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Report of the

Study Group on Herring Assessment Units in the Baltic Sea

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1 INTRODUCTION

1.1 Terms of Reference

At the 2002 Annual Science Conference it was decided that the Study Group on Herring Assessment Units in the Baltic Sea [SGHAUB] (Chair: G. Kornilovs, Latvia) will meet in Gdynia, Poland from 10 to 14 March 2003 to:

a) finalize the compilation of the assessment data for herring in Subdivisions 25–27 (coastal and open sea herring separately) and in the Subdivisions 28, 29 and 32;
b) perform the assessments for coastal herring in Subdivisions 25–26, for open sea herring in Subdivisions 25–27 and for herring in the Subdivisions 28, 29 and 32.

1.2 Participants

The list of participants is at Annex 1.

2 GENERAL COMMENTS

This report presents three assessments for herring stock components in the Central Baltic (Subdivisions 25–29, 32 Gulf of Riga herring excluded) which were recommended and justified for separable assessment by the Study Group in the previous Reports (ICES 2001a, 2002a):

1) Herring in Subdivisions 28, 29 and 32 (excluding Gulf of Riga herring). The assessments of this herring stock were performed at the Baltic Fisheries Assessment Working Group in 2001 and 2002 (ICES 2001, 2002). The present assessment includes considerable changes of effort and CPUE data.
2) Southern coast herring in Subdivisions 25–26. It is a fast-growing herring stock which is considered to spawn mainly along the southern coast of the Baltic Sea in Subdivisions 25–26 and which does not perform extensive feeding migrations outside the southern Baltic. Firstly it was distinguished by Kompowski (1969). It is distinguished in the catches by Polish and Russian scientists on the basis of otolith structure. The previous assessment of this stock was performed in 1991.
3) Swedish coast herring in Subdivisions 25–27 spawns along the eastern coast of Sweden (Subdivisions 25 and 27) and performs extensive feeding migrations to the southern Baltic where it mixes in Subdivisions 25–26 with the southern coast herring stock. It is distinguished in the herring catches in Subdivisions 25–26 by the Polish and Russian scientists, but the population composition of the catches of other countries in this region is not known. It was assumed that in Subdivision 27 only Swedish coast herring is met. This herring stock component has never been assessed previously.

3 HERRING IN SUBDIVISIONS 28 (GULF OF RIGA HERRING EXCLUDED), 29 AND 32

3.1 Catch trends

Herring fishery in the Subdivisions 28, 29 and 32 was performed by Estonia, Finland, Latvia, Russia and Sweden using both trawls and trap-nets. Herring catches in the Subdivisions 28, 29 and 32 include several local populations. The catches of the Gulf of Riga herring were excluded from present assessment. The general trend of catches in the area has been decline. Catches have been below 100,000 t in the 1990–2000s (app. 80,000 t in 1999–2001, Table 3.1.) The bulk of the catches are taken by pelagic trawl fishery. The role of trap-net catches has been marginal in the last decade.

3.2 Unallocated landings

There is no information on unallocated landings. However, the catch statistics is influenced by the fact the herring/sprat mixed fishery takes the most of the catch.

3.3 Discards

The discards of herring are very rare in the area and have not been recorded by observers working on the fishing vessels.

3.4 Effort and CPUE data

The Group used revised Finnish effort and CPUE data. The number of trap-nets used in herring fishery in the Finnish zone of the Gulf of Finland has decreased from 316 to 11 in 1983–2001 (Table 3.8). The similar trends have been observed also in other parts of the area. At the same time, the effort in Finnish pelagic trawl fishery (hauling hours) has increased in the 1990s, however remaining significantly lower than in 1980s (Table 3.7).

3.5 Age composition

The quarterly national data on catches at age by Subdivision were compiled to get the annual catch in numbers (Table 3.2).

3.6 Mean weight at age

The annual mean weights were compiled by the Subdivision and then combined to obtain the mean weight-at-age for the whole catch (Table 3.3.) The mean weights at age in the stock were assumed to be equal to the mean weights in catches. Similarly to the other regions of the Central and North-eastern Baltic decreasing trend in mean weight at age has stopped in the early 2000s and some increase can be observed.

3.7 Maturity ogive

The Finnish data on proportion of mature at age were used (Table 3.4, ICES 2001).

3.8 Natural mortality

The natural mortality was taken to be the same for the years 1984–2001, i.e., 0.2, but 0.25 for 1983 taking into account high abundance of cod in North-eastern Baltic in 1983 (Table 3.5.).

3.9 Catch at age analysis

The standard input data for XSA (CATON, CANUM, WECA, WEST; NATMOR, proportion of F and M before spawning, proportion of mature and tuning fleet data) are documented in Tables 3.1–3.11.

The following updated and revised datasets were available for tuning of VPA in trial runs (data presented in Tables 3.7–3.11 as TUNING01-TUNING05, respectively):

1) Finnish pelagic trawls in Subdivisions 29 and 32,
2) Finnish trap-nets in Subdivision 32;
3) Acoustic estimates in Subdivisions 28 and 29S;
4) Finnish pelagic trawls in Subdivisions 29 and 32 + Acoustic estimates in Subdivisions 28;
5) Finnish pelagic trawls in Subdivisions 29 and 32 + Acoustic estimates in Subdivisions 28,29S

The data from the trap-net fishery is strongly restricted due to considerable decrease of this metier in the latest years. Therefore this run was rejected. Similarly, the run, tuned with acoustic estimates in Subdivisions 28 and 29S being relatively short and having gaps, showed rather poor diagnostics. The tuning dataset 4 (Finnish pelagic trawls in Subdivisions 29 and 32 + Acoustic estimates in Subdivisions 28) gave the best diagnostics and was used for the final run.

Like in previous assessment of that stock complex, the catchability of age groups <3 was assumed to be dependent of stock size, and the catchability at ages >=6 were assumed to be independent of age in the tuning procedures (Table 3.12). The default level of shrinkage SE=0.5 was used in terminal population estimation.

The residuals of log q over time did not indicate any clear trend during the most recent period (Figure3.1). The assessment reveals a steady decrease of SSB. SSB decreased from 350–380,000 t in mid-1980s to app. 280,000 t in early 1990s. Later on a steady decrease brought the SSB down to present level of 160,000t. A series of poor year-classes in late 1980s may have been the reason for the first drop in the SSB. Later on, decreasing mean weight at age of herring, accompanied by the effect of poor year classes further supported the decreasing trend in SSB.

The landings decreased from 140,000 t to 80,000 t during the period. The fishing mortality, having been rather stable most of the period has increased since the second half of the 1990s.

In general, the new SSB estimates are by app. 30% higher of the estimates obtained in previous assessment. At the same time the fishing mortality appeared to be app. 15% lower (Table 3.14)

The retrospective analysis presented in Figure 3.2 does not show any particular trend.

The fishing mortality, stock numbers and biomasses obtained from the VPA are documented in the Tables 3.13- 3.14.

3.10 Historical stock trends

The resulting estimates of the main stock parameters (Tables 3.13–3.14 and Figure 3.3.) show that the spawning stock biomass of herring in the Subdivisions 28, 29 and 32 (Gulf of Riga herring excluded) has shown a significant drop from almost 400,000 t to 160,000 t in 1983–2001. The mean fishing mortality in age groups 3–7 steadily increased since 1995.

4 SUTHERN COAST HERRING IN SUBDIVISIONS 25 AND 26

4.1 Catch trends

In Subdivisions 25 and 26 herring fishery is performed by Denmark, Poland, Sweden, Russia, Lithuania, Latvia, Estonia (in 1991 only), Finland (in 1999 only) and Germany (in 1994 only). In 1991–1993 the total landings were on the level of 82 000–89 000 t. In 1994 they reached about 104 000 t, but then decreased to 48 000 t in 1999. An increase of the total herring landing in 2000–2001 to about 61 000–66 000 t has been noticed (Tables 4.1.1–4.1.2). The downward trend of total herring catches was mainly connected with decrease of the catches of southern coast herring stock component, which was discriminated on the base of the different otolith structure. The maximum share of southern coast herring in the total catches (72.8%) was observed in 1992. In 1996–2001 (except for 2000) it was on the level of 45–49% (Figure 4.1).

No information was available on unallocated landings and discards.

4.2 Age composition

The Polish herring catches in Subdivision 25 in the period 1991–2001 were available as numbers at age separately for southern coast and Swedish coast herring populations. The proportion and the age composition of southern coast herring in the Polish catches were applied to the catches of other states in Subdivision 25. In Subdivision 26 the same procedure was performed using the Russian data. The total catch in numbers at age of southern coast herring in Subdivisions 25–26 is presented in Table 4.2.1.

4.3 Mean weight at age

The mean weight at age data were obtained in the same manner as catch in numbers at age using for Subdivision 25 Polish data and Russian data for Subdivision 26 (Table 4.3.1).

4.4 Maturity ogive, natural mortality, proportion of F and M before spawning

The natural mortality and maturity ogive were used the same as by Baltic Fisheries Assessment WG for Central Baltic herring (ICES 2001) (Tables 4.4.1–4.4.3).

4.5 Index of stock size from acoustic surveys and commercial CPUE

Stock estimates from the International acoustic surveys for 1994–2001 were compiled. Data were lacking for SD 25 and western part of SD 26 (Polish EEZ) in 1992–1993 (Table 4.5.1).

The number of trap-nets in Russian trap-net fishery on the southern coast herring spawning grounds in the Vistula Lagoon (Subdivision 26) and the numbers at age caught in the trap-net fishery in 1991–2001 were available (Table 4.5.2). In 1991–2001 on average 8.4% of the total catch of the southern coast herring was taken by this fishery.

4.6 Catch at age analysis

The input data to catch at age analysis are presented in Tables 4.1.1., 4.2.1., 4.3.1., 4.4.1.-4.4.3., 4.5.1., 4.5.2. Two tuning data sets were available: one from International Acoustic Survey in Subdivisions 25–26 comprising years 1994–2001 and one from effort - CPUE in Russian trap-net fishery in 1991–2001.

The VPA was tuned using XSA with shrinkage option. After exploration of several XSA runs with varying parameterisation the XSA was finally run with:

- SE of the mean to which estimates shrink equal to 0.5,
- number of years and ages for shrinking mean equal to 3,
- catchability for all ages independent on year class strength,
- catchability independent on age from age 5 and older.

The diagnostic of the XSA (Table 4.6.1) shows that trap-net CPUE fits slightly better to the XSA estimates than survey data. The SE's of log-catchabilities are generally in the range 0.3–0.5 for trapnet CPUE and 0.3–0.6 for acoustic survey index of stock size. Residuals of log-catchabilities do not show clear trend in trap-net data but some decreasing tendency is observed in acoustic CPUE in 1994–1998. The correlations between survey and trap-net CPUE (adjusted to start of the year) and XSA estimates of stock size are reasonable for most ages (lower values are observed for ages 2, 4 and 5 in trap-net CPUE and age 7 in acoustic data). The relation between survey and trap-net indexes of stock size and XSA estimates is also presented in Figure 4.6.2 a, b, showing that assumption of independence of catchabilities of stock size was justified (now clear curvature in the graphs).

Both tuning series indicate decline in stock size but they produce quite different survivor's estimates: often survivors derived from trap-net tuning were much higher (even twice) than the estimates produced by acoustic tuning. The retrospective analysis shows reasonable pattern of estimates for spawning stock biomass and recruitment (Figure 4.6.3). The scatter of estimates of terminal fishing mortality is higher but still moderate taking into account that average F is based on 3 age groups only.

The estimates of stock size and fishing mortality are presented in Table 4.6.2. The SSB decreased by ca. 50% in 1991–2001: from 130 kT to 55 kT. Fishing mortality was relatively stable in assessed period, usually varying from 0.5 to 0.6.

The sensitivity analysis of dependence of XSA output (terminal F and SSB) on parameterisation of XSA is presented in Figure 4.6.4. It indicates moderate impact of shrinkage SE on the results – stronger shrinkage gives more conservative estimates. The impact of tuning series is very large, however, as demonstrated analysing survivor's estimates from Table 4.6.1. Tuning based on survey only produces much lower stock size than tuning based on trap-net data.

5 SWEDISH COAST HERRING IN SUBDIVISIONS 25–27

5.1 Catch trends

The total catches of Swedish coast herring were obtained summing the total catches in Subdivision 27 and the catches of this component in Subdivisions 25 and 26. The catches increased from the beginning of 1990s to the mid-1990s and then again slightly decreased (Table 5.1.1). In Subdivisions 25 and 26 the share of Swedish coast herring in the total catches increased from 27.2% in 1992 to 54.8% in 1994 and was around 50% since then.

5.2 Unallocated landings

No information was available.

5.3 Discards

No information was available.

5.4 Effort and CPUE data

Data on commercial effort and CPUE were not used in the assessment.

5.5 Stock estimates from the acoustic surveys

Stock estimates from the International Hydro-acoustic Surveys in 1994–2001 for Subdivisions 25–27 were used. Data were lacking for years 1995 and 1997. The acoustic surveys made by Polish and Russian vessels cover Subdivision 26 and part of Subdivision 25. The herring found in these surveys has been separated into Swedish coast herring and southern coast herring components. The total estimates of Swedish coast herring in Polish and Russian acoustic surveys in Subdivisions 25 and 26 was added to the herring stock estimates in Subdivision 27 where all herring was regarded as Swedish coast herring (Table 5.5.1).

5.6 Age composition

The Polish herring catches in Subdivision 25 in the period 1992–2001 were available as numbers at age separately for Swedish coast and southern coast herring populations. The proportion and the age composition of Swedish coast herring in the Polish catches were applied to the catches of other states in Subdivision 25. In Subdivision 26 the same procedure was performed using the Russian data. In Subdivision 27 all herring caught was considered to belong to the Swedish coast herring and data from the Reports of the Baltic Fisheries Assessment working group for this Subdivision were used. The total catch in numbers at age of Swedish coast herring in Subdivisions 25–27 is presented in Table 5.6.1.

5.7 Mean weight at age

The mean weight at age data were obtained in the same manner as catch in numbers at age using for Subdivision 25 Polish data, for Subdivision 26 Russian data and for Subdivision 27 the data from the Reports of the Baltic Fisheries Assessment working group (Table 5.7.1).

5.8 Maturity ogive

The maturity ogives for herring in Subdivisions 25–29, 32 (ICES 2001) were used for this stock component.

5.9 Natural mortality

The natural mortalities applied were the same as for herring in Subdivisions 25–29, 32 (ICES 2002) and those were based on the latest Multispecies Virtual Population Analysis (ICES 2001).

5.10 Catch at age analysis

The standard input data for these analyses are presented in Tables 5.1.1., 5.5.1–5.10.1. The VPA was tuned in XSA using the data from the hydro-acoustic surveys. The input data for XSA and the diagnostics are given in Table 5.10.2. The catchability at age groups <4 was assumed to be dependent of stock size because the slopes for ages 1–3 differed more significantly from 1 than for the older ages and it gave smaller residuals of log catchabilities. The catchability independent age >=5 was selected for the assessment. Other settings were chosen from default. The residuals of log q did not reveal any clear trend (Figure 5.10.1). The log-catchability SE are moderate being in the range of 0.15–0.42. The relationship between the acoustic estimates of stock size and the XSA estimates is presented in Figure 5.10.2. The regression analysis gave R^2 values for ages 2–7 in the range of 0.58–0.97. In general the parameterisation of XSA did not change the XSA output very significantly, e.g., SSB was varying in the range of 140 kT – 186 kT. A retrospective analysis for the period 1997–2001 did not reveal any distinct pattern except rather different estimates obtained from the assessment with 1998 year as the terminal year (Figure 5.10.3).

The SSB has decreased more than 3 times from 1992 and in the last 4 years is rather stable below 200 000 t (Table 5.10.3). The fishing mortality has also considerably increased in this period and in the last years F_{BAR3-7} is in the range 0.30–0.36 that is still much lower than in other herring stock components of the Central Baltic.

In the recent years the recruitment has been rather variable. There have been two very poor year classes of 1996 and 1998. The recruitment of 2000 seems to be well above the average level that is similar with the estimate of this year class in other regions of the Baltic Sea.

6 COMPARISON OF ASSESSMENT RESULTS FROM DIFFERENT HERRING STOCK UNITS IN SUBDIVISIONS 25–29, 32

In order to illustrate the degree of consistency between separate assessments the respective results were compared with the most recent assessment of the Central Baltic herring (Subdivisions 25–29,32 (Gulf of Riga excluded, ICES, 2002). The results of the comparison, showing trends in SSB, F and recruitment estimates are illustrated in the Figures 6.1 and 6.2. The fit, both in trends and levels, between of SSB estimates of separate stocks and that of combined stock is generally good, excluding the estimate of 1992, most probably influenced by very high SSB estimate of Swedish coast herring in Subdivisions 25, 26 and 27 (Figure 6.1).

The estimates of fishing mortality show generally similar trends, however demonstrating rather big differences in F levels between separate stock components. The dynamics in recruitment indices of Northeastern herring (Subdivision 28,29 and 32) are very close to those of the combined stock. At the same time the indices of southern coast and Swedish coast herring demonstrate higher variability and even opposite trends (Figure 6.2.).

7 RECOMMENDATIONS

1) Study Group recommends that separate assessments of the recommended stock units should be continued in order, to obtain information on developments in local herring stocks.
2) Study Group considers that the precision of separation of herring catches by population in Subdivisions 25–27 could be improved by closer cooperation and by involving all the parties in stock separation procedure.
3) It would be desirable to include Swedish hydro-acoustic survey data in Subdivision 25 in the assessment.
4) It was assumed by the Study Group that southern coast herring does not leave Subdivisions 25–26 during feeding migrations however, studies on the occurrence of southern coast herring in the catches in Subdivision 27 would be relevant.

8 REFERENCES

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Table. 3.1. Herring in Sd. 28,29,32. Catch in tonnes, 1983-2001.

Year	Catch, t
1983	143918
1984	128628
1985	125589
1986	114325
1987	119079
1988	127447
1989	122828
1990	100053
1991	92783
1992	88122
1993	95200
1994	91255
1995	90887
1996	88300
1997	92400
1998	90700
1999	79850
2000	86595
2001	79876

Table 3.2. Herring in Sd. 28,29,32. Catch in numbers (thousands), 1983-2001

	1	2	3	4	5	6	7	8	9	10
1983	467120	1216695	1078251	470479	146262	144521	90349	133081	38328	102599
1984	638667	874065	869119	662345	259583	75378	95287	63673	66160	60856
1985	731444	1643287	604418	505241	435220	155712	60823	52714	27235	69979
1986	211079	1154053	1213649	467581	351136	207277	63601	31587	29507	32441
1987	770551	335678	795256	749716	309493	269157	146510	50890	15675	40304
1988	94847	1591291	363665	586537	579282	212332	170708	83987	29954	38934
1989	527394	310020	1511905	252634	399589	403162	116473	99374	36058	28609
1990	468125	694424	302805	982085	180548	270692	210319	85093	37663	22929
1991	218533	1197892	813760	244631	602086	104950	165433	68830	29622	39417
1992	857701	754108	1184168	409618	128962	266793	49528	42417	46025	22816
1993	760737	1358461	830159	801887	257016	116666	122323	28451	30761	29600
1994	312414	914344	1020776	512763	456431	210062	72604	126470	25045	27047
1995	473727	674616	1152638	925657	360205	255540	127565	54758	81092	26088
1996	649505	1044186	757656	848551	507022	305421	215578	95864	22520	61154
1997	433164	1192813	1237945	807081	623910	338108	169668	94305	32895	26146
1998	1303956	604892	938698	895005	444812	269034	147820	77404	33463	29324
1999	286287	1361429	718969	854540	570185	187812	116380	35435	25369	16574
2000	1241770	456210	1153000	567460	485790	305770	98240	47310	51280	37090
2001	703370	1517680	396980	670150	246060	268790	178050	48360	27080	48550

Table. 3.3. Herring in Sd. 28,29,32. Catch=Stock weights at age, kg, 1983-2001.

	1	2	3	4	5	6	7	8	9	10
1983	0.0126	0.0227	0.0349	0.0463	0.057	0.0662	0.075	0.0849	0.1014	0.1072
1984	0.0131	0.0213	0.0332	0.0447	0.0538	0.0652	0.0715	0.0771	0.087	0.0997
1985	0.0141	0.0174	0.0273	0.0405	0.0504	0.0654	0.0703	0.0831	0.0861	0.0902
1986	0.0139	0.0189	0.0251	0.0351	0.0483	0.0602	0.0707	0.082	0.0897	0.0936
1987	0.0127	0.0226	0.0296	0.0372	0.0475	0.0598	0.0691	0.0749	0.0898	0.1009
1988	0.0138	0.0188	0.0317	0.0376	0.0458	0.0531	0.0657	0.0772	0.0856	0.1053
1989	0.0153	0.0243	0.0269	0.0368	0.0432	0.0497	0.0587	0.0721	0.0797	0.0988
1990	0.0131	0.0201	0.0285	0.0308	0.0406	0.0486	0.0545	0.0626	0.0696	0.0867
1991	0.0148	0.0189	0.0246	0.0298	0.0321	0.0421	0.0469	0.0558	0.0592	0.0572
1992	0.0118	0.0176	0.0233	0.0304	0.0379	0.0367	0.0473	0.0553	0.0535	0.0625
1993	0.0114	0.0158	0.0247	0.0278	0.0309	0.0361	0.0398	0.0506	0.058	0.0696
1994	0.0125	0.0179	0.0207	0.028	0.0312	0.0375	0.0468	0.0466	0.06	0.0647
1995	0.0096	0.0163	0.0195	0.0223	0.0302	0.0342	0.0364	0.0439	0.0486	0.0553
1996	0.0088	0.0132	0.0186	0.021	0.0239	0.0292	0.0345	0.0389	0.0452	0.057
1997	0.0095	0.0135	0.0166	0.0198	0.0232	0.0246	0.0284	0.0322	0.0415	0.0484
1998	0.0088	0.014	0.0182	0.0214	0.0246	0.0284	0.0338	0.039	0.0467	0.0589
1999	0.0094	0.0133	0.0184	0.0218	0.0244	0.0288	0.031	0.0356	0.0477	0.0548
2000	0.0106	0.0158	0.0191	0.0228	0.0267	0.0313	0.0326	0.0351	0.0365	0.0449
2001	0.0102	0.0147	0.0209	0.0232	0.0272	0.0303	0.0328	0.0405	0.0337	0.0426

Table 3.4. Herring in Sd. 28,29,32. Proportion of mature 1983-2001.

	1	2	3	4	5	6	7	8	9	10
1983	0	0.34	0.98	1	1	1	1	1	1	1
1984	0	0.32	0.94	1	1	1	1	1	1	1
1985	0	0.44	0.97	1	1	1	1	1	1	1
1986	0	0.41	0.9	0.97	1	1	1	1	1	1
1987	0	0.38	0.94	0.99	1	1	1	1	1	1
1988	0	0.61	0.94	1	1	1	1	1	1	1
1989	0	0.42	0.95	1	1	1	1	1	1	1
1990	0	0.64	0.89	0.98	1	1	1	1	1	1
1991	0	0.71	0.96	1	1	1	1	1	1	1
1992	0	0.6	0.94	0.95	1	1	1	1	1	1
1993	0	0.63	0.9	0.92	1	1	1	1	1	1
1994	0	0.67	0.94	0.96	1	1	1	1	1	1
1995	0	0.54	0.93	0.99	1	1	1	1	1	1
1996	0	0.57	0.96	0.99	1	1	1	1	1	1
1997	0	0.51	0.94	0.98	1	1	1	1	1	1
1998	0	0.54	0.94	0.98	1	1	1	1	1	1
1999	0	0.54	0.94	0.99	1	1	1	1	1	1
2000	0	0.54	0.95	0.99	1	1	1	1	1	1
2001	0	0.54	0.94	0.99	1	1	1	1	1	1

Table 3.5. Herring in Sd. 28,29,32. Natural mortality, 1983-2001.

	1	2	3	4	5	6	7	8	9	10
1983	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1984-2001	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 3.6. Herring in Sd. 28,29,32. Proportion of F& M before spawning, 1983-2001.

	1	2	3	4	5	6	7	8	9	10
1983-2001	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35

Table 3.7. Herring in Sd. 28,29,32. Tuning01 (Pelagic trawls, Sd. 29 and 32, 1983-2001).

	Effort	1	2	3	4	5	6	7
1983	27835.4	142.2	255.4	300.7	92.9	28.5	36.9	26.3
1984	24793.7	311.4	211.7	149.2	200.2	47.2	17.6	25.9
1985	23997.6	253.5	490.0	177.4	94.4	148.7	32.6	17.5
1986	24066.0	87.3	389.0	360.1	124.8	63.1	65.6	16.0
1987	20198.6	263.3	89.4	233.4	203.3	81.7	48.5	48.1
1988	16214.3	34.9	400.5	90.1	182.8	161.9	64.6	39.6
1989	12811.6	217.6	59.0	293.9	52.1	114.3	115.5	42.1
1990	6227.5	131.4	79.3	24.6	84.3	15.3	26.1	23.5
1991	4473.3	55.0	150.7	62.0	12.5	28.9	6.4	9.9
1992	43399.2	148.6	90.9	128.8	53.1	16.7	20.8	12.0
1993	5794.2	149.2	213.3	71.6	109.3	35.7	18.3	13.8
1994	7669.3	128.3	245.2	246.2	92.6	97.9	38.1	7.6
1995	9074.0	139.8	149.8	178.2	198.9	57.3	43.9	22.6
1996	10419.0	173.3	228.7	134.9	171.7	134.9	56.2	41.0
1997	12101.1	139.2	224.7	190.1	131.1	116.2	52.6	14.7
1998	10587.4	416.2	143.9	150.4	143.6	77.1	39.1	26.2
1999	6345.7	74.2	226.9	113.0	71.2	47.6	18.4	4.1
2000	7989.1	398.0	69.9	212.3	88.4	46.2	28.7	9.5
2001	8841.6	258.0	344.0	63.6	120.4	44.6	44.4	21.2

Table 3.8. Herring in Sd. 28,29,32. Tuning02 (Trapnets, Sd. 32, 1983-2001).

	Effort	3	4	5	6	7	8
1983	316	131.5	27.1	10.7	6.1	3.0	7.5
1984	309	51.6	66.7	17.9	6.1	6.0	3.8
1985	251	42.4	37.3	52.1	11.0	6.4	12.2
1986	292	47.7	28.2	20.5	29.5	8.5	6.5
1987	222	39.5	42.2	21.3	14.4	18.6	8.2
1988	196	20.0	37.0	32.4	16.6	13.7	18.4
1989	172	34.2	11.3	13.4	12.1	6.1	10.2
1990	76	7.6	18.9	5.3	4.2	3.7	6.5
1991	63	6.8	3.5	6.6	1.7	1.7	2.2
1992	55	12.5	5.3	2.5	5.7	2.8	4.6
1993	55	7.4	11.0	4.8	2.6	5.0	3.1
1994	48	4.4	7.6	7.4	4.2	1.8	3.0
1995	25	3.8	1.4	2.6	1.9	1.4	0.9
1996	33	5.2	6.2	2.2	1.7	1.1	1.6
1997	32	1.3	1.7	1.2	0.3	0.4	0.4
1998	27	1.0	1.1	0.5	0.2	0.1	0.1
1999	14	1.0	0.4	0.3	0.1	0.0	0.0
2000	9	0.3	0.1	0.1	0.04	0.02	0.0
2001	11	0.1	0.2	0.1	0.1	0.03	0.02

Table 3.9. Herring in Sd. 28,29,32. Tuning03 (Acoustics, Sd. 28 and 29S, 1992-2001).

	Effort	1	2	3	4	5
1992	17217.4	1506.0	3079.6	4719.6	2348.0	2052.2
1993	-11	-11	-11	-11	-11	-11
1994	17217.4	1067.7	5496.4	8730.8	4777.6	2665.0
1995	-11	-11	-11	-11	-11	-11
1996	17217.4	1128.7	5179.1	3732.2	2129.3	1817.2
1997	-11	-11	-11	-11	-11	-11
1998	17217.4	1077.7	1019.3	2710.3	25533.6	1144.9
1999	17217.4	171.2	1502.9	1299.5	1460.4	1460.4
2000	17217.4	899.7	655.8	2606.0	691.9	1143.1
2001	17217.4	781.0	2445.0	116.0	1364.0	523.0

Table 3.10. Herring in Sd. 28,29,32. Tuning04 (Pelagic trawls in Sd.29,32;Acoustics, Sd. 28 1991-2001).

Pelagic trawls in Sd. 29

	Effort	1	2	3	4	5	6	7
1993	5794.2	149.2	213.3	71.6	109.3	35.7	18.3	13.8
1994	7669.3	128.3	245.2	246.2	92.6	97.9	38.1	7.6
1995	9074.0	139.8	149.8	178.2	198.9	57.3	43.9	22.6
1996	10419.0	173.3	228.7	134.9	171.7	134.9	56.2	41.0
1997	12101.1	139.2	224.7	190.1	131.1	116.2	52.6	14.7
1998	10587.4	416.2	143.9	150.4	143.6	77.1	39.1	26.2
1999	6345.7	74.2	226.9	113.0	71.2	47.6	18.4	4.1
2000	7989.1	398.0	69.9	212.3	88.4	46.2	28.7	9.5
2001	8841.6	258.0	344.0	63.6	120.4	44.6	44.4	21.2

Acoustics in Sd. 28

	Effort	1	2	3	4	5
1991	10917.6	1048.9	4492.9	1873.6	1362.8	2910.1
1992	10917.6	478.6	1018.4	2516.6	1677.3	1833.5
1993	10917.6	285.5	2045.8	3340.4	3635.2	1312.2
1994	10917.6	240.5	1859.6	5105.1	4088	2542.6
1995	10917.6	491.5	725.8	1609.7	1749.9	1650.2
1996	10917.6	255.2	2622.5	2039.5	1334.5	1668.7
1997	10917.6	63	283.2	2214.9	1366.8	954.3
1998	10917.6	449.8	470.8	1684.9	2053.9	1120.8
1999	10917.6	139.2	513.7	666.6	696.7	1009
2000	10917.6	279.7	184.2	972.4	299.2	428.6
2001	10917.6	398	774	356	729	277

Table 3.11. Herring in Sd. 28,29,32. Tuning05 (Pelagic trawls in Sd.29,32;Acoustics, Sd. 28&29S 1992-2001).

Pelagic trawls in Sd. 29, 32

	Effort	1	2	3	4	5	6	7
1993	5794.2	149.2	213.3	71.6	109.3	35.7	18.3	13.8
1994	7669.3	128.3	245.2	246.2	92.6	97.9	38.1	7.6
1995	9074.0	139.8	149.8	178.2	198.9	57.3	43.9	22.6
1996	10419.0	173.3	228.7	134.9	171.7	134.9	56.2	41.0
1997	12101.1	139.2	224.7	190.1	131.1	116.2	52.6	14.7
1998	10587.4	416.2	143.9	150.4	143.6	77.1	39.1	26.2
1999	6345.7	74.2	226.9	113.0	71.2	47.6	18.4	4.1
2000	7989.1	398.0	69.9	212.3	88.4	46.2	28.7	9.5
2001	8841.6	258.0	344.0	63.6	120.4	44.6	44.4	21.2

Table 3.11 (continued)

Acoustics in Sd. 28

	Effort	1	2	3	4	5
1992	17217.4	1506.0	3079.6	4719.6	2348.0	2052.2
1993	-11	-11	-11	-11	-11	-11
1994	17217.4	1067.7	5496.4	8730.8	4777.6	2665.0
1995	-11	-11	-11	-11	-11	-11
1996	17217.4	1128.7	5179.1	3732.2	2129.3	1817.2
1997	-11	-11	-11	-11	-11	-11
1998	17217.4	1077.7	1019.3	2710.3	25533.6	1144.9
1999	17217.4	171.2	1502.9	1299.5	1460.4	1460.4
2000	17217.4	899.7	655.8	2606.0	691.9	1143.1
2001	17217.4	781.0	2445.0	116.0	1364.0	523.0

Table 3.12. Herring in Sub-divisions 28,29,32. Tuning diagnostics

Tuning04

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

Herring 29and 32 2001 ANON COMBSEX PLUSGROUP

CPUE data from file d:\assessment\vpa\hernor\tun4.txt

Catch data for 19 years. 1983 to 2001. Ages 1 to 10.

Fleet	First year	Last year	First age	Last age	Alpha	Beta	
Pel.29	32	1993	2001	1	7	0	1
Ac.28	1991	2001	1	5	0.75	0.83	

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 3

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

Catchability independent of age for ages >= 6

Table 3.12. Continued

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 27 iterations

1

Regression weights

0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.1	0.098	0.054	0.058	0.089	0.097	0.168	0.101	0.143	0.1
2	0.169	0.226	0.165	0.157	0.175	0.235	0.192	0.266	0.232	0.26
3	0.32	0.284	0.266	0.322	0.265	0.324	0.294	0.367	0.379	0.326
4	0.279	0.374	0.285	0.411	0.418	0.502	0.413	0.478	0.557	0.397
5	0.241	0.283	0.379	0.333	0.415	0.629	0.578	0.507	0.555	0.502
6	0.312	0.358	0.395	0.378	0.527	0.543	0.618	0.516	0.567	0.697
7	0.277	0.23	0.396	0.446	0.641	0.635	0.487	0.601	0.565	0.782
8	0.258	0.254	0.395	0.594	0.725	0.654	0.683	0.203	0.525	0.61
9	0.275	0.301	0.372	0.476	0.524	0.591	0.511	0.497	0.506	0.66

1

XSA population numbers (Thousands)

	AGE								
YEAR	1	2	3	4	5	6	7	8	9
1992	1.00E+07	5.36E+06	4.78E+06	1.86E+06	6.66E+05	1.10E+06	2.26E+05	2.06E+05	2.12E+05
1993	8.97E+06	7.41E+06	3.71E+06	2.84E+06	1.15E+06	4.28E+05	6.59E+05	1.40E+05	1.31E+05
1994	6.62E+06	6.66E+06	4.84E+06	2.28E+06	1.60E+06	7.11E+05	2.45E+05	4.29E+05	8.90E+04
1995	9.30E+06	5.14E+06	4.62E+06	3.04E+06	1.41E+06	8.97E+05	3.92E+05	1.35E+05	2.37E+05
1996	8.40E+06	7.19E+06	3.60E+06	2.74E+06	1.65E+06	8.25E+05	5.04E+05	2.05E+05	6.10E+04
1997	5.16E+06	6.29E+06	4.94E+06	2.26E+06	1.48E+06	8.92E+05	3.99E+05	2.17E+05	8.14E+04
1998	9.30E+06	3.83E+06	4.07E+06	2.92E+06	1.12E+06	6.45E+05	4.24E+05	1.73E+05	9.25E+04
1999	3.28E+06	6.43E+06	2.59E+06	2.48E+06	1.58E+06	5.15E+05	2.85E+05	2.13E+05	7.16E+04
2000	1.03E+07	2.43E+06	4.04E+06	1.47E+06	1.26E+06	7.81E+05	2.52E+05	1.28E+05	1.43E+05
2001	8.19E+06	7.32E+06	1.58E+06	2.26E+06	6.89E+05	5.92E+05	3.63E+05	1.17E+05	6.19E+04

Table 3.12. Continued

Estimated population abundance at 1st Jan 2002

0.00E+00	6.07E+06	4.62E+06	9.32E+05	1.24E+06	3.41E+05	2.42E+05	1.36E+05	5.21E+04

Taper weighted geometric mean of the VPA populations:

7.26E+06	5.36E+06	3.50E+06	2.26E+06	1.25E+06	7.08E+05	3.74E+05	1.92E+05	1.03E+05

Standard error of the weighted Log(VPA populations) :

0.3904	0.4023	0.4058	0.3332	0.3567	0.3141	0.3347	0.3778	0.4339

1

Log catchability residuals.

Fleet : P 32

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	99.99	-0.03	-0.15	-0.57	-0.38	-0.23	0.37	0.23	0.48	0.18
2	99.99	0.13	0.1	-0.18	-0.28	-0.26	-0.03	0.26	0.08	0.2
3	99.99	-0.32	0.36	-0.06	-0.25	-0.35	-0.27	0.44	0.4	0.01
4	99.99	0.12	-0.15	0.22	0.04	-0.15	-0.22	-0.22	0.33	0.03
5	99.99	-0.2	0.24	-0.35	0.24	0.15	0.13	-0.22	-0.23	0.21
6	99.99	0.13	0.09	-0.17	0.08	-0.2	-0.01	-0.07	-0.25	0.42
7	99.99	-0.64	-0.45	0.02	0.31	-0.63	-0.05	-0.94	-0.22	0.21

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

Age	3	4	5	6	7
Mean Lc	-18.966	-18.6782	-18.6156	-18.5885	-18.5885
S.E(Log	0.328	0.2006	0.2417	0.2118	0.5129

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.95	0.147	19.31	0.53	9	0.38	-19.51
2	0.81	0.901	18.46	0.78	9	0.22	-19.14

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.2	-0.504	19.76	0.48	9	0.42	-18.97
4	1.51	-1.05	20.72	0.39	9	0.3	-18.68
5	1.15	-0.396	19.31	0.51	9	0.3	-18.62
6	1.74	-1.481	22.38	0.38	9	0.34	-18.59
7	0.77	0.582	17.45	0.49	9	0.35	-18.85

1

Table 3.12. Continued

Fleet : Ac.28

Age	1991
1	1.08
2	0.64
3	0.32
4	0.66
5	0.45
6	No data for this fleet at this age
7	No data for this fleet at this age

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.11	-0.19	-0.05	0.18	-0.22	-0.84	0.18	0.24	-0.32	0.16
2	0.13	0.2	0.23	-0.01	0.34	-0.68	0.07	-0.37	0.04	-0.29
3	0.2	0.7	0.85	-0.22	0.23	0.04	-0.07	-0.48	-0.54	-0.65
4	0.32	0.75	1.01	-0.02	-0.19	0.1	0.18	-0.69	-0.95	-0.61
5	0.97	0.12	0.53	0.19	0.1	-0.18	0.22	-0.29	-0.88	-0.75
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age	3	4	5
Mean Lc	-16.6316	-16.2513	-15.8126
S.E(Log	0.4927	0.629	0.5415

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.8	0.453	18.53	0.38	11	0.48	-19.22
2	0.53	1.31	16.73	0.5	11	0.38	-17.79

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	0.57	1.787	15.98	0.69	11	0.25	-16.63
4	0.87	0.208	16.03	0.23	11	0.58	-16.25
5	0.87	0.273	15.58	0.35	11	0.5	-15.81
1							

Table 3.12. Continued

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
Pel.29	32	7297932	0.412	0	0	1	0.28	0.084
Ac.28	7155194	0.507	0	0	1	0.185	0.085	
P shrinkage mean	5359867	0.4				0.325	0.112	
F shrinkage mean	4980941	0.5				0.21	0.12	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6070277	0.22	0.14	4	0.625	0.1

Age 2 Catchability dependent on age and year class strength

Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
Pel.29	32	6074672	0.252	0.124	0.49	2	0.401	0.204
Ac.28	3426074	0.314	0.015	0.05	2	0.255	0.337	
P shrinkage mean	3496234	0.41				0.208	0.331	
F shrinkage mean	5545528	0.5				0.137	0.221	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4622774	0.17	0.13	6	0.761	0.26

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

Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
Pel.29	32	1009572	0.203	0.056	0.27	3	0.57	0.304
Ac.28	794642	0.288	0.267	0.93	3	0.279	0.373	
F shrinkage mean	925672	0.5				0.151	0.328	

Table 3.12. Continued

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
932014	0.16	0.09	7	0.595	0.326

1

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

Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
Pel.29	32	1523886	0.175	0.092	0.52	4	0.614	0.335
Ac.28	851094	0.262	0.156	0.6	4	0.239	0.538	
F shrinkage mean	991063	0.5				0.147	0.477	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1244708	0.14	0.11	9	0.781	0.397

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

Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
Pel.29	32	420912	0.162	0.087	0.54	5	0.63	0.425
Ac.28	195088	0.267	0.182	0.68	5	0.21	0.761	
F shrinkage mean	310111	0.5				0.161	0.541	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
341068	0.14	0.12	11	0.842	0.502

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

Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
Pel.29	32	248207	0.155	0.147	0.95	6	0.667	0.683
Ac.28	136178	0.257	0.156	0.61	5	0.134	1.025	
F shrinkage mean	324984	0.5				0.199	0.559	

Table 3.12. Continued

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
241575	0.15	0.12	12	0.799	0.697

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

Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
Pel.29	32	113383	0.157	0.078	0.49	7	0.617	0.884
Ac.28	141575	0.257	0.121	0.47	5	0.106	0.76	
F shrinkage mean	200072	0.5				0.277	0.591	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
135874	0.17	0.1	13	0.565	0.782

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

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
Pel.29	32	47596	0.161	0.05	0.31	7	0.542	0.652
Ac.28	58328	0.255	0.058	0.23	5	0.091	0.56	
F shrinkage mean	57942	0.5				0.366	0.563	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
52113	0.2	0.04	13	0.214	0.61

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F	
Pel.29	32	22432	0.167	0.162	0.97	7	0.392	0.738
Ac.28	23786	0.262	0.088	0.34	5	0.062	0.708	
F shrinkage mean	29628	0.5				0.546	0.603	

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
26206	0.28	0.09	13	0.33	0.66

Table 3.13. Herring in Sub-divisions 28,29,32. VPA output.

Run title : Herring in Sd 28, 29and 32 2001 ANON COMBSEX

At 11/03/2003 17:24

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE									
1	0.0826	0.0651	0.1052	0.0732	0.074	0.0356	0.0979	0.0575	0.0362
2	0.2447	0.2253	0.2375	0.2404	0.1596	0.2153	0.1563	0.1808	0.2044
3	0.3245	0.285	0.2401	0.2768	0.2597	0.2601	0.3269	0.2254	0.3335
4	0.3712	0.3494	0.2667	0.2962	0.2753	0.3108	0.2905	0.3663	0.287
5	0.3389	0.3718	0.4089	0.3004	0.3268	0.3553	0.3614	0.3484	0.4024
6	0.3109	0.3015	0.4004	0.348	0.3976	0.3914	0.4505	0.4467	0.3509
7	0.3523	0.3582	0.4259	0.282	0.4452	0.4751	0.387	0.4503	0.5453
8	0.4047	0.4663	0.344	0.4107	0.3832	0.4987	0.5664	0.5477	0.258
9	0.3586	0.3719	0.3716	0.3295	0.368	0.4091	0.414	0.435	0.3711
+gp	0.3586	0.3719	0.3716	0.3295	0.368	0.4091	0.414	0.435	0.3711
0 FBAR 3- 7	0.3395	0.3332	0.3484	0.3007	0.3409	0.3585	0.3632	0.3674	0.3838

Table 8 Fishing mortality (F) at age

YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE									
1	0.0996	0.0984	0.0535	0.0579	0.0893	0.0975	0.1684	0.1013	0.1427
2	0.169	0.2264	0.1646	0.1567	0.175	0.2352	0.1919	0.2664	0.2325
3	0.32	0.2844	0.2655	0.3223	0.2649	0.3243	0.2942	0.3668	0.3794
4	0.2789	0.3739	0.2853	0.4107	0.4184	0.5018	0.4129	0.4785	0.5572
5	0.2409	0.2831	0.3786	0.3331	0.4151	0.6285	0.5776	0.5072	0.5552
6	0.3122	0.3581	0.3954	0.3779	0.5265	0.5432	0.6176	0.5161	0.5669
7	0.2774	0.2296	0.3964	0.4459	0.6409	0.6354	0.4866	0.6006	0.5648
8	0.2576	0.254	0.3945	0.5945	0.7251	0.6537	0.6825	0.2028	0.5254
9	0.2749	0.3015	0.3725	0.4761	0.5241	0.5912	0.5107	0.4973	0.5064
+gp	0.2749	0.3015	0.3725	0.4761	0.5241	0.5912	0.5107	0.4973	0.5064
0 FBAR 3- 7	0.2859	0.3058	0.3442	0.378	0.4532	0.5267	0.4778	0.4938	0.5247

Table 3.13. Continued

	YEAR	2001	FBAR 99-**
	AGE		
	1	0.0997	0.1146
	2	0.2601	0.253
	3	0.326	0.3574
	4	0.3969	0.4775
	5	0.5025	0.5216
	6	0.6965	0.5932
	7	0.7819	0.6491
	8	0.6096	0.4459
	9	0.6601	0.5546
	+gp	0.6601	
0	FBAR 3- 7	0.5408	

Run title : Herring in Sd 28 29and 32 2001 ANON COMBSEX PLUS
At 11/03/2003 17:24
Terminal Fs derived using XSA (With F shrinkage)

Run title : Herring in Sd 28 29and 32 2001 ANON COMBSEX PLUSGROUP
At 11/03/2003 17:24

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-4

	YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991
	AGE									
	1	667799	1119916	809861	330419	1193991	299686	625110	926355	678810
	2	635259	478859	859121	596874	251425	907835	236780	464076	716077
	3	440924	387367	312968	554698	384256	175476	599287	165807	317119
	4	171938	248236	238509	201547	344332	242645	110762	353851	108352
	5	57664	92386	143307	149558	122704	214078	145589	67825	200846
	6	61290	32002	52151	77950	90676	72457	122857	83042	39193
	7	34482	34979	19380	28608	45065	49885	40111	64107	43496
	8	45312	18882	20016	10364	17668	23639	25396	22301	33456
	9	14414	23544	9698	11618	5627	9860	11755	11801	10559
	+gp	38199	21488	24723	12683	14356	12709	9247	7121	13941
0	TOTAL	2167282	2457660	2489735	1974318	2470100	2008270	1926892	2166285	2161850

Table 10 Stock number at age (start of year) Numbers*10**-4

	YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000
	AGE									
	1	999915	897275	662393	930172	840081	515565	929943	328493	1031736
	2	535989	741053	665793	514053	718695	629031	382915	643386	243043
	3	477885	370596	483804	462372	359829	493936	407077	258771	403573
	4	186003	284111	228302	303742	274263	226048	292387	248349	146809
	5	66576	115223	160053	140521	164926	147767	112045	158403	126009
	6	109960	42839	71081	89740	82457	89153	64528	51486	78097
	7	22593	65887	24517	39189	50351	39874	42399	28488	25159
	8	20642	14016	42876	13504	20543	21718	17294	21338	12793
	9	21164	13062	8901	23660	6101	8145	9248	7155	14264
	+gp	10426	12486	9537	7539	16397	6400	8022	4629	10214
0	TOTAL	2451153	2556549	2357257	2524492	2533644	2177636	2265857	1750498	2091697

Table 3.13. Continued

YEAR		2001	2002	GMST 83-99	AMST 83-99
AGE					
	1	819156	0	694987	750340
	2	732354	607028	553092	586895
	3	157707	462277	370510	391304
	4	226090	93201	227834	239022
	5	68851	124471	124997	132910
	6	59211	34107	68315	72521
	7	36273	24157	37537	39612
	8	11710	13587	21316	22880
	9	6194	5211	11106	12136
+gp		10966	7260		
0 TOTAL		2128512	1371300		

Table 3.14. Herring in Sub-divisions 28,29,32. VPA summary tables
HN04 (Tuning04)

Run title : Herri 29and 32 2001 ANON COMBSEX PLUSGROUP

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Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSE	FBAR 3- 7
1983	6677992	655175	385156	143918	0.3737	0.3395
1984	11199157	640317	346293	128628	0.3714	0.3332
1985	8098611	612955	345312	125589	0.3637	0.3484
1986	3304187	538889	345209	114325	0.3312	0.3007
1987	11939913	626710	361554	119079	0.3294	0.3409
1988	2996856	568259	380645	127447	0.3348	0.3585
1989	6251101	539462	331423	122828	0.3706	0.3632
1990	9263547	502054	281093	100053	0.3559	0.3674
1991	6788097	480368	281860	92783	0.3292	0.3838
1992	9999151	485744	271652	88122	0.3244	0.2859
1993	8972753	490546	277561	95200	0.343	0.3058
1994	6623931	485605	299432	91255	0.3048	0.3442
1995	9301716	439974	252451	90887	0.36	0.378
1996	8400811	394279	226518	88300	0.3898	0.4532
1997	5155652	341657	196762	92400	0.4696	0.5267
1998	9299432	348110	191335	90700	0.474	0.4778
1999	3284929	294058	177869	79850	0.4489	0.4938
2000	10317363	338893	164959	86595	0.5249	0.5247
2001	8191561	336691	162165	79876	0.4926	0.5408
Arith. Mean	7687725	479987	277855	103044	0.3838	0.393
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 3.14. Continued

Run title : Herring in Sd 28 29and 32 2001 ANON COMBSEX PLUSGROUP

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Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUI Age 1	TOTALBIO	TOTSPBIC	LANDINGS	YIELD/S	SOPCOF	FBAR 3- 7
1983	6677992	655791	385518	143918	0.3733	1.0009	0.3395
1984	11199157	644106	348343	128628	0.3693	1.0059	0.3332
1985	8098611	614362	346104	125589	0.3629	1.0023	0.3484
1986	3304187	541241	346716	114325	0.3297	1.0044	0.3007
1987	11939913	627086	361771	119079	0.3292	1.0006	0.3409
1988	2996856	570366	382056	127447	0.3336	1.0037	0.3585
1989	6251101	540591	332117	122828	0.3698	1.0021	0.3632
1990	9263547	498072	278864	100053	0.3588	0.9921	0.3674
1991	6788097	481649	282612	92783	0.3283	1.0027	0.3838
1992	9999151	493755	276132	88122	0.3191	1.0165	0.2859
1993	8972753	490344	277447	95200	0.3431	0.9996	0.3058
1994	6623931	490082	302193	91255	0.302	1.0092	0.3442
1995	9301716	440826	252940	90887	0.3593	1.0019	0.378
1996	8400811	395097	226988	88300	0.389	1.0021	0.4532
1997	5155652	350666	201950	92400	0.4575	1.0264	0.5267
1998	9299432	366842	201631	90700	0.4498	1.0538	0.4778
1999	3284929	297353	179862	79850	0.444	1.0112	0.4938
2000	10317363	340159	165575	86595	0.523	1.0037	0.5247
2001	8191561	340660	164077	79876	0.4868	1.0118	0.5408
Arith. Mean	7687725	483108	279626	103044	.3804		.3930
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)			

Table 4.1.1 Herring landing statistics by countries in Sub-divisions 25 and 26 in 1991-2001 (thous.t)

Sub-division	Year	Country							Total
		Denmark	Poland	Sweden	Latvia	Germany			
25	1991	6.8	34.5	13.1	2.0				56.4
	1992	8.1	22.2	19.5					49.8
	1993	8.9	25.9	16.7					51.5
	1994	11.2	28.4	24.7		3.7			68.0
	1995	11.4	24.7	15.5					51.6
	1996	12.1	19.4	13.0					44.5
	1997	9.1	13.1	17.2					39.4
	1998	13.9	10.5	24.7					49.1
	1999	4.3	9.6	13.7	0.2				27.8
	2000	15.8	13.0	13.7	0.1				42.6
	2001	15.8	17.9	3.6					37.3
		Russia	Poland	Sweden	Latvia	Lithuania	Finland	Estonia	Total
26	1991	9.4	12.6		1.2	4.8		0.1	28.1
	1992	10.2	17.0	1.2	0.5	3.0			31.9
	1993	10.6	15.2	8.6	0.7	3.0			38.1
	1994	8.0	17.7	4.4	0.8	4.9			35.8
	1995	8.8	13.6	1.8	0.1	3.6			27.9
	1996	8.0	1.3	1.3	0.3	4.3			15.2
	1997	5.2	13.1	3.6					21.9
	1998	3.6	8.9	3.6	0.5	2.4			19.0
	1999	6.4	8.5	1.6	0.5	1.3	1.9		20.2
	2000	7.7	10.0	4.8	0.2	1.1			23.8
	2001	8.7	10.5	3.0	0.3	1.6			24.1

Table. 4.1.2. Southern coast herring in Sd. 25-26. Catch in tonnes, 1991-2001.

Year	Catch, t
1991	53372
1992	48632
1993	48806
1994	49583
1995	32450
1996	25144
1997	23377
1998	28195
1999	19413
2000	30827
2001	28205

Table 4.2.1. Southern coast herring in Sd. 25-26. Catch in numbers (thousands), 1991-2001

	0	1	2	3	4	5	6	7	8
1991	8270	76520	225750	305660	181080	71880	26780	10330	5840
1992	7190	150530	166460	250230	183670	57390	33830	13600	4740
1993	8660	47770	349150	251860	203260	102010	27730	3890	1400
1994	5680	72350	193340	379390	223120	98560	24680	10740	2050
1995	34230	86320	114490	131100	182600	71990	34800	11260	4910
1996	2180	101310	245650	86290	63130	77260	37800	11690	4870
1997	21950	51640	116290	132070	60080	68040	44750	14060	5820
1998	11970	297400	164250	142450	89400	47420	29630	13510	3710
1999	19910	95430	136950	88260	61040	43980	22050	7100	3880
2000	10670	241560	131960	180800	65150	45600	23450	11630	2860
2001	28820	155070	239590	88420	103110	30730	14500	4760	3050

Table. 4.3.1. Southern coast herring in Sd. 25-26. Catch=Stock weights at age, kg, 1991-2001.

	1	2	3	4	5	6	7	8
1991	0.026	0.0453	0.059	0.0735	0.0806	0.0877	0.0943	0.1075
1992	0.03	0.0461	0.0558	0.0688	0.0824	0.0945	0.0982	0.1032
1993	0.0265	0.0366	0.0484	0.06	0.071	0.0875	0.0945	0.1179
1994	0.0302	0.0367	0.047	0.0559	0.0671	0.083	0.0918	0.1134
1995	0.0203	0.0406	0.0491	0.0591	0.0635	0.0708	0.0812	0.097
1996	0.0165	0.0283	0.0444	0.0558	0.0643	0.0711	0.0844	0.1036
1997	0.0237	0.034	0.0421	0.0562	0.0609	0.0694	0.0803	0.1061
1998	0.0177	0.0284	0.0435	0.0603	0.0667	0.0664	0.0818	0.0822
1999	0.0204	0.0339	0.0448	0.0537	0.0649	0.0714	0.0736	0.0973
2000	0.0201	0.0412	0.0533	0.0621	0.075	0.081	0.0951	0.0953
2001	0.0237	0.039	0.0522	0.0616	0.0682	0.0773	0.0825	0.0995

Table 4.4.1. Southern coast herring in Sd. 25-26. Proportion of mature 1991-2001.

	1	2	3	4	5	6	7	8
1991-2001	0	0.7	0.9	1	1	1	1	1

Table 4.4.2. Southern coast herring in Sd. 25-26. Natural mortality, 1991-2001.

	1	2	3	4	5	6	7	8
1991	0.265	0.218	0.213	0.209	0.209	0.206	0.205	0.201
1992	0.265	0.219	0.213	0.209	0.208	0.206	0.205	0.201
1993	0.281	0.225	0.218	0.212	0.212	0.208	0.207	0.202
1994	0.294	0.227	0.22	0.214	0.213	0.209	0.207	0.202
1995	0.299	0.234	0.227	0.219	0.218	0.212	0.21	0.203
1996	0.276	0.227	0.221	0.214	0.214	0.21	0.208	0.202
1997	0.287	0.228	0.221	0.215	0.214	0.21	0.208	0.202
1998	0.295	0.229	0.221	0.214	0.213	0.209	0.207	0.202
1999	0.309	0.231	0.222	0.214	0.213	0.209	0.208	0.202
2000	0.309	0.231	0.222	0.214	0.213	0.209	0.208	0.202
2001	0.309	0.231	0.222	0.214	0.213	0.209	0.208	0.202

Table 4.4.3. Southern coast herring in Sd. 25-26. Proportion of F& M before spawning, 1991-2001.

	1	2	3	4	5	6	7	8
1991-2001	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25

Table 4.5.1. Southern coast herring in Sd. 25-27. International acoustic survey in Sd 25-26.

Year	effort	1	2	3	4	5	6	7	8
1994	1	1351400	1412100	2852800	2220400	838900	230400	24200	16400
1995	1	2469900	955400	939600	1651400	887300	545800	108500	31600
1996	1	1069500	1121900	435000	414600	409900	267600	99200	46700
1997	1	1036100	1056700	987000	485300	372300	191700	55900	18500
1998	1	1058600	339800	352800	213400	110100	101400	36400	8500
1999	1	1098700	1625400	565800	459600	381800	172300	64900	44900
2000	1	1621100	438300	998200	255900	463100	154600	61900	24000
2001	1	596500	784500	276200	394000	68900	51900	29400	6600

Table 4.5.2. Southern coast herring in Sd. 25-26. Effort and catch in numbers at age in the Russian trap-net fishery in Sd 26

Year	effort	1	2	3	4	5	6	7	8
1991	38	0.1137	26.7368	35.0590	23.8715	12.0569	4.6403	1.3692	0.0994
1992	37	0.1074	12.7337	51.8858	14.1661	4.0341	1.6698	0.6272	0.1462
1993	36		54.8357	34.8563	16.3362	5.5847	2.0454	0.6790	0.1413
1994	37	0.1300	16.0000	44.3300	24.3800	11.6200	3.7100	1.5300	0.1100
1995	43	0.0130	7.0898	13.6978	20.4148	10.6545	5.7482	2.7507	0.7012
1996	24	0.0406	2.8398	7.8728	6.9109	7.9323	5.0164	2.0740	1.0273
1997	34	0.1100	6.6900	6.7500	4.6400	4.5800	5.6500	1.9200	1.1700
1998	25		4.5300	10.2600	2.6900	2.2100	1.5600	0.9700	0.1600
1999	28	0.1854	16.1202	12.2034	9.9393	2.6572	1.5978	1.1506	0.4744
2000	29		8.3590	16.9392	7.6412	4.6295	1.0449	0.6998	0.5462
2001	33	0.1170	17.1887	9.9031	10.8465	4.6705	2.3422	0.6779	0.2553

Table 4.6.1. Basic XSA run for southern coast herring in Sub-div. 25-26 - diagnostics,

Lowestoft VPA Version 3.1

13/03/2003 16:28

Extended Survivors Analysis

Southern coast herring Subdivisions 25-26

CPUE data from file C:\VPA\Tunfleet.txt

Catch data for 11 years. 1991 to 2001. Ages 1 to 8.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
Trapnets	1991	2001	2	7	0.25	0.4
acoustic	1994	2001	1	7	0.8	0.9

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Table 4.6.1. Continued

Catchability analysis :

Catchability independent of stock size for all ages
Catchability independent of age for ages >= 5

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00011

Final year F values

Age	1	2	3	4	5	6	7
Iteration	0.309	0.3588	0.4497	0.5149	0.6231	0.6059	0.4723
Iteration	0.309	0.3588	0.4496	0.5149	0.6231	0.6058	0.4723

Regression weights

0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997
1	1						

Fishing mortalities

Age	1992	1993	1994	1995	1996	1997	1998	1999
1	0.09	0.08	0.02	0.165	0.169	0.182	0.284	0.211
2	0.176	0.286	0.334	0.289	0.466	0.304	0.418	0.287
3	0.388	0.391	0.583	0.412	0.336	0.465	0.552	0.436
4	0.645	0.59	0.725	0.624	0.335	0.406	0.585	0.486
5	0.677	0.817	0.67	0.576	0.587	0.708	0.65	0.691
6	1.354	0.672	0.515	0.491	0.608	0.836	0.818	0.66
7	1.007	0.516	0.663	0.392	0.285	0.486	0.666	0.439

Age	2000	2001
1	0.342	0.309
2	0.415	0.359
3	0.513	0.45
4	0.653	0.515
5	0.849	0.623
6	0.976	0.606
7	0.879	0.472

Table 4.6.1. Continued

XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7
1992	2.7E+06	1.5E+06	1.1E+06	5.4E+05	1.7E+05	5.9E+04	2.5E+04
1993	1.4E+06	1.9E+06	1.0E+06	5.9E+05	2.3E+05	6.8E+04	1.2E+04
1994	1.0E+06	9.7E+05	1.1E+06	5.6E+05	2.6E+05	8.2E+04	2.8E+04
1995	1.6E+06	7.4E+05	5.5E+05	5.1E+05	2.2E+05	1.1E+05	4.0E+04
1996	1.2E+06	1.0E+06	4.4E+05	2.9E+05	2.2E+05	9.9E+04	5.4E+04
1997	1.0E+06	7.6E+05	5.0E+05	2.5E+05	1.7E+05	9.9E+04	4.3E+04
1998	1.8E+06	6.5E+05	4.5E+05	2.5E+05	1.3E+05	6.7E+04	3.5E+04
1999	8.8E+05	1.0E+06	3.4E+05	2.1E+05	1.1E+05	5.7E+04	2.4E+04
2000	1.7E+06	5.2E+05	6.0E+05	1.8E+05	1.0E+05	4.6E+04	2.4E+04
2001	6.8E+05	8.9E+05	2.7E+05	2.9E+05	7.4E+04	3.5E+04	1.4E+04

Estimated population abundance at 1st Jan 2002

0.0E+00	3.7E+05	5.0E+05	1.4E+05	1.4E+05	3.2E+04	1.6E+04

Taper weighted geometric mean of the VPA populations:

1.3E+06	9.4E+05	5.8E+05	3.3E+05	1.5E+05	6.7E+04	2.7E+04

Standard error of the weighted Log(VPA populations) :

1	0.4028	0.3898	0.4937	0.4364	0.4029	0.3572	0.4544

Log catchability residuals.

Fleet : Trapnets

Age	1991	1992	1993	1994	1995	1996	1997	1998
1								
2	0.16	-0.51	0.79	0.22	-0.48	-1.06	-0.33	-0.22
3	0.02	0.37	0.05	0.22	-0.43	-0.19	-0.79	0.08
4	0.53	-0.28	-0.21	0.27	-0.01	-0.04	-0.61	-0.8
5	0.67	-0.5	-0.43	0.09	0.01	0.29	-0.3	-0.51
6	0.61	-0.13	-0.27	0.06	0.06	0.65	0.49	-0.11
7	0.23	-0.37	0.28	0.29	0.29	0.26	0.12	0.02

Age	1999	2000	2001
1			
2	0.46	0.47	0.5
3	0.38	0.13	0.23
4	0.56	0.48	0.17
5	-0.26	0.42	0.55
6	-0.08	-0.23	0.59
7	0.37	0	0.23

Table 4.6.1. Continued

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

Age	2	3	4	5	6	7
Mean Lo	-7.7546	-6.8207	-6.7025	-6.5355	-6.5355	-6.5355
S.E(Log	0.5686	0.3637	0.462	0.4255	0.3921	0.265

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.84	0.365	8.7	0.40	11	0.5	-7.75
3	0.94	0.235	7.19	0.68	11	0.36	-6.82
4	1.15	-0.346	5.82	0.41	11	0.56	-6.7
5	1.5	-0.937	3.84	0.31	11	0.64	-6.54
6	0.89	0.36	6.93	0.56	11	0.34	-6.39
7	1.02	-0.141	6.29	0.83	11	0.22	-6.37
1							

Fleet : acoustic 25-26

Age	1994	1995	1996	1997	1998	1999	2000	2001
1	0.11	0.39	-0.17	-0.05	-0.47	0.22	0.05	-0.05
2	0.28	0.13	0.13	0.21	-0.67	0.36	-0.2	-0.2
3	0.66	0.13	-0.47	0.32	-0.52	0.13	0.2	-0.36
4	0.94	0.65	-0.42	-0.05	-0.73	0.16	-0.12	-0.3
5	0.36	0.53	-0.24	0.03	-1.01	0.44	0.86	-0.9
6	0.1	0.66	0.15	0.01	-0.27	0.3	0.68	-0.47
7	-0.96	-0.03	-0.52	-0.7	-0.76	0	0.34	-0.23

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

Age	1	2	3	4	5	6	7
Mean Lo	-6.4612	-6.336	-5.964	-5.6701	-5.3621	-5.3621	-5.3621
S.E(Log	0.2612	0.3421	0.416	0.5445	0.6901	0.4355	0.5831

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	1.16	-0.457	5.23	0.58	8	0.32	-6.46
2	0.53	1.864	9.74	0.73	8	0.16	-6.34
3	0.59	2.291	8.87	0.85	8	0.19	-5.96
4	0.52	2.218	8.98	0.79	8	0.22	-5.67
5	0.69	0.703	7.37	0.48	8	0.5	-5.36
6	0.77	0.754	6.59	0.65	8	0.32	-5.22
7	1.66	-0.99	2.68	0.28	8	0.74	-5.71

Table 4.6.1. Continued

Terminal year survivor and F summaries :

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

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Trapnets	1	0	0	0	0	0	0
acoustic 25-26	348115	0.3	0	0	1	0.671	0.323
F shrinkage mean	408725	0.5				0.329	0.281

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
366993	0.26	0.09	2	0.354	0.309

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

Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Trapnets	815570	0.597	0	0	1	0.117	0.232
acoustic 25-26	461113	0.235	0.126	0.54	2	0.644	0.38
F shrinkage mean	467420	0.5				0.239	0.376

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
494567	0.2	0.12	4	0.589	0.359

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

Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Trapnets	183863	0.326	0.098	0.3	2	0.281	0.358
acoustic 25-26	126904	0.212	0.178	0.84	3	0.517	0.485
F shrinkage mean	120472	0.5				0.202	0.505

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
139375	0.18	0.12	6	0.662	0.45

Table 4.6.1. Continued

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

Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Trapnets	167073	0.28	0.075	0.27	3	0.327	0.441
acoustic 25-26	129133	0.21	0.201	0.96	4	0.446	0.541
F shrinkage mean	117869	0.5				0.227	0.58

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
137585	0.17	0.11	8	0.615	0.515

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

Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Trapnets	50130	0.262	0.105	0.4	4	0.385	0.439
acoustic 25-26	23124	0.227	0.198	0.87	5	0.333	0.786
F shrinkage mean	25325	0.5				0.282	0.738

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
31949	0.19	0.15	10	0.791	0.623

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Trapnets	25162	0.257	0.104	0.4	5	0.394	0.418
acoustic 25-26	12822	0.266	0.188	0.71	6	0.331	0.702
F shrinkage mean	10157	0.5				0.275	0.827

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
15685	0.19	0.15	12	0.794	0.606

Table 4.6.1. Continued

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Trapnets	7576	0.229	0.135	0.59	6	0.551	0.449
acoustic 25-26	8133	0.307	0.179	0.58	7	0.217	0.424
F shrinkage mean	5378	0.5				0.232	0.586

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7107	0.18	0.1	14	0.53	0.472

Table 4.6.2. Basic XSA run for southern coast herring in Sub-div. 25-26.

Run title : Southern coast herring Subdivisions 25-26

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Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1991	1992	1993	1994	1995	1996	1997	1998
AGE								
1	0.0431	0.0898	0.0796	0.0205	0.1652	0.1693	0.1816	0.2835
2	0.1727	0.1756	0.2856	0.3336	0.2889	0.4661	0.3042	0.4184
3	0.4104	0.3876	0.3912	0.5827	0.4119	0.3363	0.4648	0.552
4	0.6872	0.645	0.5902	0.7252	0.6237	0.3346	0.4059	0.5854
5	0.7427	0.6773	0.8167	0.6696	0.5763	0.587	0.708	0.6502
6	0.6736	1.3535	0.6719	0.5151	0.4907	0.6083	0.8357	0.8183
7	0.5946	1.0073	0.5158	0.6625	0.3919	0.285	0.4857	0.6658
+gp	0.5946	1.0073	0.5158	0.6625	0.3919	0.285	0.4857	0.6658
0 FBAR 3- 5	0.6134	0.57	0.5994	0.6592	0.5373	0.4193	0.5262	0.5959

YEAR	1999	2000	2001	FBAR 99-**
AGE				
1	0.2108	0.3419	0.309	0.2872
2	0.2865	0.4147	0.3588	0.3533
3	0.4362	0.5132	0.4496	0.4663
4	0.4859	0.6528	0.5148	0.5512
5	0.6906	0.849	0.6231	0.7209
6	0.6597	0.9757	0.6058	0.7471
7	0.4387	0.8795	0.4723	0.5968
+gp	0.4387	0.8795	0.4723	
0 FBAR 3- 5	0.5376	0.6717	0.5292	

Table 4.6.2. Continued

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1991	1992	1993	1994	1995	1996	1997	1998
AGE								
1	2069590	2709010	1391993	1008088	1591059	1187776	1034017	1780034
2	1587064	1520778	1899833	970558	736063	1000214	760957	647186
3	1010062	1073762	1024976	1140173	554084	436342	500134	446914
4	404457	541507	588968	557378	510908	292480	249907	251910
5	152243	165062	230514	264046	217891	219964	168986	134312
6	60568	58782	68104	82405	109235	98461	98733	67208
7	25535	25133	12358	28251	39948	54099	43437	34700
+gp	14242	8792	4348	5299	16624	22030	18281	9908
0 TOTAL	5323759	6102824	5221092	4056197	3775814	3311366	2874453	3372173

YEAR	1999	2000	2001	2002	GMST 91-99	AMST 91-99
AGE						
1	875080	1710231	680845	0	1423149	1516294
2	998094	520341	892009	366995	1054378	1124527
3	338726	594843	272820	494572	658248	725019
4	206307	175389	285171	139377	372935	400425
5	113257	102461	73717	137588	178978	185142
6	56656	45880	35428	31950	75613	77795
7	24059	23767	14032	15686	29622	31947
+gp	12904	5880	8878	11631		
0 TOTAL	2625084	3178791	2262899	1197799		

Run title : Southern coast herring Subdivisions 25-26

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Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS	TOTALBIO	TOTSPBIO	LANDING	YIELD/SSI	FBAR 3- 5
	Age 1					
1991	2069590	236546	132459	53307	0.4024	0.6134
1992	2709010	261923	136860	60266	0.4403	0.57
1993	1391993	215412	130451	58385	0.4476	0.5994
1994	1008088	170471	108785	56973	0.5237	0.6592
1995	1591059	134130	85426	39683	0.4645	0.5373
1996	1187776	111336	69507	31201	0.4489	0.4193
1997	1034017	99787	61046	29606	0.485	0.5262
1998	1780034	100147	51371	33138	0.6451	0.5959
1999	875080	89452	52401	24542	0.4683	0.5376
2000	1710231	108915	55696	37646	0.6759	0.6717
2001	680845	92539	54526	27899	0.5117	0.5292
Arith. Mean	1457975	147333	85321	41150	0.5012	0.569
0 Units	(Thousan	(Tonnes)	(Tonnes)	(Tonnes)		

Table. 5.1.1. Swedish coast herring in Sd. 25-27. Catch in tonnes, 1992-2001.

Year	Catch, t
1992	39480
1993	51720
1994	58031
1995	56710
1996	44653
1997	44648
1998	59552
1999	44378
2000	44750
2001	40327

Table 5.5.1. Swedish coast herring in Sd. 25-27. International acoustic survey in Sd 25-27.

Year	effort	1	2	3	4	5	6	7	8
1994	1	957.2	2574	5887	4790.4	2842.4	1168.7	725.7	425.3
1995	1	-11	-11	-11	-11	-11	-11	-11	-11
1996	1	1482	5188.7	3585.7	3534	2176	1321.4	686.7	416.5
1997	1	-11	-11	-11	-11	-11	-11	-11	-11
1998	1	1624.8	502.2	1957.3	2295	813.5	700.4	321	248.1
1999	1	299	1060	409.2	1278.9	1393.8	549.2	312.4	377.7
2000	1	517.3	156.3	1485.3	732.5	1083.8	999	307	231
2001	1	1343.3	2536	944.3	2035.1	637.8	439.2	401.3	195.3

Table 5.6.1. Swedish coast herring in Sd. 25-27. Catch in numbers (thousands), 1992-2001

	1	2	3	4	5	6	7	8
1992	7160	35400	82470	152740	110320	113790	99390	104790
1993	2910	96660	276050	319310	261800	146280	75900	58490
1994	15420	27140	112510	264650	410620	231940	110620	70650
1995	46550	75490	306770	358640	235020	206100	97690	57930
1996	84110	96330	197920	281240	246960	183940	115940	60000
1997	6450	61310	356100	271340	239070	139740	103490	75250
1998	72370	88960	481940	627210	278330	205770	96820	76780
1999	44820	76100	108140	328050	326010	178440	96630	63060
2000	78440	80970	261040	144240	287960	264410	80780	75030
2001	125290	155700	102320	252240	91050	121190	136820	72540

Table. 5.7.1. Swedish coast herring in Sd. 25-27. Catch=Stock weights at age, kg, 1992-2001.

	1	2	3	4	5	6	7	8
1992	0.0246	0.0288	0.0366	0.0431	0.0539	0.0626	0.0719	0.0808
1993	0.0291	0.0197	0.0315	0.0373	0.0454	0.053	0.0638	0.0794
1994	0.0212	0.0284	0.0338	0.0396	0.0448	0.0533	0.0575	0.0783
1995	0.0175	0.0214	0.0283	0.0385	0.0462	0.0496	0.0648	0.0756
1996	0.0195	0.0228	0.0262	0.0325	0.0368	0.0428	0.0498	0.0626
1997	0.0264	0.0304	0.0275	0.0296	0.0357	0.0412	0.0488	0.0591
1998	0.0191	0.0194	0.0225	0.0302	0.0363	0.0381	0.046	0.0555
1999	0.0238	0.03	0.0303	0.0289	0.0368	0.0423	0.0484	0.0642
2000	0.0185	0.0325	0.0283	0.0289	0.0327	0.0413	0.0464	0.067
2001	0.019	0.0255	0.0329	0.0364	0.0392	0.0466	0.0585	0.058

Table 5.8.1. Swedish coast herring in Sd. 25-27. Proportion of mature 1992-2001.

	1	2	3	4	5	6	7	8
1992-2001	0	0.7	0.9	1	1	1	1	1

Table 5.9.1. Swedish coast herring in Sd. 25-27. Natural mortality, 1992-2001.

	1	2	3	4	5	6	7	8
1992	0.265	0.219	0.213	0.209	0.208	0.206	0.205	0.201
1993	0.281	0.225	0.218	0.212	0.212	0.208	0.207	0.202
1994	0.294	0.227	0.22	0.214	0.213	0.209	0.207	0.202
1995	0.299	0.234	0.227	0.219	0.218	0.212	0.21	0.203
1996	0.276	0.227	0.221	0.214	0.214	0.21	0.208	0.202
1997	0.287	0.228	0.221	0.215	0.214	0.21	0.208	0.202
1998	0.295	0.229	0.221	0.214	0.213	0.209	0.207	0.202
1999	0.309	0.231	0.222	0.214	0.213	0.209	0.208	0.202
2000	0.309	0.231	0.222	0.214	0.213	0.209	0.208	0.202
2001	0.309	0.231	0.222	0.214	0.213	0.209	0.208	0.202

Table 5.10.1. Swedish coast herring in Sd. 25-27. Proportion of F& M before spawning, 1992-2001.

	1	2	3	4	5	6	7	8
1992-2001	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35

Table 5.10.2. Basic XSA run for Swedish coast herring in Sub-div. 25-27 - diagnostics,

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

Swedish cost herring Subdivisions 25-27

CPUE data from file C:\VPA\Swedish\Tunfleet.txt

Catch data for 10 years. 1992 to 2001. Ages 1 to 8.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
Hydroac	1994	2001	1	7	0.8	0.9

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 4

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

Table 5.10. 2. Continued

Catchability independent of age for ages >= 5

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning had not converged after 120 iterations

Total absolute residual between iterations
119 and 120 = .00212

Final year F values

Age	1	2	3	4	5	6	7
Iteration	0.0329	0.0662	0.1045	0.2391	0.2903	0.4348	0.4218
Iteration	0.0328	0.0661	0.1043	0.2388	0.2897	0.4344	0.4213

1

Regression weights

0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1994	1995	1996	1997	1998	1999	2000	2001
1	0.005	0.009	0.025	0.004	0.024	0.025	0.024	0.033
2	0.01	0.032	0.025	0.024	0.081	0.034	0.061	0.066
3	0.056	0.152	0.113	0.123	0.278	0.137	0.163	0.104
4	0.142	0.26	0.207	0.227	0.338	0.316	0.279	0.239
5	0.3	0.184	0.293	0.277	0.392	0.3	0.518	0.29
6	0.311	0.245	0.217	0.272	0.415	0.477	0.431	0.434
7	0.21	0.21	0.214	0.184	0.311	0.354	0.417	0.421

1

XSA population numbers (Thousands)

	AGE						
YEAR	1	2	3	4	5	6	7
1994	3.65E+06	3.10E+06	2.30E+06	2.23E+06	1.76E+06	9.64E+05	6.49E+05
1995	6.00E+06	2.71E+06	2.44E+06	1.75E+06	1.56E+06	1.06E+06	5.73E+05
1996	3.86E+06	4.41E+06	2.08E+06	1.67E+06	1.08E+06	1.05E+06	6.69E+05
1997	1.72E+06	2.86E+06	3.43E+06	1.49E+06	1.10E+06	6.51E+05	6.82E+05
1998	3.48E+06	1.29E+06	2.22E+06	2.43E+06	9.56E+05	6.72E+05	4.02E+05
1999	2.16E+06	2.53E+06	9.44E+05	1.35E+06	1.40E+06	5.22E+05	3.60E+05
2000	3.81E+06	1.55E+06	1.94E+06	6.59E+05	7.93E+05	8.38E+05	2.63E+05
2001	4.53E+06	2.73E+06	1.15E+06	1.32E+06	4.03E+05	3.82E+05	4.42E+05

Table 5.10. 2. Continued

Estimated population abundance at 1st Jan 2002

0.00E+00	3.22E+06	2.03E+06	8.35E+05	8.41E+05	2.44E+05	2.01E+05

Taper weighted geometric mean of the VPA populations:

3.50E+06	2.60E+06	2.08E+06	1.61E+06	1.08E+06	7.53E+05	5.37E+05

Standard error of the weighted Log(VPA populations) :

	0.3655	0.381	0.4292	0.4031	0.439	0.3439	0.4624
1							

Log catchability residuals.

Fleet : Hydroacoustic

Age	1994	1995	1996	1997	1998	1999	2000	2001
1	-0.01	99.99	0.15	99.99	0.31	-0.06	-0.35	-0.04
2	0.04	99.99	-0.03	99.99	0.29	-0.1	-0.37	0.18
3	0.21	99.99	0.11	99.99	-0.16	-0.05	-0.19	0.11
4	0.36	99.99	0.39	99.99	-0.3	-0.31	-0.19	0.11
5	0.14	99.99	0.36	99.99	-0.42	-0.34	0.16	0.12
6	-0.14	99.99	-0.17	99.99	-0.2	-0.14	-0.05	-0.08
7	-0.3	99.99	-0.39	99.99	-0.56	-0.43	-0.08	-0.33

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

Age	4	5	6	7
Mean Log q	-6.1968	-6.1379	-6.1379	-6.1379
S.E(Log q)	0.3194	0.3117	0.1519	0.4156

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.5	1.104	11.52	0.56	6	0.25	-8.01
2	0.4	2.27	11.74	0.79	6	0.26	-7.39
3	0.44	2.555	10.9	0.85	6	0.18	-6.61

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	0.85	0.544	7.42	0.77	6	0.29	-6.2
5	1.12	-0.363	5.19	0.69	6	0.39	-6.14
6	1.04	-0.526	5.99	0.98	6	0.06	-6.27
7	1.2	-0.767	5.21	0.8	6	0.2	-6.49
1							

Table 5.10. 2. Continued

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Hydroacoustic	3097421	0.3	0	0	1	0.497	0.034
P shrinkage mean	2602252	0.38				0.318	0.04
F shrinkage mean	5141165	0.5				0.185	0.021

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3218032	0.21	0.17	3	0.793	0.033

1

Age 2 Catchability dependent on age and year class strength

Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Hydroacoustic	1872049	0.212	0.266	1.25	2	0.685	0.071
P shrinkage mean	2078816	0.43				0.181	0.065
F shrinkage mean	3008050	0.5				0.133	0.045

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2032547	0.18	0.16	4	0.92	0.066

Age 3 Catchability dependent on age and year class strength

Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Hydroacoustic	766536	0.186	0.14	0.75	3	0.71	0.113
P shrinkage mean	1608985	0.4				0.176	0.055
F shrinkage mean	515686	0.5				0.114	0.163

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
834543	0.16	0.19	5	1.175	0.104

Table 5.10. 2. Continued

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

Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Hydroacoustic	860979	0.156	0.113	0.72	4	0.875	0.234
F shrinkage mean	715455	0.5				0.125	0.275

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
841359	0.15	0.1	5	0.648	0.239

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

Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Hydroacoustic	255456	0.163	0.098	0.6	4	0.845	0.278
F shrinkage mean	189897	0.5				0.155	0.358

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
243970	0.16	0.1	5	0.618	0.29

1

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Hydroacoustic	191458	0.158	0.08	0.5	5	0.813	0.451
F shrinkage mean	247643	0.5				0.187	0.365

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
200880	0.16	0.08	6	0.511	0.434

Table 5.10. 2. Continued

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Hydroacoustic	193235	0.167	0.071	0.42	5	0.783	0.494
F shrinkage mean	481951	0.5				0.217	0.228

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
235621	0.17	0.2	6	1.169	0.421

Hydroacoustic

CPUE adjusted to start of year

	AGE						
YEAR	1	2	3	4	5	6	7
1994	1234.034	3148.02	7443.955	6481.179	4394.554	1817.578	1034.053
1995	0	0	0	0	0	0	0
1996	1914.565	6426.651	4761.062	5054.396	3348.384	1900.182	982.5398
1997	0	0	0	0	0	0	0
1998	2131.448	653.4089	2990.726	3669.975	1359.812	1190.635	498.3463
1999	396.9891	1328.114	555.1725	2006.685	2155.378	983.9382	503.5052
2000	686.6863	200.2571	2059.783	1113.714	2016.237	1721.445	522.1959
2001	1796.141	3264.384	1246.041	2990.105	977.7411	758.7437	685.0352

Table 5.10.3. Swedish coast herring in Sd 25-27. VPA output

Run title : Swedish cost herring Subdivision 25-27

At 13/03/2003 15:08

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE								
1,	.0021,	.0008,	.0049,	.0090,	.0253,	.0043,	.0244,	.0245,
2,	.0102,	.0368,	.0099,	.0318,	.0248,	.0244,	.0807,	.0343,
3,	.0288,	.1053,	.0561,	.1516,	.1126,	.1232,	.2779,	.1370,
4,	.0887,	.1509,	.1417,	.2602,	.2071,	.2272,	.3384,	.3161,
5,	.0985,	.2185,	.2997,	.1837,	.2932,	.2774,	.3916,	.3000,
6,	.1477,	.1850,	.3107,	.2446,	.2175,	.2722,	.4154,	.4772,
7,	.0750,	.1399,	.2097,	.2098,	.2135,	.1844,	.3106,	.3537,
+gp,	.0750,	.1399,	.2097,	.2098,	.2135,	.1844,	.3106,	.3537,
FBAR -3 7,		.0878,	.1599,	.2036,	.2099,	.2088,	.2169,	

Table 5.10.3. Continued

YEAR,	2000,	2001,	FBAR	99-**
AGE				
1,	.0243,	.0328,	.0272,	
2,	.0606,	.0661,	.0537,	
3,	.1628,	.1043,	.1347,	
4,	.2791,	.2388,	.2780,	
5,	.5176,	.2897,	.3691,	
6,	.4314,	.4344,	.4477,	
7,	.4171,	.4213,	.3974,	
+gp,	.4171,	.4213,		
FBAR	.3468,	.3168,	.3616,	.2977,

Run	title	:	Swedish	cost	herring	Subdivision	25-27		
At	13/03/2003	15:08							
Terminal	Fs	derived	using	XSA	(With	F	shrinkage)		
Table	10	Stock	number	at	age	(start	of	year)	Numbers*10**-4
YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,		
AGE									
1,	390673,	410487,	365100,	600391,	385947,	172180,	348461,		
2,	387396,	299099,	309676,	270769,	441217,	285535,	128665,		
3,	322870,	308031,	230198,	244365,	207561,	343016,	221851,		
4,	199724,	253515,	222941,	174659,	167354,	148684,	243117,		
5,	130543,	148297,	176365,	156212,	108163,	109843,	95551,		
6,	91846,	96086,	96420,	105617,	104539,	65136,	67200,		
7,	152340,	64482,	64858,	57342,	66903,	68177,	40217,		
+gp,	159826,	49367,	41105,	33707,	34337,	49188,	31594,		
TOTAL,	1835218,	1629364,	1506664,	1643063,	1516022,	1241758,	1176655,		

YEAR,	1999,	2000,	2001,	2002,	GMST	92-99	AMST	92-99
AGE								
1,	215754,	381405,	452673,	0,	339291,	361124,		
2,	253195,	154562,	273299,	321803,	281895,	296944,		
3,	94397,	194191,	115468,	203255,	231822,	246536,		
4,	134709,	65926,	132169,	83454,	188686,	193088,		
5,	139923,	79281,	40265,	84136,	130617,	133112,		
6,	52199,	83772,	38185,	24397,	82503,	84880,		
7,	35991,	26281,	44155,	20088,	62777,	68789,		
+gp,	23239,	24126,	23137,	35967,				
TOTAL,	949408,	1009545,	1119351,	773100,				

Table 5.10.3. Continued

Run title : Swedish cost herring Subdivisions 25-27 ,

At 13/03/2003 15:08

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

RECRUITS, ,	TOTALBIO, Age	TOTSPBIO, 1	LANDINGS,	YIELD/SSB,	FBAR -3 7,
1992,	3906727,	778457,	577922,	39480,	.0683, .0878,
1993,	4104870,	568554,	372404,	51720,	.1389, .1599,
1994,	3651002,	531323,	367168,	58031,	.1581, .2036,
1995,	6003909,	486609,	309825,	56710,	.1830, .2099,
1996,	3859469,	423988,	274154,	44653,	.1629, .2088,
1997,	1721803,	398988,	278665,	44648,	.1602, .2169,
1998,	3484605,	311177,	192654,	59552,	.3091, .3468,
1999,	2157542,	300752,	190485,	44378,	.2330, .3168,
2000,	3814045,	283683,	161553,	44750,	.2770, .3616,
2001,	4526733,	314626,	174483,	40327,	.2311, .2977,
Arith. Mean	,	3723070,	439816,	289931,	48425, .1922, .2410,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),	

Run title : Swedish cost herring Subdivisions 25-27 ,

At 13/03/2003 15:08

Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

RECRUITS, ,	TOTALBIO, Age	TOTSPBIO, 1	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR -3 7,
1992,	3906727,	778461,	577925,	39480,	.0683,	1.0000, .0878,
1993,	4104870,	568556,	372405,	51720,	.1389,	1.0000, .1599,
1994,	3651002,	531320,	367166,	58031,	.1581,	1.0000, .2036,
1995,	6003909,	486612,	309827,	56710,	.1830,	1.0000, .2099,
1996,	3859469,	423989,	274155,	44653,	.1629,	1.0000, .2088,
1997,	1721803,	408127,	285048,	44648,	.1566,	1.0229, .2169,
1998,	3484605,	311179,	192655,	59552,	.3091,	1.0000, .3468,
1999,	2157542,	300756,	190487,	44378,	.2330,	1.0000, .3168,
2000,	3814045,	283682,	161552,	44750,	.2770,	1.0000, .3616,
2001,	4526733,	314629,	174484,	40327,	.2311,	1.0000, .2977,
Arith. Mean	,	3723070,	440731,	290570,	48425,	0.1918 .2410,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

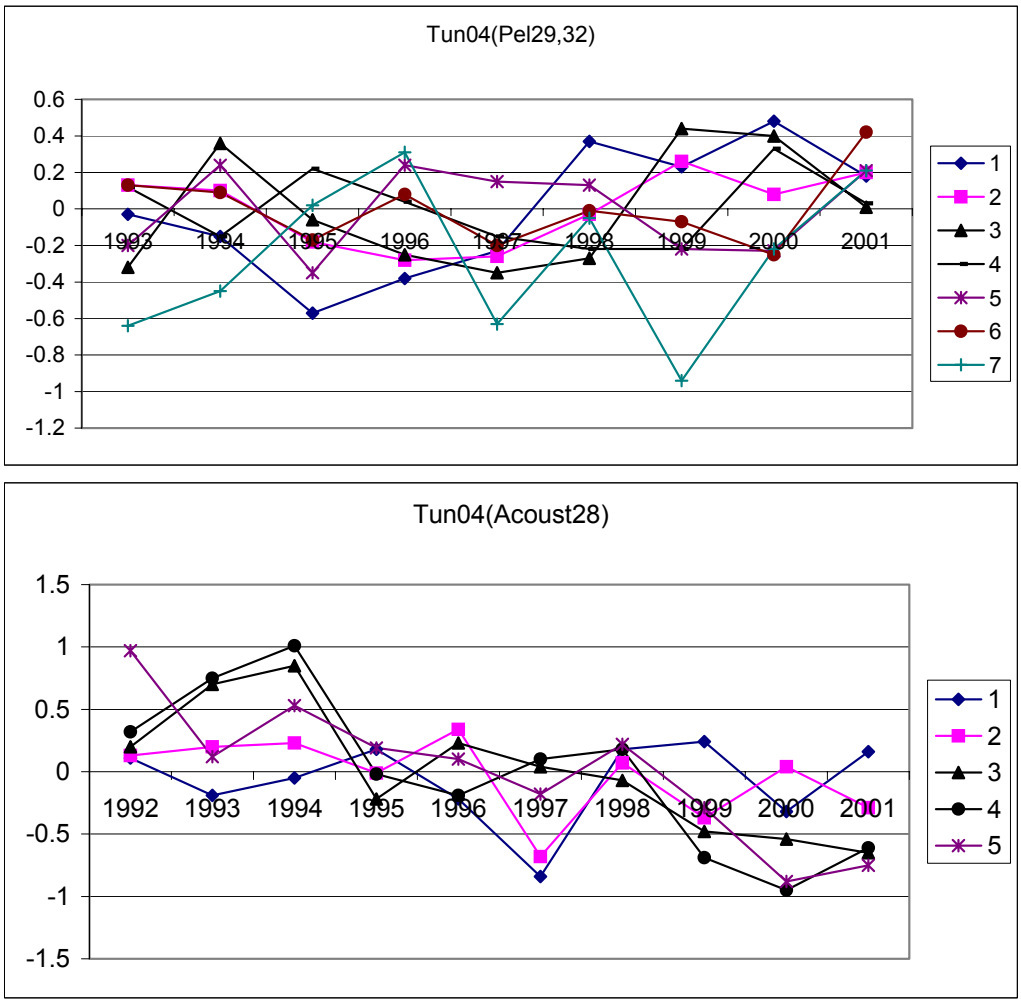


Figure 3.1. Herring in Subdvisions 28,29,32. Log catchability residuals.

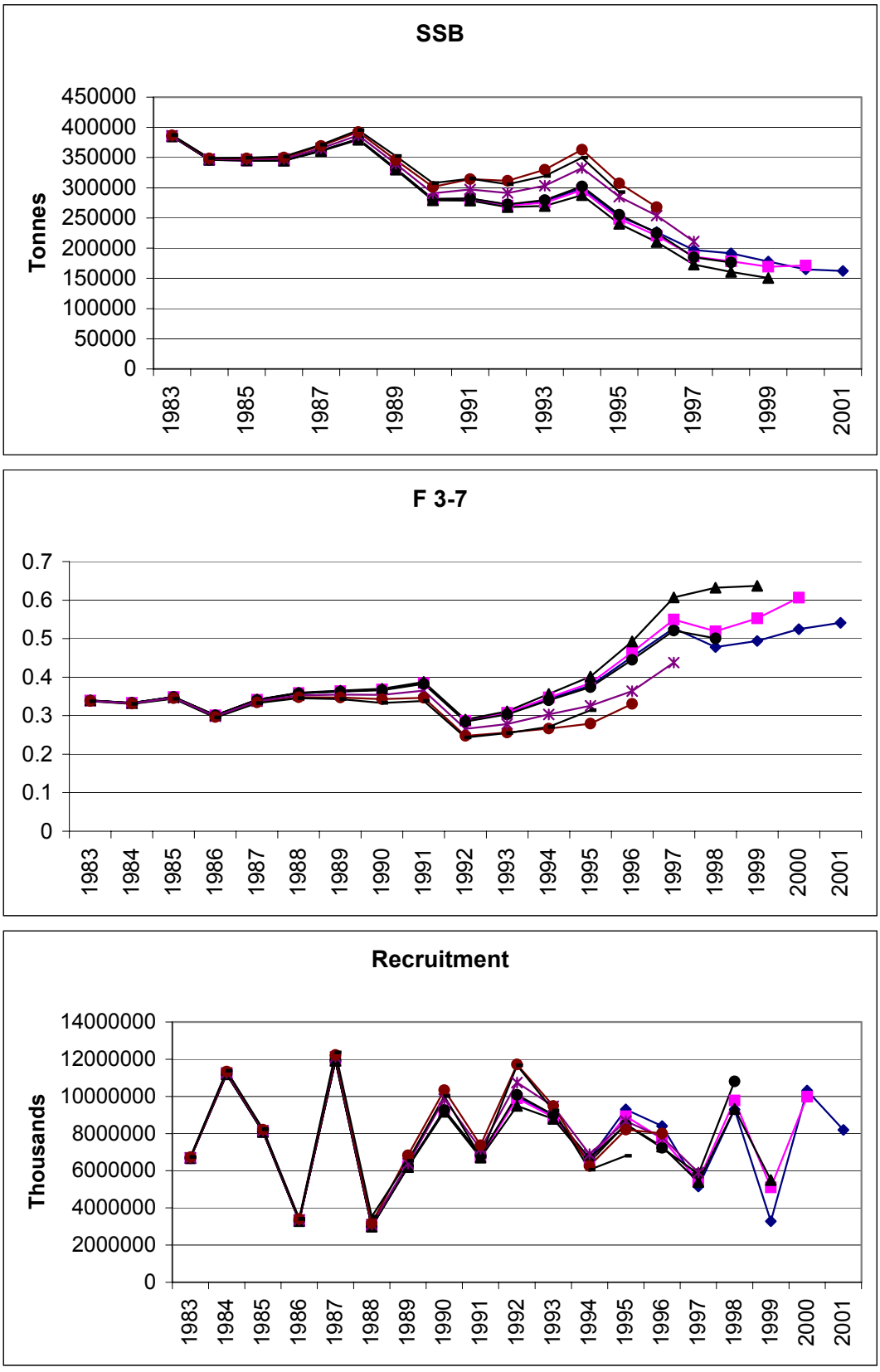


Figure 3.2. Herring in the Subdivisions 28,29,32. Retrospective analysis

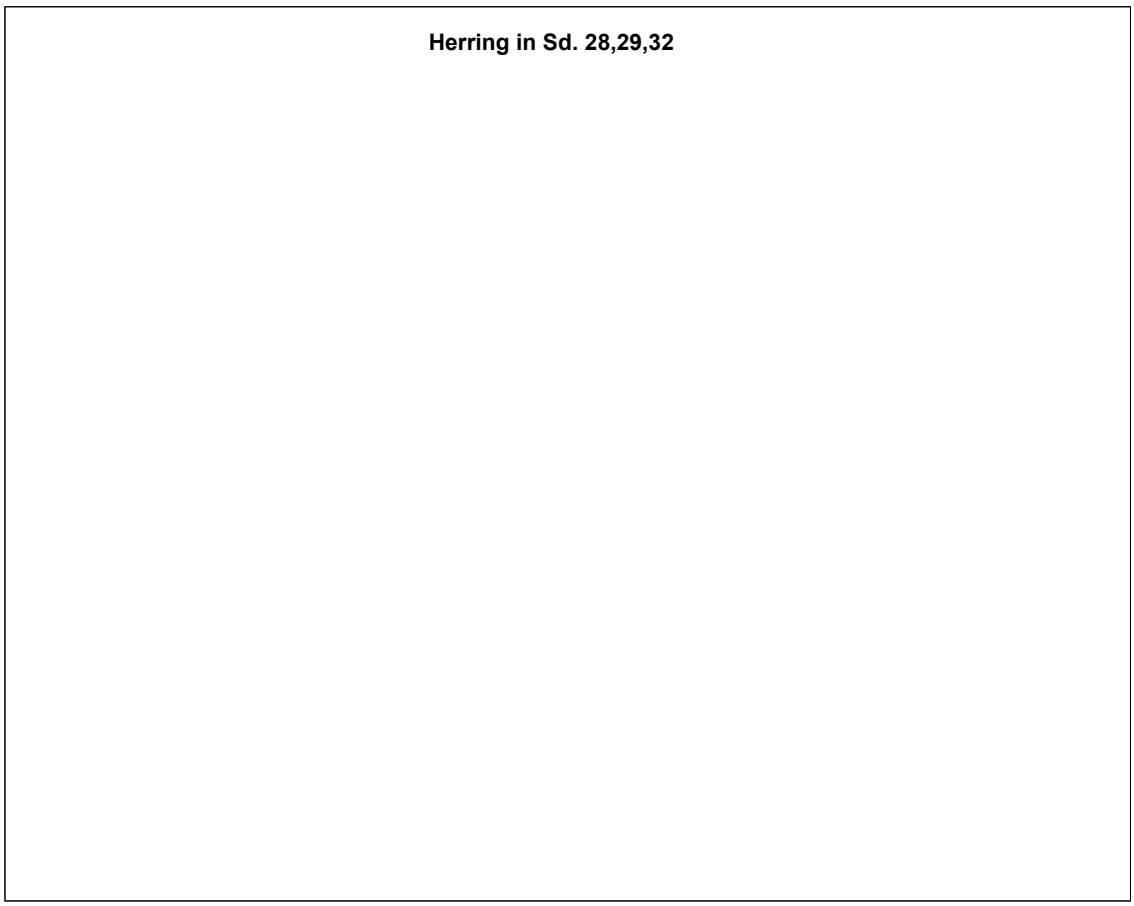


Figure 3.3. Herring in Subdivisions 28,29 and 32. Stock developments in 1983-2001.

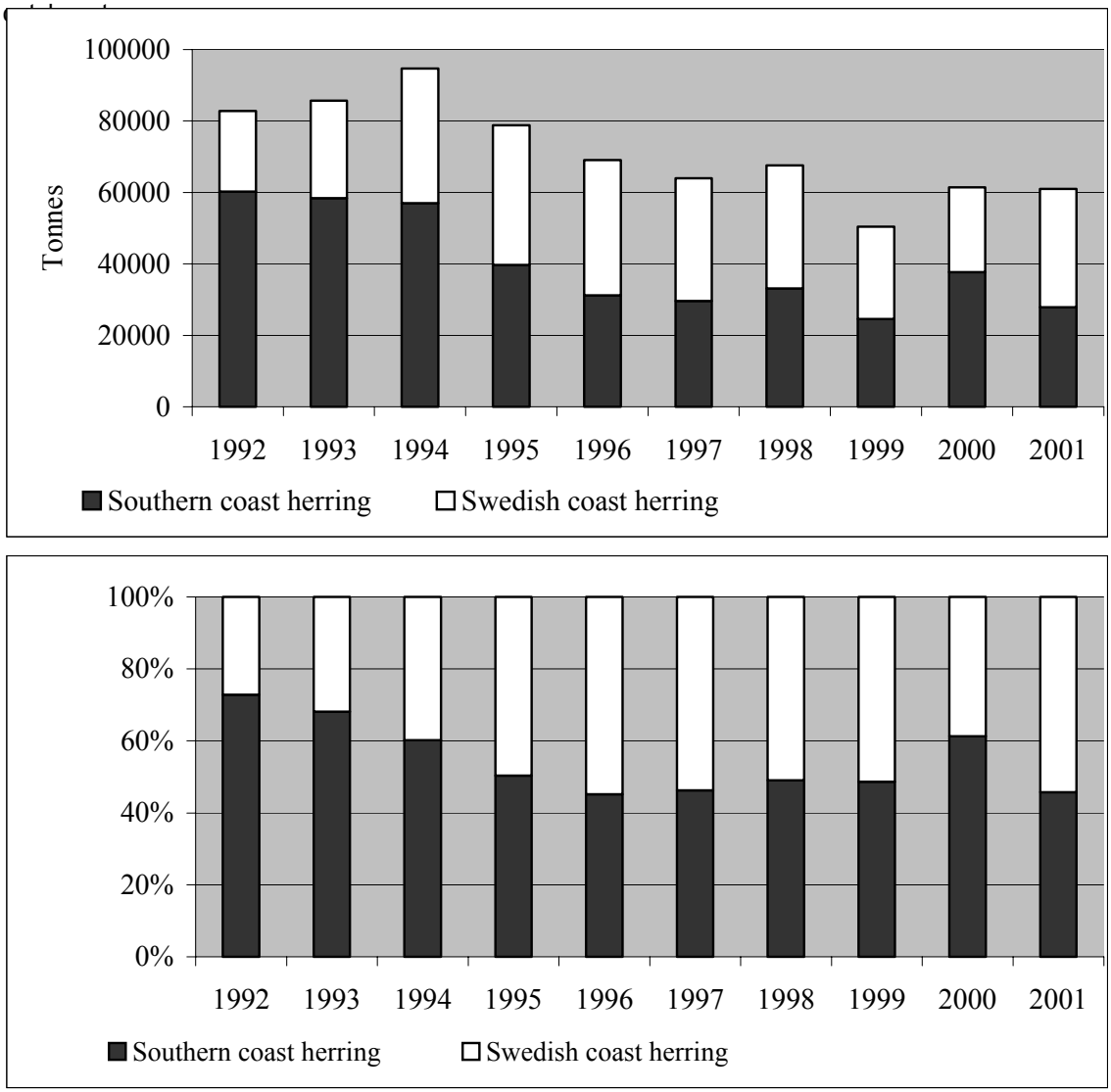
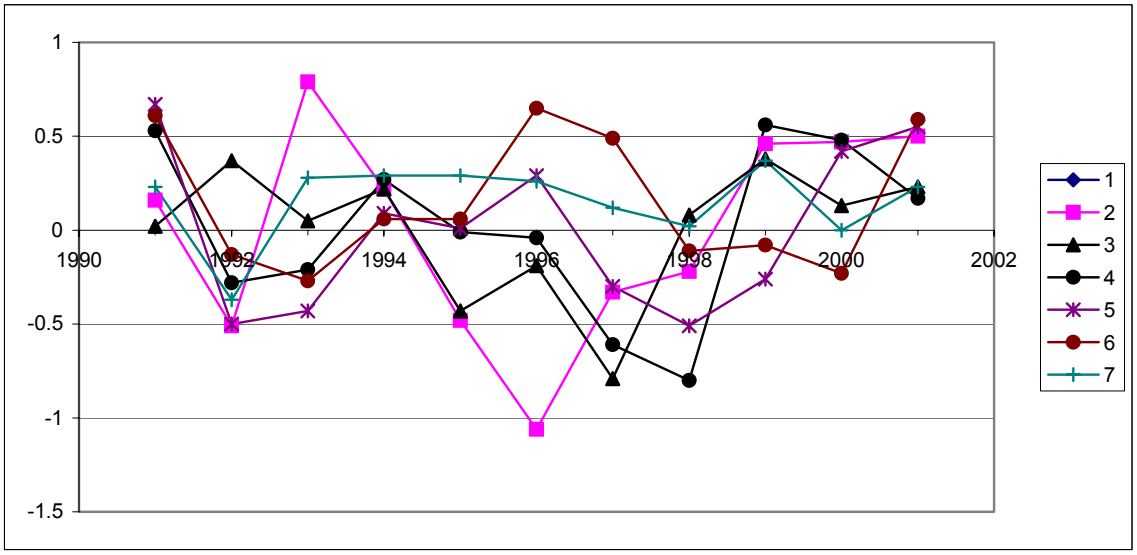


Figure 4.1. Catches of Swedish coast and southern coast herring in Subdivisions 25-26

Trapnets



Acoustic survey

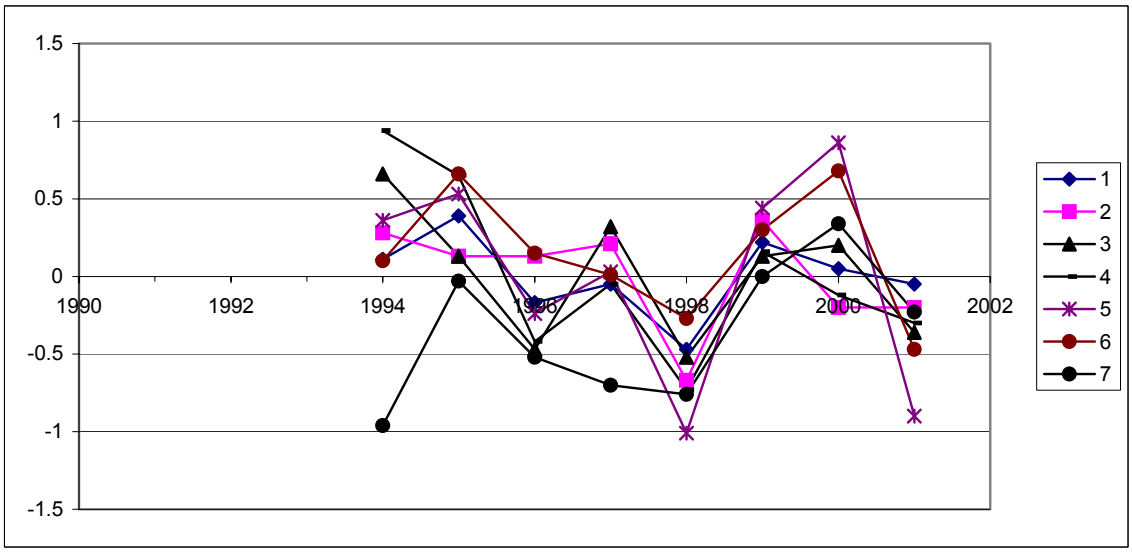


Figure 4.6. Southern coast herring in Sd. 25-26. Log catchability residuals.

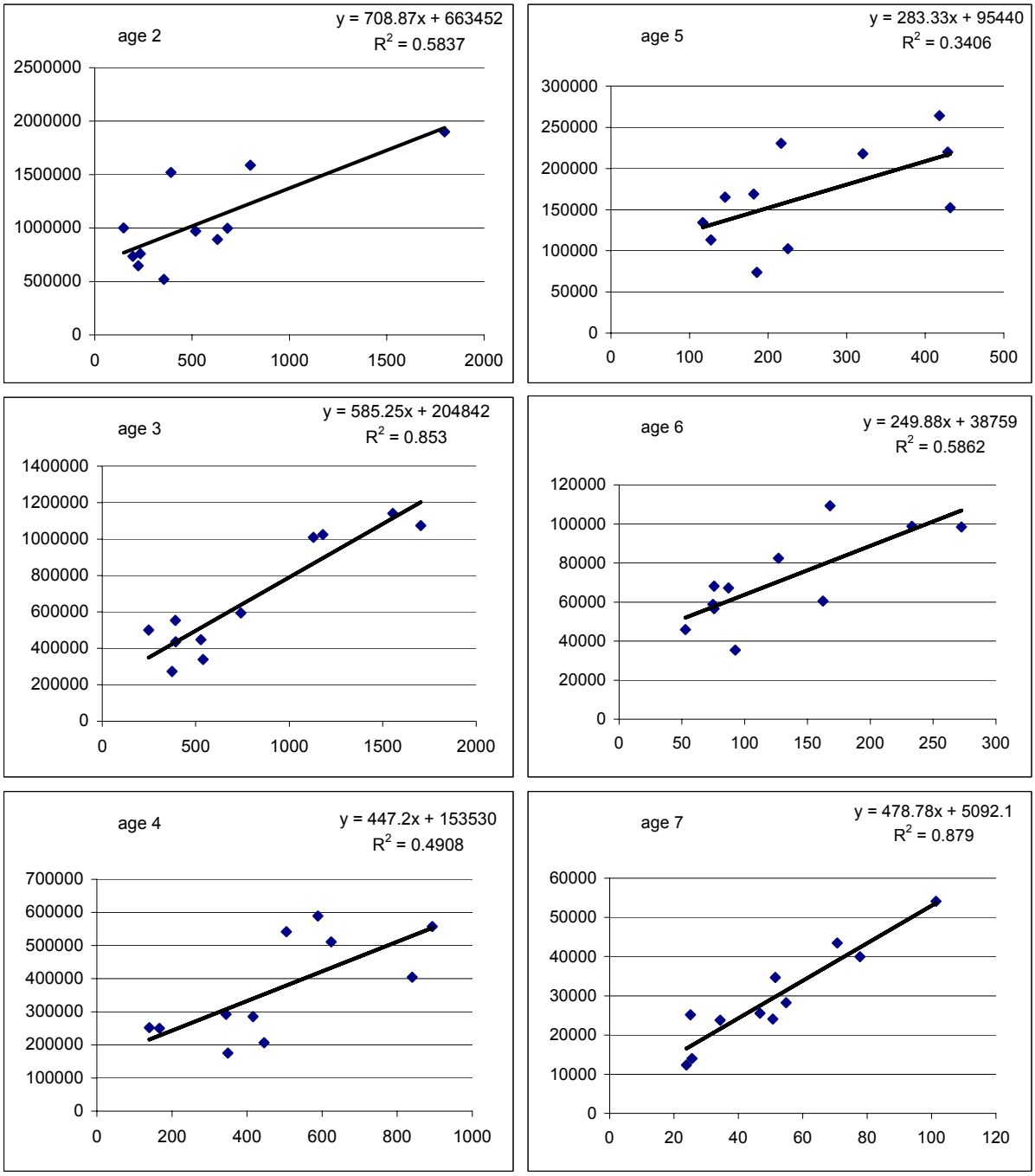


Figure 4.6.2a. Southern coast herring in Sd 25-26. CPUE of Russian trap-net in Sd 26 adjusted to start of year versus stock numbers at age (start of year)

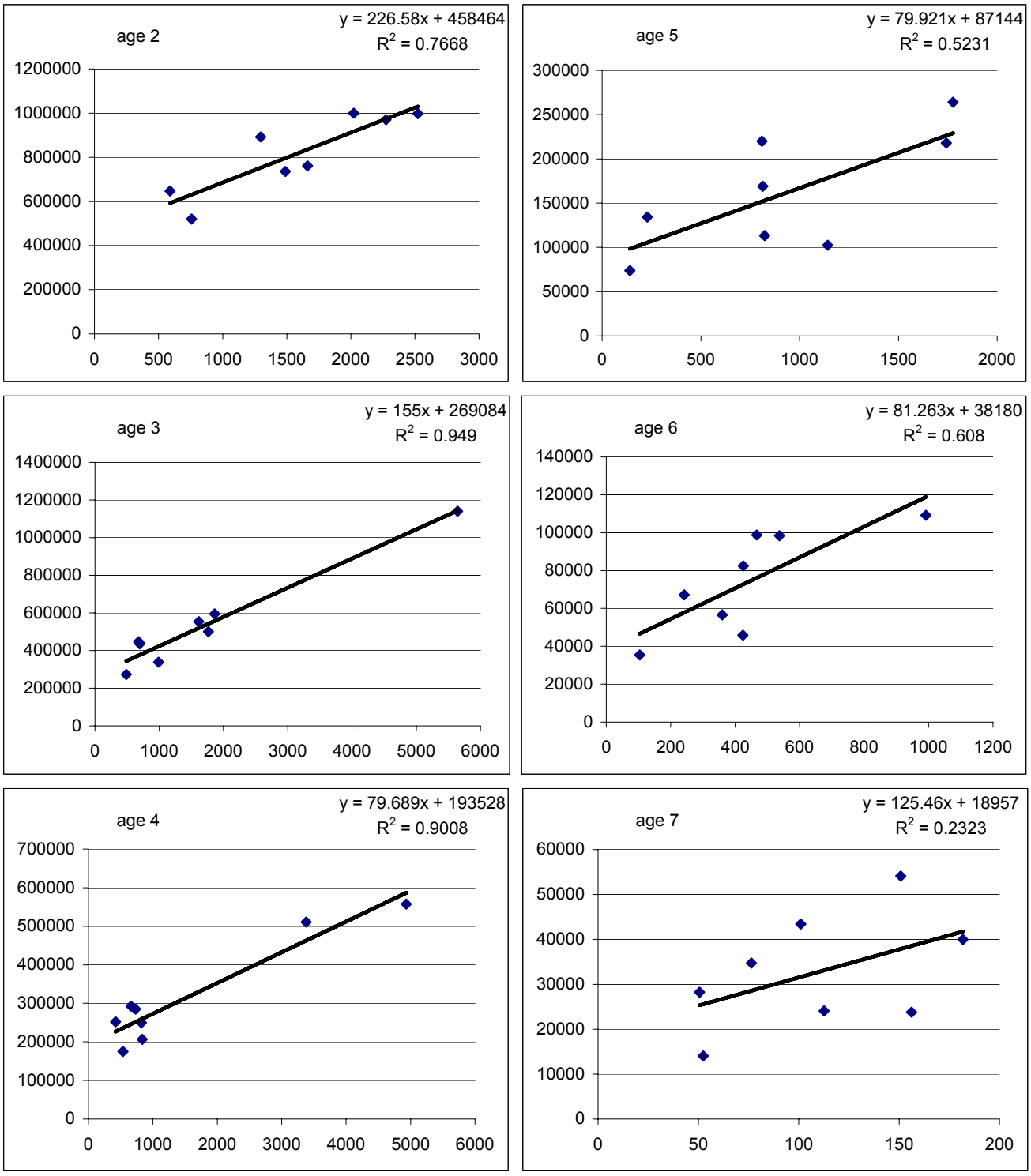


Figure 4.6.2b. Southern coast herring in Sd. 25-26. CPUE from acoustic survey in SD 25+26 adjusted to start of year versus stock numbers at age (start of year).

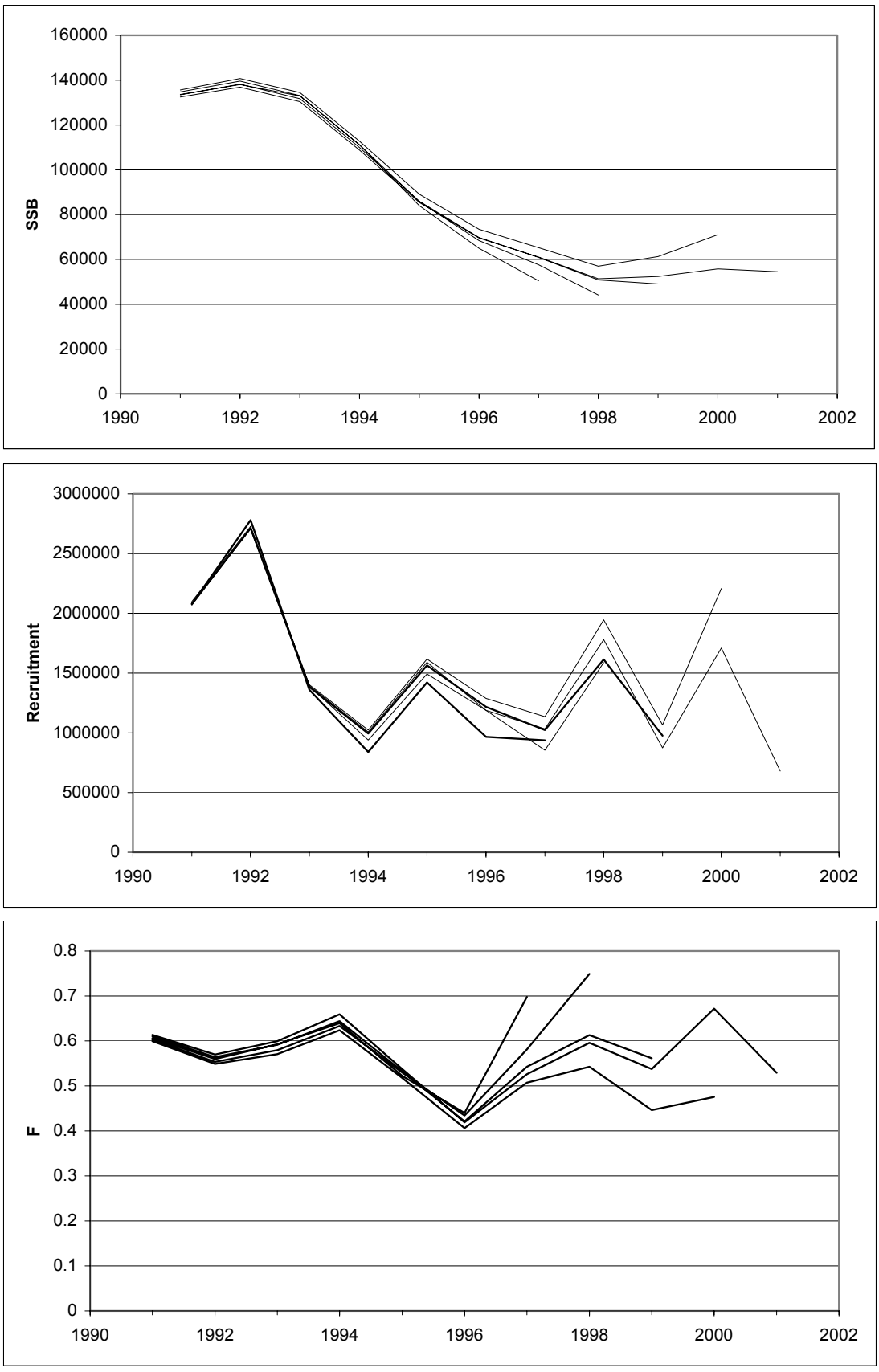


Figure 4..6. 3. Retrospective analysis. Southern coast herring in Subdiv. 25-26.

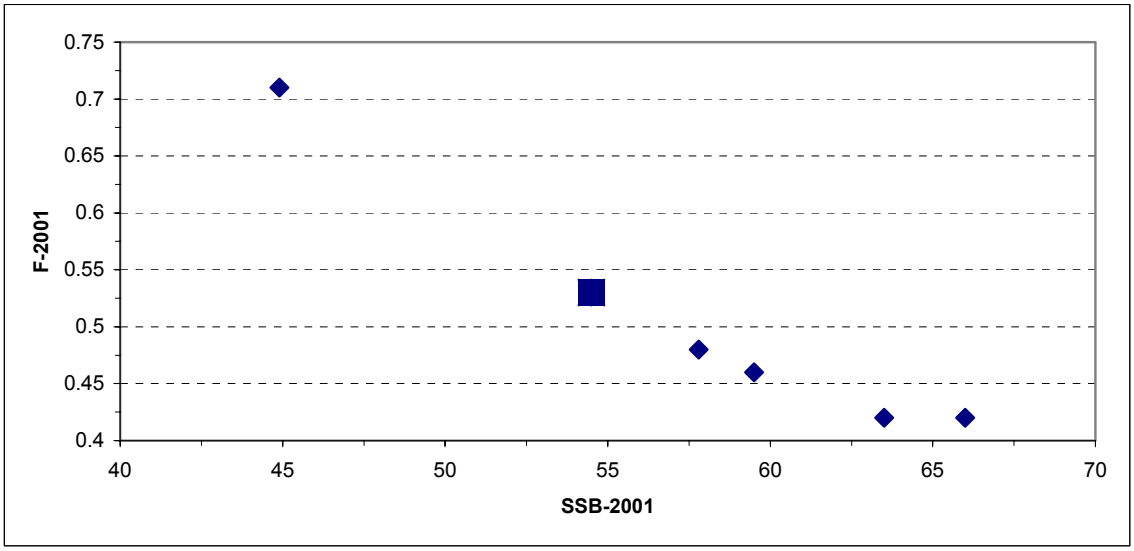


Fig. 4.6.4. Comparisson of several XSA runs with basic option (SE of shrinkage mean = 0.5, catchability independent on year-class strength and constant at age 5, two tuning series). Estimates of SSB and F for terminal year. Southern coast herring in Sd 25-26.

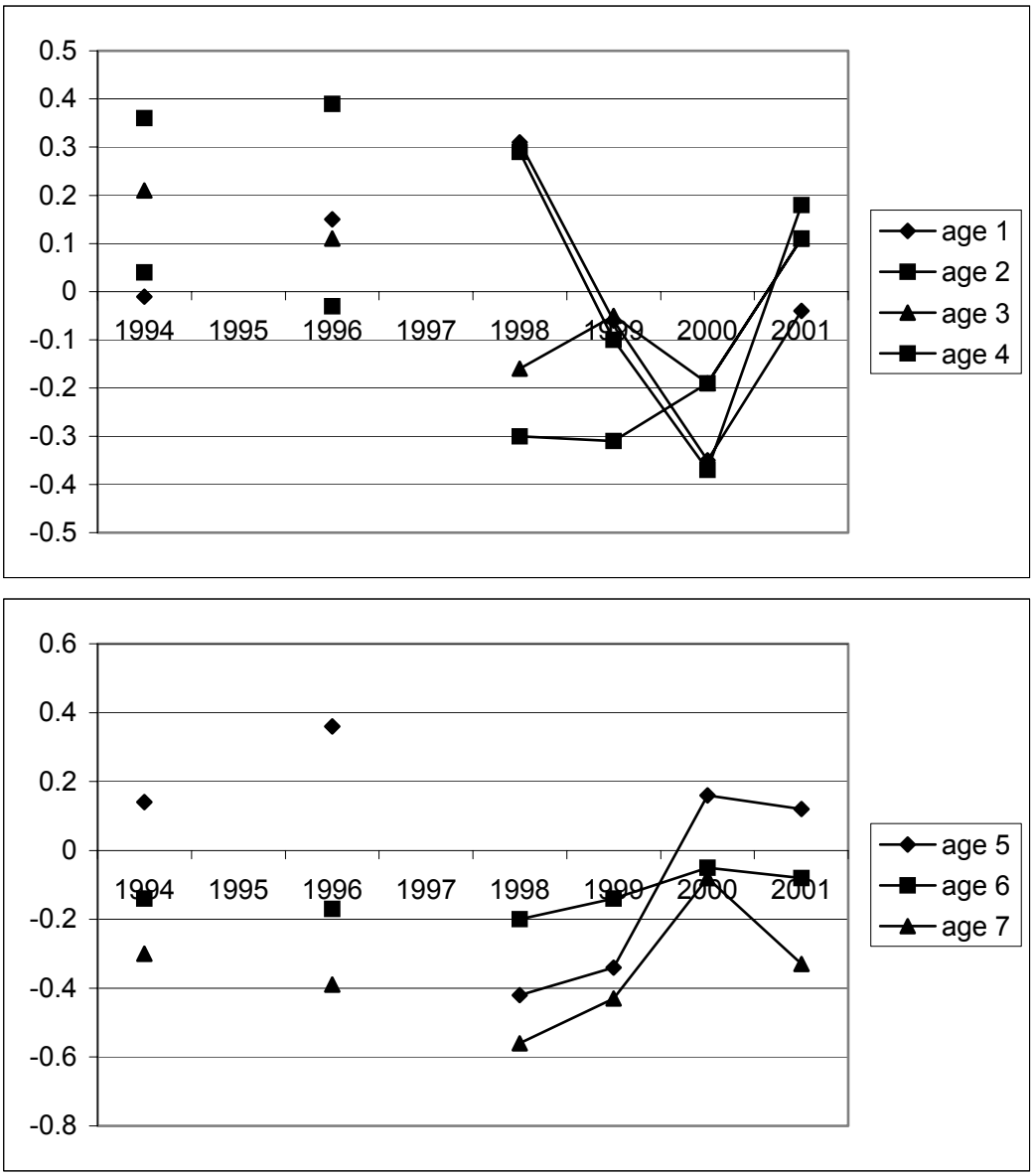


Figure 5.10.1. Swedish coast herring in Sd 25-27. Log catchability residuals.

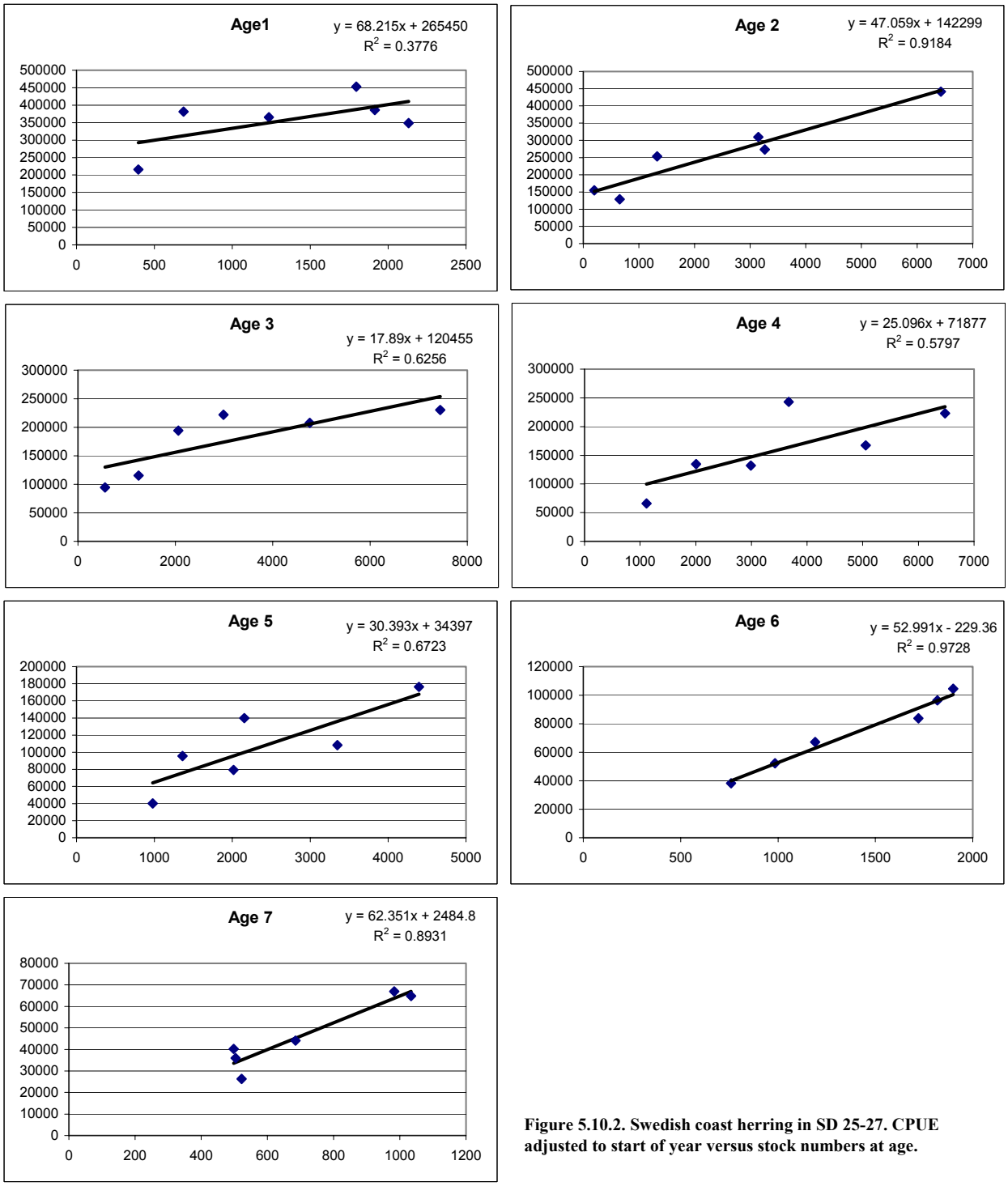


Figure 5.10.2. Swedish coast herring in SD 25-27. CPUE adjusted to start of year versus stock numbers at age.

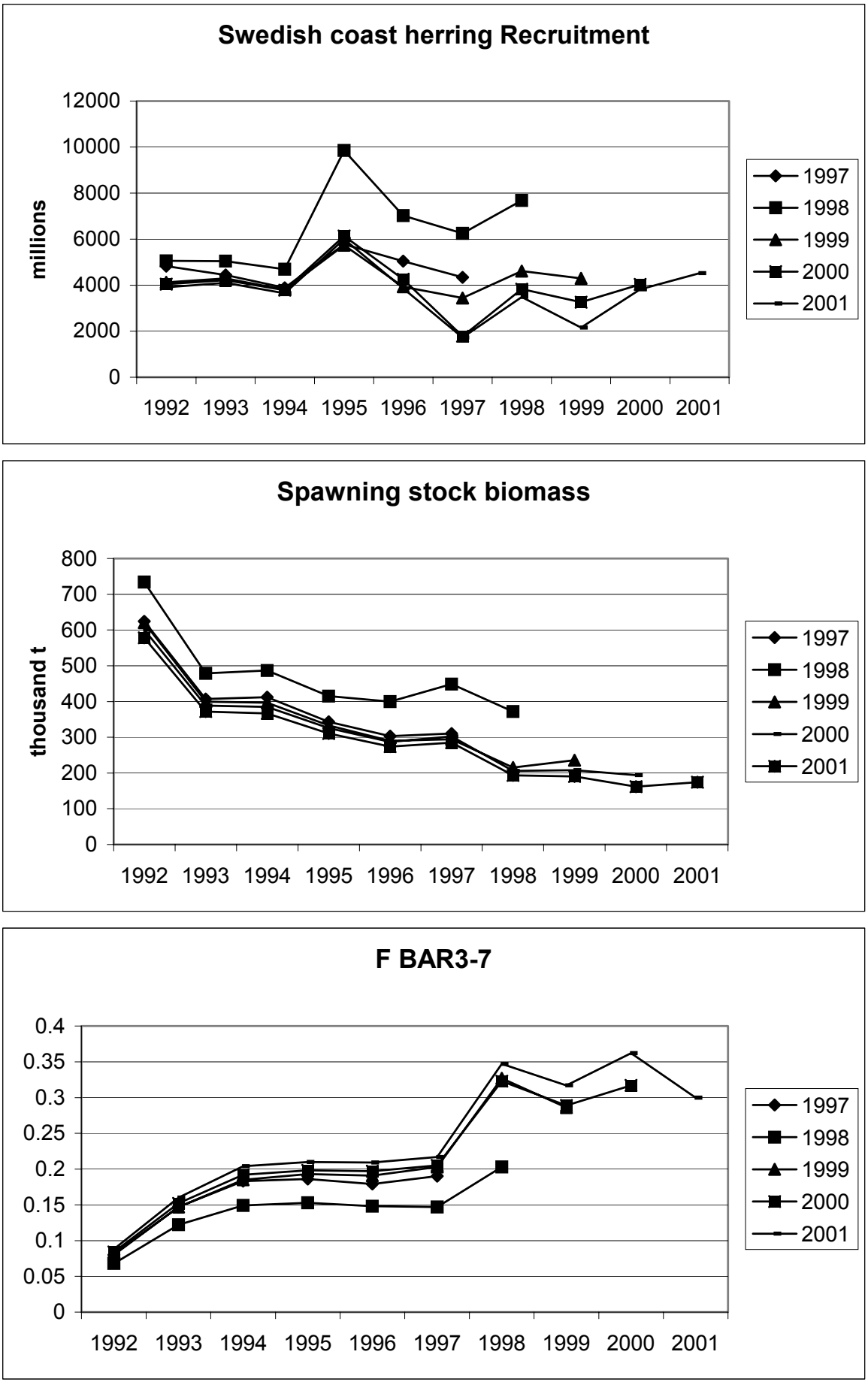


Figure 5.10.3. Swedish coast herring in Sd 25-27. Retrospective analysis.

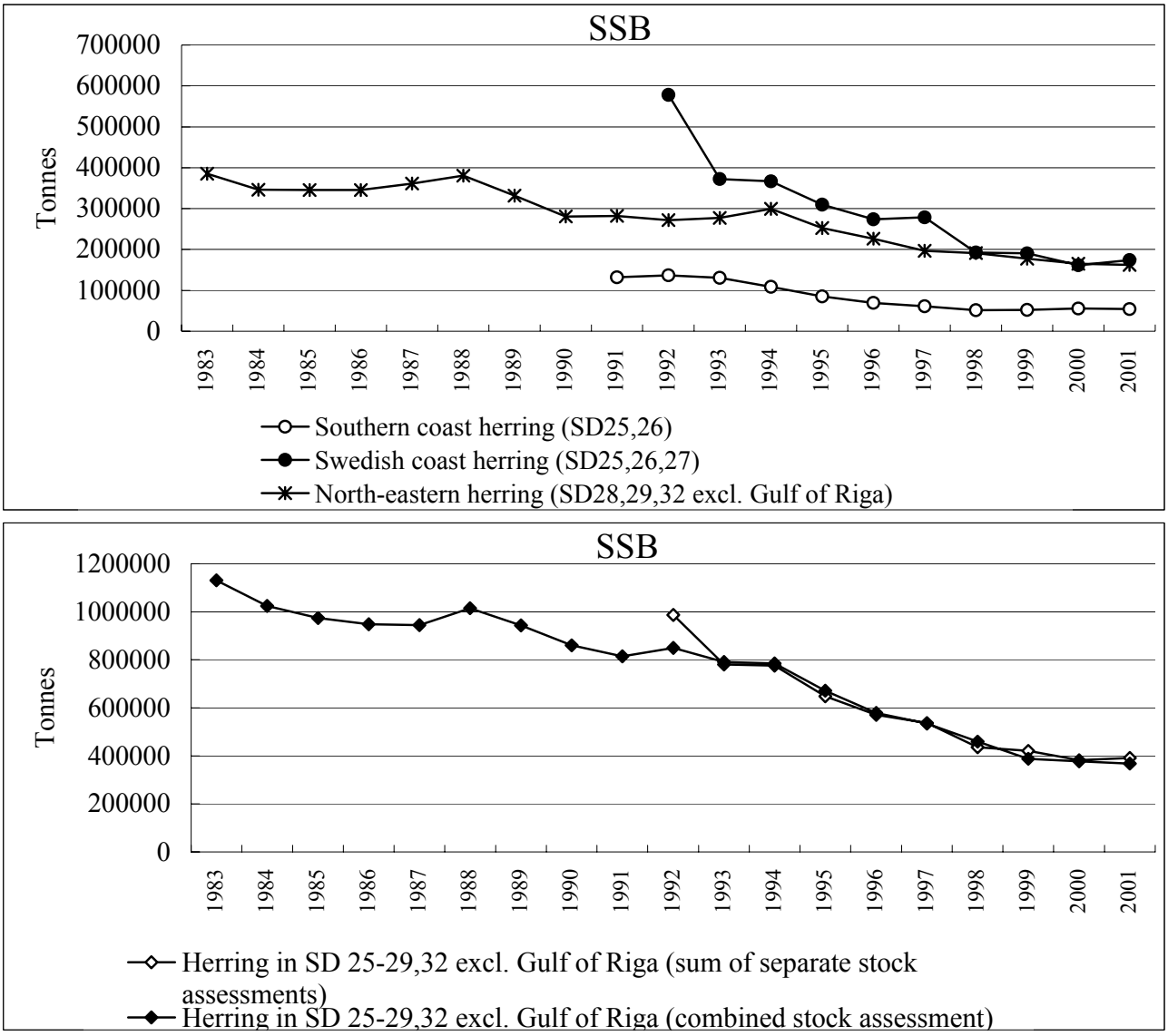


Figure 6.1. SSB estimates from separate assessments of herring stock components versus combined stock assessment in the Main Basin of the Baltic Sea

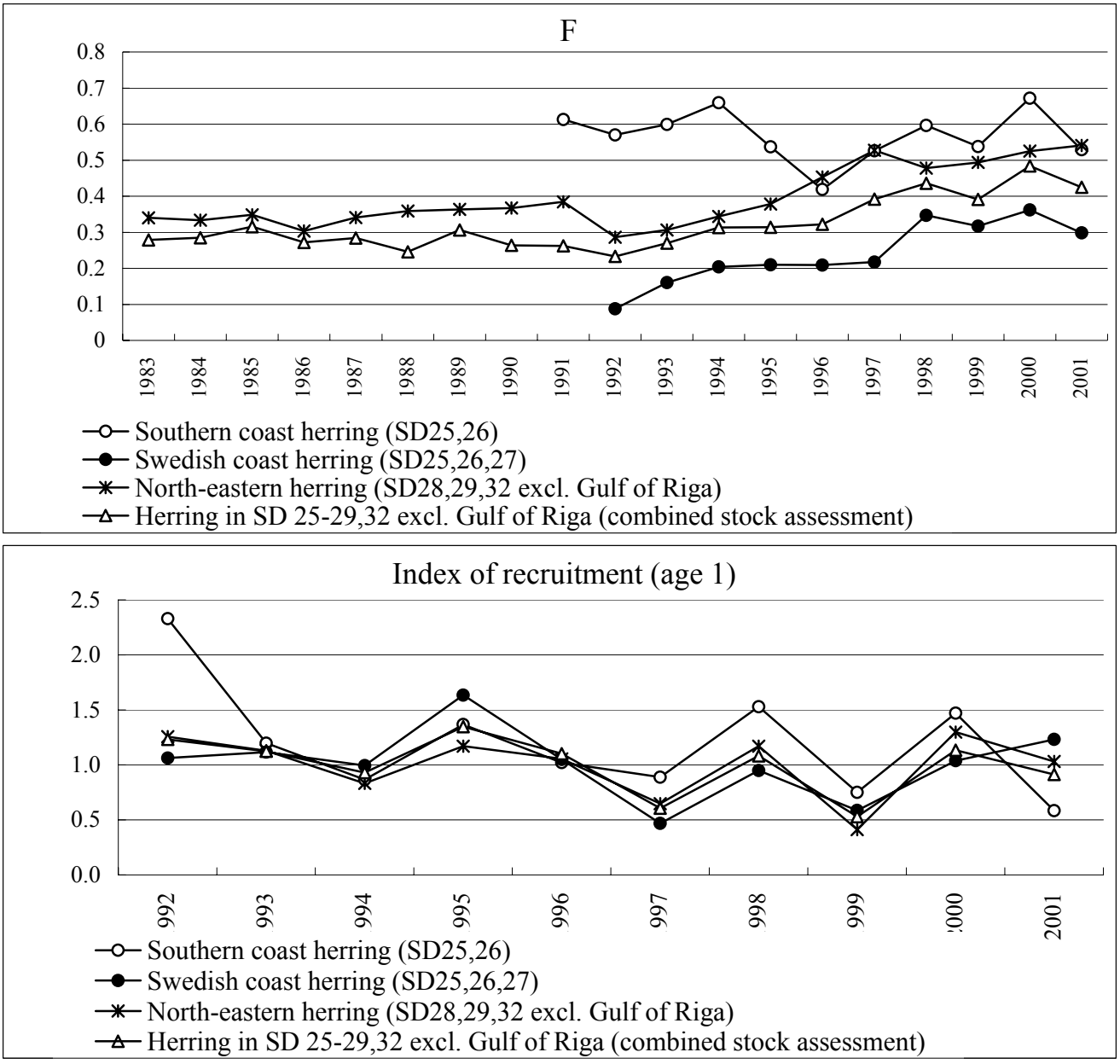


Figure 6.2. Fishing mortality and recruitment estimates from separate assessments of herring stock components versus combined stock assessment in the Main Basin of the Baltic Sea

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