



**REPORT OF THE  
BALTIC FISHERIES ASSESSMENT WORKING GROUP**

ICES Headquarters, Copenhagen, Denmark

16–25 April 1996

**PART 2**

International Council for the Exploration of the Sea  
Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK-1261 Copenhagen K Denmark

## **5 SOLE IN DIVISION IIIa (KATTEGAT AND SKAGERRAK)**

### **5.1 Fisheries and Landings**

The officially reported landings by area and country are given in Table 5.1 and in Figure 5.1. The fishery increased from 300–400 t annually to about 1,400 t between 1989 and 1993. In 1994 the total catch declined to 1,198 t to increase again in 1995 to 1,297 t. Kattegat is the most important area accounting for 70–80% of the annual catches. Denmark takes more than 95% of the total catch.

Traditionally the sole fishery has been regulated by catch quota constraints. In Kattegat a new EU (Danish) regulation scheme was introduced in November 1993. Instead of the quota regime the fleet is limited by the number of days absent from port. The vessels can choose either to fish under this system or to continue to fish under the previous system which is regulated by weekly rations. Most of the soles in 1994 and 1995 were landed under the new system and comparison of the number of days absence from port, with a reference period 1990–1992, indicated that the effort had not increased (see Section 10).

For the period 1991–1993 the official catch statistics are disputable with a very significant amounts of sole assumed landed without being properly recorded. Due to the fact that most of the sole catches in 1994 and 1995 was taken under the effort regime where there is no catch constraints the official statistics are possible fairly accurate. Studies of the effort directed at sole in the Kattegat suggest that the level has remained relatively constant from 1992 to 1995.

In the later years the sole has been the single most important species in the Danish Kattegat fisheries accounting for about 25% of the total value from the human consumption fisheries (see Section 10). The importance of sole in Skagerrak is more limited; in 1995 sole accounted for about 4% of the total value of the Danish human consumption fisheries. The major part of the sole catches is taken in the mixed species trawl fishery using mesh sizes  $\geq 90$  mm and with gillnets using mesh sizes of 90–110 mm.

The fishery is regulated by a TAC set autonomously by the EU for 1994 and 1995 at 1,995 t.

### **5.2 Discards**

Danish at sea sampling in autumn 1995, initiated to quantify the level of discarding on commercial vessel, showed that a substantial number of undersized sole may be discarded in both the gillnet and the trawl fisheries. However, the restricted temporal coverage and the low sampling effort (one gillnetter and two trawlers) impede a reliable quantification of the level of discarding. The discard program is continued in 1996 and a reliable statistic is expected at the coming Working Group meeting.

### **5.3 Age Composition**

Only Denmark provided statistics on catches in numbers broken down by age groups. Kattegat was well sampled with quarterly samples taken for the market categories large and small sole (Table 5.2). The 1995 sampling in Skagerrak was unsatisfactory with only the large market category sampled in the 2nd and 3rd quarter (Table 5.2). The larger market category in Skagerrak was broken down to age groups by these samples which was applied to the catches taken in 1st and 2nd half of the year, respectively. The small sole in Skagerrak was broken down by using the Kattegat age information applied on a quarterly basis. Applying the Kattegat samples to Skagerrak is not satisfactory as comparisons between the age compositions in the concurrent samples of the large sole market category between the two areas indicated marked differences (e.g. 66% of the large sole in Kattegat were at or below age 5 as compared to only 33% in Skagerrak).

The Danish catch at age was raised to the total international catch (Table 5.3).

### **5.4 Mean Weight at Age**

Data on mean weight at age were derived by using the same sample allocation scheme as given above. The mean weight is shown in Table 5.4 for the period 1984–1994.

## 5.5 Catch Curve Analysis

Catch curves are shown for the year classes 1983 to 1989 indicate that the full recruitment to the fisheries takes place at age 3–4 (Figure 5.2). Performing a catch curve analysis on the average catches from these year classes (age 3–9) suggests an average total mortality of around 0.42 per year (Figure 5.3).

## 5.6 IBTS February Surveys

The IBTS February survey does not provide age disaggregated abundance estimates. However, the abundance of sole between 15–22 cm has conventionally been used by the Working Group as a proxy for the recruiting age 2 group. The survey indices (no/hr) for total and for the 2-group are presented in Table 5.5 and Figures 5.4 and 5.5. These graphs show that the recruitment and the total abundance after an increase during the early 1990s have returned to previous levels. The survey, however, does not catch many sole. For instance, in February 1996 in total 55 specimens were taken in 49 hauls. Sole were only represented in about half of the hauls. The index is therefore not very precise.

## 5.7 VPA

As discussed in last year's report the value of a formal assessment is disputable due to the considerable amount of non reported catches in 1992 and 1993. It was, however, decided to attempt to carry out an indicative VPA run.

At the Working Group meeting last year a VPA was carried out by tuning with the total IBTS February abundance by an ADAPT model formulated in EXCEL 5.0. It was, however, not possible to achieve convergence in this model when including the most recent year. Some trials with a simplified model where the fishing pattern was fixed by a sigmoid curve revealed a badly determined minimum of SSQ which was found at unrealistic low values of fishing mortality for the fully recruited age groups.

In the lack of adequate tuning information a Separable VPA was carried out. As effort has remained relatively stable in recent years the terminal F was determined from subtracting a natural mortality of 0.1 from the Z of 0.42 estimated from the catch curve analysis. Scrutinization of the fisheries mortalities indicated a doomed shaped selection curve and a terminal S of 0.7 was used in the analysis. A dome shaped selection curve may be expected as the fishery is mainly composed of a trawl fishery with an sigmoid selection pattern and a 90–110 mm mesh size gillnet fishery being highly selective towards medium aged sole.

The result from the separable diagnostics are given in Table 5.6, and the log residuals are shown in Figure 5.6. High log residuals are generally seen for the younger and older age groups which is reflected in weighted row totals. The fishing mortalities (Table 5.7) are about constant at a level of 0.3 in the recent years except for 1994 where it is estimated at 0.22. The estimated stock sizes (Table 5.8) suggest that the year classes from 1988 to 1991 are above average. This is partly in agreement with the IBTS survey age-2 indices which estimates good year-classes between 1990 and 1992. The trends in stock and fishing mortalities is presented in Table 5.9.

## 5.8 Conclusions

A reliable stock assessment in Skagerrak and Kattegat is impeded by an unreliable catch statistic especially for 1992 and 1993. The new Danish management regime which is based on effort regulation is expected to remove the incentive for non-reporting and misreporting of sole catches. Another serious limitation to the assessment is the lack of adequate tuning information. However, the quarterly IBTS surveys available since 1991 and the newly established Danish R/V "Havfisker" survey may be useful for tunings provided that the necessary age-length information is available to break down total catches to CPUE at age.

**Table 5.1** Kattegat and Skagerrak Sole landings (tonnes) 1970–1995. Official statistics and Working Group corrections. Danish catches are given for Kattegat and Skagerrak combined 1952–1969. For Sweden there is no information 1962–1974.

Year	Denmark		Sweden	Germany	Belgium	Netherlands	Working Group	Total
	Kattegat	Skagerrak	Skag+Kat	Kattegat	Skagerrak	Skagerrak	Corrections	
1952	156		51	59				266
1953	159		48	42				249
1954	177		43	34				254
1955	152		36	35				223
1956	168		30	57				255
1957	265		29	53				347
1958	226		35	56				317
1959	222		30	44				296
1960	294		24	83				401
1961	339		30	61				430
1962	356			58				414
1963	338			27				365
1964	376			45				421
1965	324			50				374
1966	312			20				332
1967	429			26				455
1968	290			16				306
1969	261			7				268
1970	158	25						183
1971	242	32		9				283
1972	327	31		12				370
1973	260	52		13				325
1974	388	39		9				436
1975	381	55	16	16		9	-9	468
1976	367	34	11	21	2	155	-155	435
1977	400	91	13	8	1	276	-276	513
1978	336	141	9	9		141	-141	495
1979	301	57	8	6	1	84	-84	373
1980	228	73	9	12	2	5	-5	324
1981	199	59	7	16	1			282
1982	147	52	4	8	1	1	-1	212
1983	180	70	11	15		31	-31	276
1984	235	76	13	13		54	-54	337
1985	275	102	19	1	+	132	-132	397
1986	456	158	26	1	2	109	-109	643
1987	564	137	19		2	70	-70	722
1988	540	138	24		4			706
1989	578	217	21	7	1			824
1990	464	128	29	8	2			631
1991	746	216	38	11				1011
1992	856	372	54	12				1294
1993	1016	355	68	+				1439
1994	890	296	12	+				1198
1995	850	382	65					1297



**Table 5.2 : Danish samples of sol in Kattegat and Skagerrak in 1995**

Area	Quarter	Market category	# aged	# Weigh	# Meash.
Kattegat	1	1	157	157	157
		2	159	159	159
	2	1	248	248	248
		2	174	174	174
	3	1	229	229	229
		2	208	208	208
	4	1	185	185	185
		2	177	177	177
Total Kattegat			1360	1360	1360
Skagerrak	2	1	66	66	66
	3	1	63	63	63
Total Kattegat			129	129	129

**Table 5.3 Age composition ('000) total landings of sole from Kattegat and Skagerrak 1984-1995**

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
age												
1	0	1	0	0	10	3	0	0	0	0	0	1
2	64	786	258	391	516	863	1209	530	506	523	127	272
3	638	594	1255	857	1035	613	1300	1301	1178	1804	1037	622
4	240	190	671	1018	897	847	651	928	939	1251	1451	1359
5	117	55	210	434	484	592	564	334	493	826	752	1226
6	31	60	33	174	129	404	310	345	320	418	444	600
7	33	16	36	64	37	83	167	302	178	117	152	385
8	40	8	33	31	23	30	27	180	166	137	45	142
9	84	29	29	6	8	16	13	47	122	83	15	50
10	60	30	18	17	14	7	5	13	57	44	29	28
11+	31	10	16	64	38	29	13	16	60	30	15	26

**Table 5.4 Mean weight at age (Kg) of sole in the Kattegat and the Skagerrak**

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
age												
1	0.112	0.112	0.112	0.112	0.154	0.1	0.112	0				0.326
2	0.183	0.174	0.165	0.16	0.159	0.176	0.18	0.174	0.213	0.178	0.174	0.187
3	0.213	0.234	0.231	0.194	0.197	0.221	0.228	0.229	0.252	0.224	0.229	0.2
4	0.257	0.283	0.287	0.245	0.235	0.255	0.251	0.275	0.336	0.274	0.28	0.248
5	0.294	0.291	0.297	0.274	0.251	0.266	0.308	0.292	0.412	0.328	0.342	0.291
6	0.297	0.335	0.409	0.319	0.335	0.271	0.333	0.346	0.43	0.374	0.388	0.351
7	0.28	0.292	0.267	0.36	0.348	0.352	0.4	0.309	0.491	0.403	0.445	0.382
8	0.321	0.279	0.262	0.417	0.363	0.3	0.547	0.386	0.566	0.388	0.448	0.432
9	0.323	0.32	0.365	0.357	0.336	0.364	0.752	0.502	0.568	0.406	0.342	0.426
10	0.365	0.357	0.369	0.311	0.304	0.285	0.498	0.493	0.688	0.507	0.4	0.384
11	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.513	0.61	0.508	0.439	0.339

**Table 5.5 Sole Skagerrak and Kattegat IBTS February Indices (no/hr)**

Year	2-group Skagerrak	Total Skagerrak	2-group Kattegat	Total Kattegat
1983		0.14 0.79	0.60	1.54
1984		0.39 1.68	0.60	2.76
1985		0.00 1.11	0.84	1.77
1986		0.00 0.29	0.81	2.07
1987		0.00 0.51	1.63	3.88
1988		0.29 2.37	0.14	1.78
1989		2.00 2.00	2.48	4.29
1990		1.29 5.16	5.68	8.62
1991		5.09 10.01	4.80	7.84
1992		1.32 6.44	11.29	17.89
1993		3.66 8.03	16.44	26.71
1994		0.76 2.76	7.98	8.06
1995		1.13 2.45	1.06	2.72
1996		0.23 1.23	1.61	3.39

**Table 5.6 Sole in Div. IIIa Output from separable VPA on catch in numbers 1984 -1995**

Title : Sole in IIIa (run: SEPHMO06 S06)  
At 35178 0.66880787037037

Separable analysis  
from 1984 to 1995 on ages 2 to 10  
with Terminal F of 0.32 on age 4 and Terminal S of 0.7

Initial sum of squared residuals was 52.857 and  
final sum of squared residuals is 24.199 after 63 iterations

Matrix of Residuals

Years.	1984.85.	1985.86	1986.87	1987.88	1988.89	1989.90	1990.91	1991.92	1992.93	1993.94	1994.95	TOT.	WTS.
2/3	-1.875.	.734.	-.196.	-.392.	.748.	.210.	.838.	.056.	-.344.	-.191.	-.358.	.000.	.335.
3/4	.535.	.091.	.186.	-.507.	.104.	-.459.	.253.	.181.	-.134.	-.286.	-.014.	.000.	.804.
4/5	.468.	-.193.	.095.	-.046.	.003.	-.313.	.272.	.174.	-.257.	-.312.	.123.	.000.	1.000.
5/6	-.221.	.526.	-.044.	.537.	-.122.	.041.	.207.	-.304.	-.110.	-.084.	.289.	.000.	.887.
6/7	-.497.	.274.	-.1146.	.609.	-.117.	.013.	-.517.	.055.	.474.	.038.	-.049.	.000.	.514.
7/8	.481.	-.757.	-.117.	.309.	-.135.	.470.	-.410.	.202.	-.061.	.193.	.076.	.000.	.680.
8/9	-.781.	-.1481.	1.285.	.480.	-.140.	.019.	-1.053.	-.172.	.208.	1.279.	-.261.	.000.	.293.
9/10.	.215.	.555.	.394.	-1.433.	-.090.	.629.	-.223.	-.476.	.811.	.399.	-.511.	.000.	.388.
TOT	.000.	.000.	.000.	.000.	.000.	.000.	.000.	.000.	.000.	.000.	.000.	-1.052.	
WTS	.001.	.001.	.001.	.001.	.001.	.001.	1.000.	1.000.	1.000.	1.000.	1.000.		

Fishing Mortalities (F)

	1984.	1985.	1986.	1987.	1988.	1989.	1990.	1991.	1992.	1993.	1994.	1995.
F-values.	.4357.	.2603.	.3700.	.4512.	.3511.	.3826.	.3007.	.3150.	.3117.	.3346.	.2239.	.3200.

Selection-at-age (S)

	2.	3.	4.	5.	6.	7.	8.	9.	10.
S-values.	.2551.	.7846.	1.0000.	.9607.	1.0367.	.8503.	.8312.	.6715.	.7000.

Run title : Sole in IIIa (run: SEPHMO06 S06)  
At 35178 0.66880787037037

SEPARABLY GENERATED FISHING MORTALITIES

YEAR, AGE	1984.	1985.	1986.	1987.	1988.	1989.	1990.	1991.	1992.	1993.	1994.	1995.
2.	.1111.	.0664.	.0944.	.1151.	.0896.	.0976.	.0767.	.0803.	.0795.	.0853.	.0571.	.0816.
3.	.3419.	.2042.	.2903.	.3540.	.2755.	.3002.	.2360.	.2471.	.2446.	.2625.	.1757.	.2511.
4.	.4357.	.2603.	.3700.	.4512.	.3511.	.3826.	.3007.	.3150.	.3117.	.3346.	.2239.	.3200.
5.	.4186.	.2500.	.3554.	.4335.	.3373.	.3675.	.2889.	.3026.	.2995.	.3214.	.2151.	.3074.
6.	.4517.	.2698.	.3835.	.4677.	.3640.	.3966.	.3118.	.3265.	.3232.	.3469.	.2321.	.3317.
7.	.3705.	.2213.	.3146.	.3836.	.2985.	.3253.	.2557.	.2678.	.2651.	.2845.	.1904.	.2721.
8.	.3622.	.2163.	.3075.	.3750.	.2918.	.3180.	.2500.	.2618.	.2591.	.2781.	.1861.	.2660.
9.	.2926.	.1748.	.2484.	.3030.	.2358.	.2569.	.2020.	.2115.	.2093.	.2247.	.1503.	.2149.
10.	.3050.	.1822.	.2590.	.3158.	.2458.	.2678.	.2105.	.2205.	.2182.	.2342.	.1567.	.2240.

SEPARABLY GENERATED POPULATION NUMBERS

YEAR, AGE	1984.	1985.	1986.	1987.	1988.	1989.	1990.	1991.	1992.	1993.	1994.	1995.
2.	3782.	7328.	6947.	4488.	3634.	5705.	8008.	8275.	10921.	7903.	3011.	3644.
3.	1224.	3062.	6205.	5719.	3619.	3006.	4682.	6711.	6910.	9126.	6566.	2573.
4.	375.	787.	2259.	4200.	3632.	2486.	2015.	3346.	4742.	4895.	6351.	4984.
5.	347.	220.	549.	1412.	2420.	2313.	1534.	1350.	2209.	3142.	3170.	4594.
6.	158.	206.	155.	348.	828.	1563.	1449.	1040.	902.	1482.	2061.	2313.
7.	135.	91.	143.	95.	197.	521.	951.	960.	679.	591.	948.	1479.
8.	185.	84.	66.	94.	59.	132.	340.	666.	665.	471.	402.	709.
9.	310.	116.	61.	44.	59.	40.	87.	240.	464.	464.	323.	302.
10.	239.	209.	88.	43.	29.	42.	28.	64.	176.	341.	335.	251.

**Table 5.7 Sole in Kattegat and Skagerrak. Fishing mortalities.**

Run title : Sole in IIIa (run: SEPHMO08/S08)

At 24-Apr-96 11:30:59

Traditional vpa Terminal populations from weighted Separable populations

Table 8		Fishing mortality (F) at age	
YEAR,		1984,	1985,
AGE			
2,		.0214,	.1359,
3,		.5112,	.2508,
4,		.5922,	.2486,
5,		.4169,	.2297,
6,		.2304,	.3472,
7,		.2668,	.1600,
8,		.2621,	.0856,
9,		.3273,	.2746,
10,		.3047,	.1661,
+gp,		.3047,	.1661,
0 FBAR 4- 8,		.3537,	.2142,

Table 8		Fishing mortality (F) at age										
YEAR,		1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE												
2,		.0510,	.0832,	.1478,	.1507,	.1644,	.0721,	.0506,	.0719,	.0445,	.0816,	.0660,
3,		.2965,	.2127,	.2922,	.2343,	.3152,	.2388,	.2025,	.2282,	.1782,	.2818,	.2294,
4,		.4390,	.3700,	.3202,	.3663,	.3705,	.3457,	.2422,	.3055,	.2585,	.3315,	.2985,
5,		.4219,	.5005,	.2685,	.3219,	.3938,	.2936,	.2778,	.3097,	.2711,	.3220,	.3009,
6,		.1879,	.6534,	.2406,	.3340,	.2484,	.3948,	.4477,	.3566,	.2431,	.3209,	.3068,
7,		.3220,	.5827,	.2452,	.2150,	.2001,	.3613,	.3233,	.2595,	.1892,	.3059,	.2515,
8,		.5015,	.4482,	.3779,	.2862,	.0903,	.3060,	.3072,	.3922,	.1347,	.2421,	.2563,
9,		.4418,	.1407,	.1763,	.4352,	.1729,	.2003,	.3122,	.2217,	.0600,	.1948,	.1589,
10,		.2444,	.4460,	.4917,	.2063,	.2091,	.2339,	.3523,	.1581,	.1009,	.1365,	.1318,
+gp,		.2444,	.4460,	.4917,	.2063,	.2091,	.2339,	.3523,	.1581,	.1009,	.1365,	
0 FBAR 4- 8,		.3745,	.5109,	.2904,	.3047,	.2606,	.3403,	.3197,	.3247,	.2193,	.3045,	

G:\ACFM\wgbfas\sol\_kask\tables96\tab7-9

Tables 5.8 . Sole in Kattegat and Skagerrak. Stock numbers.

Run title : Sole in IIIa (run: SEPHM008/S08)

At 24-Apr-96 11:30:59

Traditional vpa Terminal populations from weighted Separable populations

Table 10	Stock number at age (start of year)		Numbers*10**-3
YEAR,	1984,	1985,	
AGE			
2,	3171,	6491,	
3,	1668,	2808,	
4,	562,	905,	
5,	359,	281,	
6,	158,	214,	
7,	148,	114,	
8,	182,	102,	
9,	315,	127,	
10,	239,	206,	
+gp,	124,	69,	
0 TOTAL,	6926,	11317,	

Table 10	Stock number at age (start of year)					Numbers*10**-3							
YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST 84-93	AMST 84-93
AGE													
2,	5455,	5143,	3943,	6475,	8367,	8006,	10781,	7917,	3068,	3644,	0,	6203,	6575,
3,	5127,	4691,	4282,	3077,	5040,	6423,	6740,	9274,	6667,	2656,	3039,	4444,	4913,
4,	1977,	3449,	3431,	2893,	2203,	3327,	4577,	4981,	6679,	5048,	1813,	2377,	2831,
5,	639,	1153,	2155,	2254,	1815,	1376,	2131,	3251,	3320,	4667,	3279,	1201,	1541,
6,	202,	379,	633,	1491,	1478,	1108,	928,	1460,	2158,	2291,	3060,	594,	805,
7,	137,	152,	178,	450,	966,	1043,	675,	537,	925,	1531,	1504,	317,	440,
8,	88,	90,	77,	126,	329,	716,	658,	442,	375,	693,	1020,	199,	281,
9,	85,	48,	52,	47,	86,	272,	477,	438,	270,	296,	492,	135,	195,
10,	87,	49,	38,	39,	28,	65,	201,	316,	317,	230,	221,	90,	127,
+gp,	77,	186,	102,	163,	72,	80,	212,	215,	164,	214,	351,		
0 TOTAL,	13875,	15341,	14891,	17018,	20383,	22416,	27380,	28830,	23944,	21270,	14778,		
1													

G:\ACFM\wgbfas\sol\_kask\tables96\tab7-9

**Table 5.9 Summary, Sole in Kattegat and Skagerrak**

Run title : Sole in I11a (run: SEPHM008/S08)

At 24-Apr-96 11:30:59

**Table 16 Summary (without SOP correction)**

Traditional vpa Terminal populations from weighted Separable populations

	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 8,
1984,	3171,	1573,	840,	337,	.4014,	.3537,
1985,	6491,	2400,	1136,	397,	.3496,	.2142,
1986,	5455,	3079,	1889,	643,	.3404,	.3745,
1987,	5143,	3217,	2073,	722,	.3483,	.5109,
1988,	3943,	3191,	2255,	706,	.3130,	.2904,
1989,	6475,	3854,	2380,	824,	.3462,	.3047,
1990,	8367,	4934,	3012,	1050,	.3486,	.2606,
1991,	8006,	5386,	3509,	1011,	.2881,	.3403,
1992,	10781,	8052,	5105,	1294,	.2535,	.3197,
1993,	7917,	7299,	5211,	1439,	.2762,	.3247,
1994,	3068,	6775,	5608,	1198,	.2136,	.2193,
1995,	3644,	5798,	4487,	1297,	.2890,	.3045,
Arith.						
Mean	6038,	4630,	3125,	910,	.3140,	.3181,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

1  
G:\ACFM\wgbfas\sol\_kask\tables96\tab7-9

Figure 5.1 Sole in Div.IIIa Total Landings in tonnes

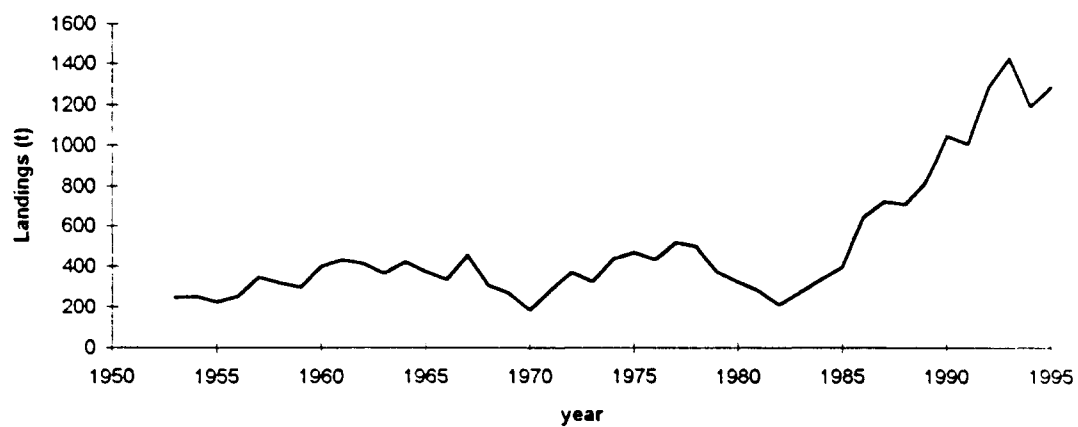


Figure 5.2 Sole in Div. IIIa Catch by age individual of year-classes 1983-1991

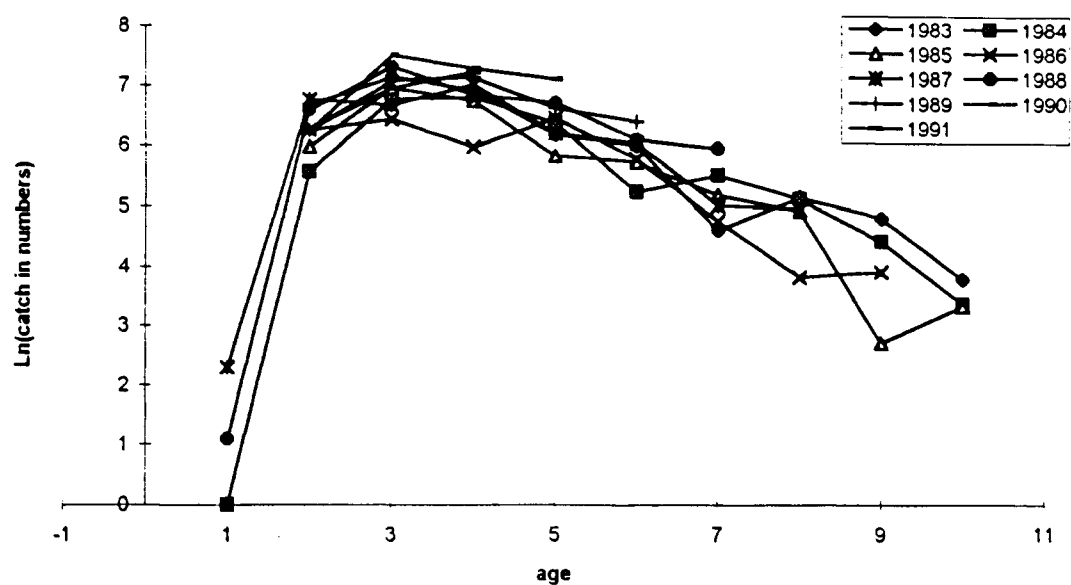


Figure 5.3 Sole in Div. IIIa Catch curve, mean of year-classes 1983-1989

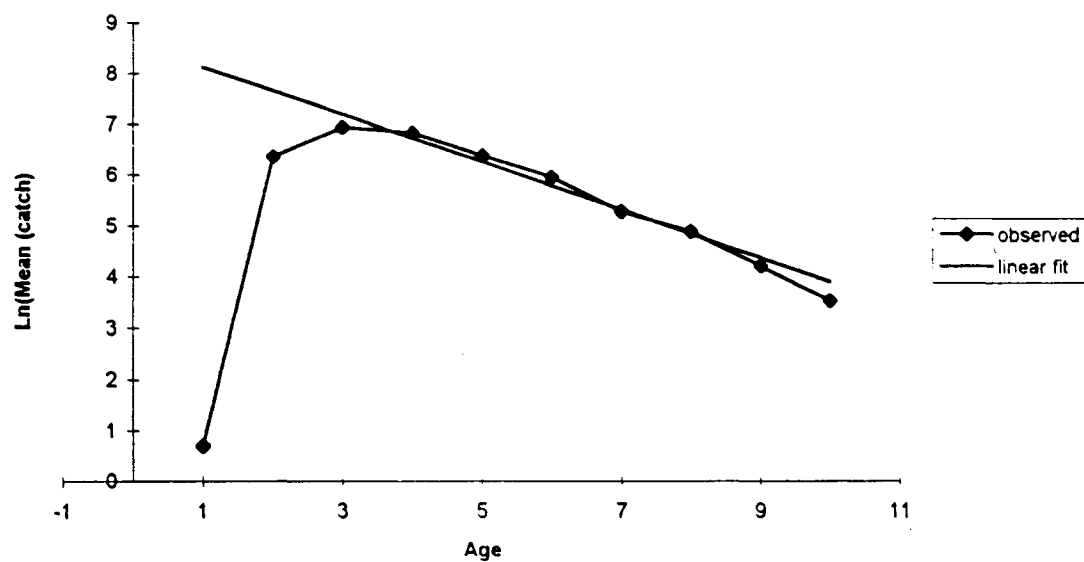




Figure 5.4 Sole Kattegat and Skagerrak 2 group IBTS (February) no/hr.

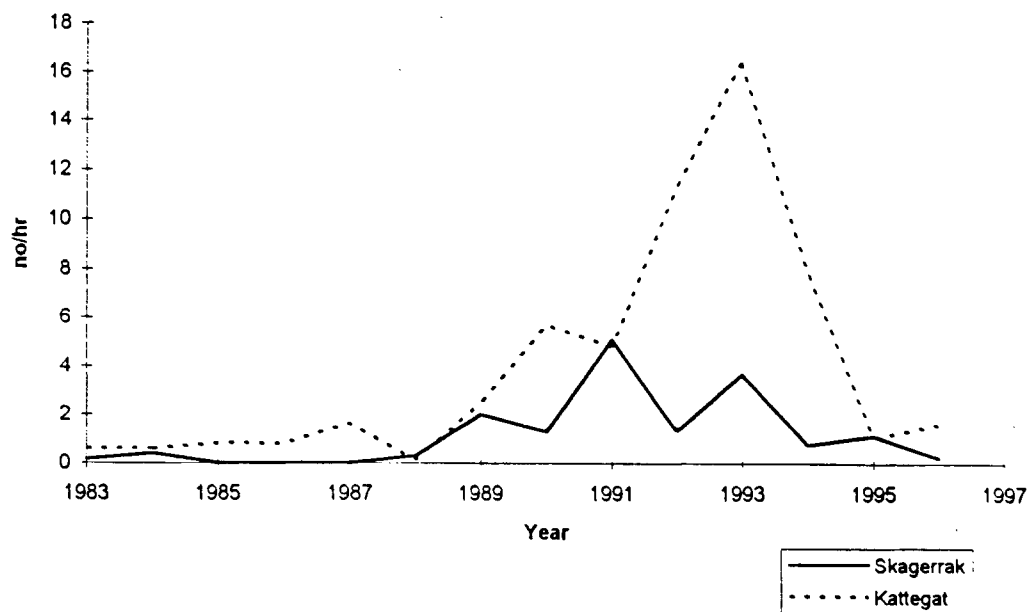
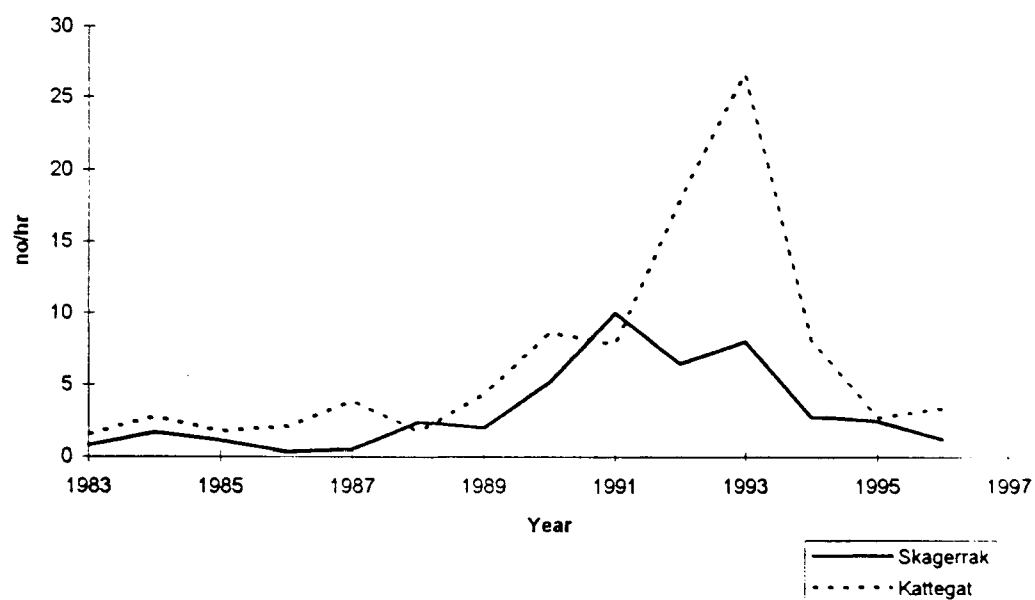
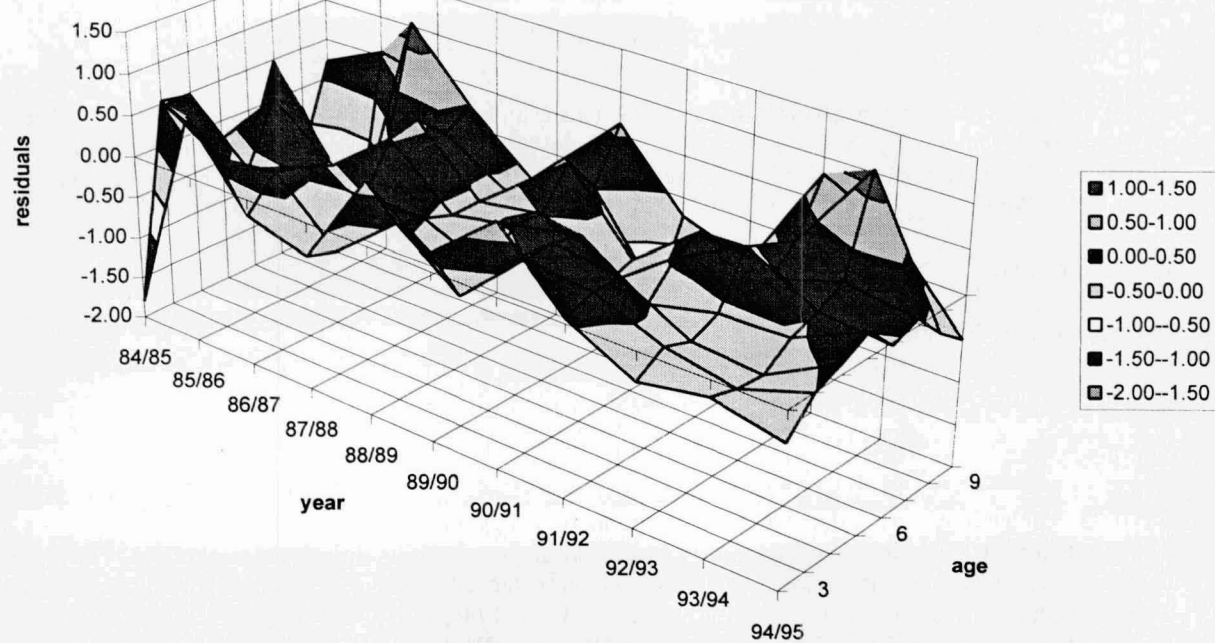


Figure 5.5 Sole Kattegat and Skagerrak IBTS (February). Total no/hr



**Figure 5.6** Sole Div. IIIa: separable VPA diagnostics. Residual plot for terminal  $F=.32$ , and terminal  $S=0.7$



## **6 FLOUNDER STOCKS IN THE BALTIC**

Nominal landings of flounder in the Baltic are given by Sub-division and country in Table 6.1.

### **6.1 Flounder in Sub-Division 22**

#### **Landings**

The total landings amounted to about 1145 t in 1995. This is an increase of 23% in comparison to 1994. These flounder landings were taken only by Denmark (859 t) and Germany (286 t). The increase of the landings is noticed only in the German fishery. In Germany the landings increased from 44 t in 1994 to 286 t in 1995, but these landings are at the level of the 1990 value.

#### **Age composition**

Catch at age data were not available.

### **6.2 Flounder in Sub-Divisions 24 and 25**

#### **Landings**

The 1995 total landings accumulated to 12,603 t and increased by about 48% in comparison with 1994. The proportion of the flounder catches in the Sub-divisions 24 and 25 in relation to the total flounder catches in the Baltic were stable in 1994 and 1995 and amounted to about 70%. The landings fluctuated between 5,000 t and 6,000 t in the period 1987–1993. After this period the catches increased from 8,433 t in 1994 to 12,603 t in 1995. This is the highest recorded value for this stock since 1973. A large increase in Danish (1,016 t in 1994; 2,110 t in 1995) and Polish (3,177 t in 1994; 7,437 t in 1995) flounder landings was observed in the Sub-divisions 24 and 25; on the other hand, the German landings decreased (4,262 t in 1994; 2,825 t in 1995) in the same area. Like in 1994 it seems that the total landings are over-reported due to misreporting of species in the catches.

#### **Age composition**

Catches at age in numbers were supplied by Germany for Sub-division 24 and by Poland for Sub-division 25. The international landings in Sub-division 24 were distributed according to the German data and that in Sub-division 25 according to the Polish data.

#### **Mean weight at age**

The 1995 mean weight at age data were available only from Germany and Poland. Weights at age for the international landings were calculated as weighted means, based on the data of Germany (Sub-division 24) and Poland (Sub-division 25).

#### **Recruitment**

A time series of data are available from Germany (1978–1995) which traditionally carried out a youngfish survey in the Oder Bank and adjacent areas (Sub-division 24) in June/July. The results from this survey indicate in 1995 as in the previous year that year class 1993 is assessed again as very low. The abundance of year class 1994 is also very low.

#### **Trends in the population**

Different VPA runs were carried out for the period 1971–1995. Catch in number and catch weights at age are based on data from Germany for Sub-division 24 and Poland for Sub-division 25. The stock weights at age were assumed to be the same as the catch weights. The youngfish survey data on the Oder Bank (June/July period 1978–1995) were used. The options of the VPA runs were different catchabilities dependent on stock size for ages (<3, <4, <5) and a run based on a catchability dependent on stock size for ages <3 and a survivor estimate shrank to the population mean for ages <3. The results of the runs were more or less the same. They show discrepancies between the results of the surveys and the VPAs. Whereas the surveys showed a rapidly downward trend of the recruitment in the last two years and of the catch in numbers since 1992 (Table 6.2.1), the results of the VPA runs give the impression of a continuous increase of recruits, total biomass and total spawning biomass, respectively. The VPA result shows the highest recorded level since

1971. In this case it seems that the results are due to the uncertain catch statistics since 1993 (see the above description of landings).

On the basis of the new survey results the year classes 1993 and 1994 are of very low abundance. This finding together with the increased catches in 1995 would probably cause a decrease of the stock size.

### **6.3 Flounder in Sub-Division 26**

#### **Landings**

The total landings amounted to 1,856 t in 1995 which is an increase by about 24% in comparison with 1994 (1,503 t). In this area only Poland has a directed flounder fishery. This fishery is mainly a gillnet fishery conducted along the coast. The portion of the Polish landings amounted to 80% of the international landings. The other landings are mainly from by-catches in the cod fishery.

#### **Catch at age in number**

Poland and Russia supplied catch at age data. Poland supplied a full set of catch at age data by quarter and year. The Russian catch in numbers per age group were submitted only for the 1st quarter from trawl activities. Furthermore Russian catch in numbers data were available from the small gillnet fishery in the 3rd quarter. Therefore it was decided to distribute the Russian quarterly catches according to the Polish catch at age data. The same procedure was used for other international landings.

#### **Mean weight at age**

Poland supplied yearly mean weight at age data. Russia provided mean weight at age data for 1st quarter flounder landings of the trawl fishery and for 3rd quarter flounder landings of the gillnet fishery. Therefore the Polish data were used for the calculation of the mean weight at age in the total landings.

### **6.4 Flounder in Sub-Division 28**

#### **Landings**

In 1995 the total landings amounted to 396 t, that is an increase by 19% in comparison with 1994, but this result is still much lower than the average at the end of the 1980s and the beginning of the 1990s. Only Latvia carried out a directed flounder fishery in this area. The portion of the Latvian landings amounted to about 90% of the total landings in this Sub-division.

#### **Catch at age in numbers and mean weight at age**

Only Latvia supplied catch at age data. These data were used to distribute the total landings into numbers at age.

### **6.5 Flounder in Sub-Divisions 29 and 30**

#### **Landings**

In 1995 the total landings amounted to 478 t (Table 6.1), that is a decrease of about 25% in comparison with 1994. The flounder fishery in this area was carried out by Sweden, Estonia and Finland. The landings are mostly taken by Finland and were more or less stable since 1992. The Finnish landings constituted about 90% of the total landings. The landings of Estonia fluctuated between 3 t (1994) and 135 t (1991) and amounted to 52 t in 1995.

#### **Catch at age in numbers and mean weight at age**

Only Finland supplied catch-at-age and mean-weight-at-age data, therefore the total landings were distributed according to the Finnish data.

## **6.6 Flounder in Sub-Division 32**

### **Landings**

The total landings amounted to 166 t (Table 6.1) in 1995. Compared with 87 t in 1994, the total landings increased by 90%. The flounder catches are mostly taken by Finland (100% in 1994; 73% in 1995).

### **Catch at age in numbers**

Catches at age in numbers were supplied only by Finland for 1994 and 1995. The Estonian landings in 1995 were distributed according to the Finnish data.

### **Mean weight at age**

In 1994 and 1995 mean weight-at-age data were available only from Finland.

**Table 6.1** Total catch (in tonnes) of FLOUNDER in the Baltic, by sub-divisions and country. (There are some gaps in the information. The "Total", therefore, is preliminary.)

Year	Denmark <sup>1</sup>			Finland			German Dem. Rep.			Germany, Fed. Rep.				Poland		Sweden <sup>3</sup>						
	22	23	24(25)	29	30	32	22	24	25(+26)	22	24(+25)	26	28	25(+24)	26	23	24	25	26	27	28	29
1973	1,983	-	386	-	-	-	181	1,624	1,516	349	4	-	-	1,580	2,070	-	-	502	-	-	-	-
1974	2,097	-	2,578	-	-	-	165	1,482	654	304	3	-	-	1,635	2,473	-	-	470	-	-	-	-
1975	1,992	-	1,678	113	22	47	163	1,469	406	469	1	-	-	1,871	2,585	-	-	400	-	-	-	-
1976	2,038	-	482	118	23	59	174	1,556	901	392	2	-	-	1,549	2,289	-	-	400	-	-	-	-
1977	1,974	-	389	115	32	56	555	2,708	1,096	393	4	-	-	2,071	2,089	-	-	416	-	-	-	-
1978	2,965	-	415	174	61	155	348	2,572	-	477	1	-	-	996	2,106	-	-	346	-	-	-	-
1979	2,451	-	405	192	54	153	189	2,509	-	259	3	-	-	1,230	1,860	-	-	315	-	-	-	-
1980	2,185	-	286	194	69	165	138	2,775	-	212	1	-	-	1,613	1,380	16	46	-	20	181	32	-
1981	1,964	-	548	227	56	135	271	2,595	-	351	1	-	-	1,151	1,541	21	30	-	21	194	34	-
1982	1,563	104	257	219	58	144	263	3,202	-	248	1	-	-	2,484	1,623	22	33	-	65	16	3	-
1983	1,714	115	450	181	67	120	280	3,572	-	418	1	-	-	1,828	905	72	108	-	212	52	9	-
1984	1,733	85	306	174	108	135	349	2,719	-	371	1	-	-	2,471	1,288	18	27	-	53	13	2	-
1985	1,561	130	649	157	97	137	236	3,253	-	199	4	-	-	2,063	1,302	16	24	-	47	12	2	-
1986	1,525	65	1,558	199	128	181	127	2,838	-	125	10	-	-	3,030	1,784	20	31	-	60	15	3	-
1987	1,208	122	1,007	159	106	143	71	2,096	-	114	11	-	-	2,530	1,745	17	26	-	51	13	2	-
1988	1,162	125	990	177	118	159	92	2,981	-	133	5	-	-	1,728	1,292	23	35	-	68	17	3	-
1989	1,321	83	1,062	175	122	163	126	3,616	-	122	2	-	-	1,896	1,089	22	34	-	66	16	3	-
1990	941	-	1,389	219	81	161	52	1,622	-	183	10	-	-	1,617	599	-	120	-	-	-	-	-
1991	925	-	1,497	236	81	167	-	-	-	246	1,814	-	-	2,008	1,905	24	31	-	88	20	-	-
1992	713	185	975	405	40	627	-	-	-	227	1,972	-	-	1,877	1,869	41	88	3	86	11	3	-
1993	649	194	635	438	57	683	-	-	-	235	1,230	-	-	3,276	1,229	26	27	63	1	83	10	-
1994	882	181	1,016	445	33	87	-	-	-	44	4,262	2	3	3,177	1,266	84	20	18	37	33	55	10
1995 <sup>5</sup>	859	231	2,110	398	28	131	-	-	-	286	2,825	4	40	7,437	1,482	58	28	186	7	81	18	+

Continued

216 Table 6.1 Continued

Year	USSR				Estonia					Latvia			Lithuania		Russia		Total													
	26	28	29	32	25	26	28	29	32	24	26	28	25	26	26	28	22	23 <sup>4</sup>	24	25	26	27	28	29	30	32	22-32			
1973	-	2,610	-	-													2,513	-	2,014	3,598	2,070	-	2,610	-	-	-	12,805			
1974	-	2,510	-	-													2,566	-	4,063	2,759	2,473	-	2,510	-	-	-	14,371			
1975	-	6,455	-	-													2,624	-	3,148	2,677	2,585	-	6,455	113	22	-	17,624			
1976	471	1,779	409	359													2,604	-	2,040	2,850	2,760	-	1,779	527	23	418	13,001			
1977	210	1,081	321	414													2,922	-	3,101	3,583	2,299	-	1,081	436	32	470	13,924			
1978	288	1,290	334	395													3,790	-	2,988	1,342	2,394	-	1,290	508	61	550	12,923			
1979	158	1,170	330	1,012													2,899	-	2,917	1,545	2,018	-	1,170	522	54	1,165	12,290			
1980	93	798	334	1,080													2,535	-	3,078	1,659	1,473	20	979	560	69	1,245	11,618			
1981	58	742	445	1,078													2,586	-	3,165	1,181	1,599	21	936	706	56	1,213	11,463			
1982	195	665	615	1,121													2,074	104	3,482	2,517	1,818	65	681	837	58	1,265	12,901			
1983	209	551	497	1,114													2,412	115	4,095	1,936	1,114	212	603	687	67	1,234	12,475			
1984	145	202	286	1,226													2,453	85	3,044	2,498	1,433	53	215	462	108	1,361	11,712			
1985	268	189	265	806													1,996	130	3,922	2,087	1,570	47	201	424	97	943	11,417			
1986	442	159	281	556													1,777	65	4,399	3,061	2,226	60	174	483	128	737	13,110			
1987	1,315	203	279	397													1,393	122	3,131	2,556	3,060	57	216	440	106	540	11,615			
1988	578	439	257	331													1,387	125	3,999	1,763	1,870	68	456	437	118	490	10,713			
1989	783	512	214	214													1,569	83	4,702	1,930	1,872	66	528	392	122	377	11,641			
1990	752	390	144	141													1,176	-	3,021	1,737	1,351	-	390	363	81	302	8,421			
1991	-	-	-	-		49	1	135	51		123	323		125	216	10	1,171	-	3,335	2,039	2,418	88	354	371	81	172	10,029			
1992	-	-	-	-		-	47	47	46		26	664		483	146	-	940	165	2,988	1,965	2,527	86	722	455	40	673	10,561			
1993 <sup>5</sup>	-	-	-	-		-	52	86	55		99	389		- <sup>6</sup>	225	-	884	220	1,892	3,339	1,562	83	430	524	57	738	9,742			
1994	-	-	-	-		-	+	3	4		31	276		- <sup>6</sup>	167	-	926	265	5,298	3,195	1,503	33	334	458	33	87	12,132			
1995	-	-	-	-	8	-	16	52	35	1	39	322	8	53	271	-	1,145	289	4,964	7,639	1,856	81	396	450	28	166	17,014			

<sup>1</sup>For the years 1970-1981 catches in Sub-division 23 are included in Sub-division 22.

<sup>2</sup>Includes landings from October-December.

<sup>3</sup>For the years 1973-1979 and 1990 catches in Sub-divisions 24-29 are included in Sub-division 25.

<sup>4</sup>For the years 1973-1981 catches in Sub-division 23 are included in Sub-division 22.

<sup>5</sup>Provisional.

<sup>6</sup>No reported.

**Table 6.2.1** Flounder recruitment indices in Sub-division 24 (Oder Bank Area).  
Catch per hour, youngfish survey, Germany.

Survey July/Aug.	Catch (kg)	Catch in numbers	Age 1 n	Age 2 n	Age 3 n	Age 4+ n
1978	100.0	1,590	118	1,329	76	67
1979	72.0	752	60	332	330	30
1980	80.0	607	48	334	185	40
1981	94.0	934	128	624	135	47
1982	77.2	531	27	282	164	58
1983	82.0	551	7	192	308	44
1984	81.0	694	33	449	147	65
1985	58.0	381	5	123	217	36
1986	51.0	353	15	100	139	99
1987	76.6	1,047	84	805	154	4
1988	47.5	397	3	177	200	17
1989	14.9	158	7	103	44	4
1990	88.5	639	41	310	203	85
1991	106.0	1,077	87	573	308	109
1992	57.0	497	78	194	205	20
1993	44.4	310	37	173	85	15
1994	18.5	129	3	37	64	25
1995	20.1	138	6	63	57	12



## **7      PLAICE, TURBOT, BRILL AND DAB IN THE BALTIC**

The landings of plaice, turbot, brill and dab are presented by Sub-divisions and countries in Tables 7.1–7.4.

The dab landings of Sub-division 22 in 1995 are more or less at the same level as in 1994. These landings increased about 80% in comparison to 1992 and 1993. The total landings in 1994 and 1995 are at record level since 1970. It seems that the total landings of dab are over-reported due to the inclusion of some other species in these catch data.

**Table 7.1** Total catch (in tonnes) of PLAICE in the Baltic by Sub-division and country. (There are some gaps in the information. The "Total", therefore, is preliminary.)

Year	Denmark			German Dem. Rep. <sup>1</sup>		Federal Rep. of Germany				Poland		Sweden <sup>2</sup>						
	22	23	24 (+25)	22	24	22	24 (+25)	26	28	25(+24)	26	23	24	25	26	27	28	29
1970	3,757		494	-	-	202	16			-	-		149	-		-	-	-
1971	3,435		314	-	-	160	2			-	-		107	-		-	-	-
1972	2,726		290	-	-	154	2			-	-		78	-		-	-	-
1973	2,399		203	2	44	163	1			174	30		75	-		-	-	-
1974	3,440		126	36	10	166	2			114	86		60	-		-	-	-
1975	2,814		184	11	67	302	1			158	142		45	-		-	-	-
1976	3,328		178	11	82	302	3			164	76		44	-		-	-	-
1977	3,452		221	5	36	348	2			265	26		41	-		-	-	-
1978	3,848		681	33	1,198	346	3			633	290		32	-		-	-	-
1979	3,554		2,027	10	1,604	195	7			555	224		113	-		-	-	-
1980	2,216		1,652	5	303	84	5			383	53		113	-		-	-	-
1981	1,193		937	6	52	74	31			239	27		118	-		-	-	-
1982	716		393	6	25	39	6			43	64		40	6		7	1	-
1983	901		297	5	12	37	14			64	12		133	20		24	2	-
1984	803		166	7	2	23	8			106	-		23	3		4	1	-
1985	648		771	68	593	26	40			119	49		25	4		5	1	-
1986	570		1,019	34	372	25	7			171	59		48	7		9	1	-
1987	414		794	4	142	14	16			188	5		68	10		12	1	-
1988	234		323	3	16	7	1			9	1		49	7		9	1	-
1989	167		149	-	5	7	-			10	-		34	5		6	1	-
1990	236		100	0	1 <sup>3</sup>	9	1			6	0		50	-		-	-	-
1991	328		112	-	-	15	9			2	1		5	2		2	-	-
1992	316		74	-	-	11	4			6	+		3	1		1	+	+
1993	171		66	-	-	16	6			4	+	2	4	+		-	-	-
1994	355		159	-	-	1	+			43	4	6	4	7		-	+	+
1995 <sup>4</sup>	601	64	343	-	-	75	91	+	1	233	2	12	13	10	1	+	+	+

Table 7.1 continued

Year	Total								
	22	23	24	25	26	27	28	29	22-28
1970	3,959	-	659	-	-	-	-	-	4,618
1971	3,595	-	423	-	-	-	-	-	4,018
1972	2,880	-	370	-	-	-	-	-	3,250
1973	2,564	-	323	174	-	-	-	-	3,091
1974	3,642	-	198	114	-	-	-	-	4,040
1975	3,127	-	297	158	-	-	-	-	3,724
1976	3,641	-	307	164	-	-	-	-	4,188
1977	3,805	-	300	265	-	-	-	-	4,396
1978	4,227	-	1,914	633	-	-	-	-	7,064
1979	3,759	-	3,751	555	-	-	-	-	8,289
1980	2,305	-	2,073	383	53	-	-	-	4,814
1981	1,273	-	1,138	239	27	-	-	-	2,677
1982	761	-	464	49	64	7	1	-	1,346
1983	943	-	456	84	12	24	2	-	1,521
1984	833	-	199	109	-	4	1	-	1,146
1985	742	-	1,429	119	49	5	1	-	2,345
1986	629	-	1,446	171	59	9	1	-	2,315
1987	432	-	1,020	198	5	12	1	-	1,668
1988	244	-	389	16	1	9	1	-	660
1989	174	-	188	15	-	6	1	-	384
1990	245	-	152	6	-	-	-	-	403
1991	343	-	126	4	1	2	-	-	476
1992	327	-	81	7	+	1	+	+	416
1993	187	2	76	4	+	-	-	-	269
1994	356	6	163	50	4	-	+	+	579
1995 <sup>4</sup>	676	76	447	243	3	+	1	+	1,446

<sup>1</sup>Includes 1990 also landings from October-December.

<sup>2</sup>For the years 1970-1981 and 1990 catches in Sub-divisions 25-28 are included in Sub-division 24.

<sup>3</sup>Includes landings from Oct-Dec.

<sup>4</sup>Provisional.

**Table 7.2** Total catch of TURBOT in the Baltic, by sub-divisions and country (in tonnes). (There are some gaps in the information. The "Total", therefore, is preliminary.)

Year	Denmark <sup>1</sup>			German Dem. Rep. <sup>1</sup>		Germany, Fed. Rep.							Poland		Sweden <sup>2</sup>						Latvia		Russia	Total								
	22	23	24	22	24	22	24	25	26	27	28	25	26	23	24	25	26	27	28	26	28	26	22	23	24	25	26	27	28	22-28		
	(+25)											(+24)																			(+29)	
1965	-	-	-	3	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	
1966	16	-	21	5	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-	74	-	-	-	-	-	95	
1967	14	-	20	7	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-	30	-	-	-	-	-	51	
1968	14	-	18	3	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	85	-	-	-	-	-	102	
1969	13	-	13	4	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	70	-	-	-	-	-	87	
1970	11	-	13	5	40	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	16	-	55	-	-	-	-	-	71	
1971	11	-	26	4	86	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	15	-	114	-	-	-	-	-	129	
1972	10	-	26	3	100	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	13	-	129	-	-	-	-	-	142	
1973	11	-	30	3	33	-	-	-	-	-	-	58	13	5	-	-	-	-	-	-	-	-	14	-	68	58	13	-	-	-	153	
1974	14	-	40	2	23	-	-	-	-	-	-	34	36	6	-	-	-	-	-	-	-	-	16	-	69	54	36	-	-	-	155	
1975	27	-	48	3	38	15	-	-	-	-	-	23	6	7	-	-	-	-	-	-	-	-	45	-	93	23	6	-	-	-	167	
1976	29	-	24	0	52	11	-	-	-	-	-	14	12	7	-	-	-	-	-	-	-	-	40	-	83	14	12	-	-	-	149	
1977	32	-	37	0	55	9	-	-	-	-	-	12	55	8	-	-	-	-	-	-	-	-	41	-	100	12	55	-	-	-	208	
1978	33	-	37	2	27	9	-	-	-	-	-	7	3	10	-	-	-	-	-	-	-	-	44	-	74	7	3	-	-	-	128	
1979	23	-	38	3	39	6	-	-	-	-	-	29	34	12	-	-	-	-	-	-	-	-	32	-	89	29	34	-	-	-	184	
1980	28	-	38	0	30	9	-	-	-	-	-	12	20	15	-	-	-	-	-	-	-	-	37	-	83	12	20	-	-	-	152	
1981	28	-	62	1	46	8	-	-	-	-	-	10	19	7	-	-	-	-	-	-	-	-	37	-	115	10	19	-	-	-	181	
1982	31	-	51	1	27	7	-	-	-	-	-	2	17	3	4	-	4	3	-	-	-	-	39	-	81	6	17	4	3	-	150	
1983	33	-	40	3	9	8	-	-	-	-	-	5	4	31	41	-	35	24	-	-	-	-	44	-	80	46	4	35	24	-	233	
1984	41	-	45	4	8	12	-	-	-	-	-	13	2	3	4	-	3	2	-	-	-	-	57	-	56	17	2	3	2	-	137	
1985	56	-	34	5	22	15	-	-	-	-	-	67	15	4	5	-	4	3	-	-	-	-	76	-	60	72	15	4	3	-	230	
1986	99	-	81	6	32	25	-	-	-	-	-	32	37	6	8	-	7	5	-	-	-	-	130	-	119	40	37	7	5	-	338	
1987	134	-	93	4	34	30	-	-	-	-	-	155	21	8	11	-	9	6	-	-	-	-	168	-	135	166	21	9	6	-	505	
1988	117	-	117	3	28	34	-	-	-	-	-	7	10	12	16	-	14	9	-	-	-	-	154	-	157	23	10	14	9	-	367	
1989	135	-	109	7	22	20	-	-	-	-	-	-	11	11	15	-	13	9	-	-	-	-	161	-	142	15	11	13	9	-	351	
1990	178	-	181	4	2	26	-	-	-	-	-	24	25	14	-	-	-	-	-	-	-	-	208	-	197	24	25	-	-	-	454	
1991	228	-	137	-	-	44	39	-	-	-	-	73	20	2	12	-	16	-	-	-	-	-	272	-	178	85	36	16	9	-	596	
1992	267	-	127	-	-	55	68	-	-	-	-	80	55	12	12	+	21	36	-	-	-	30	322	-	207	92	55	21	36	-	733	
1993	159	29	152	-	-	74	56	-	-	-	-	520	72	2	4	14	+	13	38	-	-	34	233	31	212	535	105	13	38	-	1,167	
1994	211	18	166	-	-	52	57	10	-	-	-	380	30	2	3	18	1	17	44	-	-	15	263	20	226	408	46	17	44	-	1,024	
1995 <sup>3</sup>	257	11	94	-	-	65	53	4	+	1	+	30	15	2	3	54	9	31	83	33	28	20	322	13	150	88	77	32	111	-	793	

<sup>1</sup>Includes 1990 also landings from October-December.

<sup>2</sup>For the years 1970-1981 and 1990 catches in Sub-divisions 25-29 are included in Sub-division 24.

<sup>3</sup>Provisional.

Table 7.3

Total landings of BRILL (in tonnes). (There are some gaps in the information. The "Total", therefore, is preliminary).

Year	Sub-division 22		Sub-division 23		Total	Sub-divisions 24-28		Total	Subdivisions 22-28 Total
	Denmark	Fed.Rep. of Germany	Denmark	Sweden		Denmark	Sweden		
1970	4	-			4	-	-	-	4
1971	3	-			3	-	-	-	3
1972	7	-			7	-	-	-	7
1973	11	-			11	2	-	2	13
1974	25	-			25	1	-	1	26
1975	38	1			39	1	+	1	40
1976	45	2			47	1	-	1	48
1977	60	5			65	2	-	2	67
1978	37	3			40	-	-	-	40
1979	30	0			30	-	-	-	30
1980	26	0			26	-	-	-	26
1981	22	1			23	-	-	-	23
1982	19	0			19	0	17	17	36
1983	13	0			13	0	42	42	55
1984	12	0			12	-	3	3	15
1985	16	0			16	0	1	1	17
1986	15	0			15	0	3	3	18
1987	12	0			12	0	3	3	15
1988	5	0			5	0	1	1	6
1989	9	0			9	0	1	1	10
1990	0	0			0	-	1	1	1
1991	15	0			0	-	-	-	15
1992	28	0			28	-	-	-	28
1993	29	-	5		34	1	+	1	35
1994	57	-	4		61	1	1	2	63
1995 <sup>1</sup>	- <sup>2</sup>	-	- <sup>2</sup>	5		- <sup>2</sup>	8		

<sup>1</sup>provisional.

<sup>2</sup>no reported.

**Table 7.4** Total catch of DAB in the Baltic by sub-division and country (in tonnes). (There are some gaps in the information. The "Total", therefore, is preliminary).

Year	Denmark				German Dem. Rep. <sup>1</sup>		Fed.Rep. of Germany			Sweden <sup>2</sup>								Total									
	22	23	24(+25)	25-28	22	24	22	24	25	23	24	25	27	28	29	30	22	23	24	25	27	28	29	30	22-28		
1970	845		20		11	-	74	-			+	-	-	-	-	-	930		20	-	-	-	-	-	-	950	
1971	911		26		10	-	64	-			+	-	-	-	-	-	985		26	-	-	-	-	-	-	1,011	
1972	1,110		30		9	-	63	-			23	-	-	-	-	-	1,182		53	-	-	-	-	-	-	1,235	
1973	1,087		58		18	-	118	-			30	-	-	-	-	-	1,223		88	-	-	-	-	-	-	1,311	
1974	1,178		51		18	-	118	-			34	-	-	-	-	-	1,314		85	-	-	-	-	-	-	1,399	
1975	1,273		74		20	-	131	-			32	-	-	-	-	-	1,424		106	-	-	-	-	-	-	1,530	
1976	1,238		60		17	-	114	-			27	-	-	-	-	-	1,369		87	-	-	-	-	-	-	1,456	
1977	889		32		13	-	89	-			25	-	-	-	-	-	991		57	-	-	-	-	-	-	1,048	
1978	928		51		19	14	128	4			-	-	-	-	-	-	1,075		69	-	-	-	-	-	-	1,144	
1979	1,413		50		18	25	123	1			9	-	-	-	-	-	1,554		85	-	-	-	-	-	-	1,639	
1980	1,593		21		15	25	101	+			3	-	-	-	-	-	1,709		49	-	-	-	-	-	-	1,758	
1981	1,601		32		24	39	164	+			5	-	-	-	-	-	1,789		76	-	-	-	-	-	-	1,865	
1982	1,863		50		46	38	182	4			6	5	8	6	-	1	2,001		98	5	8	6	-	-	1	2,209	
1983	1,920		42		46	28	198	-			24	20	32	22	-	2	2,164		94	20	32	22	-	-	2	2,334	
1984	1,796		65		30	47	175	2			4	3	5	4	-	1	2,001		118	3	5	4	-	-	1	2,132	
1985	1,593		58		52	51	187	2			3	3	5	3	-	1	1,832		114	3	5	3	-	-	1	1,958	
1986	1,655		85		36	35	185	1			1	1	1	1	-	-	1,876		122	1	1	1	-	-	-	2,001	
1987	1,706		93		14	87	276	4			1	1	1	1	-	-	1,996		185	1	1	1	-	-	-	2,184	
1988	1,846		75		22	91	281	1			1	1	1	1	-	-	2,149		168	1	1	1	-	-	-	2,320	
1989	1,722		48		26	19	218	1			1	1	2	1	-	-	1,966		69	1	2	1	-	-	-	2,039	
1990	1,743		146		14	11	252	1			8	-	-	-	-	-	2,009		166	-	-	-	-	-	-	2,175	
1991	1,731		95		-	-	340	5			1	-	-	-	-	-	2,071		101	-	-	-	-	-	-	2,172	
1992	1,406		81		-	-	409	6			+	1	1	+	4	-	1,406		87	1	1	+	1	+	-	1,496	
1993	996		155		-	-	556	10		7	1	1	-	+	1	-	1,552	7	166	1	-	+	1	-	-	1,727	
1994	1,621		163		-	-	1,190	80	45	5	1	1	-	+	+	-	2,811	5	245	1	-	+	+	-	-	3,062	
1995 <sup>4</sup>	1,510	47	127	10	-	-	1,185	49	3	5	1	5	-	1	+	-	2,695	52	177	18	-	1	+	-	-	2,943	

<sup>1</sup>Includes 1990 also landings from Oct-Dec.

<sup>2</sup>For the years 1970-1981 and 1990 catches in Sub-divisions 25-30 are included in Sub-division 24.

<sup>3</sup>United Germany.

<sup>4</sup>Provisional.

## **8 HERRING**

### **8.1 Introduction**

#### **8.1.1 Herring and sprat landings**

The uncertainties in the amounts of pelagic species landed is only to a lesser extent caused by inadequate reporting. The fact that a large part of the landings comes from mixed fisheries for Clupeids (either fisheries targeting herring but with occasionally large by-catches of sprat or sprat fisheries - both industrial and for human consumption - with by-catches of herring) means that the species composition has to be estimated from samples. As can be seen from Table 8.1.1.1, the level of sampling intensity is very variable between the countries. This introduced variation in the landings for herring and sprat.

#### **8.1.2 Assessment units for herring stocks**

The issue of how to separate the herring into unit stocks has been discussed on many occasions (e.g. Anon. 1994a; Anon. 1995b). This year's assessments used the same units as in the latest years. As an addendum the so-called Gulf Herring in the Gulf of Riga was assessed separately. This herring stock is mainly fished in the Gulf, but it is also caught to a varying extent on its migration routes in the open sea. The Gulf Herring is included in the assessment of all herring in Sub-divisions 25-29 and 32 and the results of the separate assessment may be used for setting a regional TAC and/or quota allocation for the countries concerned.

### **8.2 Herring in Sub-Divisions 25-29 (Including Gulf of Riga) and Sub-Division 32 (Central Baltic Herring)**

#### **8.2.1 Catches**

The total landings were 217 thousand tonnes in 1995 which is a decrease by ca. 10% from 1994 (Table 8.2.1).

#### **8.2.2 Catch in numbers at age**

The major part of the landings (ca. 95%) was covered by national sampling programmes for age and size composition. The unsampled landings were assumed to have the same composition as the total for that Sub-division and quarter in which they were caught.

The landings from the Gulf of Finland and the Gulf of Riga made up ca. 50% of the total number of herring landed even if the landings in weight only constituted ca. 30% (Figure 8.2.1).

Herring of age groups 3 and 4 were the most numerous but older fish were still represented in fair numbers. Herring of age 0 are practically not caught (<1% of total number).

Table 8.2.2 gives the catch in numbers used as input to the further analysis. In Table 8.2.3 the same data are presented by Sub-division and quarter.

#### **8.2.3 Mean weights at age**

The mean weights were compiled by Sub-division quarter of the year (Table 8.2.4). Weights in the catch are in Table 8.2.5. The weights are very variable representing different growth patterns and are illustrating the heterogeneity of this stock complex. In Figure 8.2.2 the weights are presented by age and Sub-division. The weights are low in the NE parts and relatively high in the southern parts. The range in mean weight for, say, a 6 year old herring is from 22 to 80 g.

The same values were applied as mean weights in the stock.

#### **8.2.4 Tuning data**

The Acoustic Surveys in 1995 (see Section 1.3) had a different allocation of areas on participating ships than in earlier years. The coverage of especially Sub-divisions 27 and 29 was less than in earlier years. In order to compensate the stock estimates for variation in coverage a correction was made. The coverage by sub-division and year for the period 1982-1991 was given in Anon. 1995. This data set was updated with the 1994 and 1995 data. (The results from the 1992 and 1993 surveys were excluded due to technical problems. The yearly estimates of herring by age groups and Sub-division were raised by the relation between the coverage in each year and the maximum coverage in that Sub-

division. Table 8.2.6 shows coverage and correction factors applied. The corrected stock estimates are presented in Table 8.2.7.

In the ICA one set of biomass indices was used:

Spawning Stock Biomass (as ages >1) from the Acoustic Surveys 1982–1995 (Table 8.2.8).

In the XSA/VPA two age structured data sets were used: stock estimates from the International Acoustic Surveys 1982–1995 corrected for varying coverage (Table 8.2.7) and Polish youngfish survey indices (GM of 0-group in December and 1-group in January–March) from the Gulf of Gdansk in 1976–1995 (Table 8.2.9).

The CPUE from the Polish commercial fishery (pelagic pair trawl, pelagic trawl, bottom trawl, gillnets) mainly herring caught by pair trawls in Sub-divisions 24–26, that were used last year, were not yet available for 1995. It was decided not to use this data set for tuning, taking into account the present distribution of catches for the stock.

### 8.2.5 Other input values

The values used for natural mortality in 1996 were the same as in 1995 (Table 8.2.10). The values for sexual maturation are the same for all years (age 1: 0.0, age 2: 0.7, age 3: 0.9 and age 4–10: 1.0). The proportions of M and F before spawning time were 30% and 35% respectively, and identical for all years.

### 8.2.6 ICA assessment for central Baltic herring

The ICA runs were based on the linear model. Separable fishing mortality was assumed for 5 years and age 5 was used as the reference age. The F on the oldest age group was assumed to be at the same level as the reference age group ( $S=1$ ). The weights of survey indices were assigned by the ICA program (default weighting). The results of the ICA are given in Figures 8.2.3–8.2.6 and Tables 8.2.11–8.2.14. Figure 8.2.3 shows the contribution to the overall SSQ (sum of squares of deviations between model and observations) as a function of the reference F (age groups 3–6) in year 1995. The overall curve in Figure 8.2.3 indicates a fishing mortality of 0.2–0.3 and it was estimated to 0.22 with a standard deviation of 0.07.

The results are summarised and compared with the results from an XSA/VPA on Figures 8.2.7a–c.

### 8.2.7 XSA/VPA for central Baltic herring

XSA/VPA were performed in which the catchability for ages <4 were assumed to be dependent on stock size but all other settings were default values. Tables 8.2.15–8.2.18 contain the results.

A run in which the whole set of Acoustic stock estimates (1982–1995) were used, was also the basis for a retrospective analysis. The Working Group noticed especially a big difference in the patterns between the runs with 1995 and 1994 as final years. Based on this observation and the changes in design of the 1995 Acoustic Surveys described earlier (see Section 1.3), it was decided to leave out the 1995 data point in the tuning procedure.

The retrospective analysis of this run (xsabes08) are demonstrated in Figures 8.2.8a and 8.2.8b. It shows that there still is a noticeable difference between the runs with 1995 and 1994 as final years.

### 8.2.8 Comparison between ICA and XSA results

The two assessments in which different models have been applied on the same data sets are presented in Figures 8.2.7a–c. The results are surprisingly similar for mean fishery mortality, recruitment at age 1 and spawning stock biomass.

Together with the values for SSB are in Figure 8.2.7c also given the acoustic biomass estimates. It is obvious that their large variability between years is a major contribution to the unstableness in the herring assessments during recent years.

The Working Group concluded that due to this variability and to the variability in size at age in both catches and stock, more alternative runs or further refinements of the ones made would not yield better insight in the dynamics of this stock.

It is, however, very probable that a reanalysis of the available acoustic survey data could extract more information from them and thereby reduce the variability.



### 8.2.9 Prediction for 1997

Based on the XSA run (xsabes08) a short term prediction was made. Input data are given in Table 8.2.19. Recruitment for the 1995–1997 year-classes were put to the 1986–1994 average level. Exploitation pattern was a 1993–1995 average, whereas the mean weights were introduced as averages over the last 5 years.

The results as seen in Table 8.2.20a–b present two options for the 1996 catch. The option with a *status quo* fishing mortality in 1996 predicts a catch of ca. 276,000 tonnes in both 1996 and 1997. The other option explores the consequences of the ACFM advice that catch could be increased to 394,000 tonnes in 1995 and 1996. This would demand an increase in fishing mortality in 1996 by around 50%. Table 8.2.21 gives input to and output from Y/R calculations.

### 8.2.10 Medium-term consideration

In the medium-term consideration the uncertainty in survivors estimates and uncertainty in the Ricker stock-recruitment model were taken into account. Weight at age and natural mortalities were kept constant. The fractiles of the SSB distribution for *status quo* fishing mortality are presented in Figure 8.2.9.

## 8.3 Herring in the Gulf of Riga

### 8.3.1 Catches

Herring fishery in the Gulf of Riga was performed by Estonia and Latvia, using both trawls and trapnets. The total reported landings of herring in were 38.8 thousand t in 1995, i.e. approximately 32% higher than 1994 (29,300 t, and the highest since 1976 (Table 8.3.1). The biggest increase occurred in the Estonian fishery, from 9,636 t in 1994 to 16,008 t in 1995 (60%).

Approximately 30% of total landings were taken with trapnets on herring spawning grounds. Herring catches in the Gulf of Riga include the local Gulf herring and open-sea herring, entering the Gulf for spawning. 32,656 t (approximately 84% of total catch taken in 1995) belonged to the Gulf population. The proportion of the Gulf herring in total landings was nearly the same as in 1994 (83%). The catches of the Gulf herring taken by the Latvian trawl fleet in the open sea were included in the total Gulf herring landings.

According to the information about the level of misreporting obtained from the fishermen, the Latvian catches presented to the Working Group were taken to be 20% higher compared to the official landings. The level of misreporting in the Estonian fishery was estimated below 5% and therefore the official catch figures were used in the assessment.

### 8.3.2 Catch in numbers by age

The quarterly catches of Gulf herring from Estonian and Latvian trawl and trapnet fishery in millions were compiled to get the annual catch in numbers (Table 8.3.2).

### 8.3.3 Mean weight by age

The annual mean weights by age groups used for assessment were compiled from quarterly data on the trapnet and trawl fishery of Estonia and Latvia (Table 8.3.3). The mean weights at age in stock were assumed to be equal to the mean weights in the catches.

A decreasing trend in mean weight at age of Gulf of Riga herring, observed since the mid-1980s continued in 1995 and the respective values for 1995 were found to be on record low level since 1970 almost in all age groups. So mean weight in most age groups made up approximately 30–60% of the level of mid-1980s (Table 8.3.3).

### 8.3.4 VPA

Since cod has remained on a low level and is currently absent in the Gulf of Riga, the natural mortality was taken to be the same as that used in the previous years -  $M=0.2$ .

The fishing mortalities and stock numbers at age obtained from the VPA are presented in the Tables 8.3.4 and 8.3.5. The VPA was tuned in XSA using data on the effort (number of trapnets) directed at the Gulf herring in the Estonian and Latvian trapnet fishery and the corresponding abundances of Gulf herring in trapnet catches (Table 8.3.6). Since the 1-group herring is only occasionally represented in the trapnet catches, it was excluded from tuning input data. In

1995 approximately 30% of the herring catches in the Gulf of Riga were taken by the trapnet fishery. The input data for the XSA and the diagnostics of the analysis are given in Table 8.3.7. The age groups <3 were assumed to be with catchability dependent on stock size. For selecting the age above which catchability is independent at age several runs were made with >5, >6 and >7 values. As the results obtained were very similar, the default value (>6) was used as in the previous year. Like in 1994 assessment, the low level of shrinkage (S.E.=0.5) was used in terminal population estimation. This produced slightly higher SSB estimates compared to the results of 1994 estimations. The spawning stock biomass estimate in 1996 for 1994 is about 21% higher than in the assessment of the last year. The residuals of log catchabilities did not reveal any distinct trend over the period 1980–1995 (Figure 8.3.1).

The resulting estimates of the main parameters of the stock (Table 8.3.8 and Figure 8.3.2) show the increasing trend in the spawning stock biomass since 1990, reaching the record high level in 1994–1995. The mean fishing mortality (age groups 3–7) in 1995 is  $F=0.324$  and has increased in comparison with 1993–1994, -but it is rather stable since 1987 and is close to the mean for years 1987–1994 -  $F=0.313$ .

The results of the retrospective analysis of stock parameters are presented in the Figure 8.3.3.

### 8.3.5 Prediction

The recruitment for years 1996 and 1997 (1-group) was calculated using regression equations with factors which significantly determine the year class strength of Gulf herring (Komilovs, 1995. (ICES CM 1995/J:10). The values of mean water temperature in April and the abundance of zooplankton in May were used for year class 1995. For the estimation of year-class 1996, the sum of negative temperatures in winter 1995/1996 was used. Additionally, the factors mentioned were regressed against the VPA output estimates using RCT3 program. The results are presented in the Table 8.3.9. The results of RTC3 analysis were evaluated to be more appropriate for prediction calculations.

The resulting estimate for the 1995 year class as 1-group in 1996 would be 4,598 million, corresponding to an abundant year class. The estimate for 1996 year class as 1-group in 1997 is 1,532 million, i.e. significantly lower than the average for 1970–1993. The average number of recruits of 1984–1993 year classes at age 1 was used for 1997 year class in 1998. The corresponding value is 2,742 million recruits.

The input data and the summary of prediction are presented in the Tables 8.3.10–8.3.12. For prediction, the mean weights at age were taken to be equal to the average of 1993–1995. Since the cod abundance is still on the very low level, the natural mortality was assumed to remain at the level of 0.2 and the exploitation pattern was calculated from the mean  $F_s$  for 1993–1995 and adjusted to the last's year reference  $F$ . At *status quo* fishing mortality the catches of the Gulf of Riga herring are predicted to be approximately 35,000 t in 1997. That would be approximately 11,000 t higher than it was predicted in the 1994 assessment. The corresponding SSB value for 1997 would be 150,000 t (according to the 1995 assessment, 102,000 t. ) The high abundance of several successive year classes (1989–1994) is the main reason for increase in both catches and SSB.

If the year class of 1996 will be below the average as expected, the decrease both in catches and the SSB can be expected in 1998 (Tables 8.3.11 and 8.3.12), but still remains on the high level. The catch corresponding to exploitation at  $F_{0.1}$  (0.21) would be approximately 23,000 t in 1997 (Table 8.3.12 and Figure 8.3.4).

### 8.3.6 MBAL

The stock-recruitment data for the Gulf herring did not fit to neither Ricker's nor Beverton-Holt models. As it follows from the stock-recruitment plot presented in Figure 8.3.5, the probability of year classes with abundance below average would essentially increase, when the SSB is below approximately 50,000 t. Therefore, the preliminary MBAL was estimated to be at the level of 50,000 t.

## 8.4 Herring in Sub-Division 30

### 8.4.1 Landings and effort

According to preliminary figures, the combined Swedish and Finnish landings in 1995 (53,797 t) were about 5% smaller than the updated official landings data of 1994. Compared to the last year's Finnish data, the changes in the fishing effort have been minor except for fleet 2 (bottom trawl) with a decrease of fishing effort of about 26% (Table 8.4.1).

#### **8.4.2 Updated input data**

Catch in numbers for fleet 2 and associated effort data are shown in Table 8.4.1, catch mean weights at age (used as mean weights at age in the stock) in Table 8.4.2, catch in numbers in Table 8.4.3 and maturity ogives in Table 8.4.4.

#### **8.4.3 XSA**

The same input parameters as last year, but only fleet 2 were used for tuning the XSA because of the trends found in residuals from fleets 1 (trapnet) and 3 (pelagic trawl). The plankton data was also left out from this years assessment because of their low impact on XSA estimates. The log catchability residuals from fleet 2 are shown in Figure 8.4.1. The tuning parameters are shown in Table 8.4.5 and the tuning results in Table 8.4.6. The resulting estimates concerning the stock and average fishing mortalities (FBAR) are given in Table 8.4.7. The standard XSA plots of yield, fishing mortality, spawning stock biomass and recruitment (Figure 8.4.2) show that the SSB has dropped about 8% from the 1994 record level. The retrospective analysis made for years 1989 to 1995 using FBAR 2-6, number of recruits and SSB are shown in Figure 8.4.3. As in last year the low fishing mortalities make the estimates uncertain and are mainly reflecting changes in the stock development.

#### **8.4.4 The estimate of MBAL**

The estimate of MBAL (235,000) using SSB and number of recruits from the XSA was derived fitting the Ricker function. Table 8.4.8 shows the input values and calculated values of recruitment ( $R_{mod}$ ) and the formulas used. The corresponding curve is shown in Figure 8.4.4.

#### **8.4.5 Predictions**

The natural mortality of  $M=0.2$ , mean weights at age in catch for the last three years and a ten year average for maturity ogives and recruits were used for prediction with management option table. The exploitation pattern was calculated from the mean  $F$  for 1993-1995 and adjusted to the last year. The input values are presented in Table 8.4.9. The catch forecast for 1996 is about 56,000 t and 57,000 t for 1997. The management option table is presented in Table 8.4.10. The yield-per-recruit and short-term predictions are given in Figure 8.4.5 and the corresponding values in Table 8.4.11. Due to uncertain assessment it was considered by the Working Group not to make any medium term forecast for this stock.

### **8.5 Herring in Sub-Division 31**

#### **8.5.1 Landings and effort**

According to preliminary figures, the combined Swedish and Finnish landings in 1995 (5,825 t) were about 25% smaller than the updated official landings data of 1994. Compared to the last years Finnish data, there has been a decrease in the fishing effort by 52% in fleet 2 (bottom trawl) and by 27% in fleet 3 (pelagic trawl) and an increase of fishing effort of about 24% in trapnet fisheries (fleet 1) (Table 8.5.1).

#### **8.5.2 Updated input data**

Catch in numbers per fleet and associated effort data are shown in Table 8.5.1, catch mean weights at age (used as mean weights at age in the stock) in Table 8.5.2, catch in numbers in Table 8.5.3 and maturity ogives in Table 8.5.4.

#### **8.5.3 XSA**

The same input parameters as last year were used for tuning the XSA, leaving out the previously used plankton fleets because of their low impact on XSA estimates. The log catchability residuals from fleets 1, 2 and 3 are shown in Figure 8.5.1. The tuning parameters are shown in Table 8.5.5 and the tuning results in Table 8.5.6. The resulting estimates concerning the stock and average fishing mortalities (FBAR) are given in Table 8.5.7. The standard XSA plots of yield, fishing mortality, spawning stock biomass and recruitment (Figure 8.5.2) show that the SSB has risen about 4% from the 1994 level. The retrospective analysis was made for years 1989 to 1995 using FBAR 2-6, number of recruits and SSB are shown in Figure 8.5.3. Due to the low fishing mortalities the estimates are very uncertain.

#### 8.5.4 The estimate of MBAL

The estimate of MBAL (44,000) using SSB and number of recruits from the XSA was derived fitting the Ricker function. Table 8.5.8 shows the input values and calculated values of recruitment ( $R_{mod}$ ) and the formulas used. The corresponding curve is shown in Figure 8.5.4.

#### 8.5.5 Prediction

The natural mortality of  $M=0.15$ , mean weights at age in catch for the last three years and a ten year average for maturity ogives and recruits were used for prediction with management option table. The exploitation pattern was calculated from the mean  $F$  for 1993–1995 and adjusted to the last year. The input values are presented in Table 8.5.9. The catch forecast for 1996 is about 5,000 t and 5,600 t for 1997. The management option table is presented in Table 8.5.10. The yield-per-recruit and short-term predictions are given in Figure 8.5.5 and the corresponding values in Table 8.5.11. Due to very uncertain assessment it was considered by the Working Group not to make any medium-term forecast for this stock.

**Table 8.1.1.1** Herring in Sub-divisions 22–32. Samples of commercial catches by quarter and Sub-division for 1995 available to the Working Group.

Sub-division 22	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Denmark	1				
		2				
		3				
		4				
		Total	0	0	0	0
	Germany	1	588	12	2524	511
		2	972	8	1231	547
		3	15			
		4	89	34	6429	587
		Total	1664	54	10184	1645
Sub-division 24	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Poland	1	2301	3	965	316
		2	4710	9	4211	876
		3	133	1	577	98
		4	173	14	119	78
		Total	7317	27	5872	1368
	Germany	1	5599	35	8313	694
		2	6024	17	4461	1051
		3	44			
		4	42	43	7678	611
		Total	11709	95	20452	2356
	Sweden	1	3759	5	860	216
		2	3446	7	823	247
		3	5659			
		4	2923	5	992	245
		Total	15787	17	2675	708
Sub-division 25	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Denmark	1		5		375
		2				
		3				
		4		5		1033
		Total	0	10		1408
	Germany	1	0	16	3201	200
		2	0			
		3	0			
		4	0			
		Total	0	16	3201	200
	Poland	1	1305	14	3194	632
		2	4899	15	3639	860
		3	9823	8	4674	714
		4	8684	20	17340	1314
		Total	24711	57	28847	3520
	Sweden	1	2911	6	170	104
		2	7199	24	1366	549
		3	2762	4	1198	240
		4	2650	5	1533	561
		Total	15522	39	4267	1454

continued

Table 8.1.1.1 (continued)

Sub-division 26	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Latvia	1 2 3 4 Total	48 88  1 137	    0	    0	    0
	Lithuania	1 2 3 4 Total	835 947 1218 638 3638	    	    	    
	Poland	1 2 3 4 Total	2513 3142 3971 4020 13646	43 8 4 11 66	15165 2312 1856 4082 23415	1600 613 373 887 3473
	Russia	1 2 3 4 Total	3065 2435 584 2735 8819	44 32 41 113 230	8877 6435 8200 17158 40670	1303 1400 370 1897 4970
	Sweden	1 2 3 4 Total	1264 340 1 191 1796	3 8  6 17	88 19  83 190	71 11 82  164
Sub-division 27	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Sweden	1 2 3 4 Total	12701 911 79 3989 17680	19 4 4 24 51	1841 830 965 1512 5148	607 188 238 171 1204
Sub-division 28	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Estonia	1 2 3 4 Total	4232 10324 185 1660 16401	12 23 2 7 44	1224 2346 202 714 4486	1224 2346 202 714 4486
	Latvia	1 2 3 4 Total	10618 7597 2810 7357 28375	28 41 23 61 153	2800 4100 2300 14400 23600	2800 4100 2300 6500 15700
	Sweden	1 2 3 4 Total	4795 654 414 3467 9330	8   15 23	1137   349 1486	315    315

Table 8.1.1.1 (continued)

Sub-division 29	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Estonia	1	1272	9	918	918
		2	2975	12	1220	1220
		3	444	2	204	204
		4	400	6	601	601
	Total		5091	29	2943	2943
	Finland	1		5		
		2		18		
		3		4		
		4		8		
	Total		0	35	0	0
	Russia	1				
		2				
		3				
		4		5	868	230
	Total		0	5	868	230
	Sweden	1	713			
		2	394			
		3	525			
		4	1246			
	Total		2878	0	0	0
Sub-division 30	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Finland	1		20		
		2		63		
		3		8		
		4		19		
	Total		0	110	0	0
	Sweden	1	566			
		2	1010			
		3	348			
		4	409			
	Total		2333	0	0	0
Sub-division 31	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Sweden	1	2			
		2	116			
		3	182			
		4	247			
	Total		547	0	0	0

continued

Table 8.1.1.1

Sub-division 32	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Estonia	1	8463	21	2142	2142
		2	4482	23	2342	2342
		3	3658	10	1000	1000
		4	4797	24	2435	2435
		Total	21400	78	7919	7919
	Finland	1		11		
		2		34		
		3		13		
		4		11		
		Total	0	69	0	0
	Russia	1	7279*	27	5450	883
		2				
		3	872**	12	2275	580
		4				
		Total	0	39	7725	1463

\*1 and 2 quarters

\*\*3 and 4 quarters



**Table 8.2.1** Catches of HERRING, Sub-divisions 25–29 (including Gulf of Riga) and 32. Catches as reported to the Working Group ('000 t).

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 <sup>1</sup>
Denmark	11.9	13.9	19.4	10.6	14.1	15.3	10.5	6.5	7.6	3.9	4.2	10.8	7.3	4.6	6.8	8.1	8.9	11.3	11.4
Estonia															32.7	29.7	32.7	33.7	42.9
Finland	33.7	38.3	40.4	44.0	42.5	47.5	59.1	54.1	54.2	49.4	50.4	58.1	50.0	26.9	18.1	30.0	32.3	39.2	28.1
Germany	0.0	0.1	0.0	0.0	1.0	1.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0
Latvia															33.3	25.8	25.4	26.1	28.3
Lithuania															6.5	4.6	3.0	4.9	3.6
Poland	57.2	61.3	70.4	58.3	51.2	63.0	67.1	65.8	72.8	67.8	55.5	57.2	51.8	52.3	47.1	39.2	41.1	46.1	38.3
Russia	137.0	130.6	118.1	118.0	110.2	99.2	84.6	105.6	110.8	115.7	113.8	122.8	121.8	116.2	31.9	29.5	21.6	16.7	17.0
Sweden	48.7	55.4	71.3	72.5	72.9	83.8	78.6	56.9	42.5	29.7	25.4	33.4	55.4	44.2	36.5	43.0	66.4	61.6	47.2
Total	313.7	305.2	323.1	304.4	294.0	311.1	302.0	289.9	289.5	268.3	251.9	286.3	289.9	244.2	212.8	209.9	231.4	243.3	216.8

<sup>1</sup>Preliminary.

Table 8.2.2

HER-2532: Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

CANUM: Catch in Numbers (Millions)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1974	27.0	2739.0	1857.0	1390.0	1674.0	521.0	352.0	632.0	99.0	88.0	102.0
1975	56.0	1974.0	1792.0	1694.0	987.0	1032.0	379.0	277.0	374.0	78.0	99.0
1976	21.0	2519.0	1352.0	1398.0	1067.0	536.0	639.0	250.0	140.0	262.0	98.0
1977	20.0	1328.0	2711.0	915.0	718.0	657.0	381.0	300.0	218.0	122.0	206.0
1978	86.0	1156.0	1396.0	1979.0	476.0	391.0	380.0	190.0	238.0	117.0	129.0
1979	51.0	482.0	1372.0	977.0	1502.0	361.0	298.0	288.0	182.0	170.0	132.0
1980	81.0	1138.0	1033.0	1077.0	580.0	788.0	193.0	213.0	226.0	104.0	223.0
1981	68.0	1388.0	1696.0	792.0	698.0	395.0	508.0	154.0	132.0	157.0	242.0
1982	66.0	947.0	2373.0	927.0	403.0	355.0	218.0	275.0	97.0	96.0	231.0
1983	31.0	794.0	1924.0	2014.0	703.0	272.0	269.0	178.0	185.0	79.0	179.0
1984	60.0	866.0	1330.0	1538.0	1242.0	431.0	198.0	181.0	137.0	119.0	177.0
1985	30.0	1261.0	2408.0	1280.0	989.0	739.0	264.0	139.0	118.0	76.0	159.0
1986	44.0	530.0	1808.0	2089.0	2014.0	735.0	369.0	134.0	87.0	61.0	86.0
1987	10.0	990.0	775.0	1555.0	1442.0	682.0	493.0	243.0	91.0	36.0	69.0
1988	38.0	480.0	2289.0	859.0	1122.0	994.0	393.0	282.0	115.0	45.0	56.0
1989	123.0	854.0	588.0	2481.0	723.0	917.0	749.0	273.0	206.0	81.0	55.0
1990	45.4	731.4	1277.9	652.6	1509.4	486.2	568.7	385.1	165.6	93.9	50.6
1991	114.6	492.4	1805.7	1380.6	553.5	988.2	318.9	301.3	161.7	61.5	55.8
1992	199.8	1262.9	1478.5	2066.2	794.2	357.3	579.7	176.7	116.4	109.5	40.3
1993	117.2	1029.9	2229.7	1767.9	1674.0	672.2	286.2	270.8	67.2	47.2	43.0
1994	117.0	606.3	1498.9	1775.0	1284.5	1205.4	518.2	190.0	259.0	47.5	49.9
1995	72.6	1059.6	1258.4	2083.0	1941.2	907.4	602.0	240.8	86.2	131.9	34.3

Table 8.2.3

1.st REVISION

NATION95.XLS

Stock: SD 25-29, 32

Species: HERRING

Year: 1995

Catch in numbers (millions)

Quarter: 1								
AGE	Sum	SD 25	SD 26	SD 27	SD 28	28:G.Riga	SD 29	SD 32
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	259.6	117.7	50.6	10.5	0.2	28.7	12.4	39.4
2	447.5	29.0	25.9	41.1	19.3	128.5	49.2	154.5
3	854.6	41.5	38.4	172.1	51.1	157.0	65.6	328.8
4	787.8	39.9	55.2	167.7	74.5	182.1	44.2	224.2
5	251.3	13.1	22.2	15.4	27.3	113.1	23.9	36.3
6	150.5	4.6	16.3	6.4	21.3	67.5	17.0	17.4
7	49.9	2.5	6.8	3.0	9.7	14.5	3.9	9.5
8	15.5	1.1	3.4	0.2	5.2	3.0	1.6	1.0
9	31.4	0.6	1.5	0.0	5.2	18.9	3.7	1.5
10	5.1	0.0	0.7	0.0	2.5	1.1	0.3	0.5
Total N	2853.1	250.0	221.1	416.4	216.2	714.4	221.8	813.1
CATON	66326	7101	7727	12701	8625	11880	4486	13806
NoAgeTON	1732	0	1526	0	206	0	0	0
Quarter: 2								
AGE	Sum	SD 25	SD 26	SD 27	SD 28	28:G.Riga	SD 29	SD 32
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	199.8	26.7	85.9	0.0	17.4	11.1	20.5	38.1
2	356.8	35.8	22.7	1.8	8.7	76.8	111.2	100.0
3	596.6	66.1	24.3	3.7	24.3	102.4	184.2	191.6
4	562.4	71.9	35.7	1.6	26.3	130.7	108.9	187.4
5	344.7	27.1	20.5	0.3	46.1	109.5	85.1	56.0
6	240.8	15.5	14.4	0.1	33.2	67.6	69.6	40.4
7	120.9	6.2	5.8	8.0	17.4	19.7	41.6	22.3
8	43.5	2.6	3.2	0.0	5.3	3.2	19.6	9.7
9	78.0	1.0	1.1	0.0	22.1	19.0	24.0	10.8
10	13.6	0.4	0.6	0.0	4.9	1.5	5.2	1.0
Total N	2557.2	253.4	214.1	15.5	205.6	541.4	669.9	657.3
CATON	69451	12699	6952	911	8277	10663	17349	12600
NoAgeTON	2996	0	1884	0	1112	0	0	0
Quarter: 3								
AGE	Sum	SD 25	SD 26	SD 27	SD 28	28:G.Riga	SD 29	SD 32
0	2.1	0.0	1.6	0.0	0.0	0.5	0.0	0.0
1	160.4	15.7	5.6	0.0	2.4	39.2	33.1	64.4
2	135.8	28.1	11.0	0.3	14.7	26.5	16.5	38.7
3	225.1	75.2	9.8	0.1	10.6	26.1	23.0	80.3
4	218.7	84.9	17.4	0.6	2.4	31.8	13.7	67.8
5	137.7	69.0	23.9	0.5	4.8	17.9	5.8	15.7
6	101.1	45.9	22.4	0.1	8.2	10.9	4.0	9.5
7	32.9	11.4	12.3	0.0	1.4	1.3	1.2	5.3
8	13.0	3.9	6.1	0.0	1.9	0.1	0.1	0.9
9	9.9	1.0	4.3	0.0	0.2	0.4	0.6	3.4
10	7.7	0.3	3.7	0.0	2.4	0.0	0.0	1.3
Total N	1044.3	335.5	118.1	1.7	49.0	154.7	98.0	287.4
CATON	32153	15605	5774	79	1769	2507	1734	4685
NoAgeTON	1093	0	0	0	1093	0	0	0
Quarter: 4								
AGE	Sum	SD 25	SD 26	SD 27	SD 28	28:G.Riga	SD 29	SD 32
0	66.1	12.5	16.6	0.0	0.0	17.6	6.2	13.3
1	407.0	27.8	24.0	24.6	22.3	153.4	37.2	117.7
2	301.1	30.8	20.1	22.8	48.1	85.5	20.6	73.2
3	384.4	67.7	26.7	55.9	45.6	77.6	18.5	92.4
4	360.7	88.1	38.3	17.6	45.9	82.3	12.3	76.2
5	171.7	56.2	28.6	3.1	25.7	36.6	3.9	17.6
6	108.4	40.6	17.0	0.7	18.6	24.9	3.5	3.0
7	35.9	14.4	8.0	0.0	4.3	3.9	1.7	3.7
8	14.9	4.6	4.3	0.0	4.7	0.7	0.0	0.7
9	13.8	0.7	1.4	0.0	6.9	3.4	0.4	1.0
10	9.8	0.0	1.0	0.0	8.4	0.3	0.2	0.0
Total N	1873.9	343.4	185.7	124.7	230.6	486.1	104.5	398.9
CATON	49201	16251	7585	3989	6202	7592	1774	5808
NoAgeTON	4973	0	192	0	4781	0	0	0

Table 8.2.4

1.st REVISION

NATION95.XLS

Stock: SD 25-29, 32

Species: HERRING

Year: 1995

Mean weight (g)

Quarter: 1

AGE	Sum	SD 25	SD 26	SD 27	SD 28	28:G.Riga	SD 29	SD 32
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	9.8	16.0	4.8	5.4	3.7	3.7	4.9	4.9
2	16.7	36.7	33.4	15.3	18.3	12.1	14.3	14.9
3	20.2	25.2	34.2	24.2	26.7	15.6	19.7	17.1
4	27.4	42.0	43.6	36.9	43.2	16.8	21.2	18.4
5	31.3	57.5	53.1	56.1	53.0	19.9	24.8	21.4
6	34.3	74.1	53.5	78.5	53.0	21.6	28.6	21.9
7	42.4	74.7	62.9	86.3	53.2	24.1	37.6	24.0
8	46.4	80.7	59.1	81.7	48.9	26.4	34.7	25.5
9	37.2	86.8	76.4	0.0	50.2	27.6	45.2	33.0
10	55.6	0.0	65.5	0.0	59.5	40.3	28.2	73.1
N*w	66201	7086	7675	12680	8689	11883	4451	13737

Quarter: 2

AGE	Sum	SD 25	SD 26	SD 27	SD 28	28:G.Riga	SD 29	SD 32
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	6.3	15.7	5.4	0.0	4.2	4.5	4.5	4.5
2	18.4	35.2	32.5	15.6	15.5	12.8	16.4	16.1
3	24.0	45.9	45.4	25.1	25.0	16.6	22.9	18.8
4	28.3	58.9	49.7	40.4	34.2	18.7	25.0	20.1
5	33.3	67.6	53.0	60.7	46.4	22.7	29.6	25.0
6	36.1	65.1	58.7	73.9	50.4	24.9	33.5	28.4
7	43.0	75.4	63.8	87.7	47.2	28.9	37.6	32.1
8	49.5	84.2	85.9	87.3	38.4	28.4	50.0	39.9
9	47.3	83.7	89.0	0.0	62.2	30.7	48.4	35.7
10	69.9	144.0	110.1	0.0	72.7	45.4	69.6	43.1
N*w	70271	12612	6816	910	8282	10663	17767	13220

Quarter: 3

AGE	Sum	SD 25	SD 26	SD 27	SD 28	28:G.Riga	SD 29	SD 32
0	9.9	0.0	10.7	0.0	0.0	7.2	0.0	0.0
1	12.9	30.5	20.8	11.6	16.0	11.6	11.2	9.4
2	22.7	38.5	38.5	20.7	20.5	15.7	17.7	14.7
3	28.1	44.3	43.0	28.0	21.9	17.4	20.2	17.6
4	34.6	53.8	46.4	39.7	26.0	17.9	22.3	18.1
5	39.4	47.7	47.4	66.9	28.9	19.0	26.4	21.1
6	40.8	47.0	49.2	78.5	33.5	21.0	29.1	24.3
7	51.0	59.8	59.9	102.3	34.8	24.2	37.9	24.9
8	63.5	69.9	74.4	98.0	37.5	21.4	22.4	24.2
9	52.3	84.2	70.1	110.0	55.7	21.5	32.5	27.6
10	55.1	79.8	68.2	0.0	44.9	20.0	0.0	30.7
N*w	32050	15976	5764	80	1285	2506	1769	4669

Quarter: 4

AGE	Sum	SD 25	SD 26	SD 27	SD 28	28:G.Riga	SD 29	SD 32
0	7.9	13.7	10.6	0.0	0.0	5.4	4.5	4.0
1	13.9	29.9	23.0	15.3	17.4	11.9	12.6	10.3
2	21.4	43.0	37.8	23.3	21.5	15.7	19.4	14.4
3	26.8	44.6	41.2	33.5	24.1	17.2	20.2	16.4
4	31.9	51.0	45.6	52.9	26.7	18.6	20.7	17.3
5	39.0	53.8	52.2	80.0	30.4	19.9	25.6	19.2
6	42.3	52.6	60.2	92.4	34.7	22.2	24.5	22.2
7	49.1	58.7	71.1	0.0	33.1	22.2	24.1	22.7
8	58.9	77.5	66.5	0.0	44.0	27.0	23.3	21.8
9	49.2	105.6	84.7	0.0	52.4	22.4	30.7	37.7
10	41.2	0.0	81.8	0.0	37.3	30.4	22.6	0.0
N*w	49437	16262	7889	4021	6197	7592	1770	5707

Table 8.2.5

10:31 Thursday, April 18, 1996

HER-2532: Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

WECA: Mean Weight in Catch (Grams)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1974	7.10	27.50	32.10	39.00	43.30	69.20	77.50	82.40	74.30	73.30	78.10
1975	6.40	29.20	28.70	46.70	49.10	51.20	77.20	77.50	82.30	69.60	74.60
1976	6.20	21.40	35.00	35.90	55.00	55.10	54.90	78.90	70.70	89.90	67.50
1977	5.90	27.60	25.80	46.10	53.40	67.00	60.10	69.70	88.60	91.10	93.30
1978	5.40	24.50	41.80	38.50	53.60	58.90	71.80	72.00	69.30	95.10	89.40
1979	5.40	21.70	38.90	55.20	47.30	64.00	70.40	76.30	82.50	79.70	95.60
1980	7.30	22.60	34.50	51.20	65.00	59.20	75.40	79.00	86.90	93.50	101.90
1981	6.80	25.40	33.70	50.20	65.90	73.70	71.90	83.60	87.50	97.90	107.40
1982	6.10	20.50	38.20	49.60	60.00	70.10	78.70	77.30	89.70	99.00	106.00
1983	6.50	18.40	30.00	53.90	56.50	71.50	83.90	88.10	89.20	104.70	115.40
1984	7.00	16.20	27.80	41.50	61.60	62.80	75.10	85.80	89.10	95.30	111.60
1985	5.90	15.60	21.60	39.20	53.90	66.40	72.60	83.30	93.00	99.70	107.80
1986	6.20	18.30	25.30	32.40	48.90	61.00	67.70	78.20	93.00	96.20	104.10
1987	5.70	14.90	32.30	37.10	42.20	55.70	62.40	70.30	82.40	93.80	102.50
1988	6.40	19.60	24.60	43.60	48.60	50.90	62.80	69.90	84.50	87.80	98.30
1989	7.45	22.30	33.70	33.10	45.90	53.80	56.90	66.00	74.60	84.40	103.80
1990	9.30	17.90	29.50	39.80	37.00	55.60	61.10	64.20	73.30	75.60	90.10
1991	10.00	19.60	23.10	34.10	46.50	37.00	55.20	53.30	59.80	71.80	65.66
1992	8.40	13.20	21.30	28.60	40.00	54.10	42.90	62.90	66.30	61.20	73.30
1993	7.10	12.80	19.80	28.70	33.30	41.70	48.50	43.00	58.50	60.70	64.90
1994	5.90	13.70	20.80	24.40	33.30	36.80	43.60	52.40	45.50	62.90	66.20
1995	7.70	11.20	18.80	23.30	29.20	34.50	37.10	44.50	52.30	44.60	55.80

Table 8.2.6

## AREAS Cover

ACOUSTIC SURVEYS IN SUB-DIV 24-29															
AREA:	Year factors based on areas surveyed rel to max. area per SD.														
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
24	1.152	1.000	1.178	1.311	1.293	1.293	1.248	1.465	1.293						
25	1.164	1.024	1.063	1.116	1.074	1.059	1.047	1.151	1.047	1.103			1.013	1.000	
26	1.375	1.197	1.061	1.195	1.197	1.191	1.281	1.281	1.281	1.061			1.000	1.083	
27	1.077	1.000	1.090	1.046	1.031	1.034	1.047	1.028	1.046	1.090			1.047	1.294	
28	1.101	1.130	1.348	1.082	1.000	1.066	1.178	1.079	1.069	1.000			1.002	1.080	
29S	1.000	1.169	1.334	1.249	1.154	1.611	1.993	1.144	1.144	1.000			1.083	3.050	
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Max
24	3925	4520	3836	3448	3495	3495	3622	3085	3495						4520
25	8735	9922	9563	9111	9466	9596	9706	8828	9706	9215			10038	10164	10164
26	6908	7930	8951	7950	7935	7971	7415	7414	7414	8951			9496	8769	9496
27	5631	6065	5564	5799	5881	5867	5791	5897	5797	5562			5791	4686	6065
28	7935	7732	6484	8075	8738	8201	7415	8096	8173	8738			8720	8091	8738
29S	5355	4579	4015	4289	4640	3324	2687	4679	4679	5355			4943	1756	5355
Sum25-29S	34564	36228	34577	35223	36661	34959	33014	34915	35769	37821	0	0	38988	33466	

Table 8.2.7

14:13 Sunday, April 21, 1996

HER-2532: Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

FLTNY: Internat Acoustic Surveys 1982-95. Corrected for area coverage. (Catch: Millions)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1982	1	6364	9212	3389	1967	1949	1524	888	581	385
1983	1	3263	5284	5317	2378	1531	1652	3645	739	449
1984	1	6689	5993	6033	4767	1653	1015	677	435	220
1985	1	3291	7194	3914	3333	1140	521	399	225	143
1986	1	3614	8113	8890	4078	2868	927	384	228	114
1987	1	6689	2343	5008	5149	1948	1131	361	115	37
1988	1	1422	4714	2201	4917	4196	1727	870	259	104
1989	1	5354	2560	7053	2867	4326	2579	1062	369	81
1990	1	10029	8458	5068	4601	2713	2256	1171	537	228
1991	1	7856	4409	12094	6979	3088	6698	1710	1663	1048
1992	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1993	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1994	1	2862	7989	15776	9680	4471	1599	731	411	119
1995	1	3874	2595	5044	6085	5356	3060	1463	495	140

Table 8.2.8

14:13 Sunday, April 21, 1996

HER-2532: Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

ACBIO: Acoustic Biomass estimates

Year	Fishing effort	Catch, age 1
1982	1	1636
1983	1	1608
1984	1	1186
1985	1	831
1986	1	1310
1987	1	890
1988	1	1099
1989	1	1315
1990	1	1356
1991	1	1500
1992	1	-1
1993	1	-1
1994	1	1525
1995	1	769

Table 8.2.9

HER-2532: Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

14:13 Sunday, April 21, 1996

PLINX: GM indices (0,1 group) from Polish YFS in SD 26 (Catch: Number)

Year	Fishing effort	Catch, age 1
1977	1	10.340
1978	1	1.180
1979	1	1.290
1980	1	2.110
1981	1	3.500
1982	1	2.080
1983	1	1.990
1984	1	4.080
1985	1	2.760
1986	1	1.630
1987	1	-1.000
1988	1	1.340
1989	1	2.390
1990	1	2.730
1991	1	2.180
1992	1	1.880
1993	1	1.730
1994	1	2.380
1995	1	3.170
1996	1	2.510

Table 8.2.10

HER-2532: Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

10:31 Thursday, April 18, 1996

NATMOR: Natural Mortality

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1973	.	.	.	.	.	.	.	.	.	.	.
1974	0.33	0.54	0.27	0.26	0.24	0.24	0.22	0.22	0.21	0.19	0.19
1975	0.37	0.61	0.30	0.29	0.27	0.27	0.25	0.25	0.24	0.22	0.22
1976	0.37	0.61	0.30	0.29	0.27	0.27	0.25	0.25	0.24	0.22	0.22
1977	0.40	0.58	0.32	0.31	0.28	0.28	0.27	0.27	0.26	0.25	0.25
1978	0.49	0.78	0.38	0.35	0.32	0.32	0.30	0.30	0.29	0.27	0.27
1979	0.57	1.03	0.46	0.43	0.37	0.37	0.34	0.35	0.34	0.30	0.30
1980	0.53	1.13	0.48	0.46	0.40	0.40	0.36	0.37	0.35	0.31	0.31
1981	0.48	0.84	0.40	0.39	0.35	0.35	0.32	0.33	0.31	0.28	0.28
1982	0.50	0.90	0.42	0.40	0.36	0.36	0.33	0.34	0.32	0.29	0.29
1983	0.49	0.81	0.41	0.40	0.35	0.35	0.33	0.33	0.32	0.29	0.29
1984	0.45	0.74	0.38	0.38	0.35	0.35	0.32	0.33	0.31	0.29	0.29
1985	0.43	0.71	0.37	0.38	0.35	0.35	0.32	0.33	0.31	0.29	0.29
1986	0.35	0.57	0.32	0.32	0.30	0.30	0.28	0.28	0.27	0.25	0.25
1987	0.34	0.47	0.29	0.28	0.27	0.27	0.26	0.26	0.25	0.24	0.24
1988	0.31	0.48	0.29	0.28	0.26	0.26	0.25	0.25	0.25	0.24	0.24
1989	0.27	0.38	0.26	0.25	0.24	0.24	0.23	0.24	0.23	0.22	0.22
1990	0.24	0.30	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22
1991	0.23	0.26	0.23	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.21
1992	0.22	0.24	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
1993	0.22	0.24	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
1994	0.22	0.24	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
1995	0.22	0.24	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21



Table 8.2.11

212

CATCH NUMBERS AT AGE (Millions)															
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
1	947.	794.	866.	1261.	530.	990.	480.	854.	731.	492.	1263.	1030.	606.	1060.	
2	2373.	1924.	1330.	2408.	1808.	775.	2289.	588.	1278.	1806.	1479.	2230.	1499.	1258.	
3	927.	2014.	1538.	1280.	2089.	1555.	859.	2481.	653.	1381.	2066.	1768.	1775.	2083.	
4	403.	703.	1242.	989.	2014.	1442.	1122.	723.	1509.	554.	794.	1674.	1285.	1941.	
5	355.	272.	431.	739.	735.	682.	994.	917.	486.	988.	357.	672.	1205.	907.	
6	218.	269.	198.	264.	369.	493.	393.	749.	569.	319.	580.	286.	518.	602.	
7	275.	178.	181.	139.	134.	243.	282.	273.	385.	301.	177.	271.	190.	241.	
8	97.	185.	137.	118.	87.	91.	115.	206.	166.	162.	116.	67.	259.	86.	
9	327.	258.	296.	235.	147.	105.	101.	136.	145.	117.	150.	90.	97.	166.	
INDICES OF SPAWNING STOCK BIOMASS															
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
1	.144E+04	.151E+04	.104E+04	.748E+03	.115E+04	.757E+03	.103E+04	.113E+04	.110E+04	.131E+04	-.100E+01	-.100E+01	.144E+04	.698E+03	
AGE - STRUCTURED INDICES															
FISHING MORTALITY															
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
1	.0276	.0271	.0267	.0540	.0460	.0399	.0533	.0592	.0327	.0437	.0414	.0403	.0414	.0387	
2	.1497	.1191	.0888	.1427	.1453	.1130	.1485	.1029	.1327	.1184	.1122	.1092	.1122	.1048	
3	.1617	.2309	.1625	.1399	.2082	.2004	.1937	.2577	.1668	.1959	.1858	.1808	.1858	.1734	
4	.1496	.2154	.2658	.1787	.4017	.2419	.2354	.2657	.2582	.2300	.2180	.2122	.2180	.2036	
5	.1467	.1688	.2344	.2969	.2249	.2533	.2821	.3262	.2995	.2518	.2387	.2323	.2387	.2229	
6	.1276	.1852	.2073	.2567	.2711	.2537	.2429	.3764	.3583	.2916	.2764	.2690	.2764	.2581	
7	.1847	.1677	.2110	.2528	.2244	.3129	.2399	.2796	.3489	.2837	.2689	.2618	.2689	.2511	
8	.1851	.2106	.2149	.2370	.2791	.2522	.2546	.2900	.2830	.2518	.2387	.2323	.2387	.2229	
9	.1851	.2106	.2149	.2370	.2791	.2522	.2546	.2900	.2830	.2518	.2387	.2323	.2387	.2229	
NUMBERS AT AGE (Millions)															
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	52618.	43310.	46424.	33404.	15426.	31694.	11614.	17813.	26316.	19283.	28406.	24881.	17809.	29121.	26059.
2	20790.	20810.	18752.	21566.	15560.	8332.	19035.	6813.	11481.	18869.	14232.	21438.	18799.	13441.	22039.
3	7494.	11760.	12260.	11734.	12915.	9770.	5568.	12277.	4740.	7988.	13318.	10312.	15579.	13620.	9811.
4	3438.	4273.	6258.	7127.	6977.	7615.	6043.	3467.	7389.	3187.	5270.	8965.	6976.	10487.	9282.
5	3085.	2065.	2428.	3380.	4200.	3459.	4564.	3682.	2091.	4535.	2032.	3435.	5878.	4547.	6935.
6	2130.	1859.	1229.	1353.	1770.	2485.	2050.	2654.	2090.	1231.	2829.	1298.	2207.	3753.	2949.
7	1913.	1348.	1110.	725.	760.	1020.	1487.	1252.	1447.	1172.	746.	1739.	804.	1357.	2350.
8	667.	1132.	819.	646.	405.	459.	575.	911.	745.	819.	716.	462.	1085.	498.	856.
9	337.	612.	1037.	1111.	1030.	841.	792.	830.	1040.	1079.	1196.	1221.	1081.	1383.	1220.

Table 8.2.12

## STOCK SUMMARY

Year	Recruits x10 <sup>6</sup>	Total B tonnes	Spawn B tonnes	Landings tonnes	Yld/SSB	Ref. F Fbar 3- 6
1982	52618.	3102539.	1456802.	311.	.0002	.1464
1983	43310.	2875249.	1545035.	302.	.0002	.2001
1984	46424.	2693204.	1466120.	290.	.0002	.2175
1985	33404.	2410205.	1419940.	289.	.0002	.2180
1986	15426.	1999365.	1307225.	268.	.0002	.2765
1987	31694.	1964229.	1170969.	252.	.0002	.2373
1988	11614.	1838522.	1230249.	286.	.0002	.2385
1989	17813.	1765598.	1069765.	290.	.0003	.3065
1990	26316.	1756941.	996127.	244.	.0002	.2707
1991	19283.	1662337.	975452.	213.	.0002	.2423
1992	28406.	1667383.	1023660.	210.	.0002	.2297
1993	24881.	1733922.	1099811.	231.	.0002	.2236
1994	17809.	1724786.	1155945.	243.	.0002	.2297
1995	29121.	1643050.	1065630.	217.	.0002	.2145

## PARAMETER ESTIMATES +/- SD

Separable Model: Reference F by year

1	1991	.2518	.2075	.3056
2	1992	.2387	.1955	.2915
3	1993	.2323	.1884	.2865
4	1994	.2387	.1898	.3003
5	1995	.2229	.1714	.2898

Separable Model: Selection (S) by age

6	1	.1735	.1408	.2139
7	2	.4701	.3904	.5661
8	3	.7782	.6577	.9207
9	4	.9134	.7830	1.0655
	5	1.0000	Fixed : Reference age	
10	6	1.1580	1.0175	1.3179
11	7	1.1266	.9924	1.2789
	8	1.0000	Fixed : last true age	

Separable Model: Populations in year 1995

12	1	29121480.	20276861.	41824059.
13	2	13440838.	10110260.	17868594.
14	3	13620225.	10763561.	17235052.

SSB Index catchabilities				
24	1	Linear Model :	0	
			.88135E-03	.80384E-03
				.96634E-03

25	a	.3965172E+22	.0000000E+00 +INF
26	b	.1940174E+21	.0000000E+00 +INF

Separable Model Residuals  
(log(Observed Catch)-log(Expected Catch))  
and weights (W) used in the analysis.

Biomass Index Residuals:  $\log(\text{Observed Index}) - \log(\text{Expected Index})$

[illegible]

Table 8.2.14

1 .11470E+00 .10600E+00 -.21518E+00 -.51467E+00 -.11031E-03 -.30993E+00 -.47485E-01 .17753E+00 .22730E+00 .42041E+00 -.10000E+01 -.10000E+01  
.34672E+00 -.29681E+00

PARAMETERS OF THE DISTRIBUTION OF ln CATCHES AT AGE

-----  
Separable model fitted from 1991 to 1995

Variance : .0500  
Skewness test statistic : -2.5437  
Kurtosis test statistic : .0916  
Partial chi-square : .0645  
Probability of chi-square : 1.0000  
Degrees of freedom : 17

PARAMETERS OF THE DISTRIBUTION OF THE SSB INDICES

-----  
DISTRIBUTION STATISTICS FOR ln SSB INDEX 1

Linear catchability relationship assumed.

Variance : .0820  
Skewness test statistic : -.3790  
Kurtosis test statistic : -.6726  
Partial chi-square : .1298  
Probability of chi-square : 1.0000  
Number of observations : 12  
Degrees of freedom : 11  
Weight in the analysis : .6103

Table 8.2.15

Lowestoft VPA Version 3.1

25-Apr-96 11:54:14

Extended Survivors Analysis

Herring 25-29&amp;32Riga (run: XSABES08/X08)

CPUE data from file /users/fish/ifad/ifapwork/wgbfas/her\_2532/FLEET.X08

Catch data for 22 years. 1974 to 1995. Ages 1 to 9.

Fleet,	First, Last,	First, Last,	Alpha,	Beta
	year, year,	age, age		
FLTN2: Internat Acou,	1982, 1995,	1, 8,	.800,	.900
PLINX: GM indices (0,	1982, 1995,	1, 1,	.050,	.100

Time series weights :

Tapered time weighting applied  
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages &lt; 4

Regression type = C  
Minimum of 5 points used for regression  
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages &gt;= 6

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 had not converged after 30 iterations

Total absolute residual between iterations  
29 and 30 = .00276

Final year F values

Age	1,	2,	3,	4,	5,	6,	7,	8
Iteration 29,	.0474,	.1105,	.2301,	.2327,	.1865,	.2525,	.1767,	.1836
Iteration 30,	.0474,	.1104,	.2298,	.2324,	.1862,	.2522,	.1759,	.1830

Regression weights

, .751, .820, .877, .921, .954, .976, .990, .997, 1.000, 1.000

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
1,	.044,	.042,	.052,	.055,	.035,	.025,	.053,	.057,	.039,	.047
2,	.139,	.106,	.159,	.099,	.122,	.123,	.099,	.127,	.113,	.110
3,	.202,	.190,	.180,	.280,	.161,	.194,	.207,	.167,	.143,	.230
4,	.436,	.233,	.220,	.242,	.287,	.205,	.165,	.262,	.178,	.232
5,	.274,	.282,	.269,	.298,	.265,	.318,	.200,	.208,	.309,	.186
6,	.353,	.327,	.279,	.353,	.316,	.285,	.318,	.248,	.248,	.252
7,	.347,	.454,	.337,	.337,	.318,	.280,	.255,	.243,	.261,	.176
8,	.390,	.457,	.432,	.465,	.365,	.217,	.167,	.147,	.392,	.183

Table 8.2.15 (continued)

XSA population numbers (Thousands)

YEAR ,	1,	AGE 2,	3,	4,	5,	6,	7,	8,
1986 ,	1.65E+07,	1.64E+07,	1.34E+07,	6.62E+06,	3.57E+06,	1.43E+06,	5.26E+05,	3.08E+05,
1987 ,	3.01E+07,	8.93E+06,	1.04E+07,	7.93E+06,	3.17E+06,	2.01E+06,	7.58E+05,	2.81E+05,
1988 ,	1.20E+07,	1.81E+07,	6.01E+06,	6.48E+06,	4.80E+06,	1.83E+06,	1.12E+06,	3.71E+05,
1989 ,	1.92E+07,	7.07E+06,	1.15E+07,	3.80E+06,	4.01E+06,	2.83E+06,	1.08E+06,	6.21E+05,
1990 ,	2.44E+07,	1.25E+07,	4.94E+06,	6.79E+06,	2.34E+06,	2.34E+06,	1.58E+06,	6.04E+05,
1991 ,	2.31E+07,	1.75E+07,	8.76E+06,	3.34E+06,	4.05E+06,	1.43E+06,	1.37E+06,	9.21E+05,
1992 ,	2.78E+07,	1.74E+07,	1.23E+07,	5.79E+06,	2.19E+06,	2.36E+06,	8.71E+05,	8.39E+05,
1993 ,	2.09E+07,	2.07E+07,	1.28E+07,	8.08E+06,	3.98E+06,	1.45E+06,	1.39E+06,	5.47E+05,
1994 ,	1.77E+07,	1.56E+07,	1.48E+07,	8.74E+06,	5.04E+06,	2.62E+06,	9.17E+05,	8.86E+05,
1995 ,	2.58E+07,	1.34E+07,	1.13E+07,	1.04E+07,	5.93E+06,	3.00E+06,	1.66E+06,	5.73E+05,

Estimated population abundance at 1st Jan 1996

, .00E+00, 1.94E+07, 9.71E+06, 7.27E+06, 6.69E+06, 4.00E+06, 1.89E+06, 1.13E+06,

Taper weighted geometric mean of the VPA populations:

, 2.48E+07, 1.49E+07, 9.93E+06, 6.06E+06, 3.45E+06, 1.93E+06, 1.08E+06, 6.11E+05,

Standard error of the weighted Log(VPA populations) :

, .3840, .3289, .3391, .3674, .3590, .3482, .3735, .4381,

Table 8.2.15 (continued)

Log catchability residuals.

Fleet : FLTN2: Internat Acou

Age	1982,	1983,	1984,	1985
1	.00,	-.63,	-.09,	-.51
2	.39,	-.17,	-.06,	-.06
3	-.13,	-.14,	-.11,	-.58
4	-.24,	-.15,	.15,	-.40
5	-.07,	.03,	.11,	-.59
6	-.33,	.18,	.04,	-.52
7	-.51,	1.04,	-.10,	-.25
8	-.11,	-.10,	-.55,	-.53

Age	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
1	.21,	.15,	-.51,	.30,	.63,	.39,	99.99,	99.99,	-.39,	99.99
2	.33,	-.34,	-.31,	-.05,	.55,	-.43,	99.99,	99.99,	.25,	99.99
3	.03,	-.31,	-.56,	-.04,	.38,	.66,	99.99,	99.99,	.34,	99.99
4	-.10,	-.25,	-.11,	-.12,	-.19,	.85,	99.99,	99.99,	.19,	99.99
5	.01,	-.28,	.05,	.27,	.30,	-.08,	99.99,	99.99,	.06,	99.99
6	-.30,	-.49,	-.02,	-.01,	.01,	1.55,	99.99,	99.99,	-.52,	99.99
7	-.19,	-.55,	-.16,	.07,	-.25,	.23,	99.99,	99.99,	-.24,	99.99
8	-.15,	-.70,	-.19,	-.34,	-.03,	.54,	99.99,	99.99,	-.67,	99.99

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
Mean Log q,	-6.6630,	-6.6455,	-6.4976,	-6.4976,	-6.4976,
S.E(Log q),	.3703,	.2541,	.6498,	.3920,	.4747,

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,	1.03,	-.081,	7.83,	.50,	11,	.47,	-8.12,
2,	.99,	.039,	7.68,	.53,	11,	.37,	-7.55,
3,	.96,	.094,	7.30,	.44,	11,	.45,	-6.92,

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,	1.61,	-1.033,	1.24,	.31,	11,	.59,	-6.66,
5,	1.00,	.006,	6.66,	.64,	11,	.27,	-6.65,
6,	1.77,	-.605,	.43,	.09,	11,	1.20,	-6.50,
7,	.76,	.840,	8.35,	.65,	11,	.29,	-6.60,
8,	.78,	.848,	8.16,	.70,	11,	.31,	-6.75,

Table 8.2.15 (continued)

Fleet : PLINX: GM indices (0

Age , 1982, 1983, 1984, 1985  
 1 , -.77, -.74, .61, .11  
 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

Age , 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995  
 1 , -.26, 99.99, -.36, .36, .38, -.04, -.53, -.42, .41, .63  
 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

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, 2.08, -2.565, 15.25, .40, 13, .50, -16.15,

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FLTN2: Internat Acou,	1.,	.000,	.000,	.00,	0, .000,	.000
PLINX: GM indices (0,	36273744.,	.557,	.000,	.00,	1, .188,	.026
P shrinkage mean ,	14910614.,	.33,...			.567,	.061
F shrinkage mean ,	21935960.,	.50,...			.245,	.042

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
19377756.,	.25,	.50,	3,	2.048,	.047



Table 8.2.15 (continued)

## Age 2 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Weights,	Scaled, Weights,	Estimated F
FLTN2: Internat Acou,	6543945.,	.533,	.000,	.00,	1,	.161,	.160
PLINX: GM indices (0,	14596747.,	.525,	.000,	.00,	1,	.166,	.075
P shrinkage mean ,	9928860.,	.34,,,				.461,	.108
F shrinkage mean ,	9088763.,	.50,,,				.212,	.117

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
9713446.,	.23,	.13,	4,	.596,	.110

## Age 3 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Weights,	Scaled, Weights,	Estimated F
FLTN2: Internat Acou,	9315619.,	.399,	.000,	.00,	1,	.245,	.183
PLINX: GM indices (0,	4756442.,	.544,	.000,	.00,	1,	.125,	.332
P shrinkage mean ,	6061547.,	.37,,,				.409,	.270
F shrinkage mean ,	9800850.,	.50,,,				.221,	.175

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7266222.,	.22,	.15,	4,	.696,	.230

## Age 4 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, Weights,	Scaled, Weights,	Estimated F
FLTN2: Internat Acou,	9362967.,	.526,	.000,	.00,	1,	.293,	.171
PLINX: GM indices (0,	3922192.,	.536,	.000,	.00,	1,	.236,	.369
F shrinkage mean ,	7088077.,	.50,,,				.472,	.220

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6688240.,	.31,	.23,	3,	.741,	.232

## Age 5 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, Weights,	Scaled, Weights,	Estimated F
FLTN2: Internat Acou,	5110803.,	.314,	.091,	.29,	2,	.527,	.148
PLINX: GM indices (0,	3831770.,	.530,	.000,	.00,	1,	.149,	.193
F shrinkage mean ,	2734135.,	.50,,,				.324,	.261

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3997888.,	.24,	.20,	4,	.805,	.186

Table 8.2.15 (continued)

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e.,	Ext, s.e.,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FLTN2: Internat Acou,	1927597.,	.228,	.205,	.90,	3, .651,	.248
PLINX: GM indices (0,	2762920.,	.548,	.000,	.00,	1, .071,	.179
F shrinkage mean ,	1646309.,	.50,...			.278,	.285

Weighted prediction :

Survivors, at end of year,	Int, s.e.,	Ext, s.e.,	N, ,	Var, Ratio,	F
1892296.,	.21,	.14,	5,	.653,	.252

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e.,	Ext, s.e.,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FLTN2: Internat Acou,	1488995.,	.264,	.263,	.99,	4, .539,	.136
PLINX: GM indices (0,	1609585.,	.547,	.000,	.00,	1, .095,	.126
F shrinkage mean ,	690202.,	.50,...			.366,	.273

Weighted prediction :

Survivors, at end of year,	Int, s.e.,	Ext, s.e.,	N, ,	Var, Ratio,	F
1132323.,	.24,	.26,	6,	1.089,	.176

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e.,	Ext, s.e.,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FLTN2: Internat Acou,	432966.,	.223,	.236,	1.06,	5, .657,	.165
PLINX: GM indices (0,	268603.,	.632,	.000,	.00,	1, .045,	.254
F shrinkage mean ,	321241.,	.50,...			.297,	.216

Weighted prediction :

Survivors, at end of year,	Int, s.e.,	Ext, s.e.,	N, ,	Var, Ratio,	F
387724.,	.21,	.17,	7,	.815,	.183

Table 8.2.16

Run title : Herring 25-29&amp;32Riga (run: XSABES08/X08)

At 25-Apr-96 11:55:04

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age	
YEAR,	1974,	1975,
AGE		
1,	.1304,	.1162,
2,	.1046,	.1493,
3,	.1478,	.1429,
4,	.1745,	.1595,
5,	.1089,	.1644,
6,	.1591,	.1131,
7,	.1758,	.1884,
8,	.1539,	.1545,
+gp,	.1539,	.1545,
FBAR 3- 6,	.1476,	.1450,

Table 8	Fishing mortality (F) at age									
YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.0732,	.0584,	.0507,	.0278,	.0530,	.0459,	.0314,	.0289,	.0265,	.0525,
2,	.1428,	.1393,	.1079,	.1218,	.1376,	.1916,	.1636,	.1334,	.0934,	.1394,
3,	.1848,	.1519,	.1655,	.1273,	.1755,	.1920,	.1890,	.2579,	.1855,	.1482,
4,	.1370,	.1492,	.1244,	.2179,	.1301,	.2064,	.1704,	.2607,	.3066,	.2092,
5,	.1313,	.1267,	.1259,	.1529,	.2079,	.1481,	.1818,	.1971,	.2999,	.3608,
6,	.1549,	.1400,	.1103,	.1534,	.1361,	.2402,	.1322,	.2400,	.2506,	.3560,
7,	.1070,	.1076,	.1049,	.1304,	.1851,	.1795,	.2287,	.1749,	.2928,	.3239,
8,	.1437,	.1358,	.1270,	.1578,	.1686,	.1949,	.1880,	.2751,	.2264,	.3644,
+gp,	.1437,	.1358,	.1270,	.1578,	.1686,	.1949,	.1880,	.2751,	.2264,	.3644,
FBAR 3- 6,	.1520,	.1419,	.1315,	.1629,	.1624,	.1967,	.1683,	.2389,	.2606,	.2686,

Run title : Herring 25-29&amp;32Riga (run: XSABES08/X08)

At 25-Apr-96 11:55:04

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age										FBAR 93-95
YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	
AGE											
1,	.0437,	.0424,	.0520,	.0551,	.0354,	.0246,	.0526,	.0570,	.0394,	.0474,	.0479,
2,	.1386,	.1058,	.1585,	.0995,	.1223,	.1234,	.0993,	.1272,	.1131,	.1104,	.1169,
3,	.2024,	.1895,	.1796,	.2795,	.1605,	.1935,	.2073,	.1672,	.1430,	.2298,	.1800,
4,	.4357,	.2332,	.2197,	.2418,	.2869,	.2045,	.1652,	.2616,	.1781,	.2324,	.2240,
5,	.2736,	.2823,	.2691,	.2982,	.2648,	.3181,	.2004,	.2077,	.3088,	.1862,	.2342,
6,	.3528,	.3275,	.2793,	.3528,	.3163,	.2848,	.3180,	.2476,	.2479,	.2522,	.2492,
7,	.3467,	.4541,	.3369,	.3369,	.3181,	.2802,	.2552,	.2430,	.2614,	.1759,	.2268,
8,	.3904,	.4569,	.4323,	.4652,	.3650,	.2168,	.1674,	.1466,	.3925,	.1830,	.2407,
+gp,	.3904,	.4569,	.4323,	.4652,	.3650,	.2168,	.1674,	.1466,	.3925,	.1830,	
FBAR 3- 6,	.3161,	.2581,	.2369,	.2931,	.2572,	.2502,	.2227,	.2210,	.2194,	.2252,	

Table 8.2.17

Run title : Herring 25-29&amp;32Riga (run: XSABES08/X08)

At 25-Apr-96 11:55:04

Terminal Fs derived using XSA (With F shrinkage)

Table 10 YEAR,	Stock number at age (start of year)		Numbers*10***-4
	1974,	1975,	
AGE			
1,	2934960,	2440185,	
2,	2139417,	1501254,	
3,	1152051,	1470940,	
4,	1179038,	766236,	
5,	569228,	778993,	
6,	267070,	401562,	
7,	437640,	182795,	
8,	77090,	294598,	
+gp,	145902,	137368,	
TOTAL,	8902396,	7973940,	

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10***-4					
	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	
AGE											
1,	4844555,	3126490,	3456797,	2942808,	3878361,	4703822,	4801137,	4173576,	4792235,	3513437,	
2,	1180370,	2446612,	1651150,	1506348,	1021804,	1188161,	1939490,	1891612,	1803691,	2226625,	
3,	957917,	758072,	1545589,	1013713,	841923,	551017,	657592,	1081985,	1098630,	1123489,	
4,	954115,	595845,	477644,	923029,	580630,	445921,	307901,	364900,	560384,	624125,	
5,	498694,	635127,	387910,	306278,	512737,	341722,	255641,	181154,	198127,	290636,	
6,	504500,	333861,	422902,	248362,	181554,	279182,	207649,	148703,	104824,	103437,	
7,	279291,	336514,	221574,	280587,	151635,	110545,	159439,	130800,	84097,	59245,	
8,	117916,	195449,	230676,	147793,	173550,	87037,	66416,	90283,	78942,	45113,	
+gp,	298804,	291020,	234672,	238544,	244092,	257160,	218800,	122785,	167360,	87866,	
TOTAL,	9636164,	8718994,	8628910,	7607467,	7586282,	7964562,	8614062,	8185800,	8888298,	8073969,	

Run title : Herring 25-29&amp;32Riga (run: XSABES08/X08)

At 25-Apr-96 11:55:04

Terminal Fs derived using XSA (With F shrinkage)

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10***-4						
	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST
AGE												
1,	1649123,	3013686,	1203954,	1924970,	2441149,	2309303,	2778102,	2094906,	1768036,	2581093,	0,	29543
2,	1638944,	892764,	1805295,	707230,	1245790,	1745496,	1737355,	2073322,	1556568,	1337012,	1937775,	15454
3,	1337876,	1036049,	600984,	1152833,	493678,	875914,	1225900,	1275158,	1479858,	1126779,	971344,	9668
4,	662460,	793485,	647845,	379536,	678880,	334073,	579260,	807671,	874455,	1039741,	726623,	5956
5,	356791,	317416,	479740,	401000,	234429,	404851,	218516,	398035,	503971,	593173,	668824,	3608
6,	142772,	201055,	182722,	282622,	234107,	142924,	236374,	144957,	262121,	299986,	399789,	2172
7,	52614,	75825,	111734,	107622,	157789,	136929,	87140,	139409,	91732,	165816,	189230,	1414
8,	30807,	28116,	37127,	62132,	60445,	92130,	83866,	54726,	88622,	57251,	113232,	838
+gp,	50988,	31911,	32090,	40389,	52288,	66458,	107418,	73134,	33040,	109829,	112910,	
TOTAL,	5922374,	6390313,	5101492,	5058327,	5598556,	6108074,	7053923,	7061313,	6658399,	7310687,	5119720,	

Table 8.2.18

Run title : Herring 25-29&amp;32Riga (run: XSABES08/X08)

At 25-Apr-96 11:55:04

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 6,
1974,	29349632,	3590571,	2227204,	310000,	.1392,	.1476,
1975,	24401882,	3399362,	2180454,	313000,	.1435,	.1450,
1976,	48445568,	3407212,	1959503,	318000,	.1623,	.1520,
1977,	31264928,	3479148,	2081685,	314000,	.1508,	.1419,
1978,	34567952,	3486343,	2039618,	305000,	.1495,	.1315,
1979,	29428096,	3139578,	1907655,	323000,	.1693,	.1629,
1980,	38783624,	3007557,	1645200,	304000,	.1848,	.1624,
1981,	47038256,	3040529,	1445200,	294000,	.2034,	.1967,
1982,	48011344,	3011868,	1472472,	311000,	.2112,	.1683,
1983,	41735776,	2699309,	1424774,	302000,	.2120,	.2389,
1984,	47922360,	2602403,	1367204,	290000,	.2121,	.2606,
1985,	35134400,	2277913,	1268972,	289000,	.2277,	.2686,
1986,	16491240,	1895219,	1186807,	268000,	.2258,	.3161,
1987,	30136900,	1864791,	1093485,	252000,	.2305,	.2581,
1988,	12039546,	1773711,	1167951,	286000,	.2449,	.2369,
1989,	19249706,	1751395,	1027359,	290000,	.2823,	.2931,
1990,	24411496,	1723350,	989973,	244000,	.2465,	.2572,
1991,	23093032,	1720260,	964570,	213000,	.2208,	.2502,
1992,	27781020,	1711849,	1062046,	210000,	.1977,	.2227,
1993,	20949058,	1699842,	1112475,	231000,	.2076,	.2210,
1994,	17680372,	1629886,	1094816,	243000,	.2220,	.2194,
1995,	25810946,	1573250,	1039316,	217000,	.2088,	.2252,
Arith.						
Mean	30623960,	2476607,	1443579,	278500,	.2024,	.2126,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 8.2.19

12:40 Thursday, April 25, 1996

Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

Prediction with management option table: Input data

Year: 1996								
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	21315.000	0.2400	0.0000	0.3500	0.3000	14.140	0.0490	14.100
2	19378.000	0.2100	0.7000	0.3500	0.3000	20.800	0.1190	20.760
3	9713.000	0.2100	0.9000	0.3500	0.3000	27.880	0.1830	27.820
4	7266.000	0.2100	1.0000	0.3500	0.3000	36.400	0.2270	36.460
5	6688.000	0.2100	1.0000	0.3500	0.3000	40.920	0.2380	40.820
6	3998.000	0.2100	1.0000	0.3500	0.3000	45.560	0.2530	45.460
7	1892.000	0.2100	1.0000	0.3500	0.3000	51.220	0.2300	51.220
8	1132.000	0.2100	1.0000	0.3500	0.3000	56.580	0.2440	56.480
9+	1129.000	0.2100	1.0000	0.3500	0.3000	60.300	0.2440	60.240
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	21315.000	0.2400	0.0000	0.3500	0.3000	14.140	0.0490	14.100
2	.	0.2100	0.7000	0.3500	0.3000	20.800	0.1190	20.760
3	.	0.2100	0.9000	0.3500	0.3000	27.880	0.1830	27.820
4	.	0.2100	1.0000	0.3500	0.3000	36.400	0.2270	36.460
5	.	0.2100	1.0000	0.3500	0.3000	40.920	0.2380	40.820
6	.	0.2100	1.0000	0.3500	0.3000	45.560	0.2530	45.460
7	.	0.2100	1.0000	0.3500	0.3000	51.220	0.2300	51.220
8	.	0.2100	1.0000	0.3500	0.3000	56.580	0.2440	56.480
9+	.	0.2100	1.0000	0.3500	0.3000	60.300	0.2440	60.240
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 1998								
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	21315.000	0.2400	0.0000	0.3500	0.3000	14.140	0.0490	14.100
2	.	0.2100	0.7000	0.3500	0.3000	20.800	0.1190	20.760
3	.	0.2100	0.9000	0.3500	0.3000	27.880	0.1830	27.820
4	.	0.2100	1.0000	0.3500	0.3000	36.400	0.2270	36.460
5	.	0.2100	1.0000	0.3500	0.3000	40.920	0.2380	40.820
6	.	0.2100	1.0000	0.3500	0.3000	45.560	0.2530	45.460
7	.	0.2100	1.0000	0.3500	0.3000	51.220	0.2300	51.220
8	.	0.2100	1.0000	0.3500	0.3000	56.580	0.2440	56.480
9+	.	0.2100	1.0000	0.3500	0.3000	60.300	0.2440	60.240
Unit	Millions	-	-	-	-	Grams	-	Grams

Notes: Run name : MANBES01  
Date and time: 25APR96:13:20

Table 8.2.20a

Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

12:40 Thursday, April 25, 1996

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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	0.2253	1924595	1288936	276279	0.0000	0.0000	1932078	1401075	0	2235772	1684157
.	.	.	.	.	0.1000	0.0225	.	1390977	30500	2203197	1642307
.	.	.	.	.	0.2000	0.0451	.	1380955	60404	2171267	1601606
.	.	.	.	.	0.3000	0.0676	.	1371010	89723	2139968	1562020
.	.	.	.	.	0.4000	0.0901	.	1361139	118470	2109288	1523517
.	.	.	.	.	0.5000	0.1126	.	1351342	146657	2079213	1486066
.	.	.	.	.	0.6000	0.1352	.	1341619	174297	2049730	1449636
.	.	.	.	.	0.7000	0.1577	.	1331970	201400	2020826	1414199
.	.	.	.	.	0.8000	0.1802	.	1322393	227978	1992490	1379725
.	.	.	.	.	0.9000	0.2027	.	1312888	254043	1964709	1346186
.	.	.	.	.	1.0000	0.2253	.	1303455	279604	1937471	1313557
.	.	.	.	.	1.1000	0.2478	.	1294093	304673	1910766	1281810
.	.	.	.	.	1.2000	0.2703	.	1284801	329259	1884581	1250921
.	.	.	.	.	1.3000	0.2928	.	1275579	353374	1858906	1220865
.	.	.	.	.	1.4000	0.3154	.	1266426	377027	1833730	1191618
.	.	.	.	.	1.5000	0.3379	.	1257343	400227	1809042	1163157
.	.	.	.	.	1.6000	0.3604	.	1248327	422984	1784833	1135459
.	.	.	.	.	1.7000	0.3829	.	1239379	445308	1761092	1108503
.	.	.	.	.	1.8000	0.4055	.	1230499	467208	1737809	1082268
.	.	.	.	.	1.9000	0.4280	.	1221685	488691	1714974	1056734
.	.	.	.	.	2.0000	0.4505	.	1212937	509768	1692579	1031879
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANBES01  
Date and time : 25APR96:13:20  
Computation of ref. F: Simple mean, age 3 - 6  
Basis for 1996 : F factors

Table 8.2.20b

Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

12:40 Thursday, April 25, 1996

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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
1.4934	0.3364	1924595	1244089	394000	0.0000	0.0000	1807101	1288044	0	2118992	1575316
.	.	.	.	.	0.1000	0.0225	.	1278829	28035	2088943	1536699
.	.	.	.	.	0.2000	0.0451	.	1269684	55527	2059483	1499133
.	.	.	.	.	0.3000	0.0676	.	1260607	82487	2030599	1462587
.	.	.	.	.	0.4000	0.0901	.	1251597	108925	2002280	1427032
.	.	.	.	.	0.5000	0.1126	.	1242656	134854	1974513	1392440
.	.	.	.	.	0.6000	0.1352	.	1233781	160284	1947288	1358783
.	.	.	.	.	0.7000	0.1577	.	1224973	185225	1920592	1326035
.	.	.	.	.	0.8000	0.1802	.	1216231	209687	1894414	1294169
.	.	.	.	.	0.9000	0.2027	.	1207555	233681	1868743	1263160
.	.	.	.	.	1.0000	0.2253	.	1198943	257217	1843570	1232984
.	.	.	.	.	1.1000	0.2478	.	1190396	280304	1818883	1203617
.	.	.	.	.	1.2000	0.2703	.	1181912	302951	1794671	1175035
.	.	.	.	.	1.3000	0.2928	.	1173492	325167	1770926	1147218
.	.	.	.	.	1.4000	0.3154	.	1165135	346963	1747637	1120142
.	.	.	.	.	1.5000	0.3379	.	1156841	368346	1724795	1093787
.	.	.	.	.	1.6000	0.3604	.	1148609	389324	1702391	1068132
.	.	.	.	.	1.7000	0.3829	.	1140438	409908	1680414	1043157
.	.	.	.	.	1.8000	0.4055	.	1132328	430104	1658857	1018844
.	.	.	.	.	1.9000	0.4280	.	1124278	449920	1637711	995173
.	.	.	.	.	2.0000	0.4505	.	1116289	469365	1616967	972127
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANTOM03  
Date and time : 25APR96:13:21  
Computation of ref. F: Simple mean, age 3 - 6  
Basis for 1996 : TAC constraints

Table 8.2.21

Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

12:40 Thursday, April 25, 1996

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	21315.000	0.2400	0.0000	0.3500	0.3000	14.140	0.0490	14.100
2	.	0.2100	0.7000	0.3500	0.3000	20.800	0.1190	20.760
3	.	0.2100	0.9000	0.3500	0.3000	27.880	0.1830	27.820
4	.	0.2100	1.0000	0.3500	0.3000	36.400	0.2270	36.460
5	.	0.2100	1.0000	0.3500	0.3000	40.920	0.2380	40.820
6	.	0.2100	1.0000	0.3500	0.3000	45.560	0.2530	45.460
7	.	0.2100	1.0000	0.3500	0.3000	51.220	0.2300	51.220
8	.	0.2100	1.0000	0.3500	0.3000	56.580	0.2440	56.480
9	.	0.2100	1.0000	0.3500	0.3000	60.300	0.2440	60.240
10+	.	0.2100	1.0000	0.3500	0.3000	65.180	0.2440	65.172
Unit	Millions	-	-	-	-	Grams	-	Grams

Notes: Run name : YLDBES01  
Date and time: 25APR96:13:23

Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga

12:40 Thursday, April 25, 1996

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
						Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0	0	109834421	4002682	82130225	3558770	77115638	3341484
0.1000	0.0225	1577001	65810	102361927	3577916	74704961	3135147	69626856	2920668
0.2000	0.0451	2866567	115812	96257402	3238389	68647167	2796750	63520338	2585376
0.3000	0.0676	3942623	154512	91168863	2961496	63604870	2520974	58440363	2312831
0.4000	0.0901	4855661	184928	86855893	2731870	59337657	2292451	54143956	2087563
0.5000	0.1126	5641355	209146	83148652	2538713	55675697	2100386	50459468	1898712
0.6000	0.1352	6325625	228642	79923733	2374228	52495588	1936980	47262169	1738444
0.7000	0.1577	6927766	244489	77089288	2232651	49705489	1796471	44459231	1600974
0.8000	0.1802	7462436	257476	74575538	2109635	47235628	1674511	41980123	1481945
0.9000	0.2027	7940975	268197	72328510	2001845	45032036	1567764	39770289	1378016
1.0000	0.2253	8372292	277102	70305793	1906682	43052311	1473633	37786860	1286589
1.1000	0.2478	8763490	284540	68473595	1822093	41262664	1390065	35995678	1205614
1.2000	0.2703	9120296	290782	66804652	1746438	39635840	1315419	34369182	1133455
1.3000	0.2928	9447387	296040	65276725	1678391	38149605	1248370	32884890	1068791
1.4000	0.3154	9748613	300485	63871487	1616871	36785636	1187838	31524274	1010547
1.5000	0.3379	10027179	304252	62573696	1560988	35528699	1132931	30271925	957837
1.6000	0.3604	10285773	307452	61370573	1510003	34366020	1082912	29114922	909929
1.7000	0.3829	10526665	310173	60251320	1463299	33286805	1037163	28042348	866210
1.8000	0.4055	10751789	312489	59206749	1420355	32281873	995164	27044913	826167
1.9000	0.4280	10962798	314460	58228990	1380732	31343360	956476	26114661	789362
2.0000	0.4505	11161119	316137	57311267	1344053	30464493	920721	25244740	755426
-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDBES01  
Date and time : 25APR96:13:23  
Computation of ref. F: Simple mean, age 3 - 6  
F-0.1 factor : 1.0388  
F-max factor : Not found  
F-0.1 reference F : 0.2340  
F-max reference F : Not found  
Recruitment : 21315 (Millions)



Table 8.3.1. Herring catches in the Gulf of Riga (as reported to the WG)

Category	Catch in '000 t						
	1976	1977	1978	1979	1980	1981	1982
Total catch	31.9	26.6	23	21.8	20.7	22.7	17.5
Gulf of Riga herring	27.4	24.2	16.7	17.1	15	16.8	12.8
Open sea herring	4.5	2.4	6.3	4.7	5.7	5.9	4.7

Category	Catch in '000 t						
	1983	1984	1985	1986	1987	1988	1989
Total catch	20.3	19.6	20.2	18.2	17.7	19.8	22.7
Gulf of Riga herring	15.5	15.8	15.6	16.9	12.9	16.8	16.8
Open sea herring	4.8	3.8	4.6	1.3	4.8	3	5.9

Category	Catch in '000 t					
	1990	1991	1992	1993	1994	1995
Total catch	20.8	20.8	23.9	26.5	29.3	38.8
Gulf of Riga herring	14.8	14.7	20.4	22.2	24.3	32.7
Open sea herring	6	6.1	3.5	4.3	5	6.1

Table 8.3.2

HER-RIGA: Herring in the Gulf of Riga

10:16 Thursday, April 13, 1996

CANUM: Catch in Numbers (Millions)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1970	76.6	545.6	383.4	409.7	148.6	48.8	44.5	2.3	0.5	1.5	0.0
1971	4.1	795.4	627.7	130.5	114.3	36.0	13.2	15.2	0.3	0.2	0.0
1972	2.1	105.4	770.1	154.3	53.6	35.1	13.1	7.0	5.3	0.9	0.0
1973	0.0	86.7	294.1	577.8	60.0	17.0	17.4	2.4	1.3	0.6	0.0
1974	3.7	302.7	303.2	299.4	326.1	37.9	8.5	13.0	3.0	0.9	0.0
1975	32.0	112.2	562.8	288.4	157.1	161.3	15.0	2.2	2.3	1.9	0.0
1976	10.4	425.9	237.2	364.0	159.7	59.2	80.5	3.5	3.5	2.1	0.0
1977	0.8	69.5	885.1	141.4	109.7	35.3	15.7	16.0	0.5	0.1	0.0
1978	7.6	112.0	97.3	403.9	39.2	35.9	9.3	3.2	5.3	0.4	0.0
1979	15.4	76.7	176.5	103.8	342.5	22.1	19.3	6.8	3.1	2.4	0.0
1980	18.5	101.0	125.9	99.6	55.4	133.1	10.5	8.6	1.5	1.0	0.0
1981	10.7	62.5	172.5	112.0	83.0	51.4	71.7	7.4	3.0	0.4	0.1
1982	1.4	80.0	96.0	116.9	68.8	43.0	29.9	24.5	1.7	1.0	0.6
1983	3.1	49.7	225.3	138.3	77.7	38.9	23.3	15.5	9.0	0.6	0.0
1984	1.9	44.0	152.1	255.1	96.3	56.7	32.5	14.7	9.7	1.6	0.6
1985	4.4	23.2	283.9	203.9	121.7	31.8	23.7	8.0	3.8	1.6	0.7
1986	1.0	9.2	106.7	246.9	110.6	66.5	19.6	8.0	3.5	1.8	0.5
1987	1.0	70.0	49.0	110.0	205.0	75.0	32.0	5.0	1.0	1.0	0.0
1988	1.4	6.0	197.7	112.7	112.4	144.6	38.7	27.8	3.8	1.7	0.4
1989	15.1	61.1	47.4	492.7	143.0	76.3	53.9	6.5	4.9	0.2	0.3
1990	12.5	88.1	83.1	67.1	263.5	66.8	27.6	14.6	2.6	1.2	0.3
1991	18.5	119.5	234.0	94.5	40.8	180.5	40.5	35.4	31.2	6.2	3.4
1992	12.1	150.3	339.1	369.3	91.3	33.2	157.4	19.0	17.4	23.8	6.4
1993	8.6	192.2	381.4	298.1	224.4	66.8	19.0	78.8	9.6	6.9	10.4
1994	11.8	164.2	288.4	368.9	263.5	192.7	46.1	9.4	48.7	2.9	4.6
1995	18.1	232.4	316.9	363.0	426.9	277.2	170.9	39.3	6.9	41.7	2.9

Table 8.3.3

HER-RIGA: Herring in the Gulf of Riga

10:16 Thursday, April 13, 1996

WECA: Mean Weight in Catch (Grams)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1970	6.1	12.7	19.2	24.3	29.2	33.0	46.0	45.0	50.0	55.0	-1.0
1971	4.5	12.2	19.2	26.5	34.8	42.9	64.6	45.0	50.0	55.0	-1.0
1972	7.0	15.4	21.0	31.4	40.9	46.2	40.0	68.2	54.4	60.3	-1.0
1973	7.0	16.3	21.3	28.0	34.9	42.4	45.8	45.0	50.0	55.0	-1.0
1974	6.1	13.8	18.3	26.0	32.3	37.7	41.3	54.3	66.6	50.5	-1.0
1975	5.8	14.2	17.3	22.5	32.2	33.8	39.1	47.3	43.2	55.0	-1.0
1976	5.8	12.2	18.5	24.1	29.2	30.5	39.3	38.3	39.7	65.8	-1.0
1977	2.9	13.2	16.0	22.7	26.9	29.5	31.2	29.4	50.0	55.0	-1.0
1978	5.3	9.8	17.7	21.9	27.3	31.1	30.4	38.1	50.0	55.0	-1.0
1979	6.3	12.2	16.2	23.4	27.6	29.8	34.0	36.8	36.3	35.6	-1.0
1980	7.1	14.5	20.1	24.1	32.1	39.3	45.6	53.3	70.3	72.3	-1.0
1981	7.6	12.1	21.6	28.8	33.4	39.0	43.9	49.9	55.3	83.4	90.0
1982	5.4	14.1	21.4	28.7	35.7	37.2	45.1	50.3	62.4	84.5	143.0
1983	5.7	13.8	19.3	27.6	37.9	41.6	50.9	61.0	93.6	57.3	-1.0
1984	5.4	10.0	15.0	21.5	29.1	34.3	39.1	49.1	51.2	73.4	84.9
1985	6.0	12.9	17.2	20.8	27.8	35.8	48.7	53.1	59.1	75.8	85.0
1986	6.0	12.6	19.8	25.6	31.4	40.2	46.2	63.9	65.3	77.7	85.0
1987	6.0	10.1	15.4	19.7	26.3	30.3	37.9	43.1	40.6	140.3	-1.0
1988	6.6	11.7	18.6	21.0	27.3	36.8	43.4	58.6	61.1	100.1	100.1
1989	6.7	12.0	14.8	16.6	19.6	23.0	31.5	38.2	34.0	57.7	61.4
1990	11.4	14.6	17.8	19.8	26.9	30.6	33.1	52.2	59.6	46.9	53.5
1991	6.9	11.9	15.4	17.8	19.9	21.4	22.5	26.9	31.4	37.9	45.6
1992	6.3	11.2	13.6	17.7	21.5	23.6	25.0	26.4	30.4	34.7	55.3
1993	6.4	12.5	13.6	16.1	20.1	24.7	26.3	27.5	31.6	32.7	40.2
1994	4.1	11.2	14.6	16.2	18.8	21.5	25.2	26.3	29.6	30.8	32.3
1995	5.4	10.4	13.6	16.4	17.9	20.9	22.9	26.3	27.4	28.5	42.5

Table 8.3.4

Run title : Herring Gulf of Riga (run: TUNTRA09/T09)

At 20-Apr-96 17:58:14

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age					
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,
AGE						
1,	.3900,	.2554,	.0868,	.0754,	.1867,	.1619,
2,	.8555,	1.0150,	.3966,	.3480,	.3829,	.5859,
3,	.9961,	.7654,	.6981,	.5521,	.6779,	.7248,
4,	1.1124,	.8064,	.7957,	.6093,	.6602,	.8945,
5,	.9730,	.8549,	.5841,	.5943,	.9567,	.7709,
6,	.8982,	.7282,	.8468,	.6105,	.6379,	1.3361,
7,	1.5393,	.8615,	1.0792,	.3335,	1.3108,	.3125,
8,	1.1135,	.8093,	.8067,	.5431,	.8552,	.8138,
+gp,	1.1135,	.8093,	.8067,	.5431,	.8552,	.8138,
FBAR 3- 7,	1.1038,	.8033,	.8008,	.5400,	.8487,	.8078,

Table 8	Fishing mortality (F) at age									
YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.1409,	.0927,	.1251,	.0940,	.1107,	.0790,	.0531,	.0444,	.0209,	.0218,
2,	.5652,	.4547,	.1720,	.2964,	.2329,	.2968,	.1770,	.2199,	.1910,	.1824,
3,	.9129,	.7471,	.3642,	.2803,	.2877,	.3560,	.3577,	.4434,	.4287,	.4224,
4,	1.1545,	.7387,	.4429,	.6070,	.2507,	.4411,	.4114,	.4573,	.6666,	.3738,
5,	1.0028,	.8163,	.5372,	.4839,	.5389,	.4147,	.4601,	.4613,	.7547,	.4816,
6,	1.1196,	.7588,	.4882,	.6293,	.4776,	.6812,	.4842,	.5217,	.9500,	.8565,
7,	1.4280,	.6473,	.3133,	.8259,	.6960,	.8075,	.5592,	.5355,	.7789,	.6477,
8,	1.1335,	.7469,	.4314,	.5715,	.4520,	.5987,	.4564,	.4361,	.8099,	.4657,
+gp,	1.1335,	.7469,	.4314,	.5715,	.4520,	.5987,	.4564,	.4361,	.8099,	.4657,
FBAR 3- 7,	1.1236,	.7416,	.4292,	.5653,	.4502,	.5401,	.4545,	.4838,	.7158,	.5564,

Run title : Herring Gulf of Riga (run: TUNTRA09/T09)

At 20-Apr-96 17:58:14

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age										FBAR 93-95
YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	
AGE											
1,	.0100,	.0211,	.0130,	.0549,	.0286,	.0323,	.0349,	.0596,	.0514,	.0590,	.0567,
2,	.1323,	.0678,	.0765,	.1355,	.0984,	.0990,	.1208,	.1167,	.1194,	.1328,	.1230,
3,	.2389,	.1962,	.2195,	.2771,	.2889,	.1550,	.2239,	.1484,	.1582,	.2169,	.1745,
4,	.4281,	.3197,	.3155,	.4787,	.2339,	.2861,	.2204,	.2061,	.1895,	.2773,	.2243,
5,	.3603,	.5843,	.3924,	.3675,	.4313,	.2491,	.3992,	.2490,	.2745,	.3122,	.2785,
6,	.6268,	.2943,	.6937,	.2469,	.2184,	.5097,	.3586,	.4200,	.2721,	.4188,	.3703,
7,	.8179,	.3169,	.4511,	.2299,	.0972,	.4820,	.4796,	.3062,	.3794,	.3941,	.3599,
8,	.6672,	.2148,	.4248,	.1309,	.1350,	.3100,	.4650,	.4777,	.3149,	.5331,	.4419,
+gp,	.6672,	.2148,	.4248,	.1309,	.1350,	.3100,	.4650,	.4777,	.3149,	.5331,	
FBAR 3- 7,	.4944,	.3423,	.4145,	.3200,	.2540,	.3364,	.3363,	.2659,	.2547,	.3239,	

Table 8.3.5

Run title : Herring Gulf of Riga (run: TUNTRA09/T09)

At 20-Apr-96 17:58:15

Terminal Fs derived using XSA (With F shrinkage)

Table 10 YEAR,	Stock number at age (start of year)						Numbers*10***-4
	1970,	1971,	1972,	1973,	1974,	1975,	
AGE							
1,	182098,	380321,	136675,	128701,	191578,	80893,	
2,	71881,	106116,	253553,	107859,	102730,	136810,	
3,	70019,	26299,	33100,	146790,	65550,	60292,	
4,	23863,	22256,	10529,	14174,	72738,	28643,	
5,	8456,	6752,	8552,	4090,	6634,	32353,	
6,	8093,	2751,	2472,	4105,	1943,	2193,	
7,	316,	2837,	1143,	912,	1919,	884,	
8,	80,	58,	1032,	334,	563,	445,	
+gp,	237,	38,	173,	153,	167,	364,	
TOTAL,	365043,	547430,	447230,	407118,	443821,	342876,	

Table 10 YEAR,	Stock number at age (start of year)						Numbers*10***-4			
	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	349282,	84622,	102660,	96863,	109170,	93196,	175162,	129794,	234755,	118757,
2,	59216,	261117,	66387,	77970,	68668,	76109,	67066,	129356,	96698,	188220,
3,	65540,	28962,	142631,	48113,	45147,	42368,	44050,	43759,	80860,	65407,
4,	25137,	22641,	11809,	85292,	28310,	26371,	23113,	23990,	21874,	43120,
5,	10078,	6820,	9310,	6527,	36200,	17159,	13213,	11928,	11826,	9196,
6,	12882,	3182,	2595,	4682,	3133,	16447,	8827,	6495,	5857,	4552,
7,	496,	3619,	1282,	1371,	1943,	1514,	6481,	4236,	3002,	1855,
8,	556,	102,	1630,	807,	467,	755,	526,	2885,	1931,	1128,
+gp,	329,	20,	122,	616,	308,	124,	489,	190,	431,	676,
TOTAL,	523516,	411086,	338428,	322241,	293348,	274041,	338926,	352635,	457235,	432911,

Run title : Herring Gulf of Riga (run: TUNTRA09/T09)

At 20-Apr-96 17:58:15

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)					Numbers*10**-4						
YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST
AGE												
1,	101906,	370031,	51150,	126486,	344848,	415450,	483848,	367057,	362038,	448262,	0,	1670
2,	95131,	82601,	296622,	41336,	98029,	274366,	329329,	382541,	283129,	281552,	345984,	1188
3,	128413,	68232,	63194,	224965,	29554,	72740,	203459,	238948,	278687,	205708,	201844,	685
4,	35101,	82795,	45910,	41542,	139605,	18125,	51004,	133162,	168661,	194793,	135576,	333
5,	24292,	18731,	49238,	27418,	21072,	90456,	11148,	33497,	88719,	114245,	120858,	145
6,	4651,	13871,	8549,	27228,	15544,	11208,	57727,	6123,	21381,	55201,	68456,	65
7,	1583,	2035,	8461,	3498,	17416,	10229,	5512,	33021,	3294,	13336,	29732,	25
8,	795,	572,	1214,	4412,	2276,	12938,	5172,	2794,	19905,	1845,	7363,	8
+gp,	516,	569,	665,	448,	1308,	3954,	8892,	4986,	3043,	11804,	6557,	
TOTAL,	392387,	639437,	525004,	497332,	669650,	909465,	1156088,	1202127,	1228857,	1326746,	916372,	

Table 8.3.6

14:31 Sunday, April 21, 1996

HER-RIGA: Herring in the Gulf of Riga

TNET: Herring Gulf of Riga. Tuning (Catch: Millions)

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1980	92	16.6	16.2	10.8	27.4	3.1	1.6	0.5	0.4
1981	76	16.8	12.8	9.9	6.7	17.1	1.1	0.4	0.0
1982	83	28.5	38.9	14.5	10.0	3.6	11.0	0.5	0.3
1983	44	26.9	16.5	9.3	4.6	2.8	1.9	1.1	0.0
1984	122	34.5	57.9	21.9	12.9	7.4	3.4	2.2	0.4
1985	78	16.0	14.7	42.9	6.1	10.5	2.0	1.5	1.2
1986	145	30.7	70.5	31.6	26.9	3.9	2.0	0.5	0.9
1987	65	4.6	5.4	38.4	14.4	9.0	1.6	0.7	0.9
1988	106	24.6	26.4	29.9	82.9	13.9	16.2	1.6	1.0
1989	67	5.3	48.6	13.9	12.7	28.6	2.6	4.8	0.2
1990	41	8.1	0.7	25.6	7.2	6.7	8.2	1.9	1.2
1991	87	42.9	22.8	10.0	54.0	10.0	9.1	10.5	2.8
1992	102	99.0	95.1	21.8	7.9	56.6	4.2	5.9	8.0
1993	78	67.8	74.6	70.4	24.8	7.7	32.1	2.1	4.8
1994	54	17.7	43.6	62.7	40.7	13.1	2.0	17.8	3.2
1995	64	37.3	53.4	68.7	59.2	33.6	11.4	0.8	11.9

**Table 8.3.7**

Lowestoft VPA Version 3.1

20-Apr-96 17:57:58

Extended Survivors Analysis

Herring Gulf of Riga (run: TUNTRA09/T09)

CPUE data from file /users/fish/ifad/ifapwork/wgbfas/her\_riga/FLEET.T09

Catch data for 26 years. 1970 to 1995. Ages 1 to 9.

Fleet,	First,	Last,	First,	Last,	Alpha,	Beta
	year,	year,	age,	age		
TNET: Herring Gulf o,	1980,	1995,	2,	8,	.330,	.580

Time series weights :

Tapered time weighting applied  
Power = 3 over 20 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 >= 6

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 26 iterations

Regression weights

, .751, .820, .877, .921, .954, .976, .990, .997, 1.000, 1.000

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
1,	.010,	.021,	.013,	.055,	.029,	.032,	.035,	.060,	.051,	.059
2,	.132,	.068,	.077,	.136,	.098,	.099,	.121,	.117,	.119,	.133
3,	.239,	.196,	.220,	.277,	.289,	.155,	.224,	.148,	.158,	.217
4,	.428,	.320,	.315,	.479,	.234,	.286,	.220,	.206,	.190,	.277
5,	.360,	.584,	.392,	.368,	.431,	.249,	.399,	.249,	.274,	.312
6,	.627,	.294,	.694,	.247,	.218,	.510,	.359,	.420,	.272,	.419
7,	.818,	.317,	.451,	.230,	.097,	.482,	.480,	.306,	.379,	.394
8,	.667,	.215,	.425,	.131,	.135,	.310,	.465,	.478,	.315,	.533

Table 8.3.7 (continued)

XSA population numbers (Thousands)

YEAR ,	1,	AGE 2,	3,	4,	5,	6,	7,	8,
1986 ,	1.02E+06,	9.51E+05,	1.28E+06,	3.51E+05,	2.43E+05,	4.65E+04,	1.58E+04,	7.95E+03,
1987 ,	3.70E+06,	8.26E+05,	6.82E+05,	8.28E+05,	1.87E+05,	1.39E+05,	2.03E+04,	5.72E+03,
1988 ,	5.12E+05,	2.97E+06,	6.32E+05,	4.59E+05,	4.92E+05,	8.55E+04,	8.46E+04,	1.21E+04,
1989 ,	1.26E+06,	4.13E+05,	2.25E+06,	4.15E+05,	2.74E+05,	2.72E+05,	3.50E+04,	4.41E+04,
1990 ,	3.45E+06,	9.80E+05,	2.96E+05,	1.40E+06,	2.11E+05,	1.55E+05,	1.74E+05,	2.28E+04,
1991 ,	4.15E+06,	2.74E+06,	7.27E+05,	1.81E+05,	9.05E+05,	1.12E+05,	1.02E+05,	1.29E+05,
1992 ,	4.84E+06,	3.29E+06,	2.03E+06,	5.10E+05,	1.11E+05,	5.77E+05,	5.51E+04,	5.17E+04,
1993 ,	3.67E+06,	3.83E+06,	2.39E+06,	1.33E+06,	3.35E+05,	6.12E+04,	3.30E+05,	2.79E+04,
1994 ,	3.62E+06,	2.83E+06,	2.79E+06,	1.69E+06,	8.87E+05,	2.14E+05,	3.29E+04,	1.99E+05,
1995 ,	4.48E+06,	2.82E+06,	2.06E+06,	1.95E+06,	1.14E+06,	5.52E+05,	1.33E+05,	1.85E+04,

Estimated population abundance at 1st Jan 1996

, .00E+00, 3.46E+06, 2.02E+06, 1.36E+06, 1.21E+06, 6.85E+05, 2.97E+05, 7.36E+04,

Taper weighted geometric mean of the VPA populations:

, 2.27E+06, 1.60E+06, 1.04E+06, 5.86E+05, 2.90E+05, 1.32E+05, 5.55E+04, 2.47E+04,

Standard error of the weighted Log(VPA populations) :

, .7280, .7298, .7631, .8273, .8646, .8874, .9652, 1.1173,

Log catchability residuals.

Fleet : TNET: Herring Gulf o

Age ,	1980,	1981,	1982,	1983,	1984,	1985
2 ,	.34,	.51,	1.08,	1.11,	.47,	-.57
3 ,	.23,	.28,	1.27,	1.09,	.68,	-.03
4 ,	-.42,	-.16,	.25,	.43,	.43,	.74
5 ,	.04,	-.48,	.11,	.07,	.20,	.03
6 ,	-.03,	.30,	-.81,	-.11,	.12,	1.13
7 ,	-.12,	.00,	.65,	-.06,	-.07,	.27
8 ,	.03,	-.41,	.02,	-.27,	-.05,	.40

Age ,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
2 ,	.12,	-1.03,	-.94,	-.18,	-.01,	.02,	.63,	.35,	-.47,	.20
3 ,	.16,	-1.00,	.19,	.01,	-1.70,	.07,	.34,	.17,	-.15,	.22
4 ,	.04,	.13,	-.02,	-.15,	-.38,	.00,	-.45,	.03,	.04,	-.15
5 ,	-.13,	.40,	.61,	-.23,	-.01,	-.29,	-.21,	.03,	-.07,	-.10
6 ,	-.61,	-.21,	.40,	.22,	-.19,	-.09,	-.22,	.32,	-.09,	-.20
7 ,	-.11,	-.01,	.45,	-.14,	-.16,	-.10,	-.42,	.02,	-.05,	.12
8 ,	-.88,	.39,	.07,	.20,	.43,	-.27,	-.02,	-.16,	.30,	-.49

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
Mean Log q,	-14.7440,	-14.0473,	-13.6967,	-13.3812,	-13.3812,	-13.3812,
S.E.(Log q),	.6998,	.3055,	.2654,	.4166,	.2443,	.3765,

Regression statistics :

Ages with q dependent on year class strength

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

2, 1.15, -.577, 15.50, .59, 16, .63, -15.34,

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

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

3,	.80,	.910,	14.56,	.67,	16,	.56,	-14.74,
4,	1.13,	-1.040,	14.15,	.86,	16,	.34,	-14.05,
5,	1.04,	-.347,	13.74,	.91,	16,	.29,	-13.70,
6,	1.16,	-.935,	13.63,	.78,	16,	.48,	-13.38,
7,	.98,	.201,	13.35,	.94,	16,	.25,	-13.39,
8,	.96,	.355,	13.29,	.91,	16,	.38,	-13.41,

Table 8.3.7 (continued)

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
TNET: Herring Gulf o,	1.,	.000,	.000,	.00,	0,	.000,
P shrinkage mean ,	1602895.,	.73,,,			.319,	.123
F shrinkage mean ,	4965051.,	.50,,,			.681,	.041

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3459844.,	.41,	15.07,	2,	36.526,	.059

Age 2 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
TNET: Herring Gulf o,	2469512.,	.675,	.000,	.00,	1,	.252,
P shrinkage mean ,	1038530.,	.76,,,			.225,	.244
F shrinkage mean ,	2436908.,	.50,,,			.524,	.111

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2018444.,	.36,	.29,	3,	.816,	.133

Age 3 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
TNET: Herring Gulf o,	1174191.,	.489,	.344,	.70,	2,	.442,
F shrinkage mean ,	1519220.,	.50,,,			.558,	.196

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1355762.,	.35,	.21,	3,	.599,	.217



Table 8.3.7 (continued)

Age 4 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
TNET: Herring Gulf o,	1105538.,	.271,	.113,	.42,	3, .712,	.300
F shrinkage mean ,	1506004.,	.50,...			.288,	.228

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1208585.,	.24,	.12,	4,	.513,	.277

Age 5 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
TNET: Herring Gulf o,	691115.,	.203,	.099,	.49,	4, .800,	.310
F shrinkage mean ,	658955.,	.50,...			.200,	.323

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
684561.,	.19,	.08,	5,	.405,	.312

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
TNET: Herring Gulf o,	282023.,	.186,	.060,	.32,	5, .782,	.437
F shrinkage mean ,	359192.,	.50,...			.218,	.358

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
297324.,	.18,	.07,	6,	.380,	.419

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
TNET: Herring Gulf o,	71498.,	.164,	.090,	.55,	6, .825,	.404
F shrinkage mean ,	84545.,	.50,...			.175,	.351

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
73627.,	.16,	.08,	7,	.496,	.394

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
TNET: Herring Gulf o,	7388.,	.168,	.126,	.75,	7, .768,	.613
F shrinkage mean ,	16210.,	.50,...			.232,	.326

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
8866.,	.17,	.18,	8,	1.012,	.533

Table 8.3.8

Run title : Herring Gulf of Riga (run: TUNTRA09/T09)

At 20-Apr-96 17:58:15

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,
1970,	1820981,	67881,	37135,	33196,	.8939,	1.1038,
1971,	3803218,	86710,	34392,	32178,	.9356,	.8033,
1972,	1366752,	94686,	63866,	27145,	.4250,	.8008,
1973,	1287008,	93572,	64113,	27895,	.4351,	.5400,
1974,	1915780,	90447,	55336,	30850,	.5575,	.8487,
1975,	808929,	70278,	50618,	28523,	.5635,	.8078,
1976,	3492821,	84961,	36517,	27422,	.7509,	1.1236,
1977,	846221,	69698,	50277,	24186,	.4811,	.7416,
1978,	1026601,	61817,	46231,	16728,	.3618,	.4292,
1979,	968631,	63616,	44666,	17142,	.3838,	.5653,
1980,	1091701,	67142,	44245,	14998,	.3390,	.4502,
1981,	931961,	64122,	45705,	16769,	.3669,	.5401,
1982,	1751617,	72647,	41838,	12777,	.3054,	.4545,
1983,	1297939,	77833,	51442,	15541,	.3021,	.4838,
1984,	2347547,	70988,	41374,	15843,	.3829,	.7158,
1985,	1187572,	80969,	57250,	15575,	.2721,	.5564,
1986,	1019057,	90336,	68566,	16927,	.2469,	.4944,
1987,	3700313,	96873,	53480,	12884,	.2409,	.3423,
1988,	511505,	116454,	97541,	16791,	.1721,	.4145,
1989,	1264856,	86049,	63597,	16783,	.2639,	.3200,
1990,	3448480,	135687,	75503,	14931,	.1978,	.2540,
1991,	4154495,	137694,	78217,	14791,	.1891,	.3364,
1992,	4838473,	170732,	104411,	21787,	.2087,	.3363,
1993,	3670567,	188088,	125240,	22200,	.1773,	.2659,
1994,	3620383,	191594,	136180,	24300,	.1784,	.2547,
1995,	4482620,	196296,	135275,	32656,	.2414,	.3239,
Arith.						
Mean	2179078,	101045,	65501,	21185,	.3797,	.5503,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

**Table 8.3.9 The parameters used for the calculation of herring recruitment in the Gulf of Riga**

Year	Water temperature in April ( $x_1$ )	Abundance of zooplankton in May ( $x_2$ )	Sum of negative temperatures in winter ( $x_3$ )
71	0.8	7.4	357
72	0.7	10.5	469
73	2	12.4	213
74	1.8	16.3	255
75	2.7	16.5	72
76	0.5	7	543
77	0.4	6.1	457
78	0.6	9.3	429
79	0.3	5.3	849
80	0.5	6.6	647
81	0.7	6.1	386
82	1	8.6	442
83	1.4	12.9	199
84	0.9	7.6	314
85	0.1	4.2	854
86	0.9	21	532
87	-0.2	4	849
88	0.4	4.7	268
89	3.1	7.9	158
90	3.8	20.3	159
91	1.7	13.3	200
92	2.7	19.5	102
93	2	10.8	199
94	0.9	15.3	532
95	1.3	31.5	194
96			774

Predicted recruitment 1-group (mln.):  $y_{95} = 3717830$ ,  $y_{96} = 676218$

Regression equations:

$$y_{95} = 361895,6 + 676901,4x_1 + 78602x_2$$

$$y_{96} = 3387385 - 3502,8x_3$$

Table 8.3.9 (continued)

Analysis by RCT3 ver3.1 of data from file :

recrct.txt

Recruitment of Gulf of Riga herring and factors determining it

Data for 2 surveys over 25 years : 1971 - 1995

Regression type = C

Tapered time weighting applied

power = 3 over 20 years

Survey weighting not applied

Final estimates shrunk towards mean

Minimum S.E. for any survey taken as .20

Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1995

I-----Regression-----I					I-----Prediction-----I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
temp.	1.86	13.16	.61	.521	23	.93	14.71	.708	.315
zoopl	1.63	10.74	.48	.714	24	3.48	16.40	.639	.387
VPA Mean =						14.63		.728	.298
Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA		
1995	4598395	15.34	.40	.59	2.23				

**Table 8.3.9 (continued)**

Analysis by RCT3 ver3.1 of data from file :

recrrct.txt

Recruitment of Gulf of Riga herring and factors determining it

Data for 1 surveys over 26 years : 1971 - 1996

Regression type = C

Tapered time weighting applied

power = 3 over 20 years

Survey weighting not applied

Final estimates shrunk towards mean

Minimum S.E. for any survey taken as .20

Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1996

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

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

temp.w	-1.70	24.34	.97	.383	24	6.65	13.03	1.219	.263
--------	-------	-------	-----	------	----	------	-------	-------	------

VPA Mean = 14.68 .728 .737

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

1996	1532010	14.24	.63	.73	1.35		
------	---------	-------	-----	-----	------	--	--

Table 8.3.10

Herring in the Gulf of Riga

19:06 Wednesday, April 24, 1996

Single option prediction: Input data

Year: 1996								
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	4598.000	0.2000	0.0000	0.1000	0.3000	11.367	0.0652	11.367
2	3460.000	0.2000	0.9300	0.1000	0.3000	13.933	0.1415	13.933
3	2018.000	0.2000	0.9800	0.1000	0.3000	16.233	0.2007	16.233
4	1356.000	0.2000	0.9800	0.1000	0.3000	18.933	0.2579	18.933
5	1209.000	0.2000	1.0000	0.1000	0.3000	22.367	0.3203	22.367
6	685.000	0.2000	1.0000	0.1000	0.3000	24.800	0.4258	24.800
7	297.000	0.2000	1.0000	0.1000	0.3000	26.700	0.4189	26.700
8	74.000	0.2000	1.0000	0.1000	0.3000	29.533	0.5082	29.533
9+	66.000	0.2000	1.0000	0.1000	0.3000	32.782	0.5082	32.782
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1532.000	0.2000	0.0000	0.1000	0.3000	11.367	0.0652	11.367
2	.	0.2000	0.9300	0.1000	0.3000	13.933	0.1415	13.933
3	.	0.2000	0.9800	0.1000	0.3000	16.233	0.2007	16.233
4	.	0.2000	0.9800	0.1000	0.3000	18.933	0.2579	18.933
5	.	0.2000	1.0000	0.1000	0.3000	22.367	0.3203	22.367
6	.	0.2000	1.0000	0.1000	0.3000	24.800	0.4258	24.800
7	.	0.2000	1.0000	0.1000	0.3000	26.700	0.4189	26.700
8	.	0.2000	1.0000	0.1000	0.3000	29.533	0.5082	29.533
9+	.	0.2000	1.0000	0.1000	0.3000	32.782	0.5082	32.782
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 1998								
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	2742.000	0.2000	0.0000	0.1000	0.3000	11.367	0.0652	11.367
2	.	0.2000	0.9300	0.1000	0.3000	13.933	0.1415	13.933
3	.	0.2000	0.9800	0.1000	0.3000	16.233	0.2007	16.233
4	.	0.2000	0.9800	0.1000	0.3000	18.933	0.2579	18.933
5	.	0.2000	1.0000	0.1000	0.3000	22.367	0.3203	22.367
6	.	0.2000	1.0000	0.1000	0.3000	24.800	0.4258	24.800
7	.	0.2000	1.0000	0.1000	0.3000	26.700	0.4189	26.700
8	.	0.2000	1.0000	0.1000	0.3000	29.533	0.5082	29.533
9+	.	0.2000	1.0000	0.1000	0.3000	32.782	0.5082	32.782
Unit	Millions	-	-	-	-	Grams	-	Grams

Notes: Run name : SPRTRA01  
Date and time: 24APR96:19:36

Table 8.3.11

Herring in the Gulf of Riga

19:06 Wednesday, April 24, 1996

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1996	1.0000	0.3247	1954838	35692	13763000	215214	8855320	158407	8147386	145406
1997	1.0000	0.3247	1836280	34815	11041341	185840	9186242	163676	8452504	150233
1998	1.0000	0.3247	1661087	32381	10130221	170972	7222887	137221	6628407	125644
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRTRA01  
Date and time : 24APR96:19:36  
Computation of ref. F: Simple mean, age 3 - 7  
Prediction basis : F factors

Table 8.3.12

Herring in the Gulf of Riga

19:06 Wednesday, April 24, 1996

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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	0.3247	215214	145406	35692	0.0000	0.0000	185840	154144	0	206519	162387
.	.	.	.	.	0.1000	0.0325	.	153748	3939	202487	158160
.	.	.	.	.	0.2000	0.0649	.	153352	7766	198571	154069
.	.	.	.	.	0.3000	0.0974	.	152958	11487	194767	150108
.	.	.	.	.	0.4000	0.1299	.	152565	15104	191071	146273
.	.	.	.	.	0.5000	0.1624	.	152174	18621	187480	142558
.	.	.	.	.	0.6000	0.1948	.	151783	22041	183989	138959
.	.	.	.	.	0.7000	0.2273	.	151394	25367	180596	135472
.	.	.	.	.	0.8000	0.2598	.	151006	28603	177298	132093
.	.	.	.	.	0.9000	0.2922	.	150619	31751	174091	128819
.	.	.	.	.	1.0000	0.3247	.	150233	34815	170972	125644
.	.	.	.	.	1.1000	0.3572	.	149848	37796	167939	122567
.	.	.	.	.	1.2000	0.3897	.	149465	40698	164988	119582
.	.	.	.	.	1.3000	0.4221	.	149083	43523	162118	116688
.	.	.	.	.	1.4000	0.4546	.	148702	46274	159325	113880
.	.	.	.	.	1.5000	0.4871	.	148322	48952	156607	111156
.	.	.	.	.	1.6000	0.5196	.	147943	51561	153961	108513
.	.	.	.	.	1.7000	0.5520	.	147565	54102	151386	105948
.	.	.	.	.	1.8000	0.5845	.	147189	56578	148879	103457
.	.	.	.	.	1.9000	0.6170	.	146813	58990	146438	101040
.	.	.	.	.	2.0000	0.6494	.	146439	61341	144061	98693
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANTRA02  
Date and time : 24APR96:19:42  
Computation of ref. F: Simple mean, age 3 - 7  
Basis for 1996 : F factors

Table 8.4.1

HER-30: Herring in Baltic Fishing Area 30

16:56 Saturday, April 20, 1996

FLT02: FLT02: Bottom trawl

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1974	1022	12.8	33.0	21.5	18.0	7.3	6.5	4.6	2.3	1.9	1.4
1975	1251	23.3	40.0	33.9	18.9	14.5	4.5	7.6	5.2	2.6	2.3
1976	1039	35.2	35.7	37.5	20.7	11.6	7.1	3.9	3.4	1.8	1.5
1977	833	17.2	32.2	12.9	16.2	11.8	11.2	8.6	5.8	3.3	3.3
1978	1251	5.6	26.4	55.0	21.0	17.1	15.4	4.4	6.1	2.2	0.9
1979	1263	4.5	12.1	21.4	28.4	8.9	9.3	7.2	1.5	4.1	0.2
1980	1001	12.3	9.1	8.8	7.5	23.3	10.6	7.7	3.4	2.0	1.6
1981	694	1.1	6.3	3.0	3.2	4.7	13.3	4.5	4.0	2.7	1.1
1982	907	3.0	11.1	17.7	4.2	4.6	6.2	9.6	2.5	1.7	1.4
1983	913	3.7	15.2	10.0	9.2	3.1	3.3	5.9	9.4	2.2	2.0
1984	604	7.8	6.6	11.7	6.0	5.3	2.6	2.8	1.9	4.2	1.3
1985	517	2.5	5.8	7.4	4.1	3.5	2.2	0.6	1.4	0.4	2.1
1986	728	0.5	8.7	10.3	8.9	7.7	4.5	3.1	1.0	1.8	1.6
1987	639	7.9	6.9	17.3	17.4	6.0	3.2	2.4	1.1	0.8	0.5
1988	495	2.2	18.8	5.8	14.9	12.2	4.5	2.1	0.7	0.6	0.7
1989	630	17.3	14.6	25.7	3.8	20.5	14.0	5.3	2.5	1.4	1.0
1990	1016	27.4	73.5	10.7	25.6	6.2	17.9	17.9	7.3	1.6	1.3
1991	1719	19.2	69.8	68.1	12.4	25.9	14.8	23.6	11.4	5.2	2.9
1992	2056	31.5	62.0	138.0	88.3	20.0	19.7	23.7	15.8	7.5	2.4
1993	2107	55.5	83.7	58.2	102.0	81.0	16.1	20.4	13.0	9.6	4.7
1994	2197	26.8	121.3	96.5	59.3	88.9	81.6	17.4	24.4	11.4	5.3
1995	1618	9.4	42.5	88.1	65.4	47.9	54.4	36.5	6.8	12.3	3.7

Table 8.4.2

HER-30: Herring in Baltic Fishing Area 30

14:14 Saturday, April 20, 1996

WECA: Mean Weight in Catch (Grams)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1973	7.1	11.0	19.4	25.4	30.6	35.0	42.6	42.4	46.8	50.9	51.3	67.8
1974	7.1	11.0	19.4	25.4	30.6	35.0	42.6	42.4	46.8	50.9	51.3	67.8
1975	3.8	11.4	19.7	25.4	30.0	34.2	38.5	41.7	44.9	49.8	56.0	62.3
1976	7.3	11.1	19.0	24.8	29.2	33.2	37.0	40.6	45.0	48.4	55.3	60.4
1977	7.3	14.6	18.6	24.5	28.4	32.3	37.0	40.9	44.4	47.6	51.3	62.0
1978	7.3	9.6	18.7	24.2	28.7	31.9	35.4	41.6	45.4	49.5	55.9	58.0
1979	7.3	12.0	17.8	24.5	30.0	33.4	35.4	39.5	46.0	49.7	58.5	57.6
1980	10.7	15.8	20.5	26.0	31.7	33.5	36.7	38.9	44.4	50.8	56.9	63.9
1981	9.3	10.7	16.9	25.4	33.8	40.9	41.5	46.1	49.4	56.7	64.4	81.1
1982	9.3	6.1	16.2	24.3	33.6	38.6	42.1	43.2	50.0	50.6	61.0	68.5
1983	7.7	9.4	19.6	31.9	36.9	44.6	51.0	52.0	56.2	64.5	64.0	82.7
1984	6.0	10.4	20.1	32.2	40.2	45.4	54.2	62.9	62.2	62.2	66.4	76.6
1985	7.7	7.2	18.4	28.7	38.2	41.3	47.5	51.8	58.4	57.7	62.5	74.8
1986	7.7	10.7	18.1	25.9	32.3	39.0	43.6	47.1	53.6	59.6	57.2	65.0
1987	6.0	8.4	20.0	27.6	33.5	39.2	45.2	49.5	57.2	61.1	60.9	68.9
1988	5.1	12.9	19.0	28.8	35.6	40.8	45.9	53.7	61.4	64.9	75.2	77.6
1989	5.5	12.0	23.6	33.0	41.1	46.4	52.0	57.0	61.7	67.9	66.9	81.3
1990	5.3	9.3	21.1	33.4	40.1	48.7	53.8	60.2	66.7	71.7	79.1	99.5
1991	6.5	11.4	21.4	27.5	35.5	41.0	48.3	53.0	55.4	58.8	63.6	69.8
1992	7.4	11.3	20.1	27.3	31.1	40.9	46.9	51.8	55.9	60.7	66.9	71.4
1993	6.9	12.9	19.8	27.7	30.9	34.5	47.1	50.8	56.4	63.2	66.5	73.0
1994	8.5	9.0	19.9	26.7	32.3	35.6	40.1	50.2	56.8	63.0	71.1	73.1
1995	6.5	7.2	18.5	26.6	30.6	35.4	39.0	42.6	50.1	60.6	68.5	85.6



Table 8.4.3

HER-30: Herring in Baltic Fishing Area 30

14:14 Saturday, April 20, 1996

CANUM: Catch in Numbers (Millions)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1973	0	15	45	231	140	181	78	25	7	2	1	1
1974	1	7	75	121	183	80	62	60	25	16	10	8
1975	2	36	119	133	66	74	41	36	32	17	8	14
1976	0	89	100	183	128	58	82	34	36	25	16	18
1977	0	19	177	133	196	101	60	86	49	29	16	16
1978	0	27	67	228	125	132	67	44	52	16	16	21
1979	0	3	20	48	173	49	64	41	14	24	4	10
1980	0	66	54	50	49	168	76	75	40	16	23	9
1981	0	4	45	33	43	41	91	36	25	18	8	12
1982	0	25	92	151	38	45	58	84	27	24	8	12
1983	0	97	184	105	114	17	18	32	57	15	11	8
1984	0	94	146	182	100	81	17	18	31	42	15	25
1985	0	82	348	218	126	40	46	9	14	12	32	18
1986	0	20	405	320	147	85	35	28	4	4	11	15
1987	0	43	48	219	211	94	55	29	12	8	8	16
1988	2	7	177	53	167	168	77	42	16	9	9	15
1989	21	111	71	192	44	132	109	51	23	14	6	12
1990	2	179	351	53	97	31	81	85	31	14	9	13
1991	1	45	209	256	47	75	41	58	39	19	7	17
1992	9	70	207	406	270	62	70	63	45	23	12	16
1993	11	199	330	188	290	220	45	54	33	20	10	12
1994	2	76	362	327	207	318	269	47	67	28	21	17
1995	0	49	141	311	258	198	294	198	41	61	19	29

Table 8.4.4

HER-30: Herring in Baltic Fishing Area 30

14:14 Saturday, April 20, 1996

MATPROP: Proportion Mature at Year Start

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1973	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1974	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1975	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1976	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1977	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1978	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1979	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1980	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1981	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1982	0.00	0.00	0.29	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1983	0.00	0.00	0.21	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1984	0.00	0.00	0.17	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1985	0.00	0.00	0.20	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1986	0.00	0.00	0.28	0.90	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1987	0.00	0.00	0.32	0.88	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1988	0.00	0.00	0.04	0.79	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1989	0.00	0.00	0.22	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1990	0.00	0.00	0.70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1991	0.00	0.00	0.63	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1992	0.00	0.00	0.53	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1993	0.00	0.00	0.45	0.81	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1994	0.00	0.10	0.65	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1995	0.00	0.00	0.37	0.92	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 8.4.5

Lowestoft VPA Version 3.1

19-Apr-96 16:39:55

Extended Survivors Analysis

Herring in 30 (run: XSAJAP09/X09)

CPUE data from file /users/fish/ifad/ifapwork/wgbfas/her\_30/FLEET.X09

Catch data for 23 years. 1973 to 1995. Ages 1 to 9.

Fleet,	First,	Last,	First,	Last,	Alpha,	Beta
	year,	year,	age,	age		
FLT02: FLT02: Bottom,	1974,	1995,	1,	8,	.000,	1.000

Time series weights :

Tapered time weighting applied  
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages &lt; 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 &gt;= 7

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 87 iterations

Regression weights

	.751,	.820,	.877,	.921,	.954,	.976,	.990,	.997,	1.000,	1.000
--	-------	-------	-------	-------	-------	-------	-------	-------	--------	-------

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
1,	.014,	.015,	.005,	.018,	.026,	.011,	.013,	.030,	.023,	.019
2,	.155,	.043,	.081,	.062,	.074,	.039,	.064,	.076,	.069,	.053
3,	.155,	.118,	.061,	.119,	.060,	.071,	.098,	.076,	.100,	.078
4,	.165,	.146,	.124,	.066,	.081,	.070,	.099,	.094,	.113,	.107
5,	.200,	.151,	.165,	.136,	.061,	.083,	.123,	.109,	.142,	.150
6,	.180,	.192,	.177,	.154,	.115,	.106,	.104,	.124,	.190,	.189
7,	.226,	.222,	.220,	.171,	.172,	.113,	.236,	.109,	.184,	.208
8,	.087,	.142,	.184,	.180,	.149,	.111,	.120,	.187,	.192,	.242

Table 8.4.5 (continued)

XSA population numbers (Thousands)

YEAR ,	1,	AGE 2,	3,	4,	5,	6,	7,	8,
1986 ,	1.56E+06	3.11E+06	2.46E+06	1.07E+06	5.19E+05	2.35E+05	1.53E+05	5.31E+04
1987 ,	3.11E+06	1.26E+06	2.18E+06	1.72E+06	7.43E+05	3.48E+05	1.61E+05	1.00E+05
1988 ,	1.60E+06	2.51E+06	9.88E+05	1.59E+06	1.22E+06	5.23E+05	2.35E+05	1.05E+05
1989 ,	6.78E+06	1.30E+06	1.89E+06	7.61E+05	1.15E+06	8.46E+05	3.59E+05	1.55E+05
1990 ,	7.65E+06	5.45E+06	1.00E+06	1.38E+06	5.84E+05	8.21E+05	5.94E+05	2.48E+05
1991 ,	4.56E+06	6.10E+06	4.15E+06	7.74E+05	1.04E+06	4.50E+05	5.99E+05	4.09E+05
1992 ,	6.19E+06	3.69E+06	4.80E+06	3.16E+06	5.91E+05	7.83E+05	3.31E+05	4.38E+05
1993 ,	7.53E+06	5.00E+06	2.83E+06	3.57E+06	2.34E+06	4.28E+05	5.78E+05	2.14E+05
1994 ,	3.77E+06	5.98E+06	3.80E+06	2.15E+06	2.66E+06	1.72E+06	3.09E+05	4.24E+05
1995 ,	2.83E+06	3.02E+06	4.57E+06	2.81E+06	1.57E+06	1.89E+06	1.17E+06	2.11E+05

Estimated population abundance at 1st Jan 1996

, .00E+00, 2.27E+06, 2.35E+06, 3.46E+06, 2.07E+06, 1.11E+06, 1.28E+06, 7.75E+05,

Taper weighted geometric mean of the VPA populations:

, 3.64E+06, 2.84E+06, 2.02E+06, 1.31E+06, 8.41E+05, 5.45E+05, 3.32E+05, 2.00E+05,

Standard error of the weighted Log(VPA populations) :

, .6157, .6626, .7196, .7307, .7563, .7757, .7113, .6337,

Log catchability residuals.

Fleet : FLT02: FLT02: Bottom

Age , 1974, 1975

1 ,	99.99	99.99
2 ,	99.99	99.99
3 ,	99.99	99.99
4 ,	99.99	99.99
5 ,	99.99	99.99
6 ,	99.99	99.99
7 ,	99.99	99.99
8 ,	99.99	99.99

Age , 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985

1 ,	.93	1.59	.90	1.22	1.15	-.17	-.11	-.23	.11	-.51
2 ,	1.01	.38	.79	.40	.87	-.11	.34	.20	-.50	-.95
3 ,	.63	.19	.47	.50	.24	.13	.64	.22	.38	-.24
4 ,	.42	.26	.52	.00	-.16	-.21	.44	.29	.41	-.24
5 ,	.43	.19	.07	-.24	.12	-.22	-.02	.24	.35	.17
6 ,	-.64	.89	.29	-.31	.41	.14	.00	-.16	.70	-.06
7 ,	-.93	-.02	-.15	-.29	-.03	.16	-.28	.15	.23	-.42
8 ,	-.77	.04	-.35	-.81	-.43	.08	-.30	.06	-.18	.04

Age , 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995

1 ,	-1.00	.39	.31	.18	.05	-.07	-.15	.05	.19	-.06
2 ,	-.79	-.04	.55	.70	.41	-.29	-.08	-.10	.05	-.02
3 ,	-.72	.03	-.04	.58	-.16	-.25	.14	-.23	-.05	-.03
4 ,	-.15	.17	.34	-.56	.29	-.39	.00	-.01	-.08	.06
5 ,	.19	-.31	.17	.49	-.54	-.20	-.06	-.07	-.12	.09
6 ,	.30	-.30	-.11	.29	.07	-.05	-.50	-.11	.11	-.08
7 ,	.20	.03	-.23	.01	.24	-.04	.43	-.36	.10	-.17
8 ,	.07	-.31	-.54	.10	.21	-.39	-.31	.22	.13	-.12

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
Mean Log q,	-18.4169,	-18.0809,	-17.9642,	-17.7094,	-17.5723,	-17.3974,	-17.3974,
S.E(Log q),	.4724,	.3332,	.2937,	.2766,	.2822,	.2514,	.2841,

Table 8.4.5 (continued)

## Regression statistics :

Ages with q dependent on year class strength

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

1, .72, 1.355, 18.42, .70, 20, .42, -19.72,

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,	1.32,	-1.162,	19.57,	.56,	20,	.62,	-18.42,
3,	1.15,	-.947,	18.62,	.79,	20,	.39,	-18.08,
4,	.98,	.182,	17.88,	.87,	20,	.30,	-17.96,
5,	1.04,	-.321,	17.86,	.88,	20,	.30,	-17.71,
6,	1.10,	-.845,	18.02,	.87,	20,	.32,	-17.57,
7,	1.03,	-.242,	17.53,	.98,	20,	.27,	-17.40,
8,	.97,	.197,	17.36,	.86,	20,	.27,	-17.50,

## Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FLT02: FLT02: Bottom,	2141018.,	.445,	.000,	.00,	1, .441,	.020
P shrinkage mean ,	2840136.,	.66,,,,			.203,	.015
F shrinkage mean ,	2148245.,	.50,,,,			.356,	.020

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2270028.,	.30,	.09,	3,	.303,	.019

Age 2 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
FLT02: FLT02: Bottom,	2574784.,	.329,	.103,	.31,	2, .684,	.048
F shrinkage mean ,	1916656.,	.50,,,,			.316,	.064

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2345135.,	.28,	.13,	3,	.480,	.053

Age 3 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
FLT02: FLT02: Bottom,	3496300.,	.242,	.028,	.12,	3, .791,	.077
F shrinkage mean ,	3324905.,	.50,,,,			.209,	.081

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3459828.,	.22,	.02,	4,	.111,	.078

Table 8.4.5 (continued)

Age 4 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
FLT02: FLT02: Bottom,	2013282.,	.189,	.044,	.24,	4, .853,	.110
F shrinkage mean ,	2434614.,	.50,,,,			.147,	.092

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2070364.,	.18,	.05,	5,	.287,	.107

Age 5 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
FLT02: FLT02: Bottom,	1051926.,	.161,	.057,	.36,	5, .881,	.157
F shrinkage mean ,	1634868.,	.50,,,,			.119,	.104

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1108370.,	.15,	.08,	6,	.543,	.150

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
FLT02: FLT02: Bottom,	1217797.,	.143,	.049,	.34,	6, .894,	.198
F shrinkage mean ,	1944082.,	.50,,,,			.106,	.128

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1279563.,	.14,	.08,	7,	.542,	.189

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
FLT02: FLT02: Bottom,	753111.,	.131,	.067,	.51,	7, .902,	.213
F shrinkage mean ,	1008512.,	.50,,,,			.098,	.164

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
774921.,	.13,	.07,	8,	.532,	.208

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
FLT02: FLT02: Bottom,	128281.,	.121,	.085,	.70,	8, .909,	.254
F shrinkage mean ,	234419.,	.50,,,,			.091,	.147

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
135518.,	.12,	.10,	9,	.831,	.242

Table 8.4.6

Run title : Herring in 30 (run: XSAJAP09/X09)

At 19-Apr-96 16:40:40

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age		
YEAR,	1973,	1974,	1975,
AGE			
1,	.0078,	.0030,	.0225,
2,	.0465,	.0492,	.0648,
3,	.1506,	.1701,	.1157,
4,	.1594,	.1712,	.1318,
5,	.2539,	.1286,	.0967,
6,	.1347,	.1289,	.0898,
7,	.1077,	.1456,	.1027,
8,	.1619,	.1495,	.1077,
+gp,	.1619,	.1495,	.1077,
FBAR 2- 6,	.1491,	.1296,	.0998,

Table 8	Fishing mortality (F) at age									
YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.0266,	.0156,	.0335,	.0061,	.0513,	.0036,	.0140,	.0419,	.0248,	.0236,
2,	.0804,	.0677,	.0702,	.0313,	.1435,	.0448,	.1059,	.1357,	.0819,	.1206,
3,	.1344,	.1463,	.1167,	.0658,	.1020,	.1224,	.2082,	.1692,	.1931,	.1692,
4,	.1557,	.2084,	.1994,	.1219,	.0886,	.1197,	.2023,	.2401,	.2414,	.1986,
5,	.1640,	.1772,	.2115,	.1117,	.1669,	.0994,	.1773,	.1307,	.2685,	.1432,
6,	.1479,	.2551,	.1709,	.1502,	.2534,	.1281,	.1992,	.0996,	.1869,	.2403,
7,	.1000,	.2284,	.3015,	.1500,	.2639,	.1825,	.1673,	.1608,	.1369,	.1426,
8,	.1417,	.2047,	.2100,	.1471,	.2143,	.1312,	.2026,	.1636,	.2312,	.1501,
+gp,	.1417,	.2047,	.2100,	.1471,	.2143,	.1312,	.2026,	.1636,	.2312,	.1501,
FBAR 2- 6,	.1365,	.1709,	.1538,	.0962,	.1509,	.1029,	.1786,	.1551,	.1944,	.1744,

Run title : Herring in 30 (run: XSAJAP09/X09)

At 19-Apr-96 16:40:40

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age										
YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE											
1,	.0143,	.0154,	.0048,	.0183,	.0262,	.0110,	.0126,	.0297,	.0225,	.0193,	.0238,
2,	.1553,	.0430,	.0812,	.0621,	.0738,	.0386,	.0640,	.0757,	.0692,	.0530,	.0660,
3,	.1555,	.1176,	.0611,	.1189,	.0601,	.0707,	.0981,	.0762,	.1000,	.0782,	.0848,
4,	.1646,	.1456,	.1235,	.0660,	.0811,	.0695,	.0991,	.0942,	.1125,	.1068,	.1045,
5,	.1997,	.1506,	.1653,	.1357,	.0605,	.0831,	.1233,	.1095,	.1419,	.1498,	.1337,
6,	.1798,	.1919,	.1774,	.1537,	.1154,	.1062,	.1041,	.1236,	.1897,	.1889,	.1674,
7,	.2256,	.2223,	.2198,	.1708,	.1722,	.1131,	.2361,	.1091,	.1838,	.2080,	.1669,
8,	.0869,	.1421,	.1836,	.1797,	.1489,	.1113,	.1205,	.1868,	.1919,	.2420,	.2069,
+gp,	.0869,	.1421,	.1836,	.1797,	.1489,	.1113,	.1205,	.1868,	.1919,	.2420,	.2069,
FBAR 2- 6,	.1710,	.1297,	.1217,	.1073,	.0782,	.0736,	.0977,	.0958,	.1227,	.1154,	

Table 8.4.6 (continued)

Run title : Herring in 30 (run: XSAJAP09/X09)

At 19-Apr-96 16:40:40

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)			Numbers*10***-4
YEAR,	1973,	1974,	1975,	
AGE				
1,	212454,	256798,	178637,	
2,	109404,	172585,	209614,	
3,	182554,	85501,	134515,	
4,	104980,	128561,	59054,	
5,	89197,	73283,	88698,	
6,	68384,	56651,	52760,	
7,	27071,	48931,	40772,	
8,	5174,	19902,	34632,	
+gp,	2944,	26954,	42062,	
TOTAL,	802164,	869166,	840744,	

Table 10	Stock number at age (start of year)					Numbers*10***-4				
YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	374907,	135472,	90695,	54847,	145828,	124055,	198497,	261380,	423807,	389239,
2,	142998,	298895,	109196,	71811,	44633,	113422,	101206,	160253,	205223,	338479,
3,	160850,	108029,	228699,	83340,	56985,	31657,	88790,	74536,	114555,	154812,
4,	98097,	115135,	76412,	166613,	63889,	42131,	22932,	59032,	51524,	77322,
5,	42377,	68733,	76529,	51250,	120757,	47875,	30603,	15337,	38016,	33136,
6,	65924,	29447,	47135,	50713,	37527,	83666,	35487,	20984,	11019,	23796,
7,	39486,	46555,	18681,	32528,	35729,	23847,	60266,	23806,	15551,	7483,
8,	30124,	29252,	30334,	11313,	22922,	22466,	16267,	41741,	16595,	11104,
+gp,	49171,	36232,	30758,	30581,	27363,	34018,	26376,	24789,	43656,	48969,
TOTAL,	1003934,	867750,	708438,	552996,	555633,	523137,	580424,	681858,	919947,	1084338,

Run title : Herring in 30 (run: XSAJAP09/X09)

At 19-Apr-96 16:40:40

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)					Numbers*10***-4					GMST
YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE											
1,	156149,	311080,	160061,	678011,	764668,	455568,	618906,	752552,	377286,	282679,	0,
2,	311262,	126035,	250800,	130414,	545065,	609861,	368916,	500384,	598131,	302019,	227003,
3,	245635,	218194,	98845,	189322,	100350,	414501,	480400,	283313,	379820,	456954,	234514,
4,	107024,	172154,	158826,	76132,	137631,	77364,	316201,	356582,	214946,	281382,	345983,
5,	51905,	74323,	121855,	114925,	58350,	103906,	59087,	234453,	265705,	157253,	207036,
6,	23510,	34805,	52345,	84565,	82149,	44968,	78284,	42767,	172047,	188767,	110837,
7,	15320,	16081,	23519,	35889,	59374,	59929,	33107,	57760,	30942,	116520,	127956,
8,	5312,	10010,	10542,	15456,	24769,	40920,	43817,	21405,	42404,	21081,	77492,
+gp,	39718,	26585,	21641,	21404,	28645,	44958,	49478,	27113,	41568,	55726,	49370,
TOTAL,	955834,	989266,	898436,	1346116,	1800996,	1851974,	2048198,	2276330,	2122849,	1862378,	1380190,

Table 8.4.7

Run title : Herring in 30 (run: XSAJAP09/X09)

At 19-Apr-96 16:40:40

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,
1973,	2124537,	198384,	142168,	22531,	.1585,	.1491,
1974,	2567974,	217007,	148929,	20294,	.1363,	.1296,
1975,	1786370,	219915,	154174,	16264,	.1055,	.0998,
1976,	3749073,	231744,	153258,	22012,	.1436,	.1365,
1977,	1354719,	220045,	142310,	26304,	.1848,	.1709,
1978,	906945,	186264,	143563,	25105,	.1749,	.1538,
1979,	548470,	159412,	129157,	19049,	.1475,	.0962,
1980,	1458277,	162252,	118946,	20150,	.1694,	.1509,
1981,	1240551,	154365,	115744,	13700,	.1184,	.1029,
1982,	1984967,	133131,	98102,	17847,	.1819,	.1786,
1983,	2613801,	171730,	110023,	18501,	.1682,	.1551,
1984,	4238072,	213086,	121225,	25629,	.2114,	.1944,
1985,	3892388,	229620,	136544,	26120,	.1913,	.1744,
1986,	1561495,	236201,	156938,	26489,	.1688,	.1710,
1987,	3110796,	245394,	178072,	24520,	.1377,	.1297,
1988,	1600615,	263271,	172530,	27650,	.1603,	.1217,
1989,	6780106,	348854,	220827,	28658,	.1298,	.1073,
1990,	7646680,	420684,	292872,	31282,	.1068,	.0782,
1991,	4555679,	473878,	343039,	26219,	.0764,	.0736,
1992,	6189065,	505021,	361054,	39310,	.1089,	.0977,
1993,	7525524,	549546,	348731,	40179,	.1152,	.0958,
1994,	3772863,	557297,	442313,	56380,	.1275,	.1227,
1995,	2826787,	515530,	408138,	53797,	.1318,	.1154,
Arith.						
Mean	3218946,	287506,	201681,	27304,	.1459,	.1306,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		



Table 8.4.8 Estimation of MBAL with Ricker function for herring in SD 30

a= 18.23303		Rmax =(a/b)*(exp(-1))						
b= 9.86E-07		R_mod =a*SSB*EXP(-b*SSB)		Residual in				
	observed		Model	Logs	Log	year y		
year	ssb	recruits	R mod	R mod	R obs.	(R_mod- R_obs)	(R_mod- R_obs)*2	Residuals in year y-1
1973	142168	2567974	2253068.3	6.35277436	6.40959062	-0.0568163	0.00322809	
1974	148929	1786370	2344532.39	6.37005624	6.25197142	0.11808482	0.01394402	-0.0568163
1975	154174	3749073	2414581.24	6.38284182	6.5739239	-0.1910821	0.03651236	0.11808482
1976	153258	1354719	2402404.49	6.38064613	6.13184922	0.24879691	0.0618999	-0.1910821
1977	142310	906945	2255002.91	6.35314711	5.95758095	0.39556616	0.15647258	0.24879691
1978	143563	548470	2272048.46	6.35641759	5.73915288	0.61726471	0.38101573	0.39556616
1979	129157	1458277	2073302.57	6.31666269	6.16384003	0.15282266	0.02335477	0.61726471
1980	118946	1240551	1928713.21	6.28526765	6.09361462	0.19165303	0.03673088	0.15282266
1981	115744	1984967	1882728.18	6.27478762	6.29775329	-0.0229657	0.00052742	0.19165303
1982	98102	2613801	1623762.67	6.21052255	6.41727252	-0.20675	0.04274555	-0.0229657
1983	110023	4238072	1799793.82	6.25522276	6.62716833	-0.3719456	0.13834351	-0.20675
1984	121225	3892388	1961254.6	6.29253398	6.59021612	-0.2976821	0.08861466	-0.3719456
1985	136544	1561495	2175974.09	6.33765372	6.1935406	0.14411312	0.02076859	-0.2976821
1986	156938	3110796	2451179.15	6.38937505	6.49287153	-0.1034965	0.01071152	0.14411312
1987	178072	1600615	2723902.12	6.4351915	6.20428688	0.23090462	0.05331694	-0.1034965
1988	172530	6780106	2653590.85	6.42383396	6.83123648	-0.4074025	0.16597681	0.23090462
1989	220827	7646680	3238450.83	6.51033731	6.88347292	-0.3731356	0.13923018	-0.4074025
1990	292872	4555679	4000444.09	6.6021082	6.65855312	-0.0564449	0.00318603	-0.3731356
1991	343039	6189065	4459526.8	6.64928878	6.79162504	-0.1423363	0.02025961	-0.0564449
1992	361054	7525524	4611074.51	6.66380214	6.87653675	-0.2127346	0.04525601	-0.1423363
1993	348731	3772863	4508147.5	6.65399812	6.57667104	0.07732708	0.00597948	-0.2127346
1994	442313	2826787	5213853.33	6.71715881	6.45129309	0.26586572	0.07068458	0.07732708
			Rmax= 6801897.82			SSQ=	1.51875924	
			50 % of Rmax= 3400948.91					
MBAL= 235000		3400796.72	3398467.43					

Table 8.4.9

Herring in Baltic Fishing Area 30

15:14 Thursday, April 25, 1996

Prediction with management option table: Input data

Year: 1996								
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	4663520.0	0.2000	0.0100	0.1500	0.3300	9.700	0.0247	9.700
2	2270030.0	0.2000	0.4190	0.1500	0.3300	19.400	0.0684	19.400
3	2345140.0	0.2000	0.9140	0.1500	0.3300	27.000	0.0879	27.000
4	3459830.0	0.2000	0.9830	0.1500	0.3300	31.267	0.1083	31.267
5	2070360.0	0.2000	1.0000	0.1500	0.3300	35.167	0.1386	35.167
6	1108370.0	0.2000	1.0000	0.1500	0.3300	42.067	0.1736	42.067
7	1279560.0	0.2000	1.0000	0.1500	0.3300	47.867	0.1730	47.867
8	774920.00	0.2000	1.0000	0.1500	0.3300	54.433	0.2145	54.433
9+	493700.00	0.2000	1.0000	0.1500	0.3300	67.864	0.2145	67.864
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	4663520.0	0.2000	0.0100	0.1500	0.3300	9.700	0.0247	9.700
2	.	0.2000	0.4190	0.1500	0.3300	19.400	0.0684	19.400
3	.	0.2000	0.9140	0.1500	0.3300	27.000	0.0879	27.000
4	.	0.2000	0.9830	0.1500	0.3300	31.267	0.1083	31.267
5	.	0.2000	1.0000	0.1500	0.3300	35.167	0.1386	35.167
6	.	0.2000	1.0000	0.1500	0.3300	42.067	0.1736	42.067
7	.	0.2000	1.0000	0.1500	0.3300	47.867	0.1730	47.867
8	.	0.2000	1.0000	0.1500	0.3300	54.433	0.2145	54.433
9+	.	0.2000	1.0000	0.1500	0.3300	67.864	0.2145	67.864
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 1998								
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	4663520.0	0.2000	0.0100	0.1500	0.3300	9.700	0.0247	9.700
2	.	0.2000	0.4190	0.1500	0.3300	19.400	0.0684	19.400
3	.	0.2000	0.9140	0.1500	0.3300	27.000	0.0879	27.000
4	.	0.2000	0.9830	0.1500	0.3300	31.267	0.1083	31.267
5	.	0.2000	1.0000	0.1500	0.3300	35.167	0.1386	35.167
6	.	0.2000	1.0000	0.1500	0.3300	42.067	0.1736	42.067
7	.	0.2000	1.0000	0.1500	0.3300	47.867	0.1730	47.867
8	.	0.2000	1.0000	0.1500	0.3300	54.433	0.2145	54.433
9+	.	0.2000	1.0000	0.1500	0.3300	67.864	0.2145	67.864
Unit	Thousands	-	-	-	-	Grams	-	Grams

Notes: Run name : MANJAP01  
 Date and time: 25APR96:15:15

Table 8.4.10

Herring in Baltic Fishing Area 30

15:14 Thursday, April 25, 1996

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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	0.1154	517138	402686	56010	0.0000	0.0000	512174	393586	0	571620	445564
.	.	.	.	.	0.1000	0.0115	.	392693	6125	565131	438625
.	.	.	.	.	0.2000	0.0231	.	391803	12157	558743	431813
.	.	.	.	.	0.3000	0.0346	.	390914	18097	552452	425124
.	.	.	.	.	0.4000	0.0461	.	390028	23946	546259	418557
.	.	.	.	.	0.5000	0.0577	.	389144	29706	540161	412109
.	.	.	.	.	0.6000	0.0692	.	388262	35379	534157	405778
.	.	.	.	.	0.7000	0.0808	.	387382	40966	528244	399561
.	.	.	.	.	0.8000	0.0923	.	386505	46468	522422	393456
.	.	.	.	.	0.9000	0.1038	.	385629	51888	516689	387460
.	.	.	.	.	1.0000	0.1154	.	384756	57225	511043	381573
.	.	.	.	.	1.1000	0.1269	.	383885	62483	505483	375791
.	.	.	.	.	1.2000	0.1384	.	383016	67661	500007	370112
.	.	.	.	.	1.3000	0.1500	.	382150	72762	494614	364535
.	.	.	.	.	1.4000	0.1615	.	381285	77787	489303	359057
.	.	.	.	.	1.5000	0.1730	.	380423	82737	484072	353677
.	.	.	.	.	1.6000	0.1846	.	379563	87613	478919	348392
.	.	.	.	.	1.7000	0.1961	.	378705	92416	473844	343202
.	.	.	.	.	1.8000	0.2076	.	377849	97148	468846	338102
.	.	.	.	.	1.9000	0.2192	.	376995	101811	463922	333093
.	.	.	.	.	2.0000	0.2307	.	376144	106404	459071	328173
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANJAP01  
Date and time : 25APR96:15:15  
Computation of ref. F: Simple mean, age 2 - 6  
Basis for 1996 : F factors

Table 8.4.11

Herring in Baltic Fishing Area 30

15:14 Thursday, April 25, 1996

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
						Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0	0	25727034	911930	18579444	815491	17392791	763407
0.1000	0.0115	257779	11666	24442759	834693	17303913	738452	16162653	689534
0.2000	0.0231	474197	20833	23365136	771123	16234984	675078	15131899	628822
0.3000	0.0346	659150	28151	22444691	717879	15323183	622030	14252798	578048
0.4000	0.0461	819573	34071	21646762	672627	14533847	576972	13491907	534962
0.5000	0.0577	960471	38913	20946326	633684	13841956	538221	12825084	497942
0.6000	0.0692	1085552	42914	20324860	599807	13228987	504536	12234456	465790
0.7000	0.0808	1197619	46247	19768352	570060	12680927	474978	11706501	437604
0.8000	0.0923	1298834	49045	19265997	543721	12186973	448828	11230792	412689
0.9000	0.1038	1390893	51410	18809328	520229	11738657	425524	10799158	390506
1.0000	0.1154	1475143	53421	18391609	499138	11329244	404620	10405098	370624
1.1000	0.1269	1552671	55140	18007412	480091	10953307	385758	10043373	352701
1.2000	0.1384	1624364	56618	17652312	462799	10606421	368649	9709710	336457
1.3000	0.1500	1690952	57893	17322660	447022	10284938	353056	9400588	321663
1.4000	0.1615	1753042	58999	17015422	432566	9985824	338781	9113077	308132
1.5000	0.1730	1811146	59961	16728050	419265	9706532	325661	8844716	295704
-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDJAP01  
Date and time : 25APR96:15:42  
Computation of ref. F: Simple mean, age 2 - 6  
F-0.1 factor : 1.2255  
F-max factor : Not found  
F-0.1 reference F : 0.1414  
F-max reference F : Not found  
Recruitment : 4663520 (Thousands)

Table 8.5.1

HER-31: Herring in Baltic Fishing Area 31

16:56 Saturday, April 20, 19

FLT01: FLT01: Trapnet

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1974	529	0.2	8.9	10.2	14.1	14.1	14.9	17.3	6.2	1.9	1.5
1975	554	2.2	15.4	19.6	4.1	6.1	3.9	4.5	3.7	0.9	0.7
1976	695	0.4	9.8	16.6	17.3	6.1	9.3	10.5	9.2	3.8	1.4
1977	484	0.6	16.7	5.8	9.6	7.4	3.5	6.6	3.9	2.5	0.8
1978	424	0.0	2.1	25.2	2.7	5.3	4.9	3.1	6.2	2.2	1.3
1979	556	2.8	0.6	1.1	12.3	1.6	2.2	2.3	1.1	1.5	0.3
1980	424	0.8	8.4	0.6	0.8	13.2	1.8	2.8	1.9	0.9	1.8
1981	370	0.4	16.6	3.6	0.5	1.0	8.5	1.6	1.5	0.9	0.5
1982	272	0.1	4.8	17.8	3.2	0.8	2.4	3.6	0.9	1.1	0.7
1983	233	0.8	2.3	2.1	6.8	0.6	0.3	0.9	1.5	0.4	0.6
1984	232	0.8	17.3	3.2	1.7	6.6	0.9	0.9	0.3	2.0	0.4
1985	203	0.3	7.0	14.2	3.4	1.5	4.4	0.5	0.7	0.6	1.8
1986	292	1.3	2.3	4.9	7.9	1.1	1.0	2.5	0.6	0.3	0.4
1987	263	0.1	2.8	2.3	3.7	6.5	1.0	0.9	1.0	0.4	0.4
1988	182	0.0	4.8	1.9	1.2	2.1	2.7	0.5	0.5	0.6	0.2
1989	78	0.0	1.1	2.6	1.2	0.7	1.2	0.9	0.2	0.2	0.2
1990	158	2.1	7.8	1.0	2.4	1.2	1.0	2.3	1.3	0.2	0.1
1991	126	0.1	4.0	10.1	0.4	0.8	0.1	0.7	0.4	0.4	0.1
1992	95	0.0	2.1	2.5	2.7	0.3	0.5	0.1	0.2	0.1	0.0
1993	79	0.5	1.7	2.4	4.8	5.8	0.9	0.6	0.3	0.3	0.1
1994	120	0.0	9.8	4.4	1.9	4.1	3.0	0.0	0.4	0.0	0.0
1995	149	0.0	7.4	6.2	1.8	0.8	1.6	1.8	0.0	0.0	0.0

HER-31: Herring in Baltic Fishing Area 31

16:56 Saturday, April 20, 199

FLT02: FLT02: Bottom trawl

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1974	1022	7.3	8.8	3.1	3.5	4.1	3.6	2.3	1.0	0.8	0.3
1975	2004	3.2	16.2	10.5	5.9	7.1	5.2	4.1	3.7	0.6	0.7
1976	2232	15.7	5.2	16.2	15.2	8.7	8.0	9.6	6.5	2.9	1.6
1977	2245	3.4	45.9	7.7	9.5	8.0	7.0	10.1	6.5	2.6	1.5
1978	2821	4.0	3.7	54.7	11.8	19.1	15.5	7.8	17.6	3.7	3.5
1979	6419	5.0	5.9	6.2	49.2	10.4	16.3	10.2	7.1	8.3	2.0
1980	7510	43.3	39.1	5.0	9.7	56.8	13.5	21.9	11.8	5.5	2.9
1981	6957	14.4	41.1	11.8	2.8	9.5	29.9	10.7	9.7	4.9	2.2
1982	7196	0.0	4.6	71.3	13.0	4.6	11.9	27.4	6.1	8.4	2.3
1983	5573	20.7	10.0	16.7	50.7	8.7	8.0	6.7	8.7	2.0	0.7
1984	5071	36.9	62.6	15.2	6.9	25.7	3.3	2.6	1.2	8.1	0.5
1985	3122	1.4	28.3	55.7	10.5	11.2	19.2	4.2	1.8	0.7	6.6
1986	2663	7.0	10.0	31.4	39.8	6.1	8.5	17.5	1.8	2.7	3.6
1987	2546	12.7	26.4	19.6	25.7	25.6	5.2	6.9	4.9	2.5	1.1
1988	2378	7.0	28.3	18.3	12.9	23.6	22.1	4.7	4.6	3.6	2.6
1989	1301	6.7	4.9	14.4	7.2	7.2	10.8	9.3	2.7	1.3	1.3
1990	2837	10.7	82.2	3.8	16.2	7.1	6.7	11.8	9.4	1.7	2.1
1991	2119	1.1	17.7	55.4	3.5	14.5	7.0	6.4	6.2	5.1	1.2
1992	2456	14.2	10.7	33.4	61.3	4.4	6.7	7.7	7.4	4.1	1.4
1993	2241	17.4	45.0	16.1	37.2	57.7	5.2	5.1	4.9	3.1	2.5
1994	2063	11.2	26.7	25.9	9.8	15.5	22.4	1.5	1.4	0.3	0.0
1995	992	32.6	9.9	24.9	14.3	4.5	10.0	10.6	1.5	1.5	0.9

Table 8.5.1 (continued)

HER-31: Herring in Baltic Fishing Area 31

16:56 Saturday, April 20, 1996

FLT03: FLT03: Pelagic trawl

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1974	44	3.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	108	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	731	2.2	1.3	1.1	1.8	1.4	1.6	0.7	0.7	0.3	0.2
1977	705	0.9	11.9	2.0	2.5	2.1	1.8	2.6	1.7	0.7	0.4
1978	1003	1.0	0.9	13.9	3.0	4.9	3.9	2.0	4.5	0.9	0.9
1979	1056	0.8	0.9	1.0	7.9	1.7	2.6	1.6	1.1	1.3	0.3
1980	1365	20.8	5.4	1.4	2.4	2.4	1.0	0.3	0.3	0.0	0.0
1981	1139	4.0	31.4	4.4	0.1	0.4	1.7	0.6	0.4	0.8	0.9
1982	945	5.1	7.3	6.5	1.7	0.3	0.3	0.1	0.0	0.0	0.0
1983	1128	16.8	1.8	1.9	5.7	0.9	0.8	1.6	2.3	1.1	0.7
1984	1542	21.2	34.4	2.3	1.5	10.1	2.6	1.0	0.0	1.1	0.2
1985	1177	6.3	28.9	27.1	3.3	2.3	5.6	0.7	0.9	0.6	1.7
1986	1349	0.0	9.2	18.1	23.8	4.4	4.1	7.2	1.3	1.2	1.3
1987	1249	0.9	5.3	6.8	10.4	11.9	3.0	2.9	1.9	0.7	1.3
1988	1217	0.0	4.5	4.9	6.4	7.5	8.7	1.1	2.3	0.8	0.0
1989	721	3.5	3.4	5.8	2.1	2.6	3.7	4.2	0.9	0.3	0.5
1990	1048	1.8	31.1	3.0	7.0	3.8	5.2	6.9	3.2	1.0	1.3
1991	1048	0.7	11.2	32.5	1.6	4.6	1.8	2.4	3.3	2.2	0.4
1992	845	1.1	7.7	12.1	21.3	1.5	3.9	3.1	2.4	2.3	1.0
1993	859	0.8	9.0	5.7	13.1	30.4	3.5	2.9	1.7	1.6	1.1
1994	346	0.0	3.4	3.4	1.3	3.9	10.8	1.0	2.4	1.8	1.2
1995	251	5.5	1.9	4.2	2.3	1.1	2.1	2.0	0.2	0.1	0.1

Table 8.5.2

HER-31: Herring in Baltic Fishing Area 31

13:04 Thursday, April 18, 1996

WECA: Mean Weight in Catch (Grams)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1973	6.0	12.6	22.9	30.2	35.9	38.7	41.9	44.4	46.8	49.8	52.9	57.1
1974	5.0	15.0	20.5	28.3	34.1	37.9	40.3	42.7	45.4	46.5	60.2	50.0
1975	5.0	13.0	21.3	30.3	36.2	38.8	44.5	45.7	49.5	51.6	61.3	63.0
1976	5.0	12.2	21.7	29.6	34.5	40.1	41.6	44.0	46.1	50.5	49.6	57.7
1977	5.0	13.3	20.9	29.9	34.3	38.4	41.2	44.4	46.9	48.0	51.0	56.3
1978	5.5	14.8	22.8	31.0	36.4	37.8	42.1	43.3	46.3	49.7	50.0	63.1
1979	5.9	14.5	23.9	32.0	35.7	39.0	41.0	45.2	48.7	49.6	51.5	50.7
1980	5.0	11.9	22.3	31.1	37.5	39.7	41.8	43.9	46.7	49.3	57.7	55.6
1981	5.0	14.1	21.5	29.0	35.2	39.7	42.4	45.7	47.3	50.7	51.8	57.3
1982	2.0	16.0	24.5	31.3	37.2	42.3	46.9	48.2	50.9	54.7	57.2	60.6
1983	4.0	13.0	25.1	34.7	39.8	42.9	47.8	52.7	55.7	59.0	60.0	63.6
1984	4.0	16.1	23.4	35.0	41.0	43.8	46.6	53.1	53.4	56.7	56.5	61.8
1985	4.0	13.0	22.1	30.7	38.3	43.5	45.8	52.2	53.9	57.8	57.2	62.9
1986	4.0	12.3	18.7	29.4	36.7	41.4	45.3	49.0	50.7	59.2	58.0	64.9
1987	4.0	14.3	23.8	32.4	38.9	44.2	48.9	53.5	56.7	59.4	61.3	68.8
1988	6.0	9.2	23.7	35.2	41.4	45.7	50.5	54.6	60.7	59.5	61.9	73.5
1989	6.0	13.8	23.5	34.0	42.2	47.0	50.6	53.3	57.7	65.3	60.7	70.5
1990	-1.0	12.5	19.2	33.7	38.4	44.8	49.9	53.4	55.1	61.6	60.3	68.3
1991	-1.0	15.1	22.0	27.8	35.7	41.4	46.5	50.0	53.2	58.3	64.9	79.3
1992	5.6	13.3	19.9	27.1	30.3	39.7	41.6	47.7	51.0	55.5	61.1	70.7
1993	7.5	14.7	21.9	28.8	32.2	33.9	42.1	49.8	52.5	54.7	59.1	76.8
1994	5.0	10.6	19.9	27.6	32.7	35.2	36.7	43.4	51.2	58.8	54.3	70.0
1995	7.4	9.1	17.9	29.1	32.7	36.0	38.7	40.9	49.3	61.0	56.0	72.6

Table 8.5.3

13:04 Thursday, April 18, 1996

HER-31: Herring in Baltic Fishing Area 31

CANUM: Catch in Numbers (Millions)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1973	0	10	1	11	22	28	34	5	1	0	0	0
1974	0	10	26	19	31	26	28	32	11	3	3	2
1975	0	2	45	36	13	20	16	15	13	2	2	1
1976	0	14	22	44	46	21	25	28	23	11	3	3
1977	0	2	108	28	29	25	17	23	13	8	2	1
1978	9	2	8	141	19	30	24	12	28	6	8	4
1979	1	6	7	8	87	14	24	17	12	14	3	2
1980	0	66	53	7	14	89	15	25	17	10	7	1
1981	0	13	87	24	4	11	49	16	15	9	4	5
1982	0	7	15	116	22	5	16	31	8	11	3	4
1983	0	30	12	21	74	11	12	11	16	4	3	2
1984	0	39	147	21	11	55	7	6	1	14	2	3
1985	0	4	82	127	17	12	34	5	3	3	8	4
1986	0	4	19	51	71	12	16	31	4	5	6	13
1987	0	9	40	28	41	48	10	14	9	4	3	5
1988	0	8	45	30	26	40	40	7	8	6	4	2
1989	0	11	11	25	11	12	18	16	4	2	2	1
1990	0	13	126	8	24	13	14	21	13	3	3	5
1991	0	2	33	98	6	20	9	9	10	8	2	6
1992	2	12	22	47	81	6	11	10	9	6	2	3
1993	0	19	56	24	55	94	10	9	7	5	4	2
1994	0	11	43	35	14	25	38	3	4	2	1	1
1995	1	50	21	40	21	7	15	16	2	2	1	1



Table 8.5.4

HER-31: Herring in Baltic Fishing Area 31

13:04 Thursday, April 18, 1996

MATPROP: Proportion Mature at Year Start

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1973	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1974	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1975	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1976	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1977	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1978	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1979	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1980	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1981	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1982	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1983	0.00	0.00	0.32	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1984	0.00	0.00	0.30	0.92	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1985	0.00	0.00	0.19	0.94	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1986	0.00	0.00	0.29	0.95	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1987	0.00	0.00	0.33	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1988	0.00	0.00	0.39	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1989	0.00	0.00	0.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1990	0.00	0.00	0.32	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1991	0.00	0.00	0.37	0.82	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1992	0.00	0.00	0.20	0.71	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1993	0.00	0.00	0.41	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1994	0.00	0.00	0.42	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1995	0.00	0.00	0.15	0.85	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 8.5.5

Lowestoft VPA Version 3.1

19-Apr-96 10:10:08

Extended Survivors Analysis

Herring in 31 (run: XSAJAP09/X09)

CPUE data from file /users/fish/ifad/ifapwork/wgbfas/her\_31/FLEET.X09

Catch data for 23 years. 1973 to 1995. Ages 1 to 8.

Fleet,	First,	Last,	First,	Last,	Alpha,	Beta
	year,	year,	age,	age,		
FLT01: FLT01: Trapne,	1974,	1995,	1,	7,	.400,	.600
FLT02: FLT02: Bottom,	1974,	1995,	1,	7,	.400,	.800
FLT03: FLT03: Pelagi,	1974,	1995,	1,	7,	.400,	.800

Time series weights :

Tapered time weighting applied  
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 6

Regression type = C  
Minimum of 5 points used for regression  
Survivor estimates shrunk to the population mean for ages < 6

Catchability independent of age for ages >= 6

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 had not converged after 80 iterations

Total absolute residual between iterations  
79 and 80 = .00050

Final year F values

Age	1,	2,	3,	4,	5,	6,	7
Iteration 79,	.0219,	.0362,	.0551,	.0478,	.0315,	.0433,	.0350
Iteration 80,	.0220,	.0362,	.0552,	.0478,	.0314,	.0433,	.0351

Table 8.5.6

## Regression weights

, .751, .820, .877, .921, .954, .976, .990, .997, 1.000, 1.000

## Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
1,	.009,	.016,	.031,	.006,	.013,	.004,	.015,	.018,	.016,	.022
2,	.046,	.106,	.096,	.052,	.085,	.040,	.053,	.083,	.048,	.036
3,	.088,	.083,	.103,	.067,	.046,	.083,	.070,	.072,	.065,	.055
4,	.116,	.089,	.099,	.047,	.081,	.042,	.087,	.103,	.052,	.048
5,	.087,	.102,	.112,	.057,	.069,	.085,	.051,	.131,	.059,	.031
6,	.128,	.092,	.109,	.064,	.083,	.059,	.058,	.107,	.068,	.043
7,	.147,	.149,	.082,	.055,	.094,	.067,	.082,	.059,	.040,	.035

## XSA population numbers (Thousands)

YEAR ,	1,	AGE 2,	3,	4,	5,	6,	7,
1986 ,	5.01E+05,	4.58E+05,	6.55E+05,	6.98E+05,	1.56E+05,	1.44E+05,	2.45E+05,
1987 ,	6.25E+05,	4.27E+05,	3.77E+05,	5.16E+05,	5.35E+05,	1.23E+05,	1.09E+05,
1988 ,	2.82E+05,	5.30E+05,	3.31E+05,	2.99E+05,	4.06E+05,	4.16E+05,	9.63E+04,
1989 ,	1.95E+06,	2.35E+05,	4.14E+05,	2.57E+05,	2.33E+05,	3.13E+05,	3.21E+05,
1990 ,	1.07E+06,	1.67E+06,	1.92E+05,	3.33E+05,	2.11E+05,	1.89E+05,	2.52E+05,
1991 ,	5.32E+05,	9.12E+05,	1.32E+06,	1.58E+05,	2.65E+05,	1.69E+05,	1.50E+05,
1992 ,	8.94E+05,	4.56E+05,	7.54E+05,	1.04E+06,	1.30E+05,	2.09E+05,	1.37E+05,
1993 ,	1.16E+06,	7.58E+05,	3.72E+05,	6.06E+05,	8.24E+05,	1.07E+05,	1.70E+05,
1994 ,	7.52E+05,	9.79E+05,	6.01E+05,	2.98E+05,	4.70E+05,	6.22E+05,	8.25E+04,
1995 ,	2.48E+06,	6.37E+05,	8.03E+05,	4.85E+05,	2.44E+05,	3.82E+05,	5.00E+05,

## Estimated population abundance at 1st Jan 1996

, .00E+00, 2.08E+06, 5.29E+05, 6.53E+05, 3.98E+05, 2.04E+05, 3.14E+05,

## Taper weighted geometric mean of the VPA populations:

, 8.23E+05, 6.18E+05, 4.80E+05, 3.54E+05, 2.65E+05, 2.05E+05, 1.47E+05,

## Standard error of the weighted Log(VPA populations) :

, .6417, .5816, .6158, .6222, .6372, .6531, .6754,

Table 8.5.6 (continued)

Log catchability residuals.

Fleet : FLT01: FLT01: Trapne

Age , 1974, 1975

1	, 99.99, 99.99
2	, 99.99, 99.99
3	, 99.99, 99.99
4	, 99.99, 99.99
5	, 99.99, 99.99
6	, 99.99, 99.99
7	, 99.99, 99.99

Age , 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985

1	, -1.35, .67, 99.99, 1.26, -.64, .14, -.39, -.47, -.09, .05
2	, .01, -.25, -.53, -1.46, .61, .02, .23, -.21, .31, -.03
3	, .13, .09, .27, -.87, -.62, .31, .34, -.13, .29, .22
4	, .52, .36, -.19, .01, -.93, -.74, .80, .22, -.11, .77
5	, .20, .24, .14, -.33, .37, -.01, .50, .08, .22, .20
6	, .26, .32, .47, -.56, -.04, .98, 1.11, -.36, .36, .70
7	, .41, .53, .60, -.28, .26, .29, .79, .65, 1.11, .15

Age , 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995

1	, .78, -.91, 99.99, 99.99, .67, -.31, 99.99, .15, 99.99, 99.99
2	, -.82, -.44, .19, .40, -.38, -.21, .15, -.37, .60, .56
3	, -.51, -.45, -.18, .46, -.04, -.03, -.32, .49, .16, -.04
4	, -.04, -.35, -.48, .41, .16, -.53, -.42, .83, .29, -.44
5	, -.08, -.10, -.31, .06, .06, -.28, -.03, .18, .22, -.32
6	, -.34, -.10, .05, .35, -.02, -2.00, -.32, 1.15, .15, -.22
7	, .05, -.05, -.18, .04, .53, .07, -1.50, .25, 99.99, -.37

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

Age ,	6,	7
Mean Log q,	-17.0738,	-17.0738,
S.E(Log q),	.7880,	.6275,

## Regression statistics :

Ages with q dependent on year class strength

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

1,	.60,	.745,	17.08,	.39,	14,	.64,	-19.51,
2,	.93,	.283,	16.63,	.62,	20,	.48,	-16.88,
3,	.75,	1.411,	15.87,	.77,	20,	.36,	-16.78,
4,	.91,	.361,	16.56,	.60,	20,	.54,	-16.95,
5,	.65,	3.168,	15.40,	.89,	20,	.24,	-16.99,

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

6,	1.02,	-.047,	17.16,	.40,	20,	.84,	-17.07,
7,	1.31,	-.793,	18.60,	.43,	19,	.83,	-17.04,

Table 8.5.6 (continued)

Fleet : FLT02: FLT02: Bottom

Age	1974	1975
1	99.99	99.99
2	99.99	99.99
3	99.99	99.99
4	99.99	99.99
5	99.99	99.99
6	99.99	99.99
7	99.99	99.99

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.10	.38	.81	-.42	-.05	.20	99.99	-.61	.34	-1.36
2	-.47	.31	-.53	-.34	.51	-.73	-1.57	-.58	-.29	-.17
3	-.02	-.05	.10	-.52	-.26	-.15	-.36	-.15	-.05	-.13
4	.05	-.22	.26	-.28	-.15	-.41	.14	-.21	-.52	.20
5	.13	-.25	.26	-.34	.01	-.10	-.22	.12	-.41	.18
6	-.44	.10	.35	-.39	-.28	-.06	.07	.38	-.81	.06
7	-.23	.04	.25	-.62	.07	-.12	.17	.11	-.29	.16

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.19	.51	.87	-.61	-.27	-1.23	.27	.26	.40	.71
2	-.34	.63	.53	.33	.14	-.35	-.21	.61	-.04	.16
3	-.07	.19	.33	.34	-.34	-.23	-.12	.15	.05	.23
4	-.08	-.04	.10	.25	.02	-.06	-.16	.13	.00	.24
5	-.01	-.13	.14	.24	-.25	.28	-.03	.16	-.24	.03
6	.21	-.10	.20	.35	-.39	.04	-.36	.18	-.07	.33
7	.41	.33	.10	.17	-.11	.08	.21	-.34	-.77	.12

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

Age	6	7
Mean Log q	-17.6659	-17.6659
S.E(Log q)	.3162	.3246

## Regression statistics :

Ages with q dependent on year class strength

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

1	.84	.465	18.21	.45	19	.73	-19.10
2	.86	.527	17.38	.58	20	.52	-18.05
3	.68	2.664	16.25	.87	20	.25	-17.74
4	.65	3.426	16.01	.91	20	.21	-17.74
5	.75	2.482	16.39	.91	20	.22	-17.70

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

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

6	.90	.729	17.13	.85	20	.29	-17.67
7	.87	1.000	16.94	.86	20	.28	-17.67

Table 8.5.6 (continued)

Fleet : FLT03: FLT03: Pelagi

Age , 1974, 1975

1	, 99.99, 99.99
2	, 99.99, 99.99
3	, 99.99, 99.99
4	, 99.99, 99.99
5	, 99.99, 99.99
6	, 99.99, 99.99
7	, 99.99, 99.99

Age , 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985

1	, -.23, .59, .86, -.10, 1.17, 1.02, 1.50, .96, 1.28, 1.10
2	, -.79, .08, -.94, -.50, .20, .53, .50, -.77, .16, .63
3	, -1.07, -.14, -.04, -.52, .04, .46, -.54, -.52, -.50, .14
4	, -.45, -.19, .20, -.20, .25, -1.02, .32, -.47, -.50, .24
5	, -.20, -.24, .08, -.12, -.89, -.69, -.30, -.07, -.19, -.08
6	, -.96, -.13, -.03, -.45, -1.20, -1.15, -1.61, -.36, .12, -.23
7	, -1.76, -.19, -.11, -.70, -2.55, -1.22, -3.44, .24, -.09, -.68

Age , 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995

1	, 99.99, -.77, 99.99, -.27, -.57, -.68, -.62, -1.17, 99.99, .79
2	, .10, -.21, -.55, .45, .10, -.20, .36, -.01, -.34, -.15
3	, .10, .01, -.06, .19, .22, -.01, .00, .16, -.04, .04
4	, .07, -.08, .20, -.01, .23, .09, -.13, .13, -.01, .03
5	, .39, -.18, -.17, .03, .14, .04, .17, .20, .03, .10
6	, .13, .03, -.09, -.16, .32, -.64, .13, .71, .96, .12
7	, .17, .15, -.71, -.06, .32, -.23, .34, .03, .58, -.21

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

Age ,	6,	7
Mean Log q,	-17.6368,	-17.6368,
S.E(Log q),	.5844,	.8357,

## 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,	.86,	.250,	18.71,	.30,	17,	.99,	-19.52,
2,	.87,	.631,	17.36,	.70,	20,	.40,	-17.97,
3,	.71,	2.419,	16.45,	.87,	20,	.25,	-17.83,
4,	.59,	3.053,	15.81,	.85,	20,	.28,	-17.94,
5,	.62,	3.269,	15.78,	.88,	20,	.25,	-17.83,

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

6,	.80,	.947,	16.53,	.68,	20,	.47,	-17.64,
7,	1.01,	-.030,	17.89,	.40,	20,	.86,	-17.82,

Table 8.5.6 (continued)

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: FLT01: Trapne,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT02: FLT02: Bottom,	4250408.,	.870,	.000,	.00,	1,	.144,	.011
FLT03: FLT03: Pelagi,	4598027.,	1.174,	.000,	.00,	1,	.079,	.010
P shrinkage mean ,	617985.,	.58,,,				.330,	.072
F shrinkage mean ,	3513764.,	.50,,,				.446,	.013

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2079076.,	.33,	.65,	4,	1.963,	.022

Age 2 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: FLT01: Trapne,	928843.,	.509,	.000,	.00,	1,	.180,	.021
FLT02: FLT02: Bottom,	671412.,	.443,	.111,	.25,	2,	.236,	.029
FLT03: FLT03: Pelagi,	457356.,	.421,	.000,	.00,	1,	.263,	.042
P shrinkage mean ,	480431.,	.62,,,				.127,	.040
F shrinkage mean ,	304581.,	.50,,,				.193,	.062

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
529236.,	.22,	.18,	6,	.849,	.036

Age 3 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: FLT01: Trapne,	769396.,	.284,	.196,	.69,	3,	.232,	.047
FLT02: FLT02: Bottom,	781437.,	.249,	.077,	.31,	3,	.303,	.046
FLT03: FLT03: Pelagi,	572641.,	.238,	.203,	.85,	3,	.331,	.063
P shrinkage mean ,	353716.,	.62,,,				.052,	.100
F shrinkage mean ,	533258.,	.50,,,				.081,	.067

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
653397.,	.14,	.10,	11,	.713,	.055

Table 8.5.6 (continued)

Age 4 Catchability dependent on age and year class strength

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
FLT01: FLT01: Trapne,	350745.,	.265,	.198,	.75,	3, .183,	.054
FLT02: FLT02: Bottom,	486370.,	.193,	.096,	.50,	4, .352,	.039
FLT03: FLT03: Pelagi,	388606.,	.187,	.061,	.32,	4, .372,	.049
P shrinkage mean ,	265370.,	.64, , , ,			.035,	.071
F shrinkage mean ,	256905.,	.50, , , ,			.058,	.073

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
397591.,	.11,	.07,	13,	.638,	.048

Age 5 Catchability dependent on age and year class strength

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
FLT01: FLT01: Trapne,	206764.,	.192,	.177,	.92,	5, .244,	.031
FLT02: FLT02: Bottom,	202767.,	.163,	.120,	.74,	5, .339,	.032
FLT03: FLT03: Pelagi,	225571.,	.159,	.077,	.48,	5, .354,	.028
P shrinkage mean ,	204787.,	.65, , , ,			.023,	.031
F shrinkage mean ,	78860.,	.50, , , ,			.040,	.079

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
203830.,	.10,	.08,	17,	.830,	.031

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
FLT01: FLT01: Trapne,	344586.,	.190,	.162,	.85,	6, .227,	.040
FLT02: FLT02: Bottom,	310896.,	.146,	.104,	.72,	6, .393,	.044
FLT03: FLT03: Pelagi,	319932.,	.155,	.056,	.36,	6, .340,	.043
F shrinkage mean ,	178257.,	.50, , , ,			.039,	.075

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
314392.,	.09,	.06,	19,	.692,	.043

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, , Weights,	Estimated F
FLT01: FLT01: Trapne,	396720.,	.192,	.111,	.58,	6, .212,	.037
FLT02: FLT02: Bottom,	401489.,	.136,	.070,	.52,	7, .441,	.036
FLT03: FLT03: Pelagi,	459127.,	.157,	.119,	.76,	7, .307,	.032
F shrinkage mean ,	339029.,	.50, , , ,			.041,	.043

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
414466.,	.09,	.05,	21,	.603,	.035



Table 8.5.7

Run title : Herring in 31 (run: XSAJAP09/X09)

At 19-Apr-96 10:11:26

Terminal Fs derived using XSA (With F shrinkage)

Table 8 YEAR,	Fishing mortality (F) at age 1973, 1974, 1975,		
AGE			
1,	.0160,	.0160,	.0053,
2,	.0030,	.0499,	.0880,
3,	.0216,	.0677,	.0859,
4,	.0446,	.0742,	.0573,
5,	.0792,	.0646,	.0595,
6,	.0613,	.1007,	.0489,
7,	.0421,	.0717,	.0682,
+gp,	.0421,	.0717,	.0682,
FBAR 2- 6,	.0419,	.0714,	.0679,

Table 8 YEAR,	Fishing mortality (F) at age 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985,									
AGE										
1,	.0122,	.0083,	.0134,	.0195,	.0580,	.0347,	.0209,	.0219,	.0417,	.0081,
2,	.0701,	.1164,	.0396,	.0564,	.2257,	.0959,	.0485,	.0429,	.1344,	.1099,
3,	.1104,	.1136,	.2074,	.0480,	.0699,	.1430,	.1696,	.0844,	.0934,	.1560,
4,	.1429,	.0937,	.0996,	.1806,	.1054,	.0492,	.1788,	.1473,	.0551,	.0966,
5,	.1173,	.1020,	.1256,	.0940,	.2681,	.1070,	.0761,	.1207,	.1474,	.0745,
6,	.0932,	.1245,	.1276,	.1328,	.1309,	.2190,	.2119,	.2491,	.0997,	.1211,
7,	.1075,	.1103,	.1151,	.1188,	.1886,	.1903,	.1985,	.2089,	.1795,	.0910,
+gp,	.1075,	.1103,	.1151,	.1188,	.1886,	.1903,	.1985,	.2089,	.1795,	.0910,
FBAR 2- 6,	.1068,	.1100,	.1200,	.1024,	.1600,	.1228,	.1370,	.1289,	.1060,	.1116,

Run title : Herring in 31 (run: XSAJAP09/X09)

At 19-Apr-96 10:11:26

Terminal Fs derived using XSA (With F shrinkage)

Table 8 YEAR,	Fishing mortality (F) at age 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995,										FBAR 93-95
AGE											
1,	.0086,	.0156,	.0311,	.0061,	.0131,	.0041,	.0146,	.0178,	.0159,	.0220,	.0186,
2,	.0457,	.1064,	.0960,	.0518,	.0849,	.0398,	.0534,	.0830,	.0485,	.0362,	.0559,
3,	.0877,	.0834,	.1029,	.0673,	.0459,	.0835,	.0695,	.0720,	.0649,	.0552,	.0640,
4,	.1161,	.0895,	.0986,	.0473,	.0808,	.0418,	.0873,	.1030,	.0519,	.0478,	.0676,
5,	.0868,	.1017,	.1121,	.0572,	.0688,	.0850,	.0509,	.1313,	.0590,	.0314,	.0739,
6,	.1275,	.0919,	.1094,	.0641,	.0831,	.0590,	.0583,	.1066,	.0682,	.0433,	.0727,
7,	.1467,	.1488,	.0816,	.0552,	.0939,	.0669,	.0817,	.0588,	.0400,	.0351,	.0446,
+gp,	.1467,	.1488,	.0816,	.0552,	.0939,	.0669,	.0817,	.0588,	.0400,	.0351,	.0446,
FBAR 2- 6,	.0928,	.0946,	.1038,	.0575,	.0727,	.0618,	.0639,	.0992,	.0585,	.0428,	

Table 8.5.7 (continued)

Run title : Herring in 31 (run: XSAJAP09/X09)

At 19-Apr-96 10:11:26

Terminal Fs derived using XSA (With F shrinkage)

Table 10 YEAR,	Stock number at age (start of year)			Numbers*10**-3
	1973,	1974,	1975,	
AGE				
1,	679673,	679435,	409132,	
2,	364468,	575723,	575518,	
3,	554604,	312773,	471408,	
4,	544014,	467147,	251579,	
5,	396379,	447827,	373317,	
6,	615884,	315190,	361327,	
7,	130776,	498553,	245310,	
+gp,	26117,	295474,	293845,	
TOTAL,	3311914,	3592122,	2981435,	

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10**-3				
	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	1245754,	260301,	161876,	334956,	1262083,	410410,	365210,	1495973,	1028785,	536995,
2,	350287,	1059243,	222187,	137473,	282733,	1025054,	341182,	307845,	1259763,	849301,
3,	453604,	281085,	811503,	183817,	111830,	194180,	801559,	279742,	253832,	947911,
4,	372346,	349600,	215955,	567655,	150791,	89759,	144866,	582290,	221294,	198993,
5,	204476,	277804,	273999,	168247,	407871,	116798,	73545,	104277,	432529,	180264,
6,	302762,	156511,	215915,	208001,	131823,	268489,	90324,	58662,	79547,	321255,
7,	296153,	237396,	118939,	163574,	156762,	99545,	185631,	62899,	39358,	61973,
+gp,	422113,	247145,	454851,	297560,	218746,	204633,	155160,	142446,	130777,	222639,
TOTAL,	3647496,	2869086,	2475225,	2061281,	2722639,	2408869,	2157479,	3034132,	3445886,	3319329,

Table 10	Stock number at age (start of year)					Numbers*10***-3							
YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST	
AGE													
1,	500613,	625288,	281663,	1949895,	1073535,	532448,	893839,	1158447,	751864,	2476151,	0,	6256	
2,	458484,	427170,	529841,	235008,	1668085,	911939,	456427,	758201,	979458,	636930,	2079076,	5043	
3,	654926,	376994,	330559,	414290,	192068,	1318839,	754298,	372440,	600636,	803134,	529236,	3999	
4,	698050,	516385,	298505,	256683,	333389,	157892,	1044216,	605626,	298296,	484501,	653397,	3223	
5,	155503,	534948,	406419,	232804,	210724,	264685,	130333,	823618,	470242,	243757,	397591,	2502	
6,	144022,	122710,	415902,	312698,	189244,	169311,	209261,	106612,	621686,	381547,	203830,	1945	
7,	244963,	109117,	96340,	320860,	252443,	149895,	137378,	169908,	82484,	499836,	314392,	1525	
+gp,	220646,	163218,	274719,	180191,	287898,	432263,	274218,	339248,	219643,	187181,	570015,		
TOTAL,	3077208,	2875830,	2633949,	3902429,	4207385,	3937273,	3899970,	4334100,	4024309,	5713040,	4747537,		

Table 8.5.7 (continued)

Run title : Herring in 31 (run: XSAJAP09/X09)

At 19-Apr-96 10:11:26

Terminal Fs derived using XSA (With F shrinkage)

Table 15 YEAR,	Spawning stock biomass with SOP (spawning time)						Tonnes			
	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	2406,	3093,	4601,	1674,	9751,	6731,	1691,	6433,	8485,	1547,
3,	17079,	10624,	10401,	12642,	6126,	27276,	13360,	9463,	16609,	17759,
4,	23369,	18458,	11237,	9705,	12188,	5152,	28867,	18174,	10146,	14358,
5,	6036,	21534,	17303,	9835,	9139,	9773,	4830,	26149,	16946,	7900,
6,	6098,	5509,	19639,	14320,	9100,	7194,	8134,	4197,	23651,	13372,
7,	11261,	5353,	4927,	15290,	12846,	6768,	6081,	8020,	3662,	18439,
+gp,	12421,	9045,	15837,	9883,	16309,	24201,	14162,	18254,	12701,	9768,
TOTSPBIO,	78670,	73616,	83944,	73350,	75459,	87095,	77126,	90689,	92200,	83142,

Run title : Herring in 31 (run: XSAJAP09/X09)

At 19-Apr-96 10:11:26

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,
1973,	679673,	101749,	80375,	3976,	.0495,	.0419,
1974,	679435,	112168,	86624,	6482,	.0748,	.0714,
1975,	409131,	97987,	77926,	5547,	.0712,	.0679,
1976,	1245755,	103483,	76275,	8508,	.1115,	.1068,
1977,	260301,	85229,	61208,	7330,	.1198,	.1100,
1978,	161876,	87352,	73783,	9768,	.1324,	.1200,
1979,	334956,	71970,	59107,	7060,	.1194,	.1024,
1980,	1262084,	70248,	46286,	9659,	.2087,	.1600,
1981,	410410,	67829,	42670,	7826,	.1834,	.1228,
1982,	365210,	69360,	51736,	8652,	.1672,	.1370,
1983,	1495973,	78979,	49136,	7707,	.1569,	.1289,
1984,	1028785,	95703,	53155,	8916,	.1677,	.1060,
1985,	536995,	101458,	71412,	9312,	.1304,	.1116,
1986,	500613,	97638,	77250,	9090,	.1177,	.0928,
1987,	625288,	96608,	74633,	8108,	.1086,	.0946,
1988,	281663,	101297,	83992,	8768,	.1044,	.1038,
1989,	1949895,	112692,	76194,	4437,	.0582,	.0575,
1990,	1073535,	114159,	72979,	7818,	.1071,	.0727,
1991,	532448,	123766,	89925,	6800,	.0756,	.0618,
1992,	893838,	108394,	77798,	6540,	.0841,	.0639,
1993,	1158448,	124551,	89680,	9167,	.1022,	.0992,
1994,	751864,	109829,	83589,	5825,	.0697,	.0585,
1995,	2476151,	128035,	86569,	4343,	.0502,	.0428,
Arith. Mean Units,	831058, (Thousands),	98282, (Tonnes),	71404, (Tonnes),	7463, (Tonnes),	.1118,	.0928,

Table 8.5.8 Estimation of MBAL with Ricker function for herring in SD 31

a= 14.09825		Rmax =(a/b)*(exp(-1))						
b= 5.32E-06		R_mod =a*SSB*EXP(-b*SSB)			Residual in			
				year y				
year	observed ssb	recruits	Model R mod	Logs R mod	Log R obs.	(R_mod- R_obs)	(R_mod- R_obs)^2	Residuals in year y-1
1973	80375	679435	738828.8	5.868544	5.832148	0.036396	0.001325	
1974	86624	409131	770229.2	5.88662	5.611862	0.274758	0.075492	0.036396
1975	77926	1245755	725712.7	5.860765	6.095433	-0.23467	0.055069	0.274758
1976	76275	260301	716605.2	5.85528	5.415476	0.439804	0.193428	-0.23467
1977	61208	161876	623052.9	5.794525	5.209182	0.585342	0.342626	0.439804
1978	73783	334956	702445.9	5.846613	5.524988	0.321625	0.103443	0.585342
1979	59107	1262084	608430.5	5.784211	6.101088	-0.31688	0.100411	0.321625
1980	46286	410410	510094.2	5.70765	5.613218	0.094432	0.008917	-0.31688
1981	42670	365210	479379.8	5.68068	5.562543	0.118137	0.013956	0.094432
1982	51736	1495973	553858.6	5.743399	6.174924	-0.43152	0.186214	0.118137
1983	49136	1028785	533352.5	5.727014	6.012325	-0.28531	0.081402	-0.43152
1984	53155	536995	564769.1	5.751871	5.72907	0.021901	0.00048	-0.28531
1985	71412	500613	688504.9	5.837907	5.699502	0.138405	0.019156	0.021901
1986	77250	625288	722009.7	5.858543	5.79608	0.062463	0.003902	0.138405
1987	74633	281663	707331.8	5.849623	5.44973	0.399893	0.159915	0.062463
1988	83992	1949895	757359.5	5.879302	6.290011	-0.41071	0.168682	0.399893
1989	76194	1073535	716152.8	5.855006	6.030816	-0.17581	0.030909	-0.41071
1990	72979	532448	697770.3	5.843713	5.726277	0.117435	0.013791	-0.17581
1991	89925	893838	785658.4	5.895234	5.951259	-0.05603	0.003139	0.117435
1992	77798	1158448	725014.3	5.860347	6.063877	-0.20353	0.041424	-0.05603
1993	89680	751864	784540	5.894615	5.876139	0.018476	0.000341	-0.20353
1994	83589	2476151	755343.6	5.878145	6.393777	-0.51563	0.265877	0.018476
			Rmax=	974686.7	SSQ=			1.869898
			50 % of Rmax=	487343.4				
MBAL= 43600		487343.4	486550.9					

Table 8.5.9

10:38 Thursday, April 25, 1996

Herring in Baltic Fishing Area 31

Prediction with management option table: Input data

Year: 1996								
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	833159.00	0.1500	0.0000	0.1500	0.4000	11.467	0.0119	11.467
2	2079076.0	0.1500	0.3210	0.1500	0.4000	19.900	0.0358	19.900
3	529236.00	0.1500	0.9120	0.1500	0.4000	28.500	0.0410	28.500
4	653397.00	0.1500	0.9950	0.1500	0.4000	32.533	0.0433	32.533
5	397591.00	0.1500	1.0000	0.1500	0.4000	35.033	0.0473	35.033
6	203830.00	0.1500	1.0000	0.1500	0.4000	39.167	0.0466	39.167
7	314392.00	0.1500	1.0000	0.1500	0.4000	44.700	0.0286	44.700
8+	570015.00	0.1500	1.0000	0.1500	0.4000	57.105	0.0286	57.105
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	833159.00	0.1500	0.0000	0.1500	0.4000	11.467	0.0119	11.467
2	.	0.1500	0.3210	0.1500	0.4000	19.900	0.0358	19.900
3	.	0.1500	0.9120	0.1500	0.4000	28.500	0.0410	28.500
4	.	0.1500	0.9950	0.1500	0.4000	32.533	0.0433	32.533
5	.	0.1500	1.0000	0.1500	0.4000	35.033	0.0473	35.033
6	.	0.1500	1.0000	0.1500	0.4000	39.167	0.0466	39.167
7	.	0.1500	1.0000	0.1500	0.4000	44.700	0.0286	44.700
8+	.	0.1500	1.0000	0.1500	0.4000	57.105	0.0286	57.105
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 1998								
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	833159.00	0.1500	0.0000	0.1500	0.4000	11.467	0.0119	11.467
2	.	0.1500	0.3210	0.1500	0.4000	19.900	0.0358	19.900
3	.	0.1500	0.9120	0.1500	0.4000	28.500	0.0410	28.500
4	.	0.1500	0.9950	0.1500	0.4000	32.533	0.0433	32.533
5	.	0.1500	1.0000	0.1500	0.4000	35.033	0.0473	35.033
6	.	0.1500	1.0000	0.1500	0.4000	39.167	0.0466	39.167
7	.	0.1500	1.0000	0.1500	0.4000	44.700	0.0286	44.700
8+	.	0.1500	1.0000	0.1500	0.4000	57.105	0.0286	57.105
Unit	Thousands	-	-	-	-	Grams	-	Grams

Notes: Run name : MANJAP01  
Date and time: 22APR96:16:23

Table 8.5.10

Herring in Baltic Fishing Area 31

15:48 Monday, April 22, 1996

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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	0.0428	155784	109299	5013	0.0000	0.0000	168466	136496	0	178039	147880
.	.	.	.	.	0.1000	0.0043	.	136418	571	177434	147243
.	.	.	.	.	0.2000	0.0086	.	136340	1140	176831	146608
.	.	.	.	.	0.3000	0.0128	.	136262	1707	176231	145976
.	.	.	.	.	0.4000	0.0171	.	136184	2272	175632	145347
.	.	.	.	.	0.5000	0.0214	.	136106	2834	175036	144721
.	.	.	.	.	0.6000	0.0257	.	136028	3395	174443	144098
.	.	.	.	.	0.7000	0.0300	.	135950	3953	173851	143478
.	.	.	.	.	0.8000	0.0342	.	135873	4509	173262	142860
.	.	.	.	.	0.9000	0.0385	.	135795	5063	172675	142245
.	.	.	.	.	1.0000	0.0428	.	135717	5615	172091	141633
.	.	.	.	.	1.1000	0.0471	.	135640	6165	171508	141023
.	.	.	.	.	1.2000	0.0514	.	135562	6713	170928	140416
.	.	.	.	.	1.3000	0.0556	.	135485	7259	170351	139812
.	.	.	.	.	1.4000	0.0599	.	135408	7803	169775	139211
.	.	.	.	.	1.5000	0.0642	.	135330	8344	169202	138613
.	.	.	.	.	1.6000	0.0685	.	135253	8884	168630	138017
.	.	.	.	.	1.7000	0.0728	.	135175	9422	168061	137423
.	.	.	.	.	1.8000	0.0770	.	135098	9957	167495	136833
.	.	.	.	.	1.9000	0.0813	.	135021	10491	166930	136245
.	.	.	.	.	2.0000	0.0856	.	134944	11022	166368	135660
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANJAP01  
Date and time : 22APR96:16:23  
Computation of ref. F: Simple mean, age 2 - 6  
Basis for 1996 : F factors

Table 8.5.11

Herring in Baltic Fishing Area 31

15:48 Monday, April 22, 1996

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
						Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.5000	0.0214	81129	3020	5441657	196818	4068895	176038	3821590	165361
0.6000	0.0257	95496	3534	5346109	191908	3974197	171148	3730597	160683
0.7000	0.0300	109319	4022	5254185	187198	3883122	166457	3643091	156197
0.8000	0.0342	122627	4486	5165696	182678	3795479	161956	3558890	151893
0.9000	0.0385	135446	4927	5080467	178336	3711094	157634	3477824	147760
1.0000	0.0428	147802	5345	4998331	174165	3629801	153482	3399735	143792
1.1000	0.0471	159716	5744	4919136	170155	3551445	149491	3324474	139978
1.2000	0.0514	171211	6123	4842736	166299	3475884	145654	3251902	136311
1.3000	0.0556	182307	6484	4768996	162588	3402980	141962	3181889	132784
1.4000	0.0599	193023	6827	4697789	159015	3332607	138408	3114312	129389
1.5000	0.0642	203378	7154	4628996	155575	3264646	134986	3049057	126121
-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : YLDJAP01  
Date and time : 22APR96:16:43  
Computation of ref. F: Simple mean, age 2 - 6  
F-0.1 factor : 0.5000  
F-max factor : Not found  
F-0.1 reference F : 0.0214  
F-max reference F : Not found  
Recruitment : 833159 (Thousands)

Figure 8.2.1

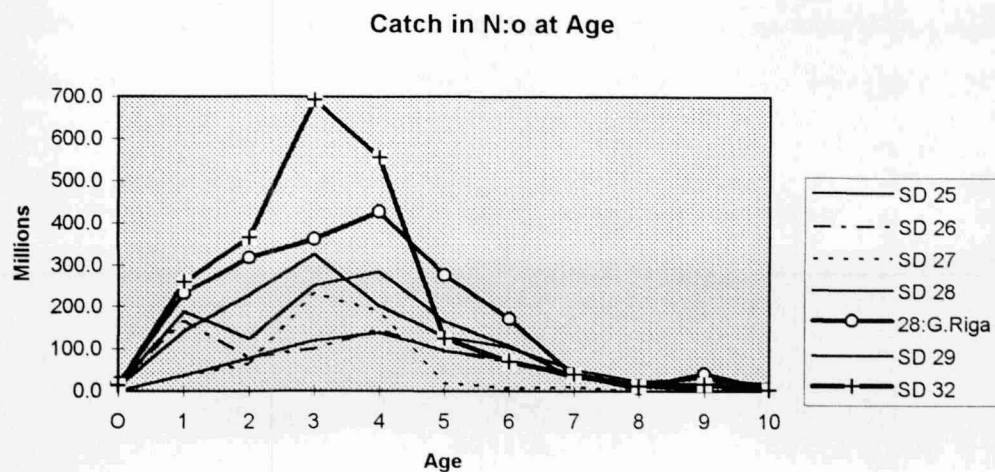


Figure 8.2.2

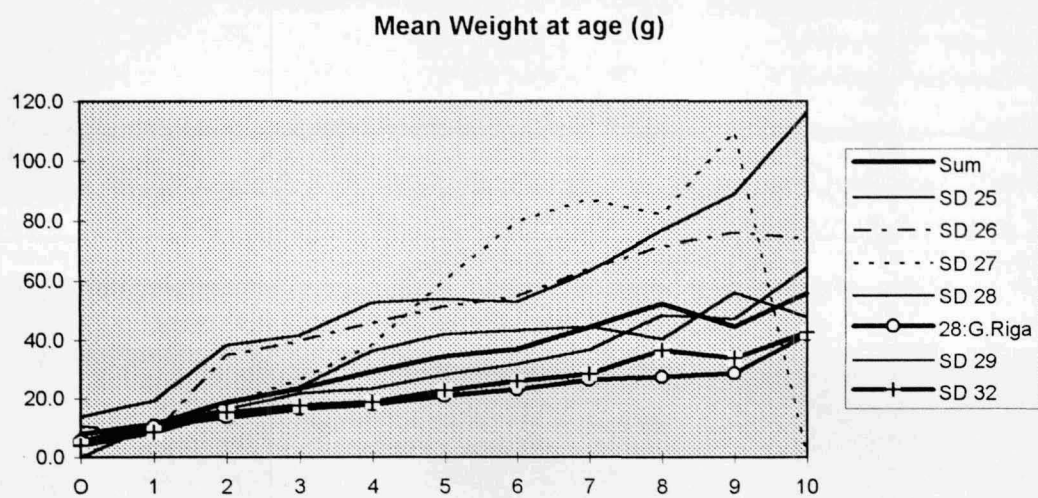




Figure 8.2.3

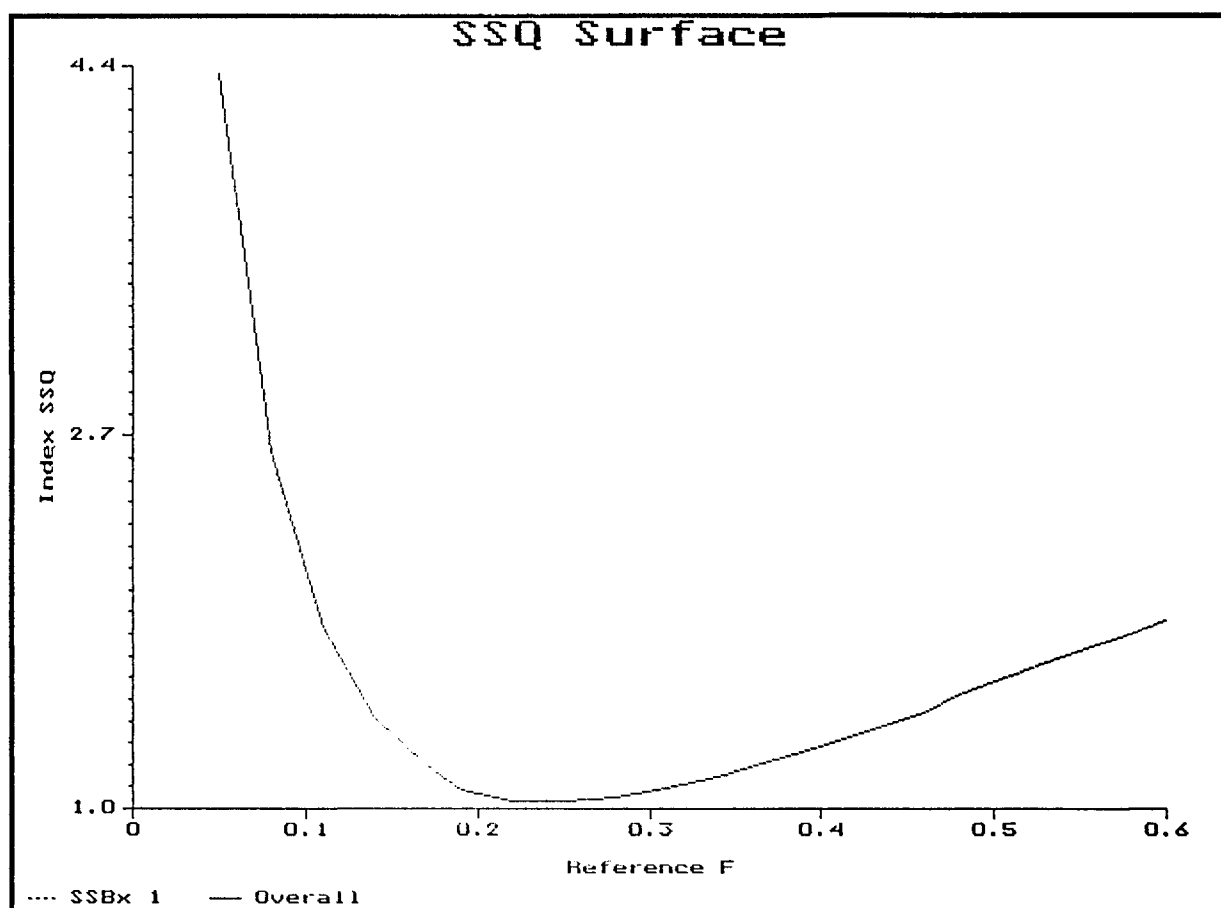


Figure 8.2.4

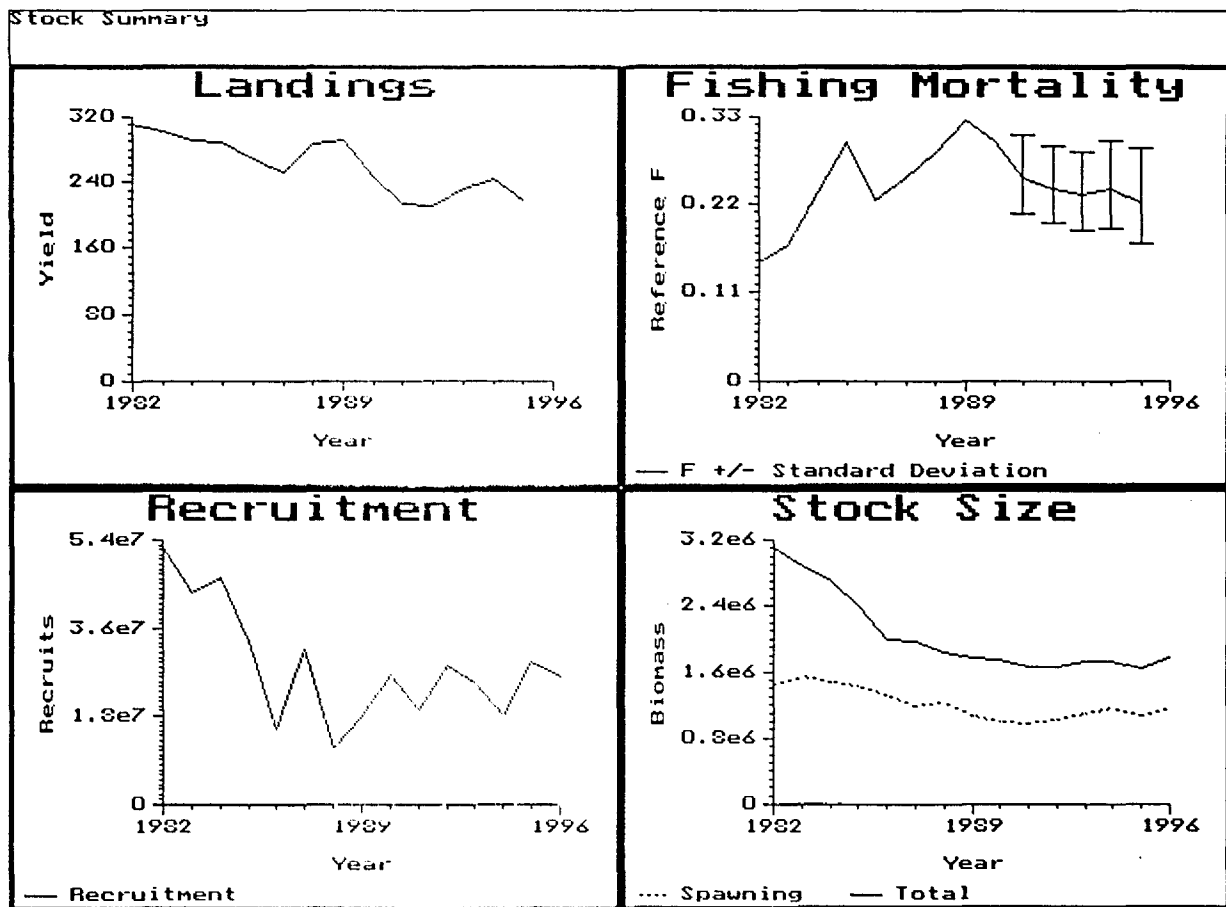


Figure 8.2.5

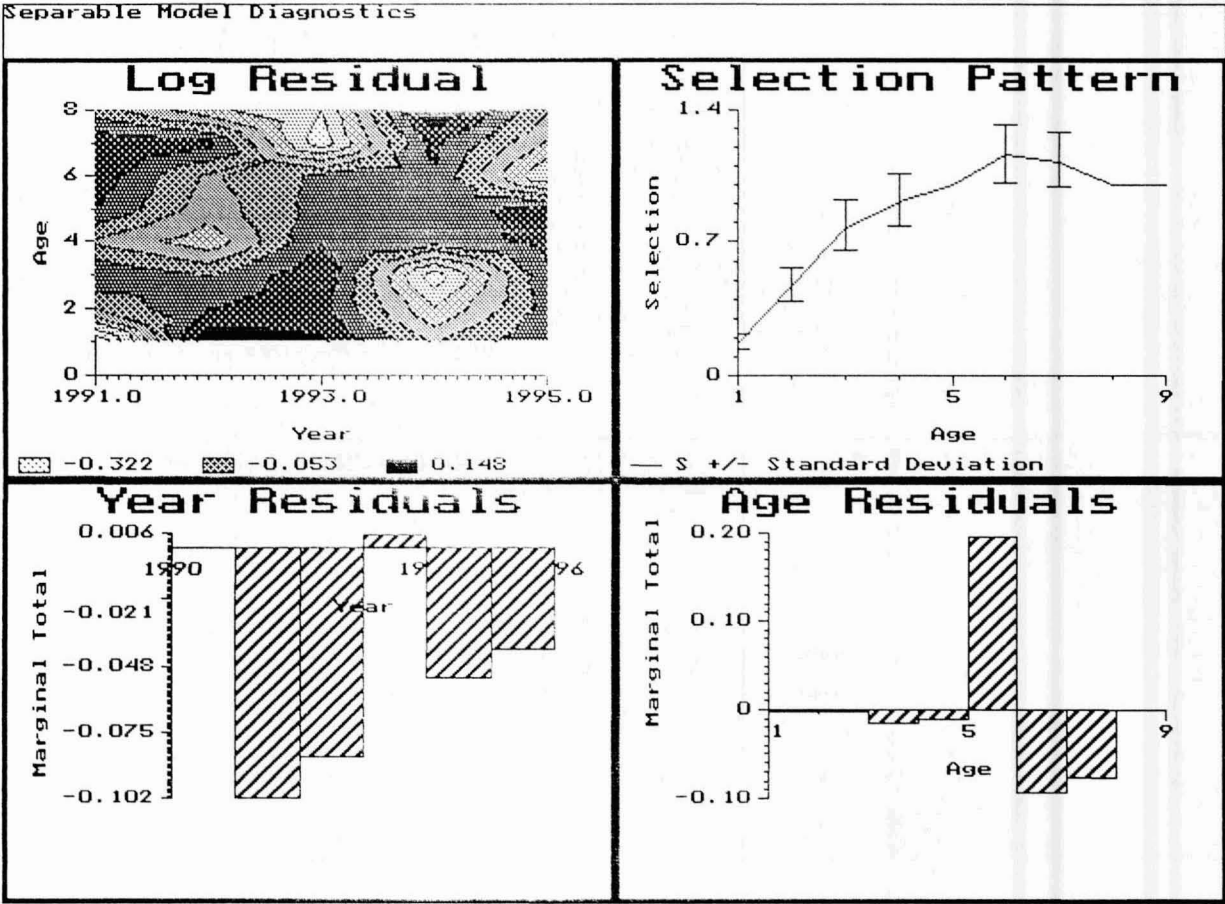


Figure 8.2.6

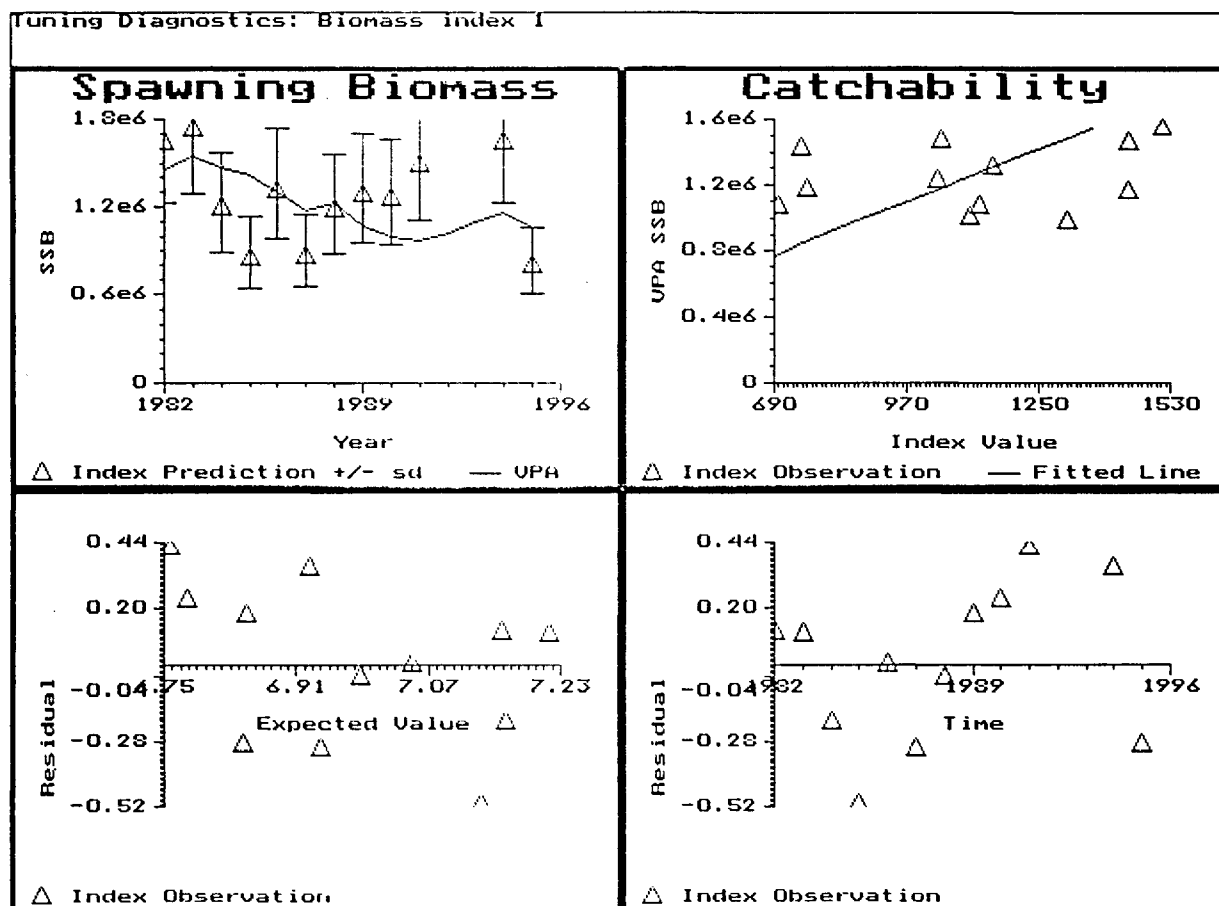
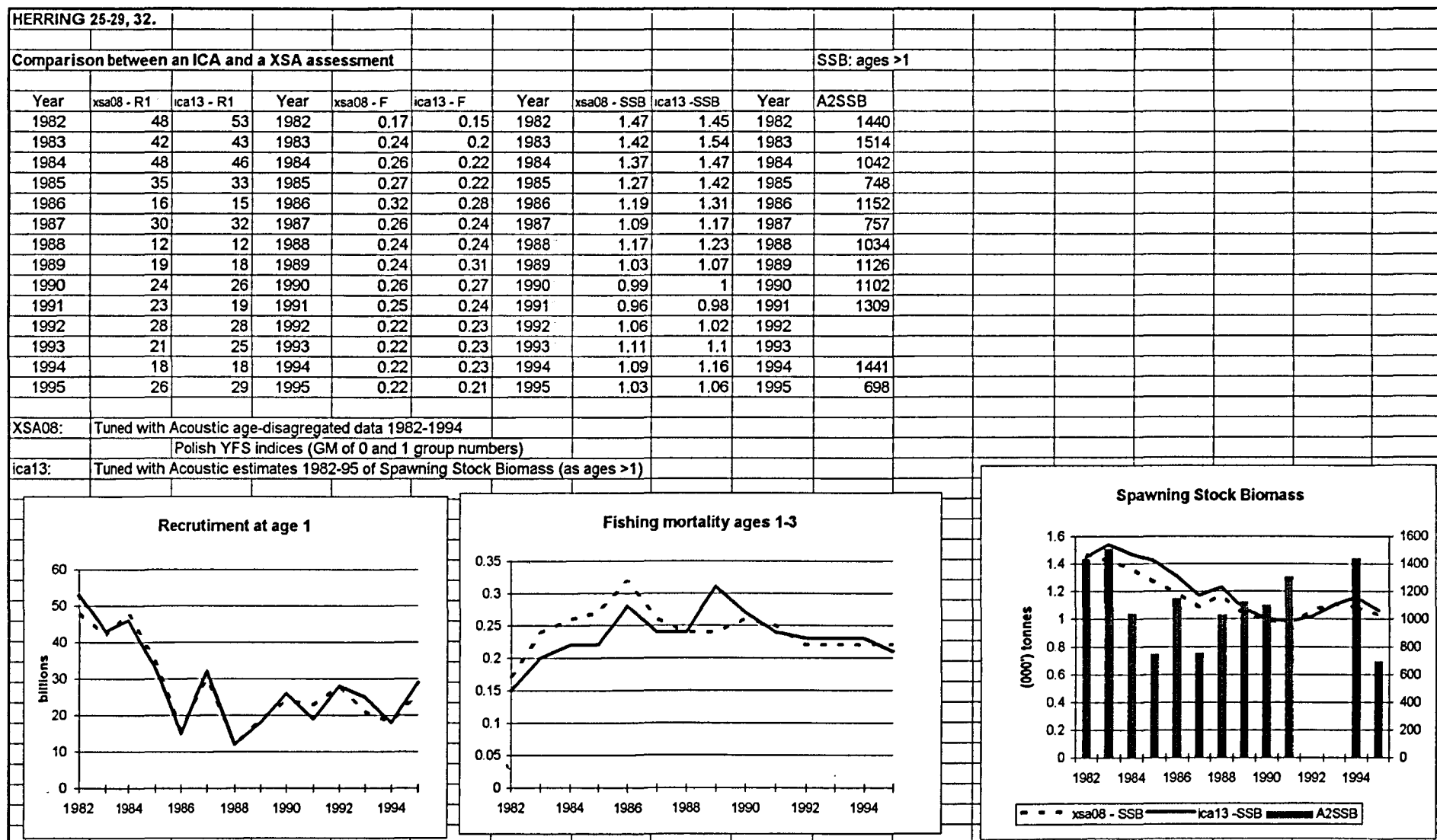


Figure 8.2.7a-c

Preferred runs



a

b

c

Figure 8.2.8a

F-retro

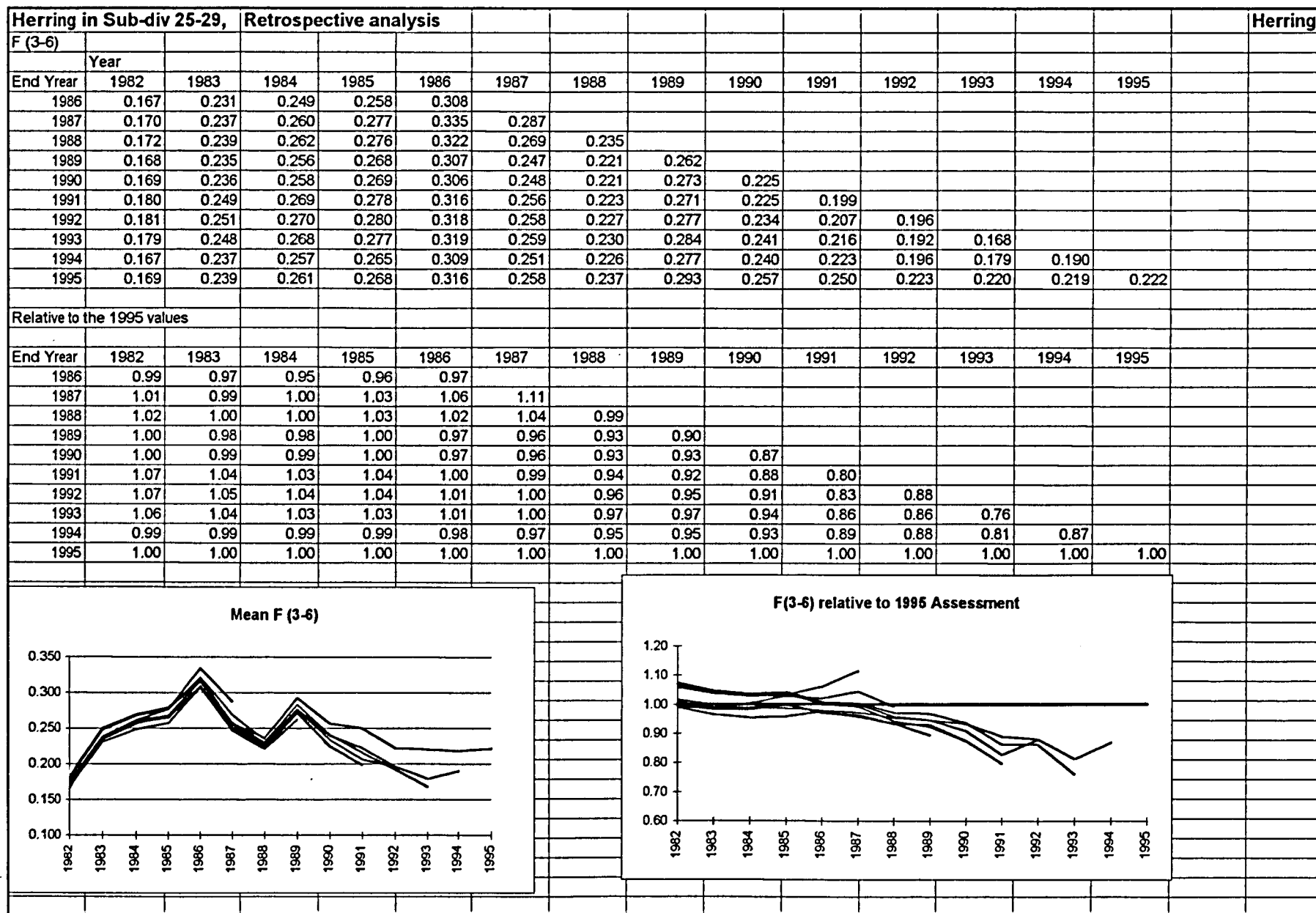


Figure 8.2.8b

SSB-retro

312

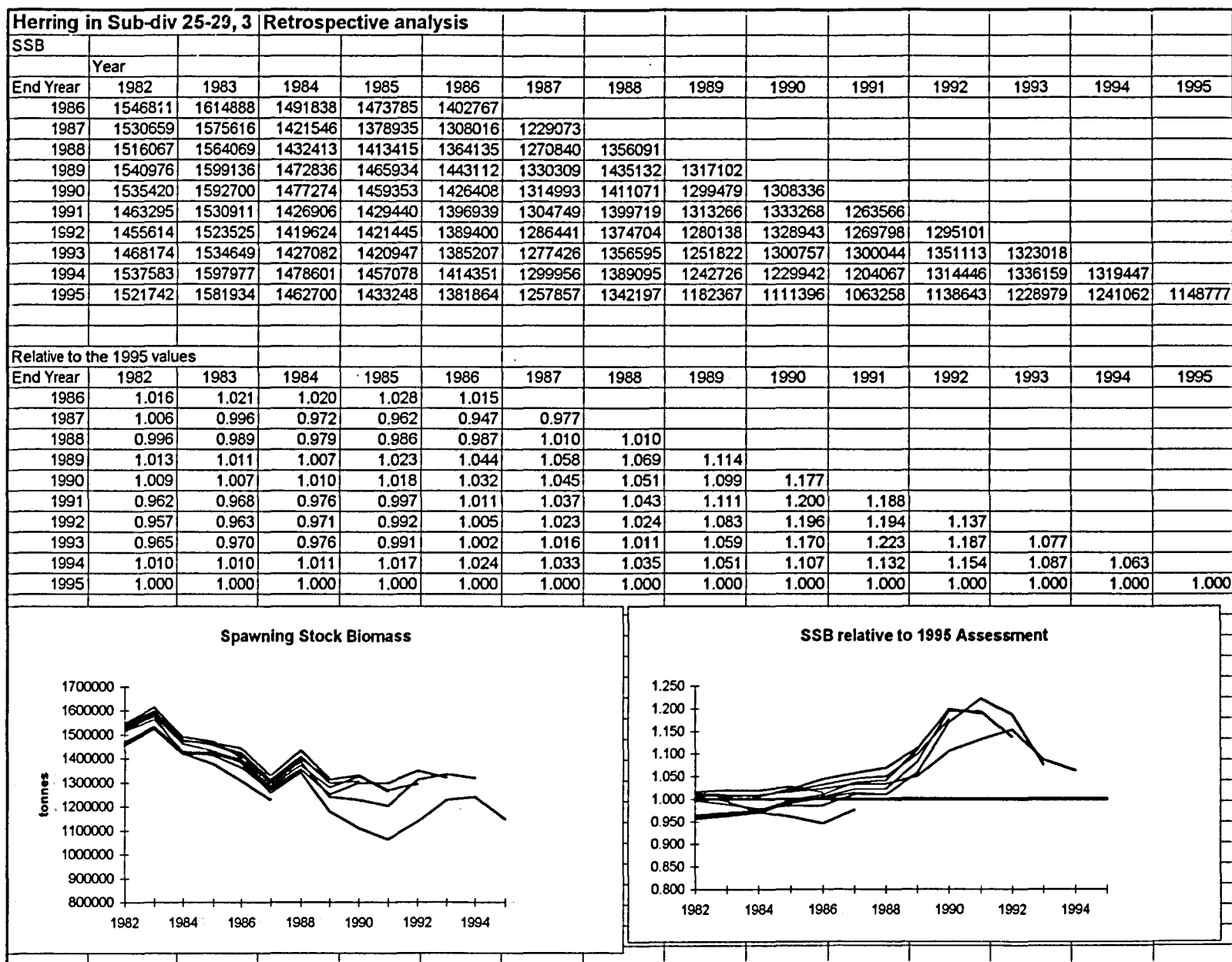


Figure 8.2.9

**Medium-term projections: HERRING 25-29+32**

**Examples of trajectories**

1158	1239	1472	1837	1925	1887	1671	1770	1911	1843
1386	1402	1459	1587	1669	1728	1704	1754	1729	1741
1223	1198	1204	1197	1170	1077	1180	1185	1336	1371
1122	1098	1132	1077	1250	1276	1383	1377	1587	1773
1223	1276	1347	1478	1496	1455	1630	1753	2043	2186
1138	1616	1787	1849	1831	1897	1789	1992	1985	2078
1294	1194	1114	1202	1318	1395	1490	1460	1588	1648

**Fractiles of SSB distribution**

year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
5%	1056	1003	989	1012	1055	1083	1118	1142	1209	1212
25%	1154	1170	1201	1224	1252	1299	1353	1399	1439	1465
50%	1254	1272	1329	1379	1435	1460	1537	1621	1660	1696
75%	1365	1412	1502	1603	1638	1717	1789	1855	1934	1941
95%	1489	1622	1784	1899	1992	2142	2203	2339	2415	2544

Rys. 8.2.10.1. Medium-term projections of SSB for herring in Sub-divisions 25-29 + 32  
Fractiles (5,25,50,75, and 95%) and selected trajectories  
Staus quo fishing mortality

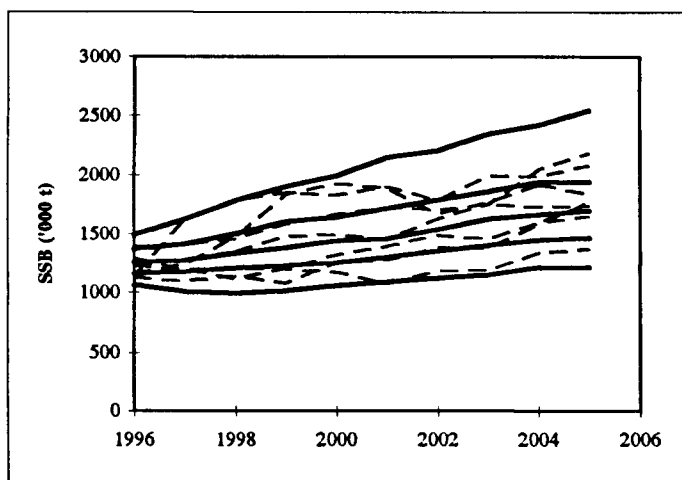
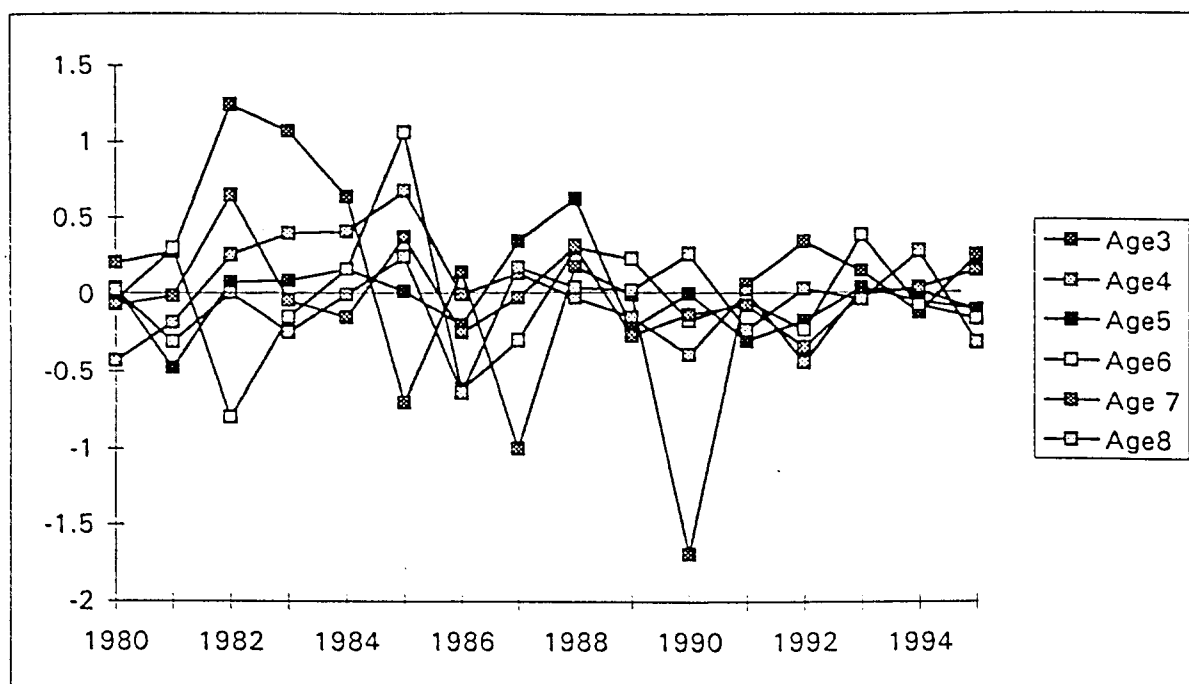


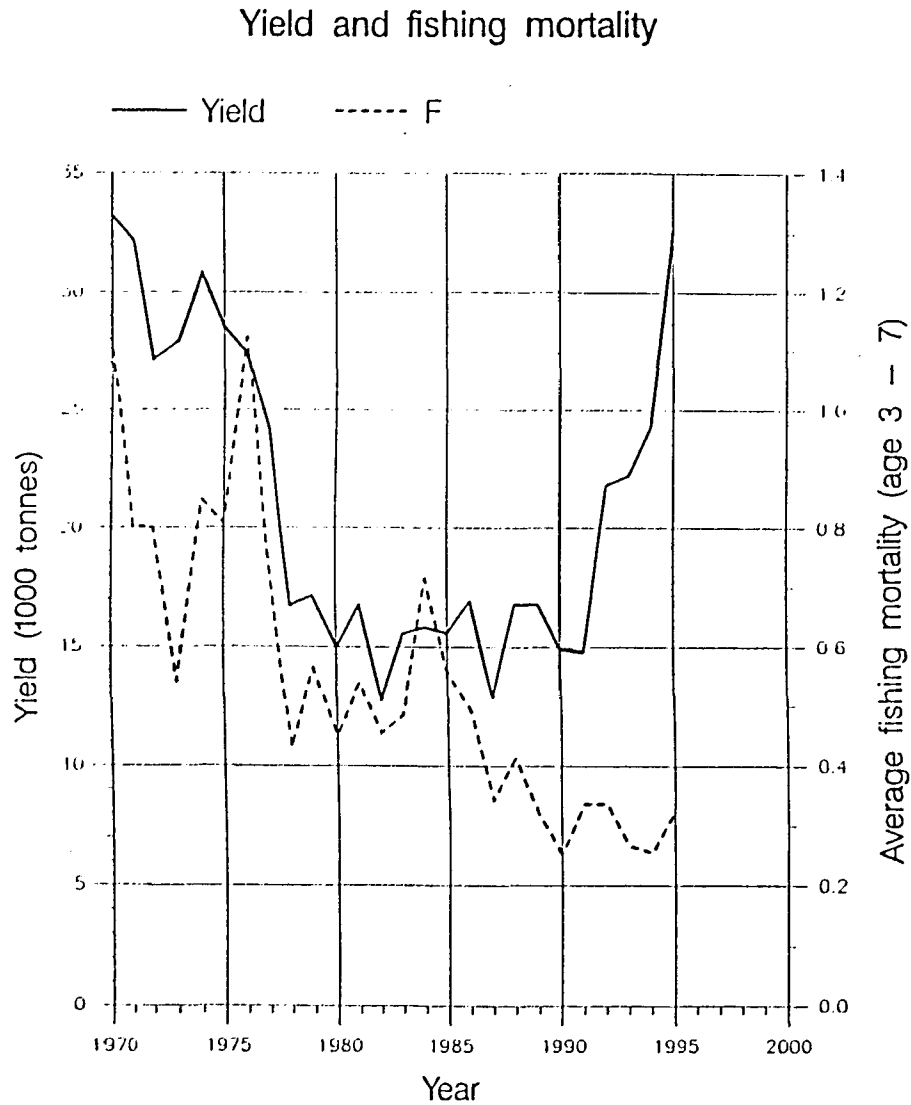


Figure 8.3.1 Herring in the Gulf of Riga. Log residuals of catchability.



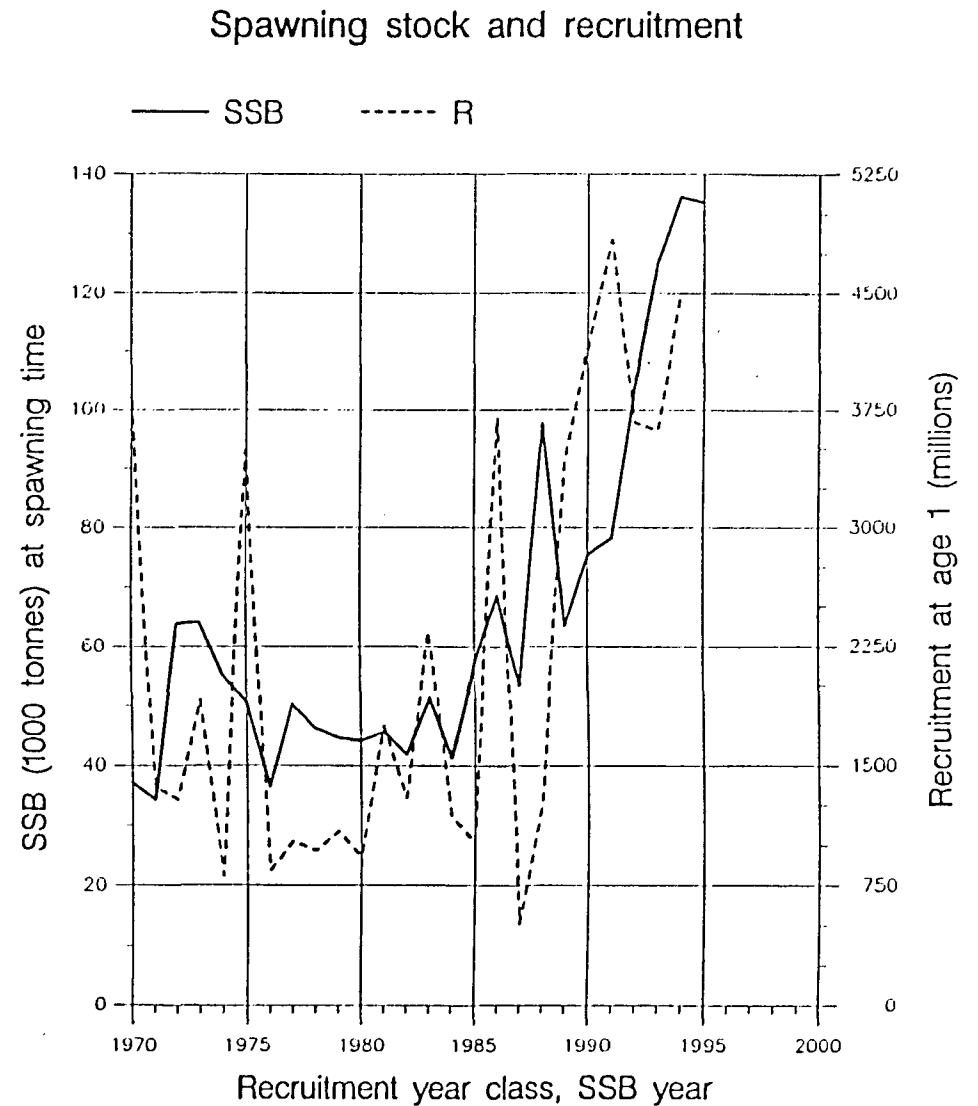
# Fish Stock Summary Herring in the Gulf of Riga 20-4-1996

Figure 8.3.2



(run: TUNTRA09)

A



(run: TUNTRA09)

B

Figure 8.3.3 Retrospective analysis for the Gulf of Riga herring

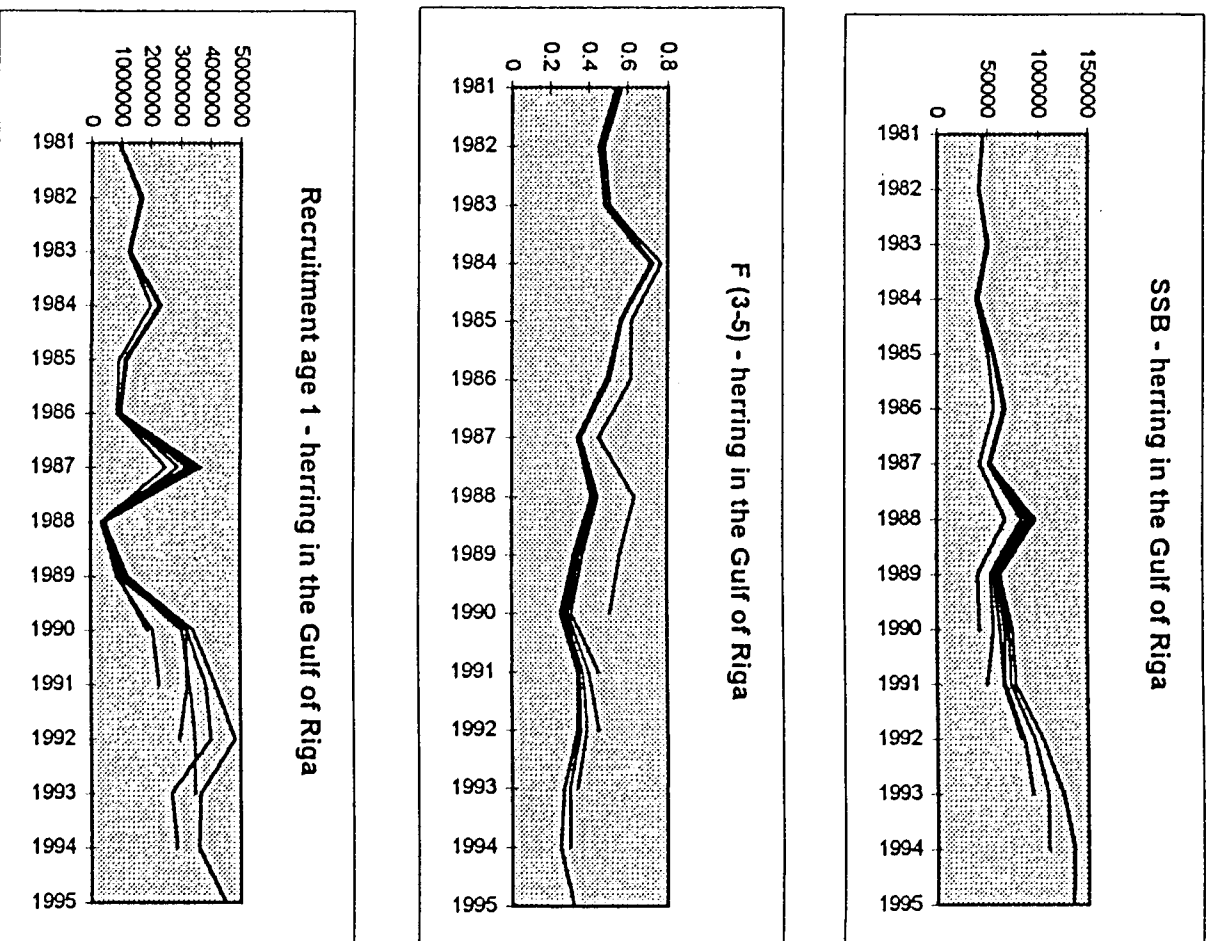
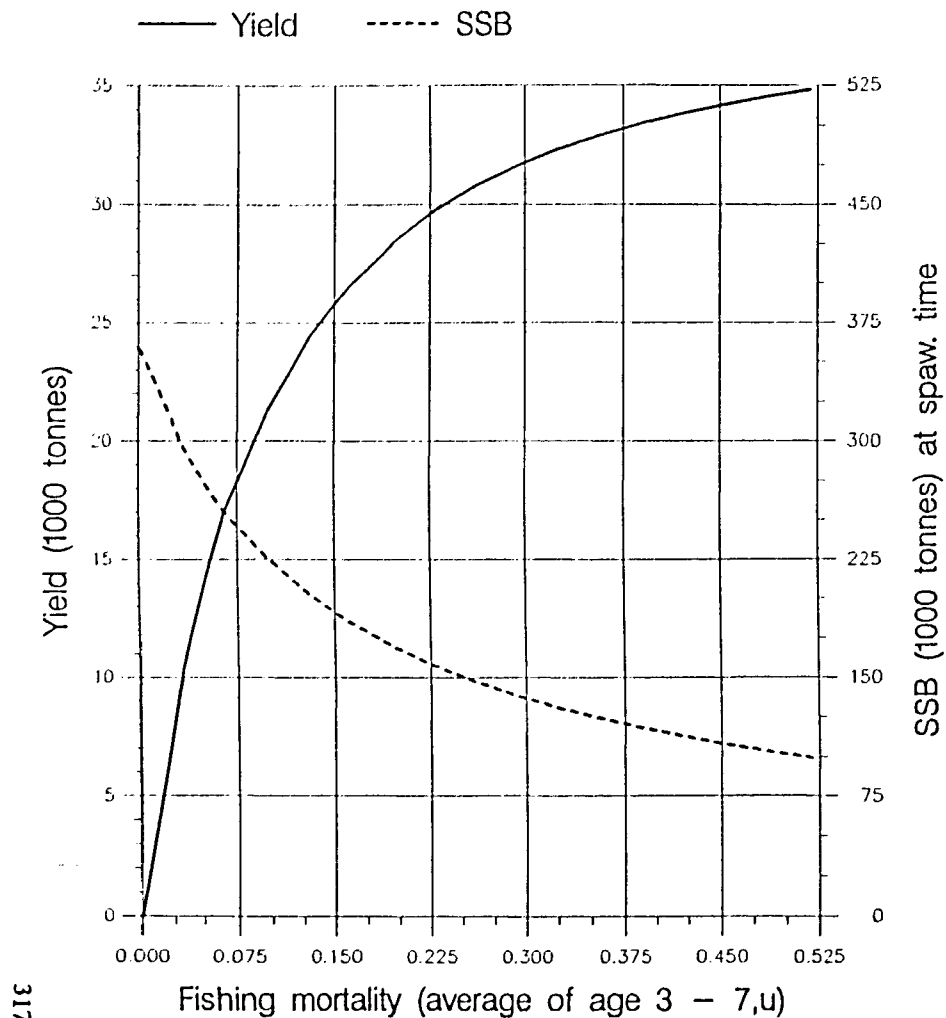


Figure 8.3.4

# Fish Stock Summary Herring in the Gulf of Riga 23-4-1996

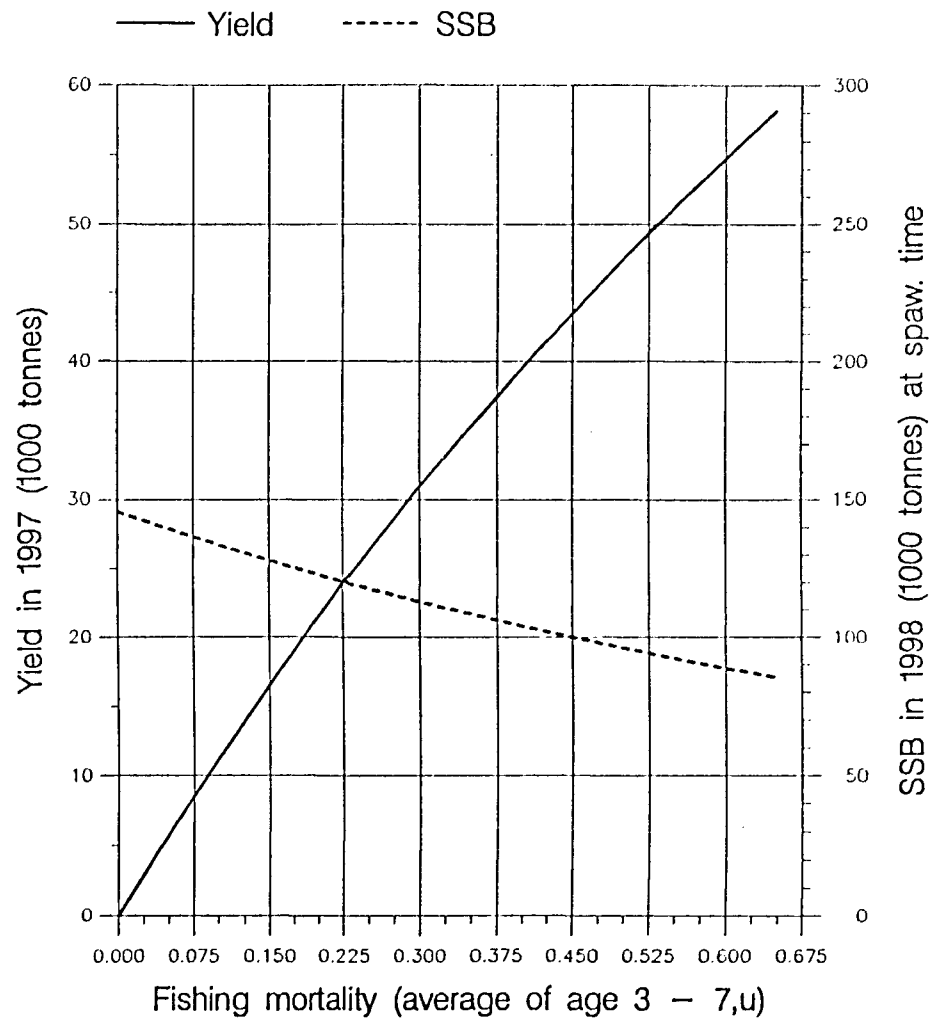
Long term yield and spawning stock biomass

Short term yield and spawning stock biomass



(run: YLDTRA10)

C



(run: MANTRA02)

D

Figure 8.3.5 Stock-recruitment plot for the herring in the Gulf of Riga (1971–1994).

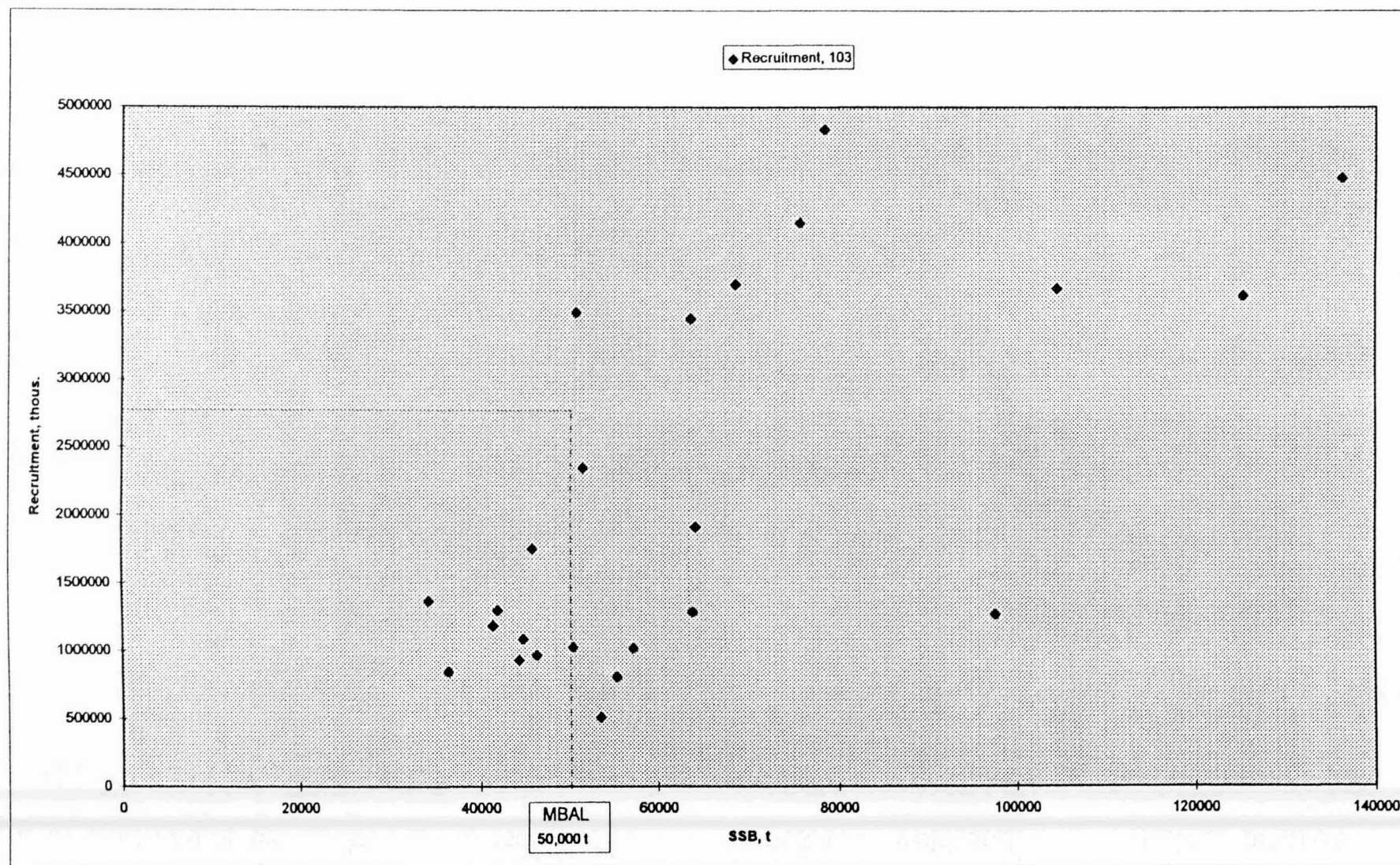


Figure 8.4.1

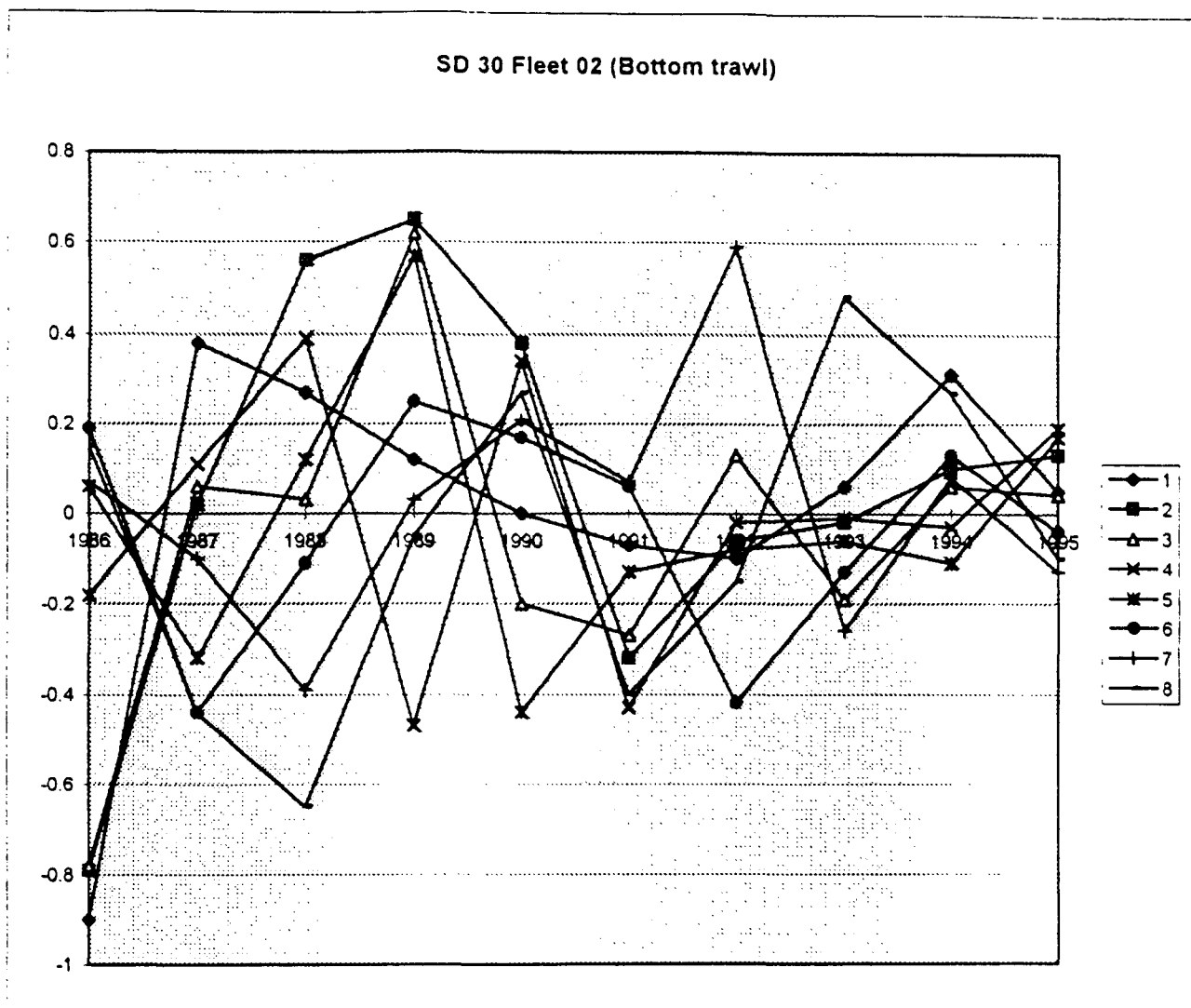
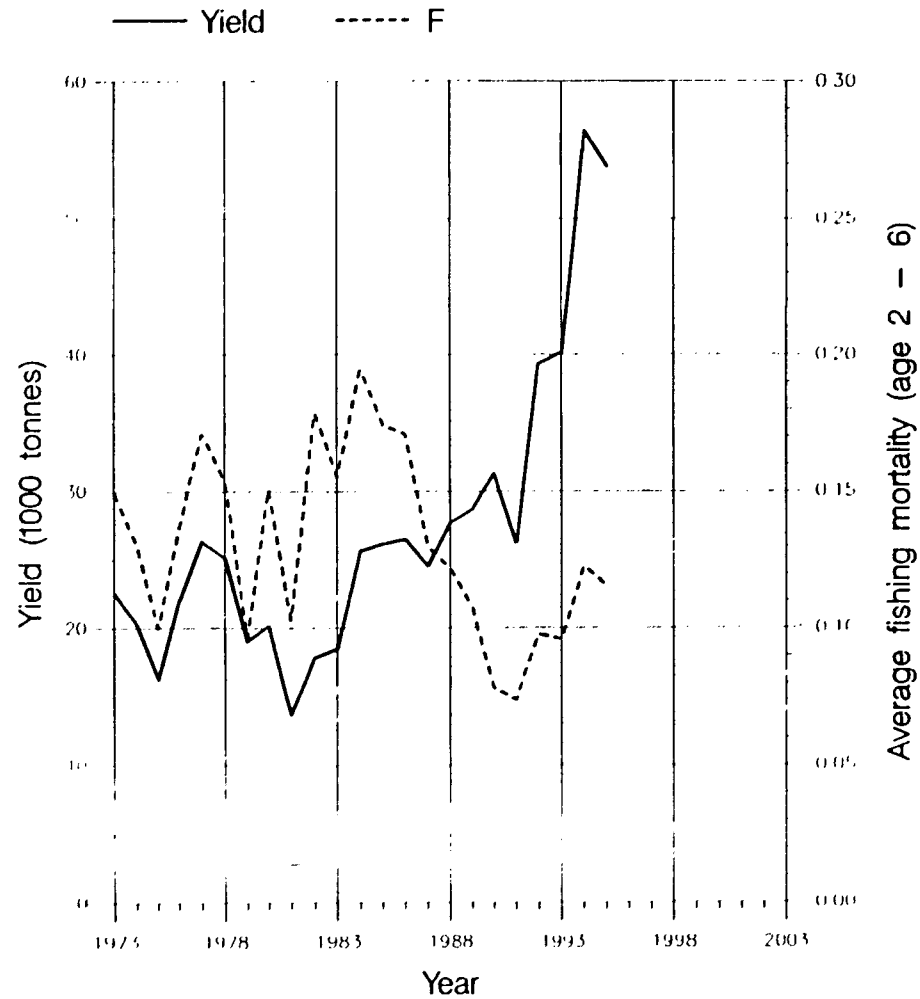


Figure 8.4.2

320

# Fish Stock Summary Herring in Baltic Fishing Area 30 19 – 4 – 1996

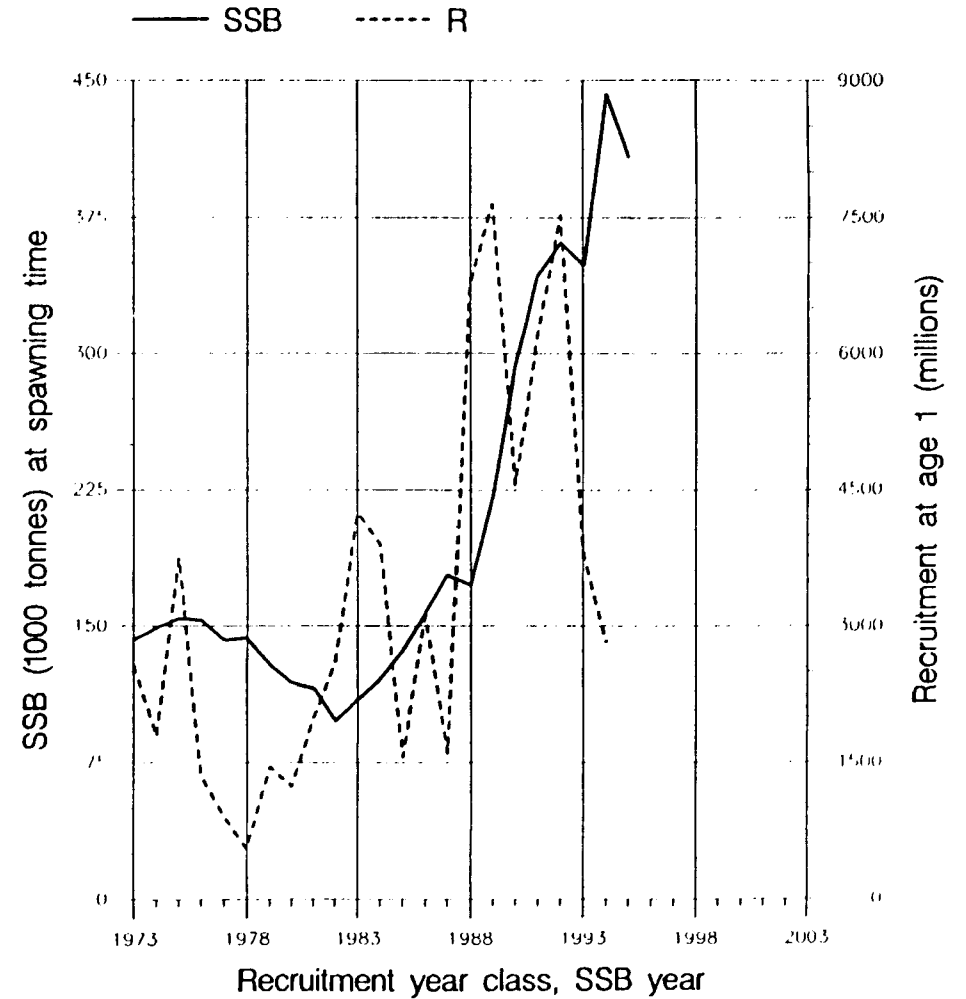
Yield and fishing mortality



(run: XSAJAP09)

A

Spawning stock and recruitment



(run: XSAJAP09)

B

Figure 8.4.3

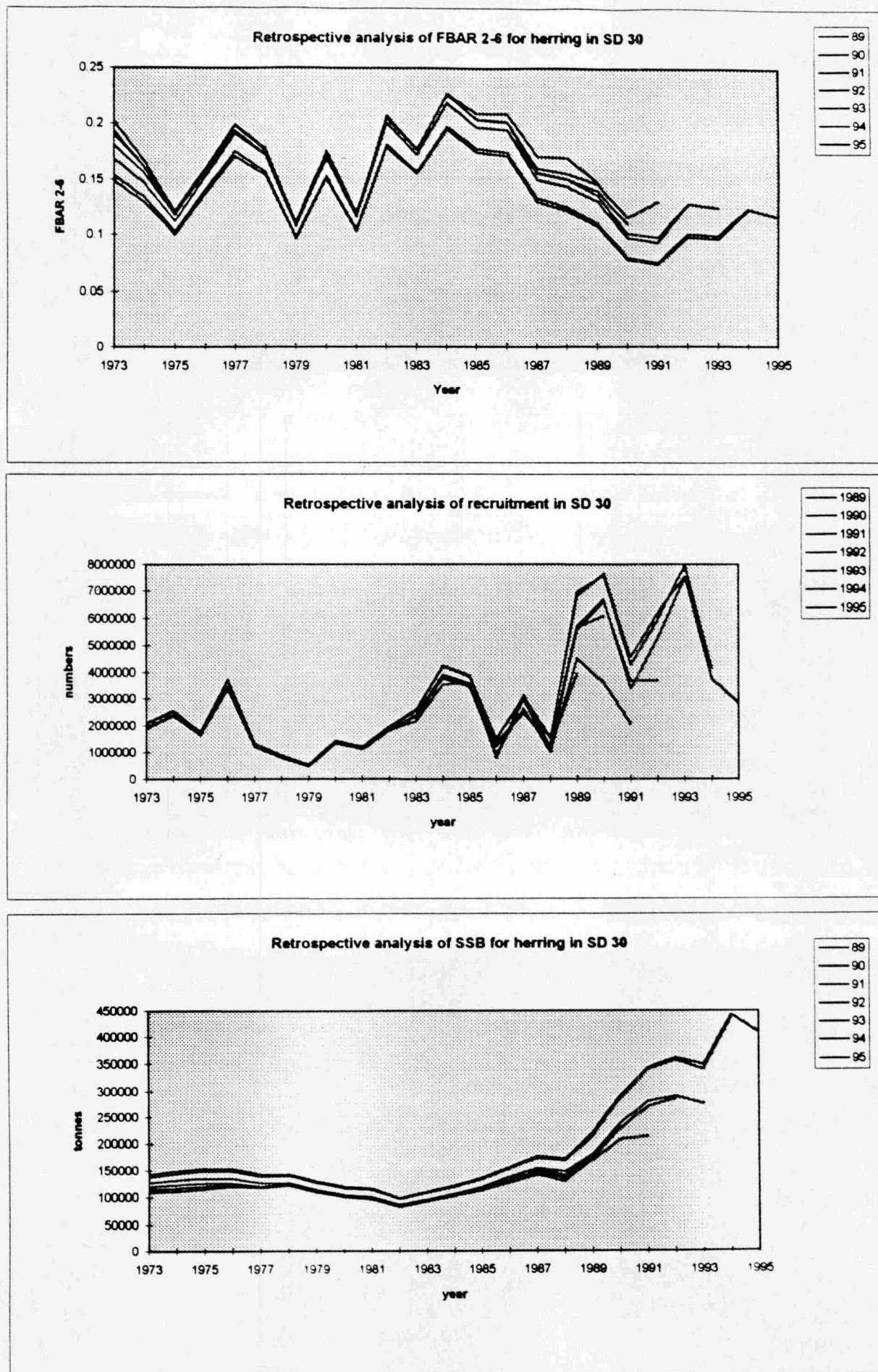




Figure 8.4.4

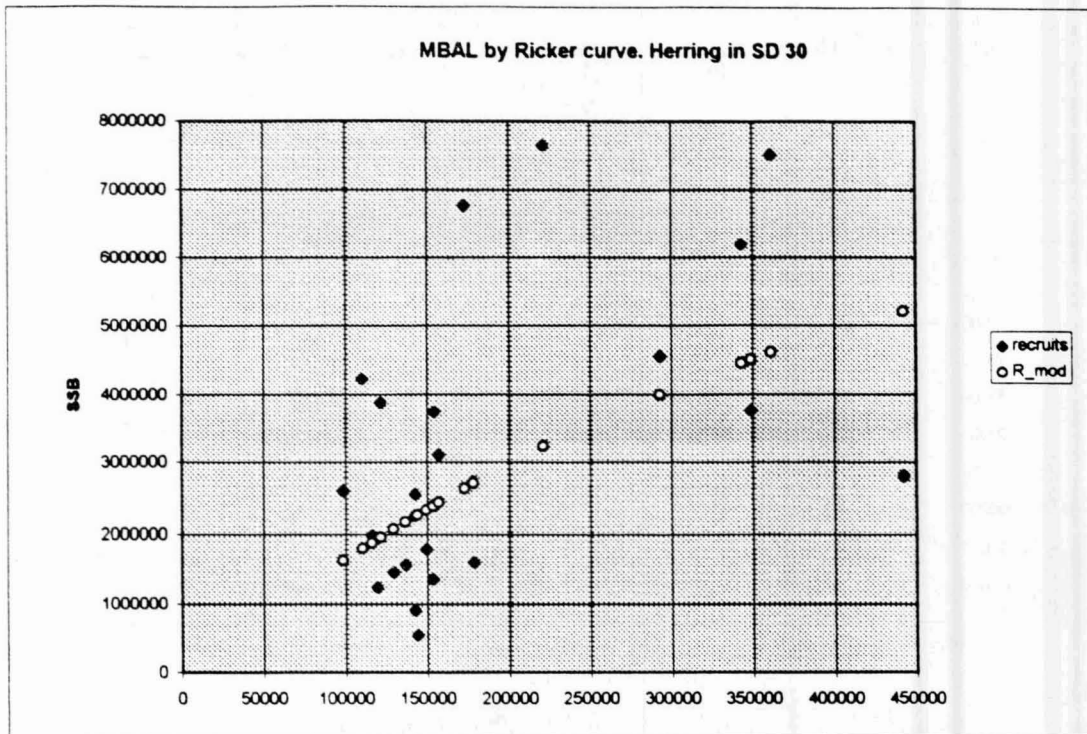
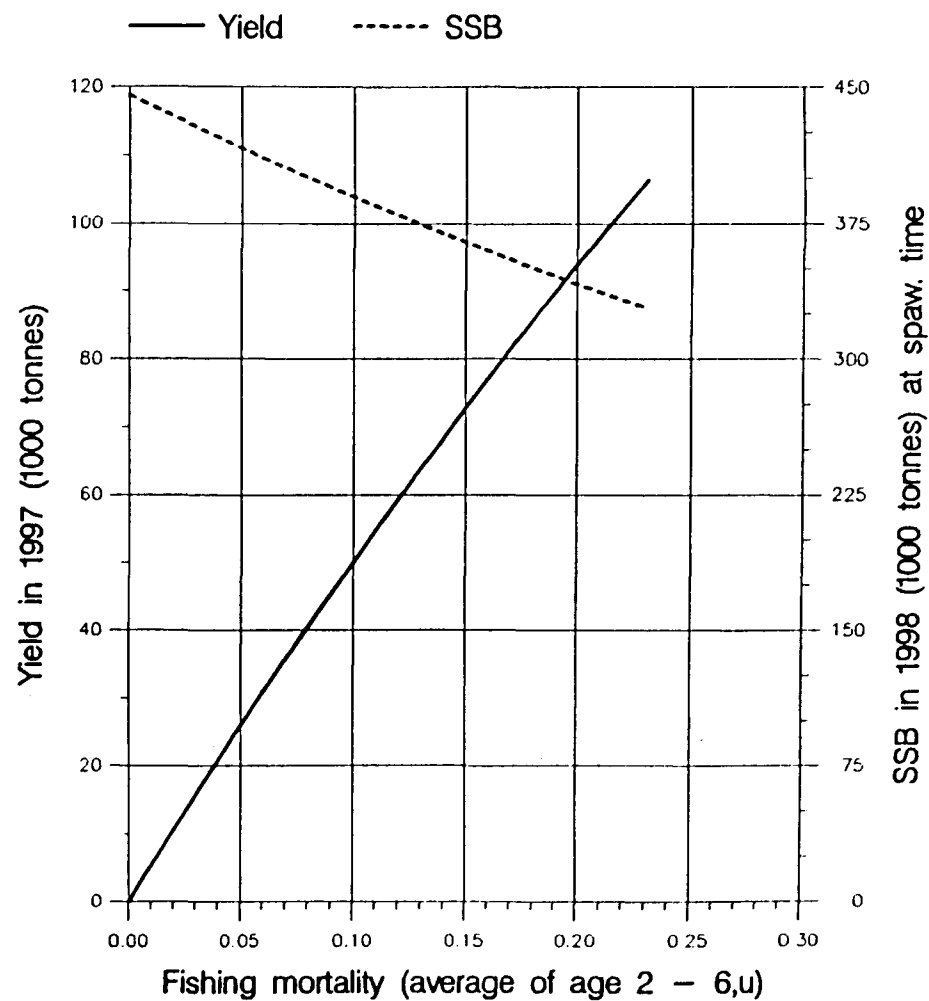
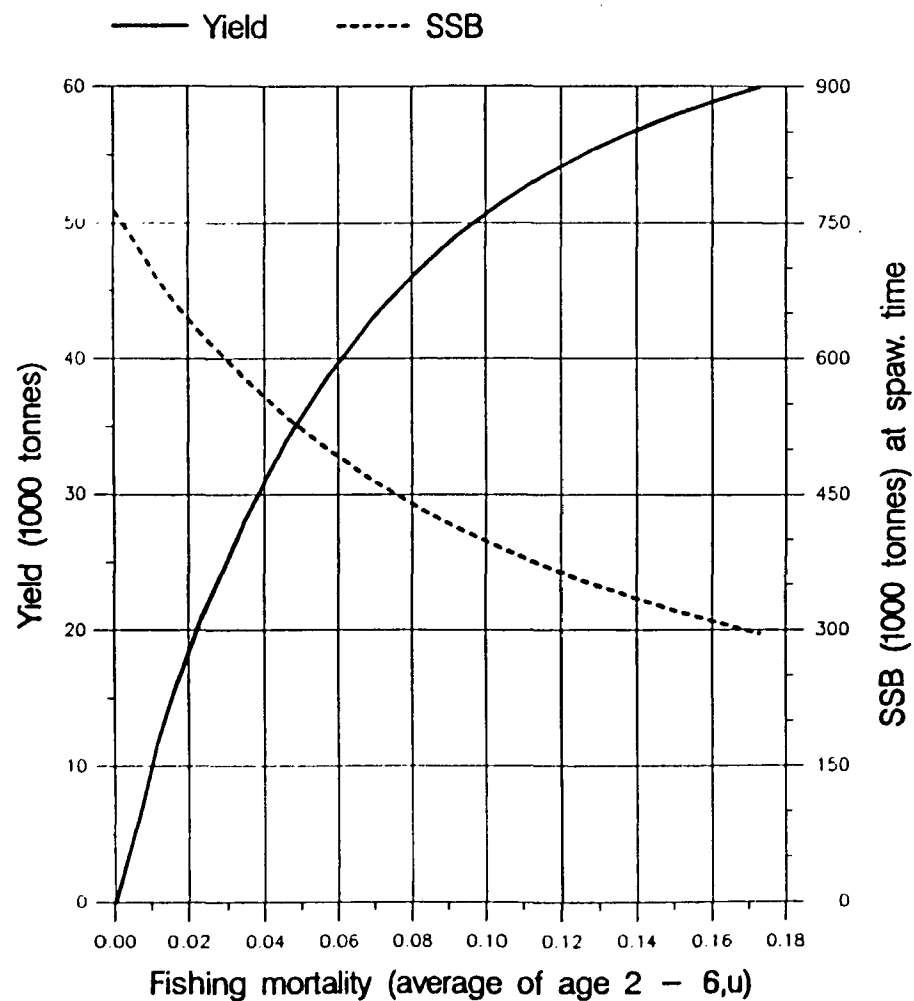


Figure 8.4.5

# Fish Stock Summary Herring in Baltic Fishing Area 30 25 - 4 - 1996

Long term yield and spawning stock biomass

Short term yield and spawning stock biomass



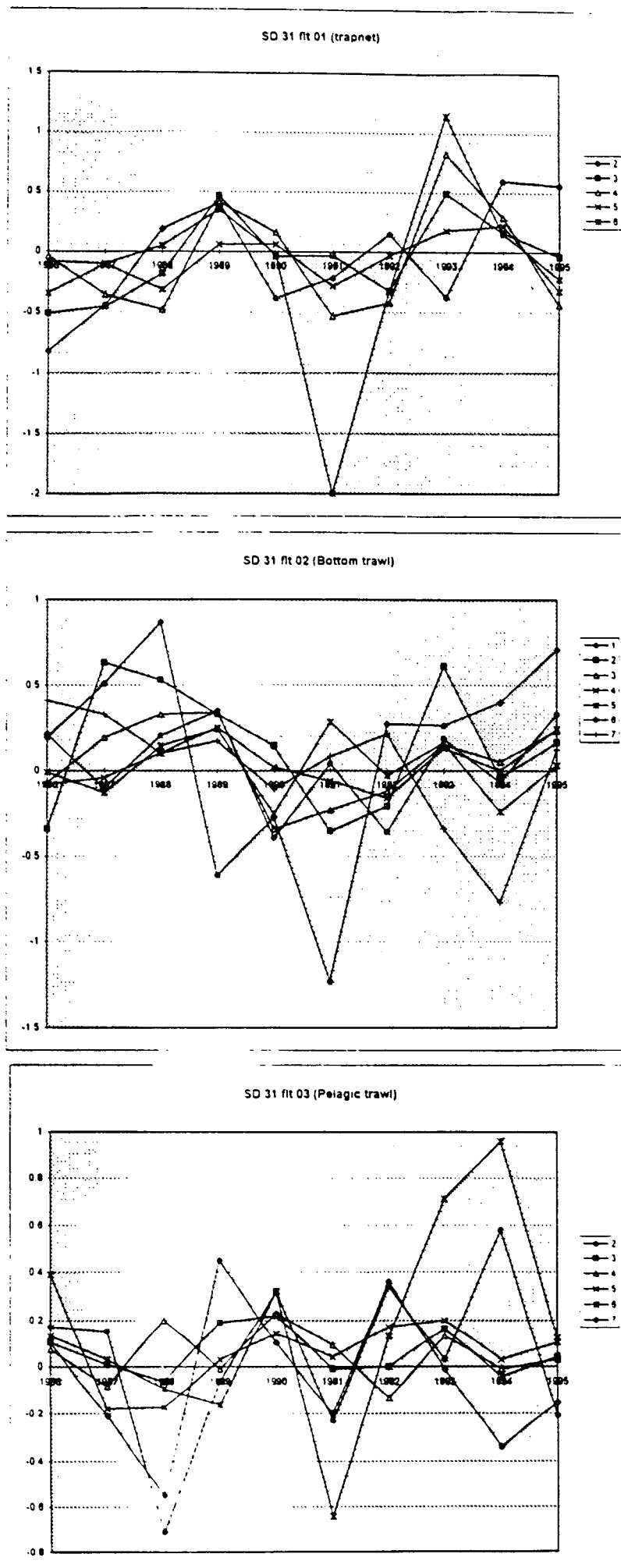
(run: YLDJAP01)

C

(run: MANJAP01)

D

Figure 8.5.1

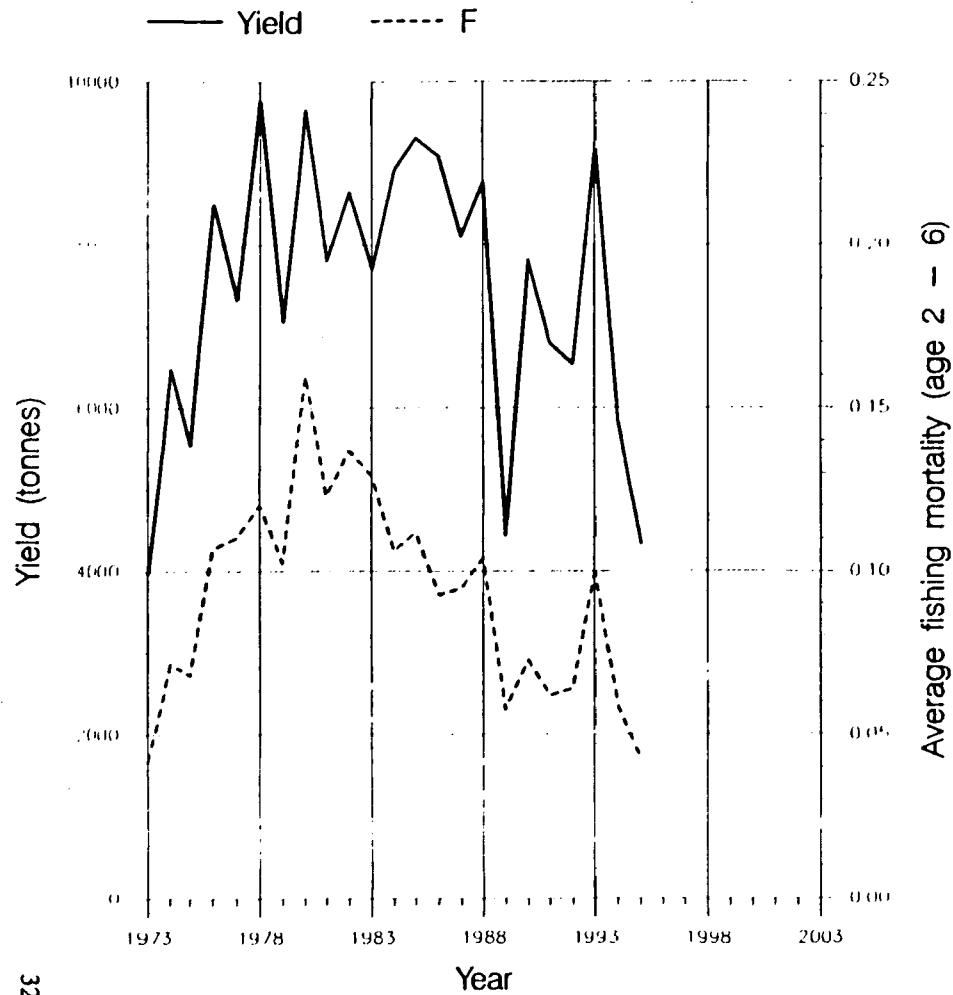


# Fish Stock Summary

## Herring in Baltic Fishing Area 31

19 - 4 - 1996

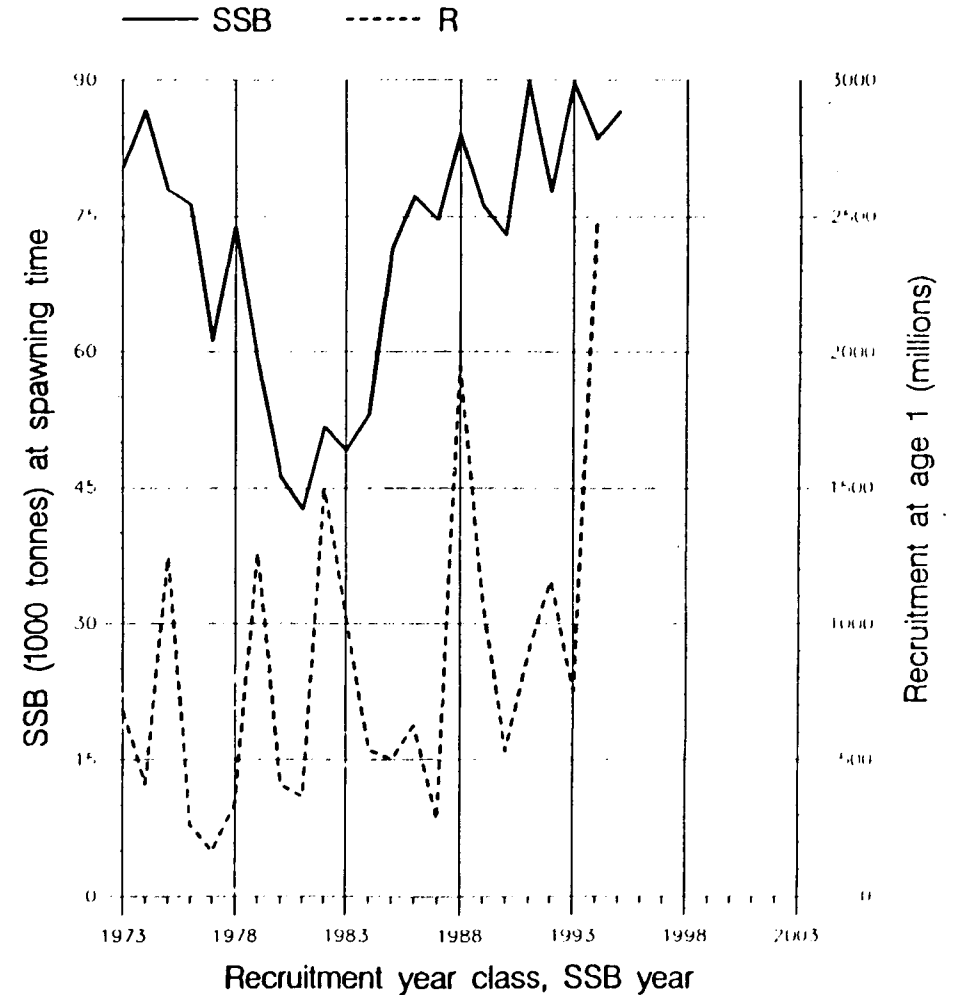
Yield and fishing mortality



(run: XSAJAP09)

A

Spawning stock and recruitment



(run: XSAJAP09)

B

Figure 8.5.3

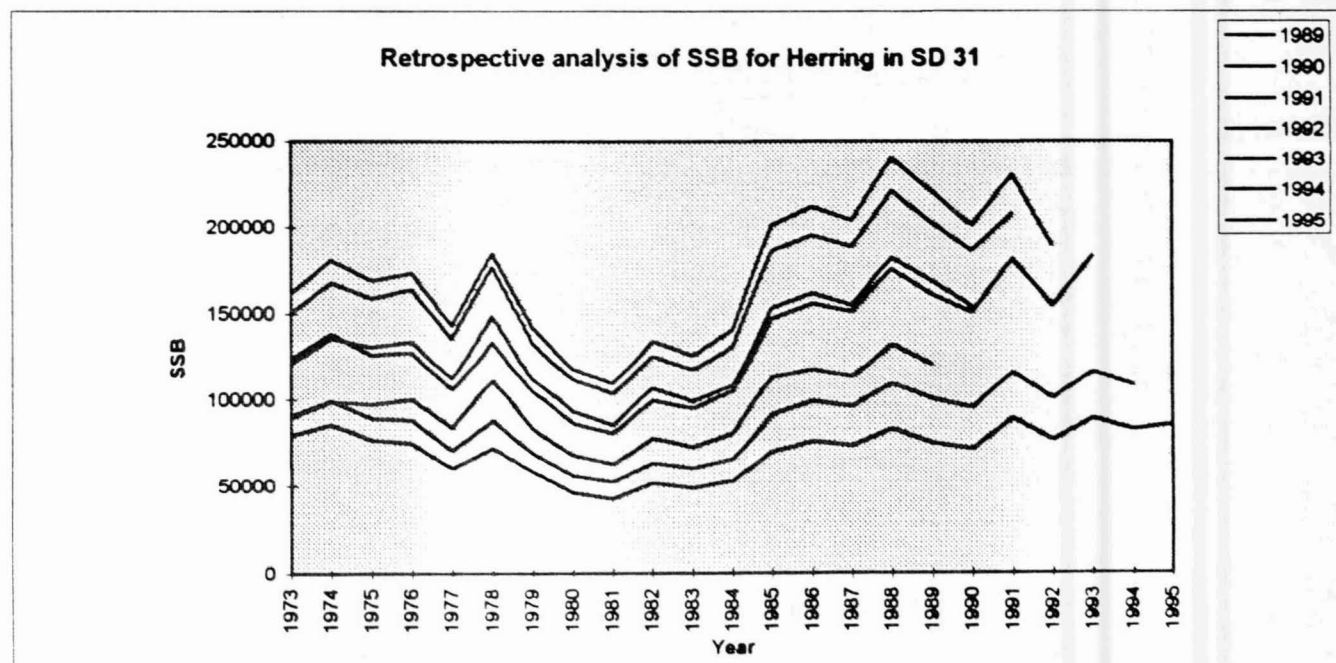
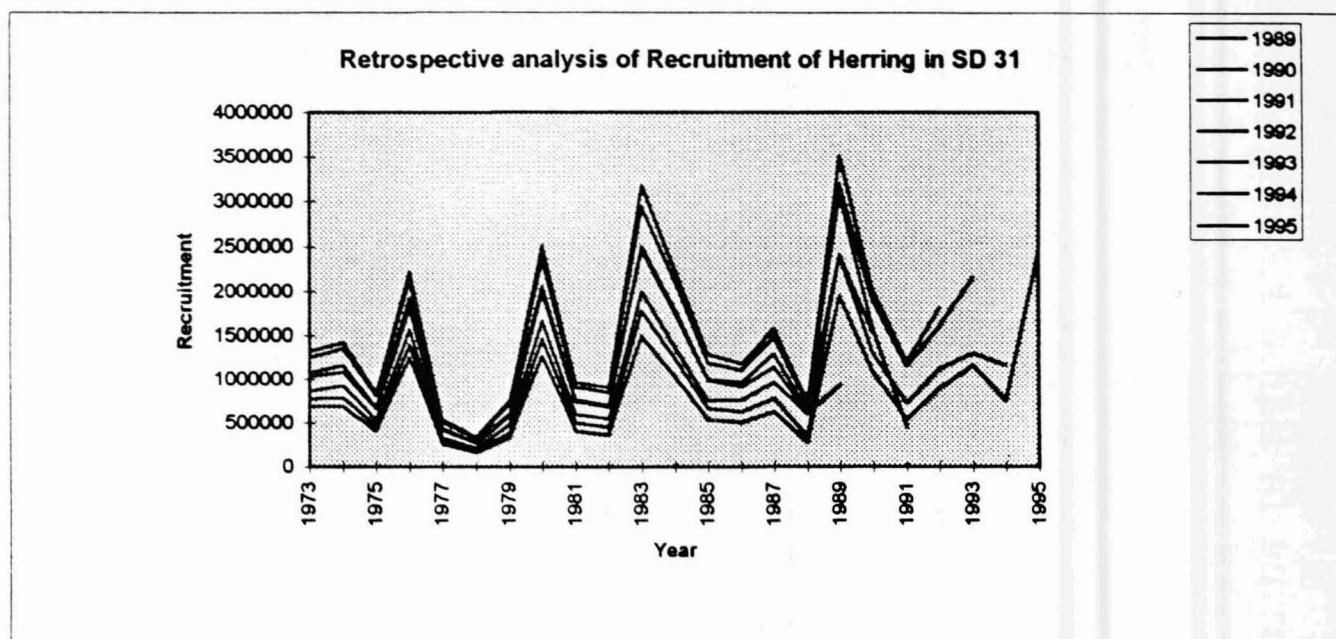
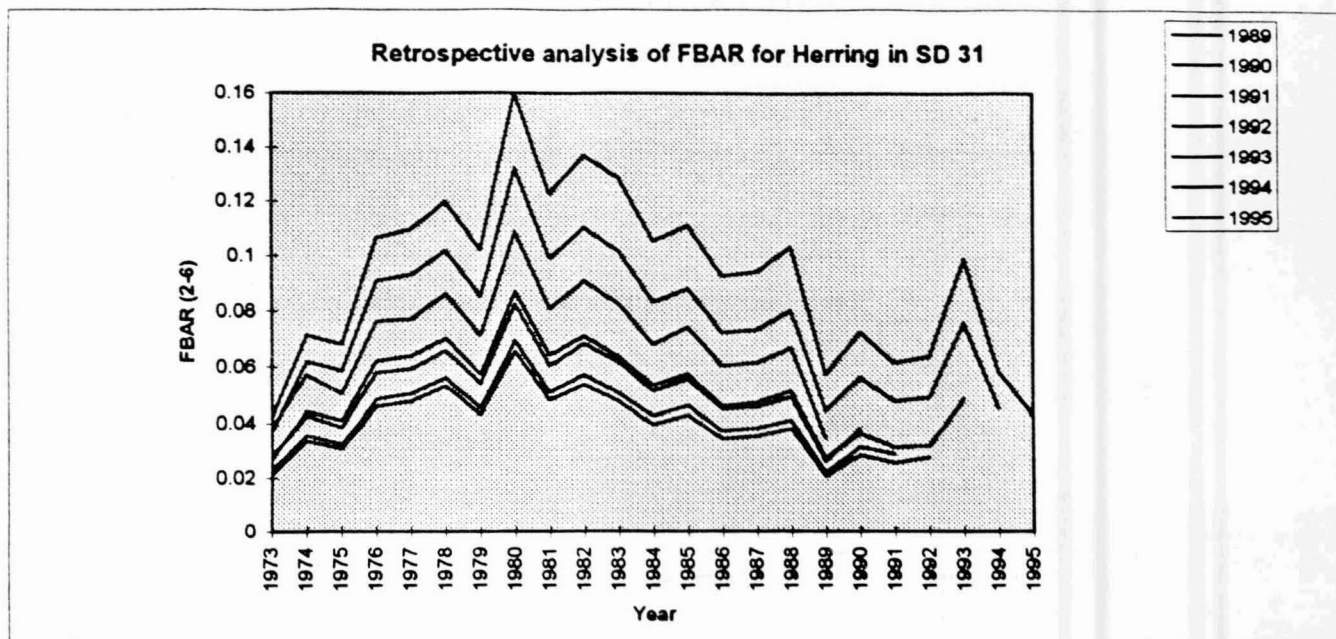


Figure 8.5.4

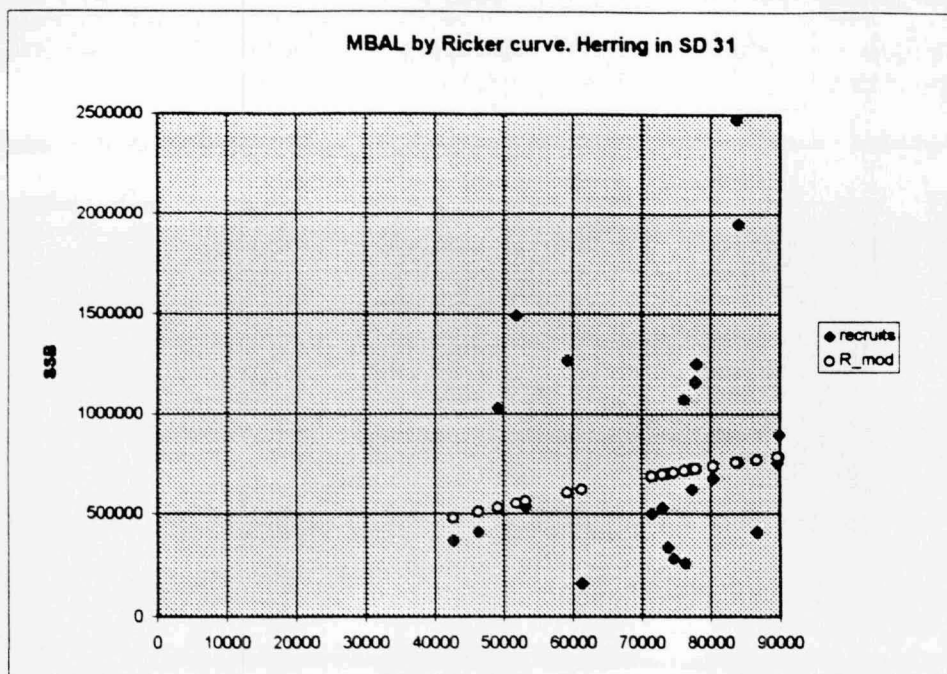


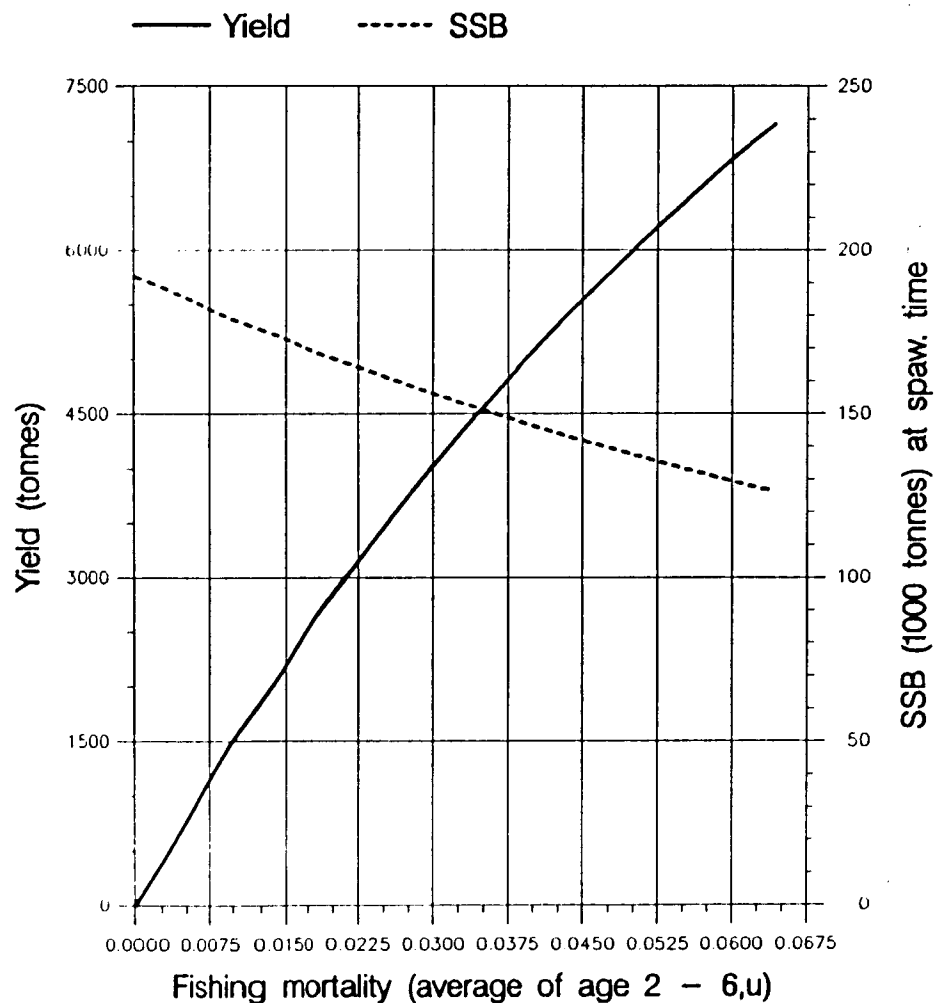
Figure 8.5.5

# Fish Stock Summary

## Herring in Baltic Fishing Area 31

### 23 - 4 - 1996

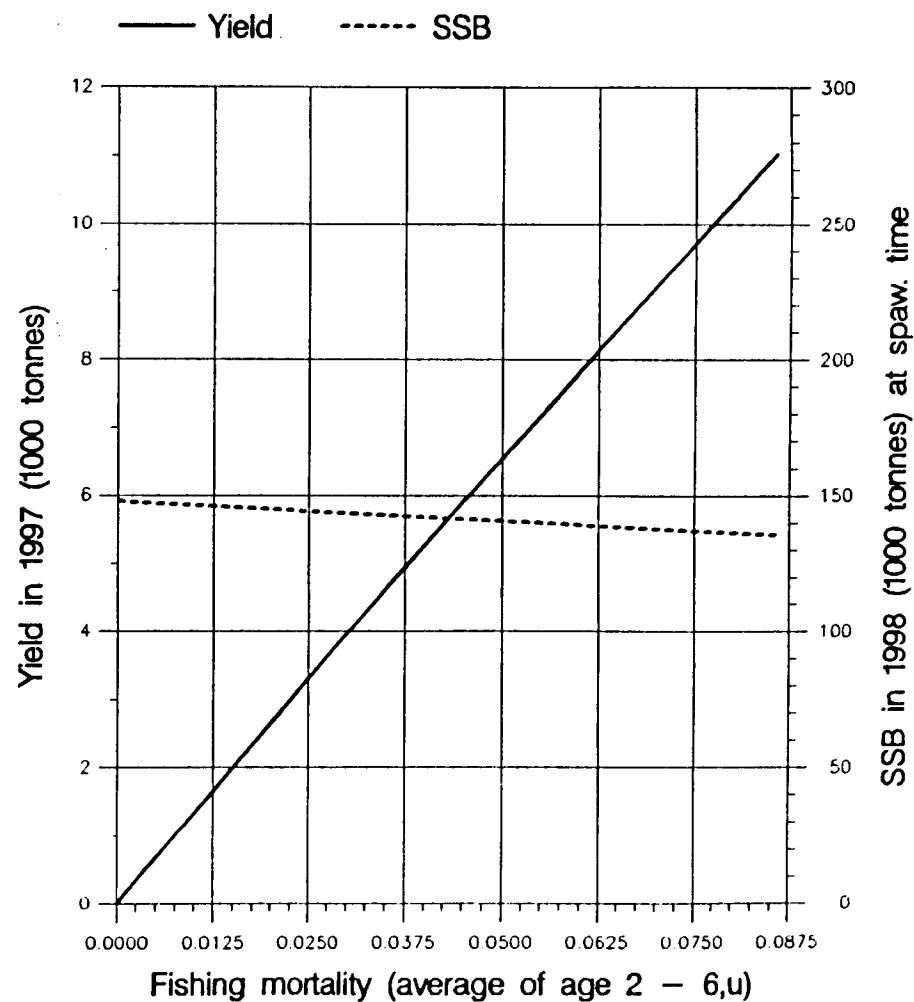
Long term yield and spawning stock biomass



(run: YLDJAP01)

C

Short term yield and spawning stock biomass



(run: MANJAP01)

D

## **9 SPRAT**

### **9.1 Assessment Units**

As in previous years sprat in Baltic Sub-divisions 22–32 was assessed as a single unit.

### **9.2 Sprat in Sub-Divisions 22–32**

#### **9.2.1 Catches**

The total catch increased from 291,000 t in 1994 to 303,000 t in 1995. Most of the countries increased their catches. The highest increase took place in Sub-divisions 25 and 27 (25% and 200%, respectively) while in Sub-division 26 the catches decreased by 40%. Landings by Sub-division, country and quarter are presented in Tables 9.2.1.1–9.2.1.2. Table 9.2.1.3 presents landings, catch numbers and weight at age by Sub-division and quarter. The sampling activity is presented in Table 9.2.1.4. As already mentioned in Sub-section 8.1.1, in some mixed fisheries the splitting of herring and sprat catches is rather imprecise.

#### **9.2.2 Input to the VPA**

Most countries provided their catch and weight at age data by quarter and Sub-division. Swedish catch numbers and weight at age data were not provided by Sub-division and catch numbers were allocated to Sub-divisions on the basis of the Swedish catches in tonnes by Sub-divisions. Mean weights at age in the catch were obtained as means weighted by catch in numbers. Mean weights in the stock were assumed the same as mean weights on the catch. As in previous years the natural mortalities used varied between years and ages as an effect of cod predation. Natural mortalities in 1993–1994 were increased slightly, when compared to last years data, on the basis of the new estimates of predation mortality from MSVPA (Anon., 1996/Assess:2). Natural mortalities in 1995 were assumed at the 1994 level. The catch numbers, weight at age, natural mortalities and maturity data are presented in Tables 9.2.2.1–9.2.2.7.

#### **9.2.3 VPA**

Four tuning data sets were available from: International Acoustic Survey in 1983–1995, Latvian/Russian Acoustic Survey in 1983–1995, Polish young fish survey (number of 0 and 1 age group in the Gulf of Gdansk) and acoustic estimates of age-0 sprat in Sub-divisions 26 and 28. The Latvian/Russian acoustic estimates of stock size for 1994 were corrected - the acoustic estimate of total stock in numbers is now higher by 8% than the value applied in 1995 assessment, but for some ages the difference reaches even 20–60%. The international acoustic survey in 1995 had different coverage than previous surveys (Sub-division 29 was not covered in 1995 - see Sub-section 1.3). Correction for this has been made in the international acoustic tuning file. Then, however, VPA produced biomass estimates for 1995 by 10% higher than when the international acoustic data from 1995 were excluded from the tuning file. It was decided to omit 1995 international acoustic estimates from the tuning procedure (see Sub-section 1.3.5). As tuning analysis comprised ages 1–7 the youngfish survey data referring to age-0 in October and December were assumed to represent CPUE of the relevant year class at the beginning of age 1. The tuning data are given in Tables 9.2.3.1–9.2.3.4.

The VPA was tuned using XSA with shrinkage option. The ages 1 to 3 were treated as recruits (slopes for Latvian/Russian fleet, which gives the highest contribution to the estimates, were significantly different from 1) and catchability plateau was set at age 4. In last five years catches increased threefold so lower weights to the shrinkage mean  $F$  were given by selecting S.E. of the mean as 0.75 (Table 9.2.3.5). The log  $q$  residuals are presented in Figure 9.2.3.1, and retrospective analyses in Figure 9.2.3.2. The log-catchability s.e. for Latvian/Russian acoustic are moderate, being in the interval 0.25–0.5; the log-catchability s.e. for international acoustic are much higher.

The assessment with the  $F$  shrinkage S.E. of 0.5 gave SSB estimate about 30% higher than the 0.75 shrinkage option. The XSA was also run with constant natural mortality ( $M=0.4$ ) to see the effect of this assumption on tuning diagnostic and stock size estimates. This option produced much worse diagnostic parameters and SSB estimate 45% higher than in the basic run. The fishing mortalities, stock in numbers and summary table are presented in Tables 9.2.3.6–9.2.3.8 and Figure 9.2.3.3.

#### **9.2.4 ICA**

Catch at age, survey indices, natural mortality, mature ogive, proportions of  $F$  and  $M$  before spawning used as input data to ICA are the same as used in XSA.



Five survey indices for tuning of ICA were considered for Sprat in the Baltic (Sub-Divisions 22–32):

INDEX 1:	1983–1995: Internat. Acoustic Surveys in SD 24–29S, Age groups 1–8+
INDEX 2:	1983–1995: USSR Acoustic Surveys in SD 26+28, Age groups 1–8+
INDEX 3:	1977–1995: Polish Young Fish Survey, Age group 1
INDEX 4:	1985–1996: Acoustic Survey in Sub-Div. 26+28, Age group 1
INDEX 5:	1983–1995: SSB (based on USSR Acoustic Surveys 26+28)

In all ICA-runs the following parameters were kept constant:

- The range of years used in separable constraint: 6,
- The reference F was given for age 3,
- The selection for oldest age was 1.

Eighteen runs were made with different combinations of indices as given in the text table. The eighteen runs were compared by using the estimates of reference F (+/- standard deviation) and SSB in 1995. The results of the comparative runs are given in the text table:

F and SSB (x1000 t) in 1995 from ICA					
Run					
No.	Index	Mean F 1995	Lower L.	Upper L.	SSB (x1000 t) 1995
1	1 Int.Acou.S.Sd24-29S, Age 1-8+, lin.	0.03	0.02	0.04	8950
2	2 USSR Surv. Sd26+28, Age 1-8+, lin.	0.10	0.09	0.13	2600
3	3 Polish YFS, Age 1, linear F.	0.30	0.11	0.81	890
4	4 Acoust.Surv.Sd26+28, Age 1, linear	0.19	0.11	0.31	1410
5	1,2,3,4 combined, linear F.	0.07	0.06	0.09	3750
6	2,3,4 combined, linear F.	0.10	0.08	0.12	2750
7	3,4 combined, linear F.	0.12	0.08	0.18	2320
8	1 Int.Acou.Surv. Sd 24-29S, power F.	no results: F at age 3 below 0.0001 !!!			
9	2 USSR Surv. Sd 26+28, power F.	0.18	0.14	0.22	1470
10	3 Polish YFS, power F.	0.36	0.17	0.78	730
11	4 Acoustic Surv. Sd 26+28, power F.	0.44	0.31	0.63	630
12	1,2,3,4 combined, power Function	0.11	0.09	0.14	2350
13	2,3,4 combined, power Function	0.20	0.16	0.25	1330
14	3,4 combined, power Function	0.42	0.26	0.59	650
15	2(Power) and 3,4 (linear)	0.18	0.14	0.22	1500
16	1,3,4 (linear) and 2 (power)	0.10	0.08	0.12	2580
17	5 SSB (fr.USSR Sur.Sd 26+28), linear	0.041	0.034	0.050	5990
18	5 SSB (fr.USSR Sur.Sd 26+28), power	0.037	0.026	0.052	6680

As can be seen, the runs gave SSB values ranging from 630,000 t to 8,950,000 t and mean F values ranging from 0.03 to 0.44.

Only for the ICA runs 3, 4, 10 and 11 using index No. 3 (Polish YFS) and index No. 4 (Acoustic Survey) either using a linear or power catchability relationship, the program could find a clearly defined optimum reference F in 1995.

For all other ICA runs there was no clear indication of the optimum reference F. In most cases the minimised SSQ (sum of squares of deviations between estimated and observed indices as a function of the reference F) were presented as rather flat curves (Run No. 1,2,5-9 and 12-16). For index No. 5 (either using a linear or power catchability relationship, Run No. 17 and 18) the curves almost went as a straight line through 0.0.

Due to the quite different results from the ICA runs the Working Group decided not to present any ICA assessment.

To illustrate the problems the key-results of the ICA analysis of run No. 3, 5 and 17 are shown in Figures 9.2.4.1-9. The SSQ as a function of the reference F (in 1995) for run No. 3, 12 and 17 are presented in Figures 9.2.4.1, 9.2.4.4 and 9.2.4.7. Figures 9.2.4.2, 9.2.4.5 and 9.2.4.8 show the stock summaries from ICA.

The overall results from these three runs show an increasing trend of stock spawning biomass and fishing mortality, respectively. Proportionally the increase in fishing mortality is much smaller than the increase in landings.

#### 9.2.5 Recruitment

Polish YFS data and acoustic estimates of age-0 sprat in Sub-division 26 + 28 were analysed using RCT3 program (Tables 9.2.5.1-9.2.5.2). The 1995 year class was estimated at a level of 70 billion fish at age 1 which is slightly higher than the long-term average. The estimate of the 1994 year-class by RCT3 program equals only 60% of the estimate of that year class strength resulting from XSA. The XSA value was, however, considered more reliable as it is based both on YFS data and acoustic estimates at age 0 and age 1.

#### 9.2.6 Prediction

The RCT3 program estimate of the 1995 year class was used in the predictions. The 1996 and 1997 year were taken as the geometric averages of the last 5 years' estimates. The natural mortality was assumed as the 1993-1995 mean. The weights at age used were the 1993-1995 averages. The fishing pattern was smoothed as the average F at age for 1993-1995 (Table 9.2.6.1). The status quo catch for 1996 and 1997 were predicted to be 391,000 and 373,000 t, respectively (Table 9.2.6.2). An option assuming the catch level in 1996 similar to the 1995 value (the reason for this option is small increase of catches in 1995 when compared to 1994) produced catch in 1996 and 1997 at a level of 320,000 t and 390,000 t (Table 9.2.6.3). The yield-per-recruit, and short-term predictions are given in Figure 9.2.6.1.

#### 9.2.7 The estimate of MBAL

An attempt to estimate MBAL was based on the Myers *et al.* (1994) approach. The stock-recruitment plots and fitted models (assuming log-normal errors) are presented in Figure 9.2.7.1. The observed recruitment shows very big variation along the fitted curve. The estimate of MBAL resulting from Ricker curve is about 190,000 t. It is impossible, however, to verify this estimate by comparing slope of the logged stock - recruitment data for  $SSB < MBAL$  and  $SSB > MBAL$ , as only one observation lower than MBAL was recorded. An attempt to estimate the MBAL from Beverton and Holt curve failed, producing entirely unrealistic value (1,000 t).

#### 9.2.8 Medium-term consideration

In the medium-term consideration the uncertainty in survivors estimates and uncertainty about stock-recruitment model were taken into account. Weight at age and natural mortalities were kept constant. The results for *status quo* fishing mortality are presented in Figure 9.2.8.1.

Table 9.2.1.1 Sprat catches in Sub-divisions 22-32 (thousand tonnes).

Year	Sub-divisions 22-32							Total
	Denmark	Finland	Germany Dem. Rep.	Germany Fed. Rep.	Poland	Sweden	USSR	
1977	7.2	6.7	17.2	0.8	38.8	0.4	109.7	180.8
1978	10.8	6.1	13.7	0.8	24.7	0.8	75.5	132.4
1979	5.5	7.1	4.0	0.7	12.4	2.2	45.1	77.1
1980	4.7	6.2	0.1	0.5	12.7	2.8	31.4	58.1
1981	8.4	6.0	0.1	0.6	8.9	1.6	23.9	49.3
1982	6.7	4.5	1.0	0.6	14.2	2.8	18.9	48.7
1983	6.2	3.4	2.7	0.6	7.1	3.6	13.7	37.3
1984	3.2	2.4	2.8	0.7	9.3	8.4	25.9	52.5
1985	4.1	3.0	2.0	0.9	18.5	7.1	34.0	69.5
1986	6.0	3.2	2.5	0.5	23.7	3.5	36.5	75.8
1987	2.6	2.8	1.3	1.1	32.0	3.5	44.9	88.2
1988	2.0	3.0	1.2	0.3	22.2	7.3	44.2	80.3
1989	5.2	2.8	1.2	0.6	18.6	3.5	54.0	85.8
1990	0.8	2.7	0.5	0.8	13.3	7.5	60.0	85.6
1991	10.0	1.6	-	0.7	22.5	8.7	59.7 <sup>1</sup>	103.2

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Total
1992	24.3	4.1	1.8	0.6	17.4	3.3	28.3	8.1	54.2	142.2
1993	18.4	5.8	1.7	0.6	12.6	3.3	31.8	11.2	92.7	178.1
1994	60.6	9.6	1.9	0.3	20.1	2.3	41.2	17.6	135.2	288.7
1995	64.1	13.1	5.2	0.2	24.4	2.9	35.7	14.8	143.7	304.0

<sup>1</sup>Sum of catches by Estonia, Latvia, Lithuania and Russia.

Table 9.2.1.2 Sprat catches in the Baltic Sea by country and Sub-division ('000 t)

Year 1994

Country	Total catch	22	23	24	25	26	27	28	29	30	31	32
Denmark	60.7	8.0	-	3.4	49.3	-	-	-	-	-	-	-
Estonia	9.6	-	-	-	-	-	-	0.5	5.4	-	-	3.6
Finland	1.9	-	-	-	-	-	-	-	1.5	-	-	0.5
Germany	0.3	0.3	-	-	-	-	-	-	-	-	-	-
Latvia	20.1	-	-	-	-	3.1	-	17.1	-	-	-	-
Lithuania	2.3	-	-	-	-	2.3	-	-	-	-	-	-
Poland	41.2	-	-	-	5.4	35.8	-	-	-	-	-	-
Russia	17.6	-	-	-	-	17.6	-	-	-	-	-	-
Sweden	135.2	-	-	8.3	28.6	56.6	10.3	29.9	1.5	-	-	0.0
Total	289.0	8.3	-	11.7	83.3	115.4	10.3	47.5	8.4	-	-	4.1

Year 1995

Country	Total catch	22	23	24	25	26	27	28	29	30	31	32
Denmark	64.1	9.7	-	-	54.5	-	-	-	-	-	-	-
Estonia	13.1	-	-	-	-	-	-	0.6	5.2	-	-	7.3
Finland	5.2	-	-	-	-	-	-	-	3.6	0.8	-	0.9
Germany	0.2	0.2	-	-	-	-	-	-	-	-	-	-
Latvia	24.4	-	-	-	-	1.9	-	22.5	-	-	-	-
Lithuania	2.9	-	-	-	-	2.9	-	-	-	-	-	-
Poland	35.7	-	-	0.1	12.2	23.4	-	-	-	-	-	-
Russia	14.8	-	-	-	-	14.8	-	-	-	-	-	-
Sweden	143.7	-	-	8.5	39.9	30.0	30.3	33.5	1.3	-	-	-
Total	304.0	9.9	-	8.7	106.6	73.0	30.3	56.6	10.1	0.8	-	8.2

**Table 9.2.1.3 Sprat catch in numbers and weight at age by quarters and Sub-division**

**Subdiv. 22**

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0.0	0.0	0.0	0.0	222.2	222.2				3.8
1	59.7	79.9	107.9	198.9	446.4	7.0	6.2	6.0		9.0
2	30.5	23.8	47.5	114.6	216.4	13.0	13.7	13.1		14.3
3	25.9	19.6	20.1	32.9	98.4	19.1	20.3	18.9		15.3
4	4.6	6.8	2.2	20.5	34.1	22.5	21.5	23.6		18.3
5	1.0	1.5	0.1	7.9	10.5	22.5	21.7	19.7		20.3
6	1.0	0.5	0.0	0.1	1.6	25.0	25.0	18.3		18.3
7	0.0	0.0	0.0	0.0	0.1	21.2	21.2	20.9		20.9
8	0.1	0.1	0.0	0.0	0.2	23.0	23.0	21.6		21.6
9	0.0	0.0	0.0	0.0	0.0					
10	0.0	0.0	0.0	0.0	0.0					
Sum	122.9	132.1	177.8	597.1	1030.0					
SOP	1464.3	1410.7	1699.1	5308.8	9882.9					
Catch	1463.4	1409.5	1702.6	5286.7	9862.2					

**Subdiv. 24**

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0.0	0.0	0.0	0.4	0.4					4.3
1	0.7	11.1	37.0	34.4	83.2	2.9	5.0	7.3		7.7
2	5.3	26.9	9.1	8.3	49.6	7.9	9.7	8.9		9.2
3	46.4	94.3	20.0	18.1	178.7	9.4	9.3	10.3		10.6
4	50.6	137.6	26.5	23.7	238.4	11.1	11.2	12.0		12.2
5	29.4	65.7	17.2	15.3	127.6	12.2	13.0	12.2		12.3
6	16.8	50.4	8.3	7.3	82.7	13.2	13.8	13.4		13.4
7	8.7	15.4	0.6	0.6	25.3	13.4	14.9	14.7		14.9
8	1.3	2.6	0.5	0.5	4.8	13.0	16.1	13.6		13.7
9	1.1	1.6	0.0	0.0	2.7	13.3	16.5	17.4		22.0
10	3.3	2.6	0.2	0.2	6.2	13.2	16.3	16.0		16.1
Sum	163.6	408.0	119.5	108.6	799.7					
SOP	1810.7	4618.9	1217.3	1129.0	8775.9					
Catch	1785.2	4495.7	1238.5	1147.4	8666.7					

**Subdiv. 25**

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0.0	0.0	0.0	0.0	39.6	39.6				3.6
1	861.9	311.8	4.0	292.2	1469.9	4.3	4.7	5.2		13.0
2	209.7	257.1	1.6	161.3	629.6	14.0	10.4	11.4		15.2
3	784.0	821.1	4.1	213.2	1822.4	14.0	10.5	13.2		16.6
4	994.7	1100.1	3.5	274.6	2372.9	16.0	12.1	14.9		17.8
5	530.6	529.6	1.7	139.8	1201.7	16.9	13.8	15.9		18.4
6	214.6	366.7	0.7	45.2	627.2	16.8	14.2	16.9		19.4
7	64.7	107.7	0.1	5.7	178.2	14.9	15.0	15.6		18.3
8	9.3	22.5	0.1	0.4	32.3	15.0	16.9	17.9		16.6
9	6.2	13.3	0.1	0.0	19.6	13.3	16.9	17.4		22.0
10	17.7	17.1	0.0	0.1	34.9	13.2	16.3			18.0
Sum	3693.2	3547.0	15.9	1172.1	8428.3					
SOP	47593.1	41042.1	189.7	18397.7	107222.7					
Catch	47431.6	40240.4	511.5	18387.5	106571.0					

Table 9.2.1.3 (continued)

## Subdiv. 26

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0.0	0.0	11.6	370.4	382.0				2.1	3.1
1	246.0	267.6	77.0	818.5	1409.0	2.8	3.5	6.5	8.2	
2	158.1	333.7	91.1	144.2	727.1	8.8	9.4	8.9	10.2	
3	706.1	887.4	92.5	327.9	2013.9	10.2	9.9	10.7	11.2	
4	480.4	806.9	47.5	199.7	1534.5	11.5	11.4	11.8	12.4	
5	242.2	373.7	7.9	94.7	718.3	12.9	13.2	14.7	13.1	
6	123.5	249.7	3.1	36.4	412.7	13.7	13.8	15.9	14.3	
7	66.1	79.7	0.6	11.4	157.8	14.4	14.8	16.1	14.9	
8	13.5	17.6	0.1	5.5	36.8	15.7	15.3	15.7	14.3	
9	6.2	6.6	0.1	0.1	13.0	13.3	17.3	24.0	20.0	
10	17.8	9.7	0.0	0.5	28.0	13.2	16.3		16.0	
Sum	2060.0	3032.5	331.4	2009.4	7433.3					
SOP	21086.8	32208.5	3058.0	17434.6	73787.9					
Catch	20922.3	31732.0	2985.9	17384.5	73024.7					

## Subdiv. 27

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0.0	0.0	0.0	0.0	0.0					
1	4.3	0.4	0.0	456.4	461.0	2.0	5.0		7.3	
2	44.7	0.9	0.0	111.4	157.0	7.9	9.7		8.8	
3	389.9	3.2	0.0	244.4	637.5	9.4	9.3		10.3	
4	425.0	4.7	0.0	326.3	755.9	11.1	11.1		12.0	
5	246.9	2.2	0.0	212.0	461.1	12.1	13.0		12.2	
6	141.0	1.7	0.0	102.7	245.5	13.2	13.8		13.3	
7	73.2	0.5	0.0	7.9	81.7	13.4	14.9		14.7	
8	10.6	0.1	0.0	6.7	17.4	13.0	16.1		13.5	
9	9.6	0.1	0.0	0.0	9.6	13.3	16.5			
10	27.4	0.1	0.0	2.2	29.7	13.2	16.3		16.0	
Sum	1372.7	13.8	0.0	1470.0	2856.5					
SOP	15187.8	156.2	0.0	14958.8	30302.8					
Catch	14972.8	152.0	1.0	15220.5	30346.3					

Table 9.2.1.3 (continued)

## Subdiv. 28

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0.0	0.0	0.0	0.0	69.9	69.9				3.1
1	4.2	56.2	22.7	1101.6	1184.7	2.0	3.9	7.5	7.4	
2	53.5	41.3	46.4	204.7	346.0	8.1	8.5	9.4	9.2	
3	489.2	120.3	199.7	510.0	1319.1	9.6	10.0	9.9	10.5	
4	529.4	150.7	146.0	492.3	1318.5	11.1	11.3	10.9	12.0	
5	271.8	62.3	33.9	295.1	663.1	12.1	12.8	11.6	12.2	
6	157.7	51.0	37.0	150.2	395.8	13.1	13.3	11.9	13.3	
7	75.0	14.7	17.4	25.5	132.7	13.5	14.0	12.0	14.0	
8	13.0	13.5	11.6	15.1	53.1	12.9	13.8	12.9	13.6	
9	9.0	0.4	0.0	0.0	9.4	13.3	16.4			
10	25.8	0.7	0.0	2.7	29.2	13.2		13.9	15.8	
Sum	1628.6	511.0	514.8	2867.0	5521.4					
SOP	18036.3	5372.4	5367.8	27661.0	56437.4					
Catch	17851.0	5335.0	5478.0	27955.0	56619.0					

## Subdiv. 29

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0.0	0.0	0.0	0.0	17.1	17.1				3.1
1	58.1	19.4	44.2	258.3	380.0	5.9	6.1	6.3	6.8	
2	25.8	2.1	35.9	54.4	118.2	9.4	9.5	9.1	9.7	
3	71.0	12.7	56.6	107.9	248.2	10.5	10.3	10.7	11.1	
4	54.6	10.9	13.6	41.7	120.7	11.6	11.2	12.0	12.9	
5	22.8	7.6	8.7	25.2	64.3	11.9	12.1	11.8	12.7	
6	15.7	4.4	2.4	31.0	53.5	12.8	13.2	10.7	13.4	
7	10.7	2.3	1.0	3.0	17.0	13.0	13.3	12.8	12.0	
8	2.7	0.3	0.0	2.9	5.8	13.4	13.9		14.2	
9	1.2	0.2	0.0	9.0	10.4	13.6	14.8		14.4	
10	4.9	0.3	1.3	13.5	20.0	13.8	14.6	13.9	13.5	
Sum	267.4	60.3	163.8	563.8	1055.3					
SOP	2680.6	586.1	1533.2	5187.1	9986.9					
Catch	2676.0	579.0	1605.0	5210.0	10070.0					

## Subdiv. 30

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0	0	0	0	0	0.0				
1	0	5	0	0	0	5.0				
2	0	0	0	0	0	0.0				
3	0	0	0	0	0	0.0				
4	0	0	0	0	0	0.0				
5	0	0	0	0	0	0.0				
6	0	0	0	0	0	0.0				
7	0	0	0	0	0	0.0				
8	0	0	0	0	0	0.0				
9	0	0	0	0	0	0.0				
10	0	0	0	0	0	0.0				
Sum	0.0	5.0	0.0	0.0	5.0					
SOP	0.0	0.0	0.0	0.0	0.0					
Catch	14.0	21.0	646.0	69.0	750.0					

Table 9.2.1.3 (continued)

Subdiv. 31

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0	0	0	0	0	0.0				
1	0	0	0	0	0	0.0				
2	0	0	0	0	0	0.0				
3	0	0	0	0	0	0.0				
4	0	0	0	0	0	0.0				
5	0	0	0	0	0	0.0				
6	0	0	0	0	0	0.0				
7	0	0	0	0	0	0.0				
8	0	0	0	0	0	0.0				
9	0	0	0	0	0	0.0				
10	0	0	0	0	0	0.0				
Sum	0.0	0.0	0.0	0.0	0.0	0.0				
Catch	0.0	0.0	0.0	0.0	0.0	0.0				

Subdiv. 32

Age	Numbers (mln)					Weight (g)				
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	
0	0.0	0.0	0.0	0.0	21.8	21.8				2.4
1	0.9	44.9	43.2	662.8	751.8	2.1	2.8	5.4		5.7
2	3.9	1.3	4.6	20.9	30.7	9.9	7.9	9.2		9.2
3	13.4	3.6	21.3	95.7	134.0	11.3	10.5	11.1		10.2
4	12.7	4.2	17.4	36.0	70.3	12.3	11.4	12.1		11.5
5	4.5	1.6	5.6	11.3	23.0	13.1	13.0	12.9		11.6
6	4.0	0.8	4.1	19.2	28.1	13.4	13.2	12.8		12.4
7	3.4	0.6	1.6	10.3	15.9	13.6	13.6	15.4		11.5
8	1.7	0.2	0.6	3.5	6.0	13.5	13.0	12.7		11.9
9	1.1	0.5	0.0	3.3	4.9	14.1	13.9			12.6
10	4.4	1.0	1.3	16.5	23.2	14.4	14.5	13.4		13.3
Sum	50.0	58.7	99.7	901.3	1109.7					
SOP	608.7	284.8	895.7	6208.5	7997.7					
Catch	741.0	272.0	903.0	6225.0	8141.0					



**Table 9.2.1.4** Sprat in Sub-divisions 22–32. Samples of commercial catches by quarter and Sub-division for 1995 available to the Working Group.

Sub-division 22	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Denmark	1	1382	1	98	98
		2	1367	3	435	435
		3	1683	1	168	168
		4	5223	1	235	235
		Total	9655	6	936	936
	Germany	1	81	0	0	0
		2	43	1	559	148
		3	20	0	0	0
		4	64	34	6624	365
		Total	208	35	7183	513
Sub-division 24	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Germany	1	+	19	3644	306
		2	+	1	105	56
		3	+	0	0	0
		4	7	41	8302	372
		Total	7	61	12051	734
	Sweden	1	1777	0	0	0
		2	4472	6	870	154
		3	1226	0	0	0
		4	1068	0	0	0
		Total	8544	6	870	154
Sub-division 25	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Denmark	1	33506	5	845	845
		2	4394	0	0	0
		3	0	0	0	0
		4	16573	6	531	410
		Total	54473	11	1376	1255
	Poland	1	4272	8	2304	275
		2	6447	19	3768	732
		3	191	1	305	55
		4	1271	21	4499	880
		Total	12181	49	10876	1942
	Sweden	1	9654	6	699	149
		2	29399	50	6218	1302
		3	321	0	0	0
		4	544	2	331	175
		Total	39917	58	7248	1626

continued

Table 9.2.1.4 (continued)

Sub-division 26	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Latvia	1	60	1	61	61
		2	1656	2	139	139
		3	20	0	0	0
		4	182	9	1600	460
		Total	1918	12	1800	660
	Lithuania	1	757	5	500	500
		2	358	6	600	600
		3	10	3	300	300
		4	1848	5	500	500
		Total	2972	19	1900	1900
	Poland	1	9205	20	2446	515
		2	9150	12	1414	331
		3	884	0	0	0
		4	4123	10	2721	435
		Total	23362	42	6581	1281
	Russia	1	2087	96	19390	360
		2	3122	57	11440	1200
		3	2081	95	19021	347
		4	7644	70	14589	1400
		Total	14934	318	64440	3307
	Sweden	1	9721	3	374	67
		2	16667	12	1738	310
		3	0	0	0	0
		4	3623	6	704	76
		Total	30011	21	2789	453
Sub-division 27	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Sweden	1	14973	15	1568	356
		2	152	0	0	0
		3	1	0	0	0
		4	15221	20	2384	212
		Total	30437	35	3952	568
Sub-division 28	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Estonia	1	56	2	204	204
		2	5	1	102	102
		3	8	0	0	0
		4	554	8	795	795
		Total	623	11	1101	1101
	Latvia	1	3772	7	700	700
		2	4154	17	1700	1700
		3	5340	7	650	650
		4	9199	36	6000	2250
		Total	22465	67	9050	5300
	Sweden	1	14023	2	389	62
		2	1176	0	0	0
		3	130	0	0	0
		4	18202	12	1681	47
		Total	33531	14	2067	109

continued

Table 9.2.1.4 (continued)

Sub-division 29	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Estonia	1	1424	7	714	714
		2	139	8	816	816
		3	1274	6	612	612
		4	2364	8	801	801
		Total	5201	29	2943	2943
	Finland	1	615	0	0	0
		2	201	0	0	0
		3	258	3	200	200
		4	2493	7	395	395
		Total	3567	10	595	595
	Sweden	1	637			
		2	239			
		3	73			
		4	353			
		Total	1302			
Sub-division 30	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Finland	1	17	1	50	50
		2	21	0	0	0
		3	646	0	0	0
		4	69	2	100	100
		Total	750	3	150	150
Sub-division 32	Country	Quarter	Landings in tons	Number of samples	Number of fish meas	Number of fish aged
	Estonia	1	608	12	1224	1224
		2	107	6	612	612
		3	631	3	306	306
		4	5920	11	1122	1122
		Total	7266	32	3264	3264
	Finland	1	133	8	437	437
		2	165	2	100	100
		3	272	5	230	230
		4	305	10	418	418
		Total	875	25	1185	1185

Table 9.2.2.1

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

CANUM: Catch in Numbers (Millions)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1973	.	.	.	.	.	.	.	.	.
1974	33.0000	2615.0000	6172.0000	3618.0000	1940.0000	1929.0000	933.0000	1213.0000	278.0000
1975	125.0000	628.0000	2032.0000	5678.0000	2387.0000	790.0000	878.0000	247.0000	546.0000
1976	215.0000	4682.0000	818.0000	2106.0000	3510.0000	1040.0000	350.0000	548.0000	422.0000
1977	104.0000	2371.0000	8399.0000	997.0000	1907.0000	1739.0000	364.0000	140.0000	399.0000
1978	97.0000	500.0000	3325.0000	4936.0000	480.0000	817.0000	683.0000	73.0000	189.0000
1979	51.0000	1340.0000	597.0000	1037.0000	2291.0000	188.0000	150.0000	335.0000	125.0000
1980	35.0000	369.0000	1476.0000	378.0000	500.0000	1357.0000	72.0000	67.0000	235.0000
1981	26.0000	2303.0000	920.0000	405.0000	94.0000	88.0000	527.0000	13.0000	99.0000
1982	24.0000	363.0000	2460.0000	425.0000	225.0000	64.0000	57.0000	231.0000	51.0000
1983	105.0000	1852.0000	297.0000	531.0000	107.0000	47.0000	12.0000	18.0000	148.0000
1984	76.0000	1005.0000	2393.0000	388.0000	447.0000	77.0000	38.0000	9.0000	83.0000
1985	65.0000	566.0000	1703.0000	2521.0000	447.0000	271.0000	30.0000	19.0000	65.0000
1986	32.0000	495.0000	1142.0000	1425.0000	2099.0000	340.0000	188.0000	16.0000	50.0000
1987	4.0000	779.0000	394.0000	1320.0000	1833.0000	1805.0000	227.0000	149.0000	73.0000
1988	180.9840	78.0670	2695.7750	730.4950	1148.8010	762.4800	760.3430	64.6660	141.1590
1989	117.5678	2101.8490	290.0210	1771.9320	403.6520	739.2420	390.2550	398.3820	137.1390
1990	70.0000	1049.0000	3171.0000	346.0000	952.0000	188.0000	316.0000	112.0000	200.0000
1991	391.6850	1043.5470	2649.3590	2438.6460	406.5360	568.6110	106.1810	160.2590	152.2260
1992	495.0000	1782.0000	2939.0000	3040.0000	1643.0000	444.0000	311.0000	121.0000	163.0000
1993	47.4000	1832.2000	5685.2000	3243.7000	1898.1000	883.7000	267.1000	244.4000	256.6880
1994	552.0000	1079.0000	8169.0000	8176.0000	3525.0000	2201.0000	779.0000	193.0000	208.0000
1995	753.1000	6190.9000	2274.7000	6452.3000	6445.3000	3269.6000	1847.1000	608.6000	397.4000

Table 9.2.2.2

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

12:33 Monday, April 22, 1996

WECA: Mean Weight in Catch (Grams)

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1974	4.80	6.60	10.50	12.20	13.40	13.90	15.40	14.10	14.30
1975	4.00	6.80	11.20	12.40	13.40	14.70	14.30	15.70	13.50
1976	4.00	6.90	10.70	12.70	13.50	14.50	16.10	14.70	14.30
1977	4.40	5.40	11.00	13.40	14.00	14.40	15.90	15.90	15.80
1978	4.30	5.10	10.90	12.50	13.10	14.10	15.20	15.80	15.10
1979	4.00	5.50	12.70	13.00	13.70	15.10	15.80	15.60	16.20
1980	4.20	7.80	11.30	14.30	14.10	14.30	16.70	15.80	16.00
1981	4.30	6.30	14.10	16.10	18.00	16.50	15.90	16.80	16.10
1982	4.20	8.80	11.70	16.00	16.20	16.70	16.40	16.30	17.30
1983	4.70	9.20	14.50	16.20	17.10	16.90	17.00	16.90	16.80
1984	3.90	9.70	11.10	14.60	15.30	15.80	16.30	16.90	17.20
1985	3.40	9.10	11.30	12.70	14.00	16.00	17.10	17.10	15.80
1986	4.40	7.90	12.10	12.90	14.00	14.80	16.10	17.00	16.70
1987	3.80	8.50	11.70	13.30	14.50	15.20	16.40	17.00	17.60
1988	4.38	5.58	10.29	12.15	14.20	15.21	15.31	16.59	17.04
1989	5.02	9.68	13.56	14.54	15.81	16.89	17.32	17.51	18.10
1990	4.57	10.36	12.60	14.89	15.96	17.52	17.72	18.43	18.09
1991	5.60	9.00	12.90	14.30	15.80	16.60	17.50	16.90	16.90
1992	6.00	8.70	12.10	14.70	15.40	17.30	17.20	18.10	18.40
1993	3.80	6.60	11.10	13.80	14.60	15.00	16.20	16.60	16.60
1994	4.90	8.00	9.80	12.10	14.00	14.50	15.20	15.50	15.90
1995	3.30	6.50	10.60	11.00	12.60	13.70	14.10	14.30	14.50

Table 9.2.2.3

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

12:33 Monday, April 22, 199

WEST: Mean Weight in Stock (Grams)									
Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1974	4.80	6.60	10.50	12.20	13.40	13.90	15.40	14.10	14.30
1975	4.00	6.80	11.20	12.40	13.40	14.70	14.30	15.70	13.50
1976	4.00	6.90	10.70	12.70	13.50	14.50	16.10	14.70	14.30
1977	4.40	5.40	11.00	13.40	14.00	14.40	15.90	15.90	15.80
1978	4.30	5.10	10.90	12.50	13.10	14.10	15.20	15.80	15.10
1979	4.00	5.50	12.70	13.00	13.70	15.10	15.80	15.60	16.20
1980	4.20	7.80	11.30	14.30	14.10	14.30	16.70	15.80	16.00
1981	4.30	6.30	14.10	16.10	18.00	16.50	15.90	16.80	16.10
1982	4.20	8.80	11.70	16.00	16.20	16.70	16.40	16.30	17.30
1983	4.70	9.20	14.50	16.20	17.10	16.90	17.00	16.90	16.80
1984	3.90	9.70	11.10	14.60	15.30	15.80	16.30	16.90	17.20
1985	3.40	9.10	11.30	12.70	14.00	16.00	17.10	17.10	15.80
1986	4.40	7.90	12.10	12.90	14.00	14.80	16.10	17.00	16.70
1987	3.80	8.50	11.70	13.30	14.50	15.20	16.40	17.00	17.60
1988	4.38	5.58	10.29	12.15	14.20	15.21	15.31	16.59	17.04
1989	5.02	9.68	13.56	14.54	15.81	16.89	17.32	17.51	18.10
1990	4.57	10.36	12.60	14.89	15.96	17.52	17.72	18.43	18.09
1991	5.60	9.00	12.90	14.30	15.80	16.60	17.50	16.90	16.90
1992	6.00	8.70	12.10	14.70	15.40	17.30	17.20	18.10	18.40
1993	3.80	6.60	11.10	13.80	14.60	15.00	16.20	16.60	16.60
1994	4.90	8.00	9.80	12.10	14.00	14.50	15.20	15.50	15.90
1995	3.30	6.50	10.60	11.00	12.60	13.70	14.10	14.30	14.50

Table 9.2.2.4

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

12:33 Monday, April 22, 199

NATMOR: Natural Mortality									
Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1973	.	.	.	.	.	.	.	.	.
1974	0.60	0.50	0.42	0.38	0.43	0.43	0.40	0.42	0.42
1975	0.33	0.70	0.57	0.48	0.44	0.50	0.46	0.48	0.48
1976	0.33	0.70	0.57	0.48	0.44	0.50	0.46	0.48	0.48
1977	0.33	0.69	0.56	0.48	0.44	0.53	0.47	0.51	0.51
1978	0.45	0.94	0.74	0.62	0.57	0.69	0.61	0.68	0.68
1979	0.54	1.19	0.93	0.77	0.70	0.86	0.75	0.86	0.86
1980	0.58	1.25	0.97	0.81	0.74	0.90	0.79	0.91	0.91
1981	0.46	0.96	0.76	0.64	0.58	0.70	0.62	0.69	0.69
1982	0.48	1.02	0.80	0.67	0.61	0.74	0.66	0.74	0.74
1983	0.44	0.89	0.71	0.60	0.55	0.66	0.58	0.66	0.66
1984	0.40	0.79	0.63	0.54	0.50	0.59	0.53	0.59	0.59
1985	0.38	0.73	0.59	0.51	0.57	0.55	0.50	0.56	0.56
1986	0.34	0.61	0.50	0.44	0.41	0.47	0.43	0.47	0.47
1987	0.31	0.53	0.44	0.39	0.36	0.42	0.38	0.41	0.41
1988	0.32	0.53	0.44	0.39	0.37	0.42	0.38	0.42	0.42
1989	0.29	0.41	0.36	0.32	0.30	0.34	0.32	0.34	0.34
1990	0.26	0.32	0.29	0.27	0.26	0.28	0.26	0.27	0.27
1991	0.18	0.28	0.26	0.24	0.24	0.25	0.24	0.24	0.24
1992	0.18	0.29	0.26	0.25	0.24	0.26	0.24	0.23	0.23
1993	0.25	0.30	0.27	0.26	0.25	0.27	0.25	0.26	0.26
1994	0.27	0.34	0.31	0.28	0.27	0.30	0.27	0.28	0.28
1995	0.27	0.34	0.31	0.28	0.27	0.30	0.27	0.28	0.28

Table 9.2.2.5

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

12:33 Monday, April 22, 1996

MATPROP: Proportion Mature at Year Start

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1973	.	.	.	.	.	.	.	.	.
1974	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1975	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1976	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1977	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1978	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1979	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1980	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1981	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1982	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1983	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1984	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1985	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1986	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1987	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1988	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1989	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1990	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1991	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1992	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1993	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1994	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1995	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0
1996	0.0	0.0	0.7	1.0	1.0	1.0	1.0	1.0	1.0

Table 9.2.2.6

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

12:33 Monday, April 22, 1996

MPROP: Proportion of M before Spawning

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1974	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1975	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1976	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1977	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1978	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1979	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1980	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1981	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1982	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1983	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1984	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1985	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1986	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1987	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1988	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1989	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1990	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1991	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1992	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1993	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1994	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1995	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Table 9.2.2.7

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

FPROP: Proportion of F before Spawning

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1974	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1975	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1976	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1977	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1978	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1979	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1980	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1981	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1982	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1983	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1984	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1985	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1986	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1987	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1988	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1989	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1990	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1991	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1992	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1993	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1994	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1995	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Table 9.2.3.1

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

15:45 Monday, April 22, 1996

FLT01: International Acoustic Surveys 24-29S

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1983	1	34442	8912	7997	1989	310	192	111	7
1984	1	12411	19142	4827	1673	189	45	67	55
1985	1	3718	10968	8455	1920	269	75	56	44
1986	1	1234	6256	8530	2496	359	26	20	34
1987	1	11203	2899	6307	2675	962	185	19	14
1988	1	644	5131	3194	3580	1568	195	30	8
1989	1	29866	2093	18258	3323	2129	1641	1591	250
1990	1	9763	21665	4690	3768	1457	728	175	43
1991	1	34639	25499	27877	1427	5879	1258	1186	2273
1992	1	-11	-11	-11	-11	-11	-11	-11	-11
1993	1	-11	-11	-11	-11	-11	-11	-11	-11
1994	1	8919	34773	24749	12075	7297	3254	598	1084
1995	1	-11	-11	-11	-11	-11	-11	-11	-11

## SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

Table 9.2.3.2

FLT02: Latvian and Russian Acoustic Surveys in SD 26+28

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1983	1	21087	2066	1938	501	166	20	69	231
1984	1	16531	12765	981	441	61	-11	-11	38
1985	1	9752	7748	7174	663	357	37	58	150
1986	1	5604	5351	5283	4693	107	175	19	24
1987	1	23035	2246	2992	2489	2341	110	81	41
1988	1	741	14404	1251	1667	1451	1301	59	60
1989	1	22461	433	8394	681	875	934	825	142
1990	1	22837	16790	170	3885	380	485	491	609
1991	1	30060	15080	12210	311	2486	284	218	592
1992	1	23758	16947	13439	5223	1008	1757	155	73
1993	1	-11	-11	-11	-11	-11	-11	-11	-11
1994	1	8407	31589	15182	6598	3439	1370	53	430
1995	1	80333	8144	23732	11722	5374	3282	1169	523



Table 9.2.3.3

13:52 Wednesday, May 1, 1996 1

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

FLT04: Polish young fish survey age 0 (Catch: Number)

Year	Fishing effort	Catch, age 1
1977	1	1241
1978	1	379
1979	1	2087
1980	1	632
1981	1	1002
1982	1	19
1983	1	817
1984	1	2037
1985	1	2582
1986	1	131
1987	1	-11
1988	1	15
1989	1	2707
1990	1	6060
1991	1	1319
1992	1	317
1993	1	728
1994	1	53
1995	1	1844
1996	1	-11

Table 9.2.3.4

13:52 Wednesday, May 1, 1996 2

SPR-2232: Sprat in the Baltic Sea (Fishing Areas 22 to 32)

FLT06: Acoustic in 26+28, 0 age (Catch: Number)

Year	Fishing effort	Catch, age 1
1985	1	9752
1986	1	5604
1987	1	11200
1988	1	750
1989	1	18815
1990	1	12124
1991	1	29172
1992	1	31190
1993	1	37800
1994	1	2264
1995	1	26007
1996	1	23080

**Table 9.2.3.5**

Lowestoft VPA Version 3.1

22-Apr-96 16:04:21

Extended Survivors Analysis

Sprat Baltic Sea (run: XSARYS11/X11)

CPUE data from file /users/fish/ifad/ifapwork/wgbfas/spr\_2232/FLEET.X11

Catch data for 22 years. 1974 to 1995. Ages 1 to 8.

Fleet,	First,	Last,	First,	Last,	Alpha,	Beta
	year,	year,	age,	age		
FLT01: International,	1983,	1995,	1,	7,	.750,	.850
FLT02: Latvian and R,	1983,	1995,	1,	7,	.750,	.850
FLT04: Polish young,	1977,	1995,	1,	1,	.000,	.100
FLT06: Acoustic in 2,	1985,	1995,	1,	1,	.000,	.100

T = series weights :

Tapered time weighting applied  
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C  
Minimum of 5 points used for regression  
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages >= 4

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 = .750

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

Prior weighting not applied

Tuning had not converged after 40 iterations

Total absolute residual between iterations  
39 and 40 = .00268

Final year F values

Age	1,	2,	3,	4,	5,	6,	7
Iteration 39,	.0594,	.1229,	.1741,	.2862,	.2236,	.2420,	.1411
Iteration 40,	.0595,	.1230,	.1746,	.2873,	.2240,	.2424,	.1412

Table 9.2.3.5 (continued)

Regression weights

, .751, .820, .877, .921, .954, .976, .990, .997, 1.000, 1.000

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
1,	.043,	.019,	.010,	.048,	.020,	.016,	.022,	.021,	.039,	.060
2,	.080,	.061,	.112,	.063,	.111,	.070,	.061,	.098,	.141,	.123
3,	.115,	.163,	.196,	.121,	.113,	.125,	.113,	.094,	.216,	.175
4,	.178,	.267,	.255,	.185,	.097,	.199,	.121,	.101,	.151,	.287
5,	.346,	.292,	.208,	.309,	.135,	.082,	.370,	.094,	.176,	.224
6,	.316,	.548,	.240,	.188,	.235,	.112,	.062,	.427,	.120,	.242
7,	.255,	.594,	.371,	.228,	.083,	.189,	.187,	.066,	.697,	.141

XSA population numbers (Thousands)

YEAR ,	1,	AGE 2,	3,	4,	5,	6,	7,
1986 ,	1.59E+07,	1.91E+07,	1.63E+07,	1.58E+07,	1.47E+06,	8.61E+05,	8.99E+04,
1987 ,	5.47E+07,	8.25E+06,	1.07E+07,	9.38E+06,	8.78E+06,	6.51E+05,	4.08E+05,
1988 ,	9.75E+06,	3.16E+07,	5.00E+06,	6.15E+06,	5.01E+06,	4.31E+06,	2.58E+05,
1989 ,	5.52E+07,	5.68E+06,	1.82E+07,	2.78E+06,	3.29E+06,	2.67E+06,	2.32E+06,
1990 ,	6.30E+07,	3.49E+07,	3.72E+06,	1.17E+07,	1.71E+06,	1.72E+06,	1.61E+06,
1991 ,	7.61E+07,	4.49E+07,	2.34E+07,	2.54E+06,	8.18E+06,	1.13E+06,	1.05E+06,
1992 ,	9.57E+07,	5.66E+07,	3.23E+07,	1.62E+07,	1.63E+06,	5.87E+06,	7.96E+05,
1993 ,	1.00E+08,	7.00E+07,	4.11E+07,	2.25E+07,	1.13E+07,	8.70E+05,	4.34E+06,
1994 ,	3.35E+07,	7.27E+07,	4.85E+07,	2.88E+07,	1.58E+07,	7.86E+06,	4.42E+05,
1995 ,	1.27E+08,	2.30E+07,	4.63E+07,	2.95E+07,	1.89E+07,	9.82E+06,	5.32E+06,

Estimated population abundance at 1st Jan 1996

, .00E+00, 8.50E+07, 1.49E+07, 2.93E+07, 1.69E+07, 1.12E+07, 5.87E+06,

Taper weighted geometric mean of the VPA populations:

, 5.27E+07, 2.72E+07, 1.54E+07, 7.71E+06, 3.73E+06, 1.61E+06, 7.05E+05,

Standard error of the weighted Log(VPA populations) :

, .7581, .8461, 1.0046, 1.1171, 1.2072, 1.2982, 1.3652,

**Table 9.2.3.5 (continued)**

Log catchability residuals.

Fleet : FLT01: International

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	-.18	-.13	-.31
2	99.99	99.99	99.99	99.99	99.99	99.99	.77	-.09	-.02
3	99.99	99.99	99.99	99.99	99.99	99.99	.54	-.01	-.86
4	99.99	99.99	99.99	99.99	99.99	99.99	1.63	.03	.38
5	99.99	99.99	99.99	99.99	99.99	99.99	-.12	.11	-1.05
6	99.99	99.99	99.99	99.99	99.99	99.99	1.34	-1.37	-.06
7	99.99	99.99	99.99	99.99	99.99	99.99	-.05	1.10	-.46

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	-.08	-.05	-.04	.49	-.37	.18	99.99	99.99	.23	99.99
2	-.11	-.06	-.82	-.06	.34	.19	99.99	99.99	.09	99.99
3	-.33	-.31	-.43	.46	.16	.69	99.99	99.99	-.06	99.99
4	-1.11	-.49	.22	.83	-.58	.04	99.99	99.99	-.27	99.99
5	-.49	-1.38	-.39	.35	.44	.20	99.99	99.99	-.13	99.99
6	-2.64	-.25	-2.33	.18	-.20	.65	99.99	99.99	-.30	99.99
7	-.66	-2.00	-1.25	.34	-1.67	.73	99.99	99.99	1.35	99.99

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
Mean Log q	-7.1730	-7.1730	-7.1730	-7.1730
S.E(Log q)	.7128	.6505	1.3378	1.2469

Regression statistics :

Ages with q dependent on year class strength

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

1	.60	2.740	11.90	.89	10	.30	-8.15
2	.95	.262	7.88	.84	10	.42	-7.43
3	1.34	-1.515	3.57	.77	10	.52	-6.81

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	2.30	-3.283	-3.83	.51	10	1.06	-7.17
5	1.11	-.446	6.56	.74	10	.72	-7.39
6	1.31	-.636	5.71	.41	10	1.67	-7.68
7	1.05	-.115	7.16	.47	10	1.37	-7.44

Table 9.2.3.5 (continued)

Fleet : FLT02: Latvian and R

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.56	.29	-.50	.21	.02	.00	-.39	99.99	-.06	.27
2	.15	.33	.32	-.49	.25	-.12	-.28	99.99	-.02	.18
3	.12	.17	.39	.25	-.72	.21	-.06	99.99	-.31	.00
4	.19	.11	.13	-.08	.12	-.81	.09	99.99	-.20	.46
5	-1.03	.18	.20	.13	-.24	.01	.96	99.99	-.21	.10
6	-.06	-.10	.23	.29	.07	-.17	-.03	99.99	-.50	.25
7	-.04	.12	.09	.36	.03	-.29	-.37	99.99	-.40	-.24

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
Mean Log q	-7.8430	-7.8430	-7.8430	-7.8430
S.E(Log q)	.4230	.4678	.2472	.2726

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,	.73,	1.883,	10.45,	.86,	12,	.34,	-7.75,
2,	.70,	2.557,	10.56,	.90,	12,	.29,	-7.78,
3,	.65,	2.772,	10.88,	.89,	12,	.35,	-7.78,

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,	.92,	.616,	8.48,	.88,	12,	.40,	-7.84,
5,	.95,	.401,	8.24,	.87,	12,	.46,	-7.85,
6,	.96,	.621,	8.12,	.97,	11,	.25,	-7.87,
7,	1.03,	-.410,	7.71,	.95,	11,	.29,	-7.90,

Table 9.2.3.5 (continued)

Fleet : FLT04: Polish young

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.54	.87	1.02	.94	.33	-1.73	-.76	.53	1.25
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								

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.29	99.99	-.60	.96	1.33	.18	-.96	-.48	-1.04	-.12
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									

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	.64	.976	13.75	.44	18	.94	-11.44
---	-----	------	-------	-----	----	-----	--------

Fleet : FLT06: Acoustic in 2

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.15
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								

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.69	-.06	-.24	.29	-.15	.27	.09	.18	-.70	-.32
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									

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	.70	1.759	11.17	.82	11	.39	-8.41
---	-----	-------	-------	-----	----	-----	-------

**Table 9.2.3.5 (continued)**

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e.,	Ext, s.e.,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FLT01: International,	1.,	.000,	.000,	.00,	0, .000,	.000
FLT02: Latvian and R,	111498528.,	.391,	.000,	.00,	1, .397,	.046
FLT04: Polish young ,	75544184.,	1.001,	.000,	.00,	1, .061,	.067
FLT06: Acoustic in 2,	62117724.,	.424,	.000,	.00,	1, .338,	.081
P shrinkage mean ,	27230656.,	.85,...			.090,	.175
F shrinkage mean ,	218005792.,	.75,...			.115,	.024

Weighted prediction :

Survivors, at end of year,	Int, s.e.,	Ext, s.e.,	N,	Var, Ratio,	F
85017976.,	.25,	.27,	5,	1.070,	.060

Age 2 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e.,	Ext, s.e.,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FLT01: International,	18648740.,	.316,	.000,	.00,	1, .263,	.099
FLT02: Latvian and R,	16180256.,	.232,	.114,	.49,	2, .499,	.114
FLT04: Polish young ,	5243386.,	1.050,	.000,	.00,	1, .024,	.316
FLT06: Acoustic in 2,	7359977.,	.448,	.000,	.00,	1, .130,	.235
P shrinkage mean ,	15370143.,	1.00,...			.030,	.119
F shrinkage mean ,	19224792.,	.75,...			.055,	.097

Weighted prediction :

Survivors, at end of year,	Int, s.e.,	Ext, s.e.,	N,	Var, Ratio,	F
14876383.,	.16,	.14,	7,	.854,	.123

Age 3 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e.,	Ext, s.e.,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FLT01: International,	32220842.,	.481,	.000,	.00,	1, .137,	.160
FLT02: Latvian and R,	29136546.,	.246,	.008,	.03,	2, .556,	.176
FLT04: Polish young ,	18260714.,	.985,	.000,	.00,	1, .032,	.268
FLT06: Acoustic in 2,	35255896.,	.435,	.000,	.00,	1, .164,	.148
P shrinkage mean ,	7708902.,	1.12,...			.035,	.547
F shrinkage mean ,	39472572.,	.75,...			.077,	.133

Weighted prediction :

Survivors, at end of year,	Int, s.e.,	Ext, s.e.,	N,	Var, Ratio,	F
29349500.,	.18,	.12,	7,	.640,	.175

**Table 9.2.3.5 (continued)**

Age 4 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, Weights,	Scaled, Weights,	Estimated F
FLT01: International,	15986596.,	.608,	.000,	.00,	1,	.086,	.302
FLT02: Latvian and R,	15335237.,	.227,	.265,	1.17,	3,	.641,	.313
FLT04: Polish young,	6493262.,	.992,	.000,	.00,	1,	.029,	.624
FLT06: Acoustic in 2,	18566046.,	.431,	.000,	.00,	1,	.152,	.265
F shrinkage mean	39076196.,	.75,...				.093,	.135

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
16866606.,	.18,	.18,	7,	.986,	.287

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Weights,	Scaled, Weights,	Estimated F
FLT01: International,	12331191.,	.308,	.176,	.57,	2,	.217,	.206
FLT02: Latvian and R,	9928500.,	.193,	.087,	.45,	4,	.596,	.250
FLT04: Polish young,	13360970.,	1.004,	.000,	.00,	1,	.020,	.191
FLT06: Acoustic in 2,	14732375.,	.432,	.000,	.00,	1,	.106,	.175
F shrinkage mean	14926795.,	.75,...				.061,	.173

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
11190370.,	.15,	.07,	9,	.503,	.224

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Weights,	Scaled, Weights,	Estimated F
FLT01: International,	4928604.,	.249,	.170,	.68,	3,	.223,	.283
FLT02: Latvian and R,	6085271.,	.161,	.087,	.54,	5,	.646,	.235
FLT04: Polish young,	22341768.,	1.077,	.000,	.00,	1,	.011,	.070
FLT06: Acoustic in 2,	5038491.,	.424,	.000,	.00,	1,	.072,	.278
F shrinkage mean	7603564.,	.75,...				.048,	.192

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5873092.,	.13,	.08,	11,	.633,	.242

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Weights,	Scaled, Weights,	Estimated F
FLT01: International,	5450621.,	.251,	.119,	.47,	4,	.173,	.093
FLT02: Latvian and R,	3135047.,	.143,	.133,	.93,	6,	.726,	.156
FLT04: Polish young,	9108263.,	1.056,	.000,	.00,	1,	.009,	.056
FLT06: Acoustic in 2,	4672842.,	.436,	.000,	.00,	1,	.053,	.107
F shrinkage mean	1835669.,	.75,...				.038,	.253

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3485451.,	.12,	.11,	13,	.919,	.141



Table 9.2.3.6

Run title : Sprat Baltic Sea (run: XSARYS11/X11)

At 22-Apr-96 16:08:31

Terminal Fs derived using XSA (with F shrinkage)

Table 8	Fishing mortality (F) at age	
YEAR,	1974,	1975,
AGE		
1,	.0664,	.0394,
2,	.1061,	.0955,
3,	.3215,	.1762,
4,	.3938,	.4732,
5,	.2964,	.3753,
6,	.5745,	.2811,
7,	.4292,	.3843,
+gp,	.4292,	.3843,
FBAR 3- 5,	.3373,	.3416,

Table 8	Fishing mortality (F) at age									
YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.0296,	.0669,	.0466,	.0553,	.0304,	.0690,	.0171,	.0200,	.0211,	.0204,
2,	.1040,	.1068,	.2210,	.1568,	.2040,	.2363,	.2033,	.0342,	.0574,	.0747,
3,	.1930,	.2558,	.1273,	.1792,	.2965,	.1496,	.2899,	.1031,	.0886,	.1165,
4,	.2090,	.3644,	.2708,	.1300,	.2249,	.1887,	.1832,	.1694,	.1726,	.2057,
5,	.5480,	.2071,	.4026,	.2864,	.2021,	.0956,	.3197,	.0826,	.2678,	.2145,
6,	.3946,	.5358,	.1741,	.2070,	.3422,	.2058,	.1373,	.1470,	.1349,	.2310,
7,	.3918,	.3773,	.2912,	.2164,	.2686,	.1677,	.2203,	.0942,	.2397,	.1330,
+gp,	.3918,	.3773,	.2912,	.2164,	.2686,	.1677,	.2203,	.0942,	.2397,	.1330,
FBAR 3- 5,	.3167,	.2758,	.2669,	.1985,	.2412,	.1446,	.2643,	.1184,	.1763,	.1789,

Run title : Sprat Baltic Sea (run: XSARYS11/X11)

At 22-Apr-96 16:08:31

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age										FBAR 93-95
YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	
AGE											
1,	.0433,	.0187,	.0105,	.0479,	.0197,	.0159,	.0218,	.0215,	.0389,	.0595,	.0400,
2,	.0800,	.0614,	.1124,	.0631,	.1110,	.0696,	.0609,	.0975,	.1406,	.1230,	.1204,
3,	.1151,	.1627,	.1957,	.1215,	.1126,	.1252,	.1129,	.0942,	.2156,	.1746,	.1615,
4,	.1779,	.2666,	.2546,	.1847,	.0973,	.1993,	.1213,	.1007,	.1508,	.2873,	.1796,
5,	.3456,	.2924,	.2079,	.3094,	.1350,	.0821,	.3701,	.0938,	.1764,	.2240,	.1647,
6,	.3159,	.5475,	.2400,	.1878,	.2348,	.1119,	.0616,	.4272,	.1205,	.2424,	.2634,
7,	.2551,	.5944,	.3708,	.2278,	.0830,	.1892,	.1871,	.0663,	.6972,	.1412,	.3016,
+gp,	.2551,	.5944,	.3708,	.2278,	.0830,	.1892,	.1871,	.0663,	.6972,	.1412,	
FBAR 3- 5,	.2128,	.2405,	.2194,	.2052,	.1150,	.1355,	.2014,	.0962,	.1809,	.2286,	

Table 9.2.3.7

Run title : Sprat Baltic Sea (run: XSARYS11/X11)

At 22-Apr-96 16:08:31

Terminal Fs derived using XSA (With F shrinkage)

Table 10 YEAR,	Stock number at age (start of year)		Numbers*10**-5
	1974,	1975,	
AGE			
1,	522783,	230767,	
2,	756301,	296719,	
3,	159115,	446895,	
4,	73891,	78894,	
5,	93235,	32420,	
6,	26077,	45092,	
7,	42881,	9841,	
+gp,	9612,	21221,	
TOTAL,	1683894,	1161847,	

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10**-5				
	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	2275412,	517550,	175627,	451242,	230035,	558260,	355897,	1461511,	714677,	404158,
2,	110170,	1096941,	242799,	65480,	129886,	63931,	199503,	126155,	588310,	317582,
3,	152521,	56152,	563105,	92876,	22085,	40150,	23607,	73153,	59941,	295865,
4,	231867,	77811,	26904,	266716,	35946,	7304,	18230,	9040,	36213,	31968,
5,	31654,	121162,	34809,	11605,	116303,	13697,	3386,	8247,	4403,	18483,
6,	13511,	11100,	57975,	11673,	3688,	38633,	6182,	1173,	3924,	1867,
7,	21490,	5748,	4060,	26466,	4483,	1189,	16917,	2785,	567,	2018,
+gp,	16139,	15952,	10144,	9433,	14895,	8791,	3602,	22375,	5096,	6774,
TOTAL,	2852759,	1902418,	1115421,	935490,	557321,	731954,	627323,	1704439,	1413132,	1078716,

Run title : Sprat Baltic Sea (run: XSARYS11/X11)

At 22-Apr-96 16:08:31

Terminal Fs derived using XSA (With F shrinkage)

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10**-5					GMST
	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE											
1,	158508,	546826,	97468,	551634,	630357,	761313,	956516,	1002848,	335233,	1269977,	0,
2,	190838,	82476,	315888,	56771,	348970,	448794,	566316,	700312,	727158,	229506,	850180,
3,	163365,	106855,	49956,	181810,	37185,	233691,	322779,	410851,	484931,	463371,	148764,
4,	158130,	93777,	61486,	27812,	116921,	25364,	162199,	224553,	288305,	295424,	293495,
5,	14717,	87844,	50116,	32923,	17130,	81793,	16346,	113018,	158131,	189288,	168666,
6,	8605,	6511,	43086,	26748,	17197,	11312,	58682,	8705,	78555,	98202,	111904,
7,	899,	4082,	2575,	23177,	16097,	10485,	7956,	43403,	4422,	53161,	58731,
+gp,	2756,	1946,	5509,	7889,	28605,	9898,	10656,	45392,	4675,	34486,	57486,
TOTAL,	697818,	930318,	626084,	908763,	1212461,	1582647,	2101452,	2549079,	2081411,	2633414,	1689224,

**Table 9.2.3.8**

Run title : Sprat Baltic Sea (run: XSARYS11/x11)

At 22-Apr-96 16:08:31

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (with F shrinkage)

	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 5,
1974,	52278328,	1728009,	861573,	241700,	.2805,	.3373,
1975,	23076688,	1283977,	772099,	201434,	.2609,	.3416,
1976,	227541056,	2360793,	551925,	194775,	.3529,	.3167,
1977,	51755024,	1869452,	942786,	210735,	.2235,	.2758,
1978,	17562654,	1279311,	804924,	132360,	.1644,	.2669,
1979,	45124168,	943533,	450171,	78363,	.1741,	.1985,
1980,	23003528,	608245,	244717,	57662,	.2356,	.2412,
1981,	55826004,	603029,	171346,	47441,	.2769,	.1446,
1982,	35589632,	675487,	192715,	49141,	.2550,	.2643,
1983,	146151104,	1695789,	241776,	37320,	.1544,	.1184,
1984,	71467784,	1529000,	472254,	52560,	.1113,	.1763,
1985,	40415792,	1189480,	554593,	69497,	.1253,	.1789,
1986,	15850750,	831627,	502994,	75482,	.1501,	.2128,
1987,	54682676,	1023318,	390803,	88276,	.2259,	.2405,
1988,	9746810,	673942,	410685,	80057,	.1949,	.2194,
1989,	55163408,	1105688,	437035,	85817,	.1964,	.2052,
1990,	63035648,	1469120,	601907,	85578,	.1422,	.1150,
1991,	76131272,	1830422,	843331,	102808,	.1219,	.1355,
1992,	95651584,	2428962,	1186091,	142195,	.1199,	.2014,
1993,	100284760,	2718764,	1547146,	178200,	.1152,	.0962,
1994,	33523326,	2350473,	1550117,	290800,	.1876,	.1809,
1995,	126997800,	2563841,	1314386,	303500,	.2309,	.2286,
Arith.						
Mean	64584536,	1489194,	683881,	127532,	.1954,	.2135,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 9.2.5.1

SPRAT 22 TO 32, RESULTS FROM THE LATVIAN, RUSSIAN AND POLISH YFS

	VPA	1)	2)	3)
1976	51755	1241	1393	-11
1977	17563	379	2	-11
1978	45124	2087	6	-11
1979	23004	632	9578	-11
1980	55826	1002	5794	-11
1981	35589	19	122	-11
1982	146151	817	13646	-11
1983	71468	2037	3651	-11
1984	40416	2582	690	9752
1985	15851	131	6629	5604
1986	54683	-11	557	11200
1987	9747	15	203	750
1988	55163	2707	1329	18815
1989	63036	6060	486	12124
1990	76131	1319	1908	29172
1991	95652	317	8918	31190
1992	100285	728	177	37800
1993	33523	53	54	2264
1994	126998	1844	2788	26007
1995	-11	-11	118	23080
1) Pol	0 YFS			
2) Pol	1 YFS			
3) Acoustic	SD 26+28	Age gr. 0		

**Table 9.2.5.1 (continued)**

Yearclass = 1993

I-----Regression-----I I-----Prediction-----I										
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No Value	Index Value	Predicted Error	Std Weights	WAP	
Pol 0	.70	6.30	1.05	383	16	3.99	9.09	1.312	.065	
Pol 1	1.45	.72	2.78	.075	17	4.01	6.52	3.481	.009	
Acoust	.70	4.20	.29	.897	9	7.73	9.60	.391	.730	
VPA Mean =						10.80	.756	.195		

Yearclass = 1994

I-----Regression-----I I-----Prediction-----I										
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No Value	Index Value	Predicted Error	Std Weights	WAP	
Pol 0	.64	6.79	.99	.398	17	7.52	11.61	1.166	.098	
Pol 1	1.27	2.22	2.44	.091	18	7.93	12.28	2.826	.017	
Acoust	.66	4.63	.37	.827	10	10.17	11.36	.455	.641	
VPA Mean =						10.78	.736	.245		

Yearclass = 1995

I-----Regression-----I I-----Prediction-----I										
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare Pts	No Value	Index Value	Predicted Error	Std Weights	WAP <sup>ifapexi</sup>	
Pol 0										
Pol 1	1.23	2.44	2.19	.117	19	4.78	8.32	2.626	.022	
Acoust	.70	4.30	.39	.819	11	10.05	11.35	.468	.708	

		VPA Mean 10.87 .758 .270						
Year Class	Weighted Average Prediction	Log WAP Error	Int Std Error	Ext Std	Var Ratio	VPA	Log VPA	
1991	65860	11.10	.37	.32	.72	95652	11.47	
1992	77651	11.26	.35	.31	.78	100286	11.52	
1993	17499	9.77	.33	.34	1.07	33524	10.42	
1994	77309	11.26	.36	.17	.23	126998	11.75	
1995	69836	11.15	.39	.34	.74			

Table 9.2.5.2

Analysis by RCT3 ver3.1 of data from file

recspr96.dat (j:\fapexim\wgbf\as\spr\_2232\96xsarct\recspr96.dat)

SPRAT 22 TO 32, RESULTS FROM THE LATVIAN, RUSSIAN AND POLISH  
YFS

Data for 3 surveys over 20 years 1976 - 1995

Regression type = C

Tapered time weighting applied

power = 3 over 20 years

Survey weighting not applied

Final estimates shrunk towards mean

Minimum S.E. for any survey taken as .20

Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1991

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

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

Pol 0	.57	6.95	.84	.483	14	5.76	10.23	.979	.144
Pol 1	1.06	3.38	2.23	.108	15	9.10	13.05	2.670	.019
Acoust	.71	4.13	.35	.856	7	10.35	11.44	.486	.583

VPA Mean = 10.65 .736 .254

Yearclass = 1992

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

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

Pol 0	.66	6.50	1.02	.396	15	6.59	10.83	1.175	.088
Pol 1	.94	4.04	1.84	.154	16	5.18	8.94	2.180	.026
Acoust	.71	4.12	.32	.879	8	10.54	11.58	.428	.668

VPA Mean = 10.72 .748 .218

Table 9.2.6.1

Sprat in the Baltic Sea (Fishing Areas 22 to 32)

13:42 Tuesday, April 23, 1996

Prediction with management option table: Input data

Year: 1996								
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	69836.000	0.3200	0.0000	0.4000	0.4000	7.000	0.0542	7.000
2	85018.000	0.2900	0.7000	0.4000	0.4000	10.500	0.1632	10.500
3	14876.400	0.2700	1.0000	0.4000	0.4000	12.300	0.2190	12.300
4	29349.500	0.2600	1.0000	0.4000	0.4000	13.730	0.2435	13.730
5	16866.700	0.2800	1.0000	0.4000	0.4000	14.400	0.2233	14.400
6	11190.400	0.2600	1.0000	0.4000	0.4000	15.100	0.3771	15.100
7	5873.100	0.2700	1.0000	0.4000	0.4000	15.470	0.4089	15.470
8+	5748.600	0.2700	1.0000	0.4000	0.4000	15.670	0.4089	15.670
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	79164.000	0.3200	0.0000	0.4000	0.4000	7.000	0.0542	7.000
2	.	0.2900	0.7000	0.4000	0.4000	10.500	0.1632	10.500
3	.	0.2700	1.0000	0.4000	0.4000	12.300	0.2190	12.300
4	.	0.2600	1.0000	0.4000	0.4000	13.730	0.2435	13.730
5	.	0.2800	1.0000	0.4000	0.4000	14.400	0.2233	14.400
6	.	0.2600	1.0000	0.4000	0.4000	15.100	0.3771	15.100
7	.	0.2700	1.0000	0.4000	0.4000	15.470	0.4089	15.470
8+	.	0.2700	1.0000	0.4000	0.4000	15.670	0.4089	15.670
Unit	Millions	-	-	-	-	Grams	-	Grams

Year: 1998								
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	79164.000	0.3200	0.0000	0.4000	0.4000	7.000	0.0542	7.000
2	.	0.2900	0.7000	0.4000	0.4000	10.500	0.1632	10.500
3	.	0.2700	1.0000	0.4000	0.4000	12.300	0.2190	12.300
4	.	0.2600	1.0000	0.4000	0.4000	13.730	0.2435	13.730
5	.	0.2800	1.0000	0.4000	0.4000	14.400	0.2233	14.400
6	.	0.2600	1.0000	0.4000	0.4000	15.100	0.3771	15.100
7	.	0.2700	1.0000	0.4000	0.4000	15.470	0.4089	15.470
8+	.	0.2700	1.0000	0.4000	0.4000	15.670	0.4089	15.670
Unit	Millions	-	-	-	-	Grams	-	Grams

Notes: Run name : MANRYS01  
Date and time: 23APR96:14:59

Table 9.2.6.2

Sprat in the Baltic Sea (Fishing Areas 22 to 32)

13:42 Tuesday, April 23, 1996

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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	0.2286	2560282	1468673	391482	0.0000	0.0000	2441753	1556108	0	2732873	1792525
.	.	.	.	.	0.1000	0.0229	.	1540978	41340	2693116	1739863
.	.	.	.	.	0.2000	0.0457	.	1526011	81707	2654308	1689031
.	.	.	.	.	0.3000	0.0686	.	1511203	121127	2616425	1639957
.	.	.	.	.	0.4000	0.0914	.	1496553	159627	2579438	1592571
.	.	.	.	.	0.5000	0.1143	.	1482060	197233	2543325	1546808
.	.	.	.	.	0.6000	0.1372	.	1467721	233969	2508060	1502605
.	.	.	.	.	0.7000	0.1600	.	1453535	269859	2473620	1459902
.	.	.	.	.	0.8000	0.1829	.	1439499	304926	2439983	1418639
.	.	.	.	.	0.9000	0.2057	.	1425612	339192	2407126	1378763
.	.	.	.	.	1.0000	0.2286	.	1411873	372680	2375028	1340220
.	.	.	.	.	1.1000	0.2515	.	1398279	405410	2343669	1302960
.	.	.	.	.	1.2000	0.2743	.	1384829	437404	2313028	1266933
.	.	.	.	.	1.3000	0.2972	.	1371521	468679	2283087	1232094
.	.	.	.	.	1.4000	0.3200	.	1358354	499257	2253825	1198397
.	.	.	.	.	1.5000	0.3429	.	1345325	529155	2225226	1165800
.	.	.	.	.	1.6000	0.3658	.	1332434	558392	2197270	1134261
.	.	.	.	.	1.7000	0.3886	.	1319678	586985	2169942	1103743
.	.	.	.	.	1.8000	0.4115	.	1307057	614952	2143224	1074206
.	.	.	.	.	1.9000	0.4343	.	1294567	642308	2117100	1045615
.	.	.	.	.	2.0000	0.4572	.	1282209	669069	2091555	1017934
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANRYS01  
Date and time : 23APR96:15:36  
Computation of ref. F: Simple mean, age 3 - 5  
Basis for 1996 : F factors

Table 9.2.6.3

Sprat in the Baltic Sea (Fishing Areas 22 to 32)

13:33 Wednesday, April 24, 1996

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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
0.8000	0.1829	2560282	1496841	320231	0.0000	0.0000	2509733	1615620	0	2788230	1842302
.	.	.	.	.	0.1000	0.0229	.	1599832	42959	2746987	1787699
.	.	.	.	.	0.2000	0.0457	.	1584213	84898	2706738	1735008
.	.	.	.	.	0.3000	0.0686	.	1568762	125846	2667454	1684152
.	.	.	.	.	0.4000	0.0914	.	1553477	165831	2629109	1635059
.	.	.	.	.	0.5000	0.1143	.	1538356	204879	2591677	1587661
.	.	.	.	.	0.6000	0.1372	.	1523396	243018	2555132	1541889
.	.	.	.	.	0.7000	0.1600	.	1508597	280270	2519449	1497682
.	.	.	.	.	0.8000	0.1829	.	1493956	316662	2484604	1454979
.	.	.	.	.	0.9000	0.2057	.	1479472	352217	2450575	1413721
.	.	.	.	.	1.0000	0.2286	.	1465141	386957	2417339	1373853
.	.	.	.	.	1.1000	0.2515	.	1450964	420905	2384874	1335321
.	.	.	.	.	1.2000	0.2743	.	1436937	454082	2353159	1298075
.	.	.	.	.	1.3000	0.2972	.	1423059	486510	2322174	1262065
.	.	.	.	.	1.4000	0.3200	.	1409329	518208	2291899	1227245
.	.	.	.	.	1.5000	0.3429	.	1395744	549196	2262315	1193571
.	.	.	.	.	1.6000	0.3658	.	1382303	579493	2233402	1160998
.	.	.	.	.	1.7000	0.3886	.	1369004	609117	2205144	1129487
.	.	.	.	.	1.8000	0.4115	.	1355846	638087	2177522	1098997
.	.	.	.	.	1.9000	0.4343	.	1342826	666420	2150520	1069491
.	.	.	.	.	2.0000	0.4572	.	1329944	694132	2124122	1040932
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

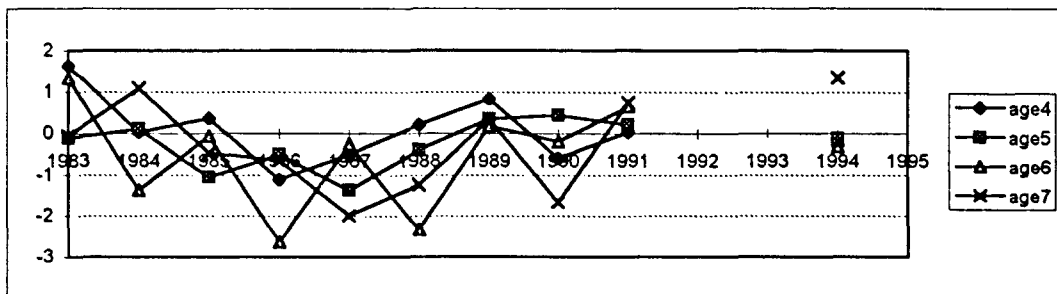
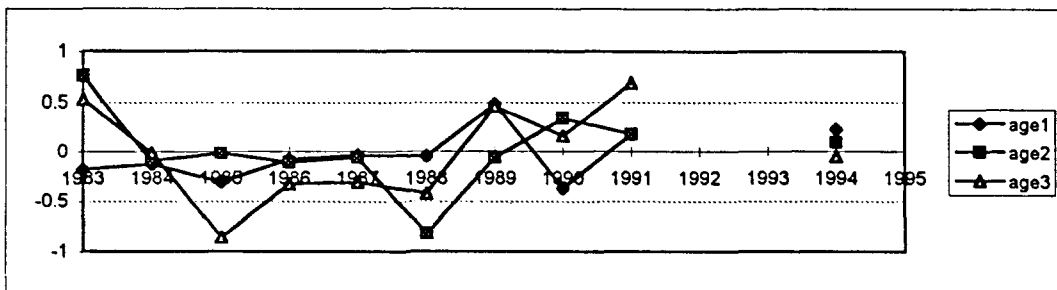
Notes: Run name : MANRYS02  
Date and time : 24APR96:13:34  
Computation of ref. F: Simple mean, age 3 - 5  
Basis for 1996 : F factors



**Figure 9.2.3.1 Residuals of log catchabilities**

**Sprat in Sub-Division 22-32**

FLT01 : International Acoustic Surveys 24-29S



FLT01 : Latvian and Russian Acoustic Surveys in SD 26+28

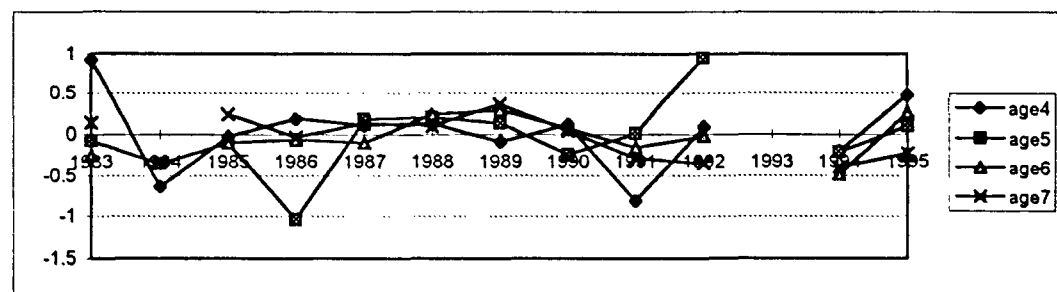
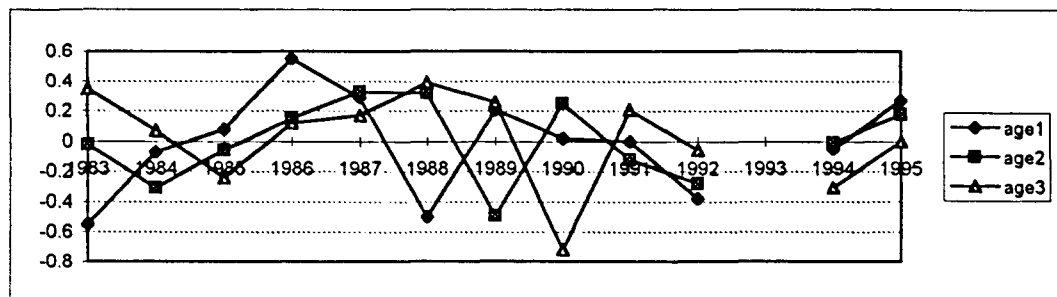


Figure 9.2.3.2 Retrospective analysis, s.e. for F-shrinkage is 0.75

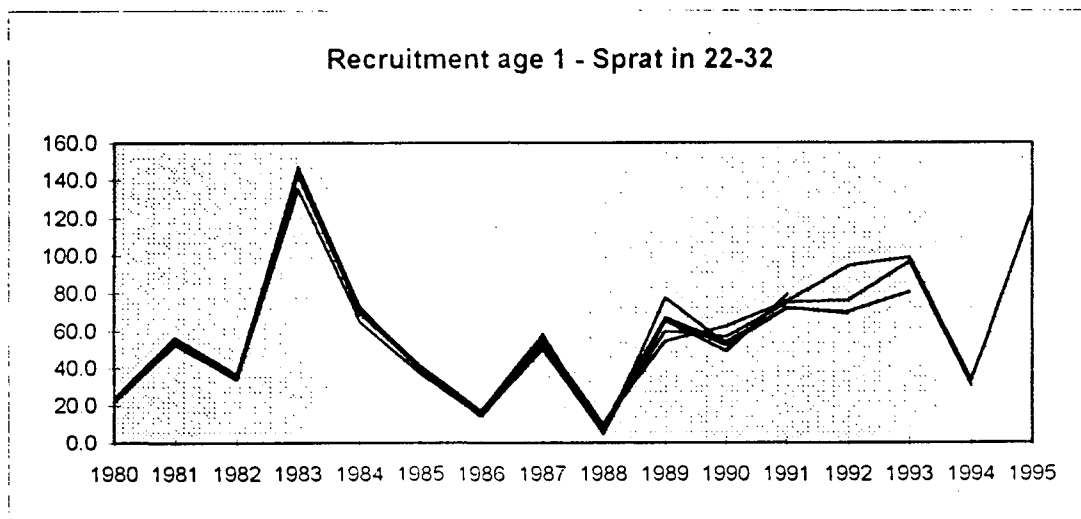
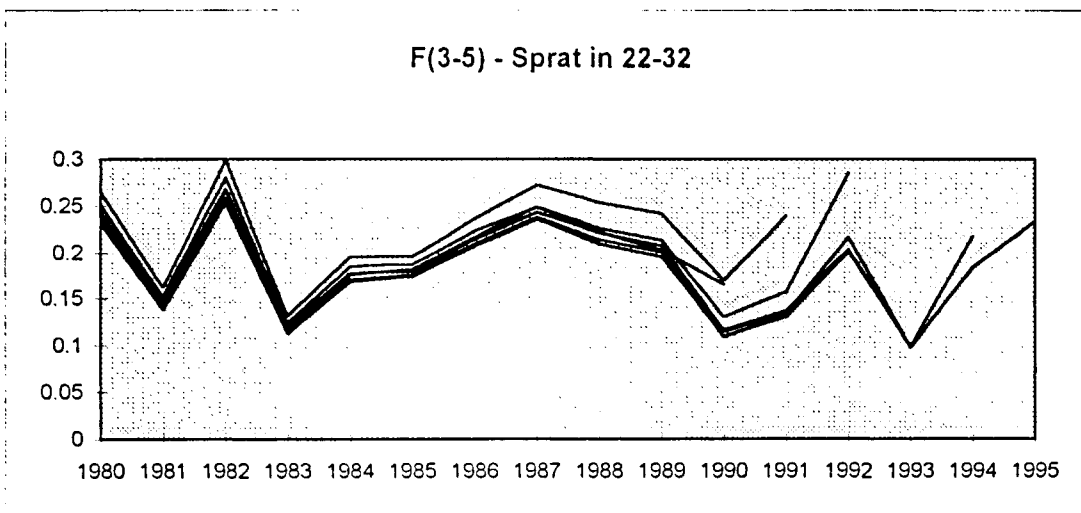
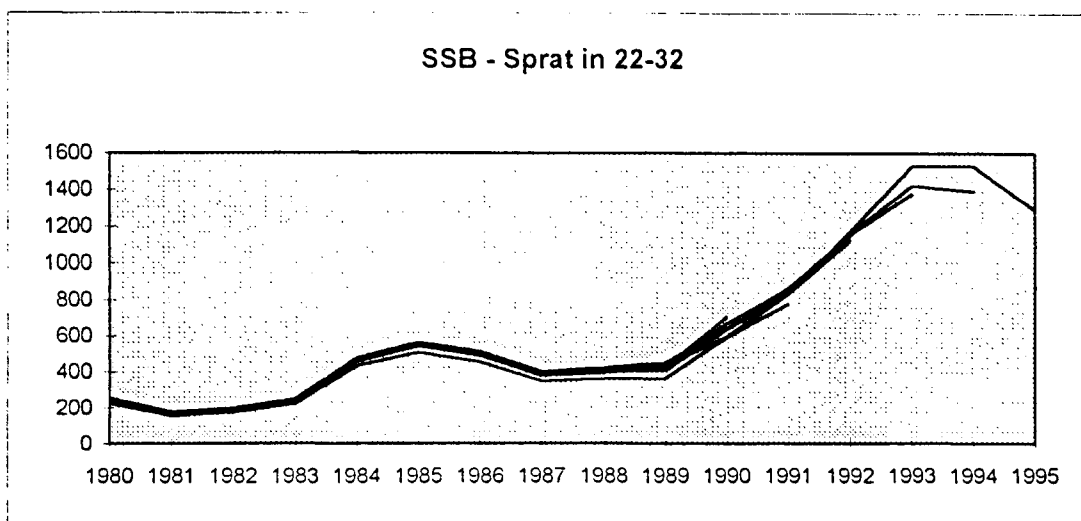


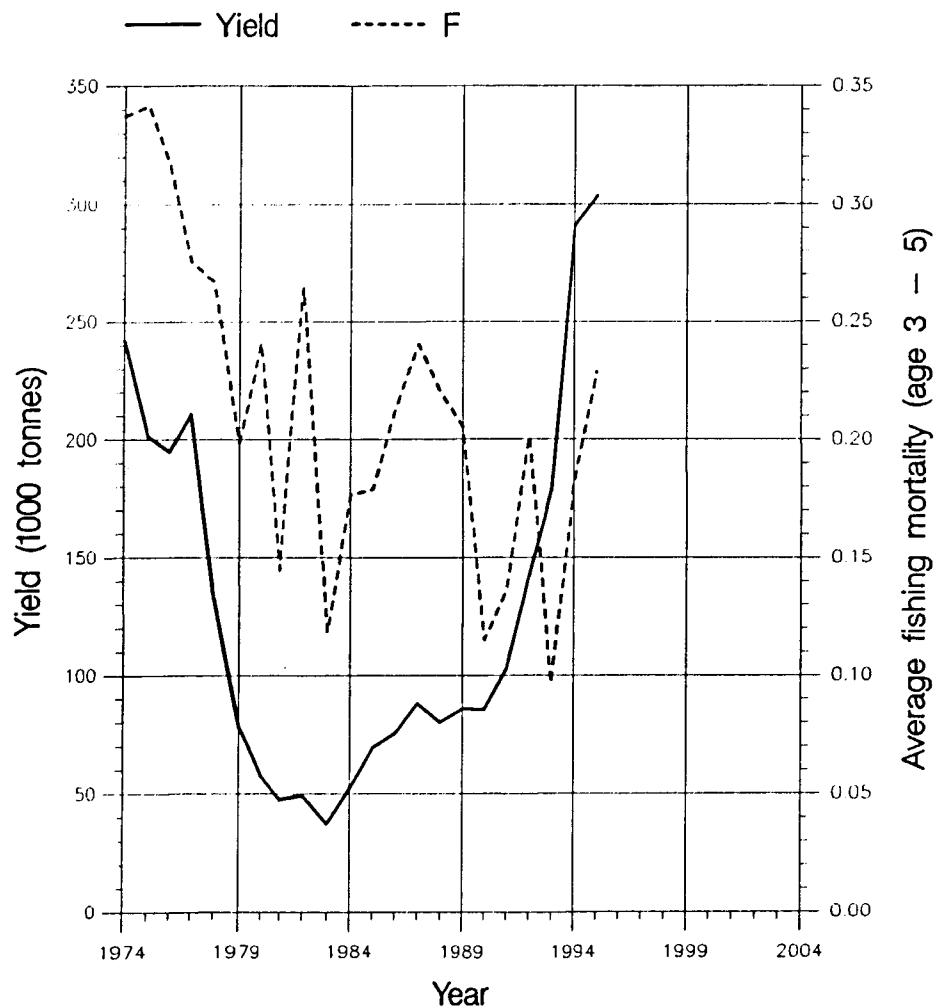
Figure 9.2.3.3

# Fish Stock Summary

## Sprat in the Baltic Sea (Fishing Areas 22 to 32)

### 22 - 4 - 1996

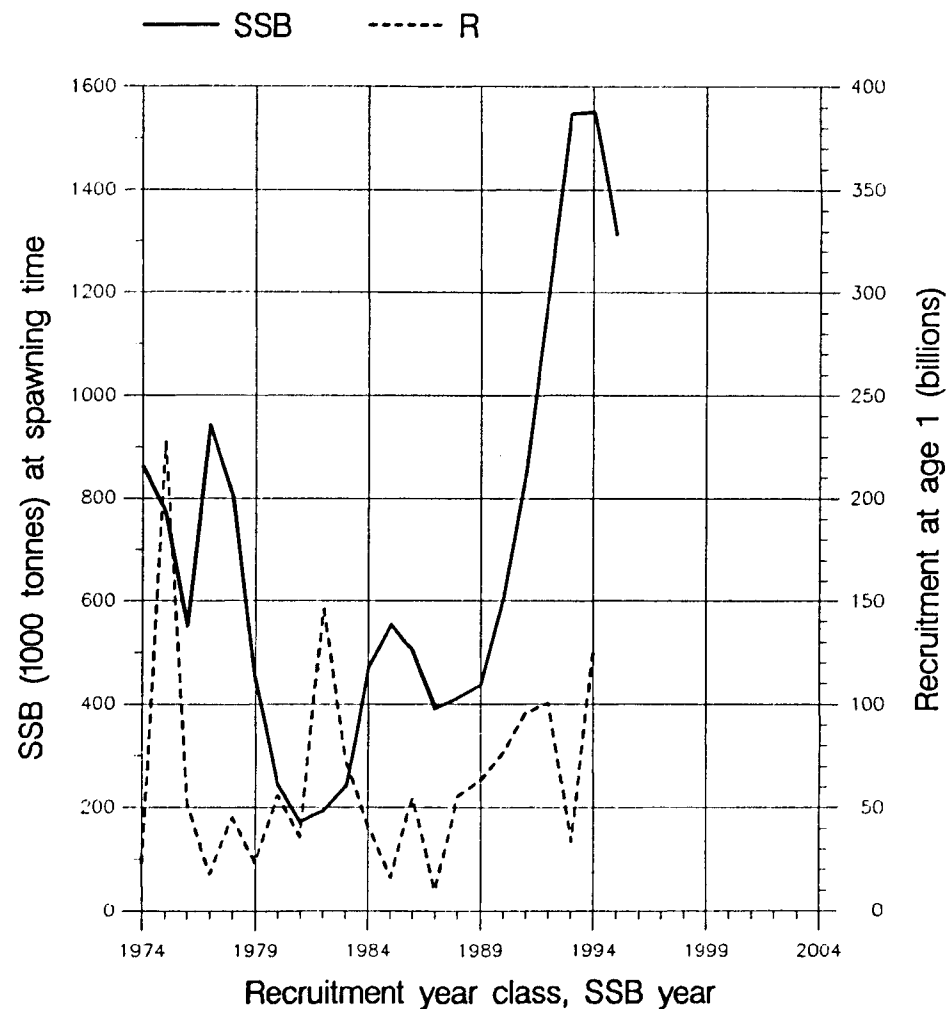
Yield and fishing mortality



(run: XSARYS11)

A

Spawning stock and recruitment



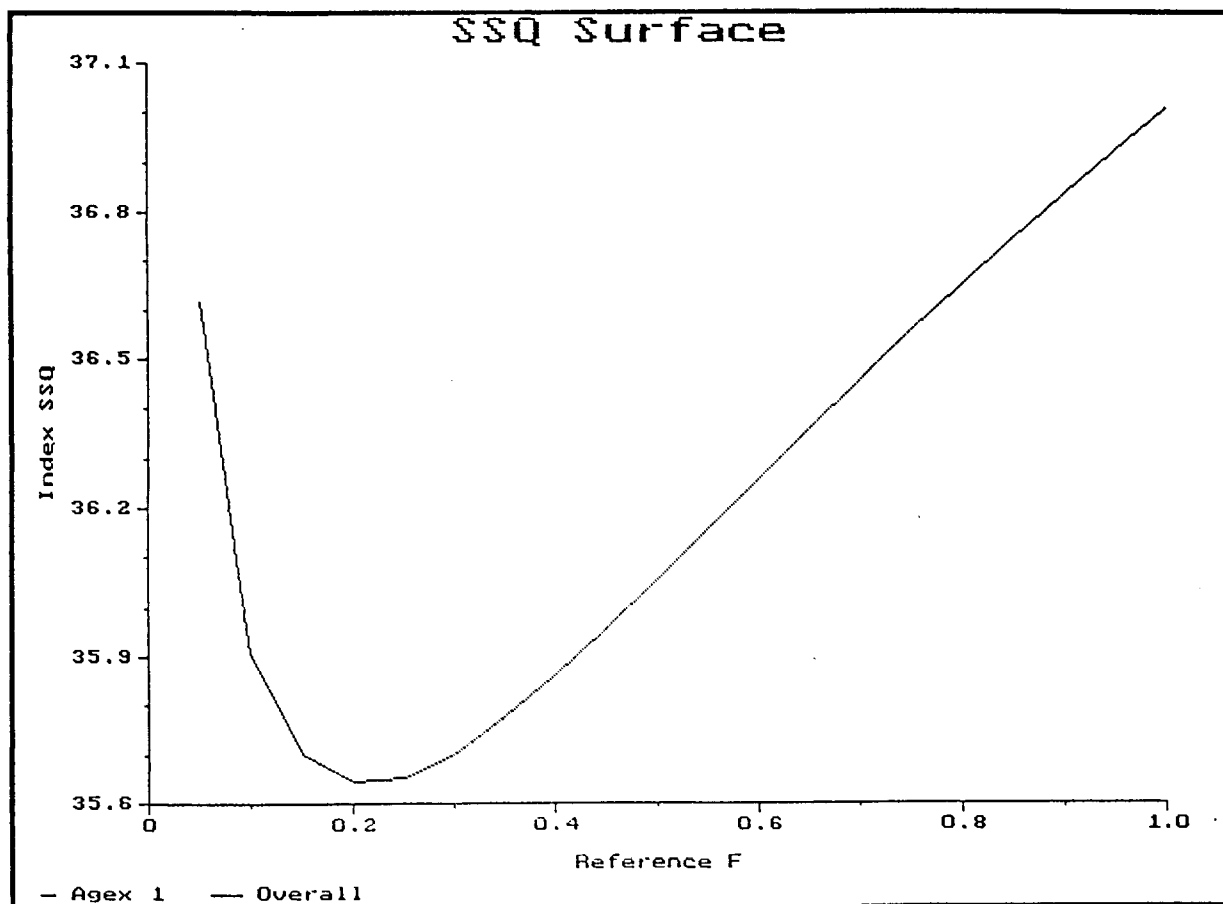
(run: XSARYS11)

B

**Figure 9.2.4.1**

Baltic Sprat (Sub-Divisions 22-32). Output from ICA. Index  
sum of squares of deviations between model and observations  
(survey index) as a function of the reference F in 1995.

**Run No. 3 (INDEX 3: 1977-95: Polish Young Fish Survey, Age group 1)**

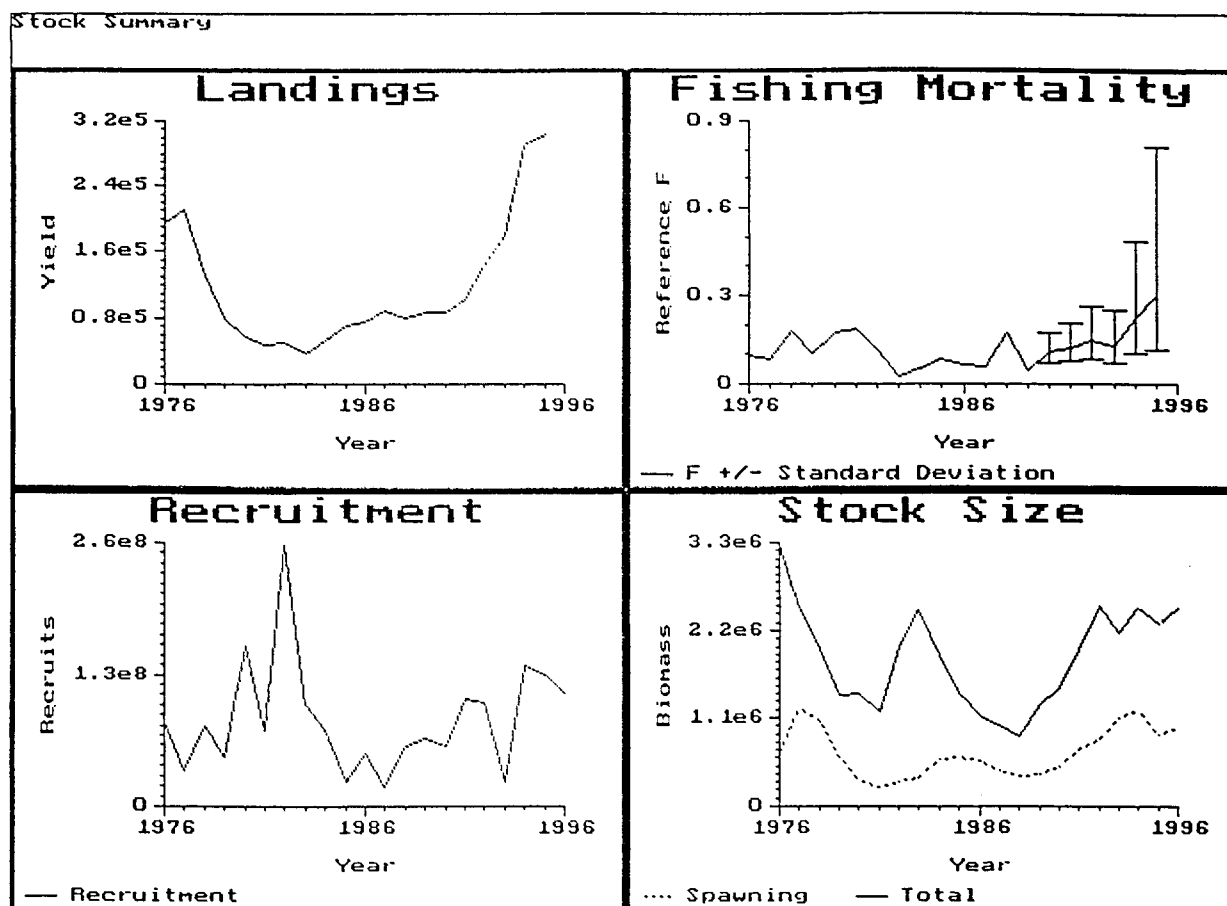


**Figure 9.2.4.2**

Baltic Sprat (Sub-Divisions 22-32). Output from ICA.

Stock summary.

Run No. 3 (INDEX 3: 1977-95: Polish Young Fish Survey, Age group 1)

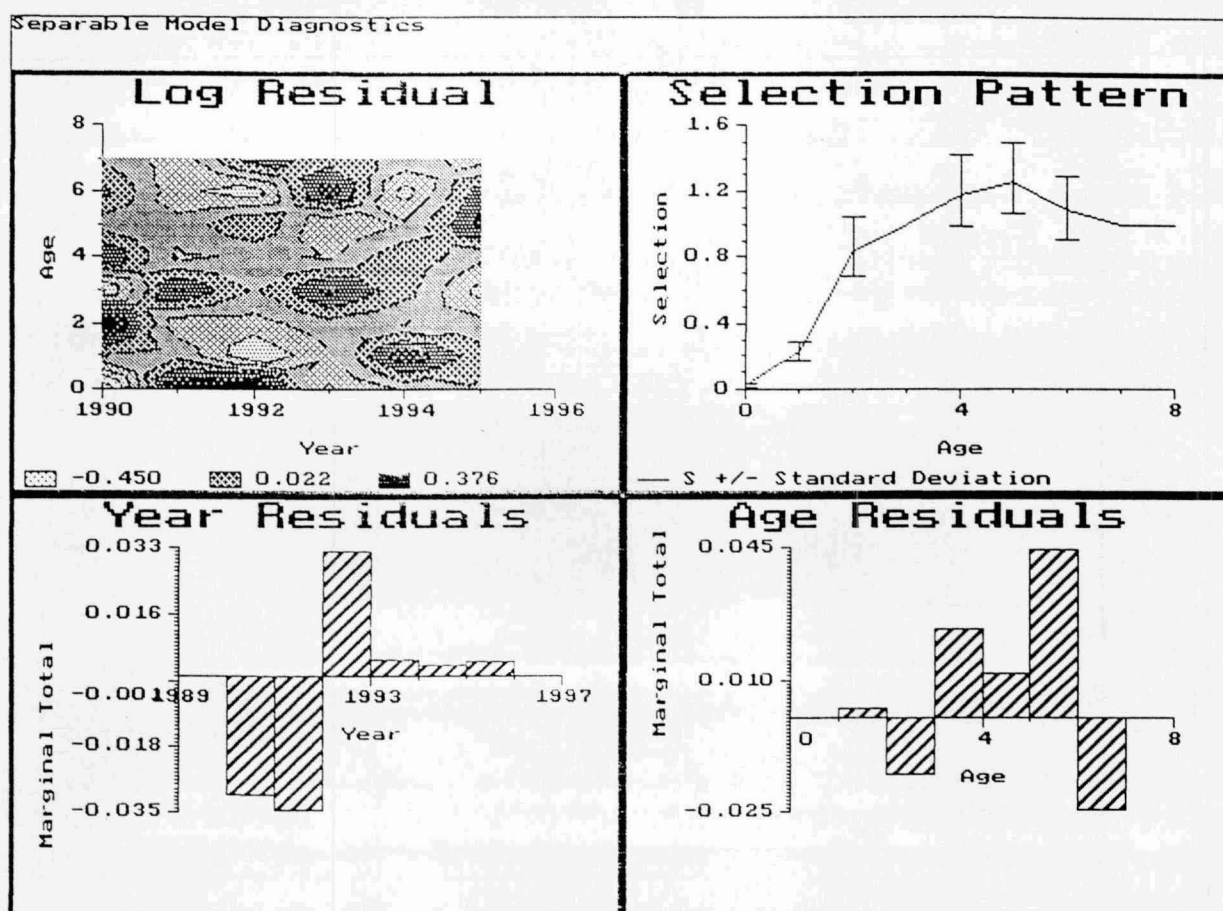


**Figure 9.2.4.3**

Baltic Sprat (Sub-Divisions 22-32). Output from ICA.

Separable model diagnostics.

**Run No. 3 (INDEX 3: 1977-95: Polish Young Fish Survey, Age group 1)**



**Figure 9.2.4.4** . . . Baltic Sprat (Sub-Divisions 22-32). Output from ICA. Index sum of squares of deviations between model and observations (survey index) as a function of the reference F in 1995.  
**RUN No. 5 (INDICES 1,2,3,4 combined)**

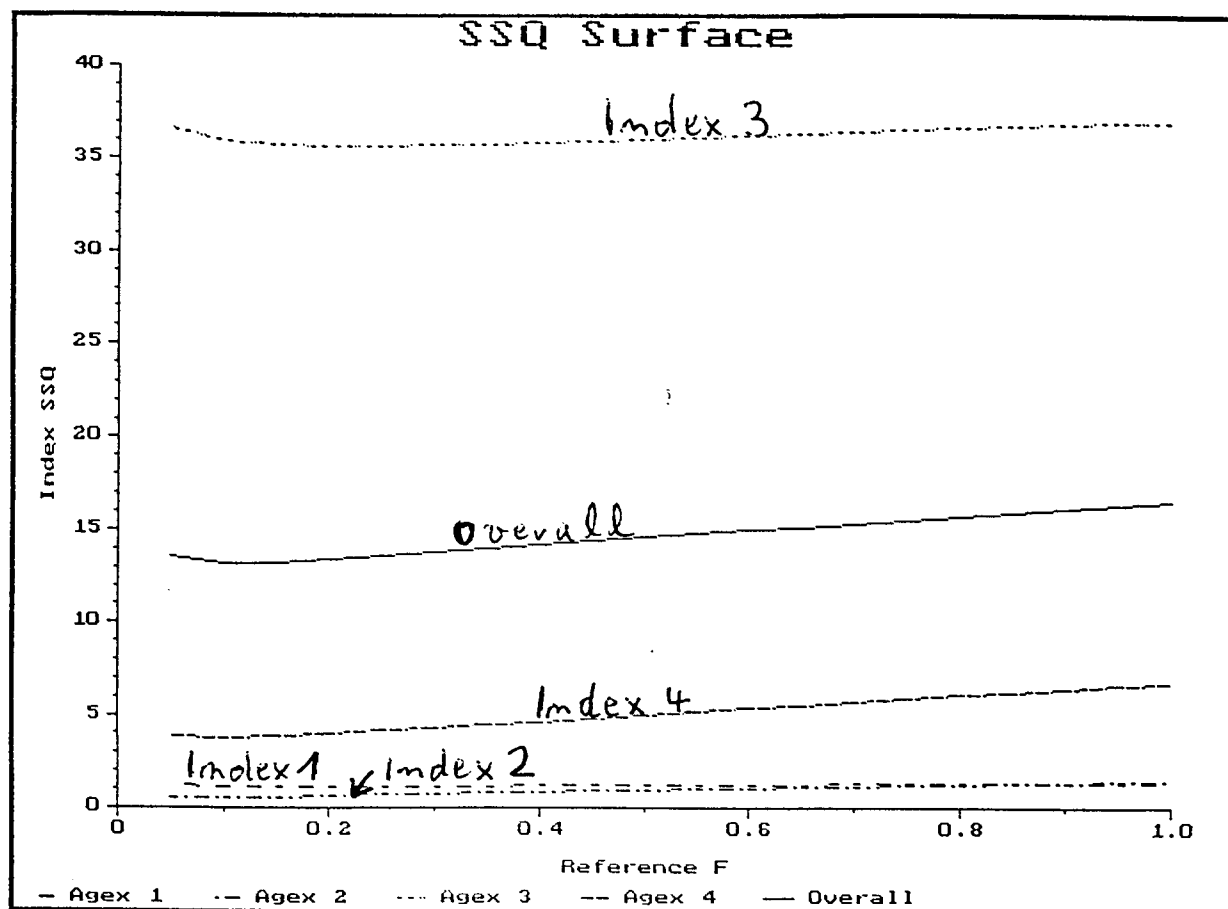
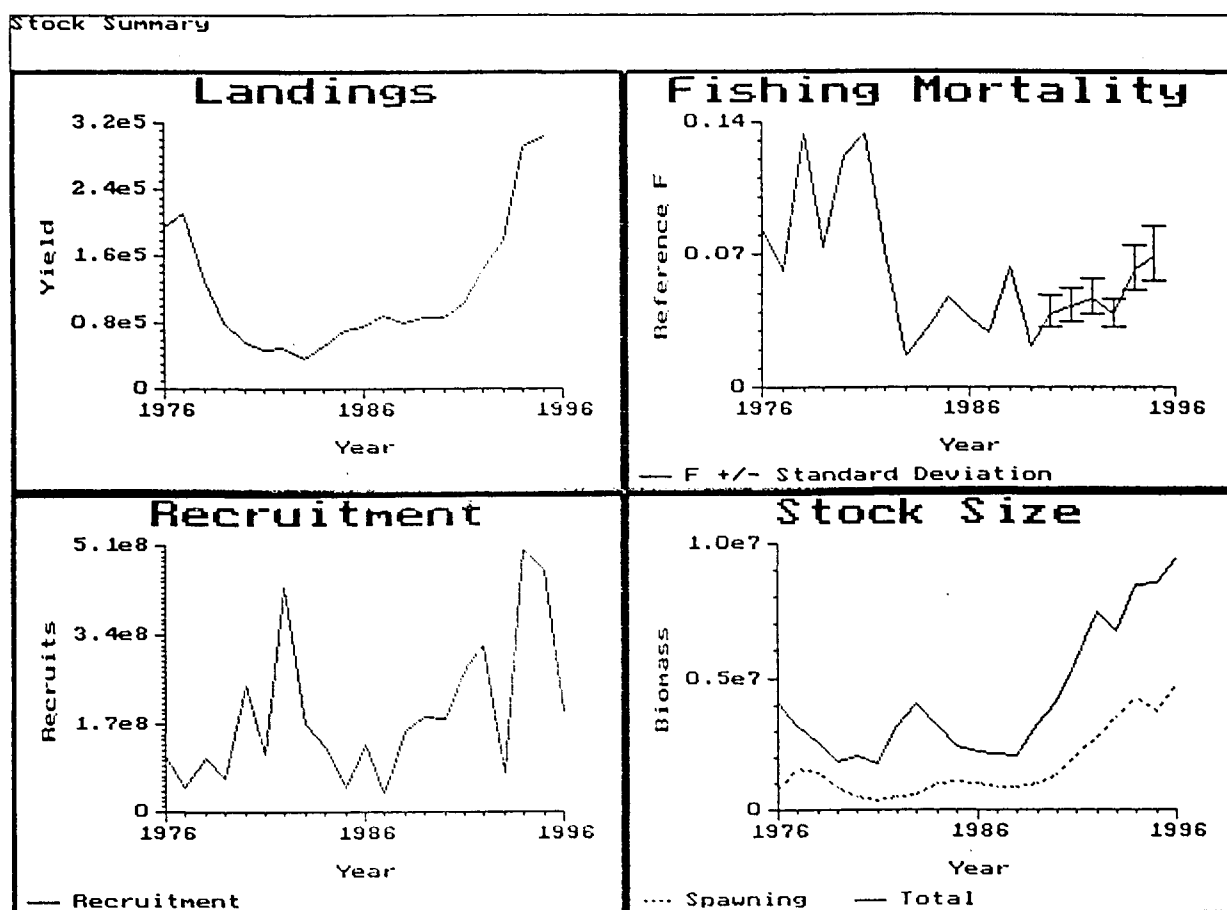


Figure 9.2.4.5

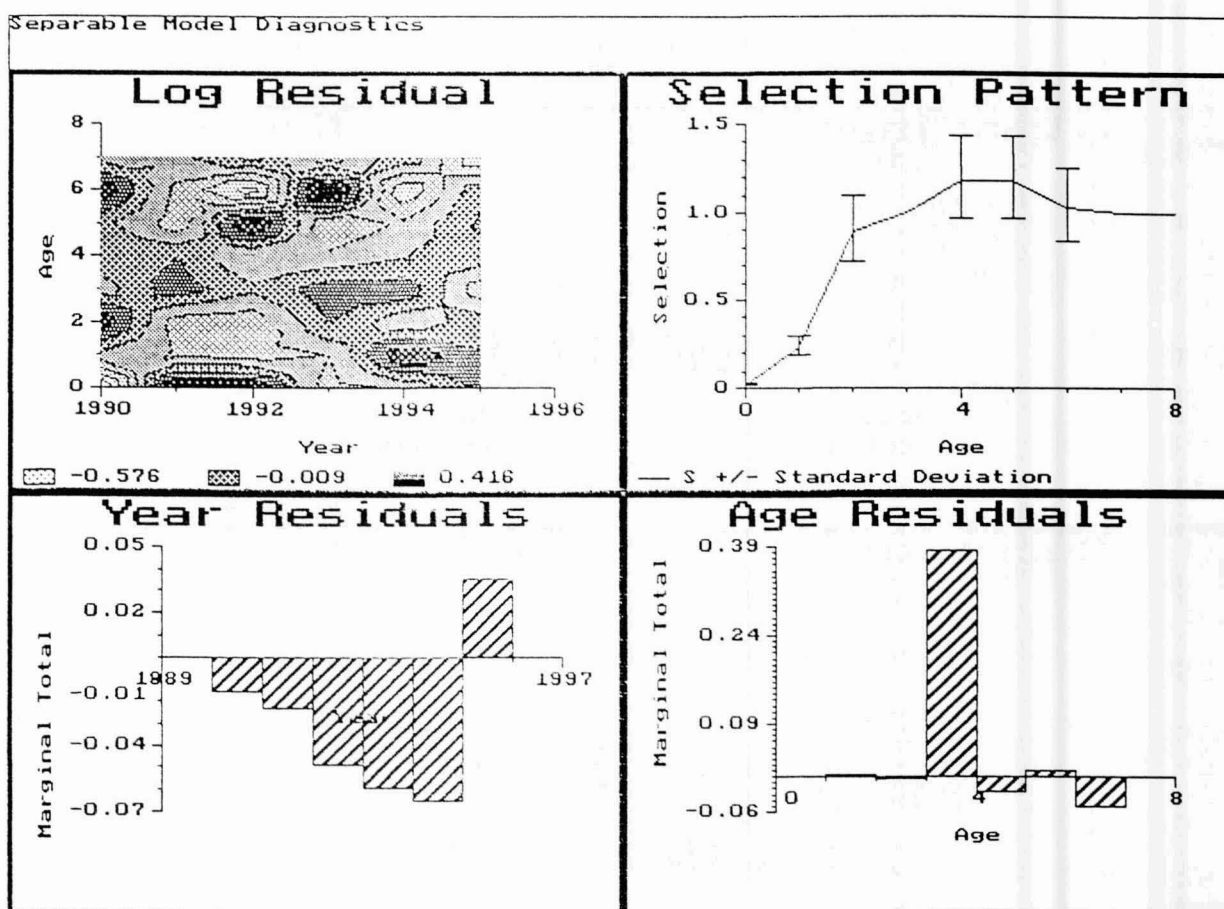
Baltic Sprat (Sub-Divisions 22-32). Output from ICA.  
Stock summary.  
RUN No. 5 (INDICES 1,2,3,4 combined)





**Figure 9.2.4.6**

Baltic Sprat (Sub-Divisions 22-32). Output from ICA.  
 Separable model diagnostics.  
 RUN No. 5 (INDICES 1,2,3,4 combined)



**Figure 9.2.4.7**

Baltic Sprat (Sub-Divisions 22-32). Output from ICA. Index sum of squares of deviations between model and observations (survey index) as a function of the reference F in 1995.

**RUN No. 17 (INDEX 5: SSB from USSR Sur. Sd 26+28)**

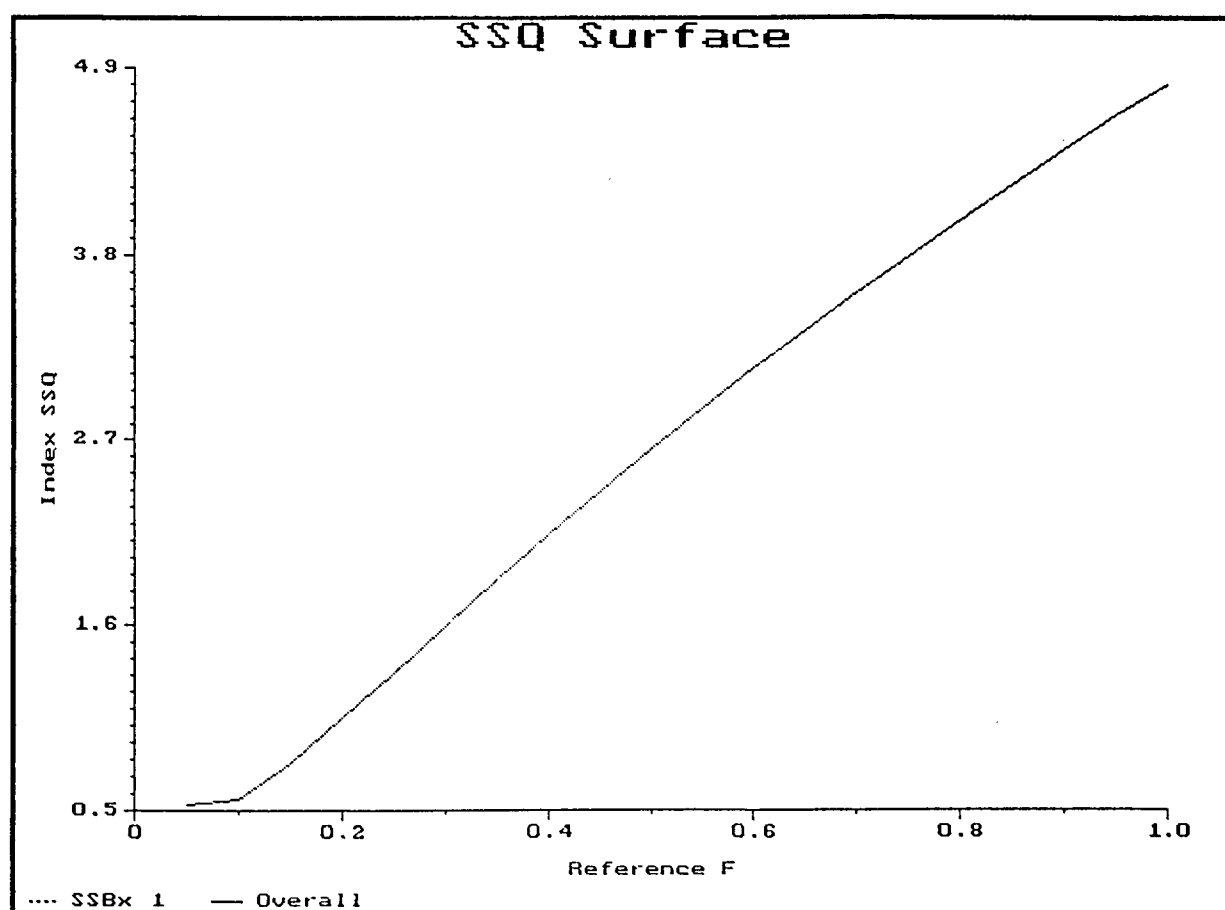
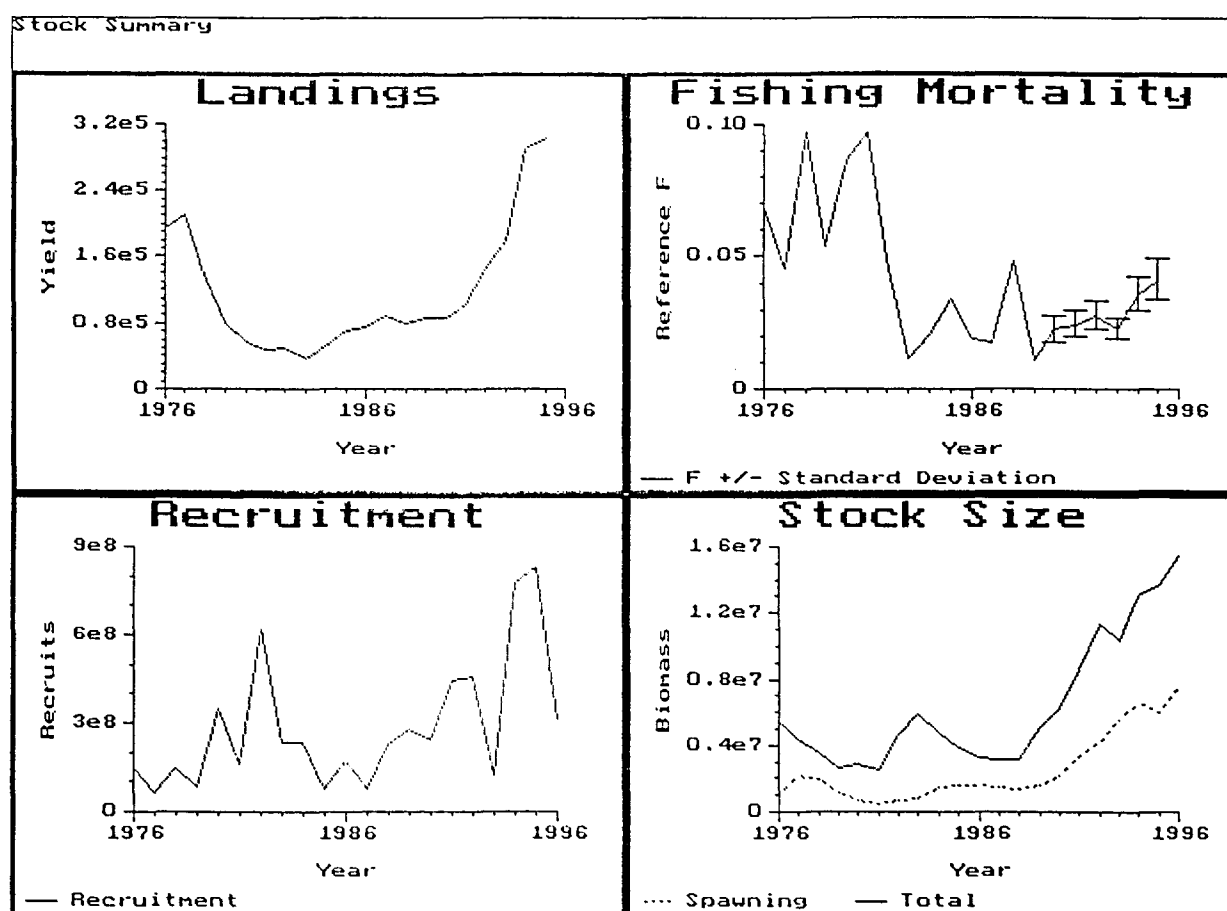


Figure 9.2.4.8

Baltic Sprat (Sub-Divisions 22-32). Output from ICA.

Stock summary.

RUN No. 17 (INDEX 5: SSB from USSR Sur. Sd 26+28)



**Figure 9.2.4.9**

Baltic Sprat (Sub-Divisions 22-32). Output from ICA.

Separable model diagnostics.

**RUN No. 17 (INDEX 5: SSB from USSR Sur. Sd 26+28)**

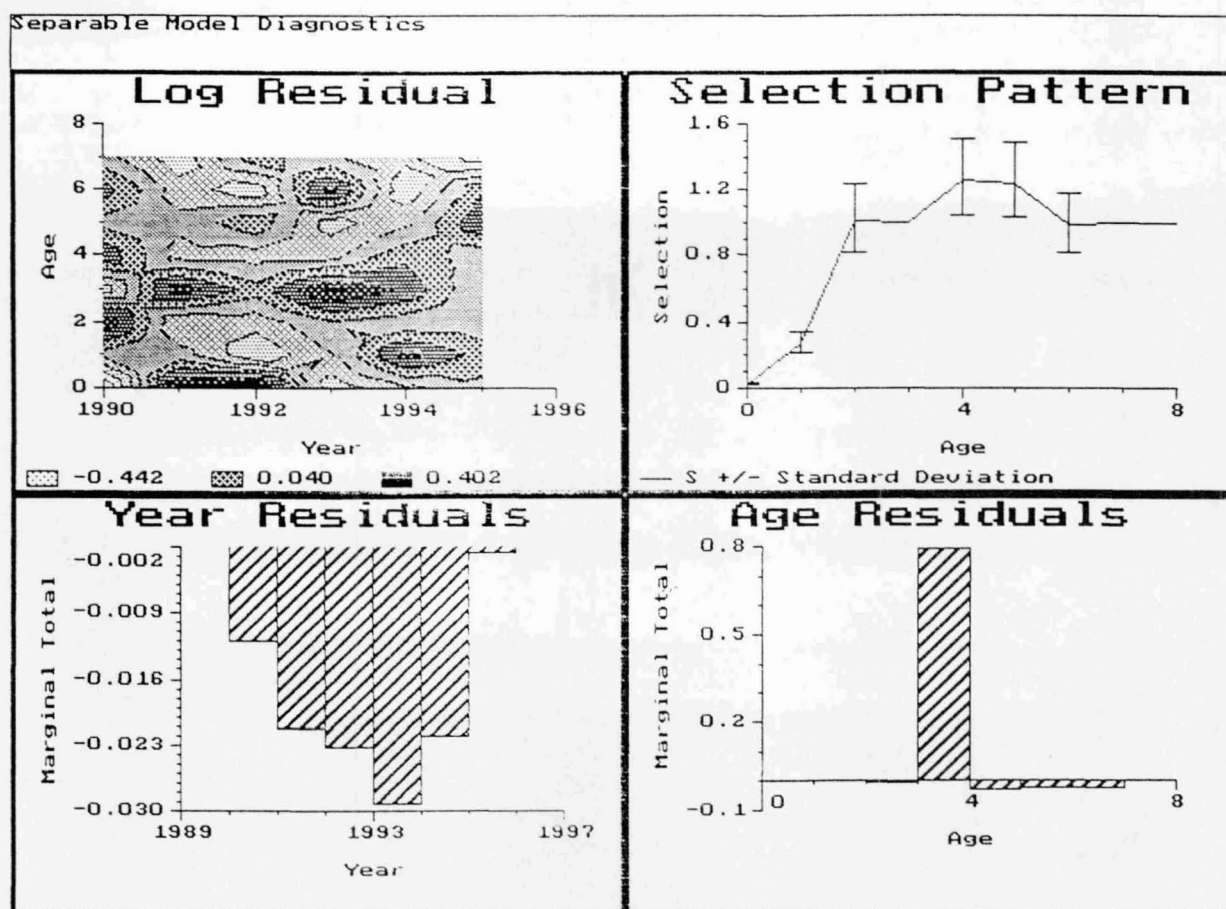
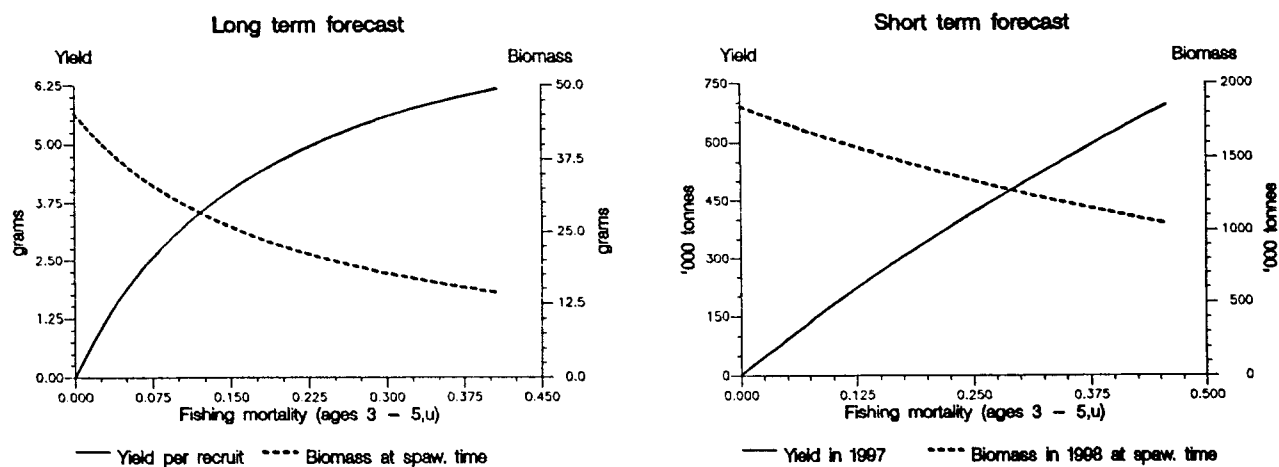


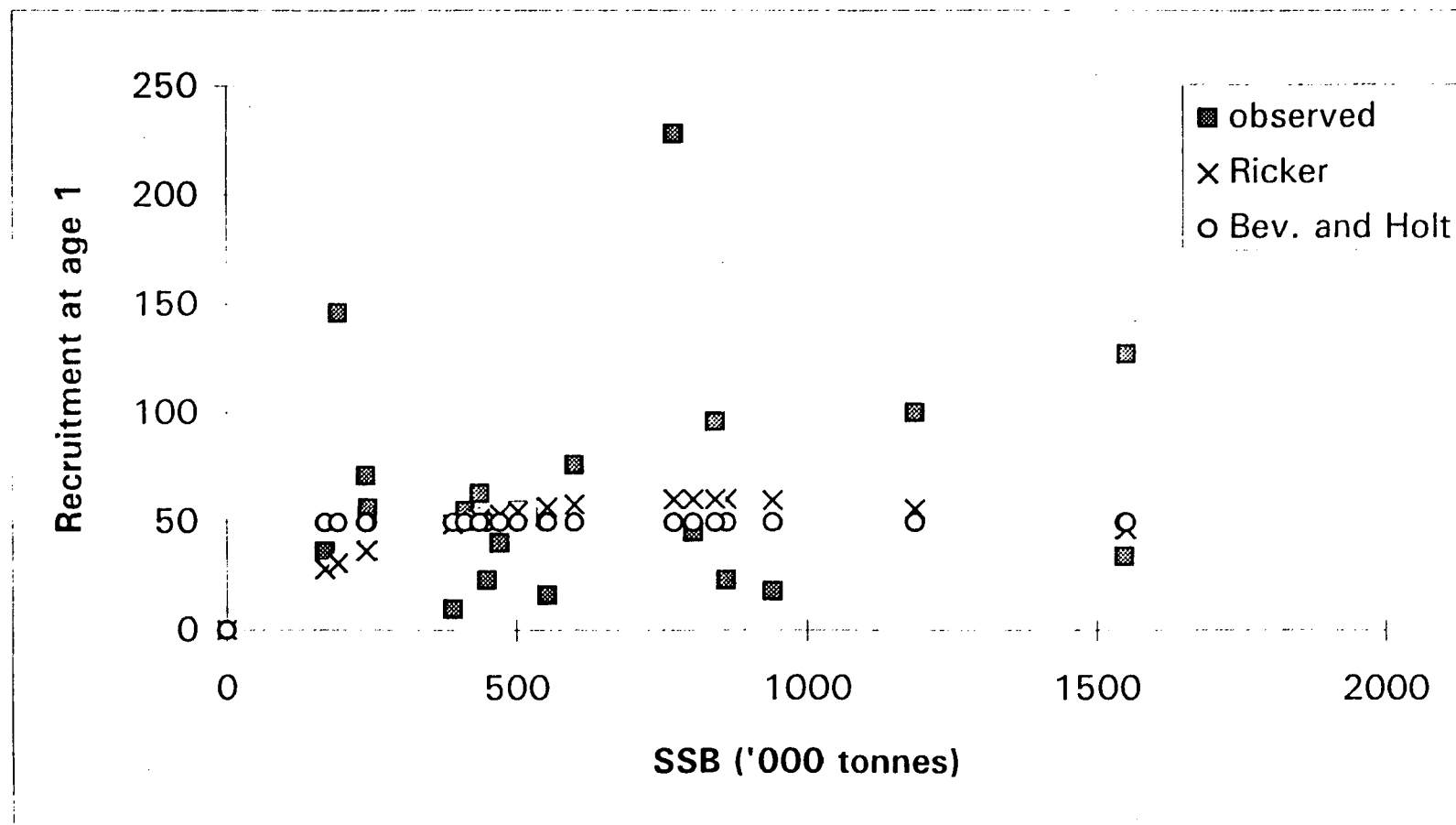
Figure 9.2.6.1

Sprat in the Baltic Sea (Fishing Areas 22 to 32)  
28-4-1995  
Yield and Spawning Stock Biomass



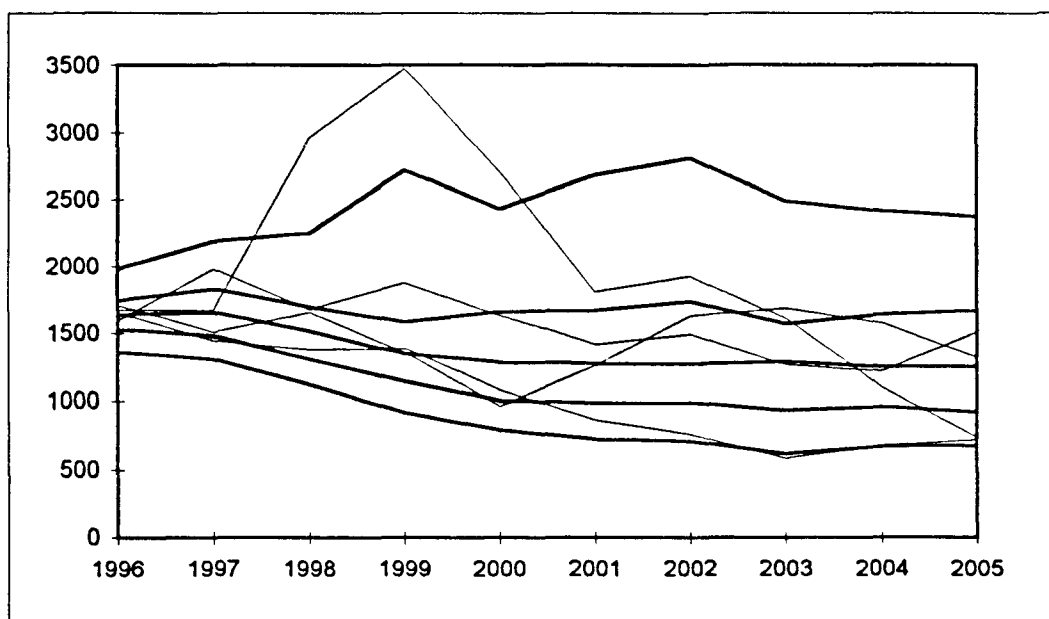
J:\IFAPEXIM\WGBFAS\SPR\_2232\CD12\_RG1.W6M

Fig. 9. 2.7.1 Stock - recruitment plot for sprat 22-32

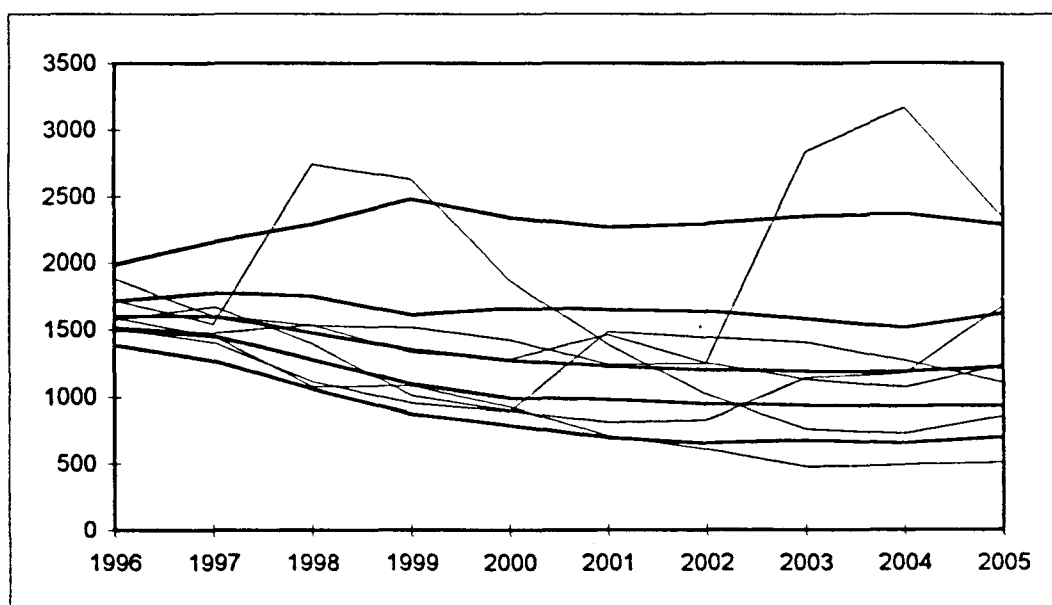


**Figure 9.2.8.1 Medium term projections of SSB ('000 tonnes) for sprat 22-32**  
(percentiles 5, 25, 50, 75, 95% and selected trajectories)

**b) Ricker stock recruitment model**



**b) Beverton and Holt stock recruitment model**



## 10 DESCRIPTION OF THE FLEETS OPERATING IN THE BALTIC AND THE CHANGES IN THE FISHERIES FOR DEMERSAL AND PELAGIC STOCKS IN THE BALTIC

### 10.1 Denmark

#### 10.1.1 The Danish fisheries in Kattegat

The Danish fisheries in Kattegat can be divided into fleet categories by the gears and mesh sizes used.

##### Trawl fisheries

The trawl fisheries can be divided into four groups:

- A) Industrial fisheries targeting mixed clupeids, Sandeel and Norway pout. This fishery is carried out using a mesh size of 32 mm in the cod end. Most vessel in this fisheries are smaller trawlers (12–16 m).
- B) A human consumption herring fishery after herring using mesh sizes of 32 mm in the cod end. This fishery is mainly carried out by the larger trawlers (>20 m).
- C) A trawl fishery targeting *nephrops* using a 70 mm mesh size. This fishery is mainly carried out by trawlers between 12–16 m. The major season for this fishery is the 2nd and 3rd quarter of the year.
- D) A human consumption trawl fishery targeting mixed fishes but being mostly dependent on sole, cod and plaice. The mesh size in the cod end is at or above 90 mm. The size of vessel in this fishery are typically between 12 and 20 m. The human consumption fishery is mainly found in the 1st and 4th quarter of the year.

##### Gillnet fisheries

Gillnets varying in mesh-sizes from 90 to about 200 mm are used in Kattegat. The species composition of the catches depends on the mesh size with the smaller mesh sizes (90 to 110 mm) being used when targeting sole and the larger mesh sizes (> 130 mm) for catching cod. Typically it is the smaller boats (<14 m) which engage in the gillnet fishery.

##### Danish seine

The Danish seine fishery is of relatively limited importance in Kattegat accounting for a catch value of about a fifth of that taken by the human consumption trawling fleet. This fishery mainly target flatfish (plaice, flounder and dab) but also catches a fair amount of cod. The typical seiner is about 12 to 16 m.

##### Importance of different species by weight and value

For 1994, the most recent year where a complete statistic are available, the total industrial catch in Kattegat amounted to 28,000 tons as compared to 16,000 tons in the human consumption fisheries. However, when measured by value the industrial catch accounted for less than 12% of the total catch value (Figure 10.1.1). In weight the human consumption fisheries are dominated by herring, cod and plaice which in 1994 accounted for 53%, 17% and 8% of the total catch, respectively (Figure 10.1.1). However, ordering the species in the human consumption fisheries by value result in a different order of importance (percent of total catch value given in the bracket): Sole (26%), *Nephrops* (24%), Cod (16%), Plaice (10%), Herring (9%), Expensive flatfish species (Lemon sole, Turbot, Brill and Witch flounder - 7%).

##### Characteristics of some major demersal fleets with emphasis on the size composition and catch rates of cod.

Major characteristics found in 1994 for five different demersal fleets - the human consumption trawl fishery, the *nephrops* trawl fishery, the Danish seine fishery and two mesh-sizes of gillnetters - are presented in Figure 10.1.2. Each fleet has been described by:

- a) the relative species composition measured by value;
- b) the relative size composition of the cod landings given in weight by market size-category (size group 1 (> 7 kg); 2 (4–7 kg); 3 (2–4 kg); 4 (1–2 kg); 5 (<1 kg));
- c) the total effort measured as days at sea given by vessel length;



d) the cod CPUE (kg. per days at sea) given by vessel size (vessel length \*\*3).

The fleets clearly differs in species composition. The trawl fishery using mesh size >90 mm (the mixed human consumption trawl fishery) depend mainly on Sole, Cod, Plaice and the expensive flatfish which accounts for 34%, 27%, 14% and 13% of the total value. In contrast, the trawl fishery using mesh sizes of 70 mm (the *nephrops* fishery) relies mainly on *Nephrops* which alone accounts for 73% of the total catch value. The relative size composition measured by the market categories differs between the two trawl fleets with substantial more small cod taken in the *nephrops* fishery. The catch rates are considerable higher in the mixed human consumption fishery than in the *nephrops* fishery. For both fleets the catch rates increases by vessel size. The catch value in the Danish seine fishery is clearly dominated by Plaice (50%), Cod (24%), and cheap flatfish (Flounder and Dab - totalling 21 % of the catch value). The size composition of cod and the catch rates resembles those found in the 90 mm trawl fishery. The two gillnets fleets, which are selected in the low and the high end of mesh sizes used, show clear differences in the species composition with the sole completely dominating for the small mesh sizes whereas the larger mesh size gillnet fishery also depends on Cod, Plaice and the expensive flatfishes. A very marked difference is seen between the size composition of the cod catches in these two gillnet fisheries which makes sense considering the narrow size selection found for gillnets.

### Recent developments in fishing effort in Kattegat

Until 1993 it was compulsory for all vessels at or above 12 m in length to submit logbooks to the fisheries authorities. In 1994 it also became compulsory for vessels between 10 and 12 m. Moreover it has been demanded that all vessels taking part in the effort regulation scheme introduced in the sole fisheries from November 1993 submitted logbooks. Effort is recorded by days absent from harbour and are available from individual trips.

Calculations of the total number of days at sea by 4 gear types - a) gill-net, b) trawl with 70 mm mesh, c) trawl with mesh size at or above 90 mm and d) all others fisheries were compiled at a monthly basis. To account for the smaller vessels not submitting logbooks effort was corrected by the ratio of the total catch (available from the sale slip database) to the catch covered by logbooks.

The total effort and the effort for each of the four fleets are shown on Figure 10.1.3. The 1995 data are preliminary and only include the total effort. The total effort have decreased from about 36,000 days at sea in 1990–1991 to about 29,000 days at sea during 1994–1995. The *Nephrops* fishery shows a clear decline with present effort levels found at about a third of what was found in 1990. The effort in the trawl fishery using mesh sizes of 90 mm have increased by about 30% from 1990 to 1994. In the same period the effort in the gillnet fleet has about doubled.

### 10.1.2 The Danish Baltic fishery and fleets

At present the Danish landings of cod, herring and sprat from the Baltic area can be divided into the following categories:

1. Cod landings from the trawl fishery where:

- a) a minimum mesh size of 120 mm. is used if no selectivity device is mounted or,
- b) a minimum mesh size of 105 mm. if some kind of special selectivity devices such as exit windows or any other design with at least a selectivity at a level of 50% retention length of 38 cm is used.

2. Cod landings from the gill net fishery using a minimum mesh size of 105 mm.

3. Herring landings from a directed fishery for human consumption carried out by trawlers using a minimum mesh size of 32 mm.

4. Sprat landings from a directed fishery for reduction purposes using a mesh size of 16mm.

### Regulations pertaining to the fisheries for cod, herring, sprat and flatfish

Only licensed vessels are allowed to participate in the fishery. Several types of licences exist which differs in respect to species, area and time of the year.

The following types of regulations have been in action in 1995:

- Specified minimum landing size for each species as agreed by The International Baltic Sea Fishery Commission (IBSFC) at its 20th session.
- Specified minimum mesh sizes for each gear as agreed by IBSFC at its 20th session.
- Prohibition of landing of cod during a time period of two month during the midsummer.

The total quota of cod allocated to Denmark was managed as a free choice for the fishermen between the following alternatives:

- Allocation of individual quota on year basis.
- Allocation of individual quota on half-month basis combined with a total yearly quota for all the vessels included in the scheme.

Various rules concerning the amount of by-catch in the landings. The possibility of laying-up vessels in periods of low income.

### **The Danish national monitoring system**

The information about the Danish fishery derives from four different sources: Sales slips, logbooks, samples of the species composition of landings for reduction purposes, and biological samples.

#### **Sales slips**

For all landings which are sold, first hand buyers are obliged to report to the Ministry of Fisheries. For each landing information on landing category (for reduction or human consumption purpose), target species, commercial market category (if applicable), quantity, price and area (ICES Division) as well as other information should be supplied. The information is recorded in the *Sales slip database*.

#### **Logbooks**

For the Baltic area the general logbook rule deals with vessels with over all length of 12 metres or more. The logbooks contain information on a daily basis about e.g. catch-date, catch-position (statistical rectangle), species and quantity. Information from these logbooks are stored in the *Logbook database* in the Ministry of Fisheries.

Landings recorded in the logbook database are specified as landings for reduction purposes if the recorded species composition is consistent with those typically landed for reduction purposes as determined from data from other sources.

#### **Samples of Species composition from landings used for meal and oil production**

The landings for reduction purposes are sampled for species composition on a routine basis by the Fishery Inspectors. One standard sample of 10 to 15 kg is taken from each landing sampled. The samples are sorted by species and the total weight by species and the position of capture (ICES statistical rectangle) are recorded. The data are stored in the species composition database in the Ministry of Fisheries. Before the data are used to calculate the landings by species a quality check is carried out using information from research and commercial vessels surveys, historical data, biological database (see below) and informal contacts in the most important ports.

The species composition of landings by other nations in Danish ports is also estimated, and included in this data base.

#### **Use of the Danish monitoring scheme for management purpose**

One of the objectives of the monitoring system for management purposes is to ensure that total quotas are not exceeded. In order to accomplish this the most up-to-date information on the development of the fishery is required. Since the information contained in the sales slip database is completed shortly after the landing has taken place this database is being used for quota management purposes.

In the case of landings for reduction purposes the sales slips only contain information about the target species, and according to the Danish control regulations only the target species in the landings for reduction purposes are counted against the quota. Partly for this reason there is, in particular for the by-catch species, a discrepancy between the total landings derived from the sales slip database and the total landings provided by DIFMAR to ICES Working Groups.

The surveillance of the catches for reduction purposes is implemented by fisheries inspectors in the various ports and at sea. Under normal circumstances, a sample of 10–15 Kg of fish would be taken at random from an inspected catch. However, if analysis of sample gives rise to suspicion that regulations with respect to catch composition are being violated, the inspectors will collect and analyse additional samples until at least 120 Kg of the catch has been investigated. This procedure is adopted as legal basis for possible prosecution.

### Biological samples

For the first three quarters the same procedure as in 1994 was followed, i.e. samples taken from random landings in the harbour of each commercial important species by weight category by quarter. In the 4th quarter the strategy was changed so the samples were taken onboard the vessels during fishery by observers.

On board the weight and length distribution of each species in the discard is recorded by haul. The weight of the consume is recorded by species and haul as well. In addition information about gear and vessel parameters are recorded.

After landing of the consume each species is sorted into price categories based on weight. Length distributions of these species are obtained. If the catch is landed for reduction, a sub sample of the catch is taken. Based on that the species distribution and length distribution is found.

The number of trips per quarter is approximately equal to the number of otoliths taken in the previous quarters so only one otolith is taken per length group by species by trip in order to obtain a sampling strategy which reflect the proportions in the commercial landings and enable us to make the best splitting of the commercial landings into age groups.

### Quality of the biological sampling

The advantages of taking the biological samples at sea are the gain of information about the discard and precise information about the circumstances under which the fishery is conducted (gear parameters, geographical information etc.). The disadvantages are that it is expensive, demands much organising in order to get observers onboard sufficiently representative for the fishery and depends on the goodwill of the fishermen.

### General remarks about the fishery

Although the Danish landings of cod increased by approximately 50 % in 1995 compared to 1994, the fishery in the Baltic was so influenced by the drop in prices for fish in general that this caused a significant decline in the Danish effort particularly of the fleet operating mainly in the area around Bornholm because this fleet which conduct a combined cod and salmon fishery also was effected by the very low TAC on salmon. The reduction in effort was caused primary by the sales of several of the larger vessels and by laying-up a significant numbers of vessels.

The change in landing pattern for cod over the year compared with 1994 is shown in text tables below for the eastern and western part respectively. The significant increase in landings in the 4th quarter is caused by an additional quota allocation.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Ratio '95/'94	2.0	1.2	1.3	1.0	1.8	0.04	0.07	0.5	0.6	4.3	8.5	11.4

The ratio between the Danish official landings of cod in the eastern part of the Baltic in 1994 and 1995.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Ratio '95/'94	1.5	1.0	1.8	2.5	2.6	0.4	1.7	6.1	4.4	8.0	58.7	69.9

The ratio between the Danish official landings of cod in the Belts and the western part of the Baltic in 1994 and 1995.

The drop in landings in both the eastern and the western part of the Baltic of cod in June and July reflects the stop for landings of cod from the trawl fishery in those months.

## **Discard**

For 1995 information about discard was only collected in the 4th quarter.

The sampling scheme is stratified on ICES Sub-divisions although all Sub-divisions east of Bornholm (>25) are pooled. This is done because very little fishery conducted by Danish vessels east of Bornholm is done outside Sub-division 25. In addition the sampling scheme is stratified on vessel categories determined by gear (trawl with mesh size <40 mm, trawl with mesh size >40 mm and gillnet). No stratification is made on gillnet. Due to the relative few samples only a weak indication of the amount of the discard for the Baltic as a whole can be made.

## **10.2 Estonia**

Estonian sea fishery is, in general, a trawl fishery and is directed mainly on herring and sprat. Pelagic trawls took, depending on region, from 40 to 99% of total landings in 1995. The rest were taken as trapnet catch at the spawning grounds of herring. The role of bottom trawls has been negligible in the Estonian economical zone during the recent decade.

The fishing fleet consists of 101 vessels: 86 vessels of 300 HP and 15 vessels of 90–150 HP and has been rather stable in recent years. The number of licensed professional fishermen was 1,041 in 1995. All Estonian catches are used for human consumption only.

### **Herring fishery**

Baltic herring is the most important target for the Estonian trawl and trapnet fishery. The total catch in 1995 was reported at the level of 42,892 t, which is 27% higher than in 1994 (33,747 t). 21,399 t (50%) were taken in Sub-division 32, 16,402 t (38%) in Sub-division 28 (16,008 t in the Gulf of Riga). The rest 5,091 t (12%) were landed in Sub-division 29.

10,440 t or 24% of total annual catch were taken with trapnets on the spawning grounds in the second quarter. Trapnet landings of 1995 were almost equal to those in 1994 (10,747 t). 7,986 t were taken in Sub-division 28 (Gulf of Riga), 2,120 t in Sub-division 29 and 334 t in Sub-division 32. 84 trapnets were used in the Gulf of Riga, 64 in the Sub-division 29 and 10 in the Sub-division 32.

Since the trapnet fishery is directed to the exploitation of spawning stock mainly, the size composition of herring in trapnet catches contains usually a considerable fraction of bigger size groups, compared to trawl catches. At the same time, the fraction of smaller fish is bigger in trawl fishery. Nevertheless, the dominant size groups in trawl and trapnet catches are usually the same in both fisheries, depending on fishing area. (Table 10.2.1).

### **Sprat fishery**

Sprat was fished as a by-catch in the herring trawl fishery. The total catch was reported to be 13,090 t, i.e. 31% higher than in 1994 (9,965 t). 7,266 t (55%) were taken in Sub-division 32, 5,201 t (40%) in Sub-division 29 and 623 t (5%) in Sub-division 28.

The trawl fishery of both herring and sprat has traditionally seasonal character, being concentrated into the first half-year. The intensity of both herring and sprat fishery is lowest in the third quarter.

According to the catch data obtained from the fishermen, the level of misreporting of catches has clearly diminished in herring and sprat fishery since 1995 and probably does not play any substantial role as a source of errors in stock assessment at present.

### **Cod fishery**

Altogether 25 vessels were licensed to fish cod in the Baltic in 1995. 20 vessels were reported operating, using the bottom trawls mostly.

The total catch was reported to be 1,049 t. The main fishery occurred in Sub-division 28 (465 t) and in Sub-division 25 (338 t). 246 t were taken in Sub-division 26. No catches of cod were reported in Sub-divisions 29 and 32.

## **Flounder fishery**

According to the logbook records, 110 t of flounder were taken by Estonian professional fishermen in 1995. 51 t were landed in Sub-division 29, 35 t in Sub-division 32 and 16 t in Sub-division 28. A small by-catch of flounder in cod fishery was also reported in Sub-division 25. Since flounder is an important target for the recreational fishery, the real catch of flounder is unknown.

### **10.3 Finnish Fleets**

#### **10.3.1 General**

The Finnish fleet is mainly targeting Baltic herring, salmon and cod. Minor importance for fisheries are sprat and flounder. In coastal areas as well as in the archipelago areas freshwater species such as bowan (*Coregonidae*), pike-perch, perch and pike are targeted. Table 10.3.5 gives the information on landings and fleet capacity in Finnish fisheries.

The total number of fishing vessels has been about 3,100 in commercial fisheries in the Baltic. Most of the vessels are shorter than 12 meters and used in coastal fisheries. The number of registered fishing vessels in Baltic herring, sprat and cod fisheries was on average 241 vessels in 1993–1994.

During the last decade the total commercial Finnish catches in the Baltic has fluctuated between 60,000 and 100,000 tonnes. In average 90% of the total catches is Baltic herring. Tables 10.3.1–10.3.5 give information on fleets and fishery based on stocks and Sub-divisions.

#### **10.3.2 Trawling**

In pelagic trawl and bottom trawl categories fishing vessels overlap. Many of the vessels use both pelagic trawl and bottom trawl or the same gear is used in both fisheries (Tables 10.3.1–10.3.5). In Baltic herring fishery pelagic trawl fishery exploit younger part of the Baltic herring stock and bottom trawling is directed to more adult part of the stock.

##### **Pelagic Trawls**

Pelagic trawling is used to exploit Baltic herring stocks in the Baltic Main Basin, the Archipelago Sea, the Gulf of Bothnia and the Gulf of Finland. Only few vessels are exploiting directly sprat stock and sprat is the main by-catch in Baltic herring fishery (Tables 10.3.1–10.3.3). In recent years cod as a by-catch in pelagic trawl fishery is very rare. Usually Baltic herring fishing is conducted as a single trawling. At certain times of the year vessels may switch to bottom trawling. In autumn, early winter and spring pelagic pair trawling is used for industrial purposes. In the Baltic Main Basin pelagic trawling is in some extent also targeting Baltic cod, but the number of such vessels is small (Table 10.3.4).

In common with pelagic trawlers, many vessels transfer between the Bothnian Bay (SD 31) and the Bothnian Sea (SD 30), the Bothnian Sea and Åland Sea (SD 29) and between the Gulf of Finland (SD 32) and the Åland Sea depending on fishing possibilities and ice cover during the winter.

##### **Bottom Trawls**

Bottom trawls are used both for Baltic herring and cod (Tables 10.3.1–10.3.4). The main target is Baltic herring. Some bottom trawl vessels are targeting Baltic cod and they are mainly fishing in the Main Basin (SDs 24–28). There are some vessels using heavy ground gear, but these have been declining and represent only a small part of the fleet.

As pelagic trawlers, the bottom trawlers transfer between fishing grounds depending on fishing possibilities and ice cover.

#### **10.3.3 Trapnets**

Trapnet fishery include a variety of trap-net types for Baltic herring, Baltic salmon and bowan (*Coregonidae*). Fishery is conducted near the coast and inside archipelagos. Trap-net fishery for Baltic herring is conducted mainly during the spawning season in spring and early summer (May–June) targeting spawning component of Baltic herring stock.

#### 10.3.4 Anchored gillnets

Anchored gillnets are used in Baltic herring, cod, flounder and freshwater species' fishery along the Finnish coast. Gillnet fishery is predominantly mixed fisheries near the coast conducted by small vessels except those few vessels targeting cod in the Baltic Main Basin.

### 10.4 The German Fishery

#### 10.4.1 Demersal fishery

In general the German demersal fishery in Sub-divisions 22, 24 and 25, conducted by trawl, is mainly a mixed fishery targeting cod but with by-catches of flounder (Sub-divisions 24 and 25) and dab (Sub-division 22). The main months or season of the cod fishery are January to May and September to December in Sub-division 22, January to May and September to December in Sub-division 24, and January to May/June in Sub-division 25.

In 1995 the total German reported cod landings in the Baltic (ICES IIIb, c, d - Sub-division 22, 23, 24, 25 and 26) amounted to 14,691 tons and in ICES IIIa 284 tons (71 t in the Kattegat; 285 t in the Skagerrak). This is an increase of the landings of cod in the Sub-divisions 22-26 of about 112 % in opposite to 1994 (7,079 t). Therefore the utilisation by Germany of the 1995 Baltic-cod quota (15.190 t including quota transfers from 195 t of Lithuania, 140 t of Latvia, 155 t of Estonia) correlated about 97 %.

In 1995 the traditional gill netting accounted for about 20 % of the total catches mainly in the western areas (Schleswig-Holstein) whereas this gear was/is traditionally unimportant in the eastern areas Mecklenburg/Vorpommern, formerly part of GDR. In this area the importance of gill netting has been declining in recent years from about 20 % in 1991 to less than 5 % in 1994, after a short time of development since German unification.

Used gear and results in the German cod-fishery in 1995:

Kind of gear	overall vessel length	catch in tonnes	catch in %
a) Fixed gears	up to 12 m	about 2700	18.6
	over 12 m	about 300	2.1
b) Trawls	over 12 m	about 1500	79.3

Also in 1995 the flounder was a dominant species in the German flatfish catches. More than 84 % were flounder; 5 % turbot, 5 % dab and 5 % plaice. Compared with 1994 (3400 t), the total flounder landings decreased by about 31 % in 1995. The landings in the Arkona Sea, SD 24, were more or less stable in 1994 (1935 t) and in 1995 (1736 t) whereas in the Bornholm Sea, SD 25, they decreased from 1994 (1131 t) to 1995 (210 t).

The background for this reduction of the landing was the increase of the cod quota. There are problems with the reliability of the reported catch data of cod and flounder in SD 24 and 25 and dab in SD 22.

#### 10.4.2 Pelagic fishery

In 1995 the total German herring landings in the Baltic (Sub-Divisions 22 and 24) of about 13,400 t are about 17 % higher than in 1994 (11,450 t). The main fishing season, in former years going from March to May, already started in February in 1995. About 97 % were caught during spring between February and May (in 1994: 91 %). About 82 % of the total landings came from the waters around Rügen Island (in 1994: 76 %). In 1995, as in former years, the proportion of herring caught by trawl was far lower than that caught by gillnets and trapnets. As in 1994 the low herring landings are caused by market problems. The total German sprat landings in the Baltic (Sub-Divisions 22 and 24) were about 215 t. This represents a decrease of about 39 % compared with 1994 (351 t). About 71 % were caught in the first and fourth quarter of the year (in 1994: 75 %). About 97 % of the landings came from ICES Sub-Division 22 (in 1994: 90 %).

### 10.4.3 Description of the fishing fleet and the regulations pertaining to the fisheries

#### The German fishing fleet in the Baltic

- coastal fleet with open boats (rowing and motor boats up to 10 m and engine up to 100 HP);
- cutter fleet of different total length and equipment. The length varies between 12 m and 30 m.

In the last two years 3 newly-built cutters with high fishing technology (named "Eurocutter") began to fish in the Baltic.

The following types of fishing boats were available to carry out the fishery in the Baltic (per 01.01.1995):

Kind of gear	Overall vessel length (m)	Number of vessels	GRT	kW
a) Fixed gears (gillnet and trapnet)	up to 12 m	1,814	6,321	26,090
	over 12 m	32	791	3,266
b) Trawls	over 12 m	430	20,451	83,381
Total		2,276	27,563	112,737

Depending on the German fishing situation (fishing quota etc.) cutters from the North Sea sometimes are fishing in the Baltic.

The mesh sizes in the cod, flatfish, herring and sprat are based on the rules of the International Baltic Sea Fishery Commission (IBSFC). All commercial fisheries on cod, herring and sprat are licensed by the national and EU quota system, respectively. Each ship, which takes part in commercial fishery, must have a special vessel permission.

#### 10.4.4 National authorities monitoring system

The information on the German fishery is derived from sales slips and logbooks. This information is sent to the corresponding state fishery board of the Federal Republic of Germany. After checking the reported catch and landing data they are delivered to the authority of the Government and stored in a computer system. The data are compiled by the type of fishery, the catch per species and the fishing area. They are submitted by month, quarter and year to the EU Commission DG XIV (catch report A). Landings of other EU member states landing in Germany submit their logbook-sheets and sales slips directly to the authority of the Government. These catches will be compiled and transferred monthly to the EU Commission (catch report B).

Catch data of German fishing boats landing in other EU member states, will be transferred by these states to the appropriate authorities of the German Government.

For the Baltic area the German logbook rule deals with overall vessel length of 10 m and more. The logbooks must contain information on quoted fish species (date, gear used, rectangle, catch in kg). Catches of boats smaller than 10 m are to be reported on sales slips which are submitted to the department fishery board.

The fishery including catches and landings will be controlled:

- at sea by controlling ships of the federal (fishery board, customs) and department government (fishery board, customs and police);
- in harbour by the port control of the fishery state board (13 check points along the Baltic coast).

#### 10.4.5 Evaluation of the national authorities monitoring system for management purposes

The system based on logbooks and sales slips used for monitoring the fishery is working satisfactorily. As the German quota for herring and sprat was not fully exploited by the fisherman due to market problems during the last few years (less than 20 % for herring and 5 % for sprat), the general problem related to misreporting can be neglected.

## **10.5 Latvian Fleet**

### **10.5.1 Latvian fleet operating on pelagic fishes**

#### **10.5.1.1 The Baltic Proper, SD 26, 28**

In 1995 there were 62 vessels catching herring in the Baltic Proper including 59 with 300 HP and 3 with 150 HP engine. 47 from them had also sprat catches and 46 cod catches in 1995. There were 13 owners or societies which had 2 or more vessels and 15 which had one vessel. 52 vessels were catching sprat in the Baltic Proper all with 300 Hp engine. Two of them had only sprat catches and three more only sprat and cod catches, but others had also herring catches. There is usually a specialised catch in the Baltic Proper and mixed catches are rare.

Herring landings in the Baltic Proper are rather stable and are about 8,000 t in the last years. After the decrease of sprat catches in 1993 in the last two years they have a tendency to grow and in 1995 have reached 24,000 t.

#### **10.5.1.2 The Gulf of Riga, 28.5**

In 1995 70 vessels were catching herring in the Gulf of Riga including 29 with 300 HP, one with 225 HP and 40 with 150 HP engine. There were 10 owners or societies which had two or more vessels and 23 which had one vessel. There is a ban of trawl fishery from May 15 till June 15. In the spawning period from April till July herring is caught also by trapnets. There were 35 large 2-cage and a number of smaller trapnets in 1995. Trapnet catches have increased in 1995 and they comprise about 14% of the total Latvian catches in the Gulf of Riga. The number of trapnets has a tendency to grow and beginning with 1996 their number is limited along the Latvian coast.

Due to high sprat stock level in the Baltic sea it is very abundant also in the Gulf of Riga. As the Gulf of Riga is rather shallow basin, herring and sprat are staying together. Therefore mixed catches were rather common in the last year especially in the western and central parts of the Gulf of Riga. 23 vessels had not reported on catches of sprat there. 19 vessels were catching herring both in the Gulf of Riga and the Baltic Proper.

The catches of herring in the Gulf of Riga have a tendency to increase. This growth is determined by the limits fishermen get for herring fishery from the Fisheries Department. The limits are delivered on the base of assessment made on Baltic Fisheries Assessment Working Group for Gulf Herring. To some extent limitation of the catches causes misreporting which is estimated on the base of information obtained from some fishermen. In 1995 the official landings were increased for 20% regarding misreporting. Due to shortage of limit it seems that some fishermen increase the share of sprat in the catches. Therefore in 1996 a specialised sprat fishery is prohibited in the Gulf of Riga and the amount of by-catch can not exceed 15%.

Sprat and herring is caught by Latvian fleet only for human consumption.

### **10.5.2 Latvian fleet operating on demersal fishes**

There are 127 vessels authorised to fish cod in the Baltic sea during 1996 including 89 with 300 HP, 7 with 225 hp and 31 with 150 HP engine. The length of the vessels is in a range of 18.0–31.6 m. In 1995 cod fishery took place in the Latvian economic zone, as well as in the economic zones of EU and Sweden in Sub-divisions 24, 25, 26, 27 and 28. The distribution of catches by Sub-division and gear is shown in Table 10.5.1.

## **10.6 The Polish Fishery**

Polish Baltic fishery fleets are operating mainly in the Polish fishery zone, but in accordance with a Polish and Swedish bilateral agreement it was possible to take about 12% of Polish herring catches in the Swedish zone. The most important species in Polish fishery were cod, herring, sprat and flounder. The importance of species in Polish fishery fluctuated in the period from 1980–1995. Highest cod catches were in 1980 - 123.5 thousand tonnes and the lowest were in 1993 - 8.9 thousand tonnes. The fluctuation of herring catches varied on a much smaller scale (in 1985 - 89.5 thousand tonnes and 1995 - 45.7 thousand tonnes). The importance of sprat and flounder increased during the last years (for details see Table 10.6.1).

According to the included Table 10.6.2 Polish fishery is a seasonal one. Herring fishery in 1995 was carried mainly from the 2nd quarter up to the 4th quarter of the year. Sprat fishery is carried out in the first half of the year. In previous years cod was caught mainly in the first and second quarter of the year, but due to misreporting this picture is spoiled. Also some noise in the seasonality of cod fishery was introduced by the gillnet fishery.



Polish fleets operating in the Baltic consisted in the late 1970s of about 550 cutters and the number decreased to a level of 403 in 1995. The changes in cutter fleets are given in the following Table 10.6.3. The number of motor boats and rowing boats is 928 and 162.

During this period the Polish fleet has developed by gear used, engine power, electronic equipment. Table 10.6.4 is showing the importance of different length classes in Polish fishery.

The 17 m length class is important in cod fishery (trawls and gillnets) while the larger cutters (length classes 25 and larger) are of large importance in herring and sprat fishery.

The smaller length classes (17 m, 19 m, 21 m and 24 m) are fishing mainly with bottom trawls and gillnets, while the larger are using mainly pelagic trawls (Table 10.6.4).

#### **Demersal species fishery**

Only two demersal species of major importance are existing in the Polish fishery zone, these are cod and flounder. For cod in general the Polish demersal fishery is conducted by the cutter fleets all the year round with the highest catches usually in the first half of the year and a coastal fishery conducted mainly in the second and fourth quarter of the year.

The trawl fishery in 1995 is represented in total cod catches by about 67%, while the gillnet fishery (including coastal fishery) is represented only by 33%.

The cutter fleets are fishing mainly with bottom trawls and to a much lower degree with gillnets. In some years a pelagic fishery is conducted successfully. While the coastal fishery (boats <12.5 m) is using mainly gillnet and to a much lower degree trawls.

The Polish official total landings of cod are given in Table 10.6.1. The cod landings have been on a record high level in the first half of the 1980s (landings at the level of 76.5–123.5 thousand tonnes), in the next period till 1993 they decreased gradually to a level of 8.9 thousand tonnes, but during the two last years they increased up to 25 thousand tonnes. It is necessary to stress that from 1986 in spite of gillnet introduction to cod fishery and shift of some effort from pelagic stocks to cod fishery, the landings still have shown a decreasing trend.

In Poland flounder fishery is the second demersal fish fishery. Up to the beginning of the 1990s flounder was mainly taken in the coastal gillnet fishery. The cutter flounder fishery shows in the last few years a rapid increase in landings. In 1995 most of the flounder landings were from the cutter trawl fishery. The landings of flounder according to Subdivisions are given in Table 10.6.1. Landings from SD 24–25 were in the range of 1.1 to 7.4 thousand tonnes. In 1995 the landings from SD 26 fluctuated in a range from 0.6 to 1.9 thousand tonnes, and only a small increase in landings was observed in 1995. The increase in Polish flounder landings is mainly caused by a market improvement and contributes to a shift of some cutter effort to directed flounder fishery.

#### **Pelagic species fishery**

There are only two important pelagic species in the Baltic. These are herring and sprat. Polish herring catches were at a very high level in the first half of the 1980s; in this period the herring catches varied from 64.6 to 89.5 thousand tonnes. In the second half of the 1980s they levelled at about 62 thousand tonnes and then in the beginning of the 1990s they levelled at a level of about 53 thousand tonnes. In 1995 the catches decreased to 47.7 thousand tonnes. The decreases firstly depend on the increase in cod fishery (landings on Bornholm started in 1986 due to much higher prices than in Poland and this caused an effort shift from herring and sprat fishery to cod directed fishery). And in addition in the 1990s due to market problems (Table 10.6.1).

In Poland there are two types of herring fishery, one in the sea area performed mainly by large cutters (>24 m of length) with pelagic trawl and to a smaller degree by small cutters with herring bottom single and pair trawls. The second type of fishery is performed in the coastal area by small boats with gillnet and trapnets. This type of fishery is carried out in spring on the spawning grounds.

Sprat fishery was at a very low level in the beginning of the 1980s (7.1–14.2 thousand tonnes) and later the sprat catches increased to a level between 13.3–41.3 thousand tonnes. The sprat fishery is mainly performed in the open sea area from November till May. During summer due to poor quality sprat landings are at a very low level (Tables 10.6.1 and 10.6.2). There are no industrial catches for sprat; all the fish are used for consumption.

## Management

The mentioned main Baltic species are managed by a Total Allowable Catch agreed and recommended by IBSFC. TACs for cod, herring and sprat are divided into national quotas. The cod quota received by Poland is divided by Polish authorities according to a single boat size (per each meter in length). This system allowed to divide the quota in accordance with the fishing possibility of smaller vessels (the smaller cutter can fish cod more easily than herring and sprat while the larger can fish the pelagic species successfully).

The herring and sprat quotas received by Poland are fished in an Olympic system. The pelagic fish quotas are far from full utilisation in Polish fishery.

### 10.7 Description of the Russian fleet operating in the Baltic Sea

According to the methods in effect, the Russian fishing fleet operating in the Baltic is classified into three length groups:

1. Fishing boats up to 24 m in length.
2. Small fishing vessels of 24–34 m in length.
3. Mid-tonnage trawlers of 35–54 m in length.

According to the list of Russian vessels permitted for fishing in 1995, numbers of different length types and engine power of vessels were as follows:

Length (m)	Engine (kw)	Number	Fishing gear
15–16	121–125	6	gillnets
18	190	9	trawls/gillnets
21	190	1	trawls
22	132–221	6	trawls/gillnets
23	165–225	24	trawls/gillnets
24	165	1	gillnets
25	110–223	50	trawls/gillnets
26	165–221	3	trawls/gillnets
28	224	2	trawls/gillnets
29	224	5	trawls/gillnets
31	224	5	trawls/gillnets
35	589	4	trawls
> 35	735	6	trawls
Total		122	

To preserve catch two thirds of small vessels have refrigerated holds and only biggest vessels have facilities to produce frozen products. Engines at the most vessels are non-powerful and are unable to provide efficient trawls fishery for cod of scattered aggregations. About half of all fishing vessels are over 15 years old. Many of them require major repair or are subject to be written off. However, the last reinforcement in the fishery fleet occurred five years ago. At present the fleet actually is not reinforced with new vessels. To perform fishery, the Russian fishing fleet utilises trawls and gillnets.

During the last 4 years the number of small vessels in the fishery has decreased from 200–150 to 140–120 in 1994–1995 which has resulted in a reduction of the total fishing effort and catches.

#### **10.7.1 The changes in the fisheries for demersal and pelagic stocks**

The Russian fishing fleet operated in ICES Sub-divisions 26 and 32. These are the sea areas adjacent to the Kaliningrad and Leningrad region within the Russian economic zone. In 1995 76% of the catch taken by Russian vessels is obtained from Sub-division 26.

#### **10.7.2 Demersal fishery**

The fishery for demersal stocks took place only in Sub-division 26. It is rather difficult to classify vessels according to fishing gear used since the same vessels often replace gears depending on seasons and fishery conditions. In general Russian demersal fishery conducted by trawlers of small size category (up to 31 m) and gillnetters up to 25 m length, is mainly a mixed fishery targeting cod with by-catches of flounder. There is also a small gillnet fishery directed to turbot.

In 1995 the total Russian reported cod landings amounted to 1,612 t. Compared with 1994 the total landings increased by about 28%. In 1995 the trawls fishery accounted for about 70% while gillnetting accounted for 30% of the total cod catches. The importance of gillnetting increased slightly compared with 1994. The CPUE in both cod fisheries also increased when comparing with the level of 1992 and 1993. In 1995 mean CPUE in the trawl fishery was about 1 tonne while in gillnets it was 0.5 tonne per fishing day.

The main months of the cod fishery are January–May and September–December.

Flounder was fished mainly as by-catch in the cod trawl and gillnet fisheries. The total catch was reported to be 271.4 t, i.e. 62% higher than in 1994 (167 t).

The most of the catches were taken in 1st and 4th quarters.

Turbot was fished in the small target gillnet fishery. According to the information presented to fish protection bodies 20 t of turbot were taken in 1995.

#### **10.7.3 Pelagic fishery**

Baltic herring is the important target for Russian trawls and trapnet fishery in Sub-divisions 26 and 32. In 1995 the total catch was reported to be 16,970 t which is almost the same level as in 1994. 8,819 t (52%) were taken in SD 26 and 8,151 t (48%) were taken in the Eastern part of Sub-division 32. Traditionally coastal pound net fishery accounted in former years for about 50–60% of total catch in Sub-division 26. In 1995 the importance of pound net fishery has been declining to 37% due to decreasing of catches from Vistula Bay to the lowest level in the last decade (3,274 t).

Since the pound net fishery is directed to the spawning stock on the spawning grounds the main months of the pound net fishery are March–April in SD 26.4 and April–May in SD 32. The main season of the pelagic trawl fisheries are 1st, 2nd and 3rd quarter in both Sub-divisions.

Herring is caught by the Russian fleet only for human consumption.

Baltic sprat is also an important target for Russian pelagic trawl fishery, mainly in SD 26. In SD 32 sprat was fished only as by-catch in the herring trawl fishery. In 1995 the total catch was reported to be 14,934 t. Compared with 1994 the total landing decreased by about 15%. The background for this reduction of the landings was the enormous by-catches of undersized sprat of a very rich 1994 year class in January–February. According to the National Fishery Rules the by-catch of undersized fish should not exceed 15%. Therefore the sprat fishery was temporarily prohibited. In former years the main sprat fishery took place in the 1st and 4th quarter because the quality of fish during this period is the best for human consumption. In the 2nd and 3rd quarter 1995 a restricted fishery for mink consumption has been allowed. Therefore the catches in these quarters increased.

#### **10.7.4 Evaluation of the national authorities monitoring system for management purposes**

In 1995 new fishery logs with detachable pages were introduced at all fishing vessels to improve catch control and to provide information required for a CPUE estimation. The system of quota control based on 15 days' reporting of catches to fish protection bodies is working. Reported catch and landing data are stored in a computer system. After the checking the data are compiled by the type of vessels, gears, catch per species and fishing area.

Cumulative catches by month are submitted to IBSFC according to the new Fishery Rule 2.2.

Since the Russian quota for cod, herring and sprat was utilised of about 40% in 1995, the problem related to non reporting or misreporting can be neglected.

## **10.8 Sweden**

### **10.8.1 The Swedish fishing fleet**

The total number of professional fishermen in Sweden were 2,925 in 1995 (1 January). About 47% of the fishermen have their home port on the Baltic coast. Capacity data for the total Swedish fishing fleet as of 1 January 1995 are presented in Table 10.8.1. Vessels in Segment 1, shellfish trawlers, are not operating in the Baltic. Segment 3, polyvalent, consists mainly of trawlers equipped for different kinds of fisheries, pelagic and demersal, depending on the seasons and the quotas. Vessels from Segments 2, 3 and 5 may operate in the Baltic for the whole year, a part of the year or not at all.

More information about in what areas the fleet is operating can be obtained from the logbook system (see Section 10.8.4). In combination with the Swedish register for fishing vessels the logbooks also can provide information about the size classes in the fleet.

### **10.8.2 The fisheries for herring and sprat**

The Swedish fishery for herring and sprat in the Baltic is carried out by four fleet categories:

1. Trawlers catching herring with a minimum mesh size of 32 mm. This fishery is for human consumption.
2. Trawlers catching sprat with a minimum mesh size of 16 mm. A small part of the landings is used for human consumption. Most of the landings are used for reduction purposes. Herring is caught as by-catches in this fishery.
3. Coastal fishery for herring with gillnets. This fishery is for human consumption.
4. Purse seine fishery near the coast for spawning herring in the second quarter of the year. This fishery is also for human consumption.

Most of the Swedish landings of herring and sprat from the Baltic are from traditional trawl fishery with pelagic trawls and also with bottom trawls for herring. Fishing with gillnets for herring is of local importance in the coastal fisheries, especially in the northern Baltic.

### **10.8.3 The fisheries for cod and flatfishes**

The Swedish fishery for cod and flatfishes in the Baltic is carried out by four fleet categories, all fisheries are for human consumption:

1. Trawlers catching cod with a minimum mesh size of 120 mm (diamond mesh) or 105 mm (selection window). Flatfishes are caught as by-catches in this fishery.
2. Baltic gillnetters/longliners fishing for cod with a minimum mesh size in the gillnets of 105 mm. Flatfishes are caught as by-catches in this fishery. Longlines are used only by a small number of boats in this category.
3. Gillnetters fishing for flatfishes. Cod is caught as by-catch in this fishery.
4. Coastal fishery with trap nets for eel and other species. Cod and flatfishes are caught in this fishery.

The Swedish fishery for cod in the Baltic was small and stable in the 1970s, accounting for about 3–4 % of the landings from the western cod stock (Sub-divisions 22–24) and 10% of the landings from the eastern cod stock (Sub-divisions 25–32). The main gears used in the 1970s were bottom trawl, gillnets and longline.

In the 1980s the Swedish landings from the western cod stock increased to about 10 to 20% of the total landings from the area. The Swedish landings have since then remained at that level. The Swedish share of the total landings from the eastern cod stock has increased steadily since the early 1980s to about 20–25 % in recent years.

The Swedish fishery for cod in the Baltic has been stopped due to quota regulations in 1993, 1994 and 1995. In 1993 the fishery for cod was allowed for about 9 months in Sub-division 24, and for just over four months in Sub-divisions 25–32. In 1994 the fishery with gillnets was allowed for just over six months and the cod trawl fishery was allowed for about four months in all Sub-divisions. In 1995 fishery for cod was allowed for about five months (1 January–30 March, 17 September–19 November) in all Sub-divisions. Small Swedish landings in the rest of the year develop from cod fishery in foreign economic zones or from by-catches in the fisheries for herring and sprat.

Since 1993 the Swedish fishery for cod also has been subject to a number of regulations with the aim to allow fishery for cod for more months with a small quota. These regulations specify the minimum mesh sizes in the gears, the days in week the fishery is allowed and the maximum landings per vessel and week.

#### **10.8.4 The Swedish data collection from commercial fishery**

The Swedish information system includes two major data flows: a fishery logbook covering catch and effort data and a sales note covering the first marketing of the fish.

All vessels with a length exceeding 10 meters and all vessels fishing in foreign economic zones shall keep a daily logbook on board the ship. The daily logbook shall be updated to the latest fishing effort. Smaller fishing vessels in the Swedish economic zone uses a monthly logbook. This logbook is updated after the fishing month with aggregated catch quantities.

All fishery logbook sheets are sent to the Board of Fisheries in Gothenburg within a few days after the landings. About 50,000 daily and 20,000 monthly logbook sheets are registered annually by the Board of Fisheries. Since the beginning of 1995 it is possible to link the catch figures in the logbooks to the figures in the corresponding sales note.

Sales notes from fish auctions and other first marketing of the fish are sent to Statistics Sweden (the central Swedish authority for statistics). Statistics Sweden registers about 100,000 sales notes annually. The landings from the sales notes provide basic data for the official Swedish fishery statistics. The landings in the fishery logbooks are used in the official statistics as keys to split the figures from the sales notes on different fishing areas.

**Table 10.2.1 Size composition (%) of herring in trawl and trapnet catches in 1995.  
(Estonian fishery).**

Length, cm	Subdivision					
	28 (Gulf of Riga)		29		32	
	Trawl	Trapnet	Trawl	Trapnet	Trawl	Trapnet
<=8	3.8	-	0.1	0.2	0.3	-
9	2	-	0.1	0.3	0.9	-
10	2.5	0.1	0.1	-	0.6	0.1
11	2.3	0.1	1	-	2.9	0.1
12	22.4	2.8	9	2	8.3	2.8
13	16.5	14.9	16.1	7	15.8	14.9
14	32.2	25.5	27	15.8	39.9	25.5
15	8.7	21.4	21.6	17.3	20.5	21.4
16	5.2	18	11.7	14.2	6.9	18
17	1.8	8	5.5	14	2.4	8
18	1.3	4.7	3.4	8.5	0.7	4.7
19	0.6	2.1	1.7	9	0.4	2.1
20	0.3	0.6	0.8	5.3	0.1	0.6
21	0.2	0.4	0.8	3.5	0.1	0.4
22	0	0.5	0.6	1.3	0.1	0.5
23	0.1	0.6	0.2	1	0.1	0.6
24	0.1	-	0.1	0.2	-	-
25	-	0.2	0.1	0.2	-	0.2
26+	-	0.1	0.1	0.2	-	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 10.3.1. Finnish fleet on Baltic herring. Stocks in SD 29, 30 and 31( Management Unit 3)

	Fleet 1 (Pelagic trawl)	Fleet 2 (Bottom trawl)	Fleet 3 (Trap-nets)	Fleet 4 (Gill-net)
<b>Average catches (tonnes) in 1990-1994:</b>				
Herring in SD 29	8405	8338	3368	929
Herring in SD 30	18253	11766	5676	407
Herring in SD 31	2017	4588	417	27
<b>Average number of vessels, gears and fishing days in 1990-1994:</b>				
	Number of vessels	Number of vessels	Number of nets	Number of fishing days
Herring in SD 29	36	33	194	4293
Herring in SD 30	61	48	340	1253
Herring in SD 31	31	40	114	402
<b>Description of vessels in 1990-1994</b>				
Herring in SD 29	Total GRT:	3079	2510	-
	GRT range:	28-156	28-153	-
	Average GRT:	86	77	-
	Total horse power (kW):	12172	10334	-
	Horse power range (kW):	151-692	149-675	-
	Average horse power (kW):	340	317	-
Herring in SD 30	Total GRT:	6080	4808	-
	GRT range:	29-323	29-298	-
	Average GRT:	100	101	-
	Total horse power (kW):	22070	16089	-
	Horse power range (kW):	152-760	156-771	-
	Average horse power (kW):	363	338	-
Herring in SD 31	Total GRT:	1867	2200	-
	GRT range:	26-96	24-112	-
	Average GRT:	61	55	-
	Total horse power (kW):	9884	12760	-
	Horse power range (kW):	165-557	133-670	-
	Average horse power (kW):	323	319	-

Table 10.3.2. Finnish fleet on Baltic herring in the Gulf of Finland. (Stock in SD 25-29 and 32 including Gulf of Riga)

	Fleet 1 (Pelagic trawl)	Fleet 2 (Bottom trawl)	Fleet 3 (Trap-nets)	Fleet 4 (Gill-net)
Average catches (tonnes) in 1990-1994:	3775	1961	1103	122
Average number of vessels, gears and fishing days in 1990-1994:	Number of vessels 15	Number of vessels 7	Number of nets 61	Number of fishing days 1328
Description of vessels in 1990-1994:				
Total GRT:	1335	504	-	-
GRT range:	35-143	38-109	-	-
Average GRT:	89	72	-	-
Total horse power (kW):	5520	2240	-	-
Horse power range (kW):	151-689	190-621	-	-
Average horse power (kW):	368	320	-	-

Table 10.3.3. Finnish fleet on Baltic sprat in Sub-divisions 29-32. (Stock in SD 22-32).

	Fleet 1 (Pelagic trawl)	Fleet 2 (Bottom trawl)
Average catches (tonnes) in 1990-1994:	52	39
Average number of vessels in 1990-1994:	4	2
Description of vessels in 1990-1994:		
Total GRT:	392	168
GRT range:	75-118	43-125
Average GRT:	98	84
Total horse power (kW):	1520	730
Horse power range (kW):	252-507	259-488
Average horse power (kW):	380	365



Table 10.3.4. Finnish fleet on Baltic cod in Sub-divisions 25-32. (Stock in SD 25-32).

	Fleet 1 (Pelagic trawl)	Fleet 2 (Bottom trawl)	Fleet 3 (Gill-net)
Average catches (tonnes) in 1990-1994:	200	268	385
Average number of vessels in 1990-1994:	No. of vessels  10	No. of vessels  12	No. of vessels  10
Description of vessels in 1990-1994:			
Total GRT:	1229	1637	200
GRT range:	67-184	55-228	8-35
Average GRT:	128	132	20
Total horse power (kW):	4349	5679	1620
Horse power range (kW):	256-638	235-728	38-397
Average horse power (kW):	453	458	162

**Table 10.3.5. Finnish fisheries in 1990-1994.**

(Landings average for 1990-94 in metric tons nominal live weight; total capacity average for 1993-94)

Landings					
Stock	Pelagic trawl	Demersal trawl	Trap nets	Gill-nets	Total catch
Herring SD 29	8405	8338	3368	929	21039
Herring SD 30	18253	11766	5676	407	36102
Herring SD 31	2017	4588	417	27	7049
Herring SD 32	3775	1961	1103	122	6961
Sprat SD 24-32	52	39	-	-	91
Cod SD 25-32	200	268	-	385	853

Capacity (Vessels in register)	Number of vessels	Total GRT	Average GRT	Total kW	Average kW
Trawl vessels	171	10010	59	47895	280
Trap-net vessels	19	276	15	2588	136
Other coastal vessels (mixed fisheries)	51	931	18	5574	109

Capacity (Vessels not in register *)	Number of vessels	Total GRT	Average GRT	Total kW	Average kW
Trawl vessels	18	636	35	4808	267
Trap-net vessels	442	1743	4	12610	29
Other coastal vessels (mixed fisheries)	2049	10918	5	78119	38

\*) Vessels not registered in 1990-94 are smaller than 12 m in total length

**Table 10.5.1** The distribution of Latvian cod catches by Sub-division and gear in 1995 (logbook statistics).

Subdivision	Gear	Catch (kg)
24	gillnet	9500
25	gillnet	301615
	trawl	400256
26	gillnet	1345768
	trawl	1335816
27	gillnet	1400
28	gillnet	1283303
	trawl	40642

**Table 10.6.1** Polish catches of demersal fish in the Baltic Sea in 1980–1995 according to stocks. In thousand tonnes.

Year	Cod	Herring		Sprat	Flounder	
	25–32	22–24	25–29, 32+R	22–32	24–25	26
1980	123.5	13.6	58.3	12.7	1.6	1.4
1981	120.9	13.4	51.2	8.9	1.1	1.5
1982	92.5	14.9	63.0	14.2	2.5	1.6
1983	76.5	16.7	67.1	7.1	1.8	0.9
1984	93.4	14.3	65.8	9.3	2.5	1.3
1985	63.3	16.7	72.8	18.5	2.1	1.3
1986	43.2	12.3	67.8	23.7	3.0	1.9
1987	32.7	8.0	55.5	32.0	2.5	1.7
1988	33.4	6.6	57.2	22.2	1.7	1.3
1989	36.9	8.5	51.8	18.6	1.9	1.1
1990	32.0	9.7	52.3	13.3	1.6	0.6
1991	25.7	5.6	47.1	22.5	2.0	1.9
1992	13.3	15.5	39.2	28.4	1.9	1.9
1993	8.9	11.8	41.1	31.8	3.3	1.2
1994	14.3	6.3	46.1	41.3	3.2	1.3
1995	25.0	7.3	38.4	35.6	7.4	1.5

**Table 10.6.2** Polish cod, herring and sprat catches in 1995 (in quarters and tonnes).

Species	Quarters				Total
	I	II	III	IV	
Cod	4,591	7,487	3,351	9,572	25,001
Herring	6,121	12,751	13,927	12,877	45,676
Sprat	13,485	15,620	1,087	5,460	35,658
Total	24,197	35,365	18,365	27,915	106,335

**Table 10.6.3** Polish fishery fleets in the Baltic.

## Cutter &gt; 12.5 m length

Length class	1993			1994		
	NO	BRT	HP	NO	BRT	HP
< 16	5	121	955	5	112	882
17-19	206	8,319	37,220	195	7,886	35,755
20-21	33	2,656	10,940	33	2,701	11,020
24	95	9,867	28,900	92	9,611	28,000
25	62	6,813	35,340	59	6,430	33,630
26	14	2,484	7,980	12	2,127	6,840
> 26	6	855	3,740	7	1,118	5,432
Total	421	31,115	125,075	403	29,985	120,659

## Boats &lt; 12.5 m length

Motor boats	928	37,718
Rowing boats	102	-

**Table 10.6.4** The importance of different cutter size in Polish fishery for cod, herring and sprat in 1994 and 1995.

Cutter length	Species						Total	
	Cod		Herring		Sprat		1994	1995
	1994	1995	1994	1995	1994	1995		
17	28.6	26.8	10.3	11.1	0.8	1.4	9.5	12.1
19	5.7	6.2	3.9	3.8	1.2	2.9	3.3	4.1
21	9.8	10.0	3.5	5.2	-	0.4	2.9	4.3
24	31.0	31.3	6.8	8.2	1.2	1.2	8.0	11.0
25	19.3	20.6	59.2	57.7	68.5	61.4	57.0	50.3
26	3.7	3.1	14.7	13.0	17.4	18.8	13.9	12.3
> 26	1.9	2.0	1.6	1.0	10.9	15.9	5.4	5.7

**Table 10.8.1** The total Swedish fishing fleet as at 1 January 1995. Vessels of 5 meters and more in length. Figures from the National Board of Fisheries, 1995.

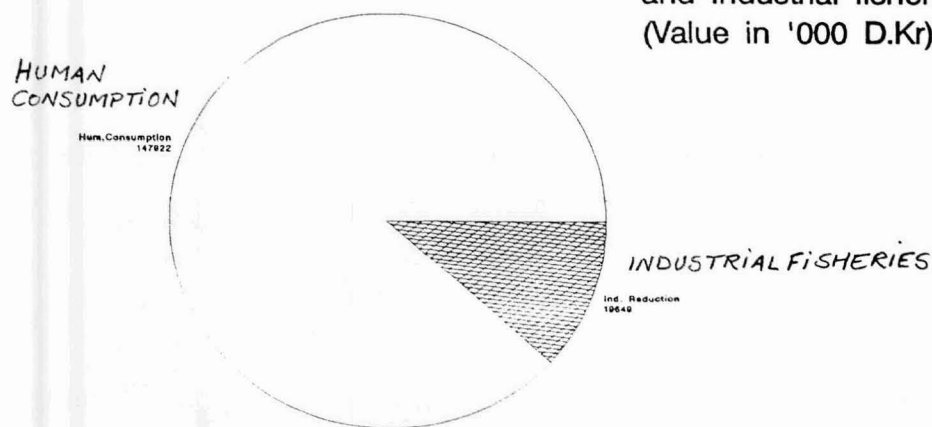
Segment	GRT/GT 1.1.1995	kW 1.1.1995	Number of vessels 1.1.1995
1. Shellfish trawlers	6610	30570	111
2. Pelagic trawlers/ seiners > 30 m	13318	42176	43
3. Polyvalent	13893	58677	193
4. Baltic netters/ longliners	5075	38602	597
5. Others	10969	101384	1601
<b>Total</b>	<b>49865</b>	<b>271409</b>	<b>2545</b>



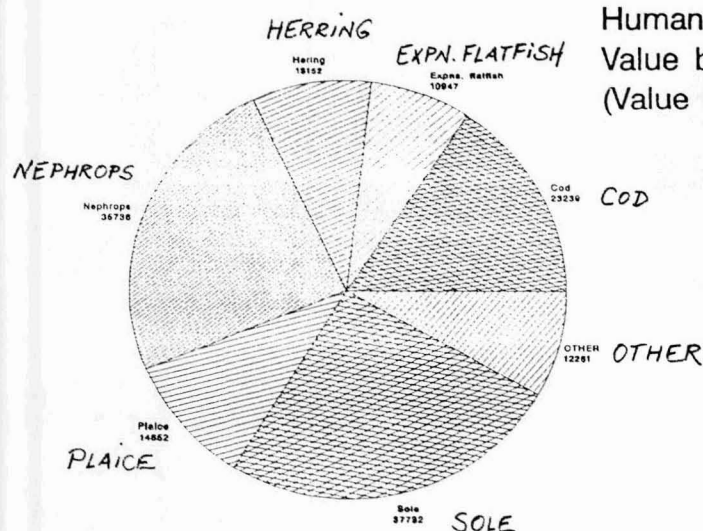
Figure 10.1.1 Importance of different species in Kattegat 1994.

# Danish fisheries, Kattegat, 1994

Value in Human Consumption  
and Industrial fisheries  
(Value in '000 D.Kr)



Human Consumption Fishery  
Value by Spp. Group  
(Value in '000 D.Kr)



Human Consumption Fishery  
Weight by Spp. Group  
(Weight in tons)

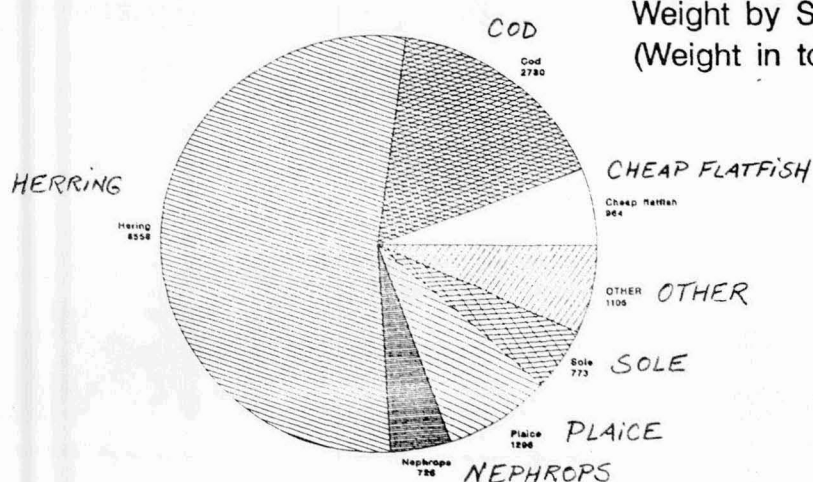


Figure 10.1.2 Characteristics of major Danish Kattegat fleets 1994.

# Species composition by value

# Size composition of cod catches

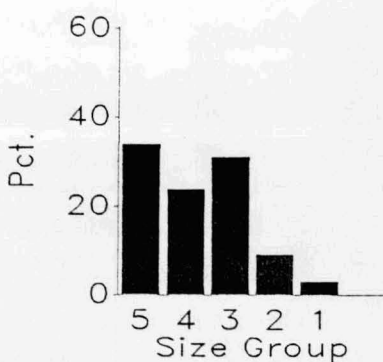
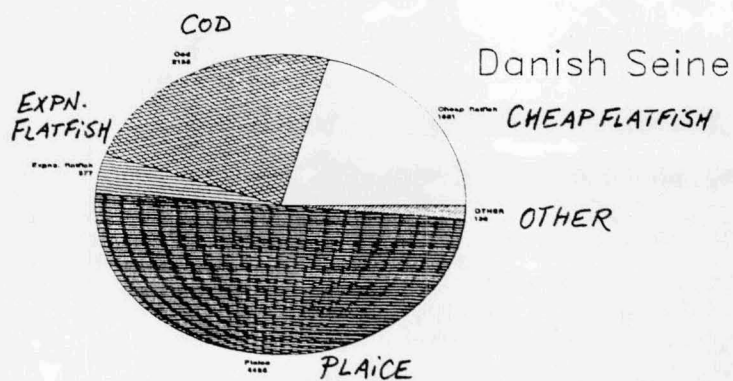
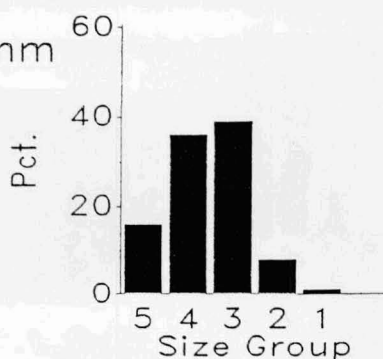
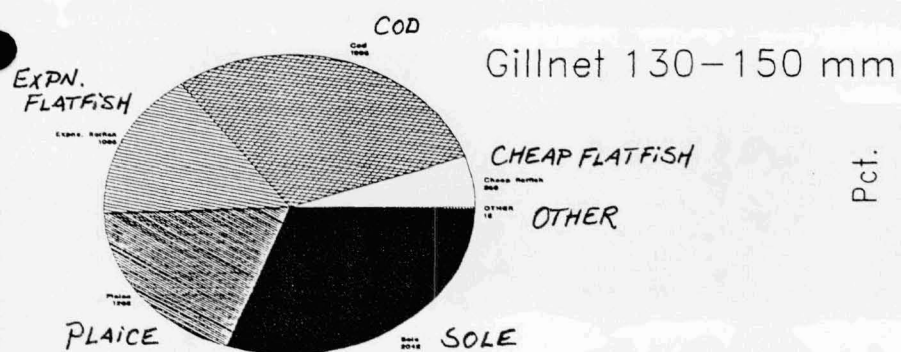
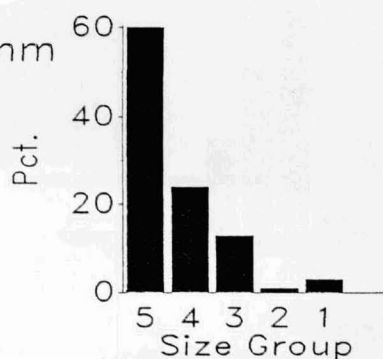
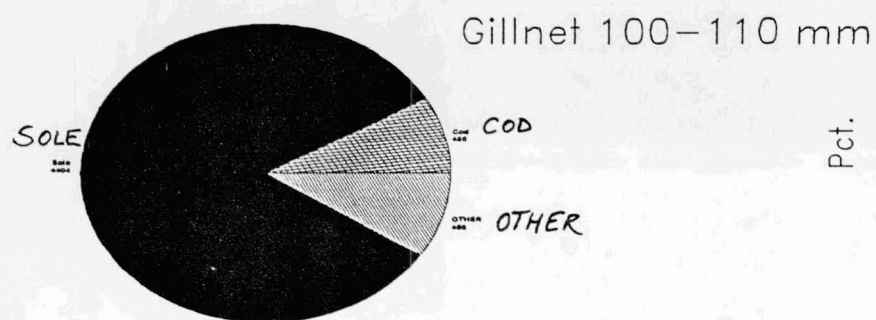
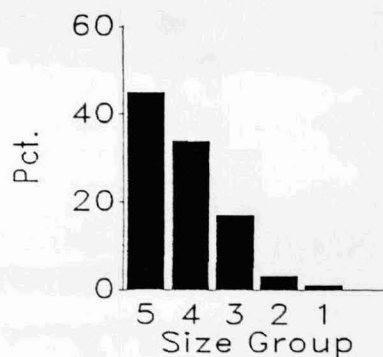
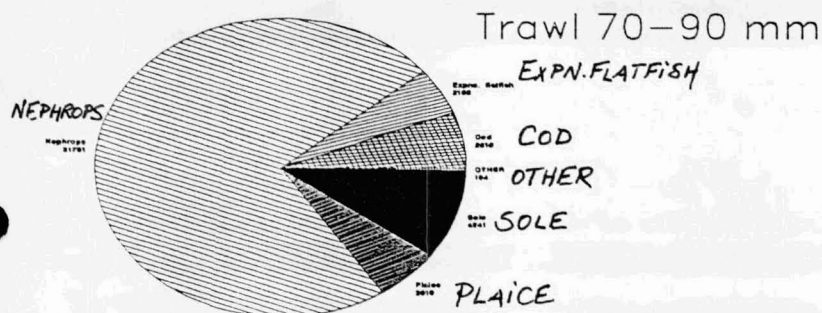
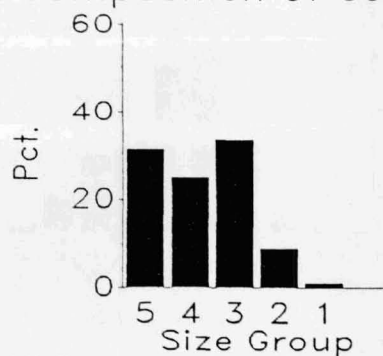
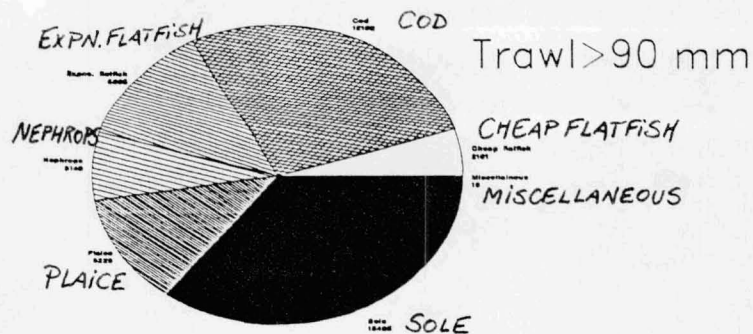


Figure 10.1.2 (continued)

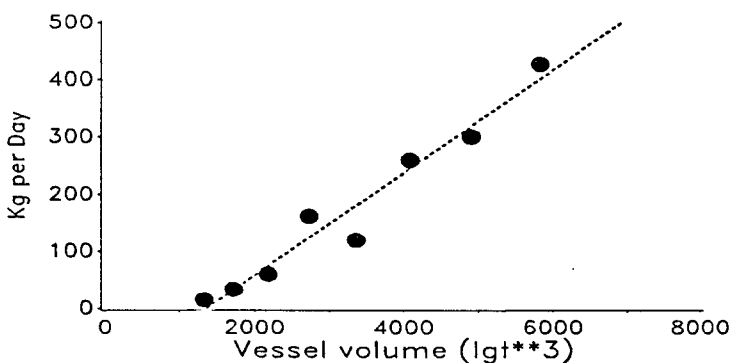
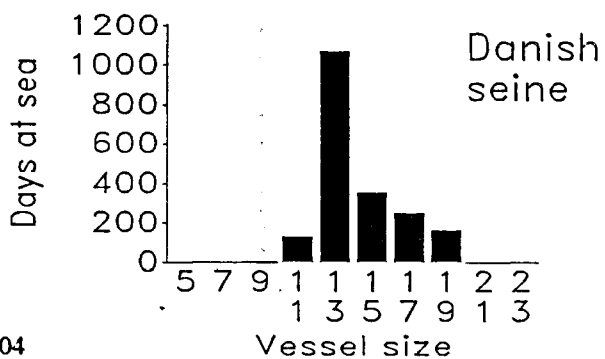
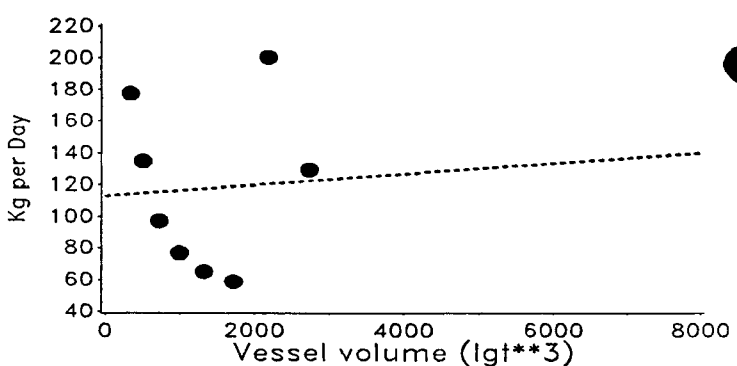
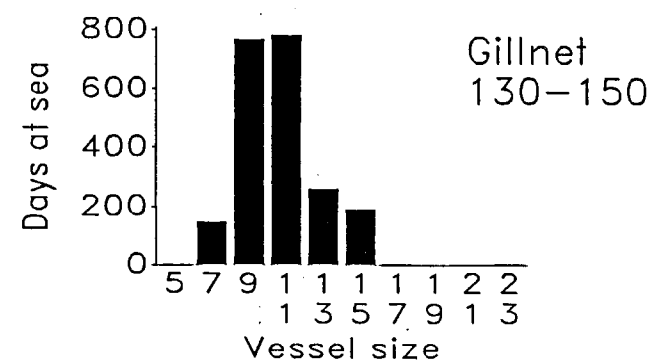
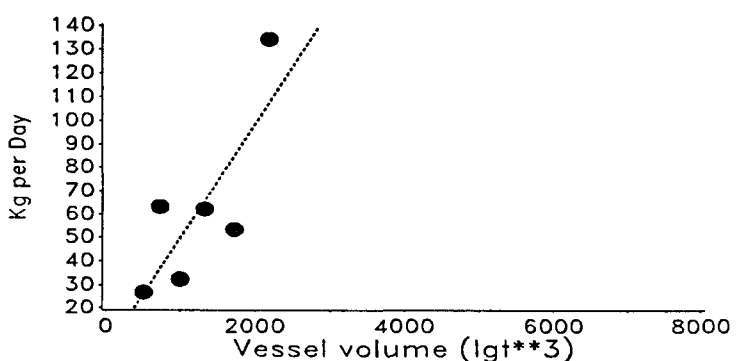
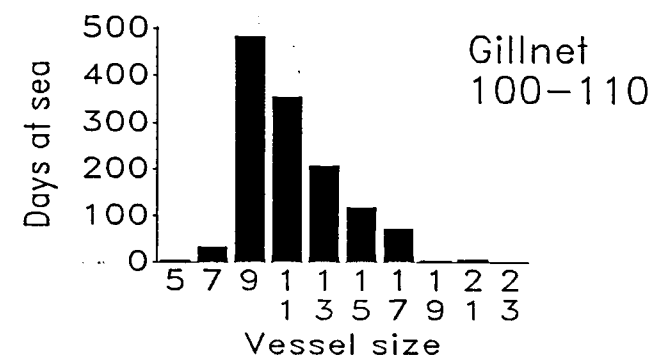
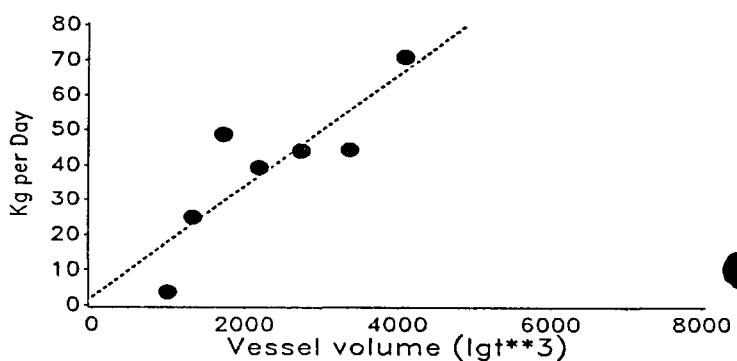
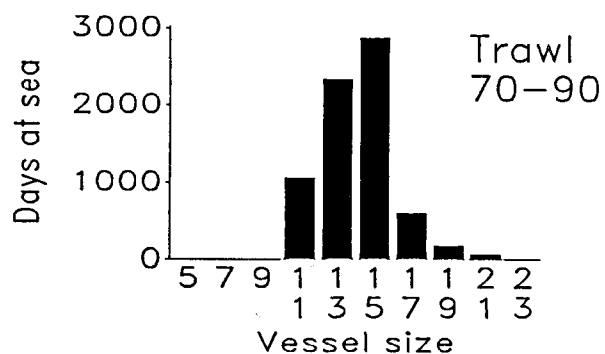
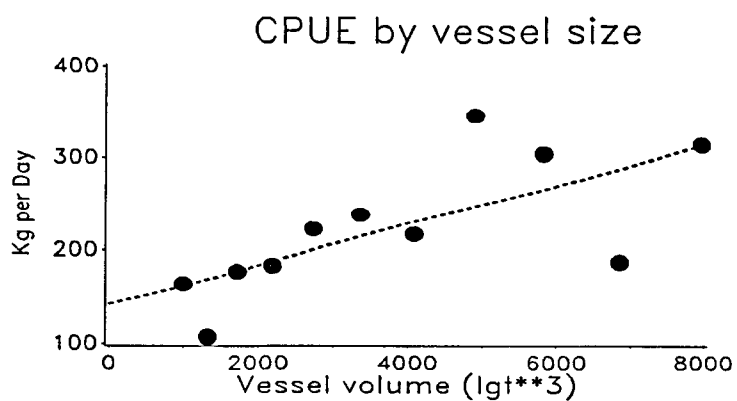
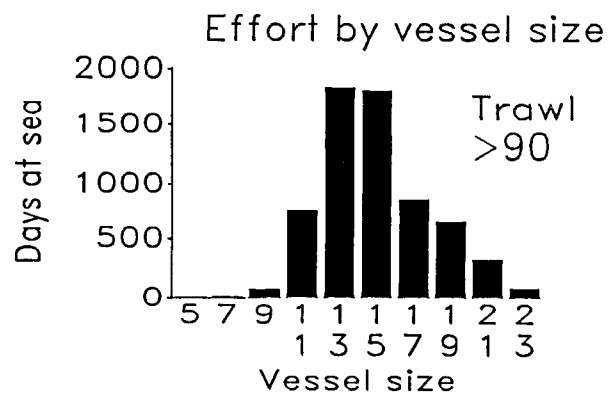
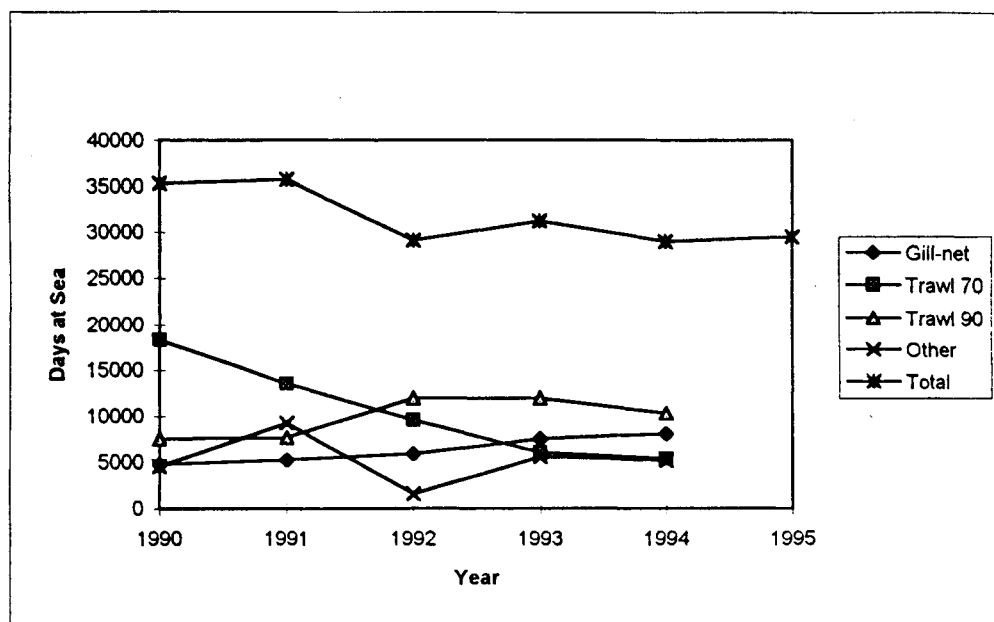


Figure 10.1.3 Effort in Kattegat, 1990–1995.



## 11 THE EFFECTS OF A BAN ON PELAGIC TRAWL FISHERY FOR COD IN APRIL-MAY ON THE SPAWNING STOCK BIOMASS AND YIELD OF COD

The pelagic trawl fishery on cod is not unknown in the Baltic. The beginning of this fishery is going back to 1963, when during some hauls in sprat directed fishery large amount of cod was taken. The first successful cod directed pelagic trawl fishery was carried out by some GDR and Polish cutters in the Bornholm Deep and Gdansk Deep in 1968 (SD 25 and 26). The large scale of the international pelagic cod fishery started in the beginning of the 1980s in SD 25-28. In SD 22 and 24 there is no existing directed pelagic trawls fishery on cod.

After this successful period in the 80's it was observed a downward trend in the pelagic cod fishery and a shrinkage of the cod stock biomass and its distribution the Baltic. The spawning areas were reduced by the influence of environmental condition from usual in Gdansk, Gotland and Bornholm Deep only to the Bornholm Deep.

The cod fishery in the pelagic was tried by the international Baltic cod fishery during every spawning season with variable success. The last successful pelagic cod fishery has been observed in 1995, when high CPUE was noticed in several national fleets at the Bornholm spawning grounds.

The pelagic cod directed fishery seems to be from the observation a seasonal one, carried out mainly of the fishing grounds of Bornholm, Gotland and Gdansk Deep. Successful pelagic cod fishery takes place only in some years and is depended of environmental condition and takes place in the years with deficit of dissolved oxygen in the near bottom water layer ( $<11\text{‰ S}$ ,  $<2\text{ ml O}_2$ ). The Baltic cod has a long spawning period from March/April up to September/October. Usually the top of spawning was in April/May in the previous year, but since the beginning of the 1990s it shifted to June/August. It resulted from the fact that the spawning stock became younger by the influence of fishery. At present the spawning stock consists mainly of younger fish of the age groups 3-5. Younger cod start to spawn later (June/August) than older cod (March). Based on this environmental condition than cod is creating large aggregation in the bathypelagic water layer.

During the period of the pelagic cod fishery on spawning grounds the dense stocks of mature large cod are exploited. The average size of cod from the pelagic fishery is higher than those from the bottom trawl fishery.

To evaluate the importance and influence for the present cod stock size the two last years of the international catches in April and May a sample of catch data for this period was selected from SD 25 (see Table 11).

The results of the table shows a variation of the pelagic cod fishery during the spawning period in 1994 and 1995. In 1994 the results of the international cod catches on the spawning ground were very poor. In 1995 the pelagic cod fishery was more successful especially in the Danish and Polish fishery. In 1995 the pelagic cod catches of these both countries were about ten times higher than in 1994. The proportion of the pelagic cod catches of the total cod landings of Poland and Denmark amounted to 27% during April and May in 1995. In the total international catches this proportion is lower and amounted to about 19%, but it should be stressed, that not all catch data were available. In relation to the total international landings the total catches in April and May amounted to 9.2% in 1994 and 7.2% in 1995.

The calculations (SD 25-32) of the years 1994 and 1995 *status quo* quarterly catches in numbers and mean weights at age of fish give sums of yearly catch in numbers of 83,334 (catch 90,102 tonnes) and of 83,263 (catch 107,474 tonnes), respectively.

On the assumption that a ban of cod fishery in the second quarter and of a shift of these catches to the first quarter, the results will be a higher catch in numbers by the same total catch weight (1994 to 89,371; 1995 to 84,681).

The assumption that a ban of the cod fishery in the second quarter and a proportional division of this second quarter catches for the first, third and fourth quarter also the total catch in numbers would increase (1994 to 90,432; 1995 to 85,176).

The analysis of the cod catch statistic of the investigated caught cod is important, but taken into account the total yearly pelagic catches of cod are off minor importance (Table 11). Also the analysis of catch in numbers of quarter shows a negative effect by introduction of a ban in the second quarter, because it would be an increase in catch in numbers by *status quo* catch.

The present low pelagic catches have only a little influence on the spawning stock biomass. Therefore the ban in present condition would have little effect on cod preservation.

In case of insignificant increase of the pelagic fishery the implementation of a ban would be more effective.

Taking into account the shrinkage of spawning areas (see above) it seems to be possible to fish out a large proportion of the dense spawning aggregations during the spawning period or in the second quarter of the year. This would cause a reduction of the spawning stock biomass. In this case it seems to be suitable to have a ban of the cod fishery on the spawning ground in the years with oxygen deficit in the near bottom water layer of Bornholm Deep. On the other hand, a ban of the cod fishery during the above mentioned period would cause an effort shift to the other quarters of the year in proportion to its catches and an increase of the total catch in numbers of the year.

**Table 11** Cod catches in April and May in 1994 and 1995 according to the gear (in tonnes).

Country	Year	Gear								Year <sup>1</sup> SD 22-32
		Pelagic trawl		Bottom trawl		Gillnet		Total		
		April	May	April	May	April	May	April	May	
Denmark	1994		23		1425		968			
	1995		348		923		768			
Finland	1994	0	0	37	74	20	71			
	1995	83	207	37	0	56	94			
Estonia	1994	Only small bottom trawl fishery								
	1995									
FRG	1994	80	105	332	308	3	0			
	1995	Not available								
Latvia	1994	Not available								
	1995	20	102	276	509	265	311			
Poland	1994	6	74	1001	1393	193	223			
	1995	141	798	1532	1534	311	391			
Russia	1994	No directed pelagic cod fishery								
	1995									
Sweden	1994	0	0	21	24	61	390			
	1995	0	0	0	0	0	2			
Total	1994	86	202	1391	3224	277	1652	1754	5078	74000
	1995	244	1455	1845	2966	632	1518	2721	5939	120000
%										
	1994	4.9	4.0	79.3	63.5	15.8	32.5	-	-	9.2
	1995	9.0	24.5	67.8	49.9	23.2	25.6	-	-	7.2

<sup>1</sup>Official reported catches

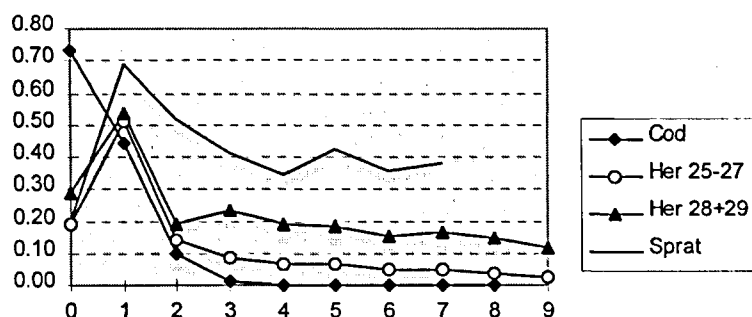
## 12 BIOLOGICAL INTERACTION BETWEEN COD, HERRING AND SPRAT STOCKS

Negative co-variation between cod catches (as a proxy for abundance) and herring and sprat catches has been observed and described by correlation analysis since 1929 (Jensen, 1929) by several authors and for several parts of the Baltic. Such statistical relationships do not tell anything about the causes of the found co-variation. It could be caused by predation on herring and sprat by cod, but also by herring and sprat eating cod egg and larvae.

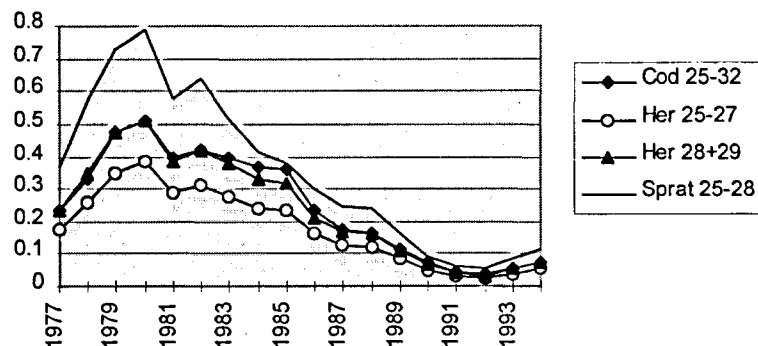
The Working Group on Multispecies Assessment of Baltic Fish has during 1982–1996 explored the interactions between these three fish species. It has used an extension of the traditional VPA - the Multispecies VPA (MSVPA) in order to estimate the mortality caused by predation. This model needs additional input data as compared with the VPA, viz. relative stomach content for each predator age group and consumption ratios by predator age. A large number of cod stomachs (more than 40,000) have been analysed in order to describe the cod diet. Descriptions of methods, material and results have been presented in the suite of reports from the Group and have also been summarised by Sparholt (1994).

Results of the MSVPA (for the Central Baltic) show that predation mortality can be high for both sprat and young herring, for some periods higher than the fishing mortality.

Predation mortality by age. Mean 1977-89



Predation mortality. Ages 0-3



It is also evident that the level of predation mortality varies with the size of the cod stock and thus is of minor importance at present.

The Working Group on the Assessment of Pelagic Stocks in the Baltic has since 1991 used these estimates of predation mortality in its standard assessments. This caused (when introduced) a revision of the stock size estimates of both



herring and sprat. The higher mortalities have not, however, had any major influence on the short term predictions or the advice.

The cod stomach analyses and the MSVPA has also revealed that cannibalism may cause a rather high mortality on young cod (age groups 0 and 1). These findings have not yet been incorporated into the single species assessment for cod.

Studies of stomach contents of herring and sprat (see Köster and Schnack, 1994 for an overview) have demonstrated that sprat is a large consumer of cod eggs. These findings are of potential importance for the species interactions. It has, however, still not been possible to estimate what contribution to the mortality during early life stages of cod the egg predation could give.

The effect of the inclusion of species interactions is seen in the medium and long-term predictions. The development of one stock as the results of recruitment and exploitation, will influence the development of the other stocks. Examples of the outcome from the Multispecies Forecast program (MSFOR) are presented in the reports from the Multispecies Working Group both in 1994 and 1995.

### 13 THE POTENTIAL FOR MULTI-ANNUAL AND MULTISPECIES CATCH OPTIONS

For most of the stocks the multi-annual catch options are not recommended by the Working Group. The main reason is heavy exploitation and variable recruitment of some stocks. For instance cod stocks are heavily exploited and very dependent on the recruiting year classes, the strength of which should be assessed each year. The sprat in the Baltic is also the one having very variable recruitment and the bulk of the catch generally consists of 2–3 year classes. Moreover, this stock, though at high level now, undergoes increasing fishing pressure. For some stocks, however, (e.g. herring stocks in Sub-division 30 and Sub-division 31) exploitation is low (or even very low) and there is no need to assess them and give catch projection every year. When shortly discussing the potential for multi-species catch option (understood by the Working Group as technical interactions) it was pointed out that in some pelagic fisheries it is difficult to split herring and sprat catches (problems with sampling activity), and the estimates of them are rather rough. On the other hand, when multispecies catch options are applied, there is a danger of overexploiting a stock showing decreasing biomass while the other stocks are in good state. The Group considered the evaluation of the potential for multispecies catch option as premature this year and intends to discuss it next year, when more data showing the mixture of the fishery are presented.

### 14 RECOMMENDATION

The Working Group recommends that the former Planning Group for Hydroacoustic Surveys in the Baltic be re-established to:

- compile the acoustic estimates of the stock size;
- investigate the variability of acoustic estimates and;
- undertake some steps to decrease this variability.

### 15 REFERENCES

- Anon., 1994b. Report of the Working Group on Multispecies Assessment of Baltic Fish. ICES CM 1994/Assess:1.
- Anon., 1995b. Report of the Study Group on Assessment-related Research Activities relevant to Baltic Fish Resources (excluding salmonids). ICES, Doc. CM 1995/J:1.
- Anon., 1996. Report of the Working Group on Multispecies Assessment of Baltic Fish. ICES CM 1996/Assess:2.
- Cook, R.M. A simple model for the analysis of research vessel data to determine stock trends. ICES CM 1995/D:12.
- Hovgaard, H.H. Estimating IBTS (February) indices for cod in Skagerrak and Kattegat by use of modal separation Techniques. ICES C.M. 1995/G:24.

- Jensen, A.J.C., 1929. On the influence of the size of the stock of cod upon the herring fishery in the Kattegat, Belt Sea and western part of the Baltic, and some other causes of variations in the cod and herring fisheries. - Meddr Komm. Havunders. ser., Fiskeri, 8: 8 pp.
- Köster, Fritz W. and Dietrich Schnack 1994. The role of predation on early life stages of cod in the Baltic. - Dana, vol 10, pp 179–201.
- Myers, R.A., A.A. Rosenberg, P.M. Mace, N. Barrowman, and V.R. Restrepo. 1994. In search of thresholds for recruitment overfishing. ICES J. mar. Sci. 51:191–205.
- Ortowski, A., 1993. Distribution of fish stocks vs environmental factors in the Polish fishery zone; Determined by the acoustic method (cruise of R/V "Profesor Siedlecki", Oct. 2–24, 1990). Bull. of the Sea Fish. Institute, 128:xx.
- Sparholt, H. 1994: Fish species interactions in the Baltic sea. - Dana, vol 10, pp 131–162.