

7 SPRAT IN SUBDIVISIONS 22-32

As in previous years sprat in the Baltic Subdivisions 22–32 was assessed as a single unit.

7.1 The Fishery

7.1.1 Catch trends

Sprat catches in 2003 were 308,260 t, which is 34,000-81,000 t lower than the three previous years. Catches were 10% less than in 2002 and 42% less than the record high level of 529,400 t in 1997. In 2003 the TAC of 341,000 t set by IBSFC was not fully utilized. In almost all countries, except Germany and Poland, catches decreased in comparison with previous year values. The German catches of sprat in 2002-2003 increased from 1,000 t in 2002 to 18,000 t in 2003, and nearly all (99,6%) were landed in foreign ports.

The spatial distribution (by Subdivision) of sprat catches was nearly the same as last year. However, two exceptions occurred – catches were proportionally lower in Subdivision 25 (from 23 to 14%, according to total catches), whereas the share of catches in Subdivision 26 increased (from 27 to 37%). Landings by country and Subdivision are presented in Tables 7.1–7.2. Table 7.3 contains landings, catch numbers and weight at age by Subdivision and quarter.

7.1.2 Unallocated landings

No information on unallocated catches was presented to the group. It is suspected, however, that misreporting of catches occurs, as the species composition of the clupeoids catches is very imprecise in mixed pelagic fishery.

7.1.3 Discards

In most countries discards are probably small because undersized and lower quality fish can be used for production of fish meal and feeding in animal farms. In fisheries directed for human consumption, however, young fish (0 and 1 age groups) are discarded with higher rates in years when strong year classes recruit to the fishery. Recruitment to the fishery takes place in the 4th (age 0) and 1st (age 1) quarters. The amount of discarding of these age-groups is unknown.

7.1.4 Effort and CPUE data

Some new sprat fishing effort and CPUE data for restricted areas and years were presented to the WGBFAS (Table 7.4). Data from ICES Subdivision 26 indicated a significant reduction of Russian fishing effort in sprat fishery in 2003 compared to 2002, e.g., 50% in relation to SRMT (51 m length, 1100 hp) type of vessels and 27% in relation to MKRT (27 m, 300 hp) type of vessels. The reduction of the Estonian fishing effort in ICES Subdivisions 28, 29 and 32 amounted of 38%. In 2003 the sprat CPUE in the Russian fishery was the highest in the last nine years. However this increase was not evident in the Estonian fishery (Table 7.4). Data submitted by Finland concern sprat fishing effort in 2003 only. Because the new effort and CPUE data were restricted to only some regions and years, it is not representative of the entire stock and therefore was not applied for tuning XSA.

7.2 Biological composition of the catch

7.2.1 Age composition

All countries provided age distribution of their major catches by quarter and Subdivision, but some gaps occur in sprat ageing, especially in the Danish and Swedish fisheries. The catches for which age composition was not available represented 16,6% of the total. These catches were distributed to ages according to the average age composition in a given Subdivision and quarter. A large part of the sprat catches is taken in the fish meal fishery. The species composition of these catches is not very precise. Moreover, sprat age composition in these catches is not well recognized. The estimated catch at age in numbers is presented in Table 7.3.

7.2.2 Quality of catch and biological data

In all countries around the Baltic Sea fish catch statistics are based on log-book data. In some countries, such as Denmark and Poland, these data are supplemented by data collected in regional Marine Offices. In Denmark, Sweden, Finland, and in a lesser degree in Poland, much of the sprat catch is taken in industrial fisheries where large by-catches

of other fish species (mostly herring) occur. The species composition of these catches is not accurately known, and can create errors in annual sprat catch statistics.

The landings and sampling activity for 2003 by quarter, ICES Subdivision and countries is presented in Table 7.5. Total catches of sprat from 2002 to 2003 decreased by 10%, but the total number of fish aged increased by 17%. This suggests that the sampling was more intensive than in 2002 (Table. 7.5). The comparison of landing distribution and allocation of sampling activity by ICES Subdivisions show significant inconsistency in timing and coverage. In 2003 relatively high percentage (17%) of the catches for which age composition was not available is recorded. In the sprat age distributions provided by individual countries, some gaps occur, especially in the Danish and Swedish fisheries in the ICES Subdivisions 22, 25, 26, 28 and in the German fishery in ICES Subdivisions 25-29. In some cases (e. g., some quarters of 2003 and Subdivisions), the amount of samples and fish taken for biological analyses was very low and even below levels recommended by ICES and limits set by the EU (EC regulation No. 1639/2001).

This misbalance can influence the quality of biological data provided to WGBFAS.

7.3 Mean weight-at-age

Almost all countries presented rather extensive data on weight at age in the catch by quarter and Subdivision. However, the inconsistency in timing and coverage of sprat sampling in oldest age groups (>5 age group) can lead to uncertainties and irregularities when comparing among years or age (e. g., decrease in weight-at-age after age 5; Table 7.7).

Mean weights at age in the catch were obtained as averages weighted by catch in numbers. The weights at age have decreased by about 40% in 1990–1998. The weights have increased since 1998 and the 2001-2002 estimates are 10–20% higher than the 1998 values. Mean weights in the stock were assumed the same as mean weights in the catch (Table 7.7).

7.4 Maturity at age

The maturity estimates were kept unchanged from last year and constant throughout the time series (Table 7.9). In 2002 the WG was provided with rather extensive maturity data by the Study Group on Herring and Sprat Maturity. These data were analysed using GLM approach and year dependent estimates were obtained (ICES 2002/J:14). These estimates at age 1 varied markedly from year to year but the WG felt that it was necessary to continue sampling and make more extensive analysis of the data. Thus the maturities were averaged over years in last year assessment. The WG is still of the opinion that it is premature to apply in the assessment yearly varying maturities. Some factors which could bias maturity estimates should be taken into account in further analysis of the maturity data e.g. different depth distribution of mature and immature fish of the same age. Such data exist and could be included into the analysis before final estimates are obtained.

7.5 Natural mortality

As in previous years the natural mortalities used varied between years and ages as an effect of cod predation. This year new estimates of predation mortality based on updated MSVPA from 2003 were used. Those new data were applied for years 2001-2002. They differed only slightly from the values used in last year assessment. Differences did not exceed 7% and were mainly restricted to the most recent years. To obtain total natural mortality a residual mortality of 0.2 was added to predation mortality (Table 7.8).

7.6 Catch-at-age analysis

7.6.1 Tuning fleets

The input data for catch at age analysis are presented in Tables 7.6–7.11. Two tuning data sets were available - from International Acoustic Surveys in 1983–2003 in the whole Baltic Sea and Russian/Latvian Acoustic Surveys in ICES SD 26+28 in 1983–2003. The tuning data are given in Tables 7.12–7.13.

7.6.2 XSA runs

The VPA was tuned using XSA with shrinkage option. The settings of the first XSA run were the same as in the final run from last year. Ages 1 to 3 were treated as recruits (some of the slopes of regressions between survey and XSA estimates of stock numbers were significantly different from 1 for both tuning fleets) and the catchability plateau was set at age 4. As in previous assessments lower weights were given to the shrinkage to mean F by selecting SE of the

mean as 0.75 (Table 7.14). The results obtained after the first XSA run indicated a considerable (30%) increase in biomass as compared with the last year's assessment.

The analysis of log q residuals indicated relatively large positive values in 2003 for both surveys (Table 7.14) resulting in overestimation of the stock. Therefore in the final XSA run tapered time weighting was not applied in order to reduce overestimation with the acoustic surveys 2003. The results of both runs are presented below in the text table.

Option	Recruits (thousands)	SSB (t)	F-bar
tapered time weighting applied	186 640 176	1 552 023	0.3109
tapered time weighting not applied	164 339 840	1 229 059	0.4412

The log q residuals are presented in Figure 7.1, and the retrospective analyses in Figure 7.2.

The log-catchability SE's for Latvian/Russian acoustic survey are moderate, being in the interval of 0.27–0.41; the log-catchability SE's for international acoustic survey are higher (ranging from 0.61 to 1.04), especially for ages 6 and 7. The assessment shows a tendency to underestimate stock size and overestimate fishing mortality.

The fishing mortalities, stock numbers and summary tables are presented in Tables 7.15-7.17. Fish stock summary plots are presented in Figures 7.3 and 7.4. The estimate of fishing mortality at age 5 in 2003 (0.76) is considered to be biased, because F s at neighbouring ages are usually approximately 0.2 (Table 7.15). This cohort also had unusually high fishing mortality-at-age 4 in last year's assessment. The catch in numbers at age 4 in 2002 was quite high in relation to the strength of its year class (1998). This year class has been the weakest for 15 years while both neighbouring year classes belonged to the strongest. That could easily, due to the ageing errors, produce largely biased estimate of catch in number for that year class in 2002. Consequently, the estimate of F for age 4 in 2002 was not used in estimations of fishing pattern and status quo fishing mortality. In 2003 fishing mortality of mentioned year class (at age 5) was again high, and F BAR for this age group was taken as average from two neighbouring age groups.

The sensitivity of XSA estimates to selected settings of XSA was examined. Results of these simulations in terms of fishing mortality and spawning stock biomass in the terminal year are presented in Figures 7.5. They show relatively small variation in both F and SSB estimates. The XSA using only Russian/Latvian survey produces ca. 25% higher estimate of SSB than the XSA based only on tuning series from international survey.

7.7 Recruitment estimates

The Russian/Latvian acoustic estimates of age-0 sprat in Subdivisions 26 + 28 were analysed using the RCT3 program (Tables 7.18 and 7.19). The method consistently overestimates the year class strength, so the RCT3 estimates were corrected for the bias by multiplying them by the average ratio of RCT3 and XSA estimates. As a result the 2003 year class was estimated at a level of 199 billion fish at age 1, which is 61% above average for the last decade (Table 7.19).

7.8 Historical stock trends

In the 1990s the SSB exceeded 1 million t, being record high in 1996-1997 (1.9 million t). These values were several times higher than the SSB estimates of 200,000–250,000 t in the early 1980s. Since 1997 the SSB has decreased, and in 2002 it was almost 40% lower than its record high level of 1996-1997. In 2003 the SSB was 37% lower than its record level (1996-1997).

7.9 Short-term forecast and management options

The RCT3 program estimate of the 2003 year class at age 1 was used in the predictions. The 2004 and 2005 year classes were taken as the geometric average of the estimates for 1989-2003, which is the period of recruitment fluctuations without clear trend. The natural mortalities and weights at age were assumed as averages for the years 2001–2003. The fishing pattern was smoothed as the average F at age for 2001–2003 (excluding biased estimate of F at age 5 in 2003) and the average F was assumed for *status quo* fishing mortality. Input data for catch prediction are presented in Table 7.20.

Yield per recruit and short-term forecast for sprat in SD 22-32 are presented in Figure 7.6.

Two prediction options were considered: one with *status quo* fishing mortality in 2004, and one assuming catches at the TAC level in 2004 (420,000 t). The WG is of the opinion that prediction assuming *status quo* F is more realistic.

The *status quo* catches for 2004 and 2005 were predicted to be 408,500 and 453,700 t, respectively. The SSB in 2006 is predicted to be at the level of 1.65 million t. In the option assuming TAC constrained catches in 2004, the prediction of *status quo* catches for 2005 is 451,500 t, which will lead to an increase of SSB to 1.65 million t in 2006 (Table 7.21 and Table 7.22).

The predicted strong year-classes 2002 and 2003 will be dominant contributors to the yield and SSB in 2005 and to SSB in 2006 (Figure 7.7). In 2005, the 2002 and 2003 year-classes will contribute 68% to the yield, and 76% of the SSB. In 2006, these year-classes will contribute 59% of SSB.

The sensitivity of the short-term predictions to environmental variability was also explored because sprat recruitment (based on year-classes 1973-1999) is positively influenced by spring (May) sea temperatures (MacKenzie and Köster, 2004).

New models were developed for the year-classes 1973-2003 (year-classes 1973-2002 as estimated from VPA and 2003 year-class as estimated from RCT3 procedure). For short-term prediction, only the NAO (January – February) index for 2004 was available to the working group as input variable. This index is correlated with both sprat recruitment and spring sea temperatures (MacKenzie and Köster 2004) and was used for prediction purposes. The index for 2004 is low compared to recent years (Section 1.8). The fitted regression model is $\ln(\text{recruitment}) = 0.25 \cdot \text{NAO} + 17.74$ ($R^2_{\text{adj.}} = 20\%$; $P = 0.007$; $N = 31$). Recruitment for the 2004 year-class based on January-February NAO data was then estimated to be 44,511.138 millions.

This estimate for age 1 abundance in 2005 was then used as input to the short-term prediction. Predicted yield in 2005 is 436,148 tonnes and predicted spawner biomass in 2006 is 1,444,987 tonnes. These yield and spawner biomass predictions are 4% and 14.5% lower than those based on predictions using standard procedures (i.e., geometric mean recruitment for 1989-2003). The difference between the two prediction methods is therefore small.

7.10 Medium-term projections

In the medium-term projection, the uncertainty in survivor estimates, weight at age, and the stock-recruitment model were taken into account. The mean weights at age and variations were based on data from 1998-2003, when weight-at-age fluctuated without clear trend. Natural mortalities and exploitation patterns were constant and the same as for the short-term prediction. The Beverton and Holt stock recruitment model was used in the projections and its parameters were estimated assuming log-normal errors (Figure 7.10). The model explains only a small part of the recruitment variance. Its estimates of recruitment within the range of observed data vary from 22 to 240 billion of fish, compared to the long-term geometrical mean of XSA recruitment equal to 83 billion.

The results of the projections for fishing mortality ranging from 0.8 to 1.2 of the status quo value (0.30) are presented in Table 7.23 and in Figures 7.8 and 7.9. All options show a decrease in spawning stock biomass. The median of spawning stock biomass under *status quo* fishing mortality tends towards equilibrium of about 800,000 t. For all projections there is a high probability that the stock will remain above \mathbf{B}_{pa} (= 275,000 t) in the medium term.

7.11 Reference points

The PA software (CEFAS, Lowestoft) was used to estimate biological reference points (Figure 7.11). The estimated \mathbf{F}_{med} (used by ACFM as a basis for $\mathbf{F}_{\text{pa}} = 0.4$) is now 0.33 and the same value was estimated last year. In Figure 7.12 the graphs with equilibrium SSB and yield as well as the observed stock and yield trajectory are presented. The biological reference points estimated based on the replacement lines depend on the natural mortality, weight at age, and maturity data used. At the moment the natural mortalities and the weights at age are low. If they change the biological reference points may change as well.

The segmented regression analysis conducted by ICES Secretariat produces estimate of \mathbf{B}_{lim} at 246,000 t., compared to presently used value of 200,000 t., adopted in 1998. However, re-estimation of \mathbf{B}_{lim} using the same methodology as in 1998 (Mayer et. al. 1994) now produces \mathbf{B}_{lim} of 511,000 t. This high change is a result of both new stock and recruitment observations and rescaling of SSB due to incorporation of new maturity estimates in the 2002 assessment. The estimate of \mathbf{B}_{lim} obtained by segmented regression approach seems to be more realistic, because it takes into account historical trends in stock and recruitment size.

7.12 Quality of assessment

The major problem for this stock is the catch data for clupeids. In the mixed fishery for herring and sprat the separation of herring and sprat catches is imprecise. These uncertainties could influence the estimates of absolute stock size and fishing mortality.

The sprat in Subdivisions 22–32, now being assessed as one unit, was previously considered as composed of three stock components: sprat in Subdivisions 22–25, 26+28, and 27+29–32. An analysis of the impact of merging components on stock assessment has not been conducted since the early 1990s.

The inputs of the assessments are catch-at-age data and age-structured stock estimates from the International and Latvian-Russian Acoustic Surveys.

The tendency of the assessment to underestimate stock size and overestimate fishing mortality should be inspected.

7.13 Comparison with previous assessment

The comparison between the results of 2003 and 2004 assessments is presented in the text table below (next page). XSA input settings in the present year assessment in principle were not changed as compared with the previous year. The only exception in the XSA setting was not applied tapered time weighting in order to reduce overestimation with the acoustic surveys 2003. In the present year assessment data input for natural mortality for 2001-2002 were taken from MSVPA 2003. For the rest of the years natural mortality was the same due to small differences (+/-7%) between MSVPA 2002 and MSVPA 2003 results. The final estimates of 2002 done in 2003 year as compared with 2004 year assessment differed, e.g.: SSB and TSB were 13.2 and 7.7%, respectively higher. Moreover, the outcome of this year's assessment shows significant decrease in fishing mortality (F3-5) of about 30% and slightly decreasing in recruitment-at-age 1 of 5.3%.

Category	Parameter	Assessment 2003	Assessment 2004	Difference (%)
Data input	Maturity ogives	Age 1 - 17%, age 2 - 93%	Age 1 - 17%, age 2 - 93%	No
	Natural mortality	MSVPA 2002	MSVPA 2003 natural mortality 2001-2002 from MSVPA 2003 natural mortality 2003=2002	Small - up to +/-7%
XSA input	Tapered time weighting	applied	not applied	Yes
	Catchability dependent on year class strength	Age<4	Age<4	No
	Catchability independent on age	Age >=4	Age >=4	No
	SE of the F shrinkage mean	0.75	0.75	No
	Tuning data	International acoustic Latvian/Russian acoustic	International acoustic Latvian/Russian acoustic	No
XSA results	SSB 2002	1.21 million t	1.37 million t	+13.2%
	TSB 2002	2.07 million t	2.23 million t	+7.7%
	F(3-5) 2002	0.44	0.31	-29.5%
	Recruitment in 2002	95 billions	90 billions	-5.3%

7.14 Management considerations

There are no explicit management objectives for this stock. As in previous years, sprat in Baltic Subdivisions 22–32 was assessed as a single unit, and this procedure shows relatively high quality assessment of stock size.

Table 7.1 Sprat landings in Subdivisions 22-32 (thousand tonnes)

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

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Total
1992	24.3	4.1	1.8	0.6	17.4	3.3	28.3	8.1	54.2	142.1
1993	18.4	5.8	1.7	0.6	12.6	3.3	31.8	11.2	92.7	178.1
1994	60.6	9.6	1.9	0.3	20.1	2.3	41.2	17.6	135.2	288.8
1995	64.1	13.1	5.2	0.2	24.4	2.9	44.2	14.8	143.7	312.6
1996	109.1	21.1	17.4	0.2	34.2	10.2	72.4	18.2	158.2	441.0
1997	137.4	38.9	24.4	0.4	49.3	4.8	99.9	22.4	151.9	529.4
1998	91.8	32.3	25.7	4.6	44.9	4.5	55.1	20.9	191.1	470.8
1999	90.2	33.2	18.9	0.2	42.8	2.3	66.3	31.5	137.3	422.6
2000	51.5	39.4	20.2	0.0	46.2	1.7	79.2	30.4	120.6	389.1
2001	39.7	37.5	15.4	0.8	42.8	3.0	85.8	32.0	85.4	342.2
2002	42.0	41.3	17.2	1.0	47.5	2.8	81.2	32.9	77.3	343.2
2003	32.0	29.2	9.0	18.0	41.7	2.2	84.1	28.7	63.4	308.3

* Sum of landings by Estonia, Latvia, Lithuania, and Russia.

Table 7.2

Sprat landings in the Baltic Sea by country and Subdivision
(thousand tonnes).**Year 2000**

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	51.5	9.4	0.8	41.2 ¹⁾	-	-	-	-	-	-	-
Estonia	39.4	-	-	-	-	-	6.1	13.9	-	-	19.4
Finland	20.2	-	-	-	-	-	-	3.6	4.8	0	11.9
Germany	0	0	-	-	-	-	-	-	-	-	-
Latvia	46.2	-	-	2.6	7.3	-	36.3	-	-	-	-
Lithuania	1.7	-	-	-	1.7	-	-	-	-	-	-
Poland	79.2	-	0.8	40.5	37.9	-	-	-	-	-	-
Russia	30.4	-	-	-	28.3	-	2	-	-	-	-
Sweden	120.6	-	2.1	31.7	13.2	31.5	23.9	18.1	-	-	-
Total	389.1	9.5	3.7	116	88.4	31.5	68.3	35.5	4.8	0	31.4

¹⁾ Danish landings in Subdivision 25 include landings in Subdivision 22 and 24.

Year 2001

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	39.7	-	-	39.7	-	-	-	-	-	-	-
Estonia	37.5	-	-	-	-	-	6.3	16.1	-	-	15.1
Finland	15.4	-	-	-	-	-	-	4.5	3.2	0.001	7.6
Germany	0.8	0.02	0.8	-	-	-	-	-	-	-	-
Latvia	42.8	-	-	1.1	7	-	34.7	-	-	-	-
Lithuania	3	-	-	-	3	-	-	-	-	-	-
Poland	85.8	-	0.4	46.3	39.1	-	-	-	-	-	-
Russia	32	-	-	-	29.6	-	2.3	-	-	-	-
Sweden	85.4	-	1	2.9	4.8	27.8	30.2	18.1	-	-	0.5
Total	342.2	0.02	2.1	90	83.5	27.8	73.5	38.7	3.2	0.001	23.2

Year 2002

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	42.0	4.7	1.0	22.5	7.7	0.7	4.6	0.9	-	-	-
Estonia	41.3	-	-	-	-	-	7.7	17.0	-	-	16.6
Finland	17.2	-	0.8	2.3	0.004	0.1	0.001	3.7	4.8	-	5.5
Germany	1.0	0.03	-	0.1	0.4	0.1	0.1	0.2	-	-	-
Latvia	47.5	-	-	1.4	4.5	-	41.7	0.0	-	-	-
Lithuania	2.8	-	-	0.0	2.8	-	-	-	-	-	-
Poland	81.2	-	0.04	39.7	41.5	-	-	-	-	-	-
Russia	32.9	-	-	-	29.9	-	2.9	-	-	-	-
Sweden	77.3	-	3.0	13.3	5.6	27.2	19.9	8.3	-	-	-
Total	343.2	4.8	4.8	79.3	92.4	28.1	76.8	30.1	4.8	0.0	22.1

Year 2003

Country	Total	22	24	25	26	27	28	29	30	31	32
Denmark	32.0	8.2	0.7	10.4	8.9	1.8	1.7	0.3	-	-	-
Estonia	29.2	-	-	-	-	-	11.1	11.6	-	-	6.5
Finland	9.0	-	0.03	0.4	0.0	0.2	0.1	4.6	1.5	0.001	2.0
Germany	18.0	0.2	0.5	0.8	3.0	9.5	2.8	1.1	-	-	-
Latvia	41.7	-	-	0.8	7.8	-	33.2	-	-	-	-
Lithuania	2.2	-	-	-	2.2	-	-	-	-	-	-
Poland	84.1	-	0.0	26.7	57.4	-	-	-	-	-	-
Russia	28.7	-	0.0	0.0	27.2	-	1.4	-	-	-	-
Sweden	63.4	-	2.1	5.5	8.6	24.1	19.3	3.8	-	-	-
Total	308.3	8.3	3.5	44.6	115.1	35.6	69.6	21.5	1.5	0.001	8.5

Table 7.3

SPRAT in SD 22-32.

Catch in numbers and weight at age
by quarter and Sub-division in 2003**Sub-division 22**

Age	Numbers (milions)				Total	Weight (g)			
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
0	0.00	0.00	3.94	775.75	779.7	0.0	0.0	3.4	3.3
1	32.00	58.81	94.21	15.15	200.2	9.2	9.2	10.3	7.6
2	51.54	94.72	39.18	6.38	191.8	15.3	15.3	16.1	14.0
3	6.04	11.10	10.68	0.00	27.8	17.2	17.2	17.5	
4	3.02	5.55	3.64	0.00	12.2	21.4	21.4	18.6	
5	0.00	0.00	0.01	0.00	0.0				
6	1.79	3.30	0.01	0.00	5.1	24.3	24.3		
7	0.00	0.00	0.00	0.00	0.0				
8	0.00	0.00	0.00	0.00	0.0				
9	0.00	0.00	0.00	0.00	0.0				
10	0.00	0.00	0.00	0.00	0.0				
Sum	94.4	173.5	151.7	797.3	1216.8				
SOP	1295.3	2380.7	1871.9	2764.2	8312.1				
Catch	1303.0	2382.8	1872.0	2764.2	8322.0				

Sub-division 24

Age	Numbers (milions)				Total	Weight (g)			
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
0	0.0	0.0	0.1	182.9	183.0				3.5
1	18.6	16.6	3.3	16.6	55.1	9.2	8.9	12.5	12.4
2	31.0	42.7	3.9	21.3	98.8	15.3	13.6	13.6	15.5
3	5.0	7.5	2.4	11.0	25.9	17.2	13.2	13.4	17.4
4	2.8	15.6	2.1	3.3	23.9	21.4	13.3	15.3	18.3
5	0.8	4.5	1.8	1.0	8.1		12.3	14.3	18.2
6	1.3	8.6	0.9	0.5	11.3	24.3	13.4	13.7	19.3
7	0.2	0.0	0.2	0.0	0.4				18.3
8	0.0	1.1	0.1	0.6	1.7		10.0		17.2
9	0.0	0.0	0.0	0.0	0.0				
10	0.0	0.0	0.0	0.0	0.0				
Sum	59.8	96.5	14.8	237.2	408.3				
SOP	825.0	1215.1	197.5	1457.3	3695.0				
Catch	720.1	1215.1	201.9	1457.3	3594.5				

Sub-division 25

Age	Numbers (milions)				Total	Weight (g)			
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
0	0.0	0.0	1.5	118.9	120.4	0.0	0.0	5.1	4.7
1	342.3	488.9	2.0	24.1	857.3	4.3	4.5	8.2	10.6
2	636.0	569.1	12.9	45.1	1263.2	10.8	10.3	12.3	14.6
3	376.8	351.8	22.6	31.4	782.5	12.1	11.4	13.4	15.2
4	319.2	335.1	17.2	25.2	696.7	12.6	11.8	14.0	15.1
5	198.7	161.5	11.2	10.9	382.2	13.1	12.5	14.2	14.5
6	91.9	67.6	1.8	12.1	173.3	12.9	12.6	15.8	15.6
7	39.3	15.1	1.7	2.3	58.5	13.9	13.2	15.8	16.2
8	8.5	31.0	0.0	1.3	40.8	10.8	11.5	0.0	15.0
9	5.2	10.2	0.0	0.0	15.4	11.0	9.0	0.0	0.0
10	1.6	0.0	0.0	0.0	1.6	18.0	0.0	0.0	0.0
Sum	2019.6	2030.1	70.9	271.3	4391.9				
SOP	21437.5	19535.8	940.4	2727.5	44641.1				
Catch	21437.5	19535.8	940.4	2727.5	44641.1				

Table 7.3 continued

Sub-division 26

Age	Numbers (milions)				Total	Weight (g)			
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
0	0.0	0.0	26.9	1284.8	1311.7	0.0	0.0	3.1	3.0
1	2266.8	1242.9	212.2	796.2	4518.0	3.4	3.6	7.1	7.8
2	1829.5	1103.2	198.4	296.3	3427.3	9.9	8.9	10.5	10.3
3	1036.8	962.7	57.0	115.2	2171.7	11.2	10.9	11.5	11.6
4	875.1	677.3	69.8	127.5	1749.7	11.4	10.8	11.3	11.3
5	356.5	140.2	13.3	38.7	548.8	12.4	11.8	13.7	12.6
6	170.9	240.5	19.1	39.9	470.4	12.3	11.5	11.7	11.5
7	39.6	33.4	3.4	6.2	82.5	12.9	12.3	13.4	12.9
8	33.9	68.3	4.3	13.5	120.0	11.8	11.7	11.0	11.6
9	1.9	0.0	0.0	0.0	1.9	14.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sum	6610.8	4468.5	604.4	2718.3	14402.1				
SOP	54726.4	37757.9	5617.1	17002.1	115103.5				
Catch	54700.2	37757.9	5617.1	17002.1	115077.4				

Sub-division 27

Age	Numbers (milions)				Total	Weight (g)			
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
0	0.0	0.0	0.0	4.8	4.8	0.0	0.0	0.0	3.7
1	96.6	35.8	0.0	91.0	223.4	3.4	3.2	0.0	8.3
2	254.4	54.5	0.0	39.3	348.1	9.2	8.1	0.0	11.3
3	390.4	72.9	0.0	31.2	494.4	10.0	9.0	0.0	11.7
4	524.1	117.3	0.0	72.9	714.2	10.3	9.3	0.0	12.3
5	795.0	28.0	0.0	23.1	846.0	11.0	9.5	0.0	11.6
6	83.9	94.8	0.0	31.3	210.1	10.6	9.4	0.0	12.7
7	334.3	5.6	0.0	1.6	341.5	10.0	8.0	0.0	15.0
8	27.1	39.5	0.0	15.2	81.7	10.7	9.9	0.0	13.6
9	133.7	34.0	0.0	3.2	171.0	10.7	9.8	0.0	11.5
10	95.9	8.7	0.0	0.0	104.6	11.0	10.7	0.0	0.0
Sum	2735.2	491.2	0.0	313.6	3539.9				
SOP	27722.5	4326.9	0.0	3412.7	35462.1				
Catch	27722.5	4326.9	144.9	3412.7	35606.9				

Sub-division 28

Age	Numbers (milions)				Total	Weight (g)			
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
0	0.0	0.0	12.2	564.3	576.5	0.0	0.0	2.4	2.5
1	453.8	78.4	247.5	1069.8	1849.5	2.7	3.8	6.9	6.6
2	510.3	164.8	176.0	598.0	1449.0	8.7	8.9	9.3	9.1
3	453.8	81.8	70.2	305.2	911.0	9.7	10.1	10.2	9.8
4	758.5	206.9	157.2	387.0	1509.6	10.2	10.4	10.4	10.1
5	194.1	20.3	11.9	176.1	402.4	10.3	10.4	10.7	10.4
6	386.3	115.2	75.0	204.6	781.2	10.5	11.1	10.7	10.6
7	103.9	21.3	15.1	80.2	220.5	10.3	10.9	10.9	10.1
8	199.1	73.0	41.6	122.8	436.5	11.0	11.1	10.9	10.8
9	26.0	3.7	2.2	7.3	39.2	10.4	10.4	10.4	10.4
10	26.0	1.6	0.9	1.8	30.3	10.5	11.4	10.8	11.3
Sum	3111.7	766.9	810.0	3517.2	8205.8				
SOP	27671.3	7322.0	7297.8	27048.7	69339.8				
Catch	27671.3	7322.0	7297.8	27315.5	69606.7				

Table 7.3 continued

Sub-division 29

Age	Numbers (milions)				Total	Weight (g)			
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
0	0.0	0.0	2.7	571.0	573.7	0.0	0.0	2.8	2.6
1	337.5	40.8	82.7	553.1	1014.1	2.2	2.4	5.9	6.3
2	84.7	25.3	12.0	112.7	234.8	8.4	8.3	8.6	9.9
3	135.8	24.8	26.3	134.4	321.2	9.5	9.2	10.1	10.1
4	148.4	44.7	13.1	91.3	297.5	9.9	9.3	10.7	10.2
5	86.2	17.2	5.4	46.4	155.1	10.0	9.4	10.1	10.1
6	93.1	25.2	8.0	50.4	176.6	10.2	9.6	11.4	10.5
7	46.7	9.8	2.1	42.0	100.6	10.2	9.4	10.1	10.7
8	48.5	10.3	4.0	26.9	89.6	9.9	9.5	9.3	10.9
9	25.0	12.9	1.8	68.6	108.3	11.6	10.4	13.0	11.4
10	22.4	3.8	1.3	13.6	41.1	9.8	10.1	11.5	11.6
Sum	1028.3	214.7	159.4	1710.3	3112.8				
SOP	7484.5	1718.6	1242.2	11049.1	21494.4				
Catch	7484.5	1715.8	1239.2	11049.1	21488.6				

Sub-division 30

Age	Numbers (milions)				Total	Weight (g)			
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
0	0.0	0.0	0.1	3.7	3.8	0.0	0.0	0.0	4.2
1	0.5	3.5	25.5	53.9	83.4	2.1	2.2	6.6	7.3
2	0.3	2.9	0.6	3.0	6.8	7.8	8.6	9.8	10.2
3	0.0	1.2	0.4	3.6	5.1	10.5	10.5	11.7	11.1
4	0.2	4.5	0.3	2.1	7.1	11.5	10.9	11.0	11.4
5	0.0	0.0	0.3	1.3	1.6	9.0	0.0	11.0	12.0
6	0.2	3.3	0.4	3.7	7.6	12.1	9.6	12.5	12.3
7	0.2	2.0	0.5	2.0	4.7	12.6	11.2	12.0	12.3
8	0.1	2.1	0.4	0.5	3.0	9.5	11.0	13.5	15.0
9	0.9	17.8	4.0	18.1	40.9	13.3	11.5	13.4	14.0
10	0.0	0.2	0.3	0.6	1.1	16.5	15.0	13.0	12.5
Sum	2.5	37.5	32.6	92.5	165.2				
SOP	24.3	379.6	258.2	860.3	1522.4				
Catch	24.3	379.6	258.2	860.3	1522.5				

Sub-division 31

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

Table 7.3 continued

Sub-division 32

Age	Numbers (milions)				Total	Weight (g)			
	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
0	0.0	0.0	1.0	408.1	409.1	0.0	0.0	2.9	2.9
1	19.6	8.5	60.6	476.3	565.1	2.2	3.5	4.9	5.9
2	4.9	3.8	6.0	74.0	88.8	8.1	8.2	9.3	9.4
3	6.8	8.0	8.0	42.7	65.6	9.8	9.8	10.1	10.0
4	7.8	9.2	8.3	31.3	56.6	10.4	10.3	10.0	10.4
5	4.3	4.2	5.6	37.8	51.8	9.6	9.6	10.1	10.2
6	5.5	5.4	6.3	49.7	66.8	11.1	10.9	11.0	10.9
7	3.1	3.9	3.8	13.5	24.3	11.3	10.8	10.9	10.9
8	2.8	3.2	2.9	13.9	22.9	11.1	11.2	11.0	11.1
9	3.9	2.3	3.0	18.1	27.4	12.5	9.8	10.8	11.2
10	1.2	1.2	0.9	1.0	4.3	11.3	11.2	11.0	10.7
Sum	59.9	49.8	106.5	1166.5	1382.6				
SOP	460.5	447.5	764.6	6849.8	8522.3				
Catch	460.6	448.2	764.3	6868.3	8541.4				

Table 7.4

SPRAT in SD 22-32. Fishing effort and CPUE data

1/1

Year	Russia - Sub-division 26			
	Type of vessels			
	SRTM (51 m length, 1100 hp)		MRTK (27 m length, 300 hp)	
	Effort	CPUE,	Effort	CPUE,
	[h]	[kg/h]	[h]	[kg/h]
1995	8907	647	8760	601
1996	12129	620	7810	953
1997	17140	470	10691	746
1998	13469	646	9986	782
1999	13898	869	15967	965
2000	14417	766	13501	1031
2001	12837	937	12912	1282
2002	11789	884	18979	1012
2003	5869	958	13800	1303

Estonia - Sub-divisions 28, 29, 32								
Year/Sub-div.	CPUE [kg/h] by quarters				Effort [h] by quarters			
	1	2	3	4	1	2	3	4
1999								
28	544	541	461		2776	1234	218	
29	1083	1011	495		5297	3377	427	
32	465	524	362		15513	8930	2458	
2000								
28	454	114	1300	1104	5480	1878	335	2452
29	1351	725	1397	1668	3420	3611	318	3533
32	471	364	586	719	9684	5448	2297	15259
2001								
28	788	489	832	850	4017	1732	174	2621
29	1360	883	1177	1187	5047	3551	513	4813
32	450	289	501	547	12008	9058	2527	11494
2002								
28	696	483	2556	1209	2643	2047	219	3755
29	1195	875	1974	1851	4570	3551	300	4222
32	376	320	585	943	7990	4999	2432	9575
2003								
28	1227	471	1160	854	4138	1387	513	143
29	1638	818	943	1324	2926	1914	796	5587
32	1205	638	501	765	316	702	1264	8888

cont.

Table 7.4

SPRAT in SD 22-32. Fishing effort and CPUE data

1/2

Year - 2003	Finland - Sub-divisions 24-32; fishing effort			
Sub-div.	Gear type	Quarter	number of days	total hours
24	Pelagic	1	3	35
25	Pelagic	1	41	461
25	Pelagic	2	17	201
25	Pelagic	4	1	16
26	Pelagic	1	2	20
26	Pelagic	2	1	10
27	Pelagic	1	5	61
27	Pelagic	2	12	171
28	Pelagic	1	1	16
28	Pelagic	4	7	34
29	Pelagic	1	14	99
29	Pelagic	2	15	193
29	Pelagic	3	66	635
29	Pelagic	4	226	2604
30	Pelagic	1	3	26
30	Pelagic	2	71	778
30	Pelagic	3	56	555
30	Pelagic	4	97	1013
32	Pelagic	1	6	36
32	Pelagic	2	1	5
32	Pelagic	3	57	408
32	Pelagic	4	143	1413
27	Bottom	1	2	18
29	Bottom	1	3	16
29	Bottom	3	2	8
29	Bottom	4	11	57
30	Bottom	1	9	69
30	Bottom	2	104	1066
30	Bottom	3	22	188
30	Bottom	4	105	986
32	Bottom	1	3	15
32	Bottom	3	8	49
32	Bottom	4	1	6

Table 7.5 Sprat in Sub-divisions 22-32. Samples of commercial catches by quarter, country and Sub-division for 2003 available to the Working Group.

1/6

Sub-division	Country	Quarter	Landings in tons	Number of samples	Number of fish	
					measured	aged
22	Denmark	1	1296	0		
		2	2382	2	211	51
		3	1866	7	717	181
		4	2621	9	753	155
		Total	8165	18	1681	387
	Germany	1	6.7	0	0	0
		2	1.0	0	0	0
		3	5.8	2	1221	210
		4	143.2	1	321	120
		Total	156.7	3	1542	330
	Total	1	1303	0	0	0
		2	2383	2	211	51
		3	1872	9	1938	391
		4	2764	10	1074	275
		Total	8322	21	3223	717
	24	Denmark	1	206	6	1,132
2			413	1	189	42
3			0			
4			92	4	377	195
Total			712	11	1698	521
Finland		1	34			
		2	0			
		3	0			
		4	0			
		Total	34	0	0	0
Germany		1	0			
		2	415.3	0	0	0
		3	127.1	1	515	92
		4	0.0	0	0	0
		Total	542.4	1	515	92
Poland		1	24	0	0	0
		2	0	0	0	0
		3	0	0	0	0
		4	10	2	278	106
		Total	34	2	278	106
Sweden		1	456	1	9	9
		2	386	1	50	48
		3	75	1	37	36
		4	1212			
	Total	2130	3	96	93	
Total	1	720	7	1141	293	
	2	1215	2	239	90	
	3	202	2	552	128	
	4	1314	6	655	301	
	Total	3451	17	2587	812	

cont.

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Table 7.5 Sprat in Sub-divisions 22-32. Samples of commercial catches by quarter, country and Sub-division for 2003 available to the Working Group.

Sub-division 25	Country	Quarter	Landings in tons	Number of samples	Number of fish	
					measured	aged
Denmark		1	3739	6	1132	284
		2	6098	1	189	42
		3	26			
		4	543	4	377	195
	Total	10406	11	1698	521	
Finland		1	318			
		2	112			
		3	0			
		4	2			
	Total	431	0	0	0	
Germany		1	580	0	0	0
		2	250	0	0	0
		3	15	0	0	0
		4	0			
	Total	845	0	0	0	
Latvia		1	263			
		2	519			
		3	0			
		4	0			
	Total	782	0	0	0	
Poland		1	14424	25	4326	570
		2	10468	8	1932	260
		3	523	1	186	61
		4	1292	24	4096	509
	Total	26707	58	10540	1400	
Sweden		1	2113	3	150	137
		2	2089	1	49	47
		3	377			
		4	893	2	99	75
	Total	5472	6	298	259	
Total		1	21437	34	5608	991
		2	19536	10	2170	349
		3	940	1	186	61
		4	2729	30	4572	779
	Total	44643	75	12536	2180	

cont.

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Table 7.5 Sprat in Sub-divisions 22-32. Samples of commercial catches by quarter, country and Sub-division for 2003 available to the Working Group.

Sub-division 26	Country	Quarter	Landings in tons	Number of samples	Number of fish	
					measured	aged
Denmark		1	8411	6	706	299
		2	66	1	50	50
		3	0			
		4	416	1	110	55
		Total	8893	8	866	404
Finland		1	34			
		2	10			
		3	0			
		4	0			
		Total	43	0	0	0
Germany		1	2247	0	0	0
		2	701	0	0	0
		3	0			
		4	95	0	0	0
		Total	3043	0	0	0
Lithuania		1	885		706	706
		2	594		500	500
		3	4		306	306
		4	679		1242	1242
		Total	2163	0	2754	2754
Latvia		1	2316	5	822	235
		2	4130	2	413	173
		3	327	1	201	61
		4	1010	0		
		Total	7783	8	1436	469
Poland		1	30993	18	3668	701
		2	20454	7	1925	228
		3	1258	1	73	256
		4	4652	27	6381	435
		Total	57356	53	12047	1620
Russia		1	7307	35	7030	300
		2	11746	19	3772	184
		3	4028	27	5429	189
		4	4137	4	764	190
		Total	27219	85	16995	863
Sweden		1	2507			
		2	58			
		3	0			
		4	6013			
		Total	8578	0	0	0
Total		1	54700	64	12932	2241
		2	37758	29	6660	1135
		3	5617	29	6009	812
		4	17002	32	8497	1922
		Total	115077	154	34098	6110

Table 7.5 Sprat in Sub-divisions 22-32. Samples of commercial catches by quarter, country and Sub-division for 2003 available to the Working Group.

Sub-division	Country	Quarter	Landings in tons	Number of samples	Number of fish	
					measured	aged
27	Denmark	1	1782	5	481	199
		2	0	1	101	50
		3	0			
		4	0			
		Total	1782	6	582	249
	Finland	1	78			
		2	130			
		3	0			
		4	0			
		Total	207	0	0	0
	Germany	1	7400	0	0	0
		2	2116	0	0	0
		3	0			
		4	0			
		Total	9516	0	0	0
	Sweden	1	18462	4	200	194
		2	2081	4	200	185
		3	145	0		
		4	3413	4	200	196
		Total	24101	12	600	575
Total	1	27722	9	681	393	
	2	4327	5	301	235	
	3	145	0	0	0	
	4	3413	4	200	196	
	Total	35607	18	1182	824	
28	Denmark	1	1749	13	1322	550
		2	0			
		3	0			
		4	0	6	709	307
		Total	1749	19	2031	857
	Estonia	1	5078	3	300	300
		2	653	1	54	54
		3	595			
		4	4769	2	305	305
		Total	11095	6	659	659
	Finland	1	15			
		2	0			
		3	0			
		4	38			
		Total	52	0	0	0
	Germany	1	2321	0	0	0
		2	240	0	0	0
		3	0			
		4	240	0	0	0
		Total	2800	0	0	0
Latvia	1	9365	18	2941	2106	
	2	6169	18	2362	1570	
	3	6195	17	2210	1523	
	4	11448	17	1850	1679	
	Total	33177	70	9363	6878	
Russia	1	0				
	2	173	5	980	200	
	3	317	16	3330	200	
	4	955	25	5080	190	
	Total	1445	46	9390	590	
Sweden	1	9144				
	2	87				
	3	191				
	4	9867	3	150	150	
	Total	19289	3	150	150	
Total	1	27671	34	4563	2956	
	2	7322	24	3396	1824	
	3	7298	33	5540	1723	
	4	27316	53	8094	2631	
	Total	69607	144	21593	9134	

Table 7.5 Sprat in Sub-divisions 22-32. Samples of commercial catches by quarter, country and Sub-division for 2003 available to the Working Group.

Sub-division	Country	Quarter	Landings in tons	Number of samples	Number of fish	
					measured	aged
29	Denmark	1	329	1	100	49
		2	0			
		3	0			
		4	0			
		Total	329	1	100	49
	Estonia	1	4792	2	200	200
		2	1566	6	600	600
		3	751	0		
		4	4473	4	2493	2493
		Total	11582	12	3293	3293
	Finland	1	168	0		
		2	150	3	588	186
		3	488	1	323	55
		4	3823	6	1831	216
		Total	4629	10	2742	457
	Germany	1	441	0	0	0
		2	0			
		3	0			
		4	679	0	0	0
		Total	1120	0	0	0
	Sweden	1	1755	0		
		2	0	0		
		3	0	0		
		4	2074	1	50	50
Total		3829	1	50	50	
Total	1	7485	3	300	249	
	2	1716	9	1188	786	
	3	1239	1	323	55	
	4	11049	11	4374	2759	
	Total	21489	24	6185	3849	
30	Finland	1	24	4	1008	97
		2	380	3	538	113
		3	258	5	1149	97
		4	860	7	1068	207
		Total	1522	19	3763	514
31	Finland	1	0			
		2	0.2			
		3	0.1		9	
		4	0.4		13	
		Total	1	0	22	0

cont.

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Table 7.5 Sprat in Sub-divisions 22-32. Samples of commercial catches by quarter, country and Sub-division for 2003 available to the Working Group.

Sub-division 32	Country	Quarter	Landings in tons	Number of samples	Number of fish	
					measured	aged
Estonia		1	381	0		
		2	448	2	149	149
		3	633	4	400	400
		4	5049	11	1662	1662
		Total	6511	17	2211	2211
Finland		1	80	0		
		2	0.2	2	432	109
		3	132	3	1577	177
		4	1820	7	3537	106
		Total	2031	12	5546	392
Sweden		1	0			
		2	0			
		3	0			
		4	0			
		Total	0	0	0	0
Total		1	461	0	0	0
		2	448	4	581	258
		3	765	7	1977	577
		4	6869	18	5199	1768
		Total	8542	29	7757	2603
Sub-divisions 22-32	Total	Quarter	Landings in tons	Number of samples	Number of fish	
		1	141,524	155	26,233	7,220
		2	75,084	88	15,284	4,841
		3	18,336	87	17,683	3,844
		4	73,317	171	33,746	10,838
		Total	308,261	501	92,946	26,743

Table 7.6 SPRAT in SD 22-32. Catch in Numbers (Thousands)
 CANUM: Catch in numbers (Total International Catch) (Total) (Thousands)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+
1974	2615000	6172000	3618000	1940000	1929000	933000	1213000	278000
1975	628000	2032000	5678000	2387000	790000	878000	247000	546000
1976	4682000	818000	2106000	3510000	1040000	350000	548000	422000
1977	2371000	8399000	997000	1907000	1739000	364000	140000	399000
1978	500000	3325000	4936000	480000	817000	683000	73000	189000
1979	1340000	597000	1037000	2291000	188000	150000	335000	125000
1980	369000	1476000	378000	500000	1357000	72000	67000	235000
1981	2303000	920000	405000	94000	88000	527000	13000	99000
1982	363000	2460000	425000	225000	64000	57000	231000	51000
1983	1852000	297000	531000	107000	47000	12000	18000	148000
1984	1005000	2393000	388000	447000	77000	38000	9000	83000
1985	566000	1703000	2521000	447000	271000	30000	19000	65000
1986	495000	1142000	1425000	2099000	340000	188000	16000	50000
1987	779000	394000	1320000	1833000	1805000	227000	149000	73000
1988	78067	2695775	730495	1148801	762480	760343	64666	141159
1989	2101849	290021	1771932	403652	739242	390255	398382	137139
1990	1049000	3171000	346000	952000	188000	316000	112000	200000
1991	1043547	2649359	2438646	406536	568611	106181	160259	152226
1992	1782000	2939000	3040000	1643000	444000	311000	121000	163000
1993	1832200	5685200	3243700	1898100	883700	267100	244400	256688
1994	1079000	8169000	8176000	3525000	2201000	779000	193000	208000
1995	6373200	2341300	6643300	6636100	3366400	1901800	626600	409200
1996	8388700	27674900	4704100	6517100	3323000	1499200	690100	403400
1997	1717800	23181900	23395000	6343200	4107900	1650800	682700	279100
1998	11017500	3802500	17687600	19617500	2658600	1777800	1468100	489100
1999	2081600	19901300	5832000	9972000	8835500	1180100	686700	515400
2000	10534600	2948125	14716398	2870128	4284070	4076601	707496	760552
2001	2775600	11557200	2670400	9252400	1998800	2651400	2263500	522500
2002	6648000	5429000	10781000	3835000	4308000	998000	880000	1340000
2003	9366111	7108722	4805394	5067481	2396044	1902532	833054	1383341

Table 7.7 SPRAT in SD 22-32.
 Mean weight in the Catch and in the Stock (Kilograms)
 WECA (=WEST): Mean weight in Catch (Total International Catch) (Total) (Kilograms)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+
1974	0.0066	0.0105	0.0122	0.0134	0.0139	0.0154	0.0141	0.0143
1975	0.0068	0.0112	0.0124	0.0134	0.0147	0.0143	0.0157	0.0135
1976	0.0069	0.0107	0.0127	0.0135	0.0145	0.0161	0.0147	0.0143
1977	0.0054	0.0110	0.0134	0.0140	0.0144	0.0159	0.0159	0.0158
1978	0.0051	0.0109	0.0125	0.0131	0.0141	0.0152	0.0158	0.0151
1979	0.0055	0.0127	0.0130	0.0137	0.0151	0.0158	0.0156	0.0162
1980	0.0078	0.0113	0.0143	0.0141	0.0143	0.0167	0.0158	0.0160
1981	0.0063	0.0141	0.0161	0.0180	0.0165	0.0159	0.0168	0.0161
1982	0.0088	0.0117	0.0160	0.0162	0.0167	0.0164	0.0163	0.0173
1983	0.0092	0.0145	0.0162	0.0171	0.0169	0.0170	0.0169	0.0168
1984	0.0097	0.0111	0.0146	0.0153	0.0158	0.0163	0.0169	0.0172
1985	0.0091	0.0113	0.0127	0.0140	0.0160	0.0171	0.0171	0.0158
1986	0.0079	0.0121	0.0129	0.0140	0.0148	0.0161	0.0170	0.0167
1987	0.0085	0.0117	0.0133	0.0145	0.0152	0.0164	0.0170	0.0176
1988	0.0056	0.0103	0.0122	0.0142	0.0152	0.0153	0.0166	0.0170
1989	0.0097	0.0136	0.0145	0.0158	0.0169	0.0173	0.0175	0.0181
1990	0.0104	0.0126	0.0149	0.0160	0.0175	0.0177	0.0184	0.0181
1991	0.0090	0.0129	0.0143	0.0158	0.0166	0.0175	0.0169	0.0169
1992	0.0087	0.0121	0.0147	0.0154	0.0173	0.0172	0.0181	0.0184
1993	0.0066	0.0111	0.0138	0.0146	0.0150	0.0162	0.0166	0.0166
1994	0.0080	0.0098	0.0121	0.0140	0.0145	0.0152	0.0155	0.0159
1995	0.0065	0.0106	0.0110	0.0126	0.0137	0.0141	0.0143	0.0145
1996	0.0043	0.0075	0.0103	0.0111	0.0124	0.0128	0.0127	0.0129
1997	0.0067	0.0074	0.0085	0.0101	0.0117	0.0124	0.0125	0.0127
1998	0.0046	0.0076	0.0083	0.0089	0.0104	0.0106	0.0108	0.0118
1999	0.0040	0.0078	0.0092	0.0091	0.0092	0.0106	0.0112	0.0110
2000	0.0062	0.0102	0.0100	0.0108	0.0113	0.0117	0.0128	0.0134
2001	0.0063	0.0093	0.0114	0.0108	0.0116	0.0113	0.0110	0.0118
2002	0.0069	0.0097	0.0102	0.0109	0.0111	0.0111	0.0115	0.0117
2003	0.005	0.0099	0.0108	0.0109	0.0114	0.0111	0.0107	0.0108

Table 7.8

SPRAT in SD 22-32. Natural Mortality
 NATMOR: Natural Mortality (Total International Catch) (Total)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+
1974	0.976	0.594	0.473	0.449	0.533	0.488	0.548	0.548
1975	1.375	0.766	0.582	0.534	0.647	0.612	0.703	0.703
1976	0.841	0.531	0.423	0.399	0.474	0.460	0.523	0.523
1977	0.756	0.499	0.416	0.384	0.441	0.434	0.493	0.493
1978	1.000	0.648	0.530	0.477	0.557	0.540	0.613	0.613
1979	1.187	0.806	0.654	0.571	0.684	0.692	0.789	0.789
1980	1.271	0.853	0.683	0.580	0.698	0.744	0.853	0.853
1981	1.024	0.708	0.577	0.513	0.607	0.618	0.715	0.715
1982	1.151	0.796	0.653	0.566	0.671	0.684	0.793	0.793
1983	1.085	0.790	0.639	0.575	0.708	0.704	0.819	0.819
1984	0.821	0.633	0.530	0.468	0.547	0.578	0.665	0.665
1985	0.727	0.540	0.455	0.409	0.474	0.499	0.570	0.570
1986	0.632	0.448	0.382	0.352	0.398	0.400	0.448	0.448
1987	0.493	0.373	0.329	0.311	0.344	0.337	0.369	0.369
1988	0.553	0.422	0.361	0.336	0.380	0.379	0.415	0.415
1989	0.447	0.354	0.314	0.293	0.322	0.327	0.354	0.354
1990	0.382	0.305	0.277	0.265	0.286	0.282	0.300	0.300
1991	0.323	0.270	0.250	0.243	0.256	0.258	0.270	0.270
1992	0.335	0.266	0.248	0.240	0.251	0.251	0.260	0.260
1993	0.335	0.278	0.256	0.250	0.268	0.256	0.269	0.269
1994	0.359	0.296	0.269	0.260	0.280	0.275	0.290	0.290
1995	0.333	0.284	0.262	0.254	0.275	0.273	0.289	0.289
1996	0.308	0.265	0.250	0.243	0.258	0.259	0.272	0.272
1997	0.325	0.272	0.253	0.246	0.262	0.264	0.278	0.278
1998	0.339	0.279	0.257	0.250	0.266	0.264	0.278	0.278
1999	0.360	0.286	0.262	0.254	0.270	0.266	0.279	0.279
2000	0.347	0.282	0.258	0.251	0.268	0.261	0.274	0.274
2001	0.393	0.304	0.273	0.265	0.285	0.278	0.296	0.296
2002	0.407	0.317	0.284	0.276	0.300	0.291	0.311	0.311
2003	0.407	0.317	0.284	0.276	0.300	0.291	0.311	0.311

Table 7.9

SPRAT in SD 22-32. Proportion Mature at Year Start
 MATPROP: Proportion of Mature at Year Start (Total international Catch) (Total)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+
1974-2003	0.172	0.930	1.0	1.0	1.0	1.0	1.0	1.0

Table 7.10

SPRAT in SD 22-32. Proportion of M before Spawning
 MPROP: Proportion of M before Spawning (Total International Catch) (Total)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+
1974-2003	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Table 7.11

SPRAT in SD 22-32. Proportion of F before Spawning
 FPROP: Proportion of F before Spawning (Total international Catch) (Total)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+
1974-2003	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Table 7.12 SPRAT in SD 22-32. Tuning Fleet/ Latvian and Russian Acoustic Survey in SD 26+28

Latvian and Russian Acoustic Survey in SD 26+28									
Year	Fish. Effort	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+
1983	1	21087	2066	1938	501	166	20	69	231
1984	1	16531	12765	981	441	61	-11	-11	38
1985	1	9752	7748	7174	663	357	37	58	150
1986	1	5604	5351	5283	4693	107	175	19	24
1987	1	23035	2246	2992	2489	2341	110	81	41
1988	1	741	14404	1251	1667	1451	1301	59	60
1989	1	22461	433	8394	681	875	934	825	142
1990	1	22837	16790	170	3885	380	485	491	609
1991	1	30060	15080	12210	311	2486	284	218	592
1992	1	23758	16947	13439	5223	1008	1757	155	73
1993	1	-11	-11	-11	-11	-11	-11	-11	-11
1994	1	8407	31589	15182	6598	3439	1370	53	430
1995	1	80333	8144	23732	11722	5374	3282	1169	523
1996	1	44341	66345	11374	10668	3919	1751	1433	404
1997	1	4726	42278	38548	3498	5056	1809	1333	420
1998	1	67660	7337	20917	14780	3166	2173	892	934
1999	1	3532	38986	5135	9616	7653	1546	1384	920
2000	1	44680	1977	32370	1928	6761	5700	802	1478
2001	1	6808	19933	2818	18214	1793	5048	3399	1211
2002	1	22363	5732	23104	2357	11564	464	2693	1474
2003	1	55065	17768	7077	13184	2373	7355	986	4965

Table 7.13 SPRAT in SD 22-32. Tuning Fleet/International Acoustic Survey

International Acoustic Survey corrected by area surveyed (Catch: Millions)									
Year	Fish. Effort	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+
1983	1	42691	11099	9886	2322	384	238	142	9
1984	1	15636	25263	6380	2209	254	60	92	73
1985	1	4930	14632	11552	2516	354	99	71	56
1986	1	1609	7937	11070	3271	447	31	24	41
1987	1	15112	3967	8595	3637	1268	235	24	20
1988	1	976	7568	4450	4912	2139	253	37	12
1989	1	37439	3048	22569	4504	2669	1939	1902	304
1990	1	13663	29939	6400	5109	1914	960	226	54
1991	1	42168	33634	30658	2925	5907	1306	1183	1916
1992	1	-11	-11	-11	-11	-11	-11	-11	-11
1993	1	-11	-11	-11	-11	-11	-11	-11	-11
1994	1	10177	40010	29116	14024	8534	3545	738	1266
1995	1	-11	-11	-11	-11	-11	-11	-11	-11
1996	1	71885	133703	19958	22827	11763	5963	3564	1233
1997	1	-11	-11	-11	-11	-11	-11	-11	-11
1998	1	94239	19307	49486	33237	7424	4405	1524	1221
1999	1	4465	82553	15237	33628	36565	6368	3807	1639
2000	1	54314	2505	48064	4911	12947	11946	1482	2416
2001	1	9262	29067	6170	28532	3938	10119	7207	3096
2002	1	29204	12209	32881	4970	16365	1936	4297	3347
2003	1	84281	29391	20086	22447	6525	12132	2331	9347

Table 7.14

SPRAT in SD 22-32. Output from XSA.

(1/4)

Lowestoft VPA Version 3.1
 15/04/2004 13:06
 Extended Survivors Analysis
 Sprat 22 32
 CPUE data from file d:\vpa\SprData\fleet1.txt
 Catch data for 30 years. 1974 to 2003. Ages 1 to 8.

Fleet,	First year	Last year	First age	Last age	Alpha	Beta
FLT01: Latvian and Russian	1983	2003	1	7	.750	.850
FLT02: International	1983	2003	1	7	.750	.850

Time series weights :
 Tapered time weighting not applied

Catchability analysis :
 Catchability dependent on stock size for ages < 4
 Regression type = C
 Minimum of 5 points used for regression
 Survivor estimates shrunk to the population mean for ages < 4
 Catchability independent of age for ages >= 4

Terminal population estimation :
 Survivor estimates shrunk towards the mean F
 of the final 5 years or the 3 oldest ages.
 S.E. of the mean to which the estimates are shrunk = .750
 Minimum standard error for population
 estimates derived from each fleet = .300

Prior weighting not applied

Tuning had not converged after 40 iterations

Total absolute residual between iterations
 39 and 40 = .00050

Final year F values

Age	1	2	3	4	5	6	7
Iteration 39	.0724	.1651	.3559	.2084	.7588	.1200	.5852
Iteration 40	.0724	.1651	.3558	.2084	.7592	.1200	.5853

Regression weights
 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

Fishing mortalities

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	.021	.029	.057	.040	.067	.062	.098	.069	.094	.072
2	.152	.064	.193	.245	.130	.188	.134	.170	.224	.165
3	.251	.194	.192	.265	.323	.327	.225	.187	.264	.356
4	.199	.359	.315	.455	.396	.325	.283	.230	.494	.208
5	.194	.321	.327	.357	.374	.334	.241	.353	.174	.759
6	.128	.280	.248	.287	.276	.304	.273	.251	.331	.120
7	.711	.157	.167	.184	.491	.176	.327	.261	.136	.585

XSA population numbers (Thousands)

YEAR	1	2	3	4	5	6	7
1994	6.32E+07	6.73E+07	4.21E+07	2.23E+07	1.43E+07	7.45E+06	4.39E+05
1995	2.59E+08	4.33E+07	4.30E+07	2.50E+07	1.41E+07	8.93E+06	4.98E+06
1996	1.76E+08	1.80E+08	3.05E+07	2.73E+07	1.35E+07	7.76E+06	5.13E+06
1997	5.16E+07	1.22E+08	1.14E+08	1.96E+07	1.56E+07	7.55E+06	4.67E+06
1998	2.01E+08	3.59E+07	7.28E+07	6.79E+07	9.74E+06	8.41E+06	4.35E+06
1999	4.14E+07	1.34E+08	2.38E+07	4.08E+07	3.56E+07	5.14E+06	4.90E+06
2000	1.34E+08	2.71E+07	8.32E+07	1.32E+07	2.28E+07	1.95E+07	2.91E+06
2001	5.04E+07	8.60E+07	1.79E+07	5.13E+07	7.75E+06	1.37E+07	1.14E+07
2002	9.04E+07	3.18E+07	5.35E+07	1.13E+07	3.13E+07	4.09E+06	8.08E+06
2003	1.64E+08	5.47E+07	1.85E+07	3.09E+07	5.23E+06	1.95E+07	2.20E+06

Estimated population abundance at 1st Jan 2004
 0.00E+00 1.02E+08 3.38E+07 9.76E+06 1.90E+07 1.81E+06 1.29E+07
 Taper weighted geometric mean of the VPA populations:
 6.10E+07 3.04E+07 1.63E+07 8.90E+06 4.66E+06 2.34E+06 1.14E+06
 Standard error of the weighted Log(VPA populations) :
 .8093 .9795 1.0975 1.1967 1.2447 1.3591 1.4471

Table 7.14

SPRAT in SD 22-32. Output from XSA (continued). (2/4)

Log catchability residuals.

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

Age	1983									
1										
2										
3										
4										
5										
6										
7										
Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	.33	.41	.81	.58	-.61	.47	.31	.48	-.03	99.99
2	.05	.23	.36	.43	.52	-.68	.48	.14	.15	99.99
3	.11	-.04	.23	.18	.29	.30	-1.16	.35	.14	99.99
4	-.55	.04	.19	.07	.07	-.11	.02	-.89	.06	99.99
5	-.39	-.05	-1.03	.13	.13	.06	-.25	-.09	.87	99.99
6	99.99	-.13	-.01	-.09	.17	.22	.01	-.15	-.12	99.99
7	99.99	.31	-.07	.22	.13	.31	-.01	-.31	-.30	99.99
Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	-.55	-.08	-.19	-.84	.06	-.82	.15	-.44	.00	.14
2	.34	-.38	-.04	.02	-.24	-.16	-1.02	-.26	-.23	.10
3	-.02	.27	.03	-.29	-.28	-.24	-.13	-.50	.09	.29
4	.00	.58	.36	-.31	-.16	-.13	-.65	.21	-.10	.39
5	-.20	.36	.08	.22	.24	-.20	.04	-.10	.24	.91
6	-.52	.29	-.23	-.14	-.07	.11	.05	.27	-.83	.21
7	-.46	-.24	-.07	-.03	-.12	-.05	.04	.09	.11	.77

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

Age	4	5	6	7
Mean Log q	-7.7585	-7.7585	-7.7585	-7.7585
S.E(Log q)	.4108	.4164	.2865	.2751

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.84	1.212	9.58	.76	20	.48	-7.95
2	.81	1.869	9.69	.84	20	.40	-7.86
3	.77	2.539	9.76	.88	20	.38	-7.69

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	.98	.273	7.95	.89	20	.41	-7.76
5	.92	1.117	8.32	.92	20	.38	-7.72
6	.96	1.031	8.14	.97	19	.27	-7.82
7	1.00	-.018	7.73	.97	19	.28	-7.74

Fleet : FLT02: International Acoustic

Age	1983									
1										
2										
3										
4										
5										
6										
7										
Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	.13	-.09	.04	.12	.01	.63	-.18	.50	99.99	99.99
2	.16	.19	-.01	.06	-.69	.02	.50	.36	99.99	99.99
3	.22	-.65	-.25	-.22	-.35	.45	.18	.62	99.99	99.99
4	.12	.44	-1.10	-.48	.22	.85	-.64	.42	99.99	99.99
5	.10	-1.00	-.53	-1.42	-.42	.24	.44	-.16	99.99	99.99
6	-1.31	-.08	-2.68	-.27	-2.40	.01	-.24	.44	99.99	99.99
7	1.21	-.42	-.77	-1.93	-1.27	.21	-1.73	.45	99.99	99.99
Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	-.39	99.99	-.14	99.99	-.08	-.49	-.01	-.19	.00	.09
2	.14	99.99	.37	99.99	.01	.20	-1.75	-.40	-.22	.07
3	.09	99.99	-.22	99.99	.37	-.19	.09	-1.36	.06	.51
4	-.18	99.99	.18	99.99	-.28	.19	-.65	-.28	-.29	-.02
5	-.22	99.99	.24	99.99	.16	.43	-.24	-.25	-.35	.98
6	-.50	99.99	.06	99.99	-.30	.59	-.15	.03	-.34	-.23
7	1.24	99.99	-.10	99.99	-.52	.03	-.28	-.10	-.36	.69

Table 7.14 SPRAT in SD 22-32. Output from XSA (continued). (3/4)

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	-6.8234	-6.8234	-6.8234	-6.8234
S.E(Log q)	.6135	.5761	1.0438	.9125

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	.66	4.055	11.32	.90	17	.28	-7.82
2	1.00	-.004	7.20	.72	17	.60	-7.21
3	1.44	-3.170	2.23	.77	17	.53	-6.67

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	1.44	-3.075	2.70	.76	17	.72	-6.82
5	.98	.208	7.15	.85	17	.56	-6.95
6	1.01	-.066	7.10	.72	17	1.02	-7.18
7	1.00	-.006	7.04	.78	17	.91	-7.04

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Latvian and R	117091100.	.507	.000	.00	1	.218	.063
FLT02: International	111227500.	.302	.000	.00	1	.613	.066
P shrinkage mean	30436510.	.98				.063	.224
F shrinkage mean	92998260.	.75				.107	.079

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
101753400.	.24	.19	4	.811	.072

Age 2 Catchability dependent on age and year class strength

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Latvian and R	35915480.	.318	.051	.16	2	.376	.156
FLT02: International	34371730.	.270	.026	.10	2	.502	.163
P shrinkage mean	16331100.	1.10				.039	.316
F shrinkage mean	32630830.	.75				.083	.171

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
33808040.	.20	.07	6	.358	.165

Age 3 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
FLT01: Latvian and R	9442757.	.248	.219	.88	3	.453	.366
FLT02: International	9560847.	.243	.215	.88	3	.435	.362
P shrinkage mean	8902719.	1.20				.032	.384
F shrinkage mean	13584580.	.75				.080	.268

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
9756928.	.17	.12	8	.683	.356

Age 4 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
FLT01: Latvian and R	21431760.	.219	.138	.63	4	.520	.187
FLT02: International	18101030.	.232	.079	.34	4	.412	.218
F shrinkage mean	10570860.	.75				.068	.349

Table 7.14 SPRAT in SD 22-32. Output from XSA (continued). (4/4)

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
19047140.	.16	.09	9	.602	.208

Age 5 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 1998

Fleet	Estimated	Int	Ext	Var	N Scaled	Estimated
	Survivors	s.e	s.e	Ratio	Weights	F
FLT01: Latvian and R	1733317.	.205	.370	1.81	5 .513	.784
FLT02: International	1309326.	.228	.433	1.90	5 .366	.946
F shrinkage mean	5936338.	.75			.120	.298

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
1813813.	.16	.28	11	1.740	.759

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 1997

Fleet	Estimated	Int	Ext	Var	N Scaled	Estimated
	Survivors	s.e	s.e	Ratio	Weights	F
FLT01: Latvian and R	14664870.	.171	.066	.39	6 .656	.106
FLT02: International	11405920.	.221	.078	.35	6 .295	.135
F shrinkage mean	4894647.	.75			.049	.290

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
12903780.	.13	.09	13	.632	.120

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 4
Year class = 1996

Fleet	Estimated	Int	Ext	Var	N Scaled	Estimated
	Survivors	s.e	s.e	Ratio	Weights	F
FLT01: Latvian and R	856109.	.159	.285	1.79	7 .759	.606
FLT02: International	810594.	.307	.194	.63	6 .154	.631
F shrinkage mean	1610201.	.75			.086	.367

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of year	s.e	s.e		Ratio	
896405.	.15	.18	14	1.259	.585

Table 7.15

SPRAT IN SD 22-32. Output from XSA. Fishing mortality (F) at age

Table 8 Fishing mortality (F) at age

YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	Run title : Sprat 22 32	
Age 1	0.0517	0.0353	0.0381	0.0827	0.0579	0.0666	0.0326	0.0732	0.0185	At 15/04/2004 13:06	
Age 2	0.1055	0.1037	0.1295	0.1464	0.2796	0.1930	0.2362	0.2513	0.2251	Terminal Fs derived using XSA	
Age 3	0.3033	0.2037	0.2296	0.3156	0.1684	0.2143	0.3337	0.1618	0.3020	(With F shrinkage)	
Age 4	0.3712	0.4889	0.2590	0.4306	0.3274	0.1598	0.2403	0.1974	0.1897		
Age 5	0.2666	0.3807	0.6066	0.2522	0.4607	0.3162	0.2151	0.0905	0.3128		
Age 6	0.5210	0.2830	0.4416	0.6156	0.2033	0.2239	0.3437	0.1984	0.1244		
Age 7	0.3960	0.3980	0.4465	0.4426	0.3397	0.2420	0.2780	0.1668	0.2166		
Age 8+	0.3960	0.3980	0.4465	0.4426	0.3397	0.2420	0.2780	0.1668	0.2166		
FBAR 3-5	0.3137	0.3578	0.3650	0.3328	0.3188	0.2301	0.2630	0.1499	0.2682		
YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Age 1	0.0209	0.0243	0.0234	0.0489	0.0192	0.0104	0.0476	0.0204	0.0192	0.0240	0.0228
Age 2	0.0411	0.0667	0.0859	0.0899	0.0681	0.1123	0.0631	0.1133	0.0748	0.0763	0.1112
Age 3	0.1184	0.1120	0.1338	0.1268	0.1747	0.2091	0.1197	0.1126	0.1299	0.1227	0.1205
Age 4	0.1791	0.2034	0.2463	0.1966	0.2821	0.2635	0.1963	0.0957	0.2005	0.1272	0.1105
Age 5	0.0861	0.2842	0.2472	0.3828	0.3072	0.2126	0.3141	0.1450	0.0810	0.3716	0.0987
Age 6	0.1473	0.1489	0.2435	0.3584	0.5973	0.2452	0.1896	0.2400	0.1229	0.0613	0.4291
Age 7	0.0929	0.2692	0.1537	0.2693	0.6966	0.4141	0.2358	0.0855	0.2000	0.2145	0.0666
Age 8+	0.0929	0.2692	0.1537	0.2693	0.6966	0.4141	0.2358	0.0855	0.2000	0.2145	0.0666
FBAR 3-5	0.1279	0.1999	0.2091	0.2354	0.2547	0.2284	0.2100	0.1178	0.1371	0.2072	0.1099
YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	FBAR 01-03
Age 1	0.0206	0.0295	0.0572	0.0399	0.0673	0.0621	0.0981	0.0693	0.0945	0.0724	0.0787
Age 2	0.1517	0.0644	0.1927	0.2452	0.1300	0.1884	0.1336	0.1702	0.2235	0.1651	0.1863
Age 3	0.2514	0.1937	0.1918	0.2650	0.3233	0.3273	0.2247	0.1875	0.2643	0.3558	0.2692
Age 4	0.1987	0.3586	0.3146	0.4548	0.3962	0.3255	0.2827	0.2304	0.4937	0.2084	0.3108
Age 5	0.1942	0.3206	0.3271	0.3567	0.3736	0.3341	0.2415	0.3531	0.1744	0.7592	0.4289
Age 6	0.1279	0.2800	0.2482	0.2871	0.2761	0.3042	0.2727	0.2512	0.3313	0.1200	0.2342
Age 7	0.7108	0.1572	0.1672	0.1837	0.4908	0.1757	0.3275	0.2613	0.1361	0.5853	0.3275
Age 8+	0.7108	0.1572	0.1672	0.1837	0.4908	0.1757	0.3275	0.2613	0.1361	0.5853	
FBAR 3-5	0.2148	0.2910	0.2779	0.3588	0.3644	0.3289	0.2497	0.2570	0.3108	0.4412	

Table 7.16

SPRAT IN SD 22-32. Output from XSA. Stock number at age (Numbers*10**⁻⁵)

YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	Run title : Sprat 22 32		
Age 1	845711	359747	1906327	436049	146599	376543	217213	544377	352871	1537619	Terminal Fs derived using XSA	
Age 2	829413	302625	87801	791411	188496	50898	107495	58985	181714	109579	(With F shrinkage)	
Age 3	175205	412070	126826	45356	415051	74552	18743	36172	22600	65454		
Age 4	78309	80615	187812	66036	21822	206432	31287	6781	17278	8697		
Age 5	107610	34483	28985	97269	29241	9762	99406	13776	3332	8115		
Age 6	29325	48373	12339	9838	48633	10569	3591	39890	6858	1246		
Age 7	48793	10691	19765	5009	3444	23127	4229	1210	17632	3056		
Age 8+	10849	22629	14763	13880	8629	8279	14117	8933	3740	24283		
TOTAL	2125214	1271233	2384618	1464846	861916	760163	496080	710124	606027	1758049		
YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	
Age 1	630888	352091	142390	523260	99453	565202	629039	643721	889050	962253	632444	
Age 2	508799	270919	166251	72075	313515	56616	344663	420650	457158	620900	672840	
Age 3	47731	252733	144877	97090	46366	183752	37307	226834	297968	324654	420731	
Age 4	30690	25118	140265	87106	58673	26218	119090	25269	155138	205667	222788	
Age 5	4091	15682	13043	81043	48133	32217	16072	83028	16217	107463	143423	
Age 6	3668	1782	7624	5974	42256	26611	17055	10445	59272	8701	74471	
Age 7	532	1773	848	3571	2347	22635	15875	10119	7137	43372	4386	
Age 8+	4745	5941	2602	1704	5015	7698	28182	9540	9542	45348	4631	
TOTAL	1231144	926040	617900	871823	615758	920950	1207283	1429606	1891482	2318358	2175714	
YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	GMST 74-03	AMST 74-03
Age 1	2590258	1759730	516437	2006837	413851	1341492	504285	903937	1643398	0	580326	783062
Age 2	432666	1802662	1221339	358538	1336839	271347	859608	317602	547461	1017534	297597	460564
Age 3	429998	305383	1140608	728141	238175	831822	179066	534996	184987	338080	155839	261617
Age 4	250028	272612	196319	679495	407574	132119	513308	112989	309189	97569	84433	151877
Age 5	140828	135498	156087	97415	356067	228325	77475	312771	52331	190471	43403	78003
Age 6	89262	77630	75477	84075	51388	194617	137179	40929	194627	18138	21266	42077
Age 7	49777	51345	46746	43498	48988	29054	114131	80812	21967	129038	10420	22610
Age 8+	32272	29809	18968	14283	36500	30905	26082	122130	35790	23570		
TOTAL	4015088	4434670	3371980	4012282	2889382	3059682	2411135	2426167	2989750	1814400		

Table 7.17

Sprat in SD 22-32. Output from XSA. Stock summary.

Table 16 Summary (without SOP correction)

Run title : Sprat 22 32

Terminal Fs derived using XSA (With F shrinkage)

At 15/04/2004 13:06

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 5
	Age 1					
1974	84571104	2026786	1104021	241700	0.2189	0.3137
1975	35974728	1369756	803600	201434	0.2507	0.3578
1976	190632736	1935988	618510	194775	0.3149	0.3650
1977	43604892	1444848	903108	180800	0.2002	0.3328
1978	14659895	961251	648224	132360	0.2042	0.3188
1979	37654300	732399	395470	77100	0.1950	0.2301
1980	21721320	539228	260947	58100	0.2227	0.2630
1981	54437740	599139	217299	49300	0.2269	0.1499
1982	35287148	639307	245266	48700	0.1986	0.2682
1983	153761936	1756199	393210	37320	0.0949	0.1279
1984	63088804	1314874	576336	52560	0.0912	0.1999
1985	35209148	1023235	573034	69497	0.1213	0.2091
1986	14238966	734280	503125	75800	0.1507	0.2354
1987	52326008	926585	440136	88276	0.2006	0.2547
1988	9945333	668731	477675	80300	0.1681	0.2284
1989	56520212	1087138	517092	85817	0.1660	0.2100
1990	62903892	1473140	765759	85578	0.1118	0.1178
1991	64372076	1675614	1001272	103200	0.1031	0.1371
1992	88905032	2164039	1283497	142195	0.1108	0.2072
1993	96225264	2395148	1566150	178100	0.1137	0.1099
1994	63244392	2321647	1537473	288700	0.1878	0.2148
1995	259025744	3367095	1610984	313000	0.1943	0.2910
1996	175972992	3096870	1964880	441100	0.2245	0.2779
1997	51643704	2776337	1958444	529400	0.2703	0.3588
1998	200683728	2659004	1491911	470770	0.3155	0.3644
1999	41385148	2275357	1672993	421397	0.2519	0.3289
2000	134149224	2647321	1593486	389140	0.2442	0.2497
2001	50428488	2276848	1604571	342200	0.2133	0.2570
2002	90393704	2229079	1366114	343191	0.2512	0.3108
2003	164339840	2238339	1229059	308260	0.2508	*0.2781
Arith. Mean	75874260	1619468	918641	197304	0.2054	0.2696
Units	(Thousands)	(tonnes)	(Tonnes)	(tonnes)		

* corrected for bias of F at age 5 (original estimate of FBAR₃₋₅ = 0.4412, see Section 7.6.2)

Table 7.18 Sprat in SD 22-32. Input Data for RCT3 analysis.

Sprat 22-32: YFS data from Latvian-Russian acoustic

'Year'	'VPA'	Acoustic Age 0'
1993	63244	2264
1994	259026	26007
1995	175973	23080
1996	51644	2075
1997	200684	34933
1998	41385	665
1999	134149	19270
2000	50428	4262
2001	90394	6390
2002	164340	31768
2003	-11	61776

Table 7.19 Sprat in SD 22-32. Output from RCT3 analysis.

**Analysis by RCT3 ver3.1 of data from file recspr04.txt
Sprat 22-32: YFS data from Latvian-Russian acoustic**

Data for 1 surveys over 11 years 1993-2003
 Regression type=C
 Tapered time weighting not applied
 Survey weighting not applied
 Final estimates shrunk towards mean
 Minimum S.E for any survey taken as 0.2
 Minimum of 3 points used for regression
 Forecast/Hindcast variance correction used.

Yearclass = 1997

Survey/ Series	-----Regression-----				-----Prediction-----				
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Acoust	0.57	6.56	0.18	0.965	4	10.46	12.5	0.332	0.847
VPA Mean =							11.61	0.781	0.153

Yearclass = 1998

Survey/ Series	-----Regression-----				-----Prediction-----				
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Acoust	0.53	6.83	0.19	0.951	5	6.5	10.29	0.361	0.802
VPA Mean =							11.73	0.728	0.198

Yearclass = 1999

Survey/ Series	-----Regression-----				-----Prediction-----				
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Acoust	0.48	7.31	0.19	0.956	6	9.87	12.09	0.261	0.902
VPA Mean =							11.55	0.791	0.098

Yearclass = 2000

Survey/ Series	-----Regression-----				-----Prediction-----				
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Acoust	0.48	7.35	0.2	0.94	7	8.36	11.32	0.257	0.889
VPA Mean =							11.59	0.729	0.111

Table 7.19

Sprat in SD 22-32. Output from RCT3 analysis (continued).

Yearclass = 2001

Survey/ Series	Regression				Prediction				
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Acoust	0.52	6.88	0.28	0.888	8	8.76	11.45	0.341	0.819
VPA Mean =							11.49	0.726	0.181

Yearclass = 2002

Survey/ Series	Regression				Prediction				
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Acoust	0.52	6.87	0.26	0.888	9	10.37	12.28	0.329	0.81
VPA Mean =							11.48	0.679	0.19

Yearclass = 2003

Survey/ Series	Regression				Prediction				
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Acoust	0.51	6.99	0.25	0.889	10	11.03	12.57	0.322	0.809
VPA Mean =							11.53	0.662	0.191

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log Prediction VPA corrected for bias	Bias	
1997	234752	12.37	0.31	0.32	1.10	200684	12.21	198339	
1998	39174	10.58	0.32	0.57	3.15	41386	10.63	33098	
1999	168194	12.03	0.25	0.16	0.42	134150	11.81	142105	
2000	84946	11.35	0.24	0.08	0.12	50428	10.83	71770	
2001	94399	11.46	0.31	0.02	0.00	90395	11.41	79757	
2002	185011	12.13	0.3	0.31	1.12	164341	12.01	156313	
2003	235333	12.37	0.29	0.41	1.96			198830	
		114847				97033			1.18359

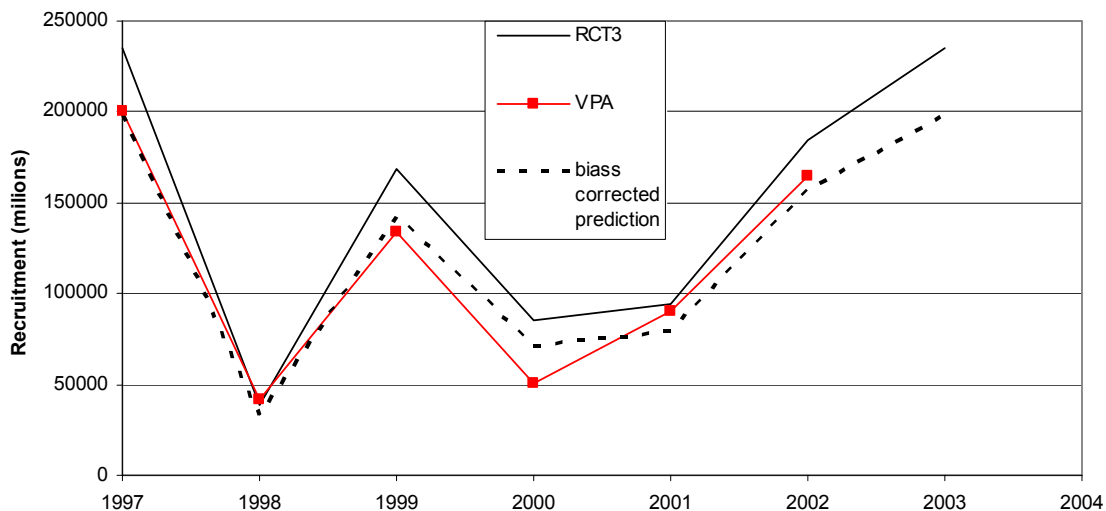


Table 7.20

Sprat in SD 22-32. Input data for short-term prediction.

MFDP version 1a

Run: Sprat_StatusQ

Time and date: 16:52 22/05/2004

Fbar age range: 3-5

2004								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	19883000	0.407	0.17	0.4	0.4	0.0061	0.0787	0.0061
2	101753400	0.317	0.93	0.4	0.4	0.0096	0.1863	0.0096
3	33808000	0.284	1	0.4	0.4	0.0108	0.2692	0.0108
4	9756900	0.276	1	0.4	0.4	0.0109	0.3108	0.0109
5	19047100	0.3	1	0.4	0.4	0.0114	0.2700	0.0114
6	1813800	0.291	1	0.4	0.4	0.0112	0.2342	0.0112
7	12903800	0.311	1	0.4	0.4	0.0111	0.3276	0.0111
8	2357000	0.311	1	0.4	0.4	0.0114	0.3276	0.0114

2005								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	91007000	0.407	0.17	0.4	0.4	0.0061	0.0787	0.0061
2		0.317	0.93	0.4	0.4	0.0096	0.1863	0.0096
3		0.284	1	0.4	0.4	0.0108	0.2692	0.0108
4		0.276	1	0.4	0.4	0.0109	0.3108	0.0109
5		0.3	1	0.4	0.4	0.0114	0.2700	0.0114
6		0.291	1	0.4	0.4	0.0112	0.2342	0.0112
7		0.311	1	0.4	0.4	0.0111	0.3276	0.0111
8		0.311	1	0.4	0.4	0.0114	0.3276	0.0114

2006								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	91007000	0.407	0.17	0.4	0.4	0.0061	0.0787	0.0061
2		0.317	0.93	0.4	0.4	0.0096	0.1863	0.0096
3		0.284	1	0.4	0.4	0.0108	0.2692	0.0108
4		0.276	1	0.4	0.4	0.0109	0.3108	0.0109
5		0.3	1	0.4	0.4	0.0114	0.2700	0.0114
6		0.291	1	0.4	0.4	0.0112	0.2342	0.0112
7		0.311	1	0.4	0.4	0.0111	0.3276	0.0111
8		0.311	1	0.4	0.4	0.0114	0.3276	0.0114

Input units are thousands and kg - output in tonnes

M = Natural mortality
MAT = Maturity ogive
PF = Proportion of F before spawning
PM = Proportion of M before spawning
SWT = Weight in stock (kg)
Sel = Exploit. Pattern
CWT = Weight in catch (kg)

N₂₀₀₄ Age 1:

Output from RCT3 Analysis (Table 7.19)

N₂₀₀₄ Age 2-8+:

Output from VPA (Table 7.16)

N_{2005/2006} Age 1:

Geometric Mean from VPA-Output of age 1 (Table 7.16) for the years 1989-2003

Natural Mortality (M):

Average for 2001-2003

Weight in the Catch/Stock (CWT/SWT):

Average for 2001-2003

Exploitation pattern (Sel):

Average for 2001-2003 (biased estimate of F at age 5 replaced with 0.27)

Table 7.21 Sprat in SD 22-32. Output from short-term prediction with management option table for status quo fishery in 2004.

MFDP version 1a
 Run: Sprat_StatusQ
 Sprat in SD 22-32 (combined sex; plus group)
 Time and date: 17:06 22/05/2004
 Fbar age range: 3-5

2004				
Biomass	SSB	FMult	FBar	Landings
3064118	1610991	1.0000	0.2833	408461

2005					2006	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
2892158	2081015	0.0000	0.0000	0	2979307	2202279
	2062128	0.1000	0.0283	49951	2932751	2139112
	2043422	0.2000	0.0567	98818	2887231	2077987
	2024897	0.3000	0.0850	146629	2842720	2018832
	2006550	0.4000	0.1133	193407	2799195	1961581
	1988379	0.5000	0.1417	239177	2756630	1906168
	1970384	0.6000	0.1700	283964	2715004	1852529
	1952562	0.7000	0.1983	327792	2674294	1800605
	1934911	0.8000	0.2267	370682	2634477	1750336
	1917429	0.9000	0.2550	412657	2595532	1701666
	1900116	1.0000	0.2833	453739	2557438	1654541
	1882968	1.1000	0.3117	493949	2520175	1608908
	1865985	1.2000	0.3400	533308	2483722	1564717
	1849165	1.3000	0.3683	571836	2448062	1521919
	1832507	1.4000	0.3967	609551	2413173	1480466
	1816007	1.5000	0.4250	646474	2379039	1440313
	1799666	1.6000	0.4534	682623	2345641	1401416
	1783481	1.7000	0.4817	718016	2312962	1363733
	1767452	1.8000	0.5100	752672	2280985	1327224
	1751575	1.9000	0.5384	786606	2249693	1291848
	1735850	2.0000	0.5667	819836	2219070	1257568

Input units are thousands and kg - output in tonnes

Table 7.22 Sprat in SD 22-32. Output from short-term prediction with management option table for TAC constraint in 2004.

MFDP version 1a
 Run: Sprat_TAC
 Sprat in SD 22-32 (combined sex; plus group)
 Time and date: 17:08 22/05/2004
 Fbar age range: 3-5

2004						
Biomass	SSB	FMult	FBar	Landings		
3064118	1606600	1.0314	0.2922	420000		
2005					2006	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
2880960	2071244	0.0000	0.0000	0	2970647	2194564
	2052456	0.1000	0.0283	49705	2924310	2131679
	2033850	0.2000	0.0567	98333	2879002	2070825
	2015423	0.3000	0.0850	145909	2834698	2011931
	1997173	0.4000	0.1133	192459	2791374	1954931
	1979099	0.5000	0.1417	238008	2749006	1899760
	1961199	0.6000	0.1700	282578	2707571	1846354
	1943470	0.7000	0.1983	326194	2667047	1794654
	1925912	0.8000	0.2267	368878	2627411	1744601
	1908523	0.9000	0.2550	410652	2588643	1696140
	1891301	1.0000	0.2833	451538	2550721	1649215
	1874243	1.1000	0.3117	491557	2513626	1603775
	1857350	1.2000	0.3400	530729	2477337	1559770
	1840618	1.3000	0.3683	569075	2441835	1517150
	1824047	1.4000	0.3967	606613	2407102	1475870
	1807634	1.5000	0.4250	643363	2373119	1435883
	1791378	1.6000	0.4534	679343	2339868	1397146
	1775278	1.7000	0.4817	714571	2307332	1359617
	1759332	1.8000	0.5100	749065	2275495	1323256
	1743538	1.9000	0.5384	782842	2244339	1288023
	1727895	2.0000	0.5667	815919	2213848	1253880

Input units are thousands and kg - output in tonnes

Table 7.23

Sprat in SD 22-32. Medium term projections.

SSB projections (thousand tons) - Sprat in SD 22-32

year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ffactor=1.2										
10%	1370	1420	1088	856	701	635	565	517	503	482
25%	1481	1562	1228	1015	873	788	739	679	650	623
50%	1616	1774	1467	1233	1097	1034	973	879	852	840
75%	1794	2012	1757	1560	1430	1391	1346	1243	1154	1137
90%	1935	2200	2088	2049	1906	1767	1813	1755	1666	1553
Ffactor=1.0										
10%	1403	1491	1177	965	803	714	640	612	573	566
25%	1521	1629	1299	1105	960	882	799	758	724	738
50%	1646	1815	1498	1331	1220	1116	1051	1026	986	983
75%	1808	2055	1796	1645	1538	1516	1447	1340	1361	1300
90%	1990	2308	2077	2027	2003	1955	1830	1762	1742	1668
Ffactor=0.8										
10%	1403	1522	1248	1070	941	899	855	783	735	675
25%	1511	1645	1416	1221	1133	1062	1010	958	890	886
50%	1637	1838	1649	1485	1393	1299	1276	1216	1184	1159
75%	1772	2086	1937	1810	1734	1722	1692	1618	1579	1542
90%	1936	2389	2323	2315	2180	2203	2192	2049	2050	1885

Catch projections (thousand tons) - Sprat in SD 22-32

year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ffactor=1.2										
10%	352	410	347	269	221	201	179	163	157	147
25%	379	451	389	322	270	243	232	214	199	193
50%	411	511	455	388	334	317	297	277	269	250
75%	451	572	541	477	435	415	415	383	359	351
90%	485	632	630	616	556	546	519	524	492	464
Ffactor=1.0										
10%	345	346	291	234	193	165	153	139	132	118
25%	389	392	346	293	242	230	212	197	190	191
50%	417	432	394	349	308	290	275	265	251	247
75%	456	485	468	421	388	382	373	352	338	331
90%	499	534	531	509	497	493	460	436	430	420
Ffactor=0.8										
10%	360	295	267	235	194	191	184	167	153	142
25%	387	317	301	261	233	219	215	202	188	189
50%	416	353	346	314	281	271	262	255	244	241
75%	447	397	398	385	356	347	342	332	318	315
90%	487	446	469	464	445	436	446	415	398	384

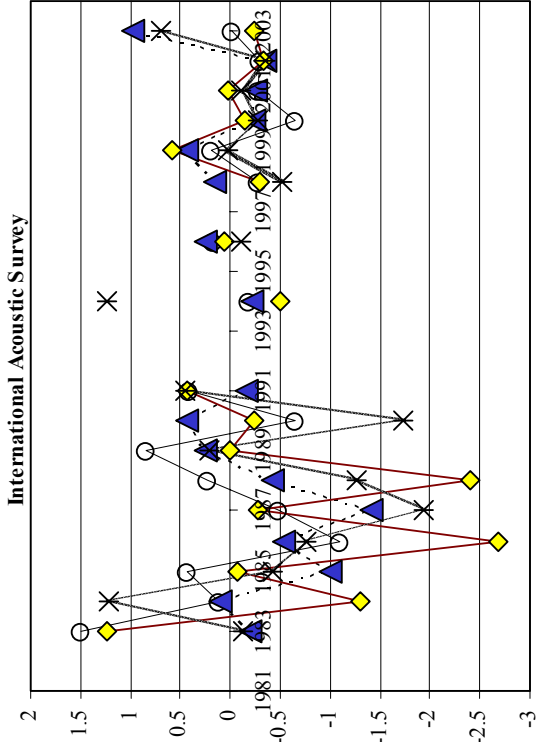
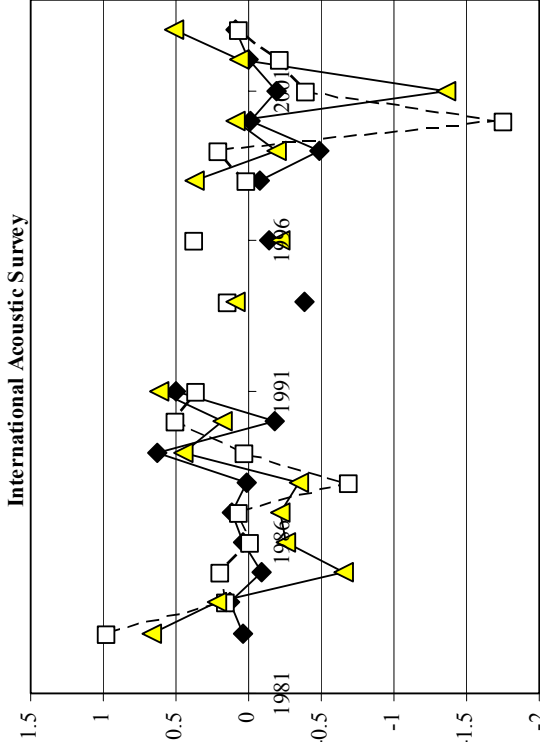
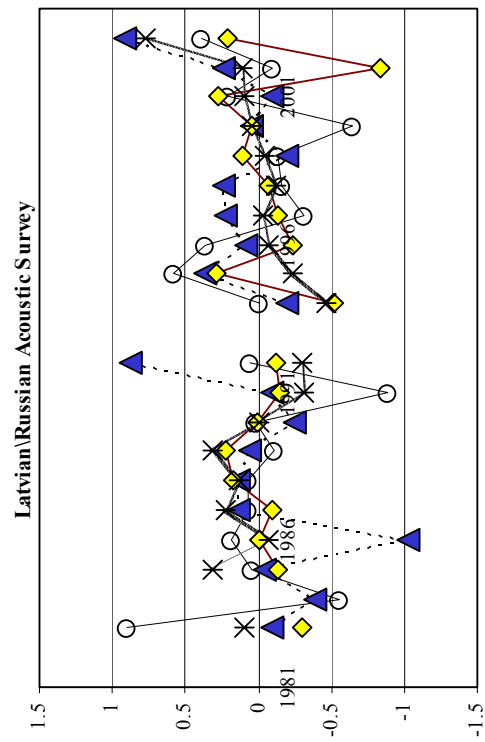
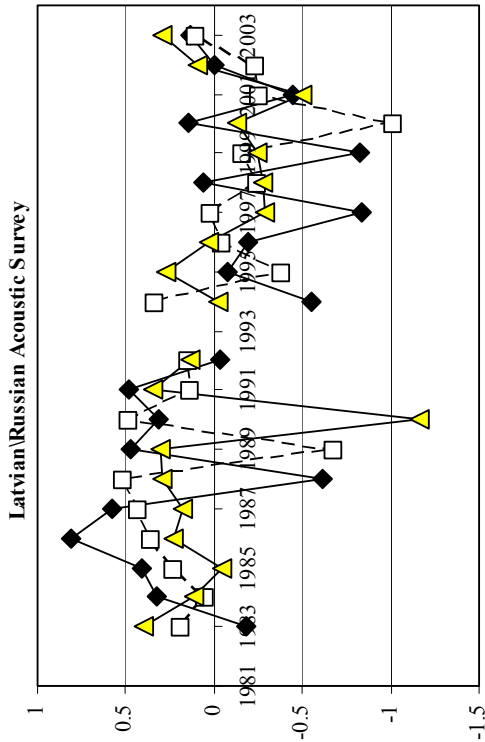


Figure 7.1 Sprat in SD 22-32. Residuals of catchabilities.

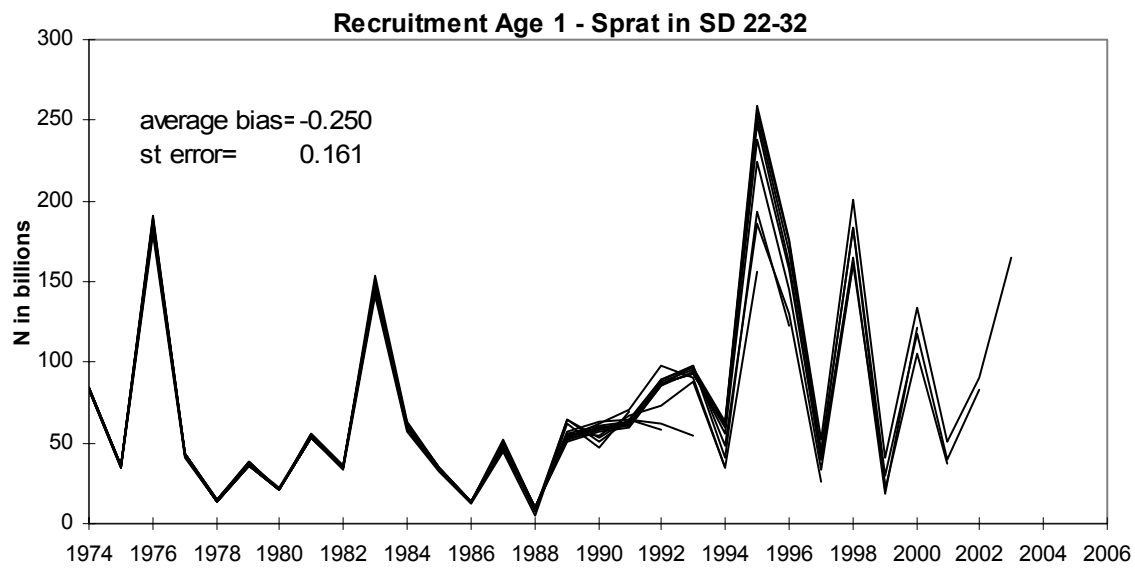
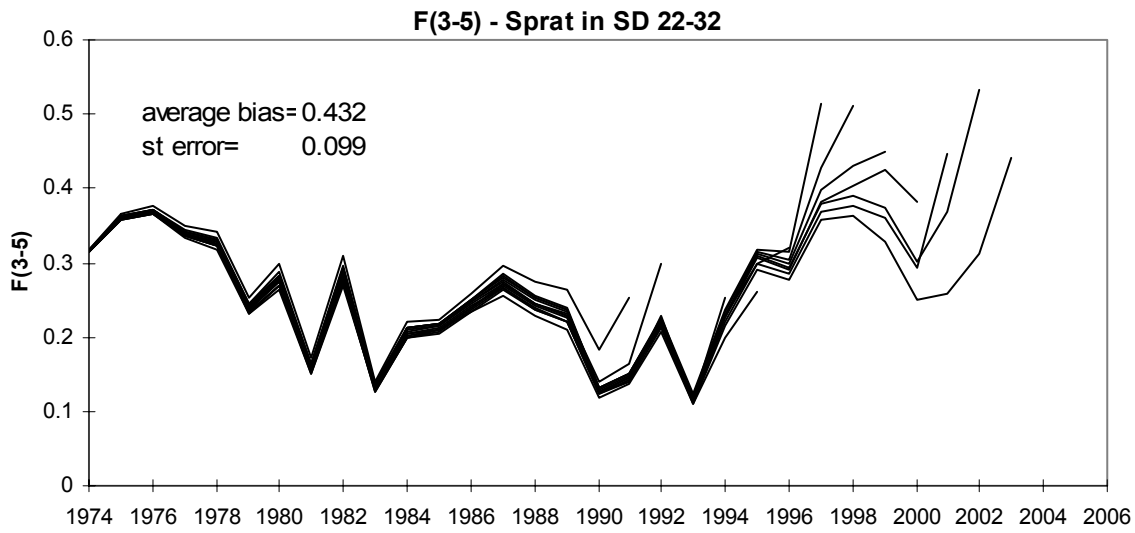
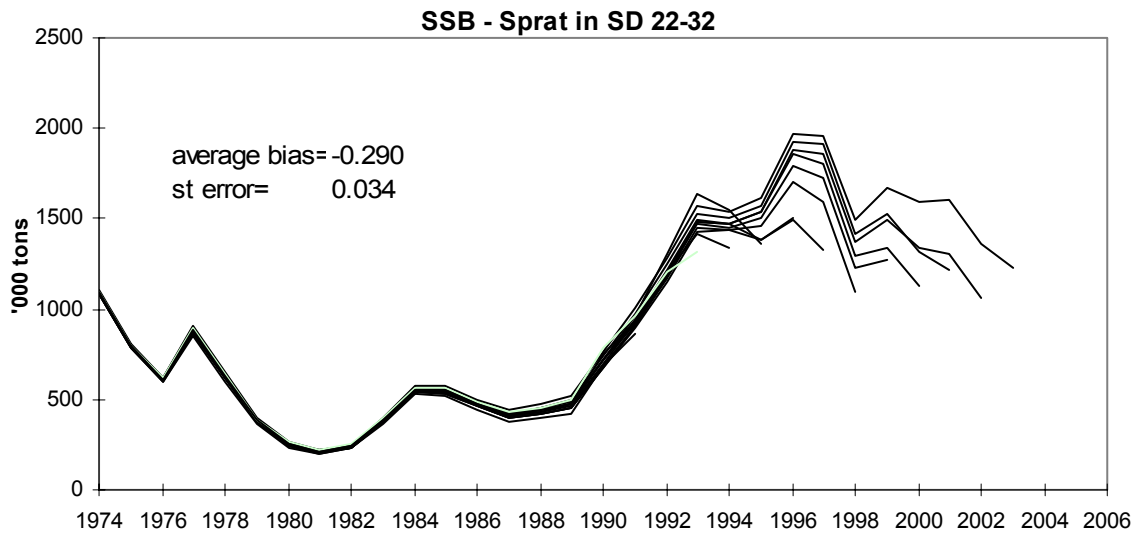


Figure 7.2 Sprat in SD 22-32. Retrospective analysis

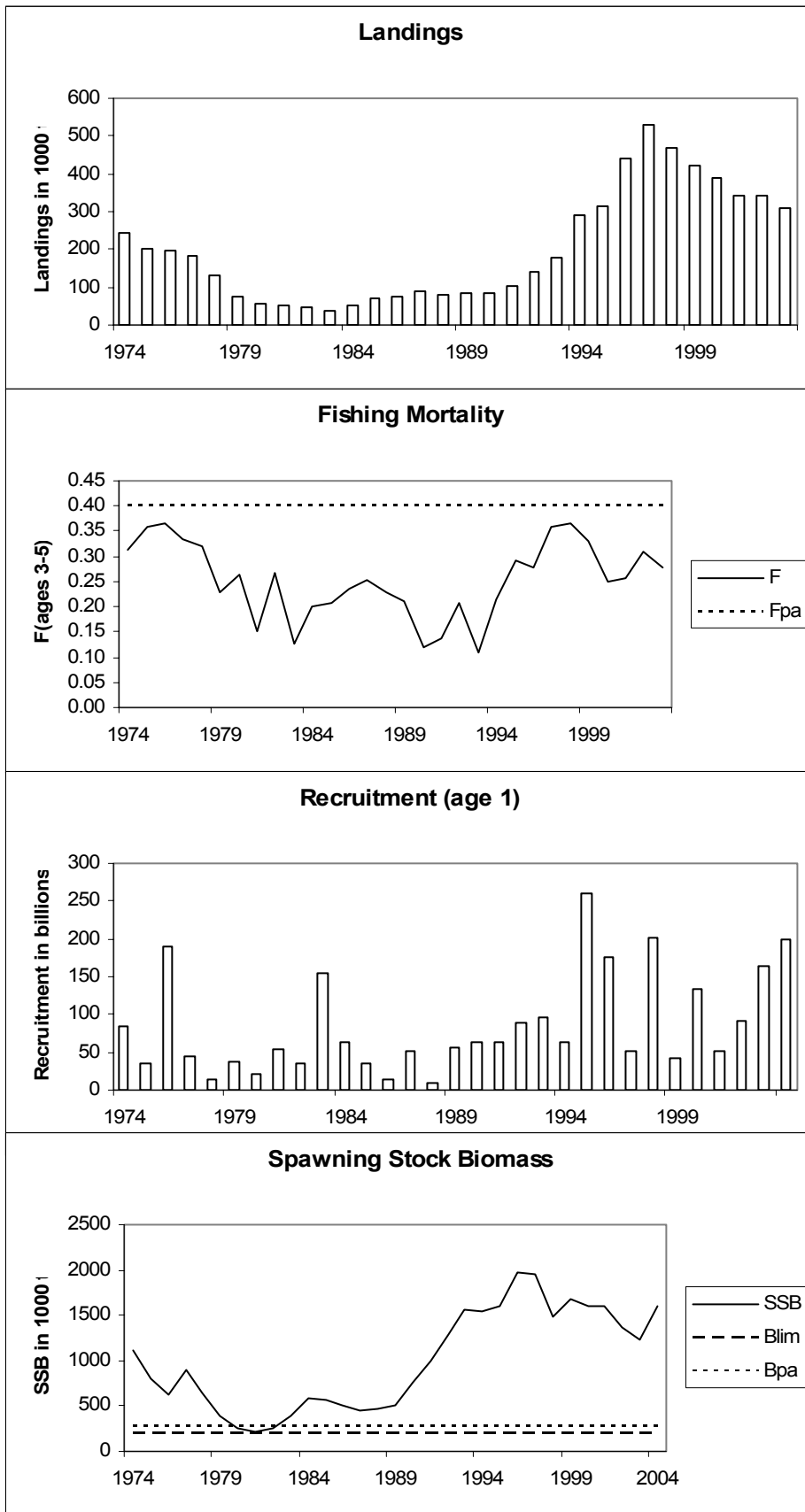


Figure 7.3

Sprat in SD 22-32. Summary sheet plots: Landings, fishing mortality, recruitment (age 1) and spawning stock biomass.

(F_{BAR_{3,5}} in 2003 corrected for bias of F at age 5 (original estimate of F_{BAR_{3,5}} in 2003 = 0.4412, see Section 7.6.2))

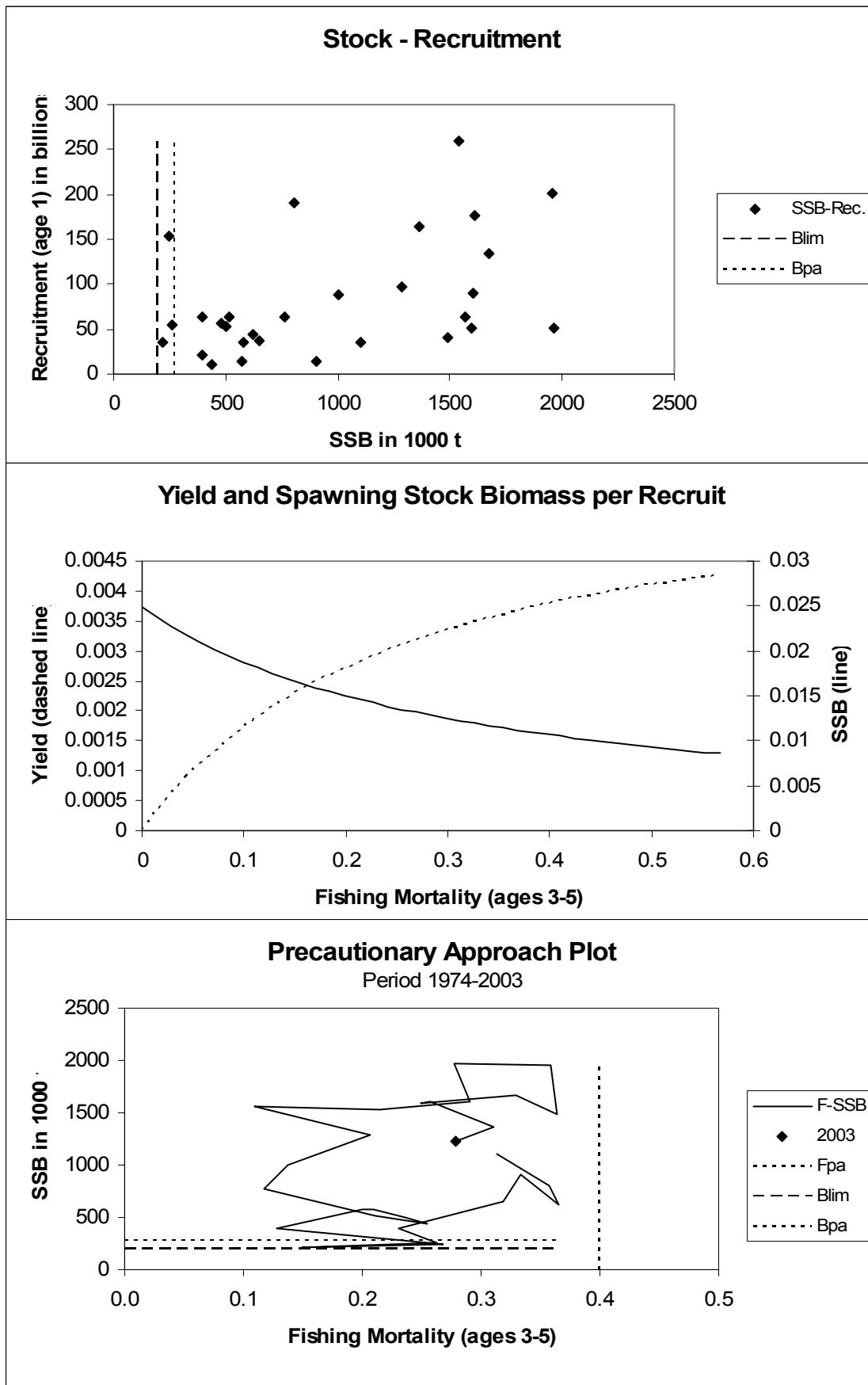


Figure 7.4

Sprat in SD 22-32. Summary sheet plots: Stock recruitment and Spawning biomass, yield and spawning biomass per recruit and Precautionary approach plot.

SSB-2002 FBAR 3-5	XSA settings	label
1288	0.37	basic except Latvian survey only
963	0.47	basic except international survey only
1229	0.44	basic */
1263	0.44	basic except q indep. on y.c. strength
1188	0.41	basic except SE of shrink.=0.5
1250	0.51	basic except SE of shrink.=1.5
976	0.39	basic except SE of shrink.=0.2

*/ basic run: 2 tuning fleets, q const at 4, q dep. on y.c. strength for ages<4, SE of shrink=0.75

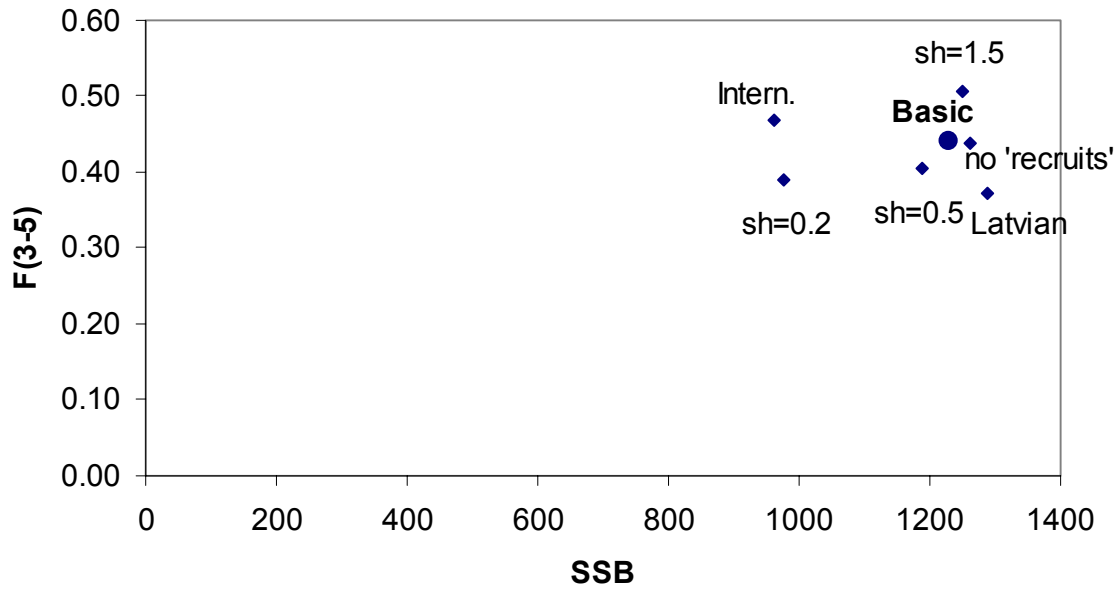
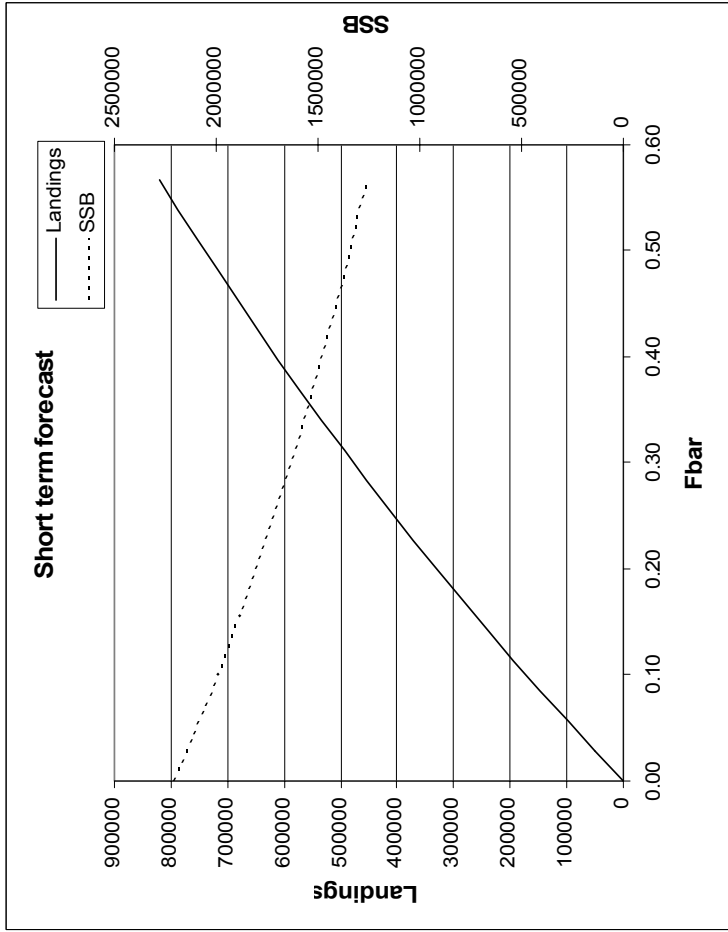
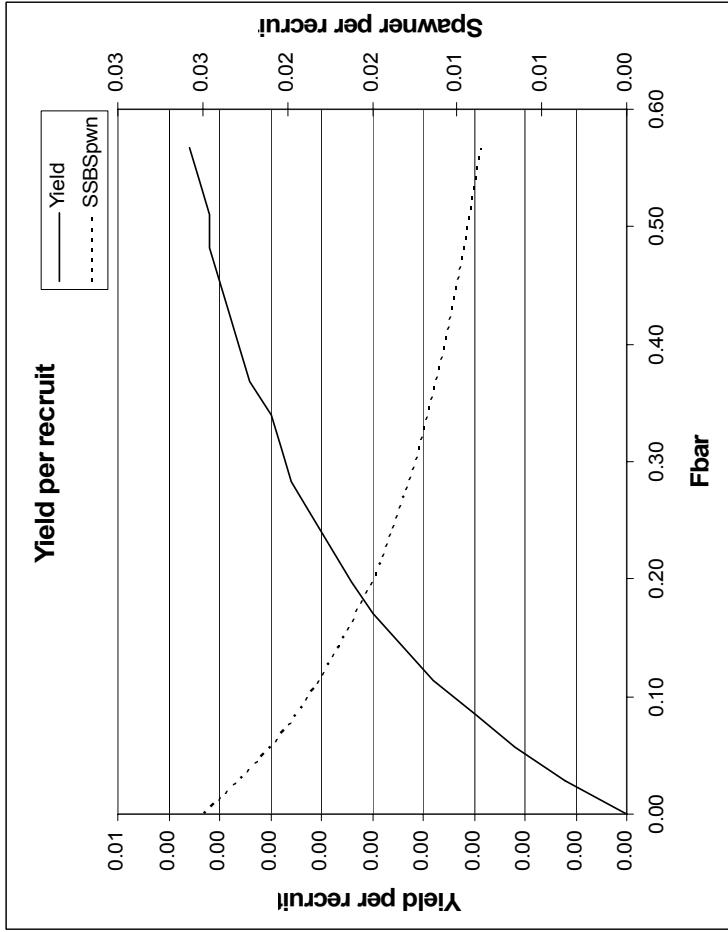


Figure 7.5 Sensitivity of XSA settings on SSB and F estimates at terminal year



MFYPR version 2a
 Run: Sprat_MFYPR_StatusQ
 Time and date: 17:09 22/05/2004

Reference point	F multiplier	Absolute F
Fbar(3-5)	1.0000	0.2833
FMax	>=1000000	
F0.1	1.9112	0.5415
F35%SPR	1.9517	0.5530

Weights in kilograms

MFDP version 1a
 Run: Sprat_StatusQ
 Sprat in SD 22-32 (combined sex; plus group)
 Time and date: 17:06 22/05/2004
 Fbar age range: 3-5

Input units are thousands and kg - output in tonnes

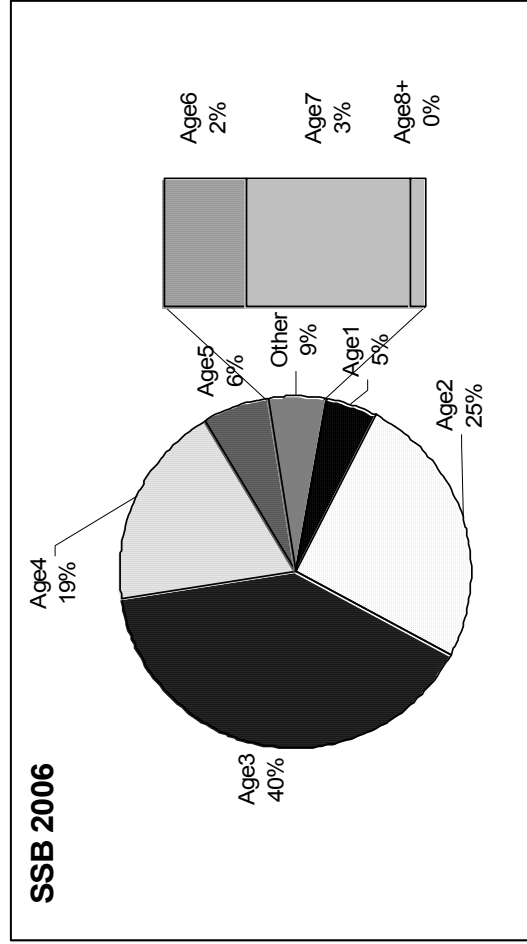
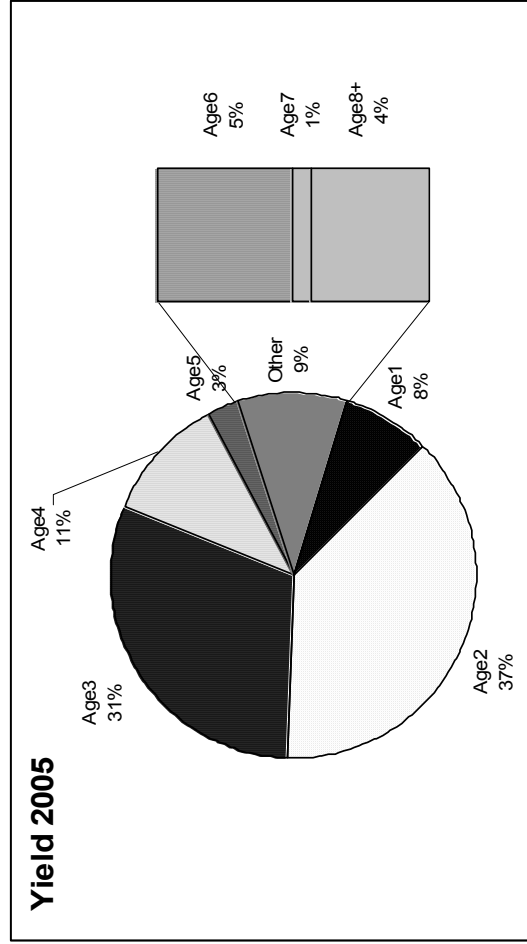
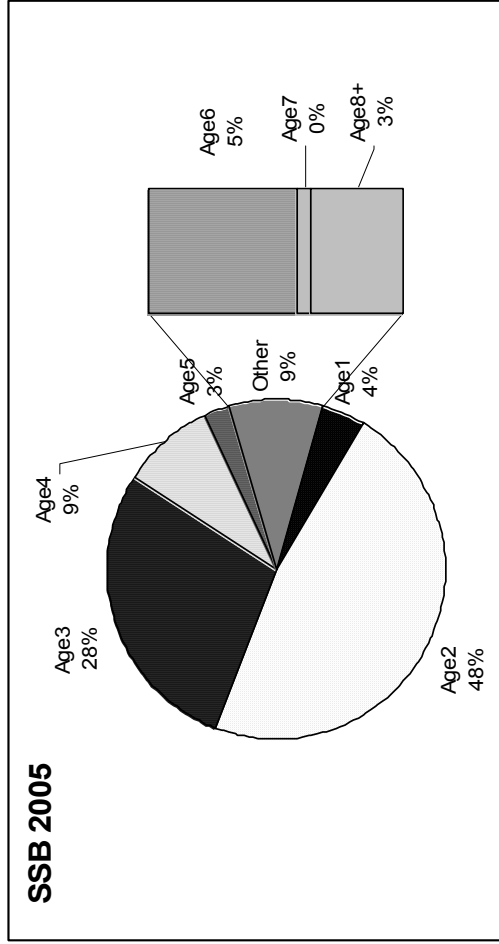
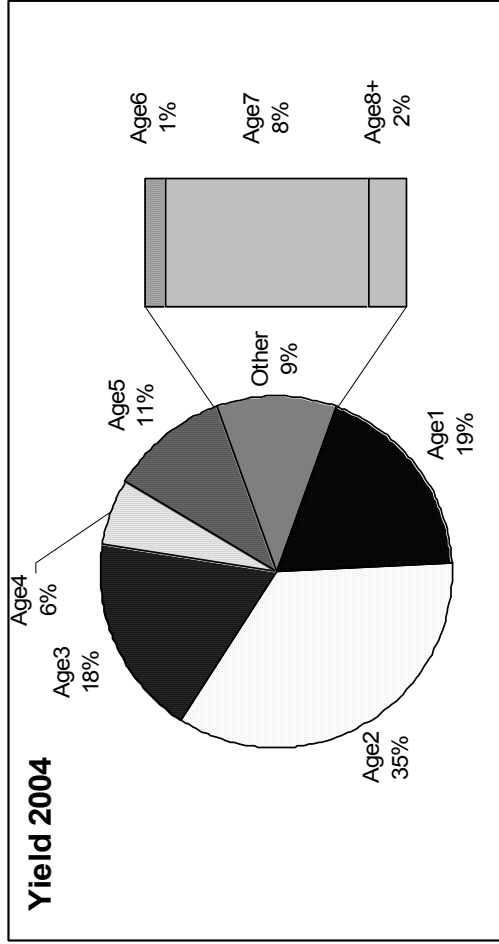


Figure 7.7 Sprat in SD 22-32. Short-term forecast for 2004-2006. Yield and SSB at age 1-8+ under the status quo fishing mortality.

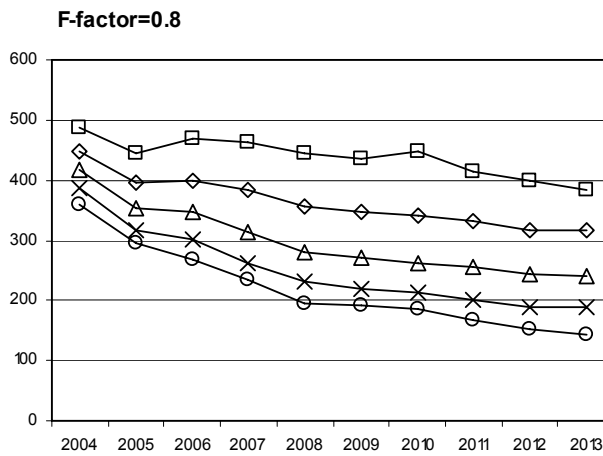
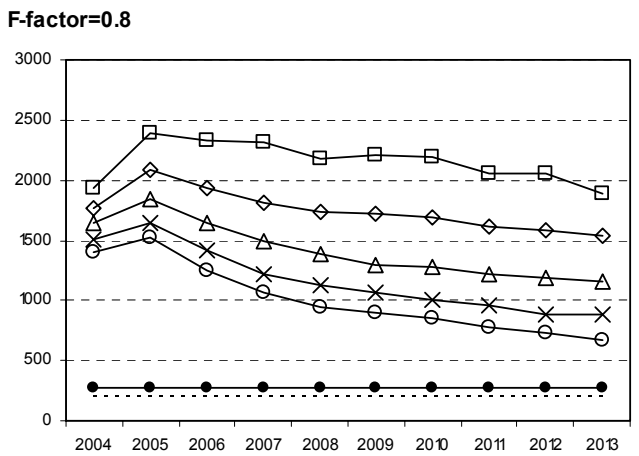
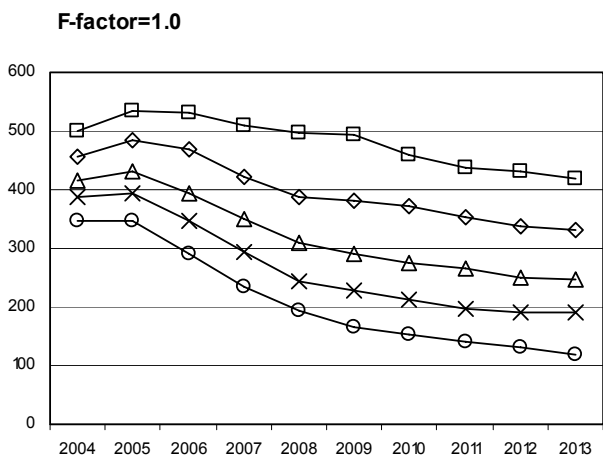
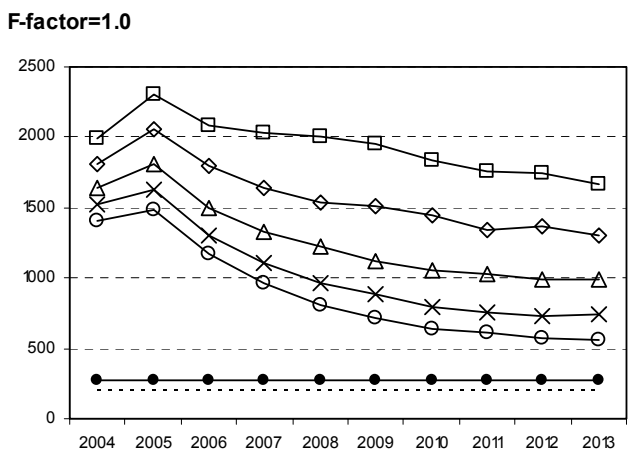
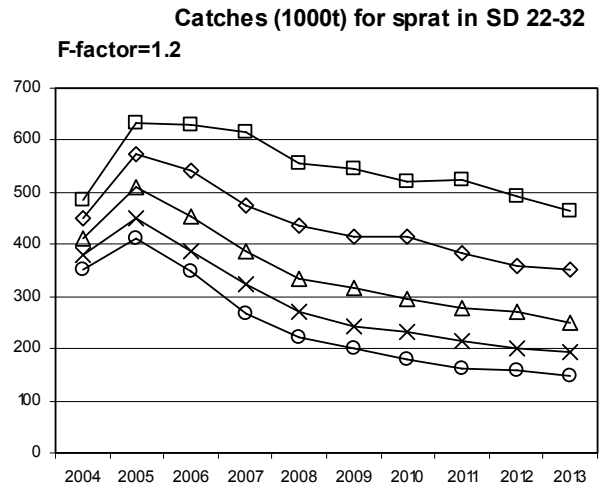
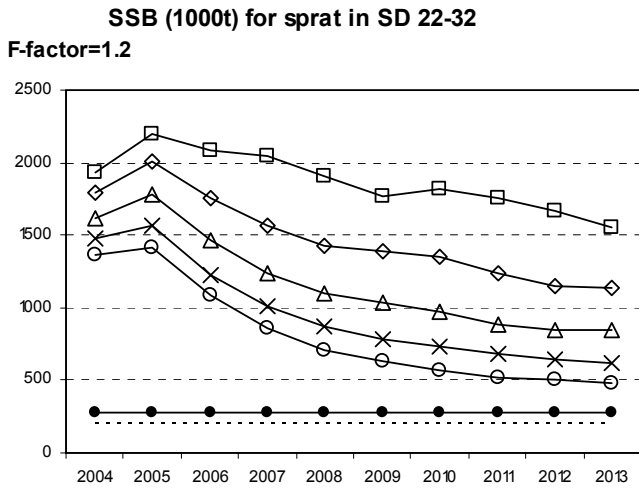
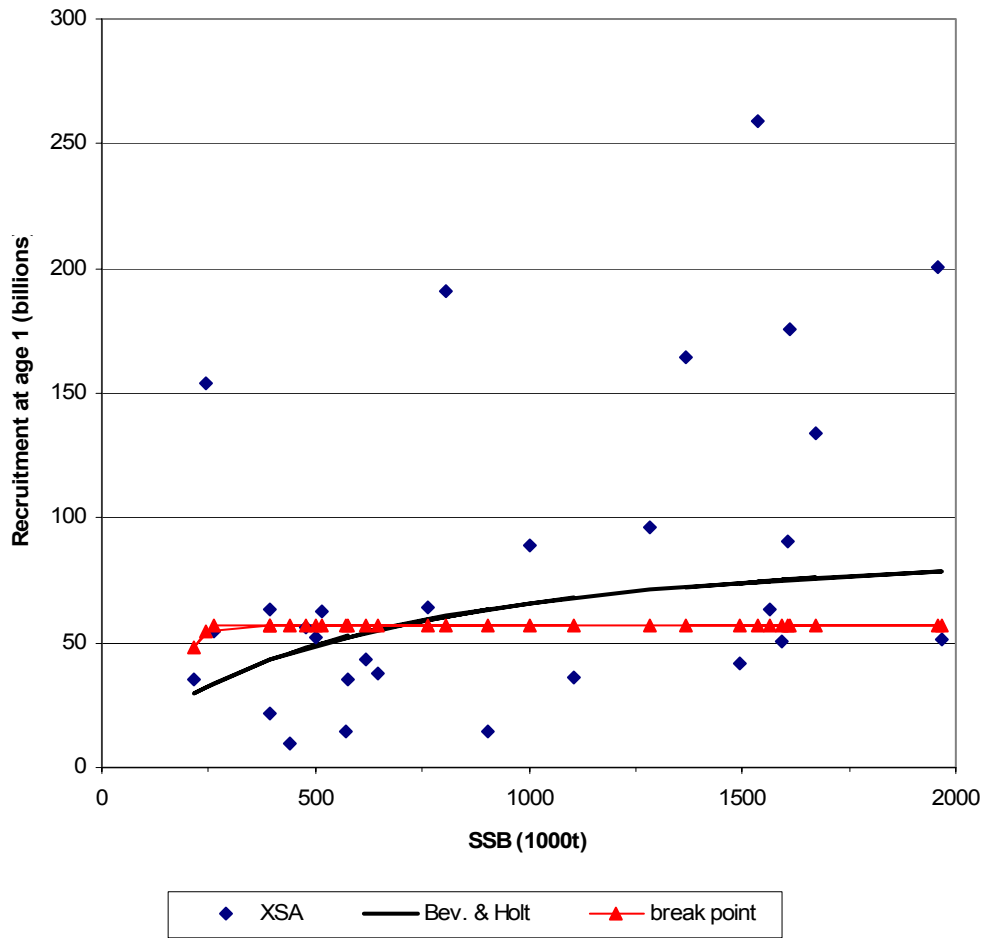


Figure 7.8 Sprat in SD 22-32. Medium term projections of biomass. (10,25,50,75 and 90 percentiles are presented)
Fsq=0.30(Ffactor=1)-Bpa 275000t, Blim 200000t

Figure 7.9 Sprat in SD 22-32. Medium term projections of catch. (10,25,50,75 and 90 percentiles are presented)

Sprat in SD 22-32: Recruitment at age 1 vs SSB



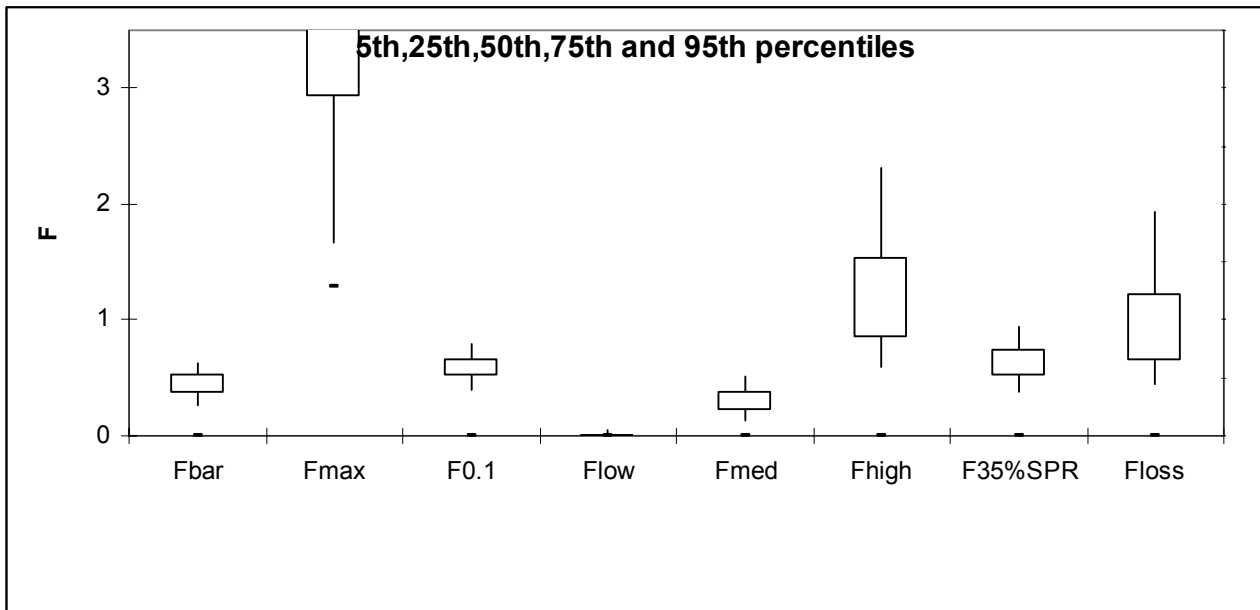
Beverton & Holt model:
 $R = a \cdot SSB / (b + SSB)$

a= 99.3
 b= 511.8
 SE= 0.8

Double linear model:
 $R = a \cdot SSB$ for $SSB < B_{break}$
 $R = b$ for $SSB \geq B_{break}$

a= 0.22
 b= 56.7
 B_{break}= 255.7
 SE= 0.85

Figure 7.10 Stock-recruitment relations for Baltic sprat (SD 22-32): XSA estimates and fitted models.



Reference point	Deterministic	Median	75th percentile	95th percentile	Hist SSB < ref pt %
MedianRecruits	59712085	59712085	63166585	76675754	
MBAL	0				0.00
Bloss	217299				
SSB90%R90%Surv	1021044	829425	955355	1190608	56.67
SPR%ofVirgin	43.05	43.42	46.32	50.52	
VirginSPR	0.02	0.02	0.03	0.03	
SPRloss	0.01	0.01	0.01	0.01	
	Deterministic	Median	25th percentile	5th percentile	Hist F > ref pt %
FBar	0.44	0.44	0.36	0.26	0.00
Fmax	21042.26	12858.25	2.93	1.67	0.00
F0.1	0.59	0.58	0.51	0.39	0.00
Flow	0.00	0.00	0.00	0.00	100.00
Fmed	0.33	0.30	0.22	0.13	20.00
Fhigh	1.10	1.16	0.85	0.59	0.00
F35%SPR	0.62	0.61	0.51	0.38	0.00
Floss	1.00	0.87	0.65	0.45	0.00

For estimation of Gloss and Floss:

A LOWESS smoother with a span of 1 was used.

Stock recruit data were log-transformed

A point representing the origin was included in the stock recruit data.

For estimation of the stock recruitment relationship used in equilibrium calculations:

A LOWESS smoother with a span of 1 was used.

Stock recruit data were log-transformed

A point representing the origin was included in the stock recruit data.

Sprat 22 32

Steady state selection averaged over 3 years.

FBar averaged from age 3 to 5

Number of iterations = 500

Random number seed = -99

Stock recruitment data Monte Carloed using residuals from the equilibrium LOWESS fit

Data source:

FLVB32.DLL built on Jun 14 1999 at 11:53:37

PASoft 4 October 1999

20/04/2004 20:24

Figure 7.11 Sprat in SD 22-32. PA reference points.

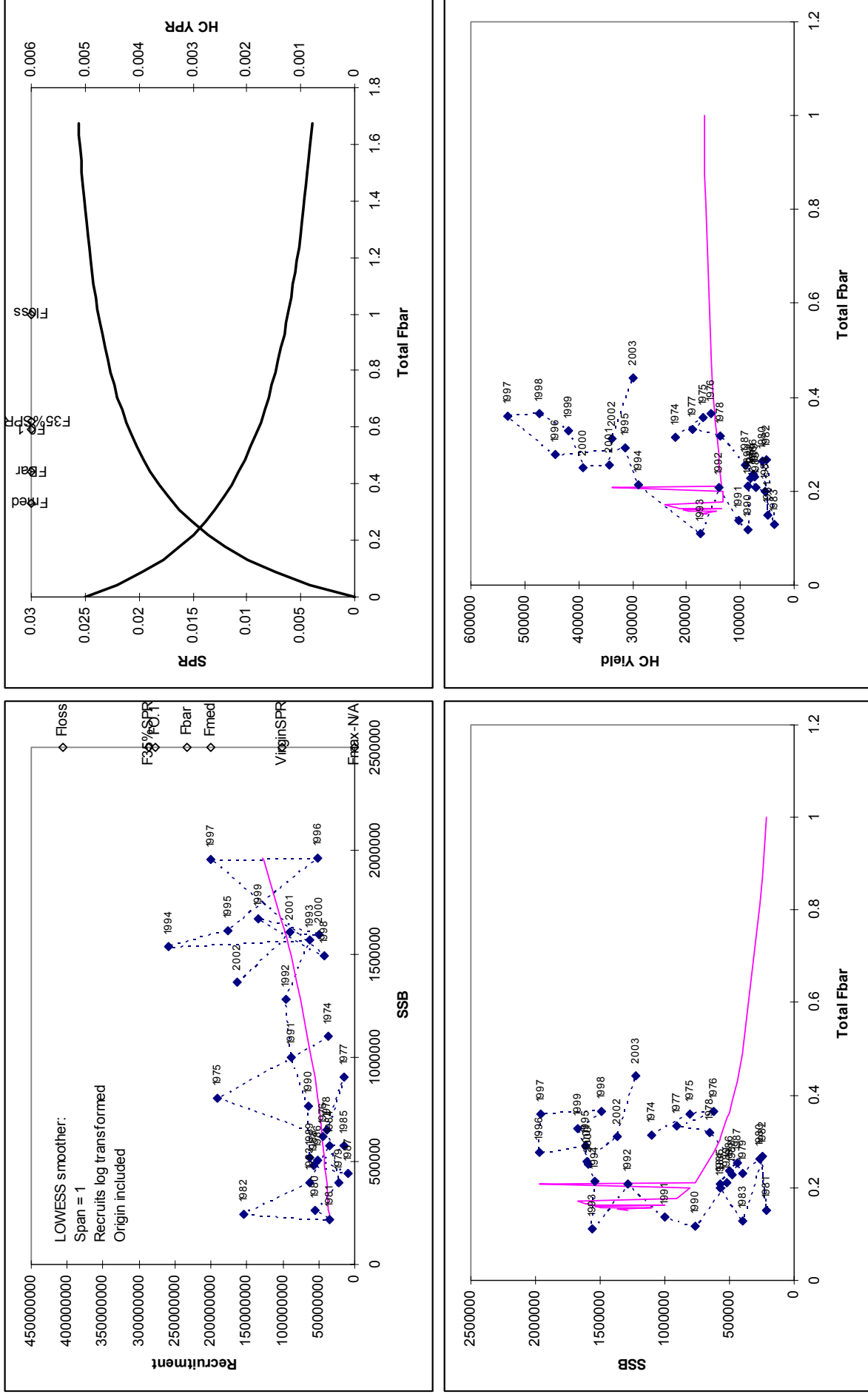


Figure 7.12 Sprat in SD 22-32. PA graphs for present natural mortality and weights.