2025 Stock Assessment and Fishery Evaluation Report for the Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions

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1 Executive Summary

1.1 Stock: species/area

Southern Tanner crab, *Chionoecetes bairdi*, in the eastern Bering Sea (EBS).

1.2 Catches: trends and current levels

Legal-sized male Tanner crab are caught and retained in the directed (male-only) Tanner crab fishery in the eastern Bering Sea (EBS). The North Pacific Fishery Management Council (NPFMC) annually determines the overfishing limit (OFL) and acceptable biological catch (ABC) levels for Tanner crab in the EBS. The Alaska Department of Fish and Game (ADF&G) sets the total allowable catch (TAC) separately for areas east and west of 166^oW longitude in the Eastern Subdistrict of the Bering Sea District Tanner crab Registration Area J based on the State's harvest strategy, which is determined by its Board of Fisheries. The OFL and ABC apply to "total catch mortality", which includes estimated bycatch mortality on discarded males and females from all fisheries that capture Tanner crab, as well as retained catch. The TAC applies only to retained catch, but is constrained by the ABC.

In addition to legal-sized males, females and sub-legal males are caught in the directed fishery as bycatch and must be discarded. Discarding of legal-sized males also occurs, primarily because the minimum size preferred by processors is larger than the minimum legal size, but also because "old shell" crab can be less desirable than "new shell" males. Tanner crab are also taken as bycatch in the snow crab and Bristol Bay red king crab fisheries, the groundfish fisheries, and, to a very minor extent, the scallop fishery. In order to account for mortality of discarded crab, handling mortality rates for Tanner crab are assumed to be 0.321 for crab discarded in the crab fisheries, 0.5 for crab discarded in the groundfish fisheries that use fixed gear, and 0.8 for crab discarded in the groundfish fisheries that use trawl gear (CPT 2014, 2021). Bycatch in the groundfish fisheries is aggregated across gear types in the assessment model and the rate for trawl gear is applied to the aggregated bycatch to estimate discard mortality. These values are intended to account for differences in gear and handling procedures used in the various fisheries.

Following rationalization of the Bering Sea and Aleutian Islands (BSAI) crab fisheries in 2005/06, the directed fishery for Tanner crab was prosecuted through 2009/10, after which ADF&G set TACs to 0 in both management areas (thus closing the directed fishery) because stock biomass failed to meet required thresholds in the State's harvest strategy. Prior to the 2010/11 closure, the retained catch averaged 766.6 t per year between 2005/06-2009/10 and total catch mortality averaged 1,868 t. In early 2012, the National Marine Fisheries Service (NMFS) declared the stock overfished because the estimated mature male biomass fell below the federal Minimum Stock Size Threshold (MSST= $\frac{1}{2}B_{MSY}$, where B_{MSY} is the equilibrium biomass associated with fishing at maximum sustainable yield, MSY), which was based at the time on a Tier 4 harvest control rule, with B_{MSY} determined by average mature male biomass over a specified time period; (Rugolo and Turnock 2011b).

Subsequently, NMFS determined that the stock was no longer overfished based on a new Tier 3 assessment model with $B_{35\%}$ as a proxy for B_{MSY}, where $B_{35\%}$ is 35% of unfished stock biomass. The OFL for 2012/13 was determined to be 19,020 t while the ABC was set to 8,170 t based on a "stair-step approach" adopted to re-open the fishery (SSC 2012; CPT 2015). ADF&G, however, set the TAC to 0 in both management areas in accordance with the State of Alaska's harvest strategy at the time. The OFL for the following year (2013/14) was determined to be 25,350 t, with an ABC of 17,820 t following the stair-step approach (CPT 2013). ADF&G subsequently set the TACs at 746 t for the western area and at 664 t for the eastern area and the directed fishery was prosecuted for the first season since 2009/10. On closing, 80% (594 t) of the TAC was taken in the western area while 99% (654 t) was taken in the eastern area. Total catch mortality was 2,267 t. Since then, the stock has remained above its Tier 3 MSST and has not been considered overfished by federal standards. OFLs have ranged from ~21,000 t to ~41,000 t while ABCs have ranged from ~17,000 t to ~33,000 t; none have constrained fishery TACs set by ADF&G. However, ADF&G has closed the directed fishery in the eastern area 6 times since the 2015/16 season (i.e., every year except 2022/23 and 2023/24) and 2 times (2016/17 and 2019/20) in the western region based on its own harvest strategies with criteria that incorporate area-specific stock size thresholds for females as well as males.

Since 2013/14, harvests reached a maximum of ~8,900 t in 2015/16, but have subsequently been less than 1,200 t until 2024/25 when the area-combined TAC was set at 2,840 t. During this period total catch mortality peaked in 2015/16 as well (~12,000 t) but has been less than (~3,000 t) since.

For 2024/25, the OFL was 41,290 t and the ABC was 33,030 t. The TAC in the eastern region was 803.0 t and 2,041 t in the western region. Total retained catch was 2,852 t and total fishing mortality was estimated directly from observer data by applying gear-specific handling mortality rates to be 3,093 t.

1.3 Stock biomass: trends and current levels relative to virgin or historic levels

The annual NMFS EBS shelf summer bottom trawl survey has been conducted since 1975. It is the principal source of fishery-independent data on the size of the Tanner crab stock. In 2025, survey biomass was 110.9 thousand t for males, 40.20 thousand t for females, and 15.71 thousand t for industry-preferred males (males $\geq$ 125 mm carapace width [CW]). Average survey biomass over the past 5 years was 58.01 thousand t for males, 24.36 thousand t for females, and 8.802 thousand t for industry-preferred males. Since the survey gear was standardized in 1982, maximum survey biomass occurred for males occurred in 1991 at 145.8 thousand t, for females in 1982 at 65.85 thousand t, and for industry-preferred males in 1992 at 127.6 thousand t. In general, the stock has fluctuated on a decadal scale imposed on a declining trend since the beginning of the survey. Since 2010, maximum survey biomass for males occurred in 2025 at 110.9 thousand t, for females in 2024 at 43.76 thousand t, and for industry-preferred males in 2014 at 35.98 thousand t.

For EBS Tanner crab, spawning stock biomass is expressed as mature male biomass (MMB) at the time of mating (mid-February), which is a model-estimated quantity. From the author's preferred model (`22.03d5 (2025)`), estimated MMB for 2024/25 was 99.53 thousand t. The most recent peak in MMB occurred in 2014/15 at 116.9 thousand t. MMB approached very low levels last seen in the mid-1990s to early 2000s (1993 to 2003 average: 51.40 thousand t) in 2020/21 at 51.56 thousand t but has increased over the past four years to its highest since 2015.

1.4 Recruitment: trends and current levels relative to virgin or historic levels.

Annual recruitment, the number of small crab ($\geq$ 25 mm CW) entering the population at the beginning of the crab year (July 1), is a model-estimated quantity. From the author's preferred model (`22.03d5 (2025)`), estimated total recruitment has increased since 2015, when recruitment reached its lowest level (119 million) since 2011. Average recruitment over the previous 10 years (2015-2024) was 882 million crab, which is ~45% more than the long-term (1982-2024) mean of 609 million crab. For 2025, estimated recruitment is 657 million crab, which is substantially less than the estimate for the previous year (933 million) and more than the longterm average. However, estimates of recruitment in the final model year are generally not well-estimated.

1.5 Management performance

Historical status and catch specifications for eastern Bering Sea Tanner crab, with 2025/26 values based on the maximum likelihood estimate (MLE) from the author's recommended model, `22.03d5 (2025)`, are given in the following tables:

Table A. Management quantities (in 1,000's t) from the author's preferred model, `22.03d5 (2025)`, and recommended ABC buffer (20%). The TAC is summed across ADF&G management areas.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2021/22	17.37	62.05	0.50	0.49	0.78	27.17	21.74
2022/23	18.19	74.17	0.91	0.91	1.19	32.81	26.25
2023/24	20.00	88.21	0.94	0.94	1.09	36.20	27.15
2024/25	21.61	99.53	2.84	2.85	3.09	41.29	33.03
2025/26	NA	75.96	NA	NA	NA	51.02	40.81

Table B. Management quantities (in millions of pounds) from the author's preferred model, `22.03d5 (2025)`, and recommended ABC buffer (20%). The TAC is summed across ADF&G management areas.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2021/22	38.29	136.80	1.10	1.08	1.72	59.90	47.93
2022/23	40.10	163.52	2.01	2.01	2.62	72.33	57.87
2023/24	44.09	194.47	2.08	2.07	2.40	79.81	59.86
2024/25	47.64	219.43	6.27	6.29	6.82	91.03	72.82
2025/26	NA	167.45	NA	NA	NA	112.47	89.98

Notes: MSST and MMB based on data available to the Crab Plan Team at the time of the assessment for the crab fishing year.

1.6 Probability density function for the OFL

The probability density function assumed for the Tier 3 OFL to determine the p^* ABC (see Section 7 for details) was a normal function with mean 51,016 t and standard deviation 3,044 t. The standard deviation for the OFL was estimated using AD Model Builder's "delta" method.

1.7 Basis for the 2025/26 OFL

Table C. Basis for the OFL from the author's preferred model, `22.03d5 (2025)`. Biomass units are in 1,000's t.

Year	Tier	Bmsy	Projected MMB	B/Bmsy	Fofl	Years to Define Bmsy	Natural Mortality
2021/22	3a	35.94	42.57	1.18	1.17	1982-2020	0.23
2022/23	3a	34.70	47.58	1.37	1.17	1982-2021	0.23
2023/24	3a	36.39	48.77	1.34	1.16	1982-2022	0.23
2024/25	3a	40.01	56.06	1.40	1.23	1982-2023	0.23
2025/26	3a	43.22	75.96	1.76	1.47	1982-2024	0.23

Table D. Basis for the OFL from the author's preferred model, `22.03d5 (2025)`. Biomass units are in millions of pounds.

Year	Tier	Bmsy	Projected MMB	B/Bmsy	Fofl	Years to Define Bmsy	Natural Mortality
2021/22	3a	79.23	93.85	1.18	1.17	1982-2020	0.23
2022/23	3a	76.50	104.90	1.37	1.17	1982-2021	0.23
2023/24	3a	80.23	107.52	1.34	1.16	1982-2022	0.23
2024/25	3a	88.21	123.59	1.40	1.23	1982-2023	0.23
2025/26	3a	95.28	167.45	1.76	1.47	1982-2024	0.23

Estimated total catch mortality (retained + discard mortality in all fisheries, using discard mortality rates of 0.321 for crab pot gear, 0.5 for fixed gear in the groundfish fisheries, and 0.8 for trawl gear) in 2024/25 was 3.093 thousand t, which was less than the OFL (41.29 thousand t); consequently, **overfishing did not occur**. B_{MSY} for this stock was calculated to be 43.22 thousand t, so the MSST is 21.61 thousand t. Because 2024/25 MMB (99.53 thousand t) > MSST, **the stock is not overfished**.

The OFL for 2025/26, based on the author's preferred model (`22.03d5 (2025)`), is 51.02 thousand t, which results in a projected MMB of 75.96 thousand t. The maximum permissible ABC, ABC_{max}, for 2025/26 is 50.94 thousand t, based on the p^* ABC. In 2014, the NPFMC's Scientific and Statistical Committee (SSC) adopted a 20% buffer to calculate ABC for Tanner crab to incorporate concerns regarding model and environmental uncertainty for this stock (SSC 2014). Because of uncertainty regarding environmental influences, the currency to describe reproductive potential, and the application of harvest control rules based on equilibrium considerations remain concerns for this stock and assessment, the author recommends continuing to use the 20% buffer to calculate the ABC. Based on this buffer, the ABC would be 40.81 thousand t.

1.8 Rebuilding analyses results summary

The Tanner crab stock was found to be above MSST (and B_{MSY}) in the 2012 assessment (Rugolo and Turnock 2012a) and was subsequently declared rebuilt. The stock remains not overfished. Consequently, no rebuilding analyses were conducted.

2 Summary of Major Changes

2.1 Management

The directed fishery was prosecuted in 2024/25 in both State management areas (i.e., east and west of 166ºW longitude in the General Section of the Eastern Subdistrict of the Bering Sea District of the Tanner Crab Registration Area J; Figure 1) in the EBS. This is only the third year since the 2015/16 season that the eastern area has been open to directed fishing (2022/23 was the first). Bycatch of Tanner crab also occurred in the snow crab fishery, the Bristol Bay red king crab (BBRKC) fishery, and the groundfish fisheries.

2.2 Input data

Retained catch time series (catch abundance and biomass) and size compositions were updated with data from the directed Tanner crab fishery for 2024/25. The time series of estimated total catch abundance and biomass, as well as associated size composition data, were updated with information from fishery observer sampling from the 2024/25 season for the directed fishery and for bycatch in the snow crab, BBRKC, and the groundfish fisheries. Fishery-independent time series ("survey" biomass and abundance) and size compositions were updated with data from the 2025 NMFS EBS shelf bottom trawl survey, as were maturity ogives for new shell males. No updates occurred to the Bering Sea Fisheries Research Foundation (BSFRF) survey data and molt increment data included in the assessment. The updates are summarized in Table E.

Table E. Data used in this assessment, with new and updated data noted.

Description	Data types	Time frame	Notes	Source
NMFS EBS Bottom Trawl Survey	area-swept abundance, biomass	1975-2019, 2021-25	2025 added	NMFS
	size compositions	1975-2019, 2021-25	2025 added	
	male maturity data	2006+	2025 added	
NMFS/BSFRF	molt-increment data	2015-17, 2019	no new data	NMFS, BSFRF
BSFRF SBS Bottom Trawl Survey	area-swept abundance, biomass	2013-18	no new data	BSFRF
	size compositions	2013-18	no new data	
Directed fishery	historical retained catch (numbers, biomass)	1965/66-1996/97	not updated	2018 assessment
	historical retained catch size compositions	1980/81-1996/97	not updated	2018 assessment
	retained catch (numbers, biomass)	2005/06+	2024/25 added	ADFG
	retained catch size compositions	2005/06+	2024/25 added	ADFG
	total catch (abundance, biomass)	1991/92+	2024/25 added	ADFG
	total catch size compositions	1991/92+	2024/25 added	ADFG
Snow Crab Fishery	historical effort	1978/79/1989/90	not updated	2018 assessment
	effort	1990/91+	2024/25 added	ADFG
	total bycatch (abundance, biomass)	1990/91+	2024/25 added	ADFG
	total bycatch size compositions	1990/91+	2024/25 added	ADFG
Bristol Bay Red King Crab Fishery	historical effort	1953/54-1989/90	not updated	2018 assessment
	effort	1990/91+	2024/25 added	ADFG
	total bycatch (abundance, biomass)	1990/91+	2024/25 added	ADFG
	total bycatch size compositions	1990/91+	2024/25 added	ADFG
Groundfish Fisheries (all gear types)	historical total bycatch (abundance, biomass)	1973/74-1990/91	not updated	2018 assessment
	historical total bycatch size compositions	1973/74-1990/91	not updated	
	total bycatch (abundance, biomass)	1991/92+	2024/25 added	NMFS/AKFIN
	total bycatch size compositions	1991/92+	2024/25 added	

2.3 Assessment methodology

The assessment model framework, TCSAM02, is described in detail in Stockhausen (2023a). The only model considered in this assessment, 22.03d5, is identical to the accepted model from last year's assessment. To avoid confusion, the 2024 assessment model will be referred to here as "`22.03d5 (2024)`" while the model with data updated for 2024/25 will be referred to as "`22.03d5 (2025)`".

In addition to the Tier 3 model, results from a Tier 4 "fallback" model are provided. The Tier 4 model uses a random walk model to reduce the variance in design-based estimates of survey MMB and applies the appropriate control rule to calculate Tier 4 alternatives to the Tier 3 OFL and ABC.

Finally, a Risk Table based on the Tanner crab Ecosystem and Socioeconomic Profile (Hennessey and Garber-Yonts 2025) is presented in Appendix A (Stockhausen 2025a).

2.4 Assessment results

Total fishing mortality in 2024/25, based on retained catch information from fish tickets and estimates of discard mortality for Tanner crab in the directed fishery, the snow crab fishery, and the groundfish fisheries, was 3.093 thousand t, which was less than the OFL for 2024/25, so **overfishing did not occur**. Based on results from the author's preferred model, `22.03d5 (2025)`, stock status did not change: the stock remains in Tier 3a and **the stock is not overfished**. The OFL for 2025/26 is 51.02 thousand t. The author-recommended buffer is 20%, which is the same as the buffer applied last year. Thus, the author-recommended ABC for 2025/26 is 40.81 thousand t.

3 Responses to the most recent two sets of SSC and CPT Comments

3.1 CPT Comments May 2025

CPT Comment (general)

With regard to Risk Tables:

- Given that baseline buffers or buffer ranges are not specified by tier level for crab stocks, buffers should consider uncertainty associated with tier level if warranted.
- The risk table should also be used to evaluate additional uncertainty, on a stock-by-stock basis, that is not already incorporated in the assessment model, tier level, or harvest control rules.
- No prescriptive formula will be used to adjust risk table scores or buffers across stocks.
- …assessment authors should coordinate with ESP authors (and ESR authors when an ESP is not available) to discuss ecosystem considerations prior to completion of a risk table.
- Risk tables should be conducted for all annual crab stock assessments (Snow crab, Tanner crab, BBRKC, NSRKC, and AIGKC). A full risk table will be contained as an appendix in each individual SAFE chapter with rationale given for risk table scoring. Brief risk table summaries will be included in the SAFE introduction (i.e., general description and risk table template, CPT-recommended risk table scores, and buffer for each stock).

Response

Sept. 2025: The risk table for the 2025 Tanner crab stock assessment is provided as a stand-alone appendix (Stockhausen 2025a). It was created as a joint effort by the assessment author and the ESP and ESR authors. It does not use a prescriptive formula to adjust the risk table scores.

CPT Comment (specific to assessment)

The CPT agreed with using the high-precision carapace width data but recommended using the full set of 1979 stations provided in `crabpack`.

Response

Sept. 2025: Done.

CPT Comment (specific to assessment)

With regards to GMACS:

- The CPT suggested starting from inputting parameters via a .PIN file in the bridging analyses and then work towards estimating parameter values
- it might also be useful to consider how selectivity is being estimated. A closer look at how priors were placed on the NMFS survey selectivity seems warranted given large differences between estimates from each model.

Response

Sept. 2025: Since May, several Tanner-specific features have been added to GMACS (e.g., additional selectivity options, growth options, etc.) to better match the bespoke model configuration and to facilitate the comparison using a directly-comparable pin file. One major stumbling block to this approach is the difference in how recruitment is handled in each model. In the bespoke model, recruitment is modeled differently in the time periods before and after 1975, the first year that survey data is incorporated into the model: recruitment prior to 1975 (the first year that survey data is available) is modeled as a first-order autoregressive (AR1) process while after 1975 it is modeled as a random walk. This two-period strategy was found to be the best way of building up the population using recruitment during a "spin-up" period from zero in 1948 (an approach that ensures the population structure is consistent with modeled growth and mortality when the survey data become available in 1975). In GMACS, recruitment cannot be defined for different time periods: a single set of recruitment parameters is applied to the entire model time period. A work-around may be to start the GMACS model in 1975 but initialized with the population structure from the bespoke model for 1975, as well as other bespoke model-equivalent parameters and processes, but this has not been implemented yet. Another issue is that the GMACS model, when run from a pin file that is thought to provide the best match to the bespoke model, generates an invalid gradient structure (i.e., a vector of NaNs) after ~150 optimization steps and the reason for this has not yet been identified. As a consequence, no GMACS models are discussed in this document.

CPT Comment (specific to assessment)

The CPT recommended bringing forward only the base model (22.03d5) and the GMACS model (G25.05) so that more effort can be placed on bridging to GMACS.

Response

Sept. 2025: The base model, 22.03d5, has been updated with 2024/25 data and provides the basis for this assessment. It was not possible to bring a GMACS model forward at this point (see comment/response above).

CPT Comment (specific to assessment)

likelihood profiles over the OFL would be an interesting addition to the currently presented analyses.

Response

Sept. 2025: Time constraints did not allow this suggestion to be pursued, although the dependence of the OFL on several parameters which were themselves profiled is illustrated in the stand-alone Appendix A to this document (Stockhausen 2025b). If time allows, the suggestion will be followed up on for the January Modeling workshop.

3.2 SSC Comments October 2024

SSC Comment (general)

The SSC notes that a historical retrospective is different from a within model retrospective and requests that crab assessments include a plot comparing the model-estimated time series of mature male biomass from the current assessment with the time series from the ten previous assessments (i.e., historical retrospective).

Response

Sept. 2025: The requested plot is given in Figures 164 and 165.

SSC Comment (general)

The SSC recommends that each crab SAFE chapter include a clear description of the buffers used in harvest specification over the most recent five years, as a basis for comparing the current year's buffer recommendations.

Response

Sept. 2025: The buffer on Tanner crab has consistently been set at 20% by the SSC in recent years, despite occasional recommendations by the author (if not the CPT) for a larger value. This is repeated several times in the text.

SSC Comment (specific to assessment)

The SSC concurs with the CPT and recommends bringing forward the base model (22.03d5) and the GMACS model (G25.05) in October.

Response

Sept. 2025: 22.03d5 has been brought forward. G25.05 was not brought forward due to unexpected (and currently unresolved) problems encountered with optimizing the model (the optimization failed after ~150 steps after generating an invalid gradient vector required to update the parameter values). Time constraints did not allow a solution to this to be found in time for model results to be included in the SAFE.

SSC Comment (specific to assessment)

The SSC also recommends bringing forward a Tier 4 calculation similar to 2024 and consistent with methods used for BBRKC and EBS snow crab.

Response

Sept. 2025: Done.

SSC Comment (specific to assessment)

The SSC agrees that focus should remain on transitioning this assessment into the GMACs framework and recommends developing a list of clear milestones for the transition for the October meeting.

Response

Sept. 2025: See GMACS-relevant responses above. A list of milestones would include: 1) agreement between GMACS and the bespoke model when the former is started in 1975 with a pin file derived from the bespoke model that includes the bespoke model's estimates of population structure in 1975; 2) successful optimization of the GMACS model (a current point of failure, as noted in responses above); 3) comparison of all likelihood components between the two models; 4) adjustment of priors and penalties to achieve model configurations that are as close as possible; 5) evaluation of the final comparison.

3.3 CPT Comments September 2024

CPT Comment (general)

None.

CPT Comment (specific to assessment)

The high priorities for future work includes completion of the BSFRF selectivity analysis to incorporate into the assessment model and work towards an acceptable GMACS Tanner crab model.

Response

May 2025: The BSFRF selectivity analysis was presented at the January 2025 Modeling Workshop and is nearly complete. Curves based on the survey-level (not haul-level) analysis were used in alternative TCSAM02 model 25_02 as pre-specified capture probability (fully-selected catchability * selectivity). Model results are discussed in Section 4 of (Stockhausen 2024b). Significant progress has been made towards an acceptable GMACS model (Section 5 of (Stockhausen 2024b)).

Sept. 2025: Further work on the BSFRF selectivity remains a priority but other commitments did not allow time to complete this analysis. Further work will be presented at the January 2026 Modeling Workshop.

3.4 SSC Comments October 2024

SSC Comment (general)

The SSC would like to see additional residual diagnostics other than raw residuals for length composition data from GMACS models. The SSC encourages crab authors to collaborate with groundfish assessment authors regarding the use of One-Step-Ahead and Pearson residuals.

Response

May 2025: One-Step-Ahead (OSA) residuals and DHARMa residual statistics are provided for most of the models discussed herein (Stockhausen 2024b). Sept. 2025: "Raw" residuals have almost never been presented in the Tanner crab assessments; Pearson's residuals have been presented. For this assessment, OSAs and DHARMa statistics are additionally presented for fits to size composition data.

SSC Comment (general)

The SSC requests that the CPT consider whether distinguishing between full and update assessments, as in the protocol recently adopted for groundfish assessments, would be useful for crab assessments.

Response

May 2025: As an author or reviewer, this distinction might be useful if the requirements for update assessments were reduced from those for full assessments.

SSC Comment (general)

The SSC suggests the CPT live link assessments and other documents in their report to facilitate review.

Response

May 2025: If the SSC is requesting that links to figures and tables be provided in the text, that has been done in the Tanner crab assessment and other reports for several assessment cycles now (just tap the figure/table number). Otherwise, it is unclear to what the request refers.

SSC Comment (general)

CPT develop a process for ensuring that authors have provided a response to all previous (including at least, the last assessment) SSC recommendations.

Response

May 2025: It would be helpful if SSC requests were extracted into a table. In particular, SSC comments that pertain to multiple stocks may only occur in the review for a single stock.

SSC Comment (specific to assessment)

While the SSC appreciates the author's attention to detail, the SSC highlights that the SAFE and the included Appendices are over 700 pages long, which makes review a daunting task. The SSC suggests that consideration should be given to streamlining the material included in future assessment documents.

Response

May 2025: Specific suggestions for streamlining the assessment would be welcome. The SAFE guidelines prescribe a substantial number of topics to be addressed in an assessment, and this has grown in recent years with incorporation of risk tables and ESPs. The Appendices generally provide supplementary information related to, but not necessarily critical to, understanding and evaluating the assessment (e.g., exhaustive residuals plots) or they provide results from requested analyses. They should be regarded the same as "Supplementary Material" in a published paper.

SSC Comment (specific to assessment)

While this [fixing Dirichlet-Multinomial parameters] addresses the immediate issue [of the parameters hitting an upper bound], fixing parameters is not a long-term solution, and evaluation of whether these parameters can be reliably estimated should continue.

Response

May 2025: Agreed, although a D-M parameter hitting an upper bound simply implies that the size composition and associated sample size being evaluated are consistent with a multinomial distribution. The input sample sizes for most size compositions fit in the Tanner crab model have already been substantially down-weighted from the number of crab sampled, so an associated D-M parameter hitting its upper bound is not surprising.

SSC Comment (specific to assessment)

The draft risk table noted increased concern for population dynamics in part due to uncertainty in the quantification of reproductive output. The SSC suggests this uncertainty is more associated with the stock assessment, rather than population dynamics.

Response

May 2025: Noted. The concern will be moved to the "stock assessment" column of the table.

SSC Comment (specific to assessment)

Directly incorporate annual molt to maturity data, as implemented in the EBS snow crab assessment, if sufficient data are available.

Response

May 2025: As has been noted previously (see below), this would require substantial development work to implement in TCSAM02. A GMACS model implementing *annual* molt to maturity data has been developed but time did not allow re-running the model for this report after issues with the GMACS code were identified (and subsequently corrected). The GMACS model discussed in this report (Stockhausen 2024b) uses the mean molt to maturity curve based on the annual data.

SSC Comment (specific to assessment)

Explore differences in the spatial distribution of small male crab in the NMFS survey, to identify if the distribution of small crab encountered in 2003-2005 and 2008-2010, which successfully propagated to larger sizes, showed differences in habitat use compared with the cohort first observed in 2017-2019, which did not propagate to larger sizes. Likewise, the SSC recommends that a comparison of environmental conditions experienced by small crabs during these periods may help to elucidate why some cohorts appear to propagate and others do not.

Response

May 2025: A preliminary analysis (Stockhausen 2024b) suggests differences in temperatures experienced by the "successful" and "unsuccessful" cohorts.

SSC Comment (specific to assessment)

[…] the SSC notes that for a number of years, the author and CPT have expressed concerns that the recommended models are overly optimistic. The SSC recommends exploring the reason for this characterization through exploring likelihood profiles and other diagnostics and sensitivities of important scale related parameters (e.g., natural mortality, catchability and mean recruitment).

Response

May 2025: Likelihood profiles were run for log-scale mean recruitment, male survey catchability, and base natural mortality. Preliminary results suggest that the three are substantially correlated (see Stockhausen 2024b). Further analysis will be presented in September.

Sept 2025: A limited set of likelihood profile results are presented in Appendix A of this SAFE (Stockhausen 2025b).

3.5 CPT Comments May 2024

CPT Comment (specific to assessment)

The CPT recognized the amount of work [the author] had accomplished in responding to SSC requests to transition to GMACS, but requested that a more complete bridging analysis be undertaken for presentation to the modeling workshop in January 2025. Some features of TCSAM02 will need to be incorporated into GMACS for the CPT to make a more direct comparison between models.

Response

Sept 2024: the author plans to address this request in the given time frame.

CPT Comment (specific to assessment)

The CPT recommended that only TCSAM02 model 22.03d be brought forward to the September final assessment.

Response

Sept 2024: Done. The author's preferred model, 22.03d5, is 22.03d, updated with 2023/24 data and modified to fix the effective sample size parameters for the two Dirichlet-Multinomial likelihoods applied to the sex-specific BSFRF SBS size compositions near their upper bounds.

3.6 SSC Comments June 2024

SSC Comment (general)

The SSC requests the authors and CPT consider coordinating the approach to analyzing the BSFRF data for the two *Chionoecetes* crab and BBRKC stocks, and specifically consider developing the results as a prior on selectivity for use in the models

Response

Sept 2024: With the 2018 BSFRF SBS data for Tanner crab provided this past year, the author is finishing up analyses using the BSFRF SBS data for Tanner crab and BBRKC to inform NMFS survey selectivity. Following completion, a similar approach will be applied to the snow crab data. Products from these analyses will include stock-specific priors for NMFS survey selectivity. The analysis for Tanner crab and BBRKC should be completed in time to present at the January 2025 Modeling Workshop. The analysis for snow crab will potentially be completed by the May 2025 CPT meeting.

SSC Comment (specific to assessment)

The SSC supports the author and CPT recommendation to bring forward Model 23.03d in September, updated with the 2023/24 NMFS survey data, provided that the issues related to parameters on bounds can be resolved.

Response

Sept 2024: The issues involved with parameters on a bound were resolved in the author's preferred model, 22.03d5. Appendices B and C for (Stockhausen 2024b) discuss bridging analyses that move from 22.03b to 22.03d, incorporating the 2013-2018 BSFRF SBS data (Appendix B), and from 22.03d to 22.03d5 incorporating the 2023/24 data.

SSC Comment

The SSC recommends the author provide additional detail in the changes to the underlying BSFRF data from 2013-17 that caused parameters to hit bounds, including details on any possible changes to the data weighting.

Response

Sept 2024: Additional details associated with incorporating the 2013-2018 BSFRF SBS data into the assessment are discussed in Appendix A and Appendix B, the first bridging analysis.

SSC Comment

If the author is unable to resolve the parameter bounding issue, the SSC recommends that an alternative model that fixes these parameters at a value of 1.0 and that has no other parameters on bounds be brought forward in addition to Model 22.03d and the Tier 4 approach (using the SSC recommended 2023 method).

Response

Sept 2024: The author's preferred model, 22.03d5, fixes the parameter bounding issue and has no estimated parameters on a bound.

SSC Comment

Consider a smoothed approach instead of the current empirical approach to the terminal molt curve, which assumes no observation error.

Response

Sept 2024: If this comment applies to the current modeling framework (TCSAM02), it seems to be based on a misunderstanding of how the current model deals with terminal molt. The model currently estimates a size-specific curve reflecting the probability of undergoing terminal molt (i.e., the probability that a crab of **pre-molt size** z_{pre} **will undergo** terminal molt), to which 2nd order difference penalties are applied to achieve a "smooth" curve. The parameter values underlying this estimated curve are principally informed by including a likelihood component in the model optimization that compares the "observed" ratio of new shell mature males to all new shell males in the NMFS EBS shelf survey, by 10-mm size bin, in several years to model-predicted ratios based on the parameter values (thus, "observed" vs. estimated probabilities at **post-molt size** z_{post} of **having undergone** terminal molt). The "observed" ratios are, for each survey year with available chela height data, based on classifying new shell mature males within a size bin on the basis of their CH to CW (chela height to carapace width) ratios. The "observation errors" used in the associated likelihood component are assumed to be binomially-distributed, conditioned on the total number of crab measured within the size bin.

On the other hand, if this comment applies to a model (which is still under development) in the GMACS framework that would be similar to the current snow crab model, then the suggestion is taken under advisement and can be addressed once the CPT and SSC have approved a preliminary GMACS Tanner crab model.

SSC Comment

Show confidence intervals on estimated time series when comparing model runs, in order to allow interpretation of whether differences among alternative models are statistically meaningful.

Response

Sept 2024: Uncertainty estimates are available in ADMB for "sdreport" variables or through MCMC. ADMB only provides sdreport variables up to two dimensions (matrices), so quantities that would require more than two dimensions (e.g., survey-related estimates would require four dimensions: fleet [NMFS or BSFRF, currently], year, sex, maturity state). TCSAM02-based models provide sdreport output only for time series of recruitment (a vector) and spawning biomass (a matrix). Confidence intervals on other estimated time series are only available in TCSAM02-based models if MCMC runs are successful. Andre Punt has suggested that it would be possible to expand GMACS sdreport capabilities to incorporate expanded coverage of estimated time series, but that this will result in substantially increased model run times.

SSC Comment

Remove the connection between 2019 to 2021 when plotting survey time-series estimates and variances.

Response

Sept 2024: The connection has been removed from the relevant plots.

SSC Comment

The SSC concurs with the CPT that these models (i.e., the GMACS models) require further development and with the author and CPT recommendation to conduct a detailed bridging analysis as a next step. The SSC supports the CPT recommendation to make GMACS development the focus of the January 2025 modeling workshop.

Response

Sept 2024: Noted. The author regards the transition to GMACS as the main priority to address in future work. He hopes that a suitable comparison can be presented at the January Modeling Workshop.

Sept 2025: Results from GMACS models that approached the bespoke model were presented to the CPT in May 2025 ((Stockhausen 2024b)).The best model exhibited scaling issues with respect to results from the bespoke model. The author subsequently added functionality to GMACS to better replicate modeling choices in the bespoke model (e.g., selectivity functions) that were missing from GMACS. Unfortunately, the current Tanner crab model in GMACS is crashing in the middle of optimization and the source of this issue has not yet been identified. No GMACS models are considered as potential alternatives here.

SSC Comment

The SSC supports the continued exploration of a geostatistical time-series for Tanner crab.

Response

Sept 2024: The author has tried a number of times to incorporate VAST-based indices of survey abundance/biomass into the assessment model. In general, these indices exhibit only small differences in the individual estimates from their design-based counterparts. The major differences between the VAST indices and the design-based indices is in the CVs; thus, using the VAST indices is really just equivalent to increasing the weight on the survey biomass trends in the model likelihood relative to other data sources. The result is increased model instability and the inability to find the maximum likelihood solution.

SSC Comment

The SSC also recommends that a similar method of the treatment of the BSFRF data be considered for the Tanner GMACS model as in the EBS snow crab model where it is used to inform the prior on survey selectivity, or at minimum an evaluation of the relative merits of each approach.

Response

Sept 2024: This suggestion will be addressed following completion of analysis of the paired haul BSFRF/NMFS selectivity study data for Tanner crab and transition of the assessment to GMACS.

3.7 CPT Comments January 2024

CPT Comments (general)

Responses for unaddressed SSC and CPT comments should include an estimate of the timeline for work, if applicable.

Response

Sept 2024: This is really only possible for the requests given the highest priority. For these requests, a preliminary estimate for completion will generally be the next May CPT meeting.

CPT Comments

Assessments should include a history of modeling approaches, and a table of historical issues addressed.

Response

Sept 2024: A general history of modeling approaches is available in the "History of modeling approaches for this stock" section (Section 6.1. A table of historical issues addressed is under development and will be included in the next assessment, although **it would be helpful if the CPT could provide a template** for all stocks.

CPT Comments

The CPT recommended the stock assessment authors that have final assessments in Sept/Oct bring forward a draft risk table for CPT review at that time.

Response

Sept 2024: A draft risk table is provided as an appendix to the SAFE chapter.

CPT Comments

The CPT recommended that total catch be fitted in the model, after which mortality rates can be applied by weighting gear-specific mortality rates (e.g., trawl vs. fixed gear) by the proportion of bycatch for each gear type.

Response

Sept 2024: In the current assessment model(s), all bycatch in the groundfish fisheries is aggregated across gear types and the bycatch rate for trawl gear is applied. Effectively, this suggestion will mean applying a year, sex, and size-specific handling mortality rates to Tanner crab bycatch in the groundfish fisheries. Addressing this will involve additional data processing and modifying input data files to the assessment model. Because the current emphasis with the assessment is to transition the Tanner crab assessment to GMACS, the author can address this issue in GMACS once the transition has been made, if it is regarded as a high priority. An alternative (and conceptually simpler) solution would be to incorporate gear-specific bycatch information directly into the assessment model as separate fleets.

CPT Comments (specific to assessment)

The CPT recommended that the Tanner assessment use 50% handling mortality rate for groundfish fixed gear (pot and long line) to be consistent with other crab assessments.

Response

Done. This assessment uses handling (discard) mortality rates of 32.1% for bycatch in the crab fisheries, 50% for bycatch in the fixed-gear groundfish fisheries, and 80% for bycatch in the groundfish trawl fisheries when determining total catch mortality directly from observer data. In the current assessment model(s), all bycatch in the groundfish fisheries is aggregated across gear types and the bycatch rate for trawl gear is applied.

3.8 SSC Comments February 2024

SSC Comments (general)

The SSC supports revisiting the topic of VAST or other spatiotemporal model-based methods for the 2025 CPT modeling workshop, as this topic is relevant to several stocks and there have been some updates that might improve applicability to crab assessments.

Response

Sept 2024: Noted.

SSC Comments

The SSC looks forward to seeing draft risk tables for the crab stocks being reviewed in October. The SSC reiterates that the risk table framework is intended to provide a clear and transparent basis for communicating assessment-related and stock condition concerns that are not directly captured in model- based uncertainty, the tier system, or harvest control rules (see Preliminary Guidance and SSC recommendations on risk tables in the June 2021 SSC Report, p.33). Also, the SSC recommends that crab assessment authors follow the same organization scheme as the groundfish assessment authors, where the full risk table is contained in each individual chapter and brief summaries are included in the SAFE introduction.

Response

Sept 2024: A draft risk table is provided as an appendix to the SAFE chapter.

3.9 CPT Comments September 2023

CPT Comments (general)

The CPT recommends that all assessment authors document assumptions and simulate data under those assumptions to test the ability of the model to estimate key parameters in an unbiased manner. These simulations would be used to demonstrate precision and bias in estimated model parameters.

Response

May 2024: On the "to do" list.

Sept 2024: Model assumptions are discussed in Section 6.2. The ability to simulate data and fit to it within a single model run was implemented in TCSAM02 this summer, but time constraints have not allowed completion of a substantive set of tests. **The author requests that the CPT include the topic of simulation testing as an agenda item for the January Modeling Workshop.**

CPT Comment

The CPT recommends that weighting factors be expressed as sigmas or CVs or effective sample sizes. The team requests all authors to follow the Guidelines for SAFE preparation and to follow the Terms of Reference as listed therein as applicable by individual assessment for both content and diagnostics.

Response

May 2024: These requests are generally followed, but the compressed time frame for SAFE preparation in the fall often precludes including analyses that require extended time frames, e.g., MCMC evaluation).

CPT Comment

Authors should focus on displaying information on revised models as compared to last year's model rather than focusing on aspects of the assessment that have not changed from the previous year.

Response

May 2024: This is generally the case, except to highlight issues that remain unresolved from the previous assessment.

CPT Comment

The current approach for fitting length-composition data accounts for sampling error but ignores the fact that selectivity among size classes is not constant within years; a small change in the selectivity on small animals could lead to a very large change in the catch of such animals. Authors are encouraged to develop approaches for accounting for this source of process error. This issue is generic to assessments of crab and groundfish stocks.

Response

May 2024: Annual survey selectivity curves for the NMFS EBS shelf survey have been estimated using selectivity models derived from the BSFRF "side-by-side" selectivity studies. Several of the GMACS models presented in this report incorporate this source of variability.

Sept 2024: The author notes the CPT rejected several GMACS models that addressed this issue, but that it remains an area of continued effort.

CPT Comment

Authors are reminded that assessments should include the time series of stock estimates at the time of survey for at least the author's recommended model in that year.

Response

May 2024: This has generally been the case.

Sept 2024: See Tables 93-96 for population abundance and biomass estimates at the start of the crab year (the time of the survey).

CPT Comment

Consider stepwise changes to data as individual model runs instead of changing multiple parameters at once so that changes in model performance may be attributed to specific data.

Response

May 2024: This has generally been the approach in presenting model results. the GMACS models presented in this report, however, represent enough of a "clean break" from the current assessment model that this incremental approach would have been extremely unwieldy (if not impossible) to implement.

Sept 2024: Appendices B and C provide the requested bridging analyses in detail.

CPT Comments (specific to assessment)

None.

3.10 SSC Comments October 2023

SSC Comments (general)

For the inclusion of trawl survey data, the SSC suggests crab assessment authors and the CPT be more explicit about best practices for which standard years are included for bottom trawl survey data. The SSC suggests that the years recommended by the Groundfish Plan Teams would be a good starting point, which specify using the following bottom trawl survey data years: - Aleutian Islands: 1991 - present (standard gear) - Eastern Bering Sea: 1982 - present (standard gear, grid, and design), 1987 - present for species that inhabit the northwest corner of the survey (which was added in 1987 for snow crab and walleye pollock)

Response

May 2024: As per every assessment since 2015, the current stock assessment model fits NMFS EBS bottom trawl survey biomass indices and size comps using crab-standardized stations starting in 1975. It estimates separate sex-specific parametric selectivity curves and fully-selected catchabilities for the 1975-1981 and gear-standardized 1982+ time periods. Alternative models such as the GMACS models considered in the May 2024 Tanner crab report have used only the 1982+ time period.

SSC Comment

Risk tables would be used to provide a more comprehensive, transparent, and defensible justification for CPT and SSC recommendations on ABC buffers.

Response

May 2024: a risk table will be included in the 2024 assessment.

Sept 2024: A draft Risk Table is provided in Appendix D.

SSC Comment

future BBRKC, Tanner and snow crab assessments routinely include a simple Tier 4 analysis that includes a smoothed time series of survey vulnerable biomass (legal size or smaller to accommodate discard mortality) using the REMA package and not adjusted for natural mortality. This model will provide a consistent alternative should the preferred Tier 3 approach fail in some way and also a point of comparison with Tier 3 and State methods used as a basis for TAC setting.

Response

May 2024: The SSC appears to have accepted the author's approach used in the 2023 assessment. This will be repeated for 2024.

Sept 2024: See the Tier 4 Model section in (Stockhausen 2024b).

SSC Comment

Include uncertainty intervals when showing time series of biomass/abundance estimated by the stock assessment models

Response

May 2024: This will be done for the 2024 assessment.

Sept 2024: Done.

SSC Comment

The SSC suggests that the CPT and crab authors continue to evaluate whether VAST or similar approaches, when specified carefully for individual crab stocks (i.e., the choice of error distributions and number of knots) might provide more robust survey time-series

Response

May 2024: Previous reports have examined the use of VAST-derived time series for survey abundance/biomass and results from a GMACS model fitting to VAST-derived estimates are presented in the May 2024 Tanner crab report. Using the VAST estimates for the survey biomass time series results in poor model fits and model convergence issues.The VAST and design-based estimates are typically similar but differ mainly in the associated estimates of uncertainty. Thus, the ultimate effect of using the VAST estimates could be achieved heuristically simply by placing more emphasis on the survey indices relative to the fishery catch data than is currently done. However, the estimates themselves suggest that interannual changes in stock biomass much larger than the current model dynamics (constant M, constant probability of terminal molt, constant growth dynamics, constant survey selectivity and fully-selected catchability) can accommodate are credible and should be captured by the model. The introduction of more flexible, time-varying dynamics is the key to better fitting the survey indices (VAST or design-based), but to do so with regard to plausible mechanisms and drivers is an area of ongoing research.

SSC Comments (specific to assessment)

The SSC continues to support development of a parallel or simplified version of the Tanner crab assessment model in the GMACS platform, and the author's proposed development timeline in fall 2023.

Response

May 2024: Simplified versions of the Tanner crab assessment model using the GMACS framework are presented in the May 2024 Tanner crab report.

Sept 2024: The CPT rejected the simplified GMACS Tanner crab models presented in May and requested full model comparison. This will be presented at the January 2025 Modeling Workshop.

SSC Comment

The SSC appreciates the author's development of a simplified Tier 4 model for use as a backup in the event that extreme and insurmountable issues are encountered by the Tier 3 assessment model in the future. The SSC supports the structure of the Tier 4 model as presented, based on the estimate of vulnerable male crab biomass from the NMFS EBS bottom trawl survey and including the use of the coefficient of variation in projected biomass as a reasonable basis for defining the ABC buffer. With respect to the reference time period for calculating BMSY, the SSC concurs with the CPT recommendation to use the entire time series since 1982.

Response

May 2024: Results from this model will be updated for the 2024 assessment.

Sept 2024: Results from a Tier 4 analysis are presented in (Stockhausen 2024a).

SSC Comment

Briefly summarize the history of the GOA Tanner crab fishery and stock dynamics, given the possible value of this information for the interpretation of BSAI Tanner crab stock dynamics.

Response

May 2024: Kally Spalinger (ADFG) and Nathaniel Nichols (ADFG) have provided the author with, respectively, data from the Kodiak Large Mesh Survey for Tanner crab and historical landings from GOA Tanner crab fisheries. A "history" has not yet been developed, but time series of abundance and landings are included in the May 2024 Tanner crab report. A preliminary comparison of survey abundance trends suggests that recruitment in the GOA and EBS is correlated, but whether this is due to a direct linkage or simply environmental mediation is unknown.

SSC Comment

Consider directly incorporating annual molt to maturity data, as implemented in the EBS snow crab assessment, if sufficient data are available.

Response

May 2024: This suggestion is explored in several GMACS models presented in the May 2024 Tanner crab report.

SSC Comment

Consider using the Bering Sea Fisheries Research Foundation (BSFRF) survey data to inform selectivity and catchability, as implemented in the EBS snow crab assessment, as an alternative to fitting these data as a separate index.

Response

May 2024: The BSFRF data has been used to inform NMFS survey selectivity/catchability in several GMACS models presented in the May 2024 Tanner crab report.

SSC Comment

Explore what might be driving the residual pattern in the fit to the NMFS survey data.

Response

May 2024: Because recruitment is freely estimated, the residual patterns are presumably due to the constraints on the model dynamics imposed by 1) constant M and 2) constant growth dynamics, as well (possibly) as variability in weight-at-size.

SSC Comment

With respect to the spatial distribution of Tanner crab captured in the NMFS bottom trawl survey, the SSC appreciates the inclusion of Figures 38-42 which highlight both the large number of small male crab encountered in 2023 and the spatially expansive nature of that increase in CPUE. The SSC encourages exploration of differences in the spatial distribution of small male crab in the NMFS survey, to identify if the distribution of small crab encountered in 2003-2005 and 2008-2010, which successfully propagated to larger sizes, showed differences in habitat use compared with the cohort first observed in 2017-2019, which did not propagate to larger sizes.

Response

May 2024: This is an avenue for future research.

SSC Comment

Likewise, the SSC recommends that a comparison of environmental conditions experienced by small crabs during these periods may help to elucidate why some cohorts appear to propagate and others do not.

Response

May 2024: This is an avenue for future research.

SSC Comment

Fits to length composition data in the recent period remain a concern, exemplified by large negative residuals in length composition fits for the largest observed length bin in recent years and as a strong positive retrospective pattern in recruitment.

Response

May 2024: Large negative residuals in (male) size compositions continue to be a problem with this assessment. The residuals to the estimated mean post-molt size for large males are also (increasingly) negative with pre-molt size. This suggests that something else in the data is forcing male crab to grow to sizes inconsistent with the molt increment and size composition data. Potential sources for this include a biased size-weight regression used to convert abundance to biomass and biased probabilities of terminal molt and suggest avenues for future research.

4 Introduction

4.1 Stock

Tanner crab, *Chionoecetes bairdi*. Tanner crab is one of five species in the genus *Chionoecetes* (Rathbun 1924). The common name "Tanner crab" for *C. bairdi* (Williams et al. 1989) was modified to "southern Tanner crab" in 2005 (McLaughlin and Co-authors 2005). Prior to this change, the term "Tanner crab" had also been used to refer to other members of the genus, or the genus as a whole. Hereafter, the common name "Tanner crab" will be used in reference to "southern Tanner crab".

4.2 Distribution

Tanner crabs are found in continental shelf waters of the north Pacific. In the east, their range extends as far south as Oregon (Hosie and Gaumer 1974) and in the west as far south as Hokkaido, Japan (Kon 1996). The northern extent of their range is in the Bering Sea (Somerton 1981a), where they are found along the Kamchatka peninsula (Slizkin 1990) to the west and in Bristol Bay to the east.

In the EBS, the unit stock is defined as the geographic range of the EBS continental shelf. *C. bairdi* is common in the southern half of Bristol Bay, around the Pribilof Islands, and along the shelf break, although males less than the industry-preferred size (125 mm carapace width [CW]) and ovigerous and immature females of all sizes are distributed broadly from southern Bristol Bay northwest to St. Matthew Island (Rugolo and Turnock 2011a). Water temperature may limit the northern extent of the spatial distribution of Tanner crab (Somerton 1981a; Murphy 2020). The southern range of snow crab, the cold water congener *C. opilio*, in the EBS is near the Pribilof Islands (Turnock and Rugolo 2011). The distributions of snow and Tanner crab overlap on the shelf from approximately 56° to 60°N, and in the two species hybridize in this area (Karinen and Hoopes 1971).

4.3 Stock structure

Tanner crab in the EBS are considered to be a separate stock distinct from Tanner crab in the eastern and western Aleutian Islands (NPFMC 1998). Clinal differences across the EBS shelf in some biological characteristics such as mean mature size exist across the range of the unit stock, leading some authors to argue for a division into eastern and western stocks in the EBS (Somerton 1981b; Zheng 2008; Zheng and Pengilly 2011). However, it was not generally recognized at the time of these arguments that this species undergoes a terminal molt at maturity (Tamone et al. 2007), nor were the implications of ontogenetic movement considered. Thus, biological characteristics estimated using comparisons of length frequency distributions across the range of the stock, or on modal length analysis over time, may have been confounded as a result and do not provide definitive evidence of stock structure.

Simulated patterns of larval dispersal suggest that Tanner crab in Bristol Bay may be somewhat isolated from other areas on the shelf, and that this component of the stock relies heavily on local retention of larvae for recruitment, suggesting that Tanner crab on the shelf may exist as a metapopulation of weakly-connected sub-stocks (Richar et al. 2015). However, recent genetic analysis has failed to distinguish multiple non-intermixing, non-interbreeding sub-stocks on the EBS shelf (Johnson 2019), suggesting that Tanner crab in the EBS form a single unit stock.

4.4 Life History

Molting and shell condition

Tanner crab, like all crustaceans, normally exhibit a hard exoskeleton of chitin and calcium carbonate. This hard exoskeleton requires individuals to grow through a process referred to as molting, in which the individual sheds its current hard shell, revealing a new, larger exoskeleton that is initially soft but which hardens over several days. Newly-molted crab in this “soft shell” phase can be vulnerable to predators because they are generally torpid and have few defenses if discovered. Subsequent to hardening, an individual’s shell provides a settlement substrate for a variety of epifaunal “fouling” organisms such as barnacles and bryozoans. The degree of hard-shell fouling was once thought to correspond closely to post-molt age and led to a classification of Tanner crab by shell condition (SC) in survey and fishery data similar to that described in Table F.

Table F. Shell condition classification table.

Shell Condition Class	Description
0	pre-molt and molting crab
1	carapace soft and pliable
2	carapace firm to hard, clean
3	carapace hard; topside usually yellowish brown; thoracic sternum and underside of legs yellow with numerous scratches; pterygostomial and bronchial spines worn and polished; dactyli on meri and metabranchial region rounded; epifauna (barnacles and leech cases) usually present but not always.
4	carapace hard, topside yellowish-brown to dark brown; thoracic sternum and undersides of legs data yellow with many scratches and dark stains; pterygostomial and branchial spines rounded with tips sometimes worn off; dactyli very worn, sometimes flattened on tips; spines on meri and metabranchial region worn smooth, sometimes completely gone; epifauna most always present (large barnacles and bryozoans).
5	conditions described in Shell Condition 4 above much advanced; large epifauna almost completely covers crab; carapace is worn through in metabranchial regions, pterygostomial branchial spines, or on meri; dactyli flattened, sometimes worn through, mouth parts and eyes sometimes nearly immobilized by barnacles.

Although these shell classifications continue to be applied to crab in the field, it has been shown that there is little real correspondence between post-molt age and shell classifications SC 3 through 5, other than that they indicate that the individual has probably not molted within the previous year (Nevisi et al. 1996). In this assessment, crab classified into SCs 3-5 have been aggregated as "old-shell" crab, indicating that these are crab likely to have not molted within the previous year. In a similar fashion, crab classified in SCs 0-2 have been combined as "new shell" crab, indicating that these are crab that have certainly (SCs 0 and 1), or are likely to have (SC 2), molted within the previous year.

Growth

Work by Somerton (1981a) estimated growth for EBS Tanner crab based on modal size frequency analysis of Tanner crab in survey data assuming no terminal molt at maturity. Somerton's approach did not directly measure molt increments and his findings are constrained by not considering that the progression of modal lengths between years was biased because crab ceased growing after their terminal molt to maturity.

Growth in immature Tanner crab larger than approximately 25 mm CW proceeds by a series of annual molts, up to a final (terminal) molt to maturity (Tamone et al. 2007). Rugolo and Turnock (2012b) derived growth relationships for male and female Tanner crab from data on observed growth in males to approximately 140 mm carapace width (CW) and in females to approximately 115 mm CW collected near Kodiak Island in the Gulf of Alaska [J. Munk, unpublished; Donaldson et al. (1981)]. These relationships were used as priors for estimated growth parameters in older (2012-2016) assessments (Rugolo and Turnock 2012a; Stockhausen 2013, 2014, 2015, 2016). Rugolo and Turnock (2010) compared the resulting growth per molt (gpm) relationships with those of Stone et al. (2003) for Tanner crab in southeast Alaska in terms of the overall pattern of gpm over the size range of crab and found that the pattern was characterized for both males and females by a higher rate of growth to an intermediate size (90-100 mm CW), followed by a decrease in growth rate from that size thereafter. Similarly-shaped growth curves were found by Somerton (1981a) and Donaldson et al. (1981), as well.

Molt increment data was collected for Tanner crab from the EBS during 2015, 2016, 2017 and 2019 in cooperative research between NMFS and BSFRF (R. Foy and E. Fedewa, NMFS, pers. comm.s). Previous analysis of the data suggests it is not substantially different from that obtained near Kodiak Island (Stockhausen 2017a). The EBS molt increment data is fit in the assessment model to inform inferred growth trajectories in all of the models evaluated in this assessment.

Weight at size

Weight-at-size relationships used in this assessment were revised in 2014 based on a comprehensive re-evaluation of data from the NMFS EBS shelf bottom trawl survey (Daly et al. 2014). Weight-at-size is described by a power-law model of the form $w = a \cdot z^b$, where w is weight in kg, z is the size in mm CW, and a and b are estimated coefficients (Daly et al. 2015). In 2021, Jon Richar (AFSC Kodiak) conducted a new analysis of the weight-at-size data for Tanner crab that incorporates shell condition as a factor. Other preliminary analyses suggest that temperature may be a factor, as well. The CPT, however, has not reviewed models based on these new relationships; thus, this assessment uses the previously-established relationships. The parameter values for the relationships used in this assessment are presented in Table G.

Table G. Weight-at-size parameters ($w = a \cdot z^b$) for Tanner crab, in grams.

sex	maturity	a	b
males	all	0.000270	3.022134
females	immature (non-ovigerous)	0.000562	2.816928
	mature (ovigerous)	0.000441	2.898686

Maturity and reproduction

It is now generally accepted that both Tanner crab males (Tamone et al. 2007) and females (Donaldson and Adams 1989) undergo a terminal molt to maturity, as in most majid crabs. Maturity in females can be determined visually rather unambiguously from the relative size of the abdomen. Females usually undergo their terminal molt from their last juvenile, or pubescent, instar while being grasped by a male (Donaldson and Adams 1989). Subsequent mating takes place annually in a hard shell state (Hilsinger 1976) and after extruding the female's clutch of eggs. While mating involving old-shell adult females has been documented (Donaldson and Hicks 1977), fertile egg clutches can be produced in the absence of males by using sperm stored in the spermathacae (Adams and Paul 1983; Paul and Paul 1992). Two or more consecutive egg fertilization events can follow a single copulation using stored sperm to self-fertilize the new clutch (Adams and Paul 1983; Paul 1992), although egg viability decreases with time and age of the stored sperm (Paul 1992).

Maturity in males can be classified either physiologically or morphometrically, but is not as easily determined as with females. Physiological maturity refers to the presence or absence of spermataphores in the gonads whereas morphometric maturity refers to the presence or absence of a large claw (Brown and Powell 1972). During the molt to morphometric maturity, there is a disproportionate increase in the size of the chelae in relation to the carapace (Somerton 1981a). The ratio of chela height (CH) to carapace width (CW) has been used to classify male Tanner crab as morphometrically immature or mature. While many earlier studies on Tanner crabs assumed that morphometrically mature male crabs continued to molt and grow, there is now convincing evidence to support a terminal molt for males (Otto 1998; Tamone et al. 2007). A consequence of the terminal molt in male Tanner crab is that a substantial portion of the population may never achieve legal size (NMFS 2008).

In this assessment, all models include fits to size-specific annual proportions of mature, new shell male crab to all new shell male from the NMFS EBS bottom trawl survey, based on classification by 10 mm CW size bin using CH:CW ratios to inform size-specific probabilities of terminal molt. The classifications are based on techniques described in Richar and Foy (2022).

Although observations are lacking in the EBS, seasonal differences have been observed between mating periods for pubescent and multiparous females in the Gulf of Alaska and Prince William Sound. There, pubescent molting and mating takes place over a protracted period from winter through early summer, whereas multiparous mating occurs over a relatively short period during mid April to early June (Hilsinger 1976; Munk et al. 1996; Stevens 2000). In the EBS, egg condition for multiparous Tanner crabs assessed between April and July 1976 also suggested that hatching and extrusion of new clutches for this maturity state begins in April and ends sometime in mid-June (Somerton 1981a).

Fecundity

A variety of factors affect female fecundity, including somatic size, maturity status (primiparous vs. multiparous), age post terminal molt, and egg loss (NMFS 2004). Of these factors, somatic size is the most important, with estimates of 89 to 424 thousand eggs for females 75 to 124 mm CW, respectively (Haynes et al. 1976). Maturity status is another important factor affecting fecundity, with primiparous females being only ~70% as fecund as equal size multiparous females (Somerton and Meyers 1983). The number of years elapsed since the molt to maturity, and whether or not a female has had to use stored sperm from that first mating can also affect egg counts (Paul 1984; Paul and Paul 1992). Additionally, older senescent females often carry small clutches or no eggs (i.e., are barren) suggesting that female crab reproductive output is a concave function of age (NMFS 2004).

Size at maturity

Rugolo and Turnock (2012a) estimated size at 50% mature for females (all shell classes combined) at 68.8 mm CW, and 74.6 mm CW for new shell females from data collected in the NMFS bottom trawl survey. For males, Rugolo and Turnock (2012b) estimated classification lines using mixture-of-two-regressions analysis to define morphometric maturity for the unit Tanner crab stock, and for the sub-stock components east and west of 166^o W, based on chela height and carapace width data collected during the 2008 NMFS bottom trawl survey. These rules were then applied to historical survey data from 1990-2007 to apportion male crab as immature or mature based on size (Rugolo and Turnock 2012a). Rugolo and Turnock (2012b) found no significant differences between the classification lines of the sub-stock components (i.e., east and west of 166^o W), or between the sub-stock components and that of the unit stock classification line. Size at 50% mature for males (all shell condition classes combined) was estimated at 91.9 mm CW, and at 104.4 mm CW for new shell males. By comparison, Zheng and Kruse (1999) used knife-edge maturity at >79 mm CW for females and >112 mm CW for males in development of the original State harvest strategy.

Mortality

Due to the lack of age information for crab, Somerton (1981a) estimated mortality separately for individual EBS cohorts of immature and adult Tanner crab. Somerton postulated that age five crab (mean CW = 95 mm) were the first cohort to be fully recruited to the NMFS trawl survey sampling gear and estimated an instantaneous natural mortality rate (M) of 0.35 for this size class using catch curve analysis. Using this analysis with two different data sets, he estimated natural mortality rates of adult male crab from the fished stock to range from 0.20 to 0.28. When using CPUE data from the Japanese fishery, estimates of M ranged from 0.13 to 0.18. Somerton concluded that estimates of M from 0.22 to 0.28 obtained from models that used both the survey and fishery data were the most representative (Somerton 1981a).

Unlike its congener the snow crab, information on longevity of the Tanner crab is lacking. Rugolo and Turnock (2011a) examined empirical evidence for reliable estimates of oldest observed age for male Tanner crab. They reasoned that longevity in a virgin population of Tanner crab would be analogous to that of the snow crab, where longevity would be at least 20 years, given the close analogues in population dynamic and life-history characteristics (Rugolo and Turnock 2011a). Employing 20 years as a proxy for longevity and assuming that this age represented the upper 98.5th percentile of the distribution of ages in an unexploited population, M was estimated to be 0.23 based on Hoenig's (1983) method. Alternatively, if 20 years was assumed to represent the 95% percentile of the distribution of ages in the unexploited stock, the estimate for M would be 0.15. Rugolo and Turnock (2011a) adopted M=0.23 for both male and female Tanner because the value corresponded with the range estimated by Somerton (1981a), as well as the value used in the analysis to estimate the overfishing definitions underlying Amendment 24 to the Crab Fishery Management Plan (NMFS 2008).

4.5 Management history

Fisheries for Tanner crab have historically taken place throughout their range in Alaska, but currently only the fishery in the EBS is managed under a federal Fishery Management Plan (FMP, NPFMC 2024). The Fishery Management Plan (FMP) for the Commercial King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands (BSAI) was approved by the Secretary of Commerce on June 2, 1989 (NPFMC 2024). The FMP establishes a State/Federal cooperative management regime that defers crab management to the State of Alaska with Federal oversight (Bowers et al. 2008; NPFMC 2024). State regulations are subject to the provisions of the FMP, including its goals and objectives, the Magnuson-Stevens Act national standards, and other applicable federal laws. The FMP has been amended several times since its implementation (NPFMC 2023). The federal process determines annual OFL and ABC levels using an F_{OFL} Control Rule based on long-term equilibrium concepts of MSY, F_{MSY}, B_{MSY}. The State manages Tanner crab based on registration areas divided into districts and, under the FMP, can adjust harvest levels under the ABC as needed to avoid overharvesting in a particular area, change size limits from other stocks in the registration area, change fishing seasons, or encourage exploration (NPFMC 2024). The State sets annual TAC limits under the federally-determined ABC using its own set of harvest strategies (ADF&G 2006, 2017; Daly et al. 2020). The Bering Sea District of Tanner crab Registration Area J (Figure 1) includes all waters of the Bering Sea north of Cape Sarichef at 54° 36'N latitude and east of the U.S.-Russia Maritime Boundary Line of 1991. This district is divided into the Eastern and Western Subdistricts at 173°W longitude. The Eastern Subdistrict is further divided at the Norton Sound Section north of the latitude of Cape Romanzof and east of 168° W longitude and the General Section to the south and west of the Norton Sound Section (Bowers et al. 2008). The ADF&G sets separate annual values on retained catch, Total Allowable Catch (TAC), in the areas east and west of 166^oW longitude in the General Section. In this report, the terms "east" and "west" (or "East 166W" and "West 166W") are used in shorthand fashion to refer to these management areas demarcated by 166^oW longitude where separate TACs are set.

In March 2011, the Alaska Board of Fisheries (BOF) approved a new minimum size limit harvest strategy for Tanner crab effective for the 2011/12 fishery based on Bechtol et al. (2011) and Zheng and Pengilly (2011). Prior to this change, the minimum legal size limit had been 5.5" (140 mm CW, including lateral spines) throughout the Bering Sea District. The new regulations established different minimum size limits east and west of 166^o W. The minimum legal size for the fishery to the east of 166^oW longitude is now 4.8" (122 mm CW) and that to the west is 4.4" (112 mm CW), where the size measurement includes the lateral spines. For economic reasons, fishers may adopt larger minimum sizes for retention of crab in both areas, and the State's harvest control rules (HCRs) used to determine TAC generally incorporate minimum "industry-preferred" sizes that are larger than the legal minimums. In 2011, these minimum preferred sizes were set at 5.5" (140 mm CW) in the east and 5" (127 mm CW) in the west, including the lateral spines (Daly et al. 2020). The harvest strategy also employed a minimum threshold that the mature female biomass (MFB) in the Eastern Subdistrict be larger than 40% of its long-term (1975-2010) average in two subsequent years before the fisheries in either management area could be opened. Minimum thresholds for opening the fishery in a management area were also defined using the ratio of area-specific MMB to its associated long-term average. Finally, the harvest strategy defined area-specific sloping harvest control rules to determine the maximum allowable exploitation rate on mature males in each area based on the ratio of MFB to average MFB, together with limits on the maximum exploitation rate (Figure 2).

Subsequently, the State's harvest strategy has undergone three revisions (Daly et al. 2020). In 2015, the minimum preferred harvest size used to compute TAC for the area east of 166^o W longitude was changed from 140 mm CW (5.5 inches; including the lateral spines) to 127 mm CW (5.0 inches), the preferred size used to compute TAC for the area west of 166^o W longitude. In 2017, the criteria being used to determine MFB was changed from an area-specific one based on carapace width to one based on morphology (the same as is used by the NMFS EBS shelf bottom trawl survey), the definition of 'long-term average' for calculating average mature biomass was changed from 1975-2010 to 1982-2016, the spatial range for calculating average MFB was expanded to include the entire NMFS EBS shelf bottom trawl survey area, and a so-called 'error band system' was introduced in the HCR to account for survey uncertainty such that the exploitation rate on industry preferred-size males used to calculate was gradually reduced when the lower 95% confidence interval of the point estimate of MFB fell below 40% of the long-term average (replacing the requirement to close the fisheries when MFB fell below the 40% threshold; ADF&G (2017); Daly et al. (2020)).

Most recently, the harvest strategy was changed in March 2020 based on results from a management strategy evaluation (MSE) conducted with input from industry stakeholders, NMFS and academic scientists, and ADF&G managers (Daly et al. 2020; Heller-Shipley et al. 2021). The current

HCR (Figure 3; HCR 4_1 in Daly et al. (2020)) defines the period for calculating average mature biomass as 1982-2018 and implements sliding scales for exploitation rates on mature males which are functions of the ratios of MMB and MFB to their long-term averages. One particularly notable change is that there is no longer a threshold for opening the fisheries based on MFB.

Landings of Tanner crab in the Japanese pot and tangle net fisheries were reported in the period 1965-1978, peaking at 19.95 thousand t in 1969. The Russian tangle net fishery was prosecuted during 1965-1971 with peak landings in 1969 at 7.08 thousand t. Both the Japanese and Russian Tanner crab fisheries were displaced by the domestic fishery by the late-1970s (Table 1; Figure 4). Foreign fishing for Tanner crab ended in 1980.

The domestic Tanner crab pot fishery developed rapidly in the mid-1970s (Tables 1 and 2; Figure 4). Domestic US landings were first reported for Tanner crab in 1968 at 0.46 thousand t taken incidentally to the EBS red king crab fishery. Tanner crab was targeted thereafter by the domestic fleet and landings rose sharply in the early 1970s, reaching a high of 30.21 thousand t in 1977/78. Landings fell sharply after the peak in 1977/78 through the early 1980s, and domestic fishing was closed in 1985/86 and 1986/87 due to depressed stock status. In 1987/88, the fishery re-opened and landings rose again in the late-1980s to a second peak in 1990/91 at 16.61 thousand t, and then fell sharply through the mid-1990s. It was formally declared overfished by NMFS in 1999. The fishery was closed from 1997/98 to 2004/05 as a result of conservation concerns regarding the depressed status of the stock.

The major fisheries for crab in the BSAI, including Tanner crab, were rationalized in 2005 with the implementation of FMP amendments 18 and 19, which assigned quota shares allocated across the harvest and processing sectors to eliminate the “race for fish” (NPFMC 2023). The Tanner crab fishery re-opened in 2005/06 and averaged 0.77 thousand t retained catch between 2005/06-2009/10 (Tables 3-5). The State closed directed commercial fishing for Tanner crab during the 2010/11-2012/13 seasons because estimated female stock metrics fell below thresholds adopted in the state harvest strategy. Additionally, the stock was once again declared overfished by NMFS in 2012 based on low survey estimates of mature male biomass.

Following a change in the federal assessment Tier level from 4 to 3 see 7 and acceptance of a Tier 3 assessment model in the fall of 2012, the stock was declared to be not overfished under Tier 3 and an OFL of 19,020 t was determined. The directed fisheries, however, remained closed per the State’s harvest strategy. For 2013/14, the Tier 3 OFL was determined to be 25,350 t, with an ABC of 17,820 t. While $maxABC$ is defined using the “p-star” (or p^*) statistical approach with $p^* = 0.49$ based on an assumed distribution for an OFL, this approach is not thought to capture the actual uncertainty in the OFL. Instead, the SSC has, in practice, used the strategy of applying a buffer to the OFL to determine the ABC, where the size of the buffer reflects a consensus level of uncertainty in the assessment model, environmental conditions, stock dynamics, and fishery conditions. For Tanner crab, this buffer has typically been 20%.

The stock metrics for 2013/14 surpassed the State harvest strategy thresholds and the directed fishery was opened in 2013/14 with a TAC was set at 1,645,000 lbs (746 t) for the area west of 166^o W and at 1,463,000 lbs (664 t) for the area east of 166^o W. On closing, 80% (594 t) of the TAC had been taken in the western area while 99% (654 t) had been taken in the eastern area. For 2014/15, the Tier 3 ABC was 25,180 t and TAC was set at 3,005 t for the area west of 166^o W and at 3,846 t for the area east of 166^o W. On closing, 78% (2,329 t) of the TAC was taken in the western area while 100% (3,829 t) was taken in the eastern area. For 2015/16, the ABC was 21,750 while TAC was set at 3,808 t in the western area and 5,113 t in the eastern area. On closing, essentially 100%

of the TAC was taken in each area (3,798 t in the west, 5,111 t in the east). The total retained catch in 2015/16 (8,910 t) has been the largest taken in the fishery since 1992/93 (Tables 2 and 3; Figure 4).

Although the ABC for 2016/17 was 20,490 t, the directed fisheries in both areas were closed in 2016/17 by the State because mature female biomass in the 2016 NMFS EBS Bottom Trawl Survey did not exceed the State's harvest strategy thresholds in either area to allow a fishery opening. Subsequently, the State has allowed a directed fishery in the eastern area only since 2022/23, following the revision of its harvest strategy, while directed fisheries in the western area have been allowed in all but two years (Table 3, Figure 5).

Tanner crab can be incidentally retained in the snow crab and BBRKC fisheries, up to a limit of 5% of the target species. In general, incidental retention in these fisheries has been small compared with retained catch in the directed fishery, although the snow crab fishery was responsible for a sizable fraction of the landed catch in 2005/06 and 2006/07 (Tables 3 and 4, Figure 5). Both fisheries were closed in 2022/23, only the BBRKC fishery was open in 2023/24, but both fisheries were open in 2024/25. Incidentally-retained catch in these fisheries has continued to be small (Table 4).

Information on bycatch and discard losses of Tanner crab originate from observer data taken in the directed Tanner crab pot fishery, the snow crab and Bristol Bay red king crab pot fisheries, and the groundfish fisheries (Tables 7-11; Figures 10-13). Bycatch estimates are converted to discard mortality using assumed handling mortality rates of 32.1% for bycatch in the crab fisheries (CPT 2014) and 80% for bycatch in the groundfish fisheries (when bycatch in the latter can be distinguished by gear type, then 80% for trawl fisheries and 50% for fixed gear fisheries; CPT (2021)). In the early-1970s, the groundfish fisheries contributed substantially to total bycatch losses (although bycatch in the crab fisheries was undocumented at the time). From the early 1990s (when reliable crab fishery bycatch estimates are considered to be first available) to 2004/05, the groundfish fisheries accounted for the largest proportion of discard mortality. Between 2005/06 and 2019/20, the snow crab fishery generally accounted for the largest proportion of Tanner crab taken as bycatch (1,922 t) on average while the Tanner crab fishery accounted for the next largest proportion (1,056 t). The snow crab fishery generally accounted for the largest proportion of Tanner crab bycatch *mortality* (617 t) on average while the Tanner crab fishery accounted for the next largest proportion (339 t). Since the collapse of the snow crab stock in 2020/21, the Tanner crab fishery generally accounted for the largest proportion of Tanner crab taken as bycatch (499 t) on average while the groundfish fisheries accounted for the next largest proportion (126 t). The Tanner crab fishery generally accounted for the largest proportion of Tanner crab bycatch *mortality* (160 t) on average while the groundfish fisheries accounted for the next largest proportion (91 t).

5 Data

Data incorporated into the Tanner crab assessment this year include:

1) annual abundance, biomass and size composition data collected by crab fishery observers for Tanner crab retained in the directed fisheries and taken as bycatch in the directed and other (snow crab, Bristol Bay red king crab) fisheries provided by ADF&G;
2) annual abundance, biomass, and size composition data collected by groundfish fishery observers for bycatch in the groundfish fisheries provided by AFSC's Fisheries Monitoring

and Analysis Division and the NMFS Alaska Regional Office (AKRO; hosted by AKFIN, https://akfin.psmfc.org);

3) limited historical (pre-1990) data on annual abundance, biomass, and size compositions for Tanner crab retained in the foreign (1965-1980) and domestic (1968-1989) crab fisheries or taken as bycatch in the groundfish fisheries (1973-1990);
4) annual abundance, biomass and size composition data, as well as limited year-specific male maturity ogives, from the NMFS EBS shelf bottom trawl survey (1975-2024);
5) abundance, biomass, and size composition data from BSFRF/NMFS cooperative side-by-side trawl studies (2013-2018); and
6) molt increment data from NMFS/ADF&G/BSFRF cooperative studies (2015-17, 2019).

5.1 Summary of new information

Retained catch in the 2024/25 directed fishery was provided by ADF&G (Ben Daly, ADF&G, pers. comm.), as well as total Tanner crab catch and effort data for the directed, BBRKC, and snow crab fisheries. Data on bycatch in the 2024/25 groundfish fisheries from the groundfish observer program and AKRO was downloaded from AKFIN on July 16, 2025. Results from the 1975-2025 NMFS EBS bottom trawl shelf surveys were obtained using the `crabpack` R package, as were the Tanner crab maturity ogives. The data from the 1979 survey includes the "extra" stations conducted that year, as requested by the CPT and SSC (see Section 3). Datasets and new information are summarized in Table G (Section 2.2).

In August 2025, ADFG provided results from previous ADFG Pribilof Islands pot surveys conducted in 2003, 2005, 2008, and 2011. This data has not been incorporated into the assessment yet.

5.2 Retained Catch

Time Series Data

Retained catch in the Tanner crab fishery is male-only. Annual time series for retained catch extend back to 1965 (Table 1; Figure 4), with historical retained catch biomass available for the domestic and foreign fleet fisheries up to 1979, when the latter fisheries ended. Time series for annual retained catch abundance, as well as biomass, in the domestic fisheries were provided by ADF&G for the 1980 to 1996 time period (Table 2). The fishery was closed from 1997/98 to 2004/05 due to concerns regarding stock biomass levels, during which time no retained catch occurred. The fishery was re-opened following rationalization of the crab fisheries in 2005. Time series of annual retained catch abundance and biomass taken in the directed fishery, as well as incidentally-retained in the snow crab and BBRKC fisheries, has been provided by ADF&G by management area starting with the 2005/06 season (Tables 3 and 4; Figure 5) for subsequent seasons when the fishery was prosecuted in either area. Since 2013/14, most of the TAC has been taken each year in areas open to fishing, while the TACs have generally been substantially lower than the corresponding Tier 3 OFLs and ABCs (Table 5, upper plot of Figure 5).

Size Composition Data

Size compositions for retained catch data, scaled to total retained catch, are available from 1980/81-1996/97 aggregated across ADF&G management areas and from 2005/06 identified by management area (Table 6, Figure 6) for seasons when the directed fishery was prosecuted. Median sizes of retained males are similar over the time period up to 2009/10, after which NMFS determined the stock was overfished and ADF&G closed the fishery in both management areas (Figure 6). Median sizes since NMFS declared the stock rebuilt (2012) have been somewhat smaller; the smallest median sizes occurred in the western management area in 2021/22 and 2022/23 while the smallest median size in the eastern management area occurred in 2022/23. Median sizes in both areas were more typical in 2024/25. The fraction of retained catch smaller than the size historically preferred by processors (125 mm CW) has continued to increase in the western management area since 2017/18 (the eastern area was closed during most of this time period; Figures 7 and 8). The fraction of new shell males among the retained crab from the western management area in 2024/25 was high, similar to that since 2021/22 and much higher than other years since the 2015/16 season (Figure 9). The fraction in the eastern management area was similarly high in 2022/23- 2024/25.

5.3 Total Catch and Discard Data

Time Series Data

Total catch estimates for Tanner crab in the directed Tanner crab, snow crab, BBRKC, and groundfish fisheries are provided in Tables 7-9 and Figure 10. ADF&G "at-sea" crab observer sampling programs started in 1989 but sampling in the different fisheries was initially inconsistent. The assessment uses observer catch data from the snow crab and BBRKC fisheries starting in 1990/91 and in 1991/92 from the directed fishery. Annual bycatch in the groundfish fisheries, based on NMFS groundfish observer programs, is available starting in 1973/74, but crab sex is not distinguished and bycatch is not distinguished by gear type until estimates are available from the Regional Office's Catch Accounting System (CAS) database, starting in 1991.

All female crab and sub-legal males caught in the directed fishery or taken as bycatch in the other fisheries must be discarded. All legal males taken in the groundfish fisheries and "most" legal males in the other crab fisheries must be discarded as well; some retention of incidentally-caught legal males is allowed in the snow and BBRKC fisheries, but the amount retained in any year tends to be very small. The assessment model fits time series of fishery-specific total catch biomass (and abundance for the groundfish fisheries), but allows for some fraction of discarded crab to survive. In practice, a value of 0.321 is used in the assessment model for "handling mortality" in the crab fisheries to convert observed bycatch to (unobserved) discard mortality (Stockhausen 2014). For the groundfish fisheries, a value of 0.8 is used for handling mortality aggregated across gear types to reflect differences in groundfish gear effects and on-deck operations compared with the crab fleets (bycatch in the groundfish fisheries is typically aggregated across gear types in the assessment model). However, when models in which groundfish bycatch type is identified by gear type are run, a value of 0.5 is used for bycatch by fixed gear and 0.8 for bycatch by trawl gear. However, no models with gear-specific bycatch in the groundfish fisheries were considered in this assessment.

Mortality associated with the handling process can also be estimated outside the assessment model for bycatch in the groundfish and non-directed crab fisheries (because most or all Tanner crab bycatch is discarded), but estimates of "discard mortality" for males in the directed fishery obtained outside the assessment model can be problematic if (due to sampling error) estimated total catch is less than reported retained catch. Annual estimates of bycatch (i.e., non-retained catch) using the "subtraction method" and mortality for the various fisheries are given in Tables 10 and 11 and illustrated in Figures 11 and 12. Estimated bycatch mortality in the groundfish fisheries was highest (~15,000 t) in the early 1970s, but it declined substantially by 1977 to ~2,000 t with the curtailment of foreign fishing fleets (Stockhausen 2017a). Bycatch mortality declined further in the 1980s (to ~500 t) but increased somewhat in the late 1980s to a peak of ~2,000 t in the early 1990s before undergoing another (gradual) decline until 2008, after which it has fluctuated annually below ~300 t to the present (75 t in 2024/25). In the crab fisheries, the largest component of bycatch occurs on males. In the early 1990s, female bycatch ranged between 6 and 40% of the bycatch in the directed and snow crab fisheries. Since the directed fishery re-opened in 2013/14, the fraction of bycatch that is female has ranged between 2% and 6% in the directed fishery, between 0.3 and 3% in the BBRKC fishery, and has been below 1% in the snow crab fishery. Estimates of total groundfish bycatch are not currently available by sex.

In 2024/25, the directed fishery was prosecuted in both State management areas for only the third time since 2015/16. Discard mortality on males, estimated using the subtraction method, was 128 t. Discard mortality on females in the directed fishery was 14 t. Bycatch mortality in the other crab fisheries in 2024/25 was very small, with 22 t occurring in the snow crab fishery and 2 t in the BBRKC fishery. Total bycatch mortality in the groundfish fisheries was 75 t. Total bycatch mortality, then, was 241 t (Table 11) whereas total catch mortality (including retained catch) was 3,093 t.

Size Composition Data

Expanded total catch (retained + discards) size compositions from at-sea crab fishery observer sampling are presented by sex for the directed fishery in Figures 14-17 and in the snow crab fishery and BBRKC fisheries in Figures 18-23. The snow crab fishery, conducted primarily in the northern and western parts of the EBS shelf, catches predominantly small males while the BBRKC fishery, conducted to the south and east in Bristol Bay, predominantly catches large males. The size compositions in the snow crab fishery clearly reflect some sort of "dome-shaped" selectivity pattern for males (assumed in the assessment model), with selectivity small for small and large males and highest for intermediate-sized males. In contrast, selectivity in the BBRKC fishery appears more consistent with asymptotic selection. The directed fishery, which extends across the shelf from west of the Pribilof Islands into Bristol Bay in the east, catches somewhat larger males than the snow crab fishery, but somewhat smaller males than the BBRKC fishery (although many more than either of the other two), with about half the new shell males caught being larger than the industry-preferred size of 125 mm CW. Similar patterns are apparent for females.

Size compositions from observer sampling for bycatch in the groundfish fisheries, expanded to total bycatch, are shown in Figures 24-28 starting in 1991/92. These fisheries, targeting a variety of groundfish stocks and using a variety of gear types, take a much larger size range of Tanner crab as bycatch than the pot gear used in the crab fisheries.

Raw (number of individuals measured) and scaled sample sizes for size composition data from the various fisheries are given in Tables 12-14. Since 2020/21, very few Tanner crab have been measured by observers in either the snow crab or BBRKC fisheries due to small TACs or closures in those fisheries.

Spatial patterns

Recent spatial patterns for retained catch are illustrated in Figure 29. Since 2020/21, retained catch has been concentrated along the 166°W longitude line, in contrast to other years when catch was also distributed along the outer shelf both northwest and southeast of the Pribilof Islands at depths of 100 m or greater.

5.4 Survey Data

The annual NMFS EBS shelf bottom trawl survey ("NMFS survey") provides the primary source of fishery-independent data for indices of relative population size ("survey" biomass and abundance) and size structure (size compositions). Data from 1975-2025 are included in the assessment. In 2024, the NMFS survey discontinued hauls at the 26 so-called "corner" stations around the Pribilof Islands and around St. Matthew Island (Figure 30). In addition to the NMFS survey, data from the "side-by-side" Tanner crab selectivity studies, conducted collaboratively by BSFRF and NMFS during the 2013-2018 NMFS surveys, provide a secondary data source.

Time Series Data

Design-based estimates (and cv's) for trends in annual survey biomass and abundance from the NMFS survey are given in Tables 16 and 17 by sex, maturity state, and ADF&G management area. Corresponding time series plots are given in Figures 31 and 32. Time series trends from the NMFS EBS bottom trawl survey suggest the Tanner crab stock in the EBS has undergone decadal-scale fluctuations.

Estimated biomass of male crab in the survey time series started at its maximum (295 thousand t) in 1975, decreased rapidly to a low (15 thousand t) in 1985, and rebounded quickly to a smaller peak (146 thousand t) in 1991 (Table 16). After 1991, male survey biomass decreased again, reaching a minimum of 14,600 t in 1997. Recovery following this decline was slow and male survey biomass did not peak again until 2007 (104 thousand t), after which it has fluctuated more rapidly—decreasing within two years by over 50% to a minimum in 2009 (47 thousand t), followed by a doubling to a peak in 2014 (109 thousand t). Since 2014 the trend had been a steady decline until 2021, with male biomass in 2019 at its lowest point (29 thousand t) since 2000. The survey was not conducted in 2020. In 2021, male survey biomass increased over the low in 2019 by ~10% to 32 thousand t, but it declined slightly to 30 thousand t in 2022. Subsequently, it has increased dramatically to 111 thousand t in 2025, the largest since 1992, although most of this increase occurred in the area west of 166°W. Male survey biomass in the eastern management area in 2023 was the smallest in the time series since 1998, almost doubled in 2024, but subsequently declined by ~25% in 2025.

Trends in female survey biomass have generally been in synchrony with those for males, although the changes for females precede those for males by a year or two (reflecting different growth patterns). Immature female biomass in 2024 doubled over that in 2023 while mature female biomass tripled (Table 16). In 2025, immature female biomass declined by almost 50% while mature female biomass increased somewhat, both changes presumably driven by maturation of immature females.

Survey abundance for males in 2024 had increased by 74% over that in 2023 but decreased slightly in 2025 due mainly to a decline east of 166° (Table 17). Immature female abundance had increased 24% over that in 2023, but decreased as much in 2025. Mature female abundance increased 250% in

2024 from that in 2023 and continued to increase in 2025 but not so dramatically as in the previous year.

Estimates for trends in industry-preferred males (≥ 125 mm CW) from the NMFS survey are given in Tables 18 and 19; corresponding time series are illustrated in Figures 31 and 32. Compared with results from 2023, industry-preferred male biomass increased in the eastern area in 2024 by 75%, with increases in both new shell and old shell categories. In the western area, survey biomass increased over 100%, again with increases in both new shell biomass and old shell biomass categories (Table 18). These increases were reversed in 2025, particularly for new shell males which returned to 2021 levels. In the west, biomass of industry-preferred males continued a three-year growth trajectory. Overall, total industry-preferred male biomass in the survey increased 92% from 2023 to 2024 to 11.5 thousand t and to 15.7 thousand t in 2025, both values higher than any year since 2018, when it was 20.4 thousand t. Changes in abundance from 2023 to 2025 followed a similar pattern (Table 19).

The annual percentages (by biomass) of new shell industry-preferred size male from the survey and caught in the directed fishery are contrasted in Figure 33: in general, the fishery is able to catch a much higher percentage of new shell males than is estimated in the survey. The time series of biomass of industry-preferred males caught in the directed fishery is compared with the biomass estimated from the survey in Figure 34: the fishery came very close to catching more than the survey estimates in 2020/21 and 2021/22, but this has no longer been the case since 2022/23.

BSFRF and NMFS engaged in a series of collaborative "side-by-side" selectivity studies ("SBS") for Tanner crab that coincided with the 2013-2018 NMFS surveys. During the SBS catchability studies, NMFS performed standard survey tows (e.g., 83-122 trawl gear, 30 minute tow duration) as part of its annual EBS bottom trawl survey while BSFRF performed parallel tows within 0.5 nm using a nephrops trawl and 5 minute tow duration. Because the nephrops trawl has better bottom-tending performance than the 83-112 gear, the BSFRF tows are hypothesized to catch all crab within the net path (i.e., to have selectivity equal to 1 at all crab sizes) and thus provide a measure of absolute abundance/biomass. The NMFS surveys provide relative indices of stock size across the entire stock area; the BSFRF SBS data provides (presumed) absolute indices within the smaller (annually-varying) study footprints (Figure 35). The NMFS SBS data (a subset of stations from the full survey each year) provides information on the annual "availability" of Tanner crab across the entire stock area relative to the area included in the associated SBS study. Design-based estimates (and cv's) for absolute biomass and abundance within the SBS study areas from BSFRF and NMFS are given in Tables 20 and 21 by sex and maturity state. Plots of biomass and abundance from the SBS studies are given in Figures 36. Any "trends" from these data are confounded by the varying areal coverage of the survey stations included in the SBS studies.

Size Composition Data

Bubble plots of NMFS EBS bottom survey size compositions for Tanner crab by sex and fishery region are shown in Figures 37 and 38. Distinct recruitment events (late 1970s, early 1990s, mid-2000s, early 2010s, and perhaps starting in 2023) and subsequent cohort progression are evident in the plots, particularly in the western area. The absence of small male crab in the 2010-2016 period is notable, although there was evidence for new recruitment in the western area in 2017-2018, with perhaps some spillover to the eastern area lagged by a year at slightly larger sizes. Unfortunately, the 2017-2018 cohorts seems to be absent from, or much reduced in, the 2021-2024 surveys. On the positive side, there is certainly evidence for a strong recruitment event in the western area in 2023 (possibly starting in 2022) propagating into larger size classes in 2024 and 2025.

The survey size compositions provide evidence for a decline in maximum size across the time series for both males and females (Figure 39). For males, maximum size decreased from over 180 mm CW in the late 1970's to less than 160 mm CW in 2023, although it was slightly larger in 2024 and 2025. For females, maximum size declined from over 120 mm CW to under 115 mm CW in 2024 and 2025, although the smallest maximum size occurred in 2019.

Based on the total abundance size compositions from the BSFRF-NMFS SBS studies (Figure 40), the BSFRF nephrops gear is in general (as expected) more selective for Tanner crab than the NMFS 83-112 gear, particularly at smaller sizes (< 60 mm CW). However, the size-specific catch ratio of the BSFRF survey to the NMFS survey appears to vary substantially across years, which one would not expect if gear-specific selectivity were, in general, constant. It is worth noting that the nephrops gear appears to give a much better indication of recruitment than the 83-112 gear (e.g., survey years 2017 and 2018).

Observed sample sizes for the NMFS survey size compositions, aggregated to the EBS regional level used in the assessment, are presented in Table 22. Given the large number of individuals sampled, a standard value of 200 is used as the input total input sample size for annual survey size compositions in the assessment model to prevent convergence issues associated with using the actual sample sizes. Input sample sizes for size compositions that are fit independently by individual category (e.g., sex) are then based on the ratio of the number of measured individuals in the category to the total number of individuals measured in the survey, such that the sum of input sample sizes over all categories for a given year would be 200.

Sample size for the SBS studies are given in Table 23.

Spatial patterns

Recent (2016-2025) spatial patterns of various population components (small males, large males, industry-preferred males, immature females, mature females) are illustrated in Figures 41-45. Small males and immature females exhibit similar spatial patterns during this time period (note that the scales in Figures 41 and 44 are different), predominantly distributed along the western shelf between the shelf edge and the 100 m isobath, but extending eastward to the 50 m isobath from the Pribilof Islands southward. High concentrations of small/immature crab were found along the outer shelf in 2024 and 2025. Large males were concentrated to the northeast of the Pribilof Islands, but also extended along the Alaska Peninsula and into Bristol Bay (Figure 42). The patterns for industry-preferred males (Figure 43) were generally similar to those for large males. The spatial patterns for immature females generally reflected those for small males (Figure 44). As in 2024, the spatial distribution of mature females was concentrated around the Pribilof Islands as well as just to the west of the 166°W longitude line near the Alaska Peninsula (Figure 45).

5.5 Other Data

Other data incorporated into the assessment model include male maturity ogives, molt increment data, weight-at-size relationships, and SBS survey availability. The first two are fit in the model estimation process while the latter two are determined outside the model framework.

Male maturity ogives

The maturity state for females can be unambiguously determined in the field based on abdominal morphology, but the state for males is much less well-defined morphometrically. Here, males taken in the NMFS EBS shelf survey are classified as immature or mature based on the ratio of their CH to CW, with annual size-specific cutlines for this ratio determined statistically after the survey has been completed (Richar and Foy 2022). CH measurements were generally collected biennially for Tanner crab until 2016 but have been taken annually since. The observed size-specific fraction of males classified as new shell and mature relative to all new shell males (i.e., immature males and new shell mature males) for a survey constitutes the "male maturity ogive" for that year (Figure 46) and provides information to the model on the size-specific probability of immature males undergoing terminal molt.

Molt increment data

Molt increment data for Tanner crab in the EBS were collected as part of collaborative studies by NMFS, BSFRF, and ADF&G during 2015-2017 and 2019 (Figure 47). These are fit in the assessment model to estimate annual growth increments for crab that have not undergone terminal molt.

Weight-at-size

Weight-at-size relationships for Tanner crab are fixed in the assessment model based on power law models ($w = \alpha \cdot z^{\beta}$) for males, immature females, and mature females (Table 24, Figure 48).

SBS survey availability

For the purposes of the assessment, the BSFRF gear in the SBS catchability studies (2013-2018) is assumed to provide absolute indices of Tanner crab stock biomass and abundance within the area included in each year's study area (Figure 35). However, these areas, which vary among years in the study, do not cover the entire stock area while the assessment model predicts stock abundance by category and size for the entire stock area. To fit the SBS data, the model needs to take into account "survey availability" for the SBS study–i.e., the fraction of the stock (by category and size) within the study area–on an annual basis. Estimating survey availability within the stock assessment for the SBS studies is confounded with estimating survey catchability for the full NMFS survey, but can be estimated empirically outside the assessment model. Consequently, availability of Tanner crab to the BSFRF gear in the SBS catchability studies was determined outside the model (see Stockhausen 2024a) on a sex-specific basis from the ratio of area-swept abundance-at-size from the NMFS gear in the study area to area-swept abundance-at-size for the entire survey (Figure 49).

6 Analytic Approach

6.1 History of modeling approaches for this stock

Prior to the 2012 stock assessment, Tanner crab was managed as a Tier-4 stock using a survey-based assessment approach (Rugolo and Turnock 2011b). The Tier 3 Tanner Crab Stock Assessment Model (TCSAM) was developed by Rugolo and Turnock and presented for review in February 2011 to the Crab Modeling Workshop. The model was subsequently revised and the report to the CPT in September 2011 (Rugolo and Turnock 2011b) described the developments in the model per recommendations of the CPT, SSC and Crab Modeling Workshop through September 2011. In January 2012, the TCSAM was reviewed at a second Crab Modeling Workshop. Model revisions were made during the Workshop based on consensus recommendations. The model resulting from the Workshop was presented to the SSC in January 2012. Recommendations from the January 2012 Workshop and the SSC, as well as the authors' research plans, guided changes to the model. A model incorporating all revisions recommended by the CPT, the SSC and both Crab Modeling Workshops was presented to the SSC in March 2012.

In May 2012 and June 2012, respectively, the TCSAM was presented to the CPT and SSC to determine model suitability for stock assessment and the rebuilding analysis (Rugolo and Turnock 2012b). The CPT agreed that the model could be accepted for management of the stock in the 2012/13 cycle, and that the stock should be promoted to Tier-3 status. The CPT also agreed that the TCSAM could be used as the basis for rebuilding analyses. In June 2012, the SSC reviewed the model and accepted the recommendations of the CPT. The Council subsequently approved the SSC recommendations and Tanner crab was assessed as a Tier-3 for the 2012 assessment using TCSAM for the first time to estimate status determination criteria and overfishing levels (Rugolo and Turnock 2012a).

For 2013, modifications were made to the TCSAM computer code to improve code readability, computational speed, model output, and user friendliness without altering its underlying dynamics and overall framework (Stockhausen 2013). A detailed description of the 2013 model (TCSAM2013) is presented in Appendix 3 of the 2014 SAFE chapter (Stockhausen 2014). Following the 2014 assessment, the model code was put under version control (at GitHub).

The current model "framework", TCSAM02, was reviewed by the CPT and SSC in May/June 2017 (SSC 2017; CPT 2017; Stockhausen 2017b) and adopted for use in subsequent assessments as a transition to GMACS. This framework is a completely-rewritten basis for the Tanner crab model: substantially different models can be created and run by editing model configuration files rather than modifying the underlying code itself. Most importantly, no time blocks are "hard-wired" into the code–any time blocks are defined in the configuration files. In addition, the framework has been used to incorporate new data types (molt increment data, male maturity ogives), new survey data (the BSFRF surveys), and new fishery data (bycatch in the groundfish fisheries by gear type). The framework also incorporates status determination and OFL calculations directly within a model run, so a follow-on, stand-alone projection model does not need to be run (as was the case with TCSAM2013). This approach has the added benefit of allowing a more complete characterization of model uncertainty in the OFL calculation, because the OFL calculations are now included in the Markov Chain Monte Carlo (MCMC) evaluation of a model's posterior probability distribution. More recently, the model code was restructured to function in a management strategy evaluation (MSE) mode and allow retrospective analyses. The Dirichlet-Multinomial likelihood for size composition data (Thorson et al. 2017) was added as an option when fitting size composition data, as was the ability to apply "tail compression" to the composition data. In 2021/22, the ability to do multi-year projections under different fishing mortality rates was added to the model in response to CPT and SSC requests (Stockhausen 2022). The ability to estimate initial numbers-at-size, rather than build up the population from zero using recruitment (as has been the approach to date), was also implemented. In 2023/24, the ability to fully simulate data and fit it within a model run was implemented to allow models to undergo comprehensive simulation testing.

In May 2024, several preliminary models based on the GMACS framework were presented to the CPT (Stockhausen 2024c). The CPT recommended that a comprehensive comparison between the TCSAM02 assessment model and an equivalent GMACS model be completed before the GMACS model could be adopted for Tanner crab. Progress toward this goal was presented at the January Modeling Workshop and the May 2025 CPT meeting (CPT 2025), with a candidate model (G25_05) exhibiting similar fits to survey and fishery data but differences in overall scale possibly due to differences in estimated natural mortality rates, selectivity/retention curves, and/or applied constraints (i.e., penalties/priors included in the objective function). Subsequent GMACS development has included adding additional options for selectivity curves and recruitment size distributions to match those in the bespoke model, implementing time blocks for survey catchability, and correcting an issue with setting up random walk parameters when they span multiple time blocks. Testing the updated code with input files for other crab stocks has not revealed any issues with reproducibility. Input parameter specifications in G25_05 were also updated to better match the bespoke model. Unfortunately, the GMACS model for Tanner crab now crashes during optimization for reasons which have yet to be identified. Consequently only results for the bespoke (TCSAM02) model recommended by the CPT and SSC are presented here.

6.2 Model description

Overall modeling approach

TCSAM02 is a stage/size-based population dynamics model that incorporates sex (male, female), shell condition (new shell, old shell), and maturity (immature, mature) as different categories into which the overall stock is divided on a size-specific basis. For details of the model, the reader is referred to Stockhausen (2023a).

In brief, crab enter the modeled population as recruits following a truncated size distribution based on the gamma probability distribution (see Figure 50 for the nominal shape). An equal (50:50) sex ratio is assumed at recruitment and all recruits begin as immature, new shell crab. Within a model year, new shell, immature recruits are added to the population numbers-at-sex/shell condition/maturity state/size remaining on July 1 from the previous year. These are then projected forward to February 15 ($\delta t = 0.625$ yr) and reduced for the interim effects of natural mortality. Subsequently, the various fisheries that either target Tanner crab or capture them as bycatch are prosecuted as pulse fisheries (i.e., instantaneously). Catch by sex/shell condition/maturity state/size in the directed Tanner crab, snow crab, BBRKC, and groundfish fisheries is calculated based on fishery-specific stage/size-based selectivity curves and fully-selected fishing mortalities and then removed from the population. The numbers of surviving immature, new shell crab that will molt to maturity are then calculated based on sex/size-specific probabilities of maturing and undergoing terminal molt, and growth (via molt) is calculated for all surviving new shell crab. Crab that were new shell, mature crab become old shell, mature crab (i.e., they don't molt) and old shell (mature) crab remain old shell. Population numbers are then adjusted for the effects of maturation, growth, and change in shell condition. Finally, population numbers are reduced for the effects of natural mortality operating from February 15 through June 30 ($\delta t = 0.375$ yr) to calculate the population numbers (prior to recruitment) on July 1 at the start of the next year.

Model parameters are estimated using a maximum likelihood approach, with Bayesian-like priors on some parameters and penalties for smoothness and regularity on others. Data components in the base model are listed in Table E.

Changes since the previous assessment

No substantive changes have been made to the TCSAM02 modeling framework that impact one's ability to define a model and run it. The code for the TCSAM02 model framework is publicly available on GitHub.

Methods used to validate the code used to implement the model

The TCSAM02 model framework was demonstrated to produce results that were exactly equivalent to those from the 2016 assessment model (Stockhausen 2017b). TCSAM02 also underwent a review in July 2017 conducted by the Center for Independent Experts and was further reviewed by the CPT in May 2017 and September 2017. Changes to model code are validated against results from the previous assessment model to ensure that modifications do not change the results of the previous assessment.

6.3 Model selection and evaluation

Description of alternative model configurations

The model selected for the 2024 assessment, Model 22.03d5, provides the base model for this assessment (Stockhausen 2024a), as well as the author's preferred model. The following three tables summarize the parameterization and time blocks for the biological and fishery processes incorporated in this model:

Table H. Population processes and parameterization in the base/preferred model, 22.03d5.

process	time blocks	time blocks	22.03d5 description
Population rates and quantities			
Population built from annual recruitment			
Recruitment	1949+	1949-1974	ln-scale mean + annual devs constrained as AR1 process
		1975+	ln-scale mean + annual devs
	1949+	1949+	sigma-R fixed, sex ratio fixed at 1:1
Growth	1949+	1949+	sex-specific
			mean post-molt size: power function of pre-molt size
			post-molt size: gamma distribution conditioned on pre-molt size
Maturity	1949+	1949+	sex-specific
			size-specific probability of terminal molt
			logit-scale parameterization
Natural mortalty	1949-1979,	1949-1979,	estimated sex/maturity state-specific multipliers on base rate
	1985+	1985+	priors on multipliers based on uncertainty in max age
	1980-1984	1980-1984	estimated "enhanced mortality" period multipliers

Table I. Characteristics for retention and total catch in the directed ("TCF") fishery and bycatch in the snow crab ("SCF") fishery in the base/preferred model, 22.03d5.

Fishery/process	time blocks	22.03d5 description
TCF	directed Tanner crab fishery	
capture rates	pre-1965	male nominal rate
	1965+	male ln-scale mean + annual devs
	1949+	ln-scale female offset
male selectivity	1949-1990	ascending logistic
	1991-1996	annually-varying ascending logistic
	2005+	annually-varying ascending logistic
female selectivity	1949+	ascending logistic
male retention	1949-1990; 1991-1996; 2005-2009; 2013+	ascending logistic
% retained	pre-1988	fixed at 100%
	1991-1996	fixed at 100%
	2005-2009	fixed at 100%
	2013+	fixed at 100%
SCF	bycatch in snow crab fishery	
capture rates	pre-1978	nominal rate on males
	1979-1991	extrapolated from effort
	1992+	male ln-scale mean + annual devs
	1949+	ln-scale female offset
male selectivity	1949-1996	dome-shaped (double normal)
		--plateau width fixed to 0
		--descending limb width fixed to 1
	1997-2004	dome-shaped (double normal)
	2005+	dome-shaped (double normal)
female selectivity	1949-1996	ascending logistic
	1997-2004	ascending logistic
	2005+	ascending logistic

Table J. Characteristics for bycatch in the BBRKC ("RKF") and groundfish fisheries ("GF All") in the base/preferred model, 22.03d5.

Fishery/process	time blocks	22.03d5 description
RKF	bycatch in BBRKC fishery	
capture rates	pre-1952	nominal rate on males
	1953-1991	extrapolated from effort
	1992+	male ln-scale mean + annual devs(*)
	1949+	ln-scale female offset
male selectivity	1949-1996	ascending normal, asymptote fixed
	1997-2004	ascending normal, asymptote fixed
	2005+	ascending normal, asymptote fixed
female selectivity	1949-1996	ascending normal, asymptote fixed
	1997-2004	ascending normal
	2005+	ascending normal
GF All	bycatch in groundfish fisheries	
capture rates	pre-1973	male ln-scale mean from 1973+
	1973+	male ln-scale mean + annual devs
	1973+	ln-scale female offset
male selectivity	1949-1986	ascending logistic
	1987-1996	ascending logistic
	1997+	ascending logistic
female selectivity	1949-1986	ascending logistic
	1987-1996	ascending logistic
	1997+	ascending logistic

Unlike females, the maturity state of individual male Tanner crab is not readily identifiable in the field and is not provided as part of the annual NMFS EBS shelf survey datasets. Consequently, while data from the survey can be characterized by maturity state for females and treated differently in the likelihood depending on maturity state, this is not possible for males. Thus, the assessment model characterizes the NMFS EBS shelf survey data separately by sex, referring to the male-specific dataset (with no information on maturity state) as the "NMFS M" survey and the female-specific dataset (with females characterized as immature or mature based on abdominal shape) as the "NMFS F" survey. Similar conventions hold for survey data from BSFRF. The following table summarizes the parameterization and time blocks for the survey processes incorporated into 22.03d5.

Table K. Characteristics for the NMFS and BSFRF surveys in the base/preferred model, 22.03d5.

Survey/process	time blocks	22.03d5 description
NMFS EBS trawl survey		
male survey q	1975-1981	ln-scale
	1982+	ln-scale w/ prior based on Somerton's underbag experiment
female survey q	1975-1981	ln-scale
	1982+	ln-scale w/ prior based on Somerton's underbag experiment
male selectivity	1975-1981	ascending normal, fixed fully-selected size at 180
	1982+	ascending normal, fixed fully-selected size at 180
female selectivity	1975-1981	ascending normal, fixed fully-selected size at 130
	1982+	ascending normal, fixed fully-selected size at 130
BSFRF SBS trawl surveys		
male catchability	2013-2018	fixed at 1 for all sizes
male availability	2013-2018	empirically-determined outside the model
female catchability	2013-2018	fixed at 1 for all sizes
female availability	2013-2018	empirically-determined outside the model

Finally, the components included in the model likelihood are summarized in the following table:

Table L. Likelihood components in the base/preferred model, 22.03d5.

		22.03d5		
Component	Type	included in optimization	Fits	Likelihood distribution
TCF: retained catch	biomass	yes	males only	lognormal
	size comp.s	yes	males only	multinomial
TCF: total catch	biomass	yes	total	lognormal
	size comp.s	yes	by sex (extended)	multinomial
SCF: total catch	biomass	yes	total	lognormal
	size comp.s	yes	by sex (extended)	multinomial
RKF: total catch	biomass	yes	total	lognormal
	size comp.s	yes	by sex (extended)	multinomial
GF All: total catch	abundance	yes	total	lognormal
	biomass	yes	total	lognormal
	size comp.s	yes	by sex	multinomial
NMFS "M" survey (males only, no maturity)	biomass	yes	males only	lognormal
	size comp.s	yes	males only	multinomial
NMFS "F" survey (females only, w/ maturity)	biomass	yes	by maturity classification	lognormal
	size comp.s	yes	by maturity classification	multinomial
BSFRF "M" survey (males only, no maturity)	biomass	yes	males only	lognormal
	size comp.s	yes	males only	D-M
BSFRF "F" survey (females only, w/ maturity)	biomass	yes	by maturity classification	lognormal
	size comp.s	yes	by maturity classification	D-M
growth data	EBS only	yes	by sex	gamma
male maturity ogive data	EBS only	yes	males only	binomial

As per recommendations by the CPT and SSC at their previous meetings, only one model version of the bespoke model proposed by the author in May, 22.03d5, has been brought forward and evaluated with new data from 2024/25 for this assessment. No suitable GMACS models were available to run as alternatives. Hence the base model and author's preferred model are the same (differing only by the data fit). The two model runs will be distinguished by appending "2024" or "2025", as appropriate, to the model name.

Progression of results from the previous assessment to the current base model

The model used in the previous assessment is the current base model, and also the preferred model. The results from the 2024 and 2025 model runs are so similar that a bridging analysis was not conducted.

Evidence of search for balance between realistic (but possibly over-parameterized) and simpler (but not realistic) models

A Tier 4 model based on survey biomass was evaluated as a "backup" for the Tier 3 model `22.03d5 (2025)` (Section 8).

Convergence status and convergence criteria

Convergence to the MLE was evaluated using parameter jittering to initialize a set of model runs at starting parameter values randomly-selected from within a large fraction of the available parameter space and selecting the run which minimized the final objective function value (i.e., maximized the likelihood) over the set of jittered model runs. Ideally, all runs should arrive at the same global minimum on the objective function hypersurface. In practice, some runs will converge to a local minimum on the hypersurface, rather than the global minimum, and some runs will simply fail to converge at all. The latter can be distinguished because the final gradient of the objective function with respect to the parameters exhibits values that are not close to zero. However, runs that converge to any minimum on the hypersurface should have gradient values that are identically zero (or "close" to zero, from a practical numerical standpoint). Thus, runs that end at a local minimum cannot be distinguished from runs that end at the global minimum based solely on the size of the final gradients. Consequently, the global minimum solution can only be selected by starting the model at many locations within the available parameter space and selecting the "one" run that achieves the minimum over all the model runs. Ideally, though, a sizable fraction of the runs should achieve the same minimum.

For this assessment, convergence was partially evaluated by making 800 jitter runs for `22.03d5 (2025)` to find the parameter values that resulted in the model's maximum likelihood (i.e., the parameters that minimized the model objective function, which is the negative of the likelihood). The jittering analysis appears to have found the parameter set that achieves the minimum objective function/maximum likelihood (3,311.97), with 66 jittered model runs out of 800 converging to the same minimum value (Figure 51). The large number of runs that converged to the same minimum objective value lends confidence to the assertion that the solution is indeed the global minimum.

Other factors that were considered were the maximum parameter gradient at model convergence, whether it was possible to obtain the parameter covariance matrix and uncertainty estimates for parameters and derived quantities by inverting the model hessian, and whether any parameters were estimated at a bound. The maximum gradient at the MLE was small (0.00682) and it was possible to invert the model hessian and obtain uncertainty estimates for parameters and derived quantities (Table M). No parameters were estimated at a bound for the preferred model, `22.03d5 (2025)` (Table 25). As an additional step, the parameters from the "best" jittered model were subjected to a final optimization step (ADMB's "hess_step" option) such that the maximum gradient after this step was 0 to machine precision.

Table M. Summary convergence diagnostics.

model configuration	parent	changes	number of parameters	no. of jitter runs	no. converged to MLE	no. of param.s at bounds	objective function value	max gradient	invertible for std. devs?
22.03d5 (2024)	--		357	800	99	0	3182.00	1.78E-02	yes
22.03d5 (2025)	--	updated 2024 model with 2024/25 survey and fisheries data	363	800	66	0	3311.97	0.00E+00	yes

Sample sizes assumed for the compositional data

"Raw" (number of measured individuals) sample sizes for survey size compositions are listed in Tables 16 and 20. Input sample sizes for all survey size compositions were set to sum to 200 for each survey year, with the sample size for an individual population component (e.g., immature females) reflecting its raw sample size relative to the total raw sample size for the year in question.

Raw and input sample sizes used for fishery-related size composition data are listed in Tables 6 and 12-14. The maximum input sample size for fishery data was set to 200. Otherwise, input sample sizes were scaled as described in Stockhausen (2014) using the formula:

$$SS_y^{inp} = min[200, \frac{SS_y}{\bar{SS}/200}]$$

where $\bar{SS}$ is the mean sample size for all males from dockside sampling in the directed fishery.

Parameter sensibility

No parameters were estimated at a bound for the preferred model, `22.03d5 (2025)`. Values for all estimated parameters are listed in the following tables:

- 26: parameters for recruitment, growth, and natural mortality
- 27: ln-scale recruitment deviations prior to 1975
- 28: ln-scale recruitment deviations after 1974
- 29: logistic-scale parameters for the probability of undergoing the molt-to-maturity
- 30: non-vector parameters related to fishing mortality rates, retention, survey catchability, and the Dirichlet-Multinomial likelihood
- 31: ln-scale fishing mortality devs for the directed fishery
- 32: ln-scale fishing mortality devs for bycatch in the snow crab fishery
- 33: ln-scale fishing mortality devs for bycatch in the BBRKC fishery
- 34: ln-scale fishing mortality devs for bycatch in the groundfish fisheries
- 35: "pS1" selectivity parameter values
- 36: "pS2" selectivity parameter values
- 37: "pS3" and "pS4" selectivity parameter values, and
- 38: dev parameters for size-at-50% selected for males in the directed fishery

Values for survey availability of the BSFRF SBS surveys were estimated outside the model but are listed in Tables 39-50 for completeness.

Criteria used to evaluate the model or to choose among alternative models

None of the models presented to the CPT and SSC in the spring, other than 22.03d5, were judged to have performed well enough to be considered as viable alternative models for this assessment (Stockhausen 2024b; SSC 2025; CPT 2025). Following the "hess_step" optimization of the "best" jittered model, `22.03d5 (2025)` appears to have converged to the MLE based on the jitter analysis, the magnitude of the maximum parameter gradient for the objective function at the presumed MLE, and the ability to invert the model hessian to obtain standard errors for parameters and derived quantities using the delta method (Table M). In addition, no parameters were estimated at a bound and none of the estimated parameter values appear to be problematic.

Residual analysis

Standardized residuals for model fits to all aggregated catch data components (e.g., retained catch biomass, survey catch biomass) and the molt increment data were calculated and plotted for both "2024" and "2025". Median absolute deviation (MAD), median absolute relative error (MARE), and root mean square error (RMSE) statistics were used to summarize overall model fit to a data component (in addition, of course, to the associated likelihood). Pearson's and OSAs (one step ahead) reiduals were examined for fits to all size composition data. Pearson's residuals were examined for the male maturity ogive data. Outliers were "flagged" graphically.

Objective function values

Objective function values related to data in the likelihood are listed by component for models `22.03d5 (2024)` and `22.03d5 (2025)` in Tables 51-53; those related to non-data components are listed in Table 54. Objective function differences relative to `22.03d5 (2024)` are listed in Tables 55-58. It should be noted, though, that most values are not directly comparable between the model runs because `22.03d5 (2025)` incorporates new data for 2024/25, so caution must be used when interpreting apparent differences between the models.

Evaluation of the model(s)

As one might expect, model-estimated quantities from `22.03d5 (2025)` were, on the whole, extremely similar to those from `22.03d5 (2024)`. Estimated capture rates in the directed fishery from `22.03d5 (2025)` were smaller from 1965-1980, particularly from 1971-193, than those from `22.03d5 (2024)`, but slightly larger from 1990-1994 after which values from both runs were essentially identical (Figure 52). Selectivity and retention functions were essentially identical (Figures 53-56). Differences between the model runs for bycatch capture rates and selectivity functions in the snow crab, BBRKC, and groundfish fisheries were also small (Figures 57-59).

Estimates of sex-specific NMFS EBS shelf survey fully-selected catchabilities were slightly smaller for male from `22.03d5 (2025)` compared with `22.03d5 (2024)` (Table 60) in the pre-1982 period but slightly larger in the post-1981 period, (Figure 60), while the corresponding selectivity curves were practically identical (Figure 60). The small differences in catchabilities between the two models appear to account for the small (opposite) differences in the estimated fishery capture rates. Survey availability curves for the BSFRF data were the same for both model runs (Figure 61).

Estimates of natural mortality, size-specific mean growth, and size-specific probability of undergoing the molt to maturity were almost identical for the two model runs (Table 59, Figure 62). The estimated recruitment size distribution (panel 1 in Figures 63 and 64) was narrower with a smaller mean size in `22.03d5 (2025)` compared with `22.03d5 (2024)`. This initial difference decreased across the first few years of cohort development and disappeared after five years for females (panel 5 in Figure Figure 63). For males,the progression is somewhat different between the two model runs because the probability of males undergoing terminal molt is higher at small sizes in `22.03d5 (2025)` as compared with (Figure 64).

Estimated recruitment exhibited only small differences between the two models, the largest being from 1962-67 (22.03d5 (2025) larger) and in the last few years (since 2020; Tables 99 and 100, Figures 65 and 66), as was the case with MMB (Tables 97 and 98; Figures 65 and 66). The estimated recruitments since 2021 exhibited larger differences than typical between the two models: the estimates from 22.03d5 (2025) were 63%, 46%, and 24% higher than those from 22.03d5 (2024) in 2021, 2022, and 2023, respectively. Estimated trends in abundance by sex and maturity state followed simlar trajectories, but values for 22.03d5 (2025) were slightly larger than those for 22.03d5 (2024) across the time series; in contrast, trends in biomass were indistinguishable except the in mid 1970s and in the last few years. (Tables 93-96; Figures 67 and 68).

Estimated trajectories (Figure 69) of total fishing mortality vs. stock size (MMB) exhibited similar patterns across time, with values for 22.03d5 (2024) exhibiting the most extreme fishing mortality (in 1971) and 22.03d5 (2025) the largest biomass (in 1974). 22.03d5 (2025) fitted the retained catch and total catch biomass series as well as Model 22.03d5 (2024) did (Figures 70-74), with only the fit to total catch in the directed fishery in 1996/97 (just prior to the closure of the fishery for nine years) as a substantial outlier in both models.

Fits to NMFS EBS shelf survey biomass were almost identical for the two models (Figures 75 and 76). The fits to immature and mature female survey biomass do not really exhibit this pattern and are similar across the time series (Figures 75 and 77). Of note, both models substantially overestimated male survey biomass in 2022 and 2023 (z-scores < -4). Both models overestimate male survey abundance rather substantially in the last two years, but this data is not included in the model likelihoods (Figures 80 and 81).

Both models fitted the BSFRF SBS biomass data equally well and estimate the abundance data equally well for 2013-2017, but substantially overestimated mature female biomass in 2018 (Figures 75, 78, and 79).

The mean growth curve estimated by 22.03d5 (2025) is almost identical to that of 22.03d5 (2024) (Figure 85), with estimated postmolt size exhibiting a slightly convex pattern with premolt size for females but an increasing trend in overestimating post-molt size in males. The z-scores are also almost identical.

The two models also fit the male maturity ogive in similar fashion in each year (Figure 86); neither model fits 2018 and 2023 very well, and 22.03d5 (2025) does not fit 2025 very well, with the caveat that Pearson's residuals are not ideal diagnostics for fits to proportions.

As with the fishery catch biomass data, Model 22.03d5 (2025) fit the fishery size composition data in a manner almost identical to that of 22.03d5 (2024) (Figures 88-Figure 118). Retained catch size compositions were generally well-fit prior to the fishery closure in 2016/17, but exhibited worse fits afterward (Figures 88 and 89), presumably at least partly due to the fact that the fishery was only prosecuted in the western management area (which exhibits a different size range of males than the combined area) in the intervening period until last year. The fit to this year's size composition is better than the fits back to 2017/18, but still overestimates the proportion of the largest crab in the catch.

Fits to the total catch size compositions in the directed and bycatch fisheries are essentially identical for the two models (excluding 2023/24, of course). The estimated size compositions since 2014/15 for the directed fishery all overestimate the proportion of males in the largest size bin (Figures 93, 95 and 96), although the bias is not really substantial judging by the z-score sizes.

Estimates of bycatch size compositions in the snow crab fishery tend to be fairly reasonable for males, although fits in the early 1990s and mid-2000s are poor (Figures 99, 101 and 102). Fits in 2020/21 and 2021/2 are not as bad, from a statistical viewpoint, as they may appear in Figure 99 (see residuals in 101).

Fits to the bycatch compositions from the BBRKC fishery are rather poor, reflecting the lower sample sizes associated with these data. Starting in 2016/17, coincident with ADF&G closing the Tanner crab fishery east of 166ºW longitude, the models consistently overestimated the proportion of large males in the size compositions (Figure 105), which may indicate the interaction among spatial processes (the BBRKC fishery only takes Tanner crab in the eastern management area) not accounted for in the modeling framework. Similar overestimates occurred in 2003/04-2007/08, but the Tanner crab fishery in the eastern management area was not closed during that period.

The groundfish fisheries take a wider range of Tanner crab as bycatch than do the other fisheries (Figures 111-118). In addition, the fixed gear and trawl gear fleets capture different size ranges, so the resulting size compositions could be expected to vary annually, even in the absence of changes in size structure in the Tanner crab population due to recruitment and growth, depending on the relative effort in the two fleets. As such, it is not too surprising that the models exhibit poor (but almost identical) fits to the size compositions from the groundfish fisheries in some years.

The fits to the NMFS EBS shelf survey size compositions for the two models are indistinguishable for all three population components: males, immature females, and mature females (Figures 127-140). While the fits are reasonably good in most instances, both models consistently overestimated the proportion of males or mature females in the largest size bin in the data from 1997 onward.

The two models fit identically to the BSFRF SBS size composition data (Figures 143-149). Both models underestimate the proportions of the small males in the 2016 and 2017 surveys and generally fit the proportions for immature females poorly (Figure 146).

The marginal size distributions (i.e., averaged across years for a given dataset) from both fishery and survey data were fit equally well by both models, with little discernible difference in the means (Figures 150-154). The worst agreement between the marginal distributions for the models and the data occurred for the groundfish fisheries male bycatch data and the BSFRF SBS immature female survey data (Figures 153-154).

On the whole, effective sample sizes from both models were very similar for both fishery and survey size composition data and tended to be larger than input sample sizes (Figures 155-161). Exceptions to the latter observation include total catch size compositions for males in the directed fishery from 2014/15 to 2021/22, NMFS EBS shelf survey size compositions for males before 1987, and all BSFRF SBS size compositions for males (Figures 156 and 161).

The value of Mohn's rho (Mohn 1999) for recruitment from the retrospective analysis for Model `22.03d5 (2025)` (Figure 162) was small (0.0681), indicating that changes to recruitment as data was added tended to cancel out across the time series. Recruitment estimates for a given terminal year tended to decrease as more years of data were added to the model, although this was not true after 2021. Similarly, Mohn's rho for MMB was only 0.002 (Figure 163). Estimates when MMB had a decreasing trend (2015-2020) tended to get slightly smaller when more data was added.

In summary, the author's preferred model `22.03d5 (2025)` performed, on the whole, very similarly to the 2024 assessment model, `22.03d5 (2024)`.

6.4 Results (best model(s))

As the only model evaluated for this assessment, model `22.03d5 (2025)` is, by default, the author's preferred model for the 2025 assessment. In this section, results not previously discussed are compared with those from the 2024 assessment model, `22.03d5 (2024)`.

List of effective sample sizes, the weighting factors applied when fitting the indices, and the weighting factors applied to any penalties

Sample sizes were not adjusted as part of the model-fitting process (iterative re-scaling by either the Francis or McAllister-Ianelli approaches have not been successful in past attempts to re-weight size composition data), thus input and effective sample sizes were identical. Input sample sizes for fishery size composition data fit in the model are listed in Tables 6 and 12-14 . Observed sample sizes for survey data are listed in Tables 22 and 23. Input sample sizes for survey composition data were set to 200 for each annual survey and apportioned across population components (sex, maturity state, and shell condition) by the proportion of samples taken in the category relative to the total number of samples.

In all model scenarios, lognormal likelihoods were used to fit aggregated biomass and, where appropriate, abundance data. For survey data, CV's based on design-based considerations were used (see Tables 16-20). For fishery-related catch data, the following CV's and minimum standard deviations applied:

Table N. Assumed CV's for fishery catch abundance and biomass data.

fishery	catch type	time period	CV
directed fishery	retained	1965-1979	10.0%
		1980	2.5%
		1996+	1.0%
	total	1990+	20.0%
snow crab	total	1990+	20.0%
BBRKC	total	1990+	20.0%
groundfish	total	1973	20.0%

A weighting factor of 1 million was applied to the square of the sum of each "devs" vector to force it to sum to 0.

Tables of estimates

All parameters

Parameter estimates and associated standard errors, based on inversion of the converged model's Hessian and the "delta" method, are listed in 26-38.

Derived values (natural mortality, survey catchability)

Estimated values for rates of natural mortality and sex-specific catchabilities for the NMFS EBS shelf survey are given in Tables 59 and 60.

Abundance and biomass time series, including spawning biomass and MMB

Model-estimated values for annual retained catch and discard mortality (abundance and biomass) in the directed and bycatch fisheries are given in Tables 61-80. Model-estimated values for survey abundance and biomass for the NMFS EBS shelf survey and BSFRF SBS surveys are documented in Tables 81-92. Model-estimated values for annual population abundance and biomass are given by sex, maturity state, and shell condition in Tables 93-96. Model estimates for mature male and female biomass at the time of mating are listed in Tables 97-98.

Recruitment time series

Model estimates for recruitment are given in Tables 99 and 100.

Time series of catch divided by biomass

Model estimated time series for total fishing mortality divided by population biomass (i.e., exploitation rate) are documented in Tables 101 and 102.

Graphs of estimates

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 52, while the associated selectivity functions are illustrated in Figures 53-55. The estimates of size-selective retention for males captured in the directed fishery are presented in Figure 56. 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 57-59.

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 60.

The BSFRF nephrops bottom trawl gear is assumed to be non-size-selective (i.e., selectivity=1 at all sizes) and catch all crab in its swept-area path (i.e., the fully-selected catchability coefficient $q = 1$). Assumed survey availability curves for the BSFRF side-by-side catchability surveys are illustrated in Figure 61. These were not estimated; they were determined outside the model and are the same in the two model runs (see Appendix A in Stockhausen 2024a for details).

Estimated Population-related Quantities

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 62, together with estimated mean post-molt size (as a function of pre-molt size) and natural mortality rates. The cohort progressions (growth and development) resulting from these schedules are illustrated in Figures 63 and 64.

Estimated population-related time series

Estimated time series for recruitment and MMB are shown in Figures 65 and 66. Time series of abundance by sex and maturity state are illustrated in Figure 67; time series of biomass by sex and maturity state are illustrated in Figure 68.

Estimated Fishing Mortality versus Estimated Spawning Stock Biomass

Estimated total fishing mortality (retained + discards) is plotted against spawning stock biomass (MMB) for the models in Figure 69.

Fit of a stock-recruitment relationship, if feasible

Fits to a stock-recruit relationship were not evaluated.

Evaluation of the fit to the data

Fits to Fishery Catch Data

Fits to the observed and model-predicted fishery catch biomass data are presented in Figures 70-74 for the previous assessment (`22.03d5 (2024)`) and preferred (`22.03d5 (2025)`) models. Residuals to the fits and summary statistics are also shown on each figure.

Fits to Survey Indices and Related Data

Graphs of model fits to survey biomass and numbers

Model fits to the survey biomass time series from the NMFS EBS shelf survey and the BSFRF SBS surveys are shown for the models in Figure 75. Residuals to the fits and summary fit statistics are shown in Figures 76-79. The fits to the NMFS survey data were similar in pattern across the models, with particularly poor fits in 1985 for both males and immature females. The models also substantially overpredict NMFS survey biomass for males in 2022 and 2023 and underpredict it in 2024 and (`22.03d5 (2025)`) 2025. The fits to the BSFRF data are more acceptable, although both models overpredict mature female biomass in most years.

Model fits to the survey abundance time series for both the NMFS EBS shelf survey and the BSFRF SBS surveys are shown for the models in Figure 80. Residuals to the fits and summary fit statistics are shown in Figures 81-84. Fits to survey abundance were not included in the model objective function but serve as independent diagnostics of model fit. As with survey biomass, both models exhibited fairly similar fits to the abundance data, and these fits generally exhibited temporal patterns that were similar to those for survey biomass. Somewhat unexpectedly, the fits to male abundance in the 2022 and 2023 NMFS surveys were much better than those for biomass.

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 85. The predicted mean growth curves were essentially identical across the models, with both models overpredicting post-molt size for large crab of either sex.

Model fits to maturity ogive data from the NMFS EBS shelf survey are presented in Figure 86, while Pearson's residuals to the fits are shown in Figure 87. The models appear to fit the maturity ogive data to an identical degree.

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 88-126 for the previous assessment model, `22.03d5 (2024)`, and the preferred model `22.03d5 (2025)`. As requested, residual plots are provided for both Pearson's residuals and OSA residuals (the latter using the `afscOSA` R package). Retained catch size compositions in the directed fishery are male-only. Total catch size composition data from the directed and bycatch fisheries are fit in the models by normalizing it across sexes and fitting the resulting proportions jointly.

On the whole, the fits are very similar across both models.

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 (both Pearson's and OSA residuals), from the NMFS EBS shelf survey and the BSFRF SBS survey are presented in Figures 127-149 for the previous assessment model, `22.03d5 (2024)`, and the preferred model `22.03d5 (2025)`. Both models exhibit similar fits to the NMFS survey size composition data, with the most salient feature perhaps being that the models overpredict the proportion of crab in the largest size bins for both males and females starting around 2000. The fits to the BSFRF size composition data are similar across the models for both sexes.

Marginal Distributions for Fits to Compositional Data

Marginal distributions for fits to the compositional data from the fisheries are shown in Figures 150-153, as well as in the previous OSA residuals plots (Figures 92, 119, 120, 121, 122, 123, 124, 125, and 126). Marginal distributions for fits to the compositional data from the surveys are shown in Figure 154, as well as in previous OSA residuals plots (Figures Figure 132, Figure 141, and Figure 142). The fits to the marginal distributions were practically identical across the models and none exhibit the problem with overpredicting the proportions of large crab noted for the fits to individual years because underpredictions in the early parts of the time series balance out overpredictions in the latter part of those time series.

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

Implied effective sample sizes were calculated by year for all size compositions using the McAllister-Ianelli method (McAllister and Ianelli 1997). Time series plots of implied and input effective sample sizes for compositional data from the fisheries are shown in Figures 155-159. Similar plots for the survey compositional data are given in Figures 160 and 161. The implied sample sizes were very similar across the two models for the fishery size compositions and are larger than the input sample sizes for most years. This was also the case for the NMFS survey size compositions, although the implied sample sizes from both models were consistently smaller than the input sample sizes for males before 1989. The results for the BSFRF size composition results provide support for fixing the effective sample size parameters in the Dirichlet-Multinomial likelihoods used to fit the BSFRF size compositions (as in 22.03d5) as a practical step to obtaining a model with no parameters estimated at a bound.

Tables of the RMSEs for the indices (and a comparison with the assumed values for the coefficients of variation assumed for the indices)

Root mean square error (RMSEs) for fits to fishery datasets are provided in 103 and for fits to survey and growth datasets in Table 104, but no comparison is available with the cv's assumed for the indices. The author has previously requested guidance on how the cv's for time series indices should be combined to compare with the RMSEs.

Quantile-quantile (q-q) plots and histograms of residuals (to the indices and compositional data) to justify the choices of sampling distributions for the data

Quantile-quantile (q-q) plots and histograms of residuals for indices were not produced for this assessment. q-q plots and histograms of OSA residuals for compositional data are illustrated for fishery data in Figures 92, 119, 120, 121, 122, 123, 124, 125, and 126. Similar plots for NMFS survey-related compositional data are illustrated in Figures 132, 141, and 142.

Retrospective and historical analyses

Retrospective analysis

Retrospective analyses were conducted for the base/preferred model `22.03d5 (2025)`. The analysis used 10 peels (ending in 2015), with the model re-fit after each removal of the previous peel's terminal year's data. Time series plots of recruitment and MMB were made to identify potential patterns in how the terminal year's estimate for each peel differed from the model result using the complete dataset (Figures 162 and 163. Relative bias in the terminal year estimates was quantified using Mohn's rho (Mohn 1999). The retrospective patterns don't indicate any apparent problems with MMB (Mohn's rho = 0.00247), but additional data (decreasing the number of peels) until 2020, after which estimates increased. Mohn's rho for the recruitment pattern was 0.0681.

Historical analysis (plot of actual estimates from current and previous assessments)

The estimated time series of recruitment and mature biomass for the author's preferred model, `22.03d5 (2025)`, are compared with those from previous assessments in Figures 164 and 165. Prior to 1975, when the NMFS EBS shelf survey data begin, the results fall into three groups: 2017 and 2018, 2019 and 2020, and the remainder (2021-2024 plus this assessment's preferred model), with results for the first two groups differing mainly in scale while the latter group differs from the first two in temporal pattern, as well. After 1975, the models differ primarily in scale, while exhibiting similar temporal patterns. The plots indicate a generally-increasing trend in the overall scale of estimated recruitment and mature biomass by assessment.

Uncertainty and sensitivity analyses

MCMC runs were not completed in time to include in the assessment. Uncertainty has been characterized using ADMB's sdreport functionality for parameters, recruitment estimates, MMB time series, and management quantities. This uses the so-called "delta approximation" to estimate uncertainty associated with parameters and derived quantities after inverting the model Hessian at the MLE and obtaining the covariance matrix.

7 Calculation of the Tier 3 OFL and ABC

7.1 Status determination and OFL calculation

The (total catch) OFL for 2024/25 was 41.29 thousand t while total catch mortality was 3.093 thousand t, based on applying mortality rates of 1.000 for retained catch, 0.321 to bycatch in the crab fisheries, 0.5 to bycatch in the groundfish fixed gear fisheries, and 0.8 to bycatch in the groundfish trawl fisheries to retained catch data and estimates of discards from fish ticket and observer data (see Tables A, 1, 10, and 11). Because total catch mortality is less than the OFL, **overfishing did not occur in 2024/25**.

For crab stocks managed by the NPFMC, *overfished* status is assessed with respect to the Minimum Stock Size Threshold (MSST, CPT 2022). If stock biomass drops below the MSST, the stock is considered to be overfished. For crab stocks, MSST is one-half of B_{MSY}, where B_{MSY} is the long-term equilibrium biomass (assumed to reflect the reproductive potential for the stock) when the stock is fished at maximum sustainable yield (MSY). Thus, the stock is overfished if $B/B_{MSY} < 0.5$, where B is the "current" biomass. In general, the overfishing limit (OFL) for the subsequent year is based on B/B_{MSY} and an F_{OFL} harvest control rule, where F_{OFL} is the fishing mortality rate that yields the OFL and $F_{OFL} \leq F_{MSY}$, the fishing mortality that yields the long-term maximum sustainable yield (MSY). Furthermore, if $B/B_{MSY} < \beta(= 0.25)$, directed fishing on the stock is prohibited. Tanner crab has been considered a "Tier 3" stock for status determination and fishery management since 2012/13 (SSC 2012) because the available biological and fishery information have been deemed sufficiently informative that Tier 3 proxies for B_{MSY} and F_{MSY} (i.e., spawner-per-recruit proxies $B_{35\%}$ and $F_{35\%}$ based on mature male biomass) can be reliably estimated.

Amendment 24 to the NPFMC fishery management plan revised the definitions for overfishing for EBS crab stocks (NMFS 2008; NPFMC 2023). The information provided in this assessment is sufficient to estimate overfishing limits for Tanner crab under Tier 3. The OFL control rule for Tier 3 is outlined in Table O (see Figure 166 for a graphical representation).

Table O. Tier 3 F_{OFL} control rule.

B, $F_{35\%}^*$, $B_{35\%}^*$	**3**	a. $\frac{B}{B_{35\%*}} > 1$	$F_{OFL} = F_{35\%}*$	
		b. $\beta < \frac{B}{B_{35\%}*} \le 1$	$F_{OFL} = F^*_{35\%} \frac{\frac{B}{B^*_{35\%}} - \alpha}{1 - \alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{35\%}*} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}^{\dagger}$	

It is based on an estimate of "current" spawning biomass at mating (B above, taken as the projected MMB at mating in the assessment year) and spawning biomass per recruit (SBPR)-based proxies for F_{MSY} and B_{MSY}. In the equations above in Table O, $\alpha = 0.1$ and $\beta = 0.25$. For Tanner crab, the proxy for F_{MSY} is $F_{35\%}$, the fishing mortality that reduces the SBPR to 35% of its value for an unfished stock. Thus, if $\phi(F)$ is the SBPR at fishing mortality F, then $F_{35\%}$ is the value of fishing mortality that yields $\phi(F) = 0.35 \cdot \phi(0)$. The Tier 3 proxy for B_{MSY} is $B_{35\%}$, the equilibrium biomass achieved when fishing at $F_{35\%}$, where $B_{35\%}$ is simply 35% of the equilibrium (longterm average) unfished stock biomass. Given an estimate of average recruitment, $\bar{R}$, $B_{35\%} = 0.35 \cdot \bar{R} \cdot \phi(0)$.

Thus Tier 3 status determination and OFL setting for 2025/26 require estimates of $B = MMB_{2025/26}$ (the projected MMB at mating time for the coming year), $F_{35\%}$, spawning biomass per recruit in an unfished stock (ϕ_0), and $\bar{R}$. Current stock status is determined by the ratio $B/B_{35\%}$ for Tier 3 stocks. If the ratio is greater than 1, then the stock falls into Tier 3a and $F_{OFL} = F_{MSY} = F_{35\%}$. If the ratio is less than one but greater than β, then the stock falls into Tier 3b and F_{OFL} is reduced from $F_{35\%}$ following the descending limb of the control rule (Figure 166). If the ratio is less than β, then the stock falls into Tier 3c and directed fishing must cease. In addition, if B is less than the Minimum Stock Size Threshold (MSST, = ½ $B_{35\%}$), the stock must be declared overfished and a rebuilding plan subsequently developed.

The OFL is calculated within the assessment model based on equilibrium calculations for F_{MSY} and projecting the state of the population at the end of the modeled time period one year forward assuming fishing mortality at F_{OFL}. Using an estimate of the uncertainty in the OFL and assumptions about the underlying distribution or MCMC, one can estimate the probability distribution of the OFL (and related quantities of interest) and better characterize model uncertainty.

To calculate F_{MSY}, the fishery capture rate for males in the directed fishery is adjusted until the long term (equilibrium) MMB-at-mating is 35% of its unfished value (i.e., $B = 0.35 \cdot B_0 = B_{35\%} = B_{MSY}$). This calculation depends on the assumed bycatch F's on Tanner crab in the snow crab, BBRKC and groundfish fisheries. Since 2017, the average F over the last 5 years for each of the bycatch fisheries has been used in these calculations. Fishery selectivity curves were set using the average curve over the last 5 years for each fishery, as in previous assessments (e.g., Stockhausen 2022).

The determination of $B_{MSY} = B_{35\%}$ for Tanner crab depends on the selection of an appropriate time period over which to calculate average recruitment ($\bar{R}$). Following discussion in 2012 and 2013, the SSC endorsed an averaging period of 1982+. Starting the average recruitment period in 1982 is consistent with a 5-6 year recruitment lag from 1976/77, when a well-known climate regime shift occurred in the EBS (Rodionov and Overland 2005) that may have affected stock productivity. This issue was revisited at the May 2018 CPT meeting with regard to whether or not the final year should be included in the calculation, but no definitive recommendations were made. In 2020, the NMFS EBS shelf bottom trawl survey was canceled due to health and safety concerns associated with the COVID-19 pandemic. This resulted in enormous uncertainty in the estimate of final year recruitment for that assessment; it was subsequently dropped from the averaging time frame. Recruitment estimates and associated uncertainties for the intervening years do not raise any concerns, but the estimated confidence interval and standard deviation for the 2025 recruitment is an outlier in terms of the time series, being the third-largest since the 1982+ time frame (Figure 167). Consequently, average recruitment for the preferred model was calculated by dropping the final year estimate and using the period 1982-2024.

The value of $\bar{R}$ for this period from the author's preferred model is 601.21 million. This estimate of average recruitment is 14% larger than that from the 2024 assessment model (526.04 million). The value of $B_{MSY} = B_{35\%}$ corresponding to $\bar{R}$ is 43.22 thousand t, which is 8% larger than that obtained in the 2024 assessment (40.01 thousand t).

Once F_{MSY} and B_{MSY} are determined, the (total catch) OFL can be calculated iteratively based on projecting the population forward one year assuming an F, calculating the catch and projected biomass B, comparing the stock's position on the harvest control rule's phase plane and adjusting F and recalculating the projected B until the point (F, B) lies on the control rule. The OFL is then the predicted total catch mortality taken when fishing at $F = F_{OFL}$, which is calculated as

$$C = \sum_f \sum_x \sum_z \{F_{\cdot,x,z} \cdot [1 - e^{F_{\cdot,x,z}}] \cdot [e^{M_x \cdot \delta t} \cdot N_{x,z}]\}$$

where C is total catch (biomass), $F_{f,x,z}$ is the fishing mortality in fishery f on crab in size bin z by sex (x), $F_{\cdot,x,z} = \sum_f F_{f,x,z}$ is the total fishing mortality by sex on crab in size bin z, $w_{x,z}$ is the mean weight of crab in size bin z by sex, M_x is the sex-specific rate of natural mortality, δt is the time from July 1 to the time of the fishery (0.625 yr), and $N_{x,z}$ is the numbers by sex in size bin z on July 1, 2025 as estimated by the assessment model. The OFL for 2025/26 from the author's preferred model (`22.03d5 (2025)`) is 51.02 thousand t (Figure 168).

The B_{MSY} proxy, $B_{35\%}$, from the author's preferred model is 43.22 thousand t , so $MSST = 0.5 \cdot B_{MSY} = 21.61$ thousand t. Because the current $B = 99.53$ thousand t > MSST, **the stock is not overfished**. Because the projected $B = 75.96$ thousand t $> B_{MSY}$, the stock falls into Tier 3a. The population state (directed F vs. MMB) is plotted with the Tier 3 harvest control rule in Figure 169.

7.2 ABC calculation

Amendments 38 and 39 to the Fishery Management Plan (NPFMC 2011) established methods for the Council to set Annual Catch Limits (ACLs). The Magnuson-Stevens Act requires that ACLs be established based upon an ABC control rule that accounts for scientific uncertainty in the OFL such that ACL=ABC and the TAC be set below the ABC so as not to exceed the ACL. ABCs must be recommended annually by the Council's SSC.

Two methods for establishing the ABC control rule are: 1) a constant buffer where the ABC is set by applying a multiplier to the OFL to meet a specified buffer below the OFL; and 2) a variable buffer, referred to as the p^*-ABC, where the ABC is set based on a specified percentile (p^*) of the distribution of the OFL that accounts for uncertainty in the OFL. p^* is the probability that ABC would exceed the OFL and overfishing occur. In 2010, the NPFMC prescribed that maximum ABCs for BSAI crab stocks be established at p^*=0.49. Thus, annual ACL=ABC levels should be established such that the risk of ovefishing, P[ABC>OFL], is 49%. For this assessment, the model-based uncertainty in the OFL was obtained using ADMB's sd_report functionality, which provides standard errors for derived quantities like the OFL based on the "delta method", which approximates the likelihood surface at the MLE as multivariate normal using the estimated parameter covariance matrix. In 2014, however, the SSC adopted a buffer of 20% on OFL for the Tanner crab stock for calculating ABC that included consideration of additional uncertainty in the stock assessment. The Risk Table for this stock (Appendix A) provides a rationale for the buffer based on the current assessment, environmental conditions, and fishery performance. Here, ABCs are provided based on both methods.

For the author's preferred model, `22.03d5 (2025)`, the P^* ABC (ABC_{max}) is 50.94 thousand t while the 20% Buffer ABC is 40.81 thousand t (Figure 168). The author remains concerned that the OFL calculation, based on $F_{35\%}$ as a proxy for F_{MSY}, is overly optimistic regarding the actual productivity of the stock. Fishery-related mortality similar to the P^* ABC level has occurred only in the latter half of the 1970s and in 1992/93, coincident with collapses in stock biomass to low levels. This suggests that $F_{35\%}$ may not be a realistic proxy for F_{MSY} and/or that MMB may not be a good proxy for reproductive success, as are currently assumed for this stock. In addition, estimates of survey catchability and mean recruitment are strongly correlated for this stock, suggesting that the estimated stock size may be problematic. However, these concerns are not new and are reflected in the previous ABC buffer. Other considerations in the evaluation of the Risk Table suggest these are at normal levels of concern and thus do not warrant increasing the buffer. Thus, the author recommends using the 20% buffer previously adopted by the SSC for this stock to to calculate the ABC. Consequently, **the author's recommended ABC is 40.81 thousand t**.

The following tables summarize the OFL/ABC results for model `22.03d5 (2025)` (repeating Tables A and B for convenience):

Management quantities (in 1,000s t) based on the author's preferred model, `22.03d5 (2025)`, and recommended ABC buffer (20%). TAC is summed across ADF&G management areas.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2021/22	17.37	62.05	0.50	0.49	0.78	27.17	21.74
2022/23	18.19	74.17	0.91	0.91	1.19	32.81	26.25
2023/24	20.00	88.21	0.94	0.94	1.09	36.20	27.15
2024/25	21.61	99.53	2.84	2.85	3.09	41.29	33.03
2025/26	NA	75.96	NA	NA	NA	51.02	40.81

Management quantities (in millions of pounds) based on the author's preferred model, `22.03d5 (2025)`, and recommended ABC buffer (20%). TAC is summed across ADF&G management areas.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2021/22	38.29	136.80	1.10	1.08	1.72	59.90	47.93
2022/23	40.10	163.52	2.01	2.01	2.62	72.33	57.87
2023/24	44.09	194.47	2.08	2.07	2.40	79.81	59.86
2024/25	47.64	219.43	6.27	6.29	6.82	91.03	72.82
2025/26	NA	167.45	NA	NA	NA	112.47	89.98

7.3 Projections

Multi-year projections were made under assumptions of fishing at 0, 0.25, 0.5, 0.75, 1, and 1.25 times the directed fishery F_{OFL} ($= F_{MSY}$ in this case for the models considered) for the preferred model (Figure 170). A total of 500 replicate projections of 20 years were made for each F_{OFL} multiplier. Each projection started at the final population state of the MLE and advanced in time under recruitments that were randomly resampled from the model-estimated recruitment time series for 1982 to 2024 (consistent with the time period to determine average recruitment for the OFL calculation). Characteristics for the fisheries were the same as those used to determine the OFL. The projections did not include any management feedback (e.g., F_{OFL} was not recalculated each year)–which would be appropriate in a management strategy evaluation (MSE) context.

For a given fishing mortality scenario, the projections follow very similar trajectories in the first 5 years before eventually diverging substantially starting around 2028, but the patterns are fairly different across scenarios (Figure 170). With no directed fishing, MMB is projected to increase relatively rapidly until 2028 as the strong recruitment events estimated in 2021 and 2022 grow to maturity, after which individual trajectories diverge substantially (but with the result that the mean MMB across trajectories in any year after 2040 is essentially the unfished value, B_{100}). For the scenarios with directed $F > 0.5$, the trajectories describe an initial decline from 2024/25 to 2025/26, the slope of which increases with the value of directed F. All scenarios then describe increases in MMB, the slopes of which decrease with increasing directed F, until 2028 at which point the trajectories for a given F start to diverge,

8 Tier 4 "fall back" model

8.1 Introduction

For crab stocks managed by the NPFMC, *overfished* status is assessed with respect to the Minimum Stock Size Threshold (MSST, CPT 2022). If stock biomass drops below the MSST, the stock is considered to be overfished. For crab stocks, MSST is one-half of B_{MSY}, where B_{MSY} is the long-term equilibrium biomass (assumed to reflect the reproductive potential for the stock) when the stock is fished at maximum sustainable yield (MSY). Thus, the stock is overfished if $B/B_{MSY} < 0.5$, where B is the "current" biomass. In general, the overfishing limit (OFL) for the subsequent year is based on B/B_{MSY} and an F_{OFL} harvest control rule, where F_{OFL} is the fishing mortality rate that yields the OFL and $F_{OFL} \leq F_{MSY}$, the fishing mortality that yields the long-term maximum sustainable yield (MSY). Furthermore, if $B/B_{MSY} < \beta(= 0.25)$, directed fishing on the stock is prohibited. Tanner crab has been considered a "Tier 3" stock for status determination and fishery management since 2012/13 (SSC 2012) because the available biological and fishery information have been deemed sufficiently informative that Tier 3 proxies for B_{MSY} and F_{MSY} (i.e., spawner-per-recruit proxies $B_{35\%}$ and $F_{35\%}$ based on mature male biomass) can be reliably estimated.

However, the SSC has expressed concerns regarding the complexity of the current Tier 3 models for Tanner and other crab stocks and has requested that simpler "Tier 4" models be developed as a fallback in the event that a candidate Tier 3 model is deemed unreliable (SSC 2022). Approaches to implement a "fallback" Tier 4 model were discussed at the March, 2023 meeting of the "simpler" crab modeling working group, a joint inter-agency and SSC working group (Anonymous 2023). The working group was formed in response to a recommendation made by the SSC during its October 2022 meeting that SSC members and stock assessments authors jointly explore model parsimony and legacy assumptions for the BBRKC, Tanner, and snow crab stocks (SSC 2022).

For Tier 4 stocks, the estimate of "current survey biomass" is considered to be reliable and the proxy B_{MSY} is defined as "average biomass over a specified time period" (CPT 2022 p. 8). F_{MSY} is taken to be $\gamma \cdot M$, where M is the assumed rate of natural mortality and γ is a constant (taken as 1 by default). Once the $B_{MSY_{proxy}}$ has been calculated, the overfished status is then determined by the ratio $B/B_{MSY_{proxy}}$: the stock is overfished if the ratio is less than 0.5, where B is taken as "current" biomass. The ratio also determines F_{OFL} relative to F_{MSY}:

1. if $B/B_{MSY_{proxy}} \geq 1$ then $F_{OFL} = F_{MSY}$;
2. if $0.25 < B/B_{MSY_{proxy}} < 1$, then $F_{OFL} < F_{MSY}$ as determined by a sloping F_{OFL} control rule (CPT 2022); or
3. $F_{OFL} = 0$ if $B/B_{MSY_{proxy}} < 0.25$.

For the Tier 3 stocks, the "simpler" crab modeling working group recommended using the mean of a smoothed time series for "vulnerable" male crab survey biomass as a very simple B_{MSY} proxy for fallback Tier 4 models, although it also supported authors bringing forward slightly more complex models that captured growth and mortality between the times of the survey and fishery (Anonymous 2023 pp. 4–5). At the May 2023 CPT meeting, the author presented a "slightly more complex" Tier 4 model for Tanner crab that incorporated natural mortality, recruitment, and fishing mortality into estimates of survey-based MMB-at-mating as the currency for the B_{MSY} proxy (Stockhausen 2023b). However, the SSC did not see the need for the additional complexity in a "fallback" model and requested that the author follow the working group's simpler B_{MSY} proxy recommendation (SSC 2023 p. 12). It also requested that authors base the averaging period "on the whole time series or develop justification for a better time block that represents current fishing potential for the stock" (SSC 2023 p. 7). For Tanner crab specifically, the SSC further requested that "a clear justification for the choice of reference time period be provided in the September SAFE document, beyond simple precedent, and that several alternative time periods be considered (each with its own justification)" (SSC 2023 p. 12).

Here, fallback Tier 4 management quantities are calculated for the eastern Bering Sea Tanner crab stock using the approach requested by the SSC. First, a time series of "vulnerable" male biomass (VMB) is calculated using data from the NMFS Bering Sea shelf bottom trawl survey, to which a state-space random walk model is applied to reduce observation error and interannual variance (process error). Current B is taken as the estimate of VMB for 2025 from the random walk model. Then B_{MSY} proxies are calculated for several candidate time periods by averaging the random walk time series values over each time period. Finally, other management quantities (e.g., stock status, F_{OFL}, OFL) are calculated based on the Tier 4 rules noted above.

8.2 Vulnerable male biomass time series

A time series of observed survey biomass for male crab classified as "vulnerable" to capture by the directed and bycatch fisheries for Tanner crab was calculated from the annual NMFS EBS shelf bottom trawl survey for 1975-2025 (the survey was not conducted in 2020) using standard methods for design-based biomass indices (Wakabayashi et al. 1985), where male crab greater than 100 mm CW were classified as vulnerable to fishing gear (Table 105; Figure 171). The observed VMB time series is rather noisy; to reduce variability associated with survey sampling error, a state-space/random effects random walk model was fit to the observed time series using the *rema* R package (Sullivan 2022) (Table 105; Figure 171). The model provided an estimate of 61,037 t for current B, as well as the values to average to obtain the B_{MSY} proxy.

8.3 Tier 4 Management Quantities

Candidate values for the Tier 4 management quantities, dependent on the time block chosen for the B_{MSY} proxy, were calculated for the time periods listed in Table 106.

For the time blocks considered, the B_{MSY} proxy ranges from 42 to 110 thousand t (see Figure 172 also). Stock status ranges from 0.56 (Tier 4b, "not overfished") to 1.44 (Tier 4a, "not overfished"). F_{OFL} and OFL cannot be determined from the control rule when the stock is in level "c" (status $<$ 0.25): in this case, directed fishing is prohibited and an $F_{OFL} \leq F_{MSY}$ would be determined based on all other sources of mortality in the development of the rebuilding plan. However, none of the alternative time frames result in a stock status classification of "c". The maximum F_{OFL} and OFL are 0.23 and 12.541 thousand t, respectively. The stock would be not be considered "overfished" (status < 0.5) under any of the time frames.

The SSC has recommended that authors base this calculation for "fallback" Tier 4 calculations on the "whole time series or develop justification for a better time block that represents current fishing potential for the stock" (SSC 2023). For the previous assessment (Stockhausen 2024a), the author recommended using the 1982-present time frame to calculate the B_{MSY} proxy, which the SSC adopted, after considering the following arguments:

> The time period for calculating the B_{MSY} proxy should ideally correspond to a time period at which the stock was in equilibrium and fished at F_{MSY} (NPFMC 2021). In 2008 for the previous Tier 4 model, the SSC recommended two time periods, 1969-1980 and 1969-2007 (i.e., "the present", at the time of the recommendation) as candidates for the time block to use to calculate the B_{MSY} proxy (SSC 2008); both time blocks included survey results from 1969, 1970, and 1972-1975 based on associated INPFC reports in addition to subsequent NMFS EBS shelf surveys. The rationale for this time period seems to have included the importance of the pre-1975 time period as indicative of unexploited stock size and the effects of fishing down the stock from unexploited levels.
>
> Rugolo and Turnock (2008) noted that both the authors and the CPT expressed concerns regarding the quality and availability of the data from the pre-1975 period, and suggested dropping the pre-1975 data. In addition (Rugolo and Turnock 2008), "the authors and CPT are not able to recommend…" the 1969-2007 period for OFL setting. From 1980-2007, the EBS Tanner crab stock collapsed twice resulting in two periods

of fishery closures and a rebuilding plan by the Council. During this period, the stock experienced exploitation rates in excess of current FMSY estimates."

Rugolo and Turnock (2010) reiterated the criticism that "during 1980-2009, the stock has not maintained itself at a level that could be reasonably construed as in dynamic equilibrium or at a level indicative of B_{MSY} capable of providing MSY to the fisheries."

The Tanner crab stock does not appear to have been in equilibrium under any fishing mortality rates since the inception of the fishery. The fishery has been closed a number of times (1985-1986, 1997/98-2004/05, 2010/11-2012/13, 2016/16, 2019/20), was declared overfished in 1999 and again in 2010, and was under rebuilding plans during 2001-2007 and 2012. Thus, it does not seem possible to identify a time period associated with the stock being at equilibrium while being fished at F_{MSY} and the selection of an averaging time period must then be based on other criteria. As noted above, the SSC has recommended that authors base this calculation for "fallback" Tier 4 calculations on the "whole time series or develop justification for a better time block that represents current fishing potential for the stock" (SSC 2023). The "whole time period" would be 1975-present or 1982-present, depending on whether the survey gear change in 1982 is a matter for concern for the consistency of the VMB time series. Results for both of these time periods are included in the analysis. The time block 1975-1980 was included in the analysis for historical continuity with the previous Tier 4 model. Two other time blocks were included in the analysis: 1987-1995 + 2005-2009 + 2013-2015 and 2005-2009 + 2013-2015, the latter a subset of the former that drops the 1987-1995 time period. These time blocks exclude the presumed "enhanced mortality" period (1980-1984) as well as periods when the fishery (as a whole) was closed.

The two time blocks that include the 1975-1980 time period are not recommended because this period encompasses a dramatic decline in VMB over the time period and thus does not appear to reflect the "current fishing potential" of the stock. In addition, the different selectivity/catchability characteristics in the pre- and post-1982 survey gear introduce potential inconsistencies across the time series. The author does not see a strong argument for any of the remaining time periods because none appear to meet the criteria outlined above for the Tier 4 $B_{MSY_{proxy}}$. Consequently, the author recommends using the OFL derived using the SSC-default period 1982-present.

Using the author-recommended time period results in a value of 42.3 thousand t for the B_{MSY} proxy, a stock status of 1.44, an F_{MSY} of 0.23, and an OFL of 12.5 thousand t.

The SSC also requested that authors recommend a suitable buffer to apply to the OFL to obtain the ABC. The cv for the estimated B (0.17) provides a natural starting point to define an ABC buffer. After review of the suggestions made at the September 2023 CPT meeting, the CPT recommended, and the SSC accepted, that authors use the cv for the estimated B, rounded to the nearest 0.05 increment (i.e., 5%), as the minimum buffer prior to evaluating any additional concerns. Taking the latter approach, the minimum buffer for ABC would be 15% and the corresponding ABC would be 10.7 thousand t.

9 Rebuilding Analyses

The Tanner crab stock is not overfished, so no rebuilding analyses are required.

10 Data Gaps and Research Priorities

A GMACS version of the Tanner crab model is under development. This is considered a high priority topic for this assessment. Several models were reviewed at the May 2024 Crab Plan Team meeting (CPT 2024), but the CPT requested a more "one-to-one" comparison between the bespoke TCSAM02 model and a new GMACS model prior to adopting any GMACS model. Progress toward this goal was presented at the January Modeling Workshop and the May 2025 CPT meeting (CPT 2025), with a candidate model (G25_05) exhibiting similar fits to survey and fishery data but differences in overall scale possibly due to differences in estimated natural mortality rates, selectivity/retention curves, and/or applied constraints (i.e., penalties/priors included in the objective function). Subsequent GMACS development has included adding additional options for selectivity curves and recruitment size distributions to match those in the bespoke model, implementing time blocks for survey catchability, and correcting an issue with setting up random walk parameters when they span multiple time blocks. Testing the updated code with input files for other crab stocks has not revealed any issues with reproducibility. Input parameter specifications in G25_05 were also updated to better match the bespoke model. Unfortunately, the GMACS model for Tanner crab now crashes during optimization for reasons which have yet to be identified. Because development of a next-generation RTMB version of GMACS (rtmbGMACS) is underway, it may make better use of limited resources to complete development of rtmbGMACS and transition the bespoke model directly to the RTMB version rather than completing the transition to the current version of GMACS followed by a second transition to the RTMB version.

Information on growth-per-molt has been collected in the EBS on Tanner crab and incorporated into the assessment. It would be helpful to have more information on growth associated with the terminal molt, because it seems likely this has different characteristics than previous molts. A better understanding of drivers of natural mortality and recruitment variability is another key to improving the ecological basis for the assessment. More comprehensive information regarding thermal tolerances and temperature-dependent effects on molting frequency and movement would be helpful to assess potential impacts of the EBS cold pool on recruitment processes and the stock distribution. Furthermore, it would be worthwhile to develop a "better" index of reproductive potential than MMB that can be calculated in the assessment model, as well as to revisit the issue of MSY proxies for this stock.

The characterization of fisheries in the assessment model also needs to be carefully reconsidered. How, and whether or not, the differences in the directed fishery in areas east and west 166^{o}W longitude should be explicitly represented in the assessment model need to be addressed. This is particularly relevant because the eastern management area was closed for several years until recently, which has implications for selectivity time blocks and whether an asymptotic function remains a reasonable description of selectivity in the directed fishery. The question of whether or not bycatch in the groundfish fisheries should be split into fixed gear- and trawl-related components to better capture changes in bycatch selectivity also needs to be revisited.

Incorporating the BSFRF side-by-side (SBS) surveys into the assessment in the best way possible is also a matter for continued exploration. A catch ratio analysis using the SBS survey data outside the model (presented at the May, 2021 CPT meeting) provided initial estimates of year-specific NMFS survey selectivity that account for variations in stock abundance across different depths and benthic substrates. This analysis needs to be drawn to a conclusion and incorporated, at least as an option, into the assessment model framework. BSFRF has provided the 2018 survey data to the assessment author and analysis is underway.

11 Information for PSC Limits

Table 107 lists Tanner crab total abundance (in millions of crab) in the NMFS EBS shelf survey using design-based expansion of the abundance of all Tanner crab in the survey, as well as survey abundance estimated by the author's preferred model, `22.03d5 (2025)`. The model only considers crab larger than 25 mm CW in its estimation process (and thus are included in the table), while all Tanner crab caught in the survey are included in the survey-estimated abundance in this table. The NMFS Alaska Regional Office will use this information when determining Prohibited Species Catch (PSC) limits.

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Tables

List of Tables

Table 1. Retained catch (metric tons) during the period when fishing by foreign fleets was allowed (1965-1979; historical data).

year	domestic	Japan	Russia	Total
1965/66	0	1,170	750	1,920
1966/67	0	1,690	750	2,440
1967/68	0	9,750	3,840	13,590
1968/69	460	13,590	3,960	18,010
1969/70	460	19,950	7,080	27,490
1970/71	80	18,930	6,490	25,500
1971/72	50	15,900	4,770	20,720
1972/73	100	16,800	0	16,900
1973/74	2,290	10,740	0	13,030
1974/75	3,300	12,060	0	15,360
1975/76	10,120	7,540	0	17,660
1976/77	23,360	6,660	0	30,020
1977/78	30,210	5,320	0	35,530
1978/79	19,280	1,810	0	21,090
1979/80	16,600	2,400	0	19,000

Table 2. Retained catch in the directed Tanner crab fishery during the period 1980-1996. The directed fishery was closed in 1985/86 and 1986/87 and from 1997/98-2004/05. Abundance units: number of individuals; biomass units: metric tons.

year	abundance	biomass
1980/81	12,928,112	13,426
1981/82	4,830,980	4,990
1982/83	2,286,756	2,390
1983/84	516,877	549
1984/85	1,272,501	1,429
1985/86	–	–
1986/87	–	–
1987/88	957,318	998
1988/89	2,894,480	3,180
1989/90	10,672,607	11,113
1990/91	16,609,286	18,189
1991/92	12,924,102	14,424
1992/93	15,265,865	15,921
1993/94	7,236,054	7,666
1994/95	3,351,639	3,538
1995/96	1,881,525	1,919
1996/97	734,303	821

Table 3. Retained catch biomass (metric tons) following rationalization of the crab fisheries in 2005, by ADF&G management area and fishery. Annual totals are also given. TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: Bristol Bay red king crab fishery. Incidental catch of Tanner crab, up to a fraction of the retained target by trip, is allowed to be retained in the snow crab and red king crab fisheries.

	TCF		SCF	RKF	all
year	East 166W	West 166W	West 166W	East 166W	all EBS
2005/06	0.0	244.5	187.7	0.0	432.2
2006/07	631.2	155.5	171.4	4.6	962.8
2007/08	710.0	151.1	86.5	8.0	955.6
2008/09	806.9	47.2	2.5	23.2	879.8
2009/10	592.4	0.0	1.7	8.4	602.5
2010/11	0.0	0.0	1.2	0.0	1.2
2011/12	0.0	0.0	2.1	0.0	2.1
2012/13	0.0	0.0	1.1	0.0	1.1
2013/14	654.3	593.6	9.9	6.3	1,264.1
2014/15	3,829.3	2,368.7	14.5	3.8	6,216.2
2015/16	5,107.7	3,770.3	30.3	1.4	8,909.6
2016/17	0.0	0.0	1.2	0.0	1.2
2017/18	0.1	1,117.5	15.0	0.0	1,132.6
2018/19	0.0	1,103.9	3.4	0.0	1,107.3
2019/20	0.0	0.0	0.1	0.0	0.1
2020/21	0.0	655.2	2.3	0.0	657.5
2021/22	0.0	493.5	0.8	0.0	494.3
2022/23	528.4	384.9	0.0	0.0	913.3
2023/24	343.5	596.8	0.0	0.0	940.3
2024/25	802.6	2,049.0	0.5	0.0	2,852.1

Table 4. Retained catch abundance (number of crab) following rationalization of the crab fisheries in 2005, by ADF&G management area and fishery. Annual totals are also given. TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: Bristol Bay red king crab fishery. Incidental catch of Tanner crab, up to a fraction of the retained target by trip, is allowed to be retained in the snow crab and red king crab fisheries.

	TCF		SCF	RKF	all
year	East 166W	West 166W	West 166W	East 166W	all EBS
2005/06	0	255,859	188,118	0	443,977
2006/07	581,024	164,719	175,904	4,456	926,103
2007/08	677,661	151,525	90,148	7,830	927,164
2008/09	758,002	48,171	3,300	20,896	830,369
2009/10	476,668	0	2,544	6,751	485,963
2010/11	0	0	1,689	6	1,695
2011/12	0	0	3,095	0	3,095
2012/13	0	0	1,643	4	1,647
2013/14	704,201	722,469	13,256	5,842	1,445,768
2014/15	4,378,199	3,121,442	19,512	3,691	7,522,844
2015/16	5,998,876	4,817,144	39,012	1,386	10,856,418
2016/17	0	0	1,733	33	1,766
2017/18	139	1,322,542	17,688	25	1,340,394
2018/19	0	1,376,977	4,013	18	1,381,008
2019/20	0	0	125	0	125
2020/21	0	870,634	3,017	1	873,652
2021/22	0	782,983	970	0	783,953
2022/23	683,223	587,079	0	0	1,270,302
2023/24	404,036	814,417	0	4	1,218,457
2024/25	916,223	2,808,477	782	2	3,725,484

Table 5. Federal management quantities (OFL, ABC), State of Alaska TACs, and harvest (retained catch biomass) in the Tanner crab fisheries following rationalization in 2005. OFL and ABC values apply to the entire EBS Tanner crab stock area, TAC values apply to individual ADF&G management areas. Harvest is retained catch in the directed fisheries. Fishery closures are indicated by "–". All quantities are in metric tons.

	OFL	ABC	TAC			Harvest		
year	all EBS	all EBS	all EBS	East 166W	West 166W	all EBS	East 166W	West 166W
2005/06	–	–	735	–	735	245	–	245
2006/07	–	–	1,347	851	496	787	631	156
2007/08	–	–	2,550	1,563	987	861	710	151
2008/09	7,040	–	1,950	1,253	697	854	807	47
2009/10	2,270	–	612	612	–	592	592	–
2010/11	1,610	–	–	–	–	–	–	–
2011/12	2,750	2,480	–	–	–	–	–	–
2012/13	19,020	8,170	–	–	–	–	–	–
2013/14	25,350	17,820	1,410	664	746	1,248	654	594
2014/15	31,480	25,180	6,852	3,847	3,005	6,198	3,829	2,369
2015/16	27,190	21,750	8,921	5,113	3,808	8,878	5,108	3,770
2016/17	25,610	20,490	–	–	–	–	–	–
2017/18	25,420	20,330	1,134	–	1,134	1,118	–	1,117
2018/19	20,870	16,700	1,106	–	1,106	1,104	–	1,104
2019/20	28,860	23,090	–	–	–	–	–	–
2020/21	21,130	16,900	1,065	–	1,065	655	–	655
2021/22	27,170	21,740	499	–	499	494	–	494
2022/23	32,810	26,250	914	528	386	913	528	384
2023/24	36,200	27,150	944	345	599	940	344	597
2024/25	41,290	33,030	2,844	803	2,041	2,852	803	2,049

Table 6. Original and scaled (input) sample sizes for retained catch size compositions. Only information aggregated to the EBS is available prior to 1990. '–': no data due to prior aggregation or lack of sampling (e.g. the fishery was closed. In addition to the closures noted here, the directed fishery was closed from 1997/98 to 2004/05.

	East 166W						West 166W						all EBS					
	new shell		old shell		all shell		new shell		old shell		all shell		new shell		old shell		all shell	
year	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled
1980/81	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	11,840	85.1	1,470	10.6	13,310	95.7
1981/82	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	10,386	74.6	925	6.6	11,311	81.3
1982/83	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	9,540	68.6	3,979	28.6	13,519	97.2
1983/84	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	679	4.9	996	7.2	1,675	12.0
1984/85	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	1,649	11.9	893	6.4	2,542	18.3
1985/86	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
1986/87	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
1987/88	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
1988/89	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	11,277	81.0	1,103	7.9	12,380	89.0
1989/90	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	34,184	190.1	1,772	9.9	35,956	200.0
1990/91	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	78,310	187.4	5,280	12.6	83,590	200.0
1991/92	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	118,583	186.4	8,644	13.6	127,227	200.0
1992/93	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	113,509	181.0	11,886	19.0	125,395	200.0
1993/94	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	67,264	187.8	4,358	12.2	71,622	200.0
1994/95	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	25,585	183.9	2,073	14.9	27,658	198.8
1995/96	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	11,297	81.2	7,979	57.3	19,276	138.5
1996/97	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	2,063	14.8	2,367	17.0	4,430	31.8
2005/06	– –	– –	– –	– –	– –	– –	649	4.7	56	0.4	705	5.1	649	4.7	56	0.4	705	5.1
2006/07	815	5.9	1,544	11.1	2,359	17.0	238	1.7	343	2.5	581	4.2	1,053	7.6	1,887	13.6	2,940	21.1
2007/08	2,730	19.6	1,439	10.3	4,169	30.0	932	6.7	726	5.2	1,658	11.9	3,662	26.3	2,165	15.6	5,827	41.9
2008/09	2,717	19.5	252	1.8	2,969	21.3	429	3.1	92	0.7	521	3.7	3,146	22.6	344	2.5	3,490	25.1
2009/10	2,369	17.0	48	0.3	2,417	17.4	– –	– –	– –	– –	– –	– –	2,369	17.0	48	0.3	2,417	17.4
2010/11	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2011/12	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2012/13	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2013/14	2,250	16.2	274	2.0	2,524	18.1	1,869	13.4	368	2.6	2,237	16.1	4,119	29.6	642	4.6	4,761	34.2
2014/15	6,278	45.1	1,274	9.2	7,552	54.3	5,012	36.0	1,807	13.0	6,819	49.0	11,290	81.1	3,081	22.1	14,371	103.3
2015/16	11,066	79.5	4,159	29.9	15,225	109.4	7,364	52.9	1,731	12.4	9,095	65.4	18,430	132.5	5,890	42.3	24,320	174.8
2016/17	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2017/18	– –	– –	– –	– –	– –	– –	1,980	14.2	1,490	10.7	3,470	24.9	1,980	14.2	1,490	10.7	3,470	24.9
2018/19	– –	– –	– –	– –	– –	– –	879	6.3	2,427	17.4	3,306	23.8	879	6.3	2,427	17.4	3,306	23.8
2019/20	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2020/21	– –	– –	– –	– –	– –	– –	1,378	9.9	1,945	14.0	3,323	23.9	1,378	9.9	1,945	14.0	3,323	23.9
2021/22	– –	– –	– –	– –	– –	– –	1,993	14.3	351	2.5	2,344	16.8	1,993	14.3	351	2.5	2,344	16.8
2022/23	2,073	14.9	258	1.9	2,331	16.8	2,059	14.8	348	2.5	2,407	17.3	4,132	29.7	606	4.4	4,738	34.1
2023/24	1,478	10.6	149	1.1	1,627	11.7	2,505	18.0	389	2.8	2,894	20.8	3,983	28.6	538	3.9	4,521	32.5
2024/25	2,013	14.5	288	2.1	2,301	16.5	3,371	24.2	677	4.9	4,048	29.1	5,384	38.7	965	6.9	6,349	45.6

Table 7. Annual total catch biomass estimates of Tanner crab, expanded from at-sea fishery observer data, in the groundfish fisheries (GF) prior to 1990. Units are metric tons. Groundfish bycatch data is from historical sources.

year	GF all gear all EBS all sexes
1973/74	17,735
1974/75	24,449
1975/76	9,408
1976/77	4,699
1977/78	2,776
1978/79	1,869
1979/80	3,397
1980/81	2,114
1981/82	1,474
1982/83	449
1983/84	671
1984/85	644
1985/86	399
1986/87	649
1987/88	640
1988/89	463
1989/90	671

Table 8. Annual total catch biomass (retained + discarded) estimates of Tanner crab, expanded from at-sea fishery observer data in all fleets after 1989. Units are metric tons. "TCF": Tanner crab fishery; "SCF": snow crab fishery; "RKF": BBRKC fishery; "GF": groundfish fisheries. Crab fishery values based on data provided by ADF&G. Groundfish bycatch estimates based on data provided by AKFIN and the AKRO.

		TCF			SCF		RKF				GF	all fleets
		crab pot			crab pot		crab pot		fixed	trawl	all gear	all gear
	East 166W		West 166W		West 166W		East 166W		all EBS	all EBS	all EBS	all EBS
year	male	female	male	female	male	female	male	female	all sexes	all sexes	all sexes	all sexes
1990/91	–	–	–	–	7,082	105	3,723	36	–	–	943	11,889
1991/92	19,597	1,445	6,220	441	8,361	144	1,970	27	148	2,395	–	40,748
1992/93	29,660	1,104	7,347	599	2,488	162	1,316	19	103	2,657	–	45,455
1993/94	10,210	860	1,644	136	2,874	401	3,130	149	23	1,735	–	21,162
1994/95	6,958	729	357	112	1,345	194	–	–	24	2,072	–	11,791
1995/96	4,415	925	650	141	1,021	121	–	–	128	1,397	–	8,798
1996/97	229	56	72	–	1,960	119	270	2	118	1,477	–	4,303
1997/98	–	–	–	–	1,964	93	160	2	64	1,116	–	3,399
1998/99	–	–	–	–	656	80	115	2	88	847	–	1,788
1999/00	–	–	–	–	132	11	75	3	85	546	–	852
2000/01	–	–	–	–	313	6	66	2	53	688	–	1,128
2001/02	–	–	–	–	546	21	42	1	125	1,061	–	1,796
2002/03	–	–	–	–	167	13	61	1	96	624	–	962
2003/04	–	–	–	–	65	7	55	2	20	403	–	552
2004/05	–	–	–	–	134	40	49	2	65	610	–	900
2005/06	–	–	684	24	1,162	16	42	0	133	488	–	2,549
2006/07	1,132	49	579	73	1,527	86	30	2	346	371	–	4,195
2007/08	1,779	30	680	15	1,862	52	61	2	474	221	–	5,176
2008/09	1,178	7	119	1	1,100	25	280	3	288	245	–	3,246
2009/10	664	2	–	–	1,559	15	187	1	225	149	–	2,802
2010/11	–	–	–	–	1,453	9	32	0	118	113	–	1,725
2011/12	–	–	–	–	2,142	13	17	0	76	128	–	2,376
2012/13	–	–	–	–	1,564	10	42	1	46	107	–	1,770
2013/14	746	12	933	11	1,841	16	129	1	182	167	–	4,038
2014/15	5,307	9	3,057	30	5,330	51	305	1	261	174	–	14,525
2015/16	6,761	29	5,468	29	3,919	17	205	6	276	85	–	16,795

(continued)

				TCF		SCF		RKF				GF	all fleets
				crab pot		crab pot		crab pot	fixed	trawl	all gear	all gear
	East 166W		West 166W		West 166W		East 166W		all EBS	all EBS	all EBS	all EBS
year	male	female	male	female	male	female	male	female	all sexes	all sexes	all sexes	all sexes
2016/17	–	–	–	–	2,576	17	176	4	161	145	–	3,079
2017/18	–	–	1,363	38	1,081	6	183	2	114	50	–	2,837
2018/19	–	–	1,598	34	880	9	74	0	122	57	–	2,774
2019/20	–	–	–	–	1,003	15	18	0	45	103	–	1,184
2020/21	–	–	1,548	33	131	0	6	0	23	102	–	1,843
2021/22	–	–	826	16	82	2	0	0	53	112	–	1,091
2022/23	794	7	677	5	–	–	0	0	26	101	–	1,610
2023/24	416	2	727	4	–	–	10	0	14	88	–	1,261
2024/25	688	9	2,446	35	65	4	5	0	40	69	–	3,361

Table 9. Annual total catch abundance (retained + discarded) estimates of Tanner crab, expanded from at-sea fishery observer data, in all fleets after 1989. Units are 1,000s of crab. “TCF”: Tanner crab fishery; “SCF”: snow crab fishery; “RKF”: BBRKC fishery; “GF”: groundfish fisheries. Crab fishery values based on data provided by ADF&G. Groundfish bycatch estimates based on data provided by AKFIN and the AKRO.

			TCF		SCF		RKF				GF	all fleets
			crab pot		crab pot		crab pot		fixed	trawl	all gear	all gear
	East 166W		West 166W		West 166W		East 166W		all EBS	all EBS	all EBS	all EBS
year	male	female	male	female	male	female	male	female	all sexes	all sexes	all sexes	all sexes
1990/91	–	–	–	–	11,947	629	3,470	144	–	–	4,522	20,712
1991/92	25,791	5,612	8,211	2,001	13,995	752	1,954	95	356	5,756	–	64,523
1992/93	40,385	5,245	10,336	2,719	5,823	884	1,475	76	236	6,109	–	73,288
1993/94	13,438	3,430	2,347	634	6,841	2,315	3,404	567	49	3,595	–	36,620
1994/95	8,907	3,276	666	567	3,513	1,289	–	–	53	4,616	–	22,887
1995/96	6,084	4,058	1,094	684	2,422	727	–	–	312	3,405	–	18,786
1996/97	328	237	102	–	3,916	660	259	9	268	3,357	–	9,136
1997/98	–	–	–	–	3,697	537	164	6	183	3,202	–	7,789
1998/99	–	–	–	–	1,425	435	132	7	275	2,649	–	4,923
1999/00	–	–	–	–	337	62	111	8	222	1,432	–	2,172
2000/01	–	–	–	–	641	27	93	5	127	1,646	–	2,539
2001/02	–	–	–	–	1,196	118	56	4	249	2,118	–	3,741
2002/03	–	–	–	–	408	72	83	6	171	1,117	–	1,857
2003/04	–	–	–	–	172	47	82	7	53	1,038	–	1,399
2004/05	–	–	–	–	420	256	77	7	169	1,591	–	2,520
2005/06	–	–	1,004	113	2,182	90	62	4	285	1,046	–	4,786
2006/07	1,503	187	849	345	2,696	429	46	5	663	711	–	7,434
2007/08	2,682	121	1,060	72	3,642	263	81	5	1,349	627	–	9,902
2008/09	1,378	28	168	8	2,364	169	289	9	731	624	–	5,768
2009/10	622	9	–	–	3,035	97	176	4	381	455	–	4,779
2010/11	–	–	–	–	2,677	49	41	2	167	390	–	3,326
2011/12	–	–	–	–	3,633	73	21	0	105	918	–	4,750
2012/13	–	–	–	–	2,790	63	54	4	69	501	–	3,481
2013/14	898	43	1,343	51	3,641	91	148	4	302	689	–	7,210
2014/15	7,570	37	4,998	133	10,716	296	346	3	414	591	–	25,104
2015/16	10,265	120	9,441	149	7,456	88	256	22	470	249	–	28,516

(continued)

			TCF		SCF		RKF				GF	all fleets
			crab pot		crab pot		crab pot		fixed	trawl	all gear	all gear
	East 166W		West 166W		West 166W		East 166W		all EBS	all EBS	all EBS	all EBS
year	male	female	male	female	male	female	male	female	all sexes	all sexes	all sexes	all sexes
2016/17	–	–	–	–	4,900	79	252	20	269	428	–	5,948
2017/18	–	–	1,979	181	1,994	39	232	5	178	126	–	4,734
2018/19	–	–	2,562	184	1,621	62	88	0	162	220	–	4,899
2019/20	–	–	–	–	1,989	95	21	0	65	453	–	2,623
2020/21	–	–	2,851	170	289	4	8	0	42	515	–	3,879
2021/22	–	–	1,568	82	183	9	0	0	93	465	–	2,400
2022/23	1,329	37	1,280	29	–	–	0	0	53	503	–	3,231
2023/24	556	8	1,160	20	–	–	13	0	24	540	–	2,321
2024/25	921	49	3,881	156	130	17	7	0	92	298	–	5,551

Table 10. Annual discard mortality (biomass) estimates of Tanner crab in the groundfish fisheries ("GF") prior to 1990. Handling mortality rates for trawl gear have been applied. Units are metric tons.

year	GF all gear all EBS all sexes
1973/74	14,188
1974/75	19,559
1975/76	7,526
1976/77	3,759
1977/78	2,221
1978/79	1,495
1979/80	2,718
1980/81	1,691
1981/82	1,179
1982/83	359
1983/84	537
1984/85	515
1985/86	319
1986/87	519
1987/88	512
1988/89	370
1989/90	537

Table 11. Annual discard mortality (biomass) estimates of Tanner crab, expanded from at-sea fishery observer data in all fleets after 1989. Assumed gear-specific handling mortality rates have been applied after (where appropriate) subtracting retained catch biomass from total catch biomass. “TCF”: Tanner crab fishery; “SCF”: snow crab fishery; “RKF”: BBRKC fishery; “GF”: groundfish fisheries. Units are metric tons.

					TCF		SCF		RKF				GF	all fleets
					crab pot		crab pot		crab pot		fixed	trawl	all gear	all gear
	East 166W		West 166W		all EBS		West 166W		East 166W		all EBS	all EBS	all EBS	all EBS
year	male	female	male	female	male	female	male	female	male	female	all sexes	all sexes	all sexes	all sexes
1990/91	–	–	–	–	–	–	2,273	34	1,195	11	–	–	755	4,268
1991/92	–	–	–	–	3,657	605	2,684	46	632	9	74	1,916	–	9,624
1992/93	–	–	–	–	6,769	547	798	52	423	6	51	2,126	–	10,772
1993/94	–	–	–	–	1,344	320	923	128	1,005	48	12	1,388	–	5,168
1994/95	–	–	–	–	1,212	270	432	62	–	–	12	1,658	–	3,646
1995/96	–	–	–	–	1,010	342	328	39	–	–	64	1,118	–	2,900
1996/97	–	–	–	–	–	18	629	38	87	1	59	1,181	–	2,014
1997/98	–	–	–	–	–	–	630	30	51	0	32	893	–	1,637
1998/99	–	–	–	–	–	–	211	26	37	0	44	678	–	996
1999/00	–	–	–	–	–	–	42	4	24	1	42	437	–	550
2000/01	–	–	–	–	–	–	100	2	21	0	27	551	–	701
2001/02	–	–	–	–	–	–	175	7	14	0	62	848	–	1,106
2002/03	–	–	–	–	–	–	54	4	20	0	48	499	–	625
2003/04	–	–	–	–	–	–	21	2	18	1	10	323	–	374
2004/05	–	–	–	–	–	–	43	13	16	0	32	488	–	593
2005/06	–	–	141	8	–	–	313	5	13	0	66	390	–	938
2006/07	161	16	136	23	–	–	435	28	8	0	173	297	–	1,277
2007/08	343	9	170	5	–	–	570	17	17	0	237	176	–	1,545
2008/09	119	2	23	0	–	–	352	8	82	1	144	196	–	928
2009/10	23	1	–	–	–	–	500	5	57	0	113	119	–	818
2010/11	–	–	–	–	–	–	466	3	10	0	59	91	–	629
2011/12	–	–	–	–	–	–	687	4	6	–	38	102	–	837
2012/13	–	–	–	–	–	–	502	3	14	0	23	86	–	628
2013/14	30	4	109	4	–	–	588	5	39	0	91	134	–	1,003
2014/15	474	3	221	10	–	–	1,706	16	97	0	131	140	–	2,798
2015/16	531	9	545	9	–	–	1,248	5	65	2	138	68	–	2,621

(continued)

						TCF crab pot all EBS		SCF crab pot West 166W		RKF crab pot East 166W	fixed all EBS	trawl all EBS	GF all gear all EBS	all fleets all gear all EBS
	East 166W		West 166W											
year	male	female	male	female	male	female	male	female	male	female	all sexes	all sexes	all sexes	all sexes
2016/17	–	–	–	–	–	–	826	5	56	1	80	116	–	1,086
2017/18	–	–	79	12	–	–	342	2	59	0	57	40	–	592
2018/19	–	–	159	11	–	–	281	3	24	–	61	45	–	584
2019/20	–	–	–	–	–	–	322	5	6	–	22	82	–	437
2020/21	–	–	286	11	–	–	41	0	2	–	12	81	–	433
2021/22	–	–	107	5	–	–	26	0	–	–	26	90	–	255
2022/23	85	2	94	2	–	–	–	–	–	–	13	81	–	277
2023/24	23	1	42	1	–	–	–	–	3	–	7	70	–	147
2024/25	–	3	128	11	–	–	21	1	2	–	20	56	–	241

Table 12. Original and scaled (input) sample sizes for Tanner crab total catch size compositions in the directed fishery. Observer information starts in 1990/91. '–': no data due to prior aggregation or lack of sampling (e.g. the fishery was closed.)

	East 166W						West 166W						all EBS					
	male		female		all sexes		male		female		all sexes		male		female		all sexes	
year	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled
1991/92	21,600	155.2	3,935	28.3	25,535	183.5	9,703	69.7	1,704	12.2	11,407	82.0	31,303	169.5	5,639	30.5	36,942	200.0
1992/93	42,260	176.2	5,707	23.8	47,967	200.0	12,576	90.4	3,048	21.9	15,624	112.3	54,836	172.5	8,755	27.5	63,591	200.0
1993/94	36,062	158.6	9,417	41.4	45,479	200.0	4,326	31.1	1,054	7.6	5,380	38.7	40,388	158.8	10,471	41.2	50,859	200.0
1994/95	5,657	40.7	2,004	14.4	7,661	55.1	135	1.0	128	0.9	263	1.9	5,792	41.6	2,132	15.3	7,924	56.9
1995/96	5,180	37.2	2,914	20.9	8,094	58.2	409	2.9	205	1.5	614	4.4	5,589	40.2	3,119	22.4	8,708	62.6
1996/97	219	1.6	168	1.2	387	2.8	133	1.0	– –	– –	133	1.0	352	2.5	168	1.2	520	3.7
2005/06	– –	– –	– –	– –	– –	– –	19,715	141.7	1,107	8.0	20,822	149.6	19,715	141.7	1,107	8.0	20,822	149.6
2006/07	12,688	91.2	1,573	11.3	14,261	102.5	11,538	82.9	2,859	20.5	14,397	103.5	24,226	169.1	4,432	30.9	28,658	200.0
2007/08	51,105	191.0	2,415	9.0	53,520	200.0	10,441	75.0	903	6.5	11,344	81.5	61,546	189.8	3,318	10.2	64,864	200.0
2008/09	25,352	182.2	528	3.8	25,880	186.0	3,814	27.4	118	0.8	3,932	28.3	29,166	195.7	646	4.3	29,812	200.0
2009/10	17,289	124.3	147	1.1	17,436	125.3	– –	– –	– –	– –	– –	– –	17,289	124.3	147	1.1	17,436	125.3
2010/11	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2011/12	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2012/13	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2013/14	7,628	54.8	311	2.2	7,939	57.1	9,663	69.4	399	2.9	10,062	72.3	17,291	124.3	710	5.1	18,001	129.4
2014/15	51,217	198.9	286	1.1	51,503	200.0	33,903	194.8	905	5.2	34,808	200.0	85,120	197.2	1,191	2.8	86,311	200.0
2015/16	61,712	197.7	713	2.3	62,425	200.0	58,131	196.9	911	3.1	59,042	200.0	119,843	197.3	1,624	2.7	121,467	200.0
2016/17	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2017/18	– –	– –	– –	– –	– –	– –	18,785	135.0	1,721	12.4	20,506	147.4	18,785	135.0	1,721	12.4	20,506	147.4
2018/19	– –	– –	– –	– –	– –	– –	28,338	186.6	2,036	13.4	30,374	200.0	28,338	186.6	2,036	13.4	30,374	200.0
2019/20	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2020/21	– –	– –	– –	– –	– –	– –	17,639	126.8	1,054	7.6	18,693	134.3	17,639	126.8	1,054	7.6	18,693	134.3
2021/22	– –	– –	– –	– –	– –	– –	19,214	138.1	1,008	7.2	20,222	145.3	19,214	138.1	1,008	7.2	20,222	145.3
2022/23	13,404	96.3	377	2.7	13,781	99.0	17,233	123.9	390	2.8	17,623	126.7	30,637	195.1	767	4.9	31,404	200.0
2023/24	8,500	61.1	129	0.9	8,629	62.0	26,134	187.8	436	3.1	26,570	191.0	34,634	196.8	565	3.2	35,199	200.0
2024/25	11,810	84.9	627	4.5	12,437	89.4	38,732	192.2	1,565	7.8	40,297	200.0	50,542	191.7	2,192	8.3	52,734	200.0

Table 13. Original and scaled (input) sample sizes for Tanner crab total catch size compositions in the snow crab ('SCF') and BBRKC ('RKF') fisheries. Observer information starts in 1990/91 in the snow crab and BBRKC fisheries. '–': no data due to prior aggregation or lack of sampling (e.g. the fishery was closed).

						SCF						RKF
						all EBS						all EBS
		male		female		all sexes		male		female		all sexes
year	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled
1990/91	14,032	100.85	478	3.44	14,510	104.28	1,580	11.36	43	0.31	1,623	11.66
1991/92	11,708	84.14	686	4.93	12,394	89.07	2,273	16.34	89	0.64	2,362	16.98
1992/93	6,280	45.13	859	6.17	7,139	51.31	2,056	14.78	105	0.75	2,161	15.53
1993/94	6,969	50.09	1,542	11.08	8,511	61.17	7,359	52.89	1,196	8.60	8,555	61.48
1994/95	2,982	21.43	1,523	10.95	4,505	32.38	– –	– –	– –	– –	– –	– –
1995/96	1,898	13.64	428	3.08	2,326	16.72	– –	– –	– –	– –	– –	– –
1996/97	3,265	23.47	662	4.76	3,927	28.22	114	0.82	5	0.04	119	0.86
1997/98	3,970	28.53	657	4.72	4,627	33.25	1,030	7.40	41	0.29	1,071	7.70
1998/99	1,911	13.73	324	2.33	2,235	16.06	457	3.28	20	0.14	477	3.43
1999/00	976	7.01	82	0.59	1,058	7.60	207	1.49	14	0.10	221	1.59
2000/01	1,237	8.89	74	0.53	1,311	9.42	845	6.07	44	0.32	889	6.39
2001/02	3,113	22.37	160	1.15	3,273	23.52	456	3.28	39	0.28	495	3.56
2002/03	982	7.06	118	0.85	1,100	7.91	750	5.39	50	0.36	800	5.75
2003/04	688	4.94	152	1.09	840	6.04	555	3.99	46	0.33	601	4.32
2004/05	833	5.99	707	5.08	1,540	11.07	487	3.50	44	0.32	531	3.82
2005/06	9,807	70.48	368	2.64	10,175	73.13	983	7.06	70	0.50	1,053	7.57
2006/07	10,391	74.68	1,256	9.03	11,647	83.71	746	5.36	68	0.49	814	5.85
2007/08	13,797	99.16	728	5.23	14,525	104.39	1,360	9.77	89	0.64	1,449	10.41
2008/09	8,455	60.76	722	5.19	9,177	65.95	3,797	27.29	121	0.87	3,918	28.16
2009/10	11,057	79.46	474	3.41	11,531	82.87	2,871	20.63	70	0.50	2,941	21.14
2010/11	12,073	86.77	250	1.80	12,323	88.56	582	4.18	28	0.20	610	4.38
2011/12	9,453	67.94	189	1.36	9,642	69.30	323	2.32	4	0.03	327	2.35
2012/13	11,004	79.08	270	1.94	11,274	81.02	618	4.44	48	0.34	666	4.79
2013/14	12,935	92.96	356	2.56	13,291	95.52	2,110	15.16	60	0.43	2,170	15.60
2014/15	24,878	178.79	804	5.78	25,682	184.57	3,110	22.35	32	0.23	3,142	22.58
2015/16	19,839	142.58	230	1.65	20,069	144.23	2,175	15.63	186	1.34	2,361	16.97
2016/17	16,369	117.64	262	1.88	16,631	119.52	3,220	23.14	246	1.77	3,466	24.91
2017/18	5,598	40.23	109	0.78	5,707	41.02	3,782	27.18	86	0.62	3,868	27.80
2018/19	6,145	44.16	233	1.67	6,378	45.84	1,283	9.22	6	0.04	1,289	9.26
2019/20	8,881	63.83	423	3.04	9,304	66.87	357	2.57	3	0.02	360	2.59
2020/21	820	5.89	10	0.07	830	5.97	106	0.76	4	0.03	110	0.79
2021/22	632	4.54	30	0.22	662	4.76	– –	– –	– –	– –	– –	– –
2022/23	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2023/24	– –	– –	– –	– –	– –	– –	233	1.67	11	0.08	244	1.75
2024/25	622	4.47	80	0.57	702	5.05	92	0.66	2	0.01	94	0.68

Table 14. Original and scaled (input) sample sizes for Tanner crab total catch size compositions in the groundfish fisheries. Observer information starts in 1973/74 in the groundfish fisheries, but is unclassified by gear type unitl 1991/92. '–': no data for respective gear type.

				fixed				trawl						all gear
		male		female		male		female		male		female		all sexes
year	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled
1973/74	– –	– –	– –	– –	– –	– –	– –	– –	3,151	22.6	2,273	16.3	5,424	39.0
1974/75	– –	– –	– –	– –	– –	– –	– –	– –	2,487	17.9	1,588	11.4	4,075	29.3
1975/76	– –	– –	– –	– –	– –	– –	– –	– –	1,244	8.9	822	5.9	2,066	14.8
1976/77	– –	– –	– –	– –	– –	– –	– –	– –	6,865	49.3	6,586	47.3	13,451	96.7
1977/78	– –	– –	– –	– –	– –	– –	– –	– –	10,541	75.8	8,264	59.4	18,805	135.1
1978/79	– –	– –	– –	– –	– –	– –	– –	– –	18,470	115.3	13,558	84.7	32,028	200.0
1979/80	– –	– –	– –	– –	– –	– –	– –	– –	19,006	125.6	11,261	74.4	30,267	200.0
1980/81	– –	– –	– –	– –	– –	– –	– –	– –	12,718	91.4	5,805	41.7	18,523	133.1
1981/82	– –	– –	– –	– –	– –	– –	– –	– –	6,085	43.7	4,028	28.9	10,113	72.7
1982/83	– –	– –	– –	– –	– –	– –	– –	– –	13,233	95.1	7,811	56.1	21,044	151.2
1983/84	– –	– –	– –	– –	– –	– –	– –	– –	18,267	131.3	8,228	59.1	26,495	190.4
1984/85	– –	– –	– –	– –	– –	– –	– –	– –	27,009	133.8	13,361	66.2	40,370	200.0
1985/86	– –	– –	– –	– –	– –	– –	– –	– –	22,893	129.3	12,524	70.7	35,417	200.0
1986/87	– –	– –	– –	– –	– –	– –	– –	– –	14,790	106.3	7,557	54.3	22,347	160.6
1987/88	– –	– –	– –	– –	– –	– –	– –	– –	23,371	119.7	15,667	80.3	39,038	200.0
1988/89	– –	– –	– –	– –	– –	– –	– –	– –	10,515	75.6	7,063	50.8	17,578	126.3
1989/90	– –	– –	– –	– –	– –	– –	– –	– –	59,642	118.5	41,027	81.5	100,669	200.0
1990/91	– –	– –	– –	– –	– –	– –	– –	– –	23,485	135.6	11,161	64.4	34,646	200.0
1991/92	1,116	8.0	290	2.1	5,683	40.8	3,157	22.7	– –	– –	– –	– –	10,246	73.6
1992/93	600	4.3	39	0.3	2,510	18.0	1,116	8.0	– –	– –	– –	– –	4,265	30.7
1993/94	683	4.9	25	0.2	530	3.8	332	2.4	– –	– –	– –	– –	1,570	11.3
1994/95	1,133	8.1	126	0.9	2,488	17.9	1,693	12.2	– –	– –	– –	– –	5,440	39.1
1995/96	162	1.2	44	0.3	3,693	26.5	2,600	18.7	– –	– –	– –	– –	6,499	46.7
1996/97	2,442	17.6	439	3.2	5,831	41.9	2,950	21.2	– –	– –	– –	– –	11,662	83.8
1997/98	1,650	11.9	217	1.6	8,272	59.4	3,668	26.4	– –	– –	– –	– –	13,807	99.2
1998/99	3,870	27.8	627	4.5	8,207	59.0	3,794	27.3	– –	– –	– –	– –	16,498	118.6
1999/00	3,551	25.5	719	5.2	7,482	53.8	3,801	27.3	– –	– –	– –	– –	15,553	111.8
2000/01	5,144	37.0	227	1.6	7,727	55.5	2,847	20.5	– –	– –	– –	– –	15,945	114.6
2001/02	6,950	49.9	303	2.2	8,809	63.3	2,763	19.9	– –	– –	– –	– –	18,825	135.3
2002/03	8,571	61.6	831	6.0	6,818	49.0	2,414	17.3	– –	– –	– –	– –	18,634	133.9
2003/04	4,589	33.0	923	6.6	4,924	35.4	1,778	12.8	– –	– –	– –	– –	12,214	87.8
2004/05	5,413	38.9	560	4.0	8,406	60.4	3,882	27.9	– –	– –	– –	– –	18,261	131.2
2005/06	8,816	63.4	388	2.8	8,963	64.4	3,318	23.8	– –	– –	– –	– –	21,485	154.4
2006/07	9,268	66.6	824	5.9	6,616	47.5	2,219	15.9	– –	– –	– –	– –	18,927	136.0
2007/08	7,235	52.0	1,175	8.4	8,910	64.0	2,642	19.0	– –	– –	– –	– –	19,962	143.5
2008/09	15,831	104.4	1,770	11.7	10,282	67.8	2,457	16.2	– –	– –	– –	– –	30,340	200.0
2009/10	12,916	92.8	688	4.9	6,037	43.4	1,988	14.3	– –	– –	– –	– –	21,629	155.4
2010/11	11,262	80.9	956	6.9	4,338	31.2	1,633	11.7	– –	– –	– –	– –	18,189	130.7
2011/12	8,709	62.6	386	2.8	7,615	54.7	3,869	27.8	– –	– –	– –	– –	20,579	147.9
2012/13	9,192	66.1	835	6.0	3,982	28.6	2,262	16.3	– –	– –	– –	– –	16,271	116.9
2013/14	22,471	128.7	3,488	20.0	6,390	36.6	2,584	14.8	– –	– –	– –	– –	34,933	200.0
2014/15	33,528	154.1	2,061	9.5	5,737	26.4	2,200	10.1	– –	– –	– –	– –	43,526	200.0
2015/16	24,488	146.3	5,149	30.8	3,208	19.2	627	3.7	– –	– –	– –	– –	33,472	200.0
2016/17	14,811	106.4	1,206	8.7	3,914	28.1	3,223	23.2	– –	– –	– –	– –	23,154	166.4

(continued)

				fixed				trawl							all gear	
		male		female		male		female		male		female		all sexes		
year	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled		
2017/18	11,538	82.9	1,264	9.1	2,020	14.5	476	3.4	– –	– –	– –	– –	15,298	109.9		
2018/19	4,130	29.7	198	1.4	3,038	21.8	1,124	8.1	– –	– –	– –	– –	8,490	61.0		
2019/20	2,572	18.5	140	1.0	5,338	38.4	2,447	17.6	– –	– –	– –	– –	10,497	75.4		
2020/21	2,267	16.3	418	3.0	6,389	45.9	2,558	18.4	– –	– –	– –	– –	11,632	83.6		
2021/22	3,425	24.6	460	3.3	5,232	37.6	1,797	12.9	– –	– –	– –	– –	10,914	78.4		
2022/23	3,792	27.3	407	2.9	5,440	39.1	1,809	13.0	– –	– –	– –	– –	11,448	82.3		
2023/24	1,562	11.2	160	1.1	4,783	34.4	1,638	11.8	– –	– –	– –	– –	8,143	58.5		
2024/25	4,677	33.6	1,223	8.8	2,431	17.5	1,045	7.5	– –	– –	– –	– –	9,376	67.4		

Table 15. Annual effort (potlifts) in the crab fisheries. "TCF": Tanner crab fishery; "SCF": snow crab fishery; "RKF": BBRKC fishery.

year	East 166W	West 166W	TCF all EBS	SCF all EBS	RKF all EBS
1953	–	–	–	–	30,083
1954	–	–	–	–	17,122
1955	–	–	–	–	28,045
1956	–	–	–	–	41,629
1957	–	–	–	–	23,659
1958	–	–	–	–	27,932
1959	–	–	–	–	22,187
1960	–	–	–	–	26,347
1961	–	–	–	–	72,646
1962	–	–	–	–	123,643
1963	–	–	–	–	181,799
1964	–	–	–	–	180,809
1965	–	–	–	–	127,973
1966	–	–	–	–	129,306
1967	–	–	–	–	135,283
1968	–	–	–	–	184,666
1969	–	–	–	–	175,374
1970	–	–	–	–	168,059
1971	–	–	–	–	126,305
1972	–	–	–	–	208,469
1973	–	–	–	–	194,095
1974	–	–	–	–	212,915
1975	–	–	–	–	205,096
1976	–	–	–	–	321,010
1977	–	–	–	–	451,273
1978	–	–	–	190,746	406,165
1979	–	–	–	255,102	315,226
1980	–	–	–	435,742	567,292
1981	–	–	–	469,091	536,646
1982	–	–	–	287,127	140,492
1983	–	–	–	173,591	0
1984	–	–	–	370,082	107,406
1985	–	–	–	542,346	84,443
1986	–	–	–	616,113	175,753
1987	–	–	–	747,395	220,971
1988	–	–	–	665,242	146,179
1989	–	–	–	912,718	205,528
1990	493,820	479	494,299	1,382,908	262,761
1991	360,864	140,050	500,914	1,278,502	227,555
1992	508,922	166,670	675,592	969,209	206,815
1993	286,620	40,100	326,720	716,524	254,389
1994	228,254	21,282	249,536	507,603	697
1995	201,988	46,454	248,442	520,685	547

(continued)

year	East 166W	West 166W	TCF all EBS	SCF all EBS	RKF all EBS
1996	64,989	8,533	73,522	754,140	77,081
1997	0	0	0	930,794	91,085
1998	0	0	0	945,533	145,689
1999	0	0	0	182,634	151,212
2000	0	0	0	191,200	104,056
2001	0	0	0	326,977	66,947
2002	0	0	0	153,862	72,514
2003	0	0	0	123,709	134,515
2004	0	0	0	75,095	97,621
2005	0	6,346	6,346	117,375	116,320
2006	15,273	4,517	19,790	86,328	72,404
2007	26,441	7,268	33,709	140,857	113,948
2008	19,401	2,336	21,737	163,537	139,937
2009	6,635	0	6,635	137,292	119,261
2010	0	0	0	147,478	132,183
2011	0	0	0	270,602	45,784
2012	0	0	0	225,627	38,842
2013	16,613	23,062	39,675	225,245	46,589
2014	72,768	68,695	141,463	279,183	57,725
2015	130,302	84,933	215,235	202,526	48,763
2016	0	0	0	118,548	33,608
2017	11	19,284	19,295	114,673	49,169
2018	0	29,833	29,833	119,484	31,975
2019	0	0	0	188,958	35,033
2020	0	34,914	34,914	171,678	21,346
2021	0	19,252	19,252	36,878	294
2022	19,434	18,130	37,564	0	242
2023	6,336	22,861	29,197	0	15,694
2024	20,999	49,305	70,304	15,665	11,766

Table 16. Design-based survey biomass trends (estimates and cv's) from the NMFS EBS shelf bottom trawl survey, by sex, maturity state, and management area. Biomass units are metric tons. The survey was not conducted in 2020.

	male all maturity						immature						female mature					
	East 166W		West 166W		all EBS		East 166W		West 166W		all EBS		East 166W		West 166W		all EBS	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
1975	213, 137	0.42	80, 684	0.34	293, 820	0.32	9, 287	0.25	262	0.51	9, 549	0.24	18, 306	0.19	13, 112	0.39	31, 418	0.20
1976	101, 952	0.18	55, 066	0.20	157, 018	0.14	4, 448	0.26	1, 920	0.57	6, 368	0.25	20, 967	0.20	10, 189	0.42	31, 157	0.19
1977	87, 462	0.13	51, 036	0.24	138, 499	0.12	1, 133	0.23	13, 338	0.65	14, 471	0.60	30, 302	0.38	8, 272	0.36	38, 573	0.31
1978	72, 913	0.15	25, 392	0.18	98, 305	0.12	714	0.29	6, 099	0.27	6, 814	0.24	17, 691	0.31	8, 065	0.26	25, 757	0.23
1979	17, 978	0.17	32, 058	0.19	50, 036	0.14	591	0.49	3, 236	0.25	3, 827	0.22	2, 858	0.36	16, 465	0.34	19, 322	0.30
1980	48, 978	0.31	103, 501	0.18	152, 479	0.16	1, 320	0.26	12, 190	0.25	13, 510	0.23	11, 562	0.38	52, 221	0.33	63, 783	0.28
1981	23, 387	0.19	56, 537	0.16	79, 924	0.13	890	0.31	631	0.25	1, 521	0.21	7, 684	0.28	34, 893	0.30	42, 577	0.25
1982	16, 600	0.16	49, 252	0.18	65, 852	0.14	1, 309	0.34	406	0.27	1, 715	0.27	6, 797	0.26	57, 347	0.29	64, 143	0.26
1983	13, 325	0.21	24, 659	0.20	37, 984	0.15	902	0.30	1, 368	0.34	2, 270	0.24	4, 438	0.27	15, 993	0.22	20, 430	0.18
1984	12, 019	0.19	18, 483	0.17	30, 503	0.13	670	0.46	1, 563	0.23	2, 233	0.21	4, 129	0.44	10, 785	0.26	14, 914	0.22
1985	8, 229	0.21	6, 671	0.16	14, 901	0.13	323	0.30	671	0.22	994	0.18	2, 836	0.42	2, 718	0.31	5, 554	0.26
1986	9, 611	0.22	11, 983	0.36	21, 594	0.22	1, 486	0.21	1, 207	0.28	2, 693	0.17	2, 006	0.25	1, 360	0.31	3, 366	0.20
1987	28, 860	0.20	16, 639	0.16	45, 499	0.14	11, 909	0.36	3, 085	0.20	14, 995	0.29	3, 097	0.23	2, 042	0.21	5, 139	0.16
1988	58, 124	0.31	41, 083	0.24	99, 207	0.21	3, 697	0.22	6, 475	0.24	10, 172	0.17	19, 182	0.30	6, 184	0.26	25, 366	0.23
1989	87, 700	0.16	45, 100	0.18	132, 800	0.12	6, 652	0.28	5, 157	0.23	11, 809	0.19	12, 309	0.20	7, 090	0.23	19, 399	0.15
1990	76, 879	0.14	55, 538	0.23	132, 417	0.13	5, 990	0.28	3, 869	0.20	9, 859	0.19	19, 032	0.24	18, 663	0.48	37, 694	0.27
1991	89, 814	0.26	55, 976	0.15	145, 790	0.17	3, 626	0.24	3, 384	0.25	7, 010	0.17	27, 708	0.33	17, 056	0.22	44, 764	0.22
1992	89, 918	0.32	37, 665	0.18	127, 582	0.23	345	0.29	1, 636	0.19	1, 981	0.17	11, 013	0.22	15, 213	0.23	26, 226	0.16
1993	53, 394	0.19	19, 873	0.15	73, 266	0.14	153	0.35	908	0.21	1, 061	0.19	5, 171	0.21	6, 470	0.20	11, 641	0.14
1994	32, 303	0.16	16, 029	0.14	48, 332	0.12	65	0.33	1, 135	0.34	1, 199	0.33	5, 268	0.30	4, 579	0.28	9, 846	0.21
1995	19, 672	0.22	15, 304	0.24	34, 976	0.16	249	0.25	802	0.19	1, 052	0.16	5, 732	0.31	6, 667	0.31	12, 398	0.22
1996	19, 979	0.28	10, 785	0.31	30, 764	0.21	1, 013	0.28	416	0.21	1, 430	0.21	5, 533	0.36	4, 047	0.45	9, 580	0.28
1997	9, 078	0.16	5, 556	0.14	14, 634	0.11	956	0.37	434	0.23	1, 389	0.27	1, 947	0.22	1, 451	0.31	3, 397	0.18
1998	8, 403	0.13	6, 600	0.16	15, 003	0.10	550	0.21	1, 407	0.25	1, 957	0.19	1, 202	0.21	1, 076	0.24	2, 278	0.16
1999	14, 833	0.36	6, 695	0.23	21, 529	0.26	1, 087	0.39	1, 762	0.20	2, 848	0.19	2, 272	0.33	1, 554	0.21	3, 826	0.22
2000	16, 427	0.27	6, 898	0.14	23, 325	0.20	728	0.30	1, 745	0.18	2, 473	0.15	2, 885	0.39	1, 246	0.25	4, 131	0.28
2001	16, 203	0.19	13, 042	0.17	29, 245	0.13	2, 594	0.43	3, 671	0.18	6, 266	0.21	1, 314	0.24	3, 247	0.30	4, 562	0.23
2002	14, 401	0.20	13, 006	0.17	27, 407	0.13	1, 768	0.28	3, 724	0.20	5, 492	0.16	1, 701	0.33	2, 766	0.25	4, 468	0.20
2003	17, 161	0.20	20, 637	0.17	37, 798	0.13	704	0.24	3, 954	0.28	4, 658	0.24	2, 090	0.23	6, 313	0.24	8, 403	0.19
2004	12, 454	0.22	26, 417	0.17	38, 871	0.14	267	0.38	3, 812	0.15	4, 079	0.15	863	0.20	3, 865	0.21	4, 729	0.17
2005	17, 442	0.19	46, 300	0.14	63, 743	0.12	1, 672	0.39	8, 698	0.22	10, 370	0.20	2, 820	0.37	8, 759	0.22	11, 579	0.19
2006	28, 635	0.34	72, 894	0.17	101, 529	0.15	2, 450	0.50	10, 789	0.25	13, 238	0.22	4, 025	0.29	10, 914	0.21	14, 939	0.17
2007	27, 938	0.28	76, 245	0.22	104, 183	0.18	696	0.33	4, 885	0.26	5, 581	0.23	5, 916	0.38	7, 521	0.16	13, 436	0.19
2008	37, 176	0.50	47, 720	0.22	84, 897	0.25	621	0.52	2, 220	0.22	2, 841	0.21	4, 457	0.31	7, 206	0.23	11, 663	0.18
2009	14, 778	0.23	32, 627	0.17	47, 405	0.14	524	0.34	2, 014	0.33	2, 538	0.27	4, 021	0.39	4, 456	0.18	8, 477	0.21
2010	14, 420	0.21	34, 575	0.22	48, 996	0.17	789	0.31	2, 986	0.19	3, 775	0.16	2, 115	0.42	3, 358	0.24	5, 473	0.22
2011	23, 382	0.21	39, 282	0.24	62, 664	0.17	4, 384	0.37	5, 960	0.19	10, 344	0.19	2, 225	0.27	3, 189	0.16	5, 414	0.14
2012	45, 365	0.28	34, 747	0.13	80, 112	0.17	5, 692	0.45	5, 959	0.19	11, 651	0.24	8, 550	0.31	3, 805	0.18	12, 355	0.22
2013	64, 573	0.32	38, 798	0.18	103, 371	0.21	2, 337	0.37	4, 036	0.19	6, 373	0.18	11, 054	0.33	6, 795	0.18	17, 849	0.21
2014	58, 196	0.14	50, 711	0.14	108, 906	0.10	489	0.20	1, 964	0.25	2, 453	0.21	8, 159	0.47	6, 705	0.27	14, 864	0.29
2015	35, 090	0.12	39, 143	0.13	74, 233	0.09	625	0.30	1, 020	0.21	1, 646	0.17	4, 675	0.34	6, 536	0.35	11, 211	0.25
2016	25, 813	0.15	43, 812	0.12	69, 625	0.09	50	0.33	1, 068	0.22	1, 118	0.22	1, 450	0.30	6, 176	0.31	7, 625	0.26
2017	24, 217	0.17	29, 985	0.14	54, 201	0.11	160	0.39	1, 221	0.20	1, 381	0.19	2, 015	0.20	5, 098	0.31	7, 113	0.23
2018	13, 931	0.13	33, 152	0.12	47, 083	0.10	1, 010	0.25	4, 005	0.20	5, 015	0.17	607	0.23	4, 360	0.23	4, 967	0.20

(continued)

					male													female
					all maturity						immature						mature	
	East 166W		West 166W		all EBS		East 166W		West 166W		all EBS		East 166W		West 166W		all EBS	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
2019	10,931	0.26	17,742	0.10	28,673	0.12	1,513	0.33	3,406	0.19	4,919	0.16	662	0.34	4,184	0.25	4,846	0.22
2020	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−
2021	12,900	0.18	18,664	0.14	31,564	0.11	1,083	0.28	2,259	0.15	3,342	0.13	2,858	0.22	5,697	0.20	8,554	0.15
2022	14,940	0.18	14,692	0.13	29,633	0.11	698	0.38	1,996	0.24	2,694	0.20	1,827	0.23	4,842	0.27	6,669	0.20
2023	10,470	0.14	24,046	0.10	34,516	0.08	1,042	0.26	8,221	0.18	9,264	0.17	1,629	0.23	5,697	0.28	7,326	0.23
2024	19,262	0.22	64,151	0.14	83,413	0.12	2,955	0.50	16,162	0.18	19,117	0.17	3,362	0.27	21,277	0.22	24,638	0.19
2025	14,441	0.16	96,471	0.16	110,912	0.14	764	0.26	10,934	0.20	11,698	0.19	3,101	0.21	25,399	0.19	28,500	0.17

Table 17. Design-based survey abundance trends (estimates and cv's) from the NMFS EBS shelf bottom trawl survey, by sex, maturity state, and management area. Abundance units are millions of crab. The survey was not conducted in 2020.

						male						immature						female
						all maturity												mature
	East 166W		West 166W		all EBS		East 166W		West 166W		all EBS		East 166W		West 166W		all EBS	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
1975	398.59	0.25	136.77	0.27	535.37	0.20	93.91	0.26	4.42	0.45	98.33	0.25	85.53	0.18	68.15	0.35	153.68	0.19
1976	228.63	0.15	143.94	0.29	372.57	0.15	68.77	0.38	67.91	0.55	136.68	0.33	94.28	0.20	58.43	0.40	152.71	0.20
1977	162.87	0.13	217.39	0.36	380.26	0.21	14.44	0.21	258.87	0.63	273.31	0.60	142.44	0.39	49.67	0.38	192.11	0.31
1978	124.72	0.14	166.20	0.19	290.92	0.12	9.32	0.25	142.71	0.29	152.02	0.27	83.00	0.33	53.81	0.28	136.81	0.23
1979	32.79	0.19	163.99	0.25	196.78	0.21	7.67	0.49	48.97	0.25	56.64	0.23	13.04	0.37	118.33	0.35	131.37	0.32
1980	90.26	0.29	554.36	0.19	644.62	0.17	15.42	0.25	154.88	0.25	170.30	0.23	50.51	0.38	380.36	0.35	430.88	0.31
1981	54.16	0.20	211.98	0.18	266.14	0.15	15.08	0.37	9.95	0.22	25.03	0.24	35.15	0.30	268.67	0.32	303.82	0.29
1982	43.53	0.15	144.58	0.18	188.11	0.14	13.76	0.25	14.29	0.23	28.05	0.17	31.09	0.27	433.08	0.31	464.17	0.29
1983	50.24	0.19	127.07	0.23	177.31	0.18	27.31	0.28	80.05	0.35	107.36	0.27	18.30	0.28	109.91	0.22	128.21	0.20
1984	40.24	0.33	90.50	0.14	130.74	0.14	19.32	0.57	56.00	0.19	75.32	0.20	16.33	0.41	70.10	0.27	86.43	0.23
1985	20.05	0.16	35.39	0.15	55.44	0.11	5.17	0.22	19.69	0.21	24.87	0.17	10.77	0.38	18.57	0.34	29.34	0.26
1986	53.63	0.16	61.88	0.26	115.50	0.16	34.08	0.21	23.34	0.25	57.42	0.16	8.65	0.23	8.29	0.28	16.94	0.18
1987	150.92	0.24	104.10	0.12	255.02	0.15	122.49	0.35	71.88	0.15	194.37	0.23	13.42	0.21	12.93	0.21	26.35	0.15
1988	185.58	0.19	234.95	0.21	420.53	0.14	54.49	0.20	127.51	0.23	182.00	0.18	84.40	0.29	38.13	0.25	122.53	0.21
1989	328.22	0.19	204.64	0.19	532.86	0.14	179.37	0.33	99.72	0.21	279.08	0.23	57.76	0.20	43.30	0.23	101.06	0.15
1990	235.20	0.15	195.37	0.15	430.56	0.10	98.52	0.27	74.95	0.18	173.48	0.18	101.55	0.24	107.46	0.43	209.01	0.25
1991	209.64	0.21	224.87	0.16	434.51	0.13	39.32	0.23	82.31	0.31	121.63	0.22	145.92	0.36	109.17	0.23	255.09	0.23
1992	160.01	0.31	141.90	0.13	301.91	0.17	4.97	0.30	46.16	0.20	51.13	0.18	53.88	0.22	97.02	0.23	150.90	0.17
1993	93.72	0.18	79.93	0.13	173.65	0.11	2.90	0.34	24.87	0.21	27.77	0.19	24.87	0.22	42.60	0.20	67.47	0.15
1994	51.96	0.16	65.93	0.14	117.89	0.10	2.67	0.33	33.60	0.37	36.27	0.34	27.00	0.32	29.16	0.27	56.16	0.21
1995	34.55	0.19	51.84	0.16	86.39	0.12	5.46	0.27	19.09	0.22	24.55	0.18	30.24	0.31	43.08	0.31	73.32	0.22
1996	51.02	0.20	37.00	0.19	88.03	0.14	17.73	0.26	12.58	0.21	30.31	0.18	28.92	0.36	26.19	0.43	55.11	0.28
1997	41.37	0.27	30.04	0.13	71.40	0.17	31.89	0.45	20.09	0.21	51.98	0.29	11.14	0.24	8.96	0.31	20.10	0.19
1998	32.57	0.14	54.94	0.17	87.51	0.12	13.39	0.22	42.86	0.22	56.25	0.17	6.74	0.22	6.56	0.24	13.30	0.16
1999	59.89	0.37	81.10	0.19	141.00	0.19	20.75	0.31	70.89	0.21	91.65	0.17	12.62	0.31	10.06	0.20	22.68	0.20
2000	49.05	0.21	75.44	0.17	124.49	0.13	16.27	0.35	54.31	0.18	70.59	0.16	14.97	0.38	7.29	0.25	22.26	0.27
2001	124.71	0.32	141.06	0.16	265.78	0.17	106.49	0.37	108.33	0.17	214.83	0.20	7.13	0.23	21.04	0.28	28.16	0.22
2002	58.90	0.22	136.65	0.20	195.55	0.15	36.36	0.27	109.08	0.24	145.43	0.19	10.76	0.38	19.10	0.29	29.87	0.23
2003	56.03	0.19	179.53	0.19	235.56	0.15	13.21	0.23	113.88	0.25	127.09	0.23	11.97	0.24	48.53	0.28	60.49	0.23
2004	30.39	0.18	219.98	0.11	250.37	0.10	8.38	0.50	153.86	0.13	162.24	0.13	4.53	0.23	27.68	0.25	32.21	0.22
2005	59.04	0.20	286.68	0.15	345.72	0.13	39.05	0.43	212.35	0.22	251.40	0.20	16.10	0.38	60.65	0.23	76.75	0.20
2006	103.52	0.38	355.13	0.14	458.66	0.14	28.83	0.39	172.38	0.19	201.21	0.18	21.91	0.28	76.44	0.21	98.34	0.17
2007	76.79	0.27	345.73	0.18	422.52	0.16	11.45	0.30	96.72	0.21	108.17	0.19	30.54	0.35	51.46	0.16	82.00	0.17
2008	79.61	0.41	166.84	0.15	246.45	0.17	8.74	0.34	47.62	0.21	56.36	0.18	24.65	0.31	48.63	0.23	73.28	0.19
2009	45.63	0.21	131.95	0.15	177.58	0.12	21.11	0.40	63.43	0.25	84.53	0.21	22.10	0.39	29.22	0.17	51.32	0.19
2010	51.73	0.20	149.43	0.14	201.16	0.11	27.59	0.35	84.27	0.17	111.86	0.16	10.60	0.41	21.92	0.23	32.51	0.21
2011	148.75	0.27	216.69	0.15	365.43	0.14	86.81	0.32	145.81	0.19	232.62	0.17	12.18	0.26	20.30	0.15	32.48	0.14
2012	189.77	0.34	244.69	0.16	434.45	0.17	64.98	0.42	113.49	0.18	178.48	0.19	52.40	0.35	25.62	0.18	78.02	0.24
2013	176.80	0.30	209.10	0.14	385.90	0.16	30.47	0.32	85.37	0.17	115.84	0.15	60.82	0.36	47.96	0.18	108.77	0.21
2014	137.61	0.13	198.85	0.17	336.46	0.11	14.94	0.25	73.20	0.29	88.14	0.24	44.74	0.48	43.62	0.28	88.36	0.28
2015	79.06	0.12	119.86	0.11	198.93	0.08	13.69	0.25	30.76	0.18	44.45	0.15	27.61	0.35	45.43	0.38	73.04	0.27
2016	53.97	0.18	133.88	0.12	187.85	0.10	1.25	0.32	37.62	0.24	38.87	0.23	7.71	0.31	42.58	0.33	50.29	0.28
2017	49.93	0.17	122.77	0.13	172.70	0.10	4.73	0.32	78.81	0.24	83.55	0.23	10.17	0.20	35.57	0.31	45.75	0.24
2018	54.89	0.17	205.36	0.15	260.25	0.12	32.97	0.25	158.21	0.20	191.18	0.17	3.46	0.24	30.33	0.22	33.80	0.20

(continued)

						male												female
						all maturity						immature						mature
	East 166W		West 166W		all EBS		East 166W		West 166W		all EBS		East 166W		West 166W		all EBS	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
2019	46.68	0.27	154.60	0.15	201.28	0.13	30.16	0.34	140.17	0.21	170.32	0.19	3.74	0.34	32.95	0.27	36.69	0.24
2020	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2021	58.08	0.19	144.08	0.18	202.16	0.14	21.61	0.38	81.50	0.28	103.10	0.24	14.79	0.22	39.48	0.22	54.27	0.17
2022	70.43	0.26	124.86	0.21	195.29	0.16	35.21	0.47	81.03	0.23	116.24	0.22	9.60	0.24	33.24	0.29	42.84	0.23
2023	51.69	0.18	311.78	0.13	363.47	0.11	35.90	0.28	282.13	0.15	318.03	0.14	8.62	0.23	39.89	0.27	48.50	0.23
2024	93.51	0.28	537.25	0.13	630.77	0.12	48.75	0.35	346.06	0.15	394.81	0.13	21.10	0.30	149.75	0.22	170.85	0.20
2025	54.40	0.17	573.24	0.15	627.64	0.14	15.07	0.25	298.94	0.25	314.01	0.24	18.96	0.23	170.88	0.18	189.83	0.16

Table 18. Design-based survey biomass trends (estimates and cv's) from the NMFS EBS shelf bottom trawl survey for industry-preferred males by management area. Biomass units are metric tons. The survey was not conducted in 2020.

	East 166W						West 166W						all EBS					
	new shell		old shell		all shell		new shell		old shell		all shell		new shell		old shell		all shell	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
1975	151,213	0.56	6,193	0.41	157,406	0.54	56,181	0.42	2,509	0.33	58,691	0.41	207,394	0.42	8,703	0.31	216,097	0.41
1976	57,463	0.23	9,245	0.47	66,709	0.24	38,231	0.24	1,409	0.36	39,640	0.24	95,695	0.17	10,654	0.41	106,349	0.17
1977	50,855	0.16	7,543	0.24	58,399	0.16	26,511	0.36	6,808	0.30	33,319	0.30	77,366	0.16	14,351	0.19	91,717	0.15
1978	40,761	0.18	9,652	0.21	50,413	0.16	3,221	0.26	6,626	0.32	9,847	0.27	43,981	0.17	16,278	0.18	60,259	0.14
1979	9,816	0.23	3,377	0.26	13,192	0.19	4,115	0.30	3,745	0.35	7,860	0.24	13,930	0.18	7,122	0.22	21,052	0.15
1980	23,184	0.41	10,857	0.53	34,041	0.33	11,210	0.31	1,677	0.69	12,887	0.31	34,394	0.30	12,534	0.47	46,927	0.25
1981	3,445	0.33	11,286	0.27	14,731	0.22	5,884	0.27	2,167	0.38	8,050	0.24	9,329	0.21	13,452	0.23	22,781	0.17
1982	3,009	0.22	4,851	0.23	7,860	0.18	5,775	0.38	5,847	0.25	11,622	0.23	8,783	0.26	10,698	0.17	19,481	0.16
1983	5,151	0.31	2,082	0.29	7,233	0.25	2,429	0.29	3,226	0.26	5,655	0.21	7,580	0.23	5,309	0.19	12,889	0.17
1984	4,348	0.24	3,077	0.40	7,424	0.23	571	0.37	3,159	0.24	3,730	0.22	4,919	0.22	6,236	0.23	11,154	0.17
1985	4,055	0.28	1,046	0.32	5,101	0.26	588	0.34	870	0.29	1,458	0.22	4,642	0.25	1,917	0.22	6,559	0.21
1986	734	0.36	2,546	0.52	3,280	0.43	142	0.41	674	0.33	816	0.30	876	0.31	3,219	0.42	4,096	0.35
1987	4,911	0.23	3,473	0.37	8,385	0.24	3,505	0.41	658	0.27	4,163	0.35	8,416	0.22	4,132	0.32	12,548	0.20
1988	15,698	0.67	2,715	0.25	18,413	0.58	9,690	0.40	929	0.31	10,618	0.37	25,387	0.44	3,644	0.20	29,031	0.39
1989	37,386	0.21	3,718	0.39	41,104	0.19	13,758	0.34	2,741	0.36	16,499	0.29	51,144	0.18	6,459	0.27	57,603	0.16
1990	35,903	0.22	7,084	0.21	42,987	0.19	21,082	0.37	3,274	0.30	24,356	0.33	56,985	0.19	10,358	0.17	67,343	0.17
1991	32,973	0.42	14,476	0.25	47,449	0.30	13,386	0.29	8,430	0.20	21,816	0.21	46,359	0.31	22,906	0.17	69,265	0.22
1992	41,423	0.44	16,242	0.40	57,665	0.33	9,893	0.50	6,418	0.28	16,311	0.32	51,316	0.37	22,660	0.30	73,977	0.27
1993	22,942	0.28	11,990	0.26	34,932	0.20	3,716	0.35	2,596	0.29	6,312	0.26	26,658	0.24	14,586	0.22	41,244	0.17
1994	10,000	0.22	13,912	0.26	23,912	0.18	1,248	0.45	4,143	0.22	5,391	0.21	11,248	0.20	18,054	0.21	29,303	0.15
1995	1,380	0.25	13,377	0.28	14,757	0.26	370	0.41	5,392	0.34	5,761	0.33	1,749	0.22	18,769	0.22	20,518	0.21
1996	330	0.35	13,912	0.35	14,242	0.35	100	0.42	3,580	0.48	3,680	0.47	430	0.29	17,492	0.30	17,922	0.29
1997	316	0.33	4,245	0.22	4,561	0.20	179	0.36	942	0.26	1,121	0.23	495	0.25	5,187	0.18	5,681	0.17
1998	1,001	0.28	2,604	0.19	3,605	0.16	441	0.35	644	0.20	1,085	0.21	1,442	0.22	3,247	0.16	4,689	0.13
1999	1,645	0.39	1,838	0.35	3,483	0.25	256	0.32	356	0.31	612	0.24	1,902	0.34	2,194	0.30	4,095	0.22
2000	4,484	0.52	3,045	0.41	7,529	0.35	250	0.35	377	0.29	627	0.24	4,734	0.49	3,422	0.36	8,156	0.33
2001	4,473	0.35	3,600	0.21	8,073	0.25	418	0.27	1,361	0.37	1,780	0.32	4,892	0.32	4,961	0.18	9,853	0.21
2002	944	0.40	7,102	0.28	8,046	0.25	384	0.42	838	0.25	1,222	0.25	1,328	0.31	7,940	0.25	9,268	0.22
2003	1,558	0.32	6,433	0.33	7,991	0.28	434	0.31	2,227	0.35	2,661	0.31	1,992	0.26	8,660	0.26	10,652	0.22
2004	1,597	0.26	4,916	0.50	6,513	0.38	980	0.26	1,825	0.29	2,805	0.22	2,577	0.19	6,741	0.37	9,318	0.27
2005	2,368	0.22	5,822	0.36	8,190	0.27	8,776	0.33	5,062	0.30	13,839	0.26	11,145	0.27	10,884	0.24	22,029	0.19
2006	2,134	0.34	6,794	0.28	8,927	0.24	3,768	0.37	15,315	0.48	19,083	0.42	5,902	0.26	22,109	0.34	28,011	0.30
2007	4,143	0.61	5,314	0.26	9,457	0.30	8,523	0.84	7,757	0.35	16,281	0.48	12,666	0.60	13,071	0.23	25,737	0.32
2008	15,476	0.78	3,288	0.27	18,764	0.65	8,731	0.56	4,414	0.28	13,145	0.40	24,206	0.54	7,702	0.20	31,909	0.42
2009	2,644	0.26	5,139	0.36	7,783	0.29	6,670	0.29	4,143	0.20	10,812	0.21	9,313	0.22	9,282	0.22	18,595	0.17
2010	3,006	0.49	4,576	0.30	7,582	0.29	9,593	0.47	4,867	0.21	14,460	0.35	12,599	0.38	9,443	0.18	22,042	0.25
2011	1,513	0.25	6,987	0.36	8,500	0.32	9,023	0.74	6,637	0.21	15,660	0.44	10,536	0.64	13,624	0.21	24,160	0.31
2012	3,352	0.49	5,026	0.24	8,378	0.25	2,368	0.32	3,997	0.19	6,365	0.19	5,720	0.32	9,023	0.16	14,743	0.16
2013	10,871	0.29	3,527	0.22	14,397	0.23	5,383	0.43	2,837	0.22	8,220	0.29	16,254	0.24	6,364	0.16	22,618	0.18
2014	14,899	0.26	9,310	0.19	24,210	0.19	7,163	0.17	4,604	0.21	11,766	0.14	22,062	0.19	13,914	0.15	35,976	0.13
2015	9,084	0.22	10,217	0.24	19,301	0.15	8,380	0.27	5,925	0.21	14,306	0.18	17,464	0.17	16,143	0.17	33,607	0.12
2016	2,666	0.17	8,137	0.18	10,803	0.14	5,855	0.18	12,649	0.18	18,504	0.14	8,521	0.14	20,786	0.13	29,308	0.10
2017	1,646	0.74	10,947	0.17	12,593	0.18	904	0.21	11,777	0.24	12,681	0.23	2,550	0.49	22,724	0.15	25,274	0.15
2018	103	0.44	7,324	0.16	7,427	0.16	1,007	0.19	11,993	0.19	13,000	0.18	1,110	0.18	19,318	0.13	20,427	0.13
2019	318	0.36	4,502	0.21	4,821	0.21	204	0.32	4,844	0.16	5,048	0.16	522	0.25	9,347	0.13	9,869	0.13

(continued)

	East 166W						West 166W						all EBS					
	new shell		old shell		all shell		new shell		old shell		all shell		new shell		old shell		all shell	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
2020	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−	−−
2021	1,462	0.32	965	0.29	2,427	0.23	420	0.33	1,608	0.22	2,028	0.19	1,883	0.26	2,573	0.18	4,455	0.15
2022	3,803	0.28	924	0.30	4,727	0.23	757	0.26	835	0.21	1,592	0.17	4,560	0.24	1,759	0.19	6,319	0.18
2023	2,514	0.24	1,103	0.24	3,617	0.19	1,166	0.24	1,235	0.23	2,401	0.17	3,680	0.18	2,339	0.17	6,018	0.13
2024	3,386	0.24	2,925	0.26	6,311	0.17	3,387	0.20	1,809	0.22	5,196	0.15	6,773	0.16	4,734	0.18	11,507	0.12
2025	1,983	0.34	2,525	0.23	4,508	0.20	7,757	0.27	3,444	0.16	11,201	0.20	9,740	0.22	5,970	0.14	15,710	0.16

Table 19. Design-based survey abundance trends (estimates and cv's) from the NMFS EBS shelf bottom trawl survey for industry-preferred males by management area. Abundance units are millions of crab. The survey was not conducted in 2020.

	East 166W						West 166W						all EBS					
	new shell		old shell		all shell		new shell		old shell		all shell		new shell		old shell		all shell	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
1975	154.812	0.53	6.988	0.41	161.800	0.50	66.706	0.42	3.129	0.33	69.835	0.40	221.518	0.39	10.117	0.30	231.635	0.37
1976	64.022	0.21	9.945	0.45	73.967	0.22	42.219	0.23	1.643	0.35	43.862	0.23	106.241	0.16	11.588	0.39	117.829	0.16
1977	55.271	0.15	8.487	0.23	63.759	0.15	26.617	0.30	7.258	0.29	33.875	0.26	81.888	0.14	15.745	0.18	97.633	0.13
1978	44.641	0.18	11.539	0.21	56.180	0.15	3.591	0.27	7.183	0.32	10.774	0.28	48.233	0.16	18.722	0.18	66.955	0.14
1979	11.155	0.22	4.001	0.24	15.156	0.19	5.335	0.28	4.610	0.33	9.945	0.23	16.490	0.18	8.611	0.21	25.101	0.15
1980	24.363	0.39	13.118	0.52	37.481	0.32	14.802	0.30	1.916	0.65	16.718	0.30	39.165	0.27	15.034	0.46	54.199	0.24
1981	4.026	0.34	14.097	0.26	18.123	0.22	7.784	0.26	2.903	0.38	10.688	0.23	11.811	0.21	17.000	0.22	28.811	0.16
1982	3.492	0.21	6.377	0.24	9.869	0.19	8.085	0.37	8.190	0.25	16.275	0.23	11.577	0.27	14.567	0.18	26.144	0.16
1983	6.917	0.31	2.732	0.28	9.649	0.25	3.375	0.29	4.685	0.27	8.061	0.21	10.292	0.23	7.418	0.20	17.710	0.17
1984	4.898	0.23	3.946	0.39	8.845	0.23	0.820	0.37	4.520	0.25	5.340	0.22	5.719	0.21	8.466	0.23	14.185	0.17
1985	4.413	0.27	1.381	0.31	5.795	0.25	0.784	0.35	1.283	0.28	2.067	0.22	5.197	0.24	2.664	0.21	7.861	0.19
1986	0.981	0.38	2.742	0.47	3.723	0.38	0.213	0.40	0.870	0.31	1.083	0.28	1.194	0.32	3.612	0.36	4.806	0.30
1987	6.307	0.22	4.039	0.33	10.345	0.22	4.658	0.40	0.917	0.27	5.575	0.34	10.965	0.21	4.956	0.28	15.921	0.19
1988	18.560	0.67	3.515	0.24	22.074	0.56	12.210	0.39	1.241	0.32	13.451	0.36	30.769	0.43	4.756	0.20	35.525	0.37
1989	46.361	0.20	4.780	0.39	51.141	0.19	17.061	0.33	3.608	0.36	20.670	0.28	63.423	0.17	8.388	0.27	71.811	0.16
1990	38.932	0.22	9.361	0.21	48.293	0.19	26.645	0.36	4.216	0.29	30.860	0.32	65.577	0.20	13.576	0.17	79.153	0.17
1991	39.106	0.46	18.355	0.24	57.462	0.33	17.264	0.30	11.383	0.20	28.647	0.21	56.371	0.33	29.738	0.17	86.109	0.23
1992	50.821	0.44	21.453	0.40	72.274	0.33	11.949	0.47	8.559	0.28	20.509	0.29	62.770	0.37	30.012	0.30	92.782	0.26
1993	27.129	0.29	16.372	0.25	43.501	0.20	5.078	0.35	3.723	0.30	8.801	0.26	32.207	0.25	20.095	0.21	52.302	0.17
1994	10.707	0.23	18.458	0.26	29.165	0.19	1.575	0.41	5.751	0.22	7.326	0.21	12.282	0.21	24.209	0.20	36.491	0.16
1995	1.510	0.25	16.795	0.28	18.305	0.26	0.569	0.42	7.622	0.35	8.191	0.34	2.079	0.22	24.418	0.22	26.497	0.21
1996	0.302	0.33	17.040	0.35	17.343	0.35	0.154	0.42	5.271	0.49	5.425	0.48	0.456	0.26	22.312	0.29	22.768	0.29
1997	0.454	0.34	4.957	0.21	5.411	0.20	0.248	0.34	1.296	0.26	1.543	0.23	0.701	0.25	6.253	0.18	6.954	0.16
1998	1.395	0.29	3.155	0.18	4.550	0.16	0.619	0.34	0.922	0.20	1.541	0.20	2.014	0.22	4.077	0.15	6.091	0.13
1999	2.022	0.37	2.256	0.32	4.278	0.24	0.387	0.33	0.505	0.30	0.892	0.24	2.409	0.32	2.760	0.27	5.169	0.20
2000	5.647	0.52	3.921	0.40	9.567	0.35	0.347	0.33	0.544	0.29	0.891	0.24	5.994	0.49	4.465	0.35	10.459	0.32
2001	5.136	0.34	4.621	0.20	9.757	0.23	0.635	0.27	1.785	0.36	2.419	0.30	5.770	0.30	6.406	0.17	12.176	0.20
2002	1.087	0.41	8.110	0.25	9.197	0.23	0.546	0.41	1.140	0.24	1.686	0.25	1.633	0.30	9.250	0.22	10.883	0.20
2003	1.895	0.32	7.156	0.29	9.051	0.25	0.615	0.32	3.019	0.35	3.634	0.31	2.510	0.25	10.175	0.23	12.685	0.20
2004	2.150	0.26	5.277	0.44	7.426	0.31	1.431	0.26	2.626	0.29	4.057	0.21	3.581	0.18	7.903	0.31	11.484	0.22
2005	3.110	0.22	6.588	0.32	9.698	0.24	11.621	0.33	7.088	0.29	18.710	0.25	14.731	0.26	13.676	0.22	28.407	0.19
2006	2.674	0.36	8.262	0.25	10.936	0.22	5.256	0.37	20.672	0.46	25.928	0.40	7.930	0.27	28.934	0.34	36.864	0.29
2007	5.023	0.56	6.765	0.23	11.788	0.28	11.886	0.83	10.728	0.34	22.614	0.47	16.909	0.61	17.493	0.23	34.401	0.33
2008	17.411	0.74	4.518	0.27	21.929	0.60	12.273	0.54	6.233	0.27	18.505	0.39	29.683	0.49	10.751	0.20	40.435	0.37
2009	3.293	0.25	6.402	0.34	9.695	0.28	9.180	0.28	5.838	0.20	15.018	0.21	12.473	0.22	12.240	0.20	24.713	0.17
2010	3.702	0.50	5.364	0.28	9.066	0.29	12.360	0.45	6.754	0.21	19.114	0.33	16.062	0.36	12.118	0.17	28.180	0.24
2011	1.866	0.25	8.110	0.31	9.976	0.28	10.018	0.70	8.845	0.20	18.863	0.39	11.884	0.59	16.954	0.18	28.839	0.27
2012	4.229	0.46	6.042	0.23	10.270	0.24	3.051	0.28	5.218	0.18	8.269	0.18	7.279	0.29	11.259	0.15	18.539	0.16
2013	15.045	0.31	4.524	0.22	19.569	0.24	7.150	0.39	3.614	0.22	10.764	0.27	22.195	0.24	8.138	0.16	30.334	0.18
2014	18.764	0.25	11.735	0.19	30.499	0.18	9.947	0.17	6.192	0.21	16.140	0.14	28.711	0.17	17.927	0.14	46.639	0.13
2015	11.442	0.20	12.676	0.22	24.119	0.14	11.343	0.27	8.298	0.22	19.641	0.18	22.785	0.17	20.975	0.16	43.760	0.11
2016	3.349	0.18	10.545	0.17	13.894	0.14	7.580	0.18	17.080	0.17	24.661	0.14	10.929	0.14	27.625	0.12	38.554	0.10
2017	2.054	0.78	13.889	0.17	15.943	0.18	1.231	0.21	15.589	0.23	16.819	0.22	3.284	0.49	29.478	0.14	32.762	0.14
2018	0.149	0.44	9.100	0.16	9.250	0.16	1.422	0.19	15.823	0.19	17.245	0.18	1.571	0.17	24.923	0.13	26.494	0.13
2019	0.460	0.37	5.666	0.20	6.125	0.20	0.301	0.33	6.608	0.16	6.909	0.16	0.761	0.26	12.274	0.13	13.034	0.13

(continued)

	East 166W						West 166W						all EBS					
	new shell		old shell		all shell		new shell		old shell		all shell		new shell		old shell		all shell	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
2020	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2021	2.047	0.32	1.311	0.29	3.357	0.23	0.632	0.32	2.243	0.22	2.875	0.19	2.679	0.25	3.553	0.18	6.232	0.15
2022	4.938	0.28	1.324	0.29	6.262	0.23	1.065	0.26	1.224	0.21	2.289	0.17	6.003	0.23	2.548	0.18	8.551	0.17
2023	3.220	0.24	1.504	0.24	4.725	0.18	1.611	0.23	1.819	0.23	3.430	0.17	4.831	0.18	3.323	0.17	8.154	0.13
2024	4.336	0.25	3.854	0.24	8.190	0.17	4.910	0.21	2.588	0.22	7.498	0.16	9.246	0.16	6.442	0.17	15.688	0.12
2025	2.695	0.34	3.214	0.22	5.909	0.20	11.113	0.27	4.782	0.16	15.895	0.21	13.808	0.23	7.996	0.13	21.805	0.16

Table 20. Design-based survey biomass estimates (and cv's) from the SBS studies, by sex, maturity state, and fleet. Biomass units are metric tons. Tanner crab SBS studies were conducted annually during 2013-2018. Different areas were included in the studies each year.

	male								female			
	all maturity				immature				mature			
	BSFRF (SBS)		NMFS (SBS)		BSFRF (SBS)		NMFS (SBS)		BSFRF (SBS)		NMFS (SBS)	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
2013	56,571	0.55	21,109	0.38	1,562	0.45	522	0.38	8,369	0.48	3,050	0.46
2014	42,969	0.21	30,866	0.24	379	0.33	148	0.33	3,428	0.33	1,252	0.35
2015	23,271	0.20	16,802	0.22	165	0.43	255	0.62	2,633	0.42	713	0.44
2016	55,992	0.18	29,037	0.15	1,275	0.31	202	0.33	11,016	0.29	2,649	0.29
2017	63,908	0.20	28,402	0.16	5,411	0.17	759	0.28	15,629	0.31	4,540	0.34
2018	47,051	0.17	25,810	0.15	9,539	0.21	2,425	0.23	12,340	0.24	3,976	0.25

Table 21. Design-based survey abundance estimates (and cv's) from the SBS studies, by sex, maturity state, and fleet. Abundance units are millions of crab. Tanner crab SBS studies were conducted annually during 2013-2018. Different areas were included in the studies each year.

				male								female
				all maturity				immature				mature
	BSFRF (SBS)		NMFS (SBS)		BSFRF (SBS)		NMFS (SBS)		BSFRF (SBS)		NMFS (SBS)	
year	value	cv	value	cv	value	cv	value	cv	value	cv	value	cv
2013	139.20	0.51	47.03	0.36	17.95	0.34	4.11	0.34	35.13	0.49	12.97	0.46
2014	90.89	0.20	60.45	0.24	5.74	0.39	2.20	0.50	14.41	0.33	5.29	0.38
2015	48.91	0.19	33.32	0.25	5.52	0.52	3.10	0.55	11.80	0.47	3.14	0.52
2016	168.96	0.20	66.34	0.17	51.21	0.28	5.19	0.37	62.79	0.31	15.32	0.31
2017	430.64	0.15	83.67	0.15	369.06	0.17	40.63	0.35	104.66	0.30	29.96	0.35
2018	442.19	0.19	119.00	0.15	429.49	0.20	86.10	0.22	82.83	0.25	26.84	0.25

Table 22. Original and scaled (input) sample sizes for Tanner crab size compositions in the NMFS EBS shelf bottom trawl survey. Scaled sample sizes are only shown for size compositions aggregated across ADF&G management areas (i.e., 'all EBS').'–': no survey conducted.

	East 166W				West 166W				all EBS							
	male		female	all sexes	male		female	all sexes	male				female		all sexes	
	all maturity	immature	mature	all maturity	all maturity	immature	mature	all maturity	all maturity		immature		mature		all maturity	
year	original	original	original	original	original	original	original	original	original	scaled	original	scaled	original	scaled	original	scaled
1975/76	4,973	956	1,664	7,593	2,314	91	903	3,308	7,287	134	1,047	19	2,567	47	10,901	200
1976/77	2,891	510	1,182	4,583	1,843	587	433	2,863	4,734	127	1,097	29	1,615	43	7,446	200
1977/78	2,680	251	1,350	4,281	1,554	525	571	2,650	4,234	122	776	22	1,921	55	6,931	200
1978/79	2,342	175	1,338	3,855	2,885	1,774	608	5,267	5,227	115	1,949	43	1,946	43	9,122	200
1979/80	669	156	272	1,097	2,250	577	804	3,631	2,919	123	733	31	1,076	46	4,728	200
1980/81	1,986	319	629	2,934	5,544	1,172	1,412	8,128	7,530	136	1,491	27	2,041	37	11,062	200
1981/82	1,279	339	739	2,357	5,709	240	1,786	7,735	6,988	138	579	11	2,525	50	10,092	200
1982/83	1,428	440	1,026	2,894	3,776	383	1,815	5,974	5,204	117	823	19	2,841	64	8,868	200
1983/84	1,687	916	611	3,214	2,961	1,197	1,744	5,902	4,648	102	2,113	46	2,355	52	9,116	200
1984/85	934	319	415	1,668	2,920	1,560	1,400	5,880	3,854	102	1,879	50	1,815	48	7,548	200
1985/86	650	171	359	1,180	1,250	676	470	2,396	1,900	106	847	47	829	46	3,576	200
1986/87	1,501	942	272	2,715	1,636	646	250	2,532	3,137	120	1,588	61	522	20	5,247	200
1987/88	3,074	1,983	401	5,458	3,389	2,247	436	6,072	6,463	112	4,230	73	837	15	11,530	200
1988/89	3,788	1,422	1,484	6,694	4,524	2,313	799	7,636	8,312	116	3,735	52	2,283	32	14,330	200
1989/90	5,615	1,640	1,304	8,559	3,630	1,631	819	6,080	9,245	126	3,271	45	2,123	29	14,639	200
1990/91	5,500	1,521	1,722	8,743	4,098	1,593	1,291	6,982	9,598	122	3,114	40	3,013	38	15,725	200
1991/92	4,748	832	1,735	7,315	5,198	1,427	2,116	8,741	9,946	124	2,259	28	3,851	48	16,056	200
1992/93	2,864	169	1,265	4,298	4,065	1,325	1,760	7,150	6,929	121	1,494	26	3,025	53	11,448	200
1993/94	2,748	104	748	3,600	2,845	765	1,134	4,744	5,593	134	869	21	1,882	45	8,344	200
1994/95	1,471	59	557	2,087	2,361	862	884	4,107	3,832	124	921	30	1,441	47	6,194	200
1995/96	1,041	147	492	1,680	1,748	687	705	3,140	2,789	116	834	35	1,197	50	4,820	200
1996/97	1,404	424	484	2,312	1,301	459	588	2,348	2,705	116	883	38	1,072	46	4,660	200
1997/98	994	501	379	1,874	1,213	828	293	2,334	2,207	105	1,329	63	672	32	4,208	200
1998/99	1,132	482	248	1,862	1,920	1,228	256	3,404	3,052	116	1,710	65	504	19	5,266	200
1999/00	1,462	516	367	2,345	2,471	2,112	398	4,981	3,933	107	2,628	72	765	21	7,326	200
2000/01	1,599	556	312	2,467	2,518	1,693	275	4,486	4,117	118	2,249	65	587	17	6,953	200
2001/02	1,844	1,093	216	3,153	3,638	2,585	792	7,015	5,482	108	3,678	72	1,008	20	10,168	200
2002/03	1,816	1,097	260	3,173	3,643	2,488	590	6,721	5,459	110	3,585	72	850	17	9,894	200
2003/04	1,812	453	415	2,680	5,191	2,381	1,260	8,832	7,003	122	2,834	49	1,675	29	11,512	200
2004/05	1,020	213	168	1,401	6,448	3,709	915	11,072	7,468	120	3,922	63	1,083	17	12,473	200
2005/06	1,859	641	437	2,937	5,670	2,711	1,125	9,506	7,529	121	3,352	54	1,562	25	12,443	200
2006/07	2,422	715	603	3,740	9,613	3,649	2,056	15,318	12,035	126	4,364	46	2,659	28	19,058	200
2007/08	2,120	348	768	3,236	7,466	2,082	1,939	11,487	9,586	130	2,430	33	2,707	37	14,723	200
2008/09	1,991	254	674	2,919	5,398	1,493	1,689	8,580	7,389	129	1,747	30	2,363	41	11,499	200
2009/10	1,545	507	554	2,606	4,432	1,901	1,126	7,459	5,977	119	2,408	48	1,680	33	10,065	200
2010/11	1,562	623	410	2,595	5,062	2,557	776	8,395	6,624	121	3,180	58	1,186	22	10,990	200
2011/12	2,923	1,610	391	4,924	6,228	3,434	785	10,447	9,151	119	5,044	66	1,176	15	15,371	200
2012/13	2,709	977	848	4,534	5,677	2,634	814	9,125	8,386	123	3,611	53	1,662	24	13,659	200
2013/14	3,478	746	972	5,196	6,133	2,171	1,447	9,751	9,611	129	2,917	39	2,419	32	14,947	200
2014/15	4,309	440	740	5,489	6,552	1,771	1,326	9,649	10,861	143	2,211	29	2,066	27	15,138	200
2015/16	2,606	479	781	3,866	4,807	976	1,027	6,810	7,413	139	1,455	27	1,808	34	10,676	200
2016/17	1,821	43	277	2,141	5,252	1,330	1,341	7,923	7,073	141	1,373	27	1,618	32	10,064	200
2017/18	1,775	175	366	2,316	4,431	1,858	972	7,261	6,206	130	2,033	42	1,338	28	9,577	200

(continued)

	East 166W				West 166W				all EBS							
	male		female	all sexes	male		female	all sexes	male				female		all sexes	
	all maturity	immature	mature	all maturity	all maturity	immature	mature	all maturity	all maturity		immature		mature		all maturity	
year	original	original	original	original	original	original	original	original	original	scaled	original	scaled	original	scaled	original	scaled
2018/19	1,904	1,147	121	3,172	6,347	3,519	1,107	10,973	8,251	117	4,666	66	1,228	17	14,145	200
2019/20	1,301	730	132	2,163	4,612	3,080	1,058	8,750	5,913	108	3,810	70	1,190	22	10,913	200
2020/21	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
2021/22	1,820	509	520	2,849	4,901	2,506	1,471	8,878	6,721	115	3,015	51	1,991	34	11,727	200
2022/23	1,919	778	345	3,042	3,474	1,906	827	6,207	5,393	117	2,684	58	1,172	25	9,249	200
2023/24	1,687	983	308	2,978	7,833	5,605	1,101	14,539	9,520	109	6,588	75	1,409	16	17,517	200
2024/25	1,875	747	482	3,104	6,941	3,960	1,841	12,742	8,816	111	4,707	59	2,323	29	15,846	200
2025/26	1,573	459	538	2,570	8,946	3,283	2,341	14,570	10,519	123	3,742	44	2,879	34	17,140	200

Table 23. Original and scaled (input) sample sizes for Tanner crab size compositions in the SBS selectivity studies. '–': no survey conducted.

	male				female								all sexes			
	all maturity				immature				mature				all maturity			
	BSFRF (SBS)		NMFS (SBS)		BSFRF (SBS)		NMFS (SBS)		BSFRF (SBS)		NMFS (SBS)		BSFRF (SBS)		NMFS (SBS)	
year	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled	original	scaled
2013/14	640	141	1,302	142	99	22	134	15	167	37	404	44	906	200	1,840	200
2014/15	441	166	1,814	180	25	9	58	6	66	25	149	15	532	200	2,021	200
2015/16	264	142	998	167	29	16	97	16	79	42	101	17	372	200	1,196	200
2016/17	992	117	2,270	154	318	38	179	12	380	45	502	34	1,690	200	2,951	200
2017/18	2,472	98	3,277	130	1,886	75	1,020	41	699	28	729	29	5,057	200	5,026	200
2018/19	2,334	92	4,306	112	2,121	84	2,406	63	618	24	969	25	5,073	200	7,681	200

Table 24. Weight-at-size parameters ($w = a \cdot z^b$) for Tanner crab weight in grams.

sex	maturity	a	b
males	all	0.000270	3.022134
females	immature (non-ovigerous)	0.000562	2.816928
	mature (ovigerous)	0.000441	2.898686

Table 25. No parameters were at a bound in the TCSAM02 models `22.03d5 (2024)`, `22.03d5 (2025)`.

	result
1	No results were returned for this table.

Table 26. 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.

			'22.03d5 (2024)'		'22.03d5 (2025)'	
process	name	label	est.	sd.	est.	sd.
recruitment	pLnR[1]	historical recruitment period	6.960	0.60	7.019	0.58
	pLnR[2]	current recruitment period	6.016	0.066	6.118	0.065
	pRa[1]	fixed value	2.201	0.030	2.166	0.034
	pRb[1]	fixed value	1.360	0.081	1.291	0.092
	pRCV[1]	full model period	-0.7000	NA	-0.7000	NA
	pRX[1]	full model period	0.000	NA	0.000	NA
natural mortality	pDM1[1]	multiplier for immature crab	1.104	0.046	1.092	0.046
	pDM1[2]	multiplier for mature males	1.391	0.037	1.380	0.037
	pDM1[3]	multiplier for mature females	1.372	0.037	1.388	0.037
	pDM2[1]	1980-1984 multiplier for mature males	2.325	0.23	2.329	0.24
	pDM2[2]	1980-1984 multiplier for mature females	1.962	0.16	2.038	0.17
	pM[1]	base ln-scale M	-1.470	NA	-1.470	NA
growth	pGrA[1]	males	32.27	0.24	32.40	0.22
	pGrA[2]	females	33.66	0.31	33.37	0.28
	pGrB[1]	males	166.3	0.70	163.9	0.62
	pGrB[2]	females	115.1	0.61	115.4	0.57
	pGrBeta[1]	both sexes	0.8488	0.10	0.7107	0.084

Table 27. TCSAM02 models final values for annual recruitment "devs" in the "historical" period up to 1975. Index begins in 1948.

	'22.03d5 (2024)'		'22.03d5 (2025)'	
index	est.	sd.	est.	sd.
1	-0.4902	1.8	-0.5419	1.8
2	-0.4895	1.7	-0.5410	1.6
3	-0.4879	1.5	-0.5389	1.5
4	-0.4852	1.4	-0.5353	1.4
5	-0.4808	1.3	-0.5295	1.3
6	-0.4742	1.2	-0.5209	1.1
7	-0.4647	1.1	-0.5084	1.1
8	-0.4513	0.98	-0.4910	0.96
9	-0.4327	0.90	-0.4669	0.89
10	-0.4072	0.84	-0.4342	0.83
11	-0.3725	0.81	-0.3902	0.80
12	-0.3258	0.80	-0.3314	0.79
13	-0.2625	0.82	-0.2524	0.81
14	-0.1753	0.86	-0.1437	0.84
15	-0.05186	0.91	0.01094	0.89
16	0.1297	0.94	0.2401	0.93
17	0.4090	0.94	0.5829	0.93
18	0.8339	0.89	1.028	0.87
19	1.380	0.79	1.455	0.74
20	1.654	0.67	1.565	0.66
21	1.157	0.69	1.089	0.68
22	0.6000	0.69	0.6059	0.67
23	0.3358	0.67	0.3655	0.65
24	-0.09246	0.67	-0.1424	0.65
25	-0.4496	0.67	-0.4945	0.65
26	-0.1056	0.70	-0.08027	0.67

Table 28. TCSAM02 models final values for annual recruitment “devs” in the “current” period from 1975. The index begins in 1975.

	‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
index	est.	sd.	est.	sd.
1	1.339	0.32	1.323	0.29
2	1.956	0.20	1.955	0.18
3	1.572	0.23	1.528	0.22
4	0.5632	0.43	0.3525	0.46
5	-0.1558	0.53	-0.1201	0.47
6	-0.2070	0.41	-0.3037	0.40
7	-0.03973	0.29	-0.06457	0.28
8	-0.1927	0.29	-0.1858	0.28
9	1.044	0.12	1.008	0.12
10	0.7401	0.17	0.7437	0.16
11	0.8817	0.17	0.8384	0.16
12	0.9181	0.16	0.9722	0.14
13	0.7504	0.17	0.6227	0.17
14	0.3312	0.21	0.2532	0.20
15	-0.4062	0.26	-0.5422	0.26
16	-1.118	0.35	-1.150	0.33
17	-1.402	0.33	-1.479	0.32
18	-1.317	0.26	-1.356	0.25
19	-1.317	0.26	-1.312	0.25
20	-1.146	0.25	-1.194	0.24
21	-0.6497	0.18	-0.6782	0.17
22	-0.8782	0.24	-0.9524	0.24
23	0.02524	0.12	-0.007354	0.12
24	-0.9865	0.25	-0.9878	0.25
25	0.5806	0.099	0.5643	0.097
26	-0.5720	0.29	-0.5766	0.28
27	0.9543	0.10	0.9165	0.10
28	-0.2663	0.29	-0.1948	0.27
29	1.058	0.11	1.003	0.11
30	0.4481	0.15	0.3450	0.16
31	-0.6667	0.28	-0.6627	0.27
32	-1.121	0.37	-1.200	0.37
33	-0.5692	0.26	-0.6053	0.27
34	-0.08877	0.27	0.1264	0.24
35	1.341	0.097	1.265	0.10
36	0.3290	0.20	0.2337	0.19
37	-0.4083	0.21	-0.5201	0.21
38	-1.660	0.38	-1.669	0.36
39	-0.7161	0.15	-0.8097	0.15
40	-1.467	0.24	-1.536	0.23
41	-1.359	0.21	-1.340	0.20
42	-0.6903	0.14	-0.6876	0.14
43	0.7621	0.074	0.7619	0.072
44	0.2075	0.13	0.1585	0.13
45	0.3513	0.14	0.4091	0.14
46	-1.158	0.59	-0.7346	0.58
47	1.162	0.14	1.347	0.13
48	1.732	0.14	1.539	0.14
49	1.462	0.19	1.514	0.16

(continued)

	'22.03d5 (2024)'		'22.03d5 (2025)'	
index	est.	sd.	est.	sd.
50	0.05030	0.44	0.7209	0.31
51	–	–	0.3694	0.38

Table 29. 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.

		'22.03d5 (2024)'		'22.03d5 (2025)'	
label	index	est.	sd.	est.	sd.
females 50-105 mmCW (entire model period)	1	-5.302	1.2	-5.029	1.1
	2	-4.084	0.56	-3.913	0.51
	3	-2.895	0.25	-2.824	0.24
	4	-1.682	0.15	-1.637	0.14
	5	-0.5442	0.090	-0.4814	0.089
	6	0.2982	0.091	0.3560	0.090
	7	0.6017	0.10	0.6701	0.10
	8	1.094	0.14	1.155	0.14
	9	2.001	0.23	2.046	0.23
	10	2.961	0.46	2.915	0.44
	11	3.964	1.0	3.825	1.0
males 60-150 mmCW (entire model period)	1	-3.162	0.21	-2.070	0.14
	2	-3.722	0.31	-2.629	0.21
	3	-3.164	0.26	-2.623	0.19
	4	-2.230	0.13	-1.946	0.12
	5	-1.564	0.12	-1.322	0.10
	6	-1.313	0.10	-1.198	0.098
	7	-0.7913	0.095	-0.7404	0.089
	8	-0.2803	0.086	-0.2212	0.083
	9	-0.1960	0.088	-0.2750	0.083
	10	0.1521	0.088	0.1230	0.085
	11	0.5834	0.094	0.4174	0.086
	12	1.088	0.12	0.8591	0.10
	13	1.682	0.14	1.387	0.12
	14	2.706	0.26	2.309	0.23
	15	3.147	0.28	2.775	0.25
	16	3.652	0.47	3.450	0.45
	17	4.665	1.1	4.670	1.0

Table 30. 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.

			‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
process	name	label	est.	sd.	est.	sd.
fisheries	pDC2[1]	TCF: female offset	-2.798	0.20	-2.798	0.20
	pDC2[2]	SCF: female offset	-2.670	0.34	-2.709	0.35
	pDC2[3]	GTF: female offset	-1.044	0.092	-0.9423	0.11
	pDC2[4]	RKF: female offset	-2.418	0.84	-2.374	0.83
	pHM[1]	handling mortality for pot fisheries	0.3210	NA	0.3210	NA
	pHM[2]	handling mortality for groundfish trawl fisheries	0.8000	NA	0.8000	NA
	pLgtRet[1]	TCF: logit-scale max retention (pre-1997)	14.90	NA	14.90	NA
	pLgtRet[2]	TCF: logit-scale max retention (2005-2009)	14.90	NA	14.90	NA
	pLgtRet[3]	TCF: logit-scale max retention (2013+)	14.90	NA	14.90	NA
	pLnC[1]	TCF: base capture rate, pre-1965 (=0.05)	-2.996	NA	-2.996	NA
	pLnC[2]	TCF: base capture rate, 1965+	-1.500	0.12	-1.626	0.12
	pLnC[3]	SCF: base capture rate, pre-1978 (=0.01)	-4.605	NA	-4.605	NA
	pLnC[4]	SCF: base capture rate, 1992+	-3.730	0.068	-3.783	0.067
	pLnC[5]	DUMMY CAPTURE RATE	-4.181	NA	-4.181	NA
	pLnC[6]	GTF: base capture rate, ALL YEARS	-5.032	0.057	-4.910	0.088
	pLnC[7]	RKF: base capture rate, pre-1953 (=0.02)	-3.912	NA	-3.912	NA
	pLnC[8]	RKF: base capture rate, 1992+	-4.798	0.11	-4.884	0.12
surveys	pQ[1]	NMFS trawl survey: males, 1975-1981	-0.7080	0.11	-0.8104	0.10
	pQ[2]	NMFS trawl survey: males, 1982+	-0.6834	0.048	-0.6594	0.047
	pQ[3]	NMFS trawl survey: females, 1975-1981	-1.100	0.13	-1.109	0.13
	pQ[4]	NMFS trawl survey: females, 1982+	-1.301	0.071	-1.284	0.071
	pQ[5]	BSFRF SBS	0.000	NA	0.000	NA
Dirichlet-Multinomial	pLnDirMul[1]	ln(theta) parameter for BSFRF SBS M	10.68	NA	10.68	NA
	pLnDirMul[2]	ln(theta) parameter for BSFRF SBS F	10.99	NA	10.99	NA

Table 31. TCSAM02 models final values for fishing mortality "devs" for the directed fishery. The index starts in 1965 and does not include years when the fishery was completely closed.

	'22.03d5 (2024)'		'22.03d5 (2025)'	
index	est.	sd.	est.	sd.
1	-1.287	0.89	-1.111	0.89
2	-1.076	0.73	-0.9053	0.74
3	0.7694	0.68	0.9397	0.69
4	1.351	0.65	1.525	0.68
5	2.520	0.94	2.714	1.0
6	4.177	0.73	4.012	0.84
7	4.723	0.67	2.831	1.7
8	2.212	1.2	0.9591	0.76
9	0.1312	0.34	-0.1073	0.36
10	-0.2104	0.21	-0.2520	0.21
11	-0.07379	0.18	-0.07345	0.18
12	0.6904	0.17	0.6884	0.17
13	1.454	0.20	1.402	0.20
14	1.723	0.28	1.606	0.26
15	2.146	0.35	2.007	0.29
16	1.914	0.25	2.026	0.25
17	0.2556	0.15	0.4223	0.15
18	-0.8804	0.13	-0.7819	0.13
19	-2.306	0.13	-2.238	0.13
20	-0.9879	0.14	-0.9179	0.14
21	-1.346	0.12	-1.204	0.12
22	-0.3883	0.12	-0.2117	0.12
23	0.7957	0.12	0.9598	0.12
24	1.563	0.13	1.736	0.13
25	1.907	0.16	2.086	0.16
26	2.235	0.17	2.386	0.17
27	1.787	0.17	1.929	0.17
28	1.028	0.18	1.149	0.17
29	0.4313	0.17	0.5433	0.17
30	0.3685	0.23	0.4855	0.23
31	-2.332	0.12	-2.171	0.12
32	-1.708	0.12	-1.541	0.12
33	-1.885	0.12	-1.735	0.12
34	-2.039	0.12	-1.881	0.12
35	-2.051	0.14	-1.917	0.14
36	-1.900	0.13	-1.751	0.12
37	-0.6279	0.12	-0.4648	0.12
38	-0.3274	0.12	-0.1867	0.12
39	-2.033	0.12	-1.909	0.12
40	-1.875	0.12	-1.744	0.12
41	-2.065	0.12	-1.925	0.12
42	-2.423	0.12	-2.245	0.12
43	-2.105	0.12	-1.933	0.12
44	-2.256	0.12	-2.115	0.12
45	–	–	-1.087	0.12

Table 32. TCSAM02 models final values for fishing mortality "devs" for the snow crab fishery. The indices start in 1990.

	'22.03d5 (2024)'		'22.03d5 (2025)'	
index	est.	sd.	est.	sd.
1	1.495	0.20	1.601	0.20
2	1.745	0.20	1.843	0.20
3	0.7345	0.19	0.8367	0.20
4	1.119	0.18	1.227	0.19
5	0.5489	0.18	0.6535	0.19
6	0.4753	0.19	0.5787	0.19
7	1.321	0.20	1.427	0.20
8	1.083	0.21	1.168	0.21
9	0.1492	0.20	0.2363	0.20
10	-1.462	0.21	-1.370	0.21
11	-0.7177	0.21	-0.6158	0.22
12	-0.2641	0.21	-0.1585	0.21
13	-1.550	0.21	-1.448	0.21
14	-2.667	0.24	-2.567	0.24
15	-1.979	0.19	-1.887	0.19
16	-0.01337	0.20	0.07822	0.20
17	0.1315	0.19	0.2096	0.19
18	0.1683	0.19	0.2535	0.19
19	-0.4585	0.20	-0.3778	0.20
20	-0.07280	0.20	-0.001874	0.20
21	0.03084	0.20	0.09881	0.20
22	0.5841	0.20	0.6546	0.20
23	0.2875	0.20	0.3661	0.20
24	0.2125	0.20	0.3009	0.20
25	1.043	0.19	1.118	0.19
26	0.8413	0.19	0.9107	0.19
27	0.6668	0.20	0.7395	0.20
28	0.04418	0.20	0.1239	0.20
29	0.05323	0.20	0.1350	0.20
30	0.3750	0.20	0.4584	0.20
31	-1.620	0.21	-1.518	0.21
32	-2.304	0.23	-2.196	0.23
33	–	–	-2.878	0.24

Table 33. TCSAM02 models final values for fishing mortality "devs" for the BBRKC fishery. The indices start in 1990.

	'22.03d5 (2024)'		'22.03d5 (2025)'	
index	est.	sd.	est.	sd.
1	3.875	0.23	4.007	0.24
2	3.567	0.25	3.700	0.25
3	3.359	0.25	3.466	0.25
4	4.269	0.23	4.373	0.24
5	2.316	0.24	2.413	0.25
6	1.041	0.26	1.155	0.27
7	0.7882	0.27	0.9009	0.27
8	0.3673	0.28	0.4874	0.28
9	0.1436	0.28	0.2718	0.28
10	-0.4514	0.35	-0.3100	0.35
11	-0.2595	0.28	-0.1190	0.29
12	-0.5569	0.29	-0.4192	0.29
13	-0.8766	0.30	-0.7442	0.30
14	-1.232	0.33	-1.110	0.33
15	-1.727	0.43	-1.605	0.44
16	-1.181	0.26	-1.068	0.27
17	0.2055	0.22	0.3239	0.22
18	-0.2631	0.22	-0.1591	0.23
19	-1.925	0.42	-1.838	0.42
20	-2.363	0.70	-2.280	0.70
21	-1.322	0.33	-1.232	0.33
22	-0.2892	0.23	-0.1736	0.23
23	0.3700	0.22	0.4969	0.22
24	-0.04319	0.22	0.06425	0.22
25	-0.08059	0.22	0.01288	0.22
26	0.1336	0.22	0.2236	0.23
27	-0.5653	0.25	-0.4709	0.26
28	-1.786	0.68	-1.691	0.69
29	-2.678	1.3	-2.575	1.3
30	-2.836	1.1	-2.730	1.1
31	–	–	-3.371	1.4

Table 34. TCSAM02 models final values for fishing mortality "devs" vectors for the groundfish fisheries. Indices start in 1973.

	'22.03d5 (2024)'		'22.03d5 (2025)'	
index	est.	sd.	est.	sd.
1	1.599	0.17	1.329	0.19
2	1.831	0.16	1.584	0.18
3	1.018	0.15	0.7835	0.18
4	0.6122	0.15	0.3891	0.17
5	0.2508	0.15	0.03743	0.17
6	0.04728	0.15	-0.1575	0.18
7	0.5368	0.16	0.3313	0.18
8	0.05682	0.16	-0.1380	0.17
9	-0.01527	0.15	-0.1987	0.17
10	-0.8601	0.15	-1.036	0.17
11	-0.3805	0.15	-0.5465	0.17
12	-0.08338	0.15	-0.2414	0.17
13	-0.4822	0.15	-0.6358	0.17
14	-0.2927	0.15	-0.4503	0.17
15	-0.4426	0.15	0.2554	0.33
16	-0.9339	0.15	-0.2380	0.33
17	-0.5198	0.15	0.1731	0.33
18	-0.1114	0.15	0.5856	0.33
19	0.6683	0.15	1.355	0.33
20	0.9291	0.15	1.605	0.34
21	0.6450	0.15	1.309	0.33
22	1.083	0.15	1.735	0.33
23	0.9958	0.15	1.639	0.33
24	1.174	0.15	1.828	0.33
25	1.614	0.15	1.534	0.16
26	1.475	0.15	1.400	0.16
27	0.9467	0.15	0.8800	0.16
28	0.9828	0.15	0.9209	0.16
29	1.206	0.15	1.148	0.16
30	0.4999	0.15	0.4382	0.16
31	-0.04478	0.15	-0.1076	0.16
32	0.2464	0.15	0.1800	0.16
33	-0.08458	0.15	-0.1549	0.16
34	-0.1111	0.15	-0.1863	0.16
35	-0.02027	0.15	-0.09804	0.16
36	-0.3534	0.14	-0.4384	0.16
37	-0.7209	0.14	-0.8102	0.16
38	-1.053	0.14	-1.144	0.16
39	-0.7442	0.14	-0.8293	0.16
40	-1.228	0.14	-1.306	0.16
41	-0.6683	0.14	-0.7424	0.16
42	-0.5856	0.14	-0.6666	0.16
43	-0.7171	0.14	-0.8057	0.16
44	-0.6185	0.14	-0.7089	0.16
45	-1.181	0.14	-1.267	0.16
46	-0.8748	0.14	-0.9552	0.16
47	-0.7521	0.14	-0.8271	0.16
48	-0.8464	0.15	-0.9170	0.16
49	-0.9053	0.15	-0.9854	0.16

(continued)

	‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
index	est.	sd.	est.	sd.
50	-1.254	0.15	-1.340	0.16
51	-1.530	0.15	-1.610	0.16
52	–	–	-1.899	0.16

Table 35. TCSAM02 models final values for the “pS1” parameters related to selectivity functions. Parameters with values whose standard error is NA are fixed, not estimated.

		‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
name	label	est.	sd.	est.	sd.
pS1[1]	size at 1 for NMFS survey selectivity (males, pre-1982)	179.0	NA	179.0	NA
pS1[10]	ascending z-at-1 for SCF selectivity (males, pre-1997)	160.3	2.4	159.9	3.0
pS1[11]	ascending z-at-1 for SCF selectivity (males, 1997-2004)	119.7	7.0	120.1	6.6
pS1[12]	ascending z-at-1 for SCF selectivity (males, 2005+)	125.3	1.3	124.9	1.3
pS1[13]	ascending z50 for SCF selectivity (females, pre-1997)	81.28	6.8	82.17	7.1
pS1[14]	ascending z50 for SCF selectivity (females, 1997-2004)	72.85	4.3	73.25	4.3
pS1[15]	ascending z50 for SCF selectivity (females, 2005+)	100.9	8.5	100.0	8.4
pS1[16]	z50 for GF.AllGear selectivity (males, pre-1987)	61.74	3.1	63.20	3.3
pS1[17]	z50 for GF.AllGear selectivity (males, 1987-1996)	72.50	6.5	157.1	59.
pS1[18]	z50 for GF.AllGear selectivity (males, 1997+)	97.24	2.5	99.74	2.2
pS1[19]	z50 for GF.AllGear selectivity (females, pre-1987)	44.57	1.9	46.94	2.2
pS1[2]	size at 1 for NMFS survey selectivity (males, 1982+)	179.0	NA	179.0	NA
pS1[20]	z50 for GF.AllGear selectivity (females, 1987-1996)	41.39	2.4	114.6	49.
pS1[21]	z50 for GF.AllGear selectivity (females, 1997+)	86.28	3.0	90.57	3.2
pS1[22]	size at 1 for RKF selectivity (males, pre-1997)	179.9	NA	179.9	NA
pS1[23]	size at 1 for RKF selectivity (males, 1997-2004)	179.9	NA	179.9	NA
pS1[24]	size at 1 for RKF selectivity (males, 2005+)	179.9	NA	179.9	NA
pS1[25]	size at 1 for RKF selectivity (females, pre-1997)	139.9	NA	139.9	NA
pS1[26]	size at 1 for RKF selectivity (females, 1997-2004)	136.2	39.	130.7	34.
pS1[27]	size at 1 for RKF selectivity (females, 2005+)	134.8	22.	133.6	21.
pS1[28]	z50 for TCF retention (2005-2009)	137.6	0.28	137.6	0.28
pS1[29]	z50 for TCF retention (2013+)	125.1	0.78	125.0	0.77
pS1[3]	size at 1 for NMFS survey selectivity (females, pre-1982)	129.9	NA	129.9	NA
pS1[4]	size at 1 for NMFS survey selectivity (females, 1982+)	129.9	NA	129.9	NA
pS1[5]	z50 for TCF retention (pre-1991)	139.1	0.66	139.0	0.69
pS1[6]	z50 for TCF retention (1991-1996)	138.5	1.2	138.4	1.5
pS1[7]	DUMMY VALUE	4.500	NA	4.500	NA
pS1[8]	ln(z50) for TCF selectivity (males)	4.838	0.0059	4.833	0.0056
pS1[9]	z50 for TCF selectivity (females)	92.90	2.2	93.01	2.1

Table 36. TCSAM02 models final values for the "pS2" parameters related to selectivity functions. Parameters with values whose standard error is NA are fixed, not estimated.

name	label	'22.03d5 (2024)'		'22.03d5 (2025)'	
		est.	sd.	est.	sd.
pS2[1]	width for NMFS survey selectivity (males, pre-1982)	64.18	2.2	64.48	2.3
pS2[10]	ascending width for SCF selectivity (males, pre-1997)	32.65	1.5	31.63	1.5
pS2[11]	ascending width for SCF selectivity (males, 1997-2004)	16.14	3.5	15.85	3.3
pS2[12]	ascending width for SCF selectivity (males, 2005+)	14.71	0.70	14.28	0.67
pS2[13]	slope for SCF selectivity (females, pre-1997)	0.1371	0.065	0.1357	0.063
pS2[14]	slope for SCF selectivity (females, 1997-2004)	0.3171	0.23	0.3117	0.22
pS2[15]	slope for SCF selectivity (females, 2005+)	0.09882	0.024	0.1039	0.025
pS2[16]	slope for GF.AllGear selectivity (males, pre-1987)	0.08943	0.010	0.08518	0.0093
pS2[17]	slope for GF.AllGear selectivity (males, 1987-1996)	0.04668	0.0073	0.02504	0.0050
pS2[18]	slope for GF.AllGear selectivity (males, 1997+)	0.06058	0.0025	0.06175	0.0023
pS2[19]	slope for GF.AllGear selectivity (females, pre-1987)	0.1343	0.019	0.1236	0.018
pS2[2]	width for NMFS survey selectivity (males, 1982+)	84.99	2.4	81.18	2.1
pS2[20]	slope for GF.AllGear selectivity (females, 1987-1996)	0.1563	0.049	0.02443	0.0073
pS2[21]	slope for GF.AllGear selectivity (females, 1997+)	0.06774	0.0042	0.06784	0.0039
pS2[22]	width for RKF selectivity (males, pre-1997)	19.73	0.79	19.75	0.78
pS2[23]	width for RKF selectivity (males, 1997-2004)	27.71	2.1	27.57	2.0
pS2[24]	width for RKF selectivity (males, 2005+)	27.20	0.95	27.17	0.93
pS2[25]	width for RKF selectivity (females, pre-1997)	–	–	17.76	2.2
	width for RKF selectivity (males, pre-1997)	17.95	2.3	–	–
pS2[26]	width for RKF selectivity (females, 1997-2004)	–	–	17.33	13.
	width for RKF selectivity (males, 1997-2004)	18.79	15.	–	–
pS2[27]	width for RKF selectivity (females, 2005+)	–	–	17.39	7.4
	width for RKF selectivity (males, 2005+)	17.87	7.8	–	–
pS2[28]	slope for TCF retention (2005-2009)	1.990	NA	1.990	NA
pS2[29]	slope for TCF retention (2013+)	0.3312	0.066	0.3186	0.059
pS2[3]	width for NMFS survey selectivity (females, pre-1982)	40.39	2.1	40.03	2.0
pS2[4]	width for NMFS survey selectivity (females, 1982+)	73.17	4.6	68.02	3.8
pS2[5]	slope for TCF retention (pre-1991)	0.6959	0.17	0.7305	0.20
pS2[6]	slope for TCF retention (1991-1996)	–	–	1.067	1.0
	slope for TCF retention (1997+)	1.004	0.74	–	–
pS2[7]	slope for TCF selectivity (males, pre-1997)	0.1212	0.0066	0.1238	0.0066
pS2[8]	slope for TCF selectivity (males, 1997+)	0.1730	0.0071	0.1757	0.0069
pS2[9]	slope for TCF selectivity (females)	0.1961	0.025	0.2014	0.024

Table 37. 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.

		'22.03d5 (2024)'		'22.03d5 (2025)'	
name	label	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
pS3[2]	scaled increment for descending z-at-1 for SCF selectivity (males, 1997-2004)	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
pS4[1]	descending width for SCF selectivity (males, pre-1997)	1.100	NA	1.100	NA
pS4[2]	descending width for SCF selectivity (males, 1997-2004)	19.82	9.4	19.42	9.0
pS4[3]	descending width for SCF selectivity (males, 2005+)	13.17	1.4	13.39	1.3

Table 38. 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.

	'22.03d5 (2024)'		'22.03d5 (2025)'	
index	est.	sd.	est.	sd.
1	0.1138	0.014	0.1175	0.014
2	0.09158	0.014	0.09448	0.014
3	0.1297	0.013	0.1311	0.013
4	0.1305	0.018	0.1311	0.018
5	0.1058	0.021	0.1054	0.021
6	0.2069	0.021	0.2086	0.021
7	-0.02782	0.013	-0.02416	0.013
8	-0.01218	0.013	-0.007486	0.013
9	-0.07863	0.013	-0.07497	0.013
10	0.03836	0.011	0.04251	0.011
11	0.1548	0.011	0.1584	0.011
12	-0.007004	0.014	-0.003785	0.013
13	-0.06034	0.012	-0.05401	0.011
14	-0.09504	0.013	-0.08958	0.013
15	-0.06247	0.015	-0.06070	0.015
16	-0.1084	0.014	-0.1047	0.014
17	-0.1602	0.016	-0.1553	0.015
18	-0.1472	0.014	-0.1388	0.013
19	-0.1325	0.013	-0.1238	0.012
20	-0.07948	0.013	-0.07256	0.012
21	–	–	-0.07935	0.013

Table 39. Assumed size-specific availability for males 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
27	0.0016	0.0016
32	0.0034	0.0034
37	0.0064	0.0064
42	0.0106	0.0106
47	0.0140	0.0140
52	0.0155	0.0155
57	0.0166	0.0166
62	0.0198	0.0198
67	0.0286	0.0286
72	0.0447	0.0447
77	0.0662	0.0662
82	0.0830	0.0830
87	0.0899	0.0899
92	0.0932	0.0932
97	0.1021	0.1021
102	0.1241	0.1241
107	0.1582	0.1582
112	0.1987	0.1987
117	0.2347	0.2347
122	0.2644	0.2644
127	0.2946	0.2946
132	0.3348	0.3348
137	0.3855	0.3855
142	0.4278	0.4278
147	0.4395	0.4395
152	0.4035	0.4035
157	0.3304	0.3304
162	0.2444	0.2444
167	0.1681	0.1681

Table 40. Assumed size-specific availability for males 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
27	0.0029	0.0029
32	0.0067	0.0067
37	0.0137	0.0137
42	0.0223	0.0223
47	0.0266	0.0266
52	0.0245	0.0245
57	0.0211	0.0211
62	0.0207	0.0207
67	0.0259	0.0259
72	0.0378	0.0378
77	0.0559	0.0559
82	0.0746	0.0746
87	0.0903	0.0903
92	0.1075	0.1075
97	0.1357	0.1357
102	0.1836	0.1836
107	0.2426	0.2426
112	0.2874	0.2874
117	0.2900	0.2900
122	0.2684	0.2684
127	0.2605	0.2605
132	0.3031	0.3031
137	0.4152	0.4152
142	0.5515	0.5515
147	0.6403	0.6403
152	0.6409	0.6409
157	0.5801	0.5801
162	0.5049	0.5049
167	0.4691	0.4691
172	0.4924	0.4924
177	0.5563	0.5563

Table 41. Assumed size-specific availability for males 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
27	0.0132	0.0132
32	0.0285	0.0285
37	0.0531	0.0531
42	0.0751	0.0751
47	0.0730	0.0730
52	0.0537	0.0537
57	0.0396	0.0396
62	0.0396	0.0396
67	0.0626	0.0626
72	0.1206	0.1206
77	0.2060	0.2060
82	0.2520	0.2520
87	0.2324	0.2324
92	0.1880	0.1880
97	0.1563	0.1563
102	0.1490	0.1490
107	0.1548	0.1548
112	0.1630	0.1630
117	0.1635	0.1635
122	0.1615	0.1615
127	0.1695	0.1695
132	0.2030	0.2030
137	0.2746	0.2746
142	0.3749	0.3749
147	0.4728	0.4728
152	0.5325	0.5325
157	0.5471	0.5471
162	0.5204	0.5204
167	0.4558	0.4558
172	0.3634	0.3634

Table 42. Assumed size-specific availability for males 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	'22.03d5 (2024)'	'22.03d5 (2025)'
27	0.1199	0.1199
32	0.1093	0.1093
37	0.1018	0.1018
42	0.0993	0.0993
47	0.1037	0.1037
52	0.1172	0.1172
57	0.1424	0.1424
62	0.1844	0.1844
67	0.2470	0.2470
72	0.3193	0.3193
77	0.3769	0.3769
82	0.3943	0.3943
87	0.3788	0.3788
92	0.3590	0.3590
97	0.3628	0.3628
102	0.4018	0.4018
107	0.4538	0.4538
112	0.4880	0.4880
117	0.4780	0.4780
122	0.4357	0.4357
127	0.3916	0.3916
132	0.3737	0.3737
137	0.3895	0.3895
142	0.4177	0.4177
147	0.4336	0.4336
152	0.4188	0.4188
157	0.3959	0.3959
162	0.4003	0.4003
167	0.4680	0.4680
172	0.6084	0.6084

Table 43. Assumed size-specific availability for males 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
27	0.3115	0.3115
32	0.3168	0.3168
37	0.3344	0.3344
42	0.3783	0.3783
47	0.4641	0.4641
52	0.5751	0.5751
57	0.6624	0.6624
62	0.6895	0.6895
67	0.6434	0.6434
72	0.5548	0.5548
77	0.4752	0.4752
82	0.4571	0.4571
87	0.4970	0.4970
92	0.5573	0.5573
97	0.5996	0.5996
102	0.6051	0.6051
107	0.5904	0.5904
112	0.5753	0.5753
117	0.5777	0.5777
122	0.5936	0.5936
127	0.6081	0.6081
132	0.6073	0.6073
137	0.5830	0.5830
142	0.5361	0.5361
147	0.4692	0.4692
152	0.3901	0.3901
157	0.3220	0.3220
162	0.2859	0.2859
167	0.2972	0.2972
172	0.3629	0.3629

Table 44. Assumed size-specific availability for males 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
27	0.5152	0.5152
32	0.4294	0.4294
37	0.3628	0.3628
42	0.3297	0.3297
47	0.3405	0.3405
52	0.3925	0.3925
57	0.4693	0.4693
62	0.5477	0.5477
67	0.6080	0.6080
72	0.6502	0.6502
77	0.6780	0.6780
82	0.6951	0.6951
87	0.7031	0.7031
92	0.7025	0.7025
97	0.6934	0.6934
102	0.6773	0.6773
107	0.6596	0.6596
112	0.6472	0.6472
117	0.6458	0.6458
122	0.6518	0.6518
127	0.6575	0.6575
132	0.6551	0.6551
137	0.6407	0.6407
142	0.6167	0.6167
147	0.5859	0.5859
152	0.5511	0.5511
157	0.5115	0.5115
162	0.4652	0.4652
167	0.4110	0.4110

Table 45. Assumed size-specific availability for females 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	'22.03d5 (2024)'	'22.03d5 (2025)'
27	0.0018	0.0018
32	0.0060	0.0060
37	0.0120	0.0120
42	0.0106	0.0106
47	0.0074	0.0074
52	0.0088	0.0088
57	0.0134	0.0134
62	0.0133	0.0133
67	0.0107	0.0107
72	0.0149	0.0149
77	0.0365	0.0365
82	0.0854	0.0854
87	0.1483	0.1483
92	0.2262	0.2262
97	0.3582	0.3582
102	0.6181	0.6181
107	0.8293	0.8293
112	0.7130	0.7130

Table 46. Assumed size-specific availability for females 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
27	0.0029	0.0029
32	0.0060	0.0060
37	0.0115	0.0115
42	0.0191	0.0191
47	0.0274	0.0274
52	0.0348	0.0348
57	0.0381	0.0381
62	0.0354	0.0354
67	0.0301	0.0301
72	0.0274	0.0274
77	0.0285	0.0285
82	0.0338	0.0338
87	0.0467	0.0467
92	0.0791	0.0791
97	0.1597	0.1597
102	0.3290	0.3290
107	0.5771	0.5771
112	0.7928	0.7928

Table 47. Assumed size-specific availability for females 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
27	0.0069	0.0069
32	0.0130	0.0130
37	0.0231	0.0231
42	0.0367	0.0367
47	0.0509	0.0509
52	0.0603	0.0603
57	0.0587	0.0587
62	0.0450	0.0450
67	0.0329	0.0329
72	0.0318	0.0318
77	0.0405	0.0405
82	0.0502	0.0502
87	0.0577	0.0577
92	0.0769	0.0769
97	0.1385	0.1385
102	0.3236	0.3236
107	0.6810	0.6810
112	0.9184	0.9184
117	0.9830	0.9830
122	0.9965	0.9965

Table 48. Assumed size-specific availability for females 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
27	0.0884	0.0884
32	0.0968	0.0968
37	0.0990	0.0990
42	0.0928	0.0928
47	0.1013	0.1013
52	0.1615	0.1615
57	0.2385	0.2385
62	0.1869	0.1869
67	0.1088	0.1088
72	0.1327	0.1327
77	0.2892	0.2892
82	0.4083	0.4083
87	0.3735	0.3735
92	0.4010	0.4010
97	0.5593	0.5593
102	0.6279	0.6279
107	0.6548	0.6548
112	0.9615	0.9615
117	1.0000	1.0000

Table 49. Assumed size-specific availability for females 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	'22.03d5 (2024)'	'22.03d5 (2025)'
27	0.3872	0.3872
32	0.3874	0.3874
37	0.4087	0.4087
42	0.4673	0.4673
47	0.5433	0.5433
52	0.6023	0.6023
57	0.6215	0.6215
62	0.5882	0.5882
67	0.5459	0.5459
72	0.5744	0.5744
77	0.6502	0.6502
82	0.6721	0.6721
87	0.6216	0.6216
92	0.5617	0.5617
97	0.4806	0.4806
102	0.2508	0.2508
107	0.0449	0.0449

Table 50. Assumed size-specific availability for females 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
27	0.4296	0.4296
32	0.4682	0.4682
37	0.4691	0.4691
42	0.4106	0.4106
47	0.3615	0.3615
52	0.4007	0.4007
57	0.5163	0.5163
62	0.6394	0.6394
67	0.7253	0.7253
72	0.7670	0.7670
77	0.7873	0.7873
82	0.8195	0.8195
87	0.8582	0.8582
92	0.8751	0.8751
97	0.8634	0.8634
102	0.8311	0.8311
107	0.7842	0.7842
112	0.7273	0.7273

Table 51. Objective function data component values for TCSAM02 models `22.03d5 (2024)`, `22.03d5 (2025)`. 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	'22.03d5 (2024)'	'22.03d5 (2025)'
surveys data	NMFS M	index catch	abundance	female	–	–
				male	–	–
			biomass	female	–	–
				male	91.38	99.36
			n.at.z	male	424.54	438.72
	NMFS F		abundance	female	–	–
				male	–	–
			biomass	female	178.95	175.61
				male	–	–
			n.at.z	female	308.84	322.95
	SBS BSFRF M		abundance	female	–	–
				male	–	–
			biomass	female	–	–
				male	-2.85	-2.84
			n.at.z	male	280.00	284.20
	SBS BSFRF F		abundance	female	–	–
				male	–	–
			biomass	female	1.17	1.70
				male	–	–

Table 52. Objective function data component values for TCSAM02 models `22.03d5 (2024)`, `22.03d5 (2025)`. 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	'22.03d5 (2024)'	'22.03d5 (2025)'
surveys data	SBS BSFRF F	index catch	n.at.z	female	173.22	169.98
fisheries data	TCF	retained catch	abundance	female	–	–
				male	–	–
			biomass	female	–	–
				male	-151.91	-156.26
			n.at.z	male	67.75	68.12
		total catch	abundance	all sexes	–	–
			biomass	all sexes	3.50	2.22
			n.at.z	female	94.86	96.30
				male	92.85	96.79
	SCF		abundance	all sexes	–	–
			biomass	all sexes	-52.26	-53.67
			n.at.z	female	52.43	52.45
				male	81.03	81.54
	GF All		abundance	all sexes	-67.88	-71.10
			biomass	all sexes	-69.41	-72.38
			n.at.z	female	228.67	241.54
				male	321.13	325.59
	RKF		abundance	all sexes	–	–

Table 53. Objective function data component values for TCSAM02 models `22.03d5 (2024)`, `22.03d5 (2025)`. 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	'22.03d5 (2024)'	'22.03d5 (2025)'
fisheries data	RKF	total catch	biomass	all sexes	-36.92	-36.47
			n.at.z	female	6.93	6.07
				male	31.94	32.76
growth data			EBS molt increment data	female	247.52	240.53
				male	280.21	270.52
maturity ogive data	NMFS M		EBS mature male ratios	male	325.54	428.91

Table 54. Objective function non-data component values for TCSAM02 models `22.03d5 (2024)`, `22.03d5 (2025)`. 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
penalties	devsSumSq	pDevsLnC	0.000	0.000
		pDevsLnR	0.000	0.000
		pDevsS1	0.000	0.000
	maturity	smoothness	1.982	1.789
priors	natural mortality	pDM1	54.188	54.463
	recruitment	pDevsLnR	116.728	117.663
	surveys	pQ	97.878	94.905

Table 55. Differences between objective function data component values for `22.03d5 (2025)` relative to `22.03d5 (2024)`. 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
surveys data	NMFS M	index catch	abundance	female	0.000	0.000
				male	0.000	0.000
			biomass	female	0.000	0.000
				male	91.381	7.979
			n.at.z	male	424.543	14.176
	NMFS F		abundance	female	0.000	0.000
				male	0.000	0.000
			biomass	female	178.949	-3.339
				male	0.000	0.000
			n.at.z	female	308.841	14.111
	SBS BSFRF M		abundance	female	0.000	0.000
				male	0.000	0.000
			biomass	female	0.000	0.000
				male	-2.851	0.010
			n.at.z	male	279.998	4.197
	SBS BSFRF F		abundance	female	0.000	0.000
				male	0.000	0.000
			biomass	female	1.170	0.533
				male	0.000	0.000

Table 56. Differences between objective function data component values for `22.03d5 (2025)` relative to `22.03d5 (2024)`. 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	'22.03d5 (2024)'	'22.03d5 (2025)'
surveys data	SBS BSFRF F	index catch	n.at.z	female	173.219	-3.237
fisheries data	TCF	retained catch	abundance	female	0.000	0.000
				male	0.000	0.000
			biomass	female	0.000	0.000
				male	-151.909	-4.351
			n.at.z	male	67.748	0.370
		total catch	abundance	all sexes	0.000	0.000
			biomass	all sexes	3.499	-1.276
			n.at.z	female	94.863	1.436
				male	92.850	3.945
	SCF		abundance	all sexes	0.000	0.000
			biomass	all sexes	-52.256	-1.410
			n.at.z	female	52.426	0.021
				male	81.029	0.512
	GF All		abundance	all sexes	-67.882	-3.221
			biomass	all sexes	-69.412	-2.967
			n.at.z	female	228.672	12.872
				male	321.126	4.461
	RKF		abundance	all sexes	0.000	0.000

Table 57. Differences between objective function data component values for `22.03d5 (2025)` relative to `22.03d5 (2024)`. 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	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
fisheries data	RKF	total catch	biomass	all sexes	-36.916	0.448
			n.at.z	female	6.933	-0.865
				male	31.937	0.822
growth data			EBS molt increment data	female	247.515	-6.987
				male	280.211	-9.689
maturity ogive data	NMFS M		EBS mature male ratios	male	325.541	103.372

Table 58. Differences between objective function non-data component values for `22.03d5 (2025)` relative to `22.03d5 (2024)`. 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	'22.03d5 (2024)'	'22.03d5 (2025)'
penalties	devsSumSq	pDevsLnC	0.000	0.000
		pDevsLnR	0.000	0.000
		pDevsS1	0.000	0.000
	maturity	smoothness	1.982	-0.193
priors	natural mortality	pDM1	54.188	0.275
	recruitment	pDevsLnR	116.728	0.935
	surveys	pQ	97.878	-2.974

Table 59. Estimated rates of natural mortality (period of elevated M is 1980-1984).

	immature				mature
	all		female		male
case	typical	typical	elevated	typical	elevated
‘22.03d5 (2024)‘	0.254	0.316	0.619	0.320	0.744
‘22.03d5 (2025)‘	0.251	0.319	0.650	0.317	0.740

Table 60. Estimated fully-selected survey catchability. The year indicates the start of the time block in which the value is used.

	NMFS F		NMFS M		SBS BSFRF F	SBS BSFRF M
	female		male		female	male
case	1975	1982	1975	1982	2013	2013
‘22.03d5 (2024)‘	0.33	0.27	0.49	0.50	1.00	1.00
‘22.03d5 (2025)‘	0.33	0.28	0.44	0.52	1.00	1.00

Table 61. Estimated retained catch abundance (millions; 1965-1989).

year	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
1965	1.9	1.9
1966	2.4	2.4
1967	13.3	13.3
1968	17.7	17.7
1969	27.7	27.7
1970	26.5	26.5
1971	22.2	21.6
1972	17.9	16.8
1973	12.7	12.5
1974	14.2	14.2
1975	16.4	16.5
1976	27.2	27.3
1977	33.1	33.1
1978	21.1	20.9
1979	18.2	17.6
1980	13.7	13.7
1981	5.0	5.0
1982	2.3	2.3
1983	0.5	0.5
1984	1.4	1.4
1987	1.0	1.0
1988	3.1	3.1
1989	10.6	10.7

Table 62. Estimated retained catch abundance (millions; 1990+).

year	'22.03d5 (2024)'	'22.03d5 (2025)'
1990	17.3	17.3
1991	13.7	13.7
1992	15.5	15.5
1993	7.3	7.3
1994	3.4	3.4
1995	1.9	1.9
1996	0.7	0.7
2005	0.4	0.4
2006	0.9	0.9
2007	0.9	0.9
2008	0.9	0.9
2009	0.5	0.5
2013	1.5	1.5
2014	7.5	7.5
2015	10.7	10.7
2017	1.3	1.3
2018	1.3	1.3
2020	0.8	0.8
2021	0.6	0.6
2022	1.1	1.1
2023	1.1	1.1
2024	–	3.4

Table 63. Estimated retained catch biomass (1,000's t; 1965-1989).

year	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
1965	1.9	1.9
1966	2.4	2.4
1967	13.6	13.6
1968	18.0	18.0
1969	27.4	27.3
1970	25.4	25.2
1971	20.4	20.2
1972	16.4	16.5
1973	12.7	12.7
1974	14.5	14.6
1975	17.0	17.0
1976	28.1	28.2
1977	33.7	33.8
1978	21.1	21.0
1979	17.9	17.4
1980	13.4	13.4
1981	5.0	5.0
1982	2.4	2.4
1983	0.5	0.5
1984	1.4	1.4
1987	1.0	1.0
1988	3.2	3.2
1989	10.9	10.9

Table 64. Estimated retained catch biomass (1,000's t; 1990+).

year	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
1990	17.5	17.5
1991	14.1	14.0
1992	15.6	15.6
1993	7.6	7.6
1994	3.6	3.6
1995	1.9	1.9
1996	0.8	0.8
2005	0.4	0.4
2006	1.0	1.0
2007	1.0	1.0
2008	0.9	0.9
2009	0.6	0.6
2013	1.3	1.3
2014	6.2	6.2
2015	8.9	8.9
2017	1.1	1.1
2018	1.1	1.1
2020	0.7	0.7
2021	0.5	0.5
2022	0.9	0.9
2023	0.9	0.9
2024	–	2.9

Table 65. Estimated discard catch mortality (abundance) in the directed fishery (millions; 1965-1989).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1965	0.10	1.18	0.10	1.21
1966	0.13	1.53	0.13	1.58
1967	0.86	10.05	0.87	10.50
1968	1.72	18.54	1.79	19.82
1969	6.50	58.43	7.13	65.12
1970	41.70	217.35	33.00	195.91
1971	90.04	331.44	13.64	91.89
1972	9.73	62.78	2.75	24.63
1973	1.46	12.97	1.08	11.32
1974	1.05	10.25	0.92	10.09
1975	1.09	10.89	0.99	10.90
1976	2.02	19.94	1.81	19.71
1977	3.66	33.53	3.10	31.37
1978	4.18	34.20	3.27	29.82
1979	6.17	46.32	4.67	39.11
1980	4.43	33.00	4.24	34.76
1981	0.72	6.08	0.72	6.78
1982	0.18	1.68	0.17	1.75
1983	0.03	0.28	0.03	0.28
1984	0.08	0.68	0.07	0.67
1987	0.06	0.66	0.06	0.66
1988	0.20	2.27	0.20	2.40
1989	0.76	8.53	0.77	8.96

Table 66. Estimated discard catch mortality in abundance in the directed fishery (millions; 1990+).

	‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
year	female	male	female	male
1990	0.93	6.50	0.92	6.78
1991	1.41	4.22	1.39	4.22
1992	1.51	4.74	1.48	4.71
1993	0.93	2.36	0.90	2.35
1994	0.88	1.84	0.84	1.81
1995	0.62	1.33	0.58	1.31
1996	0.50	0.98	0.47	0.97
1997	0.30	1.18	0.30	1.18
1998	0.22	0.76	0.22	0.75
1999	0.13	0.41	0.13	0.41
2000	0.15	0.50	0.15	0.50
2001	0.23	0.76	0.23	0.76
2002	0.12	0.41	0.12	0.41
2003	0.08	0.28	0.08	0.28
2004	0.13	0.45	0.13	0.45
2005	0.09	0.50	0.09	0.50
2006	0.10	0.64	0.10	0.64
2007	0.10	0.80	0.10	0.80
2008	0.07	0.47	0.07	0.47
2009	0.05	0.39	0.05	0.39
2010	0.04	0.40	0.04	0.40
2011	0.06	0.57	0.06	0.57
2012	0.04	0.43	0.04	0.42
2013	0.06	0.50	0.06	0.50
2014	0.11	1.33	0.11	1.32
2015	0.10	1.31	0.10	1.30
2016	0.06	0.65	0.06	0.65
2017	0.03	0.28	0.03	0.28
2018	0.03	0.28	0.03	0.28
2019	0.04	0.30	0.04	0.30
2020	0.03	0.18	0.03	0.17
2021	0.04	0.23	0.04	0.23
2022	0.06	0.37	0.06	0.37
2023	0.04	0.17	0.04	0.17
2024	–	–	0.04	0.26

Table 67. Estimated discard mortality (biomass) in the directed fishery (1,000's t; 1965-1989).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1965	0.05	0.61	0.06	0.63
1966	0.06	0.69	0.07	0.71
1967	0.11	1.91	0.12	1.99
1968	0.17	3.09	0.19	3.30
1969	0.45	8.24	0.51	9.10
1970	2.30	25.24	1.89	23.36
1971	4.73	34.25	0.90	11.82
1972	0.66	8.50	0.35	4.39
1973	0.76	5.42	0.75	5.47
1974	0.83	6.29	0.84	6.39
1975	0.37	3.97	0.37	4.05
1976	0.30	4.69	0.30	4.77
1977	0.34	6.03	0.31	5.87
1978	0.35	5.54	0.30	5.05
1979	0.51	7.04	0.44	6.17
1980	0.35	5.10	0.34	5.35
1981	0.12	1.71	0.12	1.79
1982	0.04	0.62	0.04	0.64
1983	0.03	0.29	0.03	0.29
1984	0.03	0.37	0.03	0.37
1985	0.03	0.33	0.03	0.34
1986	0.04	0.50	0.04	0.50
1987	0.04	0.59	0.04	0.59
1988	0.04	0.81	0.04	0.82
1989	0.09	1.96	0.09	2.02

Table 68. Estimated discard mortality (biomass) in the directed fishery (1,000's t; 1990+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1990	0.167	3.586	0.169	3.750
1991	0.256	2.228	0.261	2.274
1992	0.291	2.594	0.292	2.623
1993	0.182	1.330	0.181	1.342
1994	0.148	0.863	0.145	0.883
1995	0.093	0.594	0.089	0.609
1996	0.069	0.409	0.067	0.421
1997	0.048	0.520	0.048	0.520
1998	0.033	0.313	0.033	0.314
1999	0.017	0.156	0.018	0.157
2000	0.019	0.190	0.020	0.190
2001	0.027	0.277	0.028	0.277
2002	0.015	0.150	0.015	0.150
2003	0.010	0.101	0.010	0.102
2004	0.016	0.168	0.016	0.168
2005	0.012	0.229	0.012	0.229
2006	0.015	0.313	0.015	0.314
2007	0.017	0.401	0.017	0.401
2008	0.012	0.255	0.013	0.255
2009	0.009	0.211	0.009	0.211
2010	0.007	0.212	0.007	0.212
2011	0.009	0.290	0.009	0.290
2012	0.006	0.208	0.006	0.207
2013	0.010	0.240	0.010	0.239
2014	0.021	0.678	0.021	0.675
2015	0.021	0.669	0.022	0.663
2016	0.010	0.358	0.011	0.357
2017	0.005	0.153	0.005	0.152
2018	0.005	0.142	0.005	0.141
2019	0.005	0.148	0.005	0.148
2020	0.004	0.072	0.004	0.070
2021	0.006	0.089	0.006	0.088
2022	0.008	0.150	0.008	0.150
2023	0.005	0.071	0.005	0.072
2024	–	–	0.006	0.117

Table 69. Estimated discard catch mortality (abundance) in the snow crab fishery (millions; 1965-1989).

	‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
year	female	male	female	male
1965	0.05	0.42	0.05	0.39
1966	0.06	0.45	0.05	0.42
1967	0.06	0.47	0.06	0.44
1968	0.07	0.49	0.07	0.47
1969	0.09	0.51	0.09	0.49
1970	0.12	0.48	0.12	0.50
1971	0.15	0.50	0.16	0.69
1972	0.18	0.79	0.18	1.04
1973	0.19	1.12	0.18	1.28
1974	0.17	1.20	0.17	1.29
1975	0.15	1.09	0.15	1.16
1976	0.13	0.91	0.12	0.96
1977	0.11	0.70	0.11	0.73
1978	0.21	1.13	0.21	1.19
1979	0.29	1.44	0.28	1.50
1980	0.45	2.27	0.44	2.30
1981	0.38	2.23	0.37	2.27
1982	0.17	1.13	0.16	1.17
1983	0.07	0.49	0.06	0.50
1984	0.11	0.71	0.10	0.71
1985	0.15	0.98	0.14	0.98
1986	0.20	1.35	0.19	1.31
1987	0.31	2.10	0.29	2.02
1988	0.32	2.35	0.31	2.28
1989	0.49	3.58	0.48	3.51

Table 70. Estimated discard catch mortality in abundance in the snow crab fishery (millions; 1990+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1990	0.93	6.50	0.92	6.78
1991	1.41	4.22	1.39	4.22
1992	1.51	4.74	1.48	4.71
1993	0.93	2.36	0.90	2.35
1994	0.88	1.84	0.84	1.81
1995	0.62	1.33	0.58	1.31
1996	0.50	0.98	0.47	0.97
1997	0.30	1.18	0.30	1.18
1998	0.22	0.76	0.22	0.75
1999	0.13	0.41	0.13	0.41
2000	0.15	0.50	0.15	0.50
2001	0.23	0.76	0.23	0.76
2002	0.12	0.41	0.12	0.41
2003	0.08	0.28	0.08	0.28
2004	0.13	0.45	0.13	0.45
2005	0.09	0.50	0.09	0.50
2006	0.10	0.64	0.10	0.64
2007	0.10	0.80	0.10	0.80
2008	0.07	0.47	0.07	0.47
2009	0.05	0.39	0.05	0.39
2010	0.04	0.40	0.04	0.40
2011	0.06	0.57	0.06	0.57
2012	0.04	0.43	0.04	0.42
2013	0.06	0.50	0.06	0.50
2014	0.11	1.33	0.11	1.32
2015	0.10	1.31	0.10	1.30
2016	0.06	0.65	0.06	0.65
2017	0.03	0.28	0.03	0.28
2018	0.03	0.28	0.03	0.28
2019	0.04	0.30	0.04	0.30
2020	0.03	0.18	0.03	0.17
2021	0.04	0.23	0.04	0.23
2022	0.06	0.37	0.06	0.37
2023	0.04	0.17	0.04	0.17
2024	–	–	0.04	0.26

Table 71. Estimated discard mortality (biomass) in the snow crab fishery (1,000's t; 1965-1989).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1965	0.05	0.61	0.06	0.63
1966	0.06	0.69	0.07	0.71
1967	0.11	1.91	0.12	1.99
1968	0.17	3.09	0.19	3.30
1969	0.45	8.24	0.51	9.10
1970	2.30	25.24	1.89	23.36
1971	4.73	34.25	0.90	11.82
1972	0.66	8.50	0.35	4.39
1973	0.76	5.42	0.75	5.47
1974	0.83	6.29	0.84	6.39
1975	0.37	3.97	0.37	4.05
1976	0.30	4.69	0.30	4.77
1977	0.34	6.03	0.31	5.87
1978	0.35	5.54	0.30	5.05
1979	0.51	7.04	0.44	6.17
1980	0.35	5.10	0.34	5.35
1981	0.12	1.71	0.12	1.79
1982	0.04	0.62	0.04	0.64
1983	0.03	0.29	0.03	0.29
1984	0.03	0.37	0.03	0.37
1985	0.03	0.33	0.03	0.34
1986	0.04	0.50	0.04	0.50
1987	0.04	0.59	0.04	0.59
1988	0.04	0.81	0.04	0.82
1989	0.09	1.96	0.09	2.02

Table 72. Estimated discard mortality (biomass) in the snow crab fishery (1,000's t; 1990+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1990	0.167	3.586	0.169	3.750
1991	0.256	2.228	0.261	2.274
1992	0.291	2.594	0.292	2.623
1993	0.182	1.330	0.181	1.342
1994	0.148	0.863	0.145	0.883
1995	0.093	0.594	0.089	0.609
1996	0.069	0.409	0.067	0.421
1997	0.048	0.520	0.048	0.520
1998	0.033	0.313	0.033	0.314
1999	0.017	0.156	0.018	0.157
2000	0.019	0.190	0.020	0.190
2001	0.027	0.277	0.028	0.277
2002	0.015	0.150	0.015	0.150
2003	0.010	0.101	0.010	0.102
2004	0.016	0.168	0.016	0.168
2005	0.012	0.229	0.012	0.229
2006	0.015	0.313	0.015	0.314
2007	0.017	0.401	0.017	0.401
2008	0.012	0.255	0.013	0.255
2009	0.009	0.211	0.009	0.211
2010	0.007	0.212	0.007	0.212
2011	0.009	0.290	0.009	0.290
2012	0.006	0.208	0.006	0.207
2013	0.010	0.240	0.010	0.239
2014	0.021	0.678	0.021	0.675
2015	0.021	0.669	0.022	0.663
2016	0.010	0.358	0.011	0.357
2017	0.005	0.153	0.005	0.152
2018	0.005	0.142	0.005	0.141
2019	0.005	0.148	0.005	0.148
2020	0.004	0.072	0.004	0.070
2021	0.006	0.089	0.006	0.088
2022	0.008	0.150	0.008	0.150
2023	0.005	0.071	0.005	0.072
2024	–	–	0.006	0.117

Table 73. Estimated discard catch mortality (abundance) in the BBRKC fishery (millions; 1965-1989).

	‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
year	female	male	female	male
1965	0.024	0.555	0.023	0.534
1966	0.026	0.579	0.025	0.560
1967	0.029	0.546	0.028	0.531
1968	0.043	0.590	0.043	0.574
1969	0.047	0.328	0.048	0.319
1970	0.052	0.099	0.056	0.127
1971	0.047	0.044	0.056	0.182
1972	0.105	0.368	0.125	1.079
1973	0.127	1.432	0.140	2.053
1974	0.149	2.429	0.158	2.907
1975	0.134	2.371	0.140	2.719
1976	0.184	2.923	0.191	3.355
1977	0.219	2.472	0.226	2.935
1978	0.169	1.215	0.172	1.492
1979	0.122	0.608	0.122	0.737
1980	0.192	0.980	0.188	1.026
1981	0.158	1.446	0.153	1.438
1982	0.035	0.516	0.033	0.538
1984	0.013	0.254	0.013	0.271
1985	0.009	0.174	0.008	0.183
1986	0.019	0.383	0.018	0.395
1987	0.028	0.530	0.026	0.528
1988	0.023	0.431	0.022	0.417
1989	0.037	0.652	0.036	0.638

Table 74. Estimated discard catch mortality in abundance in the BBRKC fishery (millions; 1990+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1990	0.93	6.50	0.92	6.78
1991	1.41	4.22	1.39	4.22
1992	1.51	4.74	1.48	4.71
1993	0.93	2.36	0.90	2.35
1994	0.88	1.84	0.84	1.81
1995	0.62	1.33	0.58	1.31
1996	0.50	0.98	0.47	0.97
1997	0.30	1.18	0.30	1.18
1998	0.22	0.76	0.22	0.75
1999	0.13	0.41	0.13	0.41
2000	0.15	0.50	0.15	0.50
2001	0.23	0.76	0.23	0.76
2002	0.12	0.41	0.12	0.41
2003	0.08	0.28	0.08	0.28
2004	0.13	0.45	0.13	0.45
2005	0.09	0.50	0.09	0.50
2006	0.10	0.64	0.10	0.64
2007	0.10	0.80	0.10	0.80
2008	0.07	0.47	0.07	0.47
2009	0.05	0.39	0.05	0.39
2010	0.04	0.40	0.04	0.40
2011	0.06	0.57	0.06	0.57
2012	0.04	0.43	0.04	0.42
2013	0.06	0.50	0.06	0.50
2014	0.11	1.33	0.11	1.32
2015	0.10	1.31	0.10	1.30
2016	0.06	0.65	0.06	0.65
2017	0.03	0.28	0.03	0.28
2018	0.03	0.28	0.03	0.28
2019	0.04	0.30	0.04	0.30
2020	0.03	0.18	0.03	0.17
2021	0.04	0.23	0.04	0.23
2022	0.06	0.37	0.06	0.37
2023	0.04	0.17	0.04	0.17
2024	–	–	0.04	0.26

Table 75. Estimated discard mortality (biomass) in the BBRKC fishery (1,000's t; 1965-1989).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1965	0.05	0.61	0.06	0.63
1966	0.06	0.69	0.07	0.71
1967	0.11	1.91	0.12	1.99
1968	0.17	3.09	0.19	3.30
1969	0.45	8.24	0.51	9.10
1970	2.30	25.24	1.89	23.36
1971	4.73	34.25	0.90	11.82
1972	0.66	8.50	0.35	4.39
1973	0.76	5.42	0.75	5.47
1974	0.83	6.29	0.84	6.39
1975	0.37	3.97	0.37	4.05
1976	0.30	4.69	0.30	4.77
1977	0.34	6.03	0.31	5.87
1978	0.35	5.54	0.30	5.05
1979	0.51	7.04	0.44	6.17
1980	0.35	5.10	0.34	5.35
1981	0.12	1.71	0.12	1.79
1982	0.04	0.62	0.04	0.64
1983	0.03	0.29	0.03	0.29
1984	0.03	0.37	0.03	0.37
1985	0.03	0.33	0.03	0.34
1986	0.04	0.50	0.04	0.50
1987	0.04	0.59	0.04	0.59
1988	0.04	0.81	0.04	0.82
1989	0.09	1.96	0.09	2.02

Table 76. Estimated discard mortality (biomass) in the BBRKC fishery (1,000's t; 1990+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1990	0.167	3.586	0.169	3.750
1991	0.256	2.228	0.261	2.274
1992	0.291	2.594	0.292	2.623
1993	0.182	1.330	0.181	1.342
1994	0.148	0.863	0.145	0.883
1995	0.093	0.594	0.089	0.609
1996	0.069	0.409	0.067	0.421
1997	0.048	0.520	0.048	0.520
1998	0.033	0.313	0.033	0.314
1999	0.017	0.156	0.018	0.157
2000	0.019	0.190	0.020	0.190
2001	0.027	0.277	0.028	0.277
2002	0.015	0.150	0.015	0.150
2003	0.010	0.101	0.010	0.102
2004	0.016	0.168	0.016	0.168
2005	0.012	0.229	0.012	0.229
2006	0.015	0.313	0.015	0.314
2007	0.017	0.401	0.017	0.401
2008	0.012	0.255	0.013	0.255
2009	0.009	0.211	0.009	0.211
2010	0.007	0.212	0.007	0.212
2011	0.009	0.290	0.009	0.290
2012	0.006	0.208	0.006	0.207
2013	0.010	0.240	0.010	0.239
2014	0.021	0.678	0.021	0.675
2015	0.021	0.669	0.022	0.663
2016	0.010	0.358	0.011	0.357
2017	0.005	0.153	0.005	0.152
2018	0.005	0.142	0.005	0.141
2019	0.005	0.148	0.005	0.148
2020	0.004	0.072	0.004	0.070
2021	0.006	0.089	0.006	0.088
2022	0.008	0.150	0.008	0.150
2023	0.005	0.071	0.005	0.072
2024	–	–	0.006	0.117

Table 77. Estimated discard catch mortality (abundance) in the groundfish fisheries (millions; 1965-1989).

	‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
year	female	male	female	male
1965	1.9	3.6	2.5	4.3
1966	2.3	4.2	3.1	5.2
1967	3.1	5.2	4.1	6.5
1968	4.3	6.8	5.5	8.5
1969	5.3	8.5	6.7	10.4
1970	5.9	9.6	7.3	11.6
1971	5.7	9.6	7.3	12.4
1972	5.1	9.5	6.7	12.3
1973	21.9	43.5	21.8	42.4
1974	23.4	47.8	23.8	47.1
1975	9.2	18.3	9.4	18.1
1976	6.1	11.2	6.2	11.1
1977	4.5	7.6	4.6	7.5
1978	3.7	6.3	3.8	6.2
1979	5.6	10.3	5.8	10.2
1980	2.7	5.3	2.8	5.2
1981	1.7	3.5	1.8	3.5
1982	0.5	1.0	0.5	1.0
1983	0.7	1.3	0.7	1.3
1984	1.0	1.5	1.0	1.5
1985	0.8	1.2	0.8	1.2
1986	1.1	1.8	1.1	1.8
1987	1.1	1.7	1.0	1.6
1988	0.7	1.1	0.6	1.1
1989	1.0	1.6	0.9	1.5

Table 78. Estimated discard catch mortality in abundance in the groundfish fisheries (millions; 1990+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1990	0.93	6.50	0.92	6.78
1991	1.41	4.22	1.39	4.22
1992	1.51	4.74	1.48	4.71
1993	0.93	2.36	0.90	2.35
1994	0.88	1.84	0.84	1.81
1995	0.62	1.33	0.58	1.31
1996	0.50	0.98	0.47	0.97
1997	0.30	1.18	0.30	1.18
1998	0.22	0.76	0.22	0.75
1999	0.13	0.41	0.13	0.41
2000	0.15	0.50	0.15	0.50
2001	0.23	0.76	0.23	0.76
2002	0.12	0.41	0.12	0.41
2003	0.08	0.28	0.08	0.28
2004	0.13	0.45	0.13	0.45
2005	0.09	0.50	0.09	0.50
2006	0.10	0.64	0.10	0.64
2007	0.10	0.80	0.10	0.80
2008	0.07	0.47	0.07	0.47
2009	0.05	0.39	0.05	0.39
2010	0.04	0.40	0.04	0.40
2011	0.06	0.57	0.06	0.57
2012	0.04	0.43	0.04	0.42
2013	0.06	0.50	0.06	0.50
2014	0.11	1.33	0.11	1.32
2015	0.10	1.31	0.10	1.30
2016	0.06	0.65	0.06	0.65
2017	0.03	0.28	0.03	0.28
2018	0.03	0.28	0.03	0.28
2019	0.04	0.30	0.04	0.30
2020	0.03	0.18	0.03	0.17
2021	0.04	0.23	0.04	0.23
2022	0.06	0.37	0.06	0.37
2023	0.04	0.17	0.04	0.17
2024	–	–	0.04	0.26

Table 79. Estimated discard mortality (biomass) in the groundfish fisheries (1,000's t; 1965-1989).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1965	0.05	0.61	0.06	0.63
1966	0.06	0.69	0.07	0.71
1967	0.11	1.91	0.12	1.99
1968	0.17	3.09	0.19	3.30
1969	0.45	8.24	0.51	9.10
1970	2.30	25.24	1.89	23.36
1971	4.73	34.25	0.90	11.82
1972	0.66	8.50	0.35	4.39
1973	0.76	5.42	0.75	5.47
1974	0.83	6.29	0.84	6.39
1975	0.37	3.97	0.37	4.05
1976	0.30	4.69	0.30	4.77
1977	0.34	6.03	0.31	5.87
1978	0.35	5.54	0.30	5.05
1979	0.51	7.04	0.44	6.17
1980	0.35	5.10	0.34	5.35
1981	0.12	1.71	0.12	1.79
1982	0.04	0.62	0.04	0.64
1983	0.03	0.29	0.03	0.29
1984	0.03	0.37	0.03	0.37
1985	0.03	0.33	0.03	0.34
1986	0.04	0.50	0.04	0.50
1987	0.04	0.59	0.04	0.59
1988	0.04	0.81	0.04	0.82
1989	0.09	1.96	0.09	2.02

Table 80. Estimated discard mortality (biomass) in the groundfish fisheries (1,000's t; 1990+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	female	male	female	male
1990	0.167	3.586	0.169	3.750
1991	0.256	2.228	0.261	2.274
1992	0.291	2.594	0.292	2.623
1993	0.182	1.330	0.181	1.342
1994	0.148	0.863	0.145	0.883
1995	0.093	0.594	0.089	0.609
1996	0.069	0.409	0.067	0.421
1997	0.048	0.520	0.048	0.520
1998	0.033	0.313	0.033	0.314
1999	0.017	0.156	0.018	0.157
2000	0.019	0.190	0.020	0.190
2001	0.027	0.277	0.028	0.277
2002	0.015	0.150	0.015	0.150
2003	0.010	0.101	0.010	0.102
2004	0.016	0.168	0.016	0.168
2005	0.012	0.229	0.012	0.229
2006	0.015	0.313	0.015	0.314
2007	0.017	0.401	0.017	0.401
2008	0.012	0.255	0.013	0.255
2009	0.009	0.211	0.009	0.211
2010	0.007	0.212	0.007	0.212
2011	0.009	0.290	0.009	0.290
2012	0.006	0.208	0.006	0.207
2013	0.010	0.240	0.010	0.239
2014	0.021	0.678	0.021	0.675
2015	0.021	0.669	0.022	0.663
2016	0.010	0.358	0.011	0.357
2017	0.005	0.153	0.005	0.152
2018	0.005	0.142	0.005	0.141
2019	0.005	0.148	0.005	0.148
2020	0.004	0.072	0.004	0.070
2021	0.006	0.089	0.006	0.088
2022	0.008	0.150	0.008	0.150
2023	0.005	0.071	0.005	0.072
2024	–	–	0.006	0.117

Table 81. Estimated abundance in the NMFS EBS survey for females (millions; 1975-2000).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	immature	mature	immature	mature
1975	71.2	244.8	72.4	256.2
1976	87.4	209.0	89.1	217.6
1977	107.2	178.0	109.5	183.8
1978	115.8	160.9	118.2	164.8
1979	105.8	163.4	109.2	166.9
1980	77.9	175.7	80.4	180.8
1981	48.5	138.8	49.5	140.6
1982	82.5	132.7	82.3	133.3
1983	119.6	89.9	116.7	88.5
1984	142.8	61.7	141.5	59.6
1985	170.5	47.5	168.7	45.5
1986	190.6	57.6	194.4	56.4
1987	190.9	73.5	190.8	73.7
1988	170.0	89.1	169.1	91.0
1989	132.6	101.5	131.0	105.0
1990	91.7	109.0	90.4	113.6
1991	57.9	108.7	56.8	113.1
1992	36.7	99.4	36.1	102.8
1993	26.4	83.9	26.2	86.4
1994	24.0	67.5	23.8	69.3
1995	29.1	53.5	28.7	54.8
1996	31.9	43.0	31.1	44.0
1997	48.2	35.7	46.8	36.5
1998	47.0	31.6	46.4	32.2
1999	77.1	30.2	76.0	30.6
2000	74.2	31.2	74.5	31.6

Table 82. Estimated abundance in the NMFS EBS survey for females (millions; 2001+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	immature	mature	immature	mature
2001	116.6	34.1	114.6	34.7
2002	109.9	39.1	111.2	39.8
2003	149.1	46.3	147.1	47.6
2004	150.6	55.4	147.0	56.9
2005	123.7	65.5	122.4	67.7
2006	91.8	75.4	91.6	77.8
2007	66.8	83.8	66.9	86.3
2008	58.4	83.6	63.5	86.3
2009	128.4	74.2	125.3	76.7
2010	140.8	63.2	136.8	65.3
2011	131.2	59.3	128.2	61.2
2012	98.8	68.0	98.1	70.0
2013	67.7	81.8	66.9	84.2
2014	40.5	84.9	39.7	87.4
2015	28.4	75.6	27.9	77.7
2016	29.8	62.5	29.6	64.0
2017	71.3	51.1	70.7	52.1
2018	88.9	42.3	87.8	43.0
2019	107.2	38.2	109.4	38.6
2020	90.8	42.1	98.8	42.6
2021	135.6	51.7	157.0	53.2
2022	233.4	59.2	229.0	62.1
2023	294.1	63.0	295.1	68.1
2024	265.7	73.8	292.0	80.9
2025	–	–	253.4	110.6

Table 83. Estimated biomass in the NMFS EBS survey for females (1,000's t; 1975-2000).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	immature	mature	immature	mature
1975	4.4	44.3	4.4	46.2
1976	4.0	38.1	4.0	39.5
1977	4.9	32.4	4.8	33.2
1978	6.4	28.6	6.4	29.1
1979	7.2	28.2	7.4	28.6
1980	6.3	30.3	6.5	30.7
1981	4.1	24.6	4.2	24.7
1982	4.2	22.9	4.2	22.9
1983	3.7	15.8	3.7	15.5
1984	4.4	10.8	4.3	10.4
1985	5.7	8.0	5.6	7.6
1986	7.1	9.3	7.1	9.0
1987	7.7	11.6	7.8	11.5
1988	7.6	14.2	7.7	14.3
1989	6.9	16.3	6.9	16.7
1990	5.5	17.7	5.5	18.3
1991	3.8	18.0	3.7	18.6
1992	2.3	16.8	2.3	17.2
1993	1.4	14.4	1.4	14.7
1994	1.0	11.7	1.0	11.9
1995	1.0	9.2	1.0	9.4
1996	1.1	7.4	1.1	7.5
1997	1.5	6.1	1.4	6.1
1998	1.7	5.3	1.7	5.3
1999	2.3	4.9	2.3	5.0
2000	2.7	5.0	2.7	5.0

Table 84. Estimated biomass in the NMFS EBS survey for females (1,000's t; 2001+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	immature	mature	immature	mature
2001	3.6	5.4	3.6	5.5
2002	4.2	6.2	4.2	6.2
2003	5.1	7.3	5.1	7.4
2004	5.7	8.7	5.7	8.8
2005	5.8	10.3	5.8	10.5
2006	5.3	12.0	5.3	12.2
2007	4.0	13.5	4.1	13.7
2008	2.7	13.9	2.8	14.2
2009	3.0	12.7	3.0	13.0
2010	4.1	10.8	4.0	11.0
2011	5.5	9.7	5.4	9.9
2012	5.8	10.6	5.7	10.8
2013	4.4	12.9	4.4	13.1
2014	2.6	14.0	2.6	14.3
2015	1.5	12.9	1.5	13.2
2016	1.2	10.8	1.2	11.0
2017	1.6	8.8	1.6	8.9
2018	2.4	7.3	2.4	7.3
2019	3.6	6.3	3.6	6.4
2020	4.2	6.6	4.4	6.6
2021	4.7	8.1	5.2	8.2
2022	6.0	9.5	6.3	9.8
2023	8.4	10.2	8.7	10.8
2024	10.9	11.4	11.3	12.4
2025	–	–	12.5	16.5

Table 85. Estimated abundance in the NMFS EBS survey for males (millions; 1975-2000).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	immature	mature	immature	mature
1975	129.2	305.8	126.0	316.0
1976	153.7	264.0	151.6	270.0
1977	176.6	214.1	173.1	218.2
1978	183.1	172.3	176.4	176.1
1979	173.6	163.7	167.0	165.8
1980	141.0	178.5	135.8	177.9
1981	95.7	145.6	92.7	141.3
1982	116.9	153.5	116.4	163.9
1983	141.0	107.4	137.3	114.1
1984	162.5	71.6	159.9	75.8
1985	195.0	51.4	190.9	54.7
1986	224.6	63.9	225.1	68.1
1987	233.2	85.1	230.1	89.6
1988	214.3	110.3	211.2	116.1
1989	176.1	130.5	172.5	138.0
1990	131.0	139.1	128.1	147.3
1991	88.5	134.1	86.0	141.5
1992	56.6	124.8	55.1	130.6
1993	37.8	102.9	37.2	107.2
1994	30.9	82.6	30.3	86.1
1995	34.6	65.2	33.8	68.1
1996	37.4	51.7	36.3	54.3
1997	54.8	42.5	52.9	44.8
1998	55.1	37.2	53.7	39.3
1999	87.8	35.6	85.6	37.7
2000	87.3	37.5	86.3	39.4

Table 86. Estimated abundance in the NMFS EBS survey for males (millions; 2001+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	immature	mature	immature	mature
2001	133.2	41.9	130.0	43.9
2002	130.0	48.4	129.6	51.0
2003	174.2	58.2	170.4	61.4
2004	179.9	70.8	174.0	74.9
2005	156.1	85.4	152.5	90.1
2006	125.4	100.2	122.6	105.6
2007	98.4	113.5	96.6	118.4
2008	80.7	121.1	85.6	124.9
2009	143.1	114.5	140.1	118.6
2010	155.3	98.1	150.3	102.8
2011	153.7	85.4	148.1	91.2
2012	133.0	87.2	128.6	93.6
2013	103.9	105.7	100.9	110.7
2014	64.3	121.6	63.1	125.4
2015	40.4	113.6	39.7	117.2
2016	37.3	91.3	36.6	94.6
2017	78.7	74.7	77.7	77.4
2018	97.4	61.1	95.7	63.4
2019	120.6	51.9	121.3	54.7
2020	112.3	51.8	118.0	55.1
2021	163.2	62.9	184.0	66.3
2022	262.0	78.0	257.9	82.5
2023	325.7	86.9	327.1	94.8
2024	311.6	94.9	335.9	108.3
2025	–	–	316.4	136.7

Table 87. Estimated biomass in the NMFS EBS survey for males (1,000's t; 1975-2000).

	‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
year	immature	mature	immature	mature
1975	16.7	164.9	16.5	165.6
1976	13.3	142.9	13.0	142.1
1977	13.5	111.6	12.9	110.6
1978	17.2	81.7	16.3	80.6
1979	22.5	72.0	21.4	69.5
1980	23.8	78.0	23.3	73.5
1981	18.3	70.0	18.4	64.3
1982	15.8	78.6	16.7	81.2
1983	10.0	59.3	10.2	61.6
1984	9.3	40.1	9.3	41.5
1985	11.5	27.5	11.3	28.1
1986	15.3	31.9	15.2	32.1
1987	18.8	40.4	19.0	39.8
1988	19.8	52.9	20.4	52.0
1989	19.2	63.5	19.8	63.1
1990	17.2	66.5	17.8	66.4
1991	13.4	62.2	13.8	62.3
1992	8.9	58.3	9.1	58.3
1993	5.2	47.3	5.3	47.1
1994	3.2	38.1	3.2	38.0
1995	2.5	30.2	2.5	30.2
1996	2.6	23.9	2.6	23.9
1997	3.1	19.6	3.0	19.6
1998	3.7	17.2	3.7	17.2
1999	4.9	16.5	4.8	16.4
2000	6.0	17.4	5.9	17.2

Table 88. Estimated biomass in the NMFS EBS survey for males (1,000's t; 2001+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	immature	mature	immature	mature
2001	7.6	19.7	7.6	19.2
2002	9.2	22.9	9.2	22.4
2003	11.4	27.5	11.4	27.0
2004	13.2	33.8	13.3	33.4
2005	14.5	41.2	14.6	40.7
2006	14.7	49.0	14.8	48.5
2007	13.6	56.1	13.7	55.6
2008	10.0	62.0	10.5	61.2
2009	7.1	61.6	7.5	61.5
2010	7.2	53.7	7.3	54.3
2011	10.4	45.4	10.3	46.1
2012	14.6	42.8	14.4	43.2
2013	15.3	50.4	15.5	49.8
2014	10.6	61.4	11.1	60.4
2015	5.6	60.4	5.8	60.1
2016	3.4	48.8	3.5	49.0
2017	3.5	40.3	3.4	40.4
2018	4.2	32.7	4.2	32.7
2019	6.3	27.0	6.3	27.1
2020	9.4	25.0	9.4	24.9
2021	12.1	29.1	12.7	28.4
2022	13.3	37.6	14.4	37.0
2023	15.5	43.6	16.7	44.3
2024	21.2	46.4	22.4	48.8
2025	–	–	30.1	57.0

Table 89. Estimated abundance in the BSFRF SBS survey for females (millions; 2001+).

	‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
year	immature	mature	immature	mature
2013	7.9	42.5	8.0	42.6
2014	6.5	25.7	6.7	25.9
2015	7.1	28.6	7.4	29.0
2016	27.6	98.9	29.7	101.8
2017	252.8	133.7	278.4	139.5
2018	306.3	155.5	333.7	160.7

Table 90. Estimated biomass in the BSFRF SBS survey for females (1,000's t; 2001+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	immature	mature	immature	mature
2013	0.8	9.4	0.8	9.4
2014	0.5	5.8	0.5	5.7
2015	0.4	6.7	0.4	6.7
2016	1.3	19.1	1.3	19.4
2017	5.5	21.0	5.9	21.6
2018	7.9	26.2	8.4	26.7

Table 91. Estimated abundance in the BSFRF SBS survey for males (millions; 2001+).

	‘22.03d5 (2024)‘		‘22.03d5 (2025)‘	
year	immature	mature	immature	mature
2013	23.2	55.8	24.1	55.7
2014	18.9	82.5	20.1	81.4
2015	18.6	65.5	19.2	67.9
2016	38.2	101.3	40.4	106.3
2017	220.3	112.9	240.9	122.4
2018	287.7	108.2	310.8	117.0

Table 92. Estimated biomass in the BSFRF SBS survey for males (1,000's t; 2001+).

	'22.03d5 (2024)'		'22.03d5 (2025)'	
year	immature	mature	immature	mature
2013	5.1	31.4	5.4	30.4
2014	5.0	50.0	5.5	48.3
2015	2.9	37.9	3.1	37.7
2016	4.1	49.7	4.2	49.7
2017	7.9	52.5	8.3	52.9
2018	10.6	49.7	11.1	50.0

Table 93. Estimated population abundance (millions; 1948-1990).

					‘22.03d5 (2024)‘							‘22.03d5 (2025)‘
			female			male			female			male
	immature		mature	immature		mature	immature		mature	immature		mature
year	new shell	new shell	old shell	new shell	new shell	old shell	new shell	new shell	old shell	new shell	new shell	old shell
1949	322.8	–	–	322.8	–	–	325.0	–	–	325.0	–	–
1950	572.7	0.7	–	573.0	0.4	–	577.3	0.6	–	577.1	0.9	–
1951	757.5	9.8	0.5	763.5	4.2	0.3	766.0	8.6	0.5	767.5	6.9	0.6
1952	869.9	40.8	7.5	894.7	20.9	3.2	883.8	37.7	6.6	897.6	25.3	5.5
1953	915.9	82.3	35.2	963.1	54.6	17.4	933.7	80.2	32.1	967.6	57.3	22.3
1954	929.4	106.1	85.5	986.2	85.6	51.9	949.3	105.5	81.4	993.6	87.6	57.5
1955	936.3	112.5	139.5	994.7	97.8	98.8	958.3	112.5	135.5	1004.4	100.7	104.7
1956	945.1	113.6	183.4	1003.7	99.8	141.1	970.0	113.7	179.8	1016.3	103.0	147.8
1957	957.6	114.2	216.1	1016.5	100.2	172.5	986.7	114.5	212.8	1033.2	103.6	180.3
1958	975.3	115.0	240.4	1034.6	100.9	195.4	1010.1	115.6	237.3	1057.1	104.5	204.0
1959	1000.1	116.2	258.6	1060.1	101.8	212.1	1043.1	117.1	255.8	1090.7	105.8	221.6
1960	1035.0	117.9	272.8	1095.9	103.1	224.8	1089.3	119.4	270.3	1137.8	107.6	235.1
1961	1084.4	120.4	284.4	1146.6	104.9	234.7	1155.0	122.5	282.5	1204.7	110.2	246.1
1962	1156.1	123.8	294.6	1220.2	107.5	243.0	1251.4	126.9	293.6	1302.8	113.8	255.7
1963	1264.8	128.6	304.5	1331.6	111.1	250.6	1400.9	133.0	304.8	1454.8	118.9	265.1
1964	1441.8	135.5	315.2	1512.3	116.3	258.4	1653.6	141.9	317.4	1710.9	126.2	275.2
1965	1761.9	145.6	328.0	1838.0	123.8	267.8	2126.9	155.1	332.9	2189.3	137.0	287.8
1966	2414.1	161.4	344.7	2498.9	135.1	279.5	3035.0	176.0	353.7	3105.2	154.0	304.2
1967	3773.9	188.0	368.2	3873.6	153.6	295.5	4535.4	212.4	384.0	4619.1	183.1	327.6
1968	5436.4	238.2	404.2	5564.3	186.5	303.9	5911.3	280.2	431.7	6020.0	235.5	349.1
1969	5545.1	338.1	466.2	5730.1	250.7	323.3	5841.9	402.3	514.7	5998.9	328.0	391.5
1970	4737.3	508.6	580.3	5018.8	364.5	345.2	4968.2	580.2	659.2	5202.8	459.9	447.7
1971	3703.4	684.3	760.3	4072.8	493.0	341.6	3907.7	735.2	873.0	4214.4	573.3	501.7
1972	2610.0	712.1	982.8	2971.0	550.2	386.0	2756.7	743.1	1155.3	3071.4	646.6	698.3
1973	1771.8	572.3	1226.1	2045.9	561.8	617.8	1877.5	589.4	1374.2	2119.6	585.1	939.9
1974	1445.6	386.0	1298.5	1621.1	409.3	813.4	1552.3	405.8	1413.9	1712.0	424.0	1065.8
1975	1633.5	256.4	1213.7	1750.2	265.4	837.5	1770.9	274.6	1307.1	1878.0	283.2	1032.6
1976	2526.1	183.0	1065.6	2612.0	183.8	763.6	2778.7	193.6	1142.8	2852.9	199.7	919.8
1977	2776.8	164.1	905.6	2859.2	146.0	637.8	3030.7	170.3	966.2	3093.4	163.3	764.1
1978	2293.3	213.6	775.0	2409.4	159.8	505.5	2449.9	222.7	821.1	2534.6	185.3	612.6
1979	1635.3	309.8	715.8	1806.6	226.7	432.0	1767.4	329.0	754.0	1904.1	257.4	532.9
1980	1066.1	357.7	740.3	1254.4	295.7	420.6	1141.1	388.1	780.5	1310.3	320.8	523.3
1981	727.5	257.2	586.3	865.8	246.2	305.9	777.3	276.8	605.3	909.9	260.6	367.3
1982	558.8	151.6	452.5	632.4	170.7	251.4	606.7	159.8	458.6	676.4	180.2	288.3
1983	920.3	83.1	324.7	960.8	92.5	196.3	993.4	86.1	322.2	1029.1	98.1	219.2
1984	1073.1	61.2	219.2	1106.6	56.4	135.9	1176.1	63.4	212.7	1203.4	61.5	150.1
1985	1249.8	67.3	150.5	1289.7	52.3	88.9	1358.1	69.7	143.8	1387.8	60.0	98.4
1986	1371.0	109.0	158.6	1431.4	79.7	101.4	1539.3	113.7	154.8	1584.5	91.9	114.1
1987	1345.7	147.8	194.7	1426.3	114.0	129.8	1458.1	157.6	194.7	1524.2	126.7	148.2
1988	1160.2	164.7	249.3	1246.5	140.4	173.3	1243.4	177.8	255.5	1316.8	155.9	196.5
1989	863.2	169.0	301.3	950.8	147.8	221.0	910.1	184.0	314.3	986.0	164.8	249.6
1990	570.2	162.0	341.7	653.0	145.7	247.8	598.7	176.1	360.8	672.7	159.8	281.5

Table 94. Estimated population abundance (millions; 1991+).

	'22.03d5 (2024)'						'22.03d5 (2025)'					
	female			male			female			male		
year	immature new shell	mature new shell	mature old shell	immature new shell	mature new shell	mature old shell	immature new shell	mature new shell	mature old shell	immature new shell	mature new shell	mature old shell
1991	353.6	135.3	364.7	420.1	130.3	250.7	369.5	143.5	387.6	429.2	138.6	285.4
1992	231.8	94.3	360.6	275.6	100.1	252.1	244.3	98.2	381.9	284.2	103.1	284.0
1993	177.1	55.6	327.1	201.6	63.6	227.3	191.3	57.7	344.3	213.8	64.8	253.2
1994	170.1	31.4	276.2	183.8	35.9	197.2	183.7	32.8	289.2	196.0	37.3	217.4
1995	216.6	21.5	222.4	226.8	21.6	162.1	234.5	22.5	232.2	243.1	23.2	178.3
1996	232.8	19.6	176.6	242.7	17.3	128.9	248.3	20.8	183.9	256.4	19.1	142.2
1997	368.3	21.5	141.9	379.4	17.7	103.0	394.5	22.8	147.6	403.4	20.0	114.2
1998	334.8	26.5	118.5	348.9	20.9	85.1	362.7	27.9	123.2	373.7	23.5	95.1
1999	591.3	33.9	105.4	609.3	26.5	75.4	644.8	35.2	109.4	658.7	29.7	84.8
2000	529.9	43.3	101.4	553.1	34.0	73.3	582.8	45.0	104.9	600.9	37.7	82.6
2001	888.6	53.5	105.3	917.1	42.8	77.1	962.8	56.4	108.7	985.3	47.9	86.8
2002	777.8	66.8	115.5	813.5	52.9	85.9	862.8	70.8	119.7	891.0	59.9	96.8
2003	1108.0	83.6	132.8	1152.8	66.5	100.2	1198.3	89.4	138.2	1234.6	75.1	113.4
2004	1077.2	100.8	157.7	1131.1	81.8	120.6	1142.8	107.0	165.3	1186.1	92.1	136.8
2005	821.2	116.9	188.3	883.1	96.7	146.3	877.3	125.3	197.7	928.9	107.6	166.0
2006	572.2	128.6	222.4	639.9	108.8	174.8	611.1	136.1	234.5	666.8	120.6	197.5
2007	424.4	132.2	255.7	493.3	115.8	203.4	455.9	139.6	269.1	516.2	122.8	228.9
2008	413.1	101.3	282.7	461.3	105.7	228.6	501.4	108.0	296.8	547.0	108.8	252.9
2009	1043.4	59.1	279.9	1069.0	70.4	240.6	1128.7	63.4	293.9	1152.5	74.6	261.2
2010	1051.2	42.1	247.1	1071.4	41.6	224.2	1118.2	45.3	259.5	1133.5	48.3	242.7
2011	886.8	63.5	210.8	922.5	43.8	192.1	934.8	68.2	221.4	959.3	55.9	210.9
2012	606.1	118.0	200.0	674.1	78.4	170.0	641.9	124.8	210.4	694.5	92.0	192.9
2013	418.2	148.7	231.9	498.2	121.6	179.5	438.9	157.3	243.5	509.7	128.1	206.5
2014	256.2	112.8	277.4	309.2	121.1	216.0	267.7	119.4	291.2	318.1	123.7	241.0
2015	189.2	60.8	284.2	214.6	75.2	234.3	202.2	63.8	298.0	226.1	77.9	255.0
2016	215.3	33.4	251.3	230.2	37.6	211.2	236.0	34.4	262.6	248.7	39.6	228.8
2017	580.3	25.4	207.5	592.9	24.2	179.0	642.8	26.2	215.7	653.4	25.5	193.8
2018	678.4	23.5	169.8	690.2	21.4	145.5	740.7	24.6	175.8	749.8	23.7	157.5
2019	781.6	35.2	140.9	801.1	24.9	119.2	880.4	36.5	145.5	892.9	31.1	129.9
2020	600.8	68.3	128.3	640.3	44.4	104.0	720.0	71.8	132.2	749.1	52.9	116.5
2021	1021.3	98.0	143.4	1075.2	75.0	106.6	1323.8	106.5	148.2	1370.0	83.3	122.2
2022	1850.4	98.3	176.0	1900.6	89.9	130.9	1973.8	110.5	185.0	2019.6	100.7	148.7
2023	2225.3	92.2	200.0	2271.6	84.7	159.0	2454.5	109.2	214.7	2495.0	104.4	180.2
2024	1805.4	133.4	213.1	1879.5	95.8	175.6	2217.9	154.2	235.3	2275.4	128.7	205.8
2025	–	–	–	–	–	–	1795.1	252.0	282.9	1900.7	192.7	239.8

Table 95. Estimated population biomass (1,000's t; 1948-1990).

	'22.03d5 (2024)'						'22.03d5 (2025)'					
	female			male			female			male		
	immature	mature		immature	mature		immature	mature		immature	mature	
year	new shell	new shell	old shell	new shell	new shell	old shell	new shell	new shell	old shell	new shell	new shell	old shell
1949	3.72	–	–	3.71	–	–	3.64	–	–	3.63	–	–
1950	9.73	0.05	–	10.14	0.03	–	9.48	0.04	–	9.89	0.06	–
1951	17.90	0.94	0.03	20.93	0.54	0.02	17.47	0.78	0.03	20.14	0.71	0.05
1952	25.70	4.87	0.71	35.87	4.66	0.40	25.36	4.34	0.59	34.34	4.32	0.55
1953	30.08	11.43	4.06	49.04	17.98	3.65	29.95	10.82	3.58	47.66	15.56	3.52
1954	31.41	16.17	11.27	54.84	35.54	15.52	31.39	15.75	10.44	54.16	31.98	13.74
1955	31.71	17.73	19.97	55.96	44.70	36.46	31.74	17.43	18.98	55.54	41.77	32.77
1956	31.93	17.98	27.44	56.30	46.39	57.77	32.03	17.71	26.39	55.97	43.76	53.20
1957	32.24	18.07	33.05	56.74	46.62	74.00	32.43	17.83	31.97	56.54	44.03	69.05
1958	32.68	18.19	37.20	57.37	46.86	85.68	33.00	17.98	36.09	57.35	44.33	80.51
1959	33.30	18.37	40.31	58.28	47.22	94.10	33.81	18.20	39.19	58.51	44.77	88.84
1960	34.18	18.62	42.70	59.55	47.74	100.34	34.95	18.52	41.60	60.14	45.39	95.07
1961	35.42	18.97	44.62	61.35	48.47	105.12	36.56	18.96	43.57	62.44	46.29	99.93
1962	37.19	19.47	46.28	63.91	49.51	108.87	38.86	19.59	45.32	65.72	47.54	103.87
1963	39.80	20.17	47.84	67.62	50.96	112.07	42.30	20.47	47.05	70.54	49.31	107.38
1964	43.85	21.16	49.48	73.25	53.01	115.17	47.80	21.72	48.93	78.03	51.80	110.94
1965	50.69	22.61	51.40	82.46	55.95	118.84	57.42	23.56	51.20	90.64	55.39	115.26
1966	63.65	24.83	53.85	99.14	60.28	123.31	75.30	26.43	54.18	113.38	60.79	120.57
1967	89.84	28.48	57.24	131.78	67.06	129.02	106.70	31.31	58.42	153.36	69.50	127.67
1968	130.71	35.18	62.23	185.02	78.09	124.21	147.94	40.26	64.88	210.49	84.05	125.17
1969	165.98	48.50	70.58	244.32	99.32	121.08	180.27	56.76	75.89	270.13	111.06	126.03
1970	181.96	72.66	85.50	297.89	138.16	109.68	190.98	82.64	94.90	317.32	153.90	120.22
1971	168.12	101.72	108.01	317.34	183.38	83.28	172.94	109.27	123.04	327.02	197.73	109.67
1972	129.26	113.44	137.88	276.92	217.70	85.71	132.94	118.24	166.09	285.79	266.36	172.86
1973	88.65	98.37	181.25	204.29	277.71	181.73	92.35	99.71	205.63	211.43	281.13	292.33
1974	62.04	68.26	201.79	137.29	222.31	307.12	65.50	70.22	219.76	145.26	218.88	390.19
1975	51.97	44.93	194.47	101.93	144.10	352.25	54.87	47.32	208.20	108.66	146.10	410.52
1976	60.87	31.29	173.45	98.01	96.98	332.44	64.56	32.82	184.53	103.83	99.96	376.78
1977	76.13	25.87	148.35	112.00	70.80	271.17	80.93	26.49	156.99	117.73	72.23	305.94
1978	85.80	30.82	125.95	134.58	65.50	197.97	91.13	31.45	132.33	140.61	65.49	225.39
1979	81.01	45.02	113.22	149.97	87.94	154.13	86.62	46.76	118.08	157.21	86.93	176.24
1980	60.65	56.18	113.81	136.52	126.02	137.47	64.72	59.75	118.46	144.95	124.67	156.44
1981	37.63	44.62	90.53	95.63	122.28	101.92	39.68	47.37	92.05	102.75	123.01	110.31
1982	23.39	28.29	72.43	55.71	97.45	98.42	24.54	29.61	72.43	59.55	100.64	103.07
1983	23.11	15.21	54.12	40.86	54.87	89.63	24.35	15.60	53.15	43.06	56.62	93.71
1984	27.93	10.08	37.26	42.34	29.63	67.72	29.64	10.28	35.82	44.62	30.00	70.77
1985	35.88	10.07	25.41	53.00	23.25	44.20	38.05	10.25	23.99	55.59	23.43	46.00
1986	43.14	15.59	25.82	67.89	31.53	48.21	46.50	15.96	24.83	71.47	31.57	49.76
1987	46.00	22.04	30.13	78.86	45.98	56.76	49.50	22.96	29.57	83.50	44.96	58.04
1988	44.38	25.72	37.95	80.24	62.30	71.87	47.61	27.24	38.09	85.63	62.00	72.23
1989	38.84	26.74	46.32	74.97	68.33	92.05	41.25	28.59	47.36	79.69	69.61	92.32
1990	30.02	26.20	53.01	64.04	68.50	100.46	31.38	28.11	54.93	67.61	69.82	101.74

Table 96. Estimated population biomass (1,000's t; 1991+).

						‘22.03d5 (2024)‘						‘22.03d5 (2025)‘
			female			male			female			male
	immature		mature	immature		mature	immature		mature	immature		mature
year	new shell	new shell	old shell	new shell	new shell	old shell	new shell	new shell	old shell	new shell	new shell	old shell
1991	20.2	22.8	57.2	47.8	64.2	95.5	20.8	24.0	59.8	49.8	65.2	97.2
1992	12.3	16.7	57.6	30.9	53.3	96.3	12.7	17.2	60.1	32.0	53.2	98.4
1993	7.7	10.2	53.2	18.3	35.9	86.1	8.0	10.5	55.2	19.2	35.4	87.8
1994	5.9	5.7	45.6	12.0	20.8	77.4	6.2	5.9	47.1	12.6	20.8	78.5
1995	6.1	3.6	37.1	10.5	11.7	66.0	6.5	3.8	38.1	11.1	11.8	66.9
1996	6.9	3.1	29.5	11.1	8.3	53.2	7.3	3.2	30.2	11.6	8.4	54.0
1997	9.2	3.3	23.5	14.0	7.9	42.6	9.7	3.4	24.1	14.6	8.0	43.2
1998	10.6	4.0	19.4	16.6	8.8	35.3	11.1	4.1	19.9	17.2	8.9	36.0
1999	14.7	5.0	17.0	22.3	11.1	31.3	15.6	5.2	17.3	23.2	10.9	31.9
2000	16.8	6.5	16.0	26.4	14.2	30.4	17.8	6.6	16.3	27.7	14.0	30.8
2001	22.6	8.0	16.4	34.6	18.2	32.0	24.1	8.3	16.6	36.4	17.8	32.2
2002	25.4	10.0	17.7	40.3	22.4	35.8	27.2	10.4	18.0	42.6	22.4	35.8
2003	31.3	12.6	20.2	49.9	28.1	41.9	33.4	13.2	20.6	52.8	28.0	42.0
2004	34.5	15.3	23.9	56.8	35.2	50.6	36.5	15.9	24.5	59.6	35.5	50.8
2005	33.7	18.0	28.5	59.4	42.3	62.0	35.5	18.9	29.4	62.3	42.2	62.4
2006	29.3	19.9	33.8	57.2	48.8	74.6	30.8	20.8	35.0	59.5	49.1	75.1
2007	21.8	21.2	39.2	49.5	53.2	87.8	23.0	22.0	40.6	51.5	52.8	88.6
2008	15.2	17.8	44.0	35.7	54.2	100.3	16.8	18.6	45.4	38.6	53.0	100.9
2009	20.0	11.0	45.0	31.4	40.8	110.5	21.6	11.6	46.5	34.2	41.5	110.4
2010	26.9	6.9	40.8	36.1	22.6	108.6	28.6	7.3	42.2	38.6	23.8	109.3
2011	33.1	8.6	34.7	48.4	16.9	94.7	34.7	9.1	35.9	50.5	17.9	96.4
2012	32.1	16.3	31.6	58.9	27.2	80.4	33.6	17.0	32.7	60.5	27.7	82.5
2013	23.5	23.2	34.9	55.4	50.4	77.6	24.5	24.1	36.1	57.2	48.8	79.7
2014	13.6	20.1	42.3	36.2	62.5	91.1	14.1	21.0	43.7	38.3	61.1	91.7
2015	8.3	11.6	45.5	19.6	44.7	104.0	8.6	12.0	46.9	20.7	45.2	103.8
2016	7.0	6.0	41.5	13.4	22.1	98.0	7.3	6.2	42.8	13.9	22.5	98.5
2017	11.0	4.2	34.7	16.3	12.5	86.3	11.8	4.3	35.5	17.1	12.3	87.2
2018	16.0	3.7	28.3	21.4	10.2	70.2	17.1	3.8	28.9	22.7	10.0	70.9
2019	22.6	4.8	23.4	31.1	9.9	56.9	24.4	4.9	23.8	33.0	10.2	57.4
2020	24.8	9.3	20.5	40.6	15.1	48.1	27.5	9.5	20.8	43.5	15.1	48.9
2021	28.5	14.7	21.7	50.2	29.4	45.1	33.9	15.5	22.0	56.7	28.5	45.8
2022	39.4	16.0	26.5	60.4	41.7	53.5	44.2	17.5	27.3	67.9	42.1	53.5
2023	55.0	14.6	31.0	75.8	41.0	68.1	60.8	16.8	32.5	85.2	44.1	68.6
2024	66.2	18.4	33.2	97.8	38.5	78.2	74.0	21.2	35.8	108.8	44.3	81.0
2025	–	–	–	–	–	–	75.9	35.1	41.4	130.7	62.0	88.4

Table 97. Comparison of estimates of mature biomass-at-mating by sex (in 1,000's t) from the base and preferred models (model start to 1980).

		female		male
year	'22.03d5 (2024)'	'22.03d5 (2025)'	'22.03d5 (2024)'	'22.03d5 (2025)'
1948	0.000	0.000	0.000	0.000
1949	0.000	0.000	0.000	0.000
1950	0.038	0.031	0.023	0.051
1951	0.800	0.664	0.455	0.614
1952	4.569	4.031	4.118	3.965
1953	12.689	11.763	17.500	15.479
1954	22.483	21.399	41.109	36.911
1955	30.883	29.751	65.130	59.924
1956	37.203	36.036	83.426	77.779
1957	41.877	40.684	96.595	90.693
1958	45.376	44.176	106.097	100.071
1959	48.066	46.889	113.133	107.093
1960	50.229	49.112	118.518	112.568
1961	52.090	51.087	122.740	117.000
1962	53.850	53.027	126.358	120.962
1963	55.701	55.149	129.852	124.970
1964	57.860	57.710	133.983	129.828
1965	60.616	61.068	139.027	135.819
1966	64.431	65.844	145.461	143.808
1967	70.049	73.131	140.041	140.993
1968	79.448	85.542	136.512	141.964
1969	96.247	106.965	123.660	135.422
1970	121.582	138.689	93.895	123.534
1971	155.203	187.207	96.628	194.713
1972	204.028	231.778	204.885	329.297
1973	227.142	247.708	346.258	439.529
1974	218.904	234.669	397.144	462.424
1975	195.243	207.991	374.807	424.418
1976	166.989	176.957	305.734	344.617
1977	141.780	149.158	223.198	253.886
1978	127.446	133.091	173.774	198.519
1979	128.114	133.526	154.991	176.221
1980	114.190	117.470	134.692	145.567

Table 98. Comparison of estimates of mature biomass-at-mating by sex (in 1,000's t) from the base and preferred models (1981 to model end).

		female		male
year	'22.03d5 (2024)'	'22.03d5 (2025)'	'22.03d5 (2024)'	'22.03d5 (2025)'
1981	91.4	92.4	130.1	136.0
1982	68.3	67.8	118.5	123.7
1983	47.0	45.7	89.5	93.4
1984	32.1	30.6	58.4	60.7
1985	29.1	28.0	54.4	56.0
1986	33.9	33.3	64.0	65.4
1987	42.7	42.9	81.0	81.4
1988	52.1	53.4	103.8	104.0
1989	59.7	61.9	113.3	114.6
1990	64.4	67.4	107.6	109.5
1991	64.8	67.7	108.5	110.9
1992	59.9	62.2	97.1	98.9
1993	51.4	53.1	87.2	88.4
1994	41.7	43.0	74.4	75.3
1995	33.2	34.1	59.9	60.8
1996	26.5	27.2	48.0	48.7
1997	21.9	22.4	39.9	40.5
1998	19.1	19.6	35.3	35.9
1999	18.0	18.4	34.3	34.7
2000	18.4	18.7	36.1	36.2
2001	20.0	20.3	40.4	40.3
2002	22.7	23.2	47.3	47.3
2003	26.8	27.7	57.1	57.2
2004	32.1	33.1	69.9	70.3
2005	38.1	39.5	84.1	84.6
2006	44.1	45.7	99.0	99.8
2007	49.5	51.2	113.1	113.6
2008	50.7	52.4	124.6	124.4
2009	45.9	47.5	122.5	123.2
2010	39.1	40.5	106.8	108.6
2011	35.5	36.8	90.6	92.9
2012	39.3	40.7	87.5	89.8
2013	47.7	49.3	102.7	103.3
2014	51.2	52.9	117.2	116.9
2015	46.8	48.2	110.5	111.0
2016	39.0	40.1	97.3	98.2
2017	31.9	32.6	79.1	79.9
2018	26.3	26.8	64.2	64.7
2019	23.1	23.5	54.3	55.0
2020	24.4	24.8	50.9	51.6
2021	29.8	30.7	60.3	60.2
2022	34.9	36.6	76.8	77.3
2023	37.4	40.3	88.2	91.3
2024	–	46.7	–	99.5

Table 99. Comparison of estimates of recruitment (in millions) from the base and preferred models (model start to 1980)

year	'22.03d5 (2024)'	'22.03d5 (2025)'
1949	645.6	650.0
1950	646.1	650.5
1951	647.1	651.9
1952	648.9	654.3
1953	651.7	658.1
1954	656.0	663.8
1955	662.3	672.1
1956	671.2	683.9
1957	683.8	700.5
1958	701.5	723.9
1959	726.3	756.5
1960	761.0	802.2
1961	810.7	868.2
1962	884.6	967.8
1963	1000.8	1129.7
1964	1200.1	1420.7
1965	1586.8	2001.6
1966	2426.9	3124.7
1967	4190.0	4788.5
1968	5508.9	5346.4
1969	3353.4	3319.9
1970	1920.7	2048.3
1971	1474.7	1610.5
1972	961.0	969.1
1973	672.4	681.5
1974	948.4	1031.3
1975	1563.6	1704.0
1976	2898.1	3205.2
1977	1975.1	2092.3
1978	720.1	645.6
1979	350.8	402.5
1980	333.4	335.0

Table 100. Comparison of estimates of recruitment (in millions) from the base and preferred models (1981 to model end).

year	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
1981	394.0	425.5
1982	338.2	376.9
1983	1164.4	1243.2
1984	859.4	954.7
1985	990.2	1049.5
1986	1026.9	1199.9
1987	868.4	846.0
1988	571.0	584.6
1989	273.1	263.9
1990	134.0	143.7
1991	100.9	103.4
1992	109.9	117.0
1993	109.9	122.1
1994	130.3	137.5
1995	214.1	230.3
1996	170.4	175.1
1997	420.5	450.5
1998	152.9	169.0
1999	732.8	798.0
2000	231.4	255.0
2001	1064.8	1134.8
2002	314.2	373.5
2003	1180.5	1237.9
2004	641.8	640.8
2005	210.5	233.9
2006	133.6	136.7
2007	232.0	247.8
2008	375.2	515.0
2009	1567.1	1607.5
2010	569.7	573.3
2011	272.6	269.8
2012	78.0	85.5
2013	200.4	201.9
2014	94.6	97.7
2015	105.3	118.8
2016	205.6	228.2
2017	878.5	972.2
2018	504.6	531.8
2019	582.6	683.2
2020	128.8	217.7
2021	1311.1	1745.7
2022	2317.6	2114.7
2023	1768.2	2062.1
2024	431.2	933.2
2025	–	656.7

Table 101. Comparison of exploitation rates (i.e., catch divided by biomass) from the model scenarios (model start to 1980).

year	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
1949	0.00044	0.00046
1950	0.00079	0.00082
1951	0.00135	0.00140
1952	0.00213	0.00219
1953	0.00370	0.00355
1954	0.00594	0.00567
1955	0.00793	0.00776
1956	0.00919	0.00912
1957	0.00959	0.00958
1958	0.00998	0.00999
1959	0.01009	0.01011
1960	0.01022	0.01025
1961	0.01084	0.01083
1962	0.01143	0.01137
1963	0.01200	0.01186
1964	0.01171	0.01150
1965	0.01196	0.01191
1966	0.01275	0.01239
1967	0.04297	0.04031
1968	0.05038	0.04744
1969	0.08287	0.08017
1970	0.15299	0.13150
1971	0.18334	0.06837
1972	0.05517	0.03102
1973	0.03619	0.03174
1974	0.04306	0.03922
1975	0.03854	0.03557
1976	0.06056	0.05618
1977	0.08407	0.07692
1978	0.06969	0.06175
1979	0.07614	0.06523
1980	0.05585	0.05408

Table 102. Comparison of exploitation rates (i.e., catch divided by biomass) from the model scenarios (from 1981 to model end).

year	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
1981	0.0250	0.0246
1982	0.0134	0.0131
1983	0.0054	0.0053
1984	0.0141	0.0138
1985	0.0056	0.0056
1986	0.0070	0.0068
1987	0.0126	0.0122
1988	0.0204	0.0198
1989	0.0550	0.0538
1990	0.0951	0.0939
1991	0.0780	0.0763
1992	0.1017	0.0997
1993	0.0646	0.0634
1994	0.0394	0.0388
1995	0.0296	0.0292
1996	0.0244	0.0241
1997	0.0169	0.0165
1998	0.0110	0.0107
1999	0.0051	0.0050
2000	0.0057	0.0055
2001	0.0069	0.0068
2002	0.0033	0.0032
2003	0.0018	0.0018
2004	0.0025	0.0025
2005	0.0057	0.0056
2006	0.0086	0.0084
2007	0.0096	0.0094
2008	0.0073	0.0071
2009	0.0057	0.0056
2010	0.0027	0.0026
2011	0.0038	0.0037
2012	0.0026	0.0025
2013	0.0085	0.0084
2014	0.0339	0.0333
2015	0.0500	0.0491
2016	0.0059	0.0058
2017	0.0107	0.0105
2018	0.0113	0.0110
2019	0.0031	0.0030
2020	0.0061	0.0058
2021	0.0041	0.0038
2022	0.0052	0.0049
2023	0.0041	0.0038
2024	–	0.0092

Table 103. Comparison of RMSEs from fits to fishery catch data.

				all sexes		male	
	fleet	catch type	data type	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
fisheries data	GF All	total catch	abundance	0.759	0.710	–	–
			biomass	0.719	0.674	–	–
	RKF	total catch	abundance	0.697	0.686	–	–
			biomass	0.232	0.241	–	–
	SCF	total catch	abundance	1.087	1.076	–	–
			biomass	0.148	0.153	–	–
	TCF	retained catch	abundance	–	–	5.212	5.270
			biomass	–	–	0.393	0.403
		total catch	abundance	2.165	2.113	–	–
			biomass	1.916	1.879	–	–

Table 104. Comparison of RMSEs from fits to survey data and molt increment data.

							female				male
					immature		mature		all		immature
category	fleet	catch type	data type	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘	‘22.03d5 (2024)‘	‘22.03d5 (2025)‘
growth data	–	–	molt incr.	0.645	0.586	–	–	–	–	1.064	0.964
surveys data	NMFS F	index catch	abundance	3.126	3.094	2.515	2.510	–	–	–	–
			biomass	2.845	2.818	2.352	2.331	–	–	–	–
	NMFS M	index catch	abundance	–	–	–	–	3.414	3.360	–	–
			biomass	–	–	–	–	2.763	2.808	–	–
	SBS BSFRF F	index catch	abundance	1.795	1.563	1.694	1.768	–	–	–	–
			biomass	1.141	1.159	1.948	1.983	–	–	–	–
	SBS BSFRF M	index catch	abundance	–	–	–	–	1.524	1.444	–	–
			biomass	–	–	–	–	1.426	1.427	–	–

Table 105. Observed and random walk model-estimated time series for vulnerable male biomass from the NMFS EBS shelf survey. All values are in 1,000s t. lci: lower confidence interval; uci: upper confidence interval. Confidence intervals are 80%.

	observed			rema		
year	value	lci	uci	value	lci	uci
1975	268.0	173.6	413.7	208.7	147.5	295.3
1976	139.5	115.1	169.0	142.8	119.8	170.1
1977	119.2	100.9	140.7	117.1	100.4	136.5
1978	82.6	70.0	97.5	79.9	68.5	93.1
1979	33.5	28.3	39.6	38.4	32.7	45.0
1980	88.7	69.5	113.3	72.7	58.8	89.7
1981	51.8	44.2	60.7	53.0	45.7	61.4
1982	51.7	43.0	62.3	49.3	41.7	58.4
1983	30.2	24.9	36.7	31.0	26.0	36.9
1984	24.2	20.3	28.9	23.4	19.9	27.5
1985	11.7	9.6	14.2	12.9	10.8	15.4
1986	13.6	10.1	18.4	15.0	11.8	19.1
1987	22.9	19.0	27.7	24.1	20.3	28.7
1988	68.1	48.4	96.0	58.7	45.2	76.2
1989	104.4	87.3	124.8	99.0	84.0	116.7
1990	103.2	85.2	125.0	103.6	87.1	123.2
1991	116.7	90.0	151.5	111.7	89.6	139.3
1992	112.2	82.1	153.4	100.3	78.2	128.6
1993	64.2	52.6	78.4	64.6	54.0	77.3
1994	43.1	36.5	50.9	43.4	37.2	50.6
1995	31.1	24.7	39.2	31.2	25.5	38.2
1996	26.0	19.1	35.4	22.8	17.9	29.2
1997	10.7	9.2	12.5	11.3	9.8	13.1
1998	10.5	9.1	12.0	10.6	9.3	12.1
1999	11.8	9.2	15.0	12.1	9.8	14.9
2000	16.9	12.4	23.0	15.9	12.4	20.3
2001	17.5	14.4	21.2	17.3	14.5	20.6
2002	16.5	13.5	20.2	17.1	14.3	20.5
2003	21.8	17.9	26.5	21.7	18.2	25.9
2004	25.6	20.4	32.2	26.8	22.0	32.7
2005	43.4	36.2	52.1	42.7	36.1	50.4
2006	60.9	48.1	77.0	58.3	47.5	71.6
2007	67.5	50.8	89.7	64.0	50.5	81.1
2008	66.9	46.7	95.9	58.4	44.5	76.6
2009	37.2	30.5	45.4	39.4	32.9	47.1
2010	40.0	31.1	51.3	40.0	32.3	49.6
2011	41.1	30.6	55.2	41.2	32.4	52.3
2012	39.3	31.5	49.0	42.5	34.9	51.6
2013	76.2	55.3	104.9	69.2	53.9	88.8
2014	88.8	77.9	101.2	86.2	76.1	97.7
2015	64.5	57.1	73.0	65.2	58.0	73.4
2016	60.4	53.6	68.1	60.0	53.5	67.3
2017	48.2	41.7	55.7	48.0	41.9	55.0
2018	37.8	32.9	43.4	36.8	32.4	42.0
2019	18.3	15.7	21.3	19.2	16.6	22.2
2020	– –	– –	– –	18.3	12.3	27.1
2021	17.2	14.7	20.0	17.4	15.0	20.2
2022	19.9	16.9	23.5	19.7	16.9	22.8

(continued)

year	observed value	lci	uci	rema value	lci	uci
2023	18.6	16.6	20.9	19.1	17.1	21.3
2024	32.1	28.3	36.5	32.3	28.6	36.5
2025	68.8	54.6	86.9	61.0	49.2	75.8

Table 106. Tier 4 management quantities for candidate B_{MSY} averaging periods. Biomass quantities (B, B_{MSY}, OFL) are in 1,000s t.

time block	M	B	B_{MSY}	status	F_{OFL}	OFL
1975:2025	0.23	61.04	50.50	1.21	0.23	12.54
1975:1980	0.23	61.04	109.90	0.56	0.12	6.71
1982:2025	0.23	61.04	42.34	1.44	0.23	12.54
1987:1995,2005:2009,2013:2015	0.23	61.04	65.88	0.93	0.21	11.62
2005:2009,2013:2015	0.23	61.04	60.42	1.01	0.23	12.54

Table 107. Abundance measures for PSC. "model": preferred model-based estimates of total survey abundance (excludes crab < 25 mm CW). "survey": design-based estimates of total survey abdundance (includes crab < 25 mm CW). Abundance units are millions of crab. The survey was not conducted in 2020.

year	model millions	survey millions
1975	770.6	790.1
1976	728.2	683.5
1977	684.6	847.9
1978	635.6	582.0
1979	609.0	384.9
1980	574.9	1252.8
1981	424.1	598.5
1982	495.9	684.5
1983	456.5	451.3
1984	437.0	298.4
1985	459.8	113.2
1986	544.1	199.1
1987	584.3	483.2
1988	587.4	734.0
1989	546.5	925.9
1990	479.4	813.8
1991	397.4	822.6
1992	324.6	510.2
1993	257.1	272.3
1994	209.6	212.2
1995	185.5	188.0
1996	165.6	178.8
1997	180.9	153.7
1998	171.6	160.7
1999	229.9	272.3
2000	231.7	222.9
2001	323.2	555.2
2002	331.6	374.8
2003	426.5	442.5
2004	452.8	478.1
2005	432.6	681.7

(continued)

year	model millions	survey millions
2006	397.7	769.0
2007	368.3	644.3
2008	360.3	388.5
2009	460.7	336.5
2010	455.1	368.1
2011	428.7	659.6
2012	390.2	708.6
2013	362.8	642.8
2014	315.6	540.0
2015	262.6	329.2
2016	224.8	285.4
2017	277.8	344.8
2018	290.0	507.3
2019	324.0	420.9
2020	314.5	NA
2021	460.4	385.0
2022	631.6	381.4
2023	785.1	774.8
2024	817.1	1215.7
2025	817.2	1151.3

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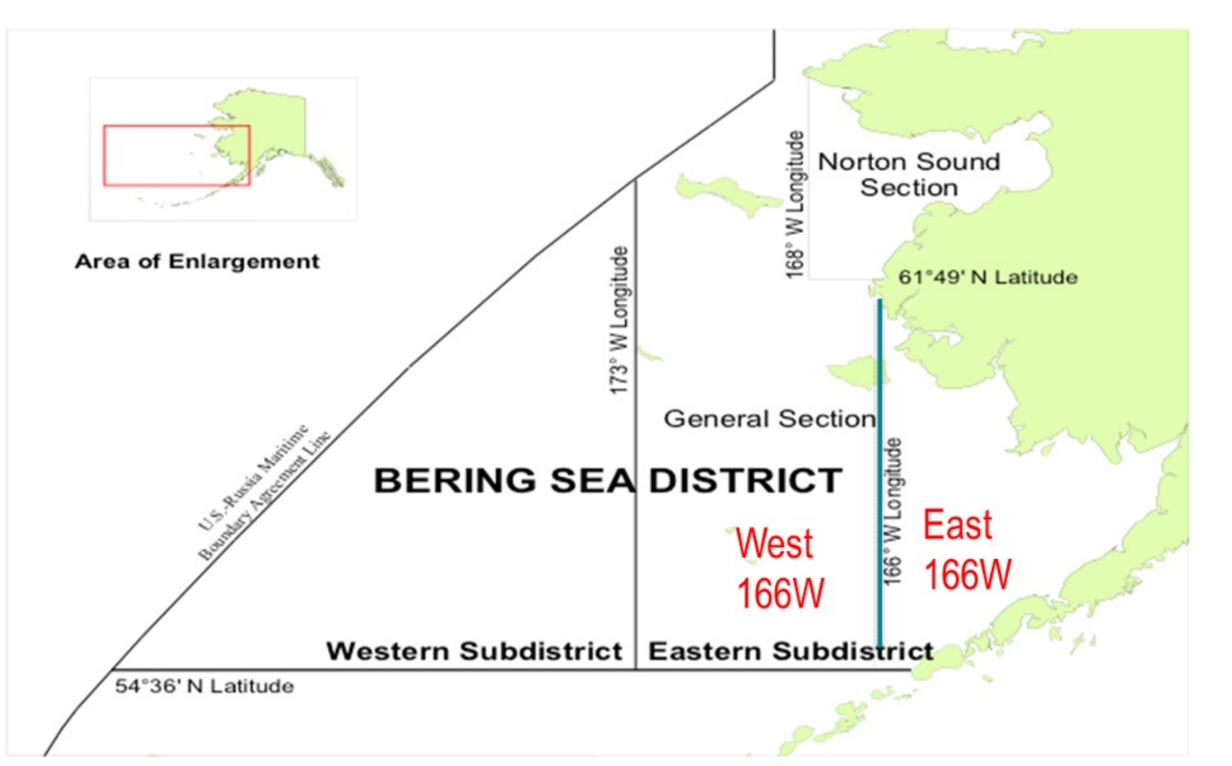


Figure 1. Eastern Bering Sea District of the ADF&G Tanner crab Registration Area J, including sub-districts and sections (from Bowers et al. 2008). Separate TACs are set annually for the areas east and west of 166^{o}W in the General Section. These management areas are identified in the text, tables, and figures as 'East 166W'and 'West 166W', respectively based on the split at 166^{o}W longitude.

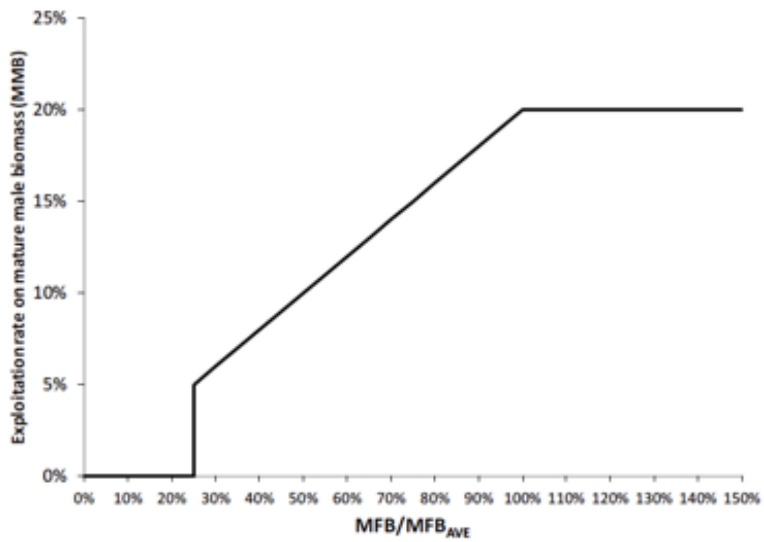


Figure 2. Sloping control rule used by ADF&G from 2011 to 2019 as part of its TAC setting process to determine the maximum exploitation rate on mature male biomass as a function of the ratio of current mature female biomass (MFB) to MFB averaged over some time period.

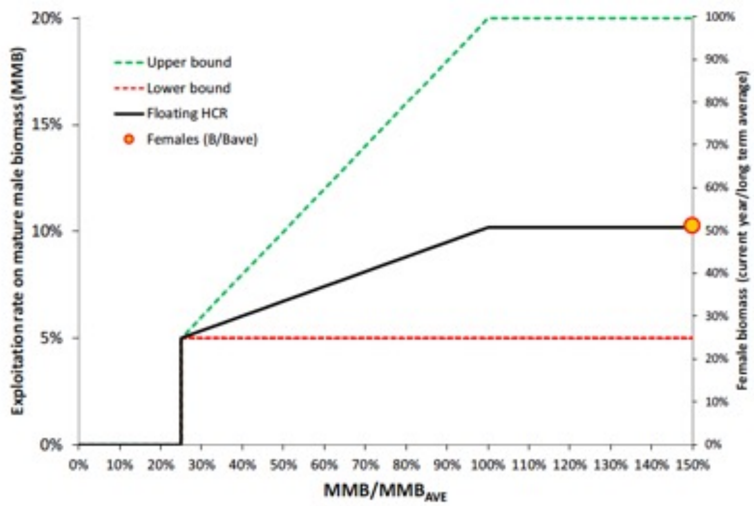


Figure 3. Current ADF&G "floating" sloping control rule to determine the maximum exploitation rate on mature male biomass (MMB) as a function of the ratio of current MMB to the average MMB over 1982-2018. The ratio of current mature female biomass (MFB) to MFB averaged over 1982-2018 is used to determine the value of the maximum exploitation rate for the control rule, up to a maximum of 20%.

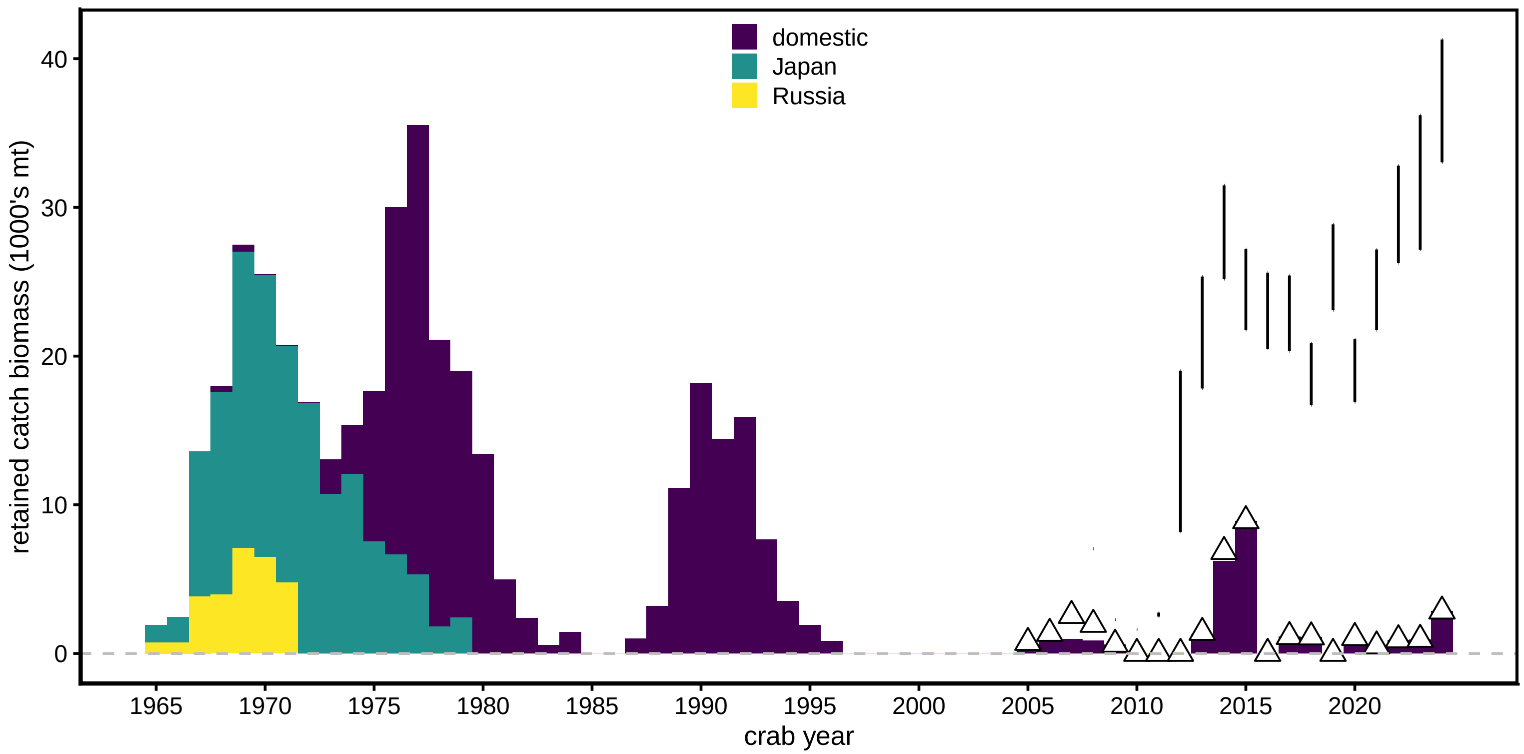


Figure 4. Total retained catch (males, 1000's t) in the directed fisheries (foreign [1965-1979] and domestic [1968-]) for Tanner crab (aggregated across State management areas). The bars indicate the Tier 3 OFL and ABC (upper and lower limits, respectively; (values start in 2011/12); the triangles indicate the area-aggregated TAC (values start in 2005/06, following rationalization).

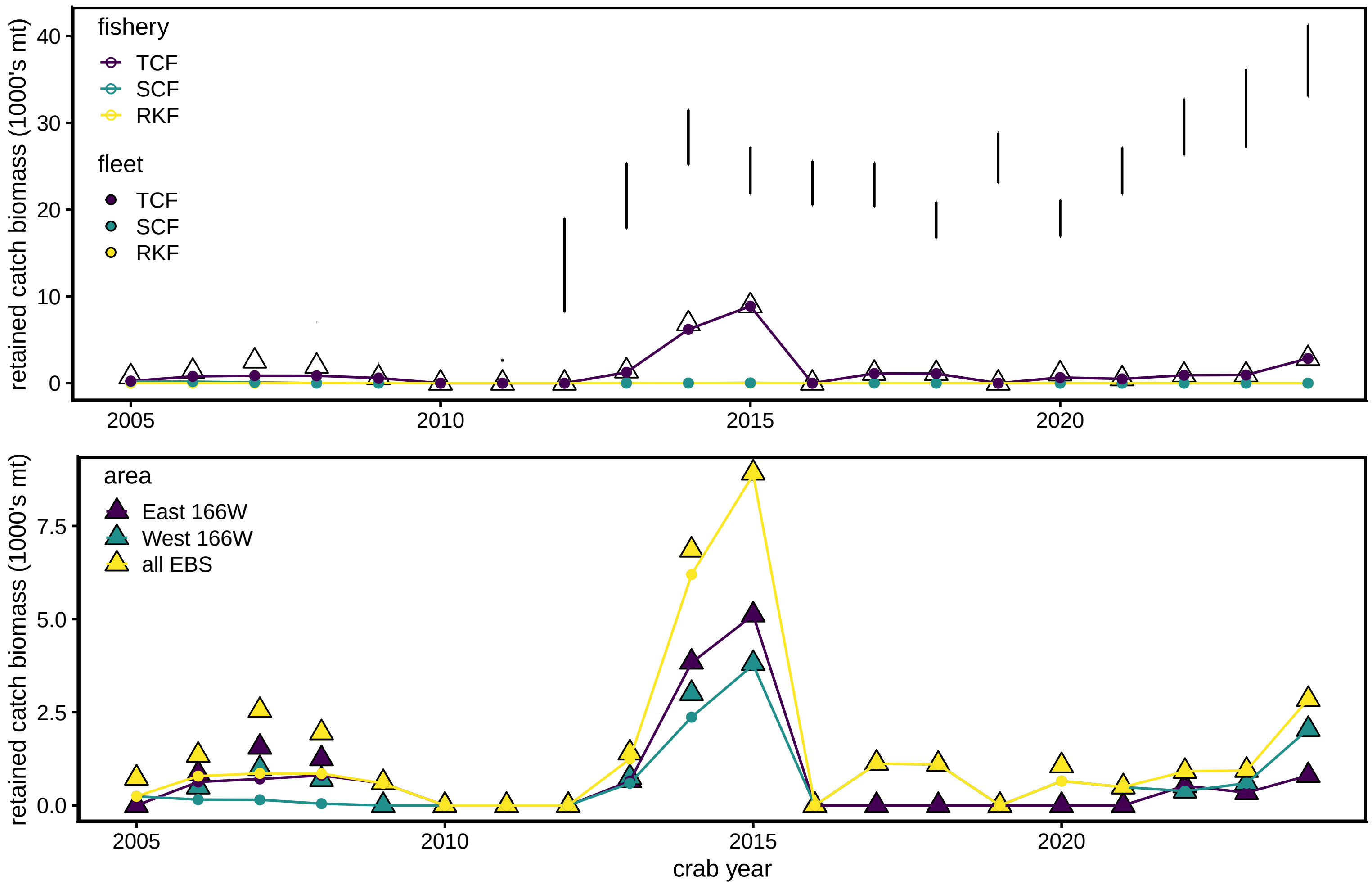


Figure 5. Upper plot: time series of retained catch biomass (1000's t) in the directed Tanner crab (TCF), snow crab (SCF), and BBRKC (RKF) fisheries since 2005. The bars indicate the OFL and ABC (upper and lower limits, respectively; values start in 2011/12); the triangles indicate the total (area-combined) TAC, points indicate the retained catch. Legal-sized Tanner crab can be incidentally-retained in the snow crab and BBRKC fisheries up to a cap of 5% the target catch. Lower plot: retained catch biomass (1000's t) by SOA management area and combined. The triangles indicate the area-combined ("all EBS") and area-specific ("East 166W", "West 166W") TACS. The directed fisheries in both SOA management areas were both closed from 2010/11 to 2012/13, as well as in 2016/17 and 2019/20. The directed fishery in the eastern area was also closed in 2005/06, 2017/18, 2018/19, 2020/21, and 2021/22.

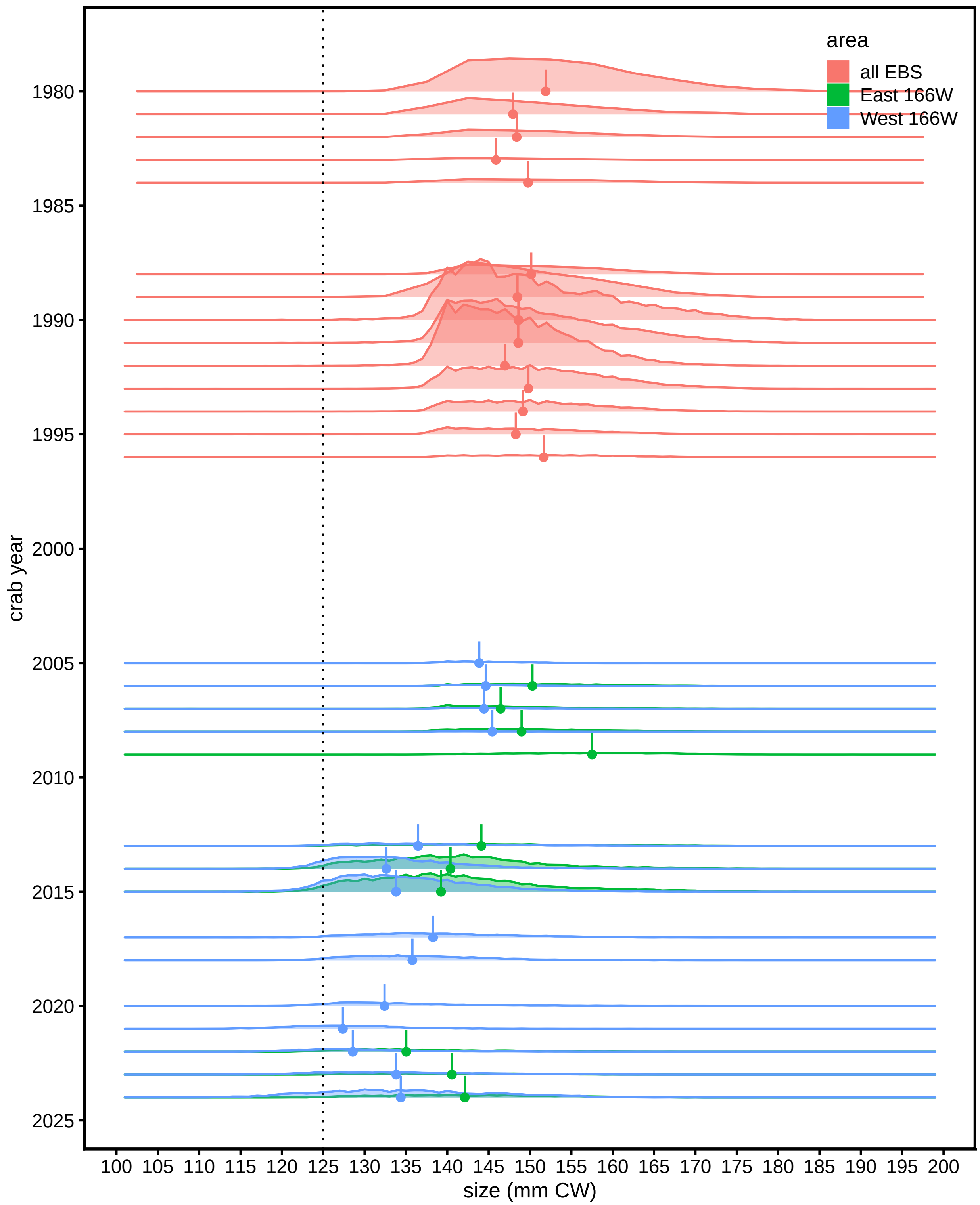


Figure 6. Retained catch size compositions, scaled to total abundance by area and year. Vertical bars and points indicate median sizes, dotted vertical line indicates recent industry-preferred size.

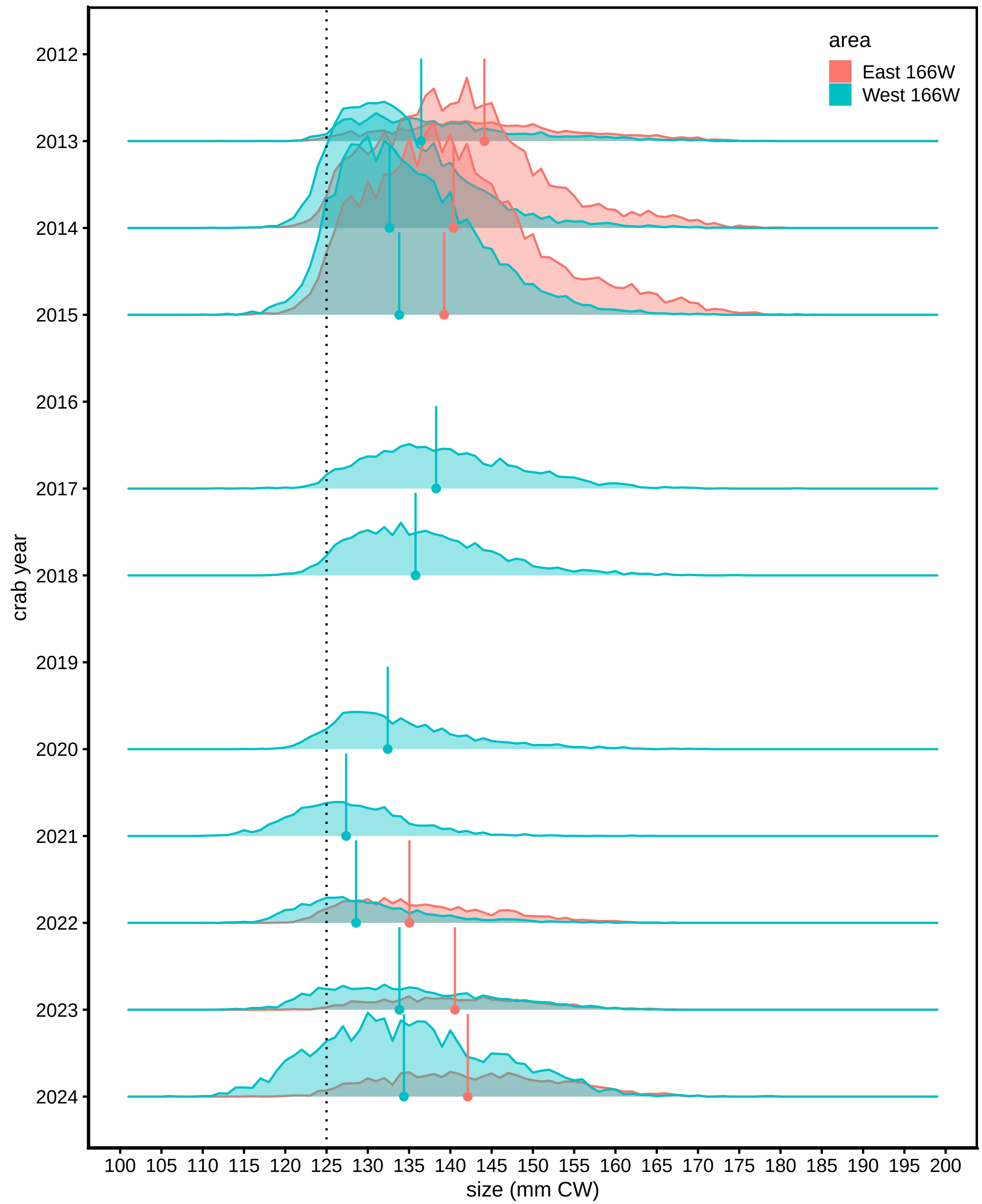


Figure 7. Retained catch size compositions, scaled to total retained abundance by area and year from recent seasons. Vertical bars and points indicate median sizes.Vertical dotted line indicates recent industry-preferred size.

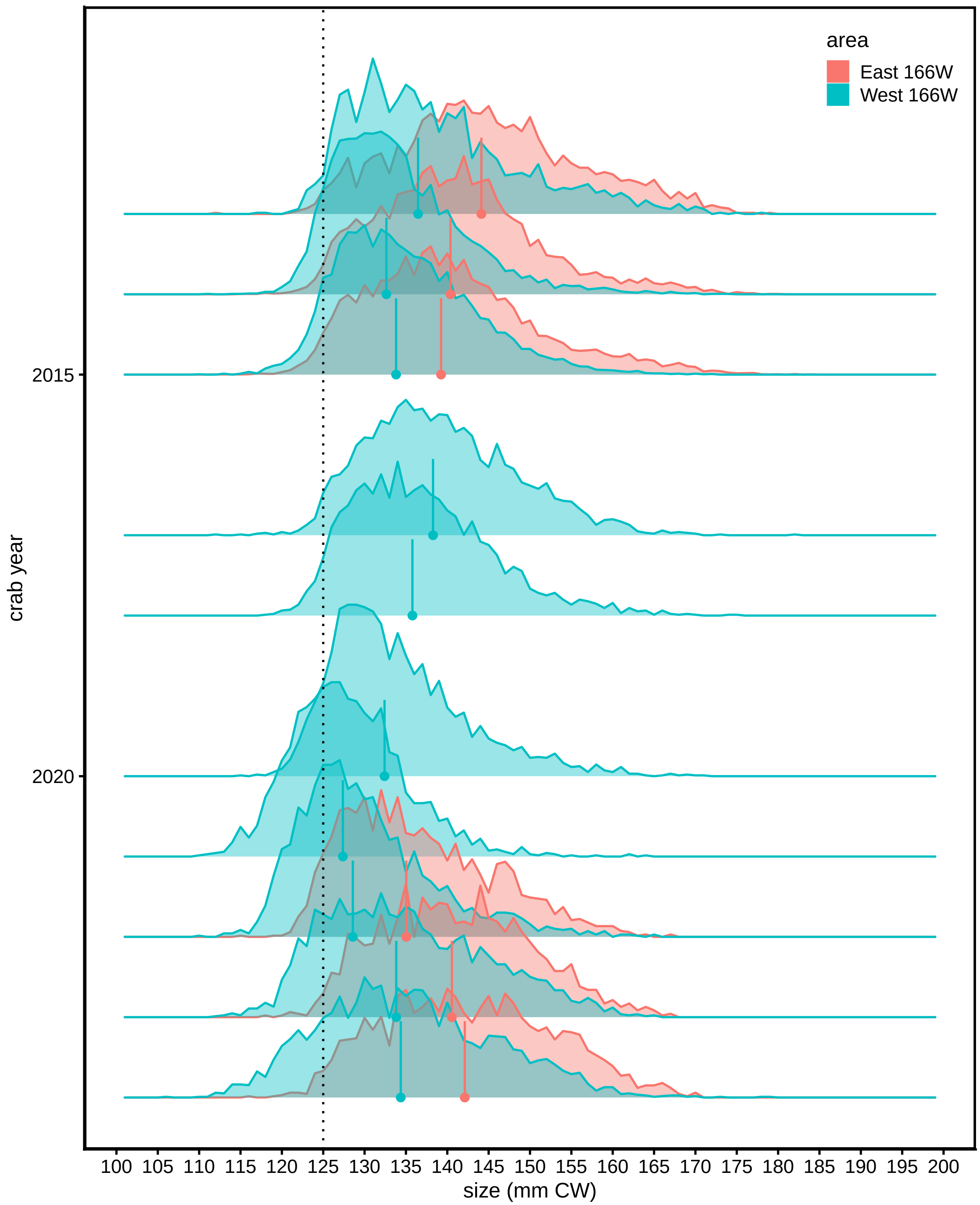


Figure 8. Retained catch size compositions from recent seasons, normalized to sum to 1 by area and year to show contrast. Vertical bars and points indicate median size. Dotted line indicates recent industry-preferred size.

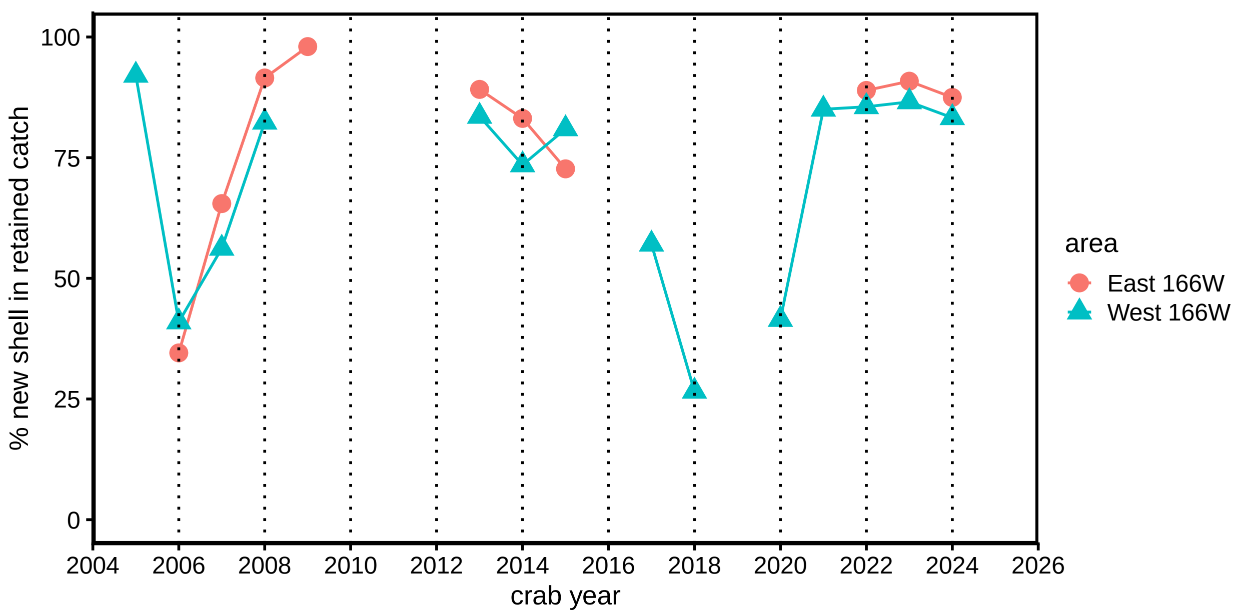


Figure 9. The fraction of new shell males in the retained catch, by management area, for the directed fishery since 2005/06.

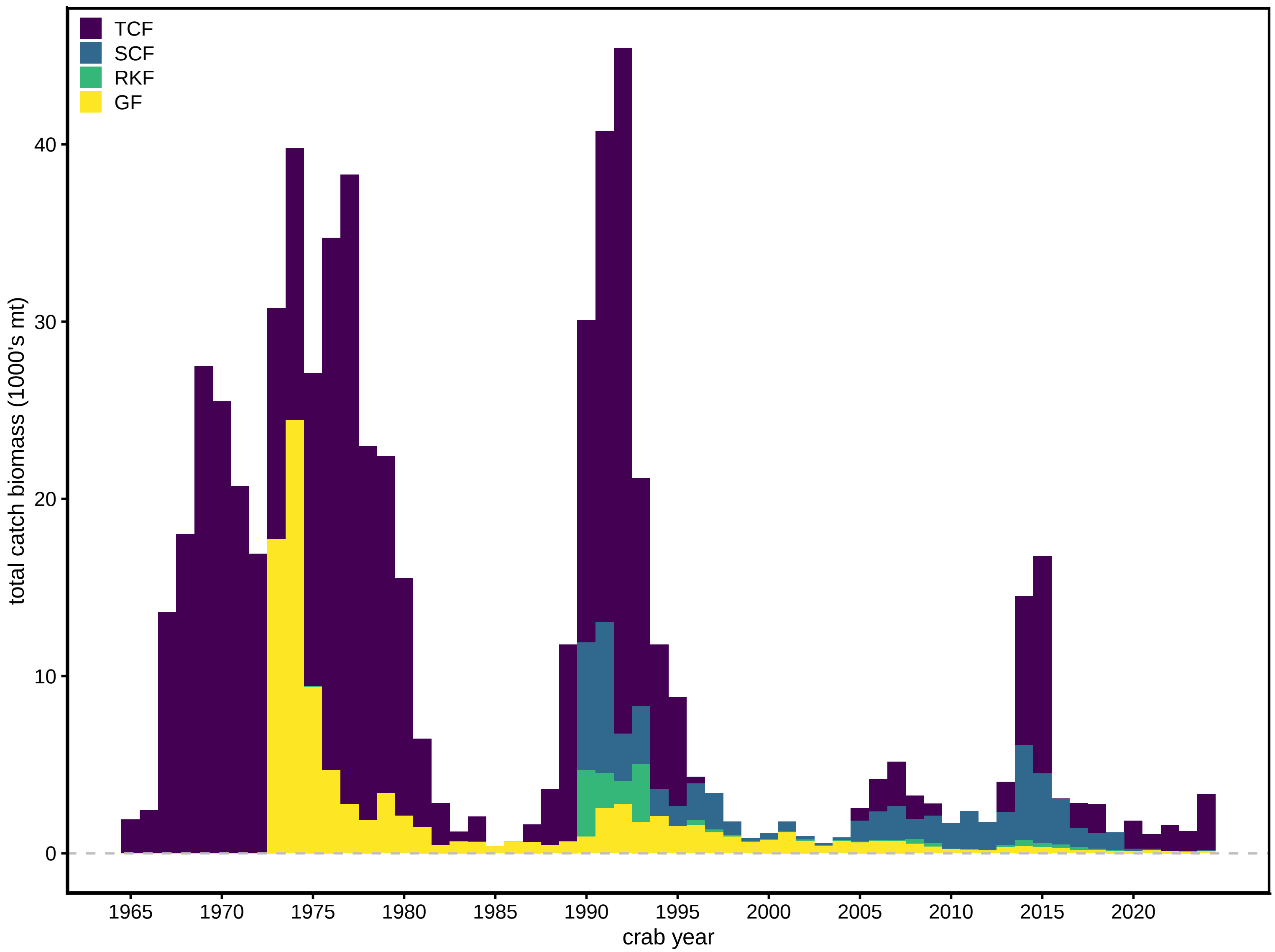


Figure 10. Total catch (retained + discards) biomass estimates for Tanner crab (sexes combined) in the directed Tanner crab (TCF), snow crab (SCF), Bristol Bay red king crab (RKF), and groundfish fisheries (GF). Values for the directed fishery prior to 1991/92 do not include bycatch. **Discard mortality rates have not been applied to these estimates.**

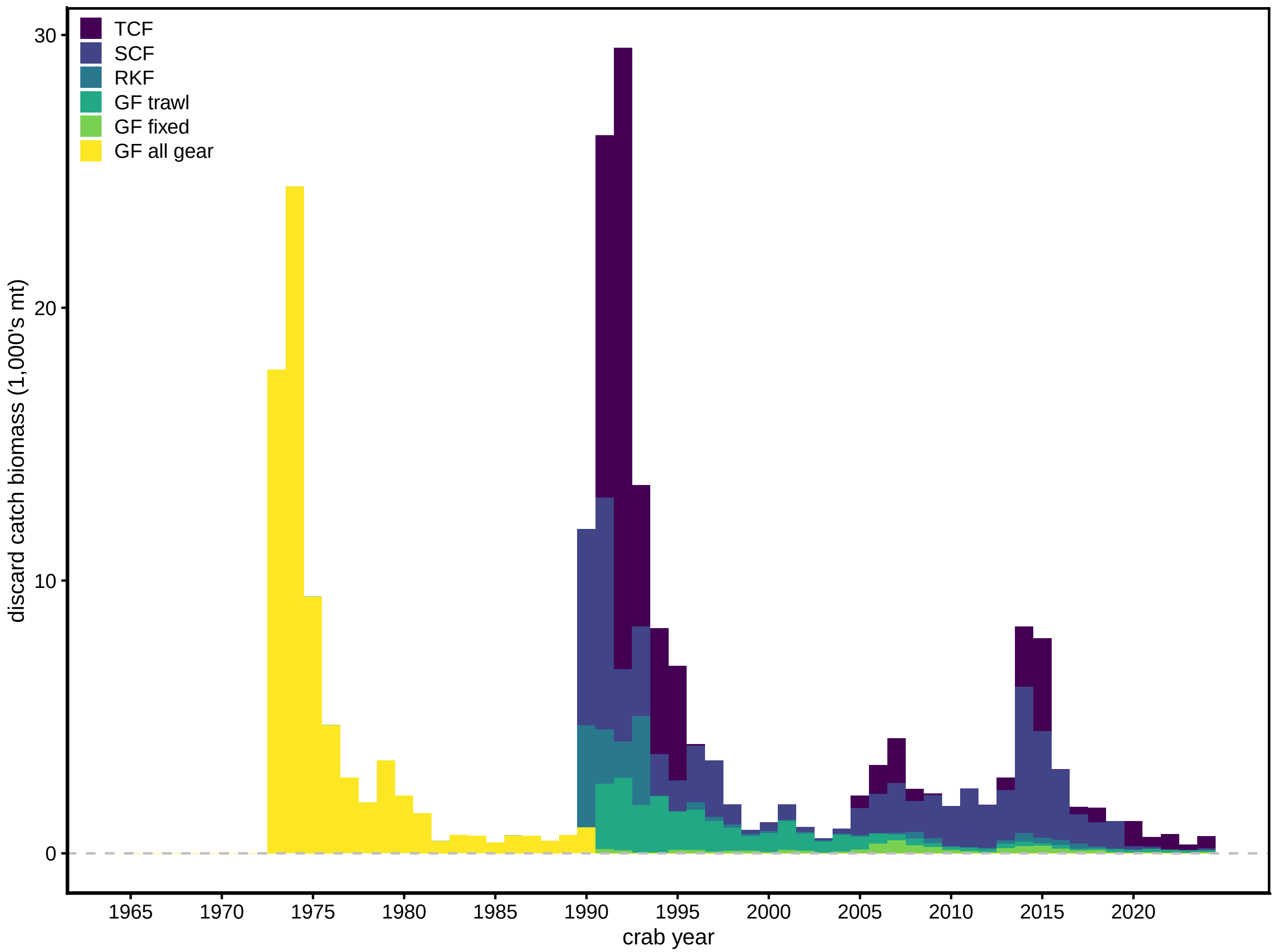


Figure 11. Discard biomass estimates for Tanner crab (sexes combined) in the directed Tanner crab (TCF), snow crab (SCF), Bristol Bay red king crab (RKF), and groundfish fisheries (GF). Discard estimates for the directed fishery were derived using the subtraction method. **Discard mortality rates have not been applied to these estimates.**

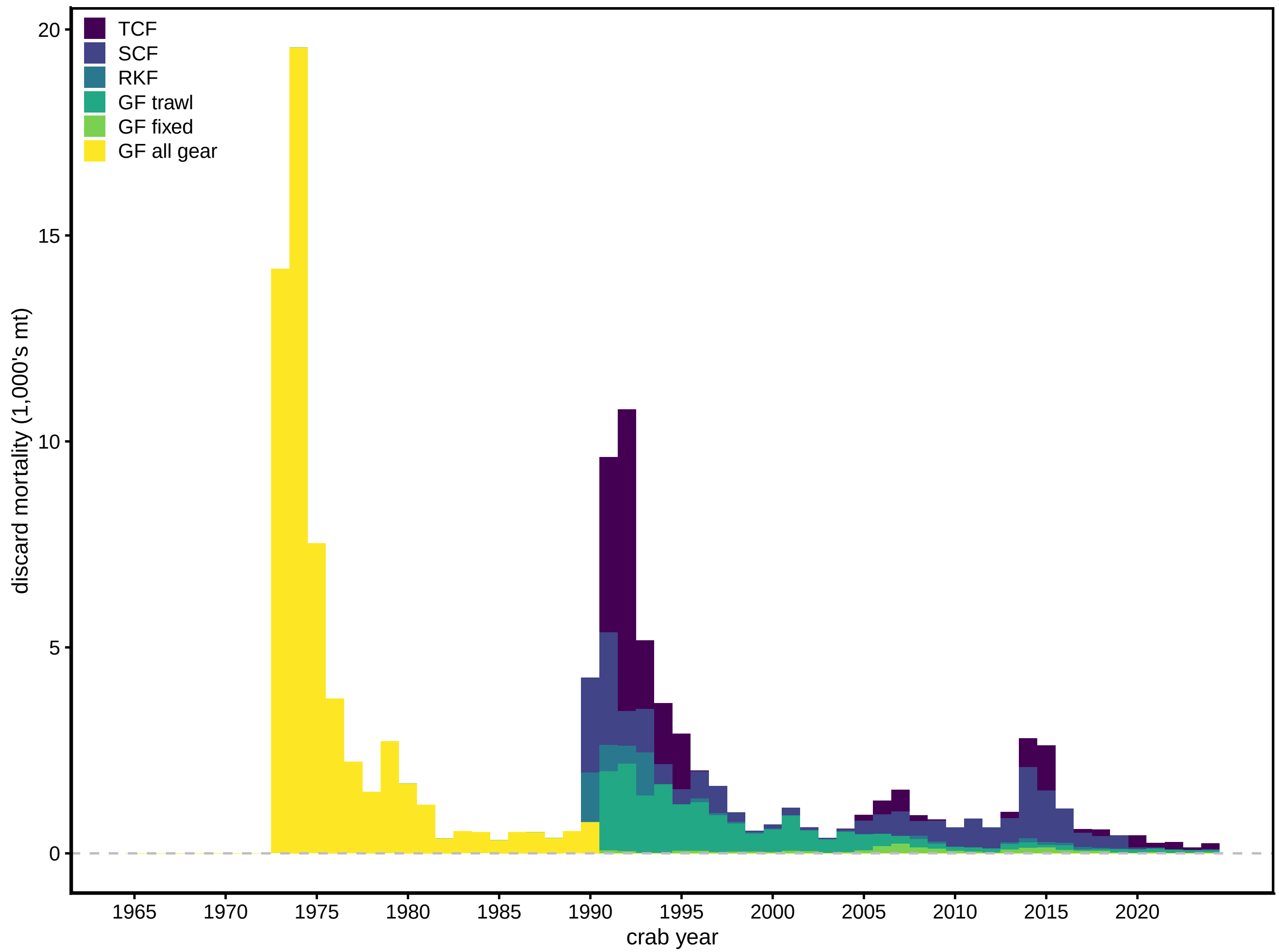


Figure 12. Discard mortality (biomass) estimates for Tanner crab (sexes combined) in the directed Tanner crab (TCF), snow crab (SCF), Bristol Bay red king crab (RKF), and groundfish fisheries (GF). Discard estimates for the directed fishery were derived using the subtraction method. **Gear-specific assumed discard mortality rates have been applied.**

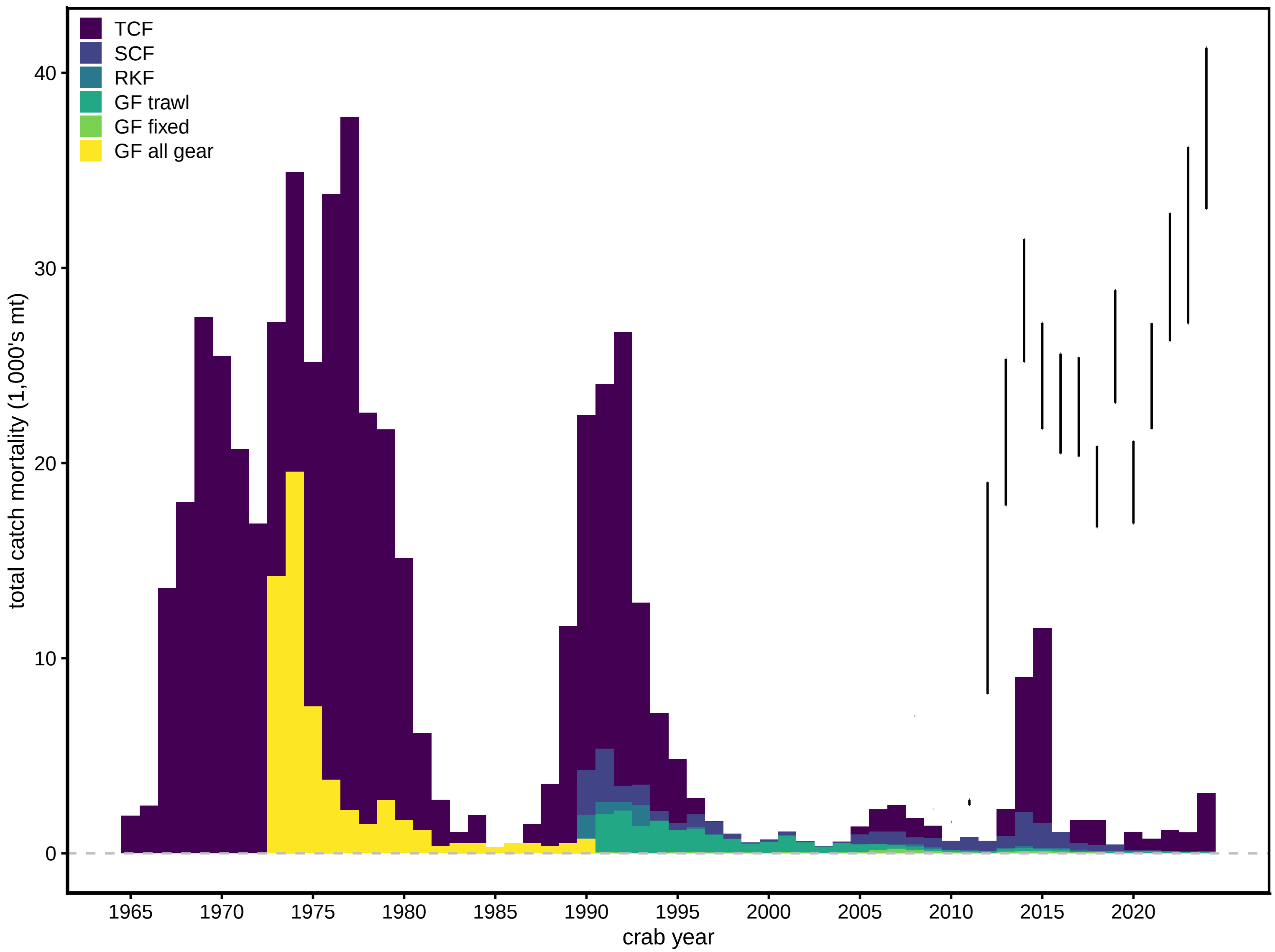


Figure 13. Total catch mortality (biomass) estimates for Tanner crab (sexes combined) in the directed Tanner crab (TCF), snow crab (SCF), Bristol Bay red king crab (RKF), and groundfish fisheries (GF). The bars indicate the Tier 3 OFL and ABC (upper and lower limits, respectively; values start in 2011/12). Values for discards in the crab fisheries are not available prior to 1991/92.

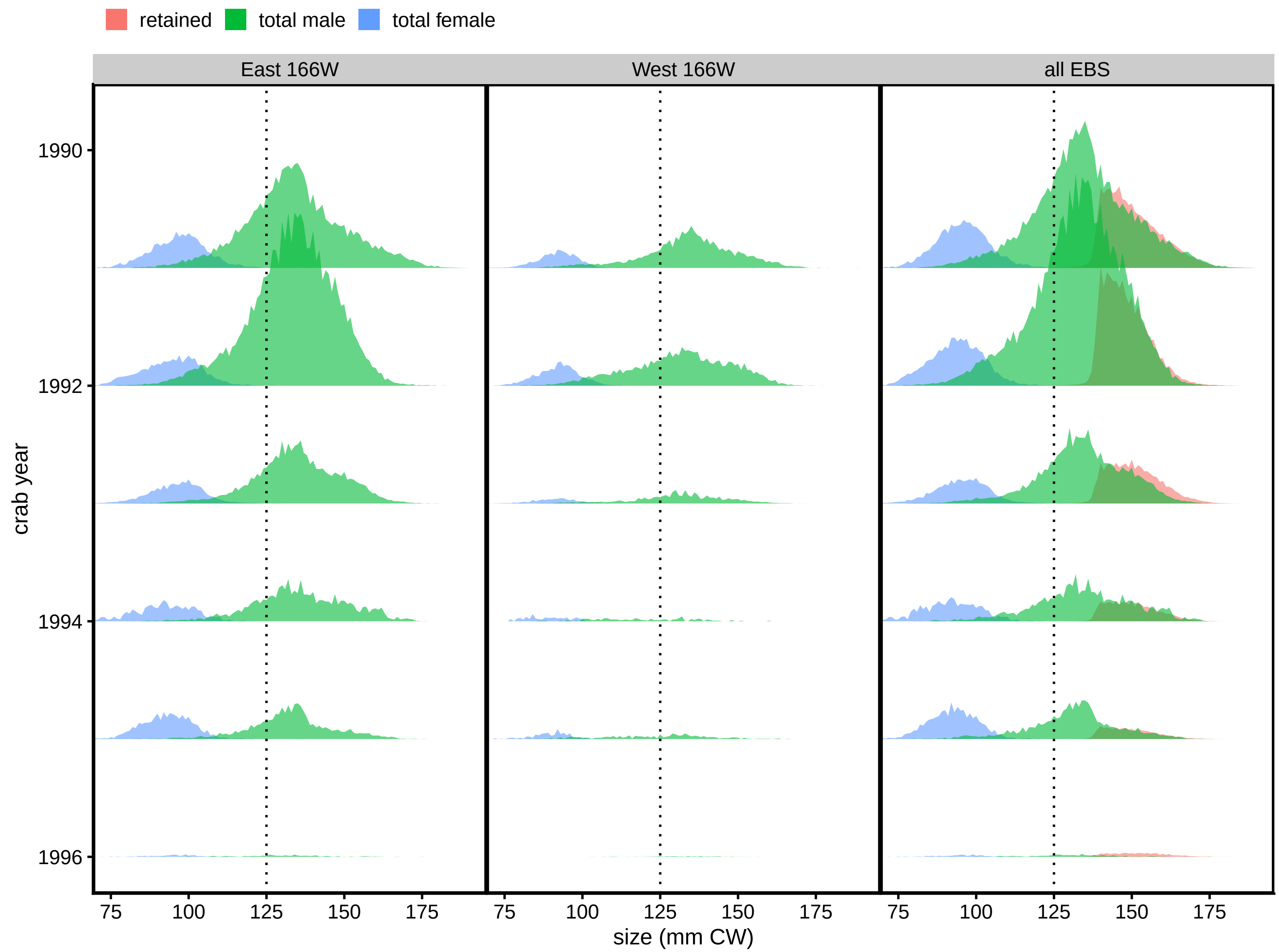


Figure 14. Comparison of expanded size compositions for retained and total catch in the directed fishery prior to 1997/98. Retained catch has already been aggregated across ADF&G management areas. Dotted line indicates recent industry-preferred size.

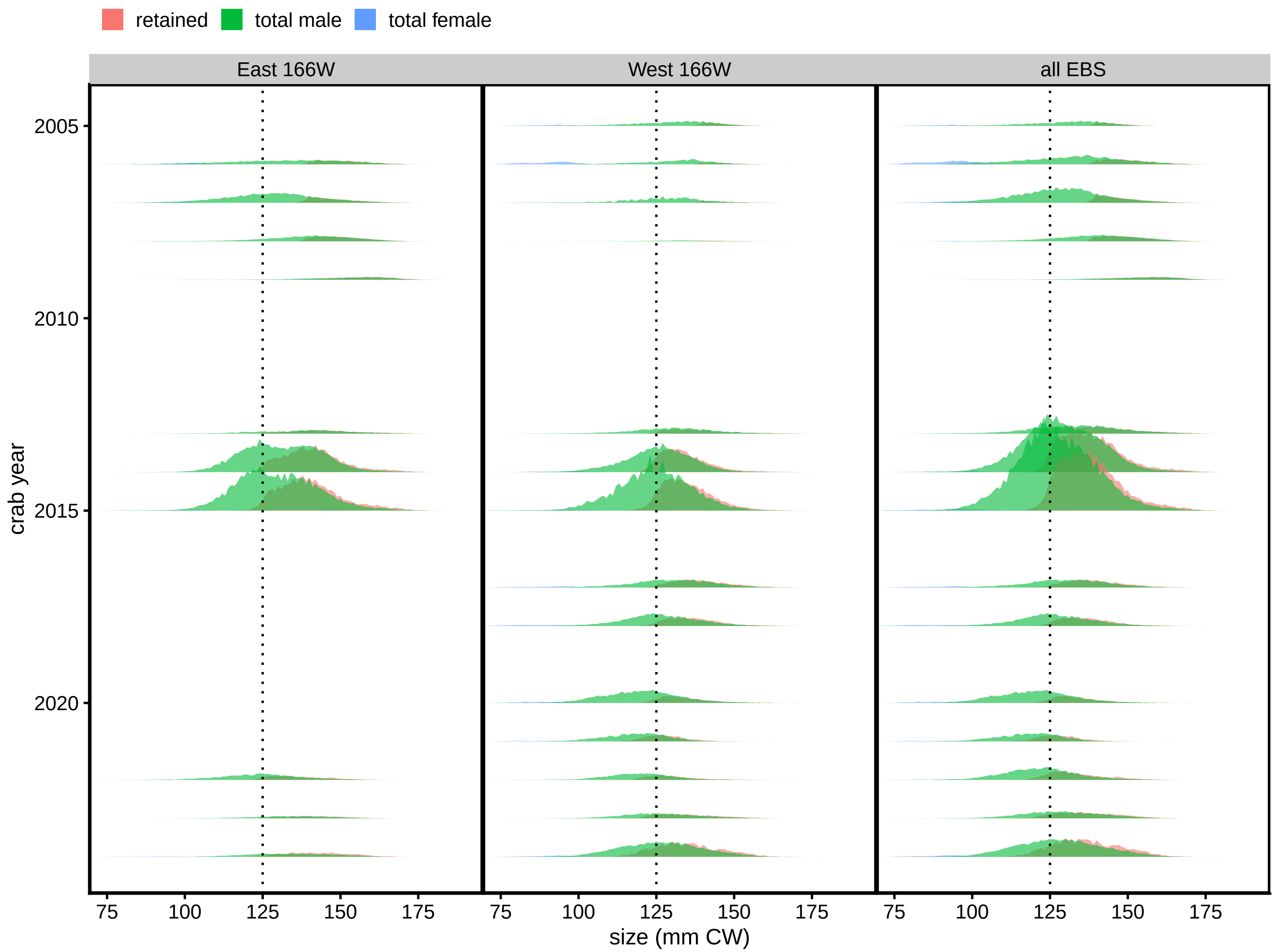


Figure 15. Comparison of expanded size compositions for retained and total catch in the directed fishery after 2004/05. Dotted line indicates recent industry-preferred size.

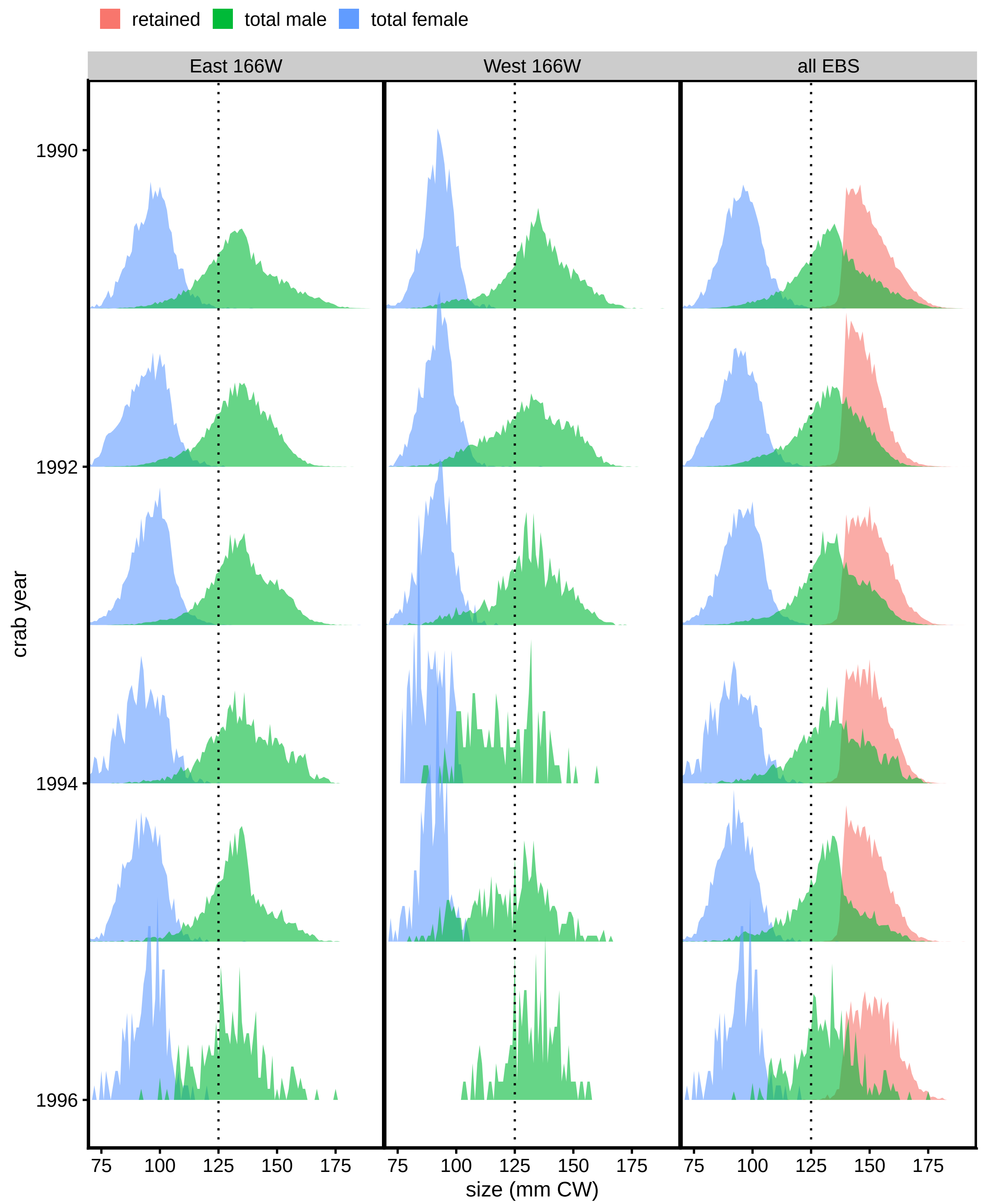


Figure 16. Comparison of *relative* size compositions for retained and total catch in the directed fishery prior to 1997/98. Individual compositions are scaled to sum to 1 across sizes. Retained catch has already been aggregated across ADF&G management areas. Dotted line indicates recent industry-preferred size.

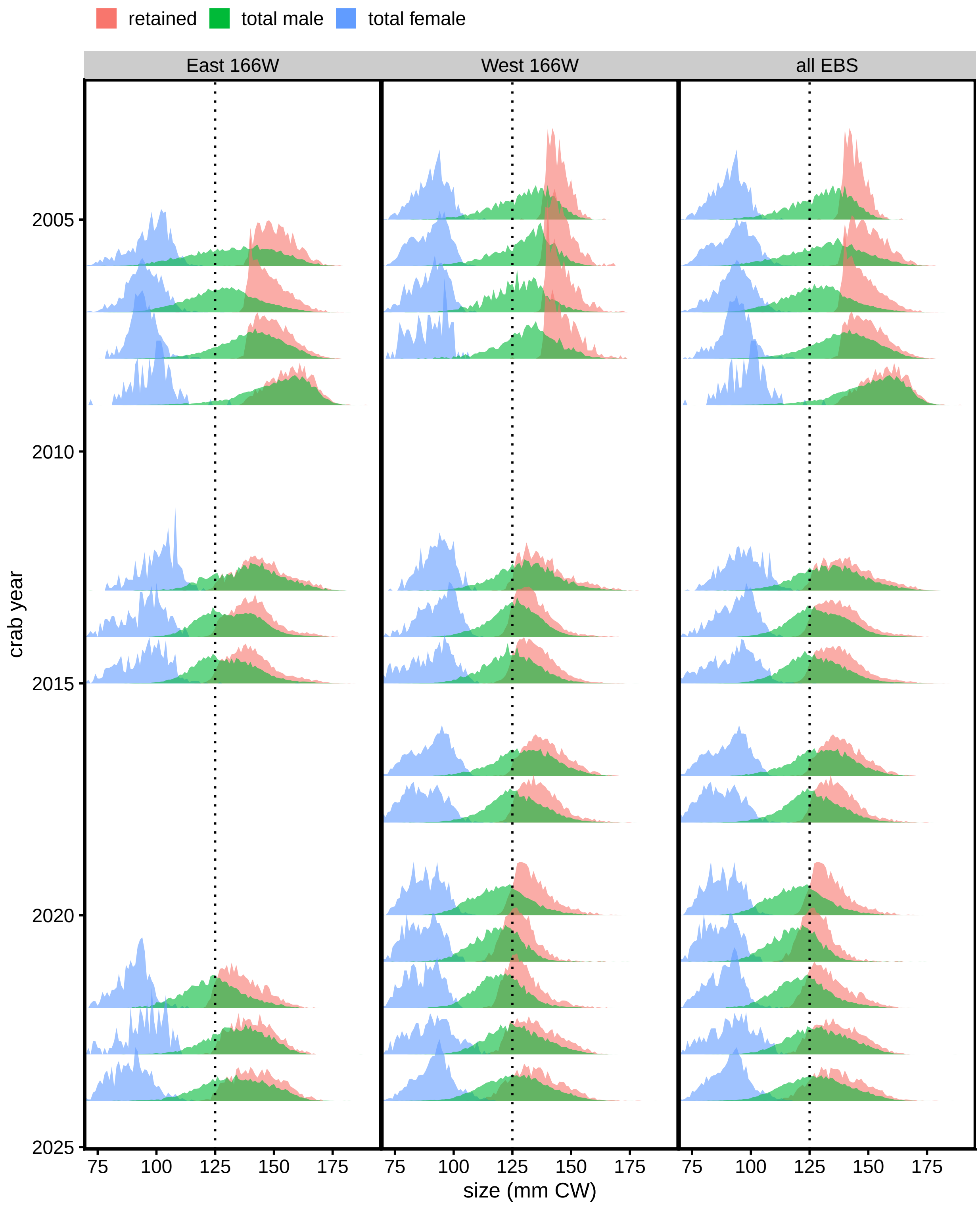


Figure 17. Comparison of *relative* size compositions for retained and total catch in the directed fishery after 2004/05. Individual compositions are scaled to sum to 1 across sizes. Dotted line indicates recent industry-preferred size.

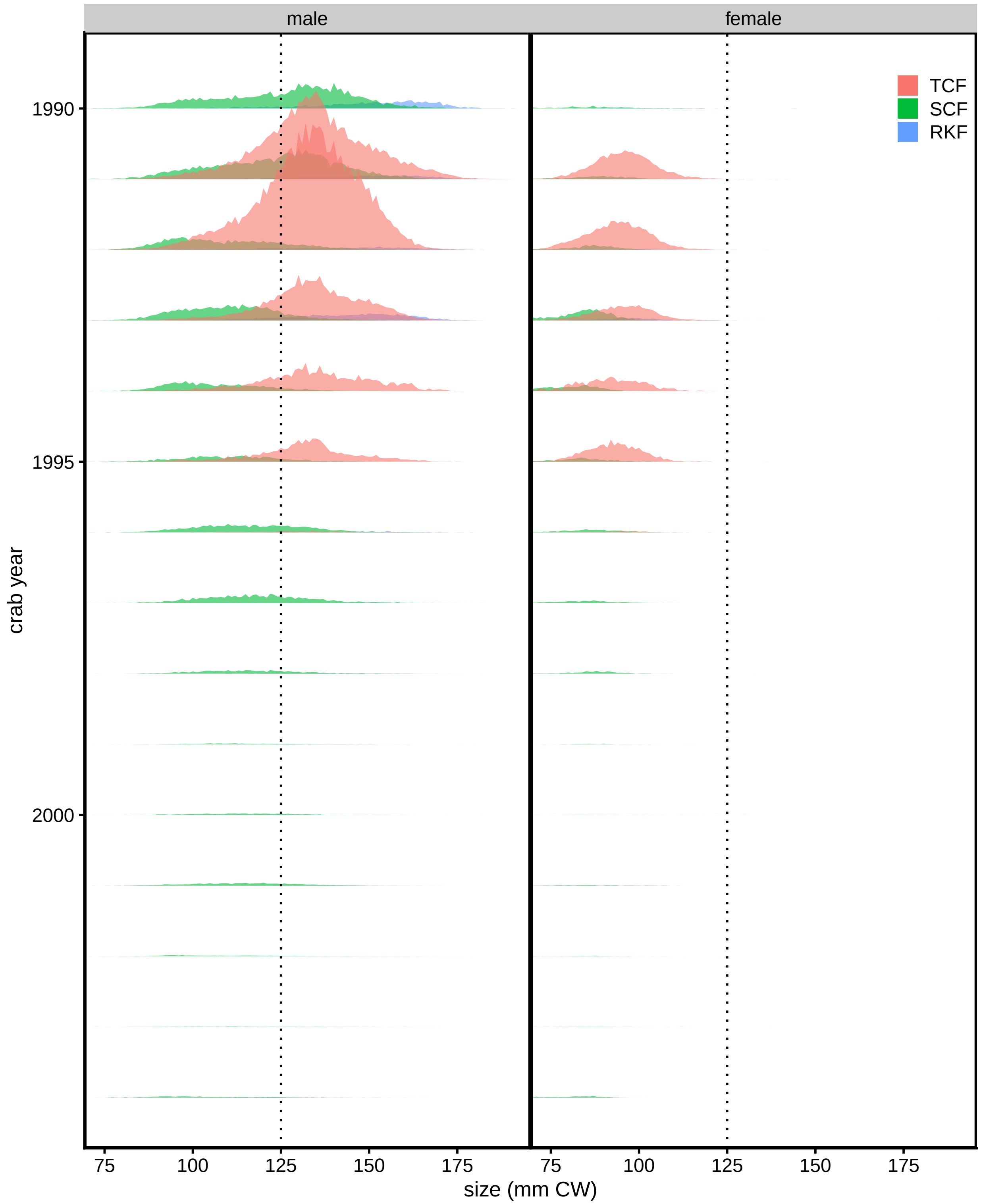


Figure 18. Comparison of expanded size compositions for total catch of Tanner crab in the crab fisheries prior to 2005/06. Catch has already been aggregated across ADF&G management areas. Dotted line indicates recent industry-preferred size. TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: BBRKC fishery.

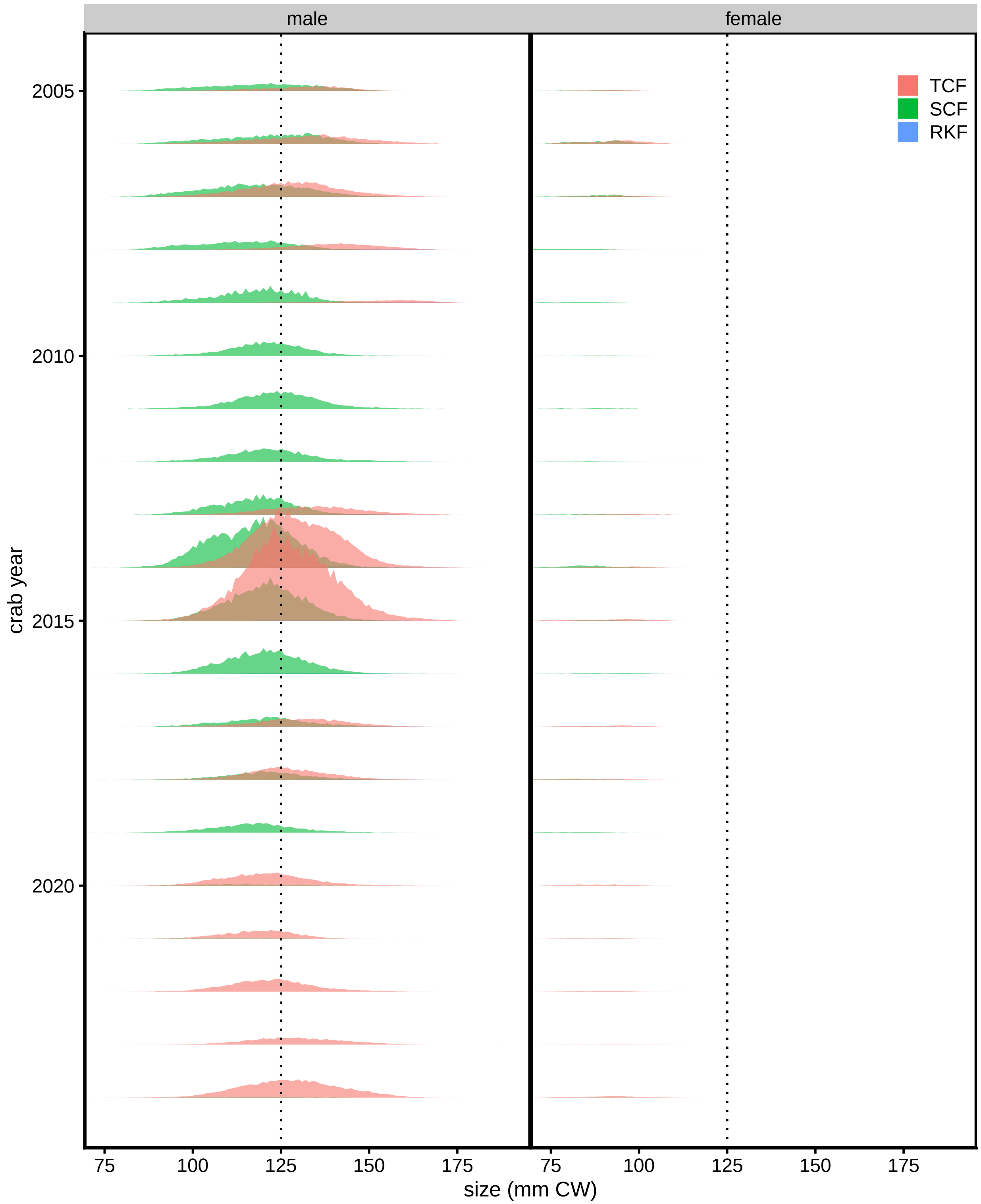


Figure 19. Comparison of expanded size compositions for total catch of Tanner crab in the crab fisheries after 2004/05. Catch has already been aggregated across ADF&G management areas. Dotted line indicates recent industry-preferred size. TCF: directed Tanner crab fishery; SCF: snow crab fishery; RKF: BBRKC fishery.

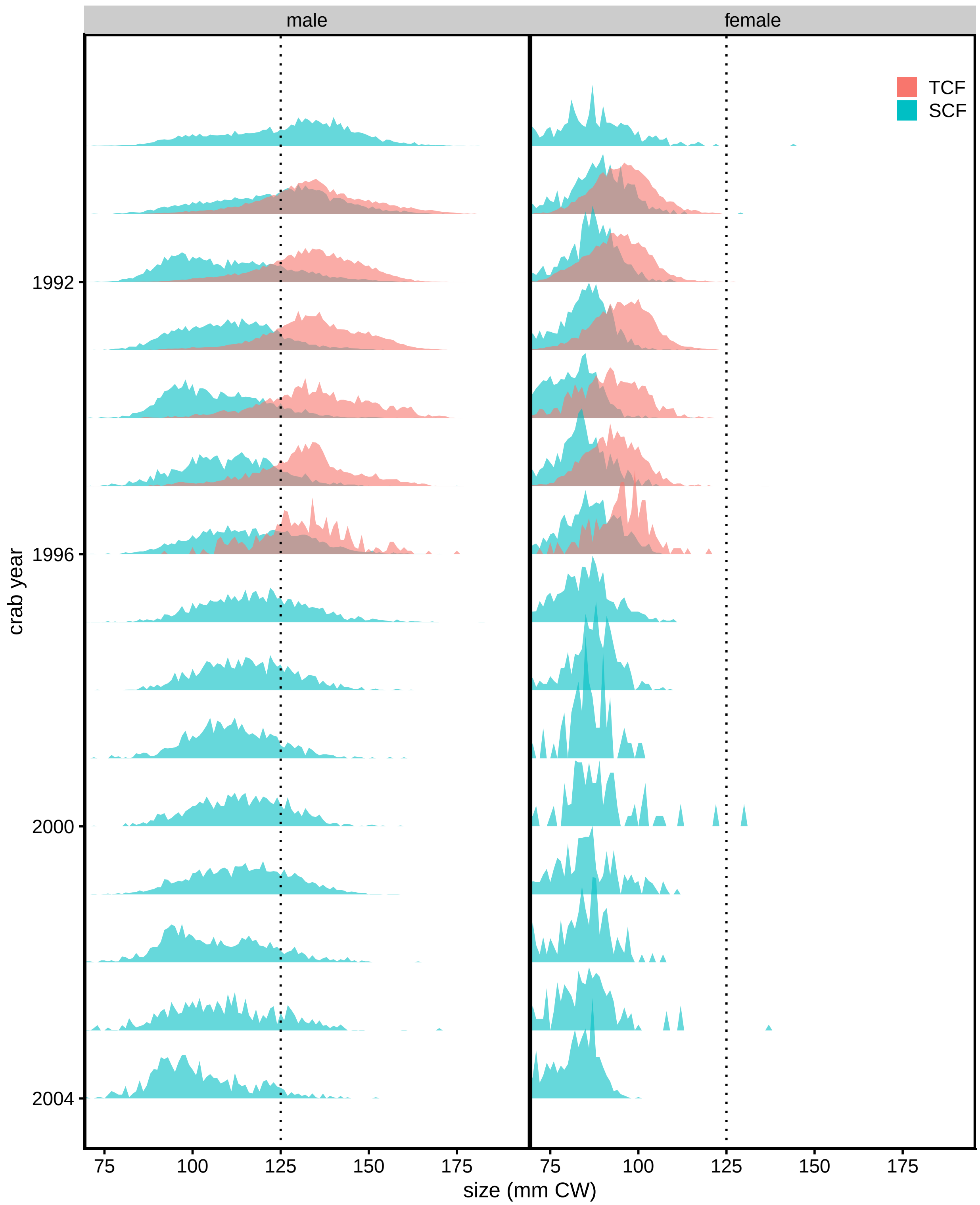


Figure 20. Comparison of *relative* size compositions for total catch of Tanner crab in the directed and snow crab fisheries prior to 2005/06. Catch has already been aggregated across ADF&G management areas. Individual compositions are scaled to sum to 1 across sizes. Dotted line indicates recent industry-preferred size. TCF: directed Tanner crab fishery; SCF: snow crab fishery.

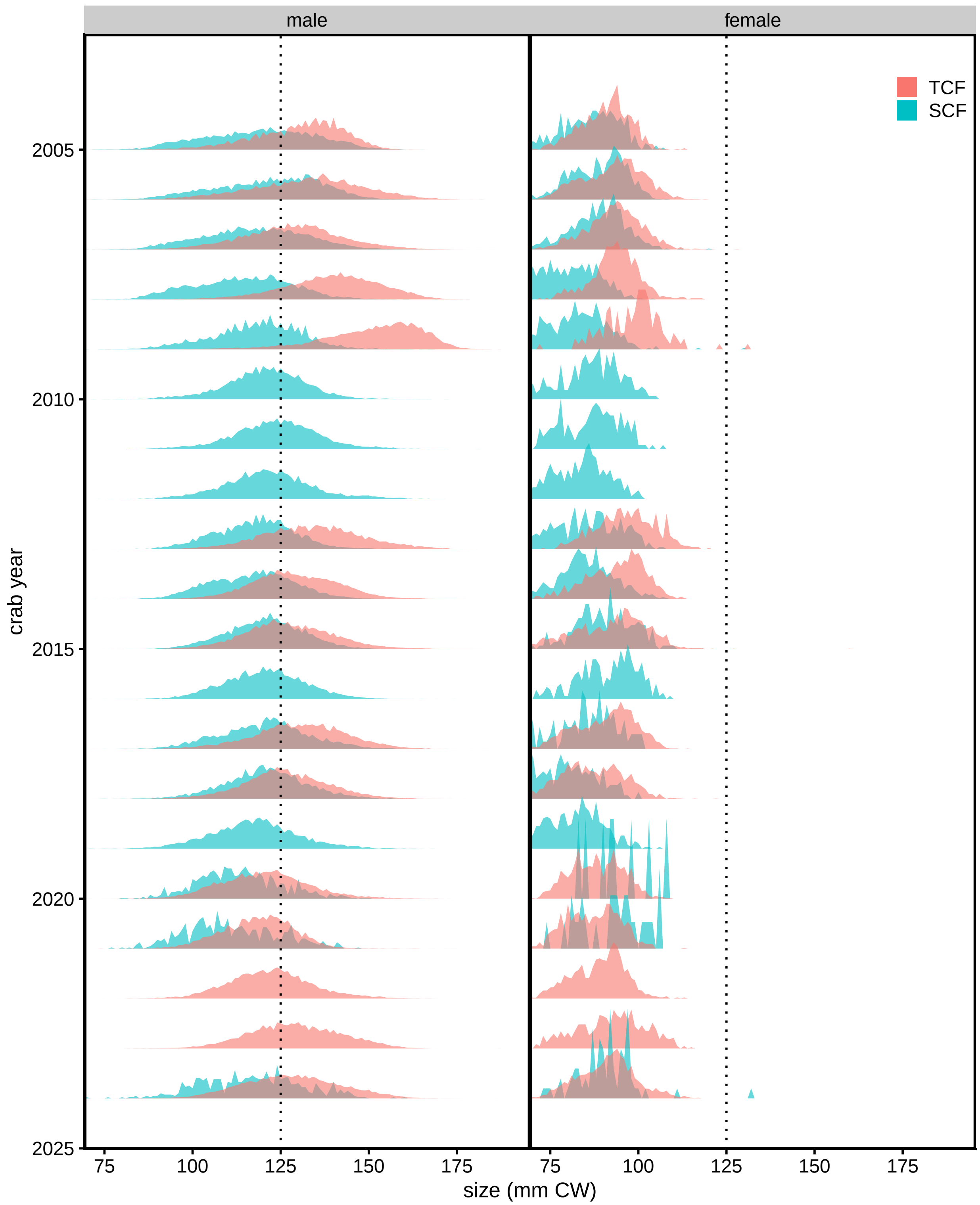


Figure 21. Comparison of *relative* size compositions for total catch of Tanner crab in the crab fisheries after 2004/05. Catch has already been aggregated across ADF&G management areas. Individual compositions are scaled to sum to 1 across sizes. Dotted line indicates recent industry-preferred size. TCF: directed Tanner crab fishery; SCF: snow crab fishery.

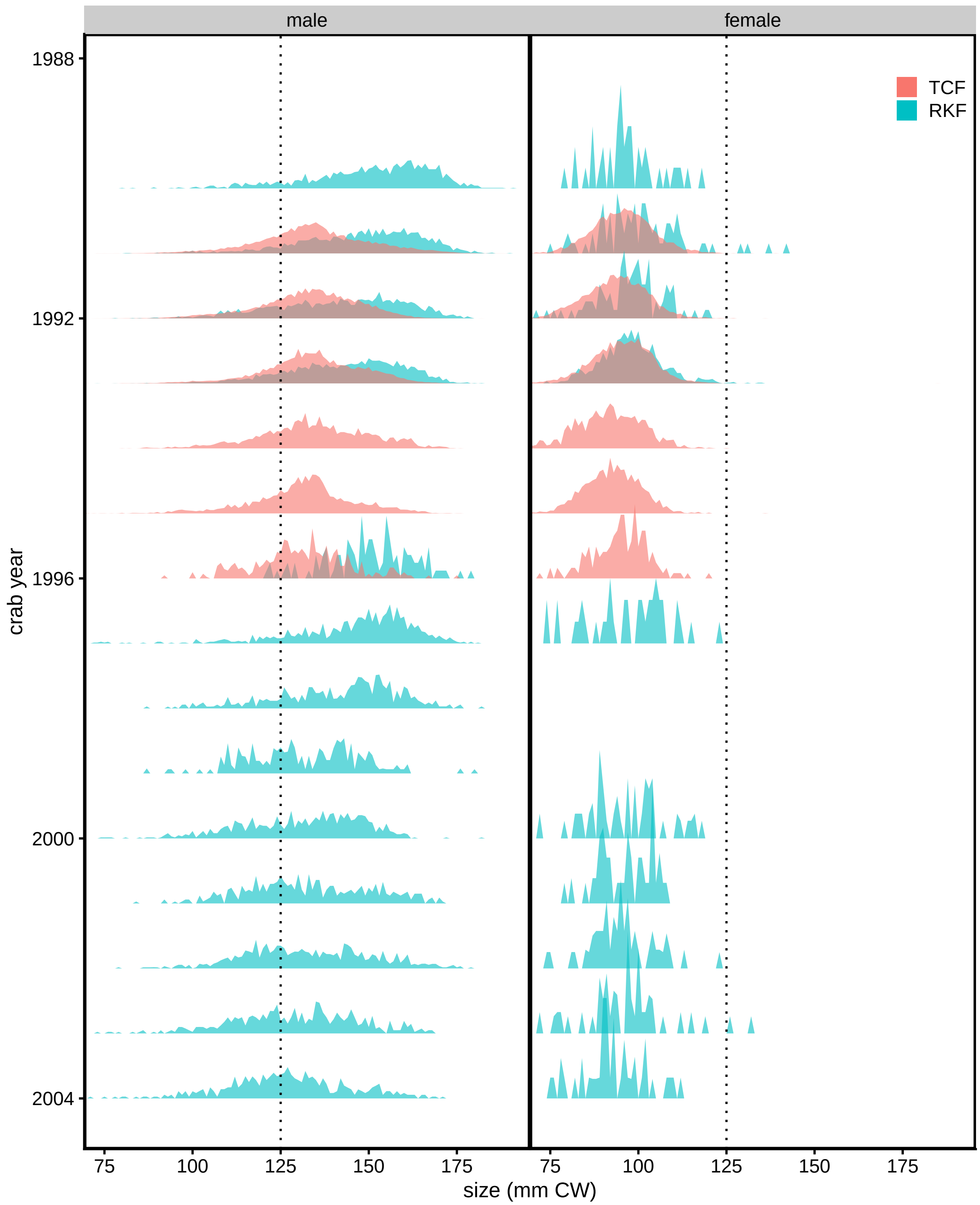


Figure 22. Comparison of *relative* size compositions for total catch of Tanner crab in the directed and BBRKC fisheries prior to 2005/06. Catch has already been aggregated across ADF&G management areas. Individual compositions are scaled to sum to 1 across sizes. Size compositions limited to a few samples are not plotted to improve clarity. Dotted line indicates recent industry-preferred size. TCF: directed Tanner crab fishery; RKF: BBRKC fishery.

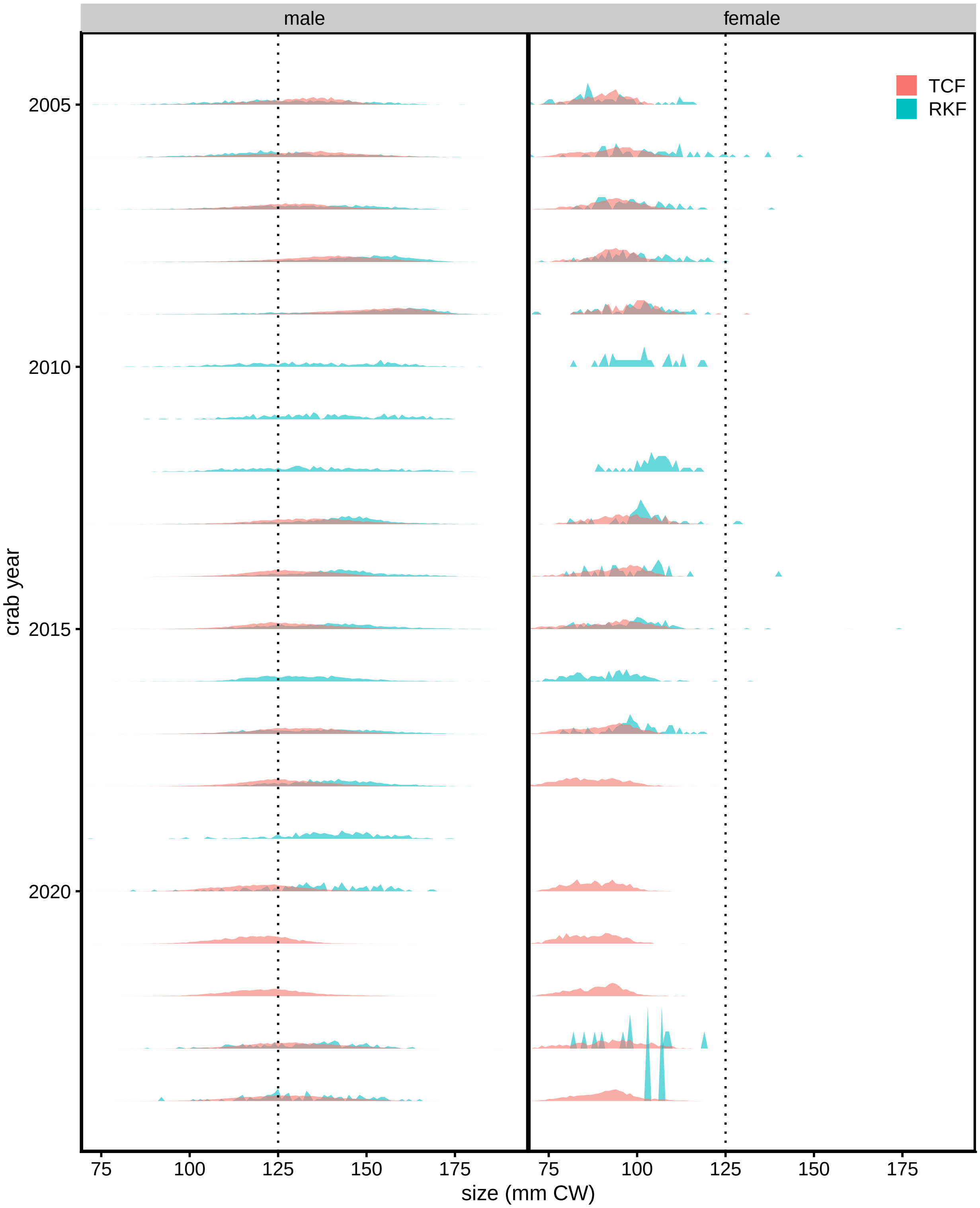


Figure 23. Comparison of *relative* size compositions for total catch of Tanner crab in the directed and BBRKC fisheries after 2004/05. Catch has already been aggregated across ADF&G management areas. Individual compositions are scaled to sum to 1 across sizes. Size compositions lmited to a few samples are not plotted to improve clarity. Dotted line indicates recent industry-preferred size. TCF: directed Tanner crab fishery; RKF: BBRKC fishery.

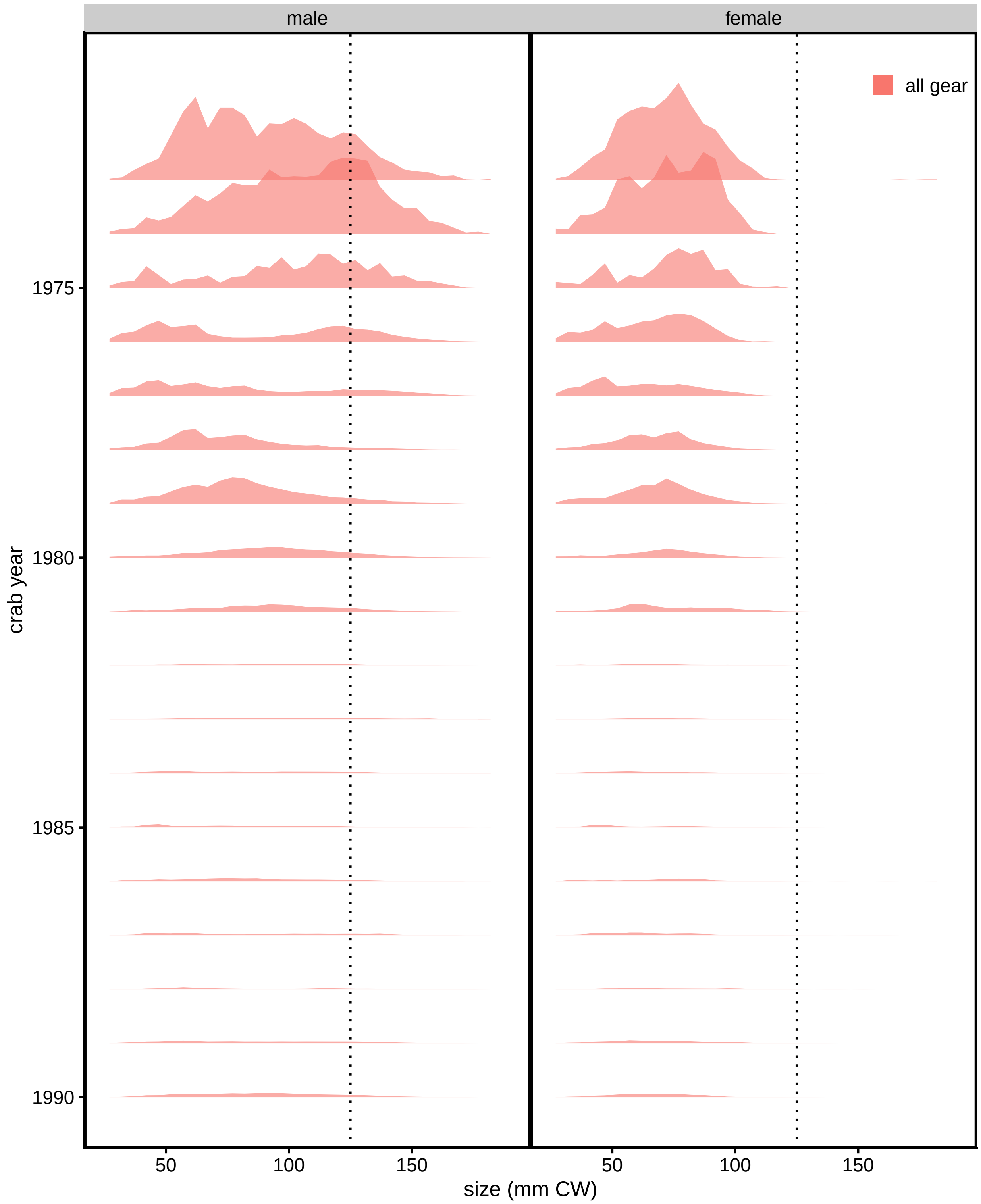


Figure 24. Expanded size compositions for total catch of Tanner crab in the groundfish fisheries prior to 1990/91. Dotted line indicates recent industry-preferred size.

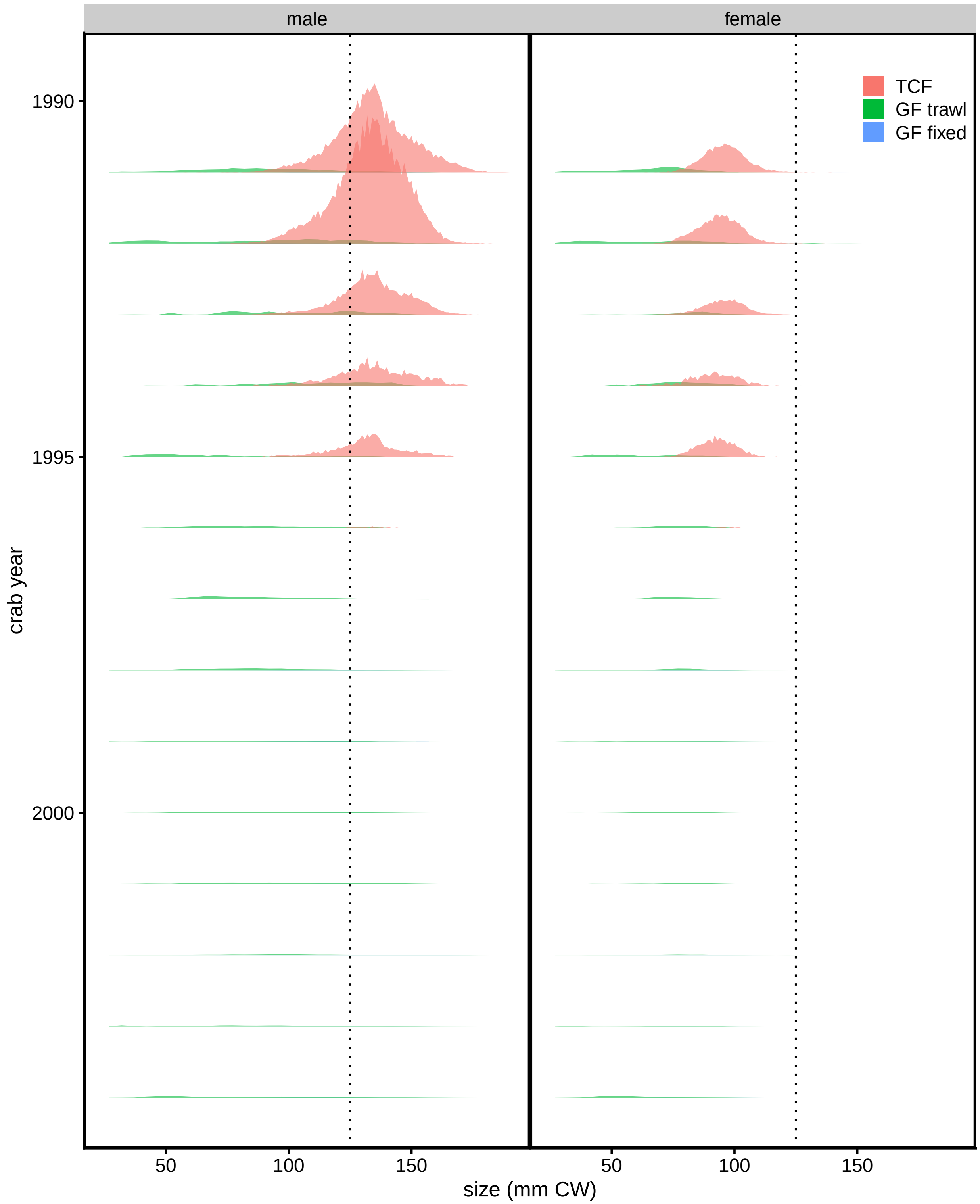


Figure 25. Comparison of expanded size compositions for total catch of Tanner crab in the directed ('TCF') and groundfish ('GF') fisheries during 1991/92-2004/05. Dotted line indicates recent industry-preferred size.

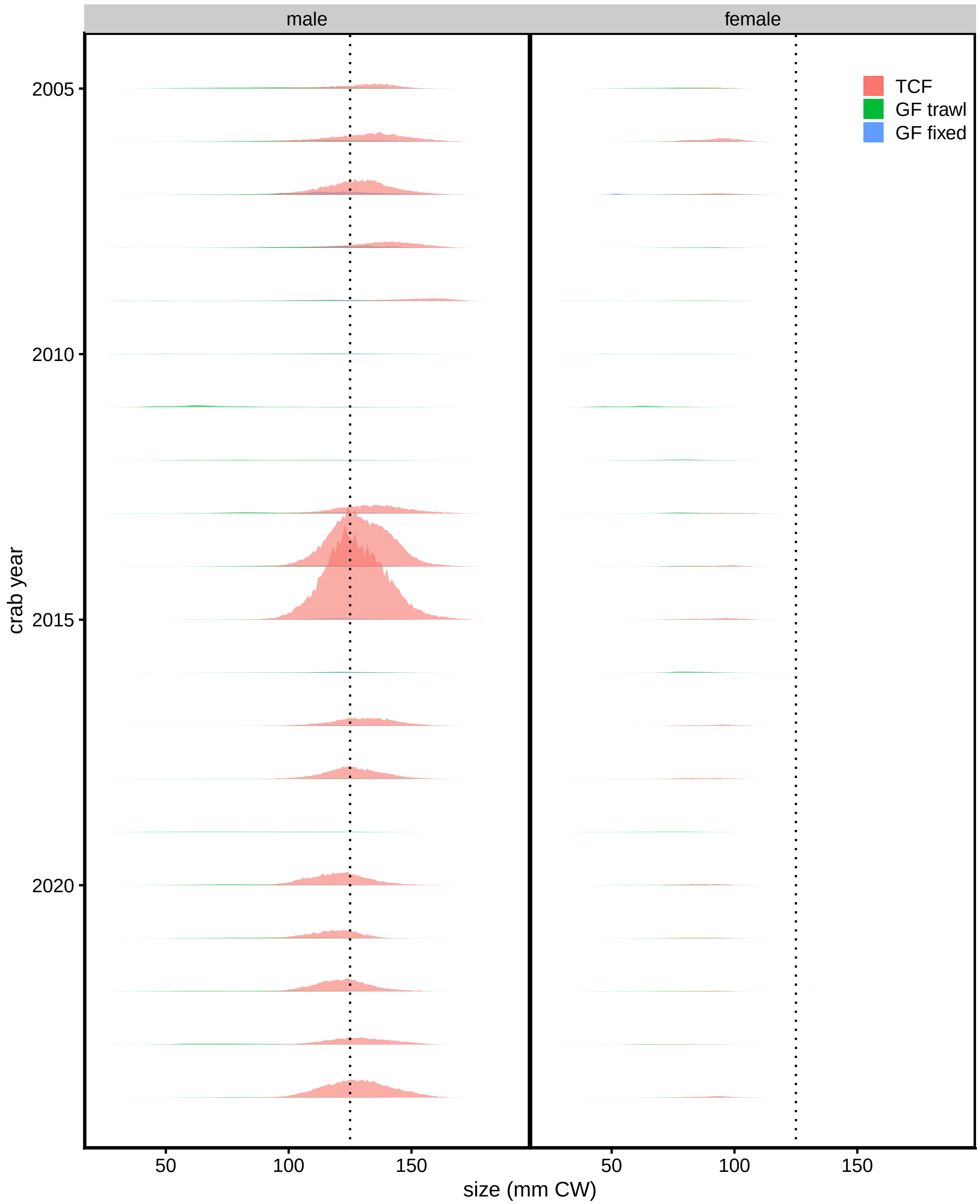


Figure 26. Comparison of expanded size compositions for total catch of Tanner crab in the directed ('TCF') and groundfish ('GF') fisheries since 2005/06. Dotted line indicates recent industry-preferred size.

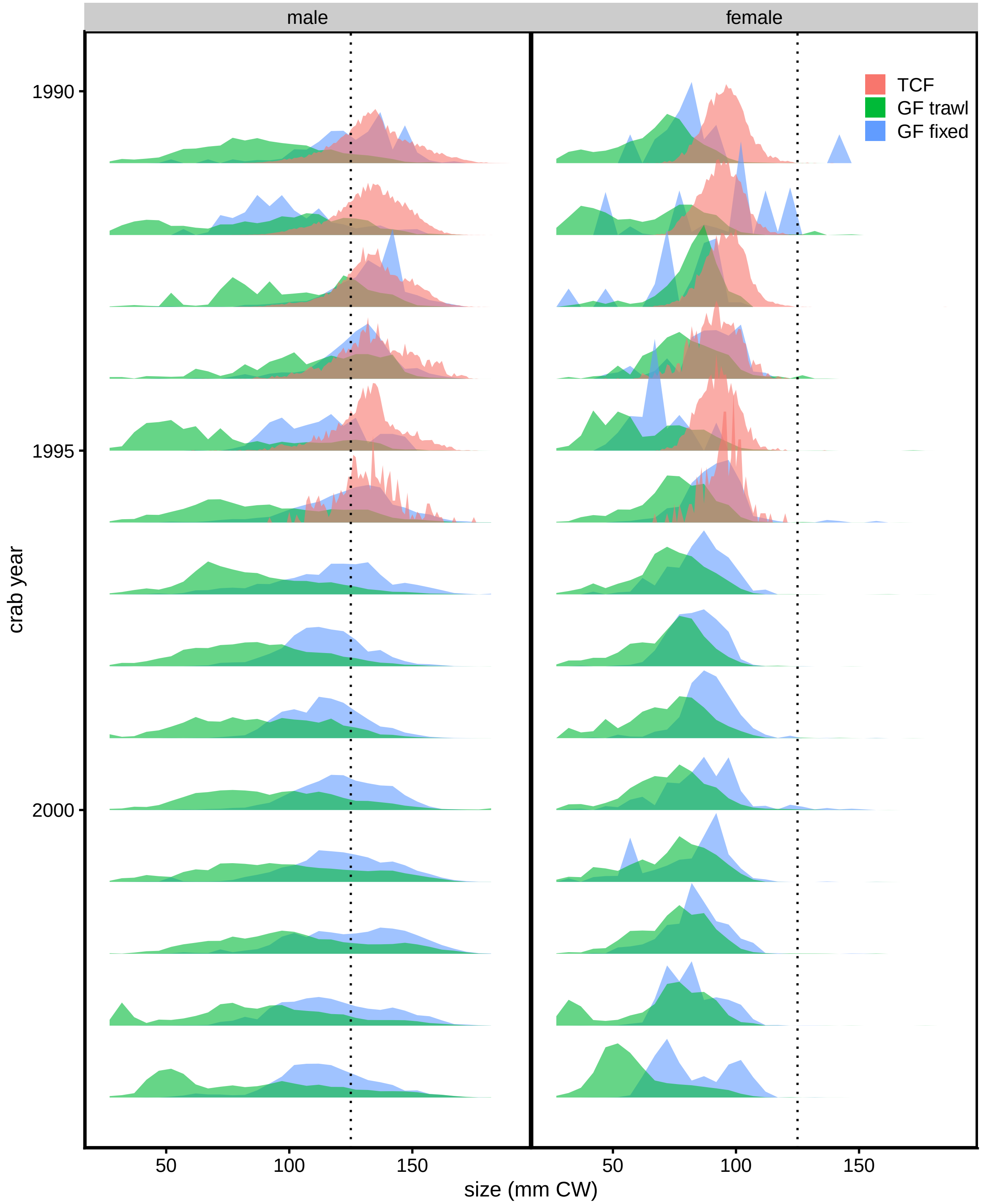


Figure 27. Comparison of *relative* size compositions for total catch of Tanner crab in the directed ('TCF') and groundfish ('GF') fisheries during 1991/92-2004/05. Dotted line indicates recent industry-preferred size.

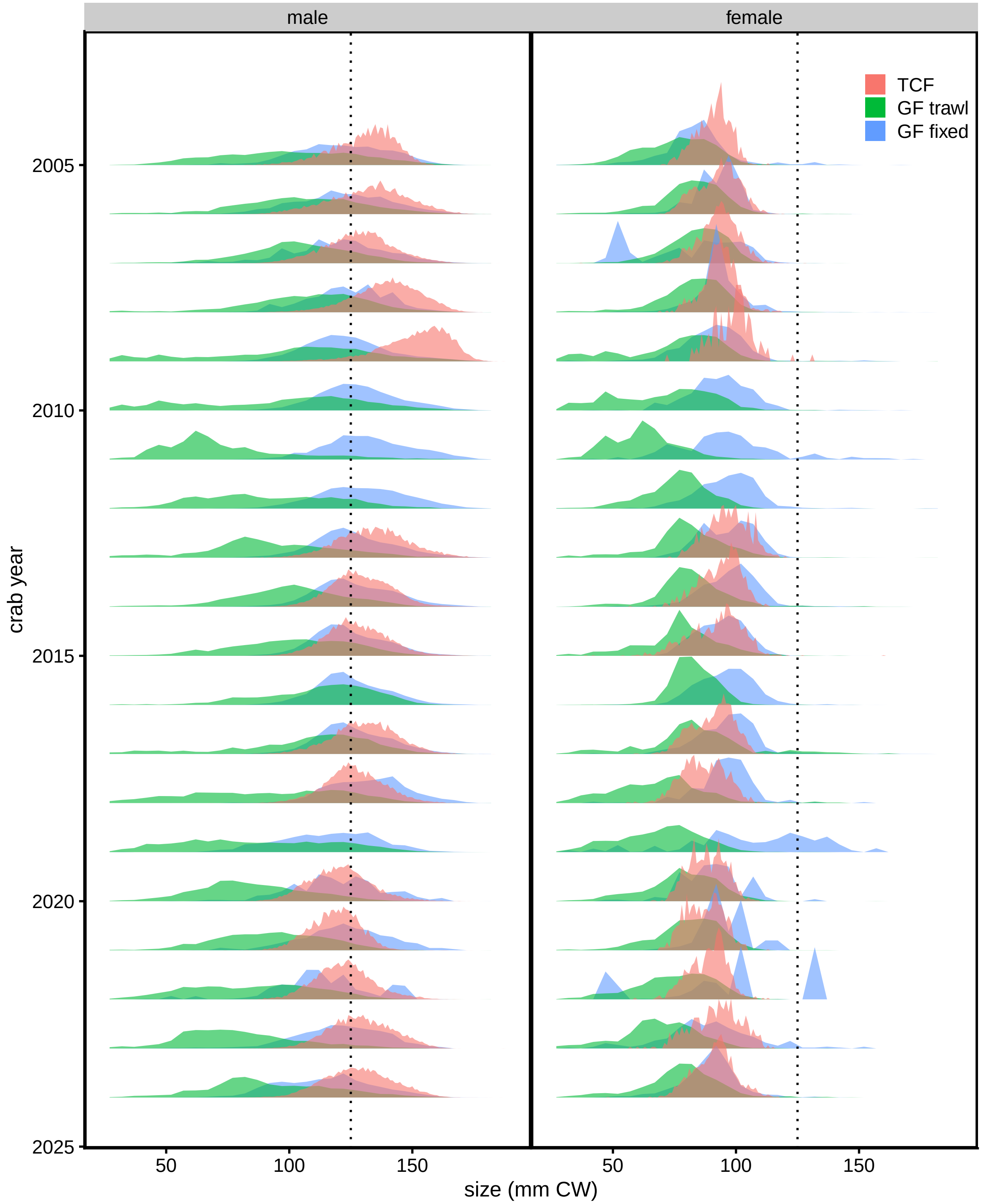


Figure 28. Comparison of *relative* size compositions for total catch of Tanner crab in the directed ('TCF') and groundfish ('GF') fisheries since 2005/06. Dotted line indicates recent industry-preferred size.

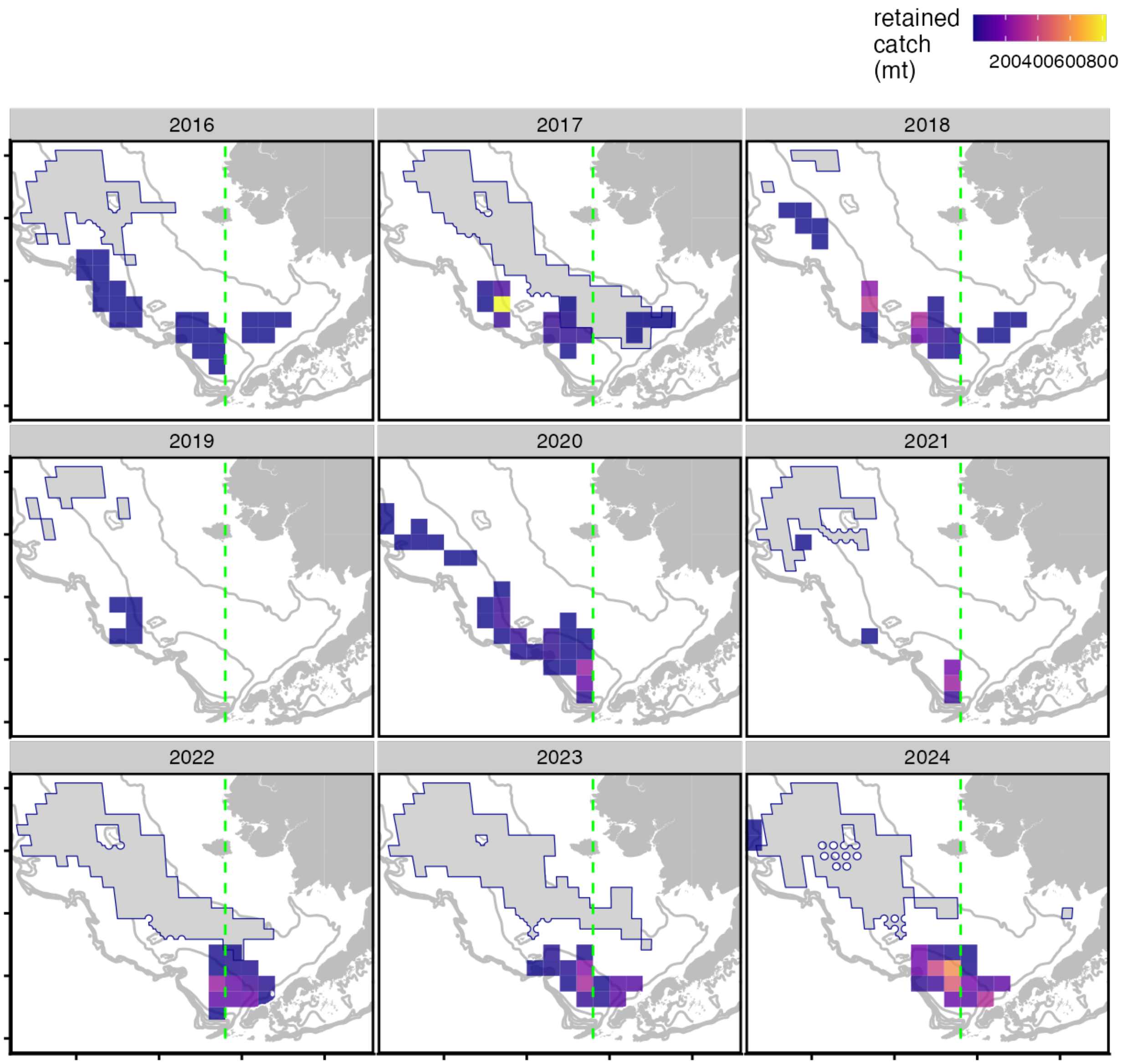


Figure 29. Retained catch in the directed fishery (for a minimum of 3 vessels/statistical area/year). The directed fishery east of 166°W longitude was closed in 2016/17-2021/22. Retained catch in the area was incidentally taken in the BBRKC fishery. The grey polygon with blue outline indicates the summer cold pool location.

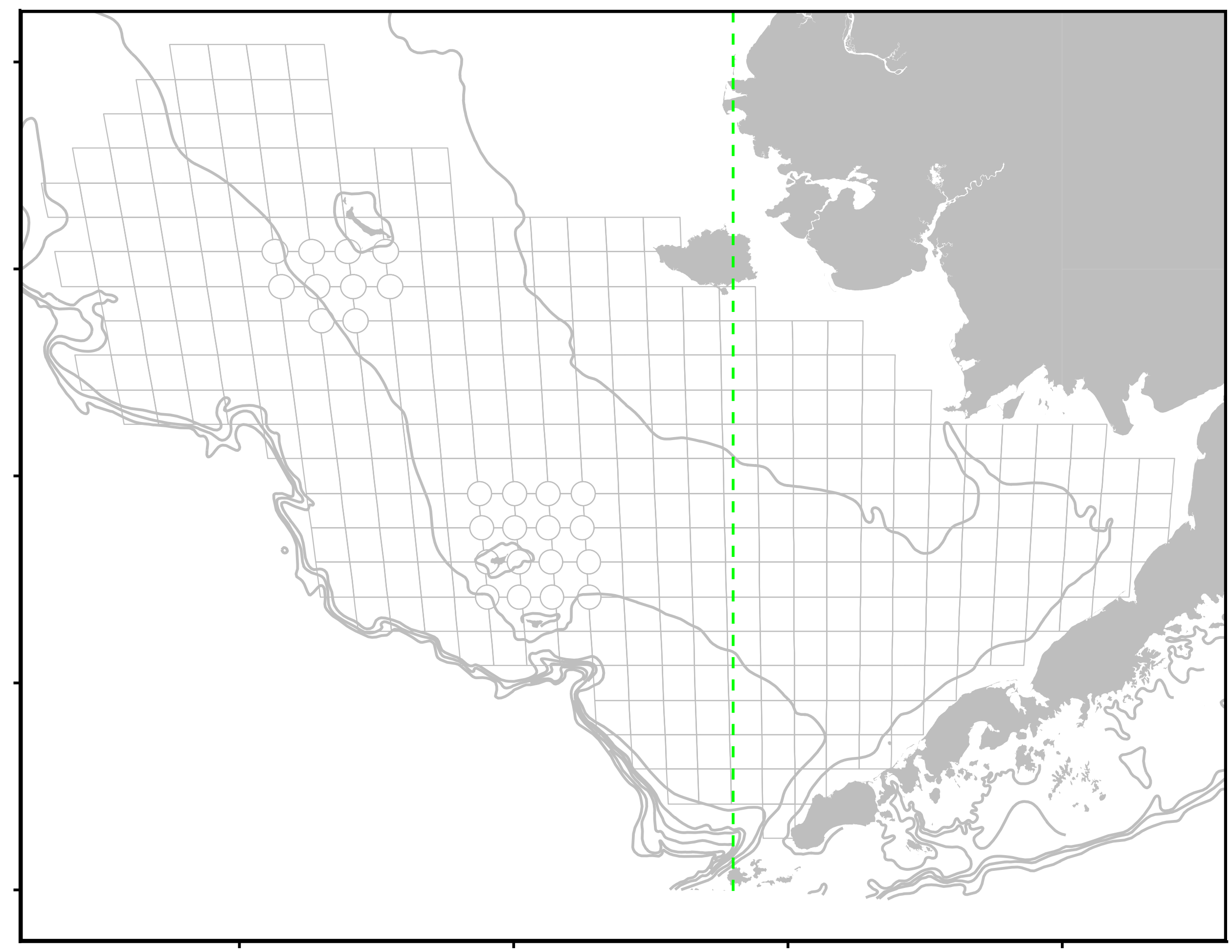


Figure 30. NMFS EBS shelf startion grid (squares and circles). Hauls at the 26 so-called “corner” stations (circles) near the Pribilof Islands and St. Matthew Island were discontinued in 2024.

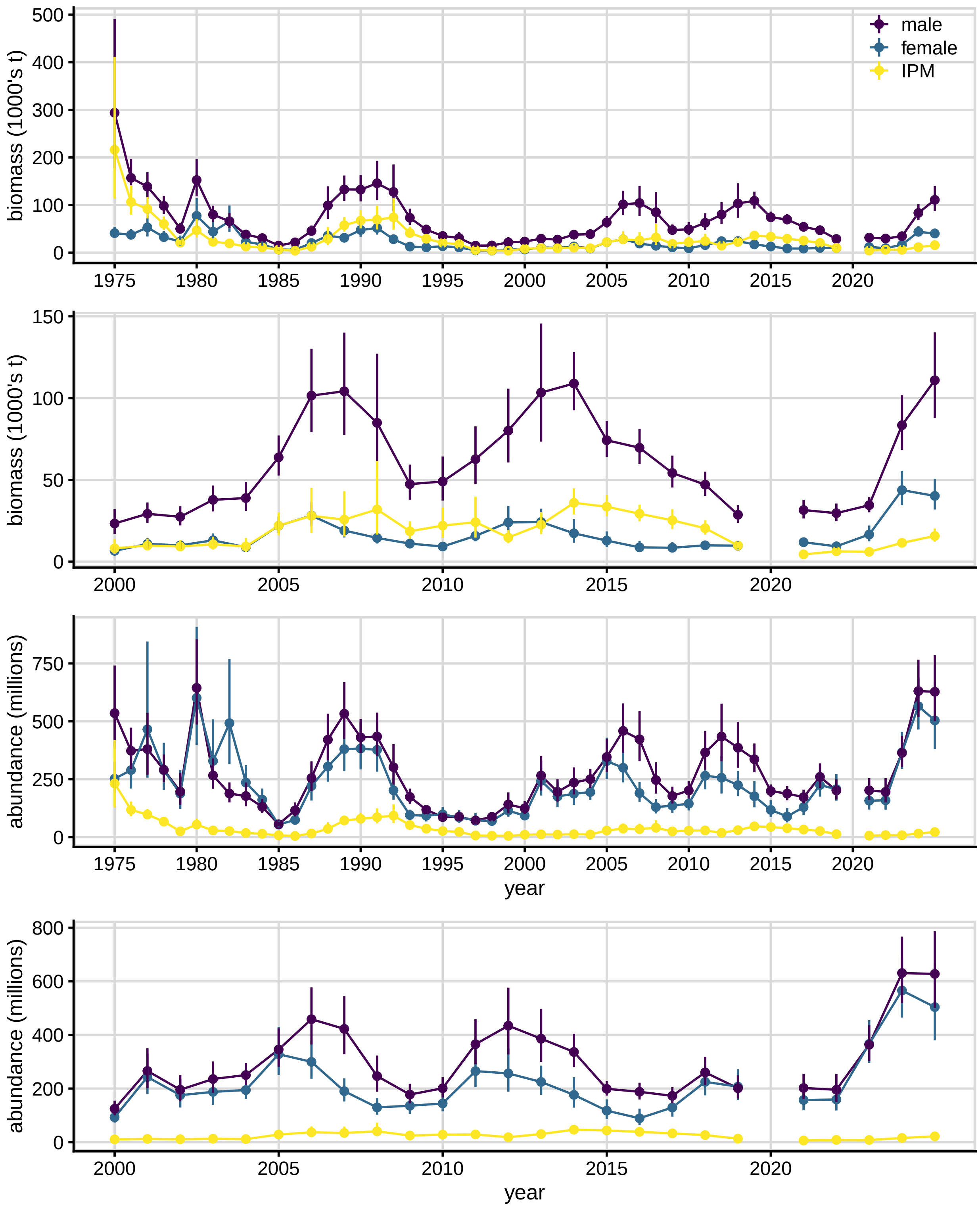


Figure 31. Annual estimates of design-based area-swept biomass (upper plots) and abundance (lower plots) from the NMFS EBS bottom trawl survey by sex. The lower plot in each pair shows the trends since 2000. The biomass/abundance trends for industry-preferred size males (> 125 mm CW; 'IPM') are also shown.

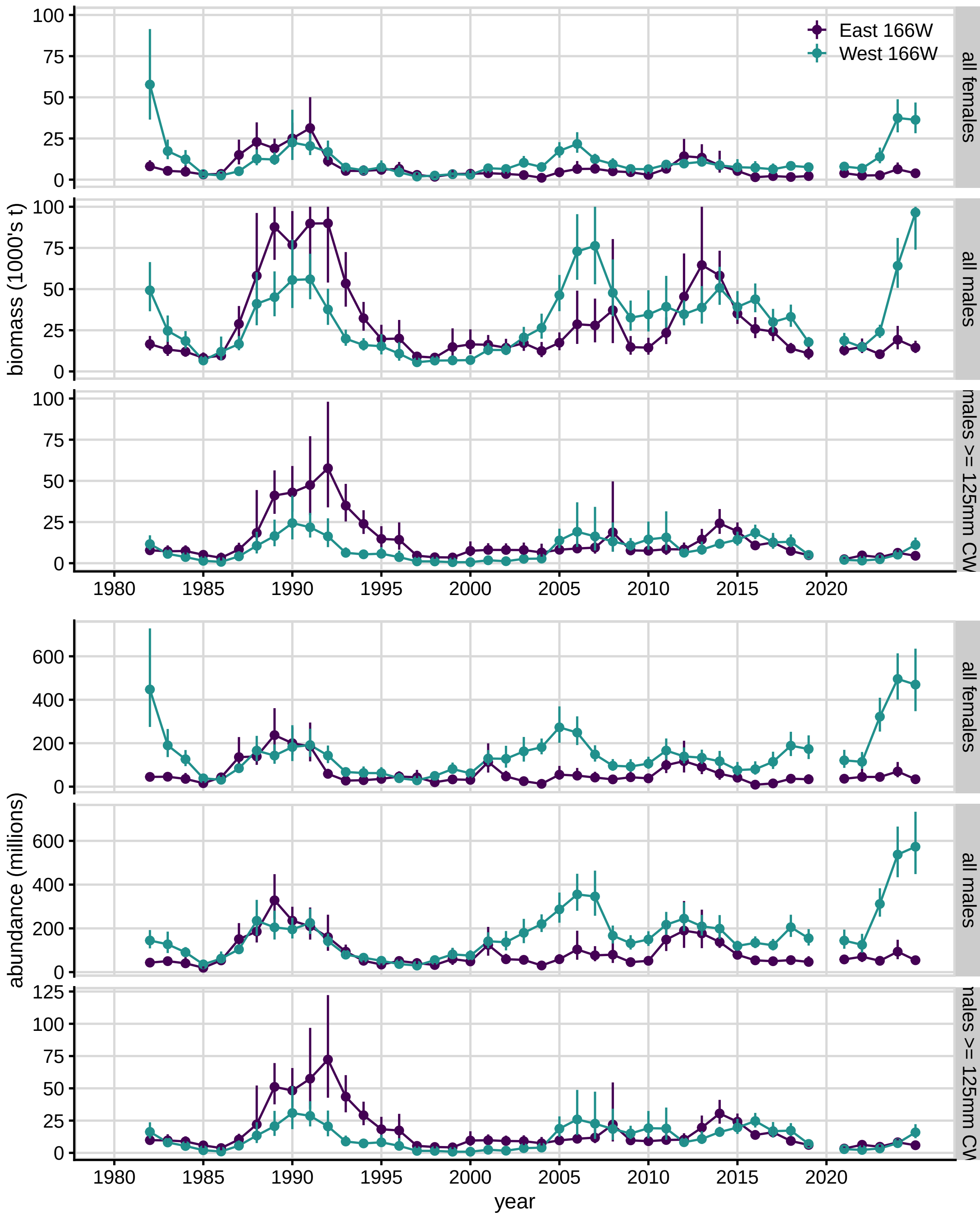


Figure 32. Annual estimates of design-based area-swept biomass (upper plots) and abundance (lower plots) from the NMFS EBS bottom trawl survey by population category and management area.

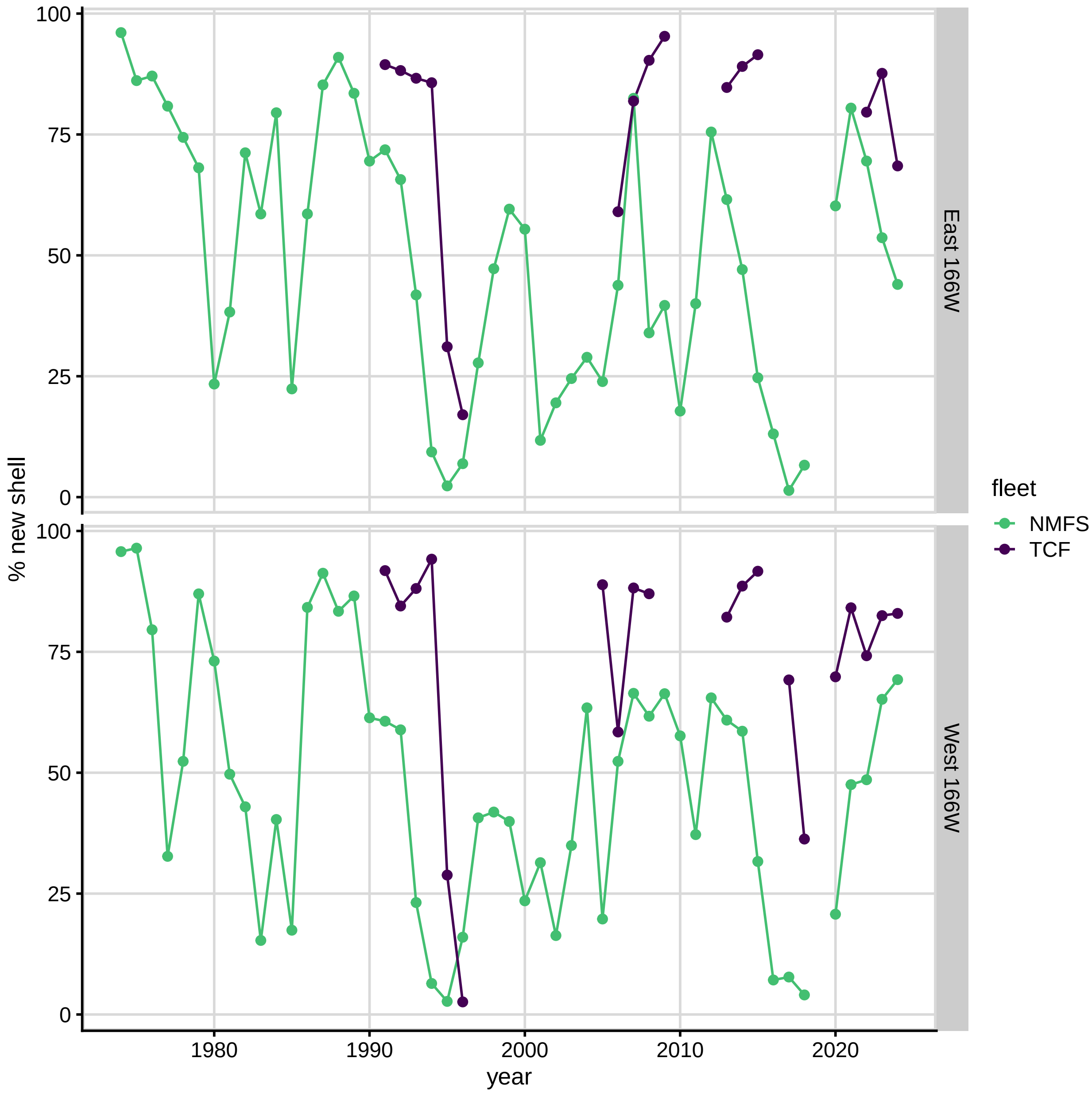


Figure 33. Comparison of the annual percent of new shell industry-preferred size males caught in the NMFS EBS shelf survey and the directed fishery ('TCF'), by ADF&G management area. The survey values have been lagged a year to align visually with the fishery values.

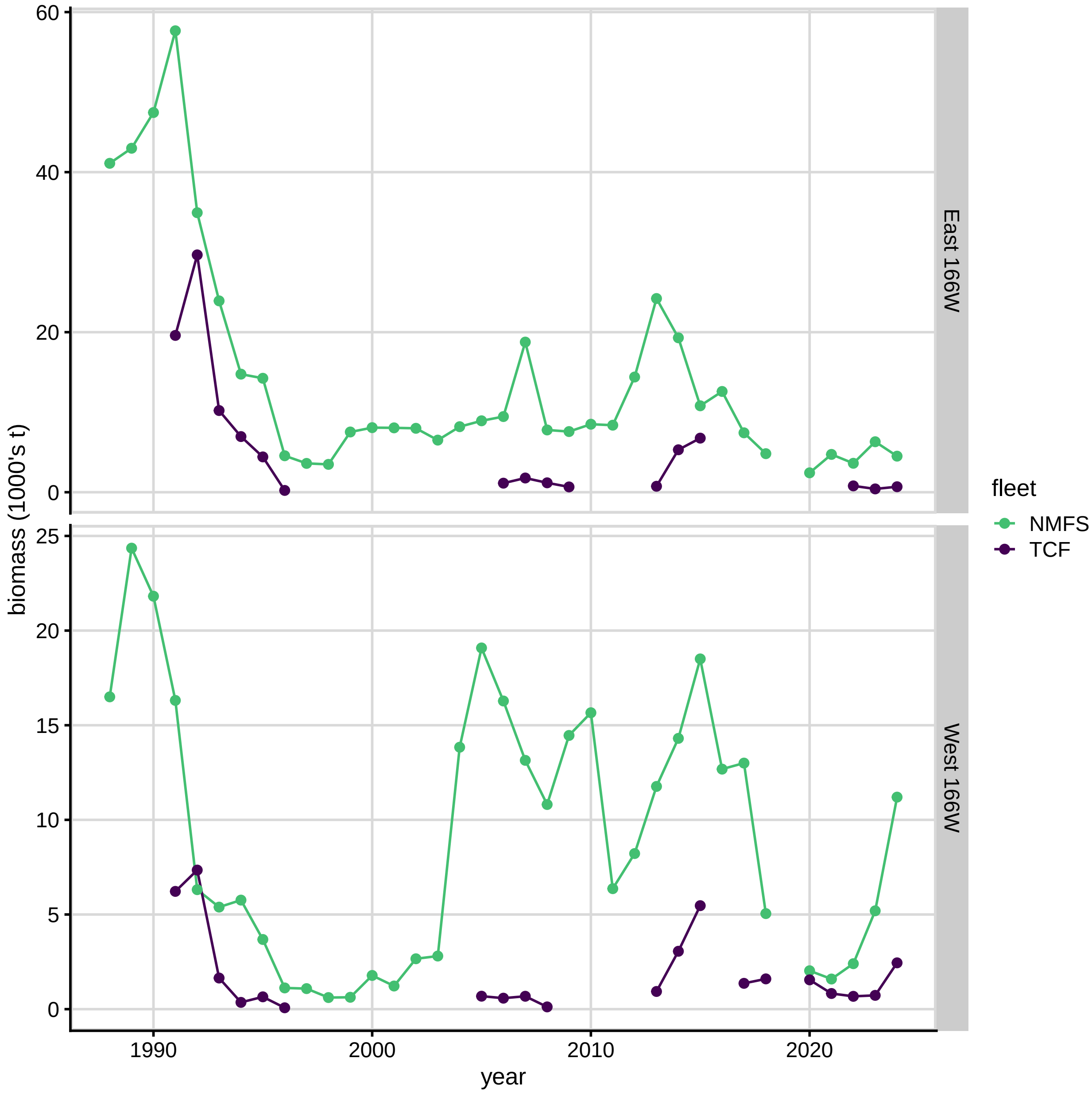


Figure 34. Comparison of the biomass of industry-preferred size males estimated from the NMFS EBS shelf survey and caught in the directed fishery ('TCF'), by ADF&G management area. The survey values have been lagged a year to align visually with the fishery values.

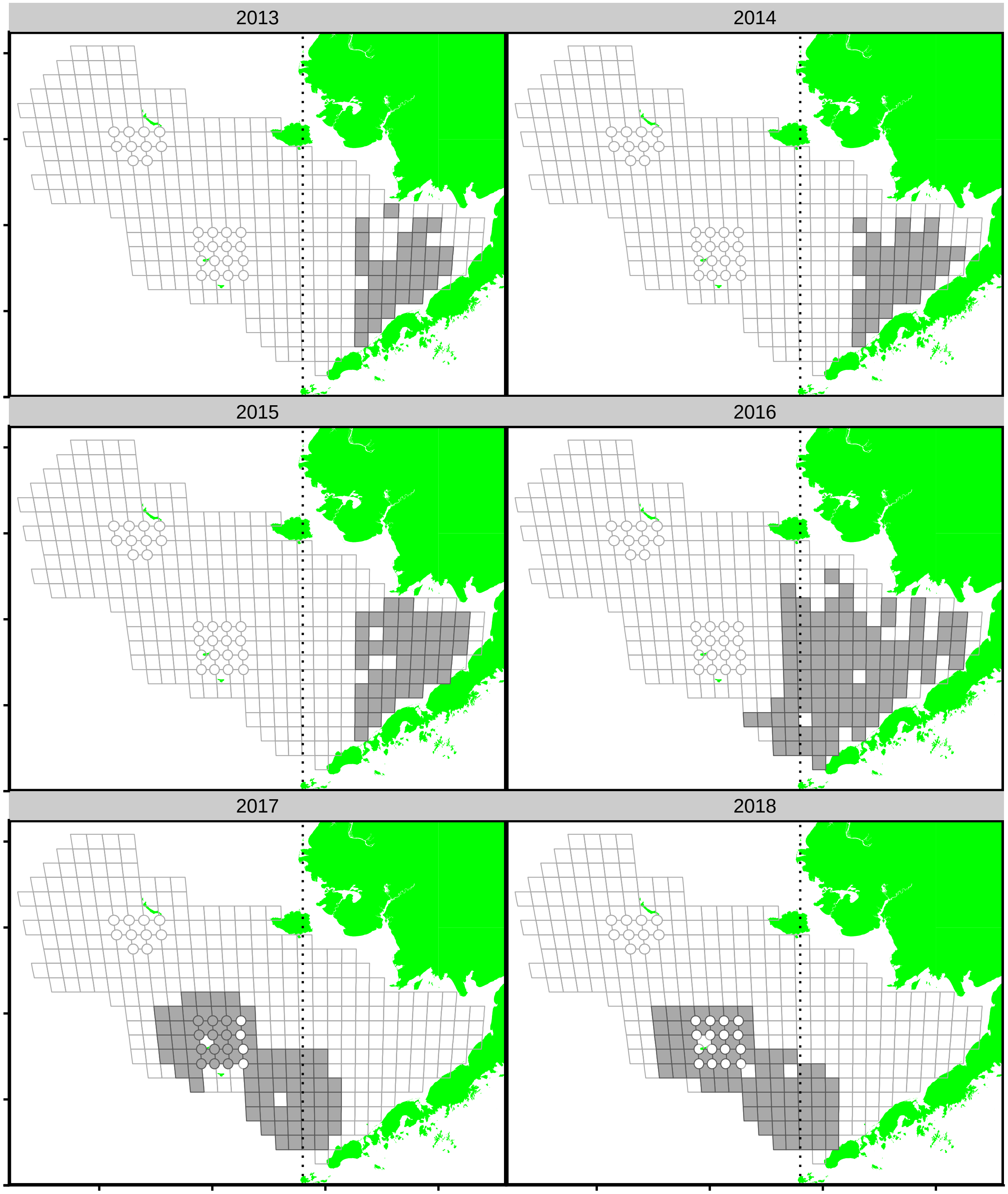


Figure 35. Annual spatial footprints of the BSFRF-NMFS collaborative side-by-side (SBS) Tanner crab catchability studies (2013-2018). BSFRF SBS tows were made in parallel to standard NMFS survey tows at a (different) subset of standard NMFS stations each year of the study. The BSFRF vessel used a modified nephrops bottom trawl assumed to capture all crab within the area swept.

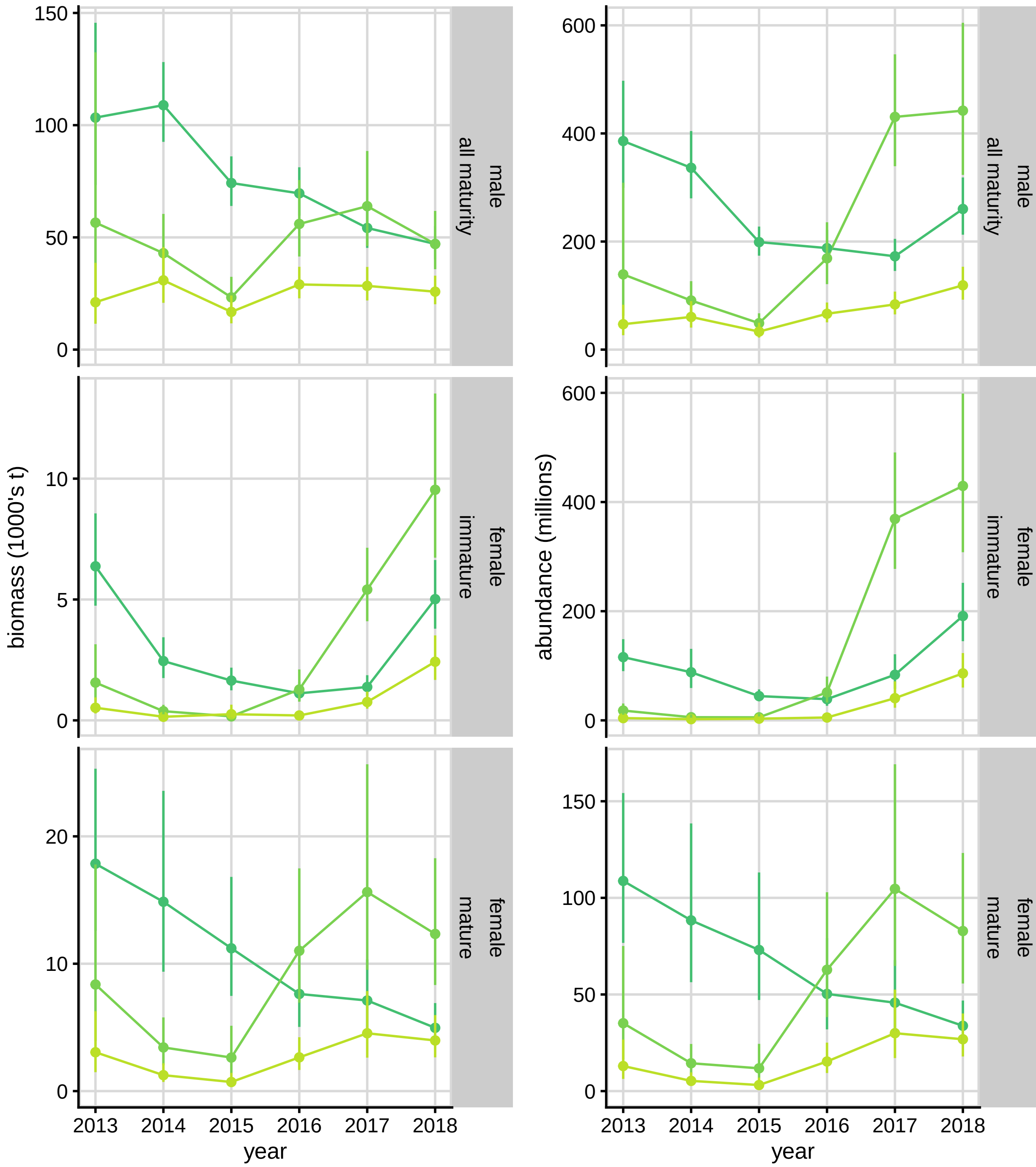


Figure 36. Comparison of estimates of area-swept biomass (left column) and abundance (right column) from the BSFRF-NMFS cooperative side-by-side (SBS) catchability studies and the full NMFS survey in 2013-2018. The SBS studies had different spatial footprints each year, so annual changes in biomass do not necessarily reflect underlying population trends.

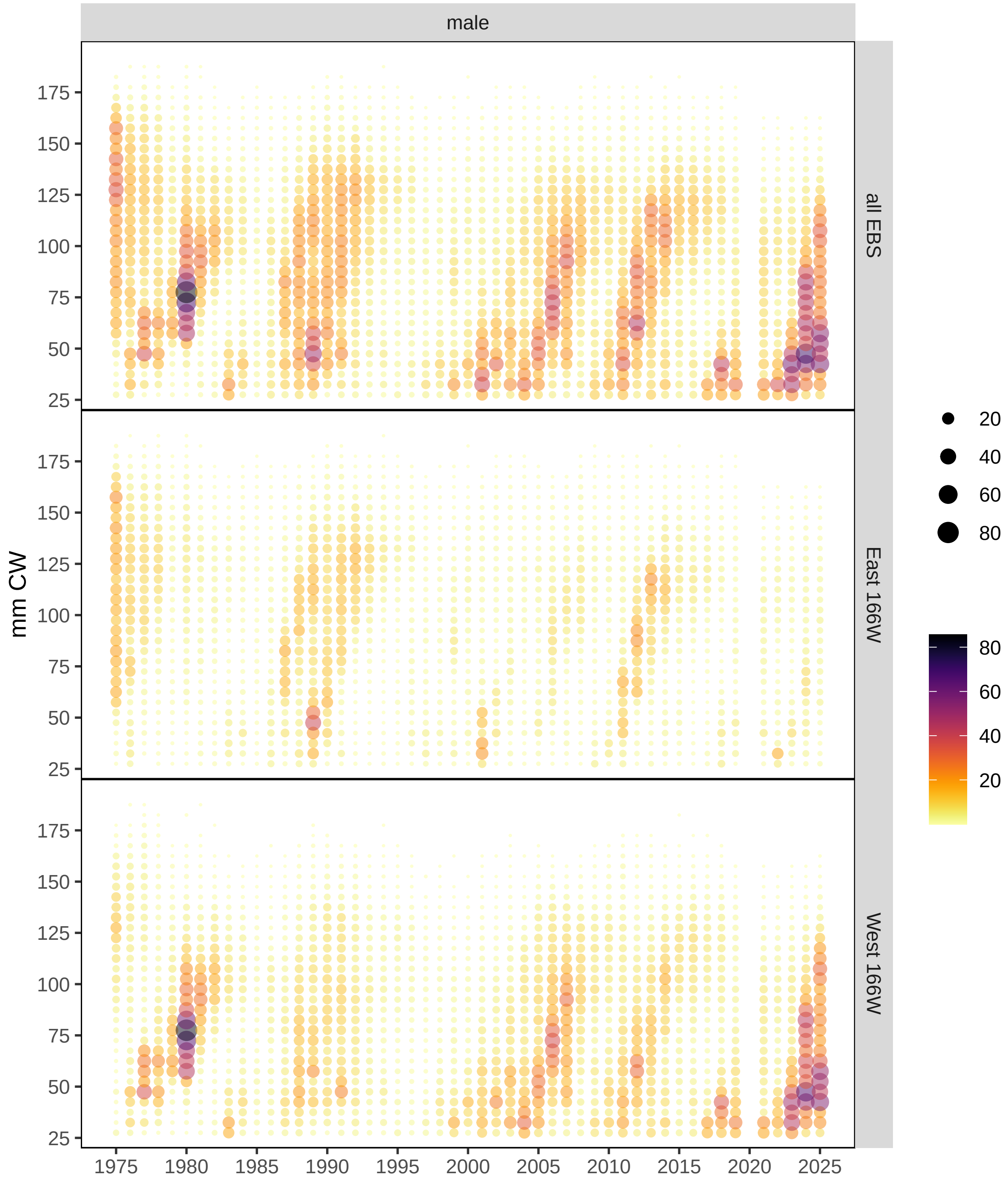


Figure 37. Annual size compositions, by 5-mm CW bin, from the NMFS EBS shelf bottom trawl survey for males by ADF&G management area for 1975-2025 as a bubble plot. The size compositions are truncated for crab < 25 mm CW.

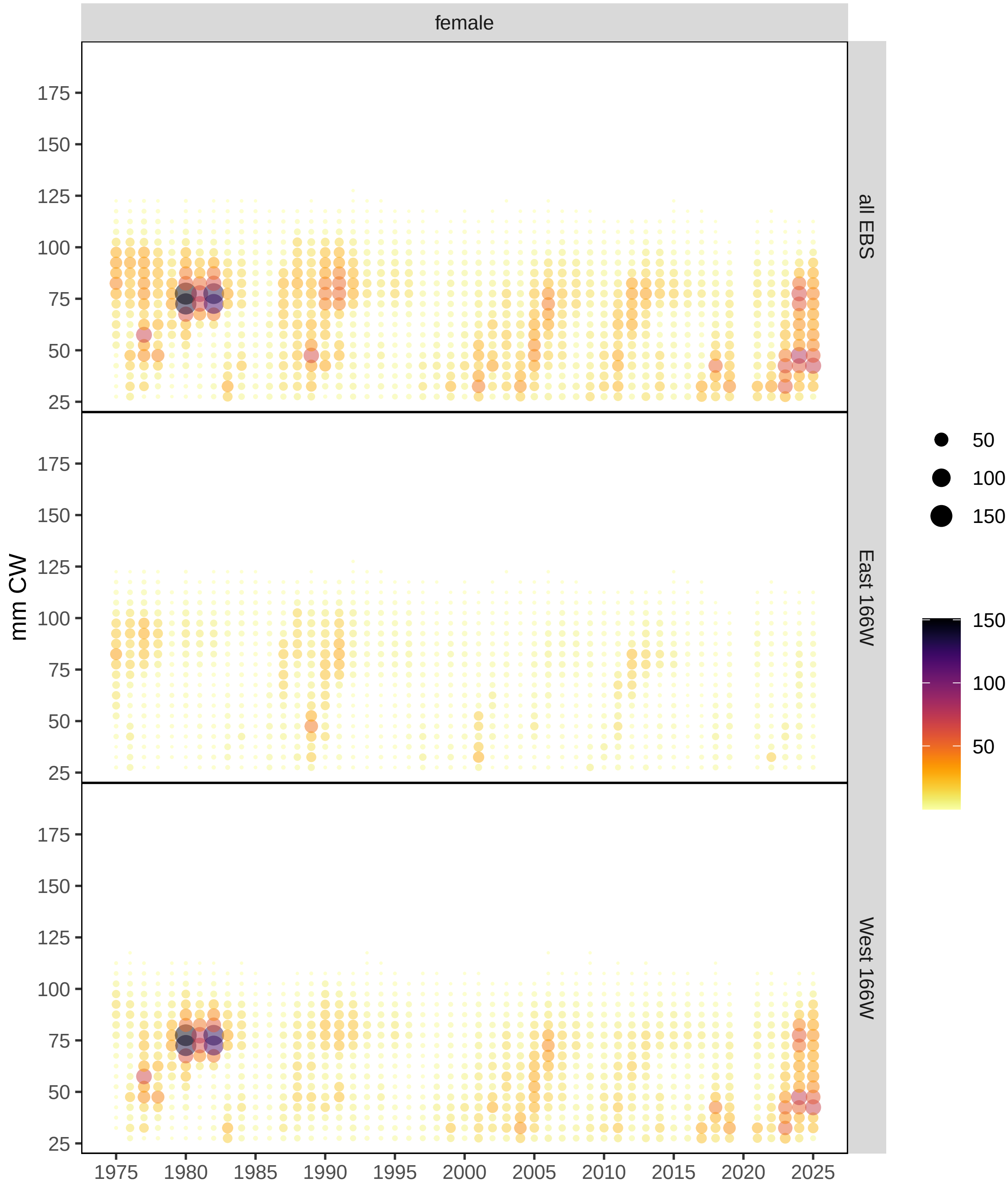


Figure 38. Annual size compositions, by 5-mm CW bin, from the NMFS EBS shelf bottom trawl survey for females by ADF&G management area for 1975-2025 as a bubble plot. The size compositions are truncated for crab < 25 mm CW.

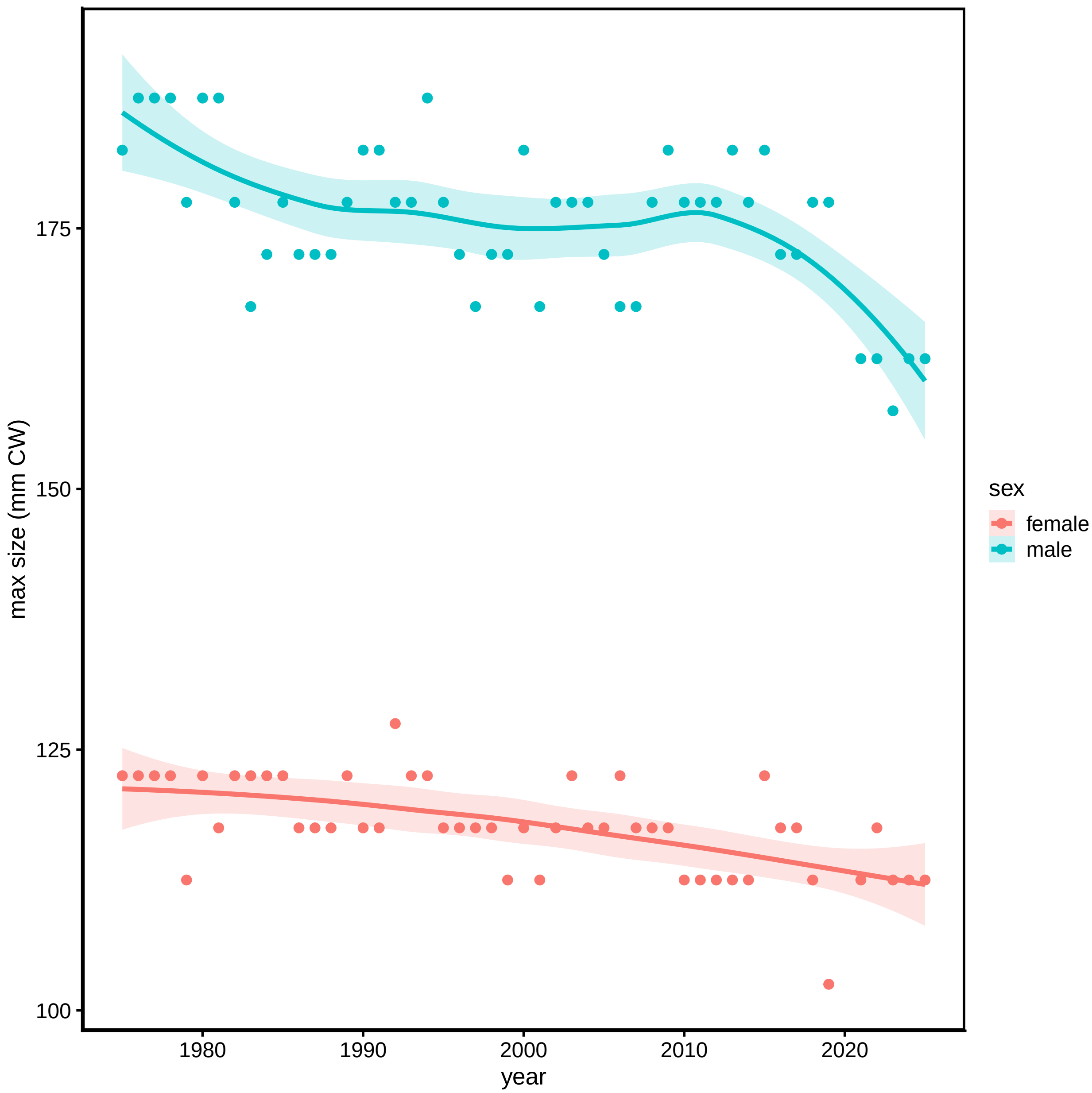


Figure 39. Maximum size in the annual 5-mm CW binned size compositions from the NMFS EBS shelf bottom trawl survey by sex for 1975-2025. Circles: annual values; lines and shading: loess-smoothed trends.

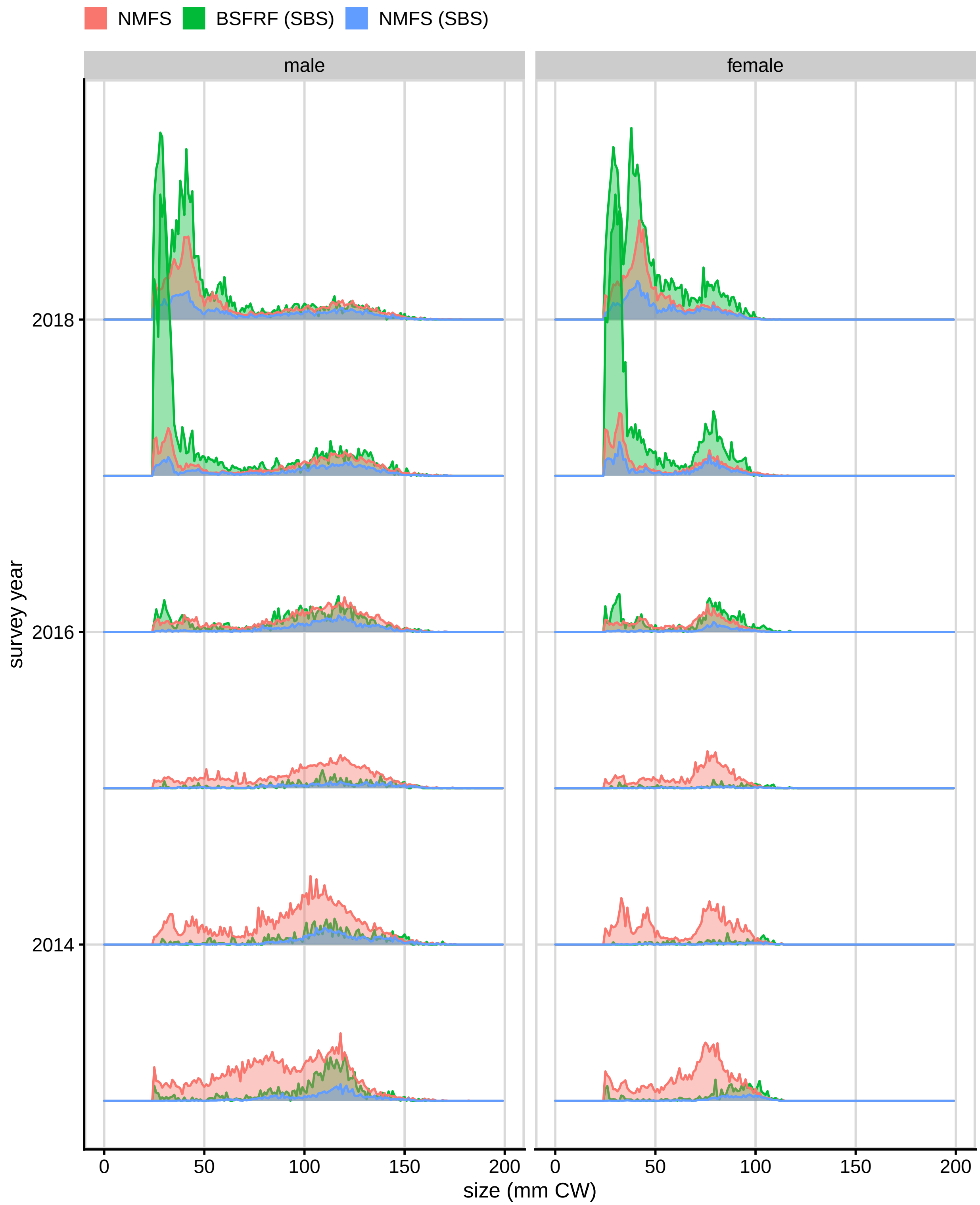


Figure 40. Comparison of size compositions from the SBS catchability study and the corresponding full NMFS EBS shelf survey. The size compositions are truncated for crab < 25 mm CW.

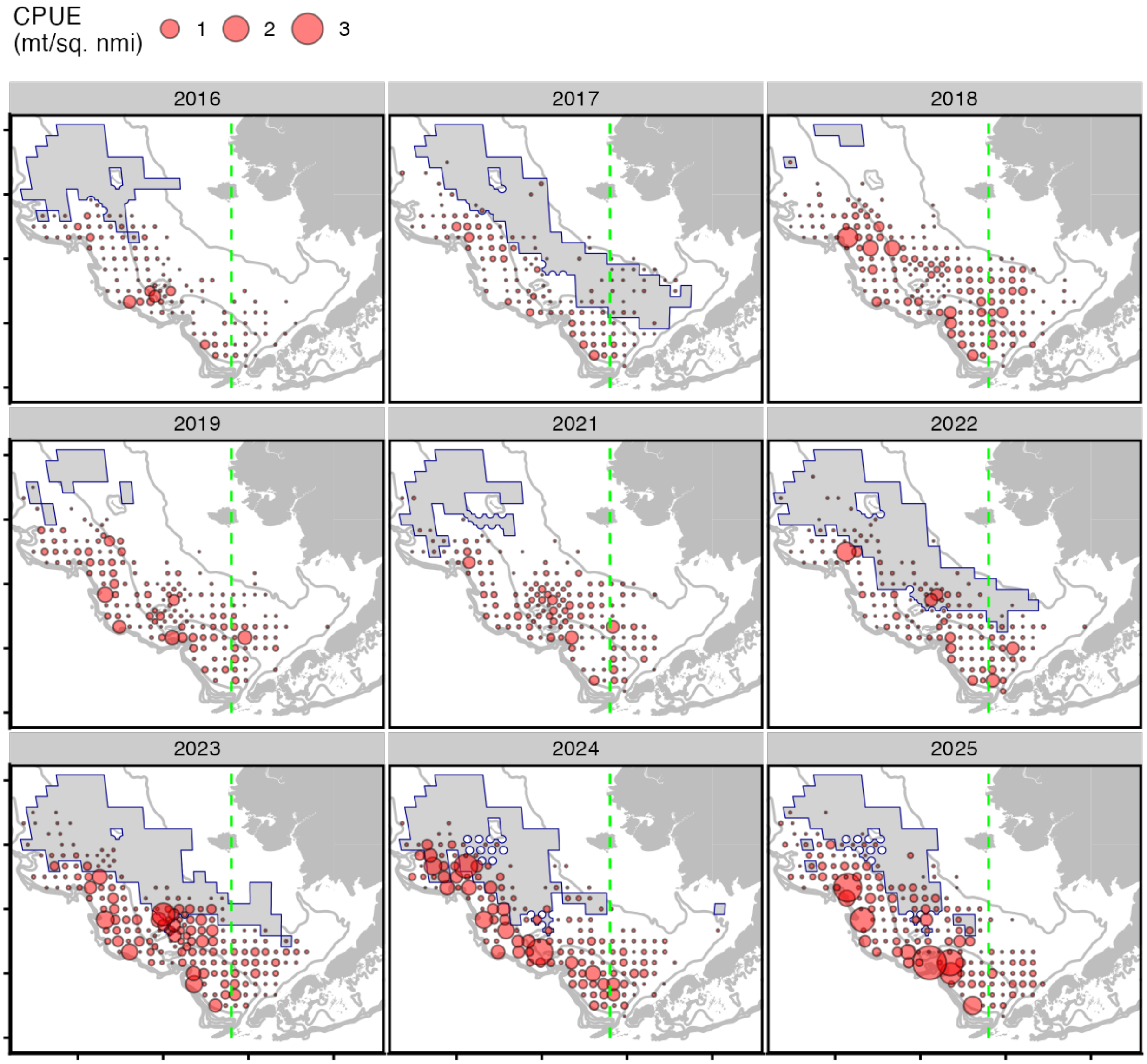


Figure 41. Spatial CPUE of small males (< 60 mm CW) in the NMFS EBS survey. The grey area with blue outline indicates the summer cod pool.

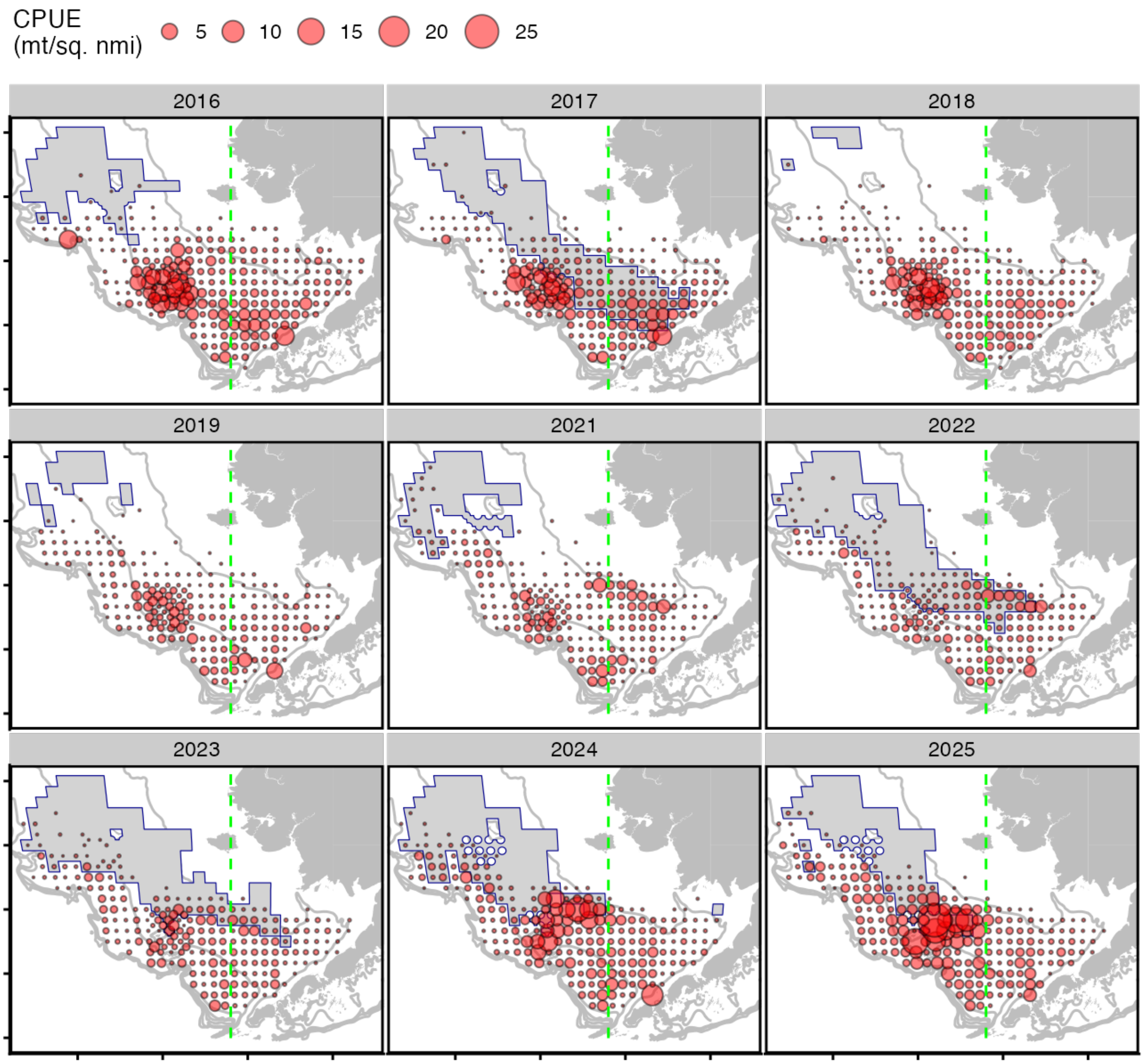


Figure 42. Spatial CPUE of large males (> 60 mm CW) in the NMFS EBS survey. The grey area with blue outline indicates the summer cod pool.

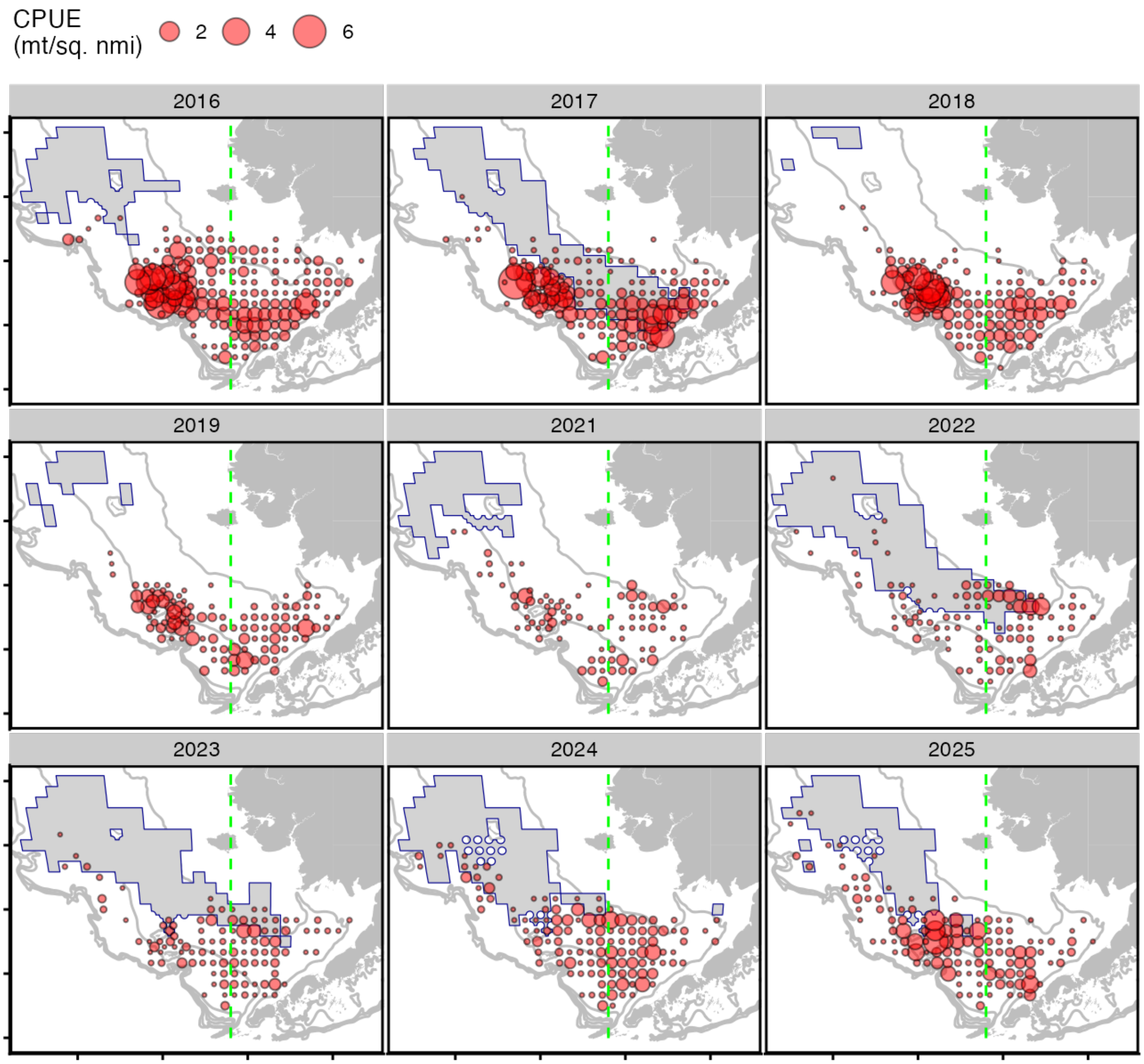


Figure 43. Spatial CPUE of industry-preferred (≥ 125 mm CW) in the NMFS EBS survey. The grey area with blue outline indicates the summer cod pool.

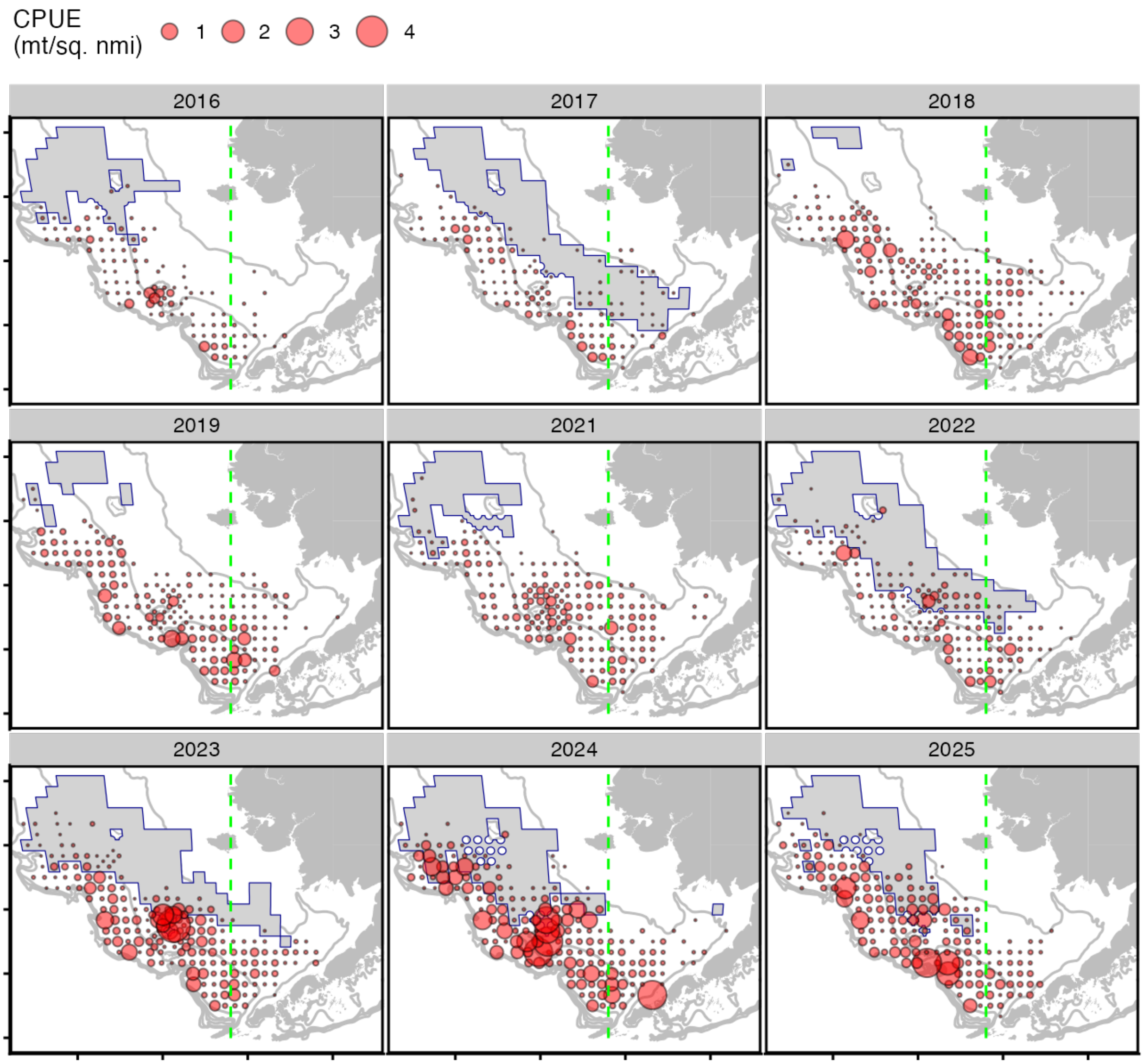


Figure 44. Spatial CPUE of immature females in the NMFS EBS survey. The grey area with blue outline indicates the summer cod pool.

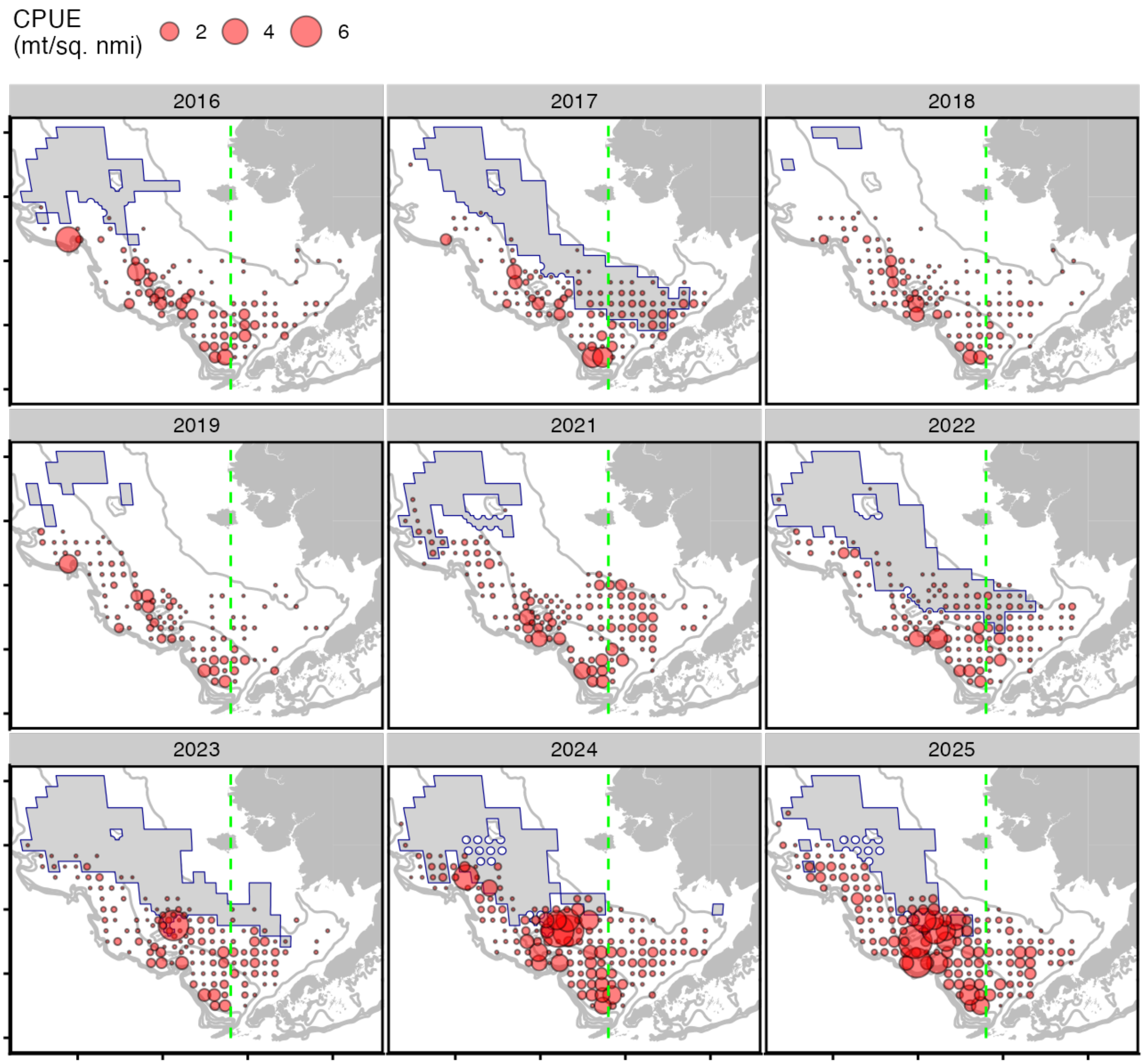


Figure 45. Spatial CPUE of mature females in the NMFS EBS survey. The grey area with blue outline indicates the summer cod pool.

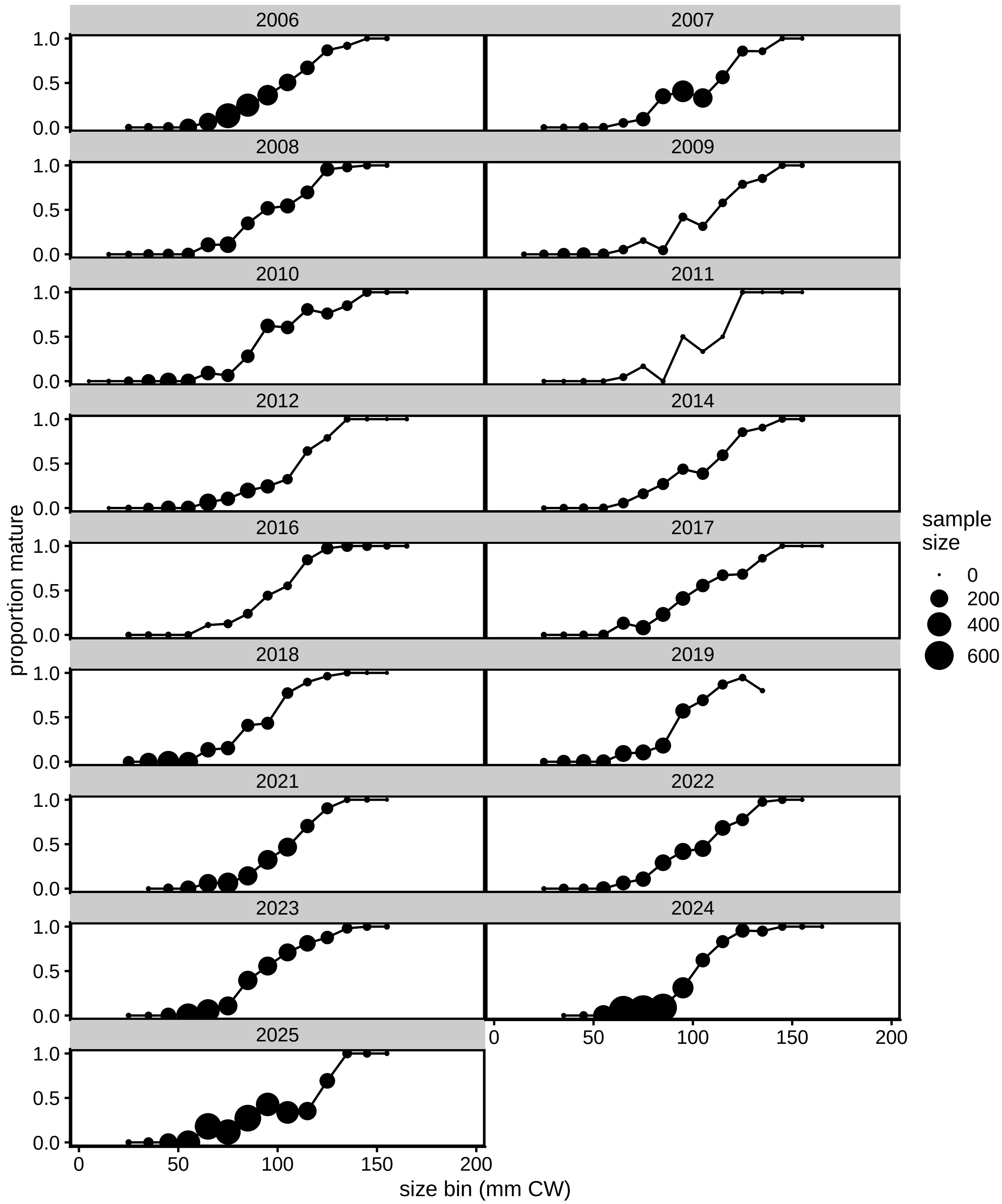


Figure 46. Estimates of the proportion of mature new shell males in the NMFS EBS shelf survey, by 10 mm CW size bin, based on male crab with chela height/carapace width measurements taken with 0.1 mm precision. Symbol size (area) indicates the number of crab measured. Chela heights for Tanner crab are not measured every year.

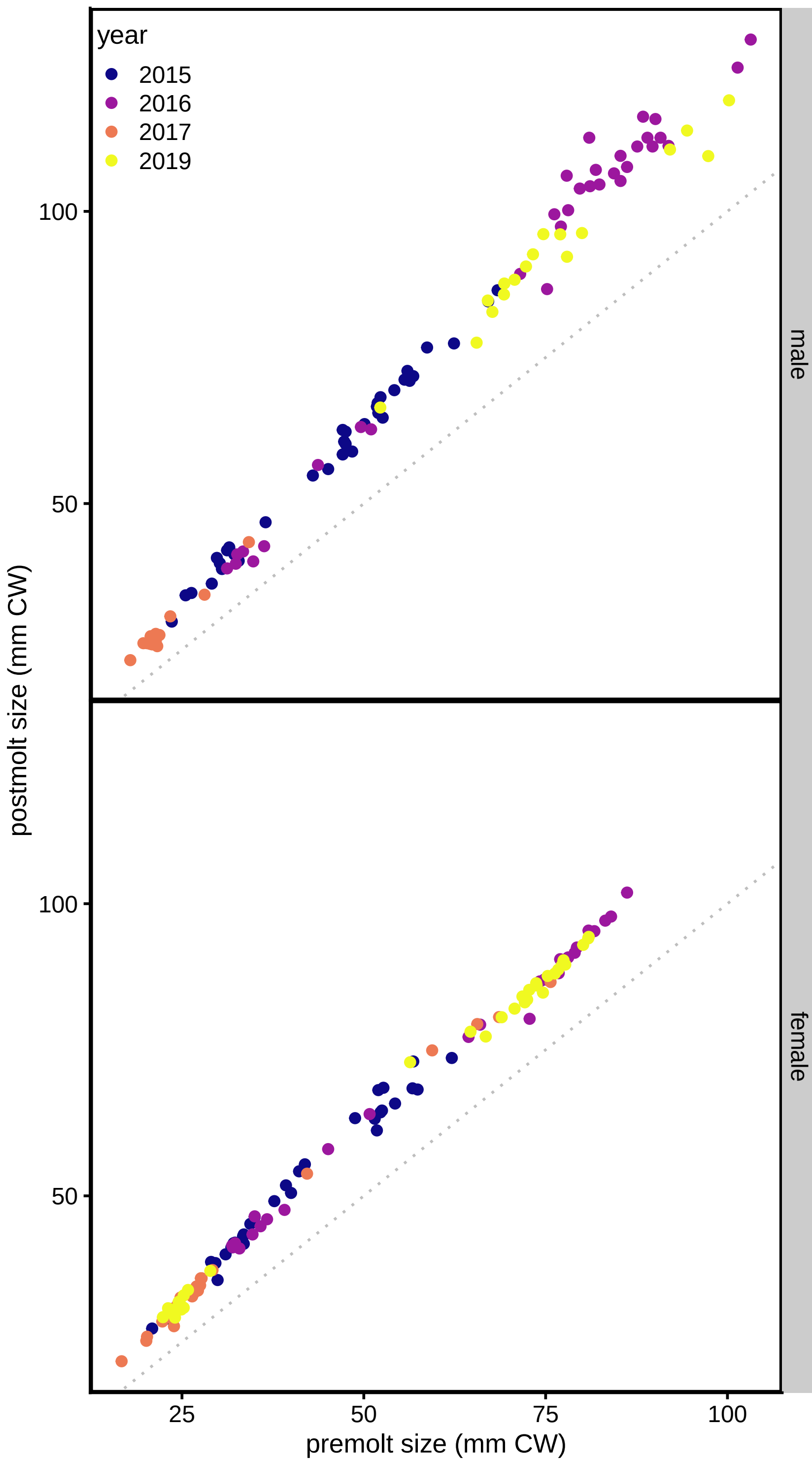


Figure 47. Molt increment data collected collaboratively by NMFS, BSFRF, and ADF&G. Symbol color denotes collection year. Dotted line indicates no growth (i.e., post-molt size = pre-molt size).

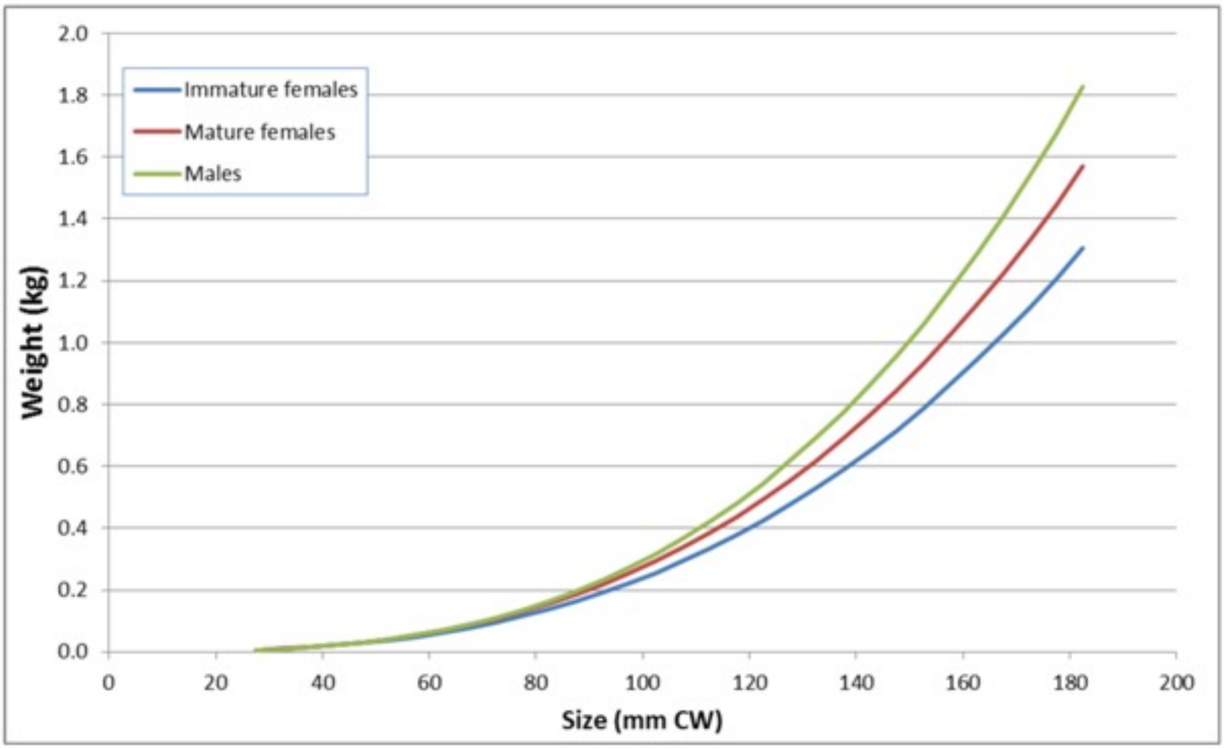


Figure 48. Size-weight relationships for Tanner crab.

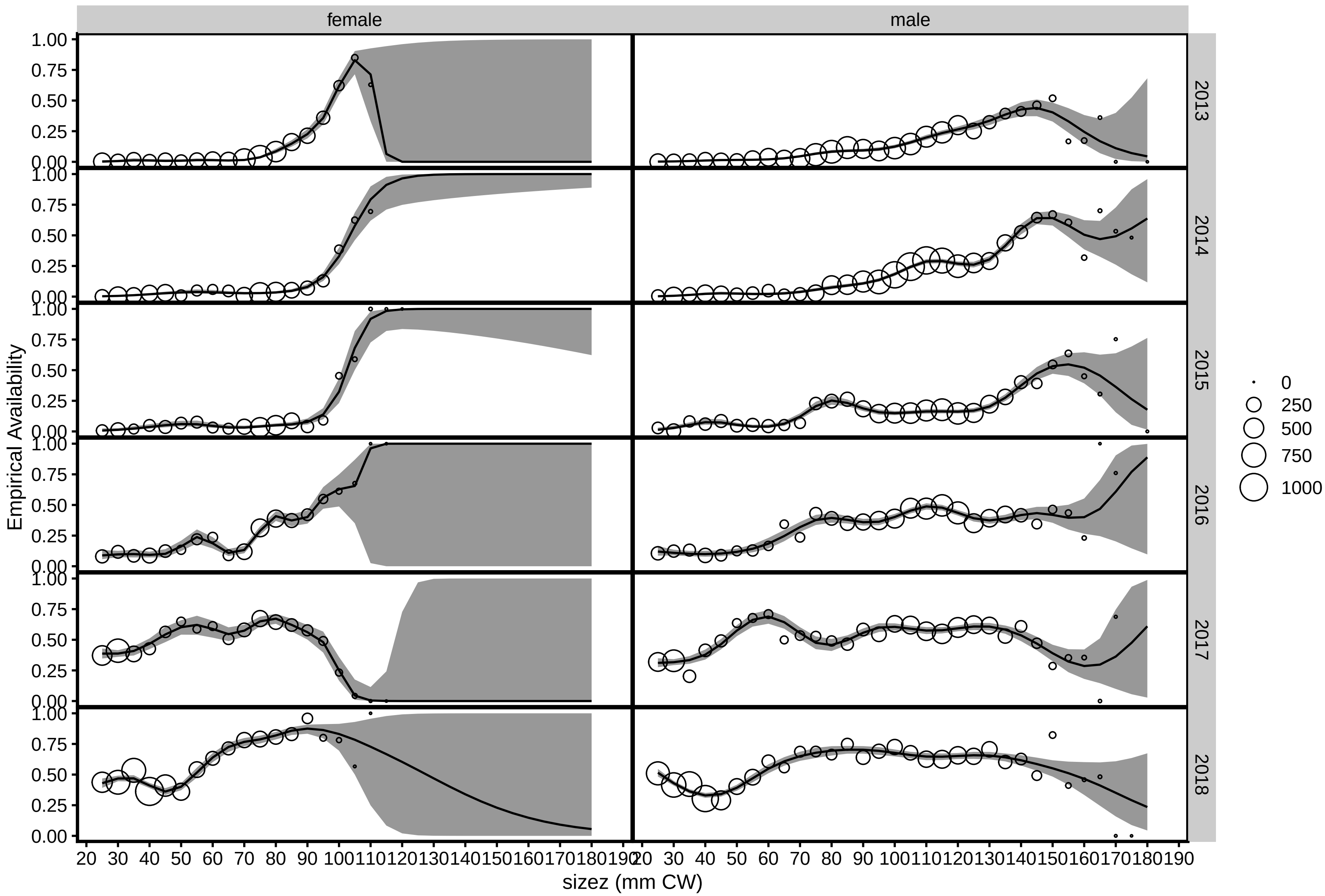


Figure 49. Empirical availability curves for BSFRF SBS data. Circles: "raw" empirical availability estimates. Size: total number of individual crab sampled. Lines/fills: smooth GAM model fits to "raw" data, with 95% confidence intervals.

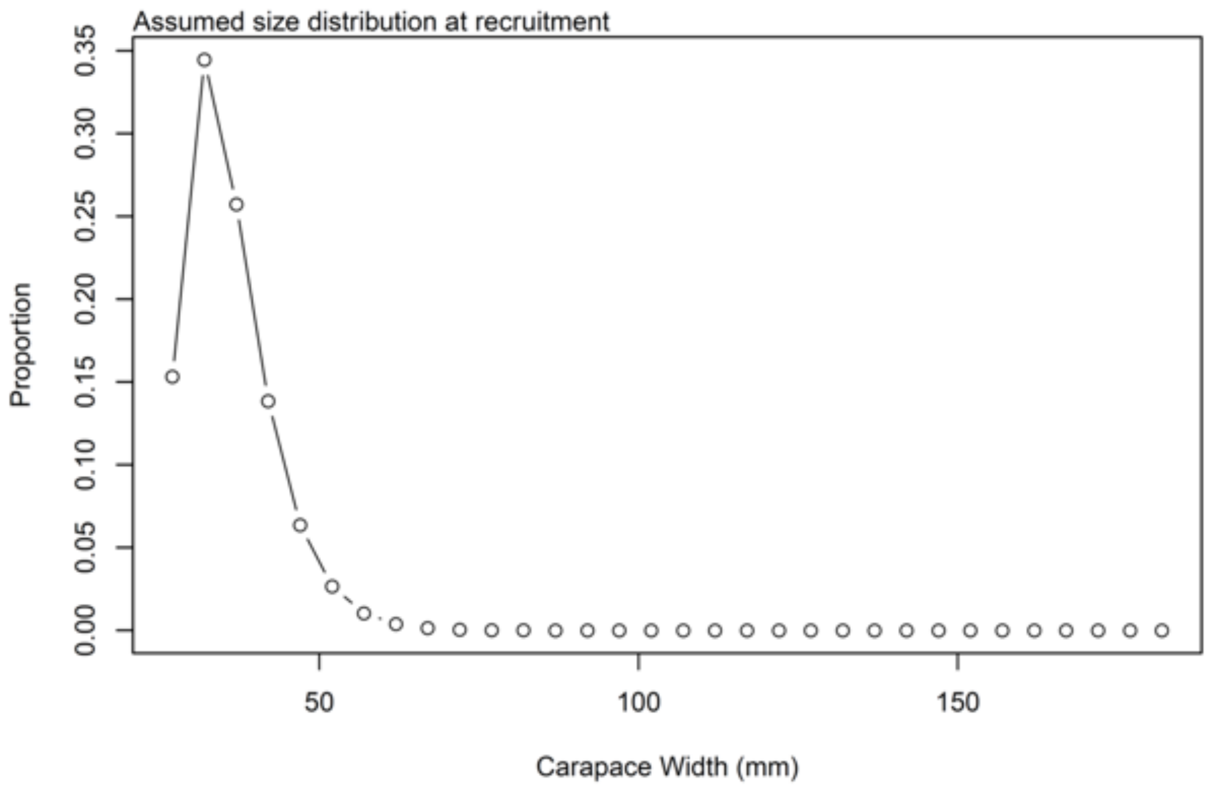


Figure 50. The nominal shape (a truncated gamma distribution) for the assumed size distribution of Tanner crab at recruitment to the model.

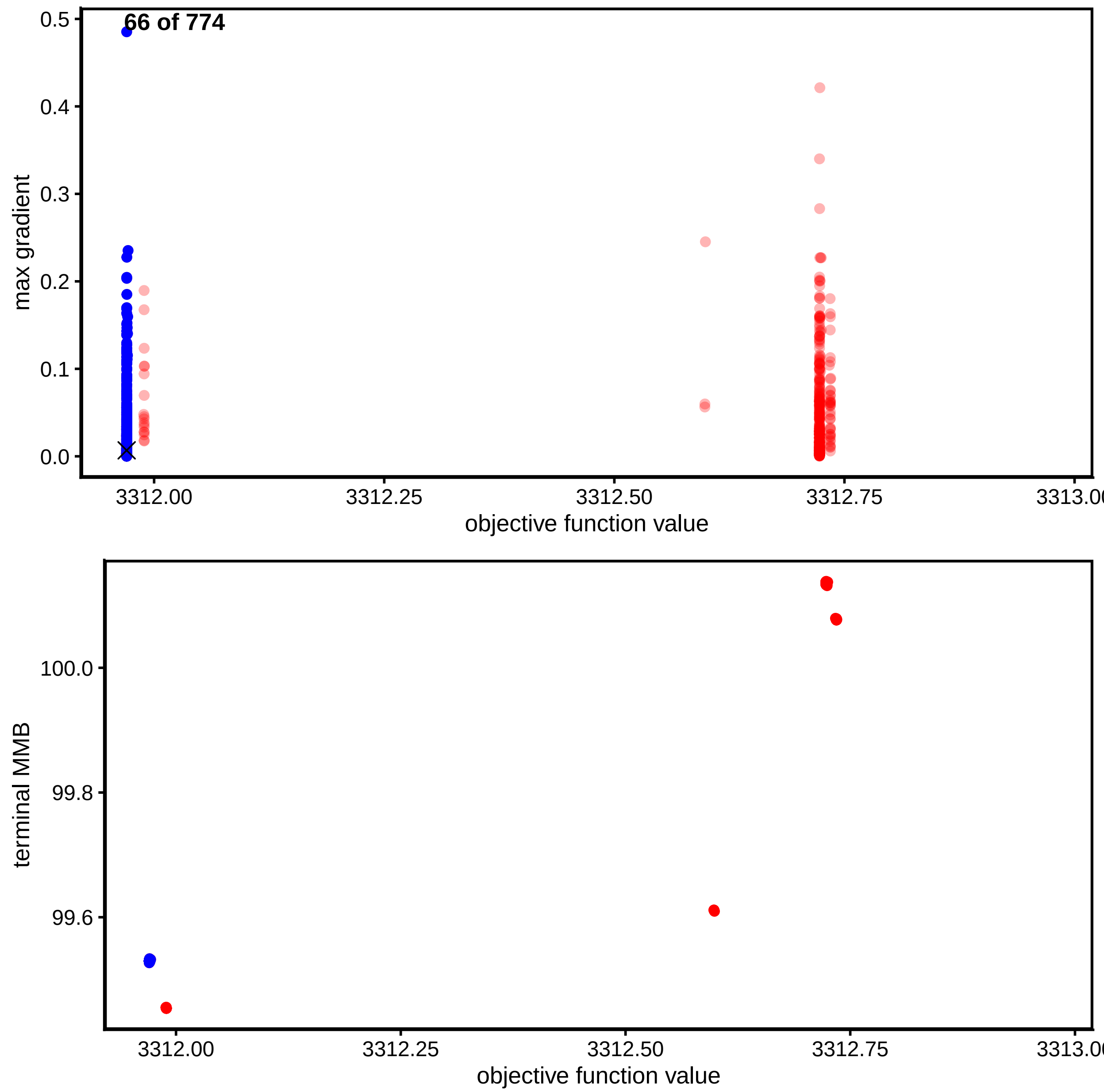


Figure 51. Results from 800 jitter runs for Model `22.03d5 (2025)`. Of these, 66 appear to have converged to the MLE (blue dots). The minimum objective function found was 3,311.97; the maximum gradient for that model run was 0.00682. 26 failed to finish.

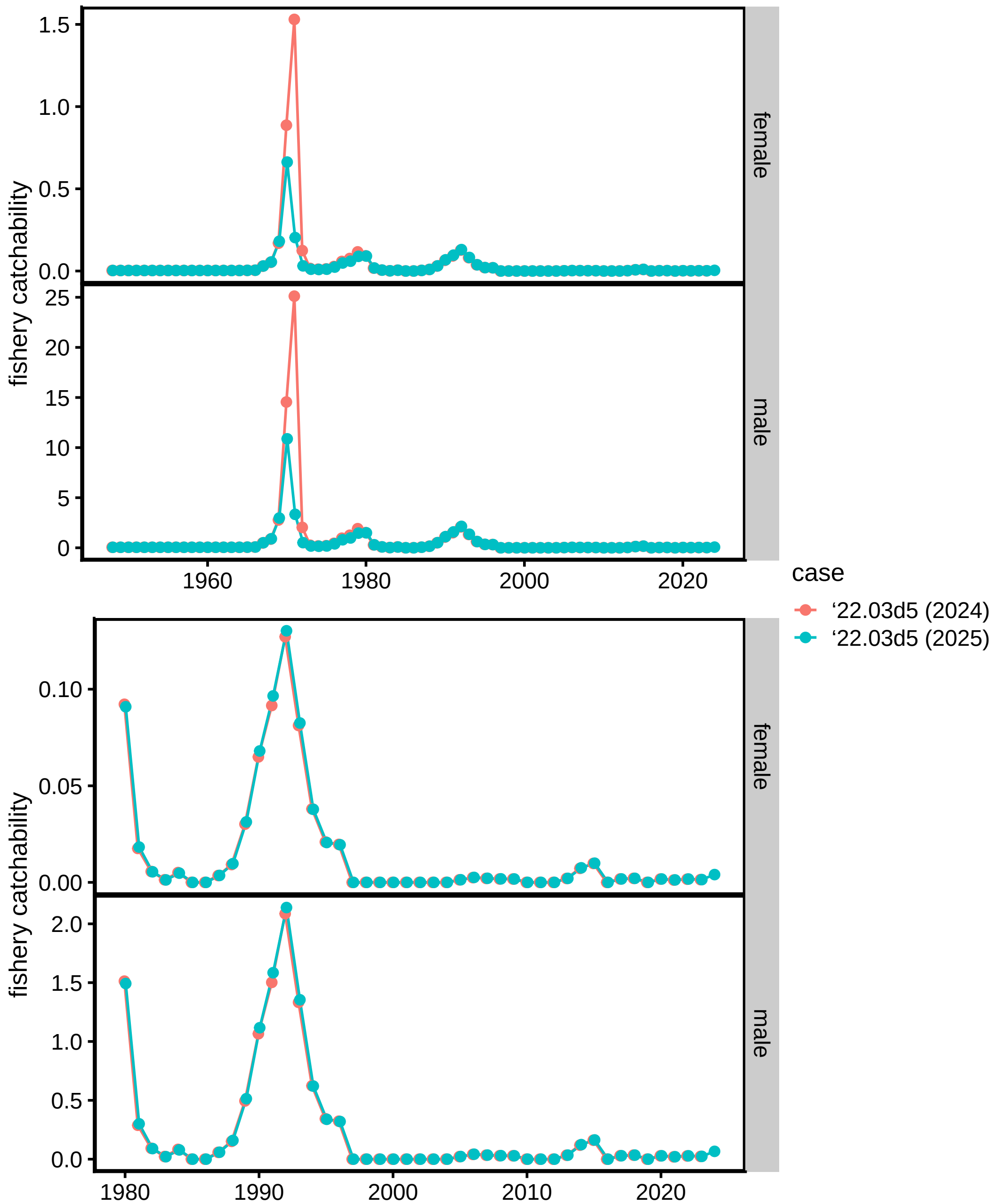


Figure 52. Estimated fully-selected capture rates (not mortality) in the directed fishery. The lower pair of plots show the estimated time series since 1980. Preferred model is `22.03d5 (2025)`.

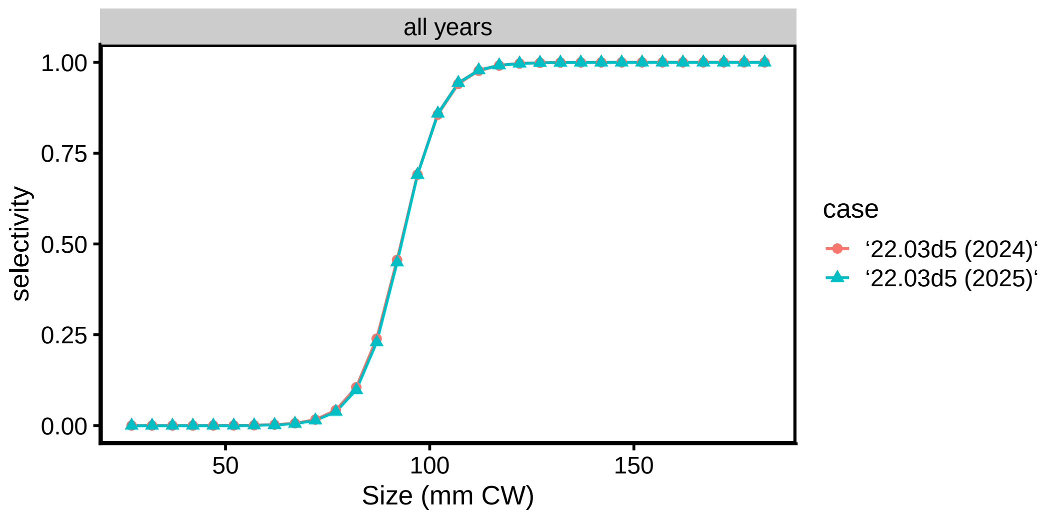


Figure 53. Estimated selectivity for females in the directed fishery for all years. Preferred model is `22.03d5 (2025)`.

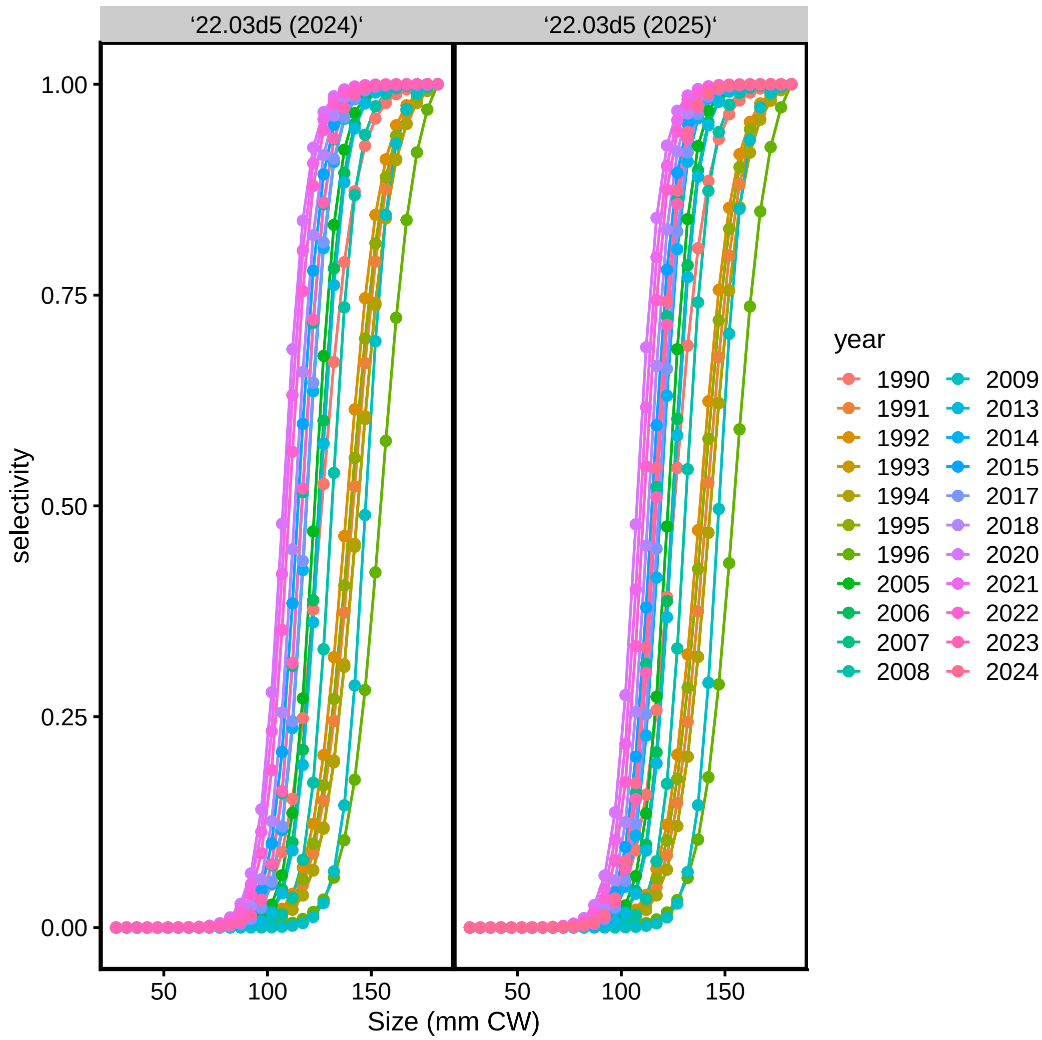


Figure 54. Estimated selectivity curves for males in the directed fishery, faceted by model scenario. Curves labelled 1990 applies to all years before 1991. Others apply in the year indicated in the legend. Preferred model is `22.03d5 (2025)`.

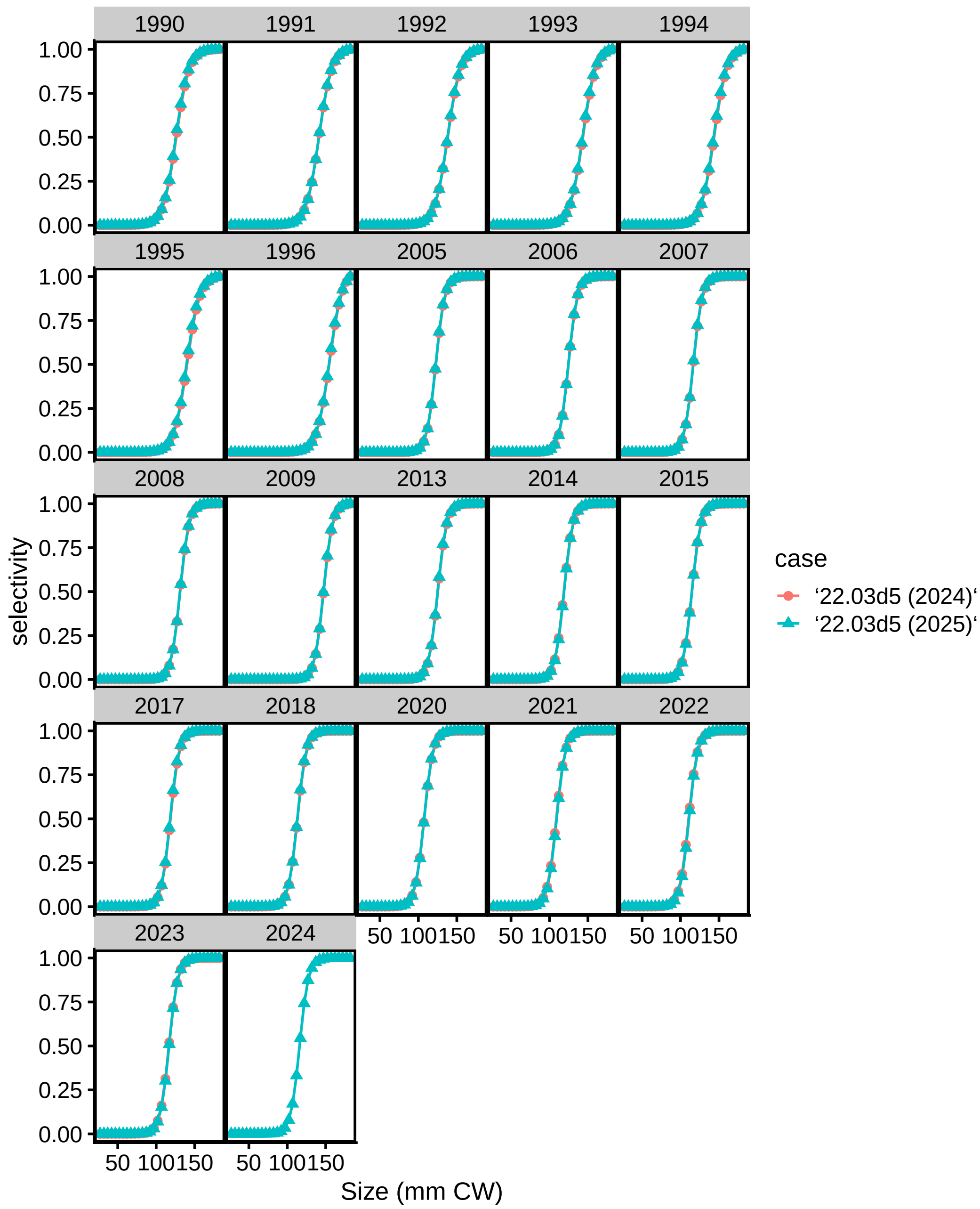


Figure 55. Estimated selectivity curves for males in the directed fishery by year. Curve labelled 1990 applies to all years before 1991. Others apply in the year indicated in the panel. Preferred model is `22.03d5 (2025)`.

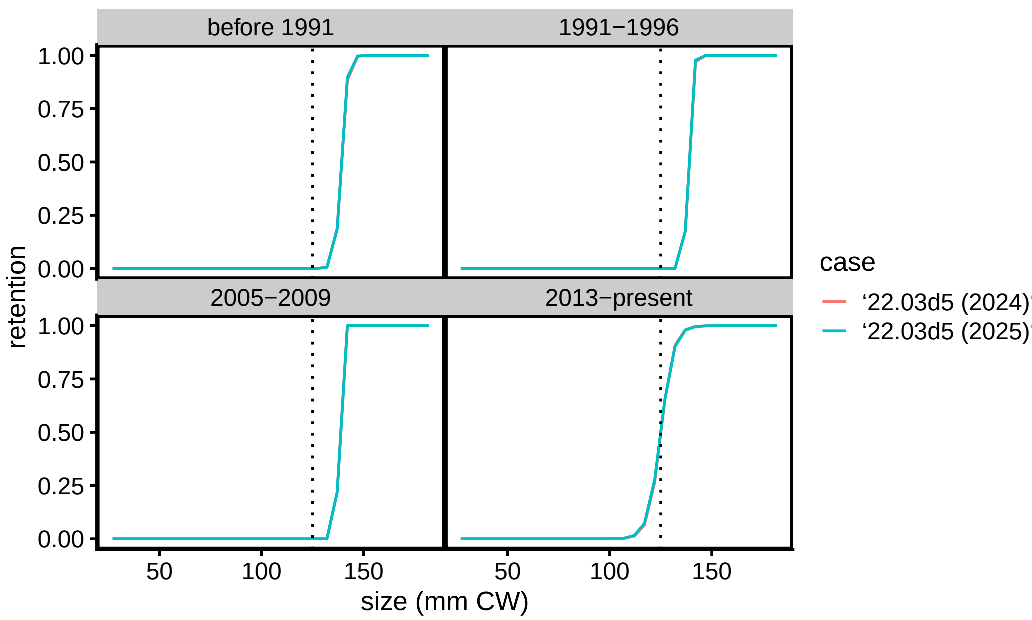


Figure 56. TCSAM02 models estimated retention curves for males in the directed fishery by time block. The dotted line indicates the current industry-preferred size (125 mm CW). Preferred model is `22.03d5 (2025)`.

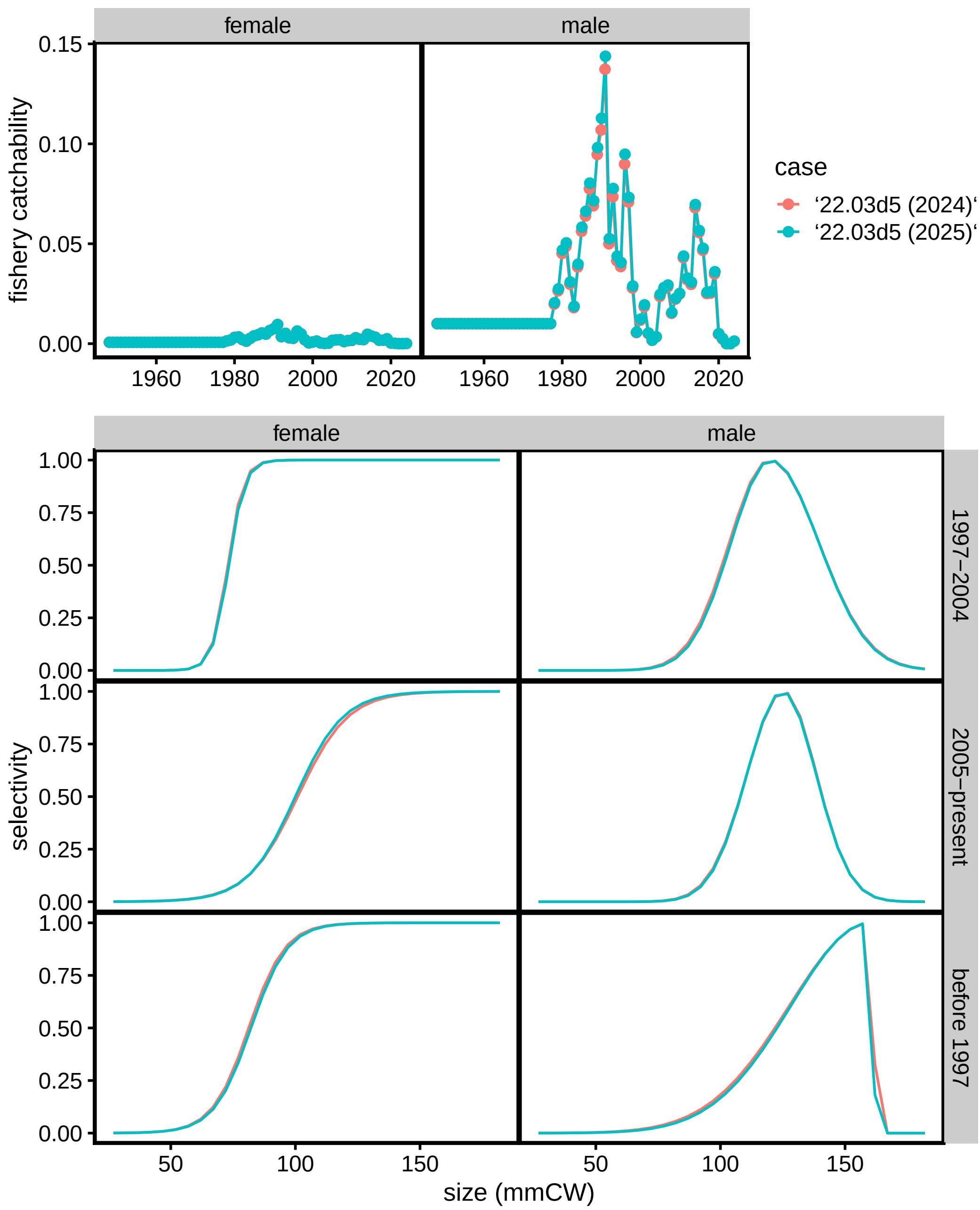


Figure 57. TCSAM02 models estimated fully-selected bycatch capture rates (not mortality) and selectvity functions in the snow crab fishery. Time blocks for selectivity functions are labelled: 1) before 1997; 2) 1997-2004; 3) 2005-present. Preferred model is `22.03d5 (2025)`.

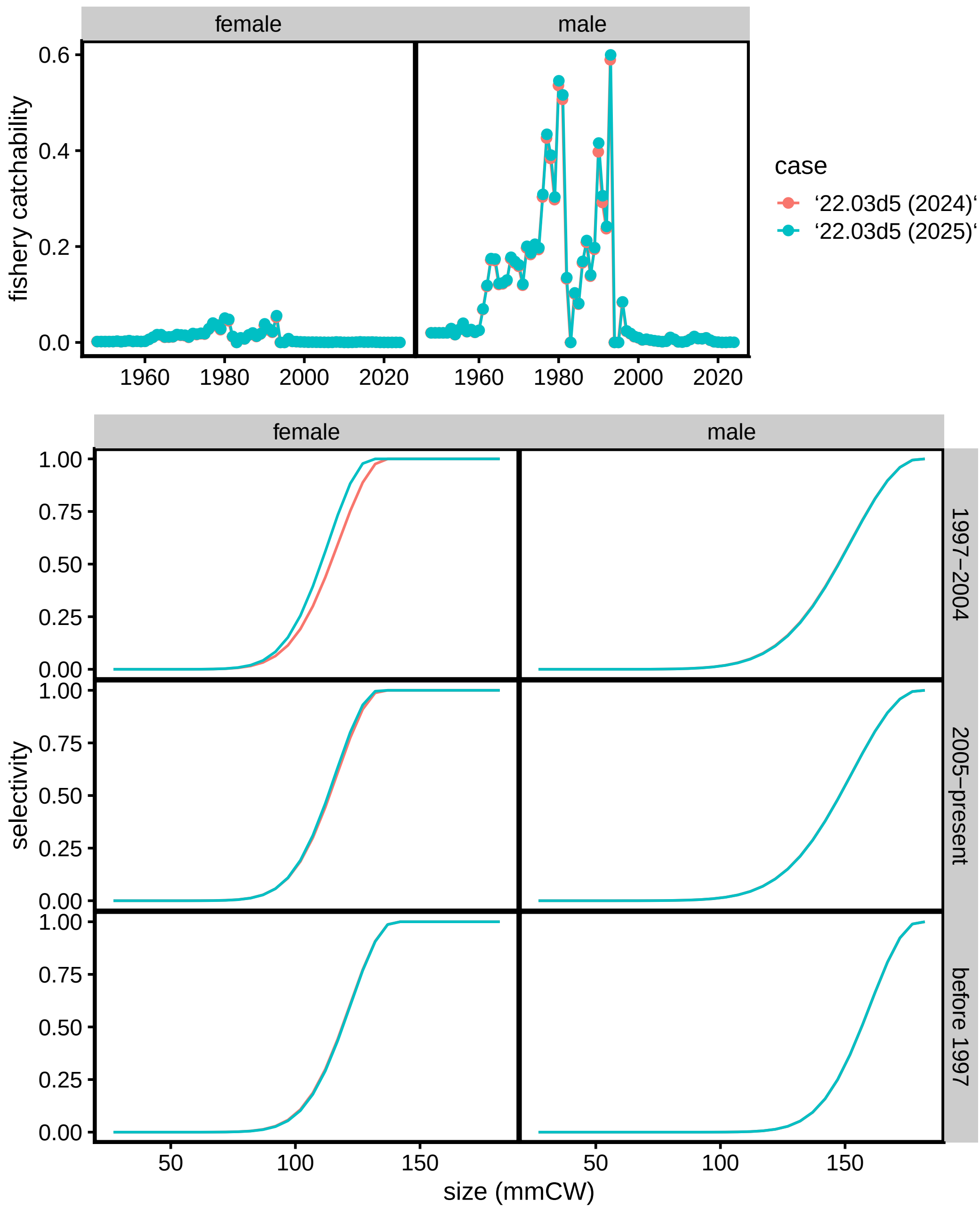


Figure 58. TCSAM02 models estimated fully-selected bycatch capture rates (not mortality) and selectvity functions in the BBRKC fishery. Time blocks for selectivity functions are 1) before 1997; 2) 1997-2004; 3) 2005-present. Preferred model is `22.03d5 (2025)`.

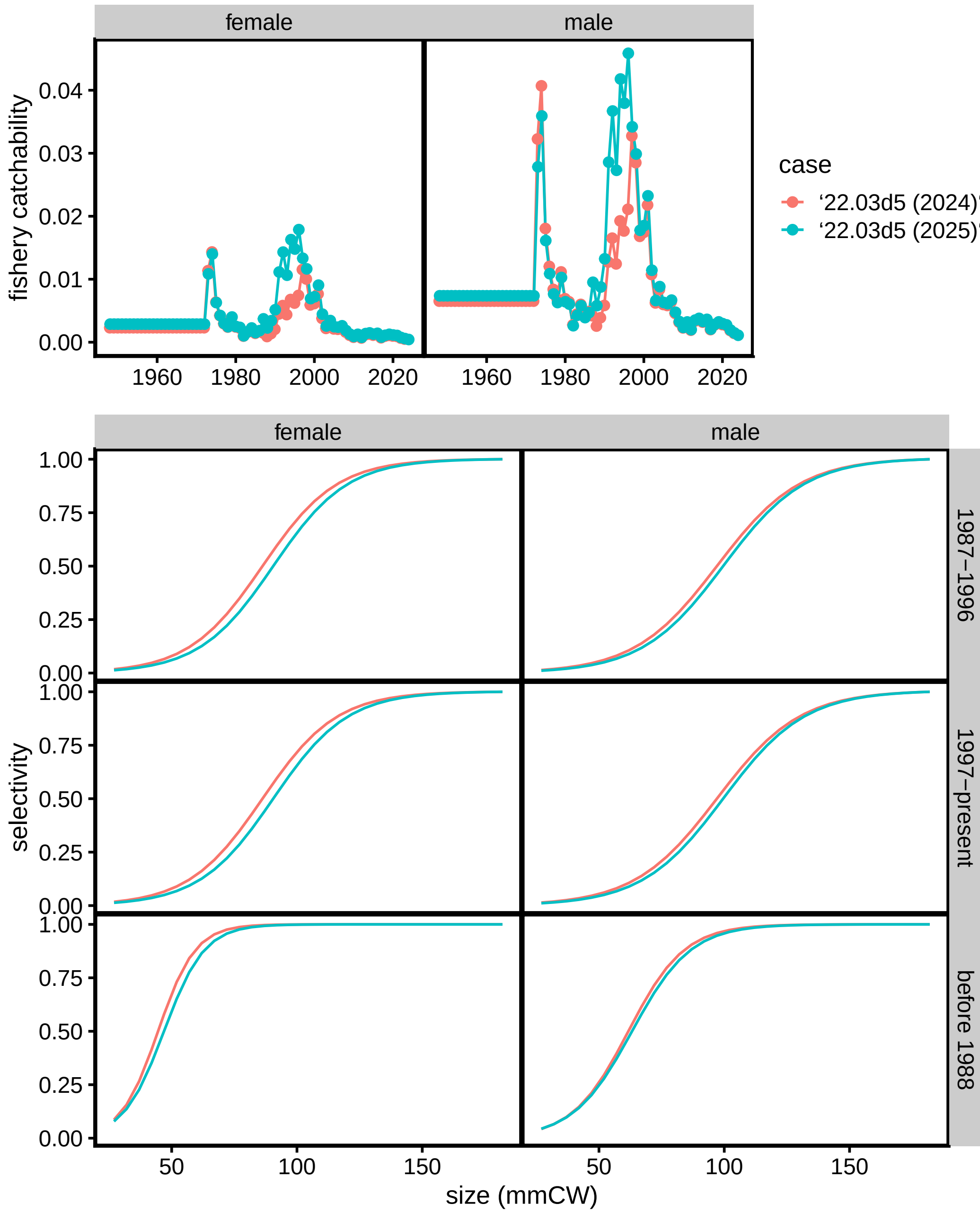


Figure 59. TCSAM02 models estimated fully-selected bycatch capture rates (not mortality) and selectvity functions in the groundfish fisheries. Time blocks for selectivity functions are : 1) before 1988; 2) 1987-1996; 3) 1997-present. Preferred model is `22.03d5 (2025)`.

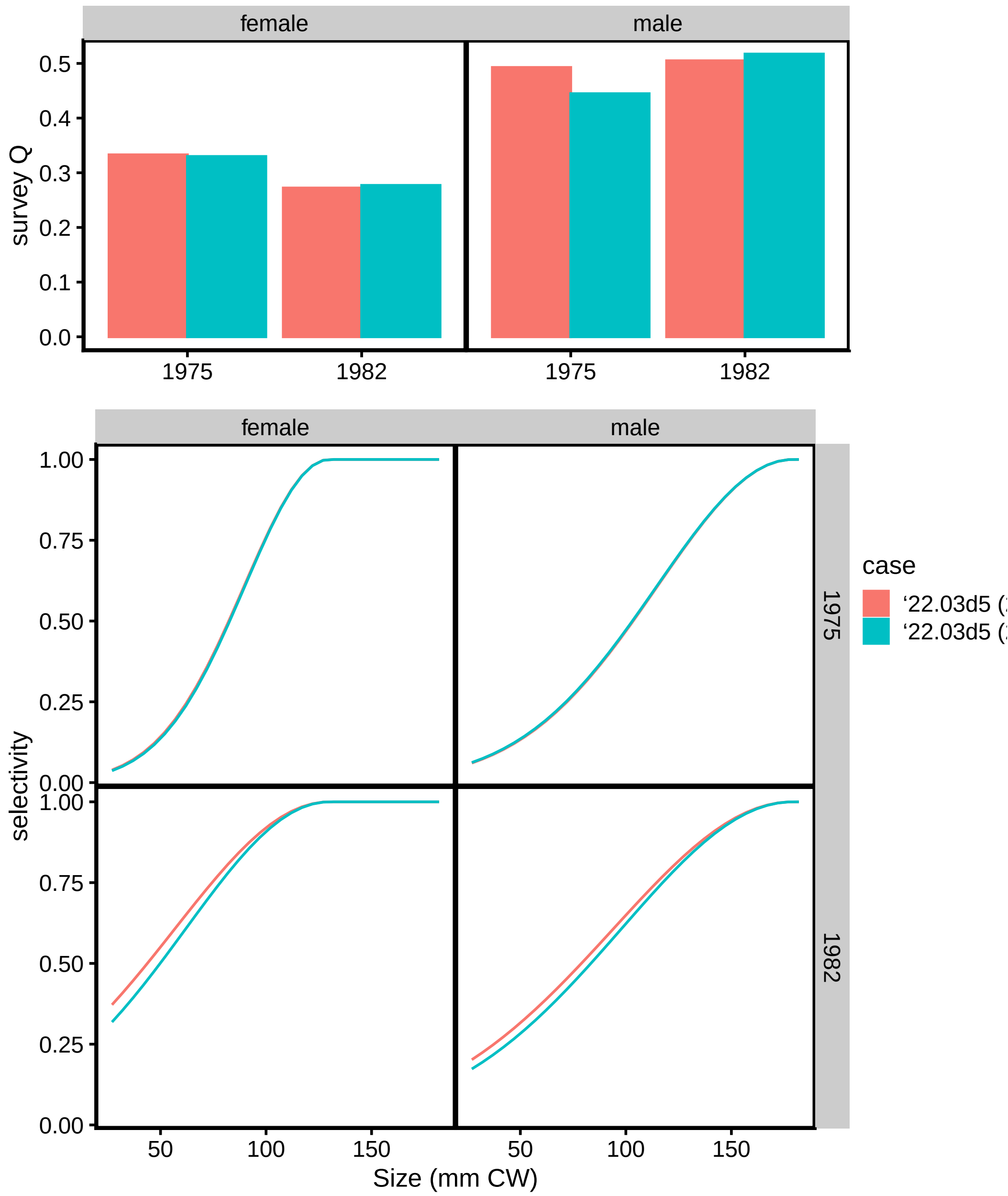


Figure 60. Estimated NMFS EBS Survey fully-selected catchability (survey Q's) and selectivity functions by sex for different time periods. 1975: 1975-1981; 1982: 1982-current. Preferred model is `22.03d5 (2025)`.

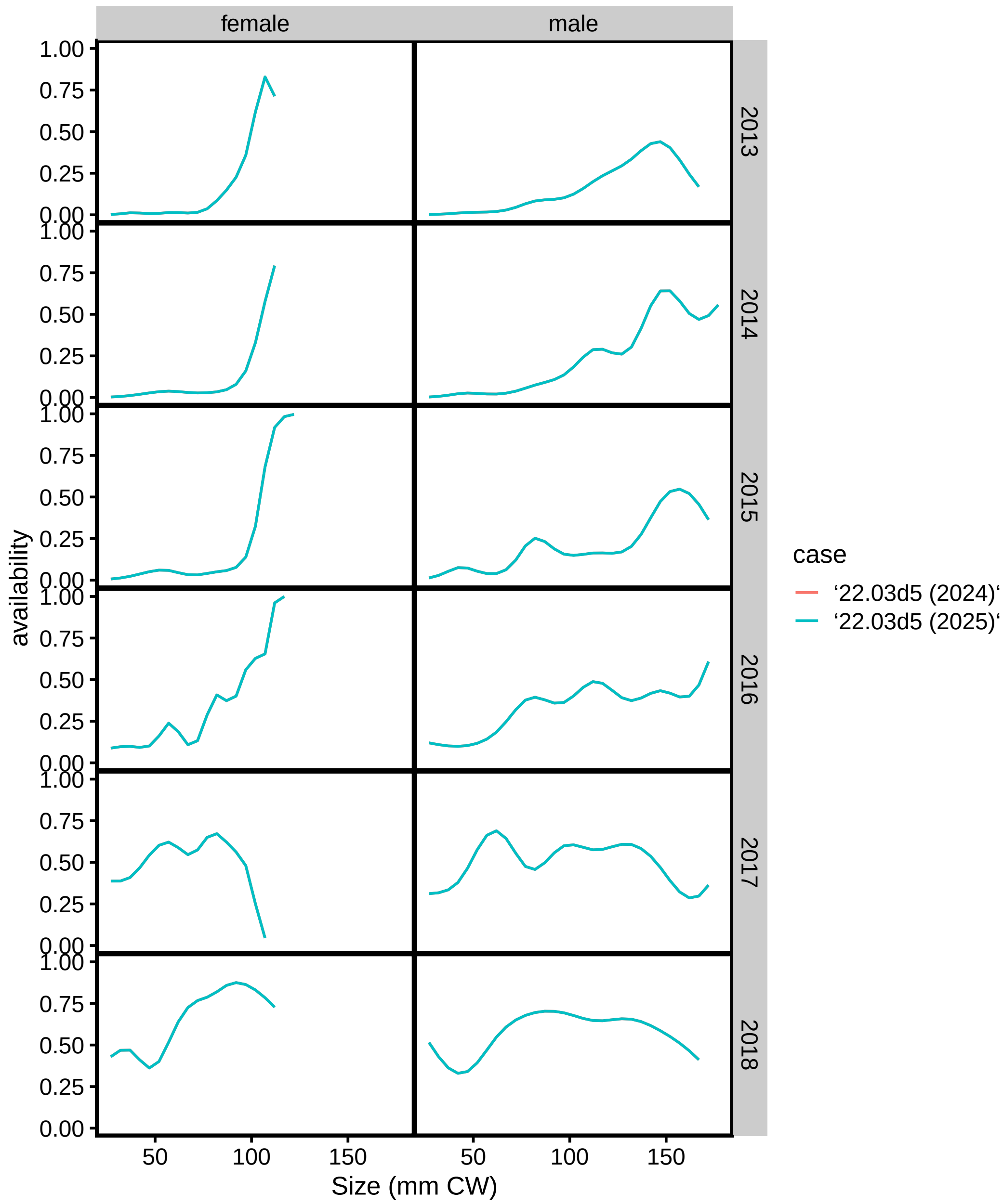


Figure 61. Annual sex-specific availability curves assumed for the BSFRF side-by-side (SBS) survey data. The availability curves were estimated outside the TCSAM02 models. Preferred model is `22.03d5 (2025)`.

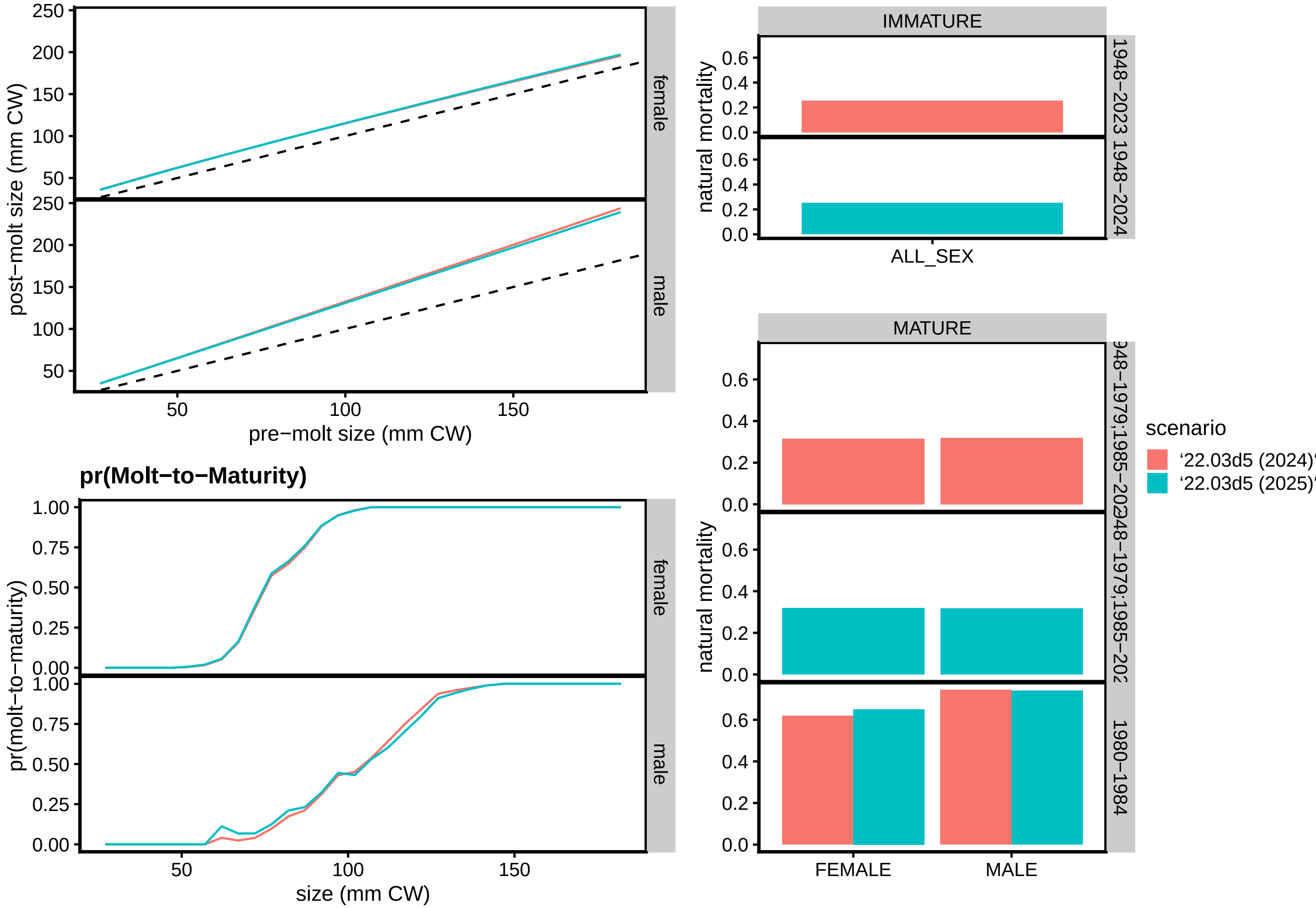


Figure 62. Estimated population processes. Plots in upper lefthand quadrant: sex-specific mean growth; plots in lower lefthand quadrant: sex-specific probability of the molt-to-maturity (i.e., terminal molt); plots in righthand column: natural mortality rates, by maturity state and sex. Preferred model is `22.03d5 (2025)`.

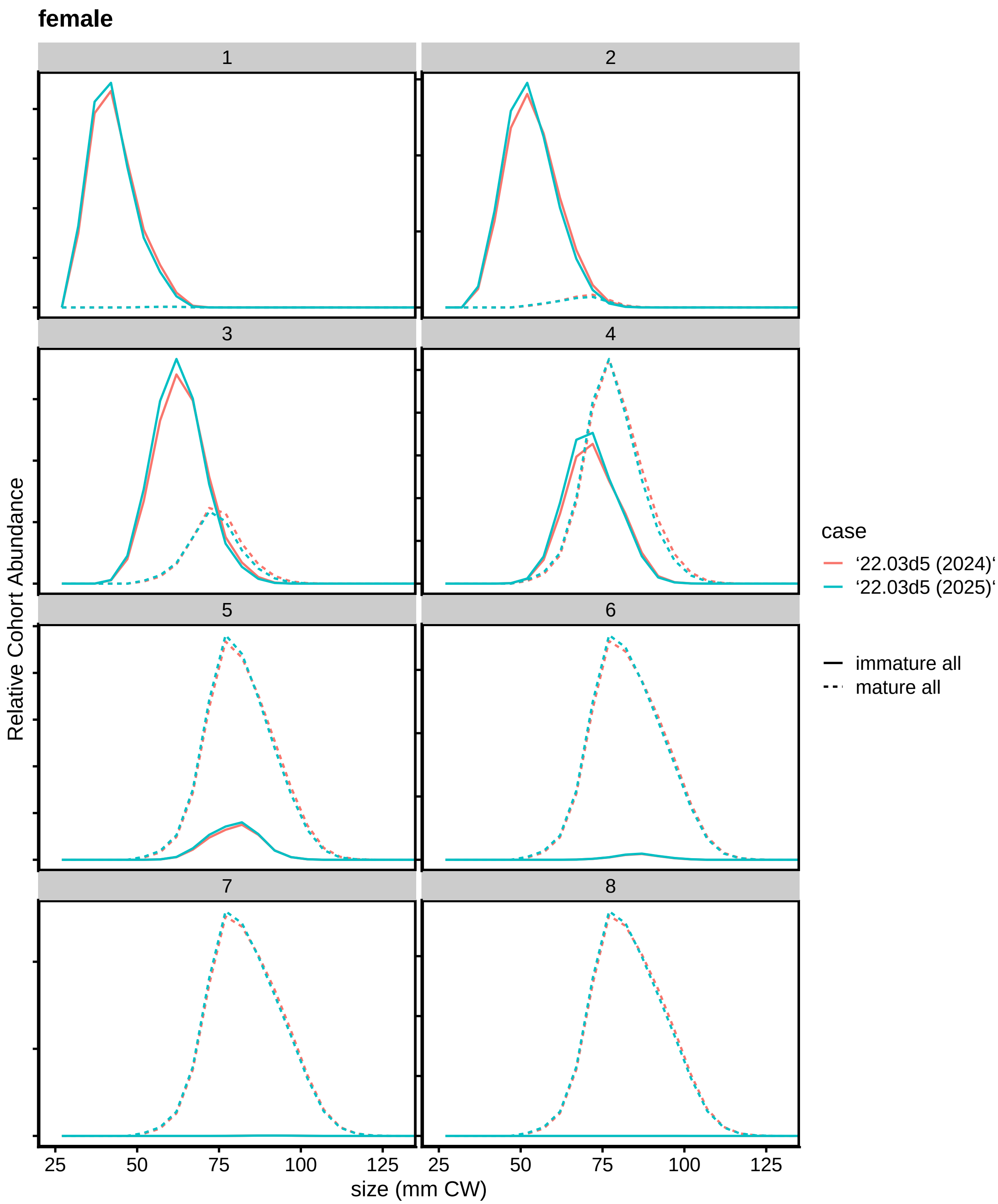


Figure 63. Estimated annual cohort progression for female crab based on rates from final model year (by age; individual scales are relative). Preferred model is `22.03d5 (2025)`.

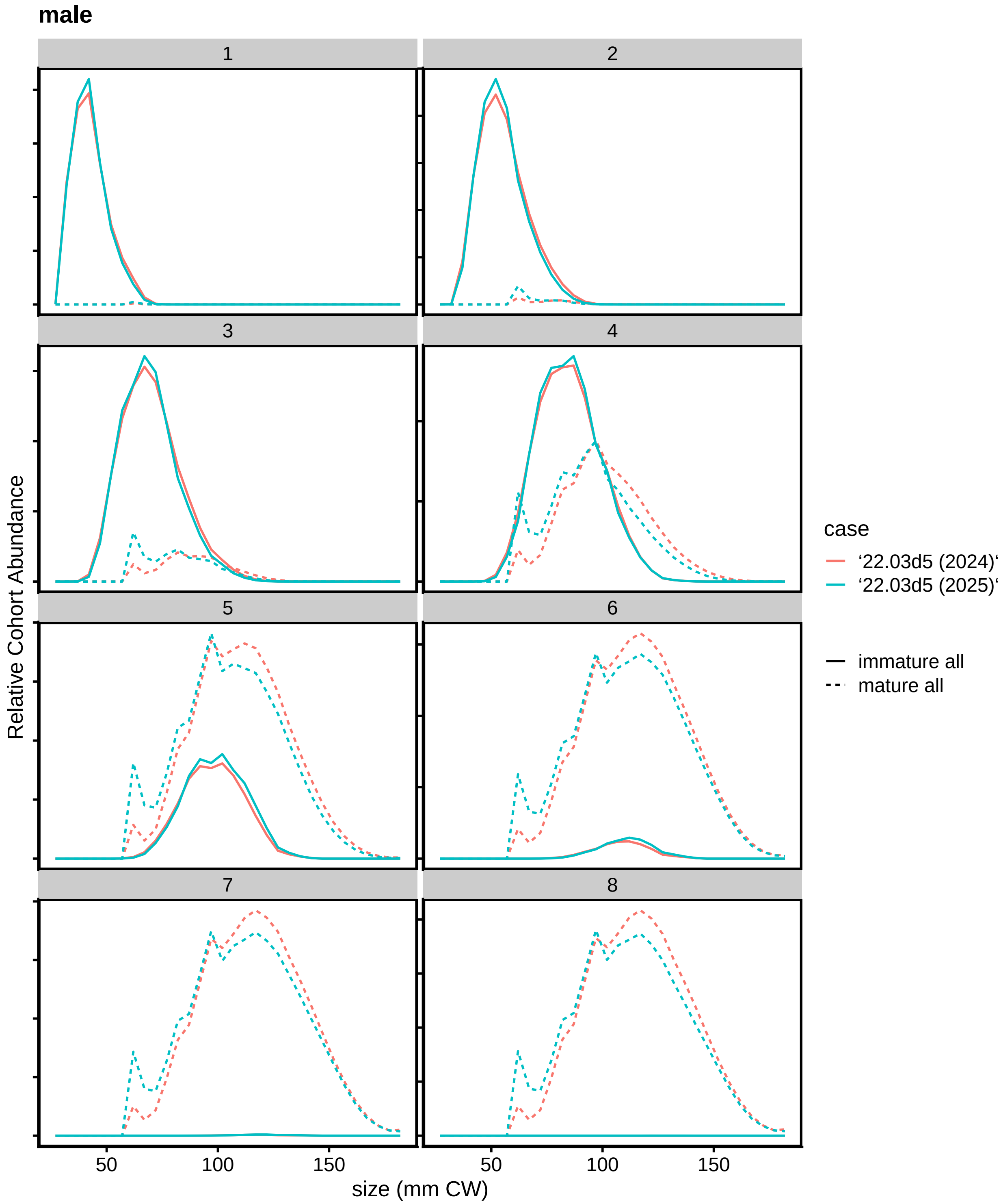


Figure 64. Estimated annual cohort progression for male crab based on rates from final model year (by age; individual scales are relative). Preferred model is `22.03d5 (2025)`.

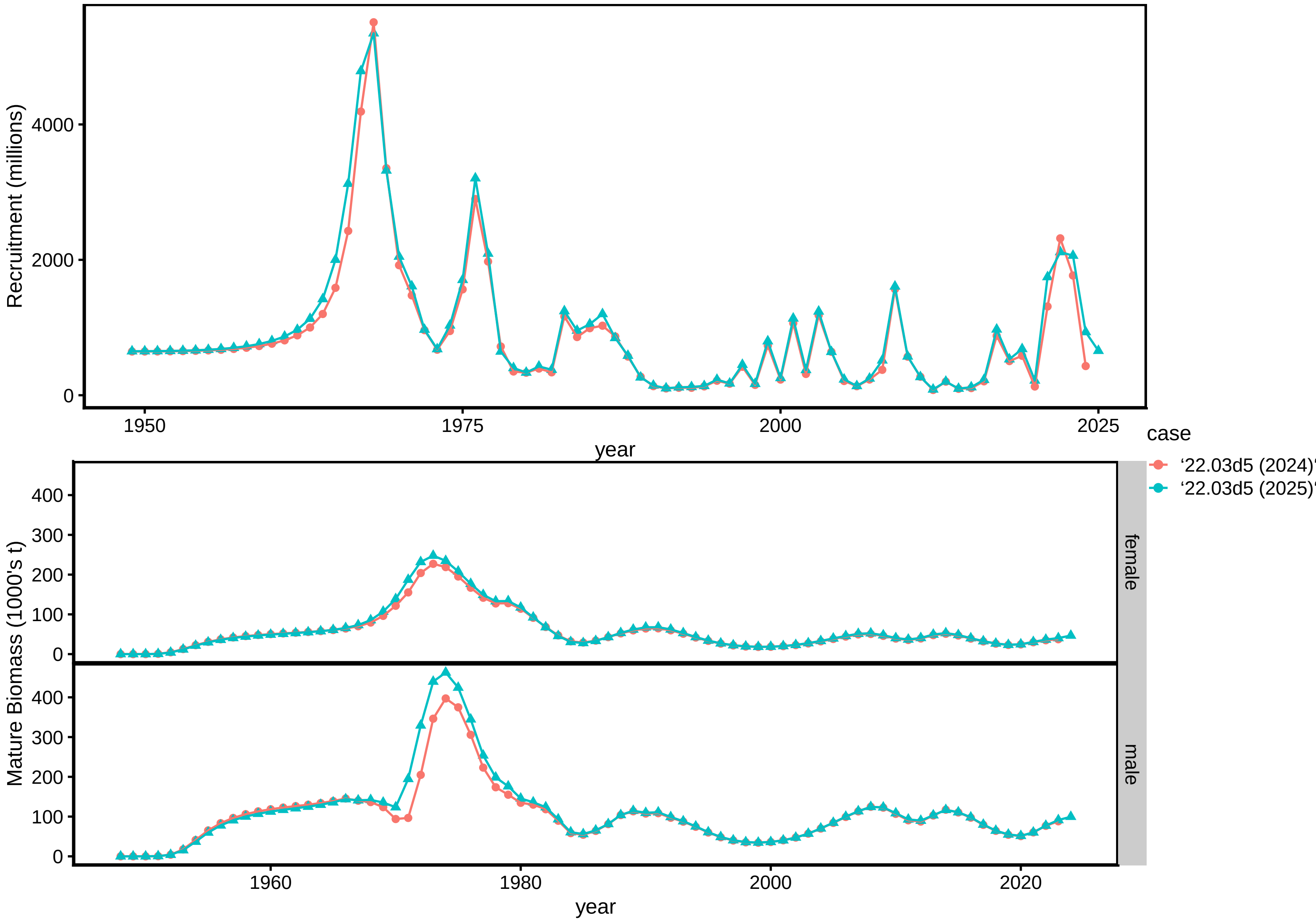


Figure 65. Estimated recruitment and mature biomass time series (all years). Upper plot: recruitment; lower plots: sex-specific mature biomass-at-mating. Preferred model is `22.03d5 (2025)`.

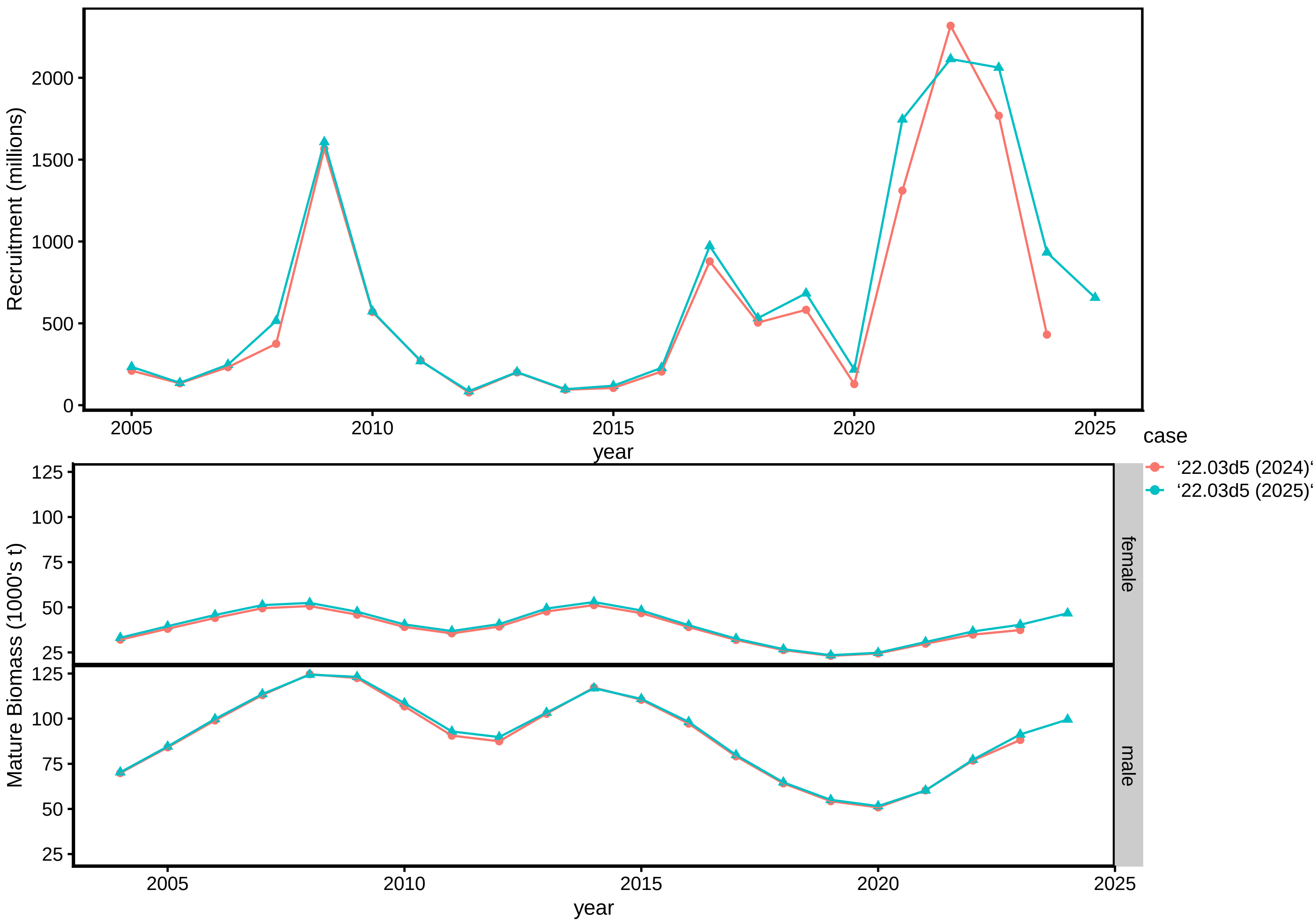


Figure 66. Estimated recruitment and mature biomass time series (recent years). Upper plot: recruitment; lower plots: sex-specific mature biomass-at-mating. Preferred model is `22.03d5 (2025)`.

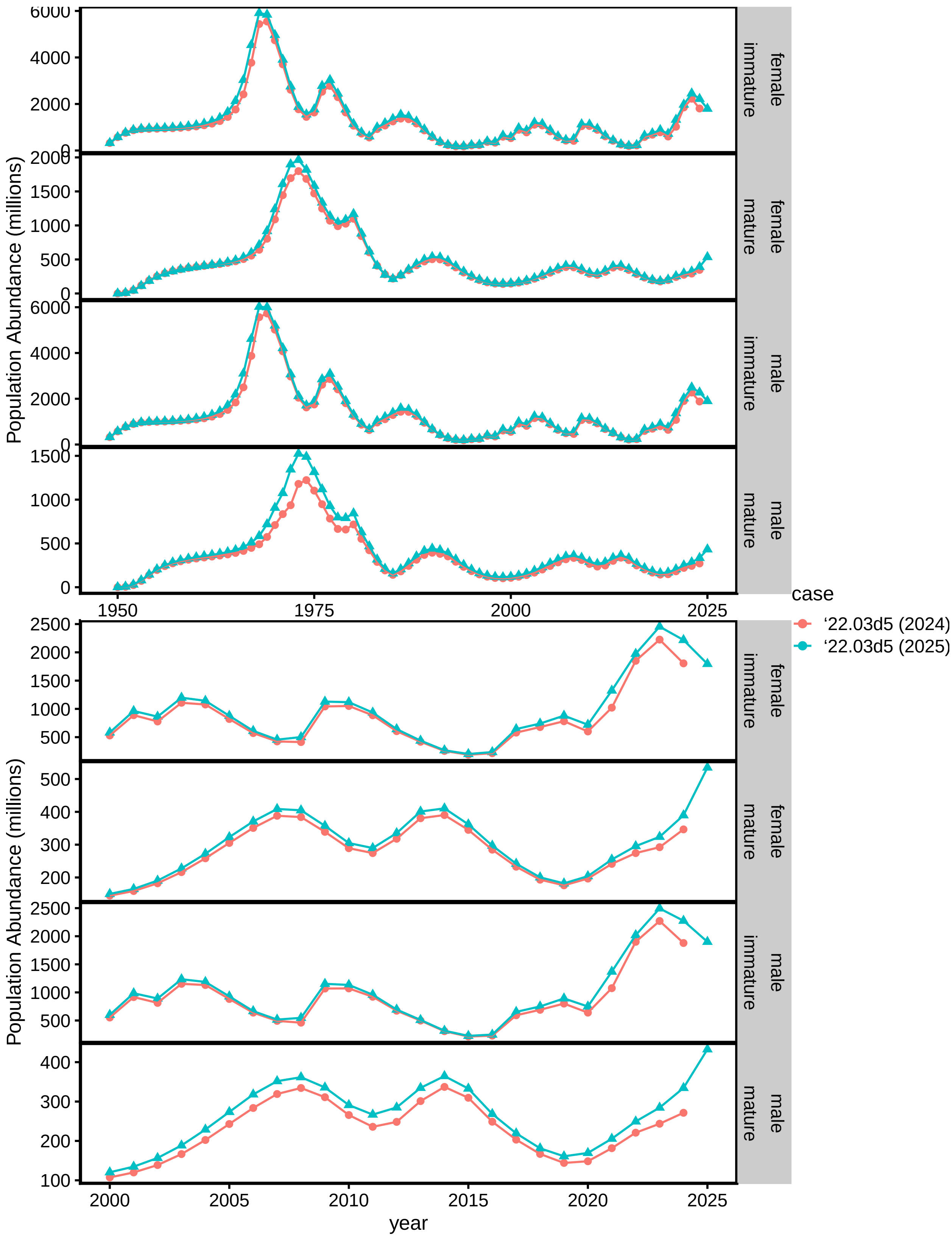


Figure 67. Estimated population abundance trends, by sex and maturity state. Upper plots: all years; lower plots: recent years. Preferred model is 22.03d5 (2025).

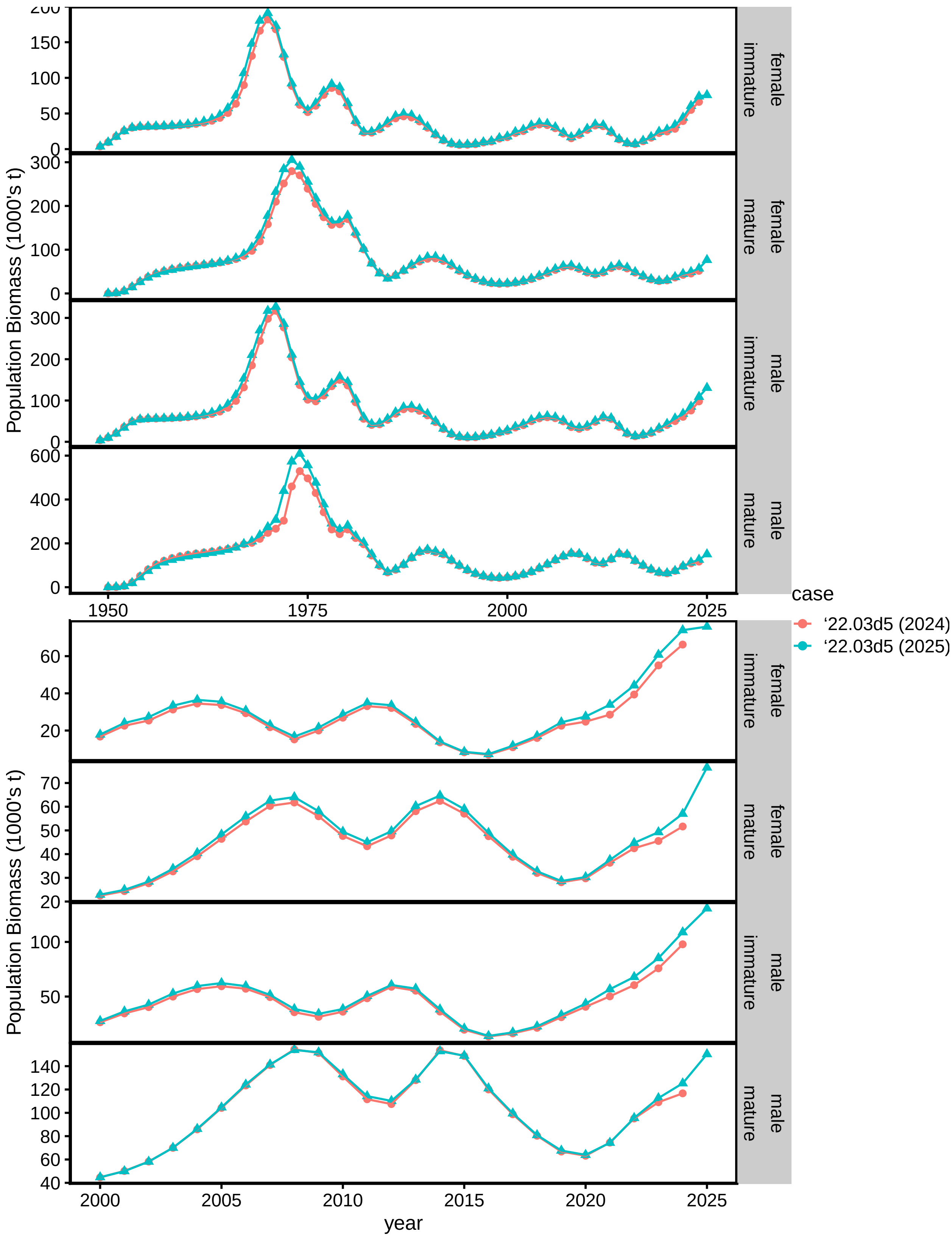


Figure 68. Estimated population biomass trends, by sex and maturity state. Upper plots: all years; lower plots: recent years. Preferred model is `22.03d5 (2025)`.

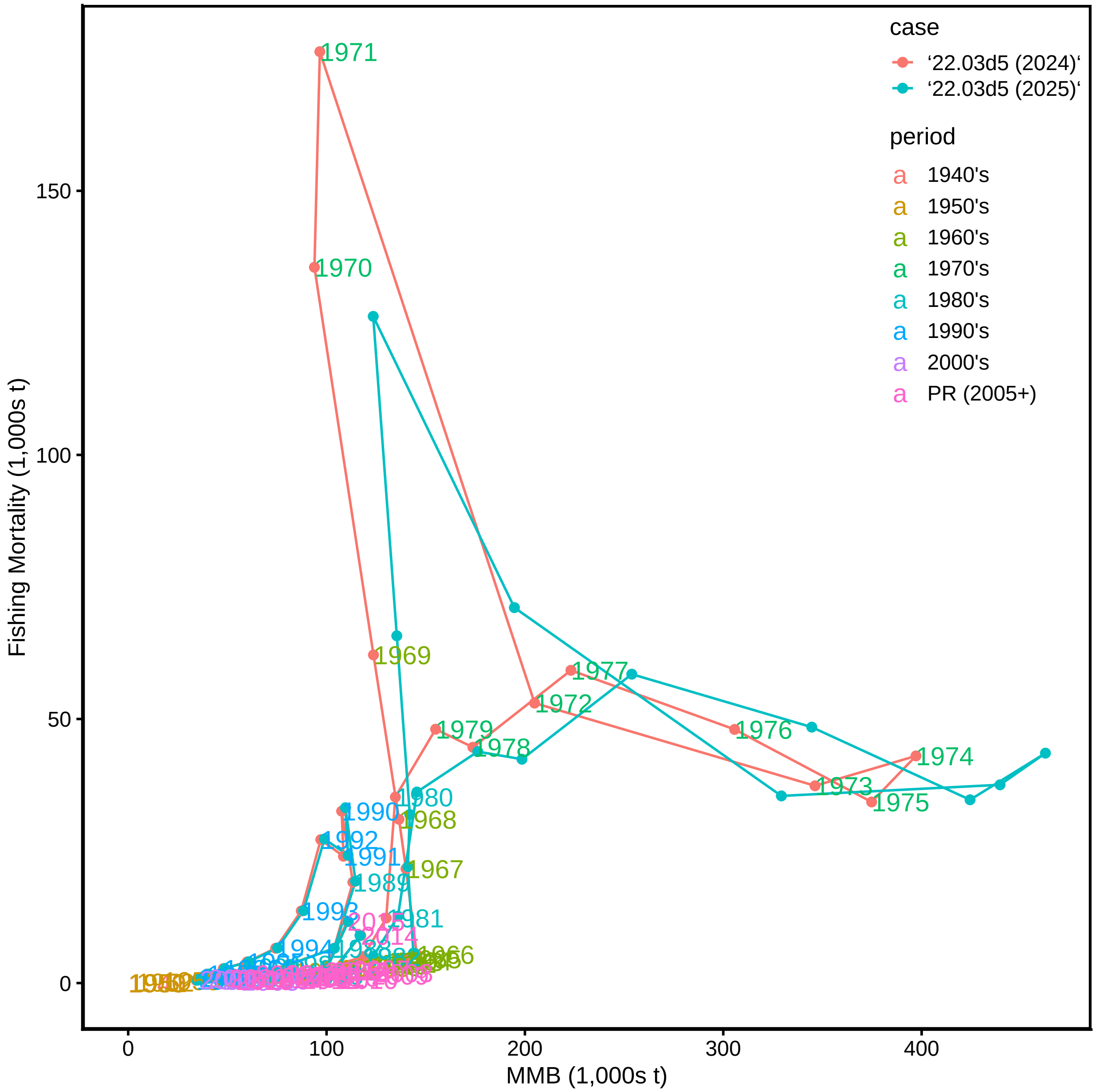


Figure 69. Estimated total fishing mortality vs. MMB. Decades prior to rationalization are grouped by color; the post-rationalization period ("PR"), 2005+, is also highlighted. Data to inform fishing mortality is only available from 1965 on. Preferred model is `22.03d5 (2025)`.

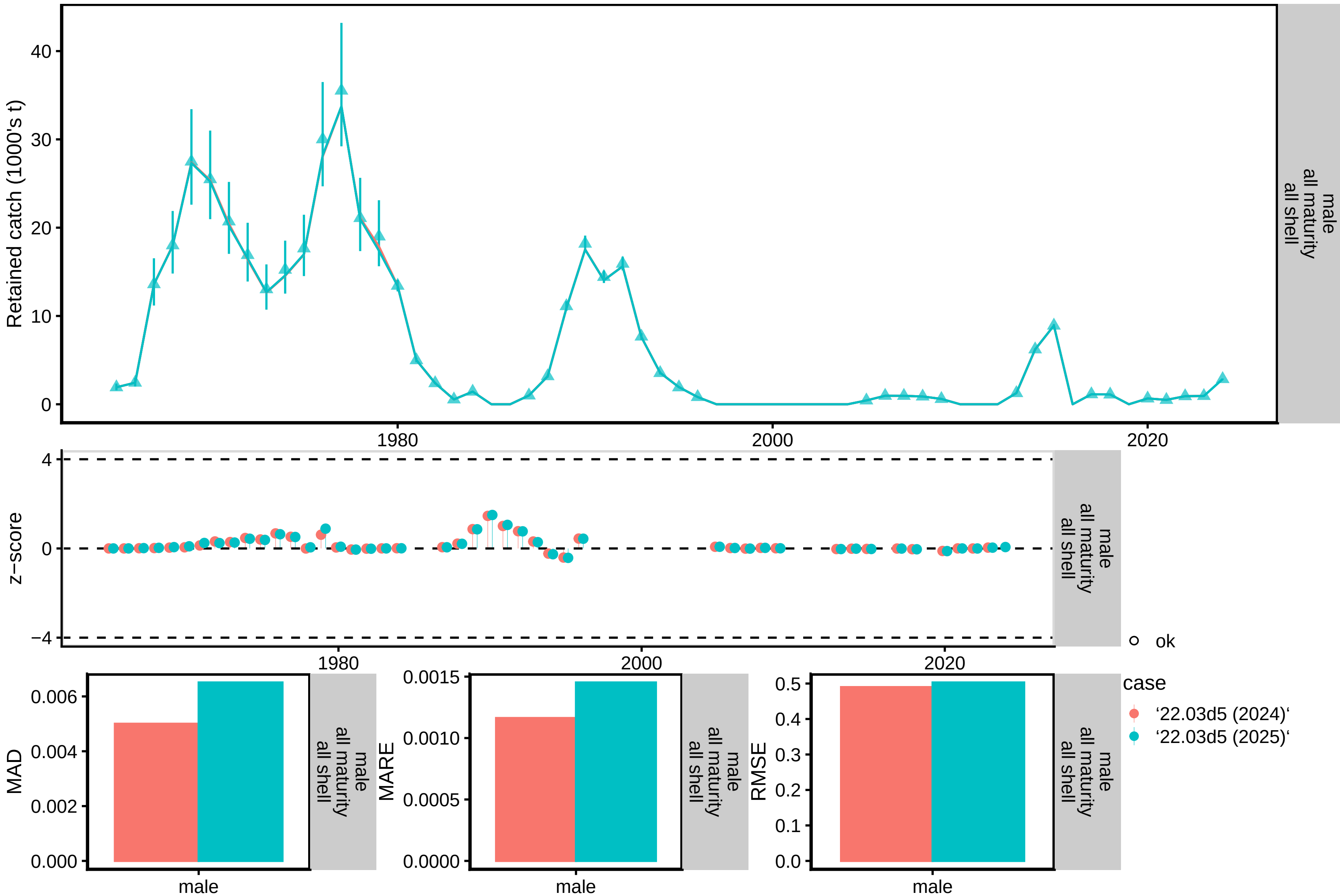


Figure 70. TCSAM02 models fits to retained catch biomass in the directed fishery (upper two rows) and residuals analysis plots (lower two rows). Confidence intervals are 95%. Preferred model is `22.03d5 (2025)`.

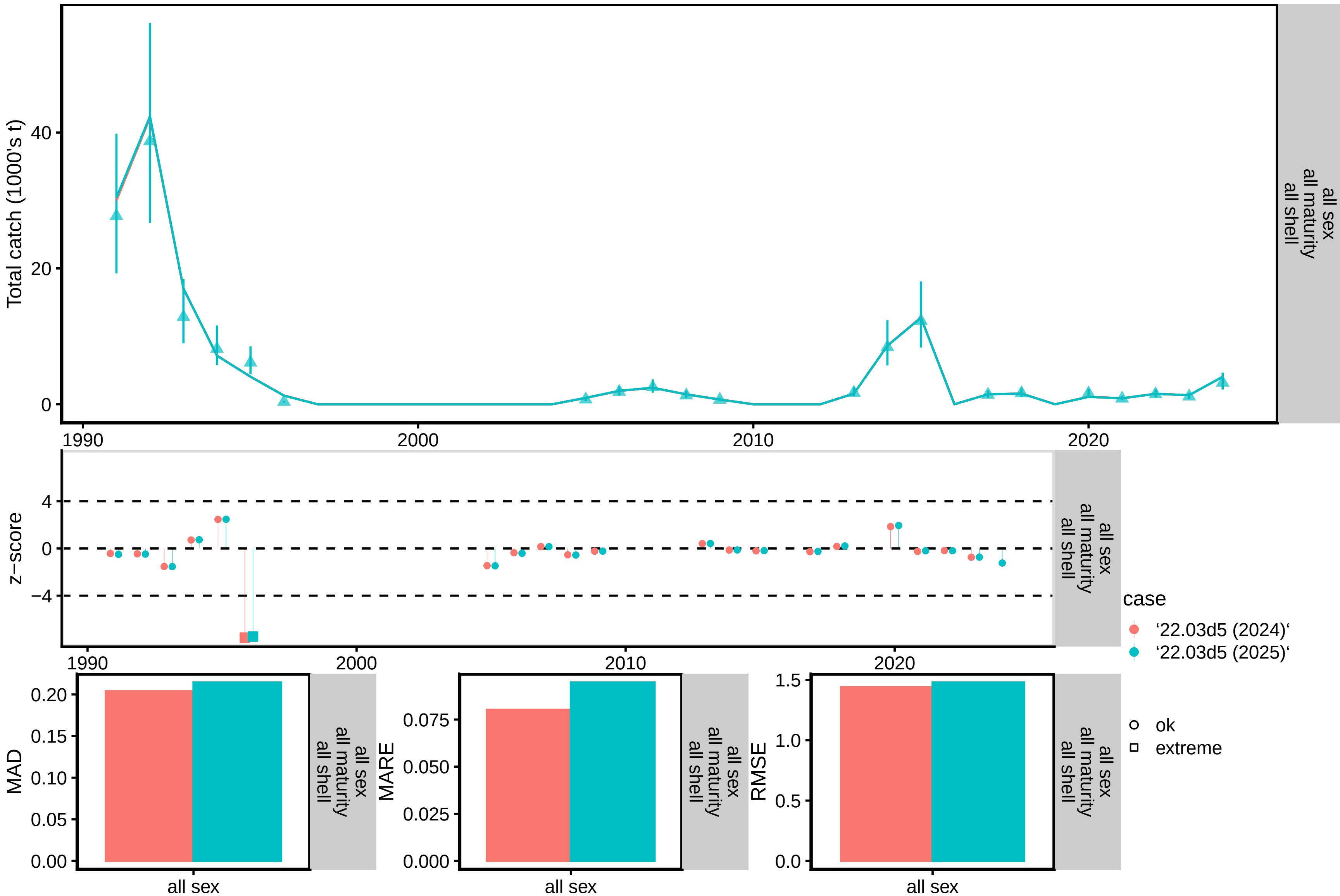


Figure 71. TCSAM02 models fits to total catch biomass of all crab in the TCF fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%. Preferred model is `22.03d5 (2025)`.

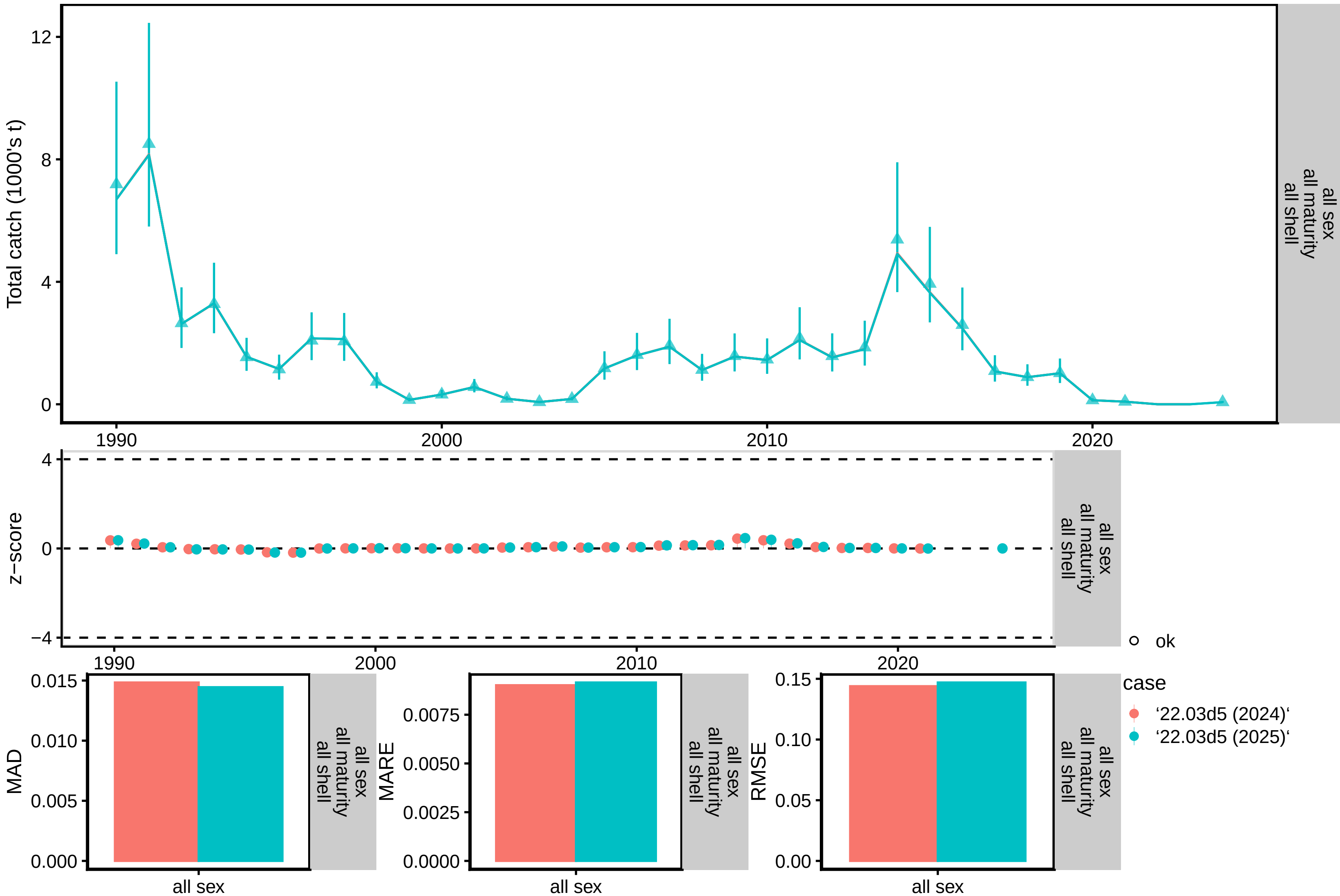


Figure 72. TCSAM02 models fits to total catch biomass of all crab in the SCF fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%. Preferred model is `22.03d5 (2025)`.

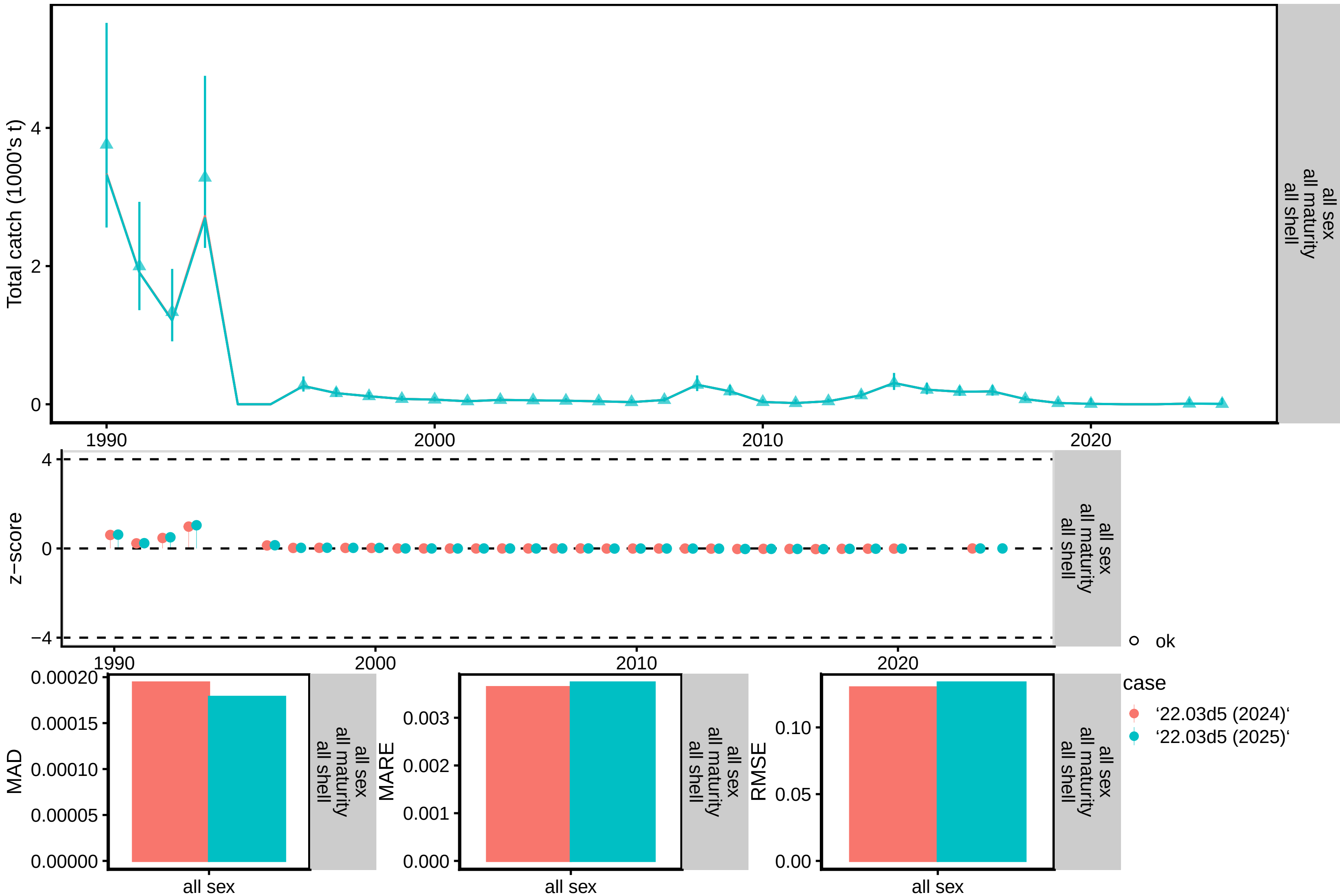


Figure 73. TCSAM02 models fits to total catch biomass of all crab in the RKF fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%. Preferred model is `22.03d5 (2025)`.

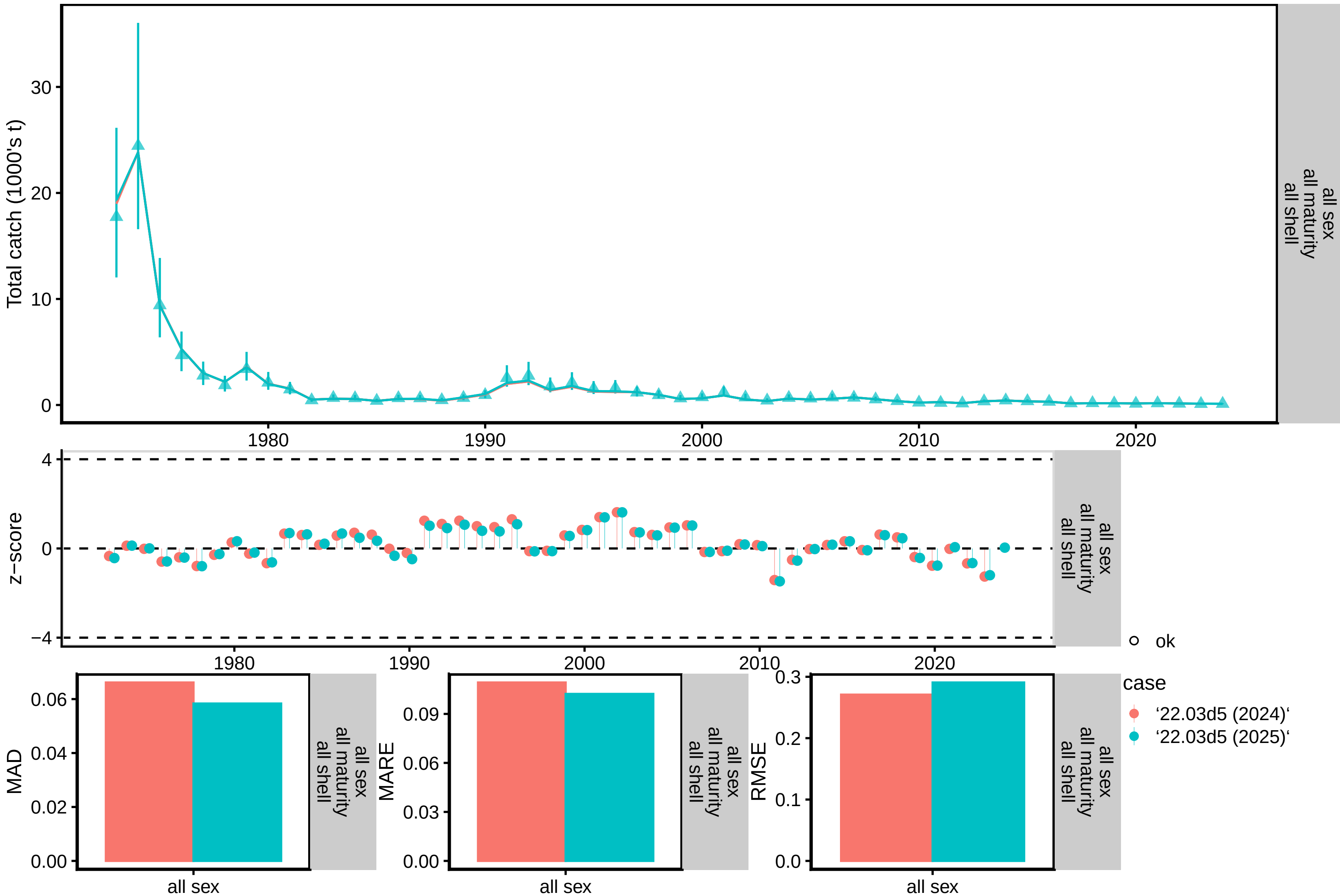


Figure 74. TCSAM02 models fits to total catch biomass of all crab in the GF All fishery (upper row) and residuals analysis plots (lower two rows). Confidence intervals are 95%. Preferred model is `22.03d5 (2025)`.

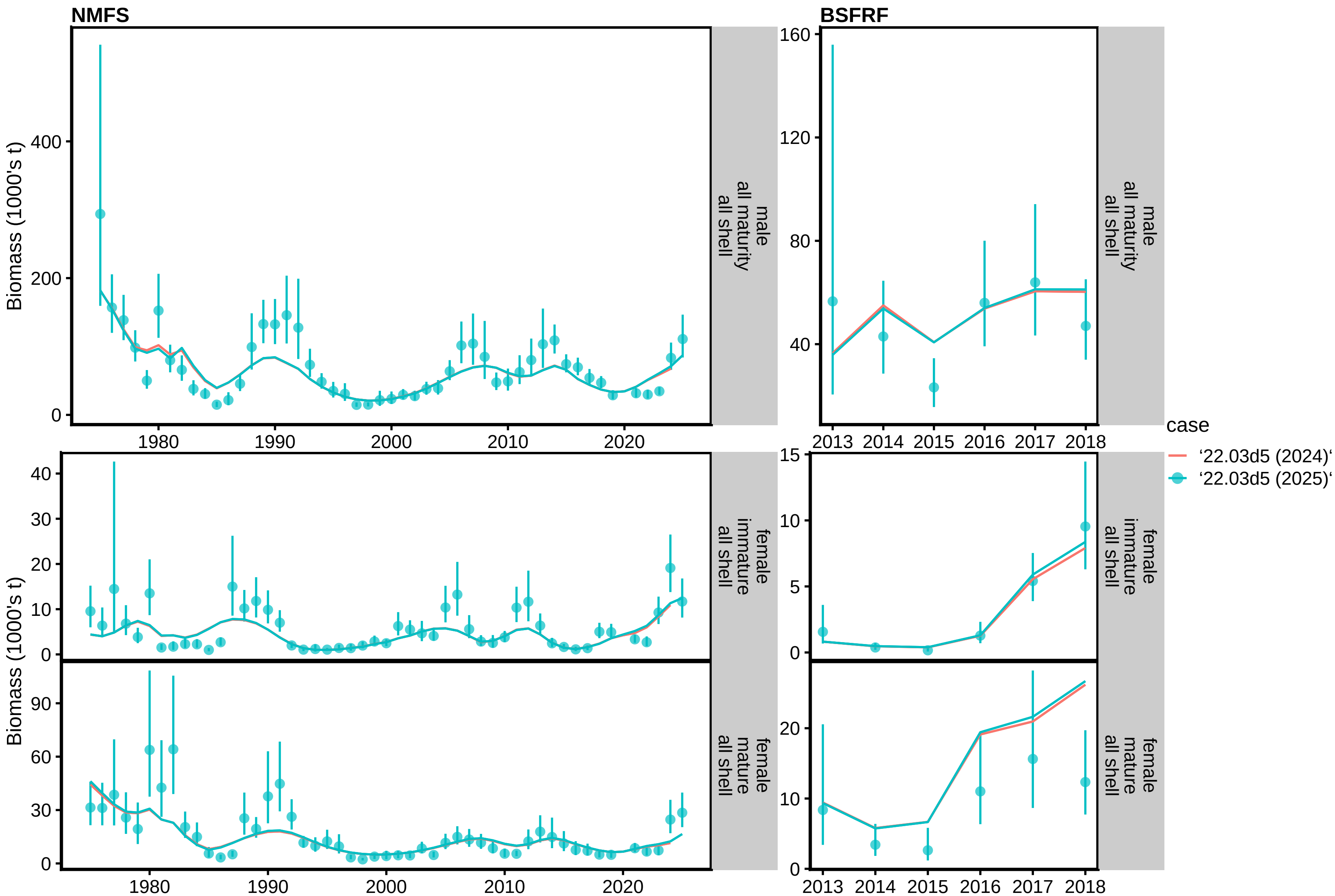


Figure 75. TCSAM02 models fits to time series of all male (upper graph), immature female (center graph), and mature female (lower plot) biomass from the NMFS EBS shelf bottom trawl survey (left column) and the BSFRF SBS trawl survey (right column). Confidence intervals are 95%.

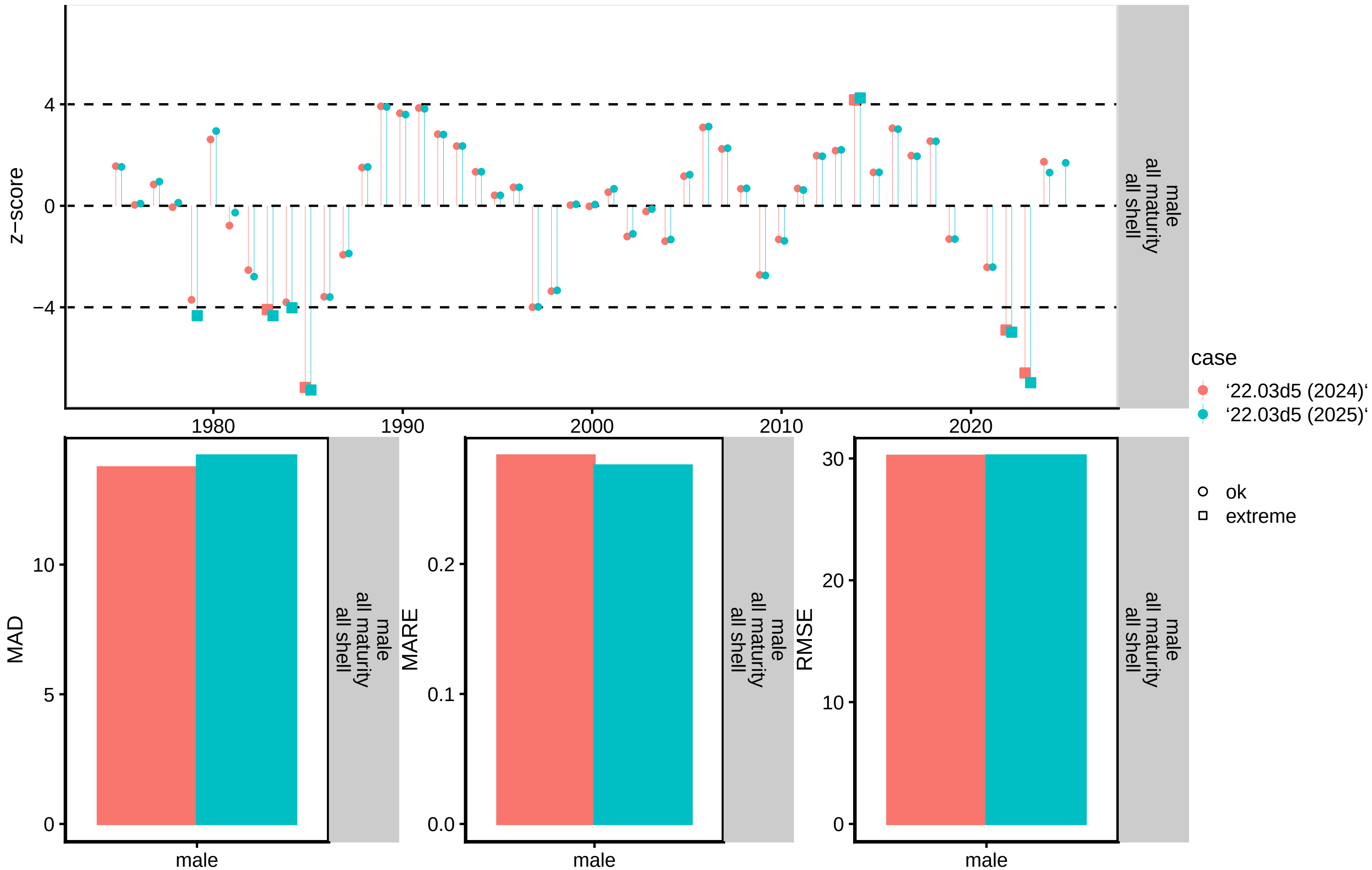


Figure 76. TCSAM02 models residuals analysis by model scenario for fits to male biomass in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

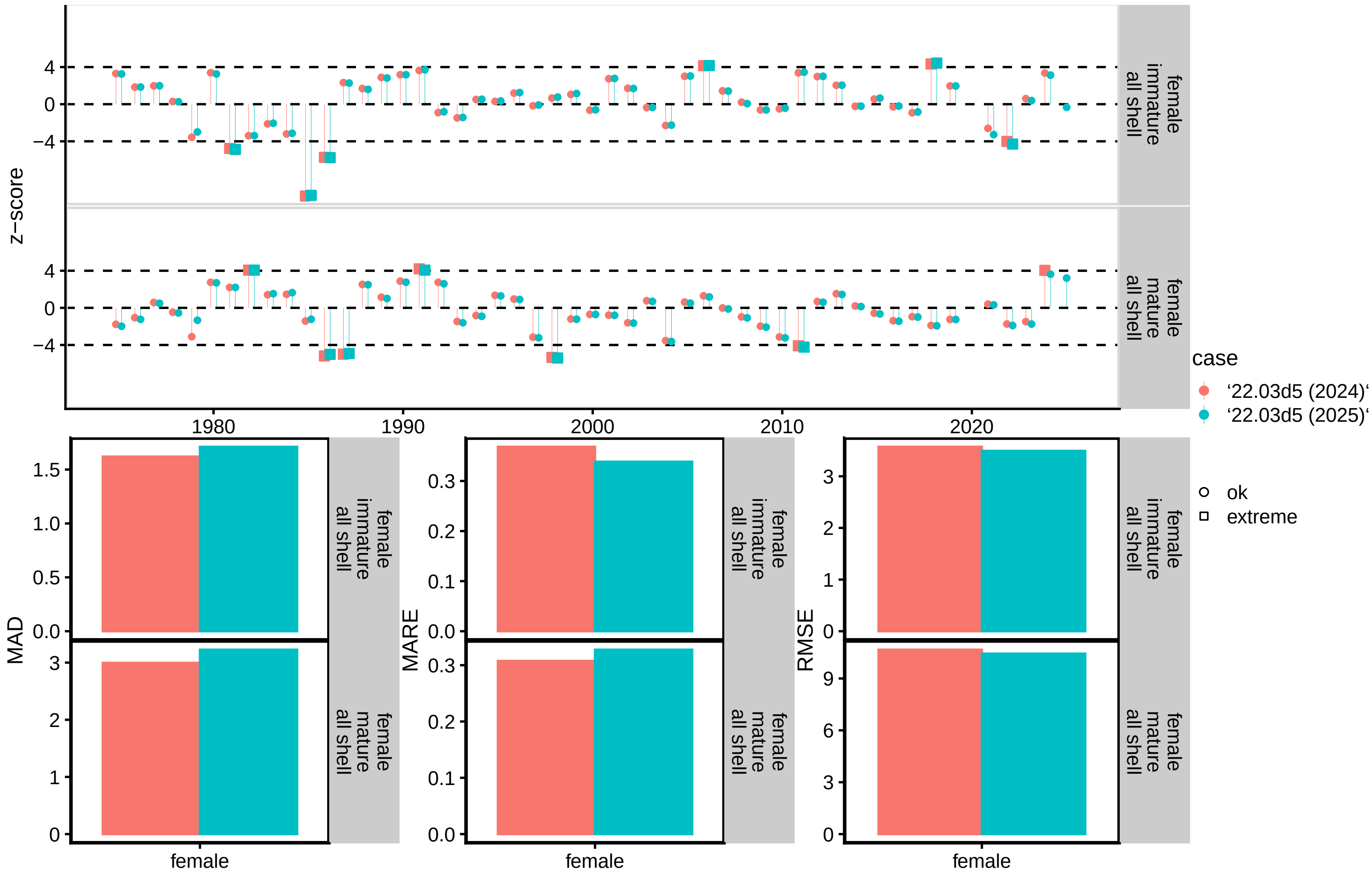


Figure 77. TCSAM02 models residuals analysis by model scenario for fits to female biomass in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

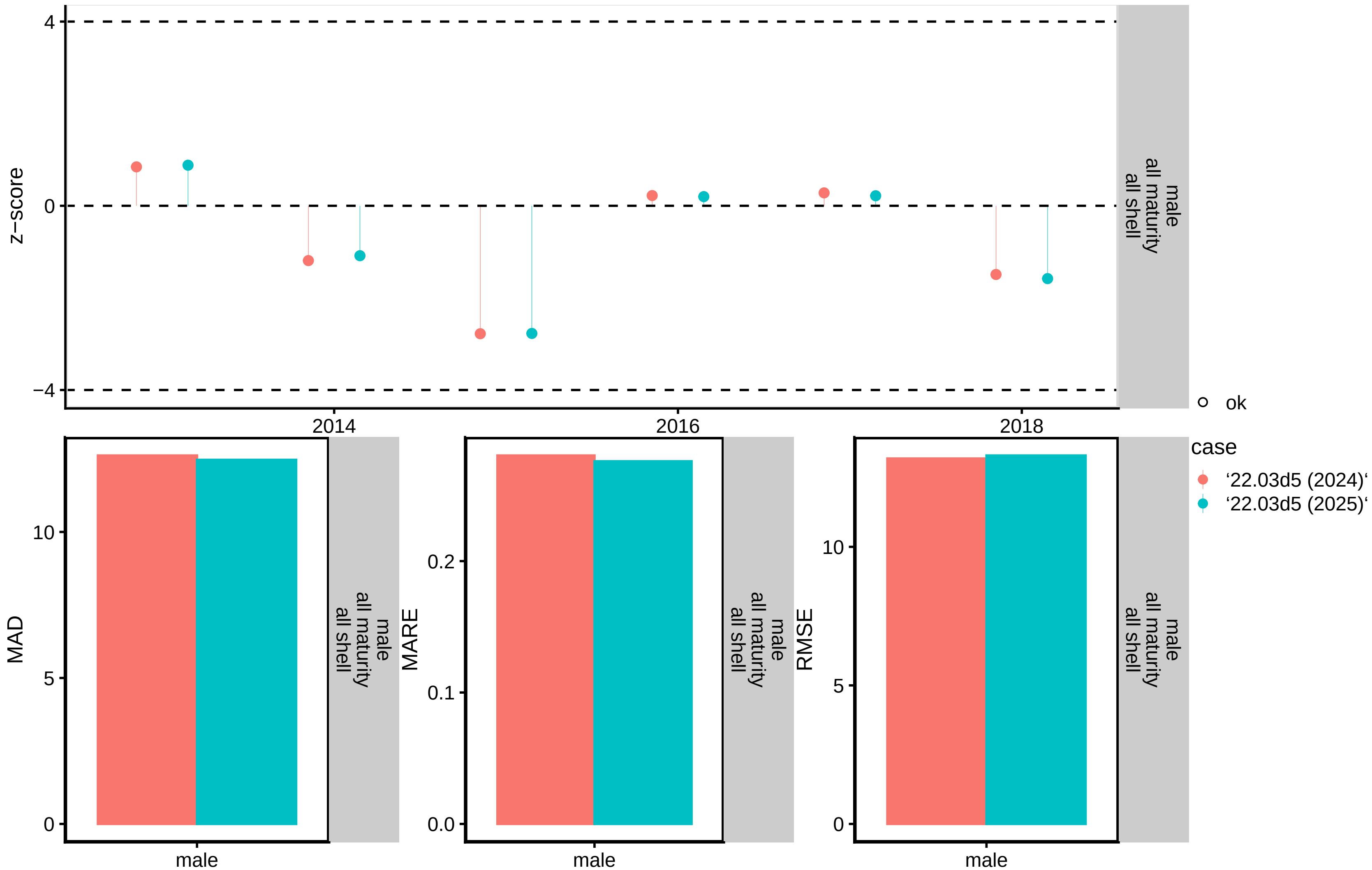


Figure 78. TCSAM02 models residuals analysis by model scenario for fits to male biomass in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

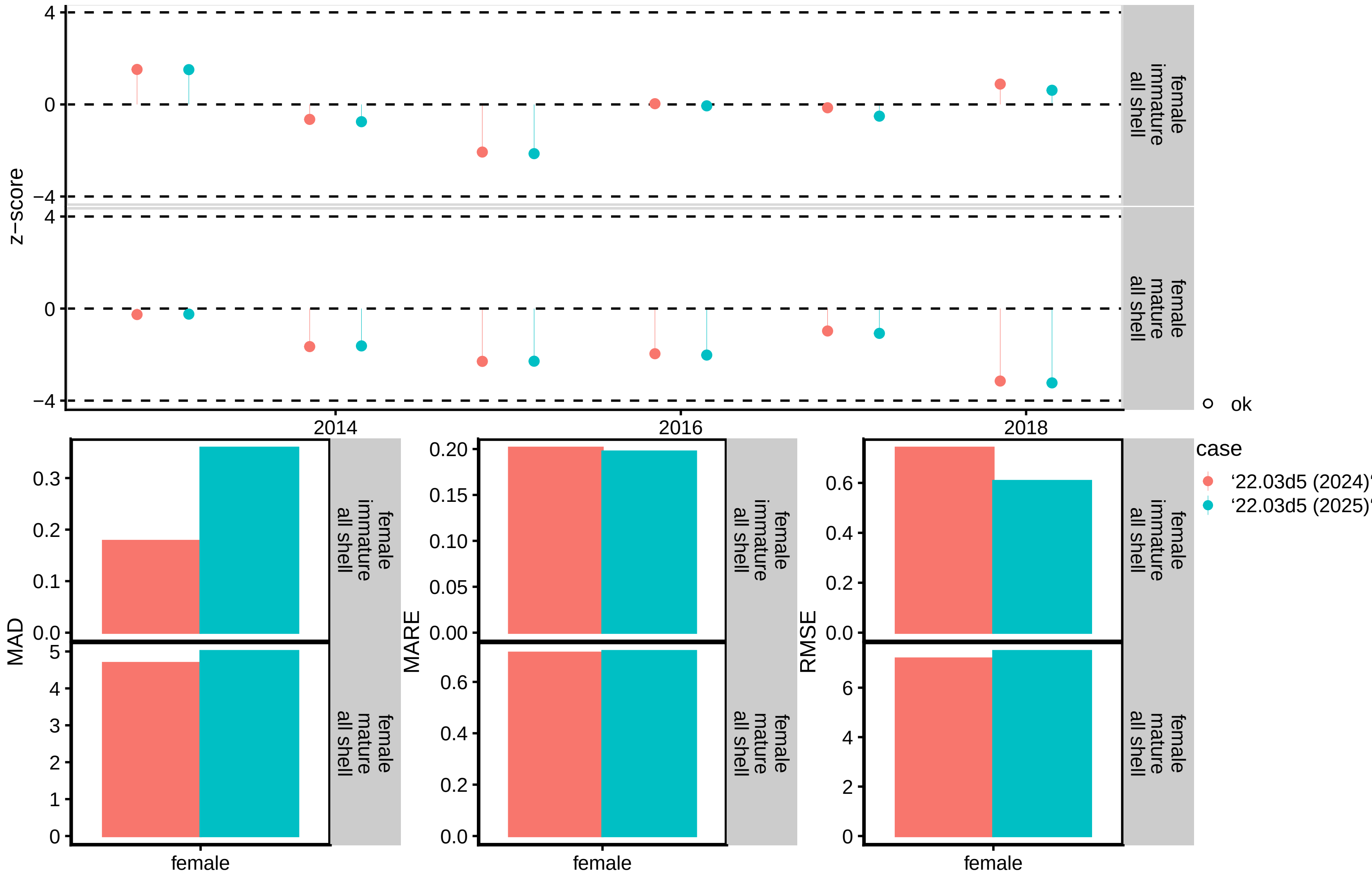


Figure 79. TCSAM02 models residuals analysis by model scenario for fits to female biomass in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

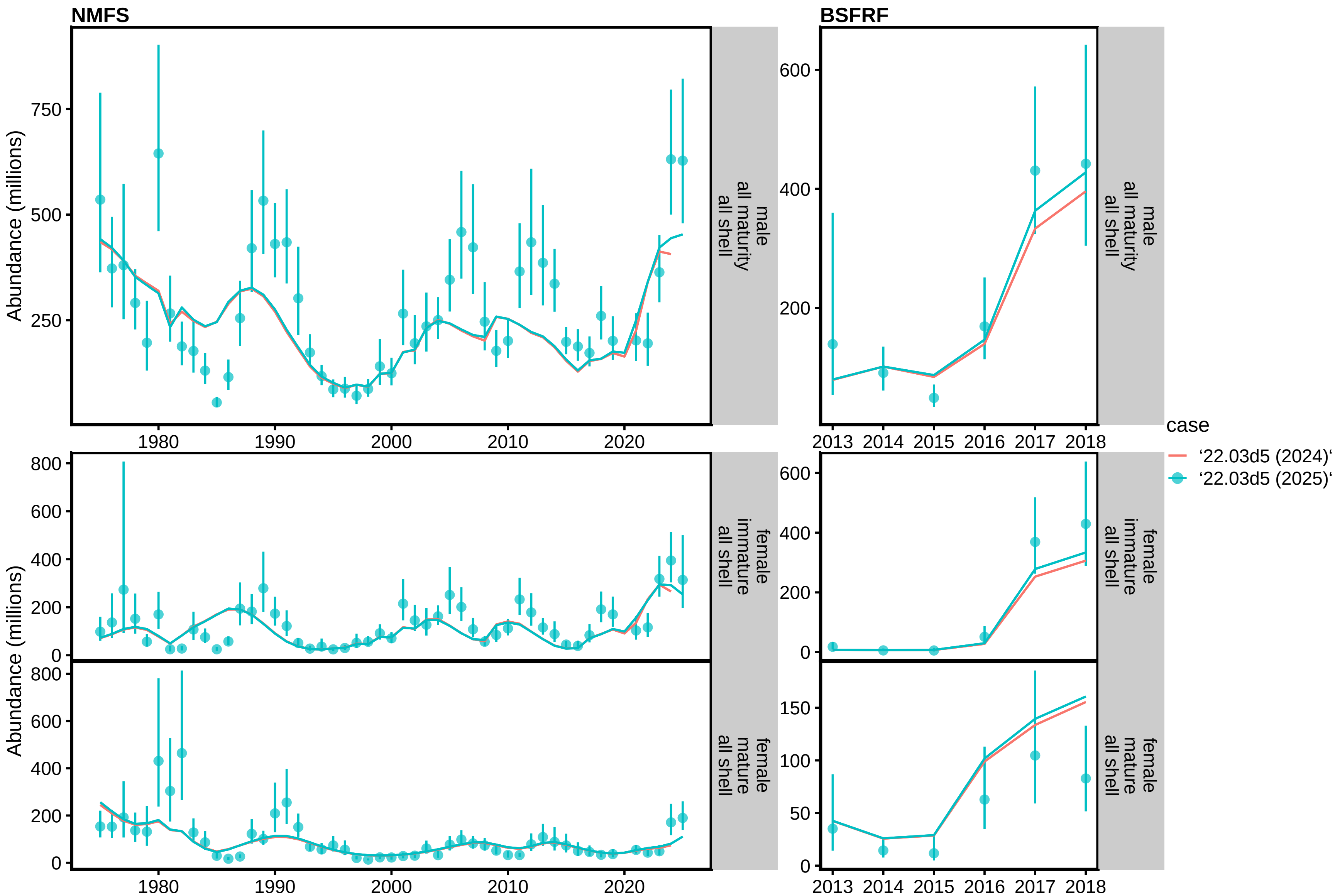


Figure 80. TCSAM02 models fits to time series of all male (upper graph), immature female (center graph), and mature female (lower plot) abundance from the NMFS EBS shelf bottom trawl survey (left column) and the BSFRF SBS trawl survey (right column). Note that these fits are not included in the model objective function and simply provide a diagnostic check. Confidence intervals are 95%.

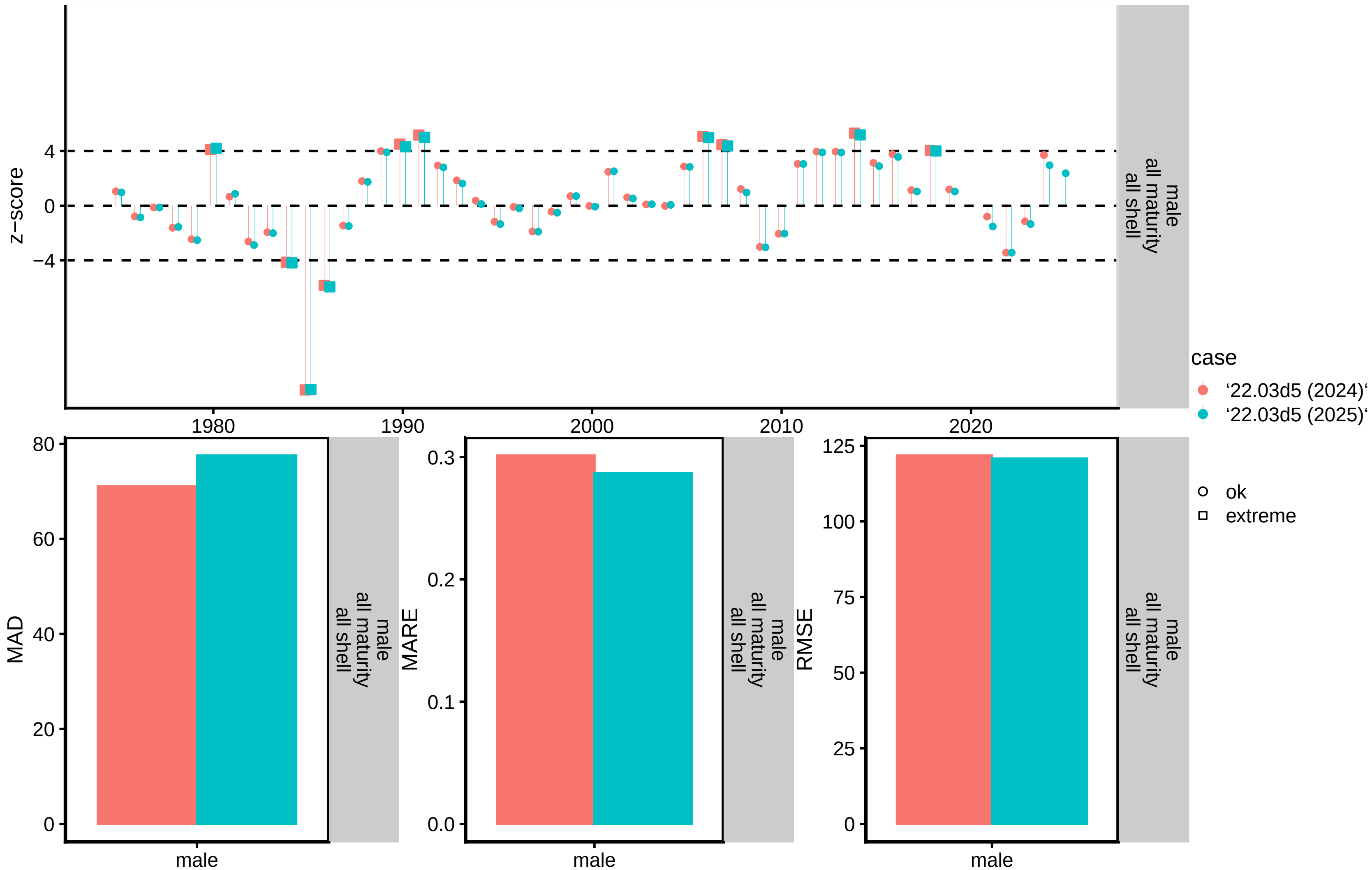


Figure 81. TCSAM02 models residuals analysis by model scenario for fits to male abundance in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

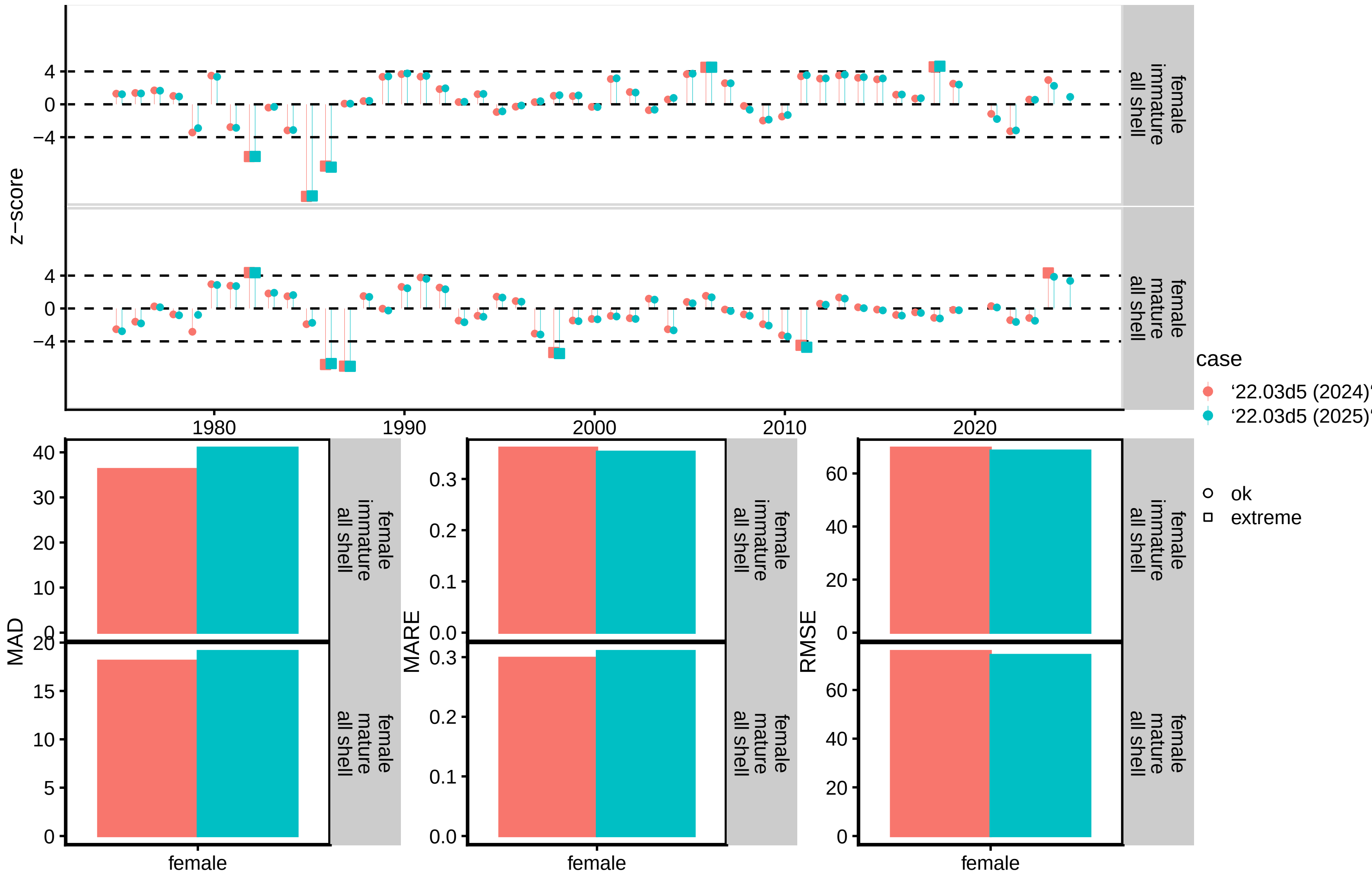


Figure 82. TCSAM02 models residuals analysis by model scenario for fits to female abundance in the NMFS EBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

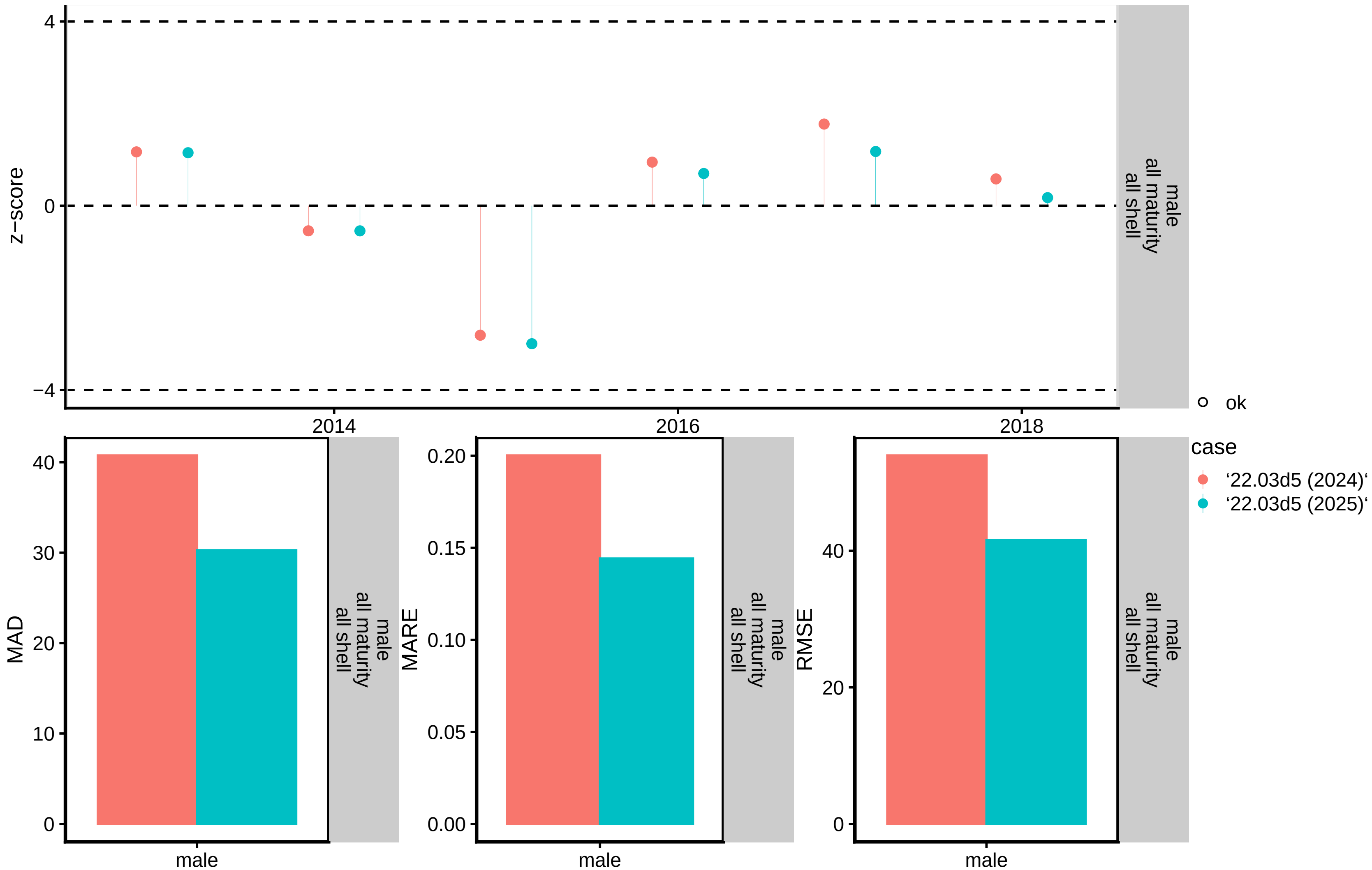


Figure 83. TCSAM02 models residuals analysis by model scenario for fits to male abundance in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

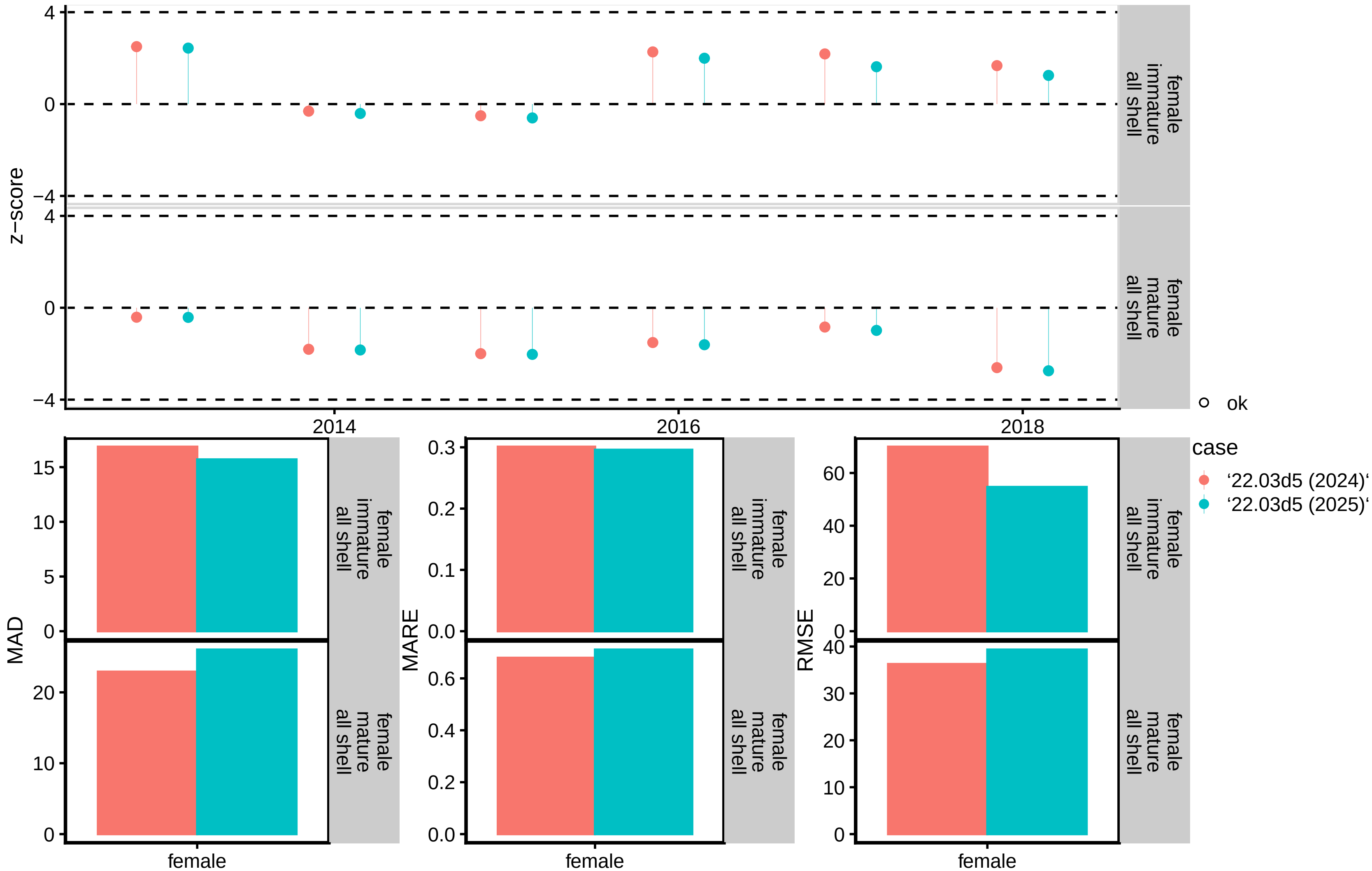


Figure 84. TCSAM02 models residuals analysis by model scenario for fits to female abundance in the BSFRF SBS bottom trawl survey. Upper row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

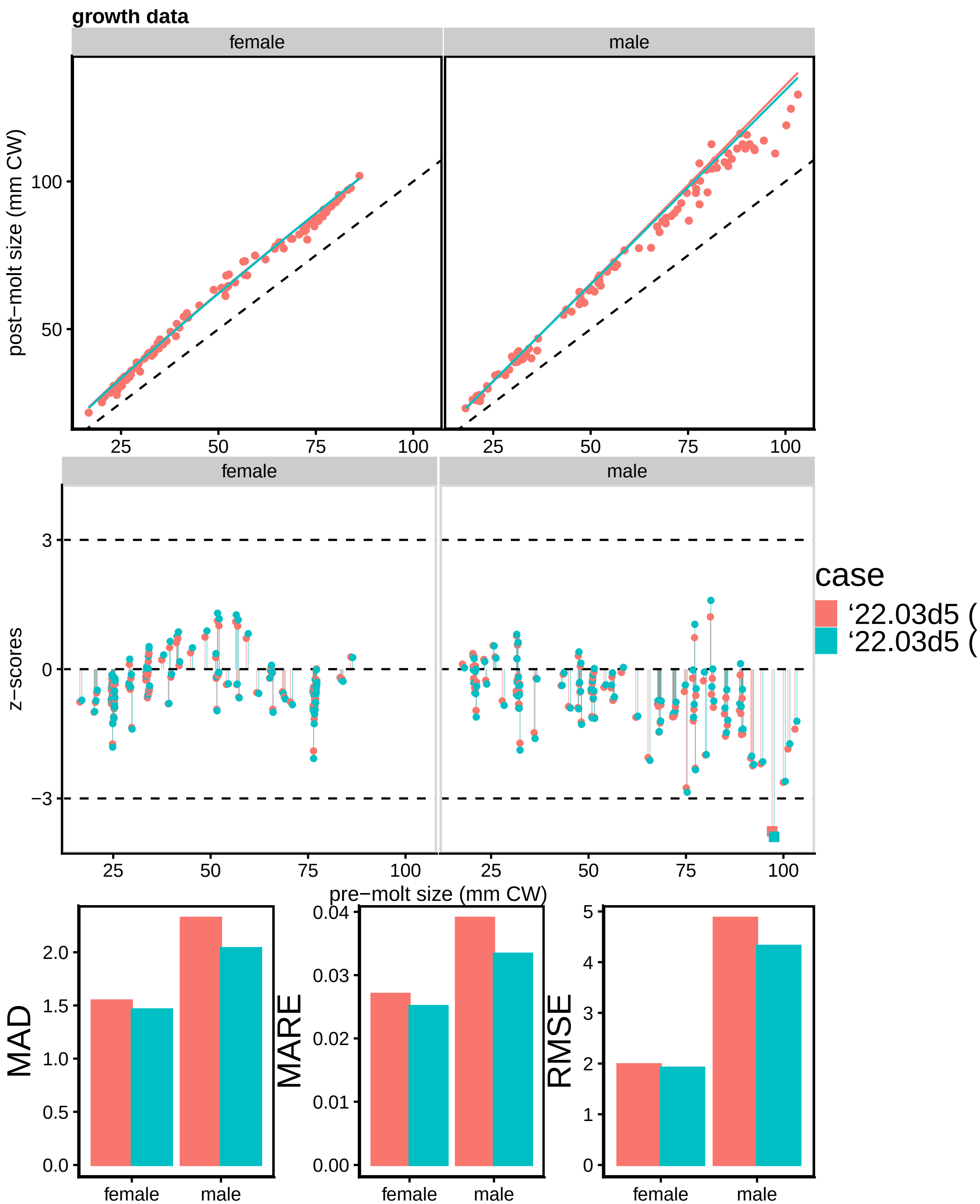


Figure 85. TCSAM02 models fits and residuals analysis by model scenario for fits to molt increment data. Upper row: fits to data; center row: annual z-scores; bottom row: 1) MAD: median absolute deviations, 2) MARE: median absolute relative error; 3) RMSE: root mean square error.

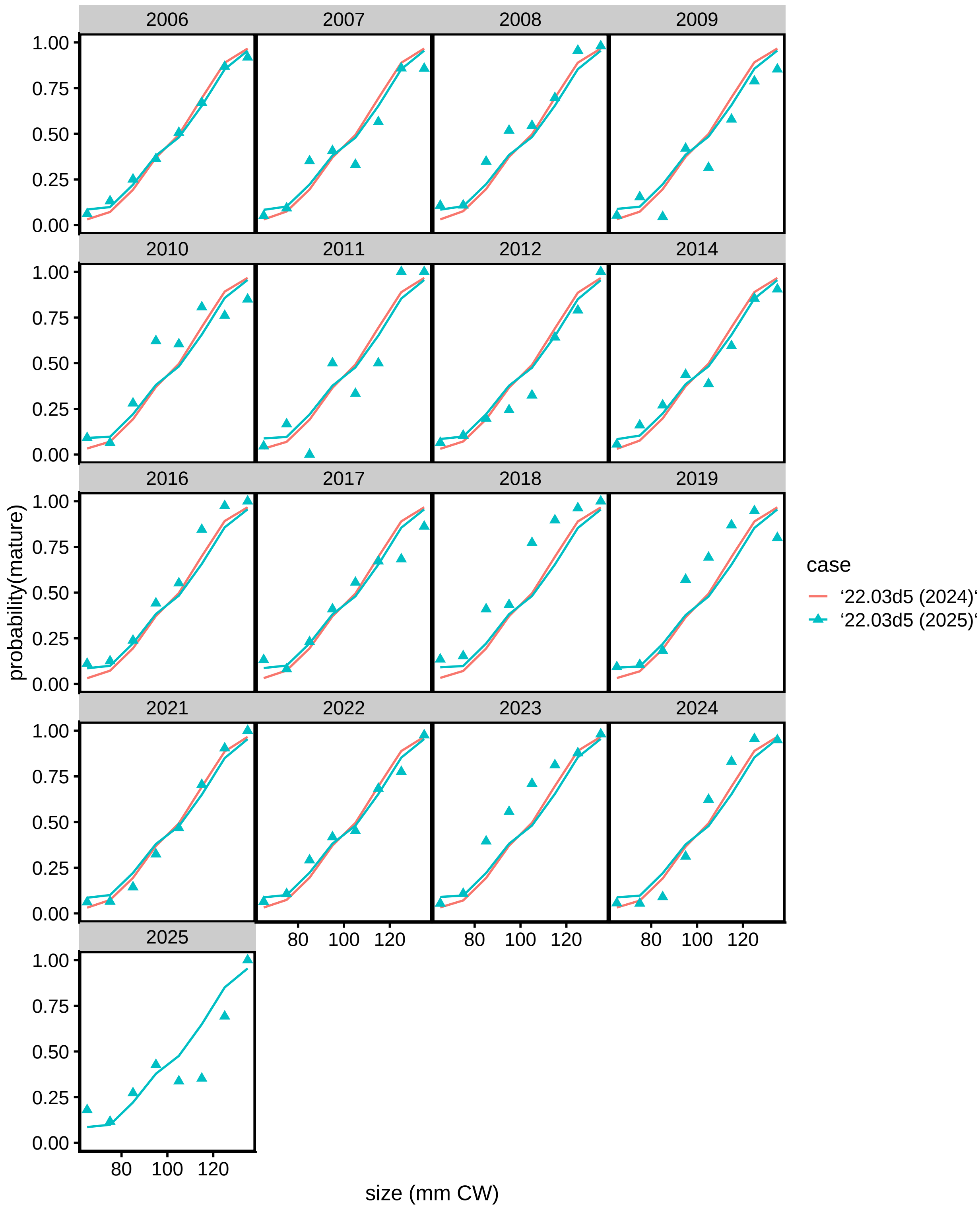


Figure 86. TCSAM02 models fits to maturity ogive data by model scenario and year.

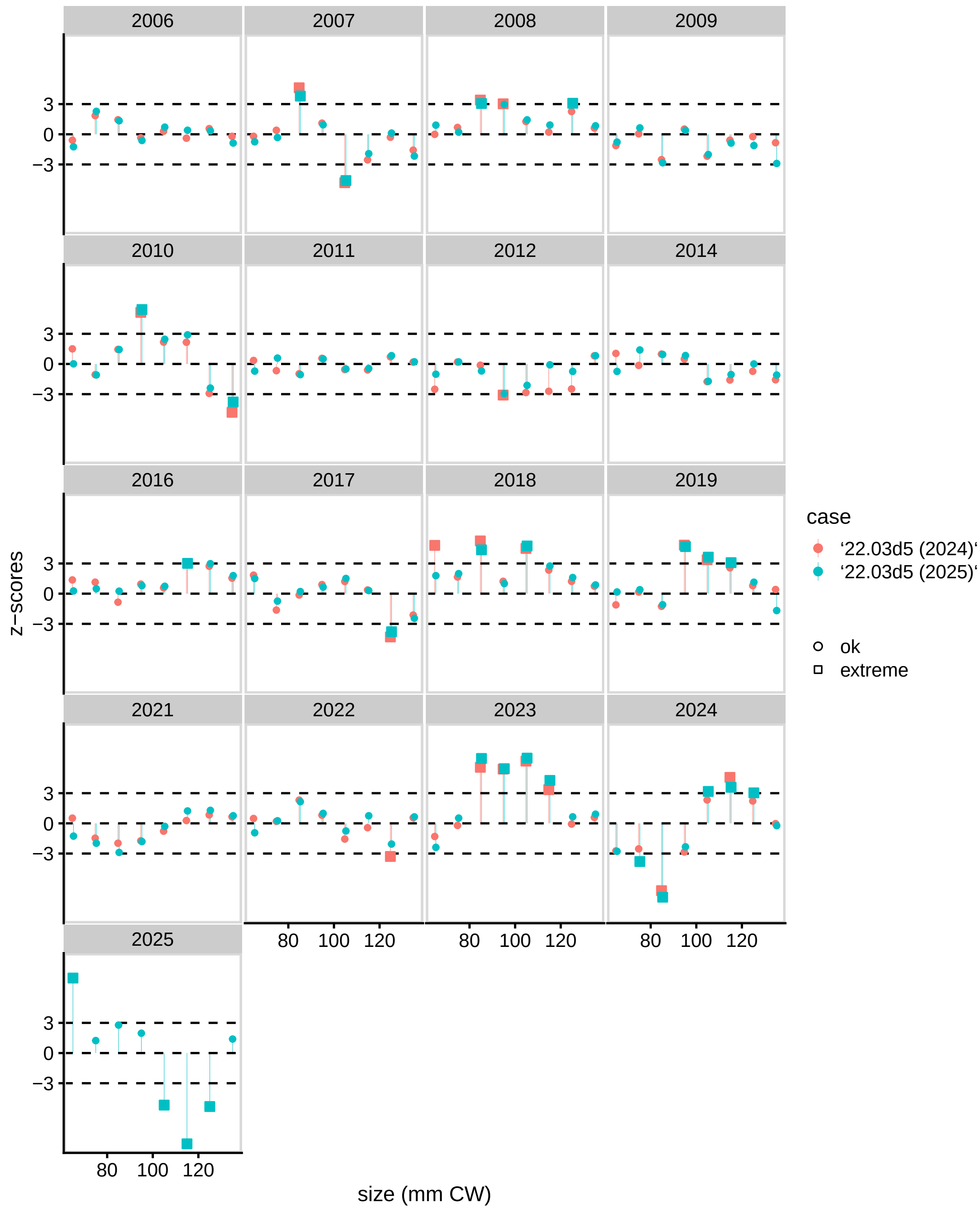


Figure 87. TCSAM02 models residuals analysis for maturity ogive data, by model scenario and year.

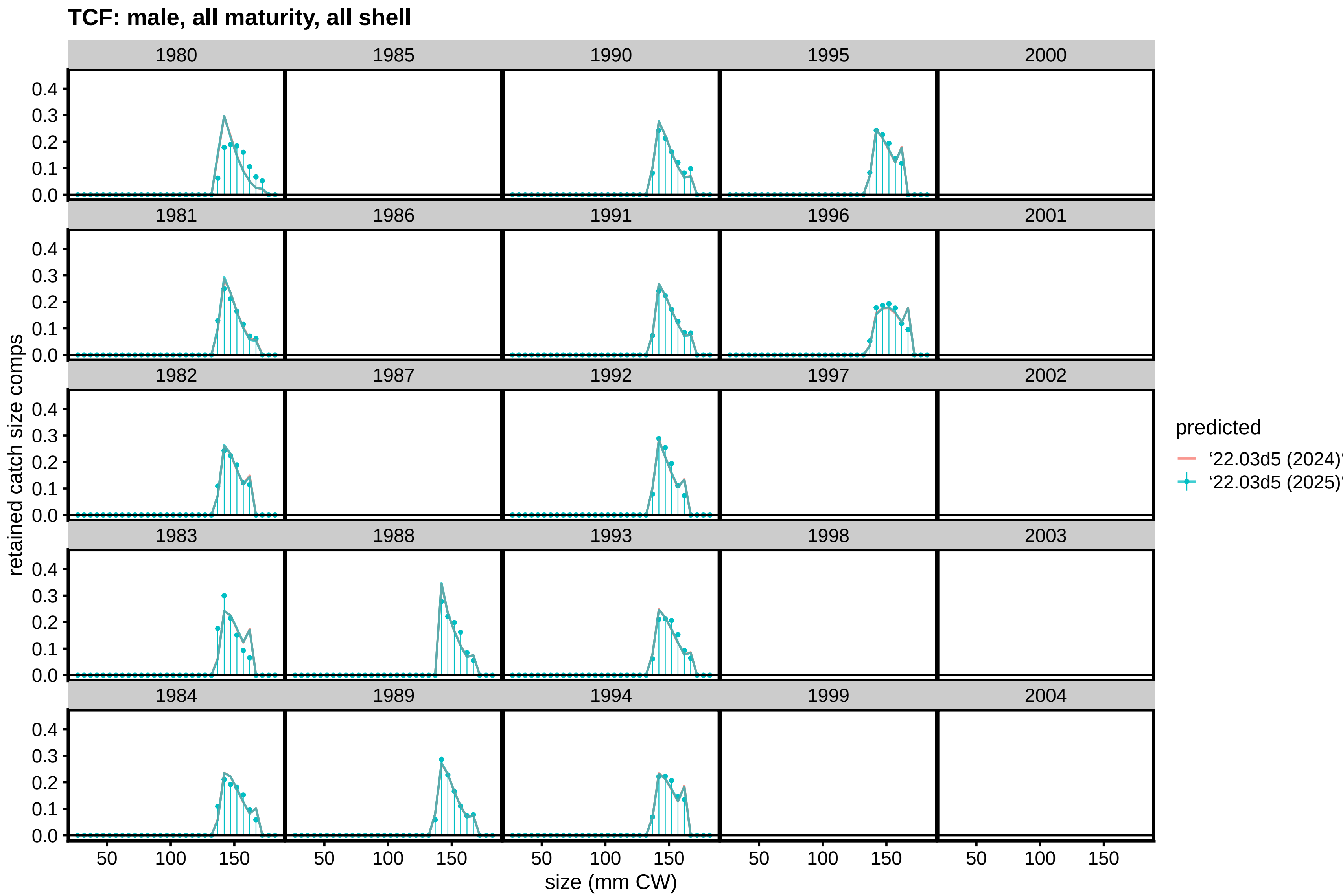


Figure 88. TCSAM02 models fits to retained catch size compositions in the directed fishery. Preferred model is `22.03d5 (2025)`.

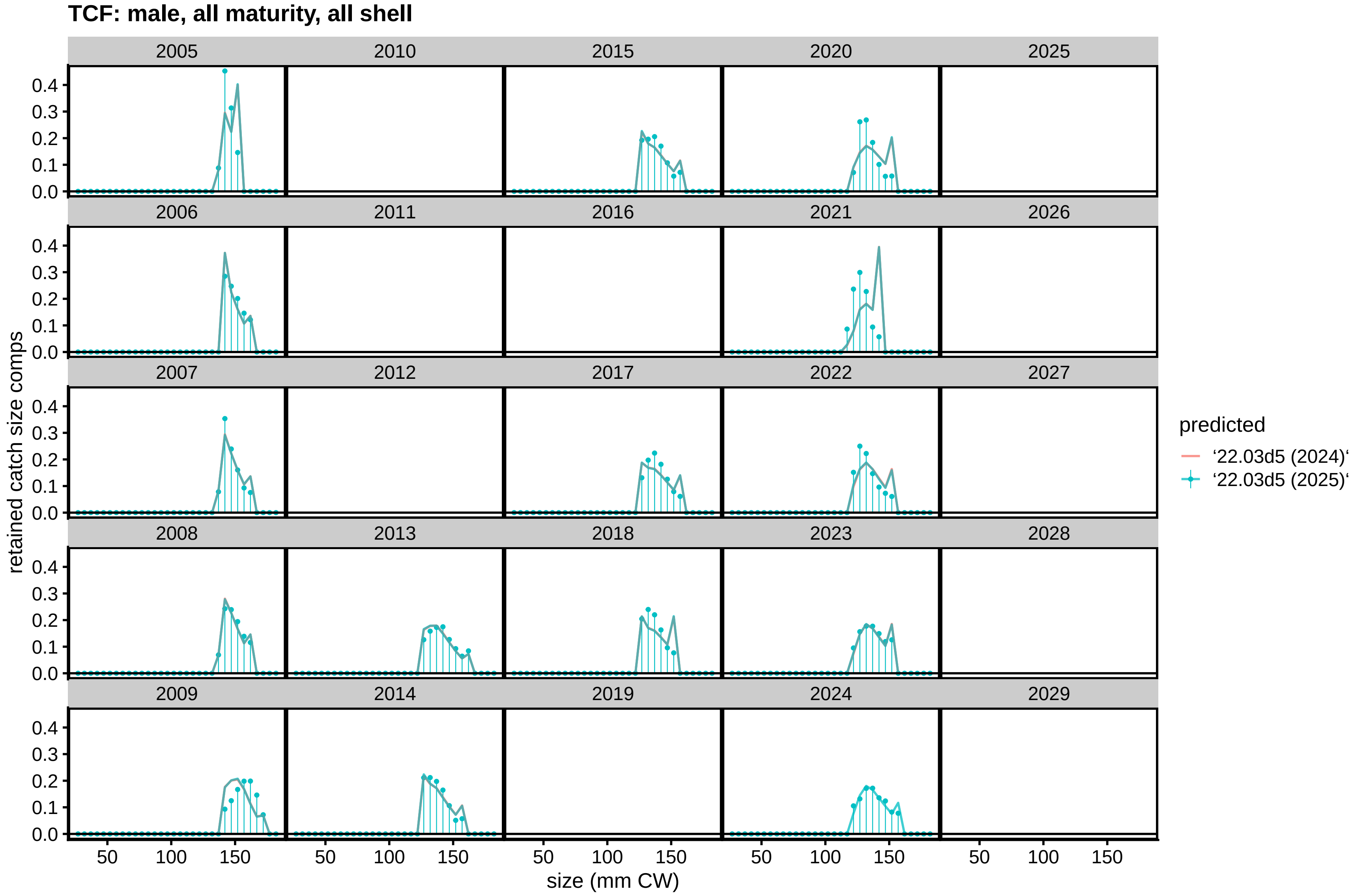


Figure 89. TCSAM02 models fits to retained catch size compositions in the directed fishery. Preferred model is `22.03d5 (2025)`.

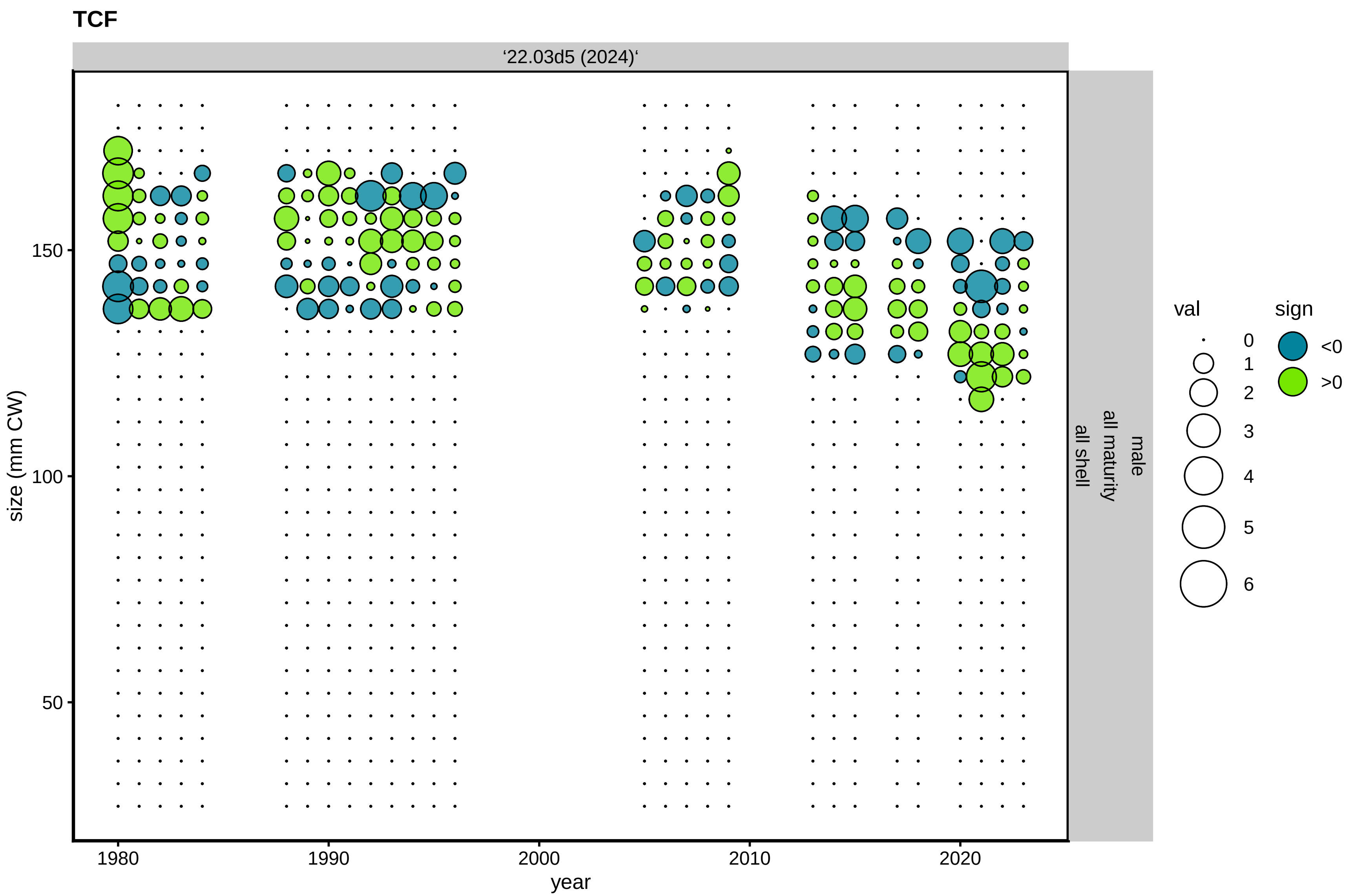


Figure 90. Pearson's residuals for fits to retained catch size composition data. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

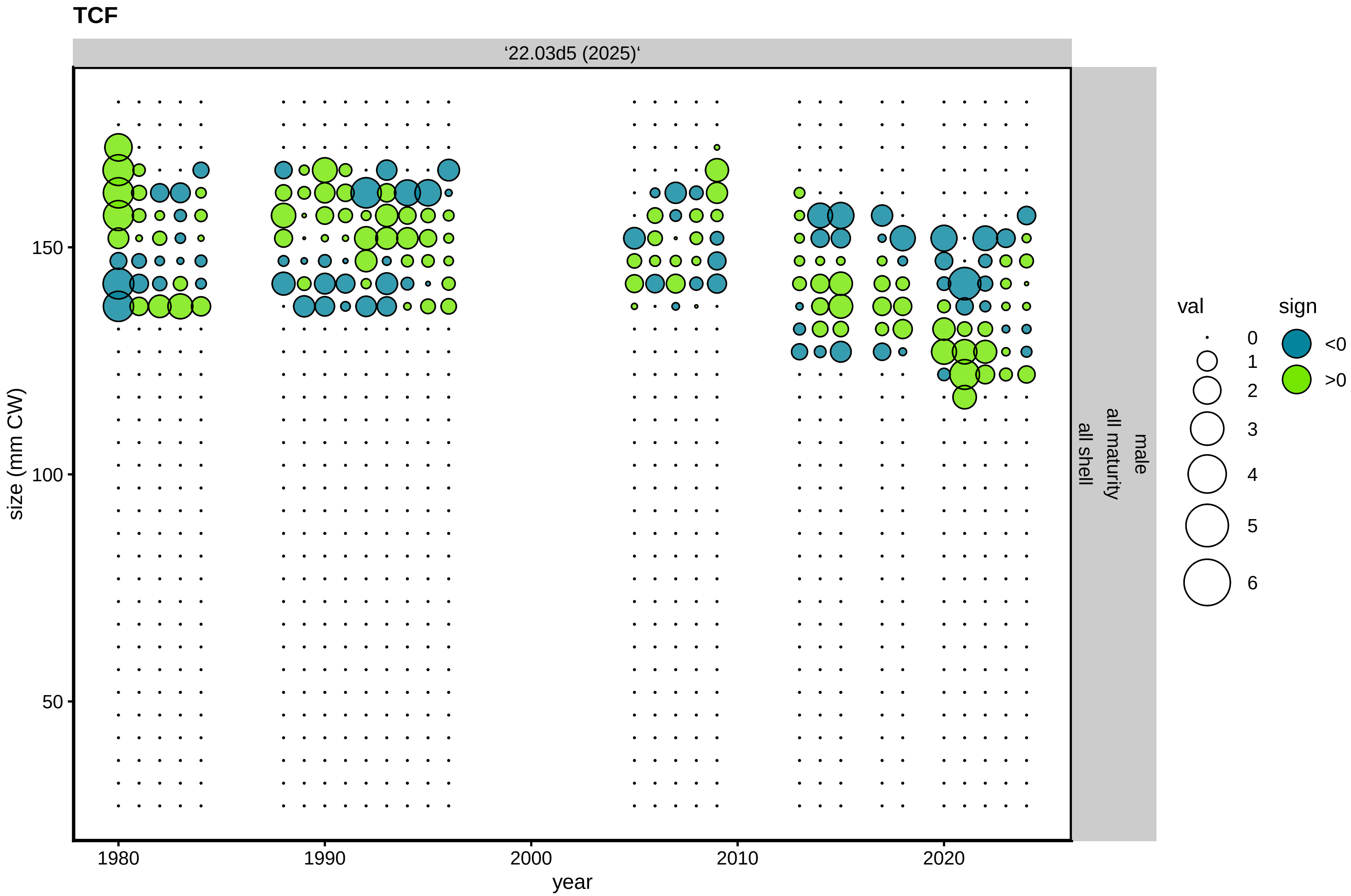


Figure 91. Pearson's residuals for fits to retained catch size composition data. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

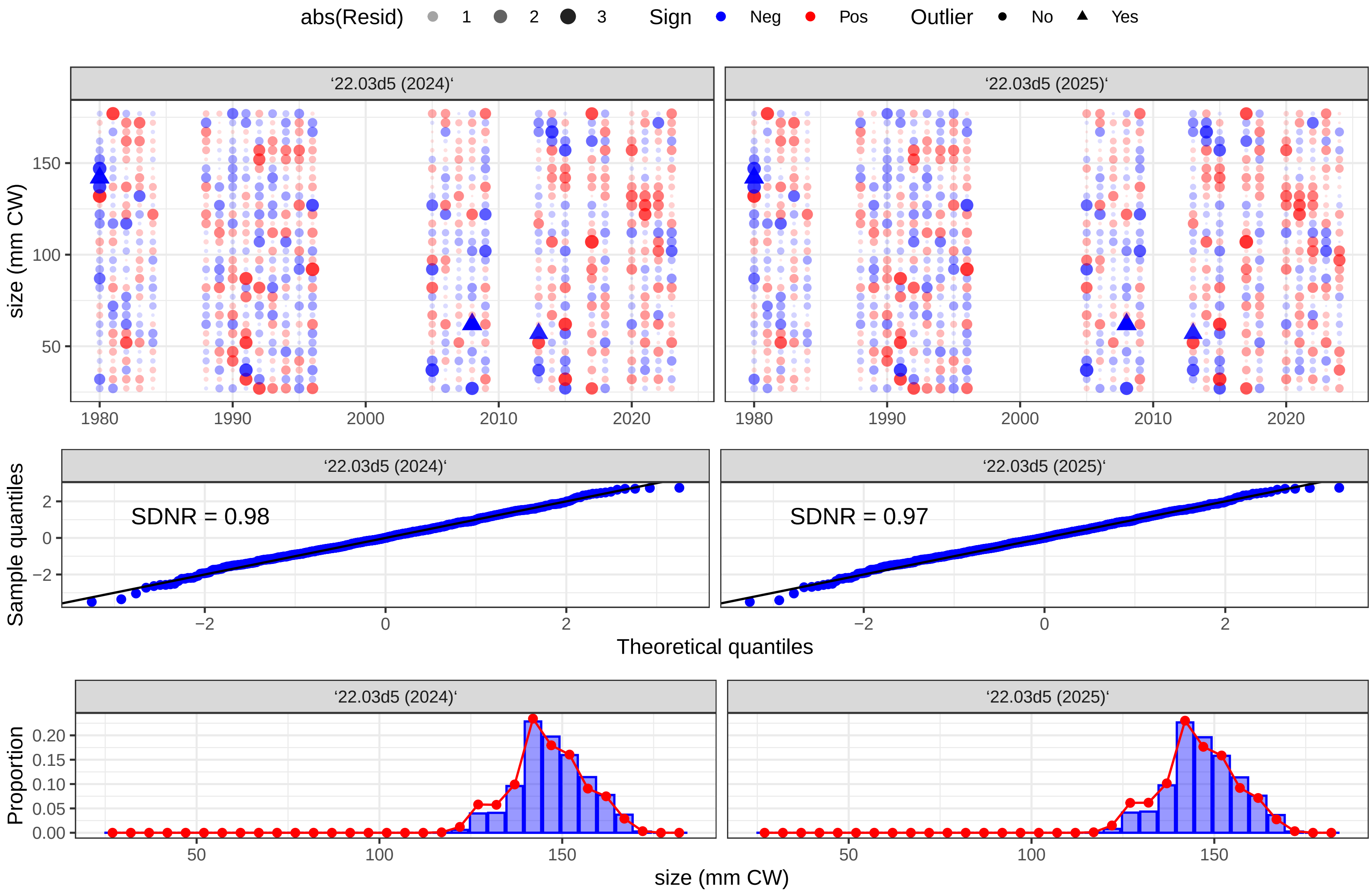


Figure 92. OSA residuals for TCSAM02 models fit to male retained catch size compositions from the directed fishery. The preferred model is `22.03d5 (2025)`.

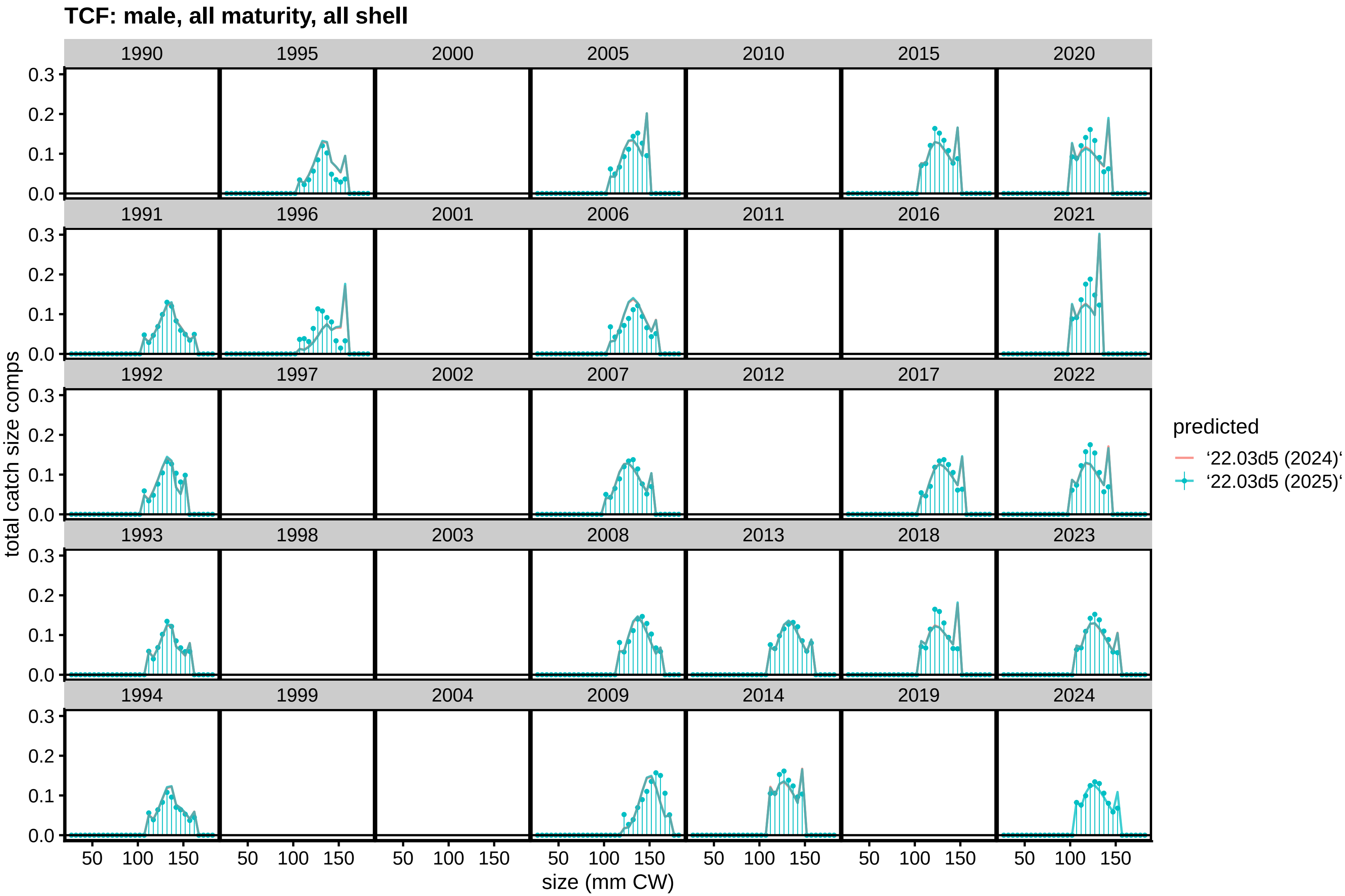


Figure 93. TCSAM02 models fits to total catch size compostiions in the TCF fishery. The preferred model is `22.03d5 (2025)`.

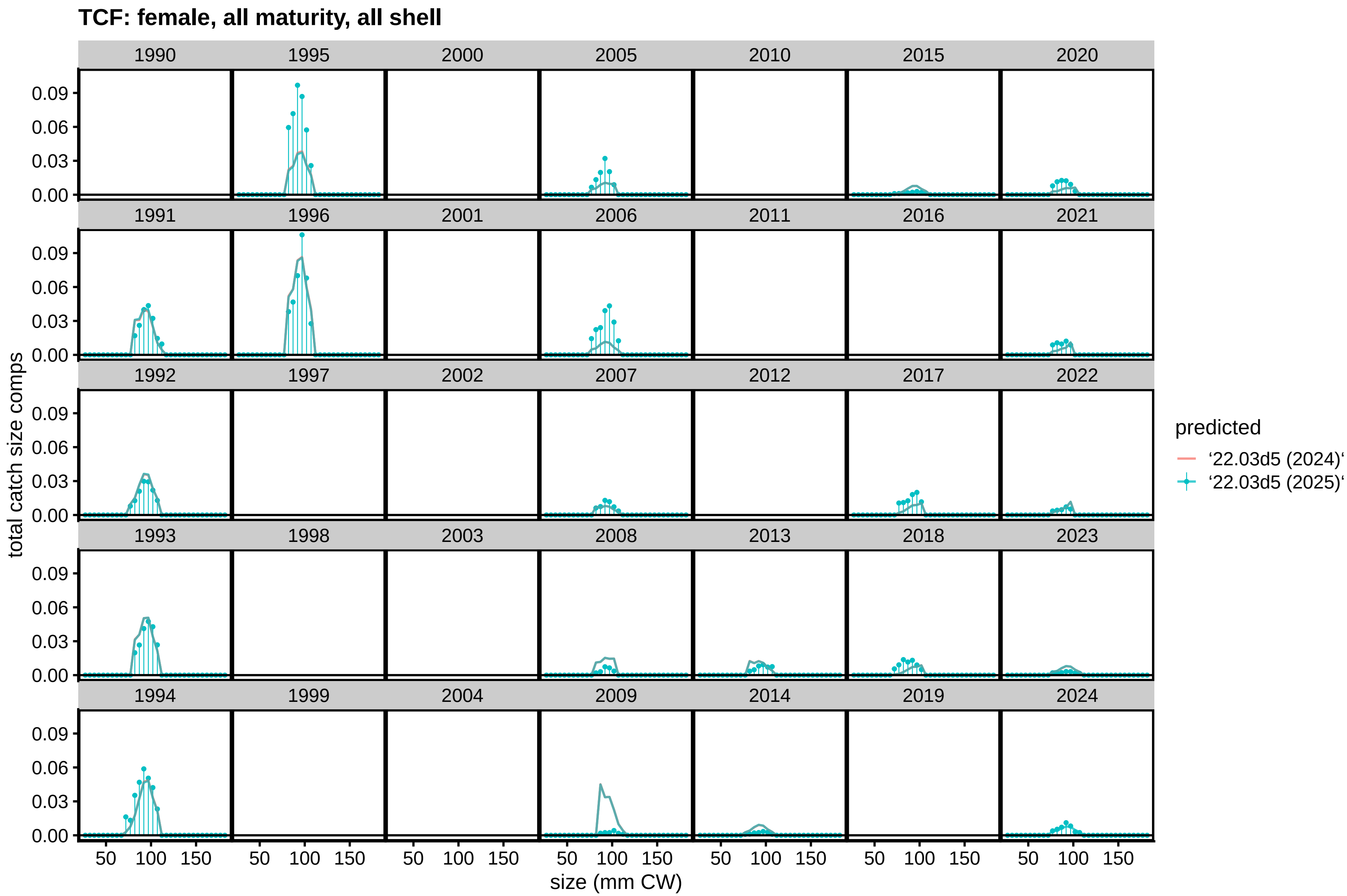


Figure 94. TCSAM02 models fits to total catch size compostiions in the TCF fishery. The preferred model is `22.03d5 (2025)`.

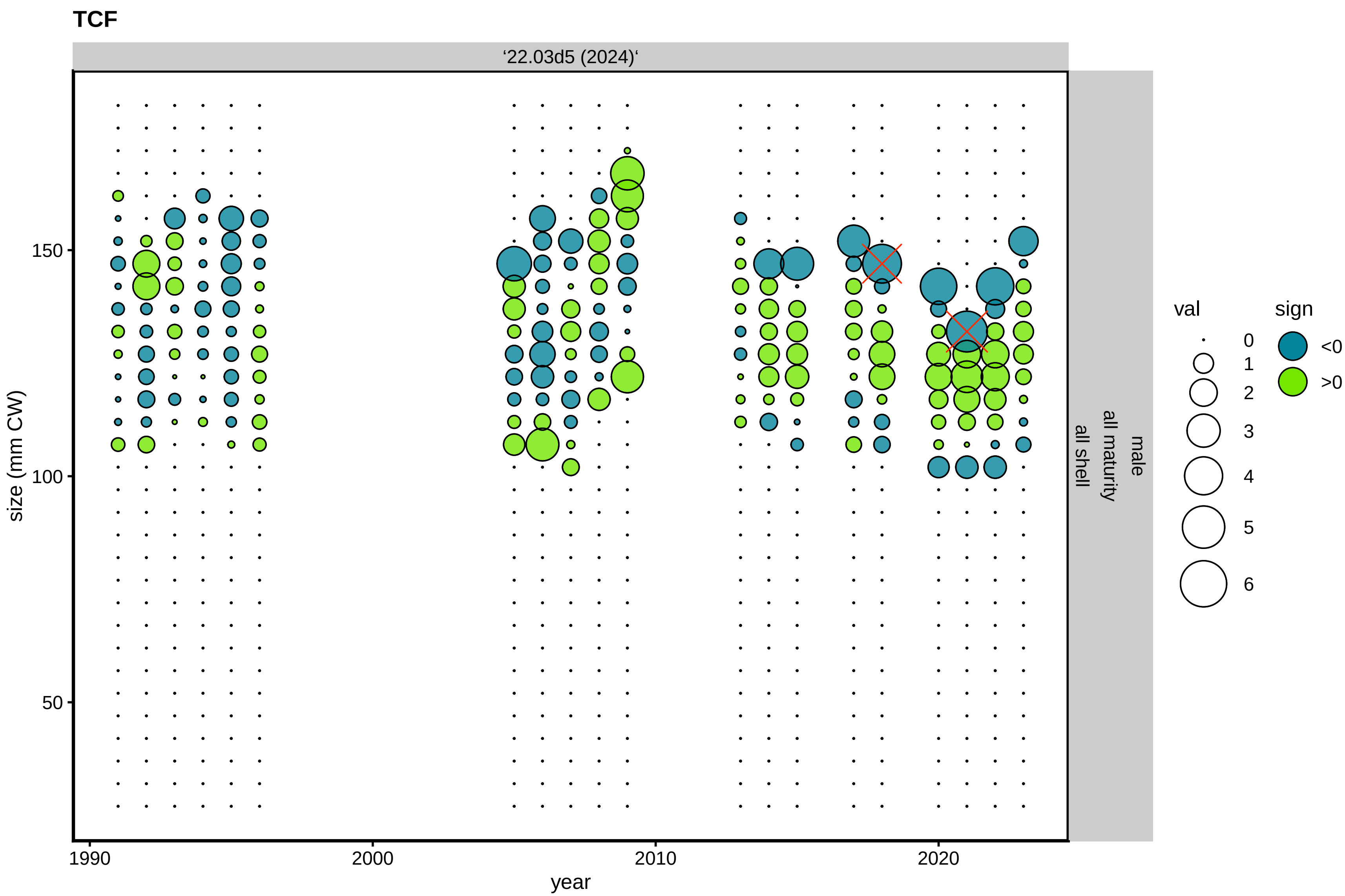


Figure 95. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

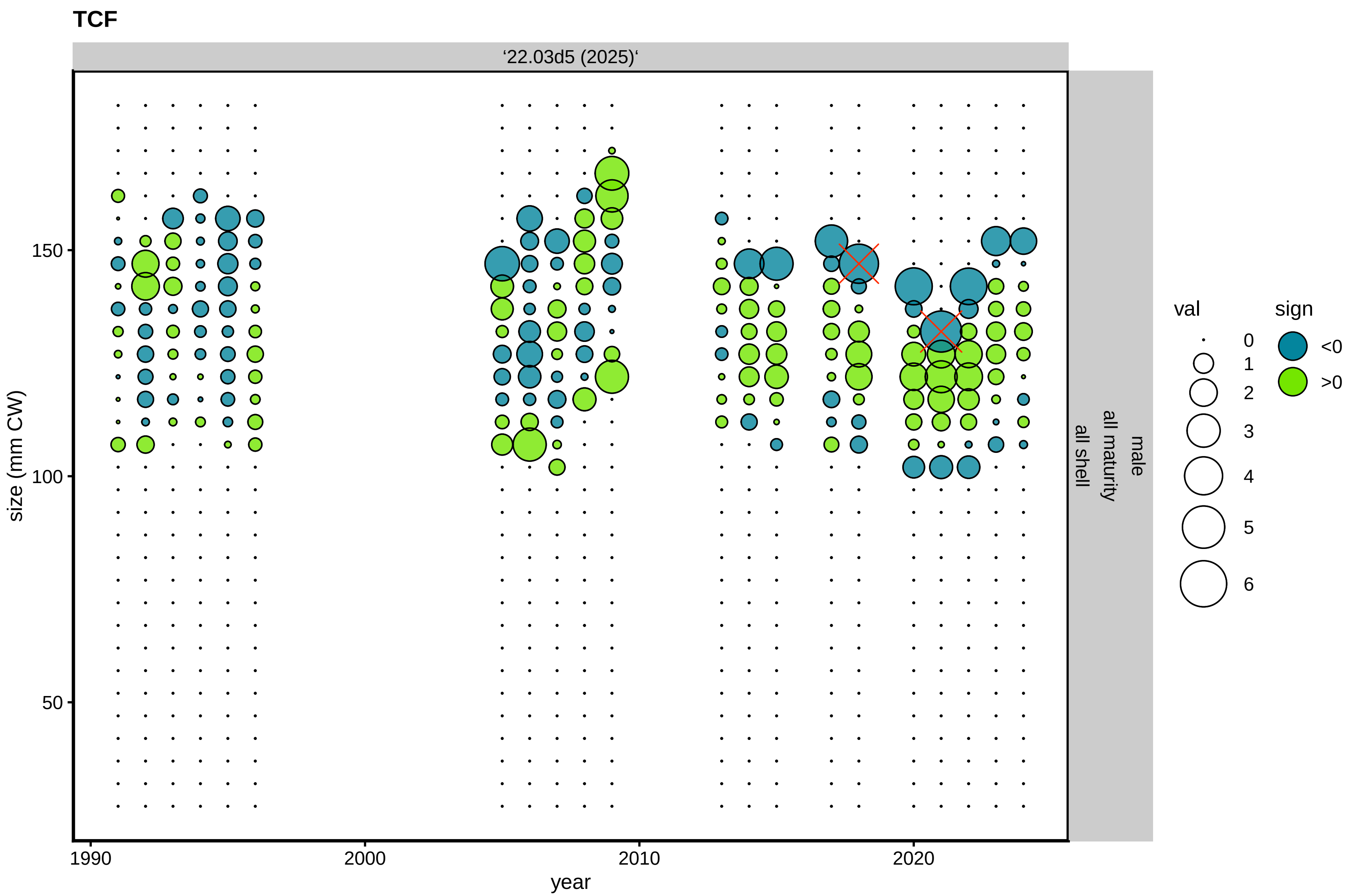


Figure 96. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

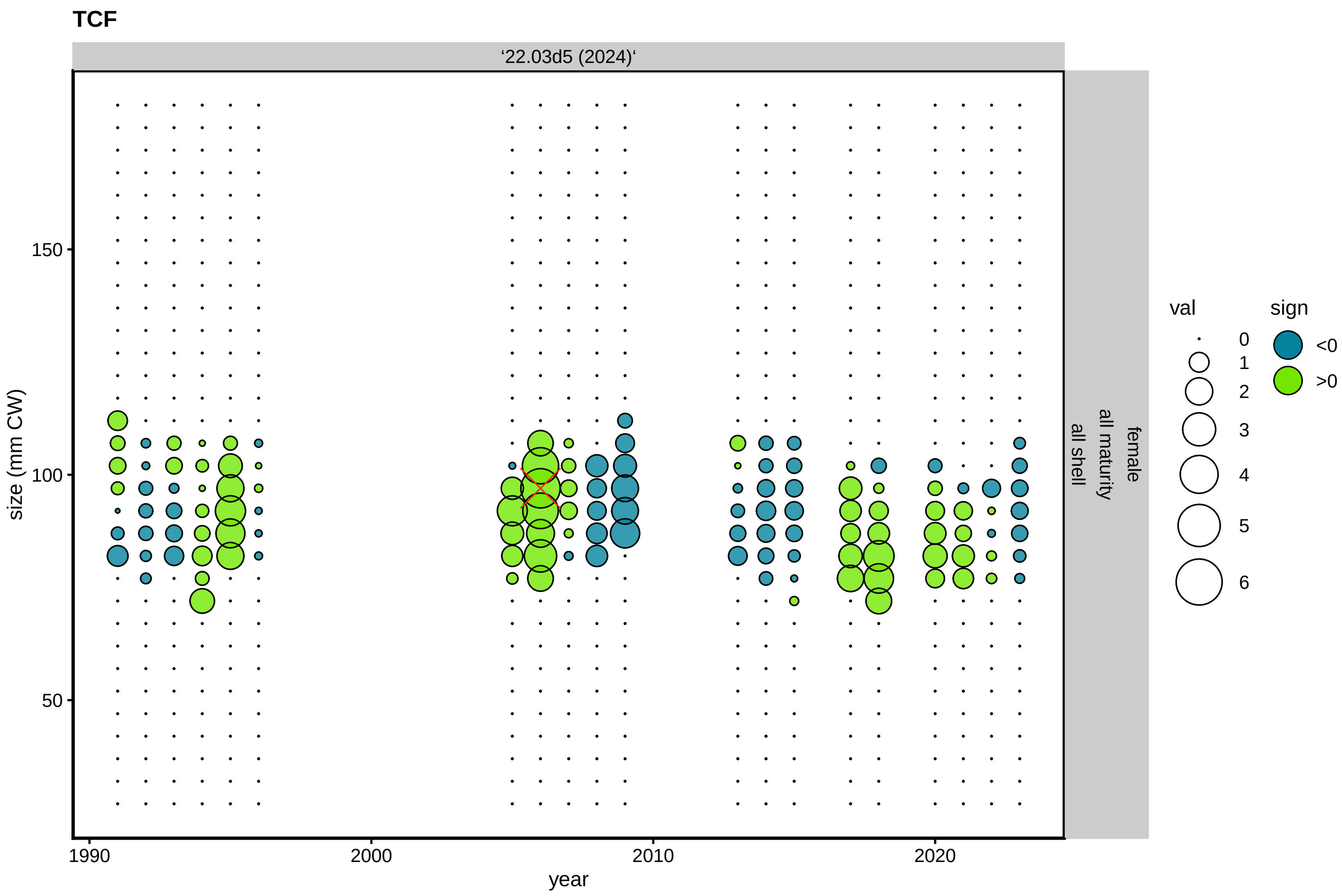


Figure 97. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

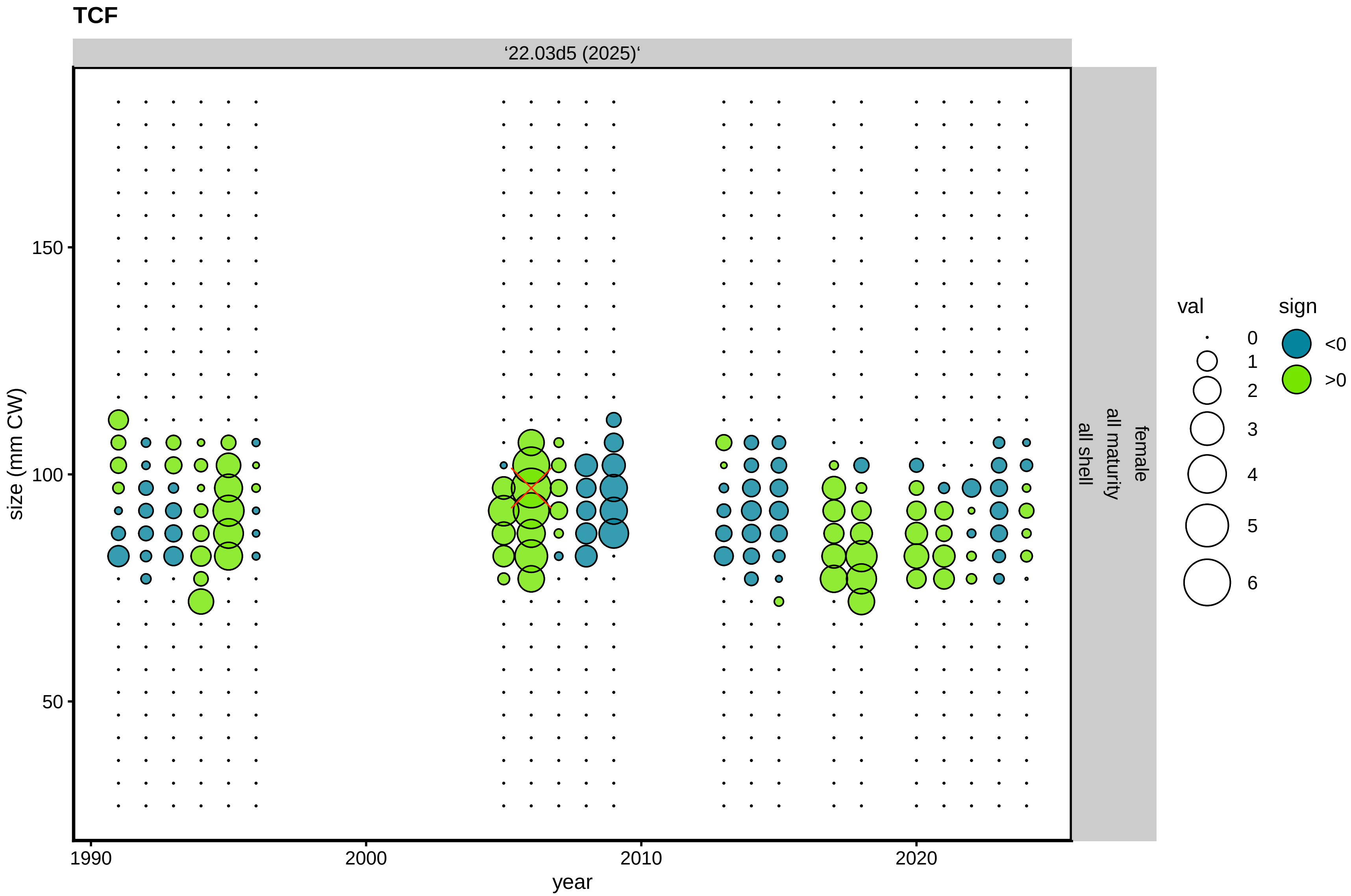


Figure 98. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

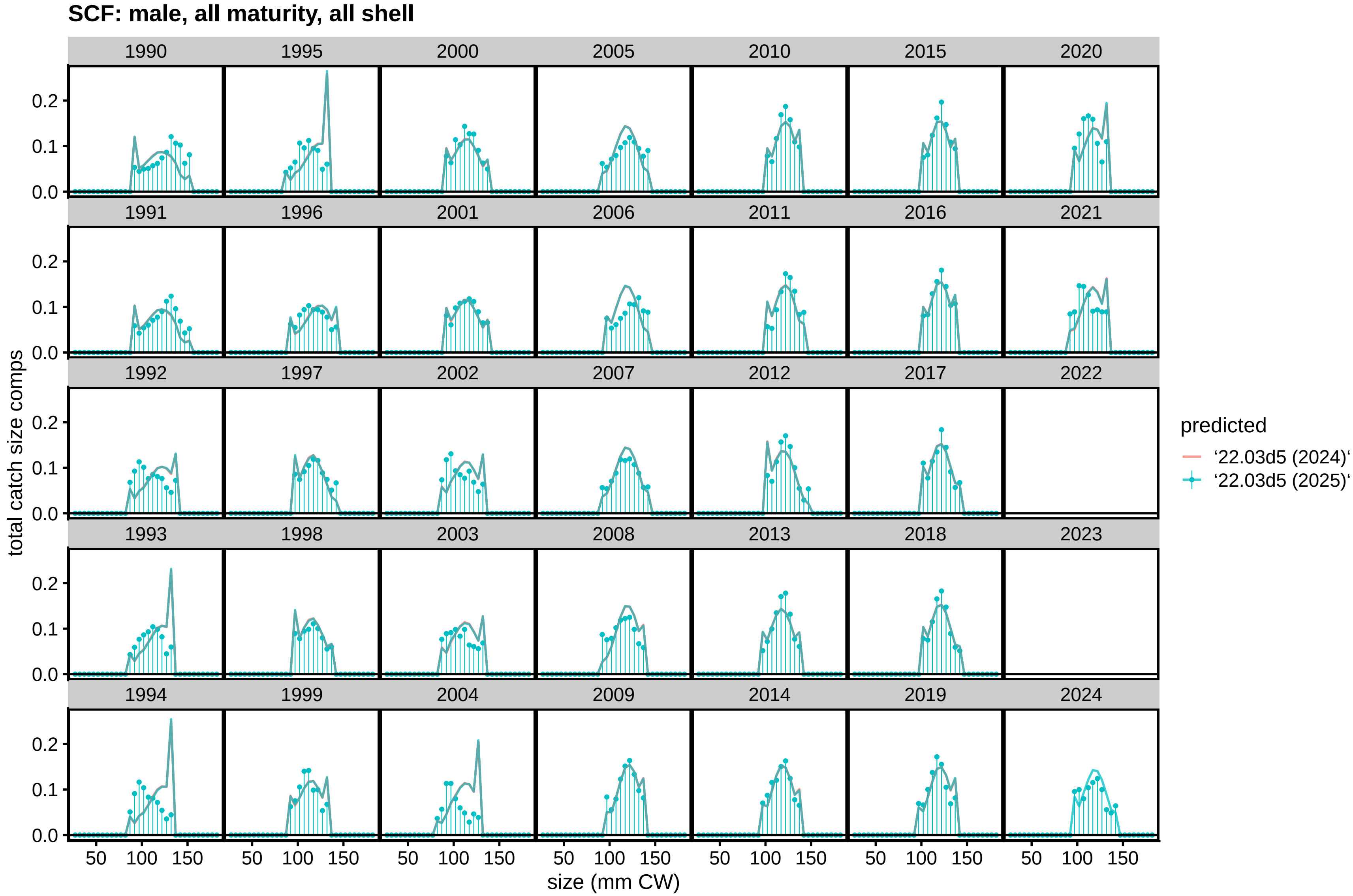


Figure 99. TCSAM02 models fits to total catch size compostiions in the SCF fishery. The preferred model is 22.03d5 (2025).

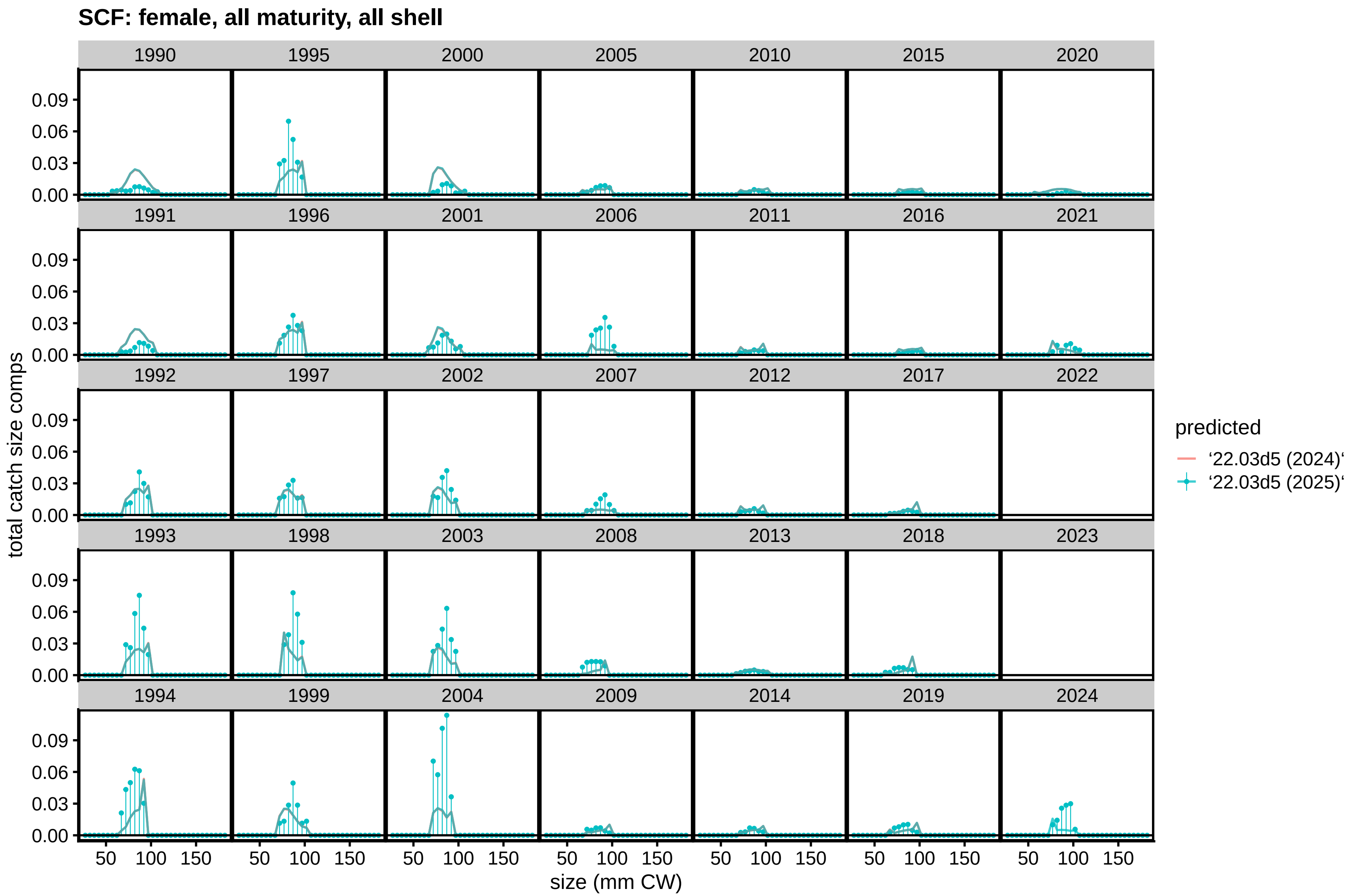


Figure 100. TCSAM02 models fits to total catch size compostiions in the SCF fishery. The preferred model is `22.03d5 (2025)`.

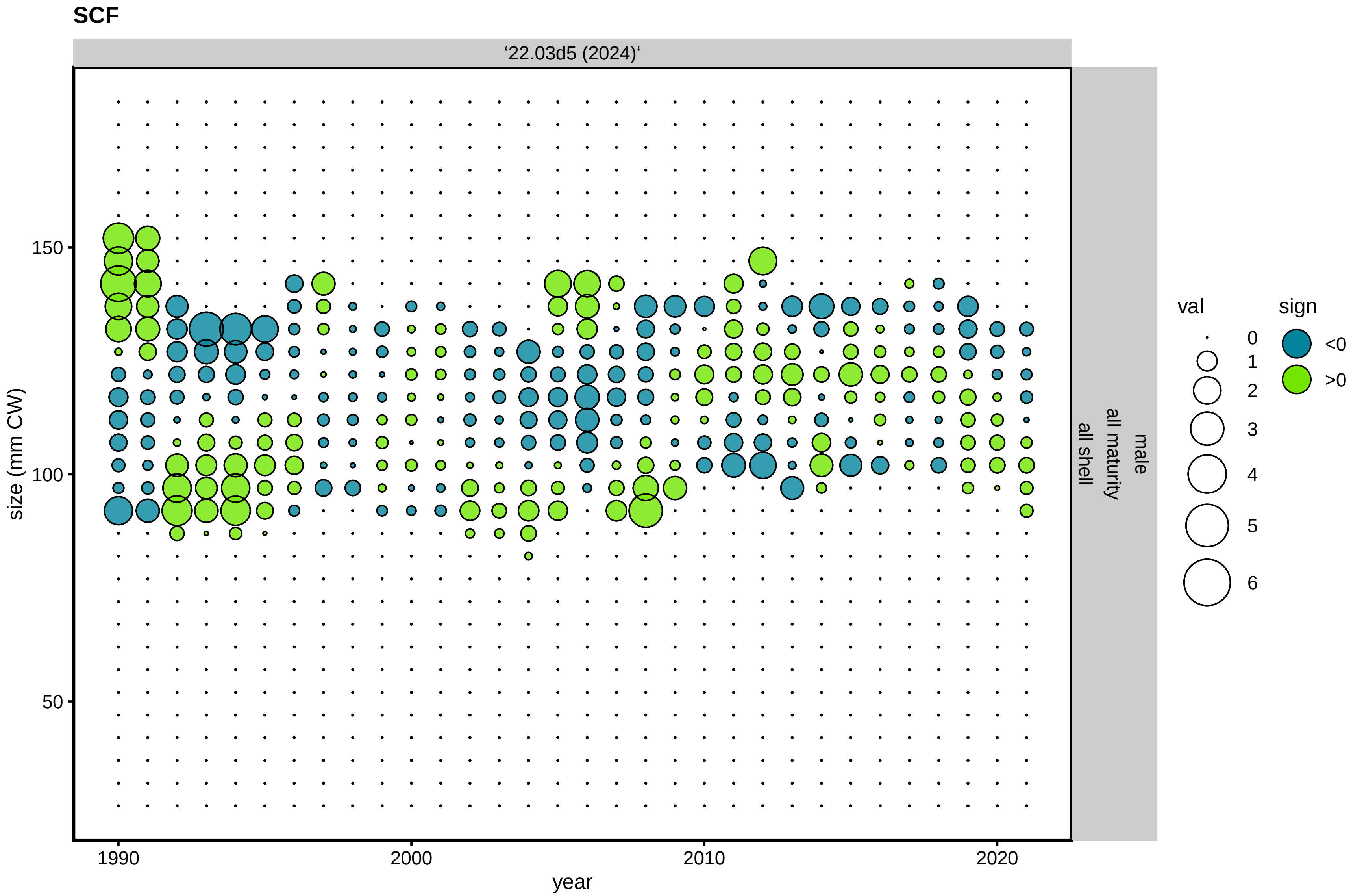


Figure 101. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

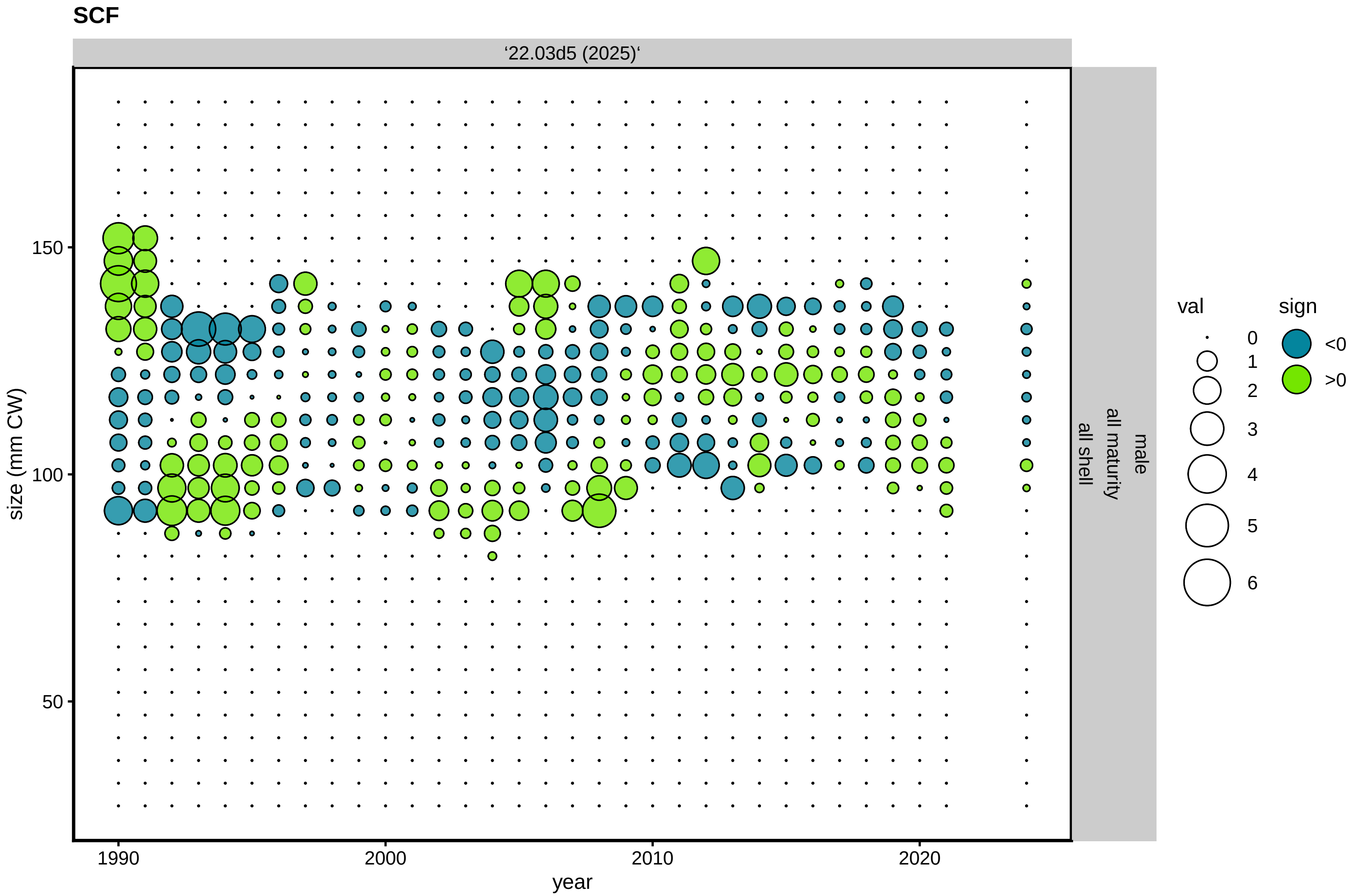


Figure 102. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

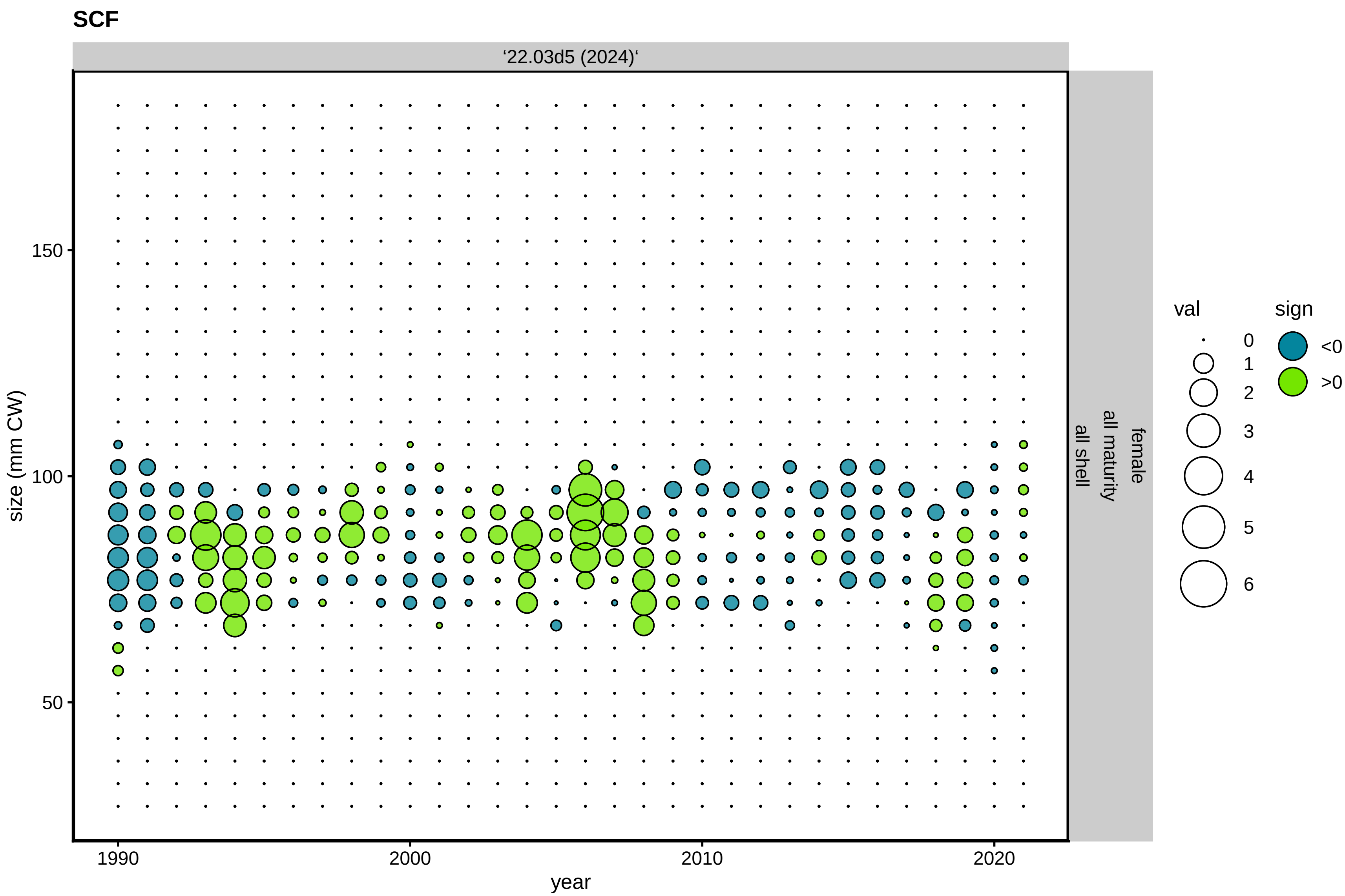


Figure 103. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

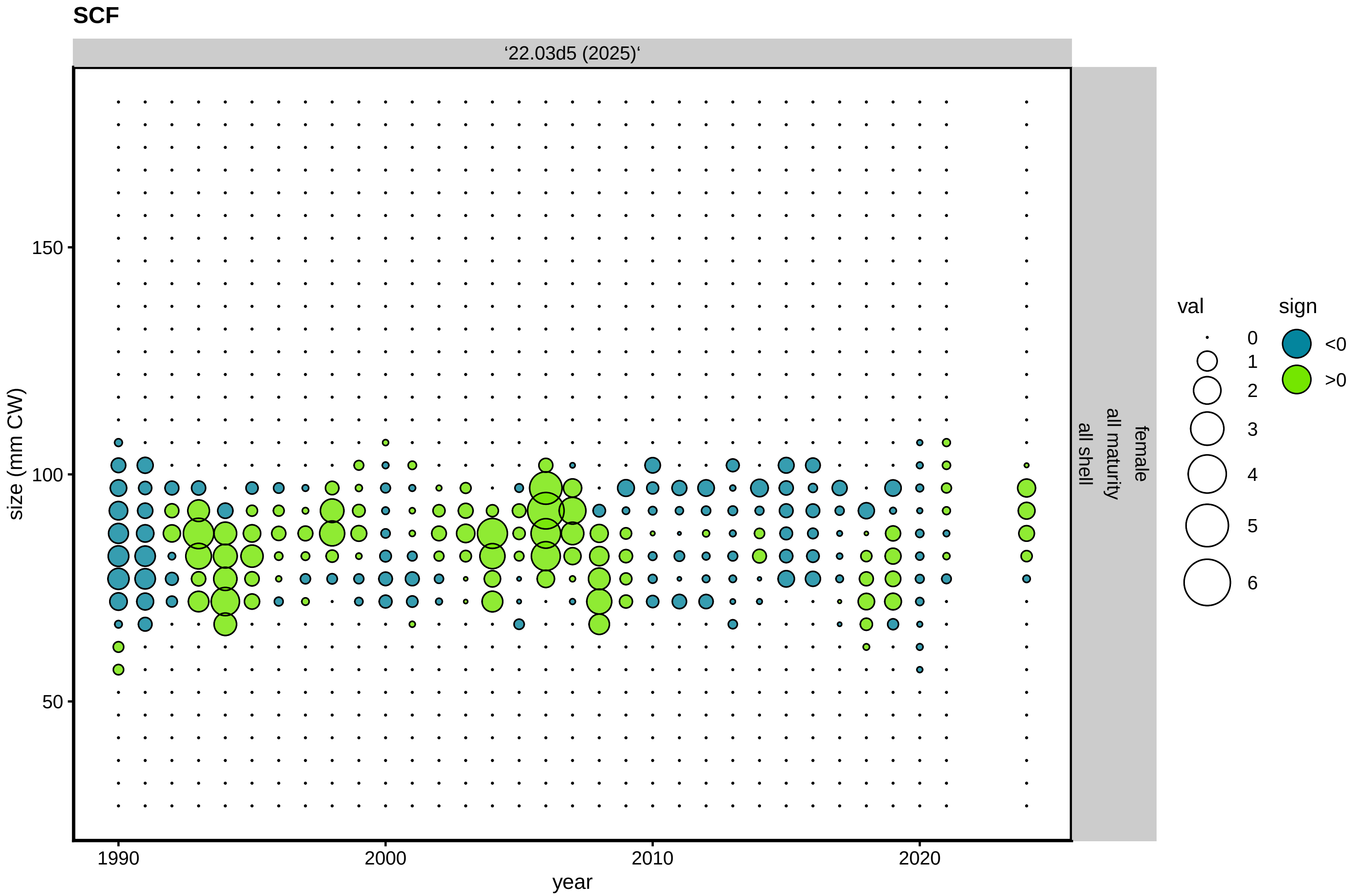


Figure 104. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

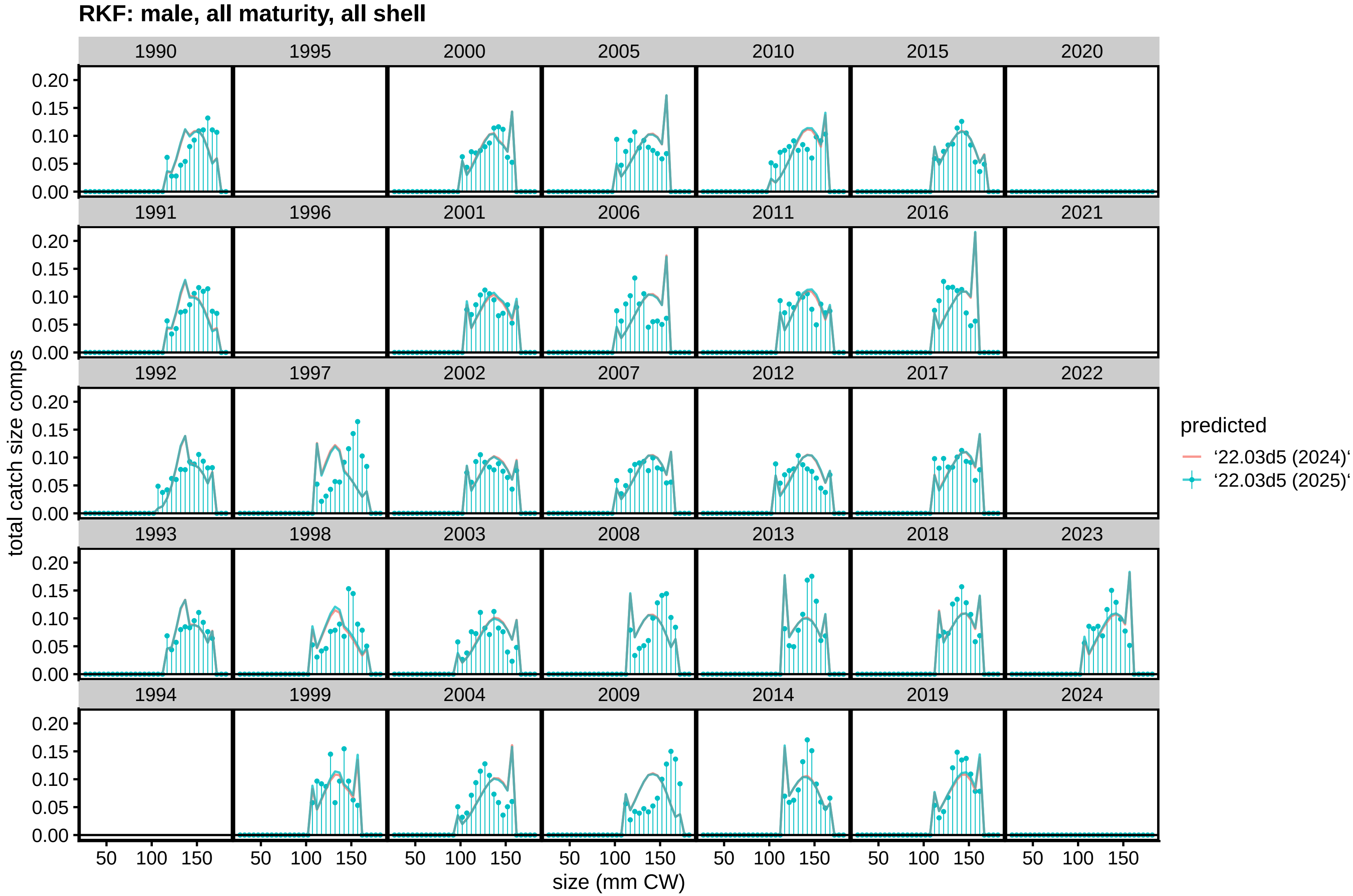


Figure 105. TCSAM02 models fits to total catch size compostiions in the RKF fishery. The preferred model is 22.03d5 (2025).

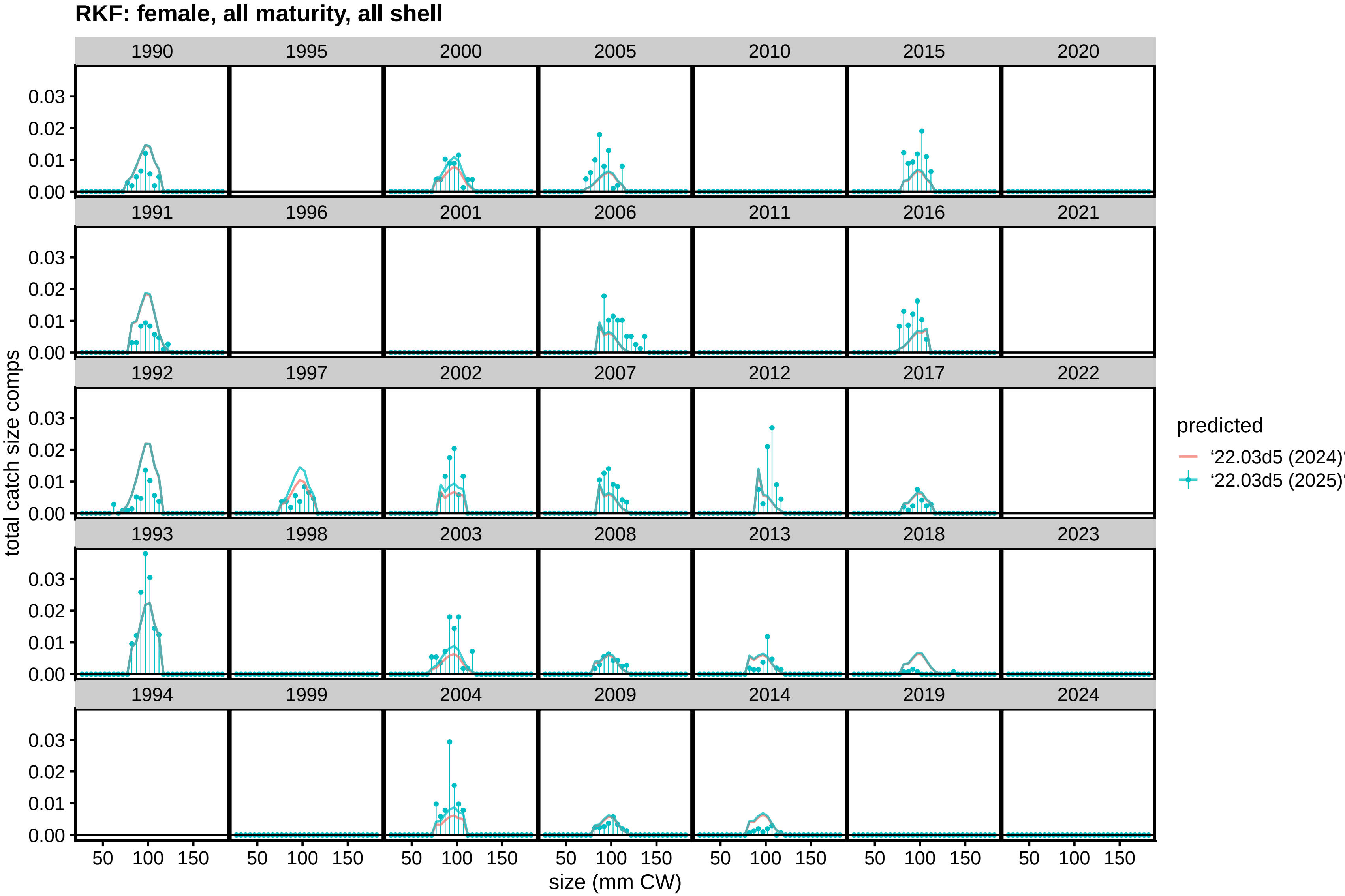


Figure 106. TCSAM02 models fits to total catch size compostiions in the RKF fishery. The preferred model is `22.03d5 (2025)`.

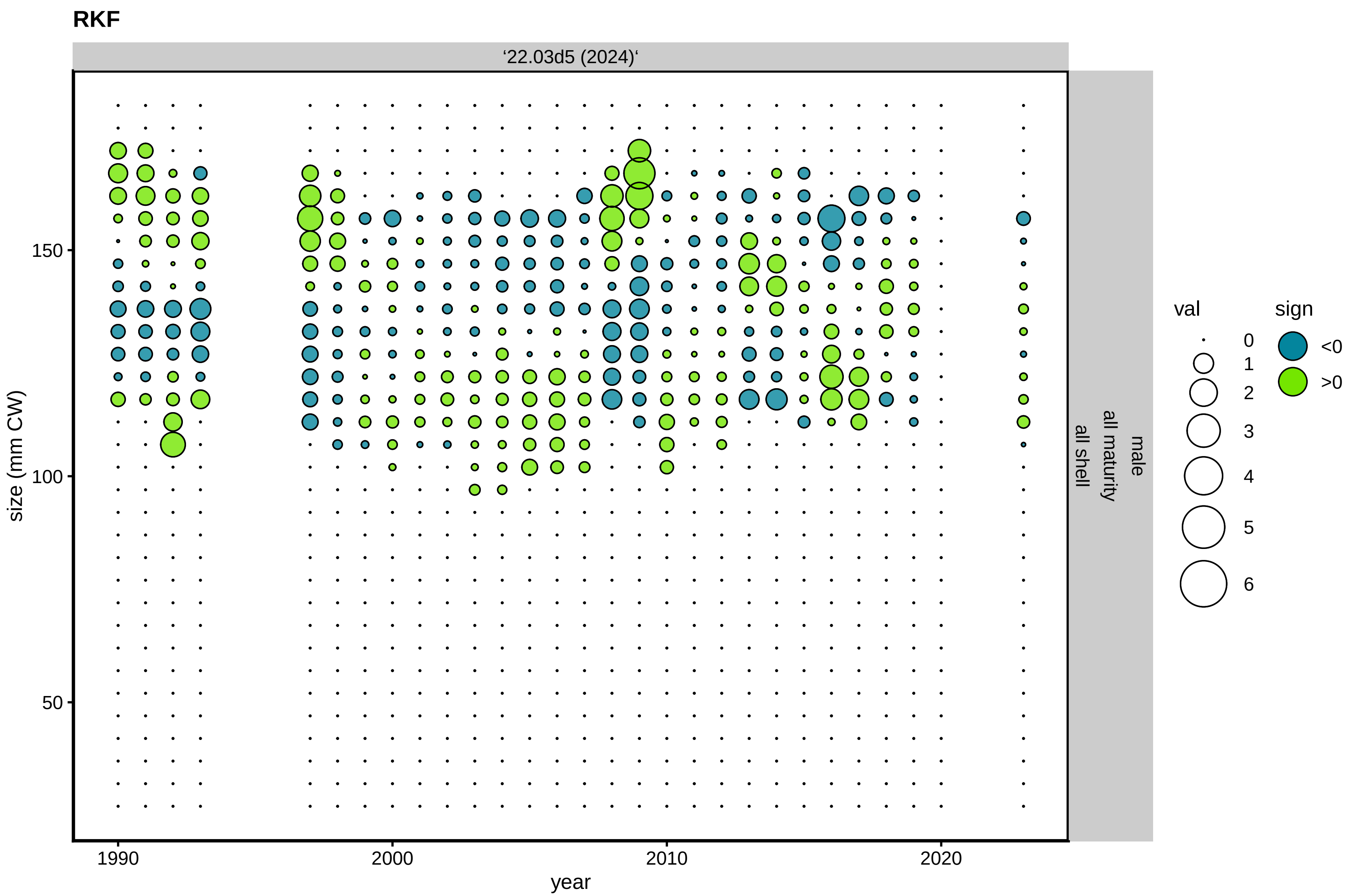


Figure 107. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

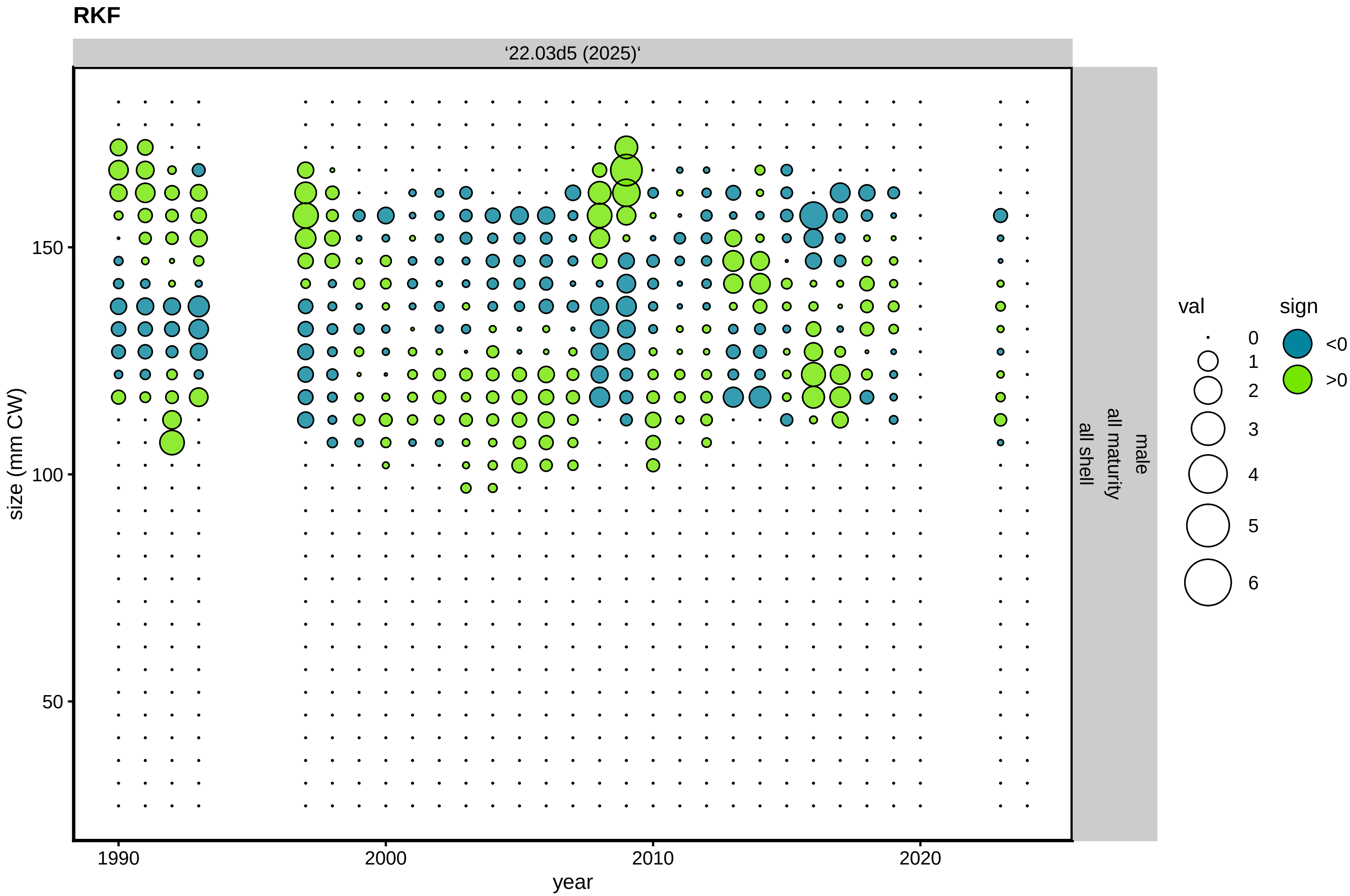


Figure 108. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

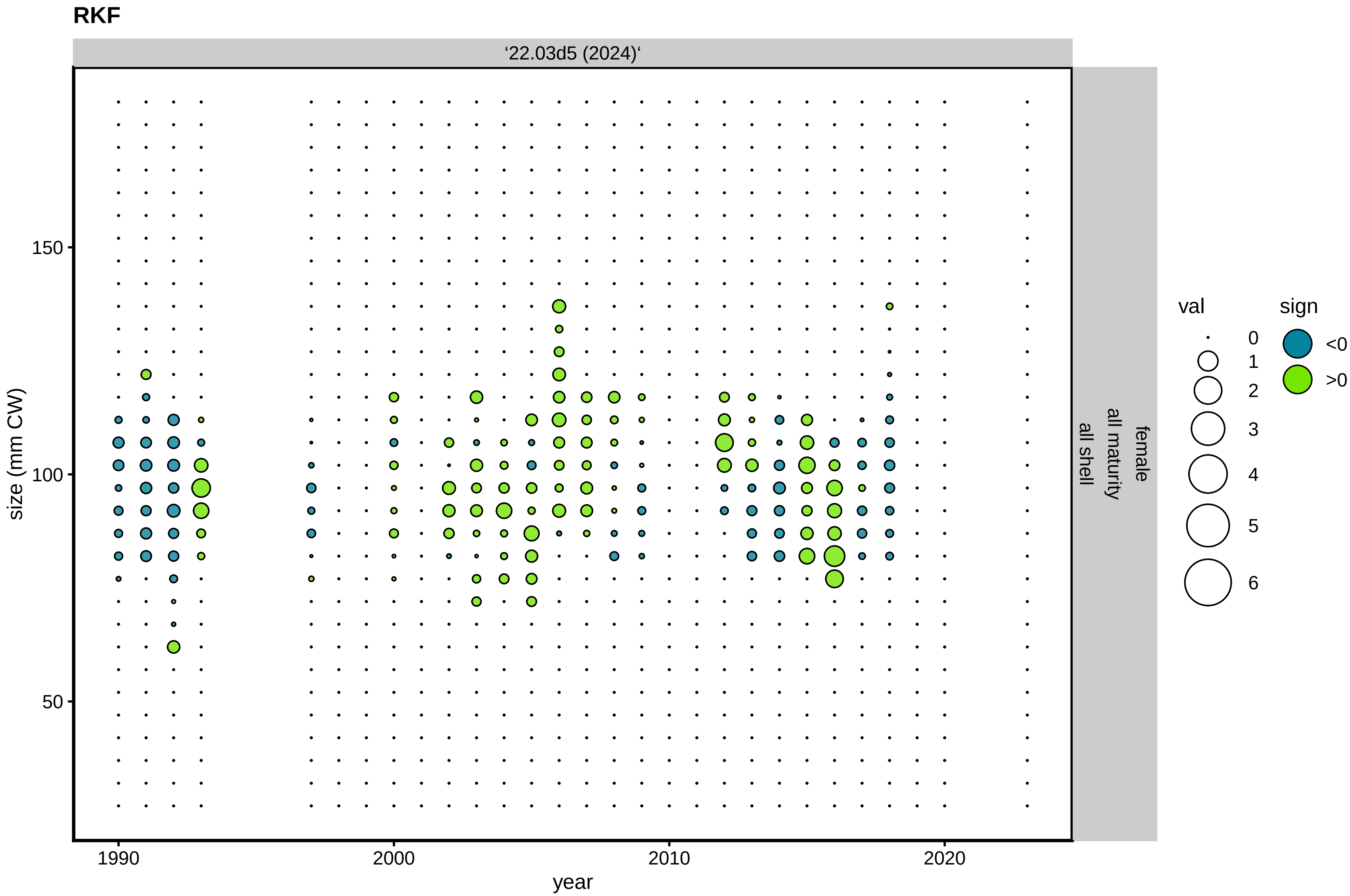


Figure 109. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

Figure 110. 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. The preferred model is `22.03d5 (2025)`.

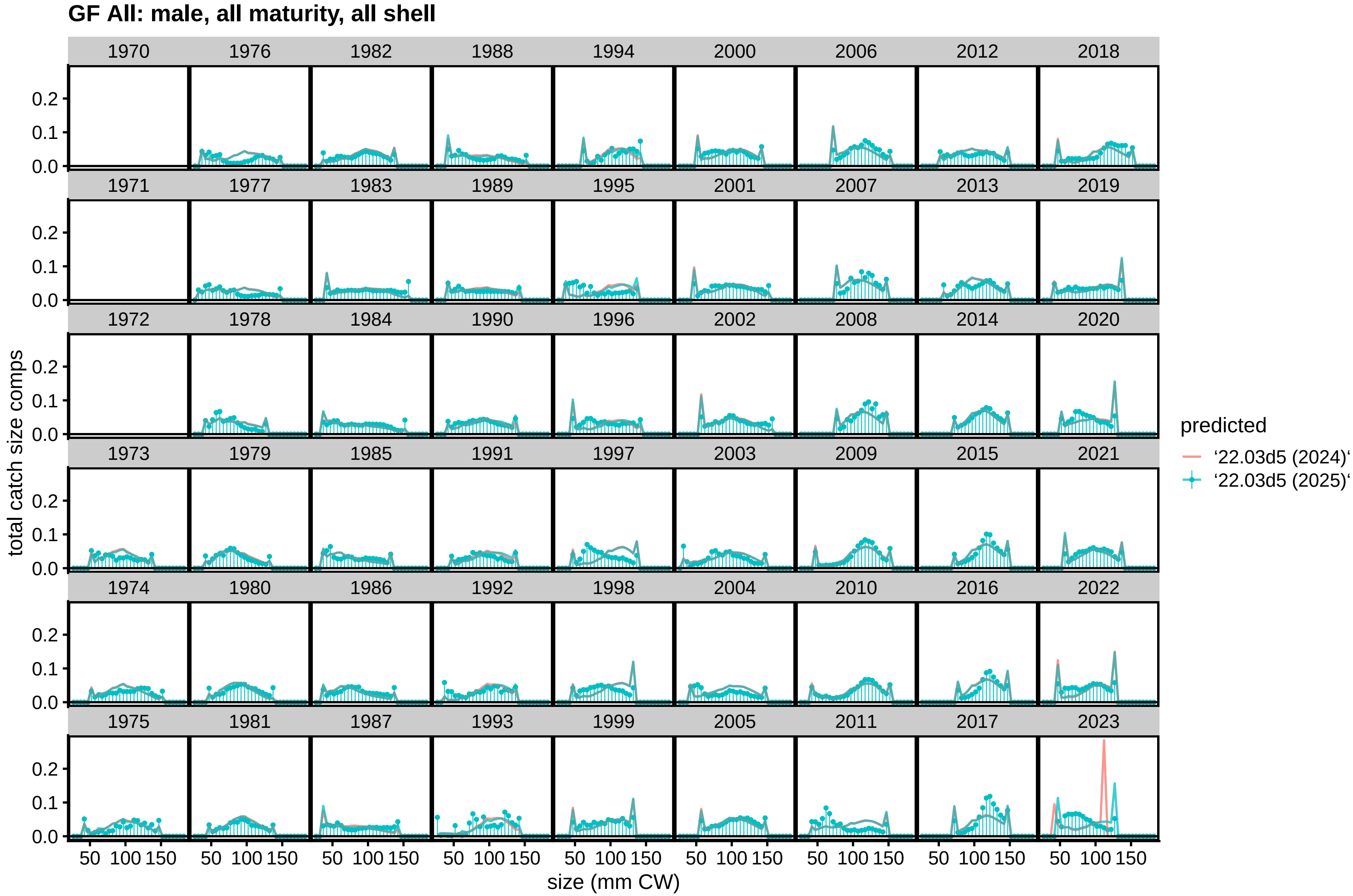


Figure 111. TCSAM02 models fits to total catch size compostiions in the GF All fishery. The preferred model is `22.03d5 (2025)`.

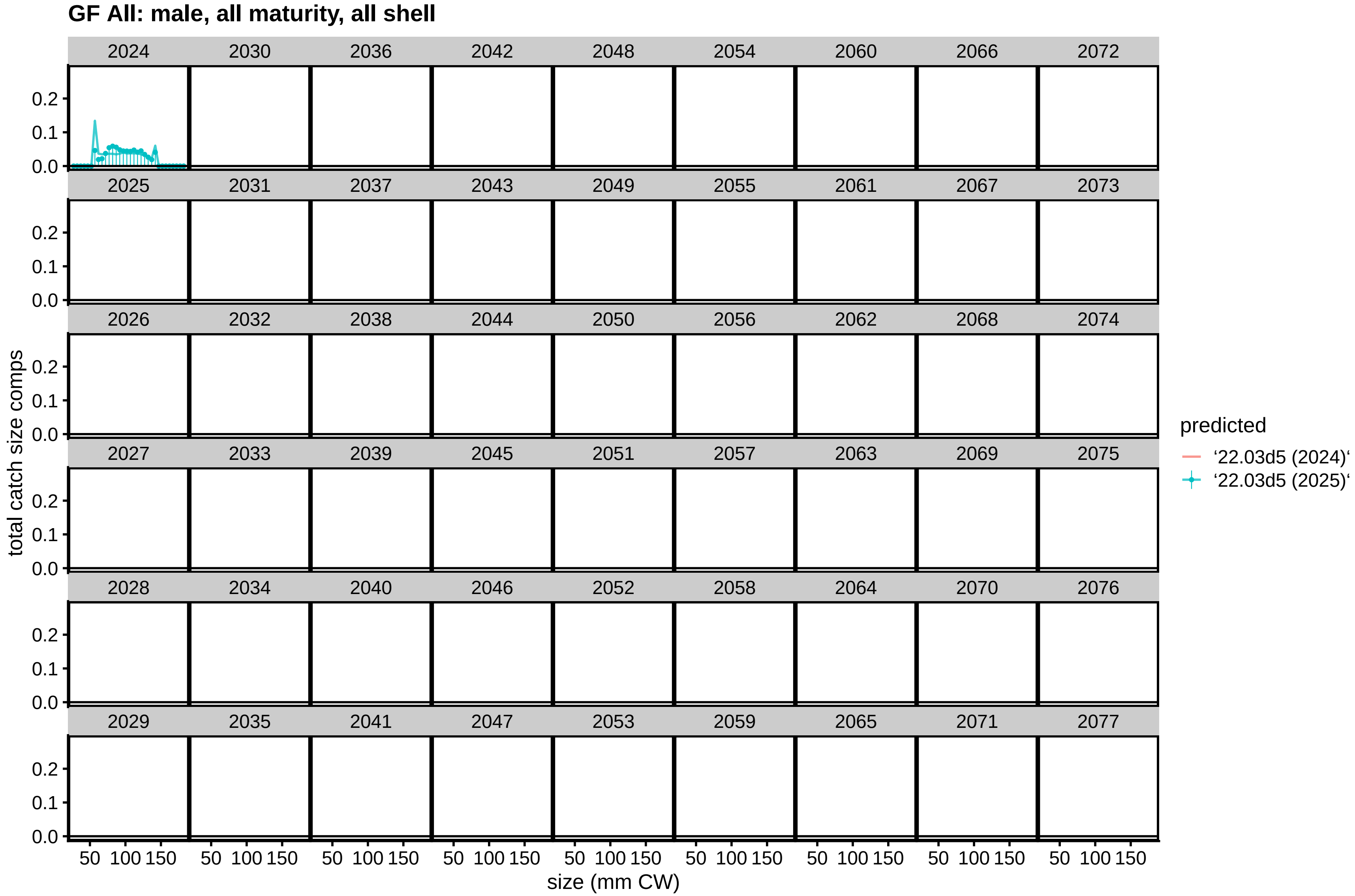


Figure 112. TCSAM02 models fits to total catch size compostiions in the GF All fishery. The preferred model is `22.03d5 (2025)`.

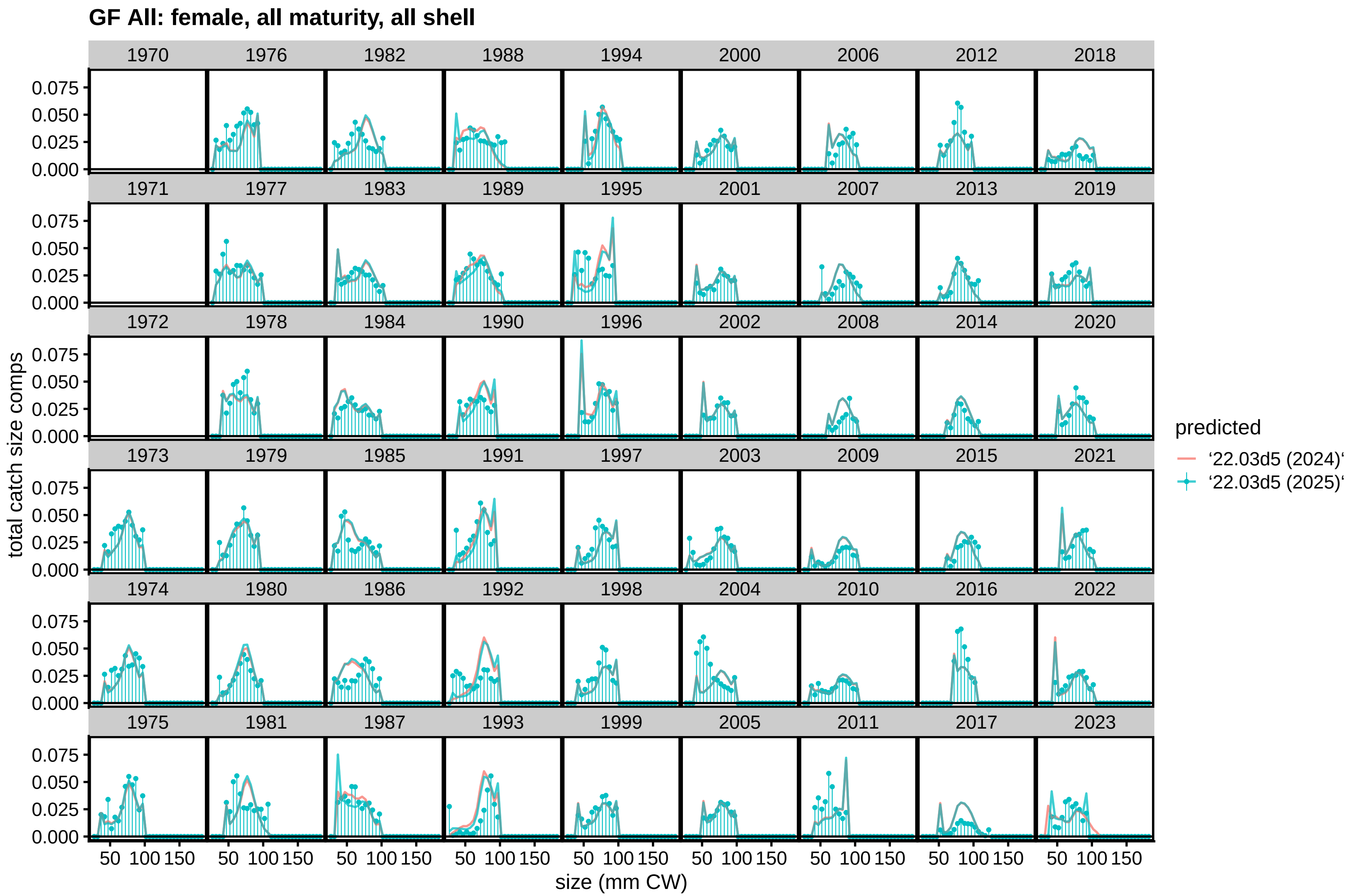


Figure 113. TCSAM02 models fits to total catch size compostiions in the GF All fishery. The preferred model is `22.03d5 (2025)`.

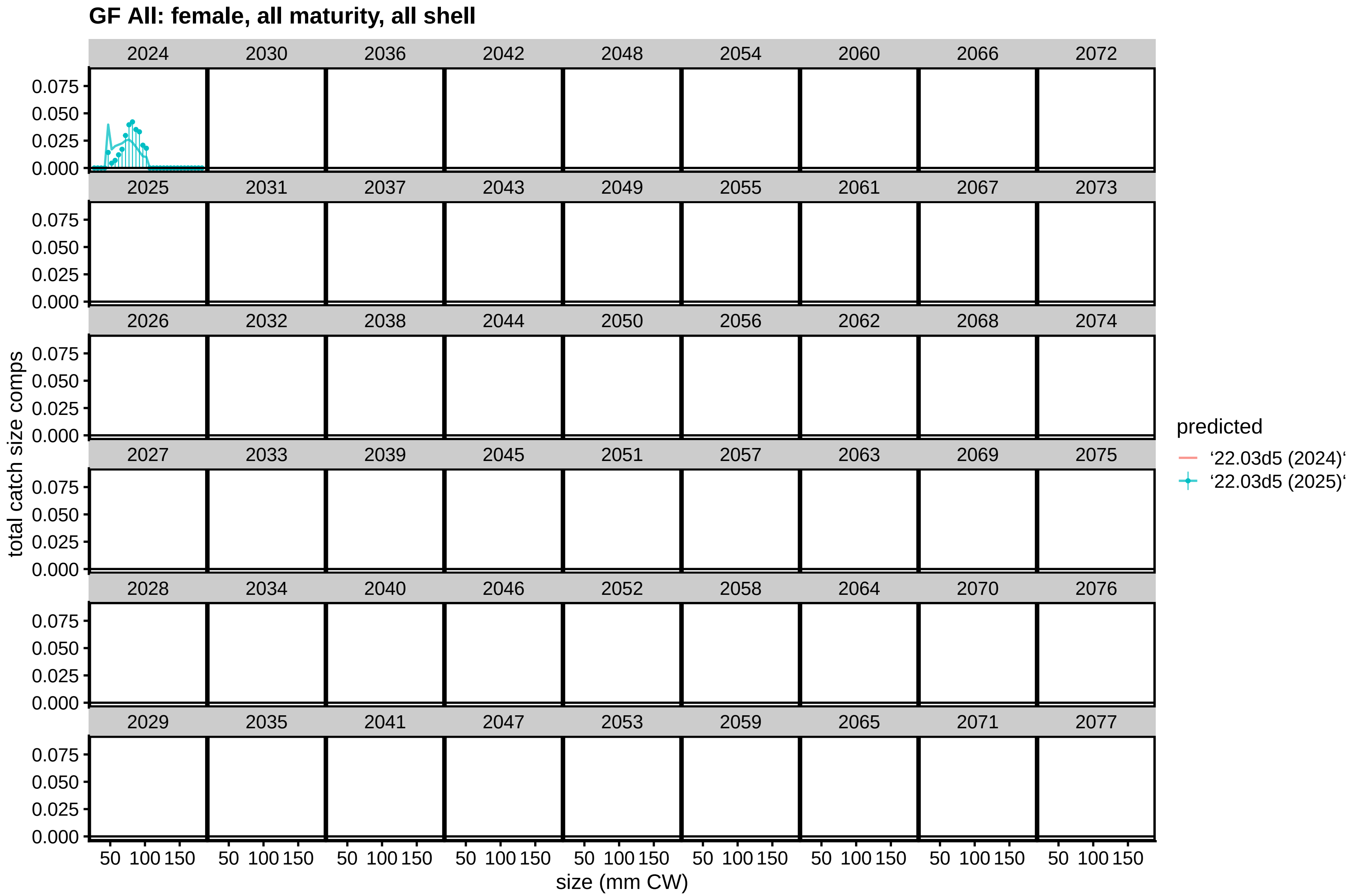


Figure 114. TCSAM02 models fits to total catch size compostiions in the GF All fishery. The preferred model is `22.03d5 (2025)`.

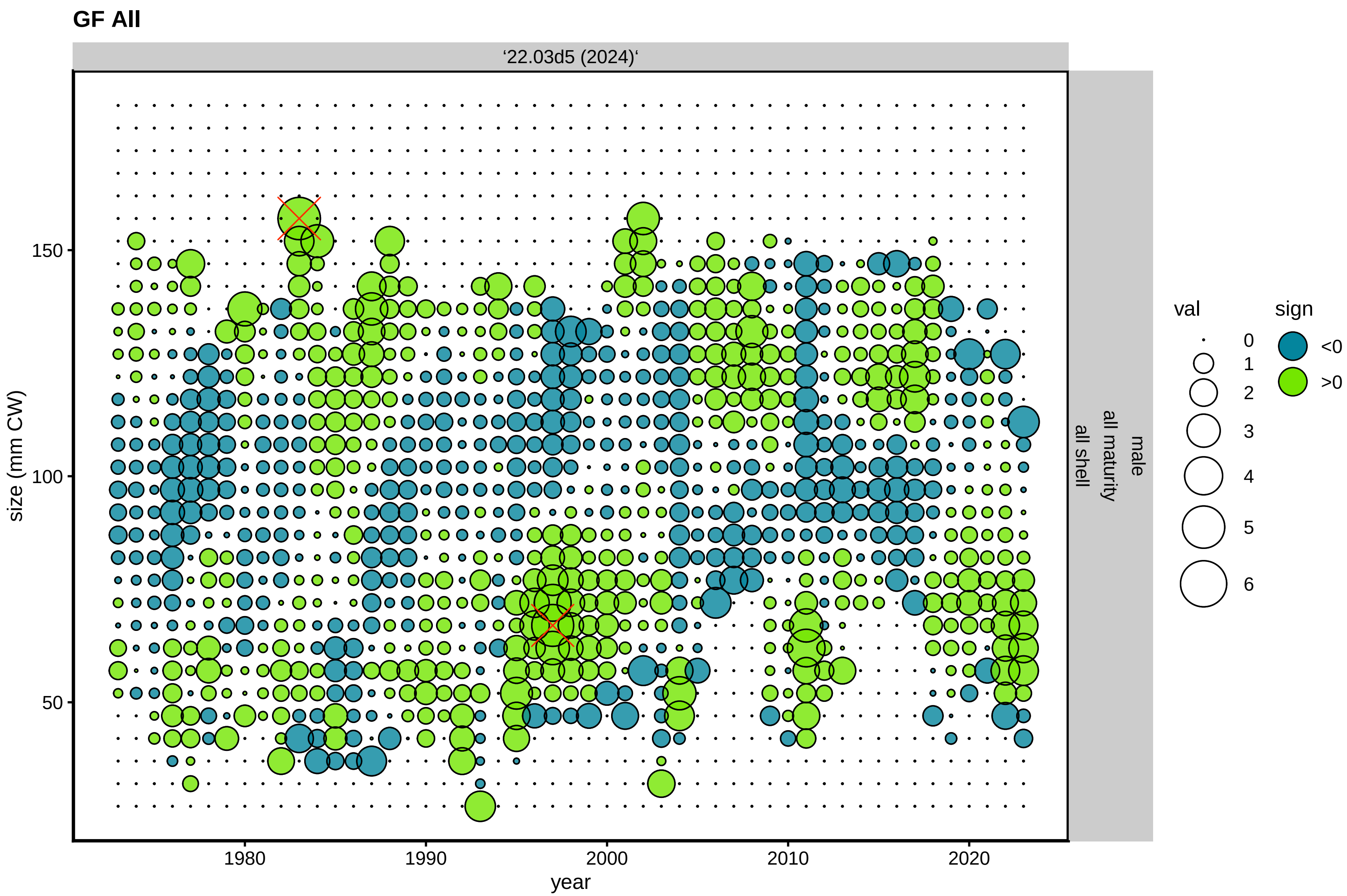


Figure 115. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

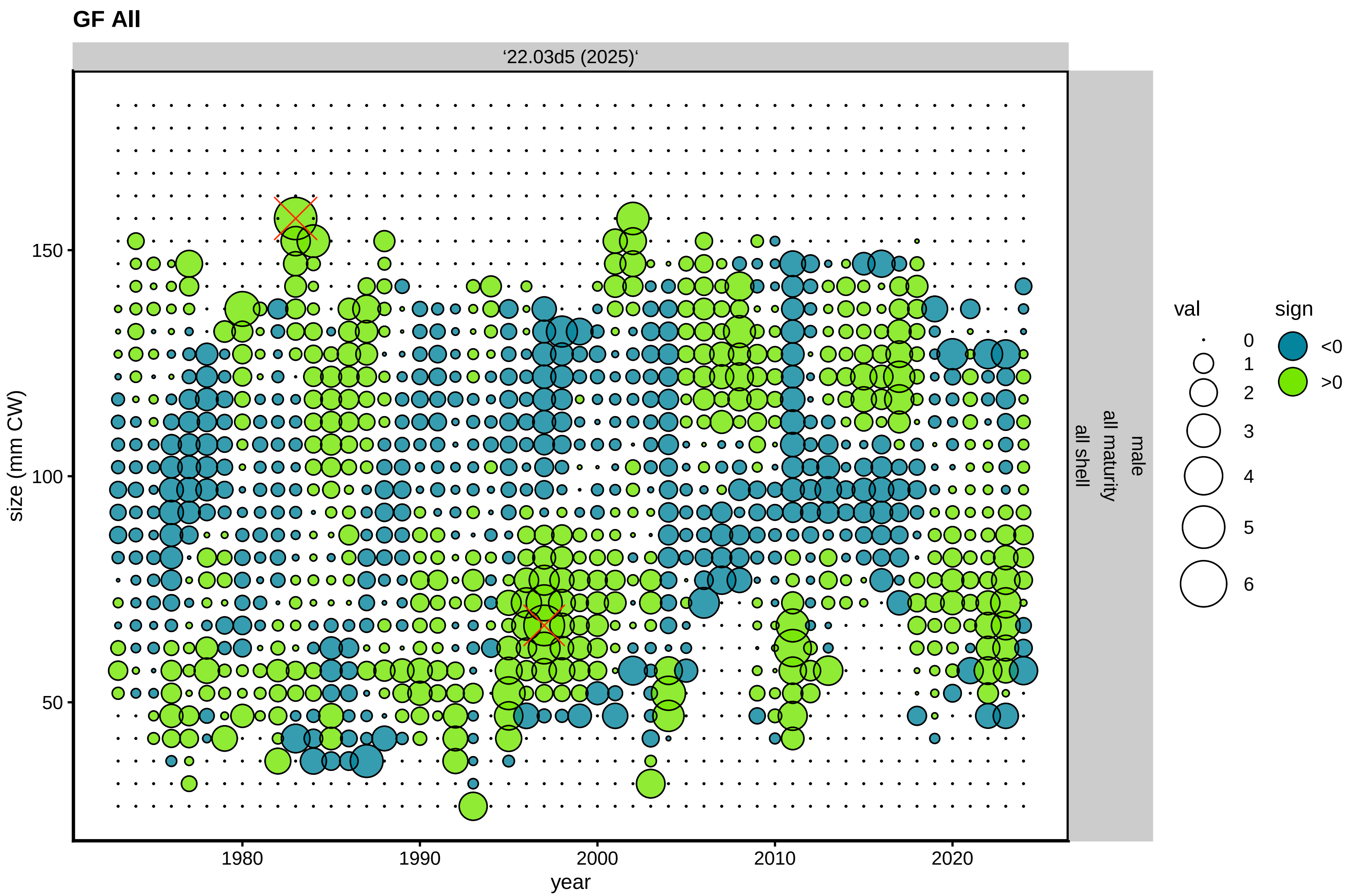


Figure 116. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

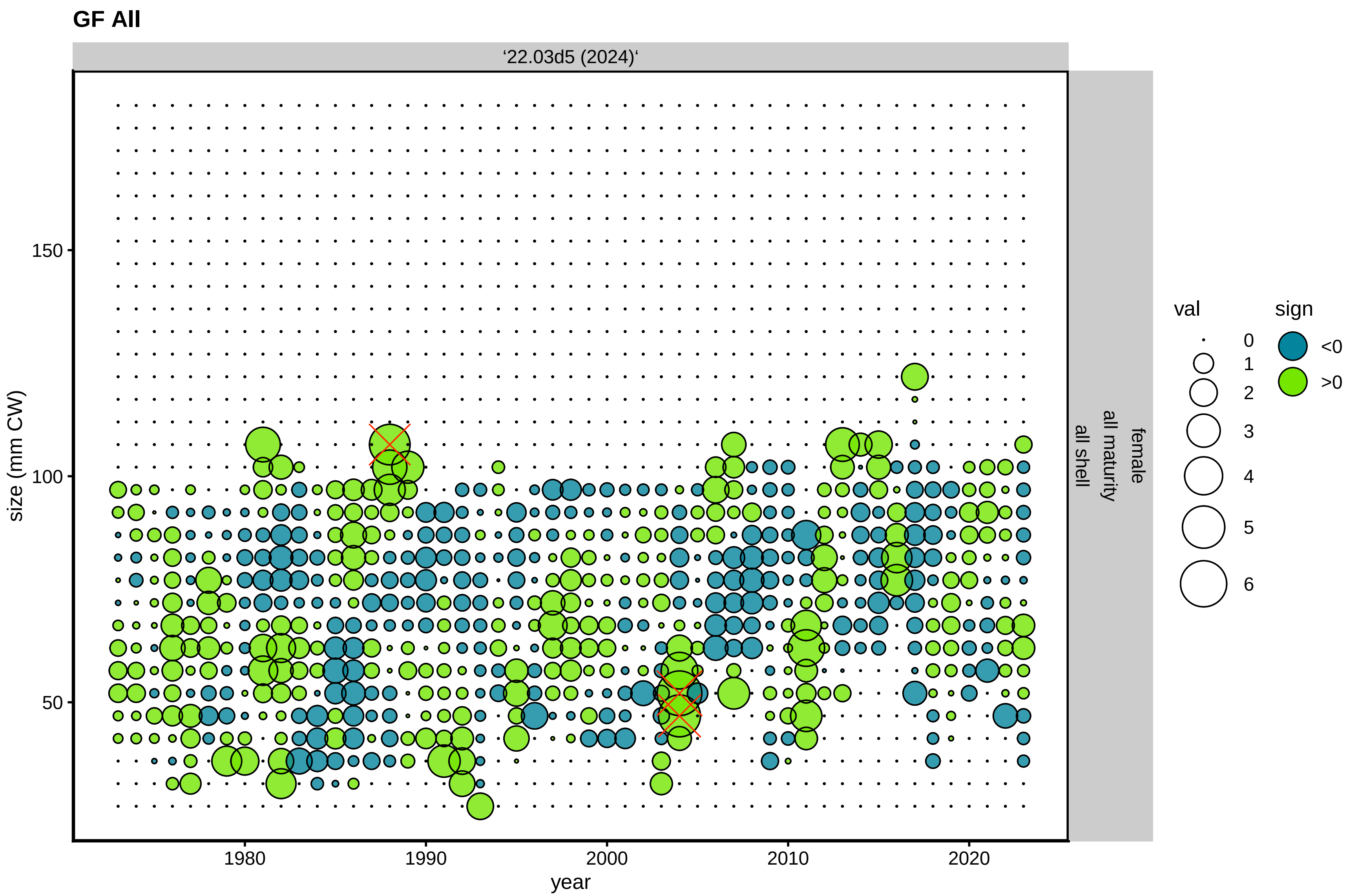


Figure 117. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

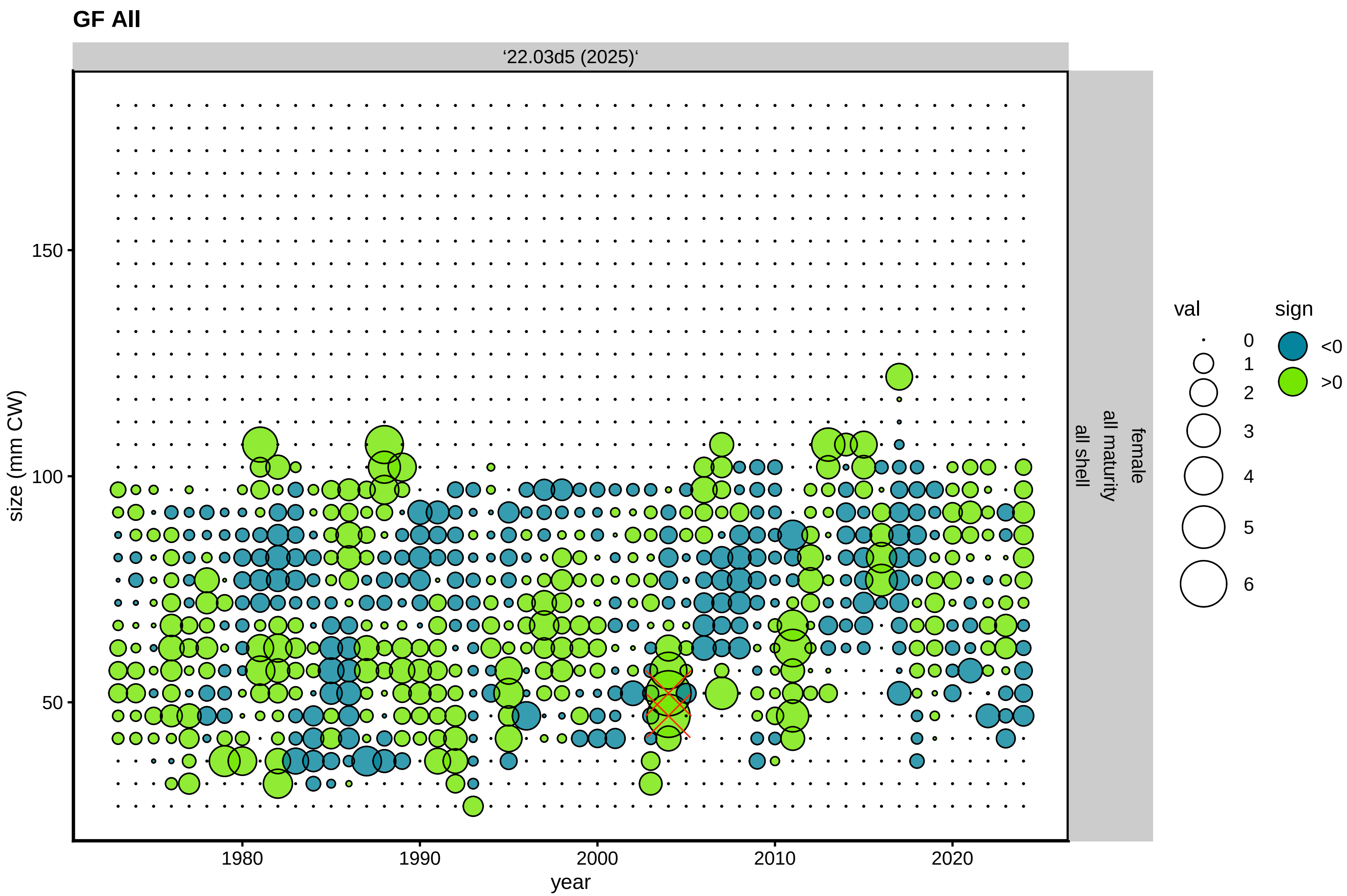


Figure 118. Pearson's residuals for fits to total catch size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. The preferred model is `22.03d5 (2025)`.

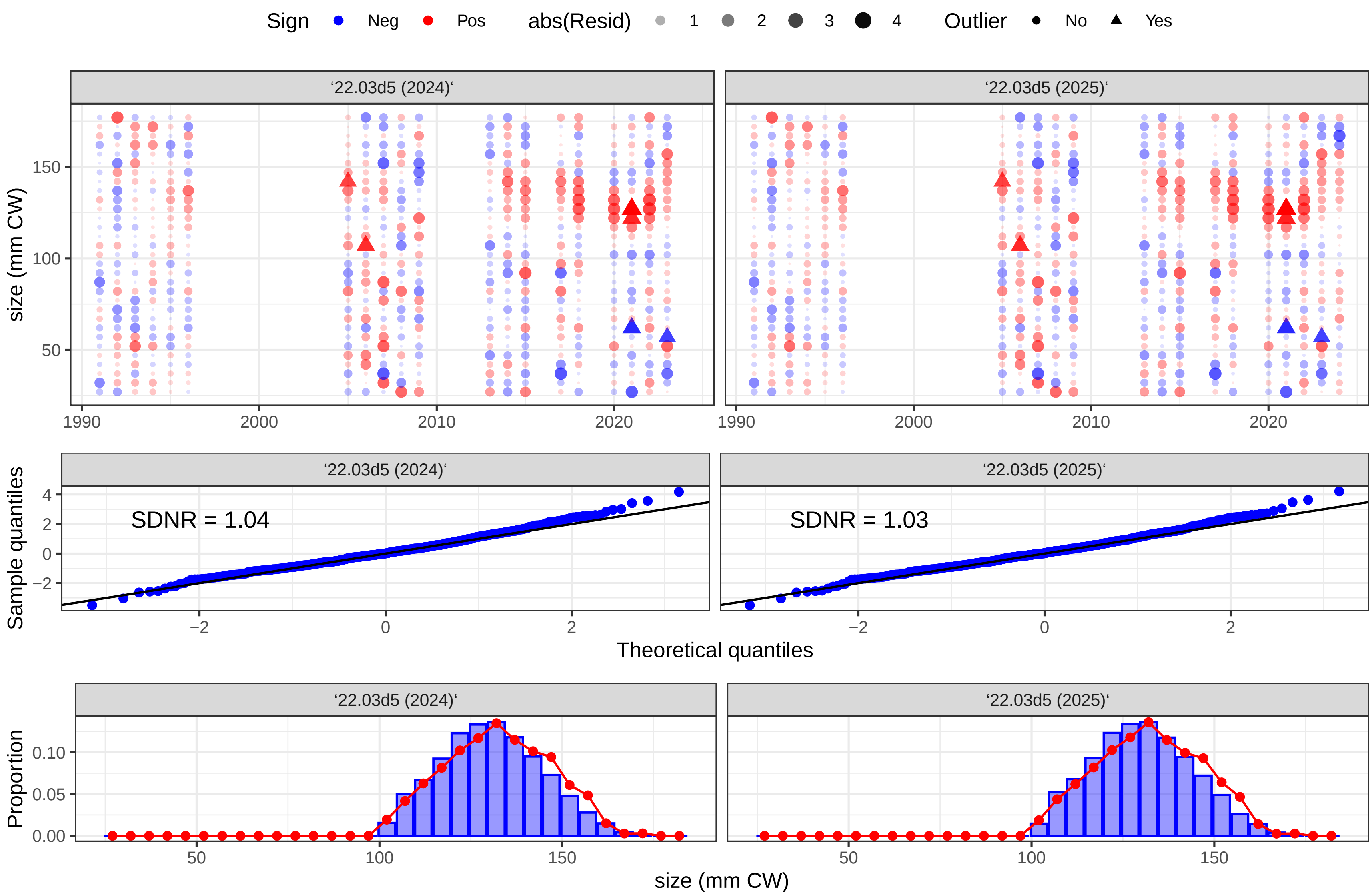


Figure 119. OSA residuals for TCSAM02 models fit to male size compositions from the TCF fishery. The preferred model is `22.03d5 (2025)`.

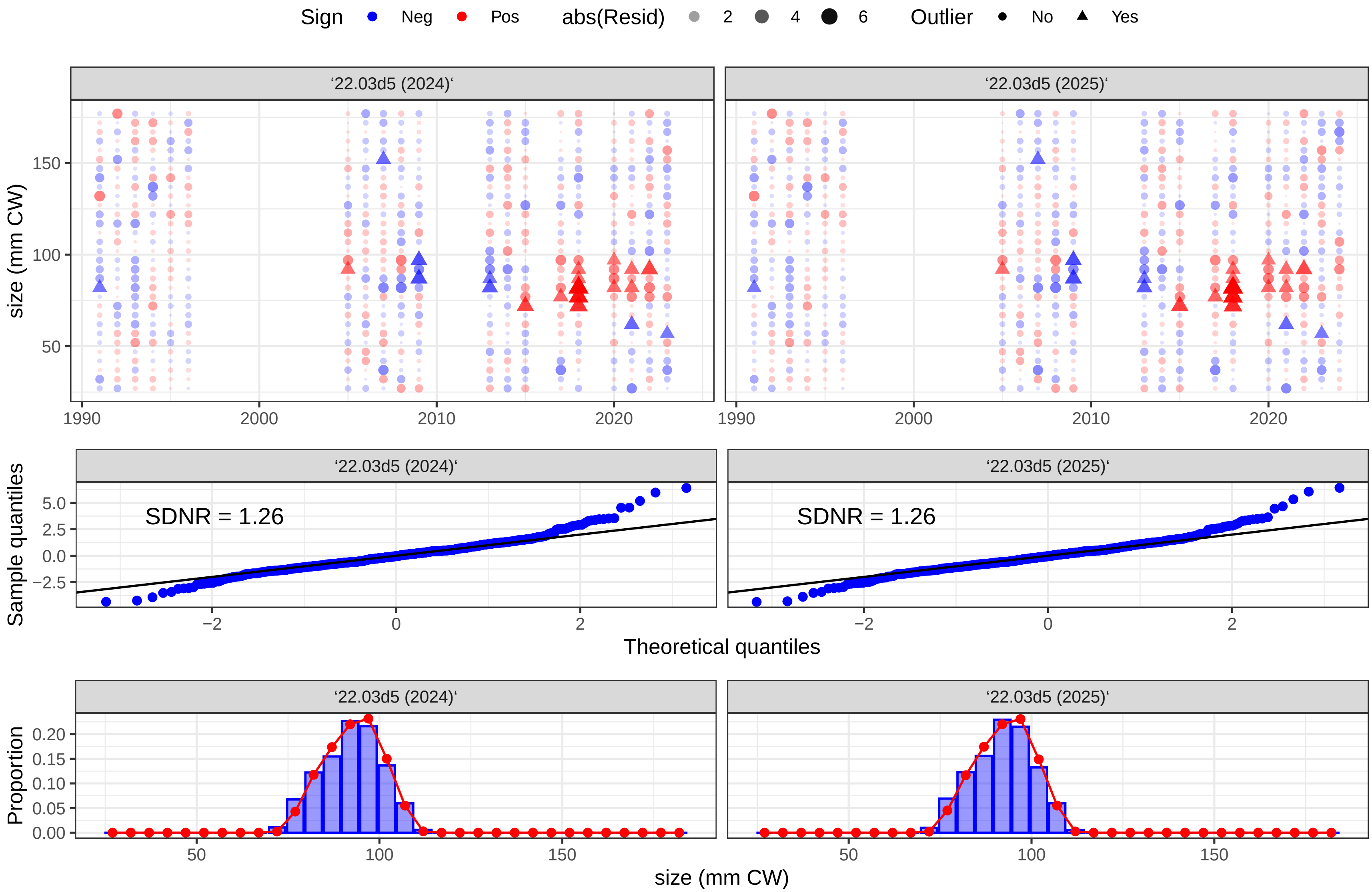


Figure 120. OSA residuals for TCSAM02 models fit to female size compositions from the TCF fishery. The preferred model is `22.03d5 (2025)`.

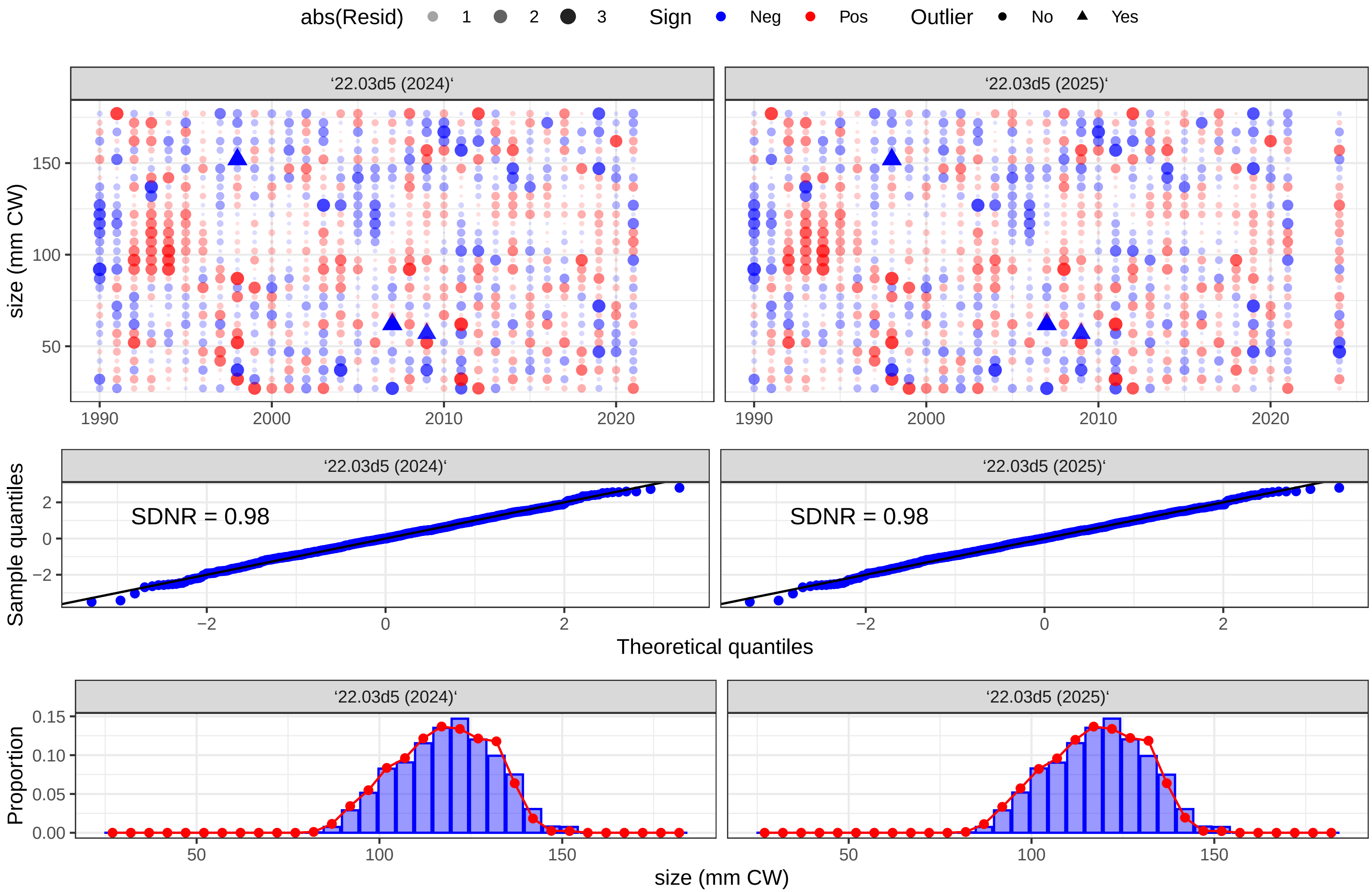


Figure 121. OSA residuals for TCSAM02 models fit to male size compositions from the SCF fishery. The preferred model is `22.03d5 (2025)`.

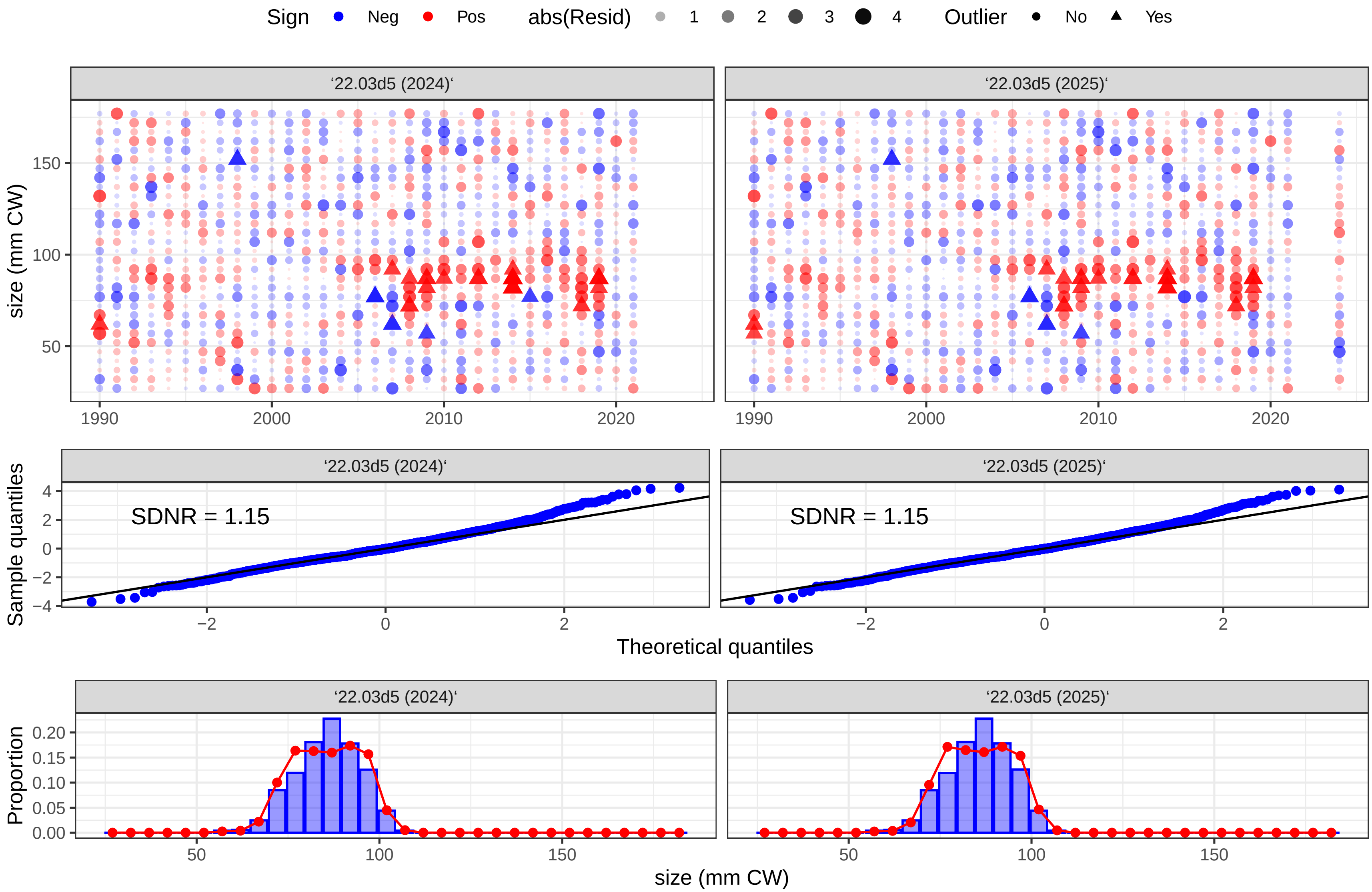


Figure 122. OSA residuals for TCSAM02 models fit to female size compositions from the SCF fishery. The preferred model is `22.03d5 (2025)`.

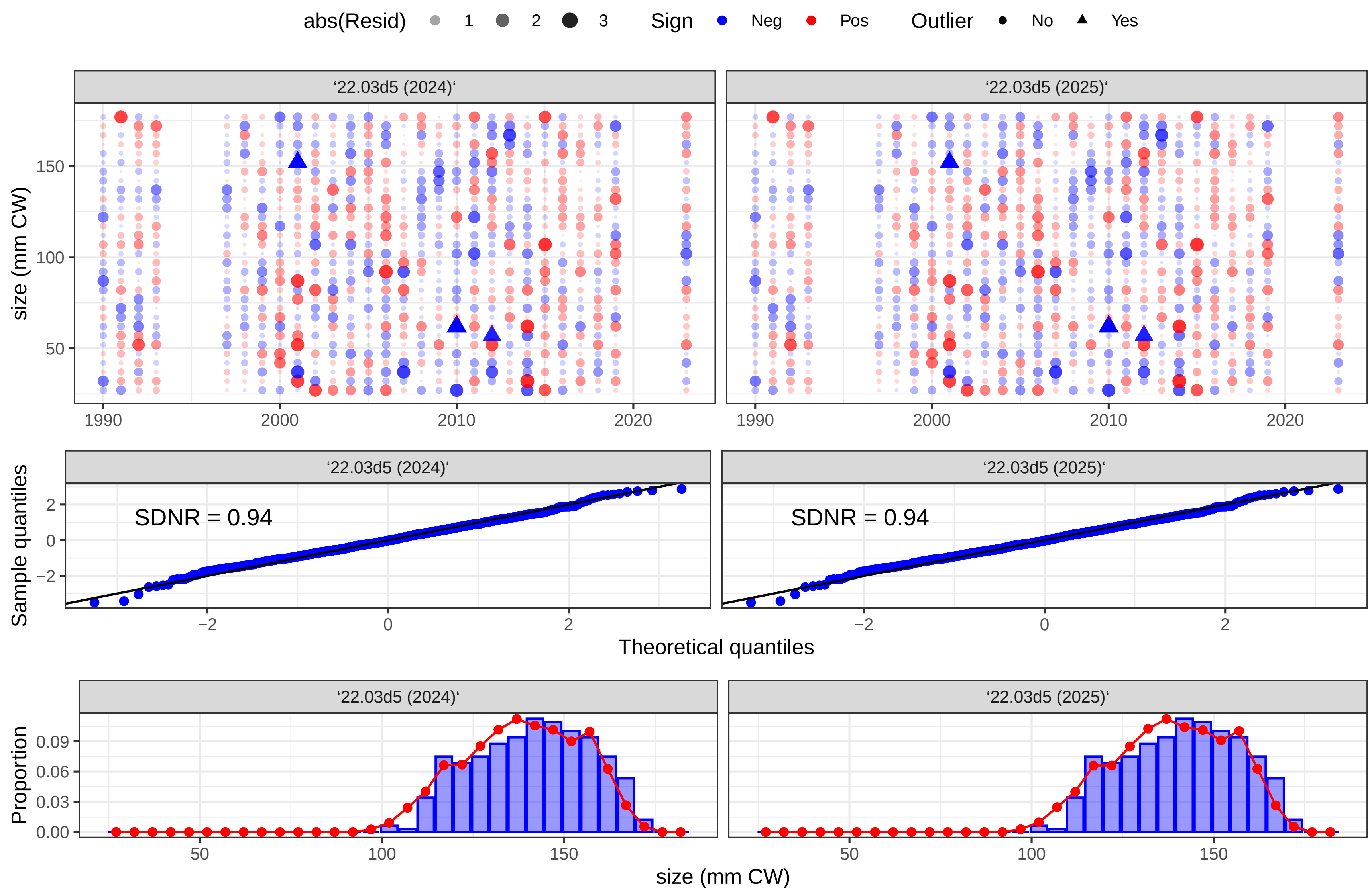


Figure 123. OSA residuals for TCSAM02 models fit to male size compositions from the RKF fishery. The preferred model is `22.03d5 (2025)`.

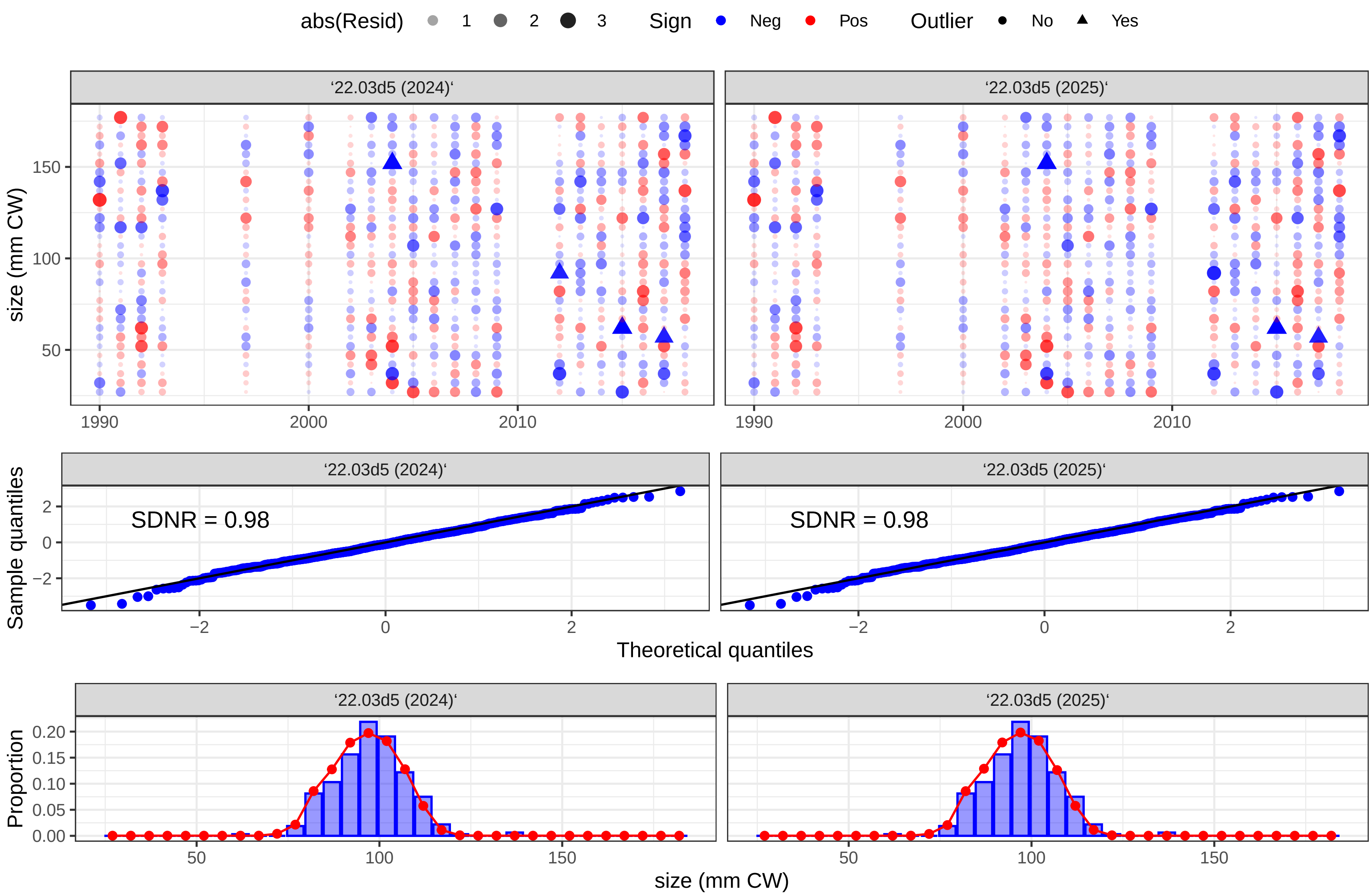


Figure 124. OSA residuals for TCSAM02 models fit to female size compositions from the RKF fishery. The preferred model is 22.03d5 (2025).

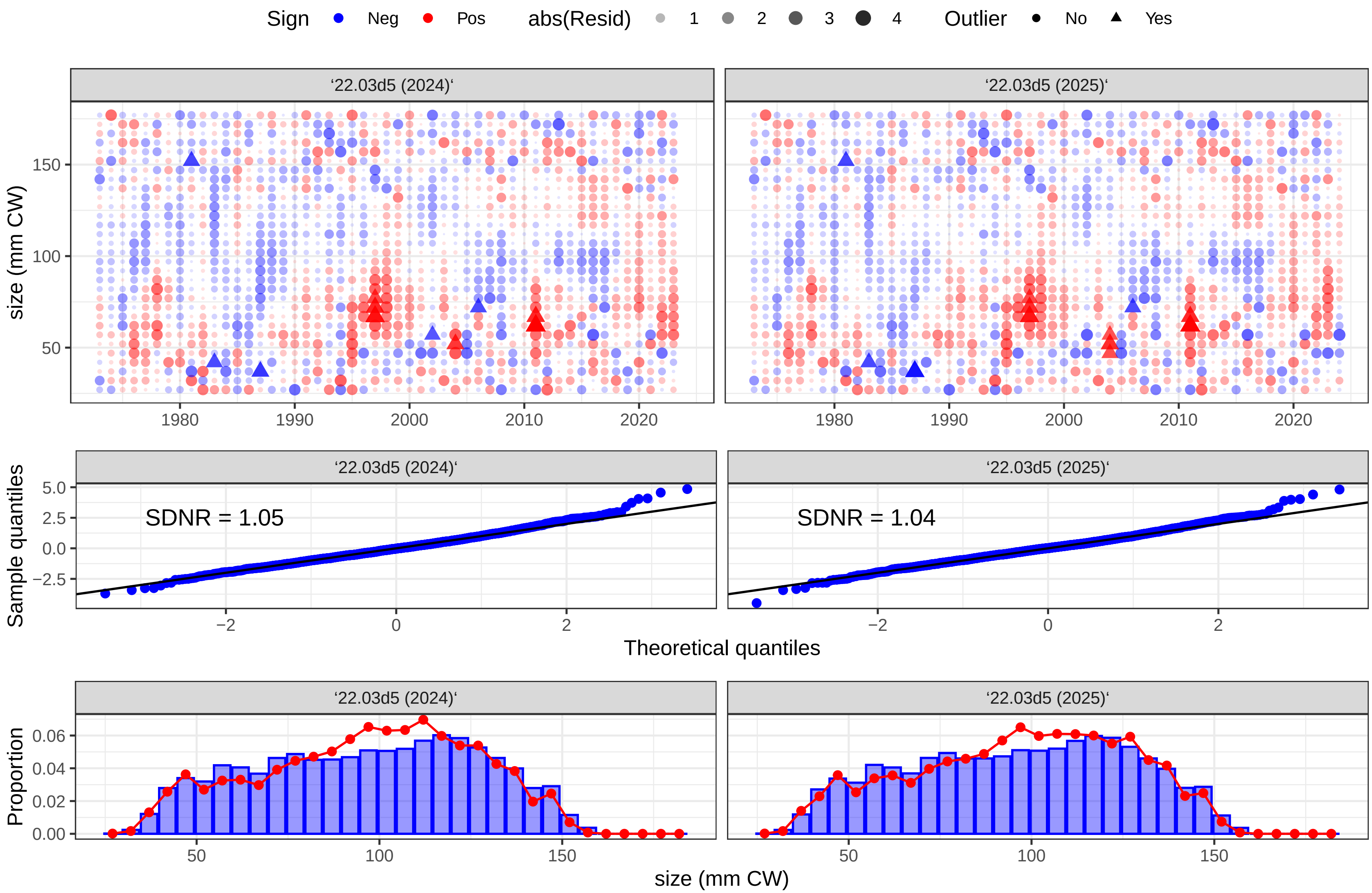


Figure 125. OSA residuals for TCSAM02 models fit to male size compositions from the GF All fishery. The preferred model is `22.03d5 (2025)`.

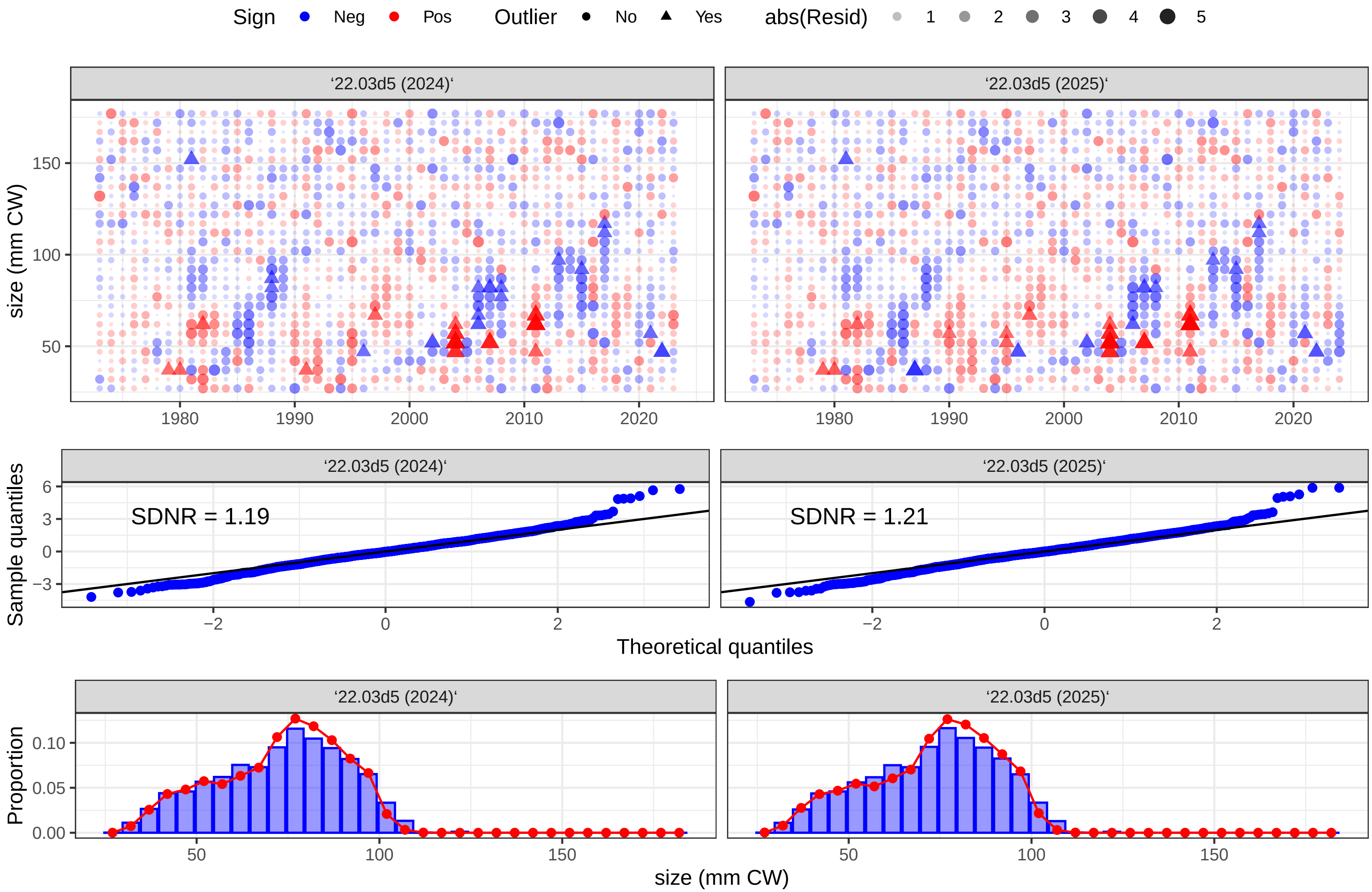


Figure 126. OSA residuals for TCSAM02 models fit to female size compositions from the GF All fishery. The preferred model is `22.03d5 (2025)`.

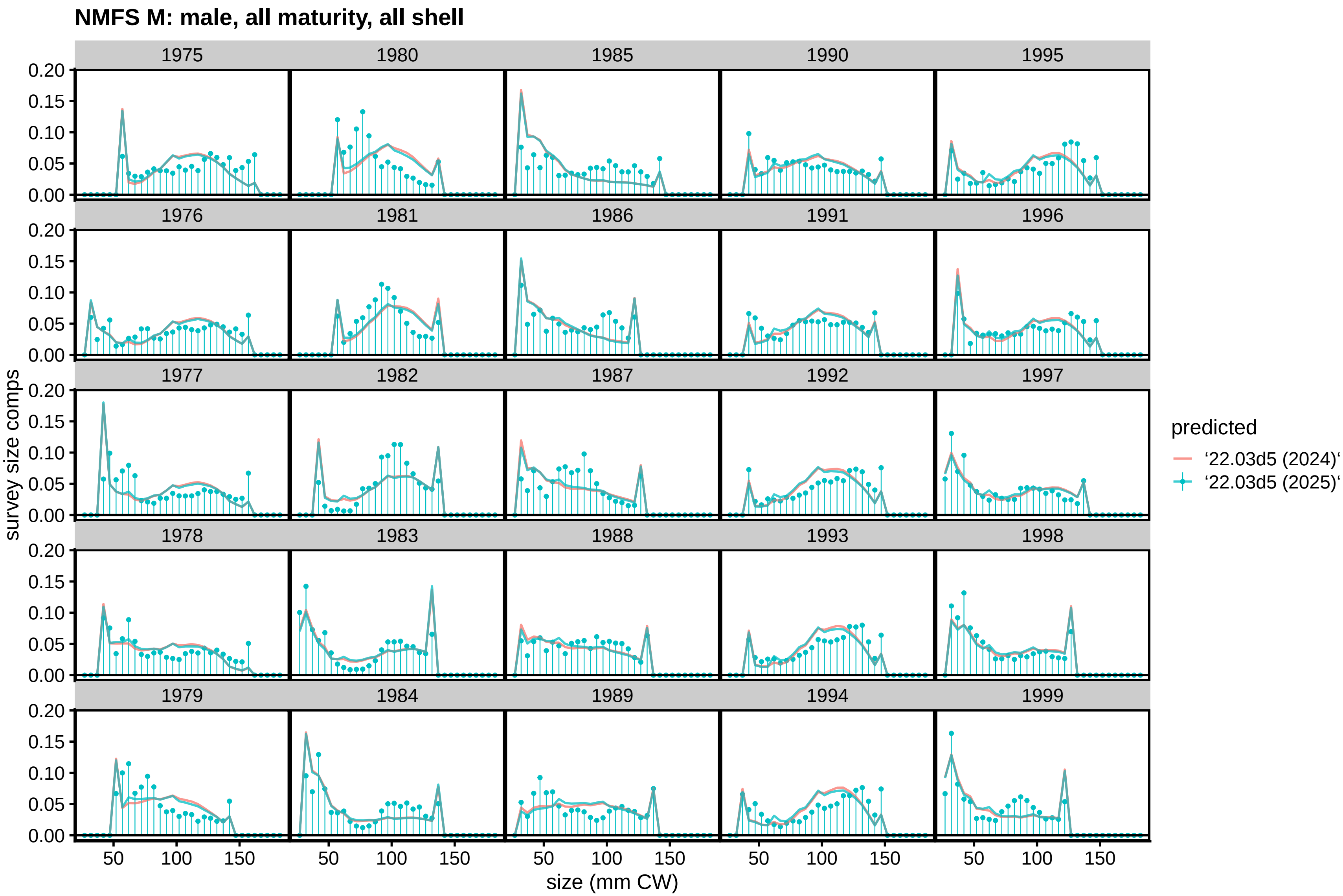


Figure 127. TCSAM02 models fits to survey size compositions in the NMFS M survey. Preferred model is `22.03d5 (2025)`.

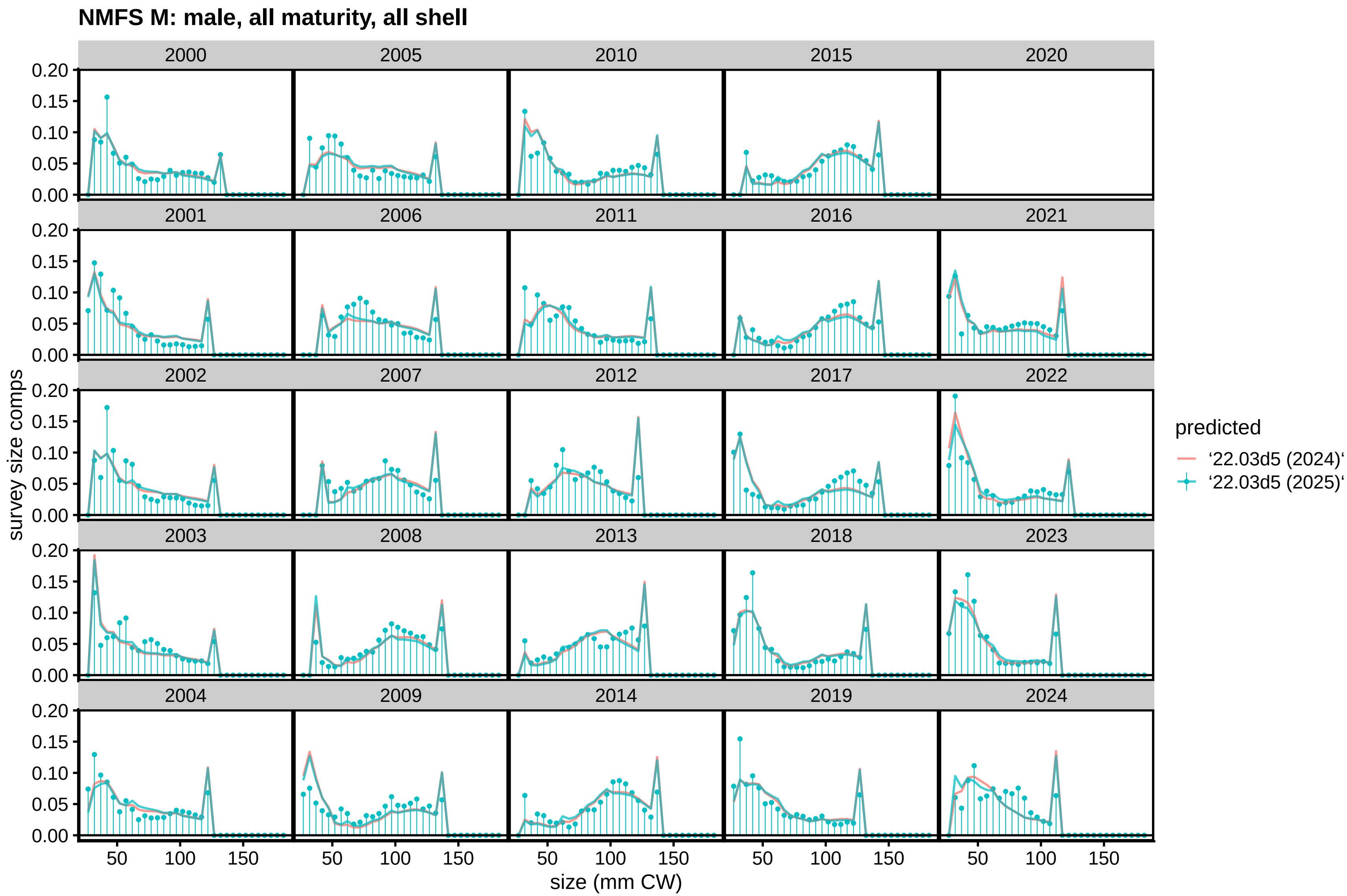


Figure 128. TCSAM02 models fits to survey size compositions in the NMFS M survey. Preferred model is `22.03d5 (2025)`.

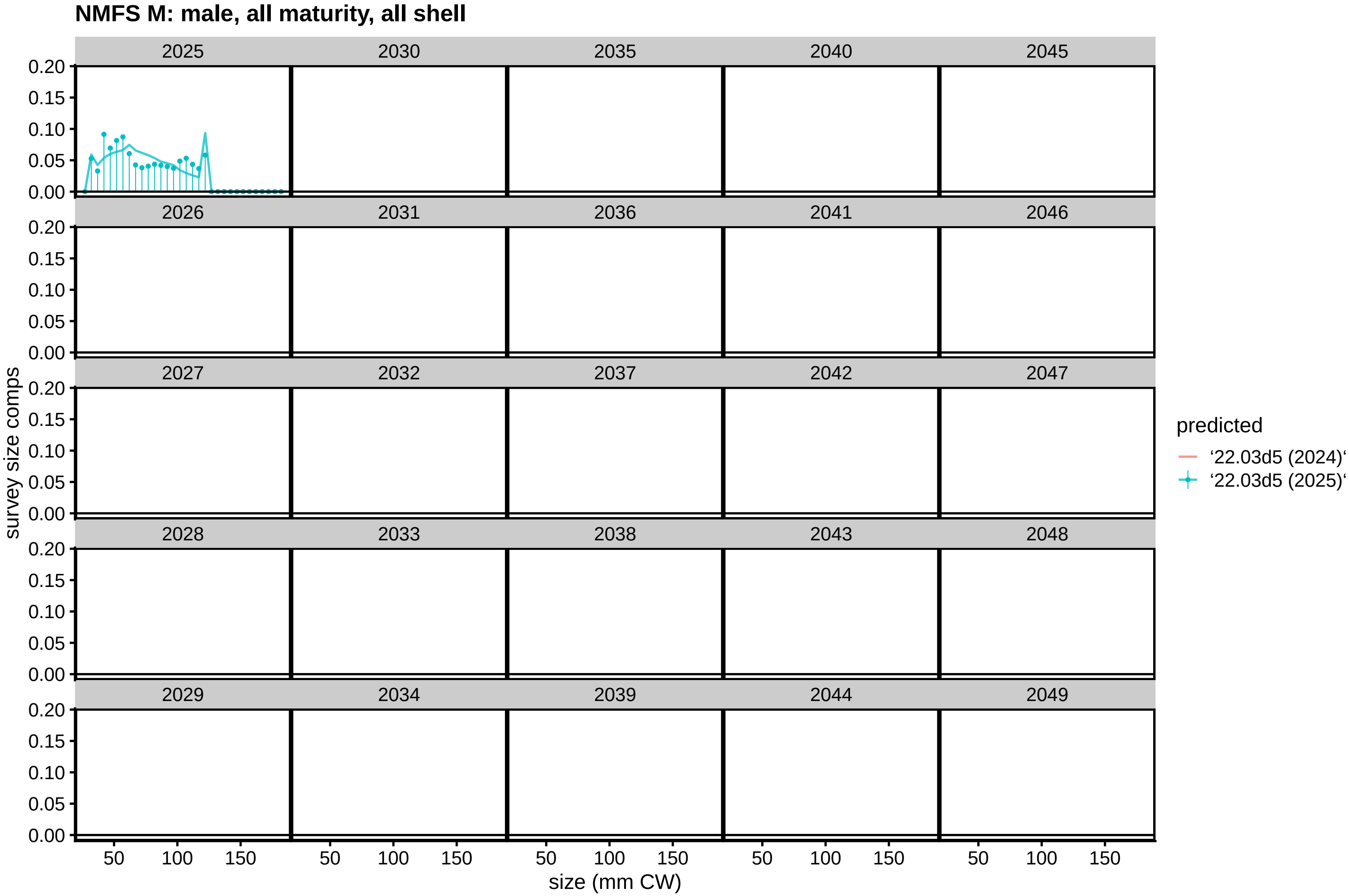


Figure 129. TCSAM02 models fits to survey size compositions in the NMFS M survey. Preferred model is `22.03d5 (2025)`.

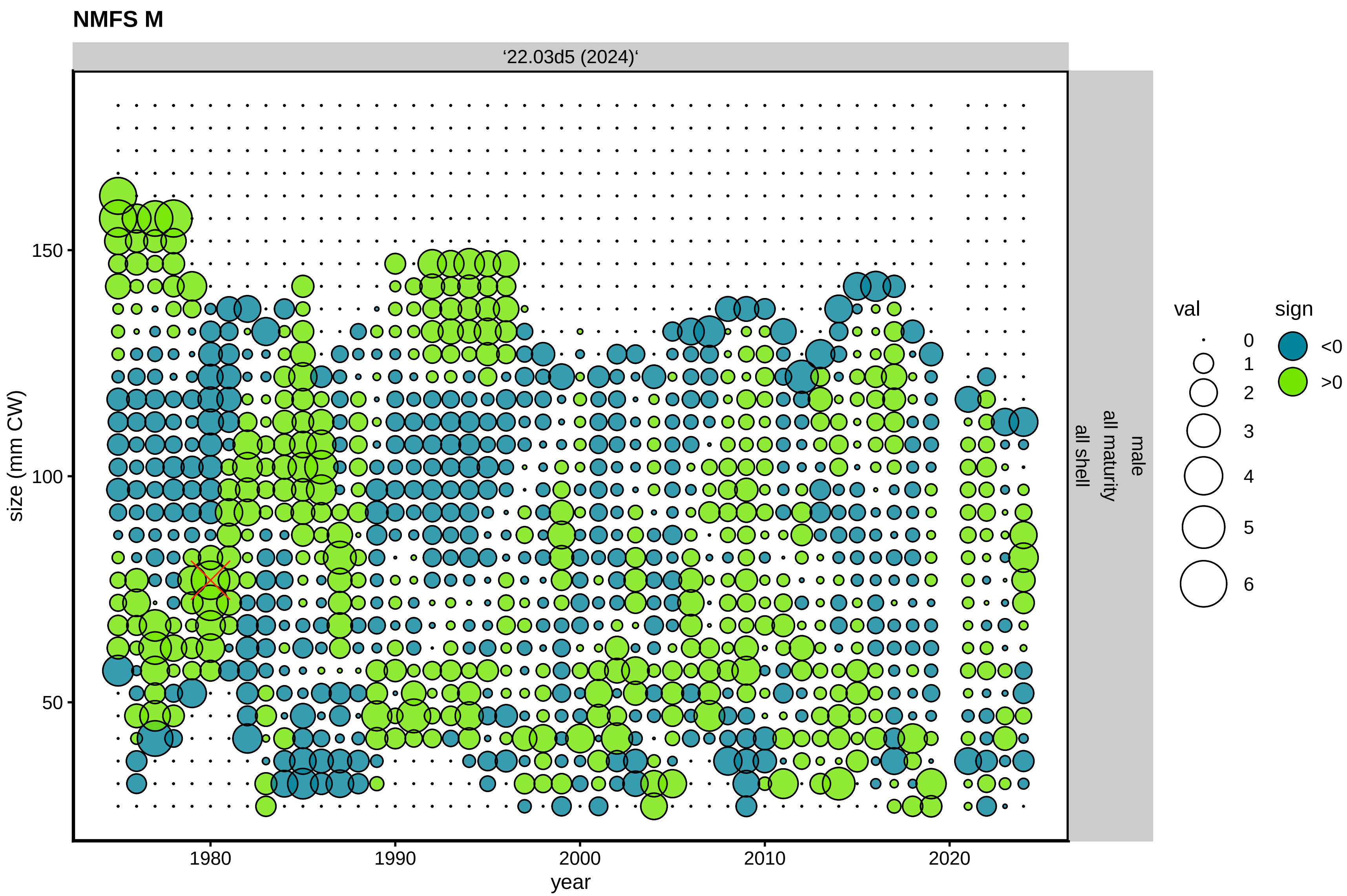


Figure 130. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. Preferred model is `22.03d5 (2025)`.

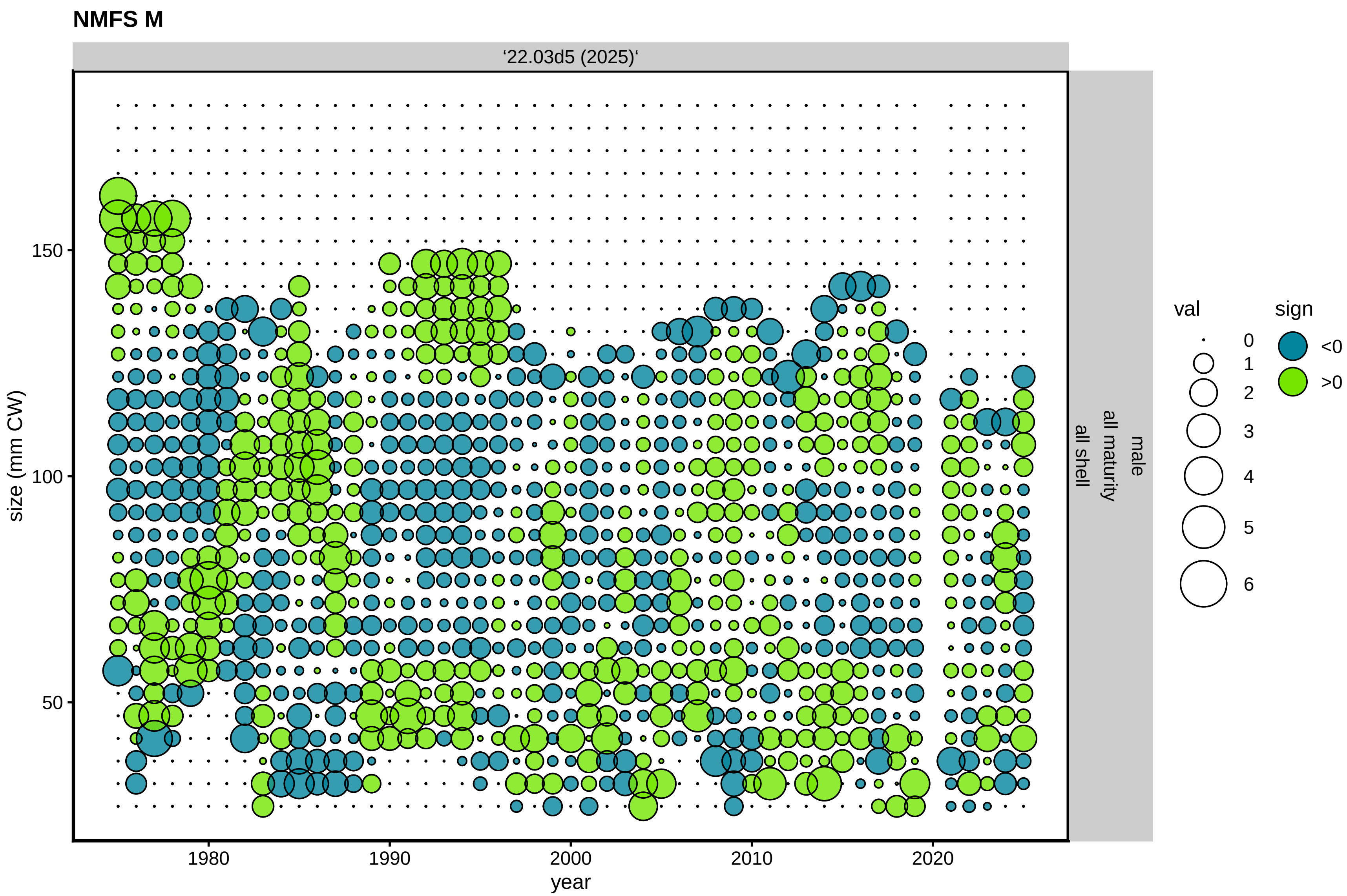


Figure 131. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. Preferred model is `22.03d5 (2025)`.

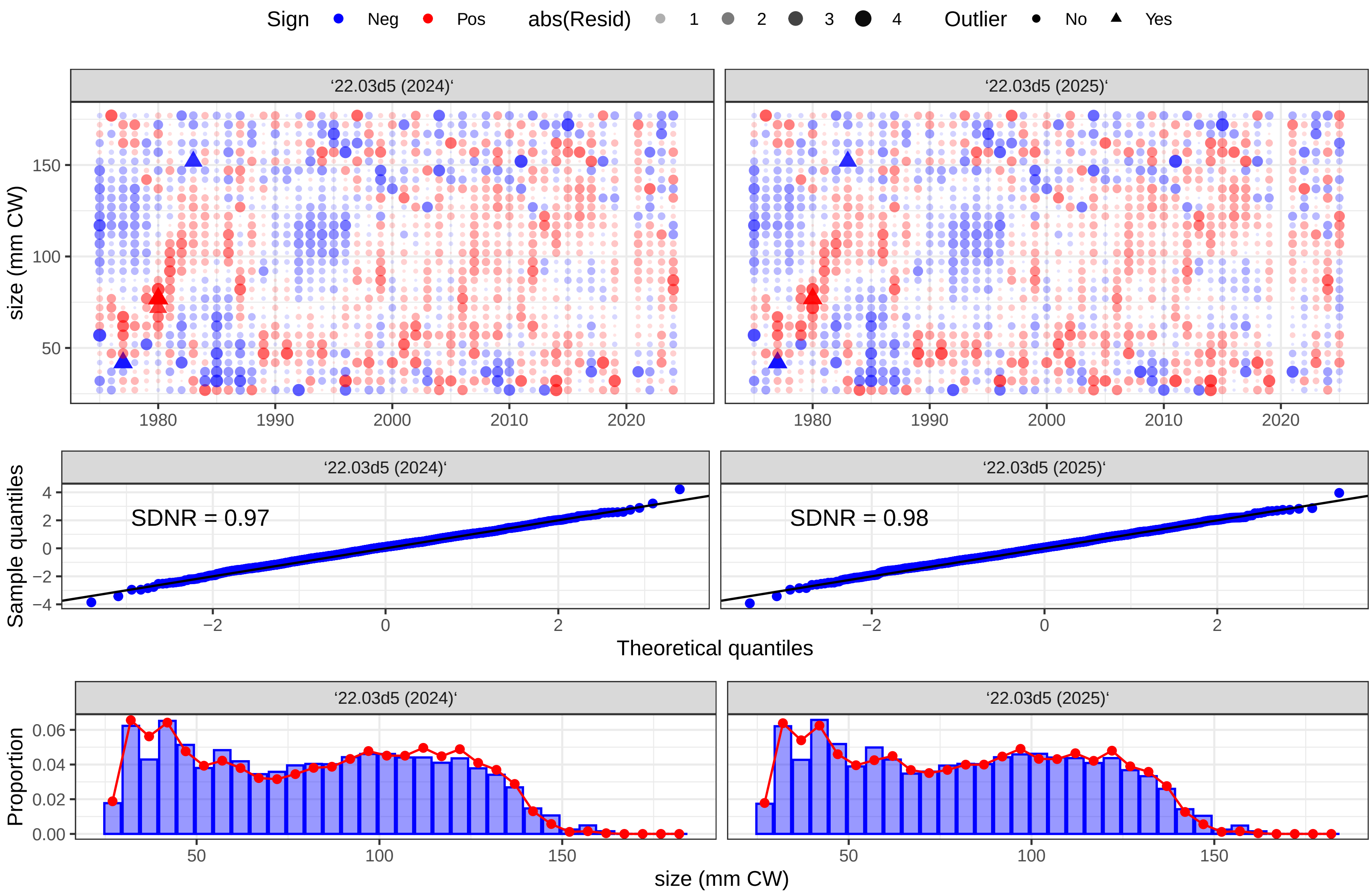


Figure 132. OSA residuals for fits to size compositions from the NMFS_M survey. The base/preferred model is 22.03d5.

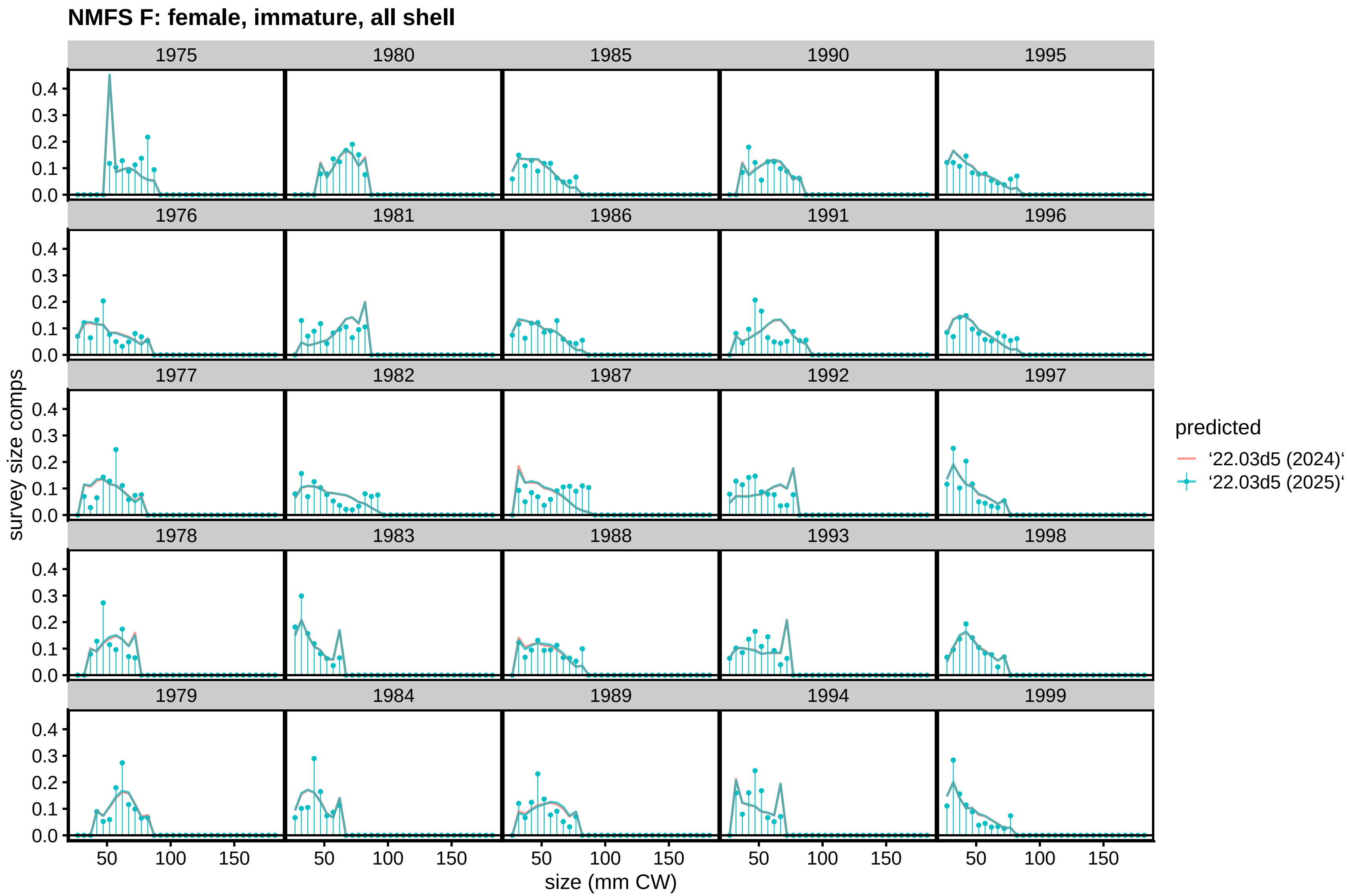


Figure 133. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is `22.03d5 (2025)`.

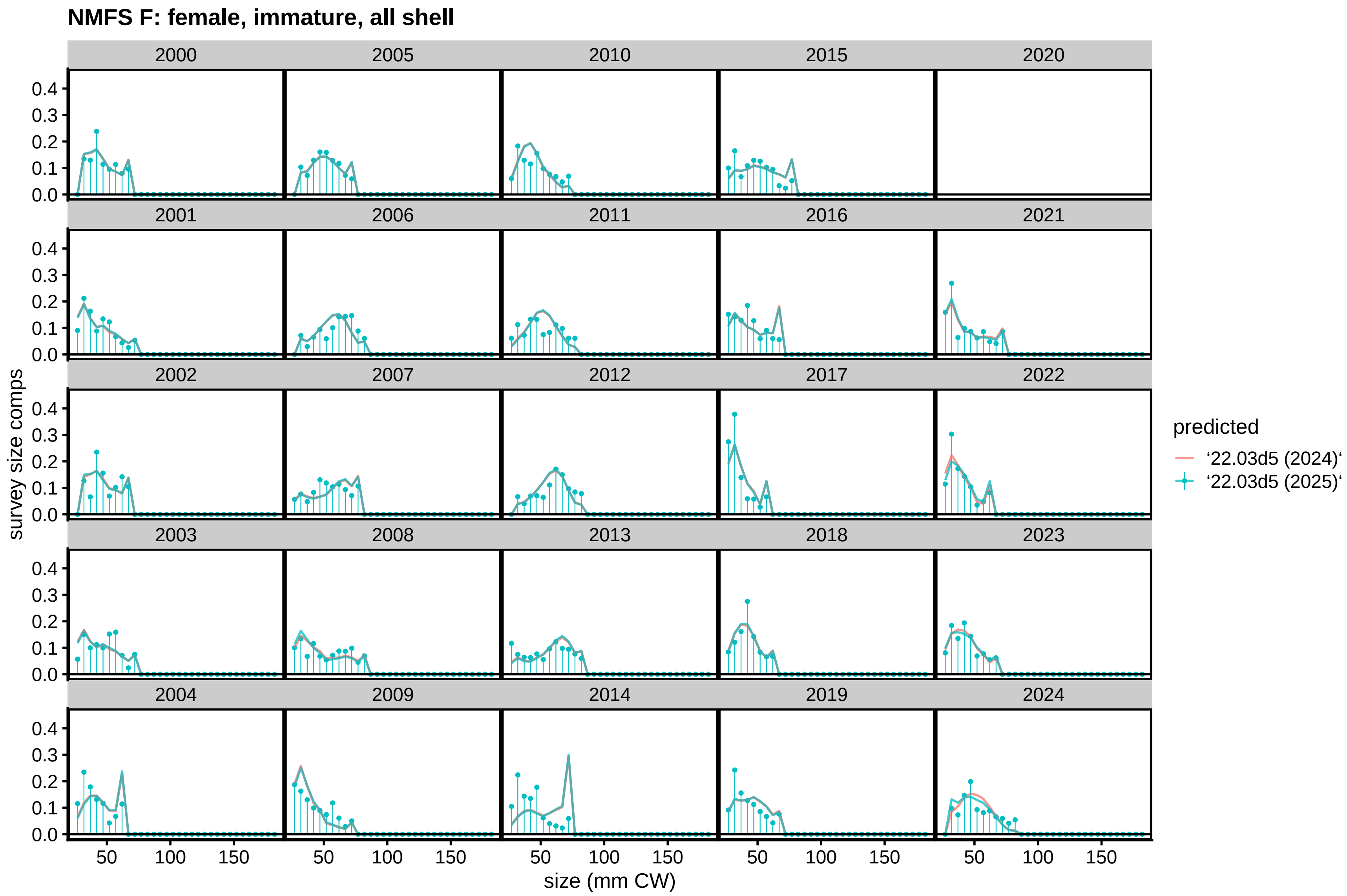


Figure 134. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is `22.03d5 (2025)`.

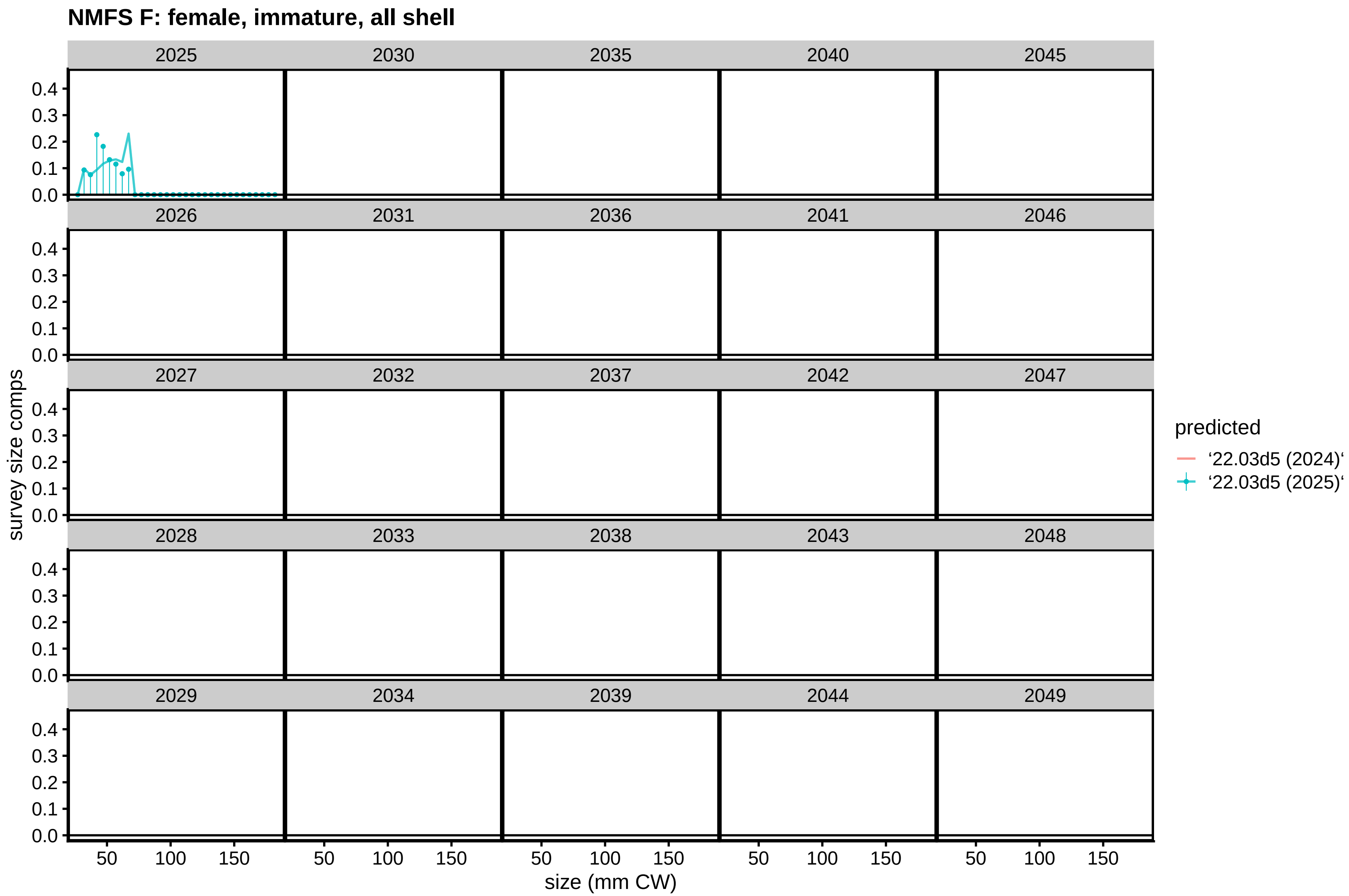


Figure 135. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is `22.03d5 (2025)`.

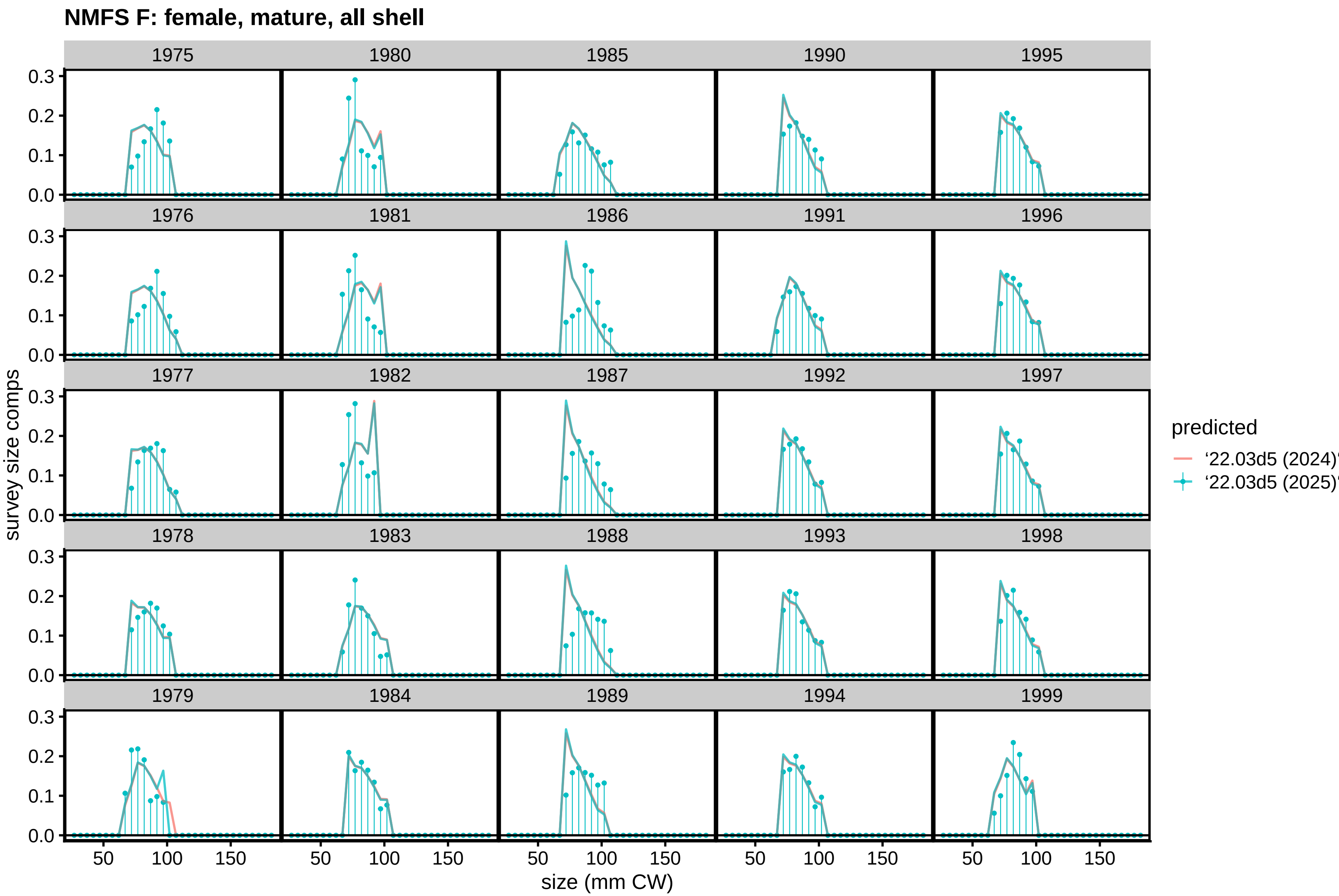


Figure 136. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is `22.03d5 (2025)`.

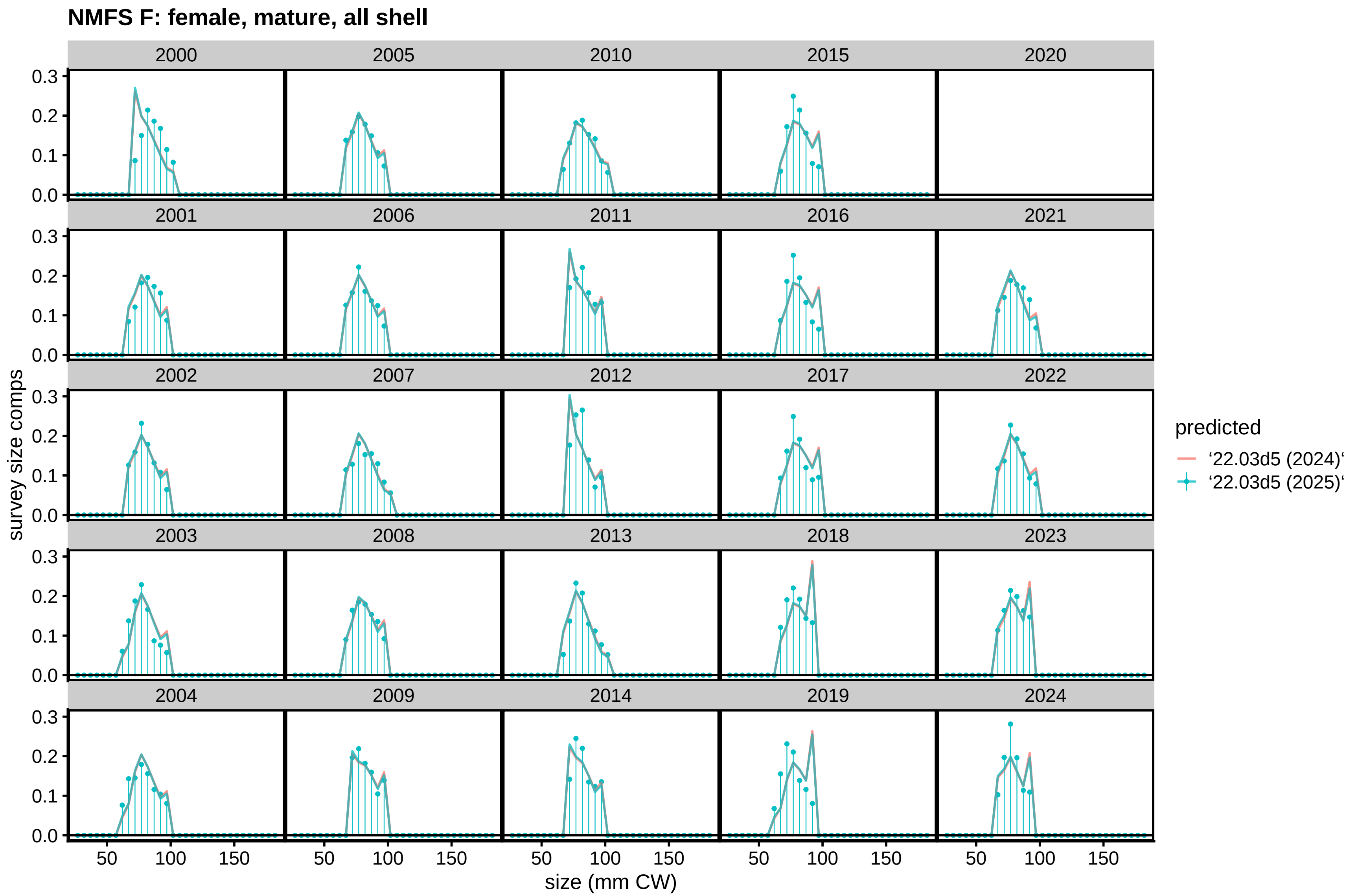


Figure 137. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is `22.03d5 (2025)`.

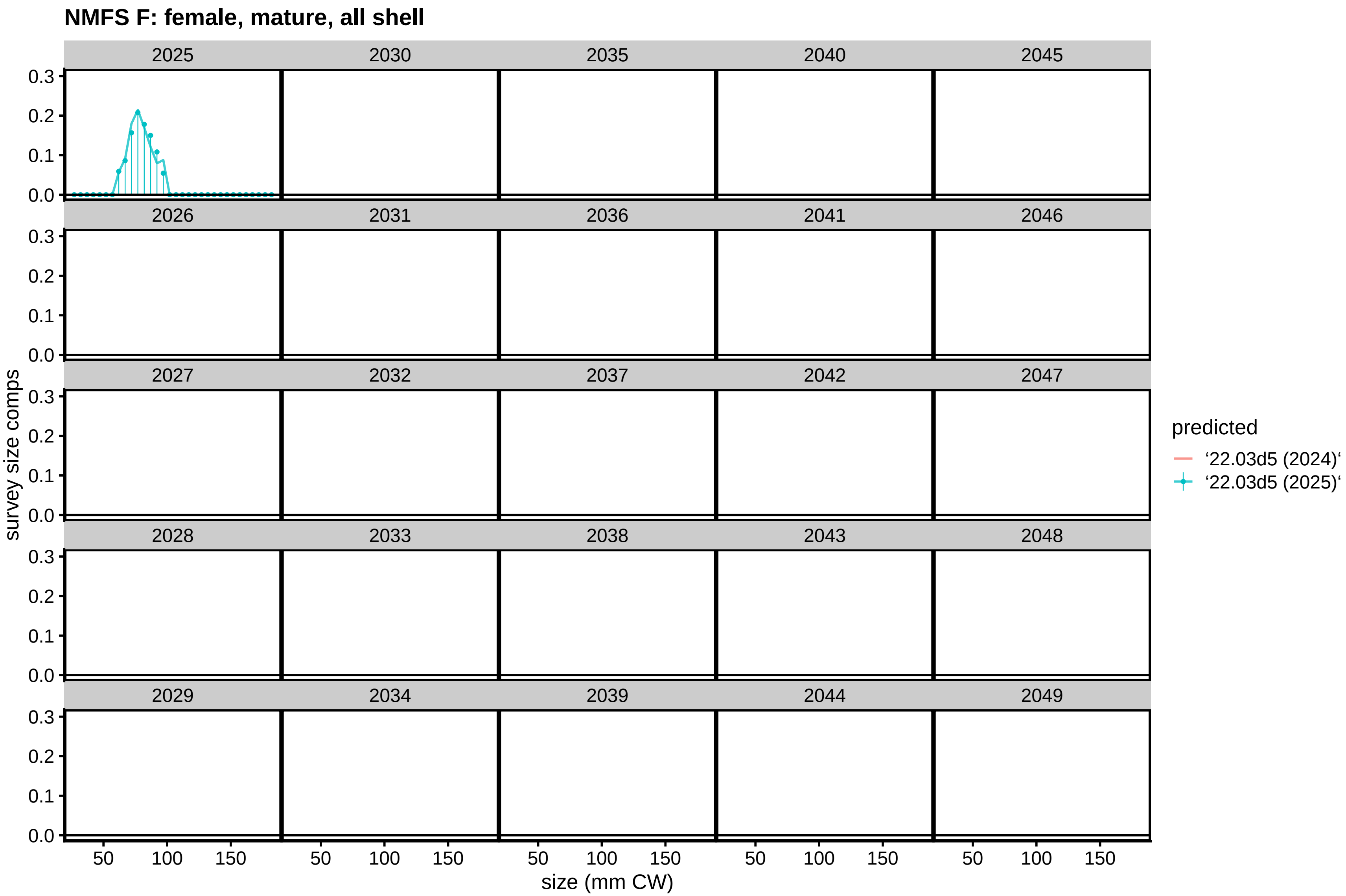


Figure 138. TCSAM02 models fits to survey size compositions in the NMFS F survey. Preferred model is `22.03d5 (2025)`.

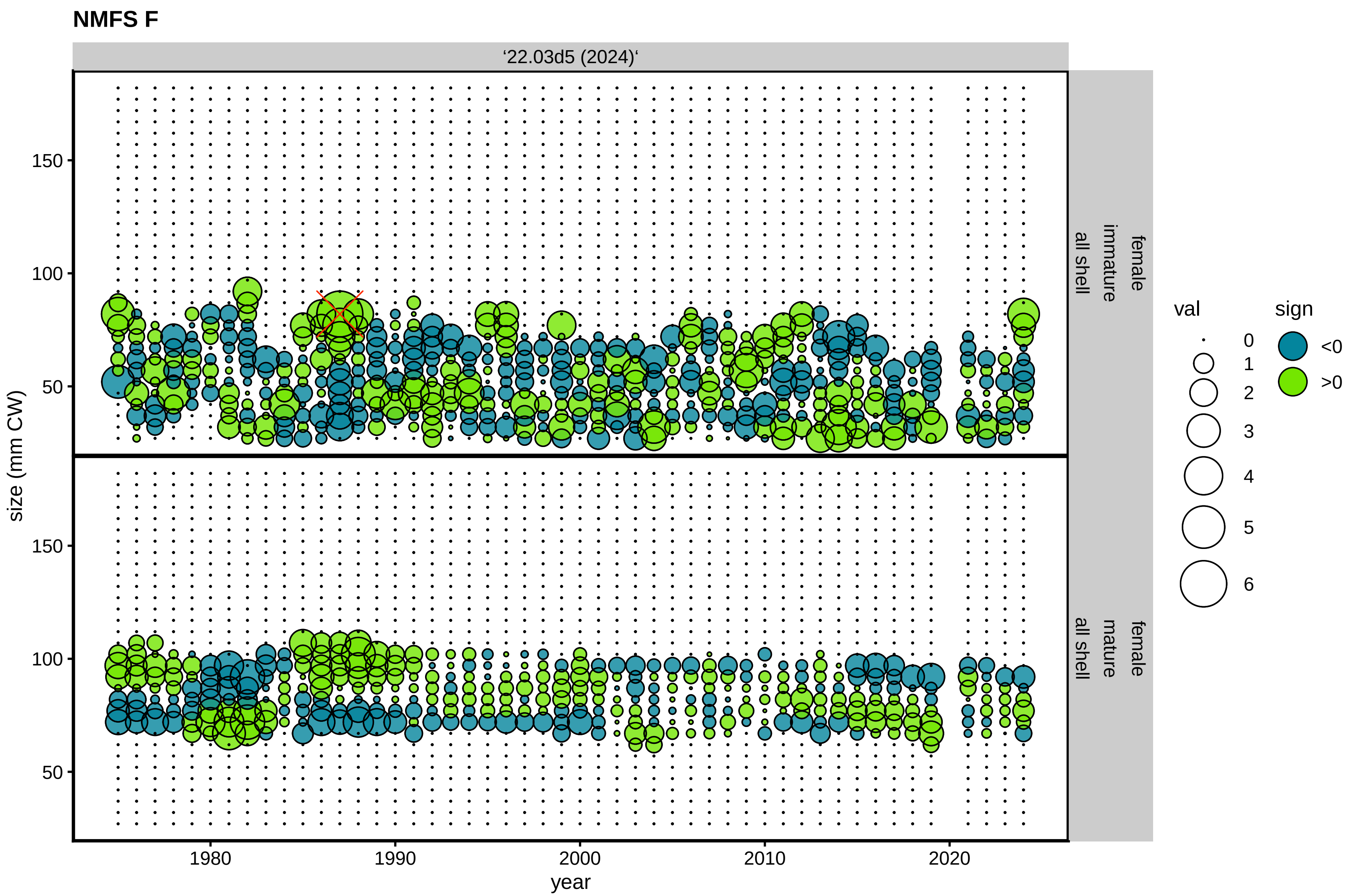


Figure 139. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. Preferred model is `22.03d5 (2025)`.

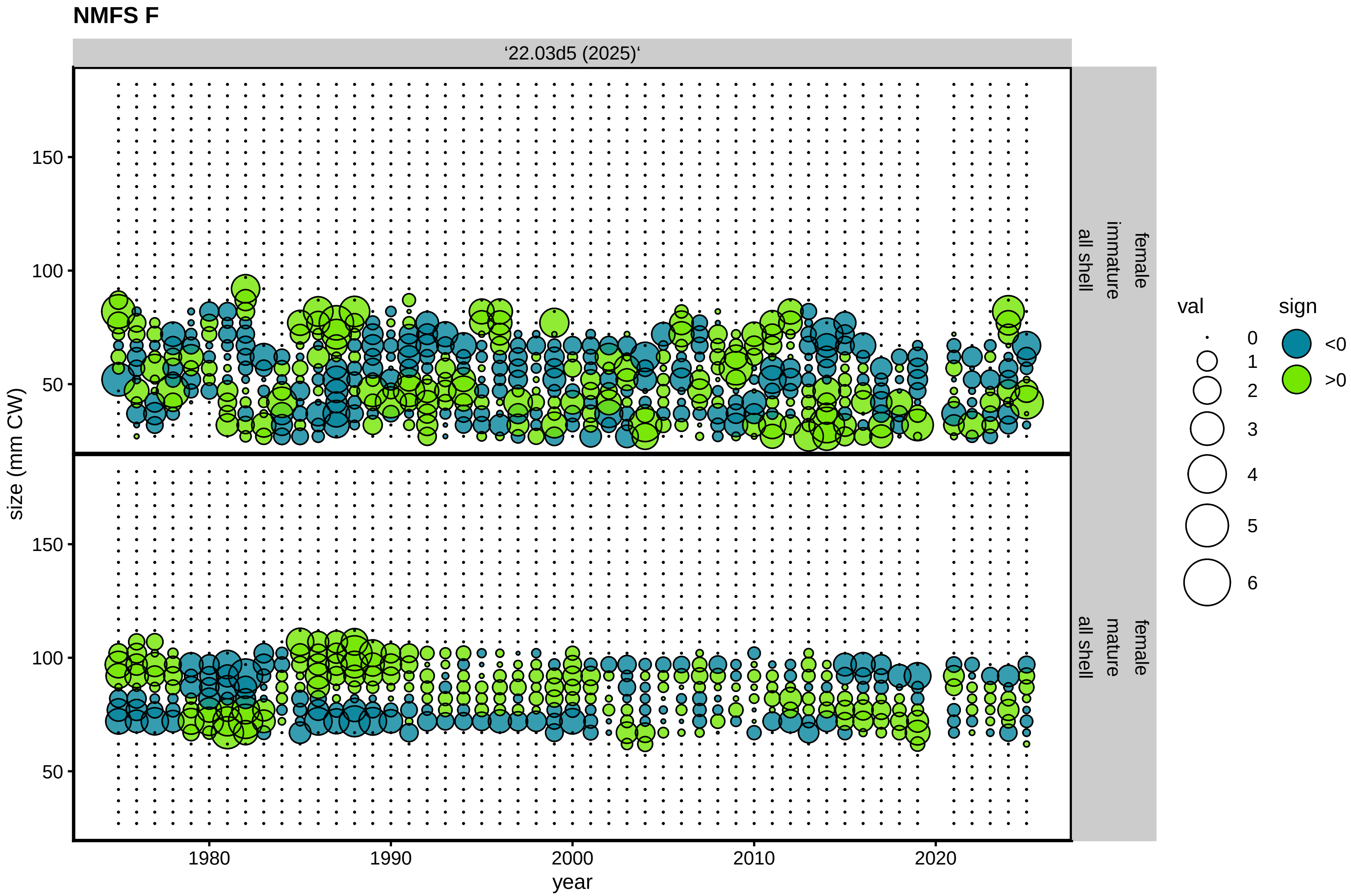


Figure 140. Pearson's residuals for fits to survey size composition data in the TCSAM02 models. Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification. Preferred model is `22.03d5 (2025)`.

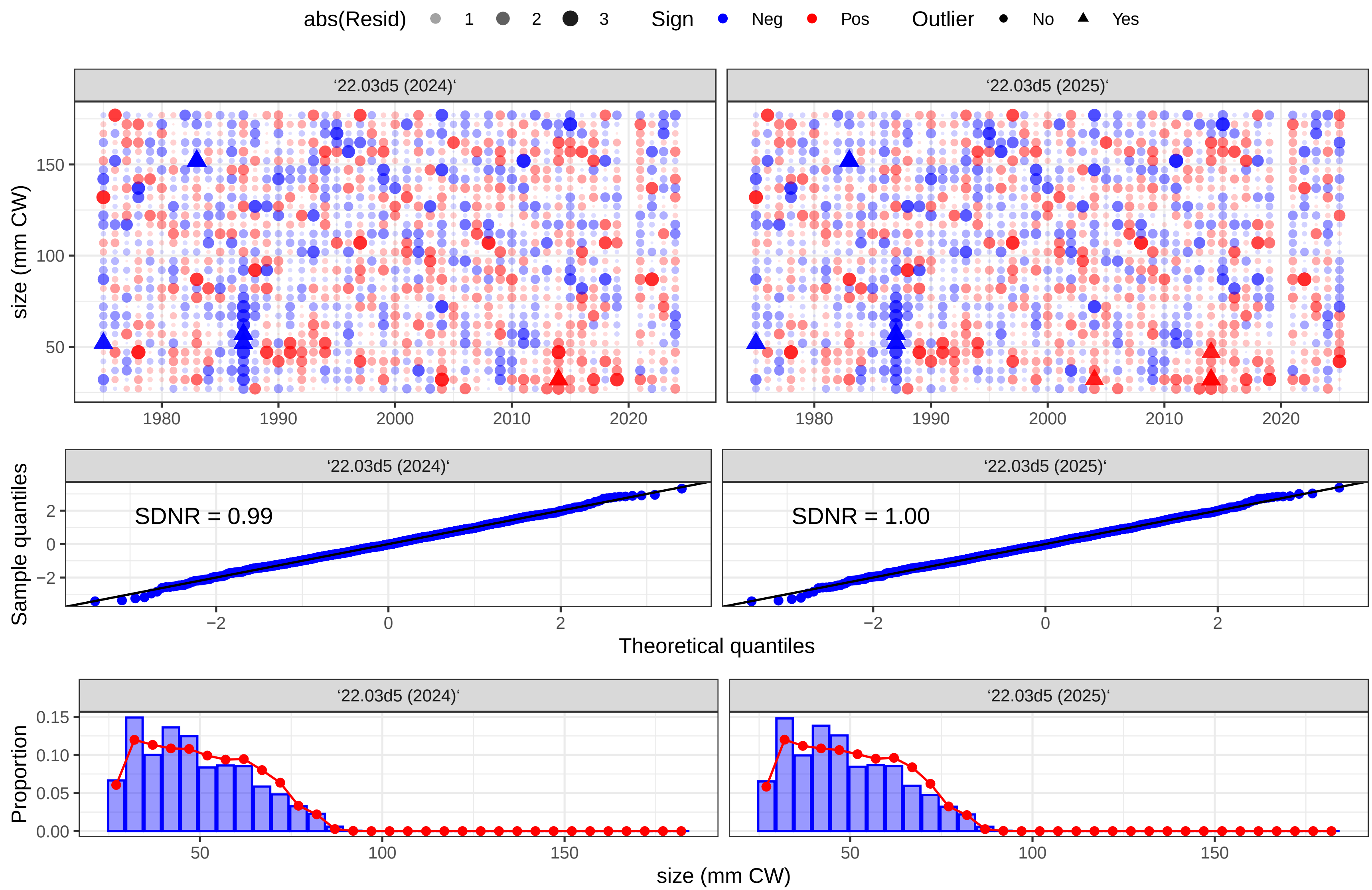


Figure 141. OSA residuals for fits to size compositions from the NMFS_F survey. The base/preferred model is 22.03d5.

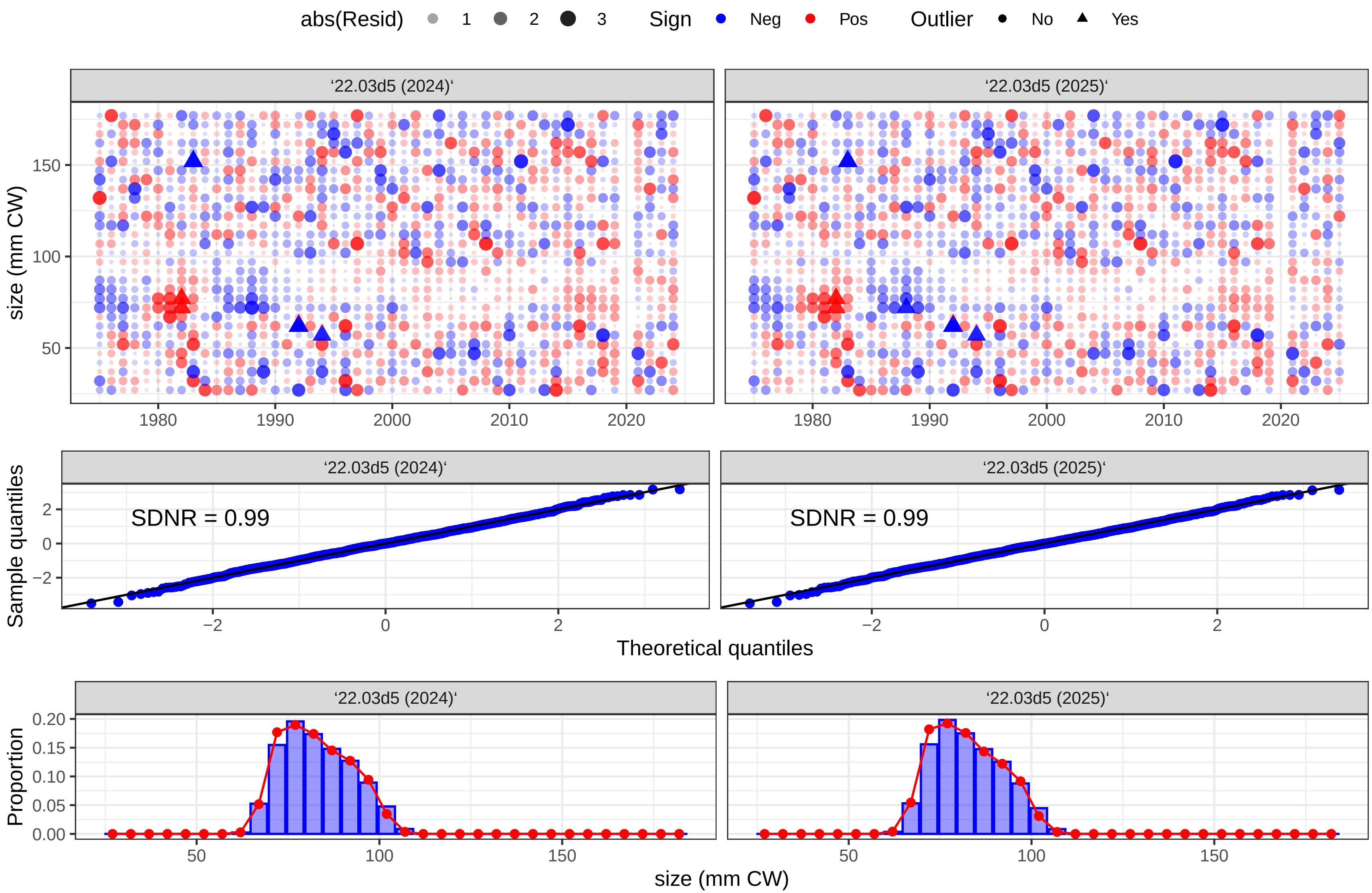


Figure 142. OSA residuals for fits to size compositions from the NMFS_F survey. The base/preferred model is 22.03d5.

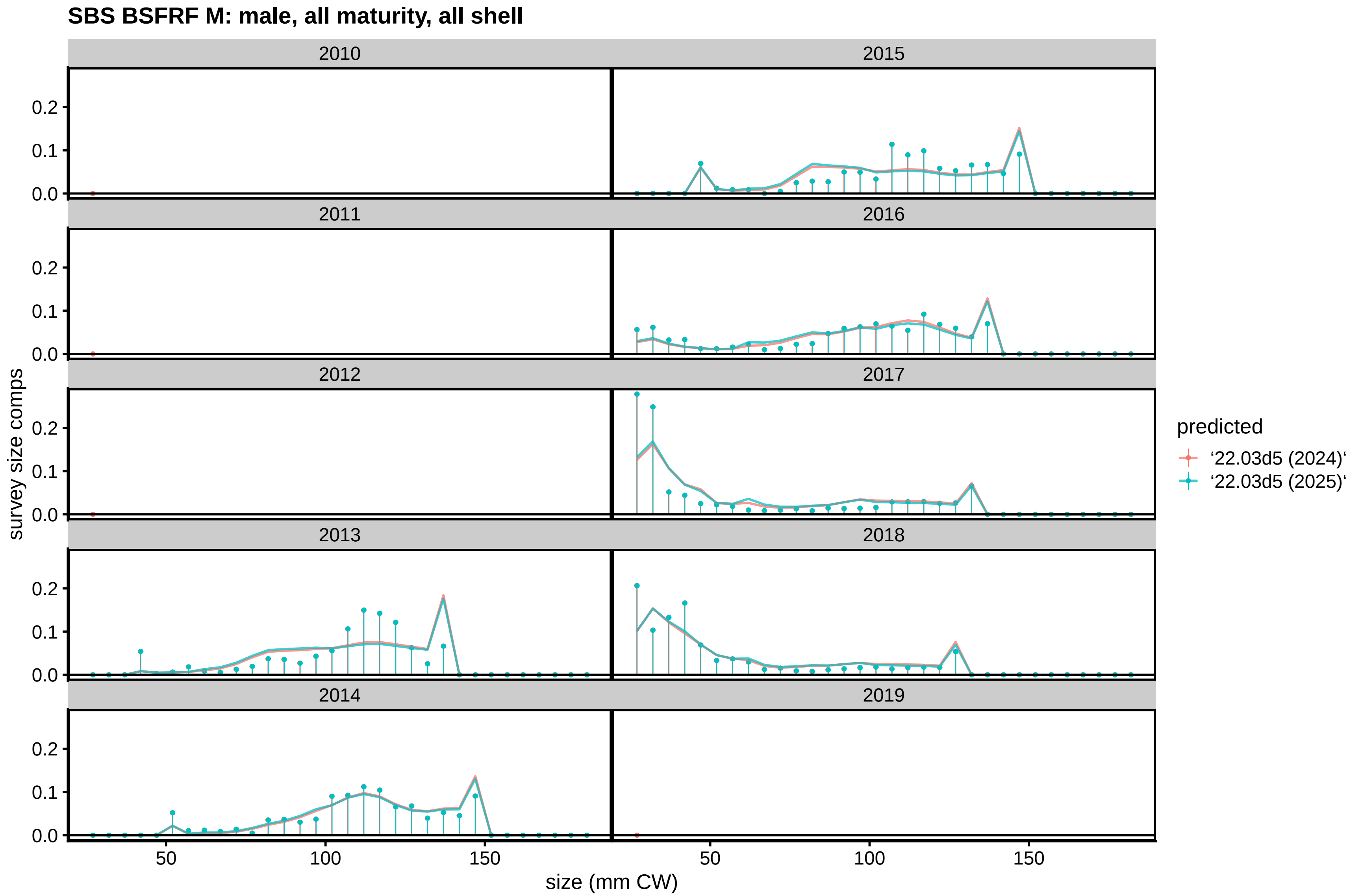


Figure 143. Fits to survey size compositions in the SBS BSFRF M survey. The base/preferred model is 22.03d5.

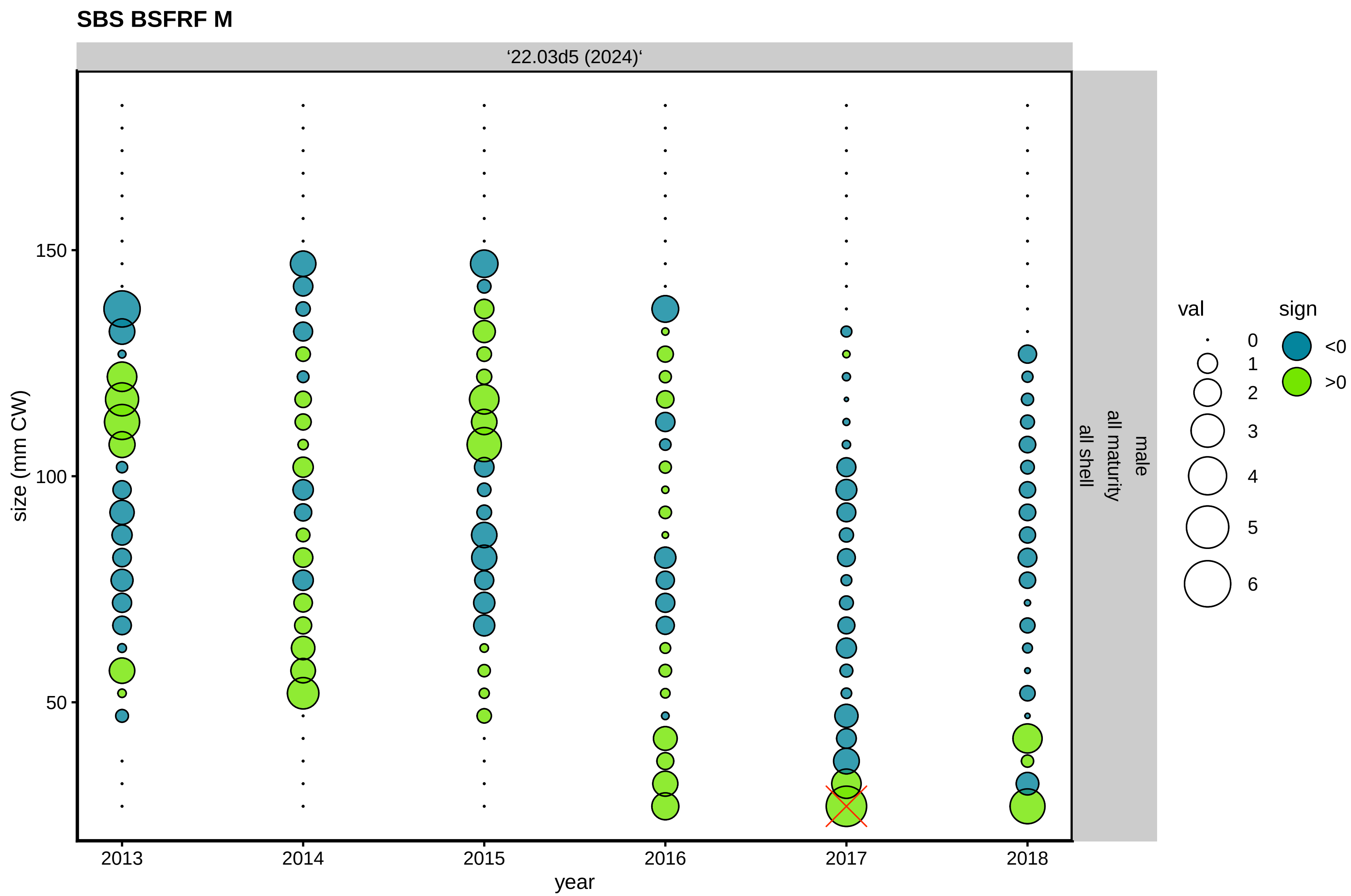


Figure 144. Pearson's residuals for fits to survey size composition in the BSFRF_M survey.Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

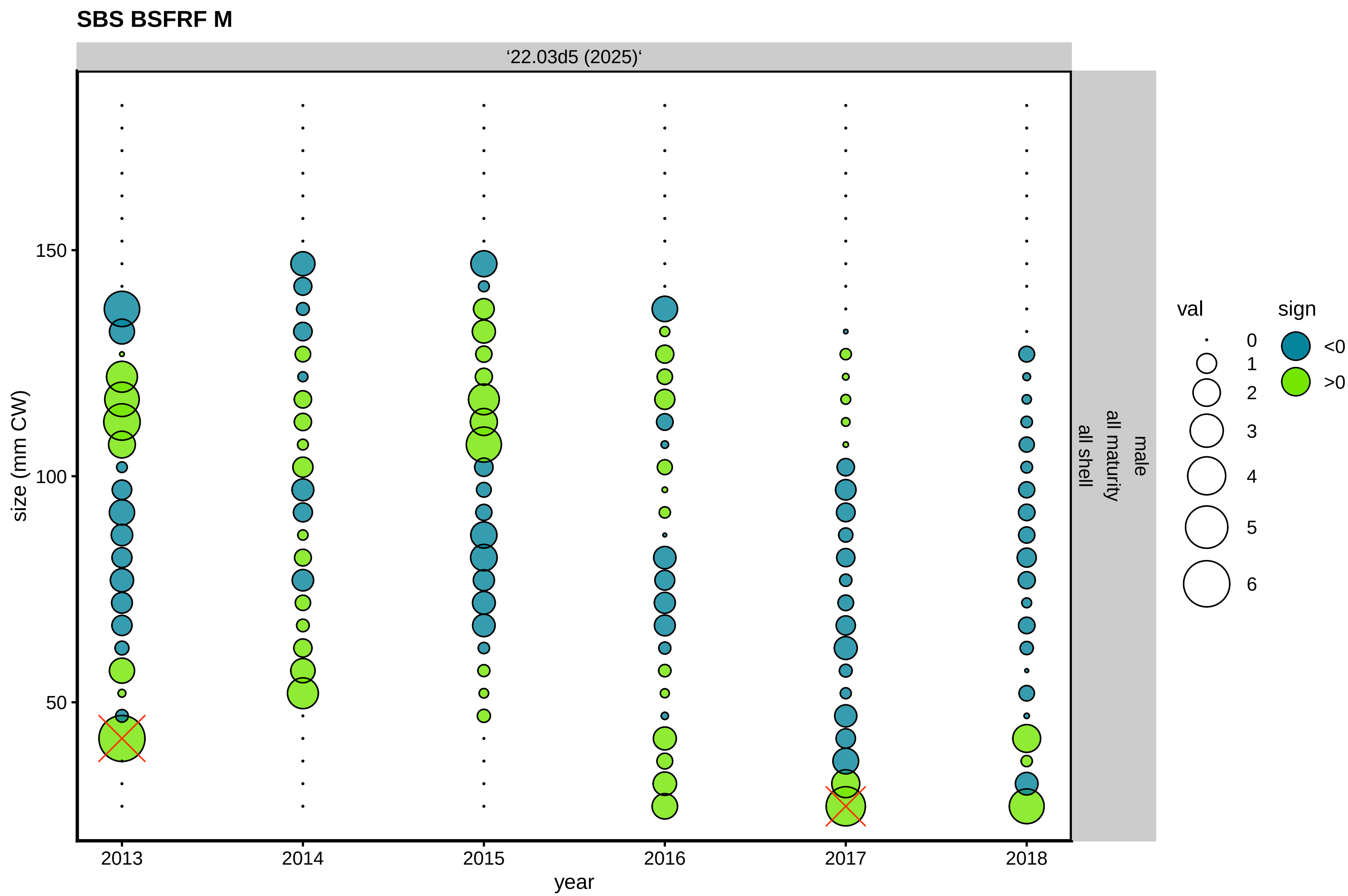


Figure 145. Pearson's residuals for fits to survey size composition in the BSFRF_M survey.Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

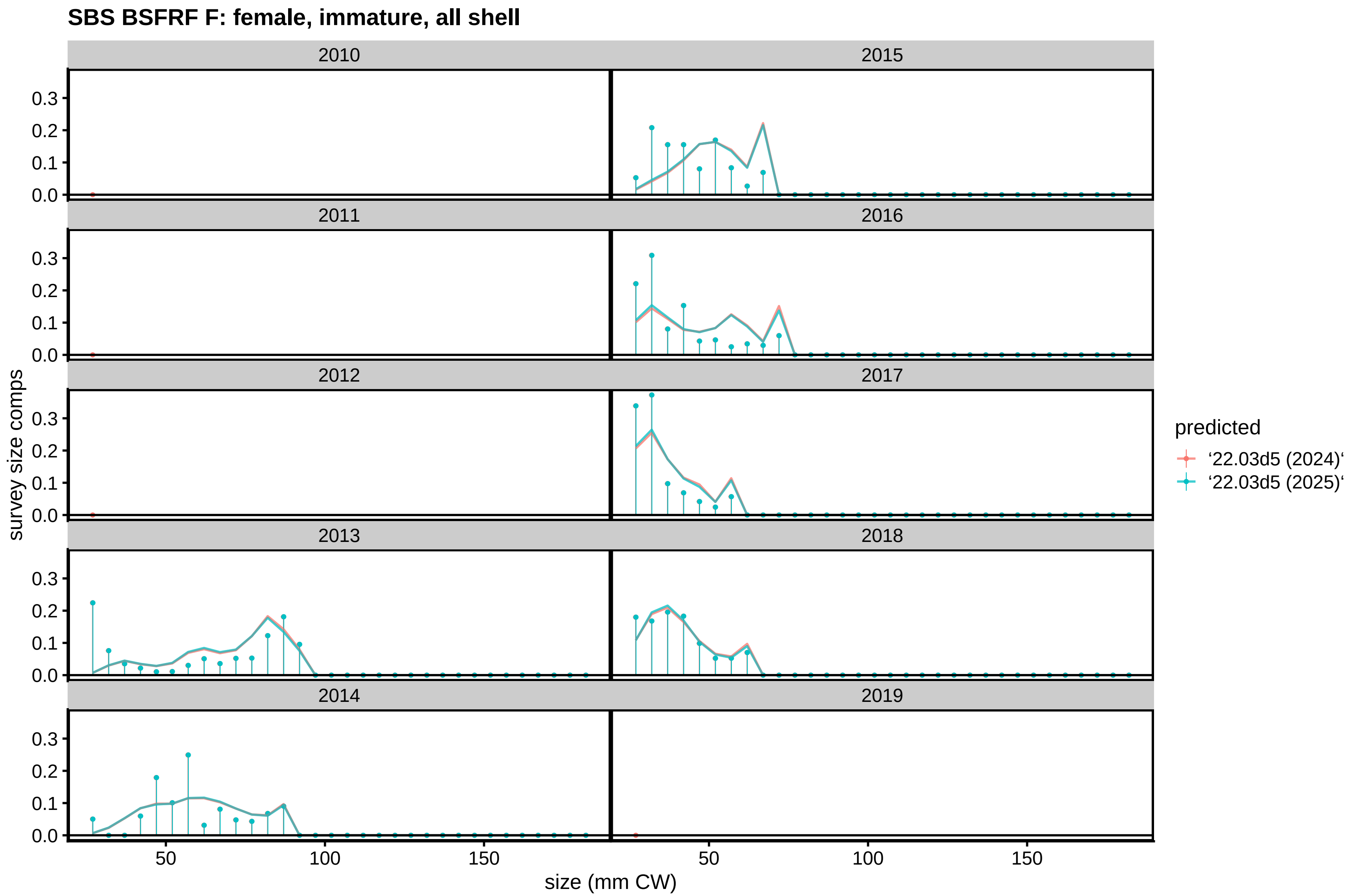


Figure 146. Fits to survey size compositions in the SBS BSFRF F survey. The base/preferred model is 22.03d5.

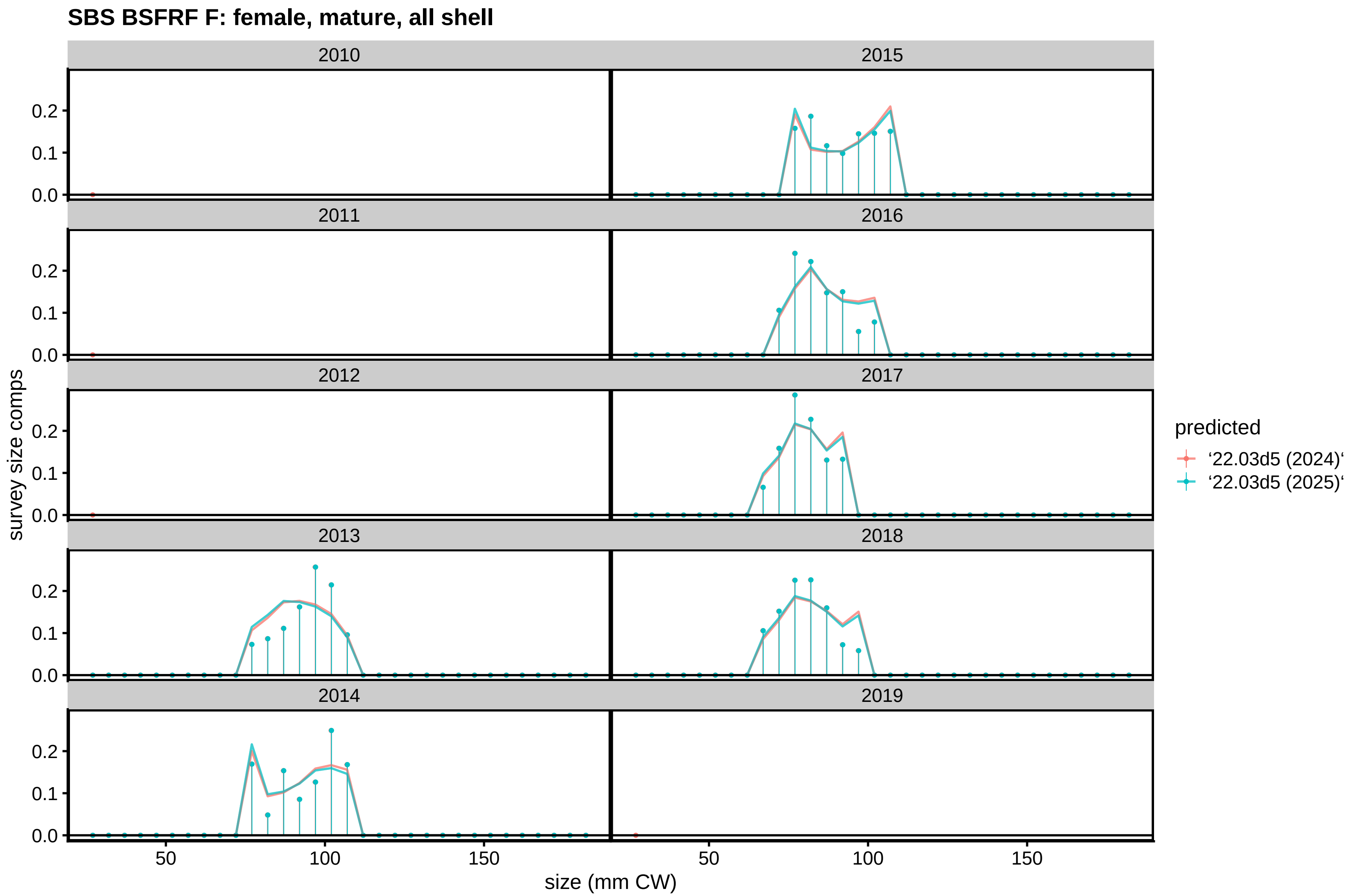


Figure 147. Fits to survey size compositions in the SBS BSFRF F survey. The base/preferred model is 22.03d5.

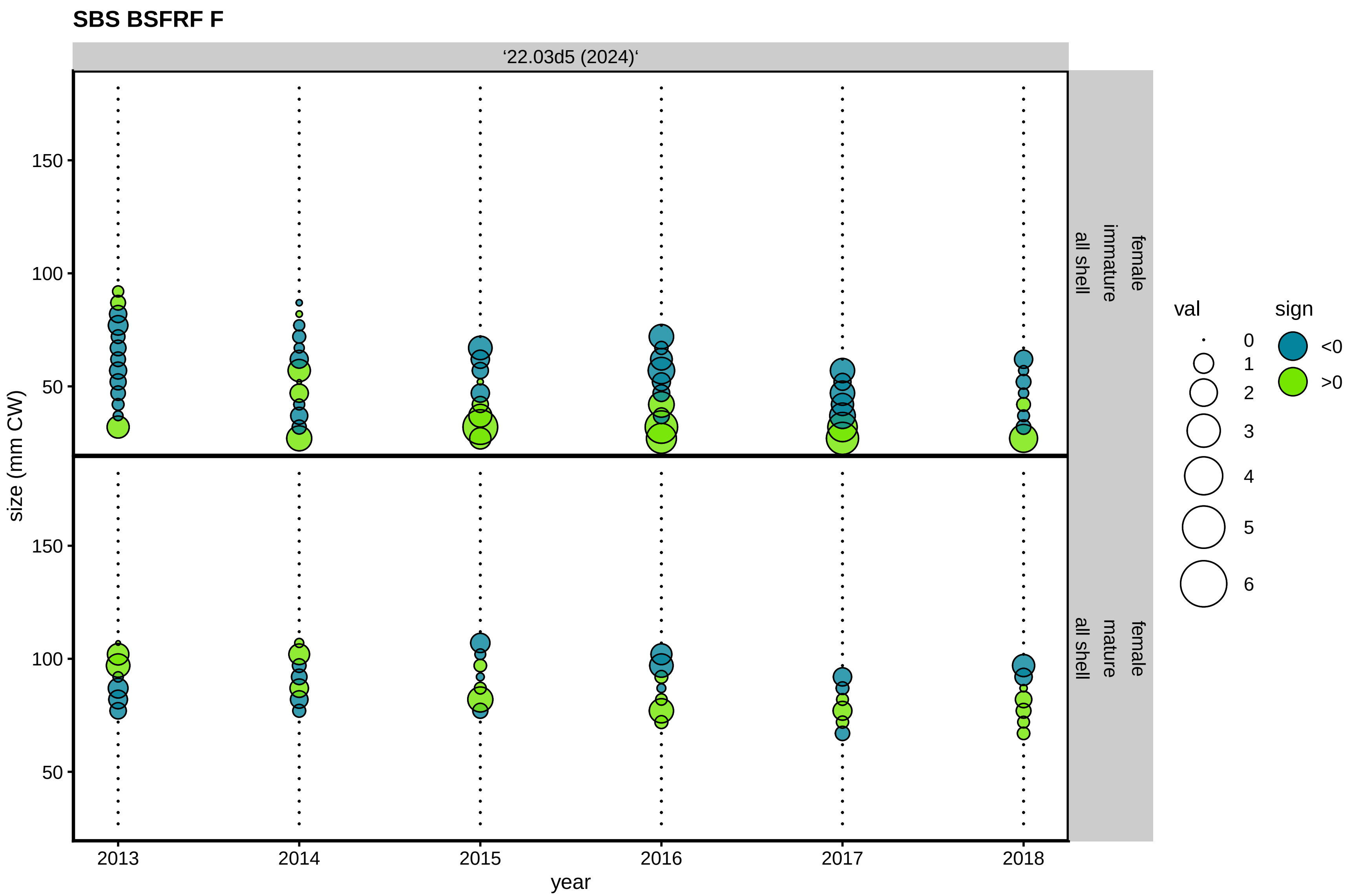


Figure 148. Pearson's residuals for fits to survey size composition in the BSFRF_F survey.Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

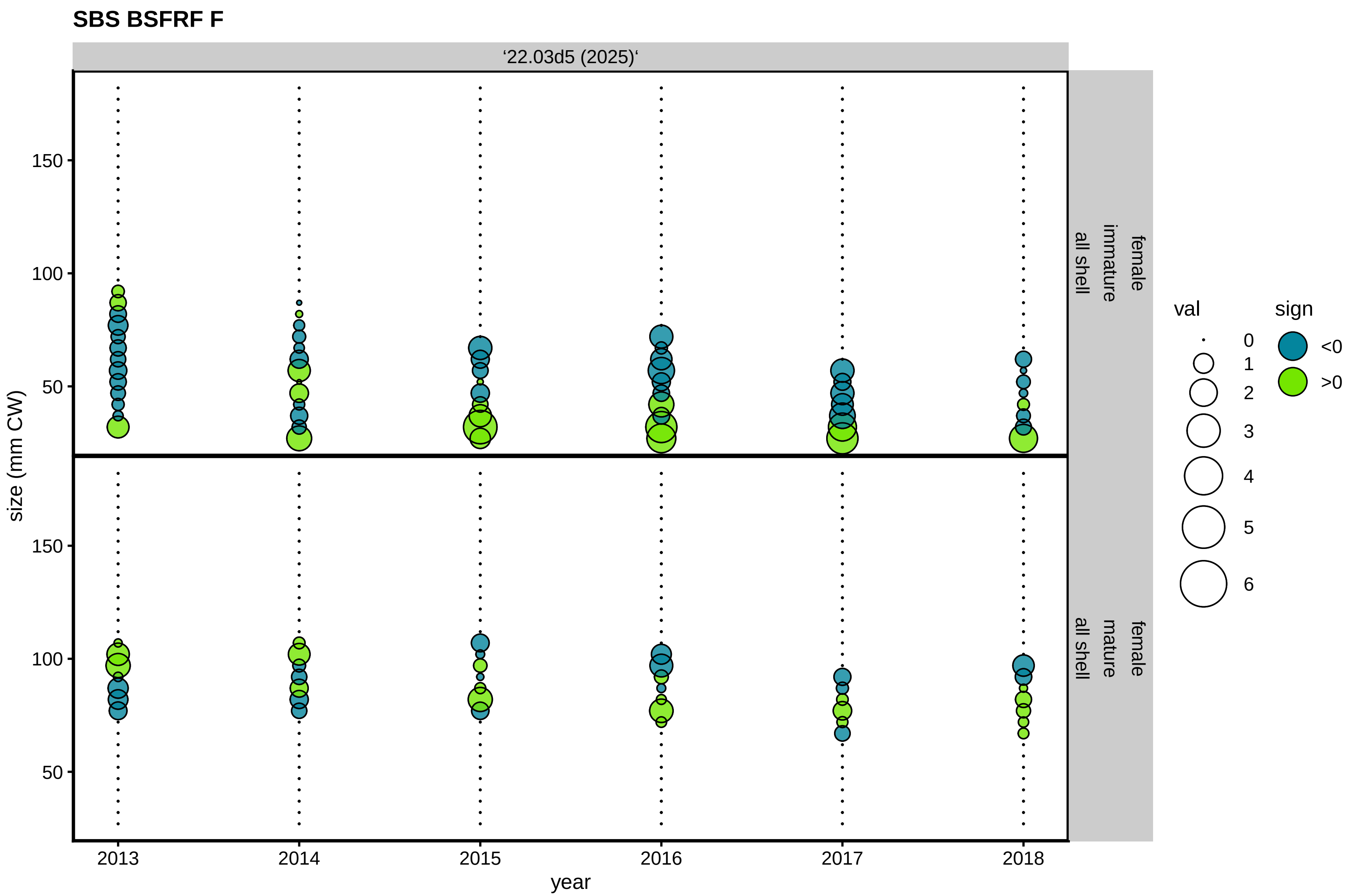


Figure 149. Pearson's residuals for fits to survey size composition in the BSFRF_F survey.Symbol areas reflect the size of each residual, extreme values (residuals larger than 4 in scale) are indicated with a red 'X'to facilitate identification.

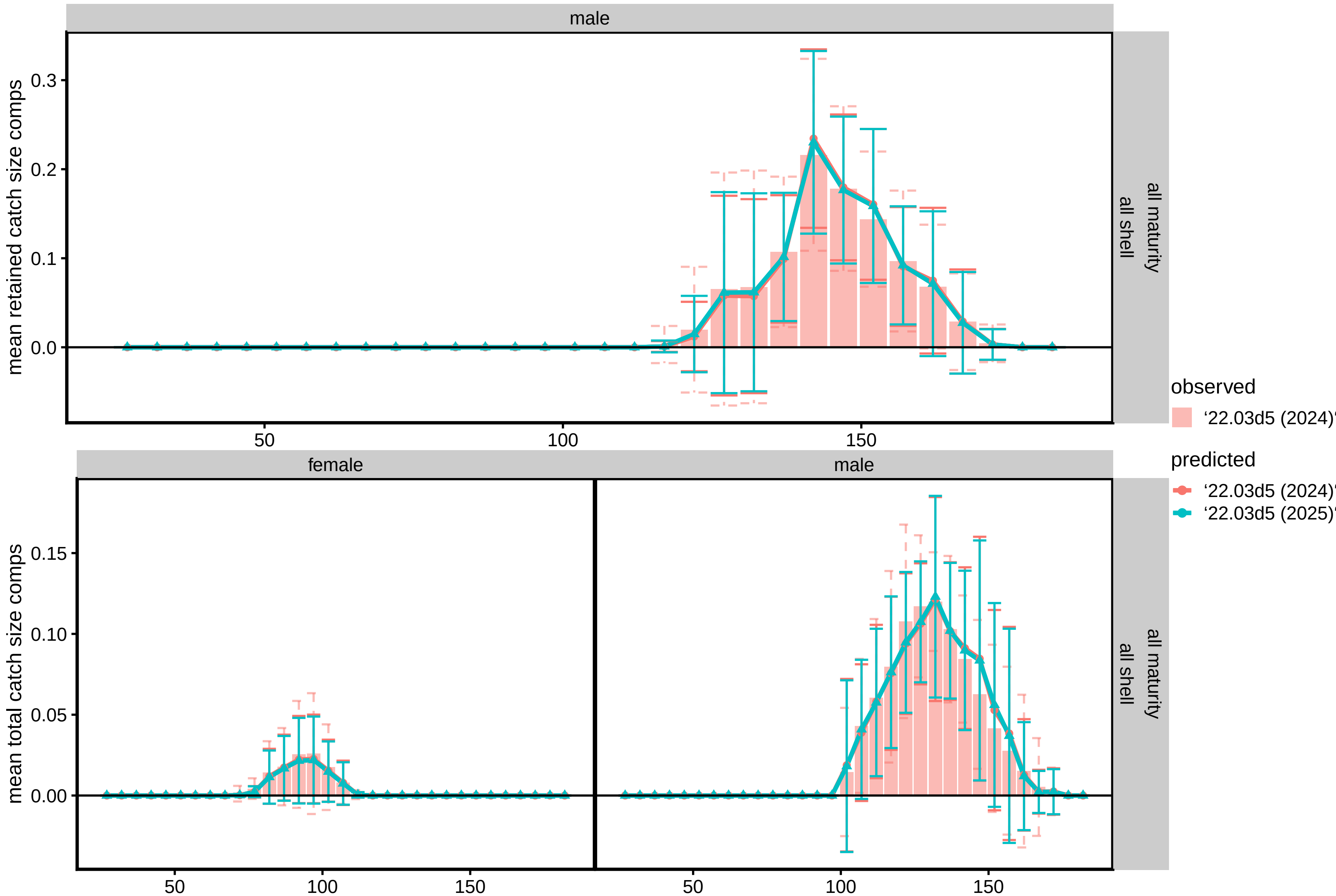


Figure 150. TCSAM02 models fits to directed fishery mean size compositions. Upper plot: retained catch; lower plot: total catch. Model `22.03d5 (2025)` is the preferred model.

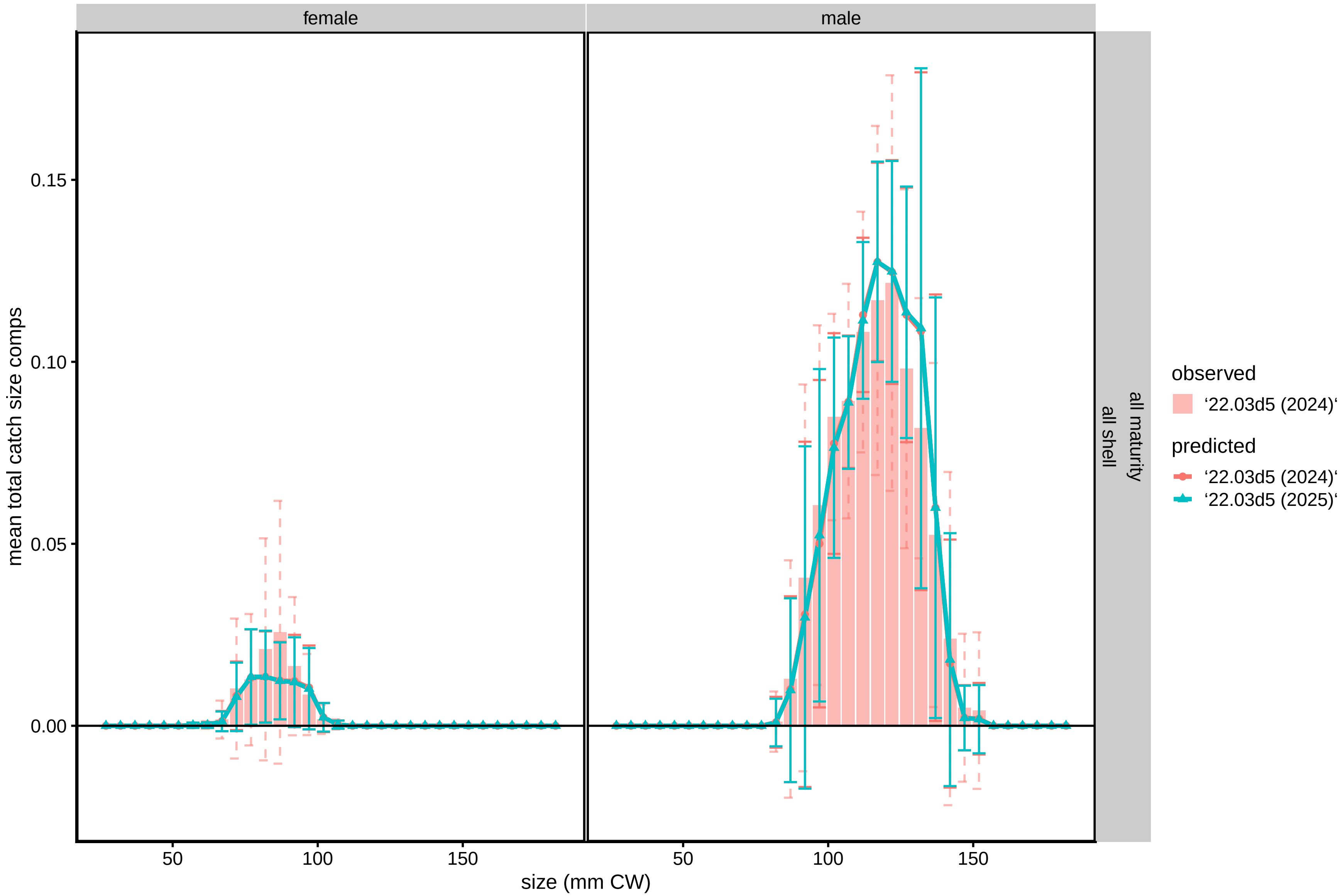


Figure 151. TCSAM02 models fits to mean bycatch size compositions from the snow crab fishery. Model `22.03d5 (2025)` is the preferred model.

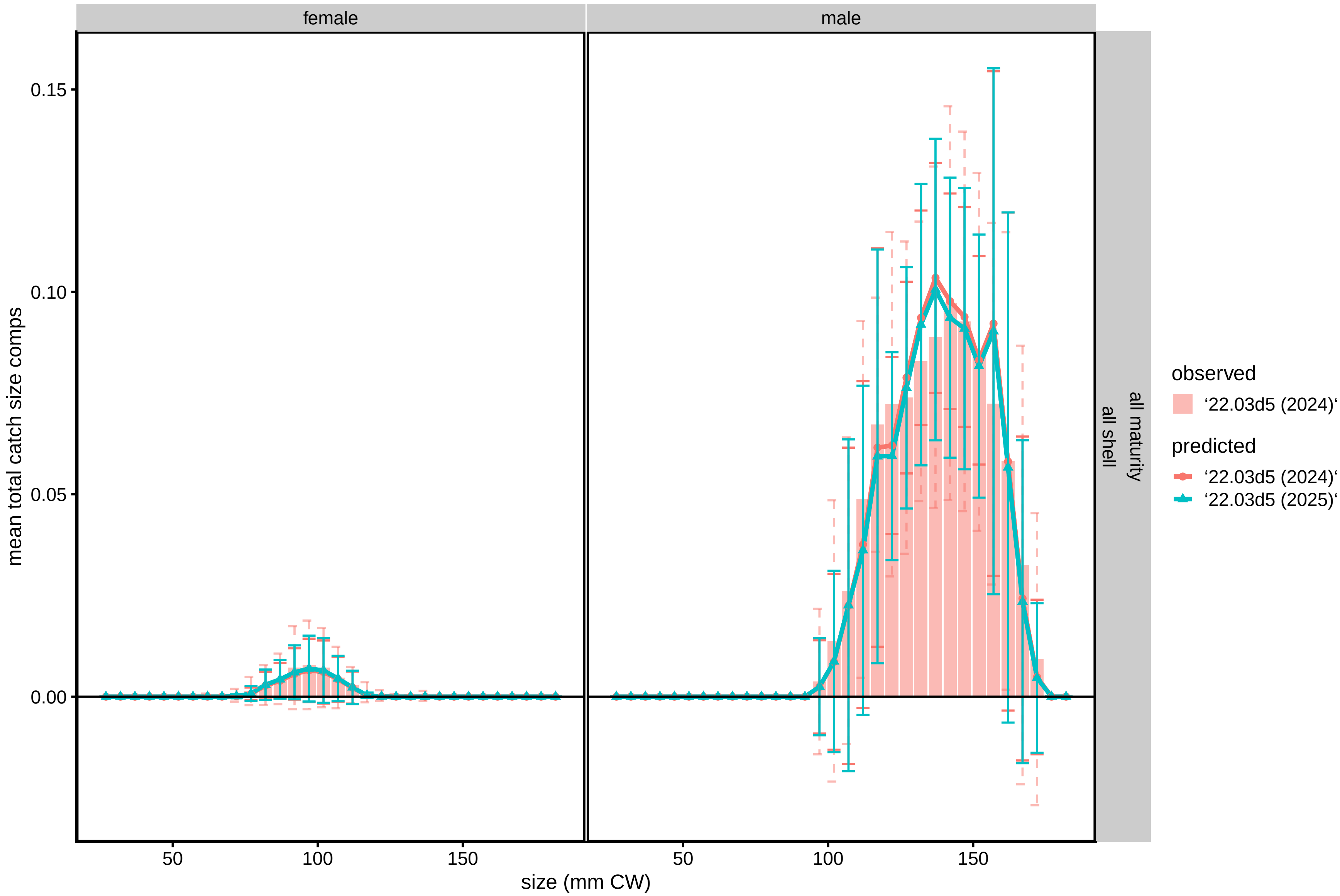


Figure 152. TCSAM02 models fits to mean bycatch size compositions from the BBRKC fishery. Model `22.03d5 (2025)` is the preferred model.

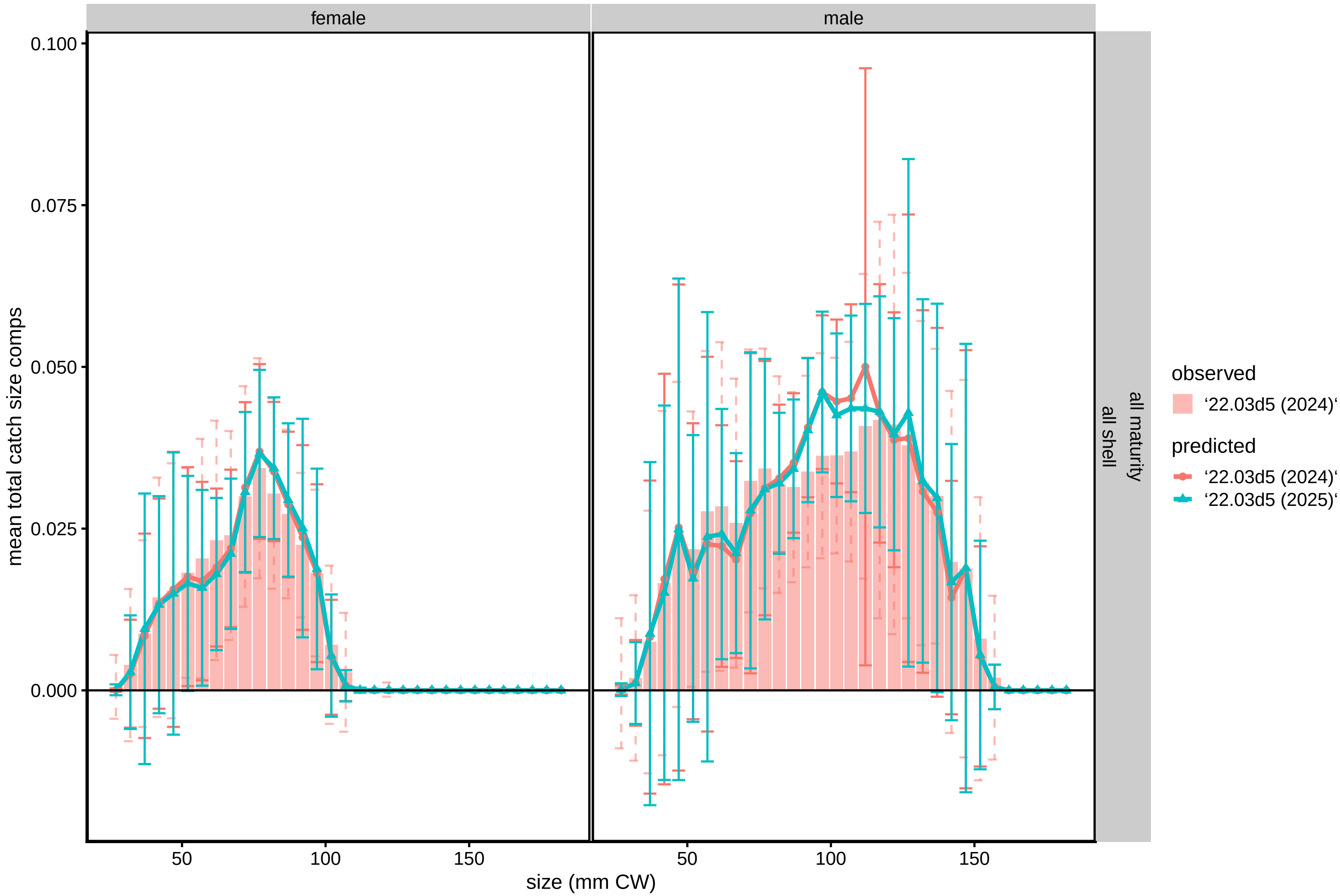


Figure 153. TCSAM02 models fits to mean bycatch size compositions from the groundfish fisheries. The total catch size compositions were normalized similarly for all model scenarios. Model `22.03d5 (2025)` is the preferred model.

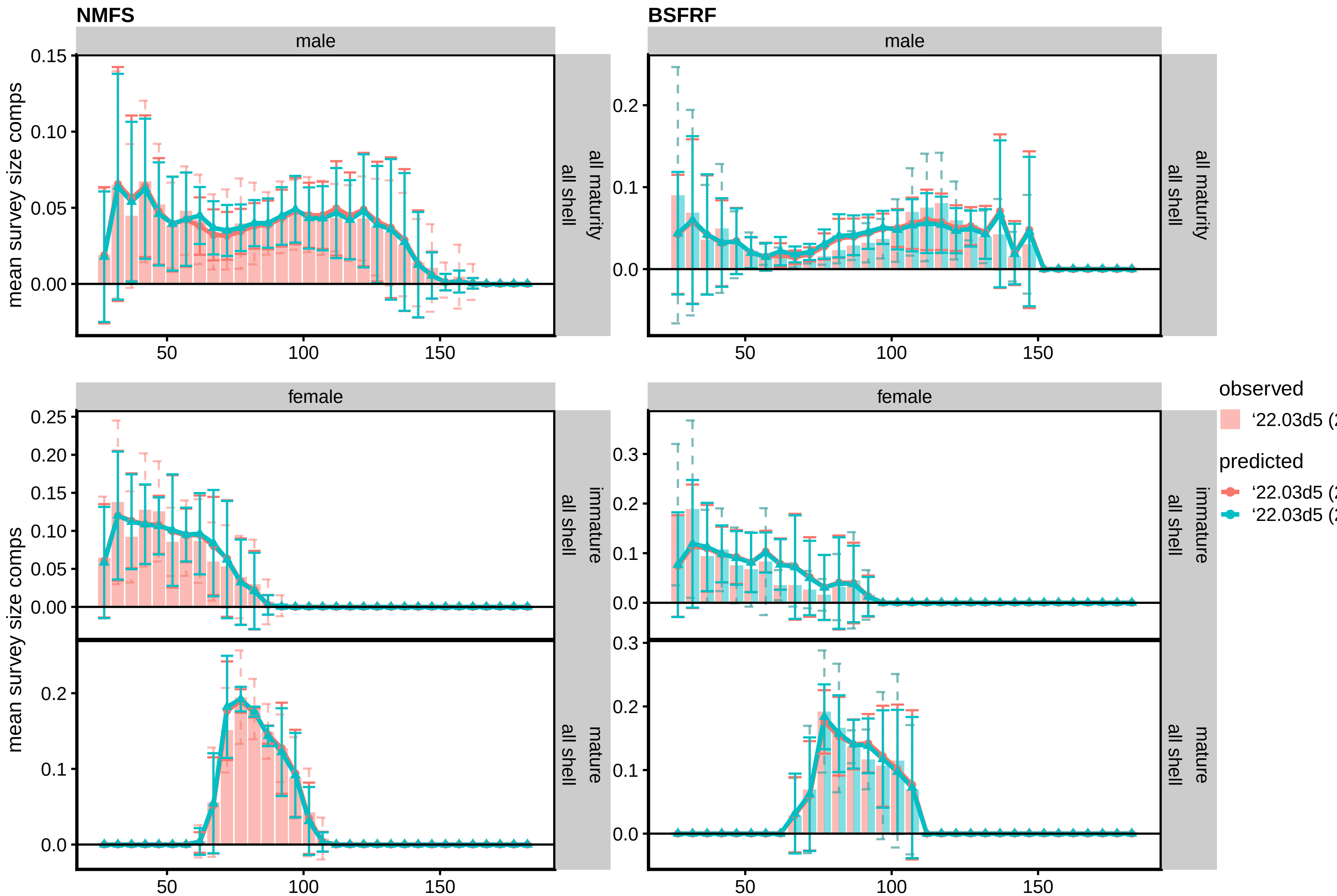


Figure 154. TCSAM02 models fits to mean survey size compositions from the NMFS EBS (left column) and BSFRF SBS (right column) surveys. The total catch size compositions were normalized similarly for all model scenarios.

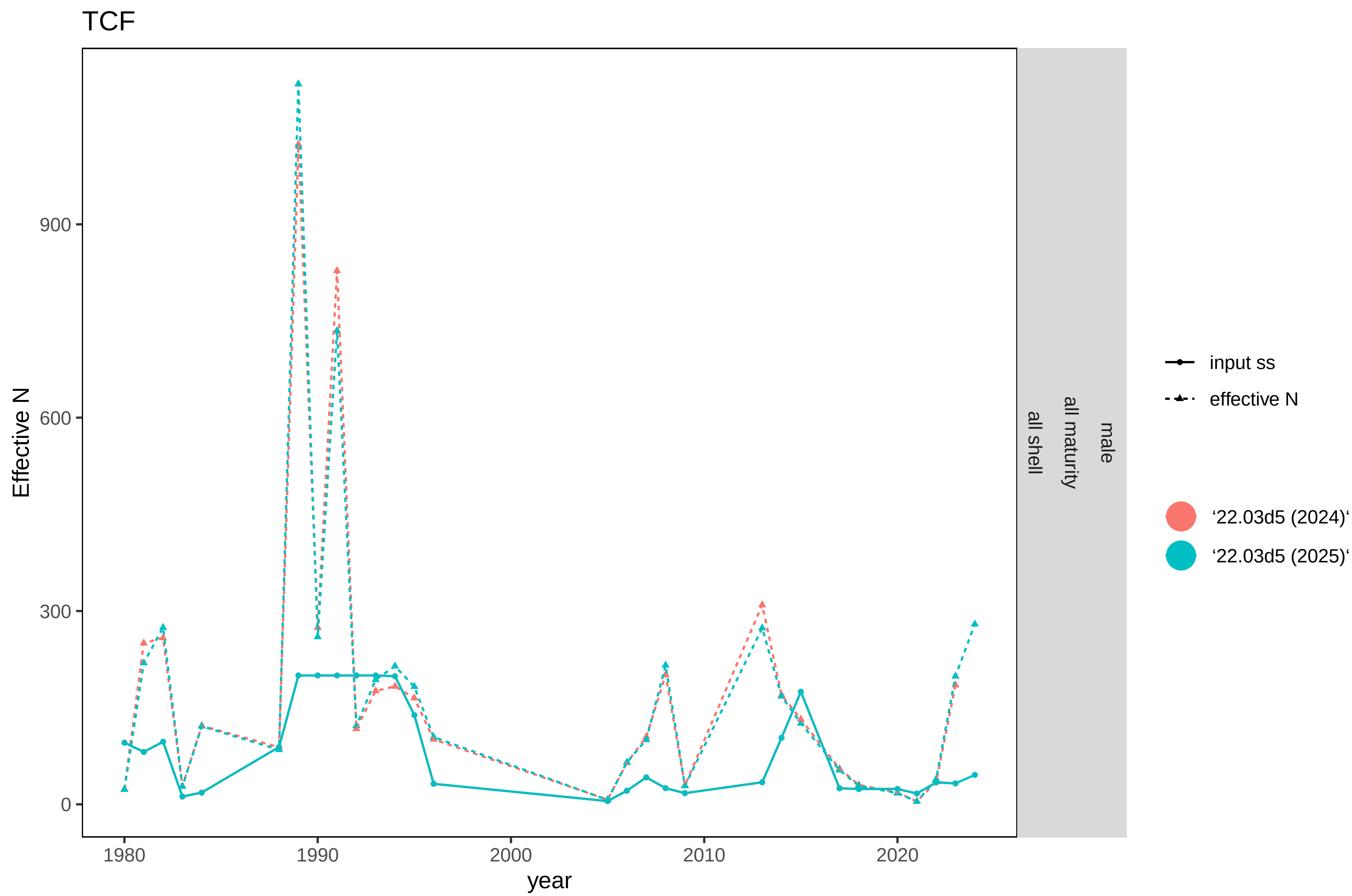


Figure 155. Effective sample sizes compared with input sample sizes for retained catch data. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are constrained to a maximum of 200. Model `22.03d5 (2025)` is the preferred model.

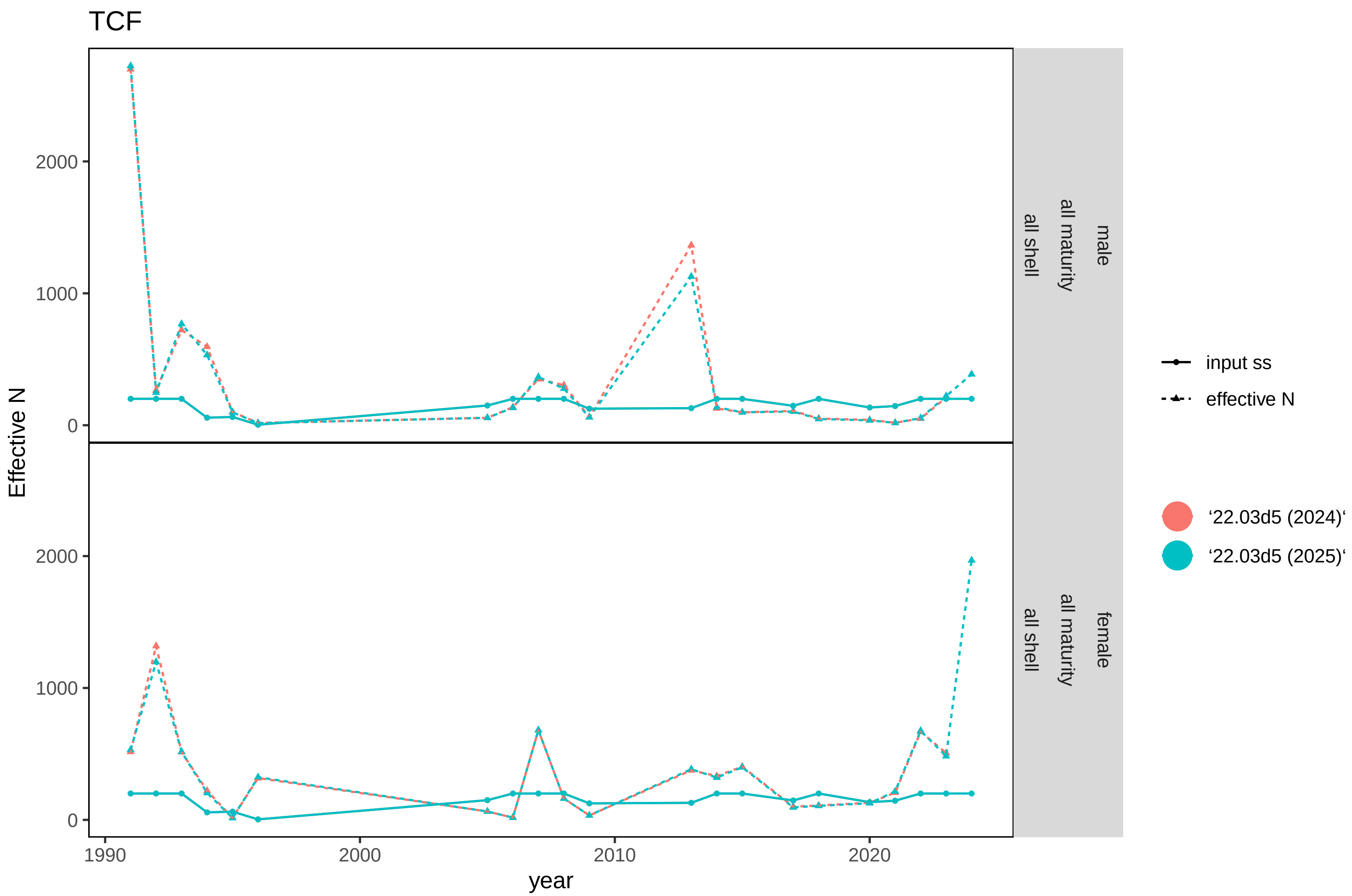


Figure 156. Effective sample sizes compared with input sample sizes for total catch data from the TCF fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories. Model `22.03d5 (2025)` is the preferred model.

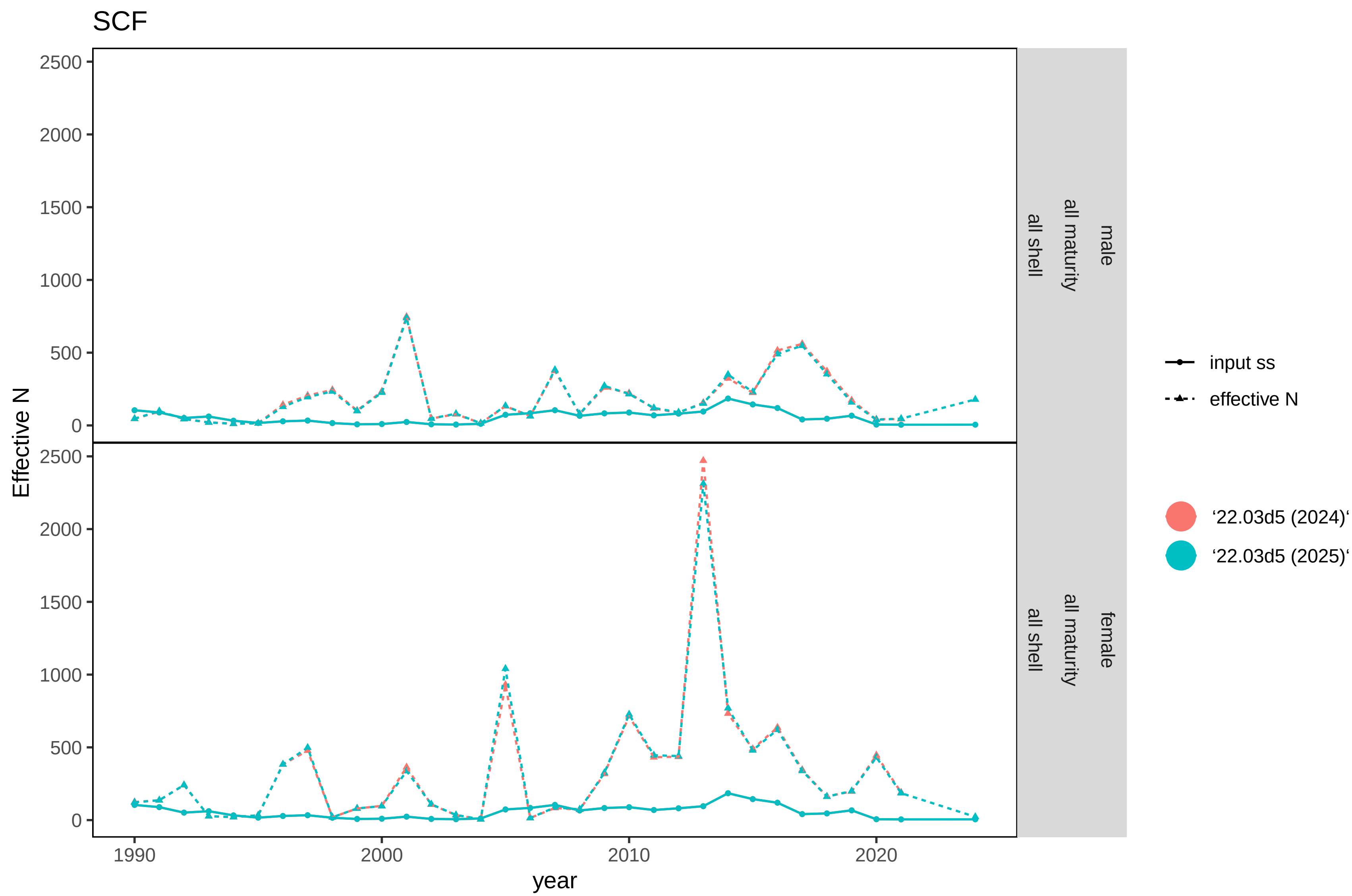


Figure 157. Effective sample sizes compared with input sample sizes for total catch data from the SCF fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories. Model `22.03d5 (2025)` is the preferred model.

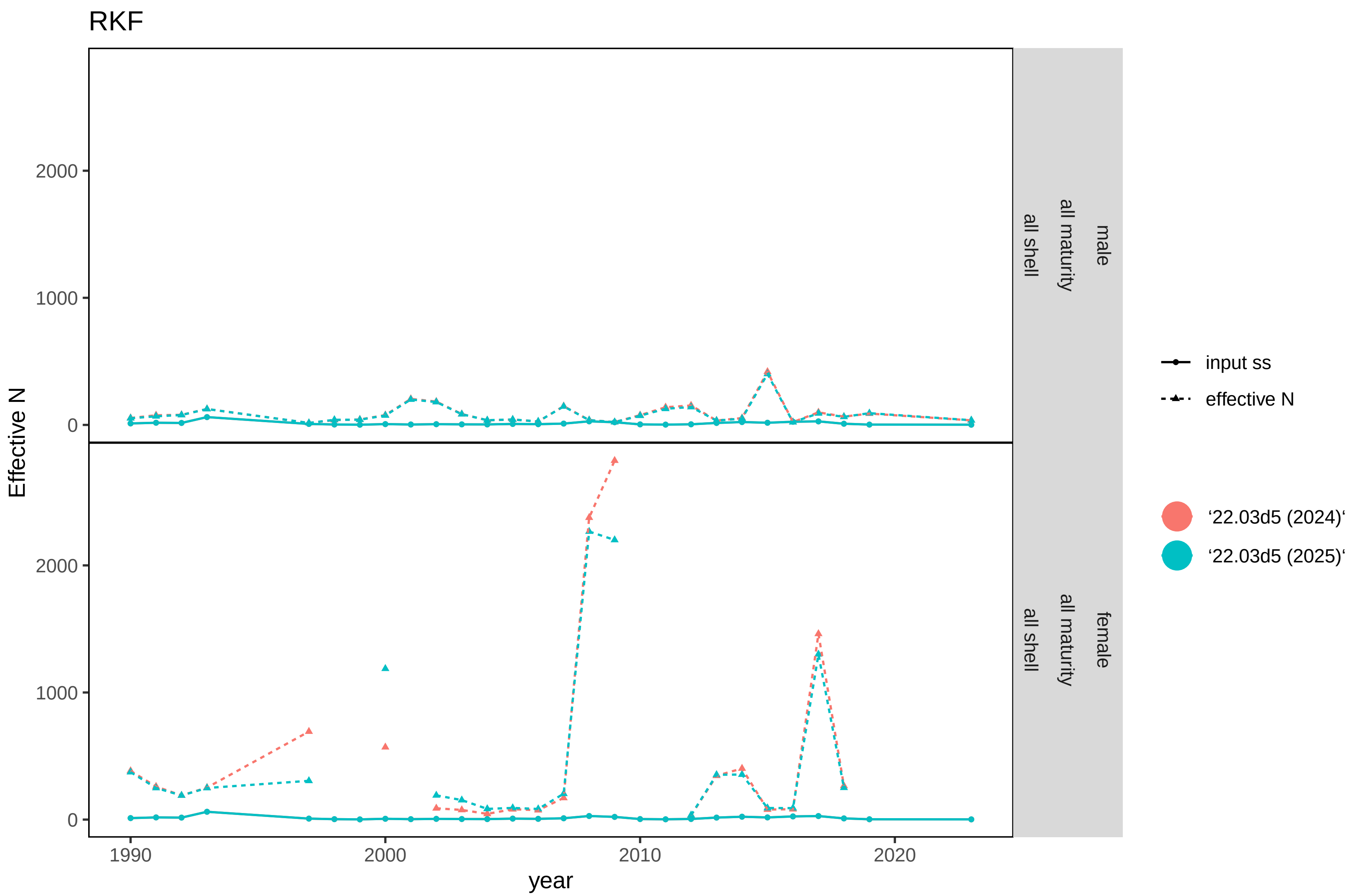


Figure 158. Effective sample sizes compared with input sample sizes for total catch data from the RKF fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories. Model `22.03d5 (2025)` is the preferred model.

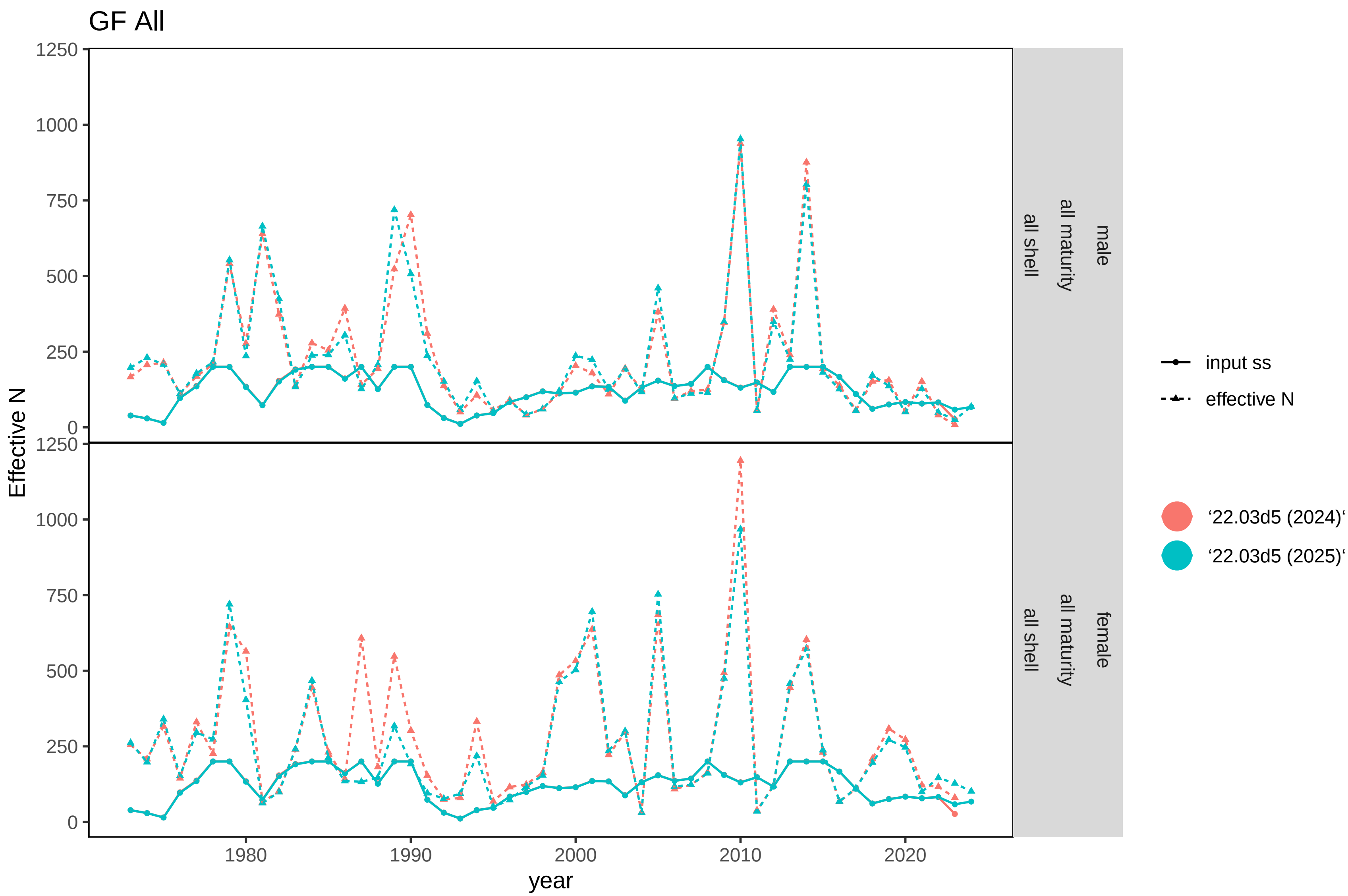


Figure 159. Effective sample sizes compared with input sample sizes for total catch data from the GF All fishery. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories. Model `22.03d5 (2025)` is the preferred model.

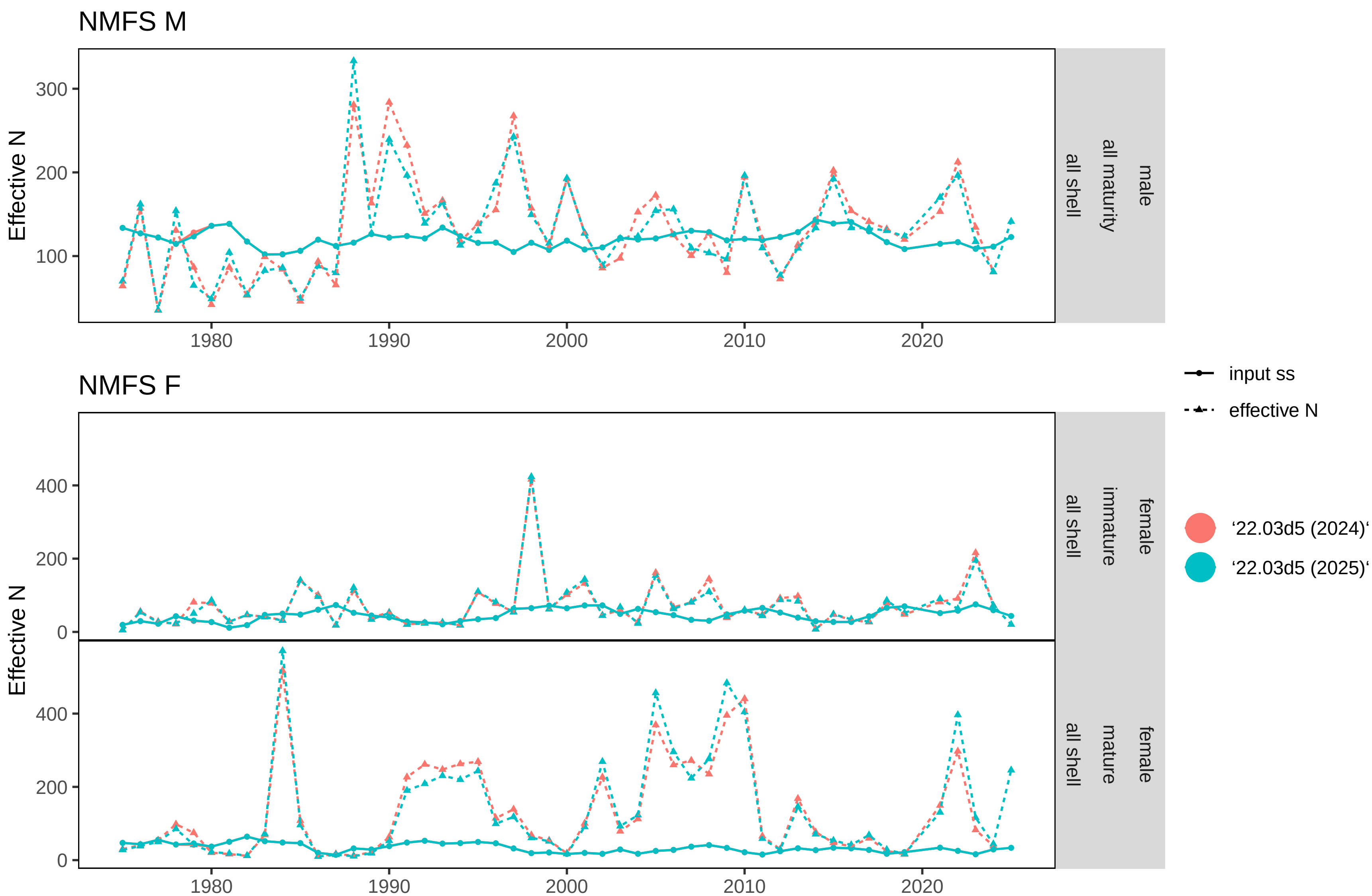


Figure 160. Effective sample sizes compared with input sample sizes for NMFS survey data. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.

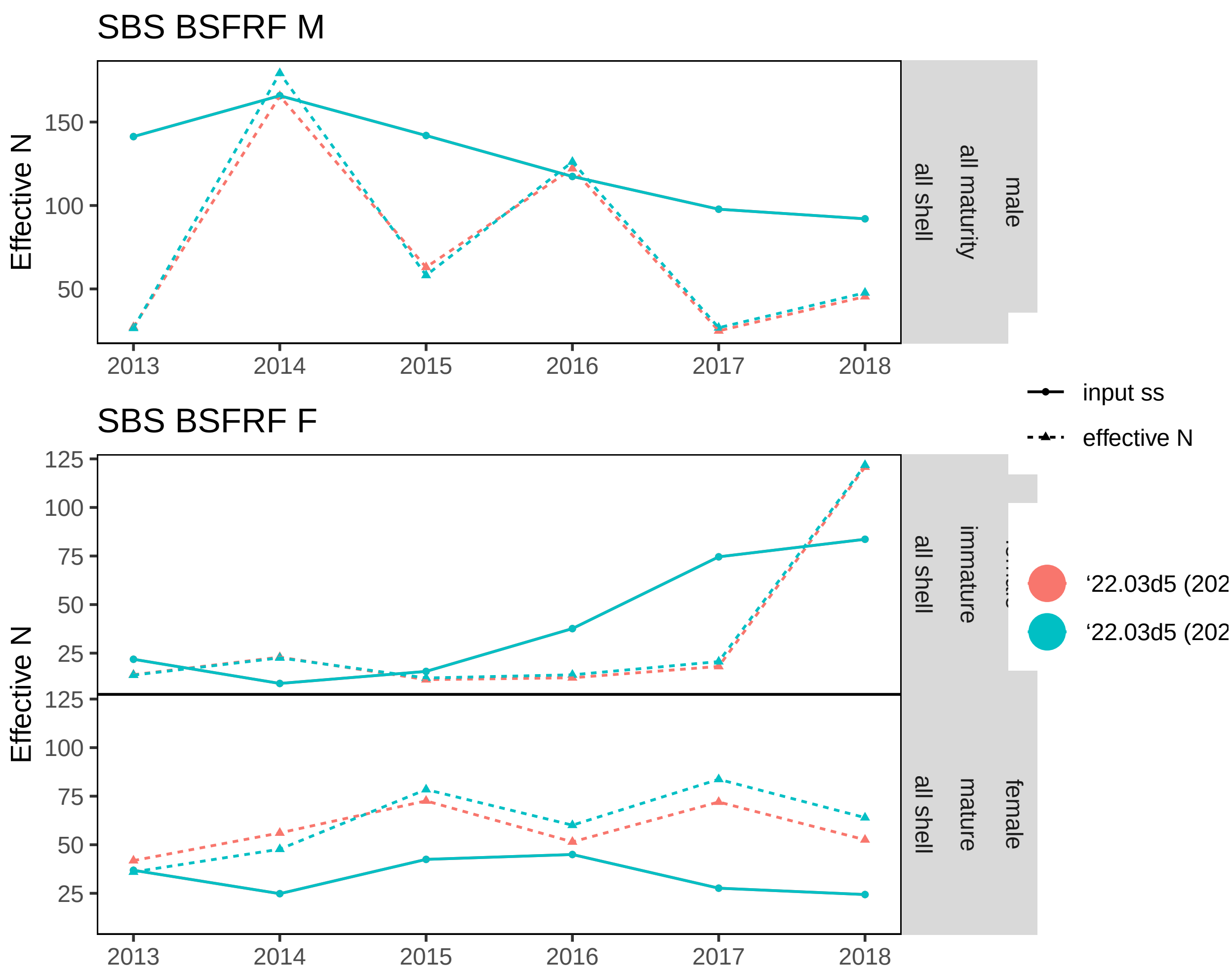


Figure 161. Effective sample sizes compared with input sample sizes for the BSFRF survey data. Dotted lines are effective N's, solid lines are input sample sizes. Input sample sizes are scaled to sum to 200 in each year across categories.

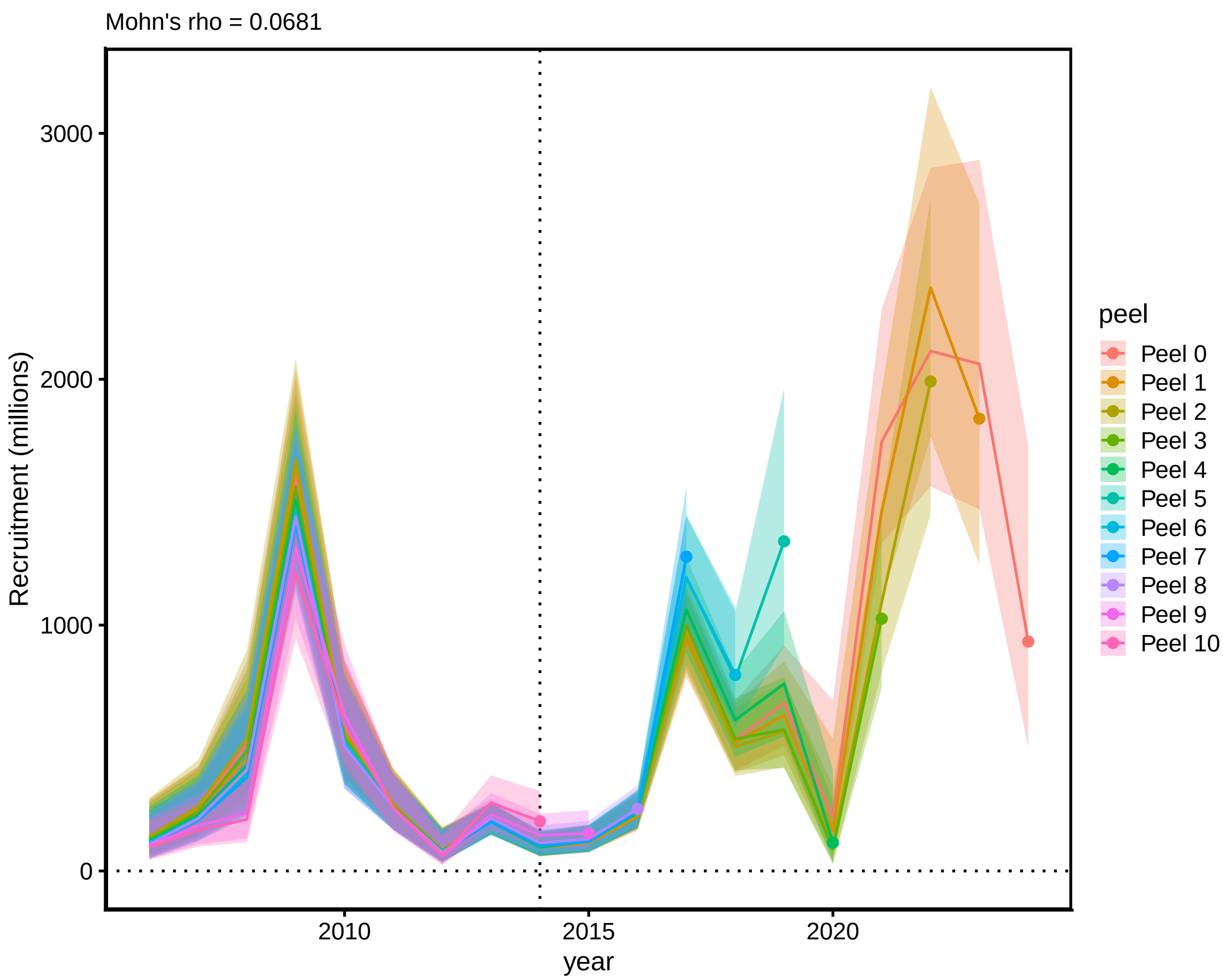


Figure 162. Retrospective analysis for recruitment time series, with Mohn's rho value (0.0681). Each “peel” represents results from the model run with that number of years of data removed from the complete data series. Lines: estimates; fills: 80% confidence intervals; points: end point of estimated time series for each peel.

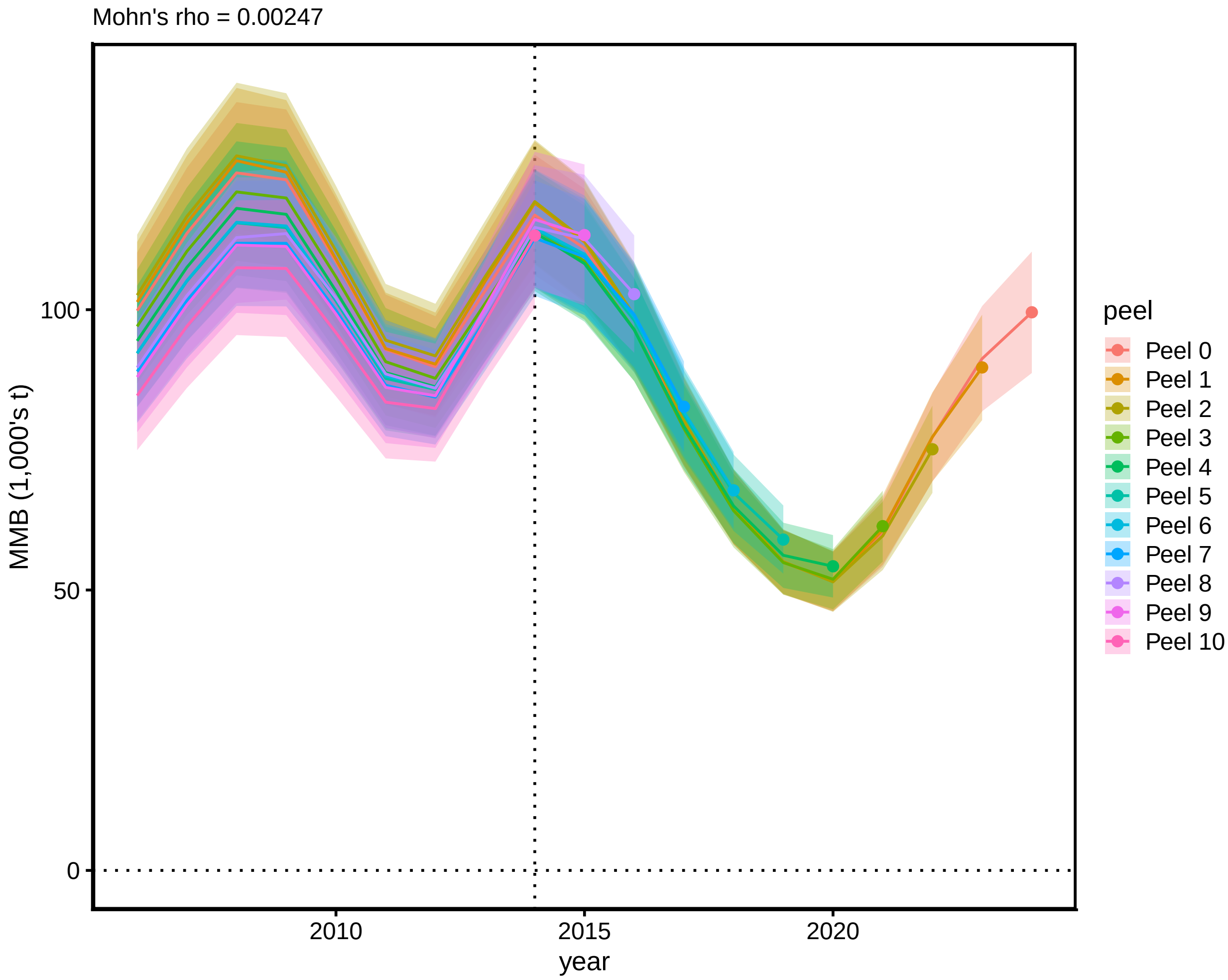


Figure 163. Retrospective analysis for mature male biomass time series, with Mohn's rho value (0.00247). Each “peel” represents results from the model run with that number of years of data removed from the complete data series. Lines: estimates; fills: 80% confidence intervals; points: end point of estimated time series for each peel.

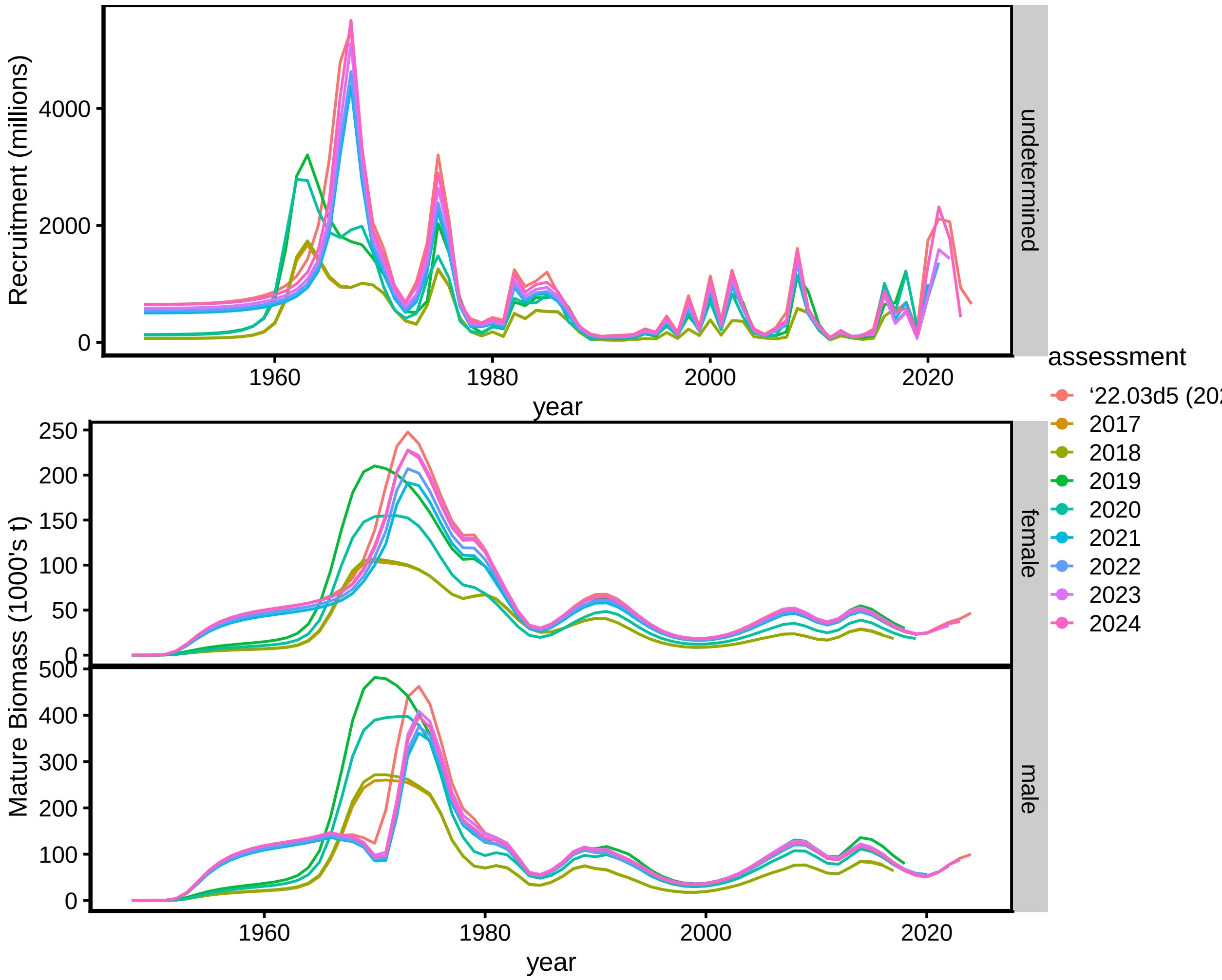


Figure 164. Comparison of estimated recruitment (upper plot) and mature biomass (lower plot) for the full model time period from the preferred model and previous assessments.

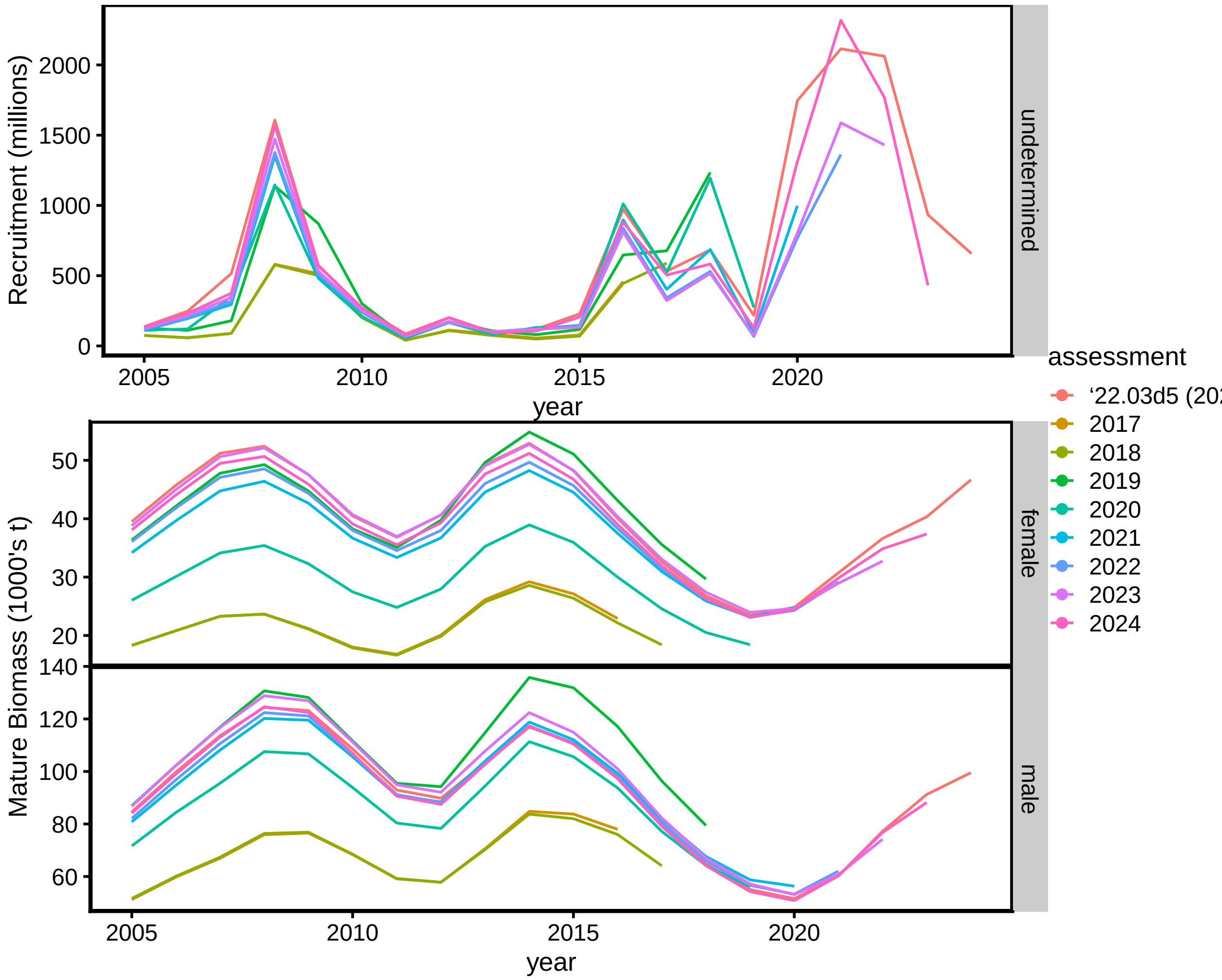


Figure 165. Comparison of estimated recruitment (upper plot) and mature biomass (lower plot) for the last 20 years from the preferred model and previous assessments.

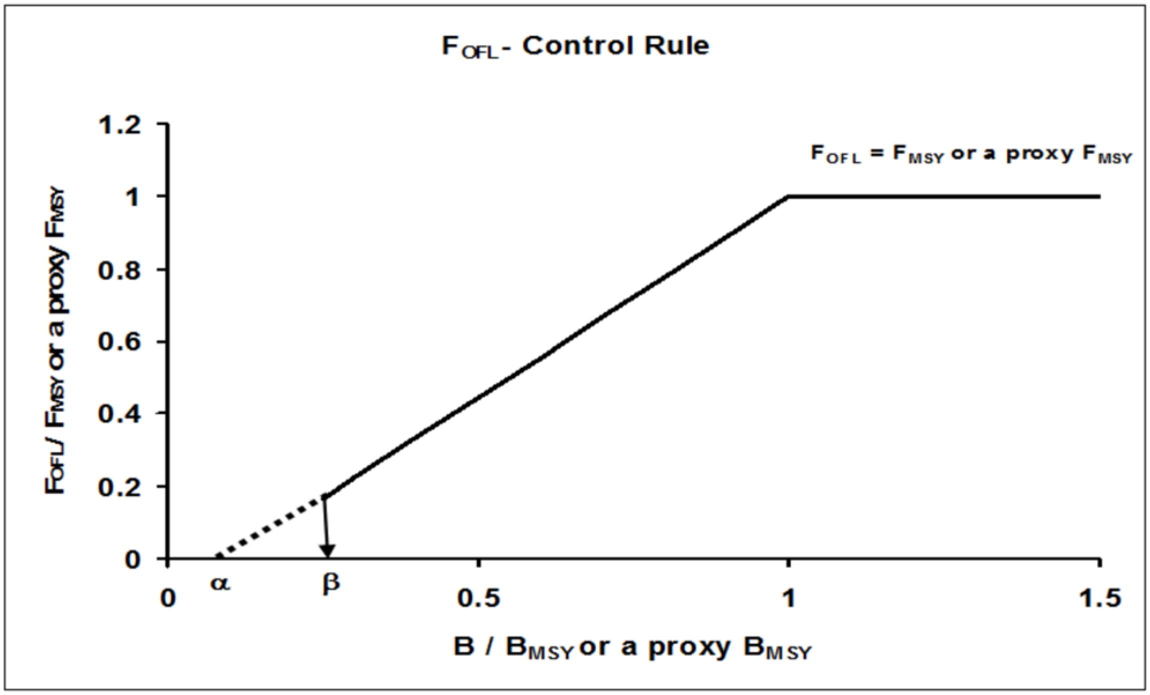
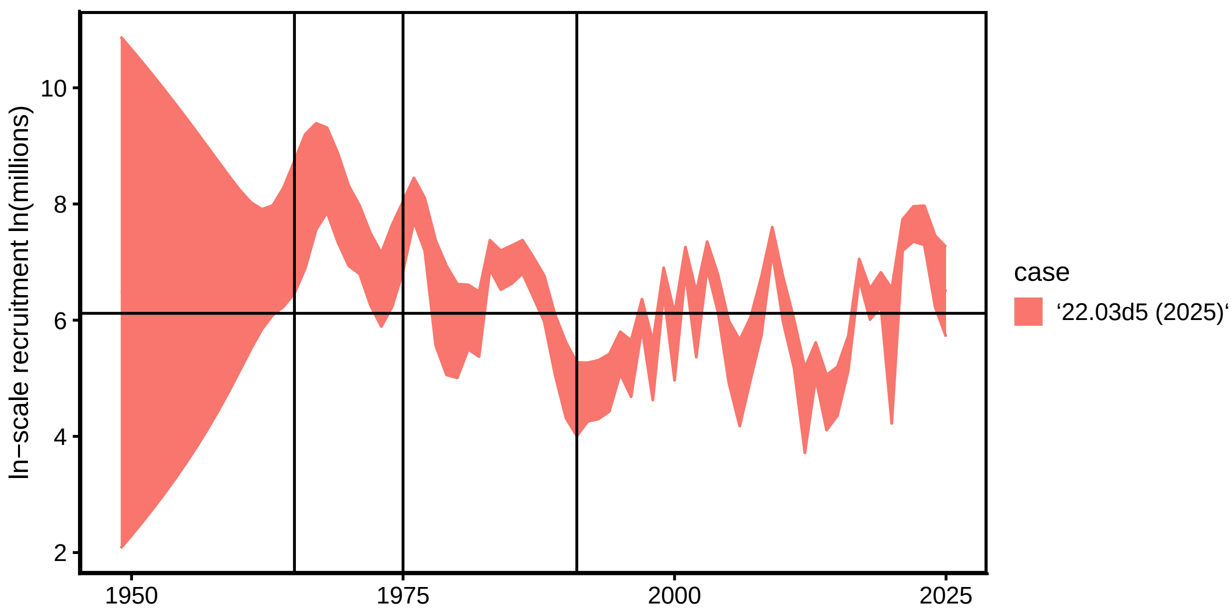


Figure 166. The F_{OFL} control rule.



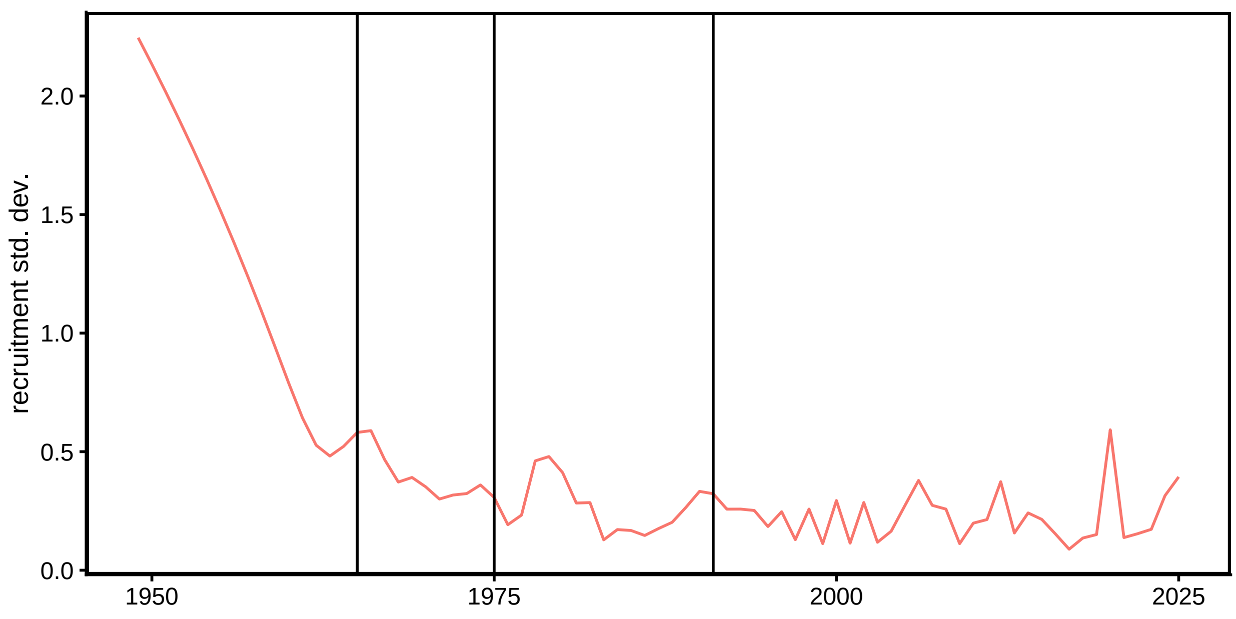


Figure 167. Upper plot: Time series of the estimated ln-scale recruitment, with 95% confidence intervals from the author's preferred model `22.03d5 (2025)`. Lower plot: time series of the estimated standard deviation for the ln-scale mean recruitment parameter from the author's preferred model `22.03d5 (2025)`. Vertical lines indicate 1965, 1975, and 1991.

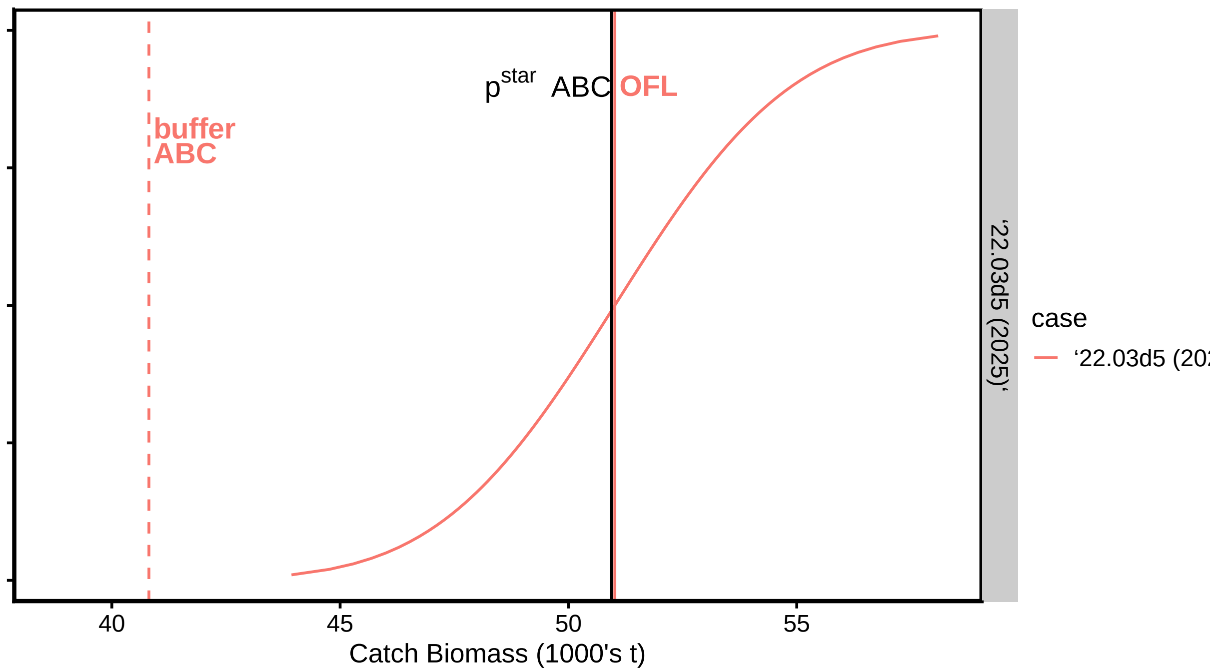


Figure 168. OFL and ABCs for the author's preferred model, `22.03d5 (2025)`

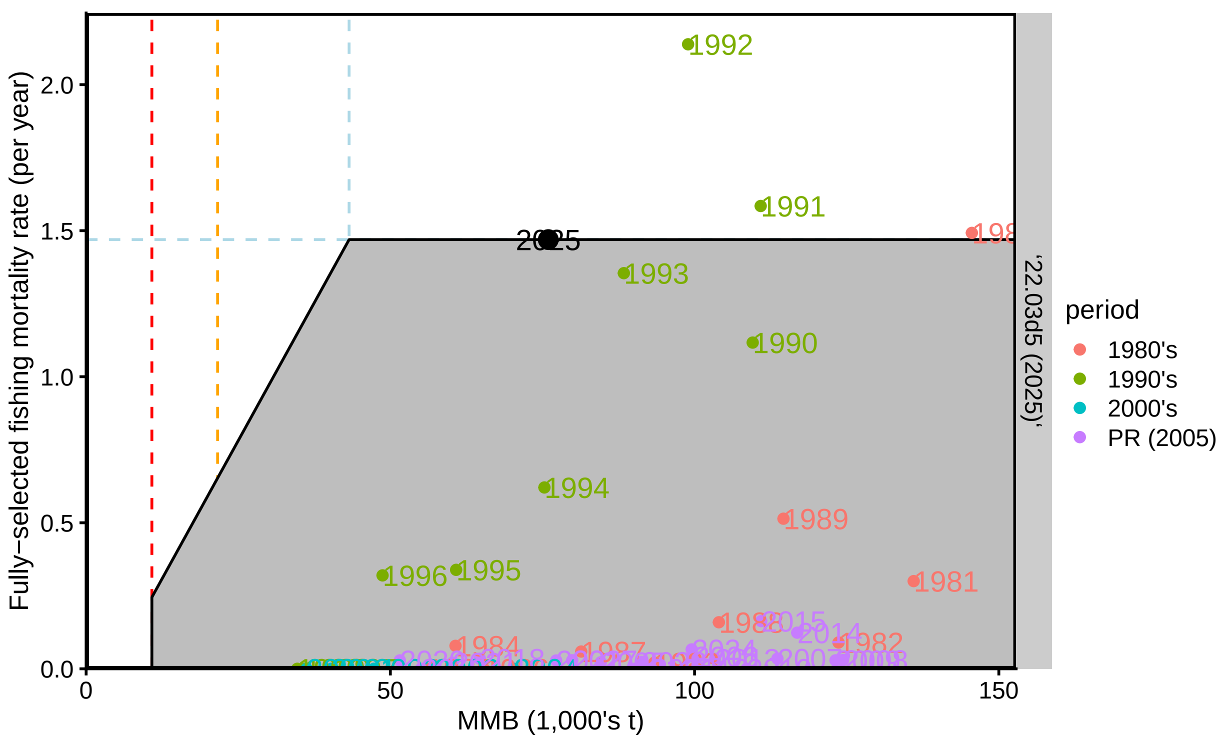


Figure 169. Quad plot for the author's preferred model, `22.03d5 (2025)`. Estimated values are shown starting in 1980. The value for 2025 assumes the OFL is taken in the upcoming fishing season. Colors refer to different time periods (PR: post-rationalization). Vertical dashed lines indicate: red–β; orange–MSST; blue–B_{MSY}. Horizontal dashed line indicates F_{MSY}.

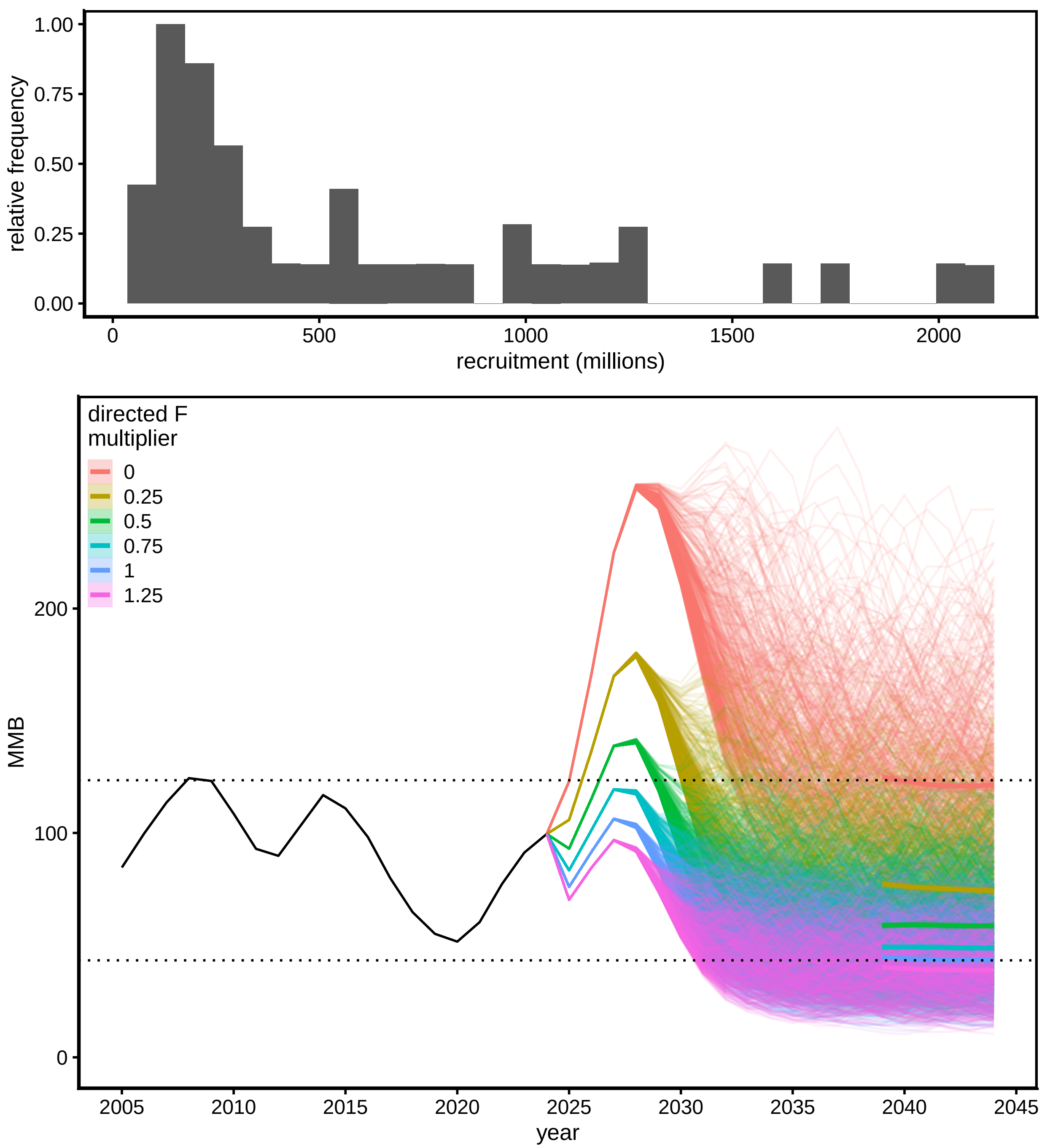


Figure 170. Multi-year projections using the preferred model, `22.03d5 (2025)` under a range of directed F multipliers using randomly-resampled recruitment values. Upper plot: histogram of randomly-resampled recruitments. Lower plot: projected MMB trajectories under different F scenarios (colored lines); black line: ML estimate of MMB time series up to 2024/25 upper dotted line: expected mean unfished MMB (B_{100}), lower dotted line: $B_{MSY} = B_{35}$, thick colored lines at righthand side: scenario-specific annual means (last 5 years).

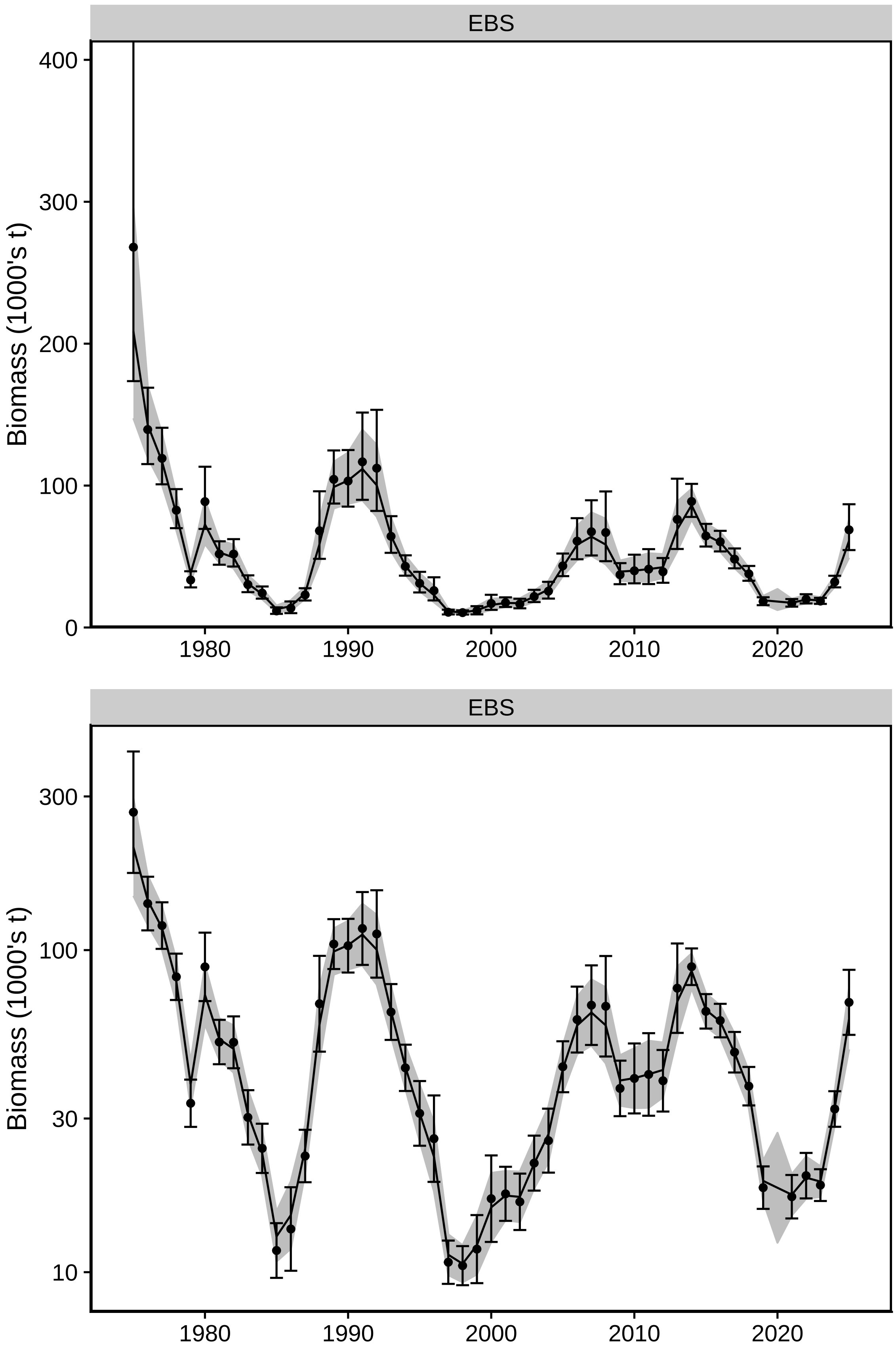


Figure 171. Estimated time series for vulnerable male biomass from the NMFS EBS shelf survey: 1) design based estimates (circles) and 80% lognormal confidence intervals (vertical bars); 2) random walk model-estimated time series (line) and 80% confidence intervals (shading). Upper plot: y-axis on arithmetic scale; lower plot: y-axis on log-scale.

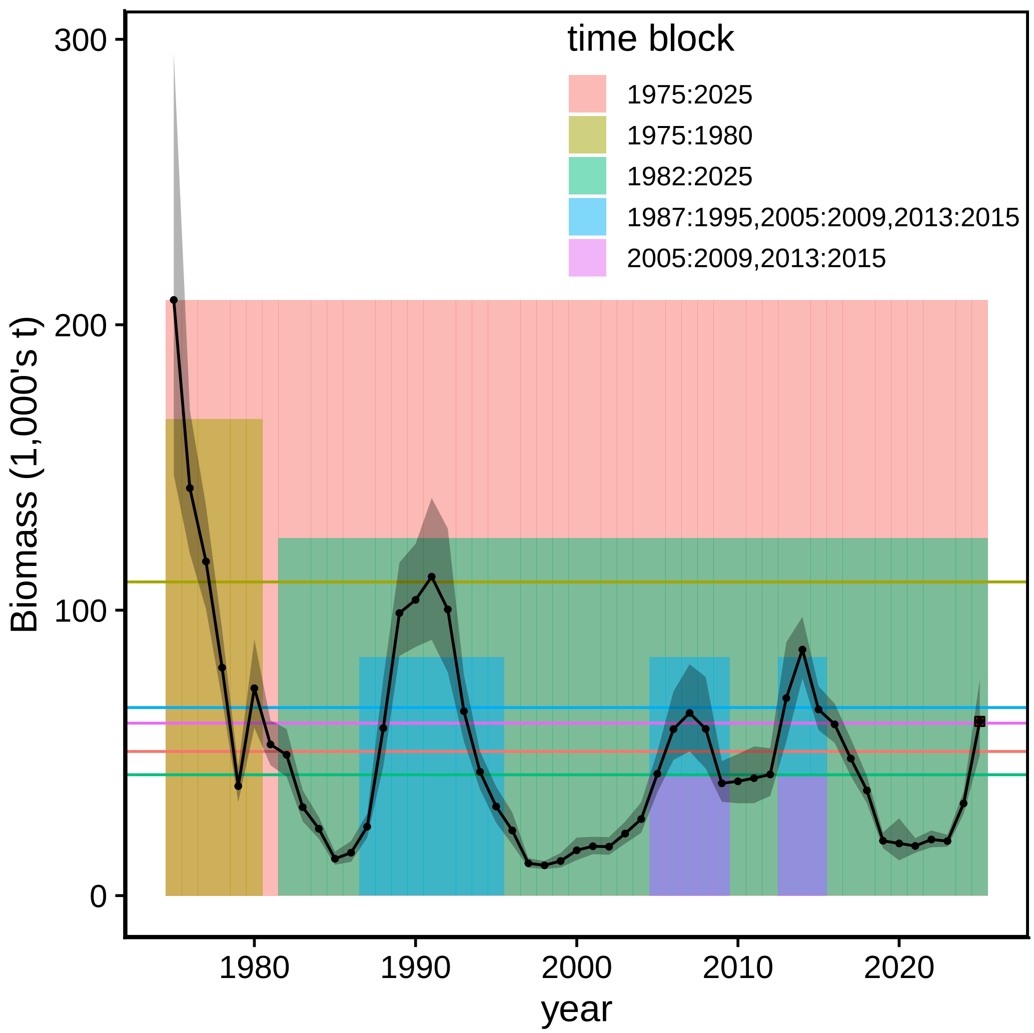


Figure 172. B_{MSY} proxies for different averaging time blocks. REMA-estimated vulnerable male biomass time series: black line and points (estimates), grey shading (80% confidence intervals). Colored rectangles indicate averaging time periods. Colored horizontal colored lines indicate resulting B_{MSY} proxy value.