Bridging Analysis 2: Appendix C 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

This appendix provides a bridging analysis from 22.03d, the final model in the first bridging analysis, as 2023/24 datasets are added in sequence to 22.03d5, the model evaluated for the 2024 assessment. 22.03d included the entire 2013-2018 BSFRF dataset and associated empirical availability curves in the model optimization. The empirical availability curves were estimated outside the assessment model using the revised 2013-2018 data and the GAM model with the binomial error distribution and logit link (see Appendix A). Model 22.03d was the alternative to the 2023 assessment model, 22.03b, that the CPT and SSC at their Spring 2024 meetings recommended be brought forward for consideration for harvest specifications in Fall 2024.

2 Model progression

This bridging analysis proceeded by the following incremental steps:

- 22.03d1: 22.03d + 2023/24 directed fishery data and associated catch parameters.
- 22.03d2: 22.03d1 + 2023/24 groundfish fisheries bycatch data and associated catch parameters.
- 22.03d3: 22.03d2 + 2023/24 BBRKC fishery bycatch data and associated catch parameters.
- 22.03d4: 22.03d3 + 20224 design-based estimates of survey abundance, biomass, and size composition from the NMFS EBS shelf survey.
- 22.03d5: 22.03d4 + 2024 male maturity ogives derived from the NMFS EBS shelf survey + changes necessary to achieve a model with no parameters estimated at a bound (the two effective sample size parameters for the Dirichlet-Multinomial likelihoods applied to BSFRF size composition data were fixed to values near their upper bounds).

3 Model Results

Parameter estimation for all models converged successfully, with small final maximum gradients and invertible hessians (allowing parameter uncertainty to be estimated; Table A), although it was necessary to run jittering analyses to find the MLE's for models 22.03d3, 22.03d4, and 22.03d5 (the analysis for the latter model was done as a matter of standard practice). As 2023/24 fishery and survey data was added to the analysis, estimates for most management quantities (average recruitment, unfished biomass, B_{MSY}, MSY, and current biomass) increased, resulting in estimates from the final model 22.03d5 being ~10% larger for those quantities than in 22.03d. The estimated sample size parameters associated with the Dirichlet multinomial likelihoods used to fit the BSFRF size compositions were estimated for each model except 22.03d5, but came very close to or hit their upper bounds in each model (Table 1); they were fixed to values near their upper limits in 22.03d5 to improve model stability and more reliably estimate parameter uncertainty in the author's preferred model. In general, only relatively small changes in estimated parameter values occurred (Tables 2-14). The largest effective changes were in the final ln-scale "rec dev" parameters from 22.03d3 to 22.03d4 with the addition of the 2024 NMFS survey data.

Individual components to the overall objective function value for the models are compared in Tables 27-30 while the difference in values relative to 22.03d are presented in Tables 31-34. Some care must be taken when interpreting these tables because the results for individual data components are only comparable across models that fit the same data. However, for those that do fit the same data, the subsequent addition of another source of 2023/24 data generally had very little impact on fits to the shared data components.

Table A. Convergence properties and summary management quantities.

case	objective function	max gradient	avg recruitment	B_{100}	B_{MSY}	F_{MSY}	MSY	B
22.03d	3,088.781	0.1925393	486.0105	102.3224	35.81285	1.239754	17.37937	104.1558
22.03d1	3,090.467	0.1194642	524.0217	109.9975	38.49912	1.284085	18.70280	108.2475
22.03d2	3,083.415	0.0414069	525.9317	110.7095	38.74833	1.278229	18.81169	108.9733
22.03d3	3,083.740	0.0209578	525.9982	110.7198	38.75194	1.278426	18.81349	108.9885
22.03d4	3,115.031	0.0234043	537.4908	115.0196	40.25685	1.274491	19.57682	118.0031
22.03d5	3,182.004	0.0178043	526.0374	114.3069	40.00740	1.224960	19.52557	116.7005

Table B. Convergence properties and summary management quantities. Parameter changes: 22.03d1–2023 rec dev (+), 2023 TCF capture rate (+), 2023 TCF selectivity dev (+); 22.03d2–2023 GF capture rate (+); 22.03d3–2023 RKF capture rate (+); 22.03–none; 22.03d5–fixed D-M effective sample size parameters (-2).

case	num. parameters	num. at bound	obtained std. dev.s
22.03d	354	0	yes
22.03d1	357	0	yes
22.03d2	358	1	yes
22.03d3	359	2	yes
22.03d4	359	2	yes
22.03d5	357	0	yes

3.1 Estimated Fishery-related Quantities

Graphs of time series of estimated fully-selected F (total catch capture rates, not necessarily mortality) in the directed fishery are shown in Figure 1. The associated selectivity functions are illustrated in Figures 2-4. The estimates of size-selective retention of males captured in the directed fishery are presented in Figure 5. 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 6-8.

Differences between the models for most of these quantities were negligible. Small differences among the models can be discerned in the estimated F's prior to 1980 in the directed fishery and the groundfish fisheries, as well as the estimated selectivity curves for males in the groundfish fisheries (Figures 1 and 8).

3.2 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 9. Assumed survey availability curves for the BSFRF side-by-side catchability studies are illustrated in Figure 10. These were not estimated; they were determined outside the model (see Appendix A for details). 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 $q = 1$).

Small differences in estimated NMFS fully-selected survey catchability (on the order of 0.01) occur cross the models, but the associated selectivity curves are indistinguishable (Figure 9).

3.3 Estimated Population-related Quantities

3.3.1 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 11, together with estimated mean molt increments (as a function of pre-molt size) and natural mortality rates. Of these, only the estimates of M in the so-called "elevated mortality event" during 1980-84 show any discernible differences among the models.

The cohort progressions (growth and development) resulting from these schedules are illustrated in Figures 12 and 13, and show essentially negligible differences across the models.

3.3.2 Estimated population-related time series

Estimated time series for recruitment and MMB are shown in Figures 14 and 15. Time series of abundance by sex and maturity state are illustrated in Figure 16, while time series of biomass by sex and maturity state are illustrated in Figure 17.

With the addition of the 2024 NMFS survey data, models 22.03d4 and 22.03d5 exhibit higher estimates of recruitment in 2021-2023 than the other models as well as slightly higher estimates for MMB (15). These differences also propagate through to estimates of population abundance and biomass (Figures 16 and 17).

3.4 Estimated Fishing Mortality versus Estimated Spawning Stock Biomass

The trajectories of estimated total fishing mortality (retained + discards) against spawning stock biomass (MMB) are compared for all of the models in Figure 18. The trajectory for 22.03d5 is shifted slightly to the right (lower MMB) of those of the other models from the late 1960's to 1980. After 1980, however, the trajectories for all of the models are very similar.

3.5 Fits to Fishery Catch Data

All of the models fit both the retained catch and total catch very well, with the exception of total catch in 1996/97 (which none fit well; Figures 19-20). Of note, 1996/97 was the last year the directed fishery was open prior to rationalization in 2005; the total catch was very small and observer coverage was poor so the assumed cv on the value (0.20) may be biased low.

Fits to the remaining fishery bycatch datasets are all very good and essentially identical across the models (Figures 21–23).

Although the summary statistics presented in the figures noted above indicate changes across the models (particularly the MAD statistics), the values of the associated changes are very small.

3.6 Fits to Survey Indices and Related Data

3.6.1 Graphs of model fits to survey biomass and numbers

Model fits to survey biomass time series from the NMFS EBS shelf survey and the BSFRF SBS surveys are compared across the models in Figure 24. Residuals to the fits and summary fit statistics are shown in Figures 25-28. Although none of the models fit the NMFS survey biomass data particularly well, the temporal patterns of residuals are similar across all of the models, with differences expected near the end of the time series because 22.03d4 and 22.03d5 include the 2024 survey data while the other models do not. In general, the predicted values do not achieve the dynamic range of the observed values–under-predicting observed highs and over-predicting lows.

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 29. Residuals to the fits and summary fit statistics are shown in Figures 30-33. Note that the fits to survey abundance are not included in the model objective function but serve as independent diagnostics of model fit. Differences between the observed and predicted survey abundance values generally follow the same patterns as those for survey biomass. None of the models predict the NMFS survey abundance indices particularly well, with all of the models exhibiting standardized differences to the observed abundance values larger than 4 (or smaller than -4) in some (the same) years for all three sex/maturity categories. Models 22.03d4 and 22.03d5, which include the 2024 NMFS survey data, substantially under-predict the abundance of all three population components in the 2024 survey while predicting the values for the 2023 survey reasonably well. All of the models also predict the BSFRF abundance indices reasonably well, with all differences falling within four standard deviations of the observed values.

3.6.2 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 34. The fits are extremely similar, but not identical across the models. Overall, judging by the summary statistics, 22.03d5 fit the data slightly worse than the other models.

Model fits to maturity ogive data from the NMFS EBS shelf survey are presented in Figure 35, while Pearson's residuals to the fits are shown in Figure 36. As with the growth data, the fits are similar, but not identical, across the models. Model 22.03d5 tended to exhibit slightly worse fits than the other models when the fits were extremely poor (e.g., 2007, 2018).

3.7 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 37-92. All of 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 37-50. Graphs for the snow crab fishery are given in Figures 59-64. Graphs for the BBRKC fishery are given in Figures 73-78. Graphs for the groundfish fisheries are given in Figures 87-92. None of the figures offer any indication of differences among the models for fits to the fishery size compositions.

3.8 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 101-129. The figures indicate nothing to distinguish among the models as to fits for either the NMFS or BSFRF survey size compositions.

3.9 Marginal Distributions for Fits to Compositional Data

Marginal distributions for fits to the compositional data from the fisheries are shown in Figures 134-137. Marginal distributions for fits to the compositional data from the surveys are shown in Figure 138. Differences between the models are negligible.

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

Time series plots of input and implied effective sample sizes for compositional data from the fisheries are shown in Figures 139-**?@fig-PrefMod-EffNs-TotCatch-GFAll**. Similar plots for the survey compositional data are given in Figures **?@fig-PrefMod-EffNs-Surveys1** and **?@fig-PrefMod-EffNs-Surveys2**.

4 Conclusion

The only substantive changes associated with adding the 2023/24 data to the results from model 22.03d presented in May 2024 were the changes to estimated recruitment and associated stock sizes in 2021-2024 resulting from the addition of the 2024 NMFS survey, as well as the subsequent changes, on the order of 10%, in several management-related summary quantities. The author consequently recommends the final model in the progression of adding 2023/24 data, 22.03d5, as the model on which to base further consideration for use in determining stock status and setting harvest specifications for 2024/25.

Tables

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Table 1. TCSAM02 models parameters at bounds.

		name	label	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
likelihood	Dirichlet-Multinomial	pLnDirMul[1]	ln(theta) parameter for BSFRF SBS M	–	–	–	1	1	–
		pLnDirMul[2]	ln(theta) parameter for BSFRF SBS F	–	–	1	1	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.

			22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
process	name	label	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
recruitment	pLnR[1]	historical recruitment period	7.010	0.59	7.022	0.59	7.016	0.59	7.016	0.59	6.993	0.59	6.960	0.60
	pLnR[2]	current recruitment period	6.025	0.066	6.035	0.069	6.038	0.069	6.038	0.069	6.043	0.066	6.016	0.066
	pRa[1]	fixed value	2.181	0.031	2.180	0.031	2.186	0.031	2.186	0.031	2.192	0.031	2.201	0.030
	pRb[1]	fixed value	1.320	0.084	1.321	0.084	1.336	0.083	1.336	0.083	1.346	0.082	1.360	0.081
	pRCV[1]	full model period	-0.7000	NA	-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	0.000	NA
natural mortality	pDM1[1]	multiplier for immature crab	1.106	0.046	1.105	0.046	1.107	0.046	1.107	0.046	1.103	0.046	1.104	0.046
	pDM1[2]	multiplier for mature males	1.386	0.037	1.387	0.037	1.386	0.037	1.386	0.037	1.387	0.037	1.391	0.037
	pDM1[3]	multiplier for mature females	1.363	0.037	1.363	0.037	1.363	0.037	1.363	0.037	1.372	0.037	1.372	0.037
	pDM2[1]	1980-1984 multiplier for mature males	2.373	0.25	2.388	0.25	2.368	0.25	2.368	0.25	2.365	0.24	2.325	0.23
	pDM2[2]	1980-1984 multiplier for mature females	1.966	0.17	1.974	0.17	1.970	0.17	1.970	0.17	1.978	0.17	1.962	0.16
	pM[1]	base ln-scale M	-1.470	NA	-1.470	NA	-1.470	NA	-1.470	NA	-1.470	NA	-1.470	NA
growth	pGrA[1]	males	32.15	0.22	32.14	0.22	32.15	0.23	32.15	0.23	32.29	0.24	32.27	0.24
	pGrA[2]	females	33.46	0.29	33.44	0.28	33.44	0.29	33.44	0.29	33.61	0.31	33.66	0.31
	pGrB[1]	males	165.9	0.70	165.7	0.69	165.8	0.70	165.8	0.70	165.9	0.70	166.3	0.70
	pGrB[2]	females	115.1	0.59	115.1	0.58	115.1	0.59	115.1	0.59	115.1	0.60	115.1	0.61
	pGrBeta[1]	both sexes	0.7642	0.090	0.7542	0.088	0.7662	0.090	0.7660	0.090	0.8182	0.10	0.8488	0.10

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

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	-0.4886	1.8	-0.4936	1.8	-0.4894	1.8	-0.4893	1.8	-0.4812	1.8	-0.4902	1.8
2	-0.4879	1.6	-0.4931	1.6	-0.4887	1.6	-0.4886	1.6	-0.4804	1.6	-0.4895	1.7
3	-0.4862	1.5	-0.4915	1.5	-0.4870	1.5	-0.4870	1.5	-0.4788	1.5	-0.4879	1.5
4	-0.4833	1.4	-0.4886	1.4	-0.4840	1.4	-0.4840	1.4	-0.4759	1.4	-0.4852	1.4
5	-0.4786	1.3	-0.4839	1.3	-0.4794	1.3	-0.4794	1.3	-0.4714	1.3	-0.4808	1.3
6	-0.4717	1.2	-0.4768	1.2	-0.4725	1.2	-0.4725	1.2	-0.4645	1.2	-0.4742	1.2
7	-0.4616	1.1	-0.4665	1.1	-0.4626	1.1	-0.4626	1.1	-0.4547	1.1	-0.4647	1.1
8	-0.4475	0.97	-0.4520	0.97	-0.4486	0.97	-0.4486	0.97	-0.4410	0.97	-0.4513	0.98
9	-0.4280	0.90	-0.4321	0.89	-0.4293	0.90	-0.4293	0.90	-0.4220	0.90	-0.4327	0.90
10	-0.4015	0.84	-0.4052	0.84	-0.4029	0.84	-0.4029	0.84	-0.3961	0.84	-0.4072	0.84
11	-0.3659	0.81	-0.3690	0.81	-0.3674	0.81	-0.3674	0.81	-0.3614	0.81	-0.3725	0.81
12	-0.3184	0.80	-0.3209	0.80	-0.3199	0.80	-0.3199	0.80	-0.3151	0.80	-0.3258	0.80
13	-0.2548	0.82	-0.2563	0.82	-0.2559	0.82	-0.2559	0.82	-0.2532	0.82	-0.2625	0.82
14	-0.1680	0.86	-0.1679	0.86	-0.1681	0.86	-0.1682	0.86	-0.1688	0.86	-0.1753	0.86
15	-0.04586	0.90	-0.04321	0.90	-0.04438	0.90	-0.04440	0.90	-0.05046	0.90	-0.05186	0.91
16	0.1341	0.94	0.1410	0.94	0.1380	0.94	0.1380	0.94	0.1232	0.94	0.1297	0.94
17	0.4149	0.93	0.4272	0.93	0.4204	0.93	0.4205	0.93	0.3928	0.94	0.4090	0.94
18	0.8495	0.87	0.8654	0.87	0.8518	0.87	0.8519	0.87	0.8099	0.88	0.8339	0.89
19	1.412	0.77	1.425	0.77	1.402	0.77	1.402	0.77	1.358	0.78	1.380	0.79
20	1.653	0.66	1.654	0.66	1.643	0.66	1.643	0.66	1.643	0.67	1.654	0.67
21	1.109	0.69	1.101	0.69	1.115	0.68	1.115	0.68	1.149	0.69	1.157	0.69
22	0.5802	0.68	0.5754	0.68	0.5801	0.68	0.5800	0.68	0.5965	0.68	0.6000	0.69
23	0.3223	0.66	0.3207	0.66	0.3118	0.66	0.3117	0.66	0.3260	0.66	0.3358	0.67
24	-0.1393	0.66	-0.1403	0.66	-0.1446	0.66	-0.1447	0.66	-0.1153	0.67	-0.09246	0.67
25	-0.4770	0.66	-0.4722	0.66	-0.4671	0.66	-0.4671	0.66	-0.4645	0.67	-0.4496	0.67
26	-0.07037	0.69	-0.05667	0.68	-0.04926	0.69	-0.04908	0.69	-0.1036	0.69	-0.1056	0.70

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

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	1.397	0.31	1.399	0.31	1.382	0.32	1.382	0.32	1.360	0.31	1.339	0.32
2	2.002	0.20	2.013	0.20	2.011	0.20	2.011	0.20	1.962	0.20	1.956	0.20
3	1.587	0.23	1.590	0.23	1.581	0.24	1.581	0.24	1.579	0.23	1.572	0.23
4	0.5054	0.45	0.5046	0.46	0.5281	0.45	0.5280	0.45	0.5442	0.43	0.5632	0.43
5	-0.08843	0.52	-0.07815	0.52	-0.09264	0.53	-0.09251	0.53	-0.1317	0.53	-0.1558	0.53
6	-0.1664	0.41	-0.1609	0.41	-0.1658	0.41	-0.1657	0.41	-0.1993	0.41	-0.2070	0.41
7	0.03255	0.29	0.03900	0.29	0.02871	0.29	0.02879	0.29	-0.02550	0.29	-0.03973	0.29
8	-0.1320	0.29	-0.1293	0.29	-0.1416	0.29	-0.1416	0.29	-0.1773	0.29	-0.1927	0.29
9	1.113	0.12	1.118	0.12	1.108	0.12	1.108	0.12	1.049	0.12	1.044	0.12
10	0.7879	0.17	0.7900	0.17	0.7741	0.17	0.7741	0.17	0.7455	0.17	0.7401	0.17
11	0.8869	0.17	0.8831	0.17	0.8771	0.17	0.8771	0.17	0.8677	0.17	0.8817	0.17
12	0.9601	0.15	0.9616	0.15	0.9537	0.15	0.9537	0.15	0.9172	0.15	0.9181	0.16
13	0.7638	0.17	0.7611	0.17	0.7576	0.17	0.7576	0.17	0.7431	0.17	0.7504	0.17
14	0.2877	0.21	0.2772	0.22	0.2874	0.22	0.2872	0.22	0.3029	0.21	0.3312	0.21
15	-0.3902	0.25	-0.3911	0.26	-0.3905	0.26	-0.3905	0.26	-0.4129	0.26	-0.4062	0.26
16	-1.115	0.35	-1.117	0.35	-1.119	0.35	-1.119	0.35	-1.130	0.35	-1.118	0.35
17	-1.404	0.33	-1.408	0.33	-1.407	0.33	-1.407	0.33	-1.418	0.33	-1.402	0.33
18	-1.285	0.26	-1.284	0.26	-1.284	0.26	-1.284	0.26	-1.326	0.26	-1.317	0.26
19	-1.271	0.26	-1.270	0.26	-1.279	0.26	-1.279	0.26	-1.318	0.26	-1.317	0.26
20	-1.112	0.25	-1.110	0.25	-1.111	0.25	-1.111	0.25	-1.154	0.25	-1.146	0.25
21	-0.5988	0.18	-0.5968	0.18	-0.6012	0.18	-0.6012	0.18	-0.6514	0.18	-0.6497	0.18
22	-0.8394	0.24	-0.8407	0.24	-0.8477	0.24	-0.8477	0.24	-0.8780	0.24	-0.8782	0.24
23	0.05852	0.12	0.05917	0.12	0.05699	0.12	0.05702	0.12	0.01938	0.12	0.02524	0.12
24	-0.9446	0.25	-0.9440	0.25	-0.9517	0.25	-0.9516	0.25	-0.9809	0.25	-0.9865	0.25
25	0.6347	0.098	0.6364	0.10	0.6304	0.10	0.6305	0.10	0.5815	0.099	0.5806	0.099
26	-0.5581	0.30	-0.5609	0.30	-0.5654	0.30	-0.5654	0.30	-0.5705	0.29	-0.5720	0.29
27	0.9950	0.10	0.9955	0.10	0.9928	0.10	0.9929	0.10	0.9510	0.10	0.9543	0.10
28	-0.2054	0.29	-0.2025	0.29	-0.2162	0.29	-0.2161	0.29	-0.2545	0.29	-0.2663	0.29
29	1.082	0.11	1.080	0.11	1.078	0.11	1.077	0.11	1.052	0.11	1.058	0.11
30	0.4330	0.16	0.4313	0.16	0.4345	0.16	0.4345	0.16	0.4297	0.16	0.4481	0.15
31	-0.6368	0.28	-0.6381	0.28	-0.6491	0.28	-0.6491	0.28	-0.6601	0.28	-0.6667	0.28
32	-1.127	0.37	-1.131	0.38	-1.135	0.38	-1.135	0.38	-1.140	0.37	-1.121	0.37
33	-0.5224	0.27	-0.5204	0.27	-0.5262	0.27	-0.5262	0.27	-0.5744	0.27	-0.5692	0.26
34	0.07660	0.26	0.08733	0.26	0.05448	0.26	0.05477	0.26	-0.03869	0.26	-0.08877	0.27
35	1.358	0.10	1.355	0.10	1.355	0.10	1.355	0.10	1.331	0.098	1.341	0.097

(continued)

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
36	0.2690	0.20	0.2590	0.21	0.2569	0.21	0.2566	0.21	0.3040	0.20	0.3290	0.20
37	-0.4255	0.21	-0.4305	0.21	-0.4341	0.21	-0.4343	0.21	-0.4303	0.21	-0.4083	0.21
38	-1.634	0.38	-1.636	0.38	-1.651	0.38	-1.651	0.38	-1.663	0.38	-1.660	0.38
39	-0.7223	0.15	-0.7266	0.15	-0.7326	0.15	-0.7327	0.15	-0.7369	0.15	-0.7161	0.15
40	-1.465	0.24	-1.467	0.24	-1.473	0.24	-1.473	0.24	-1.482	0.23	-1.467	0.24
41	-1.317	0.21	-1.318	0.21	-1.336	0.21	-1.336	0.21	-1.353	0.21	-1.359	0.21
42	-0.6508	0.14	-0.6524	0.14	-0.6671	0.14	-0.6671	0.14	-0.6877	0.14	-0.6903	0.14
43	0.7791	0.073	0.7786	0.076	0.7584	0.076	0.7583	0.076	0.7638	0.073	0.7621	0.074
44	0.1641	0.13	0.1747	0.13	0.1511	0.13	0.1514	0.13	0.1916	0.13	0.2075	0.13
45	0.2323	0.14	0.2291	0.14	0.2525	0.14	0.2528	0.14	0.3430	0.14	0.3513	0.14
46	-1.490	0.57	-1.509	0.57	-1.333	0.58	-1.333	0.58	-1.048	0.59	-1.158	0.59
47	0.8692	0.14	0.8713	0.14	0.9543	0.14	0.9543	0.14	1.185	0.14	1.162	0.14
48	1.501	0.15	1.501	0.15	1.507	0.15	1.507	0.15	1.703	0.14	1.732	0.14
49	1.326	0.23	1.327	0.23	1.338	0.23	1.338	0.23	1.475	0.19	1.462	0.19
50	–	–	-7.732e-05	0.99	0.000	0.99	0.000	0.99	0.04164	0.45	0.05030	0.44

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.

			22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5
label	index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
females 50-105 mmCW (entire model period)	1	-5.316	1.2	-5.316	1.2	-5.333	1.2	-5.333	1.2	-5.299	1.2	-5.302	1.2
	2	-4.094	0.56	-4.094	0.56	-4.099	0.56	-4.099	0.56	-4.083	0.56	-4.084	0.56
	3	-2.905	0.25	-2.906	0.25	-2.900	0.25	-2.900	0.25	-2.896	0.25	-2.895	0.25
	4	-1.698	0.15	-1.699	0.15	-1.693	0.14	-1.693	0.14	-1.682	0.15	-1.682	0.15
	5	-0.5676	0.090	-0.5678	0.090	-0.5681	0.090	-0.5681	0.090	-0.5432	0.090	-0.5442	0.090
	6	0.2696	0.090	0.2691	0.090	0.2693	0.090	0.2693	0.090	0.2980	0.090	0.2982	0.091
	7	0.5851	0.10	0.5853	0.10	0.5850	0.10	0.5850	0.10	0.6032	0.10	0.6017	0.10
	8	1.075	0.14	1.075	0.14	1.075	0.14	1.075	0.14	1.094	0.14	1.094	0.14
	9	1.974	0.23	1.973	0.23	1.974	0.23	1.974	0.23	1.999	0.23	2.001	0.23
	10	2.918	0.45	2.914	0.44	2.915	0.44	2.915	0.44	2.952	0.46	2.961	0.46
	11	3.911	1.0	3.904	1.0	3.904	1.0	3.905	1.0	3.949	1.0	3.964	1.0
males 60-150 mmCW (entire model period)	1	-2.933	0.20	-2.931	0.20	-2.931	0.20	-2.931	0.20	-2.941	0.20	-3.162	0.21
	2	-3.576	0.30	-3.574	0.30	-3.567	0.30	-3.567	0.30	-3.558	0.30	-3.722	0.31
	3	-3.018	0.25	-3.022	0.25	-3.014	0.25	-3.014	0.25	-3.002	0.25	-3.164	0.26
	4	-2.149	0.13	-2.151	0.13	-2.154	0.13	-2.154	0.13	-2.151	0.13	-2.230	0.13
	5	-1.349	0.11	-1.349	0.11	-1.349	0.11	-1.349	0.11	-1.340	0.11	-1.564	0.12
	6	-1.246	0.10	-1.242	0.10	-1.246	0.10	-1.246	0.10	-1.244	0.10	-1.313	0.10
	7	-0.7775	0.095	-0.7761	0.094	-0.7739	0.094	-0.7739	0.094	-0.7602	0.095	-0.7913	0.095
	8	-0.2316	0.085	-0.2393	0.085	-0.2429	0.085	-0.2429	0.085	-0.2431	0.086	-0.2803	0.086
	9	-0.2150	0.087	-0.2201	0.086	-0.2227	0.086	-0.2227	0.086	-0.2192	0.087	-0.1960	0.088
	10	0.1474	0.088	0.1469	0.087	0.1462	0.088	0.1461	0.088	0.1463	0.088	0.1521	0.088
	11	0.5436	0.092	0.5452	0.092	0.5423	0.092	0.5423	0.092	0.5402	0.093	0.5834	0.094
	12	0.9954	0.11	1.002	0.11	1.009	0.11	1.009	0.11	1.022	0.12	1.088	0.12
	13	1.594	0.14	1.595	0.14	1.601	0.14	1.601	0.14	1.612	0.14	1.682	0.14
	14	2.619	0.26	2.612	0.26	2.618	0.26	2.618	0.26	2.618	0.26	2.706	0.26
	15	3.103	0.28	3.099	0.28	3.105	0.28	3.104	0.28	3.107	0.28	3.147	0.28
	16	3.647	0.48	3.656	0.48	3.665	0.48	3.665	0.48	3.679	0.48	3.652	0.47
	17	4.671	1.1	4.696	1.1	4.710	1.1	4.710	1.1	4.731	1.1	4.665	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.

			22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
process	name	label	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
fisheries	pDC2[1]	TCF: female offset	-2.778	0.21	-2.825	0.21	-2.822	0.21	-2.822	0.21	-2.812	0.20	-2.798	0.20
	pDC2[2]	SCF: female offset	-2.704	0.34	-2.707	0.34	-2.705	0.34	-2.705	0.34	-2.697	0.34	-2.670	0.34
	pDC2[3]	GTF: female offset	-1.080	0.098	-1.087	0.099	-1.087	0.098	-1.088	0.098	-1.075	0.097	-1.044	0.092
	pDC2[4]	RKF: female offset	-2.409	0.84	-2.431	0.84	-2.432	0.84	-2.433	0.84	-2.427	0.84	-2.418	0.84
	pHM[1]	handling mortality for pot fisheries	0.3210	NA	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	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	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	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	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	-2.996	NA
	pLnC[2]	TCF: base capture rate, 1965+	-1.472	0.12	-1.521	0.12	-1.514	0.12	-1.514	0.12	-1.515	0.12	-1.500	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	-4.605	NA
	pLnC[4]	SCF: base capture rate, 1992+	-3.720	0.068	-3.728	0.068	-3.730	0.068	-3.730	0.068	-3.722	0.068	-3.730	0.068
	pLnC[5]	DUMMY CAPTURE RATE	-4.181	NA	-4.181	NA	-4.181	NA	-4.181	NA	-4.181	NA	-4.181	NA
	pLnC[6]	GTF: base capture rate, ALL YEARS	-4.979	0.059	-4.983	0.059	-5.021	0.058	-5.021	0.058	-5.018	0.058	-5.032	0.057
	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	-3.912	NA
	pLnC[8]	RKF: base capture rate, 1992+	-4.698	0.11	-4.693	0.11	-4.699	0.11	-4.796	0.11	-4.795	0.11	-4.798	0.11
surveys	pQ[1]	NMFS trawl survey: males, 1975-1981	-0.7328	0.11	-0.7419	0.11	-0.7234	0.11	-0.7235	0.11	-0.7176	0.11	-0.7080	0.11
	pQ[2]	NMFS trawl survey: males, 1982+	-0.6786	0.048	-0.6844	0.048	-0.6861	0.048	-0.6862	0.048	-0.6802	0.048	-0.6834	0.048
	pQ[3]	NMFS trawl survey: females, 1975-1981	-1.138	0.13	-1.156	0.13	-1.144	0.13	-1.144	0.13	-1.123	0.13	-1.100	0.13
	pQ[4]	NMFS trawl survey: females, 1982+	-1.348	0.072	-1.358	0.072	-1.356	0.072	-1.356	0.072	-1.317	0.072	-1.301	0.071
	pQ[5]	BSFRF SBS	0.000	NA	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	10.68	6.2	10.72	10.	10.75	6.1	11.00	0.32	11.00	0.70	10.68	NA
	pLnDirMul[2]	ln(theta) parameter for BSFRF SBS F	11.00	1.3	11.00	0.98	11.00	0.82	11.00	0.068	11.00	0.067	10.99	NA

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.

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	-1.329	0.89	-1.276	0.89	-1.286	0.89	-1.286	0.89	-1.294	0.89	-1.287	0.89
2	-1.119	0.73	-1.066	0.74	-1.075	0.73	-1.075	0.73	-1.083	0.73	-1.076	0.73
3	0.7252	0.67	0.7779	0.67	0.7683	0.67	0.7683	0.67	0.7600	0.67	0.7694	0.68
4	1.304	0.65	1.357	0.65	1.346	0.65	1.347	0.65	1.337	0.65	1.351	0.65
5	2.462	0.91	2.514	0.91	2.501	0.90	2.501	0.90	2.483	0.88	2.520	0.94
6	4.130	0.76	4.144	0.74	4.122	0.74	4.122	0.74	4.107	0.76	4.177	0.73
7	4.589	0.88	4.589	0.85	4.635	0.73	4.635	0.73	4.623	0.76	4.723	0.67
8	1.995	1.3	2.042	1.3	2.152	1.2	2.152	1.2	2.132	1.2	2.212	1.2
9	0.04222	0.36	0.09227	0.36	0.1303	0.34	0.1303	0.34	0.1321	0.34	0.1312	0.34
10	-0.2848	0.22	-0.2369	0.21	-0.2149	0.21	-0.2149	0.21	-0.2091	0.21	-0.2104	0.21
11	-0.1462	0.18	-0.09863	0.18	-0.08341	0.18	-0.08343	0.18	-0.07675	0.18	-0.07379	0.18
12	0.6120	0.18	0.6596	0.18	0.6756	0.18	0.6756	0.18	0.6827	0.17	0.6904	0.17
13	1.349	0.21	1.395	0.20	1.424	0.20	1.424	0.20	1.434	0.20	1.454	0.20
14	1.574	0.28	1.615	0.28	1.665	0.28	1.665	0.28	1.683	0.28	1.723	0.28
15	1.976	0.34	2.009	0.34	2.065	0.34	2.064	0.34	2.095	0.34	2.146	0.35
16	1.831	0.26	1.880	0.26	1.902	0.26	1.902	0.26	1.907	0.25	1.914	0.25
17	0.2300	0.15	0.2870	0.15	0.2778	0.15	0.2778	0.15	0.2732	0.15	0.2556	0.15
18	-0.9143	0.13	-0.8624	0.13	-0.8755	0.13	-0.8755	0.13	-0.8679	0.13	-0.8804	0.13
19	-2.344	0.13	-2.294	0.13	-2.309	0.13	-2.309	0.13	-2.295	0.13	-2.306	0.13
20	-1.020	0.15	-0.9679	0.14	-0.9891	0.14	-0.9891	0.14	-0.9725	0.14	-0.9879	0.14
21	-1.380	0.13	-1.330	0.12	-1.346	0.12	-1.346	0.12	-1.335	0.12	-1.346	0.12
22	-0.4168	0.13	-0.3652	0.12	-0.3802	0.12	-0.3802	0.12	-0.3742	0.12	-0.3883	0.12
23	0.7545	0.13	0.8054	0.12	0.7946	0.12	0.7946	0.12	0.8057	0.12	0.7957	0.12
24	1.521	0.14	1.574	0.13	1.565	0.13	1.565	0.13	1.575	0.13	1.563	0.13
25	1.854	0.16	1.933	0.16	1.923	0.16	1.923	0.16	1.925	0.16	1.907	0.16
26	2.178	0.17	2.253	0.17	2.244	0.17	2.244	0.17	2.252	0.17	2.235	0.17
27	1.722	0.17	1.802	0.17	1.791	0.17	1.791	0.17	1.799	0.17	1.787	0.17
28	0.9640	0.18	1.041	0.18	1.027	0.18	1.027	0.18	1.036	0.18	1.028	0.18
29	0.3608	0.17	0.4319	0.17	0.4176	0.17	0.4177	0.17	0.4358	0.17	0.4313	0.17
30	0.2909	0.22	0.3680	0.23	0.3534	0.23	0.3534	0.23	0.3739	0.23	0.3685	0.23
31	-2.352	0.13	-2.300	0.12	-2.315	0.12	-2.315	0.12	-2.311	0.12	-2.332	0.12
32	-1.724	0.13	-1.673	0.12	-1.687	0.12	-1.687	0.12	-1.687	0.12	-1.708	0.12
33	-1.909	0.13	-1.858	0.12	-1.871	0.12	-1.871	0.12	-1.866	0.12	-1.885	0.12
34	-2.056	0.13	-2.003	0.12	-2.018	0.12	-2.018	0.12	-2.019	0.12	-2.039	0.12

(continued)

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
35	-2.082	0.15	-2.022	0.15	-2.036	0.14	-2.036	0.14	-2.038	0.14	-2.051	0.14
36	-1.915	0.13	-1.869	0.13	-1.882	0.13	-1.882	0.13	-1.882	0.13	-1.900	0.13
37	-0.6325	0.13	-0.5867	0.12	-0.5992	0.12	-0.5993	0.12	-0.6066	0.12	-0.6279	0.12
38	-0.3398	0.13	-0.2956	0.12	-0.3059	0.12	-0.3059	0.12	-0.3096	0.12	-0.3274	0.12
39	-2.051	0.13	-2.007	0.12	-2.016	0.12	-2.016	0.12	-2.018	0.12	-2.033	0.12
40	-1.889	0.13	-1.846	0.12	-1.854	0.12	-1.854	0.12	-1.857	0.12	-1.875	0.12
41	-2.074	0.13	-2.030	0.12	-2.038	0.12	-2.038	0.12	-2.045	0.12	-2.065	0.12
42	-2.406	0.13	-2.360	0.12	-2.370	0.12	-2.370	0.12	-2.395	0.12	-2.423	0.12
43	-2.080	0.13	-2.034	0.13	-2.039	0.12	-2.039	0.12	-2.079	0.12	-2.105	0.12
44	–	–	-2.189	0.12	-2.190	0.12	-2.190	0.12	-2.235	0.12	-2.256	0.12

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

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	1.489	0.20	1.493	0.20	1.495	0.20	1.495	0.20	1.496	0.20	1.495	0.20
2	1.739	0.20	1.744	0.20	1.746	0.20	1.746	0.20	1.746	0.20	1.745	0.20
3	0.7310	0.19	0.7345	0.19	0.7358	0.19	0.7358	0.19	0.7375	0.19	0.7345	0.19
4	1.118	0.18	1.120	0.18	1.120	0.18	1.120	0.18	1.123	0.18	1.119	0.18
5	0.5464	0.18	0.5478	0.18	0.5468	0.18	0.5468	0.18	0.5515	0.18	0.5489	0.18
6	0.4709	0.19	0.4714	0.19	0.4700	0.19	0.4699	0.19	0.4771	0.19	0.4753	0.19
7	1.317	0.20	1.317	0.20	1.315	0.20	1.315	0.20	1.323	0.20	1.321	0.20
8	1.075	0.21	1.072	0.21	1.071	0.21	1.071	0.21	1.081	0.21	1.083	0.21
9	0.1439	0.20	0.1413	0.20	0.1402	0.20	0.1402	0.20	0.1493	0.20	0.1492	0.20
10	-1.466	0.21	-1.468	0.21	-1.470	0.21	-1.470	0.21	-1.461	0.21	-1.462	0.21
11	-0.7188	0.21	-0.7203	0.22	-0.7222	0.21	-0.7222	0.21	-0.7157	0.21	-0.7177	0.21
12	-0.2627	0.21	-0.2636	0.21	-0.2656	0.21	-0.2656	0.21	-0.2618	0.21	-0.2641	0.21
13	-1.549	0.21	-1.550	0.21	-1.551	0.21	-1.551	0.21	-1.548	0.21	-1.550	0.21
14	-2.666	0.24	-2.666	0.24	-2.668	0.24	-2.668	0.24	-2.665	0.24	-2.667	0.24
15	-1.980	0.19	-1.980	0.19	-1.981	0.19	-1.982	0.19	-1.978	0.19	-1.979	0.19
16	-0.01235	0.20	-0.01242	0.20	-0.01507	0.20	-0.01507	0.20	-0.01366	0.20	-0.01337	0.20
17	0.1269	0.19	0.1263	0.19	0.1249	0.19	0.1248	0.19	0.1288	0.19	0.1315	0.19
18	0.1683	0.19	0.1682	0.19	0.1661	0.19	0.1661	0.19	0.1673	0.19	0.1683	0.19
19	-0.4592	0.20	-0.4597	0.20	-0.4607	0.20	-0.4607	0.20	-0.4607	0.20	-0.4585	0.20
20	-0.08026	0.20	-0.08217	0.20	-0.08203	0.20	-0.08204	0.20	-0.07722	0.20	-0.07280	0.20
21	0.02084	0.20	0.01834	0.20	0.01904	0.20	0.01902	0.20	0.02595	0.20	0.03084	0.20
22	0.5752	0.20	0.5732	0.20	0.5735	0.20	0.5735	0.20	0.5795	0.20	0.5841	0.20
23	0.2844	0.20	0.2837	0.20	0.2833	0.20	0.2833	0.20	0.2850	0.20	0.2875	0.20
24	0.2183	0.20	0.2196	0.20	0.2184	0.20	0.2185	0.20	0.2118	0.20	0.2125	0.20
25	1.043	0.19	1.045	0.19	1.045	0.19	1.045	0.19	1.038	0.19	1.043	0.19
26	0.8396	0.19	0.8400	0.19	0.8416	0.19	0.8416	0.19	0.8368	0.19	0.8413	0.19
27	0.6668	0.20	0.6659	0.20	0.6685	0.20	0.6685	0.20	0.6642	0.20	0.6668	0.20
28	0.04729	0.20	0.04620	0.20	0.04892	0.20	0.04894	0.20	0.04380	0.20	0.04418	0.20
29	0.05799	0.20	0.05689	0.20	0.05985	0.20	0.05987	0.20	0.05349	0.20	0.05323	0.20
30	0.3811	0.20	0.3799	0.20	0.3831	0.20	0.3831	0.20	0.3756	0.20	0.3750	0.20
31	-1.599	0.21	-1.598	0.21	-1.596	0.21	-1.596	0.21	-1.615	0.21	-1.620	0.21
32	-2.268	0.23	-2.265	0.23	-2.261	0.23	-2.260	0.23	-2.298	0.23	-2.304	0.23

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

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	3.755	0.23	3.759	0.23	3.764	0.23	3.861	0.23	3.868	0.23	3.875	0.23
2	3.449	0.24	3.462	0.24	3.466	0.24	3.563	0.25	3.565	0.25	3.567	0.25
3	3.236	0.25	3.247	0.25	3.252	0.25	3.349	0.25	3.355	0.25	3.359	0.25
4	4.149	0.23	4.156	0.23	4.160	0.23	4.257	0.23	4.264	0.23	4.269	0.23
5	2.190	0.24	2.195	0.24	2.194	0.24	2.291	0.24	2.307	0.24	2.316	0.24
6	0.9380	0.26	0.9337	0.26	0.9316	0.26	1.029	0.26	1.041	0.26	1.041	0.26
7	0.6875	0.26	0.6834	0.26	0.6808	0.26	0.7779	0.26	0.7896	0.26	0.7882	0.27
8	0.2710	0.27	0.2673	0.27	0.2641	0.27	0.3611	0.28	0.3710	0.28	0.3673	0.28
9	0.04932	0.28	0.04619	0.28	0.04292	0.28	0.1400	0.28	0.1482	0.28	0.1436	0.28
10	-0.5409	0.34	-0.5433	0.34	-0.5470	0.34	-0.4500	0.35	-0.4451	0.35	-0.4514	0.35
11	-0.3482	0.28	-0.3500	0.28	-0.3532	0.28	-0.2562	0.28	-0.2538	0.28	-0.2595	0.28
12	-0.6447	0.29	-0.6466	0.29	-0.6499	0.29	-0.5528	0.29	-0.5509	0.29	-0.5569	0.29
13	-0.9665	0.30	-0.9680	0.30	-0.9704	0.30	-0.8733	0.30	-0.8720	0.30	-0.8766	0.30
14	-1.323	0.33	-1.323	0.33	-1.326	0.33	-1.231	0.33	-1.230	0.33	-1.232	0.33
15	-1.817	0.43	-1.818	0.43	-1.820	0.43	-1.725	0.43	-1.725	0.43	-1.727	0.43
16	-1.274	0.26	-1.275	0.26	-1.277	0.26	-1.182	0.26	-1.180	0.26	-1.181	0.26
17	0.1166	0.22	0.1161	0.22	0.1142	0.22	0.2091	0.22	0.2073	0.22	0.2055	0.22
18	-0.3581	0.22	-0.3595	0.22	-0.3600	0.22	-0.2649	0.22	-0.2646	0.22	-0.2631	0.22
19	-2.029	0.41	-2.031	0.42	-2.030	0.42	-1.935	0.42	-1.930	0.42	-1.925	0.42
20	-2.468	0.69	-2.472	0.69	-2.470	0.69	-2.374	0.70	-2.368	0.70	-2.363	0.70
21	-1.423	0.32	-1.426	0.32	-1.425	0.32	-1.330	0.32	-1.326	0.32	-1.322	0.33
22	-0.3780	0.23	-0.3784	0.23	-0.3793	0.23	-0.2844	0.23	-0.2877	0.23	-0.2892	0.23
23	0.2887	0.22	0.2894	0.22	0.2884	0.22	0.3833	0.22	0.3732	0.22	0.3700	0.22
24	-0.1311	0.22	-0.1318	0.22	-0.1308	0.22	-0.03573	0.22	-0.04339	0.22	-0.04319	0.22
25	-0.1731	0.22	-0.1748	0.22	-0.1722	0.22	-0.07706	0.22	-0.08249	0.22	-0.08059	0.22
26	0.04023	0.22	0.03836	0.22	0.04145	0.22	0.1367	0.22	0.1317	0.22	0.1336	0.22
27	-0.6562	0.25	-0.6578	0.25	-0.6548	0.25	-0.5595	0.25	-0.5661	0.25	-0.5653	0.25
28	-1.877	0.68	-1.877	0.68	-1.875	0.68	-1.779	0.68	-1.787	0.68	-1.786	0.68
29	-2.763	1.3	-2.760	1.3	-2.760	1.3	-2.665	1.3	-2.677	1.3	-2.678	1.3
30	–	–	–	–	–	–	-2.782	1.1	-2.832	1.1	-2.836	1.1

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

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	1.451	0.23	1.445	0.23	1.572	0.17	1.572	0.17	1.578	0.17	1.599	0.17
2	1.789	0.21	1.783	0.21	1.802	0.16	1.802	0.16	1.809	0.16	1.831	0.16
3	0.9535	0.21	0.9479	0.21	0.9876	0.16	0.9876	0.16	0.9946	0.16	1.018	0.15
4	0.4276	0.21	0.4219	0.21	0.5812	0.15	0.5812	0.15	0.5895	0.15	0.6122	0.15
5	0.1015	0.21	0.09548	0.21	0.2218	0.15	0.2218	0.15	0.2296	0.15	0.2508	0.15
6	-0.1812	0.21	-0.1872	0.21	0.02103	0.16	0.02098	0.16	0.02775	0.16	0.04728	0.15
7	0.4082	0.21	0.4020	0.21	0.5090	0.16	0.5089	0.16	0.5156	0.16	0.5368	0.16
8	0.04769	0.21	0.04331	0.21	0.02941	0.16	0.02936	0.16	0.03770	0.16	0.05682	0.16
9	-0.1211	0.20	-0.1242	0.20	-0.04316	0.15	-0.04321	0.15	-0.03144	0.15	-0.01527	0.15
10	-1.051	0.20	-1.053	0.20	-0.8886	0.15	-0.8887	0.15	-0.8738	0.15	-0.8601	0.15
11	-0.3089	0.20	-0.3100	0.20	-0.4088	0.15	-0.4088	0.15	-0.3910	0.15	-0.3805	0.15
12	-0.02454	0.21	-0.02424	0.21	-0.1074	0.16	-0.1074	0.16	-0.08985	0.16	-0.08338	0.15
13	-0.5148	0.20	-0.5150	0.21	-0.5012	0.15	-0.5012	0.15	-0.4873	0.15	-0.4822	0.15
14	-0.2561	0.20	-0.2570	0.20	-0.3098	0.15	-0.3098	0.15	-0.2990	0.15	-0.2927	0.15
15	-0.3682	0.20	-0.3680	0.20	-0.4459	0.15	-0.4459	0.15	-0.4388	0.15	-0.4426	0.15
16	-0.8683	0.20	-0.8680	0.20	-0.9339	0.15	-0.9339	0.15	-0.9295	0.15	-0.9339	0.15
17	-0.5812	0.20	-0.5804	0.20	-0.5179	0.15	-0.5179	0.15	-0.5150	0.15	-0.5198	0.15
18	-0.2061	0.20	-0.2040	0.20	-0.1083	0.15	-0.1083	0.15	-0.1062	0.15	-0.1114	0.15
19	0.6266	0.15	0.6290	0.15	0.6702	0.15	0.6702	0.15	0.6729	0.15	0.6683	0.15
20	0.8864	0.15	0.8880	0.15	0.9283	0.15	0.9283	0.15	0.9327	0.15	0.9291	0.15
21	0.6013	0.15	0.6022	0.15	0.6418	0.15	0.6418	0.15	0.6479	0.15	0.6450	0.15
22	1.036	0.15	1.037	0.15	1.076	0.15	1.076	0.15	1.085	0.15	1.083	0.15
23	0.9477	0.15	0.9474	0.15	0.9866	0.15	0.9866	0.15	0.9973	0.15	0.9958	0.15
24	1.125	0.15	1.125	0.15	1.164	0.15	1.164	0.15	1.176	0.15	1.174	0.15
25	1.595	0.15	1.595	0.15	1.608	0.15	1.608	0.15	1.619	0.15	1.614	0.15
26	1.458	0.15	1.458	0.15	1.470	0.15	1.470	0.15	1.482	0.15	1.475	0.15
27	0.9319	0.15	0.9323	0.15	0.9439	0.15	0.9439	0.15	0.9549	0.15	0.9467	0.15
28	0.9709	0.15	0.9718	0.15	0.9830	0.15	0.9830	0.15	0.9917	0.15	0.9828	0.15
29	1.195	0.15	1.196	0.15	1.207	0.15	1.207	0.15	1.215	0.15	1.206	0.15
30	0.4900	0.15	0.4915	0.15	0.5025	0.15	0.5025	0.15	0.5091	0.15	0.4999	0.15
31	-0.05436	0.15	-0.05263	0.15	-0.04151	0.15	-0.04150	0.15	-0.03567	0.15	-0.04478	0.15
32	0.2369	0.15	0.2389	0.15	0.2504	0.15	0.2504	0.15	0.2551	0.15	0.2464	0.15
33	-0.09391	0.15	-0.09189	0.15	-0.07984	0.15	-0.07983	0.15	-0.07627	0.15	-0.08458	0.15
34	-0.1214	0.15	-0.1194	0.15	-0.1064	0.15	-0.1064	0.15	-0.1036	0.15	-0.1111	0.15
35	-0.03104	0.15	-0.02905	0.15	-0.01491	0.15	-0.01490	0.15	-0.01324	0.15	-0.02027	0.15

(continued)

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
36	-0.3694	0.15	-0.3679	0.15	-0.3514	0.15	-0.3514	0.15	-0.3488	0.15	-0.3534	0.14
37	-0.7433	0.14	-0.7425	0.15	-0.7244	0.14	-0.7244	0.14	-0.7185	0.14	-0.7209	0.14
38	-1.076	0.14	-1.076	0.14	-1.058	0.14	-1.058	0.14	-1.051	0.14	-1.053	0.14
39	-0.7615	0.14	-0.7604	0.14	-0.7442	0.14	-0.7442	0.14	-0.7400	0.14	-0.7442	0.14
40	-1.236	0.15	-1.234	0.15	-1.220	0.14	-1.220	0.14	-1.221	0.14	-1.228	0.14
41	-0.6715	0.15	-0.6682	0.15	-0.6536	0.15	-0.6536	0.15	-0.6595	0.15	-0.6683	0.14
42	-0.5930	0.15	-0.5899	0.15	-0.5723	0.14	-0.5723	0.14	-0.5789	0.14	-0.5856	0.14
43	-0.7295	0.14	-0.7271	0.14	-0.7071	0.14	-0.7070	0.14	-0.7124	0.14	-0.7171	0.14
44	-0.6325	0.14	-0.6305	0.14	-0.6094	0.14	-0.6093	0.14	-0.6142	0.14	-0.6185	0.14
45	-1.194	0.14	-1.192	0.14	-1.170	0.14	-1.170	0.14	-1.176	0.14	-1.181	0.14
46	-0.8827	0.14	-0.8807	0.14	-0.8598	0.14	-0.8597	0.14	-0.8685	0.14	-0.8748	0.14
47	-0.7488	0.15	-0.7463	0.15	-0.7272	0.14	-0.7271	0.14	-0.7435	0.14	-0.7521	0.14
48	-0.8257	0.15	-0.8225	0.15	-0.8055	0.15	-0.8054	0.15	-0.8351	0.15	-0.8464	0.15
49	-0.8615	0.15	-0.8585	0.15	-0.8437	0.15	-0.8436	0.15	-0.8942	0.15	-0.9053	0.15
50	-1.173	0.15	-1.171	0.15	-1.173	0.15	-1.173	0.15	-1.244	0.15	-1.254	0.15
51	–	–	–	–	-1.429	0.15	-1.429	0.15	-1.523	0.15	-1.530	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.

			22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5
name	label	est.	sd.	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	179.0	NA
pS1[10]	ascending z-at-1 for SCF selectivity (males, pre-1997)	160.2	2.6	160.2	2.5	160.2	2.5	160.2	2.5	160.2	2.6	160.3	2.4
pS1[11]	ascending z-at-1 for SCF selectivity (males, 1997-2004)	119.7	6.8	119.6	6.8	119.6	6.8	119.6	6.8	119.6	6.8	119.7	7.0
pS1[12]	ascending z-at-1 for SCF selectivity (males, 2005+)	125.1	1.3	125.1	1.3	125.1	1.3	125.1	1.3	125.1	1.3	125.3	1.3
pS1[13]	ascending z50 for SCF selectivity (females, pre-1997)	81.39	7.0	81.44	7.0	81.39	7.0	81.39	7.0	81.37	6.9	81.28	6.8
pS1[14]	ascending z50 for SCF selectivity (females, 1997-2004)	72.87	4.3	72.86	4.3	72.84	4.3	72.84	4.3	72.86	4.3	72.85	4.3
pS1[15]	ascending z50 for SCF selectivity (females, 2005+)	100.9	8.6	100.8	8.6	100.9	8.6	100.9	8.6	100.8	8.5	100.9	8.5
pS1[16]	z50 for GF.AllGear selectivity (males, pre-1987)	63.33	3.5	63.62	3.6	63.65	3.6	63.65	3.6	63.27	3.6	61.74	3.1
pS1[17]	z50 for GF.AllGear selectivity (males, 1987-1996)	75.21	6.8	75.60	6.8	75.76	6.7	75.76	6.7	75.23	6.7	72.50	6.5
pS1[18]	z50 for GF.AllGear selectivity (males, 1997+)	99.82	2.5	100.1	2.5	98.98	2.5	98.98	2.5	98.69	2.5	97.24	2.5
pS1[19]	z50 for GF.AllGear selectivity (females, pre-1987)	44.77	1.9	44.79	1.9	44.76	1.9	44.77	1.9	44.63	1.9	44.57	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	179.0	NA
pS1[20]	z50 for GF.AllGear selectivity (females, 1987-1996)	41.47	2.4	41.44	2.4	41.65	2.4	41.65	2.4	41.56	2.4	41.39	2.4
pS1[21]	z50 for GF.AllGear selectivity (females, 1997+)	87.45	3.1	87.42	3.1	86.53	3.1	86.54	3.1	86.53	3.0	86.28	3.0
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	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	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	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	139.9	NA
pS1[26]	size at 1 for RKF selectivity (females, 1997-2004)	136.8	39.	136.6	39.	136.5	39.	136.5	39.	136.3	39.	136.2	39.
pS1[27]	size at 1 for RKF selectivity (females, 2005+)	135.1	22.	134.9	22.	134.8	22.	134.9	22.	134.8	22.	134.8	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	137.6	0.28
pS1[29]	z50 for TCF retention (2013+)	125.2	0.81	125.1	0.79	125.1	0.79	125.1	0.79	125.1	0.78	125.1	0.78
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	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	129.9	NA
pS1[5]	z50 for TCF retention (pre-1991)	139.0	0.69	139.1	0.67	139.1	0.67	139.1	0.67	139.1	0.67	139.1	0.66
pS1[6]	z50 for TCF retention (1991-1996)	138.5	1.4	138.5	1.4	138.5	1.4	138.5	1.4	138.5	1.4	138.5	1.2
pS1[7]	DUMMY VALUE	4.500	NA	4.500	NA	4.500	NA	4.500	NA	4.500	NA	4.500	NA
pS1[8]	ln(z50) for TCF selectivity (males)	4.841	0.0061	4.838	0.0059	4.838	0.0059	4.838	0.0059	4.837	0.0059	4.838	0.0059
pS1[9]	z50 for TCF selectivity (females)	93.02	2.3	93.03	2.3	92.99	2.3	92.99	2.3	92.93	2.2	92.90	2.2

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.

			22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5
name	label	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
pS2[1]	width for NMFS survey selectivity (males, pre-1982)	63.62	2.2	63.50	2.2	63.27	2.2	63.27	2.2	63.64	2.2	64.18	2.2
pS2[10]	ascending width for SCF selectivity (males, pre-1997)	32.29	1.5	32.29	1.5	32.30	1.5	32.30	1.5	32.33	1.5	32.65	1.5
pS2[11]	ascending width for SCF selectivity (males, 1997-2004)	15.93	3.4	15.91	3.4	15.90	3.4	15.90	3.4	15.90	3.4	16.14	3.5
pS2[12]	ascending width for SCF selectivity (males, 2005+)	14.51	0.69	14.51	0.69	14.51	0.69	14.51	0.69	14.51	0.69	14.71	0.70
pS2[13]	slope for SCF selectivity (females, pre-1997)	0.1361	0.065	0.1357	0.065	0.1363	0.065	0.1363	0.065	0.1366	0.065	0.1371	0.065
pS2[14]	slope for SCF selectivity (females, 1997-2004)	0.3166	0.23	0.3169	0.23	0.3174	0.23	0.3174	0.23	0.3171	0.23	0.3171	0.23
pS2[15]	slope for SCF selectivity (females, 2005+)	0.09887	0.024	0.09902	0.024	0.09890	0.024	0.09890	0.024	0.09921	0.024	0.09882	0.024
pS2[16]	slope for GF.AllGear selectivity (males, pre-1987)	0.08540	0.010	0.08463	0.010	0.08443	0.010	0.08443	0.010	0.08484	0.010	0.08943	0.010
pS2[17]	slope for GF.AllGear selectivity (males, 1987-1996)	0.04445	0.0065	0.04411	0.0064	0.04434	0.0063	0.04434	0.0063	0.04446	0.0064	0.04668	0.0073
pS2[18]	slope for GF.AllGear selectivity (males, 1997+)	0.05953	0.0023	0.05939	0.0023	0.05976	0.0024	0.05975	0.0024	0.06006	0.0024	0.06058	0.0025
pS2[19]	slope for GF.AllGear selectivity (females, pre-1987)	0.1341	0.018	0.1339	0.018	0.1340	0.018	0.1340	0.018	0.1344	0.019	0.1343	0.019
pS2[2]	width for NMFS survey selectivity (males, 1982+)	83.97	2.3	83.87	2.3	83.95	2.3	83.95	2.3	83.96	2.3	84.99	2.4
pS2[20]	slope for GF.AllGear selectivity (females, 1987-1996)	0.1557	0.050	0.1559	0.050	0.1535	0.049	0.1535	0.049	0.1540	0.049	0.1563	0.049
pS2[21]	slope for GF.AllGear selectivity (females, 1997+)	0.06684	0.0041	0.06689	0.0042	0.06749	0.0042	0.06749	0.0042	0.06777	0.0042	0.06774	0.0042
pS2[22]	width for RKF selectivity (males, pre-1997)	19.80	0.79	19.74	0.79	19.74	0.79	19.74	0.79	19.75	0.79	19.73	0.79
pS2[23]	width for RKF selectivity (males, 1997-2004)	27.68	2.1	27.63	2.1	27.65	2.1	27.65	2.1	27.69	2.1	27.71	2.1
pS2[24]	width for RKF selectivity (males, 2005+)	27.17	0.95	27.11	0.94	27.14	0.94	27.16	0.94	27.21	0.95	27.20	0.95
pS2[25]	width for RKF selectivity (males, pre-1997)	17.90	2.3	17.90	2.3	17.92	2.3	17.92	2.3	17.93	2.3	17.95	2.3
pS2[26]	width for RKF selectivity (males, 1997-2004)	18.90	15.	18.85	15.	18.85	15.	18.84	15.	18.81	15.	18.79	15.
pS2[27]	width for RKF selectivity (males, 2005+)	17.91	7.8	17.86	7.8	17.87	7.8	17.88	7.8	17.86	7.8	17.87	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	1.990	NA
pS2[29]	slope for TCF retention (2013+)	0.3315	0.069	0.3285	0.065	0.3287	0.065	0.3287	0.065	0.3298	0.066	0.3312	0.066
pS2[3]	width for NMFS survey selectivity (females, pre-1982)	40.26	2.0	40.27	2.0	40.19	2.0	40.19	2.0	40.27	2.0	40.39	2.1
pS2[4]	width for NMFS survey selectivity (females, 1982+)	73.90	4.8	73.91	4.8	73.80	4.8	73.80	4.8	72.67	4.5	73.17	4.6
pS2[5]	slope for TCF retention (pre-1991)	0.7278	0.20	0.7133	0.19	0.7107	0.18	0.7106	0.18	0.7114	0.19	0.6959	0.17
pS2[6]	slope for TCF retention (1997+)	1.063	0.99	1.056	0.96	1.049	0.93	1.049	0.93	1.048	0.92	1.004	0.74
pS2[7]	slope for TCF selectivity (males, pre-1997)	0.1225	0.0066	0.1217	0.0065	0.1215	0.0066	0.1215	0.0065	0.1215	0.0066	0.1212	0.0066
pS2[8]	slope for TCF selectivity (males, 1997+)	0.1719	0.0073	0.1732	0.0071	0.1733	0.0071	0.1733	0.0071	0.1737	0.0071	0.1730	0.0071
pS2[9]	slope for TCF selectivity (females)	0.1952	0.025	0.1951	0.025	0.1954	0.025	0.1954	0.025	0.1962	0.025	0.1961	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.

		22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
name	label	est.	sd.	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	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	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	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	1.100	NA
pS4[2]	descending width for SCF selectivity (males, 1997-2004)	19.85	9.3	19.91	9.4	19.89	9.3	19.89	9.3	19.86	9.3	19.82	9.4
pS4[3]	descending width for SCF selectivity (males, 2005+)	13.31	1.4	13.34	1.4	13.34	1.4	13.34	1.4	13.32	1.3	13.17	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.

	22.03d		22.03d1		22.03d2		22.03d3		22.03d4		22.03d5	
index	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.	est.	sd.
1	0.1073	0.014	0.1139	0.014	0.1142	0.014	0.1142	0.014	0.1139	0.014	0.1138	0.014
2	0.08519	0.014	0.09164	0.014	0.09192	0.014	0.09193	0.014	0.09181	0.014	0.09158	0.014
3	0.1224	0.013	0.1291	0.013	0.1294	0.013	0.1294	0.013	0.1295	0.013	0.1297	0.013
4	0.1230	0.018	0.1298	0.018	0.1300	0.018	0.1300	0.018	0.1300	0.018	0.1305	0.018
5	0.09733	0.021	0.1045	0.021	0.1046	0.021	0.1046	0.021	0.1049	0.021	0.1058	0.021
6	0.2004	0.020	0.2060	0.021	0.2064	0.021	0.2064	0.021	0.2067	0.021	0.2069	0.021
7	-0.03060	0.014	-0.02760	0.013	-0.02770	0.013	-0.02770	0.013	-0.02798	0.013	-0.02782	0.013
8	-0.01413	0.013	-0.01107	0.013	-0.01135	0.013	-0.01135	0.013	-0.01231	0.013	-0.01218	0.013
9	-0.08162	0.013	-0.07876	0.013	-0.07886	0.013	-0.07886	0.013	-0.07883	0.013	-0.07863	0.013
10	0.03550	0.011	0.03888	0.011	0.03878	0.011	0.03878	0.011	0.03842	0.011	0.03836	0.011
11	0.1508	0.011	0.1547	0.011	0.1547	0.011	0.1547	0.011	0.1547	0.011	0.1548	0.011
12	-0.01040	0.014	-0.007338	0.014	-0.007391	0.014	-0.007397	0.014	-0.007261	0.014	-0.007004	0.014
13	-0.06261	0.012	-0.05932	0.012	-0.05952	0.012	-0.05952	0.012	-0.06007	0.012	-0.06034	0.012
14	-0.09766	0.013	-0.09427	0.013	-0.09449	0.013	-0.09449	0.013	-0.09498	0.013	-0.09504	0.013
15	-0.06593	0.015	-0.06286	0.015	-0.06293	0.015	-0.06294	0.015	-0.06313	0.015	-0.06247	0.015
16	-0.1113	0.014	-0.1083	0.014	-0.1084	0.014	-0.1084	0.014	-0.1086	0.014	-0.1084	0.014
17	-0.1635	0.016	-0.1609	0.016	-0.1609	0.016	-0.1610	0.016	-0.1596	0.016	-0.1602	0.016
18	-0.1491	0.014	-0.1462	0.014	-0.1467	0.014	-0.1467	0.014	-0.1461	0.014	-0.1472	0.014
19	-0.1348	0.013	-0.1316	0.013	-0.1318	0.013	-0.1318	0.013	-0.1316	0.013	-0.1325	0.013
20	–	–	-0.08027	0.013	-0.07991	0.013	-0.07991	0.013	-0.07928	0.012	-0.07948	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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016
32	0.0034	0.0034	0.0034	0.0034	0.0034	0.0034
37	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064
42	0.0106	0.0106	0.0106	0.0106	0.0106	0.0106
47	0.0140	0.0140	0.0140	0.0140	0.0140	0.0140
52	0.0155	0.0155	0.0155	0.0155	0.0155	0.0155
57	0.0166	0.0166	0.0166	0.0166	0.0166	0.0166
62	0.0198	0.0198	0.0198	0.0198	0.0198	0.0198
67	0.0286	0.0286	0.0286	0.0286	0.0286	0.0286
72	0.0447	0.0447	0.0447	0.0447	0.0447	0.0447
77	0.0662	0.0662	0.0662	0.0662	0.0662	0.0662
82	0.0830	0.0830	0.0830	0.0830	0.0830	0.0830
87	0.0899	0.0899	0.0899	0.0899	0.0899	0.0899
92	0.0932	0.0932	0.0932	0.0932	0.0932	0.0932
97	0.1021	0.1021	0.1021	0.1021	0.1021	0.1021
102	0.1241	0.1241	0.1241	0.1241	0.1241	0.1241
107	0.1582	0.1582	0.1582	0.1582	0.1582	0.1582
112	0.1987	0.1987	0.1987	0.1987	0.1987	0.1987
117	0.2347	0.2347	0.2347	0.2347	0.2347	0.2347
122	0.2644	0.2644	0.2644	0.2644	0.2644	0.2644
127	0.2946	0.2946	0.2946	0.2946	0.2946	0.2946
132	0.3348	0.3348	0.3348	0.3348	0.3348	0.3348
137	0.3855	0.3855	0.3855	0.3855	0.3855	0.3855
142	0.4278	0.4278	0.4278	0.4278	0.4278	0.4278
147	0.4395	0.4395	0.4395	0.4395	0.4395	0.4395
152	0.4035	0.4035	0.4035	0.4035	0.4035	0.4035
157	0.3304	0.3304	0.3304	0.3304	0.3304	0.3304
162	0.2444	0.2444	0.2444	0.2444	0.2444	0.2444
167	0.1681	0.1681	0.1681	0.1681	0.1681	0.1681

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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.0029	0.0029	0.0029	0.0029	0.0029	0.0029
32	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067
37	0.0137	0.0137	0.0137	0.0137	0.0137	0.0137
42	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223
47	0.0266	0.0266	0.0266	0.0266	0.0266	0.0266
52	0.0245	0.0245	0.0245	0.0245	0.0245	0.0245
57	0.0211	0.0211	0.0211	0.0211	0.0211	0.0211
62	0.0207	0.0207	0.0207	0.0207	0.0207	0.0207
67	0.0259	0.0259	0.0259	0.0259	0.0259	0.0259
72	0.0378	0.0378	0.0378	0.0378	0.0378	0.0378
77	0.0559	0.0559	0.0559	0.0559	0.0559	0.0559
82	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746
87	0.0903	0.0903	0.0903	0.0903	0.0903	0.0903
92	0.1075	0.1075	0.1075	0.1075	0.1075	0.1075
97	0.1357	0.1357	0.1357	0.1357	0.1357	0.1357
102	0.1836	0.1836	0.1836	0.1836	0.1836	0.1836
107	0.2426	0.2426	0.2426	0.2426	0.2426	0.2426
112	0.2874	0.2874	0.2874	0.2874	0.2874	0.2874
117	0.2900	0.2900	0.2900	0.2900	0.2900	0.2900
122	0.2684	0.2684	0.2684	0.2684	0.2684	0.2684
127	0.2605	0.2605	0.2605	0.2605	0.2605	0.2605
132	0.3031	0.3031	0.3031	0.3031	0.3031	0.3031
137	0.4152	0.4152	0.4152	0.4152	0.4152	0.4152
142	0.5515	0.5515	0.5515	0.5515	0.5515	0.5515
147	0.6403	0.6403	0.6403	0.6403	0.6403	0.6403
152	0.6409	0.6409	0.6409	0.6409	0.6409	0.6409
157	0.5801	0.5801	0.5801	0.5801	0.5801	0.5801
162	0.5049	0.5049	0.5049	0.5049	0.5049	0.5049
167	0.4691	0.4691	0.4691	0.4691	0.4691	0.4691
172	0.4924	0.4924	0.4924	0.4924	0.4924	0.4924
177	0.5563	0.5563	0.5563	0.5563	0.5563	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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.0132	0.0132	0.0132	0.0132	0.0132	0.0132
32	0.0285	0.0285	0.0285	0.0285	0.0285	0.0285
37	0.0531	0.0531	0.0531	0.0531	0.0531	0.0531
42	0.0751	0.0751	0.0751	0.0751	0.0751	0.0751
47	0.0730	0.0730	0.0730	0.0730	0.0730	0.0730
52	0.0537	0.0537	0.0537	0.0537	0.0537	0.0537
57	0.0396	0.0396	0.0396	0.0396	0.0396	0.0396
62	0.0396	0.0396	0.0396	0.0396	0.0396	0.0396
67	0.0626	0.0626	0.0626	0.0626	0.0626	0.0626
72	0.1206	0.1206	0.1206	0.1206	0.1206	0.1206
77	0.2060	0.2060	0.2060	0.2060	0.2060	0.2060
82	0.2520	0.2520	0.2520	0.2520	0.2520	0.2520
87	0.2324	0.2324	0.2324	0.2324	0.2324	0.2324
92	0.1880	0.1880	0.1880	0.1880	0.1880	0.1880
97	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563
102	0.1490	0.1490	0.1490	0.1490	0.1490	0.1490
107	0.1548	0.1548	0.1548	0.1548	0.1548	0.1548
112	0.1630	0.1630	0.1630	0.1630	0.1630	0.1630
117	0.1635	0.1635	0.1635	0.1635	0.1635	0.1635
122	0.1615	0.1615	0.1615	0.1615	0.1615	0.1615
127	0.1695	0.1695	0.1695	0.1695	0.1695	0.1695
132	0.2030	0.2030	0.2030	0.2030	0.2030	0.2030
137	0.2746	0.2746	0.2746	0.2746	0.2746	0.2746
142	0.3749	0.3749	0.3749	0.3749	0.3749	0.3749
147	0.4728	0.4728	0.4728	0.4728	0.4728	0.4728
152	0.5325	0.5325	0.5325	0.5325	0.5325	0.5325
157	0.5471	0.5471	0.5471	0.5471	0.5471	0.5471
162	0.5204	0.5204	0.5204	0.5204	0.5204	0.5204
167	0.4558	0.4558	0.4558	0.4558	0.4558	0.4558
172	0.3634	0.3634	0.3634	0.3634	0.3634	0.3634

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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.1199	0.1199	0.1199	0.1199	0.1199	0.1199
32	0.1093	0.1093	0.1093	0.1093	0.1093	0.1093
37	0.1018	0.1018	0.1018	0.1018	0.1018	0.1018
42	0.0993	0.0993	0.0993	0.0993	0.0993	0.0993
47	0.1037	0.1037	0.1037	0.1037	0.1037	0.1037
52	0.1172	0.1172	0.1172	0.1172	0.1172	0.1172
57	0.1424	0.1424	0.1424	0.1424	0.1424	0.1424
62	0.1844	0.1844	0.1844	0.1844	0.1844	0.1844
67	0.2470	0.2470	0.2470	0.2470	0.2470	0.2470
72	0.3193	0.3193	0.3193	0.3193	0.3193	0.3193
77	0.3769	0.3769	0.3769	0.3769	0.3769	0.3769
82	0.3943	0.3943	0.3943	0.3943	0.3943	0.3943
87	0.3788	0.3788	0.3788	0.3788	0.3788	0.3788
92	0.3590	0.3590	0.3590	0.3590	0.3590	0.3590
97	0.3628	0.3628	0.3628	0.3628	0.3628	0.3628
102	0.4018	0.4018	0.4018	0.4018	0.4018	0.4018
107	0.4538	0.4538	0.4538	0.4538	0.4538	0.4538
112	0.4880	0.4880	0.4880	0.4880	0.4880	0.4880
117	0.4780	0.4780	0.4780	0.4780	0.4780	0.4780
122	0.4357	0.4357	0.4357	0.4357	0.4357	0.4357
127	0.3916	0.3916	0.3916	0.3916	0.3916	0.3916
132	0.3737	0.3737	0.3737	0.3737	0.3737	0.3737
137	0.3895	0.3895	0.3895	0.3895	0.3895	0.3895
142	0.4177	0.4177	0.4177	0.4177	0.4177	0.4177
147	0.4336	0.4336	0.4336	0.4336	0.4336	0.4336
152	0.4188	0.4188	0.4188	0.4188	0.4188	0.4188
157	0.3959	0.3959	0.3959	0.3959	0.3959	0.3959
162	0.4003	0.4003	0.4003	0.4003	0.4003	0.4003
167	0.4680	0.4680	0.4680	0.4680	0.4680	0.4680
172	0.6084	0.6084	0.6084	0.6084	0.6084	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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.3115	0.3115	0.3115	0.3115	0.3115	0.3115
32	0.3168	0.3168	0.3168	0.3168	0.3168	0.3168
37	0.3344	0.3344	0.3344	0.3344	0.3344	0.3344
42	0.3783	0.3783	0.3783	0.3783	0.3783	0.3783
47	0.4641	0.4641	0.4641	0.4641	0.4641	0.4641
52	0.5751	0.5751	0.5751	0.5751	0.5751	0.5751
57	0.6624	0.6624	0.6624	0.6624	0.6624	0.6624
62	0.6895	0.6895	0.6895	0.6895	0.6895	0.6895
67	0.6434	0.6434	0.6434	0.6434	0.6434	0.6434
72	0.5548	0.5548	0.5548	0.5548	0.5548	0.5548
77	0.4752	0.4752	0.4752	0.4752	0.4752	0.4752
82	0.4571	0.4571	0.4571	0.4571	0.4571	0.4571
87	0.4970	0.4970	0.4970	0.4970	0.4970	0.4970
92	0.5573	0.5573	0.5573	0.5573	0.5573	0.5573
97	0.5996	0.5996	0.5996	0.5996	0.5996	0.5996
102	0.6051	0.6051	0.6051	0.6051	0.6051	0.6051
107	0.5904	0.5904	0.5904	0.5904	0.5904	0.5904
112	0.5753	0.5753	0.5753	0.5753	0.5753	0.5753
117	0.5777	0.5777	0.5777	0.5777	0.5777	0.5777
122	0.5936	0.5936	0.5936	0.5936	0.5936	0.5936
127	0.6081	0.6081	0.6081	0.6081	0.6081	0.6081
132	0.6073	0.6073	0.6073	0.6073	0.6073	0.6073
137	0.5830	0.5830	0.5830	0.5830	0.5830	0.5830
142	0.5361	0.5361	0.5361	0.5361	0.5361	0.5361
147	0.4692	0.4692	0.4692	0.4692	0.4692	0.4692
152	0.3901	0.3901	0.3901	0.3901	0.3901	0.3901
157	0.3220	0.3220	0.3220	0.3220	0.3220	0.3220
162	0.2859	0.2859	0.2859	0.2859	0.2859	0.2859
167	0.2972	0.2972	0.2972	0.2972	0.2972	0.2972
172	0.3629	0.3629	0.3629	0.3629	0.3629	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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.5152	0.5152	0.5152	0.5152	0.5152	0.5152
32	0.4294	0.4294	0.4294	0.4294	0.4294	0.4294
37	0.3628	0.3628	0.3628	0.3628	0.3628	0.3628
42	0.3297	0.3297	0.3297	0.3297	0.3297	0.3297
47	0.3405	0.3405	0.3405	0.3405	0.3405	0.3405
52	0.3925	0.3925	0.3925	0.3925	0.3925	0.3925
57	0.4693	0.4693	0.4693	0.4693	0.4693	0.4693
62	0.5477	0.5477	0.5477	0.5477	0.5477	0.5477
67	0.6080	0.6080	0.6080	0.6080	0.6080	0.6080
72	0.6502	0.6502	0.6502	0.6502	0.6502	0.6502
77	0.6780	0.6780	0.6780	0.6780	0.6780	0.6780
82	0.6951	0.6951	0.6951	0.6951	0.6951	0.6951
87	0.7031	0.7031	0.7031	0.7031	0.7031	0.7031
92	0.7025	0.7025	0.7025	0.7025	0.7025	0.7025
97	0.6934	0.6934	0.6934	0.6934	0.6934	0.6934
102	0.6773	0.6773	0.6773	0.6773	0.6773	0.6773
107	0.6596	0.6596	0.6596	0.6596	0.6596	0.6596
112	0.6472	0.6472	0.6472	0.6472	0.6472	0.6472
117	0.6458	0.6458	0.6458	0.6458	0.6458	0.6458
122	0.6518	0.6518	0.6518	0.6518	0.6518	0.6518
127	0.6575	0.6575	0.6575	0.6575	0.6575	0.6575
132	0.6551	0.6551	0.6551	0.6551	0.6551	0.6551
137	0.6407	0.6407	0.6407	0.6407	0.6407	0.6407
142	0.6167	0.6167	0.6167	0.6167	0.6167	0.6167
147	0.5859	0.5859	0.5859	0.5859	0.5859	0.5859
152	0.5511	0.5511	0.5511	0.5511	0.5511	0.5511
157	0.5115	0.5115	0.5115	0.5115	0.5115	0.5115
162	0.4652	0.4652	0.4652	0.4652	0.4652	0.4652
167	0.4110	0.4110	0.4110	0.4110	0.4110	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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018
32	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
37	0.0120	0.0120	0.0120	0.0120	0.0120	0.0120
42	0.0106	0.0106	0.0106	0.0106	0.0106	0.0106
47	0.0074	0.0074	0.0074	0.0074	0.0074	0.0074
52	0.0088	0.0088	0.0088	0.0088	0.0088	0.0088
57	0.0134	0.0134	0.0134	0.0134	0.0134	0.0134
62	0.0133	0.0133	0.0133	0.0133	0.0133	0.0133
67	0.0107	0.0107	0.0107	0.0107	0.0107	0.0107
72	0.0149	0.0149	0.0149	0.0149	0.0149	0.0149
77	0.0365	0.0365	0.0365	0.0365	0.0365	0.0365
82	0.0854	0.0854	0.0854	0.0854	0.0854	0.0854
87	0.1483	0.1483	0.1483	0.1483	0.1483	0.1483
92	0.2262	0.2262	0.2262	0.2262	0.2262	0.2262
97	0.3582	0.3582	0.3582	0.3582	0.3582	0.3582
102	0.6181	0.6181	0.6181	0.6181	0.6181	0.6181
107	0.8293	0.8293	0.8293	0.8293	0.8293	0.8293
112	0.7130	0.7130	0.7130	0.7130	0.7130	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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.0029	0.0029	0.0029	0.0029	0.0029	0.0029
32	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
37	0.0115	0.0115	0.0115	0.0115	0.0115	0.0115
42	0.0191	0.0191	0.0191	0.0191	0.0191	0.0191
47	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274
52	0.0348	0.0348	0.0348	0.0348	0.0348	0.0348
57	0.0381	0.0381	0.0381	0.0381	0.0381	0.0381
62	0.0354	0.0354	0.0354	0.0354	0.0354	0.0354
67	0.0301	0.0301	0.0301	0.0301	0.0301	0.0301
72	0.0274	0.0274	0.0274	0.0274	0.0274	0.0274
77	0.0285	0.0285	0.0285	0.0285	0.0285	0.0285
82	0.0338	0.0338	0.0338	0.0338	0.0338	0.0338
87	0.0467	0.0467	0.0467	0.0467	0.0467	0.0467
92	0.0791	0.0791	0.0791	0.0791	0.0791	0.0791
97	0.1597	0.1597	0.1597	0.1597	0.1597	0.1597
102	0.3290	0.3290	0.3290	0.3290	0.3290	0.3290
107	0.5771	0.5771	0.5771	0.5771	0.5771	0.5771
112	0.7928	0.7928	0.7928	0.7928	0.7928	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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069
32	0.0130	0.0130	0.0130	0.0130	0.0130	0.0130
37	0.0231	0.0231	0.0231	0.0231	0.0231	0.0231
42	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367
47	0.0509	0.0509	0.0509	0.0509	0.0509	0.0509
52	0.0603	0.0603	0.0603	0.0603	0.0603	0.0603
57	0.0587	0.0587	0.0587	0.0587	0.0587	0.0587
62	0.0450	0.0450	0.0450	0.0450	0.0450	0.0450
67	0.0329	0.0329	0.0329	0.0329	0.0329	0.0329
72	0.0318	0.0318	0.0318	0.0318	0.0318	0.0318
77	0.0405	0.0405	0.0405	0.0405	0.0405	0.0405
82	0.0502	0.0502	0.0502	0.0502	0.0502	0.0502
87	0.0577	0.0577	0.0577	0.0577	0.0577	0.0577
92	0.0769	0.0769	0.0769	0.0769	0.0769	0.0769
97	0.1385	0.1385	0.1385	0.1385	0.1385	0.1385
102	0.3236	0.3236	0.3236	0.3236	0.3236	0.3236
107	0.6810	0.6810	0.6810	0.6810	0.6810	0.6810
112	0.9184	0.9184	0.9184	0.9184	0.9184	0.9184
117	0.9830	0.9830	0.9830	0.9830	0.9830	0.9830
122	0.9965	0.9965	0.9965	0.9965	0.9965	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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.0884	0.0884	0.0884	0.0884	0.0884	0.0884
32	0.0968	0.0968	0.0968	0.0968	0.0968	0.0968
37	0.0990	0.0990	0.0990	0.0990	0.0990	0.0990
42	0.0928	0.0928	0.0928	0.0928	0.0928	0.0928
47	0.1013	0.1013	0.1013	0.1013	0.1013	0.1013
52	0.1615	0.1615	0.1615	0.1615	0.1615	0.1615
57	0.2385	0.2385	0.2385	0.2385	0.2385	0.2385
62	0.1869	0.1869	0.1869	0.1869	0.1869	0.1869
67	0.1088	0.1088	0.1088	0.1088	0.1088	0.1088
72	0.1327	0.1327	0.1327	0.1327	0.1327	0.1327
77	0.2892	0.2892	0.2892	0.2892	0.2892	0.2892
82	0.4083	0.4083	0.4083	0.4083	0.4083	0.4083
87	0.3735	0.3735	0.3735	0.3735	0.3735	0.3735
92	0.4010	0.4010	0.4010	0.4010	0.4010	0.4010
97	0.5593	0.5593	0.5593	0.5593	0.5593	0.5593
102	0.6279	0.6279	0.6279	0.6279	0.6279	0.6279
107	0.6548	0.6548	0.6548	0.6548	0.6548	0.6548
112	0.9615	0.9615	0.9615	0.9615	0.9615	0.9615
117	1.0000	1.0000	1.0000	1.0000	1.0000	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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.3872	0.3872	0.3872	0.3872	0.3872	0.3872
32	0.3874	0.3874	0.3874	0.3874	0.3874	0.3874
37	0.4087	0.4087	0.4087	0.4087	0.4087	0.4087
42	0.4673	0.4673	0.4673	0.4673	0.4673	0.4673
47	0.5433	0.5433	0.5433	0.5433	0.5433	0.5433
52	0.6023	0.6023	0.6023	0.6023	0.6023	0.6023
57	0.6215	0.6215	0.6215	0.6215	0.6215	0.6215
62	0.5882	0.5882	0.5882	0.5882	0.5882	0.5882
67	0.5459	0.5459	0.5459	0.5459	0.5459	0.5459
72	0.5744	0.5744	0.5744	0.5744	0.5744	0.5744
77	0.6502	0.6502	0.6502	0.6502	0.6502	0.6502
82	0.6721	0.6721	0.6721	0.6721	0.6721	0.6721
87	0.6216	0.6216	0.6216	0.6216	0.6216	0.6216
92	0.5617	0.5617	0.5617	0.5617	0.5617	0.5617
97	0.4806	0.4806	0.4806	0.4806	0.4806	0.4806
102	0.2508	0.2508	0.2508	0.2508	0.2508	0.2508
107	0.0449	0.0449	0.0449	0.0449	0.0449	0.0449

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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
27	0.4296	0.4296	0.4296	0.4296	0.4296	0.4296
32	0.4682	0.4682	0.4682	0.4682	0.4682	0.4682
37	0.4691	0.4691	0.4691	0.4691	0.4691	0.4691
42	0.4106	0.4106	0.4106	0.4106	0.4106	0.4106
47	0.3615	0.3615	0.3615	0.3615	0.3615	0.3615
52	0.4007	0.4007	0.4007	0.4007	0.4007	0.4007
57	0.5163	0.5163	0.5163	0.5163	0.5163	0.5163
62	0.6394	0.6394	0.6394	0.6394	0.6394	0.6394
67	0.7253	0.7253	0.7253	0.7253	0.7253	0.7253
72	0.7670	0.7670	0.7670	0.7670	0.7670	0.7670
77	0.7873	0.7873	0.7873	0.7873	0.7873	0.7873
82	0.8195	0.8195	0.8195	0.8195	0.8195	0.8195
87	0.8582	0.8582	0.8582	0.8582	0.8582	0.8582
92	0.8751	0.8751	0.8751	0.8751	0.8751	0.8751
97	0.8634	0.8634	0.8634	0.8634	0.8634	0.8634
102	0.8311	0.8311	0.8311	0.8311	0.8311	0.8311
107	0.7842	0.7842	0.7842	0.7842	0.7842	0.7842
112	0.7273	0.7273	0.7273	0.7273	0.7273	0.7273

Table 27. Objective function data component values for TCSAM02 models 22.03d, 22.03d1, 22.03d2, 22.03d3, 22.03d4, 22.03d5. 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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
surveys data	NMFS M	index catch	abundance	female	–	–	–	–	–	–
				male	–	–	–	–	–	–
			biomass	female	–	–	–	–	–	–
				male	83.65	84.15	85.48	85.49	91.45	91.38
			n.at.z	male	417.43	417.15	415.90	415.89	423.79	424.54
	NMFS F		abundance	female	–	–	–	–	–	–
				male	–	–	–	–	–	–
			biomass	female	167.25	167.87	168.33	168.35	180.52	178.95
				male	–	–	–	–	–	–
			n.at.z	female	303.21	303.14	302.64	302.64	308.74	308.84
	SBS BSFRF M		abundance	female	–	–	–	–	–	–
				male	–	–	–	–	–	–
			biomass	female	–	–	–	–	–	–
				male	-2.90	-2.80	-2.81	-2.81	-2.77	-2.85
			n.at.z	male	281.85	281.42	282.17	282.16	282.22	280.00
	SBS BSFRF F		abundance	female	–	–	–	–	–	–
				male	–	–	–	–	–	–
			biomass	female	1.96	2.23	2.16	2.16	1.71	1.17
				male	–	–	–	–	–	–

Table 28. Objective function data component values for TCSAM02 models 22.03d, 22.03d1, 22.03d2, 22.03d3, 22.03d4, 22.03d5. 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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
surveys data	SBS BSFRF F	index catch	n.at.z	female	172.27	172.18	172.61	172.61	172.55	173.22
fisheries data	TCF	retained catch	abundance	female	–	–	–	–	–	–
				male	–	–	–	–	–	–
			biomass	female	–	–	–	–	–	–
				male	-147.32	-151.89	-151.90	-151.90	-151.87	-151.91
			n.at.z	male	66.67	66.70	67.02	67.01	67.39	67.75
		total catch	abundance	all sexes	–	–	–	–	–	–
			biomass	all sexes	4.49	3.34	3.33	3.33	3.38	3.50
			n.at.z	female	91.77	95.17	95.27	95.27	94.96	94.86
				male	90.96	92.62	93.02	93.00	93.55	92.85
	SCF		abundance	all sexes	–	–	–	–	–	–
			biomass	all sexes	-52.23	-52.24	-52.24	-52.24	-52.23	-52.26
			n.at.z	female	52.36	52.40	52.41	52.41	52.40	52.43
				male	80.37	80.48	80.51	80.51	80.71	81.03
	GF All		abundance	all sexes	-39.43	-39.43	-67.45	-67.45	-67.81	-67.88
			biomass	all sexes	-70.24	-70.23	-68.85	-68.85	-69.29	-69.41
			n.at.z	female	226.52	226.64	229.28	229.28	229.31	228.67
				male	311.46	311.77	325.90	325.90	322.92	321.13
	RKF		abundance	all sexes	–	–	–	–	–	–

Table 29. Objective function data component values for TCSAM02 models 22.03d, 22.03d1, 22.03d2, 22.03d3, 22.03d4, 22.03d5. 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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
			biomass	all sexes	-37.00	-36.97	-36.99	-36.91	-36.91	-36.92
fisheries data	RKF	total catch	n.at.z	female	6.87	6.87	6.88	6.94	6.93	6.93
				male	31.64	31.90	31.84	32.02	32.02	31.94
growth data			EBS molt increment data	female	242.61	242.07	242.60	242.59	246.03	247.52
				male	278.11	277.34	277.62	277.61	278.40	280.21
maturity ogive data	NMFS M		EBS mature male ratios	male	255.98	256.14	256.48	256.48	255.87	325.54

Table 30. Objective function non-data component values for TCSAM02 models 22.03d, 22.03d1, 22.03d2, 22.03d3, 22.03d4, 22.03d5. 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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
penalties	devsSumSq	pDevsLnC	0.000	0.000	0.000	0.000	0.000	0.000
		pDevsLnR	0.000	0.000	0.000	0.000	0.000	0.000
		pDevsS1	0.000	0.000	0.000	0.000	0.000	0.000
	maturity	smoothness	2.220	2.197	2.188	2.187	2.185	1.982
	natural mortality	pDM1	52.268	52.188	52.100	52.096	53.522	54.188
priors	recruitment	pDevsLnR	115.407	116.406	116.257	116.258	116.691	116.728
	surveys	pQ	100.592	101.655	101.662	101.678	98.670	97.878

Table 31. Differences between objective function data component values for 22.03d1, 22.03d2, 22.03d3, 22.03d4, and 22.03d5 relative to 22.03d. 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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
surveys data	NMFS M	index catch	abundance	female	0.000	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000	0.000
			biomass	female	0.000	0.000	0.000	0.000	0.000	0.000
				male	83.649	0.497	1.834	1.844	7.799	7.733
			n.at.z	male	417.429	-0.281	-1.531	-1.538	6.364	7.114
	NMFS F		abundance	female	0.000	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000	0.000
			biomass	female	167.246	0.629	1.088	1.102	13.279	11.703
				male	0.000	0.000	0.000	0.000	0.000	0.000
			n.at.z	female	303.215	-0.076	-0.573	-0.576	5.527	5.626
	SBS BSFRF M		abundance	female	0.000	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000	0.000
			biomass	female	0.000	0.000	0.000	0.000	0.000	0.000
				male	-2.905	0.100	0.090	0.091	0.136	0.054
			n.at.z	male	281.847	-0.427	0.319	0.315	0.369	-1.848
	SBS BSFRF F		abundance	female	0.000	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000	0.000
			biomass	female	1.955	0.270	0.200	0.203	-0.247	-0.786
				male	0.000	0.000	0.000	0.000	0.000	0.000

Table 32. Differences between objective function data component values for 22.03d1, 22.03d2, 22.03d3, 22.03d4, and 22.03d5 relative to 22.03d. 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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
surveys data	SBS BSFRF F	index catch	n.at.z	female	172.270	-0.090	0.345	0.343	0.281	0.949
fisheries data	TCF	retained catch	abundance	female	0.000	0.000	0.000	0.000	0.000	0.000
				male	0.000	0.000	0.000	0.000	0.000	0.000
			biomass	female	0.000	0.000	0.000	0.000	0.000	0.000
				male	-147.321	-4.568	-4.583	-4.582	-4.551	-4.588
			n.at.z	male	66.674	0.030	0.346	0.340	0.712	1.074
		total catch	abundance	all sexes	0.000	0.000	0.000	0.000	0.000	0.000
			biomass	all sexes	4.487	-1.143	-1.157	-1.155	-1.104	-0.988
			n.at.z	female	91.771	3.395	3.498	3.501	3.188	3.092
				male	90.959	1.665	2.062	2.045	2.588	1.891
	SCF		abundance	all sexes	0.000	0.000	0.000	0.000	0.000	0.000
			biomass	all sexes	-52.232	-0.009	-0.006	-0.006	-0.003	-0.025
			n.at.z	female	52.361	0.035	0.054	0.054	0.041	0.065
				male	80.367	0.117	0.146	0.147	0.340	0.662
	GF All		abundance	all sexes	-39.434	0.008	-28.012	-28.012	-28.377	-28.447
			biomass	all sexes	-70.244	0.010	1.391	1.391	0.949	0.832
			n.at.z	female	226.518	0.125	2.760	2.764	2.790	2.154
				male	311.460	0.307	14.438	14.441	11.461	9.666
	RKF		abundance	all sexes	0.000	0.000	0.000	0.000	0.000	0.000

Table 33. Differences between objective function data component values for 22.03d1, 22.03d2, 22.03d3, 22.03d4, and 22.03d5 relative to 22.03d. 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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
fisheries data	RKF	total catch	biomass	all sexes	-37.004	0.033	0.012	0.093	0.098	0.088
			n.at.z	female	6.874	-0.004	0.001	0.063	0.060	0.059
				male	31.644	0.251	0.195	0.380	0.375	0.293
growth data			EBS molt increment data	female	242.608	-0.534	-0.003	-0.015	3.422	4.907
				male	278.114	-0.772	-0.497	-0.508	0.286	2.097
maturity ogive data	NMFS M		EBS mature male ratios	male	255.984	0.160	0.495	0.500	-0.113	69.556

Table 34. Differences between objective function non-data component values for 22.03d1, 22.03d2, 22.03d3, 22.03d4, and 22.03d5 relative to 22.03d. 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	22.03d	22.03d1	22.03d2	22.03d3	22.03d4	22.03d5
penalties	devsSumSq	pDevsLnC	0.000	0.000	0.000	0.000	0.000	0.000
		pDevsLnR	0.000	0.000	0.000	0.000	0.000	0.000
		pDevsS1	0.000	0.000	0.000	0.000	0.000	0.000
	maturity	smoothness	2.220	-0.023	-0.032	-0.032	-0.035	-0.237
	natural mortality	pDM1	52.268	-0.080	-0.168	-0.172	1.254	1.920
priors	recruitment	pDevsLnR	115.407	0.999	0.850	0.851	1.285	1.321
	surveys	pQ	100.592	1.063	1.070	1.085	-1.922	-2.714

Figures

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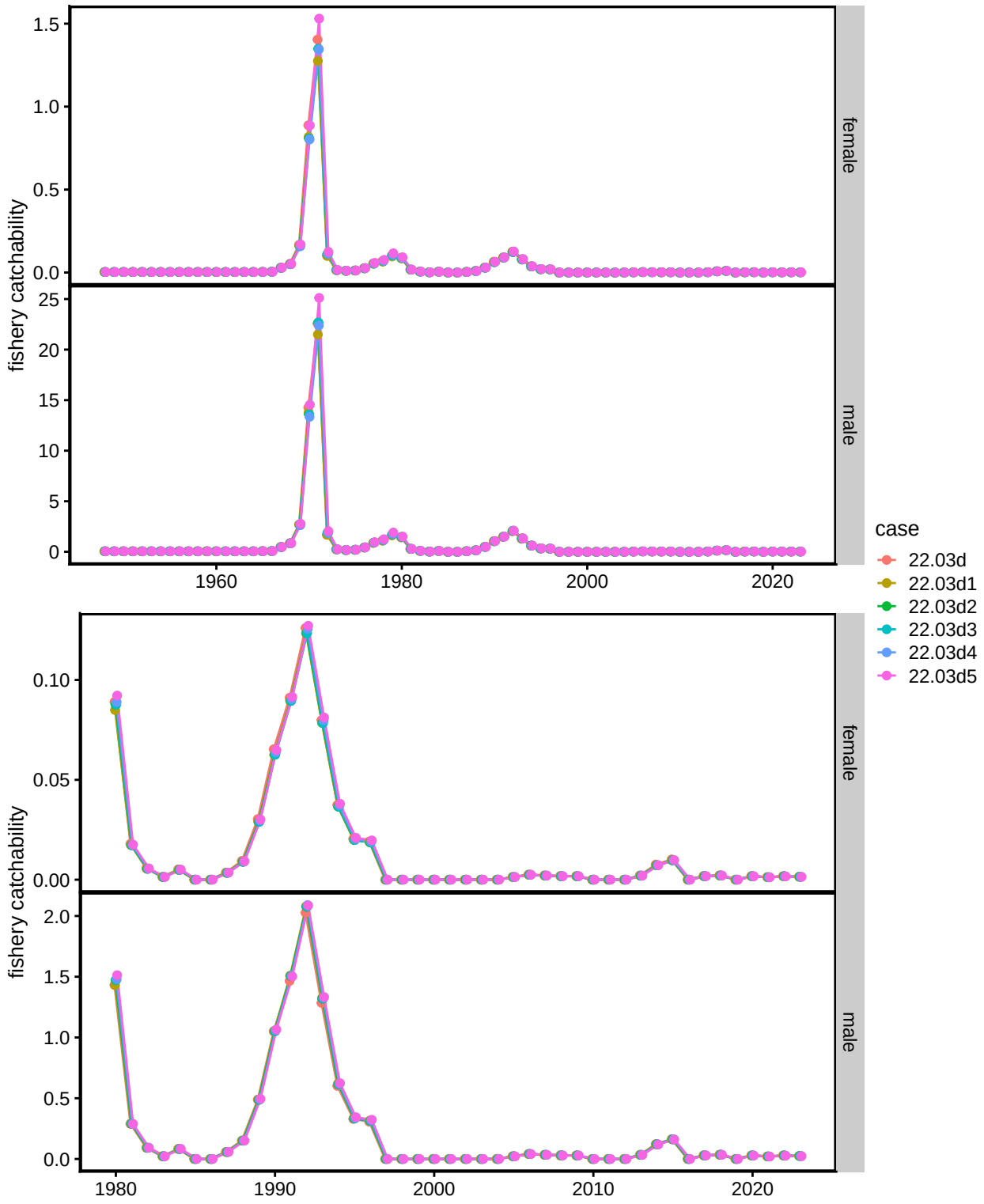

Figure 1. TCSAM02 models estimated fully-selected capture rates (not mortality) in the directed fishery. The lower pair of plots show the estimated time series since 1980.

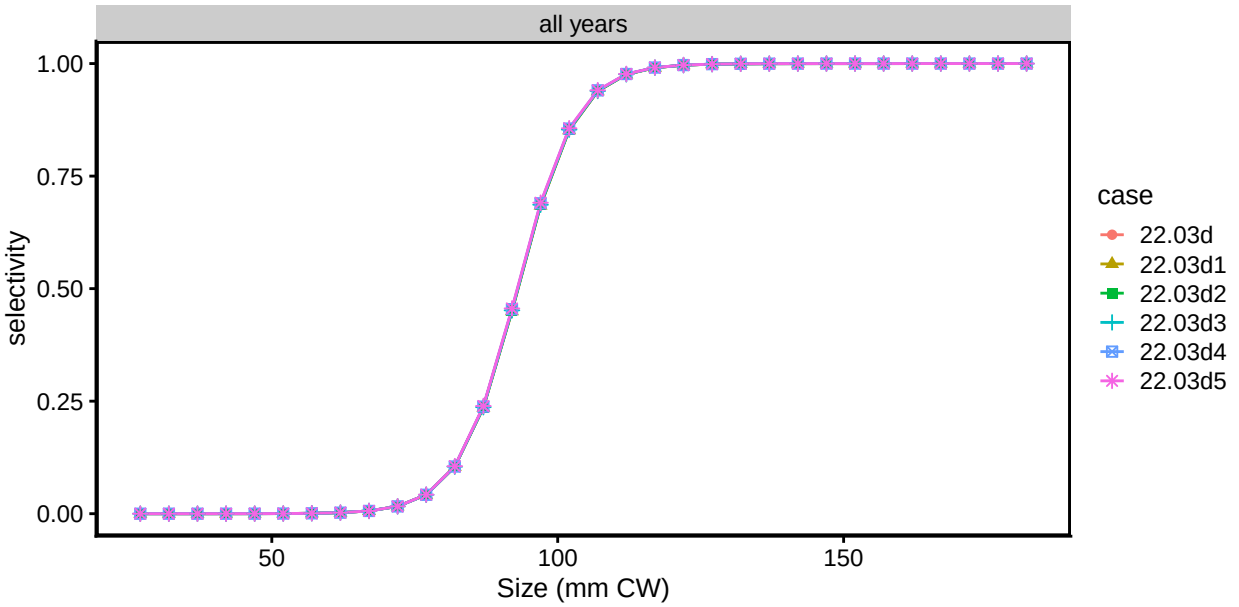

Figure 2. TCSAM02 models estimated selectivity for females in the directed fishery for all years.

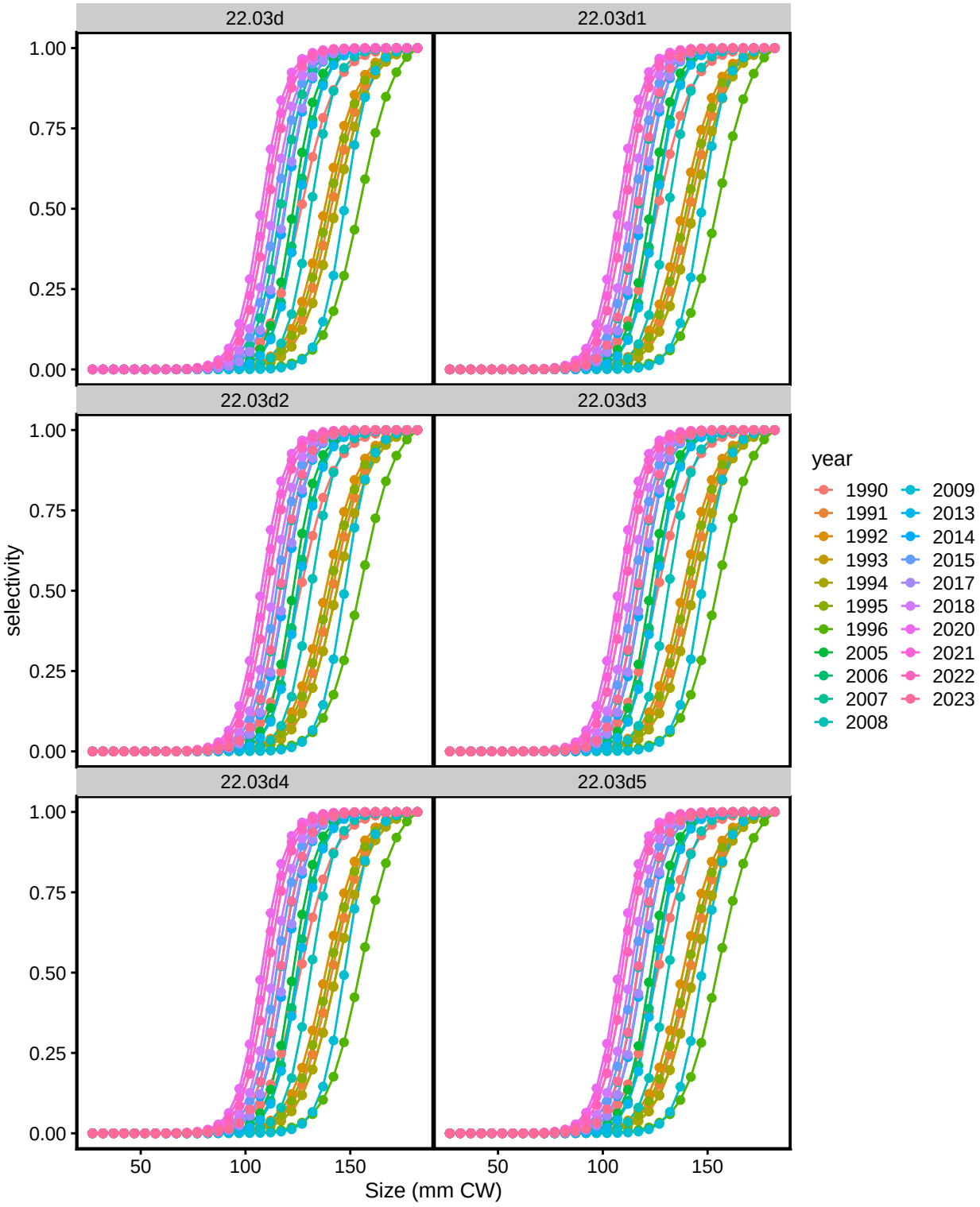

Figure 3. TCSAM02 models estimated selectivity curves for males in the directed fishery, faceted by model scenario. Selectivity curve labeled '1990'applies to all years before 1991.

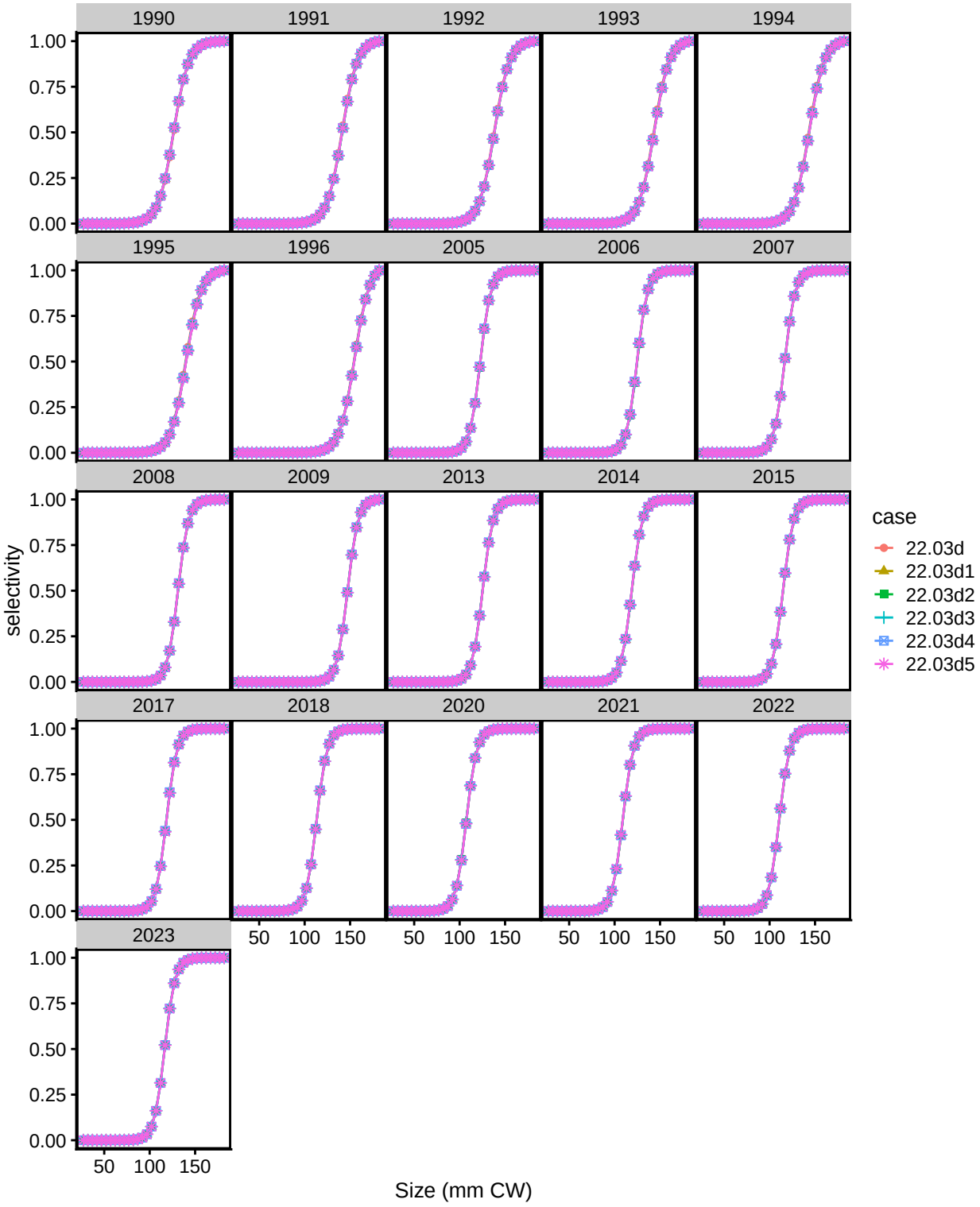

Figure 4. TCSAM02 models estimated selectivity curves for males in the directed fishery by year. Selectivity curve labeled 1990 applies to all years before 1991.

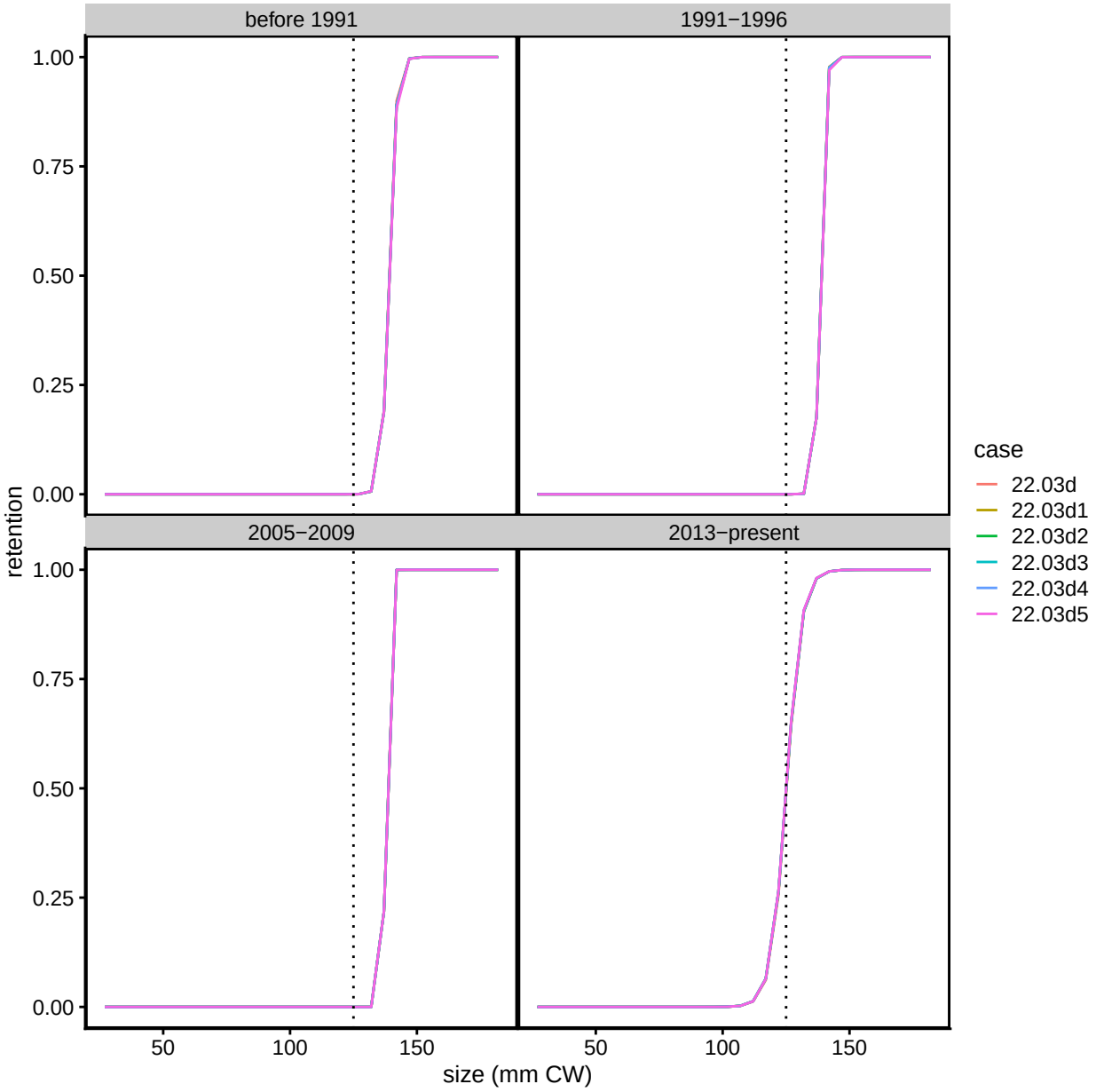

Figure 5. TCSAM02 models estimated retention curves for males in the directed fishery by time block. The dotted line indicates the current industry-preferred size (125 mm CW).

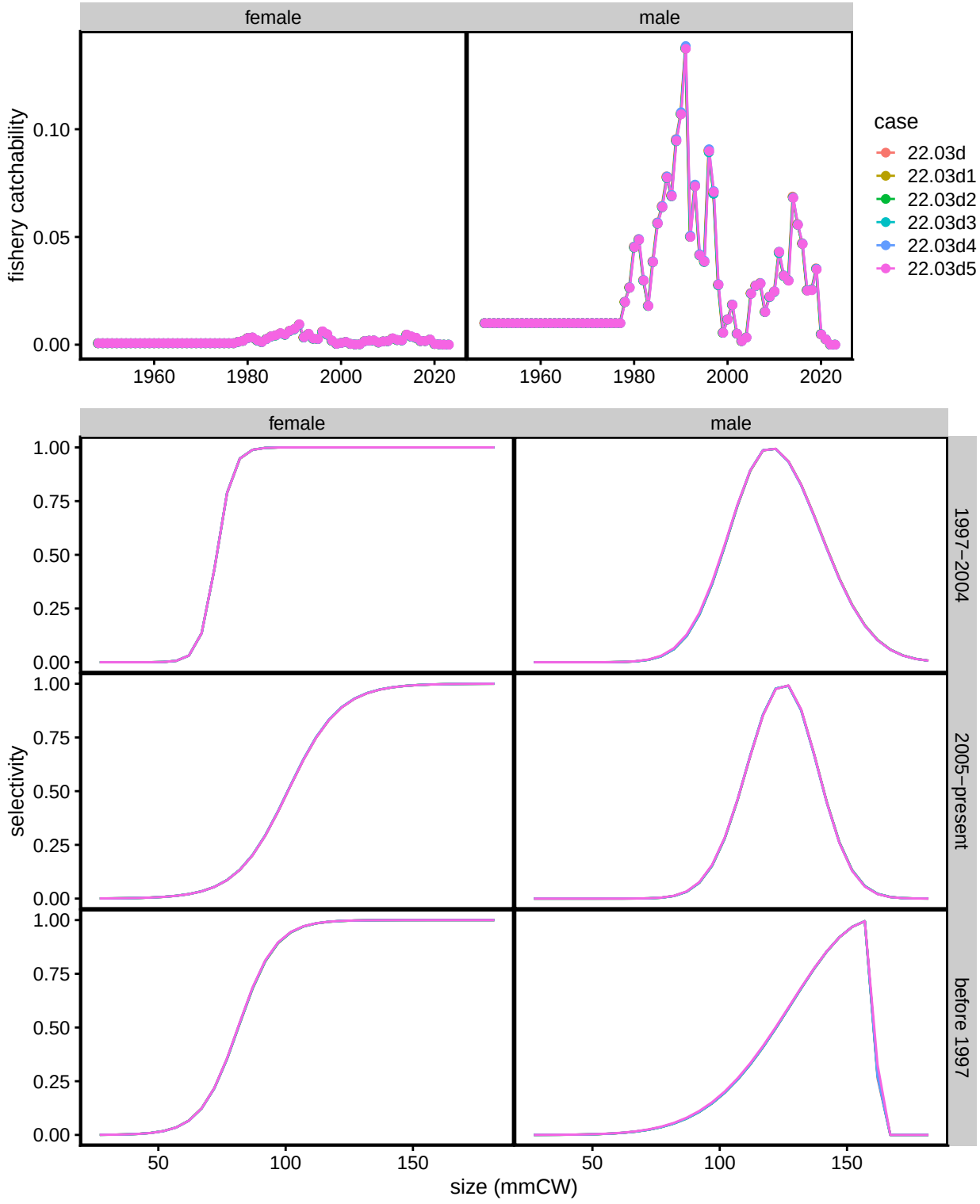

Figure 6. TCSAM02 models estimated fully-selected bycatch capture rates (not mortality) and selectvity functions in the snow crab fishery. Time blocks for selectivity functions are labelled: 1) before 1997; 2) 1997-2004; 3) 2005-present.

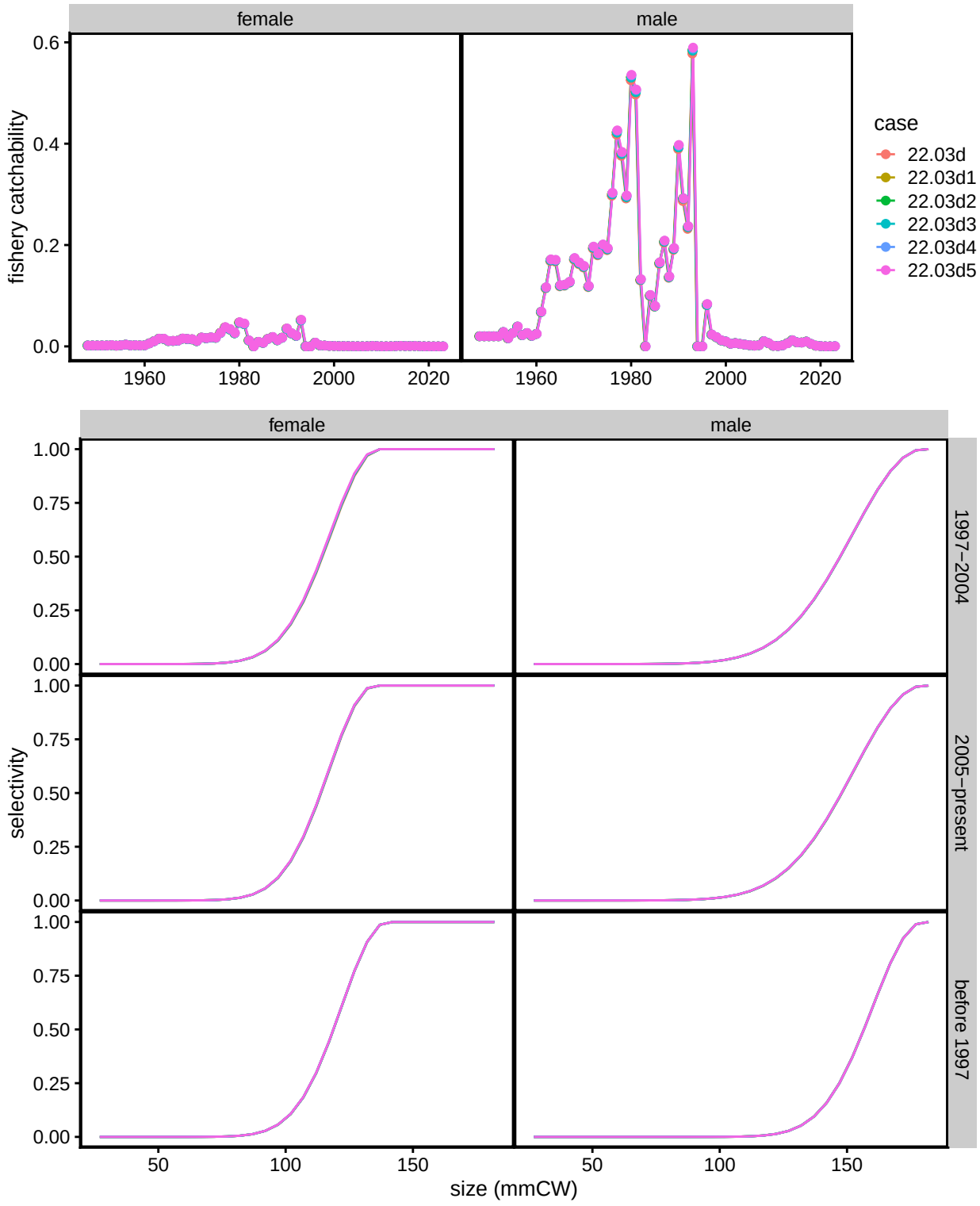

Figure 7. TCSAM02 models estimated fully-selected bycatch capture rates (not mortality) and selectvity functions in the BBRKC fishery. Time blocks for selectivity functions are 1) before 1997; 2) 1997-2004; 3) 2005-present.

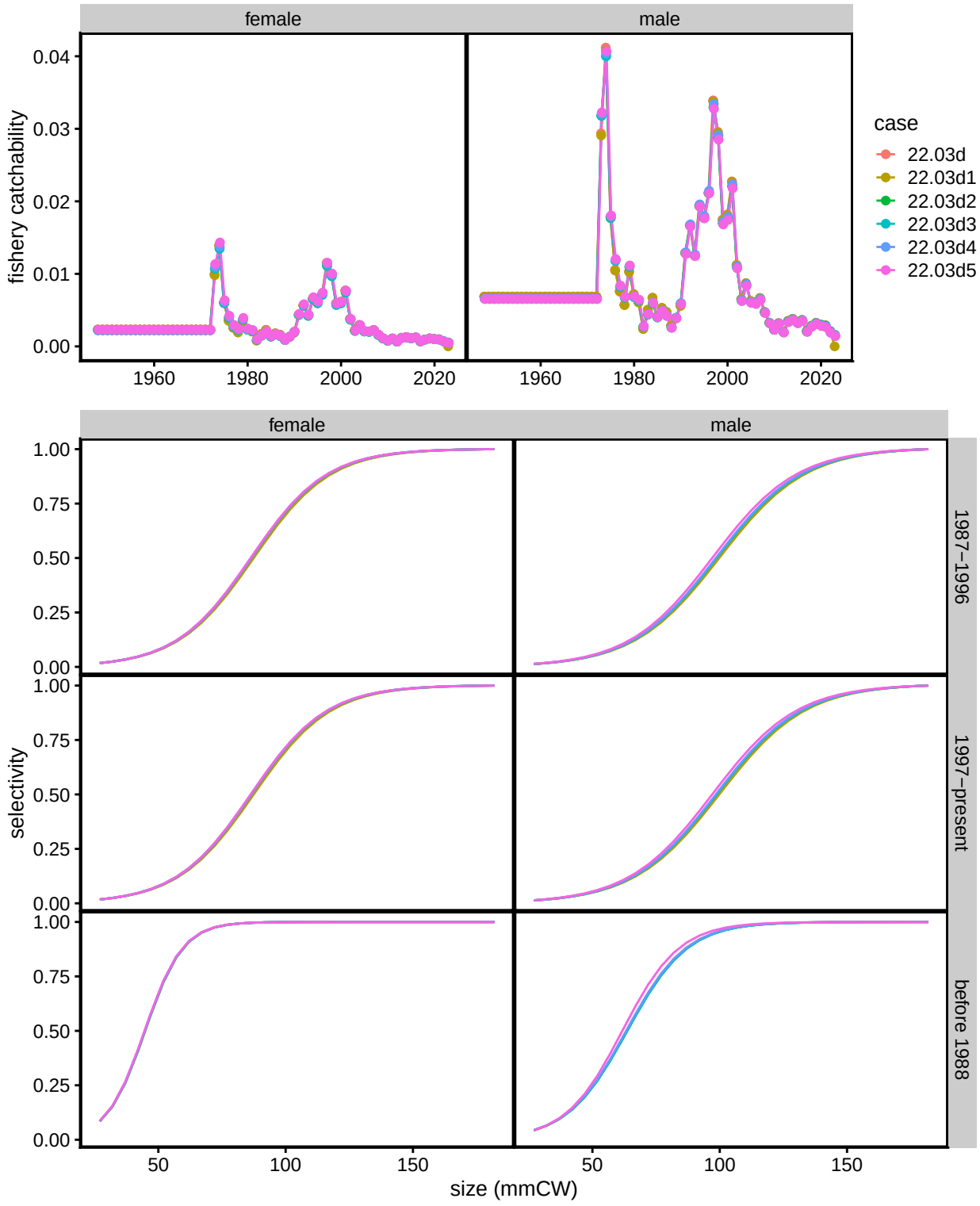

Figure 8. TCSAM02 models estimated fully-selected bycatch capture rates (not mortality) and selectvity functions in the groundfish fisheries. Time blocks for selectivity functions are : 1) before 1988; 2) 1987-1996; 3) 1997-present.

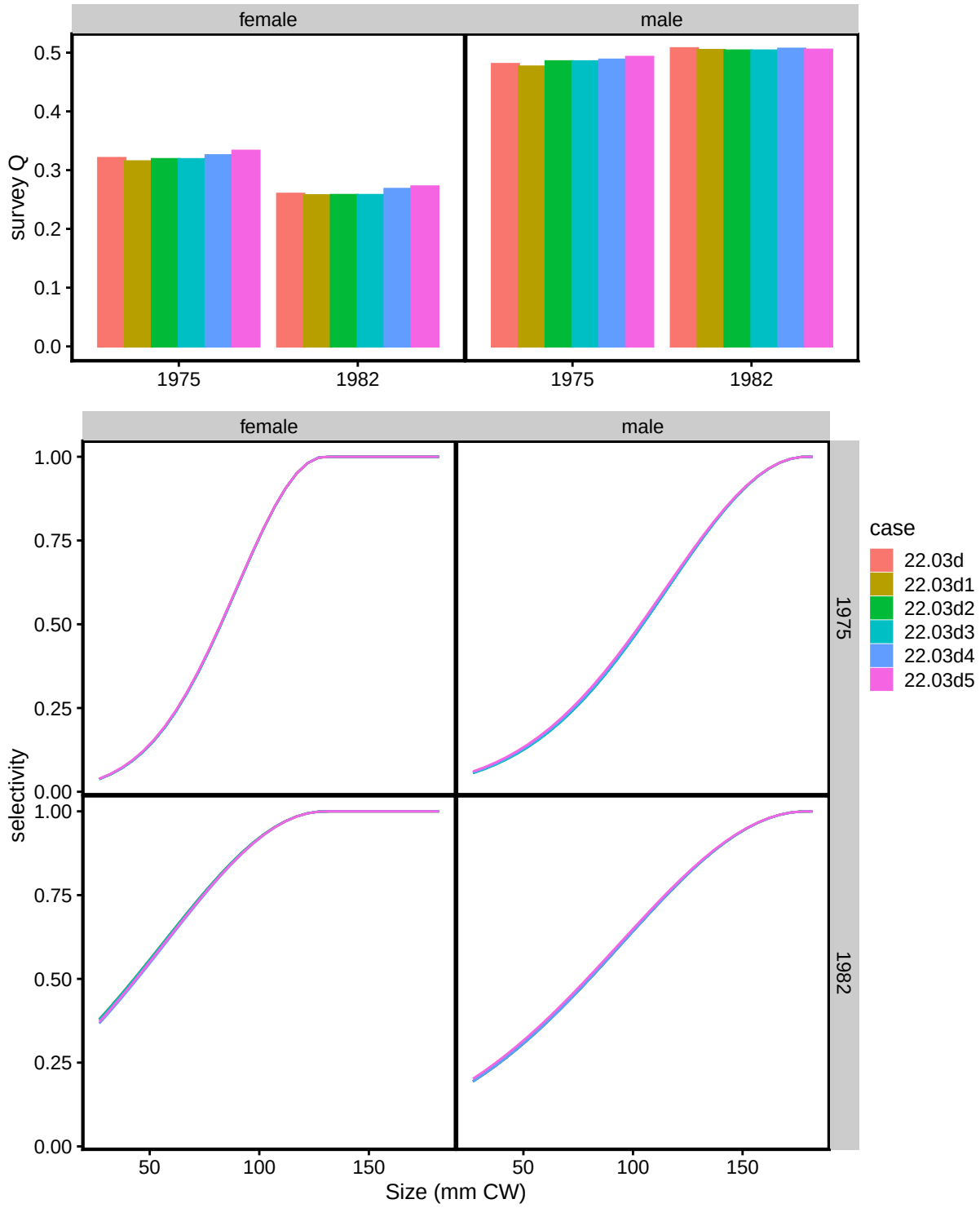

Figure 9. TCSAM02 models estimated NMFS EBS Survey fully-selected catchability (survey Q's) and selectivity functions by sex for different time periods. 1975: 1975-1981; 1982: 1982-current.

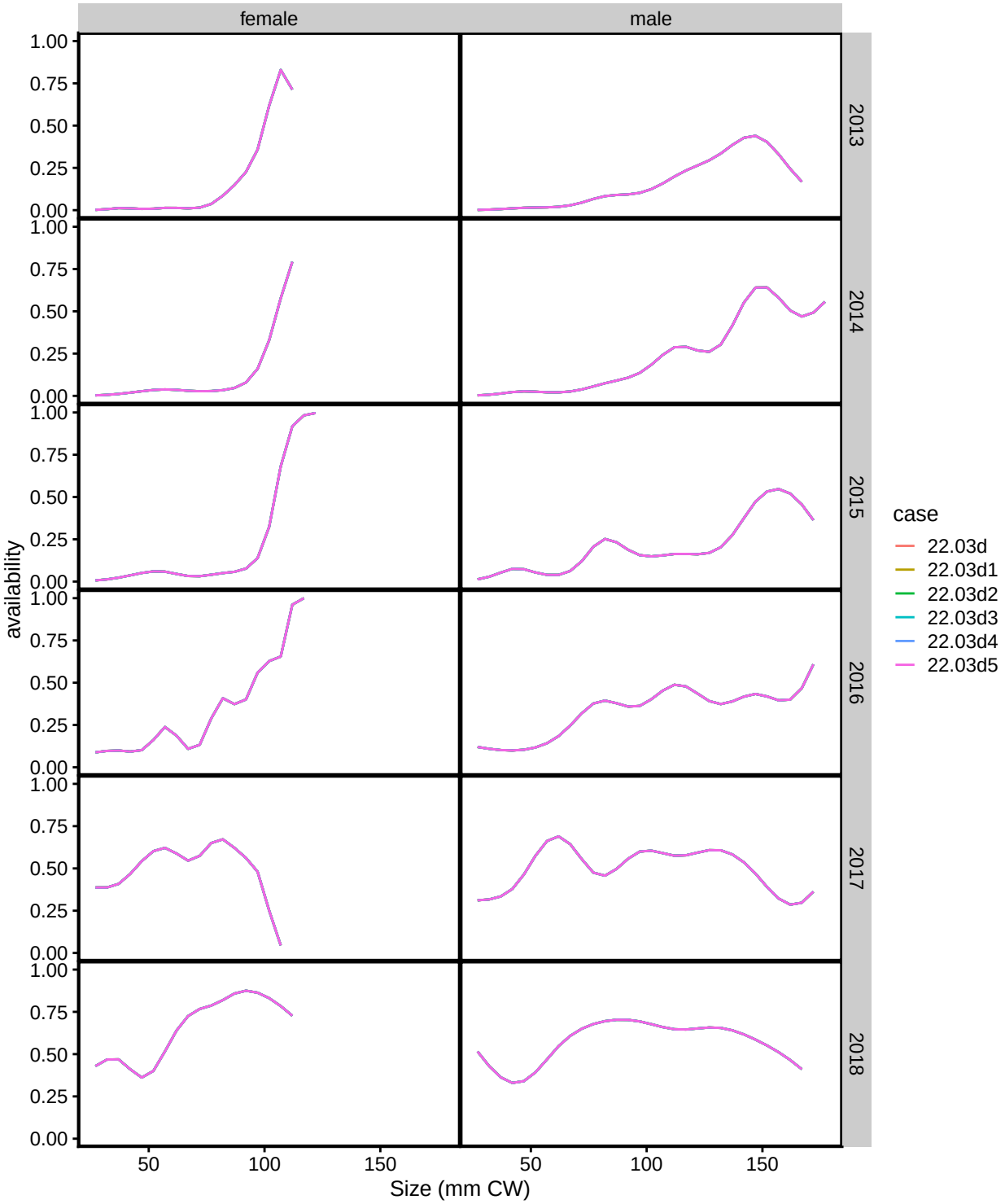

Figure 10. Annual sex-specific availability curves assumed for the BSFRF side-by-side (SBS) survey data. The availability curves were estimated outside the TCSAM02 models.

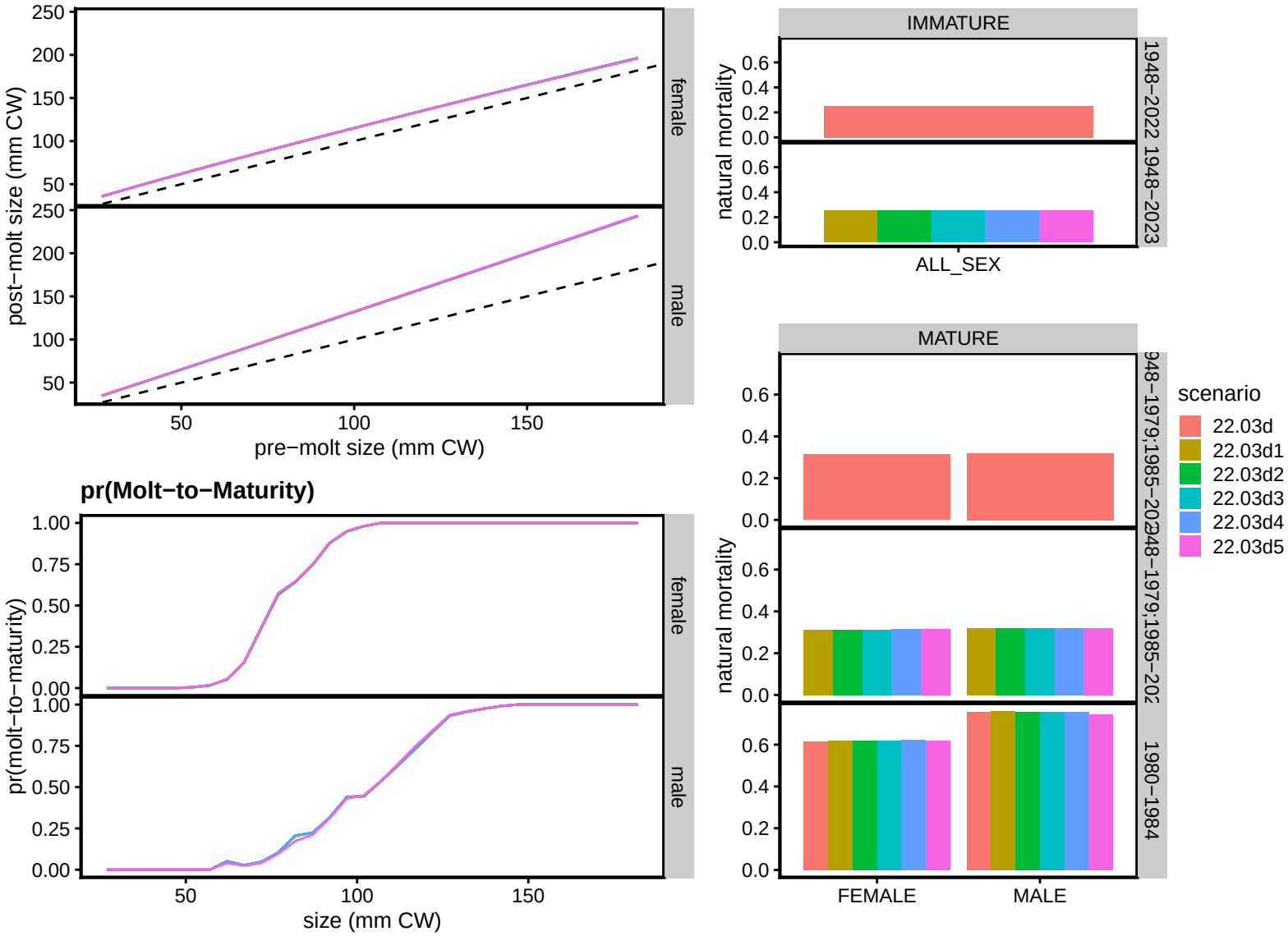

Figure 11. TCSAM02 models estimated population processes. Plots in upper lefthand quadrant: sex-specific mean growth; plots in lower lefthand quadrant: sex-specific probability of the molt-to-maturity (i.e., terminal molt); plots in righthand column: natural mortality rates, by maturity state and sex.

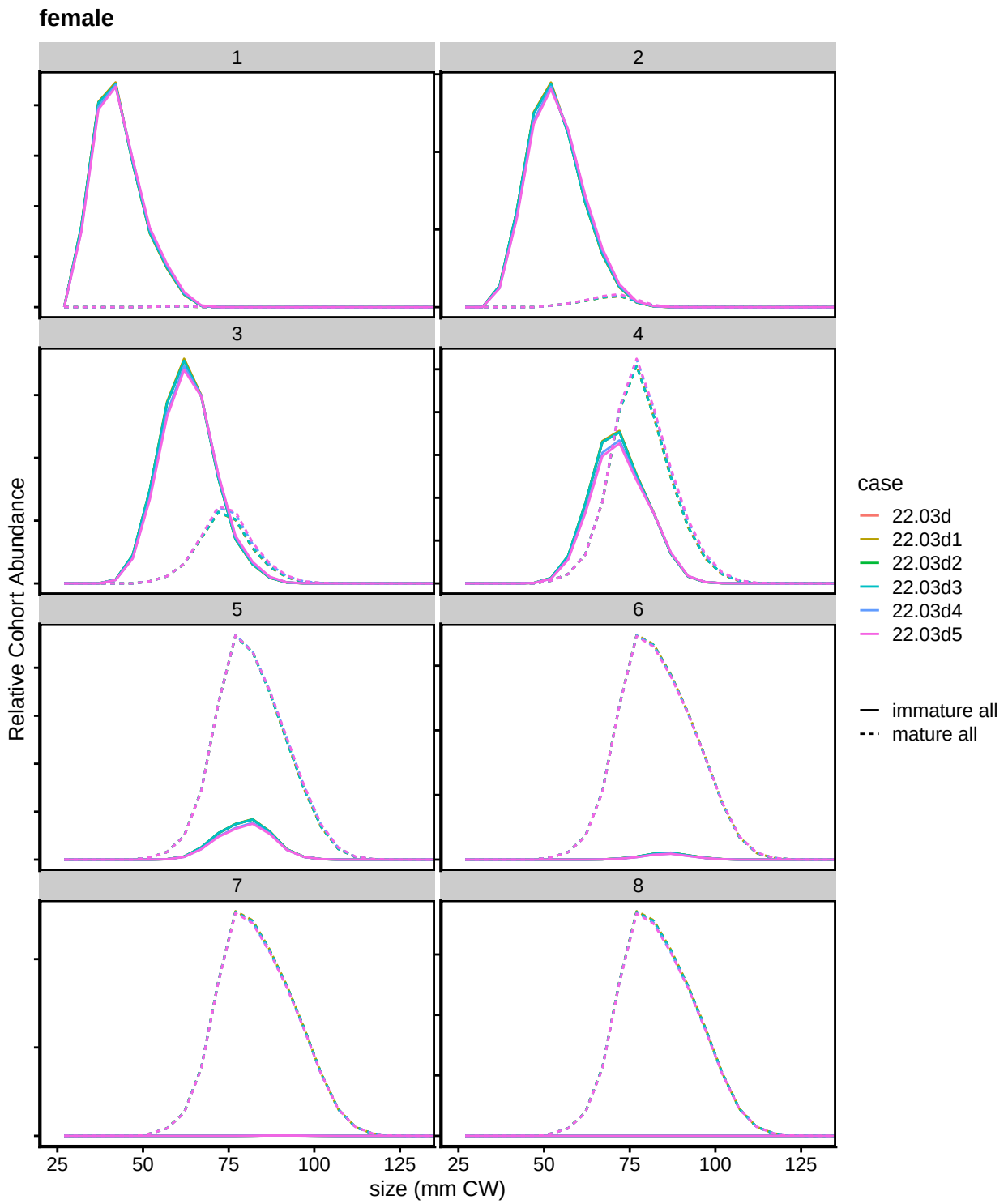

Figure 12. TCSAM02 models estimated annual cohort progression for female crab based on rates from final model year (by age; individual scales are relative).

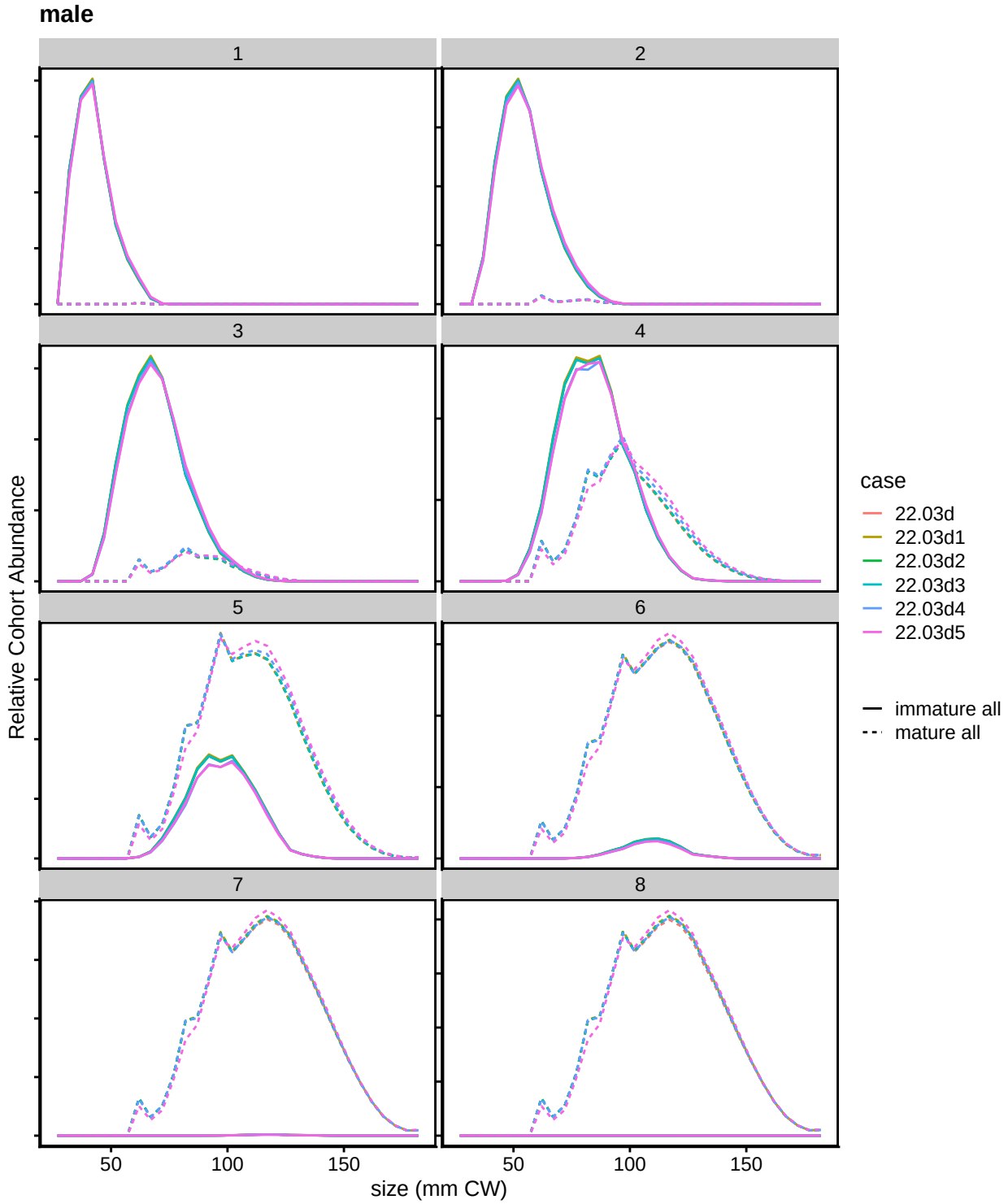

Figure 13. TCSAM02 models estimated annual cohort progression for male crab based on rates from final model year (by age; individual scales are relative).

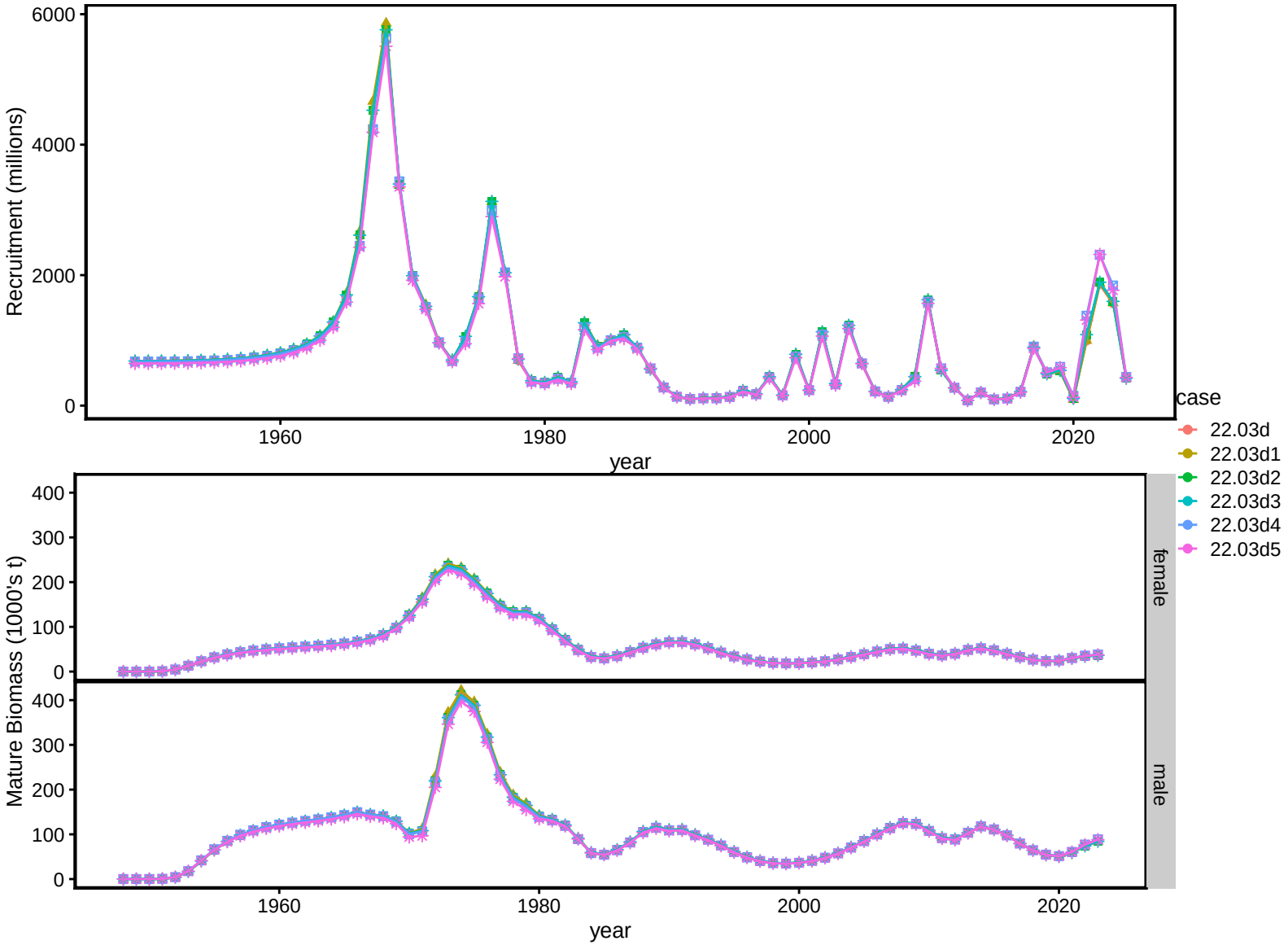

Figure 14. TCSAM02 models estimated recruitment and mature biomass time series (all years). Upper plot: recruitment; lower plots: sex-specific mature biomass-at-mating.

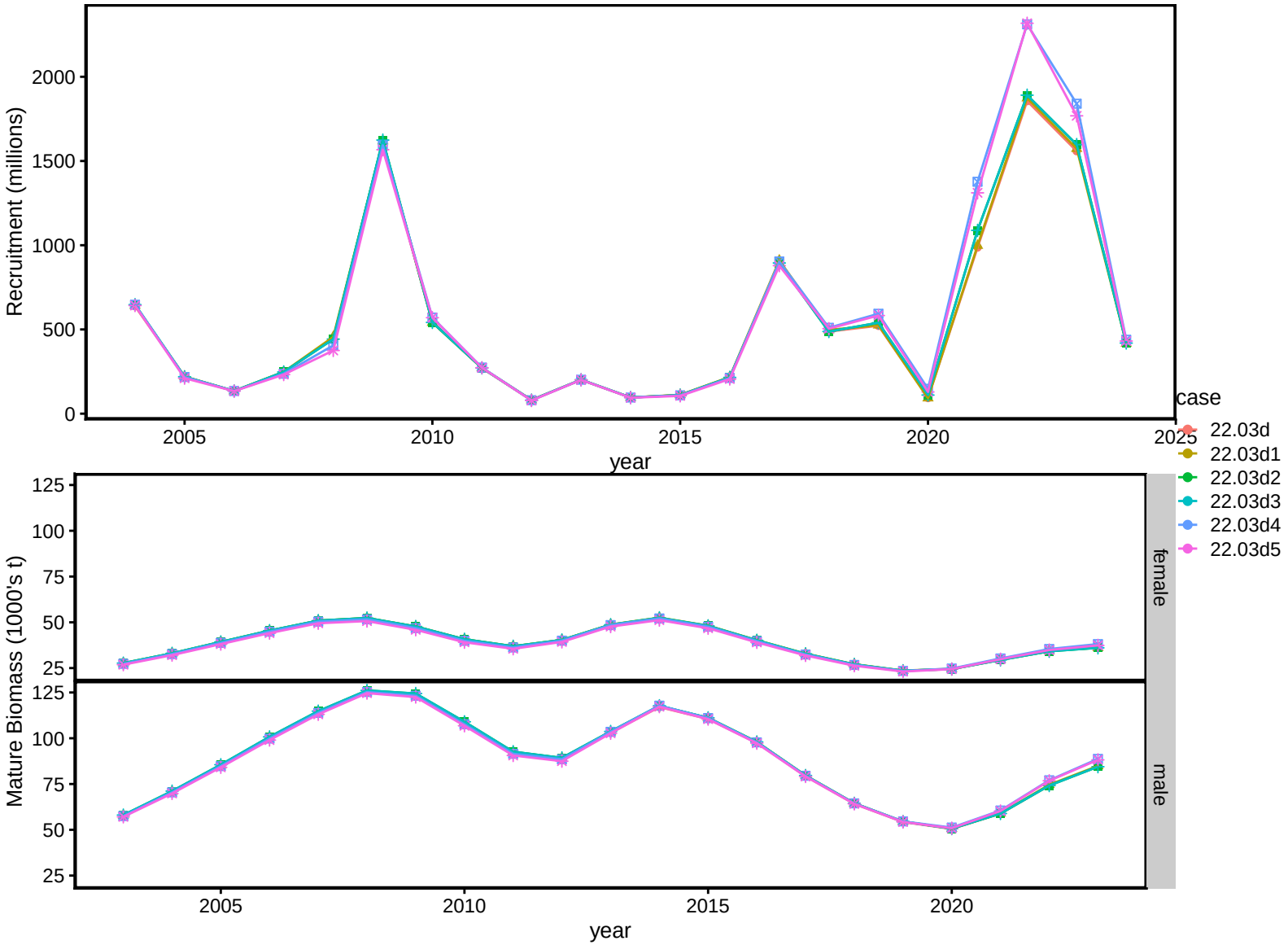

Figure 15. TCSAM02 models estimated recruitment and mature biomass time series (recent years). Upper plot: recruitment; lower plots: sex-specific mature biomass-at-mating.

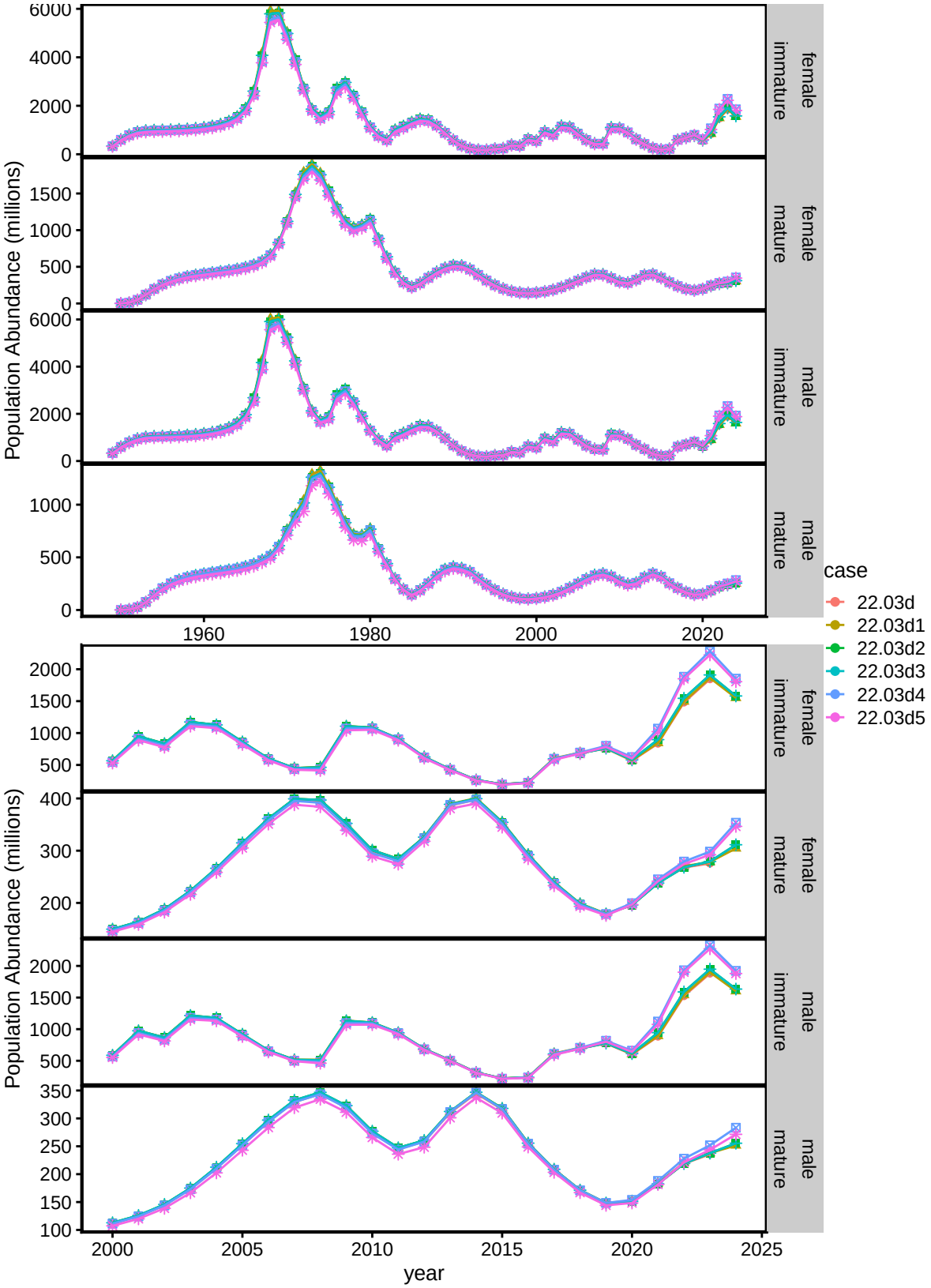

Figure 16. TCSAM02 models estimated population abundance trends, by sex and maturity state. Upper plots: all years; lower plots: recent years.

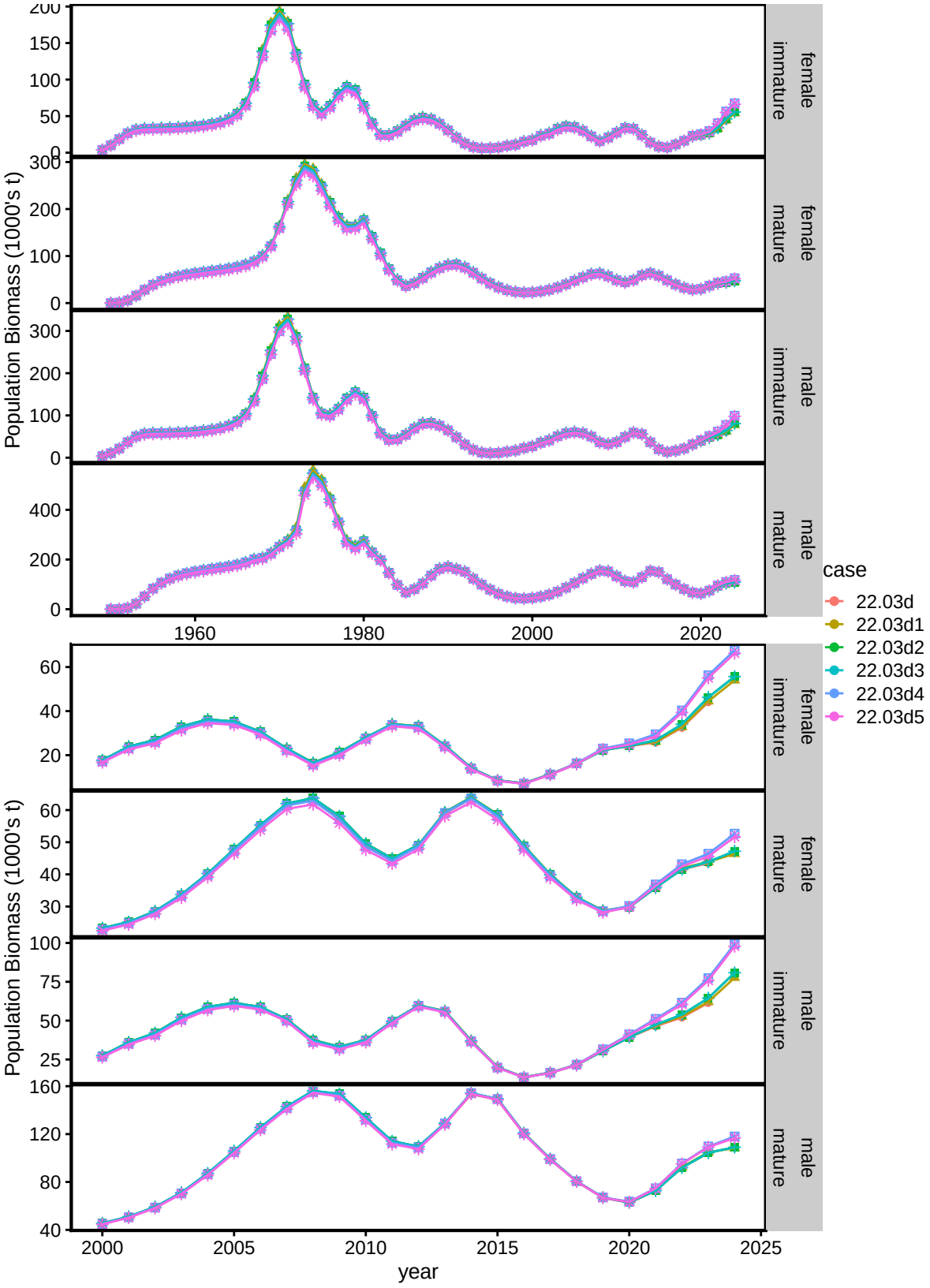

Figure 17. TCSAM02 models estimated population biomass trends, by sex and maturity state. Upper plots: all years; lower plots: recent years.

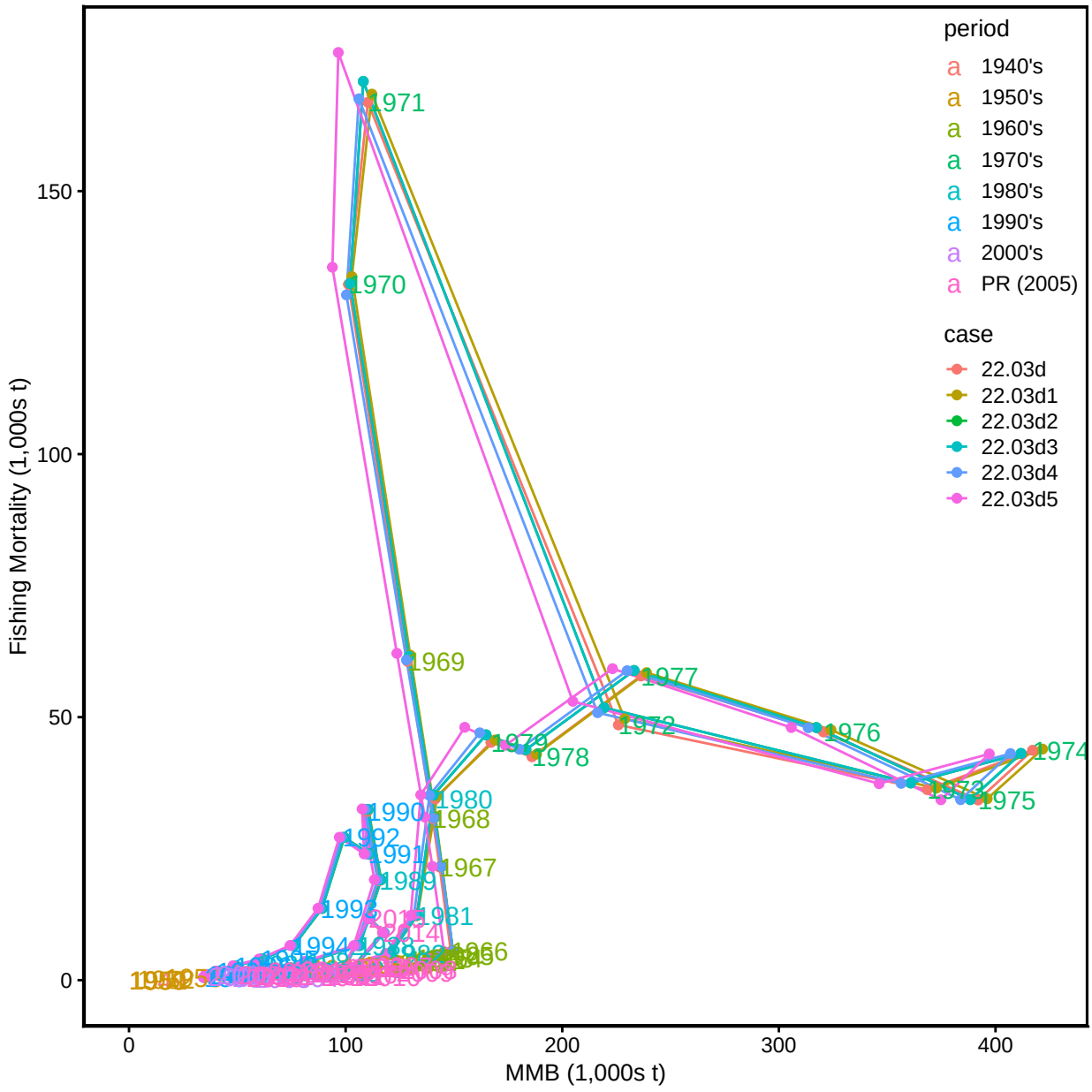

Figure 18. TCSAM02 models estimated total fishing mortality vs. MMB.

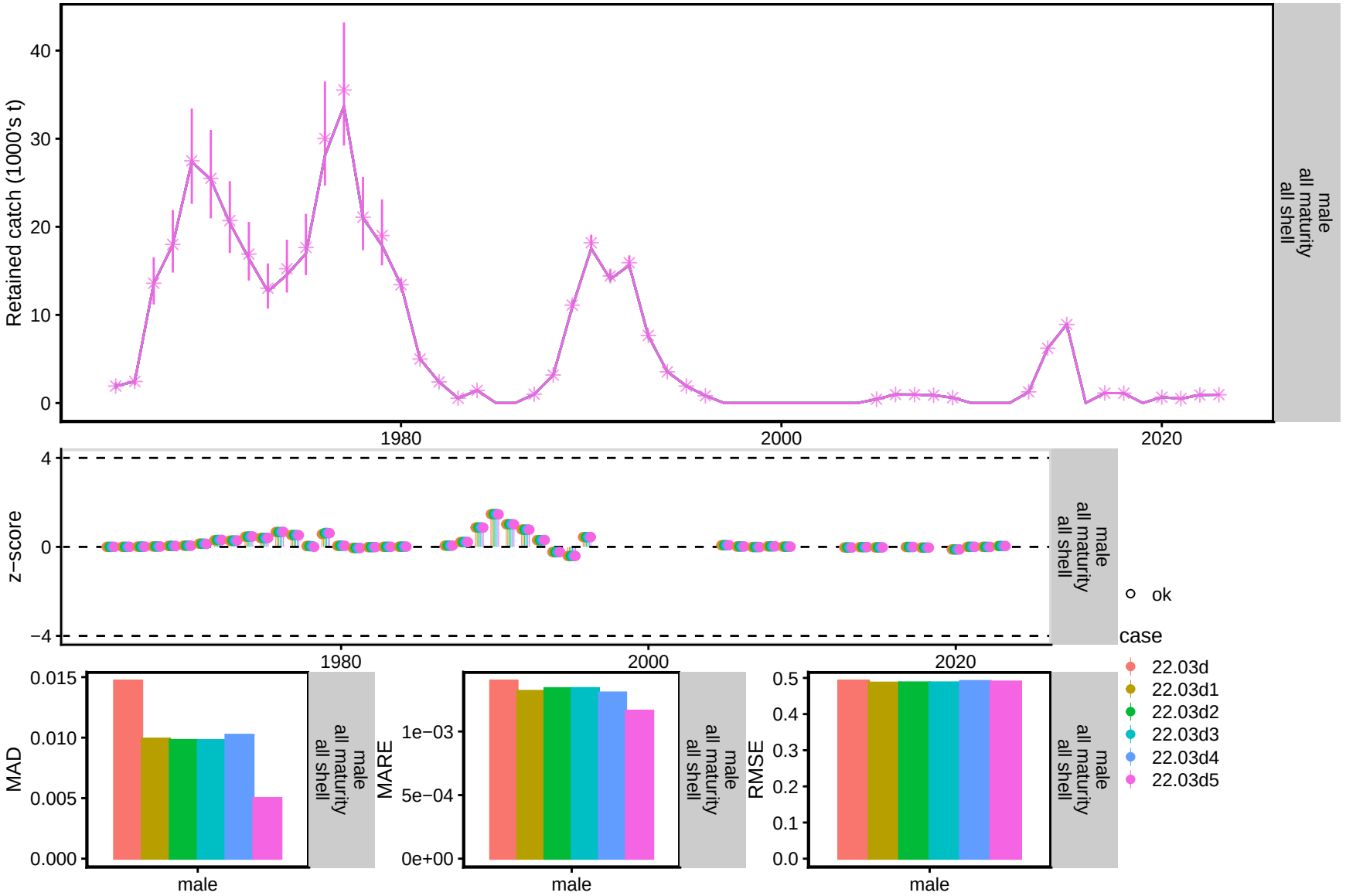

Figure 19. TCSAM02 models fits to retained catch biomass in the directed fishery (upper two rows) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

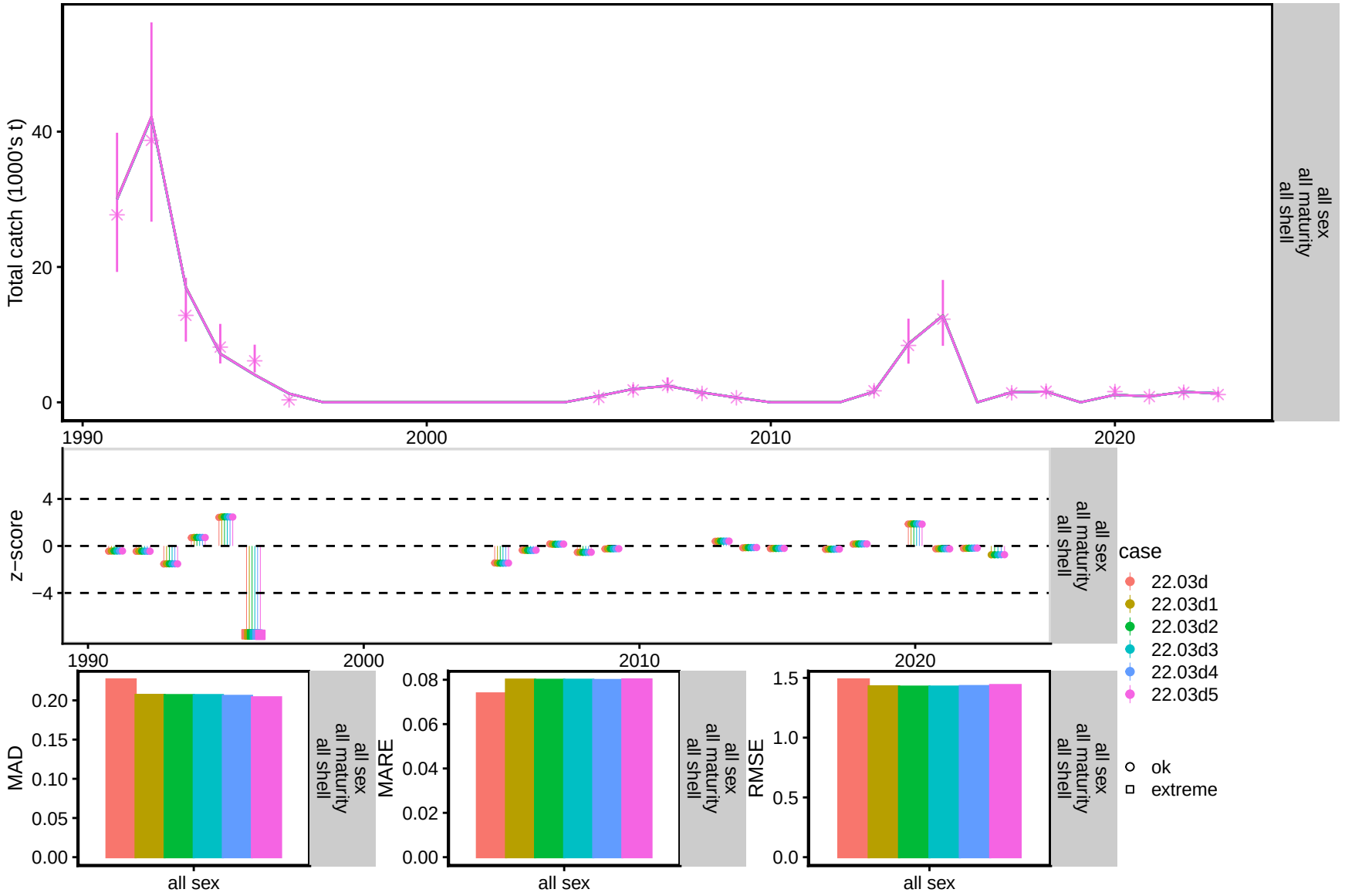

Figure 20. TCSAM02 models fits to total catch biomass of all crab in the TCF fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

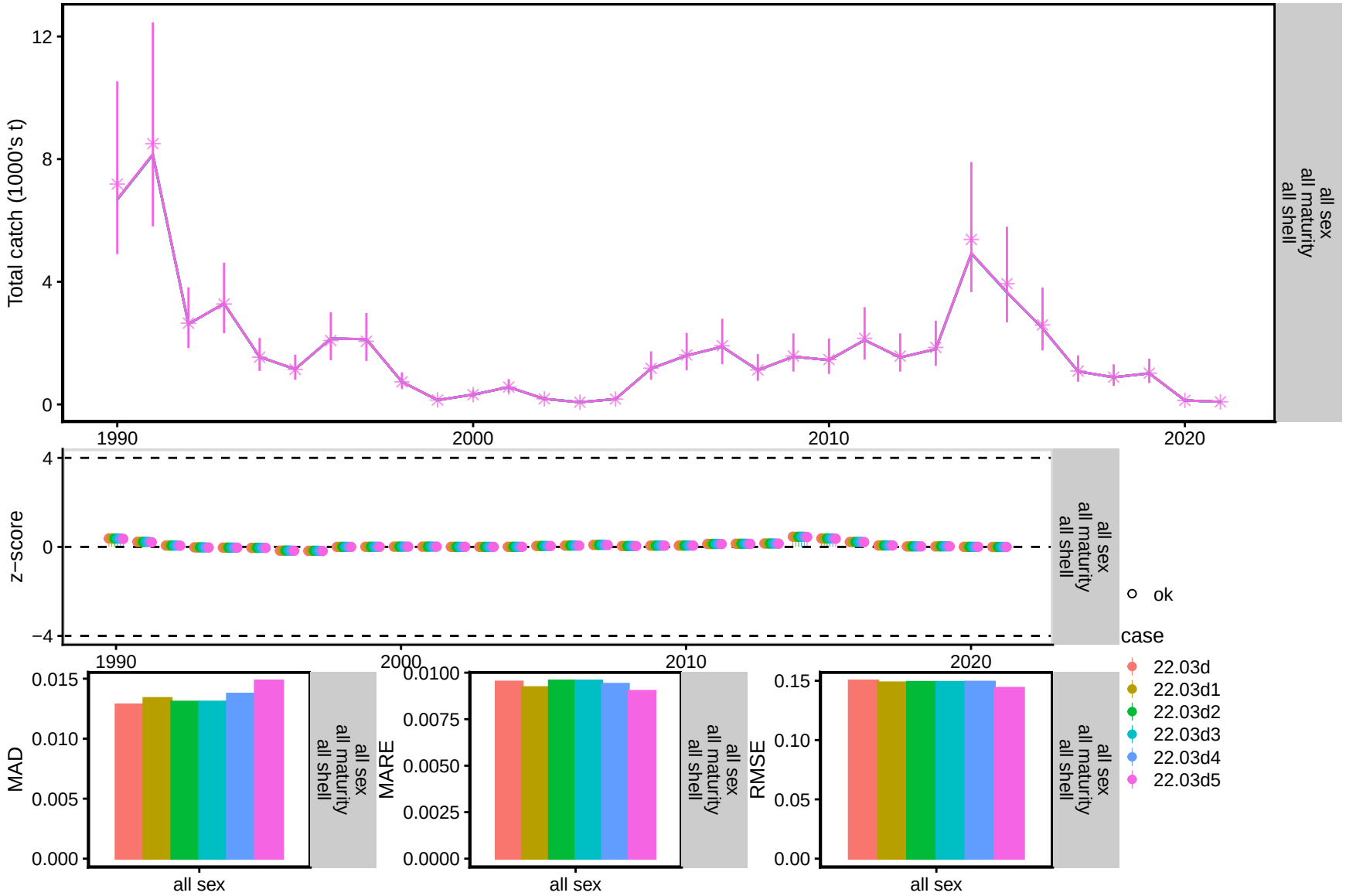

Figure 21. TCSAM02 models fits to total catch biomass of all crab in the SCF fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

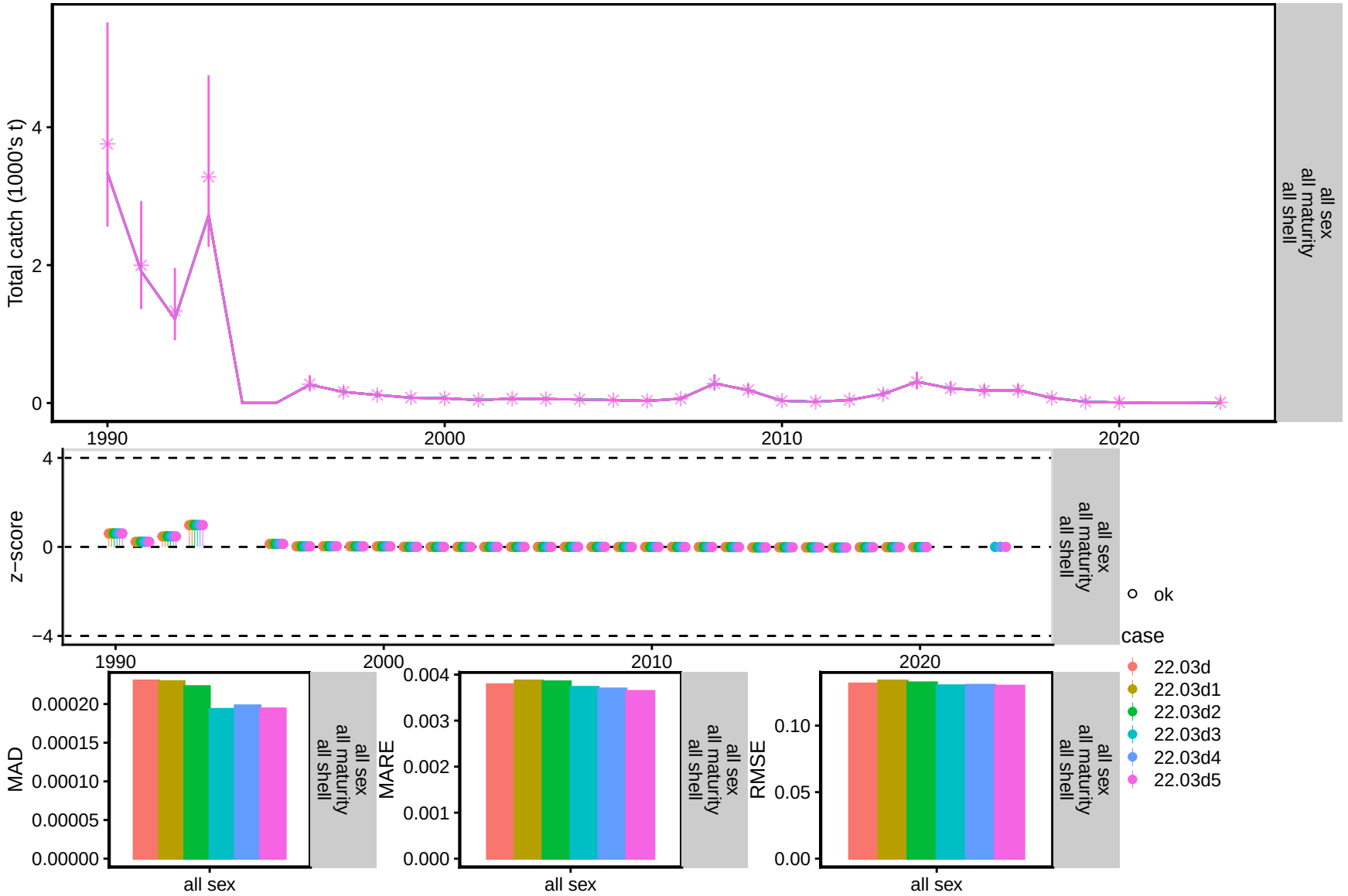

Figure 22. TCSAM02 models fits to total catch biomass of all crab in the RKF fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

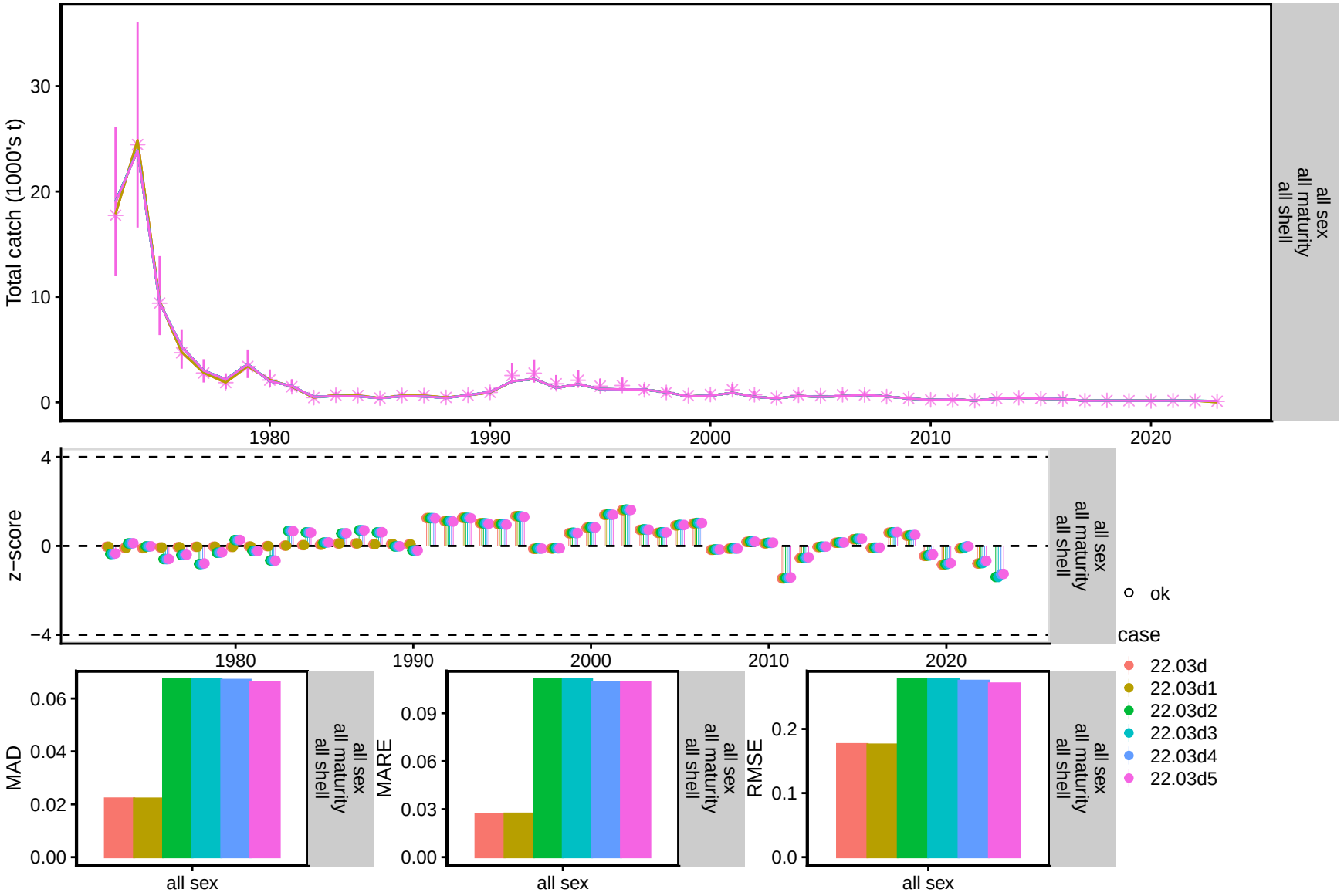

Figure 23. TCSAM02 models fits to total catch biomass of all crab in the GF All fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%.

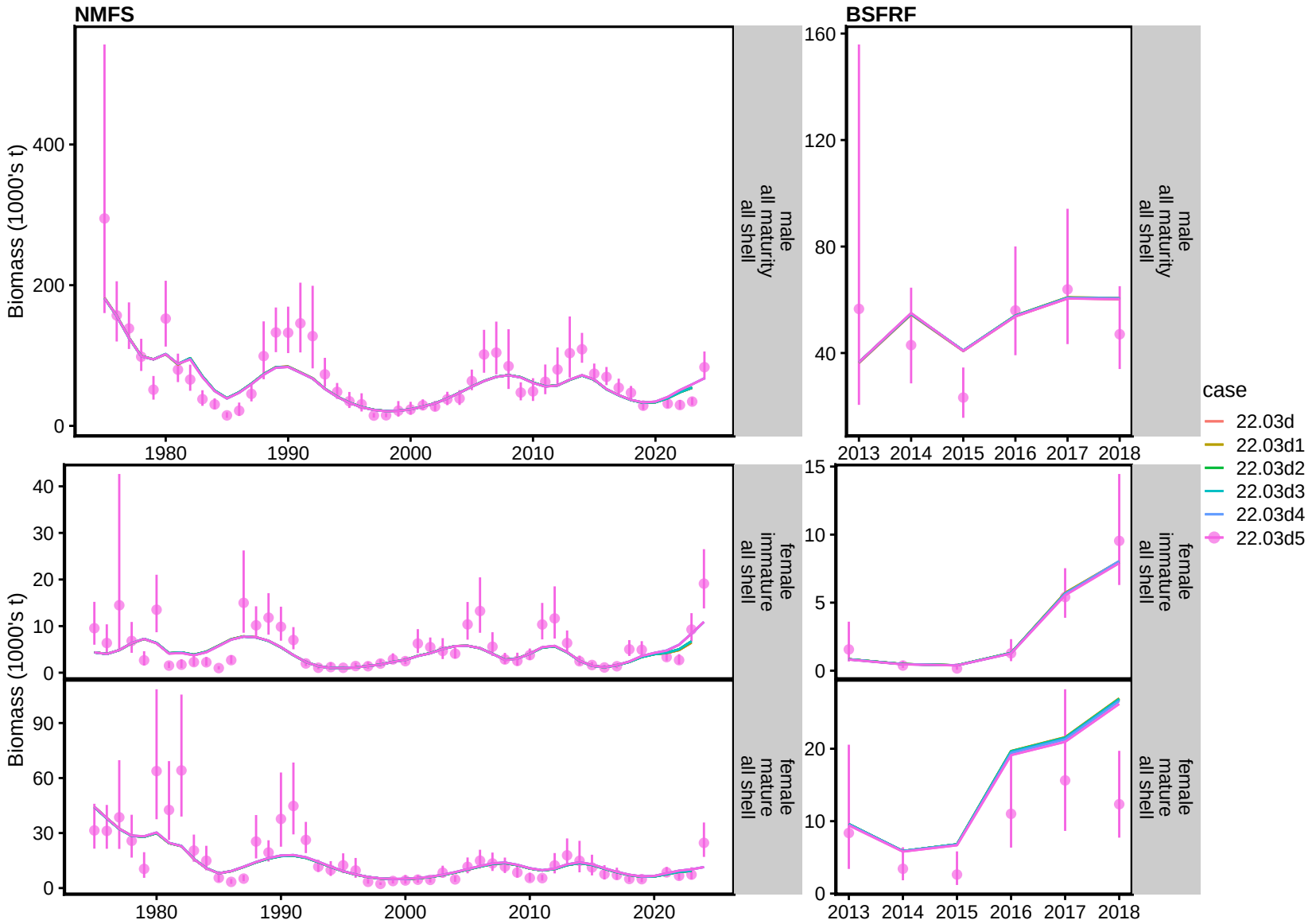

Figure 24. TCSAM02 models fits to time series of all male (upper graph), immature female (center graph), and mature female (lower plot) biomass from the NMFS EBS shelf bottom trawl survey (left column) and the BSFRF SBS trawl survey (right column). Confidence intervals are 95%.

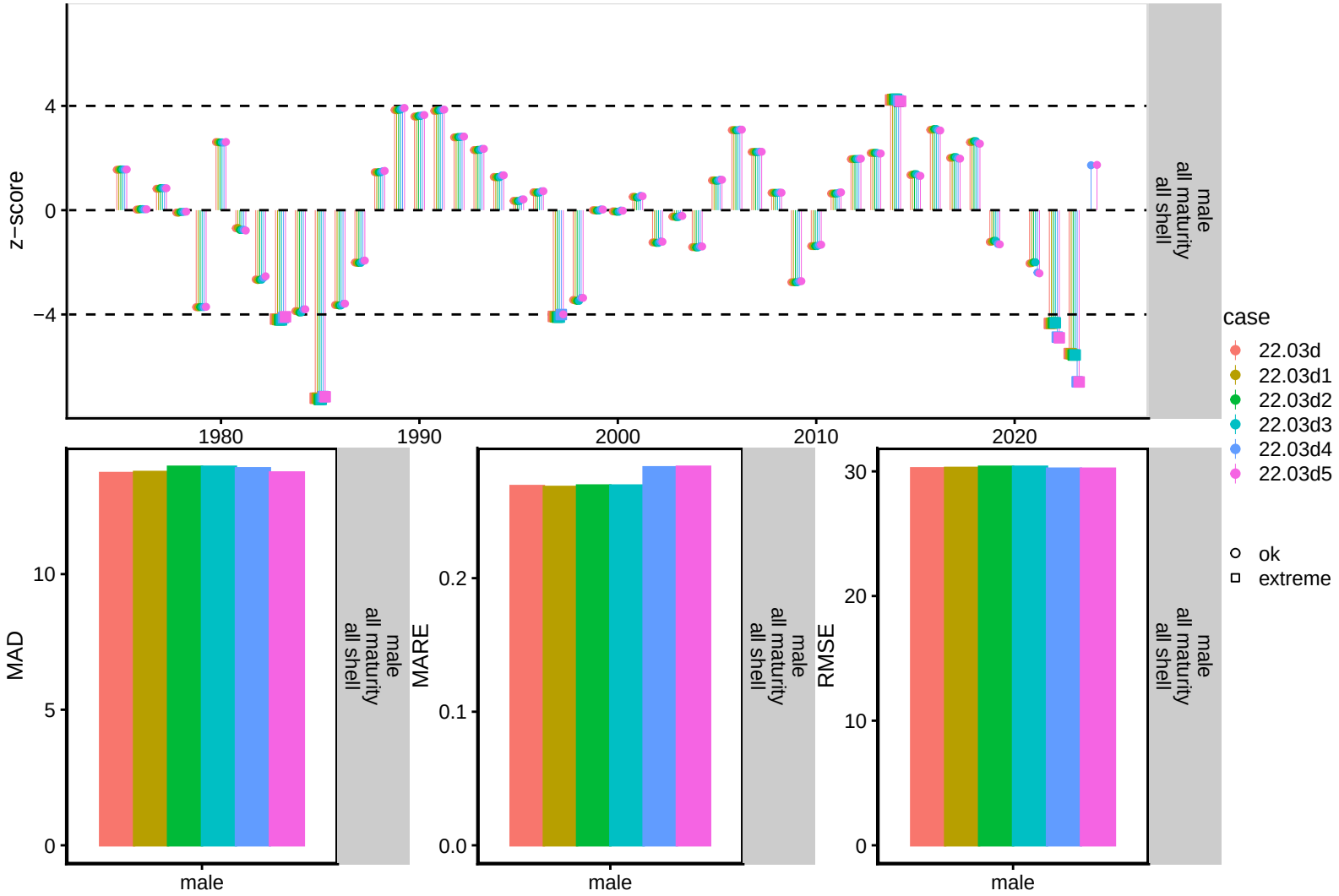

Figure 25. TCSAM02 models residuals analysis by model scenario for fits to male biomass in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

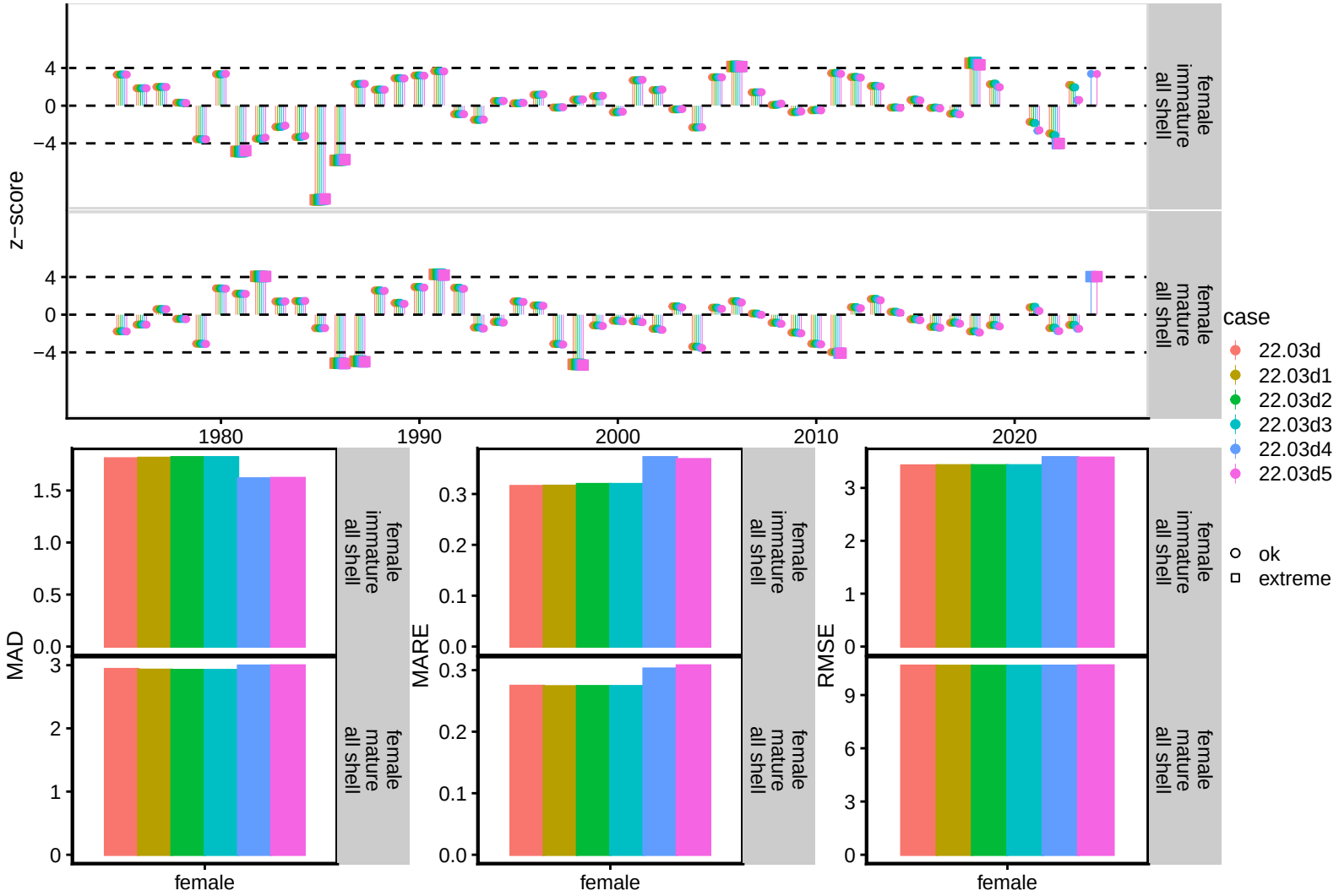

Figure 26. TCSAM02 models residuals analysis by model scenario for fits to female biomass in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

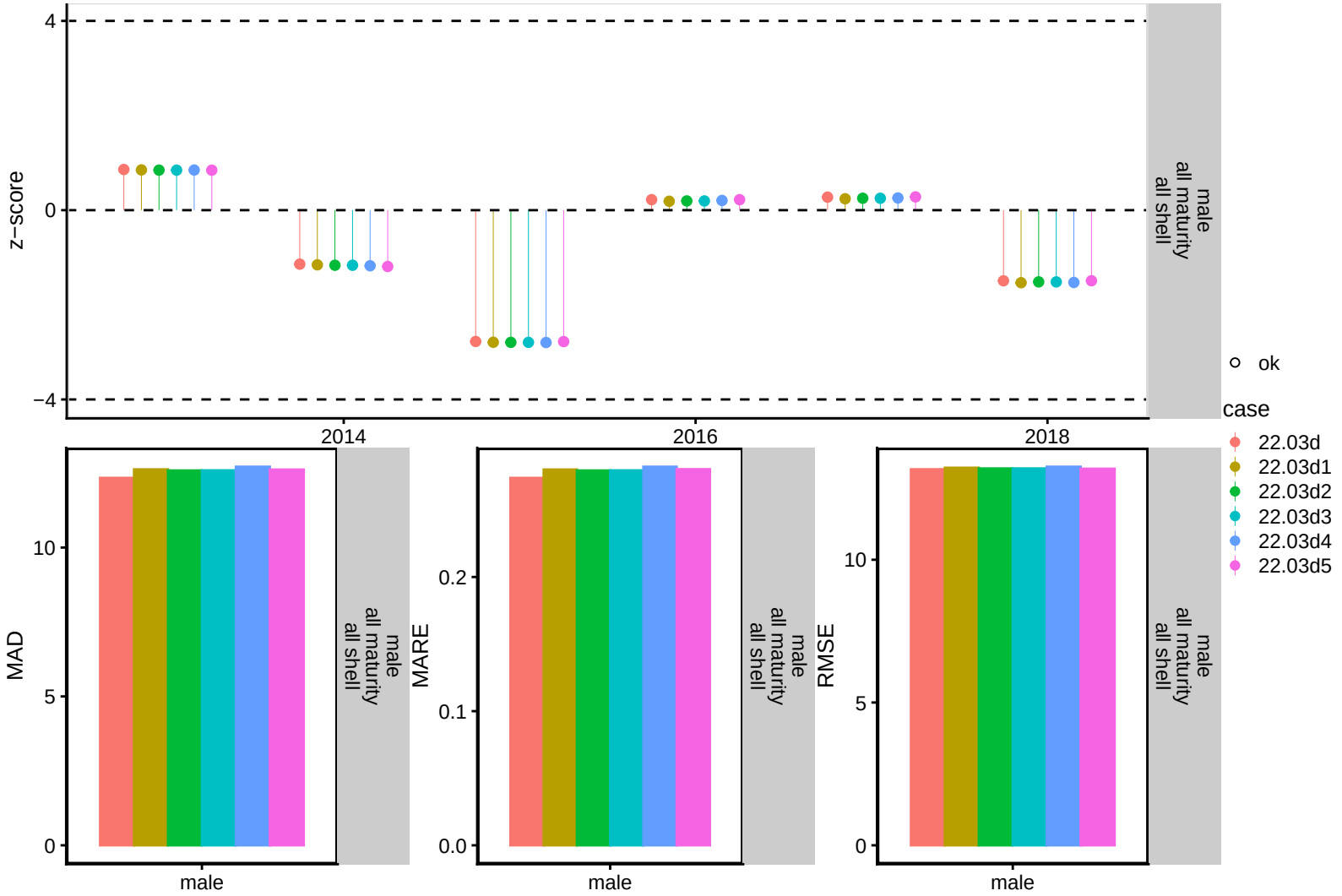

Figure 27. TCSAM02 models residuals analysis by model scenario for fits to male biomass in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

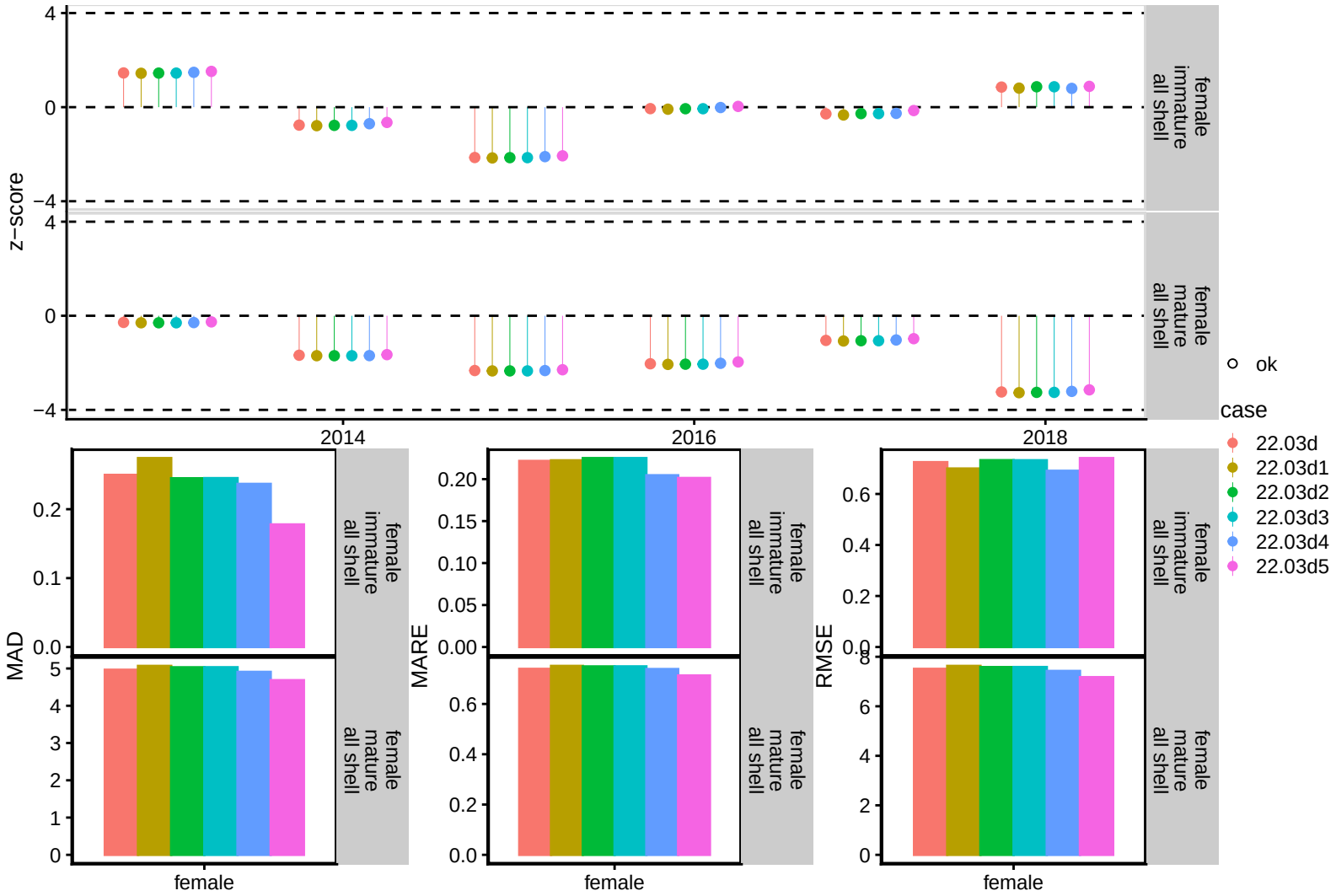

Figure 28. TCSAM02 models residuals analysis by model scenario for fits to female biomass in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

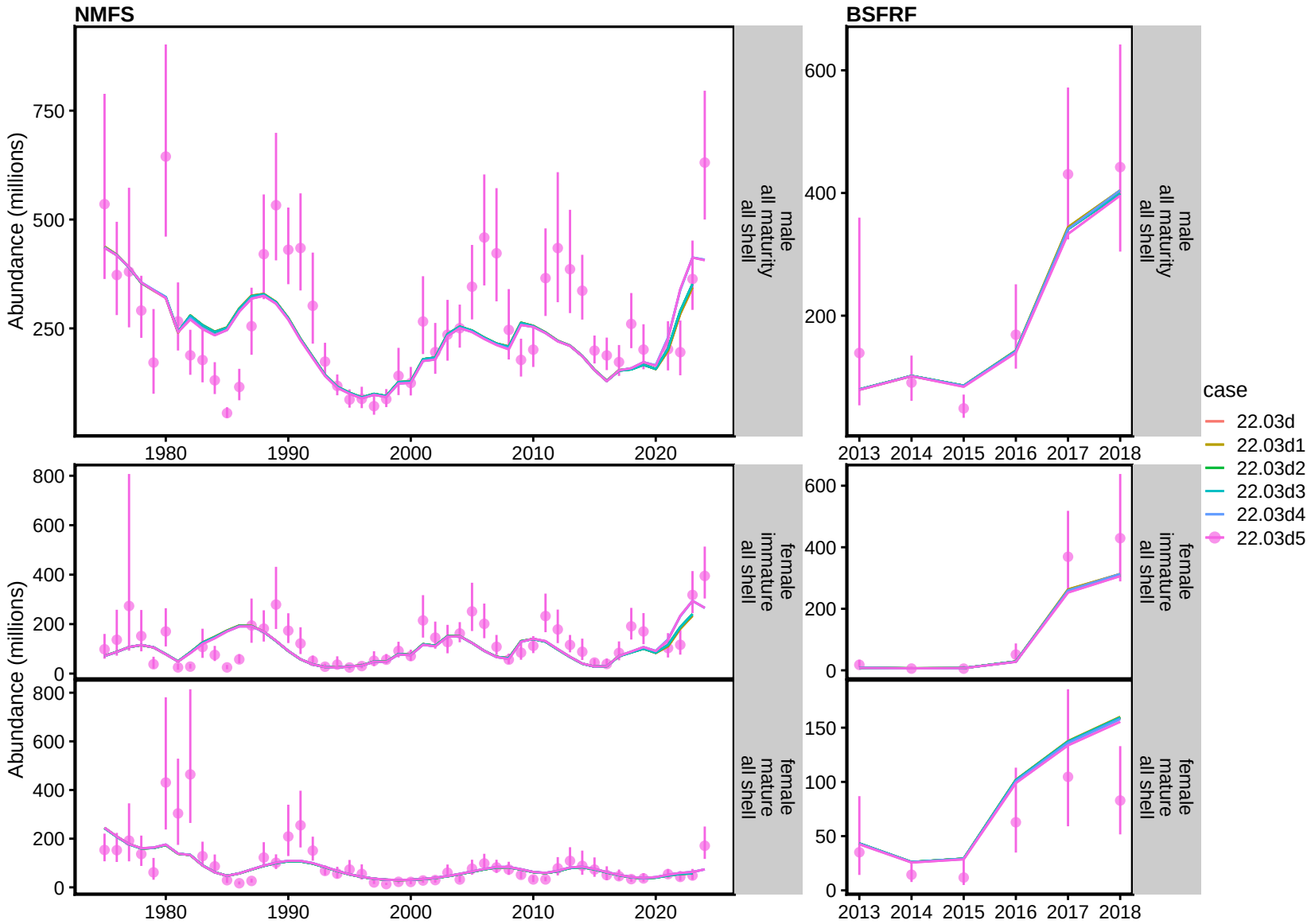

Figure 29. TCSAM02 models fits to time series of all male (upper graph), immature female (center graph), and mature female (lower plot) abundance from the NMFS EBS shelf bottom trawl survey (left column) and the BSFRF SBS trawl survey (right column). Note that these fits are not included in the model objective function and simply provide a diagnostic check. Confidence intervals are 95%.

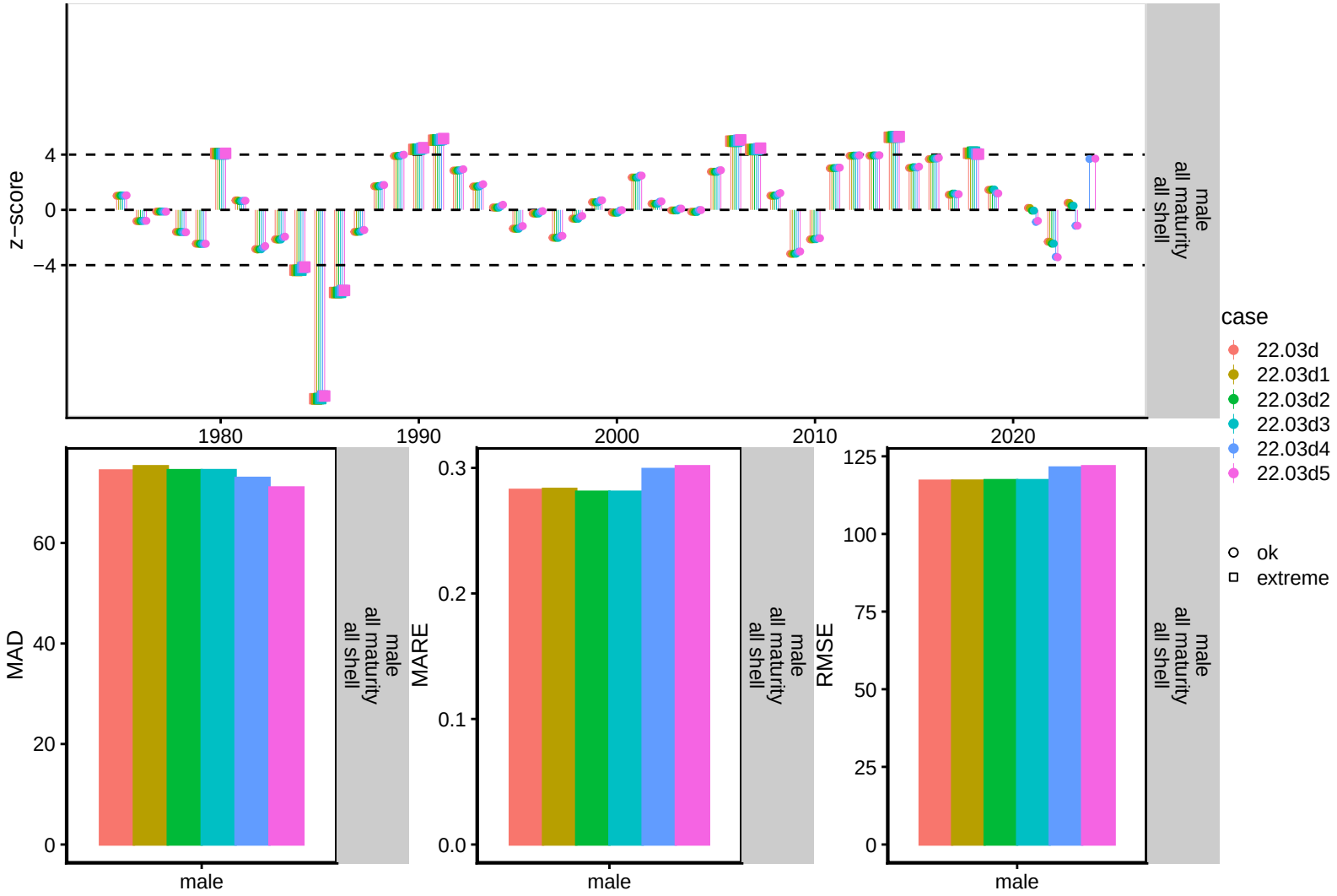

Figure 30. TCSAM02 models residuals analysis by model scenario for fits to male abundance in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

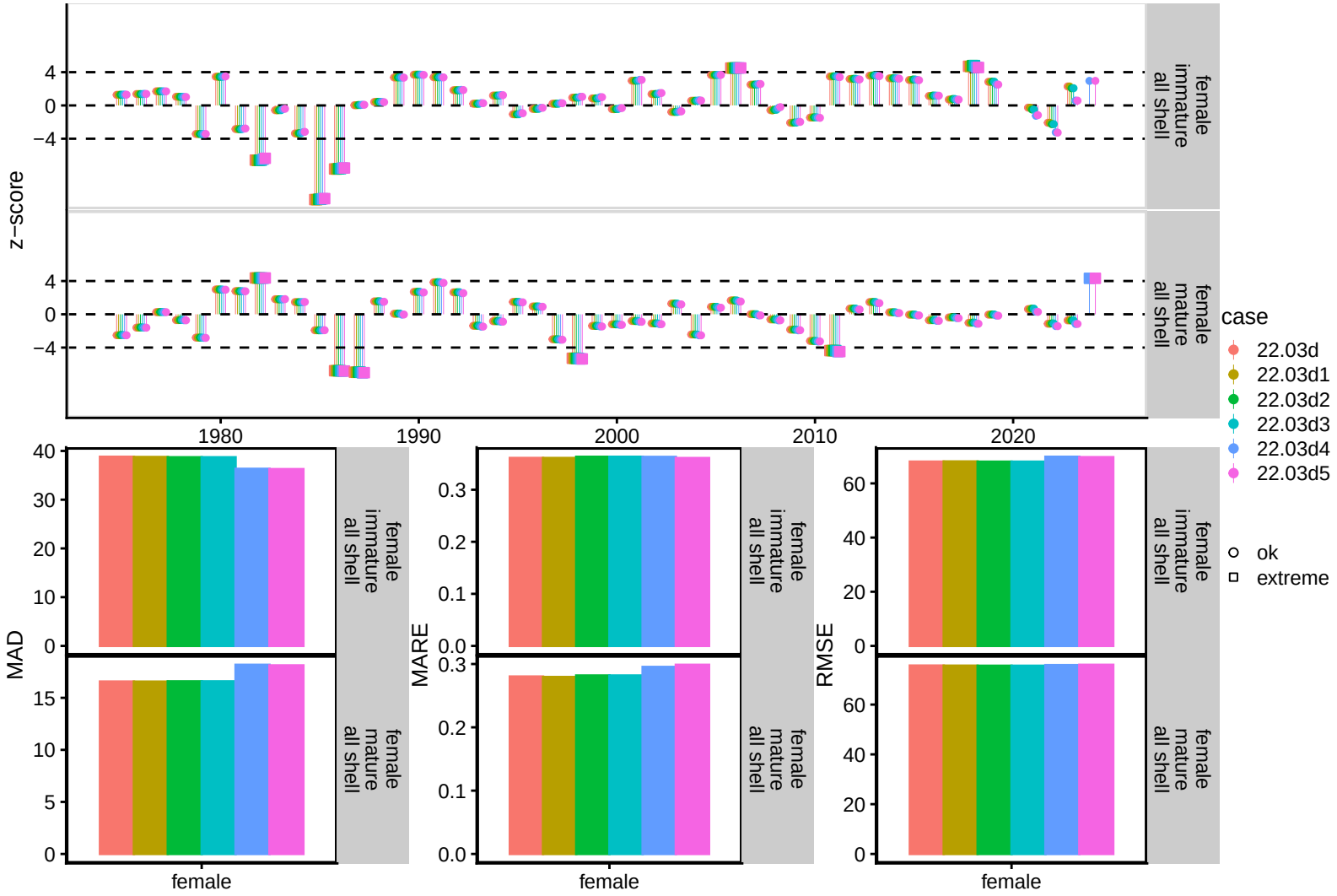

Figure 31. TCSAM02 models residuals analysis by model scenario for fits to female abundance in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

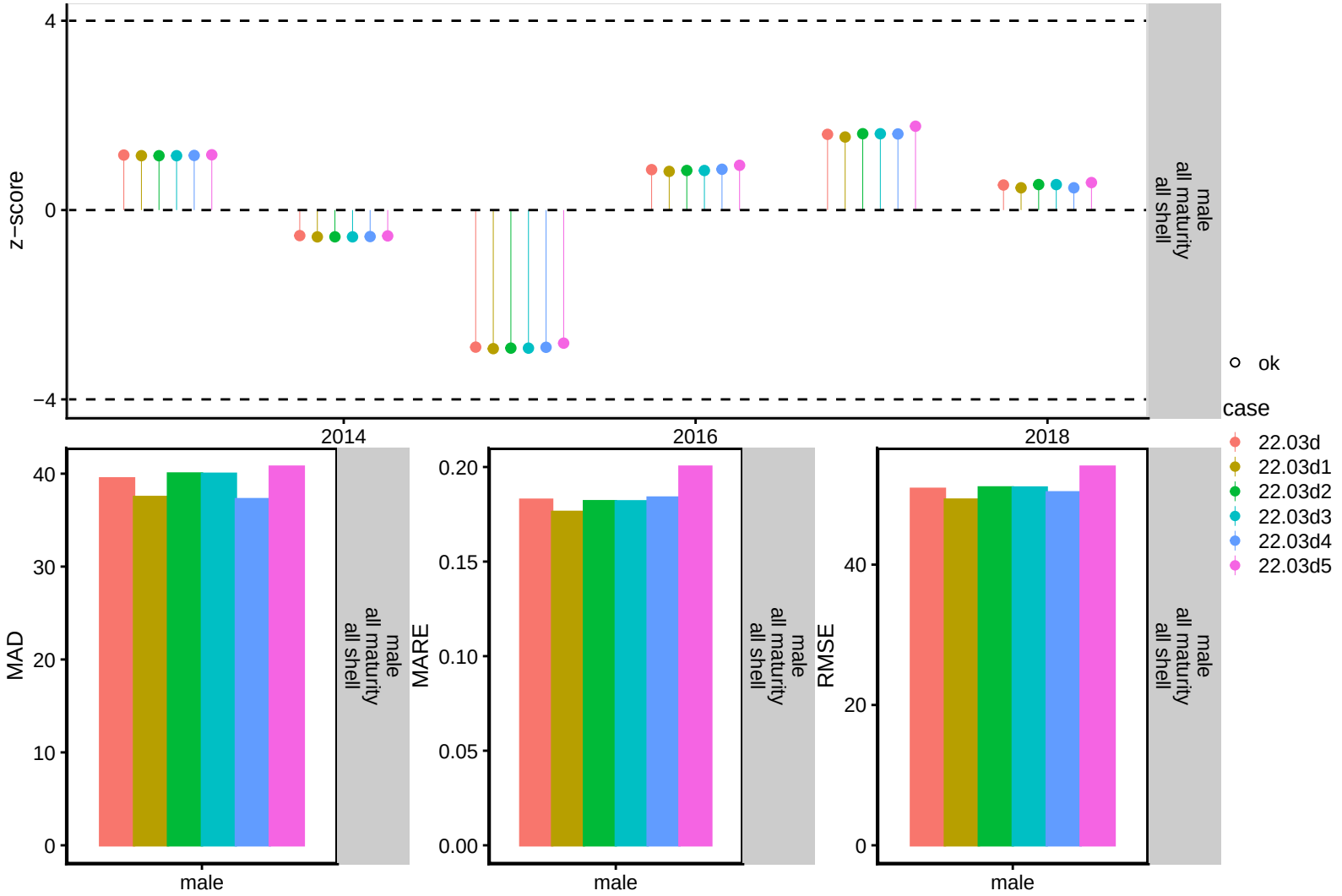

Figure 32. TCSAM02 models residuals analysis by model scenario for fits to male abundance in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

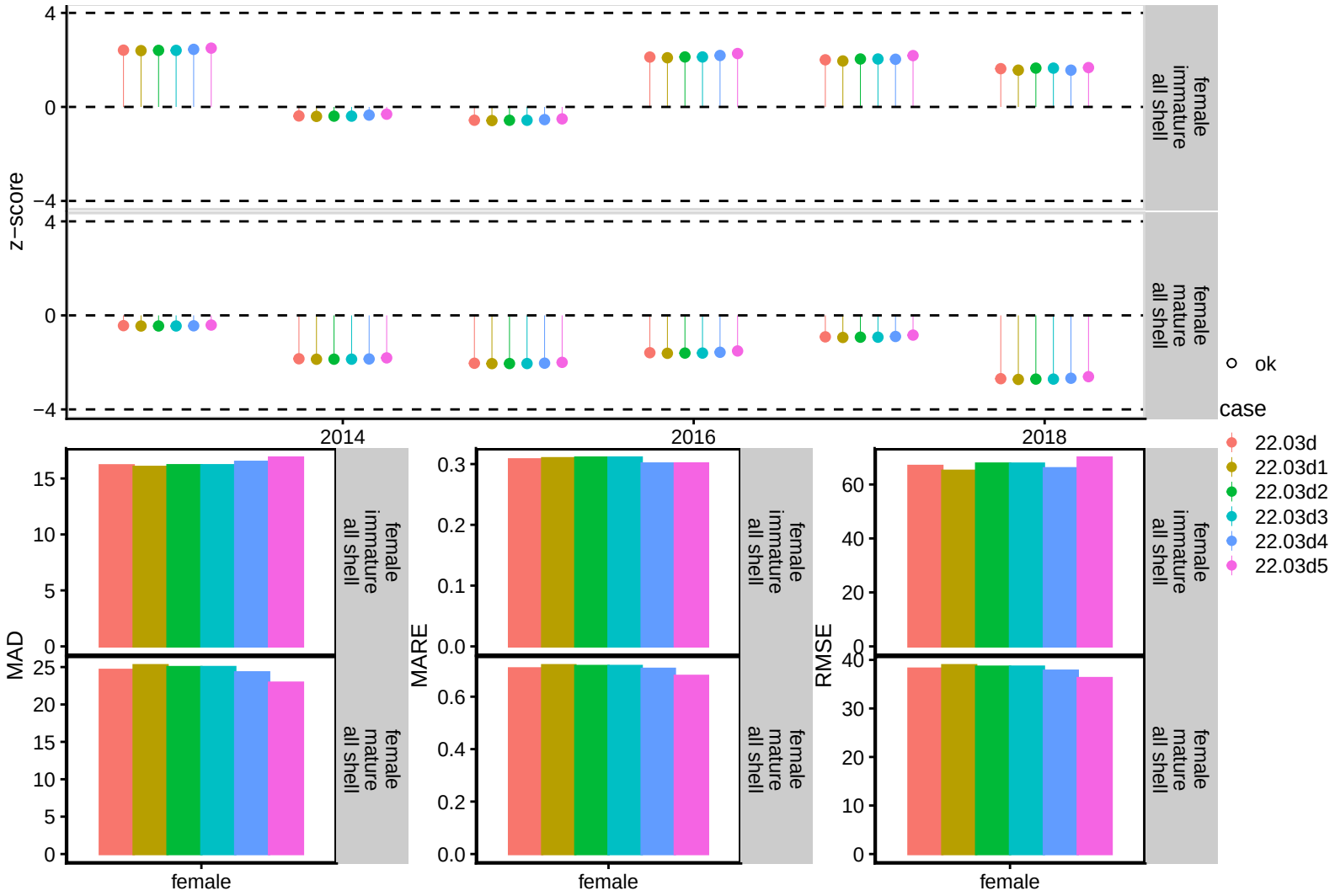

Figure 33. TCSAM02 models residuals analysis by model scenario for fits to female abundance in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

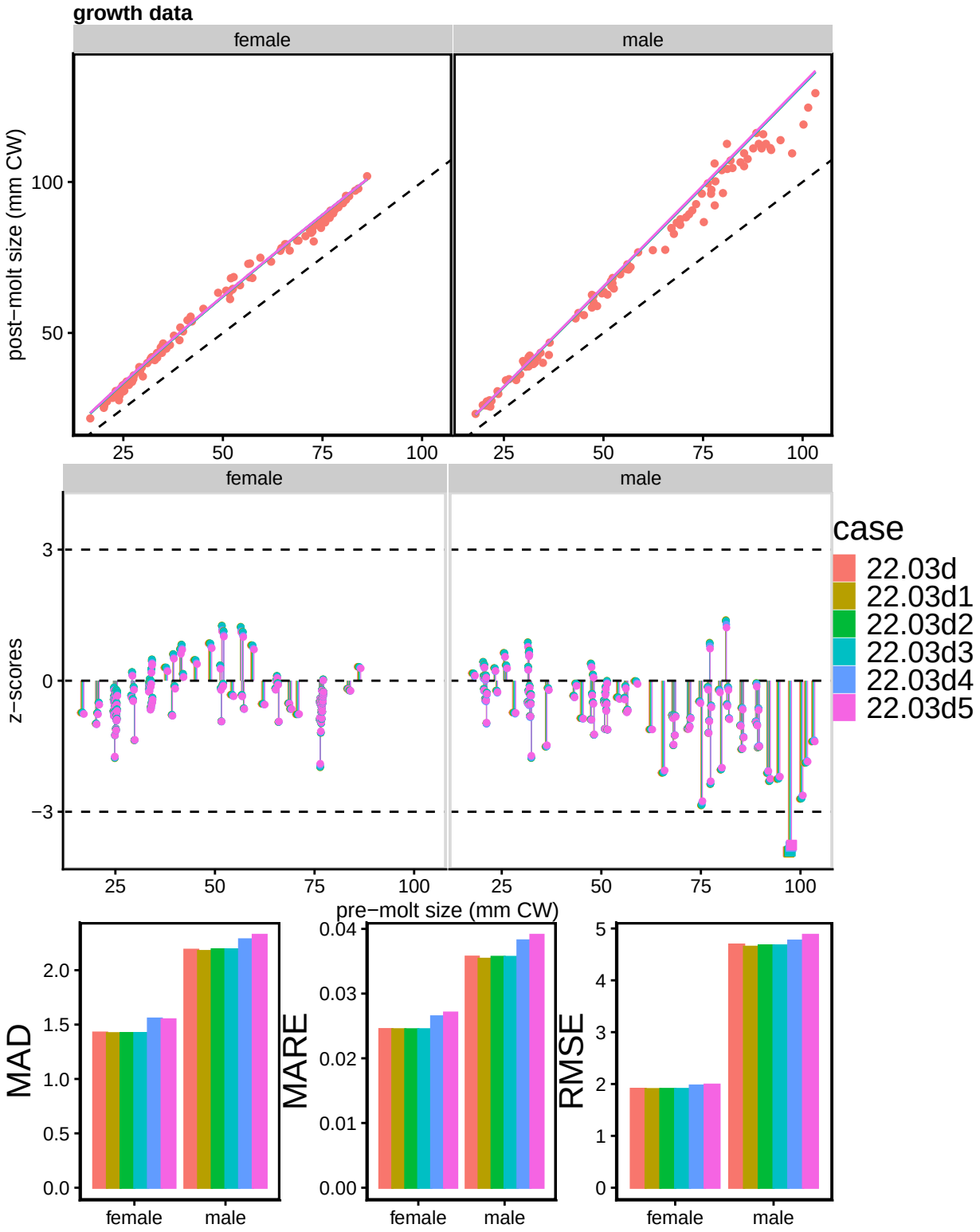

Figure 34. TCSAM02 models fits and residuals analysis by model scenario for fits to molt increment data. Upper row: fits to data; center row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

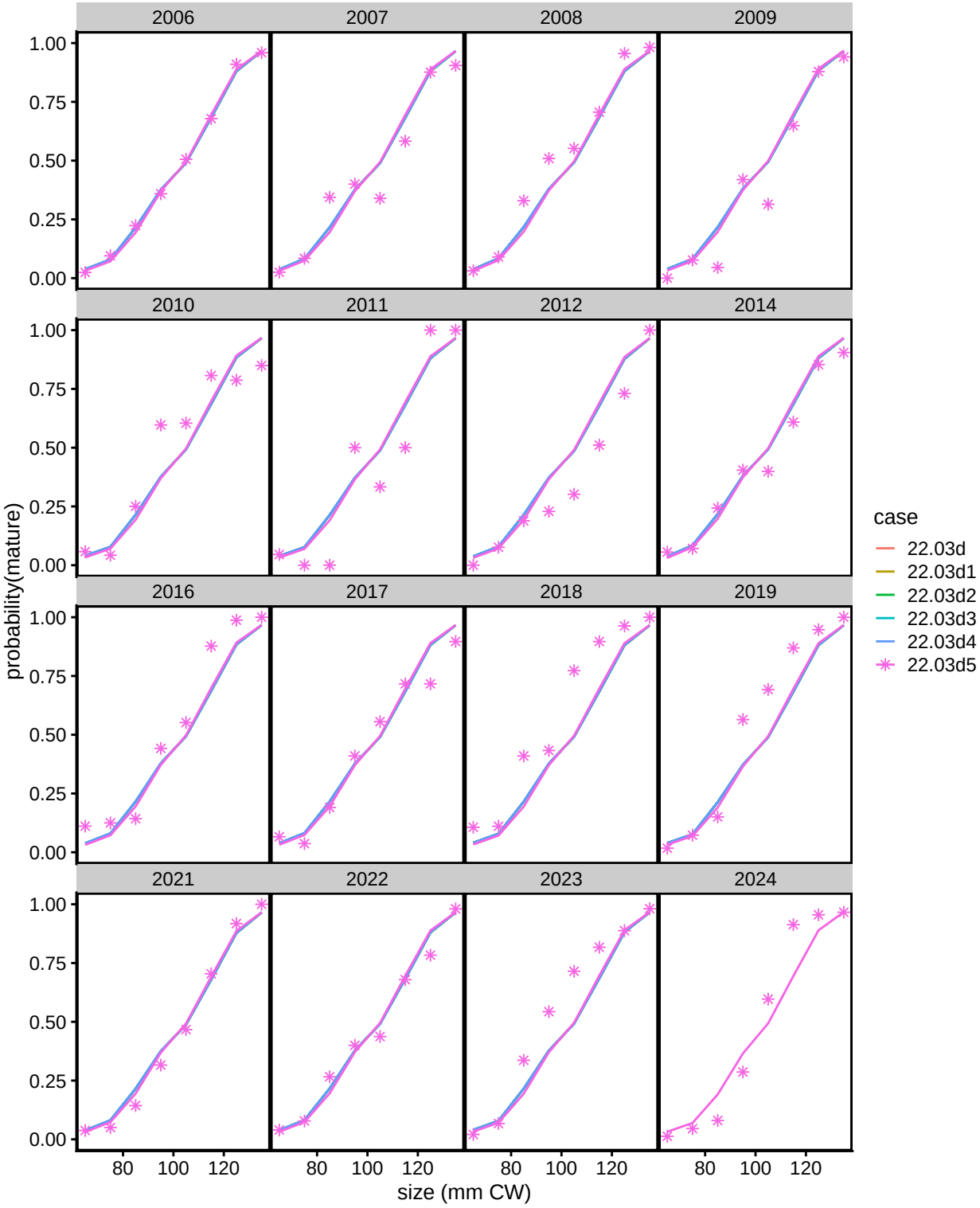

Figure 35. TCSAM02 models fits to maturity ogive data by model scenario and year.

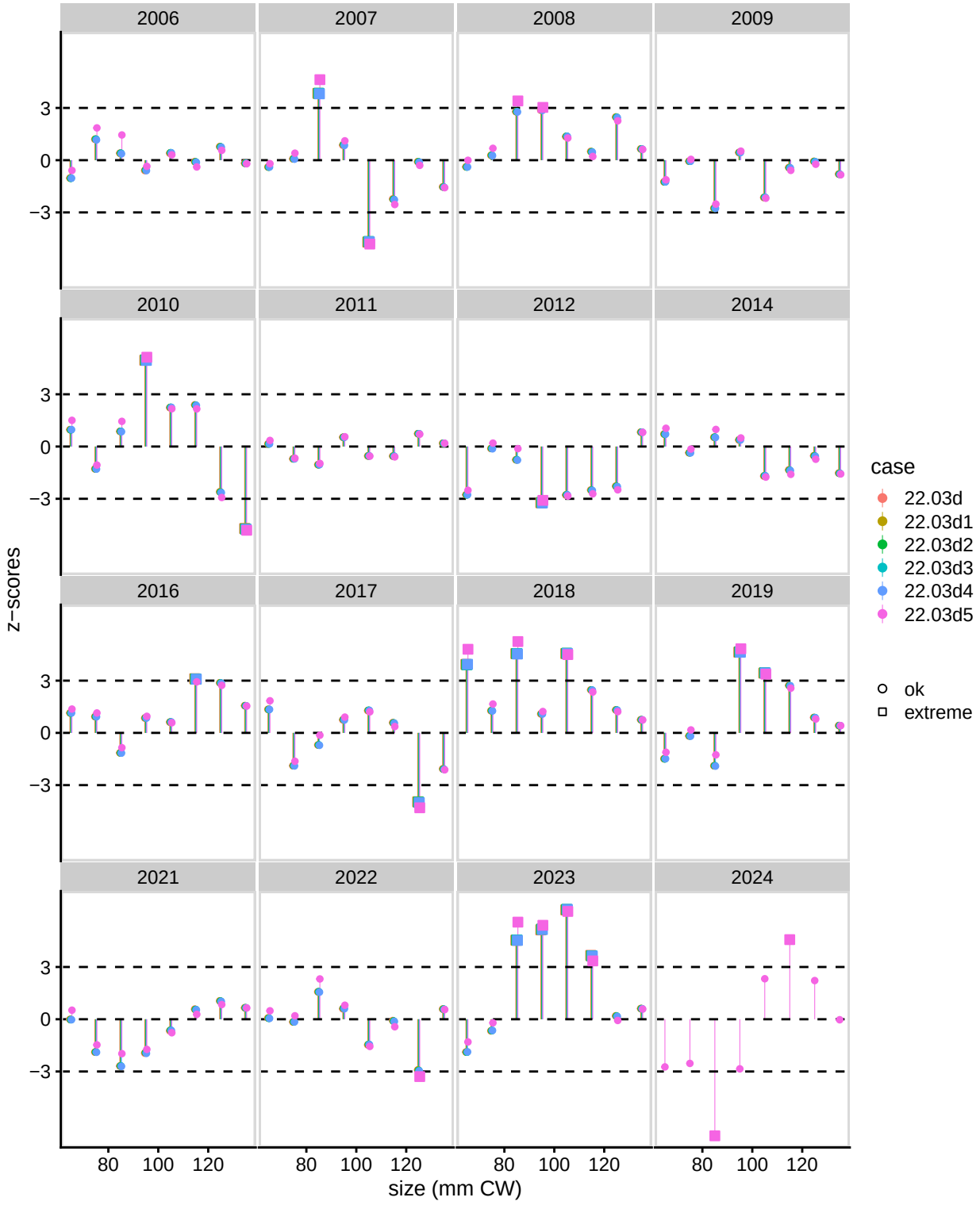

Figure 36. TCSAM02 models residuals analysis for maturity ogive data, by model scenario and year.

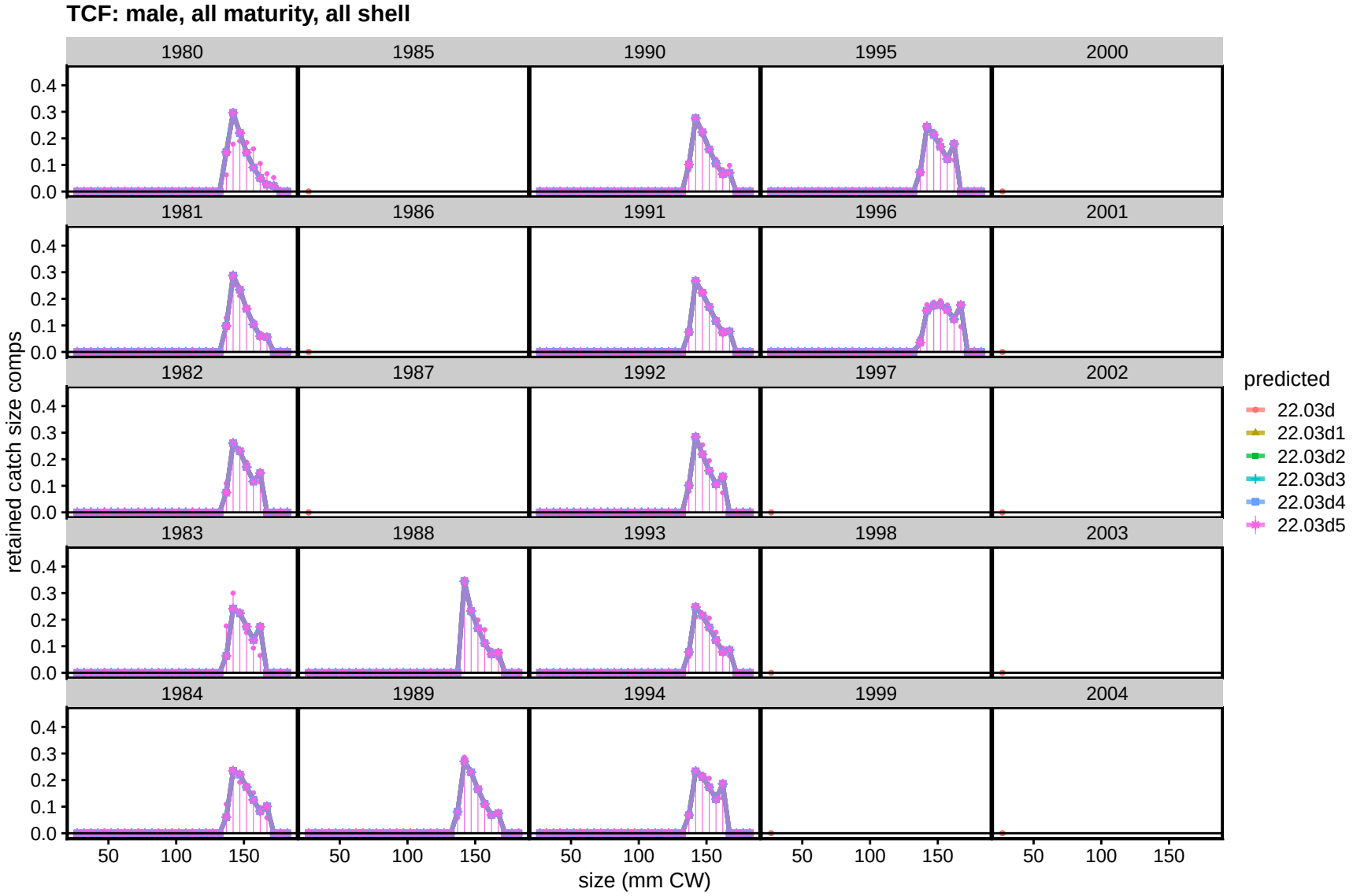

Figure 37. TCSAM02 models fits to retained catch size compositions in the directed fishery. Preferred model is 22.03d5.

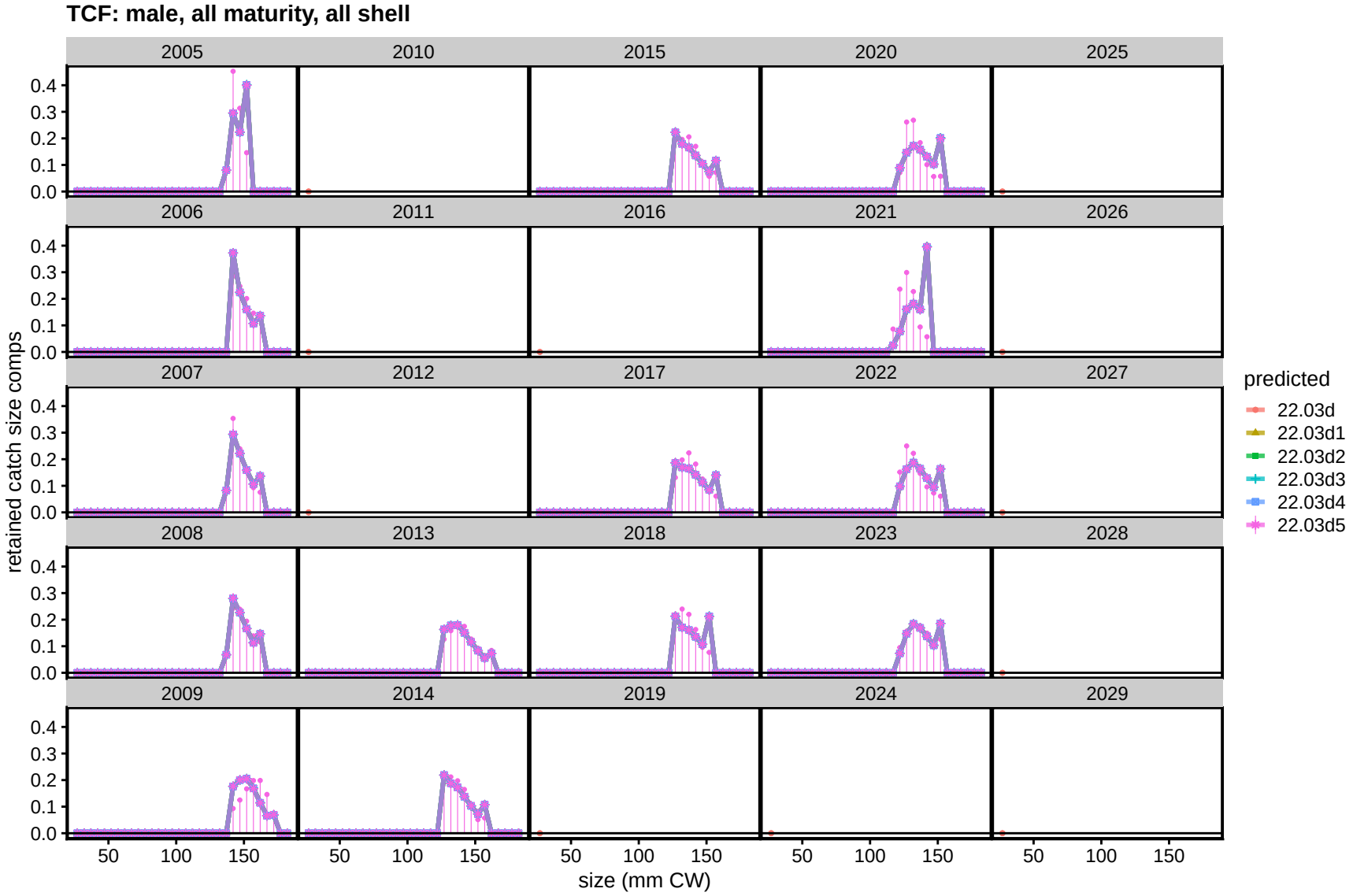

Figure 38. TCSAM02 models fits to retained catch size compositions in the directed fishery. Preferred model is 22.03d5.

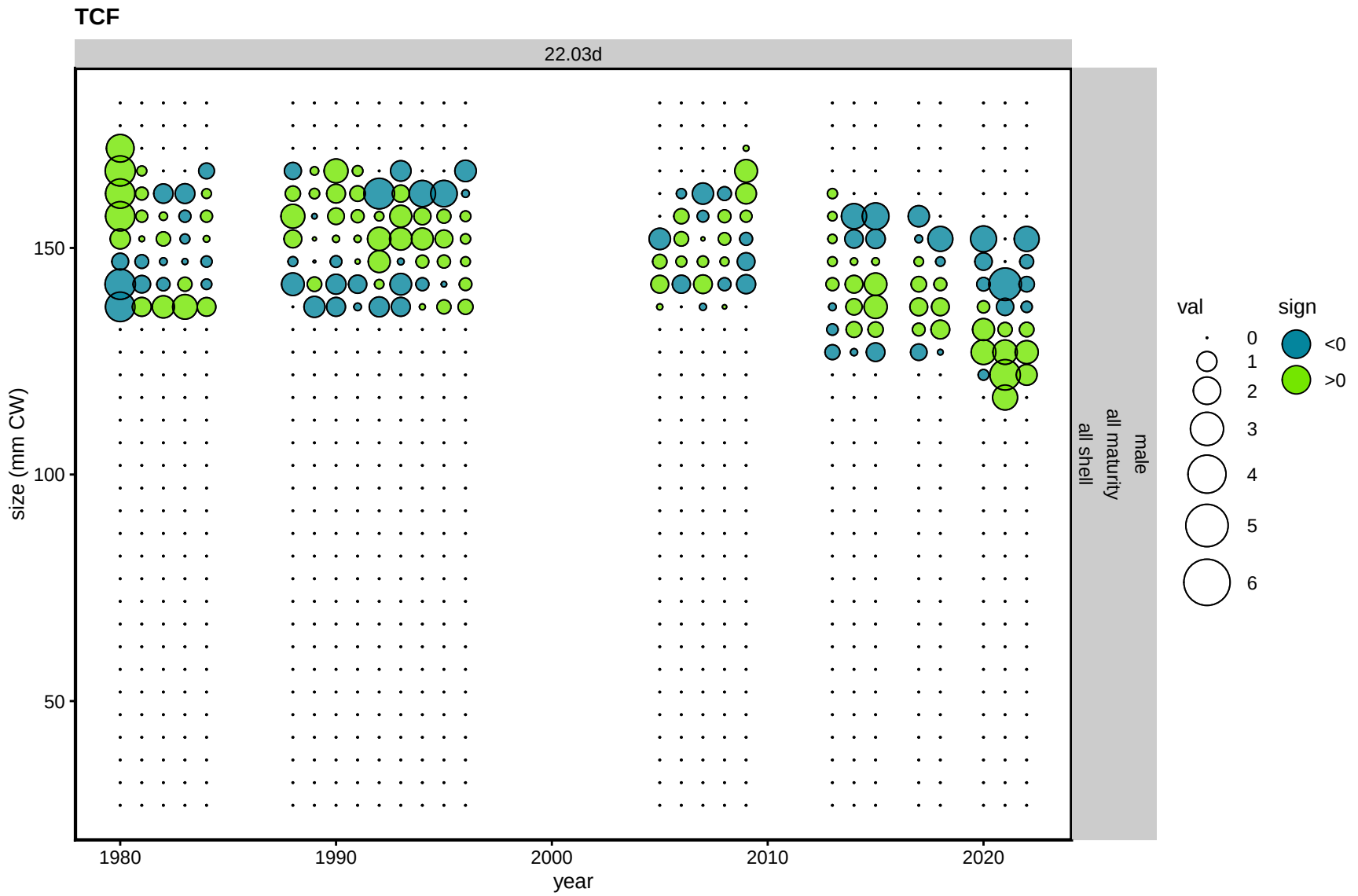

Figure 39. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

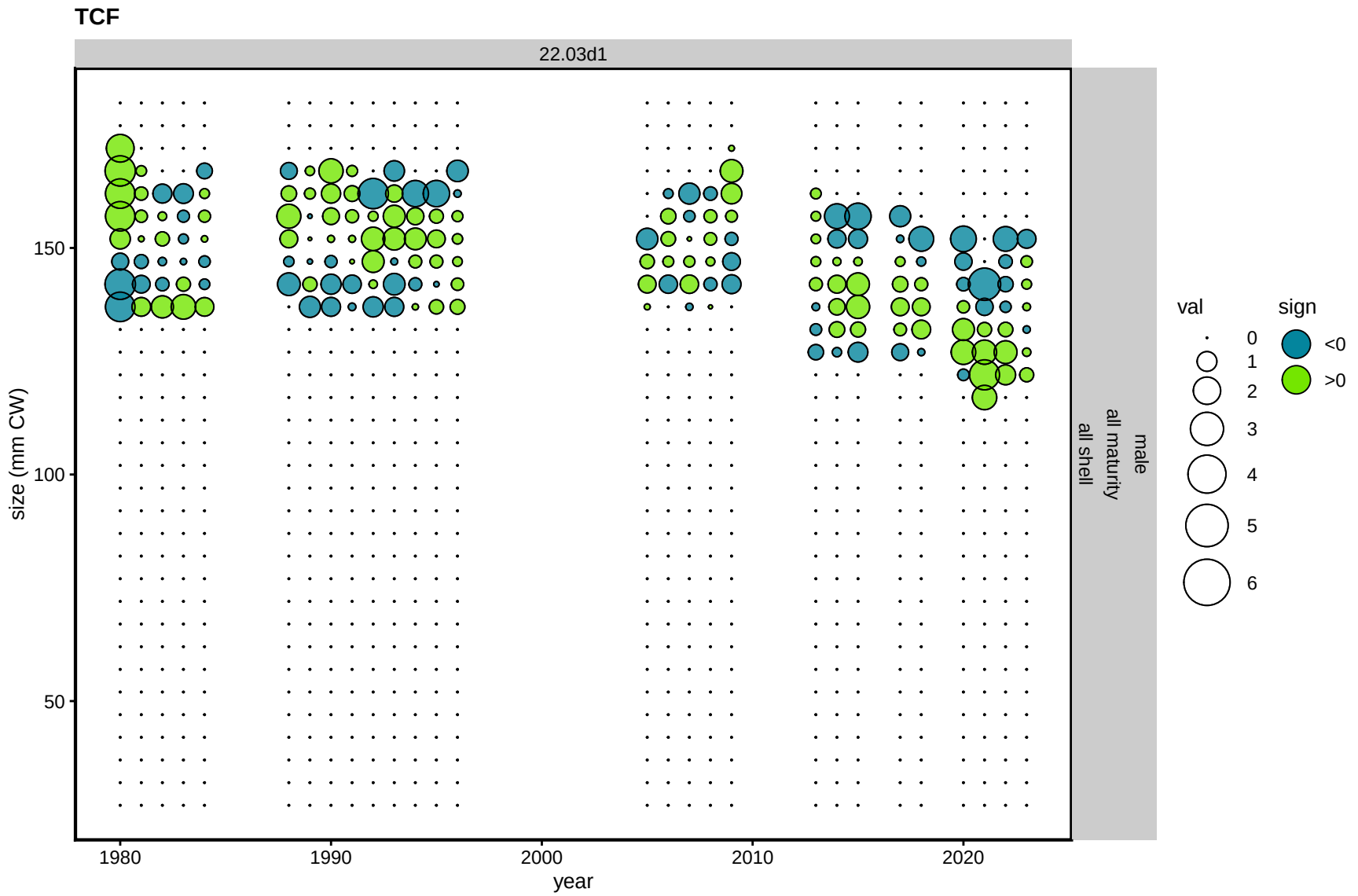

Figure 40. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

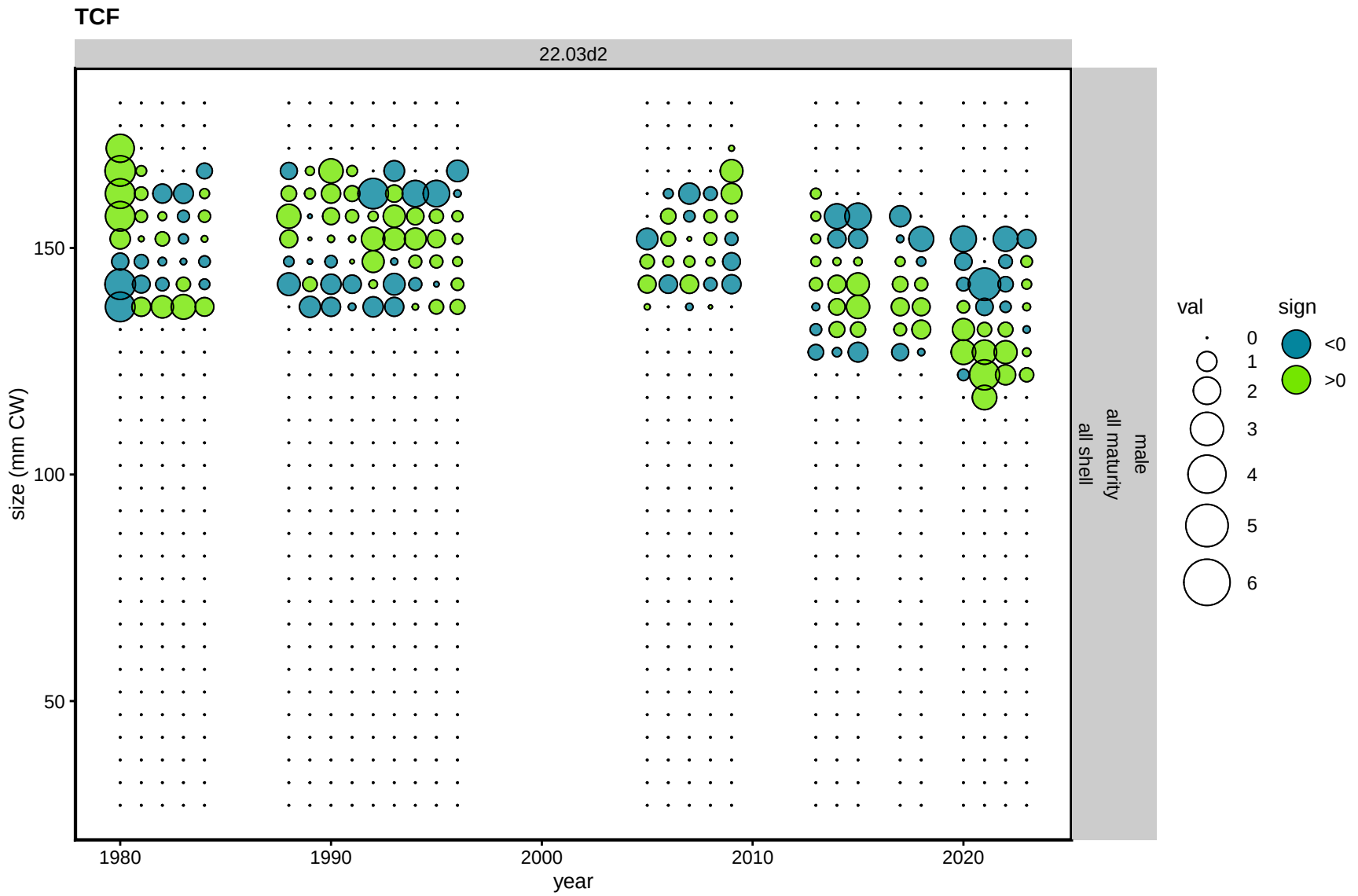

Figure 41. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

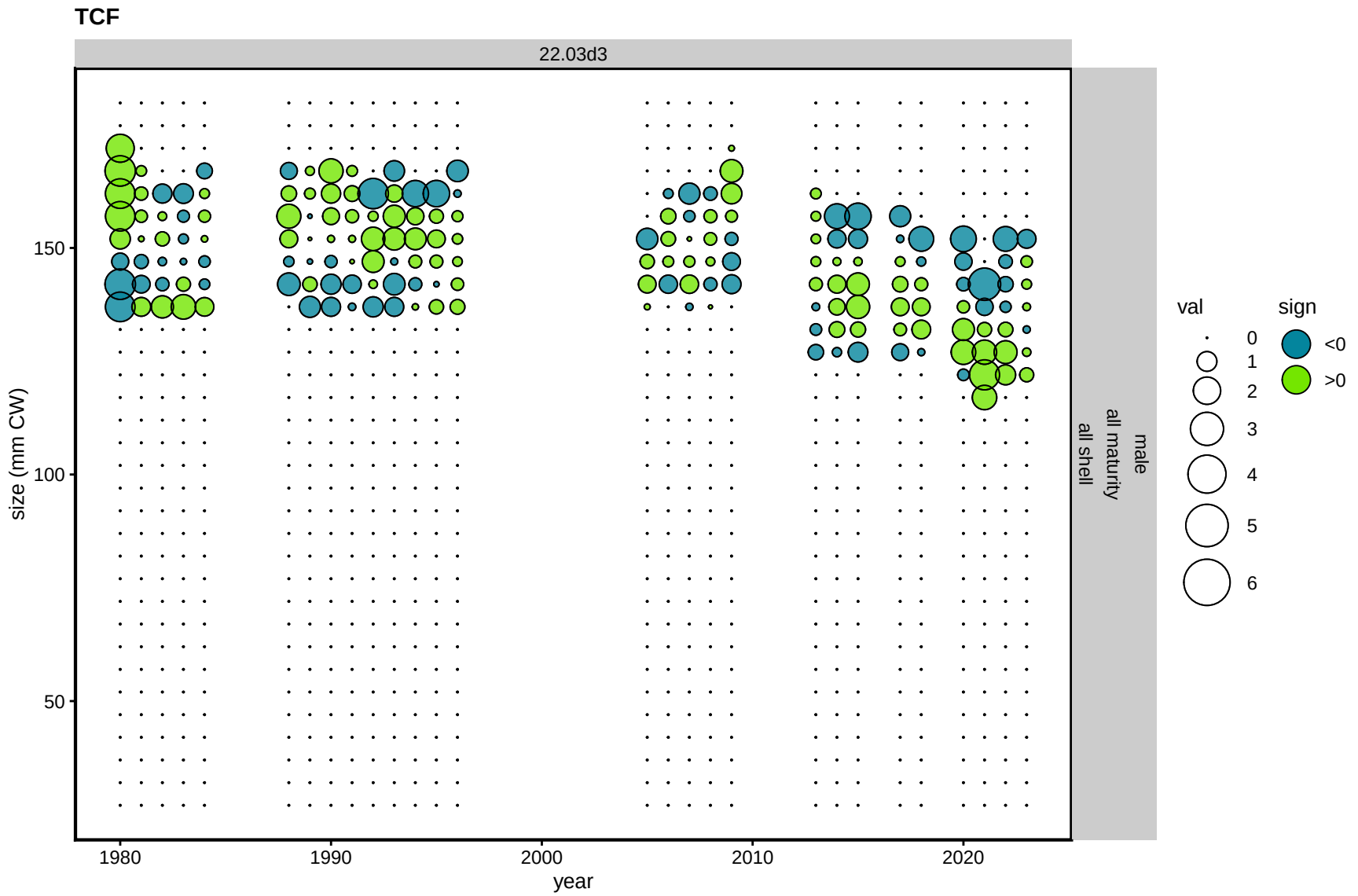

Figure 42. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

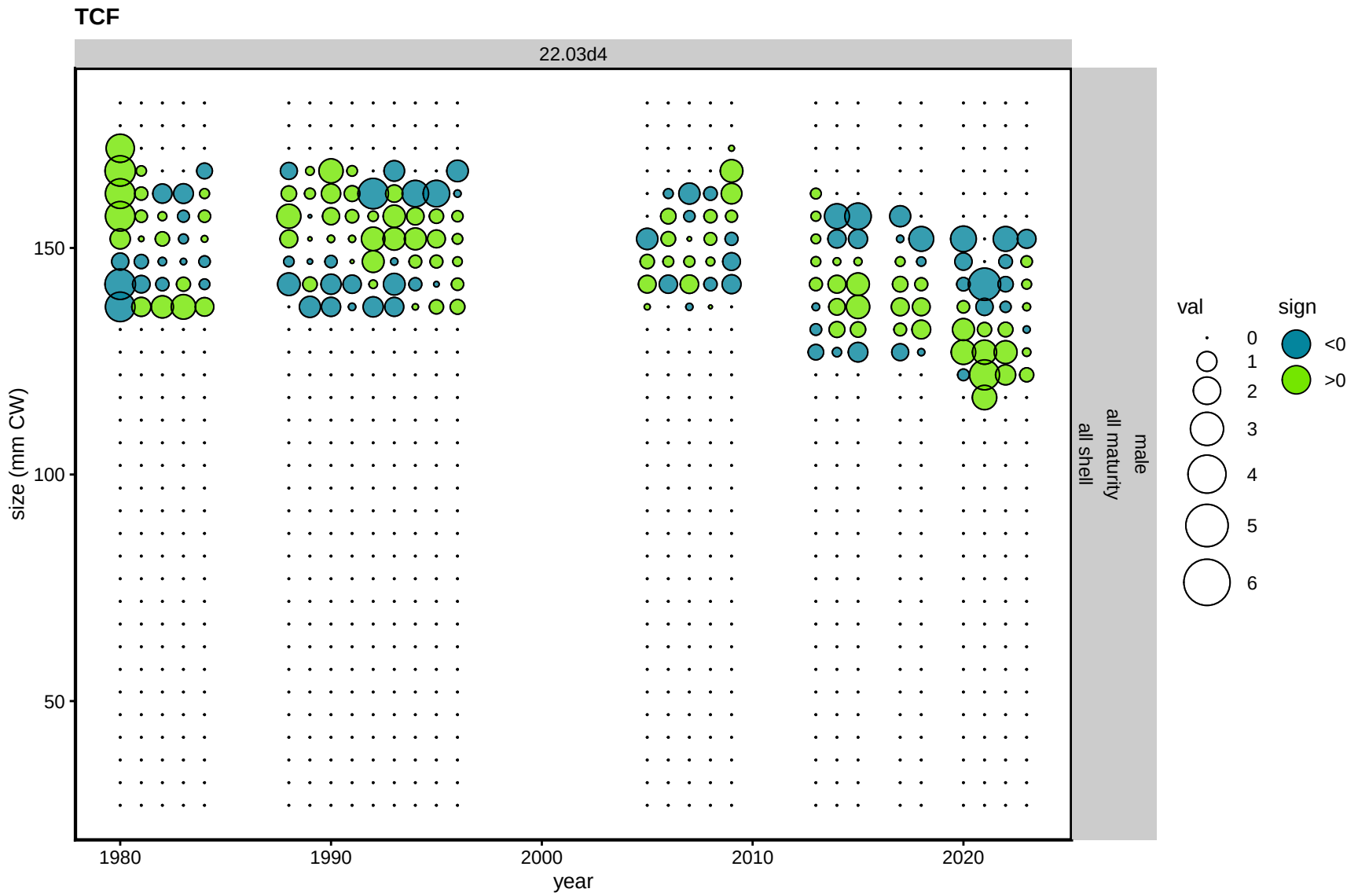

Figure 43. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

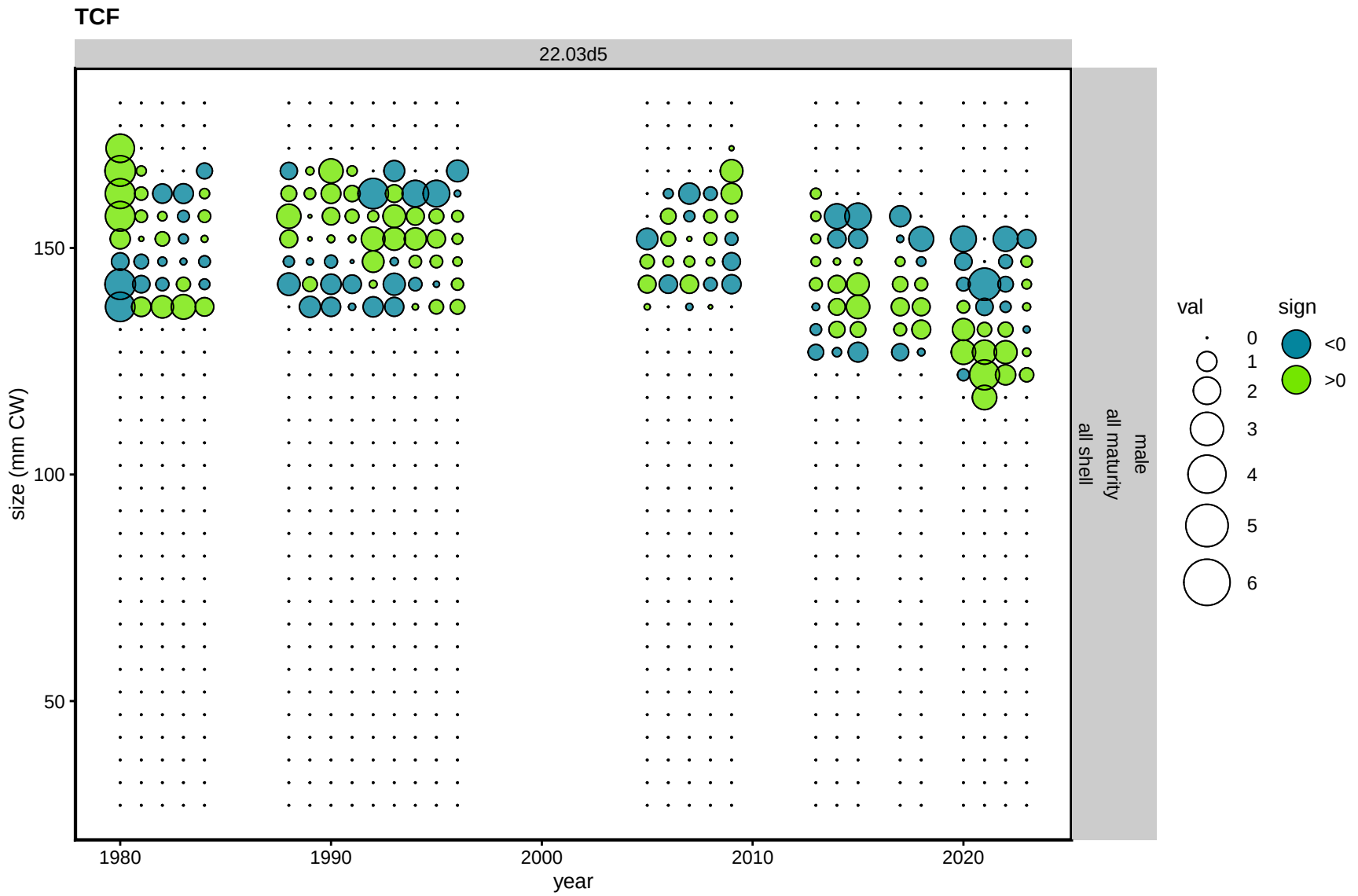

Figure 44. Pearson's residuals for fits to retained catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

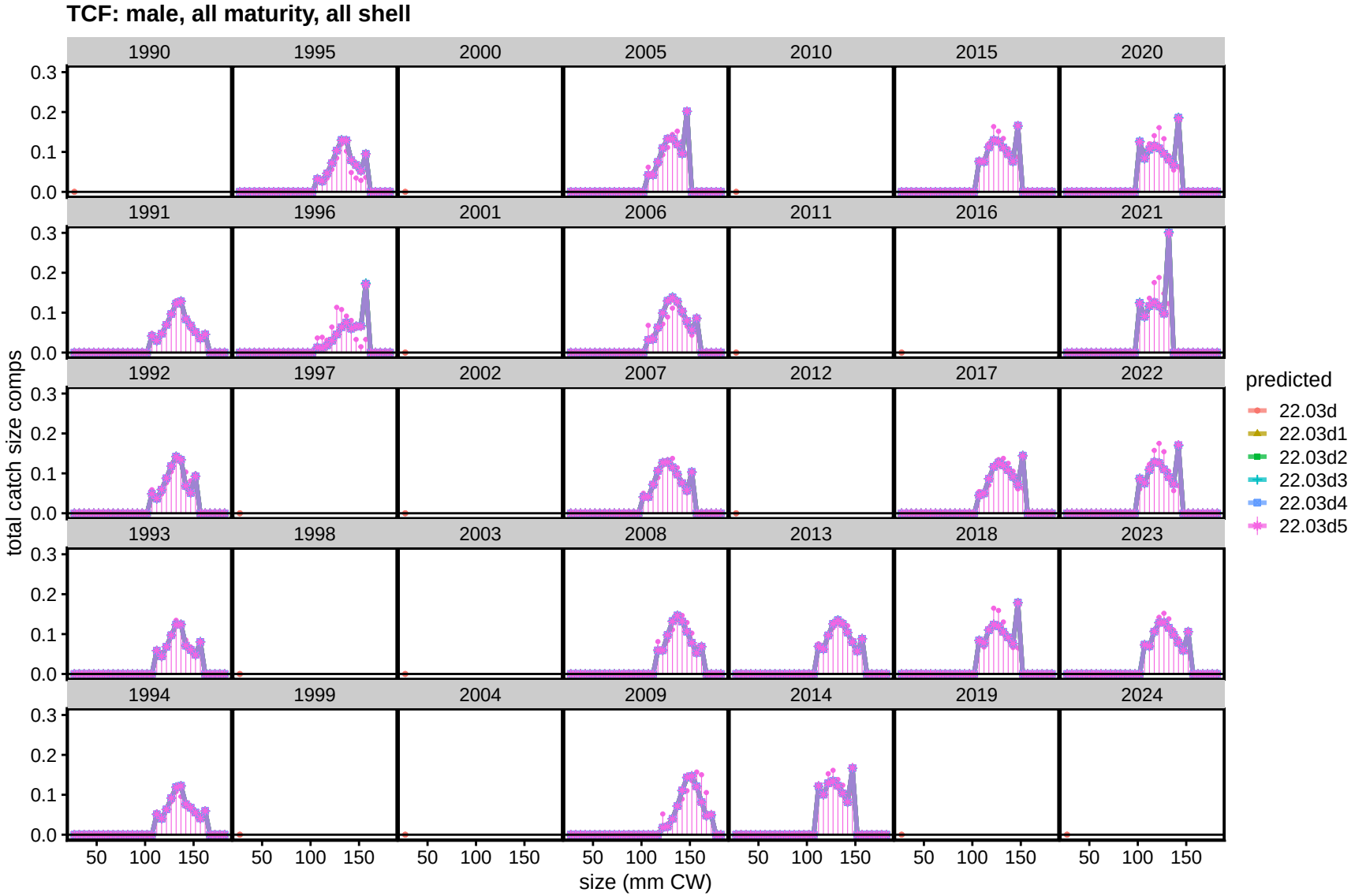

Figure 45. TCSAM02 models fits to total catch size compositions in the TCF fishery. Preferred model is 22.03d5.

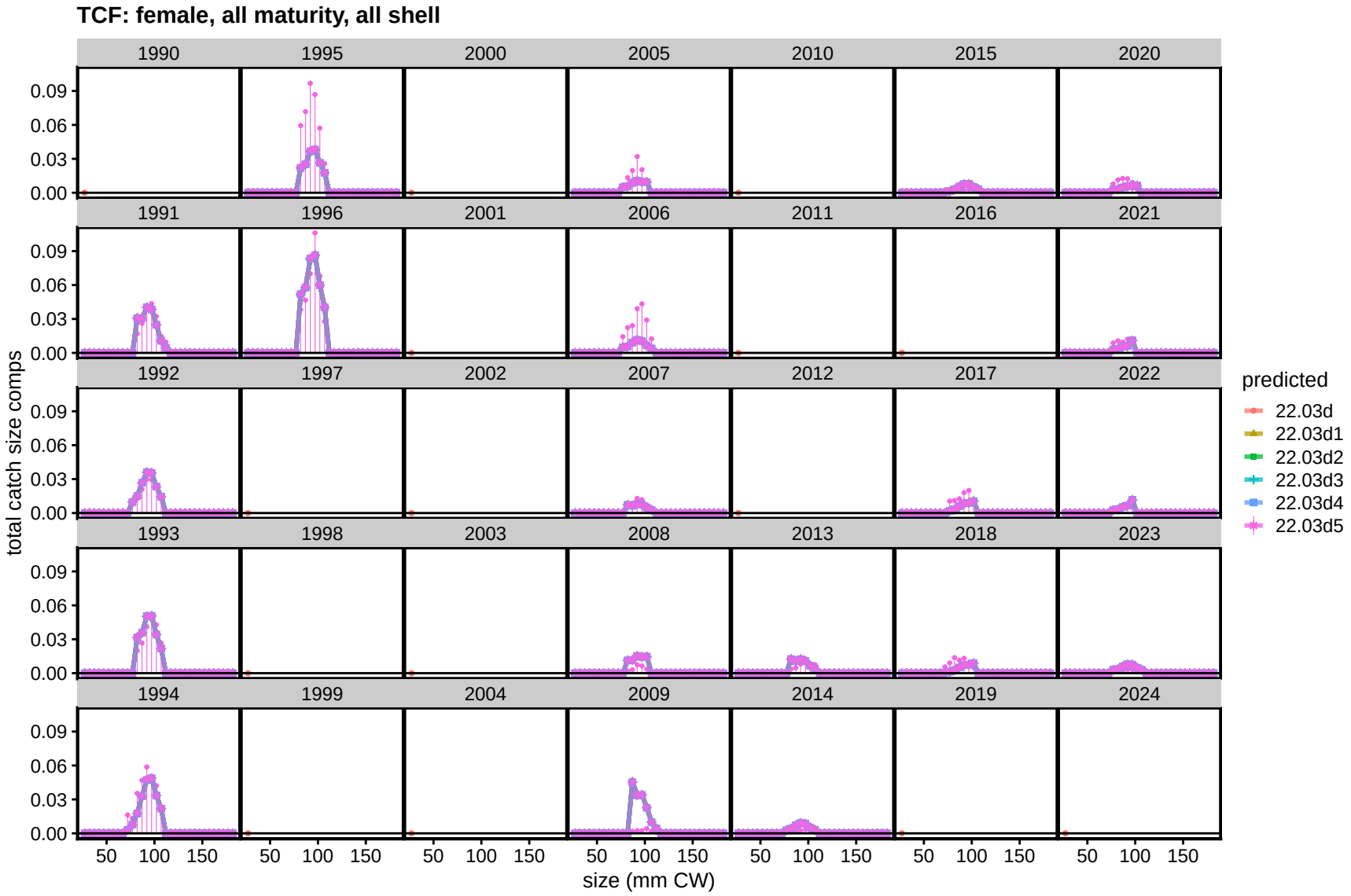

Figure 46. TCSAM02 models fits to total catch size compositions in the TCF fishery. Preferred model is 22.03d5.

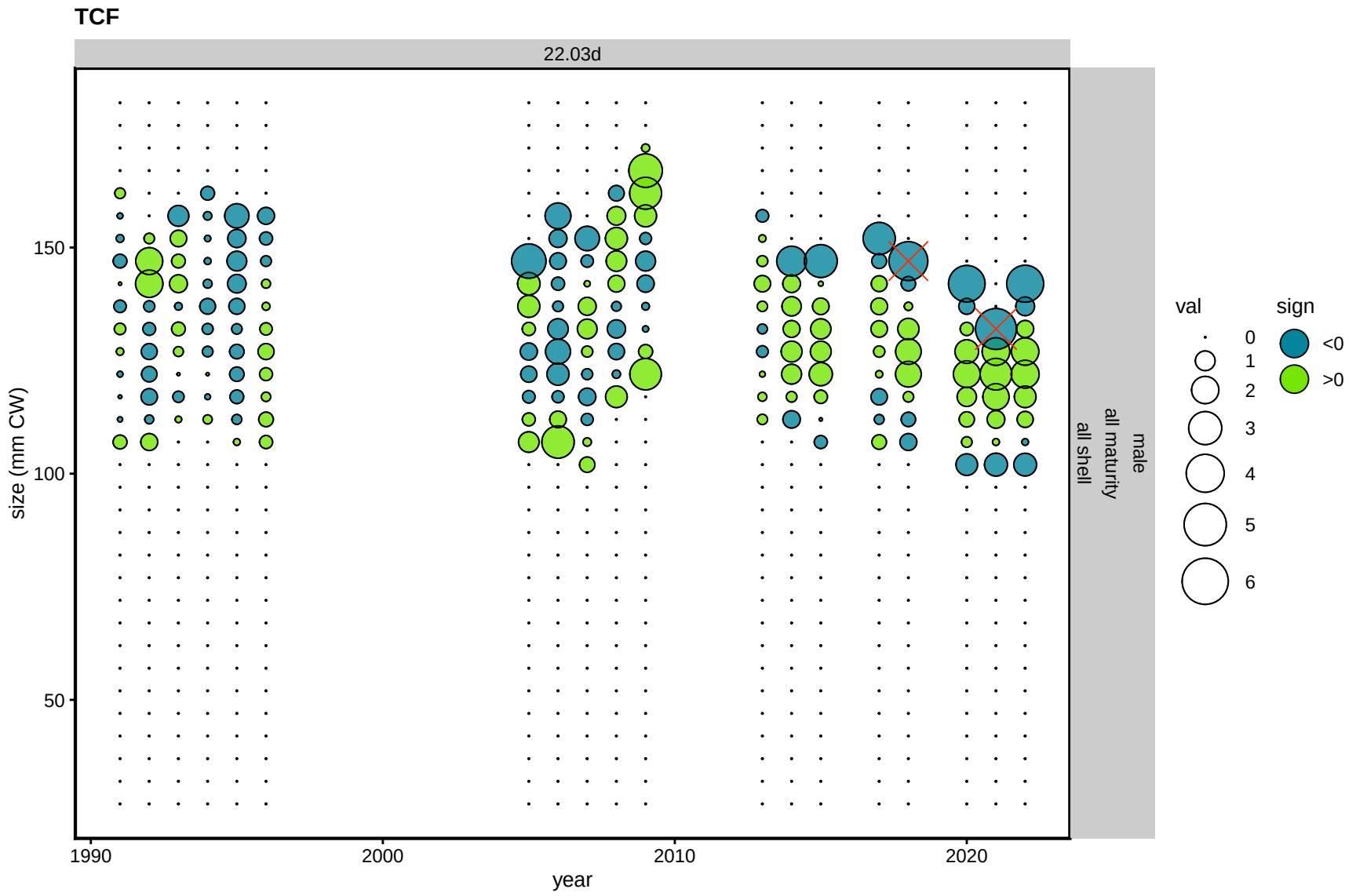

Figure 47. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

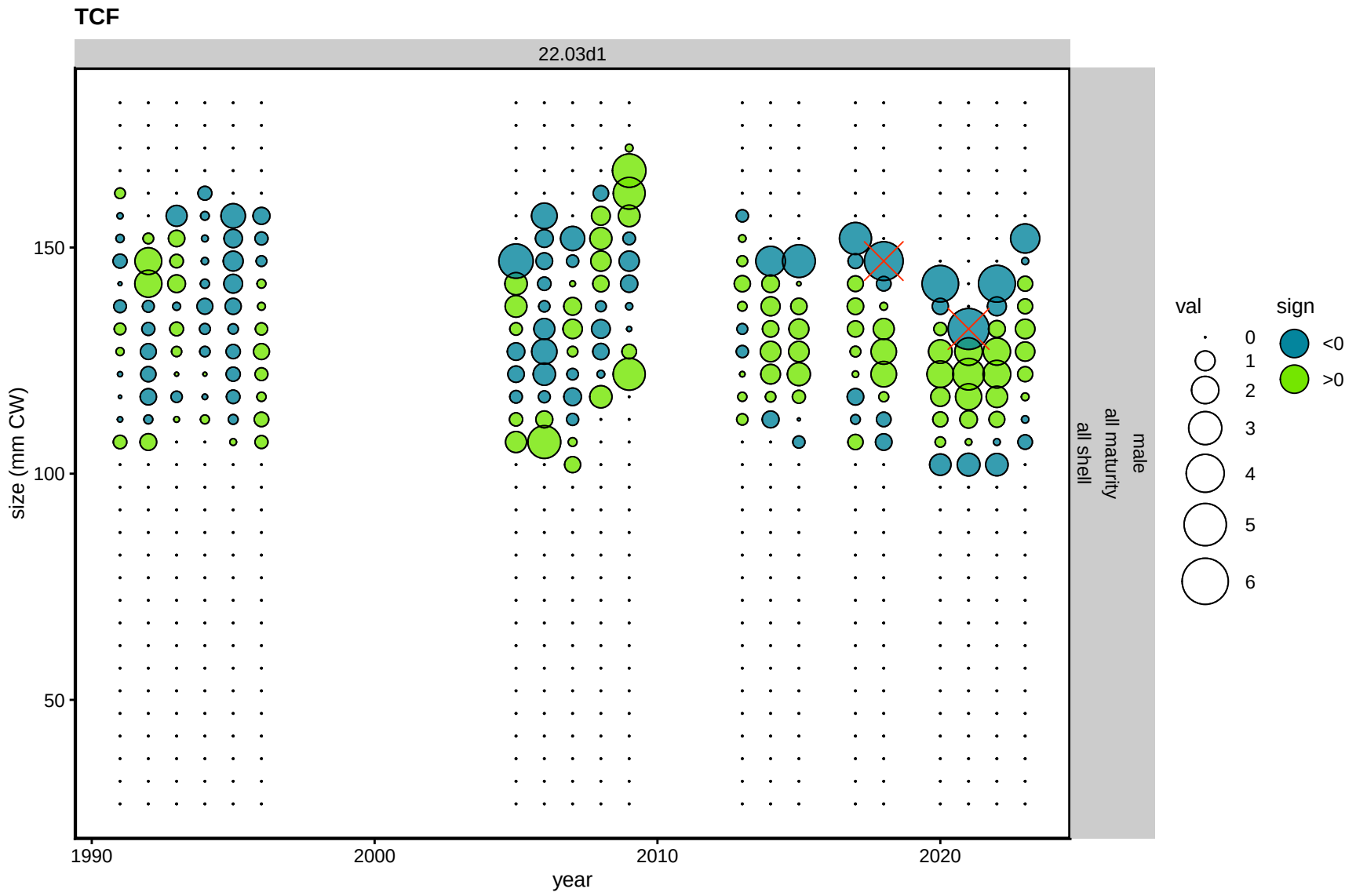

Figure 48. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

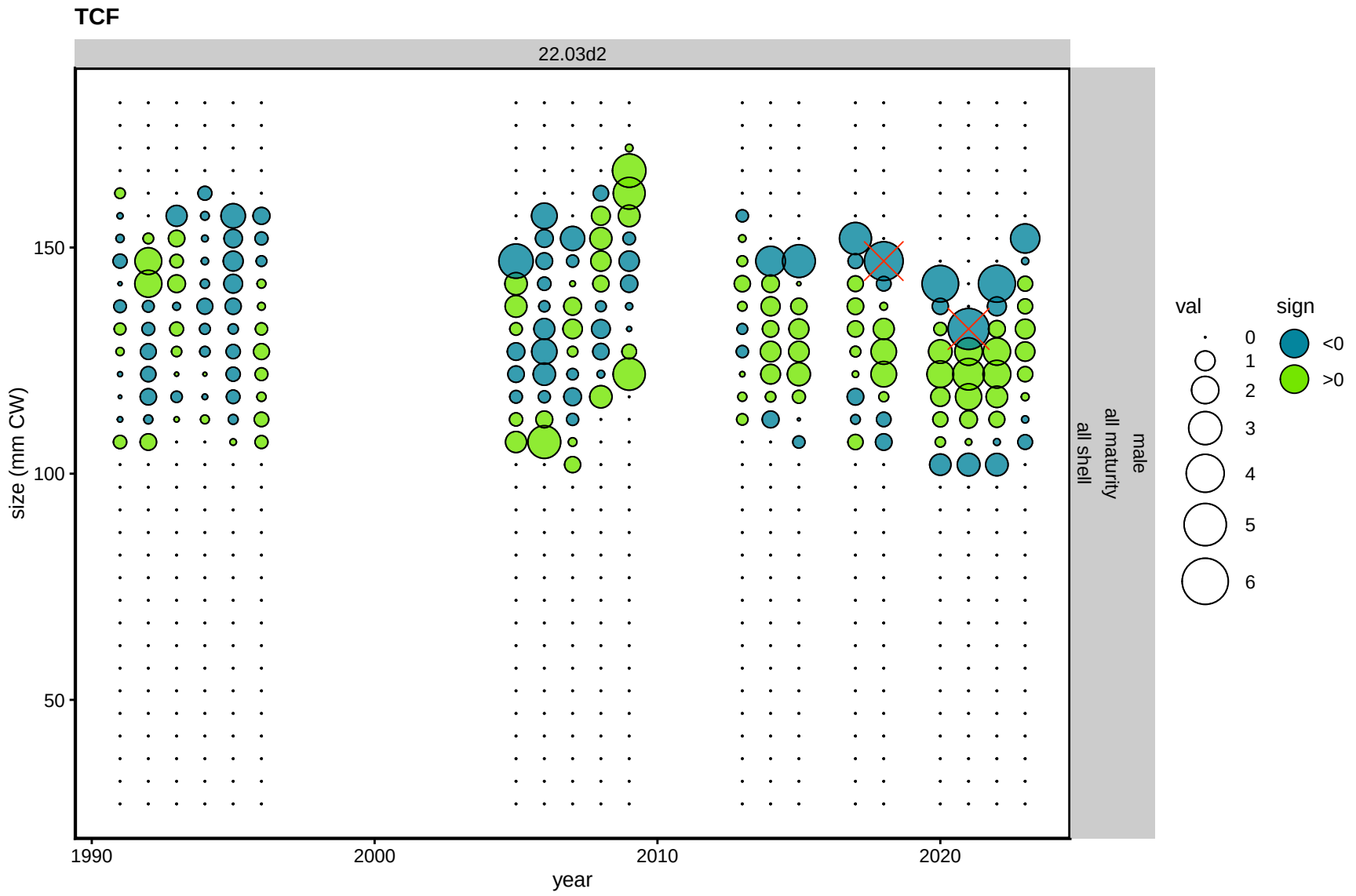

Figure 49. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

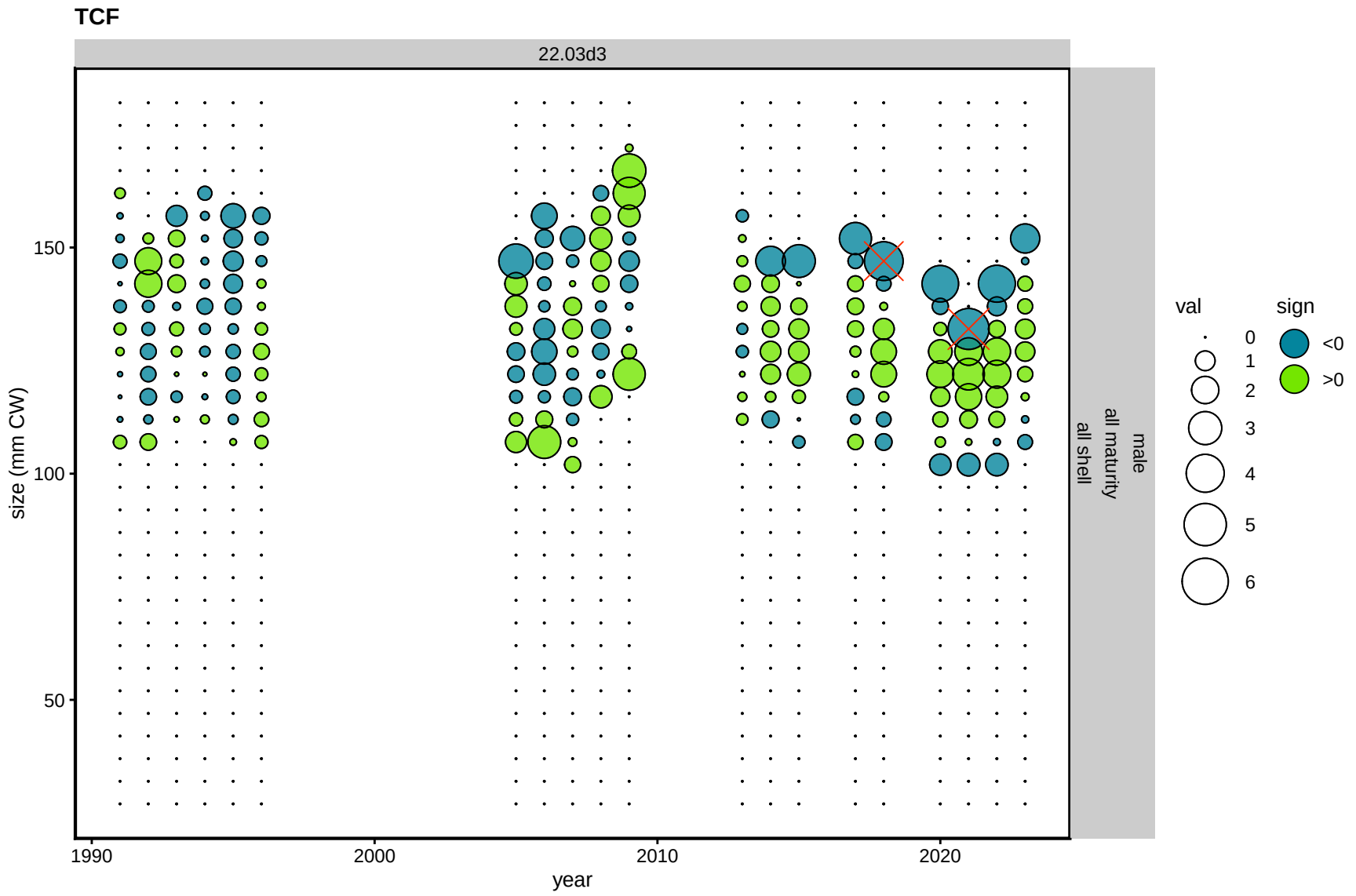

Figure 50. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

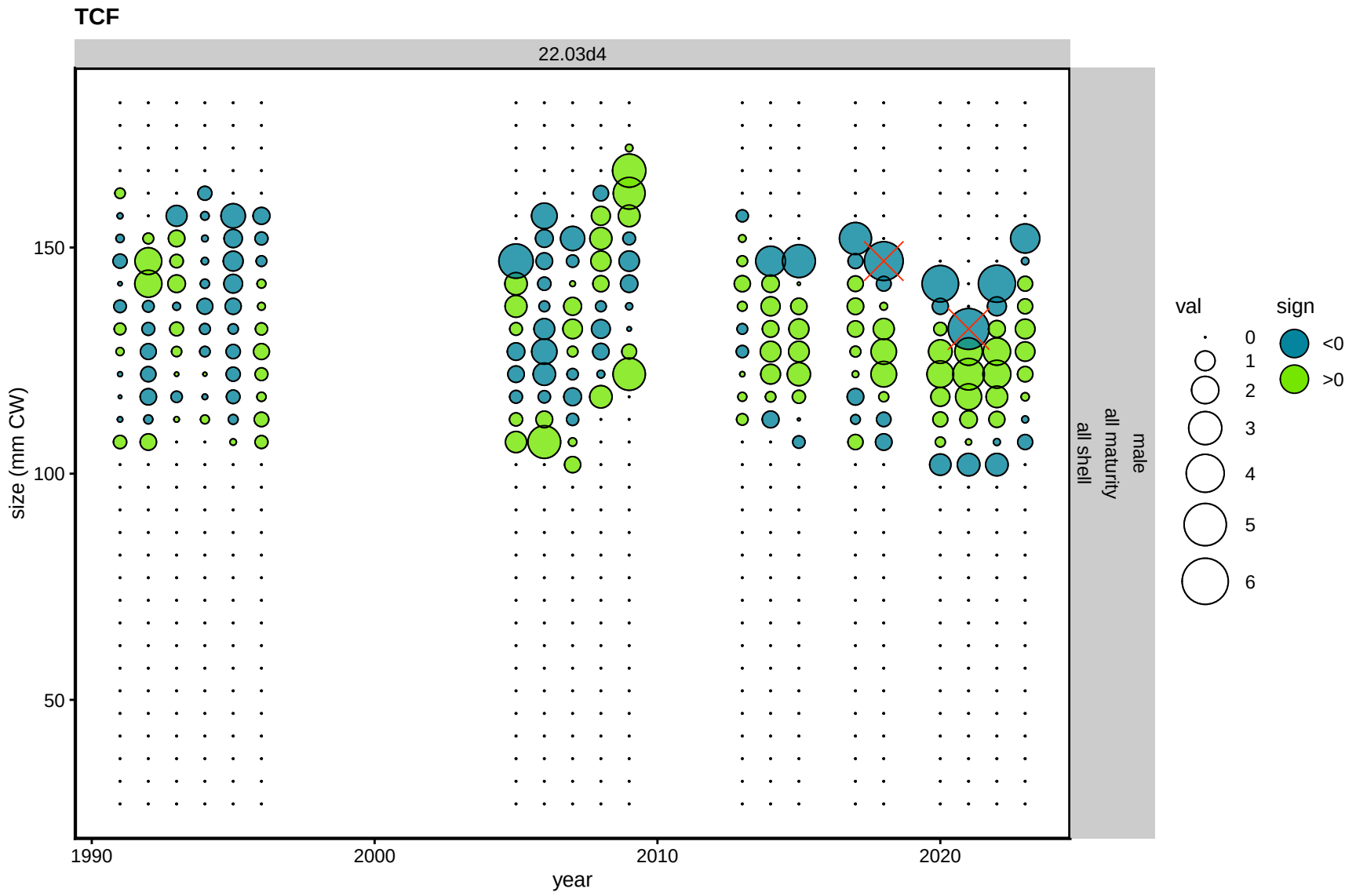

Figure 51. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

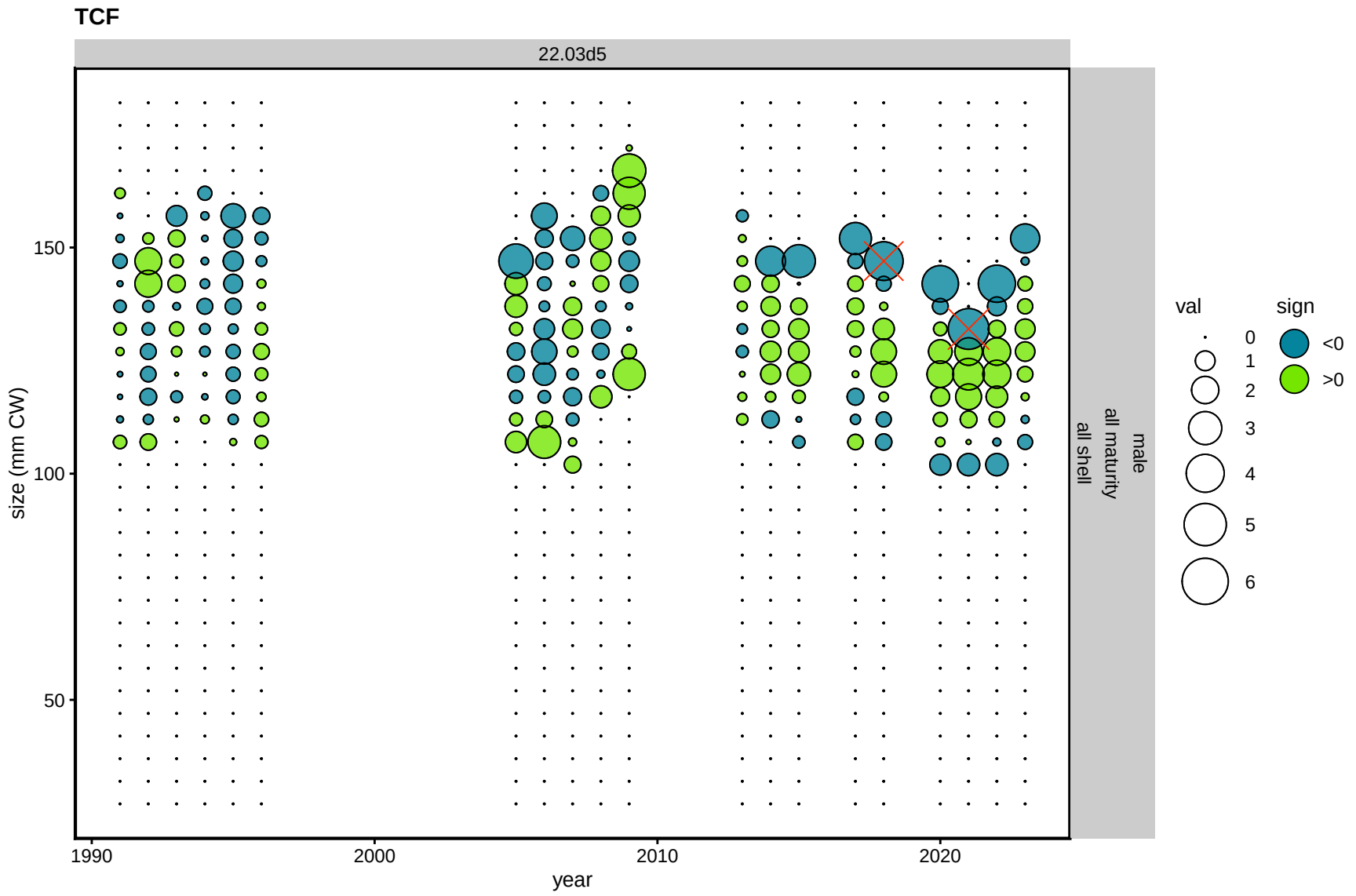

Figure 52. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

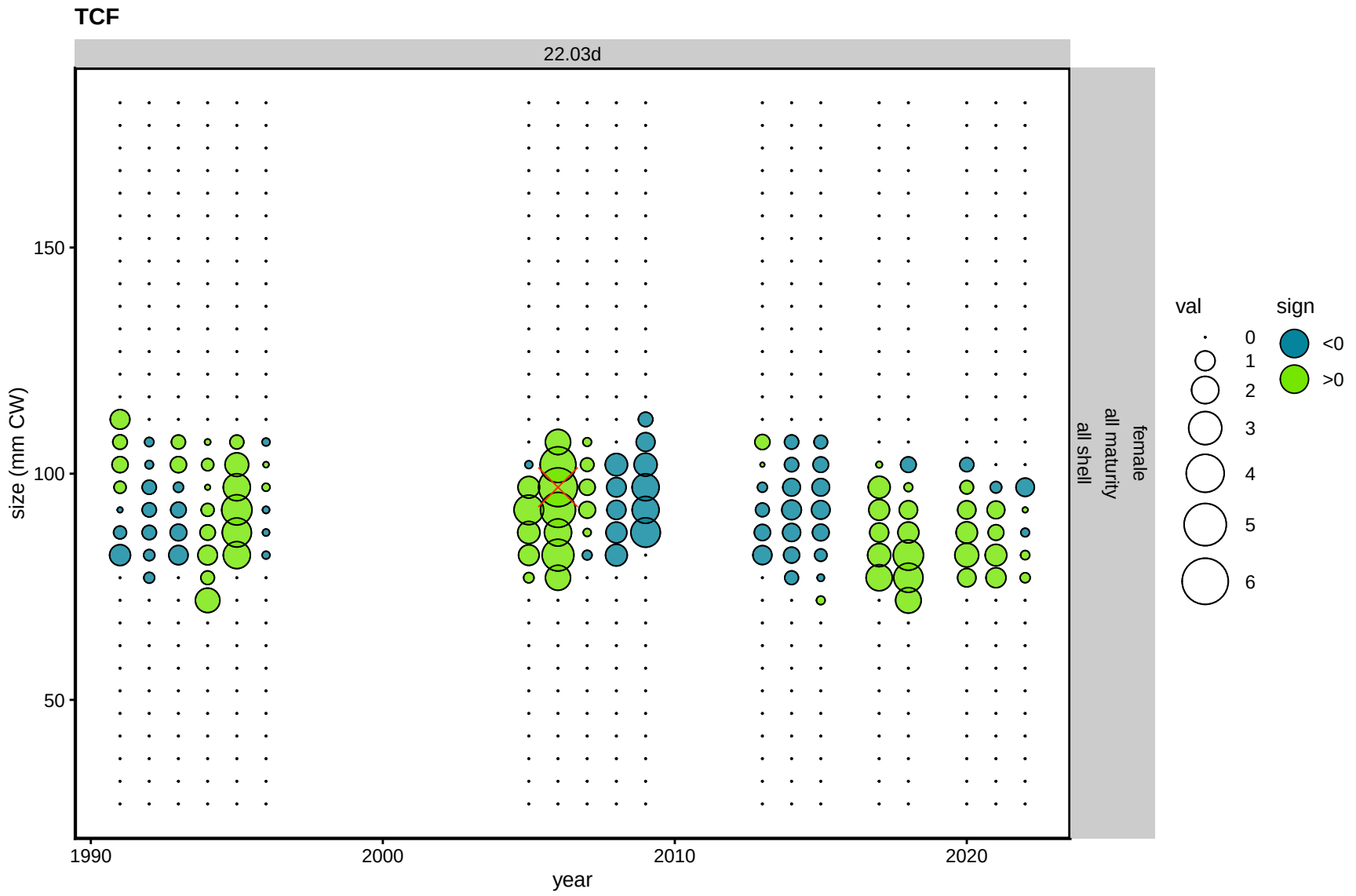

Figure 53. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

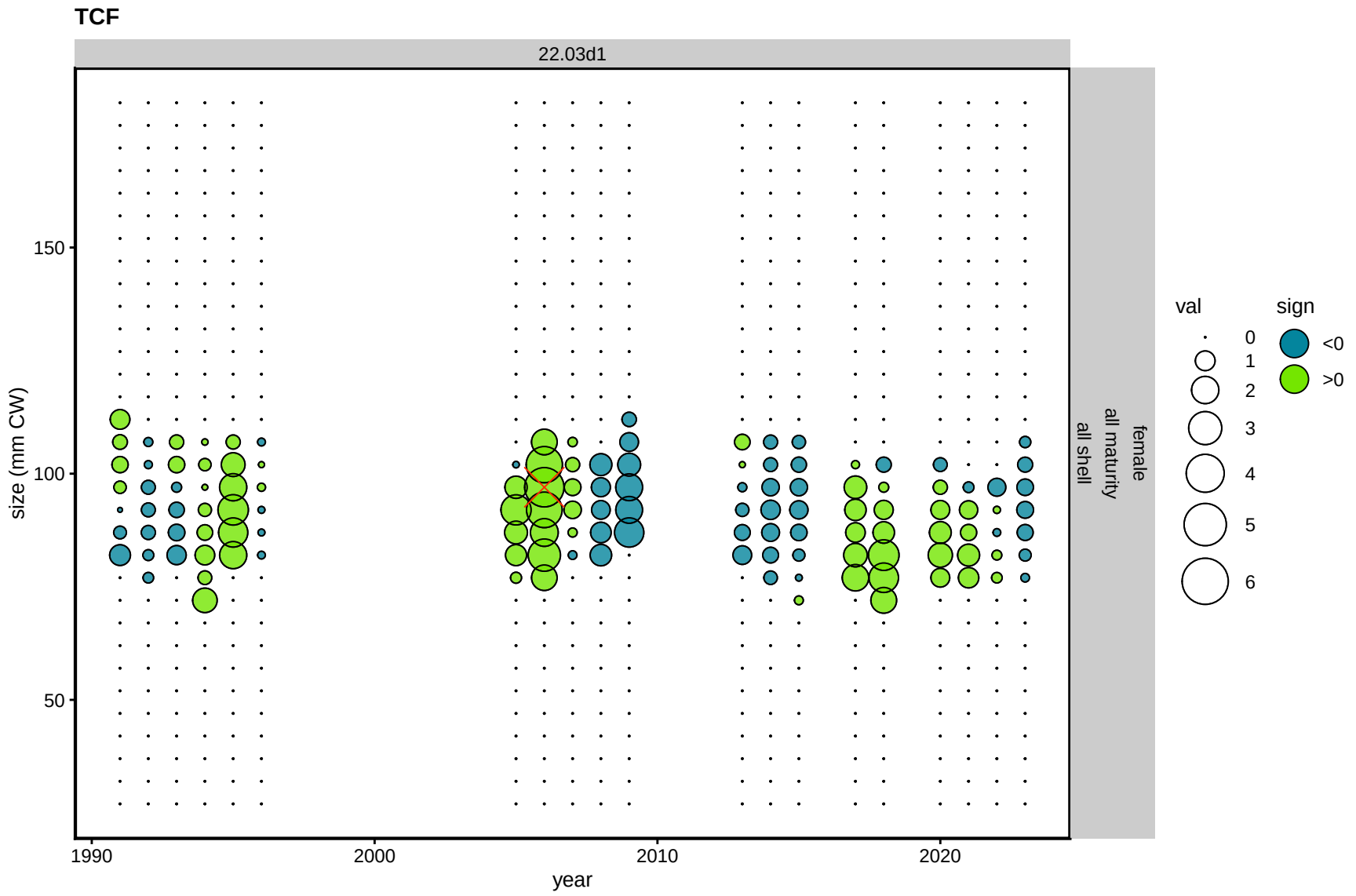

Figure 54. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

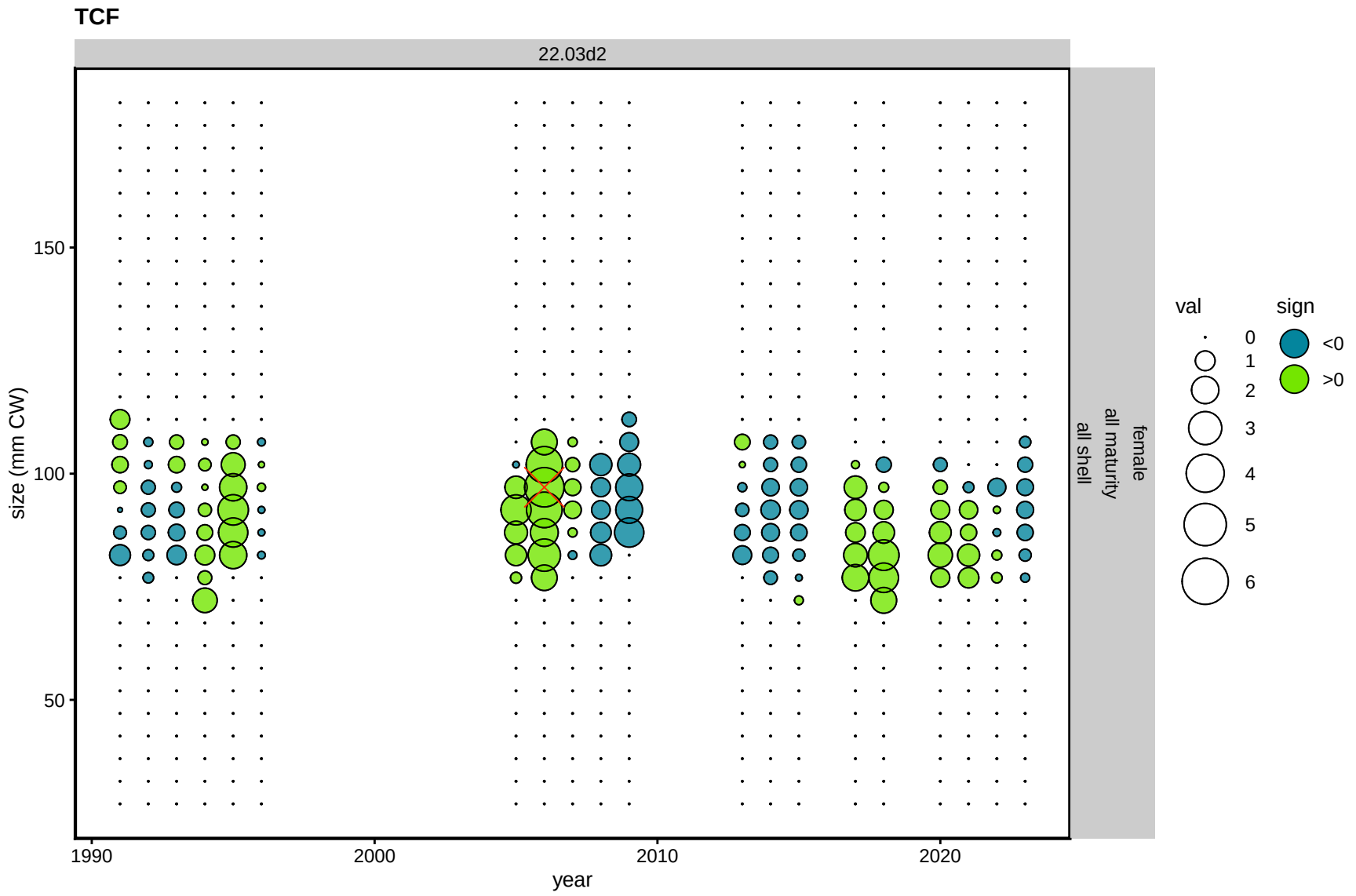

Figure 55. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

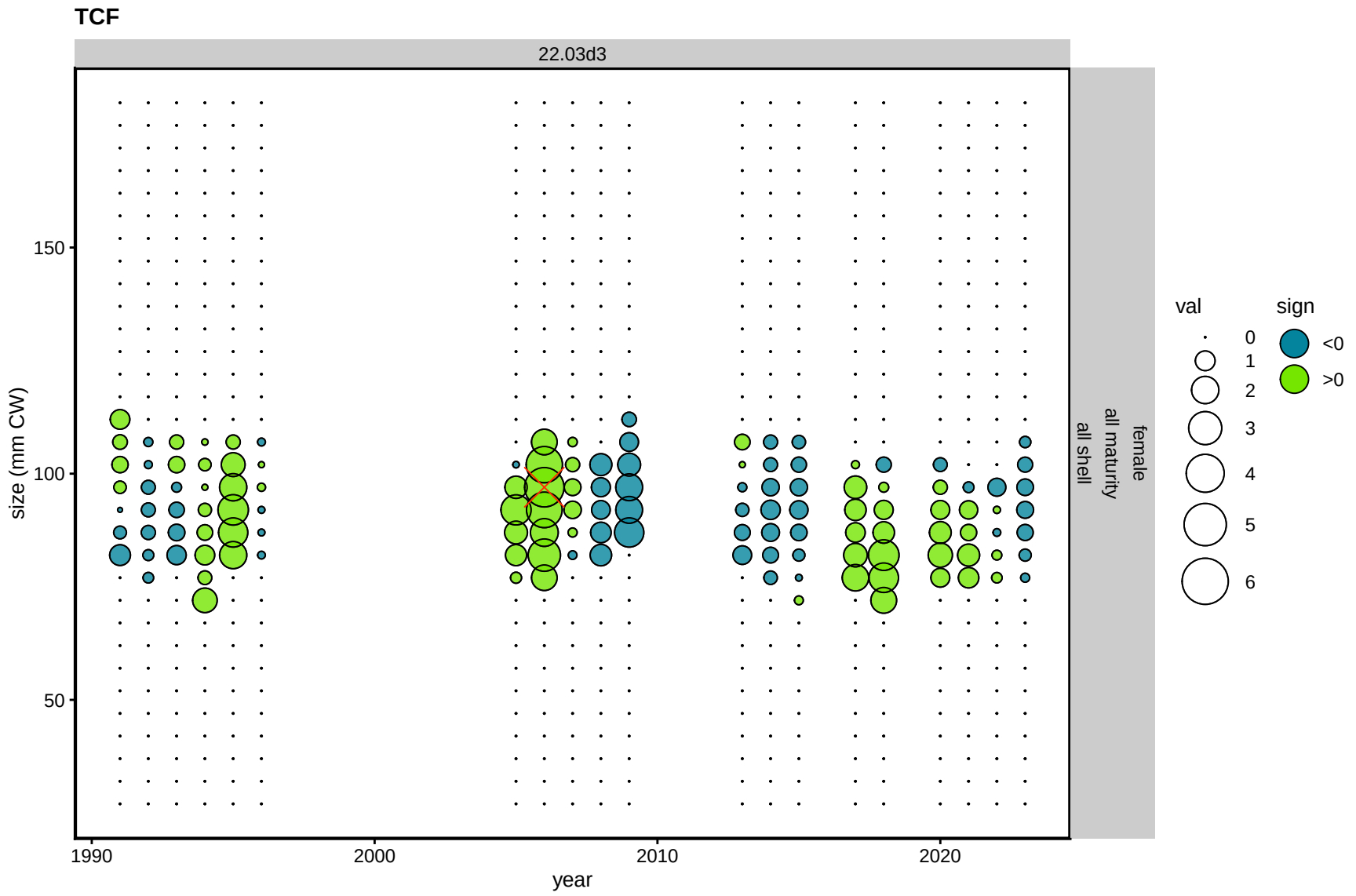

Figure 56. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

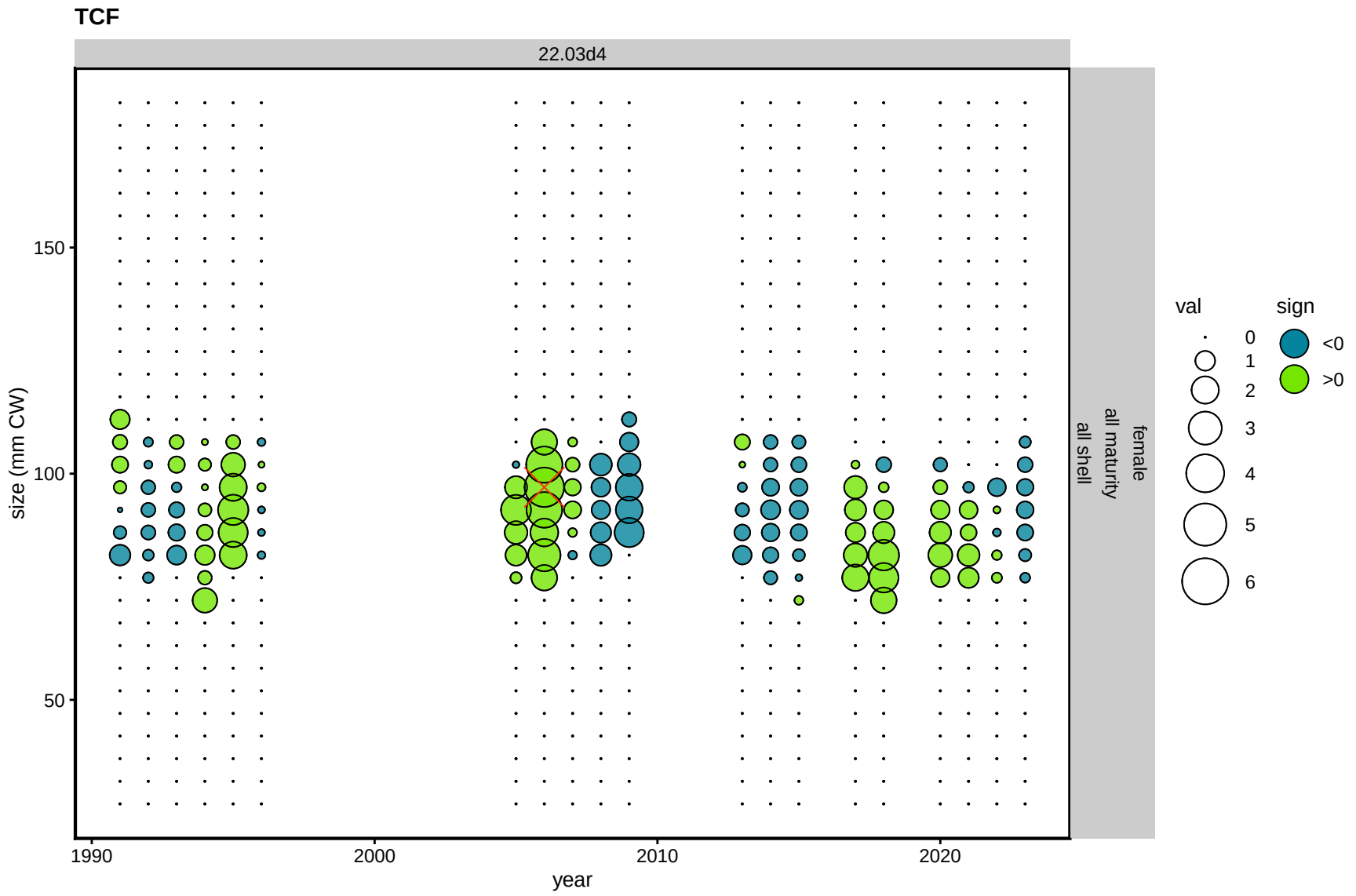

Figure 57. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

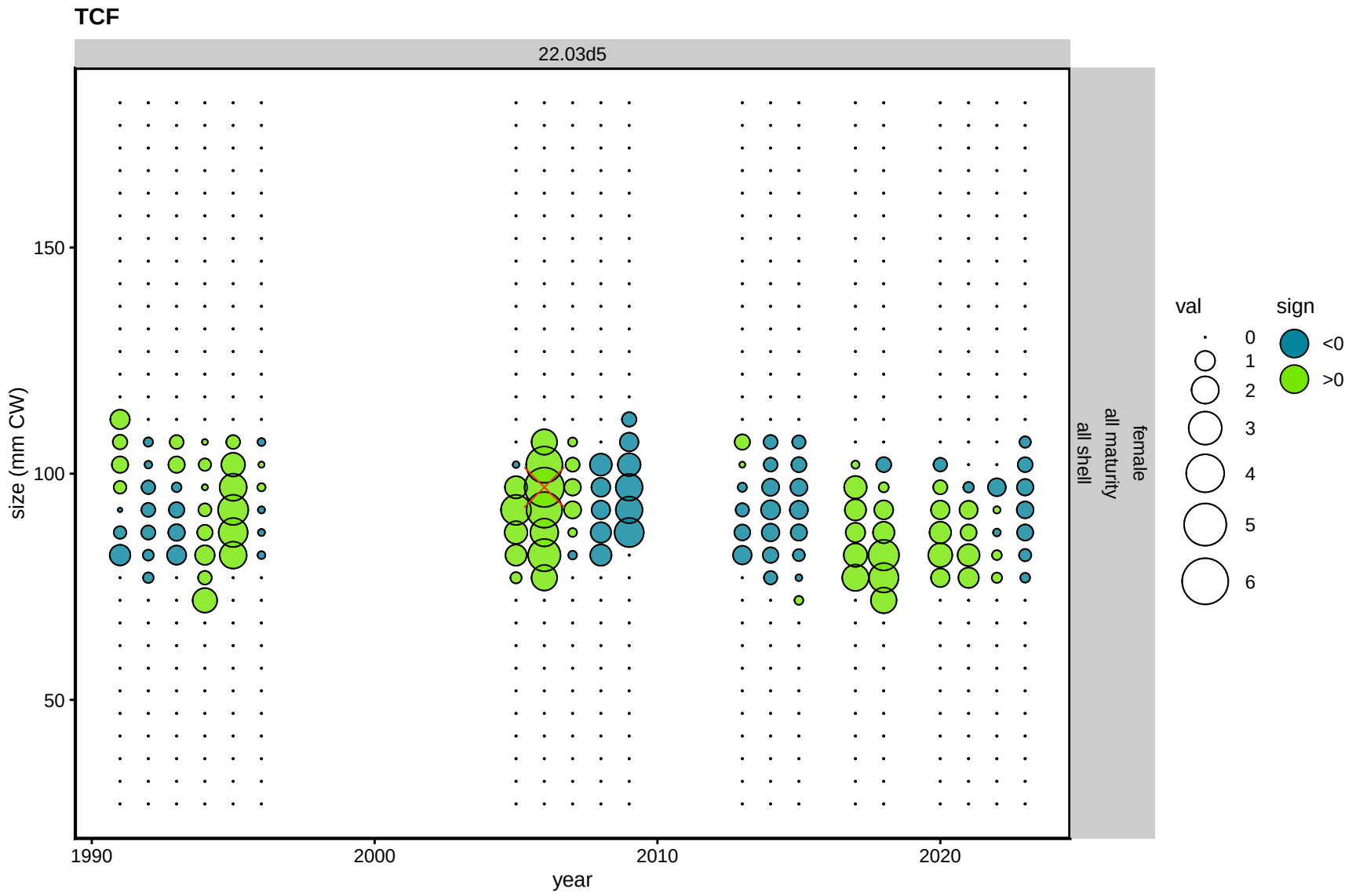

Figure 58. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

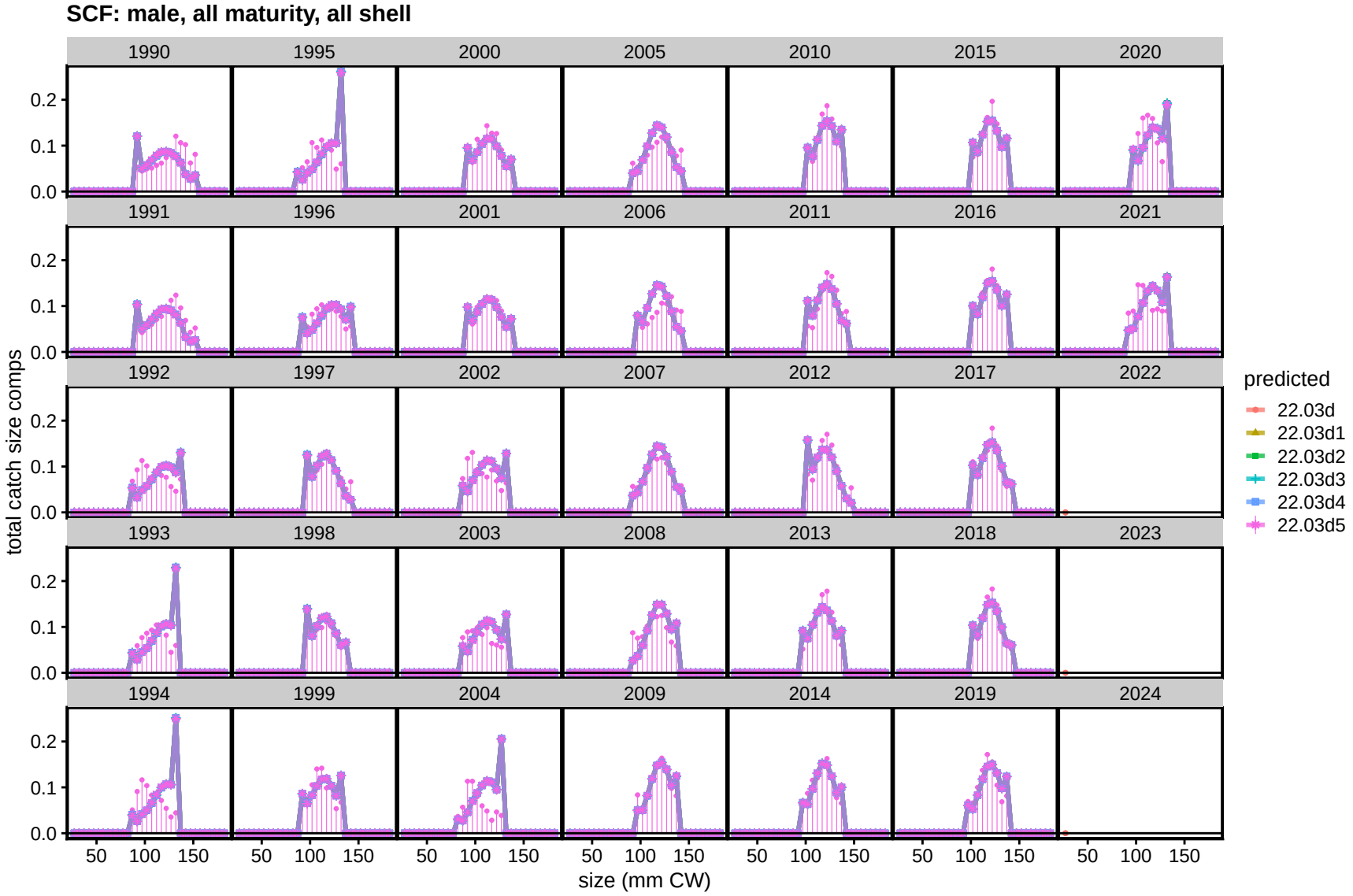

Figure 59. TCSAM02 models fits to total catch size compositions in the SCF fishery. Preferred model is 22.03d5.

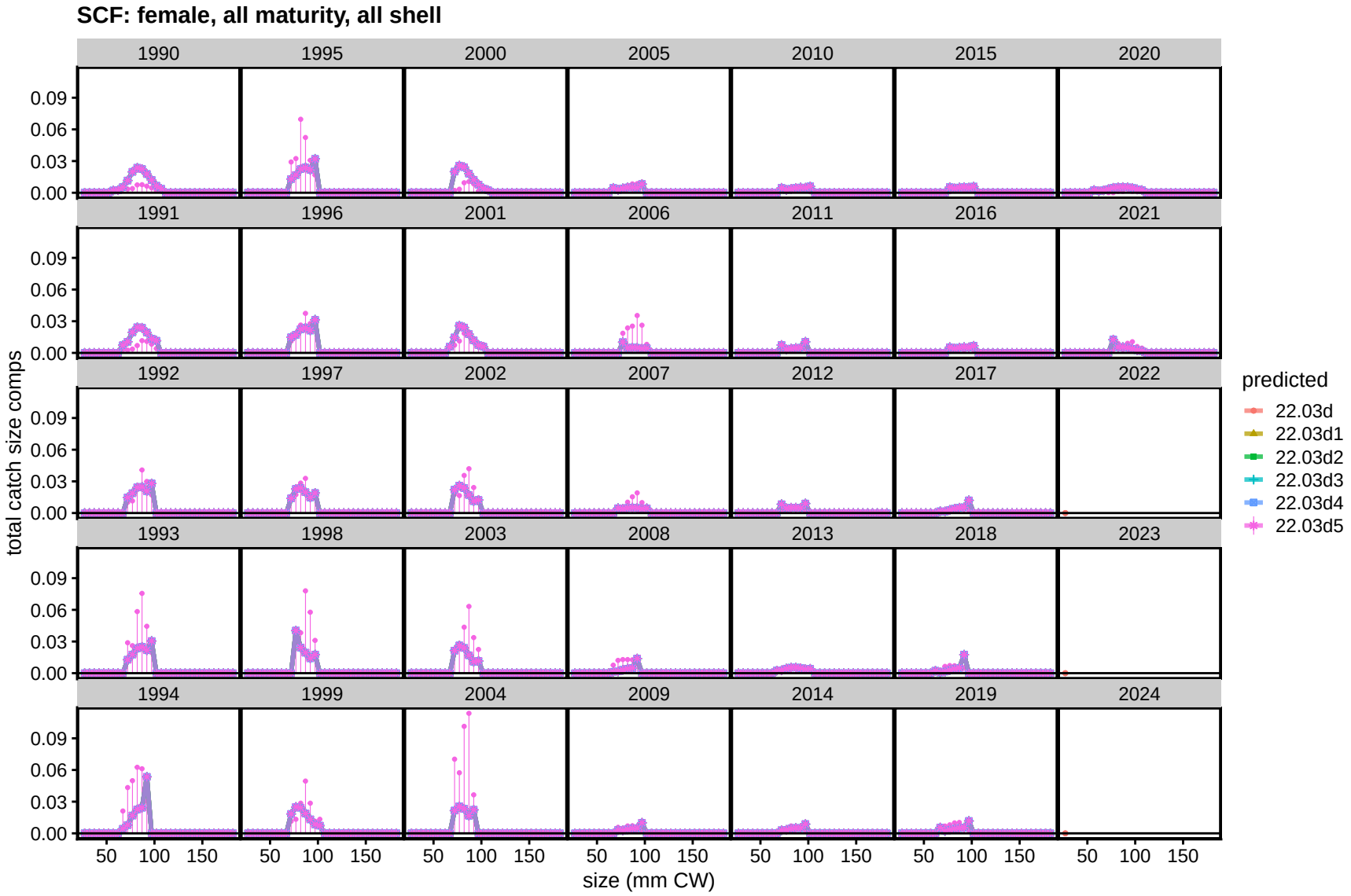

Figure 60. TCSAM02 models fits to total catch size compositions in the SCF fishery. Preferred model is 22.03d5.

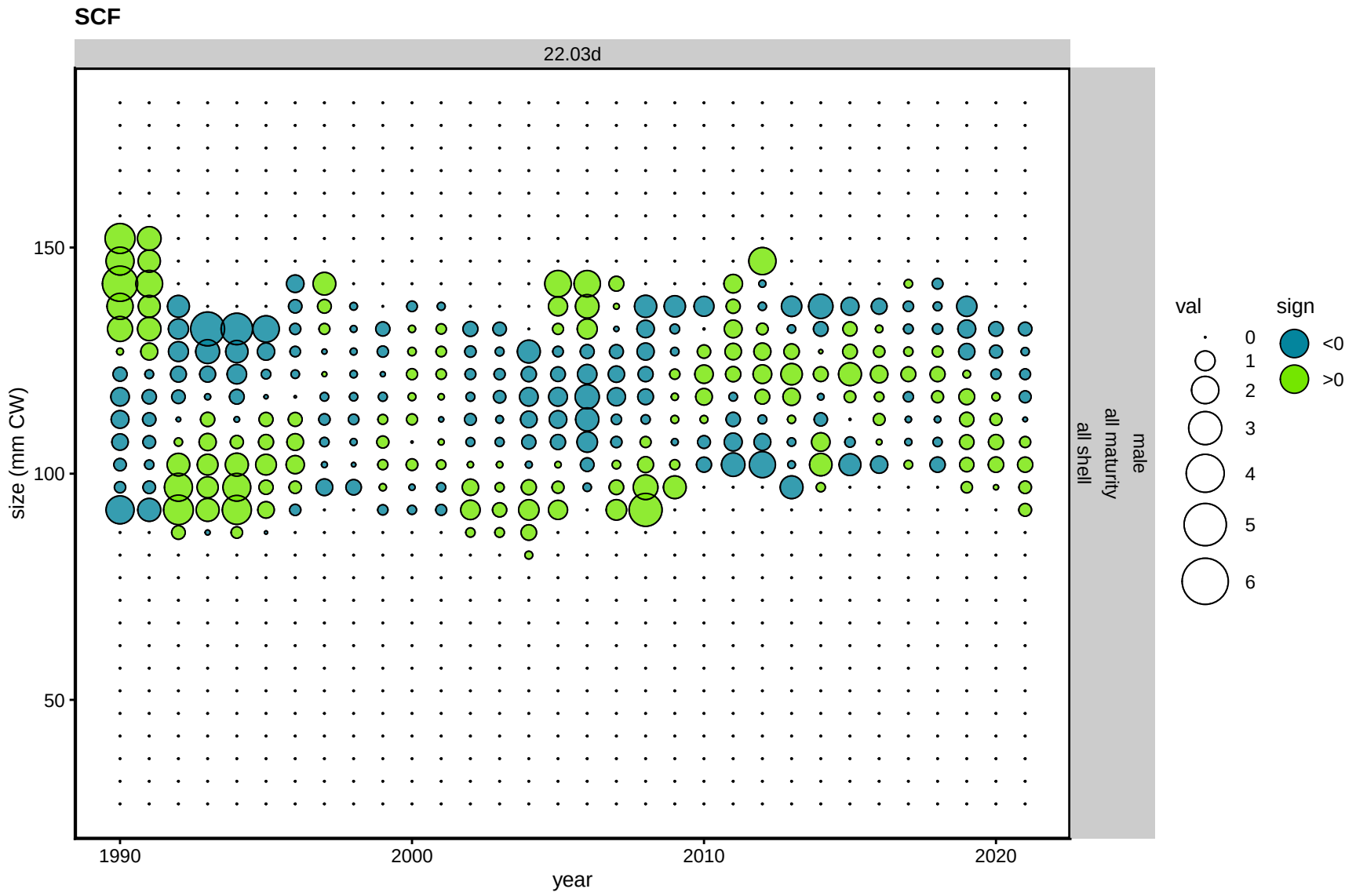

Figure 61. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

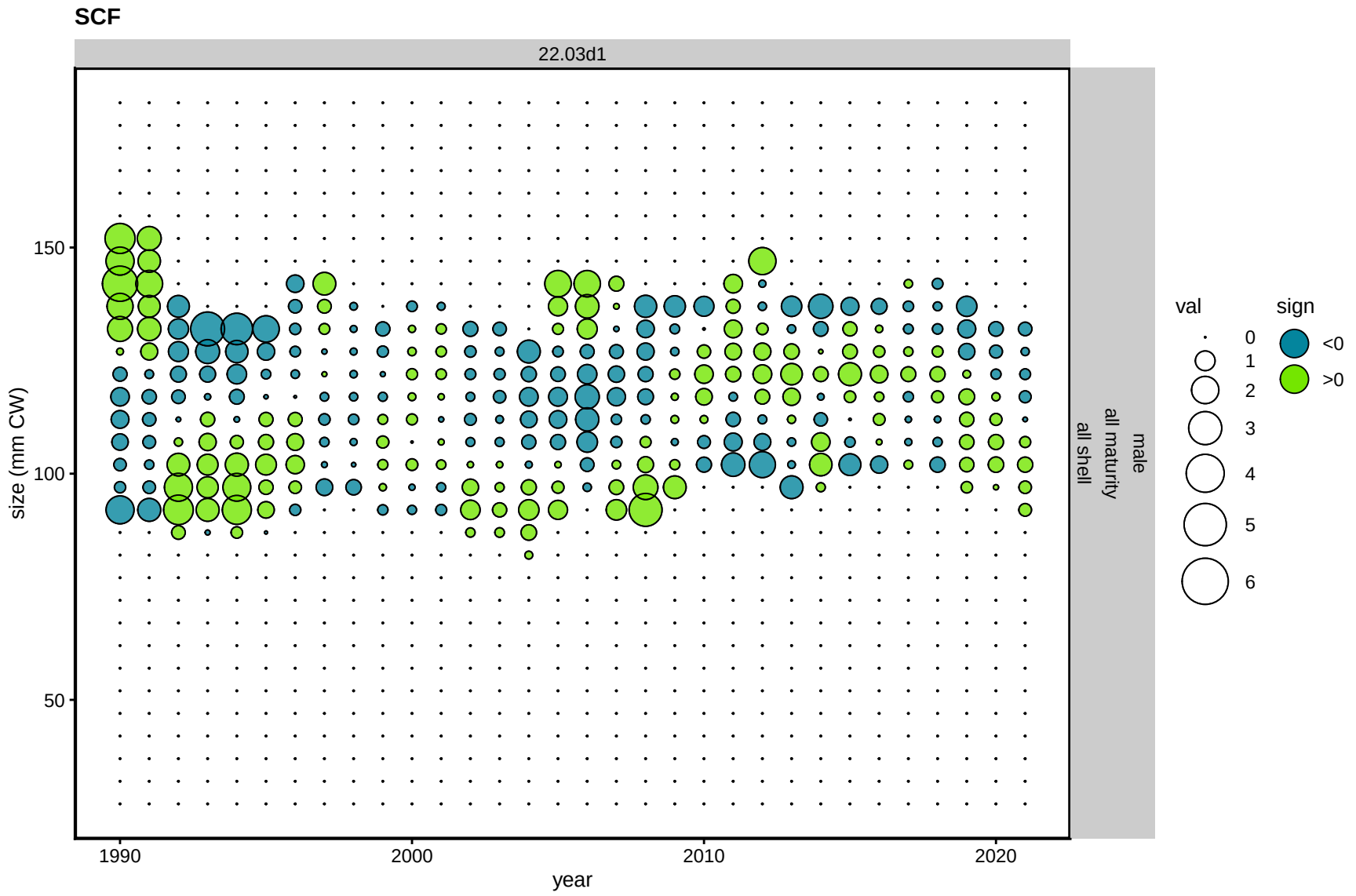

Figure 62. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

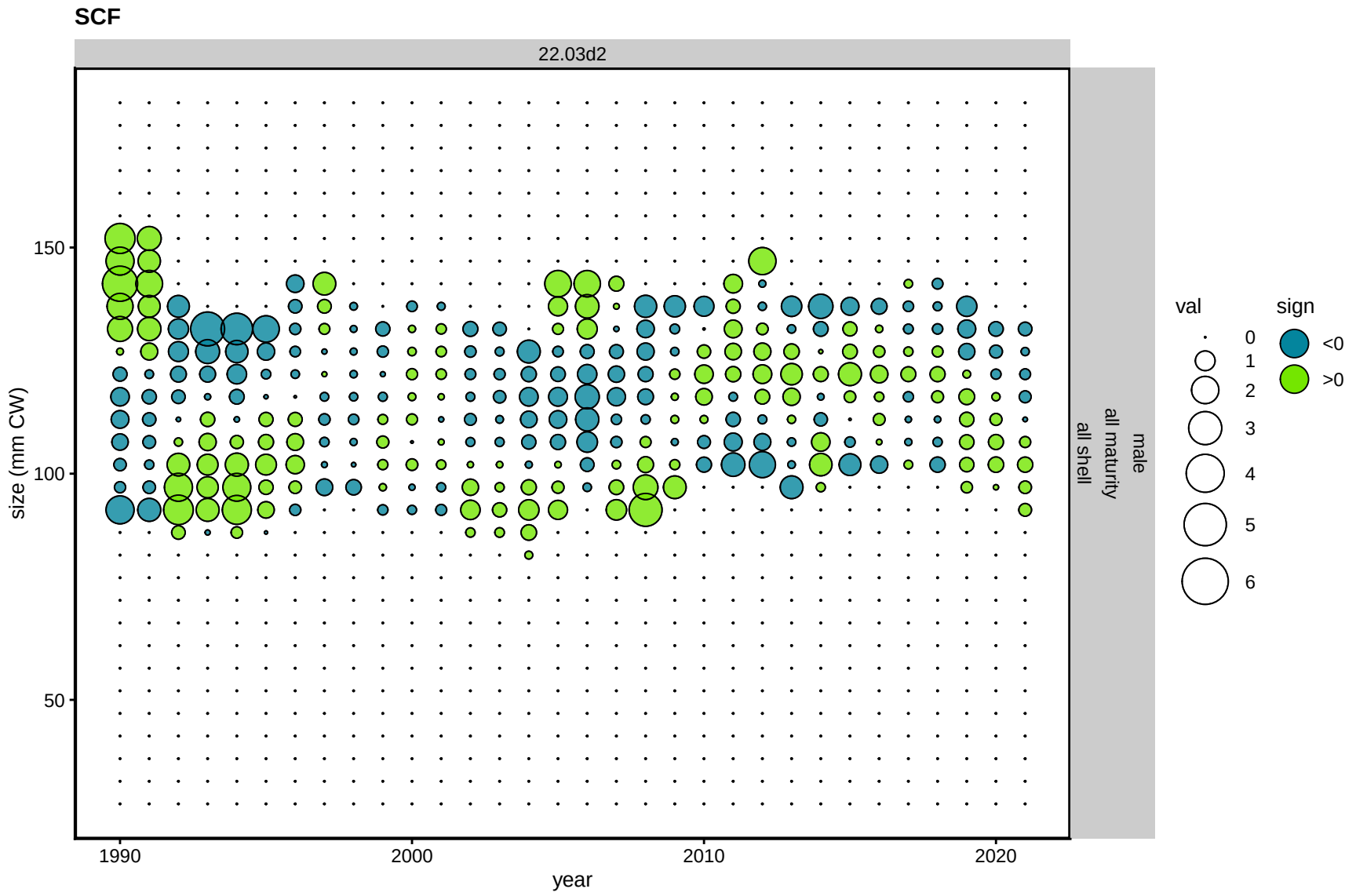

Figure 63. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

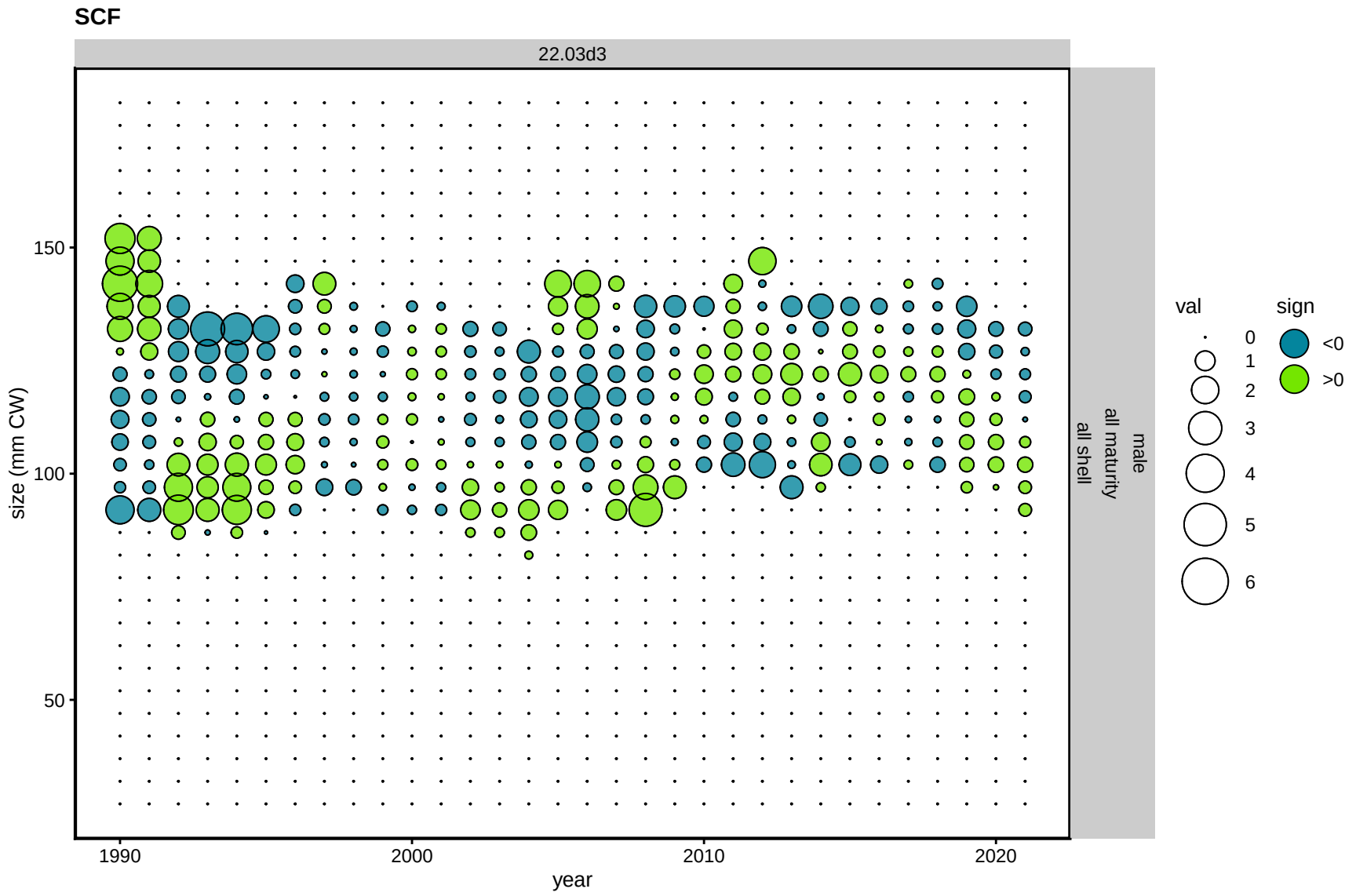

Figure 64. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

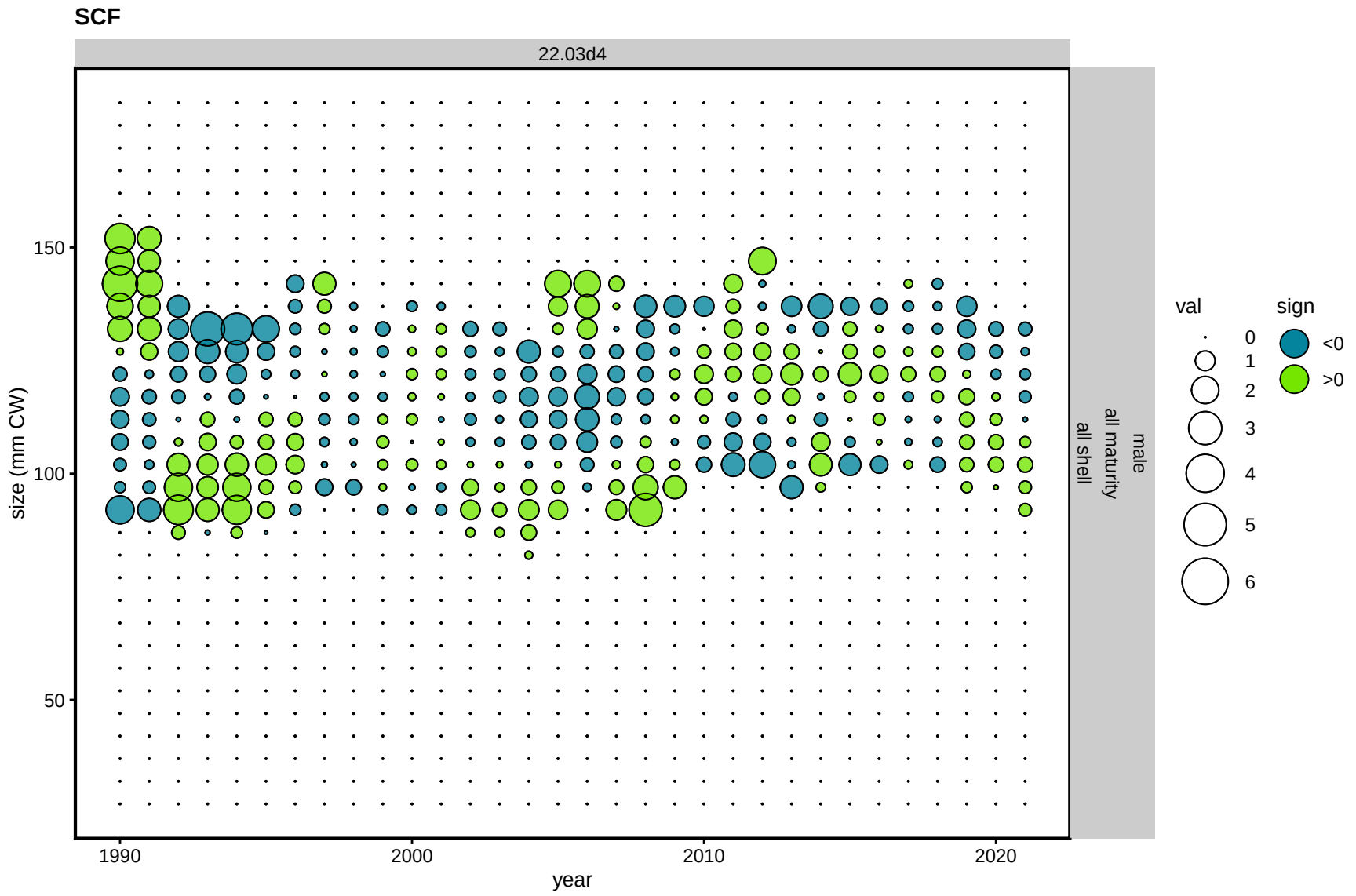

Figure 65. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

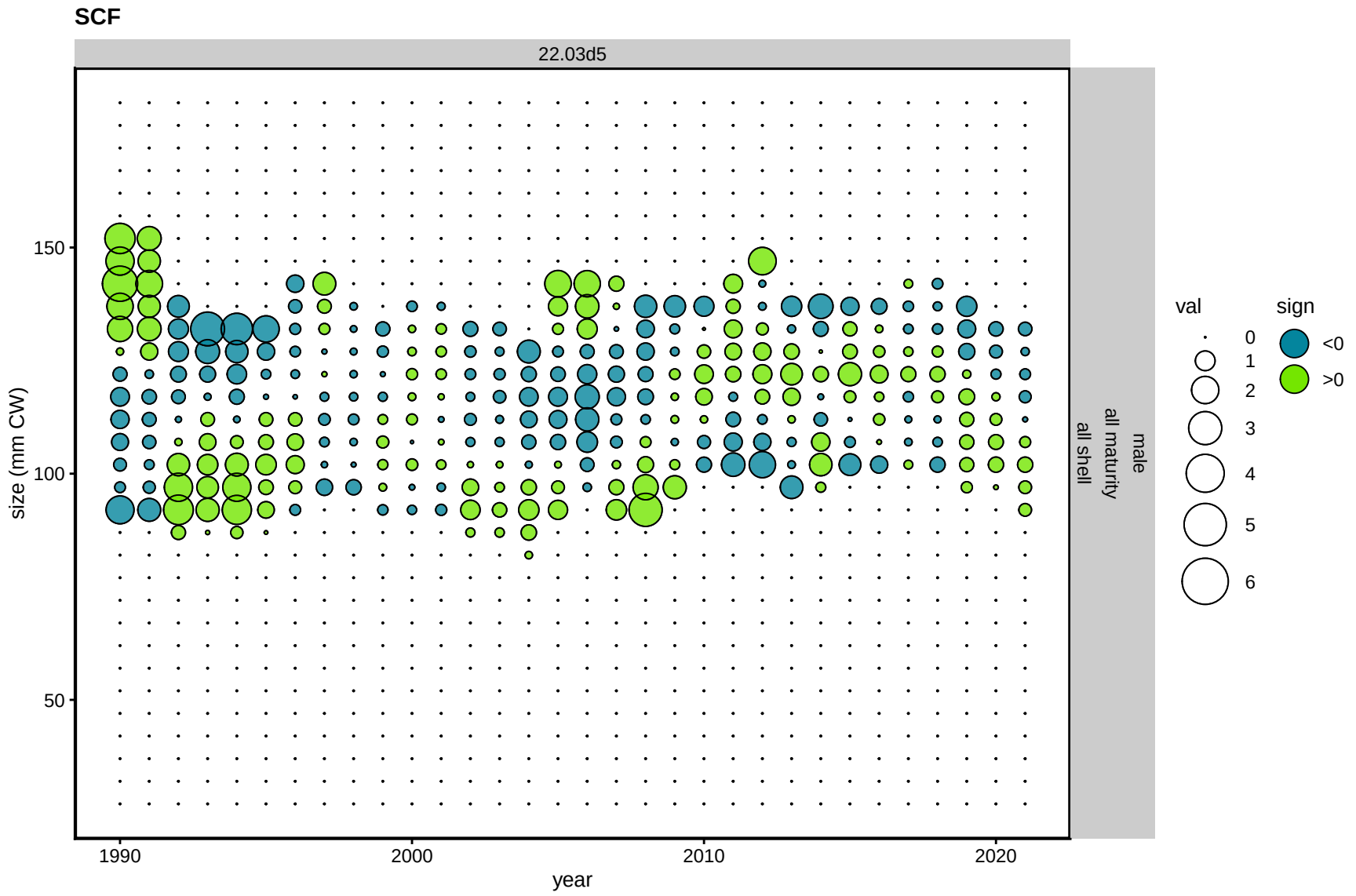

Figure 66. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

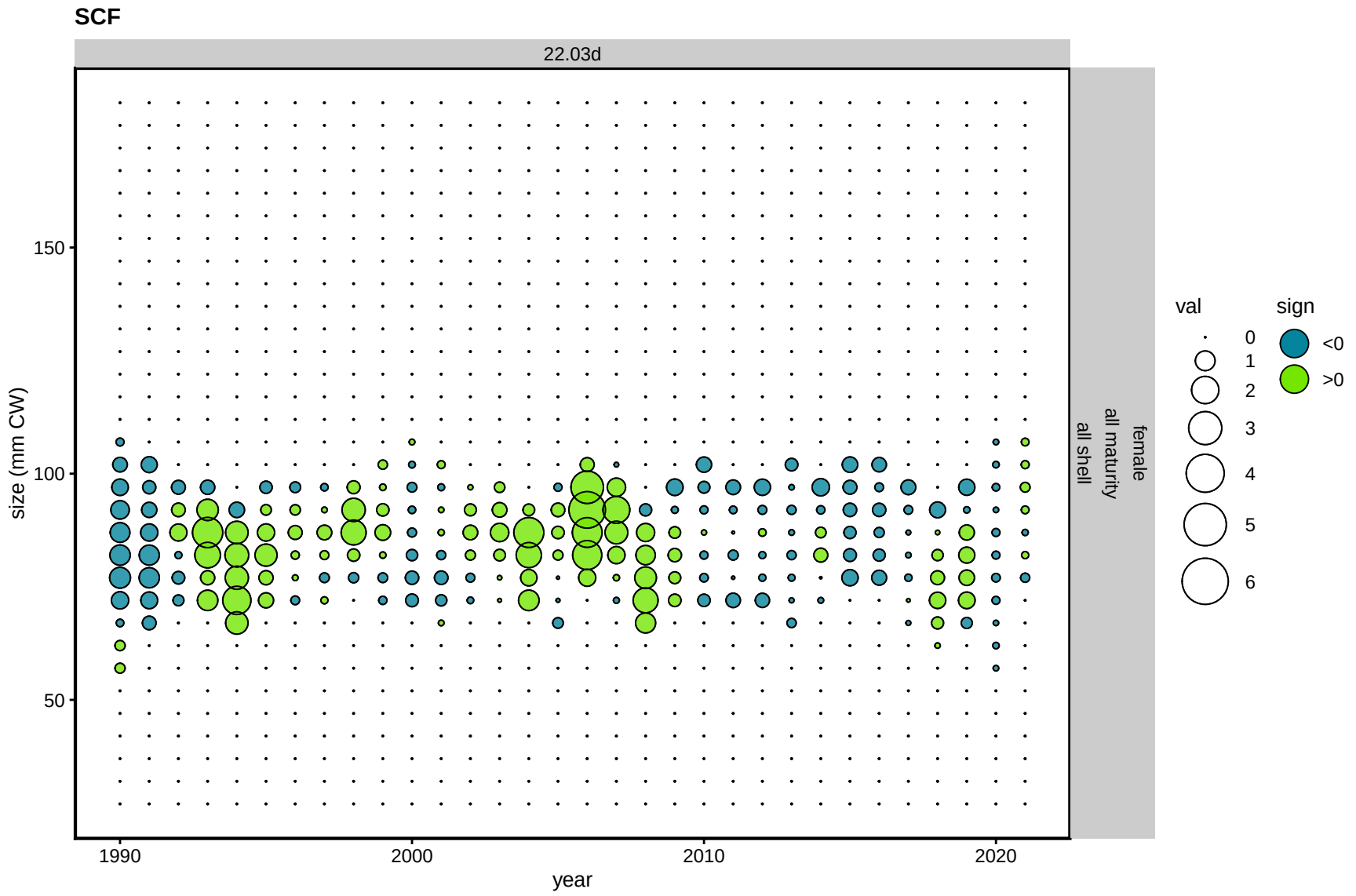

Figure 67. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

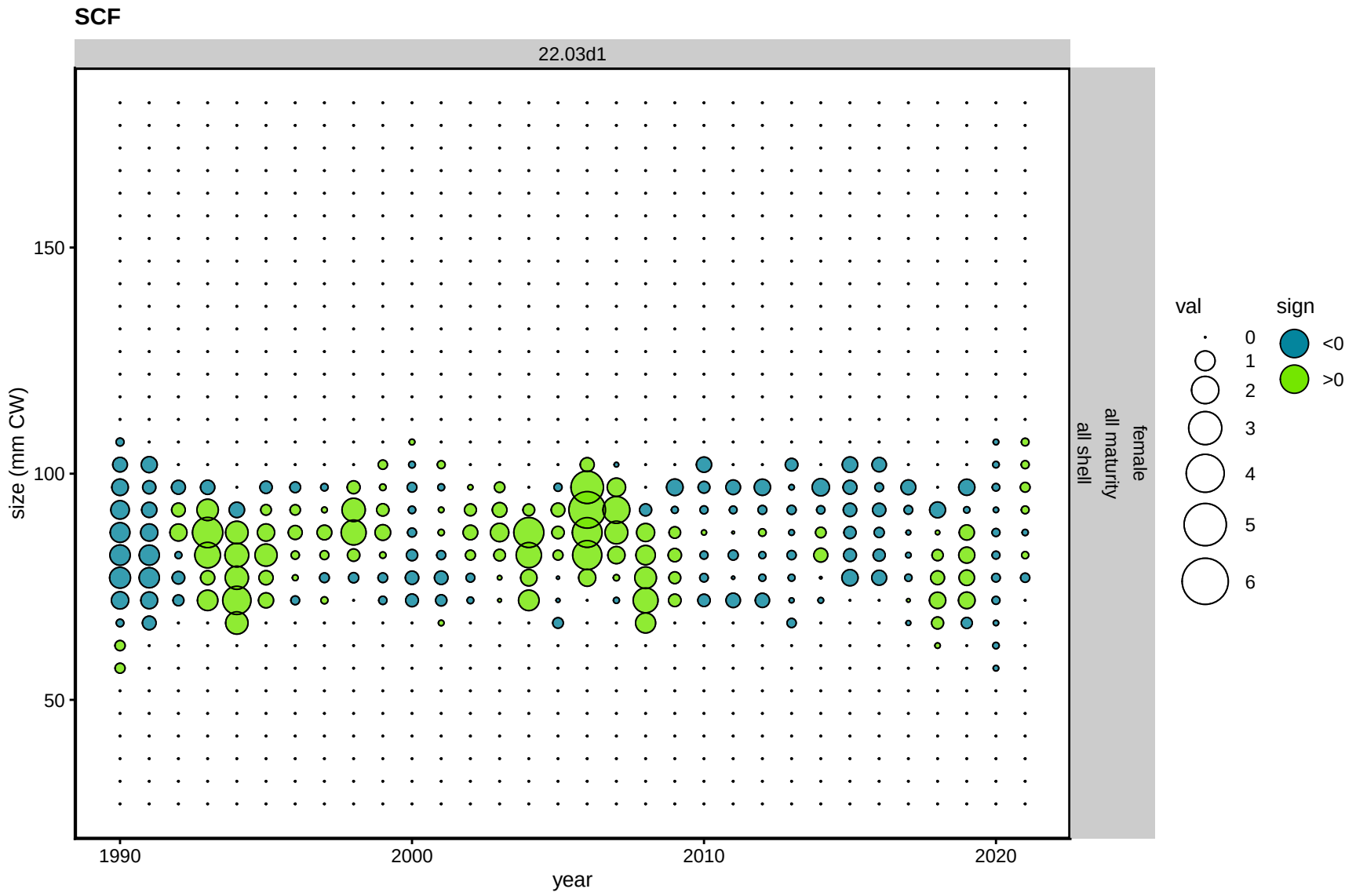

Figure 68. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

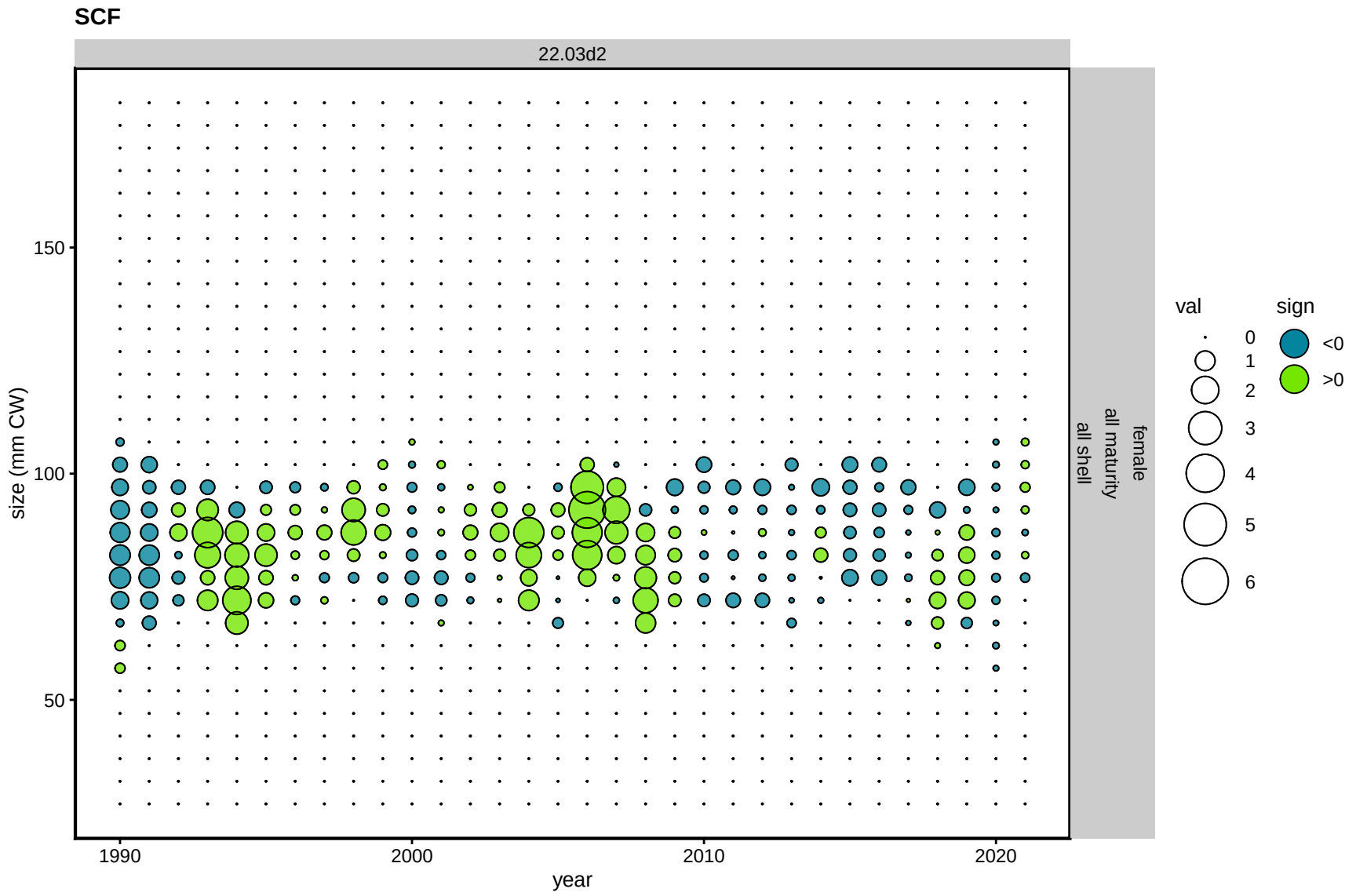

Figure 69. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

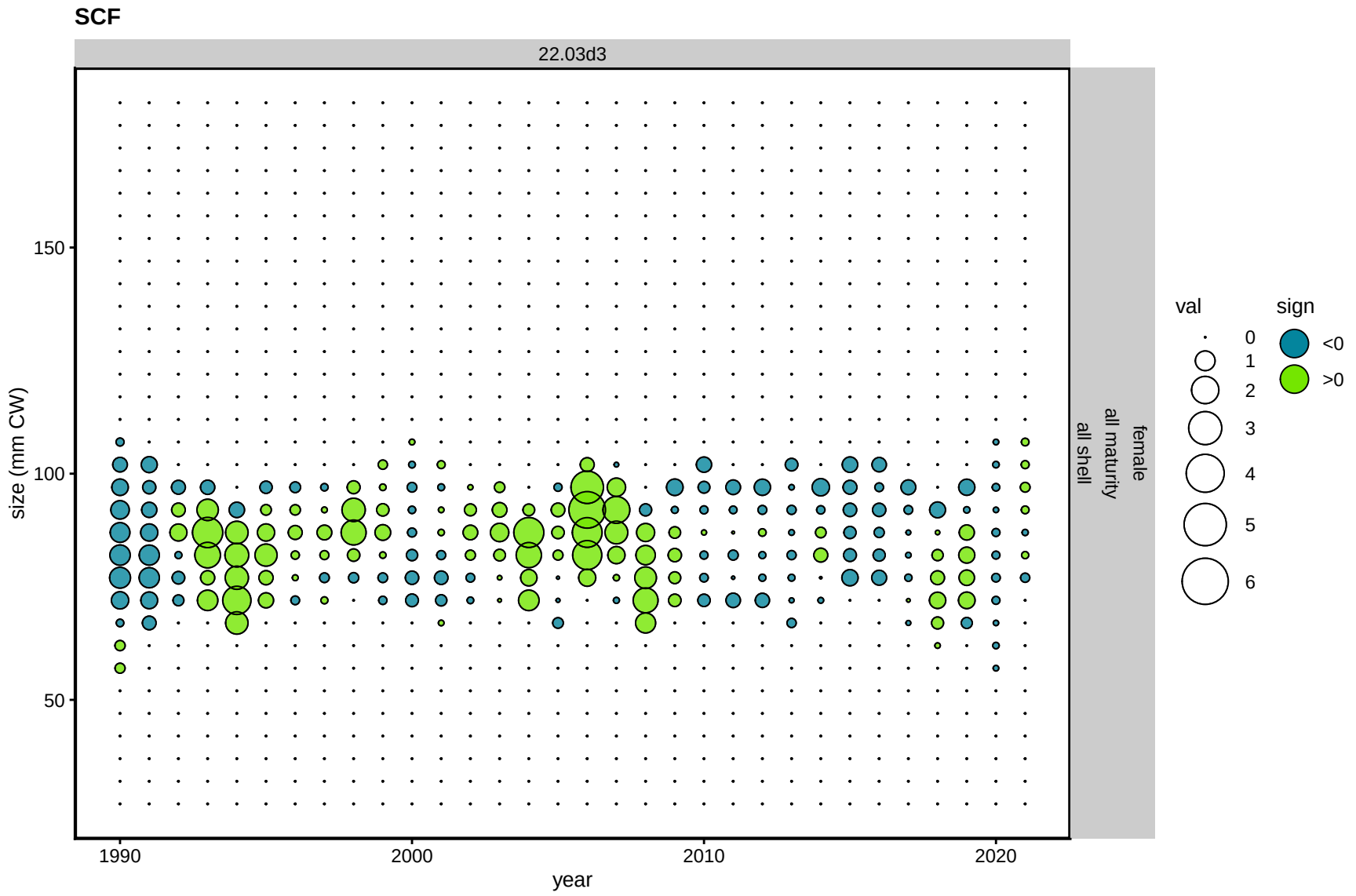

Figure 70. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

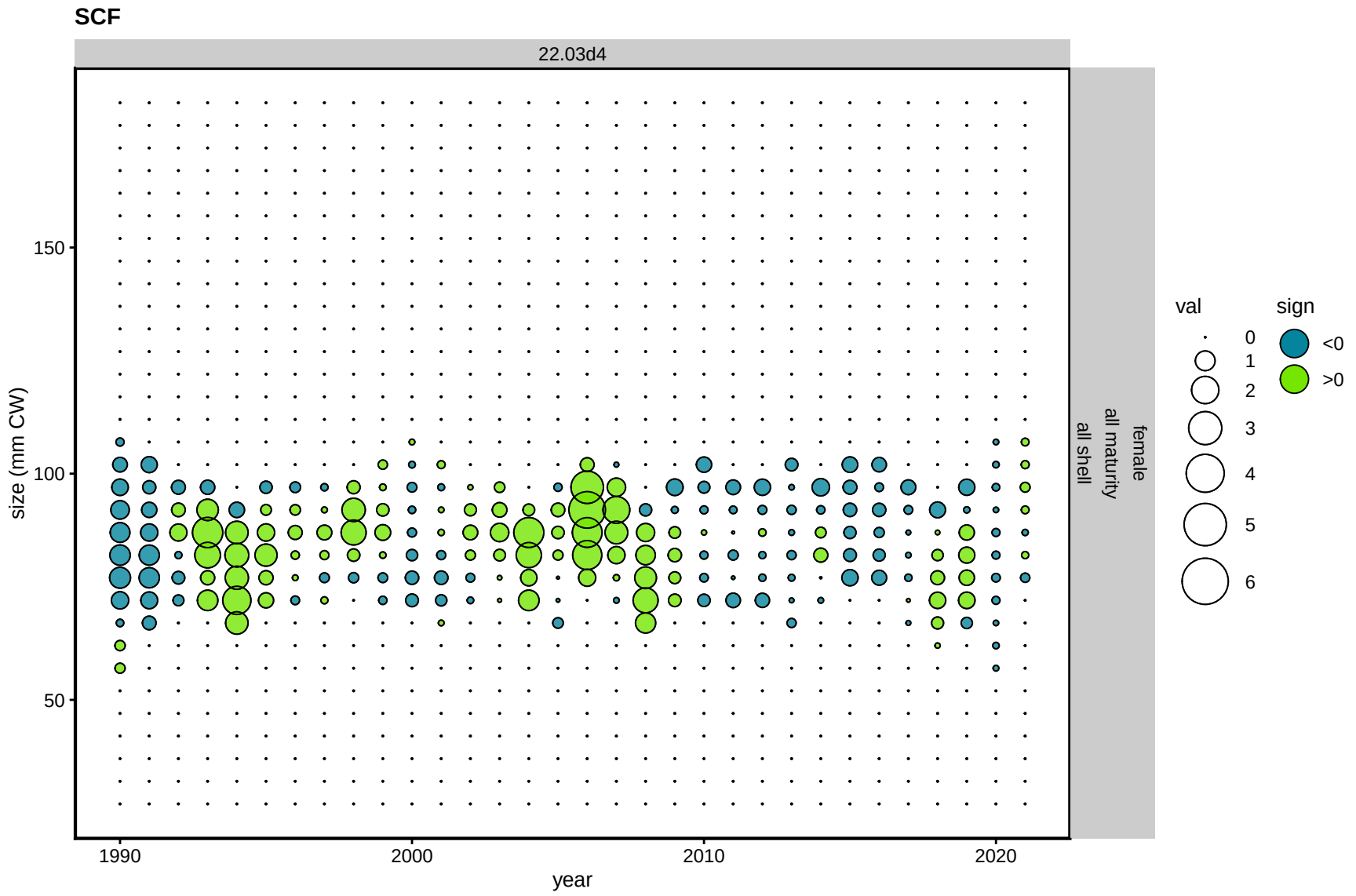

Figure 71. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

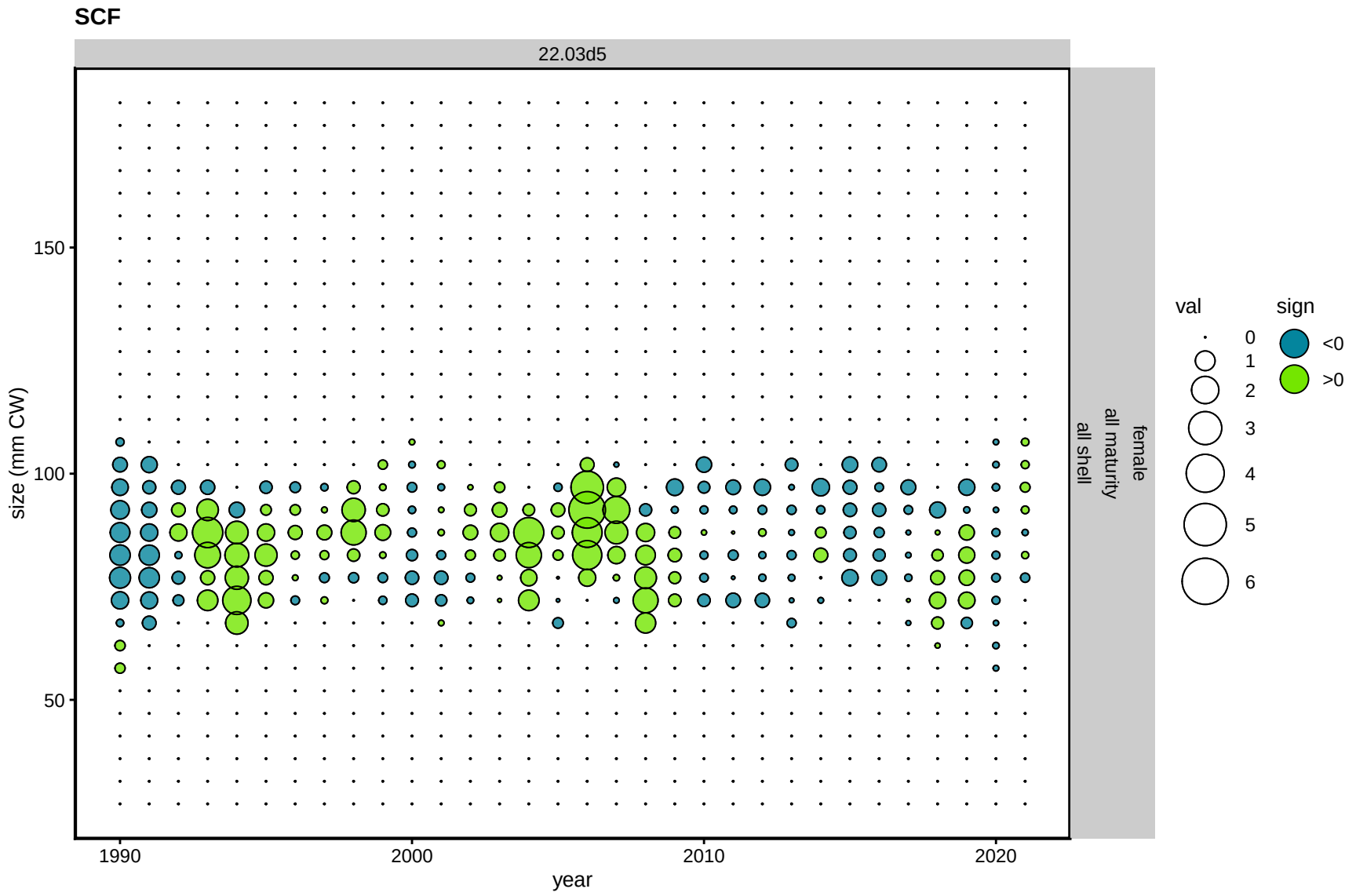

Figure 72. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

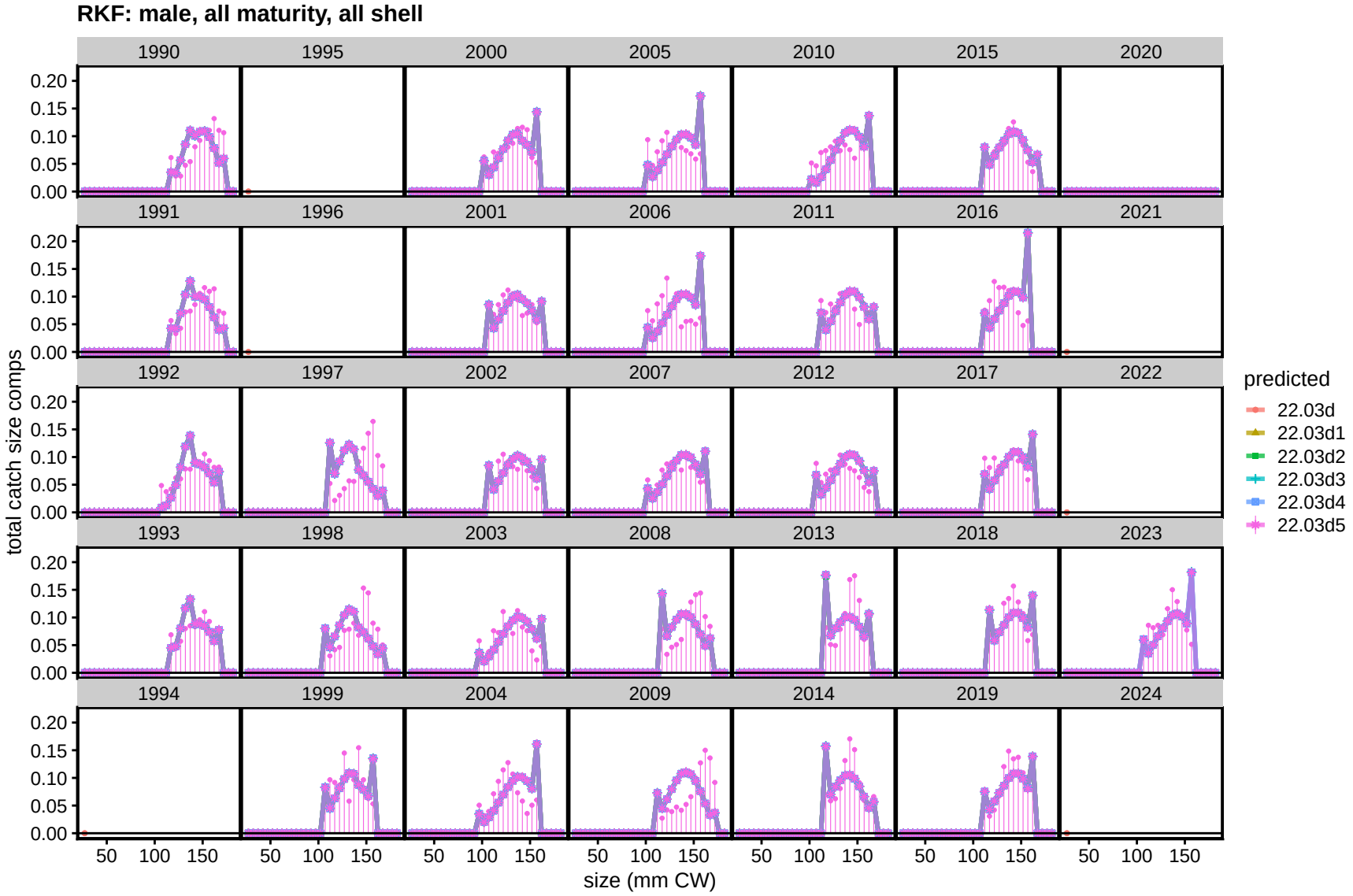

Figure 73. TCSAM02 models fits to total catch size compositions in the RKF fishery. Preferred model is 22.03d5.

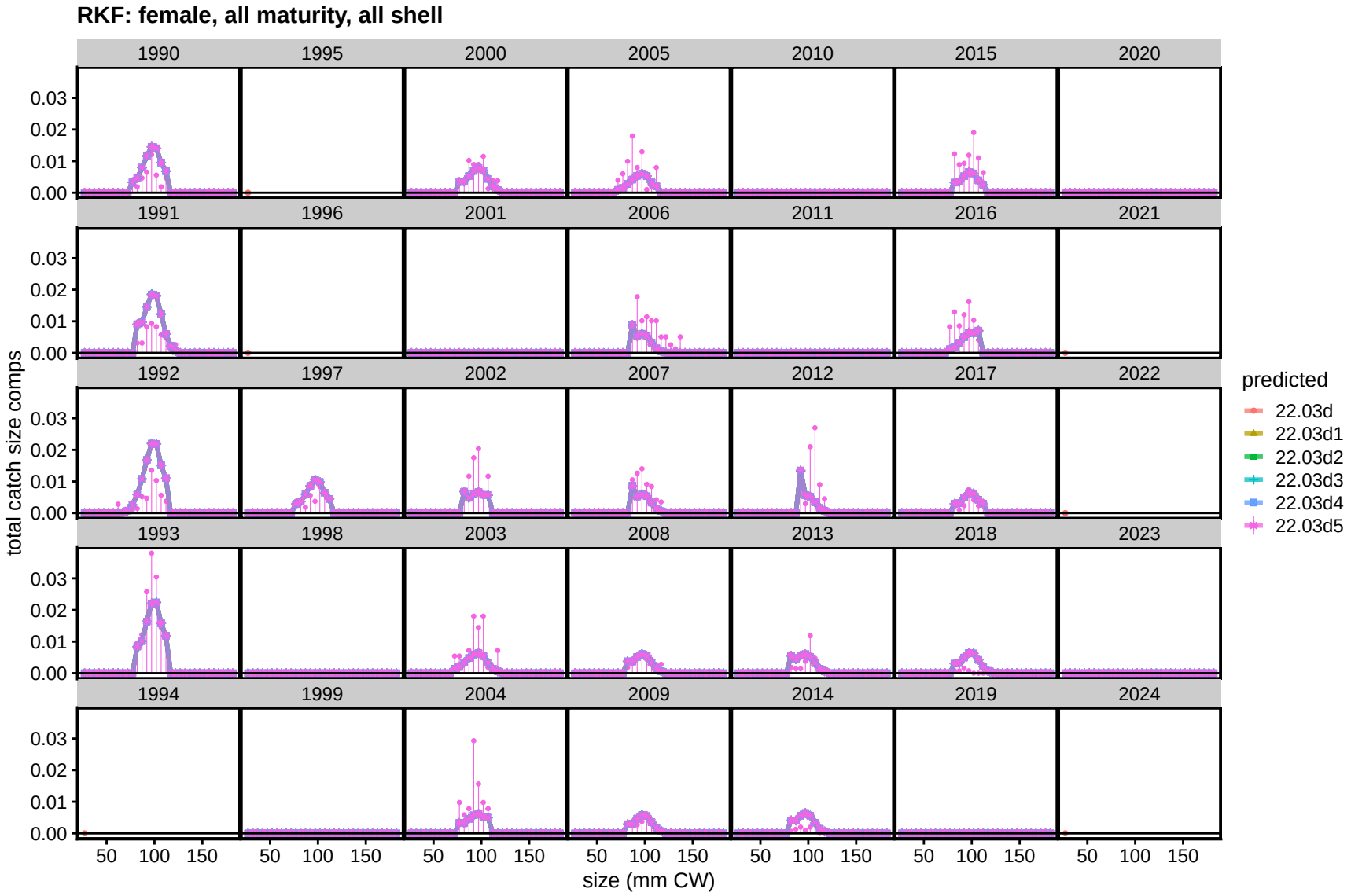

Figure 74. TCSAM02 models fits to total catch size compositions in the RKF fishery. Preferred model is 22.03d5.

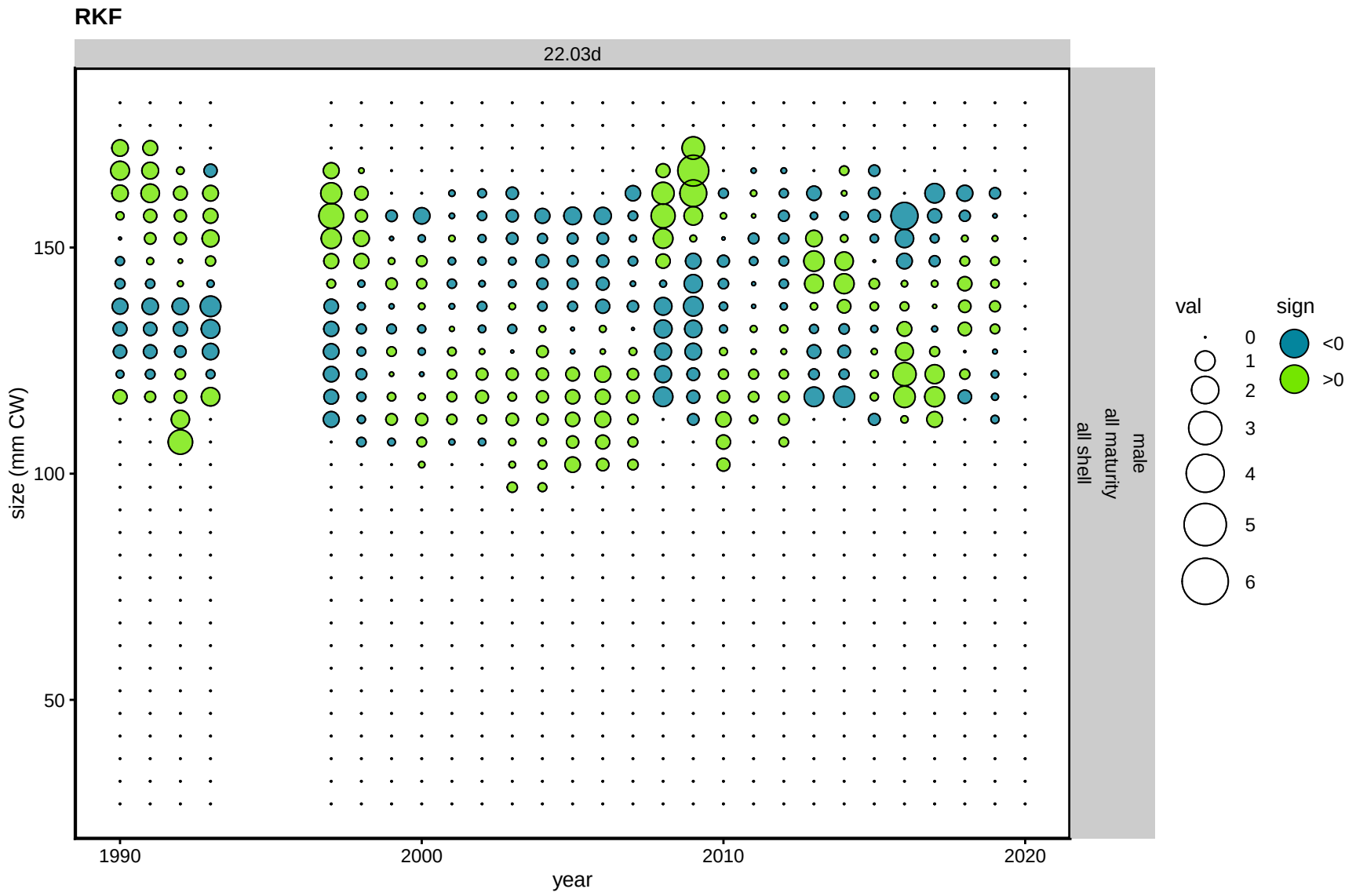

Figure 75. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

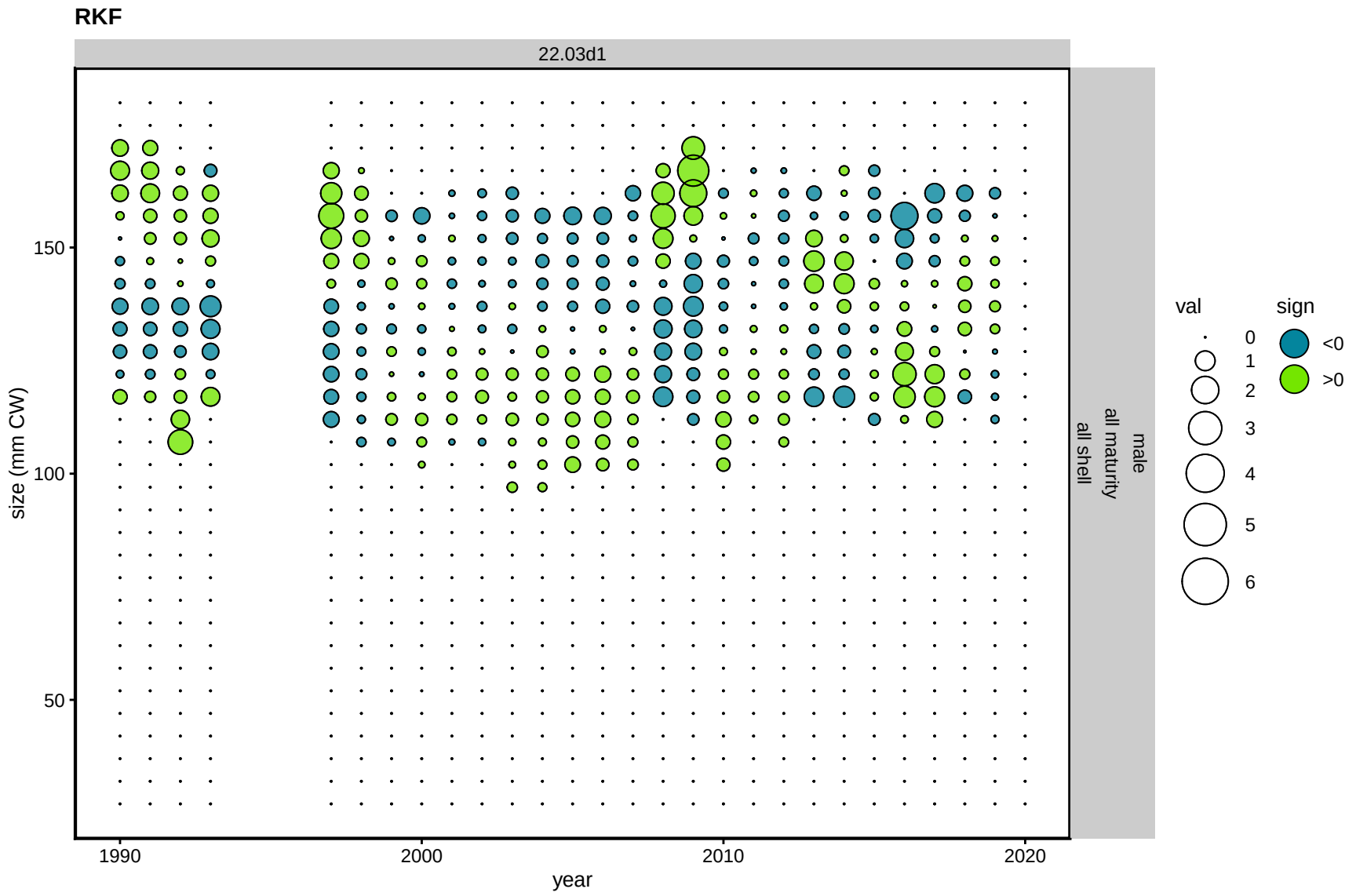

Figure 76. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

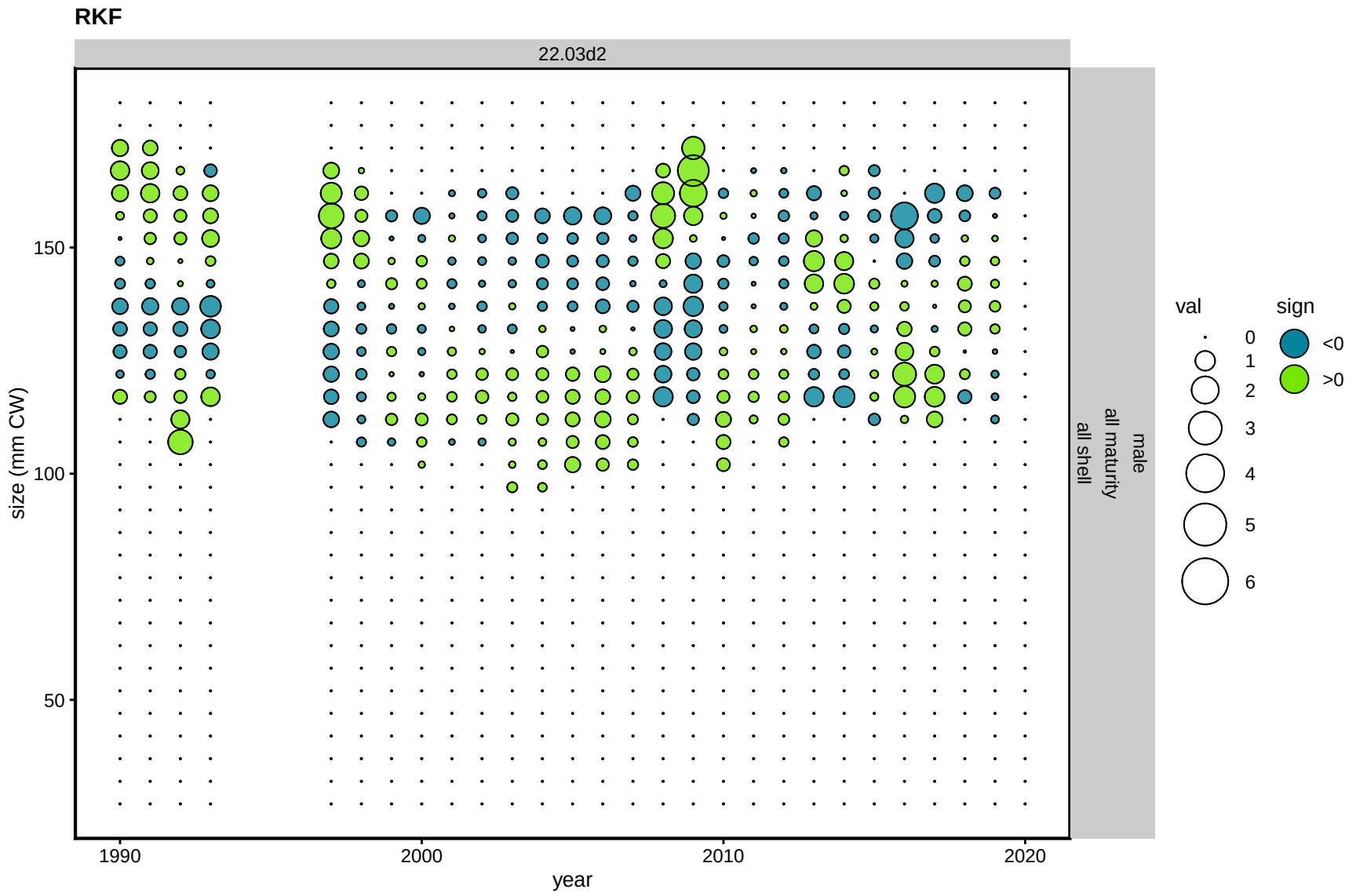

Figure 77. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

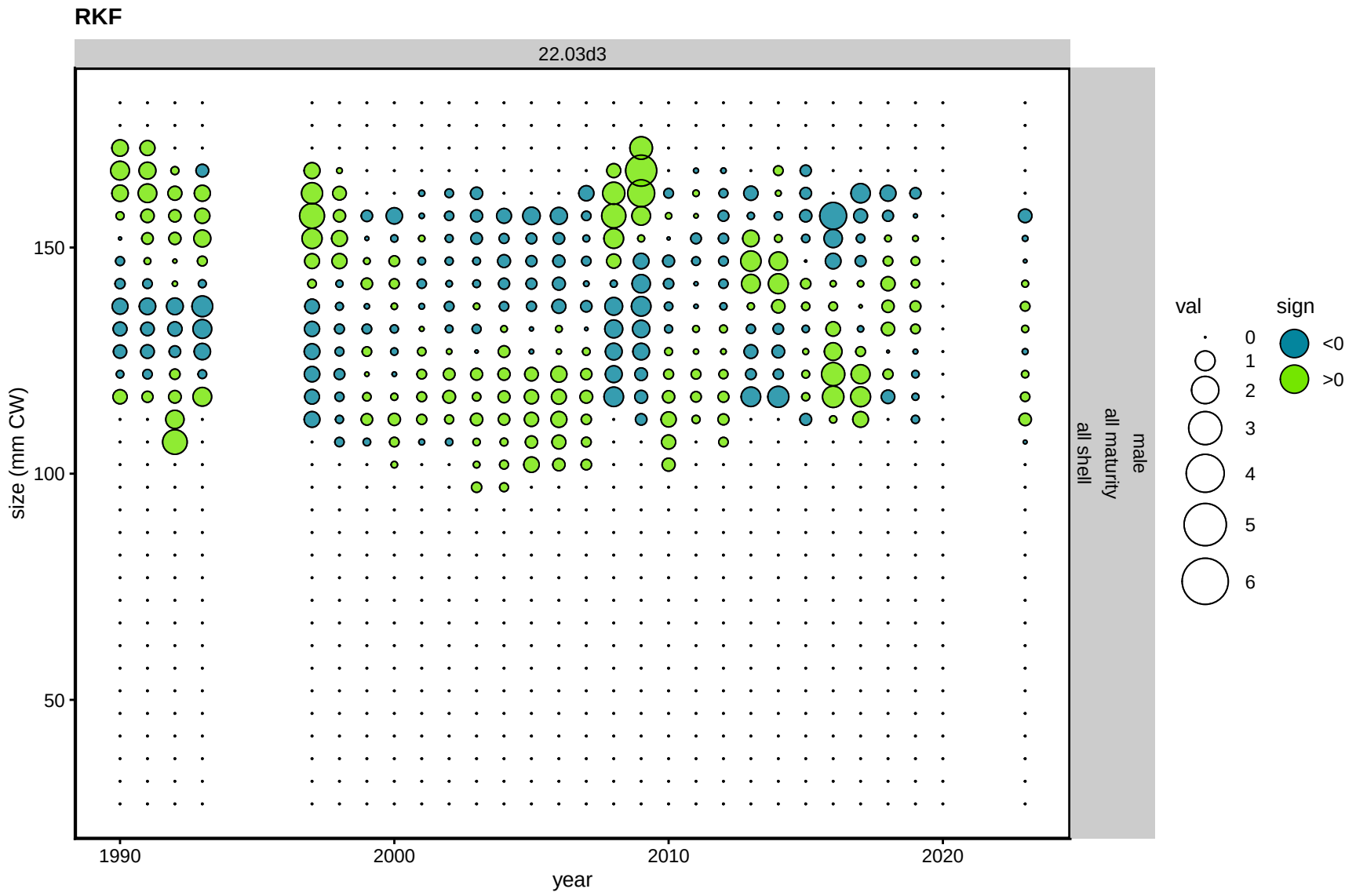

Figure 78. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

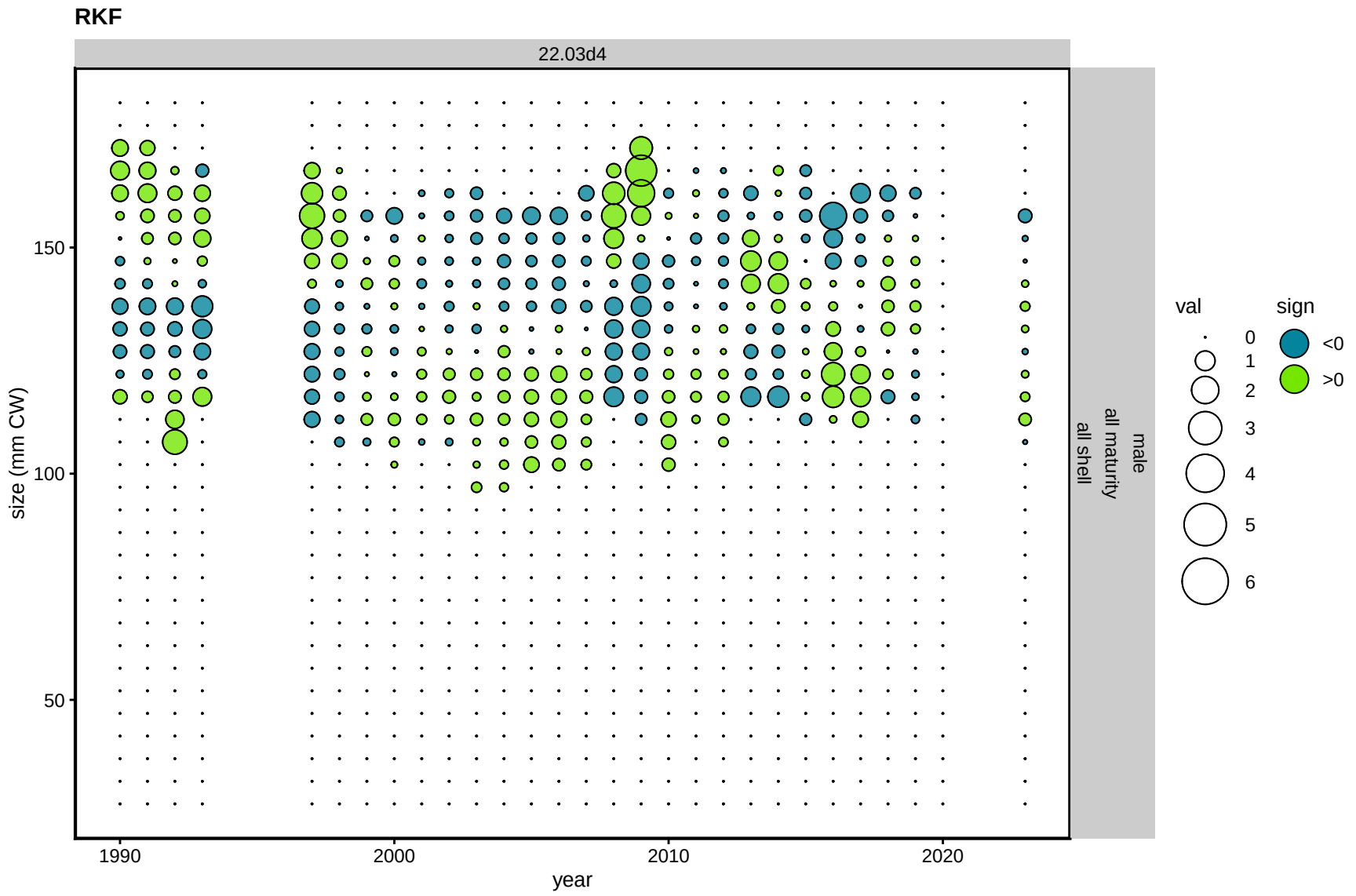

Figure 79. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

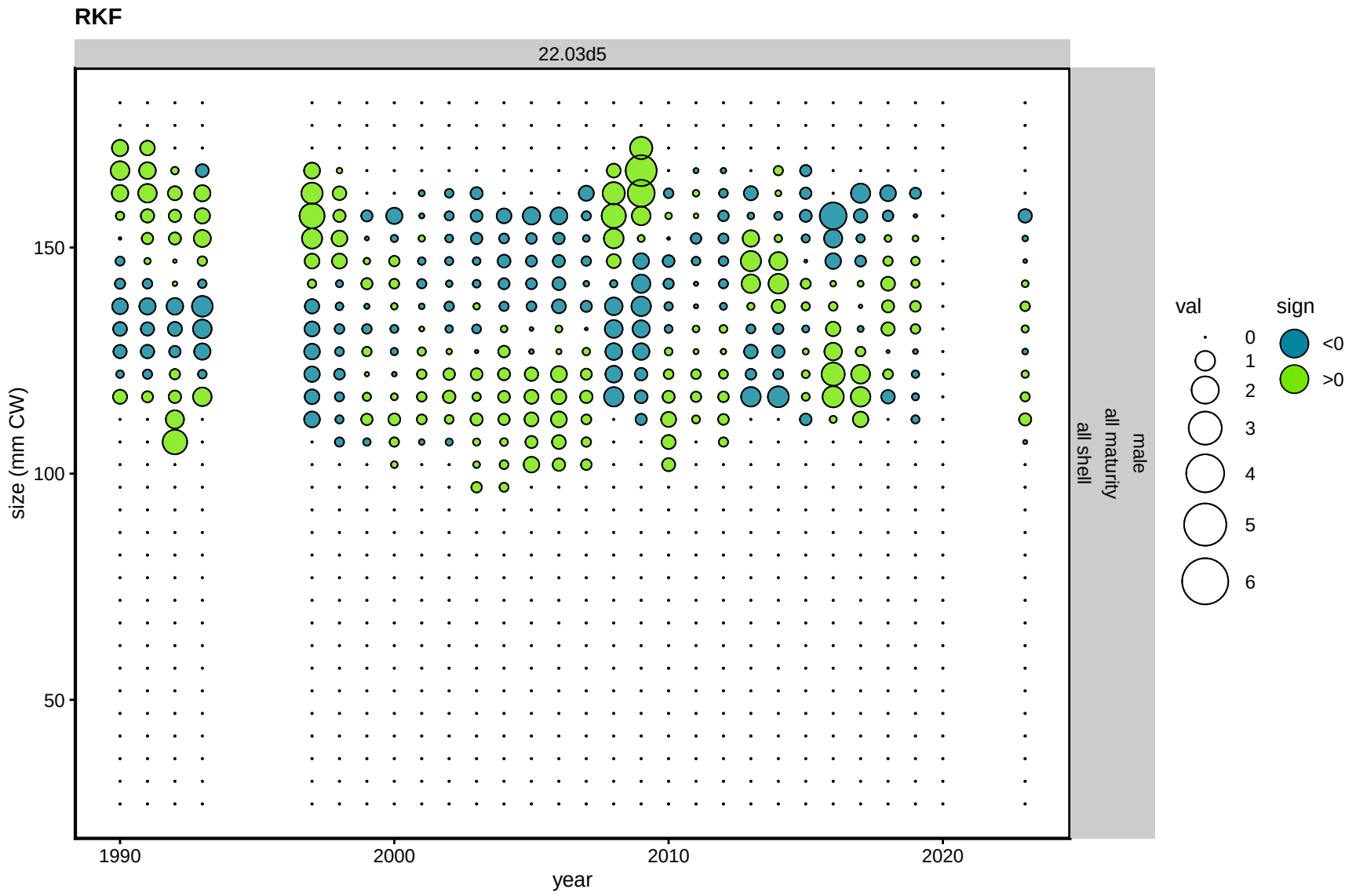

Figure 80. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

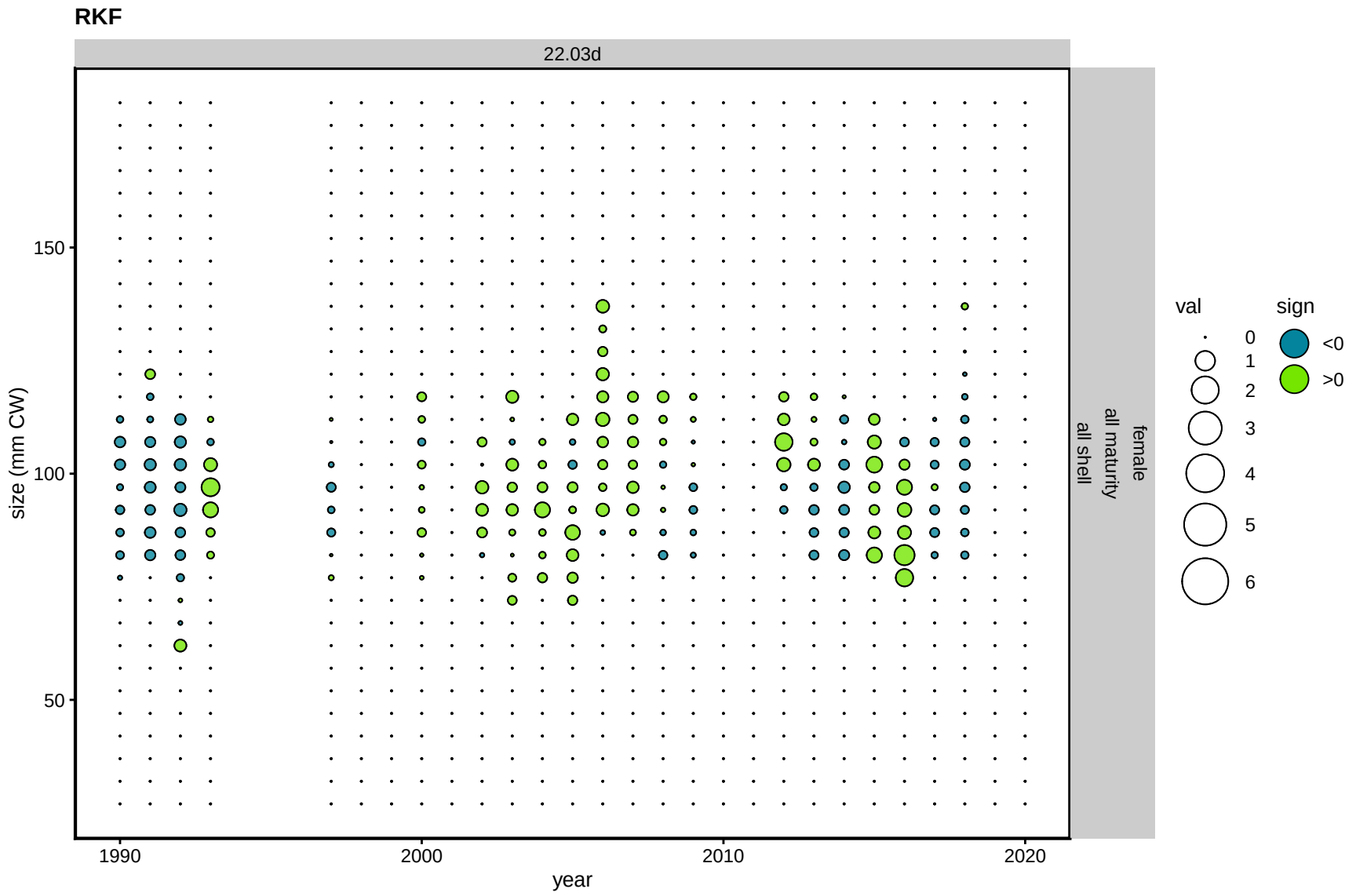

Figure 81. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

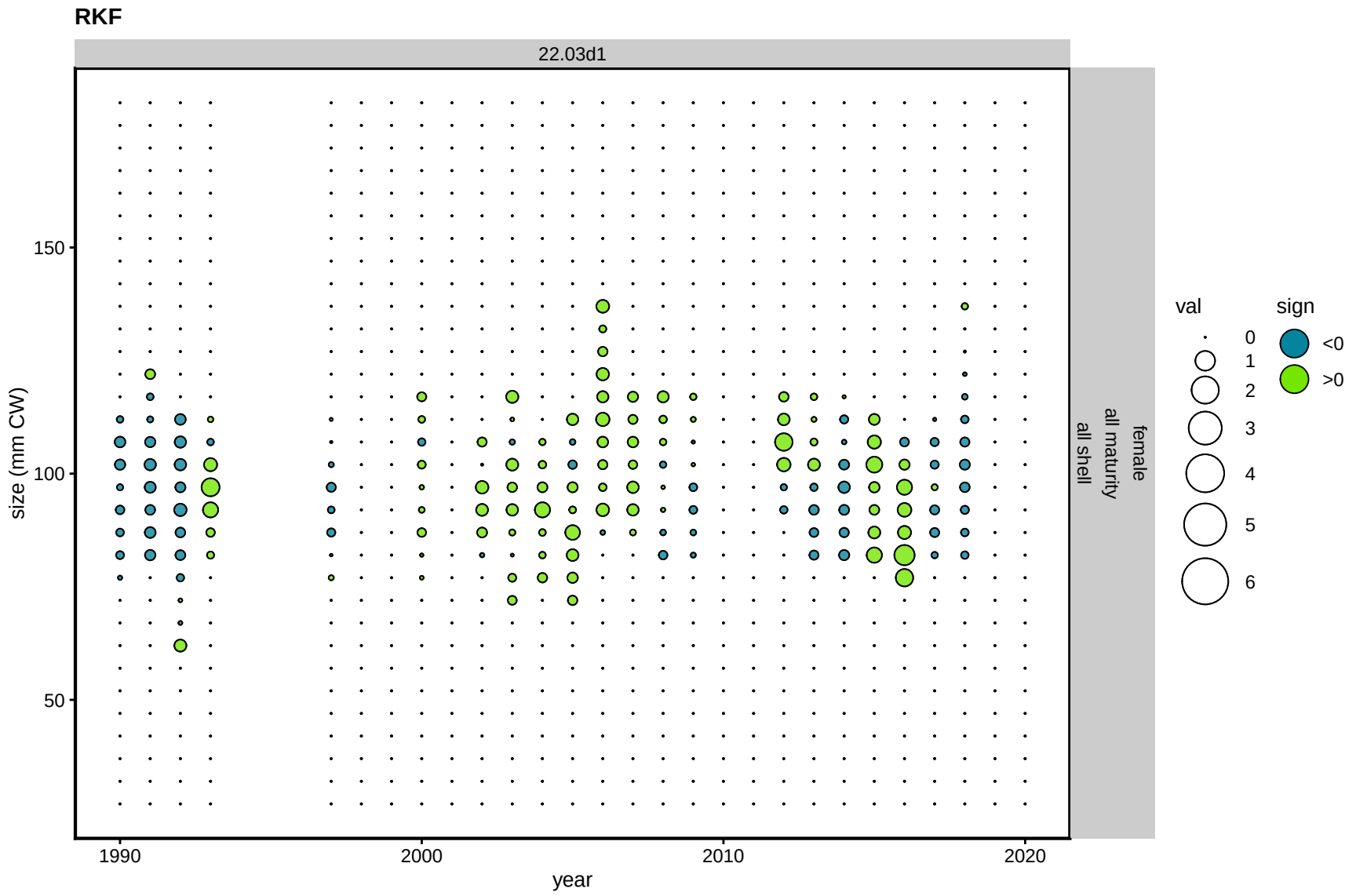

Figure 82. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

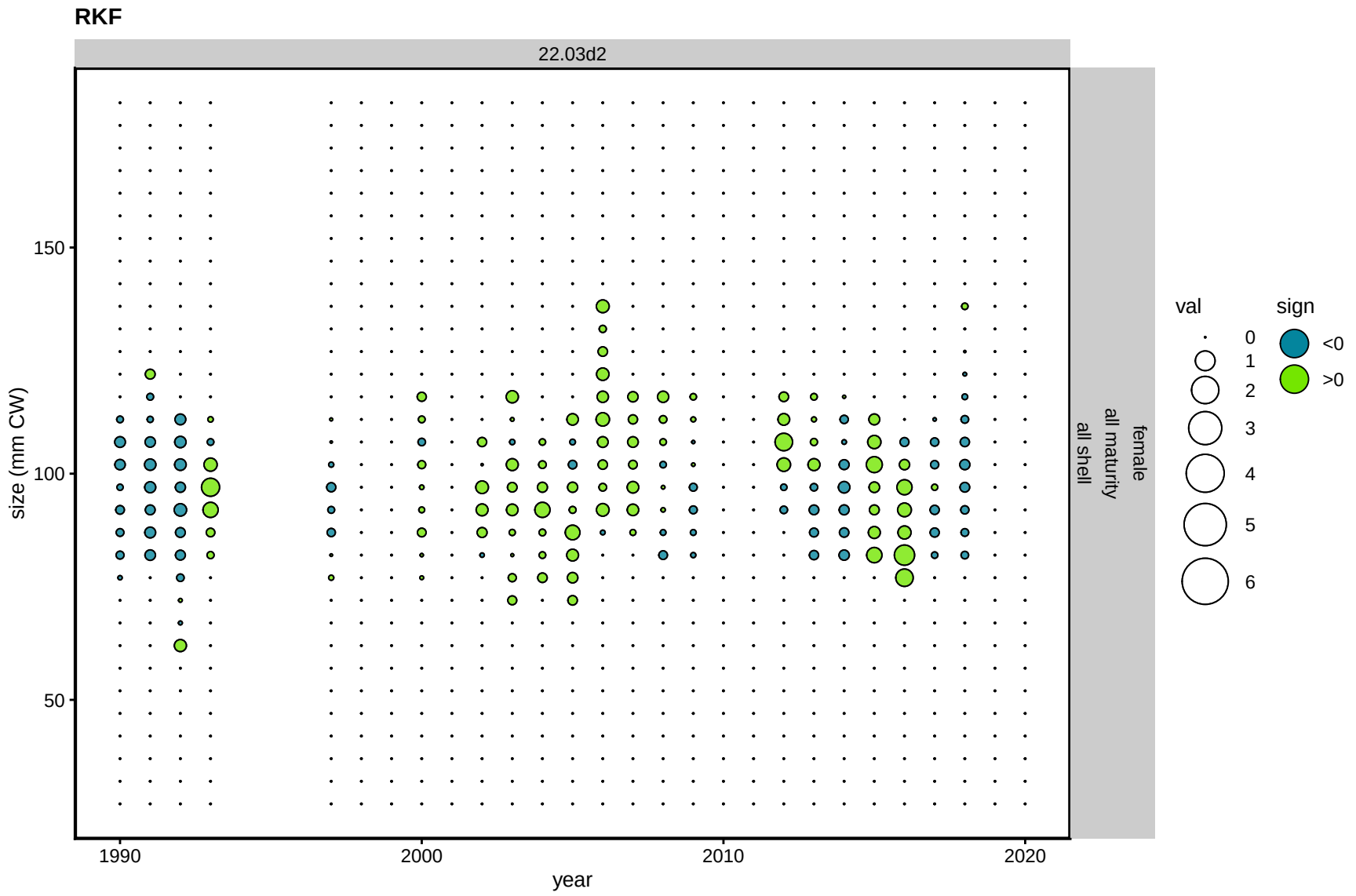

Figure 83. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

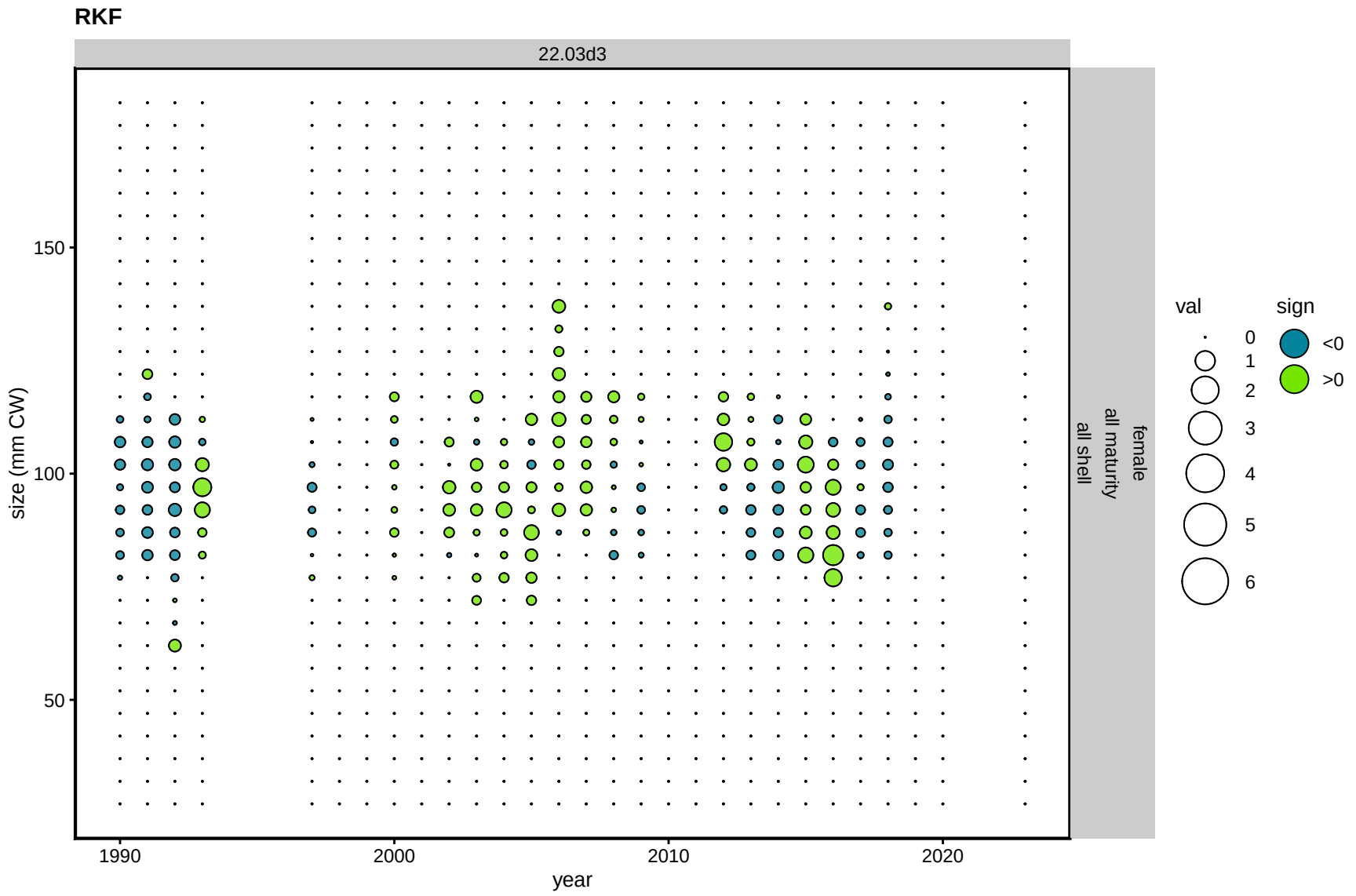

Figure 84. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

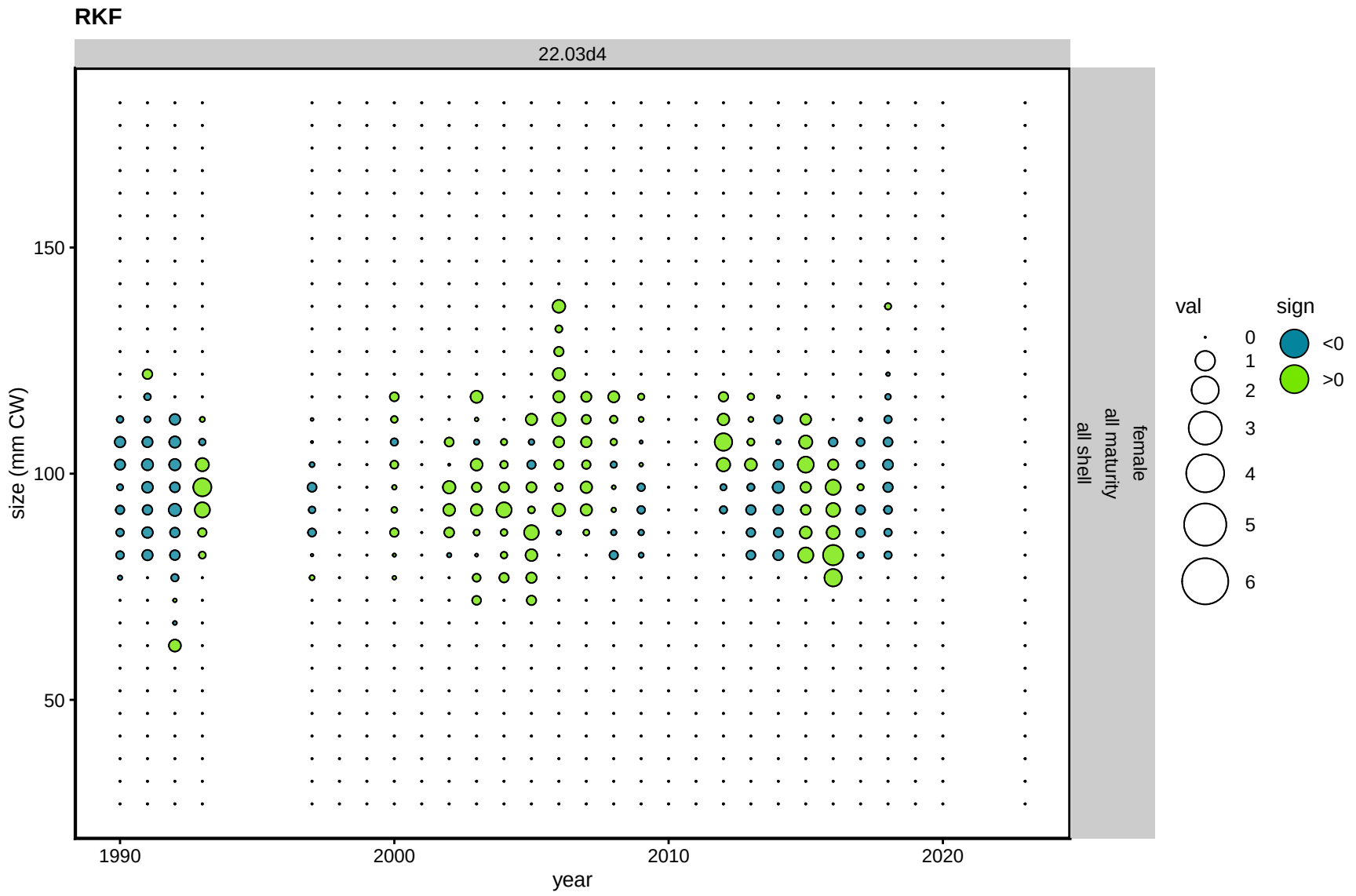

Figure 85. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

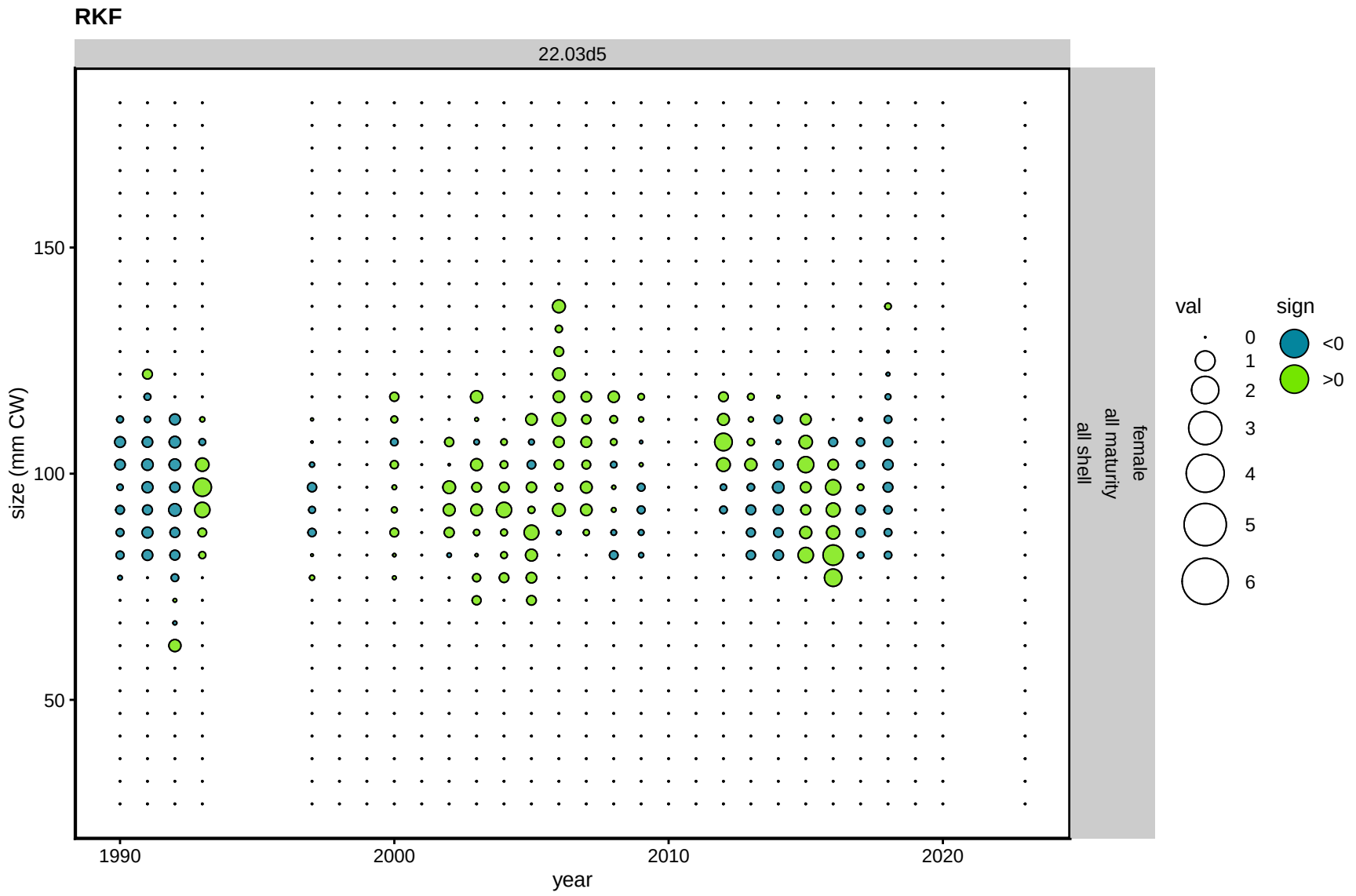

Figure 86. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

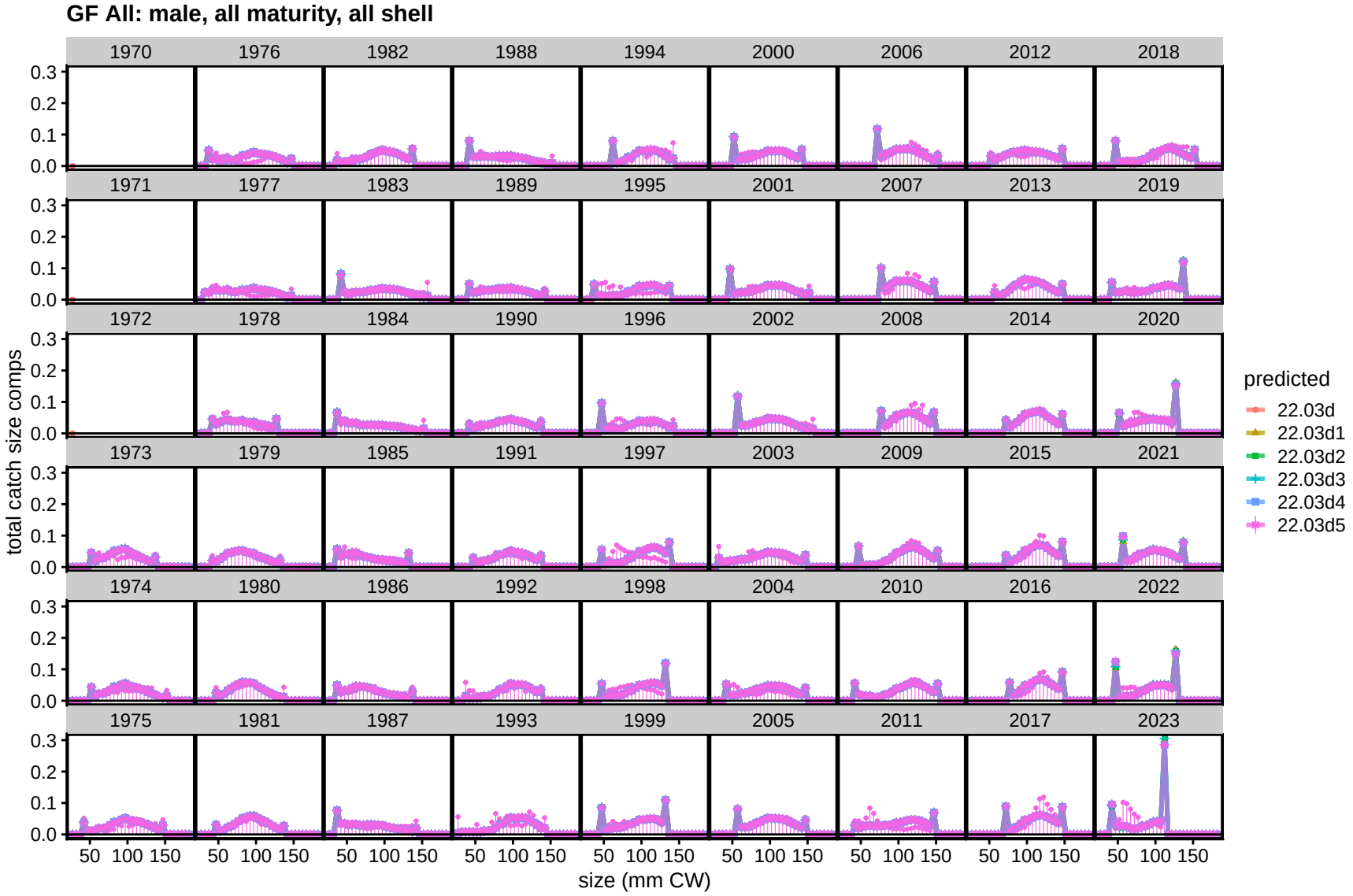

Figure 87. TCSAM02 models fits to total catch size compositions in the GF All fishery.

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

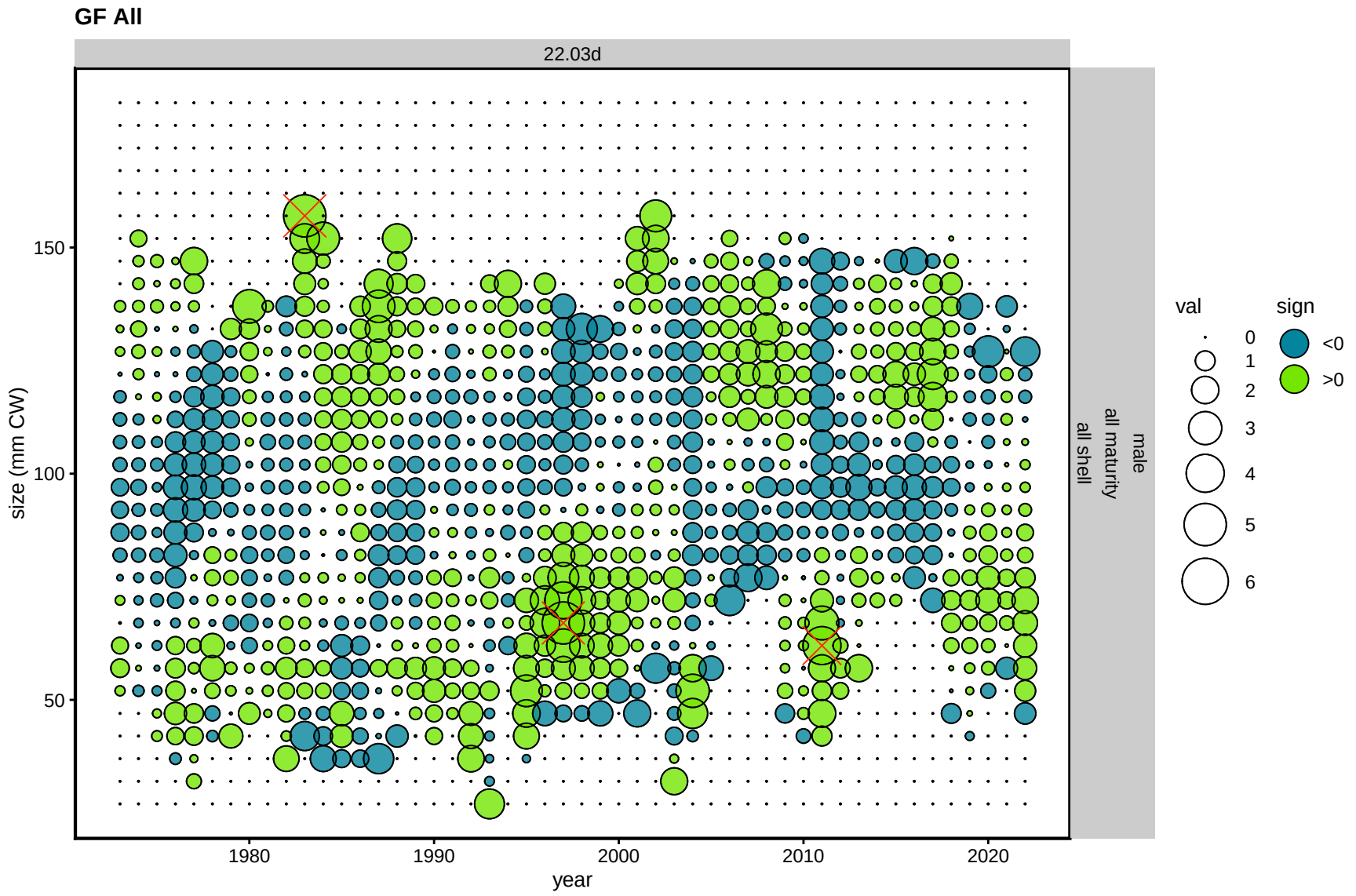

Figure 89. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

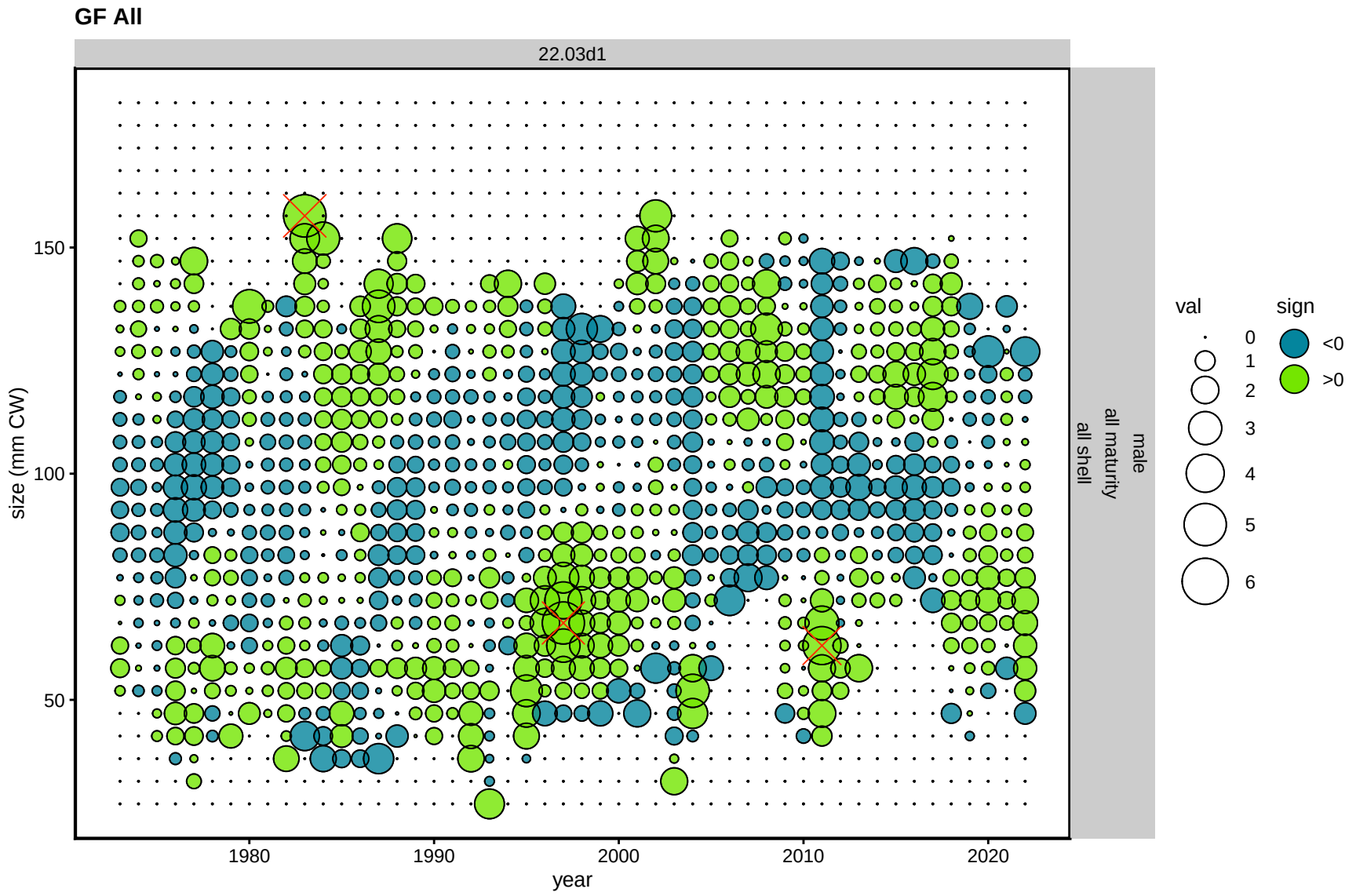

Figure 90. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

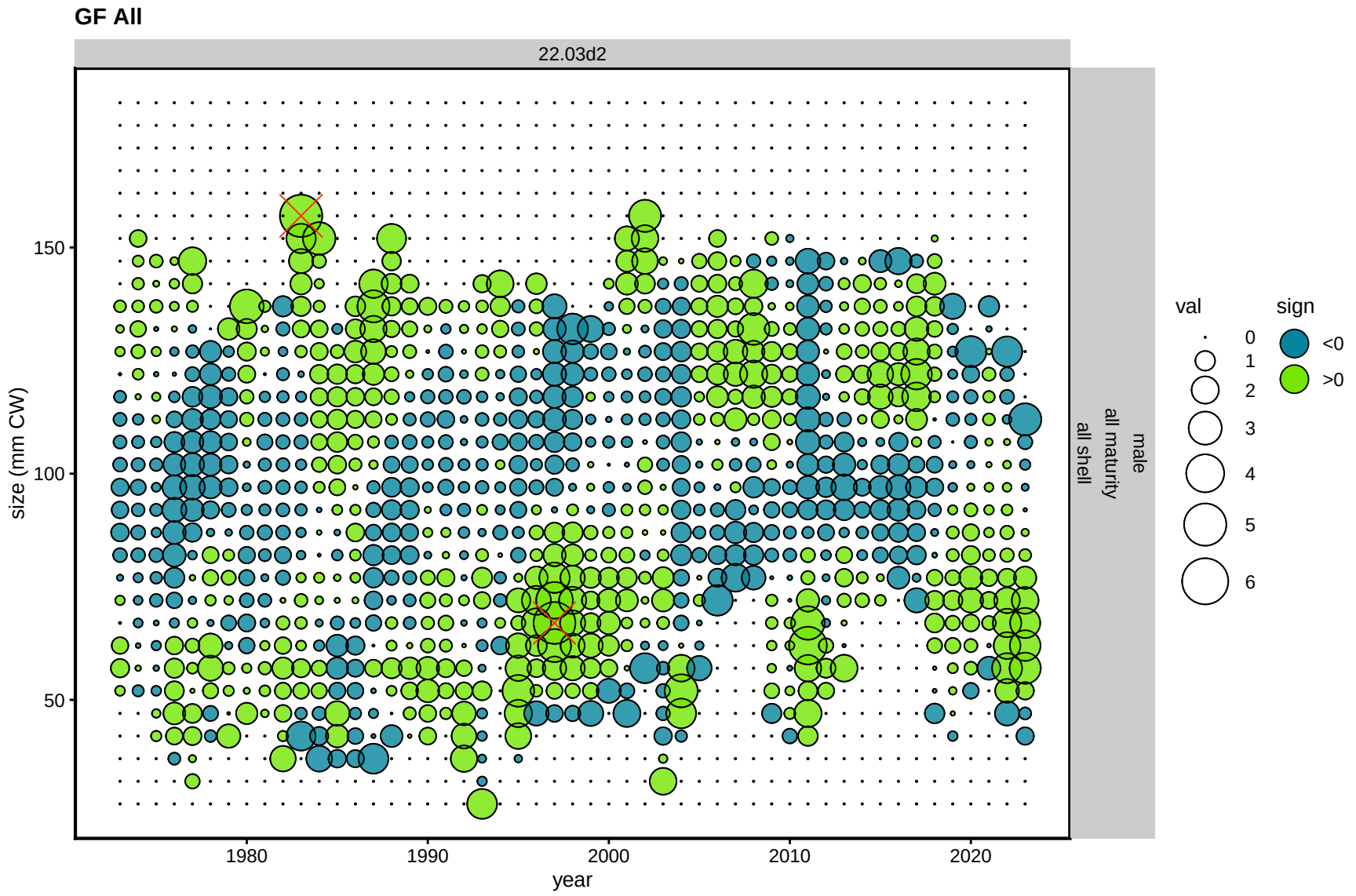

Figure 91. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

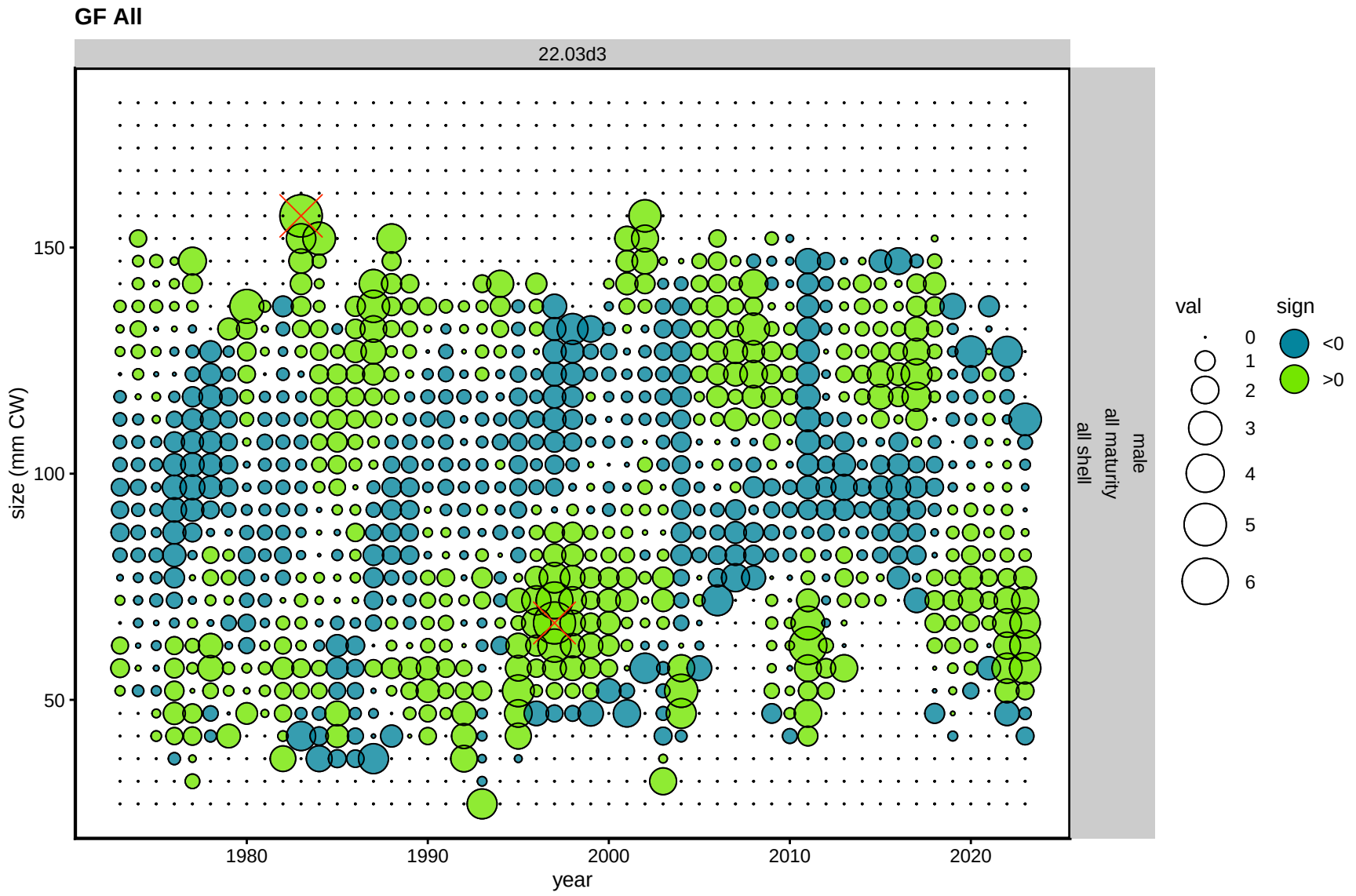

Figure 92. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

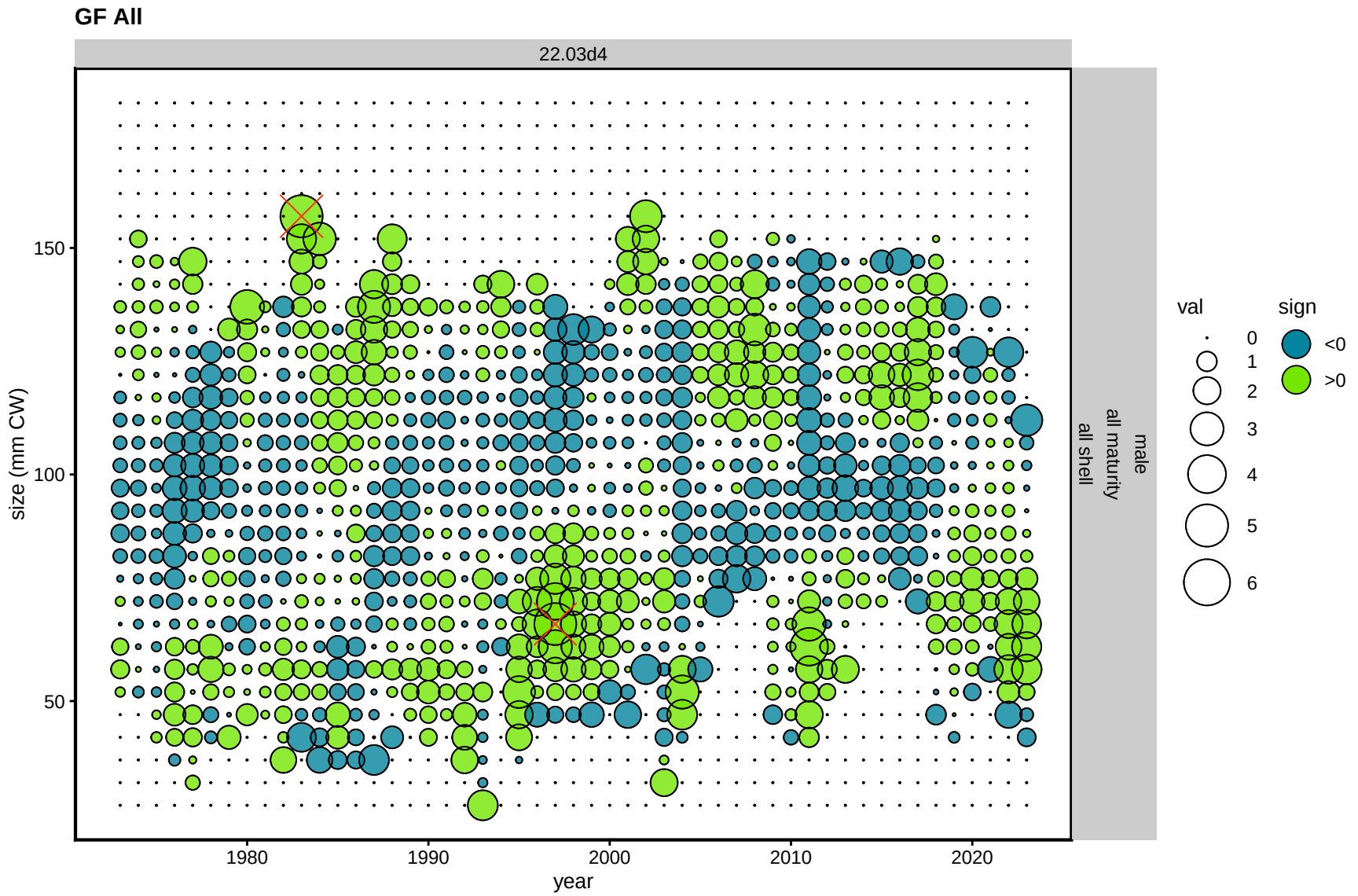

Figure 93. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

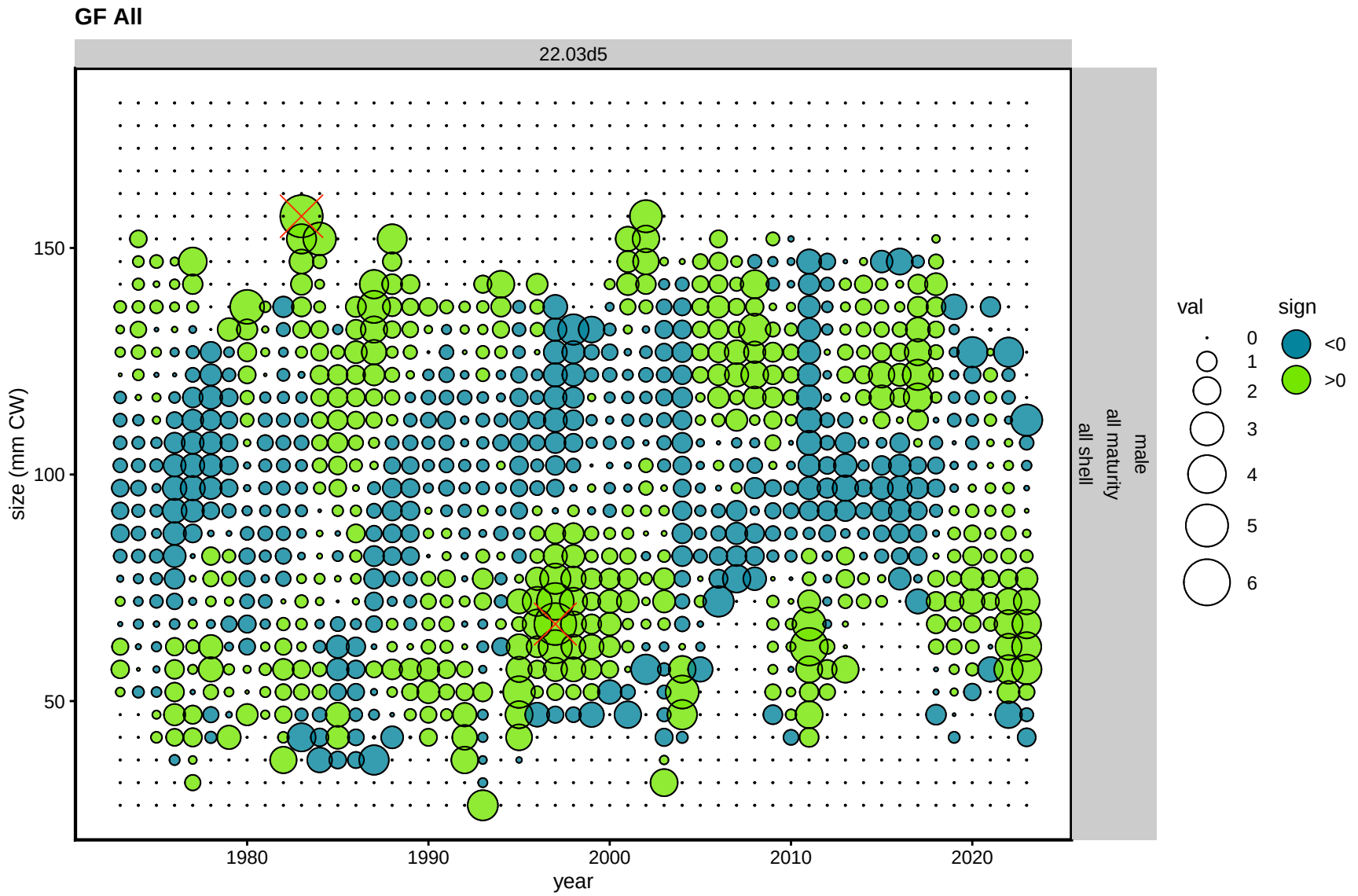

Figure 94. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

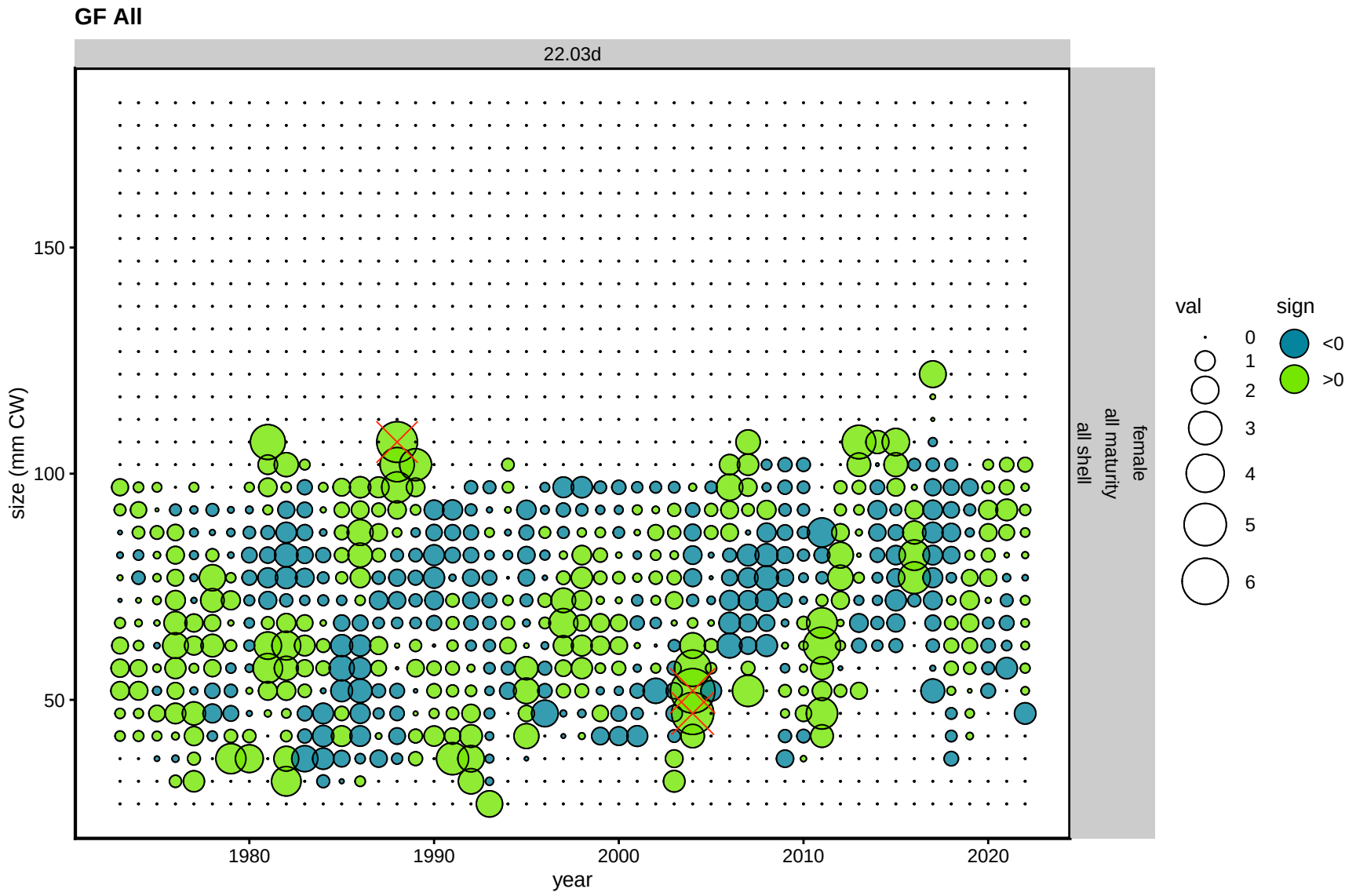

Figure 95. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

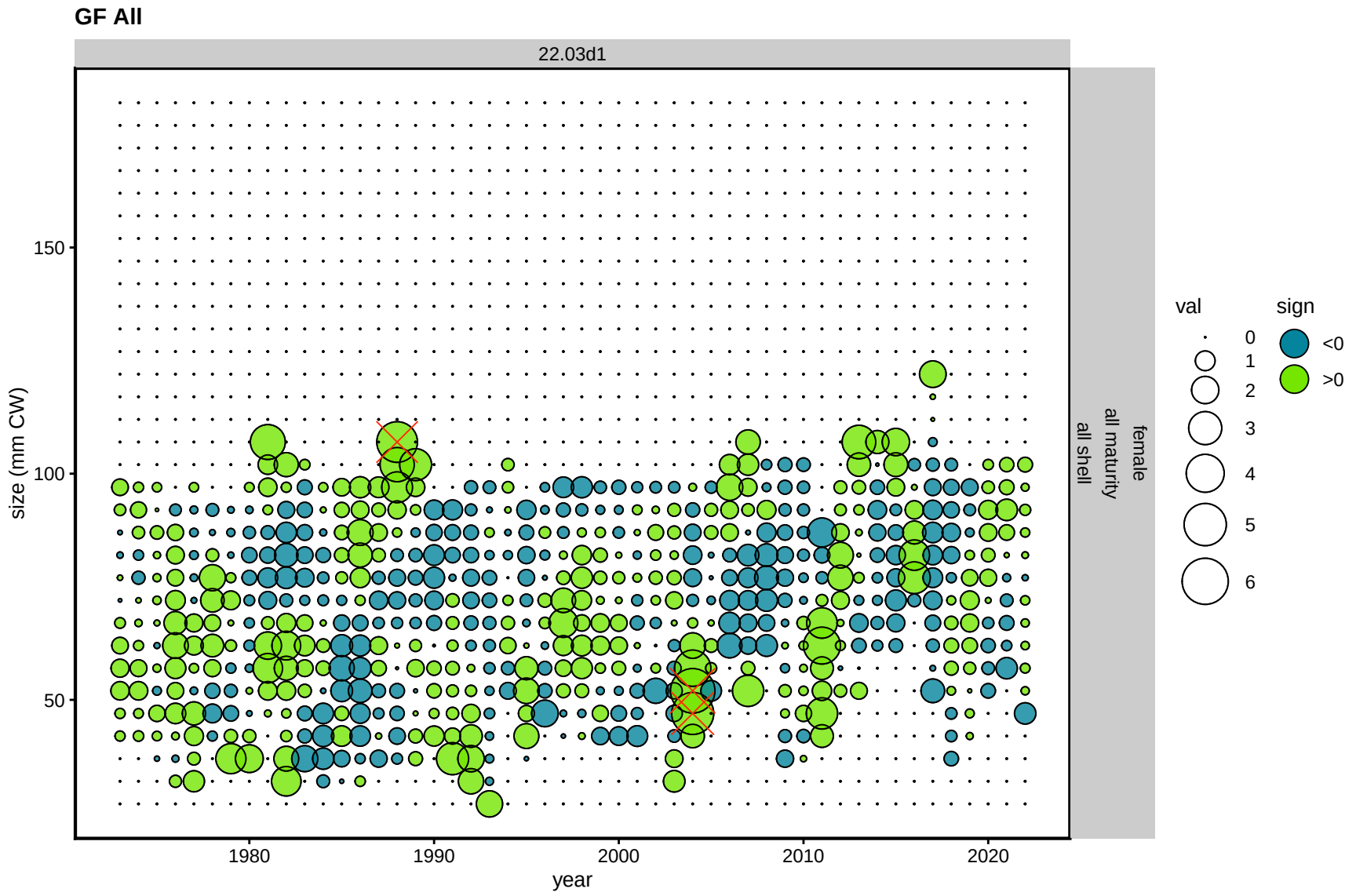

Figure 96. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

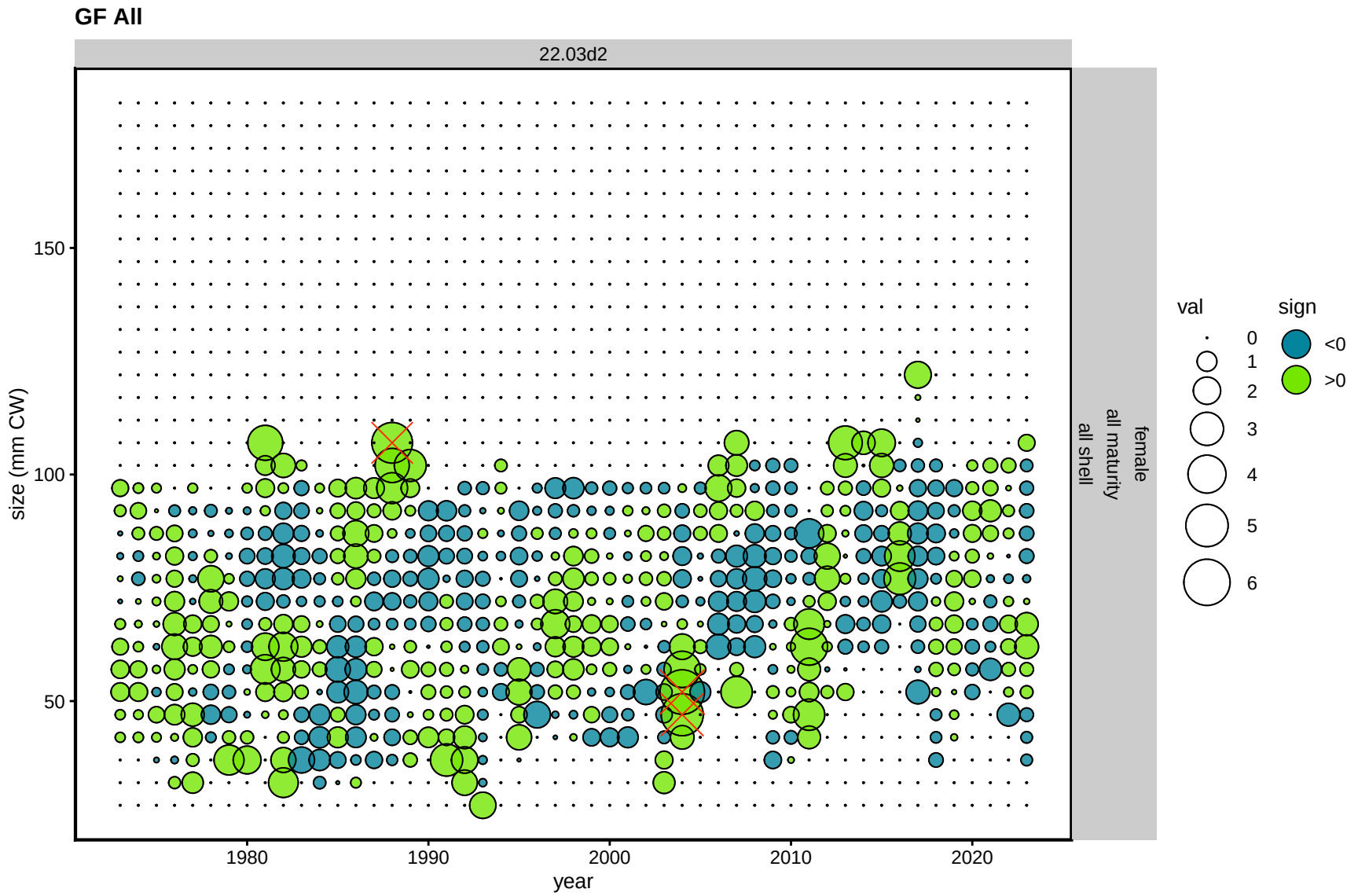

Figure 97. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

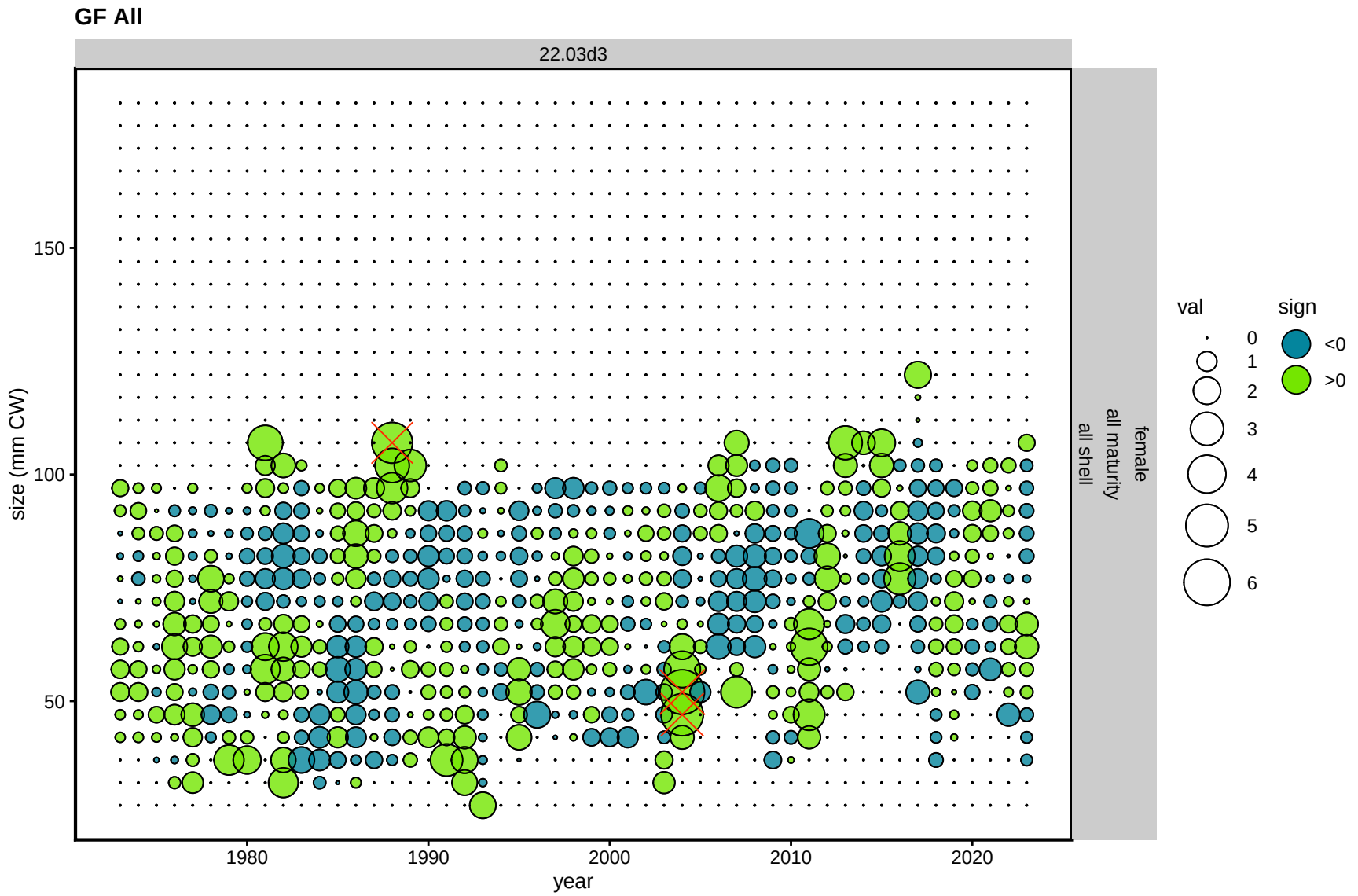

Figure 98. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

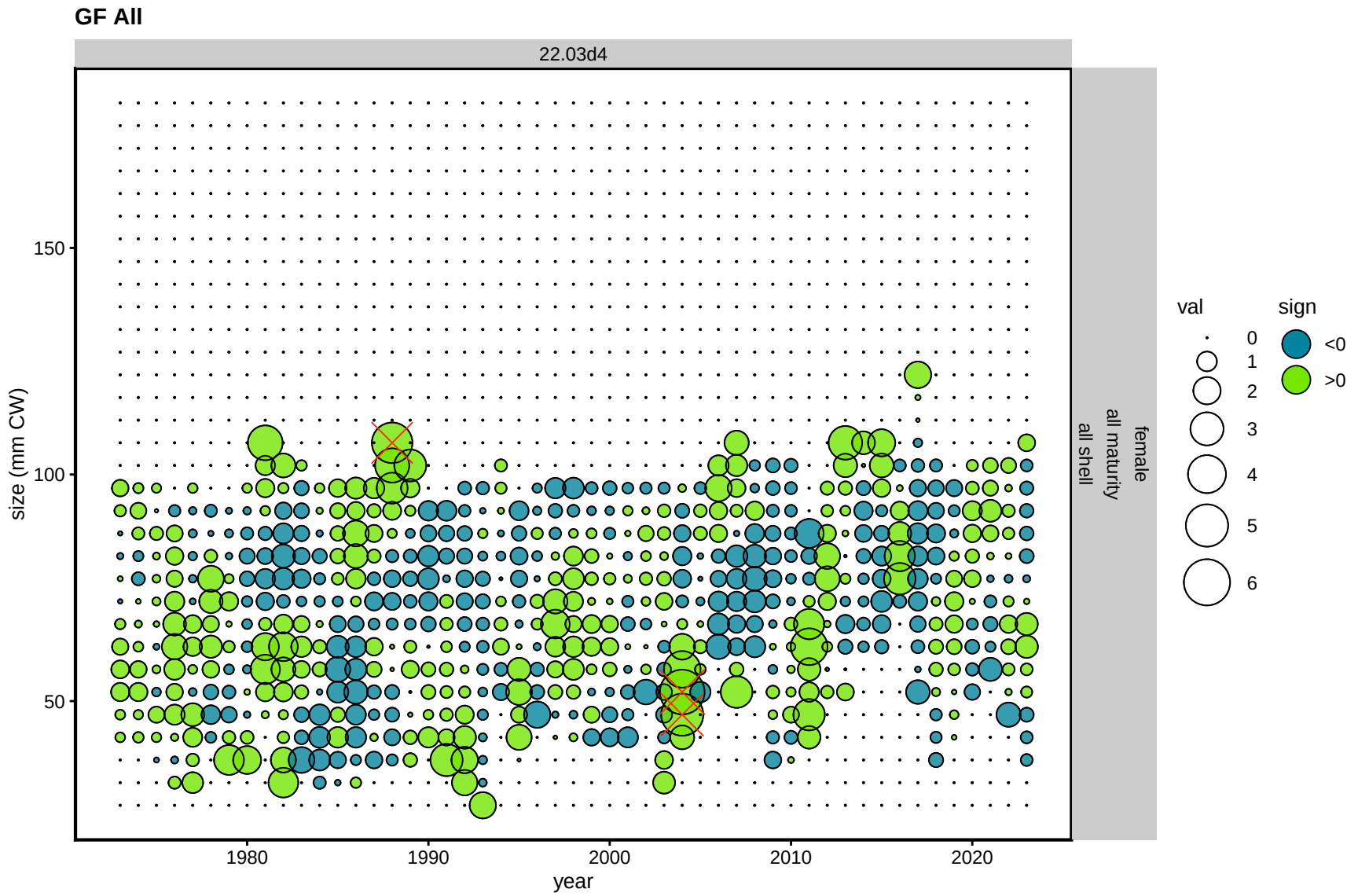

Figure 99. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

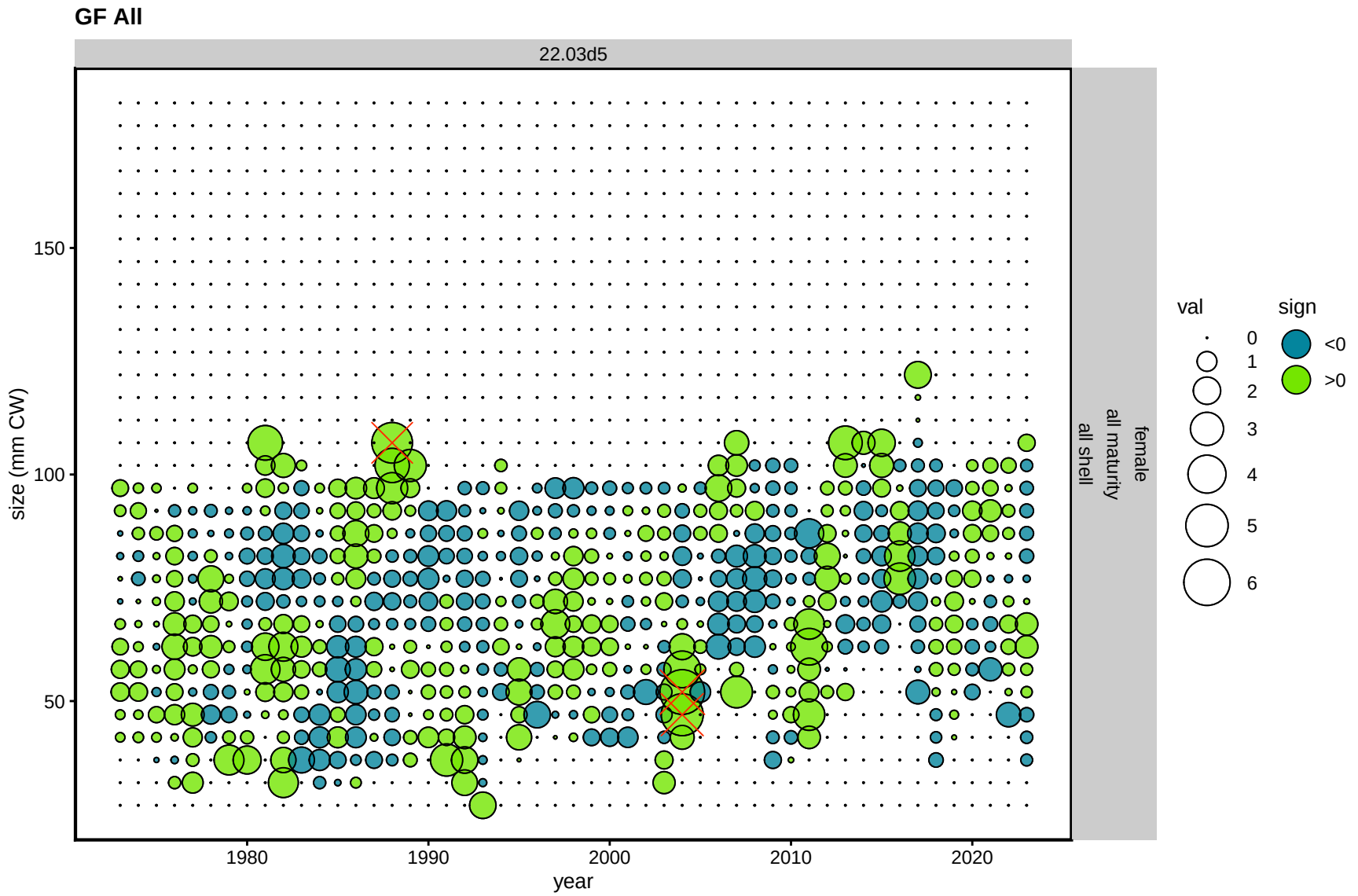

Figure 100. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

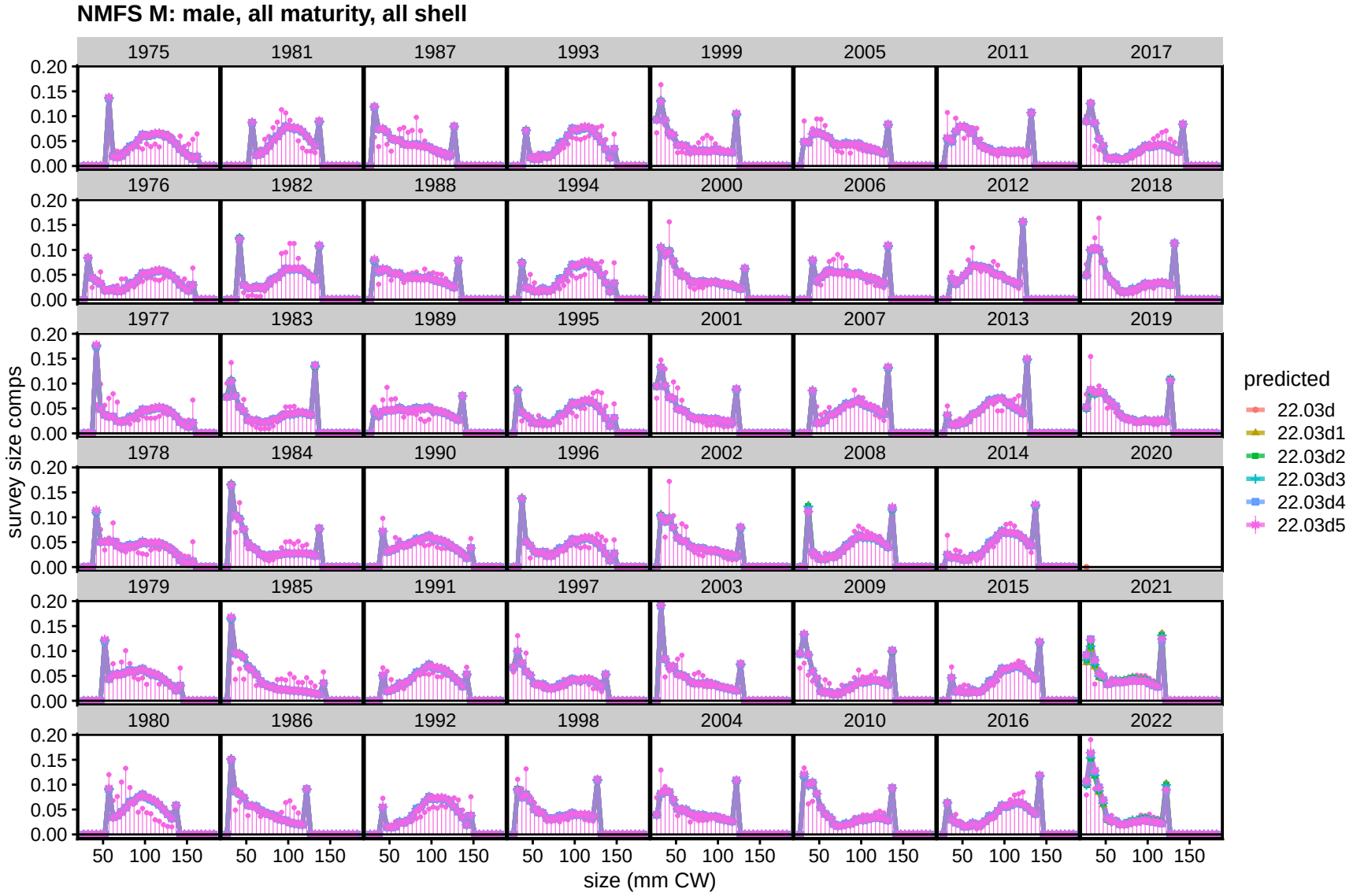

Figure 101. TCSAM02 models fits to survey size compositions in the NMFS M survey. Preferred model is 22.03d5.

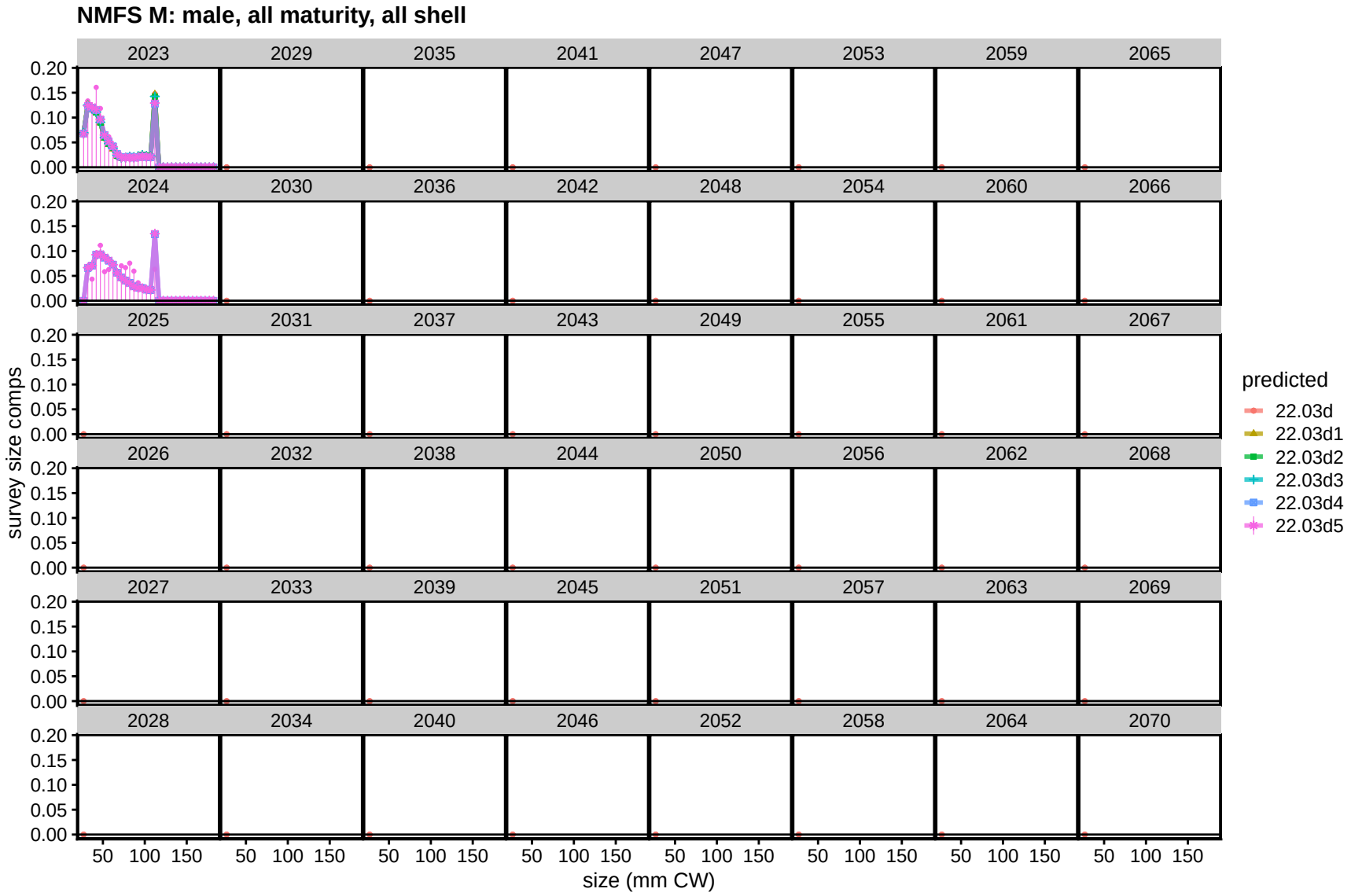

Figure 102. TCSAM02 models fits to survey size compositions in the NMFS M survey. Preferred model is 22.03d5.

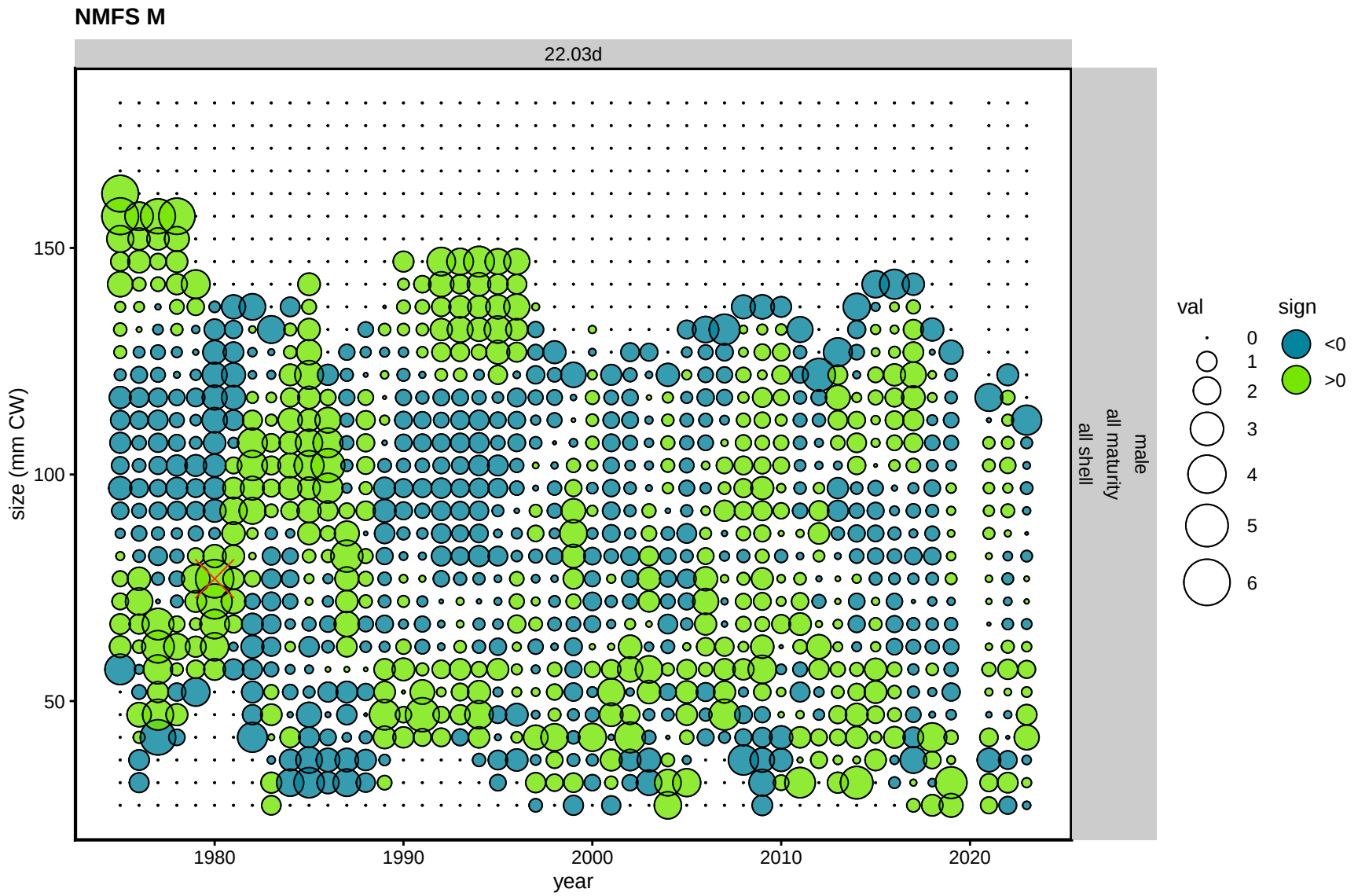

Figure 103. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

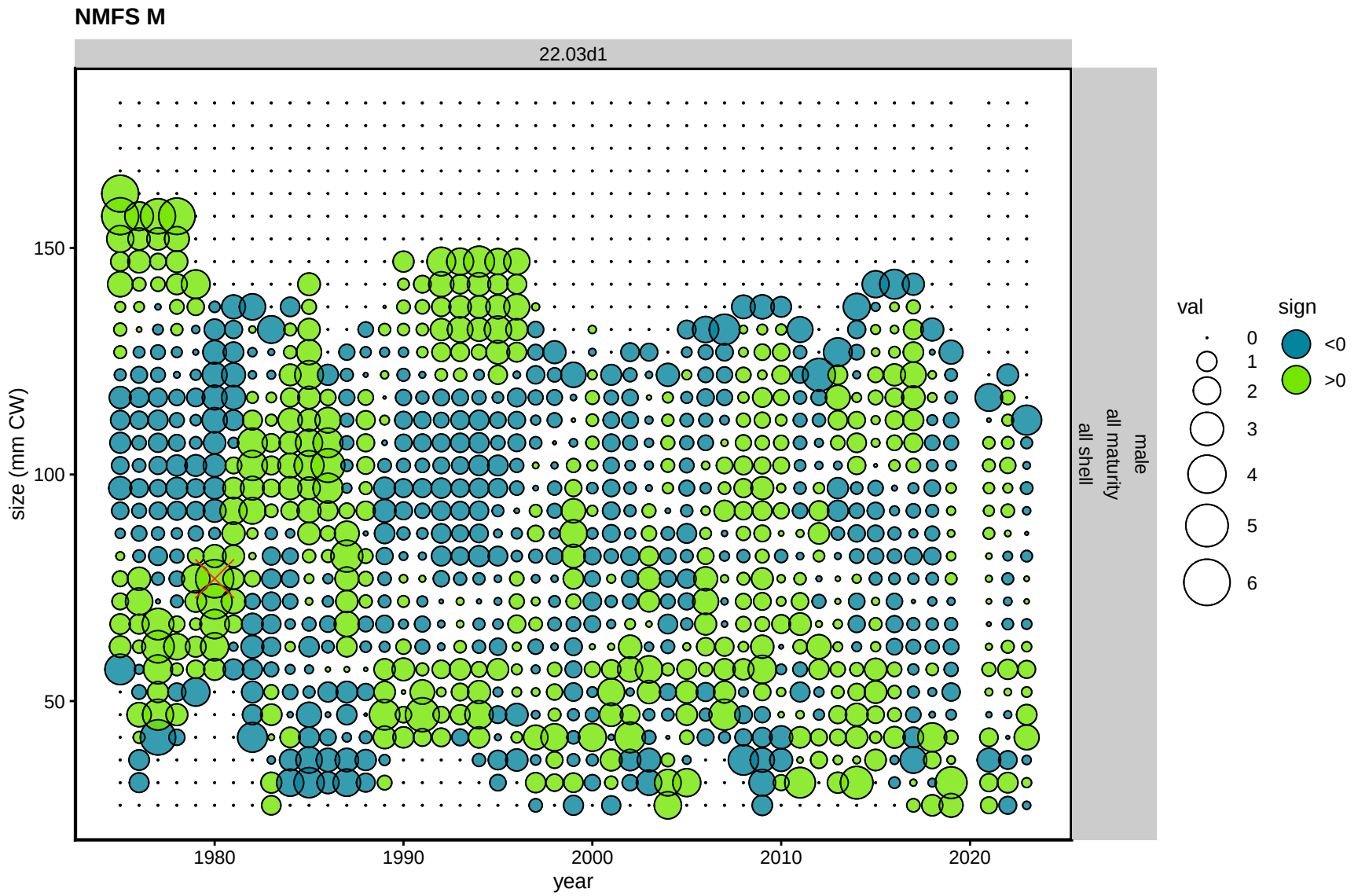

Figure 104. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

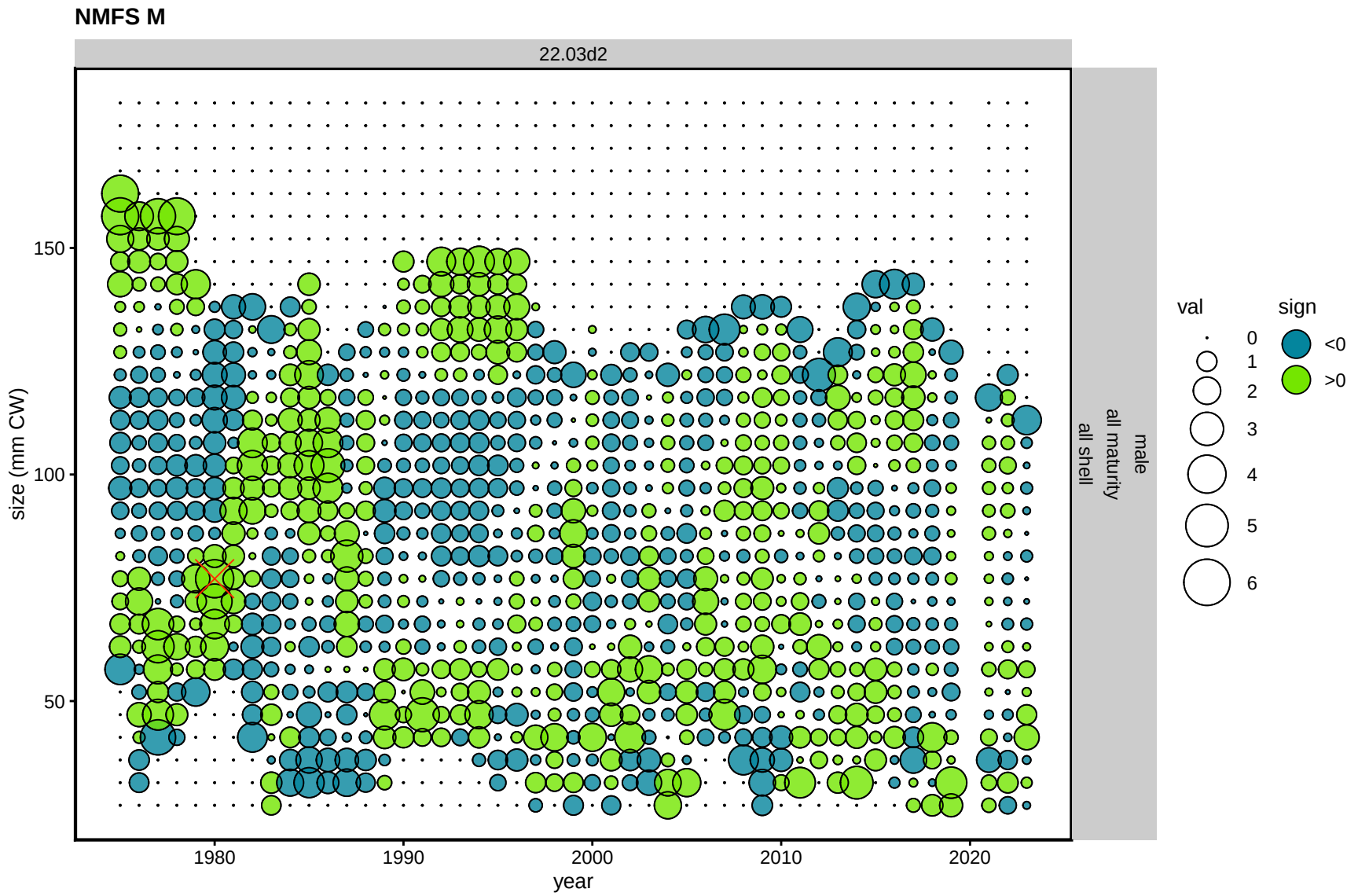

Figure 105. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

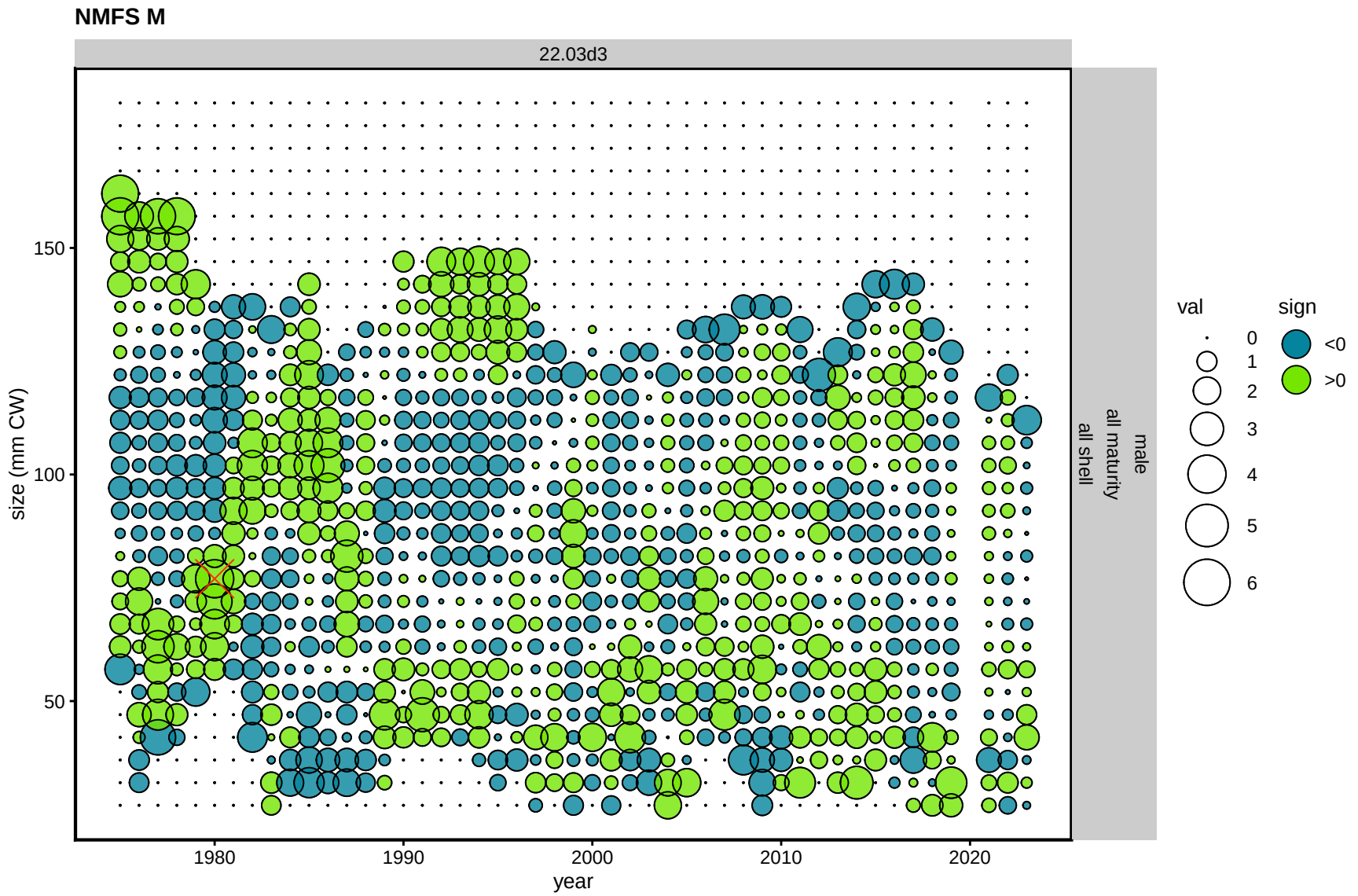

Figure 106. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

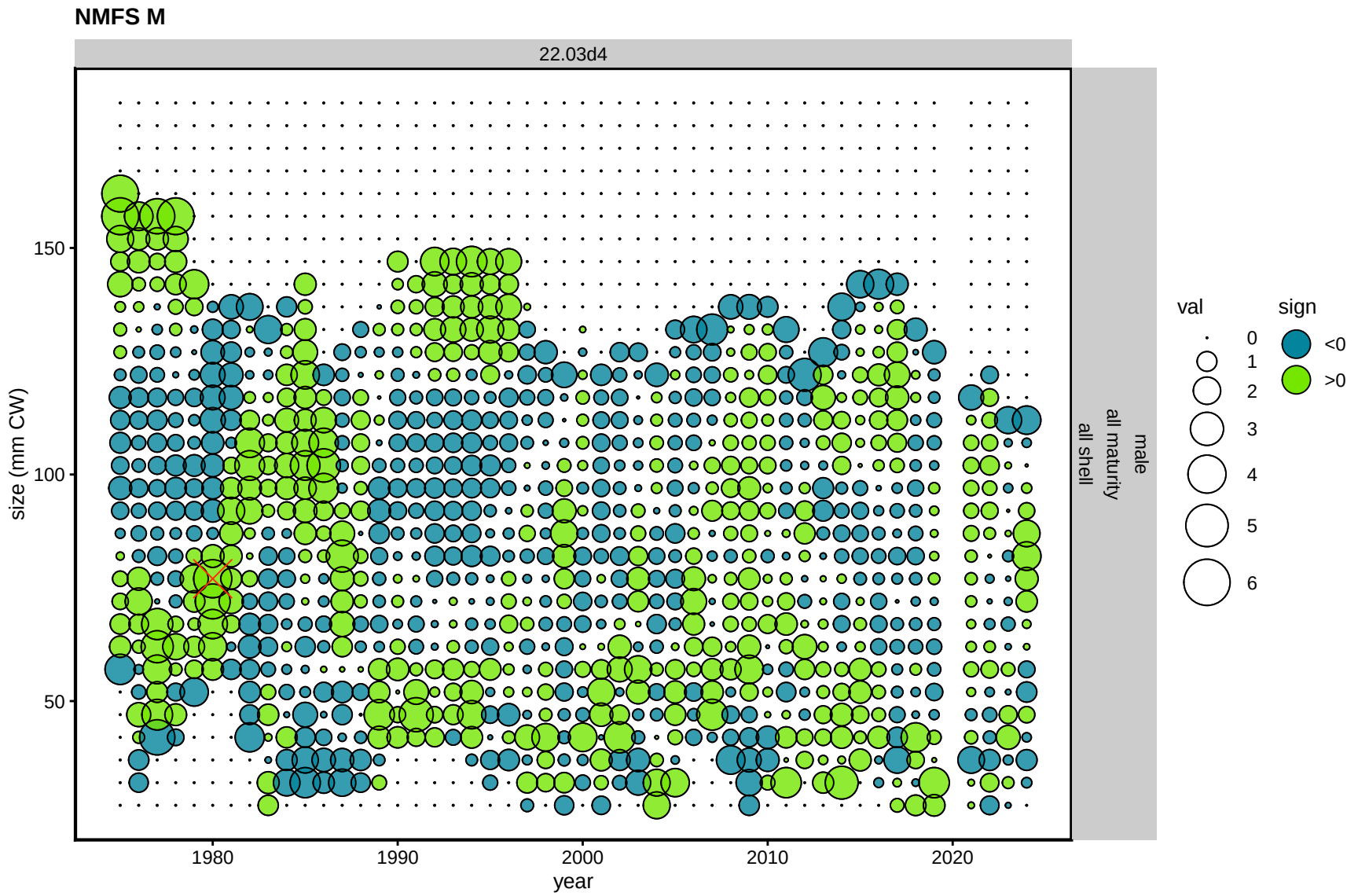

Figure 107. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

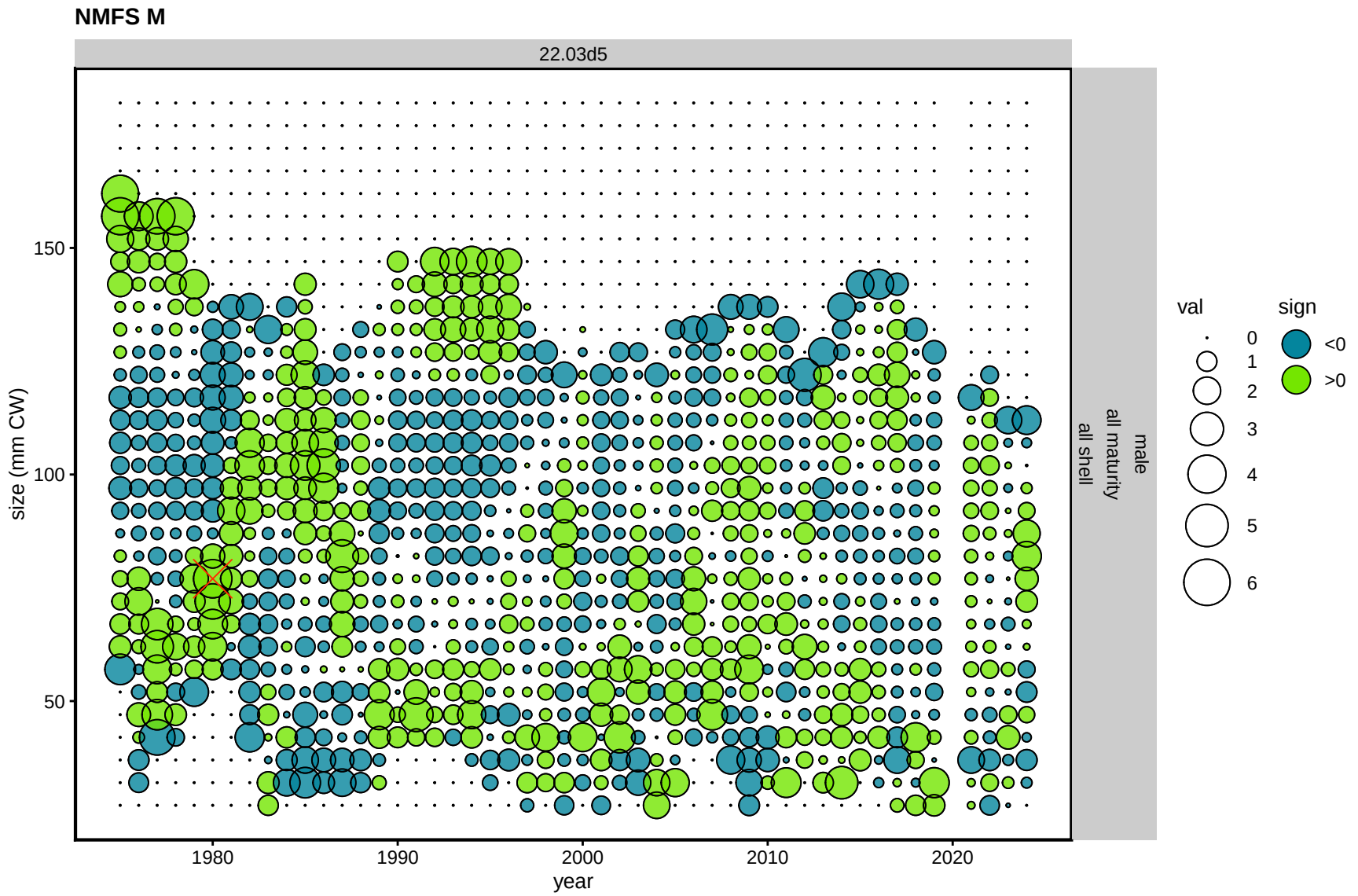

Figure 108. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

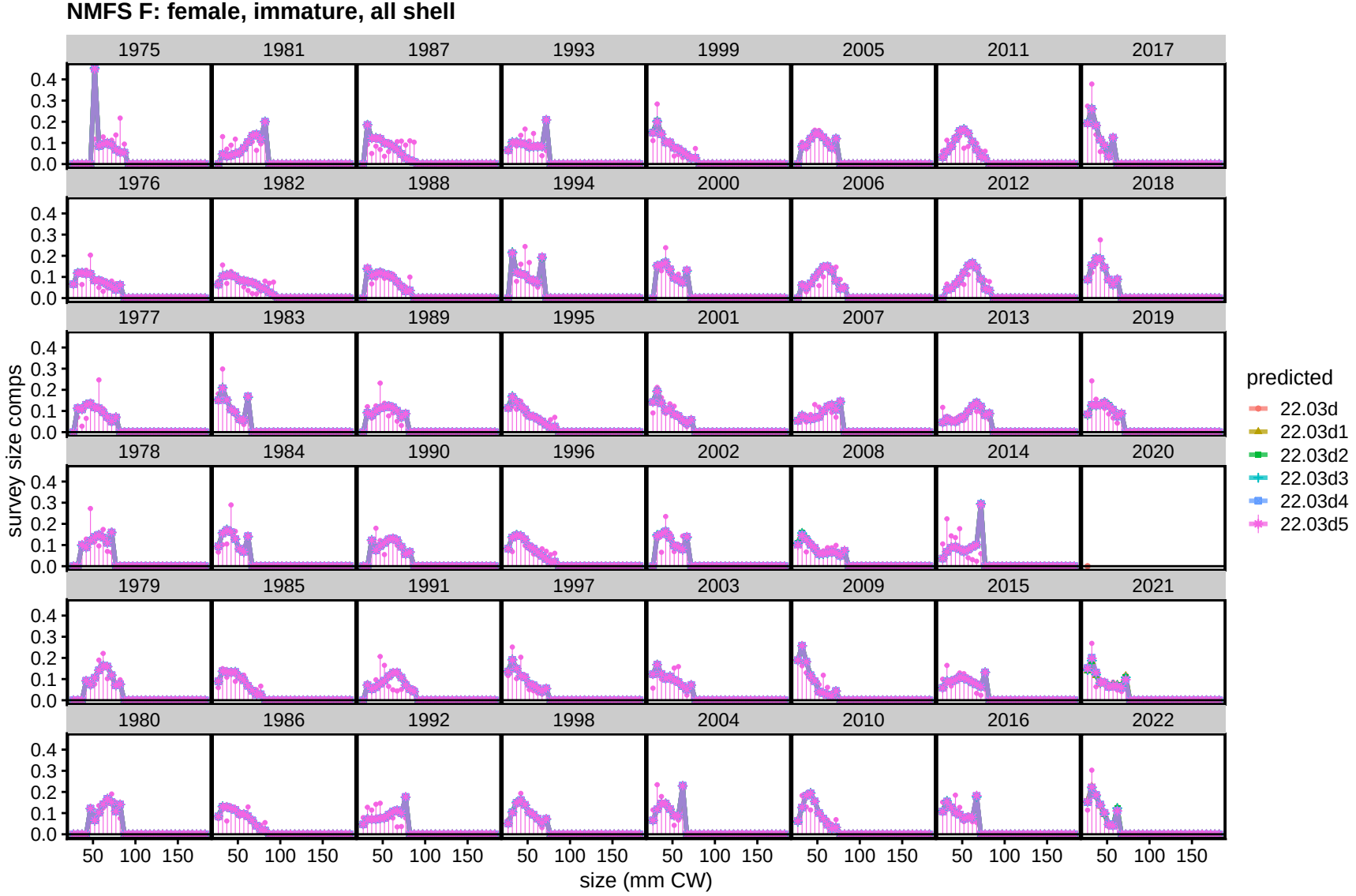

Figure 109. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is 22.03d5.

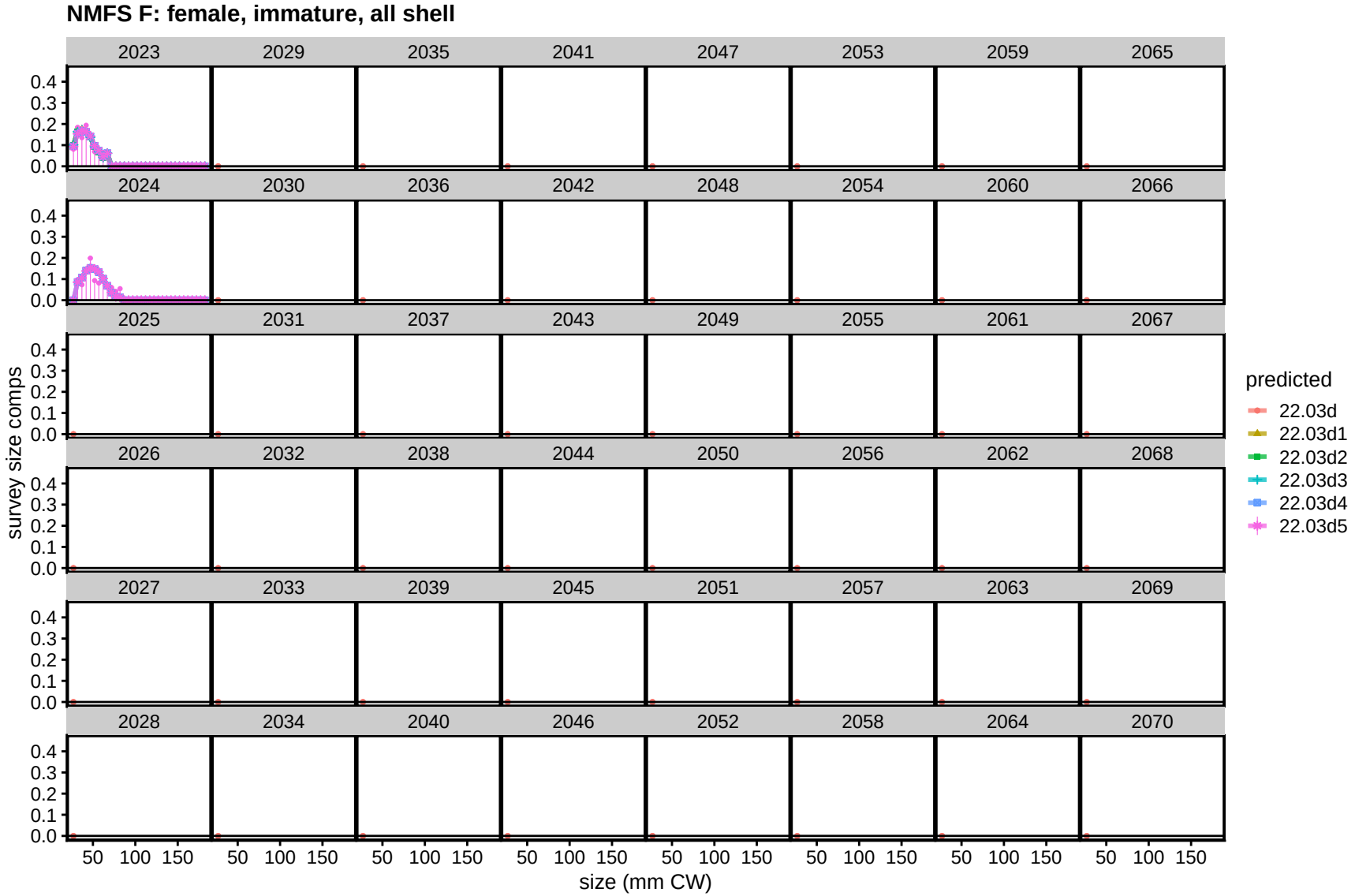

Figure 110. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is 22.03d5.

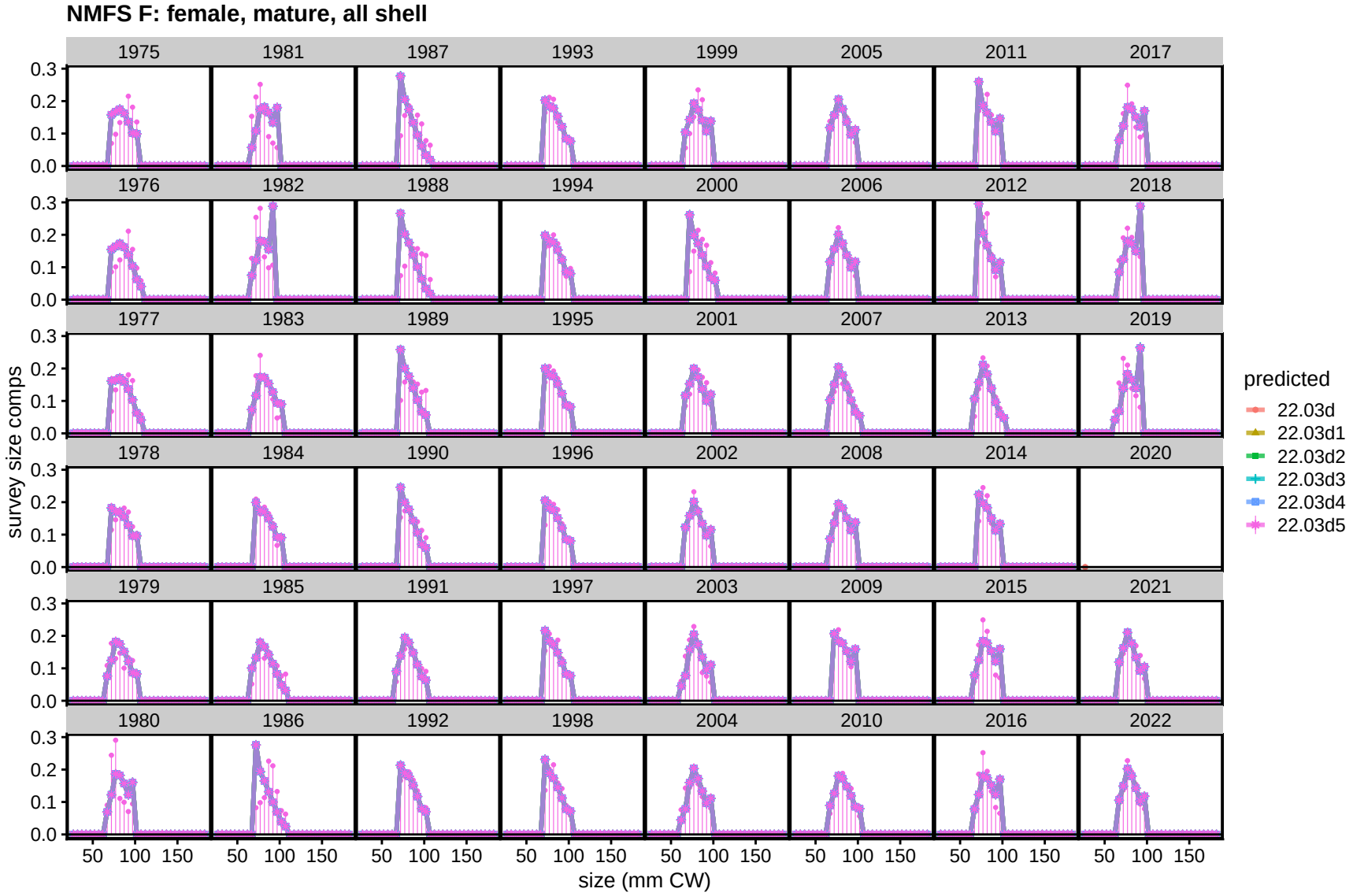

Figure 111. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is 22.03d5.

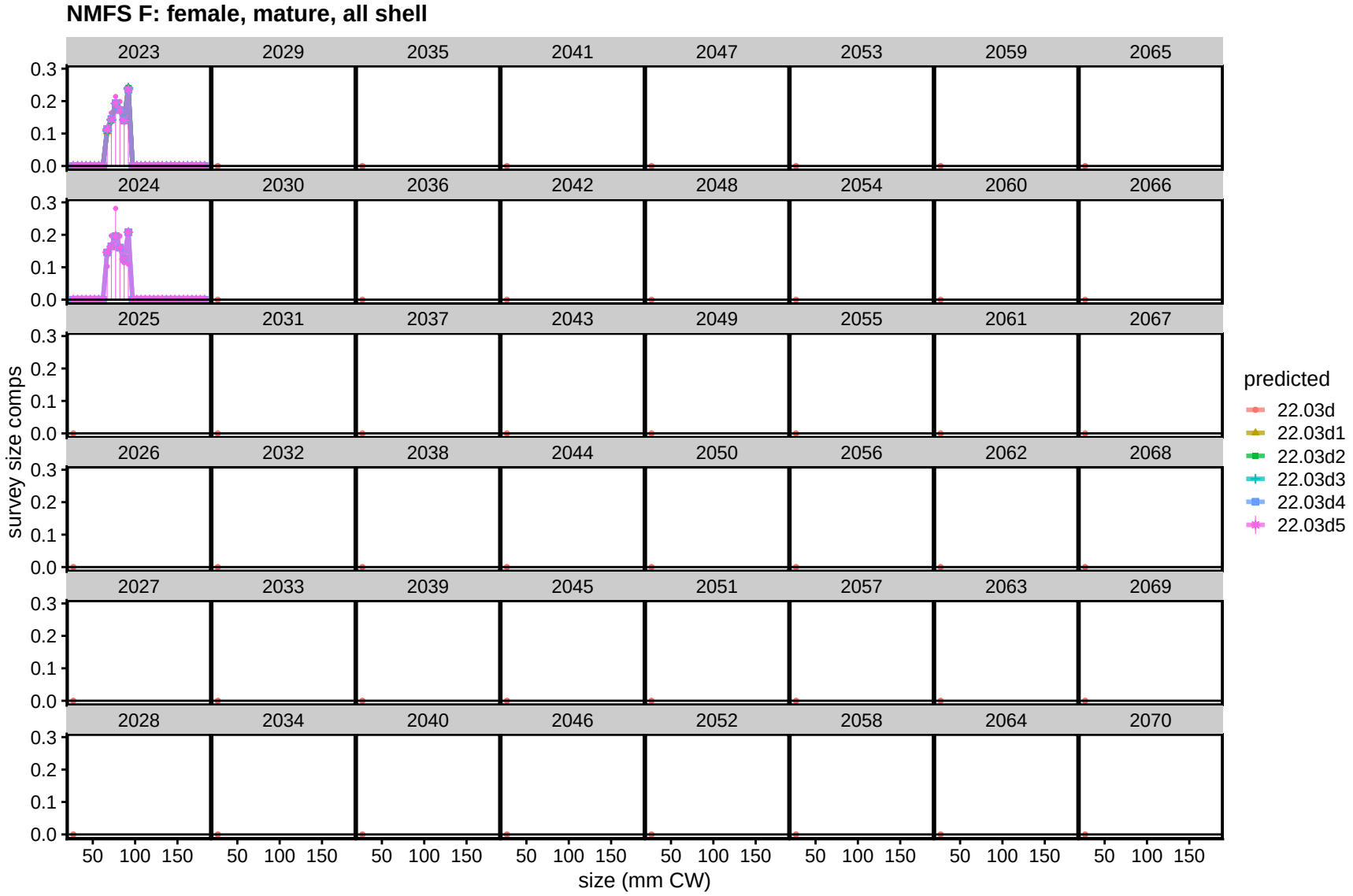

Figure 112. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is 22.03d5.

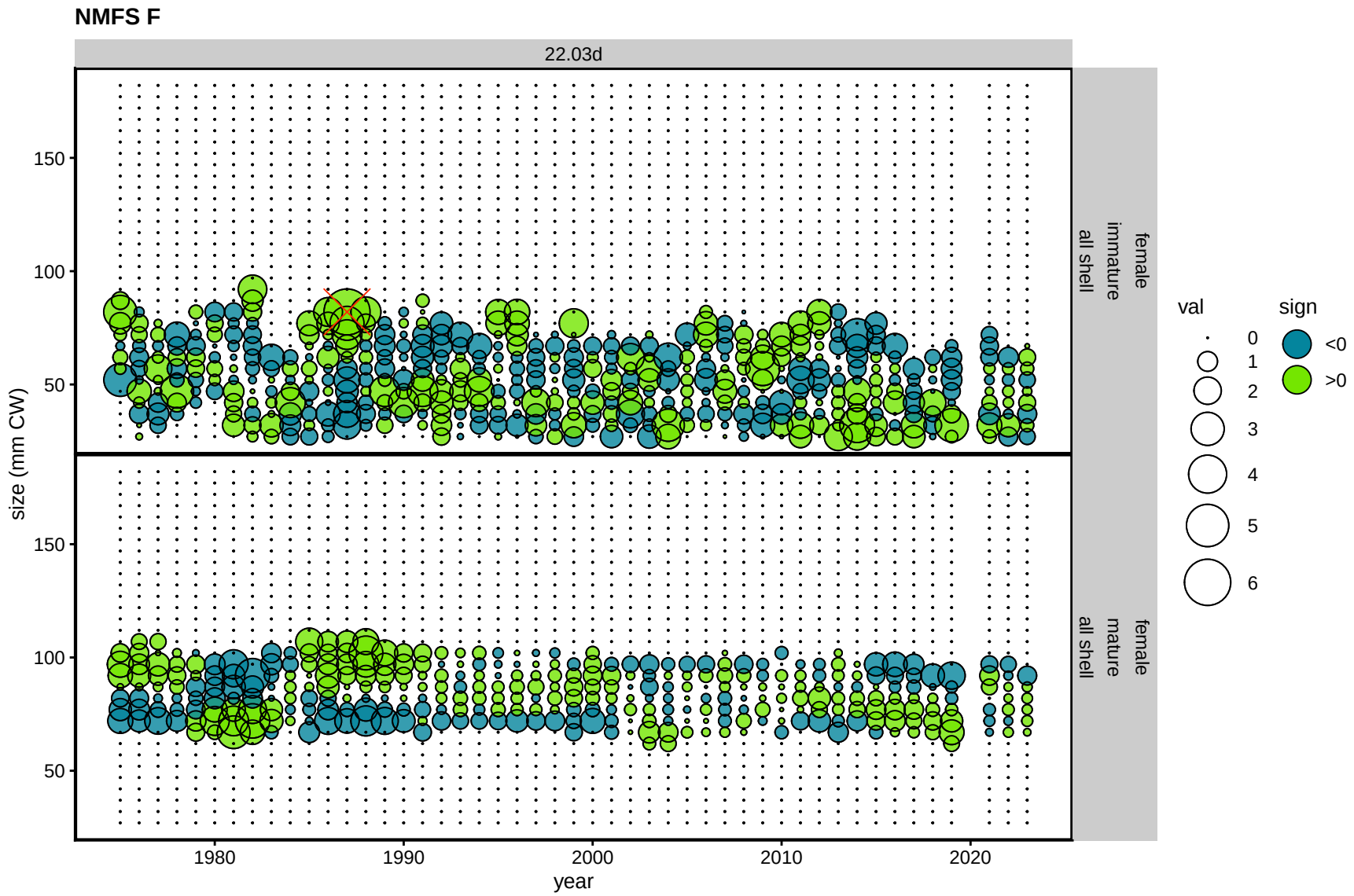

Figure 113. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

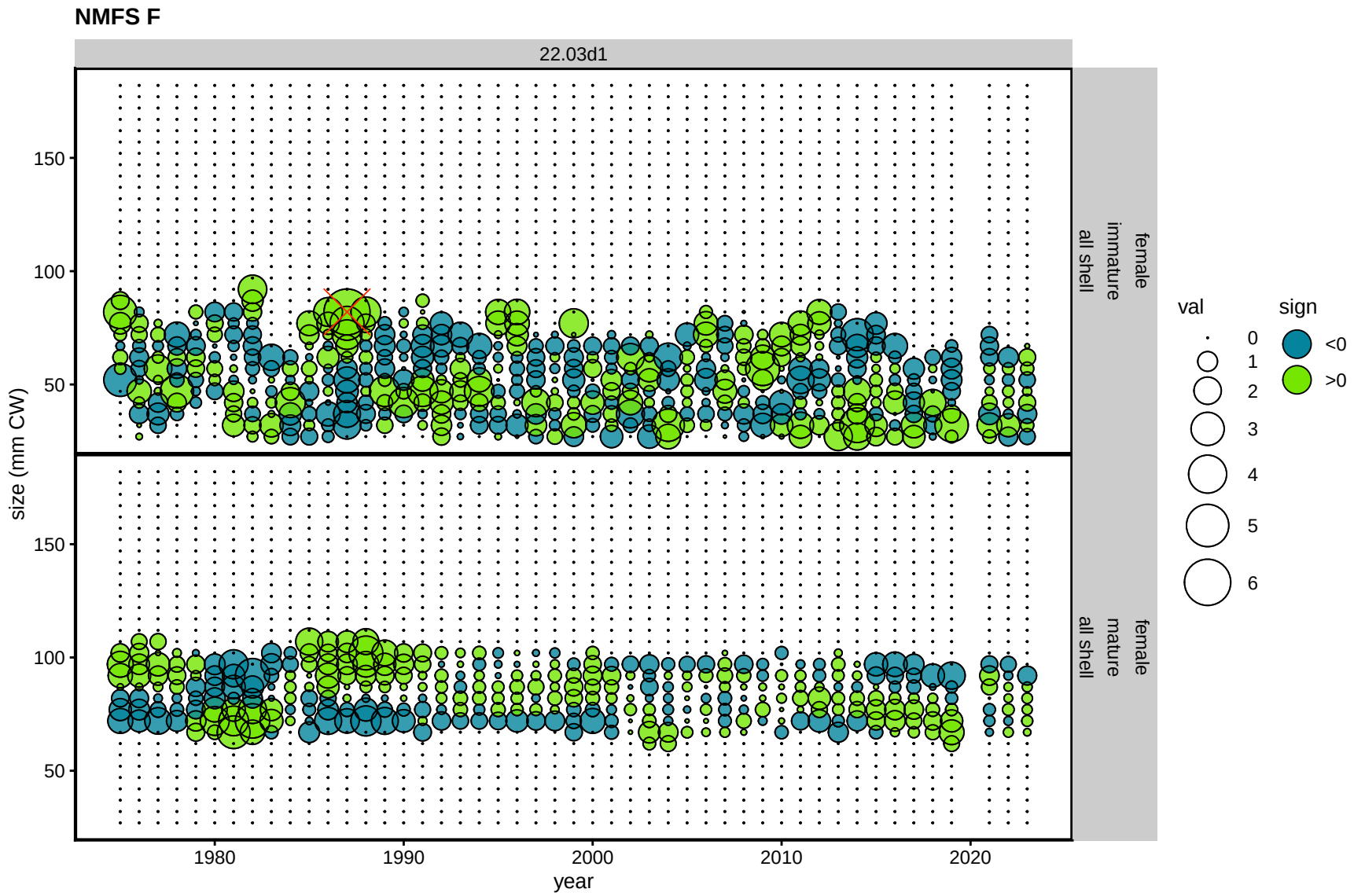

Figure 114. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

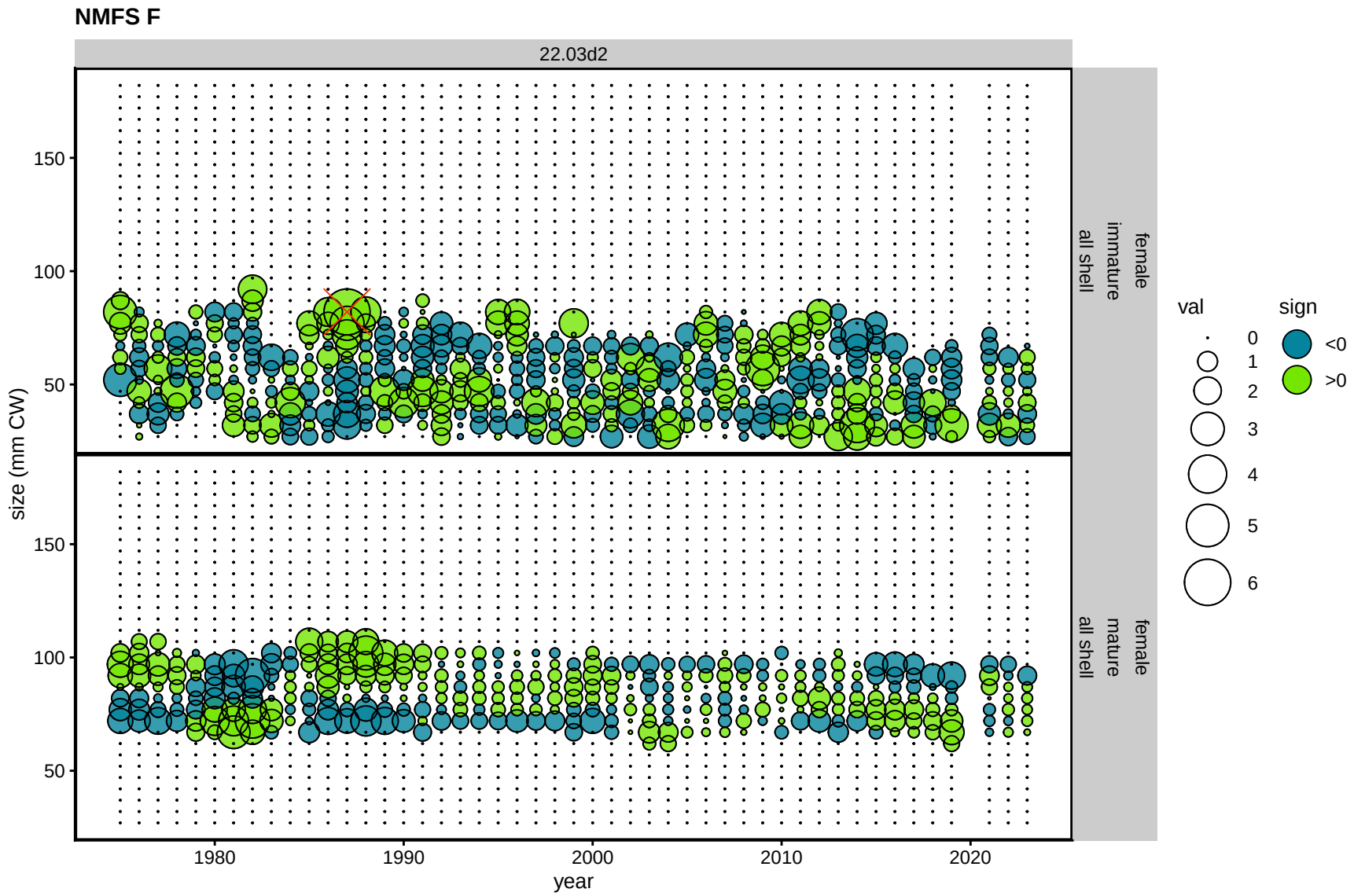

Figure 115. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

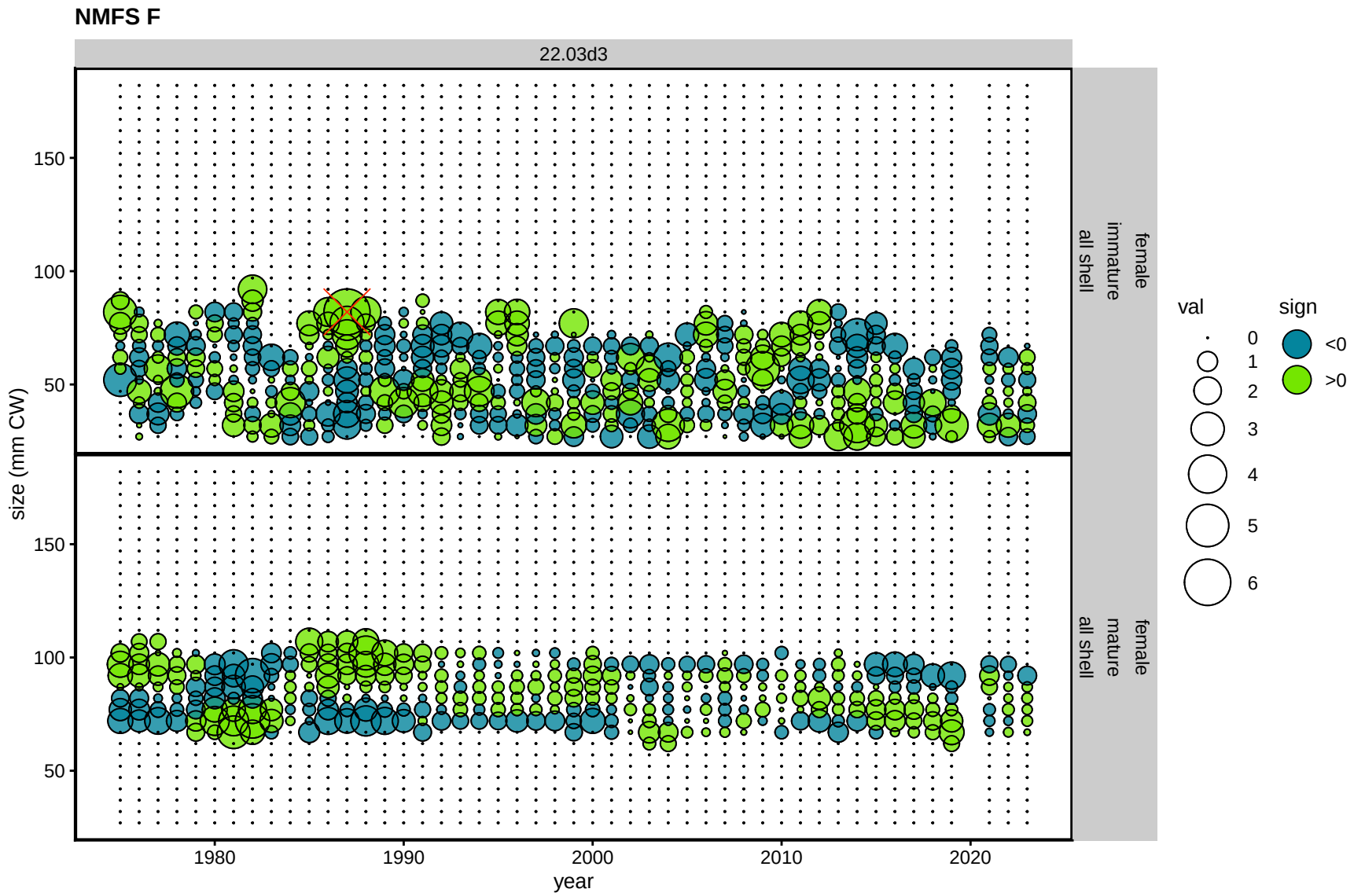

Figure 116. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

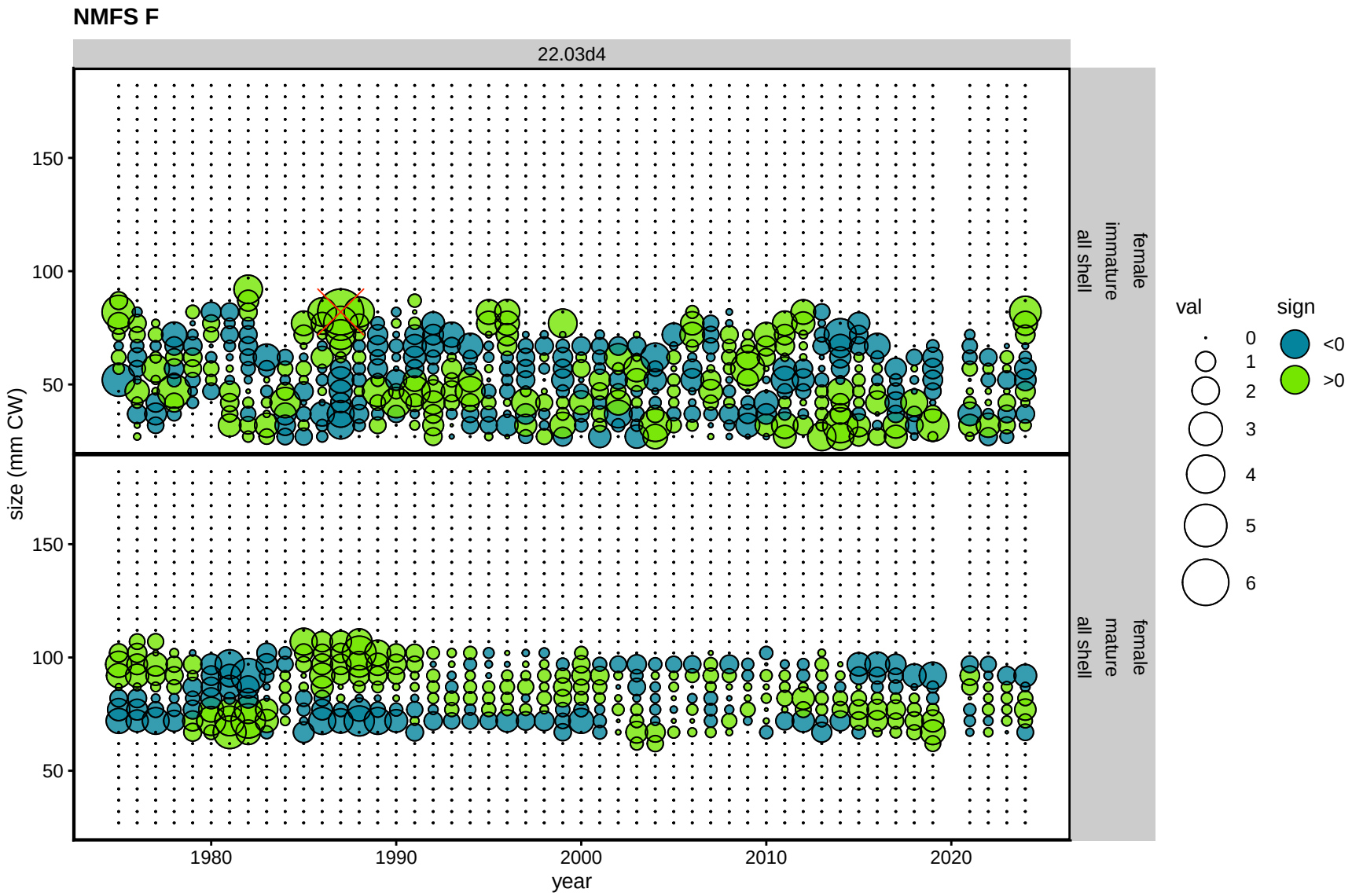

Figure 117. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

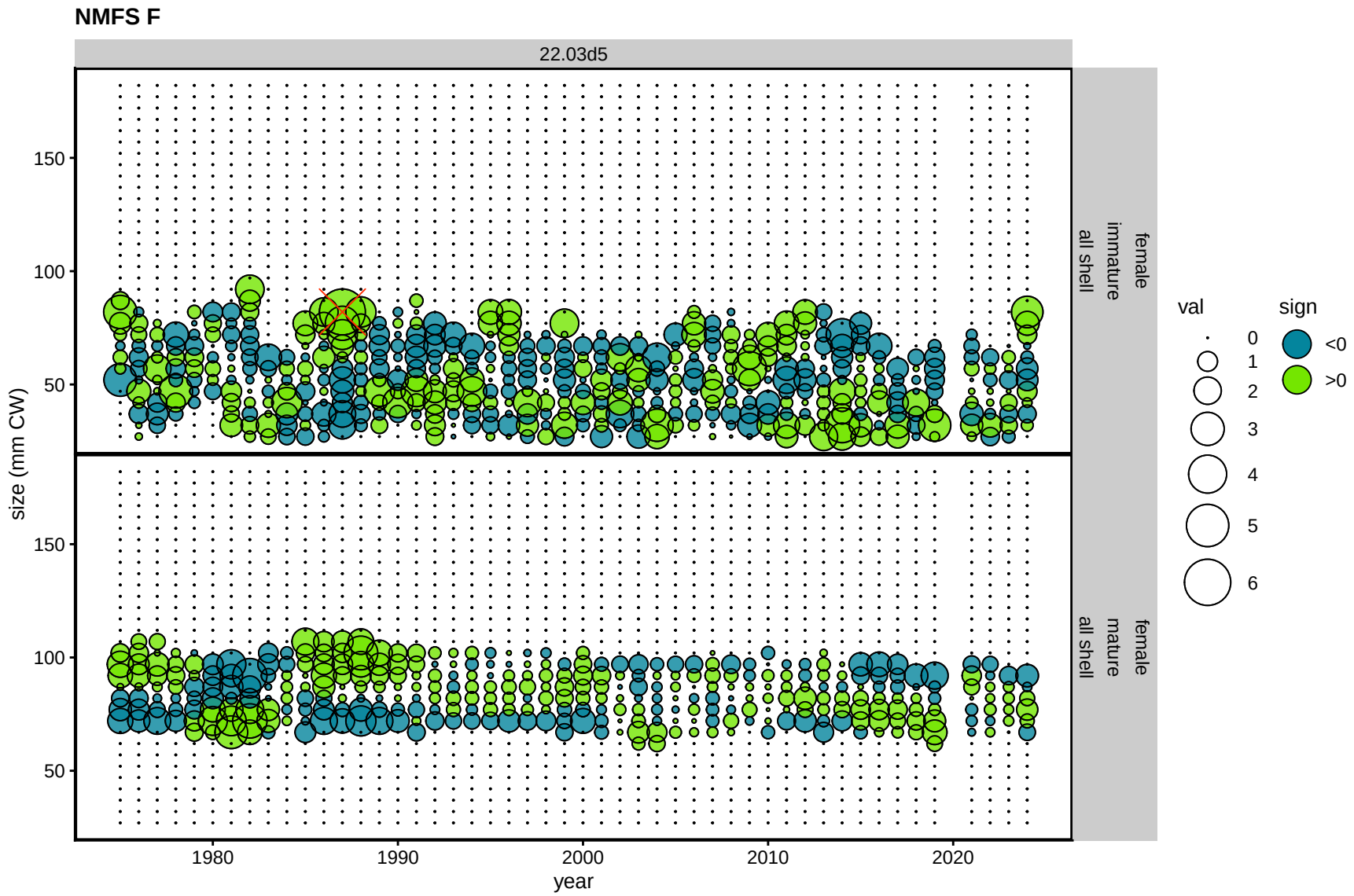

Figure 118. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

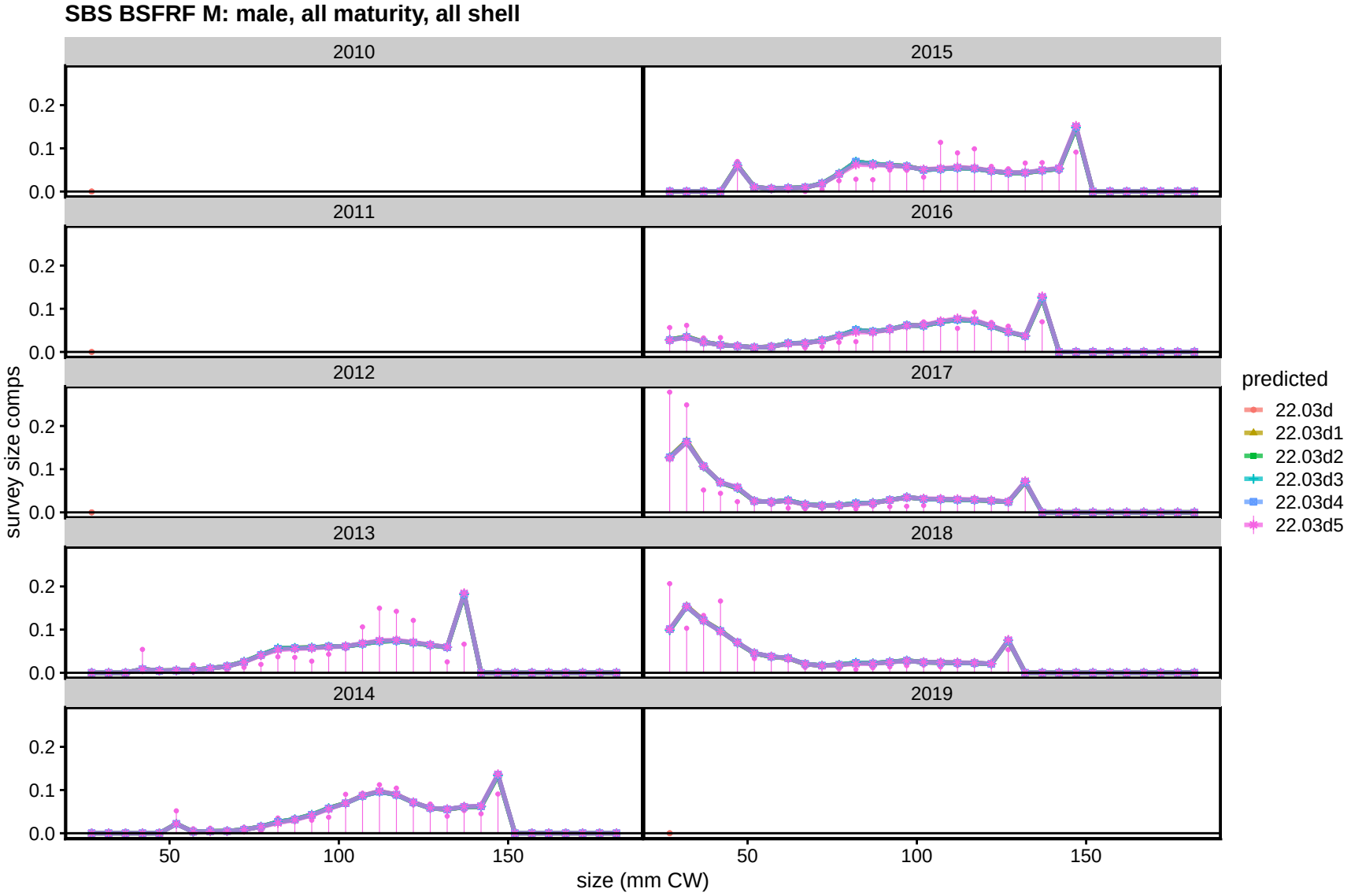

Figure 119. TCSAM02 model fits to survey size compositions in the SBS BSFRF M survey. Preferred model is 22.03d5.

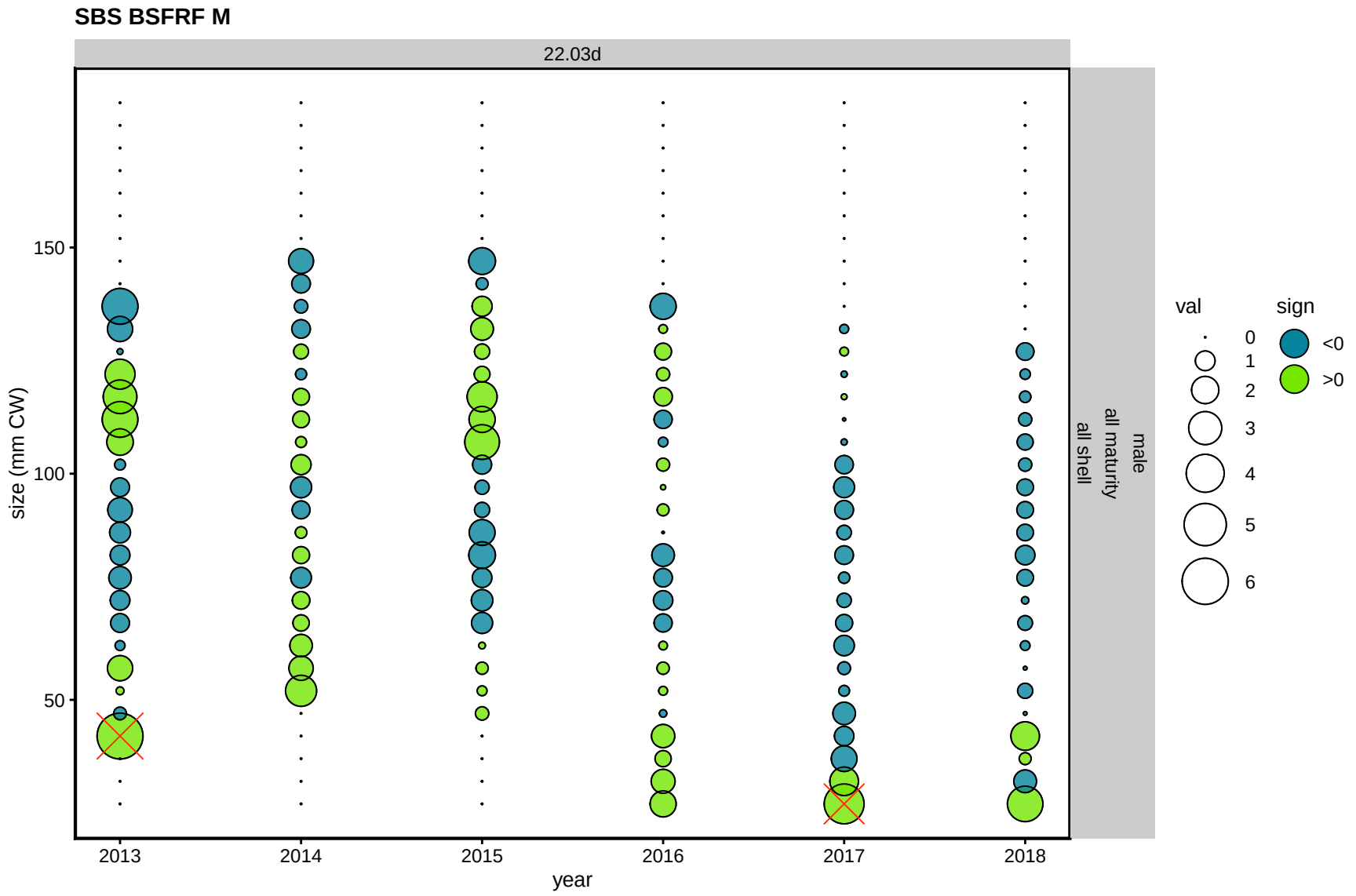

Figure 120. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

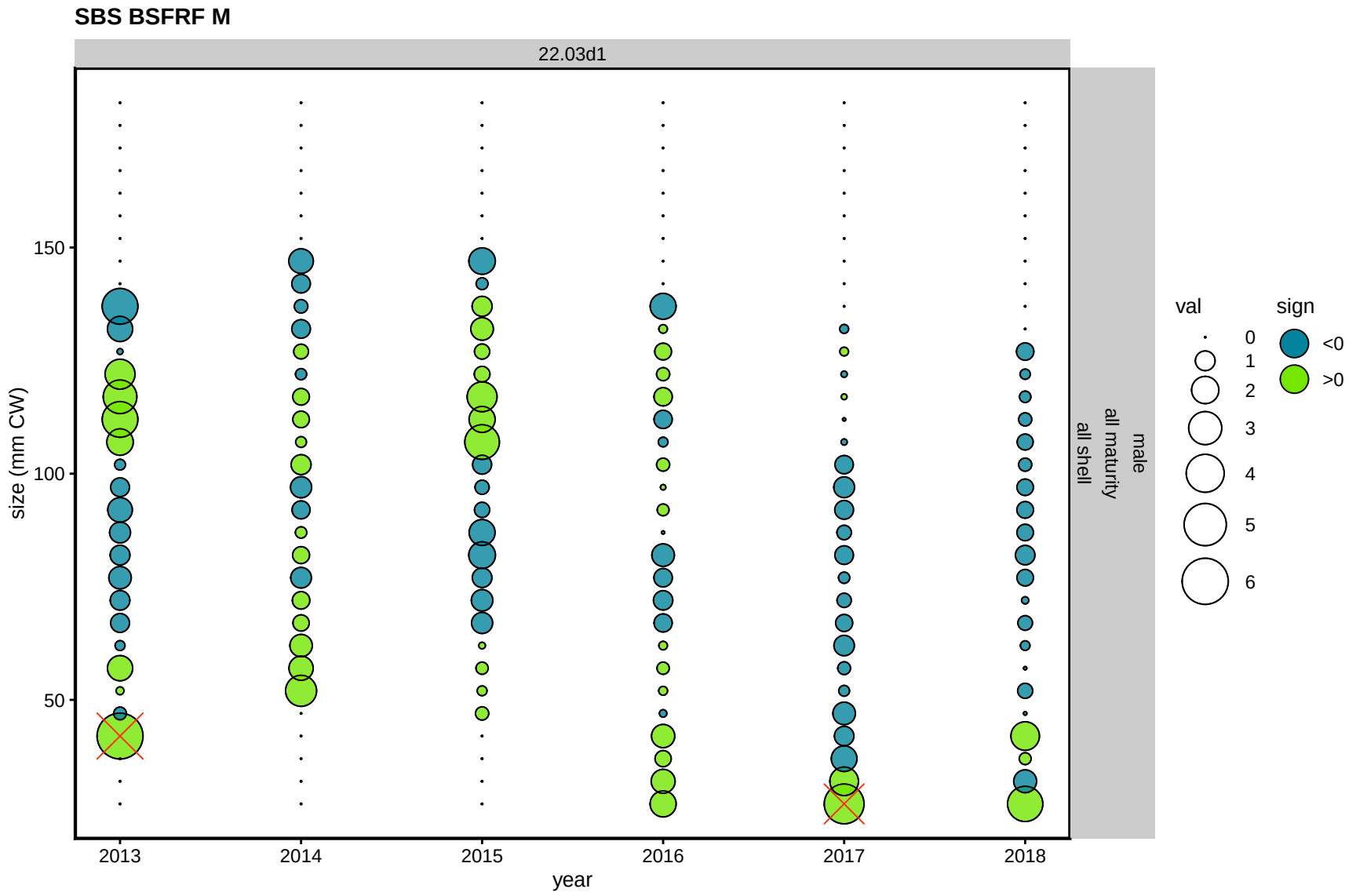

Figure 121. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

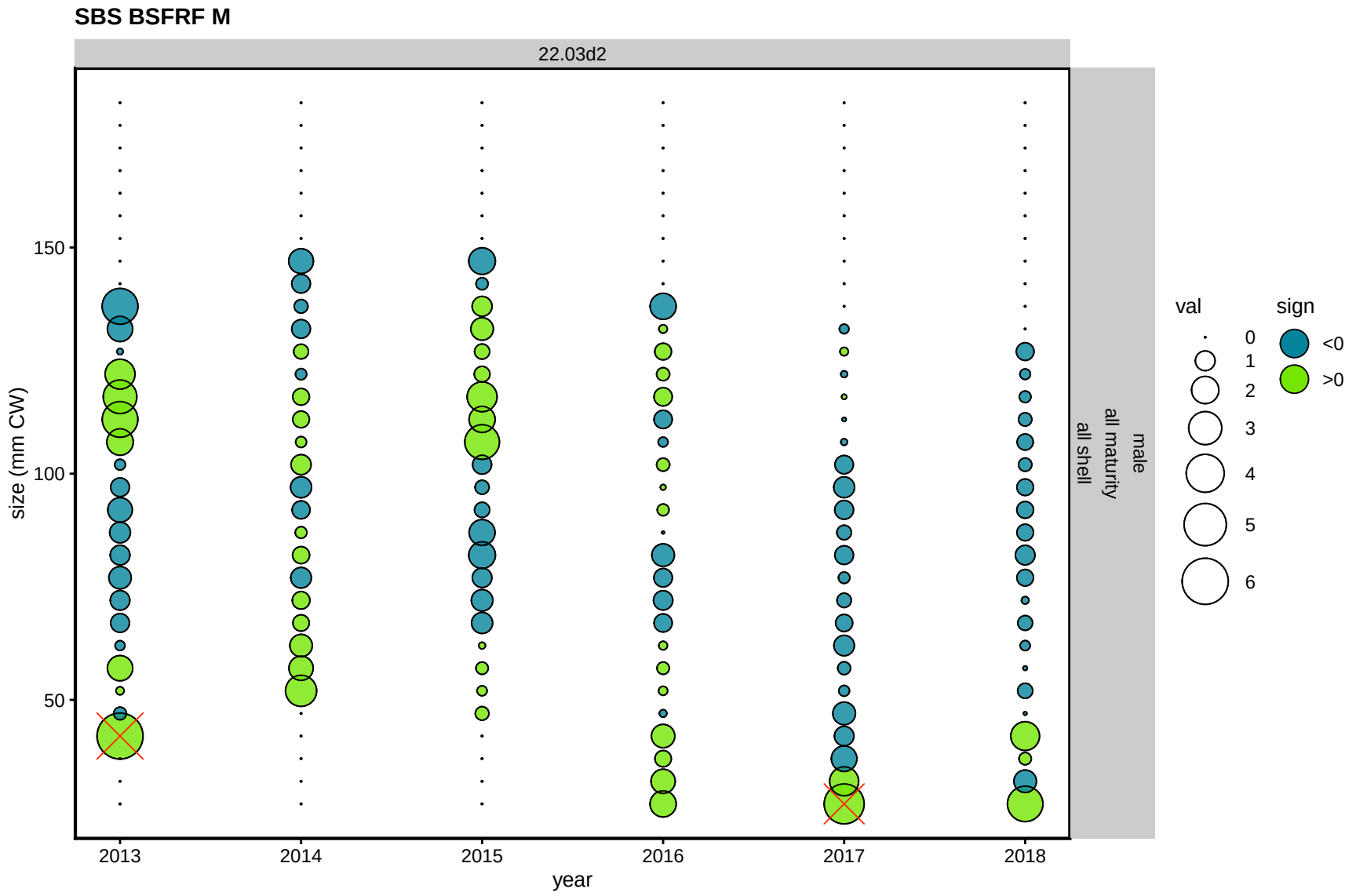

Figure 122. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

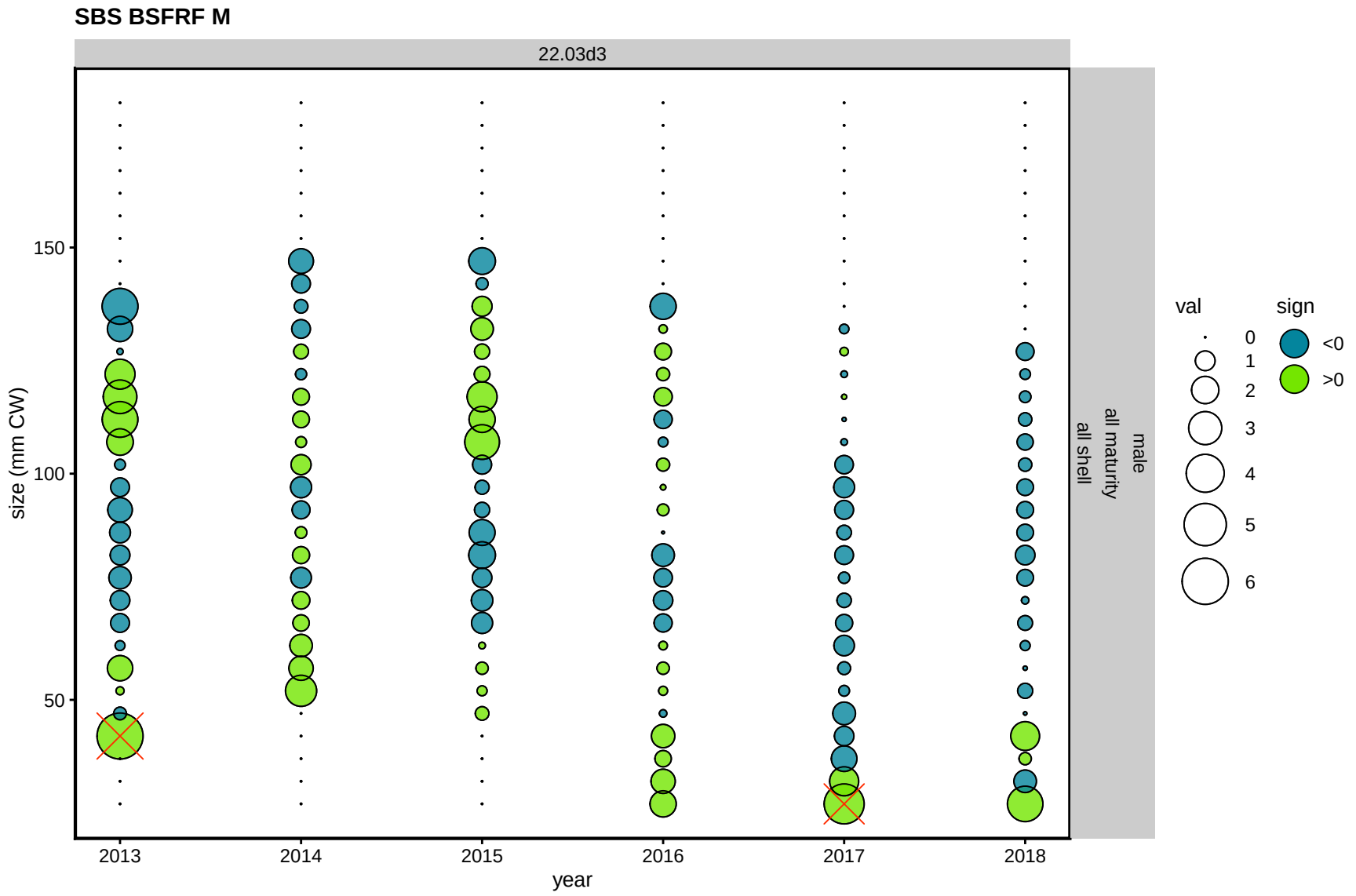

Figure 123. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

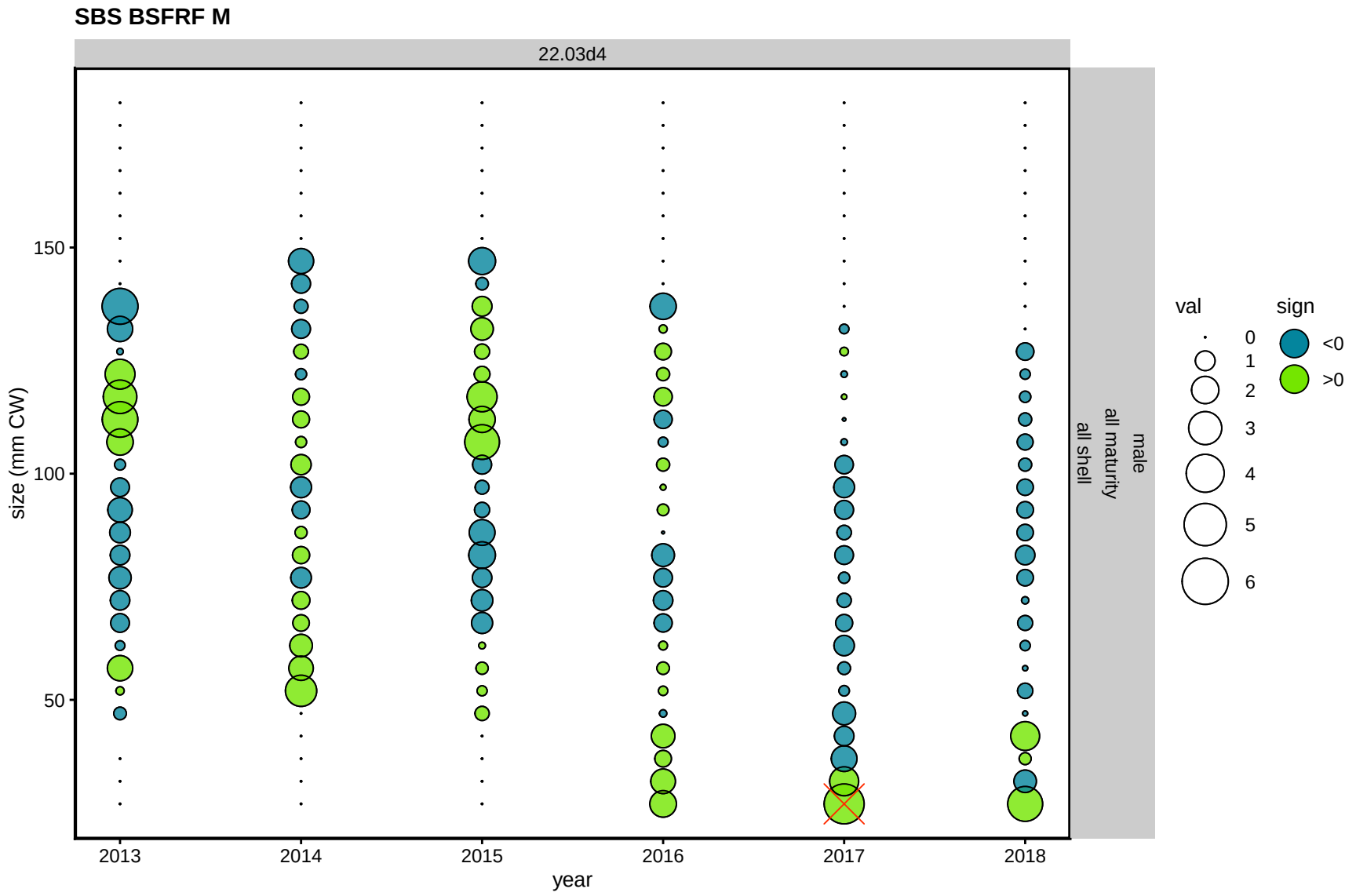

Figure 124. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

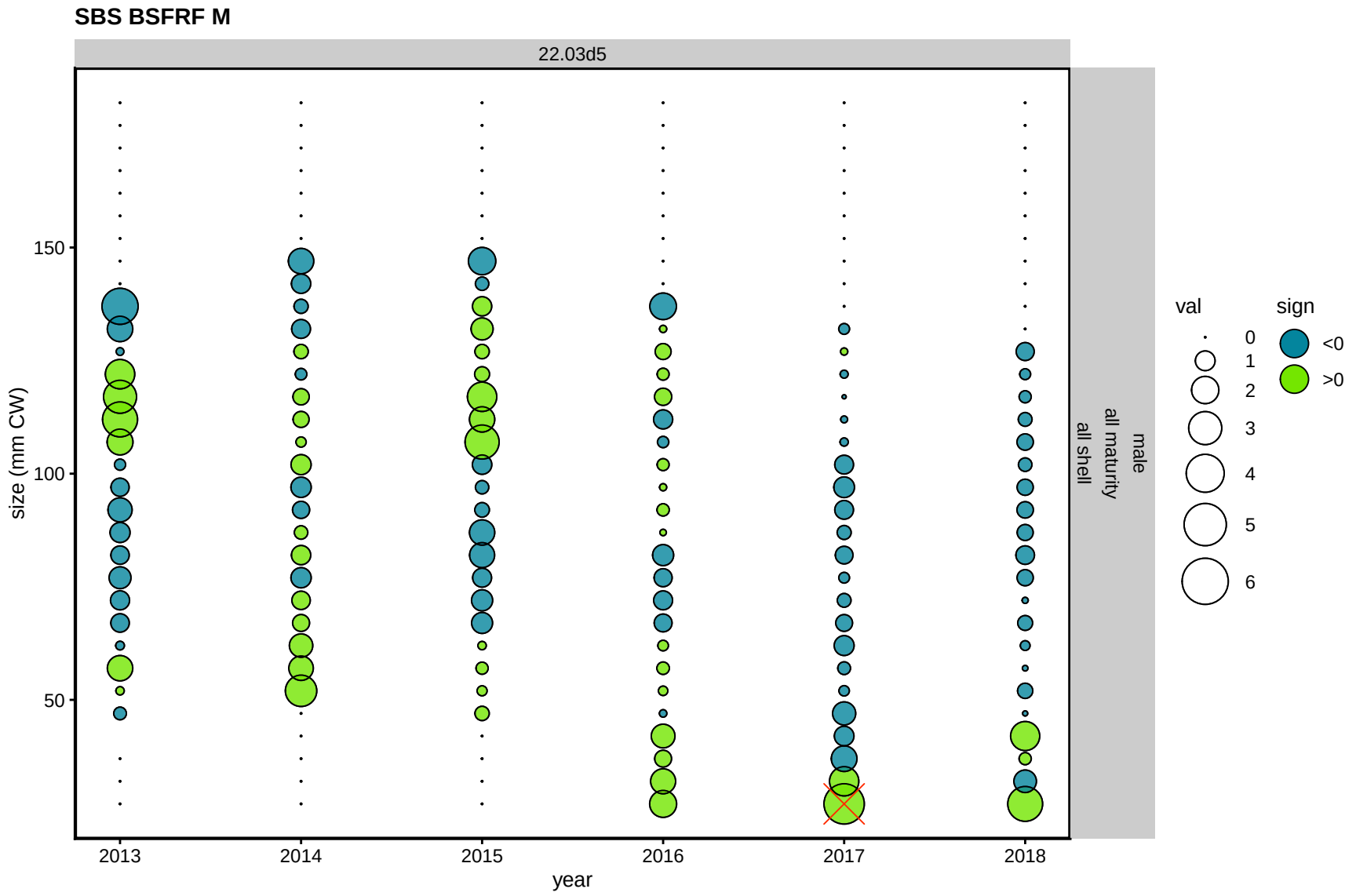

Figure 125. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

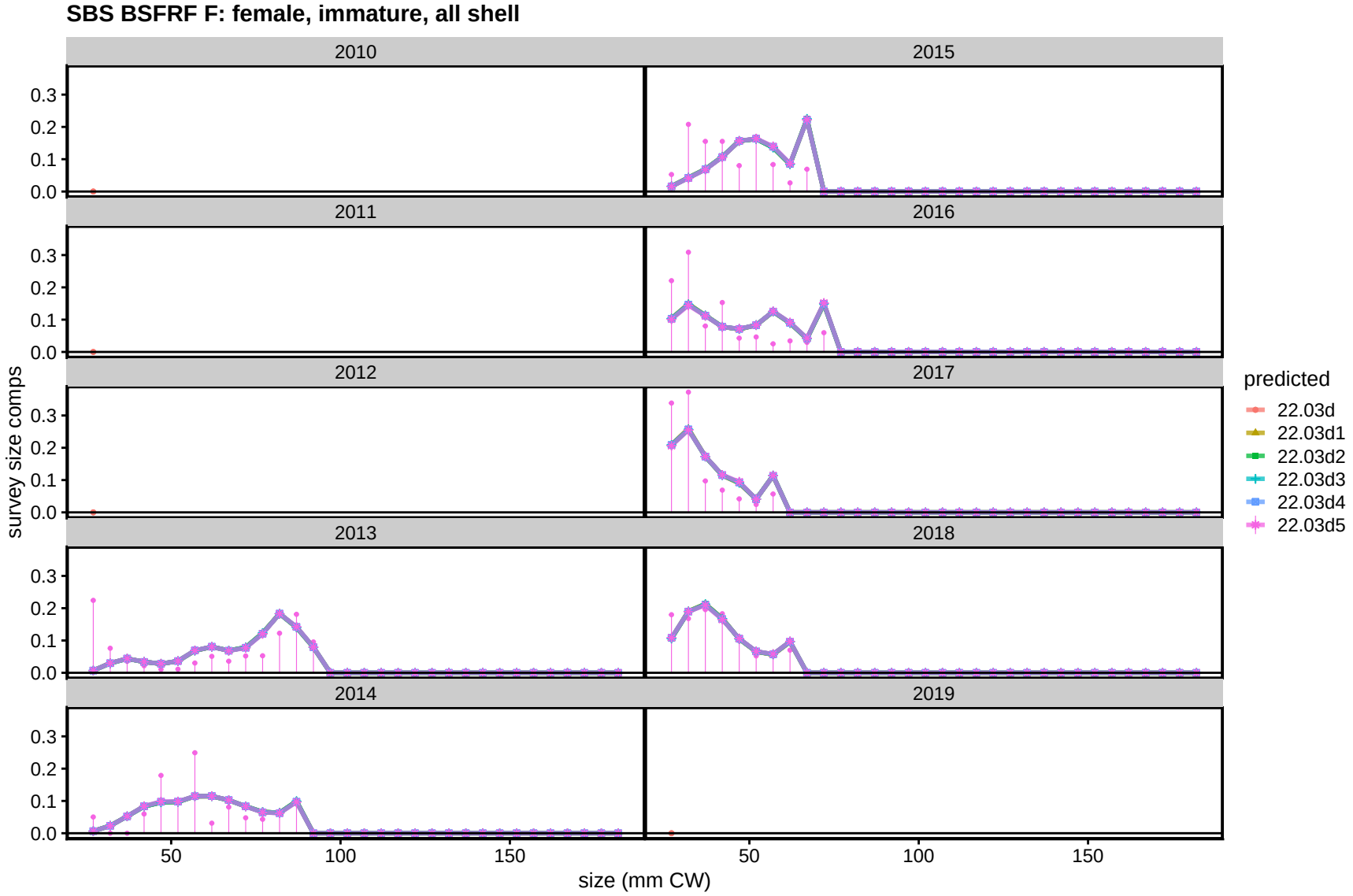

Figure 126. TCSAM02 model fits to survey size compositions in the SBS BSFRF F survey. Preferred model is 22.03d5.

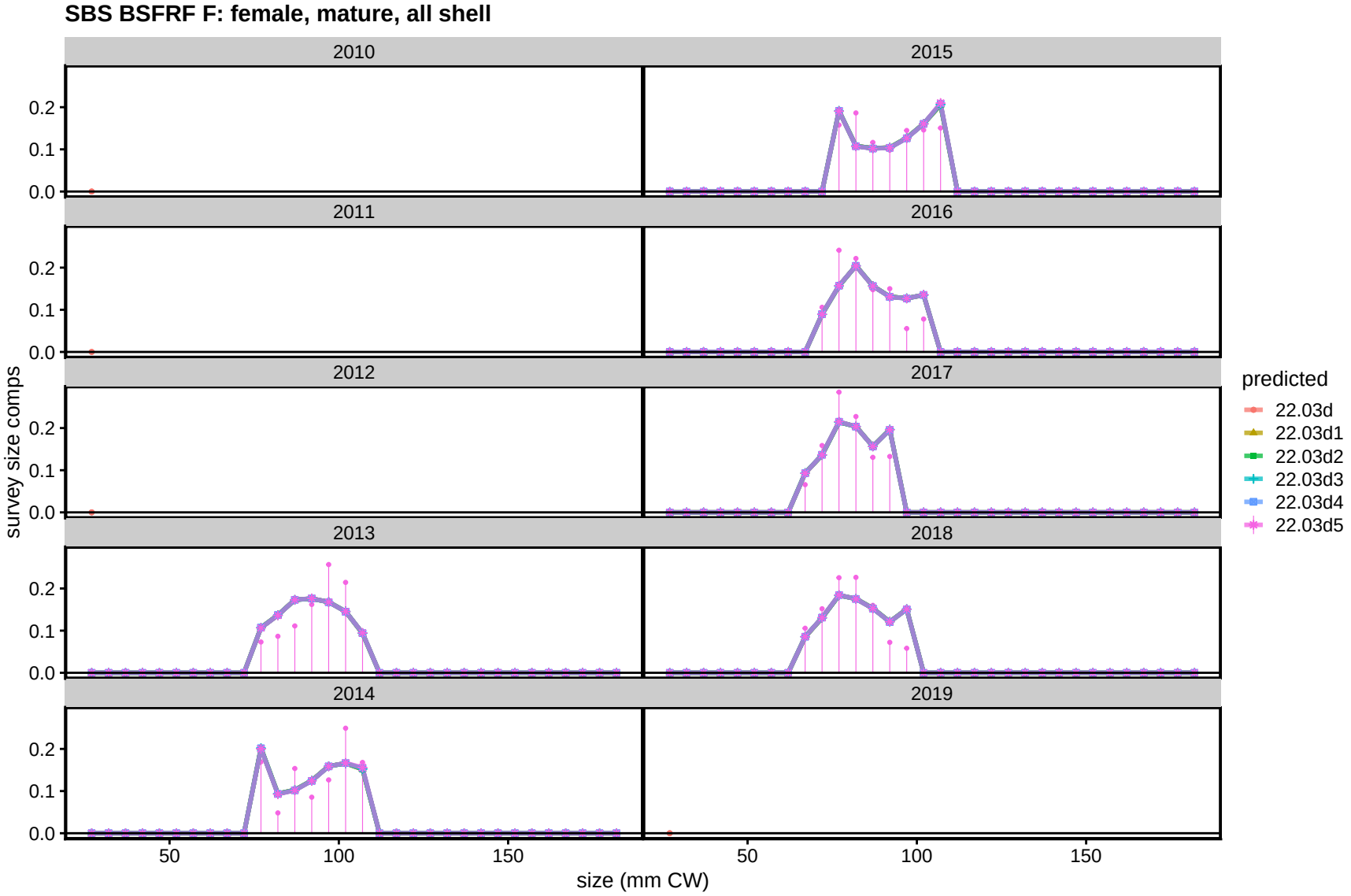

Figure 127. TCSAM02 model fits to survey size compositions in the SBS BSFRF F survey. Preferred model is 22.03d5.

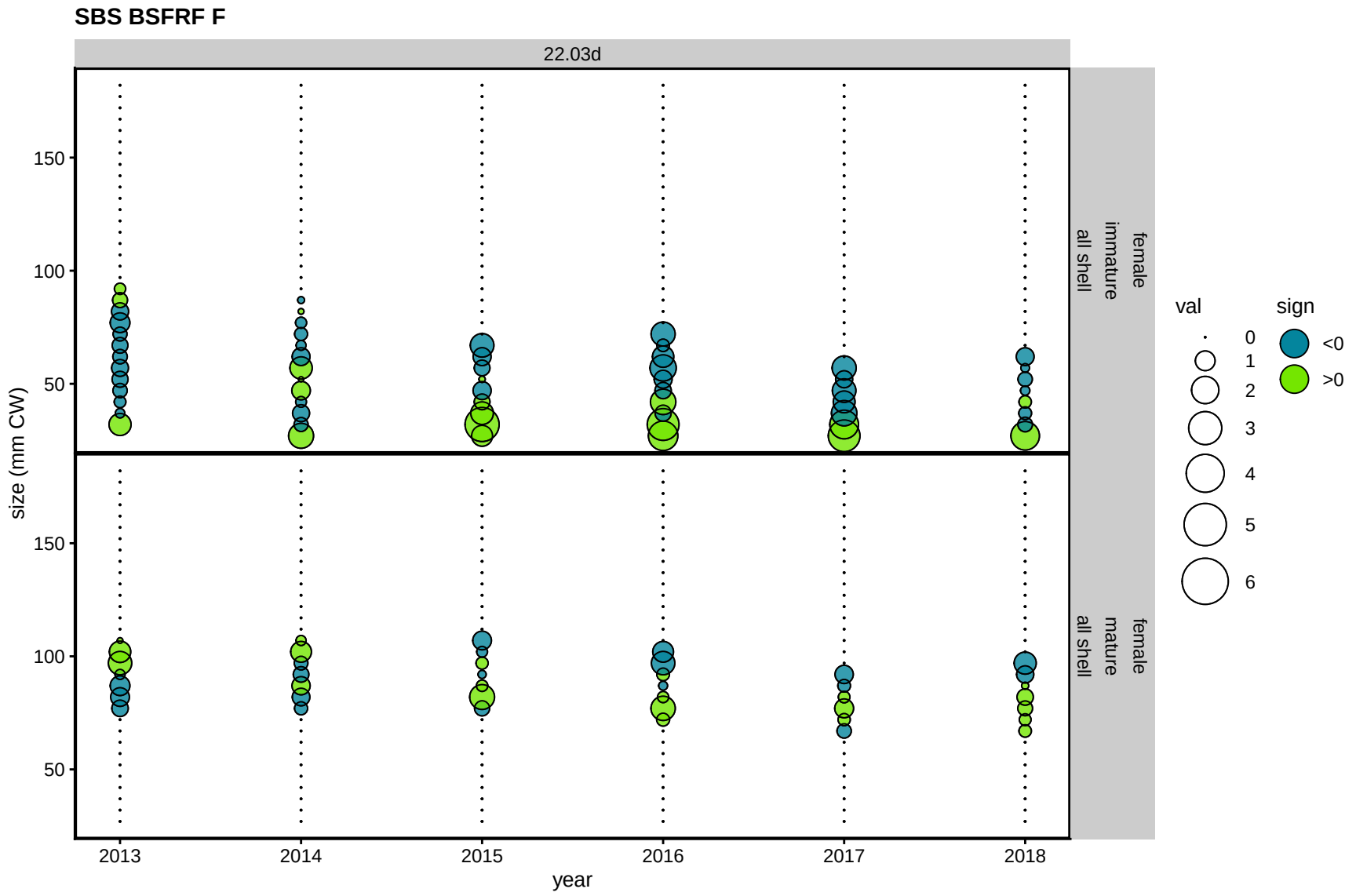

Figure 128. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

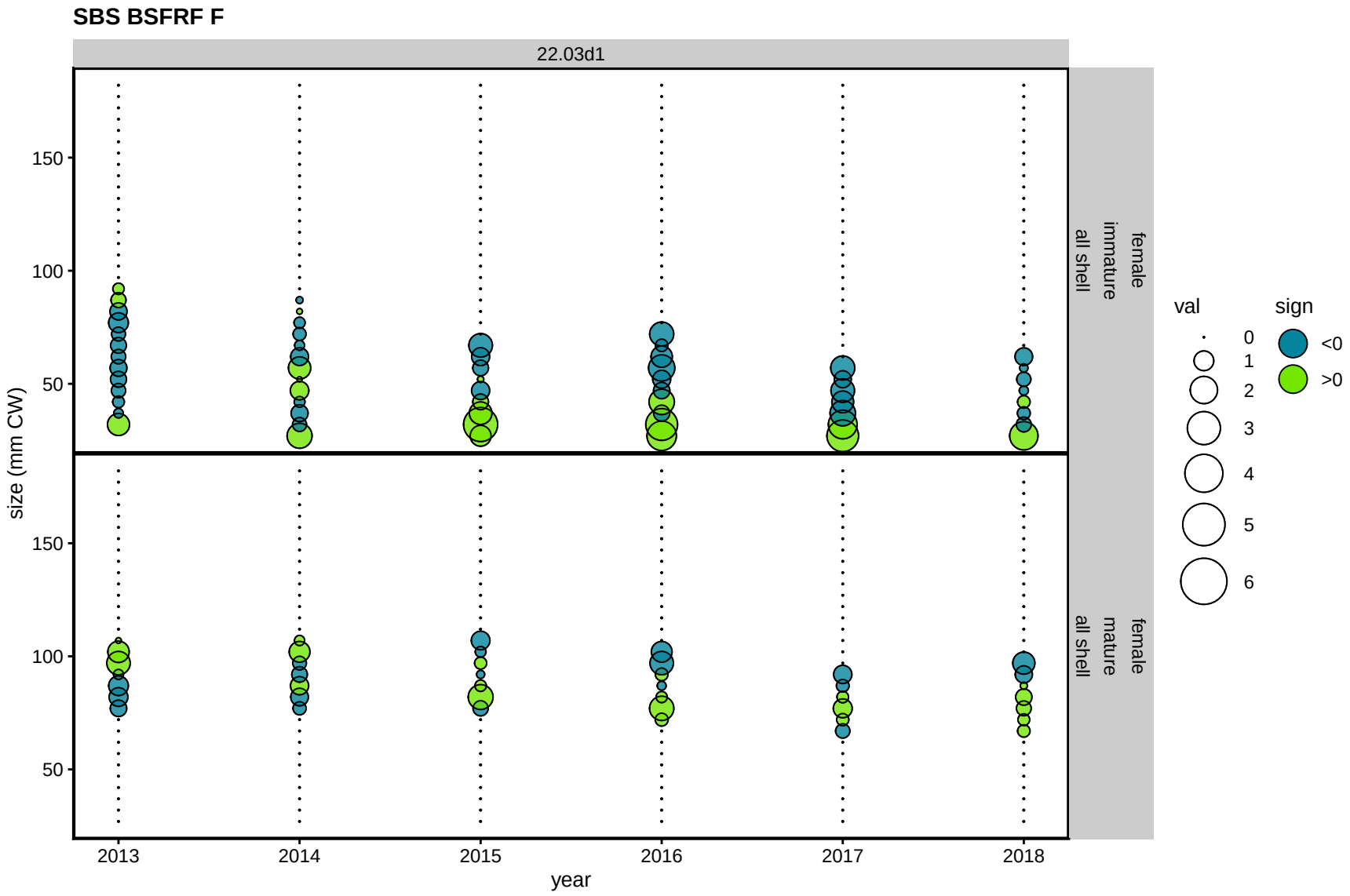

Figure 129. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

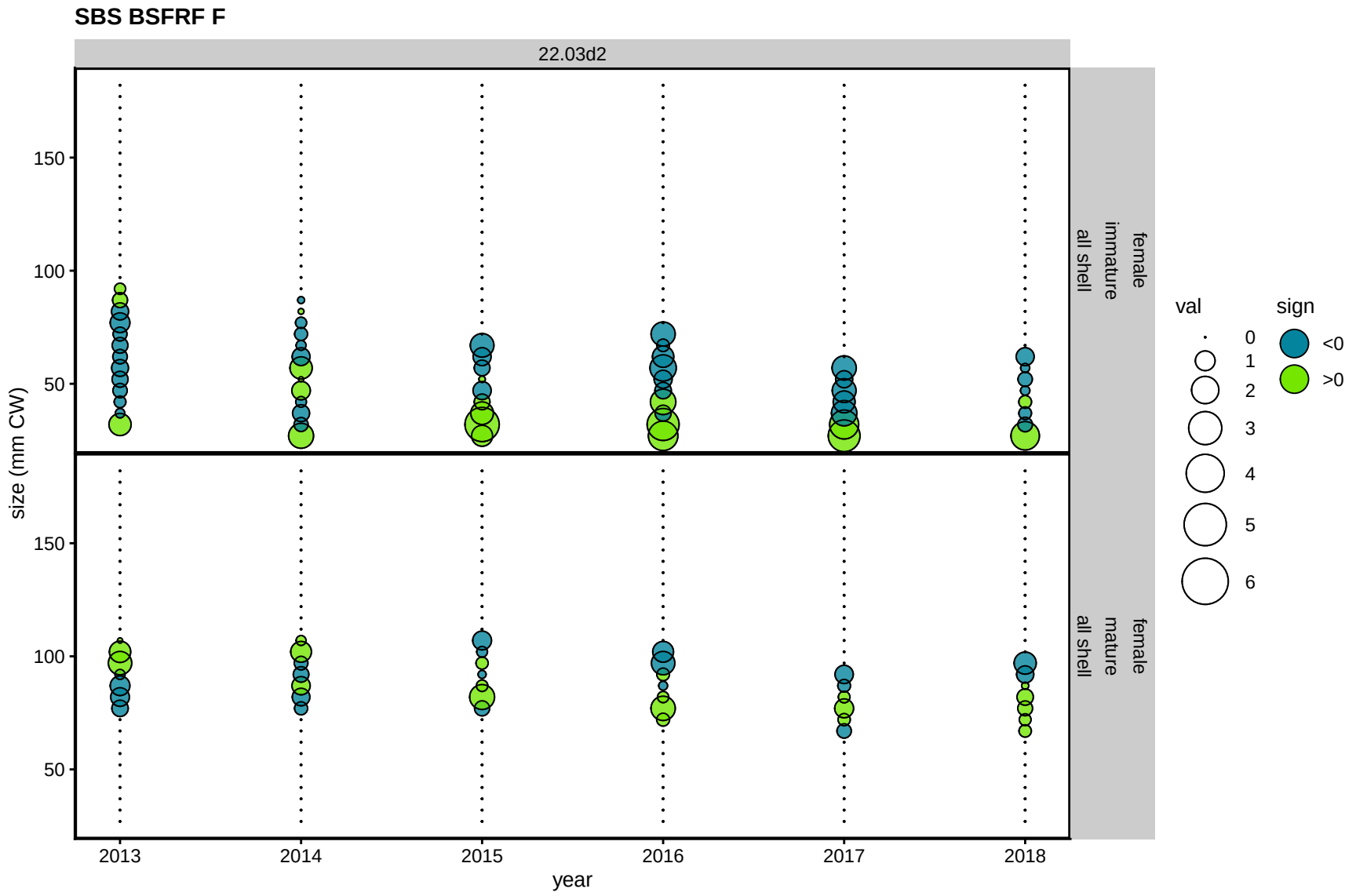

Figure 130. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

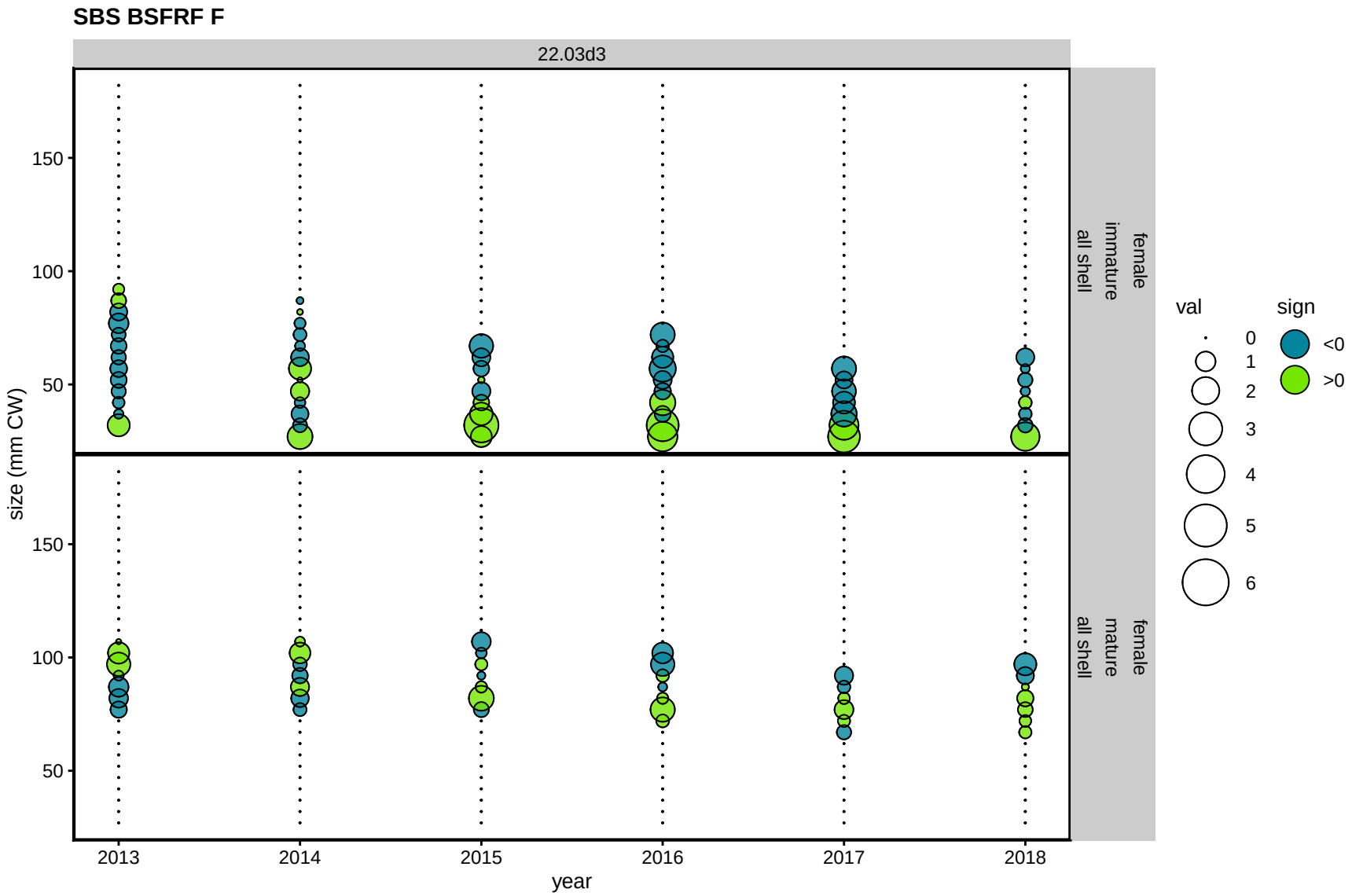

Figure 131. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

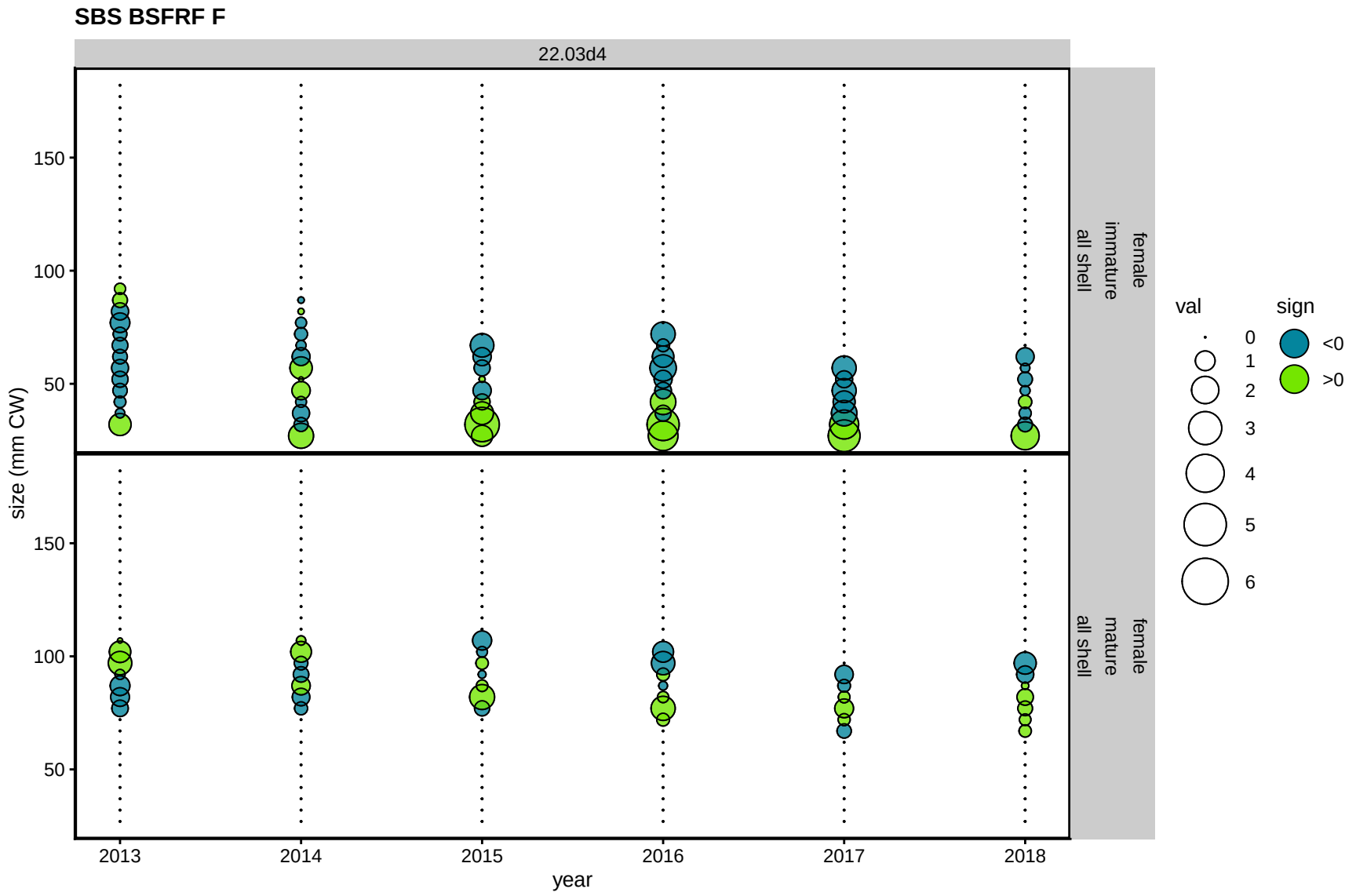

Figure 132. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

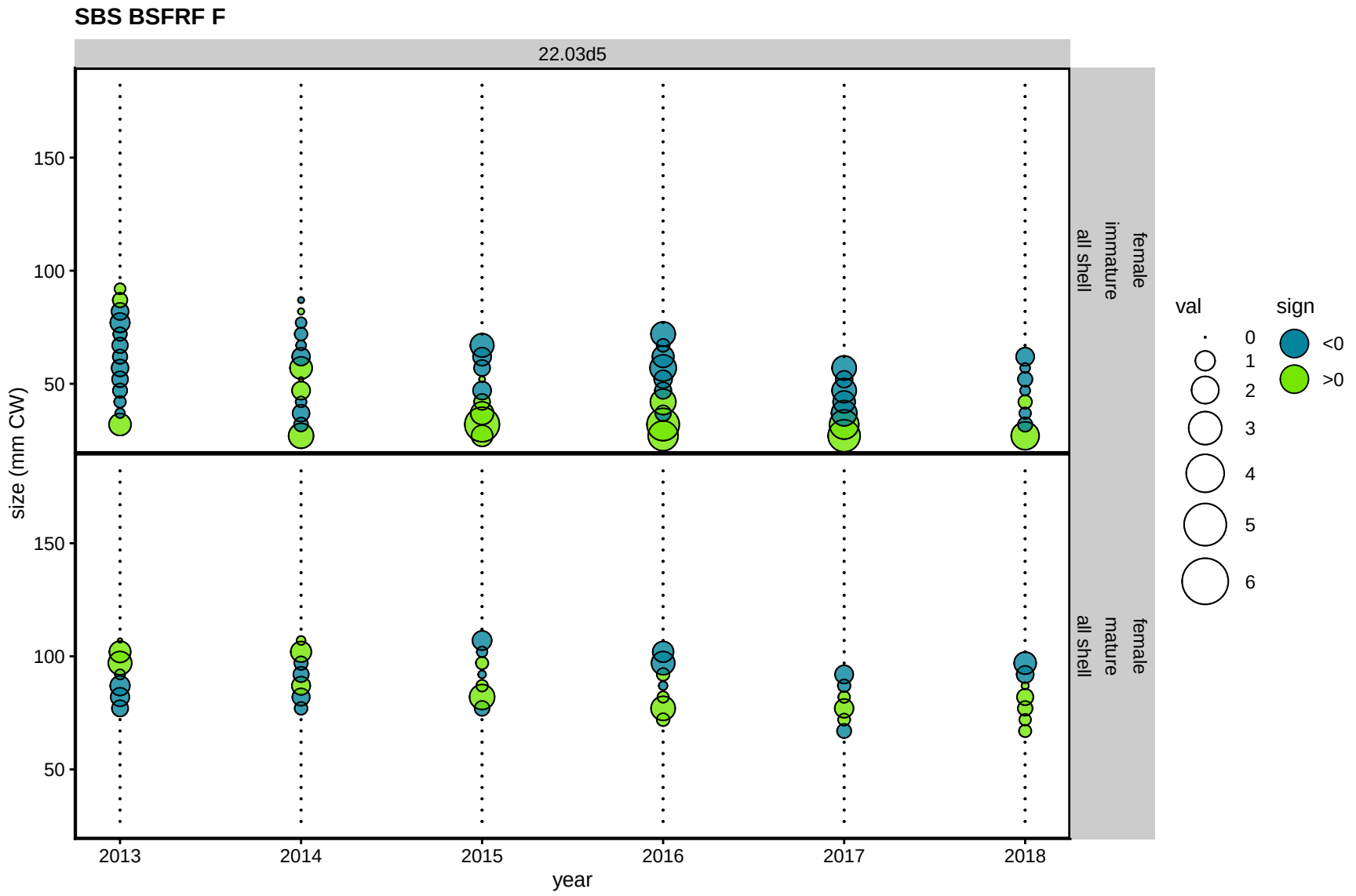

Figure 133. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

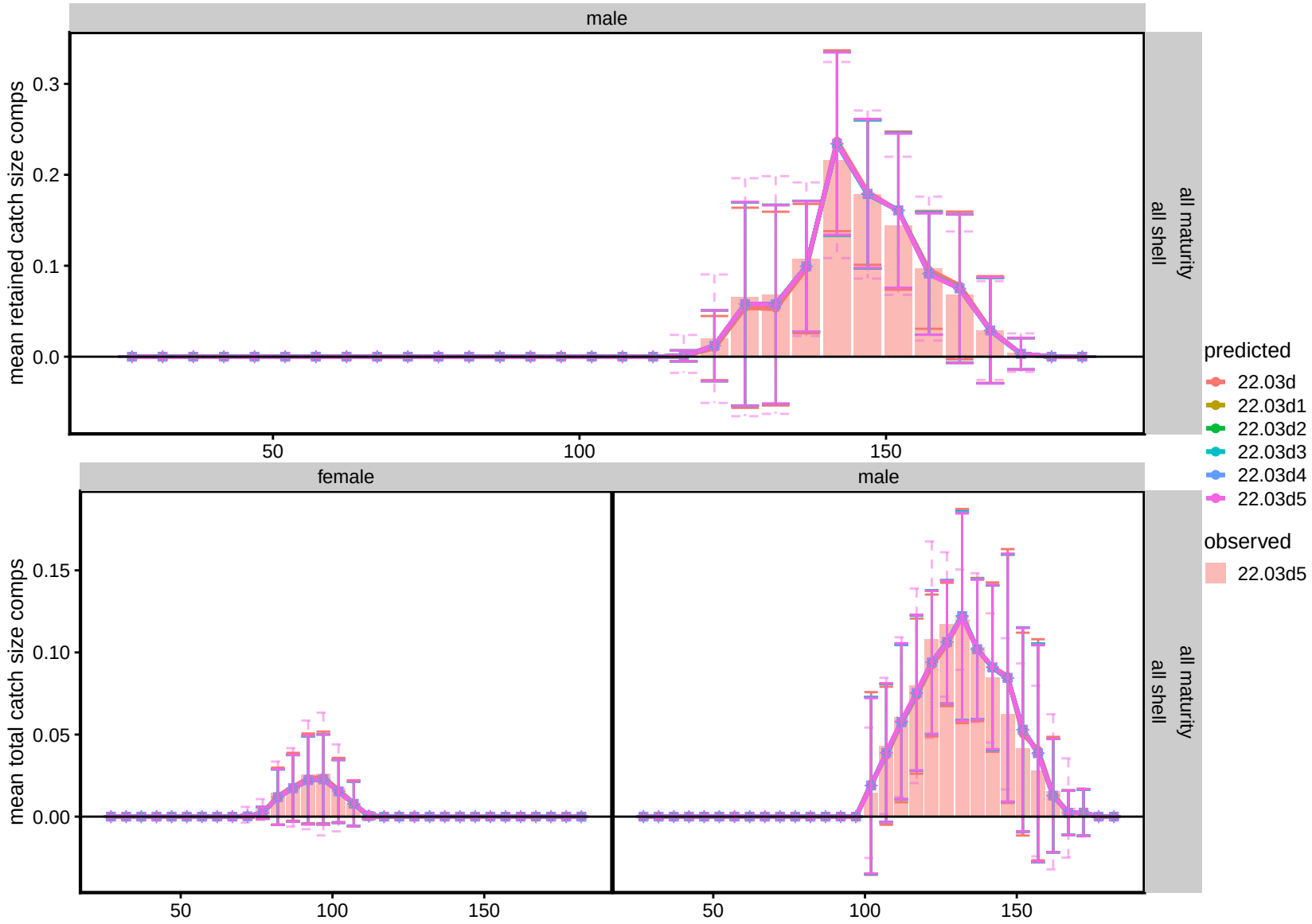

Figure 134. TCSAM02 models fits to directed fishery mean size compositions. Upper plot: retained catch; lower plot: total catch. Model 22.03d5 is the preferred model.

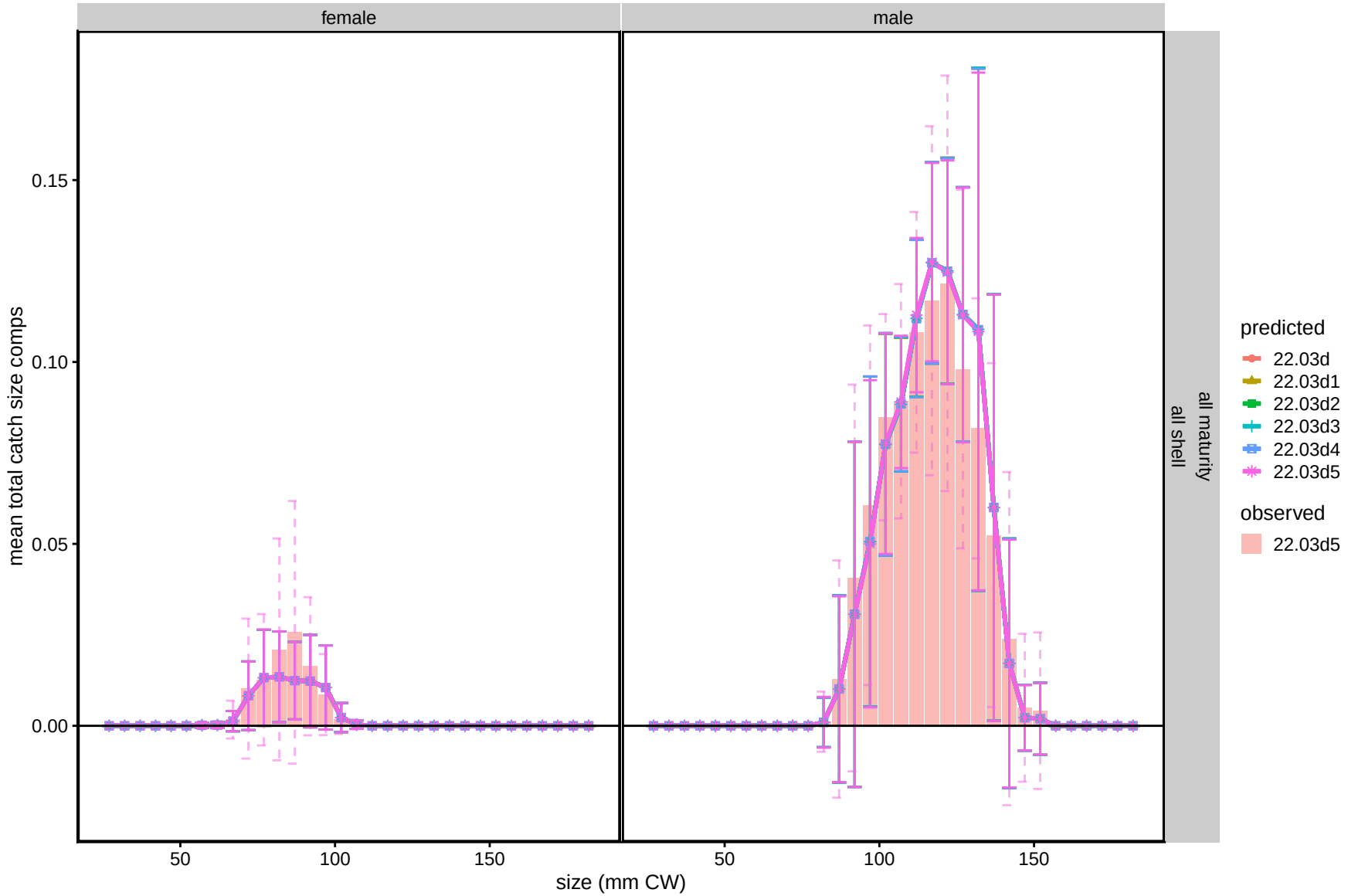

Figure 135. TCSAM02 models fits to mean bycatch size compositions from the snow crab fishery. Model 22.03d5 is the preferred model.

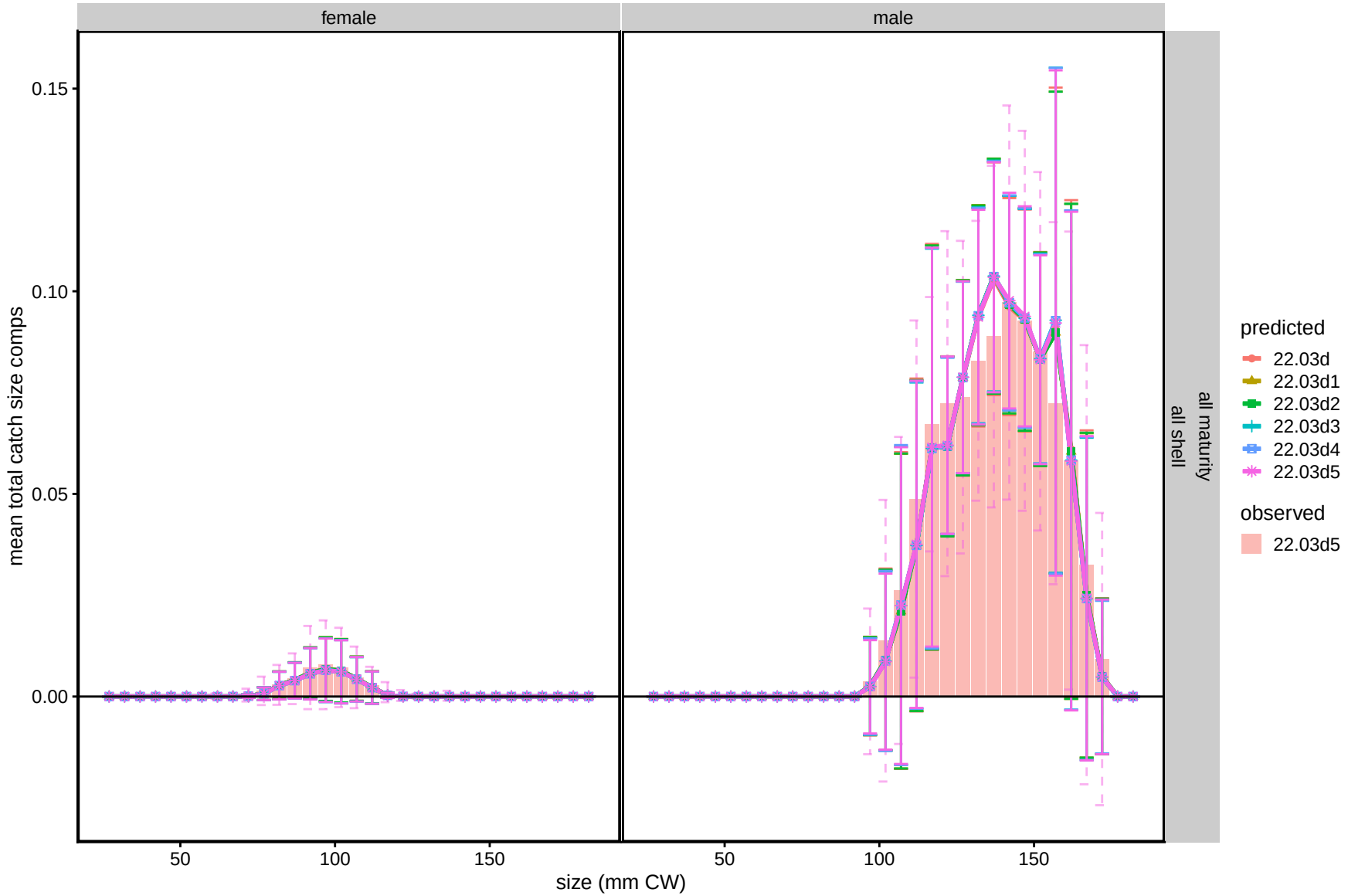

Figure 136. TCSAM02 models fits to mean bycatch size compositions from the BBRKC fishery. Model 22.03d5 is the preferred model.

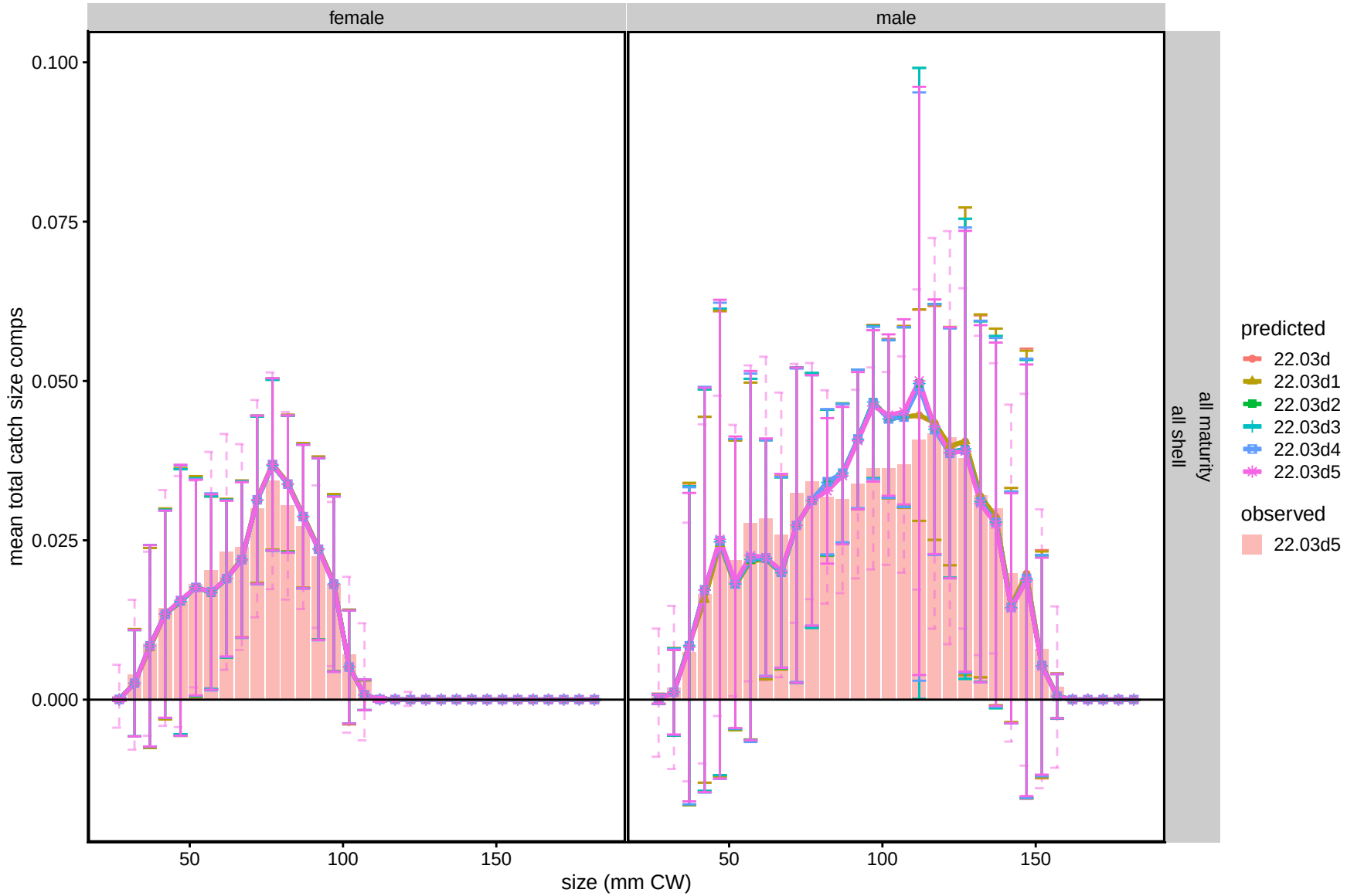

Figure 137. TCSAM02 models fits to mean bycatch size compositions from the groundfish fisheries. The total catch size compositions were normalized similarly for all model scenarios. Model 22.03d5 is the preferred model.

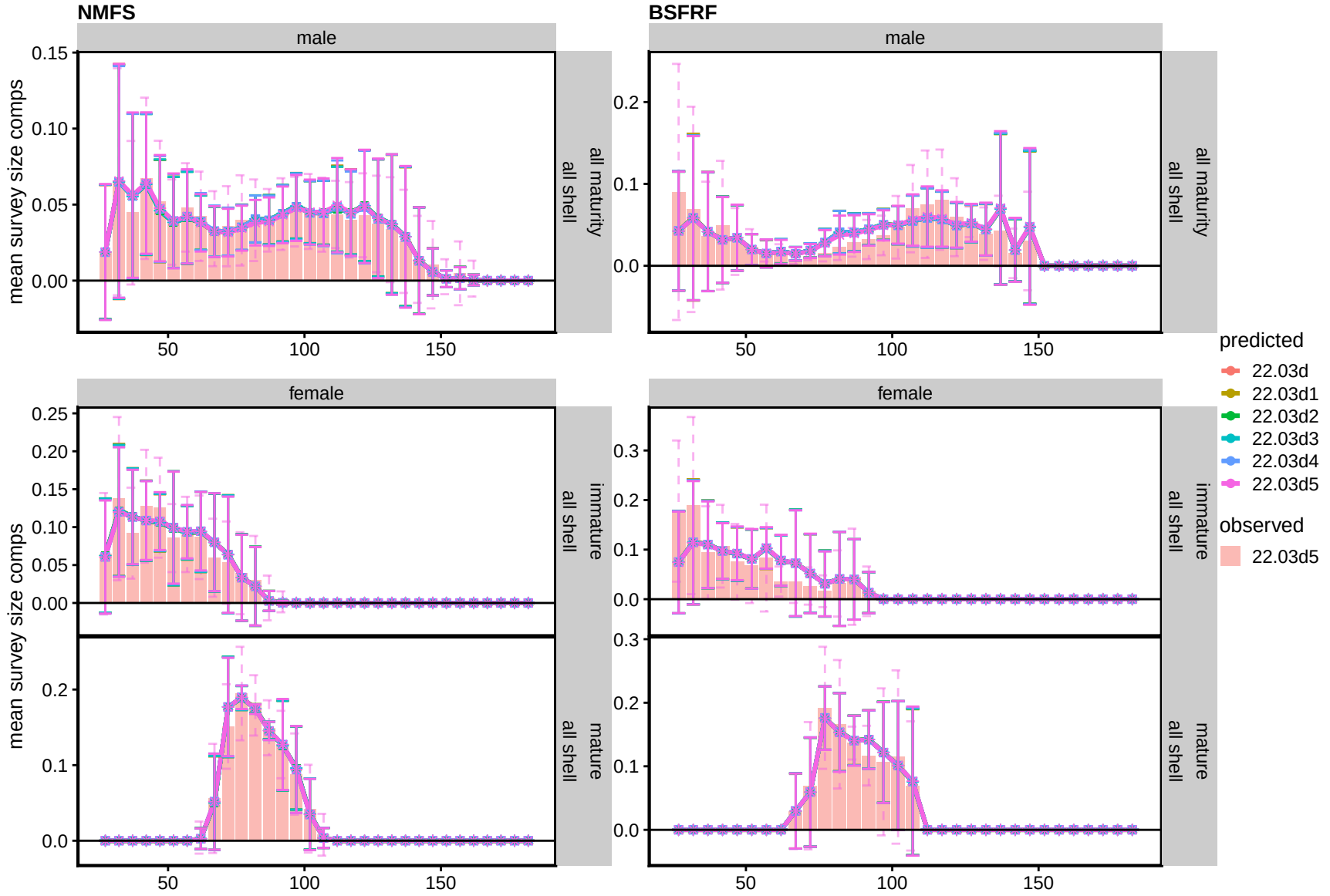

Figure 138. TCSAM02 models fits to mean survey size compositions from the NMFS EBS (left column) and BSFRF SBS (right column) surveys. The total catch size compositions were normalized similarly for all model scenarios.

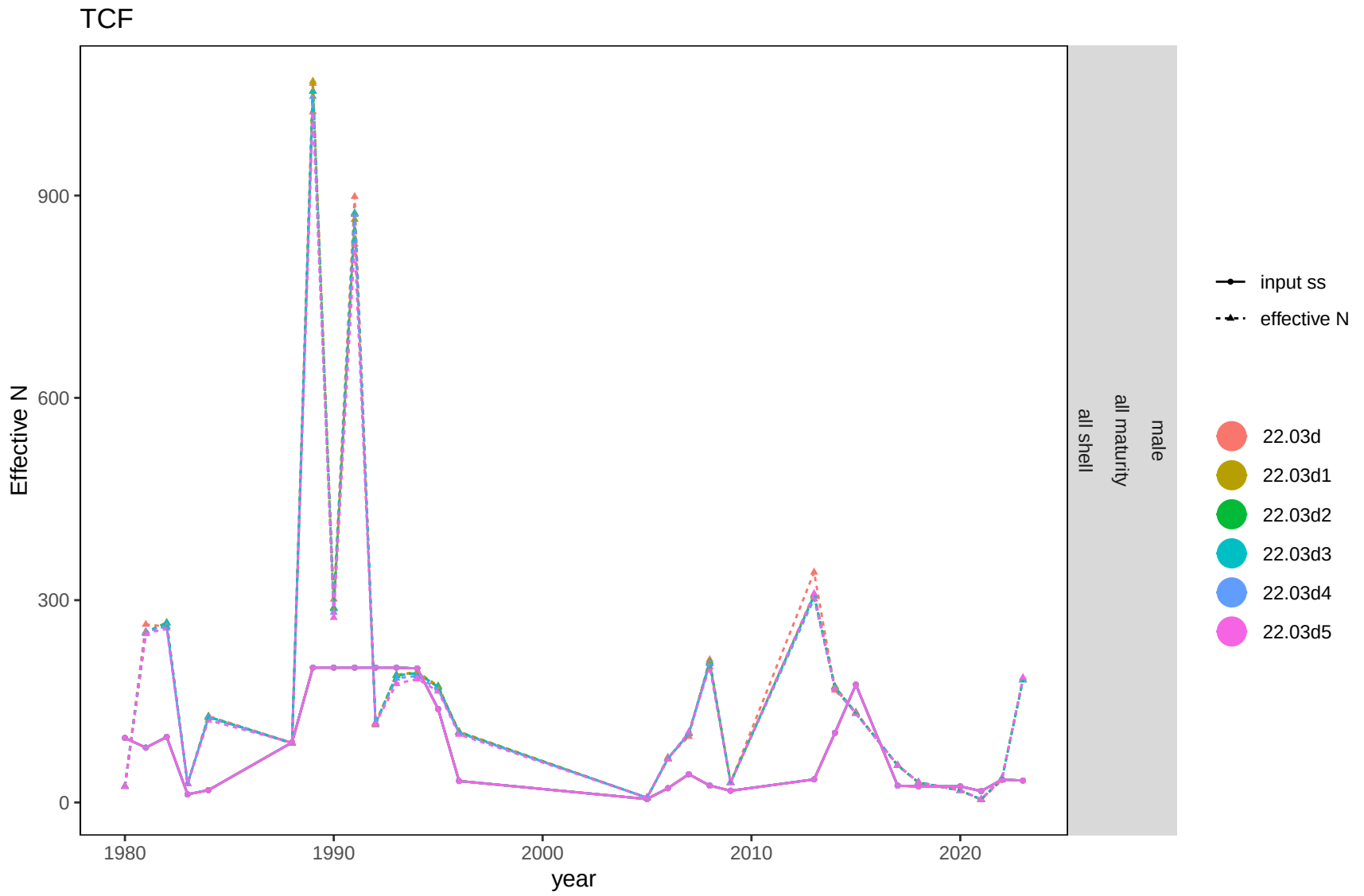

Figure 139. Effective sample sizes compared with input sample sizes for retained catch data. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are constrained to a maximum of 200.

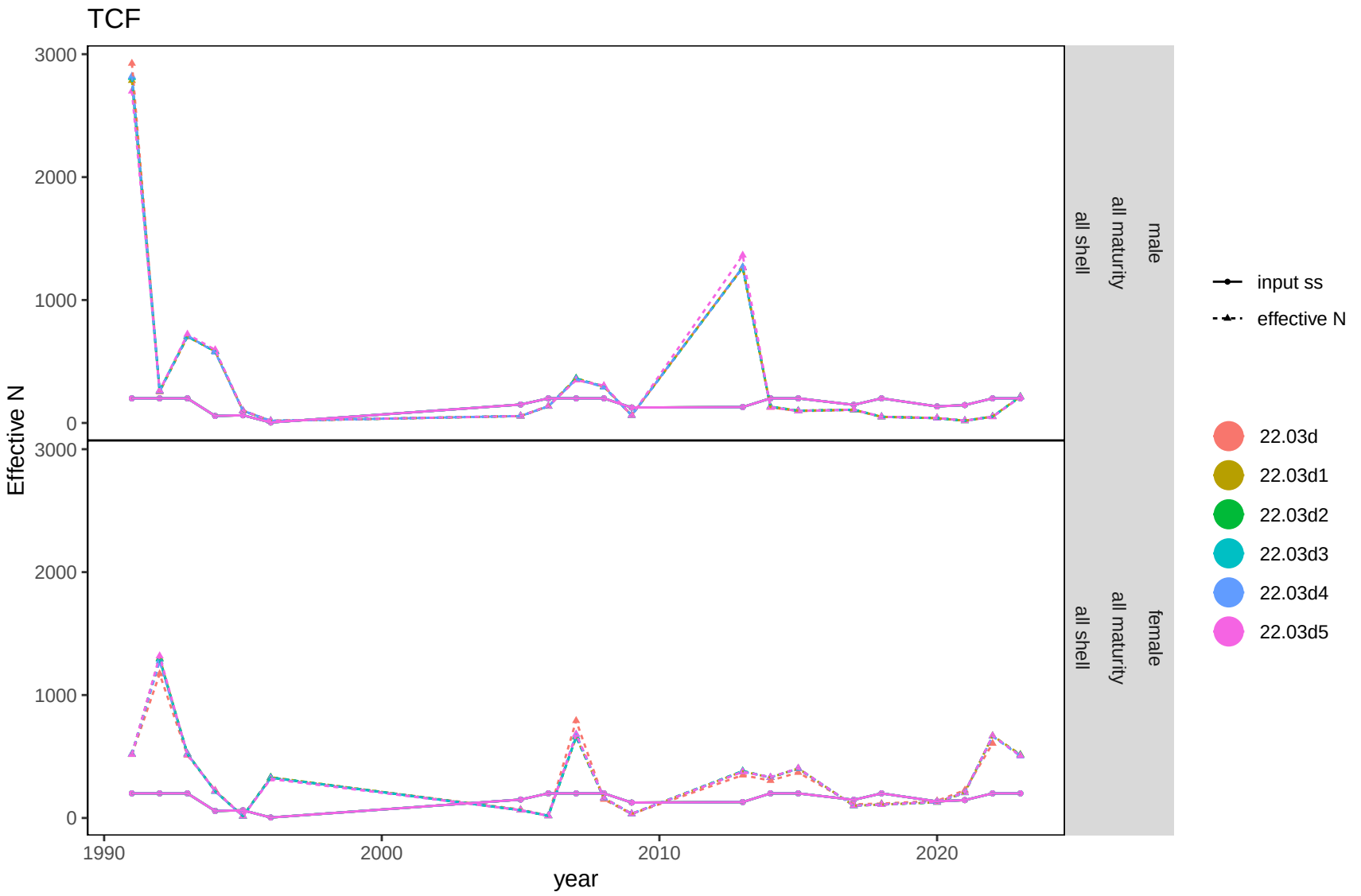

Figure 140. Effective sample sizes compared with input sample sizes for total catch data from the TCF fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.

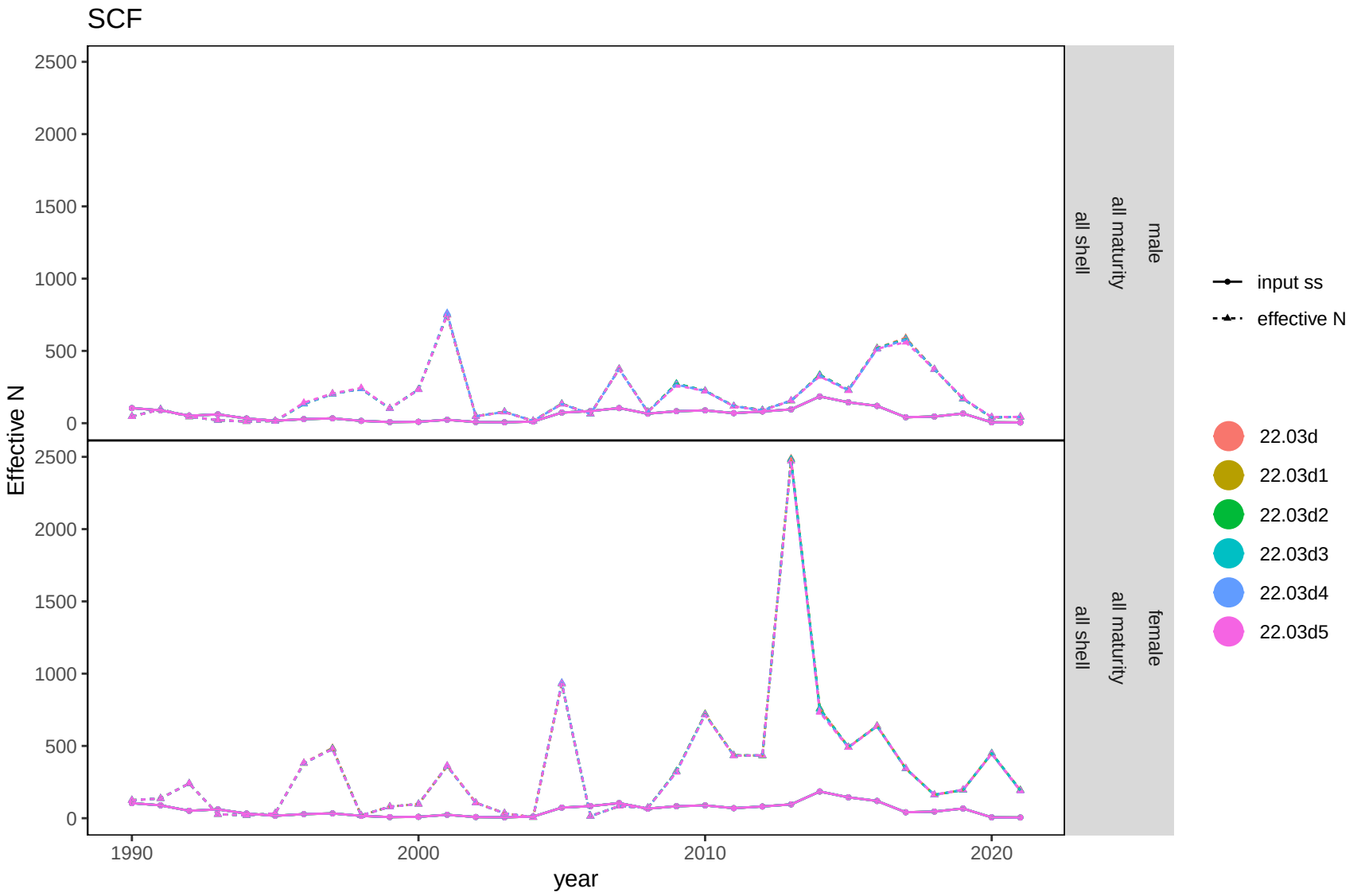

Figure 141. Effective sample sizes compared with input sample sizes for total catch data from the SCF fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.

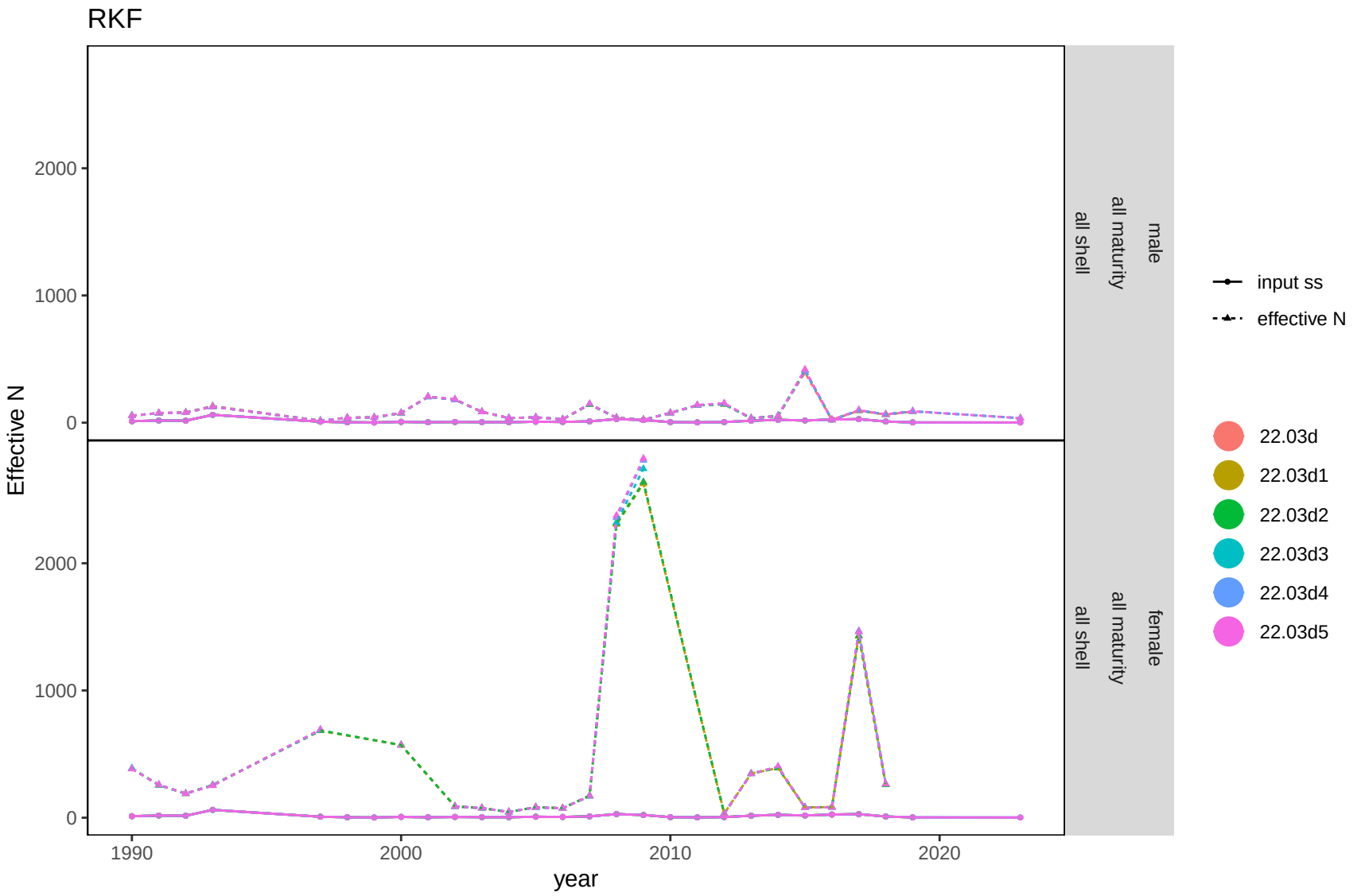

Figure 142. Effective sample sizes compared with input sample sizes for total catch data from the RKF fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.

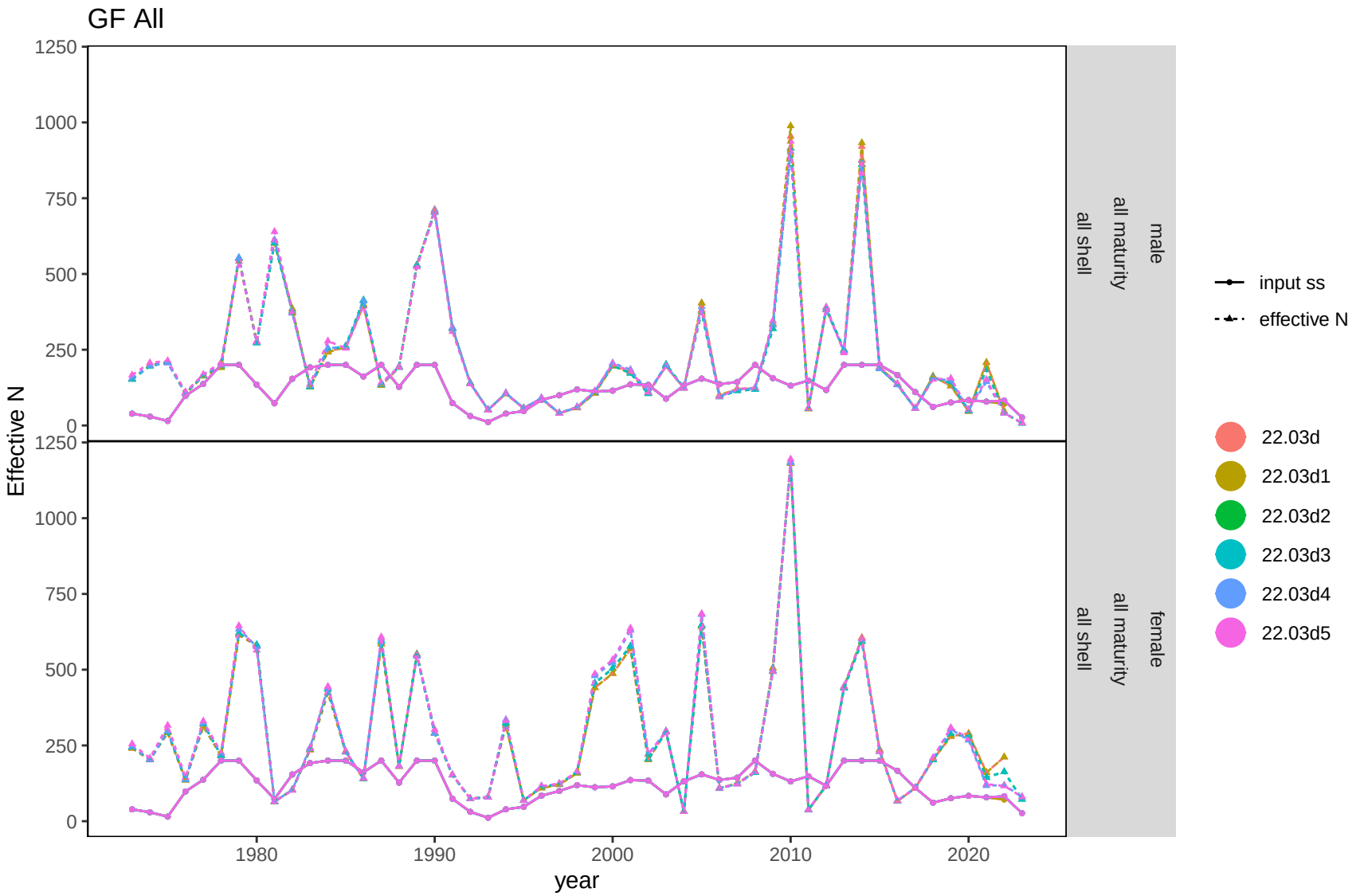

Figure 143. Effective sample sizes compared with input sample sizes for total catch data from the GF All fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.

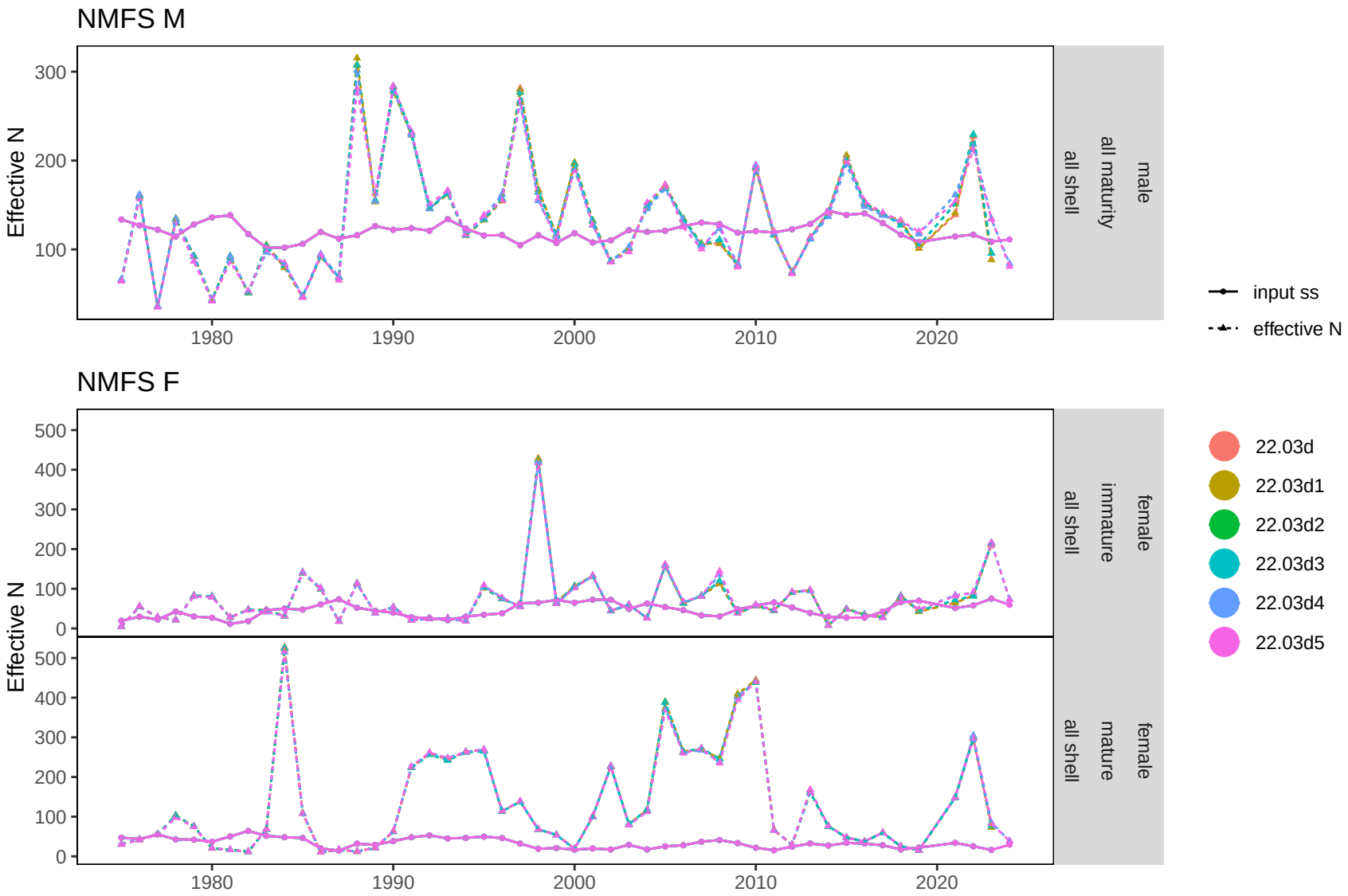

Figure 144. Effective sample sizes compared with input sample sizes for NMFS survey data. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.

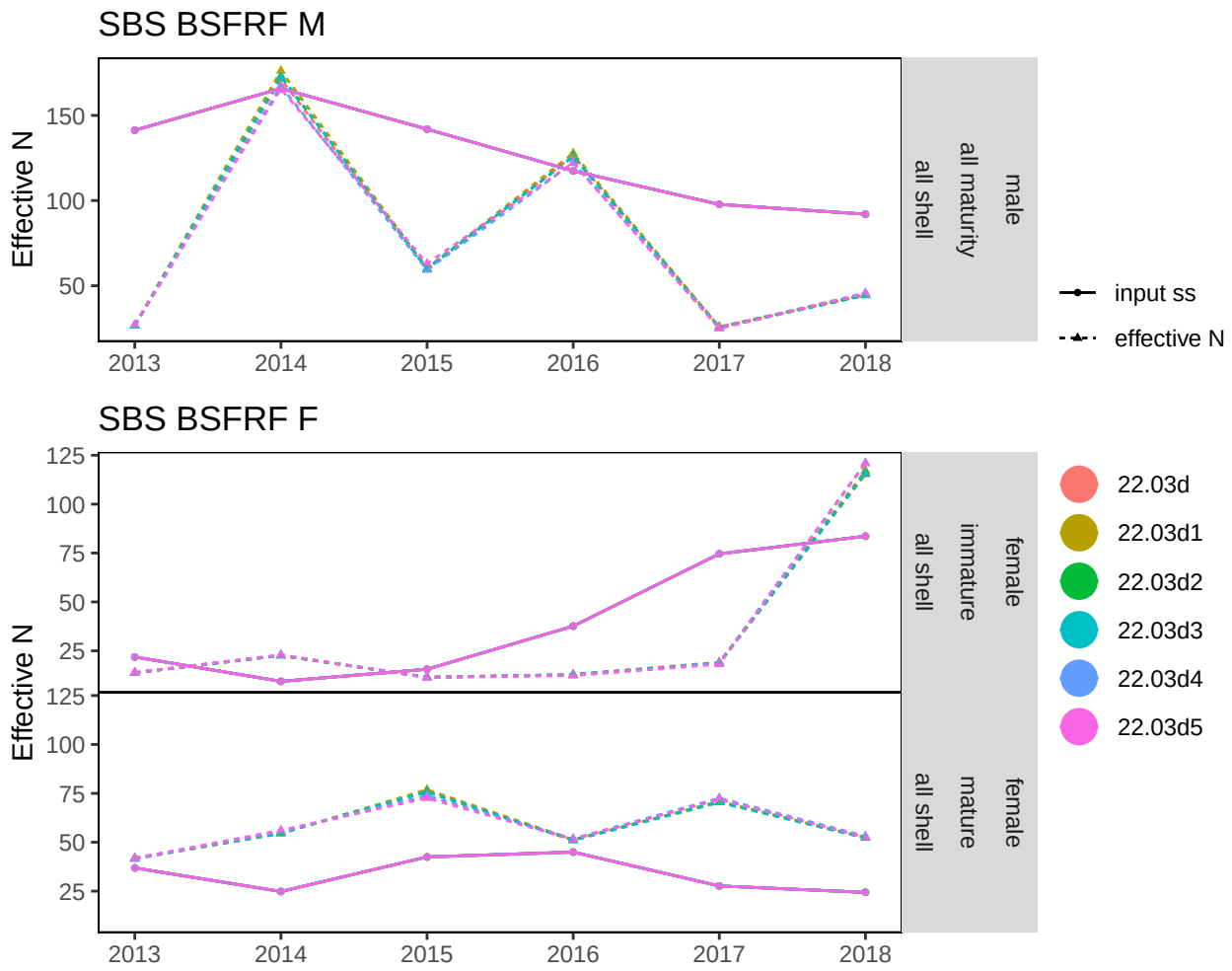

Figure 145. Effective sample sizes compared with input sample sizes for the BSFRF survey data. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.