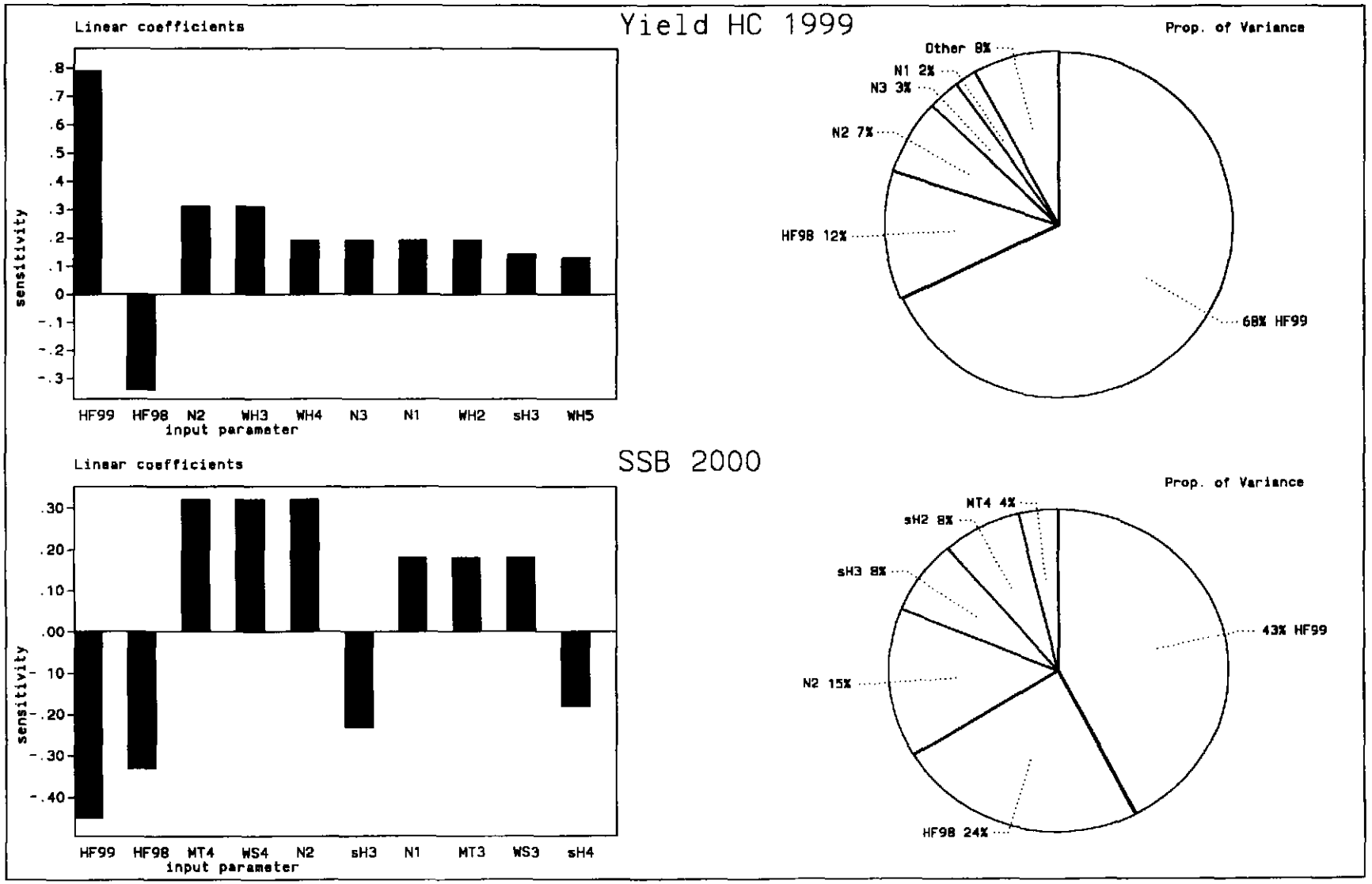
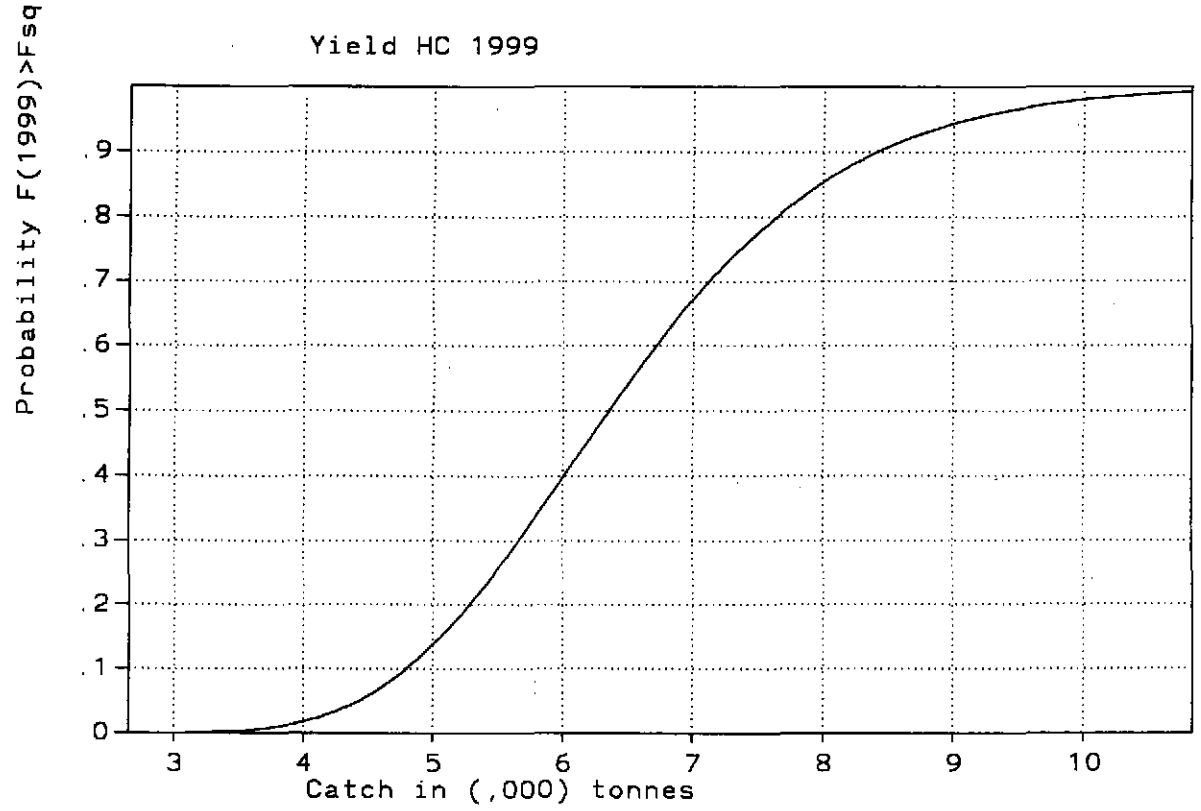


Figure 11.7.4 Plaice,English Channel East. Probability profiles for short term forecast.



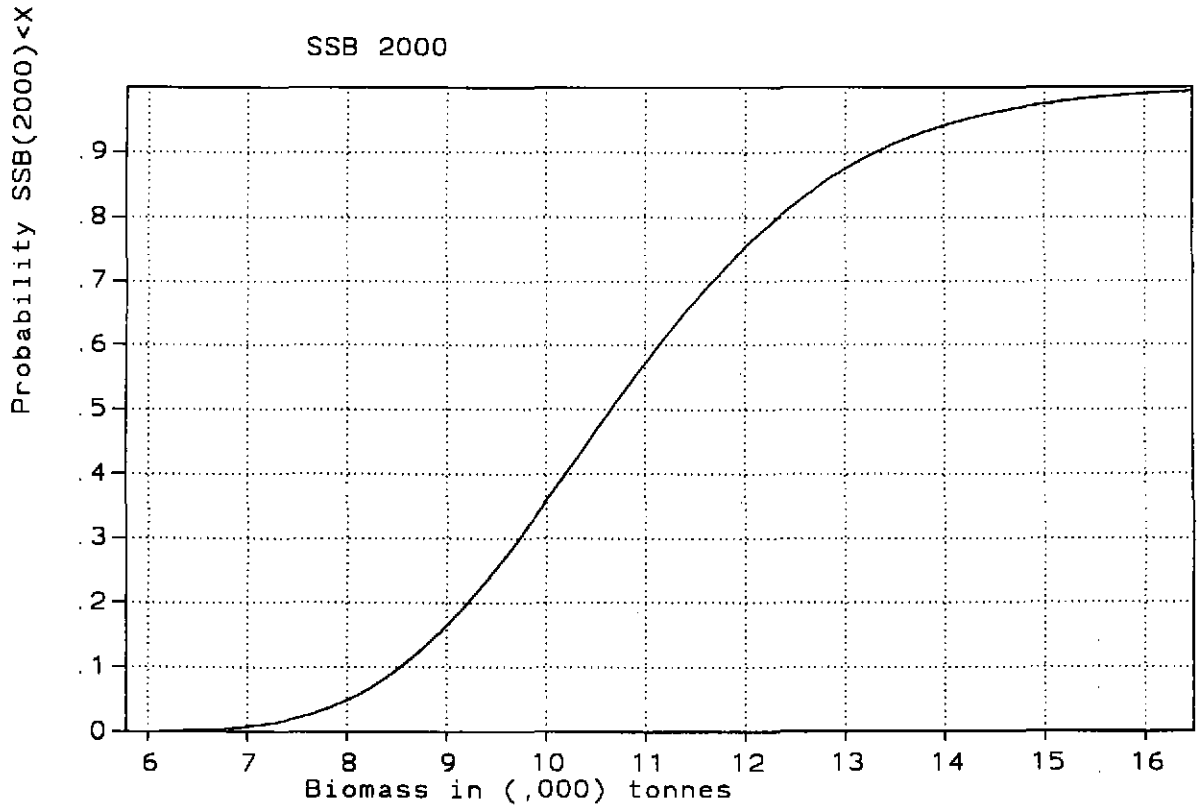
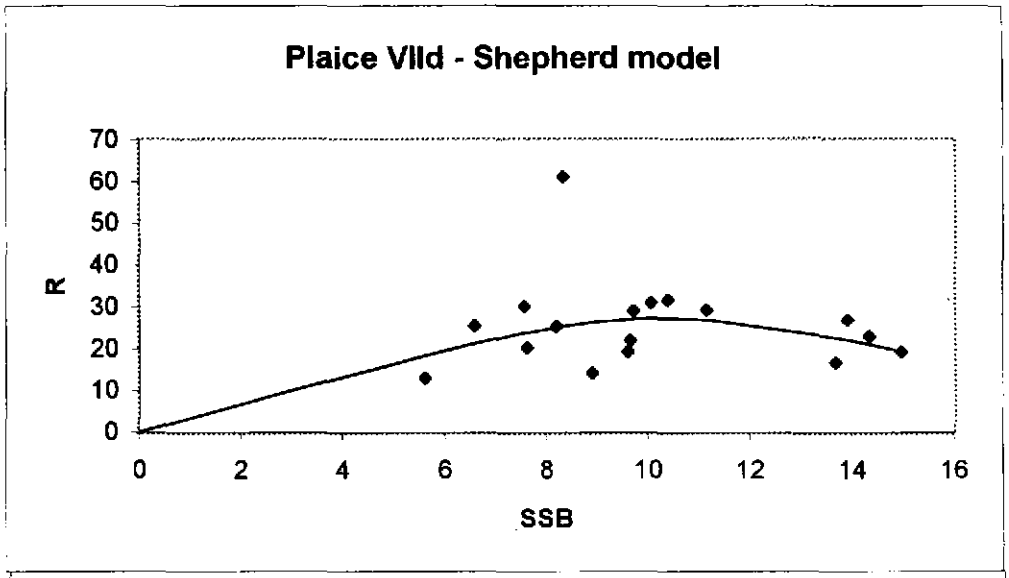
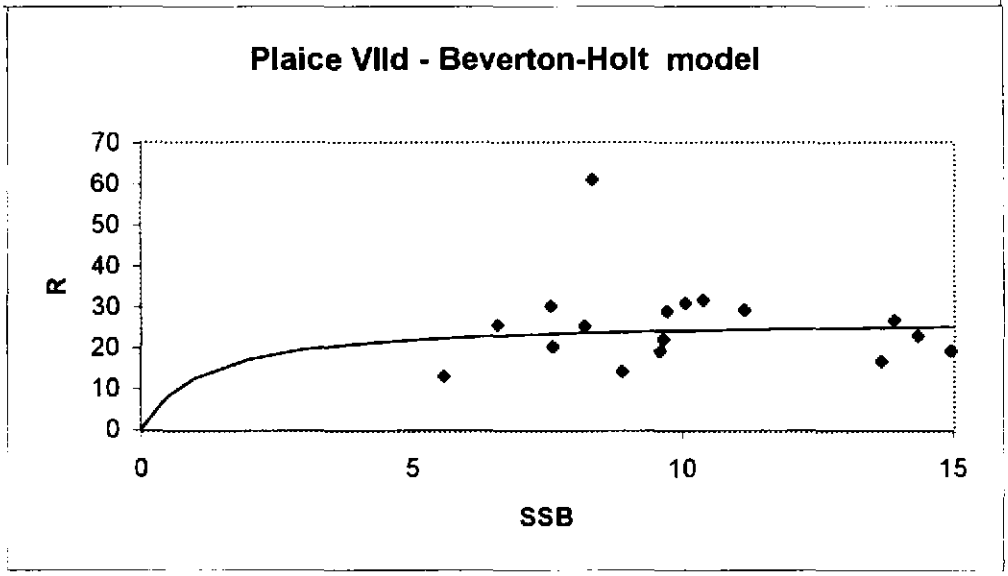


Figure 11.8.1.- Plaice in VIId. Different recruitment model.





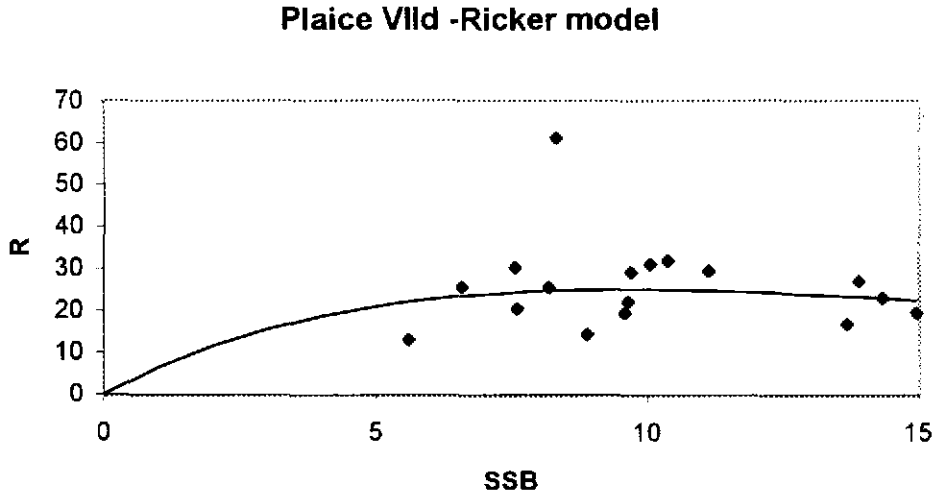


Figure 11.8.2.- Plaice in VIID. Medium term projections showing 5, 10, 20, 50 and 95 percentiles from Butterworth Berg Stock recruitment model.

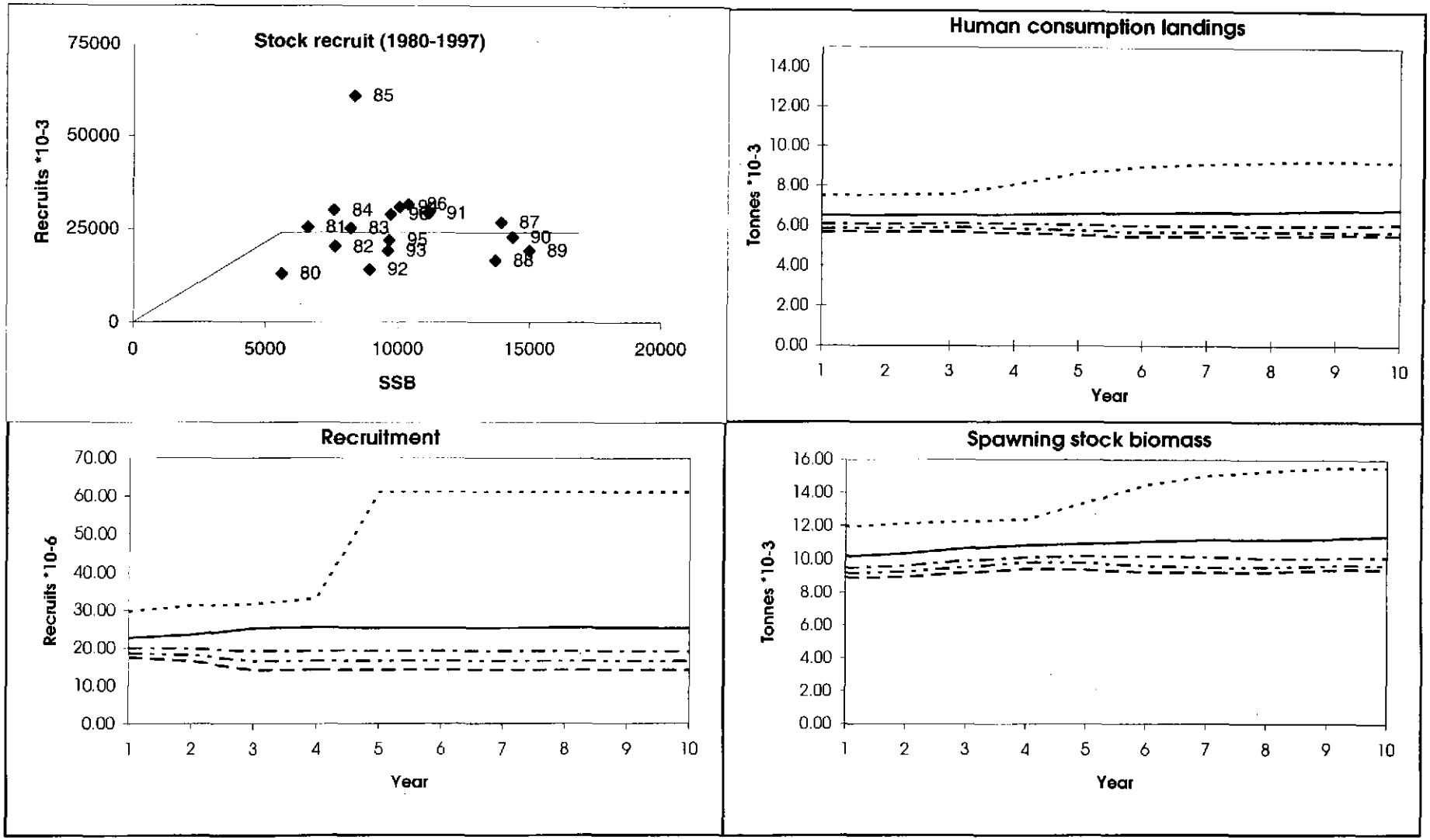
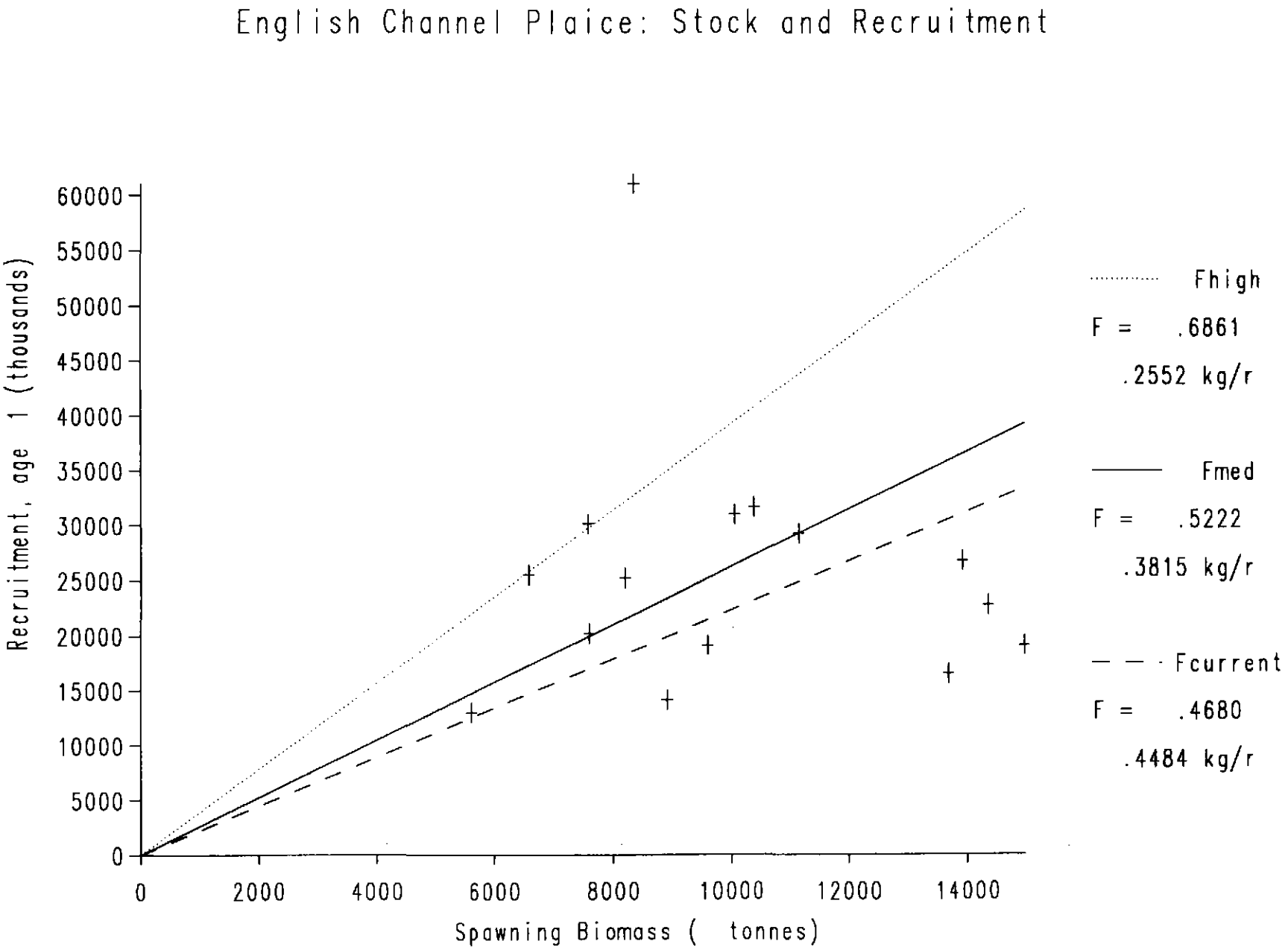


Figure 11.10.1



12 NORWAY POUT IN SUB-AREA IV AND DIVISION IIIA

12.1 The fishery

12.1.1 ICES advice applicable to 1998

There is no management objective set for this stock. With historical and present fishing mortality levels the status of the stock is mainly determined by natural processes and less by the fishery. The ACFM advice and assessment conclusion for 1997 and 1998 was that the stock can sustain current fishing mortality. However, there is a need to ensure that the stock remains high enough to provide food for a variety of predator species. It may therefore be relevant to formulate reference points based on biomass or total mortality rather than on fishing mortality.

Conventional single species reference points and standard deterministic catch forecasts are inappropriate because of high natural mortality.

12.1.2 Management applicable to 1997 and 1998

In 1997 and 1998 the TAC for Norway pout was set to 220,000 t.

12.1.3 Catch trends

Annual landings (1957–1997) as provided by Working Group members are shown in Table 12.1.1. The total landings in 1997 were 200,000 t which is approximately a 20% increase from the lower level in 1996 at 166,000 t. The high total landings in 1995 of 241,000 t and also in 1997 are above the long term average of 187,000 t (1985–1997). This is probably based on the strong 1994 and 1996 year classes which in 1995 and 1997 were fished as 1-groups. Also the effort increased about 20% from 1996 to 1997 while the catch per unit of effort (CPUE) remained at the same level in the period 1995–97. The decline in the catches from 1995 to 1996 was mainly due to a reduction in Danish catches in 1996, but in 1997 the Danish catches increased again. The long term average of total landings of 187,000 t for the period 1985–1997 is lower than that for the period 1968–1984 with a long term average of 387,000 t. A plot of total yield is shown in Figure 12.6.1A.

The landings by month and country are shown in Table 12.1.2. The seasonal distribution of the landings in 1997 were the same as in recent years. The Danish landings decreased in the second quarter of the year, while the Norwegian landings were more evenly distributed over the year.

12.2 Natural Mortality, Maturity, Age Composition and Mean Weight at Age

Age compositions were available from Norway and Denmark, Table 12.2.1. Mean weight at age in the catch was estimated as a weighted average of Danish and Norwegian data, Table 12.2.2. The mean weights at age in the catches are very variable between years and seasons, and also between countries, for the same age groups in the same year. For 1990 only nominal landings were available. Catch and weight at age data available were modelled in the same way as in previous years (estimation method given in ICES 1997a) but the model is now based on fixed estimates from the 1996 assessment. Table 12.2.2 include data from 1983 to 1998 and data from the period 1974–1982 are assumed to be the same as for 1983. The same mean weight at age in the stock, maturity ogive and natural mortality are used for all years, Table 12.2.3. The natural mortality is set to 0.4 for all age groups in all seasons which results in an annual natural mortality of 1.6 for all age groups (see background description for this in ICES 1987a5) which also is at the same level of the MSVPA estimate of M for Norway pout (ICES 1997a).

The natural mortalities from the MSVPA have not been used in the present assessment for several reasons. Firstly, the MSVPA estimates are only available for age groups 0–3. As nearly no Norway pout above the age 4–5 years is observed in the stock the natural mortality for the older age groups seems to be relatively high. Secondly, the MSVPA do not estimate quarterly natural mortalities. High variation in the natural mortality for Norway pout over the year must be expected as the mortality is highly dependent on the predation pressure from several predators, especially saithe. The migration patterns of the saithe in the North Sea and in Skagerrak, and the variation in overlap in distribution between Norway pout and saithe, are not well known which makes the MSVPA estimate of natural mortality for Norway pout rather uncertain. Further analyses has to made to determine whether presently used natural mortalities in the Norway pout assessment are appropriate.

12.3 Catch, Effort and Research Vessel Data

The assessment uses the combined catch and effort data from the commercial Danish and Norwegian small meshed trawler fleets fishing mainly in the northern North Sea. See also Section 1.3.2 for an overview of the available data sources. The fishery targets both Norway pout and blue whiting. Previous years reports (ICES 1997a, ICES 1998a) give background descriptions of the commercial fishery tuning series used. In 1997 Norwegian effort data were revised as described in Sections 13.1.3.1 and 1.3.2 of the 1997 Working Group report (ICES 1998a). More details, and the coefficients of the different previous regression models used, can be found in two reports of the Working Group on the Assessment of Norway Pout and Sandeel (ICES 1994a, ICES 1995a). Tables 12.3.1 and 12.3.2 give CPUE data by vessel category for the Danish and Norwegian commercial fleets in the period 1984–97.

The combined and standardised Danish and Norwegian fishing effort data for commercial vessels targeting Norway pout are given in Table 12.3.3. Tuning should ideally be performed on divided national commercial fleets. However, long term catch data series back to 1974 divided by the fleets for each country have not been compiled splitting of the combined Danish and Norwegian fleet data into two tuning fleets was impossible in the assessment. Historical data series for national fleets should be compiled and made available to the Working Group to be used in future assessments. Research vessel data: Survey indices series of abundance of Norway pout were available from the IBTS, the EGFS (English Ground Fish Survey) and the SGFS (Scottish Ground Fish Survey), Table 12.3.4.

12.4 Catch-at-Age Analysis

The SXSA (Seasonal Extended Survivors Analysis: Skagen (1993)) was used to estimate quarterly stock numbers and fishing mortalities for Norway pout in the North Sea and Skagerrak. For details concerning the SXSA see Skagen 1994. The settings of the SXSA was the same this year as in the last year's assessment. In the SXSA the catchability was assumed to be constant within the period 1983–1998. Tuning was performed over the period 1983 to 1998 producing logged residual stock numbers and survivor estimates, where the contributions from the various age groups to the survivor estimates were weighted in proportion to the inverse of their variance. The three surveys and the commercial fleet were all used in the tuning. In previous years the catch at age in 1990 was extrapolated from the estimated catchabilities and stock sizes, under the constraint that the quarterly SOP should be in accordance with observed landings. For this year's SXSA the catch at age numbers for 1990 was set as fixed values based on the estimates from the 1996 assessment and which are also expected to be used in the coming years assessment. Table 12.4.1 contains the options used as well as the estimated stock numbers, fishing mortalities and additional output from the analysis. The log residual stock numbers are plotted in Figure 12.4.2. In Figure 12.4.4 the SSQ Residuals are shown. Weighting factors for computing survivors of the different tuning fleets are shown in Figure 12.4.3. Retrospective analyses has been done for recruitment and SSB as in previous years. The results of the these analyses are shown in Figure 12.4.1. Compiled results of the SXSA are shown in Table 12.6.1 and in Figures 12.6.1A and B and 12.6.2.

The log residual stock numbers are least variable for 1- and 2-year-old fish as these age groups are the most abundant (Figure 12.4.2). There is no apparent trend in the residuals with time.

Figure 12.4.4 indicates large interannual variations with large SSQ residuals for commercial fishery in 1992 (3rd quarter), 1993 (4 th quarter), and 1996 (2 nd and 4 th quarter). The sum of squared residuals for the surveys show relatively smaller variations in SSQ compared to the commercial fishery. However, the English Ground Fish Survey gives slightly higher residuals with peaks in 1987, '92, and '96.

The weights in the tuning process in the final run (constant catchability) were evenly distributed over the different CPUE series with a general tendency towards most weight given to the CPUE data from the commercial fishery (CF), Figure 12.4.3. In the 2 nd and 4 th quarter only, the commercial fishery was used in the tuning, while survey weighting was also performed for the 1st and 3rd quarter. For several age groups and seasons approximately the same weight were given to the IBTS and SGFS surveys as the weight given to the commercial fishery. Higher weight is given to SGFS age 3, season 3 compared with EGFS and the commercial fishery.

The retrospective analyses for recruitment and SSB performed as in previous years (Figure 12.4.1) revealed a general tendency to overestimate SSB and recruitment values in the last year. In most cases the estimates converged rapidly, but the initial high estimates of the large 1991 and 1994 year classes have in general been gradually revised downwards in the successive years. However, initially the large 1996 year class was not estimated to be high. Investigations during the 1995 assessment showed that when the cosine time taper was applied, the tendency to overestimate SSB and recruitment was somewhat reduced. Cosine time taper has not been used in this assessment to shrink the estimated values towards the mean.

Results on catch and age analyses are given in Table 12.4.1 and Figures 12.4.1–12.4.4 and 12.6.1A and B-12.6.2.

12.5 Recruitment Estimates

Recruitment estimates are available from the Scottish and English groundfish surveys both performed in August (Table 12.3.4), and as the SXSA performed in 1998 also includes the 1st and 2 nd quarter of 1998 (Table 12.4.1), these surveys has been included in the VPA based on the assumption that the surveys in August are representative for the stock situation on 1 July. It should be noted that the SGFS recruitment indices from 1998 should be used with caution as a new survey design (new vessel and new gear) was introduced in 1998. However, the VPA does not use 0-group indices from this survey series any year, and the same levels and trends for the 1+-group is observed for the SGFS as for the EGFS for which reason the SGFS survey index for the age groups 1–3 was included in the SXSA.

Both the surveys and the national landings indicate that the 1991, 1994 and 1996 year classes of Norway pout were strong. The 0-group estimates in the beginning of quarter 3 for these year classes are 170, 252 and 203 millions, respectively. Both the catches as 0- and 1-group in the commercial fishery in 1997 and 1998 as well as the survey indices from 1997–98 suggest that the 1997 year class is very weak.

12.6 Historical Stock Trends

Trends in landings, fishing mortality, spawning biomass and recruitment for the period 1974–1997 are presented in Table 12.6.1. These results are also presented in Figures 12.6.1A and B. Historical trends in fishing mortality for 1- and 2-group are shown in Figure 12.6.2.

Average fishing mortality for ages 1–2 was at a level of around 1.0 in the early 1980's up to 1986 but then declined to the a level of approximately 0.7 until 1994 and then again to a level around 0.4 in 1995 to 1997 (Figure 12.6.1). Total effort was high in the period 1982–86. The fishery in 1992–98 concentrated on the strong 1991, 1994 and 1996 year classes as the fishery mainly is targeting both 1-groups and the 2-groups.

Spawning stock biomass decreased in the mid 1980s after having reached peaks at above 300,000 t in 1983–84, but has since slowly increased again with a smaller drop in 1994 and 1995. The spawning stock biomass has in the period 1996–98 increased to 250,000–400,000 t which is on the same level as in 1983–84 (Figure 12.6.1B and Table 12.6.1). Reduction in F since 1987 and good year classes in 1991, 1994 and 1996 have resulted in an increase in SSB in the years 1989–1998.

12.7 Short-Term Forecasts

No forecast is given for this stock. Deterministic catch forecasts as given for most other stocks are not considered appropriate due to the few year classes contributing to the catch, the large dependence of the forecast on the size of year classes which are poorly known and the uncertainty in the forecast arising from variations in natural mortality.

12.8 Medium-Term Predictions

For technical reasons no medium term predictions have been performed (see also under comments to the assessment).

12.9 Long-Term Considerations

In the 1997 assessment for this stock (ICES CM 1998/Assess:7) SSB/R and Y/R -plots were generated for Norway pout in order to produce long term projections for the stock using a quarterly based model for the period 1974–1996. However, no F_{max} could be estimated based on the Y/R-plot (Figure 12.8.3).

12.10 Biological Reference Points

In 1997 a precautionary limit reference point for SSB was proposed based on the lowest observed level of SSB where the stock has produced strong year classes. In line with the 1997 proposal, a deterministic reference point for SSB at 150,000 t is proposed as the B_{pa} for the Norway pout stock.

An F-based reference point has been estimated based on a 50% quantile plot of SSB/R using mean weights and fishing mortalities from the period 1974–1997. This $F_{pa} = 0.76$, which is F_{med}, represents the exploitation level where the stock

has a 50% chance of replacing itself (Figure 12.8.1). The F reference point is independent of the deterministic estimated B_{pa}. Current F is around 0.4.

Historical observed fishing mortality is plotted against deserved SSB in Figure 12.8.2.

A major concern is to ensure that the stock remains on a high enough level to satisfy both a number of fish predators and the fishery. The biomass necessary to support the different predator stocks (especially saithe in the North Sea and Skagerrak) at given levels is not known. It is therefore presently impossible to adjust reference points to take account of predator-prey effects. However, in general it is more appropriate to formulate reference points based on biomass or of total mortality rather than only on fishing mortality. (See also under comments to the assessment).

12.11 Comments on the Assessment

The fishing mortalities and the catches vary considerably between years and seasons for both the important age groups (Table 12.4.1). Calculating an average fishing mortality for the 1- and 2-group therefore seems reasonable. However, as the fishing mortalities vary considerably between years and seasons for both age groups, measurement of a weighted average of the two Fs would give a more precise picture. Variation in the exploitation pattern between age groups, years, and season can be a result of a) changes in distribution of fishing effort which could have lead to reduction in effort targeted at a certain age group; b) when the proportion of a certain age group is very low in the catches one year this proportion is estimated with a higher CV.

It should be noted that there seems to be two levels of the stock-recruitment-relationship for the stock (Figure 12.8.1) with no periodical and historical trends to explain them. Secondly, the dynamics of the Norway pout stock in the North Sea and Skagerrak is mainly driven by the changes in predation mortality and not fishery as the natural mortality is much higher than the fishing mortality. This complicates medium term projections. Evaluation of the stock-recruitment relationship for this stock and the factors and biological processes affecting it, as well as fisheries interactions should be performed in order to investigate the possibilities for producing a realistic stock-recruitment-model and realistic medium term predictions for this stock.

The reasons for performing seasonal VPA are that there are seasonal differences in the fishery and in the fishing pattern (and most likely also in the natural mortality). If the ratio between F and M varies between seasons, then seasonal and annual VPAs will produce different results. Comparisons between annual and seasonal assessments were performed for Norway pout in 1997 (ICES CM 1998/Assess:7). Here it was shown that the annual VPA had a tendency to under-estimate the stock numbers. This indicates that the seasonal VPA is the most adequate for Norway pout.

Table 12.1.1 Norway pout annual landings ('000 t) in the North Sea and Division IIIa, by country, for 1957–1996. (Data provided by Working Group members).

Year	Denmark		Faroes	Norway	Sweden	UK (Scotland)	Others	Total
	North Sea	Div. IIIa						
1957	-	-	-	0.2	-	-	-	0.2
1958	-	-	-	-	-	-	-	-
1959	61.5	-	-	7.8	-	-	-	69.3
1960	17.2	-	-	13.5	-	-	-	30.7
1961	20.5	-	-	8.1	-	-	-	28.6
1962	121.8	-	-	27.9	-	-	-	149.7
1963	67.4	-	-	70.4	-	-	-	137.8
1964	10.4	-	-	51.0	-	-	-	61.4
1965	8.2	-	-	35.0	-	-	-	43.2
1966	35.2	-	-	17.8	-	-	+	53.0
1967	169.6	-	-	12.9	-	-	+	182.6
1968	410.8	-	-	40.9	-	-	+	451.8
1969	52.5	-	19.6	41.4	-	-	+	113.5
1970	142.1	-	32.0	63.5	-	0.2	0.2	238.0
1971	178.5	-	47.2	79.3	-	0.1	0.2	305.3
1972	259.6	-	56.8	120.5	6.8	0.9	0.2	444.8
1973	215.2	-	51.2	63.0	2.9	13.0	0.6	345.9
1974	464.5	-	85.0	154.2	2.1	26.7	3.3	735.8
1975	251.2	-	63.6	218.9	2.3	22.7	1.0	559.7
1976	244.9	-	64.6	108.9	+	17.3	1.7	435.4
1977	232.2	-	50.9	98.3	2.9	4.6	1.0	389.9
1978	163.4	-	19.7	80.8	0.7	5.5	-	270.1
1979	219.9	9.0	21.9	75.4	-	3.0	-	329.2
1980	366.2	11.6	34.1	70.2	-	0.6	-	482.7
1981	167.5	2.8	16.6	51.6	-	+	-	238.5
1982	256.3	35.6	15.4	88.0	-	-	-	395.3
1983	301.1	28.5	24.5	97.3	-	+	-	451.4
1984	251.9	38.1	19.1[1]	83.8	-	0.1	-	393.0
1985	163.7	8.6	9.9	22.8	-	0.1	-	205.1
1986	146.3	4.0	6.6	21.5	-	-	-	178.4
1987	108.3	2.1	4.8	34.1	-	-	-	149.3
1988	79.0	7.9	1.5	21.1	-	-	-	109.5
1989	95.6	5.4	0.8	65.3	+	0.1	0.3	172.5
1990	61.5	12.1	0.9	77.1	+	-	-	151.6
1991	85.0	38.3	1.3	68.3	+	-	+	192.9
1992	146.9	44.7	2.6	105.5	+	-	0.1	299.8
1993	97.3	7.8	2.4	76.7	-	-	+	184.2
1994	97.9	6.6	3.6	74.2	-	-	+	182.3
1995	138.4	50.3	8.9	43.1	0.1	-	0.2	241.0
1996	74.3	36.2	7.6	47.8	0.2	0.1	+	166.2
1997	125.8	29.3	7.0	39.1	+	+	0.1	201.3

Table 12.1.2 Norway Pout, North Sea and Skagerak. National landings (t) by month 1993-1997.
(Data provided by Working Group members).

Month	Denmark	Norway	Total	Denmark	Norway	Total
		1993			1994	
Jan	5,678	2,578	8,256	8,600	3,425	12,025
Feb	10,871	7,460	18,331	9,579	4,146	13,725
Mar	6,654	2,558	9,212	4,603	3,478	8,101
Apr	0	4,128	4,128	681	5,126	5,807
May	79	12,585	12,664	0	4,209	4,209
Jun	1,419	10,171	11,590	0	5,340	5,340
Jul	9,646	10,713	20,359	312	9,653	9,965
Aug	10,686	7,866	18,552	4,763	13,524	18,287
Sep	12,609	7,358	19,967	13,697	8,629	22,326
Oct	20,741	4,168	24,909	17,750	8,435	26,185
Nov	10,650	3,995	14,645	21,538	4,706	26,244
Dec	8,296	3,092	11,388	16,335	3,501	19,836
Total	97,329	76,672	174,001	97,858	74,192	172,050

Month	Denmark	Norway	Total	Denmark	Norway	Total
		1995 [1]			1996	
Jan	6,501	1,195	7,696	3,246	458	3,704
Feb	6,501	8,966	15,467	3,307	3,304	6,611
Mar	8,345	5,360	13,705	3,390	6,842	10,232
Apr	3,448	2,646	6,074	1,675	1,802	3,477
May	6,695	5,326	12,021	1,118	1,351	2,469
Jun	7,191	2,667	9,858	153	1,128	1,281
Jul	19,833	1,671	21,504	1,134	6,739	7,873
Aug	11,620	471	12,091	7,192	9,053	16,245
Sep	32,529	3,648	36,177	17,861	11,674	29,535
Oct	39,772	6,837	46,609	14,475	3,028	17,503
Nov	31,378	2,578	33,956	14,813	1,361	16,174
Dec	14,675	1,716	16,391	5,893	1,077	6,970
Total	188,488	43,117	231,605	74,257	47,817	122,074

Month	Denmark	Norway	Total
		1997	
Jan	6490	1,151	7,641
Feb	3344	1,513	4,857
Mar	1303	1,519	2,822
Apr	6	2,137	2,143
May	3319	3,391	6,710
Jun	2516	2,938	5,454
Jul	11425	10,351	21,776
Aug	19890	8091	27,981
Sep	25934	3,104	29,038
Oct	31713	2,056	33,769
Nov	10901	1,210	12,111
Dec	6614	1,618	8,232
Total	123,455	39,079	162,534

[1] IV+IIIa, (North Sea and Skagerak).

Table 12.2.1 NORWAY POUT in the North Sea and Skagerak. Catch in numbers at age by quarter (millions). + represents less than half a million. Data for 1990 were estimated within the SXSA program used in the 1996 assessment.

Year	1978				1979				1980			
Age	1	2	3	4	1	2	3	4	1	2	3	4
0	0	0	304	1,225	0	0	997	890	0	0	25	660
1	2,931	1,181	2,385	1,400	5,231	3,368	4,371	2,219	5,196	2,664	7,942	4,038
2	1,371	650	786	322	968	256	786	172	1,107	710	2,019	527
3	93	194	30	6	175	28	50	11	61	30	19	6
4+	4	0	0	0	3	1	0	0	2	5	0	0
Age Year	1981				1982				1983			
0	0	0	78	36,926	0	0	156	1,090	0	0	446	2,671
1	2,245	1,083	1,329	1,048	5,425	3,349	6,773	3,108	4,207	1,826	5,825	4,296
2	1,705	627	953	304	427	283	444	47	1,297	1,234	1,574	379
3	77	78	17	3	222	24	64	0	15	10	17	7
4+	6	2	0	0	0	0	0	0	0	2	0	0
Age Year	1984				1985				1986			
0	0	0	1	2,231	0	0	6	678	0	0	0	5,572
1	2,759	2,252	5,290	3,492	2,264	857	1,400	2,991	396	260	1,186	1,791
2	1,375	1,165	1,683	734	1,364	145	793	174	1,069	87	245	39
3	143	269	8	0	192	13	19	0	72	3	6	0
4+	0	0	0	0	1	0	0	0	3	0	0	0
Age Year	1987				1988				1989			
0	0	0	8	227	0	0	741	3,146	0	0	151	4,854
1	2,687	1,075	1,627	2,151	249	95	183	632	1,736	678	1,672	1,741
2	401	60	171	233	700	73	250	405	48	133	266	93
3	12	0	0	5	20	0	0	0	6	6	5	13
4+	1	0	0	0	0	0	0	0	0	0	0	0
Age Year	1990				1991				1992			
0	0	0	20	993	0	0	734	3,486	0	0	879	954
1	1,840	1,780	971	1,181	1,501	636	1,519	1,048	3,556	1,522	3,457	2,784
2	584	572	185	116	1,336	404	215	187	1,086	293	389	267
3	20	19	6	4	93	19	22	18	118	20	1	2
4+	10	0	0	0	6	0	0	0	3	0	0	0
Age Year	1993				1994				1995			
0	0	0	96	1,175	0	0	647	4,238	0	0	700	1,692
1	1,942	813	1,147	1,050	1,975	372	1,029	1,148	3,992	1,905	2,545	3,348
2	699	473	912	445	591	285	421	134	240	256	47	59
3	15	58	19	2	56	29	71	0	6	32	3	3
4+	0	0	0	0	0	0	0	0	0	0	0	0
Age Year	1996				1997				1998			
0	0	0	724	2,517	0	0	109	343	*	*		
1	535	560	1043	650	672	99	3,090	1,922	264	233		
2	772	201	1002	333	325	131	372	207	729	259		
3	14	38	37	0	79	119	105	35	53	15		
4+	0	0	0	0	0	0	0	0	9	19		

Table 12.2.2 Norway pout in North Sea + Division IIIa. Mean weights (grams) at age, by quarter, 1983-1998, from Danish and Norwegian catches combined. Data for 1974 to 1982 are assumed to be the same as 1983.

		Age-Group				
Year	Qtr	0	1	2	3	4+
1983	1	.00	7.00	22.00	40.00	56.00
1983	2	.00	15.00	34.00	50.00	56.00
1983	3	4.00	25.00	43.00	60.00	.00
1983	4	6.00	23.00	42.00	58.00	.00
1984	1	.00	6.55	24.04	39.54	.00
1984	2	.00	8.97	22.66	37.00	.00
1984	3	6.54	17.83	34.28	34.10	.00
1984	4	6.54	20.22	35.07	46.23	.00
1985	1	.00	7.86	22.70	45.26	41.80
1985	2	.00	12.56	28.81	43.38	.00
1985	3	8.37	23.10	36.52	58.99	.00
1985	4	6.23	26.97	40.90	.00	.00
1986	1	.00	6.69	29.74	44.08	82.51
1986	2	.00	14.49	42.92	55.39	.00
1986	3	.00	28.81	43.39	47.60	.00
1986	4	7.20	26.90	44.00	.00	.00
1987	1	.00	8.13	28.26	52.93	63.09
1987	2	.00	12.59	31.51	.00	.00
1987	3	5.80	20.16	34.53	.00	.00
1987	4	7.40	23.36	37.32	46.60	.00
1988	1	.00	9.23	27.31	38.38	69.48
1988	2	.00	11.61	33.26	.00	.00
1988	3	9.42	26.54	39.82	.00	.00
1988	4	7.91	30.60	43.31	.00	.00
1989	1	.00	7.98	26.74	39.95	.00
1989	2	.00	13.49	28.70	44.39	.00
1989	3	7.48	26.58	35.44	.00	.00
1989	4	6.69	26.76	34.70	46.50	.00
1990	1	.00	6.51	25.47	37.72	68.00
1990	2	.00	13.75	25.30	40.35	0.00
1990	3	6.40	20.29	32.92	39.40	0.00
1990	4	6.67	28.70	38.90	52.94	0.00
1991	1	.00	7.85	20.54	35.43	44.30
1991	2	.00	12.95	28.75	49.87	.00
1991	3	6.06	30.95	44.28	67.25	.00
1991	4	6.64	30.65	43.10	59.37	.00

Table 12.2.2 (cont'd) Norway pout in North Sea + Division IIIa. Mean weights (grams) at age, by quarter, 1983-1998, from Danish and Norwegian catches combined. Data for 1974 to 1982 are assumed to be the same as 1983.

		Age-Group				
Year	Qtr	0	1	2	3	4+
1992	1	.00	8.78	25.73	41.80	43.90
1992	2	8.00	11.71	31.25	49.49	.00
1992	3	6.70	26.52	42.42	50.00	.00
1992	4	8.14	27.49	44.14	50.30	.00
1993	1	.00	9.32	24.94	46.50	.00
1993	2	.00	14.76	30.58	48.73	.00
1993	3	4.40	25.03	35.19	55.40	.00
1993	4	8.14	26.24	36.44	70.80	.00
1994	1	.00	8.56	25.91	42.09	.00
1994	2	.00	15.22	29.27	46.88	.00
1994	3	5.40	29.26	38.91	53.95	.00
1994	4	8.81	31.23	49.59	.00	.00
1995	1	.00	7.70	24.69	50.78	.00
1995	2	.00	10.99	22.95	37.69	.00
1995	3	5.01	25.37	33.40	45.56	.00
1995	4	7.19	24.60	39.57	57.00	.00
1996	1	.00	8.95	21.47	37.58	.00
1996	2	.00	12.06	25.72	37.94	.00
1996	3	3.88	27.81	40.90	50.44	.00
1996	4	5.95	28.09	38.81	56.00	.00
1997	1	.00	7.01	23.11	39.11	.00
1997	2	.00	11.69	26.40	34.47	.00
1997	3	3.61	20.14	31.13	44.03	.00
1997	4	10.18	22.11	32.69	38.62	.00
1998	1	.00	8.77	22.28	34.65	42.36
1998	2	.00	11.34	25.05	32.44	39.95

Table 12.2.3 Norway pout. Mean weight at age in the stock, proportion mature and natural mortality.

Age	w(g)				Matprop	M (per quarter)
	Q1	Q2	Q3	Q4		
0	-	-	4	6	0	0.4
1	7.0	15.0	25.0	23.0	0.1	0.4
2	22.0	34.0	43.0	42.0	1.0	0.4
3	40.0	50.0	60.0	58.0	1.0	0.4
4	56.0	56.0	-	-	1.0	0.4

Table 12.3.1 Norway pout. Danish CPUE data (tonnes/day fishing) by vessel category for 1983-97.

Vessel GRT	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
51-100	12.53	11.60	10.83	11.73	20.26	14.64	9.68	12.56	-	-	-	29.53	-	20.00
101-150	21.35	17.98	19.49	20.70	19.83	19.93	18.21	24.14	26.43	23.72	26.45	39.81	20.67	23.33
151-200	24.17	20.76	22.97	22.20	23.91	24.06	25.62	28.22	34.20	27.36	31.43	42.77	32.55	28.42
201-250	27.82	24.80	25.20	27.51	30.50	27.43	25.34	29.45	37.50	28.44	40.70	39.60	25.00	34.26
251-300	26.59	22.86	25.12	25.58	24.03	26.10	21.87	28.15	31.90	32.05	37.94	37.91	30.25	32.94
301-	37.47	26.86	26.63	31.10	40.09	28.92	25.91	36.73	41.84	35.10	46.09	59.11	85.38	42.97

Table 12.3.2 Days fishing and average GRT of Norwegian vessels fishing for Norway pout by quarter, 1982-1998

		Q1	Q2	Q3	Q4
1982	Effort	528	1578	1043	616
	Ave GRT	178.8	142.0	178.0	187.1
1983	Effort	293	1168	2039	552
	Ave GRT	167.6	168.4	159.9	171.7
1984	Effort	509	1442	1576	315
	Ave GRT	178.5	141.6	161.2	212.4
1985	Effort	363	417	230	250
	Ave GRT	166.9	169.1	202.8	221.4
1986	Effort	429	598	195	222
	Ave GRT	184.3	148.2	197.4	226.0
1987	Effort	412	555	208	334
	Ave GRT	199.3	170.5	158.4	196.3
1988	Effort	296	152	73	590
	Ave GRT	216.4	146.5	191.1	202.9
1989	Effort	132	586	1054	1687
	Ave GRT	228.5	113.7	192.1	178.7
1990	Effort	369	2022	1102	1143
	Ave GRT	211.0	171.7	193.9	187.6
1991	Effort	774	820	1013	836
	Ave GRT	196.1	180.0	179.4	187.7
1992	Effort	847	352	1030	1133
	Ave GRT	206.3	181.3	202.2	199.8
1993	Effort	475	1045	1129	501
	Ave GRT	227.5	206.6	217.8	219.8
1994	Effort	436	450	1302	686
	Ave Grt	226.5	223.5	212.0	211.4
1995	Effort	545	237	155	297
	Ave Grt	223.6	233.8	221.7	218.1
1996	Effort	456	136	547	132
	Ave Grt	213.6	219.9	208.3	207.2
1997	Effort	132	193	601	218
	Ave Grt	202.4	218.9	194.8	182.3
1998	Effort	497	272		
	Ave-Grt	192.6	216.5		

Table 12.3.3 Combined Danish and Norwegian fishing effort (standardised) for Norway pout.

		Q1	Q2	Q3	Q4	Total
1987	Norway	441	547	197	355	1539
	Denmark	1169	7	1333	1946	4455
	Total	1610	554	1530	2301	5994
1988	Norway	316	143	75	617	1151
	Denmark	910	3	464	1957	3334
	Total	1226	146	539	2574	4485
1989	Norway	146	483	1093	1701	3423
	Denmark	565	76	1323	2009	3973
	Total	711	559	2416	3710	7396
1990	Norway	408	2001	1165	1188	4762
	Denmark	574	616	446	1167	2803
	Total	982	2617	1611	2355	7565
1991	Norway	824	833	1027	869	3553
	Denmark	979	18	517	1524	3038
	Total	1803	851	1544	2393	6591
1992	Norway	901	357	1087	1191	3536
	Denmark	1682	101	1213	1264	4260
	Total	2583	458	2300	2455	7796
1993	Norway	525	1115	1229	547	3416
	Denmark	1210	35	1527	1650	4422
	Total	1735	1150	2756	2197	7838
1994	Norway	502	514	1447	761	3224
	Denmark	1106	27	452	1283	2868
	Total	1608	541	1899	2044	6092
1995	Norway	581	256	165	315	1317
	Denmark	685	78	571	1561	2895
	Total	1266	334	736	1876	4212
1996	Norway	511	155	604	145	1415
	Denmark	456	116	571	905	2048
	Total	967	271	1175	1050	3463
1997	Norway	132	193	601	218	1144
	Denmark	321	5	1444	1413	3183
	Total	453	198	2045	1631	4327
1998	Norway	497	272			769
	Denmark	542	32			574
	Total	1039	304			1343

Table 12.3.4 Research vessel indices of abundance for Norway Pout.

Year Class	IBTS/IYFS[1] February			EGFS[2,3] August				SGFS[4] August			
	1-group	2-group	3-group	0-group	1-group	2-group	3-group	0-group	1-group	2-group	3-group
1970	35	6	-	-	-	-	-	-	-		-
1971	1,556	22	-	-	-	-	-	-	-	-	-
1972	3,425	653	-	-	-	-	-	-	-	-	-
1973	4,207	438	-	-	-	-	-	-	-	-	-
1974	25,626	399	-	-	-	-	-	-	-	-	-
1975	4,242	2,412	-	-	-	-	-	-	-	-	-
1976	4,599	385	-	-	-	-	-	-	-	-	-
1977	4,813	334	-	-	-	-	-	-	-	-	-
1978	1,913	1,215	-	-	-	-	-	-	-	-	-
1979	2,690	240	-	-	-	-	-	-	-	-	-
1980	4,081	611	-	-	-	-	-	-	1,928	346	12
1981	1,375	557	-	-	-	-	-	-	185	127	9
1982	3,315	403	-	6,594	2,609	39	77	8	991	44	22
1983	2,331	663	9	6,067	1,558	114	0.4	13	490	91	1
1984	3,925	802	58	457	3,605	359	14	2	615	69	9
1985	2,109	1,423	71	362	1,201	307	0	5	636	173	5
1986	2,043	384	23	285	717	150	80	38	389	54	9
1987	3,023	469	65	8	552	122	0.9	7	338	23	1
1988	127	760	13	165	102	134	21	14	38	209	4
1989	2,079	260	178	1,530	1,274	621	20	2	382	21	14
1990	1,320	773	46	2,692	917	158	23	58	206	51	2
1991	2,497	677	129	1,509	683	399	6	10	732	42	6
1992	5,121	902	33	2,885	6,193	1,069	157	12	1,715	221	24
1993	2,681	2,644	259	5,699	3,278	1,715	0	2	580	329	20
1994	1,868	375	67	7,764	1,305	112	7	136	387	106	6
1995	5,941	785	77	7,546	6,174	387	14	37	2,438	234	21
1996	912	2,635	234	3,274	1,262	303	2	127	412	321	8
1997	9,752	1,474	670	1,103	5,579	364	32	1	2154	130	32
1998	1006	5343	300	2684	411	248	0	2628	938	1027	5

[1]International Bottom Trawl Survey, arithmetic mean catch in no./h in standard area.
[2]English groundfish survey, arithmetic mean catch in no./h, 22 selected rectangles within Roundfish areas 1, 2, and 3.
[3]1982-91 EGFS numbers adjusted from Granton trawl to GOV trawl by multiplying by 3.5.
[4]Scottish groundfish surveys, arithmetic mean catch no./h.

Table 12.4.1 Seasonal extended survivors analysis (SXSA) of Norway Pout in the North Sea and Skagerak.

SURVIVORS ANALYSIS OF: Norway pout 1998

The following parameters were used:

Year range: 1983 - 1998
Seasons per year: 4
The last season in the last year is season : 2
Youngest age: 0; Oldest age: 3; (Plus age: 4)
Recruitment in season: 3
Spawning in season: 1

The following fleets were included:
Fleet 1: commercial
Fleet 2: ibts
Fleet 3: egfs
Fleet 4: sgfs

The following options were used:

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

Data were input from the following files:
Catch in numbers: canum.qrt
Weight in catch: weca.qrt
Weight in stock: west.qrt
Natural mortalities: natmor.qrt
Maturity ogive: matprop.qrt
Tuning data (CPUE): tuning.xsa
Weighting for rhats: rweigh.xsa

Catch in numbers in millions for fleet: 1
Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	446.	2671.	*	*	1.	2231.	*	*	6.	678.
1	4207.	1826.	5825.	4296.	2759.	2252.	5290.	3492.	2254.	857.	1400.	2991.
2	1297.	1234.	1574.	379.	1375.	1165.	1683.	734.	1364.	145.	793.	174.
3	15.	10.	17.	7.	143.	269.	8.	0.	132.	13.	19.	0.
4+	0.	2.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.
SOP	58587.	69964.	216106.	131207.	56790.	56532.	152291.	110942.	57464.	15509.	62489.	92017.

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.	5572.	*	*	8.	227.	*	*	741.	3146.
1	396.	260.	1186.	1791.	2687.	1075.	1627.	2151.	249.	95.	183.	632.
2	1069.	87.	245.	39.	401.	60.	171.	233.	700.	74.	250.	405.
3	72.	3.	6.	0.	12.	0.	0.	5.	20.	0.	0.	0.
4+	3.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.
SOP	37889.	7657.	45085.	89993.	33894.	15435.	38729.	60847.	22181.	3559.	21793.	61762.

Table 12.4.1 (Cont'd)

Catch in numbers in millions for fleet: 1
Commercial fishery

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	159.	4854.	*	*	20.	993.	*	*	734.	3486.
1	1736.	678.	1672.	1741.	1840.	1780.	971.	1181.	1501.	636.	1519.	1048.
2	48.	133.	266.	93.	584.	572.	185.	116.	1336.	404.	215.	187.
3	6.	6.	5.	13.	20.	19.	6.	4.	93.	19.	22.	18.
4+	0.	0.	0.	0.	10.	0.	0.	0.	6.	0.	0.	0.
SOP	15379.	13234.	55066.	82880.	28287.	39713.	26156.	45242.	42776.	20786.	62518.	64380.

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	879.	954.	*	*	96.	1175.	*	*	647.	4238.
1	3556.	1522.	3457.	2784.	1942.	813.	1147.	1050.	1975.	372.	1029.	1148.
2	1086.	293.	389.	267.	699.	473.	912.	445.	591.	285.	421.	134.
3	118.	20.	1.	2.	15.	58.	19.	2.	56.	29.	71.	0.
4+	3.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOP	64224.	27973.	114122.	96177.	36206.	29291.	62290.	53470.	34575.	15373.	53799.	79838.

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	700.	1692.	*	*	724.	2517.	*	*	109.	343.
1	3992.	1905.	2545.	3348.	535.	560.	1043.	650.	672.	99.	3090.	1922.
2	240.	256.	47.	59.	772.	201.	1002.	333.	325.	131.	372.	207.
3	6.	32.	3.	3.	14.	38.	37.	0.	79.	119.	105.	35.
4+	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOP	36942.	28019.	69763.	97048.	21888.	13366.	74631.	46194.	15320.	8708.	78809.	54096.

Year	1998	
Season	1	2
AGE		
0	*	*
1	264.	233.
2	729.	259.
3	53.	18.
4+	9.	19.
SOP	20803.	10395.

Stock numbers in millions (at start of season)

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	154290.	103059.	*	*	79425.	53239.	*	*	57990.	38867.
1	109544.	69985.	45417.	25675.	66895.	42582.	26700.	13566.	33861.	20844.	13270.	7749.
2	13716.	8132.	4440.	1687.	13693.	8053	4445.	1602.	6235.	3063.	1934.	648.
3	117.	66.	36.	11.	820.	433.	70.	40.	473.	160.	96.	49.
4+	6.	3.	0.	0.	1.	1.	0.	0.	27.	18.	12.	8.
SSN	24793.				21204.				10121.			
SSB	383454.				380951.				181296.			
TSN	123383.	78185.	204184.	130432.	81410.	51069.	110640.	68448.	40595.	24084.	73303.	47320.
TSB	1073582.	1329700.	1945701.	1280368.	802392.	934212.	1180520.	701066.	394619.	425766.	652676.	441454.

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	114306.	76621.	*	*	33252.	22283.	*	*	90617.	60136.
1	25498.	16767.	11026.	6420.	46799.	29170.	18673.	11185.	14751.	9684.	6414.	4149.
2	2746.	965.	576.	185.	2838.	1573.	1005.	534.	5737.	3272.	2133.	1225.
3	291.	136.	89.	55.	92.	52.	35.	23.	167.	96.	64.	43.
4+	38.	23.	15.	10.	44.	28.	19.	13.	20.	13.	9.	6.
SSN	5625.				7653.				7399.			
SSB	92035.				101321.				144348.			
TSN	28573.	17891.	126012.	83292.	49773.	30824.	52984.	34038.	20675.	13066.	99237.	65559.
TSB	252671.	292411.	762972.	618348.	396156.	495243.	645158.	414736.	237279.	262064.	618387.	510204.

Table 12.4.1 (Cont'd)

Stock numbers (at start of season) in millions

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	101882.	68163.	*	*	98021.	65689.	*	*	169870.	113267.
1	37735.	23873.	15447.	8986.	41718.	26458.	16278.	10116.	43220.	27742.	18076.	10872.
2	2264.	1478.	882.	373.	4598.	2604.	1277.	705.	5814.	2804.	1549.	862.
3	490.	323.	212.	138.	174.	100.	52.	30.	377.	177.	103.	51.
4+	33.	22.	15.	10.	89.	51.	34.	23.	32.	17.	11.	7.
SSN	6560.				9033.				10546.			
SSB	97651.				142285.				175060.			
TSN	40521.	25696.	118437.	77670.	46578.	29213.	115662.	76563.	49443.	30739.	189609.	125059.
TSB	335379.	425755.	844340.	639338.	405106.	493286.	857048.	658130.	447343.	521236.	1204159.	968809.

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	80082.	52960.	*	*	65811.	44036.	*	*	252330.	168613.
1	73071.	46069.	29635.	17034.	34719.	21683.	13869.	8357.	28556.	17525.	11442.	6828.
2	6430.	3421.	2053.	1058.	9139.	5554.	3336.	1489.	4742.	2695.	1573.	710.
3	425.	188.	110.	73.	490.	317.	165.	95.	634.	379.	230.	96.
4+	24.	14.	9.	6.	51.	34.	23.	15.	72.	48.	32.	22.
SSN	14186.				13153.				8304.			
SSB	210966.				247864.				153736.			
TSN	79950.	49692.	111889.	71132.	44401.	27588.	83204.	53993.	34005.	20648.	265609.	176268.
TSB	671313.	817544.	1156077.	758207.	466597.	531851.	763302.	524490.	333641.	376180.	1376852.	1204121.

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	86342.	57304.	*	*	203363.	135725.	*	*	21877.	14576.
1	109554.	70168.	45476.	28400.	37027.	24382.	15885.	9794.	88919.	59054.	39504.	23951.
2	3637.	2241.	1292.	828.	16295.	10291.	6734.	3694.	6032.	3777.	2425.	1321.
3	366.	241.	135.	88.	507.	328.	189.	97.	2203.	1412.	849.	483.
4+	79.	53.	36.	24.	73.	49.	33.	22.	79.	53.	36.	24.
SSN	15038.				20578.				17207.			
SSB	175782.				408762.				287527.			
TSN	113637.	72704.	133281.	86644.	53902.	35050.	226204.	149332.	97234.	64296.	64691.	40355.
TSB	865974.	1143752.	1545964.	1036925.	642030.	734765.	1511464.	1200359.	847714.	1087818.	1230330.	721841.

Year	1998	
Season	1	2
AGE		
0	*	*
1	9490.	6145.
2	14481.	9110.
3	716.	436.
4+	312.	201.
SSN	16457.	
SSB	371308.	
TSN	24998.	15892.
TSB	431096.	434993.

Partial fishing mortality for fleet: 1
Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.004	0.032	*	*	0.000	0.052	*	*	0.000	0.021
1	0.048	0.032	0.167	0.224	0.051	0.066	0.270	0.364	0.084	0.051	0.136	0.594
2	0.121	0.201	0.534	0.311	0.129	0.191	0.580	0.744	0.302	0.059	0.642	0.383
3	0.166	0.190	0.757	1.385	0.235	1.144	0.150	0.000	0.634	0.106	0.275	0.000
4+	0.000	1.807	*	*	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000
F (1- 2)	0.084	0.117	0.351	0.267	0.090	0.128	0.425	0.554	0.193	0.055	0.389	0.489

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.000	0.092	*	*	0.000	0.012	*	*	0.010	0.065
1	0.019	0.019	0.139	0.400	0.072	0.046	0.111	0.261	0.021	0.012	0.035	0.202
2	0.601	0.115	0.674	0.288	0.186	0.047	0.227	0.696	0.159	0.028	0.152	0.490
3	0.348	0.026	0.085	0.000	0.171	0.000	0.012	0.298	0.156	0.000	0.000	0.000
4+	0.101	0.000	0.000	0.000	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 12.4.1 (Cont'd)

F (1- 2)	0.310	0.067	0.406	0.344	0.129	0.047	0.169	0.478	0.090	0.020	0.094	0.346
Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.002	0.090	*	*	0.000	0.018	*	*	0.005	0.038
1	0.057	0.035	0.140	0.263	0.055	0.085	0.075	0.151	0.043	0.028	0.107	0.123
2	0.026	0.115	0.440	0.350	0.166	0.303	0.191	0.220	0.319	0.190	0.183	0.298
3	0.015	0.023	0.027	0.120	0.149	0.257	0.151	0.176	0.346	0.139	0.300	0.532
4+	0.000	0.000	0.000	0.000	0.146	0.000	0.000	0.000	0.253	0.000	0.000	0.000
F (1- 2)	0.042	0.075	0.290	0.307	0.110	0.194	0.133	0.185	0.181	0.109	0.145	0.211
Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.013	0.022	*	*	0.002	0.033	*	*	0.003	0.031
1	0.061	0.041	0.151	0.218	0.070	0.046	0.105	0.164	0.087	0.026	0.115	0.225
2	0.226	0.109	0.257	0.356	0.097	0.108	0.391	0.433	0.162	0.136	0.380	0.255
3	0.397	0.137	0.011	0.034	0.037	0.247	0.149	0.026	0.113	0.097	0.450	0.000
4+	0.161	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F (1- 2)	0.143	0.075	0.204	0.287	0.083	0.077	0.248	0.299	0.125	0.081	0.248	0.240
Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.010	0.036	*	*	0.004	0.023	*	*	0.006	0.029
1	0.045	0.033	0.070	0.153	0.018	0.028	0.083	0.084	0.009	0.002	0.099	0.102
2	0.083	0.148	0.045	0.090	0.059	0.024	0.197	0.115	0.067	0.043	0.203	0.209
3	0.018	0.173	0.027	0.042	0.034	0.150	0.262	0.004	0.044	0.107	0.161	0.091
4+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F (1- 2)	0.064	0.091	0.057	0.122	0.038	0.026	0.140	0.099	0.038	0.022	0.151	0.155

Year	1998	
Season	1	2
AGE		
0	*	*
1	0.034	0.047
2	0.063	0.035
3	0.094	0.042
4+	0.036	0.123
F (1- 2)	0.049	0.041

Log inverse catchabilities for fleet: 1
Commercial fishery

Season	1	2	3	4
AGE				
0	*	*	15.576	11.570
1	10.595	10.265	9.950	9.473
2	9.351	8.857	8.970	9.086
3	9.351	8.857	8.970	9.086

Log inverse catchabilities for fleet: 2
IBTS / IYFS

Season	1	2	3	4
AGE				
0	*	*	*	*
1	2.766	*	*	*
2	1.654	*	*	*
3	1.654	*	*	*

Log inverse catchabilities for fleet: 3
EGFS

Season	1	2	3	4
AGE				
0	*	*	4.017	*
1	*	*	2.320	*
2	*	*	1.547	*
3	*	*	1.547	*

Table 12.4.1 (Cont'd)

Log inverse catchabilities for fleet: 4
SGFS

Season	1	2	3	4
AGE				
0	*	*	*	*
1	*	*	3.354	*
2	*	*	2.628	*
3	*	*	2.628	*

Log residual stock number (nhat/n) for fleet: 1
Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	1.224	-0.268	*	*	-4.087	0.132	*	*	-1.144	-0.490
1	-0.373	-0.639	-0.538	-0.418	-0.171	0.246	0.056	-0.020	0.264	0.807	0.197	0.738
2	-0.683	-0.214	-0.358	-0.474	-0.491	-0.103	-0.158	0.307	0.297	-0.458	0.769	-0.087
3	-0.368	-0.269	-0.009	1.019	0.108	1.689	-1.514	*	1.039	0.125	-0.079	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	0.444	*	*	0.104	-0.586	*	*	1.235	0.923
1	-1.570	-0.577	0.264	-0.218	0.570	0.859	0.393	0.382	-0.409	0.709	0.314	0.018
2	0.640	-0.187	0.864	-0.951	0.278	-0.513	0.121	0.969	0.397	0.254	0.798	0.520
3	0.094	-1.670	-1.206	*	0.195	*	*	0.134	0.356	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	-1.636	0.914	*	*	-0.374	0.053	*	*	0.717	0.228
1	1.157	0.609	-0.230	0.030	0.588	-0.057	-0.073	-0.233	-0.061	-0.467	-0.036	-0.416
2	-0.863	0.460	0.060	-0.212	0.740	-0.266	0.036	-0.224	0.711	0.431	-1.247	0.090
3	-1.259	-1.168	*	-1.271	1.142	0.107	0.360	0.057	0.791	0.137	-2.308	0.628

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.261	-0.788	*	*	-0.878	0.224	*	*	1.009	0.360
1	-0.127	0.517	0.039	0.092	0.468	0.073	-0.322	-0.047	0.735	0.325	0.236	0.358
2	-0.011	0.272	-0.176	0.196	-0.451	-0.415	0.082	0.550	0.147	0.569	0.410	0.098
3	0.566	0.730	-3.356	-1.933	-1.488	0.406	-0.865	-2.403	-0.209	0.225	0.617	*

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	2.590	-0.836	*	*	1.567	0.288	*	*	-0.589	-0.597
1	0.341	0.527	0.394	-0.030	-0.642	-1.550	-0.430	0.035	-0.456	-1.254	-0.265	-0.272
2	-0.292	1.136	-0.915	-0.856	-0.352	-0.883	0.221	-0.032	0.293	0.415	-0.507	0.107
3	-1.784	1.289	-1.236	-1.622	-0.910	1.356	0.562	-3.452	0.106	1.335	-0.481	-0.713

Year	1998	
Season	1	2
AGE		
0	*	*
1	-0.313	-0.127
2	-0.362	-0.500
3	0.044	-0.088

Log residual stock number (nhat/n) for fleet: 2
IBTS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	-0.869	*	*	*	0.147	*	*	*	0.221	*	*	*
2	-1.129	*	*	*	-0.934	*	*	*	0.498	*	*	*
3	-0.643	*	*	*	-0.701	*	*	*	0.204	*	*	*

Table 12.4.1 (Cont'd)

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.444	*	*	*	0.252	*	*	*	-1.786	*	*	*
2	0.121	*	*	*	0.128	*	*	*	-0.105	*	*	*
3	-0.546	*	*	*	1.570	*	*	*	-0.640	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.087	*	*	*	-0.469	*	*	*	0.128	*	*	*
2	-0.305	*	*	*	0.136	*	*	*	-0.168	*	*	*
3	0.842	*	*	*	0.582	*	*	*	0.919	*	*	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.329	*	*	*	0.430	*	*	*	0.272	*	*	*
2	-0.020	*	*	*	0.650	*	*	*	-0.619	*	*	*
3	-0.543	*	*	*	1.225	*	*	*	-0.351	*	*	*

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.065	*	*	*	-0.736	*	*	*	0.754	*	*	*
2	0.351	*	*	*	0.051	*	*	*	0.468	*	*	*
3	0.296	*	*	*	1.090	*	*	*	0.677	*	*	*

Year	1998	
Season	1	2
AGE		
0	*	*
1	0.731	*
2	0.878	*
3	1.019	*

Log residual stock number (nhat/n) for fleet: 3
IGFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.976	*	*	*	-0.947	*	*	*	-0.866	*
1	*	*	-0.786	*	*	*	0.626	*	*	*	0.170	*
2	*	*	-1.705	*	*	*	-0.543	*	*	*	0.155	*
3	*	*	*	*	*	*	0.197	*	*	*	*	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	-1.783	*	*	*	-1.883	*	*	*	-2.093	*
1	*	*	-0.159	*	*	*	-0.959	*	*	*	-1.612	*
2	*	*	0.662	*	*	*	-0.271	*	*	*	-0.961	*
3	*	*	1.672	*	*	*	-1.806	*	*	*	0.623	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.014	*	*	*	0.616	*	*	*	-0.510	*
1	*	*	0.079	*	*	*	-0.330	*	*	*	-0.716	*
2	*	*	1.571	*	*	*	-0.267	*	*	*	0.463	*
3	*	*	-0.608	*	*	*	0.997	*	*	*	-0.975	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.893	*	*	*	1.765	*	*	*	0.731	*
1	*	*	1.014	*	*	*	1.117	*	*	*	0.393	*
2	*	*	1.198	*	*	*	1.238	*	*	*	-0.752	*
3	*	*	2.102	*	*	*	*	*	*	*	-1.568	*

Table 12.4.1 (Cont'd)

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	1.778	*	*	*	0.084	*	*	*	1.226	*
1	*	*	0.547	*	*	*	0.017	*	*	*	0.600	*
2	*	*	0.554	*	*	*	-1.275	*	*	*	-0.068	*
3	*	*	-0.517	*	*	*	-2.696	*	*	*	-1.468	*

Year	1998	
Season	1	2
AGE		
0	*	*
1	*	*
2	*	*
3	*	*

Log residual stock number (nhat/n) for fleet: 4
SGFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	-0.909	*	*	*	-0.108	*	*	*	0.569	*
2	*	*	-0.850	*	*	*	-1.111	*	*	*	0.662	*
3	*	*	-0.481	*	*	*	0.718	*	*	*	-0.019	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	0.264	*	*	*	-0.416	*	*	*	-1.566	*
2	*	*	0.721	*	*	*	-0.859	*	*	*	0.565	*
3	*	*	0.568	*	*	*	-0.725	*	*	*	0.045	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	-0.091	*	*	*	-0.789	*	*	*	0.388	*
2	*	*	-0.735	*	*	*	-0.317	*	*	*	-0.707	*
3	*	*	0.116	*	*	*	-0.364	*	*	*	0.106	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	0.764	*	*	*	0.419	*	*	*	0.211	*
2	*	*	0.702	*	*	*	0.668	*	*	*	0.283	*
3	*	*	1.304	*	*	*	0.777	*	*	*	-0.642	*

Year	1995				1996				1997			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	0.652	*	*	*	-0.068	*	*	*	0.682	*
2	*	*	1.132	*	*	*	-0.137	*	*	*	-0.017	*
3	*	*	0.969	*	*	*	-0.229	*	*	*	-0.387	*

Year	1998	
Season	1	2
AGE		
0	*	*
1	*	*
2	*	*
3	*	*

Table 12.4.1 (Cont'd)

Weighting factors for computing survivors for fleet: 1
Commercial fishery

Season	1	2	3	4
AGE				
0	*	*	0.583	1.698
1	1.474	1.334	3.196	3.110
2	1.905	1.843	1.612	1.899
3	1.107	0.960	0.655	0.544

Weighting factors for computing survivors for fleet: 2
IBTS / IYFS

Season	1	2	3	4
AGE				
0	*	*	*	*
1	1.470	*	*	*
2	1.772	*	*	*
3	1.148	*	*	*

Weighting factors for computing survivors for fleet: 3
EGFS

Season	1	2	3	4
AGE				
0	*	*	0.748	*
1	*	*	1.257	*
2	*	*	1.009	*
3	*	*	0.633	*

Weighting factors for computing survivors for fleet: 4
SGFS

Year	1997			
Season	1	2	3	4
AGE				
0	*	*	*	*
1	*	*	1.439	*
2	*	*	1.329	*
3	*	*	1.529	*

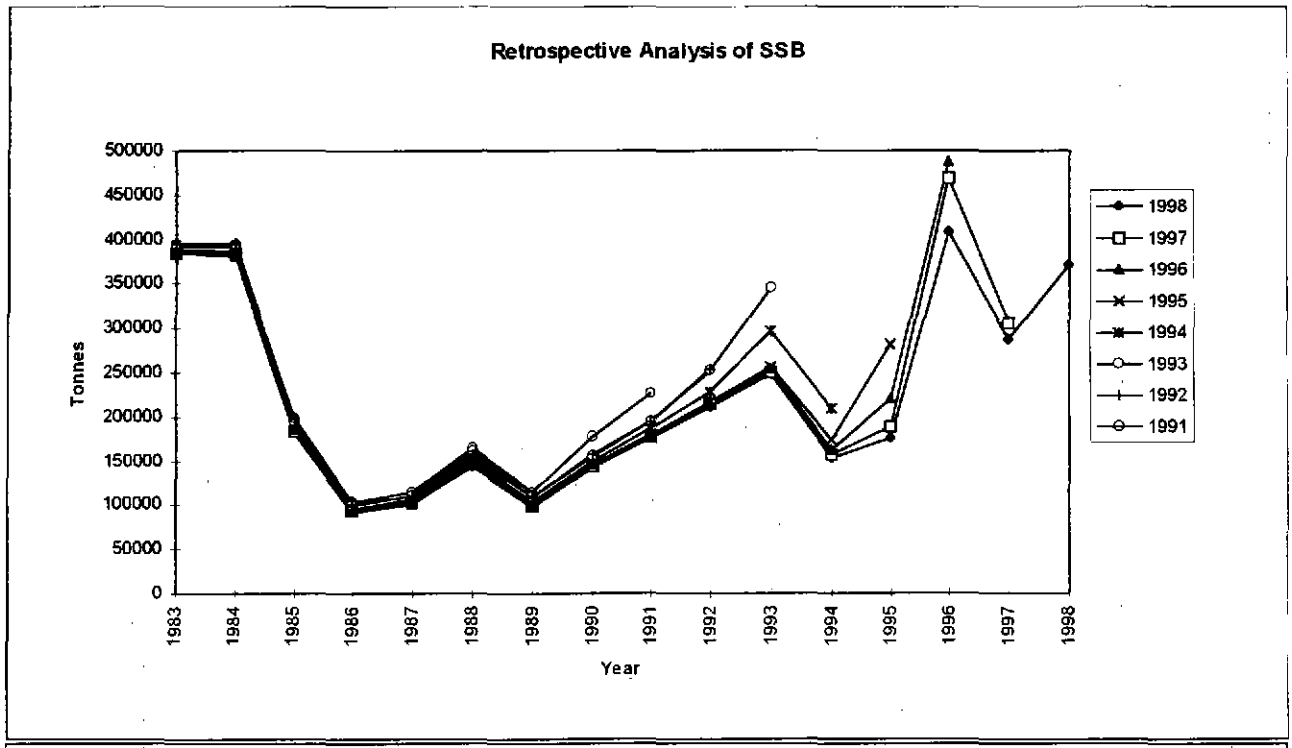
Table 12.6.1 Trends in Yield, Annual fishing mortality for 1- and 2-group, SSB (beginning of year) and Recruitment (0-group, beginning of Q3) for Norway Pout in Norh Sea and Skagerrak[1].

Year	Yield ('000 tonnes)	$F_{ann(1-2)}$	SSB ('000 tonnes)	Recruitment ('000 millions)
1974	735.8	1.84	171	176
1975	559.7	1.206	208	212
1976	435.4	1.204	200	198
1977	389.9	0.835	242	102
1978	270.1	0.907	241	201
1979	329.2	1.006	198	233
1980	482.7	1.233	332	61
1981	238.5	0.777	278	306
1982	395.3	1.016	174	238
1983	451.4	0.819	383	154
1984	393.0	1.197	381	79
1985	205.1	1.126	181	58
1986	178.4	1.127	92	114
1987	149.3	0.823	101	33
1988	109.5	0.550	144	91
1989	172.5	0.714	98	102
1990	151.6	0.622	142	98
1991	192.9	0.646	175	170
1992	299.8	0.709	211	80
1993	184.2	0.707	248	66
1994	182.3	0.694	154	252
1995	241.0	0.334	176	86
1996	166.2	0.303	409	203
1997	201.3	0.366	288	22

[1] The estimates before 1983 are based on previous assessment runs which do not include data from the Skagerrak

Figure 12.4.1 Retrospective analyses of SSB and Recruitment

SXSA - Norway pout in the North Sea and Skagerak



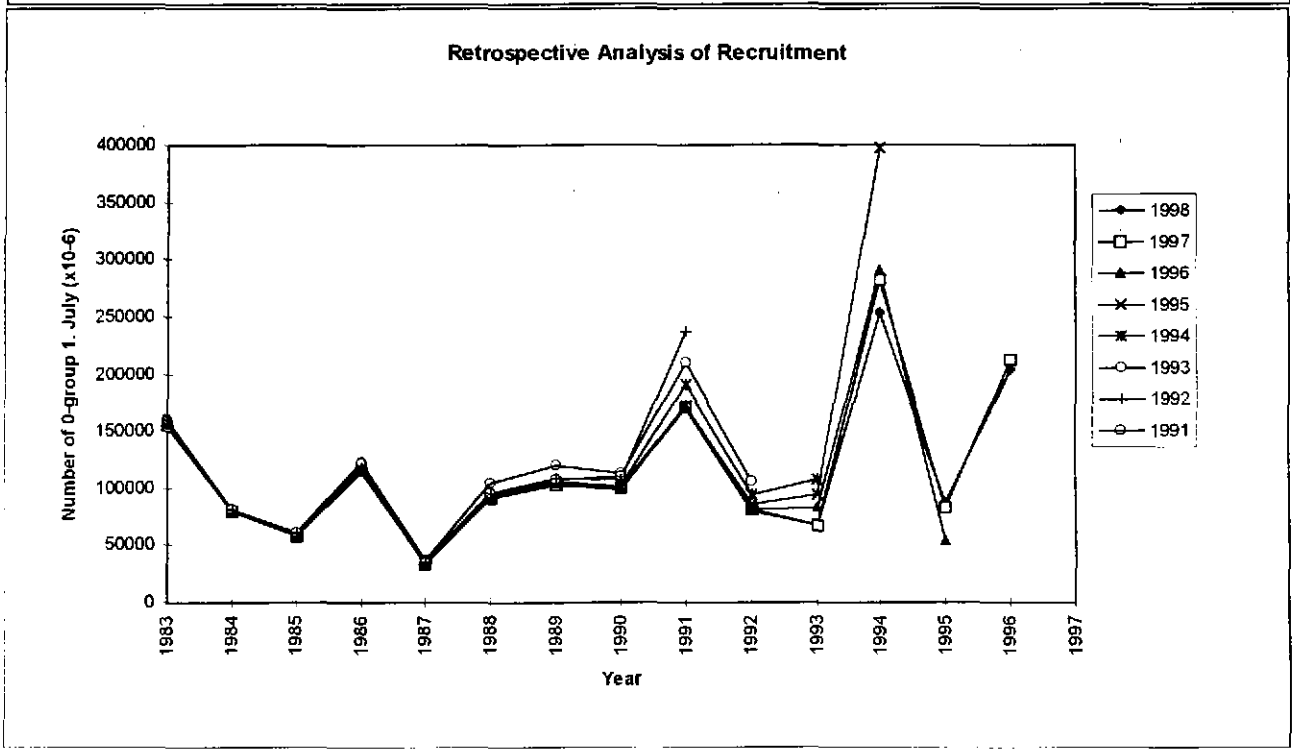
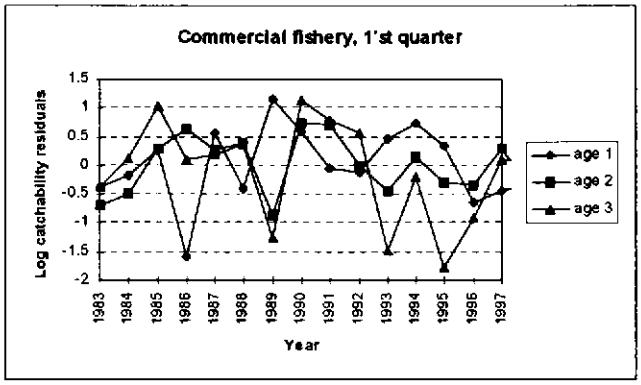
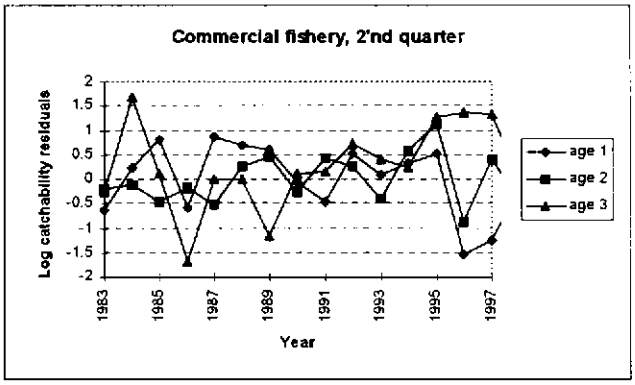
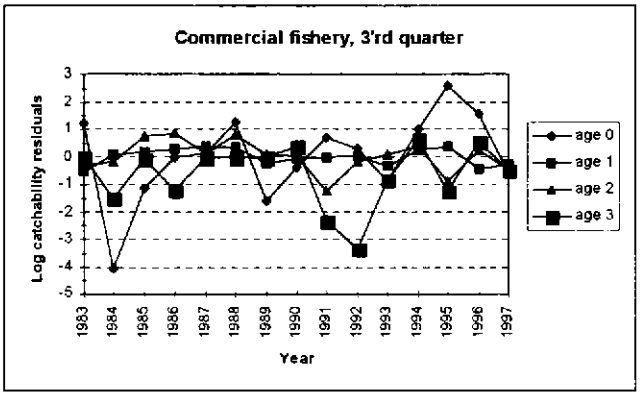


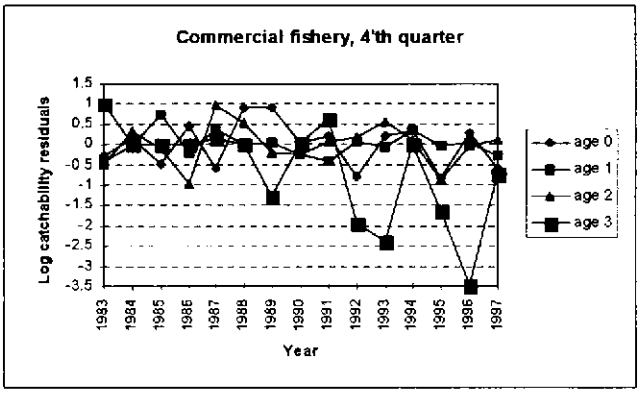
Figure 12.4.2 Log residual stock numbers per age group divided by fleet and season.

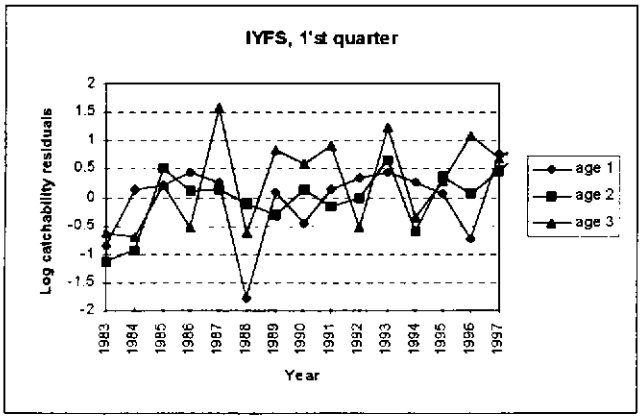
SXSA - Norway pout in the North Sea and Skagerak

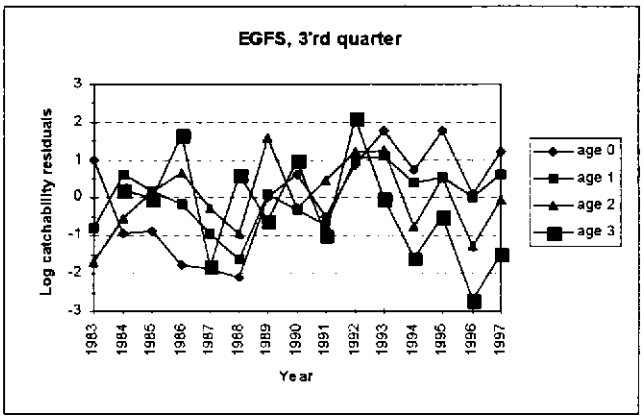












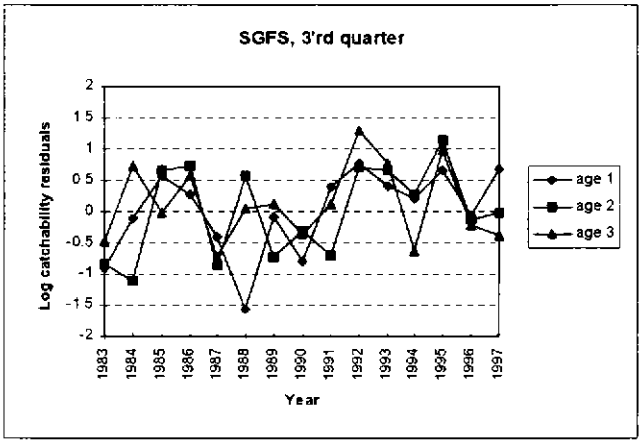


Figure 12.4.3 Weighting factors for computing survivors.

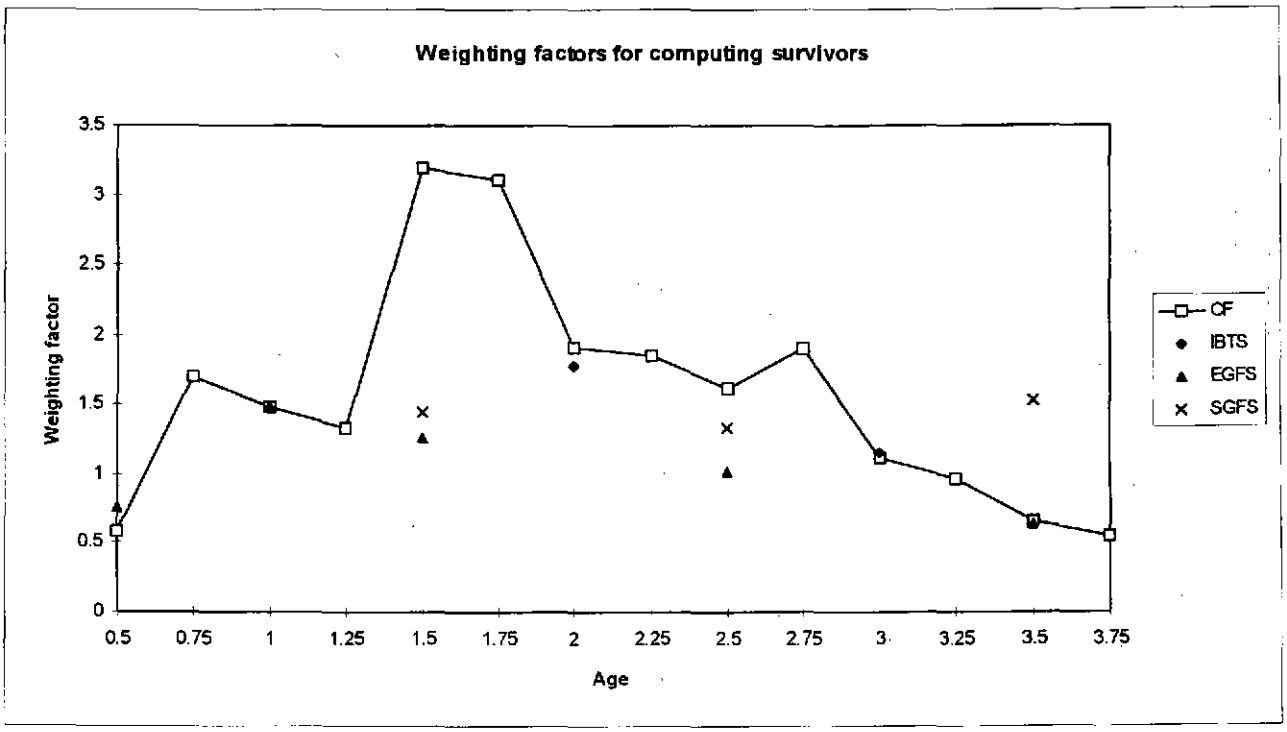
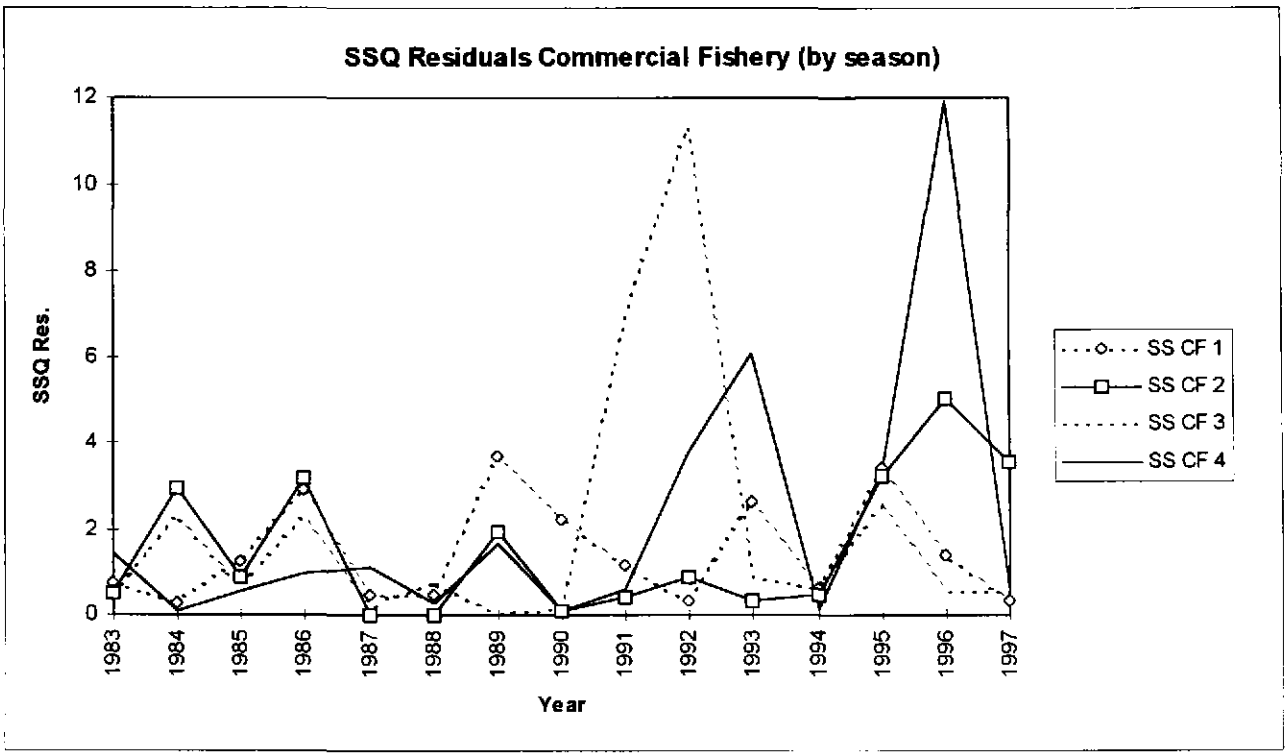


Figure 12.4.4 SSQ residuals for commercial fishery (by season) and for the survey series.

SXSA - Commercial fishery fleet (CF), IBTS, EGFS and SGFS



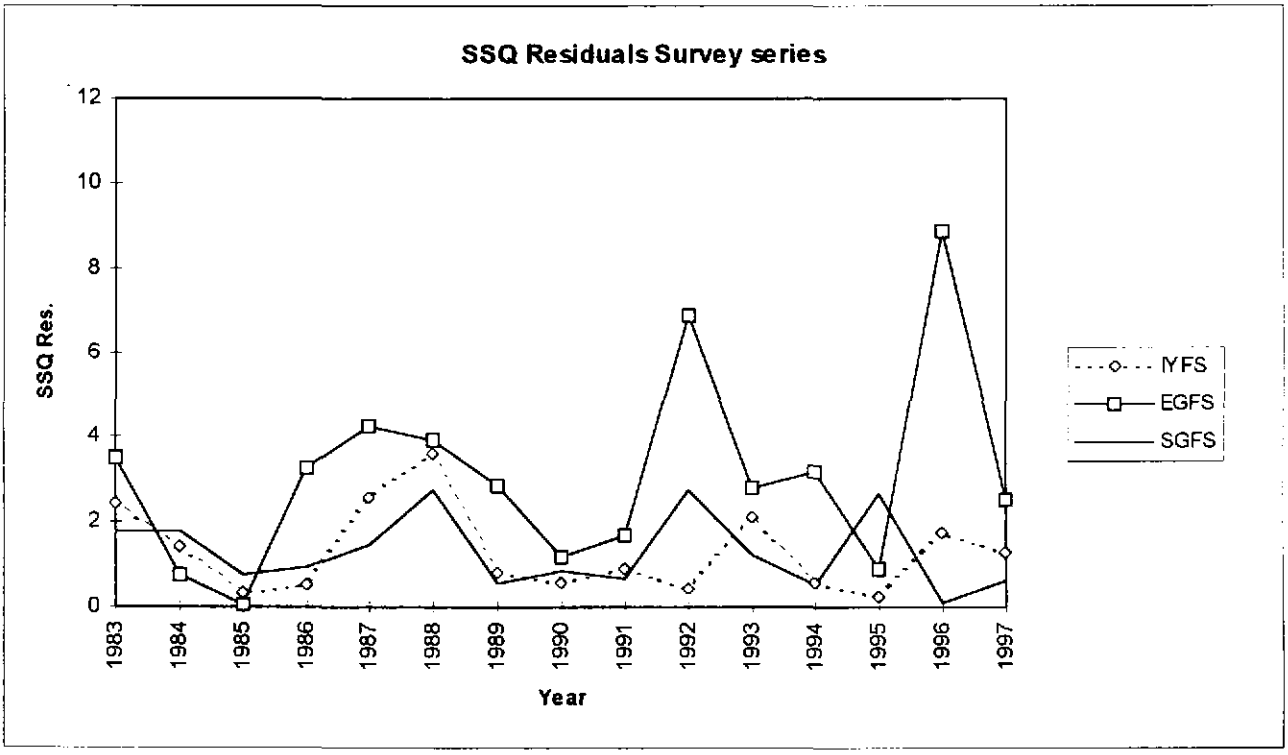


Figure 12.6.1A Historical trends in Yield, Annual fishing mortality for age 1 and 2.

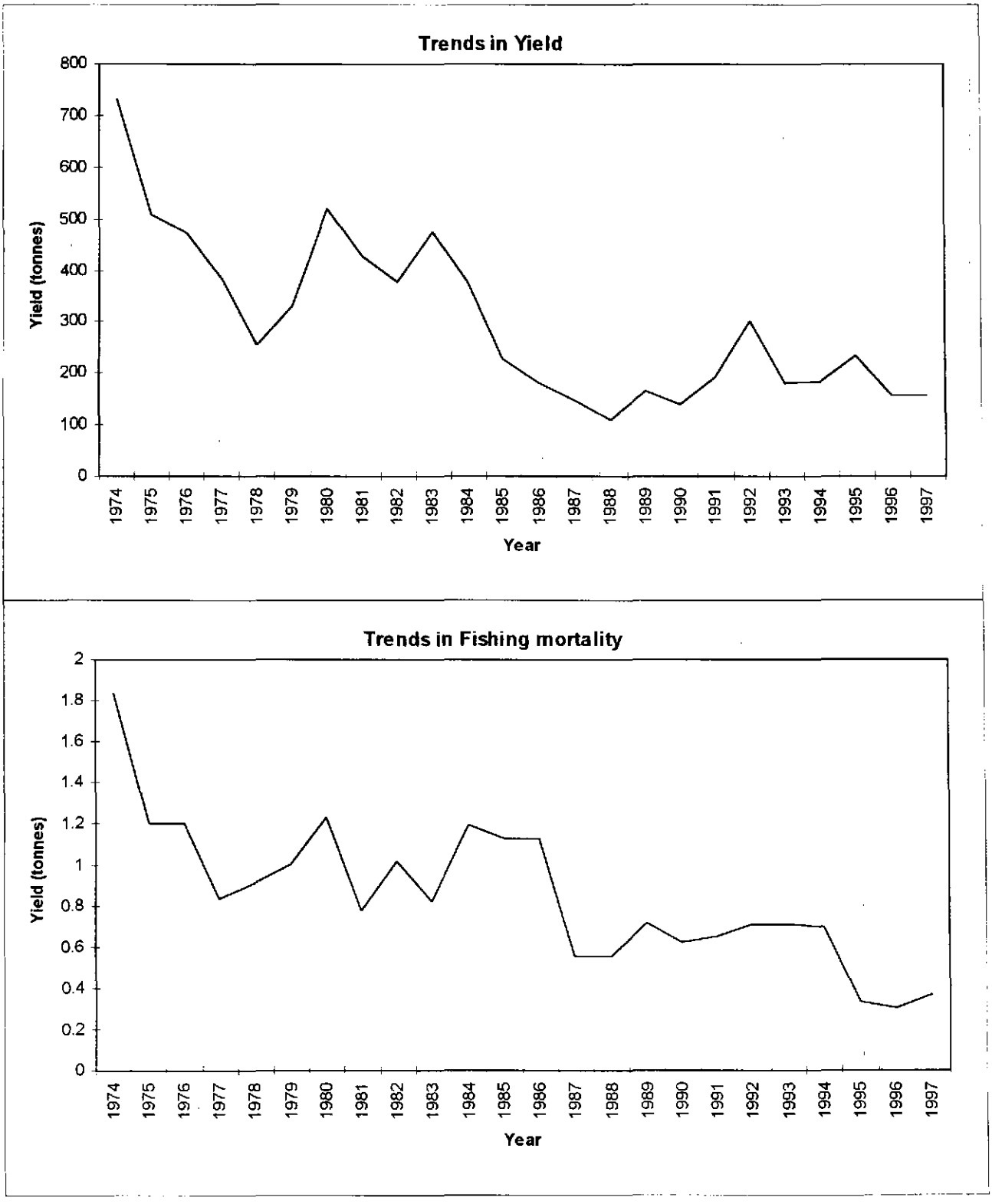


Figure 12.6.1B Historical trends in Spawning Stock Biomass and Recruitment (age 0, 3rd quarter of the year).

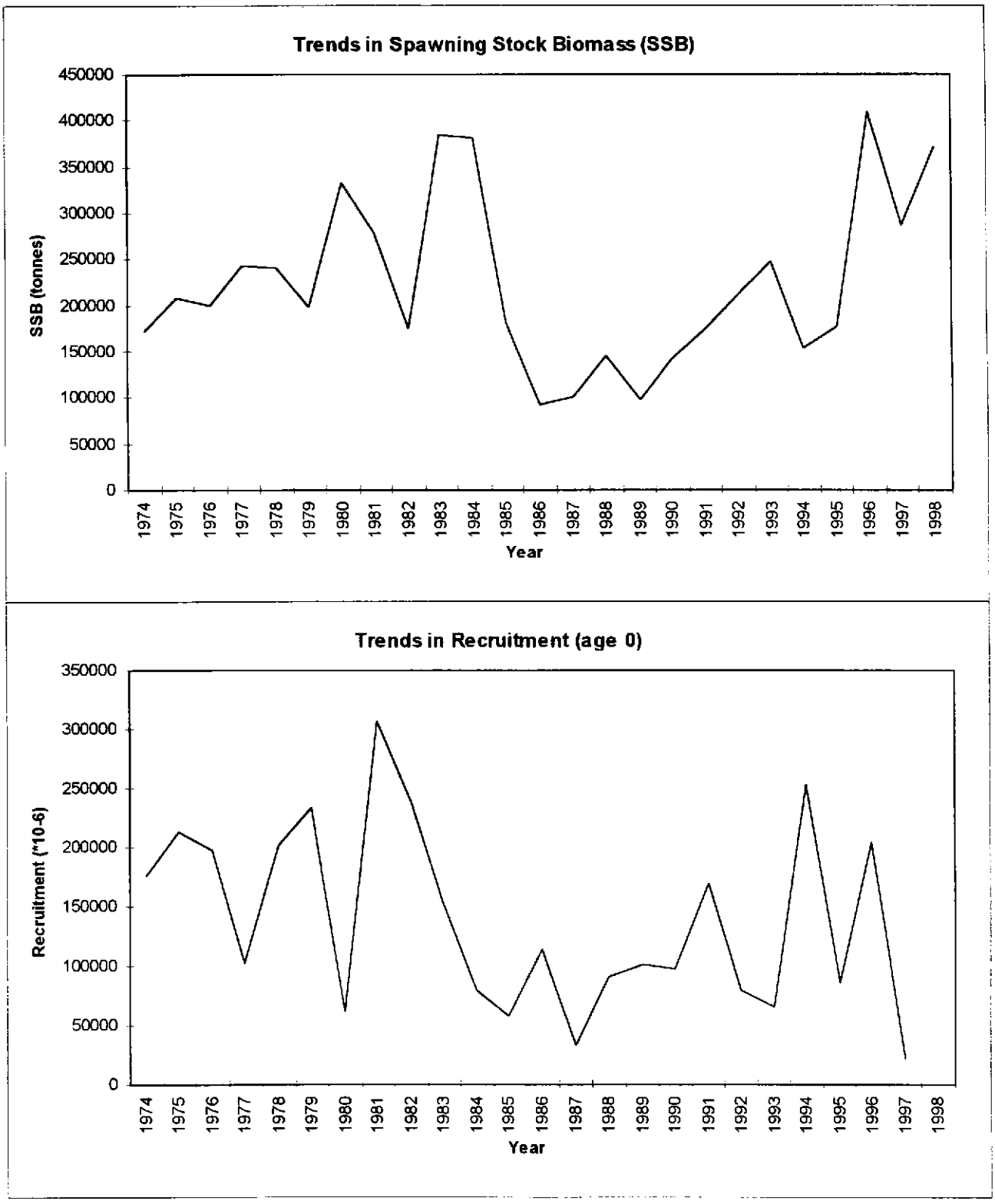


Figure 12.6.2 Historical trends in fishing mortality for 1- and 2-group Norway pout

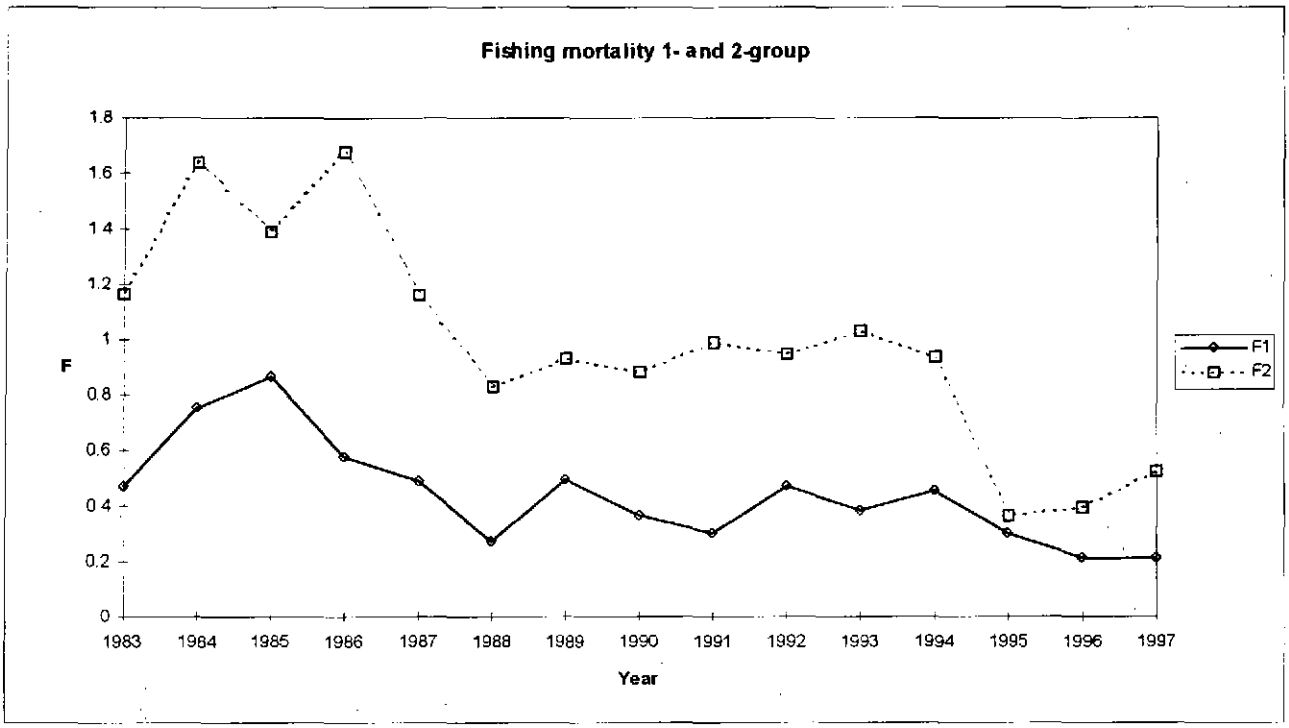


Figure 12.8.1 **Recruitment / SSB plot used to calculate F(pa). SXSA - Norway pout in the North Sea and Skagerak. Period: 1974-1997.**

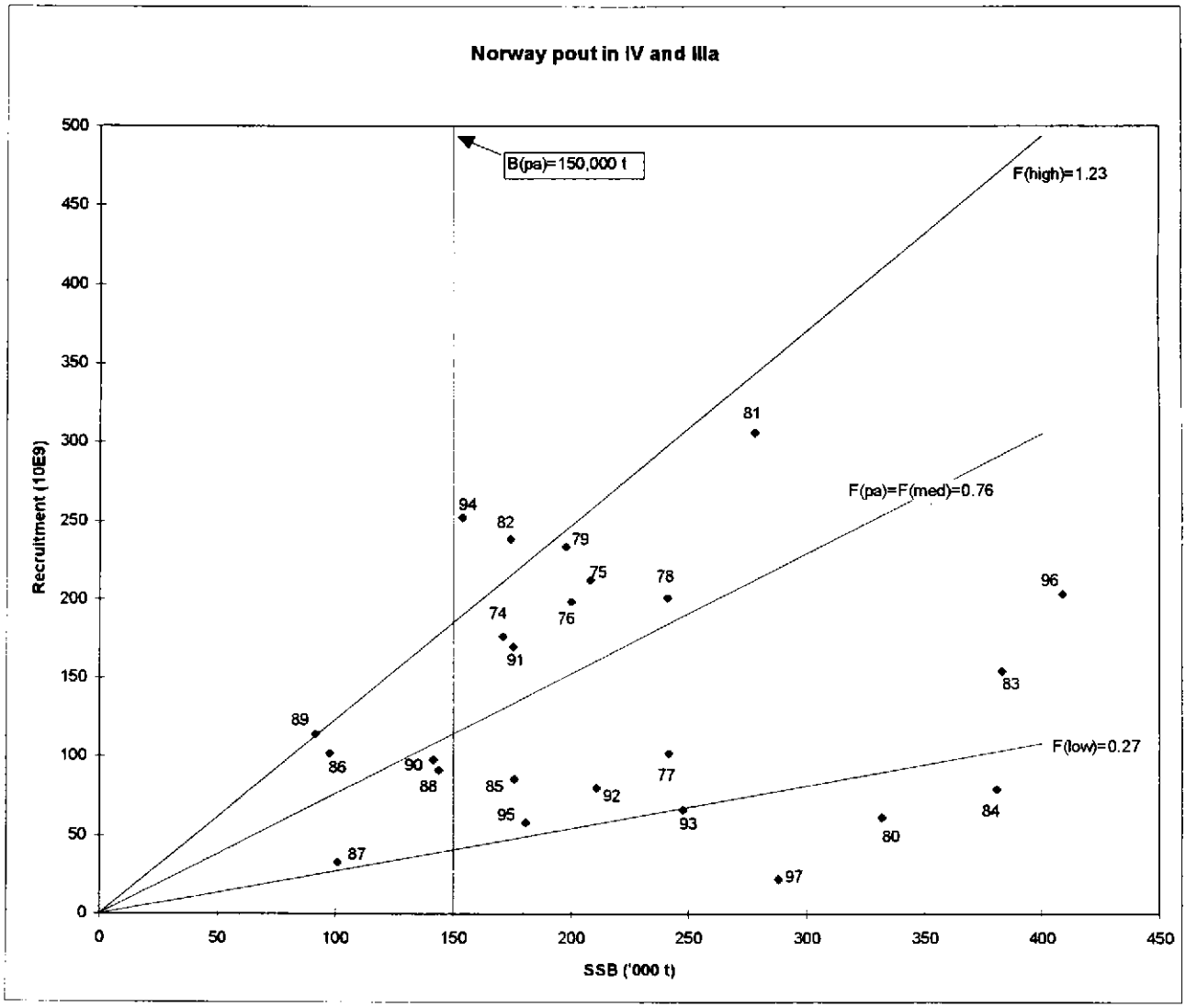
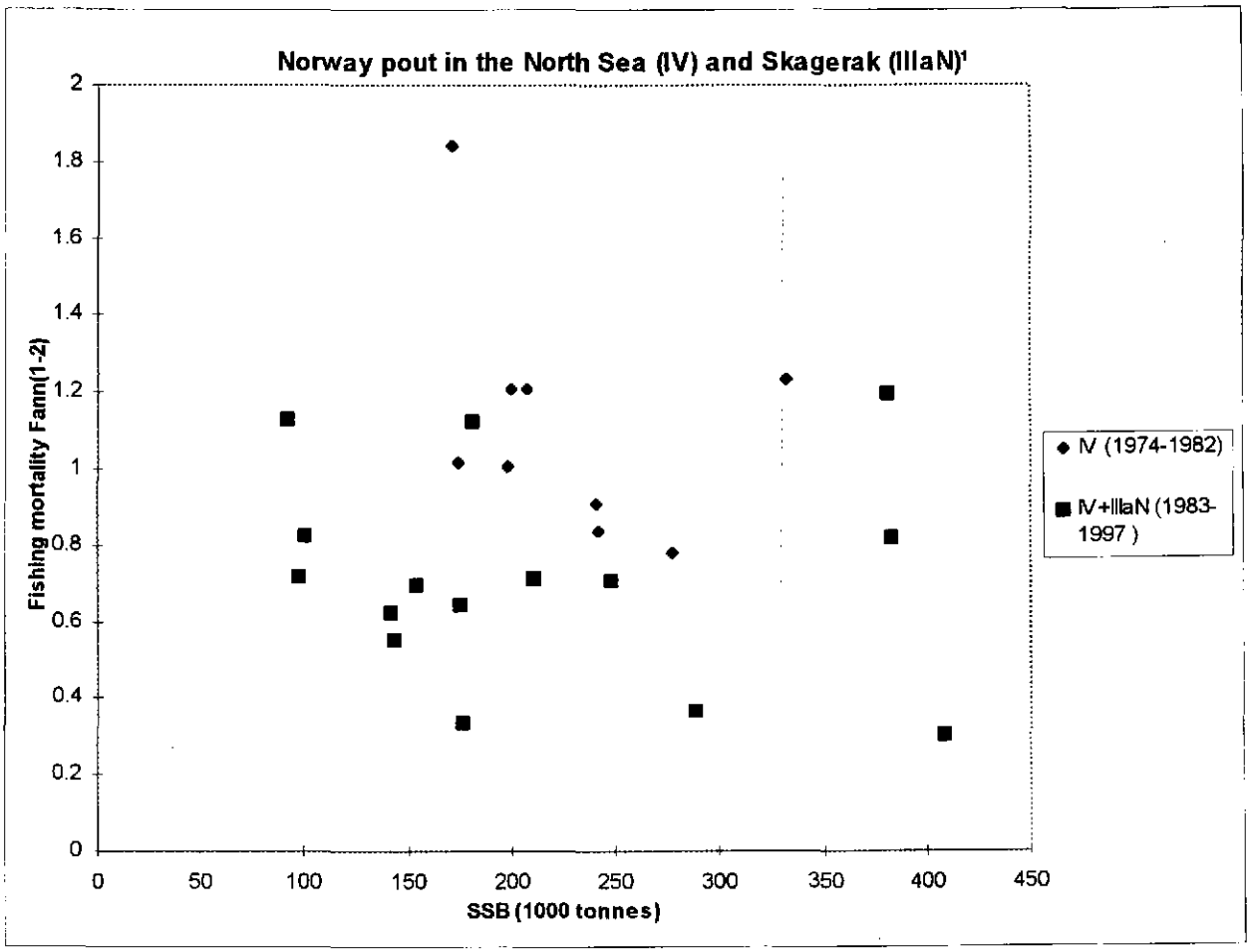
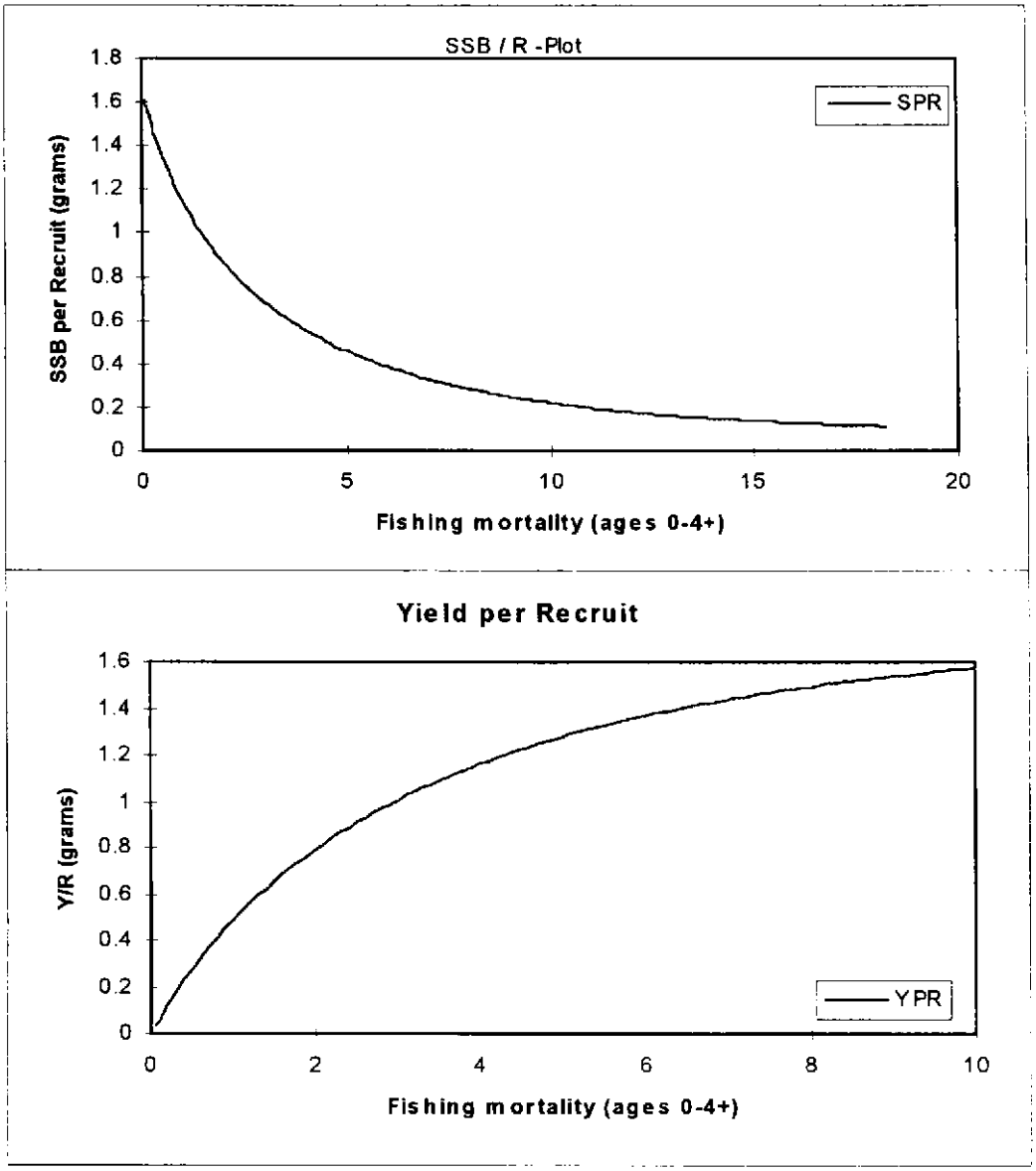


Figure 12.8.2 **Annual fishing mortality, $F_{ann}(1\text{-}2)$, versus SSB for Norway pout in the North Sea and Skagerrak.**



[1] Results and data previous to 1983 do not include Skagerak.

Figure 12.8.3 **SSB / R plot and Y / R plot for Norway pout in the North Sea and Skagerrak**



13 SANDEEL

13.1 Sandeel in Sub-area IV and IIIa

13.1.1 The fishery

13.1.1.1 ACFM advice applicable to 1997 and 1998

There is no management objective set for this stock. There is a need to ensure that the stock remains high enough to provide food for a variety of predator species. The ACFM advice for 1997 and 1998 was that the stock can sustain current fishing mortality. The fishing mortality should not to be allowed to increase because the consequences of removing a larger fraction of the food-biomass for other biota are unknown.

Conventional single species reference points and standard deterministic catch forecasts are inappropriate because of high natural mortality.

13.1.1.2 Management applicable to 1997 and 1998

There was no TAC for 1997 while a TAC of 1 million tonnes was set for 1998.

13.1.1.3 Catch trends

The overall landings of sandeel in the North Sea increased from 835,000 tonnes in 1996 to 1140,000 t in 1997, of which 66% was landed by the Danish fishery, Table 13.1.1.1. The catch in 1997 is the highest on record, which is caused by the large 1-group catches, which also is the highest on record. The same applies to the high catch in the first half of 1998, that also is due to the strong 1996 year class at age 2. This is in accordance with the fact that the 1996 year class at age zero is the largest seen since 1983, Figure 13.1.6.1. The landings in IIIa increased from 54,000 tonnes in 1996 to 82,000 tonnes in 1997.

Landing statistics are listed in Tables 13.1.1.1- 4.

The distribution of the fishery by area was slightly changed in 1997 relative to 1996 as the proportion taken in the northern North Sea increased from about 45 percent in 1996 to about 51 percent in 1997. Landings increased in both areas due to the large 1996 year class. Figure 13.1.1.2 shows the distribution of catches by quarter and ICES statistical rectangle for 1997 and the first half of 1998 based on fishermen's logbooks.

From 1976 and onwards landings have fluctuated around a long-term mean without any particular trend, Figure 13.1.6.1.

13.1.2 Natural mortality, maturity, age composition, mean weight at age

Values of natural mortality and maturity at age assumed in the assessment were the same as used at previous meetings and are given together with weight at age in the stock in Table 13.1.2.1. Natural mortality is an average over years of multispecies M's. The mean weight at age in the stock by half-year was constructed as a weighted average of the mean weight at age in the catch in the northern and southern North Sea weighted by catch in numbers.

The catch and weight at age data for the southern and northern North Sea were worked up separately. The catch and weight at age data from the northern North Sea were constructed by combining Danish and Norwegian data. Before 1996 the Norwegian age composition data were based on Danish ALK's. For 1997 and 1998 the Norwegian age compositions are based on samples from their own fishery. Catch in numbers and weight at age is given in Tables 13.1.2.2 and 13.1.2.3.

Catch numbers and weight at age for the southern North Sea were based on Danish age composition data, Tables 13.1.2.4 and 13.1.2.5. Weights at age are average values prior to 1987 in the southern North Sea and 1989 for the northern North Sea. For both areas the strong 1996 year class can be followed in the catches in 1996 to 1998 at age 0, 1 and 2 respectively.

13.1.3 Catch, effort and research vessel data

13.1.3.1 Calculation of the total international effort in the sandeel fishery

The data from the southern and northern North Sea were treated as two independent fleets. The fleet fishing in the southern North Sea consists almost completely of Danish vessels and the fleet in the northern North Sea being a mixture of Danish and Norwegian vessels and a minimal contribution from other countries. Total international standardised effort was estimated as described in the WG report from 1996. Input data for these calculations are given in the Tables 13.1.3.1 - 13.1.3.6 and total international effort is given in Tables 13.1.3.4 and 13.1.3.6.

In 1996, the Norwegian effort series from 1993 onwards were revised. The number of fishing days is now estimated as the number of trips of the fleet, which is known from landings reports from sales organisations, multiplied by an estimate of the average number of days per trip. The latter is obtained from logbook information from random samples of the fleet. Norwegian fleet effort used in the assessments is given in Table 13.1.3.6.

13.1.3.2 Research vessel data

There are no appropriate survey data available for this species.

13.1.4 Catch-at-age analysis

The Seasonal XSA (SXSA) developed by Skagen (1993) was used to estimate fishing mortalities and stock numbers at age. As in last years assessment, half-yearly fixed weighting factors were applied to the catchabilities in order to down weight the influence of older fish and estimates from the second half of the year, both of which were expected to suffer from higher sampling variance, Table 13.1.4.1.

The assessment was slightly changed compared to last year's assessment. The change is caused by a minor error with the plus group, which was set to 4 in the SXSA. However, the implemented program requires that the input file should be changed such that the catch at age 4 should be the catch of 4+. This has not previously been done and the program has interpreted the catch at age 4 as the plus group. In the present assessment this error has been corrected, but then a new problem arose, as the SXSA program would not converge. This was found to be due to problems with the missing age composition data in 1990. Due to these missing data the age composition of the catch in 1990 has previously been estimated in the SXSA program. As recommended by ACFM these estimated catches were fixed last year and it was these fixed estimates which created the problem. The SXSA was therefore re-run using the option for which the age composition in 1990 was re-estimated. The results of this revised assessment were very similar to last year's assessment.

In the SXSA catchability was assumed to remain constant over the time period considered (1983–1998). The options used (Table 13.1.4.1) were the same as in last years report (except for the fact, that the age composition in catches in 1990 was re-estimated). The analysis resulted in large log stock number residuals, but did not suggest a trend in catchability with time, (Figure 13.1.4.2), thus justifying the constant catchability assumption. A plot of fishing mortality versus effort show a high correlation ($r^2 = 0.77$) between effort and average fishing mortality for ages 1 and 2, Figure 13.1.4.3.

Figure 13.1.4.4 shows the relationship between log stock numbers and log CPUE by age of the tuning fleets.

The retrospective analysis, Figure 13.1.4.1, indicates that the SXSA estimates of sandeel SSB converge rapidly and show no sign of a consistent bias in the most recent estimates.

As in last year's assessment the results indicate that fishing mortality has decreased in most recent years. Recruitment in 1996 is estimated to be the highest on record. Because the weight at age of the 0-group in the stock has been set equal to the weight at age in the catch the estimate of total stock biomass in the second half of the year is likely to be an overestimate and should hence be treated with caution.

The stock-recruitment relationship is shown in Figure 13.1.4.5 indicating that there is no relationship between stock and recruitment. This can also be seen from Figure 13.1.6.1 which indicates that a high sandeel year class is followed by a low year class and reverse.

13.1.5 Recruitment estimates

No recruitment estimates from surveys are available.

13.1.6 Historical stock trends

Average fishing mortality, recruitment at age 0 and SSB are shown in Table 13.1.6.1 and Figure 13.1.6.1 for the period 1976 to 1997.

Fishing mortality has been fluctuating around the long-term average, but appears to have decreased since 1991 to a value below the long-term average of 0.57.

Recruitment has been fluctuating with a pattern of alternating strong and weak year classes. The 1996 year class is estimated to be the largest in the time series while the 1997 year class is low.

The spawning stock biomass has fluctuated around a level of 1 million t. After declining to 485,000 t in 1991 it has been increasing in recent years, and the 1997 and early 1998 estimates were the largest since 1976.

13.1.7 Stochastic short and median term forecast

As stated by ACFM, traditional deterministic forecasts are not appropriate because of high natural mortality and the few year classes exploited by the fishery. Instead stock projections were made using the Lowestoft seasonal XSA, contained in FishLab, to provide estimates of uncertainty using bootstrap and Monte Carlo simulation. The method was the same as presented and described in last year's report.

Empirical probability distributions of quantities of interest, numbers at age, fishing mortality and various reference points, were obtained by bootstrapping the catch at age data. Future stock size was estimated by projecting forward the terminal population estimates obtained. The advantage of this approach compared to the deterministic XSA is that CV of estimated N and F is not underestimated and that the correlation between F and N is included. Recruitment was modelled as a time series including autoregression. Uncertainty in growth, selectivity and natural mortality was included by the use of a non-parametric Monte Carlo simulation where observed weights, partial F's and natural mortality were randomly resampled from the observed historical values. This procedure was thought to reflect the uncertainty in the sandeel stock better.

The projection of SSB investigated the probability of SSB remaining above the median of the minimum SSB of 460 thousand tonnes over a ten years period for different levels of F by applying multipliers of 0.5, 0.75, 1.0, 1.25 and 1.50.

The SSB projections are presented in Figure 13.1.7.1. From 1998–2008 SSB declines from a high level due to the presence of a strong year class in 1996. For F multipliers less than 1 the probability of $SSB < SSB_{pa} = 460$ thousands tonnes (see Section 13.1.8) is less than 12 percent for all years 1998–2008 while the probability is larger than 23 percent for multipliers greater than 1.25.

13.1.8 Biological reference points

Last year, a precautionary limit reference point for SSB was proposed based on the minimum level of SSB observed. The deterministic minimum value was not used. Instead it's empirical probability distribution was calculated and the median minimum value of 330 thousand tonnes was estimated. Last year this was suggested as B_{pa}. However, in accordance with the guidance of SGPAFM, this value is now proposed as B_{lim}. The B_{pa} was estimated to 460 thousand tonnes, approximately equal to $B_{lim} * e^{1.65*0.2}$.

Other biological reference points were also calculated, Table 13.1.8.1. Section 13.1.1.1 refers to ACFM's comment that conventional single species reference points are inappropriate because of high natural mortality. For this reason no attempts have been made to quantify F_{pa}.

Stock recruitment modelling showed no clear indications of a reduction in recruitment at the lower levels of SSB in the time series. However, a major concern is to ensure that the stock remains high enough to provide food for a variety of predator species.

A definition of reference points based on the North Sea assessment assumes that the sandeel stock can be treated as a unit stock. If sandeel in the North Sea consist of a number of smaller self-sustained sub stocks, the use of a reference point for the entire North Sea may be inappropriate.

13.1.9 Comments on the assessment

The present assessment is very similar to that of last year, as estimates of SSB and F in the first half of 1997 only deviate 5 and 6 percent, respectively.

A problem with the assessment is that the dynamics of the sandeel stock is mainly driven by changes in natural mortality as this is about twice fishing mortality and is highly variable. Estimates of population size and reference points are very different if annual rather than average Ms from the Multi-Species Working Group are used.

It should be noted that catches from Div. IIIa are not included in the assessments.

13.2 Sandeel at Shetland

13.2.1 Catch trends

The sandeel population adjacent to Shetland has been exploited since the early 1970s. The grounds fished are close inshore and the vessels involved are generally small and local. Seasonal closures were introduced in 1989 following a decline in SSB and recruitment and poor breeding success of sandeel-dependent seabird populations, and the fishery was closed completely from 1991–1994. A restricted fishery has operated since 1995. Landings in 1997 increased slightly relative to the previous two years, but were still at a very low level (Table 13.1.1.4)

13.2.2 Assessment

Management of the Shetland fishery is on a three year basis, with management measure being agreed in advance of the fishing season and then reviewed every three years. As a result of this ACFM have previously commented that the assessment of this stock need not be updated annually, but instead the assessments need only reflect the three-year management cycle. For this reason the assessment has not been updated this year.

13.2.3 Management in 1998

The fishery re-opened at the start of the 1998 season with a pre-emptive TAC of 7,000 t, limited licensing and seasonal closures. The fishery is closed during the months of June and July to avoid any possibility of the fishery having any impact on the availability of 0-group sandeels to Shetlands seabird populations during their chick-rearing season. It is anticipated that these management measures will remain in place until at least the 2000 fishing season.

Table 13.1.1.1. Landings ('000 t) of sandeel from the North Sea, 1952-1998.
(Data provided by Working Group members.)

Year	Denmark	Germany	Faroes	Netherlands	Norway	Sweden	UK	Total
1952	1.6	-	-	-	-	-	-	1.6
1953	4.5	+	-	-	-	-	-	4.5
1954	10.8	+	-	-	-	-	-	10.8
1955	37.6	+	-	-	-	-	-	37.6
1956	81.9	5.3	-	+	1.5	-	-	88.7
1957	73.3	25.5	-	3.7	3.2	-	-	105.7
1958	74.4	20.2	-	1.5	4.8	-	-	100.9
1959	77.1	17.4	-	5.1	8.0	-	-	107.6
1960	100.8	7.7	-	+	12.1	-	-	120.6
1961	73.6	4.5	-	+	5.1	-	-	83.2
1962	97.4	1.4	-	-	10.5	-	-	109.3
1963	134.4	16.4	-	-	11.5	-	-	162.3
1964	104.7	12.9	-	-	10.4	-	-	128.0
1965	123.6	2.1	-	-	4.9	-	-	130.6
1966	138.5	4.4	-	-	0.2	-	-	143.1
1967	187.4	0.3	-	-	1.0	-	-	188.7
1968	193.6	+	-	-	0.1	-	-	193.7
1969	112.8	+	-	-	-	-	0.5	113.3
1970	187.8	+	-	-	+	-	3.6	191.4
1971	371.6	0.1	-	-	2.1	-	8.3	382.1
1972	329.0	+	-	-	18.6	8.8	2.1	358.5
1973	273.0	-	1.4	-	17.2	1.1	4.2	296.9
1974	424.1	-	6.4	-	78.6	0.2	15.5	524.8
1975	355.6	-	4.9	-	54.0	0.1	13.6	428.2
1976	424.7	-	-	-	44.2	-	18.7	487.6
1977	664.3	-	11.4	-	78.7	5.7	25.5	785.6
1978	647.5	-	12.1	-	93.5	1.2	32.5	786.8
1979	449.8	-	13.2	-	101.4	-	13.4	577.8
1980	542.2	-	7.2	-	144.8	-	34.3	728.5
1981	464.4	-	4.9	-	52.6	-	46.7	568.6
1982	506.9	-	4.9	-	46.5	0.4	52.2	610.9
1983	485.1	-	2	-	12.2	0.2	37	536.5
1984	596.3	-	11.3	-	28.3	-	32.6	668.6
1985	587.6	-	3.9	-	13.1	-	17.2	621.8
1986	752.5	-	1.2	-	82.1	-	12	847.8
1987	605.4	-	18.6	-	193.4	-	7.2	824.6
1988	686.4	-	15.5	-	185.1	-	5.8	892.8
1989	824.4	-	16.6	-	186.8	-	11.5	1039.1
1990	496.0	-	2.2	0.3	88.9	-	3.9	591.3
1991	701.4	-	11.2	-	128.8	-	1.2	842.6
1992	751.1	-	9.1	-	89.3	0.5	4.9	855.0
1993	482.2	-	-	-	95.5	-	1.5	579.2
1994	603.5	-	10.3	-	165.8	-	5.9	765.5
1995	647.8	-	-	-	263.4	-	6.7	917.9
1996	669.1	-	5	-	160.7	-	9.7	834.8
1997	751.9	-	11.2	-	350.1	-	26.6	1139.8

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

Table 13.1.1.2 Sandeel North Sea. Monthly landings (t) by country, 1988-1997. (Data provided by Working Group members).

Year	Month	Denmark	Faroes	Norway	Scotland	Total[1]
1988	Mar	48,766		21,582	4	70,352
	Apr	147,839		27,181	1,518	186,538
	May	246,852		65,160	2,481	314,493
	Jun	169,526		32,995	744	203,265
	Jul	33,120	n/a	104	633	33,857
	Aug	21,155		5,212	198	26,565
	Sep	9,224		9,111	181	18,516
	Oct	9,885		13,709	36	23,630
	Nov	-		-	-	-
	Dec	-		-	-	-
	Total	686,367	15,531	185,054	5,795	8,772,161
1989	Mar	62,927		23,117	106	86,150
	Apr	164,296		27,953	1,345	193,594
	May	300,524		61,764	4,912	376,200
	Jun	235,779	n/a	59,079	5,124	299,982
	Jul	31,670		187	-	31,857
	Aug	6,533		9,581	-	16,114
	Sep	22,705		5,086	-	27,791
	Oct	-		65	-	65
	Nov	-		-	-	-
	Dec	-		-	-	-
	Total	824,434	16,612	186,832	11,487	10,227,531
1990	Mar	24,700		11,542	-	36,242
	Apr	94,670		13,673	906	109,249
	May	181,582		35,394	2,184	219,160
	Jun	121,981	n/a	6,660	797	129,438
	Jul	17,307		1,101	-	18,408
	Aug	48,992		17,519	-	66,511
	Sep	6,793		2,541	-	9,334
	Oct	-		474	-	474
	Nov	-		-	-	-
	Total	496,025	2,230	88,904	3,887	5,888,161
1991	Mar	23,454		7,349	-	30,803
	Apr	78,374		12,582	30	90,986
	May	204,894	n/a	50,110	1,124	256,519
	Jun	217,334		13,176	-	230,509
	Jul	129,548		8,267	-	137,815
	Aug	43,024		16,955	-	59,979
	Sep	4,801		16,153	-	20,955
	Oct	-		4,242	-	4,242
	Nov	-		-	-	-
	Total	701,429		128,834	1,154	8,318,081

[1]Excluding the Faroes.

continued

Table 13.1.1.2 (continued)

Year	Month	Denmark	Faroes	Norway	Scotland	Total[1]
1992	Mar	22,686		3,490	392	26,269
	Apr	148,866		10,998	2,975	160,256
	May	242,170		29,149	1,469	274,294
	Jun	265,879		44,197	-	311,545
	Jul	64,910	n/a	1,464	-	66,374
	Aug	6,574		-	-	6,574
	Sep	1		-	-	1
	Oct	16		-	-	16
	Nov	-		-	-	-
	Dec	-		-	-	-
	Total	751,102	9,139	89,298	4,836	854,462
1993	Mar	18,374		8,006	0	26,830
	Apr	49,794		22,169	0	71,963
	May	134,695		19,213	0	153,908
	Jun	186,936		17,242	204	204,382
	Jul	56,049	n/a	2,883	0	58,932
	Aug	10,552		8,017	0	18,569
	Sep	4,474		6,421	0	10,895
	Oct	13,145		9,392	0	22,537
	Nov	8,163		2,150	0	10,313
	Total	482,182		95,463	204	577,869
1994	Mar	79		1,919	0	1,998
	Apr	98,123		18,887	0	117,010
	May	243,826		69,048	607	313,481
	Jun	222,409		48,228	4,755	275,392
	Jul	84,191	n/a	22,060	559	106,810
	Aug	2,320		7,922	0	10,242
	Sep	7,425		5,137	0	12,562
	Oct	9		599	0	608
	Nov	0		0	0	0
	Total	658,381		173,800	5,921	838,103
1995	Mar	12,980		5,646	0	18,626
	Apr	106,606		43,423	0	150,425
	May	210,966		71,961	397	284,572
	Jun	230,302		89,119	1,645	324,095
	Jul	69,777	n/a	6,112	4,674	75,889
	Aug	15,372		37,389	0	52,761
	Sep	705		2,916	0	3,621
	Oct	1,127		6,842	0	7,969
	Nov	0		0	0	0
	Total	647,835		263,408	6,716	917,958

[1]Excluding the Faroes.

continued

Table 13.1.1.2 (continued)

Year	Month	Denmark	Faroes	Norway	Scotland	Total[1]
1996	Mar	1,202		829	-	2,031
	Apr	30,651		7,720	-	38,371
	May	137,629		45,637	2,742	186,008
	Jun	184,507		50,912	3,740	239,159
	Jul	131,018	n/a	17,610	68	148,696
	Aug	67,913		11,829	-	79,742
	Sep	34,257		11,955	-	46,212
	Oct	13,222		12,480	-	25,702
	Nov	-		927	-	927
	Total	600,399		159,899	6,550	766,848
1997	Mar	15,343		23,005		38,348
	Apr	88,690		52,642		141,332
	May	208,647	n/a	71,951	8029	288,627
	Jun	276,974		107,270	11581	395,825
	Jul	136,708		35,369	2396	174,473
	Aug	22,394		22,811		45,205
	Sept	2,490		24,448		26,938
	Oct	640		13,067		13,707
	Nov	0				0
	Dec	0				0
	Total	751,886		350,563	22,007	1,124,456
1998	Mar	9,332		14,729		24,061
	Apr	60,796		130,629		191,425
	May	80,885	n/a	191,407	n/a	272,292
	Jun	77,929		204,102		282,031
	Total	228,942		540,867		769,809

Table 13.1.1.3. Monthly landings of sandeels (t) by Denmark and Norway from each area in Figure 13.5.13.1, 1993-1997

	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland
1993											
Mar	222	131	0	0	25,069	0	928	30	0	0	0
Apr	14,927	11,121	0	2,287	38,170	0	4,496	747	55	160	0
May	47,453	1,490	0	7,546	35,118	0	34,186	17,192	685	10,238	0
Jun	125,991	3,038	23	7,550	21,544	148	13,509	5,018	1,879	25,682	0
Jul	7,942	4,494	65	6,894	18,563	116	6,871	3,608	1,258	9,121	0
Aug	0	1,573	0	703	7,863	0	5,744	0	0	2,686	0
Sept	0	0	0	186	7,127	0	3,501	0	0	81	0
Oct	0	0	0	899	9,296	0	11,807	0	0	535	0
Nov	0	20	0	112	2,150	0	7,803	0	0	228	0
Total	196,535	21,867	88	26,177	164,900	264	88,845	26,595	3,877	48,731	0
1994											
Mar	79	0	21	168	1730	0	0	0	0	0	0
Apr	10512	41080	0	9700	33383	2249	17145	318	0	113	0
May	47346	36777	6	21386	78640	281	83588	1064	10	2314	0
Jun	85405	29250	0	23947	47986	38	41184	10087	2572	16450	0
Jul	13679	1483	0	4966	27474	0	27813	4521	267	23164	0
Aug	0	0	0	1	7794	128	174	0	0	5	0
Sep	0	0	0	1487	5845	0	5048	0	0	0	0
Oct	0	0	0	0	522	0	79	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0
Total	157,021	108,590	,021	61,655	203,374	2,696	175,031	15,990	2,849	42,046	0
1995											
Mar	0	3,769	0	317	14,428	0	94	0	0	18	
Apr	64,640	29,155	17,990	10,529	26,818	248	123	751	0	171	
May	105,246	9,646	25,901	62,345	47,201	340	27,795	2,267	293	3,539	
Jun	139,864	1,308	68,056	3,874	58,920	369	16,343	12,261	4,424	18,676	
Jul	12,612	0	104	8,811	9,605	0	7,541	11,301	367	25,548	
Aug	0	0	34,151	867	3,242	0	6,507	0	193	7,801	
Sep	0	0	1,234	4	1,683	0	615	0	0	85	
Oct	0	0	0	0	7,555	0	410	0	0	4	
Total	322,361	43,878	147,436	86,747	169,452	957	59,428	26,580	5,277	55,842	1,160
1996											
Mar	0	28	10	0	2,379	0	0	0	0	0	
Apr	8,792	35	1,551	3,944	21,184	0	5,438	247	0	534	
May	78,847	13,217	4,595	13,739	54,993	611	18,817	2,509	455	3,064	
Jun	112,059	81	20,441	12,692	32,264	489	25,078	7,097	1,711	35,186	
Jul	108,624	1,976	59	1,282	9,565	1	22,477	2,885	802	6,034	
Aug	1,313	461	3,679	7,153	8,849	125	34,315	0	0	5,441	
Sep	875	43	767	1,256	12,586	3,307	19,781	0	0	2,262	
Oct	0	2,671	0	726	10,252	0	8,156	0	0	0	
Nov	0	48	0	0	879	0	0	0	0	0	
Total	310,510	18,560	31,102	40,792	152,951	4,533	134,062	12,738	2,968	52,521	1,000
1997											
Mar	17	7,562	2,326	1,402	25,821		1,220				
Apr	23,736	35,036	5,800	11,404	42,308	535	21,745	588		180	
Mai	117,700	6,326	584	24,309	76,216	487	36,499	3,074	1,768	13,636	
Jun	132,631	2,751		37,848	142,941		36,966	1,121	51	29,935	
Jul	58,429	1,235	197	14,212	42,478		11,632	11,057	1,278	31,738	
Aug	1,660	293		1,552	24,113	15	3,497	83	1,602	12,211	
Sep				1,024	23,859	156	1,230			666	
Okt		140		859	12,513		134			61	
Total	334,173	53,343	8,907	92,610	390,249	1,193	112,923	15,923	4,699	88,427	2,100

Table 13.1.1.4 Annual landings ('000 t) of Sandeels by area of the North Sea (Denmark, Norway and UK (Scotland)). Data provided by Working Group members (Figure 13.5.13.1).

	Area										Assessment areas[1]		
Year	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland	Northern	Southern
1972	98.8	28.1	3.9	24.5	85.1	0.0	13.5	58.3	6.7	28.0	0.0	130.6	216.3
1973	59.3	37.1	1.2	16.4	60.6	0.0	8.7	37.4	9.6	59.7	0.0	107.6	182.4
1974	50.4	178.0	1.7	2.2	177.9	0.0	29.0	27.4	11.7	25.4	7.4	386.6	117.1
1975	70.0	38.2	17.8	12.2	154.7	4.8	38.2	42.8	12.3	19.2	12.9	253.7	156.5
1976	154.0	3.5	39.7	71.8	38.5	3.1	50.2	59.2	8.9	36.7	20.2	135.0	330.6
1977	171.9	34.0	62.0	154.1	179.7	1.3	71.4	28.0	13.0	25.3	21.5	348.4	392.3
1978	159.7	50.2		346.5	70.3		42.5	37.4	6.4	27.2	28.1	163.0	577.2
1979	194.5	0.9	61.0	32.3	27.0	72.3	34.1	79.4	5.4	44.3	13.4	195.3	355.9
1980	215.1	3.3	119.3	89.5	52.4	27.0	90.0	30.8	8.7	57.1	25.4	292.0	401.2
1981	105.2	0.1	42.8	151.9	11.7	23.9	59.6	63.4	13.3	45.1	46.7	138.1	378.9
1982	189.8	5.4	4.4	132.1	24.9	2.3	37.4	75.7	6.9	74.7	52.0	74.4	479.2
1983	197.4	-	2.8	59.4	17.7	-	57.7	87.6	8.0	66.0	37.0	78.2	419.0
1984	337.8	4.1	5.9	74.9	30.4	0.1	51.3	56.0	3.9	60.2	32.6	91.8	532.8
1985	281.4	46.9	2.8	82.3	7.1	0.1	29.9	46.6	18.7	84.5	17.2	79.7	513.5
1986	295.2	35.7	8.5	55.3	244.1	2.0	84.8	22.5	4.0	80.3	14.0	375.1	457.4
1987	275.1	63.6	1.1	53.5	325.2	0.4	5.6	21.4	7.7	45.1	7.2	395.9	402.8
1988	291.1	58.4	2.0	47.0	256.5	0.3	37.6	35.3	12.0	102.2	4.7	384.8	487.6
1989	228.3	31.0	0.5	167.9	334.1	1.5	125.3	30.5	4.5	95.1	3.5	492.4	526.3
1990	141.4	1.4	0.1	80.4	156.4	0.6	61.0	45.5	13.8	85.5	2.3	219.5	366.7
1991	228.2	7.1	0.7	114.0	252.8	1.8	110.5	22.6	1.0	93.1	+	372.9	458.9
1992	422.4	3.9	4.2	168.9	67.1	0.3	101.2	20.1	2.8	54.4	0	176.7	668.6
1993	196.5	21.9	0.1	26.2	164.9	0.3	88.0	26.6	3.9	48.7	0	276.0	301.9
1994	157.0	108.6	-	61.7	203.4	2.7	175.0	16.0	2.8	42.0	0	489.7	279.5
1995	322.4	43.9	147.4	86.7	169.5	1.0	59.4	26.6	5.3	55.8	1.2	421.2	496.8
1996	310.5	18.6	31.2	40.8	153.0	4.5	134.1	12.7	3.0	52.5	1.0	341.2	419.5
1997	352.0	53.3	8.9	92.8	390.5	1.2	112.9	18.1	4.7	88.6	2.1	566.8	535.8
1998[2]	270.4	55.4	2.0	85.3	254.3	1.0	35.2	24.9	2.9	38.4	-	347.9	421.9

[1]Assessment areas: Northern - Areas 1B, 1C, 2B, 2C, 3.

Southern - Areas 1A, 2A, 4, 5, 6.

[2]Only January–June included.

Table 13.1.2.1 Sandeel in the North Sea. Natural mortality, maturity and stock weight at age.

Age	Weight at age in the stock			Maturity	Natural mortality	
	1997 Jan-Jun	1997 Jul-Dec	1998 Jan-Jun		Jan-Jun	Jul-Dec
0	2.2	2.3	1.8	0.0		0.8
1	5.5	8	4.9	0.0	1.0	0.2
2	9.3	12	8.4	1.0	0.4	0.2
3	12.5	14.7	11.1	1.0	0.4	0.2
4+	19.6	18.9	14.8	1.0	0.4	0.2

Table 13.1.2.2 Sandeels in the northern North Sea. Catch in numbers, half-year (millions).

Age group	1979		1980		1981		1982		1983	
	1	2	1	2	1	2	1	2	1	2
0	-	44,203	17	8,349	17	9,128	2	6,530	-	7,911
1	2,335	1,310	13,394	1,173	5,505	346	3,518	65	5,684	303
2	1,328	433	8,865	214	4,109	94	2,132	-	1,215	316
3	242	66	1,050	19	904	14	556	-	89	19
4	5	10	645	4	128	6	76	-	8	-
5+	7	-	183	4	46	-	9	-	4	-

Age group	1984		1985		1986		1987		1988	
	1	2	1	2	1	2	1	2	1	2
0	-	-	1	349	7	7,105	-	455	2,453	13,196
1	11,692	1,207	2,688	109	23,934	7,077	26,236	5,768	9,855	1,283
2	1,647	121	3,292	239	2,600	473	10,855	198	25,922	340
3	153	43	1,002	89	200	-	350	-	1,319	119
4	5	-	377	7	-	-	107	-	26	17
5+	-	-	103	4	-	-	48	-	-	-

Age group	1989		1990[1]		1991		1992		1993	
	1	2	1	2	1	2	1	2	1	2
0	6,163	3,380	1,599	18,293	-	13,616	137	6,797	-	26,960
1	57,002	4,038	10,551	-	41,855	866	9,871	48	15,768	1,004
2	2,233	274	1,481	-	2,342	28	4,056	3	2,635	112
3	3,406	-	232	-	908	8	486	-	1,023	34
4	-	-	-	-	225	3	195	-	207	8
5+	-	-	-	-	93	-	110	-	439	14

Age group	1994		1995		1996		1997		1998	
	1	2	1	2	1	2	1	2	1	2
0	398	456	-	4,046		31,822	1,991	2,332	1,902	
1	28,490	829	36,140	3,374	11,507	1,706	67,267	10,909	5,369	
2	7,225	1,211	3,360	338	5,377	1,772	3,450	509	27,664	
3	5,954	396	1,091	26	760	136	2,938	6	2,160	
4	1,579	12	116	2	238	24	372	1	165	
5+	577	12	29	-	62	31	650	1	126	

[1]Based on Norwegian data only.

Note: 1 = Jan-Jun.
2 = Jul-Dec.

Table13.1.2.3 SANDEEL, North Sea. Northern area. Mean weight at age (g) in the catch for 1993-1997 and 1998, first half. Data from Denmark and Norway.

1993	Half-year	
Age	1	2
0	0.92	2.71
1	5.97	10.37
2	20.62	19.22
3	24.92	20.28
4	19.65	20.27
5+	23.31	22.00
1994	Half-year	
Age	1	2
0	1.10	6.58
1	6.43	22.75
2	13.70	30.20
3	15.08	58.07
4	18.18	59.30
5+	21.47	85.00
1995	Half-year	
Age	1	2
0	-	5.08
1	6.95	13.46
2	19.75	14.20
3	24.90	21.00
4	23.01	19.00
5+	31.47	-
1996	Half-year	
Age	1	2
0	-	2.94
1	7.80	10.85
2	14.98	14.92
3	25.93	15.59
4	36.29	20.72
5+	42.04	25.81
1997	Half-year	
Age	1	2
0	2.2	2.1
1	4.6	8.0
2	7.7	10.6
3	13.0	10.7
4+	21.7	17.2
1998	Half-year	
Age	1	
0	1.8	
1	4.1	
2	8.5	
3	11.8	
4+	26.0	

Table 13.1.2.4 SANDEELS in the Southern North Sea. Catch in numbers, half-year (millions).

Age groups	1977		1978		1979		1980		1981		1982		1983	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
0	-	13,263	922	41,224	181	1,947	62	72	415	43,420	242	5,039	955	9,298
1	19,500	269	58,839	2,774	16,018	5,210	33,269	4,738	13,394	407	56,545	4,718	2,232	240
2	5,596	27	16,948	385	22,737	2,085	12,472	840	11,719	1,892	6,224	490	35,029	2,806
3	6,300	8	1,793	124	4,487	138	3,794	575	2,466	115	3,277	344	934	513
4	965	8	1,006	97	1,265	110	375	9	774	36	1,813	36	234	2
5	445	3	114	26	441	30	63	-	353	3	94	4	122	-
6	239	3	21	26	244	-	50	-	84	-	24	-	25	-
7+	159	-	39	9	35	-	+	-	21	-	8	-	6	-

Age groups	1984		1985		1986		1987		1988		1989		1990	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
0	20	-	6,573	11,940	-	112	-	298	1,420	-	29	1		
1	62,517	9,423	7,790	1,896	43,629	5,350	4,351	3,095	2,349	-	44,444	1,619		
2	2,257	92	39,301	3,229	7,333	293	22,771	6,664	10,074	234	405	165		
3	13,272	577	2,490	2,234	1,604	241	1,158	196	17,914	2,084	957	35		
4	267	44	233	163	30	9	141	45	1,920	63	3,350	122		
5	109	-	18	77	-	9	24	6	617	5	18	1		
6	66	-	7	30	-	-	-	-	146	-	-	-		
7+	-	-	7	28	-	-	-	-	86	-	-	-		

Age groups	1991		1992		1993		1994		1995		1996		1997		1998
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
0	-	12,115	2	134	-	838	-	-	-	-	-	2,089		189	1
1	20,058	11,411	60,337	3,903	3,581	1,037	24,697	4,093	39,683	3,166	10,152	2,031	49,347	14,551	65
2	9,224	344	10,021	382	14,659	953	2,594	322	6,607	2,789	15,949	4,082	3,438	511	8,871
3	1,320	111	1,002	157	3,707	266	2,654	198	1,555	307	6,377	536	2,266	388	36,930
4	454	-	427	25	451	60	447	116	988	93	596	312	588	72	3,111
5	-	-	69	2	375	17	268	21	217	41	477	550	56	58	1,433
6			103	5	186	10	61	-	21	20	91	148			658
7+			22	2			31	-		3	29	13			

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

Table 13.1.2.5 SANDEEL, North Sea. Southern area. Mean weight at age (g) in the catch for 1993–1996 and 1997 first half.

1993	Half-year	
Age	1	2
0	-	3.08
1	6.08	10.13
2	11.54	15.66
3	15.09	17.04
4	19.18	21.84
5	20.02	22.43
6	22.46	23.10
7+	23.63	21.89
1994	Half-year	
Age	1	2
0		
1	6.07	8.56
2	11.01	17.16
3	13.46	19.50
4	16.17	23.29
5	17.90	26.25
6	18.49	
7	19.15	
1995	Half-year	
Age	1	2
0	-	-
1	7.30	6.60
2	13.20	13.60
3	16.60	17.70
4	19.50	20.90
5	25.00	21.30
6	20.00	21.20
7+	-	30.00
1996	Half-year	
Age	1	2
0	-	2.3
1	5.6	9.9
2	8.3	16.7
3	13.2	21.8
4	15.9	31.5
5	17.9	33.3
6	18.0	36.8
7		43.8
1997	Half-year	
Age	1	2
0	-	4.7
1	6.5	8.0
2	10.9	13.5
3	11.8	14.7
4+	16.3	18.9
1998	Half-year	
Age	1	
0	0.9	
1	5.5	
2	8.2	
3	10.5	
4+	13.3	

Table 13.1.3.1 Sandeel. Northern North Sea. Danish CPUE data (t/day).

Year	Vessel size (GRT)						
	5-50	50-100	100-150	150-200	200-250	250-300	>300
				First half year			
1982	11.2	17.2	31.8	26.7	47.6	40.8	25.8
1983	11.1	17.1	23.6	23.9	31.6	36.4	41.3
1984	14.6	24.8	33.4	32.1	44.4	55.5	19.7
1985	12.1	17.2	35.7	51.2	57.9	67.2	55.8
1986	21.0	32.0	45.5	50.2	63.9	57.4	71.8
1987	23.7	37.8	67.0	66.5	78.6	79.9	113.0
1988	19.0	25.6	34.4	42.5	48.0	47.8	75.3
1989	16.3	25.2	36.7	41.0	49.6	51.4	76.2
1990	14.5	21.6	27.3	27.8	29.5	27.4	39.7
1991	16.7	25.5	38.4	42.5	47.6	47.5	72.2
1992	16.6	24.6	36.3	34.7	60.6	46.9	76.9
1993	14.9	19.3	33.6	36.5	47.2	51.1	51.8
1994	26.9	32.0	53.9	61.8	75.0	87.9	102.5
1995	19.6	29.5	49.5	57.8	61.0	66.9	73.6
1996	16.5	21.1	35.9	39.1	36.7	40.0	56.2
1997	24.9	34.9	51.4	56.1	76.8	58.9	90.4
1998	16.9	24.4	28.0	44.6	52.0	54.4	65.5
				Second half year			
1982	-	17.7	33.6	46.7	19.9	-	-
1983	17.9	25.7	31.0	32.9	44.5	34.3	57.1
1984	113.2	22.0	21.5	35.2	-	28.3	24.0
1985	21.6	23.5	25.8	39.6	60.7	33.3	-
1986	17.1	27.5	50.2	50.0	77.9	74.0	80.7
1987	21.3	31.8	23.9	24.3	42.6	25.4	46.3
1988	16.8	21.3	30.0	32.4	38.0	33.1	43.9
1989	16.6	22.3	23.6	27.3	28.3	35.6	25.0
1990	17.6	32.5	29.4	34.1	40.4	32.6	53.3
1991	15.1	26.3	40.8	44.8	54.4	51.3	72.5
1992	20.4	25.4	35.2	38.2	53.6	50.9	52.1
1993	18.5	21.4	26.5	27.5	38.8	47.9	59.0
1994	24.3	31.5	42.7	53.5	59.8	65.8	74.6
1995	21.9	34.6	46.1	53.8	58.6	62.7	68.6
1996	15.3	30.6	41.9	37.8	47.4	44.9	47.3
1997	14.1	26.2	32.5	34.1	40.2	33.6	43.3

Table 13.1.3.2 Sandeel. Southern North Sea. Danish CPUE data (t/day).

Year	Vessel size (GRT)						
	5-50	50-100	100-150	150-200	200-250	250-300	>300
				First half year			
1982	16.1	26.9	43.1	47.2	59.2	53/2	59.6
1983	17.0	20.6	36.3	44.4	49.1	51.2	50.9
1984	19.9	26.3	42.6	50.4	60.9	56.4	60.1
1985	13.8	21.2	35.5	43.4	49.8	49.1	56.3
1986	23.2	31.4	41.1	49.8	58.9	58.4	69.4
1987	23.9	33.9	53.9	67.4	76.1	76.4	115.5
1988	19.2	26.8	42.9	52.3	60.0	56.6	82.8
1989	19.4	24.5	43.3	52.3	58.9	55.2	74.3
1990	20.0	20.8	30.4	33.7	39.8	35.7	49.1
1991	27.0	30.0	49.5	50.3	62.8	60.7	92.8
1992	18.4	23.4	53.1	63.2	83.8	82.4	115.9
1993	17.2	18.1	38.1	40.2	58.6	60.9	89.5
1994	24.6	29.0	59.1	59.5	75.2	78.9	96.6
1995	23.6	33.2	63.7	63.5	68.0	80.0	00.8
1996	23.4	25.3	40.9	48.4	58.8	56.4	84.1
1997	32.2	36.7	60.1	55.9	86.5	90.3	124.9
1998	20.0	27.1	35.3	46.7	60.9	61.2	87.8
				Second half year			
1982	-	20.3	37.5	40.5	-	27.9	-
1983	15.1	21.3	25.1	32.4	45.4	34.0	34.7
1984	12.7	16.4	26.9	34.2	36.5	40.2	40.9
1985	13.2	19.5	26.0	35.8	36.2	38.2	39.4
1986	18.4	25.2	32.5	44.5	45.8	51.8	55.5
1987	16.2	22.6	41.4	45.8	49.3	45.6	75.4
1988	18.8	29.3	29.9	31.1	38.6	31.1	44.0
1989	26.7	26.2	27.0	38.3	38.0	29.3	40.4
1990	27.9	32.8	36.4	41.3	48.3	45.2	42.7
1991	21.4	26.8	41.8	49.4	65.1	53.7	98.3
1992	21.3	28.7	36.7	42.6	44.8	39.1	58.3
1993	20.2	22.7	30.8	35.6	45.3	39.3	51.8
1994	28.6	38.9	50.4	54.3	60.7	56.9	65.2
1995	28.6	42.2	50.2	53.3	72.4	60.8	73.9
1996	22.9	23.3	56.3	69.4	81.0	87.5	123.6
1997	22.9	25.9	35.5	41.7	54.8	51.0	74.9

Table 13.1.3.3 Danish CPUE data. Parameter estimates from regressions of ln(CPUE) versus ln(Av. GRT) together with estimates of standardized CPUE (200 GRT)

$$CPUE = b \cdot GRT^{a}$$

Northern North Sea

	Jan-Jun				Jul-Dec			
Year	**SLOPE**	**INTERCEPT**	**R-square**	**CPUE**	**SLOPE**	**INTERCEPT**	**R-square**	**CPUE**
1987	0.57	3.60	0.98	75.2	0.20	11.22	0.58	31.9
1988	0.48	3.58	0.95	46.4	0.36	5.06	0.96	33.9
1989	0.55	2.54	0.98	47.5	0.23	8.11	0.87	27.3
1990	0.33	5.13	0.95	29.4	0.33	6.37	0.89	37.3
1991	0.52	2.99	0.97	46.5	0.58	2.31	0.99	49.4
1992	0.55	2.55	0.94	47.0	0.41	5.05	0.96	43.7
1993	0.54	2.40	0.97	40.9	0.43	3.86	0.90	37.4
1994	0.54	4.02	0.96	70.3	0.45	5.20	0.98	56.1
1995	0.54	3.36	0.99	57.8	0.45	5.15	1.00	55.5
1996	0.44	3.74	0.95	38.9	0.43	4.3	0.96	42.3
1997	0.47	5.11	0.95	62.60	0.40	4.24	0.96	35.60
1998	0.54	2.62	0.97	45.70				

Southern North Sea

	Jan -Jun				Jul-Dec			
Year	**SLOPE**	**INTERCEPT**	**R-square**	**CPUE**	**SLOPE**	**INTERCEPT**	**R-square**	**CPUE**
1987	0.58	3.28	0.97	71.7	0.55	2.54	0.95	47.4
1988	0.55	3.00	0.97	54.7	0.27	8.17	0.91	34.4
1989	0.53	3.18	0.96	52.6	0.15	15.33	0.69	33.7
1990	0.34	5.93	0.92	35.8	0.20	14.18	0.94	41.8
1991	0.45	5.54	0.93	58.8	0.54	3.23	0.93	56.3
1992	0.74	1.41	0.96	70.6	0.34	6.85	0.95	42.5
1993	0.64	1.67	0.93	51.0	0.37	5.56	0.94	38.5
1994	0.55	3.60	0.96	67.8	0.32	10.23	0.99	55.6
1995	0.55	3.71	0.97	69.6	0.36	8.88	0.97	60.1
1996	0.48	4.14	0.93	53.3	0.68	1.97	0.93	73.8
1997	0.51	5.17	0.92	76.7	0.44	4.67	0.93	48.3
1998	0.55	2.89	0.96	54.0				

Table 13.1.3.4 SANDEEL Southern North Sea. Standardized CPUE, based on Danish data.

Year	Half-year	CPUE (t/day)	Total international Catch ('000 t)	Total Int'l fishing effort ('000 days) Half-year
1982	1	48.2	426.5	8.9
	2	35.7	52.6	1.5
1983	1	42.8	359.8	8.4
	2	33.9	59.3	1.8
1984	1	50.5	461.1	9.1
	2	32.9	71.1	2.2
1985	1	41.9	417.1	10.0
	2	33.6	110.6	3.3
1986	1	53.7	386.4	7.2
	2	44.1	75.5	1.7
1987	1	71.7	297.7	4.2
	2	47.4	105.1	2.2
1988	1	54.7	462.0	8.5
	2	34.4	33.4	1.0
1989	1	52.6	506.1	9.6
	2	33.7	18.5	0.5
1990	1	35.8	341.7	9.5
	2	41.8	24.0	0.6
1991	1	58.8	326.6	5.6
	2	56.3	132.3	2.4
1992	1	70.6	621.1	8.8
	2	42.5	73.0	1.7
1993	1	51.0	267.7	5.3
	2	38.5	34.2	0.9
1994	1	67.8	226.4	3.3
	2	55.6	47.6	0.9
1995	1	69.6	429.2	6.2
	2	60.1	67.6	1.1
1996	1	53.3	292.5	5.5
	2	73.8	138.7	1.9
1997	1	76.7	421	5.5
	2	48.3	139	2.9
1998	1	54.0	435	8.1

Table 13.1.3.5 Sandeel northern North Sea. Norwegian effort data.

Year	Fishing days		Mean gross register tonnage (GRT)[1]	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
1976	595		198.8	
1977	2212	457	172.3	184.9
1978	1747	806	203.4	203.7
1979	1407	1720	213.8	188.9
1980	2642	1099	215.5	210.3
1981	1740	404	216.6	190.9
1982	1206		209.1	
1983	304	66	254.6	191.1
1984	145		182.6	
1985	366		219.5	
1986	1562	567	201.1	187.4
1987	2123	1584	218.8	200.9
1988	3571	925	203.3	198.2
1989	4292	588	192.3	202.1
1990	2275	731	207.9	189.2
1991	1749	958	199.7	194.1
1992	1202	23	204.5	212.7
1993	1462	971	230.9	200.6
1994	2559	742	222.3	226.5
1995	3305	980	215.7	217.6
1996	1935	724	223.9	218.6
1997	3354	1484	217.9	221.2
1998	2567		222.7	

[1]Av. GRT pr. trip.

Table 13.1.4.1 cont.

Catch in numbers for fleet: 1
Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	7911.	*	0.	*	349.	*	7105.	*	455.	*	13196.
1	5684.	303.	11692.	1207.	2688.	109.	23934.	7077.	26236.	5768.	9855.	1283.
2	1215.	316.	1647.	121.	3292.	239.	2600.	473.	10855.	198.	25922.	340.
3	89.	19.	153.	43.	1002.	89.	200.	0.	350.	0.	1319.	119.
4+	12.	0.	5.	0.	480.	11.	0.	0.	155.	0.	26.	17.
SOP	50871.	37464.	91792.	20871.	106279.	12946.	174378.	128325.	305979.	83202.	430970.	71479.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	3380.	*	12107.	*	13616.	*	6797.	*	26960.	*	457.
1	56661.	4038.	13101.	1670.	41855.	866.	9871.	48.	15768.	1004.	28490.	829.
2	2219.	274.	3907.	342.	2342.	28.	4056.	3.	2635.	112.	7225.	1211.
3	3385.	0.	578.	51.	908.	8.	486.	0.	1023.	34.	5954.	396.
4+	0.	0.	175.	15.	318.	3.	305.	0.	646.	22.	2155.	25.
SOP	437540.	57222.	148400.	70800.	374465.	55404.	115957.	38189.	188264.	86785.	413536.	83222.

Year	1995		1996		1997		1998
Season	1	2	1	2	1	2	1
AGE							
0	*	4046.	*	31822.	*	2460.	*
1	36140.	3374.	11507.	1706.	70163.	11512.	5607.
2	3360.	338.	5377.	1772.	3600.	628.	28890.
3	1091.	26.	760.	136.	3065.	6.	2256.
4+	145.	2.	300.	55.	1066.	2.	303.
SOP	348280.	71351.	201253.	141923.	413447.	104011.	303053.

Catch in numbers for fleet: 2
Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	9298.	*	0.	*	11940.	*	112.	*	298.	*	0.
1	2232.	240.	62517.	9423.	7790.	1896.	43629.	5350.	4351.	3095.	2349.	0.
2	35029.	2906.	2257.	92.	39301.	3229.	7333.	293.	22771.	6664.	10074.	234.
3	934.	513.	13272.	577.	2490.	2234.	1604.	241.	1158.	196.	17914.	2084.
4+	387.	2.	442.	44.	265.	298.	30.	18.	165.	51.	2769.	68.
SOP	380561.	61745.	556796.	80581.	472949.	114931.	335960.	47286.	296758.	105111.	464851.	40003.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	1.	*	597.	*	12115.	*	134.	*	838.	*	0.
1	44444.	1619.	20179.	1438.	20058.	11411.	60337.	3903.	3581.	1037.	24697.	4093.
2	4525.	165.	16670.	477.	9224.	344.	10021.	382.	14659.	953.	2594.	322.
3	957.	35.	2467.	71.	1320.	111.	1002.	157.	3707.	266.	2654.	198.
4+	3368.	123.	745.	21.	454.	0.	621.	34.	1012.	87.	715.	137.
SOP	309830.	22244.	341700.	24000.	345866.	123092.	618474.	47520.	267430.	34453.	226318.	47670.

Table 13.1.4.1 cont.

Year	1995		1996		1997		1998
Season	1	2	1	2	1	2	1
AGE							
0	*	0.	*	2089.	*	198.	*
1	39683.	3166.	10152.	2031.	52357.	15263.	9333.
2	6607.	2789.	15949.	4082.	3648.	536.	38856.
3	1555.	307.	6377.	536.	2404.	407.	3274.
4+	1226.	157.	1164.	1023.	683.	136.	2200.
SOP	427820.	67591.	293099.	138914.	419584.	138824.	433588.

Stock numbers (at start of season)
****

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	869550.	*	227639.	*	1205954.	*	630119.	*	200336.	*	723763.
1	98493.	31432.	379179.	94482.	102285.	31273.	533632.	155333.	278293.	83826.	89512.	25528.
2	88400.	29582.	25243.	13725.	67737.	10533.	23790.	7815.	115932.	50181.	60612.	11158.
3	3451.	1476.	21395.	3350.	11045.	4545.	5486.	2200.	5705.	2589.	34876.	7631.
4+	498.	6.	729.	123.	2243.	894.	2071.	1364.	2683.	1537.	3155.	0.
SSN	92348.		47367.		81025.		31347.		124320.		98642.	
SSB	1210190.		712238.		1122980.		458732.		1634494.		1511335.	
TSN	190841.	932046.	426546.	339319.	183310.	1253198.	564979.	796831.	402613.	338470.	188154.	768080.
TSB	1705607.	1801161.	2266870.	1566231.	1551553.	2048216.	2689314.	2932843.	2942472.	2017571.	1905189.	1650979.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	332369.	*	651564.	*	830301.	*	325276.	*	633755.	*	811567.
1	316362.	55060.	147076.	33921.	284251.	67018.	355830.	88319.	141510.	40323.	266131.	65645.
2	19739.	7710.	39961.	9940.	24961.	7262.	43761.	17809.	68735.	31915.	31167.	12852.
3	8616.	2221.	5915.	1471.	7397.	3134.	5609.	2542.	14232.	5667.	25166.	9822.
4+	4254.	94.	1786.	444.	1426.	324.	2720.	1065.	2780.	506.	4684.	790.
SSN	32610.		47662.		33783.		52091.		85747.		61017.	
SSB	512753.		670330.		484797.		725858.		1165384.		859424.	
TSN	348972.	397453.	194739.	697341.	318034.	908039.	407921.	435011.	227257.	712167.	327148.	900676.
TSB	1904746.	1179383.	1296875.	1441295.	1704233.	1803655.	2177646.	1768148.	1802179.	1917498.	2525405.	6880782.

Year	1995		1996		1997		1998
Season	1	2	1	2	1	2	1
AGE							
0	*	366373.	*	2069407.	*	198397.	*
1	364354.	88050.	161910.	46426.	907113.	259396.	87364.
2	49292.	24881.	66171.	26896.	34629.	17279.	188149.
3	9135.	3957.	17542.	5915.	16723.	6732.	13093.
4+	8004.	4243.	6268.	3003.	5718.	2401.	6979.
SSN	66431.		89981.		57071.		208221.
SSB	1109999.		1048200.		643166.		1829076.
TSN	430786.	487503.	251891.	2151647.	964184.	484205.	295585.
TSB	3707846.	3254845.	2141090.	7134841.	5632288.	2883168.	2257160.

Table 13.1.4.1 cont.

Partial fishing mortality for fleet: 1
Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.013	*	0.000	*	0.000	*	0.016	*	0.003	*	0.027
1	0.096	0.011	0.056	0.015	0.044	0.004	0.077	0.052	0.160	0.080	0.190	0.057
2	0.022	0.012	0.087	0.010	0.090	0.030	0.172	0.070	0.135	0.005	0.770	0.035
3	0.037	0.018	0.013	0.016	0.133	0.030	0.054	0.000	0.087	0.000	0.066	0.020
4+	0.051	0.000	0.011	0.000	0.318	0.017	0.000	0.000	0.075	0.000	0.029	*
F (1- 2)	0.059	0.012	0.071	0.012	0.067	0.017	0.125	0.061	0.148	0.043	0.480	0.046

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.015	*	0.027	*	0.024	*	0.031	*	0.063	*	0.001
1	0.354	0.086	0.164	0.057	0.269	0.016	0.050	0.001	0.193	0.028	0.193	0.014
2	0.168	0.040	0.165	0.040	0.153	0.004	0.137	0.000	0.054	0.004	0.340	0.111
3	0.659	0.000	0.165	0.040	0.179	0.003	0.123	0.000	0.107	0.007	0.354	0.046
4+	0.000	*	0.165	0.040	0.385	0.010	0.167	0.000	0.419	0.054	0.842	0.039
F (1- 2)	0.261	0.063	0.165	0.048	0.211	0.010	0.093	0.000	0.123	0.016	0.267	0.063

Year	1995		1996		1997		1998
Season	1	2	1	2	1	2	1
AGE							
0	*	0.016	*	0.023	*	0.018	*
1	0.180	0.044	0.123	0.042	0.134	0.052	0.114
2	0.093	0.016	0.120	0.082	0.143	0.042	0.232
3	0.172	0.008	0.068	0.027	0.271	0.001	0.272
4+	0.024	0.001	0.067	0.025	0.272	0.001	0.066
F (1- 2)	0.137	0.030	0.121	0.062	0.138	0.047	0.173

Partial fishing mortality for fleet: 2
Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.016	*	0.000	*	0.014	*	0.000	*	0.002	*	0.000
1	0.038	0.009	0.297	0.117	0.129	0.069	0.140	0.040	0.027	0.043	0.045	0.000
2	0.621	0.111	0.119	0.007	1.076	0.409	0.485	0.044	0.284	0.158	0.299	0.024
3	0.392	0.473	1.149	0.211	0.331	0.741	0.433	0.128	0.288	0.087	0.894	0.355
4+	1.655	0.485	1.109	0.482	0.175	0.449	0.018	0.015	0.080	0.037	3.079	*
F (1- 2)	0.329	0.060	0.208	0.062	0.602	0.239	0.313	0.042	0.155	0.100	0.172	0.012

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.000	*	0.001	*	0.022	*	0.001	*	0.002	*	0.000
1	0.277	0.034	0.253	0.049	0.129	0.208	0.306	0.050	0.044	0.029	0.168	0.072
2	0.342	0.024	0.706	0.055	0.602	0.054	0.338	0.024	0.300	0.034	0.122	0.030
3	0.186	0.018	0.706	0.055	0.260	0.040	0.254	0.070	0.387	0.053	0.158	0.023
4+	1.701	*	0.706	0.055	0.550	0.000	0.341	0.036	0.657	0.214	0.279	0.214
F (1- 2)	0.310	0.029	0.479	0.052	0.365	0.131	0.322	0.037	0.172	0.031	0.145	0.051

Table 13.1.4.1 cont.

Year	1995		1996		1997		1998
Season	1	2	1	2	1	2	1
AGE							
0	*	0.000	*	0.001	*	0.001	*
1	0.198	0.041	0.108	0.050	0.100	0.069	0.189
2	0.183	0.132	0.355	0.189	0.144	0.035	0.312
3	0.246	0.090	0.568	0.106	0.213	0.069	0.395
4+	0.205	0.042	0.259	0.463	0.174	0.064	0.476
F (1- 2)	0.190	0.087	0.232	0.120	0.122	0.052	0.251

Log inverse catchabilities, fleet no: 1
Fishery in the Northern North Sea

Season	1	2
AGE		
0	*	4.884
1	3.550	4.147
2	3.541	4.510
3	3.541	4.510

Log inverse catchabilities, fleet no: 2
Fishery in the Southern North Sea

Season	1	2
AGE		
0	*	6.985
1	4.059	3.389
2	3.031	3.269
3	3.031	3.269

Log residual stocknr. (nhat/n), fleet no: 1
Fishery in the Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	1.080	*	*	*	-1.968	*	-0.214	*	-1.416	*	0.475
1	0.515	0.124	0.072	0.457	-0.034	-0.463	-0.495	0.206	0.050	1.038	-0.150	0.493
2	-0.990	0.637	0.506	0.393	0.665	1.929	0.300	0.864	-0.128	-1.440	1.239	0.357
3	-0.438	0.977	-1.372	0.857	1.056	1.904	-0.859	*	-0.567	*	-1.220	-0.176

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	-0.114	*	0.590	*	0.472	*	1.913	*	1.210	*	-2.561
1	0.198	0.900	0.056	0.590	0.398	-0.695	-0.639	-2.737	0.399	-0.337	0.035	-0.423
2	-0.555	0.513	0.056	0.590	-0.178	-1.615	0.357	-3.558	-0.882	-1.942	0.591	1.975
3	0.812	*	0.056	0.590	-0.022	-2.035	0.253	*	-0.200	-1.396	0.630	1.094

Year	1995		1996		1997		1998
Season	1	2	1	2	1	2	1
AGE							
0	*	0.496	*	-0.006	*	0.087	*
1	0.062	0.761	-0.074	-0.114	-0.365	0.398	-0.292
2	-0.608	0.116	-0.106	0.911	-0.309	0.541	0.414
3	0.008	-0.634	-0.677	-0.201	0.334	-3.225	0.573

Table 13.1.4.1 cont.

Log residual stocknr. (nhat/n), fleet no: 2
Fishery in the Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	2.245	*	*	*	1.556	*	-1.800	*	0.062	*	*
1	-1.347	-1.967	0.636	0.454	-0.294	-0.476	0.121	-0.369	-1.005	-0.543	-1.174	*
2	0.426	0.482	-1.309	-2.422	0.802	1.181	0.334	-0.394	0.336	0.635	-0.315	-0.470
3	-0.033	1.933	0.962	0.923	-0.377	1.776	0.220	0.685	0.352	0.039	0.779	2.234

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	-4.656	*	0.886	*	2.275	*	-0.954	*	0.862	*	*
1	0.515	0.709	0.411	0.886	0.289	0.942	0.699	-0.139	-0.738	-0.041	1.079	0.857
2	-0.302	0.247	0.411	0.886	0.800	-0.530	-0.230	-0.994	0.160	-0.020	-0.265	-0.148
3	-0.910	-0.081	0.411	0.886	-0.041	-0.828	-0.515	0.086	0.413	0.442	-0.010	-0.401

Year	1995		1996		1997		1998
Season	1	2	1	2	1	2	1
AGE							
0	*	*	*	-0.172	*	-0.608	*
1	0.599	0.106	0.130	-0.241	0.048	-0.355	0.302
2	-0.508	1.152	0.292	0.962	-0.609	-1.134	-0.224
3	-0.213	0.761	0.761	0.386	-0.222	-0.470	0.011

Weighting factors for computing survivors:
Fleet no: 1
Fishery in the Northern North Sea

Season	1	2
AGE		
0	*	0.020
1	1.000	0.100
2	1.000	0.100
3	1.000	0.100

Weighting factors for computing survivors:
Fleet no: 2
Fishery in the Southern North Sea

Season	1	2
AGE		
0	*	0.020
1	1.000	0.100
2	1.000	0.100
3	1.000	0.100

The estimates before 1983 are based on previous assessment runs

Table 13.1.6.1 North Sea sandeel. Average fishing mortality, recruitment and SSB, 1976-1997

Year	Mean F (age 1-2)	Recruits age 0 in year (billions)	SSB ('000 t)
1976	0.55	487	780
1977	0.54	657	546
1978	0.68	532	701
1979	0.64	543	881
1980	0.68	213	841
1981	0.68	985	706
1982	0.62	201	427
1983	0.46	870	1210
1984	0.35	228	712
1985	0.93	1206	1123
1986	0.54	630	459
1987	0.45	200	1634
1988	0.71	724	1511
1989	0.66	332	513
1990	0.74	652	670
1991	0.72	830	485
1992	0.45	325	726
1993	0.34	634	1165
1994	0.53	812	859
1995	0.44	366	1110
1996	0.54	2069	1048
1997	0.36	198	643
Average	0.57	622	852

The estimates before 1983 are based on previous assessment runs.

Table 13.1.8.1 Biological reference points

	Median	5% 'ile
SSB_{pa} ('000t)	460	
SSB 1998 ('000t)	2084	1155
F_{bar} 1997	0,36	0,27
F_{low}	0,22	0,12
F_{med}	0,55	0,42
F_{high}	1,23	0,86
$F_{SPR35PercMax}$	0,26	0,21
$F_{YPR0pt1}$	0,23	0,20
$SPR_{Current}$	22,6	19,0

Figure 3.5.13.1 Danish SANDEEL areas and assessment areas used by the Working Group

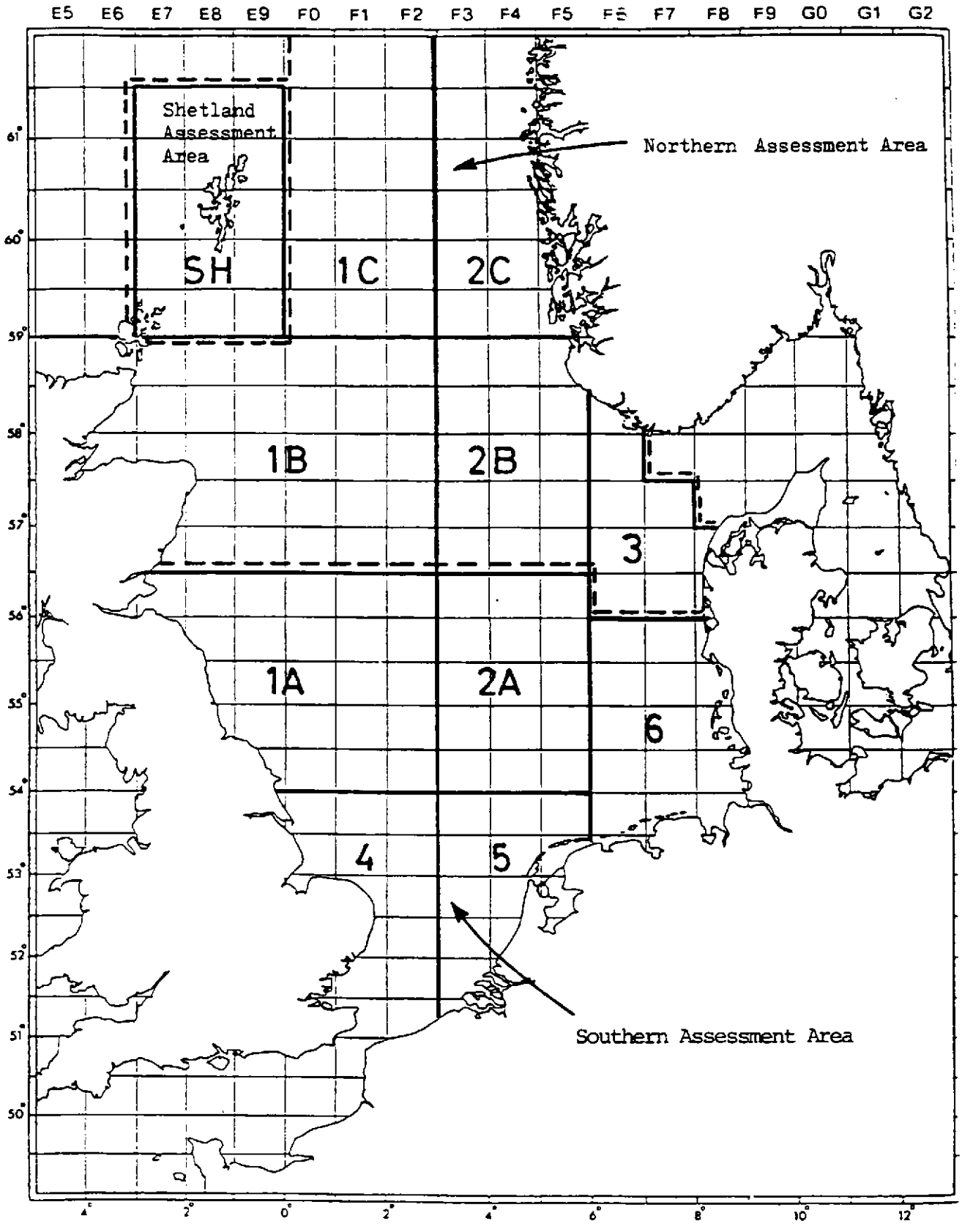


Figure 13.1.1.2 **Danish sandeel areas and assessment areas**

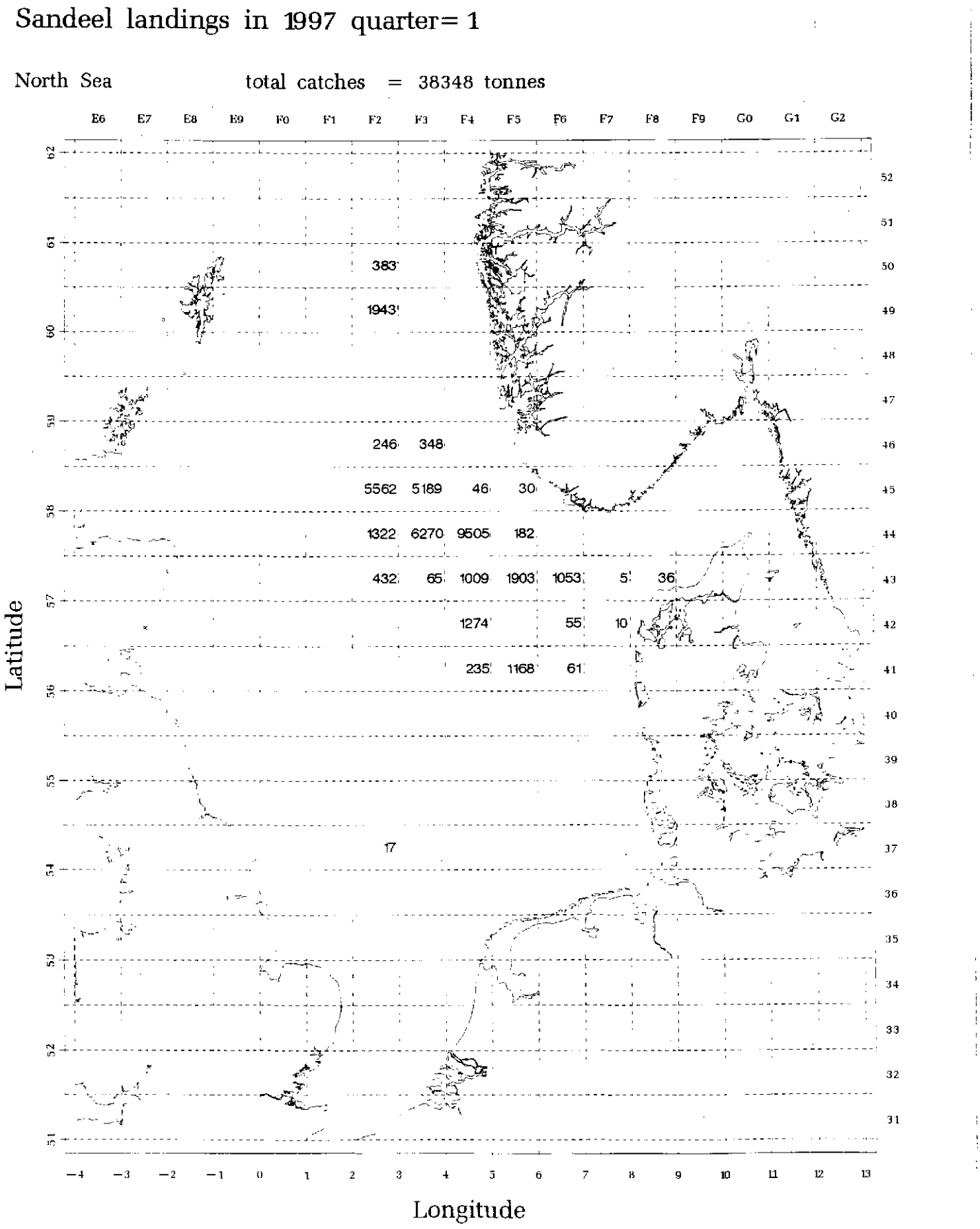
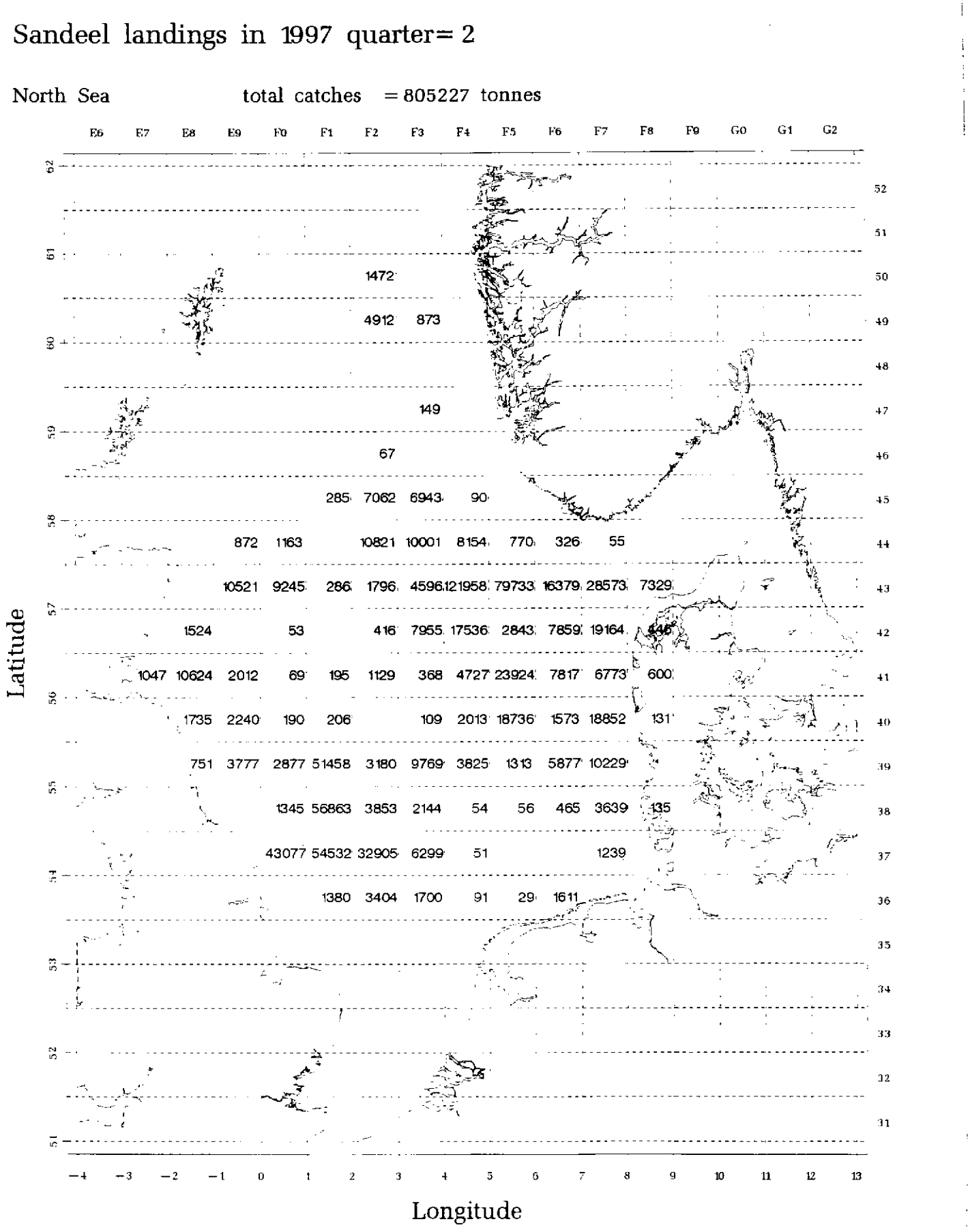


Figure 13.1.1.2 Continued



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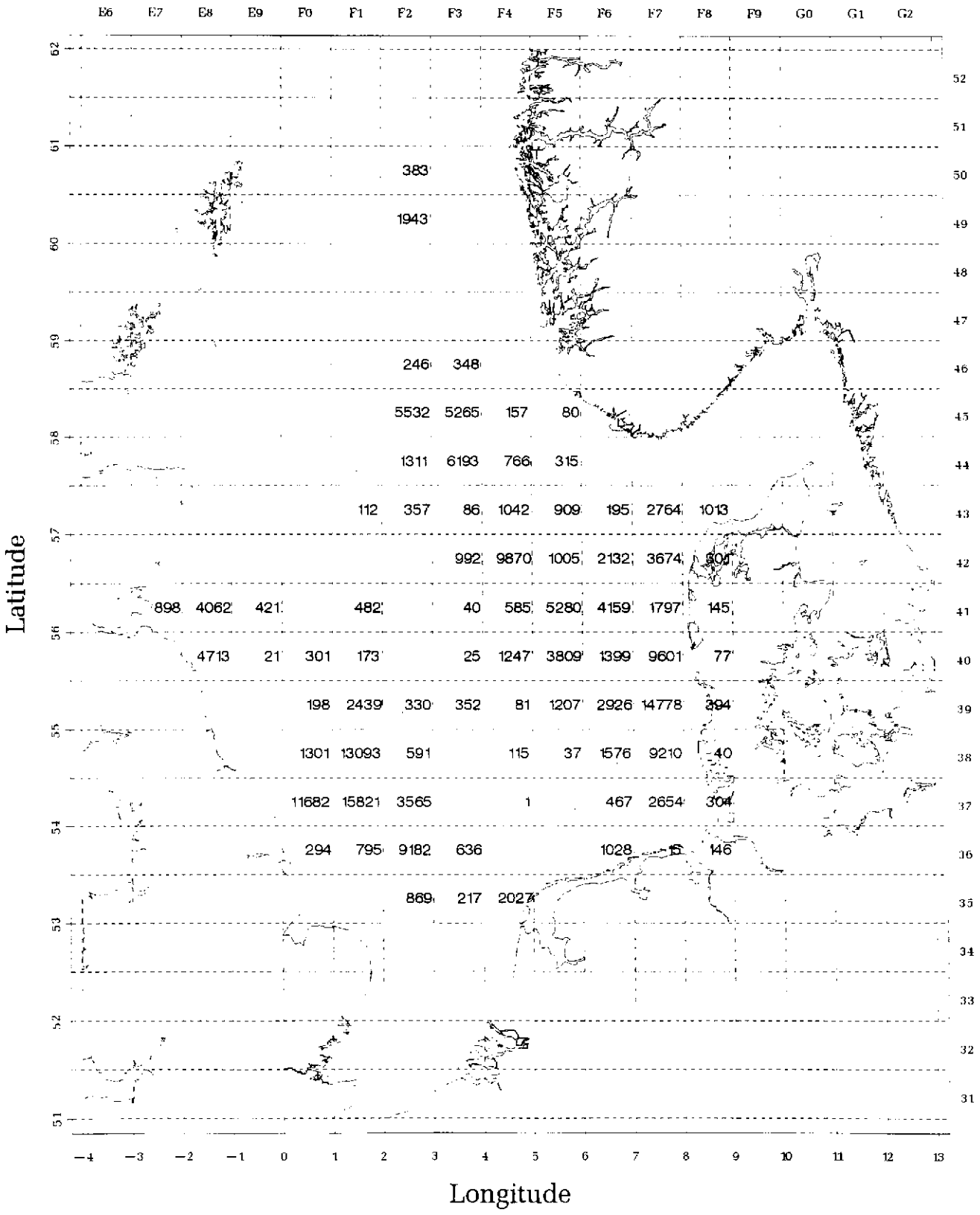
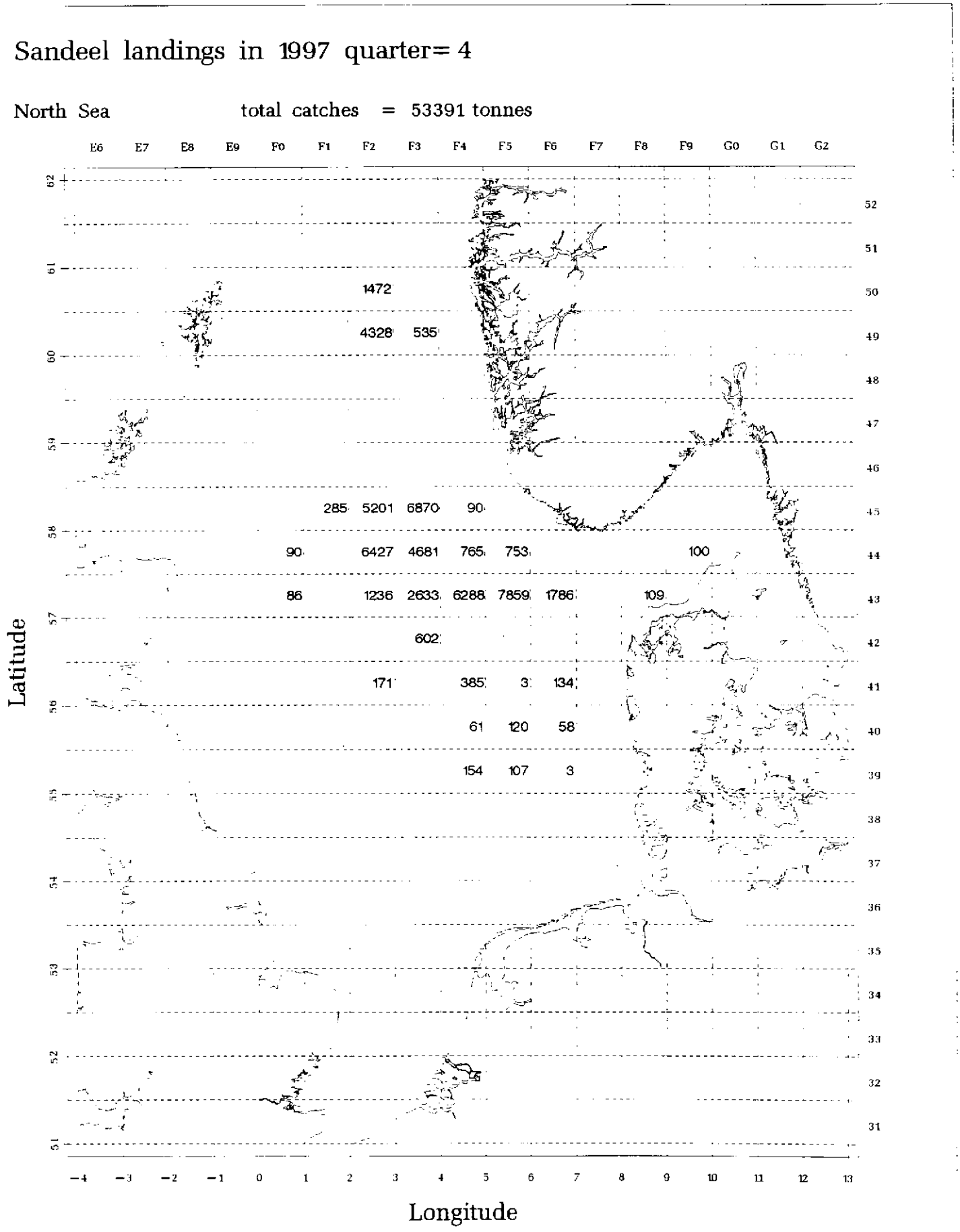


Figure 13.1.1.2 Continued



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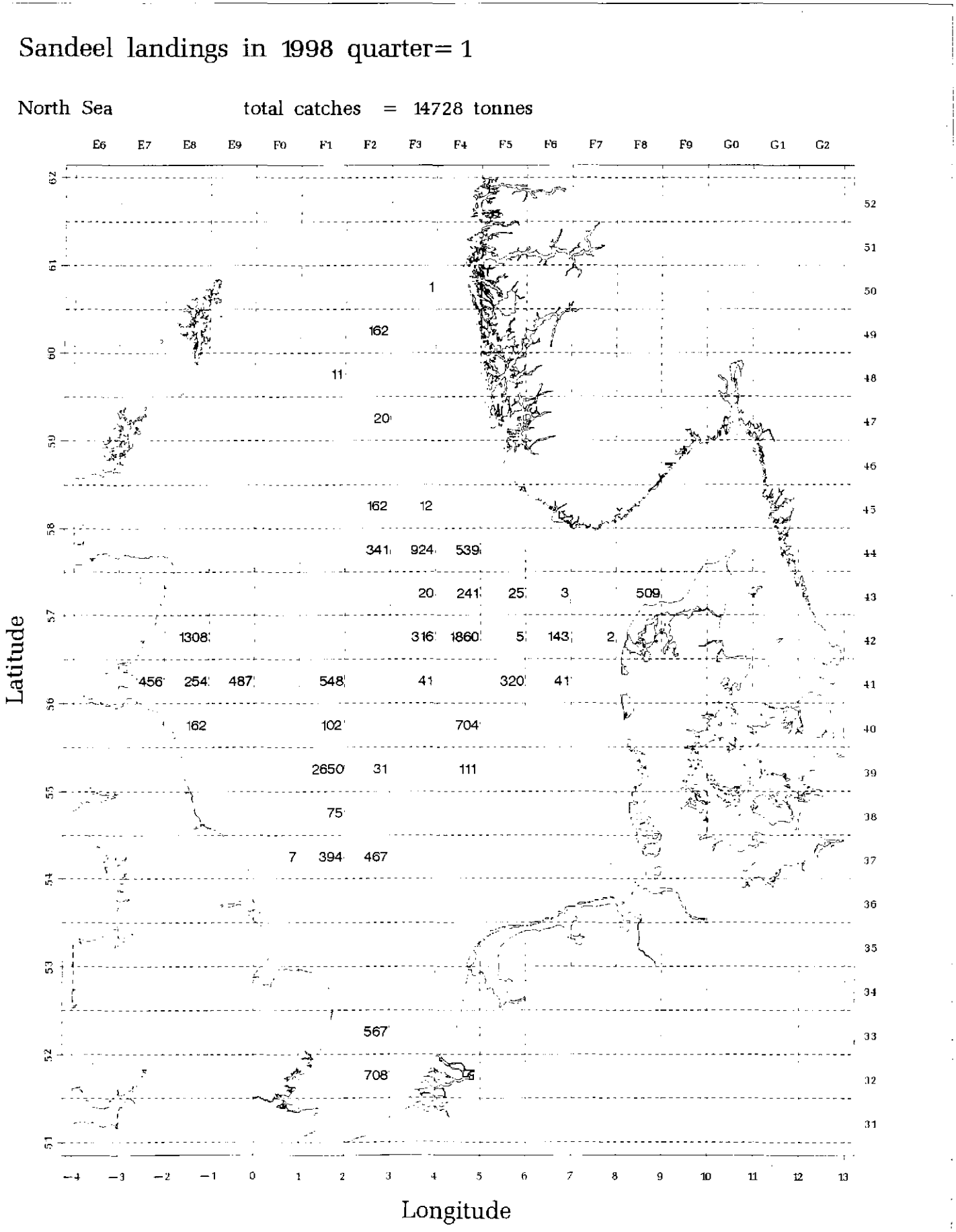


Figure 13.1.1.2 Continued

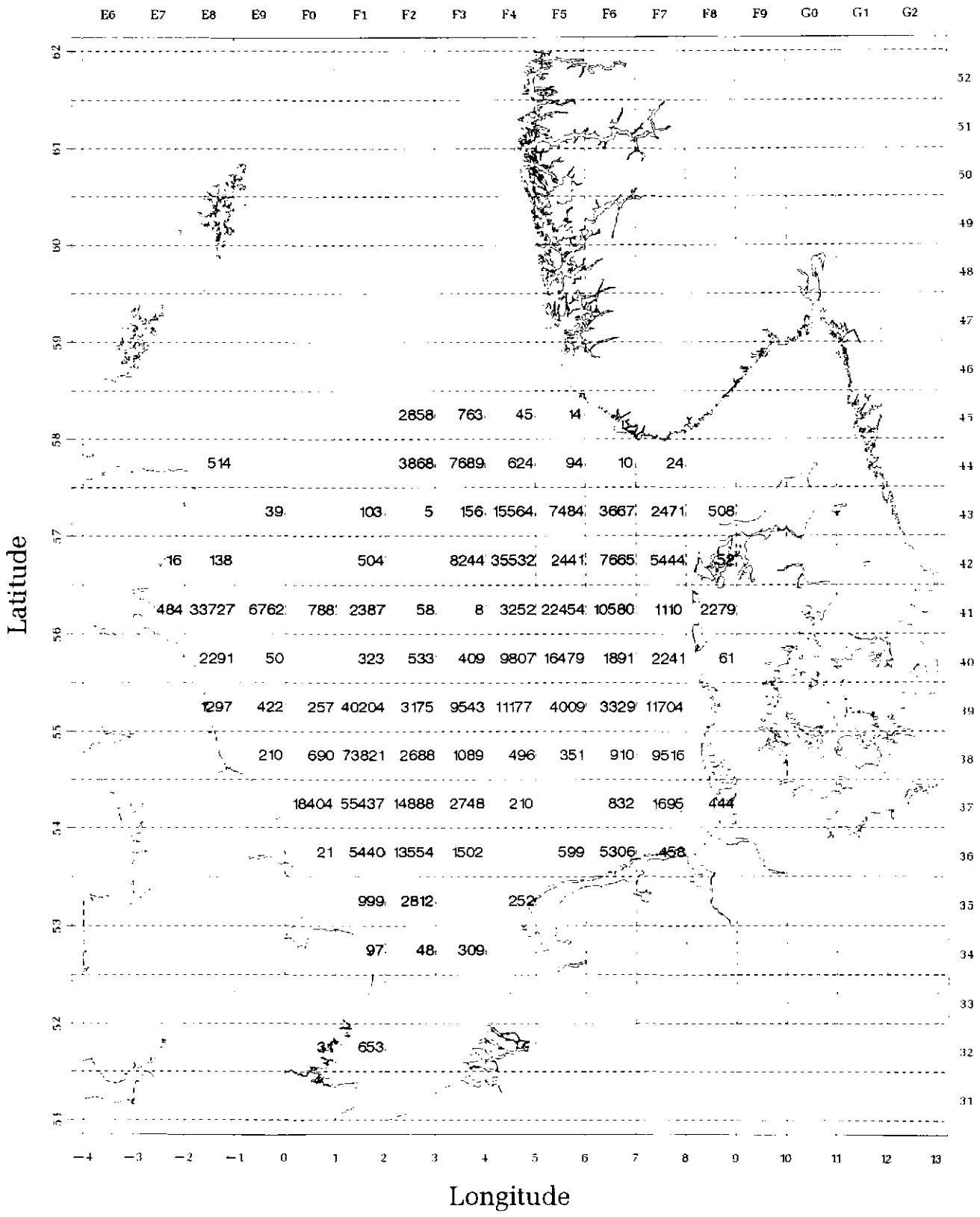
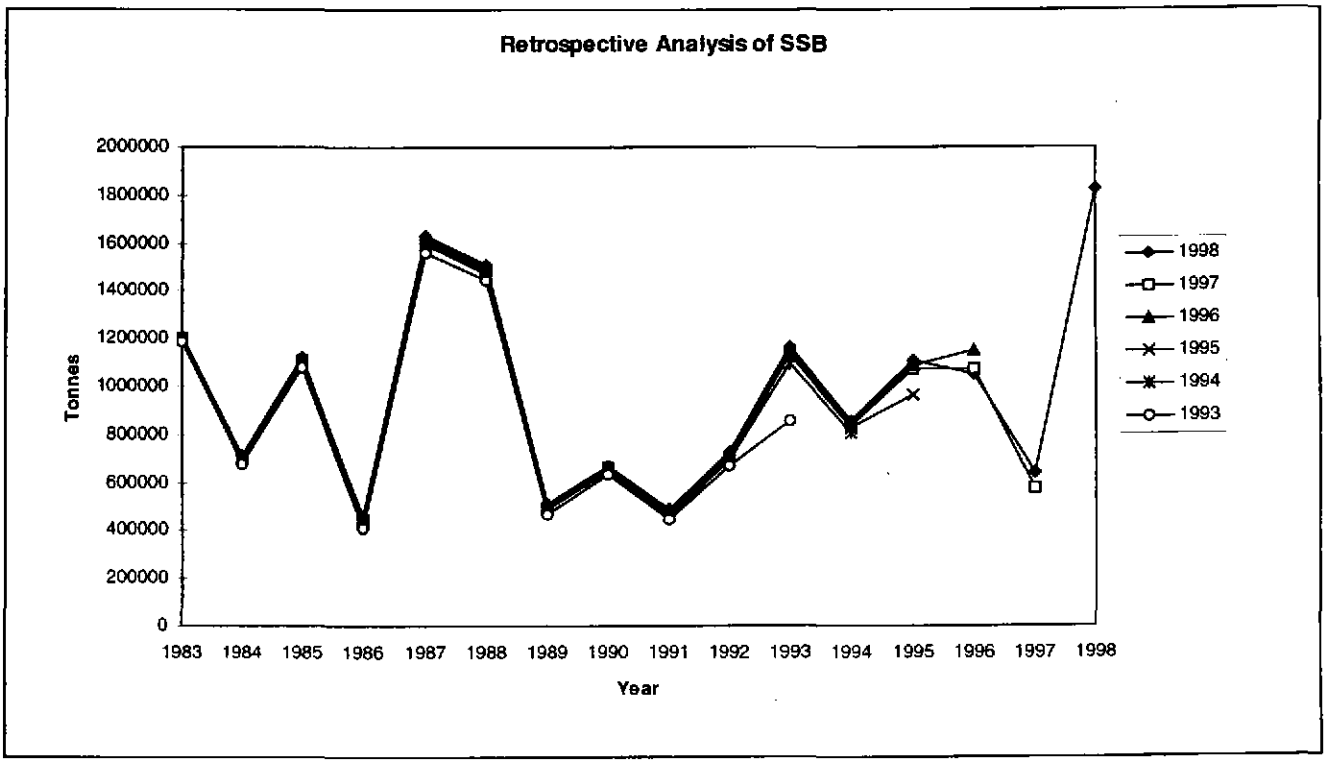


Figure 13.1.4.1 Retrospective analysis of SSB and Recruitment[1]

SXSA – Sandeel in the North Sea



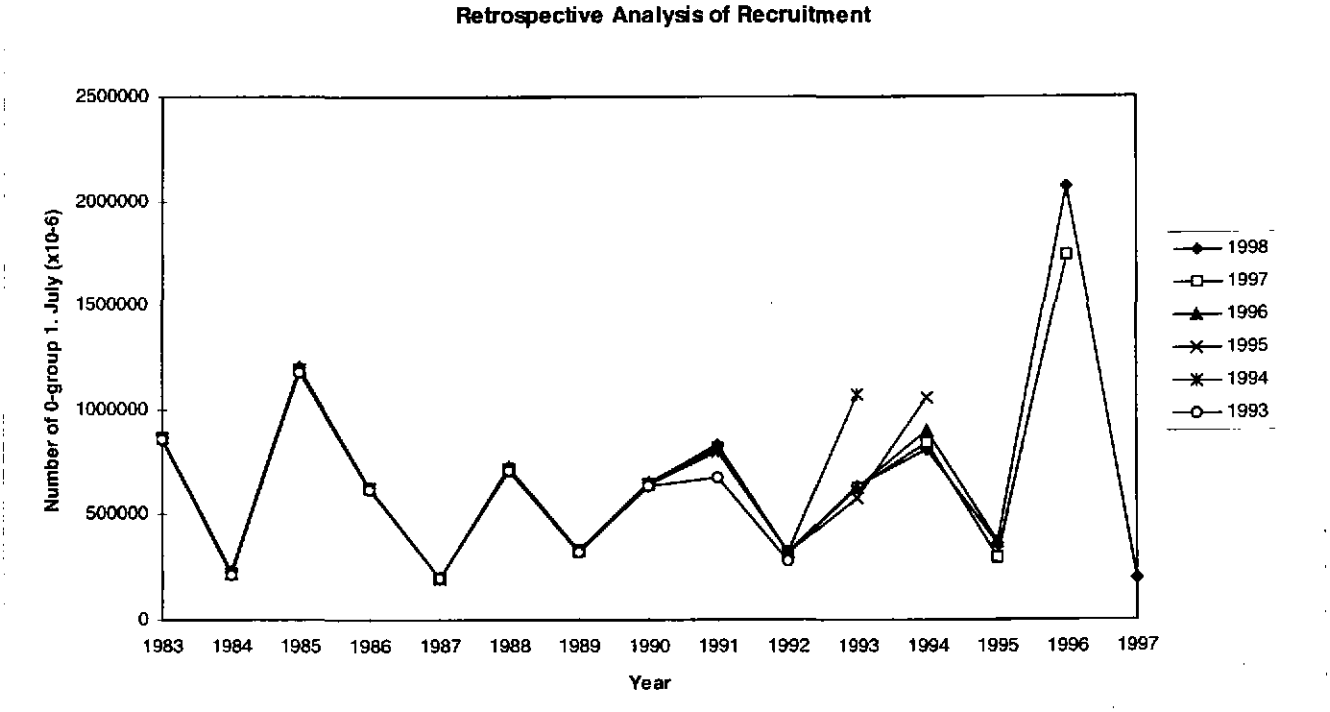


Figure 13.1.4.2 Log residual stocknumbers by fleet and season.

SXSA – Sandeel in the North Sea

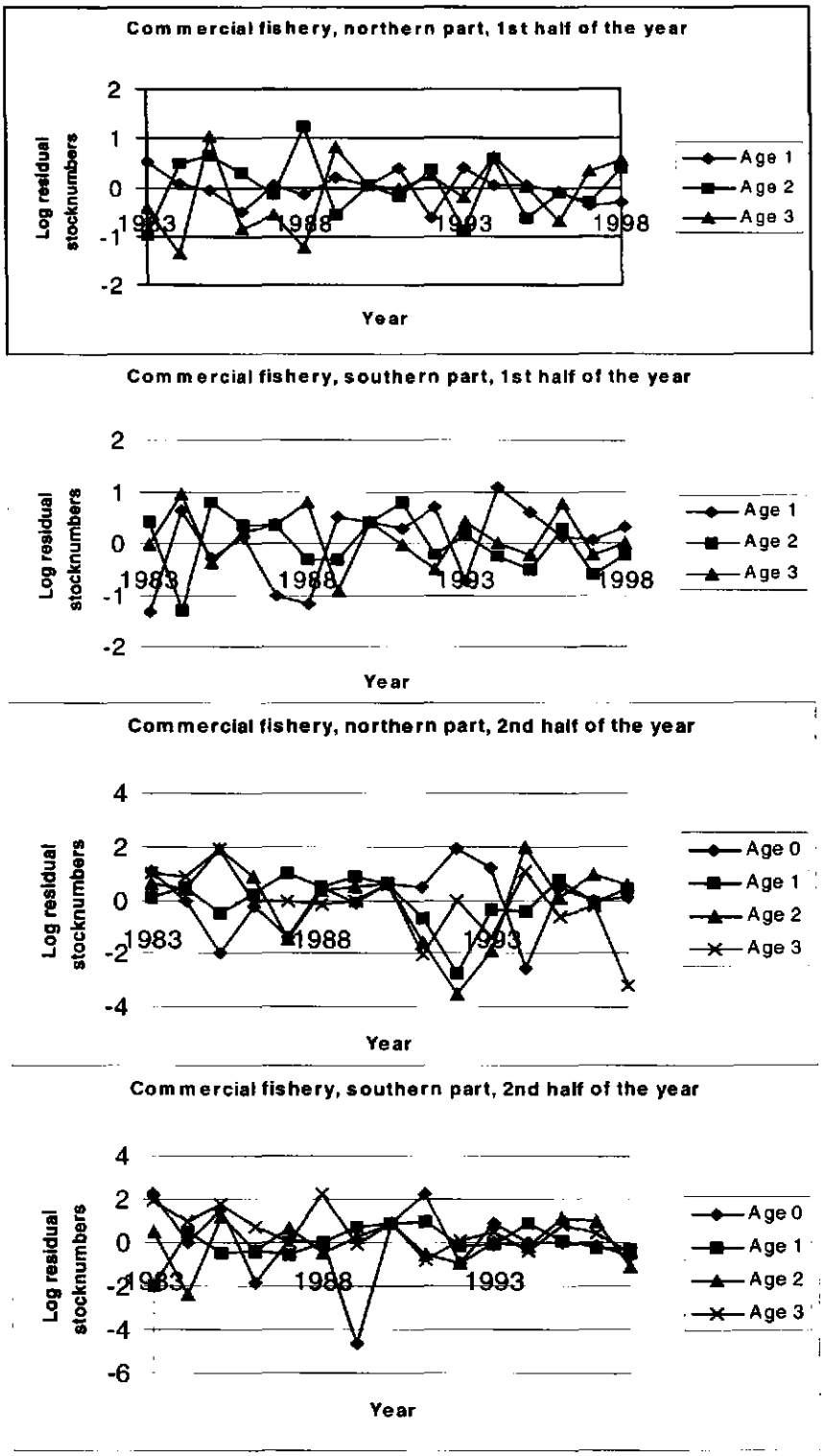


Figure 13.1.4.3 North Sea sandeel. Average fishing mortality for ages 1 and 2 versus fishing effort

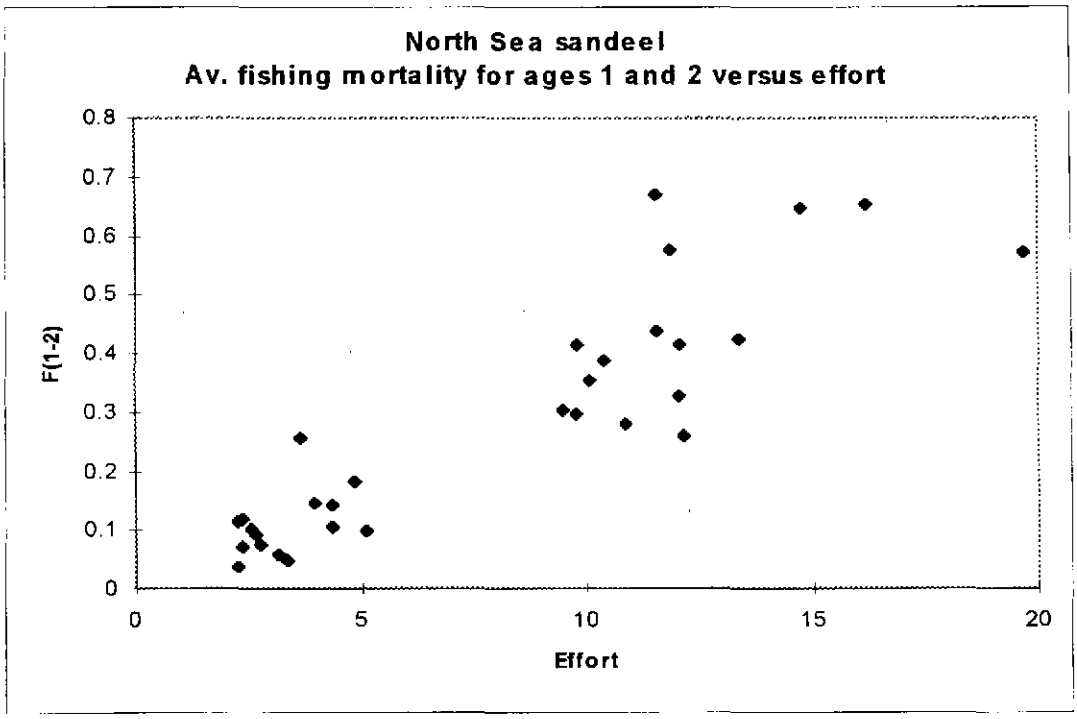


Figure 13.1.4.4 North Sea sandeel. Relationship between stocknumbers estimated by SXSA and CPUE of tuning fleet.

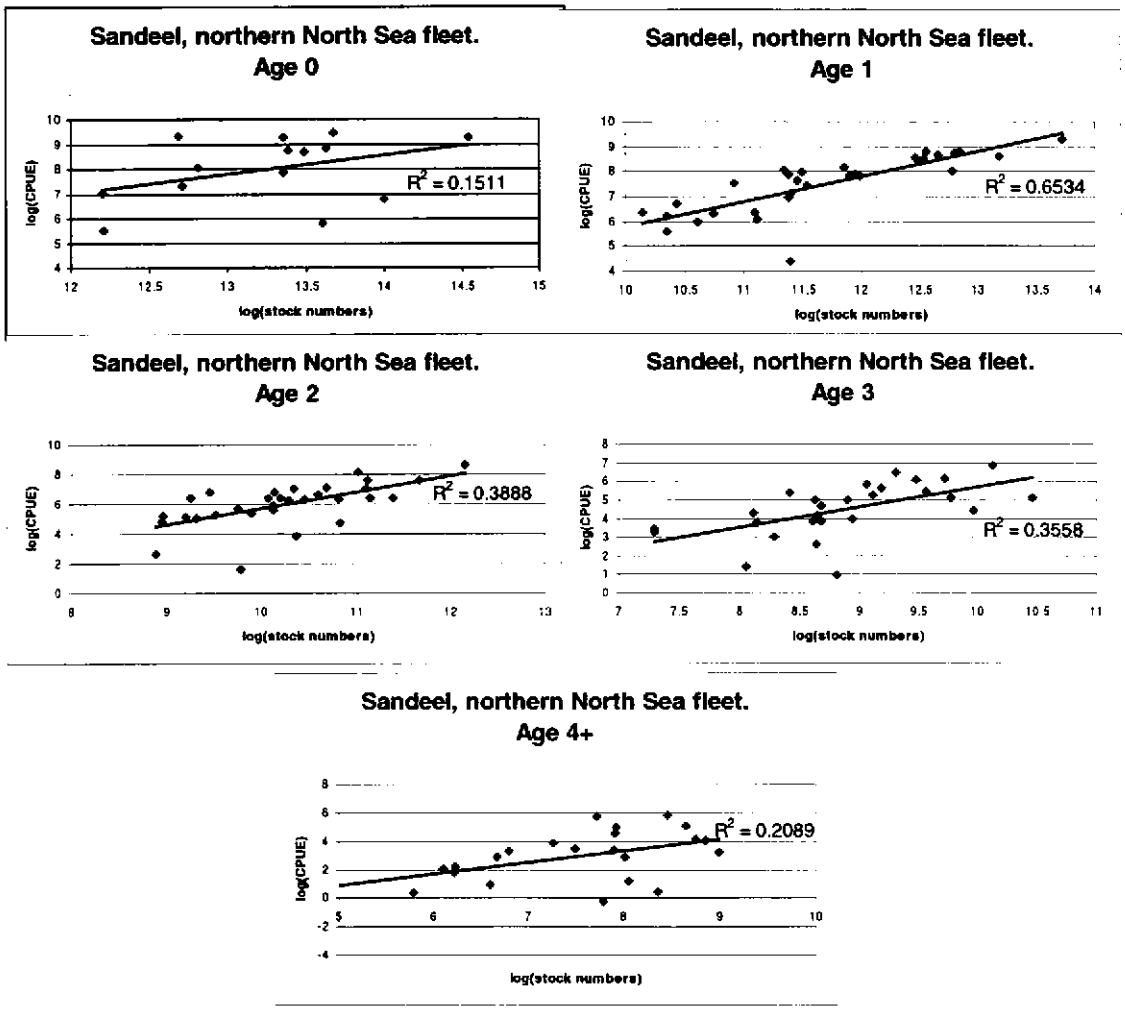
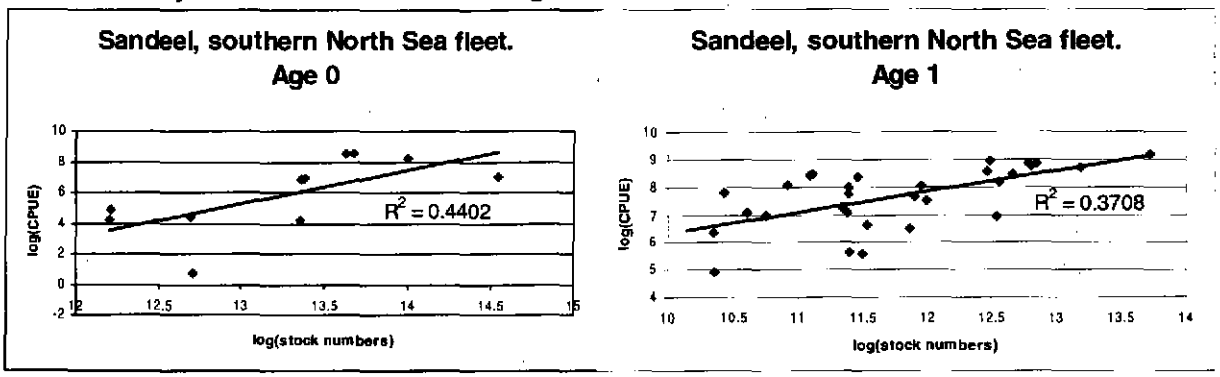
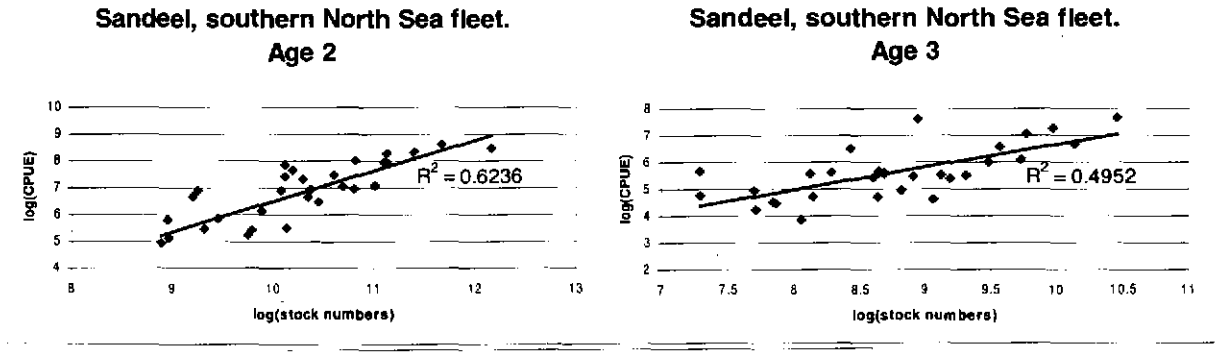


Figure 13.1.4.4 cont. North Sea sandeel. Relationship between stocknumbers estimated by SXSA and CPUE of tuning fleet.





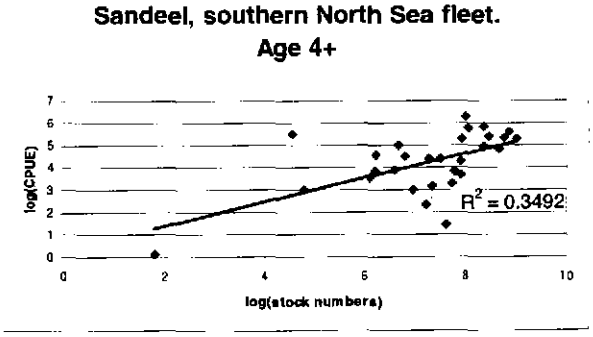


Figure 13.1.4.5 Stock recruitment relationship for sandeel in the North Sea.

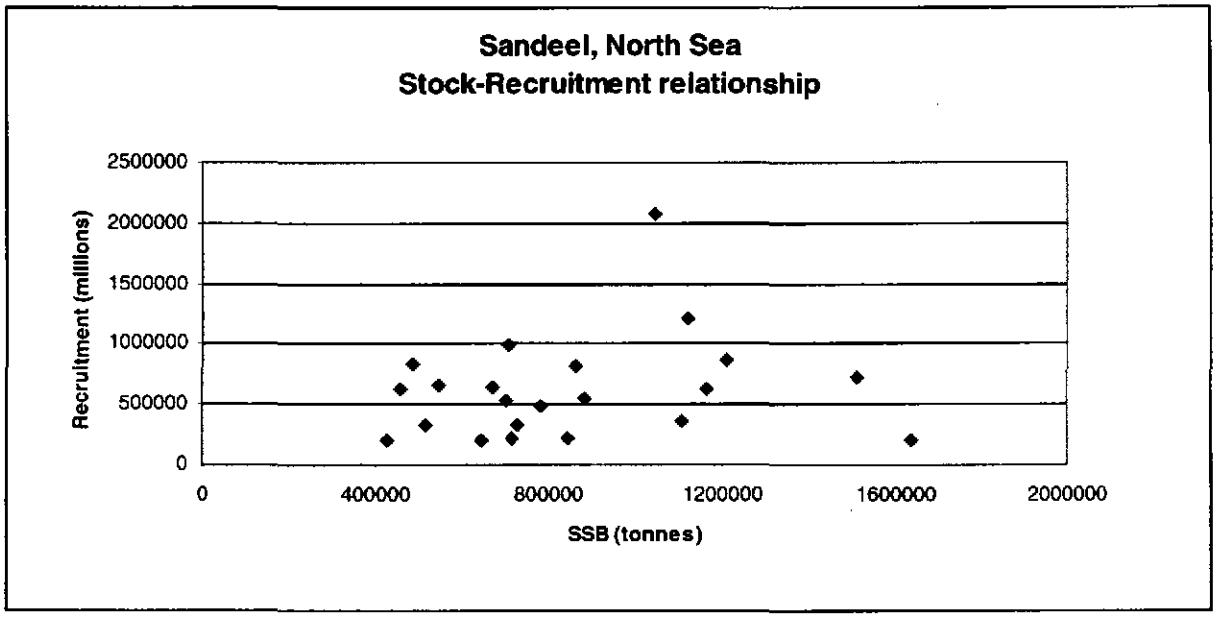


Figure 13.1.6.1 Trends in yield, fishing mortality (Fav1-2), SSB and recruitment

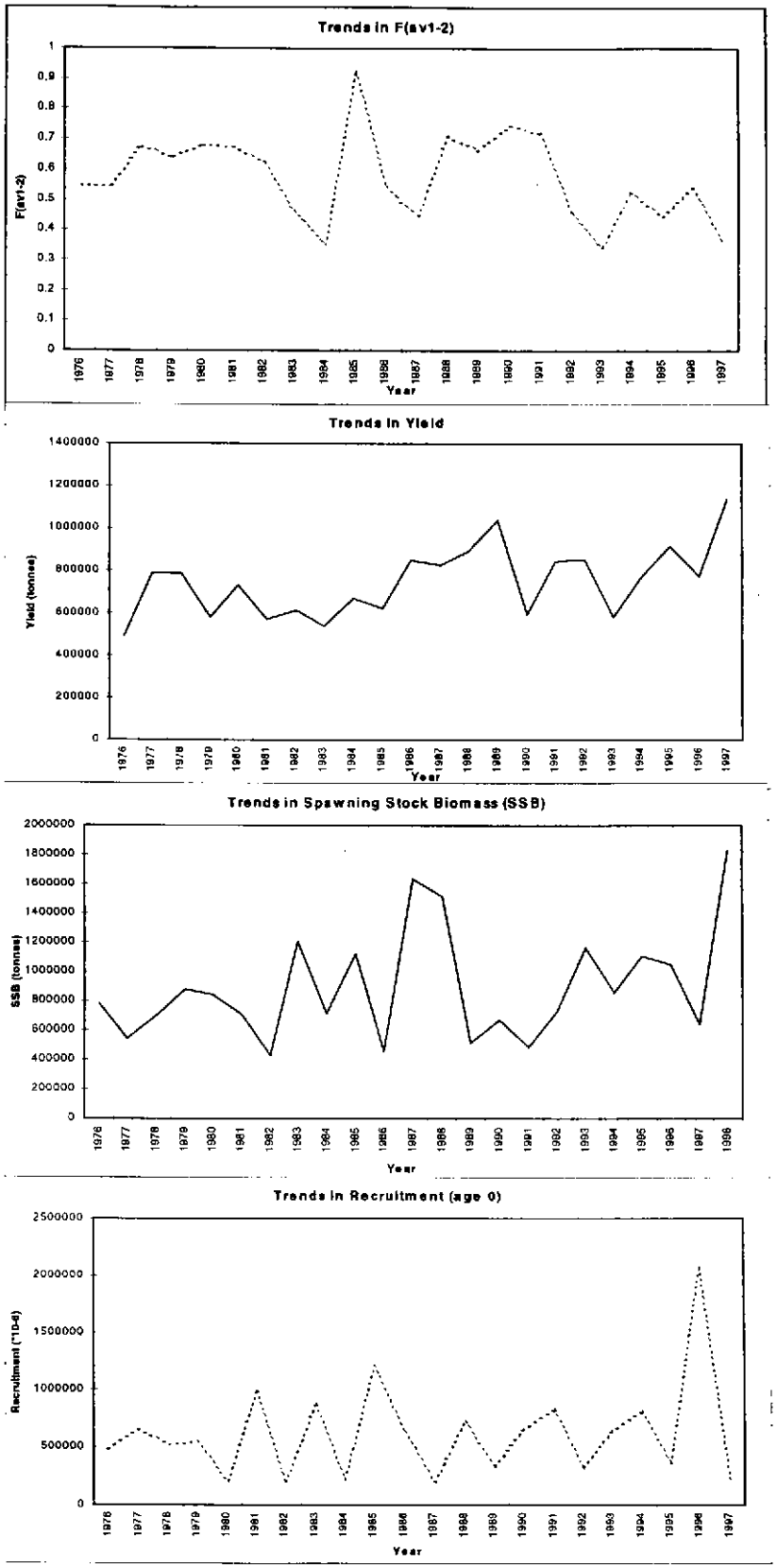


Figure 13.1.6.1 cont.

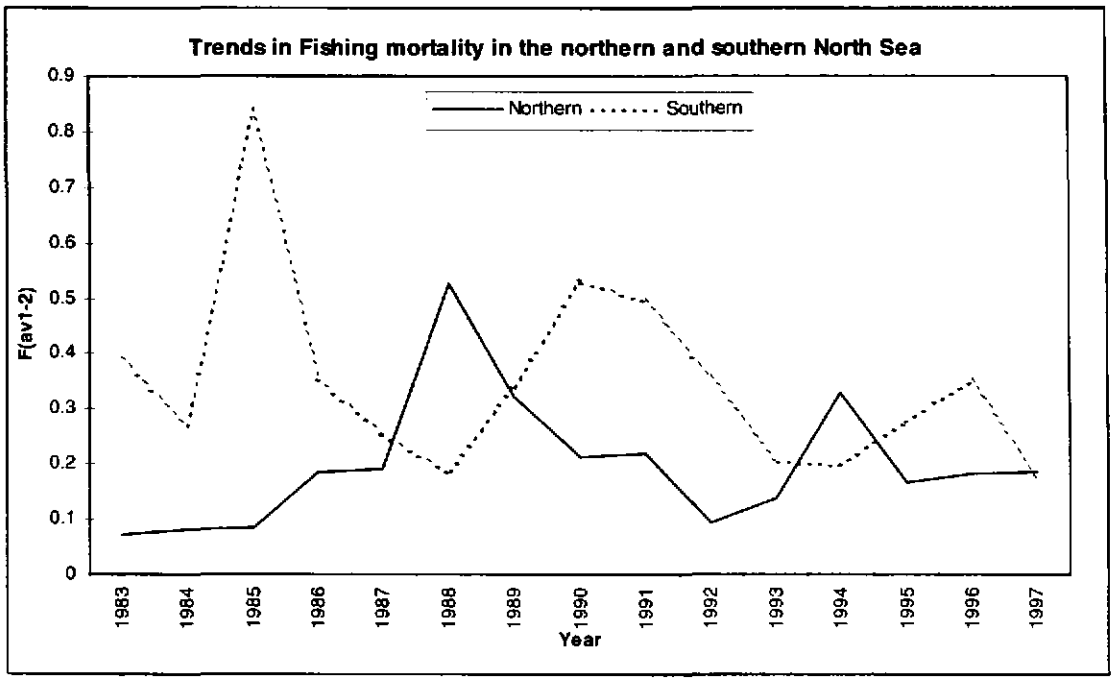
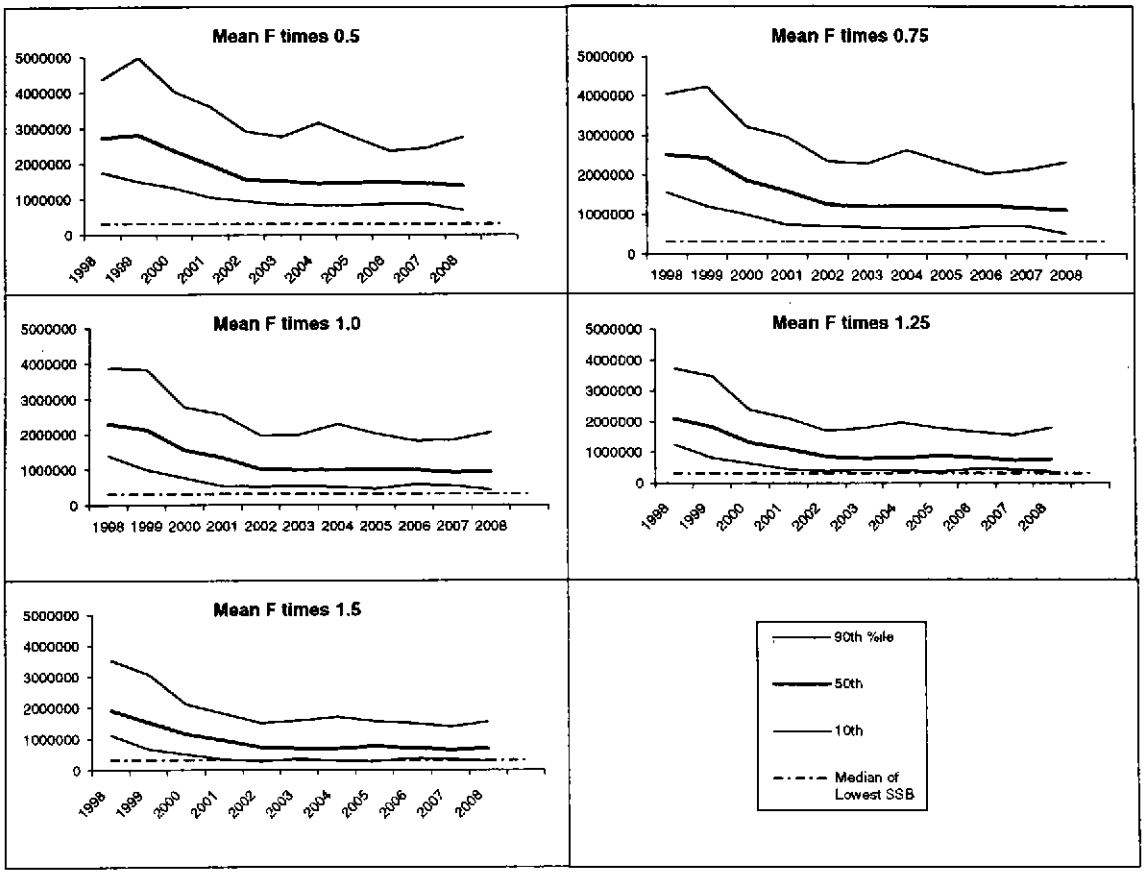


Figure 13.1.7.1 Medium term predictions of SSB for sandeel in the North Sea (mean F=average 1988-1997)



14 NORWAY POUT AND SANDEEL IN DIVISION VIA

14.1 Overview of industrial fisheries in Division VIa

There are two distinct industrial fisheries operating in Division VIa; a Norway Pout fishery and a sandeel fishery. The Norway Pout fishery is predominately Danish, whereas the sandeel fishery is almost exclusively Scottish and operates in more inshore areas. No information is available on bycatches in the Norway Pout fishery. The sandeel fishery has a small bycatch of other species; information from the 1995 and 1996 catches indicates that in excess of 97% of the catch consisted of *Ammodytes marinus,* with the bycatch consisting mostly of other species of sandeel. Landings from both fisheries are small compared to the fisheries in the North Sea.

14.2 Norway Pout in Division VIa

Landings of Norway Pout from Division VIa as reported to ICES are given in Table 14.2.1 and Figure 14.2.1. Landings in 1997 were 9,562 t, which is below the series average of 12,258 t. No data are available on bycatches in this fishery. In addition, no age composition date are available so there are insufficient data available to assess this stock.

14.3 Sandeel in Division VIa

14.3.1 Catch Trends

Landings of sandeel in Division VIa as officially reported to ICES are given in Table 14.3.1.1, and trends in landings are given in Figure 14.3.1.1. In 1997 landings declined slightly from the 1996 figure of 13,257 t. to 12,679 t. The 1997 landings were taken during June and July, mostly from grounds at North Minch and North Rona.

14.3.2 Assessment

As with the fishery at Shetland, management of this fishery is on a three-yearly basis, with management measures effort being agreed and then kept in place for a three year period. As ACFM have noted that the assessment does not need to be updated annually, but only needs to reflect the three-year interval of the management regime, the assessment has not been updated this year.

Table 14.2.1 Norway Pout. Annual landings (t) in Division VIa (Data officially reported to ICES)

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Denmark	37714	5849	28180	3316	4348	5147	7338	14147	24431	6175	9549
Faroes	-	376	11	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-	-	1	-	-
Netherlands	-	-	-	-	-	10	-	-	7	7	-
Norway	-	-	-	-	-	-	-	-	-	-	-
Poland	-	-	-	-	-	-	-	-	-	-	-
UK (E+W)	-	-	-	-	-	1	-	1	-	-	-
UK (Scotland)	553	517	5	-	-	-	-	+	-	140	13
Total	38267	6742	28196	3316	4348	5158	7338	14148	24439	6322	9562

Table 14.3.1.1, Sandeel, Division VIa
Landings (tonnes), 1981-1997, as officially reported to ICES,

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Denmark	-	-	-	-	-	-	-	-	-	-
UK, Scotland	5972	10786	13051	14166	18586	24469	14479	24465	18785	16515
Total	5972	10786	13051	14166	18586	24469	14479	24465	18785	16515

Country	1991	1992	1993	1994	1995	1996	1997
Denmark	-	-	80	-	-	-	-
UK, Scotland	8532	4935	6156	10627	7111	13.257	12.679
Total	8532	4935	6236	10627	7111	13257	12679

Figure 14.2.1; **Norway Pout in Division VIa**
Catch trends

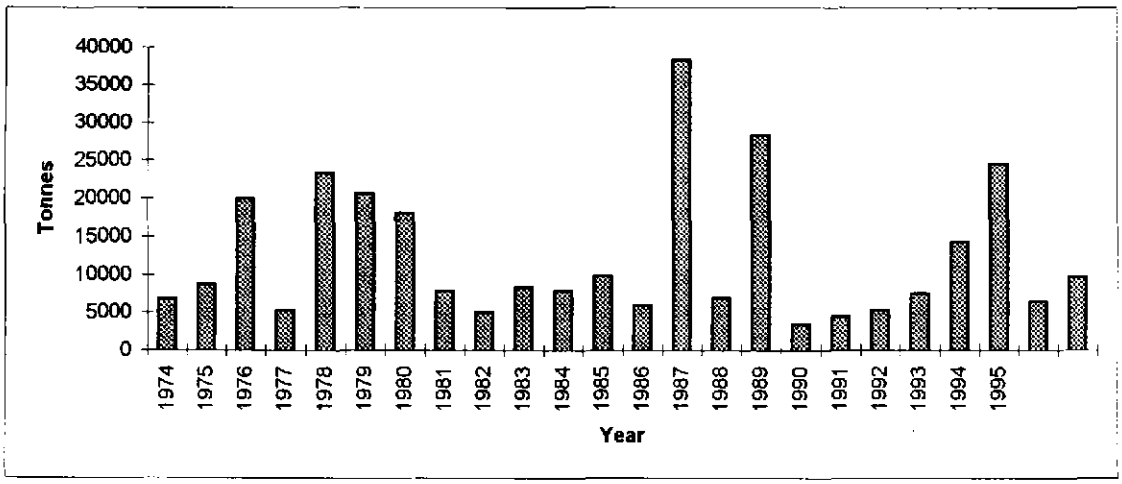
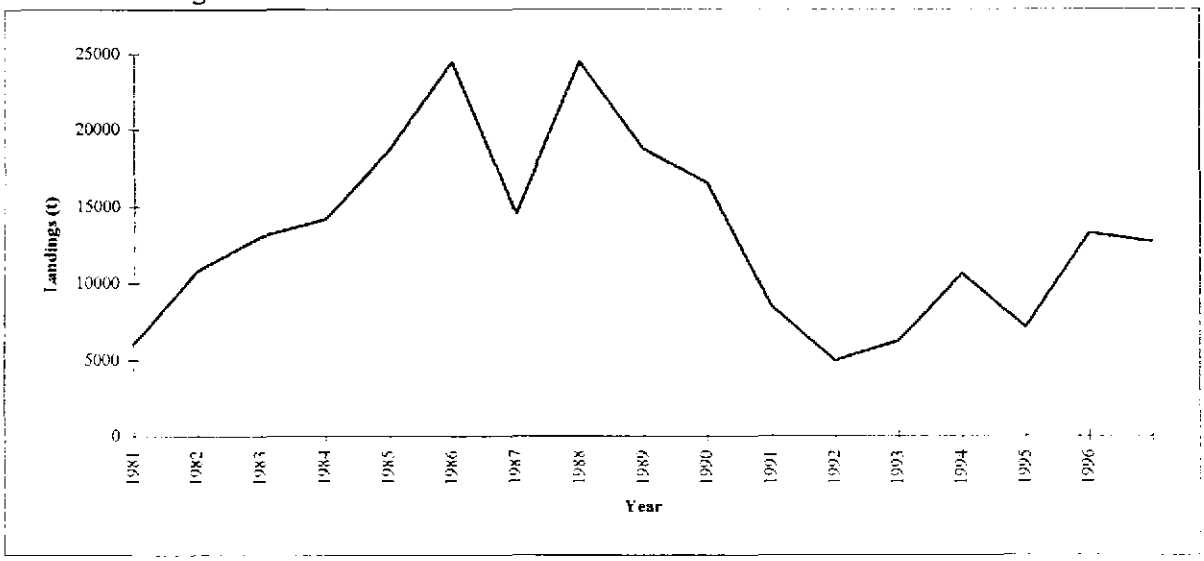


Figure 14.3.1.1, Sandeel in Division VIa.
Trends in landings



15 DISCARDS

Information on discarding is presently collected by Scotland on a routine basis for Scottish fleets. Estimates of Scottish haddock and whiting discards are extrapolated to other fleets and presented and used in the assessment of these species in this report. In England, Denmark and Germany discard programmes have been initiated in recent years on a routine basis in some of the fleets. No discard sampling has been carried out by other countries. The data, which are available, have been presented in last years report. Unfortunately errors have been detected in some of the tables. These corrected tables are given in Tables 15.1 and 15.2 (source: van Beek, 1990). These tables replace Tables 18.3.1 and 18.3.2 in last years report.

No new information on discards has become available since last year. Although data have been collected in 1997 by the countries listed above, it has not been processed. The Working Group also considers that the guidelines, given to the Group, in how to present the data are not very clear. The interpretation of the guidelines by the Group was that all data were requested on the finest possible scale, and that considerable detail about the sampling schemes should also be provided.

Whilst information on sampling is available, its extraction and compilation would add considerably to the workload of an already hard-pressed Working Group. Also, the existing sampling programmes do not provide discard estimates on a fine scale, since annual estimates of the spatial and seasonal variation in discards requires much larger and expensive programmes than can be carried out with the existing resources. In addition, some of the existing programmes monitor only a few commercial roundfish species, while other monitor bycatches as well.

Table 15.1 Discards of selected species in the Dutch pair trawl and otter trawl fisheries.

The Dutch pair trawl and otter trawl fisheries, Percentages discards and numbers per 100 fishing hours.

Discards		No of samples	Area	Cod		Whiting		Haddock		Bib		Plaice		Dab	
				%	No	%	No	%	No	%	No	%	No	%	No
Average	1976-1990	45	North Sea	20	6179	53	27944	29	303	88	949	64	3647	84	20499
	1989-1990	10	North Sea	44	7827	80	44671	29	1101	na	459	na	4678	na	32780

Average percentages are weighted over total catch numbers

Table 15.2 Discards of selected species in the Dutch beam trawl fishery.

The Dutch beam trawl fishery, Percentages discards and numbers per 100 fishing hours.

Discards		No of samples	Area	Plaice		Sole		Dab		Flounder		Whiting		Cod	
				%	No	%	No	%	No	%	No	%	No	%	No
Average	1976-1990	49	North Sea	49	29064	16	2395	98	100953	81	1411	85	8508	66	2762
	1978	8	North Sea	41	16910	9	912	98	75310	100	197	93	12926	41	1591
	1979	9	North Sea	55	27101	5	908	99	103525	100	64	71	3508	49	1735
	1980	9	North Sea	58	50052	5	246	96	80832	80	1547	70	5860	71	6217
	1981	8	North Sea	59	42494	21	2125	96	92940	84	6152	81	6454	87	5520
	1982	5	North Sea	20	7503	29	5214	96	54234	0	0	86	15663	49	830
	1989-1990	6	North Sea	46	32972	22	8263	99	202118	54	640	96	12469	61	32
			Plaicebox	83	83433	8	935	99	160347	100	201	88	3852	80	10215
			Nonplaicebox	36	17489	18	2658	97	75979	81	1647	85	8953	51	1308

Average percentages are weighted over total catch numbers

16 WORKING DOCUMENTS

Pastoors, M. A. Trends in effort, fishing mortality, catchability and CPUE in the North Sea flatfish fishery. Working Document no.1.

Pastoors, M. A., A. D. Rijnsdorp and F. A. van Beek. Evaluation of the effects of a closed area in the North Sea ('Plaice Box') on the stock development of plaice (*Pleuronectes platessa*). ICES CM 1998/U:2. Working Document no. 2.

Beek, F. A. van. Comparison of historical results for WGNSSK stocks. Working Document no. 3.

Beek, F. A. van. Compilation of precautionary reference points proposed by ACFM in 1998 for the stocks considered in its May meeting. Working Document no. 4.

Ehrich, S., W. Weber and C. Zimmermann. A four-week area closure in the German Bight: A measure to protect the strong 1996 cod year class. ICES CM 1998/U:8. Working Document no. 5.

Kell, L. Lowestoft Precautionary Approach suite. Working Document no. 6.

Pastoors, M. A. and A.T.G.W. Eltink. Market Sampling at the RIVO-DLO (The Netherlands). Working Document no. 7.

16.1 References

Armstrong, D. W. and W. B. Hall, 1987. Collection, processing and retrieval of data from catches by Scottish commercial fishing vessels of demersal fish species 1950–1982. In: Bailey, R. and B. B. Parrish (eds.). Developments in fisheries research in Scotland. London, Fishing News Books.

Beek, F. A. van, 1990. Discard sampling programme for the North Sea, Dutch participation. RIVO Intern Rapport Dem Vis 90–303.

Cleveland, W. S., 1979. Robust locally weighted regression and smoothing scatterplots. J Amer Stat Soc 74: 829–836.

Cook R. M. 1993. The use of sensitivity analysis to quantify uncertainties in stock projections. ICES C. M. 1993/D:66.

Fowlkes, E. B., 1987. A Folio of Distributions: A Collection of Theoretical Quantile-Quantile Plots. New York: Marcel Dekker.

Hastie, T. J. and Tibshirani, R.J., 1990. Generalized Additive Models. London: Chapman & Hall.

ICES 1979. Report of the Flatfish Working Group. ICES CM 1979/G:10.

ICES 1986 a. Report of the Ad Hoc Multispecies Assessment Working Group. ICES CM 1986/Assess:9.

ICES 1986 b. Report of the North Sea Roundfish Working Group. ICES CM 1986/Assess:16.

ICES 1987 a. Report of the Ad Hoc Multispecies Assessment Working Group. ICES CM 1987/Assess:9.

ICES 1987 b. Report of the North Sea Roundfish Working Group. ICES CM 1987/Assess:15.

ICES 1987 c. Report of the Ad Hoc Meeting of the North Sea Flatfish Working Group, Ijmuiden. ICES CM 1987/Assess:14.

ICES 1987 d. Report of the Working Group on Industrial Fisheries, Copenhagen 5.-8. March 1987. ICES CM 1987/Assess:17.

ICES 1989. Report of the Multispecies Assessment Working Group. ICES CM 1989/Assess:20.

ICES 1990. Report of the North Sea Roundfish Working Group. ICES CM 1990/Assess:7.

ICES 1991. Report of Division IIIa Demersal Stocks Working Group. Copenhagen, 25 February - 4 March 1991. ICES CM 1991/Assess:9.

ICES 1994 a. Report of the Sandeel and Norway Pout Assessment Group. ICES CM 1994/Assess:7.

ICES 1994 b. Report of the ICES Study Group on the North Sea Plaice Box, Charlottenlund Denmark 12–15 April 1994. ICES CM 1994/Assess 14.

ICES 1995 a. Report of the Sandeel and Norway Pout Assessment Group. ICES CM 1994/Assess:5.

ICES 1995 b. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES CM 1995/Assess:8.

ICES 1996. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES CM 1996/ Assess:6.

ICES 1997 a. Report of the Multispecies Assessment Working Group. ICES CM 1997/Assess:16.

ICES 1997 b. Extract of the Report of the Advisory Committee on Fishery Management to the European Commission and the Government of Norway, May 1997.

ICES 1997 c. Extract of the Report of the Advisory Committee on Fishery Management to the North-East Atlantic Commission, October 1997.

ICES 1997 d. Report of the ICES Advisory Committee on Fishery Management, 1996. ICES Cooperative Research Report 221.

ICES 1997 e. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES CM 1997/ Assess:6.

ICES 1998. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES CM 1998/Assess:7.

ICES 1999. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES CM 1999/ACFM:1.

Kell, L.T., M.T. Smith, and CM O'Brien. 1997. A bootstrapped seasonal survivors analysis for the North Sea sandeels. Working Document no.1 (unpublished) to the ICES Working Group on the Assessment of Demersal Stocks in the North Sea and the Skagerrak, Copenhagen, October 1997.

Reeves, S. and R. Cook, 1994. Demersal assessment programs, September 1994. Working Document (unpublished) to the 1994 meeting of the North Sea Demersal Working Group.

Skagen, D. W. 1993. A seasonal extended survivors analysis (SXSA) with optional estimation of unknown catches at age. Report of the Working Group on the Assessment of Norway Pout and Sandeel. ICES CM 1994/Assess:7, Appendix I.

Skagen, D. 1994. Revision and extension of the Seasonal Extended Survivors Analysis (SXSA). Working Document (unpublished) to the 1994 meeting of the Report of the Working Group on the Assessment of Norway Pout and Sandeel.

Staehr, K.-J. and J. G. Stottrup 1991. Migration of plaice transplanted from the North Sea to the Kattegat. ICES CM 1991/G39.

Ulmestrand,1989. Erfarenheter och preliminaere resultat fron et umplantings forsoek med roedspaetter i 1987. 6p (in Swedish).

Weber, W. 1995. Estimation of cod discards caused by the fishery on roundfish in the German Bight. ICES CM 1995/B+G+H+J+K:6.

Wilk, M. B. and Gnanadesikan, R., 1968. Probability plotting methods for the analysis of data. Biometrika 55: 1–7.