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PART 2

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**REPORT OF
THE WORKING GROUP ON ASSESSMENT OF PELAGIC STOCKS
IN THE BALTIC
COPENHAGEN, 17-27 APRIL 1990**

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Table 3.5.1 VIRTUAL POPULATION ANALYSIS

HERRING IN BALTIC FISHING AREA 30E

CATCH IN NUMBERS

UNIT: millions

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	1	2	0	0	0	0	0	0	0	0	0	0
1	6	30	78	16	24	3	61	4	23	84	85	76
2	55	99	88	153	59	18	50	41	83	160	132	323
3	105	111	161	115	202	44	47	30	136	91	165	202
4	159	55	112	169	111	159	46	39	34	99	91	117
5	69	62	51	87	117	45	156	37	41	15	15	43
6	54	34	72	52	59	59	71	82	52	16	15	8
7	52	30	30	74	39	38	70	33	76	28	16	8
8	22	27	32	42	46	13	37	23	24	50	28	13
9	14	14	22	25	14	22	15	16	22	13	38	11
10	9	7	14	14	14	4	21	7	7	10	14	30
11+	7	12	16	14	19	9	8	11	11	7	23	17
TOTAL	563	483	676	761	704	414	582	323	509	573	680	877
	1986	1987	1988	1989								
0	0	0	2	6								
1	18	40	6	98								
2	367	44	157	69								
3	290	202	47	185								
4	133	195	148	41								
5	77	87	149	114								
6	32	51	68	97								
7	25	27	37	44								
8	4	11	14	22								
9	4	7	8	12								
10	10	7	8	5								
11+	14	15	13	12								
TOTAL	974	666	657	705								

Table 3.5.3 Tuning file. Herring in Sub-divisions 29NE-30E.

Herring 29NE-30E. Bal-Pel. W6, Raimo Parmanne 20.04.90

103

Trapnet

1974, 1989

1,1

1, 10

1963,1.4,14.6,89.9,162.3,61.8,53.5,53.9,28.2,24.2,10.4
 1592,1.9,28.2,88.1,73.6,78.8,36.0,34.6,35.0,18.0,13.8
 1896,2.5,36.1,108.1,105.5,69.4,77.6,29.1,35.8,28.2,16.1
 2227,2.8,51.0,86.3,122.8,80.3,52.4,67.0,34.3,23.9,16.5
 2114,14.6,26.0,128.7,82.9,102.3,55.1,42.7,47.6,16.4,14.6
 1987,8.2,17.8,41.6,144.7,58.6,68.5,39.0,19.8,23.8,7.8
 1944,4.7,14.5,34.5,40.0,126.9,56.8,61.3,33.8,15.5,19.0
 1848,3.2,33.1,22.7,38.7,35.1,67.1,28.8,18.4,14.1,7.8
 1682,3.9,41.9,91.2,30.0,35.5,38.7,56.5,20.1,15.6,6.1
 1544,0.4,31.2,52.6,63.1,15.9,17.1,21.6,31.6,10.9,7.6
 1667,4.3,17.5,79.1,36.9,38.8,11.6,13.3,18.4,21.2,5.8
 1523,3.5,33.2,58.9,76.7,26.7,31.3,10.1,11.6,10.3,17.0
 1433,0.2,33.9,111.6,58.5,44.3,15.7,11.6,5.8,3.5,3.8
 1142,0.7,13.3,72.1,107.8,48.3,36.0,17.4,8.4,3.7,5.8
 1316,0,27.5,34.5,79.3,95.3,42.8,23.5,9.9,5.3,5.0
 1349,0.8,4.85.5,28.1,61.8,60.5,24.2,13.7,7.6,2.1

Bottom trawl

1974, 1989

1,1

1, 10

4233,1.6,16.5,169.6,153.5,110.6,43.4,28.8,18.5,10.6,11.2,7.4
 4816,18.5,146.5,169.1,183.1,116.2,77.4,23.3,30.9,17.5,13.6,5.5
 2843,1.4,117.2,109.5,85.5,75.6,36.0,28.0,14.5,13.0,8.3,6.6
 3106,0.3,41.2,137.6,69.6,52.7,54.6,43.1,23.3,19.0,9.5,10.6
 3076,0.0,78.3,107.3,142.3,62.5,42.9,35.4,15.1,14.3,6.8,3.1
 2799,0.0,11.0,28.3,46.7,60.9,18.0,21.7,19.6,7.3,9.9,2.8
 3451,32.6,120.3,103.1,94.1,49.8,64.2,18.9,19.0,11.6,8.1,2.5
 2647,18.1,41.6,22.8,31.0,44.7,30.7,51.8,14.0,15.0,13.7,5.1
 2736,1.0,37.9,46.6,49.3,18.7,19.7,19.4,26.1,7.9,4.6,8.8
 2741,0.2,359.1,112.2,47.7,41.5,8.5,8.7,5.9,9.4,7.5,2.0
 1943,8.0,51.8,42.6,46.4,33.0,14.9,9.4,11.1,6.3,13.5,3.8
 1377,9.9,43.2,79.6,30.0,25.2,29.4,10.1,2.1,4.2,2.5,3.5
 1531,0.0,0.5,89.8,53.4,26.2,15.5,13.1,4.8,3.5,2.6,3.3
 2089,1.5,43.5,29.3,73.6,58.0,26.1,8.9,6.2,2.0,0.8,2.0
 2418,3.5,60.0,14.6,73.2,53.2,23.7,10.1,2.0,0.6,0.7
 2218,15.8,28.7,82.8,15.4,46.1,28.4,8.9,6.6,1.9,2.4

Pelagic trawl

1974, 1989

1,1

1, 10

782,4.4,34.0,64.8,34.0,23.4,6.2,4.1,2.6,1.4,0.5,0.9
 799,0.4,3.15.9,21.7,15.5,12.7,8.1,7.7,7.8,5.1,2.9
 682,2.3,34.3,20.4,17.2,28.0,22.2,24.9,10.8,10.5,4.5,2.7
 1086,0.0,45.4,45.4,26.3,22.6,45.9,16.1,14.9,17.4,7.4,3.7
 1437,2.4,31.9,30.5,60.3,39.1,37.3,35.4,17.3,17.4,13.0,6.5
 2374,16.2,38.8,73.4,71.7,111.0,40.5,45.2,49.0,22.3,23.3,8.1
 2879,11.6,38.9,31.4,32.5,37.6,68.9,31.0,42.0,44.1,18.6,19.3
 2485,38.7,60.7,91.9,47.5,35.2,28.6,42.7,14.1,19.8,29.0,7.5
 2858,14.6,67.1,131.3,61.0,32.5,26.5,31.7,49.5,14.8,23.5,15.0
 3208,18.5,137.5,144.5,182.0,83.9,24.4,34.4,30.5,45.5,15.8,14.1
 4767,40.1,189.4,170.3,153.5,148.7,55.5,16.4,25.5,38.2,31.6,19.6
 3590,15.7,283.1,596.5,217.1,101.2,118.6,37.2,18.9,15.1,12.8,22.1
 3909,26.2,60.3,507.3,402.3,166.9,85.2,66.2,24.1,8.0,12.6,17.7
 5316,0.0,77.5,74.4,270.3,220.7,99.0,56.4,43.0,11.6,7.5,7.2
 5538,17.7,251.9,85.7,227.9,183.6,88.6,47.1,31.2,9.3,7.4
 4930,146.0,96.8,235.7,58.9,145.9,120.9,57.2,29.0,18.8,7.3

Table 3.5.4 Herring in Sub-divisions 29NE-30E. Tuning analysis.

DISAGGREGATED qs
 LOG TRANSFORMATION
 NO explanatory variate (Mean used)
 Fleet 1, Trapnet , has terminal q estimated as the mean
 Fleet 2, Bottom trawl , has terminal q estimated as the mean
 Fleet 3, Pelagic trawl , has terminal q estimated as the mean
 FLEETS COMBINED BY ** VARIANCE **

Regression weights
 , .005, .036, .100, .193, .308, .432, .555, .670, .769, .850, .911, .954, .980, .994, .999, 1.000,
 Oldest age F = 1.000 average of 5 younger ages. Fleets combined by variance of predictions
 Fishing mortalities

Age,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,
1,	.012,	.044,	.034,	.036,	.045,	.027,	.108,	.035,	.038,	.138,	.040,	.045,	.056,	.039,	.014,	.070,
2,	.091,	.093,	.094,	.074,	.078,	.052,	.174,	.112,	.137,	.150,	.103,	.152,	.198,	.133,	.099,	.118,
3,	.174,	.155,	.126,	.142,	.116,	.094,	.167,	.164,	.255,	.206,	.205,	.169,	.210,	.192,	.204,	.163,
4,	.181,	.191,	.140,	.166,	.182,	.143,	.141,	.163,	.245,	.297,	.232,	.196,	.206,	.199,	.236,	.234,
5,	.164,	.149,	.164,	.161,	.189,	.143,	.200,	.146,	.199,	.159,	.267,	.276,	.195,	.207,	.250,	.246,
6,	.142,	.143,	.167,	.228,	.167,	.156,	.210,	.191,	.190,	.177,	.137,	.314,	.212,	.203,	.272,	.248,
7,	.167,	.160,	.141,	.189,	.230,	.221,	.299,	.170,	.209,	.166,	.254,	.219,	.232,	.235,	.252,	.251,
8,	.127,	.220,	.208,	.261,	.217,	.204,	.284,	.226,	.172,	.219,	.279,	.208,	.132,	.197,	.237,	.237,
9,	.182,	.193,	.197,	.203,	.206,	.226,	.283,	.274,	.215,	.211,	.233,	.213,	.163,	.151,	.200,	.239,
10,	.156,	.173,	.176,	.208,	.202,	.190,	.255,	.201,	.197,	.186,	.234,	.246,	.187,	.199,	.242,	.244,

Log catchability estimates

Age 1 Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1,	-15.39,	-14.68,	-15.16,	-14.49,	-12.59,	-12.78,	-13.77,	-14.39,	-14.13,	-16.49,	-14.65,	-14.58,	-16.03,	-15.81,	-17.70,	-18.18
2,	-16.03,	-13.51,	-16.14,	-17.06,	-18.86,	-18.45,	-12.40,	-13.02,	-15.98,	-17.76,	-14.18,	-13.44,	-17.71,	-15.65,	-13.83,	-12.70
3,	-13.33,	-16.93,	-14.22,	-17.11,	-14.01,	-12.28,	-13.26,	-12.19,	-13.34,	-13.39,	-13.47,	-13.94,	-12.16,	-19.29,	-13.04,	-11.27

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.48	1.345	.0003	1.0344	.000E+00	.000E+00	-15.480	.410
2	-15.11	1.744	.0006	.0062	.000E+00	.000E+00	-15.109	.532
3	-13.65	1.822	.0058	.0065	.000E+00	.000E+00	-13.647	.556
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)	Variance ratio	
	.065	.920		1.80	1.80		3.816	

cont'd.

Table 3.5.4 cont'd.

Age 2	Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1		-12.91	-11.93	-11.64	-12.05	-11.96	-12.08	-11.89	-11.45	-11.44	-11.67	-12.47	-12.22	-11.93	-11.31	-12.01	-12.11
2		-13.56	-11.39	-10.87	-12.60	-11.23	-12.90	-10.35	-11.59	-12.03	-9.80	-11.53	-11.86	-16.22	-10.73	-11.84	-11.38
3		-11.15	-13.12	-10.67	-11.45	-11.36	-11.48	-11.30	-11.14	-11.50	-10.92	-11.13	-10.94	-12.36	-11.09	-11.23	-10.96

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-11.88	.292	.0093	.1484	.000E+00	.000E+00	-11.885	.089
2	-11.86	1.381	.0157	.0732	.000E+00	.000E+00	-11.860	.421
3	-11.28	.360	.0624	.0863	.000E+00	.000E+00	-11.278	.110
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
	.118	.224	.193	.224	.744			

Age 3	Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1		-10.57	-10.59	-10.45	-10.61	-10.78	-11.14	-11.09	-11.02	-9.97	-10.76	-10.44	-10.83	-10.57	-10.56	-10.14	-10.57
2		-10.70	-11.04	-10.84	-10.48	-11.34	-11.87	-10.57	-11.38	-11.13	-10.57	-11.22	-10.43	-10.86	-12.06	-11.60	-11.10
3		-9.98	-11.61	-11.10	-10.54	-11.83	-10.75	-11.58	-9.92	-10.13	-10.48	-10.73	-9.37	-10.06	-12.06	-10.66	-10.85

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-10.60	.272	.0336	.1590	.000E+00	.000E+00	-10.599	.083
2	-11.14	.425	.0322	.1570	.000E+00	.000E+00	-11.141	.130
3	-10.63	.635	.1188	.2036	.000E+00	.000E+00	-10.633	.194
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
	.163	.216	.569E-01	.216	.070			

Age 4	Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1		-10.00	-10.18	-10.23	-10.14	-10.24	-10.27	-10.84	-10.56	-10.25	-9.78	-10.77	-9.98	-10.39	-9.97	-10.19	-9.95
2		-10.82	-10.37	-10.85	-11.04	-10.08	-11.75	-10.56	-11.14	-10.24	-10.63	-10.69	-10.82	-10.54	-10.96	-10.88	-11.05
3		-10.64	-10.71	-11.02	-10.94	-10.17	-11.15	-11.44	-10.65	-10.07	-9.45	-10.40	-9.80	-9.46	-10.59	-10.57	-10.50

cont'd.

Table 3.5.4 cont'd.

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-10.23	.264	.0485	.1762	.000E+00	.000E+00	-10.233	.081
2	-10.79	.285	.0457	.3029	.000E+00	.000E+00	-10.789	.087
3	-10.31	.474	.1647	.2852	.000E+00	.000E+00	-10.307	.144
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.234		.179		.186		.186		1.073

Age 5

Fleet	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89
1	-10.15	-10.15	-10.03	-10.32	-9.89	-10.16	-10.01	-10.58	-10.17	-10.39	-9.86	-10.55	-10.08	-9.94	-9.82	-10.02
2	-10.34	-10.86	-10.35	-11.07	-10.76	-10.47	-11.52	-10.69	-11.30	-10.01	-10.17	-10.51	-10.67	-10.37	-11.01	-10.82
3	-10.21	-11.08	-9.92	-10.82	-10.47	-9.70	-11.62	-10.87	-10.79	-9.46	-9.56	-10.08	-9.75	-9.96	-10.60	-10.46

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-10.13	.212	.0540	.2221	.000E+00	.000E+00	-10.125	.065
2	-10.67	.345	.0517	.2848	.000E+00	.000E+00	-10.667	.105
3	-10.24	.488	.1769	.3080	.000E+00	.000E+00	-10.235	.149
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.245		.169		.947E-01		.169		.313

Age 6

Fleet	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89
1	-10.13	-10.13	-9.98	-10.08	-10.28	-9.86	-9.80	-10.20	-10.02	-10.43	-10.44	-9.49	-10.57	-9.66	-9.77	-9.85
2	-11.10	-10.47	-11.15	-10.37	-10.90	-11.54	-10.25	-11.34	-11.18	-11.70	-10.34	-9.45	-10.65	-10.58	-10.97	-11.10
3	-11.36	-10.48	-10.21	-9.49	-10.28	-10.56	-10.00	-11.35	-10.93	-10.80	-9.92	-9.02	-9.89	-10.18	-10.48	-10.45

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-10.02	.294	.0600	.2083	.000E+00	.000E+00	-10.020	.090
2	-10.78	.512	.0461	.3409	.000E+00	.000E+00	-10.781	.156
3	-10.26	.499	.1720	.2987	.000E+00	.000E+00	-10.264	.152
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.247		.227		.150		.227		.439

cont'd.

Table 3.5.4 cont'd.

Age 7	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
Fleet,																
1,	-9.82,	-10.00,	-10.18,	-9.91,	-9.80,	-10.17,	-9.53,	-10.04,	-9.88,	-10.14,	-10.34,	-10.11,	-9.95,	-9.82,	-9.80,	-9.90
2,	-11.22,	-11.50,	10.62,	-10.68,	-10.37,	-11.10,	-11.28,	-9.81,	-11.44,	-11.62,	-10.84,	-10.01,	-9.89,	-11.10,	-11.25,	-11.40
3,	-11.48,	-10.76,	-9.31,	-10.62,	-9.61,	-10.20,	-10.60,	-9.94,	-10.99,	-10.40,	-11.18,	-9.67,	-9.21,	-10.18,	-10.54,	-10.34

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	,	,	F	F	,	Slope	,	Intrcpt
1	-9.97	.166	.0632	.2352	.000E+00	.000E+00	-9.968	.051
2	-10.85	.530	.0429	.4342	.000E+00	.000E+00	-10.852	.162
3	-10.26	.478	.1734	.2728	.000E+00	.000E+00	-10.255	.146
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.251	.150	.119	.150	.628				

Age 8	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
Fleet,																
1,	-10.07,	-9.65,	-9.76,	-9.78,	-9.80,	-10.09,	-9.84,	-10.21,	-9.93,	-9.96,	-9.95,	-9.96,	-10.23,	-9.63,	-10.09,	-9.92
2,	-11.26,	-10.89,	-11.07,	-10.50,	-11.32,	-10.45,	-10.99,	-10.85,	-10.16,	-12.21,	-10.61,	-11.56,	-10.48,	-10.53,	-12.30,	-11.15
3,	-11.54,	-10.48,	-9.94,	-9.89,	-10.42,	-9.36,	-10.02,	-10.78,	-9.56,	-10.73,	-10.68,	-10.32,	-9.81,	-9.53,	-10.38,	-10.47

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	,	,	F	F	,	Slope	,	Intrcpt
1	-9.96	.144	.0635	.2272	.000E+00	.000E+00	-9.964	.044
2	-11.07	.582	.0345	.2560	.000E+00	.000E+00	-11.072	.177
3	-10.18	.390	.1865	.3151	.000E+00	.000E+00	-10.183	.119
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.237	.131	.741E-01	.131	.319				

Age 9	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
Fleet,																
1,	-9.74,	-9.95,	-9.64,	-9.92,	-10.03,	-10.01,	-9.88,	-10.18,	-9.86,	-10.07,	-10.01,	-10.00,	-10.71,	-10.11,	-9.83,	-9.94
2,	-11.33,	-11.09,	-10.82,	-10.48,	-10.54,	-11.53,	-10.74,	-10.48,	-11.03,	-10.79,	-11.38,	-10.79,	-10.77,	-11.33,	-12.62,	-11.83
3,	-11.67,	-10.10,	-9.60,	-9.52,	-9.58,	-10.25,	-9.22,	-10.14,	-10.45,	-9.37,	-10.47,	-10.47,	-10.88,	-10.50,	-10.71,	-10.33

cont'd.

Table 3.5.4 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-10.06	.204	.0579	.2134	.000E+00	.000E+00	-10.056	.062	
2	-11.21	.522	.0301	.4440	.000E+00	.000E+00	-11.207	.159	
3	-10.27	.415	.1712	.2550	.000E+00	.000E+00	-10.268	.126	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)	Variance ratio			
.239		.173	.161		.173	.869			

Table 3.5.5 VIRTUAL POPULATION ANALYSIS From tuning.

HERRING IN THE ARCHIPELAGO AND BOTHNIAN SEAS (BALTIC FISHING AREAS 29NE AND 30E)

FISHING MORTALITY COEFFICIENT	UNIT: Year-1					NATURAL MORTALITY COEFFICIENT = .20						
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.012	.044	.034	.036	.045	.027	.108	.035	.038	.137	.040	.045
2	.091	.093	.094	.074	.078	.052	.174	.112	.137	.150	.103	.152
3	.174	.155	.126	.142	.116	.094	.167	.164	.255	.206	.205	.169
4	.181	.191	.140	.166	.182	.143	.141	.163	.245	.297	.231	.196
5	.164	.149	.164	.161	.189	.143	.200	.146	.199	.159	.267	.276
6	.142	.143	.167	.228	.167	.156	.210	.191	.190	.177	.137	.314
7	.167	.160	.141	.189	.230	.221	.299	.170	.209	.166	.254	.219
8	.127	.220	.208	.261	.217	.204	.284	.226	.172	.219	.279	.208
9	.182	.193	.197	.203	.206	.226	.283	.274	.215	.211	.233	.213
10	.156	.173	.176	.208	.202	.190	.255	.201	.197	.186	.234	.246
11+	.156	.173	.176	.208	.202	.190	.255	.201	.197	.186	.234	.246
(2- 6)U	.150	.146	.138	.154	.146	.118	.178	.155	.205	.198	.189	.221
	1986	1987	1988	1989	1980-87							
1	.056	.039	.014	.069	.062							
2	.198	.133	.098	.118	.145							
3	.210	.192	.204	.163	.196							
4	.206	.199	.236	.234	.210							
5	.195	.207	.250	.245	.206							
6	.212	.202	.272	.247	.204							
7	.232	.235	.251	.251	.223							
8	.132	.197	.237	.237	.215							
9	.163	.151	.200	.239	.218							
10	.187	.199	.242	.244	.213							
11+	.187	.199	.242	.244	.213							
(2- 6)U	.204	.187	.212	.202								

Table 3.5.6

Title : HERRING IN BALTIC FISHING AREA 30E
 At 11.47.03 25 APRIL 1990
 from 74 to 89 on ages 1 to 10
 with Terminal F of .160 on age 3 and Terminal S of .800

Initial sum of squared residuals was 86.418 and
 final sum of squared residuals is 26.499 after 150 iterations

Matrix of Residuals

Years	74/75	75/76	76/77	77/78	78/79
Ages					
1/ 2	-1.492	.759	1.138	.223	1.467
2/ 3	-.728	-.152	.031	-.272	-.044
3/ 4	.151	.026	-.053	-.266	-.405
4/ 5	.311	-.024	.114	-.068	.123
5/ 6	.176	-.151	-.058	.053	.005
6/ 7	-.014	.055	-.134	-.115	-.308
7/ 8	-.115	-.303	-.607	-.090	.184
8/ 9	-.153	.131	.144	.704	-.008
9/10	.476	.311	.732	.569	.895

	.000	.000	.000	.000	.000
WTS	.001	.001	.001	.001	.001

Years	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	WTS	
Ages												
1/ 2	-.743	1.619	-1.077	-.628	1.328	.067	-.137	.688	.227	-.848	.000	.121
2/ 3	-.401	.207	-.763	-.314	.221	-.561	.015	.653	-.001	-.104	.000	.315
3/ 4	.211	-.428	.005	-.218	-.058	-.107	.014	.143	.066	-.115	.000	.616
4/ 5	.143	-.532	-.052	.148	-.114	.316	-.120	.037	-.110	-.124	.000	.570
5/ 6	-.234	-.005	-.242	.374	-.089	.048	-.291	.126	-.030	.147	.000	.668
6/ 7	-.016	.050	.107	-.016	-.155	.081	.039	-.183	-.023	.087	.000	1.000
7/ 8	.019	.233	.190	-.377	-.314	-.499	.029	.307	.153	.012	.000	.420
8/ 9	.017	.131	.086	-.008	.133	.403	.688	-.902	-.012	-.179	.000	.316
9/10	.587	.441	1.248	.552	.164	.088	-.012	-.519	-.082	.518	.000	.277

	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	4.871
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000	1.000	

cont'd.

Table 3.5.6 cont'd.

Fishing Mortalities (F)										
	74	75	76	77	78	79				
F-values	.0924	.0721	.0957	.1255	.1240	.0853				
	80	81	82	83	84	85	86	87	88	89
F-values	.1457	.1055	.1619	.1294	.1670	.1471	.1334	.1400	.1494	.1600
Selection-at-age (S)										
	1	2	3	4	5	6	7	8	9	10
S-values	.1207	.7230	1.0000	1.0376	.9383	.9322	.6615	.6656	.6001	.8000

Table 3.5.8 VIRTUAL POPULATION ANALYSIS

HERRING IN BALTIC FISHING AREA 30E

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .150
PROPORTION OF ANNUAL M BEFORE SPAWNING: .330

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	2967	1935	4129	1509	874	619	1552	1394	2207	2589	4029	3283
2	1938	2424	1557	3310	1221	694	504	1215	1137	1786	2044	3222
3	1176	1528	1895	1196	2572	946	552	368	958	856	1318	1554
4	1704	868	1151	1406	875	1924	735	410	274	662	619	930
5	775	1251	661	841	999	617	1431	560	300	194	453	425
6	740	573	969	495	610	713	464	1031	425	209	145	305
7	666	557	438	728	359	446	530	316	770	301	157	105
8	406	498	429	332	529	259	331	371	229	562	222	114
9	228	312	383	323	234	392	200	238	283	166	415	156
10	139	174	243	294	241	179	301	150	180	212	124	306
11+	108	298	278	294	328	402	115	236	283	148	204	173
TOTAL NO	10847	10419	12134	10728	8843	7190	6716	6289	7048	7686	9729	10574
SPS NO	5873	6133	6201	6200	6331	5503	4359	3690	3628	3316	3572	4195
TOT. BIOM	284188	288974	299687	291514	255100	229123	207444	199554	183329	214176	252044	248284
SPS BIOM	204040	212504	210757	204709	207162	193844	159795	156183	142304	146925	158108	158952

cont'd.

Table 3.5.8 cont'd.

	1986	1987	1988	1989	1990	1974-87
1	691	2294	659	5654 ¹	0	2148
2	2620	549	1842	534	4540 ²	1730
3	2347	1814	410	1367	375	1363
4	1091	1660	1303	293	952	1022
5	656	773	1183	934	203	710
6	315	468	555	835	662	533
7	211	229	337	393	596	415
8	79	150	163	243	282	322
9	81	61	113	121	179	248
10	118	63	44	85	88	195
11+	165	135	71	205	222	226
TOTAL NO	8373	8197	6680	10662		
SPS NO	5077	4830	3772	3404		
TOT.BIOM	226622	224180	219663	292238		
SPS BIOM	163588	174197	158807	169234		

¹Revised to 4,296

²Revised to 3,460

Table 3.5.9

List of input variables for the ICES prediction program.

HERRING 30E

The reference F is the mean F for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1990	2148.0
1991	2148.0
1992	2148.0

Proportion of F (fishing mortality) effective before spawning: .1500
 Proportion of M (natural mortality) effective before spawning: .3300

Data are printed in the following units:

Number of fish: millions
 Weight by age group in the catch: gram
 Weight by age group in the stock: gram
 Stock biomass: tonnes
 Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	2148.0	.02	.20	.00	12.000	12.000
2	3460.0	.15	.20	.02	23.600	23.600
3	375.0	.16	.20	.57	33.000	33.000
4	952.0	.16	.20	.78	41.100	41.100
5	203.0	.15	.20	.87	46.400	46.400
6	662.0	.14	.20	1.00	52.000	52.000
7	596.0	.13	.20	1.00	57.000	57.000
8	282.0	.12	.20	1.00	61.700	61.700
9	179.0	.11	.20	1.00	67.900	67.900
10	88.0	.10	.20	1.00	66.900	66.900
11+	222.0	.09	.20	1.00	81.300	81.300

Table 3.5.10

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

HERRING 30E

Year 1990					Year 1991					Year 1992	
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.15	290	155	32	.0	.00	291	172	0	324	204
					.1	.02	172	172	3	320	201
					.2	.03		172	7	316	198
					.4	.06		171	13	309	191
					.6	.09		170	20	302	185
					.8	.12		170	26	296	180
					1.0	.15		169	32	289	174
					1.2	.18		168	38	283	169
					1.4	.21		168	43	277	163
					1.6	.24		167	49	271	158
					1.8	.27		166	54	265	153
					2.0	.30		166	60	259	149

The data unit of the biomass and the catch is 1000 tonnes.
 The spawning stock biomass is given for the time of spawning.
 The spawning stock biomass for 1992 has been calculated with the same fishing mortality as for 1991.
 The reference F is the mean F for the age group range from 2 to 6

Table 3.5.11 Herring in Sub-division 30. Catch options in 1991 and SSB in 1992 in thousand tonnes.

	F	Catch 1991	SSB 1992
F _{med}	0.09	19	186
F ₈₉	0.15	32	174
1.2 x F ₈₉	0.18	38	169
F _{0.1}	0.26	51	156

Table 3.5.12 Herring in Sub-division 30E. Detailed perediction.

Year 1990. F-Factor 1.000 and reference F .1520						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0200	38.563	462.8	2148.00	25776	.00	0	.00	0
2	.1500	437.905	10334.6	3460.00	81656	69.20	1633	63.34	1494
3	.1600	50.387	1662.8	375.00	12375	213.75	7053	195.35	6446
4	.1600	127.917	5257.4	952.00	39127	742.56	30519	678.65	27892
5	.1500	25.692	1192.1	203.00	9419	176.61	8194	161.65	7500
6	.1400	78.568	4085.5	662.00	34424	662.00	34424	606.84	31555
7	.1300	65.993	3761.6	596.00	33972	596.00	33972	547.16	31188
8	.1200	28.960	1786.8	282.00	17399	282.00	17399	259.28	15997
9	.1100	16.930	1149.6	179.00	12154	179.00	12154	164.83	11191
10	.1000	7.603	508.6	88.00	5887	88.00	5887	81.15	5429
11+	.0900	17.344	1410.0	222.00	18048	222.00	18048	205.03	16669
Total		895.862	31611.8	9167.00	290238	3231.12	169286	2963.28	155365

 * Year 1991. F-factor 1.000 and reference F .1520 *

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0200	38.563	462.8	2148.00	25776	.00	0	.00	0
2	.1500	218.169	5148.8	1723.81	40681	34.48	813	31.56	744
3	.1600	327.614	10811.3	2438.22	80461	1389.79	45862	1270.17	41915
4	.1600	35.154	1444.8	261.63	10752	204.07	8387	186.51	7665
5	.1500	84.061	3900.4	664.19	30818	577.84	26811	528.90	24541
6	.1400	16.978	882.8	143.05	7438	143.05	7438	131.13	6818
7	.1300	52.174	2973.9	471.19	26857	471.19	26857	432.58	24657
8	.1200	44.002	2714.9	428.48	26437	428.48	26437	393.96	24307
9	.1100	19.368	1315.1	204.77	13904	204.77	13904	188.56	12803
10	.1000	11.342	758.8	131.29	8783	131.29	8783	121.07	8099
11+	.0900	18.071	1469.2	231.31	18805	231.31	18805	213.63	17368
Total		865.496	31882.8	8845.94	290716	3816.27	184102	3498.06	168920

cont'd.

Table 3.5.12 cont'd.

 * Year 1992, F-factor 1.000 and reference F .1520 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0200	38.563	462.8	2148.00	25776	.00	0	.00	0
2	.1500	218.169	5148.8	1723.81	40681	34.48	813	31.56	744
3	.1600	163.221	5386.3	1214.75	40086	692.41	22849	632.81	20882
4	.1600	228.569	9394.2	1701.09	69914	1326.85	54533	1212.65	49839
5	.1500	23.102	1071.9	182.53	8469	158.80	7368	145.35	6744
6	.1400	55.549	2888.5	468.05	24338	468.05	24338	429.05	22310
7	.1300	11.274	642.6	101.82	5803	101.82	5803	93.48	5328
8	.1200	34.788	2146.4	338.75	20900	338.75	20900	311.46	19216
9	.1100	29.429	1998.2	311.14	21126	311.14	21126	286.50	19453
10	.1000	12.976	868.1	150.19	10047	150.19	10047	138.51	9265
11+	.0900	21.120	1717.1	270.34	21978	270.34	21978	249.68	20298
Total		836.759	31724.8	8610.46	289124	3852.82	189760	3531.03	174085

Table 3.5.13 Swedish catches in the western part
of Sub-divisions 30 and 31.

Year	Sub-division	
	30	31
1977	3,610	750
1978	2,890	700
1979	1,590	785
1980	1,392	760
1981	1,270	620
1982	1,730	670
1983	2,397	696
1984	2,401	524
1985	1,885	717
1986	2,501	336
1987	1,905	320
1988	3,172	267
1989	3,242	432

Table 3.6.1 SUM OF PRODUCTS CHECK

HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)
 CATEGORY: TOTAL

CATCH IN NUMBERS	UNIT: millions											
-----	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
0	0	0	0	0	0	8	1	0	0	0	0	0
1	8	9	2	13	2	2	5	61	12	6	27	36
2	1	23	39	20	97	7	6	49	80	14	11	137
3	9	17	31	40	25	131	7	6	22	107	19	20
4	18	27	11	42	26	18	77	13	4	20	67	10
5	23	23	17	19	22	28	12	82	10	5	10	51
6	28	25	14	23	15	22	21	14	45	15	11	7
7	4	28	13	26	21	11	15	23	15	29	10	6
8	1	10	11	21	12	26	11	16	14	7	15	1
9	0	3	2	10	7	6	12	9	8	10	4	13
10	0	3	2	3	2	7	3	6	4	3	3	2
11+	0	2	1	3	1	4	2	1	5	4	2	3
TOTAL	92	168	142	219	230	268	172	279	220	217	178	287
	1985	1986	1987	1988	1989							
0	0	0	0	0	0							
1	4	4	9	8	10							
2	76	18	38	44	9							
3	117	49	27	29	19							
4	16	68	39	25	9							
5	11	12	46	39	9							
6	31	15	10	39	13							
7	5	30	13	7	13							
8	3	4	9	8	3							
9	3	5	4	6	1							
10	7	6	3	4	2							
11+	4	13	5	2	1							
TOTAL	276	224	203	211	89							

Table 3.6.2 SUM OF PRODUCTS CHECK

HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)
 CATEGORY: TOTAL

	MEAN WEIGHT AT AGE IN THE CATCH												UNIT: gram
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	
0	6.0	5.0	5.0	5.0	5.0	5.5	5.9	5.0	5.0	2.0	4.0	4.0	
1	12.6	15.0	13.0	12.2	13.3	14.8	14.5	11.9	14.1	16.0	13.0	16.1	
2	22.9	20.5	21.3	21.7	20.9	22.8	23.9	22.3	21.5	24.5	25.1	23.4	
3	30.2	28.3	30.3	29.6	29.9	31.0	32.0	31.1	29.0	31.3	34.7	35.0	
4	35.9	34.1	36.2	34.5	34.3	36.4	35.7	37.5	35.2	37.2	39.8	41.0	
5	38.7	37.9	38.8	40.1	38.4	37.8	39.0	39.7	39.7	42.3	42.9	43.8	
6	41.9	40.3	44.5	41.6	41.2	42.1	41.0	41.8	42.4	46.9	47.8	46.6	
7	44.4	42.7	45.7	44.0	44.4	43.3	45.2	43.9	45.7	48.2	52.7	53.1	
8	46.8	45.4	49.5	46.1	46.9	46.3	48.7	46.7	47.3	50.9	55.7	53.4	
9	49.8	46.5	51.6	50.5	48.0	49.7	49.6	49.3	50.7	54.7	59.0	56.7	
10	52.9	60.2	61.3	49.6	51.0	50.0	51.5	57.7	51.8	57.2	60.0	56.5	
11+	57.1	50.0	63.0	57.7	56.3	63.1	50.7	55.6	57.3	60.6	63.6	61.8	
	1985	1986	1987	1988	1989								
0	4.0	4.0	4.0	6.0	6.0								
1	13.0	12.3	14.3	9.2	13.8								
2	22.1	18.7	23.8	23.7	23.5								
3	30.7	29.4	32.4	35.2	34.0								
4	38.3	36.7	38.9	41.4	42.2								
5	43.5	41.4	44.2	45.7	47.0								
6	45.8	45.3	48.9	50.5	50.6								
7	52.2	49.0	53.5	54.6	53.3								
8	53.9	50.7	56.7	60.7	57.7								
9	57.8	59.2	59.4	59.5	65.3								
10	57.2	58.0	61.3	61.9	60.7								
11+	62.9	64.9	68.8	73.5	70.5								

Table 3.6.3

Herring Botnby VPA Tuning-module, Baltic-Pelagic WG,

103

Trapnet

1974, 1989

1,1

1,10

529,	0.2,	8.9,	10.2,	14.1,	14.1,	14.9,	17.3,	6.2,	1.9,	1.5
554,	2.2,	15.4,	19.6,	4.1,	6.1,	3.9,	4.5,	3.7,	0.9,	0.7
695,	0.4,	9.8,	16.6,	17.3,	6.1,	9.3,	10.5,	9.2,	3.8,	1.4
484,	0.6,	16.7,	5.8,	9.6,	7.4,	3.5,	6.6,	3.9,	2.5,	0.8
424,	0.0,	2.1,	25.2,	2.7,	5.3,	4.9,	3.1,	6.2,	2.2,	1.3
556,	2.8,	0.6,	1.1,	12.3,	1.6,	2.2,	2.3,	1.1,	1.5,	0.3
424,	0.8,	8.4,	0.6,	0.8,	13.2,	1.8,	2.8,	1.9,	0.9,	1.8
370,	0.4,	16.6,	3.6,	0.5,	1.0,	8.5,	1.6,	1.5,	0.9,	0.5
272,	0.1,	4.8,	17.8,	3.2,	0.8,	2.4,	3.6,	0.9,	1.1,	0.7
233,	0.8,	2.3,	2.1,	6.8,	0.6,	0.3,	0.9,	1.5,	0.4,	0.6
232,	0.8,	17.3,	3.2,	1.7,	6.6,	0.9,	0.9,	0.3,	2.0,	0.4
203,	0.3,	7.0,	14.2,	3.4,	1.5,	4.4,	0.5,	0.7,	0.6,	1.8
292,	1.3,	2.3,	4.9,	7.9,	1.1,	1.0,	2.5,	0.6,	0.3,	0.4
263,	0.1,	2.8,	2.3,	3.7,	6.5,	1.0,	0.9,	1.0,	0.4,	0.4
182,	0.0,	4.8,	1.9,	1.2,	2.1,	2.7,	0.5,	0.5,	0.6,	0.2
132,	0.0,	0.9,	2.1,	0.9,	0.6,	1.0,	0.7,	0.2,	0.1,	0.1

Bottom trawl

1974, 1989

1,1

1,10

1022,	7.3,	8.8,	3.1,	3.5,	4.1,	3.6,	2.3,	1.0,	0.8,	0.3
2004,	3.2,	16.2,	10.5,	5.9,	7.1,	5.2,	4.1,	3.7,	0.6,	0.7
2232,	15.7,	5.2,	16.2,	15.2,	8.7,	8.0,	9.6,	6.5,	2.9,	1.6
2245,	3.4,	45.9,	7.7,	9.5,	8.0,	7.0,	10.1,	6.5,	2.6,	1.5
2821,	4.0,	3.7,	54.7,	11.8,	19.1,	15.5,	7.8,	17.6,	3.7,	3.5
6419,	5.0,	5.9,	6.2,	49.2,	10.4,	16.3,	10.2,	7.1,	8.3,	2.0
7510,	43.3,	39.1,	5.0,	9.7,	56.8,	13.5,	21.9,	11.8,	5.5,	2.9
6957,	14.4,	41.1,	11.8,	2.8,	9.5,	29.9,	10.7,	9.7,	4.9,	2.2
7196,	0.0,	4.6,	71.3,	13.0,	4.6,	11.9,	27.4,	6.1,	8.4,	2.3
5573,	20.7,	10.0,	16.7,	50.7,	8.7,	8.0,	6.7,	8.7,	2.0,	0.7
5071,	36.9,	62.6,	15.2,	6.9,	25.7,	3.3,	2.6,	1.2,	8.1,	0.5
3122,	1.4,	28.3,	55.7,	10.5,	11.2,	19.2,	4.2,	1.8,	0.7,	6.6
2663,	7.0,	10.0,	31.4,	39.8,	6.1,	8.5,	17.5,	1.8,	2.7,	3.6
2546,	12.7,	26.4,	19.6,	25.7,	25.6,	5.2,	6.9,	4.9,	2.5,	1.1
2378,	7.0,	28.3,	18.3,	12.9,	23.6,	22.1,	4.7,	4.6,	3.6,	2.6
1719,	6.6,	4.1,	11.5,	5.8,	5.7,	8.5,	7.5,	2.1,	1.0,	1.0

Pelagic trawl

1974, 1989

1,1

1,10

44,	3.5,	0.4,	0.0,	0.0,	0.0,	0.0,	0.0,	0.0,	0.0,	0.0
108,	0.0,	0.0,	0.1,	0.0,	0.0,	0.0,	0.0,	0.0,	0.0,	0.0
731,	2.2,	1.3,	1.1,	1.8,	1.4,	1.6,	0.7,	0.7,	0.3,	0.2
705,	0.9,	11.9,	2.0,	2.5,	2.1,	1.8,	2.6,	1.7,	0.7,	0.4
1003,	1.0,	0.9,	13.9,	3.0,	4.9,	3.9,	2.0,	4.5,	0.9,	0.9
1056,	0.8,	0.9,	1.0,	7.9,	1.7,	2.6,	1.6,	1.1,	1.3,	0.3
1365,	20.8,	5.4,	1.4,	2.4,	2.4,	1.0,	0.3,	0.3,	0.0,	0.0
1139,	4.0,	31.4,	4.4,	0.1,	0.4,	1.7,	0.6,	0.4,	0.8,	0.9
945,	5.1,	7.3,	6.5,	1.7,	0.3,	0.3,	0.1,	0.0,	0.0,	0.0
1128,	16.8,	1.8,	1.9,	5.7,	0.9,	0.8,	1.6,	2.3,	1.1,	0.7
1542,	21.2,	34.4,	2.3,	1.5,	10.1,	2.6,	1.0,	0.0,	1.1,	0.2
1177,	6.3,	28.9,	27.1,	3.3,	2.3,	5.6,	0.7,	0.9,	0.6,	1.7
1349,	0.0,	9.2,	18.1,	23.8,	4.4,	4.1,	7.2,	1.3,	1.2,	1.3
1249,	0.9,	5.3,	6.8,	10.4,	11.9,	3.0,	2.9,	1.9,	0.7,	1.3
1217,	0.0,	4.5,	4.9,	6.4,	7.5,	8.7,	1.1,	2.3,	0.8,	0.0
879,	2.2,	3.5,	4.1,	0.8,	1.8,	2.6,	3.9,	0.6,	0.2,	0.4

Table 3.6.4 Herring in the Bothnian Bay (Sub-division 31E- Tuning analysis.

Module run at 16.57.03 24 APRIL 1990

DISAGGREGATED Qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1 ,Trapnet , has terminal q estimated as the mean

Fleet 2 ,Bottom trawl , has terminal q estimated as the mean

Fleet 3 ,Pelagic trawl , has terminal q estimated as the mean

FLEETS COMBINED BY " VARIANCE "

Regression weights

, .005, .036, .100, .193, .308, .432, .555, .670, .769, .850, .911, .954, .980, .994, .999, 1.000,

Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions

Fishing mortalities

Age,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,
1,	.020,	.009,	.013,	.009,	.016,	.022,	.086,	.062,	.032,	.036,	.069,	.016,	.019,	.024,	.053,	.071,
2,	.073,	.113,	.099,	.122,	.038,	.052,	.277,	.150,	.091,	.075,	.242,	.193,	.092,	.218,	.160,	.074,
3,	.093,	.126,	.155,	.164,	.227,	.049,	.069,	.183,	.286,	.161,	.172,	.317,	.174,	.181,	.241,	.091,
4,	.120,	.081,	.234,	.137,	.159,	.192,	.108,	.055,	.231,	.274,	.113,	.194,	.290,	.194,	.236,	.104,
5,	.189,	.097,	.178,	.181,	.203,	.143,	.305,	.110,	.089,	.166,	.331,	.164,	.201,	.307,	.282,	.118,
6,	.214,	.155,	.181,	.194,	.255,	.214,	.233,	.259,	.224,	.259,	.164,	.324,	.329,	.241,	.436,	.135,
7,	.531,	.158,	.453,	.232,	.195,	.269,	.356,	.392,	.243,	.220,	.220,	.140,	.548,	.491,	.263,	.238,
8,	.444,	.372,	.396,	.388,	.484,	.300,	.472,	.370,	.288,	.182,	.035,	.135,	.174,	.311,	.621,	.162,
9,	.215,	.162,	.677,	.215,	.317,	.409,	.409,	.429,	.436,	.242,	.223,	.089,	.337,	.248,	.319,	.135,
10,	.318,	.189,	.377,	.242,	.291,	.267,	.355,	.312,	.256,	.214,	.195,	.171,	.318,	.320,	.384,	.158,

Log catchability estimates

Age 1 Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1,	-13.93,	-11.03,	-14.35,	-12.06,	-14.82,	-10.76,	-12.83,	-12.10,	-13.12,	-12.30,	-11.93,	-12.02,	-10.85,	-13.73,	-14.13,	-13.75
2,	-10.99,	-11.94,	-11.85,	-11.86,	-11.42,	-12.63,	-11.71,	-11.45,	-16.90,	-12.22,	-11.18,	-13.21,	-11.37,	-11.16,	-10.84,	-10.52
3,	-8.58,	-14.09,	-12.70,	-12.03,	-11.77,	-12.65,	-10.74,	-10.92,	-10.43,	-10.83,	-10.55,	-10.74,	-16.55,	-13.09,	-16.03,	-10.94

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised,	SLOPE	SE	INTRCPT	SE
,	q	,	F	F	,	Slope	,	Intrcpt
1	,-12.68	, .960	, .0004	, .2058,	.000E+00,	.000E+00,	-12.678,	.293
2	,-11.98	, 1.374,	.0108	, .0163,	.000E+00,	.000E+00,	-11.979,	.419
3	,-12.28	, 1.853,	.0041	, .0186,	.000E+00,	.000E+00,	-12.277,	.565
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.071	.724	.871	.871	1.447				

cont'd.

Table 3.6.4 cont'd.

Age 2 Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1,	-9.84,	-9.42,	-9.56,	-10.04,	-10.50,	-11.51,	-9.10,	-9.39,	-9.08,	-9.62,	-8.94,	-9.35,	-10.15,	-9.71,	-9.25,	-9.79
2,	-10.51,	-10.66,	-11.36,	-10.57,	-11.83,	-11.67,	-10.43,	-11.42,	-12.40,	-11.33,	-10.74,	-10.68,	-10.89,	-9.74,	-10.05,	-10.84
3,	-10.45,	-14.43,	-11.63,	-10.76,	-12.21,	-11.74,	-10.71,	-9.88,	-9.91,	-11.44,	-10.14,	-9.69,	-10.29,	-10.63,	-11.22,	-10.33

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	, q	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt
1	-9.60	.482	.0089	.0892	.000E+00	.000E+00	-9.602	.147
2	-10.88	.600	.0325	.0714	.000E+00	.000E+00	-10.875	.183
3	-10.58	.598	.0223	.0574	.000E+00	.000E+00	-10.580	.182
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.074	.318	.130	.318	.167				

Age 3 Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1,	-9.13,	-8.85,	-9.29,	-9.44,	-9.18,	-11.22,	-11.03,	-9.42,	-8.65,	-9.48,	-9.02,	-8.57,	-9.73,	-9.76,	-9.35,	-9.48
2,	-10.98,	-10.76,	-10.48,	-10.69,	-10.30,	-11.94,	-11.78,	-11.17,	-10.54,	-10.58,	-10.54,	-9.94,	-10.09,	-9.89,	-9.66,	-10.35
3,	-12.88,	-12.49,	-12.05,	-10.88,	-10.63,	-11.96,	-11.35,	-10.35,	-10.90,	-11.16,	-11.24,	-9.68,	-9.96,	-10.23,	-10.30,	-10.71

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	, q	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt
1	-9.47	.566	.0102	.0921	.000E+00	.000E+00	-9.470	.173
2	-10.43	.520	.0505	.0835	.000E+00	.000E+00	-10.435	.159
3	-10.64	.519	.0211	.0978	.000E+00	.000E+00	-10.637	.158
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.091	.308	.473E-01	.308	.024				

Age 4 Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1,	-9.02,	-9.85,	-8.87,	-9.18,	-9.76,	-9.80,	-11.04,	-10.86,	-8.88,	-9.03,	-9.40,	-8.49,	-9.07,	-9.58,	-9.68,	-9.45
2,	-11.07,	-10.77,	-10.17,	-10.72,	-10.18,	-10.86,	-11.42,	-12.07,	-10.75,	-10.19,	-11.08,	-10.10,	-9.66,	-9.91,	-9.88,	-10.15
3,	-13.09,	-13.54,	-11.18,	-10.90,	-10.52,	-10.89,	-11.11,	-13.59,	-10.76,	-10.78,	-11.42,	-10.28,	-9.50,	-10.10,	-9.91,	-11.46

cont'd.

Table 3.6.4 cont'd.

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-9.47	.567	.0102	.1017	.000E+00	.000E+00	-9.471	.173
2	-10.43	.565	.0506	.0785	.000E+00	.000E+00	-10.434	.172
3	-10.00	.641	.0180	.2020	.000E+00	.000E+00	-10.799	.256
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio	
.104		.361	.239		.361		.437	

Age 5

Fleet	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89
1	-8.43	-9.64	-9.40	-9.00	-9.32	-10.25	-9.07	-10.43	-9.86	-10.05	-8.60	-9.10	-9.64	-8.71	-9.39	-9.72
2	-10.32	-10.78	-10.21	-10.46	-9.94	-10.83	-10.48	-11.11	-11.39	-10.55	-10.33	-9.83	-10.13	-9.61	-9.54	-10.04
3	-12.50	-13.73	-10.92	-10.63	-10.26	-10.83	-11.94	-12.47	-12.09	-11.22	-10.07	-10.43	-9.78	-9.66	-10.02	-10.52

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-9.45	.462	.0103	.1551	.000E+00	.000E+00	-9.454	.141
2	-10.25	.464	.0605	.0956	.000E+00	.000E+00	-10.254	.141
3	-10.68	.762	.0202	.1010	.000E+00	.000E+00	-10.681	.232
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio	
.118		.301	.165		.301		.299	

Age 6

Fleet	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89
1	-8.31	-9.44	-9.16	-9.26	-8.91	-10.12	-9.53	-8.94	-8.93	-10.37	-9.32	-8.40	-9.48	-9.26	-8.71	-9.45
2	-10.39	-10.43	-10.48	-10.10	-9.66	-10.56	-10.39	-10.62	-10.60	-10.26	-11.11	-9.66	-9.55	-9.88	-9.17	-9.87
3	-12.44	-13.07	-10.97	-10.30	-10.00	-10.59	-11.29	-11.67	-12.25	-10.96	-10.16	-9.91	-9.60	-9.72	-9.44	-10.39

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-9.26	.446	.0126	.1640	.000E+00	.000E+00	-9.256	.136
2	-10.07	.467	.0726	.1111	.000E+00	.000E+00	-10.072	.142
3	-10.42	.723	.0261	.1306	.000E+00	.000E+00	-10.424	.220
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio	
.135		.295	.126		.295		.184	

cont'd.

Table 3.6.4 cont'd.

Age 7 Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1,	-7.38,	-9.22,	-8.23,	-8.79,	-8.90,	-9.53,	-9.17,	-9.05,	-9.09,	-9.38,	-8.87,	-9.47,	-8.75,	-8.93,	-9.18,	-9.24
2,	-10.06,	-10.60,	9.49,	-9.90,	-9.88,	-10.49,	-9.99,	-10.09,	-10.33,	-10.55,	-10.90,	-10.08,	-9.01,	-9.16,	-9.51,	-9.43
3,	-11.66,	-13.00,	-10.99,	-10.10,	-10.20,	-10.53,	-12.58,	-11.16,	-13.92,	-10.38,	-10.66,	-10.90,	-9.22,	-9.32,	-10.29,	-9.42

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-9.11	.215	.0146	.2717	.000E+00	.000E+00	-9.108	.066	
2	-9.89	.495	.0870	.1508	.000E+00	.000E+00	-9.892	.151	
3	-10.59	1.094	.0220	.0734	.000E+00	.000E+00	-10.595	.334	
Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
.238	.194		.212		.212		1.193		

Age 8 Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1,	-7.52,	-8.36,	-8.31,	-8.28,	-8.22,	-9.82,	-8.94,	-9.15,	-8.83,	-9.45,	-10.20,	-8.66,	-9.35,	-8.97,	-8.45,	-9.41
2,	-10.00,	-9.64,	-9.82,	-9.31,	-9.07,	-10.40,	-9.99,	-10.22,	-10.19,	-10.86,	-11.89,	-10.45,	-10.46,	-9.65,	-8.80,	-9.62
3,	-10.77,	-11.94,	-10.94,	-9.49,	-9.40,	-10.46,	-11.95,	-11.60,	-13.88,	-10.60,	-14.80,	-10.17,	-10.11,	-9.89,	-8.83,	-10.21

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-9.12	.448	.0145	.2176	.000E+00	.000E+00	-9.116	.136	
2	-10.15	.679	.0674	.0963	.000E+00	.000E+00	-10.146	.207	
3	-10.95	1.480	.0154	.0770	.003E+00	.000E+00	-10.952	.451	
Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
.162	.362		.289		.362		.637		

Age 9 Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1,	-8.39,	-9.03,	-7.90,	-8.79,	-8.22,	-9.31,	-9.25,	-8.95,	-8.60,	-9.07,	-8.80,	-9.16,	-9.49,	-9.29,	-8.65,	-9.19
2,	-9.91,	-10.72,	-9.34,	-10.28,	-9.59,	-10.05,	-10.31,	-10.19,	-9.84,	-10.63,	-10.49,	-11.74,	9.51,	-9.73,	-9.43,	-9.46
3,	-10.46,	-11.21,	-10.49,	-10.44,	-9.97,	-10.09,	-14.22,	-10.19,	-13.85,	-9.63,	-11.29,	-10.92,	-9.64,	-10.29,	-10.26,	-10.39

cont'd.

Table 3.6.4 cont'd.

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-9.02	.279	.0160	.1600	.000E+00	.000E+00	-9.018	.085
2	-10.09	.576	.0715	.0715	.000E+00	.000E+00	-10.088	.176
3	-10.82	1.145	.0176	.0881	.000E+00	.000E+00	-10.818	.349
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.134		.246		.228		.246		.862

Table 3.6.5 VIRTUAL POPULATION ANALYSIS From tuning.

HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)

FISHING MORTALITY COEFFICIENT	UNIT: Year-1					NATURAL MORTALITY COEFFICIENT = .15						
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.020	.009	.013	.009	.016	.022	.086	.062	.032	.036	.069	.016
2	.073	.113	.099	.122	.038	.052	.277	.150	.091	.075	.242	.193
3	.093	.126	.155	.164	.227	.049	.069	.183	.286	.161	.172	.317
4	.120	.081	.234	.137	.159	.192	.108	.055	.231	.274	.113	.194
5	.189	.097	.178	.181	.203	.143	.305	.110	.089	.166	.331	.164
6	.214	.155	.181	.194	.255	.214	.233	.259	.224	.259	.164	.324
7	.531	.158	.453	.232	.195	.269	.356	.392	.243	.220	.220	.140
8	.444	.372	.396	.388	.484	.300	.472	.370	.288	.182	.035	.135
9	.215	.162	.677	.215	.317	.409	.409	.429	.436	.242	.223	.089
10	.318	.189	.377	.242	.291	.267	.355	.312	.256	.214	.195	.171
11+	.318	.189	.377	.242	.291	.267	.355	.312	.256	.214	.195	.171
(2- 6)U	.138	.114	.169	.159	.177	.130	.198	.151	.184	.187	.204	.238
	1986	1987	1988	1989	1980-87							
1	.019	.024	.053	.071	.043							
2	.092	.218	.160	.074	.167							
3	.174	.181	.241	.091	.193							
4	.290	.194	.236	.104	.182							
5	.201	.307	.282	.118	.209							
6	.329	.241	.436	.135	.254							
7	.548	.491	.263	.238	.326							
8	.174	.311	.621	.162	.246							
9	.337	.248	.319	.134	.302							
10	.318	.320	.384	.158	.267							
11+	.318	.320	.384	.158	.267							
(2- 6)U	.217	.228	.271	.104								

Table 3.6.6

Title : HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)
 At 18.27.22 24 APRIL 1990
 from 74 to 89 on ages 1 to 10
 with Terminal F of .100 on age 3 and Terminal S of .700

Initial sum of squared residuals was 77.976 and
 final sum of squared residuals is 27.820 after 142 iterations

Matrix of Residuals

Years	74/75	75/76	76/77	77/78	78/79							
Ages												
1/ 2	-.428	-.264	-.862	.211	.185							
2/ 3	-.679	.479	-.527	-.335	-.317							
3/ 4	-.192	.037	-.070	.122	.071							
4/ 5	.021	-.060	.244	-.177	.067							
5/ 6	.071	.114	-.121	-.078	-.034							
6/ 7	.104	-.267	-.353	.151	-.068							
7/ 8	.151	-.408	.002	-.693	-.732							
8/ 9	1.074	.561	.762	.672	.491							
9/10	.065	.050	1.334	.045	.319							
	.000	.000	.000	.000	.000							
WTS	.001	.001	.001	.001	.001							
Years	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89		WTS
Ages												
1/ 2	-.501	.877	1.212	.568	-.457	.582	.008	-.770	-.194	.374	.000	.327
2/ 3	.185	.448	-.410	-.576	-.889	-.004	.480	-.485	.210	-.197	.000	.445
3/ 4	-.502	-.100	-.184	.008	.123	-.133	.401	-.049	-.163	-.056	.000	1.000
4/ 5	.121	-.165	-.441	.334	-.138	-.312	.283	.236	-.124	-.082	.000	.877
5/ 6	.038	.184	-.592	-1.096	-.069	.274	-.332	.033	.033	-.006	.000	.579
6/ 7	.022	-.562	.186	-.041	.066	.144	-.061	-.088	.099	-.094	.000	.958
7/ 8	-.207	-.284	.263	-.037	1.378	.238	-.279	.660	-.007	-.611	.000	.362
8/ 9	.450	.363	.266	.321	-.185	-.893	-.486	-.075	.395	1.054	.000	.369
9/10	.917	.430	.877	.908	.238	.441	-.897	.438	-.040	.053	.000	.373
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	4.086	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		
Fishing Mortalities (F)												
F-values	74	75	76	77	78	79						
	.0815	.0630	.1217	.1058	.1207	.1084						
F-values	80	81	82	83	84	85	86	87	88	89		
	.1690	.1472	.1589	.1475	.1275	.1301	.1650	.1888	.2277	.1000		
Selection-at-age (S)												
S-values	1	2	3	4	5	6	7	8	9	10		
	.1971	.9116	1.0000	.9139	.9346	.9584	.9007	.6359	.6721	.7000		

Table 3.6.7 VIRTUAL POPULATION ANALYSIS

HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .15

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.014	.007	.011	.008	.011	.019	.068	.044	.026	.026	.060	.016
2	.047	.078	.082	.102	.033	.036	.230	.116	.064	.061	.171	.163
3	.060	.078	.102	.133	.184	.042	.046	.146	.209	.109	.135	.205
4	.066	.050	.135	.086	.125	.149	.092	.036	.176	.185	.073	.147
5	.083	.051	.105	.095	.119	.108	.222	.092	.057	.121	.201	.101
6	.088	.062	.088	.105	.120	.114	.168	.174	.182	.156	.113	.170
7	.136	.058	.149	.101	.096	.110	.165	.257	.149	.171	.119	.092
8	.109	.067	.121	.095	.171	.130	.153	.139	.165	.102	.026	.068
9	.057	.031	.078	.053	.058	.106	.143	.100	.126	.123	.114	.066
10	.057	.043	.059	.018	.059	.039	.068	.085	.045	.048	.088	.079
11+	.057	.043	.059	.018	.059	.039	.068	.085	.045	.048	.088	.079
(2- 6)U	.069	.054	.102	.104	.116	.090	.152	.113	.138	.126	.139	.157
	1986	1987	1988	1989	1980-87							
1	.018	.029	.055	.020	.036							
2	.092	.210	.195	.077	.138							
3	.142	.181	.231	.114	.147							
4	.166	.153	.236	.098	.129							
5	.145	.153	.211	.118	.136							
6	.183	.162	.178	.096	.164							
7	.230	.224	.162	.078	.176							
8	.108	.099	.203	.092	.108							
9	.149	.142	.081	.033	.120							
10	.223	.116	.190	.033	.094							
11+	.223	.116	.190	.033	.094							
(2- 6)U	.146	.172	.210	.101								

Table 3.6.8 VIRTUAL POPULATION ANALYSIS

HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)

STOCK SIZE IN NUMBERS

UNIT: millions

BIOMASS TOTALS

UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .150
 PROPORTION OF ANNUAL M BEFORE SPAWNING: .400

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	657	316	1261	266	202	302	985	297	244	1120	672	267
2	540	557	270	1074	227	172	255	791	245	204	939	545
3	308	443	444	214	835	189	143	174	607	198	165	682
4	445	250	353	345	161	598	156	117	130	424	152	124
5	311	359	205	265	273	122	443	123	97	94	303	122
6	313	246	294	159	208	208	95	306	96	79	71	213
7	236	247	199	231	123	158	160	69	221	69	58	55
8	100	177	200	148	180	96	122	117	46	164	50	45
9	66	77	143	153	116	131	73	90	87	33	127	42
10	60	54	64	114	125	94	101	54	70	66	25	98
11+	33	26	53	36	74	51	13	70	85	39	41	57
TOTAL NO	3069	2752	3485	3004	2522	2122	2546	2209	1928	2490	2606	2249
SPS NO	1881	1894	1864	1849	1957	1558	1267	1258	1367	1119	1153	1374
TOT. BIOM	92183	92288	98417	93280	89253	74953	72130	68278	69279	72407	78391	73141
SPS BIOM	68903	73985	72435	68717	75130	62130	51715	48194	55526	49564	47268	53817

	1986	1987	1988	1989	1990	1974-87
1	257	319	160	552	0	512
2	226	217	267	130	466	447
3	399	178	151	189	104	356
4	478	298	128	103	145	288
5	92	348	220	87	81	226
6	95	69	257	153	66	175
7	155	68	50	185	120	146
8	43	106	47	37	147	114
9	36	33	83	33	29	86
10	34	27	25	66	27	70
11+	68	50	12	33	82	50
TOTAL NO	1883	1712	1400	1567		
SPS NO	1311	1141	980	820		
TOT. BIOM	63067	62522	54390	53721		
SPS BIOM	51049	49947	44719	39880		

Table 3.6.9
 List of input variables for the ICES prediction program.

HERRING 31E

The reference F is the mean F for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1990	512.0
1991	512.0
1992	512.0

Proportion of F (fishing mortality) effective before spawning: .1500

Proportion of M (natural mortality) effective before spawning: .4000

Data are printed in the following units:

Number of fish: millions
 Weight by age group in the catch: gram
 Weight by age group in the stock: gram
 Stock biomass: tonnes
 Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	512.0	.02	.15	.00	13.800	13.800
2	466.0	.08	.15	.03	23.500	23.500
3	104.0	.10	.15	.96	34.000	34.000
4	145.0	.10	.15	1.00	42.200	42.200
5	81.0	.10	.15	1.00	47.000	47.000
6	66.0	.10	.15	1.00	50.600	50.600
7	120.0	.09	.15	1.00	53.300	53.300
8	147.0	.08	.15	1.00	57.700	57.700
9	29.0	.07	.15	1.00	65.300	65.300
10	27.0	.06	.15	1.00	60.700	60.700
11+	82.0	.05	.15	1.00	70.500	70.500

Table 3.6.10

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

HERRING 31E

Year 1990					Year 1991					Year 1992		
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass	
1.0	.10	59	38	4	.0	.00	65	45	0	75	54	
					.1	.01		45	0	75	54	
					.2	.02		45	1	74	53	
					.4	.04		45	2	73	52	
					.6	.06		45	3	72	51	
					.8	.08		45	4	71	50	
					1.0	.10		44	4	70	49	
					1.2	.12		44	5	70	48	
					1.4	.13		44	6	69	47	
					1.6	.15		44	7	68	47	
					1.8	.17		44	8	67	46	
					2.0	.19		44	9	66	45	

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for the time of spawning.

The spawning stock biomass for 1992 has been calculated with the same fishing mortality as for 1991.

The reference F is the mean F for the age group range from 2 to 6

Table 3.6.11 HERRING in Sub-division 31E. Catch and spawning stock options in thousand tonnes.

	F	Catch 1991	SSB 1992
F _{med}	0.058	3	51
F ₈₉	0.096	4	49
F ₈₈	0.200	9	44
F ₀	0.218	10	44

Table 3.6.12

16.31.20 25 APRIL 1990
HERRING 31E

Detailed prediction

* Year 1990, F-factor 1.000 and reference F .0960 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0200	9.417	129.95	512.00	7065.6	.000	.0	.000	.0
2	.0800	33.303	782.63	466.00	10951.0	13.980	328.5	13.009	305.7
3	.1000	9.202	312.86	104.00	3536.0	99.840	3394.6	92.626	3149.3
4	.1000	12.830	541.41	145.00	6119.0	145.000	6119.0	134.523	5676.9
5	.1000	7.167	336.84	81.00	3807.0	81.000	3807.0	75.147	3531.9
6	.1000	5.840	295.49	66.00	3339.6	66.000	3339.6	61.231	3098.3
7	.0900	9.602	511.77	120.00	6396.0	120.000	6396.0	111.496	5942.8
8	.0800	10.506	606.17	147.00	8481.9	147.000	8481.9	136.788	7892.7
9	.0700	1.822	118.99	29.00	1893.7	29.000	1893.7	27.026	1764.8
10	.0600	1.461	88.70	27.00	1638.9	27.000	1638.9	25.200	1529.6
11+	.0500	3.716	261.98	82.00	5781.0	82.000	5781.0	76.648	5403.7
Total		104.865	3986.79	1779.00	59009.7	810.820	41180.2	753.694	38295.6

* Year 1991, F-factor 1.000 and reference F .0960 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0200	9.417	129.95	512.00	7065.6	.00	.0	.000	.0
2	.0800	30.870	725.46	431.96	10151.0	12.96	304.5	12.058	283.4
3	.1000	32.760	1113.83	370.25	12588.6	355.44	12085.0	329.760	11211.8
4	.1000	7.166	302.42	81.00	3418.0	81.00	3418.0	75.143	3171.0
5	.1000	9.992	469.61	112.93	5307.5	112.93	5307.5	104.766	4924.0
6	.1000	5.582	282.43	63.08	3192.0	63.08	3192.0	58.525	2961.4
7	.0900	4.113	219.21	51.40	2739.7	51.40	2739.7	47.758	2545.5
8	.0800	6.746	389.25	94.40	5446.6	94.40	5446.6	87.838	5068.2
9	.0700	7.339	479.23	116.80	7626.8	116.80	7626.8	108.846	7107.6
10	.0600	1.260	76.45	23.27	1412.7	23.27	1412.7	21.721	1318.5
11+	.0500	4.034	284.41	89.02	6276.0	89.02	6276.0	83.211	5866.4
Total		119.278	4472.26	1946.10	65224.5	1000.29	47808.9	929.626	44457.9

cont'd.

Table 3.5.12 cont'd.

 * Year 1992. F-factor 1.000 and reference F .0960 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0200	9.417	129.95	512.00	7065.6	.00	.0	.00	.0
2	.0800	30.870	725.46	431.96	10151.0	12.96	304.5	12.06	283.4
3	.1000	30.367	1032.46	343.20	11668.9	329.48	11202.2	305.67	10392.7
4	.1000	25.513	1076.67	288.35	12168.5	288.35	12168.5	267.52	11289.2
5	.1000	5.581	262.32	63.08	2964.7	63.08	2964.7	58.52	2750.5
6	.1000	7.782	393.74	87.95	4450.1	87.95	4450.1	81.59	4128.6
7	.0900	3.931	209.52	49.13	2618.6	49.13	2618.6	45.65	2433.0
8	.0800	2.890	166.73	40.43	2333.0	40.43	2333.0	37.62	2170.9
9	.0700	4.713	307.74	75.00	4897.5	75.00	4897.5	69.89	4564.1
10	.0600	5.073	307.91	93.73	5689.5	93.73	5689.5	87.48	5310.2
11+	.0500	4.158	293.13	91.75	6468.3	91.75	6468.3	85.76	6046.1
Total		130.294	4905.63	2076.58	70475.8	1131.86	53097.0	1051.77	49368.8

Table 3.7.1 SUM OF PRODUCTS CHECK

HERRING IN THE GULF OF FINLAND (FISHING AREA 32)
 CATEGORY: TOTAL

	CATCH IN NUMBERS											
	UNIT: millions											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	0	17	7	14	23	24	11	19	78	36	62	57
1	166	673	147	237	334	120	670	223	285	122	379	350
2	191	256	742	450	507	359	267	921	177	287	325	658
3	1114	187	224	957	357	259	308	211	630	166	254	202
4	183	654	141	140	613	200	197	154	108	392	78	120
5	80	79	221	82	69	334	95	84	85	67	179	35
6	133	51	25	99	41	31	246	107	74	41	24	80
7	17	74	14	14	87	20	21	56	35	30	20	12
8	27	18	47	4	7	52	16	12	90	20	26	16
9	17	15	6	8	8	6	34	10	8	41	3	9
10+	5	21	7	3	21	8	12	31	24	18	36	22
TOTAL	1933	2045	1581	2008	2067	1413	1877	1828	1594	1220	1386	1561
	1982	1983	1984	1985	1986	1987	1988	1989				
0	65	28	58	26	43	9	59	61				
1	404	243	353	518	111	469	56	272				
2	724	759	495	926	675	148	1086	92				
3	145	512	411	253	650	304	143	653				
4	64	191	314	142	170	266	180	84				
5	43	36	105	118	92	94	147	100				
6	8	18	28	36	67	67	45	97				
7	26	8	16	10	19	53	39	31				
8	2	15	8	5	7	17	24	20				
9	3	2	13	3	5	7	12	14				
10+	9	8	7	12	3	7	5	8				
TOTAL	1493	1820	1808	2049	1842	1441	1796	1432				

Table 3.7.2 SUM OF PRODUCTS CHECK

HERRING IN THE GULF OF FINLAND (FISHING AREA 32)
 CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH

UNIT: gram

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	7.300	7.300	7.300	7.300	7.300	7.300	6.500	6.100	5.400	5.000	7.400	6.700
1	11.900	11.900	11.900	11.900	11.900	11.900	10.800	13.600	15.900	14.800	15.900	13.500
2	19.500	19.500	19.500	19.500	19.500	19.500	19.400	20.300	23.000	24.900	24.300	23.300
3	23.700	23.700	23.700	23.700	23.700	23.700	24.200	28.300	29.700	30.700	32.900	31.200
4	27.500	27.500	27.500	27.500	27.500	27.500	30.000	32.700	34.500	38.600	40.800	41.500
5	32.200	32.200	32.200	32.200	32.200	32.200	32.100	36.900	40.200	42.900	46.500	53.400
6	36.500	36.500	36.500	36.500	36.500	36.500	38.800	41.000	41.700	44.800	51.200	60.000
7	42.500	42.500	42.500	42.500	42.500	42.500	43.700	44.200	44.000	45.900	53.000	70.700
8	44.600	44.600	44.600	44.600	44.600	44.600	47.900	49.900	54.100	53.900	61.000	68.500
9	48.200	48.200	48.200	48.200	48.200	48.200	54.800	48.600	53.800	58.800	64.100	75.700
10+	52.200	52.200	52.200	52.200	52.200	52.200	51.600	67.900	62.700	67.800	78.300	79.900

	1982	1983	1984	1985	1986	1987	1988	1989
0	6.100	6.600	7.100	5.900	6.200	5.700	6.400	6.000
1	16.900	15.200	13.400	14.000	14.000	12.500	12.200	15.500
2	21.400	21.900	19.100	16.400	17.900	20.500	16.500	19.700
3	30.400	33.100	29.300	22.900	22.400	25.900	25.500	22.000
4	41.400	41.100	40.400	34.500	29.500	31.100	32.300	29.600
5	48.900	53.000	42.600	46.000	39.600	41.200	37.100	36.900
6	66.400	59.500	54.100	57.700	55.900	53.200	45.800	42.200
7	60.500	73.700	72.500	63.300	63.400	69.600	59.500	47.900
8	70.600	71.700	75.200	75.900	82.000	74.800	72.600	65.600
9	97.900	65.700	83.400	79.700	83.800	90.500	66.700	77.300
10+	80.200	110.300	70.400	93.800	100.100	106.700	103.600	96.900

Table 3.7.3 Herring in Sub-division 33. Tuning analysis.

Module run at 11.33.25 26 APRIL 1999

0. SAGGREGATED as

LOG TRANSFORMATION

10 explanatory variate (None used)

Fleet 1 USSR, Pelagic trawl , has terminal q estimated as the mean

Fleet 2 SF Trawl , has terminal q estimated as the mean

Fleet 3 SF Bottom trawl , has terminal q estimated as the mean

Fleet 4 SF Pelagic trawl , has terminal q estimated as the mean

FLEETS COMBINED BY ** VARIANCE **

Regression weights

.036, .193, .432, .670, .850, .754, .994, 1.000,

Oldest age F = 1.000*average of 4 younger ages. Fleets combined by variance of predictions

Fishing mortalities

Age	82	83	84	85	86	87	88	89
0	.022	.005	.014	.016	.005	.010	.011	.012
1	.143	.199	.174	.168	.086	.074	.079	.064
2	.513	.431	.356	.279	.342	.158	.244	.181
3	.132	.382	.440	.287	.323	.254	.225	.227
4	.235	.385	.428	.267	.319	.212	.235	.200
5	.328	.257	.379	.282	.277	.293	.174	.128
6	.147	.222	.326	.215	.256	.334	.222	.166
7	.256	.214	.313	.185	.168	.331	.331	.235
8	.158	.241	.343	.152	.190	.223	.245	.282
9	.224	.233	.340	.208	.223	.295	.243	.220

Log catchability estimates

Age	82	83	84	85	86	87	88	89
Fleet 1	-.13.72	-.14.45	-.13.93	-.13.15	-.14.20	-.14.44	-.14.27	-.14.27
Fleet 2	No data for this fleet at this age							
Fleet 3	-.16.27	-.17.66	-.14.43	-.12.94	-.17.91	-.15.97	-.18.22	-.15.42
Fleet 4	-.14.34	-.15.00	-.13.46	-.13.49	-.14.57	-.15.58	-.12.87	-.12.54

cont'd.

Table 3.7.3 cont'd.

SUMMARY STATISTICS									
Fleet	Prod.	SE(a)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	F		F	F		Slope		Intrcpt	
1	-14.11	.379	.0027	.0136	.000E+00	.000E+00	-14.100	.153	
2	No data for this fleet at this age								
3	-15.79	1.843	.0000	.0080	.000E+00	.000E+00	-15.779	.744	
4	-15.81	1.044	.0027	.0032	.000E+00	.000E+00	-15.814	.422	
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio	
.011		.350		.323		.350		.351	

Age 1								
Fleet	32	33	34	35	36	37	38	39
1	-10.31	-11.00	-11.45	-10.53	-11.15	-11.48	-11.27	-11.29
2	-13.81	-14.34	-16.86	-15.76	-14.25	-18.47	-16.29	-16.41
3	-12.93	-9.67	-12.88	-12.15	-16.03	-12.89	-13.69	-13.26
4	-13.00	-12.08	-12.54	-11.56	-12.12	-13.27	-11.55	-11.41

SUMMARY STATISTICS									
Fleet	Prod.	SE(a)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	F		F	F		Slope		Intrcpt	
1	-11.20	.243	.0347	.0677	.000E+00	.000E+00	-11.202	.106	
2	-16.26	1.251	.0000	.0741	.000E+00	.001E+00	-16.257	.575	
3	-13.35	1.341	.0005	.0586	.000E+00	.000E+00	-13.346	.542	
4	-12.05	.638	.0160	.0336	.000E+00	.001E+00	-12.053	.253	
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio	
.063		.235		.145		.235		.391	

Age 2								
Fleet	32	33	34	35	36	37	38	39
1	-10.14	-7.53	-7.30	-9.99	-9.83	-10.36	-9.95	-10.74
2	-10.53	-10.67	-11.36	-11.53	-11.19	-10.31	-11.60	-9.03
3	-12.72	-10.67	-11.20	-11.53	-10.28	-11.24	-12.05	-11.47
4	-12.17	-12.13	-11.75	-11.14	-11.00	-11.44	-11.01	-11.35

cont'd.

*p4u00

SUMMARY STATISTICS									
Fleet	Pred.	SE(n)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	F		F	F		Slope		Intrcpt	
1	-10.09	.282	.1115	.1902	.000E+00	.000E+00	-10.089	.114	
2	-10.73	.896	.0368	.0329	.000E+00	.000E+00	-10.732	.362	
3	-11.38	.556	.0737	.1986	.000E+00	.000E+00	-11.378	.225	
4	-11.29	.277	.0343	.1926	.000E+00	.000E+00	-11.286	.112	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	.179	.132	.203	.203	1.242				

Age 3

Fleet. 32, 33, 34, 35, 36, 37, 38, 39

1	-9.85	-10.10	-9.30	-10.31	-9.92	-10.10	-10.23	-9.83
2	-9.24	-9.16	-9.41	-9.51	-9.60	-9.13	-9.23	-9.67
3	-11.73	-11.33	-11.30	-11.51	-10.94	-16.56	-10.98	-10.96
4	-12.79	-11.30	-11.31	-10.94	-11.00	-10.50	-11.19	-10.81

SUMMARY STATISTICS									
Fleet	Pred.	SE(n)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	F		F	F		Slope		Intrcpt	
1	-10.06	.207	.1154	.1874	.000E+00	.000E+00	-10.055	.084	
2	-9.43	.199	.0250	.2889	.000E+00	.000E+00	-9.433	.080	
3	-12.14	1.988	.0715	.0700	.000E+00	.000E+00	-12.140	.803	
4	-10.94	.262	.0484	.1983	.000E+00	.000E+00	-10.944	.106	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	.225	.125	.124	.125	.991				

Age 4

Fleet. 32, 33, 34, 35, 36, 37, 38, 39

1	-10.54	-9.82	-10.45	-10.51	-10.02	-10.52	-10.45	-10.20
2	-8.52	-9.04	-9.14	-8.93	-8.82	-8.93	-8.76	-8.81
3	-11.34	-10.57	-11.53	-11.06	-10.54	-10.94	-11.16	-11.22
4	-11.19	-11.24	-10.84	-11.16	-10.57	-10.79	-11.10	-11.17

Table 3.7.3 cont'd.

SUMMARY STATISTICS									
Fleet	Prod.	SE(n)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	1		F	F		Slope		Intrcpt	
1	-10.33	.195	.0779	.1758	.000E+00	.000E+00	-10.327	.079	
2	-8.98	.108	.0436	.1957	.000E+00	.000E+00	-8.897	.044	
3	-11.02	.271	.0046	.2428	.000E+00	.000E+00	-11.022	.109	
4	-11.96	.216	.0476	.2470	.000E+00	.000E+00	-10.959	.087	
Fbar		SIGMA(int.)	SIGMA(ext.)			SIGMA(overall)	Variance ratio		
	.197	.325E-01	.727E-01			.825E-11	.777		

Age 5

Fleet	82	83	84	85	86	87	88	89
1	-10.50	-10.47	-10.05	-11.09	-10.23	-10.49	-11.73	-10.46
2	-7.35	-9.33	-9.10	-8.81	-8.79	-8.39	-8.09	-8.71
3	-10.71	-11.16	-11.51	-10.50	-10.81	-10.27	-10.77	-10.71
4	-10.25	-10.90	-11.17	-10.53	-10.76	-10.21	-10.98	-10.84

SUMMARY STATISTICS									
Fleet	Prod.	SE(n)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	1		F	F		Slope		Intrcpt	
1	-10.60	.349	.0666	.1708	.000E+00	.000E+00	-10.605	.141	
2	-8.74	.223	.0490	.1910	.000E+00	.000E+00	-8.745	.090	
3	-10.72	.300	.0062	.1948	.000E+00	.000E+00	-10.726	.121	
4	-10.70	.305	.0616	.2272	.000E+00	.000E+00	-10.715	.122	
Fbar		SIGMA(int.)	SIGMA(ext.)			SIGMA(overall)	Variance ratio		
	.396	.141	.510E-01			.141	.135		

Age 6

Fleet	82	83	84	85	86	87	88	89
1	-11.33	-11.65	-10.79	-11.41	-11.07	-10.17	-10.00	-10.83
2	-7.07	-7.61	-8.15	-8.50	-9.12	-9.30	-8.25	-9.00
3	-10.23	-10.64	-10.35	-10.90	-10.48	-11.09	-10.64	-10.40
4	-10.05	-10.07	-10.24	-11.02	-10.50	-10.28	-11.33	-10.72

Table 3.7.3 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(a)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	F		F	F		Slope		Intrcpt	
1	-10.85	.355	.0523	.1033	.000E+00	.000E+00	-10.847	.144	
2	-8.54	.402	.0617	.1261	.000E+00	.000E+00	-8.543	.162	
3	-10.67	.243	.0063	.1380	.000E+00	.000E+00	-10.675	.098	
4	-10.76	.369	.0582	.1594	.000E+00	.000E+00	-10.759	.149	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	.163	.161	.127	.161	.622				

Age 7

Fleet	82	83	84	85	86	87	88	89
1	-11.25	-11.25	-11.12	-12.37	-11.12	-10.84	-10.57	-10.58
2	-7.31	-7.01	-7.43	-7.65	-9.31	-8.58	-7.91	-8.14
3	-10.33	-12.57	-10.74	-11.77	-11.34	-11.33	-12.00	-10.53
4	-10.19	-9.53	-9.74	-10.25	-11.05	-10.19	-10.78	-10.93

SUMMARY STATISTICS									
Fleet	Pred.	SE(a)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	F		F	F		Slope		Intrcpt	
1	-11.02	.539	.0442	.1521	.000E+00	.000E+00	-11.016	.218	
2	-8.29	.598	.0862	.2202	.000E+00	.000E+00	-8.197	.237	
3	-10.88	.691	.0053	.1653	.000E+00	.000E+00	-10.820	.279	
4	-10.55	.429	.0728	.1347	.000E+00	.000E+00	-10.535	.175	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	.230	.269	.205	.269	.582				

Age 8

Fleet	82	83	84	85	86	87	88	89
1	-11.70	-10.74	-11.43	-11.37	-11.25	-10.58	-11.73	-11.76
2	-6.32	-7.23	-5.74	-7.15	-7.76	-8.13	-7.73	-7.84
3	-9.32	-13.00	-7.95	-10.53	-7.81	-12.20	-10.30	-10.42
4	-9.18	-9.61	-8.71	-9.83	-10.62	-10.98	-11.36	-10.30

cont'd.

Table 3.7.3 cont'd.

SUMMARY STATISTICS									
Fleet	Prod.	SE(0)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	"1		F	F		Slope		Intrcpt	
1	-11.25	.419	.0343	.2523	.000E+00	.000E+00	-11.253	.169	
2	-7.65	.388	.1497	.3481	.000E+00	.000E+00	-7.643	.157	
3	-10.69	.873	.0064	.2141	.000E+00	.000E+00	-10.693	.352	
4	-10.47	.702	.0774	.2581	.000E+00	.000E+00	-10.473	.283	
Ebar		STGMA(int.)		STGMA(ext.)		STGMA(overall)		Variance ratio	
	.278	.253		.115		.253		.207	

Table 3.7.4

Title : HERRING IN THE GULF OF FINLAND (FISHING AREA 32)
 At 10.15.25 25 APRIL 1990
 from 70 to 89 on ages 1 to 9
 with Terminal F of .230 on age 3 and Terminal S of .800

Initial sum of squared residuals was 47.246 and
 final sum of squared residuals is 20.150 after 61 iterations

Matrix of Residuals

Years Ages	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79
1/ 2	.290	.336	-.474	.034	.507	.011	.258	.912	.642
2/ 3	-.430	-.620	-.761	-.121	.089	-.185	-.363	-.109	-.472
3/ 4	.022	-.532	-.093	.037	-.061	-.121	.036	.122	-.122
4/ 5	.247	.185	-.106	.215	-.119	.266	.111	-.037	-.202
5/ 6	-.150	-.240	-.139	.186	.059	-.185	-.871	-.513	.045
6/ 7	-.148	.547	.074	-.271	.137	.056	.890	.638	.382
7/ 8	-.543	-.341	.697	.295	-.115	-.159	-.079	-1.001	-.009
8/ 9	.164	.367	1.277	-1.031	-.414	.104	-1.106	-.059	.281

	.008	.007	.006	.005	.004	.003	.003	.002	.002
--	------	------	------	------	------	------	------	------	------

WTS	.100	.100	.100	.100	.100	.100	.100	.100	.100
-----	------	------	------	------	------	------	------	------	------

Years Ages	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	WTS	
1/ 2	-.413	.013	-.691	.226	.103	-.665	.456	.364	-.165	.149	.001	.355
2/ 3	-.511	-.161	.352	.089	.293	-.183	-.035	.339	-.397	.052	.000	.475
3/ 4	.060	.052	-.071	-.586	.114	.153	-.044	.382	.042	.025	.001	.697
4/ 5	.006	.021	-.285	.179	-.138	-.021	-.095	-.007	.022	-.009	.001	1.000
5/ 6	.246	.022	.150	.452	-.225	.051	.011	-.309	.138	-.210	.001	.503
6/ 7	.103	.076	-.034	-.267	-.204	.169	.235	-.240	.093	-.103	.001	.496
7/ 8	-.519	-.441	.582	.233	-.371	.252	-.077	-.414	.293	.141	.000	.361
8/ 9	1.299	.460	.529	-.258	-.167	.131	-.395	-.466	-.092	.071	.001	.273

	.001	.001	.000	.000	-.001	-.001	-.001	-.001	.000	.000	.538
--	------	------	------	------	-------	-------	-------	-------	------	------	------

WTS	.100	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
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Fishing Mortalities (F)

F-values	70	71	72	73	74	75	76	77	78	79
	.4474	.4910	.3887	.3710	.4182	.3762	.4467	.4333	.4740	.5141

F-values	80	81	82	83	84	85	86	87	88	89
	.5178	.5220	.2799	.3350	.3987	.2714	.2761	.2606	.2498	.2300

Selection-at-age (S)

S-values	1	2	3	4	5	6	7	8	9
	.3226	.9428	1.0000	1.0178	.9422	.8287	.8343	.7953	.8000

Table 3.7.5 VIRTUAL POPULATION ANALYSIS

HERRING IN THE GULF OF FINLAND (FISHING AREA 32)

	FISHING MORTALITY COEFFICIENT					UNIT: Year-1		VARIABLE NATURAL MORTALITY COEFFICIENT				
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	.151	.124	.072	.118	.192	.102	.164	.240	.202	.100	.167	.098
2	.219	.287	.185	.307	.372	.306	.335	.354	.304	.321	.419	.483
3	.489	.525	.412	.362	.403	.311	.453	.482	.437	.520	.524	.501
4	.619	.561	.410	.462	.392	.390	.400	.431	.490	.538	.497	.507
5	.476	.562	.351	.419	.410	.362	.314	.297	.450	.650	.507	.435
6	.426	.600	.326	.248	.360	.308	.480	.701	.463	.400	.514	.448
7	.282	.421	.306	.289	.338	.282	.343	.189	.522	.345	.358	.528
8	.387	.511	.488	.127	.217	.327	.371	.336	.520	.650	.571	.544
9	.357	.364	.300	.133	.375	.275	.357	.419	.393	.472	.185	.395
10+	.357	.334	.300	.133	.375	.275	.357	.419	.393	.478	.185	.395
(2-5)U	.451	.434	.339	.387	.394	.342	.375	.391	.420	.507	.487	.482
	1982	1983	1984	1985	1986	1987	1988	1989				
1	.154	.105	.079	.164	.097	.075	.088	.074				
2	.301	.397	.321	.303	.333	.181	.249	.206				
3	.184	.362	.389	.270	.361	.246	.267	.232				
4	.291	.391	.395	.224	.294	.246	.225	.248				
5	.342	.264	.387	.252	.222	.262	.203	.188				
6	.166	.235	.338	.221	.222	.250	.193	.207				
7	.255	.249	.338	.194	.174	.274	.226	.197				
8	.154	.229	.422	.167	.202	.232	.192	.173				
9	.182	.226	.317	.276	.250	.312	.255	.164				
10+	.182	.226	.317	.276	.250	.318	.255	.164				
(2-5)U	.280	.353	.373	.262	.303	.234	.237	.218				

Table 3.7.6 VIRTUAL POPULATION ANALYSIS

HERRING IN THE GULF OF FINLAND (FISHING AREA 32)

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .200
PROPORTION OF ANNUAL M BEFORE SPAWNING: .300

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	1457	6214	2277	2288	2757	1326	4877	1151	1714	1406	2715	4116
2	1045	1100	4725	1824	1750	1461	1730	3390	741	1147	1041	1881
3	3085	723	711	3381	1154	1059	276	604	1948	443	681	561
4	424	1629	449	405	2027	664	655	482	305	1030	218	350
5	220	196	800	257	220	1179	387	359	257	153	492	109
6	411	121	96	485	145	125	707	232	219	134	65	243
7	74	231	57	60	326	87	79	358	94	113	75	32
8	90	48	130	34	39	200	57	46	243	46	65	42
9	61	53	25	69	27	27	124	32	27	118	20	30
10+	18	74	29	26	72	36	44	99	81	52	234	74
TOTAL NO	8889	10388	9300	8830	7817	6144	8887	6753	5629	4646	5605	7417
SFS NO	3045	3132	4520	4585	4275	3598	2965	3602	2788	2308	2013	2084
TOTAL BIOM	155759	186389	188662	188843	174715	145482	169814	166491	155933	133544	153468	164278
SFS BIOM	101051	87457	109447	117405	115143	101287	90888	104645	95051	84272	82794	75087

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1970-87
1	3548	2682	5138	3761	1322	7136	732	4192	0	3066
2	3054	2340	1977	3888	2612	983	5419	549	3187	2011
3	951	1850	1399	1174	2351	1532	671	3460	367	1362
4	278	648	1055	776	733	1341	981	421	2245	747
5	163	170	359	582	508	448	859	641	269	381
6	58	95	107	200	370	333	282	571	435	230
7	127	40	61	62	131	243	212	190	380	125
8	15	81	25	36	42	90	151	139	128	74
9	20	11	53	14	25	28	58	102	96	42
10+	59	43	28	55	15	28	24	58	112	59
TOTAL NO	8273	8160	10202	10547	8110	12162	9391	10323	0	0
SFS NO	2953	3581	3495	4456	4664	3883	6103	5264	0	0
TOTAL BIOM	122999	213127	224009	221249	195708	256101	221942	243881	0	0
SFS BIOM	80444	121074	115275	123155	133270	135237	163785	156106	0	0

Table 3.7.7

List of input variables for the ICES prediction program.

HERRING-FITLAND PREDICTION

The reference F is the mean F for the age group range from 2 to 5

The number of recruits per year is as follows:

Year	Recruitment
1991	3203.0
1991	3066.0
1992	3066.0

Proportion of F (fishing mortality) effective before spawning: .2000
 Proportion of M (natural mortality) effective before spawning: .3000

Data are printed in the following units:

Number of fish: millions
 Weight by age group in the catch: gram
 Weight by age group in the stock: gram
 Stock biomass: tonnes
 Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	3203.0	.08	.20	.00	13.850	13.850
2	3187.0	.23	.20	.66	18.100	13.100
3	367.0	.25	.20	.97	23.750	23.750
4	2245.0	.24	.20	1.00	30.950	30.950
5	269.0	.20	.20	1.00	37.000	37.000
6	435.0	.20	.20	1.00	44.000	44.000
7	380.0	.20	.20	1.00	53.700	53.700
8	128.0	.20	.20	1.00	69.100	69.100
9	96.0	.20	.20	1.00	72.000	72.000
10	112.0	.20	.20	1.00	100.250	100.250

Table 3-7.8

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

HERRING-FINLAND PREDICTION

Year 1990					Year 1991					Year 1992	
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.25	257	173	41	.0	.00	253	197	0	305	231
					.1	.02		197	5	300	226
					.2	.05		186	9	295	220
					.4	.09		184	18	285	210
					.6	.14		183	26	276	200
					.8	.18		181	34	267	190
					1.0	.23		180	41	259	181
					1.2	.27		178	49	251	172
					1.4	.32		176	56	243	164
					1.6	.37		175	62	235	156
					1.8	.41		173	69	228	149
					2.0	.46		172	75	221	142

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for the time of spawning.

The spawning stock biomass for 1992 has been calculated with the same fishing mortality as for 1991.

The reference F is the mean F for the age group range from 2 to 5.

Table 3.7.9 Herring-Finland - Prediction.

 * Year 1990. F-factor 1.000 and reference F .2283 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
1	.0810	225.97	3129.6	3200.0	44320.	.00	.00	.00	.00
2	.2260	586.50	10615.6	3187.0	57494.	2103.42	38071.	1893.38	34270.
3	.2500	73.38	1754.7	367.0	8716.	355.99	8454.	318.91	7574.
4	.2370	431.04	13340.8	2245.0	69482.	2245.00	69482.	2016.38	62407.
5	.2000	44.34	1640.7	269.0	9953.	269.00	9953.	243.40	9005.
6	.2000	71.71	3155.0	435.0	19140.	435.00	19140.	393.60	17318.
7	.2000	62.64	3365.7	580.0	20406.	580.00	20406.	543.84	18444.
8	.2000	21.10	1458.0	128.0	8844.	128.00	8844.	115.82	8003.
9	.2000	15.82	1139.4	96.0	6912.	96.00	6912.	86.86	6254.
10+	.2000	18.46	1850.8	112.0	11228.	112.00	11228.	101.34	10159.
Total		1551.46	41448.3	10419.0	256687.	6124.41	192493.	5513.54	173456.

 * Year 1991. F-factor 1.000 and reference F .2283 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
1	.0810	216.50	2998.6	3066.0	42464.	.00	.00	.00	.00
2	.2260	444.63	8047.7	2416.1	43731.	1594.62	28852.	1435.39	25980.
3	.2500	419.04	9952.2	2091.5	49435.	2019.04	47952.	1408.72	42957.
4	.2370	44.93	1390.6	234.0	7247.	724.00	7247.	210.18	6505.
5	.2000	239.03	8844.9	1450.2	53657.	1450.21	53657.	1312.20	48551.
6	.2000	29.72	1307.8	180.3	7233.	180.30	7233.	163.16	7178.
7	.2000	48.07	2581.1	291.6	15658.	291.60	15658.	263.84	14168.
8	.2000	41.99	2901.4	254.7	17601.	254.72	17601.	230.48	15926.
9	.2000	14.14	1018.3	85.8	6177.	85.80	6177.	77.64	5599.
10+	.2000	22.98	2304.1	139.4	13977.	139.45	13977.	126.16	12647.
Total		1521.06	41346.7	10199.6	257879.	6249.73	190063.	5627.76	179504.

Table 3.7.9 cont'd.

 * Year 1992, F-factor 1.000 and reference F .2283 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	so.stock size	sp.stock biomass
1	.0810	216.50	2998.0	3766.0	42464	.00	.00	.00	.00
2	.2260	426.01	7717.8	2314.9	41899	1527.85	27653	1375.28	24892
3	.2500	317.60	7544.8	1570.0	37477	1530.55	36352	1371.21	32566
4	.2370	254.83	7886.9	1327.2	41077	1327.21	41077	1192.06	36004
5	.2000	24.42	922.0	151.2	5543	151.16	5523	136.78	5060
6	.2000	167.24	7050.6	972.1	42772	972.10	42772	979.59	39702
7	.2000	17.92	1069.9	127.9	6400	127.87	6490	109.37	5873
8	.2000	32.22	2226.4	195.5	13506	195.46	13506	176.86	12220
9	.2000	28.15	2026.6	170.7	12293	170.74	12293	154.50	11123
10+	.2000	24.89	2494.9	151.0	15135	150.97	15135	136.61	13694
Total		1505.35	41931.3	10047.4	258709	6147.02	200875	5532.25	181020

Table 4.1 SPRAT catches in the Baltic Sea by country and sub-division, 1987 and 1989 (t). By-catch of herring in directed sprat fisheries excluded and by-catch of sprat in herring fisheries included. (Data as reported to the Working Group.)

Year and country	Total catch	Sub-division										
		22	23	24	25	26	27	28	29	30	31	32
1987												
Denmark	2,593	2,456	-	-	137	-	-	-	-	-	-	-
Finland	2,817	-	-	-	-	-	-	21	1,776	4	-	1,016
German Dem. Rep.	1,307	4	-	1,303	-	-	-	-	-	-	-	-
Germany, Fed.Rep.	1,125	1,123	-	2	-	-	-	-	-	-	-	-
Poland	32,003	-	-	90	15,398	16,515	-	-	-	-	-	-
Sweden	3,453	-	-	242	481	727	46	1,957	-	-	-	-
USSR	44,888	-	-	-	-	25,602	-	11,824	5,693	-	-	1,769
Total	88,186	3,583	-	1,637	16,016	42,844	46	13,802	7,855	3	-	2,785
1988												
Denmark	1,972	6	-	983	983	-	-	-	-	-	-	-
Finland	3,025	-	-	-	-	-	-	-	1,979	6	-	1,040
German Dem. Rep.	1,234	-	-	1,234	-	-	-	-	-	-	-	-
Germany, Fed.Rep.	330	330	-	-	-	-	-	-	-	-	-	-
Poland	22,236	-	-	284	10,648	11,304	-	-	-	-	-	-
Sweden	7,345	-	-	439	791	616	2,194	3,305	-	-	-	-
USSR	44,181	-	-	-	-	23,205	-	13,368	4,330	-	-	3,278
Total	80,323	336	-	2,940	12,422	35,125	2,194	16,673	6,309	6	-	4,318
1989¹												
Denmark	5,239	735	-	-	4,504	-	-	-	-	-	-	-
Finland	2,754	-	-	-	-	-	-	2	1,690	34	-	1,028
German Dem. Rep.	1,166	-	-	1,166	-	-	-	-	-	-	-	-
Germany, Fed.Rep.	565	565	-	-	-	-	-	-	-	-	-	-
Poland	18,648	-	-	79	11,823	6,746	-	-	-	-	-	-
Sweden	3,450	-	28	746	1,247	110	694	625	-	-	-	-
USSR	53,996	-	-	-	-	13,208	-	29,567	7,305	-	-	3,916
Total	85,818	1,300	28	1,991	17,574	20,064	694	30,194	8,995	34	-	4,944

¹Preliminary data.

²Denmark Sub-division 25 includes catches in Sub-division 24.

Table 4.2.1 SUM OF PRODUCTS CHECK

SPRAT IN FISHING AREAS 22 TO 25
CATEGORY: TOTAL

CATCH IN NUMBERS		UNIT: millions											
-----		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	3	3	7	5	0	32	33	27	4	2	0	6	
1	110	11	142	390	188	68	1071	961	315	559	91	508	
2	28	75	46	207	688	308	105	1698	726	360	408	470	
3	250	69	120	167	346	537	354	273	386	212	183	120	
4	149	304	189	168	202	257	425	325	6	85	83	29	
5	26	159	410	202	155	187	148	199	45	45	69	2	
6	21	49	117	82	134	73	97	31	33	22	22	1	
7	2	13	10	11	68	35	33	21	9	10	5	1	
8+	1	1	1	1	1	1	1	1	1	1	1	1	
TOTAL	590	684	1042	1233	1782	1498	2267	3536	1524	1295	863	1138	
		1982	1983	1984	1985	1986	1987	1988	1989				
0	11	21	23	40	19	4	42	18					
1	211	700	339	143	277	84	41	158					
2	506	139	236	394	230	90	188	110					
3	149	231	103	365	409	207	167	363					
4	55	32	49	102	508	484	247	197					
5	18	10	7	25	113	372	247	223					
6	9	2	1	1	35	77	179	195					
7	4	1	0	1	1	13	36	73					
8+	2	1	1	1	1	0	9	15					
TOTAL	965	1137	759	1072	1593	1332	1157	1351					

Table 4.2.2 SUM OF PRODUCTS CHECK

SPRAT IN FISHING AREAS 22 TO 25
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH		UNIT: gram										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.80
1	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	6.00	4.80
2	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	15.90
3	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	19.00
4	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	22.50
5	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	27.00
6	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	.00
7	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	.00
8+	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

	1982	1983	1984	1985	1986	1987	1988	1989
0	4.70	4.80	4.40	3.00	4.70	3.80	4.60	5.73
1	10.30	9.90	12.90	13.00	9.40	7.20	5.10	9.44
2	15.30	16.50	15.30	15.00	16.10	12.80	11.40	14.99
3	19.00	18.10	18.50	16.00	14.90	15.10	11.90	15.20
4	18.90	18.90	20.00	17.00	15.40	16.20	13.70	16.42
5	18.30	19.20	21.80	18.00	16.40	16.70	16.20	17.34
6	19.10	19.40	19.90	18.00	17.50	17.30	16.10	17.77
7	19.60	20.00	20.80	.00	26.00	18.10	16.60	17.84
8+	21.10	20.00	.00	.00	22.90	23.40	17.00	19.33

Table 4.3.1 VIRTUAL POPULATION ANALYSIS

SPRAT IN FISHING AREAS 26 AND 28

CATCH IN NUMBERS	UNIT: millions											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	151	394	534	1826	1896	378	1298	1133	132	706	146	1400
2	314	876	609	960	2405	865	517	3485	2352	188	940	219
3	4201	1530	2501	1399	2413	2642	1066	417	2636	696	139	162
4	970	3438	1981	2177	1363	1573	1501	1205	375	926	318	45
5	938	1228	2956	1105	918	464	660	803	626	77	509	42
6	362	248	370	448	453	245	130	240	297	64	25	121
7	59	62	63	75	132	90	67	41	21	84	27	6
8+	16	25	24	33	17	21	38	87	27	33	51	25
TOTAL	7011	7801	9038	8023	9597	6278	5277	7411	6465	2774	2155	2019
	1982	1983	1984	1985	1986	1987	1988	1989				
1	117	1029	539	227	198	525	34	1638				
2	1605	95	1805	1163	645	265	2245	169				
3	192	110	226	1850	934	866	540	1148				
4	121	26	277	321	1351	1236	666	182				
5	39	8	50	149	210	1205	462	336				
6	28	2	27	14	97	127	428	158				
7	18	3	4	7	7	80	17	219				
8+	14	7	16	4	11	25	21	56				
TOTAL	2132	1280	2942	3735	3453	4328	4413	3906				

Table 4.3-2 SUM OF PRODUCTS CHECK

SPRAT IN FISHING AREAS 26 AND 28
 CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH		UNIT: gram										

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
2	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	11.800
3	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	15.000
4	13.000	13.000	13.000	13.000	13.000	13.000	13.000	13.000	13.000	13.000	13.000	16.500
5	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	14.000	16.700
6	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.200
7	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.600
8+	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	18.000
	1982	1983	1984	1985	1986	1987	1988	1989				
1	5.700	9.000	8.000	8.170	5.500	8.200	5.750	9.300				
2	10.400	12.800	10.300	10.130	10.600	11.200	9.860	12.700				
3	14.200	14.500	13.100	11.980	11.900	12.600	12.150	14.400				
4	15.300	16.600	14.500	12.890	13.300	13.800	13.860	15.200				
5	16.000	17.200	14.900	16.100	13.900	14.600	14.570	16.700				
6	15.800	16.800	16.200	18.350	15.900	15.800	14.520	16.800				
7	18.000	17.700	17.500	19.370	16.600	17.000	16.160	17.500				
8+	19.400	18.200	18.300	18.810	17.000	18.100	17.020	18.900				

Table 4.3.3 VIRTUAL POPULATION ANALYSIS

SPRAT IN FISHING AREAS 26 AND 28

MEAN WEIGHT AT AGE OF THE STOCK

UNIT: gram

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
2	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	12.000	10.000
3	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	12.000
4	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	13.000
5	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	14.000
6	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000	16.000
7	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	17.000
8+	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	20.000

	1982	1983	1984	1985	1986	1987	1988	1989
1	6.000	4.100	3.800	8.170	5.500	4.610	5.750	4.500
2	10.000	11.600	9.100	10.130	10.600	11.700	9.860	11.110
3	13.400	13.800	12.200	11.980	11.900	12.800	12.150	13.800
4	15.000	15.500	14.100	12.890	13.300	14.100	13.860	14.900
5	16.400	16.000	14.600	16.100	13.900	14.600	14.570	15.830
6	17.000	17.000	16.600	18.350	15.900	15.600	14.520	16.740
7	18.000	17.100	17.500	19.370	16.600	17.000	16.160	16.460
8+	19.800	18.000	18.300	18.810	17.000	18.000	17.020	20.100

Table 4.3.4 SUM OF PRODUCTS CHECK

SPRAT IN FISHING AREAS 26 AND 28

CATEGORY: TOTAL

CATCH WEIGHT AND SOP CHECK

SUM OF PRODUCTS UNIT: tonnes

NOMINAL CATCH UNIT: tonnes

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	906	2364	3204	10956	11376	2268	7788	6798	794	4237	877	8397
2	3140	8760	6090	9600	24050	8650	5170	34850	23522	1880	9404	2589
3	50412	18360	30012	16788	28956	31704	12792	5004	31633	8357	1672	2427
4	12610	44694	25753	28301	17719	20449	19513	15665	4878	12042	4133	749
5	13132	17192	41384	15470	12852	6496	9240	11242	8767	1072	7123	701
6	5792	3968	5920	7168	7248	3920	2080	3840	4744	1024	392	1960
7	1003	1054	1071	1275	2244	1530	1139	697	362	1426	456	97
8+	322	500	480	660	340	420	760	1740	530	652	1022	445
A) SOP	87317	96892	113914	90218	104785	75437	58482	79836	75230	30691	25078	17365
B)NOMIN.	0	0	0	0	0	0	0	0	0	0	25529	17770
(B/A) %	0	0	0	0	0	0	0	0	0	0	102	102
	1982	1983	1984	1985	1986	1987	1988	1989				
1	665	9261	4309	1852	1089	4303	193	15229				
2	16691	1216	18590	11786	6834	2968	22136	2145				
3	2719	1595	2954	22165	11115	10913	6561	16533				
4	1847	432	4017	4136	17965	17054	9235	2769				
5	626	138	739	2396	2922	17594	6731	5613				
6	436	34	429	255	1549	2008	6215	2648				
7	324	53	74	134	111	1357	274	3829				
8+	272	127	295	77	182	449	363	1064				
A) SOP	23579	12855	31406	42800	41768	56646	51706	49829				
B)NOMIN.	23508	13476	31149	42978	41962	56646	51853	50258				
(B/A) %	100	105	99	100	100	100	100	101				

Table 4.3.6

BALTIC SPRAT 26 AND 28. TUNING DATA: ACOUSTIC SURVEY

101

USSR DATA

1983,1989

1,1

1,8

1,21087,2066,1938,501,166,20,69,231

1,16531,12765,981,441,61,0,0,38

1,9752,7748,7174,663,357,37,58,150

1,5604,5351,5283,4693,107,175,19,24

1,23035,2246,2992,2489,2341,110,81,41

1,741,14404,1251,1667,1451,1301,59,60

1,22461,433,8394,681,875,934,825,142

Table 4.3.7 Sprat in Sub-divisions 26 and 28. Tuning analysis.

Module run at 12.32.00 27 APRIL 1990
 DISAGGREGATED Qs
 LOG TRANSFORMATION
 NO explanatory variate (Mean used)
 Fleet 1 ,USSR DATA , has terminal q estimated as the mean
 FLEETS COMBINED BY ** VARIANCE **

Regression weights
 , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,
 Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions
 Fishing mortalities

Age,	83,	84,	85,	86,	87,	88,	89,
1,	.019,	.014,	.013,	.031,	.012,	.022,	.039,
2,	.023,	.061,	.051,	.058,	.062,	.075,	.180,
3,	.028,	.099,	.109,	.065,	.125,	.211,	.060,
4,	.078,	.131,	.269,	.136,	.139,	.161,	.124,
5,	.042,	.309,	.127,	.365,	.210,	.085,	.138,
6,	.044,	.283,	.178,	.145,	.489,	.130,	.045,
7,	.043,	.177,	.147,	.154,	.205,	.132,	.109,

Log catchability estimates

Age 1							
Fleet,	83,	84,	85,	86,	87,	88,	89
1,	-.93,	-.83,	-.58,	-.15,	-.68,	-.72,	-.63

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-.64	.266	.5260	.0384	.000E+00	.000E+00	-.642	.094
	Fbar .038	SIGMA(int.) .266	SIGMA(ext.) 0.000	SIGMA(overall) .266	Variance ratio 0.000			

Age 2

Fleet,	83,	84,	85,	86,	87,	88,	89
1,	-.71,	-.83,	-1.08,	-.73,	-.64,	-.73,	-.78

cont'd.

Table 4.3.7 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-.78	.155	.4561	.1779	.000E+00	.000E+00	-.785	.055	
Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
.178	.155		0.000		.155		0.000		

Age 3

Fleet	83	84	85	86	87	88	89
1	-.72	-.84	-.86	-1.00	-.84	-.72	-.82

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-.83	.101	.4373	.0598	.000E+00	.000E+00	-.827	.036	
Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
.060	.101		0.000		.101		0.000		

Age 4

Fleet	83	84	85	86	87	88	89
1	.40	-1.57	-.59	-.75	-1.27	-.91	-.77

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-.78	.665	.4588	.1228	.000E+00	.000E+00	-.779	.235	
Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
.123	.665		0.000		.665		0.000		

Age 5

Fleet	83	84	85	86	87	88	89
1	-.13	-.97	-1.19	-1.68	-.89	-1.32	-1.02

cont'd.

Table 4.3.7 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-1.03	.509	.3572	.1372	.000E+00	.000E+00	-1.029	.180	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	.137	.509	0.000	.509	0.000				

Age 6

Fleet	83	84	85	86	87	88	89
1	-.83	-3.21	-.75	-1.35	-.86	-.93	-1.31

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-1.32	.924	.2673	.0451	.000E+00	.000E+00	-1.319	.327	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	.045	.924	0.000	.924	0.000				

Table 4.3.8 VIRTUAL POPULATION ANALYSIS From tuning.

SPRAT IN FISHING AREAS 26 AND 28

	FISHING MORTALITY COEFFICIENT					VARIABLE NATURAL MORTALITY COEFFICIENT						
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	.089	.046	.114	.041	.078	.015	.019	.014	.013	.030	.011	.022
2	.228	.391	.131	.368	.130	.192	.023	.061	.051	.058	.062	.075
3	.273	.397	.307	.224	.164	.256	.028	.099	.109	.065	.124	.209
4	.527	.641	.384	.381	.174	.285	.078	.131	.269	.136	.138	.160
5	.434	.921	.422	.674	.129	.364	.042	.309	.127	.365	.210	.084
6	1.320	.417	.350	.395	.596	.186	.044	.283	.178	.145	.489	.130
7	.556	.554	.320	.414	.240	.264	.043	.177	.147	.154	.205	.132
8+	.556	.554	.320	.414	.240	.264	.043	.177	.147	.154	.205	.132
1989												
1	.038											
2	.178											
3	.060											
4	.123											
5	.137											
6	.045											
7	.109											
8+	.109											

Table 4.3.9 VIRTUAL POPULATION ANALYSIS From tuning.

SPRAT IN FISHING AREAS 26 AND 28

STOCK SIZE IN NUMBERS UNIT: millions

 BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE

USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .500

PROPORTION OF ANNUAL M BEFORE SPAWNING: .500

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	16733	3942	8795	5040	24951	10834	71613	48384	21641	7981	54887	1862
2	21278	9504	2052	4150	2409	12326	5647	38280	29107	13798	5258	37592
3	2170	10511	3502	952	1430	1130	5383	3008	21966	17876	8843	3424
4	3622	1025	3849	1362	379	648	463	2854	1662	12720	11376	5413
5	2822	1327	294	1387	463	170	258	233	1528	820	7537	6863
6	392	1135	288	102	352	218	63	135	104	869	387	4230
7	118	65	408	107	34	104	96	33	62	56	511	164
8+	251	81	158	205	154	81	223	125	37	90	159	206
TOTAL NO	47385	27589	19347	13304	30172	25511	83744	93052	76106	54212	88957	59754
SPS NO	17069	12617	6243	4159	3085	7606	7801	26433	36294	33678	25338	38018
TOT. BIOM	507502	356234	211605	147029	211655	223088	451402	617652	784638	599753	713127	665567
SPS BIOM	229135	179660	94555	59747	37102	83264	102867	260475	409976	408050	343826	439846

	1989	1990
1	52178	0
2	1237	34443
3	23694	710
4	1886	15309
5	3133	1144
6	4283	1873
7	2524	2808
8+	649	1951
TOTAL NO	89584	
SPS NO	29596	
TOT. BIOM	779510	
SPS BIOM	431736	

Table 4.3.10

Title : SPRAT IN FISHING AREAS 26 AND 28
 At 12.47.59 27 APRIL 1990
 from 77 to 89 on ages 1 to 7
 with Terminal F of .100 on age 3 and Terminal S of 1.600

Initial sum of squared residuals was 81.094 and
 final sum of squared residuals is 19.212 after 72 iterations

Matrix of Residuals

Years	77/78	78/79											
Ages													
1/ 2	.472	.108											
2/ 3	.255	.454											
3/ 4	-.434	-.242											
4/ 5	-.221	-.052											
5/ 6	-.155	.336											
6/ 7	1.147	-.826											
	.002	.002											
WTS	.010	.010											
Years	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	WTS		
Ages													
1/ 2	.770	-.163	1.060	-.642	1.655	.297	.119	1.150	-.455	-.849	.000	.304	
2/ 3	.171	-.837	.208	.745	.305	-.031	.314	.068	-.792	.381	.000	.566	
3/ 4	.179	-.269	-.050	-.328	-.090	-.723	.047	-.285	-.190	.447	.000	.773	
4/ 5	-.310	.331	-.446	.153	.004	.040	-.052	-.103	.315	-.155	.000	1.000	
5/ 6	-.029	-.532	-.403	.174	-.735	.482	-.258	.080	.154	.032	.000	.648	
6/ 7	-.428	-.624	.948	-.740	-.419	.412	-.096	-.364	.987	-.522	.000	.323	
	.002	.001	.001	.000	.000	-.001	.000	.000	.000	.000	2.627		
WTS	.010	.010	.010	.010	.010	.010	1.000	1.000	1.000	1.000			
Fishing Mortalities (F)													
F-values	77	78	79										
	.4645	.6018	.3875										
F-values	80	81	82	83	84	85	86	87	88	89			
	.4766	.2490	.3279	.0523	.1691	.1592	.1563	.1972	.1583	.1000			
Selection-at-age (S)													
S-values	1	2	3	4	5	6	7						
	.1016	.5255	1.0000	1.4237	1.7484	1.8061	1.6000						

Table 4.3.12 VIRTUAL POPULATION ANALYSIS

SPRAT IN FISHING AREAS 26 AND 28

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .500
 PROPORTION OF ANNUAL M BEFORE SPAWNING: .500

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	13974	3130	7811	4343	19184	11286	53468	24582	16980	8053	38201	4236
2	20481	7792	1610	3630	2062	9247	5886	28392	14584	10788	5307	26032
3	1940	10017	2579	718	1173	945	3759	3139	15933	8496	6799	3458
4	3355	883	3583	877	263	512	365	1969	1741	8825	5008	3997
5	2120	1163	219	1247	225	108	186	180	989	871	4894	2458
6	387	704	203	63	284	90	30	96	72	521	421	2404
7	97	62	176	63	15	68	29	15	38	36	275	188
8+	207	77	69	120	67	53	67	58	23	57	85	236
TOTAL NO	42562	23829	16249	11060	23274	22310	63789	58430	50361	37648	60991	43009
SPS NO	15571	10707	4764	3138	2316	5497	6420	19905	22250	20570	15889	24619
TOT.BIOM	460498	310928	173761	119971	162516	186121	350204	423362	518198	399089	477427	456217
SPS BIOM	206566	152866	71952	44372	27027	59857	82561	196855	255823	248697	210839	279243

	1989	1990	1980-87
1	43379	0	22012
2	2849	28408	9987
3	15846	1816	5120
4	1909	9926	2445
5	2173	1160	1088
6	1294	1215	197
7	1285	758	67
8+	331	883	66
TOTAL NO	69064		
SPS NO	19545		
TOT.BIOM	557812		
SPS BIOM	277044		

Table 4.3.13 Results from the USSR young sprat (t=0) surveys.

Year class	Relative abundance of young sprat according to pelagic trawl survey (ptrawl)	Mean weight of young sprat on pelagic trawl catches, g (W1)	Relative abundance of young sprat according to Isaacs-Kid trawl survey, (ikid)	Mean weight of young sprat on Isaacs-Kid trawl catches, g (W2)
1980	0.90	3.50	1.0	1.70
1981	0.36	2.90	0.26	2.00
1982	2.64	3.20	1.42	2.50
1983	4.56	2.90	3.54	1.30
1984	0.80	2.30	1.20	1.70
1985	0.10	1.10	0.26	1.70
1986	9.22	2.50	2.23	1.20
1987	0.01	2.60	2.08	0.43
1988	12.30	3.20	0.36	2.00
1989	7.20	3.00	1.73	2.80

Table 4.3.14 Sprat in Sub-divisions 26 and 28. Results of RCRTINX2 analysis.

Data for 4 surveys over 10 years
 REGRESSION TYPE = C
 TAPERED TIME WEIGHTING APPLIED
 POWER = 3 OVER 20 YEARS
 PRIOR WEIGHTING NOT APPLIED
 FINAL ESTIMATES SHRUNK TOWARDS MEAN
 ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
 MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
 MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
p1raw1	6.8276	.565	7.315	.7467	6	11.1705	.42990	.57789	.35951
w1	3.2581	2.417	1.956	.4557	6	9.8303	.80673	.87225	.15780
ikid	3.1485	1.002	7.507	.5343	6	10.6617	.68920	.79966	.18775
w2	2.5649	8.813	-16.047	.1319	6	6.5591	1.89346	2.55898	.01833
MEAN						9.8203	.65881	.65881	.27661

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
p1raw1	.6931	.490	7.582	.7758	7	7.9218	.39176	.60176	.33365
w1	3.2958	2.904	.482	.3824	7	10.0536	.92616	.99261	.12262
ikid	3.0819	.976	7.553	.5945	7	10.5599	.60186	.66998	.26916
w2	1.6677	*****	-860.459	.0001	7	*****	78.00494186	.35825	.00000
MEAN						9.9262	.66336	.66336	.27456

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
p1raw1	7.1156	.434	7.874	.8797	8	10.9635	.33501	.39900	.72459
w1	3.4965	5.753	-8.999	.1796	8	11.1147	1.93688	2.12513	.02554
ikid	1.5261	2.741	2.819	.1292	8	7.0013	2.35272	2.71682	.01563
w2	3.0445	2.819	2.049	.3704	8	10.6321	1.18147	1.29152	.06916
MEAN						9.7223	.83593	.83593	.16508

cont'd.

Table 4.3.14 cont'd.

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
p1raw1	6.5806	.589	7.307	.8138	9	11.1814	.59081	.65522	.66734
w1	3.4340	7.468	-14.483	.2156	9	11.1610	2.35588	2.52203	.04504
ikid	2.9069	*****	58.046	.0045	9	.0283	18.44702	19.88294	.00072
w2	3.3673	4.221	-1.621	.3347	9	12.5919	1.74156	2.01724	.07041
MEAN						10.0060	1.15038	1.15038	.21649

Yearclass	Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE	
1986	10.41	33040.30	.35	.40	10.5538202.03	1.16
1987	9.44	12611.32	.35	.65	8.35 4237.00	1.87
1988	10.68	43374.45	.34	.33	12.18*****	.96
1989	11.02	60914.42	.54	.35		.66

Table 4.3.15

List of input variables for the ICES prediction program.

SPRAT IN SUB-DIVISIONS 26 AND 28

The reference F is the mean F for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1990	60914.0
1991	22012.0
1992	22012.0

Proportion of F (fishing mortality) effective before spawning: .5000

Proportion of M (natural mortality) effective before spawning: .5000

Data are printed in the following units:

Number of fish: millions

Weight by age group in the catch: gram

Weight by age group in the stock: gram

Stock biomass: tonnes

Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	60914.0	.05	.38	.00	9.300	4.500
2	28408.0	.07	.38	.75	12.700	11.110
3	1816.0	.09	.38	1.00	14.400	13.800
4	9926.0	.12	.38	1.00	15.200	14.900
5	1160.0	.20	.38	1.00	16.700	15.830
6	1215.0	.16	.38	1.00	16.800	16.740
7	758.0	.23	.38	1.00	17.500	16.460
8+	883.0	.23	.38	1.00	18.900	20.100

Table 4.3.16

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

SPRAT IN SUB-DIVISIONS 26 AND 28

Year 1990					Year 1991					Year 1992		
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass	
.9	.12	832	377	65	.0	.00	949	612	0	944	665	
					.1	.01		609	8	936	655	
					.2	.03		606	17	929	646	
					.4	.05		599	33	915	628	
					.6	.08		593	50	900	610	
					.8	.10		587	65	887	593	
					1.0	.13		581	81	873	576	
					1.2	.16		575	96	860	560	
					1.4	.18		569	111	847	545	
					1.6	.21		563	125	834	530	
					1.8	.23		557	140	822	516	
					2.0	.26		552	154	810	501	

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for the time of spawning.

The spawning stock biomass for 1992 has been calculated with the same fishing mortality as for 1991.

The reference F is the mean F for the age group range from 2 to 6

Table 4.3.17

SPRAT IN SUB-DIVISIONS 26 AND 28

 * Year 1990, F-factor .929 and reference F .1202 *

 * Run depending on a TAC value *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0430	2139.83	19900.4	60914	274113	.0	0	.0	0
2	.0688	1576.04	20015.7	28408	315612	21306.0	236709	17049.3	189417
3	.0846	122.99	1771.1	1816	25060	1816.0	25060	1441.8	19896
4	.1124	882.48	13413.8	9926	147897	9926.0	147897	7771.3	115792
5	.1896	167.86	2803.3	1160	18362	1160.0	18362	873.8	13832
6	.1459	138.03	2318.9	1215	20339	1215.0	20339	935.5	15659
7	.2109	120.88	2115.5	758	12476	758.0	12476	564.9	9298
8+	.2109	140.82	2661.5	883	17748	883.0	17748	658.1	13227
Total		5288.93	65000.0	105080	831610	37064.0	478594	29294.8	377126

 * Year 1991, F-factor 1.000 and reference F .1294 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0463	830.92	7727.6	22012.0	99054	.0	0	.0	0
2	.0740	2383.84	30274.8	40022.5	444650	30016.9	333487	23957.0	266162
3	.0910	1321.97	19036.4	18190.7	251031	18190.7	251031	14395.4	198657
4	.1210	109.09	1658.2	1144.6	17054	1144.6	17054	892.3	13295
5	.2040	941.40	15721.4	6084.4	96315	6084.4	96315	4550.5	72033
6	.1570	80.08	1345.3	658.3	11019	658.3	11019	504.0	8437
7	.2270	122.73	2147.7	720.3	11855	720.3	11855	532.5	8765
8+	.2270	155.32	2935.5	911.5	18321	911.5	18321	673.9	13546
Total		5945.35	80846.9	89744.3	949304	57726.7	739087	45505.7	580897

cont'd.

Table 4.3.17 cont'd.

 * Year 1992. F-factor 1.000 and reference F .1294 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0463	830.92	7727.6	22012.0	99054	.0	0	.0	0
2	.0740	858.61	10904.3	14415.3	160153	10811.5	120115	8628.8	95866
3	.0910	1852.72	26679.2	25494.0	351816	25494.0	351816	20175.0	278414
4	.1210	1085.74	16503.2	11392.0	169740	11392.0	169740	8881.0	132326
5	.2040	107.63	1797.5	695.6	11012	695.6	11012	520.3	8235
6	.1570	413.98	6954.9	3403.2	56970	3403.2	56970	2605.8	43620
7	.2270	65.76	1150.8	385.9	6352	385.9	6352	285.3	4696
8+	.2270	151.99	2872.5	892.0	17928	892.0	17928	659.5	13255
Total		5367.35	74590.0	78690.0	873028	53074.2	733936	41755.6	576415

Table 4.4.1 VIRTUAL POPULATION ANALYSIS

SPRAT IN FISHING AREAS 27, 29-32

CATCH IN NUMBERS UNIT: millions

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	940	249	592	2677	522	184	2232	283	54	76	109	448
2	633	1674	520	1049	3011	861	193	3262	246	45	127	230
3	3956	626	1695	617	864	2477	672	309	1877	126	58	120
4	257	3526	431	1085	381	555	1597	376	99	1273	102	20
5	82	184	3065	526	870	143	232	725	143	68	784	45
6	317	95	70	1617	350	552	119	91	334	63	25	402
7	0	356	23	151	1019	122	447	78	44	234	42	7
8	29	0	155	64	129	505	70	127	25	13	131	13
9	11	28	3	149	53	13	299	47	88	12	8	55
10+	13	36	25	78	82	8	15	129	49	60	50	12
TOTAL	6238	6774	6579	8013	7281	5420	5876	5427	2958	1969	1436	1352
	1982	1983	1984	1985	1986	1987	1988	1989				
1	35	127	131	175	22	166	3	307				
2	352	61	346	151	269	38	263	11				
3	83	183	58	316	83	224	24	261				
4	54	45	120	23	242	63	236	25				
5	8	33	19	93	16	170	53	180				
6	24	8	9	10	53	14	153	38				
7	230	16	5	11	9	49	12	107				
8	1	134	5	1	4	3	58	6				
9	4	2	58	2	1	3	5	32				
10+	31	16	8	51	26	26	48	28				
TOTAL	822	625	759	833	725	756	854	994				

Table 4.4.2 SUM OF PRODUCTS CHECK

SPRAT IN FISHING AREAS 27, 29-32
CATEGORY: TOTAL

	MEAN WEIGHT AT AGE IN THE CATCH										UNIT: gram	
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	9.500	9.500	9.500	9.500	9.600	9.400	8.700	7.800	9.800	11.400	11.000	9.500
2	10.000	10.000	10.000	10.000	10.200	11.300	10.800	10.500	10.900	12.900	12.600	12.600
3	11.800	11.800	11.800	11.800	11.400	12.000	12.200	13.100	12.400	13.700	14.600	14.600
4	12.600	12.600	12.600	12.600	12.300	12.200	12.800	13.500	13.000	14.000	14.300	14.800
5	12.700	12.700	12.700	12.700	13.000	12.400	13.700	13.900	13.600	14.300	14.200	15.800
6	13.300	13.300	13.300	13.300	13.300	12.900	13.900	14.800	14.100	14.400	15.300	15.800
7	13.100	13.100	13.100	13.100	13.300	13.500	14.000	14.200	14.400	14.900	14.300	16.200
8	12.500	12.500	12.500	12.500	13.800	13.200	13.200	14.500	14.900	15.000	14.900	15.600
9	13.400	13.400	13.400	13.400	14.900	14.200	13.800	15.600	14.100	15.100	13.800	15.600
10+	12.600	12.600	12.600	12.600	13.300	12.300	14.200	14.400	14.500	15.000	15.000	14.000
	1982	1983	1984	1985	1986	1987	1988	1989				
1	9.800	7.600	8.200	7.400	10.100	9.900	10.000	11.800				
2	12.500	12.600	12.100	11.200	12.400	12.200	13.200	12.400				
3	14.600	14.900	13.800	13.000	13.900	14.000	13.800	14.900				
4	15.200	16.200	15.200	15.200	14.900	14.600	15.700	15.400				
5	16.100	16.000	16.100	15.300	15.600	15.400	16.100	16.700				
6	15.900	16.400	16.300	15.800	15.600	16.300	16.600	17.200				
7	16.100	16.500	16.400	15.700	16.200	16.600	17.200	17.300				
8	16.700	16.700	16.900	16.500	16.700	17.400	17.300	16.800				
9	16.500	17.700	16.900	15.400	16.200	15.500	16.400	17.400				
10+	16.200	17.100	16.700	15.600	16.300	16.500	16.800	16.900				

Table 4.5.1 SUM OF PRODUCTS CHECK

SPRAT IN FISHING AREAS 22 TO 32
CATEGORY: TOTAL

CATCH IN NUMBERS	UNIT: millions											
-----	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	33	125	215	104	97	51	35	26	24	105	76	65
1	2615	628	4682	2371	500	1340	369	2303	363	1852	1005	566
2	6172	2032	818	8399	3325	597	1476	920	2460	297	2393	1703
3	3618	5678	2106	997	4936	1037	378	405	425	531	388	2521
4	1940	2387	3510	1907	480	2291	500	94	225	107	447	447
5	1929	790	1040	1739	817	188	1357	88	64	47	77	271
6	933	878	350	364	683	150	72	527	57	12	38	30
7	1213	247	548	140	73	335	67	13	231	18	9	19
8+	278	546	422	399	189	125	235	99	51	148	83	65
TOTAL	18731	13311	13691	16420	11100	6114	4489	4475	3900	3117	4516	5687
	1986	1987	1988	1989								
0	32	4	181	118								
1	495	779	78	2102								
2	1142	394	2696	290								
3	1425	1320	730	1772								
4	2099	1833	1149	404								
5	340	1805	762	739								
6	188	227	760	390								
7	16	149	65	398								
8+	50	73	141	137								
TOTAL	5787	6584	6563	6350								

Table 4.5.2 VIRTUAL POPULATION ANALYSIS

SPRAT IN FISHING AREAS 22 TO 32

MEAN WEIGHT AT AGE OF THE STOCK

UNIT: gram

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.800	1.000	1.000	1.000
1	6.500	6.100	6.100	5.800	6.000	6.500	7.000	6.500	7.000	7.000	7.000	8.300
2	11.400	11.500	11.500	11.000	11.500	12.200	12.000	13.500	12.000	13.000	11.200	11.200
3	13.100	13.200	13.200	13.500	13.100	13.800	14.000	16.000	15.800	15.500	14.000	13.000
4	14.500	14.000	14.500	14.500	14.500	14.800	14.500	17.500	16.000	16.800	15.500	14.500
5	14.800	14.500	15.000	15.100	15.100	15.100	14.900	16.500	16.500	16.800	16.500	15.800
6	16.000	15.900	16.200	16.500	16.100	16.200	16.500	16.000	16.500	17.000	17.000	17.000
7	16.500	16.700	16.900	16.900	16.800	17.000	16.800	16.500	17.000	17.500	17.500	17.300
8+	16.900	16.500	17.000	17.300	17.300	17.400	16.900	16.500	18.000	18.000	17.300	17.300

	1986	1987	1988	1989
0	1.000	1.000	4.380	5.020
1	8.300	8.300	5.580	9.680
2	12.000	12.000	4.460	13.560
3	14.300	14.300	12.150	14.540
4	14.800	14.800	14.200	15.810
5	16.000	16.000	15.210	16.890
6	17.000	17.000	15.310	17.320
7	17.500	17.500	16.590	17.510
8+	17.700	17.700	17.040	18.100

Table 4.5.3

BALTIC SPRAT Tuning Data: Acoustical Surveys

102

Internat. Surveys 24-29S

1983, 1989

1, 1

1, 8

1,	34442,	8912,	7997,	1989,	310,	192,	111,	7
1,	12411,	19142,	4827,	1673,	189,	45,	67,	55
1,	3718,	10968,	8455,	1920,	269,	75,	56,	44
1,	1234,	6256,	8530,	2496,	359,	26,	20,	34
1,	11203,	2899,	6307,	2675,	962,	185,	19,	14
1,	644,	5131,	3194,	3580,	1568,	195,	30,	8
1,	29866,	2093,	18258,	3323,	2129,	1641,	1591,	250

USSR Surveys 26+28

1983, 1989

1, 1

1, 8

1,	21087,	2066,	1938,	501,	166,	20,	69,	231
1,	16531,	12765,	981,	441,	61,	0,	0,	38
1,	9752,	7748,	7174,	663,	357,	37,	58,	150
1,	5604,	5351,	5283,	4693,	107,	175,	19,	24
1,	23035,	2246,	2992,	2489,	2341,	110,	81,	41
1,	741,	14404,	1251,	1667,	1451,	1301,	59,	60
1,	22461,	433,	8394,	681,	875,	934,	825,	142

Table 4.5.4 Sprat in Sub-divisions 22-32. Tuning analysis.

DISAGREGATED AS

LOG TRANSFORMATION

No explanatory variate (Mean used)

Fleet 1, Internat. Surveys 24, has terminal q estimated as the mean

Fleet 2, USJA Surveys 26+23, has terminal q estimated as the mean

FLEETS COMBINED BY ** VARIANCE **

Regression weights

1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,

Oldest age $F = 1.000$ * average of 5 younger ages. Fleets combined by variance of predictions

Finishing mortalities

Age	83	84	85	86	87	88	89
1	.043	.019	.021	.048	.013	.035	.035
2	.043	.073	.048	.060	.052	.060	.093
3	.081	.043	.120	.056	.087	.137	.055
4	.133	.117	.174	.155	.172	.122	.112
5	.174	.220	.113	.215	.206	.059	.114
6	.100	.148	.147	.118	.233	.134	.042
7	.093	.130	.120	.121	.138	.102	.104

Log catchability estimates

Age	83	84	85	86	87	88	89
1	-.44	-1.44	-1.77	-2.13	-1.68	-1.23	-.71
2	-.73	-1.16	-1.01	-.61	-.26	-1.00	-.99

cont'd.

Table 4.5.4 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(n)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt	
1	-1.57	.670	.2537	.0170	.000E+00	.000E+00	-1.373	.237	
2	-.26	.185	.3212	.0357	.000E+00	.000E+00	-.934	.065	
	Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio	
	.734	.174		.177		.178		.992	
Age 2									
Fleet	83	84	85	86	87	88	89		
1	-.25	-.54	-1.18	-1.11	-.96	-2.17	-.33		
2	-1.21	-.94	-1.53	-1.27	-1.22	-1.13	-1.25		

SUMMARY STATISTICS									
Fleet	Pred.	SE(n)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt	
1	-1.77	.835	.4334	.0443	.000E+00	.000E+00	-1.739	.335	
2	-1.22	.198	.2948	.1974	.000E+00	.000E+00	-1.222	.066	
	Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio	
	.189	.184		.217		.217		1.397	
Age 3									
Fleet	83	84	85	86	87	88	89		
1	-.20	-.15	-.71	-1.09	-.77	-.31	-.57		
2	-1.22	-1.45	-1.07	-1.57	-1.51	-1.45	-1.35		

SUMMARY STATISTICS									
Fleet	Pred.	SE(n)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt	
1	-.50	.533	.6164	.0508	.000E+00	.000E+00	-1.500	.133	
2	-1.57	.188	.2552	.0534	.000E+00	.000E+00	-1.374	.066	
	Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio	
	.354	.177		.302E-01		.177		.029	
Age 6									
Fleet	83	84	85	86	87	88	89		
1	1.11	-.23	-.27	-1.80	-1.91	-.97	-.68		
2	-.27	-2.10	-1.50	-1.76	-1.92	-1.73	-1.66		

cont'd.

Table 4.5.4 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	1		F	F		Slope		Intrcpt	Intrcpt
1	-.67	1.100	.5137	.0624	.000E+00	.000E+00	-.464	.339	
2	-1.44	.685	.2320	.1375	.000E+00	.000E+00	-1.401	.242	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio		
	.110	.582	.355		.542		.372		

REG 5

Fleet	83	84	85	86	87	88	89
1	-.58	-.62	-2.19	-1.48	-2.21	-2.10	-1.10
2	-1.79	-1.75	-1.71	-2.69	-1.52	-2.18	-1.89

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	1		F	F		Slope		Intrcpt	Intrcpt
1	-1.44	.819	.2373	.0824	.000E+00	.000E+00	-1.402	.289	
2	-1.83	.523	.1507	.1351	.000E+00	.000E+00	-1.833	.210	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio		
	.114	.480	.235		.490		.240		

REG 6

Fleet	83	84	85	86	87	88	89
1	-.47	-1.74	-1.80	-4.11	-1.85	-3.37	-1.73
2	-1.79	-4.21	-1.71	-2.21	-2.18	-1.47	-2.30

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	1		F	F		Slope		Intrcpt	Intrcpt
1	-1.88	1.679	.1527	.0533	.000E+00	.000E+00	-1.873	.567	
2	-2.27	.973	.1035	.0433	.000E+00	.000E+00	-2.263	.344	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio		
	.041	.835	.776	.01	.33		.009		

Table 4.5.5 VIRTUAL POPULATION ANALYSIS from tuning.

SPRAT IN FISHING AREAS 22 TO 32

	FISHING MORTALITY COEFFICIENT					VARIABLE NATURAL MORTALITY COEFFICIENT						
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.112	.078	.069	.145	.100	.142	.058	.095	.031	.035	.019	.021
2	.160	.147	.172	.206	.401	.230	.338	.294	.196	.043	.073	.047
3	.370	.271	.280	.403	.229	.295	.331	.213	.306	.081	.093	.120
4	.471	.575	.338	.554	.449	.220	.335	.186	.249	.163	.117	.174
5	.323	.455	.699	.345	.650	.457	.289	.131	.265	.104	.220	.113
6	.555	.300	.479	.733	.283	.331	.482	.256	.164	.100	.148	.147
7	.376	.350	.394	.448	.403	.307	.359	.218	.240	.098	.130	.120
8+	.376	.350	.394	.448	.403	.307	.359	.218	.240	.098	.130	.120
(2- 6)U	.376	.350	.394	.448	.402	.307	.355	.216	.236	.098	.130	.120
	1986	1987	1988	1989	1974-87							
1	.047	.013	.035	.034	.069							
2	.059	.051	.059	.189	.173							
3	.056	.096	.135	.054	.225							
4	.155	.100	.120	.110	.292							
5	.215	.206	.059	.114	.319							
6	.118	.233	.134	.041	.309							
7	.121	.138	.102	.104	.264							
8+	.121	.138	.102	.104	.264							
(2- 6)U	.121	.137	.101	.102								

Table 4.5.6

Title : SPRAT IN FISHING AREAS 22 TO 32

from 74 to 89 on ages 1 to 7
with Terminal F of .085 on age 3 and Terminal S of 1.300

Initial sum of squared residuals was 37.598 and
final sum of squared residuals is 11.563 after 89 iterations

Matrix of Residuals

Years	74/75	75/76	76/77	77/78	78/79										
Ages															
1/ 2	.767	.423	.218	.119	.122										
2/ 3	-.157	-.103	-.173	.199	.693										
3/ 4	-.067	.171	-.144	.119	.036										
4/ 5	-.009	.102	.024	-.223	-.239										
5/ 6	-.331	-.121	.167	-.352	.301										
6/ 7	.208	-.466	.042	.332	-.677										
	.000	.000	.000	.000	.000										
WTS	.001	.001	.001	.001	.001										
Years	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	WTS				
Ages															
1/ 2	.478	-.979	.507	-.110	.582	.173	.061	1.146	-.639	-.743	.000	.335			
2/ 3	.267	.477	.631	.529	-.095	-.022	.272	.102	-.684	.330	.000	.525			
3/ 4	.287	.341	.247	.202	.199	-.261	.128	-.157	-.077	.366	.000	.991			
4/ 5	-.346	.252	-.341	.010	.016	.035	-.126	-.099	.315	-.124	.000	1.000			
5/ 6	-.117	-.762	-.495	-.096	-.299	.277	-.234	-.045	.100	-.096	.000	.670			
6/ 7	-.270	-.002	-.125	-.650	-.266	-.013	-.012	-.256	.450	-.166	.000	.594			
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.047				
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000					
Fishing Mortalities (F)															
	74	75	76	77	78	79									
F-values	.3507	.3237	.3573	.4470	.4102	.3420									
	80	81	82	83	84	85	86	87	88	89					
F-values	.3943	.2314	.2452	.1026	.1255	.1228	.1210	.1348	.1087	.0850					
Selection-at-age (S)															
	1	2	3	4	5	6	7								
S-values	.1973	.6056	1.0000	1.5016	1.6672	1.5196	1.3000								

Table 4.5.7 VIRTUAL POPULATION ANALYSIS From separable VPA.

SPRAT IN FISHING AREAS 22 TO 32

	FISHING MORTALITY COEFFICIENT					VARIABLE NATURAL MORTALITY COEFFICIENT						
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.117	.082	.082	.168	.106	.153	.061	.118	.031	.037	.037	.026
2	.186	.155	.181	.251	.486	.248	.374	.314	.252	.044	.078	.094
3	.367	.328	.297	.434	.293	.392	.365	.245	.335	.109	.096	.130
4	.502	.569	.441	.608	.503	.303	.506	.212	.297	.183	.163	.181
5	.407	.504	.685	.515	.773	.548	.446	.227	.312	.129	.254	.165
6	.588	.416	.566	.704	.511	.444	.654	.475	.322	.122	.189	.176
7	.451	.383	.648	.591	.376	.767	.559	.346	.587	.223	.164	.160
8+	.451	.383	.648	.591	.376	.767	.559	.346	.587	.223	.164	.160
(2- 6)U	.410	.394	.434	.502	.513	.387	.469	.295	.304	.117	.156	.149
	1986	1987	1988	1989	1974-87							
1	.047	.019	.014	.017	.077							
2	.074	.051	.088	.071	.199							
3	.117	.122	.133	.083	.259							
4	.169	.232	.157	.109	.348							
5	.226	.230	.152	.155	.387							
6	.183	.248	.153	.117	.400							
7	.148	.232	.110	.120	.403							
8+	.148	.232	.110	.120	.403							
(2- 6)U	.154	.177	.137	.107								

Table 4.5.9

List of input variables for the ICES prediction program.

SPRAT IN TOTAL BALTIC

The reference F is the mean F for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1990	56000.0
1991	27167.0
1992	27167.0

Proportion of F (fishing mortality) effective before spawning: .4000

Proportion of M (natural mortality) effective before spawning: .4000

Data are printed in the following units:

Number of fish: millions
 Weight by age group in the catch: gram
 Weight by age group in the stock: gram
 Stock biomass: tonnes
 Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	56000.0	.02	.27	.00	7.920	8.300
2	42029.0	.07	.27	.70	9.907	12.000
3	3452.0	.08	.27	1.00	13.330	14.300
4	17814.0	.11	.27	1.00	14.837	14.800
5	3041.0	.16	.27	1.00	15.767	16.000
6	3824.0	.12	.27	1.00	16.343	17.000
7	2741.0	.12	.27	1.00	17.033	17.500
8+	3642.0	.12	.27	1.00	17.580	17.700

Table 4.5.10

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

SPRAT IN TOTAL BALTIC

Year 1990					Year 1991					Year 1992	
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.11	1508	770	82	.0	.00	1544	1048	0	1579	1148
					.1	.01		1044	10	1568	1134
					.2	.02		1040	21	1558	1120
					.4	.04		1032	41	1537	1093
					.6	.06		1024	60	1516	1067
					.8	.09		1016	80	1496	1042
					1.0	.11		1008	99	1477	1017
					1.2	.13		1000	117	1458	993
					1.4	.15		992	136	1439	970
					1.6	.17		985	154	1420	947
					1.8	.19		977	171	1402	925
					2.0	.21		970	188	1385	903

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for the time of spawning.

The spawning stock biomass for 1992 has been calculated with the same fishing mortality as for 1991.

The reference F is the mean F for the age group range from 2 to 6

Table 4.5.11 Sprat in Sub-divisions 22-32. Detailed prediction.

SPRAT IN TOTAL BALTIC

 * Year 1990. F-factor 1.000 and reference F .1070 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0170	827.57	6554.4	5600	464799	.0	0	.0	0
2	.0710	2528.50	25049.0	42029	504348	29420.3	353043	25669.0	308028
3	.0830	241.41	3217.9	3452	49363	3452.0	49363	2997.4	42863
4	.1090	1616.16	23978.5	17814	263647	17814.0	263647	15308.1	226560
5	.1550	383.99	6054.3	3041	48656	3041.0	48656	2565.6	41049
6	.1170	371.00	6063.4	3824	65008	3824.0	65008	3275.6	55684
7	.1200	272.37	4639.3	2741	47967	2741.0	47967	2345.1	41039
8+	.1200	361.90	6362.1	3642	64463	3642.0	64463	3115.9	55152
Total		6602.89	81918.8	132543	1508253	63934.3	892149	55276.8	770377

 * Year 1991. F-factor 1.000 and reference F .1070 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0170	401.48	3179.7	27167	225486	.0	0	.0	0
2	.0710	2528.48	25048.8	42028	504343	29420.1	353040	25668.8	308025
3	.0830	2089.93	27858.8	29885	427356	29885.1	427356	25949.7	371080
4	.1090	220.03	3264.6	2425	35894	2425.3	35894	2084.1	30845
5	.1550	1539.83	24277.9	12194	195111	12194.5	195111	10288.1	164609
6	.1170	192.88	3152.4	1988	33797	1988.1	33797	1703.0	28950
7	.1200	258.04	4395.3	2596	45444	2596.8	45444	2221.8	38880
8+	.1200	429.43	7549.4	4321	76493	4321.7	76493	3697.4	65444
Total		7660.10	98726.8	122607	1543929	82831.6	1167140	71612.9	1007837

cont'd.

Table 4.5.11 cont'd.

 * Year 1992. F-factor 1.000 and reference F .1070 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0170	401.48	3179.7	27167	225486	.0	0	.0	0
2	.0710	1226.63	12151.8	20389	244669	14272.4	171268	12452.6	149431
3	.0830	2089.92	27858.6	29884	427353	29884.9	427353	25949.5	371077
4	.1090	1904.90	28262.4	20996	310749	20996.6	310749	18043.0	267036
5	.1550	209.64	3305.3	1660	26563	1660.2	26563	1400.7	22410
6	.1170	773.47	12641.1	7972	135530	7972.4	135530	6829.0	116093
7	.1200	134.16	2285.1	1350	23626	1350.1	23626	1155.1	20214
8+	.1200	465.46	8182.7	4684	82910	4684.2	82910	4007.6	70934
Total		7205.65	97866.8	114104	1476890	80820.8	1178003	69837.5	1017199

Table 4.5.12 Sprat 1987-1989 average of catch in number and mean weight at age.

Age	Sub-div. 22-25		Sub-div. 26+28		Sub-div. 27-29+32		Total
	N	W	N	W	N	W	N
1	94.3	7.2	732.3	7.8	158.7	10.6	985.3
2	129.3	13.1	893.0	11.3	104.0	12.6	1,126.3
3	245.7	14.1	851.3	13.1	169.7	14.2	1,266.7
4	309.3	15.4	694.7	14.3	108.0	15.2	1,112.0
5	280.7	16.7	667.7	15.3	134.3	16.1	1,082.7
6	150.3	17.1	237.7	15.7	68.3	16.7	456.3
7	40.7	17.5	105.3	16.9	56.0	17.0	202.0
8	8.0	19.9	34.0	18.0	69.7	16.9	111.7
SUM	1258.3		4216.0		868.7		6,343.0

Age	Sub-div. 22-25		Sub-div. 26+28		Sub-div. 27-29+32		Total catch N:R	
	SQC 90	SQC 91	SQC 90	SQC 91	SQC 90	SQC 91	1990	1991
1	574	279	4,767	2,313	1,994	683	828	401
2	3,793	3,793	22,559	22,559	2,942	2,942	2,529	2,528
3	659	5,702	2,117	18,331	460	3,094	241	2,090
4	6,942	045	14,424	1,964	2,391	326	1,616	220
5	1,667	6,685	3,621	14,519	765	3,070	384	1,540
6	2,085	1,083	3,035	1,577	928	492	381	103
7	960	910	2,398	2,272	1,286	1,218	272	258
8	516	613	1,984	2,354	3,813	4,525	362	420
Total	17,195		54,906		13,994		86,095	
Ton		20,009		65,889		17,230		103,128

Predicted status quo catches for 1990 and 1991 distributed in sub-areas according to catches and mean weights (1987-1989).

Table 5.1 HERRING effort and CPUE for 1988.

Sub-division and country	Total catch (t)	Pelagic trawl			Bottom trawl			Trap net		
		Catch (t)	Trawling days	Catch per day (t)	Catch (t)	Trawling days	Catch per day (t)	Catch (t)	No. of nets	Catch per net (t)
22										
Denmark	23,987	-	-	-	-	-	-	-	-	-
German Dem.Rep.	-	-	-	-	-	-	-	-	-	-
Germany, Fed.Rep.	4,937	-	-	-	-	-	-	-	-	-
Total	28,924	-	-	-	-	-	-	-	-	-
23										
Denmark	102	-	-	-	-	-	-	-	-	-
Sweden	117	-	-	-	-	-	-	-	-	-
Total	219	-	-	-	-	-	-	-	-	-
24										
Denmark	9,088	-	-	-	-	-	-	-	-	-
German Dem.Rep. ¹	49,488	49,488	12,372	4	-	-	-	-	-	-
Germany, Fed.Rep.	251	-	-	-	-	-	-	-	-	-
Poland ⁵	6,590	1,711	920	1.86	-	-	-	-	-	-
Sweden	4,586	2,945	1,722	1.71	-	-	-	-	-	-
USSR	-	-	-	-	-	-	-	-	-	-
Total	70,003	-	-	-	-	-	-	-	-	-
25										
Denmark	10,794	-	-	-	-	-	-	-	-	-
German Dem.Rep. ⁶	3,866	-	-	-	-	-	-	-	-	-
Germany, Fed.Rep.	-	-	-	-	-	-	-	-	-	-
Poland ⁵	36,777	26,152	727	3.59	-	-	-	-	-	-
Sweden	16,941	5,557	3,185	1.745	-	-	-	-	-	-
USSR	9,051	-	-	-	-	-	-	-	-	-
Total	77,429	-	-	-	-	-	-	-	-	-

cont'd.

Table 5.1 (cont'd) 1988

Sub-division and country	Total catch (t)	Pelagic trawl			Bottom trawl			Trap net		
		Catch (t)	Trawling days	Catch per day (t)	Catch (t)	Trawling days	Catch per day (t)	Catch (t)	No. of nets	Catch per net (t)
26										
German Dem. Rep.	102	-	-	-	-	-	-	-	-	-
Poland ³	20,379	6,786	3,310	2.05	-	-	-	-	-	-
Sweden ⁵	24	14	158	0.086	-	-	-	-	-	-
USSR ¹	26,767	16,687	1,512	7.2	-	-	-	10,080	90	112
Total	47,272	-	-	-	-	-	-	-	-	-
27										
Finland	115	115	15	7.7	-	-	-	-	-	-
Poland ⁵	-	-	-	-	-	-	-	-	-	-
Sweden ⁵	14,366	14,366	3,807	3.774	-	-	-	-	-	-
USSR	4,795	-	-	-	-	-	-	-	-	-
Total	19,276	-	-	-	-	-	-	-	-	-
28 (except Gulf of Riga)										
German Dem. Rep.	82	-	-	-	-	-	-	-	-	-
Finland ³	1,869	1,860	197	9.4	9	2	4.5	-	-	-
Sweden ⁵	1,319	122	240	0.51	-	-	-	-	-	-
USSR ²	16,894	16,894	1,714	6.1	-	-	-	-	-	-
Total	20,164	-	-	-	-	-	-	-	-	-
28 Gulf of Riga										
USSR ²	19,779	11,582	658	6.0	-	-	-	8,190	165	49.6
Total	39,914	-	-	-	-	-	-	-	-	-

(cont'd)

Table 5.1 (cont'd) 1988

Sub-division and country	Total catch (t)	Pelagic trawl			Bottom trawl			Trap net		
		Catch (t)	Trawling days	Catch per day (t)	Catch (t)	Trawling days	Catch per day (t)	Catch (t)	No. of nets	Catch per net (t)
29S										
Finland	1,600	1,404	143	9.8	196	51	3.8	-	-	-
German Dem.Rep.	-	-	-	-	-	-	-	-	-	-
Sweden	100	-	-	-	-	-	-	-	-	-
USSR ²	22,423	17,593	1,296	7.6	-	-	-	4,830	115	42
Total	24,123	-	-	-	-	-	-	-	-	-
29N										
Finland	35,424	17,862	3,643	4.9	7,237	1,923	3.8	5,376	439	12.2
Sweden	648	-	-	-	-	-	-	-	-	-
Total	36,072	-	-	-	-	-	-	-	-	-
30										
Finland	24,478	13,202	1,895	7.0	2,513	495	5.1	7,982	877	9.1
Sweden	3,172	-	-	-	-	-	-	-	-	-
Total	27,650	-	-	-	-	-	-	-	-	-
31										
Finland	8,501	2,967	1,217	2.4	4,625	2,378	1.9	706	182	3.9
Sweden	267	-	-	-	-	-	-	-	-	-
Total	8,768	-	-	-	-	-	-	-	-	-
32										
Finland	19,135	7,959	3,335	2.4	665	303	2.2	6,965	335	20.8
USSR ²	23,140	21,193	1,153	5.6	-	-	-	1,940	130	14.9
Total	42,275	-	-	-	-	-	-	-	-	-

¹ Catch per pair of vessels (150-300 HP) with pair trawl.

² Catch per pair of vessels (80-150 HP) with pair trawl.

³ Standardized effort.

⁴ 26 meter cutters, pelagic pair trawling system, catch per vessel.

⁵ Trawling hours, catch per hour.

Table 5.2 HERRING effort and CPUE for 1989.

Sub-division and country	Total catch (t)	Pelagic trawl			Bottom trawl			Trap net		
		Catch (t)	Trawling days	Catch per day (t)	Catch (t)	Trawling days	Catch per day (t)	Catch (t)	No. of nets	Catch per net (t)
22										
Denmark	15,419	-	-	-	-	-	-	-	-	-
German Dem.Rep.	366	-	-	-	-	-	-	-	-	-
Germany, Fed.Rep.	4,943	-	-	-	-	-	-	-	-	-
Total	20,728	-	-	-	-	-	-	-	-	-
23										
Denmark	1,528	-	-	-	-	-	-	-	-	-
Sweden	102	-	-	-	-	-	-	-	-	-
Total	1,630	-	-	-	-	-	-	-	-	-
24										
Denmark	6,311	-	-	-	-	-	-	-	-	-
German Dem.Rep. ⁴	50,841	14,243	3,006	4.74	-	-	-	-	-	-
Germany, Fed.Rep.	223	-	-	-	-	-	-	-	-	-
Poland ⁵	8,524	2,092	854	2.45	-	-	-	-	-	-
Sweden ⁵	6,327	5,019	3,214	1.56	-	-	-	-	-	-
USSR	-	-	-	-	-	-	-	-	-	-
Total	72,226	-	-	-	-	-	-	-	-	-
25										
Denmark	7,313	-	-	-	-	-	-	-	-	-
German Dem.Rep. ⁴	2,302	1,683	587	2.87	-	-	-	-	-	-
Poland ⁵	33,602	25,834	8,361	3.09	-	-	-	-	-	-
Sweden ⁵	18,676	7,965	4,051	1.97	-	-	-	-	-	-
USSR	8,756	8,750	-	-	-	-	-	-	-	-
Total	70,649	-	-	-	-	-	-	-	-	-

cont'd.

Table 5.2 (cont'd) 1989

Sub-division and country	Total catch (t)	Pelagic trawl			Bottom trawl			Trap net		
		Catch (t)	Trawling days	Catch per day (t)	Catch (t)	Trawling days	Catch per day (t)	Catch (t)	No. of nets	Catch per net (t)
26										
German Dem.Rep. ⁴	357	357	98	3.64	-	-	-	-	-	-
Poland ⁵	18,152	5,148	1,619	3.18	-	-	-	-	-	-
Sweden ⁵	146	139	85	1.64	-	-	-	-	-	-
USSR ¹	21,495	12,095	960	8.0	-	-	-	9,400	89	105.6
Total	40,150	-	-	-	-	-	-	-	-	-
27										
Finland	450	450	59	7.7	-	-	-	-	-	-
German Dem.Rep. ⁴	96	96	29	3.32	-	-	-	-	-	-
Sweden ⁵	35,552	29,213	7,793	3.75	-	-	-	-	-	-
USSR	5,858	5,858	-	-	-	-	-	-	-	-
Total	41,956	-	-	-	-	-	-	-	-	-
28 (except Gulf of Riga)										
German Dem.Rep.	865	865	292	2.96	-	-	-	-	-	-
Finland	1,586	1,578	167	9.4	8	2	4.0	-	-	-
Sweden ⁵	1,263	119	127	0.94	-	-	-	-	-	-
USSR ²	17,488	17,326	1,857	6.1	-	-	-	162	-	-
Total	21,202	-	-	-	-	-	-	-	-	-
28 Gulf of Riga										
USSR ²	22,676	13,771	454	6.9	-	-	-	8,905	197	45.2
Total	22,676	-	-	-	-	-	-	-	-	-

cont'd.

Table 5.2 (cont'd) 1989

Sub-division and country	Total catch (t)	Pelagic trawl			Bottom trawl			Trap net		
		Catch (t)	Trawling days	Catch per day (t)	Catch (t)	Trawling days	Catch per day (t)	Catch (t)	No. of nets	Catch per net (t)
29S										
Finland	1,692	1,485	151	9.8	207	54	3.8	-	-	-
Sweden	84	-	-	-	-	-	-	-	-	-
USSR ²	27,127	21,852	1,061	6.7	-	-	-	5,775	172	33.5
Total	28,903	-	-	-	-	-	-	-	-	-
29N										
Finland	30,799	13,930	2,841	4.9	6,292	1,672	3.8	4,674	382	12.2
Sweden	675	-	-	-	-	-	-	-	-	-
Total	31,474	-	-	-	-	-	-	-	-	-
30										
Finland	26,989	14,556	2,089	7.0	2,771	546	5.1	8,801	967	9.1
Sweden	3,242	-	-	-	-	-	-	-	-	-
Total	30,231	-	-	-	-	-	-	-	-	-
31										
Finland	3,783	1,320	879	1.5	2,058	1,719	1.2	314	132	2.4
Sweden	432	-	-	-	-	-	-	-	-	-
Total	4,215	-	-	-	-	-	-	-	-	-
32										
Finland	17,871	5,533	2,738	2.4	621	283	2.2	6,505	313	20.8
USSR ²	18,384	16,383	789	6.1	-	-	-	2,001	135	14.8
Total	36,255	-	-	-	-	-	-	-	-	-

¹ Catch per pair of vessels (150-300 HP) with pair trawl.

² Catch per pair of vessels (80-150 HP) with pair trawl.

³ Standardized effort.

⁴ 26 meter cutters, pelagic pair trawling system, catch per vessel.

⁵ Trawling hours, catch per hour.

Data preliminary.

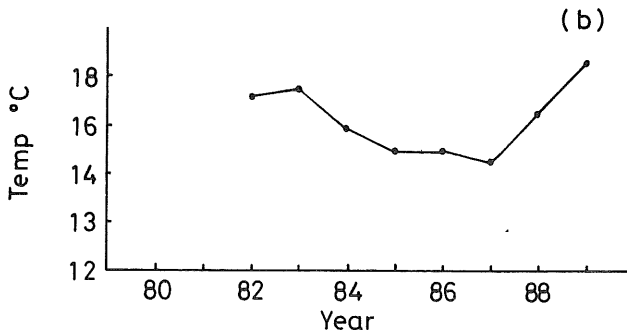
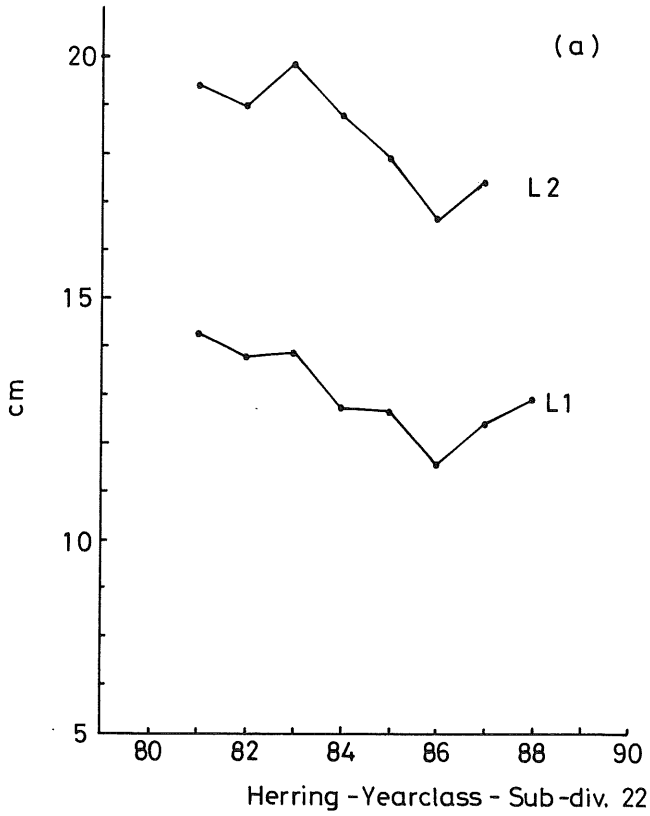


Figure 3.1.1 a) Length at age 1 (L1) and 2 (L2) in herring year classes 1981-1988. estimated by back calculations
 b) Surface water temperature in the 3 quarter in 1982-1988.

Figure 3.1.2 Correlation between L1 and surface water temperature in the third quarter in corresponding year.

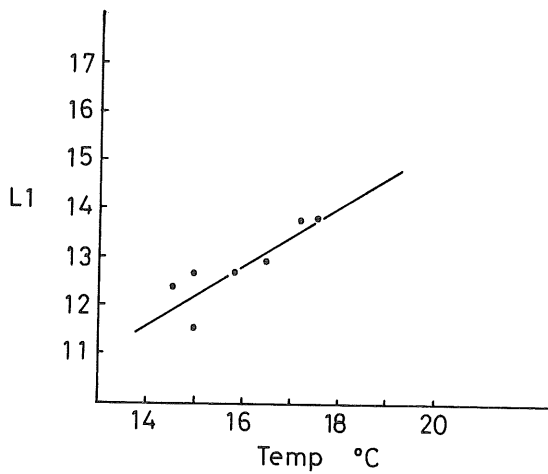
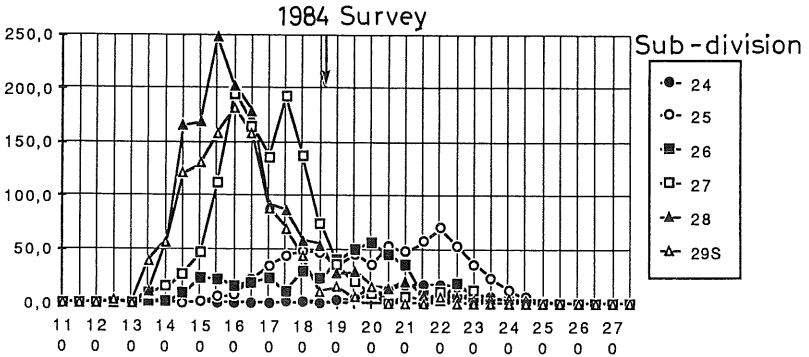
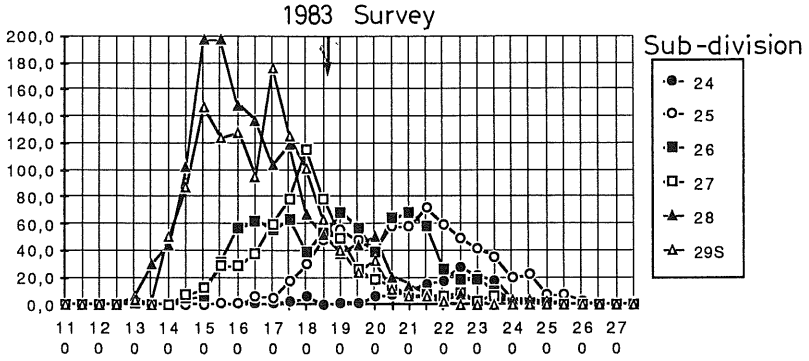


Figure 3.1.3 Herring age group 2. Length frequency distribution by sub-division and from acoustic surveys.



cont'd.

Figure 3.1.3 cont'd.

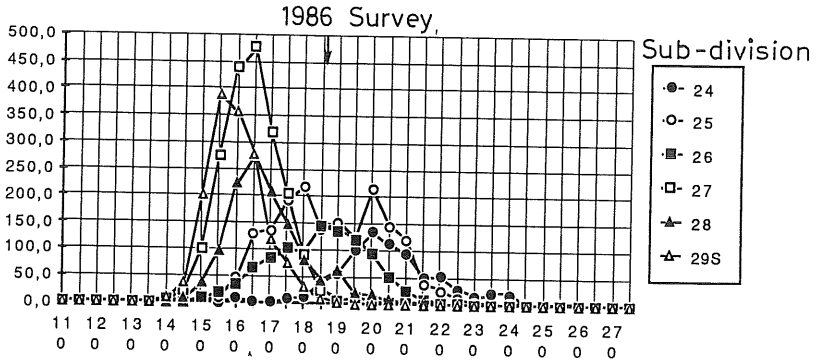
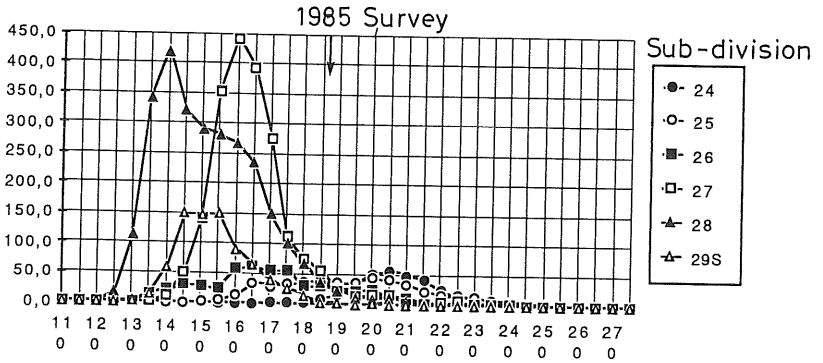
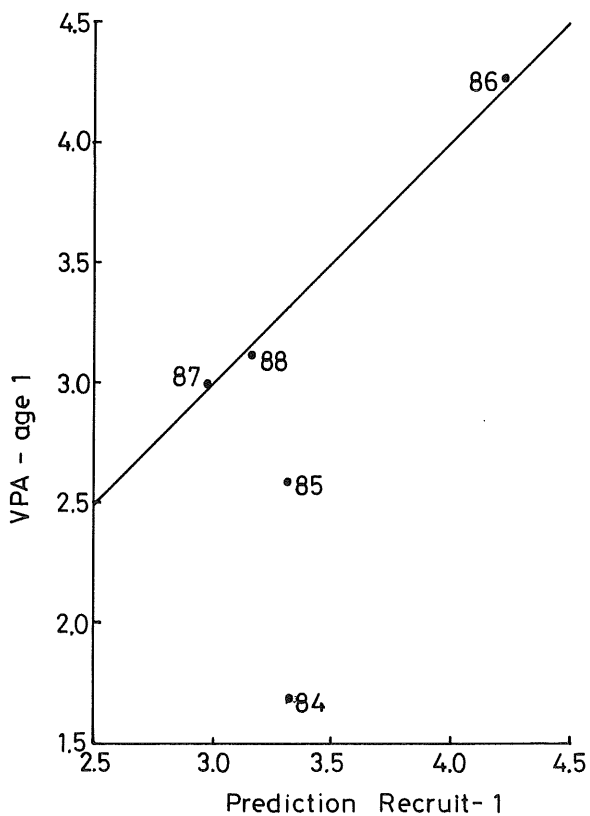


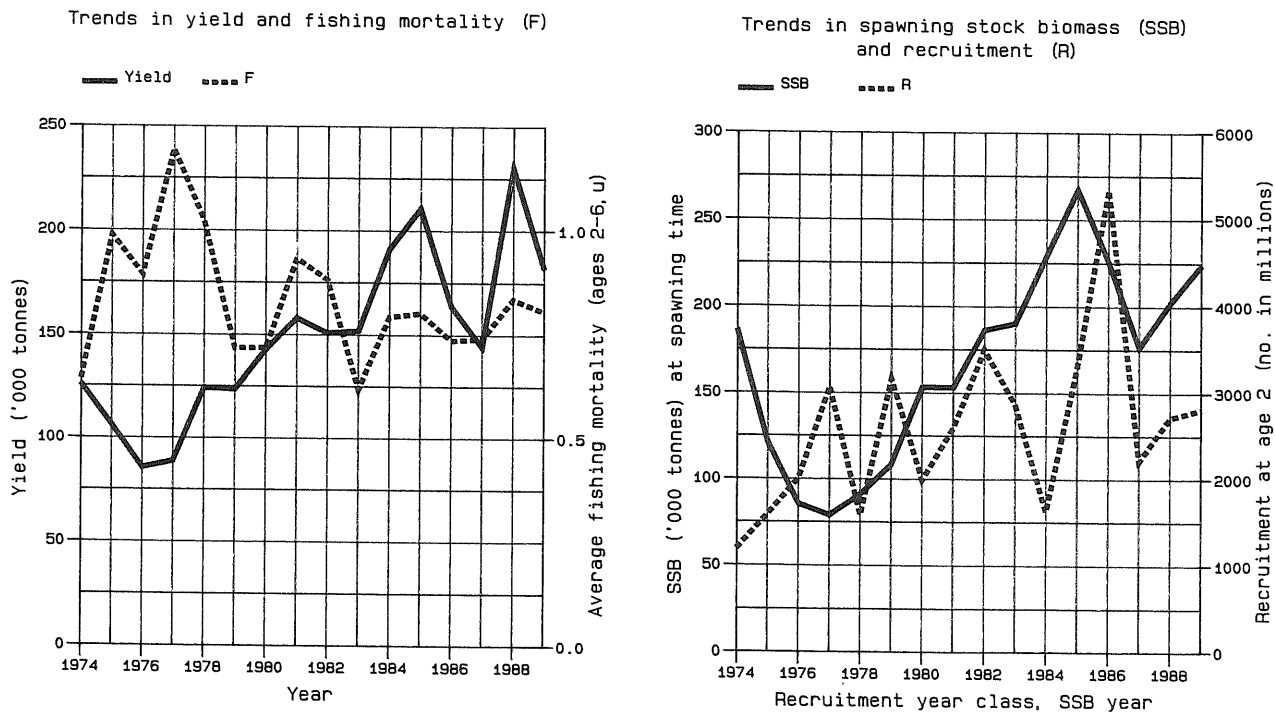
Figure 3.2.5 Herring Sub-divisions 22-24.
Prediction of age 1 in numbers ($\times 10^9$)
versus VPA for the year classes 1984 to
1989.



FISH STOCK SUMMARY

STOCK: Herring in the Western Baltic and Kattegat 07-05-1990

Figure 3.2.6



A

B

cont'd.

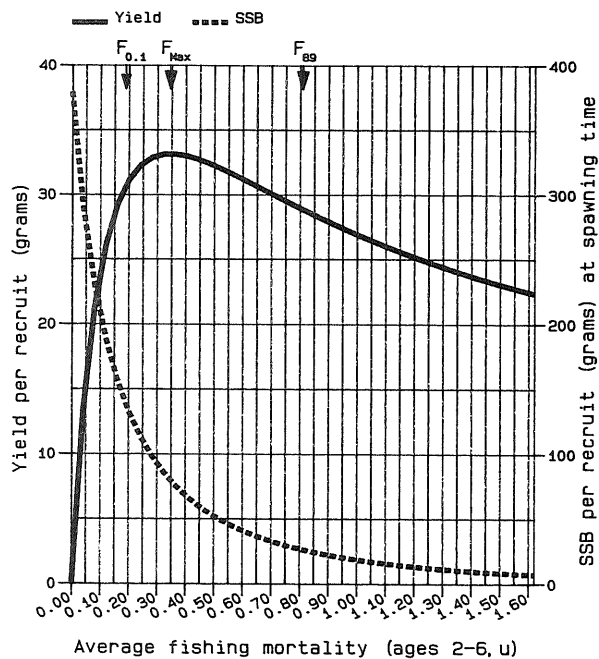
Figure 3.2.6 cont'd.

FISH STOCK SUMMARY

STOCK: Herring in the Western Baltic and Kattegat

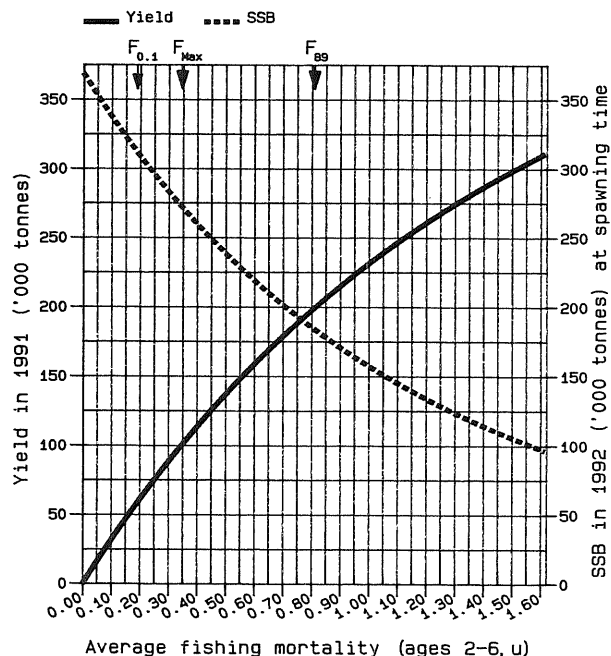
07-05-1990

Long-term yield and spawning stock biomass



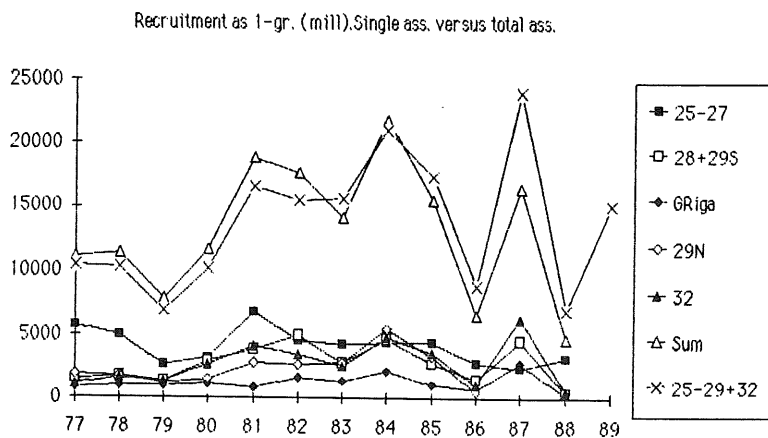
C

Short-term yield and spawning stock biomass



D

Figure 3.3.2 Comparison of combined and "small area" assessments of herring in Sub-divisions 25-29, 32 and the Gulf of Riga.



Spawning stock biomass (000) t. Single ass. versus total ass.

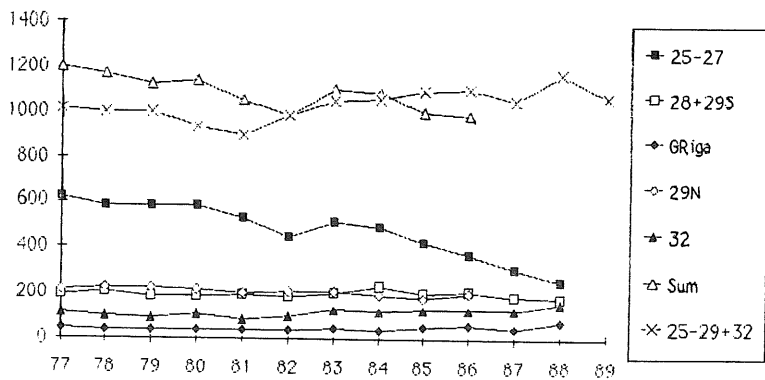
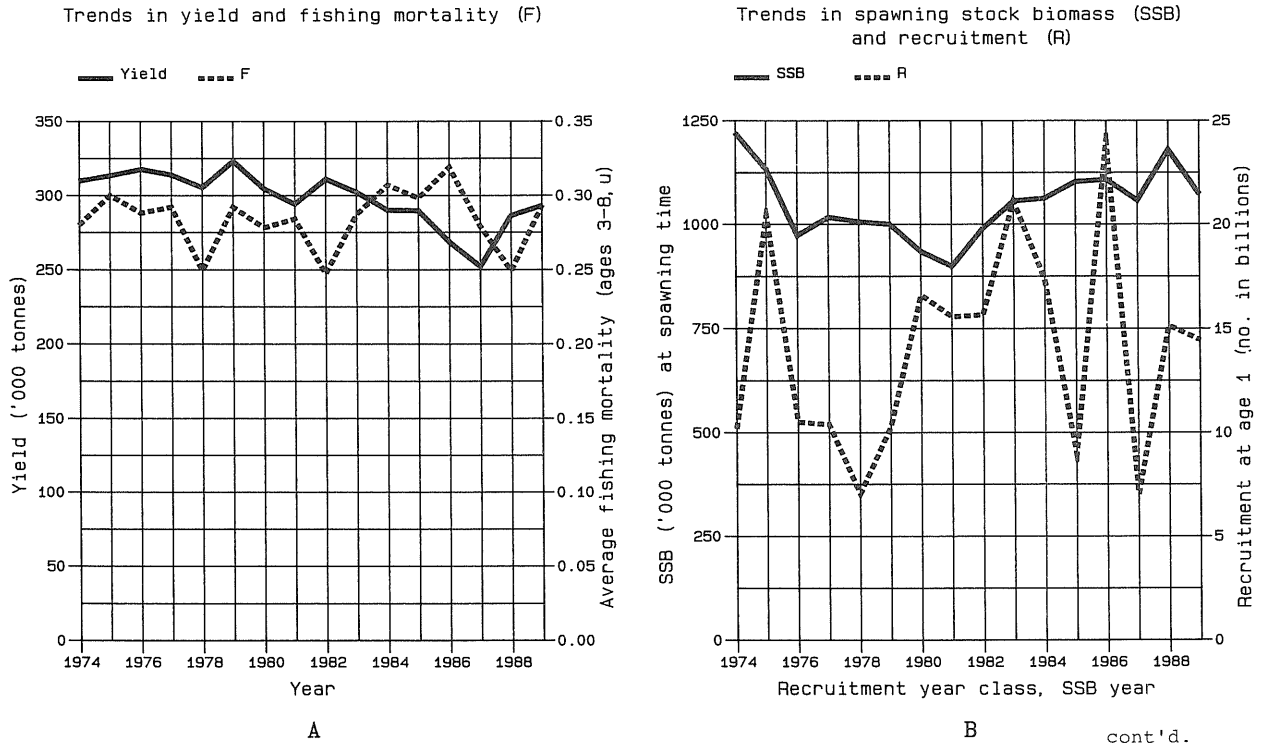


Figure 3.3.3

FISH STOCK SUMMARY

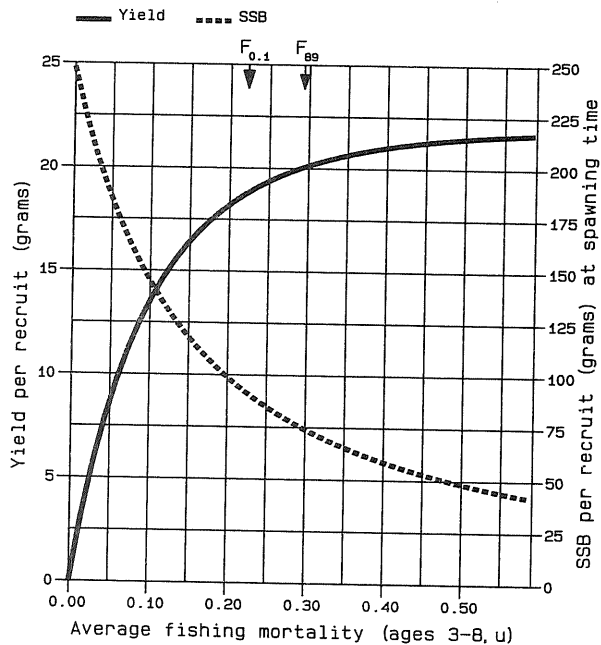
STOCK: Herring - Areas 25-29 plus Gulf of Riga 07-05-1990



FISH STOCK SUMMARY

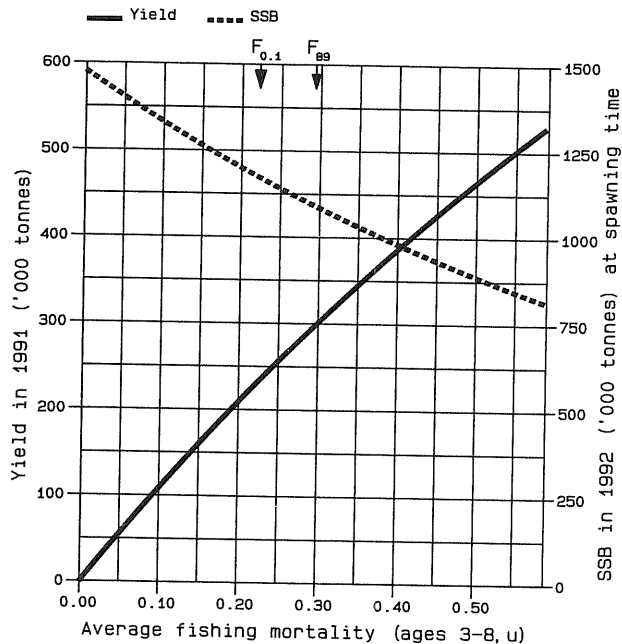
STOCK: Herring - Areas 25-29 plus Gulf of Riga
07-05-1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass

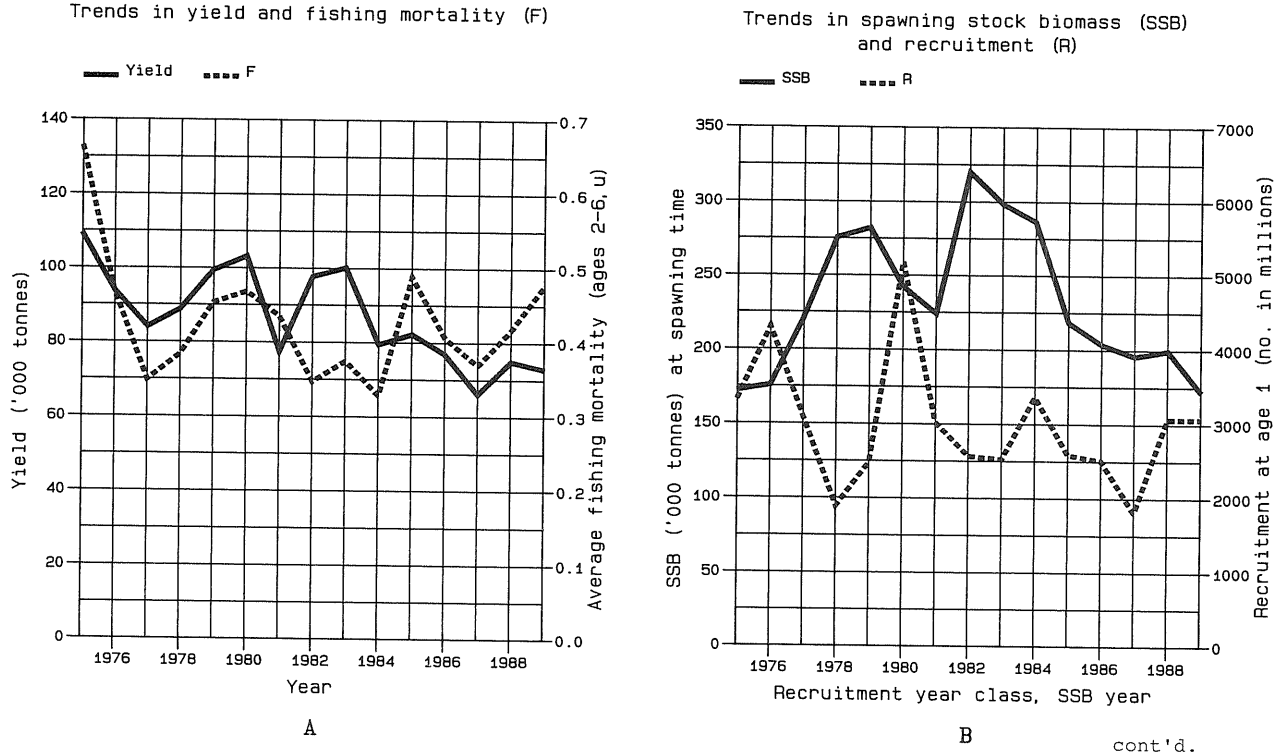


D

FISH STOCK SUMMARY

STOCK: Herring - Coastal Areas 25-27 07-05-1990

Figure 3.3.4

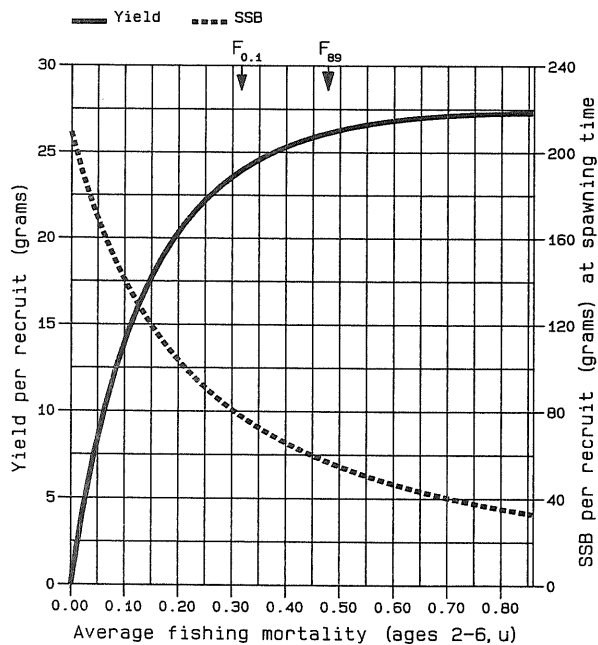


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Figure 3.3.4 cont'd.

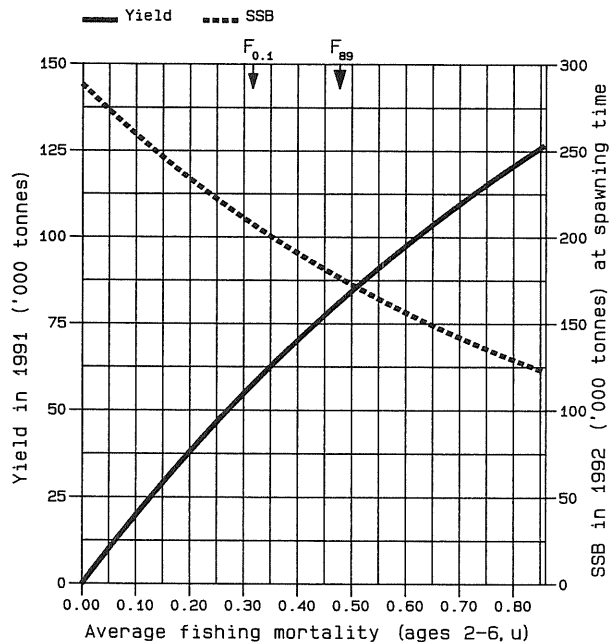
FISH STOCK SUMMARY
STOCK: Herring - Coastal Areas 25-27
07-05-1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

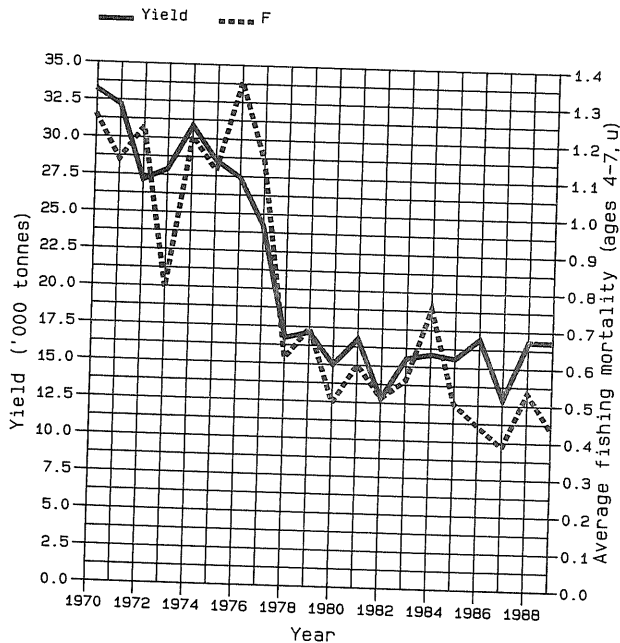
Figure 3.4.1

FISH STOCK SUMMARY

STOCK: Herring - Gulf of Riga

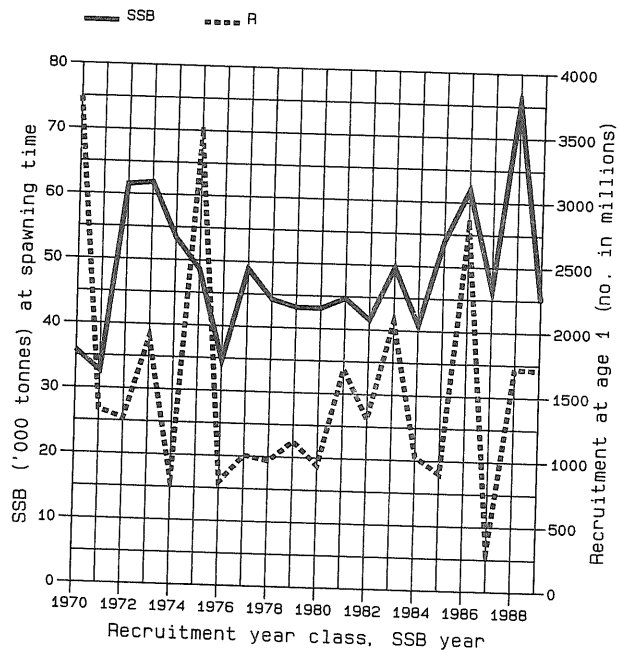
07-05-1990

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



B

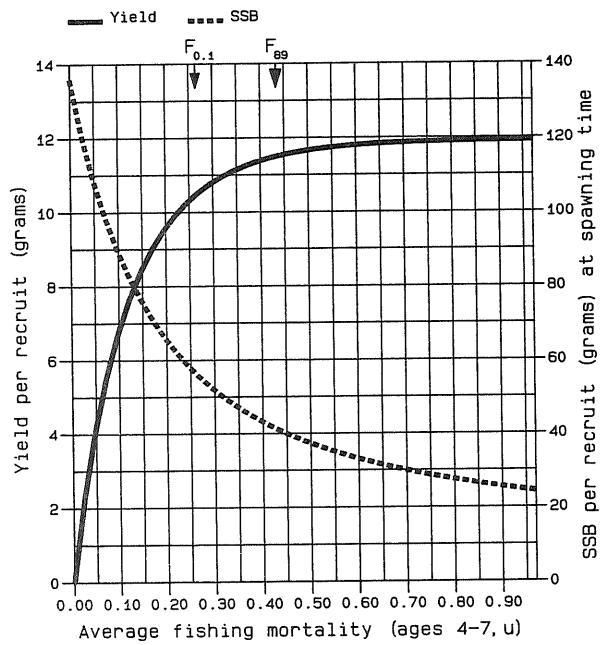
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Figure 3.4.1 cont'd.

FISH STOCK SUMMARY

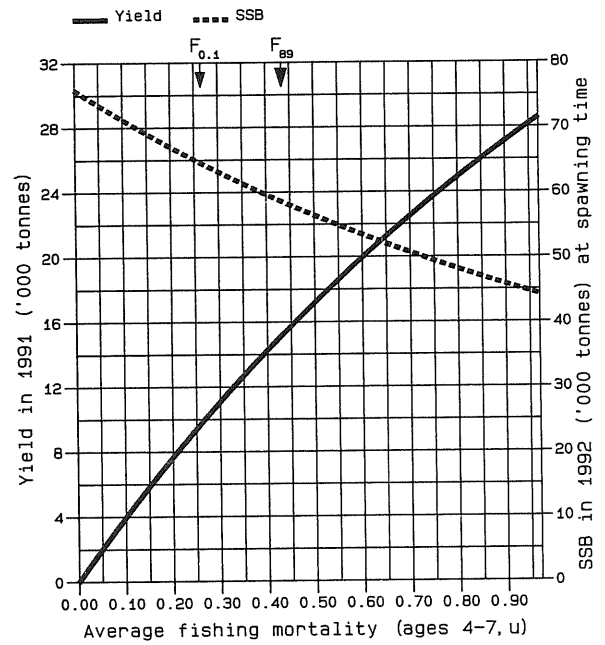
STOCK: Herring - Gulf of Riga
07-05-1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass

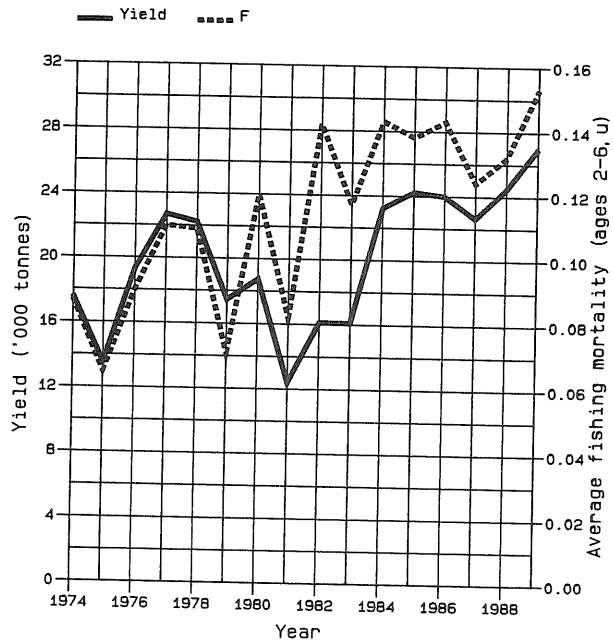


D

FISH STOCK SUMMARY
 STOCK: Herring - 30E
 08-05-1990

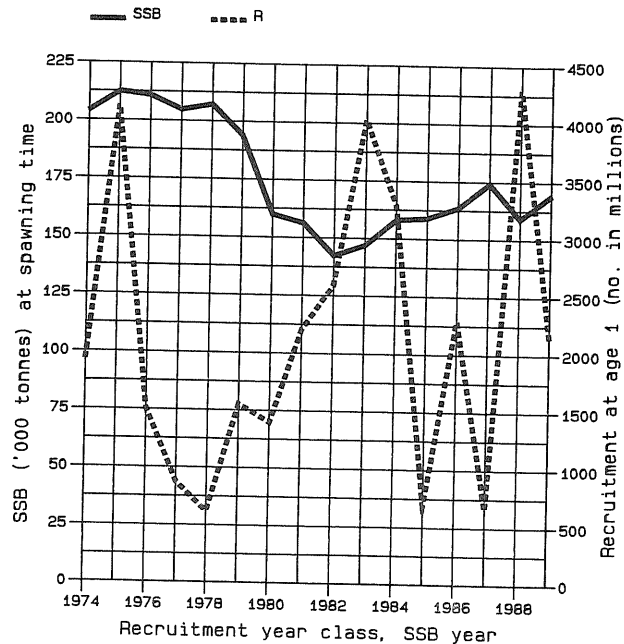
Figure 3.5.1

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



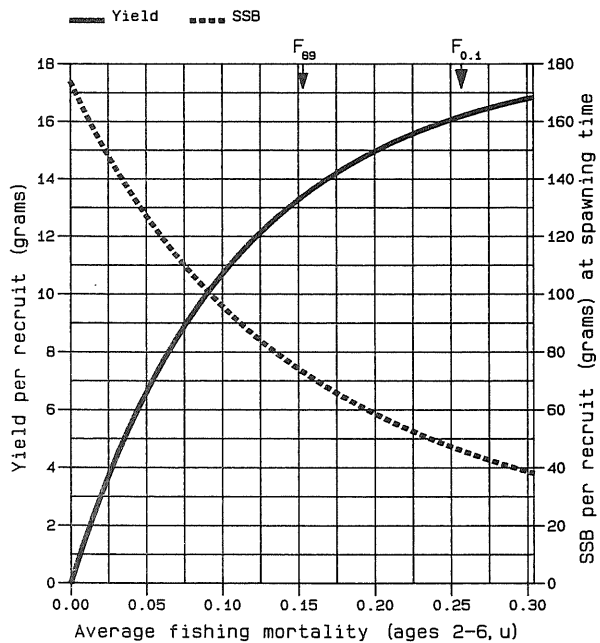
B

cont'd.

Figure 3.5.1 cont'd.

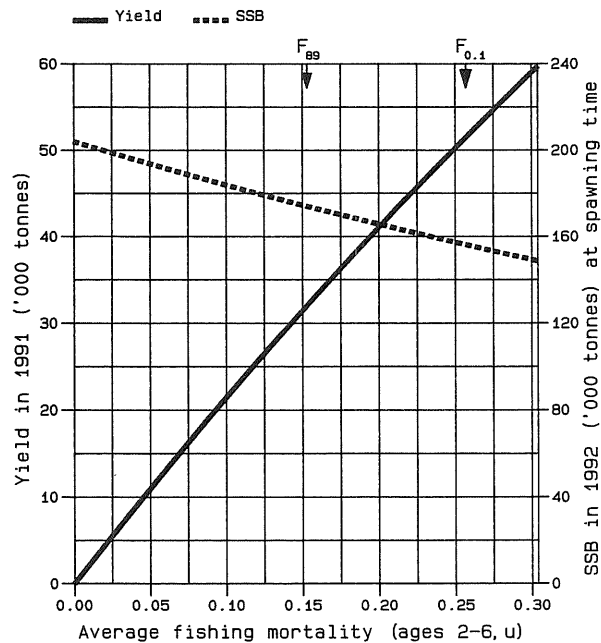
FISH STOCK SUMMARY
 STOCK: Herring - 30E
 08-05-1990

Long-term yield and spawning stock biomass



C

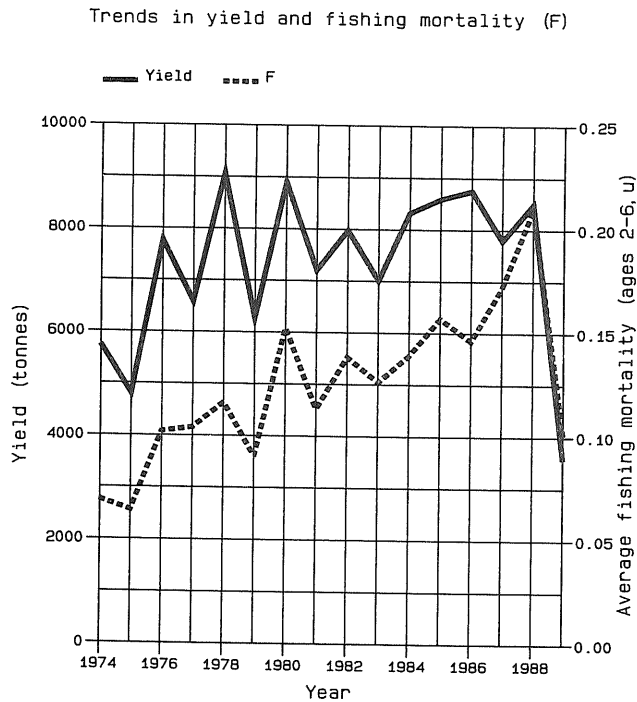
Short-term yield and spawning stock biomass



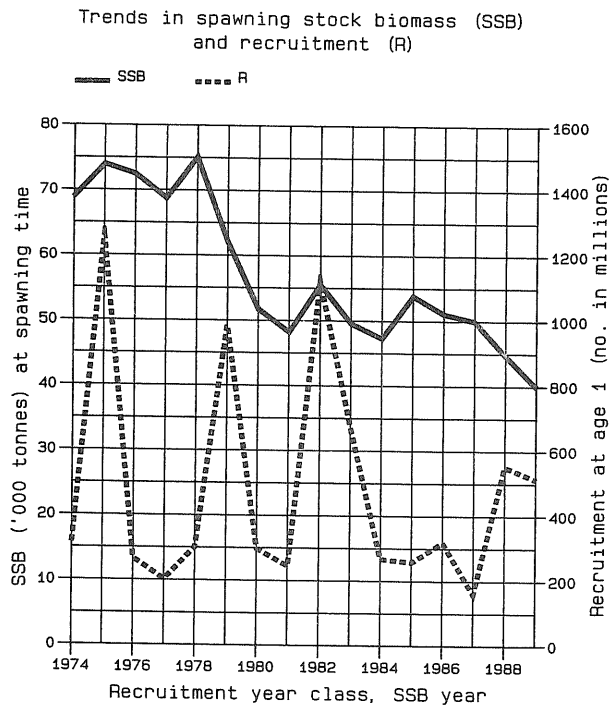
D

Figure 3.6.1

FISH STOCK SUMMARY
 STOCK: Herring - 31E
 07-05-1990



A



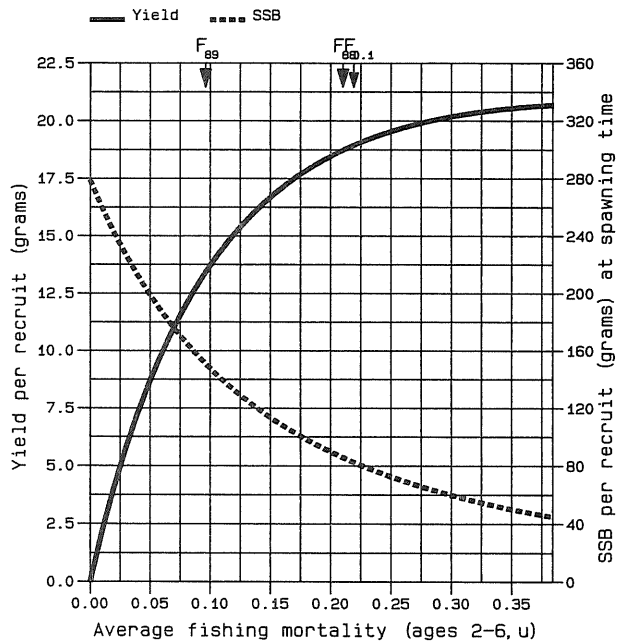
B

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Figure 3.6.1 cont'd.

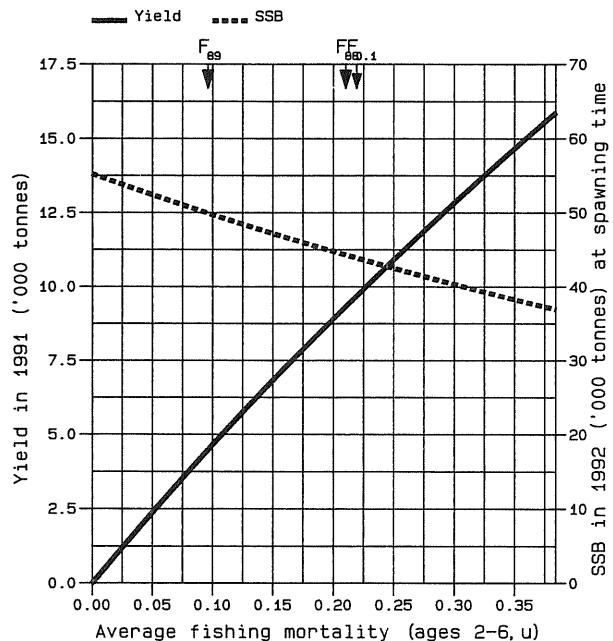
FISH STOCK SUMMARY
 STOCK: Herring - 31E
 07-05-1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

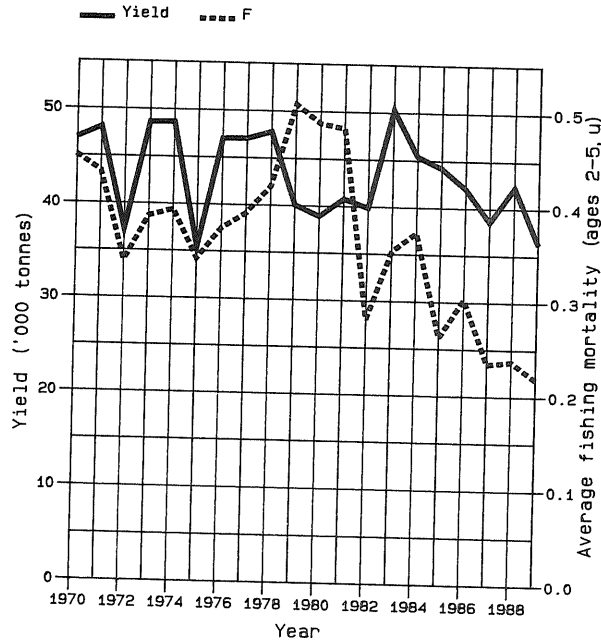
Figure 3.7.1

FISH STOCK SUMMARY

STOCK: Herring - Gulf of Finland

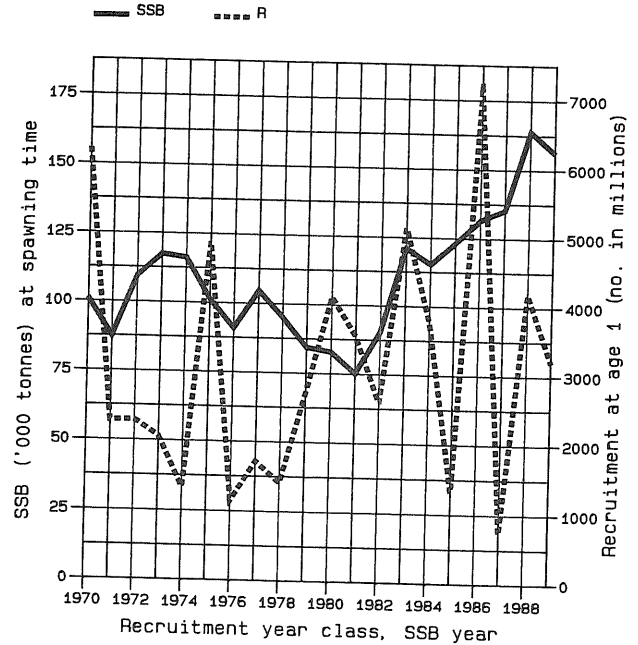
08-05-1990

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



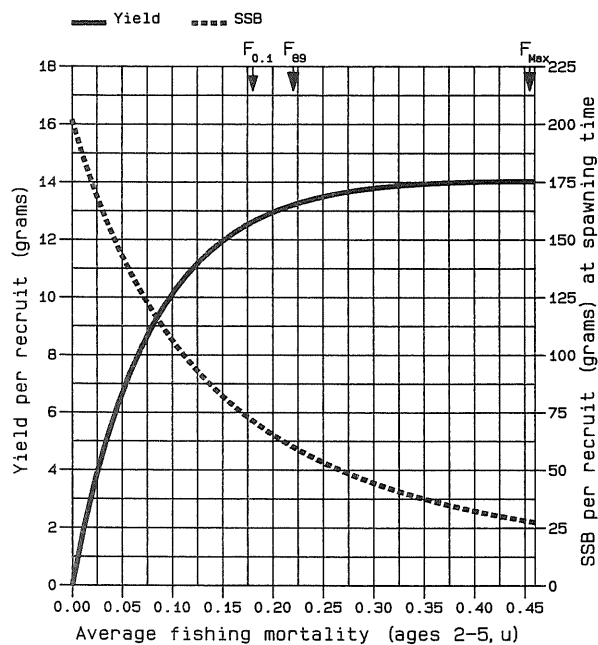
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Figure 3.7.1 cont'd.

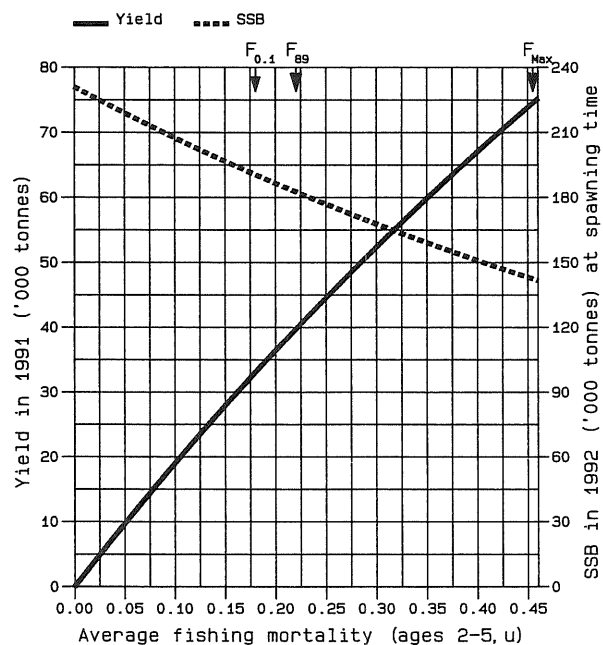
FISH STOCK SUMMARY
STOCK: Herring - Gulf of Finland
08-05-1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass

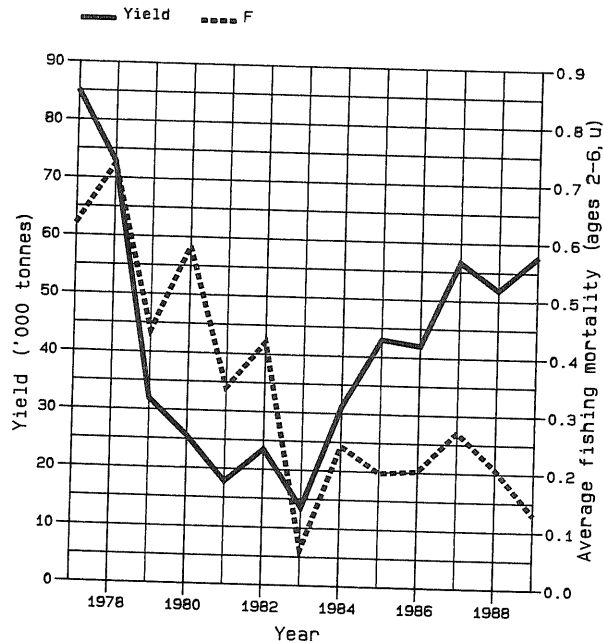


D

Figure 4.3.1

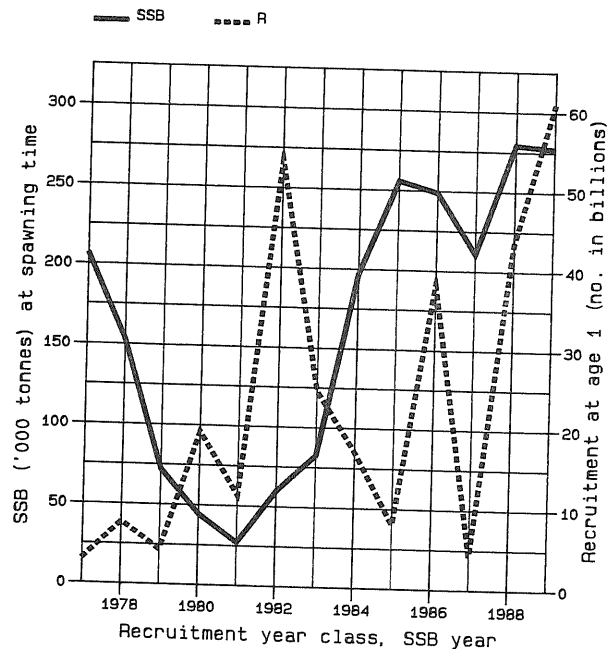
FISH STOCK SUMMARY
 STOCK: Sprat - 26 and 28
 08-05-1990

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



B

cont'd.

Figure 4.3.1 cont'd.

FISH STOCK SUMMARY
STOCK: Sprat - 26 and 28
08-05-1990

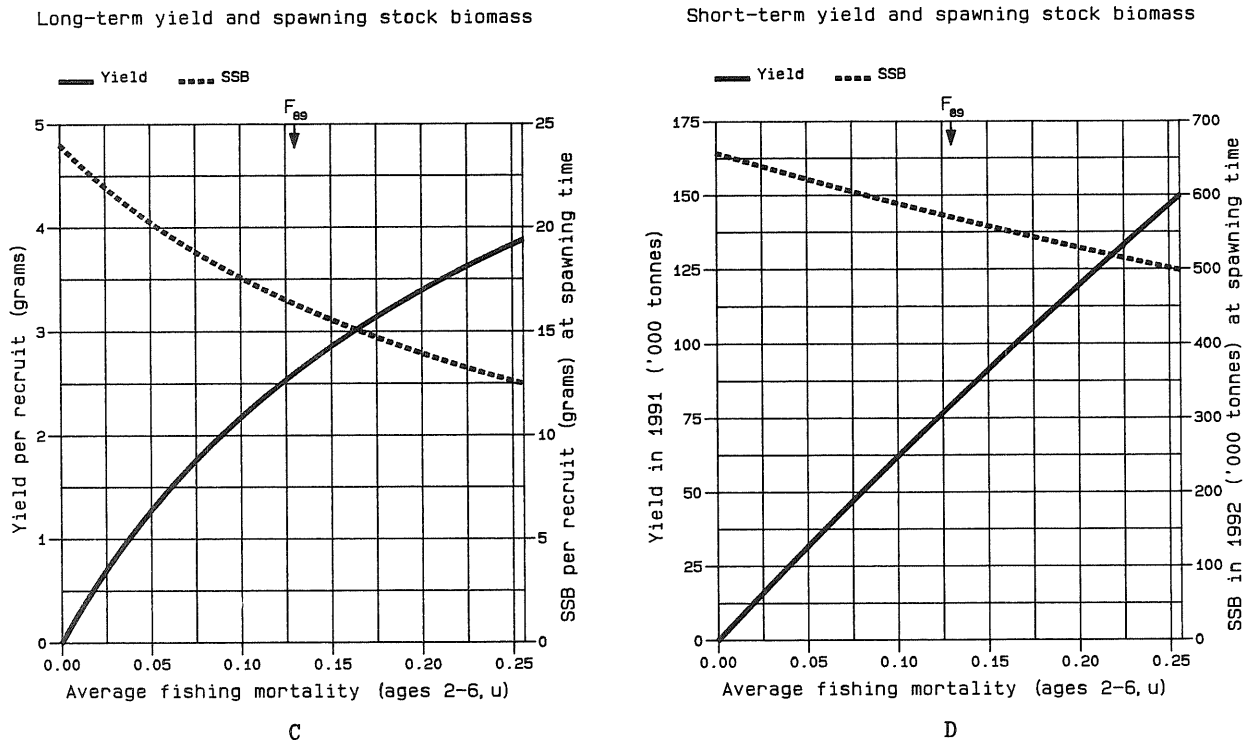


Figure 4.5.1 Natural mortality used for assessment of sprat in Sub-divisions 22-32 (average for ages 1-3) and cod biomass for ages 2+ and spawning stock biomass in Sub-divisions 22-32.

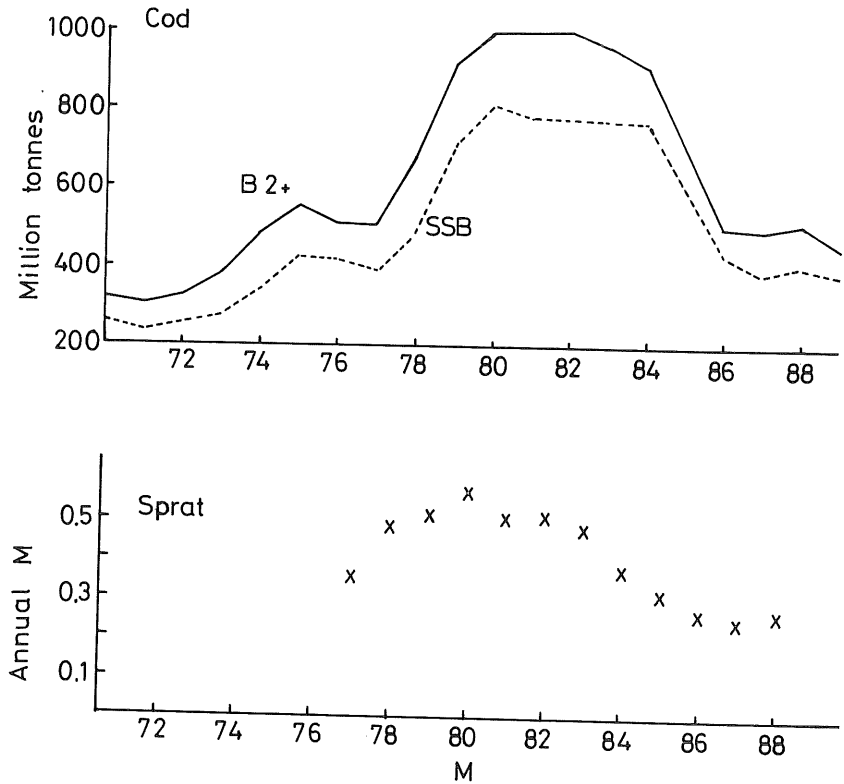
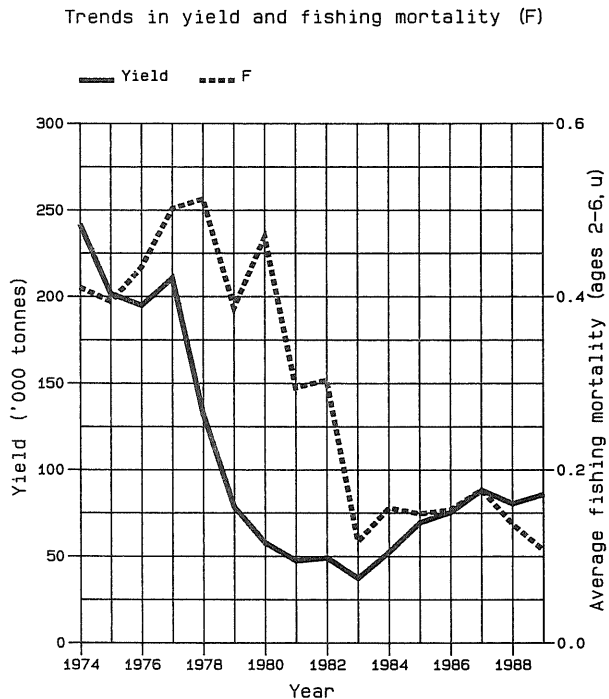


Figure 4.5.2

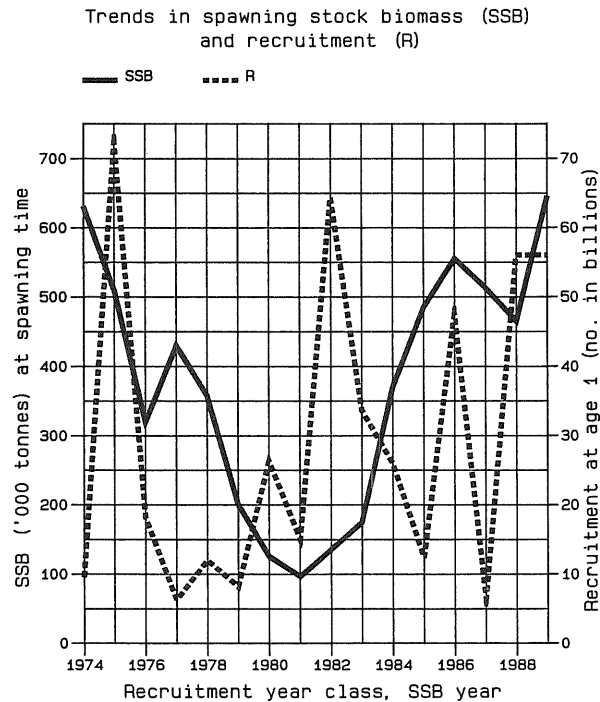
FISH STOCK SUMMARY

STOCK: Sprat - Baltic Areas 22 to 32

08-05-1990



A



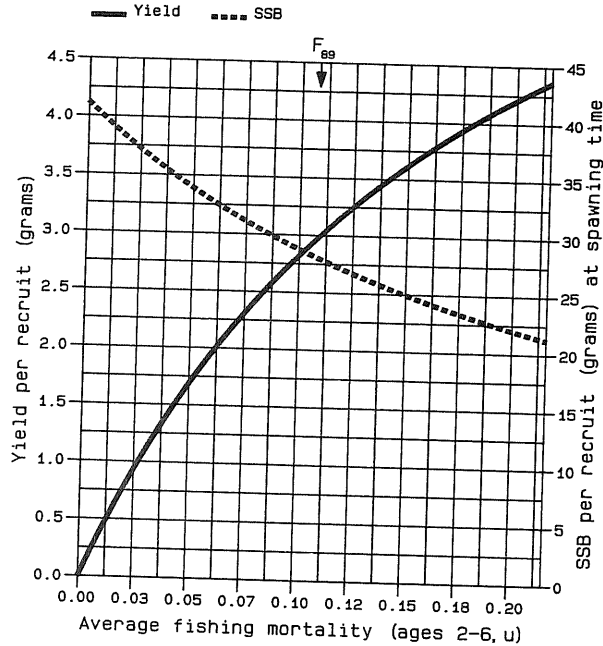
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Figure 4.5.2 cont'd.

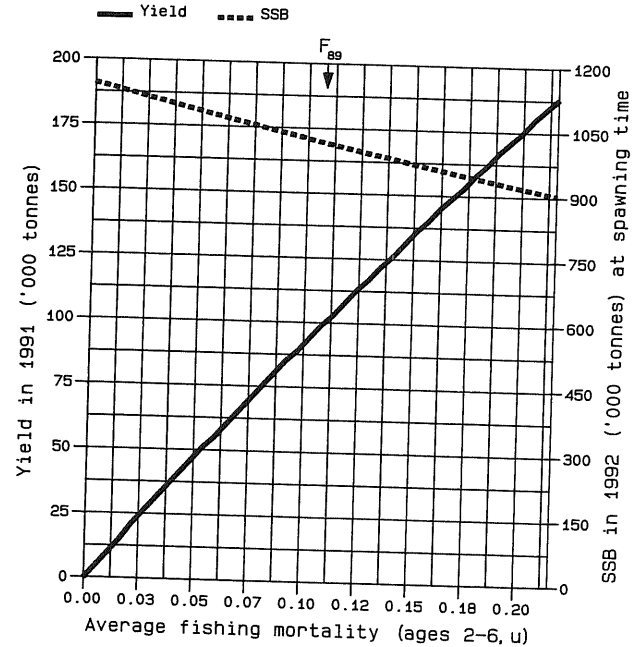
FISH STOCK SUMMARY
 STOCK: Sprat - Baltic Areas 22 to 32
 08-05-1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D