10 Sprat in Division 3.a and Subarea 4 (Skagerrak, Kattegat and North Sea)

10.1 The Fishery

10.1.1 ACOM advice applicable to 2020 and 2021

There have never been any explicit management objectives for this stock. Last year, the advised TAC (July 2021 to June 2022) was set to 106 715 t for sprat in Subarea 4 and Division 3.a. The 2021 herring bycatch quotas were 7 750 t for the North Sea and 6 659 t for Division 3.a. During the WKSPRAT benchmark meeting in 2018, sprat in Subarea 4 and Division 3.a were merged into one stock assessment model. Also, several other modifications were made to the configurations of the assessment model (see (WKSPRAT: ICES, 2018) for further details).

10.1.2 Catches in 2021

Catch statistics for 1997–2021 for sprat in the North Sea by area and country are presented in Table 10.1.1. Catch data prior to 1996 are considered less reliable due to uncertainty of potential bycatches of North Sea herring (see Stock Annex). The small catches of sprat from the fjords of Norway are not included in the catch tables (Table 10.1.1–10.1.2). The WG estimate of total catches for the North Sea and Division 3.a in 2021 were 80 761t (total official catches amounted to 81 807 t). This is a 56% decrease compared to 2020. The Danish catches represent 86% of the total catches.

The spatial distribution of landings was similar to 2020, although smaller catches were seen (Figure 10.1.1). A very low percentage (~1% in 2021) of the catches were landed in the first and second quarter of 2021 (Table 10.1.2).

10.1.3 Regulations and their effects

Most sprat catches are taken in an industrial fishery where catches are limited by herring bycatch quantities. Bycatches of herring are practically unavoidable except in years with high sprat abundance or low herring recruitment. Bycatch is especially considered to be a problem in area 4.c. This led to the introduction of a closed area (sprat box) to ensure that sprat catches were not taken close to the Danish west coast where large bycatches were expected.

ICES evaluated the effectiveness of the sprat box in 2017 (ICES, 2017). The evaluation showed that fishing inside the sprat box would be expected to reduce unwanted catches of herring by weight but not in number and concluded that other management measures are sufficient to control herring bycatch. The sprat box was removed in 2017.

The Norwegian vessels have a maximum vessel quota of 550 t when fishing in the North Sea. A herring bycatch of up to 10% in biomass is allowed in Norwegian sprat catches.

10.1.4 Changes in fishing technology and fishing patterns

No major changes in fishing technology and fishing patterns for the sprat fisheries in the North Sea have been reported. From about 2000, Norwegian pelagic trawlers were licensed to take part in the sprat fishery in the North Sea. In the first years, the Norwegian catches were mainly taken by purse-seine, and the catches taken by trawl were low. In recent years, the share of the total Norwegian catches taken by trawl has increased (2020: 92% taken by trawl).

10.2 Biological composition of the catch

Only data on bycatch from the Danish fishery were available to the Working Group (Table 10.2.1). The Danish sprat fishery was conducted with a 7.2% and 10.7% bycatch of herring in 2021 in the North Sea and Division 3.a, respectively. The total amount of herring caught as bycatch in the sprat fishery has mostly been less than 10%. From 1st of April 2020 the Danish methodology behind the by-catch estimation in the fisheries for reduction changed. Before, the Danish fishery control regularly sampled the landings for reduction, and afterwards a species composition was estimated per month, square and fishery. Now, each and every landing for reduction into Denmark is subsampled by the buyer and the estimated species composition is reported directly in the sale slips. Many of the buyers use independent companies, 3rd party, for sampling.

The estimated quarterly landings at age in numbers for the period 1974–2021 are presented in Table 10.2.2. In the model year 2021 (1 July 2021–30 June 2022), one-year old sprat contributed 68% of the total landings, which is close to the 1990–2020 average (66%). 2-year-olds contributed 20% in 2021 (model year), which is above the 1990–2020 average (15%). 0-year-olds contributed 8% of the total landings, which is lower than the 1990–2020 average (16%).

Denmark and Sweden provided age data of commercial landings in 2021 (Table 10.2.4). Quarter 1, 3 and 4 were covered. Quarter 1 in 2021 had very low catches and low number of samples. The sample data were used to raise the landings data from the North Sea, Skagerrak, and Kattegat. The landings by Germany (3 572 t), the Netherlands (139 t), UK-Scotland (105 t), UK-England and Wales (33 t) and Belgium (<1 t) were unsampled and Norway didn't catch the stock in 2021. The sampling level has been greatly improved since 2014 because of the implementation of a sampling programme for collecting haul-based samples from the Danish sprat fishery. However, the sampling level in 2020 (model year) was substantially reduced with only 0.6 samples taken per 2000 t. The low level of sampling in 2020 was caused by a not fully implemented change in the Danish sampling program. Since the introduction of the new by-catch estimation method in 2020, mentioned above, the Danish institute has been able to get samples from most of the buyers / 3rd party companies. Therefore, the Danish institute introduced a new sampling strategy in 2020, where vessels above 24 meters are sampled with a higher frequency than smaller vessels. Vessels above 24 meters are still being encouraged to deliver self-samples, but if not, a 3rd party sample is used as a substitute. All samples from vessels below 24 meters comes from the 3rd party companies. The new sampling strategy has secured a high level of sampling in 2021.

The number of samples used for the assessment, both length and age-length samples, is shown in Table 10.2.4–5 and Figure 10.2.1.

10.3 Fishery Independent Information

10.3.1 IBTS Q1 and Q3

Table 10.3.1 and Figure 10.3.1 and 10.3.2 give the time-series of IBTS indices by age (calculated using a delta-GAM model formulation; see WKSPRAT report (2018) for further details). The data

source is the IBTS Q1 data from 1983–2022. The index for IBTS Q1 1-year old in 2021 (age-0 in the model and the table, serving as a recruitment index) was 35% below average and 45% lower than last year's index. There has been a tendency for an increase in the IBTS age 0 in the time-series since 1990. Furthermore, older age-groups (i.e. age-1 and age-2) decreased by >45% compared to the year before. Note that due to both rough weather and outbreaks of Covid-19, IBTS Q1 survey was limited, which affected the sampling coverage. Thus, the coverage was reduced drastically for some parts of the North Sea. Although, it is not expected to have any significant effect for the sprat assessment, a 15% increase in CV for the index is reported compared to last year. Spatial pattern in residuals was checked and did not raise any concerns. Furthermore, the model is designed to handle such issues to some extent. IBTS Q3 survey indices were also used in the assessment for older age-groups, and the 2021 values for all age-groups (i.e. age-1, age-2 and age-3+) were more than 50% lower compared to 2020.

10.3.2 Acoustic Survey (HERAS)

Abundance indices were provided by WGIPS (ICES, 2022) (see Section 1.4.2). The abundance indices for Subarea 4 and Division 3.a were summed (Table 10.3.2 and Figure 10.3.2b). The 2021 values were 22% higher, 61% lower, and 27% lower (age-1, age-2, and age-3, respectively) compared to the 2020-values.

10.4 Mean weights-at-age and maturity-at-age

Mean weights-at-age in catches are given in Table 10.2.3 and Figure 10.4.1. Mean weights in model season 1 and 2 (S1 and S2; quarter 3 and 4), where most of the catches are taken, show a declining trend over the past decade. In 2019, the mean weights of age-1 and age-3 fish in S1 were the lowest observed for nearly two decades but since 2020 this decline was arrested. Weights were almost identical for all age-groups S1 compared to 2020. In contrast weights for all age-groups declined in S2 (Figure 10.4.1).

Proportion of mature fish was derived from IBTSQ1, following the benchmark procedure. Long-term average maturity ogives were used in the assessment model (0.0, 0.41, 0.87, and 0.95 for age-0 to age-3+). More details about the maturity staging are given in Section 4.5.3.2 in the WKSPRAT 2013 report (ICES, 2013).

10.5 Recruitment

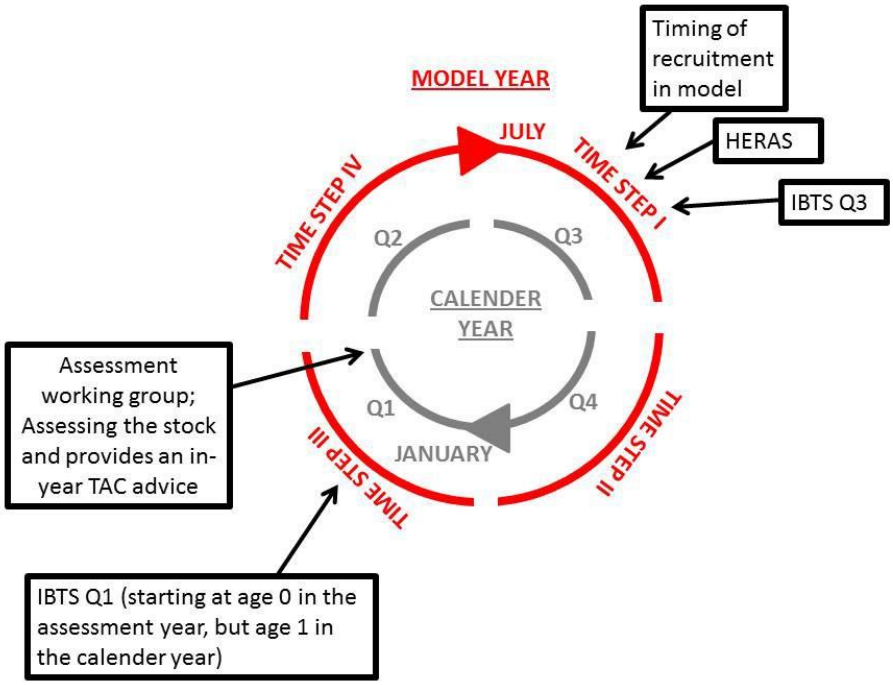
The IBTS Q1 age-1 index (age-0 in the model) (Table 10.3.1) is used as a recruitment index for this stock. The 2022 value, indicative of the 2021 recruitment, was 35% below average, corresponding to a 45% decrease of the recruitment index in the previous year. The recruitment estimated by the model for 2021 is 19% lower than the recruitment in 2020 and 43% below the 2011-2020 geometric mean (Table 10.6.4). At the most recent benchmark, it was decided to implement a power model (directly within the assessment model) to the age-0 IBTS Q1 index to dampen the effect of very high index values. This was done to reduce the retrospective bias on recruitment (see WKSPRAT 2018 for further details).

10.6 Stock Assessment

The stock assessment was benchmarked in November 2018 (WKSPRAT: ICES, 2018). During the WKSPRAT benchmark meeting in 2018, sprat in Subarea 4 and Division 3.a were merged into one stock assessment model. Also, several other modifications were made to the configuration of the assessment model (see WKSPRAT report (ICES, 2018) for further details).

In-year advice is the only possible type of advice for this short-lived species with catches dominated by 1- and 2-year-old fish. This, however, requires information about incoming 1-year old fish. To meet this requirement and to come up with a model that logically matches the natural life cycle of sprat, the annual time-step in the model was shifted, relative to the calendar year, to a time-step going from July to June (see text table below). SSB and recruitment was estimated at 1 July. In figures and tables with assessment output and input, the years refer to the shifted model year (July to June) and in each figure and table it is noted whether model year or calendar year apply (when the model year is given the year refers to the year at the beginning of the model year; for example: 2000 refers to the model year 1 July 2000 to 30 June 2001). The following schematic illustrates the shifted model year relative to the calendar year and provides an overview of the timing of surveys etc.

Model year		Calendar year	
2000	Season 1	2000	Quarter 3
2000	Season 2	2000	Quarter 4
2000	Season 3	2001	Quarter 1
2000	Season 4	2001	Quarter 2



10.6.1 Input data

10.6.1.1 Catch data

Information on catch data are provided in Tables 10.1.1–2 and in Figures 10.1.1 and 10.6.1. Sampling effort is presented in Table 10.2.5 and Figure 10.2.1.

Since catches in quarter 2 (season 4 in the model) are often less than 5000 tonnes, these are poorly estimated by the model and the number of samples from these catches are low (sometimes no samples). Furthermore, at the time of the assessment working group, S4 catches are unknown. Therefore, during the latest benchmark it was decided to move S4 catches into S1 in the following model year. In 2022, only 478 t were taken in quarter 1 and no age samples taken. To avoid the resulting high uncertainty in the age distribution of these catches, they were transferred to 2021 quarter 4, leading to a total catch of 15 617 t in this quarter.

10.6.1.2 Weight-at-age

The mean weights at age observed in the catch are given in Table 10.2.3 and Figure 10.4.1 by season. It is assumed that the mean weights in the stock are the same as in the catch. The mean weight at age of S1 that is used to calculated SSB.

10.6.1.3 Surveys

Three surveys were included (Tables 10.3.1–3), IBTS Q1 (1975–present), IBTS Q3 (1991–present) and HERAS (Q3) (2003–present). 0-group (young-of-the-year) sprat is unlikely to be fully recruited by the time of IBTS Q3 and HERAS, and for this reason these age indices were excluded from the model.

10.6.1.4 Natural mortality

New natural mortalities were available from the 2020 North Sea key run from WGSAM (ICES, 2017). The major changes were changes to mean weight of whiting leading to lower mortalities particularly in the early part of the time series. HAWG reviewed stock assessments based on the old and new M's. The new mortalities reduced AIC of the model from 865 to 859, indicating a substantially improved fit. CVs for the catches decreased by up to 3% while survey CVs changed by -4 to +5% (average +0.2%). The CV on the terminal SSB increased by 9%. For comparison, the change from the 2019 to the 2020 assessment, both using old mortalities, was an increase in CVs for the catches of up to 4% while survey CVs changed by -5 to +20% (average +6%). The CV on the terminal SSB decreased by 20%). In summary, the AIC of the assessment using new mortalities was substantially improved and changes to estimated parameters were within the range observed in annual updates. The change in average recruitment, SSB and F over the past 20 years were 2%, -4% and +1% (new compared to old). The change to selection pattern was between -2 and 5% for age groups 1 and 2 (the F-bar ages). The group inspected the stock-recruitment plot and found no substantial changes. According to benchmark guidelines, no substantial changes in stock parameters or stock-recruitment plot would lead to the adoption of new mortalities in the assessment. However, the recent guidance from ACOM LS requires that reference points are re-estimated and an inter-benchmark process conducted when new M's are introduced. Given the strict time schedule for advice on this stock and the fact that the reference points according to the benchmark are estimated in a full (time consuming) MSE model, the group did not consider it feasible to conduct an inter-benchmark in time for the 2021 advice. Further, the group felt that they could not guarantee that using new mortalities would not lead to changes in reference points if these were re-estimated. Therefore, the old mortalities were used in the assessments from 2021 and onwards. Variable mortality is applied as three-year averages up till 2015, and after this the average mortality for 2013–2015 is used. Natural mortalities used in the model are given in Table 10.6.1.

10.6.1.5 Proportion mature

Proportion of mature fish was derived from IBTSQ1, following the benchmark procedure. Long-term average maturity ogives were used in the assessment model (0.0, 0.41, 0.87, and 0.95 for age-0 to age-3+). More details about the maturity staging are given in Section 4.5.3.2 in the WKSPRAT 2013 report (ICES, 2013).

10.6.2 Stock assessment model

The assessment was made using SMS (Lewy and Vinther, 2004) with quarterly time-steps (referred to as season S1–S4). Three surveys were included, IBTS Q1 ages 1–4+, IBTS Q3 ages 1–3 and HERAS (Q3) ages 1–3. 0-group sprat is unlikely to be fully recruited to the IBTSQ3 or HERAS in Q3 and these age indices were excluded from runs. External consistency between IBTS Q1, IBTS Q3 and HERAS can be found in the benchmark report (WKSPRAT2018: ICES, 2018).

The model converged and fitted the catches of the main ages caught in the main seasons reasonably (ages 1–2, seasons 1 and 2, Table 10.6.2). All surveys had low CVs (Table 10.6.2). There were no patterns in the residuals raising concern. Although, there appears to be a periodic cycling (on a decadal time-scale) between positive and negative residuals in the IBTS Q3 survey and the catches (Figures 10.6.2–3). Common CVs were estimated for the groups: 1 to 3-year olds in IBTS Q1 and 2 and 3-year olds in IBTS Q3 and HERAS.

The retrospective analyses showed a tendency to overestimate recruitment (5 years Mohn´s rho = 0.27) (Figure 10.6.5). As 41% (see 10.6.1.5) of the recruiting year class mature in their first year and thus contributes to the SSB at the end of the year, there is a similar large retrospective pattern in SSB (5-year Mohn´s rho = 0.25). The assessment model was improved with this respect during the last benchmark and Mohn´s rho was reduced by roughly a factor of 3 due to the improvement.

The final outputs detailing trends in mean F, SSB and recruitment are given in Figures 10.6.4–7 and Tables 10.6.3–4.

10.7 Reference points

A B_{lim} of 94 000 t (Figure 10.7.1) and B_{pa} of 125 000 t were agreed at the most recent benchmark. B_{pa} is defined as the upper 90% confidence interval of B_{lim} and calculated based on a terminal SSB CV of 0.173.

10.8 State of the stock

The sprat stock has a decreasing trend during the last couple of years judging by all the surveys and by the assessment output. The stock has been well above B_{pa} since 2013 and above B_{lim} since 1991 but is now estimated to be below B_{pa} for the first time in nine years. The current SSB is 20% below B_{pa}. Fishing mortality has fluctuated without a trend, but the F of 2.169 in 2021 was the third highest in the time-series. The advised TAC was based on the predicted catch at F equal to F_{cap} (0.69). A large overshoot of F_{cap} is seen in simulations applying the escapement strategy on very large incoming year classes, and this is the rationale for implementing an F_{cap} as otherwise, the escapement strategy is not precautionary at large stock sizes.

A stock summary from the assessment output can be found in Table 10.6.4 and Figure 10.6.7.

10.9 Short-term projections

Management strategy evaluations for this stock were made in December 2018 (WKSPRATMSE: ICES, 2018). These evaluations clearly show that the current management strategy ($B_{escapement}$) is not precautionary unless an additional constraint is imposed on the fishing mortality (referred to as F_{cap}). During the WKSPRATMSE (ICES, 2018) 0.69 was found to be the optimal F_{cap} value (from both a full MSE and a shortcut MSE, see the WKSPRATMSE report (WKSPRATMSE: ICES, 2018) for further details), which is a revision of the previous value of 0.7. This means, that the fishing mortality ($F_{bar}(1–2)$) derived from the $B_{escapement}$ strategy, should not exceed 0.69.

SSB in 2023 is expected to be higher than in 2022 and above the long-term average, and well above B_{pa} (+45%). Using the input and assumptions detailed above, the projection for an F = 0 is an SSB in July 2023 of 222 210 t (Table 10.9.2). The F_{MSY} approach prescribes the use of an F value of 0.69 (F_{cap}, see explanation above) and results in a TAC advice of 69 690 t (July 2022–June 2023), which is expected to result in an SSB of 181 215 t in July 2023, well above B_{pa}.

10.10 Quality of the assessment

The data used within the assessment, the assessment methods and settings were carefully scrutinized during the 2018 benchmark (ICES, 2018). A complete overview of the choices made during the benchmark can be found in the WKSPRAT report (ICES, 2018) and these are also described in the Stock Annex for sprat in Division 3.a and Subarea 4.

The assessment shows medium to high CVs for the catches but low CVs for surveys. The CVs of F, SSB and recruitment are generally low (see Table 10.6.2 and Figure 10.6.4). The model converged and fitted the catches of the main ages caught in the main seasons (the periods with most samples) reasonably well (ages 1–2, season 2, Table 10.6.2). The retrospective pattern in SSB and recruitment (5-years Mohn´s rho of 0.25 and 0.27, respectively) is below the advised limit of 0.3 discussed in WKFORBIAS (2019).

There appears to be a systematic pattern in the catch residuals of model season 1 (quarter 3), which remains unexplained.

10.11 Management Considerations

A management plan needs to be developed for this stock. Sprat is an important forage fish; thus, also multispecies considerations should be made.

The sprat stock in the North Sea is dominated by young fish. The stock size is mostly driven by the recruiting year class. Thus, the fishery in a given year will be dependent on that year's incoming year class.

Industrial fisheries are allocated a bycatch of 8174 t and 6659 t of juvenile herring in 2022 in the North Sea and Division 3.a, respectively. It is important to continue monitoring bycatch of juvenile herring to ensure compliance with this allocation.

10.11.1 Stock units

After the latest benchmark, sprat in the Subarea 4 and Division 3.a is considered to be one cohesive stock. This is documented in the WKSPRAT report (ICES, 2018). In addition, there are several peripheral areas of the North Sea and Division 3.a where there may be populations of sprat that behave as separate stocks from the main stock. Local depletion of sprat in such areas can be an issue of ecological concern.

10.12 Ecosystem Considerations

Sprat is an important prey species in the North Sea ecosystem. The influence of the sprat fishery on other fish species and seabirds are at present not documented to be substantial.

In the North Sea, the key predators consuming sprats are included in the stock assessment, using SMS estimates of sprat consumption for each predatory fish stock, and estimates for seabirds though this information is as described under natural mortality not up to date. Impacts of changes in zooplankton communities and consequent changes in food densities for sprats are not included in the assessment, but it may be useful to explore the possibility of including this, or a similar proxy bottom-up driver, in future assessments. However, the effect of changes in productivity is included in the observed quarterly weight-at-age and in the estimated recruitment, as a decline in e.g. available food can lead to lower observed weights and lower estimated recruitment even in the absence of a causal link in the model.

10.13 Changes in the environment

Temperatures in this area have been increasing over the last few decades. This may have implications for sprat, although the correlation between temperature and recruitment from the model has been found to be low (see WKSPRAT2018: ICES, 2018).

Table 10.1.1. North Sea & 3.a sprat. Landings (' 000 t) 1998–2021. See ICES CM 2006/ACFM:20 for earlier data. Catch in coastal areas of Norway excluded. Data provided by Working Group members. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Division 27.4.a																								
Denmark		0.7		0.1	1.1		*		*	0.8	*	*					*	*	0.1	0.1		*	0.5	*
Norway												*		*								0.1	*	
Sweden				0.1																				
UK (Scot-land)														0.5						*	*			
Germany																		*	*					
Netherlands																		*						
Total		0.7		0.2	1.1		*		*	0.8	*	*		0.5			*	*	0.1	0.1	*	0.1	0.5	*
Division 27.4.b																								
Denmark	119.3	160.3	162.9	143.9	126.1	152.9	175.9	204.0	79.5	55.5	51.4	115.6	80.8	90.9	65.7	44.7	121.3	234.4	177.6	100.6	156.5	110.3	138.4	66.0
Norway	15.3	13.1	0.9	5.9	*		0.1		0.8	3.7	1.3	4.0	8.0	0.1	6.2	*	8.9	0.3	19.6	9.7	9.3	10.0	9.3	
Sweden	1.7	2.1		1.4				*				0.3	0.6	1.1	1.8	0.1	3.9	5.5	11.7	8.1	7.6	7.5	3.5	5.9
UK (Scot-land)		1.4								0.1		2.5	1.1	1.9	0.7						*	1.3	1.7	*
UK (Engl. & Wales)												*								*	*		0.1	
Germany														3.3	0.5	0.6	1.5	3.1	5.4	6.0	3.7	3.4	10	3.6
Netherlands														1.1	2.7	0.4	2.4	1.2	1.0	1.6	1.6		0.5	
Faroe Is-lands																			4.7	1.0	1.0		1	
Total	136.3	176.9	163.8	151.2	126.1	152.9	176.0	204.1	80.3	59.3	52.7	122.4	90.4	98.4	77.5	45.8	138.0	244.6	220.0	127.0	179.7	132.6	164.7	75.5
Division 27.4.c																								
Denmark	11.8	3.3	28.2	13.1	14.8	22.3	16.8	2.0	23.8	20.6	8.1	8.2	48.5	20.0	3.2	15.4	2.2	34.0	18.7	1.5	6.2	8.9	2.4	2.7
Norway	16.0	5.7	1.8	3.6					9.0	2.9		1.8	3.2	9.9	3.0	1.7	0.1	8.8	0.6		0.5	0.6	0.7	

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Sweden												0.6	0.6	0.2	0.4	1.3		1.2	0.4					1.1
UK (Scotland)											0.2			0.4					*				0.7	0.1
UK (Engl. & Wales)	0.2	1.6	2.0	2.0	1.6	1.3	1.5	1.6	0.5	0.3	*	*	0.8	0.6	0.5	*	*	*	*	*	0.1	0.2	0.1	*
Germany														*	*	1.0		0.6	0.2				0.1	
Netherlands		0.2												4.2	1.0	0.7	*	1.2	0.8	*	0.7		1.6	0.1
Belgium														*		*	*	*	*	*		*	*	*
France																		*		*				
Total	28.0	10.8	32.0	18.7	16.4	23.6	18.3	3.6	33.4	23.8	8.4	10.6	53.0	35.2	8.0	20.1	2.3	45.8	20.6	1.6	7.5	9.6	5.6	4.0
Division 27.3.a																								
Denmark	11.2	17.2	12.8	20.2	13.4	10.2	14.4	31.9	7.8	9.9	5.8	6.9	8.4	8.0	8.4	1.9	16.7	11.7	6.7	1.0	2.9	3.9	9.5	0.6
Sweden	6.2	9.3	6.4	7.6	4.3	5.5	6.5	7.7	4.4	4.2	2.4	1.6	1.4	2.0	1.5	1.1	1.5	1.3	1.1	0.2	1.1	1.7	2.4	0.7
Germany																	*				*			
Faroe Islands																			*					
Total	17.4	26.5	19.2	27.7	17.7	15.7	20.9	39.6	12.2	14.1	8.2	8.5	9.8	10.0	9.9	3.0	18.3	13.0	7.9	1.2	4.0	5.6	11.9	1.3
Total North Sea and Skagerrak-Kattegat																								
Denmark	142.3	181.5	203.9	177.3	155.4	185.4	207.1	237.9	111.2	86.7	65.4	130.7	137.7	119.0	77.4	62.1	140.2	280.1	203.1	103.3	165.6	123.1	150.9	69.3
Norway	31.3	18.8	2.7	9.5	*		0.1		9.8	6.7	1.3	5.8	11.1	10.0	9.1	1.7	9.0	9.1	20.2	9.7	9.8	10.6	10	
Sweden	7.9	11.4	6.4	9.1	4.3	5.5	6.5	7.8	4.4	4.2	2.4	2.5	2.6	3.3	3.7	2.5	5.4	8.1	13.2	8.3	8.7	9.2	5.9	7.6
UK (Scotland)		1.4								0.1	0.2	2.5	1.1	2.8	0.7				*	*	*	1.3	2.5	0.1
UK (Engl. & Wales)	0.2	1.6	2.0	2.0	1.6	1.3	1.5	1.6	0.5	0.3	*	*	0.8	0.6	0.5	*	*	*	*	*	*	0.2	0.2	*
Germany														3.3	0.5	1.6	1.6	3.7	5.6	6.0	3.7	3.4	10.1	3.6
Netherlands		0.2												5.3	3.7	1.1	2.4	2.4	1.8	1.6	2.3		2.1	0.1

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Faroe Islands																			4.7	1.0	1.0		1	
Belgium														*		*	*	*	*	*		*	*	*
France																		*		*				
Total	181.7	214.9	215.1	197.9	161.3	192.2	215.2	247.3	125.9	97.9	69.3	141.6	153.3	144.1	95.5	68.9	158.7	303.3	248.5	129.9	191.2	147.8	182.7	80.8

* < 50 t

Table 10.1.2. North Sea & 3.a sprat. Catches (tonnes) by quarter. Catches in coastal areas of Norway excluded. Data for 1996–1999 in ICES CM 2007/ACFM:11.

Year	Quarter	Division 27.4.a	27.4.b	27.4.c	27.3.a	Total
2000	1		18 126	28 063		46 189
	2		1722	45		1767
	3		131 306	1216		132 522
	4		12 680	2718		15 398
	Total		163 834	32 042		195 876
2001	1	115	40 903	9716		50 734
	2		1071			1071
	3		44 174	481		44 655
	4	79	65 102	8538		73 719
	Total	194	151 249	18 735		170 177
2002	1	1 136	2182	2790		6108
	2		435	93		528
	3		70 504	647		71 151
	4		52 942	12 911		65 853
	Total	1 136	126 063	16 441		143 640
2003	1		11 458	7727	5217	24 402
	2		625	26	1397	2049

Year	Quarter	Division 27.4.a	27.4.b	27.4.c	27.3.a	Total
2012	1		81	1649	4668	6399
	2		2924	0	909	3832
	3		26 779	307	1631	28 717
	4		47 765	6060	2728	56 553
	Total		77 549	8016	9936	95 501
2013	1		1281	3158	1296	5734
	2		32	0	443	474
	3		25 577	720	211	26 509
	4		18 892	16 276	943	36 110
	Total		45 781	20 154	2893	68 827
2014	1		59	125	384	568
	2		11 631	3	1415	13 050
	3	1	88 457	1428	9622	99 507
	4	7	37 851	822	6905	45 586
	Total	8	137 999	2378	18 327	158 711
2015	1	*	14 816	16 972	1442	33 230
	2		16 843	107	619	17 568

Year	Quarter	Division 27.4.a	27.4.b	27.4.c	27.3.a	Total
	3		56 207	165	1720	58 092
	4		84 629	15 651	7349	107 629
	Total		152 919	23 570	15 683	192 172
2004	1		827	1831	4456	7113
	2	7	260	16	1510	1793
	3		54 161	496	4138	58 794
	4		120 685	15 937	10 775	147 397
	Total	7	175 932	18 280	20 879	215 097
2005	1		11 538	2457	8148	22 143
	2		2515	123	4722	7360
	3		107 530		19 418	126 948
	4		82 474	1033	7296	90 803
	Total		204 057	3613	39 584	247 254
2006	1	47	13 713	33 534	8105	55 399
	2		190	8	324	522
	3		40 051	8	1440	41 499
	4	2	26 579	77	2335	28 993
	Total	49	80 533	33 627	12 204	126 413
2007	1		582	247	2646	3475
	2		241	3	1291	1535
	3		16 603		5357	21 960
	4	769	41 850	23 531	4761	70 911
	Total	769	59 276	23 781	14 055	97 881
2008	1		2872	43	2890	5805
	2		52	*	1017	1069
	3		21 787		636	22 423

Year	Quarter	Division 27.4.a	27.4.b	27.4.c	27.3.a	Total
	3		124 512	335	6528	131 375
	4	25	88 395	28 375	4389	121 184
	Total	25	244 566	45 789	12 978	303 358
2016	1	68	18 487	5969	746	25 250
	2		8927	51	669	9 647
	3	*	158 522	111	4664	163 297
	4	2	34 070	14 466	1764	50 301
	Total	70	220 007	20 596	7843	248 516
2017	1	1	3432	1220	92	4 745
	2		1327	0	33	1 360
	3	*	92 885	217	227	93 329
	4	94	29 310	174	849	30 426
	Total	95	126 954	1611	1200	129 860
2018	1	*	8994	1628	168	10 790
	2		11 898	0	224	12 122
	3		112 361	1	1328	113 690
	4		46 411	5922	2249	54 582
	Total	*	179 664	7551	3969	191 184
2019	1		389	9 592	627	10 609
	2	2	3 606	11	379	3 999
	3	2	95 829	7	2 249	98 087
	4	49	32 750	3	2 296	35 098
	Total	53	132 574	9 614	5 551	147 793
2020	1	3	298	1 076	378	1 746
	2		19 430	*	173	19 603
	3	2	120 890	*	4 268	125 160

Year	Quarter	Division 27.4.a	27.4.b	27.4.c	27.3.a	Total
	4		27 994	8334	3672	40 001
	Total		52 706	8377	8215	69 298
2009	1		36	1268	2600	3904
	2		2526	1	300	2827
	3	22	41 513		3300	44 835
	4		78 373	9336	2400	90 109
	Total	22	122 448	10 604	8600	141 675
2010	1		10 976	17 072	1462	29 510
	2		3235	3	648	3886
	3		14 220		3405	17 625
	4		62 006	35 973	4278	102 257
	Total		90 437	53 048	9793	153 278
2011	1		3747	21 039	3216	28 002
	2		2067	3	617	2687
	3		22 309	451	2311	25 072
	4	8	70 256	13 759	3887	87 910
	Total	8	98 380	35 252	10 031	143 671

Year	Quarter	Division 27.4.a	27.4.b	27.4.c	27.3.a	Total
	4	520	24 049	4 489	7 087	36 145
	Total	526	164 667	5 566	11 896	182 654
2021	1	0	137	236	445	818
	2	*	326	1	11	338
	3	1	63 401	902	57	64 361
	4	1	11 601	2 850	791	15 244
	Total	2	75 464	3 989	1 305	80 761
2022	1**		81		330	412

* < 0.5 t

** Until the 1st of March

Table 10.2.1. North Sea & 3.a sprat. Species composition in Danish sprat fishery in tonnes and percentage of the total catch. Left: North Sea, right: Division 3.a.

	Year	Sprat	Herring	Horse mack	Whiting	Haddock	Mackerel	Cod	Sandeel	Other	Total
t	1998	129 315	11 817	573	673	6	220	11	2 174	1 187	145 978
t	1999	157 003	7 256	413	1 088	62	321	7	4 972	635	171 757
t	2000	188 463	11 662	3 239	2 107	66	766	4	423	1 911	208 641
t	2001	136 443	13 953	67	1 700	223	312	4	17 020	1 141	170 862
t	2002	140 568	16 644	2 078	2 537	27	715	0	4 102	801	167 471
t	2003	172 456	10 244	718	1 106	15	799	11	5 357	3 504	194 210
t	2004	179 944	10 144	474	334	0	4 351	3	3 836	1 821	200 906
t	2005	201 331	21 035	2 477	545	4	1 009	16	6 859	974	234 251
t	2006	103 236	8 983	577	343	25	905	4	5 384	576	120 033
t	2007	74 734	6 596	168	900	6	126	18	6	253	82 807
t	2008	61 093	7 928	26	380	10	367	0	23	1 735	71 563
t	2009	112 721	7 222	44	307	3	116	1	1 526	407	122 345
t	2010	112 395	4 410	11	119	2	18	0	1 236	577	118 769
t	2011	109 376	8 073	35	191	0	127	0	1 881	345	120 026
t	2012	67 263	8 573	2	354	0	246	0	93	411	76 943
t	2013	55 792	5 176	47	445	0	277	2	1	369	62 109
t	2014	123 180	11 402	0	897	0	70	16	16	1 700	137 280
t	2015	265 356	4 568	5	1 809	0	527	0	147	3 311	275 723
t	2016	192 718	11 107	18	4 223	0	439	0	46	2 093	210 643
t	2017	100 833	5 130	1	1 344	0	197	0	503	12 386	120 394
t	2018	161 536	7 528	174	716	0	366	0	24	344	170 687
t	2019	118 302	2 757	1	897	1	176	0	3	503	122 639
t	2020	140 954	6 227	19	898	93	1 188	0	11	724	150 114
t	2021	68 492	5 518	39	1 064	345	747	0	3	602	76 809
%	1998	88.6	8.1	0.4	0.5	0	0.2	0	1.5	0.8	100
%	1999	91.4	4.2	0.2	0.6	0	0.2	0	2.9	0.4	100
%	2000	90.3	5.6	1.6	1	0	0.4	0	0.2	0.9	100
%	2001	79.9	8.2	0	1	0.1	0.2	0	10	0.7	100

	Year	Sprat	Herring	Horse mack	Whiting	Haddock	Mackerel	Cod	Sandeel	Other	Total
t	1998	9 143	3 385	230	467	54	0	49	7	2 866	16 202
t	1999	16 603	8 470	138	1 026	210	5	75	3 337	2 896	32 760
t	2000	12 578	8 034	5	1 062	308	8	52	13	3 556	25 617
t	2001	18 236	8 196	75	1 266	50	13	35	4 281	1 271	33 423
t	2002	11 451	12 982	21	1 164	3	6	30	606	2 280	28 541
t	2003	8 182	4 928	340	252	4	4	4	1	567 14	14 282
t	2004	13 374	4 620	97	976	18	24	27	116	2 155	21 408
t	2005	30 157	6 171	244	871	63	18	20	746	1 758	40 047
t	2006	6 814	2 852	215	276	13	3	45	1	232 10	10 451
t	2007	7 116	2 043	34	190	31	8	4	1	469 9	9 896
t	2008	4 805	1 948	14	285	0	0	11	462	39 7	7 563
t	2009	4 839	3 016	37	169	15	0	1	53	47 8	8 177
t	2010	2 851	2 134	25	142	6	1	2	135	171 5	5 466
t	2011	4 754	2 461	0	43	0	7	1	141	40 7	7 447
t	2012	5 707	5 495	9	149	7	10	5	0	228 11	11 610
t	2013	1 143	1 751	2	46	0	0	1	1	27 2	2 971
t	2014	16 751	3 777	5	343	1	20	5	12	888 21	21 801
t	2015	11 448	5 831	0	565	0	29	8	1	154 18	18 036
t	2016	7 001	2 140	0	335	1	19	3	0	78 9	9 579
t	2017	963	328	0	172	0	19	1	0	32 1	1 515
t	2018	2 872	257	2	150	1	11	0	0	12 3	3 304
t	2019	3 429	351	0	59	0	2	0	0	8 3	3 850
t	2020	9 494	551	4	249	5	41	1	0	27 10	10 372
t	2021	638	82	0	13	1	1	0	0	32	767
%	1998	56.4	20.9	1.4	2.9	0.3	0	0.3	0	17.7	100
%	1999	50.7	25.9	0.4	3.1	0.6	0	0.2	10.2	8.8	100
%	2000	49.1	31.4	0	4.1	1.2	0	0.2	0.1	13.9	100
%	2001	54.6	24.5	0.2	3.8	0.2	0	0.1	12.8	3.8	100

	Year	Sprat	Herring	Horse mack	Whiting	Haddock	Mackerel	Cod	Sandeel	Other	Total
%	2002	83.9	9.9	1.2	1.5	0	0.4	0	2.4	0.5	100
%	2003	88.8	5.3	0.4	0.6	0	0.4	0	2.8	1.8	100
%	2004	89.6	5	0.2	0.2	0	2.2	0	1.9	0.9	100
%	2005	85.9	9	1.1	0.2	0	0.4	0	2.9	0.4	100
%	2006	86	7.5	0.5	0.3	0	0.8	0	4.5	0.5	100
%	2007	90.3	8	0.2	1.1	0	0.2	0	0	0.3	100
%	2008	85.4	11.1	0	0.5	0	0.5	0	0	2.4	100
%	2009	92.1	5.9	0	0.3	0	0.1	0	1.2	0.3	100
%	2010	94.6	3.7	0	0.1	0	0	0	1	0.5	100
%	2011	91.1	6.7	0	0.2	0	0.1	0	1.6	0.3	100
%	2012	87.4	11.1	0	0.5	0	0.3	0	0.1	0.5	100
%	2013	89.8	8.3	0.1	0.7	0	0.4	0	0	0.6	100
%	2014	89.7	8.3	0	0.7	0	0.1	0	0	1.2	100
%	2015	96.2	1.7	0	0.7	0	0.2	0	0.1	1.2	100
%	2016	91.5	5.3	0	2	0	0.2	0	0	1	100
%	2017	83.8	4.3	0	1.1	0	0.2	0	0.4	10.3	100
%	2018	94.6	4.4	0.1	0.4	0	0.2	0	0	0.2	100
%	2019	96.5	2.2	0	0.7	0	0.1	0	0	0.4	100
%	2020	93.9	4.1	0	0.6	0.1	0.8	0	0	0.5	100
%	2021	89.2	7.2	0.1	1.4	0.4	1.0	0.0	0.0	0.8	100.0

	Year	Sprat	Herring	Horse mack	Whiting	Haddock	Mackerel	Cod	Sandeel	Other	Total
%	2002	40.1	45.5	0.1	4.1	0	0	0.1	2.1	8	100
%	2003	57.3	34.5	2.4	1.8	0	0	0	0	4	100
%	2004	62.5	21.6	0.5	4.6	0.1	0.1	0.1	0.5	10.1	100
%	2005	75.3	15.4	0.6	2.2	0.2	0	0	1.9	4.4	100
%	2006	65.2	27.3	2.1	2.6	0.1	0	0.4	0	2.2	100
%	2007	71.9	20.6	0.3	1.9	0.3	0.1	0	0	4.7	100
%	2008	63.5	25.8	0.2	3.8	0	0	0.1	6.1	0.5	100
%	2009	59.2	36.9	0.5	2.1	0.2	0	0	0.6	0.6	100
%	2010	52.2	39	0.5	2.6	0.1	0	0	2.5	3.1	100
%	2011	63.8	33	0	0.6	0	0.1	0	1.9	0.5	100
%	2012	49.2	47.3	0.1	1.3	0.1	0.1	0	0	2	100
%	2013	38.5	58.9	0.1	1.6	0	0	0	0	0.9	100
%	2014	76.8	17.3	0	1.6	0	0.1	0	0.1	4.1	100
%	2015	63.5	32.3	0	3.1	0	0.2	0	0	0.9	100
%	2016	73.1	22.3	0	3.5	0	0.2	0	0	0.8	100
%	2017	63.6	21.6	0	11.4	0	1.2	0.1	0	2.1	100
%	2018	86.9	7.8	0.1	4.5	0	0.3	0	0	0.4	100
%	2019	89.1	9.1	0	1.5	0	0.1	0	0	0.2	100
%	2020	91.5	5.3	0	2.4	0	0.4	0	0	0.3	100
%	2021	83.1	10.7	0.0	1.6	0.2	0.1	0.0	0.0	4.2	100.0

Table 10.2.2. North Sea & 3.a sprat. Catch in numbers by age (1000's) by season and year. (Model year, e.g., 2021 = July 2021–June 2022)

Catch-at-age used as input for the assessment model (years refer to the model years)					
Note that all catches in S4 have been moved to S1 in the following year					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
1974	1	0	16101061	2155723	475613
1974	2	1884146	11544114	866399	48228
1974	3	2842702	11091303	1336036	34534
1974	4	1302331	2511315	359117	14822
1975	1	250931	27723510	10052550	260182
1975	2	1179567	14541887	4378415	166807
1975	3	5240024	4755878	2206781	66186
1975	4	0	0	0	0
1976	1	2143211	42209830	2888653	180913
1976	2	7439656	18762732	1613139	88604
1976	3	7703416	6925346	267638	8289
1976	4	0	0	0	0
1977	1	2690194	12786056	5181867	109712
1977	2	2520082	4904593	3679153	67688
1977	3	15857197	1843468	2200876	37836
1977	4	0	0	0	0
1978	1	454090	32184524	427473	96435
1978	2	5517665	10344970	1209584	116695
1978	3	6154606	4973568	1119045	29941
1978	4	0	0	0	0
1979	1	3579389	36866800	644042	117139
1979	2	1052920	11355949	2152261	63386
1979	3	3882781	6399259	332781	25964
1979	4	0	0	0	0
1980	1	0	14237558	17421360	1481066
1980	2	0	9415158	11520576	979415
1980	3	2536060	3866612	389674	8724
1980	4	0	0	0	0
1981	1	428776	12322431	1483241	130805
1981	2	40632	3540737	3025289	202048
1981	3	374254	3854059	319763	9835
1981	4	0	0	0	0
1982	1	545769	6350511	601581	64879
1982	2	818525	5021082	1070960	55333
1982	3	2530673	401839	46913	3525
1982	4	0	0	0	0

Catch-at-age used as input for the assessment model (years refer to the model years)					
Note that all catches in S4 have been moved to S1 in the following year					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
1983	1	5613728	2819244	969599	155653
1983	2	2375763	1334333	588678	91112
1983	3	1697718	596857	7271	0
1983	4	0	0	0	0
1984	1	954757	6475021	417235	2532
1984	2	521866	2535354	247654	4803
1984	3	405095	612407	10648	1053
1984	4	0	0	0	0
1985	1	0	1304457	1972027	37680
1985	2	0	576004	870780	16638
1985	3	84760	215856	150819	14916
1985	4	0	0	0	0
1986	1	0	177780	452745	347620
1986	2	0	156913	399604	306818
1986	3	580936	58710	740	0
1986	4	0	0	0	0
1987	1	2236	2250587	128512	2525
1987	2	49451	1790264	267597	978
1987	3	209788	826994	34626	32980
1987	4	0	0	0	0
1988	1	4082942	2096911	2830054	42364
1988	2	1163964	314106	527986	11526
1988	3	1817700	637489	129384	5491
1988	4	0	0	0	0
1989	1	12451	1706824	3613841	5716
1989	2	783	76415	88925	342
1989	3	469458	416920	34789	12751
1989	4	0	0	0	0
1990	1	1568	2633068	2234213	342514
1990	2	1225	2058041	1746290	267714
1990	3	291837	62050	1941	429
1990	4	0	0	0	0
1991	1	40504	1684266	2416750	8159
1991	2	1552315	2936717	614233	9587
1991	3	208352	64565	1036	99
1991	4	0	0	0	0
1992	1	18948	9695465	1315325	177584
1992	2	222991	1185132	132166	16491

Catch-at-age used as input for the assessment model (years refer to the model years)					
Note that all catches in S4 have been moved to S1 in the following year					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
1992	3	1279875	1583952	259251	5821
1992	4	0	0	0	0
1993	1	264173	3026867	5339043	247839
1993	2	1441317	4911453	1324444	31435
1993	3	1867838	1819506	338969	43965
1993	4	0	0	0	0
1994	1	445326	40720484	516854	100737
1994	2	1856101	7146622	1455656	142774
1994	3	818875	2936362	559871	22813
1994	4	0	0	0	0
1995	1	170693	24466578	3192395	371759
1995	2	612010	8620522	2863267	505875
1995	3	1797666	4488224	533786	128194
1995	4	0	0	0	0
1996	1	299367	233497	816511	286503
1996	2	1083655	776795	2208631	911256
1996	3	1670742	289815	113580	49534
1996	4	0	0	0	0
1997	1	6447	2286585	130593	202822
1997	2	148657	4395265	1078225	277615
1997	3	596223	728240	181187	46667
1997	4	0	0	0	0
1998	1	86124	3567341	1498339	258993
1998	2	5465889	2665032	1451844	326463
1998	3	1615982	1096547	489541	241493
1998	4	0	0	0	0
1999	1	830	15939248	477815	69219
1999	2	90557	2456063	254931	44836
1999	3	1967130	3351942	641059	183015
1999	4	0	0	0	0
2000	1	6101	9822669	1767256	70160
2000	2	81906	801375	384854	49827
2000	3	1093613	2807143	1310052	176418
2000	4	0	0	0	0
2001	1	13056	5767627	315550	7694
2001	2	550512	3967343	1528712	498496
2001	3	143017	531588	59709	13418
2001	4	0	0	0	0

Catch-at-age used as input for the assessment model (years refer to the model years)					
Note that all catches in S4 have been moved to S1 in the following year					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
2002	1	63416	6586442	594557	108679
2002	2	927294	4326530	661656	59022
2002	3	1182692	1199165	296900	65718
2002	4	0	0	0	0
2003	1	197639	4003316	594498	68144
2003	2	2785630	6826281	1115905	218400
2003	3	713229	39824	29774	26427
2003	4	0	0	0	0
2004	1	229309	4217281	731500	78913
2004	2	24806798	4735686	264373	53425
2004	3	5233945	309955	44145	15707
2004	4	0	0	0	0
2005	1	97602	13409729	479222	88858
2005	2	839944	7903545	228337	22051
2005	3	1089274	5408581	230703	38557
2005	4	0	0	0	0
2006	1	0	1987696	1401797	295158
2006	2	319709	493221	1003837	235542
2006	3	176742	129541	176585	10933
2006	4	0	0	0	0
2007	1	0	1693273	189551	67672
2007	2	609939	4186796	1681648	254768
2007	3	404452	329724	19675	20964
2007	4	0	0	0	0
2008	1	11590	422430	1447939	329770
2008	2	2087187	1901763	1006626	260966
2008	3	893785	131774	41692	21858
2008	4	0	0	0	0
2009	1	0	4776947	219922	39037
2009	2	231412	8163927	554425	137328
2009	3	168362	3385107	519516	88967
2009	4	0	0	0	0
2010	1	12414	1732171	689166	90040
2010	2	349703	3105417	3011291	2157387
2010	3	298472	2412405	683264	90603
2010	4	0	0	0	0
2011	1	2469	1847215	1105017	281708
2011	2	420004	4234059	2917969	999295

Catch-at-age used as input for the assessment model (years refer to the model years)					
Note that all catches in S4 have been moved to S1 in the following year					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
2011	3	57320	250247	95834	42266
2011	4	0	0	0	0
2012	1	147896	2527701	729427	121665
2012	2	187098	3756225	1690250	281071
2012	3	78240	463743	86910	30157
2012	4	0	0	0	0
2013	1	10002	1973364	411558	72705
2013	2	462029	2176971	745578	144434
2013	3	193678	1554	2447	4794
2013	4	0	0	0	0
2014	1	2640874	9499013	627237	105519
2014	2	1215080	4046244	323320	92685
2014	3	1755944	2496884	177328	21685
2014	4	0	0	0	0
2015	1	1682642	12947813	2926867	161595
2015	2	615375	10862082	1632428	226924
2015	3	374504	1926029	733105	90223
2015	4	0	0	0	0
2016	1	4450616	12775033	4537366	439570
2016	2	3593237	1451842	1251213	301252
2016	3	533954	47715	7358	2718
2016	4	0	0	0	0
2017	1	1767809	9076648	738627	88295
2017	2	1302514	2796713	182538	82806
2017	3	658881	807010	184005	68052
2017	4	0	0	0	0
2018	1	4548741	11562002	2878462	310552
2018	2	2090509	2888456	1516387	534059
2018	3	157673	1090798	254223	15776
2018	4	0	0	0	0
2019	1	2420231	9775216	3342785	163696
2019	2	799272	2399200	1041391	139590
2019	3	211007	34475	3918	413
2019	4	0	0	0	0
2020	1	207574	10153348	3429492	429318
2020	2	69142	2695178	385767	137741
2020	3	28346	78759	8459	1779
2020	4	0	0	0	0

Catch-at-age used as input for the assessment model (years refer to the model years)					
Note that all catches in S4 have been moved to S1 in the following year					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
2021	1	539434	5840604	1505982	255540
2021	2	254055	814057	395606	139605
2021	3	0	0	0	0
2021	4	0	0	0	0

Table 10.2.3. North Sea & 3.a sprat. Mean weight at age (kg) in catches by season and year. (Model year, e.g., 2021 = July 2021–June 2022)

Weight-at-age used as input for the assessment model (years refer to the model years)					
Note that weights in S4 are not used since there are no catches in S4					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
1974	1	0.0063	0.0083	0.0135	0.0184
1974	2	0.0058	0.0089	0.0150	0.0197
1974	3	0.0050	0.0077	0.0150	0.0197
1974	4	0.0066	0.0107	0.0183	0.0163
1975	1	0.0048	0.0086	0.0129	0.0172
1975	2	0.0075	0.0111	0.0168	0.0216
1975	3	0.0048	0.0106	0.0154	0.0192
1975	4	0.0062	0.0116	0.0170	0.0171
1976	1	0.0049	0.0070	0.0113	0.0134
1976	2	0.0043	0.0090	0.0153	0.0190
1976	3	0.0022	0.0059	0.0104	0.0126
1976	4	0.0034	0.0057	0.0085	0.0106
1977	1	0.0054	0.0082	0.0126	0.0180
1977	2	0.0059	0.0110	0.0146	0.0196
1977	3	0.0023	0.0080	0.0106	0.0138
1977	4	0.0025	0.0063	0.0083	0.0122
1978	1	0.0038	0.0069	0.0122	0.0146
1978	2	0.0044	0.0103	0.0155	0.0196
1978	3	0.0031	0.0089	0.0123	0.0166
1978	4	0.0020	0.0052	0.0087	0.0094
1979	1	0.0050	0.0058	0.0087	0.0113
1979	2	0.0057	0.0105	0.0150	0.0173
1979	3	0.0032	0.0077	0.0129	0.0165
1979	4	0.0029	0.0106	0.0121	0.0153
1980	1	0.0063	0.0052	0.0068	0.0083
1980	2	0.0051	0.0052	0.0069	0.0083
1980	3	0.0032	0.0086	0.0131	0.0168
1980	4	0.0046	0.0073	0.0105	0.0101
1981	1	0.0038	0.0099	0.0129	0.0156

Weight-at-age used as input for the assessment model (years refer to the model years)					
Note that weights in S4 are not used since there are no catches in S4					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
1981	2	0.0082	0.0126	0.0153	0.0194
1981	3	0.0049	0.0089	0.0157	0.0194
1981	4	0.0060	0.0139	0.0191	0.0192
1982	1	0.0085	0.0089	0.0171	0.0155
1982	2	0.0071	0.0110	0.0160	0.0219
1982	3	0.0029	0.0075	0.0115	0.0174
1982	4	0.0044	0.0078	0.0114	0.0160
1983	1	0.0044	0.0092	0.0128	0.0152
1983	2	0.0042	0.0124	0.0169	0.0211
1983	3	0.0034	0.0094	0.0174	0.0163
1983	4	0.0038	0.0093	0.0127	0.0156
1984	1	0.0060	0.0081	0.0121	0.0166
1984	2	0.0053	0.0122	0.0168	0.0164
1984	3	0.0093	0.0135	0.0197	0.0197
1984	4	0.0093	0.0135	0.0197	0.0197
1985	1	0.0063	0.0093	0.0135	0.0197
1985	2	0.0051	0.0093	0.0135	0.0197
1985	3	0.0073	0.0099	0.0166	0.0166
1985	4	0.0073	0.0099	0.0166	0.0166
1986	1	0.0063	0.0073	0.0099	0.0166
1986	2	0.0051	0.0073	0.0099	0.0166
1986	3	0.0083	0.0164	0.0228	0.0163
1986	4	0.0084	0.0156	0.0208	0.0156
1987	1	0.0066	0.0086	0.0117	0.0153
1987	2	0.0060	0.0093	0.0112	0.0165
1987	3	0.0064	0.0125	0.0175	0.0206
1987	4	0.0068	0.0125	0.0167	0.0189
1988	1	0.0042	0.0088	0.0115	0.0138
1988	2	0.0046	0.0085	0.0113	0.0137
1988	3	0.0052	0.0132	0.0208	0.0158
1988	4	0.0063	0.0117	0.0155	0.0175
1989	1	0.0054	0.0086	0.0099	0.0170
1989	2	0.0044	0.0082	0.0109	0.0130
1989	3	0.0048	0.0077	0.0125	0.0155
1989	4	0.0046	0.0086	0.0115	0.0129
1990	1	0.0046	0.0070	0.0092	0.0115
1990	2	0.0038	0.0069	0.0092	0.0113
1990	3	0.0044	0.0099	0.0133	0.0156

Weight-at-age used as input for the assessment model (years refer to the model years)					
Note that weights in S4 are not used since there are no catches in S4					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
1990	4	0.0048	0.0089	0.0119	0.0135
1991	1	0.0128	0.0143	0.0154	0.0168
1991	2	0.0048	0.0146	0.0189	0.0168
1991	3	0.0052	0.0101	0.0147	0.0172
1991	4	0.0062	0.0118	0.0152	0.0186
1992	1	0.0081	0.0099	0.0124	0.0148
1992	2	0.0058	0.0121	0.0153	0.0178
1992	3	0.0035	0.0096	0.0141	0.0179
1992	4	0.0042	0.0078	0.0104	0.0118
1993	1	0.0065	0.0109	0.0123	0.0138
1993	2	0.0075	0.0107	0.0135	0.0164
1993	3	0.0022	0.0080	0.0116	0.0152
1993	4	0.0023	0.0128	0.0154	0.0134
1994	1	0.0068	0.0067	0.0095	0.0129
1994	2	0.0087	0.0104	0.0125	0.0151
1994	3	0.0030	0.0082	0.0097	0.0140
1994	4	0.0038	0.0068	0.0090	0.0131
1995	1	0.0032	0.0082	0.0117	0.0121
1995	2	0.0051	0.0101	0.0133	0.0155
1995	3	0.0084	0.0096	0.0129	0.0158
1995	4	0.0058	0.0107	0.0142	0.0161
1996	1	0.0071	0.0108	0.0142	0.0175
1996	2	0.0079	0.0115	0.0150	0.0169
1996	3	0.0029	0.0062	0.0087	0.0103
1996	4	0.0031	0.0057	0.0077	0.0086
1997	1	0.0071	0.0128	0.0148	0.0163
1997	2	0.0058	0.0120	0.0161	0.0199
1997	3	0.0071	0.0097	0.0122	0.0147
1997	4	0.0052	0.0095	0.0127	0.0144
1998	1	0.0056	0.0139	0.0166	0.0186
1998	2	0.0050	0.0124	0.0153	0.0177
1998	3	0.0043	0.0061	0.0095	0.0094
1998	4	0.0039	0.0073	0.0097	0.0110
1999	1	0.0053	0.0097	0.0115	0.0121
1999	2	0.0046	0.0116	0.0135	0.0164
1999	3	0.0036	0.0094	0.0118	0.0138
1999	4	0.0052	0.0097	0.0129	0.0146
2000	1	0.0067	0.0122	0.0148	0.0185

Weight-at-age used as input for the assessment model (years refer to the model years)					
Note that weights in S4 are not used since there are no catches in S4					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
2000	2	0.0062	0.0149	0.0174	0.0183
2000	3	0.0051	0.0105	0.0131	0.0150
2000	4	0.0036	0.0046	0.0080	0.0135
2001	1	0.0078	0.0109	0.0118	0.0159
2001	2	0.0048	0.0116	0.0136	0.0166
2001	3	0.0062	0.0127	0.0150	0.0162
2001	4	0.0065	0.0120	0.0161	0.0181
2002	1	0.0073	0.0109	0.0141	0.0154
2002	2	0.0077	0.0122	0.0142	0.0158
2002	3	0.0047	0.0101	0.0133	0.0145
2002	4	0.0060	0.0116	0.0129	0.0155
2003	1	0.0042	0.0125	0.0146	0.0228
2003	2	0.0058	0.0108	0.0145	0.0167
2003	3	0.0049	0.0115	0.0135	0.0141
2003	4	0.0050	0.0092	0.0123	0.0139
2004	1	0.0088	0.0116	0.0139	0.0154
2004	2	0.0041	0.0094	0.0126	0.0153
2004	3	0.0030	0.0097	0.0112	0.0130
2004	4	0.0044	0.0093	0.0115	0.0129
2005	1	0.0076	0.0097	0.0130	0.0154
2005	2	0.0066	0.0103	0.0115	0.0141
2005	3	0.0055	0.0080	0.0114	0.0138
2005	4	0.0047	0.0087	0.0115	0.0130
2006	1	0.0063	0.0108	0.0133	0.0152
2006	2	0.0055	0.0143	0.0158	0.0180
2006	3	0.0041	0.0095	0.0129	0.0134
2006	4	0.0050	0.0093	0.0124	0.0139
2007	1	0.0063	0.0119	0.0131	0.0149
2007	2	0.0065	0.0101	0.0127	0.0151
2007	3	0.0045	0.0075	0.0106	0.0126
2007	4	0.0048	0.0089	0.0118	0.0133
2008	1	0.0088	0.0103	0.0114	0.0131
2008	2	0.0044	0.0076	0.0126	0.0142
2008	3	0.0034	0.0076	0.0082	0.0085
2008	4	0.0044	0.0068	0.0090	0.0081
2009	1	0.0063	0.0096	0.0123	0.0142
2009	2	0.0046	0.0095	0.0130	0.0160
2009	3	0.0043	0.0077	0.0103	0.0135

Weight-at-age used as input for the assessment model (years refer to the model years)					
Note that weights in S4 are not used since there are no catches in S4					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
2009	4	0.0087	0.0096	0.0105	0.0141
2010	1	0.0066	0.0080	0.0097	0.0137
2010	2	0.0047	0.0094	0.0114	0.0148
2010	3	0.0050	0.0072	0.0094	0.0130
2010	4	0.0038	0.0071	0.0095	0.0107
2011	1	0.0052	0.0085	0.0101	0.0134
2011	2	0.0044	0.0089	0.0114	0.0145
2011	3	0.0042	0.0102	0.0128	0.0171
2011	4	0.0050	0.0092	0.0123	0.0139
2012	1	0.0085	0.0087	0.0106	0.0150
2012	2	0.0072	0.0087	0.0119	0.0152
2012	3	0.0040	0.0069	0.0113	0.0146
2012	4	0.0047	0.0087	0.0117	0.0132
2013	1	0.0061	0.0096	0.0120	0.0150
2013	2	0.0043	0.0097	0.0124	0.0156
2013	3	0.0026	0.0051	0.0071	0.0084
2013	4	0.0022	0.0094	0.0128	0.0153
2014	1	0.0086	0.0086	0.0104	0.0168
2014	2	0.0070	0.0079	0.0116	0.0139
2014	3	0.0053	0.0083	0.0116	0.0119
2014	4	0.0065	0.0099	0.0101	0.0115
2015	1	0.0076	0.0082	0.0104	0.0150
2015	2	0.0072	0.0088	0.0109	0.0155
2015	3	0.0038	0.0078	0.0107	0.0153
2015	4	0.0044	0.0082	0.0109	0.0123
2016	1	0.0041	0.0077	0.0112	0.0145
2016	2	0.0051	0.0074	0.0118	0.0145
2016	3	0.0073	0.0143	0.0199	0.0235
2016	4	0.0076	0.0141	0.0188	0.0212
2017	1	0.0064	0.0083	0.0103	0.0139
2017	2	0.0038	0.0078	0.0099	0.0162
2017	3	0.0042	0.0064	0.0098	0.0130
2017	4	0.0076	0.0141	0.0188	0.0212
2018	1	0.0046	0.00664	0.0086	0.0126
2018	2	0.0053	0.0074	0.0097	0.0134
2018	3	0.0041	0.0067	0.0095	0.0136
2018	4	0.0057	0.0065	0.00762	0.0129
2019	1	0.0034	0.0063	0.0088	0.0116

Weight-at-age used as input for the assessment model (years refer to the model years)					
Note that weights in S4 are not used since there are no catches in S4					
Year	**Season**	**age 0**	**age 1**	**age 2**	**age 3**
2019	2	0.0041	0.0076	0.0098	0.0141
2019	3	0.0058	0.0010	0.0130	0.0165
2019	4	0.0064	0.0078	0.0105	0.0157
2020	1	0.0049	0.0093	0.0122	0.0162
2020	2	0.0071	0.0108	0.0144	0.0172
2020	3	0.0057	0.0100	0.0143	0.0165
2020	4	0.0065	0.0103	0.0134	0.0161
2021	1	0.0061	0.0071	0.0110	0.0131
2021	2	0.0061	0.0087	0.0117	0.0158
2021	3	0.0101	0.0132	0.0170	0.0197
2021	4	0.0064	0.0102	0.0133	0.0160

Table 10.2.4. North Sea and Division 3.a sprat. Sampling for biological parameters in 2021. This table only shows age-length samples, and therefore the number of samples may differ from Table 10.2.5.

Country	Quarter	Landings ('000 tonnes)	No. samples	No. measured	No. aged
Denmark	1	0.4	2	202	99
	2	0.2	0	0	0
	3	59.1	84	9086	3979
	4	9.6	14	1350	594
	Total	69.3	100	10638	4672
Norway	1	0.0	0	0	0
	2	0.0	0	0	0
	3	0.0	0	0	0
	4	0.0	0	0	0
	Total	0.0	0	0	0
Sweden	1	0.4	9	237	236
	2	0.0	0	0	0
	3	3.6	0	0	0
	4	3.6	8	489	489
	Total	7.6	17	726	725
All countries	1	0.8	11	439	335
	2	0.2	0	0	0
	3	62.7	84	9086	3979
	4	13.2	22	1839	1083
Total		76.9	117	11364	5397

Table 10.2.5. North Sea and Division 3.a sprat. Number of biological samples taken from 1974 and onward. The number of samples may differ from Table 10.2.4, since this table shows both length and age-length samples. These are the samples used to generate the catch-at-age matrix for the assessment model (Model year, e.g., 2021 = July 2021–June 2022).

Year	S1	S2	S3	S4
1974	15	31	102	25
1975	67	46	40	11
1976	54	70	53	16
1977	37	51	32	18
1978	52	78	47	22
1979	86	55	90	9
1980	0	0	49	28
1981	61	32	29	14
1982	27	48	13	16
1983	11	44	27	8
1984	9	23	29	7
1985	4	4	0	4
1986	4	1	0	1
1987	16	15	4	3
1988	8	4	9	1
1989	13	0	7	2
1990	4	0	13	1
1991	6	56	15	8
1992	42	35	24	4
1993	21	30	24	7
1994	42	50	32	5
1995	40	47	41	4
1996	2	12	8	3
1997	9	34	12	1
1998	25	38	16	3
1999	41	25	25	1
2000	29	23	22	14
2001	23	9	17	4
2002	26	37	28	7
2003	12	60	17	2
2004	26	43	24	15
2005	77	56	56	2
2006	23	7	13	0
2007	34	40	13	4
2008	10	9	14	5
2009	33	36	18	5
2010	35	28	15	3
2011	28	57	20	3

Year	S1	S2	S3	S4
2012	37	88	15	3
2013	31	23	2	10
2014	116	19	19	13
2015	165	47	21	2
2016	90	30	3	0
2017	69	21	11	6
2018	65	60	20	5
2019	65	45	2	12
2020	27	30	6	0
2021	85	22	0	NA

Table 10.3.1. North Sea sprat. Abundance indices by age from IBTS Q1

IBTS Q1 survey index (area 4 and 3a combined; years apply to the calendar year and ages the model year)				
Index is calculated using a delta GAM model formulation (see Stock Annex)				
Year	**Age 0**	**Age 1**	**Age 2**	**Age 3**
1983	252619	551262	574173	47111
1984	619180	553686	100186	25687
1985	374594	292408	75083	19254
1986	116338	137304	39250	9993
1987	503284	86061	25143	9769
1988	248663	789924	77117	15148
1989	744970	154929	114877	11326
1990	360108	185946	47580	21180
1991	1412224	176334	33438	7582
1992	1882139	281520	36961	9645
1993	1863182	1224852	103248	10709
1994	1195289	887347	132008	8288
1995	2258852	2257140	263386	10391
1996	604673	967027	199658	28253
1997	599335	270098	168138	27513
1998	1072937	1104108	180777	16056
1999	5183400	583736	73757	5308
2000	2017439	1164352	150449	25036
2001	1997862	1309083	239142	13995
2002	1191954	968965	87712	10393
2003	2493114	589410	66441	5540
2004	4084377	685280	106637	9076
2005	8918279	675529	29062	2718
2006	1230441	1416990	58676	7654
2007	1917763	1035569	162880	12506

IBTS Q1 survey index (area 4 and 3a combined; years apply to the calendar year and ages the model year)				
Index is calculated using a delta GAM model formulation (see Stock Annex)				
Year	**Age 0**	**Age 1**	**Age 2**	**Age 3**
2008	1526985	803061	47400	8526
2009	4133598	312030	34043	3833
2010	3288300	2489705	118665	17586
2011	1078333	926246	206207	47562
2012	3356603	3143308	245116	36666
2013	1137772	1116849	203191	29306
2014	3886605	443621	50655	9871
2015	7727188	3460669	317090	26651
2016	2112309	3409890	675849	37763
2017	10317128	1707447	128002	15146
2018	10440866	1547476	94598	11384
2019	6097175	2511994	226057	9585
2020	7316245	2219294	421523	40023
2021	3308192	1977916	196830	16693
2022	1810546	769303	57700	6537

Table 10.3.1. North Sea sprat. Abundance indices by age from IBTS Q3

IBTS Q3 survey index (area 4 and 3a combined; years and ages apply to both the model year and calendar year)			
Index is calculated using a delta GAM model formulation (see Stock Annex)			
Year	**Age 1**	**Age 2**	**Age 3**
1992	14555861	2633020	104865
1993	5767651	3015219	217792
1994	16468664	1326478	95089
1995	30622687	7433288	454582
1996	2317117	2219591	215543
1997	13080865	1171944	200385
1998	2676263	1107920	117795
1999	13792780	1719505	82599
2000	8212868	3228536	133847
2001	8998081	2277278	187452
2002	10011480	1319291	102476
2003	11610320	1272970	66231
2004	14371331	1945227	122791
2005	52835449	2266372	102272
2006	9340785	5459057	155440
2007	10549586	1552282	184767
2008	7894186	2085499	130785
2009	35252950	3032568	337850
2010	35355908	9422666	428224
2011	16742275	8341042	1191533
2012	11469646	5231406	575643
2013	9052264	3060010	414534
2014	63182232	3573736	215965
2015	59775893	18619852	653613
2016	27891385	4266699	482295
2017	27754797	2886164	173266
2018	18709889	3123833	200733
2019	40210818	8468920	521293
2020	53930015	16906066	1479519
2021	21858420	5602150	519985

Table 10.3.2. North Sea and Division 3.a sprat. HERAS survey index.

HERAS abundance index (area 4 and 3.a summed), data are from WGIPS (2019)			
Years and ages apply to both the model year and calendar year			
Year	**Age 1**	**Age 2**	**Age 3**
2006	21923	21368	1413
2007	42862	5837	2252
2008	17188	7868	840
2009	47690	16920	2815
2010	20328	14087	1174
2011	26581	14207	3412
2012	22036	12831	4693
2013	9347	6342	2049
2014	59020	20274	3982
2015	27082	22676	10142
2016	58604	33989	8160
2017	38135	3664	1465
2018	109180	10113	779
2019	93775	28020	5275
2020	38415	17993	2055
2021	46918	7051	1509

Table 10.6.1. North Sea and Division 3.a sprat. Natural mortality input (Model year, e.g. 2021 = July 2021–June 2022). From multispecies SMS (WKSAM: ICES, 2017) 2017 key run.

Year	Season	age 0	age 1	age 2	age 3
1974	1	0.483	0.456	0.402	0.280
1974	2	0.327	0.235	0.217	0.188
1974	3	0.297	0.275	0.175	0.175
1974	4	0.445	0.409	0.318	0.318
1975	1	0.518	0.492	0.422	0.237
1975	2	0.289	0.220	0.200	0.169
1975	3	0.329	0.299	0.218	0.218
1975	4	0.474	0.442	0.423	0.423
1976	1	0.490	0.466	0.415	0.290
1976	2	0.318	0.242	0.225	0.195
1976	3	0.364	0.332	0.240	0.240
1976	4	0.485	0.443	0.421	0.421
1977	1	0.441	0.411	0.368	0.312
1977	2	0.373	0.245	0.227	0.199
1977	3	0.380	0.351	0.248	0.248
1977	4	0.490	0.440	0.432	0.432
1978	1	0.411	0.398	0.385	0.330
1978	2	0.347	0.230	0.218	0.192
1978	3	0.382	0.356	0.208	0.208
1978	4	0.445	0.396	0.374	0.374
1979	1	0.436	0.424	0.419	0.405
1979	2	0.416	0.252	0.245	0.227
1979	3	0.393	0.366	0.232	0.232
1979	4	0.444	0.389	0.377	0.377
1980	1	0.470	0.464	0.444	0.415
1980	2	0.447	0.261	0.257	0.230
1980	3	0.388	0.355	0.232	0.232
1980	4	0.419	0.372	0.336	0.336
1981	1	0.501	0.486	0.448	0.360
1981	2	0.409	0.271	0.267	0.232
1981	3	0.361	0.314	0.222	0.222
1981	4	0.376	0.330	0.267	0.267
1982	1	0.511	0.431	0.377	0.245
1982	2	0.331	0.231	0.217	0.177
1982	3	0.305	0.231	0.182	0.182
1982	4	0.318	0.277	0.205	0.205
1983	1	0.532	0.429	0.349	0.224
1983	2	0.336	0.235	0.217	0.194
1983	3	0.296	0.207	0.173	0.173

Year	Season	age 0	age 1	age 2	age 3
1983	4	0.312	0.259	0.168	0.168
1984	1	0.539	0.425	0.287	0.182
1984	2	0.397	0.236	0.209	0.189
1984	3	0.309	0.239	0.177	0.177
1984	4	0.321	0.274	0.197	0.197
1985	1	0.549	0.502	0.373	0.198
1985	2	0.482	0.277	0.251	0.210
1985	3	0.323	0.249	0.178	0.178
1985	4	0.318	0.269	0.165	0.165
1986	1	0.590	0.534	0.422	0.254
1986	2	0.452	0.313	0.288	0.227
1986	3	0.346	0.258	0.188	0.188
1986	4	0.335	0.284	0.169	0.169
1987	1	0.596	0.484	0.443	0.256
1987	2	0.470	0.315	0.299	0.232
1987	3	0.356	0.217	0.190	0.190
1987	4	0.338	0.281	0.185	0.185
1988	1	0.622	0.502	0.455	0.258
1988	2	0.493	0.342	0.316	0.270
1988	3	0.371	0.238	0.220	0.220
1988	4	0.361	0.301	0.233	0.233
1989	1	0.603	0.509	0.433	0.214
1989	2	0.525	0.332	0.294	0.261
1989	3	0.356	0.228	0.221	0.221
1989	4	0.374	0.312	0.281	0.281
1990	1	0.518	0.489	0.402	0.244
1990	2	0.496	0.331	0.283	0.261
1990	3	0.337	0.260	0.249	0.249
1990	4	0.387	0.319	0.287	0.287
1991	1	0.462	0.423	0.320	0.263
1991	2	0.396	0.269	0.232	0.211
1991	3	0.310	0.264	0.223	0.223
1991	4	0.389	0.320	0.287	0.287
1992	1	0.410	0.360	0.281	0.255
1992	2	0.312	0.227	0.204	0.180
1992	3	0.294	0.275	0.212	0.212
1992	4	0.371	0.299	0.270	0.270
1993	1	0.456	0.414	0.340	0.303
1993	2	0.238	0.209	0.190	0.173
1993	3	0.272	0.253	0.192	0.192

Year	Season	age 0	age 1	age 2	age 3
1993	4	0.347	0.274	0.244	0.244
1994	1	0.502	0.446	0.348	0.337
1994	2	0.292	0.223	0.197	0.182
1994	3	0.258	0.219	0.190	0.190
1994	4	0.318	0.248	0.223	0.223
1995	1	0.512	0.460	0.338	0.308
1995	2	0.290	0.223	0.195	0.182
1995	3	0.222	0.191	0.178	0.178
1995	4	0.265	0.211	0.190	0.190
1996	1	0.504	0.395	0.263	0.214
1996	2	0.363	0.227	0.202	0.177
1996	3	0.215	0.171	0.151	0.151
1996	4	0.238	0.195	0.156	0.156
1997	1	0.451	0.293	0.210	0.155
1997	2	0.298	0.204	0.187	0.154
1997	3	0.227	0.193	0.171	0.171
1997	4	0.269	0.214	0.171	0.171
1998	1	0.430	0.283	0.226	0.190
1998	2	0.362	0.197	0.176	0.145
1998	3	0.252	0.209	0.173	0.173
1998	4	0.318	0.245	0.197	0.197
1999	1	0.421	0.287	0.232	0.214
1999	2	0.291	0.191	0.169	0.152
1999	3	0.275	0.241	0.191	0.191
1999	4	0.335	0.267	0.242	0.242
2000	1	0.406	0.342	0.253	0.219
2000	2	0.355	0.199	0.180	0.170
2000	3	0.254	0.213	0.157	0.157
2000	4	0.279	0.236	0.192	0.192
2001	1	0.409	0.328	0.233	0.190
2001	2	0.299	0.213	0.202	0.195
2001	3	0.266	0.225	0.191	0.191
2001	4	0.306	0.258	0.213	0.213
2002	1	0.434	0.321	0.240	0.171
2002	2	0.315	0.223	0.214	0.206
2002	3	0.252	0.206	0.194	0.194
2002	4	0.323	0.262	0.218	0.218
2003	1	0.419	0.269	0.215	0.168
2003	2	0.295	0.229	0.208	0.204
2003	3	0.259	0.229	0.226	0.226

Year	Season	age 0	age 1	age 2	age 3
2003	4	0.383	0.308	0.286	0.286
2004	1	0.436	0.276	0.231	0.192
2004	2	0.278	0.216	0.193	0.185
2004	3	0.231	0.212	0.208	0.208
2004	4	0.376	0.302	0.278	0.278
2005	1	0.442	0.321	0.227	0.216
2005	2	0.309	0.219	0.181	0.174
2005	3	0.220	0.201	0.179	0.179
2005	4	0.367	0.291	0.225	0.225
2006	1	0.504	0.315	0.226	0.215
2006	2	0.265	0.212	0.172	0.166
2006	3	0.217	0.197	0.172	0.172
2006	4	0.364	0.277	0.202	0.202
2007	1	0.480	0.312	0.204	0.184
2007	2	0.287	0.222	0.170	0.166
2007	3	0.210	0.175	0.152	0.152
2007	4	0.312	0.237	0.175	0.175
2008	1	0.478	0.307	0.187	0.166
2008	2	0.269	0.203	0.157	0.151
2008	3	0.200	0.173	0.167	0.167
2008	4	0.304	0.225	0.197	0.197
2009	1	0.444	0.362	0.233	0.162
2009	2	0.327	0.200	0.158	0.150
2009	3	0.190	0.170	0.163	0.163
2009	4	0.293	0.215	0.190	0.190
2010	1	0.527	0.412	0.312	0.170
2010	2	0.395	0.217	0.179	0.164
2010	3	0.207	0.182	0.159	0.159
2010	4	0.309	0.226	0.197	0.197
2011	1	0.511	0.437	0.386	0.182
2011	2	0.381	0.239	0.193	0.179
2011	3	0.229	0.202	0.179	0.179
2011	4	0.338	0.254	0.224	0.224
2012	1	0.509	0.432	0.344	0.176
2012	2	0.368	0.238	0.191	0.178
2012	3	0.219	0.176	0.145	0.145
2012	4	0.292	0.225	0.180	0.180
2013	1	0.399	0.367	0.285	0.150
2013	2	0.271	0.209	0.164	0.158
2013	3	0.206	0.175	0.148	0.148

Year	Season	age 0	age 1	age 2	age 3
2013	4	0.270	0.221	0.178	0.178
2014	1	0.367	0.335	0.245	0.140
2014	2	0.257	0.198	0.167	0.154
2014	3	0.211	0.181	0.153	0.153
2014	4	0.272	0.227	0.184	0.184
2015	1	0.365	0.339	0.249	0.139
2015	2	0.237	0.194	0.164	0.149
2015	3	0.212	0.177	0.149	0.149
2015	4	0.278	0.224	0.181	0.181
2016	1	0.377	0.347	0.260	0.143
2016	2	0.255	0.200	0.165	0.153
2016	3	0.212	0.177	0.149	0.149
2016	4	0.278	0.224	0.181	0.181
2017	1	0.377	0.347	0.260	0.143
2017	2	0.255	0.200	0.165	0.153
2017	3	0.212	0.177	0.149	0.149
2017	4	0.278	0.224	0.181	0.181
2018	1	0.377	0.347	0.260	0.143
2018	2	0.255	0.200	0.165	0.153
2018	3	0.212	0.177	0.149	0.149
2018	4	0.278	0.224	0.181	0.181
2019	1	0.377	0.347	0.260	0.143
2019	2	0.255	0.200	0.165	0.153
2019	3	0.212	0.177	0.149	0.149
2019	4	0.278	0.224	0.181	0.181
2020	1	0.377	0.347	0.260	0.143
2020	2	0.255	0.200	0.165	0.153
2020	3	0.212	0.177	0.149	0.149
2020	4	0.278	0.224	0.181	0.181
2021	1	0.377	0.347	0.260	0.143
2021	2	0.255	0.200	0.165	0.153
2021	3	0.212	0.177	0.149	0.149
2021	4	0.278	0.224	0.181	0.181

Table 10.6.2. North Sea sprat. Assessment diagnostics.

ate: 03/23/22 Start time:17:06:28 run time:1 seconds

objective function (negative log likelihood): 299.074
Number of parameters: 143
Maximum gradient: 0.239804
Akaike information criterion (AIC): 884.147
Number of observations used in the likelihood:

Catch	CPUE	S/R	Stomach	Sum
768	298	48	0	1114

objective function weight:

Catch	CPUE	S/R
1.00	1.00	0.10

unweighted objective function contributions (total):

Catch	CPUE	S/R	Stom.	Stom N.	Penalty	Sum
412.8	-114.9	11.8	0.0	0.0	0.00	310

unweighted objective function contributions (per observation):

Catch	CPUE	S/R	Stomachs
0.54	-0.39	0.25	0.00

contribution by fleet:

IBTS Q1	total: -74.980	mean: -0.469
IBTS Q3	total: -31.619	mean: -0.351
Acoustic	total: -8.283	mean: -0.173

F, Year effect:

1974:	1.000
1975:	1.802
1976:	1.884
1977:	1.624
1978:	1.073
1979:	0.684
1980:	2.495
1981:	1.247
1982:	1.080
1983:	1.772
1984:	1.057
1985:	1.458
1986:	1.248
1987:	0.397
1988:	1.388
1989:	0.448
1990:	1.602
1991:	0.876
1992:	0.941
1993:	1.726
1994:	0.871
1995:	1.495

```
1996:   1.539
1997:   1.112
1998:   1.885
1999:   0.964
2000:   1.605
2001:   1.740
2002:   1.776
2003:   1.387
2004:   2.176
2005:   1.423
2006:   1.766
2007:   1.853
2008:   1.678
2009:   0.948
2010:   1.178
2011:   1.067
2012:   1.500
2013:   1.569
2014:   0.680
2015:   1.428
2016:   2.494
2017:   1.595
2018:   1.583
2019:   1.325
2020:   2.010
2021:   2.730

F, season effect:
-----------------
age: 0
   1974-2021:   0.037 0.201 0.362 0.250
age: 1
   1974-2021:   0.541 0.527 0.196 0.250
age: 2
   1974-2021:   0.240 0.474 0.114 0.250
age: 3
   1974-2021:   0.219 0.549 0.351 0.250

F, age effect:
--------------
              0     1     2     3
1974-2021:  0.037  0.399  1.520  1.520


Exploitation pattern (scaled to mean F=1)
-----------------------------------------
                    0     1     2     3
1974-2021 season 1:  0.001  0.192  0.326  0.297
          season 2:  0.007  0.188  0.642  0.744
          season 3:  0.012  0.070  0.154  0.476
          season 4:  0.008  0.089  0.339  0.339


sqrt(catch variance) ~ CV:
--------------------------

             season
```

---
age 1 2 3 4

0 1.414 1.414 1.271 0.100
1 0.853 0.763 1.414 0.100
2 1.012 1.084 1.414 0.100
3 1.012 1.084 1.414 0.100

Survey catchability:
---
	age 0	age 1	age 2	age 3
IBTS Q1		0.000	1.590	3.153	6.540
IBTS Q3			0.870	1.126	1.140
Acoustic			1.172	2.362	6.561

Stock size dependent catchability (power model)
---
	age 0	age 1	age 2	age 3
IBTS Q1	1.65	1.00	1.00	1.00
IBTS Q3		1.00	1.00	1.00
Acoustic		1.00	1.00	1.00

sqrt(Survey variance) ~ CV:
---
	age 0	age 1	age 2	age 3
IBTS Q1		0.43	0.37	0.37	0.37
IBTS Q3			0.48	0.40	0.40
Acoustic			0.44	0.55	0.55

Average F:
---
	sp. 1
1974:	1.109
1975:	1.705
1976:	1.802
1977:	1.602
1978:	1.049
1979:	0.676
1980:	2.299
1981:	1.152
1982:	0.986
1983:	1.589
1984:	0.987
1985:	1.308
1986:	1.117
1987:	0.361
1988:	1.259
1989:	0.423
1990:	1.494
1991:	0.848
1992:	0.916
1993:	1.587
1994:	0.804
1995:	1.342
1996:	1.395
1997:	1.049
1998:	1.765

1999: 0.936
2000: 1.485
2001: 1.644
2002: 1.676
2003: 1.372
2004: 2.085
2005: 1.356
2006: 1.659
2007: 1.722
2008: 1.578
2009: 0.886
2010: 1.072
2011: 0.969
2012: 1.336
2013: 1.422
2014: 0.638
2015: 1.314
2016: 2.253
2017: 1.459
2018: 1.448
2019: 1.217
2020: 1.827
2021: 2.169

Recruit-SSB		alfa	beta	recruit s2	recruit s
Sprat	Hockey stick -break.:	1316.549	9.000e+04	0.601	0.776

Table 10.6.3. North Sea and Division 3.a Sprat. Assessment output: Stock numbers (thousands) (years, seasons (S1-S4), and age (A0-A3+) refer to the model year, e.g., 2021 = July 2021–June 2022)

Year/Age Quarter	A0_S1	A0_S2	A0_S3	A0_S4	A1_S1	A1_S2	A1_S3	A1_S4	A2_S1	A2_S2	A2_S3	A2_S4	A3+_S1	A3+_S2	A3+_S3	A3+_S4
1974	543036000	334604000	239556000	175705000	139916000	71456700	45757200	32147400	10206300	4740150	1856610	1311090	564485	306102	110129	54212
1975	709595000	421523000	311385000	218722000	111574000	46246900	25400300	16362000	19327000	6562280	1467900	864143	679416	294583	55264	16978
1976	327714000	200305000	143739000	97395300	136215000	56933800	30088300	18618100	10520700	3492490	718691	408031	577268	230920	39462	11353
1977	630579000	405010000	275610000	184507000	59943200	28014100	15589700	9660700	11954300	4571630	1131060	666272	275344	117455	24819	8136
1978	1071680000	709383000	497293000	334648000	113084000	60277900	38202800	24590400	6223900	2862460	1062380	717015	437888	220394	74254	34022
1979	539449000	348437000	228676000	152913000	214500000	121129000	81524400	53582800	16543100	8477520	4053540	2856720	516645	274597	123664	68080
1980	334838000	208560000	130888000	85906800	98051400	36021800	16412600	9464200	36302200	9368020	1201790	618695	2006250	577864	57232	11974
1981	87282900	52813800	34749200	23829500	56502300	26570100	15585600	10329200	6522900	2644320	824742	532257	450514	207577	58145	23924
1982	45555800	27300800	19447700	14127300	16355000	8419360	5327480	3884760	7423910	3432010	1269890	878234	425886	232756	79136	37065
1983	58821600	34454900	24295000	17645200	10279300	4569930	2488660	1761840	2945250	1088410	244596	151429	745375	330588	62084	20282
1984	31588200	18407300	12284500	8893450	12912600	6719240	4250850	3082660	1359230	693448	262874	183354	145108	85103	29152	13886
1985	23019800	13264800	8102330	5754980	6448840	2852700	1591720	1107200	2343350	947696	258165	168002	161927	81829	19657	7560
1986	70963900	39277900	24758600	17228700	4186070	1876160	1055200	739060	845766	351832	107452	71770	148853	76240	21440	9129
1987	38488000	21196500	13203800	9196920	12322200	6971920	4678720	3652010	556102	308891	172070	132845	68300	46320	26377	17645
1988	55817100	29924200	18094000	12251500	6559980	2945170	1562910	1104490	2757330	1053900	283000	178650	125118	60921	14603	5587
1989	48771900	26657400	15711900	10939400	8536000	4657730	3040950	2336520	817077	449786	242811	180096	146005	101554	53824	33961
1990	67307700	40016200	24089900	16834900	7524810	3267040	1675650	1139490	1710590	637302	151469	89498	161558	74287	15031	4981
1991	103265000	64967900	43460400	31493600	11432900	6200460	3939730	2825750	828606	436979	184461	126784	70924	40750	15885	7960
1992	98542600	65307900	47469400	34938400	21346600	12158200	7950910	5609240	2051690	1098170	454928	312678	101110	57313	21822	10679
1993	129113000	81680600	63540700	47296400	24116200	10990800	6205100	4208490	4159450	1576050	376218	230322	246785	102653	20436	6710
1994	113155000	68384200	50722500	38749000	33413800	17722600	11803700	8852710	3198710	1643500	721318	513028	185724	99320	40055	20808
1995	35487900	21223000	15701900	12328100	28200700	12905300	7538890	5541070	6909940	2854090	800120	517089	427172	191081	45770	17247
1996	59588600	35915800	24695800	19517200	9461590	4574380	2637400	1969810	4487250	1966670	530904	349843	442030	213995	49667	18785
1997	46909200	29830500	21972400	17247600	15384400	9032030	5829660	4405610	1621100	875433	326079	226809	315342	186651	63298	29481

Year/Age Quarter	A0_S1	A0_S2	A0_S3	A0_S4	A1_S1	A1_S2	A1_S3	A1_S4	A2_S1	A2_S2	A2_S3	A2_S4	A3+_S1	A3+_S2	A3+_S3	A3+_S4
1998	105848000	68705600	47185300	35779000	13178700	6617570	3655170	2559150	3555840	1424570	307293	186608	216003	95415	17109	5262
1999	75667400	49581800	36815200	27619900	26037400	15871400	10710000	7806430	2002530	1116250	470693	329117	157605	92331	35463	17511
2000	72250500	48034400	33277400	25274800	19765200	9939310	5813380	4142640	5976400	2582580	679193	439846	272028	128241	28364	10294
2001	58320100	38658700	28297200	21180500	19128800	9471370	5307730	3696480	3272880	1373460	320622	195989	371477	172239	33179	10824
2002	77193400	49869200	35902200	27255600	15592300	7710180	4248190	3007840	2854650	1173930	263910	159833	167104	78070	14439	4607
2003	98936600	64923600	47852100	36257500	19739000	11186500	6648750	4742960	2315440	1125270	336658	211375	132257	70488	18072	6880
2004	166990000	107622000	80201400	61834900	24730700	11740100	5984970	4083420	3485160	1250330	215256	120043	163976	65654	8877	2257
2005	63546300	40780100	29619800	23312100	42466000	22680000	13511500	9887520	3017980	1430700	428579	280082	92584	46486	11917	4660
2006	80677800	48624200	36830800	28953900	16154400	8061150	4500040	3218460	7388710	3094690	730428	452924	227374	102001	19789	6488
2007	56916600	35127100	25990800	20548200	20114100	9873790	5357310	3890690	2439230	1011160	224692	140075	375259	168619	30422	9719
2008	124143000	76807100	57979500	46400900	15035700	7707420	4419340	3259170	3068290	1378780	352157	223023	125743	60963	12924	4468
2009	104609000	67004900	47975700	39157400	34238000	19432600	13031200	10210100	2601340	1457570	629108	453453	186832	115897	45212	23146
2010	109958000	64799600	43261800	34634500	29225800	15010200	9430000	7166920	8232240	3919490	1402810	975767	394248	224740	71364	32451
2011	89088900	53381500	36186600	28382500	25428900	13053500	8216910	6175170	5714940	2632520	1006520	699597	828122	484339	166193	78607
2012	67893400	40718700	27860800	21938900	20241300	9515820	5469660	4079530	4791890	1964890	551427	367917	621832	316709	75810	29442
2013	151849000	101659000	76624500	61038400	16386900	8094030	4723490	3506530	3257200	1380800	378710	248903	332029	169702	39123	14596
2014	171345000	118599000	91223000	73167400	46597100	28788900	20463600	16192200	2811660	1716910	890556	679152	220470	152916	74360	44370
2015	95014500	65823400	51382800	40770100	55746600	29190300	17814700	13342900	12902800	5972630	1814030	1220960	602108	325834	85265	34283
2016	136982000	93631400	71213800	55706300	30878400	12747800	6175880	4254930	10661400	3307910	465689	260642	1047910	396437	42419	9652
2017	168157000	115082000	88114100	69758900	42190700	21142500	12375000	9147960	3399830	1464670	393931	257575	225649	115102	26081	9591
2018	163028000	111574000	85435800	67649600	52833800	26546400	15578300	11527100	7309530	3163210	858347	562436	223037	114237	26153	9680
2019	139860000	95751900	73460700	58368200	51236300	27215200	16861000	12730800	9210530	4379360	1430820	980317	477617	266526	75670	32143
2020	85515000	58490800	44646600	35150700	44206700	20256400	10864900	7774630	10172300	3765950	751141	457106	845227	375561	60179	17729
2021	69413200	47430600	36011600	29123700	26622400	10446200	4816020	4033920	6212200	1768500	210101	181019	396405	138661	12187	10500
2022	0				22057600				3223240				159885			

Table 10.6.4. North Sea & 3.a Sprat. Assessment output: Estimated recruitment, spawning-stock biomass (SSB), average fishing mortality (F), and landings weight (Yield). All estimates refer to the model year, e.g., 2021 = July 2021–June 2022.

Year	Recruitment	High	Low	SSB	High	Low	Catches	F ages 1-2	High	Low
	(thousands)			(tonnes)			(tonnes)	(per year)		
1974	543036000	974148742	302713625	607031	989431	372423	463344	1.109	1.745	0.705
1975	709595000	1246579022	403925507	622040	1003062	385752	732312	1.705	2.538	1.145
1976	327714000	568380217	188951801	501939	813172	309827	628598	1.802	2.602	1.247
1977	630579000	1072938408	370598976	338439	521324	219712	385257	1.602	2.337	1.098
1978	1071680000	2020964214	568292112	389956	614573	247433	458804	1.049	1.768	0.623
1979	539449000	951361745	305882831	641332	1100917	373604	463638	0.676	1.302	0.351
1980	334838000	523306464	214246324	440425	747259	259581	387434	2.299	3.174	1.666
1981	87282900	128749607	59171479	307740	455678	207831	280582	1.152	1.754	0.757
1982	45555800	66143585	31376148	176147	263737	117646	162357	0.986	1.419	0.685
1983	58821600	79197337	43688093	82240	111675	60563	115440	1.589	1.941	1.300
1984	31588200	46065568	21660742	59357	76799	45877	113444	0.987	1.369	0.712
1985	23019800	31533307	16804808	55195	72629	41947	62514	1.308	1.657	1.033
1986	70963900	98483537	51134182	22058	29283	16616	27520	1.117	1.486	0.839
1987	38488000	52243884	28354059	50112	67314	37307	53942	0.361	0.549	0.238
1988	55817100	81761291	38105424	52957	67389	41616	103652	1.259	1.572	1.008
1989	48771900	67851635	35057346	39506	53836	28990	58420	0.423	0.804	0.222
1990	67307700	92743440	48847946	36902	50947	26728	78180	1.494	1.890	1.181
1991	103265000	134841771	79082766	79217	105401	59537	125815	0.848	1.175	0.613
1992	98542600	132518416	73277694	110149	138739	87450	156471	0.916	1.229	0.682
1993	129113000	203275378	82007801	155391	200600	120370	208848	1.587	1.894	1.330
1994	113155000	150994478	84798161	120194	177863	81223	424206	0.804	1.085	0.596
1995	35487900	47272692	26640984	169861	229949	125474	446555	1.342	1.679	1.072
1996	59588600	78950898	44974805	104983	130860	84223	95496	1.395	1.705	1.141
1997	46909200	62490879	35212707	106236	134353	84003	125174	1.049	1.354	0.813
1998	105848000	142504252	78620805	130525	162642	104750	188907	1.765	2.072	1.504
1999	75667400	98896332	57894517	125568	164272	95983	243158	0.936	1.248	0.702
2000	72250500	94446022	55271092	180665	227382	143546	222027	1.485	1.826	1.208
2001	58320100	75670180	44948143	124318	156010	99064	153321	1.644	1.981	1.364
2002	77193400	102094534	58365720	106899	133428	85644	174713	1.676	1.992	1.411
2003	98936600	131377949	74506041	132982	168882	104713	174988	1.372	1.700	1.108
2004	166990000	218038501	127893285	161765	206207	126901	231352	2.085	2.414	1.801
2005	63546300	81669576	49444756	203907	260209	159787	280275	1.356	1.666	1.104
2006	80677800	103508005	62883131	160733	200768	128681	78028	1.659	1.987	1.384
2007	56916600	74132739	43698633	130934	162701	105369	99902	1.722	2.046	1.449
2008	124143000	158849105	97019649	95608	119311	76613	69892	1.578	1.913	1.301
2009	104609000	134930708	81101204	164733	205575	132005	170934	0.886	1.182	0.664
2010	109958000	153382153	78827696	170207	211284	137116	145415	1.072	1.377	0.835

Year	Recruitment	High	Low	SSB	High	Low	Catches	F ages 1-2	High	Low
	(thousands)			(tonnes)			(tonnes)	(per year)		
2011	89088900	115680121	68610164	149422	192407	116040	122472	0.969	1.296	0.724
2012	67893400	86480522	53301179	124904	153810	101430	96030	1.336	1.634	1.093
2013	151849000	206375367	111729027	103116	127342	83499	60207	1.422	1.808	1.119
2014	171345000	232252288	126410419	192302	251584	146989	190268	0.638	0.883	0.461
2015	95014500	126602235	71308024	311969	410654	236999	298227	1.314	1.629	1.059
2016	136982000	176588472	106258739	216052	278800	167426	227169	2.253	2.561	1.982
2017	168157000	216616887	130538192	176752	221935	140768	135824	1.459	1.774	1.199
2018	163028000	217041203	122456605	200339	249556	160828	190779	1.448	1.749	1.199
2019	139860000	183850729	106395116	209892	267130	164919	137489	1.217	1.558	0.951
2020	85515000	115933635	63077598	288838	368367	226479	181990	1.827	2.159	1.546
2021	69413200	106348965	45305493	141574	178714	112152	80032	2.169	2.567	1.832
2022	120979028			100495	138634	72848				

* Geometric mean recruitment (2011–2020)

Table 10.9.1. North Sea and Division 3.a Sprat. Input to forecast (years and age refer to the model year, e.g., 2021 = July 2021–June 2022).

Age	Age 0	Age 1	Age 2	Age 3
Stock numbers(2022) (millions)	120979	22058	3223	160
Exploitation pattern S1	0.003	0.433	0.734	0.668
Exploitation pattern S2	0.015	0.423	1.447	1.678
Exploitation pattern S3	0.027	0.157	0.348	1.073
Exploitation pattern S4	0.000	0.000	0.000	0.000
Weight in the stock S1 (gram)	4.800	7.593	10.633	13.621
Weight in the catch S1 (gram)	4.80	7.59	10.63	13.62
Weight in the catch S2 (gram)	5.78	9.00	11.84	15.58
Weight in the catch S3 (gram)	5.81	9.34	12.21	15.19
Weight in the catch S4 (gram)	6.44	9.42	12.36	15.93
Proportion mature(2020)	0.00	0.41	0.87	0.95
Proportion mature(2021)	0.00	0.41	0.87	0.95
Natural mortality S1	0.38	0.35	0.26	0.14
Natural mortality S2	0.26	0.20	0.16	0.15
Natural mortality S3	0.21	0.18	0.15	0.15
Natural mortality S4	0.28	0.22	0.18	0.18

Table 10.9.2. Sprat North Sea Division 3.a. Short-term predictions options table. Years refer to the model year, e.g., 2021 = July 2021–June 2022.

Catch options. Catches and SSB are in thousands of tonnes.					
3-year average weight-at-age was used to calculate SSB. Recruitment(2021) = geometric average 2011–2020.					
Basis	**Catches(2022)**	**F(2022)**	**SSB(2023)**	**%SSB change***	**%TAC change****
F_{cap}	68.690	0.69	181215	80%	-36%
F=0	0	0	222210	121%	-100%
F=0.1	12.231	0.1	214704	114%	-89%
F=0.2	23.557	0.2	207825	107%	-78%
F=0.3	34.071	0.3	201505	101%	-68%
F=0.4	43.852	0.4	195688	95%	-59%
F=0.5	52.971	0.5	190322	89%	-50%
F=0.6	61.490	0.6	185363	84%	-42%
F=0.7	69.465	0.7	180772	80%	-35%
F=0.8	76.944	0.8	176512	76%	-28%
F=0.9	83.971	0.9	172554	72%	-21%
F=1.0	90.586	1	168869	68%	-15%
$B_{escapement}$ without F_{cap}	178.672	3.28	125000	24%	-67%

* SSB in July 2023 relative to SSB in July 2022

** catch (July 2022-June 2023) relative to the sum of the TACs (106715 tonnes) for July 2021–June 2022 in Subarea 4 and Division 3.a.

Figure 10.1.1. North Sea and Division 3.a sprat. Sprat catches in the North Sea and Division 3.a (in tonnes) for each calendar year by statistical rectangle.

Figure 10.2.1. North Sea and Division 3.a sprat. Number of samples taken in the North Sea and Division 3.a for each calendar year by statistical rectangle.

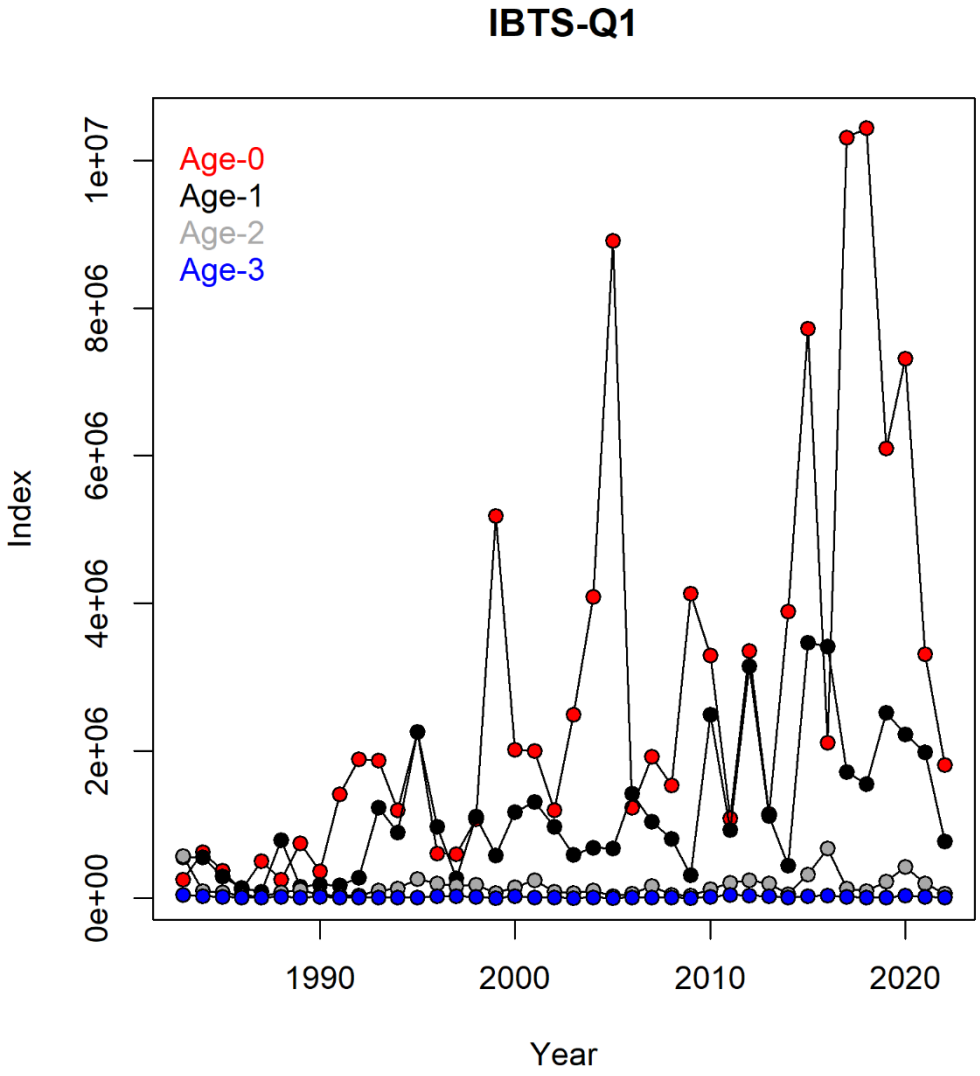


Figure 10.3.1. North Sea and Division 3.a sprat. IBTS Q1 survey index for Subarea 4 and Division 3.a combined. The index is calculated using a delta-GAM model formulation (see WKSPRAT report (ICES, 2018) for details). Years refer to the calendar year.

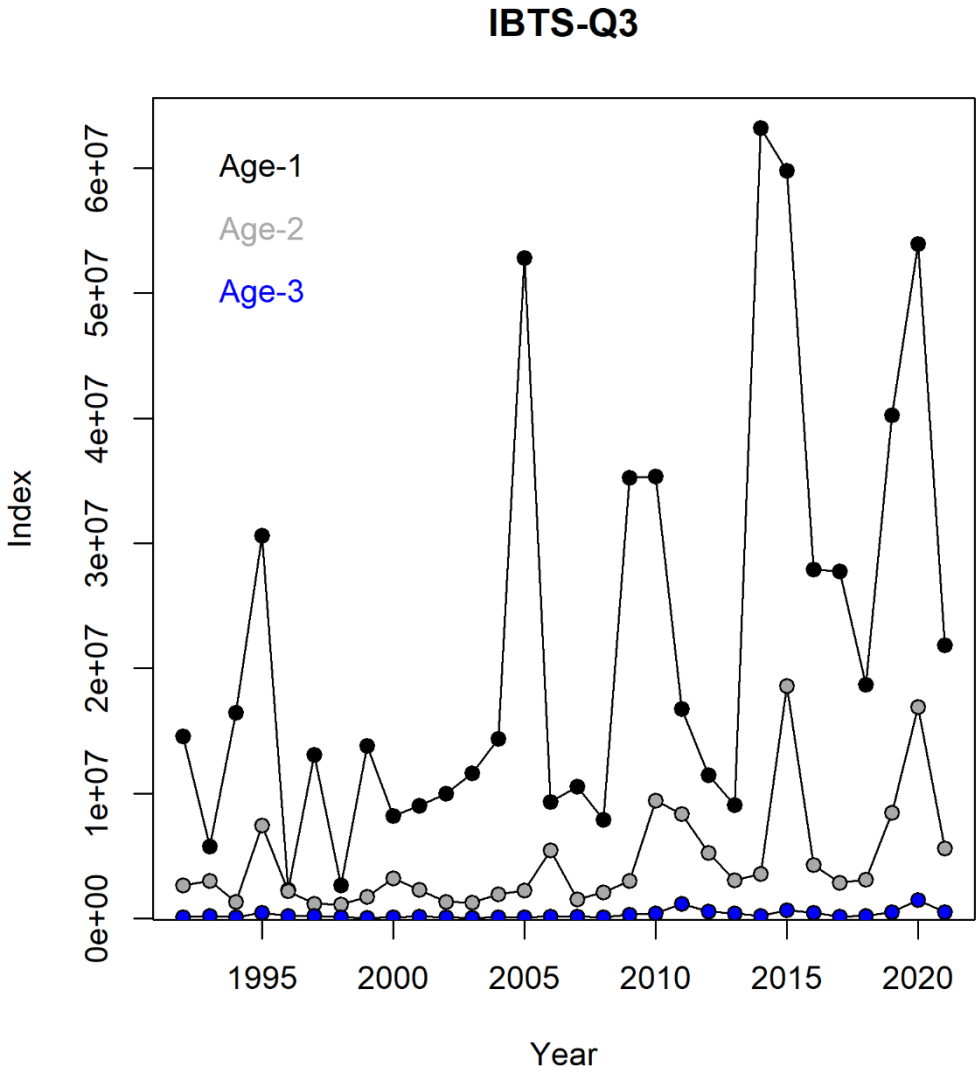


Figure 10.3.2a. North Sea and Division 3.a sprat. IBTS Q3 survey index for Subarea 4 and Division 3.a combined. The index is calculated using a delta-GAM model formulation (see WKSPRAT report (ICES, 2018) for details). Years refer to the calendar year.

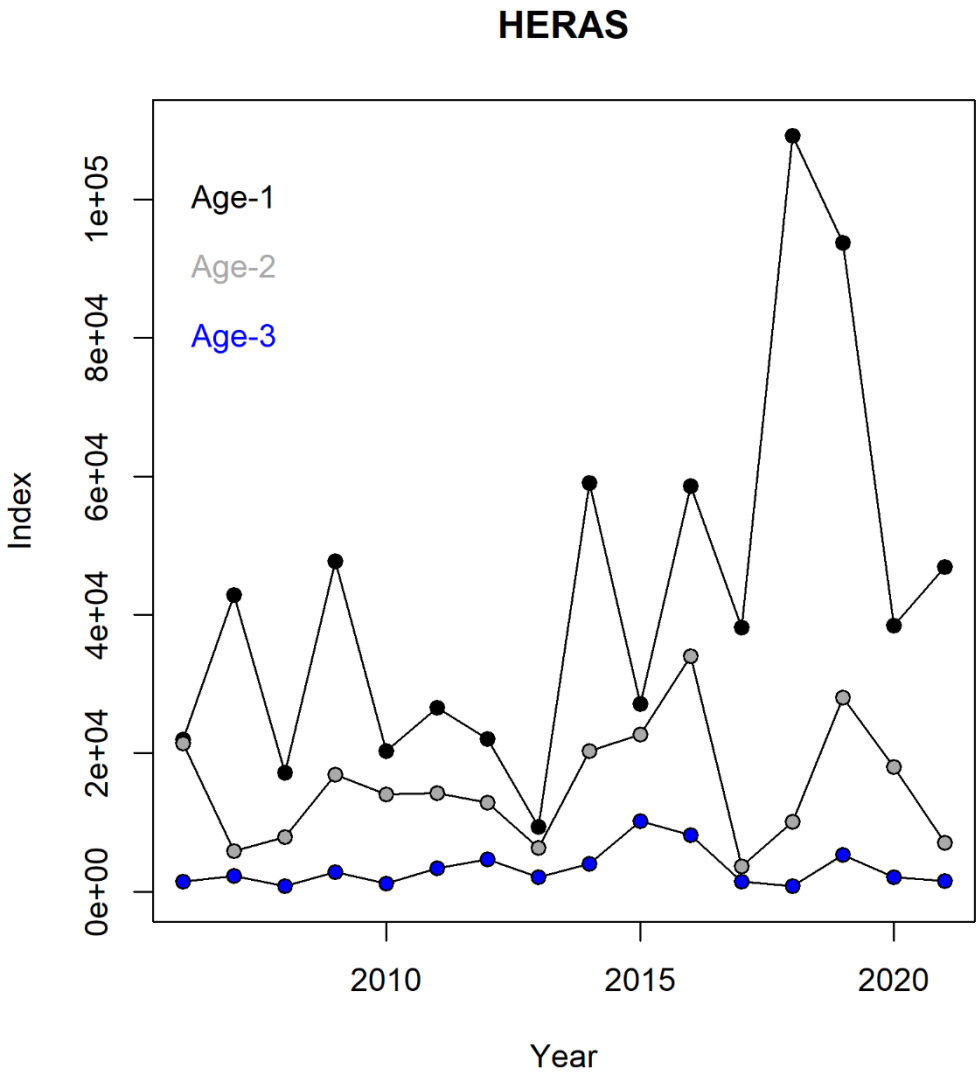
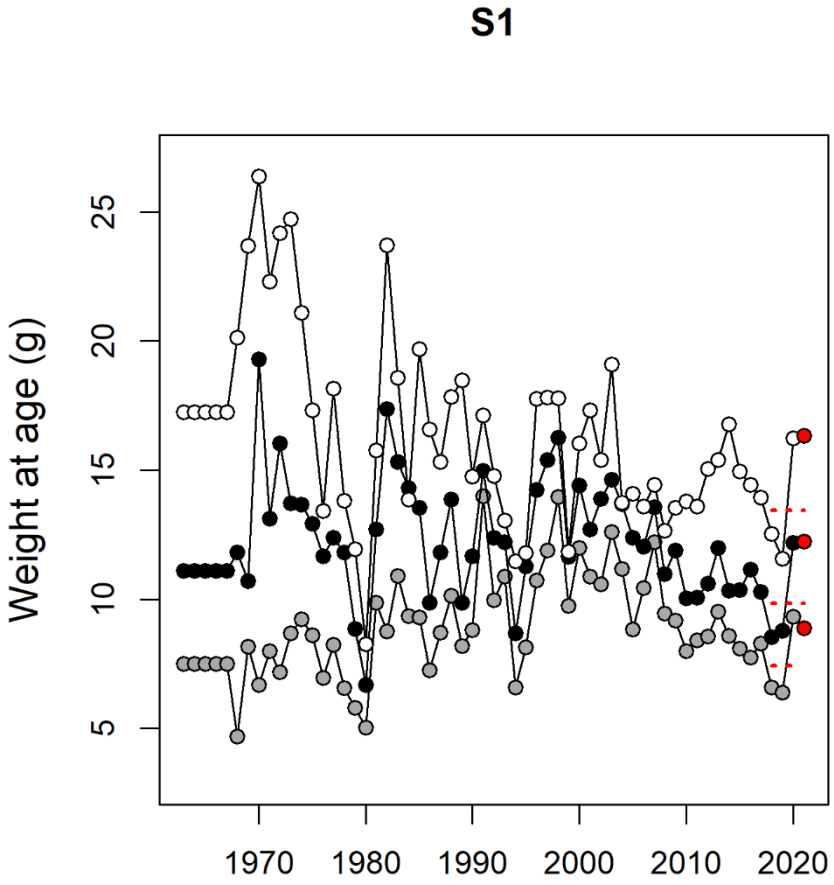
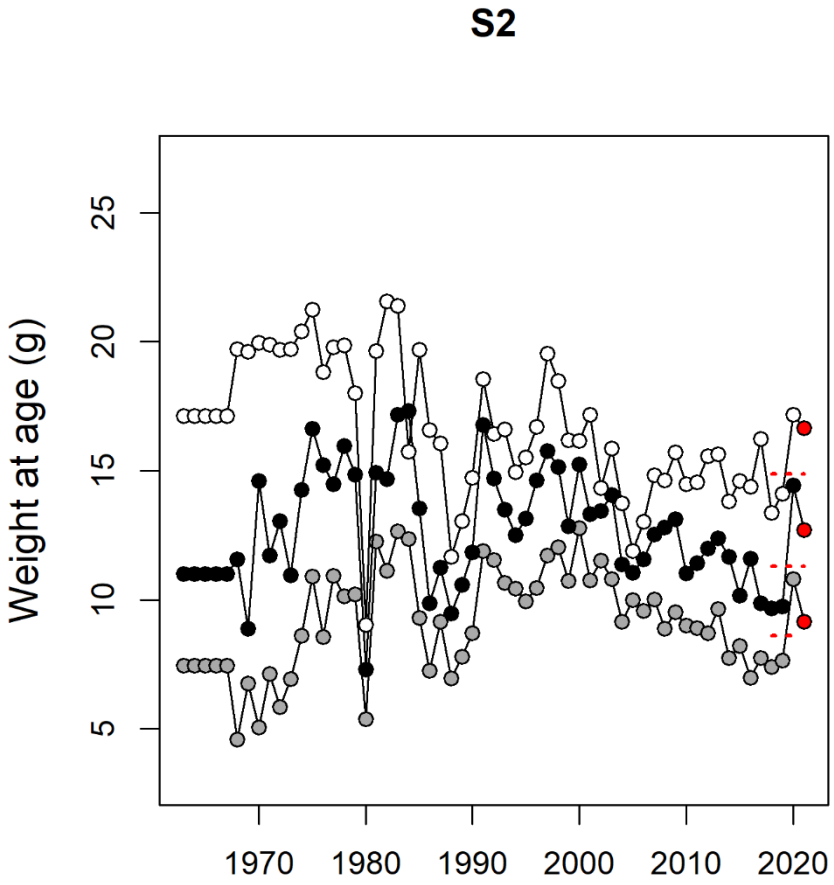
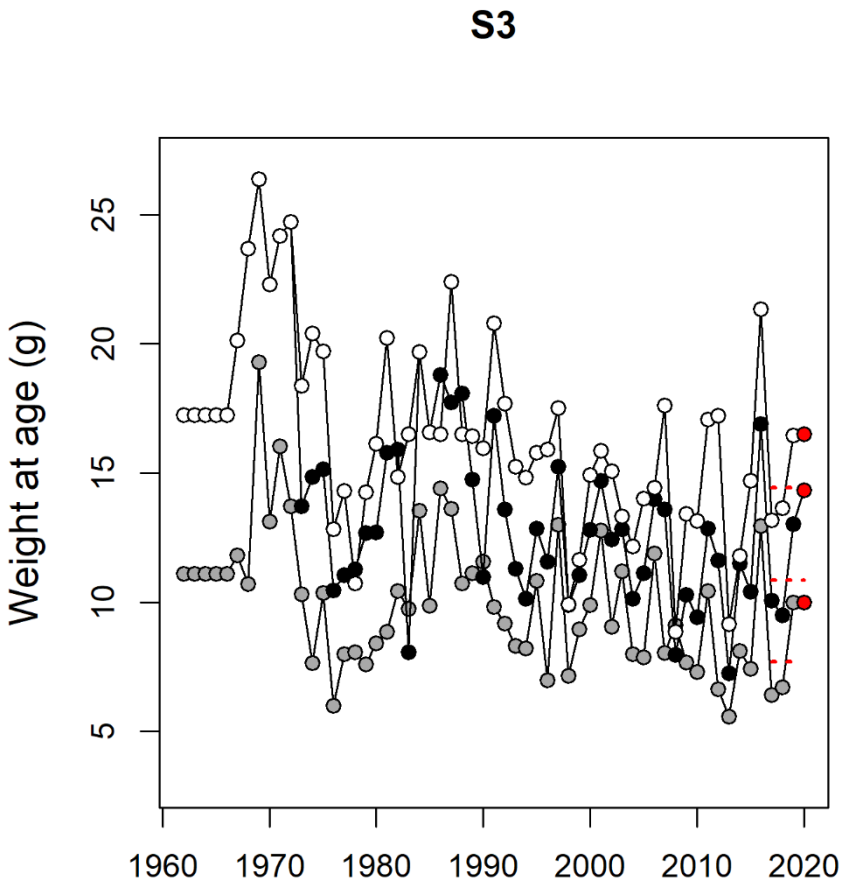


Figure 10.3.2b. North Sea and Division 3.a sprat. HERAS survey index for Subarea 4 and Division 3.a combined (sum of abundance indices published by WGIPS). Years refer to the calendar year.


S1
Weight at age (g)
5
10
15
20
25
1970
1980
1990
2000
2010
2020


S2
Weight at age (g)
5
10
15
20
25
1970
1980
1990
2000
2010
2020


S3
Weight at age (g)
5
10
15
20
25
1960
1970
1980
1990
2000
2010
2020

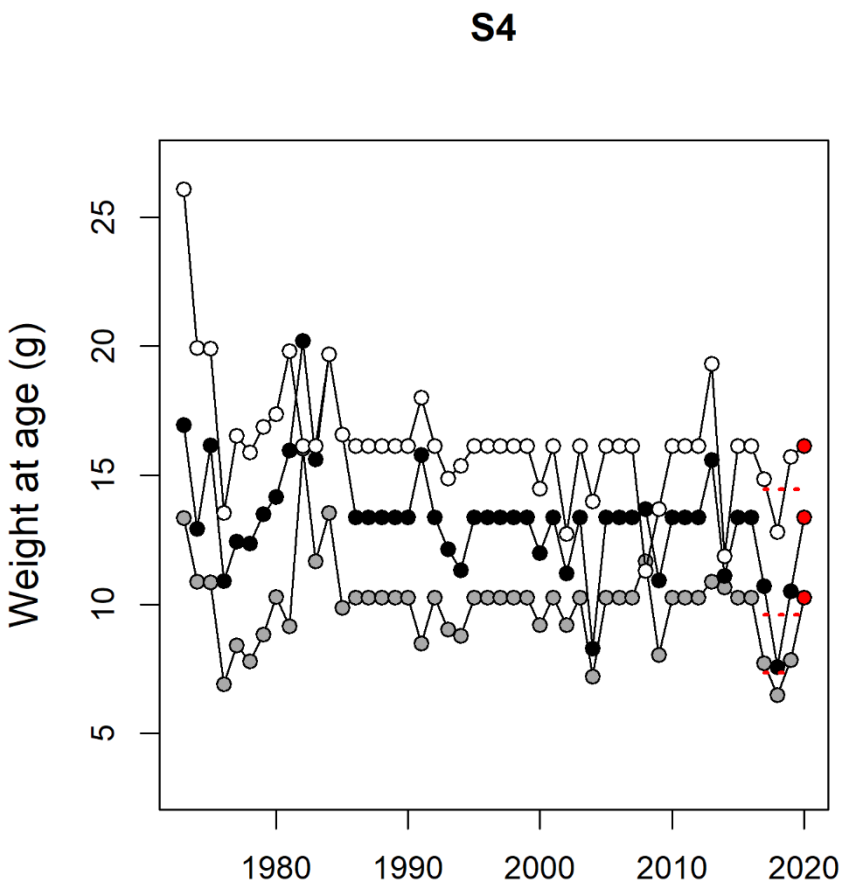


Figure 10.4.1. North Sea & 3.a sprat. Mean weight at age in season 1–4 (S1–S4) (years refer to the model year, e.g., 2021 = July 2021–June 2022). Age 1 (grey), age 2 (black), age 3 (white). Red dot is the status quo weight and the red dashed line refer to the 3-year average used in the forecast last year.

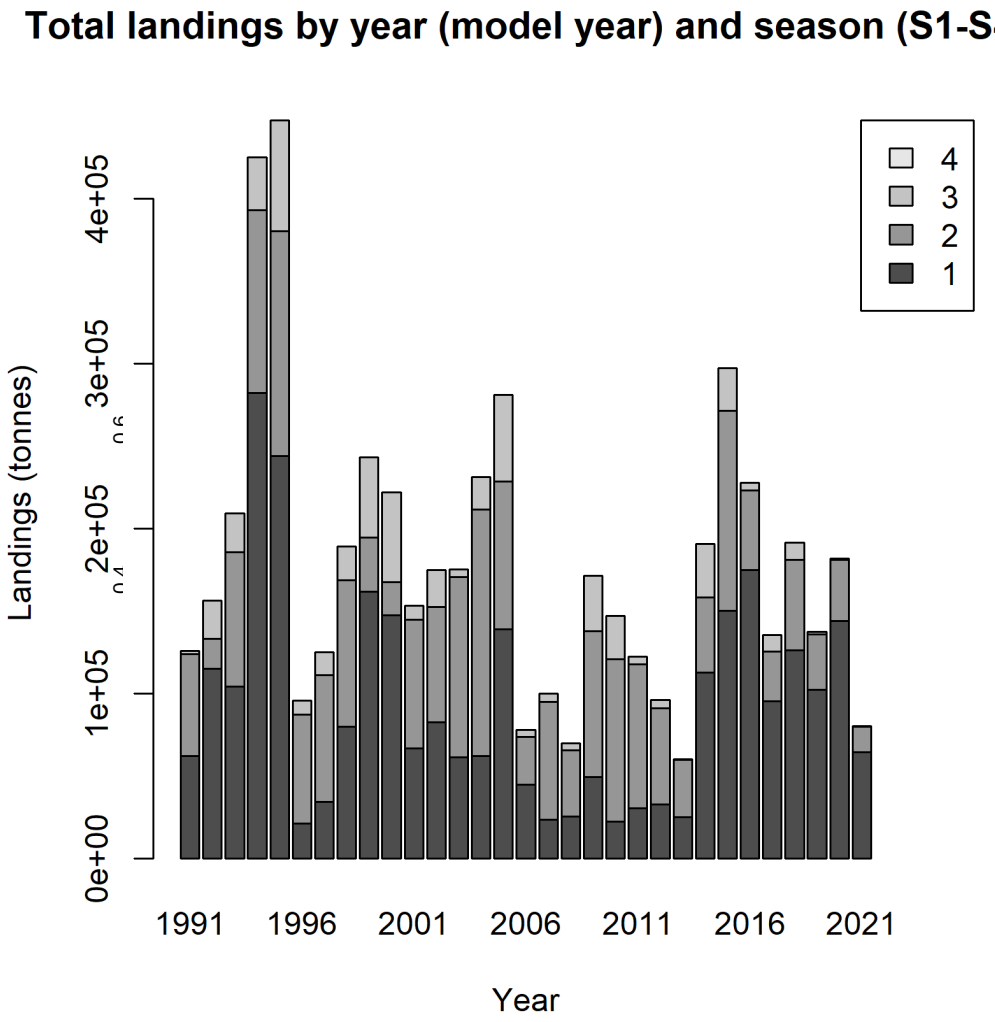


Figure 10.6.1a. North Sea & 3.a sprat. Seasonal distribution of catches. Year and season 1-4 refer to the time-steps of the model (e.g., 2021 = July 2021–June 2022). Note that since the model year of 2021 is not yet finished, the 2021 column will be updated next year. Also note that there are no catches shown for S4, since these are moved to S1 in the following year (see WKSPRAT 2018 report (ICES, 2018) for details).

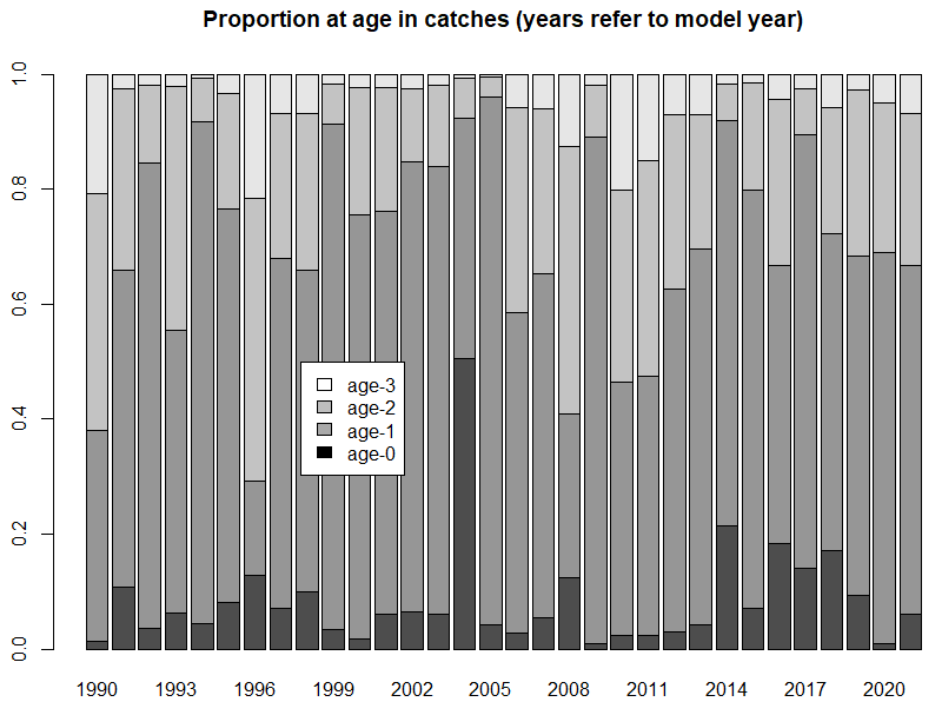


Figure 10.6.1b. North Sea & 3.a sprat. Proportion of each age group in the catches. Year and age refer to the model year (e.g., 2021 = July 2021–June 2022).

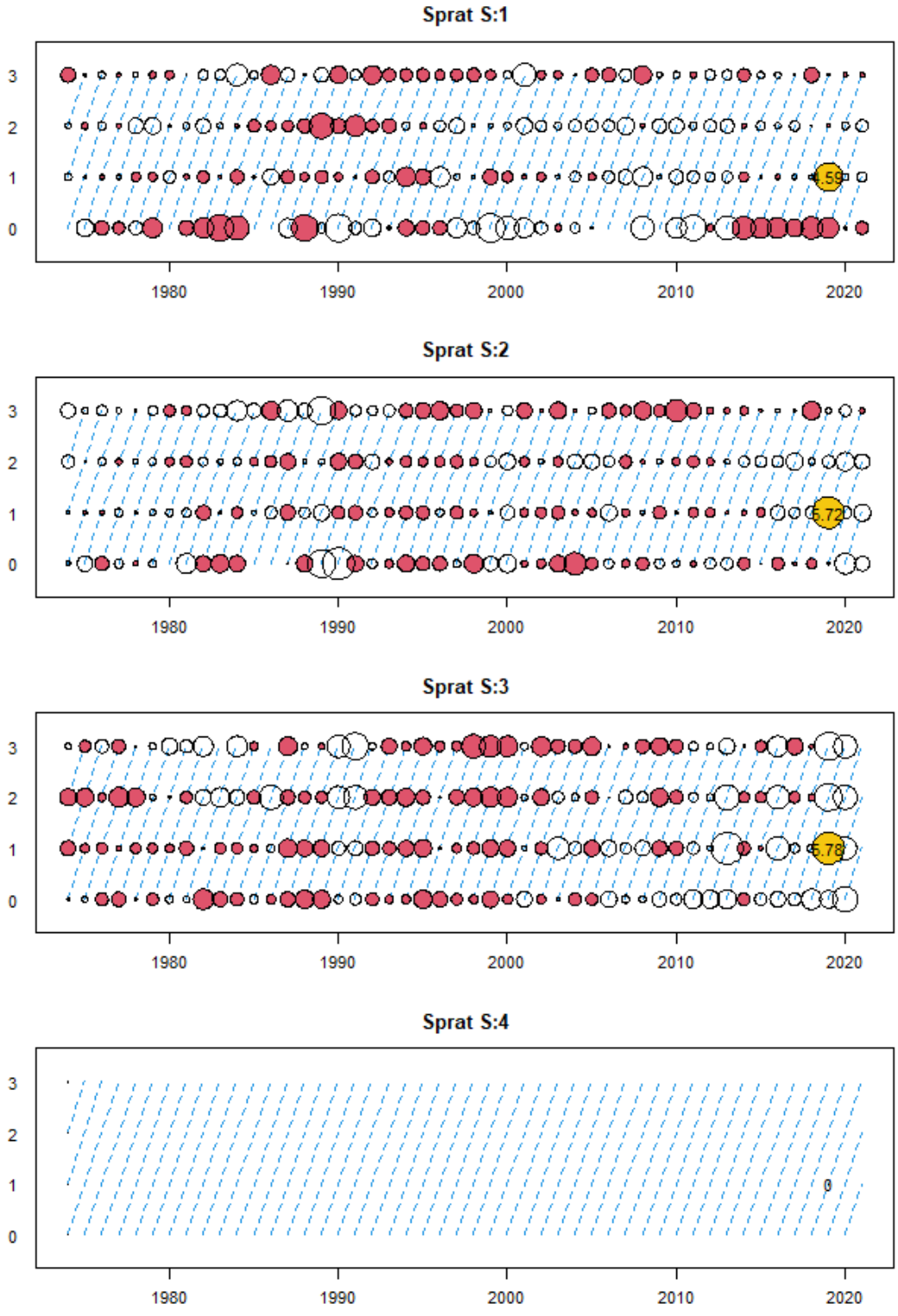


Figure 10.6.2. North Sea & 3.a sprat. Catch residuals by age. (Model year, e.g., 2021 = July 2021–June 2022)

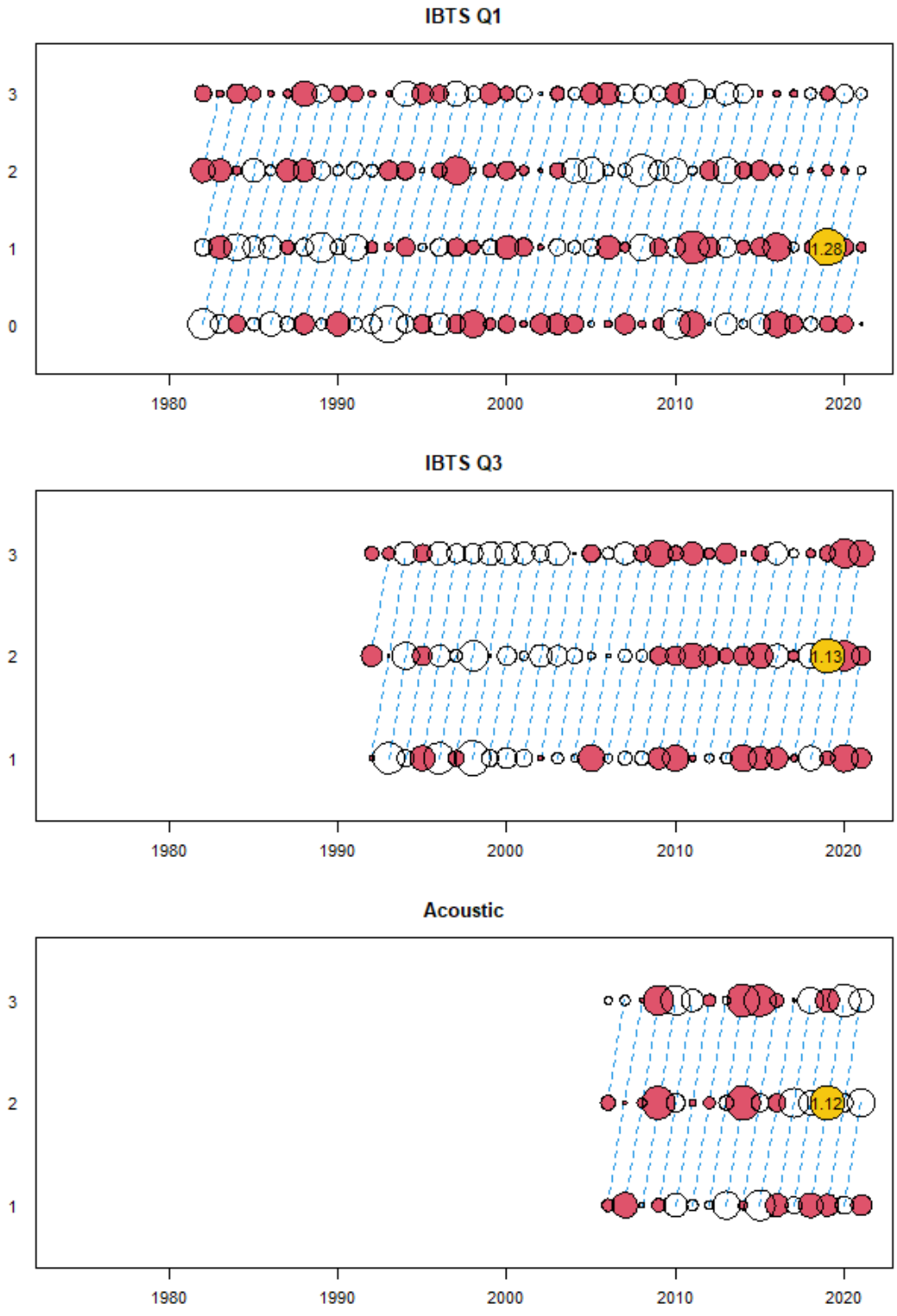


Figure 10.6.3. North Sea & 3.a sprat. Survey residuals by age. (Model year, e.g., 2021 = July 2021–June 2022)

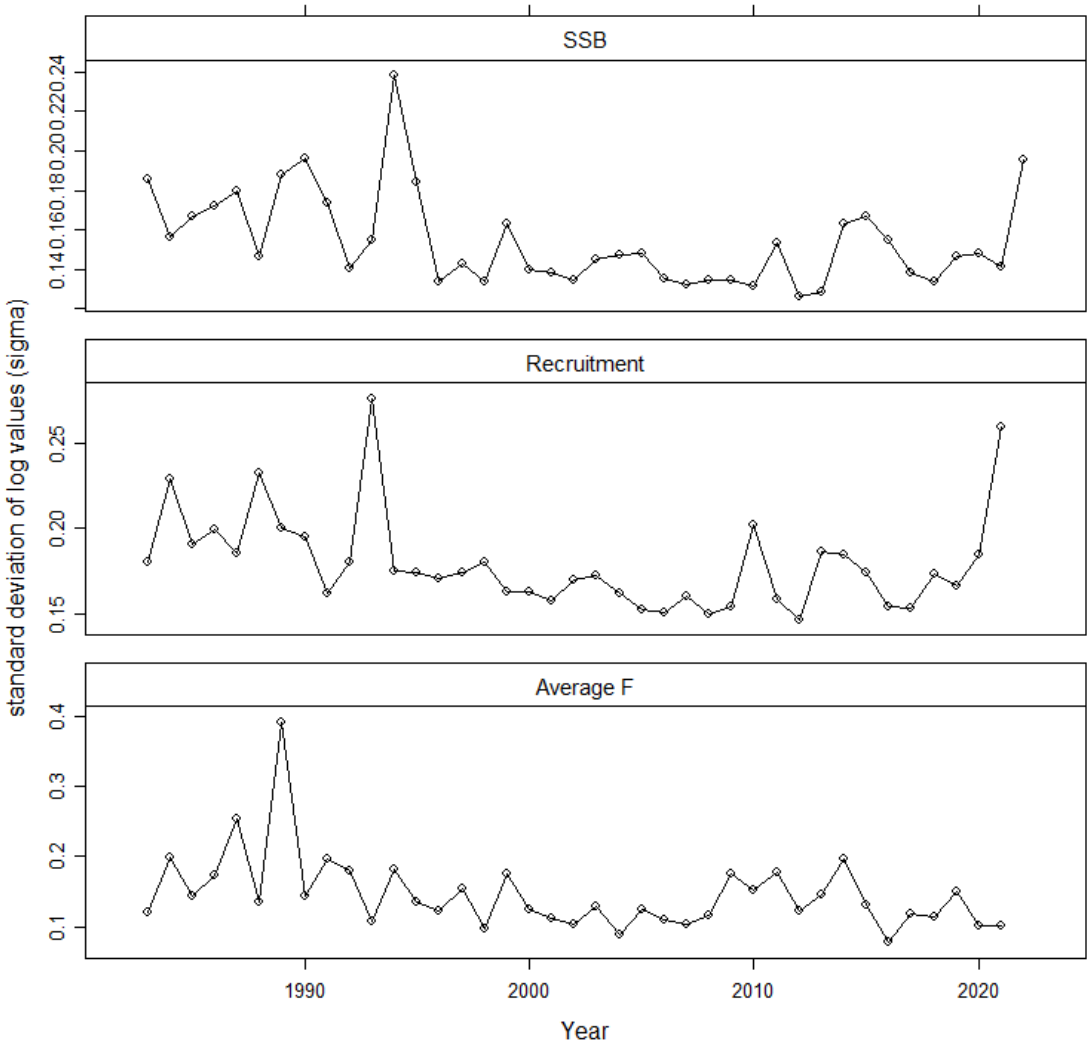


Figure 10.6.4. North Sea & 3.a sprat. Coefficients of variance (Model year, e.g., 2021 = July 2021–June 2022).

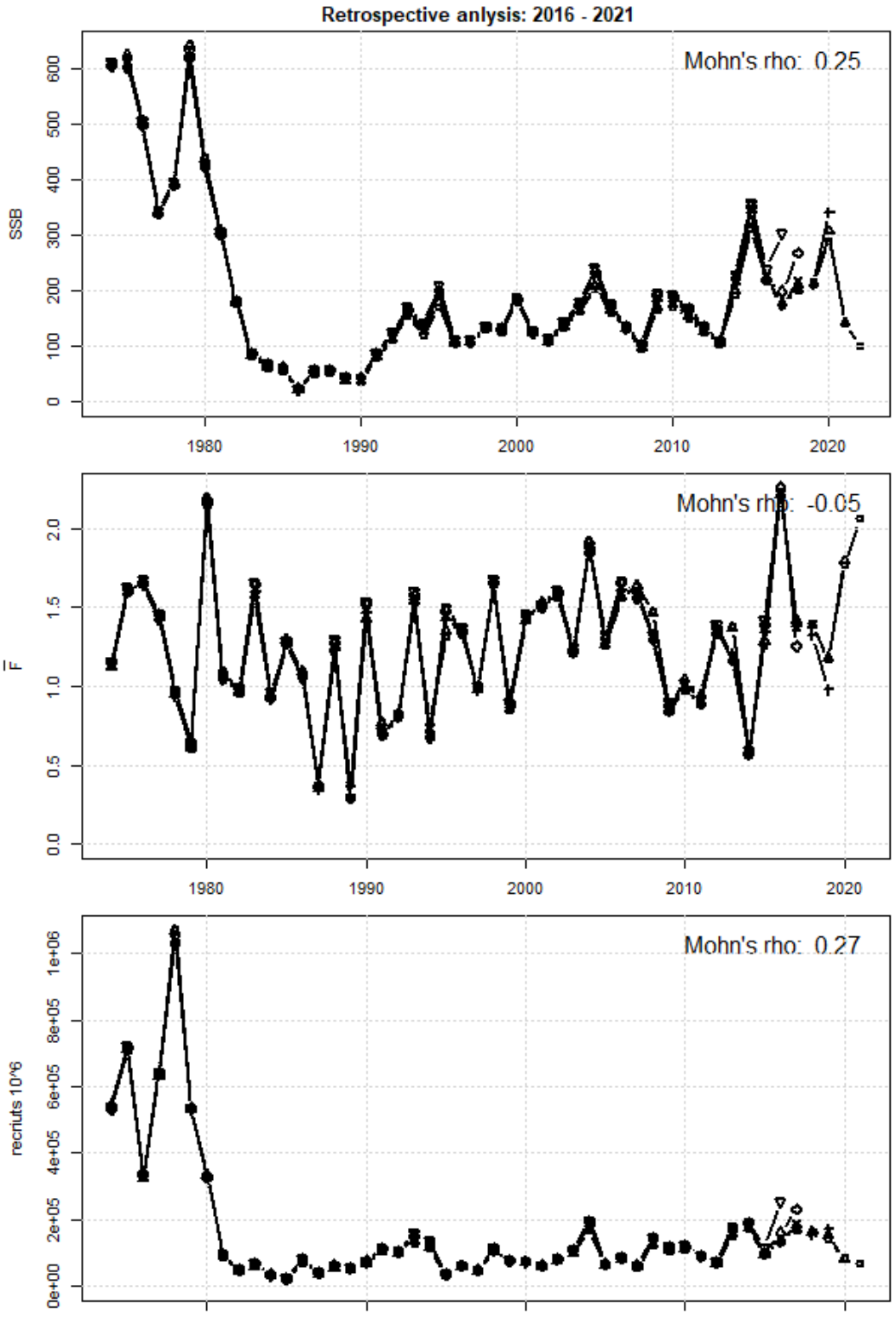


Figure 10.6.5. North Sea & 3.a sprat. Retrospective analysis (Model year, e.g., 2021 = July 2021–June 2022)

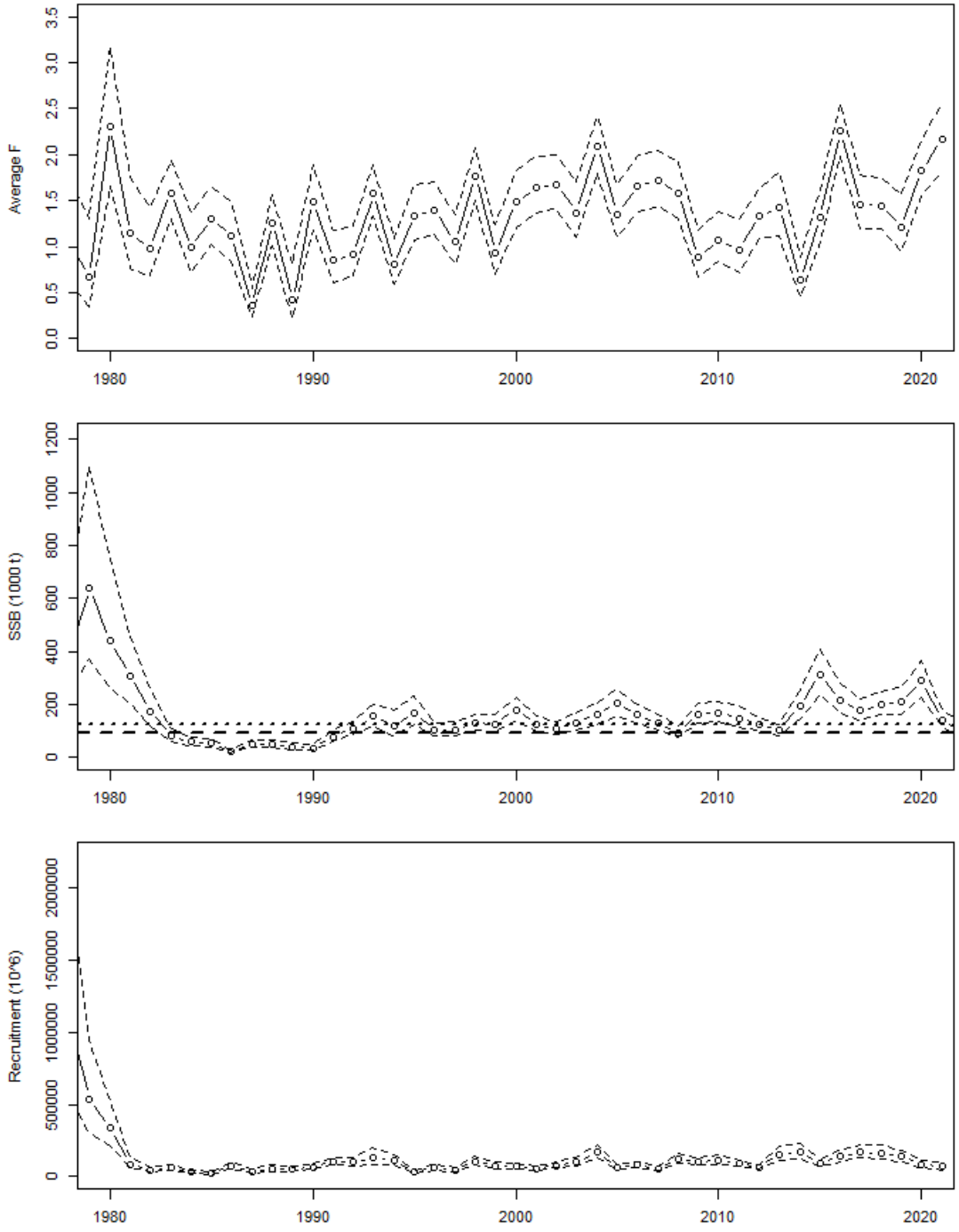


Figure 10.6.6. North Sea & 3.a sprat. Temporal development in Mean F, SSB and recruitment. Hatched lines are 95% confidence intervals (Model year, e.g., 2021 = July 2021–June 2022).

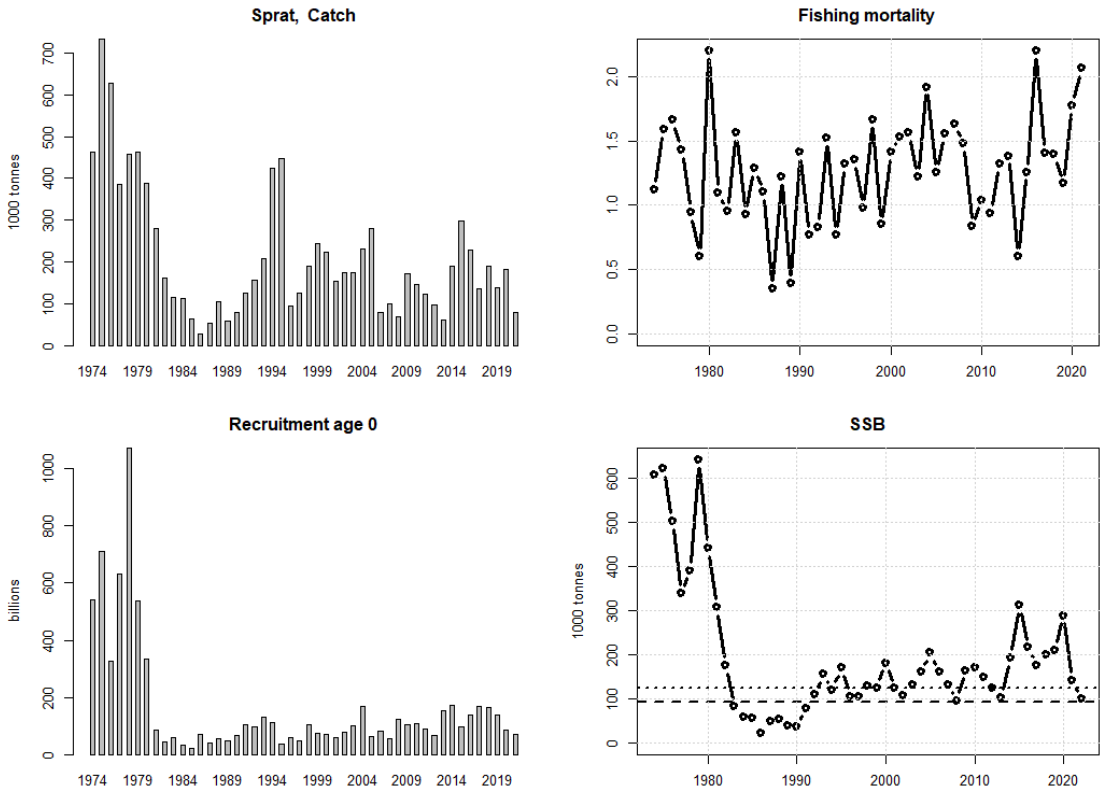


Figure 10.6.7. North Sea & 3.a sprat. Assessment summary (Model year, e.g., 2021 = July 2021–June 2022).

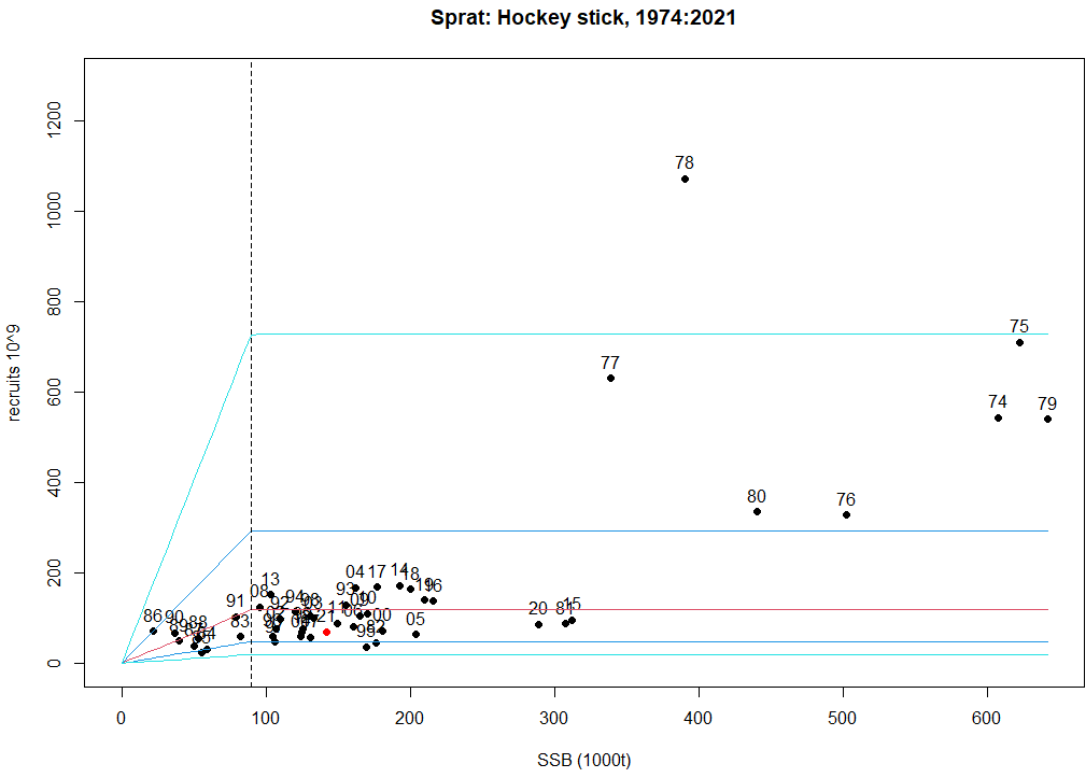


Figure 10.7.1. North Sea & 3.a sprat. Stock-recruitment relationship (Model year, e.g., 2021 = July 2021–June 2022).

10.14 References

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