Bridging Analysis 1: Appendix B to the 2024 Stock Assessment and Fishery Evaluation Report for the Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions

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2024-09-11

1 Introduction

Model 22.03d was recommended by the CPT and SSC at their Spring 2024 (May and June, respectively) meetings as a candidate to be evaluated for setting harvest specifications in the fall (SSC 2024; CPT 2024; Stockhausen 2024). This model was identical to the 2023 assessment model, 22.03b, in all but two respects. Firstly, 22.03b included fits to BSFRF survey biomass and size composition data from the 2013-2017 side-by-side (SBS) Tanner crab selectivity studies whereas 22.03d included additional data from the 2018 study and very small changes to the 2013-2017 data based on more thorough consistency checks to match the paired BSFRF and NMFS hauls. Secondly, the empirical availability curves used to scale the model-predicted EBS-wide population structure to the SBS study areas were updated for 22.03d with the addition of the 2018 data using a different approach than had been used to estimate those used in 22.03b. Smoothed versions of the annual empirical availability curves were originally estimated using a generalized additive model (GAM) assuming a gaussian error distribution with log link for the raw estimates whereas the new approach assumed a binomial error distribution with a logit link.

One issue that the CPT and SSC raised regarding 22.03d was that the θ parameters, related to effective sample size, for the Dirichlet-Multinomial fits to the BSFRF size compositions were estimated at their upper bound, indicating that the effective sample sizes were potentially larger than the input sample sizes, whereas this was not the case for 22.03b. While this result is not necessarily indicative of a problem, this appendix provides a more complete bridging analysis moving from 22.03b to 22.03d to determine what changes to 22.03b were associated with the θ parameter estimates moving to their upper bounds.

2 Changes

Changes to the SBS data included in the models as a result of the addition of the 2018 data and application of more thorough consistency checks between the BSFRF and NMFS paired hauls were, in general, very small; differences were noticeable, but still small, only in the 2017 data (Figures

1-4). Differences between the smooth empirical availability curves were more noticeable (Figures 5–Figure 8), particularly at the largest crab sizes where sample sizes were small. The curves obtained by fitting GAMs with binomial error distributions with logit links follow the variability in the "raw" curves more closely than those obtained with the gaussian error distributions; they also reflect the nature of the raw curves (which are proportions) better.

3 Model progression

The bridging analysis proceeded by the following incremental steps:

- 22.03b1: fit the revised 2013-2018 BSFRF dataset, but did not include the 2018 data. Otherwise, it was identical to 22.03b.
- 22.03b2: included the entire 2013-2018 BSFRF dataset in the model optimization. The sex-specific empirical availability curves used for 2018 were estimated (outside the assessment model) using the same approach as that used previously (GAM model with lognormal error distribution). The empirical availability curves for 2013-2017 were *not* updated.
- 22.03b3: included the entire 2013-2018 BSFRF dataset in the model optimization. The empirical availability curves for 2013-2017 were updated using the revised 2013-2017 data with the original GAM model.
- 22.03d: included the entire 2013-2018 BSFRF dataset in the model optimization. The empirical availability curves for 2013-2018 were estimated (outside the assessment model) using the revised 2013-2018 data and the GAM model with the binomial error distribution and logit link.

4 Model Results

Parameter estimation for all of the models converged successfully, with small final maximum gradients and invertible hessians (allowing parameter uncertainty to be estimated; Table A). The total objective function value decreased substantially (3142.77 to 3088.78 likelihood units) from 22.03b to 22.03d; the differences, however, are primarily due to differences in the components of the objective function related to the BSFRF data, rendering direct inference on model fits based on the total objective function value invalid. The estimated θ (effective sample size) parameters associated with the Dirichlet-Multinomial likelihoods used to fit the BSFRF size compositions hit their upper bound only for females in 22.03b3 (Table 1), although the values for both sexes were close to their upper bounds (11) in 22.03d (6). Large values for a Dirichlet-Multinomial θ parameter indicate that the effective sample size is no smaller than the input sample size, suggesting that such parameters could be fixed to their upper limits or that simple multinomial likelihoods would be appropriate for fitting the data. Only relatively small changes in other estimated parameter values occurred (Tables 2-14). For completeness, the (fixed) values used in the models for empirical availability are given in Tables 15-26.

Individual components to the overall objective function value for the models are compared in Tables 27-30 while the difference in values relative to 22.03b are presented in Tables 31-34. The largest difference is that 22.03d fits the BSFRF SBS size composition data much better than 22.03b due to the changes in the empirical availability curves.

Table A. Convergence properties and summary management quantities. Diagnostics for 22.03b are from the 2023 assessment.

case	objective function	max gradient	avg recruitment	B_{100}	B_{MSY}	F_{MSY}	MSY	B
22.03b	3,142.770	0.0000813	429.5742	103.9696	36.38937	1.163916	17.25974	101.1324
22.03b1	3,143.011	0.0002388	428.1823	103.3786	36.18249	1.163943	17.18150	100.5539
22.03b2	3,216.643	0.0084206	436.4138	101.5339	35.53685	1.173097	16.95602	101.2348
22.03b3	3,136.590	0.0136333	465.1854	102.4675	35.86364	1.210361	17.26305	103.1668
22.03d	3,088.781	0.1925393	486.0105	102.3224	35.81285	1.239754	17.37937	104.1558

4.1 Estimated Fishery-related Quantities

All estimated fishery-related quantities are essentially identical for all of the models. Graphs of time series of estimated fully-selected F (total catch capture rates, not necessarily mortality) in the directed fishery are shown in Figure 9, while the associated selectivity functions are illustrated in Figures 10-12. The estimates of size-selective retention of males captured in the directed fishery are presented in Figure 13. Graphs of time series of estimated fully-selected F (again, total catch capture rates, not mortality) and the associated selectivity functions for the bycatch fisheries are shown in Figures 14-16.

4.2 Estimated Survey-related Quantities

Graphs of estimated sex-specific survey catchability and the associated selectivity functions for the NMFS EBS survey are shown in Figure 17. The BSFRF nephrops bottom trawl gear is assumed to be non-size-selective (i.e., selectivity=1 at all sizes) and catch all crab in its swept-area path (i.e., the fully-selected catchability coefficient $q = 1$). Assumed survey availability curves for the BSFRF side-by-side catchability studies are illustrated in Figure 18. These were not estimated; they were determined outside the model (see Appendix A for details).

4.3 Estimated Population-related Quantities

4.3.1 Molting probabilities, growth, and other schedules depending on parameter estimates

Immature crab are assumed to molt annually. The estimated sex/size-specific probability of undergoing the molt to maturity (terminal molt) is shown in Figure 19, together with estimated mean molt increments (as a function of pre-molt size) and natural mortality rates. The cohort progressions (growth and development) resulting from these schedules are illustrated in Figures 20 and 21. The cohort progression curves differ slightly across the models because natural mortality is estimated slightly higher in 22.03d than in the other models.

4.3.2 Estimated population-related time series

Estimated time series for recruitment and MMB are shown in Figures 22 and 23. Time series of abundance by sex and maturity state are illustrated in Figure 24, while time series of biomass by sex and maturity state are illustrated in Figure 25. While the temporal patterns are essentially identical, 22.03d exhibits slightly higher estimates of recruitment than the other models, but when combined with its slightly higher estimates of natural mortality, the resulting estimates of population abundance and biomass are almost indistinguishable across the models for mature crab.

4.4 Estimated Fishing Mortality versus Estimated Spawning Stock Biomass

Estimated total fishing mortality (retained + discards) is plotted against spawning stock biomass (MMB) for the models in Figure 26.

4.5 Fits to Fishery Catch Data

Fits to the observed and model-predicted fishery catch biomass data are presented in Figures 27-31. Residuals to the fits and summary statistics are also shown on each figure. Graphs of fits to observed catches from the directed fishery are presented in Figures 27-28 for retained catch and total catch. Fits to bycatch data from the snow crab fishery are shown in Figure 29. Fits to bycatch data from the BBRKC fishery are shown in Figure 30. Fits to bycatch data from the groundfish fisheries are shown in Figure 31. All of the models exhibit similar fits to the catch data.

4.6 Fits to Survey Indices and Related Data

4.6.1 Graphs of model fits to survey biomass and numbers

Model fits to the survey biomass time series from the NMFS EBS shelf survey and the BSFRF SBS surveys are shown for the models in Figure 32. Residuals to the fits and summary fit statistics are shown in Figures 33-36. The fits to the NMFS survey data are similar in pattern across all the models, with particularly poor fits in 1985 for both males and immature females. The models also substantially overpredict NMFS survey biomass for males in 2022 and 2023. The fits to the BSFRF data are much more acceptable, although all of the models overpredict mature female biomass in all years.

Model fits to the survey abundance time series for both the NMFS EBS shelf survey and the BSFRF SBS surveys are shown for the models in Figure 37. Residuals to the fits and summary fit statistics are shown in Figures 38-41. Fits to survey abundance are not included in the model objective function but serve as independent diagnostics of model fit. As with survey biomass, all of the models exhibit fairly similar fits to the abundance data, and these fits generally exhibit temporal patterns that are similar to those for survey biomass. Somewhat unexpectedly, the fits to male abundance in the 2022 and 2023 NMFS surveys are much better than those for biomass.

4.6.2 Graphs of model fits to other data

Model fits to molt increment growth data, as well as residual patterns and summary fit statistics, are illustrated in Figure 42. The predicted mean growth curves are essentially identical across the models, with all of the models overpredicting post-molt size for large crab of either sex. In contrast, the summary residual statistics reveal some differences among the models: 22.03d fits the growth data slightly better than the other models.

Model fits to maturity ogive data from the NMFS EBS shelf survey are presented in Figure 43, while Pearson's residuals to the fits are shown in Figure 44. The models appear to fit the maturity ogive data to an identical degree.

4.7 Fits to Fishery Size Compositions

Fits to the observed and model-predicted fishery catch proportions by size class, as well as the resulting patterns of residuals, are presented in Figures 45-93 for the models. The models fit the total catch size composition data from the directed and bycatch fisheries by normalizing it across sexes and fitting the resulting proportions jointly. Graphs for the directed fishery are given in Figures 45-57. Graphs for the snow crab fishery are given in Figures 64-69. Graphs for the BBRKC fishery are given in Figures 76-81. Graphs for the groundfish fisheries are given in Figures 88-93. On the whole, the fits are very similar across all of the models.

4.8 Fits to Survey Size Compositions

Fits to the observed and model-predicted survey proportions by size class/sex/maturity state, as well as the resulting patterns of residuals, from the NMFS EBS shelf survey and the BSFRF SBS survey are presented in Figures 100-125 for the models. All of the models exhibit similar fits to the NMFS survey size composition data, with the most salient feature perhaps being that the models overpredict the proportion of crab in the largest size bins for both males and females starting around 2000. The fits to the BSFRF size composition data are similar across the models for males, but exhibit some differences for females–particularly for the 2016 immature females.

4.9 Marginal Distributions for Fits to Compositional Data

Marginal distributions for fits to the compositional data from the fisheries are shown in Figures 129-132. Marginal distributions for fits to the compositional data from the surveys are shown in Figure 133. Except for the BSFRF survey data, the fits to the marginal distributions are practically identical across all the models and none exhibit the problem with overpredicting the proportions of large crab noted for the fits to individual years because underpredictions in the early parts of the time series balance out overpredictions in the latter part of those time series. The models do exhibit some variability with respect to the marginal distributions for the BSFRF size compositions, reflecting the differences in fit to the individual size compositions and the relatively few years to available to form the marginal distributions.

Plots of implied versus input effective sample sizes and time-series of implied effective sample sizes.

Implied effective sample sizes were calculated by year for all size compositions using the McAllister-Ianelli method (McAllister and Ianelli 1997). Time series plots of implied and input effective sample sizes for compositional data from the fisheries are shown in Figures 134-138. Similar plots for the survey compositional data are given in Figures 139 and 140. The implied sample sizes were very similar across the models for the fishery size compositions and were larger than the input sample sizes for most years. This was also the case for the NMFS survey size compositions, although the implied sample sizes from the models were consistently smaller than the input sample sizes for males before 1989. In contrast, the implied sample sizes were smaller than the input sample sizes for males in the BSFRF SBS data in all years in all models except 22.03d, in which they exceeded the input sample sizes in two years. For immature females in the BSFRF SBS data, the effective sample sizes were similar for all of the models and exceeded the input sample sizes in two of the six years of data. For mature females, the effective sample sizes were larger than the input sample sizes in all years for all of the models; effective sample sizes were larger in 2015 and 2016 for 22.03b3 and 22.03d relative to the other models, but similar in other years. Using the revised availability curves (models 22.03b3 and 22.03d), coupled with the addition of the 2018 BSFRF SBS data, appears to be the factor that "pushed" the effective sample size parameters in the Dirichlet-Multinomial likelihood to be estimated near (or at) their upper bounds.

5 Conclusion

The addition of the 2018 BSFRF SBS data, revisions to the 2013-2017 dataset, and updates to the empirical availability curves used to predict the BSFRF SBS data affected model performance and estimates in generally small ways. The only change that was concerning was that the effective sample size parameter associated with the Dirichlet-Multinomial likelihood applied to BSFRF SBS female size compositions increased to its upper bound when the empirical availability curves estimated by data-weighted gaussian GAMS replaced the original curves estimated without data weighting. Switching to the curves estimated by the preferred data-weighted binomial GAMs did not improve this aspect of the model fitting. Thus, this parameter needed to be fixed to a value near its upper limit. However, the effect of smaller parameter values in this instance is to reduce the effective size for the associated size compositions, and thus their influence on the overall model optimization. Consequently, the implication of this result is that the BSFRF SBS size compositions may have been underweighted in the overall likelihood in the previous assessment relative to other likelihood components.

References

CPT. 2024. Crab Plan Team report. North Pacific Fishery Management Council, Anchorage, AK. Available from https://meetings.npfmc.org/CommentReview/DownloadFile?p=03041f11-ae77-4b6a-9368-803256817cd8.pdf&fileName=C2%20CPT%20May%202024%20Report.pdf.

McAllister, M. K., and Ianelli, J.N. 1997. Bayesian stock assessment using catch-age data and the sampling-importance resampling algorithm. Can. J. Fish. Aquat. Sci. **54**(2): 284–300. doi:doi:10.1139/cjfas-54-2-284.

SSC. 2024. Scientific and Statistical Committee Final Report to the North Pacific Fishery Management Council. North Pacific Fishery Management Council, Anchorage, AK. Available from https://meetings.npfmc.org/CommentReview/DownloadFile?p=3f613228-e6a8-4e8b-abd6-221f9f88785a.pdf&fileName=SSC%20Report%20June%202024_FINAL.pdf.

Stockhausen, W.T. 2024. Tanner Crab Proposed Models. North Pacific Fishery Management Council, Anchorage, AK. Available from https://meetings.npfmc.org/CommentReview/DownloadFile?p=357c9428-80f9-488e-917e-d9c805947897.pdf&fileName=Tanner%20Crab%20proposed%20models_updated%20model%20numbering.pdf.

Tables

List of Tables

Table 1. TCSAM02 models parameters at bounds.

				22.03b	22.03b1	22.03b2	22.03b3	22.03d
likelihood	Dirichlet-Multinomial	pLnDirMul[2]	ln(theta) parameter for BSFRF SBS F	–	–	–	1	–

Table 2. TCSAM02 models final values for non-vector parameters related to recruitment, initial abundance, natural mortality, and growth. Parameters with values whose standard error is NA are fixed, not estimated.

			22.03b		22.03b1		22.03b2		22.03b3		22.03d	
process	name	label	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
recruitment	pLnR[1]	historical recruitment period	6.862	0.59	6.862	0.59	6.892	0.59	6.958	0.59	7.010	0.59
	pLnR[2]	current recruitment period	5.901	0.071	5.897	0.071	5.913	0.067	5.980	0.067	6.025	0.066
	pRa[1]	fixed value	2.233	0.031	2.233	0.031	2.222	0.030	2.204	0.031	2.181	0.031
	pRb[1]	fixed value	1.351	0.077	1.349	0.077	1.363	0.077	1.346	0.080	1.320	0.084
	pRCV[1]	full model period	-0.7000	NA	-0.7000	NA	-0.7000	NA	-0.7000	NA	-0.7000	NA
	pRX[1]	full model period	0.000	NA	0.000	NA	0.000	NA	0.000	NA	0.000	NA
natural mortality	pDM1[1]	multiplier for immature crab	1.029	0.047	1.030	0.047	1.062	0.046	1.085	0.046	1.106	0.046
	pDM1[2]	multiplier for mature males	1.349	0.038	1.351	0.038	1.358	0.037	1.373	0.037	1.386	0.037
	pDM1[3]	multiplier for mature females	1.341	0.038	1.342	0.038	1.361	0.037	1.361	0.037	1.363	0.037
	pDM2[1]	1980-1984 multiplier for mature males	2.345	0.24	2.345	0.24	2.325	0.24	2.364	0.25	2.373	0.25
	pDM2[2]	1980-1984 multiplier for mature females	1.966	0.17	1.967	0.17	1.944	0.17	1.958	0.17	1.966	0.17
	pM[1]	base ln-scale M	-1.470	NA	-1.470	NA	-1.470	NA	-1.470	NA	-1.470	NA
growth	pGrA[1]	males	32.33	0.25	32.33	0.25	32.33	0.24	32.20	0.23	32.15	0.22
	pGrA[2]	females	33.69	0.31	33.69	0.31	33.66	0.31	33.54	0.30	33.46	0.29
	pGrB[1]	males	166.0	0.73	166.1	0.73	166.2	0.72	166.0	0.71	165.9	0.70
	pGrB[2]	females	114.9	0.61	114.9	0.61	114.9	0.61	115.1	0.60	115.1	0.59
	pGrBeta[1]	both sexes	0.8166	0.099	0.8186	0.099	0.8299	0.10	0.7894	0.094	0.7642	0.090

Table 3. TCSAM02 models final values for annual recruitment "devs" in the "historical" period up to 1975. Index begins in 1948.

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	-0.4961	1.8	-0.4949	1.8	-0.4891	1.8	-0.4909	1.8	-0.4886	1.8
2	-0.4953	1.6	-0.4941	1.6	-0.4883	1.6	-0.4901	1.6	-0.4879	1.6
3	-0.4935	1.5	-0.4923	1.5	-0.4865	1.5	-0.4884	1.5	-0.4862	1.5
4	-0.4903	1.4	-0.4891	1.4	-0.4834	1.4	-0.4854	1.4	-0.4833	1.4
5	-0.4852	1.3	-0.4840	1.3	-0.4785	1.3	-0.4806	1.3	-0.4786	1.3
6	-0.4778	1.2	-0.4766	1.2	-0.4712	1.2	-0.4735	1.2	-0.4717	1.2
7	-0.4671	1.1	-0.4660	1.1	-0.4608	1.1	-0.4633	1.1	-0.4616	1.1
8	-0.4523	0.97	-0.4512	0.97	-0.4463	0.97	-0.4490	0.97	-0.4475	0.97
9	-0.4319	0.90	-0.4309	0.90	-0.4264	0.90	-0.4293	0.90	-0.4280	0.90
10	-0.4045	0.84	-0.4036	0.84	-0.3995	0.84	-0.4026	0.84	-0.4015	0.84
11	-0.3680	0.81	-0.3672	0.81	-0.3637	0.81	-0.3668	0.81	-0.3659	0.81
12	-0.3199	0.80	-0.3192	0.80	-0.3165	0.80	-0.3192	0.80	-0.3184	0.80
13	-0.2563	0.82	-0.2558	0.82	-0.2539	0.82	-0.2558	0.82	-0.2548	0.82
14	-0.1707	0.86	-0.1704	0.86	-0.1696	0.86	-0.1695	0.86	-0.1680	0.86
15	-0.05195	0.90	-0.05199	0.90	-0.05255	0.90	-0.04878	0.90	-0.04586	0.90
16	0.1205	0.94	0.1201	0.94	0.1177	0.94	0.1282	0.94	0.1341	0.94
17	0.3872	0.93	0.3860	0.93	0.3813	0.94	0.4032	0.93	0.4149	0.93
18	0.8028	0.88	0.8007	0.88	0.7935	0.88	0.8295	0.88	0.8495	0.87
19	1.362	0.78	1.359	0.78	1.349	0.79	1.389	0.78	1.412	0.77
20	1.678	0.67	1.676	0.67	1.666	0.67	1.662	0.67	1.653	0.66
21	1.200	0.68	1.200	0.68	1.199	0.69	1.144	0.69	1.109	0.69
22	0.6397	0.68	0.6398	0.68	0.6421	0.68	0.6024	0.68	0.5802	0.68
23	0.3565	0.66	0.3558	0.66	0.3508	0.66	0.3364	0.66	0.3223	0.66
24	-0.07634	0.66	-0.07756	0.66	-0.09196	0.67	-0.1150	0.66	-0.1393	0.66
25	-0.4516	0.66	-0.4529	0.66	-0.4658	0.67	-0.4657	0.67	-0.4770	0.66
26	-0.1578	0.70	-0.1589	0.70	-0.1545	0.70	-0.1012	0.69	-0.07037	0.69

Table 4. TCSAM02 models final values for annual recruitment "devs" in the "current" period from 1975. The index begins in 1975.

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	1.363	0.31	1.366	0.31	1.365	0.31	1.374	0.32	1.397	0.31
2	1.978	0.19	1.978	0.19	1.982	0.20	2.000	0.20	2.002	0.20
3	1.630	0.22	1.631	0.22	1.615	0.23	1.605	0.23	1.587	0.23
4	0.6179	0.42	0.6180	0.42	0.6127	0.42	0.5501	0.44	0.5054	0.45
5	-0.1172	0.53	-0.1170	0.53	-0.1360	0.54	-0.1040	0.53	-0.08843	0.52
6	-0.1723	0.41	-0.1718	0.41	-0.1761	0.41	-0.1642	0.41	-0.1664	0.41
7	-0.001938	0.29	-0.001473	0.29	-0.003738	0.29	0.01879	0.29	0.03255	0.29
8	-0.1593	0.28	-0.1581	0.28	-0.1614	0.29	-0.1509	0.29	-0.1320	0.29
9	1.069	0.12	1.070	0.12	1.079	0.12	1.099	0.12	1.113	0.12
10	0.7746	0.17	0.7766	0.17	0.7785	0.17	0.7815	0.17	0.7879	0.17
11	0.9094	0.16	0.9124	0.16	0.9257	0.17	0.9005	0.17	0.8869	0.17
12	0.9429	0.15	0.9455	0.15	0.9577	0.15	0.9579	0.15	0.9601	0.15
13	0.7695	0.17	0.7728	0.17	0.7858	0.17	0.7691	0.17	0.7638	0.17
14	0.3943	0.20	0.3954	0.20	0.3926	0.21	0.3362	0.21	0.2877	0.21
15	-0.3706	0.26	-0.3701	0.26	-0.3704	0.26	-0.3809	0.26	-0.3902	0.25
16	-1.083	0.35	-1.081	0.35	-1.080	0.35	-1.105	0.35	-1.115	0.35
17	-1.366	0.32	-1.365	0.32	-1.365	0.32	-1.388	0.33	-1.404	0.33
18	-1.297	0.26	-1.297	0.26	-1.293	0.26	-1.287	0.26	-1.285	0.26
19	-1.293	0.26	-1.293	0.26	-1.298	0.26	-1.285	0.26	-1.271	0.26
20	-1.118	0.24	-1.118	0.24	-1.120	0.25	-1.113	0.25	-1.112	0.25
21	-0.6249	0.18	-0.6253	0.18	-0.6248	0.18	-0.6095	0.18	-0.5988	0.18
22	-0.8545	0.23	-0.8543	0.23	-0.8551	0.24	-0.8504	0.24	-0.8394	0.24
23	0.06910	0.12	0.06826	0.12	0.06684	0.12	0.06470	0.12	0.05852	0.12
24	-0.9424	0.25	-0.9428	0.25	-0.9505	0.25	-0.9502	0.25	-0.9446	0.25
25	0.6167	0.099	0.6159	0.099	0.6155	0.099	0.6275	0.099	0.6347	0.098
26	-0.5172	0.28	-0.5174	0.28	-0.5282	0.28	-0.5486	0.29	-0.5581	0.30
27	1.003	0.10	1.002	0.10	1.001	0.10	1.000	0.10	0.9950	0.10
28	-0.2241	0.29	-0.2250	0.29	-0.2357	0.29	-0.2212	0.29	-0.2054	0.29
29	1.099	0.11	1.099	0.11	1.099	0.11	1.091	0.11	1.082	0.11
30	0.5298	0.15	0.5291	0.15	0.5173	0.15	0.4751	0.16	0.4330	0.16
31	-0.6041	0.28	-0.6047	0.28	-0.6132	0.28	-0.6324	0.28	-0.6368	0.28
32	-1.068	0.36	-1.068	0.36	-1.076	0.37	-1.108	0.37	-1.127	0.37
33	-0.5162	0.26	-0.5174	0.26	-0.5204	0.26	-0.5166	0.26	-0.5224	0.27
34	-0.06014	0.27	-0.06098	0.27	-0.06088	0.27	-0.002163	0.27	0.07660	0.26
35	1.394	0.095	1.393	0.095	1.388	0.095	1.381	0.098	1.358	0.10

(continued)

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
36	0.3749	0.20	0.3731	0.20	0.3400	0.20	0.3052	0.20	0.2690	0.20
37	-0.3674	0.20	-0.3705	0.20	-0.3951	0.21	-0.4183	0.21	-0.4255	0.21
38	-1.665	0.38	-1.669	0.38	-1.694	0.38	-1.690	0.39	-1.634	0.38
39	-0.7416	0.16	-0.7434	0.16	-0.7712	0.16	-0.7196	0.15	-0.7223	0.15
40	-1.291	0.22	-1.292	0.22	-1.322	0.23	-1.377	0.23	-1.465	0.24
41	-1.129	0.20	-1.128	0.20	-1.160	0.20	-1.303	0.21	-1.317	0.21
42	-1.006	0.21	-1.006	0.21	-1.006	0.21	-0.7300	0.16	-0.6508	0.14
43	0.7964	0.080	0.7987	0.079	0.7693	0.076	0.7648	0.075	0.7791	0.073
44	-0.1233	0.19	-0.1271	0.19	0.1783	0.13	0.1617	0.13	0.1641	0.13
45	0.3454	0.13	0.3455	0.13	0.2450	0.14	0.2436	0.14	0.2323	0.14
46	-1.587	0.57	-1.586	0.57	-1.561	0.57	-1.534	0.57	-1.490	0.57
47	0.7880	0.14	0.7882	0.14	0.8162	0.14	0.8417	0.14	0.8692	0.14
48	1.469	0.15	1.470	0.15	1.482	0.15	1.492	0.15	1.501	0.15
49	1.365	0.23	1.365	0.23	1.364	0.23	1.348	0.23	1.326	0.23

Table 5. TCSAM02 models final values for parameters related to the probability of terminal molt. Index corresponds to 5-mm size bin starting at 50 mm CW for females and 60 mm CW for males.

		22.03b		22.03b1		22.03b2		22.03b3		22.03d	
label	index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
females 50-105 mmCW (entire model period)	1	-5.425	1.2	-5.422	1.2	-5.363	1.2	-5.343	1.2	-5.316	1.2
	2	-4.159	0.57	-4.158	0.57	-4.121	0.57	-4.111	0.57	-4.094	0.56
	3	-2.931	0.25	-2.930	0.25	-2.912	0.25	-2.910	0.25	-2.905	0.25
	4	-1.711	0.15	-1.711	0.15	-1.701	0.15	-1.698	0.15	-1.698	0.15
	5	-0.5840	0.091	-0.5852	0.091	-0.5750	0.091	-0.5704	0.090	-0.5676	0.090
	6	0.2544	0.091	0.2542	0.091	0.2666	0.091	0.2708	0.091	0.2696	0.090
	7	0.5724	0.10	0.5718	0.10	0.5847	0.10	0.5922	0.10	0.5851	0.10
	8	1.063	0.14	1.063	0.14	1.071	0.14	1.071	0.14	1.075	0.14
	9	1.949	0.23	1.949	0.23	1.944	0.23	1.938	0.22	1.974	0.23
	10	2.904	0.44	2.902	0.44	2.870	0.44	2.866	0.44	2.918	0.45
	11	3.922	1.0	3.919	1.0	3.854	0.99	3.869	0.98	3.911	1.0
males 60-150 mmCW (entire model period)	1	-2.988	0.21	-2.988	0.21	-2.992	0.21	-2.960	0.21	-2.933	0.20
	2	-3.561	0.30	-3.560	0.30	-3.555	0.30	-3.552	0.30	-3.576	0.30
	3	-3.016	0.25	-3.015	0.25	-3.001	0.25	-3.001	0.25	-3.018	0.25
	4	-2.139	0.13	-2.139	0.13	-2.146	0.13	-2.147	0.13	-2.149	0.13
	5	-1.342	0.11	-1.342	0.11	-1.352	0.11	-1.349	0.11	-1.349	0.11
	6	-1.236	0.10	-1.237	0.10	-1.238	0.10	-1.238	0.10	-1.246	0.10
	7	-0.7567	0.096	-0.7560	0.096	-0.7587	0.096	-0.7649	0.095	-0.7775	0.095
	8	-0.2357	0.086	-0.2354	0.086	-0.2372	0.086	-0.2366	0.086	-0.2316	0.085
	9	-0.2080	0.088	-0.2077	0.088	-0.2119	0.088	-0.2132	0.087	-0.2150	0.087
	10	0.1413	0.089	0.1401	0.089	0.1351	0.089	0.1376	0.088	0.1474	0.088
	11	0.5439	0.094	0.5417	0.094	0.5314	0.094	0.5385	0.093	0.5436	0.092
	12	1.020	0.12	1.022	0.12	1.025	0.12	1.004	0.12	0.9954	0.11
	13	1.620	0.14	1.621	0.14	1.623	0.14	1.605	0.14	1.594	0.14
	14	2.640	0.26	2.641	0.26	2.640	0.26	2.626	0.26	2.619	0.26
	15	3.129	0.28	3.129	0.28	3.128	0.28	3.112	0.28	3.103	0.28
	16	3.715	0.49	3.716	0.49	3.712	0.49	3.673	0.48	3.647	0.48
	17	4.786	1.1	4.787	1.1	4.784	1.1	4.715	1.1	4.671	1.1

Table 6. TCSAM02 models final values for non-vector parameters related to fisheries, surveys, and the Dirichlet-Multinomial likelihood. Parameters with values whose standard error is NA are fixed, not estimated.

			22.03b		22.03b1		22.03b2		22.03b3		22.03d	
process	name	label	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
fisheries	pDC2[1]	TCF: female offset	-2.757	0.21	-2.759	0.21	-2.745	0.20	-2.789	0.20	-2.778	0.21
	pDC2[2]	SCF: female offset	-2.682	0.34	-2.685	0.34	-2.676	0.34	-2.704	0.34	-2.704	0.34
	pDC2[3]	GTF: female offset	-1.045	0.097	-1.047	0.097	-1.040	0.096	-1.069	0.098	-1.080	0.098
	pDC2[4]	RKF: female offset	-2.399	0.84	-2.402	0.84	-2.400	0.84	-2.450	0.84	-2.409	0.84
	pHM[1]	handling mortality for pot fisheries	0.3210	NA	0.3210	NA	0.3210	NA	0.3210	NA	0.3210	NA
	pHM[2]	handling mortality for groundfish trawl fisheries	0.8000	NA	0.8000	NA	0.8000	NA	0.8000	NA	0.8000	NA
	pLgtRet[1]	TCF: logit-scale max retention (pre-1997)	14.90	NA	14.90	NA	14.90	NA	14.90	NA	14.90	NA
	pLgtRet[2]	TCF: logit-scale max retention (2005-2009)	14.90	NA	14.90	NA	14.90	NA	14.90	NA	14.90	NA
	pLgtRet[3]	TCF: logit-scale max retention (2013+)	14.90	NA	14.90	NA	14.90	NA	14.90	NA	14.90	NA
	pLnC[1]	TCF: base capture rate, pre-1965 (=0.05)	-2.996	NA	-2.996	NA	-2.996	NA	-2.996	NA	-2.996	NA
	pLnC[2]	TCF: base capture rate, 1965+	-1.501	0.12	-1.497	0.12	-1.479	0.12	-1.479	0.12	-1.472	0.12
	pLnC[3]	SCF: base capture rate, pre-1978 (=0.01)	-4.605	NA	-4.605	NA	-4.605	NA	-4.605	NA	-4.605	NA
	pLnC[4]	SCF: base capture rate, 1992+	-3.752	0.071	-3.745	0.071	-3.716	0.068	-3.724	0.068	-3.720	0.068
	pLnC[5]	DUMMY CAPTURE RATE	-4.181	NA	-4.181	NA	-4.181	NA	-4.181	NA	-4.181	NA
	pLnC[6]	GTF: base capture rate, ALL YEARS	-5.008	0.060	-5.001	0.060	-4.979	0.058	-4.983	0.059	-4.979	0.059
	pLnC[7]	RKF: base capture rate, pre-1953 (=0.02)	-3.912	NA	-3.912	NA	-3.912	NA	-3.912	NA	-3.912	NA
	pLnC[8]	RKF: base capture rate, 1992+	-4.750	0.11	-4.744	0.11	-4.720	0.11	-4.714	0.11	-4.698	0.11
surveys	pQ[1]	NMFS trawl survey: males, 1975-1981	-0.7497	0.11	-0.7450	0.11	-0.7235	0.11	-0.7312	0.11	-0.7328	0.11
	pQ[2]	NMFS trawl survey: males, 1982+	-0.7258	0.052	-0.7189	0.052	-0.6882	0.049	-0.6893	0.049	-0.6786	0.048
	pQ[3]	NMFS trawl survey: females, 1975-1981	-1.155	0.14	-1.152	0.14	-1.113	0.13	-1.138	0.13	-1.138	0.13
	pQ[4]	NMFS trawl survey: females, 1982+	-1.391	0.076	-1.385	0.076	-1.337	0.072	-1.357	0.072	-1.348	0.072
	pQ[5]	BSFRF SBS	0.000	NA	0.000	NA	0.000	NA	0.000	NA	0.000	NA
Dirichlet-Multinomial	pLnDirMul[1]	ln(theta) parameter for BSFRF SBS M	0.9312	0.25	0.9234	0.24	1.110	0.25	1.142	0.25	10.68	6.2
	pLnDirMul[2]	ln(theta) parameter for BSFRF SBS F	2.523	0.24	2.519	0.24	2.729	0.24	11.00	0.057	11.00	1.3

Table 7. TCSAM02 models final values for fishing mortality "devs" for the directed fishery. The index starts in 1965 (or 1982 for models 22.07 and 22.08) and does not include years when the fishery was completely closed.

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	-1.302	0.88	-1.308	0.88	-1.329	0.88	-1.323	0.88	-1.329	0.89
2	-1.093	0.73	-1.098	0.73	-1.119	0.73	-1.113	0.73	-1.119	0.73
3	0.7475	0.66	0.7425	0.67	0.7220	0.67	0.7298	0.67	0.7252	0.67
4	1.323	0.64	1.318	0.64	1.298	0.64	1.308	0.65	1.304	0.65
5	2.471	0.89	2.465	0.89	2.445	0.89	2.462	0.90	2.462	0.91
6	4.127	0.76	4.123	0.76	4.111	0.77	4.128	0.75	4.130	0.76
7	4.631	0.79	4.628	0.79	4.618	0.80	4.604	0.83	4.589	0.88
8	2.075	1.2	2.072	1.2	2.053	1.2	2.026	1.3	1.995	1.3
9	0.08760	0.35	0.08478	0.35	0.07103	0.35	0.05958	0.35	0.04222	0.36
10	-0.2471	0.21	-0.2496	0.21	-0.2615	0.21	-0.2699	0.22	-0.2848	0.22
11	-0.1150	0.18	-0.1173	0.18	-0.1291	0.18	-0.1340	0.18	-0.1462	0.18
12	0.6381	0.18	0.6361	0.18	0.6255	0.18	0.6225	0.18	0.6120	0.18
13	1.373	0.20	1.372	0.20	1.369	0.20	1.361	0.21	1.349	0.21
14	1.597	0.28	1.599	0.28	1.612	0.28	1.588	0.28	1.574	0.28
15	2.014	0.35	2.019	0.35	2.043	0.35	1.996	0.35	1.976	0.34
16	1.819	0.26	1.822	0.26	1.834	0.26	1.832	0.26	1.831	0.26
17	0.2080	0.15	0.2077	0.15	0.2046	0.15	0.2223	0.15	0.2300	0.15
18	-0.9157	0.13	-0.9161	0.13	-0.9195	0.13	-0.9152	0.13	-0.9143	0.13
19	-2.341	0.13	-2.341	0.13	-2.342	0.13	-2.343	0.13	-2.344	0.13
20	-1.027	0.14	-1.026	0.14	-1.027	0.14	-1.022	0.14	-1.020	0.15
21	-1.381	0.12	-1.381	0.12	-1.383	0.12	-1.382	0.13	-1.380	0.13
22	-0.4222	0.12	-0.4232	0.12	-0.4278	0.12	-0.4210	0.12	-0.4168	0.13
23	0.7617	0.13	0.7608	0.13	0.7561	0.13	0.7563	0.13	0.7545	0.13
24	1.518	0.13	1.518	0.13	1.516	0.13	1.520	0.13	1.521	0.14
25	1.828	0.16	1.828	0.16	1.826	0.16	1.842	0.16	1.854	0.16
26	2.157	0.17	2.159	0.17	2.162	0.17	2.171	0.17	2.178	0.17
27	1.711	0.17	1.712	0.17	1.716	0.17	1.719	0.17	1.722	0.17
28	0.9555	0.17	0.9573	0.17	0.9666	0.17	0.9603	0.18	0.9640	0.18
29	0.3663	0.17	0.3689	0.17	0.3816	0.17	0.3626	0.17	0.3608	0.17
30	0.2977	0.22	0.2999	0.22	0.3121	0.22	0.2938	0.22	0.2909	0.22
31	-2.362	0.13	-2.362	0.13	-2.363	0.13	-2.357	0.13	-2.352	0.13
32	-1.744	0.13	-1.744	0.13	-1.744	0.13	-1.734	0.13	-1.724	0.13
33	-1.921	0.12	-1.920	0.12	-1.920	0.12	-1.915	0.13	-1.909	0.13
34	-2.079	0.12	-2.078	0.12	-2.079	0.12	-2.067	0.13	-2.056	0.13

(continued)

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
35	-2.104	0.15	-2.104	0.15	-2.106	0.15	-2.093	0.15	-2.082	0.15
36	-1.953	0.13	-1.951	0.13	-1.948	0.13	-1.931	0.13	-1.915	0.13
37	-0.6772	0.12	-0.6751	0.12	-0.6675	0.12	-0.6501	0.13	-0.6325	0.13
38	-0.3711	0.12	-0.3678	0.12	-0.3536	0.12	-0.3513	0.12	-0.3398	0.13
39	-2.076	0.12	-2.071	0.12	-2.049	0.12	-2.057	0.12	-2.051	0.13
40	-1.917	0.12	-1.912	0.12	-1.886	0.12	-1.896	0.12	-1.889	0.13
41	-2.119	0.13	-2.115	0.13	-2.086	0.12	-2.087	0.13	-2.074	0.13
42	-2.448	0.13	-2.445	0.13	-2.419	0.13	-2.420	0.13	-2.406	0.13
43	-2.090	0.13	-2.089	0.13	-2.083	0.13	-2.084	0.13	-2.080	0.13

Table 8. TCSAM02 models final values for fishing mortality "devs" for the snow crab fishery. The indices start in 1990.

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	1.500	0.20	1.497	0.20	1.485	0.20	1.490	0.20	1.489	0.20
2	1.748	0.20	1.746	0.20	1.734	0.20	1.740	0.20	1.739	0.20
3	0.7377	0.19	0.7360	0.20	0.7278	0.20	0.7319	0.19	0.7310	0.19
4	1.121	0.18	1.120	0.19	1.115	0.19	1.117	0.18	1.118	0.18
5	0.5481	0.18	0.5477	0.18	0.5458	0.18	0.5456	0.18	0.5464	0.18
6	0.4713	0.19	0.4714	0.19	0.4717	0.19	0.4700	0.19	0.4709	0.19
7	1.312	0.20	1.313	0.20	1.315	0.20	1.315	0.20	1.317	0.20
8	1.082	0.21	1.082	0.21	1.082	0.21	1.079	0.21	1.075	0.21
9	0.1489	0.20	0.1492	0.20	0.1487	0.20	0.1468	0.20	0.1439	0.20
10	-1.460	0.21	-1.460	0.21	-1.461	0.21	-1.463	0.21	-1.466	0.21
11	-0.7120	0.21	-0.7121	0.21	-0.7146	0.21	-0.7151	0.21	-0.7188	0.21
12	-0.2581	0.21	-0.2584	0.21	-0.2614	0.21	-0.2599	0.21	-0.2627	0.21
13	-1.543	0.21	-1.543	0.21	-1.547	0.21	-1.546	0.21	-1.549	0.21
14	-2.660	0.24	-2.660	0.24	-2.665	0.24	-2.663	0.24	-2.666	0.24
15	-1.971	0.19	-1.971	0.19	-1.976	0.19	-1.976	0.19	-1.980	0.19
16	-0.009352	0.20	-0.01007	0.20	-0.01522	0.20	-0.01235	0.20	-0.01235	0.20
17	0.1356	0.19	0.1350	0.19	0.1298	0.19	0.1294	0.19	0.1269	0.19
18	0.1713	0.19	0.1706	0.19	0.1654	0.19	0.1681	0.19	0.1683	0.19
19	-0.4576	0.20	-0.4582	0.20	-0.4621	0.20	-0.4596	0.20	-0.4592	0.20
20	-0.07353	0.20	-0.07384	0.20	-0.07627	0.20	-0.07859	0.20	-0.08026	0.20
21	0.02648	0.20	0.02650	0.20	0.02543	0.20	0.02240	0.20	0.02084	0.20
22	0.5734	0.20	0.5736	0.20	0.5727	0.20	0.5742	0.20	0.5752	0.20
23	0.2741	0.20	0.2741	0.20	0.2715	0.20	0.2804	0.20	0.2844	0.20
24	0.2001	0.20	0.2000	0.20	0.1972	0.20	0.2104	0.20	0.2183	0.20
25	1.038	0.19	1.038	0.19	1.036	0.19	1.040	0.19	1.043	0.19
26	0.8372	0.19	0.8384	0.19	0.8427	0.19	0.8379	0.19	0.8396	0.19
27	0.6638	0.20	0.6661	0.20	0.6763	0.20	0.6679	0.20	0.6668	0.20
28	0.04276	0.20	0.04491	0.20	0.05907	0.20	0.04889	0.20	0.04729	0.20
29	0.04770	0.20	0.05018	0.20	0.06641	0.20	0.05682	0.20	0.05799	0.20
30	0.3588	0.20	0.3612	0.20	0.3796	0.20	0.3756	0.20	0.3811	0.20
31	-1.622	0.21	-1.621	0.21	-1.603	0.21	-1.606	0.21	-1.599	0.21
32	-2.272	0.23	-2.272	0.23	-2.266	0.23	-2.269	0.23	-2.268	0.23

Table 9. TCSAM02 models final values for fishing mortality "devs" for the BBRKC fishery. The indices start in 1990.

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	3.773	0.23	3.771	0.23	3.763	0.23	3.762	0.23	3.755	0.23
2	3.451	0.24	3.450	0.24	3.443	0.24	3.449	0.24	3.449	0.24
3	3.243	0.25	3.243	0.25	3.238	0.25	3.240	0.25	3.236	0.25
4	4.164	0.23	4.163	0.23	4.159	0.23	4.156	0.23	4.149	0.23
5	2.205	0.24	2.207	0.24	2.214	0.24	2.197	0.24	2.190	0.24
6	0.9511	0.26	0.9524	0.26	0.9566	0.26	0.9435	0.26	0.9380	0.26
7	0.7002	0.26	0.7012	0.26	0.7042	0.26	0.6929	0.26	0.6875	0.26
8	0.2824	0.27	0.2830	0.27	0.2838	0.27	0.2755	0.27	0.2710	0.27
9	0.06274	0.28	0.06273	0.28	0.06100	0.28	0.05452	0.28	0.04932	0.28
10	-0.5299	0.34	-0.5304	0.34	-0.5344	0.34	-0.5370	0.34	-0.5409	0.34
11	-0.3393	0.28	-0.3400	0.28	-0.3447	0.28	-0.3450	0.28	-0.3482	0.28
12	-0.6368	0.29	-0.6376	0.29	-0.6436	0.29	-0.6429	0.29	-0.6447	0.29
13	-0.9578	0.30	-0.9588	0.30	-0.9647	0.30	-0.9638	0.30	-0.9665	0.30
14	-1.319	0.33	-1.321	0.33	-1.329	0.33	-1.323	0.33	-1.323	0.33
15	-1.817	0.43	-1.819	0.43	-1.826	0.43	-1.819	0.43	-1.817	0.43
16	-1.271	0.26	-1.272	0.26	-1.279	0.26	-1.275	0.26	-1.274	0.26
17	0.1124	0.22	0.1111	0.22	0.1046	0.22	0.1132	0.22	0.1166	0.22
18	-0.3592	0.22	-0.3602	0.22	-0.3652	0.22	-0.3599	0.22	-0.3581	0.22
19	-2.025	0.41	-2.026	0.41	-2.029	0.41	-2.028	0.41	-2.029	0.41
20	-2.468	0.69	-2.468	0.69	-2.470	0.69	-2.469	0.69	-2.468	0.69
21	-1.431	0.32	-1.431	0.32	-1.433	0.32	-1.427	0.32	-1.423	0.32
22	-0.3982	0.23	-0.3987	0.23	-0.4030	0.23	-0.3869	0.23	-0.3780	0.23
23	0.2625	0.22	0.2622	0.22	0.2603	0.22	0.2773	0.22	0.2887	0.22
24	-0.1473	0.22	-0.1465	0.22	-0.1423	0.22	-0.1379	0.22	-0.1311	0.22
25	-0.1820	0.22	-0.1804	0.22	-0.1708	0.22	-0.1753	0.22	-0.1731	0.22
26	0.03261	0.22	0.03460	0.22	0.04721	0.22	0.04010	0.22	0.04023	0.22
27	-0.6683	0.25	-0.6660	0.25	-0.6504	0.25	-0.6577	0.25	-0.6562	0.25
28	-1.897	0.68	-1.895	0.68	-1.877	0.68	-1.882	0.68	-1.877	0.68
29	-2.793	1.3	-2.791	1.3	-2.772	1.3	-2.772	1.3	-2.763	1.3

Table 10. TCSAM02 models final values for fishing mortality "devs" vectors for the groundfish fisheries. Indices start in 1973.

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	1.495	0.23	1.493	0.23	1.482	0.23	1.469	0.23	1.451	0.23
2	1.829	0.21	1.827	0.21	1.816	0.21	1.805	0.21	1.789	0.21
3	0.9887	0.21	0.9866	0.21	0.9770	0.21	0.9677	0.21	0.9535	0.21
4	0.4594	0.21	0.4576	0.21	0.4498	0.21	0.4405	0.21	0.4276	0.21
5	0.1311	0.21	0.1298	0.21	0.1246	0.21	0.1140	0.21	0.1015	0.21
6	-0.1531	0.21	-0.1539	0.21	-0.1569	0.21	-0.1688	0.21	-0.1812	0.21
7	0.4365	0.21	0.4361	0.21	0.4354	0.21	0.4210	0.21	0.4082	0.21
8	0.07031	0.21	0.07018	0.21	0.07035	0.21	0.05844	0.21	0.04769	0.21
9	-0.1028	0.20	-0.1028	0.20	-0.1030	0.20	-0.1124	0.20	-0.1211	0.20
10	-1.036	0.20	-1.036	0.20	-1.036	0.20	-1.044	0.20	-1.051	0.20
11	-0.3013	0.20	-0.3009	0.20	-0.3014	0.20	-0.3046	0.20	-0.3089	0.20
12	-0.02304	0.21	-0.02246	0.21	-0.02389	0.21	-0.02242	0.21	-0.02454	0.21
13	-0.5094	0.20	-0.5092	0.20	-0.5117	0.20	-0.5115	0.20	-0.5148	0.20
14	-0.2439	0.20	-0.2443	0.20	-0.2488	0.20	-0.2507	0.20	-0.2561	0.20
15	-0.3566	0.20	-0.3572	0.20	-0.3638	0.20	-0.3626	0.20	-0.3682	0.20
16	-0.8523	0.20	-0.8533	0.20	-0.8617	0.20	-0.8613	0.20	-0.8683	0.20
17	-0.5638	0.20	-0.5652	0.20	-0.5747	0.20	-0.5740	0.20	-0.5812	0.20
18	-0.1902	0.20	-0.1915	0.20	-0.2013	0.20	-0.1995	0.20	-0.2061	0.20
19	0.6432	0.15	0.6421	0.15	0.6324	0.15	0.6338	0.15	0.6266	0.15
20	0.9007	0.15	0.9002	0.15	0.8931	0.15	0.8933	0.15	0.8864	0.15
21	0.6129	0.15	0.6129	0.15	0.6089	0.15	0.6077	0.15	0.6013	0.15
22	1.046	0.15	1.046	0.15	1.045	0.15	1.042	0.15	1.036	0.15
23	0.9548	0.15	0.9557	0.15	0.9567	0.15	0.9533	0.15	0.9477	0.15
24	1.130	0.15	1.131	0.15	1.134	0.15	1.131	0.15	1.125	0.15
25	1.583	0.15	1.583	0.15	1.588	0.15	1.589	0.15	1.595	0.15
26	1.445	0.15	1.445	0.15	1.450	0.15	1.452	0.15	1.458	0.15
27	0.9188	0.15	0.9192	0.15	0.9225	0.15	0.9259	0.15	0.9319	0.15
28	0.9573	0.15	0.9575	0.15	0.9598	0.15	0.9647	0.15	0.9709	0.15
29	1.180	0.15	1.180	0.15	1.182	0.15	1.188	0.15	1.195	0.15
30	0.4750	0.15	0.4750	0.15	0.4762	0.15	0.4827	0.15	0.4900	0.15
31	-0.06963	0.15	-0.06973	0.15	-0.06916	0.15	-0.06205	0.15	-0.05436	0.15
32	0.2206	0.15	0.2204	0.15	0.2208	0.15	0.2288	0.15	0.2369	0.15
33	-0.1107	0.15	-0.1109	0.15	-0.1108	0.15	-0.1025	0.15	-0.09391	0.15
34	-0.1376	0.15	-0.1378	0.15	-0.1378	0.15	-0.1298	0.15	-0.1214	0.15
35	-0.04778	0.15	-0.04802	0.15	-0.04798	0.15	-0.03973	0.15	-0.03104	0.15

(continued)

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
36	-0.3839	0.15	-0.3840	0.15	-0.3833	0.15	-0.3768	0.15	-0.3694	0.15
37	-0.7573	0.14	-0.7571	0.14	-0.7549	0.14	-0.7504	0.14	-0.7433	0.14
38	-1.095	0.14	-1.095	0.14	-1.090	0.14	-1.085	0.14	-1.076	0.14
39	-0.7880	0.14	-0.7875	0.14	-0.7823	0.14	-0.7729	0.14	-0.7615	0.14
40	-1.269	0.15	-1.268	0.15	-1.264	0.15	-1.250	0.15	-1.236	0.15
41	-0.7032	0.15	-0.7027	0.15	-0.6979	0.15	-0.6853	0.15	-0.6715	0.15
42	-0.6180	0.15	-0.6171	0.15	-0.6100	0.14	-0.6038	0.15	-0.5930	0.15
43	-0.7509	0.14	-0.7493	0.14	-0.7377	0.14	-0.7375	0.14	-0.7295	0.14
44	-0.6526	0.14	-0.6505	0.14	-0.6348	0.14	-0.6387	0.14	-0.6325	0.14
45	-1.218	0.14	-1.216	0.14	-1.196	0.14	-1.200	0.14	-1.194	0.14
46	-0.9073	0.14	-0.9051	0.14	-0.8897	0.14	-0.8915	0.14	-0.8827	0.14
47	-0.7780	0.15	-0.7763	0.15	-0.7607	0.15	-0.7596	0.15	-0.7488	0.15
48	-0.8471	0.15	-0.8463	0.15	-0.8374	0.15	-0.8353	0.15	-0.8257	0.15
49	-0.8609	0.15	-0.8611	0.15	-0.8661	0.15	-0.8654	0.15	-0.8615	0.15
50	-1.150	0.15	-1.151	0.15	-1.170	0.15	-1.171	0.15	-1.173	0.15

Table 11. TCSAM02 models final values for the "pS1" parameters related to selectivity functions. Parameters with values whose standard error is NA are fixed, not estimated.

			22.03b		22.03b1		22.03b2		22.03b3		22.03d
name	label	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
pS1[1]	size at 1 for NMFS survey selectivity (males, pre-1982)	179.0	NA	179.0	NA	179.0	NA	179.0	NA	179.0	NA
pS1[10]	ascending z-at-1 for SCF selectivity (males, pre-1997)	160.1	2.8	160.1	2.8	160.1	2.8	160.1	2.7	160.2	2.6
pS1[11]	ascending z-at-1 for SCF selectivity (males, 1997-2004)	119.3	6.9	119.3	6.9	119.4	6.8	119.6	6.8	119.7	6.8
pS1[12]	ascending z-at-1 for SCF selectivity (males, 2005+)	125.0	1.3	125.0	1.3	125.0	1.3	125.0	1.3	125.1	1.3
pS1[13]	ascending z50 for SCF selectivity (females, pre-1997)	81.08	7.1	81.08	7.1	81.18	7.0	81.10	6.8	81.39	7.0
pS1[14]	ascending z50 for SCF selectivity (females, 1997-2004)	72.69	4.4	72.68	4.4	72.75	4.4	72.74	4.3	72.87	4.3
pS1[15]	ascending z50 for SCF selectivity (females, 2005+)	101.6	8.8	101.5	8.8	101.3	8.7	101.0	8.6	100.9	8.6
pS1[16]	z50 for GF.AllGear selectivity (males, pre-1987)	61.28	3.5	61.34	3.5	61.48	3.4	62.76	3.5	63.33	3.5
pS1[17]	z50 for GF.AllGear selectivity (males, 1987-1996)	72.57	6.9	72.68	6.9	72.89	6.8	74.55	6.8	75.21	6.8
pS1[18]	z50 for GF.AllGear selectivity (males, 1997+)	98.51	2.6	98.49	2.6	98.45	2.5	99.27	2.5	99.82	2.5
pS1[19]	z50 for GF.AllGear selectivity (females, pre-1987)	43.48	1.8	43.49	1.8	43.95	1.9	44.37	1.9	44.77	1.9
pS1[2]	size at 1 for NMFS survey selectivity (males, 1982+)	179.0	NA	179.0	NA	179.0	NA	179.0	NA	179.0	NA
pS1[20]	z50 for GF.AllGear selectivity (females, 1987-1996)	40.25	2.2	40.26	2.2	40.82	2.3	41.11	2.3	41.47	2.4
pS1[21]	z50 for GF.AllGear selectivity (females, 1997+)	87.48	3.2	87.44	3.2	87.23	3.1	87.28	3.1	87.45	3.1
pS1[22]	size at 1 for RKF selectivity (males, pre-1997)	179.9	NA	179.9	NA	179.9	NA	179.9	NA	179.9	NA
pS1[23]	size at 1 for RKF selectivity (males, 1997-2004)	179.9	NA	179.9	NA	179.9	NA	179.9	NA	179.9	NA
pS1[24]	size at 1 for RKF selectivity (males, 2005+)	179.9	NA	179.9	NA	179.9	NA	179.9	NA	179.9	NA
pS1[25]	size at 1 for RKF selectivity (females, pre-1997)	139.9	NA	139.9	NA	139.9	NA	139.9	NA	139.9	NA
pS1[26]	size at 1 for RKF selectivity (females, 1997-2004)	137.1	40.	137.1	40.	136.7	39.	136.4	39.	136.8	39.
pS1[27]	size at 1 for RKF selectivity (females, 2005+)	135.2	23.	135.2	23.	134.9	22.	134.8	22.	135.1	22.
pS1[28]	z50 for TCF retention (2005-2009)	137.6	0.28	137.6	0.28	137.6	0.28	137.6	0.28	137.6	0.28
pS1[29]	z50 for TCF retention (2013+)	125.1	0.81	125.1	0.81	125.1	0.80	125.2	0.81	125.2	0.81
pS1[3]	size at 1 for NMFS survey selectivity (females, pre-1982)	129.9	NA	129.9	NA	129.9	NA	129.9	NA	129.9	NA
pS1[4]	size at 1 for NMFS survey selectivity (females, 1982+)	129.9	NA	129.9	NA	129.9	NA	129.9	NA	129.9	NA
pS1[5]	z50 for TCF retention (pre-1991)	139.0	0.67	139.0	0.67	139.0	0.69	139.0	0.68	139.0	0.69
pS1[6]	z50 for TCF retention (1991-1996)	138.6	1.2	138.5	1.2	138.5	1.4	138.5	1.3	138.5	1.4
pS1[7]	DUMMY VALUE	4.500	NA	4.500	NA	4.500	NA	4.500	NA	4.500	NA
pS1[8]	ln(z50) for TCF selectivity (males)	4.839	0.0062	4.839	0.0062	4.838	0.0061	4.840	0.0061	4.841	0.0061
pS1[9]	z50 for TCF selectivity (females)	92.89	2.3	92.88	2.3	92.84	2.3	92.70	2.2	93.02	2.3

Table 12. TCSAM02 models final values for the "pS2" parameters related to selectivity functions. Parameters with values whose standard error is NA are fixed, not estimated.

			22.03b		22.03b1		22.03b2		22.03b3		22.03d
name	label	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
pS2[1]	width for NMFS survey selectivity (males, pre-1982)	65.69	2.5	65.67	2.5	65.28	2.4	64.24	2.3	63.62	2.2
pS2[10]	ascending width for SCF selectivity (males, pre-1997)	32.62	1.6	32.60	1.6	32.51	1.6	32.38	1.6	32.29	1.5
pS2[11]	ascending width for SCF selectivity (males, 1997-2004)	15.90	3.5	15.89	3.5	15.91	3.5	15.92	3.4	15.93	3.4
pS2[12]	ascending width for SCF selectivity (males, 2005+)	14.54	0.70	14.53	0.70	14.53	0.70	14.50	0.69	14.51	0.69
pS2[13]	slope for SCF selectivity (females, pre-1997)	0.1345	0.067	0.1345	0.067	0.1357	0.066	0.1369	0.066	0.1361	0.065
pS2[14]	slope for SCF selectivity (females, 1997-2004)	0.3180	0.24	0.3181	0.24	0.3181	0.24	0.3187	0.24	0.3166	0.23
pS2[15]	slope for SCF selectivity (females, 2005+)	0.09552	0.023	0.09555	0.023	0.09685	0.023	0.09770	0.024	0.09887	0.024
pS2[16]	slope for GF.AllGear selectivity (males, pre-1987)	0.08671	0.011	0.08664	0.011	0.08743	0.011	0.08551	0.010	0.08540	0.010
pS2[17]	slope for GF.AllGear selectivity (males, 1987-1996)	0.04363	0.0069	0.04362	0.0069	0.04433	0.0069	0.04409	0.0066	0.04445	0.0065
pS2[18]	slope for GF.AllGear selectivity (males, 1997+)	0.05839	0.0024	0.05844	0.0024	0.05896	0.0024	0.05926	0.0024	0.05953	0.0023
pS2[19]	slope for GF.AllGear selectivity (females, pre-1987)	0.1356	0.020	0.1357	0.020	0.1350	0.019	0.1344	0.019	0.1341	0.018
pS2[2]	width for NMFS survey selectivity (males, 1982+)	90.17	3.0	90.04	3.0	88.38	2.8	85.87	2.5	83.97	2.3
pS2[20]	slope for GF.AllGear selectivity (females, 1987-1996)	0.1649	0.054	0.1648	0.054	0.1589	0.052	0.1578	0.051	0.1557	0.050
pS2[21]	slope for GF.AllGear selectivity (females, 1997+)	0.06409	0.0042	0.06413	0.0042	0.06538	0.0042	0.06608	0.0042	0.06684	0.0041
pS2[22]	width for RKF selectivity (males, pre-1997)	19.87	0.80	19.87	0.80	19.87	0.80	19.83	0.79	19.80	0.79
pS2[23]	width for RKF selectivity (males, 1997-2004)	27.79	2.1	27.79	2.1	27.80	2.1	27.74	2.1	27.68	2.1
pS2[24]	width for RKF selectivity (males, 2005+)	27.34	0.97	27.35	0.97	27.38	0.97	27.26	0.95	27.17	0.95
pS2[25]	width for RKF selectivity (males, pre-1997)	17.99	2.4	17.99	2.4	18.01	2.4	18.05	2.4	17.90	2.3
pS2[26]	width for RKF selectivity (males, 1997-2004)	19.09	15.	19.09	15.	18.97	15.	18.92	15.	18.90	15.
pS2[27]	width for RKF selectivity (males, 2005+)	18.05	7.9	18.04	7.9	17.97	7.9	17.95	7.9	17.91	7.8
pS2[28]	slope for TCF retention (2005-2009)	1.990	NA	1.990	NA	1.990	NA	1.990	NA	1.990	NA
pS2[29]	slope for TCF retention (2013+)	0.3345	0.070	0.3346	0.070	0.3349	0.070	0.3329	0.070	0.3315	0.069
pS2[3]	width for NMFS survey selectivity (females, pre-1982)	41.58	2.3	41.59	2.3	41.11	2.2	40.72	2.1	40.26	2.0
pS2[4]	width for NMFS survey selectivity (females, 1982+)	84.76	7.4	84.63	7.3	80.00	6.1	77.04	5.5	73.90	4.8
pS2[5]	slope for TCF retention (pre-1991)	0.7107	0.19	0.7135	0.19	0.7235	0.20	0.7215	0.20	0.7278	0.20
pS2[6]	slope for TCF retention (1997+)	1.003	0.73	1.014	0.77	1.056	0.96	1.034	0.85	1.063	0.99
pS2[7]	slope for TCF selectivity (males, pre-1997)	0.1216	0.0067	0.1217	0.0067	0.1221	0.0067	0.1222	0.0067	0.1225	0.0066
pS2[8]	slope for TCF selectivity (males, 1997+)	0.1718	0.0074	0.1719	0.0074	0.1723	0.0074	0.1722	0.0073	0.1719	0.0073
pS2[9]	slope for TCF selectivity (females)	0.1935	0.025	0.1935	0.025	0.1951	0.025	0.1966	0.025	0.1952	0.025

Table 13. TCSAM02 models final values for the "pS3" and "pS4" parameters related to selectivity functions. Parameters with values whose standard error is NA are fixed, not estimated.

		22.03b		22.03b1		22.03b2		22.03b3		22.03d	
name	label	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
pS3[1]	scaled increment for descending z-at-1 for SCF selectivity (males, pre-1997)	0.001000	NA	0.001000	NA	0.001000	NA	0.001000	NA	0.001000	NA
pS3[2]	scaled increment for descending z-at-1 for SCF selectivity (males, 1997-2004)	0.001000	NA	0.001000	NA	0.001000	NA	0.001000	NA	0.001000	NA
pS3[3]	scaled increment for descending z-at-1 for SCF selectivity (males, 2005+)	0.001000	NA	0.001000	NA	0.001000	NA	0.001000	NA	0.001000	NA
pS4[1]	descending width for SCF selectivity (males, pre-1997)	1.100	NA	1.100	NA	1.100	NA	1.100	NA	1.100	NA
pS4[2]	descending width for SCF selectivity (males, 1997-2004)	19.93	9.3	19.93	9.2	19.87	9.2	19.77	9.2	19.85	9.3
pS4[3]	descending width for SCF selectivity (males, 2005+)	13.26	1.3	13.26	1.3	13.25	1.3	13.29	1.3	13.31	1.4

Table 14. TCSAM02 models final values for the devs parameters related to selectivity in the directed fishery. Parameters with values whose standard error is NA are fixed, not estimated.

	22.03b		22.03b1		22.03b2		22.03b3		22.03d	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	0.1072	0.014	0.1072	0.014	0.1069	0.014	0.1072	0.014	0.1073	0.014
2	0.08506	0.014	0.08509	0.014	0.08491	0.014	0.08514	0.014	0.08519	0.014
3	0.1236	0.013	0.1235	0.013	0.1231	0.013	0.1229	0.013	0.1224	0.013
4	0.1242	0.018	0.1241	0.018	0.1240	0.018	0.1235	0.018	0.1230	0.018
5	0.09926	0.021	0.09919	0.021	0.09912	0.021	0.09807	0.021	0.09733	0.021
6	0.2029	0.021	0.2028	0.020	0.2025	0.020	0.2015	0.020	0.2004	0.020
7	-0.02991	0.014	-0.02996	0.014	-0.03050	0.014	-0.03058	0.014	-0.03060	0.014
8	-0.01494	0.013	-0.01504	0.013	-0.01560	0.013	-0.01480	0.013	-0.01413	0.013
9	-0.08091	0.013	-0.08092	0.013	-0.08130	0.013	-0.08152	0.013	-0.08162	0.013
10	0.03598	0.011	0.03592	0.011	0.03539	0.011	0.03547	0.011	0.03550	0.011
11	0.1523	0.011	0.1523	0.011	0.1520	0.011	0.1514	0.011	0.1508	0.011
12	-0.009697	0.014	-0.009715	0.014	-0.01012	0.014	-0.01034	0.014	-0.01040	0.014
13	-0.06388	0.012	-0.06390	0.012	-0.06422	0.012	-0.06322	0.012	-0.06261	0.012
14	-0.09887	0.014	-0.09887	0.014	-0.09909	0.014	-0.09828	0.013	-0.09766	0.013
15	-0.06597	0.015	-0.06595	0.015	-0.06611	0.015	-0.06606	0.015	-0.06593	0.015
16	-0.1108	0.014	-0.1108	0.014	-0.1107	0.014	-0.1111	0.014	-0.1113	0.014
17	-0.1649	0.016	-0.1647	0.016	-0.1642	0.016	-0.1638	0.016	-0.1635	0.016
18	-0.1523	0.014	-0.1521	0.014	-0.1501	0.014	-0.1500	0.014	-0.1491	0.014
19	-0.1383	0.013	-0.1383	0.013	-0.1358	0.013	-0.1354	0.013	-0.1348	0.013

Table 15. Assumed size-specific availability for male in the 2013 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.0553	0.0553	0.0553	0.0180	0.0016
32	0.0579	0.0579	0.0579	0.0202	0.0034
37	0.0606	0.0606	0.0606	0.0227	0.0064
42	0.0635	0.0635	0.0635	0.0255	0.0106
47	0.0667	0.0667	0.0667	0.0287	0.0140
52	0.0703	0.0703	0.0703	0.0324	0.0155
57	0.0744	0.0744	0.0744	0.0367	0.0166
62	0.0791	0.0791	0.0791	0.0419	0.0198
67	0.0848	0.0848	0.0848	0.0481	0.0286
72	0.0915	0.0915	0.0915	0.0556	0.0447
77	0.0994	0.0994	0.0994	0.0642	0.0662
82	0.1087	0.1087	0.1087	0.0742	0.0830
87	0.1199	0.1199	0.1199	0.0858	0.0899
92	0.1333	0.1333	0.1333	0.0996	0.0932
97	0.1497	0.1497	0.1497	0.1169	0.1021
102	0.1696	0.1696	0.1696	0.1386	0.1241
107	0.1936	0.1936	0.1936	0.1650	0.1582
112	0.2218	0.2218	0.2218	0.1958	0.1987
117	0.2543	0.2543	0.2543	0.2299	0.2347
122	0.2902	0.2902	0.2902	0.2661	0.2644
127	0.3276	0.3276	0.3276	0.3029	0.2946
132	0.3634	0.3634	0.3634	0.3383	0.3348
137	0.3927	0.3927	0.3927	0.3699	0.3855
142	0.4076	0.4076	0.4076	0.3944	0.4278
147	0.4007	0.4007	0.4007	0.4085	0.4395
152	0.3692	0.3692	0.3692	0.4102	0.4035
157	0.3213	0.3213	0.3213	0.4020	0.3304
162	0.2681	0.2681	0.2681	0.3883	0.2444
167	0.2174	0.2174	0.2174	0.3733	0.1681
172	0.1733	0.1733	0.1733	–	–
177	0.1366	0.1366	0.1366	–	–
182	0.1070	0.1070	0.1070	–	–

Table 16. Assumed size-specific availability for male in the 2014 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.0217	0.0217	0.0217	0.0103	0.0029
32	0.0248	0.0248	0.0248	0.0121	0.0067
37	0.0283	0.0283	0.0283	0.0141	0.0137
42	0.0324	0.0324	0.0324	0.0163	0.0223
47	0.0370	0.0370	0.0370	0.0189	0.0266
52	0.0424	0.0424	0.0424	0.0217	0.0245
57	0.0485	0.0485	0.0485	0.0252	0.0211
62	0.0558	0.0558	0.0558	0.0299	0.0207
67	0.0642	0.0642	0.0642	0.0365	0.0259
72	0.0740	0.0740	0.0740	0.0453	0.0378
77	0.0856	0.0856	0.0856	0.0566	0.0559
82	0.0993	0.0993	0.0993	0.0706	0.0746
87	0.1152	0.1152	0.1152	0.0879	0.0903
92	0.1338	0.1338	0.1338	0.1107	0.1075
97	0.1553	0.1553	0.1553	0.1428	0.1357
102	0.1797	0.1797	0.1797	0.1872	0.1836
107	0.2074	0.2074	0.2074	0.2380	0.2426
112	0.2382	0.2382	0.2382	0.2789	0.2874
117	0.2723	0.2723	0.2723	0.2894	0.2900
122	0.3097	0.3097	0.3097	0.2801	0.2684
127	0.3508	0.3508	0.3508	0.2780	0.2605
132	0.3959	0.3959	0.3959	0.3112	0.3031
137	0.4441	0.4441	0.4441	0.3992	0.4152
142	0.4909	0.4909	0.4909	0.5290	0.5515
147	0.5300	0.5300	0.5300	0.6458	0.6403
152	0.5550	0.5550	0.5550	0.6634	0.6409
157	0.5660	0.5660	0.5660	0.5982	0.5801
162	0.5665	0.5665	0.5665	0.5176	0.5049
167	0.5608	0.5608	0.5608	0.4686	0.4691
172	0.5518	0.5518	0.5518	0.4600	0.4924
177	0.5410	0.5410	0.5410	0.4775	0.5563

Table 17. Assumed size-specific availability for male in the 2015 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.0204	0.0204	0.0204	0.0008	0.0132
32	0.0252	0.0252	0.0252	0.0042	0.0285
37	0.0311	0.0311	0.0311	0.0181	0.0531
42	0.0383	0.0383	0.0383	0.0493	0.0751
47	0.0470	0.0470	0.0470	0.0686	0.0730
52	0.0576	0.0576	0.0576	0.0549	0.0537
57	0.0704	0.0704	0.0704	0.0380	0.0396
62	0.0864	0.0864	0.0864	0.0345	0.0396
67	0.1061	0.1061	0.1061	0.0524	0.0626
72	0.1281	0.1281	0.1281	0.1047	0.1206
77	0.1495	0.1495	0.1495	0.1981	0.2060
82	0.1659	0.1659	0.1659	0.2624	0.2520
87	0.1751	0.1751	0.1751	0.2429	0.2324
92	0.1777	0.1777	0.1777	0.1907	0.1880
97	0.1757	0.1757	0.1757	0.1545	0.1563
102	0.1715	0.1715	0.1715	0.1450	0.1490
107	0.1679	0.1679	0.1679	0.1501	0.1548
112	0.1677	0.1677	0.1677	0.1596	0.1630
117	0.1736	0.1736	0.1736	0.1640	0.1635
122	0.1873	0.1873	0.1873	0.1661	0.1615
127	0.2109	0.2109	0.2109	0.1756	0.1695
132	0.2479	0.2479	0.2479	0.2054	0.2030
137	0.3015	0.3015	0.3015	0.2674	0.2746
142	0.3688	0.3688	0.3688	0.3610	0.3749
147	0.4411	0.4411	0.4411	0.4674	0.4728
152	0.5020	0.5020	0.5020	0.5420	0.5325
157	0.5353	0.5353	0.5353	0.5554	0.5471
162	0.5288	0.5288	0.5288	0.5053	0.5204
167	0.4785	0.4785	0.4785	0.4105	0.4558
172	0.3993	0.3993	0.3993	0.3030	0.3634
177	0.3154	0.3154	0.3154	–	–
182	0.2423	0.2423	0.2423	–	–

Table 18. Assumed size-specific availability for male in the 2016 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.0003	0.0003	0.0003	0.0000	0.1199
32	0.0008	0.0008	0.0008	0.0000	0.1093
37	0.0022	0.0022	0.0022	0.0005	0.1018
42	0.0059	0.0059	0.0059	0.0072	0.0993
47	0.0149	0.0149	0.0149	0.0409	0.1037
52	0.0354	0.0354	0.0354	0.1039	0.1172
57	0.0755	0.0755	0.0755	0.1584	0.1424
62	0.1399	0.1399	0.1399	0.1969	0.1844
67	0.2200	0.2200	0.2200	0.2490	0.2470
72	0.2982	0.2982	0.2982	0.3148	0.3193
77	0.3565	0.3565	0.3565	0.3738	0.3769
82	0.3851	0.3851	0.3851	0.3948	0.3943
87	0.3895	0.3895	0.3895	0.3801	0.3788
92	0.3851	0.3851	0.3851	0.3599	0.3590
97	0.3886	0.3886	0.3886	0.3618	0.3628
102	0.4087	0.4087	0.4087	0.3987	0.4018
107	0.4363	0.4363	0.4363	0.4525	0.4538
112	0.4579	0.4579	0.4579	0.4915	0.4880
117	0.4593	0.4593	0.4593	0.4798	0.4780
122	0.4420	0.4420	0.4420	0.4334	0.4357
127	0.4158	0.4158	0.4158	0.3894	0.3916
132	0.3895	0.3895	0.3895	0.3737	0.3737
137	0.3702	0.3702	0.3702	0.3909	0.3895
142	0.3634	0.3634	0.3634	0.4194	0.4177
147	0.3751	0.3751	0.3751	0.4316	0.4336
152	0.4127	0.4127	0.4127	0.4066	0.4188
157	0.4785	0.4785	0.4785	0.3756	0.3959
162	0.5731	0.5731	0.5731	0.3793	0.4003
167	0.6952	0.6952	0.6952	0.4658	0.4680
172	0.8448	0.8448	0.8448	0.7127	0.6084

Table 19. Assumed size-specific availability for male in the 2017 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.3022	0.3022	0.3022	0.3032	0.3115
32	0.3438	0.3438	0.3438	0.3204	0.3168
37	0.3929	0.3929	0.3929	0.3455	0.3344
42	0.4536	0.4536	0.4536	0.3881	0.3783
47	0.5308	0.5308	0.5308	0.4625	0.4641
52	0.6163	0.6163	0.6163	0.5674	0.5751
57	0.6806	0.6806	0.6806	0.6679	0.6624
62	0.6844	0.6844	0.6844	0.7017	0.6895
67	0.6168	0.6168	0.6168	0.6364	0.6434
72	0.5299	0.5299	0.5299	0.5379	0.5548
77	0.4680	0.4680	0.4680	0.4669	0.4752
82	0.4554	0.4554	0.4554	0.4545	0.4571
87	0.4842	0.4842	0.4842	0.4923	0.4970
92	0.5309	0.5309	0.5309	0.5534	0.5573
97	0.5659	0.5659	0.5659	0.6015	0.5996
102	0.5696	0.5696	0.5696	0.6085	0.6051
107	0.5588	0.5588	0.5588	0.5912	0.5904
112	0.5560	0.5560	0.5560	0.5739	0.5753
117	0.5797	0.5797	0.5797	0.5762	0.5777
122	0.6195	0.6195	0.6195	0.5936	0.5936
127	0.6464	0.6464	0.6464	0.6100	0.6081
132	0.6277	0.6277	0.6277	0.6079	0.6073
137	0.5651	0.5651	0.5651	0.5800	0.5830
142	0.5026	0.5026	0.5026	0.5353	0.5361
147	0.4737	0.4737	0.4737	0.4838	0.4692
152	0.4601	0.4601	0.4601	0.3964	0.3901
157	0.2592	0.2592	0.2592	0.1648	0.3220
162	0.0394	0.0394	0.0394	0.0164	0.2859
167	0.0008	0.0008	0.0008	0.0002	0.2972
172	0.0000	0.0000	0.0000	0.0000	0.3629

Table 20. Assumed size-specific availability for male in the 2018 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b2	22.03b3	22.03d
27	0.5216	0.5216	0.5152
32	0.4225	0.4225	0.4294
37	0.3570	0.3570	0.3628
42	0.3282	0.3282	0.3297
47	0.3414	0.3414	0.3405
52	0.3954	0.3954	0.3925
57	0.4778	0.4778	0.4693
62	0.5643	0.5643	0.5477
67	0.6226	0.6226	0.6080
72	0.6523	0.6523	0.6502
77	0.6671	0.6671	0.6780
82	0.6829	0.6829	0.6951
87	0.7008	0.7008	0.7031
92	0.7110	0.7110	0.7025
97	0.7033	0.7033	0.6934
102	0.6767	0.6767	0.6773
107	0.6475	0.6475	0.6596
112	0.6317	0.6317	0.6472
117	0.6413	0.6413	0.6458
122	0.6649	0.6649	0.6518
127	0.6781	0.6781	0.6575
132	0.6559	0.6559	0.6551
137	0.6066	0.6066	0.6407
142	0.5801	0.5801	0.6167
147	0.6239	0.6239	0.5859
152	0.7175	0.7175	0.5511
157	0.3950	0.3950	0.5115
162	0.0358	0.0358	0.4652
167	0.0002	0.0002	0.4110

Table 21. Assumed size-specific availability for female in the 2013 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.0163	0.0163	0.0163	0.0114	0.0018
32	0.0166	0.0166	0.0166	0.0118	0.0060
37	0.0169	0.0169	0.0169	0.0122	0.0120
42	0.0170	0.0170	0.0170	0.0128	0.0106
47	0.0171	0.0171	0.0171	0.0135	0.0074
52	0.0176	0.0176	0.0176	0.0147	0.0088
57	0.0186	0.0186	0.0186	0.0164	0.0134
62	0.0206	0.0206	0.0206	0.0194	0.0133
67	0.0251	0.0251	0.0251	0.0244	0.0107
72	0.0355	0.0355	0.0355	0.0339	0.0149
77	0.0557	0.0557	0.0557	0.0512	0.0365
82	0.0864	0.0864	0.0864	0.0819	0.0854
87	0.1304	0.1304	0.1304	0.1353	0.1483
92	0.2141	0.2141	0.2141	0.2288	0.2262
97	0.3845	0.3845	0.3845	0.3825	0.3582
102	0.6400	0.6400	0.6400	0.5861	0.6181
107	0.8178	0.8178	0.8178	0.7909	0.8293
112	0.6568	0.6568	0.6568	0.9772	0.7130

Table 22. Assumed size-specific availability for female in the 2014 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.0151	0.0151	0.0151	0.0147	0.0029
32	0.0185	0.0185	0.0185	0.0178	0.0060
37	0.0225	0.0225	0.0225	0.0214	0.0115
42	0.0269	0.0269	0.0269	0.0253	0.0191
47	0.0315	0.0315	0.0315	0.0289	0.0274
52	0.0361	0.0361	0.0361	0.0318	0.0348
57	0.0393	0.0393	0.0393	0.0331	0.0381
62	0.0395	0.0395	0.0395	0.0327	0.0354
67	0.0376	0.0376	0.0376	0.0316	0.0301
72	0.0357	0.0357	0.0357	0.0314	0.0274
77	0.0355	0.0355	0.0355	0.0334	0.0285
82	0.0383	0.0383	0.0383	0.0393	0.0338
87	0.0486	0.0486	0.0486	0.0534	0.0467
92	0.0826	0.0826	0.0826	0.0885	0.0791
97	0.1815	0.1815	0.1815	0.1732	0.1597
102	0.3785	0.3785	0.3785	0.3342	0.3290
107	0.5978	0.5978	0.5978	0.5626	0.5771
112	0.7107	0.7107	0.7107	0.8436	0.7928

Table 23. Assumed size-specific availability for female in the 2015 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.0102	0.0102	0.0102	0.0091	0.0069
32	0.0147	0.0147	0.0147	0.0129	0.0130
37	0.0208	0.0208	0.0208	0.0182	0.0231
42	0.0282	0.0282	0.0282	0.0246	0.0367
47	0.0356	0.0356	0.0356	0.0312	0.0509
52	0.0402	0.0402	0.0402	0.0360	0.0603
57	0.0408	0.0408	0.0408	0.0378	0.0587
62	0.0380	0.0380	0.0380	0.0369	0.0450
67	0.0344	0.0344	0.0344	0.0353	0.0329
72	0.0326	0.0326	0.0326	0.0354	0.0318
77	0.0337	0.0337	0.0337	0.0382	0.0405
82	0.0380	0.0380	0.0380	0.0441	0.0502
87	0.0493	0.0493	0.0493	0.0565	0.0577
92	0.0816	0.0816	0.0816	0.0882	0.0769
97	0.1702	0.1702	0.1702	0.1679	0.1385
102	0.3622	0.3622	0.3622	0.3325	0.3236
107	0.6583	0.6583	0.6583	0.5962	0.6810
112	0.9415	0.9415	0.9415	0.8960	0.9184
117	1.0000	1.0000	1.0000	1.0972	0.9830
122	0.9901	0.9901	0.9901	1.2000	0.9965

Table 24. Assumed size-specific availability for female in the 2016 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.0000	0.0000	0.0000	0.0872	0.0884
32	0.0000	0.0000	0.0000	0.0938	0.0968
37	0.0117	0.0117	0.0117	0.0960	0.0990
42	0.1017	0.1017	0.1017	0.0920	0.0928
47	0.1102	0.1102	0.1102	0.1003	0.1013
52	0.1390	0.1390	0.1390	0.1513	0.1615
57	0.2271	0.2271	0.2271	0.2247	0.2385
62	0.2123	0.2123	0.2123	0.1944	0.1869
67	0.1391	0.1391	0.1391	0.1312	0.1088
72	0.1454	0.1454	0.1454	0.1496	0.1327
77	0.2528	0.2528	0.2528	0.2779	0.2892
82	0.3893	0.3893	0.3893	0.4049	0.4083
87	0.4249	0.4249	0.4249	0.3873	0.3735
92	0.4314	0.4314	0.4314	0.3934	0.4010
97	0.4860	0.4860	0.4860	0.5248	0.5593
102	0.5985	0.5985	0.5985	0.7029	0.6279
107	0.7664	0.7664	0.7664	0.2327	0.6548
112	0.9329	0.9329	0.9329	0.0005	0.9615
117	1.0000	1.0000	1.0000	0.0000	1.0000

Table 25. Assumed size-specific availability for female in the 2017 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b	22.03b1	22.03b2	22.03b3	22.03d
27	0.4480	0.4480	0.4480	0.3879	0.3872
32	0.4225	0.4225	0.4225	0.3867	0.3874
37	0.4358	0.4358	0.4358	0.4061	0.4087
42	0.5208	0.5208	0.5208	0.4655	0.4673
47	0.6392	0.6392	0.6392	0.5490	0.5433
52	0.6865	0.6865	0.6865	0.6116	0.6023
57	0.6556	0.6556	0.6556	0.6238	0.6215
62	0.6137	0.6137	0.6137	0.5832	0.5882
67	0.6057	0.6057	0.6057	0.5436	0.5459
72	0.6628	0.6628	0.6628	0.5737	0.5744
77	0.7555	0.7555	0.7555	0.6555	0.6502
82	0.7682	0.7682	0.7682	0.6716	0.6721
87	0.6891	0.6891	0.6891	0.6049	0.6216
92	0.6363	0.6363	0.6363	0.5712	0.5617
97	0.5586	0.5586	0.5586	0.5017	0.4806
102	0.2931	0.2931	0.2931	0.2247	0.2508
107	0.0205	0.0205	0.0205	0.0108	0.0449
112	0.0000	0.0000	0.0000	–	–
117	0.0000	0.0000	0.0000	–	–

Table 26. Assumed size-specific availability for female in the 2018 BSFRF SBS survey. The value for size (in mm CW) indicates the midpoint of the associated size bin. The availability curves were estimated outside the models.

size	22.03b2	22.03b3	22.03d
27	0.4216	0.4216	0.4296
32	0.4729	0.4729	0.4682
37	0.4777	0.4777	0.4691
42	0.4088	0.4088	0.4106
47	0.3553	0.3553	0.3615
52	0.3936	0.3936	0.4007
57	0.5151	0.5151	0.5163
62	0.6471	0.6471	0.6394
67	0.7321	0.7321	0.7253
72	0.7693	0.7693	0.7670
77	0.7828	0.7828	0.7873
82	0.8103	0.8103	0.8195
87	0.8597	0.8597	0.8582
92	0.8986	0.8986	0.8751
97	0.8809	0.8809	0.8634
102	0.7545	0.7545	0.8311
107	0.0763	0.0763	0.7842
112	0.0000	0.0000	0.7273

Table 27. Objective function data component values for TCSAM02 models 22.03b, 22.03b1, 22.03b2, 22.03b3, 22.03d. Table 1 of 3. Abbreviations: n.at.z: size composition data; M: males only; F: females only; NMFS: NMFS EBS shelf survey; SBS BSFRF: BSFRF side-by-side catchability study survey; TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: BBRKC fishery; GF All: combined groundfish fisheries. Components not included in the objective function are indicated by "–".

category	fleet	catch type	data type	sex	22.03b	22.03b1	22.03b2	22.03b3	22.03d
surveys data	NMFS M	index catch	abundance	female	–	–	–	–	–
				male	–	–	–	–	–
			biomass	female	–	–	–	–	–
				male	79.29	79.26	81.90	82.50	83.65
			n.at.z	male	415.48	415.77	416.24	416.08	417.43
	NMFS F		abundance	female	–	–	–	–	–
				male	–	–	–	–	–
			biomass	female	165.61	165.51	164.11	166.04	167.25
				male	–	–	–	–	–
			n.at.z	female	299.20	299.25	301.81	301.97	303.21
	SBS BSFRF M		abundance	female	–	–	–	–	–
				male	–	–	–	–	–
			biomass	female	–	–	–	–	–
				male	-0.81	-1.13	-2.66	-3.03	-2.90
			n.at.z	male	290.59	290.56	330.74	339.14	281.85
	SBS BSFRF F		abundance	female	–	–	–	–	–
				male	–	–	–	–	–
			biomass	female	-0.19	-0.29	0.41	0.16	1.96
				male	–	–	–	–	–

Table 28. Objective function data component values for TCSAM02 models 22.03b, 22.03b1, 22.03b2, 22.03b3, 22.03d. Table 2 of 3. Abbreviations: n.at.z: size composition data; M: males only; F: females only; NMFS: NMFS EBS shelf survey; SBS BSFRF: BSFRF side-by-side catchability study survey; TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: BBRKC fishery; GF All: combined groundfish fisheries. Components not included in the objective function are indicated by "–".

category	fleet	catch type	data type	sex	22.03b	22.03b1	22.03b2	22.03b3	22.03d
surveys data	SBS BSFRF F	index catch	n.at.z	female	232.90	233.12	261.29	170.99	172.27
fisheries data	TCF	retained catch	abundance	female	–	–	–	–	–
				male	–	–	–	–	–
			biomass	female	–	–	–	–	–
				male	-147.65	-147.61	-147.44	-147.43	-147.32
			n.at.z	male	66.94	67.10	67.68	67.01	66.67
		total catch	abundance	all sexes	–	–	–	–	–
			biomass	all sexes	4.79	4.78	4.76	4.59	4.49
			n.at.z	female	91.38	91.32	91.21	91.58	91.77
				male	93.48	93.71	94.03	92.33	90.96
	SCF		abundance	all sexes	–	–	–	–	–
			biomass	all sexes	-52.25	-52.24	-52.22	-52.23	-52.23
			n.at.z	female	52.39	52.39	52.39	52.52	52.36
				male	80.30	80.30	80.36	80.30	80.37
	GF All		abundance	all sexes	-39.43	-39.43	-39.45	-39.46	-39.43
			biomass	all sexes	-70.21	-70.22	-70.29	-70.27	-70.24
			n.at.z	female	224.62	224.68	225.15	224.89	226.52
				male	307.29	307.37	307.58	309.74	311.46
	RKF		abundance	all sexes	–	–	–	–	–

Table 29. Objective function data component values for TCSAM02 models 22.03b, 22.03b1, 22.03b2, 22.03b3, 22.03d. Table 3 of 3. Abbreviations: n.at.z: size composition data; M: males only; F: females only; NMFS: NMFS EBS shelf survey; SBS BSFRF: BSFRF side-by-side catchability study survey; TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: BBRKC fishery; GF All: combined groundfish fisheries. Components not included in the objective function are indicated by "–".

category	fleet	catch type	data type	sex	22.03b	22.03b1	22.03b2	22.03b3	22.03d
fisheries data	RKF	total catch	biomass	all sexes	-37.08	-37.07	-37.03	-37.03	-37.00
			n.at.z	female	6.88	6.87	6.87	6.88	6.87
				male	31.47	31.47	31.50	31.61	31.64
growth data			EBS molt increment data	female	246.16	246.24	246.51	244.35	242.61
				male	280.00	280.16	281.00	278.82	278.11
maturity ogive data	NMFS M		EBS mature male ratios	male	255.63	255.66	255.76	255.87	255.98

Table 30. Objective function non-data component values for TCSAM02 models 22.03b, 22.03b1, 22.03b2, 22.03b3, 22.03d. Table 1 of 1. Abbreviations: devsSumSq: sum of squared annual deviations ("devs"); pDevsLnC: fishery capture probablity devs; pDevsLnR: recruitment devs; pDevsM: natural mortality devs; pDevsS1: selectivity deviations; pDM1: natural mortality multiplier; pQ: survey catchability. Components not included in the objective function are indicated by "–".

category	type	element	22.03b	22.03b1	22.03b2	22.03b3	22.03d
penalties	devsSumSq	pDevsLnC	0.000	0.000	0.000	0.000	0.000
		pDevsLnR	0.000	0.000	0.000	0.000	0.000
		pDevsS1	0.000	0.000	0.000	0.000	0.000
	maturity	smoothness	2.090	2.090	2.054	2.092	2.220
	natural mortality	pDM1	41.676	41.992	46.295	49.153	52.268
priors	recruitment	pDevsLnR	115.363	115.382	115.519	115.488	115.407
	surveys	pQ	106.871	106.007	100.570	101.920	100.592

Table 31. Differences between objective function data component values for 22.03b1, 22.03b2, 22.03b3, and 22.03d relative to 22.03b. Negative values indicate better fits. Table 1 of 3. Abbreviations: n.at.z: size composition data; M: males only; F: females only; NMFS: NMFS EBS shelf survey; SBS BSFRF: BSFRF side-by-side catchability study survey; TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: BBRKC fishery; GF All: combined groundfish fisheries.

category	fleet	catch type	data type	sex	22.03b	22.03b1	22.03b2	22.03b3	22.03d
surveys data	NMFS M	index catch	abundance	female	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000
			biomass	female	0.000	0.000	0.000	0.000	0.000
				male	79.289	-0.026	2.613	3.208	4.360
			n.at.z	male	415.477	0.289	0.763	0.608	1.952
	NMFS F		abundance	female	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000
			biomass	female	165.612	-0.104	-1.500	0.430	1.635
				male	0.000	0.000	0.000	0.000	0.000
			n.at.z	female	299.199	0.054	2.606	2.771	4.016
	SBS BSFRF M		abundance	female	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000
			biomass	female	0.000	0.000	0.000	0.000	0.000
				male	-0.814	-0.317	-1.848	-2.212	-2.091
			n.at.z	male	290.592	-0.027	40.148	48.550	-8.745
	SBS BSFRF F		abundance	female	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000
			biomass	female	-0.185	-0.104	0.592	0.347	2.141
				male	0.000	0.000	0.000	0.000	0.000

Table 32. Differences between objective function data component values for 22.03b1, 22.03b2, 22.03b3, and 22.03d relative to 22.03b. Negative values indicate better fits. Table 2 of 3. Abbreviations: n.at.z: size composition data; M: males only; F: females only; NMFS: NMFS EBS shelf survey; SBS BSFRF: BSFRF side-by-side catchability study survey; TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: BBRKC fishery; GF All: combined groundfish fisheries.

category	fleet	catch type	data type	sex	22.03b	22.03b1	22.03b2	22.03b3	22.03d
surveys data	SBS BSFRF F	index catch	n.at.z	female	232.897	0.225	28.389	-61.902	-60.627
fisheries data	TCF	retained catch	abundance	female	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000
			biomass	female	0.000	0.000	0.000	0.000	0.000
				male	-147.653	0.045	0.216	0.223	0.332
			n.at.z	male	66.936	0.163	0.743	0.074	-0.262
		total catch	abundance	all sexes	0.000	0.000	0.000	0.000	0.000
			biomass	all sexes	4.793	-0.010	-0.032	-0.208	-0.306
			n.at.z	female	91.380	-0.064	-0.166	0.202	0.392
				male	93.482	0.228	0.547	-1.155	-2.523
	SCF		abundance	all sexes	0.000	0.000	0.000	0.000	0.000
			biomass	all sexes	-52.247	0.003	0.030	0.015	0.015
			n.at.z	female	52.392	-0.006	-0.001	0.133	-0.031
				male	80.300	-0.002	0.064	-0.003	0.067
	GF All		abundance	all sexes	-39.433	0.001	-0.022	-0.028	-0.002
			biomass	all sexes	-70.213	-0.007	-0.075	-0.053	-0.030
			n.at.z	female	224.620	0.056	0.529	0.271	1.898
				male	307.289	0.078	0.295	2.451	4.171
	RKF		abundance	all sexes	0.000	0.000	0.000	0.000	0.000

Table 33. Differences between objective function data component values for 22.03b1, 22.03b2, 22.03b3, and 22.03d relative to 22.03b. Negative values indicate better fits. Table 3 of 3. Abbreviations: n.at.z: size composition data; M: males only; F: females only; NMFS: NMFS EBS shelf survey; SBS BSFRF: BSFRF side-by-side catchability study survey; TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: BBRKC fishery; GF All: combined groundfish fisheries.

category	fleet	catch type	data type	sex	22.03b	22.03b1	22.03b2	22.03b3	22.03d
fisheries data	RKF	total catch	biomass	all sexes	-37.077	0.010	0.047	0.047	0.073
			n.at.z	female	6.876	-0.004	-0.011	0.007	-0.003
				male	31.474	0.001	0.023	0.138	0.171
growth data			EBS molt increment data	female	246.159	0.085	0.346	-1.806	-3.551
				male	279.997	0.166	1.002	-1.180	-1.883
maturity ogive data	NMFS M		EBS mature male ratios	male	255.629	0.035	0.136	0.239	0.355

Table 34. Differences between objective function non-data component values for 22.03b1, 22.03b2, 22.03b3, and 22.03d relative to 22.03b. Negative values indicate better fits. Table 1 of 1. Abbreviations: devsSumSq: sum of squared annual deviations ("devs"); pDevsLnC: fishery capture probablity devs; pDevsLnR: recruitment devs; pDevsM: natural mortality devs; pDevsS1: selectivity deviations; pDM1: natural mortality multiplier; pQ: survey catchability.

category	type	element	22.03b	22.03b1	22.03b2	22.03b3	22.03d
penalties	devsSumSq	pDevsLnC	0.000	0.000	0.000	0.000	0.000
		pDevsLnR	0.000	0.000	0.000	0.000	0.000
		pDevsS1	0.000	0.000	0.000	0.000	0.000
	maturity	smoothness	2.090	0.000	-0.036	0.003	0.130
	natural mortality	pDM1	41.676	0.316	4.619	7.477	10.592
priors	recruitment	pDevsLnR	115.363	0.019	0.157	0.125	0.044
	surveys	pQ	106.871	-0.864	-6.301	-4.951	-6.279

Figures

List of Figures

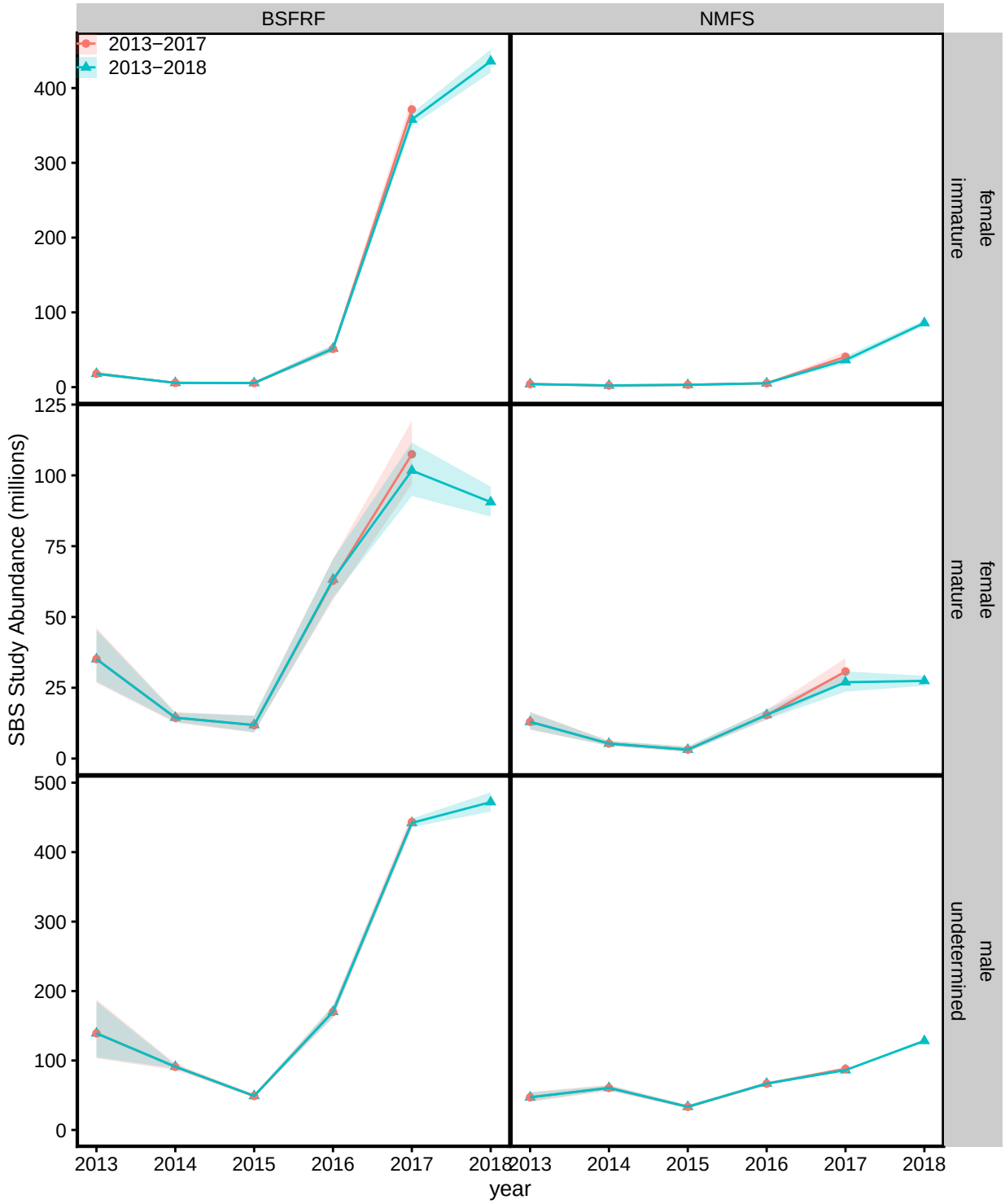

Figure 1. Conmparison of design-based estimates of abundance from SBS study stations by gear/fleet and population category.

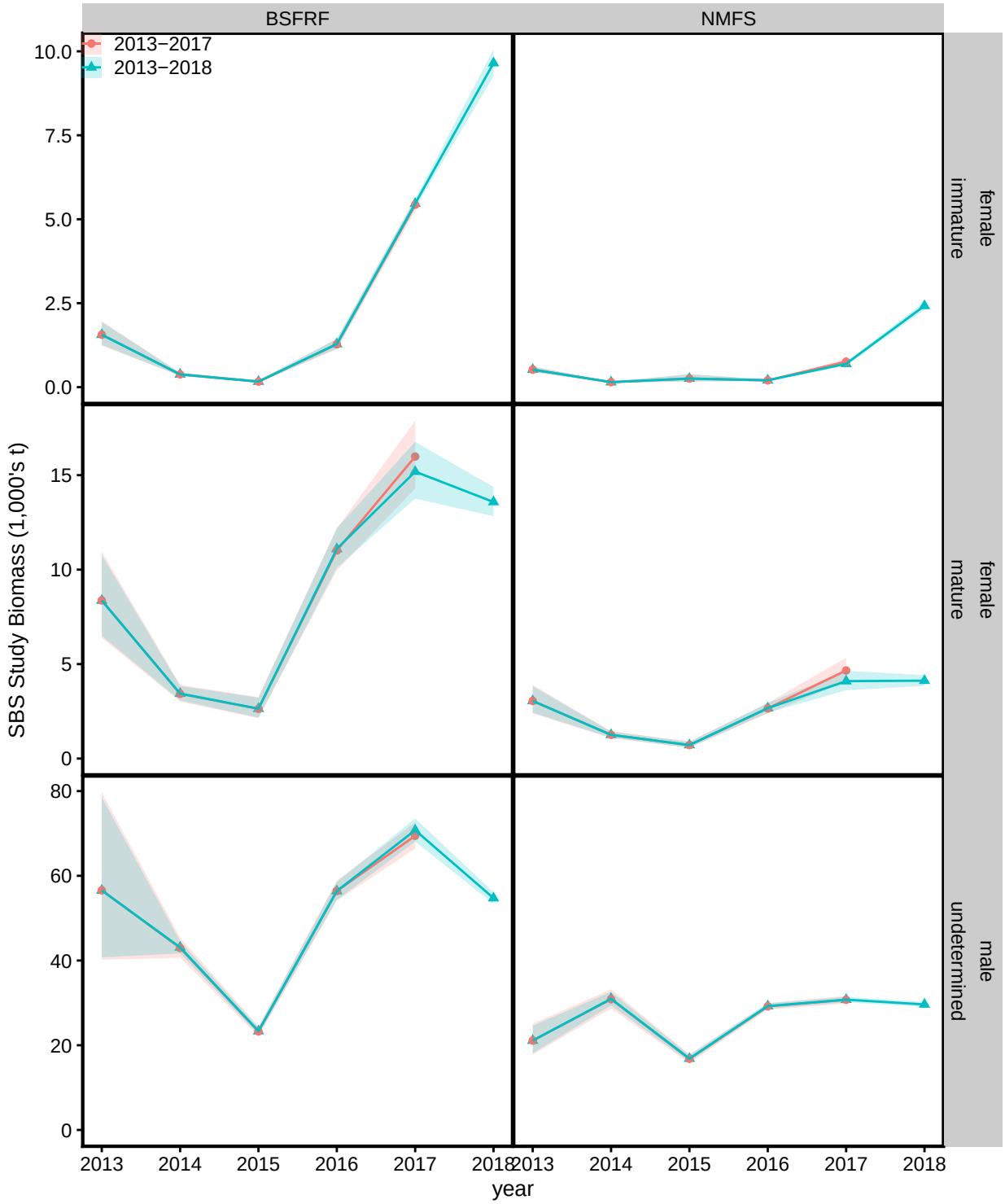

Figure 2. Conmparison of design-based estimates of biomass from SBS study stations by gear/fleet and population category.

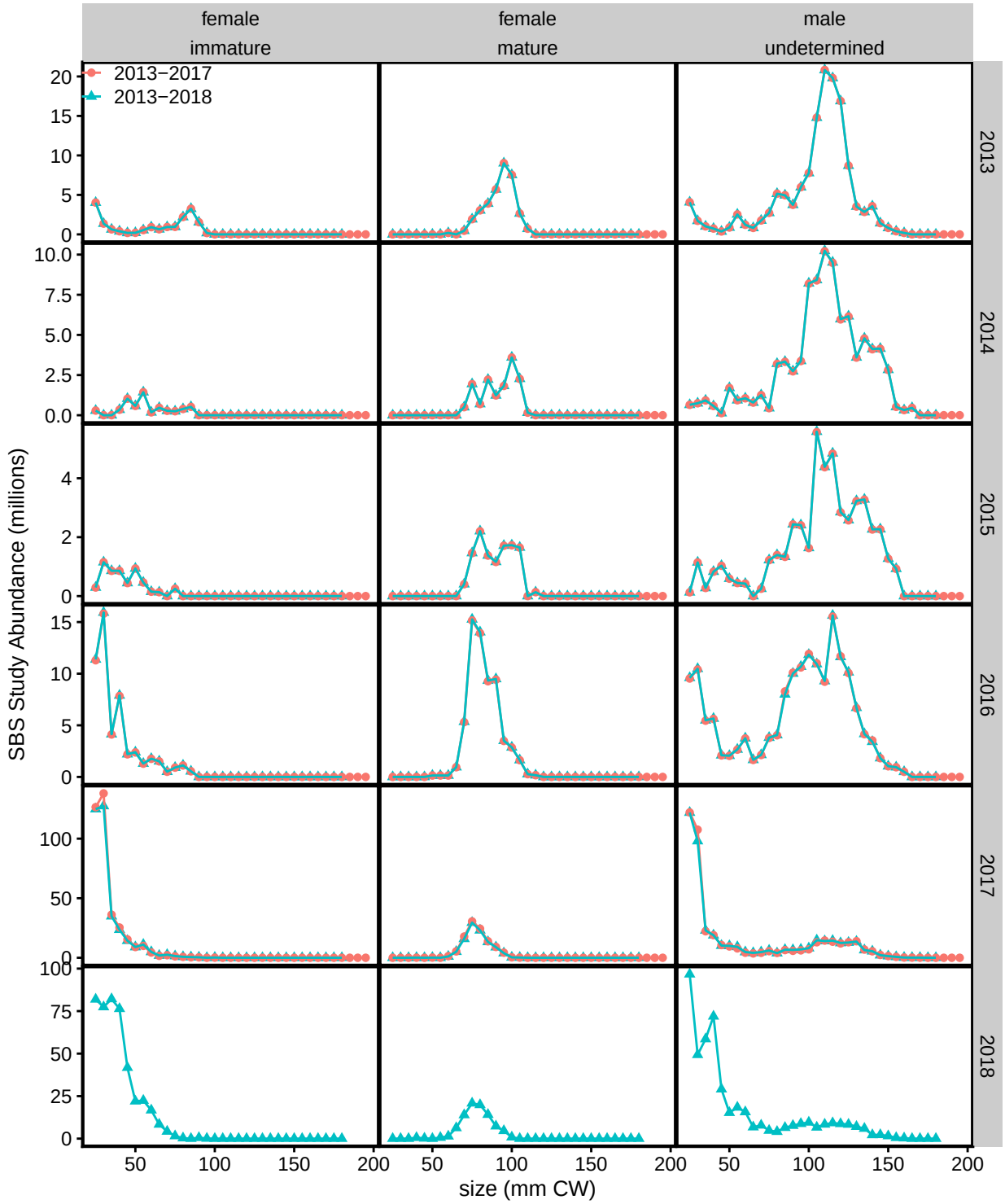

Figure 3. Conmparison of design-based BSFRF size compositions from the SBS study stations by year and population category.

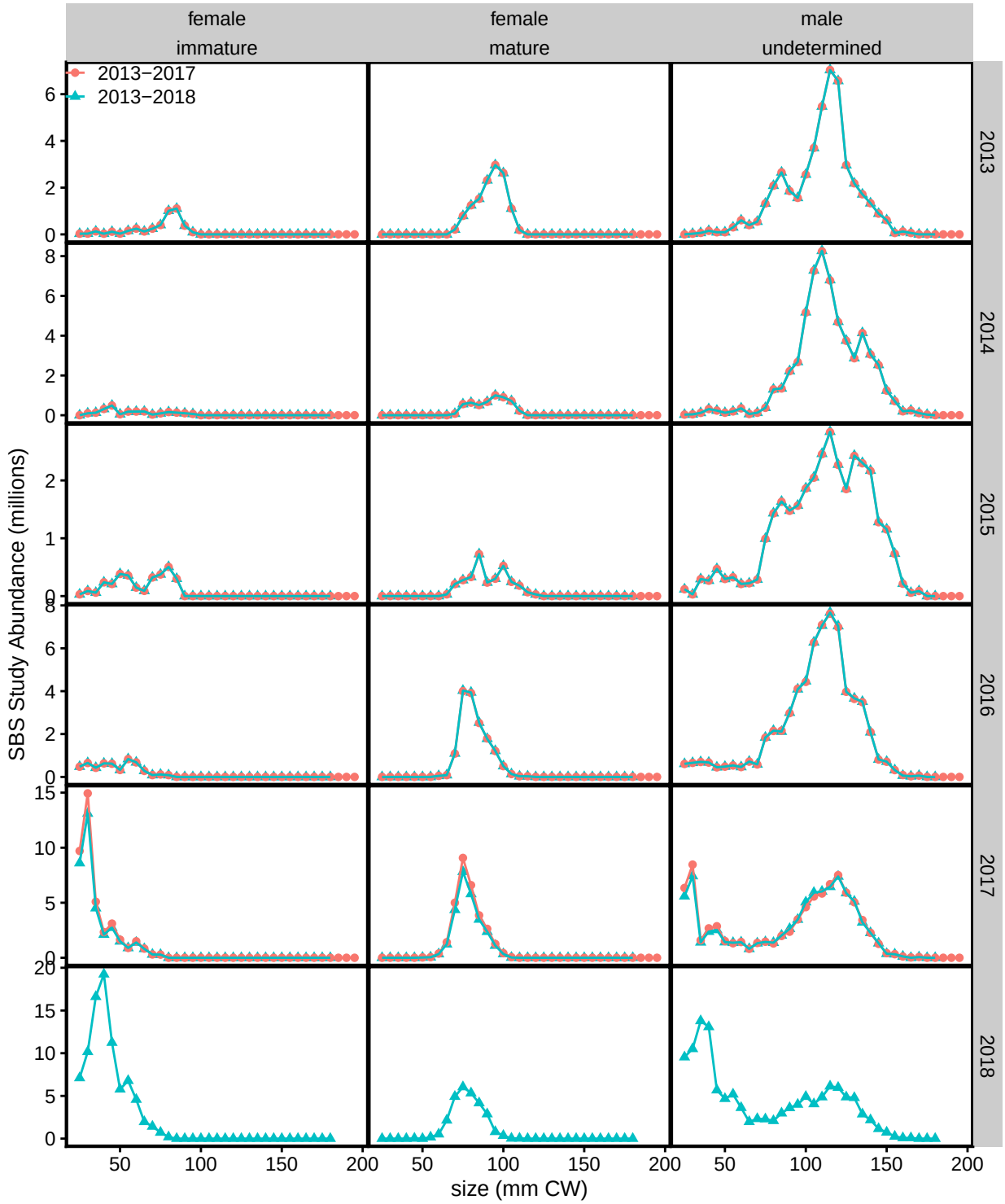

Figure 4. Conmparison of design-based NMFS size compositions from the SBS study stations by year and population category.

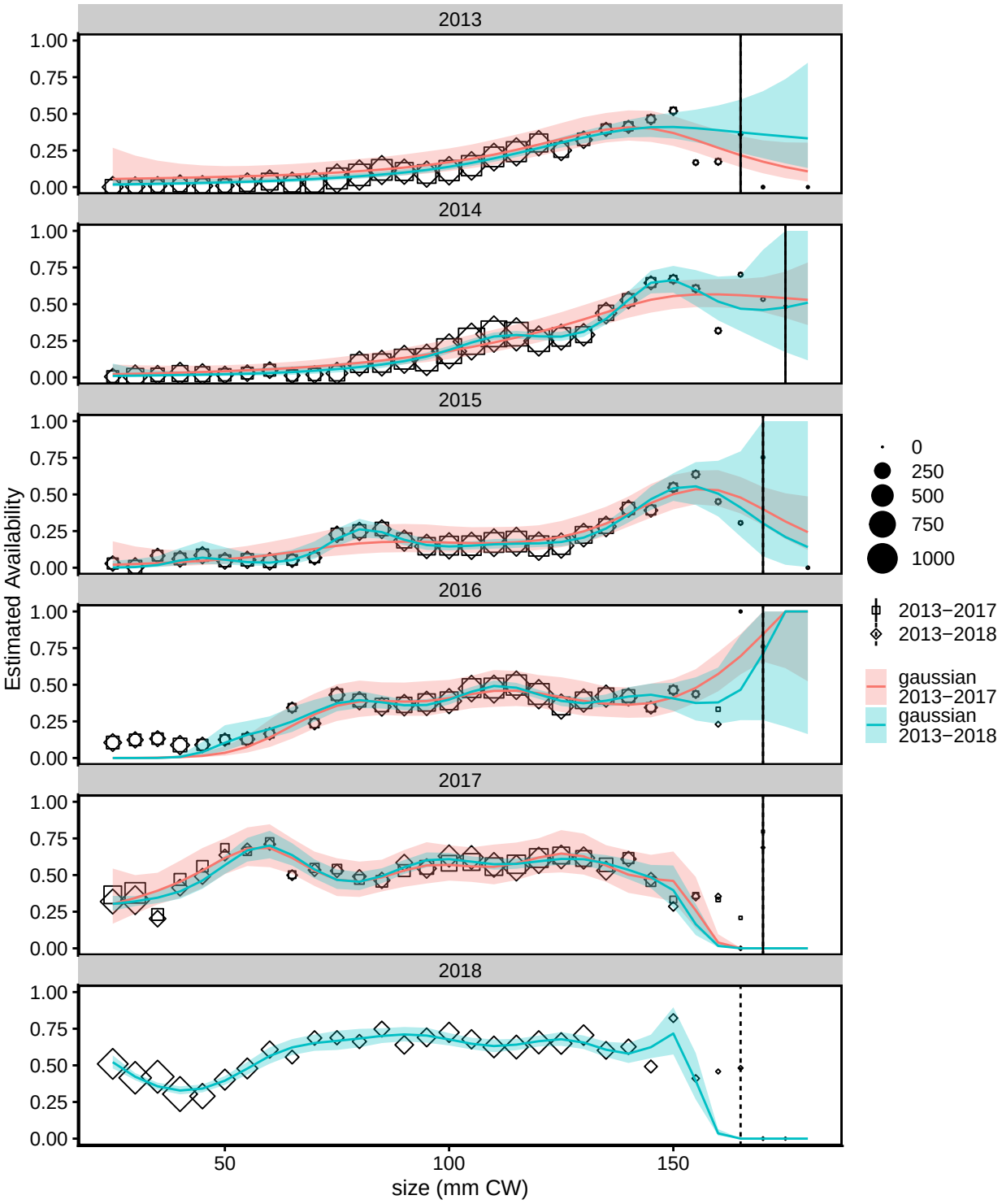

Figure 5. Comparison of smoothed model estimates for emprical availability for male Tanner crab from the 2013-2017 and 2013-2018 datasets using the original GAM approach (gaussian with log link). Lines: model estimates. Envelopes: 95% confidence intervals. Shapes: "raw" estimates; size represents the number of males measured in the full survey. The vertical lines represent the largest size (by year) in the survey. See text for more details.

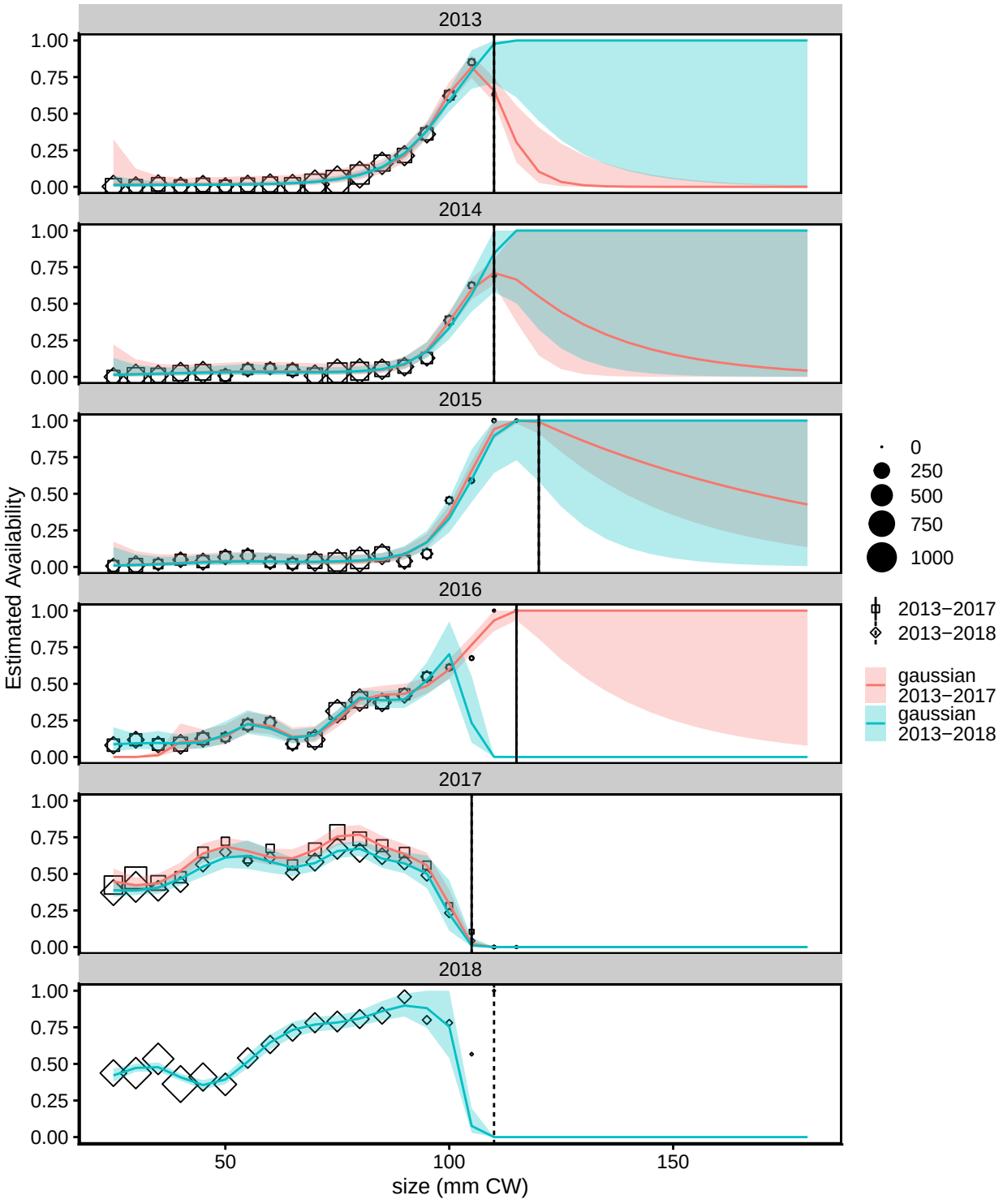

Figure 6. Comparison of smoothed model estimates for emprical availability for female Tanner crab from the 2013-2017 and 2013-2018 datasets using the original GAM approach (gaussian with log link). Lines: model estimates. Envelopes: 95% confidence intervals. Shapes: "raw" estimates; size represents the number of females measured in the full survey. The vertical lines represent the largest size (by year) in the survey.

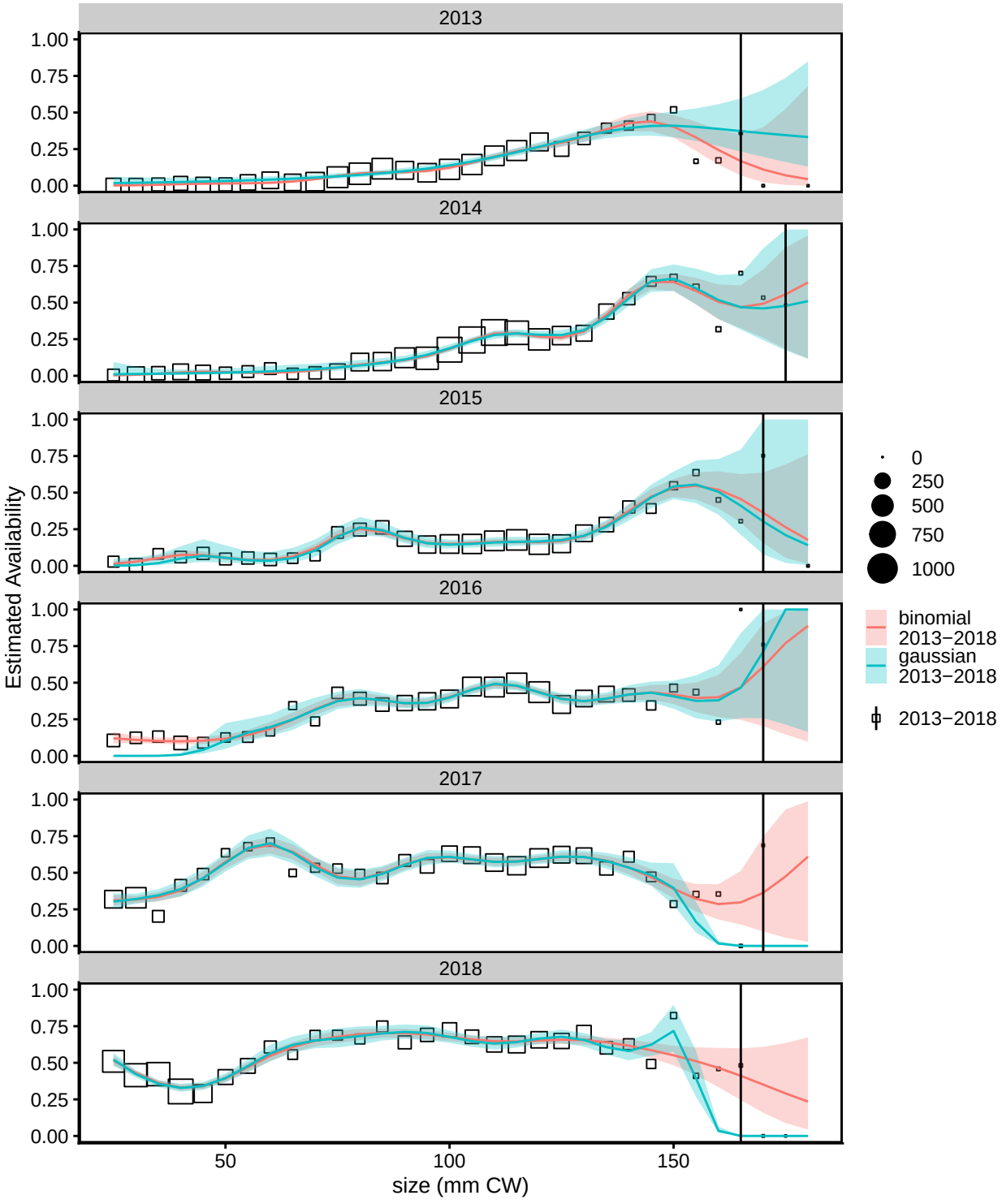

Figure 7. Comparison of smoothed model estimates for emprical availability for male Tanner crab from the the 2013-2018 dataset using the original GAM approach (labeled "gaussian") and the new approach (labeled "bionomial"). Lines: model estimates. Envelopes: 95% confidence intervals. Shapes: "raw" estimates; size represents the number of males measured in the full survey. The vertical lines represent the largest size (by year) in the survey. See text for more details.

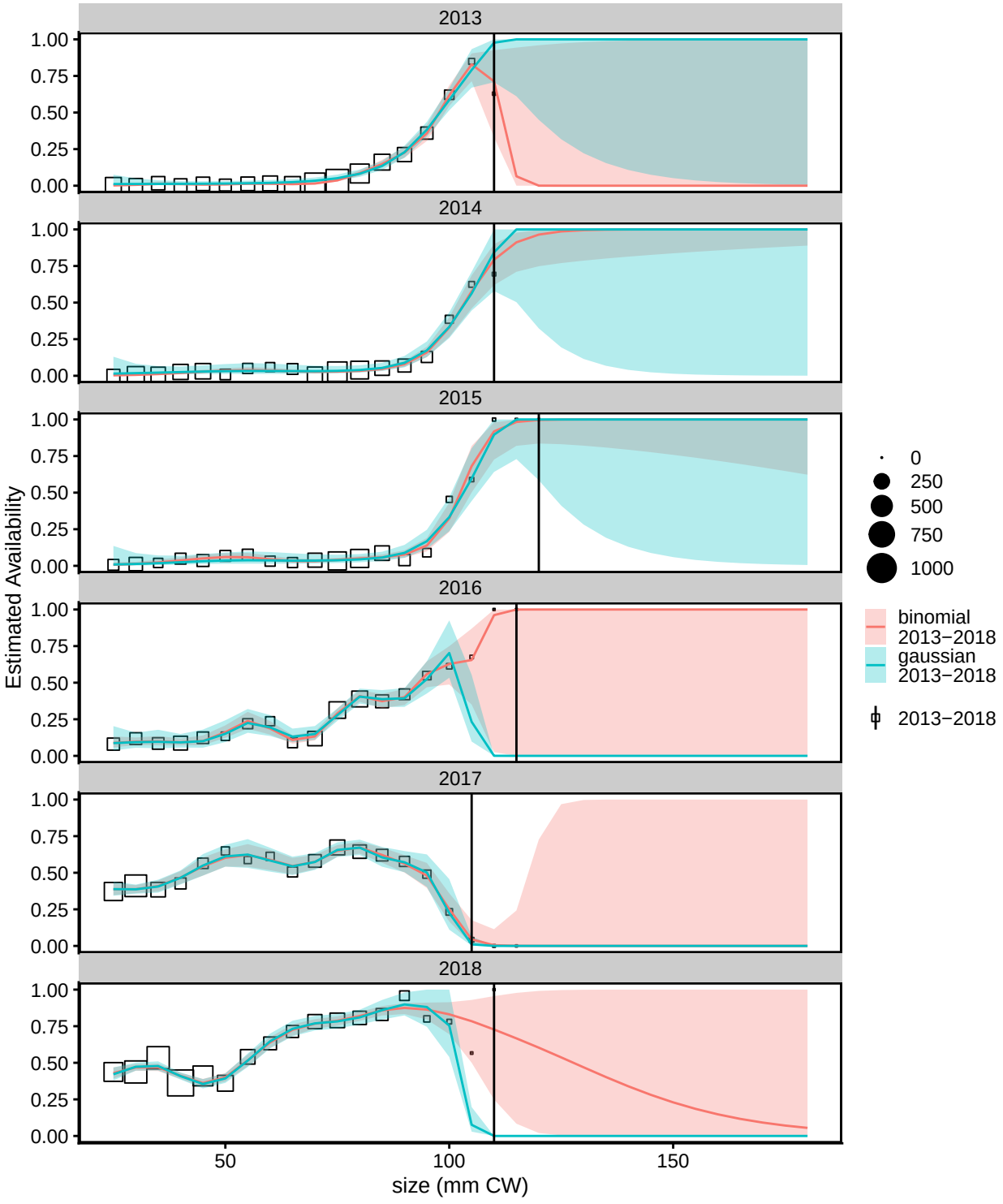

Figure 8. Comparison of smoothed model estimates for emprical availability for female Tanner crab from the 2013-2018 dataset using the original GAM approach (labeled "gaussian") and the new approach (labeled "bionomial"). Lines: model estimates. Envelopes: 95% confidence intervals. Shapes: "raw" estimates; size represents the number of females measured in the full survey. The vertical lines represent the largest size (by year) in the survey.

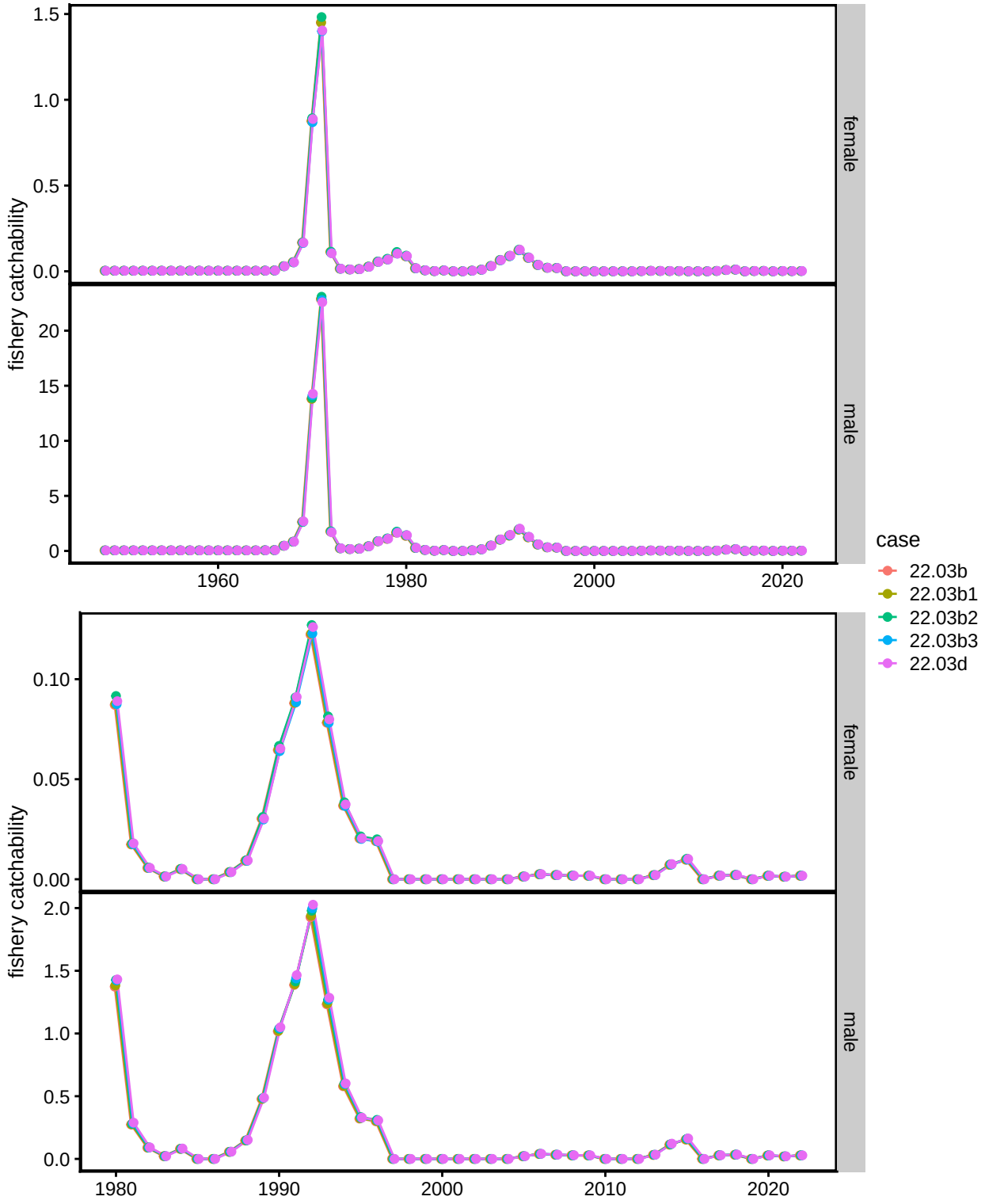

Figure 9. TCSAM02 models estimated fully-selected capture rates (not mortality) in the directed fishery. The lower pair of plots show the estimated time series since 1980.

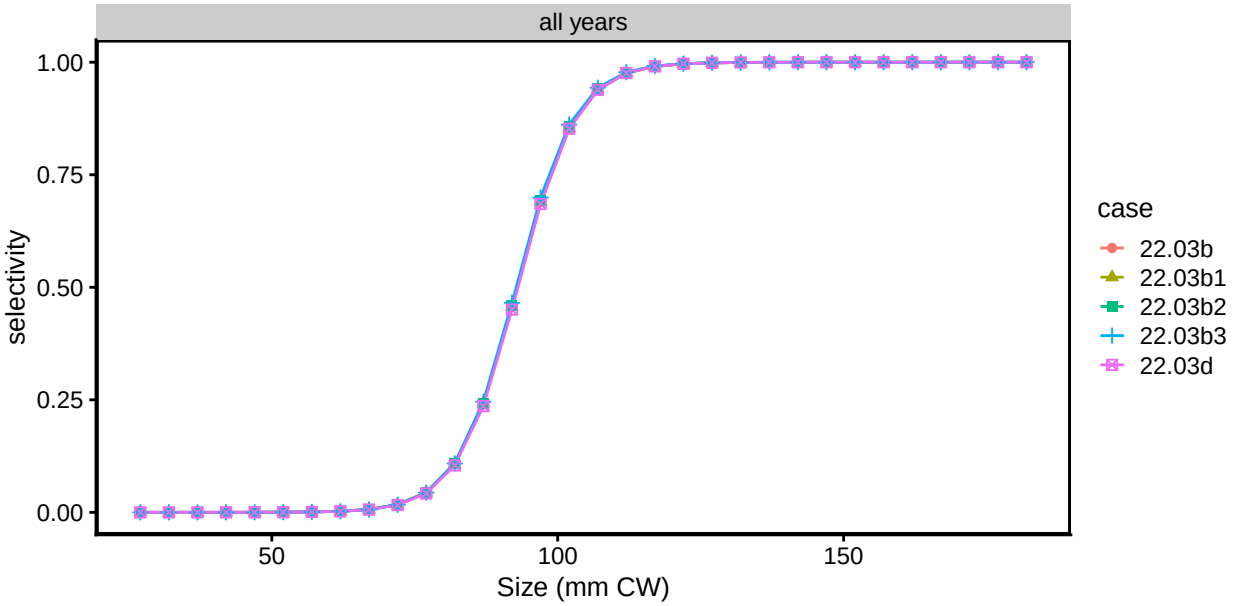

Figure 10. TCSAM02 models estimated selectivity for females in the directed fishery for all years.

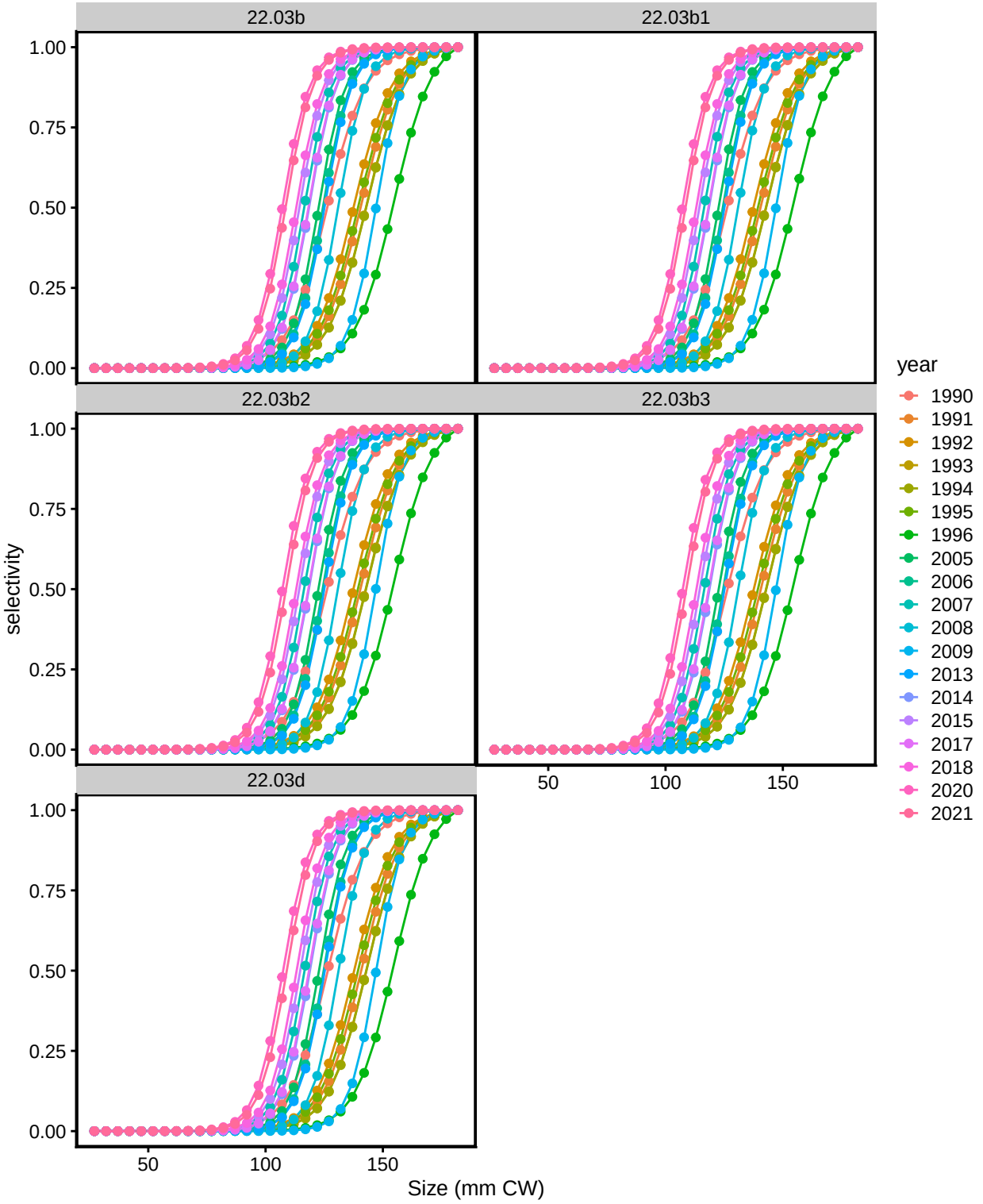

Figure 11. TCSAM02 models estimated selectivity curves for males in the directed fishery, faceted by model scenario. Curves labelled 1990 applies to all years before 1991. Others apply in the year indicated in the legend.

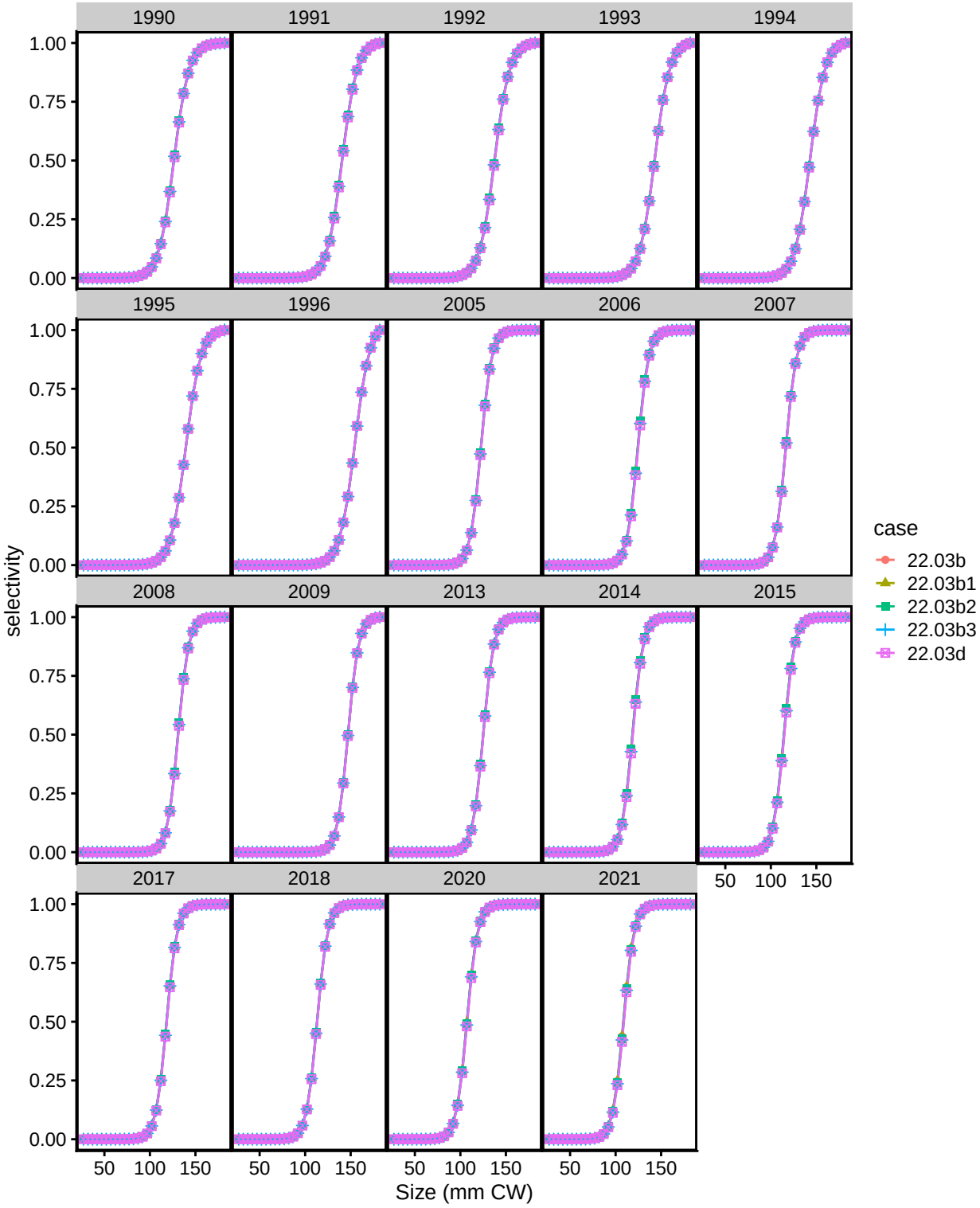

Figure 12. TCSAM02 models estimated selectivity curves for males in the directed fishery by year. Curve labelled 1990 applies to all years before 1991. Others apply in the year indicated in the panel.

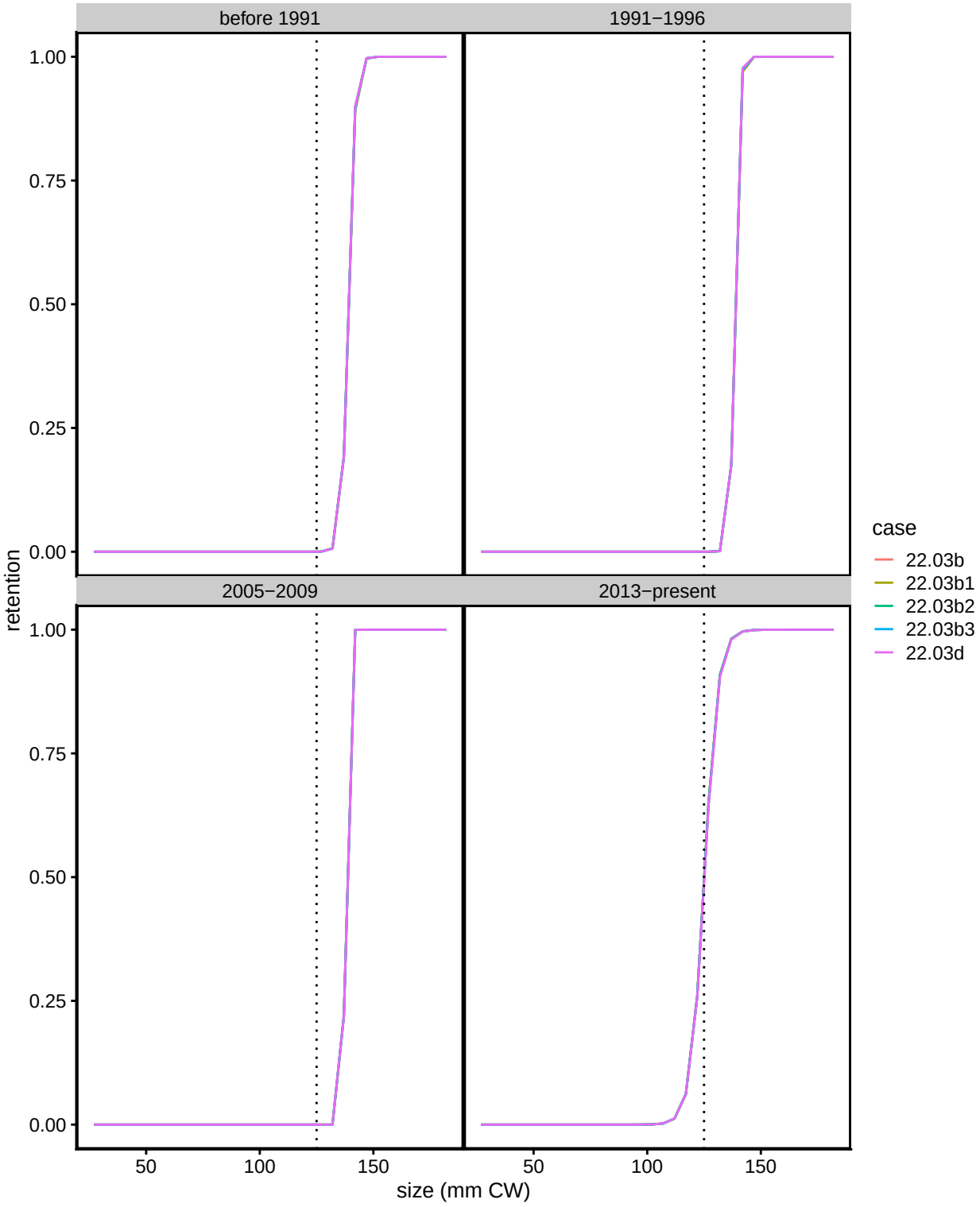

Figure 13. TCSAM02 models estimated retention curves for males in the directed fishery by time block. The dotted line indicates the current industry-preferred size (125 mm CW).

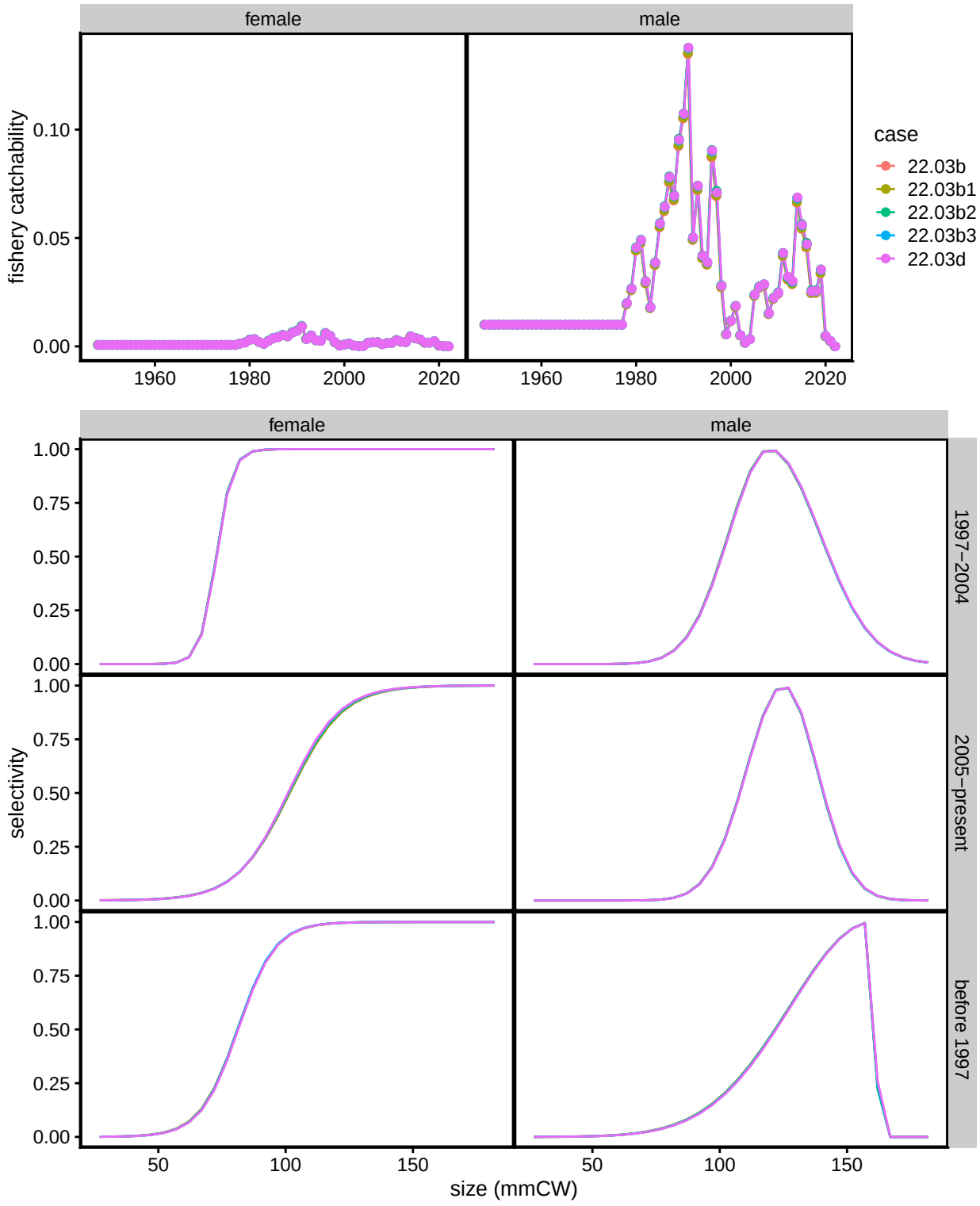

Figure 14. TCSAM02 models estimated fully-selected bycatch capture rates (not mortality) and selectvity functions in the snow crab fishery. Time blocks for selectivity functions are labelled: 1) before 1997; 2) 1997-2004; 3) 2005-present.

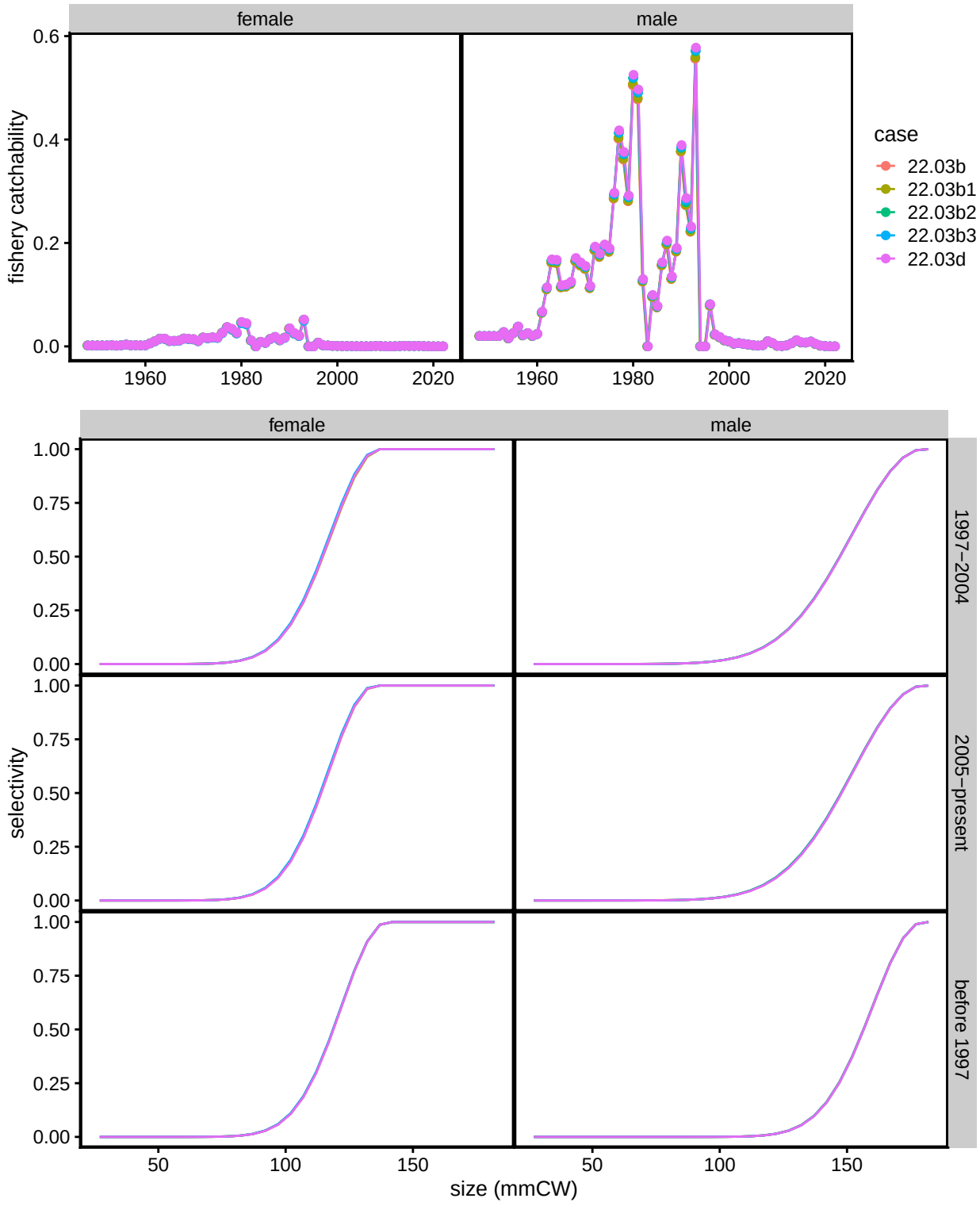

Figure 15. TCSAM02 models estimated fully-selected bycatch capture rates (not mortality) and selectvity functions in the BBRKC fishery. Time blocks for selectivity functions are 1) before 1997; 2) 1997-2004; 3) 2005-present.

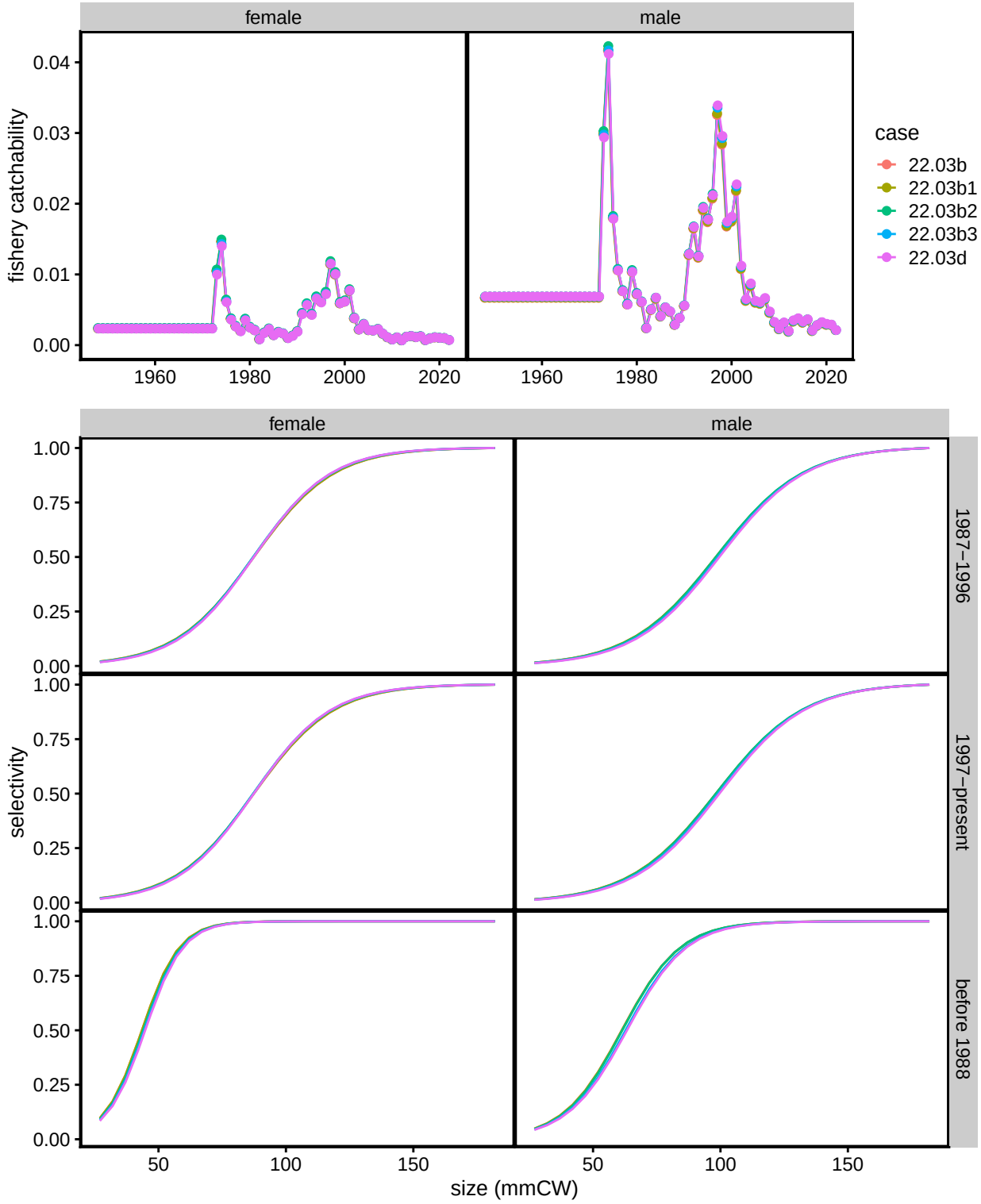

Figure 16. TCSAM02 models estimated fully-selected bycatch capture rates (not mortality) and selectvity functions in the groundfish fisheries. Time blocks for selectivity functions are : 1) before 1988; 2) 1987-1996; 3) 1997-present.

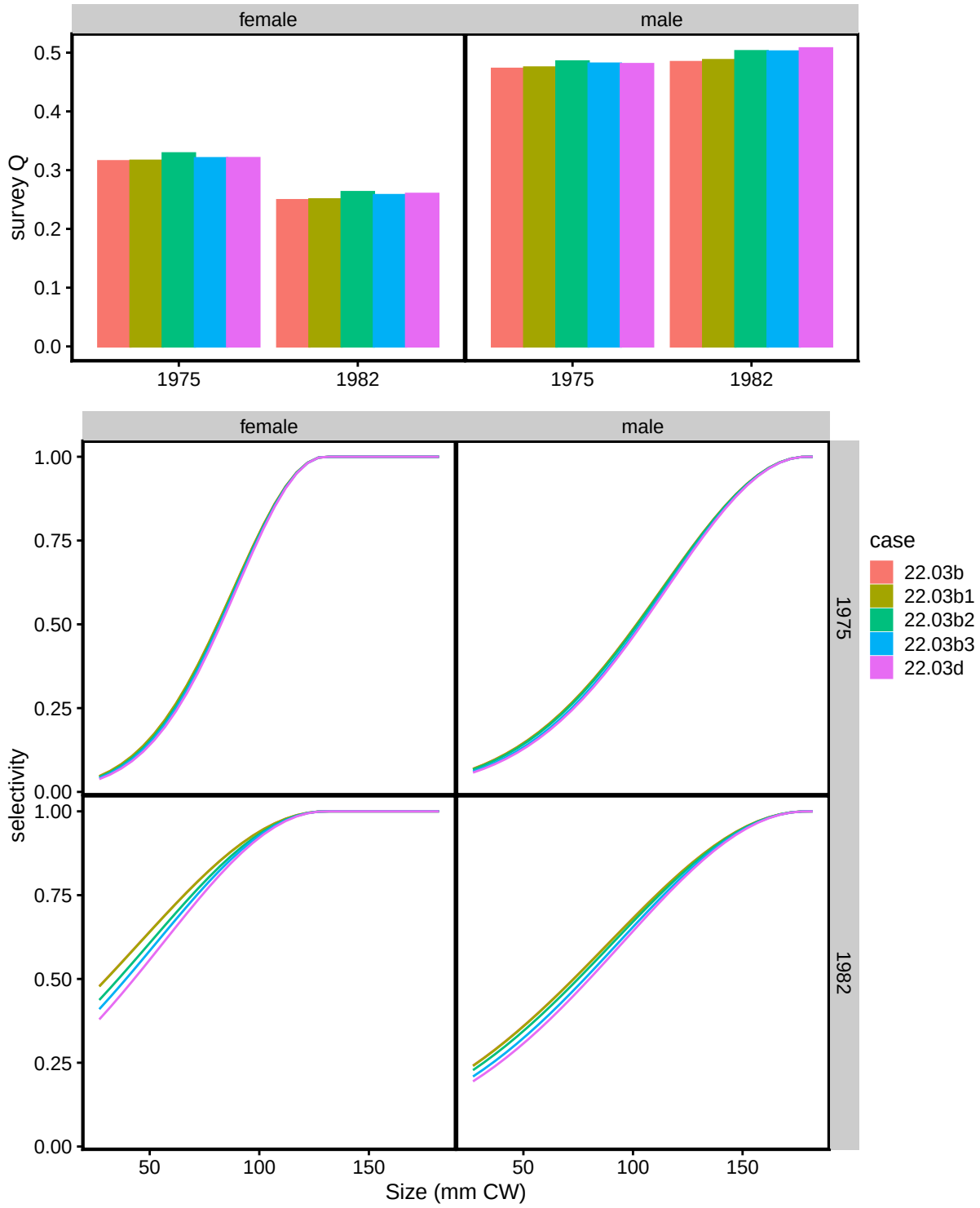

Figure 17. TCSAM02 models estimated NMFS EBS Survey fully-selected catchability (survey Q's) and selectivity functions by sex for different time periods. 1975: 1975-1981; 1982: 1982-current.

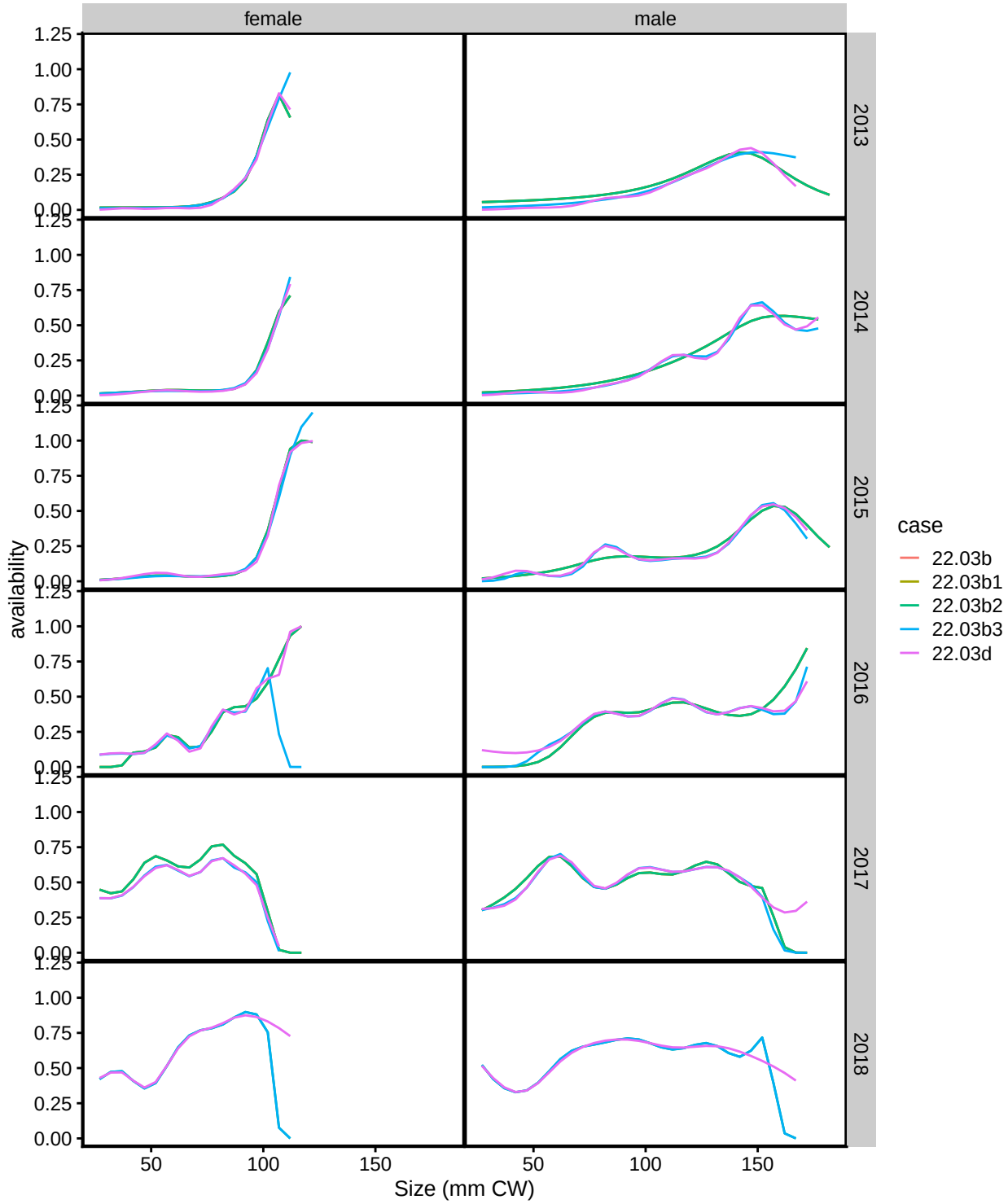

Figure 18. Annual sex-specific availability curves assumed for the BSFRF side-by-side (SBS) survey data. The availability curves were estimated outside the TCSAM02 models.

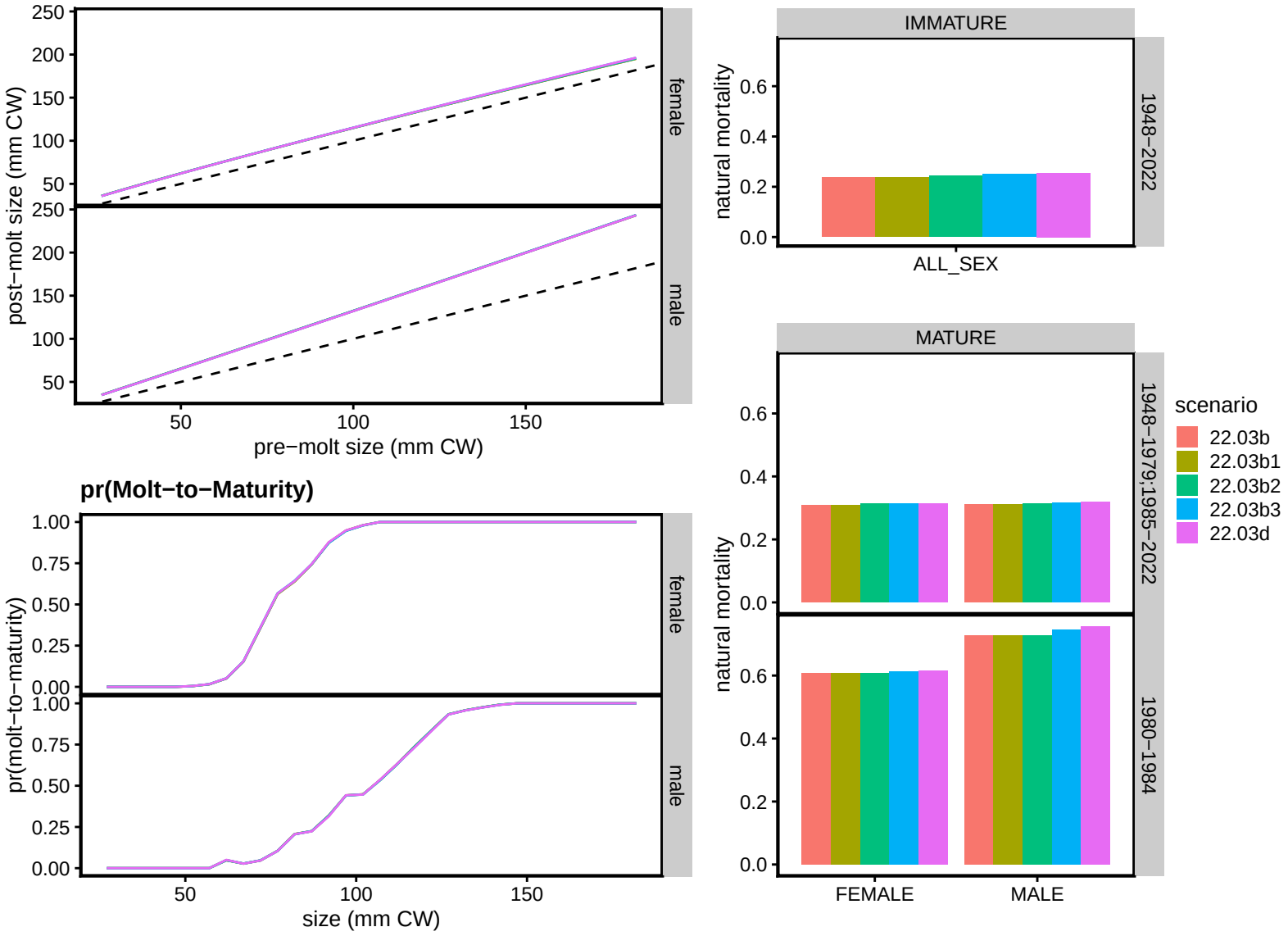

Figure 19. TCSAM02 models estimated population processes. Plots in upper lefthand quadrant: sex-specific mean growth; plots in lower lefthand quadrant: sex-specific probability of the molt-to-maturity (i.e., terminal molt); plots in righthand column: natural mortality rates, by maturity state and sex.

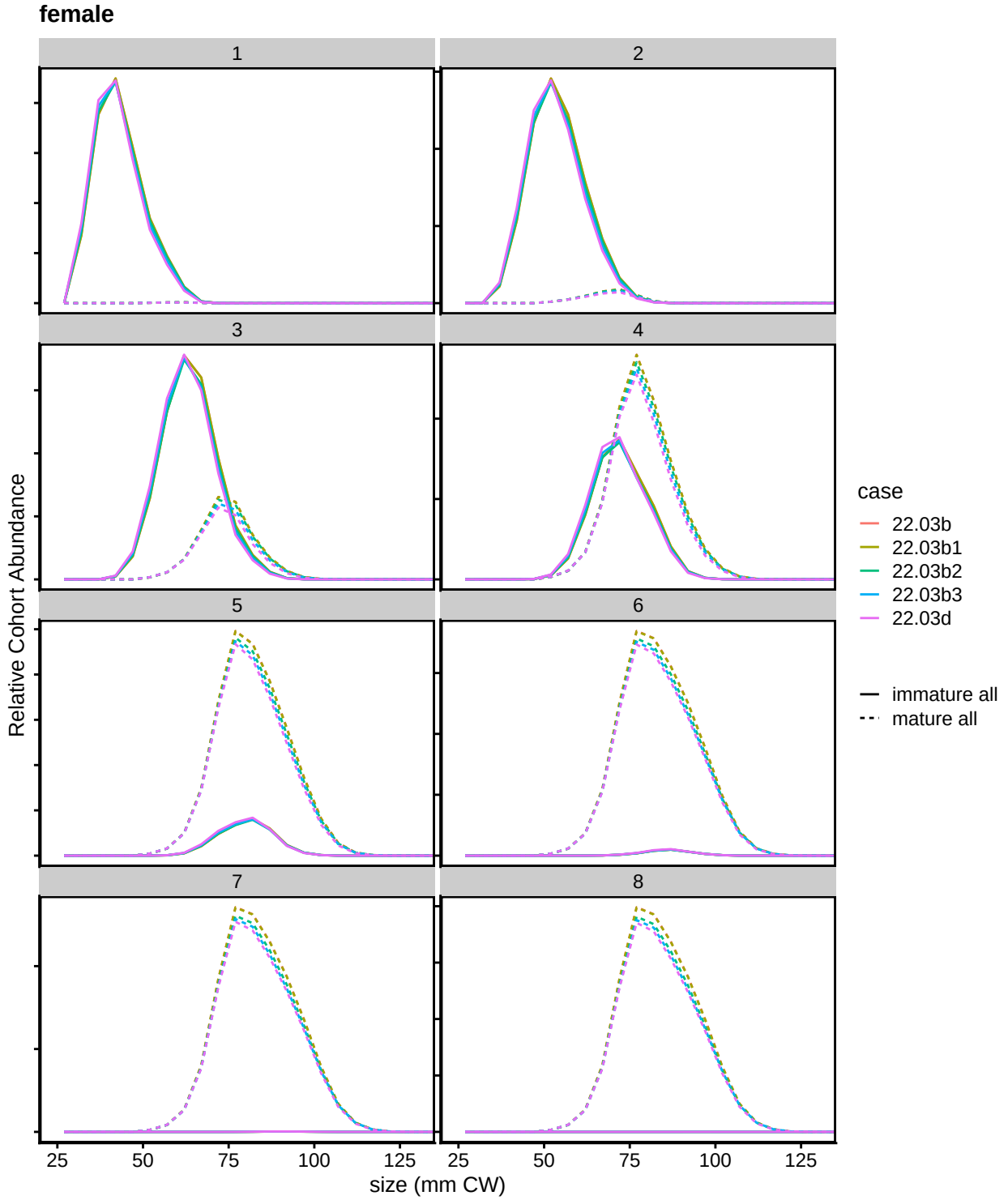

Figure 20. TCSAM02 models estimated annual cohort progression for female crab based on rates from final model year (by age; individual scales are relative).

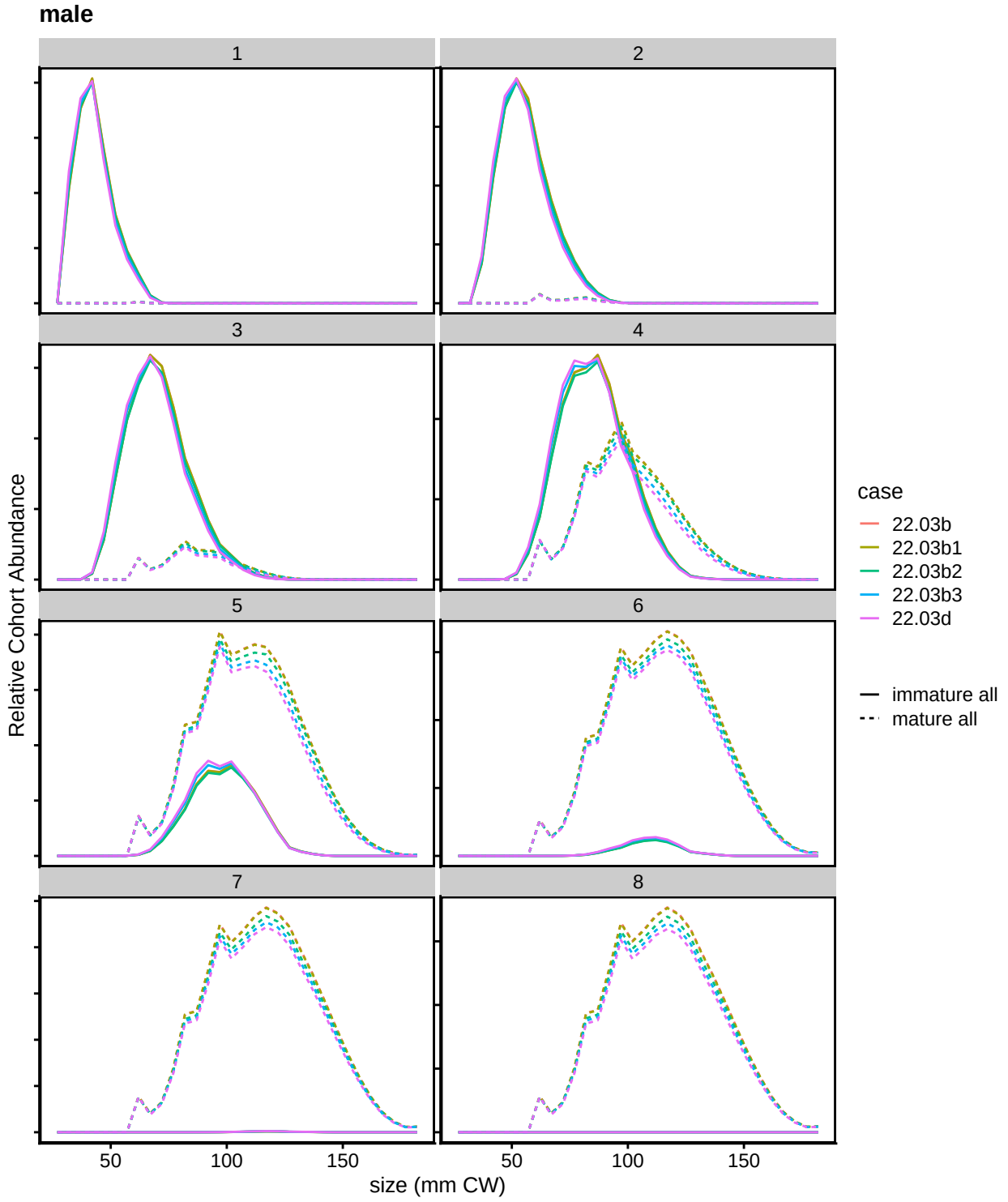

Figure 21. TCSAM02 models estimated annual cohort progression for male crab based on rates from final model year (by age; individual scales are relative).

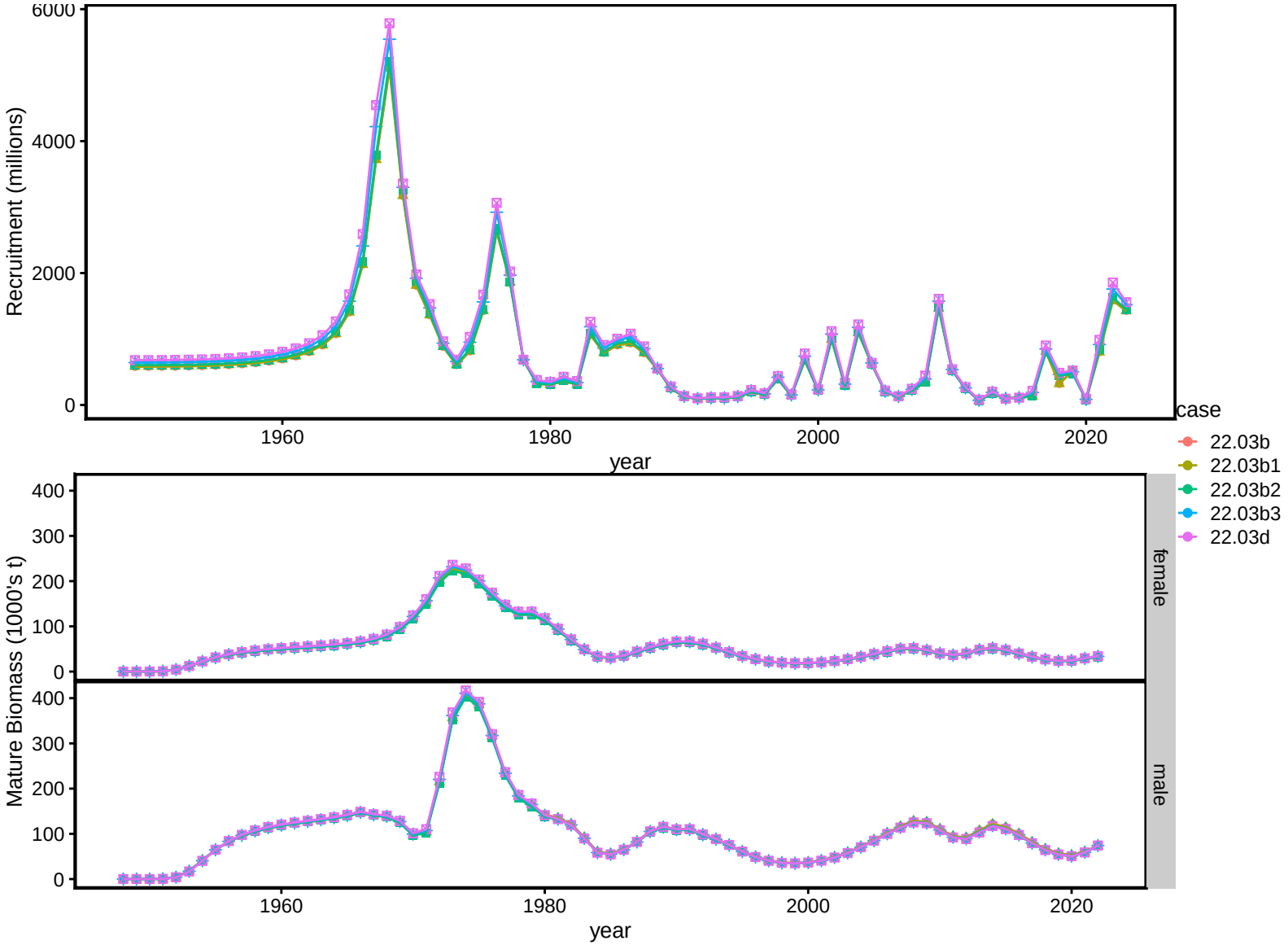

Figure 22. TCSAM02 models estimated recruitment and mature biomass time series (all years). Upper plot: recruitment; lower plots: sex-specific mature biomass-at-mating.

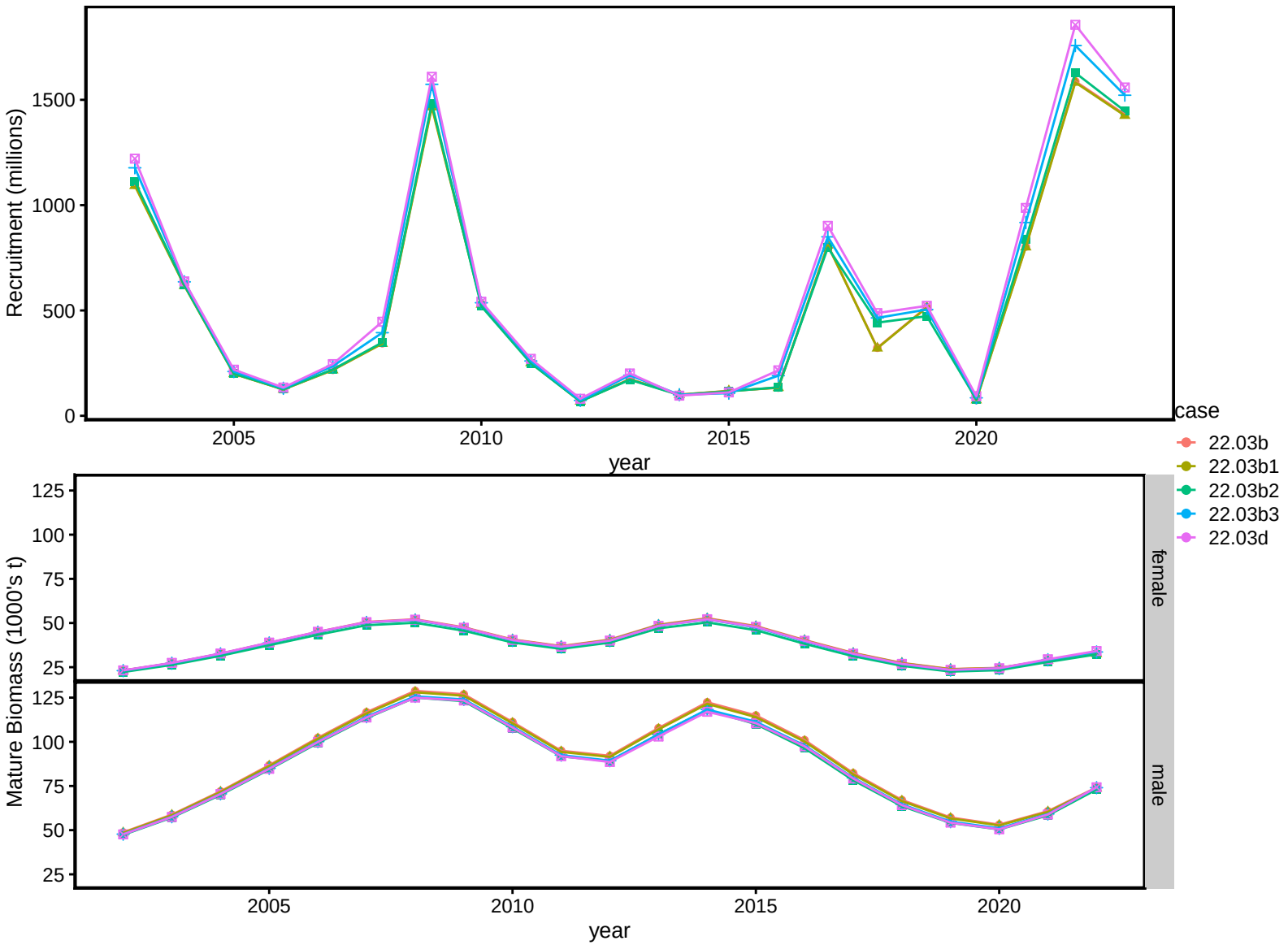

Figure 23. TCSAM02 models estimated recruitment and mature biomass time series (recent years). Upper plot: recruitment; lower plots: sex-specific mature biomass-at-mating.

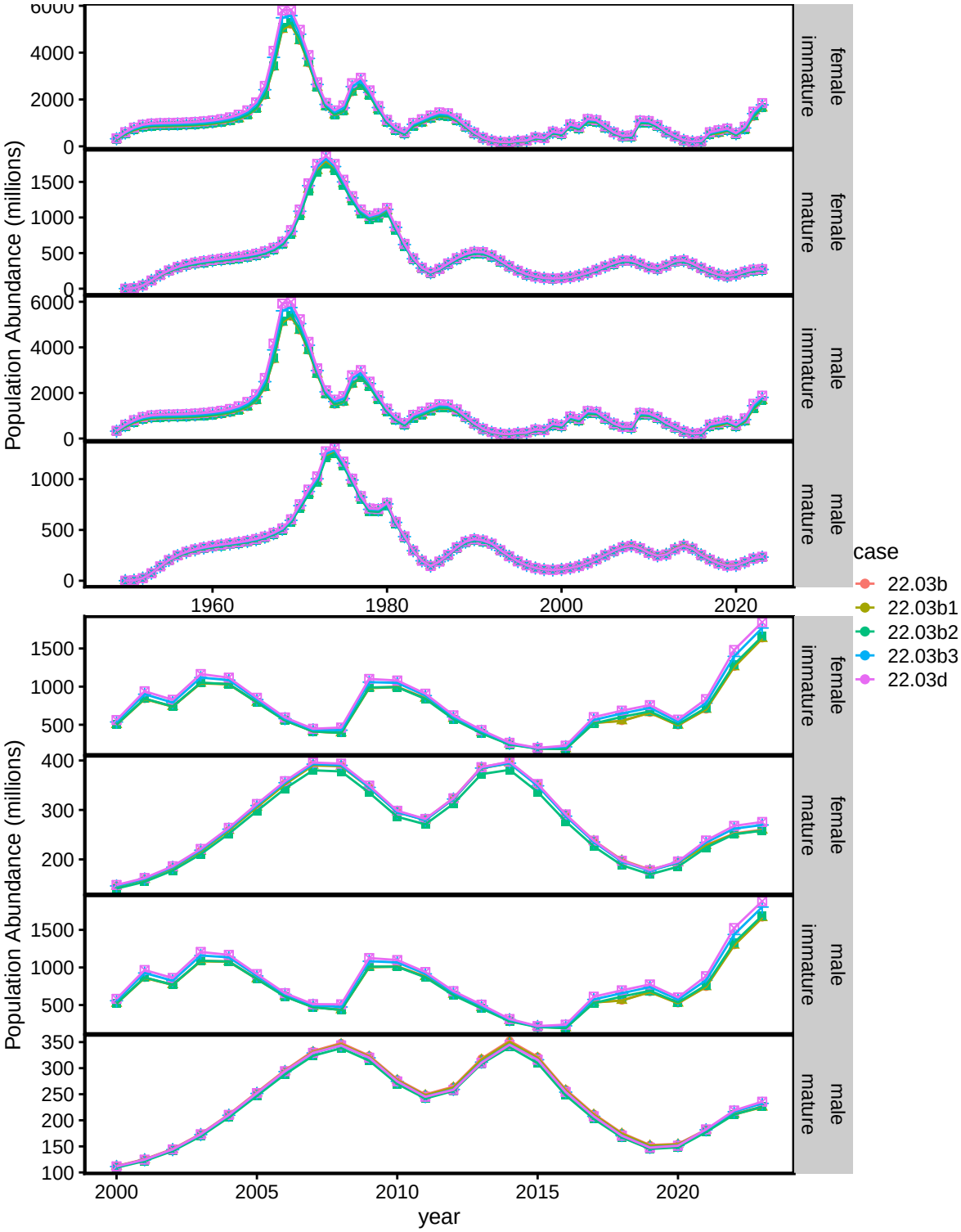

Figure 24. TCSAM02 models estimated population abundance trends, by sex and maturity state. Upper plots: all years; lower plots: recent years.

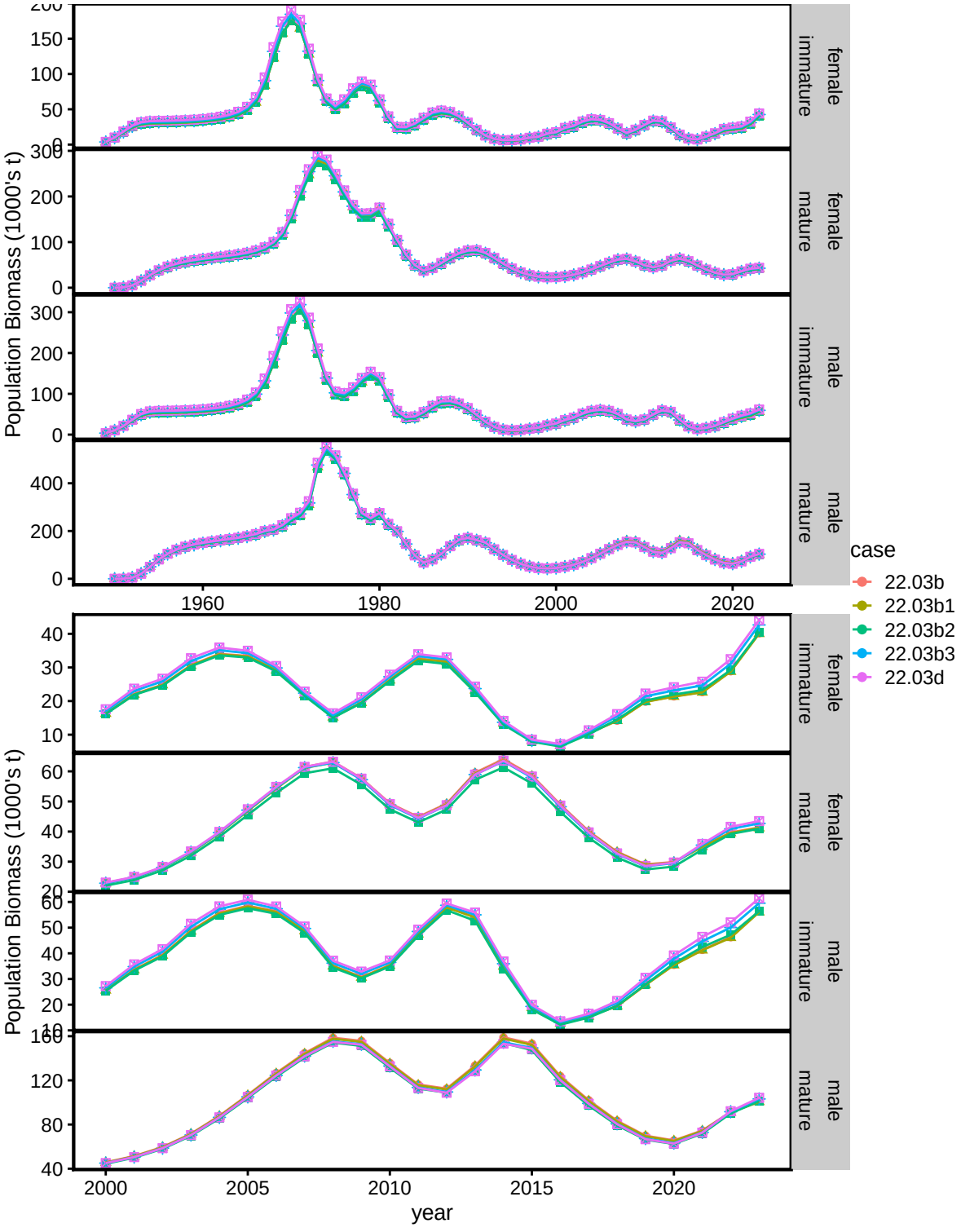

Figure 25. TCSAM02 models estimated population biomass trends, by sex and maturity state. Upper plots: all years; lower plots: recent years.

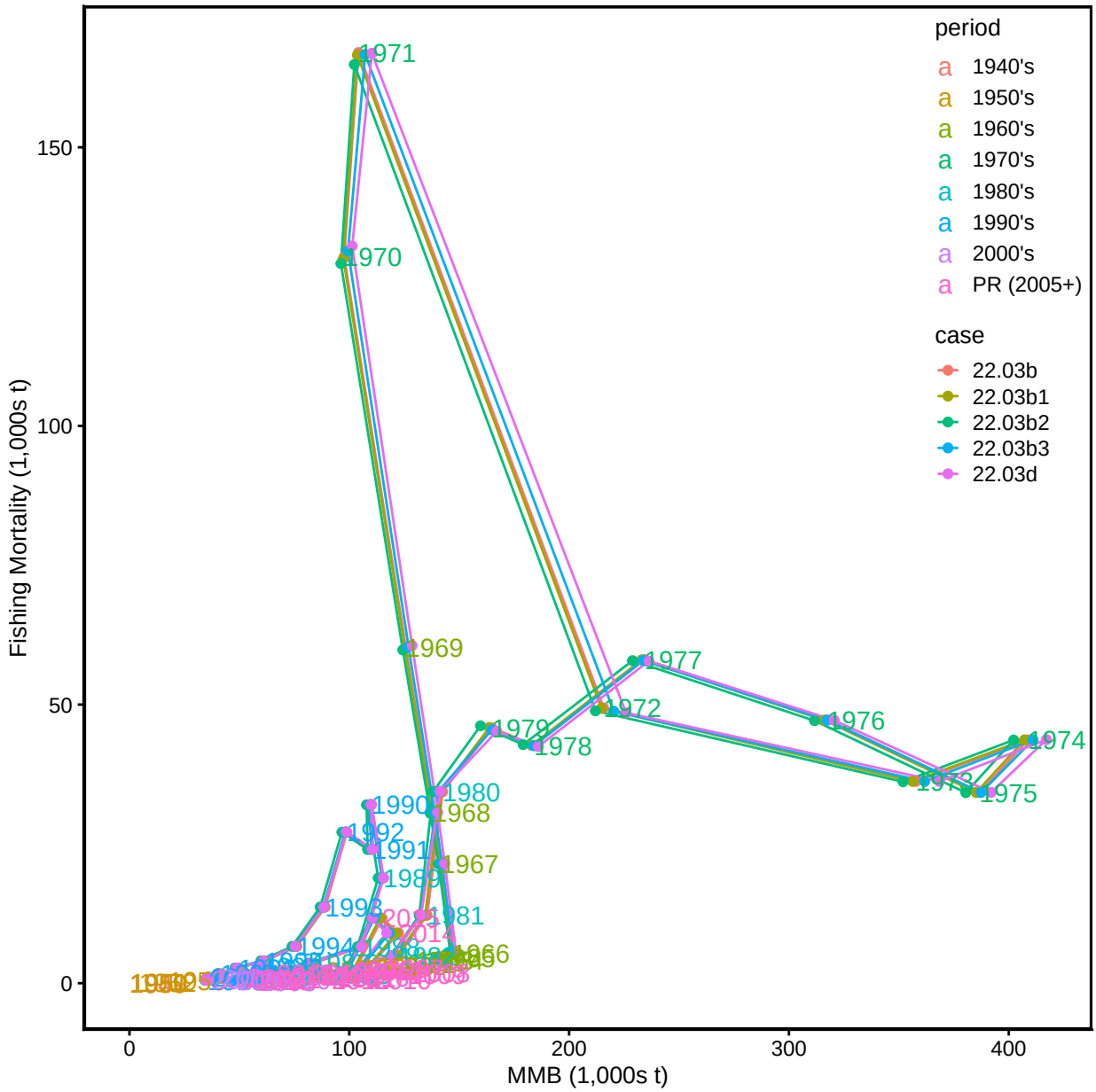

Figure 26. Estimated total fishing mortality vs. MMB. Decades prior to rationalization are grouped by color; the post-rationalization period ("PR"), 2005+, is also highlighted. Data to inform fishing mortality is only available from 1965 on.

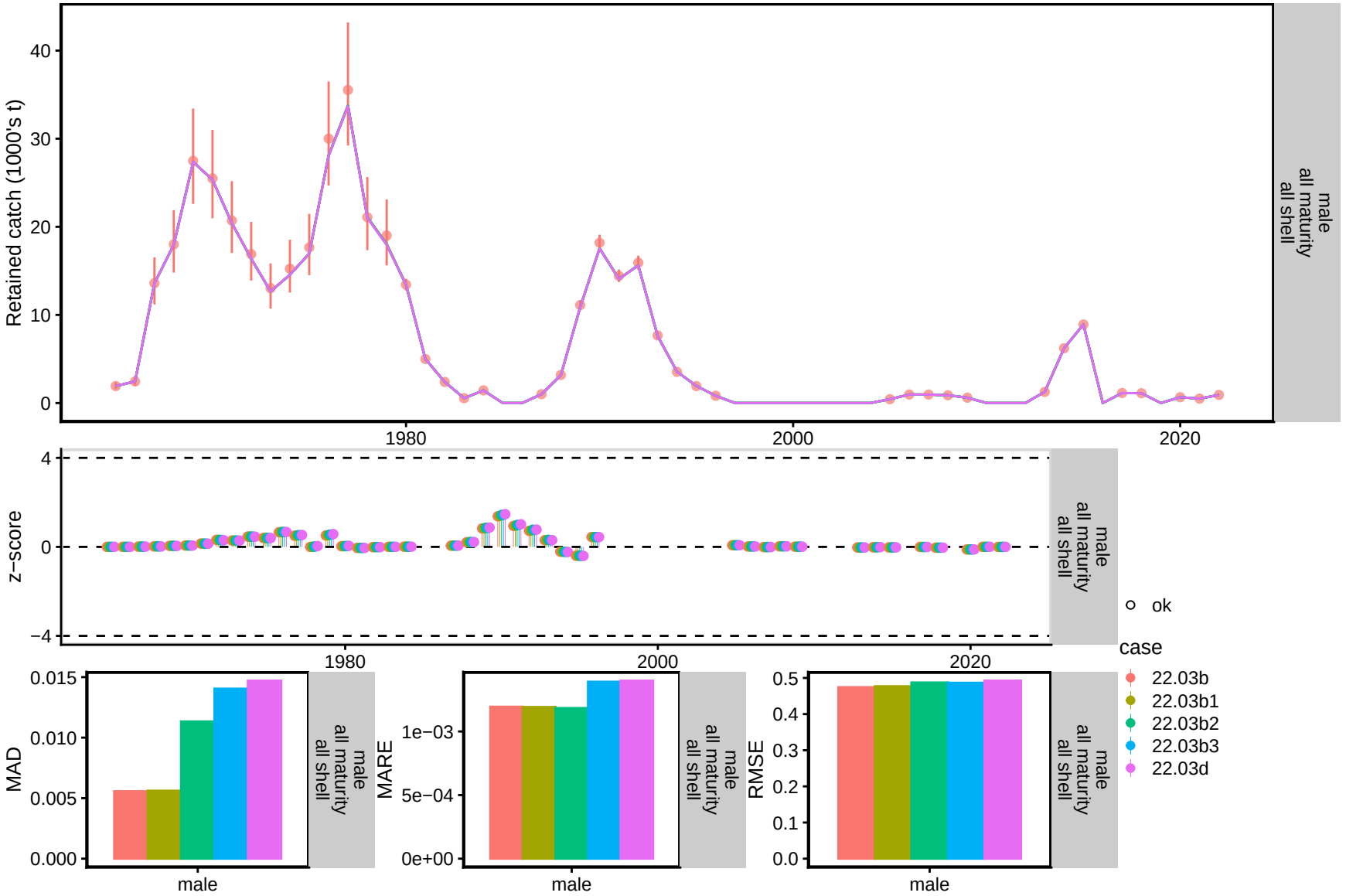

Figure 27. TCSAM02 models fits to retained catch biomass in the directed fishery (upper two rows) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

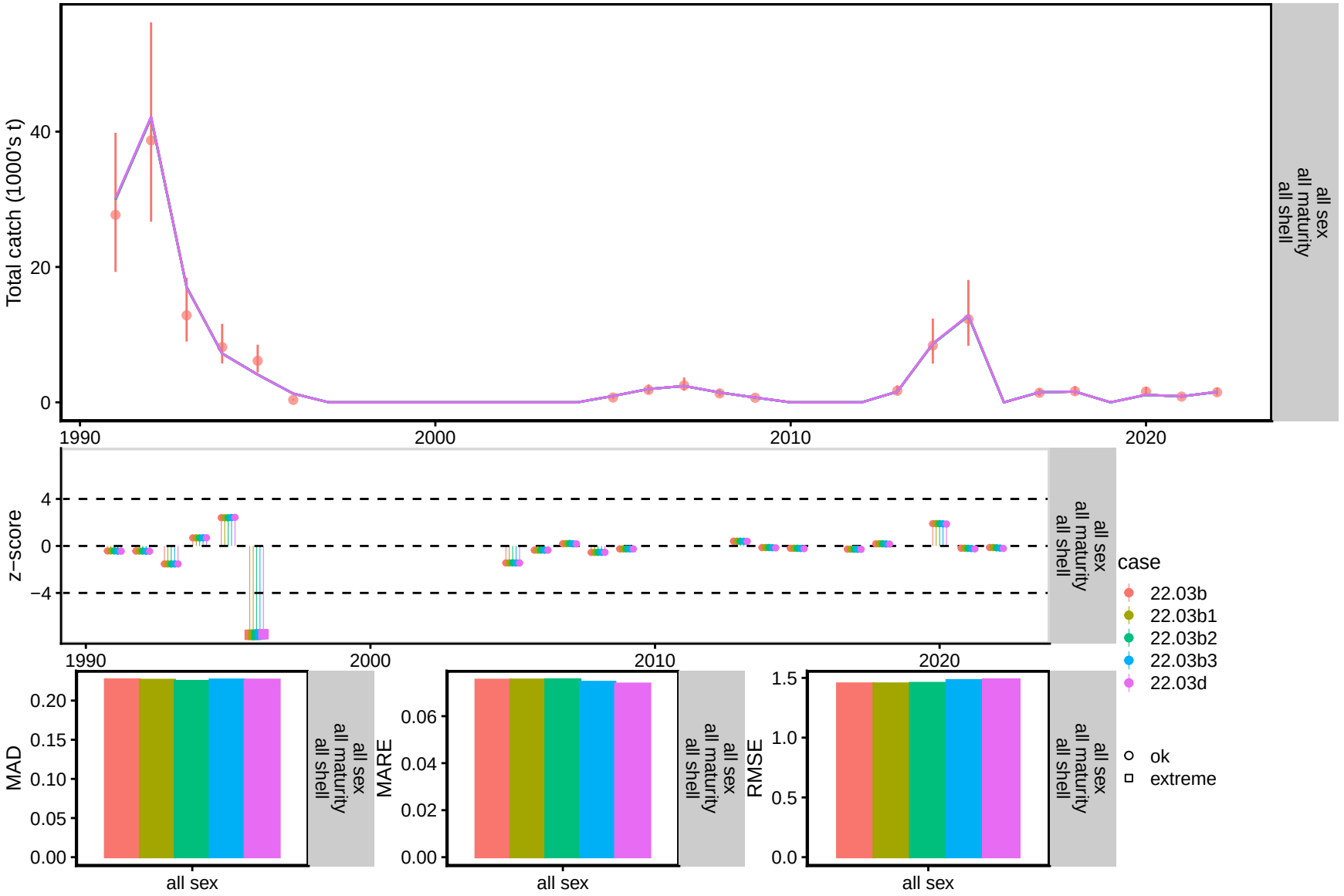

Figure 28. TCSAM02 models fits to total catch biomass of all crab in the TCF fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

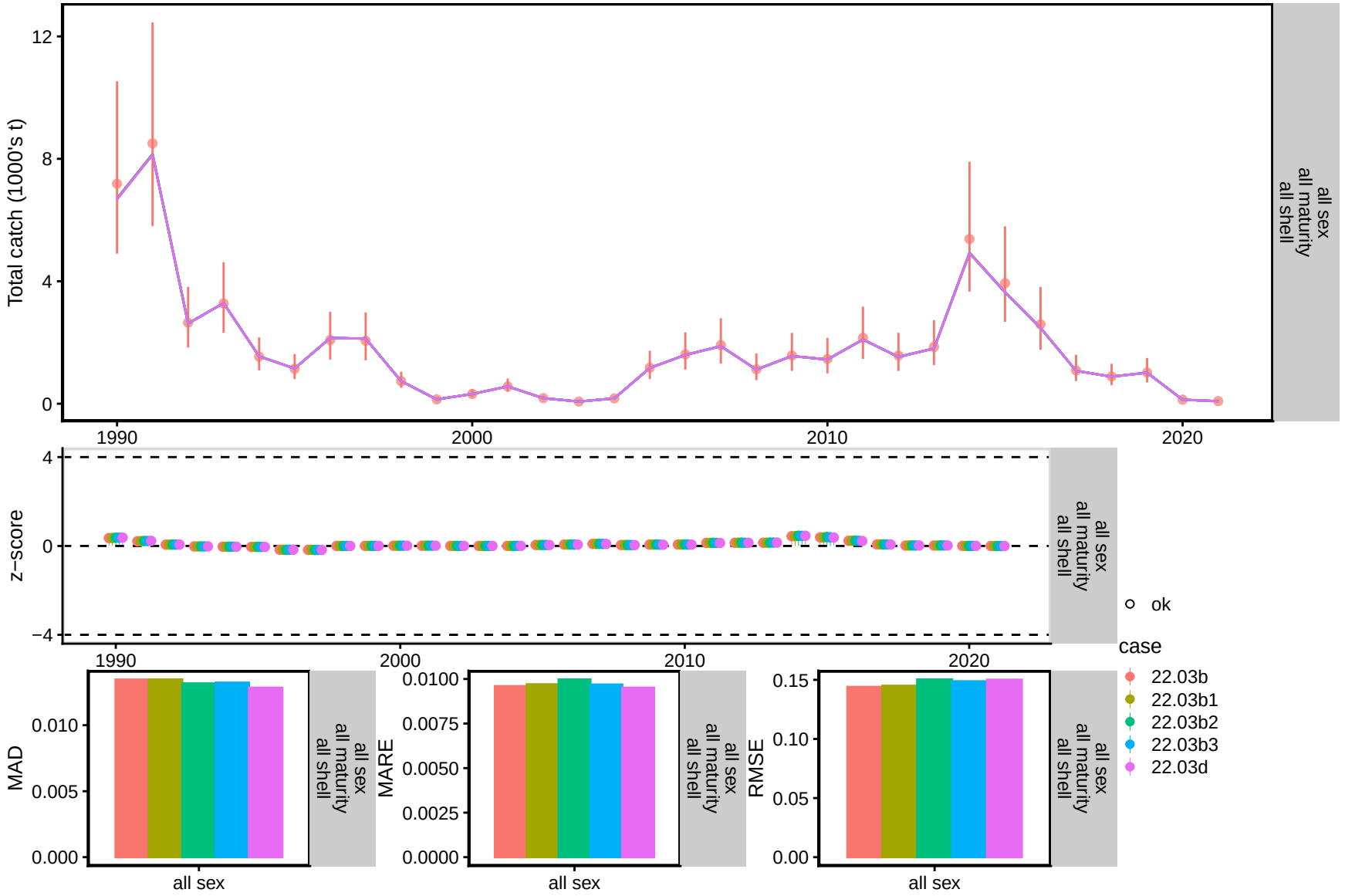

Figure 29. TCSAM02 models fits to total catch biomass of all crab in the SCF fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

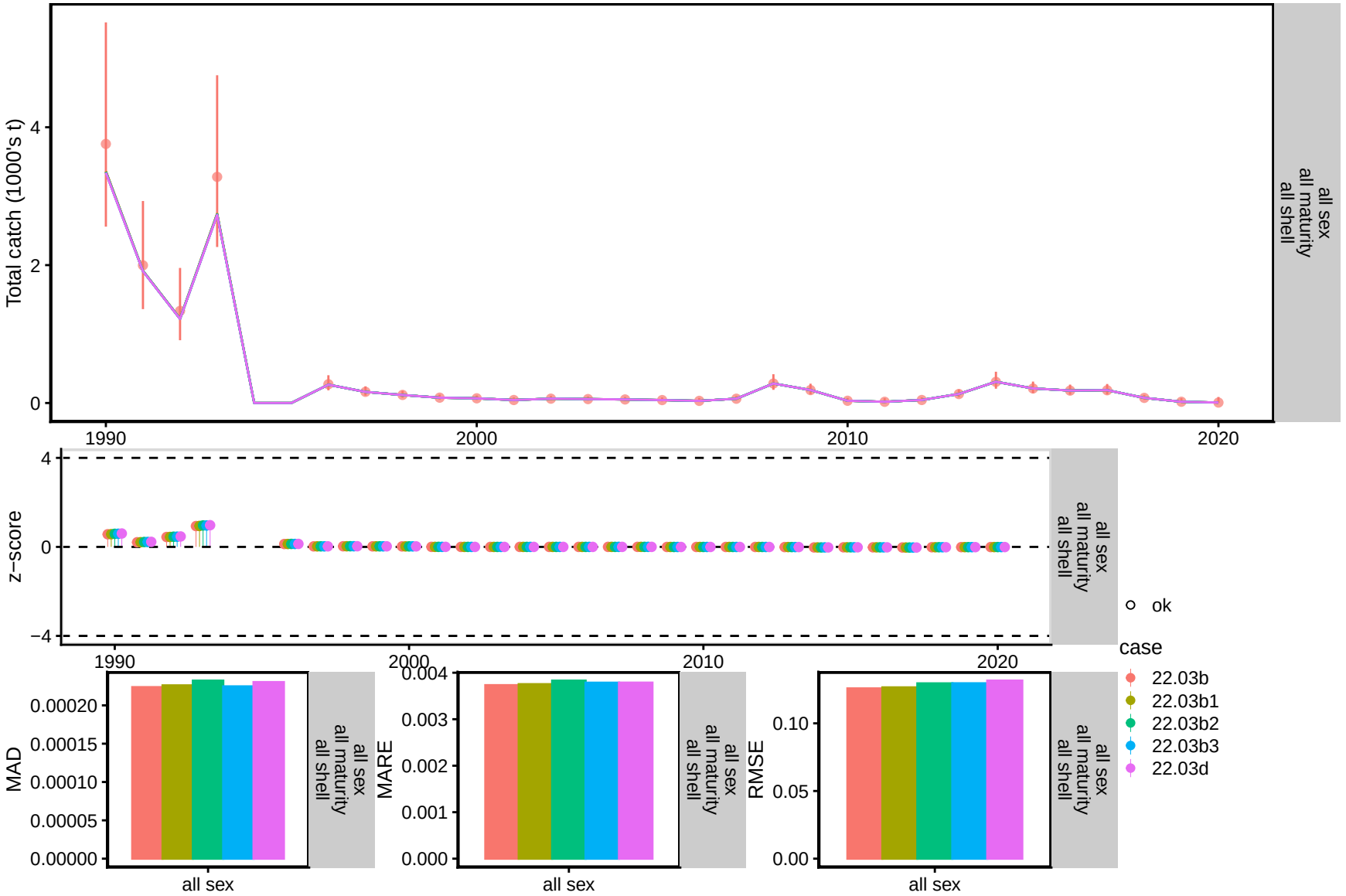

Figure 30. TCSAM02 models fits to total catch biomass of all crab in the RKF fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

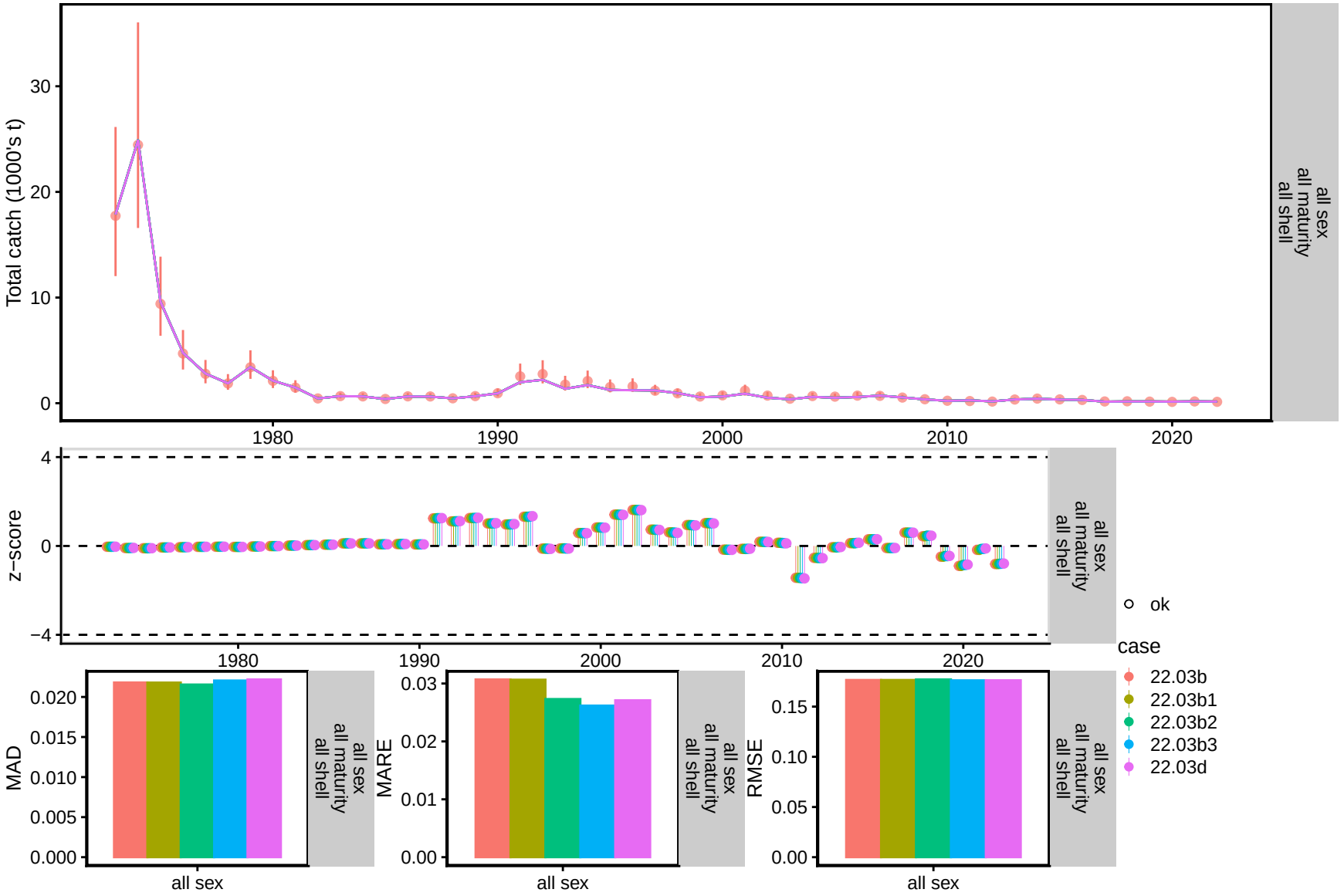

Figure 31. TCSAM02 models fits to total catch biomass of all crab in the GF All fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

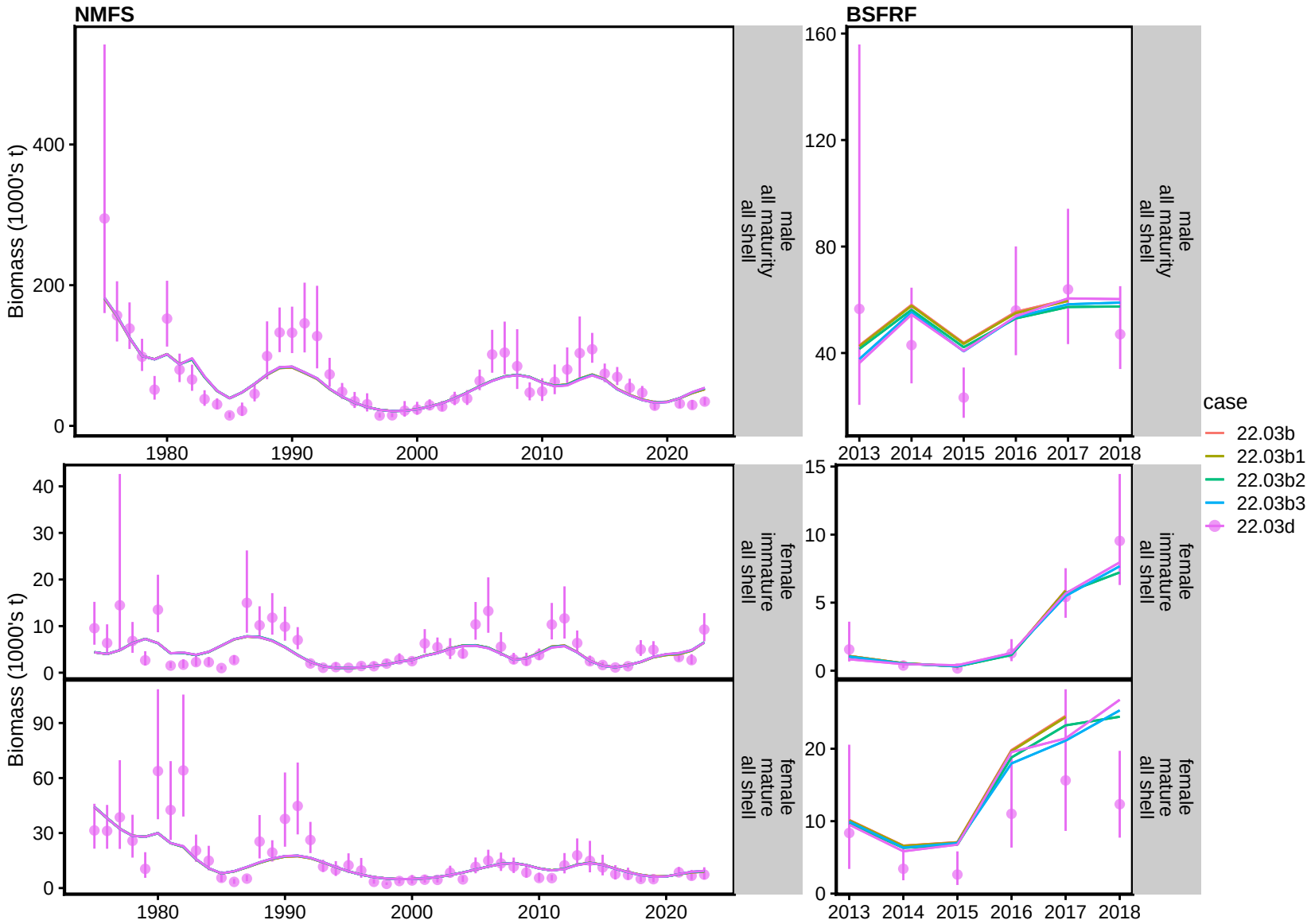

Figure 32. TCSAM02 models fits to time series of all male (upper graph), immature female (center graph), and mature female (lower plot) biomass from the NMFS EBS shelf bottom trawl survey (left column) and the BSFRF SBS trawl survey (right column). Confidence intervals are 95%.

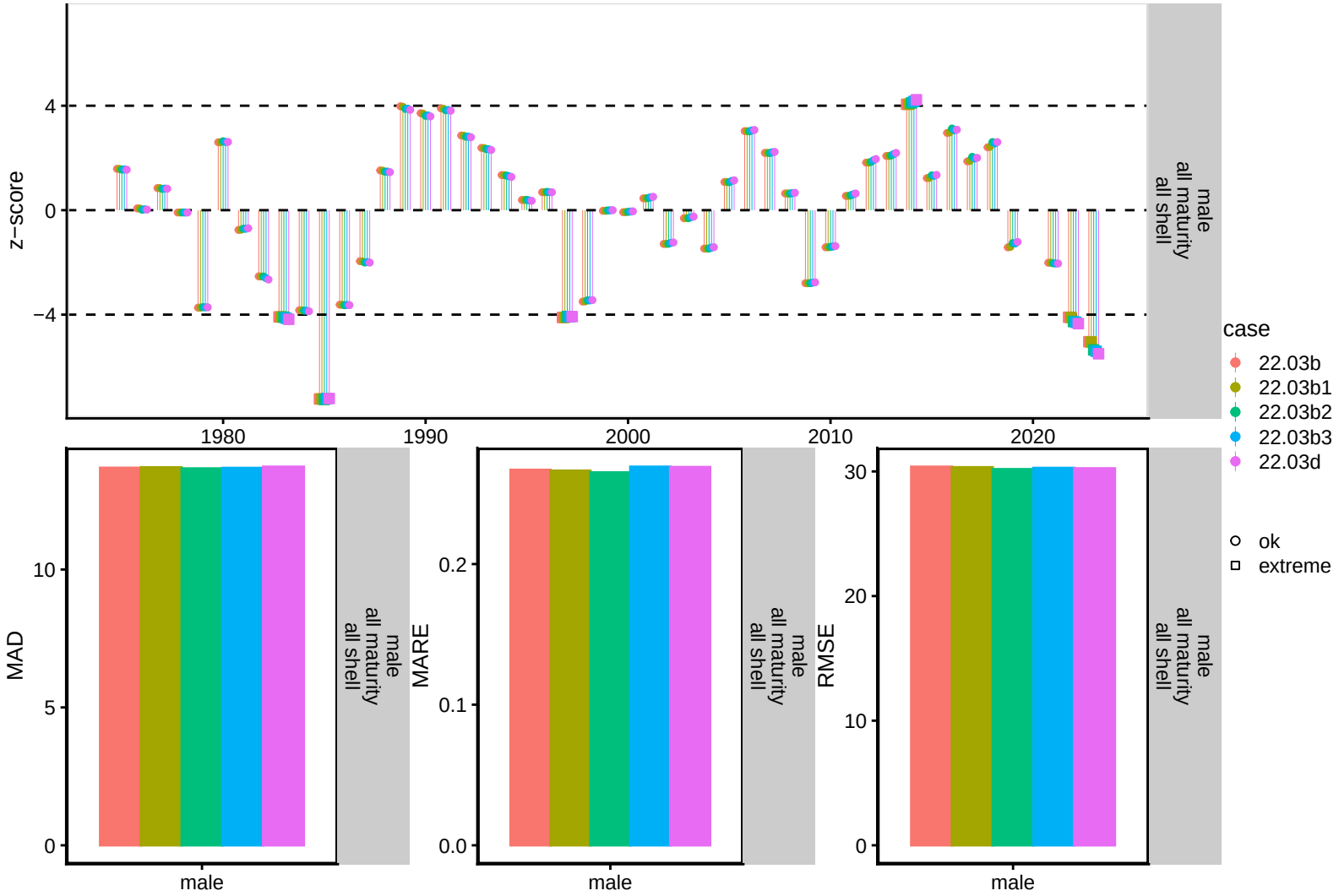

Figure 33. TCSAM02 models residuals analysis by model scenario for fits to male biomass in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

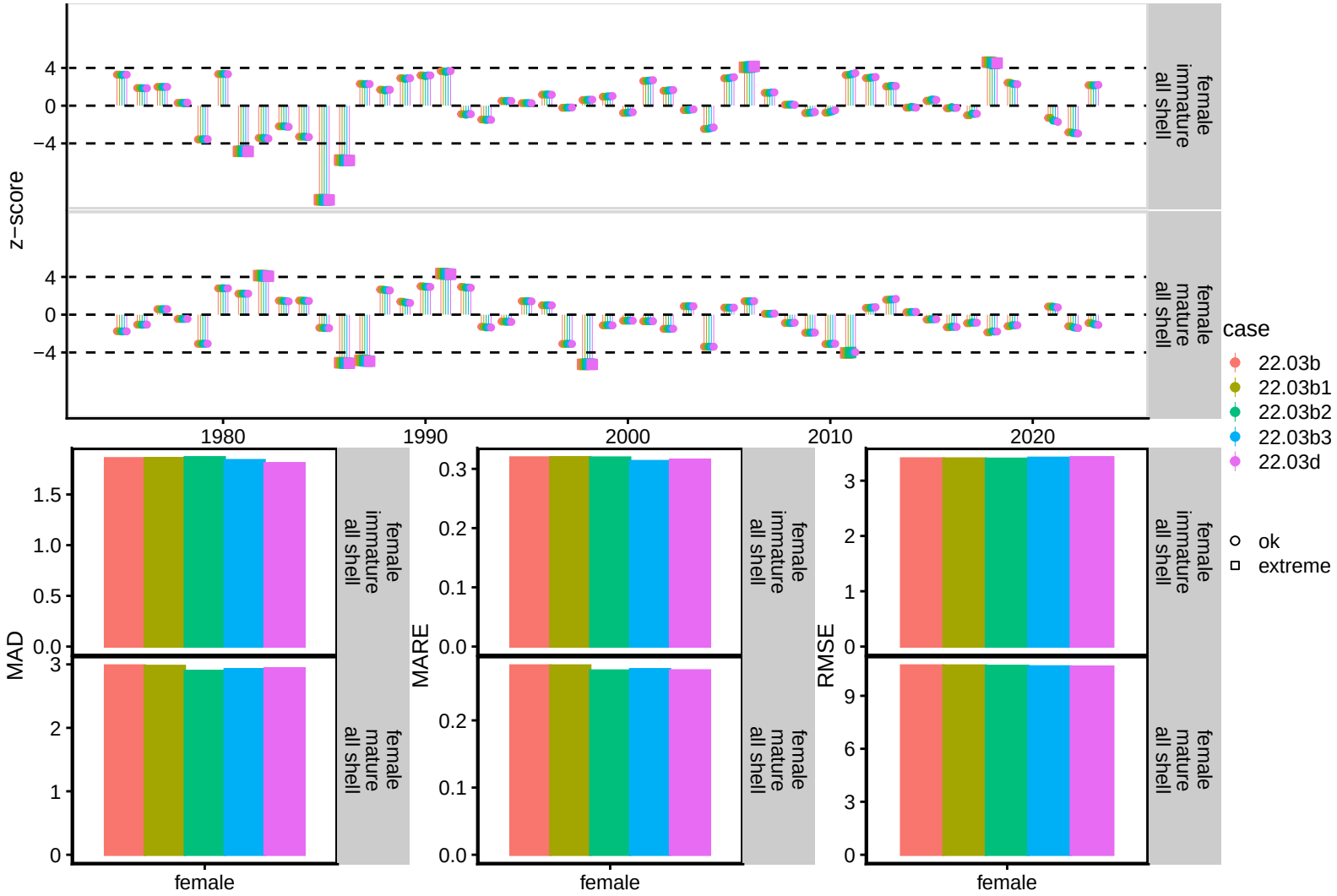

Figure 34. TCSAM02 models residuals analysis by model scenario for fits to female biomass in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

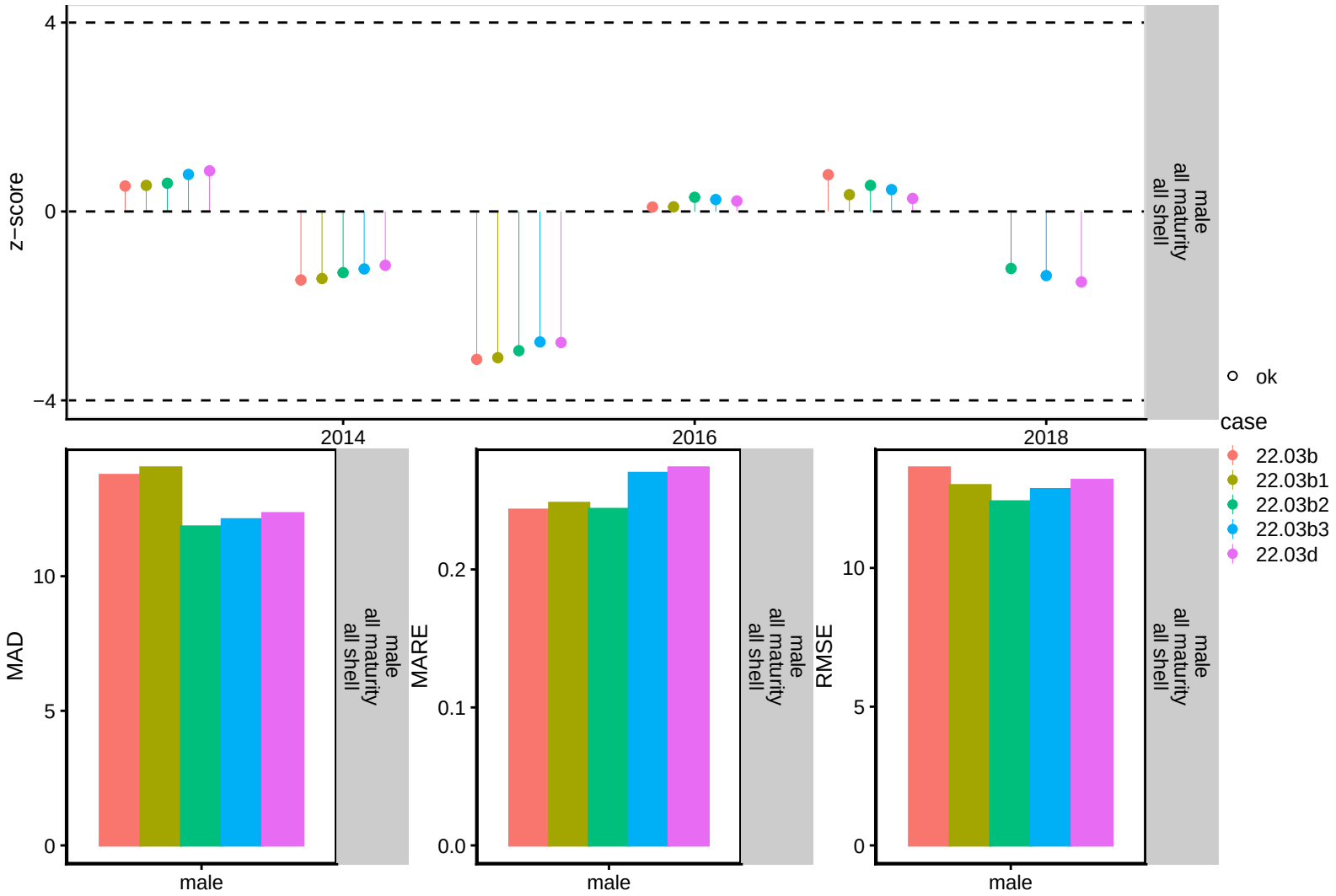

Figure 35. TCSAM02 models residuals analysis by model scenario for fits to male biomass in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

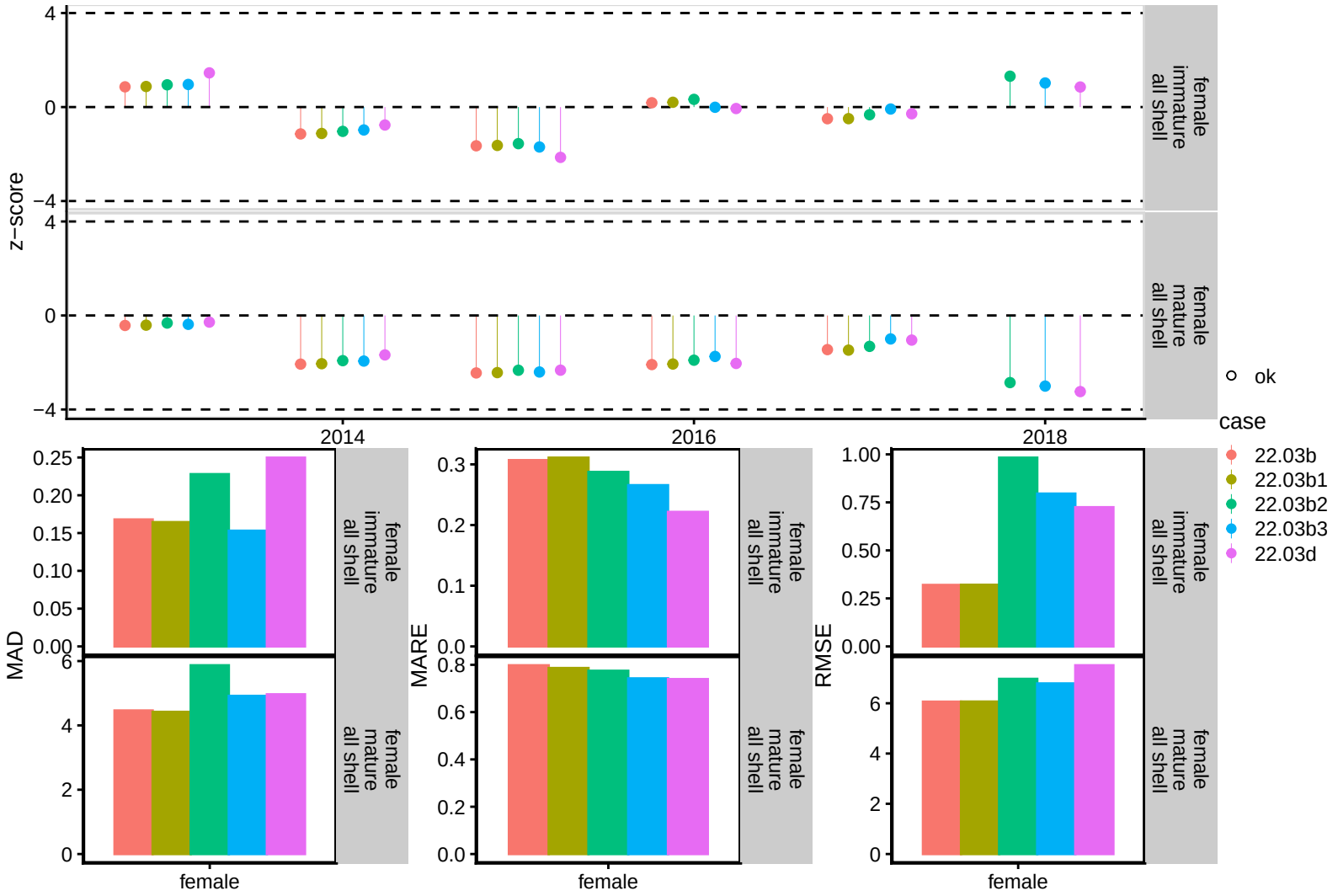

Figure 36. TCSAM02 models residuals analysis by model scenario for fits to female biomass in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

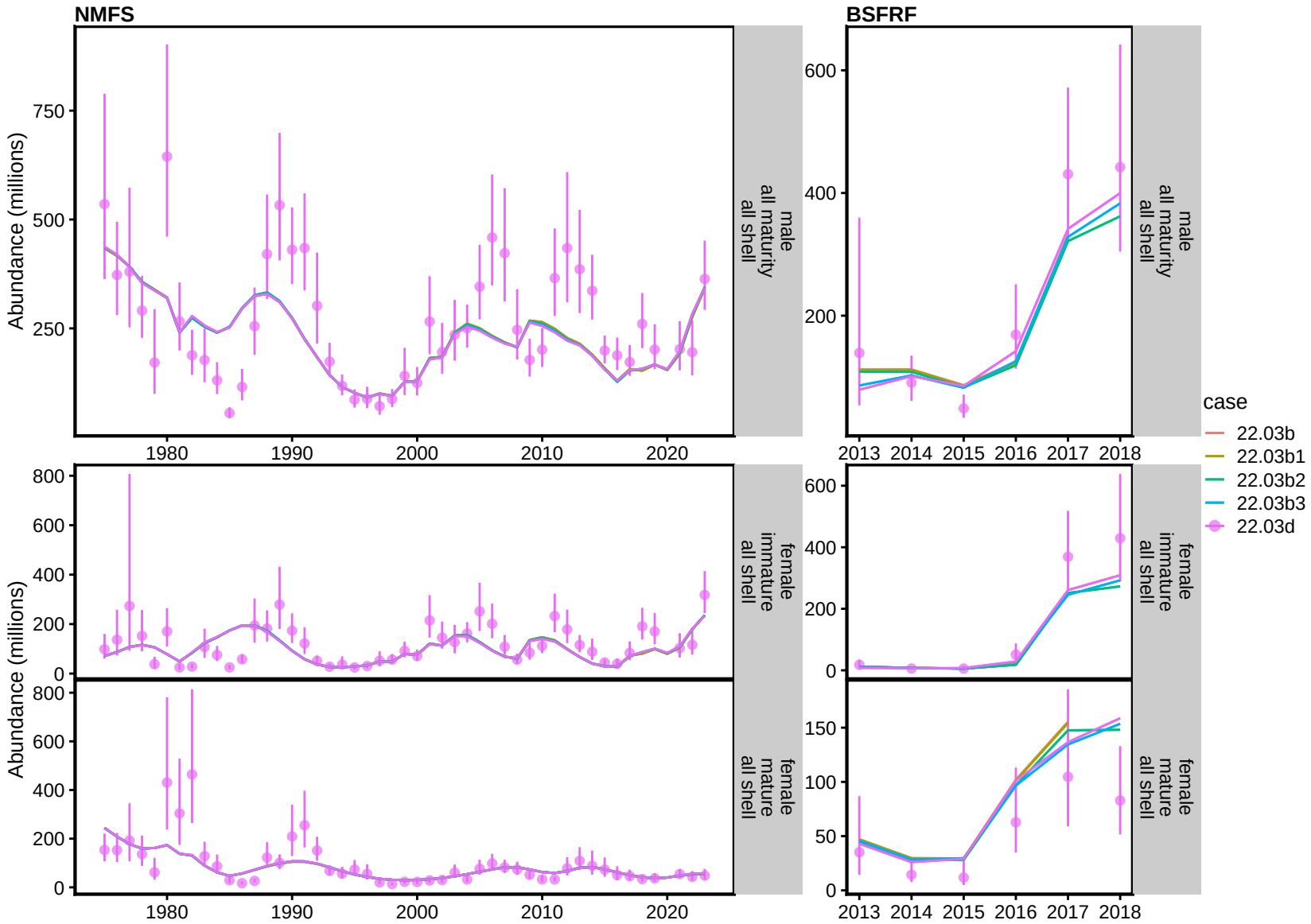

Figure 37. TCSAM02 models fits to time series of all male (upper graph), immature female (center graph), and mature female (lower plot) abundance from the NMFS EBS shelf bottom trawl survey (left column) and the BSFRF SBS trawl survey (right column). Note that these fits are not included in the model objective function and simply provide a diagnostic check. Confidence intervals are 95%.

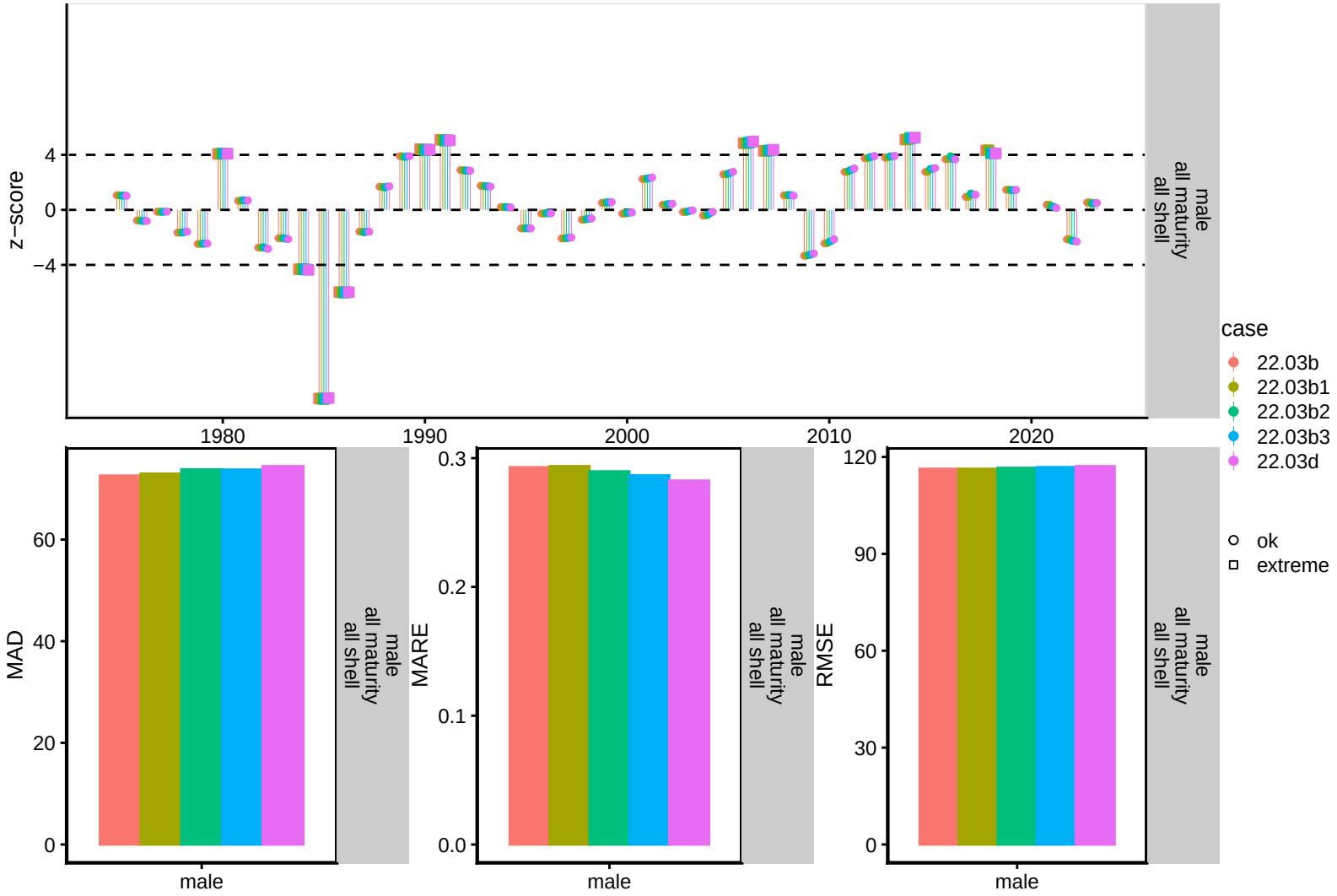

Figure 38. TCSAM02 models residuals analysis by model scenario for fits to male abundance in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

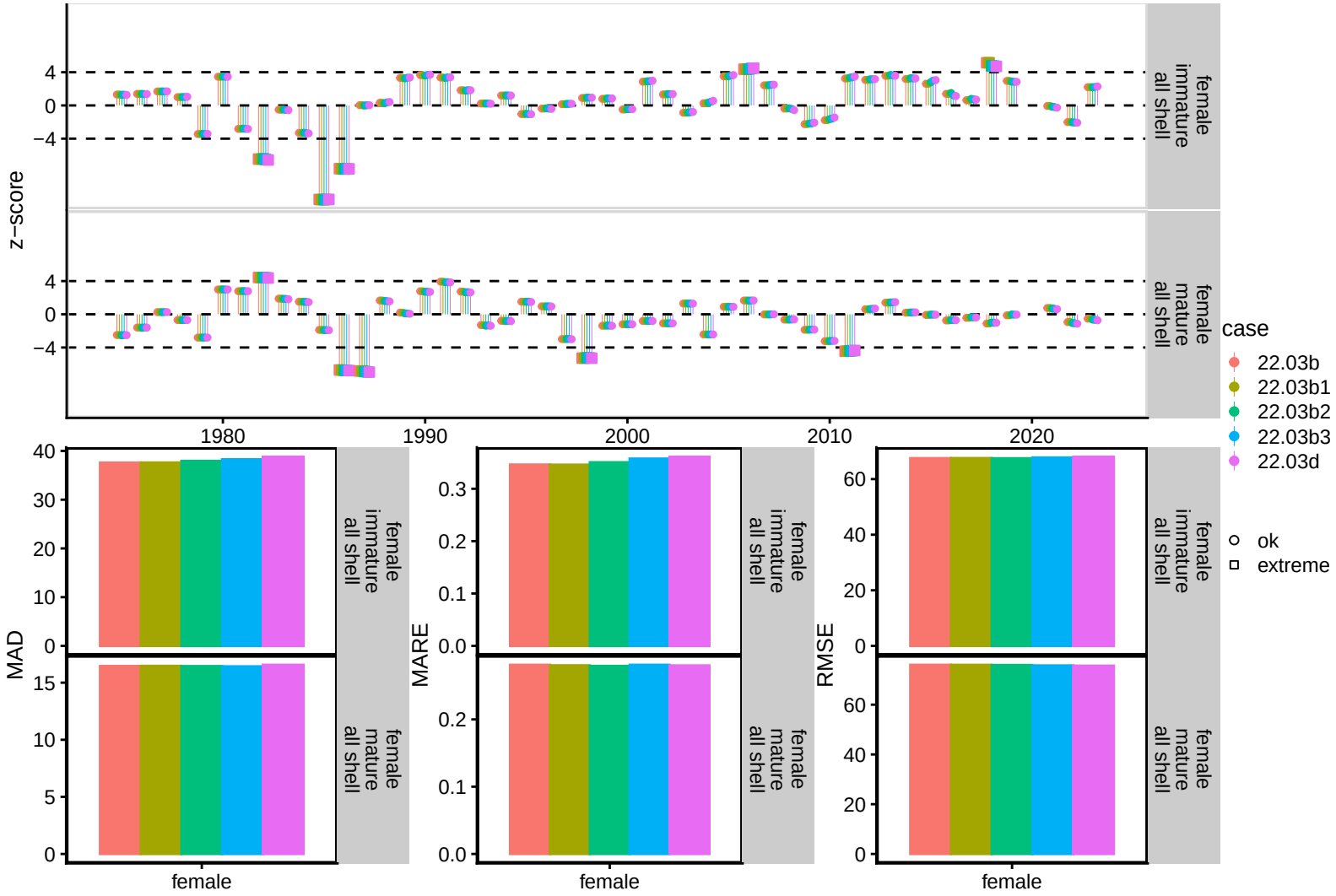

Figure 39. TCSAM02 models residuals analysis by model scenario for fits to female abundance in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

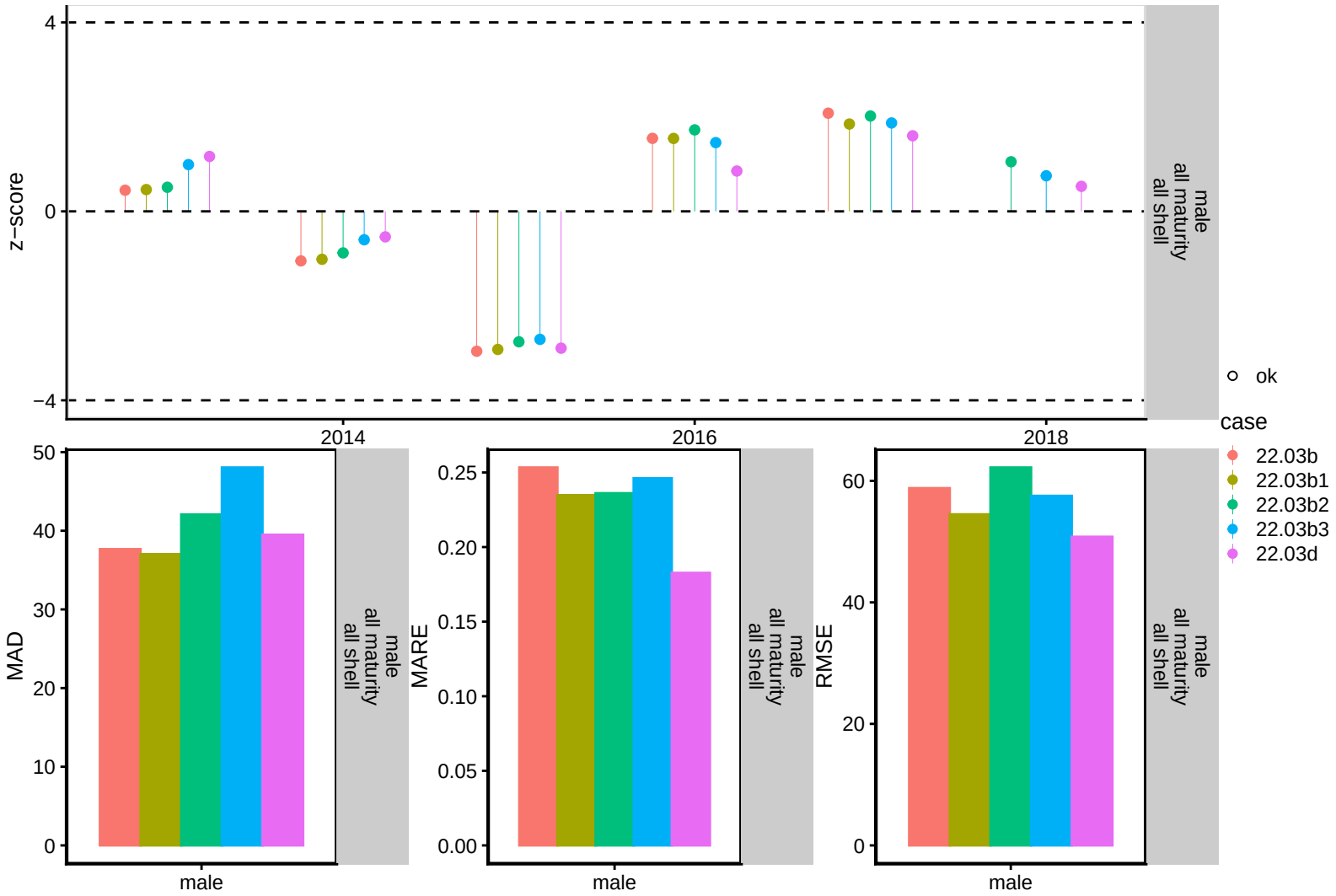

Figure 40. TCSAM02 models residuals analysis by model scenario for fits to male abundance in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

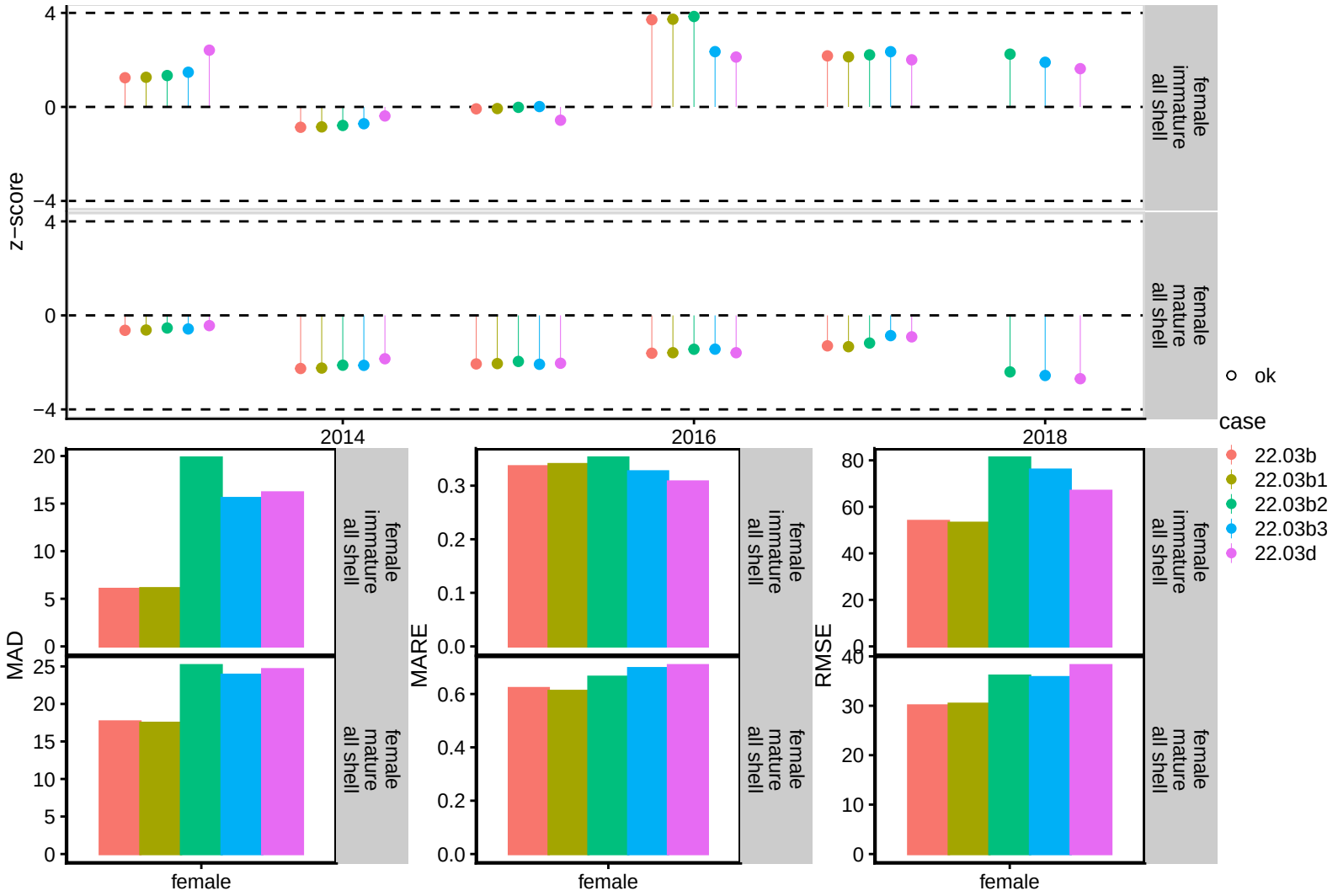

Figure 41. TCSAM02 models residuals analysis by model scenario for fits to female abundance in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

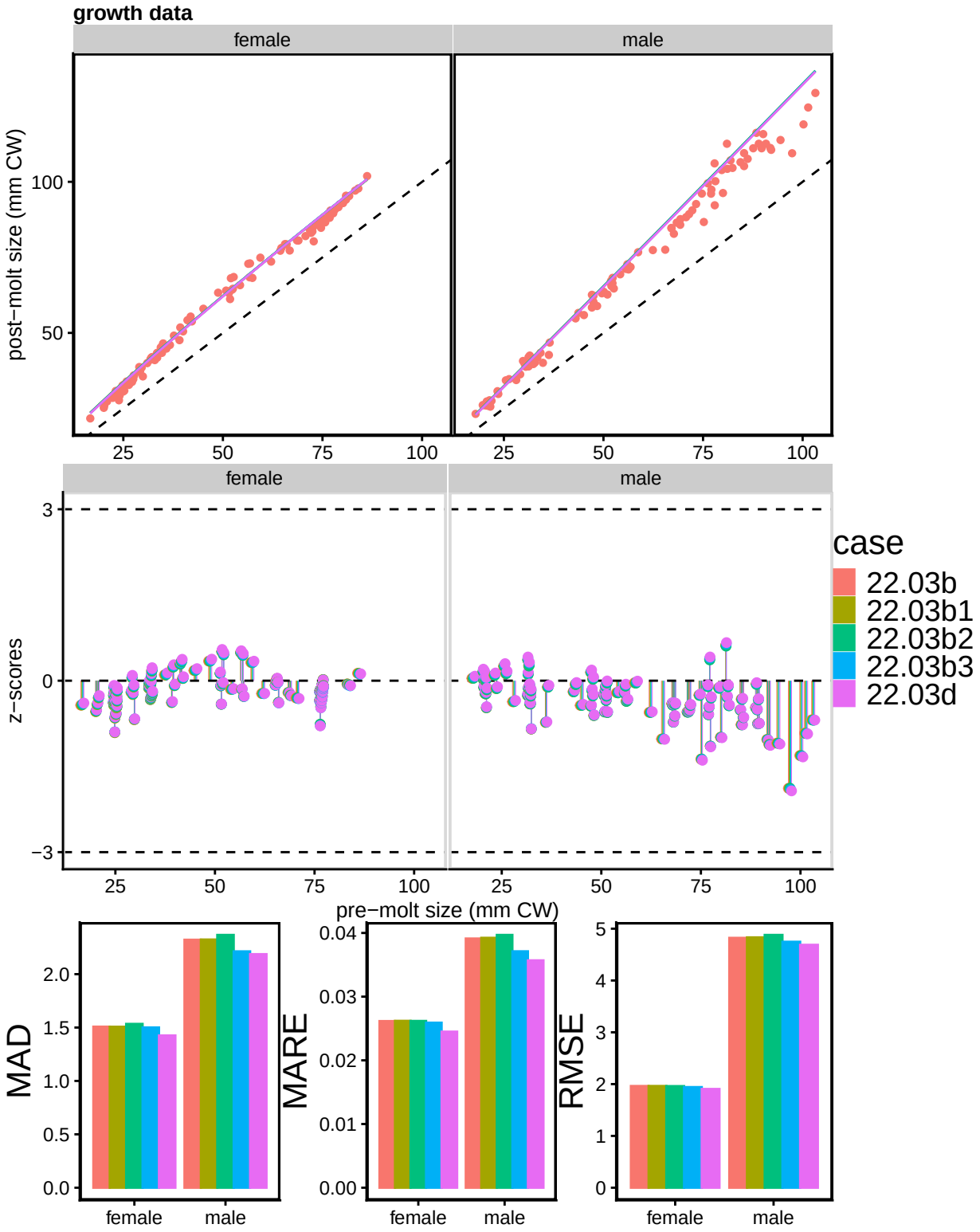

Figure 42. TCSAM02 models fits and residuals analysis by model scenario for fits to molt increment data. Upper row: fits to data; center row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

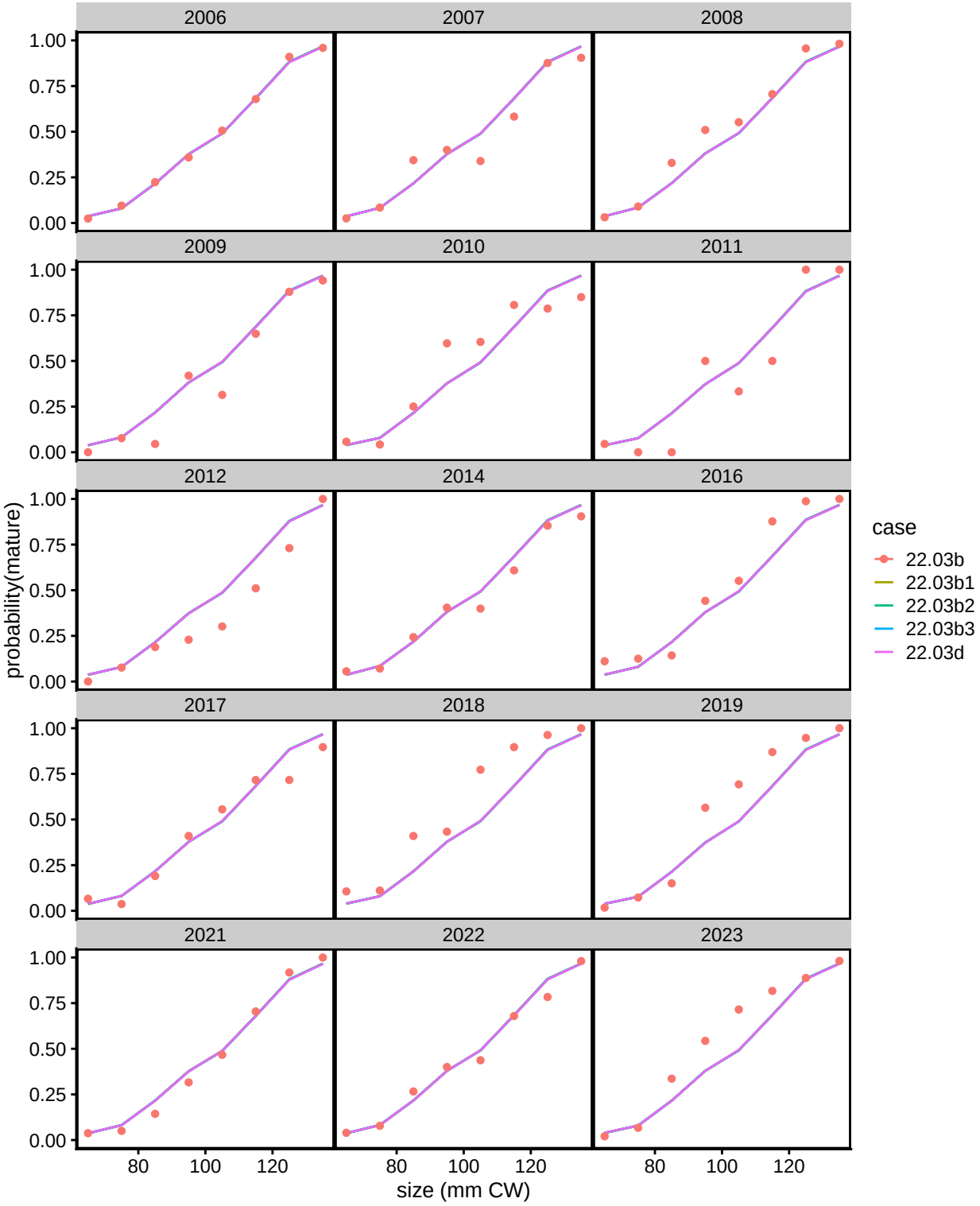

Figure 43. TCSAM02 models fits to maturity ogive data by model scenario and year.

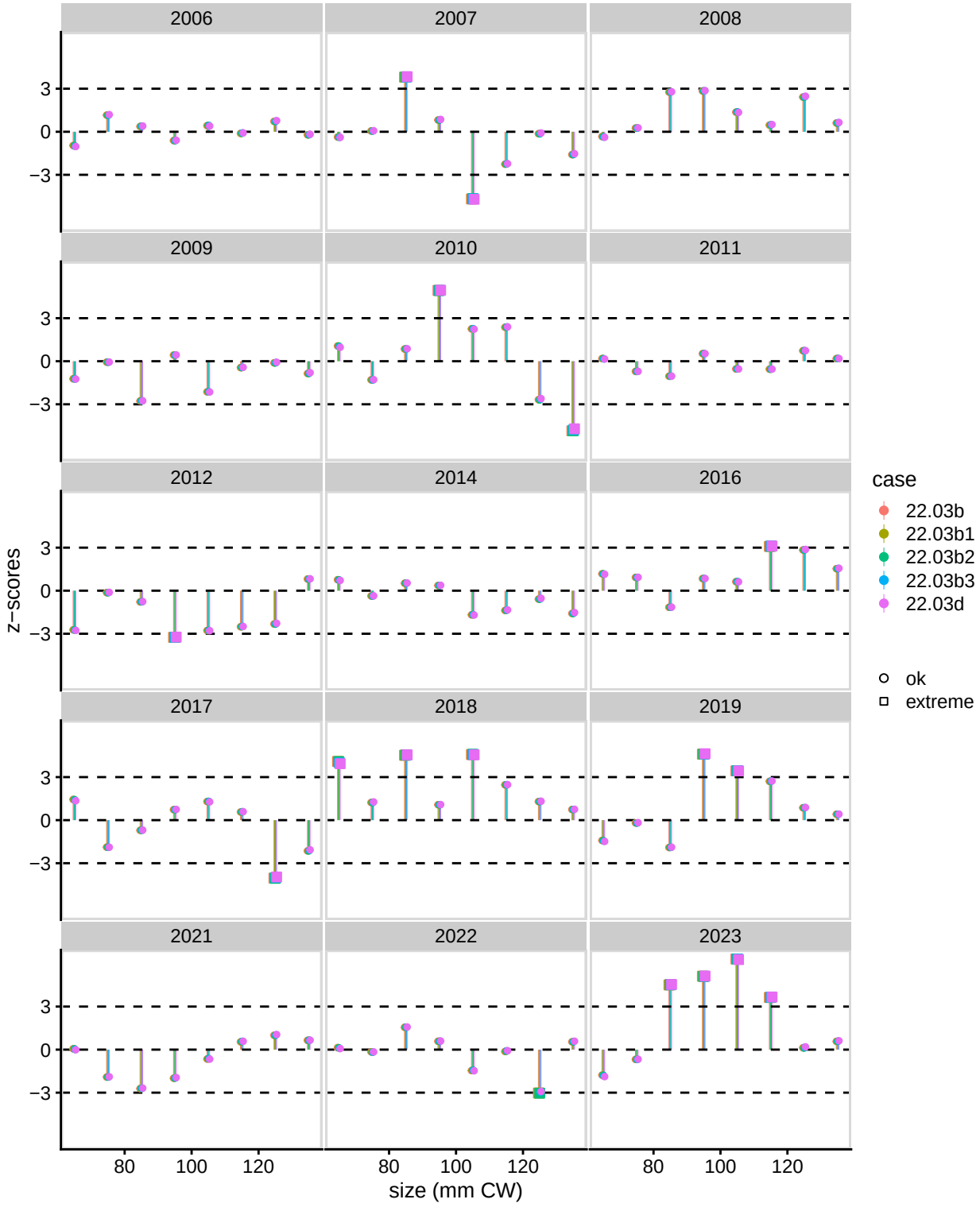

Figure 44. TCSAM02 models residuals analysis for maturity ogive data, by model scenario and year.

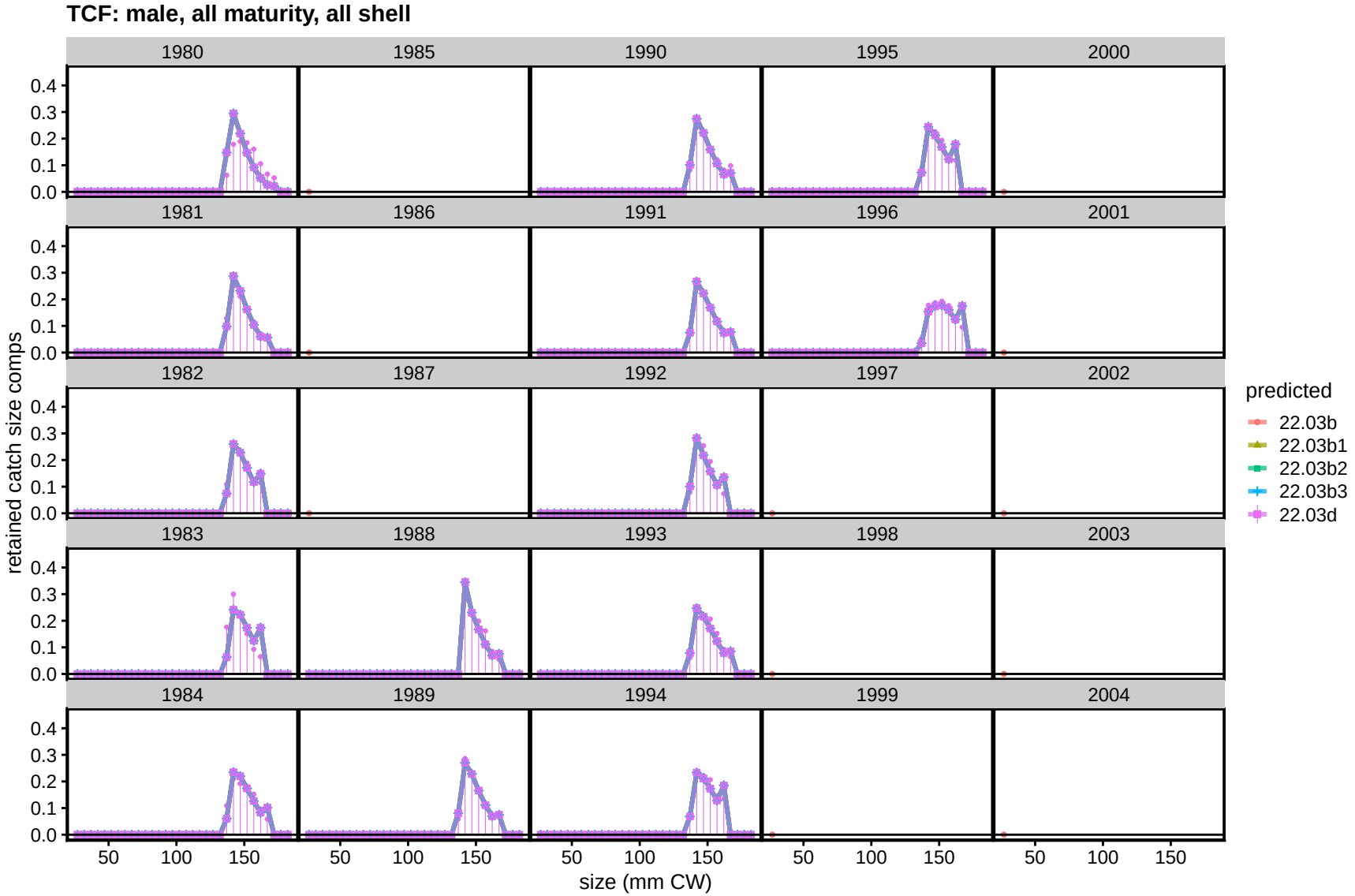

Figure 45. TCSAM02 models fits to retained catch size compositions in the directed fishery. Preferred model is 22.03d.

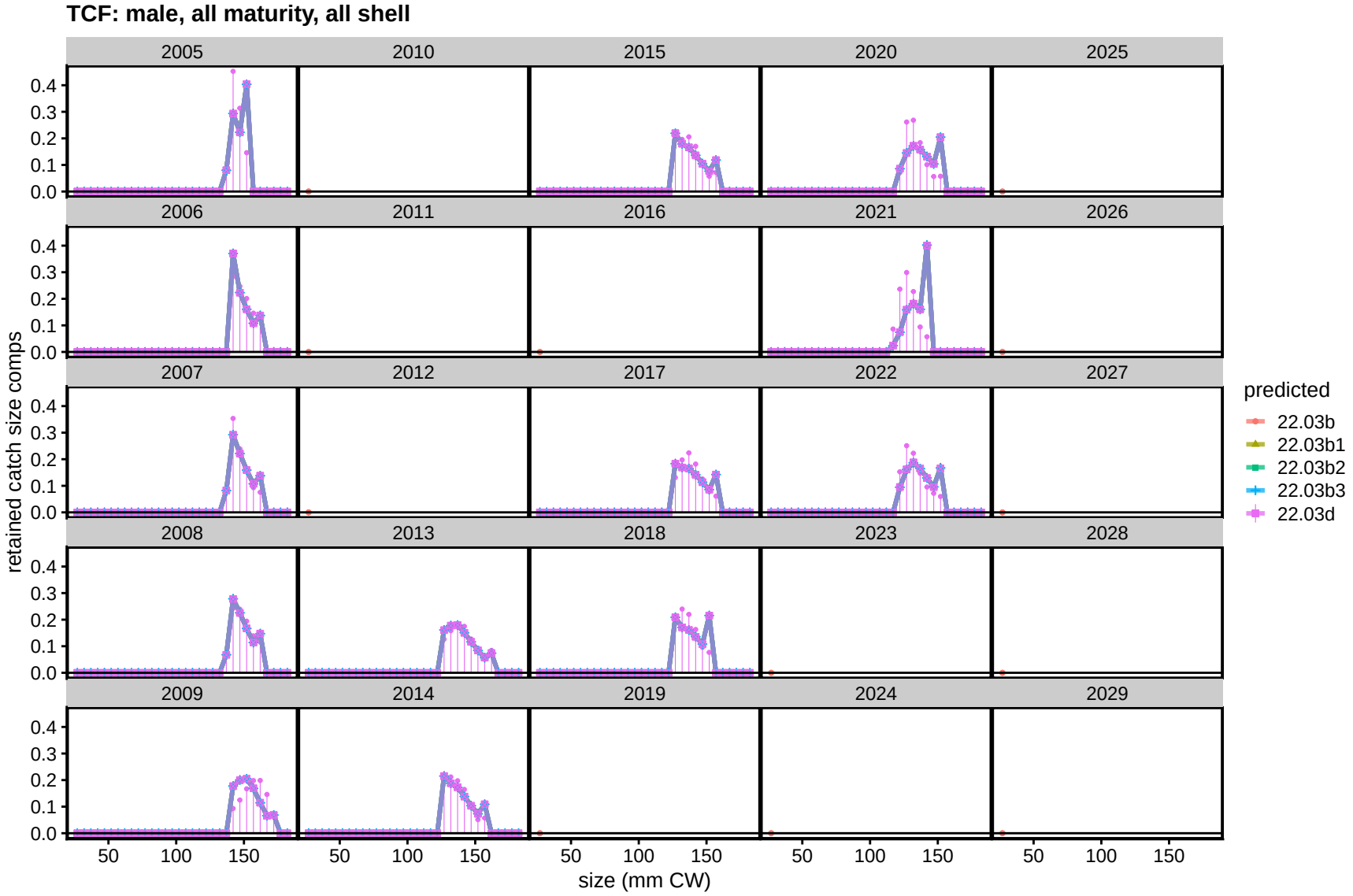

Figure 46. TCSAM02 models fits to retained catch size compositions in the directed fishery. Preferred model is 22.03d.

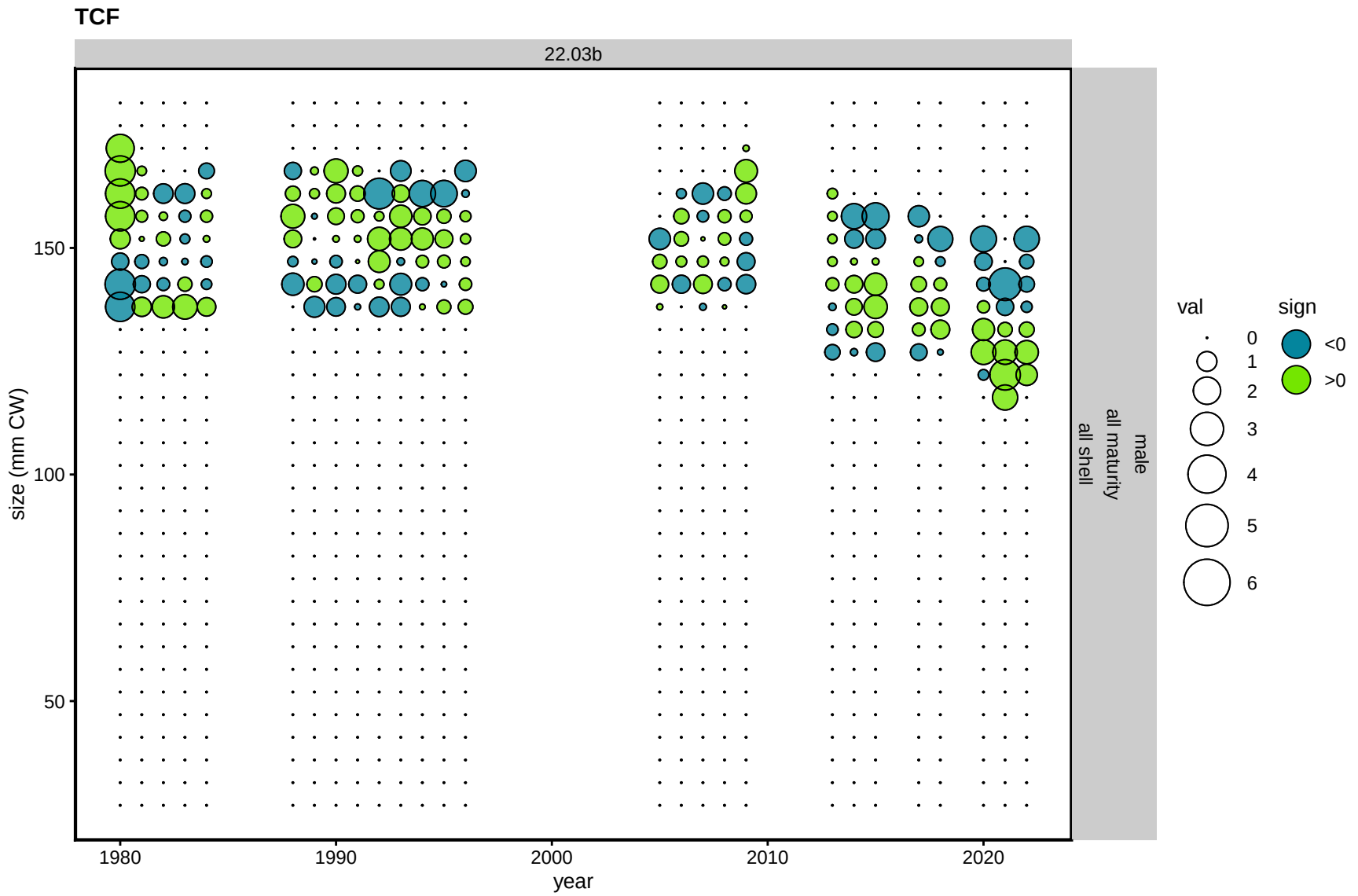

Figure 47. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

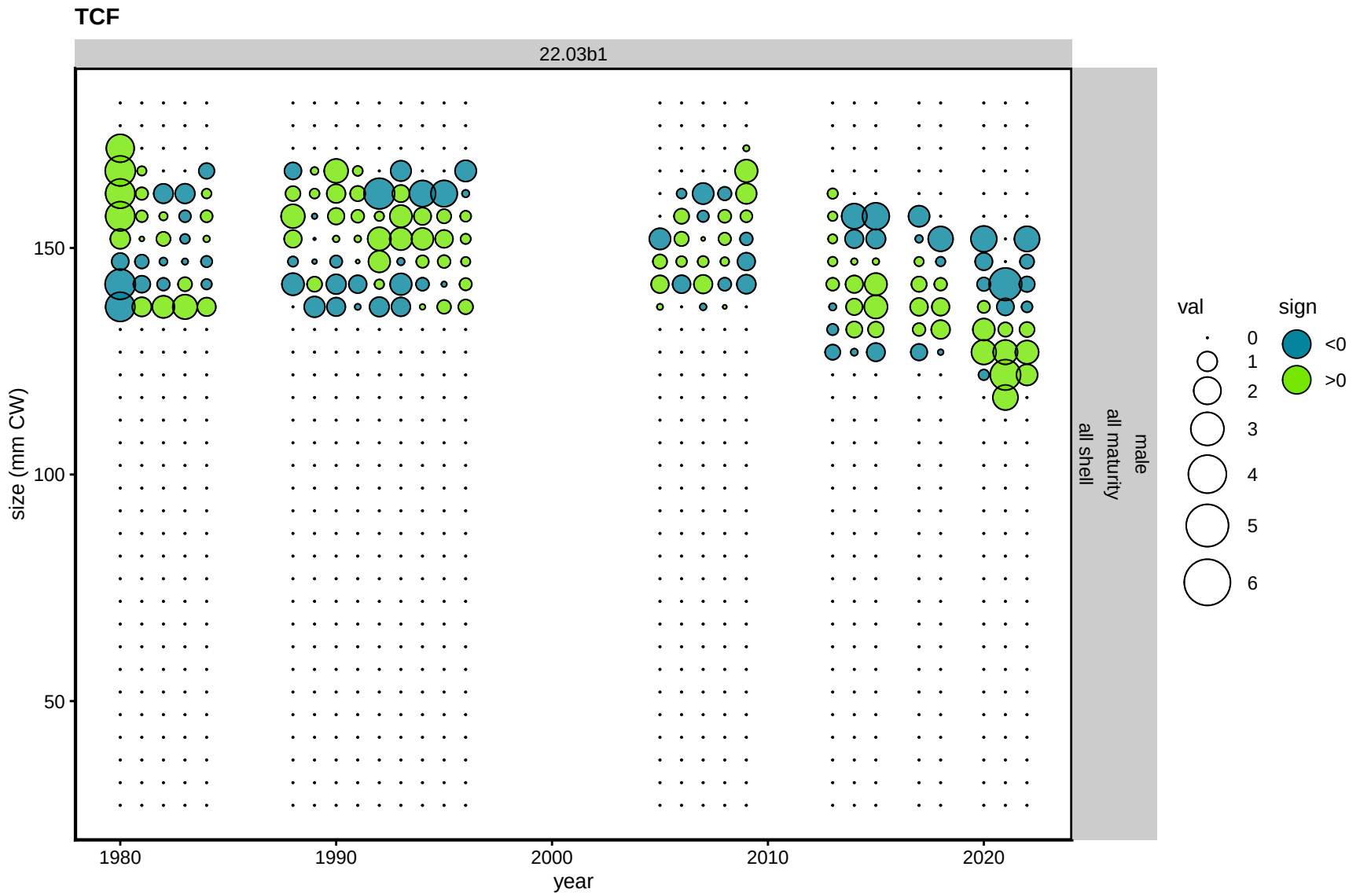

Figure 48. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

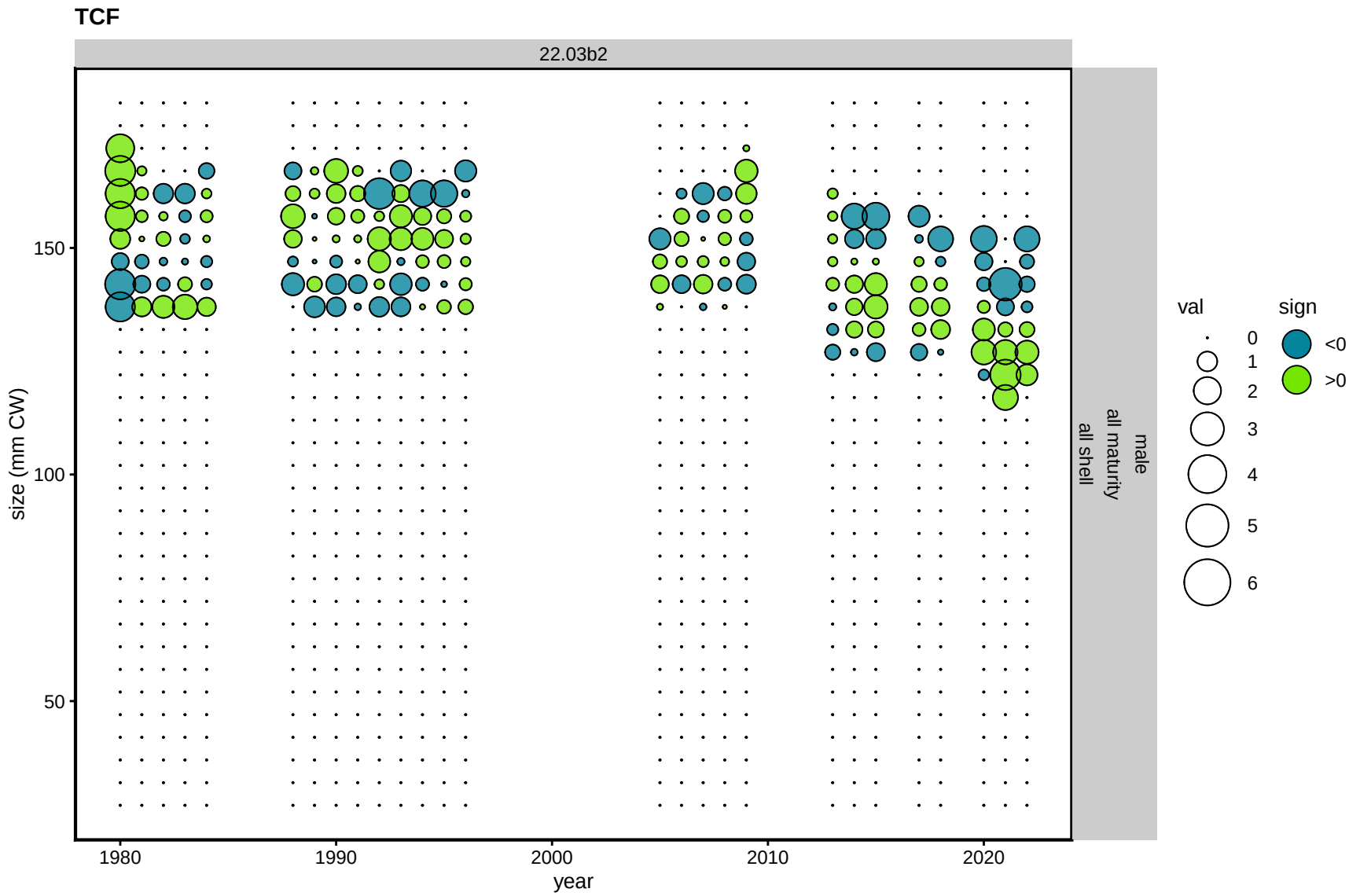

Figure 49. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

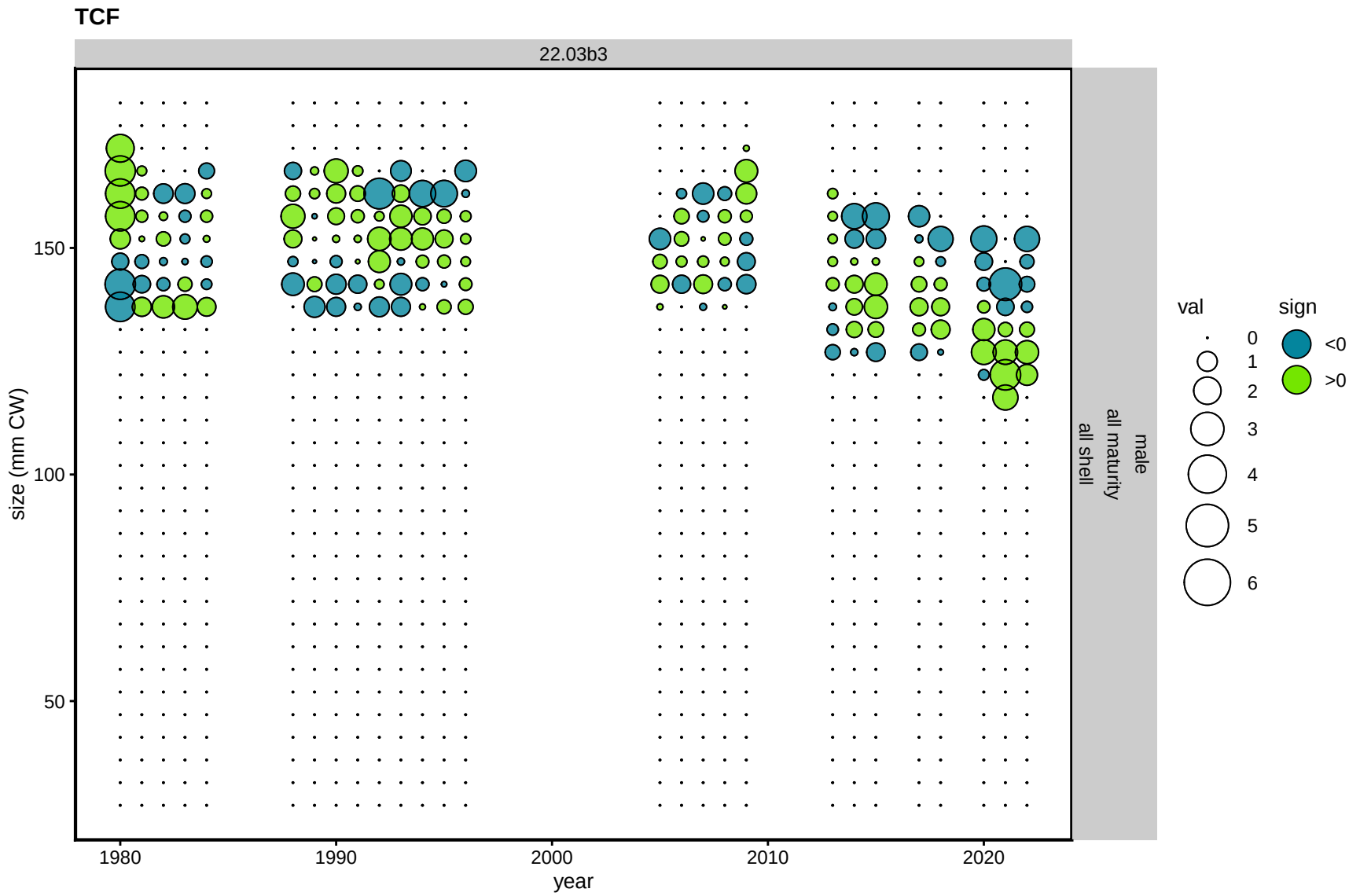

Figure 50. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

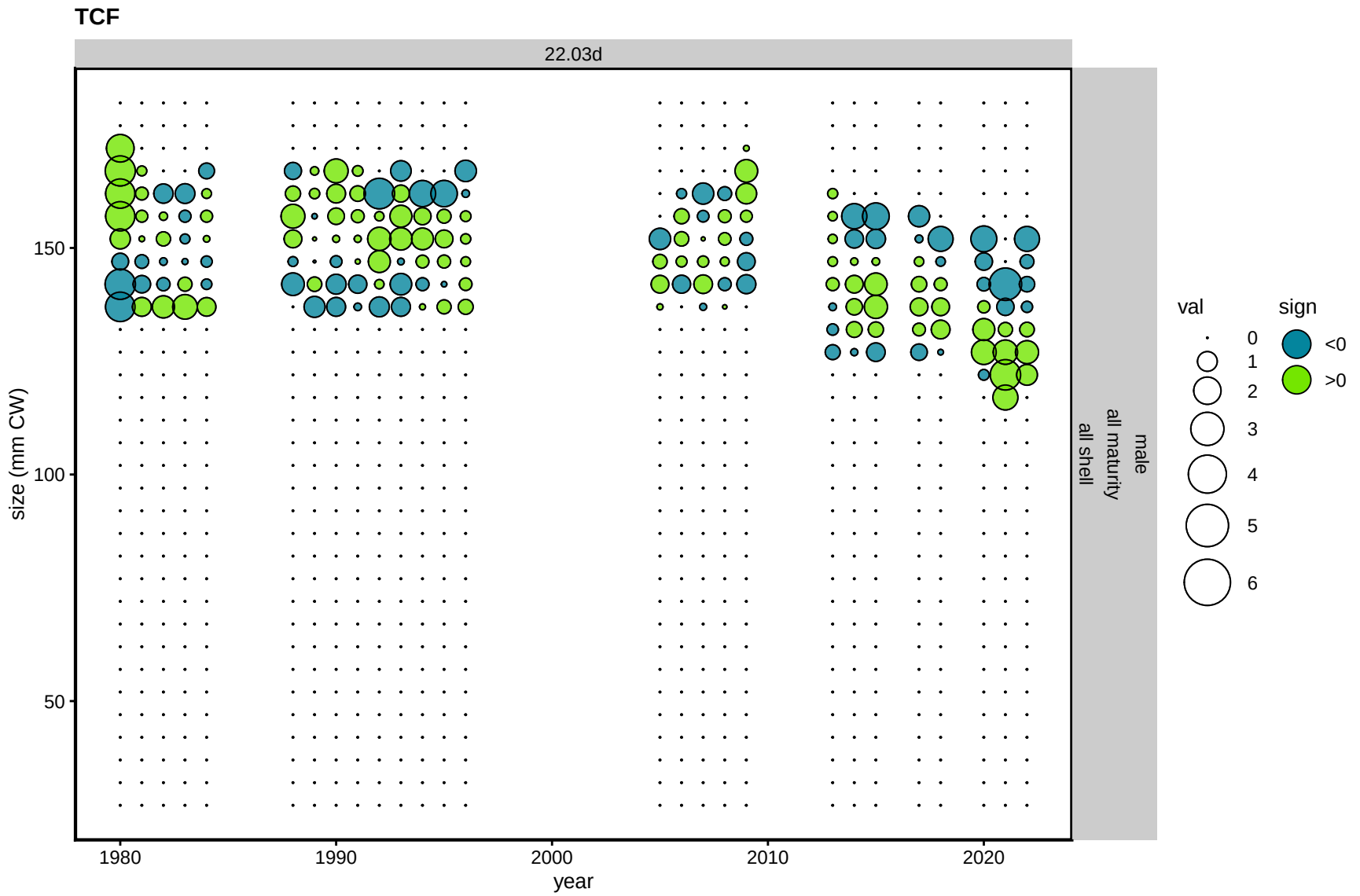

Figure 51. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

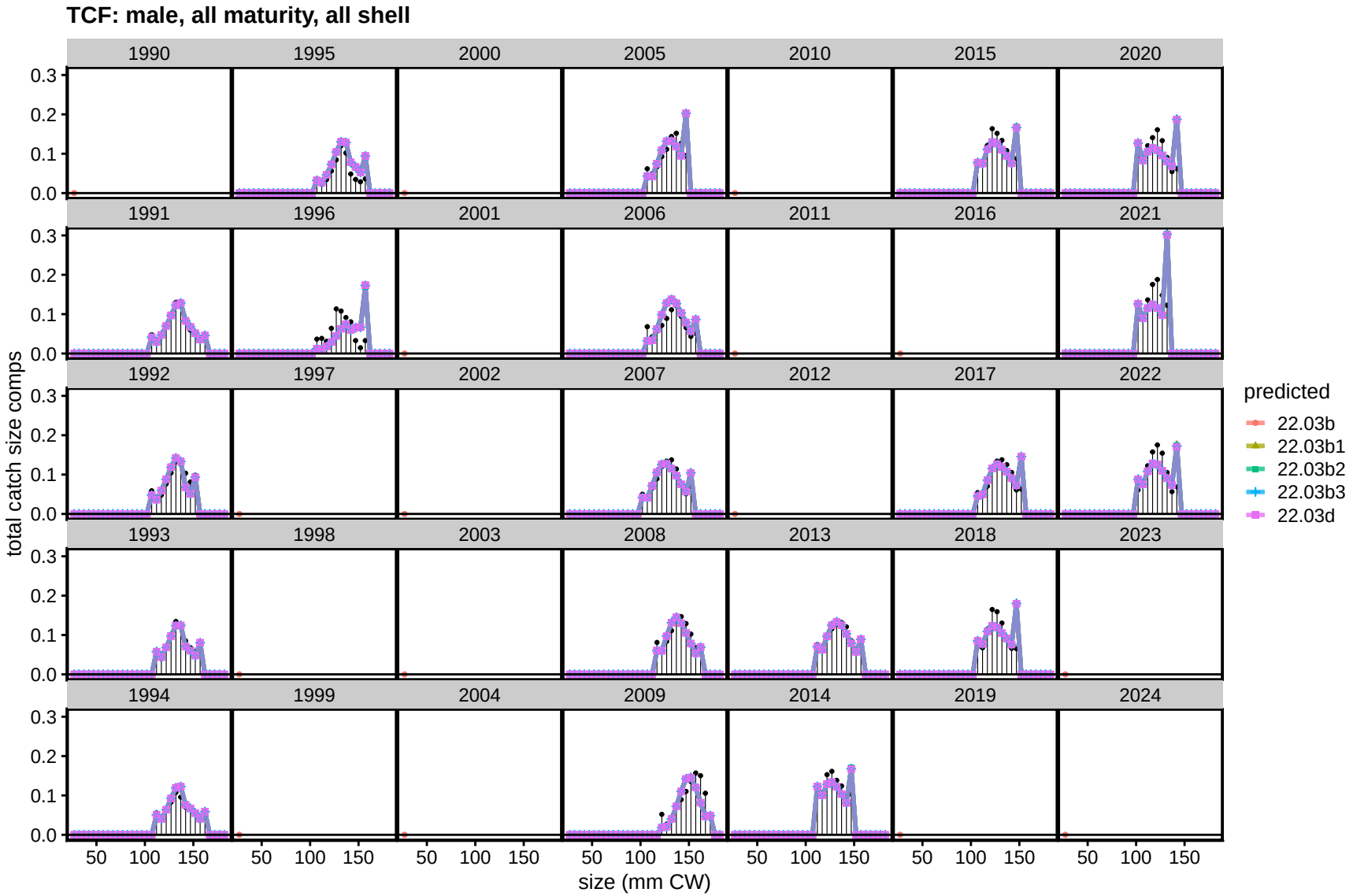

Figure 52. TCSAM02 models fits to total catch size compostiions in the TCF fishery. Preferred model is 22.03d.

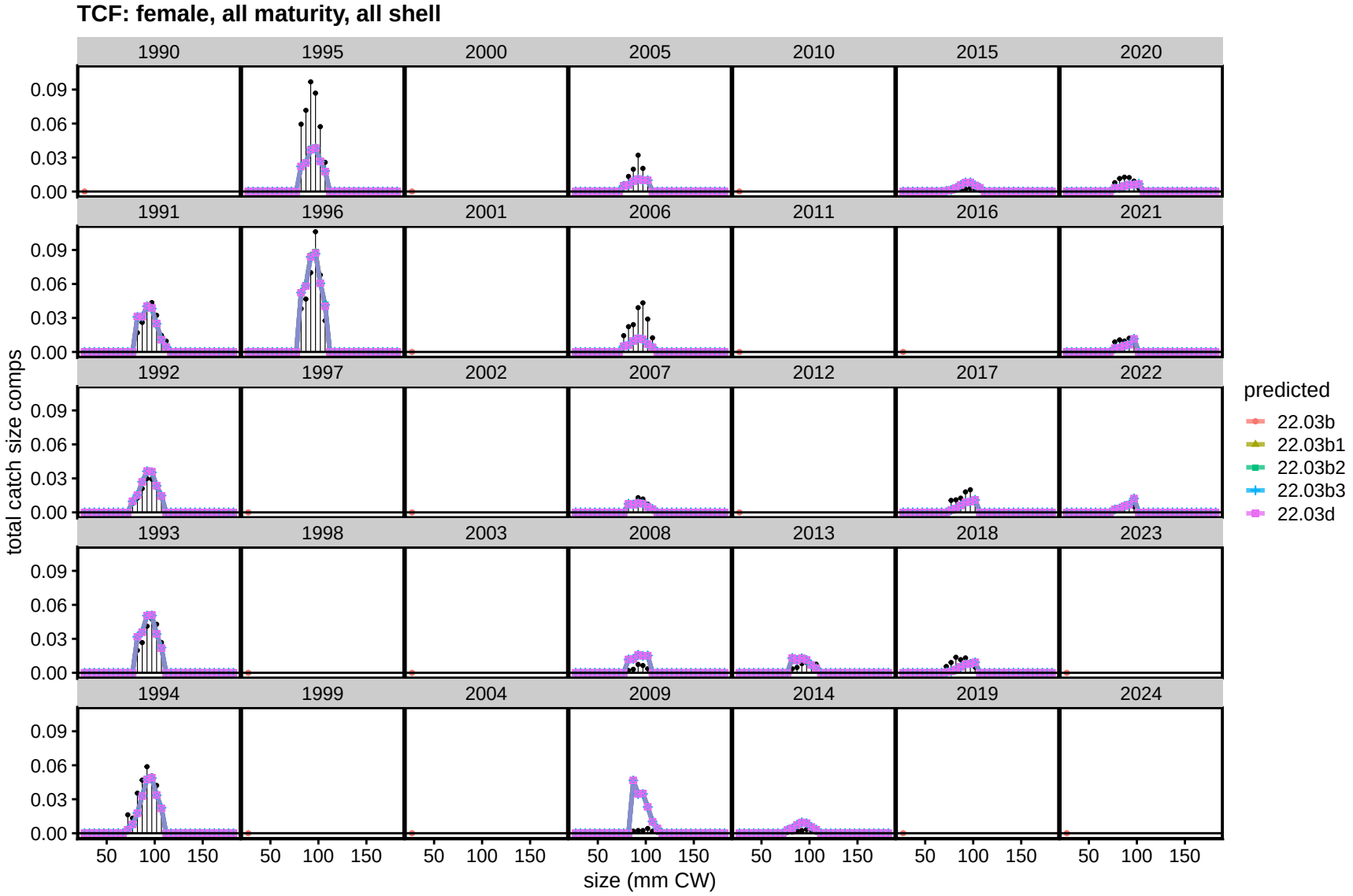

Figure 53. TCSAM02 models fits to total catch size compostiions in the TCF fishery. Preferred model is 22.03d.

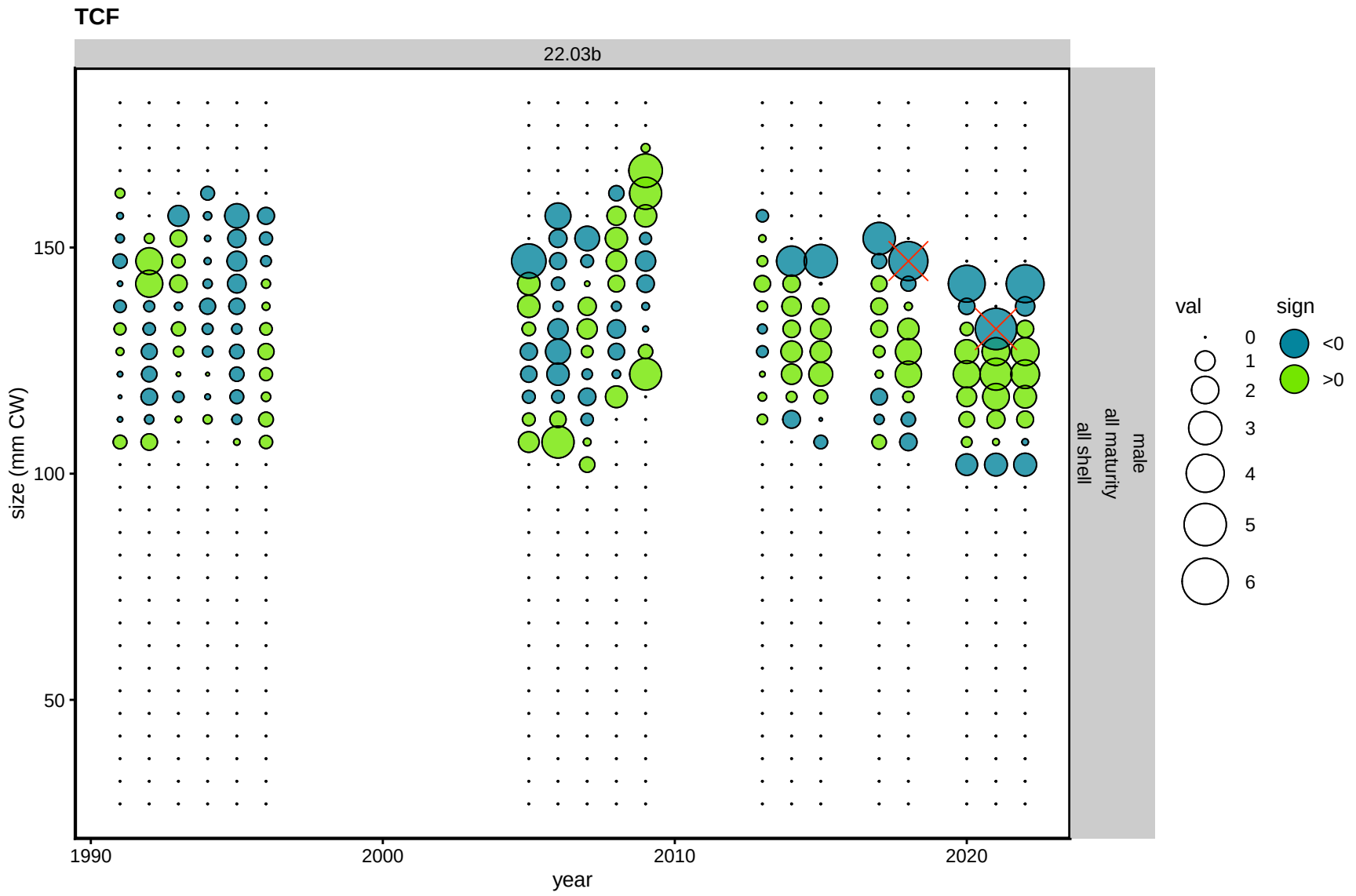

Figure 54. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

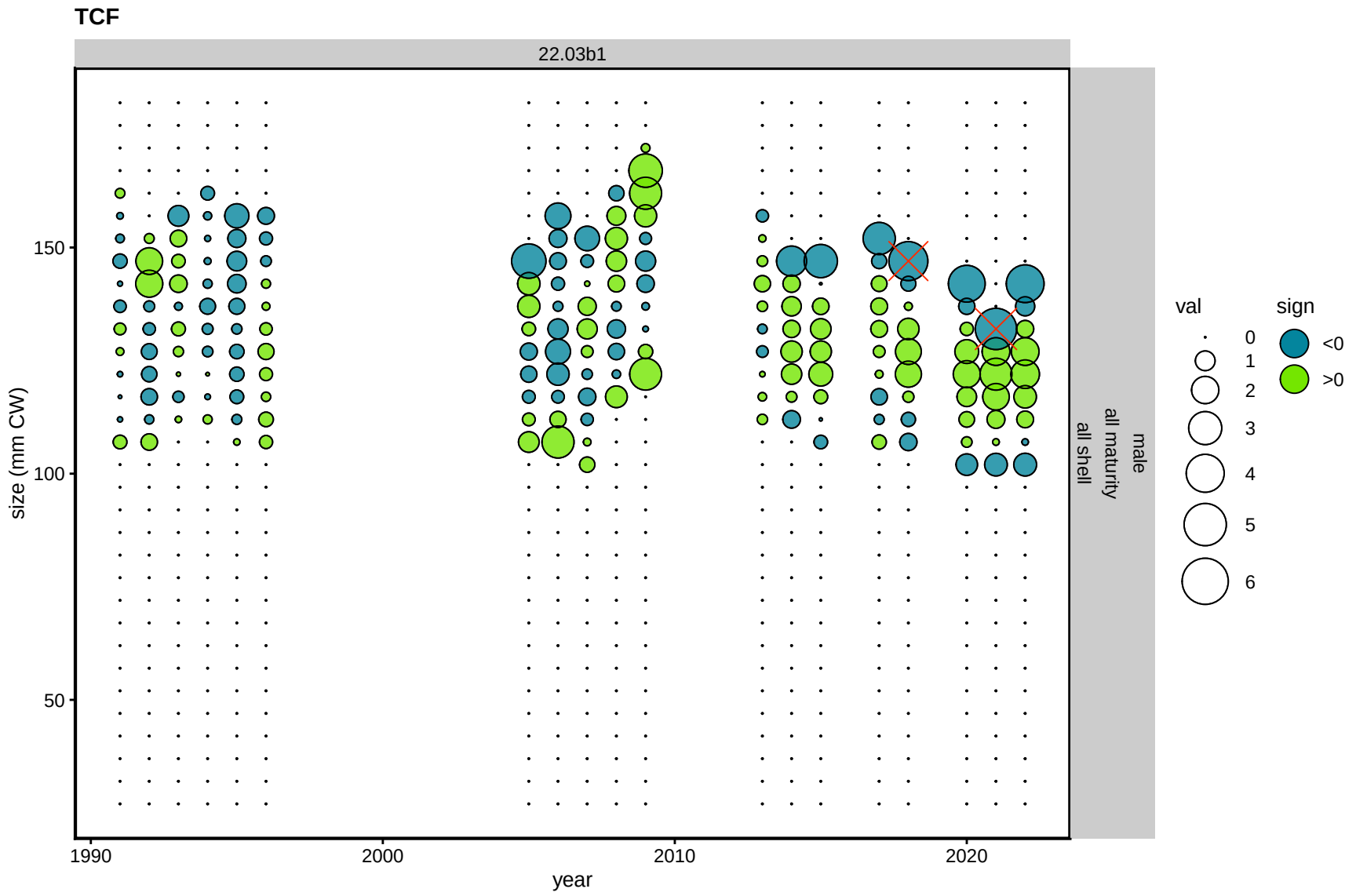

Figure 55. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

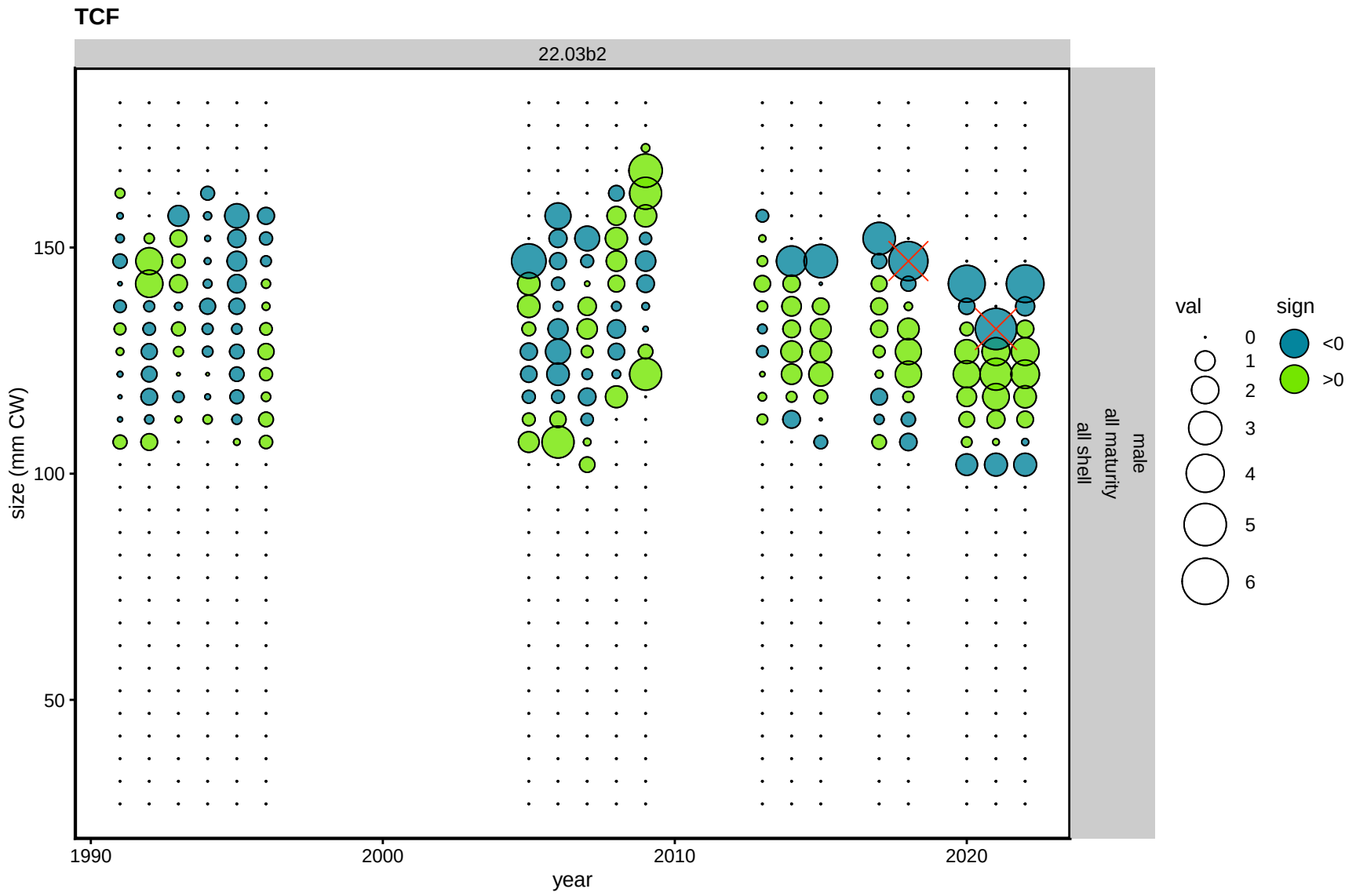

Figure 56. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

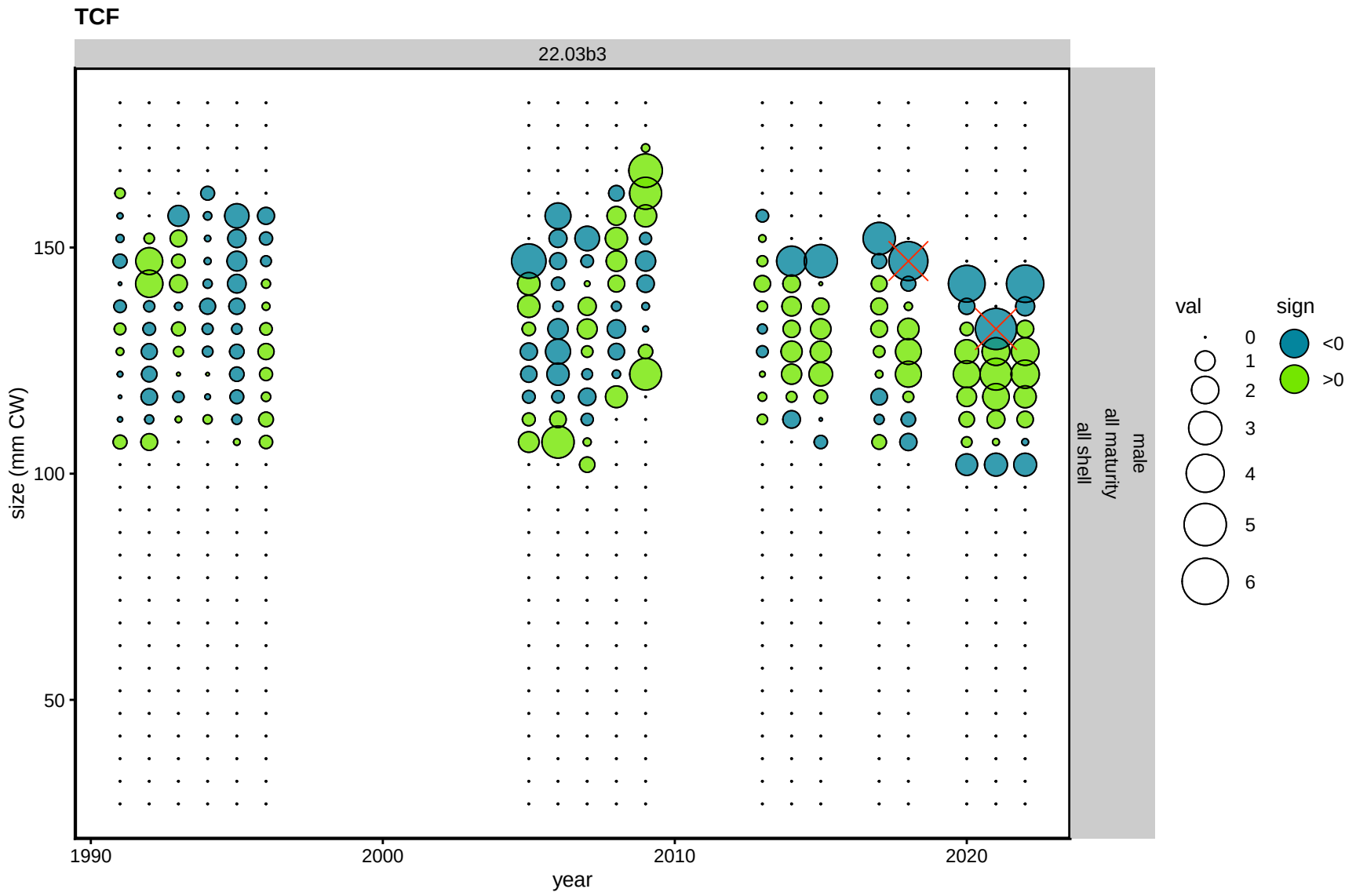

Figure 57. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

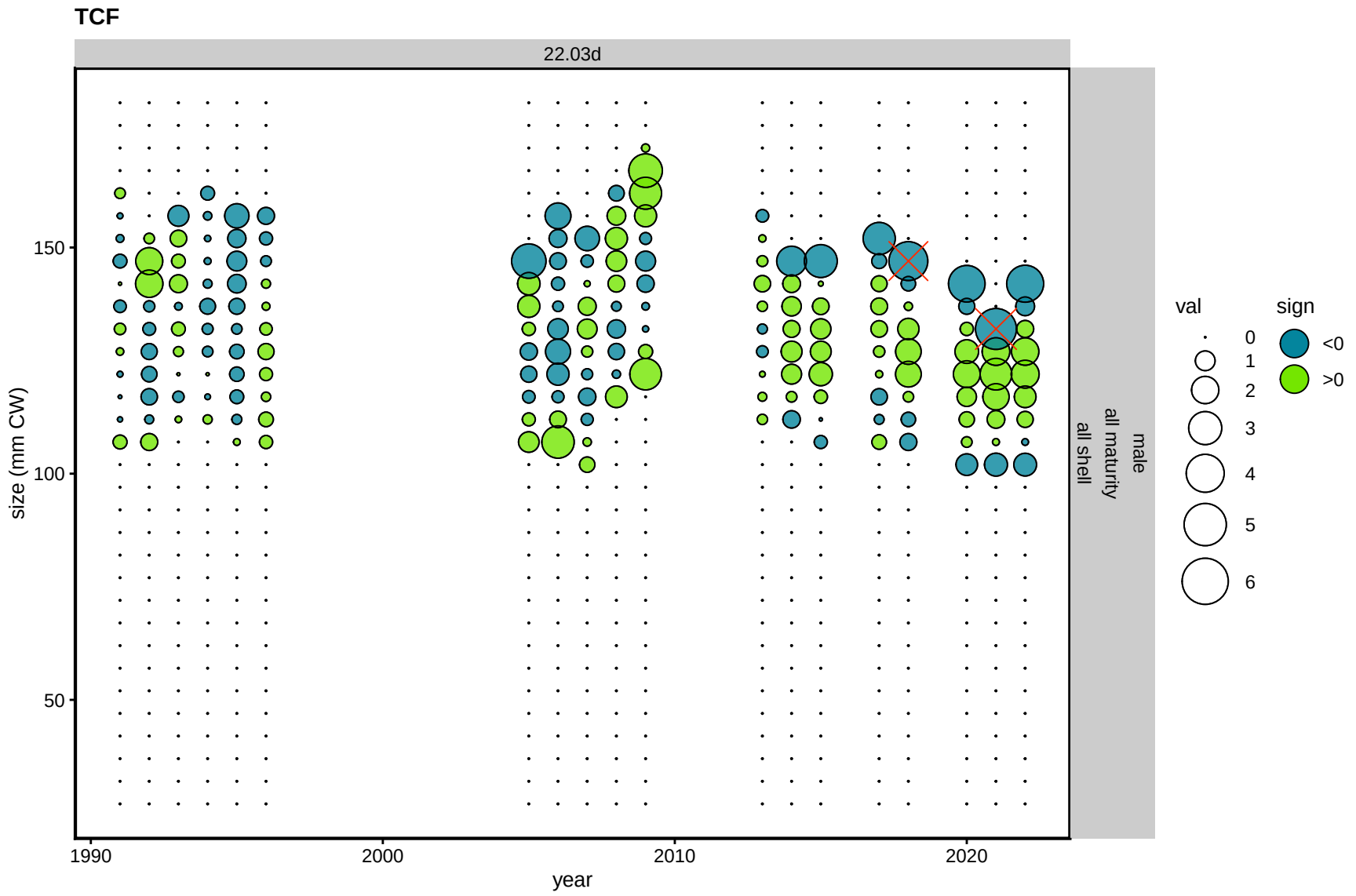

Figure 58. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

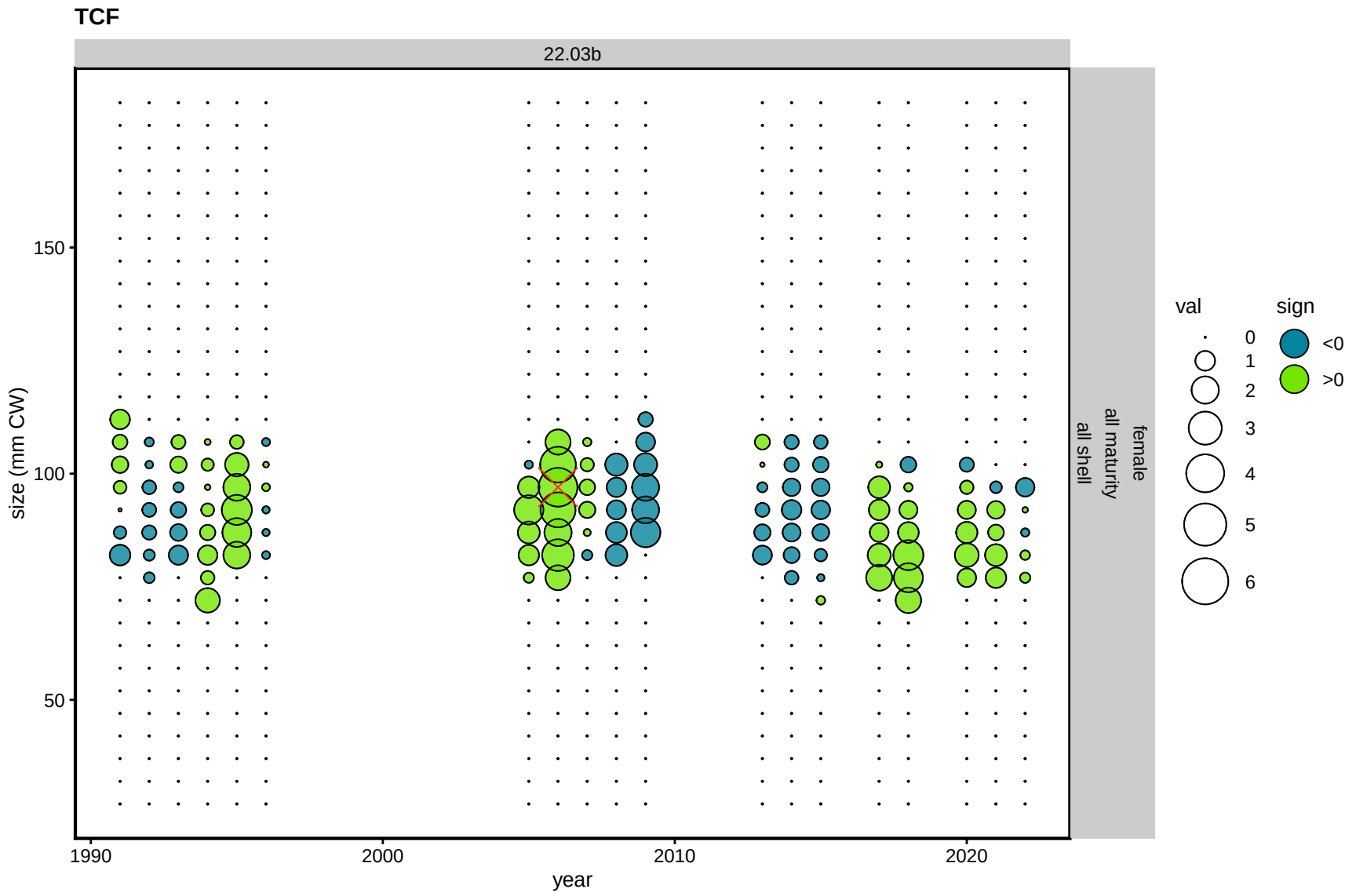

Figure 59. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

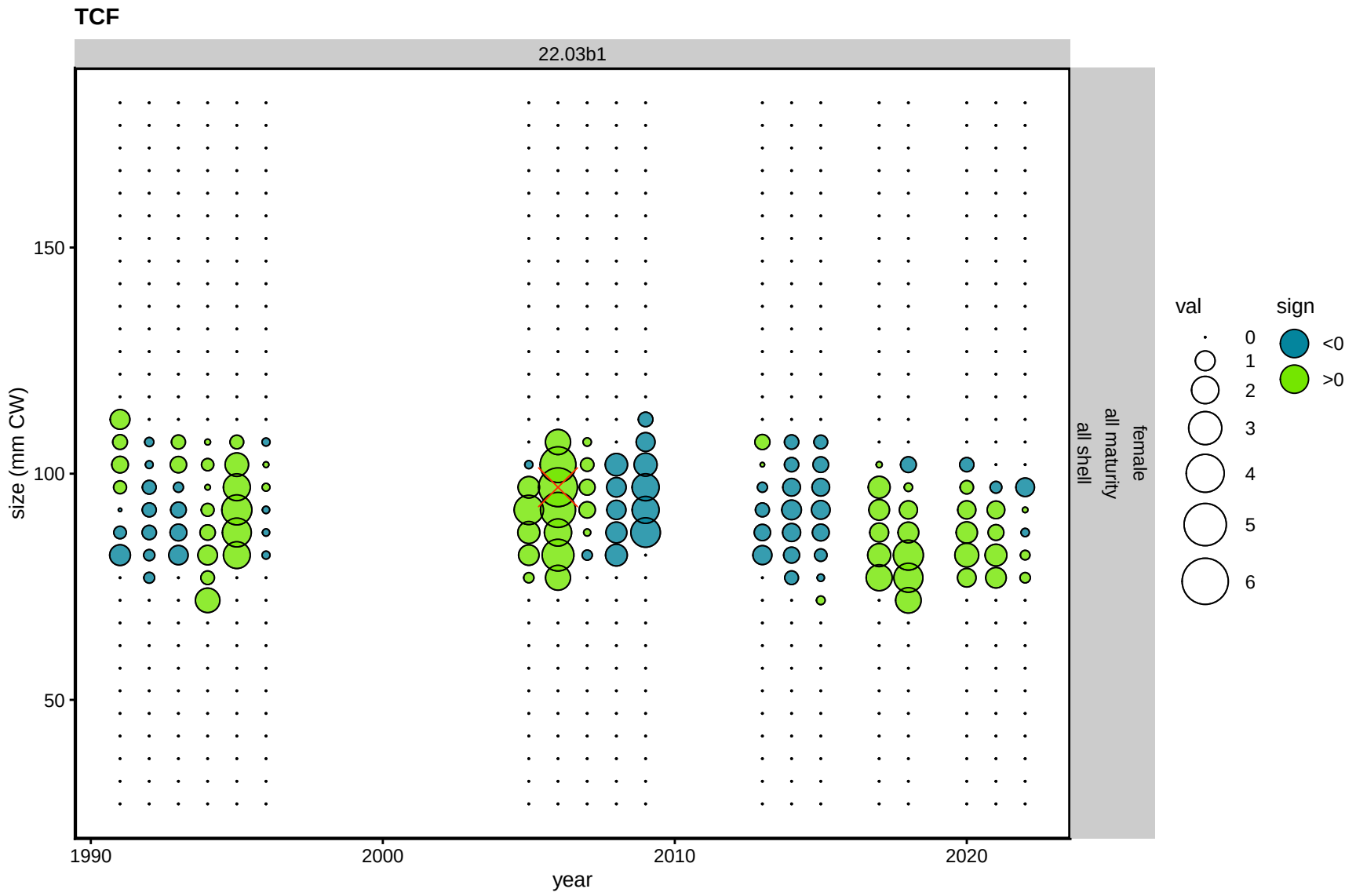

Figure 60. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

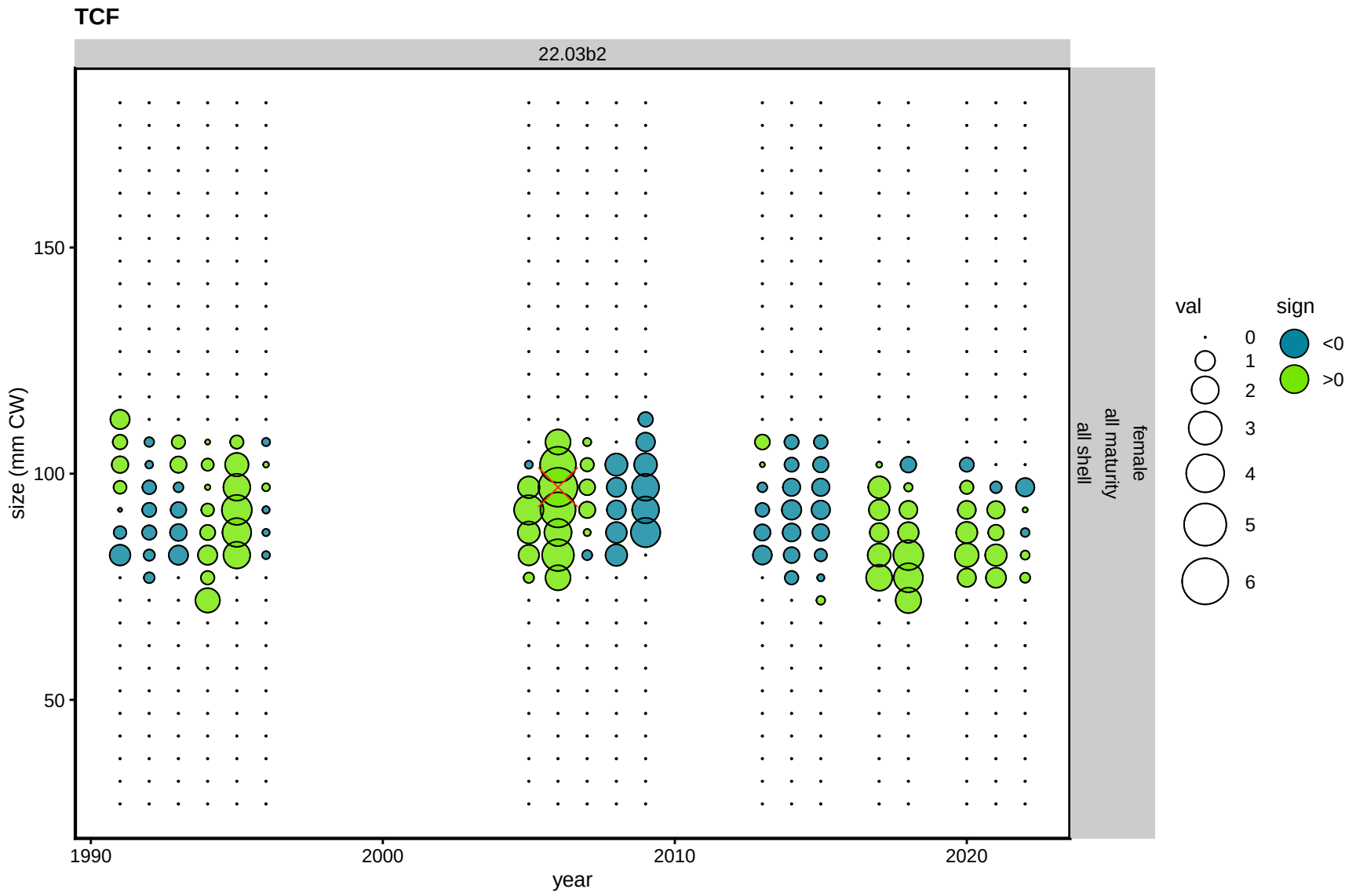

Figure 61. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

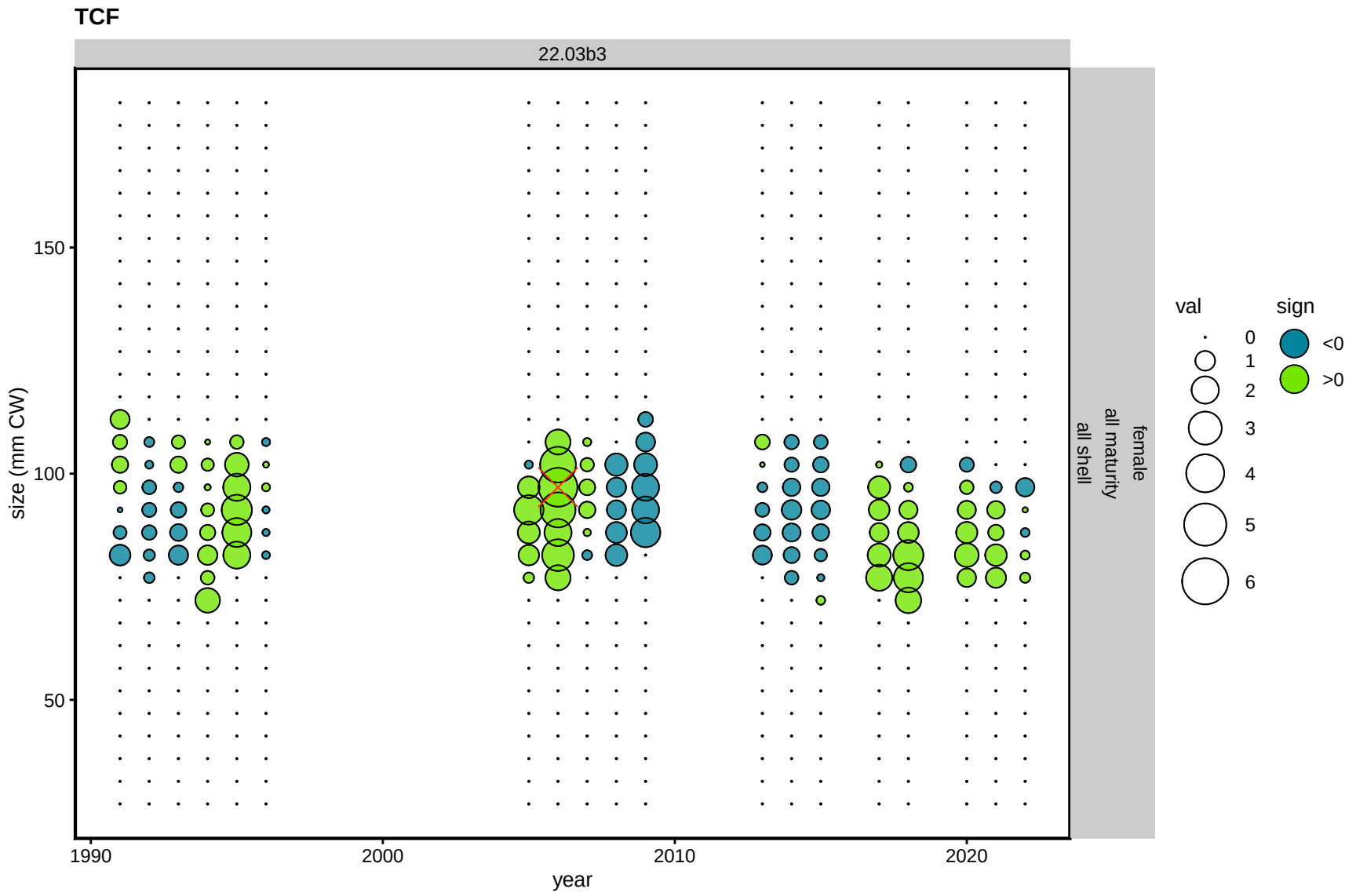

Figure 62. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

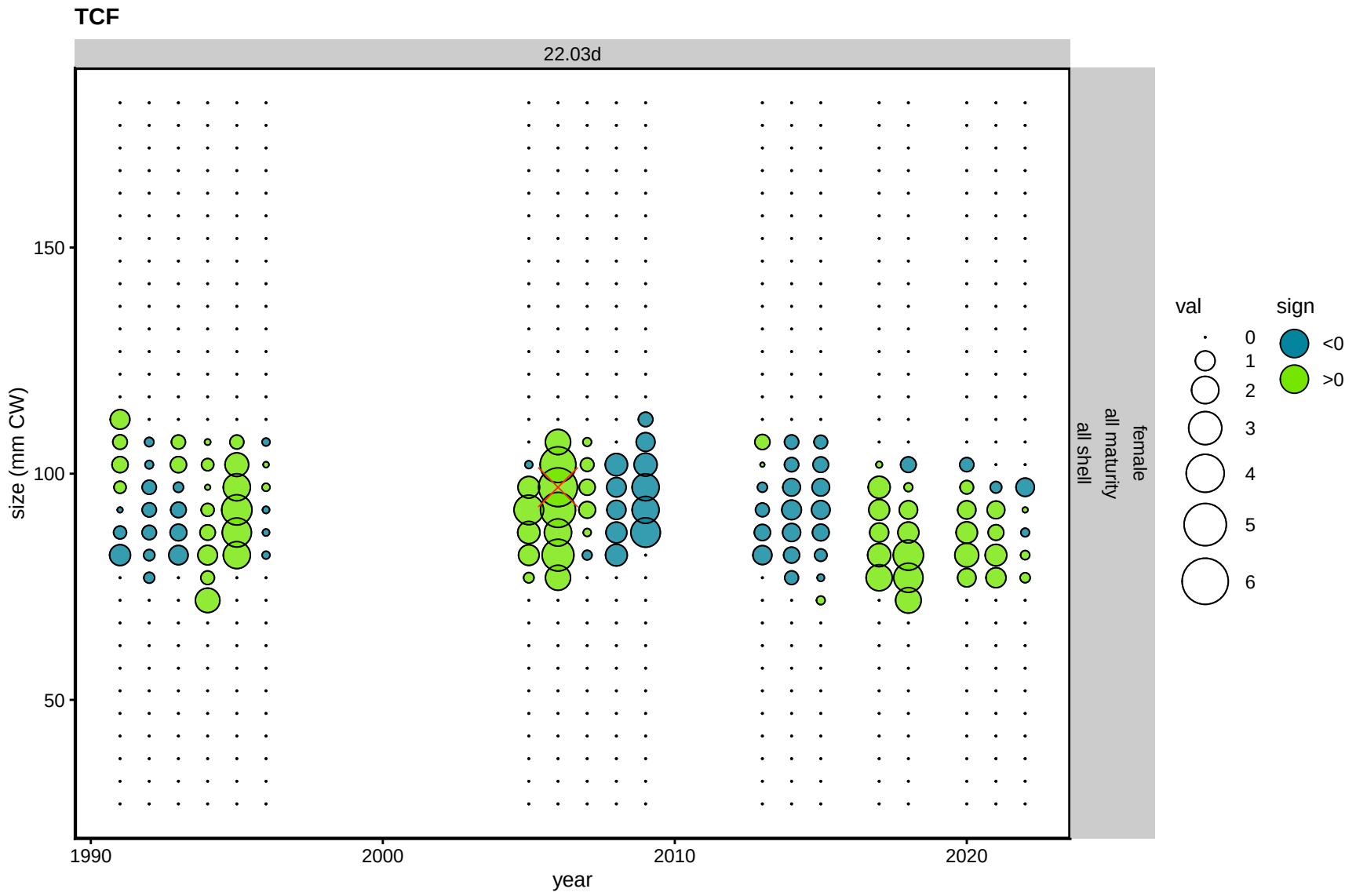

Figure 63. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

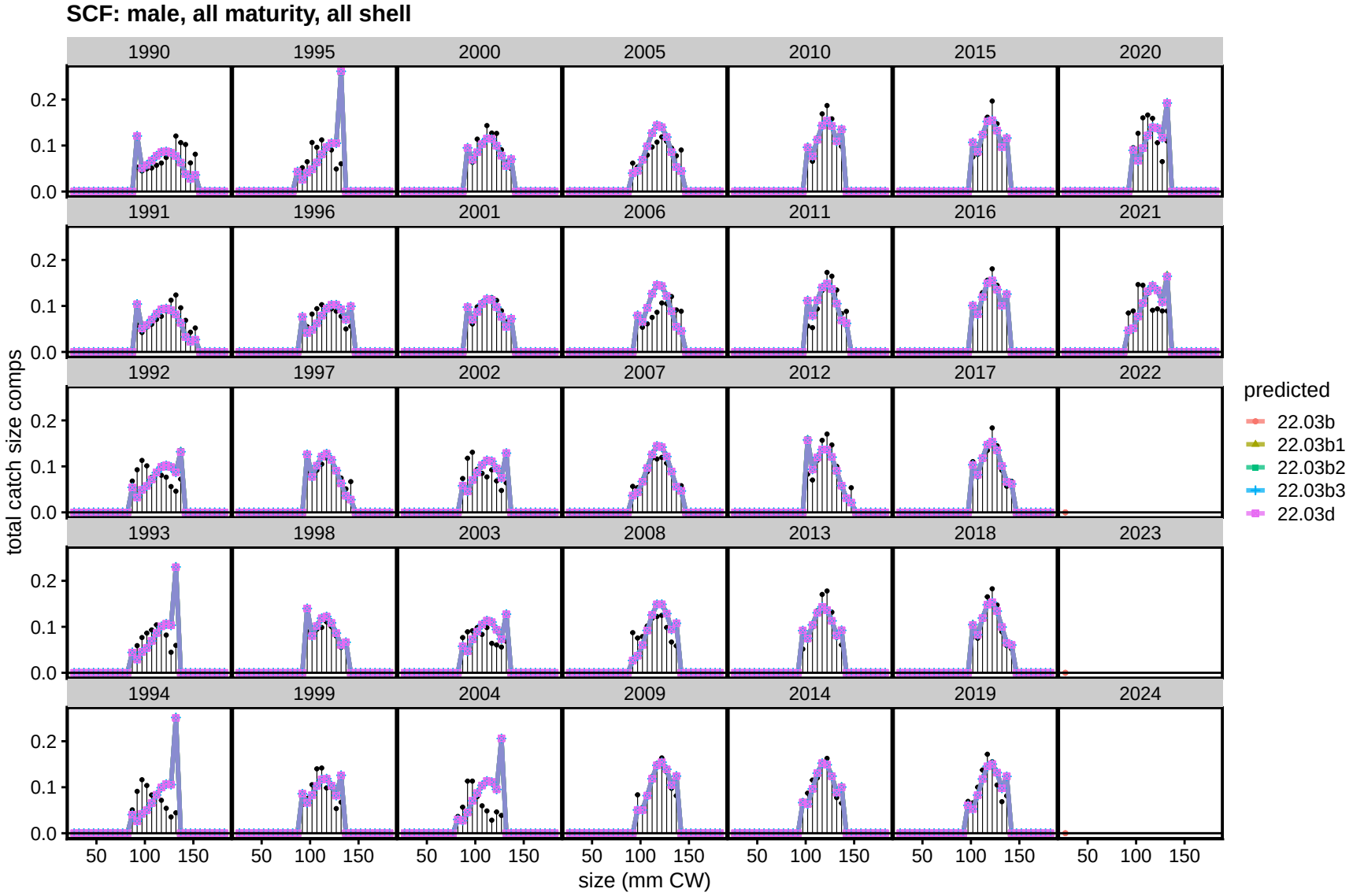

Figure 64. TCSAM02 models fits to total catch size compostiions in the SCF fishery. Preferred model is 22.03d.

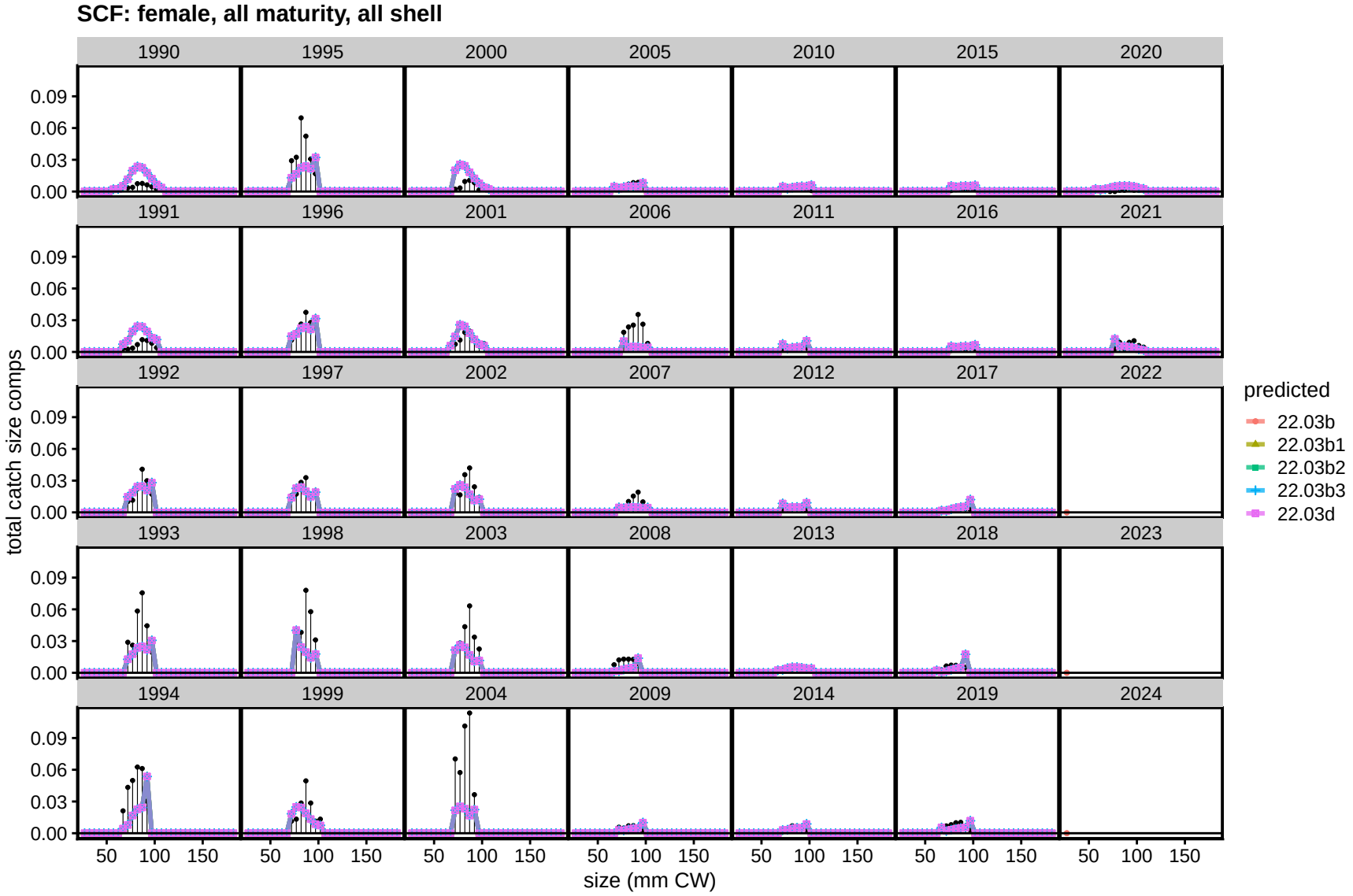

Figure 65. TCSAM02 models fits to total catch size compostiions in the SCF fishery. Preferred model is 22.03d.

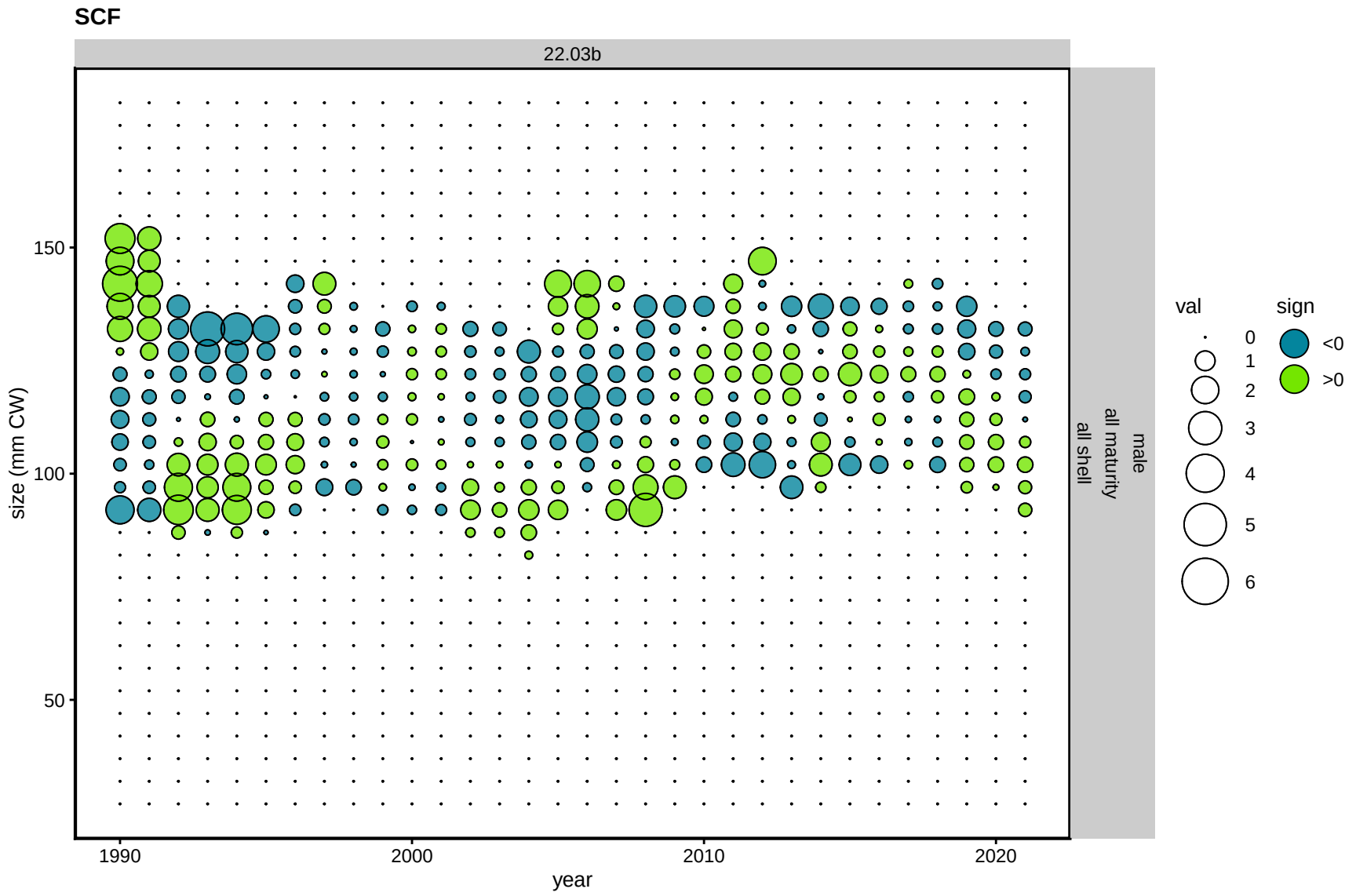

Figure 66. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

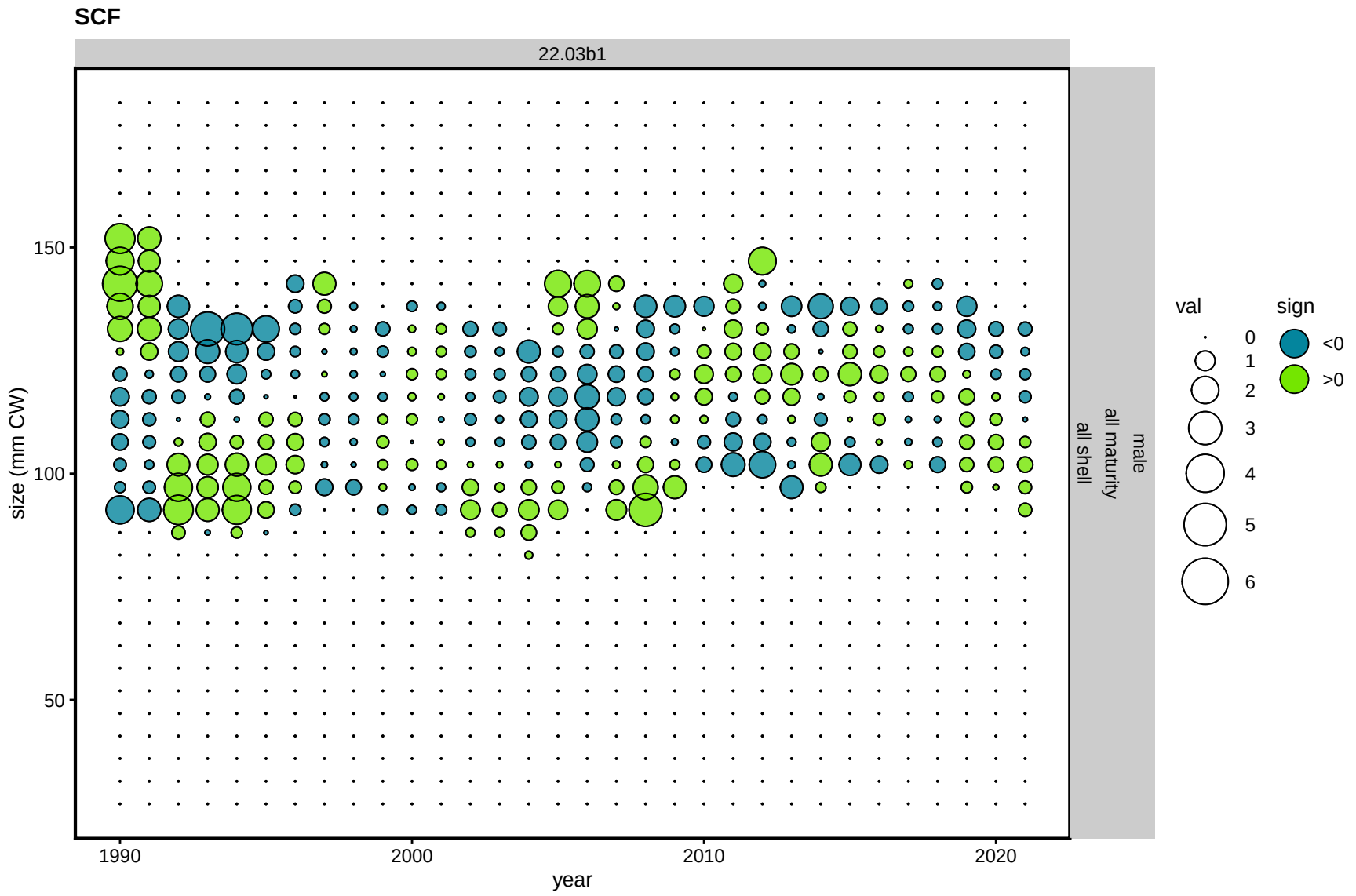

Figure 67. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

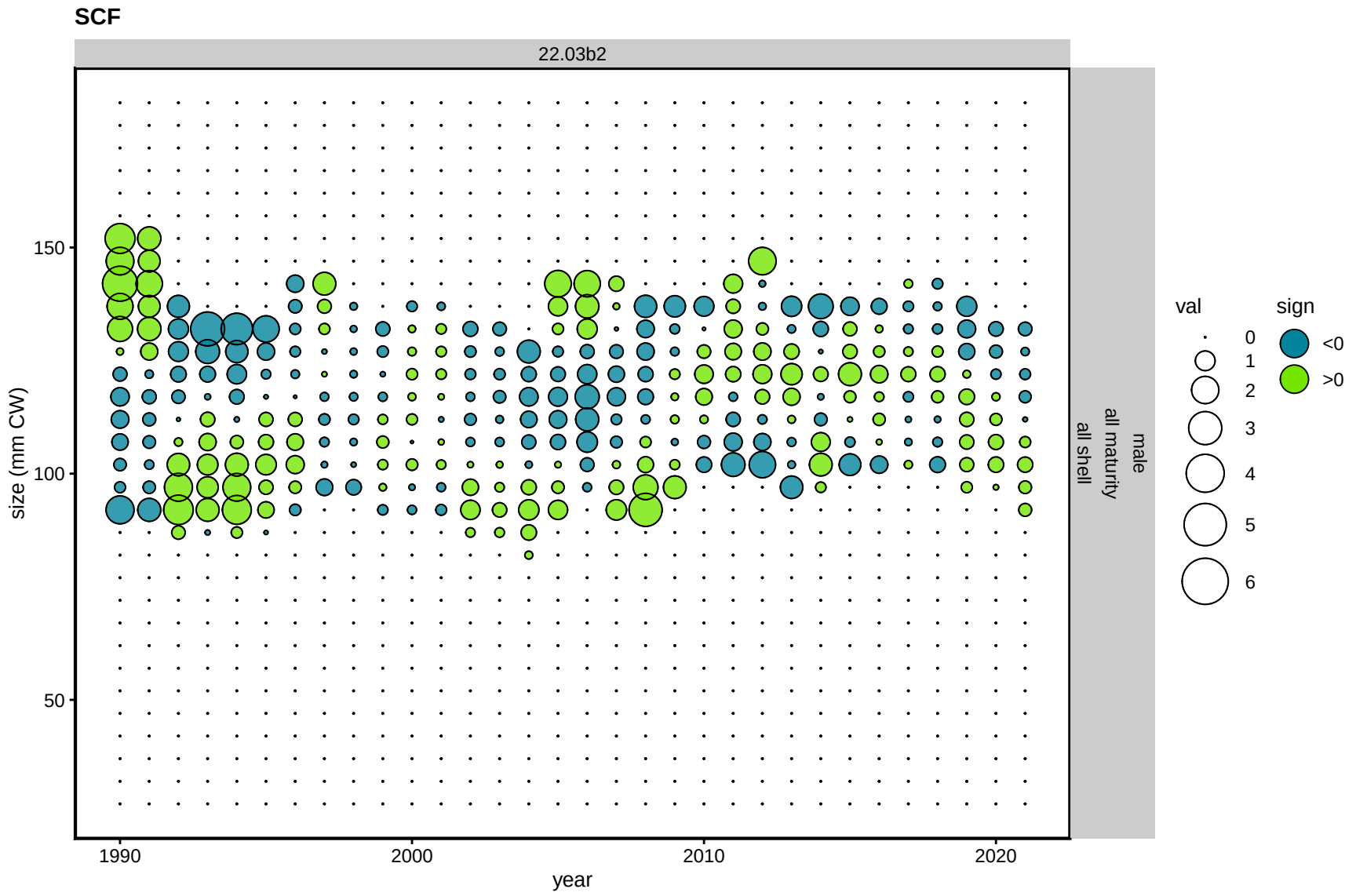

Figure 68. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

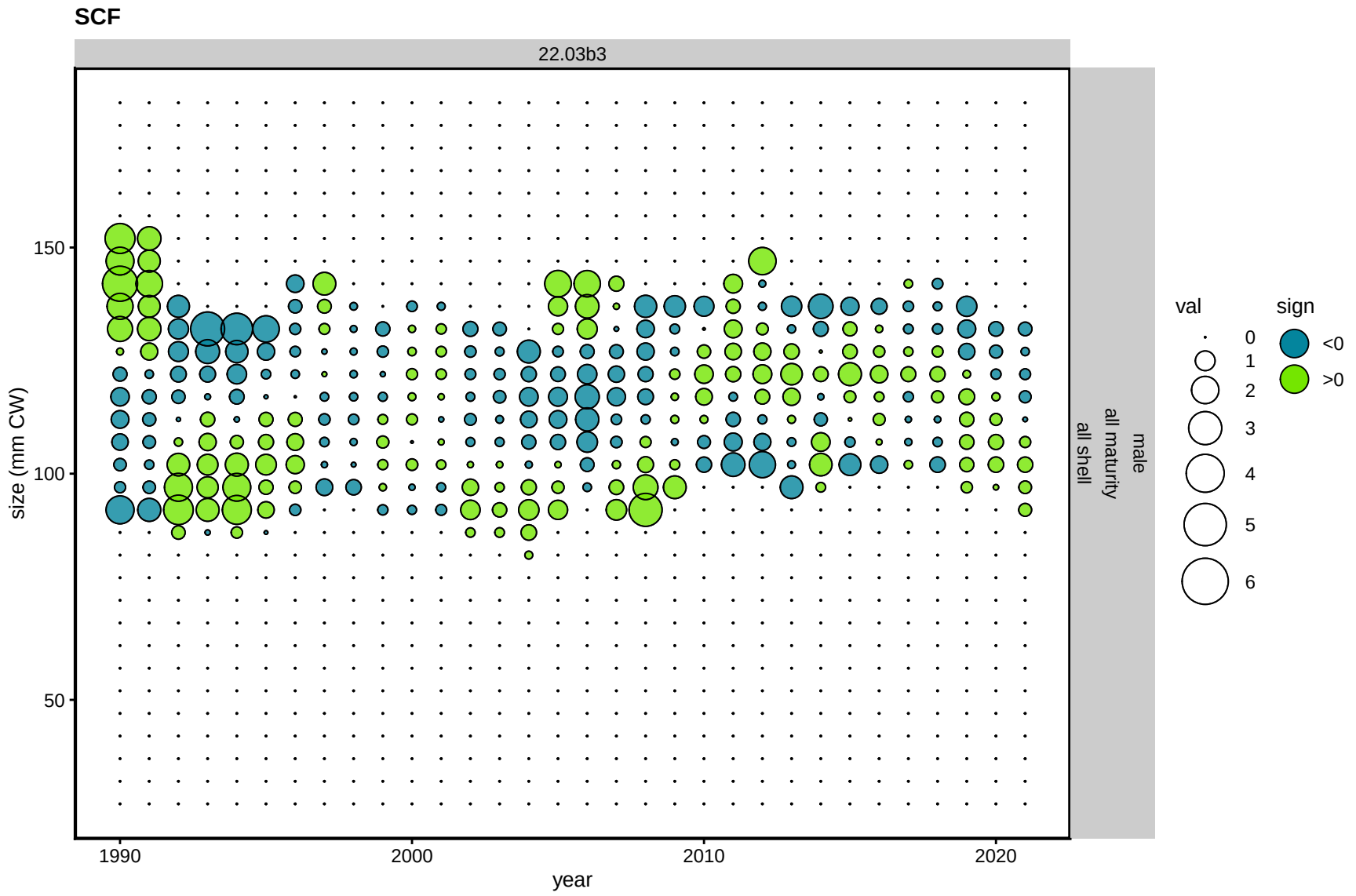

Figure 69. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

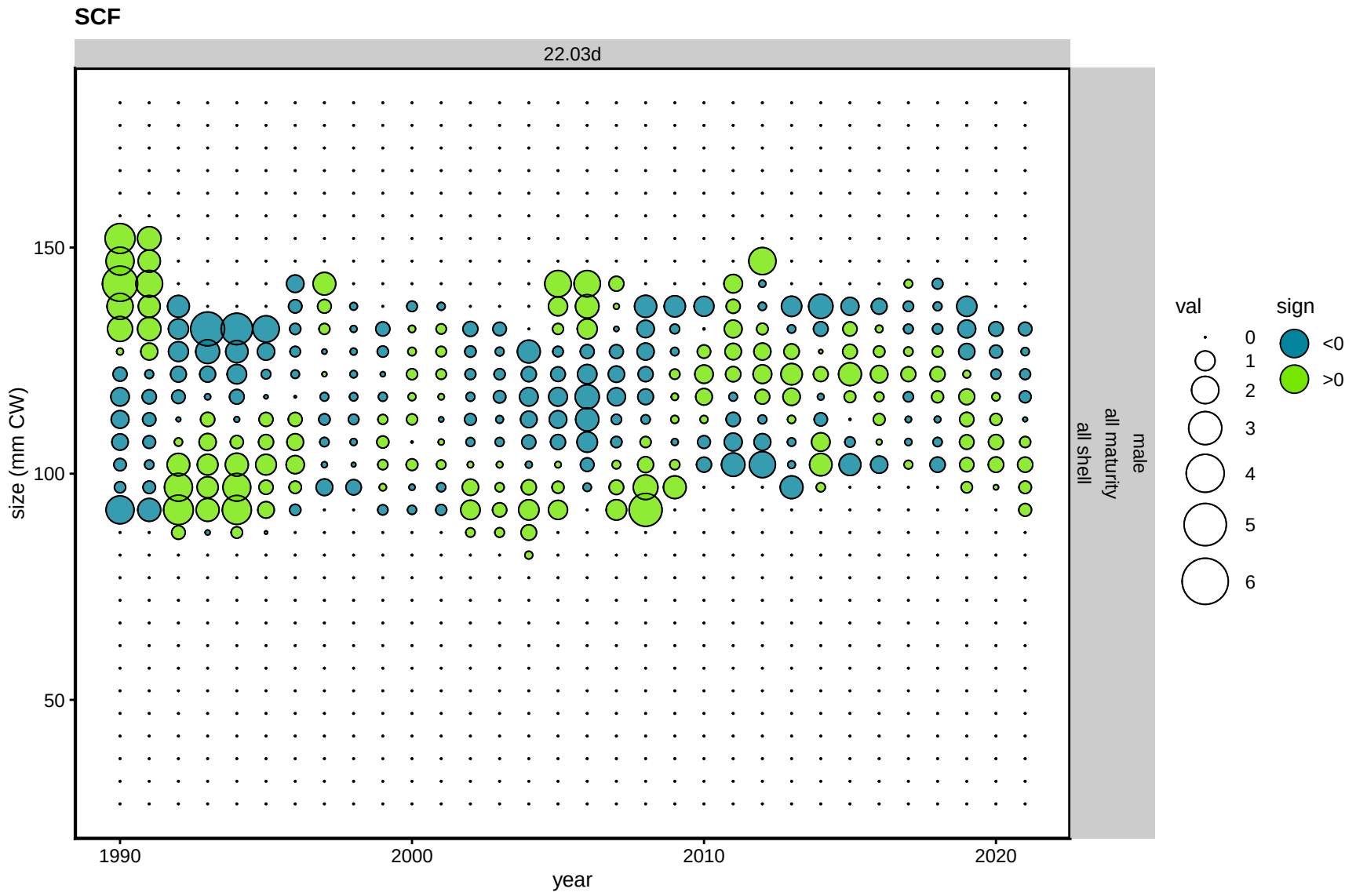

Figure 70. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

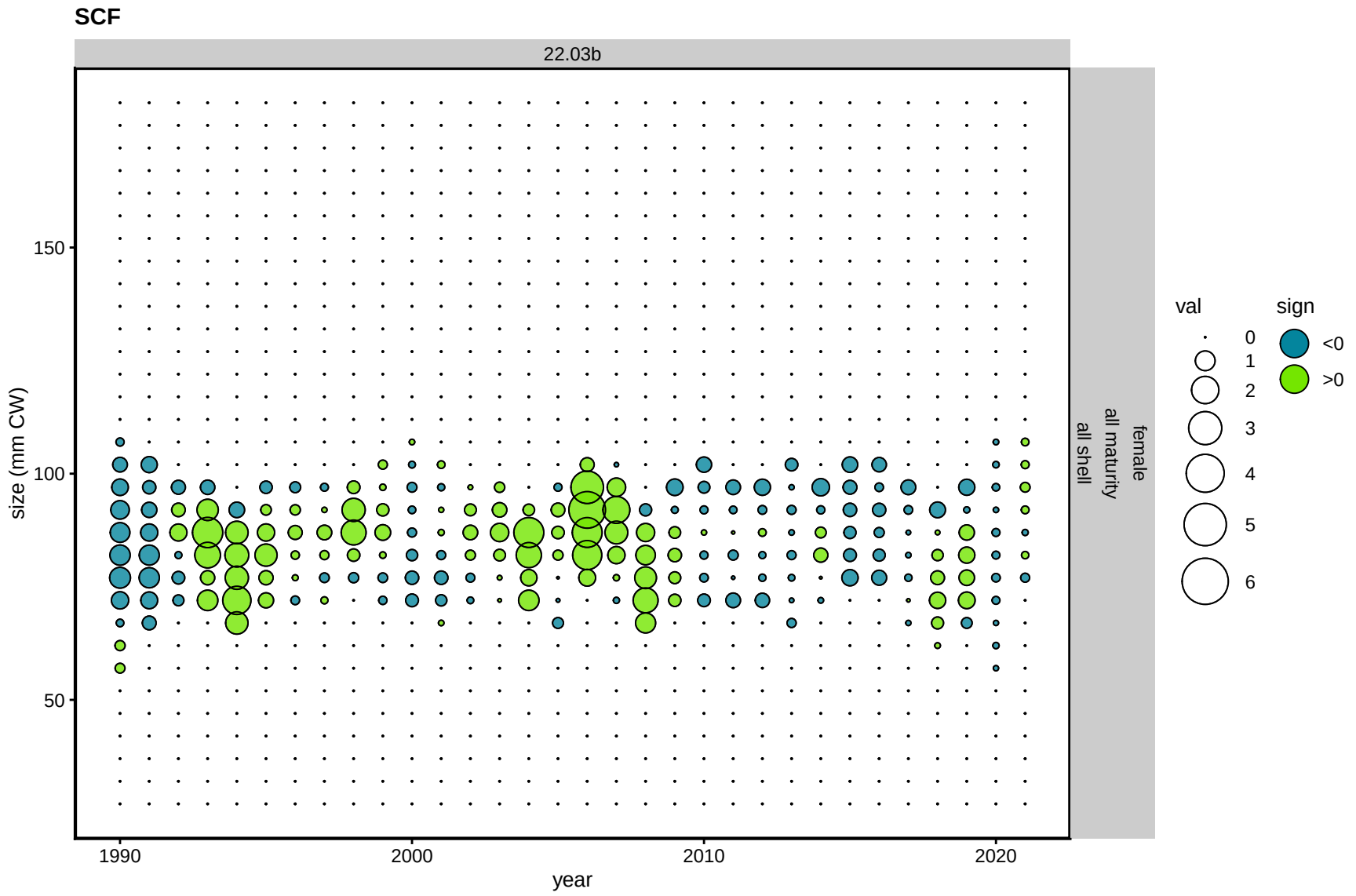

Figure 71. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

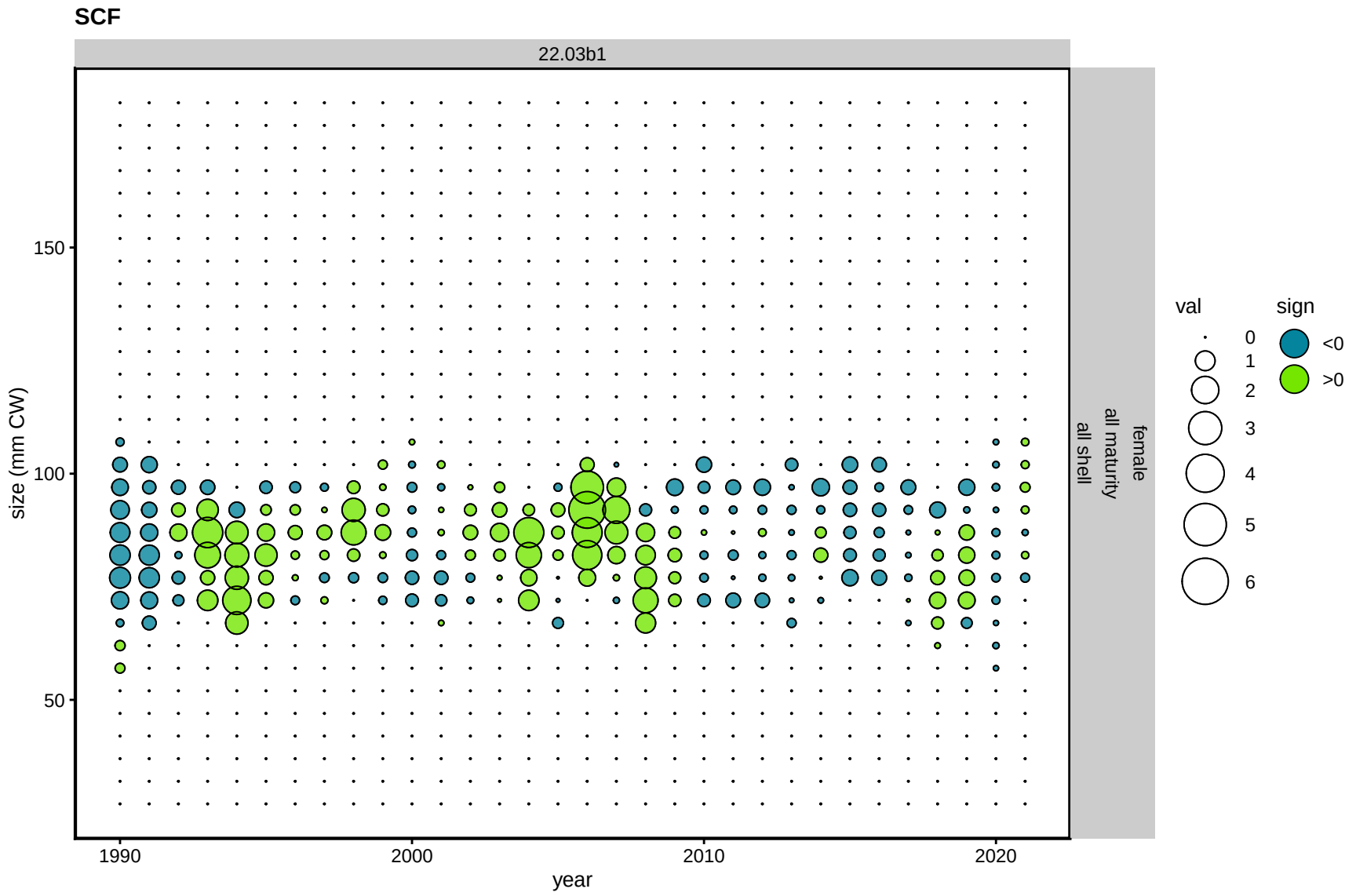

Figure 72. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

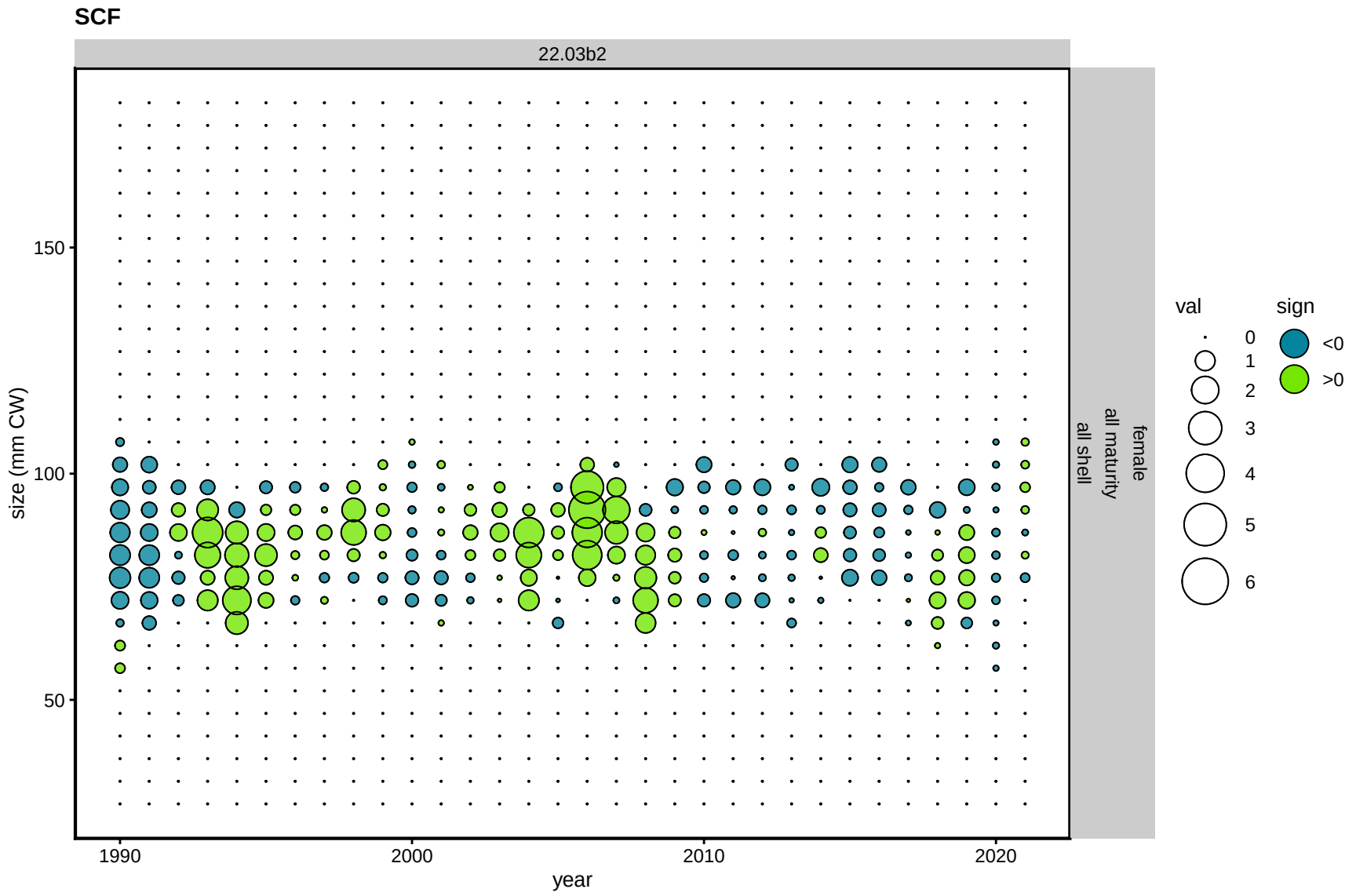

Figure 73. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

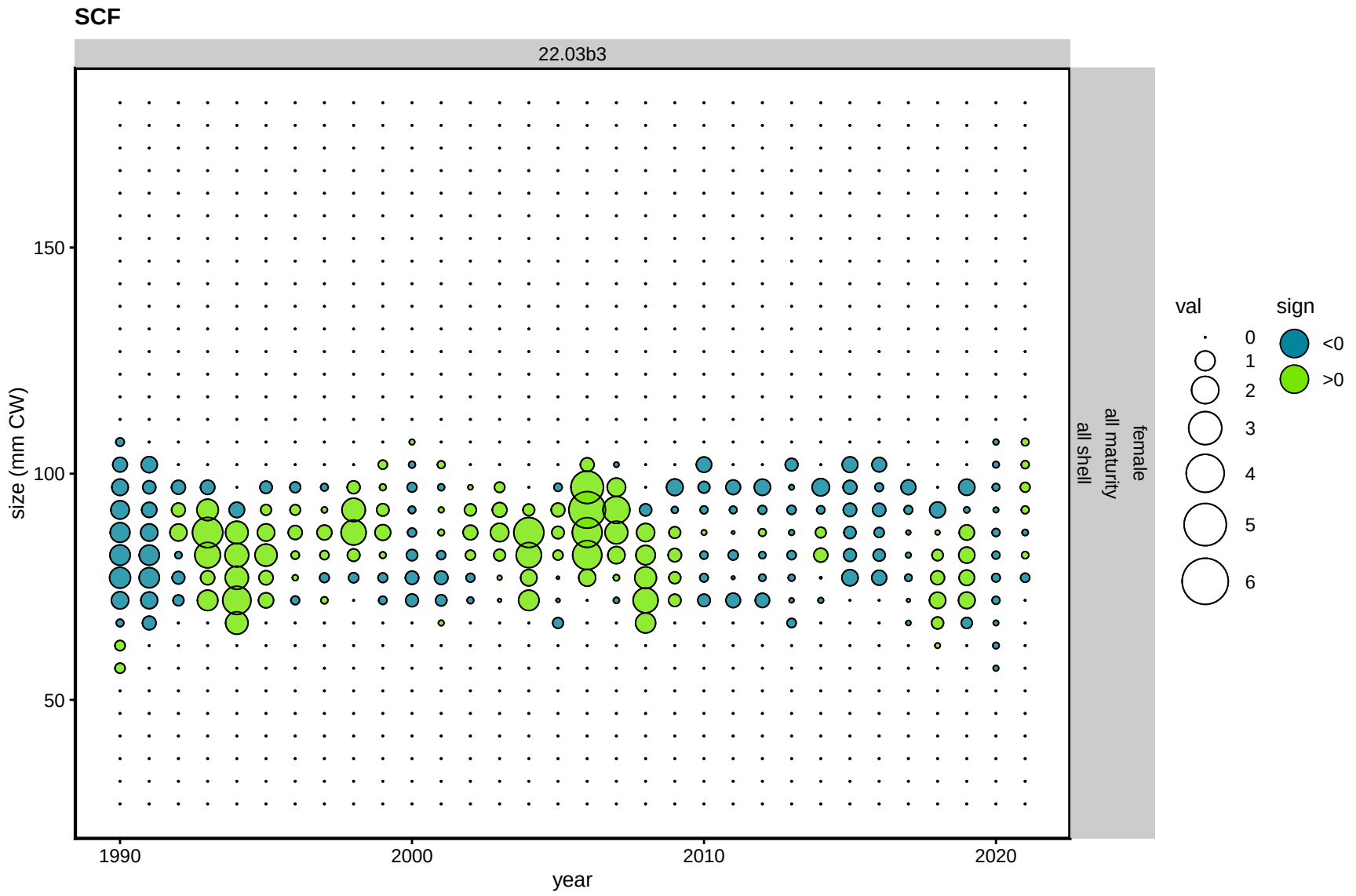

Figure 74. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

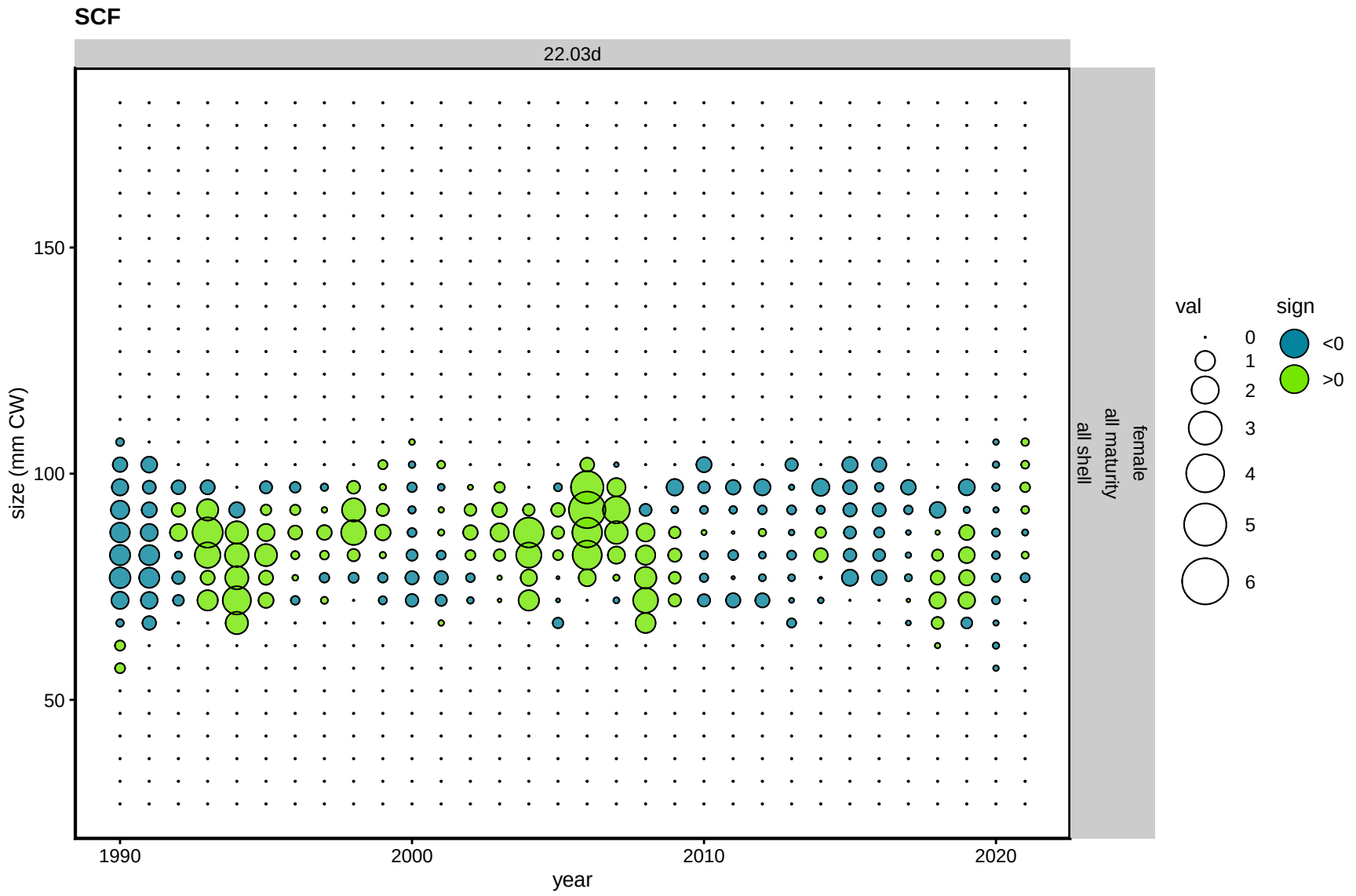

Figure 75. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

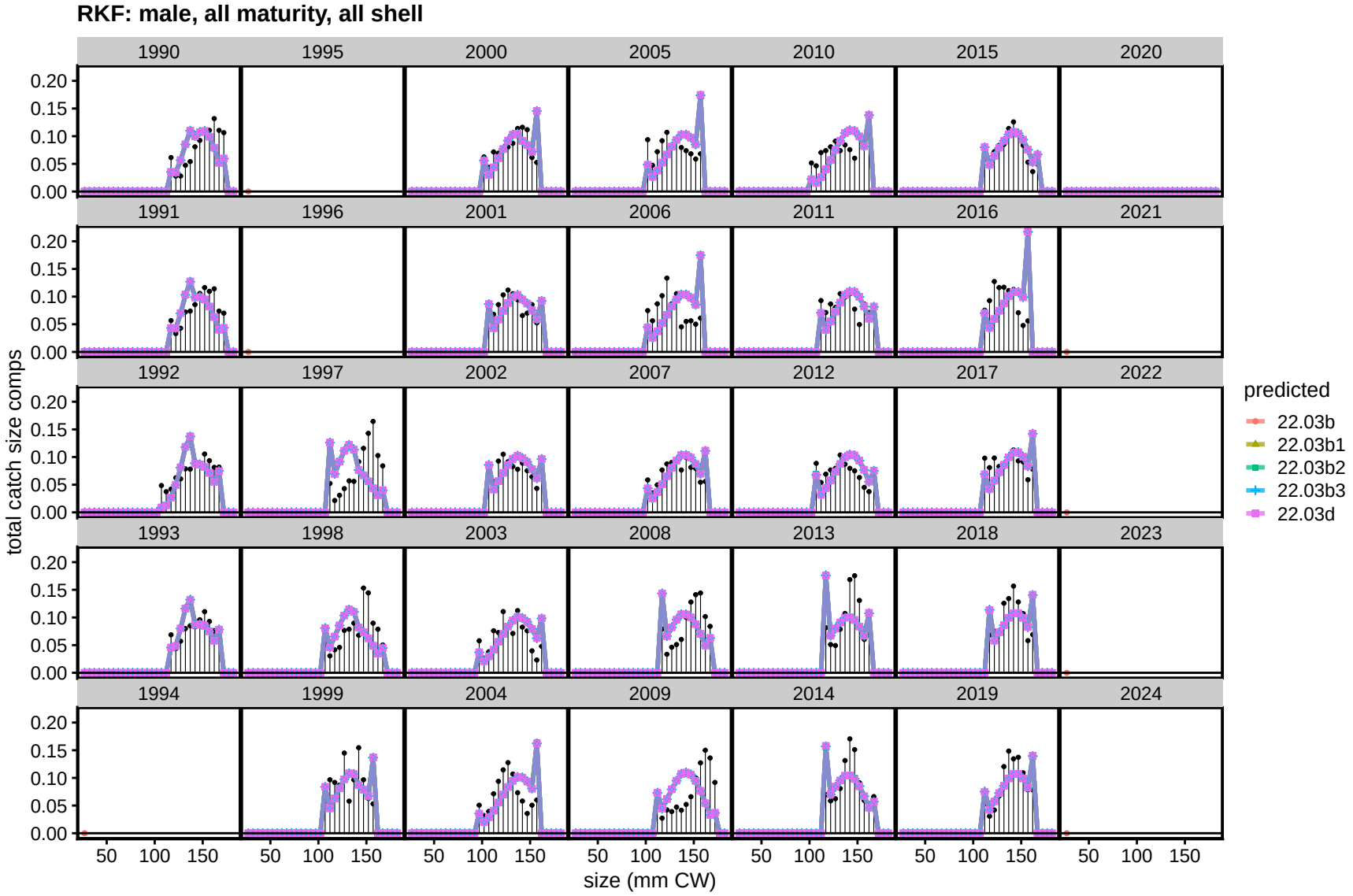

Figure 76. TCSAM02 models fits to total catch size compostiions in the RKF fishery. Preferred model is 22.03d.

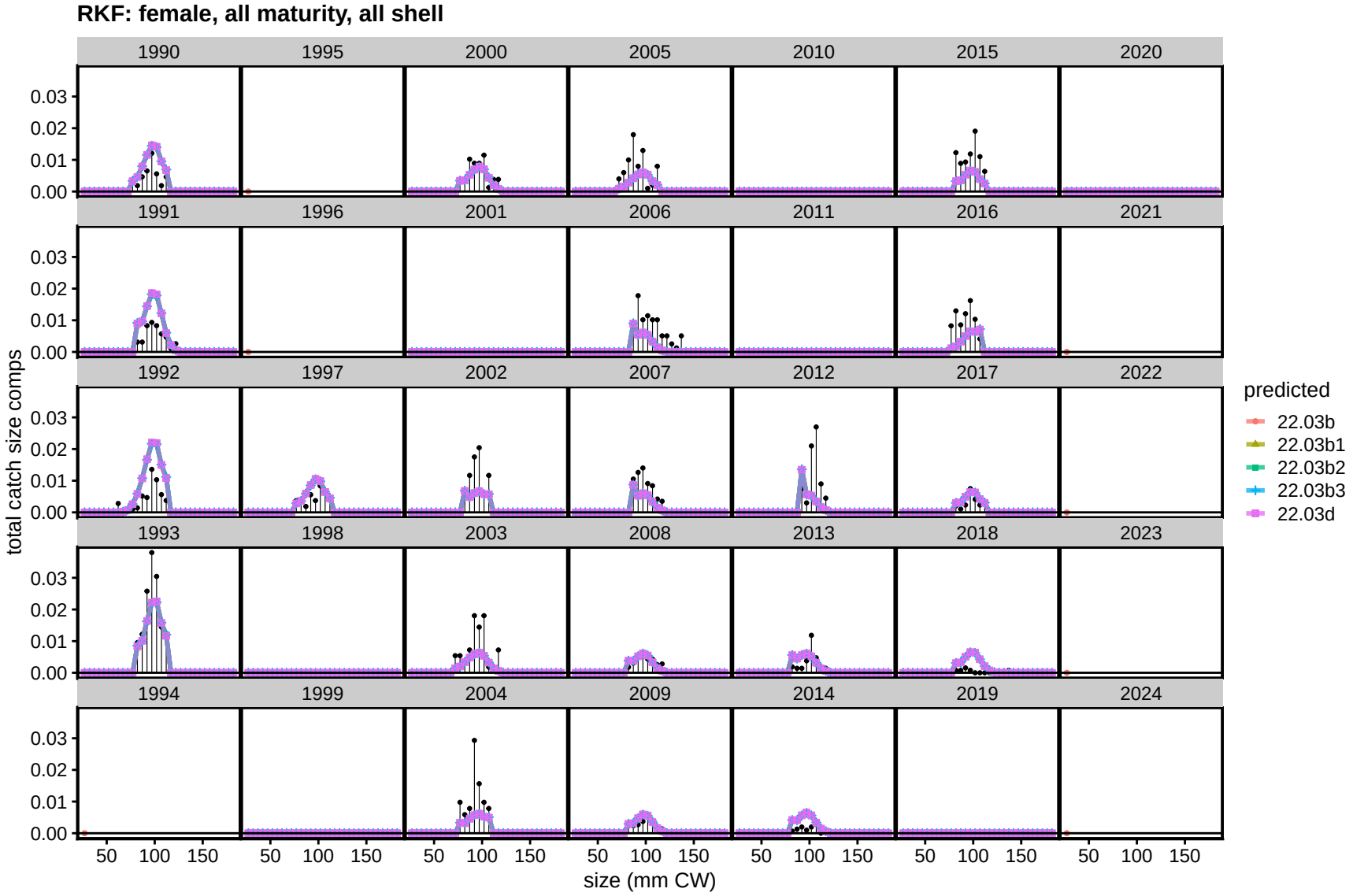

Figure 77. TCSAM02 models fits to total catch size compostiions in the RKF fishery. Preferred model is 22.03d.

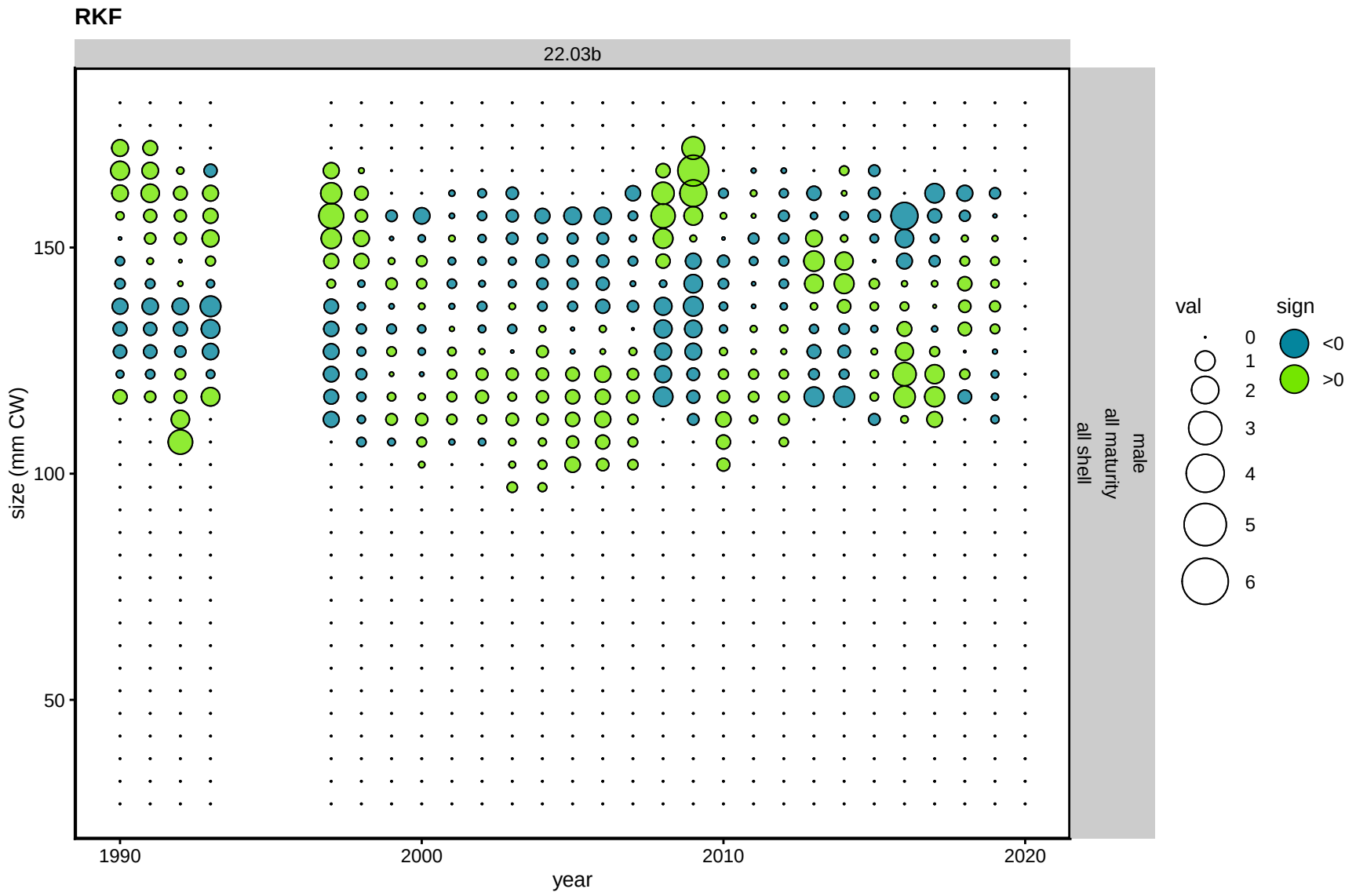

Figure 78. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

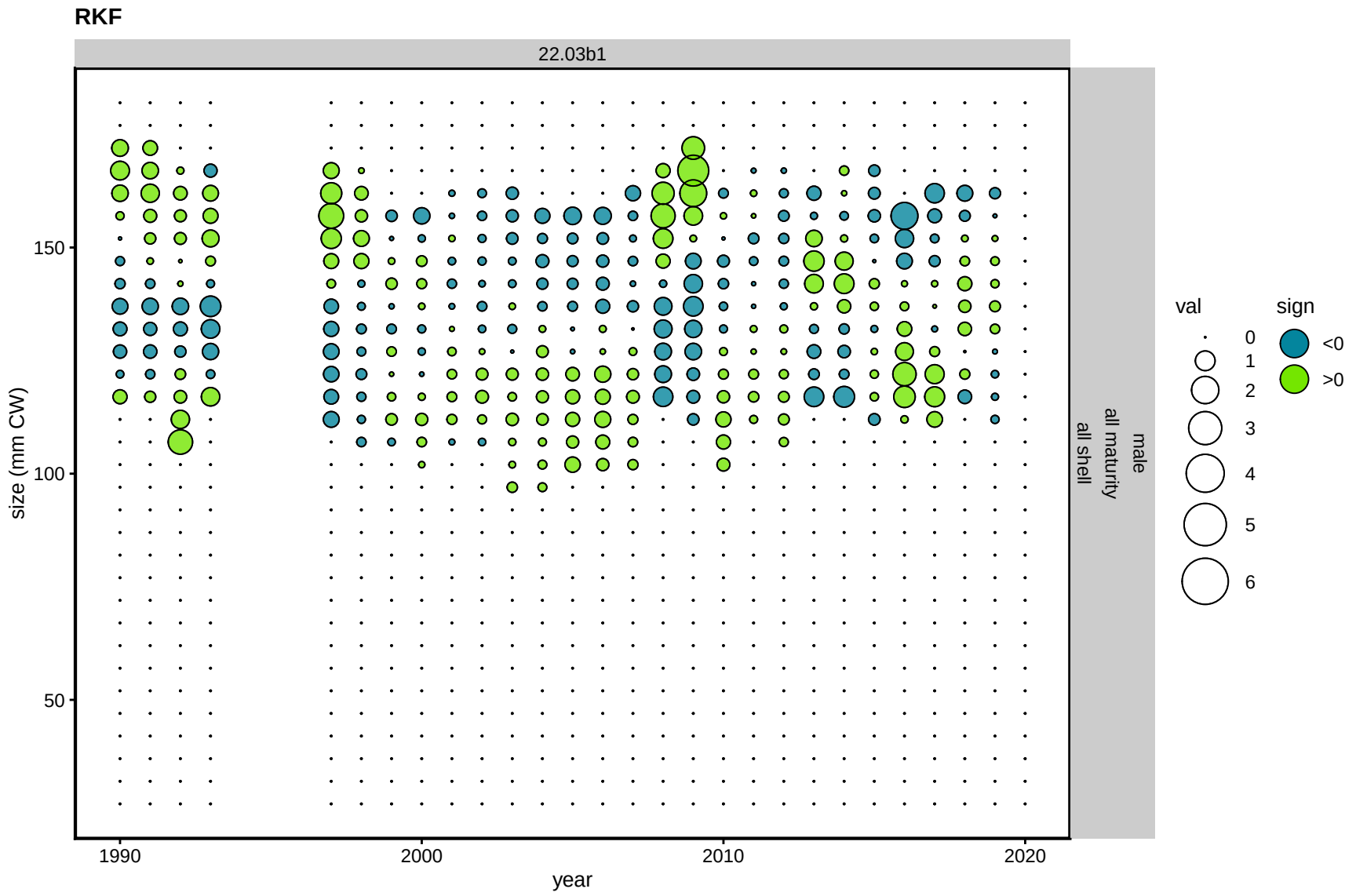

Figure 79. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

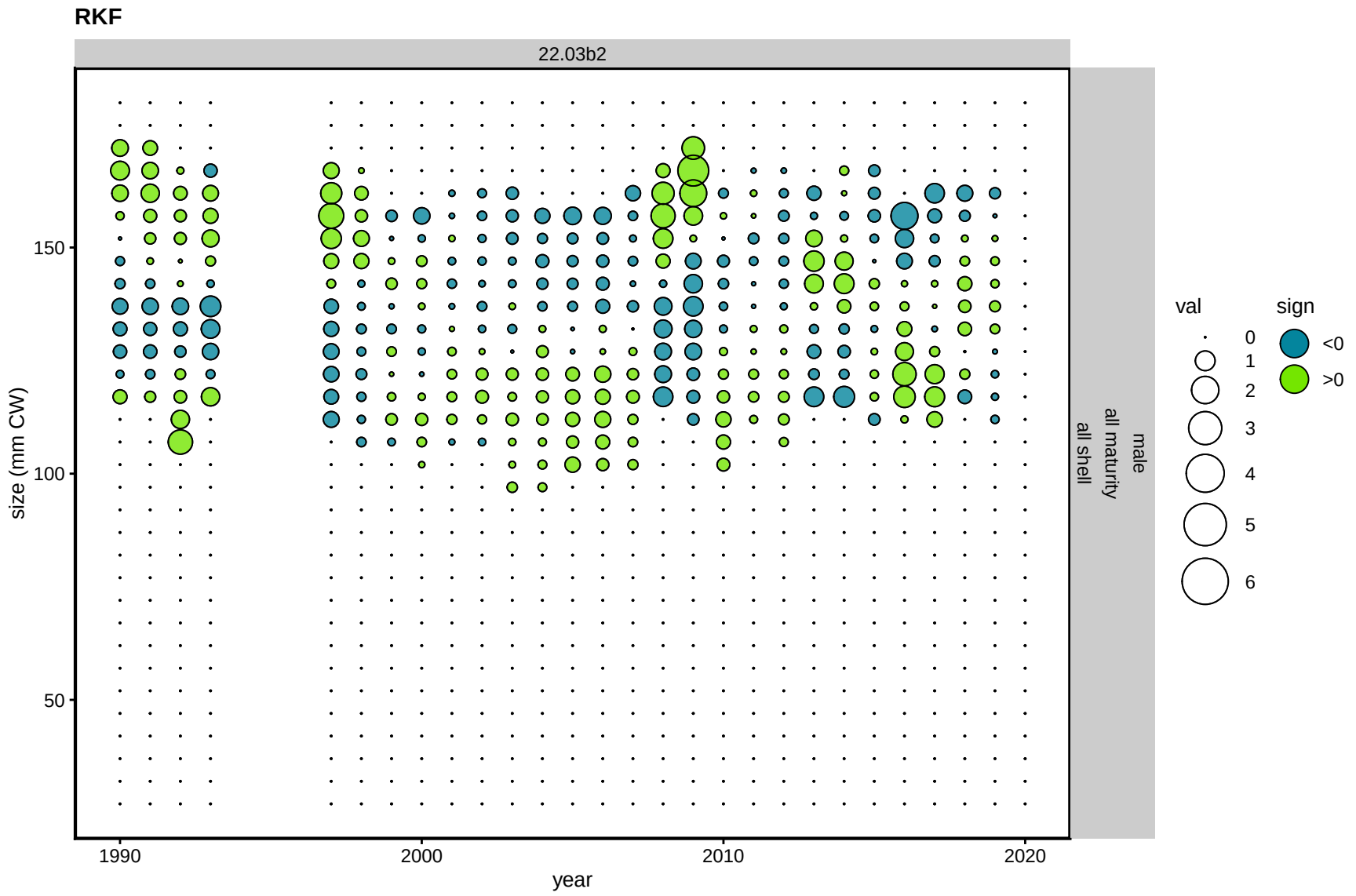

Figure 80. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

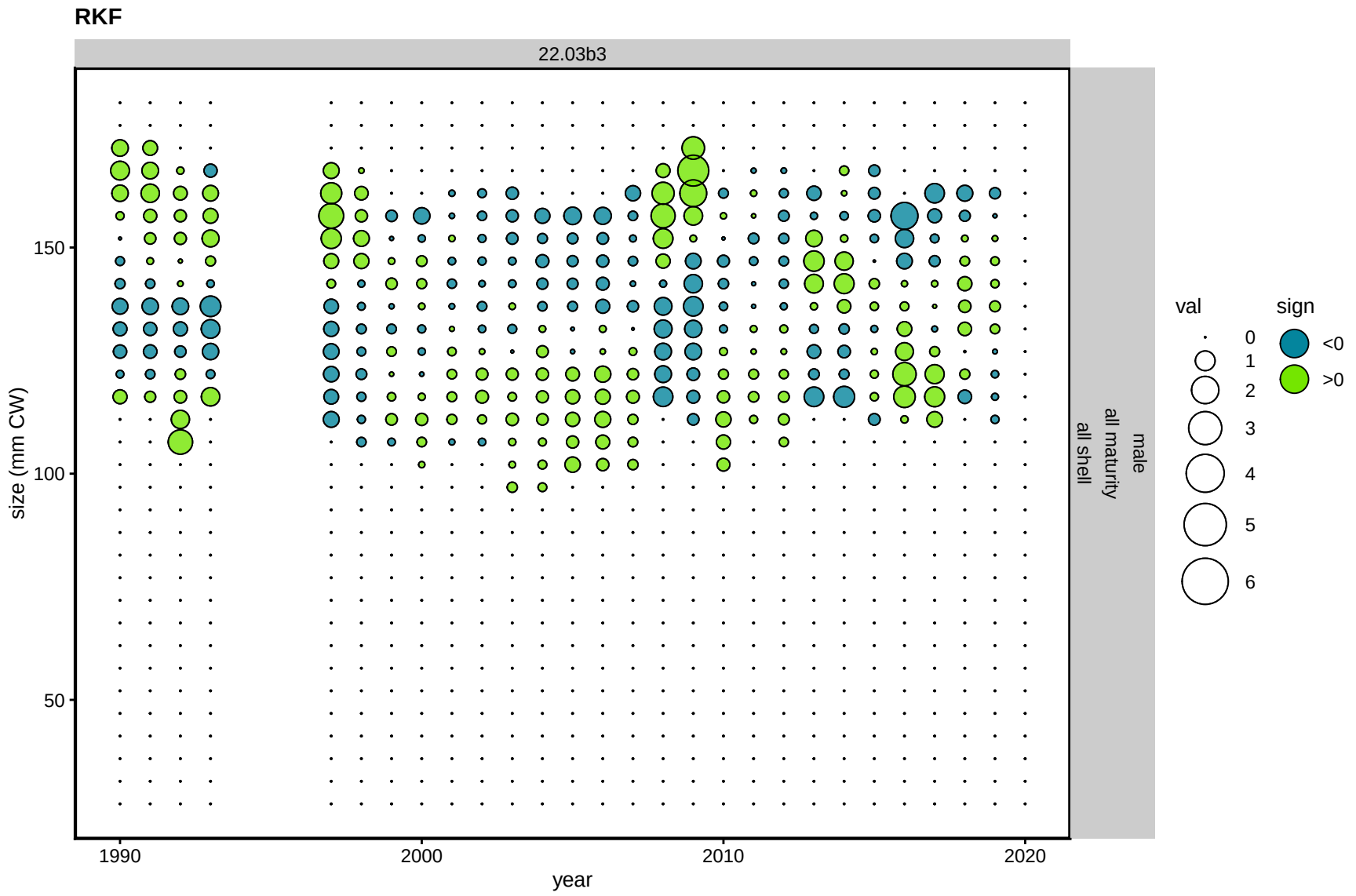

Figure 81. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

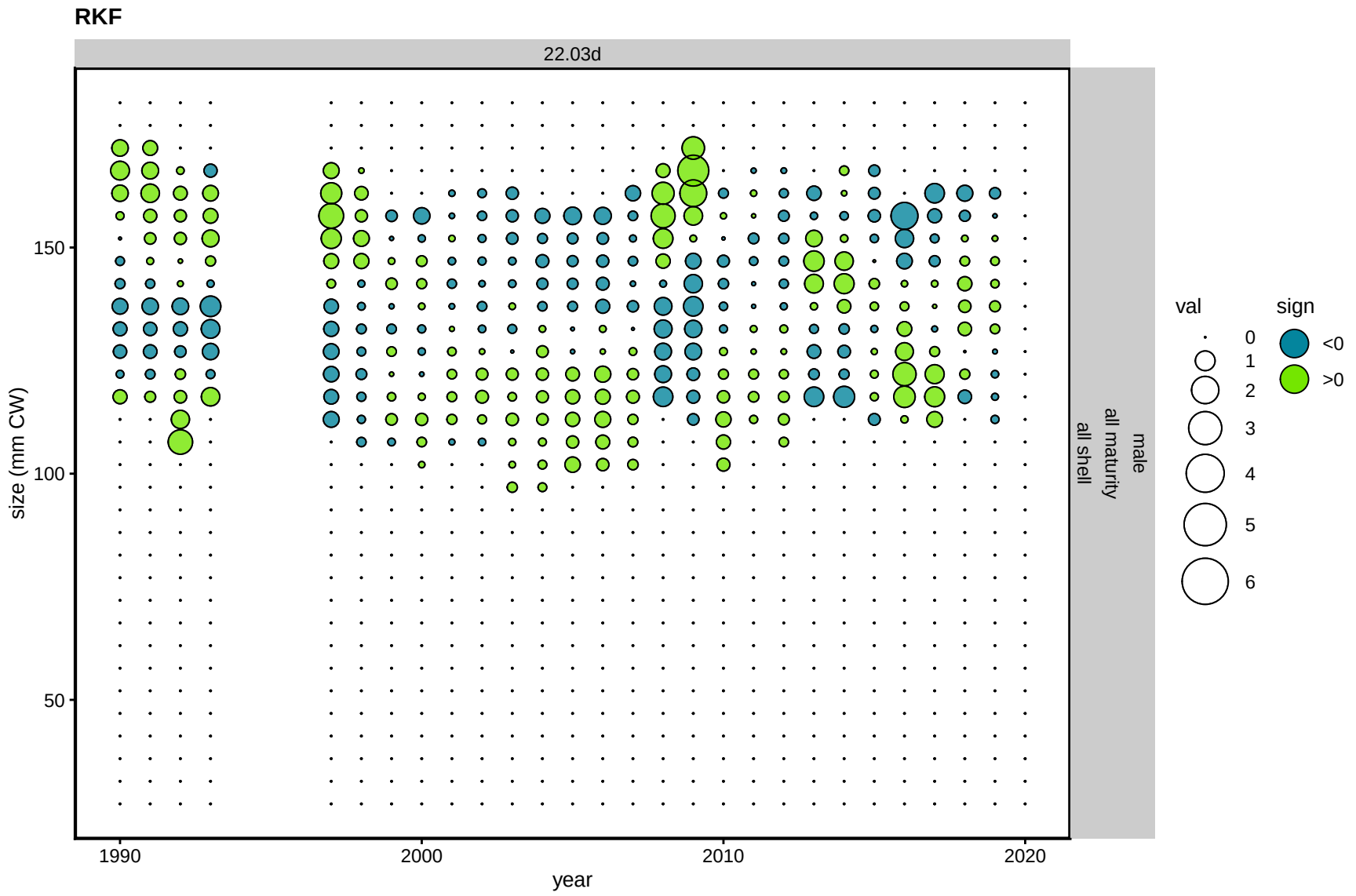

Figure 82. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

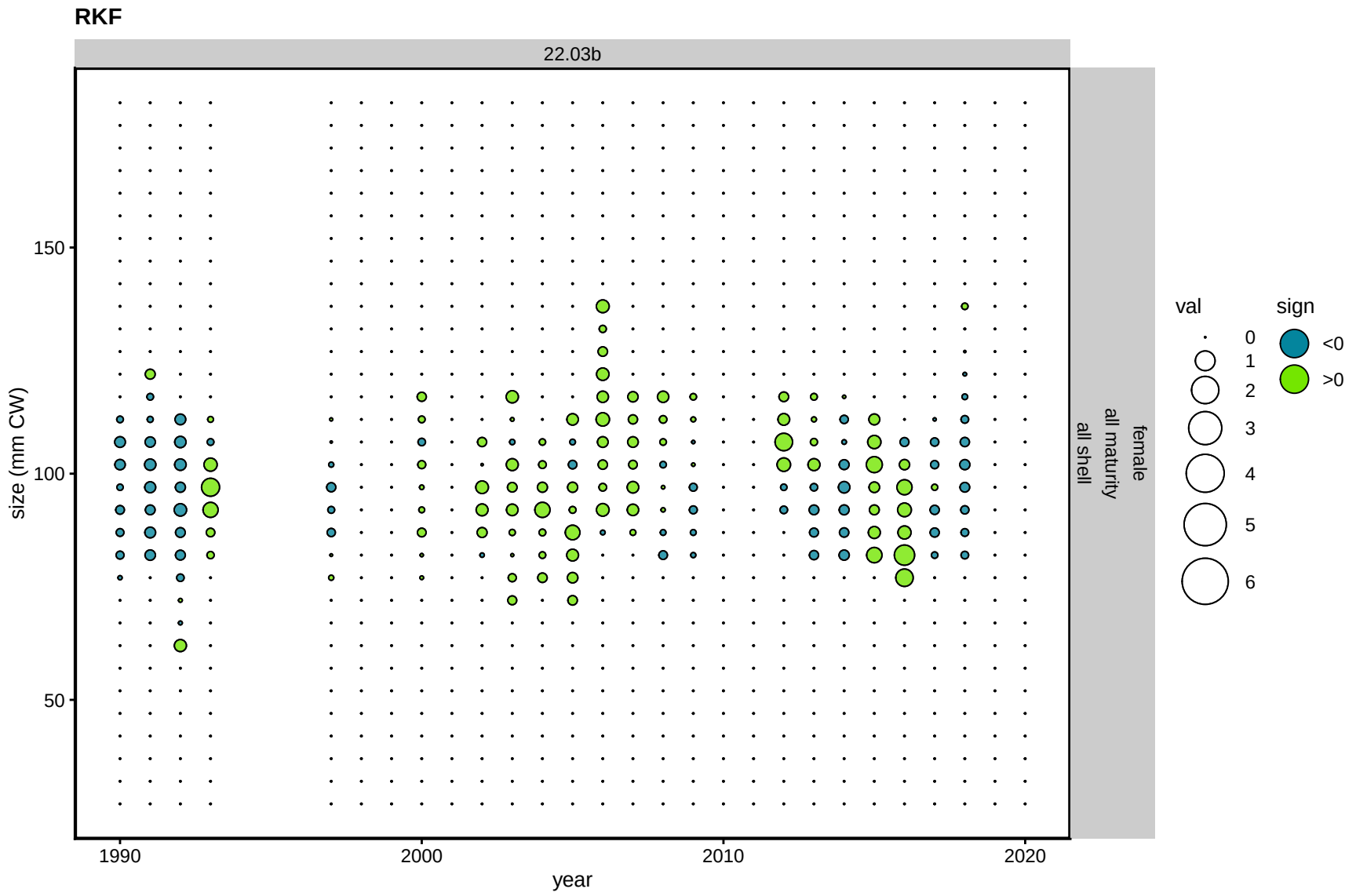

Figure 83. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

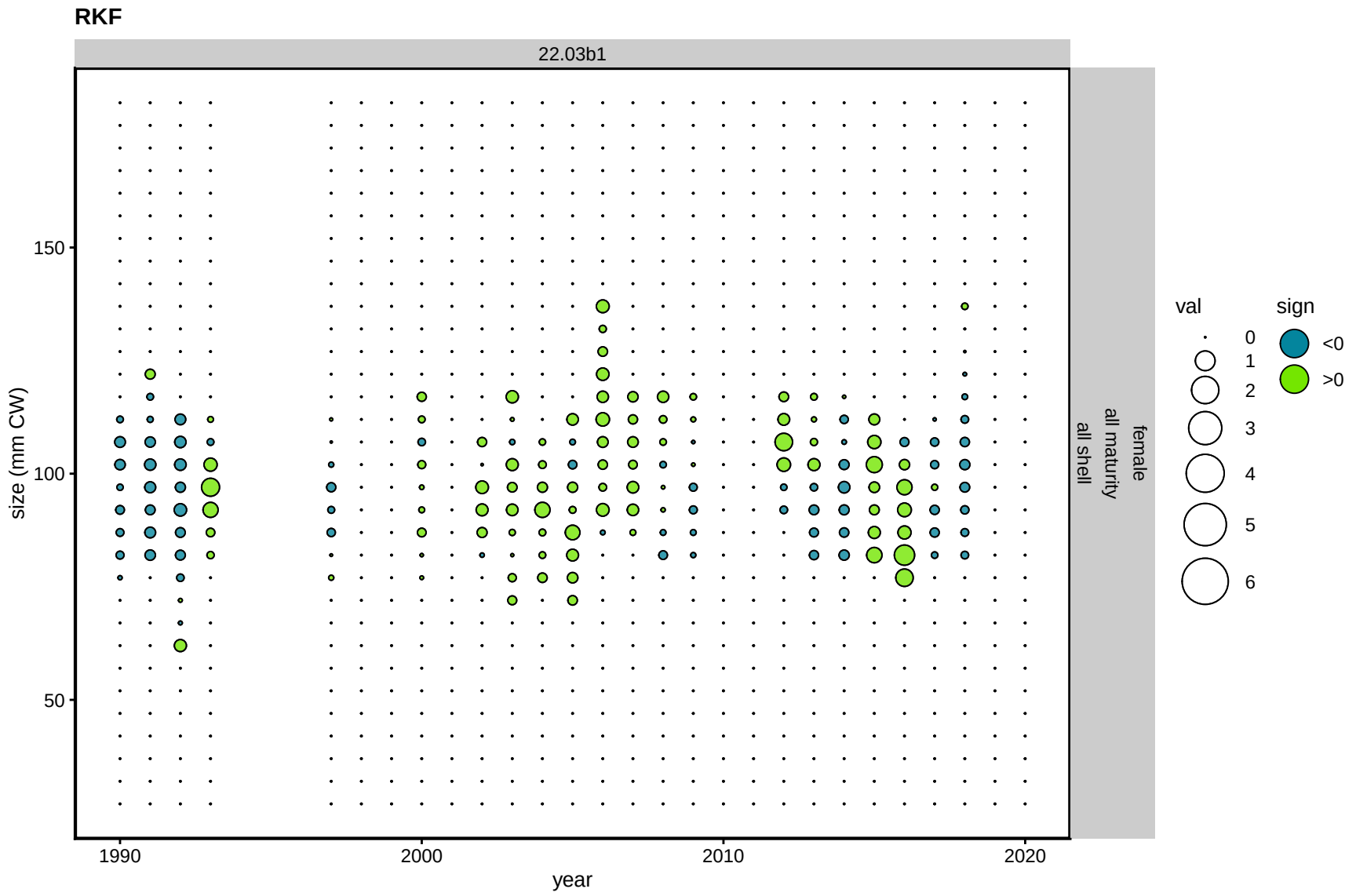

Figure 84. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

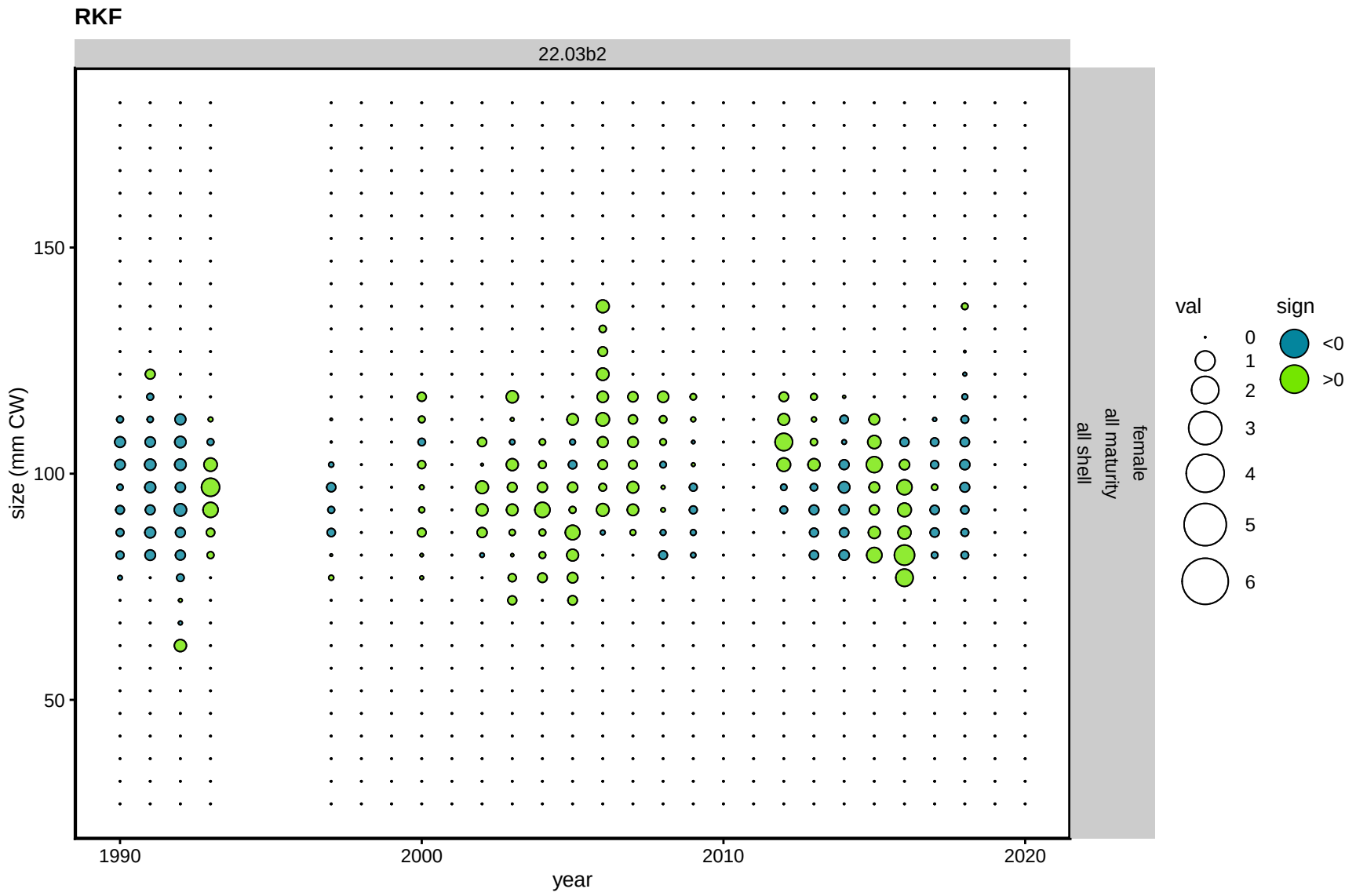

Figure 85. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

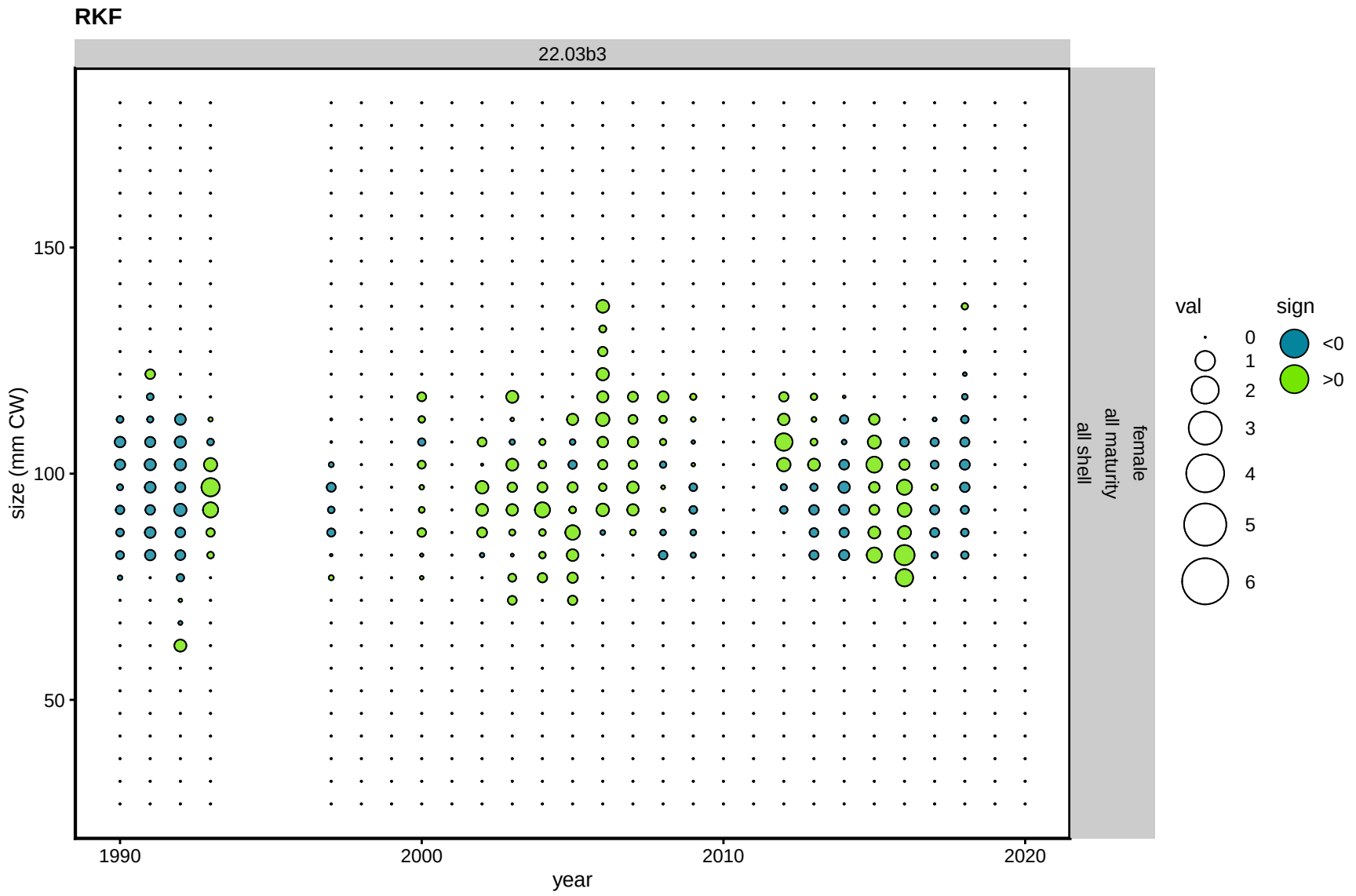

Figure 86. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

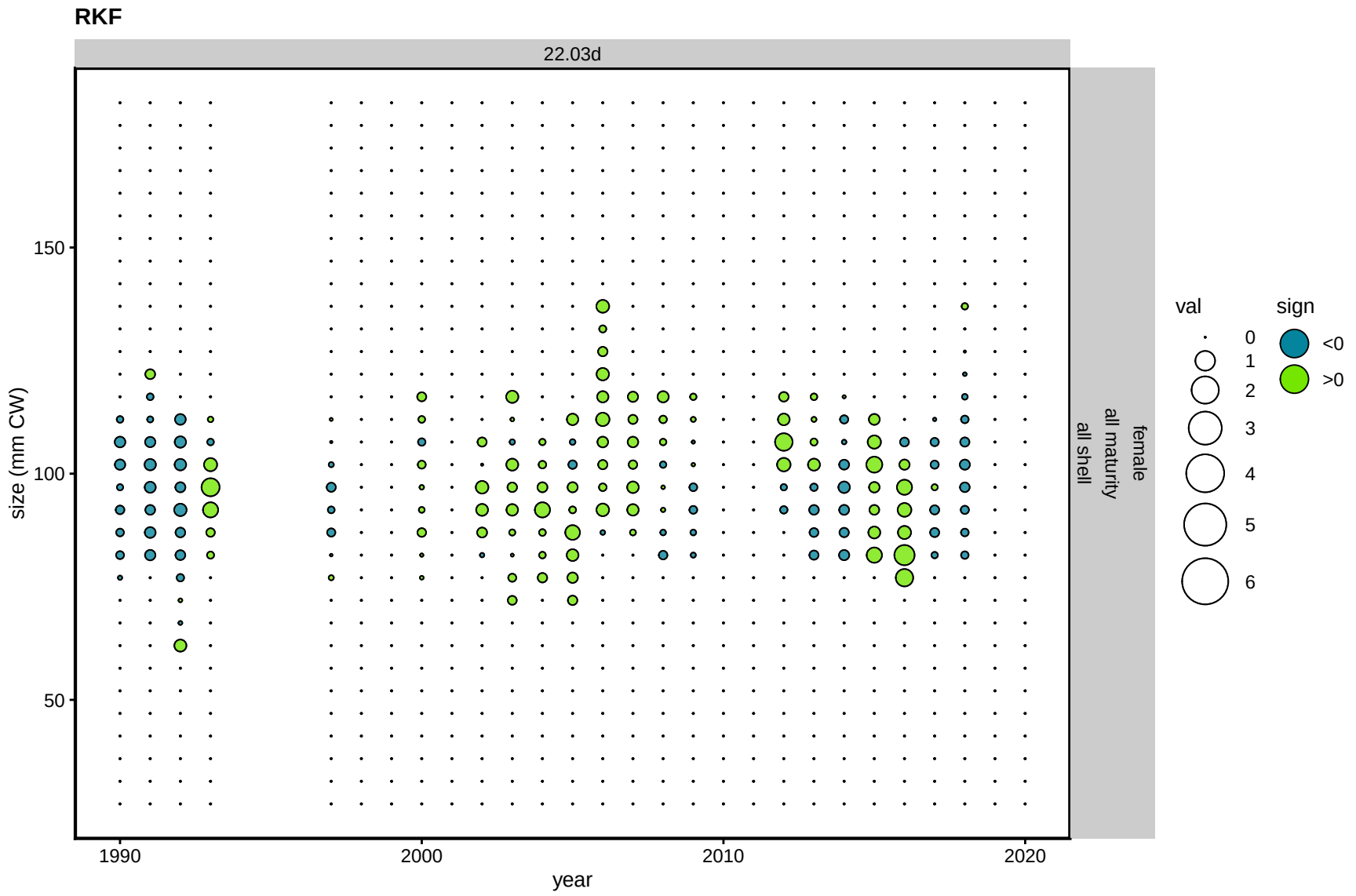

Figure 87. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

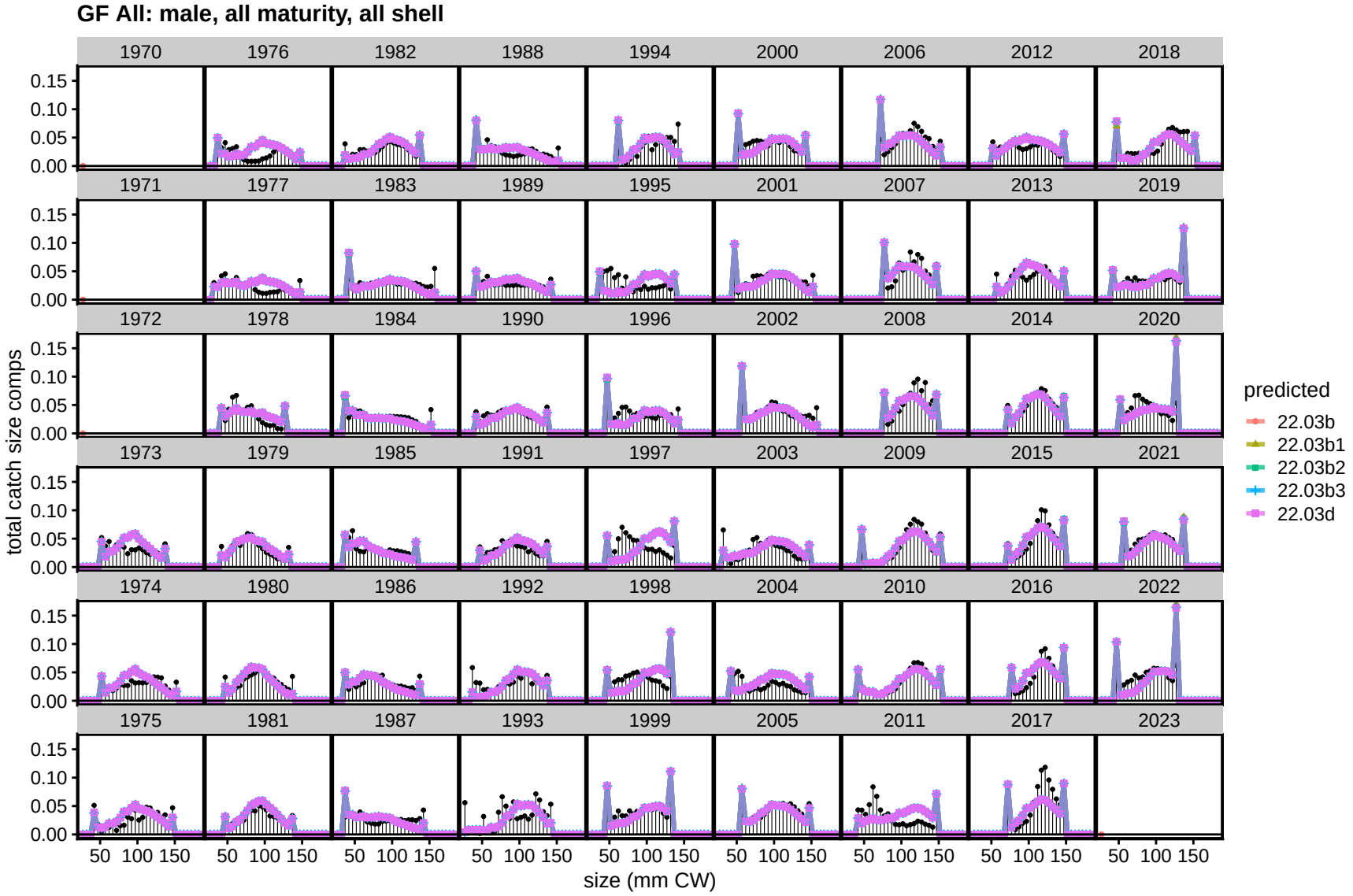

Figure 88. TCSAM02 models fits to total catch size compostiions in the GF All fishery.

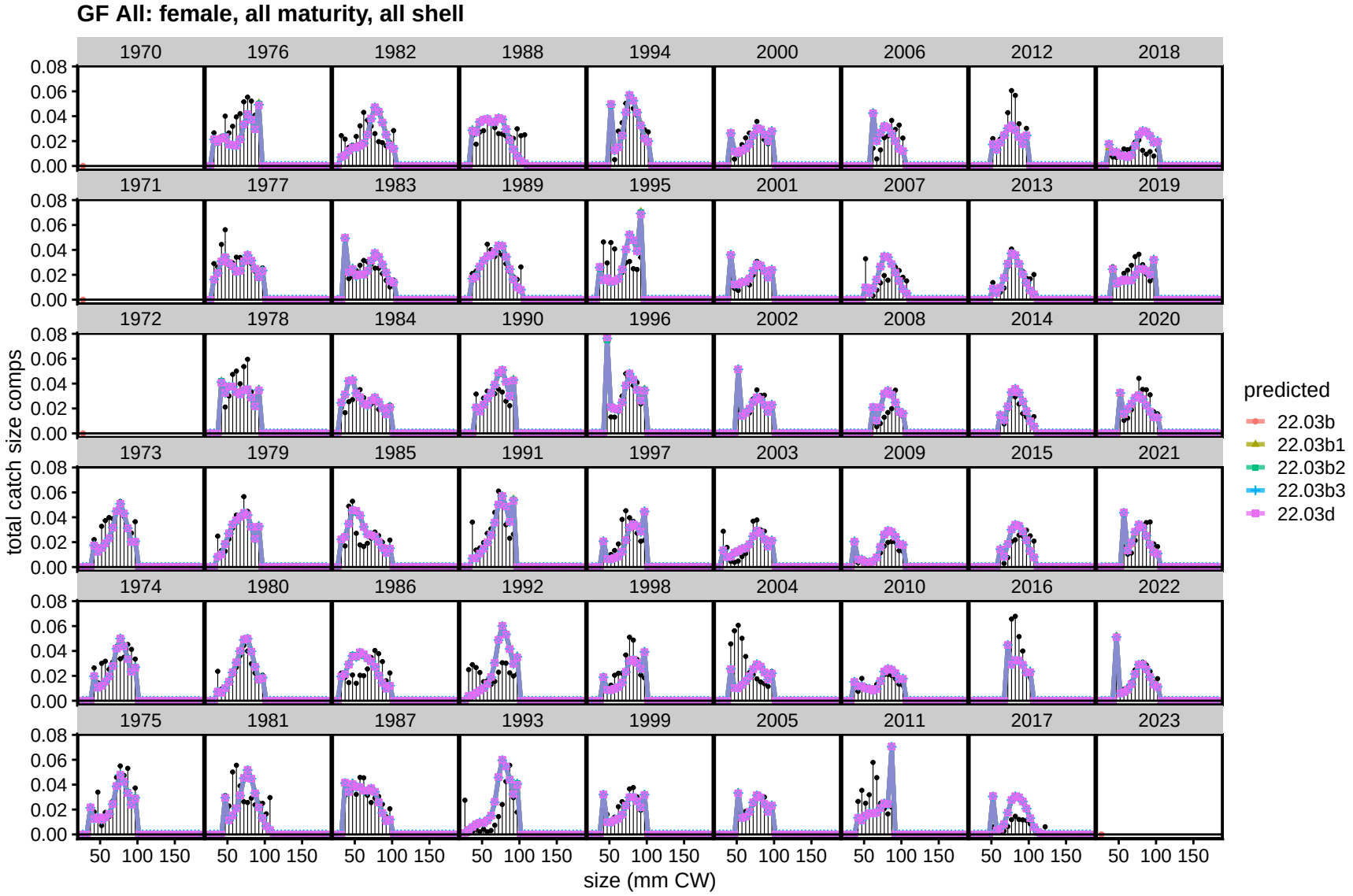

Figure 89. TCSAM02 models fits to total catch size compostiions in the GF All fishery.

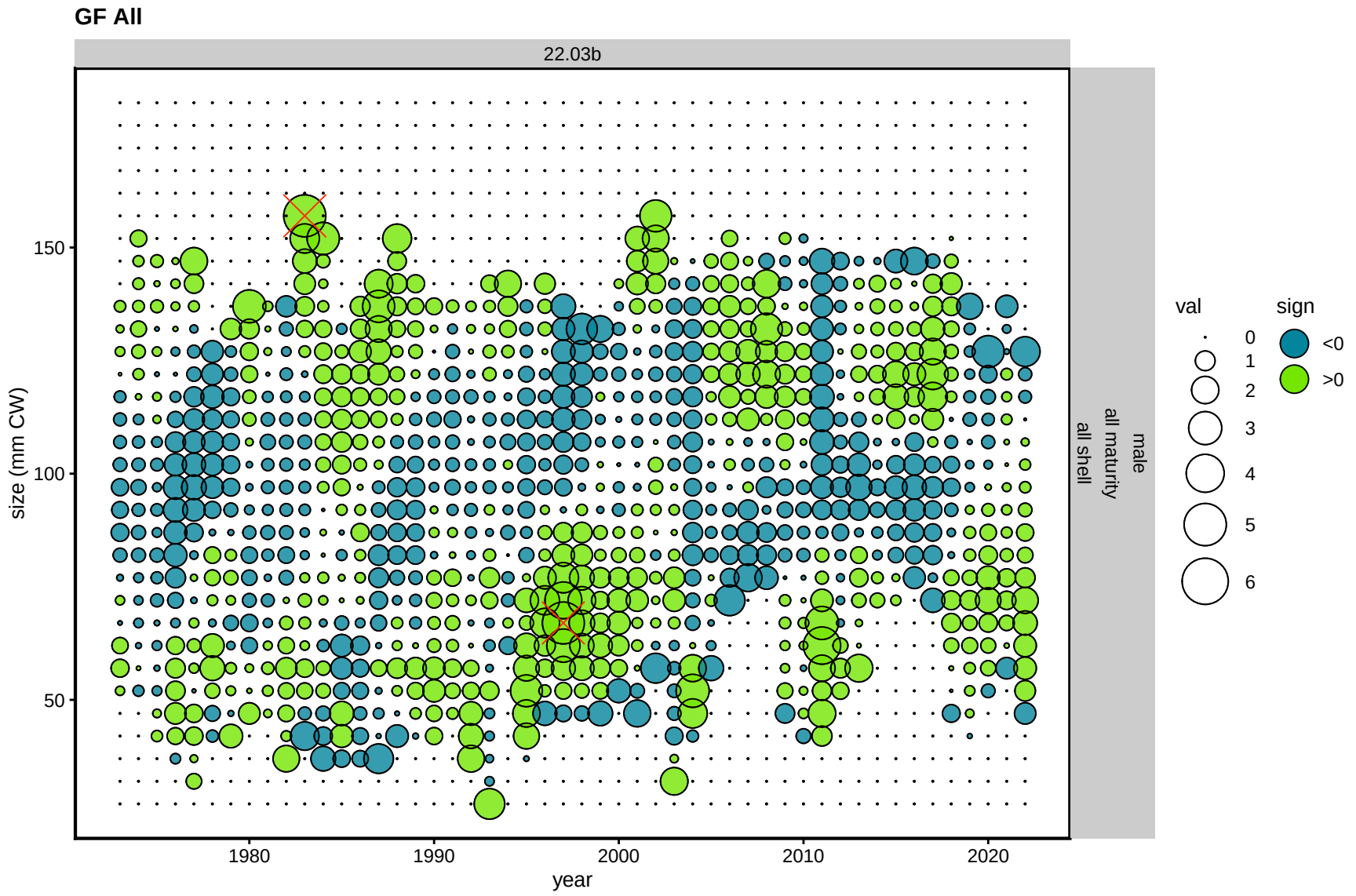

Figure 90. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

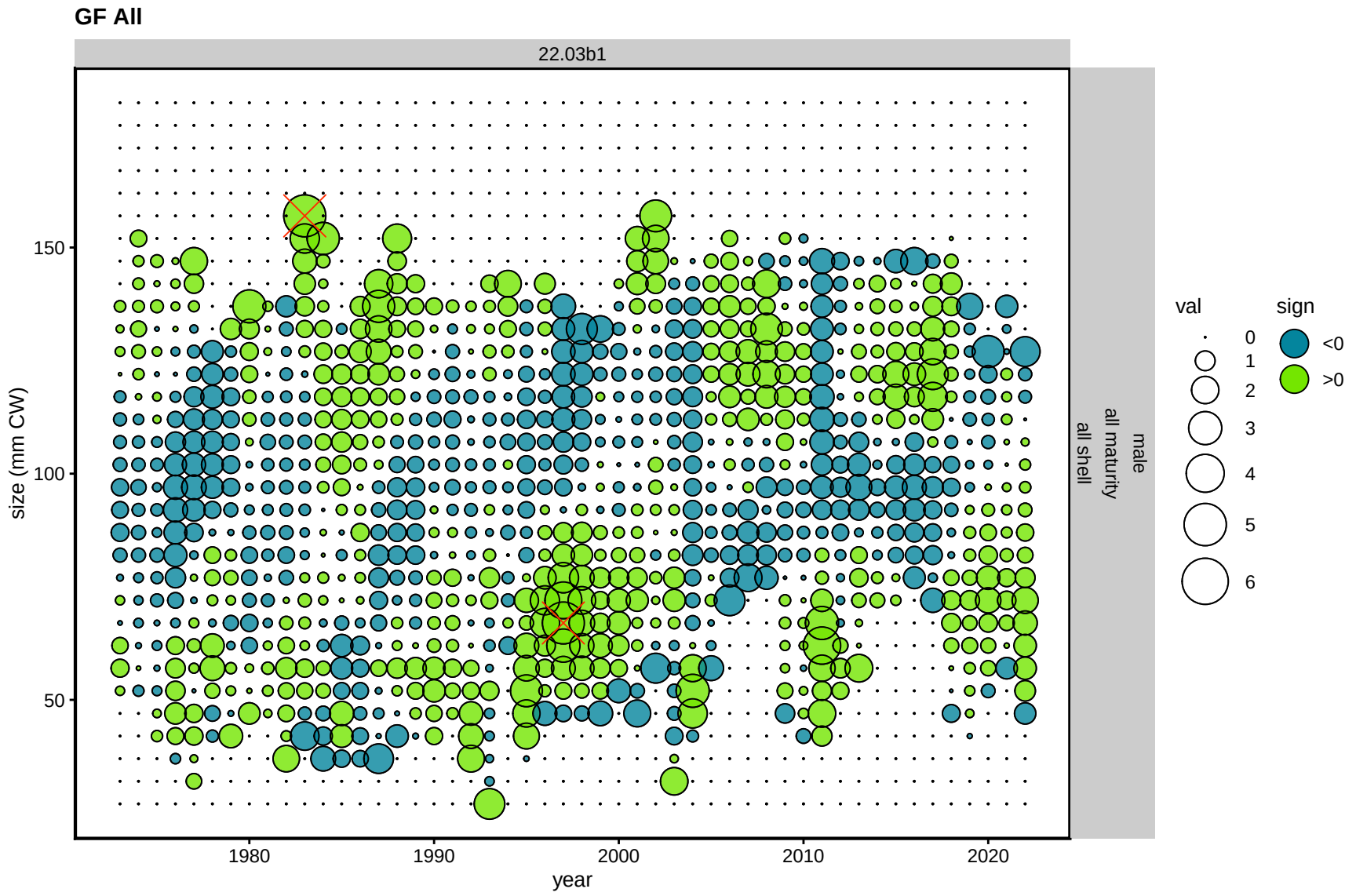

Figure 91. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

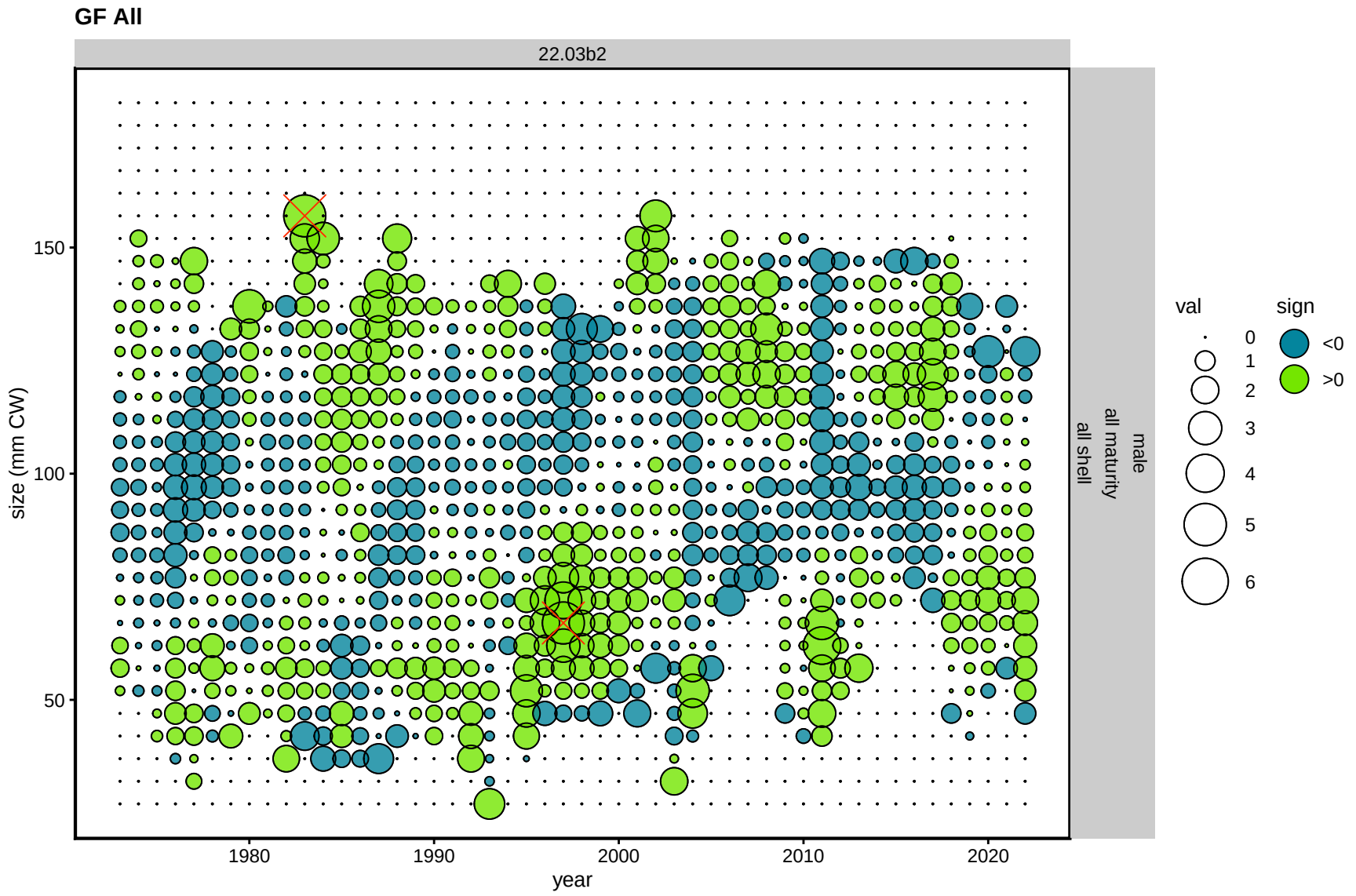

Figure 92. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

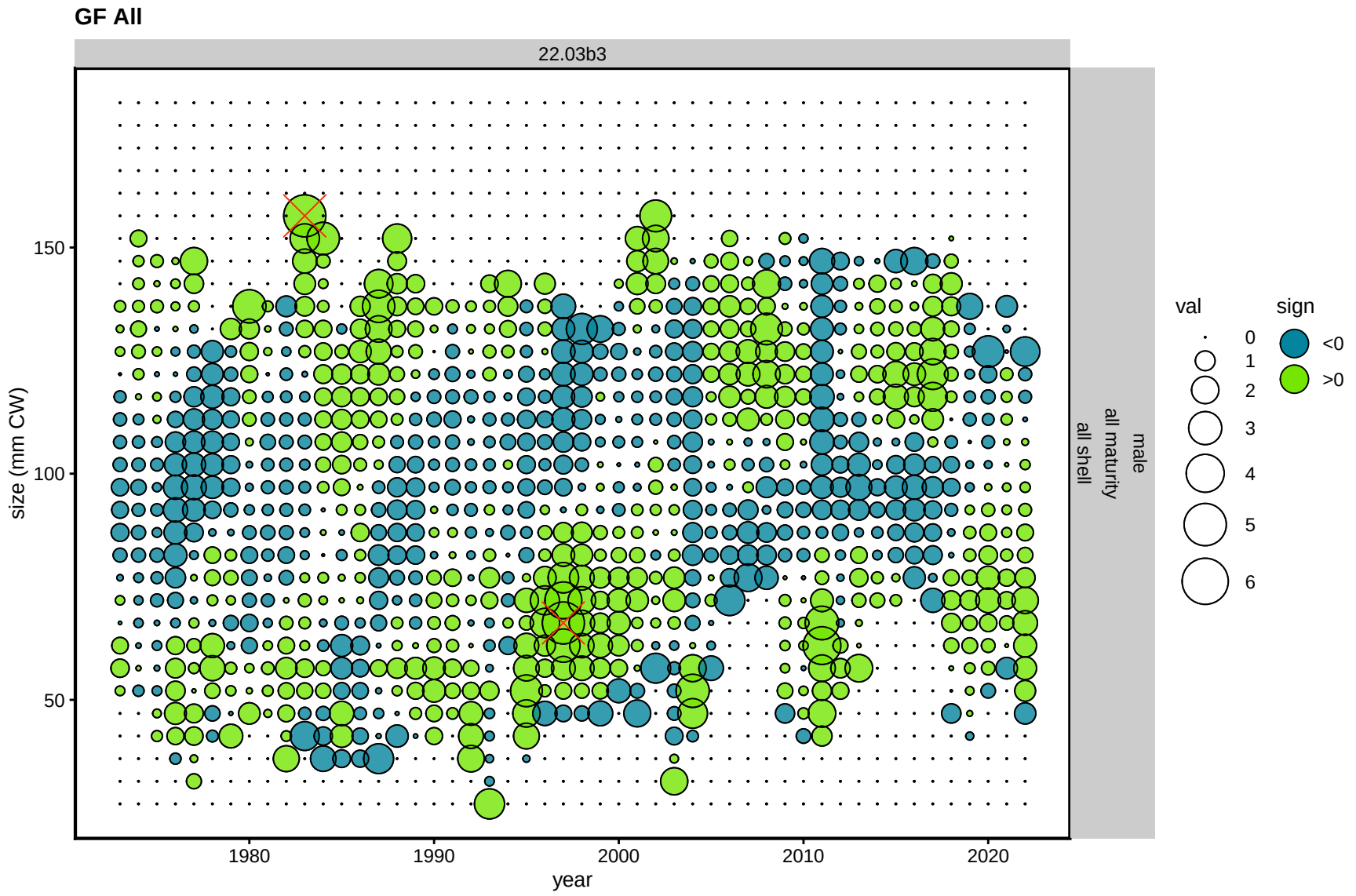

Figure 93. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

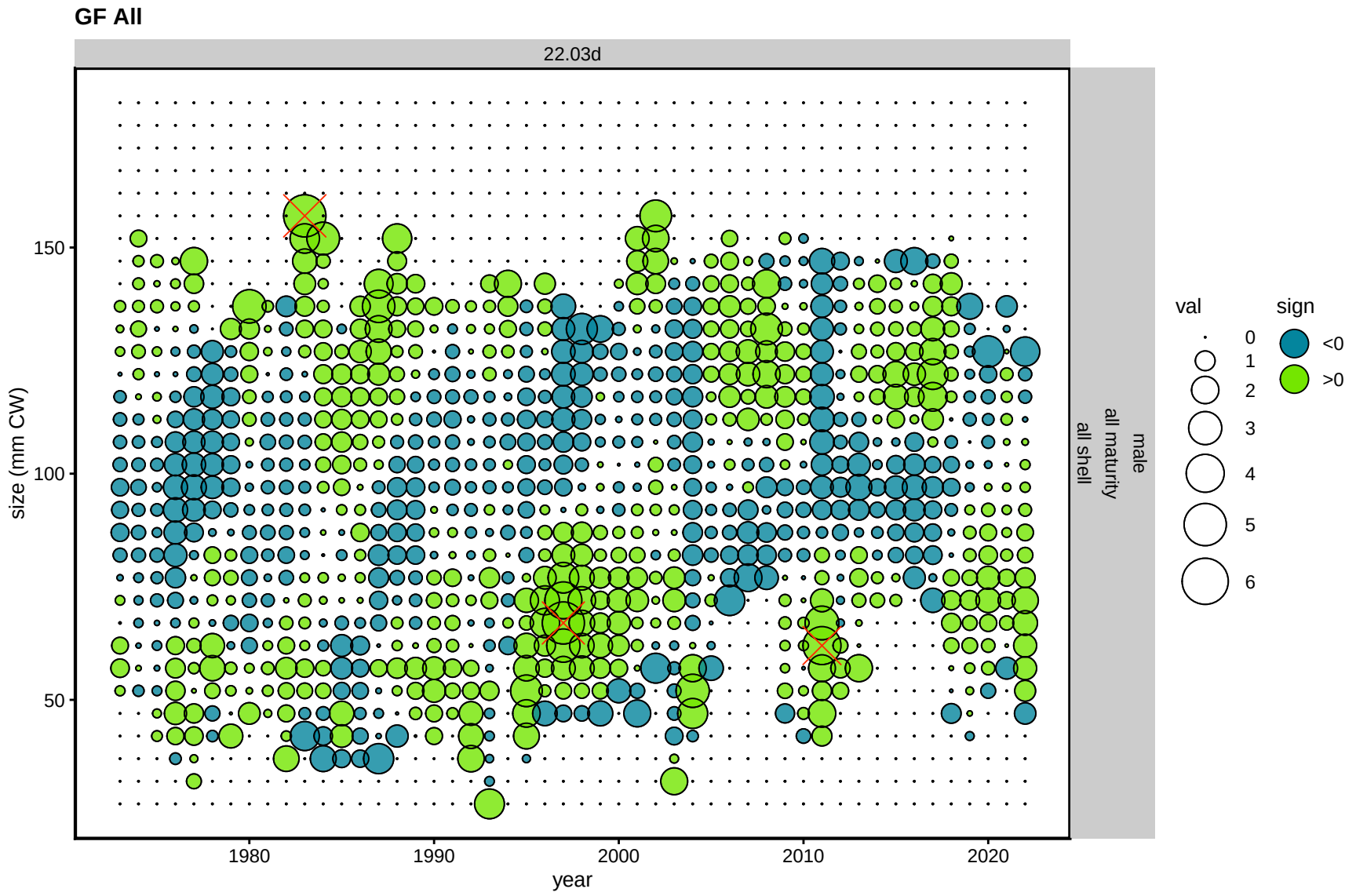

Figure 94. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

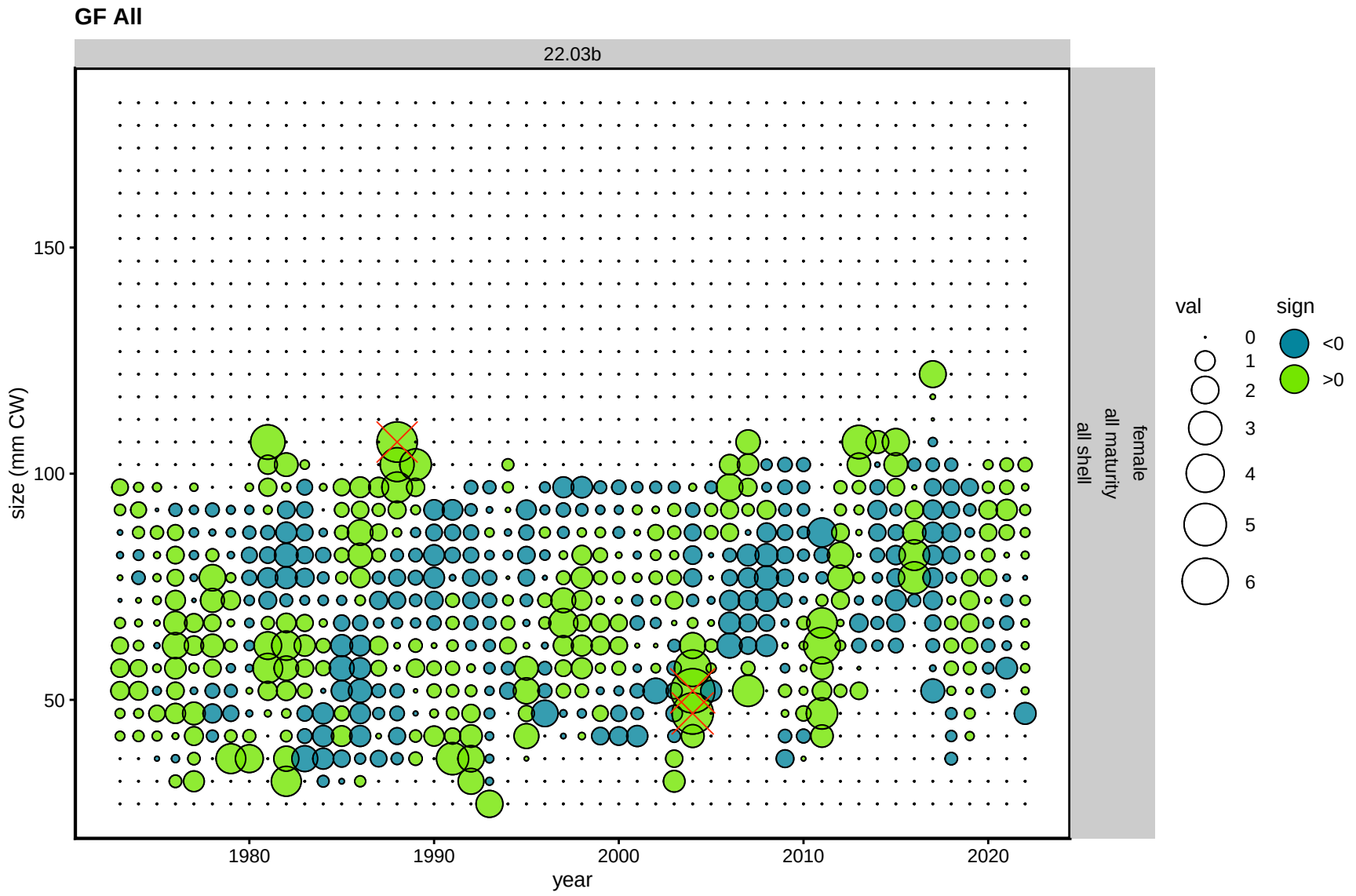

Figure 95. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

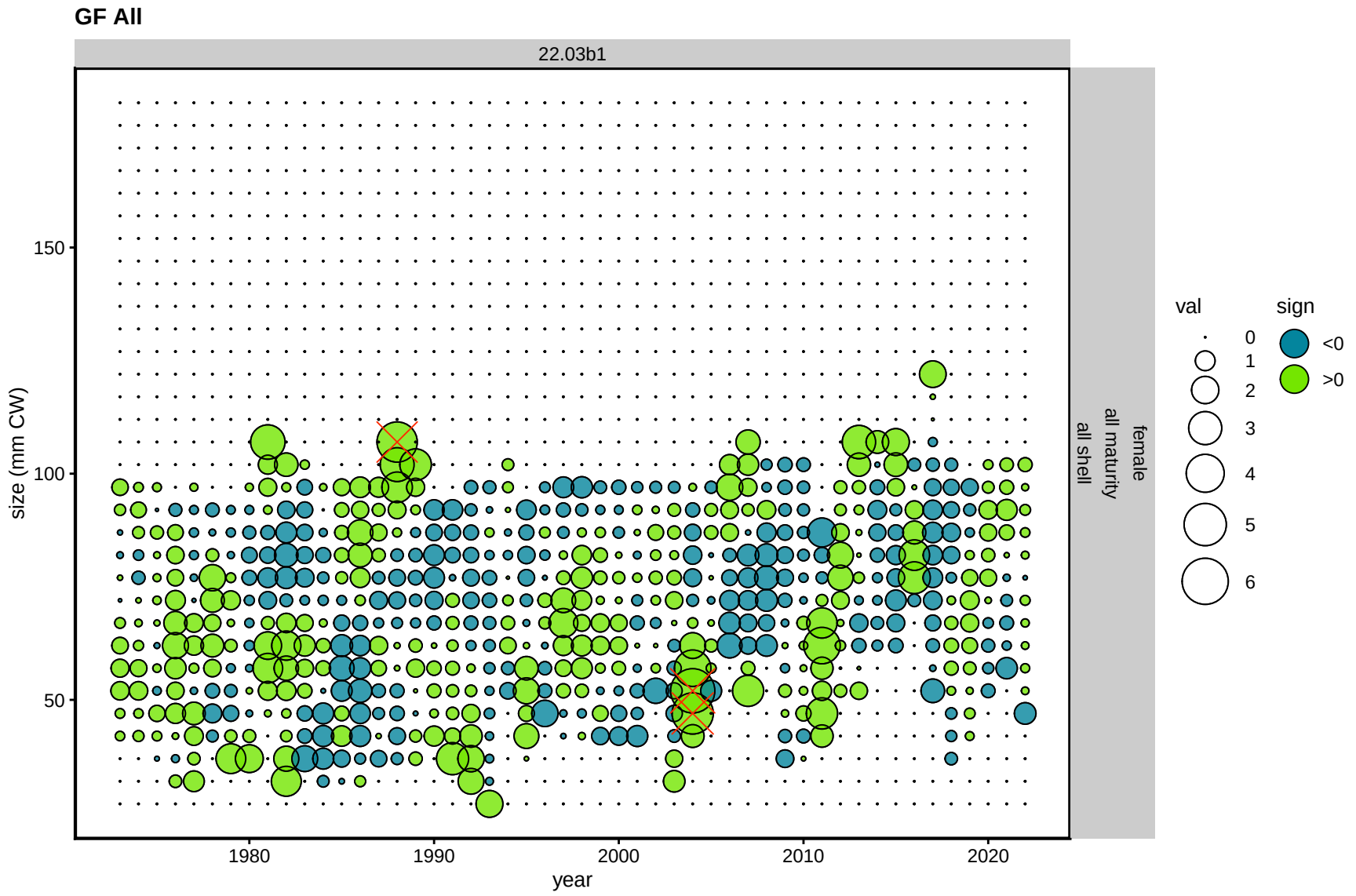

Figure 96. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

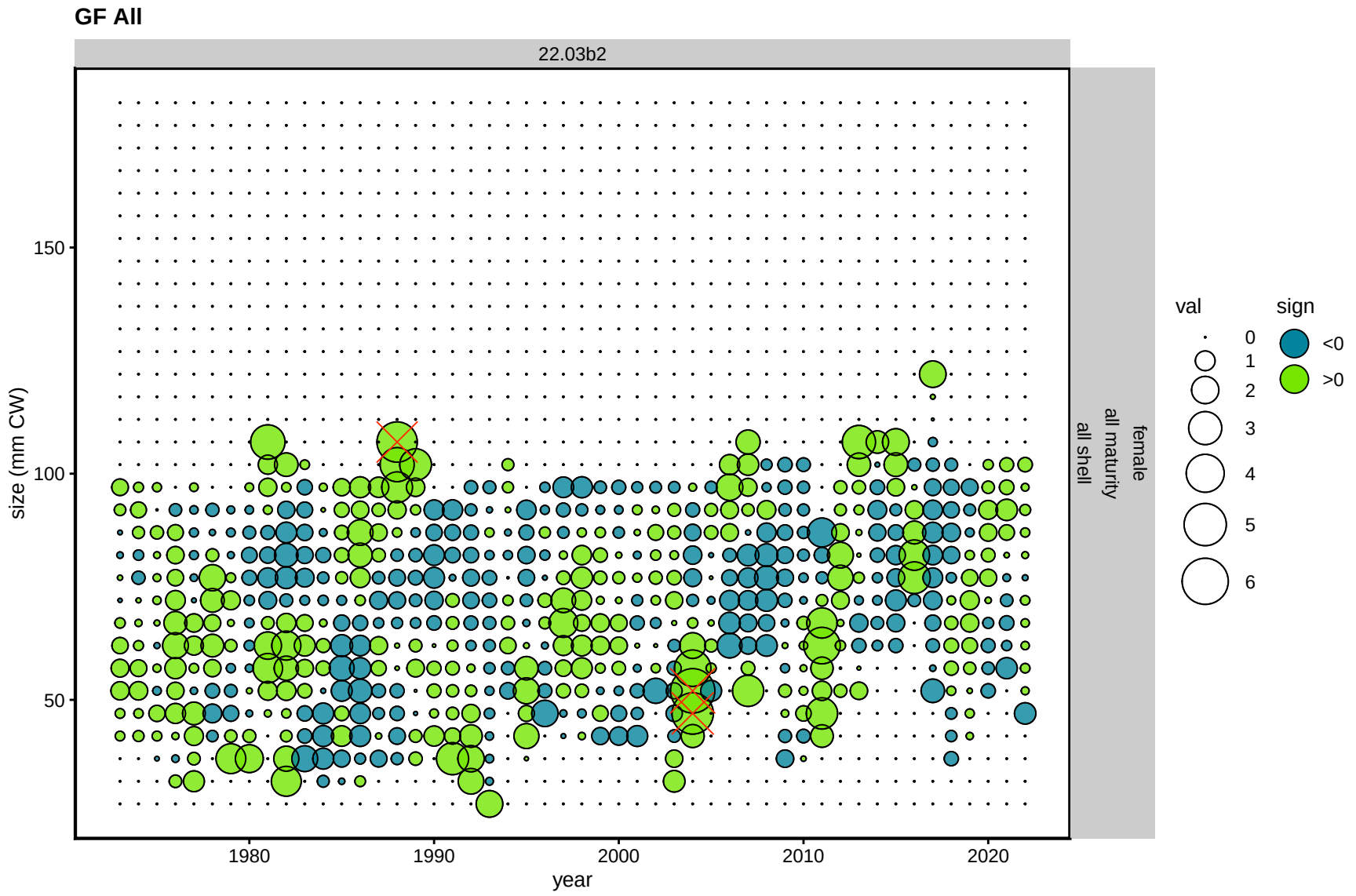

Figure 97. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

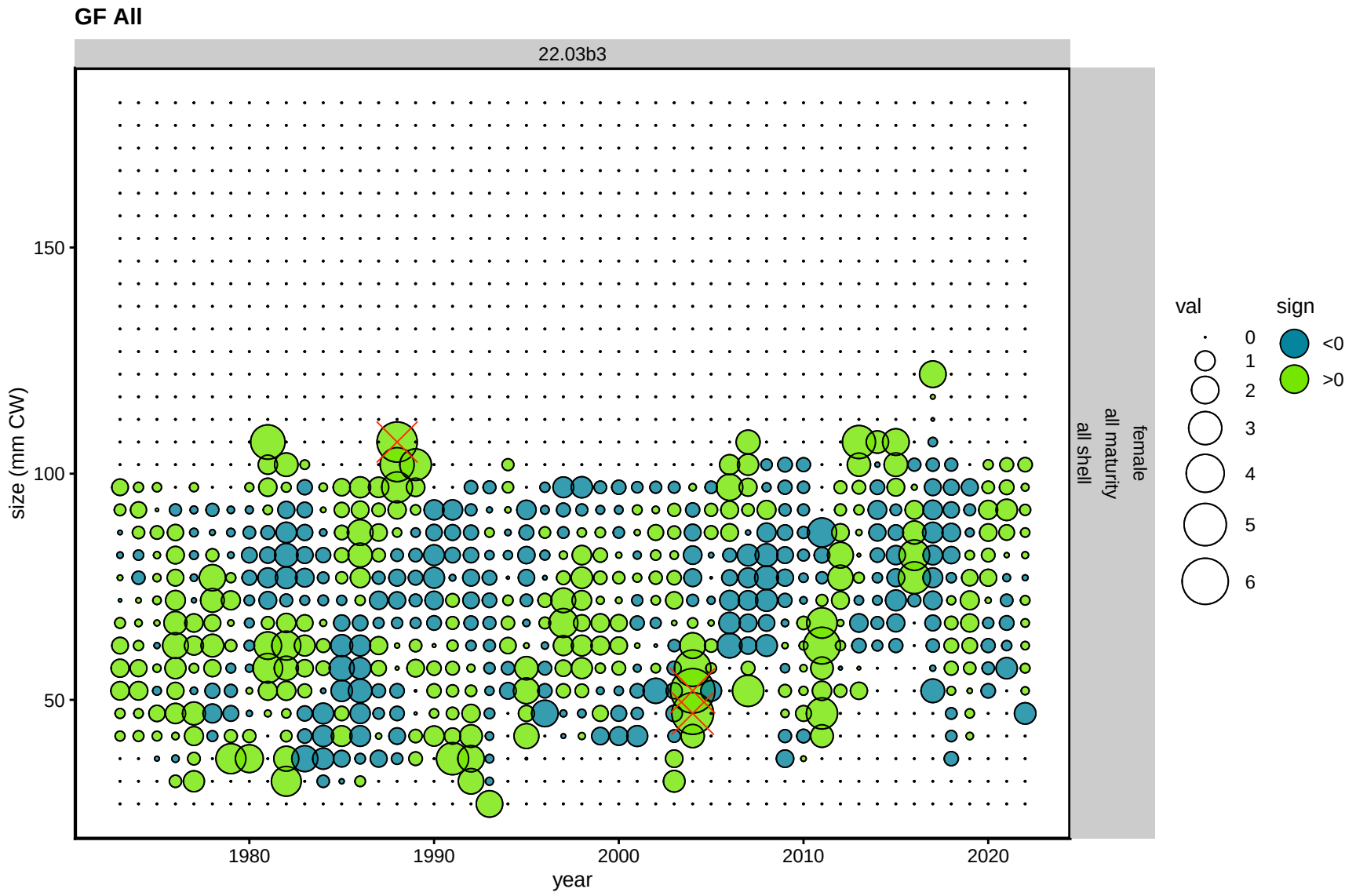

Figure 98. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

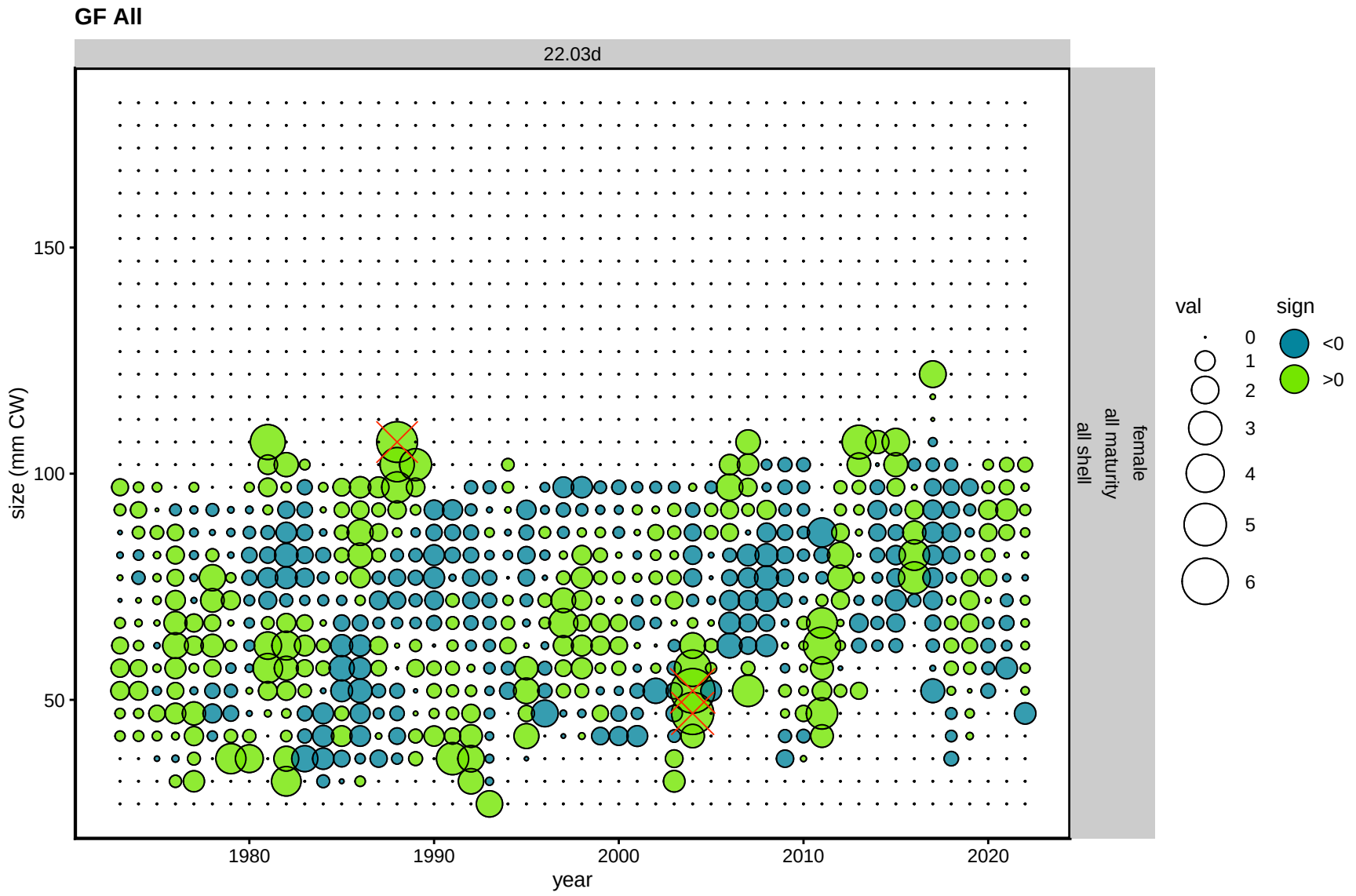

Figure 99. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

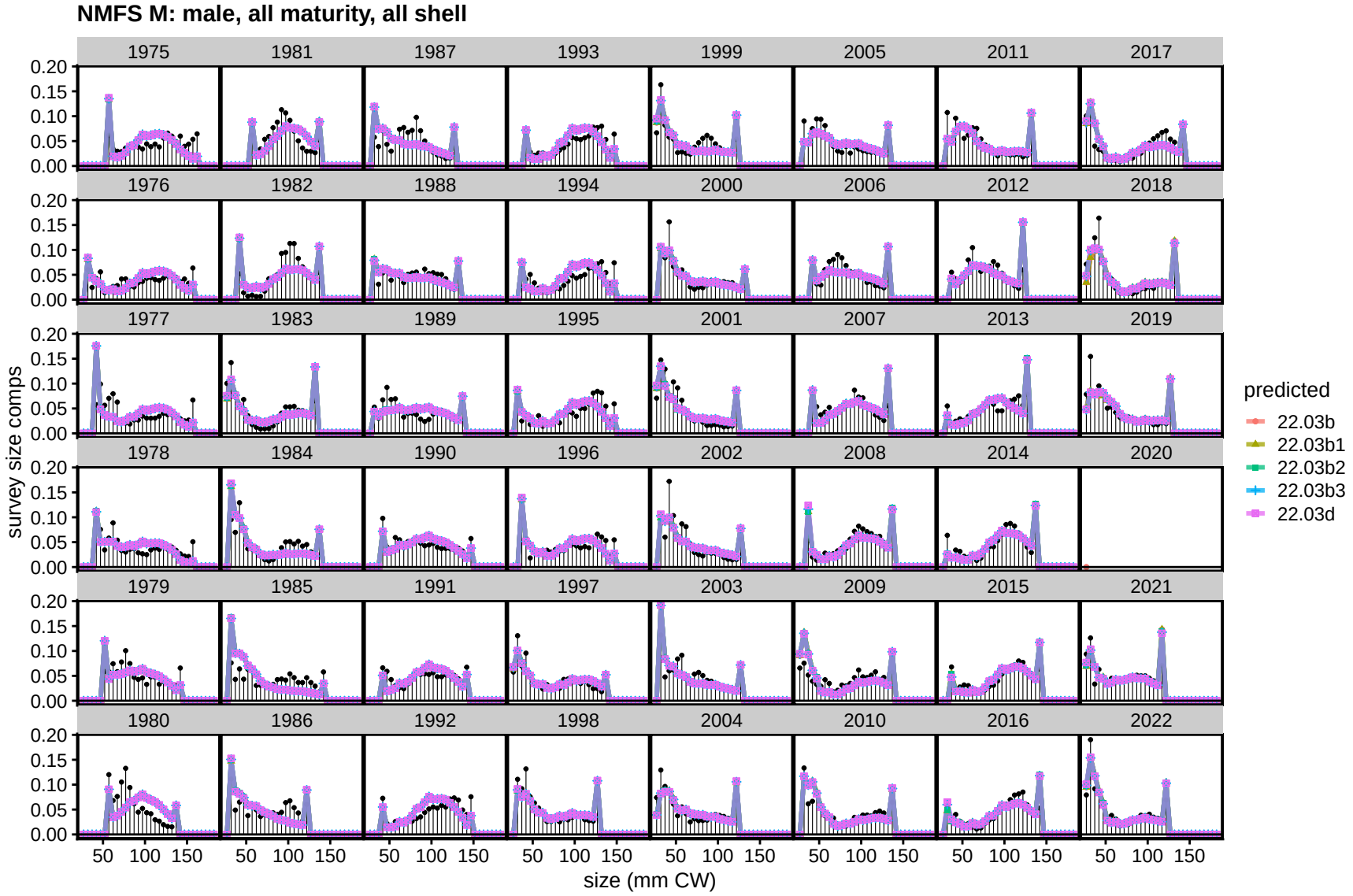

Figure 100. TCSAM02 models fits to survey size compositions in the NMFS M survey. Preferred model is 22.03d.

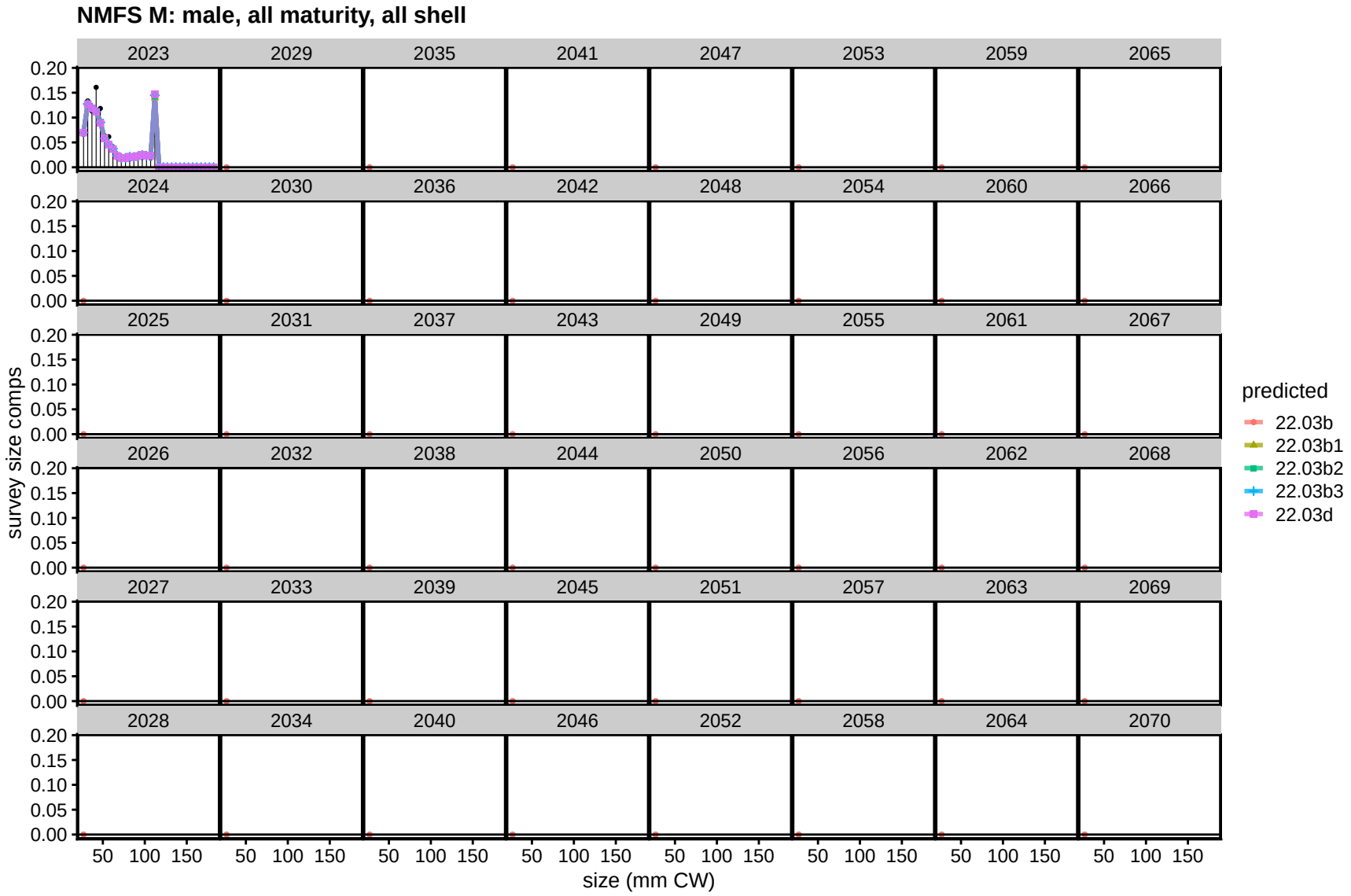

Figure 101. TCSAM02 models fits to survey size compositions in the NMFS M survey. Preferred model is 22.03d.

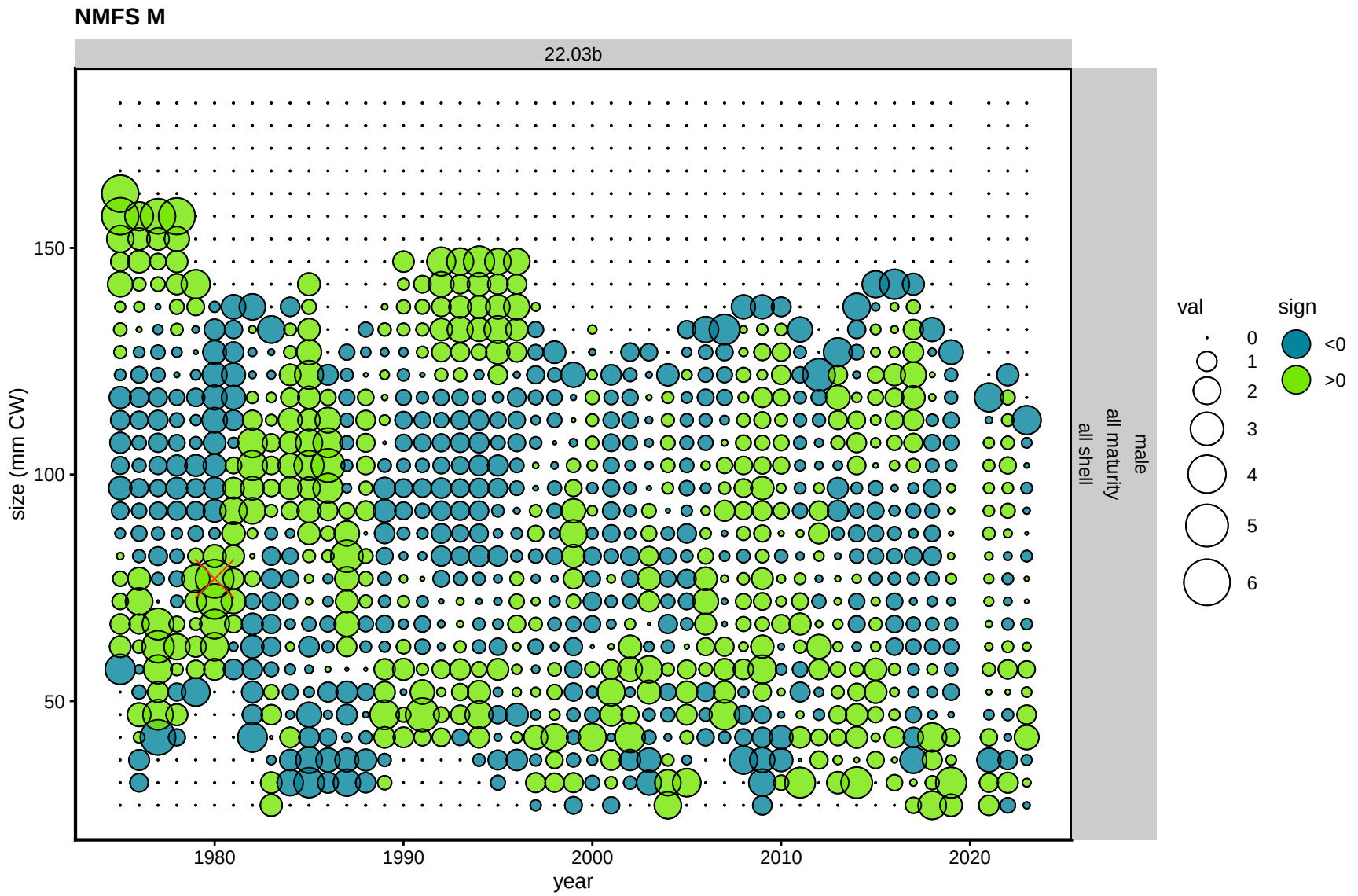

Figure 102. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

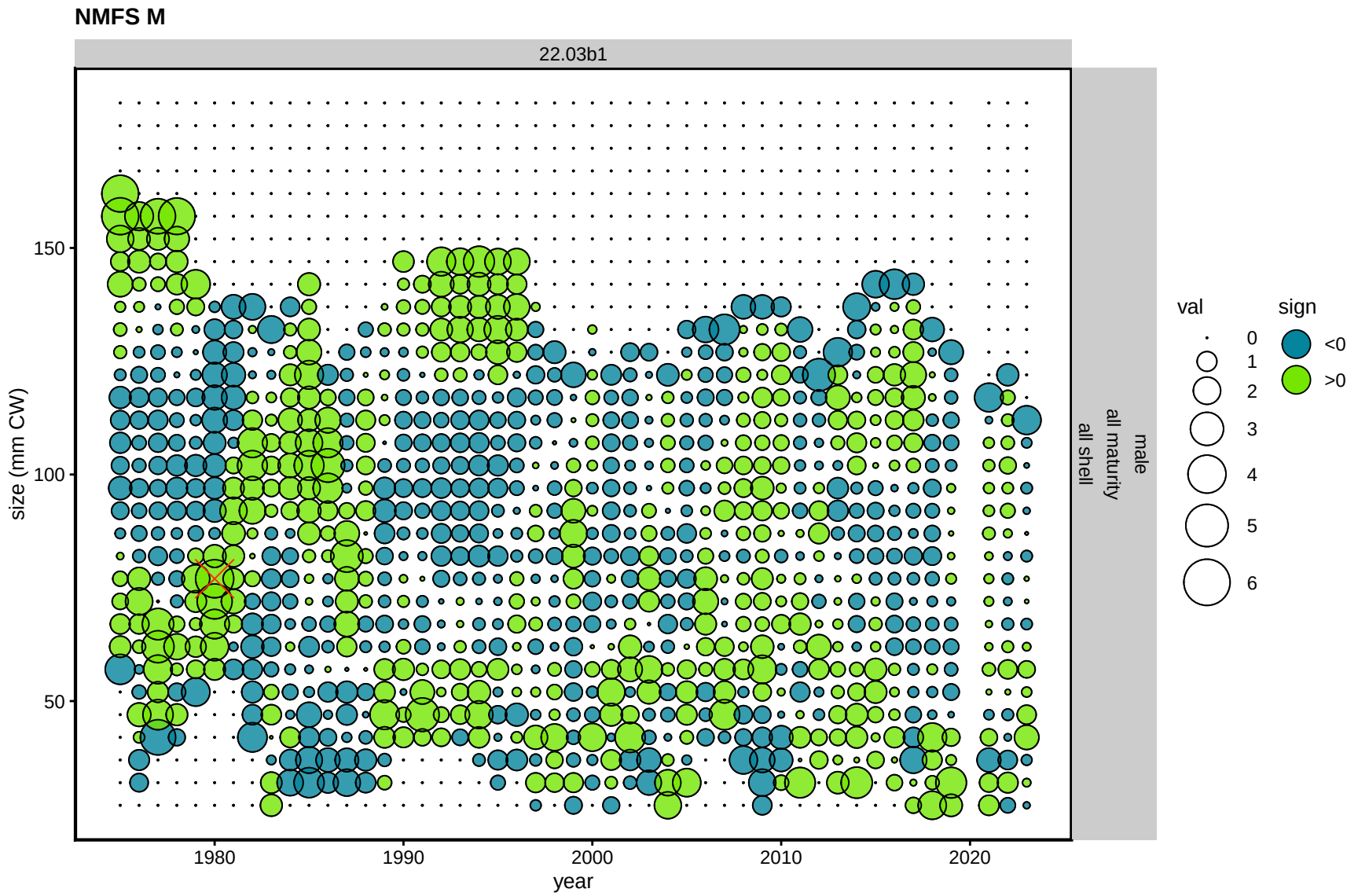

Figure 103. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

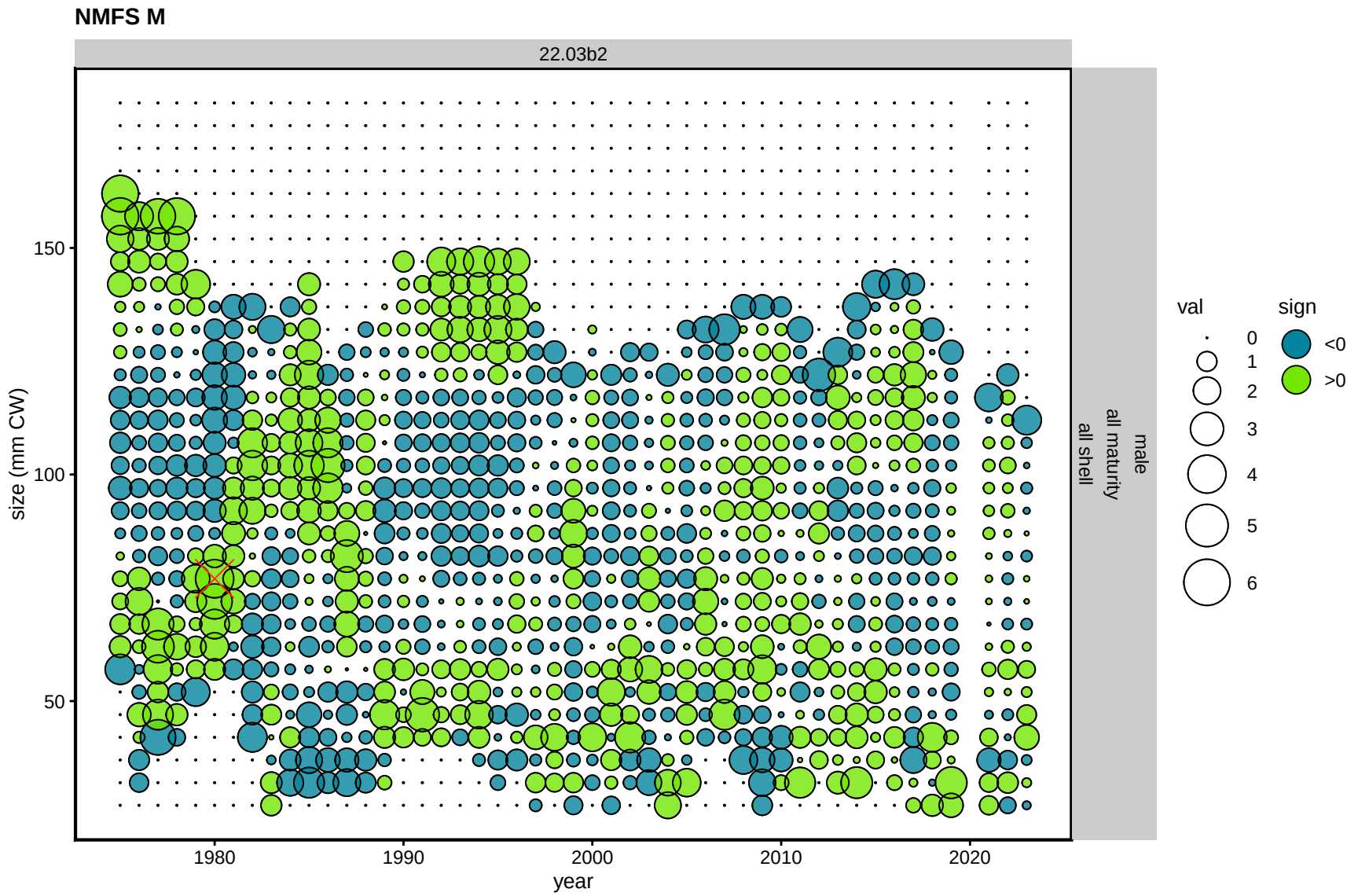

Figure 104. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

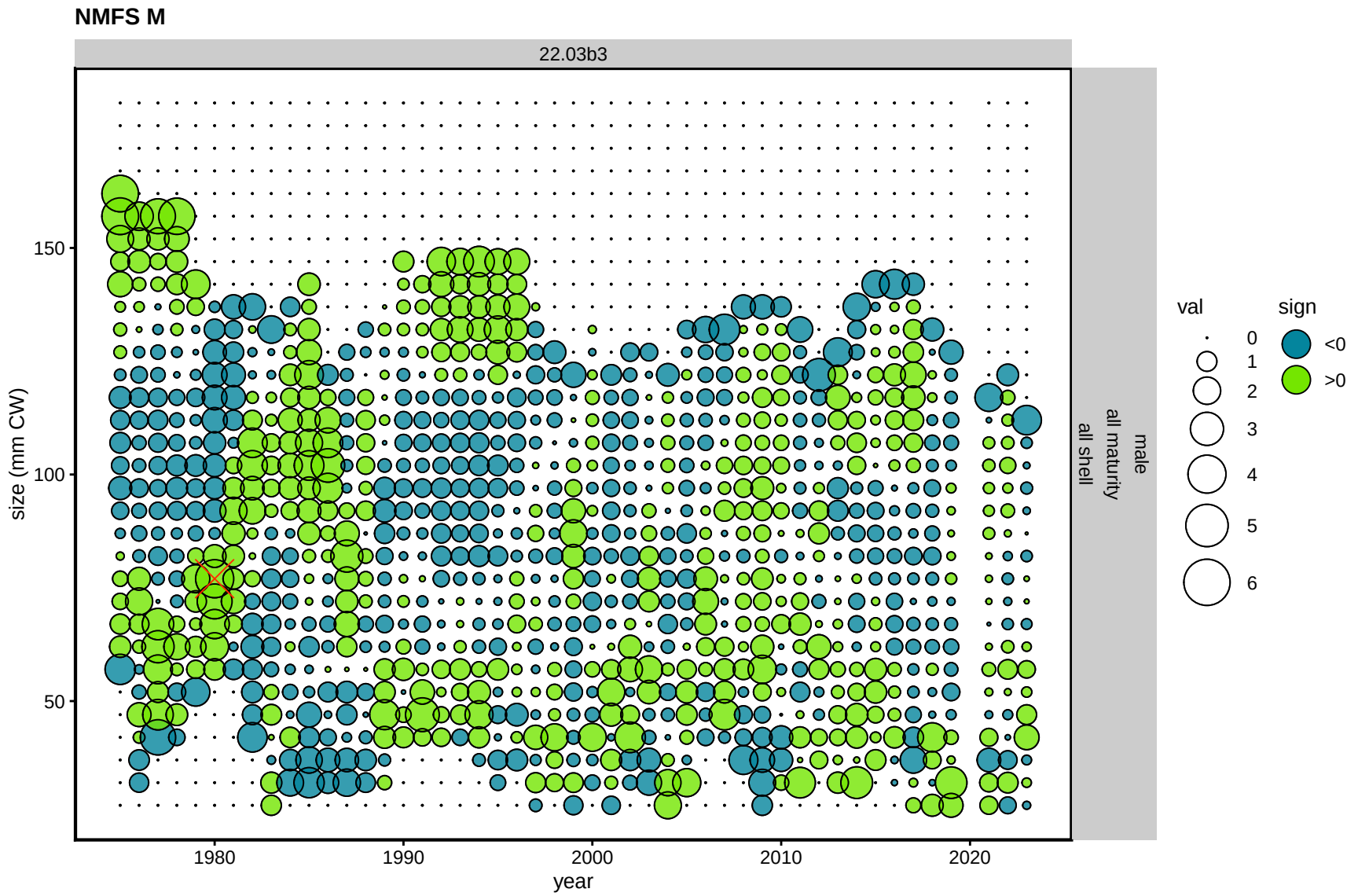

Figure 105. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

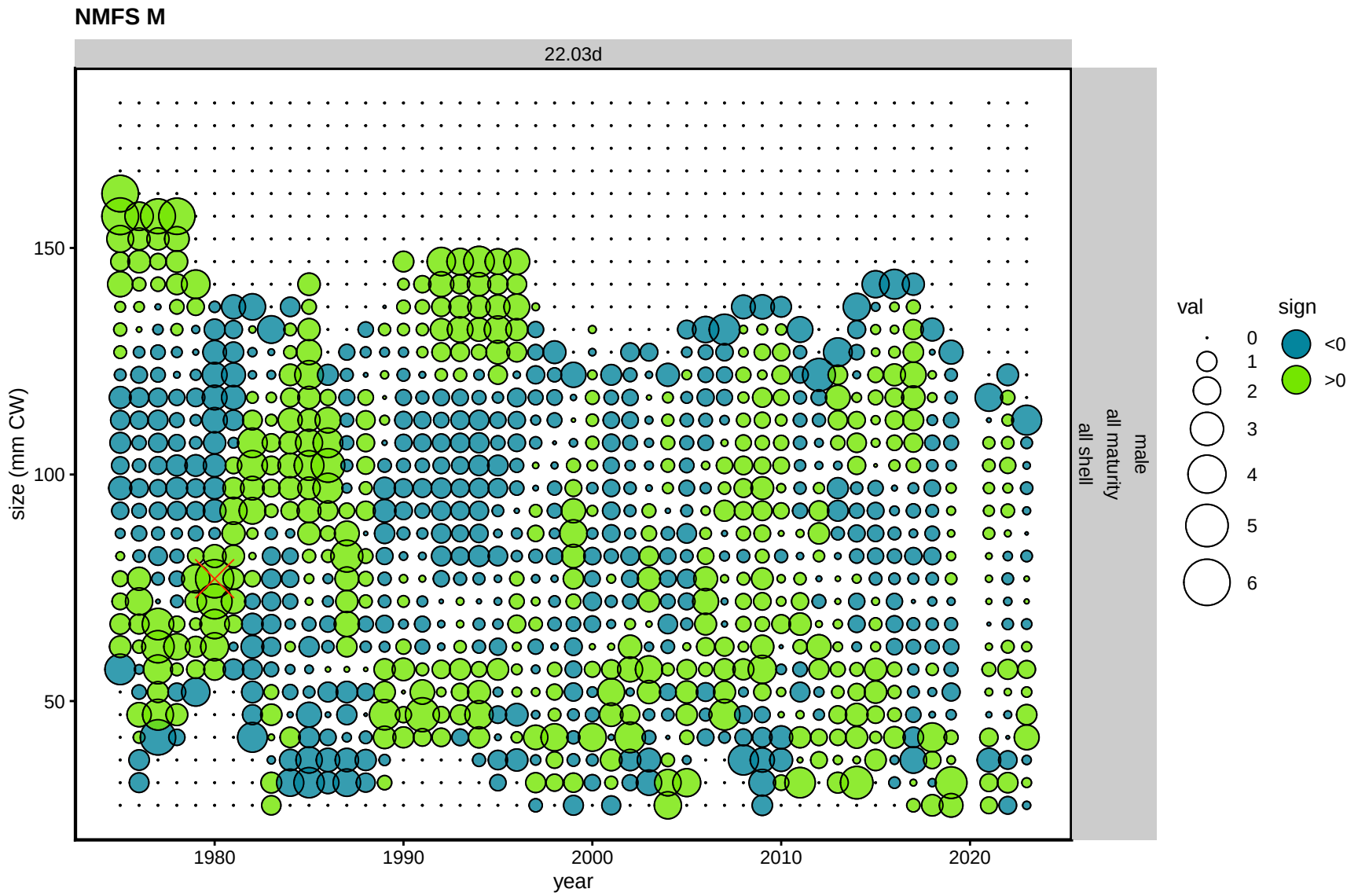

Figure 106. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

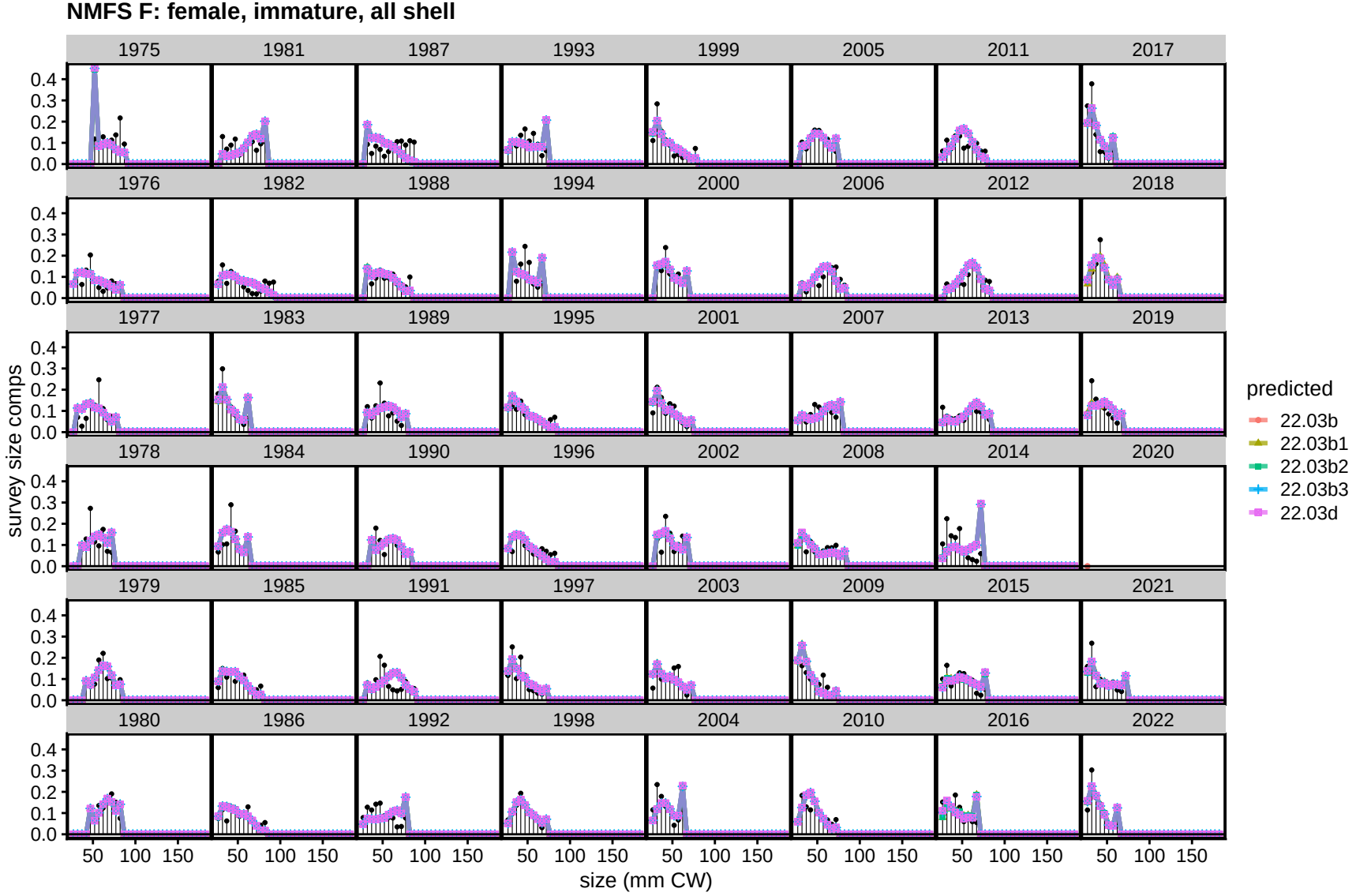

Figure 107. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is 22.03d.

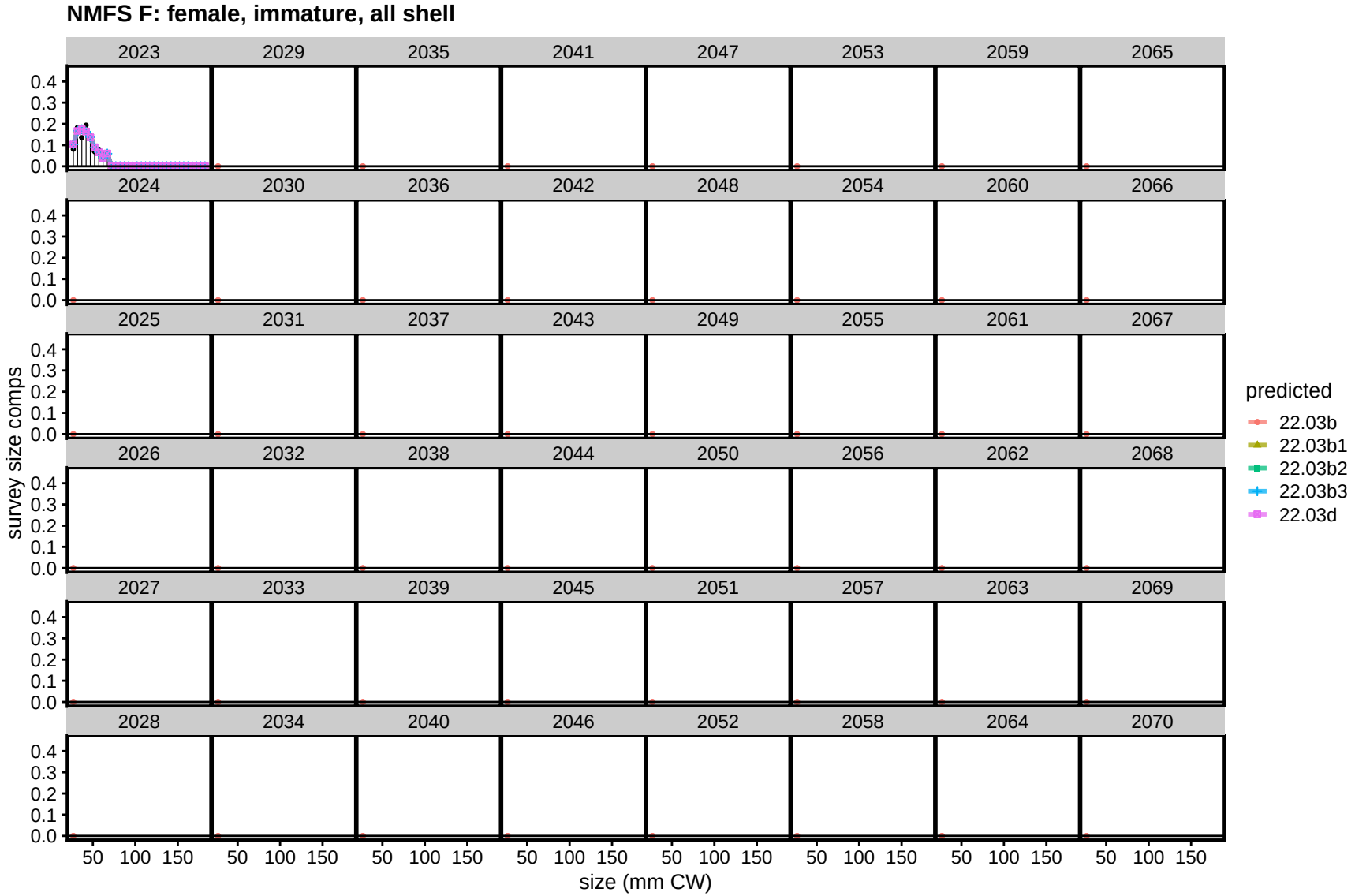

Figure 108. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is 22.03d.

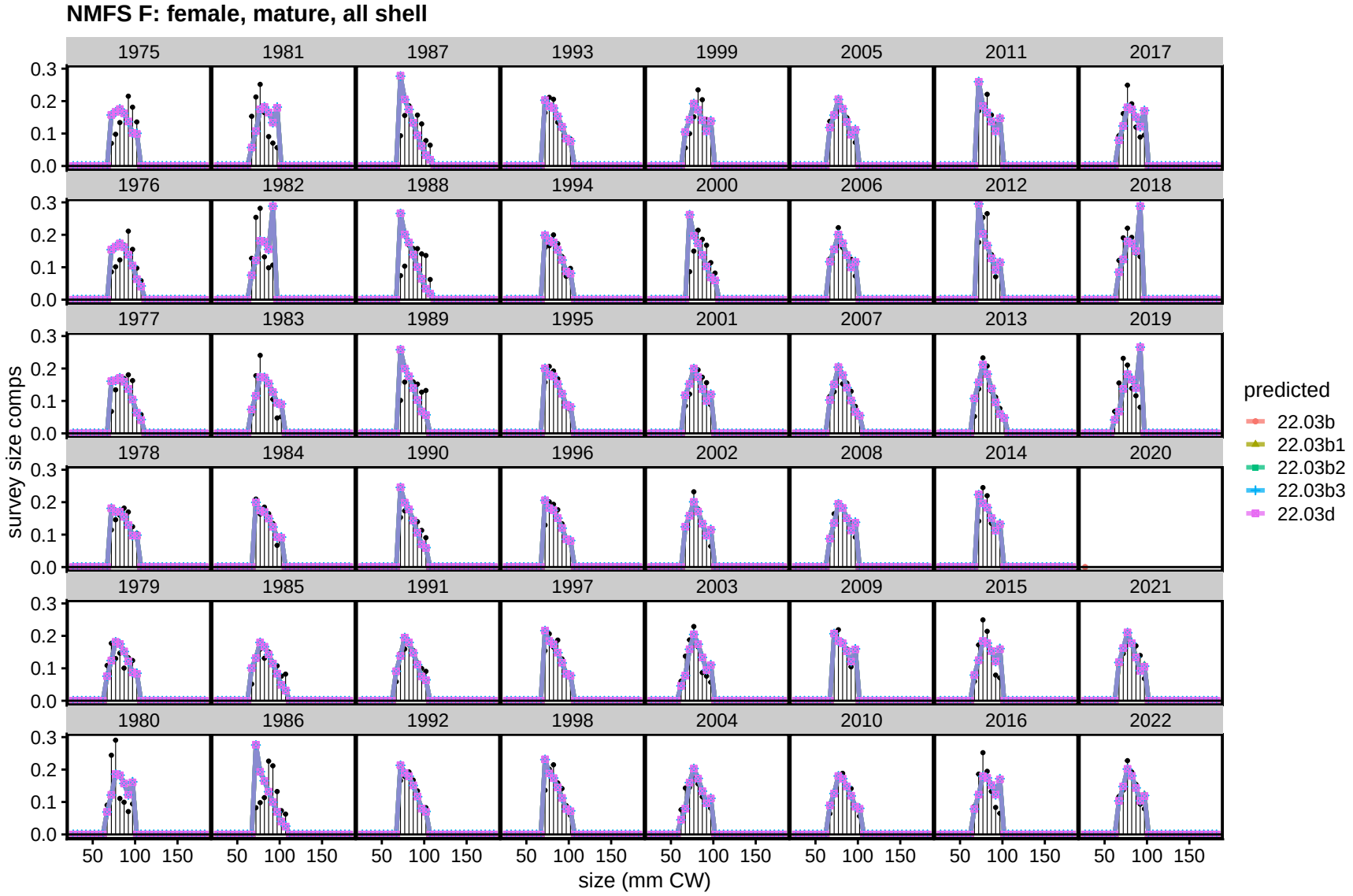

Figure 109. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is 22.03d.

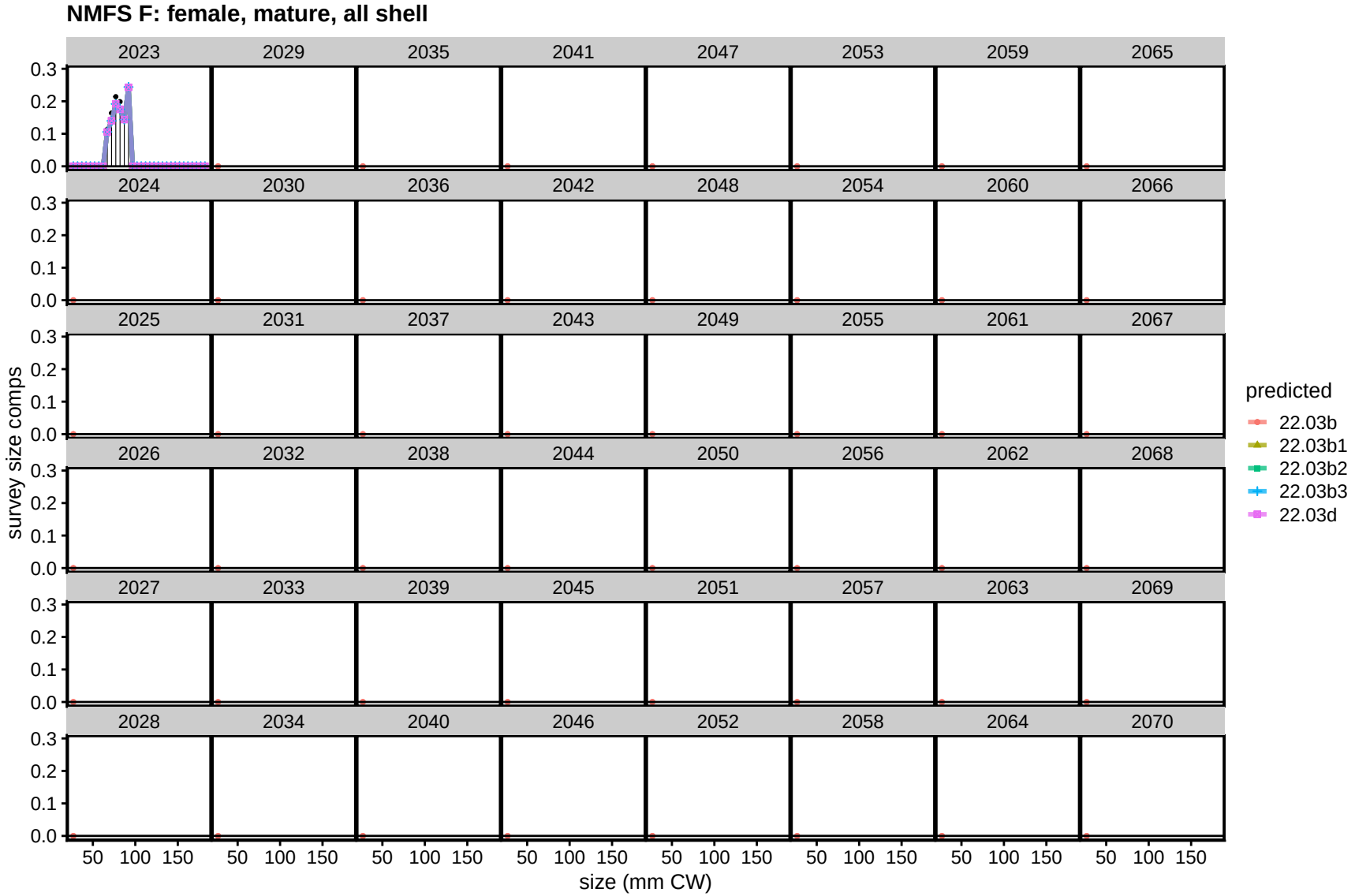

Figure 110. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is 22.03d.

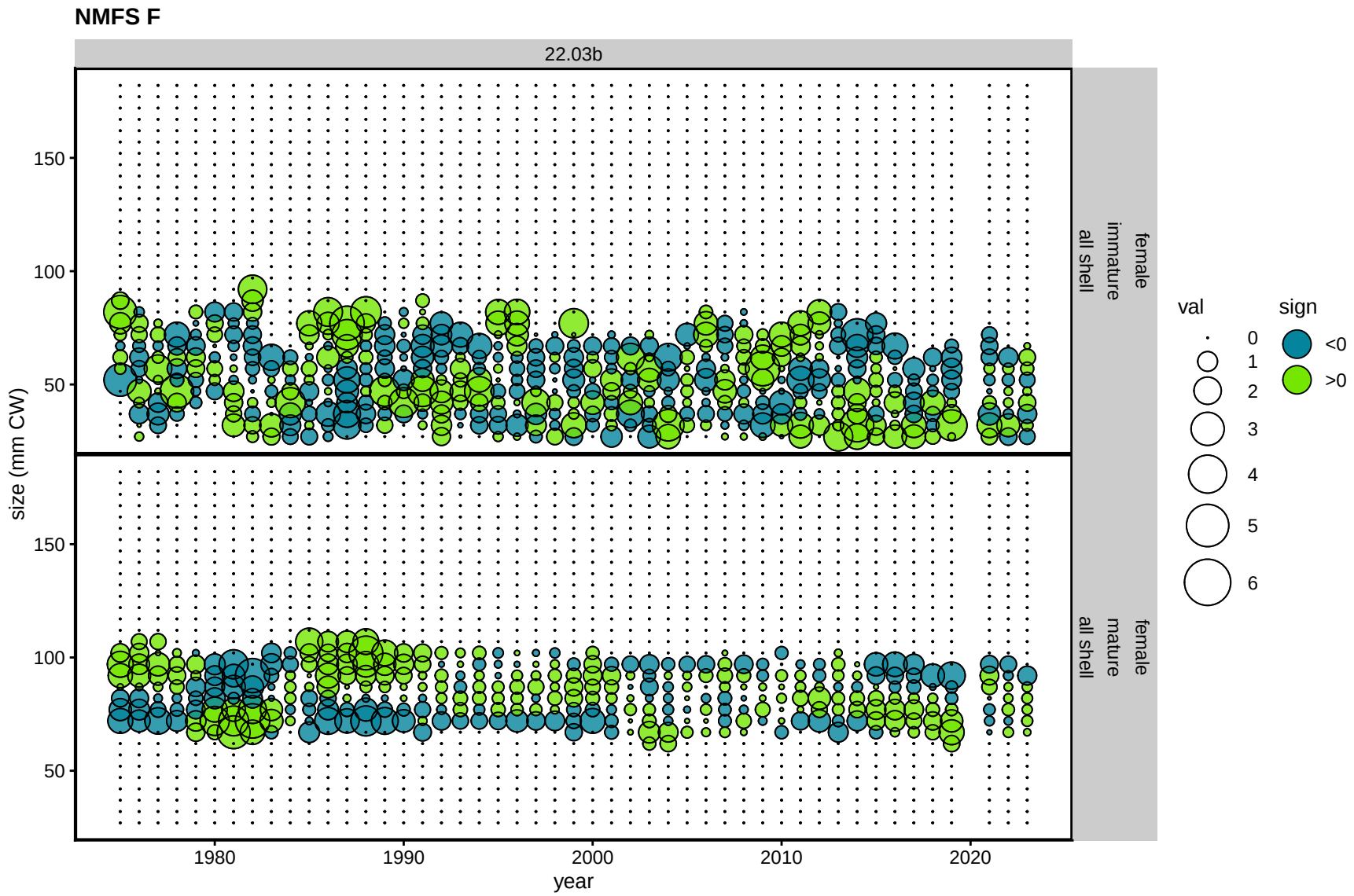

Figure 111. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

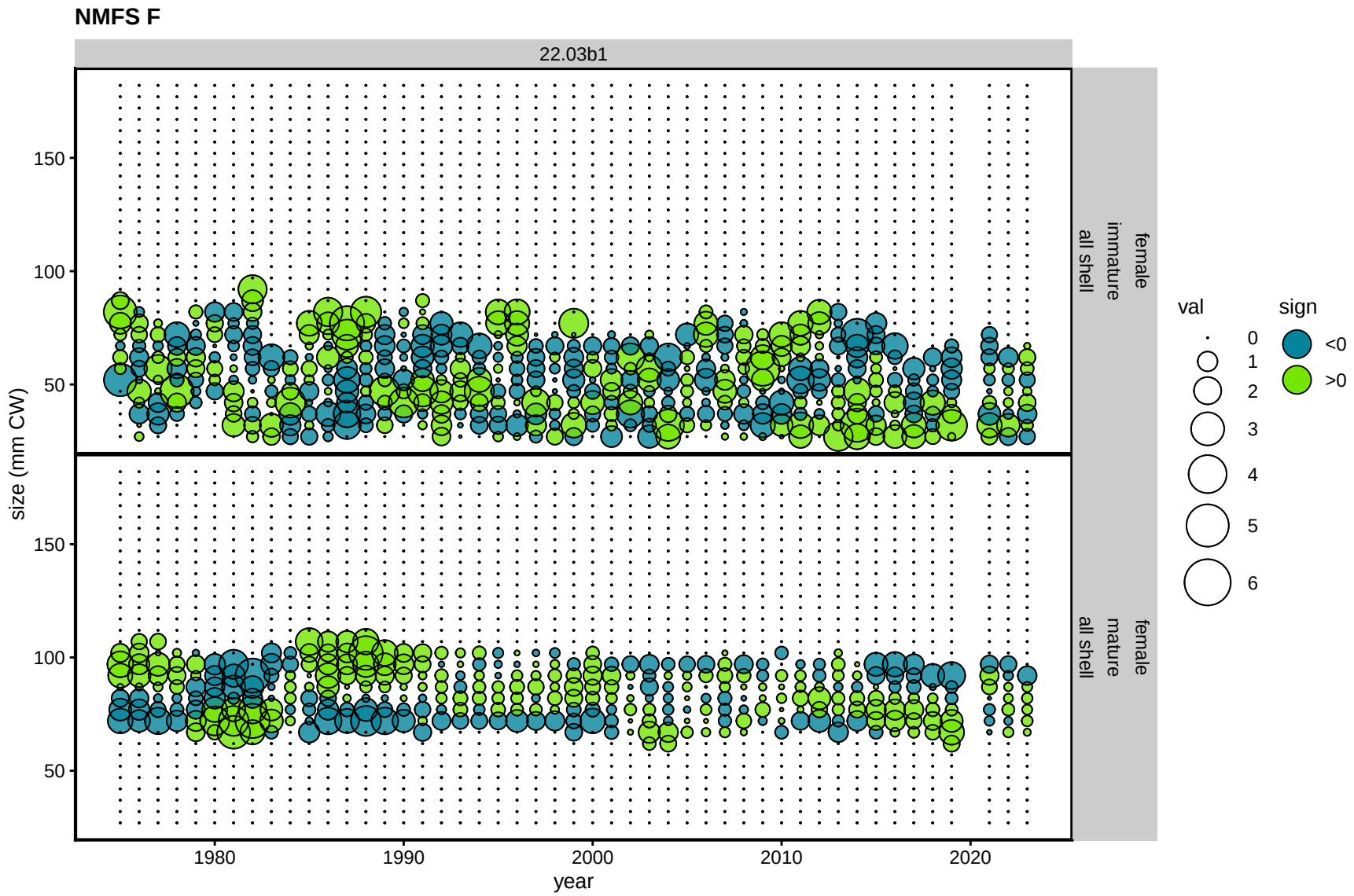

Figure 112. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

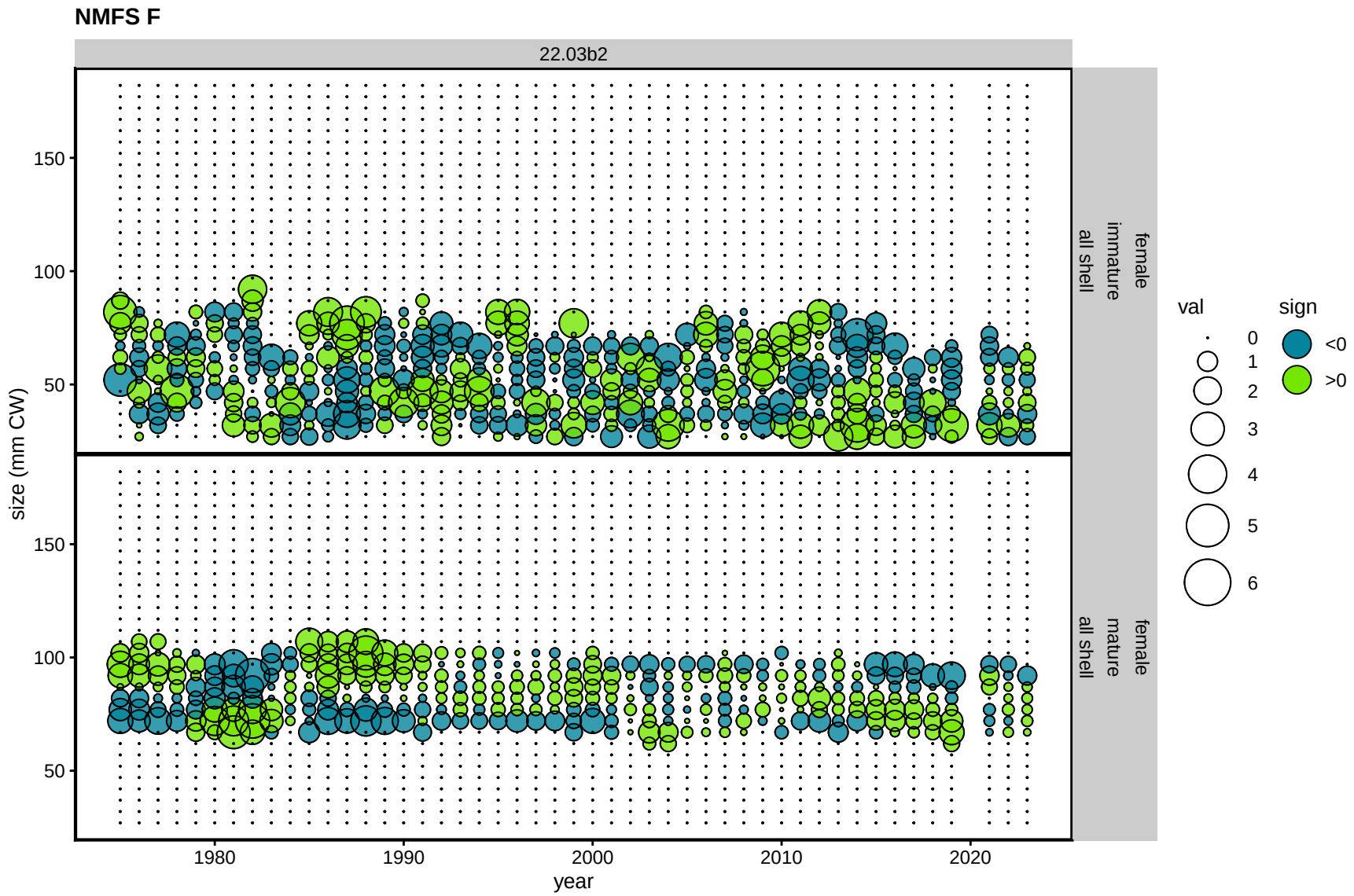

Figure 113. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

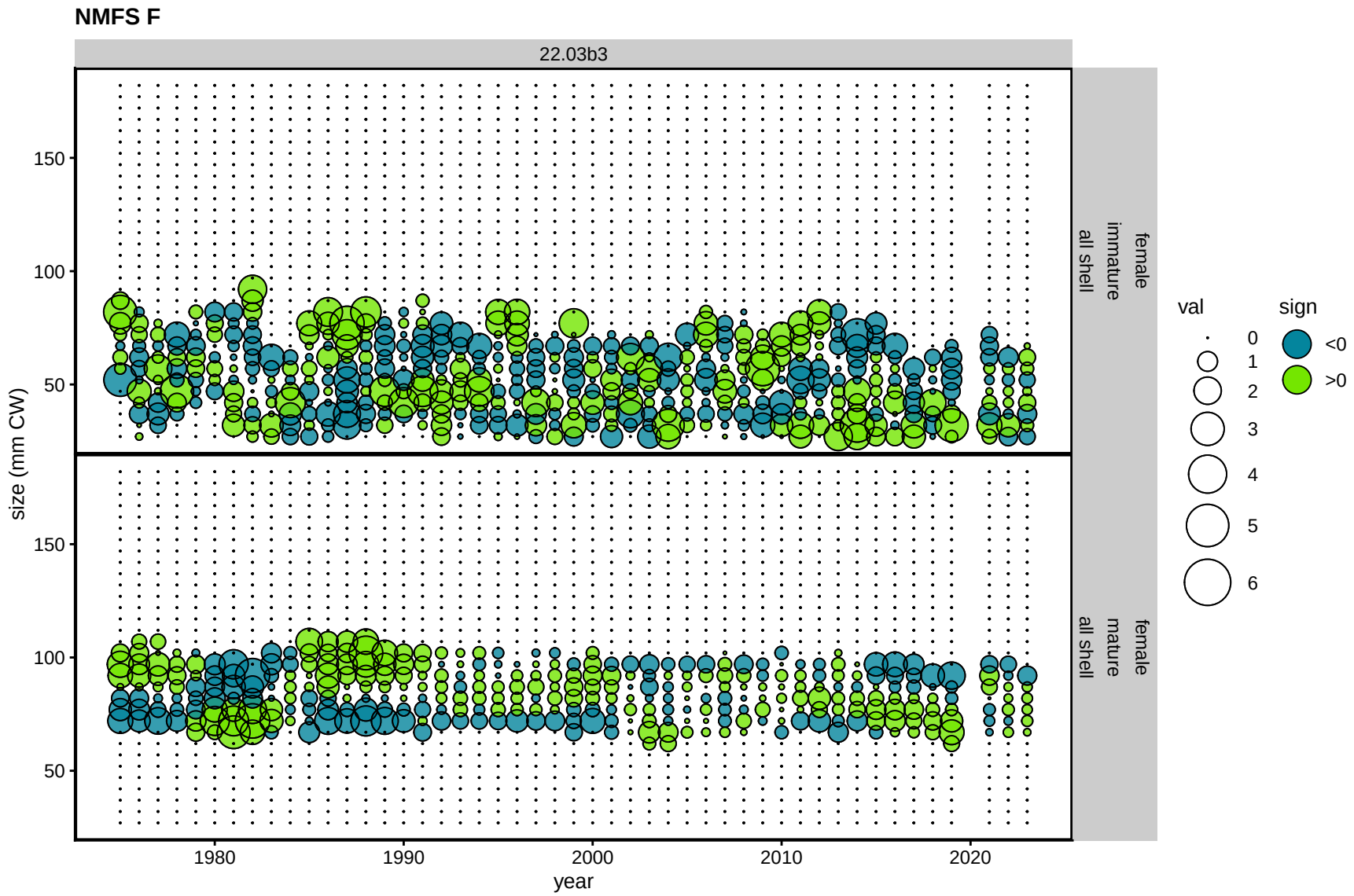

Figure 114. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

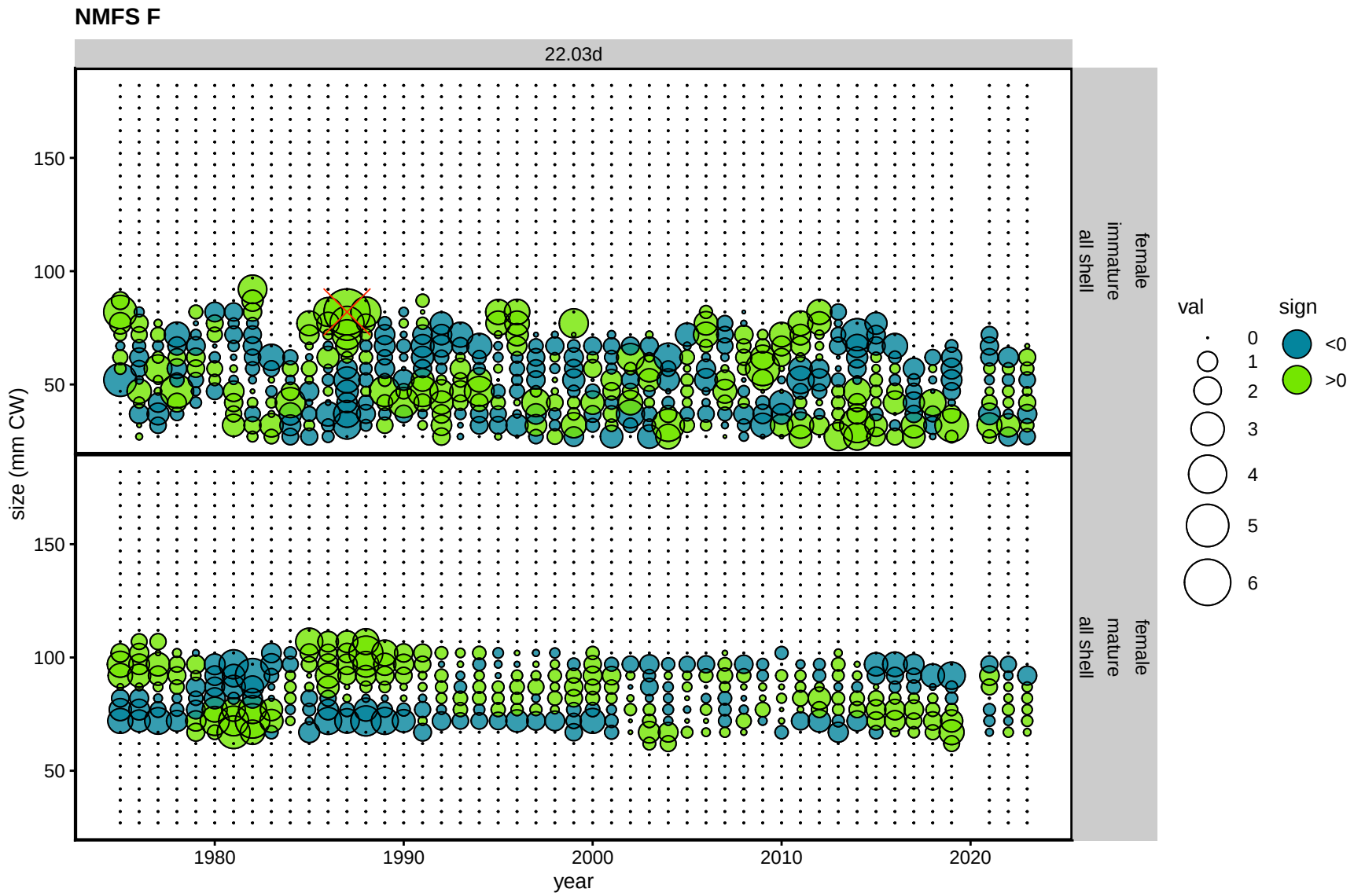

Figure 115. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

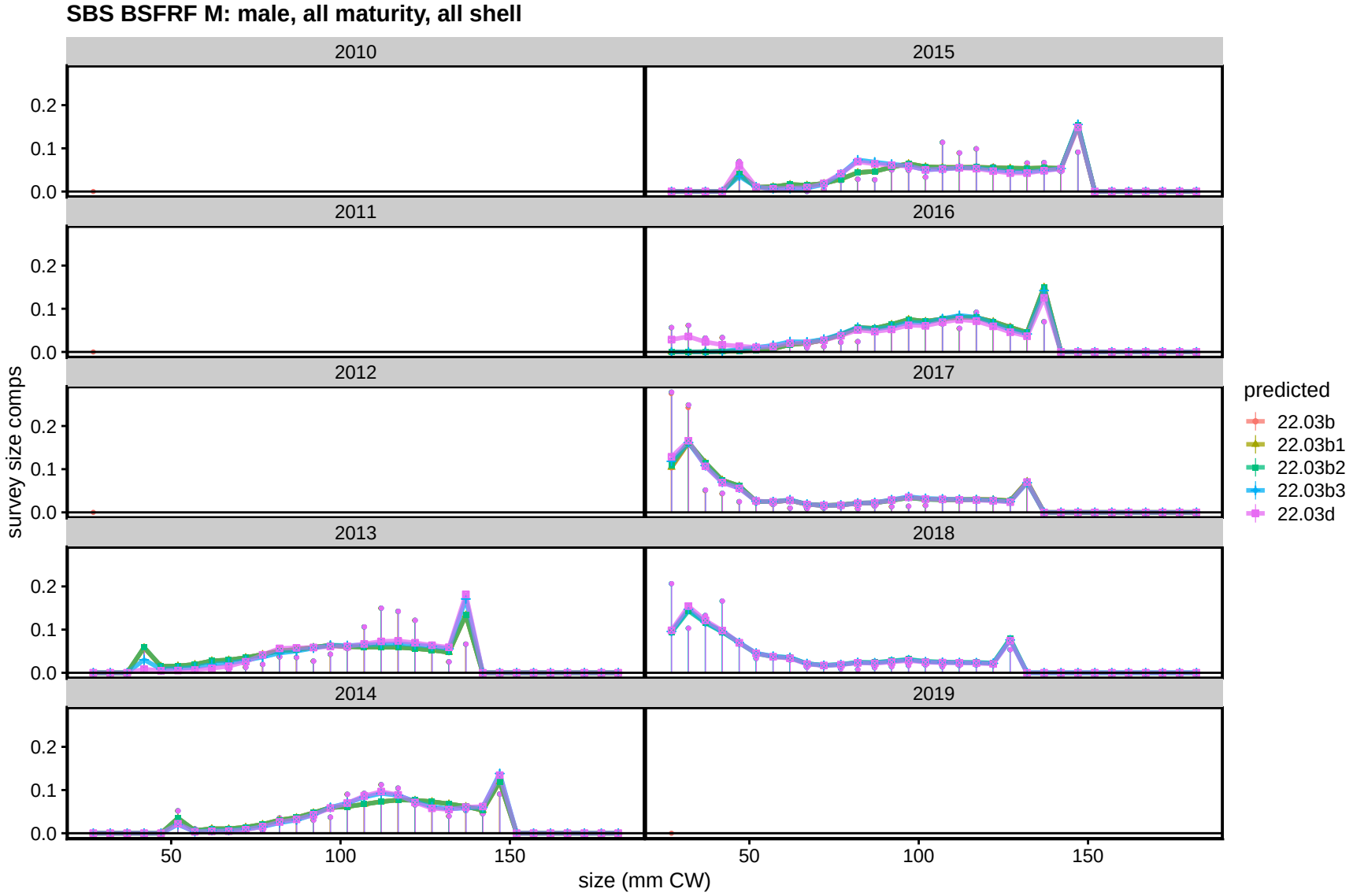

Figure 116. TCSAM02 model fits to survey size compositions in the SBS BSFRF M survey. Preferred model is 22.03d.

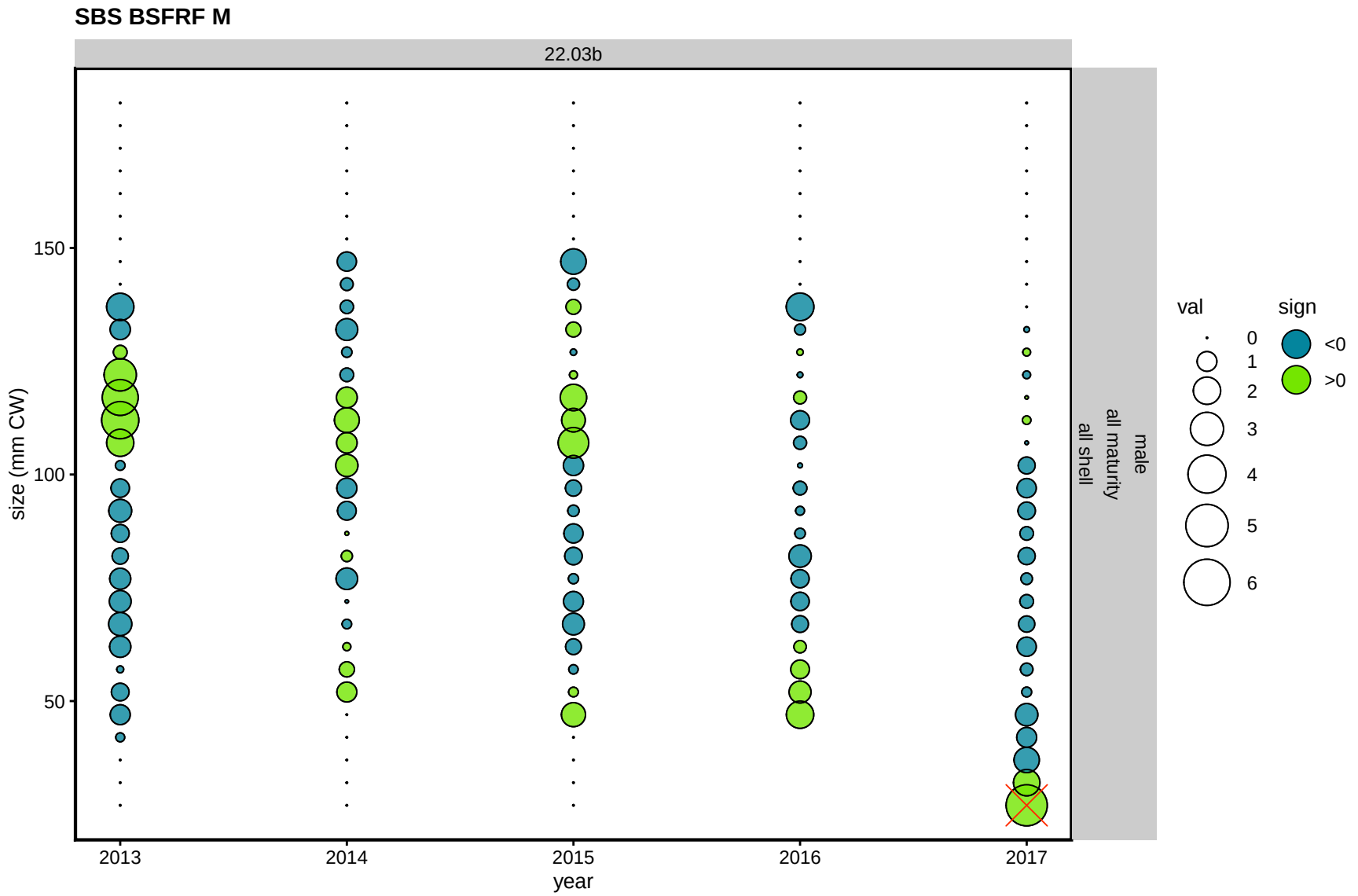

Figure 117. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

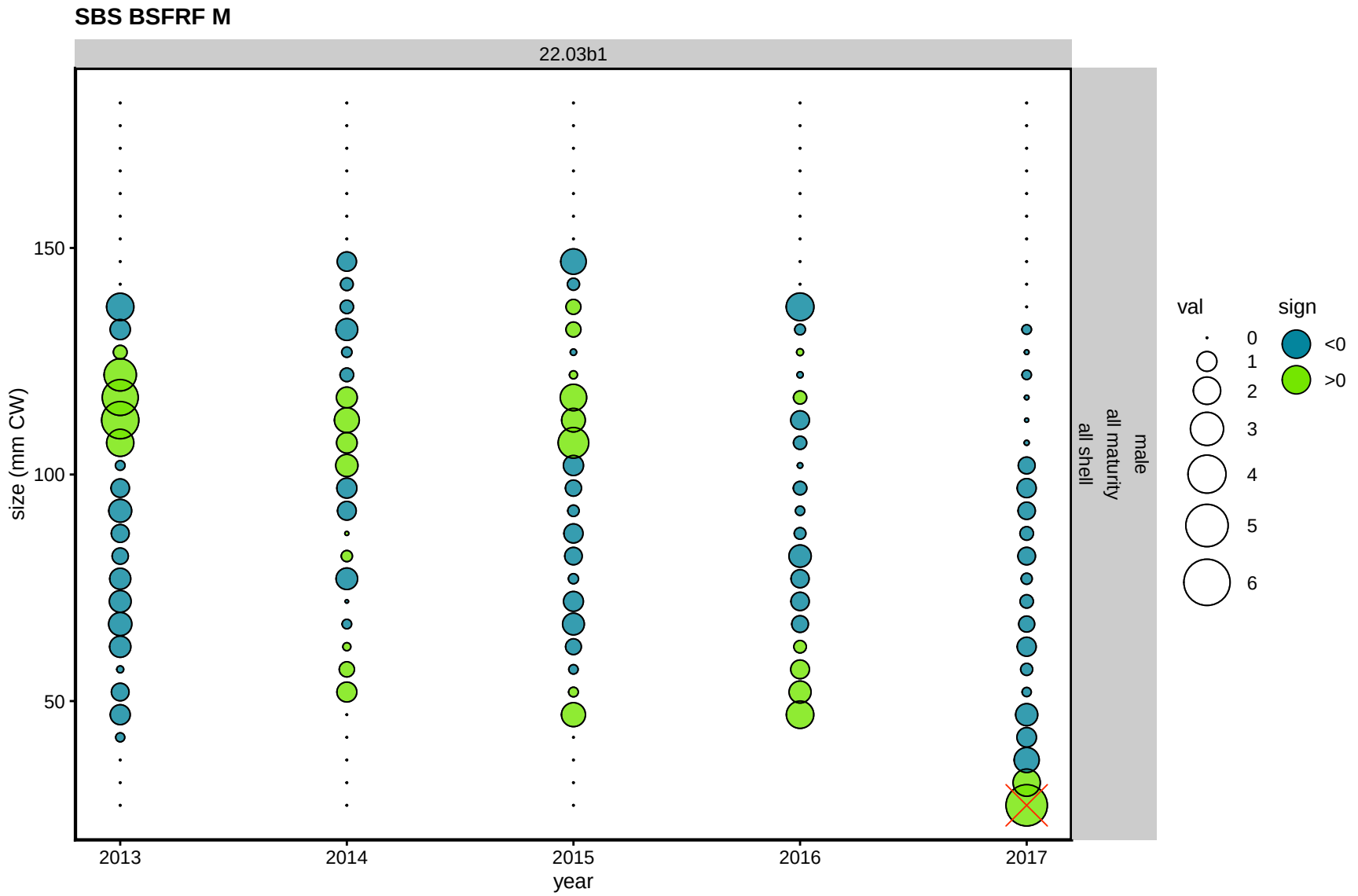

Figure 118. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

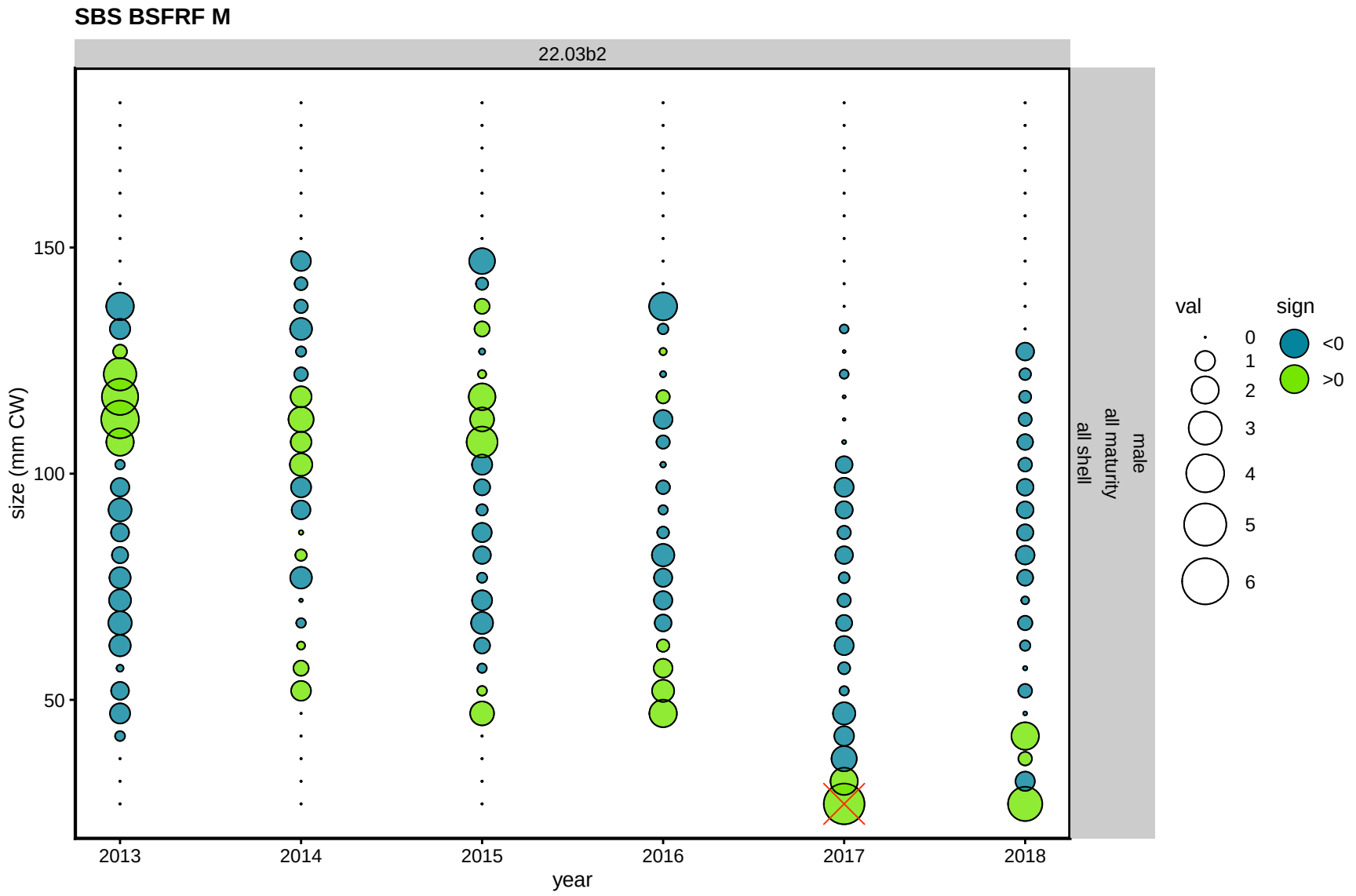

Figure 119. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

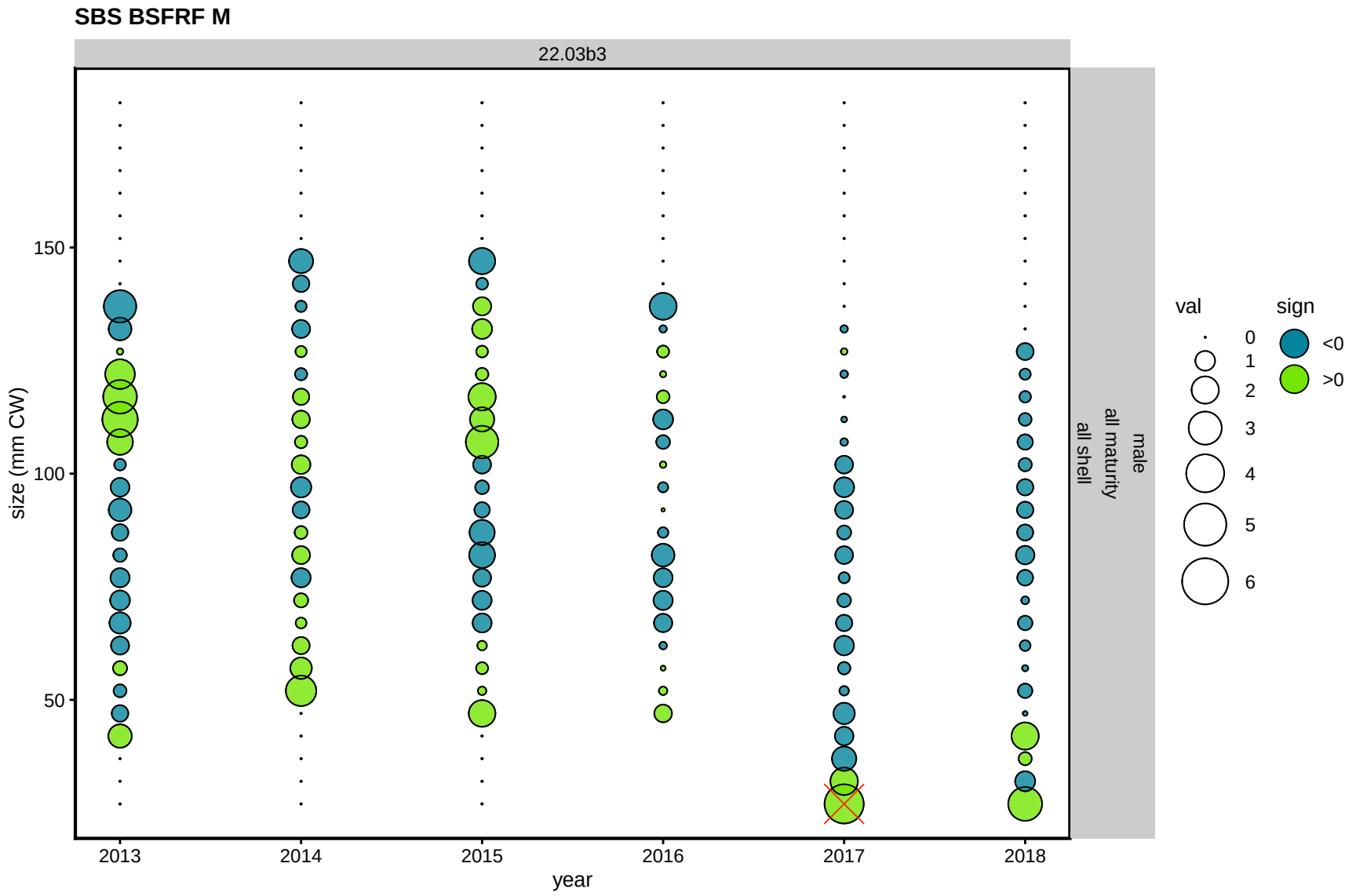

Figure 120. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

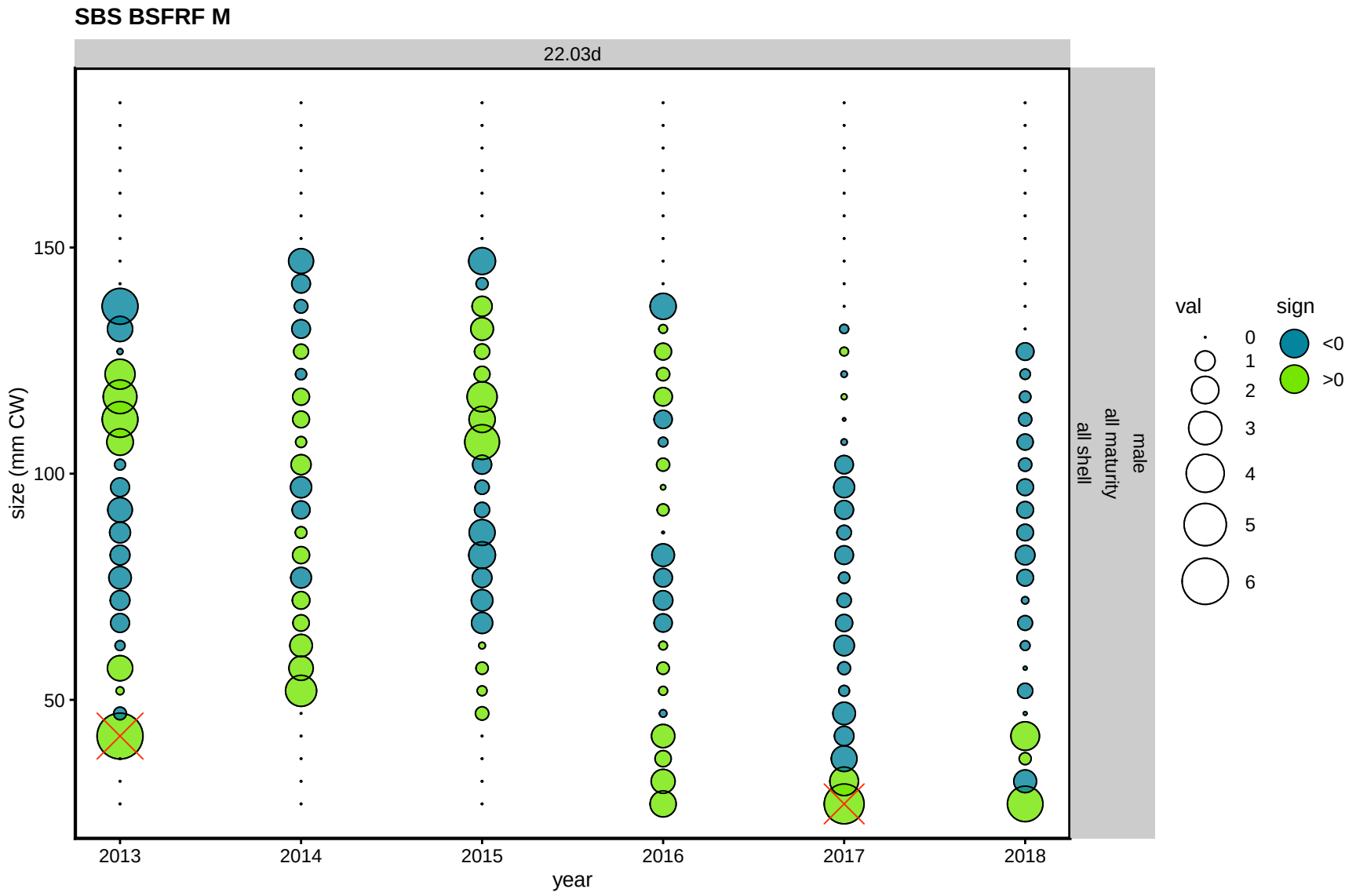

Figure 121. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

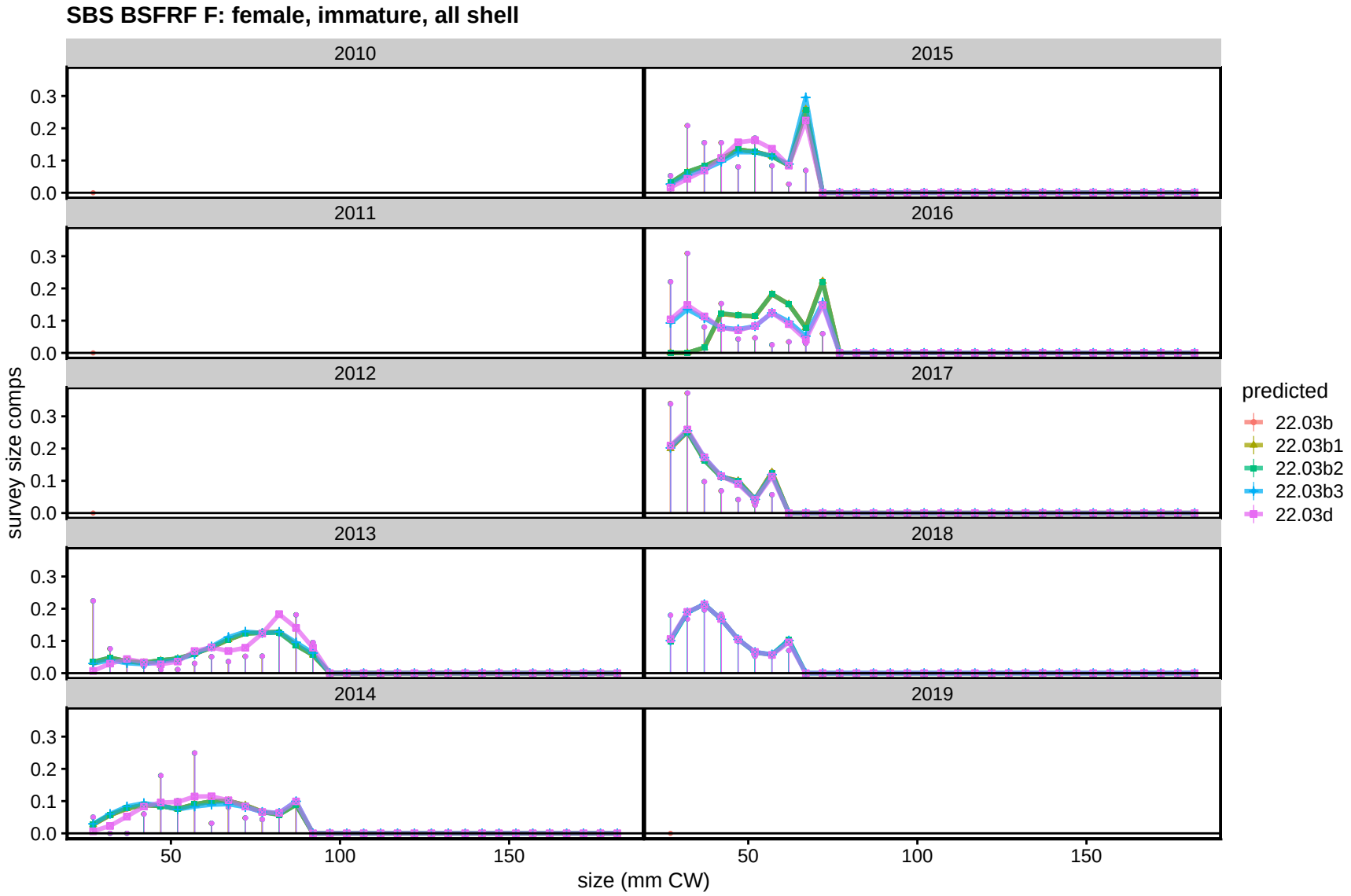

Figure 122. TCSAM02 model fits to survey size compositions in the SBS BSFRF F survey. Preferred model is 22.03d.

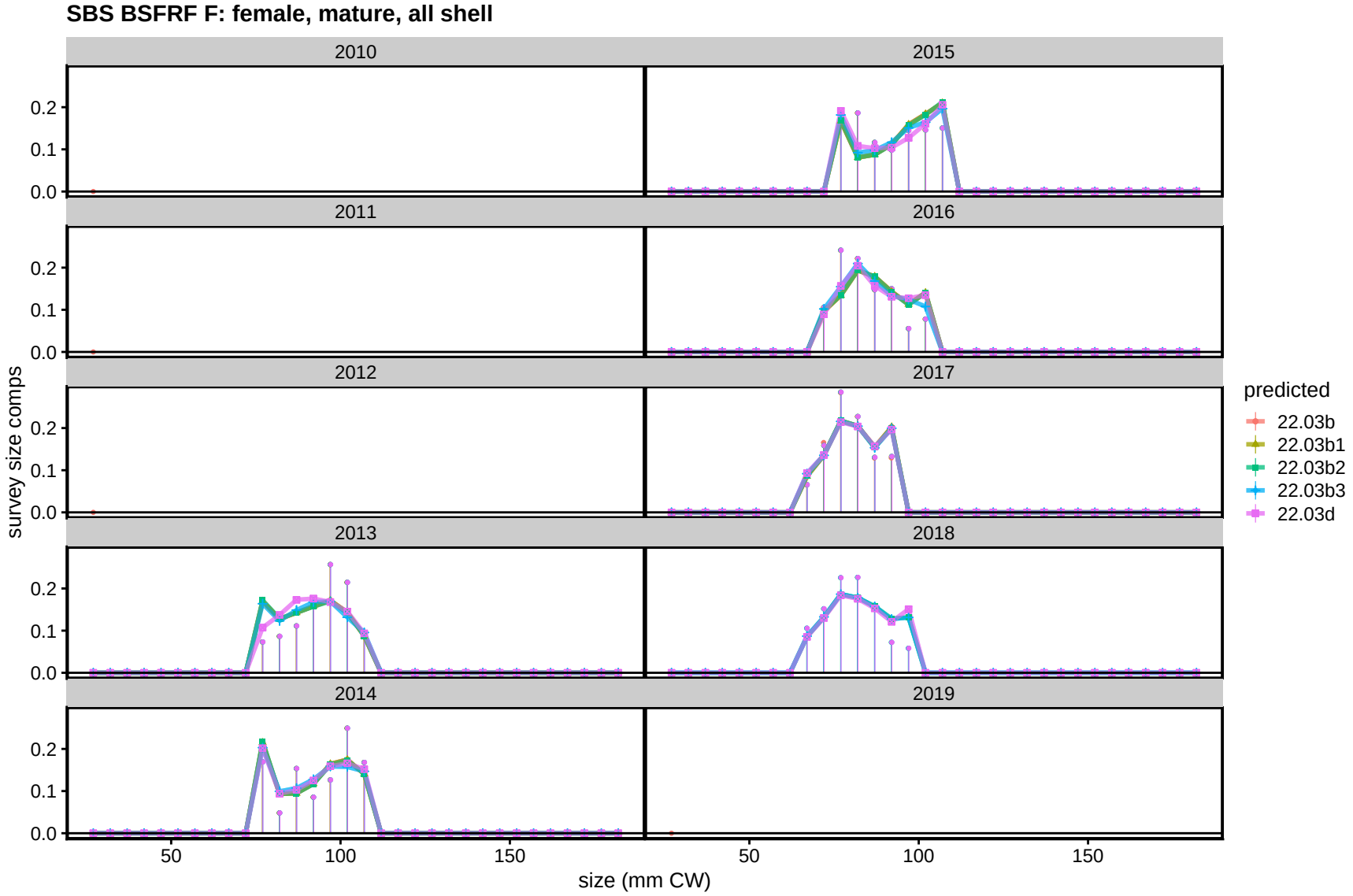

Figure 123. TCSAM02 model fits to survey size compositions in the SBS BSFRF F survey. Preferred model is 22.03d.

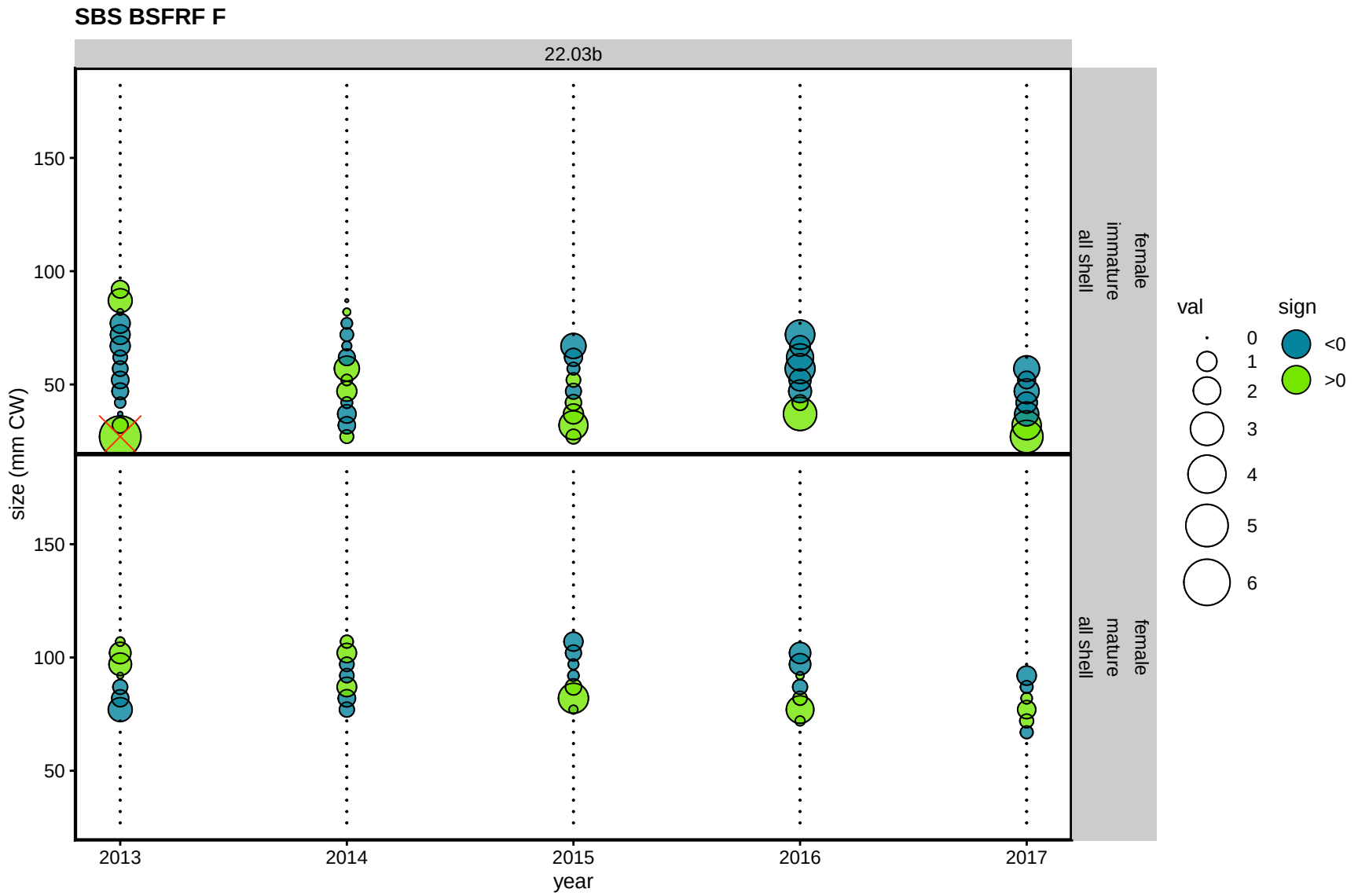

Figure 124. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

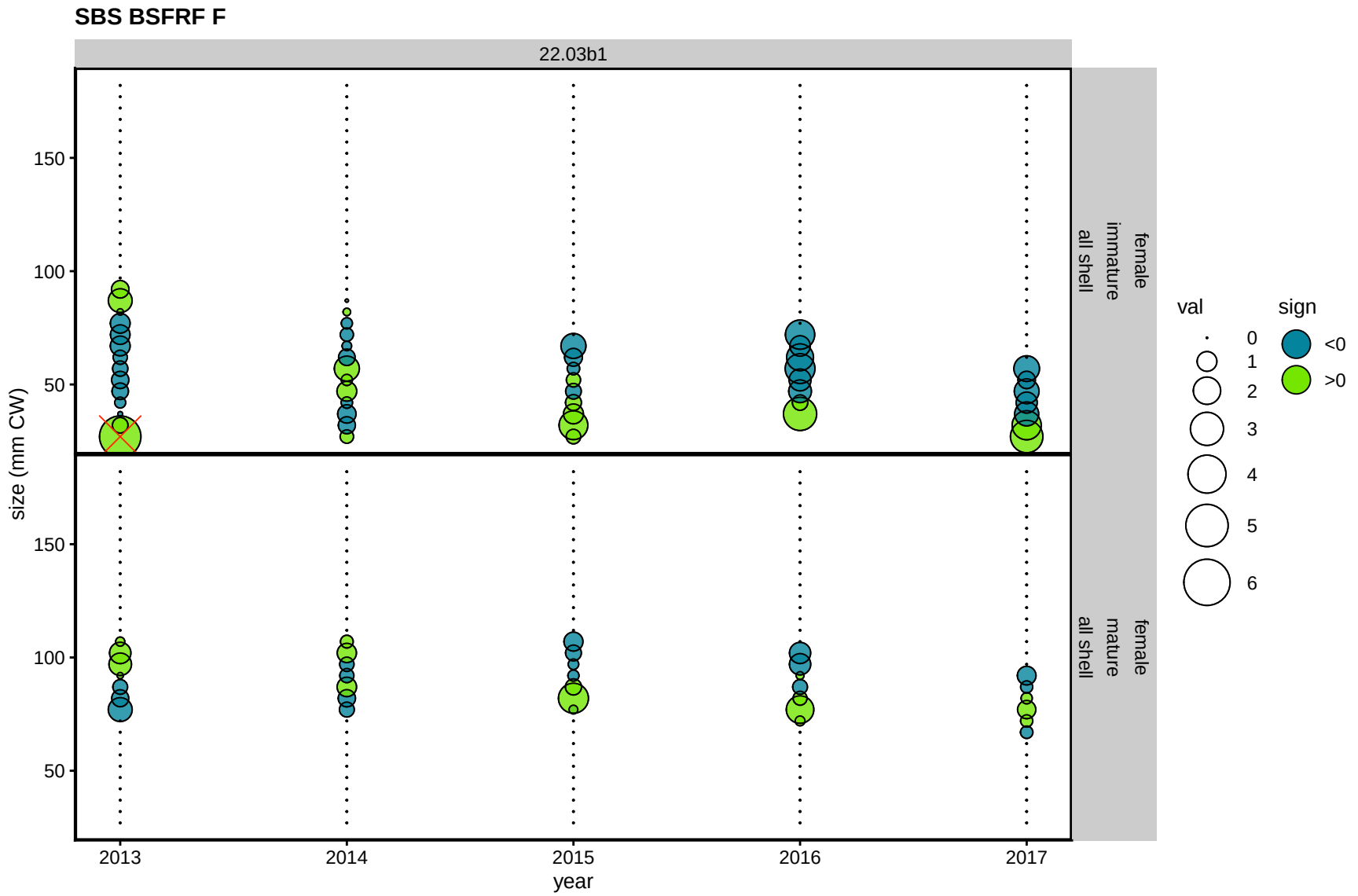

Figure 125. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

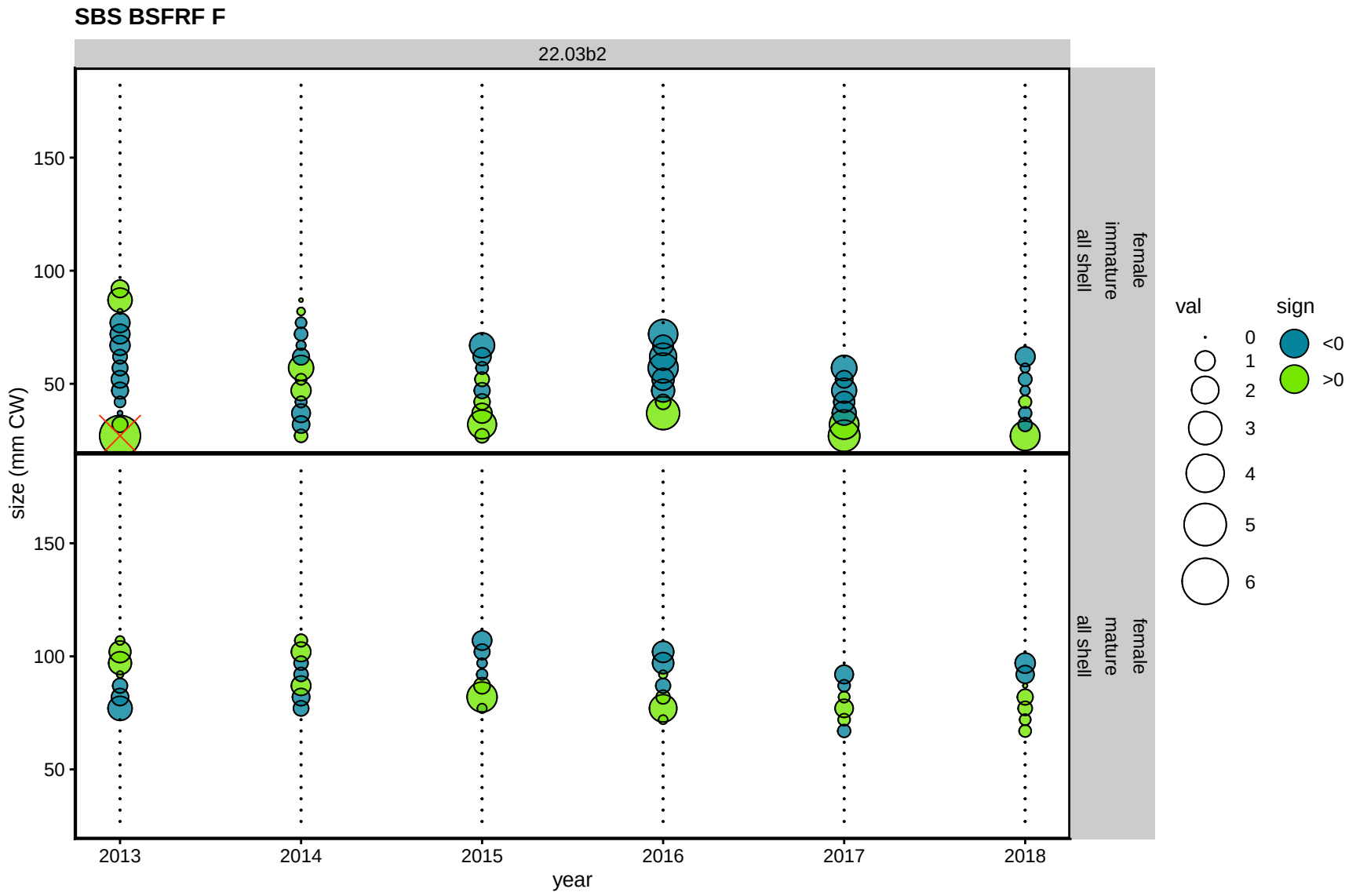

Figure 126. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

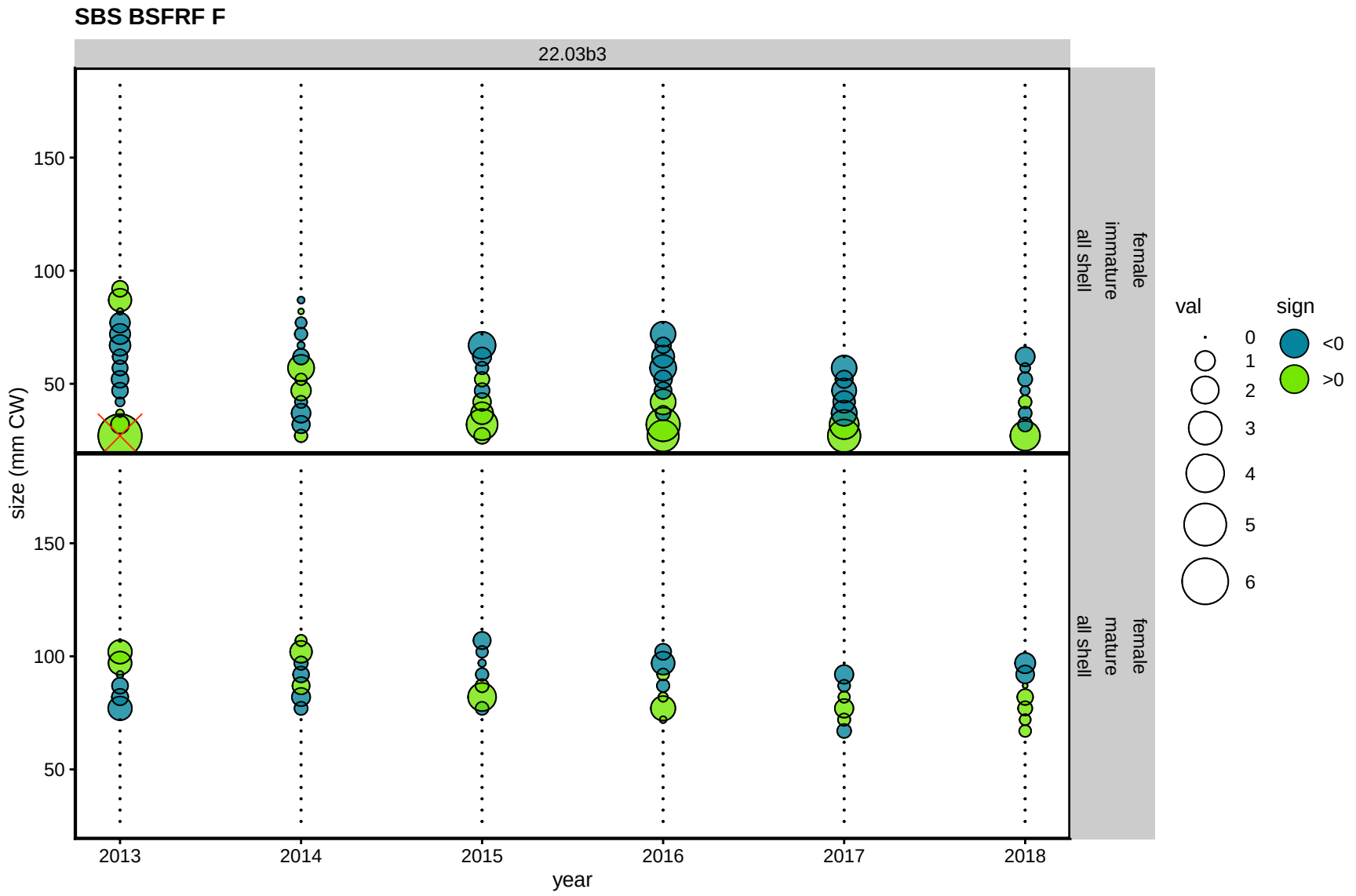

Figure 127. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

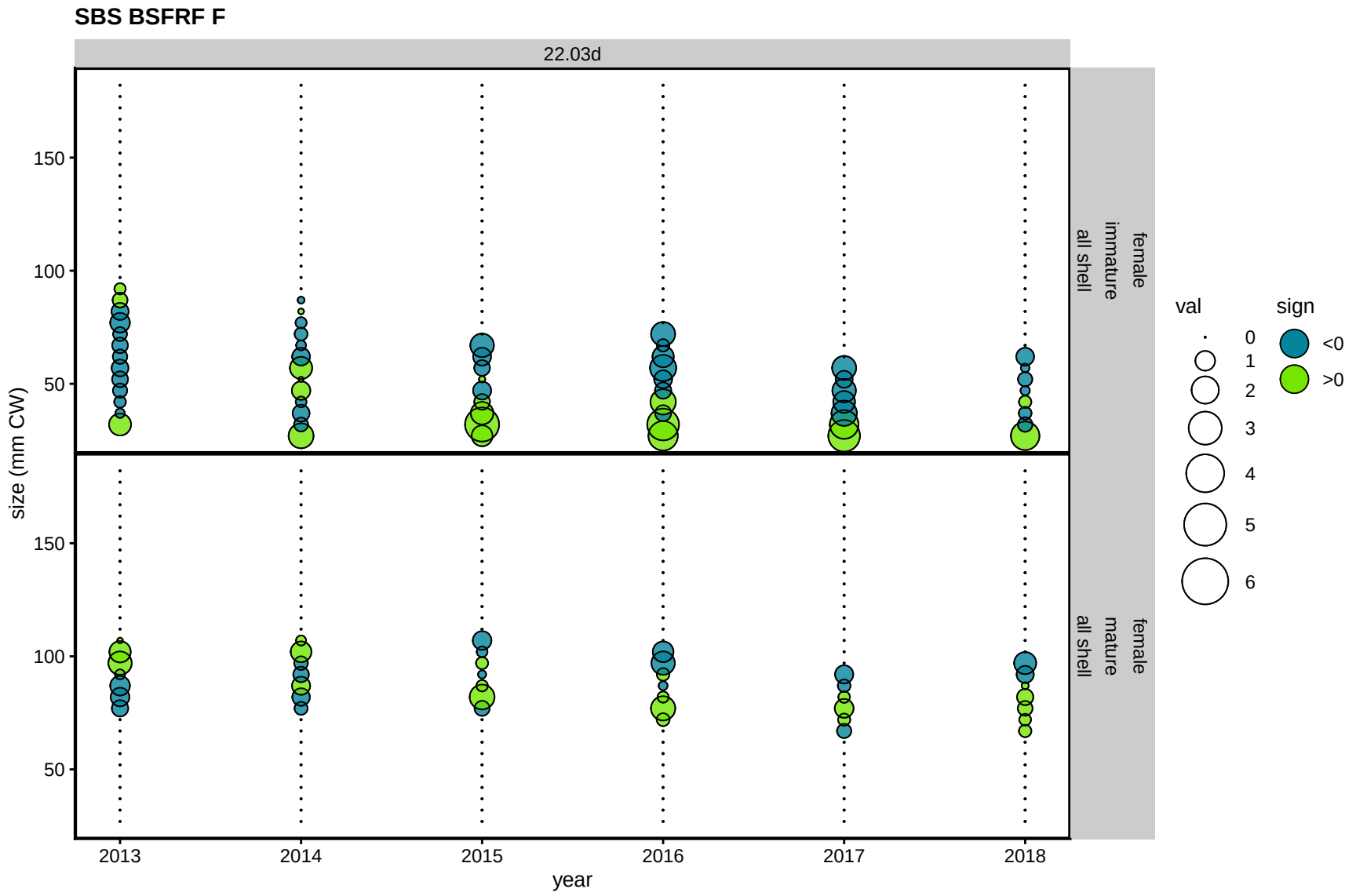

Figure 128. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

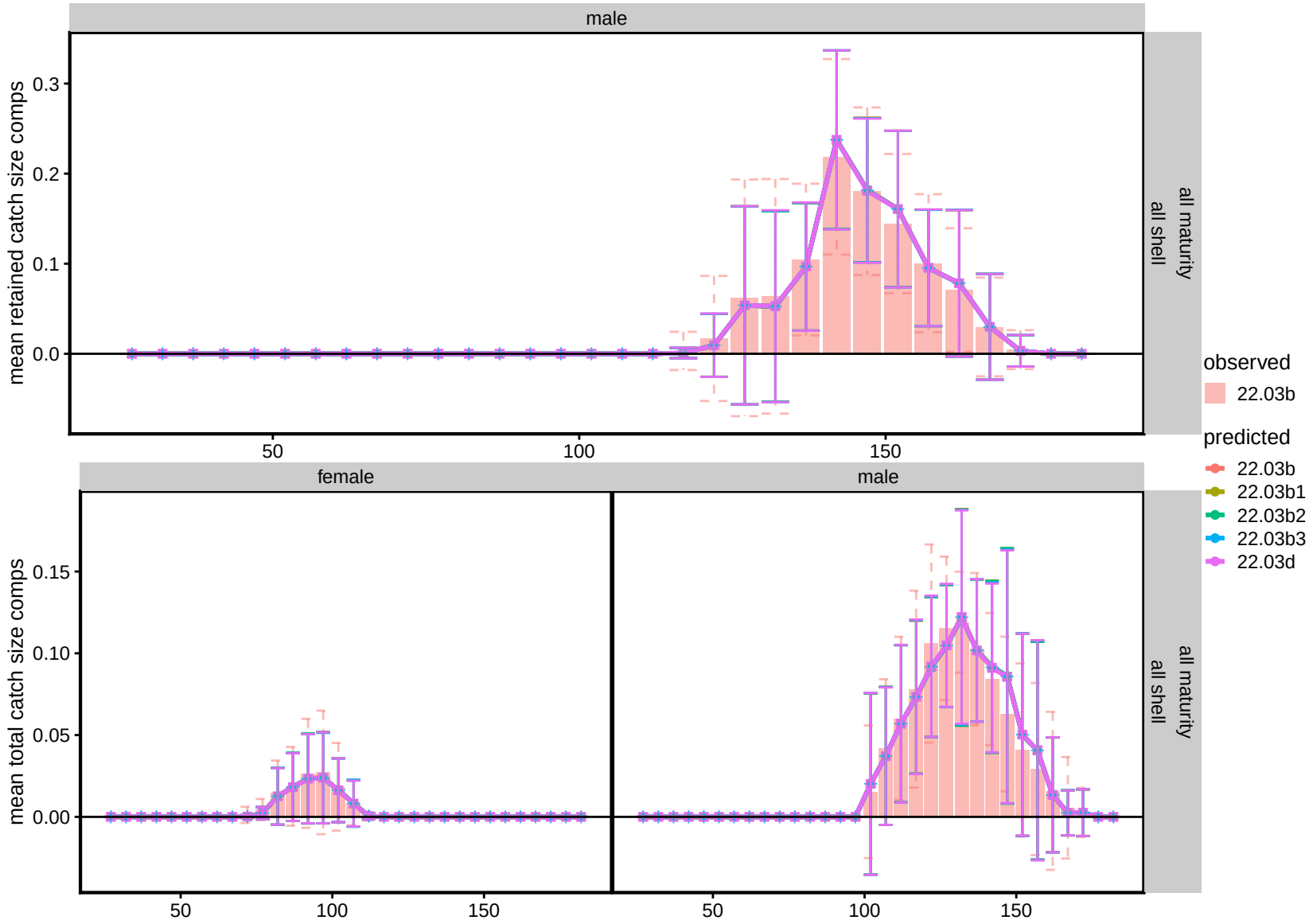

Figure 129. TCSAM02 models fits to directed fishery mean size compositions. Upper plot: retained catch; lower plot: total catch. Model 22.03d is the preferred model.

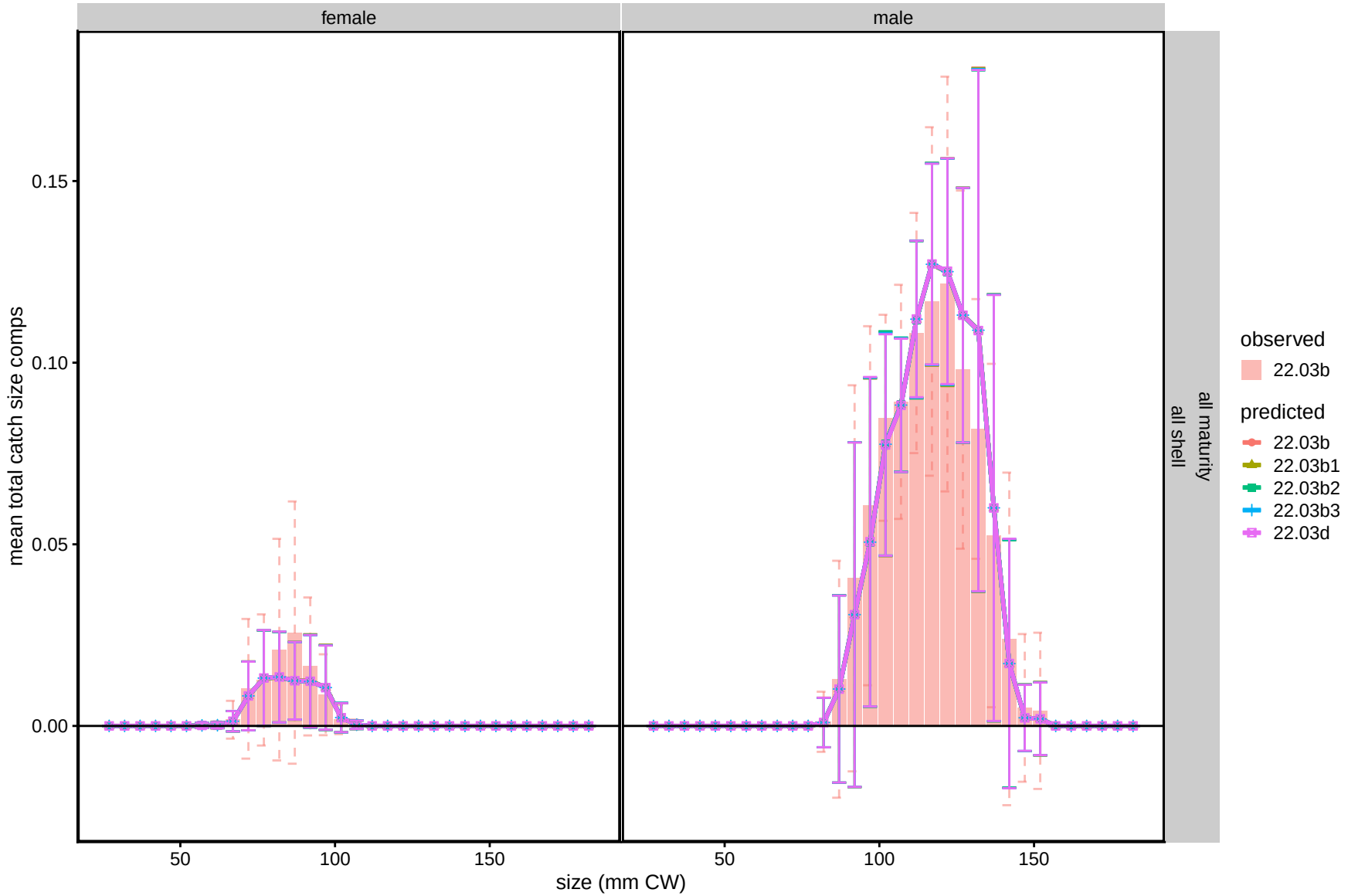

Figure 130. TCSAM02 models fits to mean bycatch size compositions from the snow crab fishery. Model 22.03d is the preferred model.

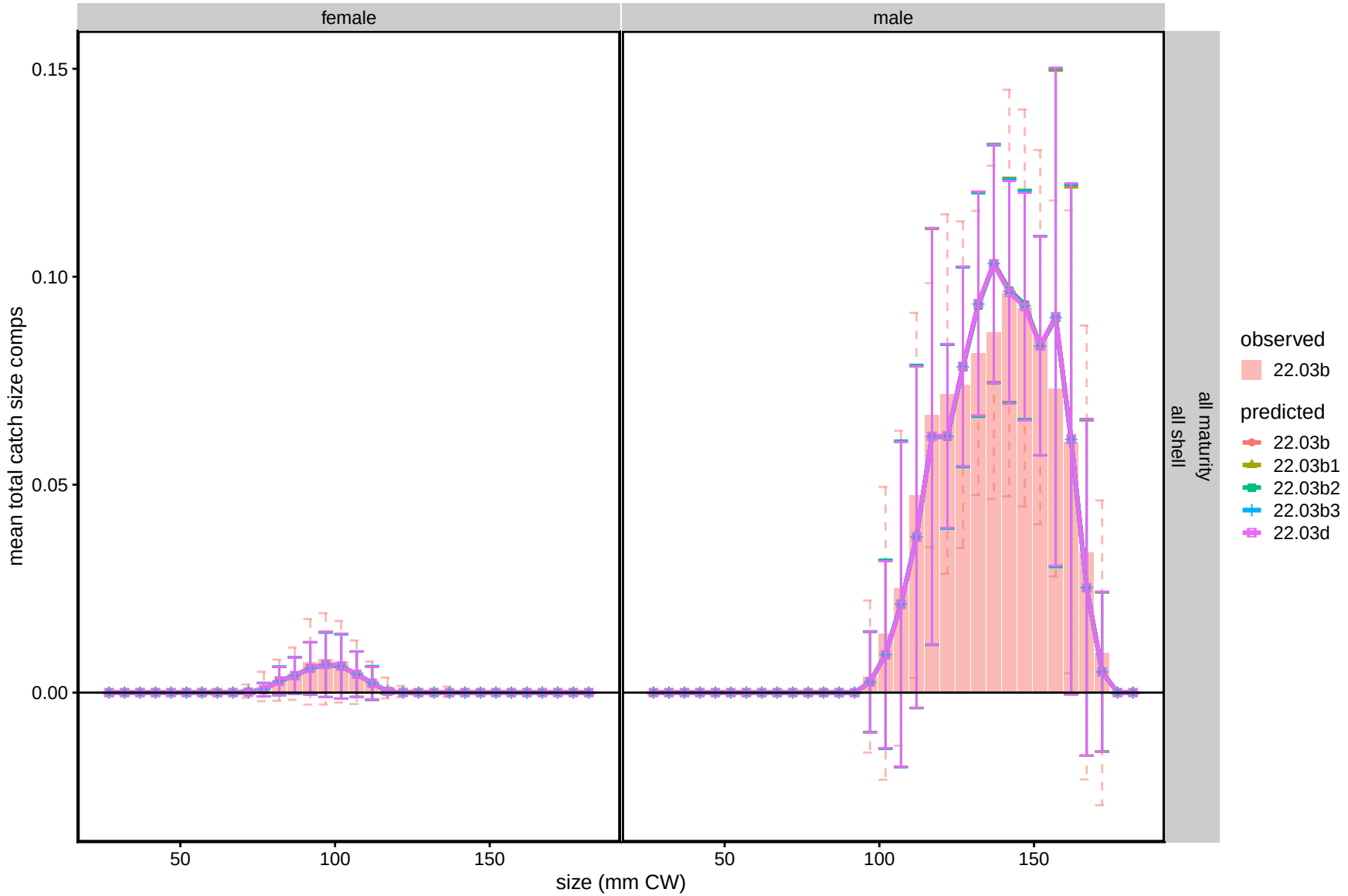

Figure 131. TCSAM02 models fits to mean bycatch size compositions from the BBRKC fishery. Model 22.03d is the preferred model.

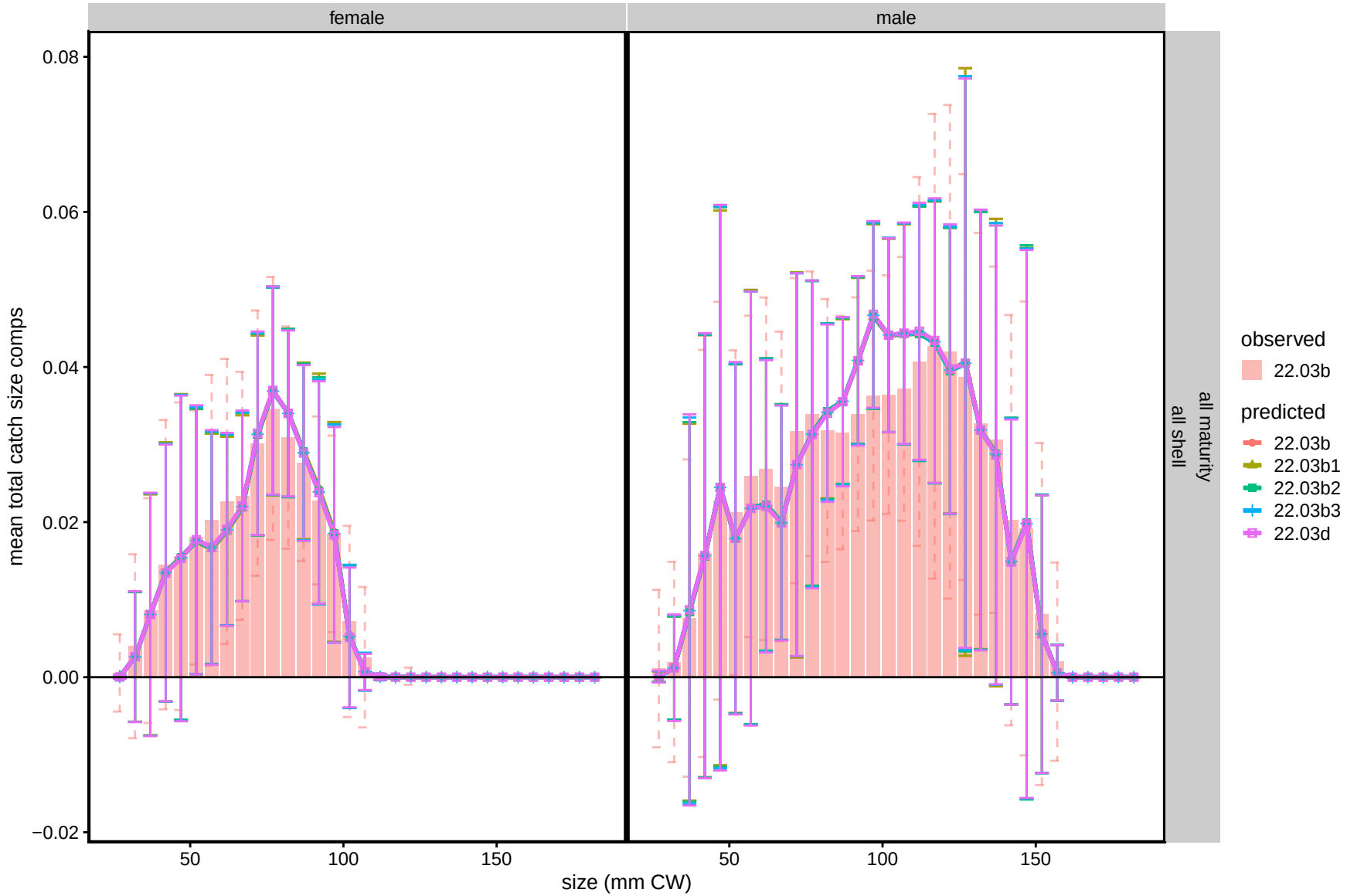

Figure 132. TCSAM02 models fits to mean bycatch size compositions from the groundfish fisheries. The total catch size compositions were normalized similarly for all model scenarios. Model 22.03d is the preferred model.

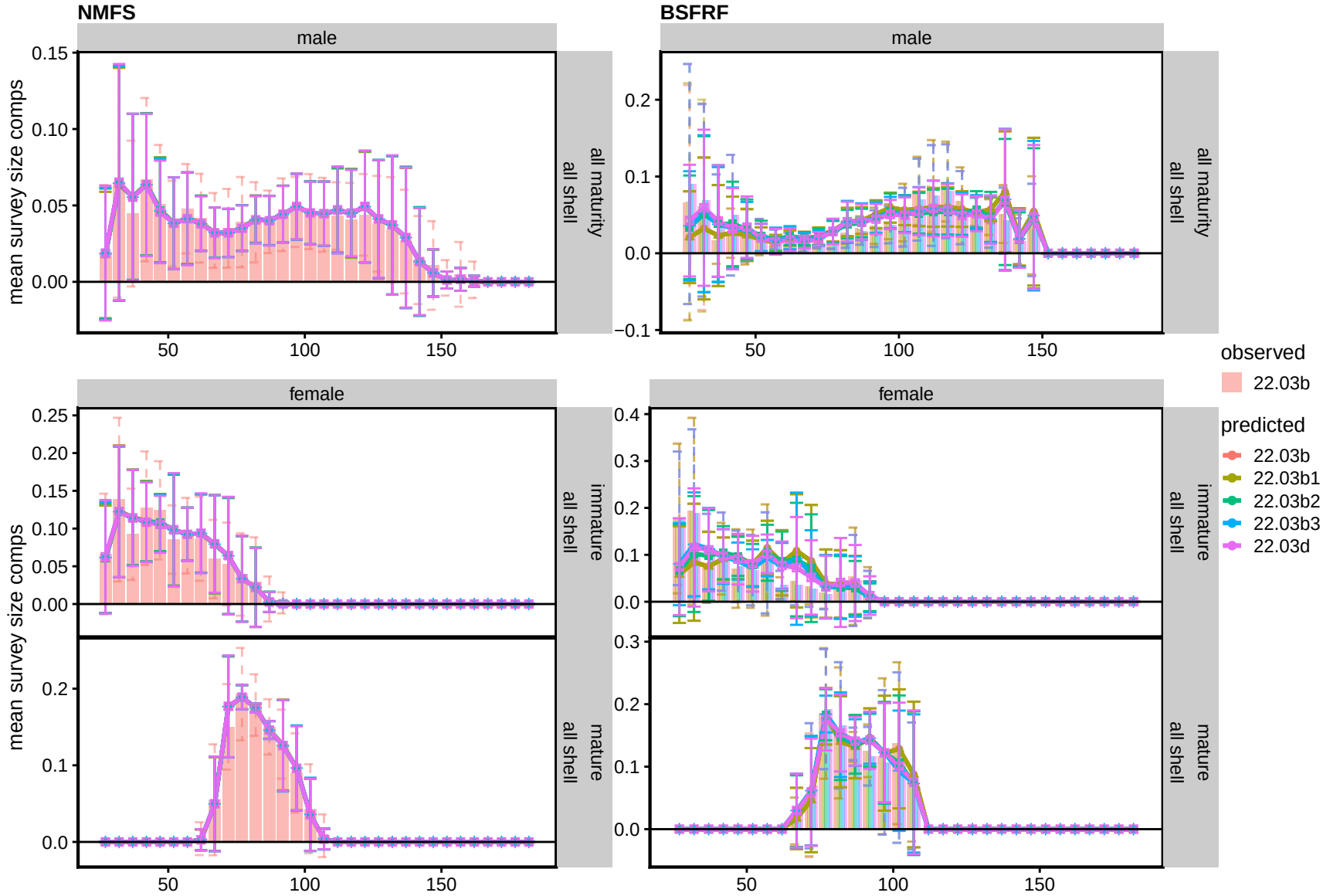

Figure 133. TCSAM02 models fits to mean survey size compositions from the NMFS EBS (left column) and BSFRF SBS (right column) surveys. The total catch size compositions were normalized similarly for all model scenarios.

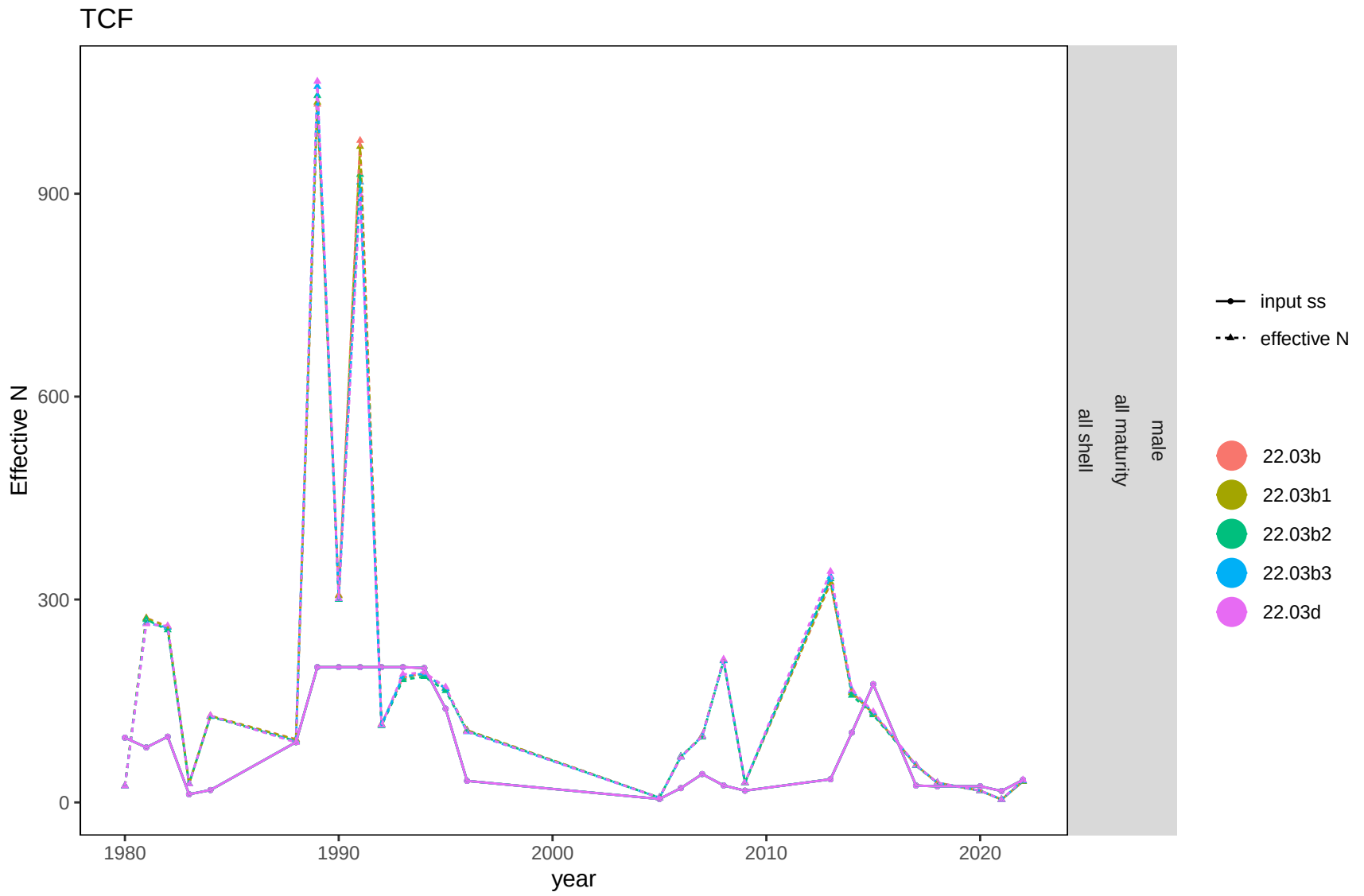

Figure 134. Effective sample sizes compared with input sample sizes for retained catch data. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are constrained to a maximum of 200.

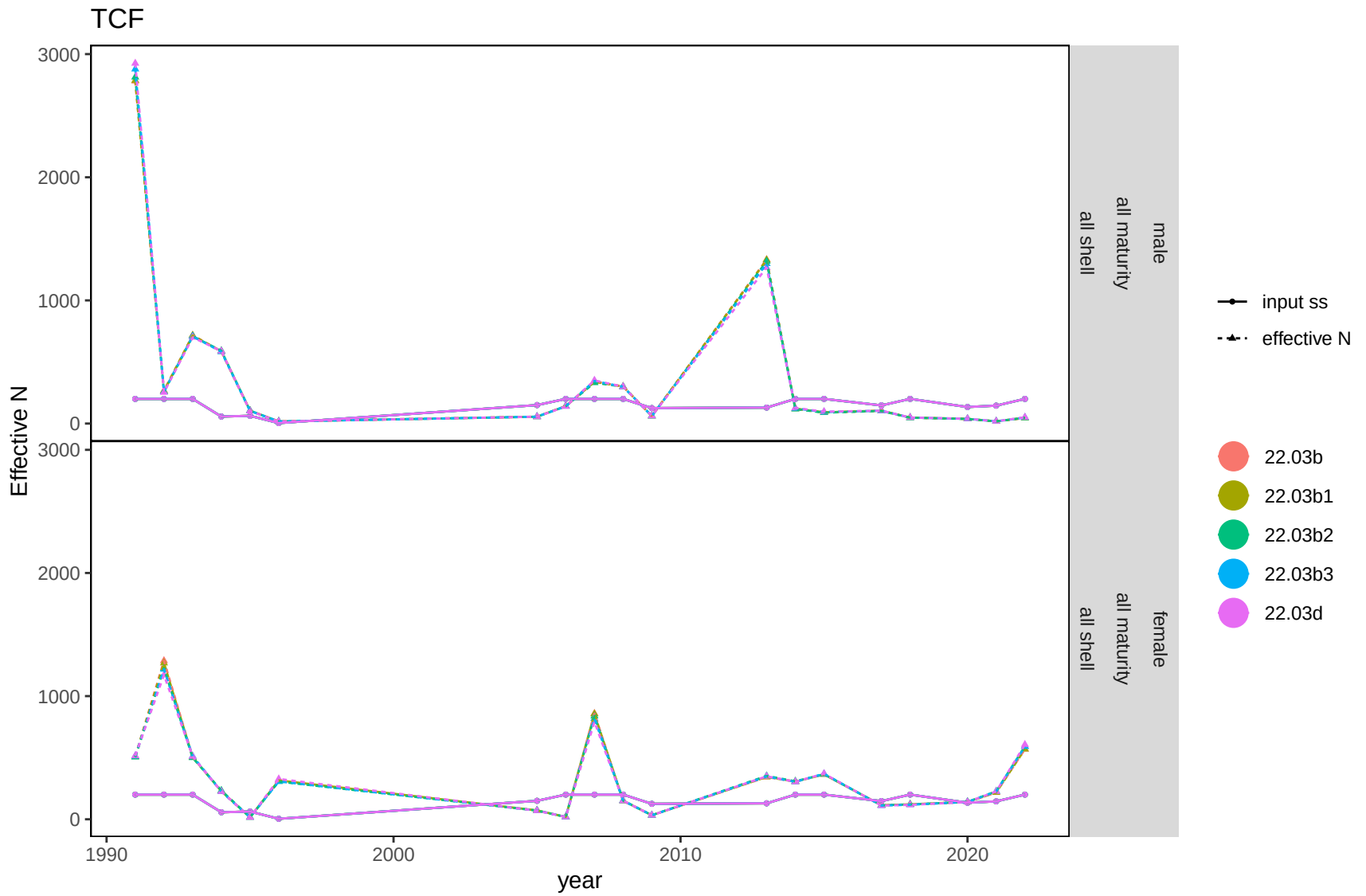

Figure 135. Effective sample sizes compared with input sample sizes for total catch data from the TCF fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories. Model 22.03d is the preferred model.

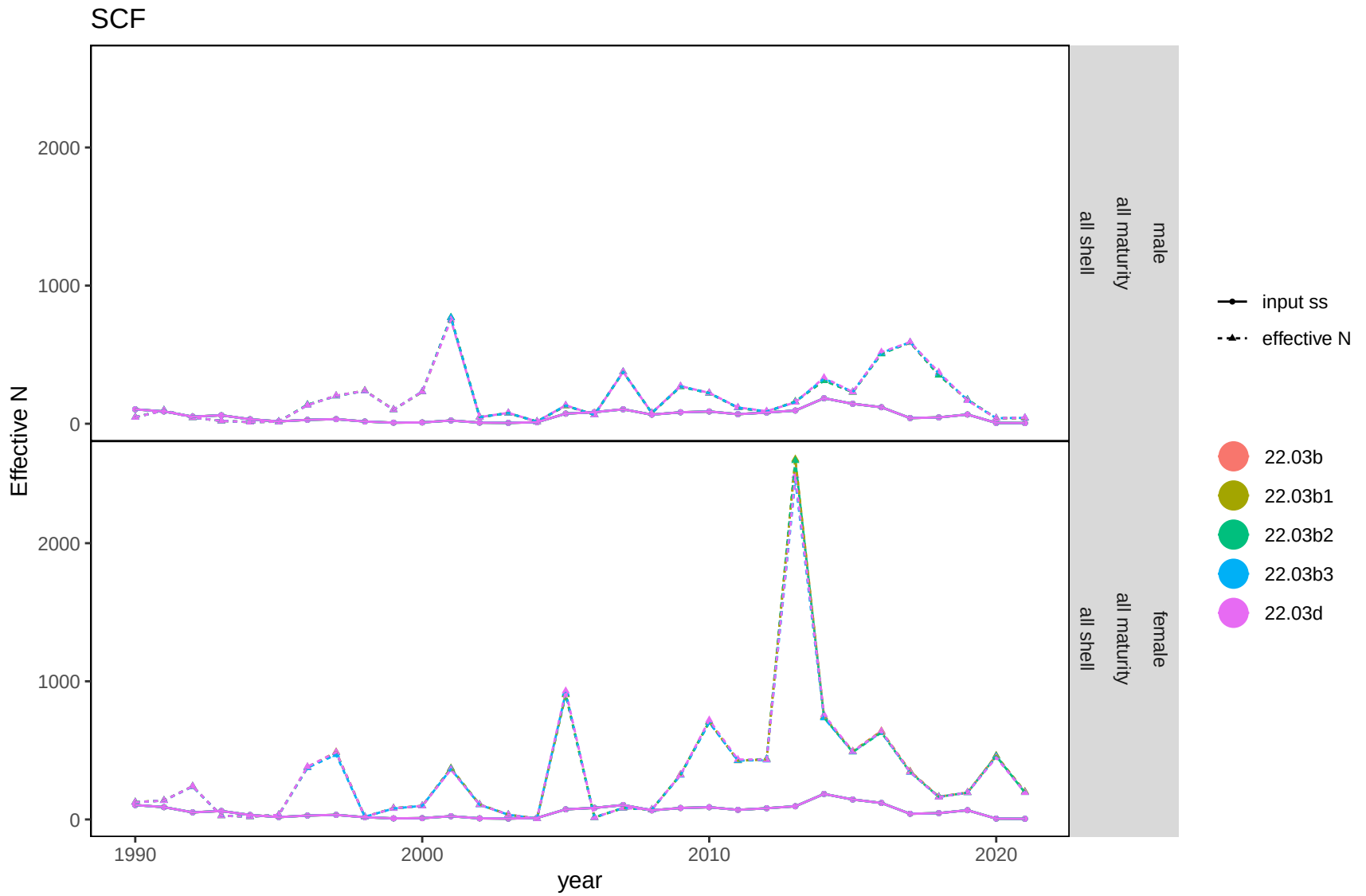

Figure 136. Effective sample sizes compared with input sample sizes for total catch data from the SCF fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories. Model 22.03d is the preferred model.

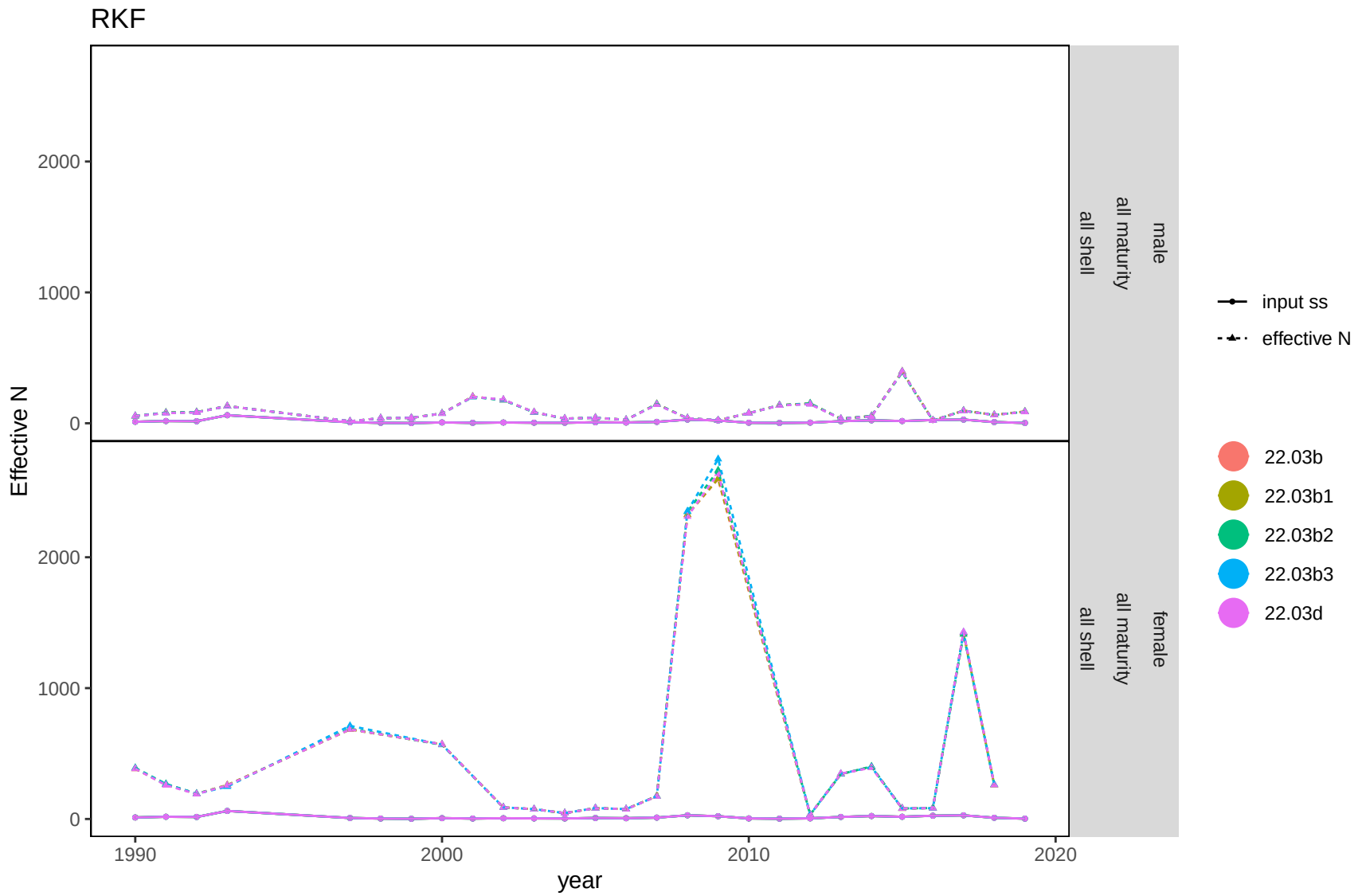

Figure 137. Effective sample sizes compared with input sample sizes for total catch data from the RKF fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories. Model 22.03d is the preferred model.

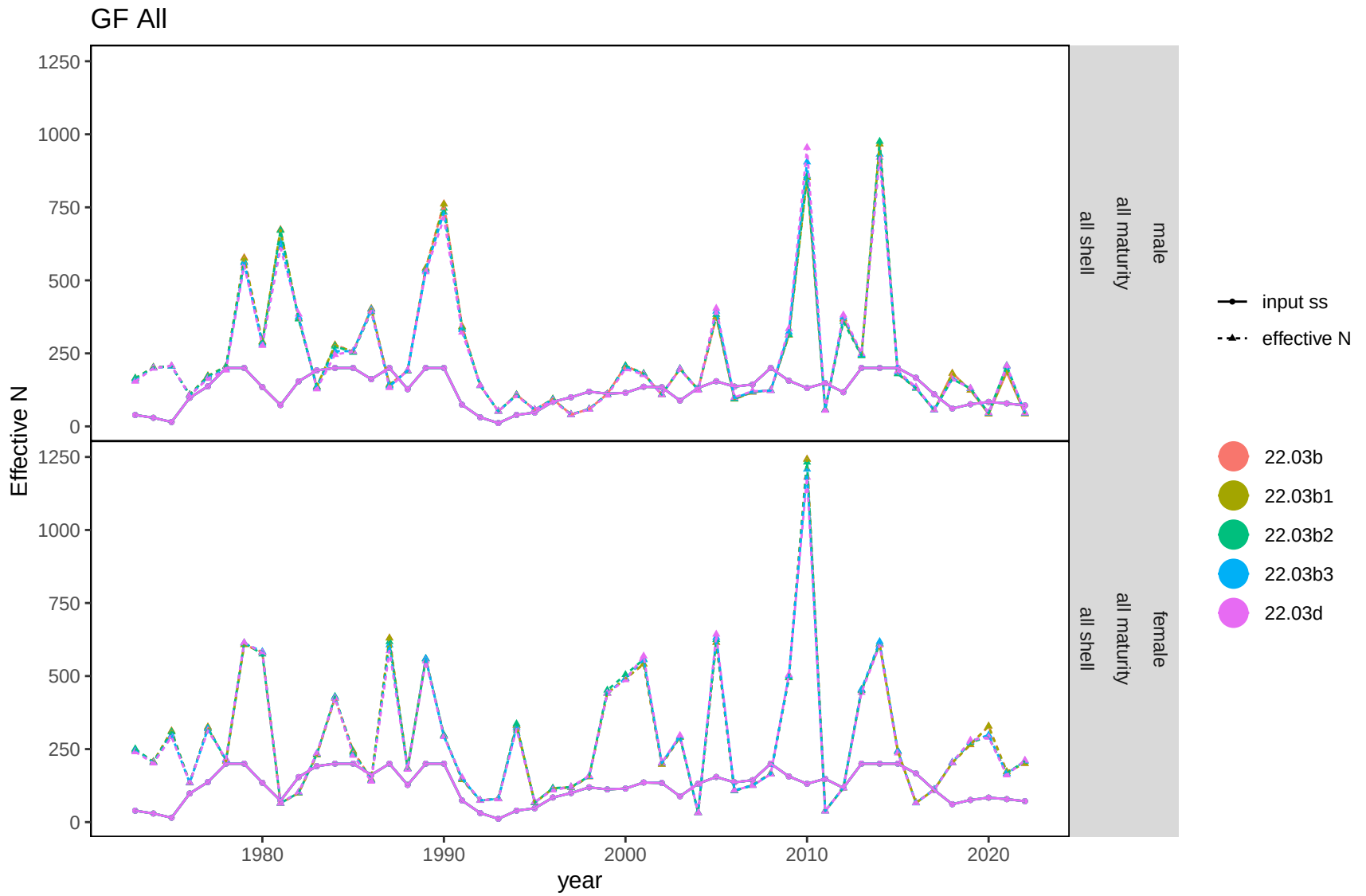

Figure 138. Effective sample sizes compared with input sample sizes for total catch data from the GF All fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories. Model 22.03d is the preferred model.

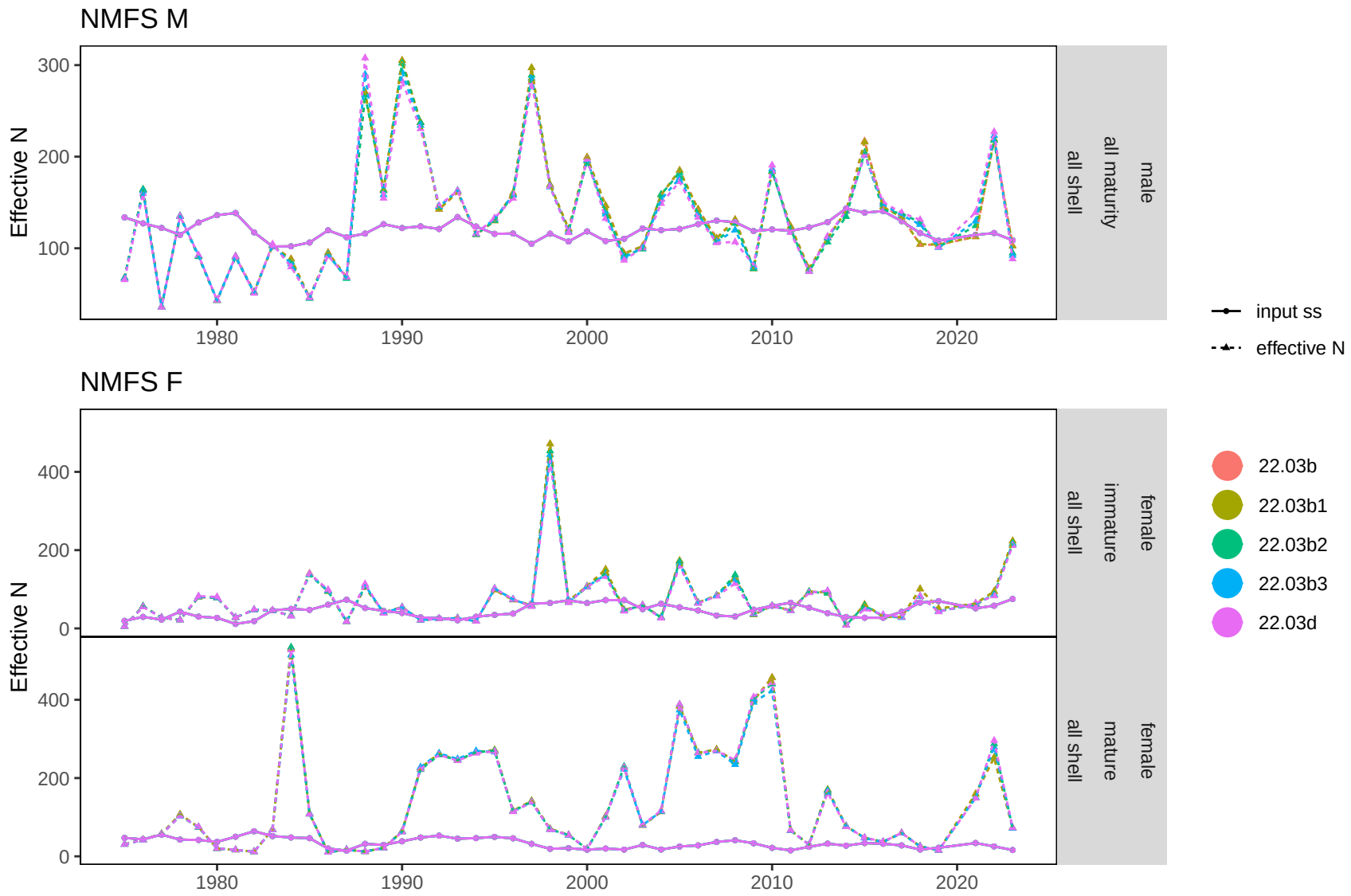

Figure 139. Effective sample sizes compared with input sample sizes for NMFS survey data. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.

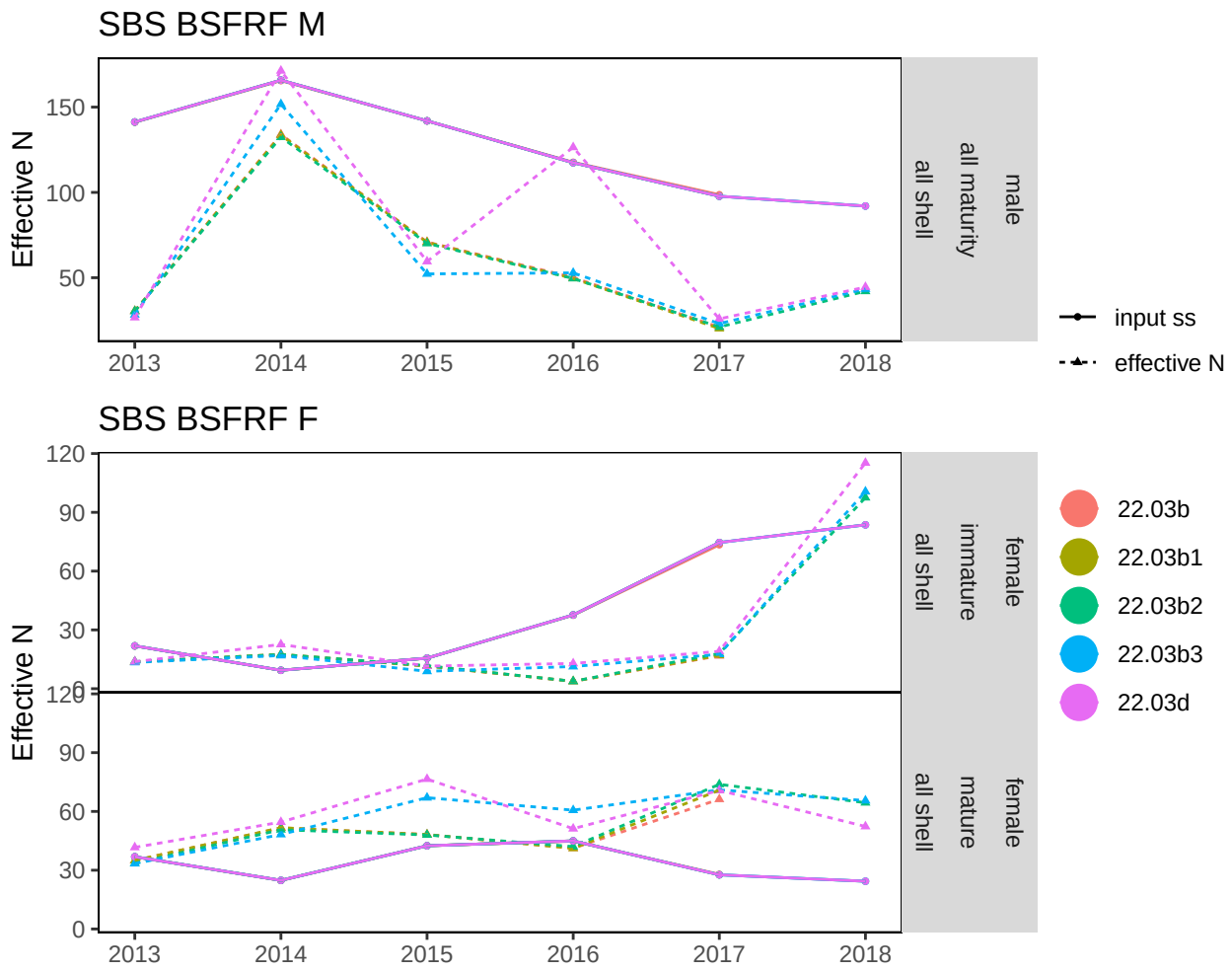

Figure 140. Effective sample sizes compared with input sample sizes for the BSFRF survey data. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.