Tanner Crab Appendix B: Scope of the 2022 Revision of Crab Bycatch in the Groundfish Fisheries on Tanner Crab and PIBKC

William T. Stockhausen (AFSC, NMFS)

07 May, 2022

Contents

Introduction

In 2022, the National Marine Fisheries Service Alaska Regional Office (AKRO) changed the way it calculated crab bycatch to better account for unspeciated king and *Chionoecetes* (Tanner and snow) crab, correct an error in an extrapolation method, and improve the logic used to identify fishing trips. The changes were described on the AKFIN Stock Assessment Portal (https://reports.psmfc.org/akfin/f?p=501:3000; accessed Apr 29, 2022) as:

> 2017 (calendar year) crab bycatch estimate data have been updated to reflect a number of improvements and corrections to the Catch Accounting System (CAS). Changes have not been applied to the 2016 and earlier estimates at this time. Changes to the later data include:
>
> 1) An error in an extrapolation method for the number of hooks on some observed hauls was corrected and data were updated. This error was not in CAS, but rather in the AFSC NORPAC database, but had downstream impacts in CAS.

2) Unidentified king and tanner crab for all gear types were speciated using observer information. This update was only needed in situations on observed hauls/sets where no crab were speciated by the observer and, overall, was not a common occurrence. The speciation process looks for any records in the observer data for "King Crab Unidentified" or "Tanner Crab Unidentified" and splits the record into species based on the ratio of species within those groups using ratios derived from speciated observer data. The ratio is averaged over a 6 month period from the prior year (i.e, Jan-July, August-Dec) and applied to the unidentified crab for the same period in the current year.

3) Improvements to the logic in CAS used to identify fishing trips. This resulted in small impacts on estimates. Changes in estimates occur because trip-target is used in the post stratification processes used for estimation.

The changes were applied to CAS data starting with the 2017 calendar year; it is not possible to apply the changes to data earlier than 2017.

The purpose of this paper is to 1) document the changes to bycatch data for the Pribilof Islands blue king crab (PIBKC) and Eastern Bering Sea Tanner crab stocks and 2) determine the effects on the Tanner crab stock assessment by running the 2021 assessment model with the revised bycatch data.

Changes in bycatch estimates

PIBKC

The absolute scale of the bycatch estimates for PIBKC is extremely small (< 0.6 t), so although the revised bycatch estimates differed by up to over 200% from the previous estimates, the absolute differences were less than 50 kg (Table 1, Figures 1-2).

Tanner crab

In contrast, because the absolute scale for the bycatch estimates for Tanner crab (~150 t for the entire EBS) is much larger than that for PIBKC, the relative differences were small ($< 3\%$ for the entire EBS) but the absolute differences were larger but still rather small (< 4 t; Table 2, Figures 3-4).

Changes in Tanner crab assessment model results

The 2021 Tanner crab assessment model, 21.22a, was re-run with the revised values for bycatch of Tanner crab in the groundfish fisheries. Th revision to the bycatch estimation is considered (by the author) a major change in the manner in which the input data to the assessment are calculated, even though the scale of the changes was relatively small for Tanner crab. Consequently, the re-run model with the revised data will be referred to as 22.01, to be consistent with SSC model naming conventions (Table 3). Given the relatively small changes between the old and revised values, both in absolute and percentage terms, the revised values were not expected to have a substantial effect on the assessment results. The model optimization for 22.01 was run using the final (i.e., maximum likelihood) parameter estimates from 21.22a. The revised model converged almost immediately to nearly identical parameter estimates, indicating that the revised bycatch values had no detectable

effect on the assessment. The almost immediate model convergence was a bit unexpected, but the changes to the bycatch estimates were much smaller than the assumed uncertainty associated with them (CV = 20%). Consequently, the model optimization criteria were satisfied within one or two iterations and the results were nearly identical to those from the 2021 assessment (Figures 5-14).

Conclusions

The changes in estimated bycatch of PIBKC and Tanner crab in the groundfish fisheries associated with recent changes in the algorithms used by the AKRO were small by either relative (Tanner crab) or absolute (both) measures. Furthermore, the changes had no discernible impact on results from the 2021 Tanner crab assessment model.

References

Stockhausen, W. 2021. 2021 Stock Assessment and Fishery Evaluation Report for the Pribilof Islands Blue King Crab Fisheries of the Bering Sea and Aleutian Islands Regions. In: Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands: 2021 Final Crab SAFE. North Pacific Fishery Management Council. Anchorage, AK. https://meetings.npfmc.org/CommentReview/DownloadFile?p=6b1606ce-3b55-4273-935a-8ec90b8d5295.pdf&fileName=5%20Priblof%20Island%20Blue%20King%20Crab%20SAFE.pdf

Stockhausen, W. 2021. 2021 Stock Assessment and Fishery Evaluation Report for the Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions. In: Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands: 2021 Final Crab SAFE. North Pacific Fishery Management Council. Anchorage, AK. https://meetings.npfmc.org/CommentReview/DownloadFile?p=acbf6b6c-18ba-4b1a-abb5-84a87cfbaea3.pdf&fileName=3%20Eastern%20Bering%20Sea%20Tanner%20Crab%20SAFE.pdf

List of Tables

List of Figures

Tables

Table 1: Comparison of original and revised estimates for PIBKC bycatch in the groundfish fisheries.

	Pribilof Islands			
	revised	original	abs. diff.	pct. diff.
year	t	t	t	percent
2017	0.38185	0.37815	0.00370	0.97855
2018	0.53662	0.48568	0.05094	10.48870
2019	0.54077	0.52692	0.01384	2.62676
2020	0.01933	0.00586	0.01347	229.84109
2021	0.00104	0.00040	0.00064	159.84259

Table 2: Comparison of original and revised estimates for Tanner crab bycatch in the groundfish fisheries.

	West 166W				East 166W				All EBS			
	revised	original	abs. diff.	pct. diff.	revised	original	abs. diff.	pct. diff.	revised	original	abs. diff.	pct. diff.
year	t	t	t	percent	t	t	t	percent	t	t	t	percent
2017	42.395	39.939	2.456	6.150	121.878	120.581	1.298	1.076	164.274	160.520	3.754	2.338
2018	47.530	45.493	2.037	4.476	131.378	130.756	0.622	0.476	178.908	176.249	2.659	1.509
2019	83.625	82.581	1.044	1.264	64.193	63.329	0.864	1.364	147.818	145.910	1.908	1.308
2020	48.468	47.719	0.749	1.569	76.578	76.169	0.410	0.538	125.047	123.888	1.158	0.935
2021	20.251	19.952	0.298	1.495	44.937	44.888	0.049	0.109	65.188	64.841	0.347	0.535

Table 3: Model descriptions relative to base model, with summary results.

model configuration	parent	changes	number of parameters	jitter runs	number at bounds	objective function value	max gradient	invertible for std. devs?
21.22a	--	--	346	--	0	3014.12	5.92E-04	yes
22.01	21.22a	using updated bycatch estimates for the groundfish fisheries used in place of old versions	346	--	0	3014.11	5.83E-04	yes

Figures

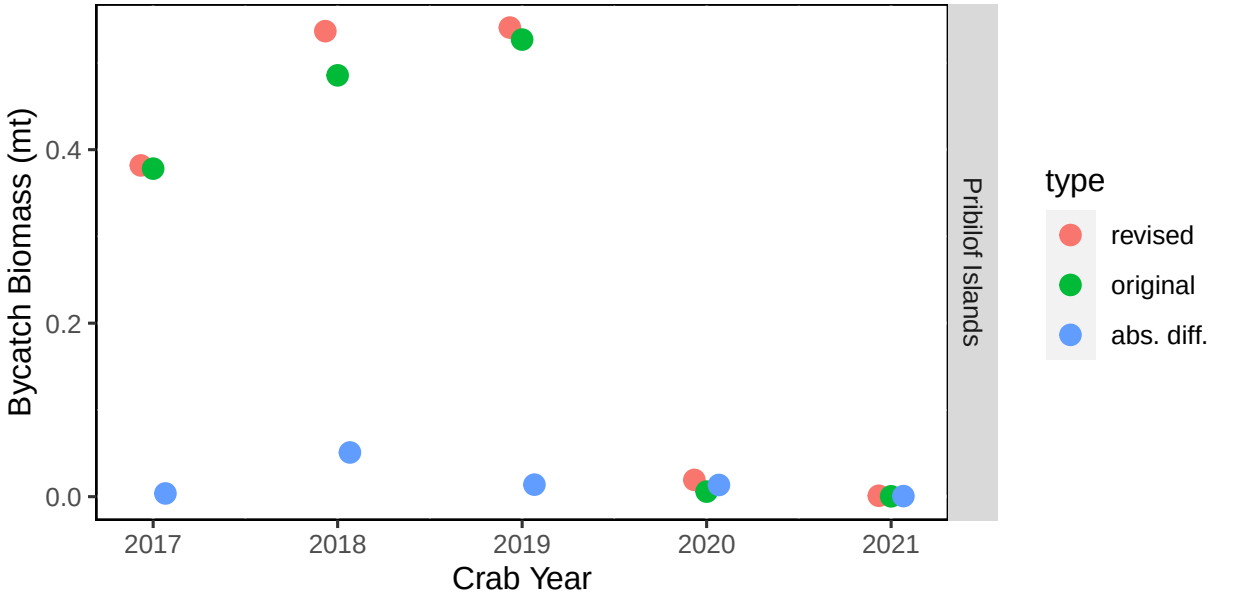

Figure 1: Comparison of original and revised estimates of bycatch (biomass) of Pribilof Islands blue king crab in the groundfish fisheries.Revised bycatch values: blue symbols. Original bycatch values: red symbols.

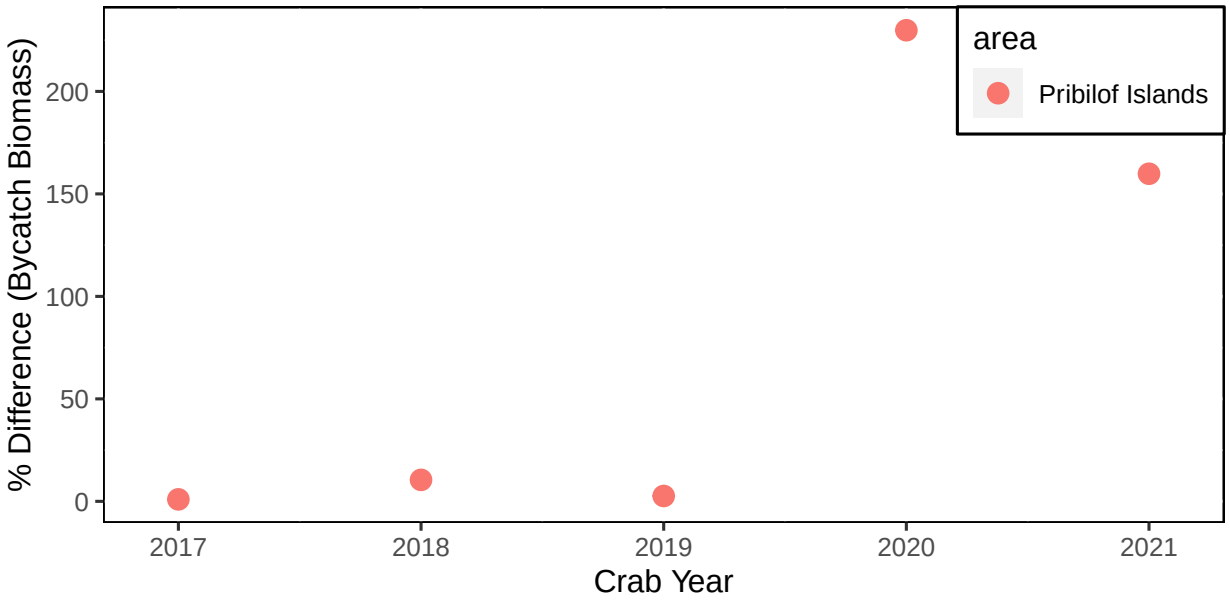

Figure 2: Comparison of previous and revised estimates of bycatch (biomass) of Pribilof Islands blue king crab in the groundfish fisheries as percent difference.

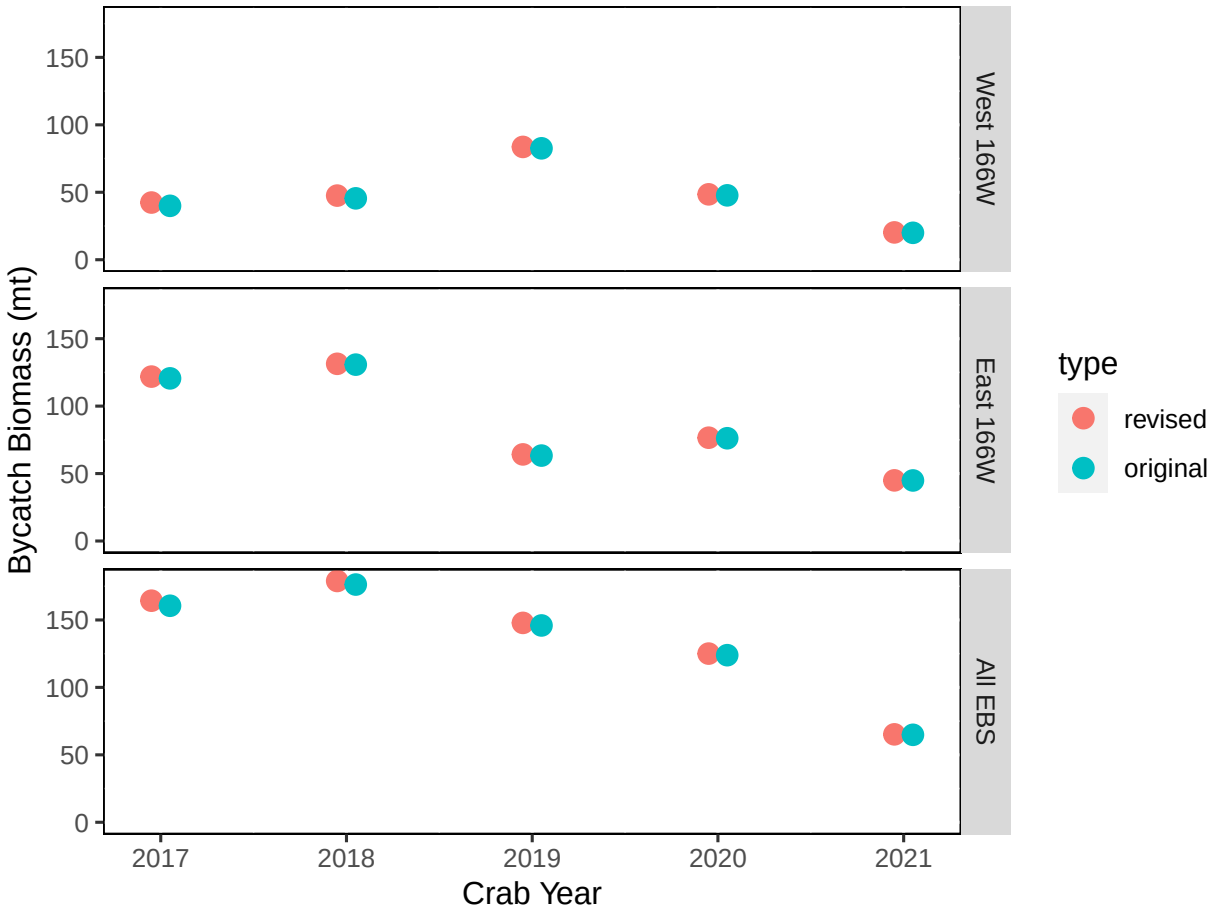

Figure 3: Comparison of original and revised estimates of bycatch (biomass) of Tanner crab in the groundfish fisheries, by area.Revised bycatch values: blue symbols. Original bycatch values: red symbols.

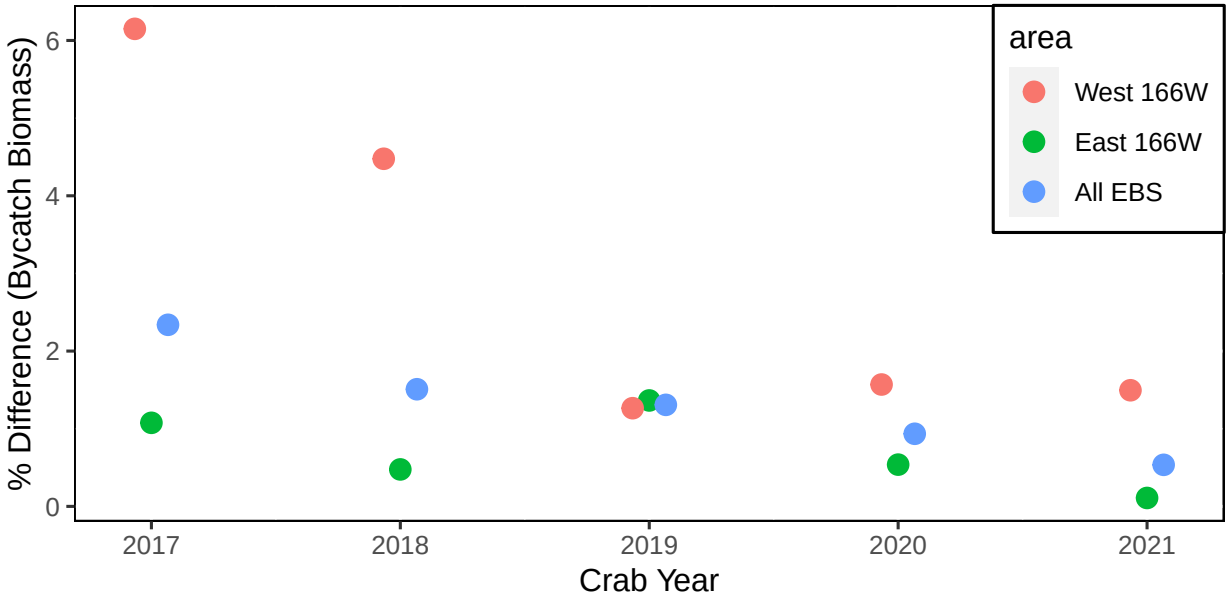

Figure 4: Comparison of original and revised estimates of bycatch (biomass) of Tanner crab in the groundfish fisheries, by area, as percent difference.

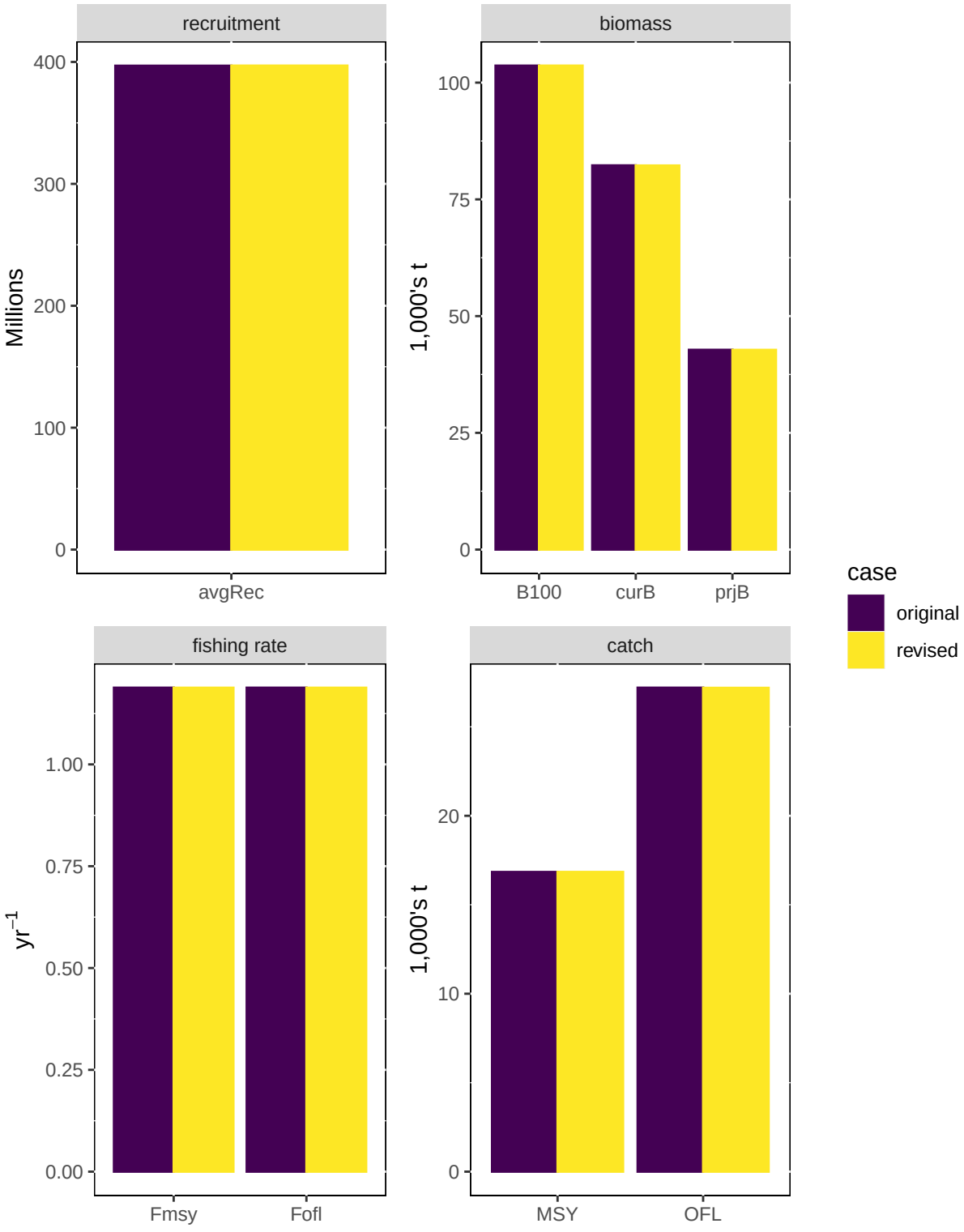

Figure 5: Comparison of management quantities among model scenarios.

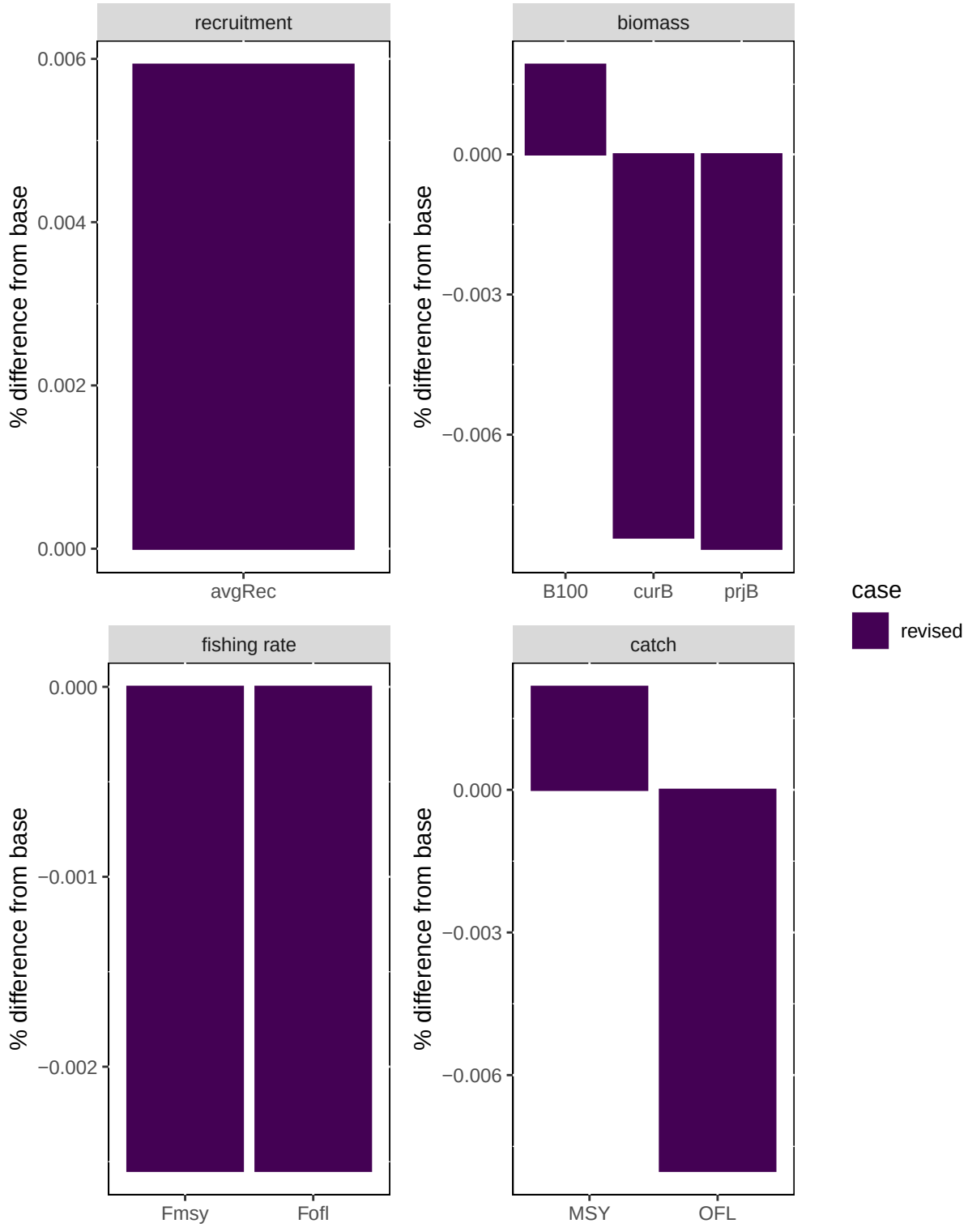

Figure 6: Comparison of differences in management quantities among model scenarios, relative to the base case ().

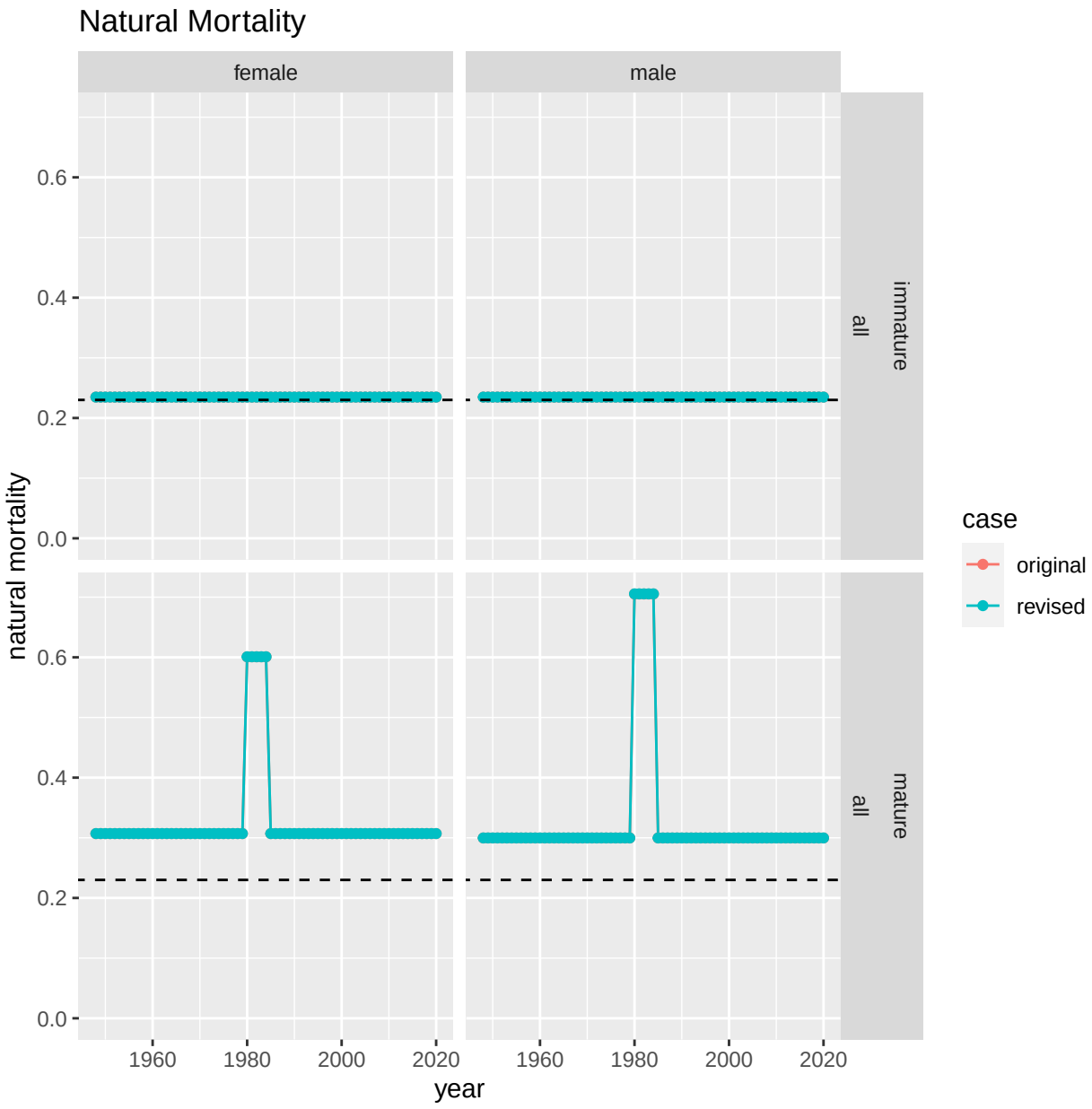

Figure 7: Estimated natural mortality rates, by year.

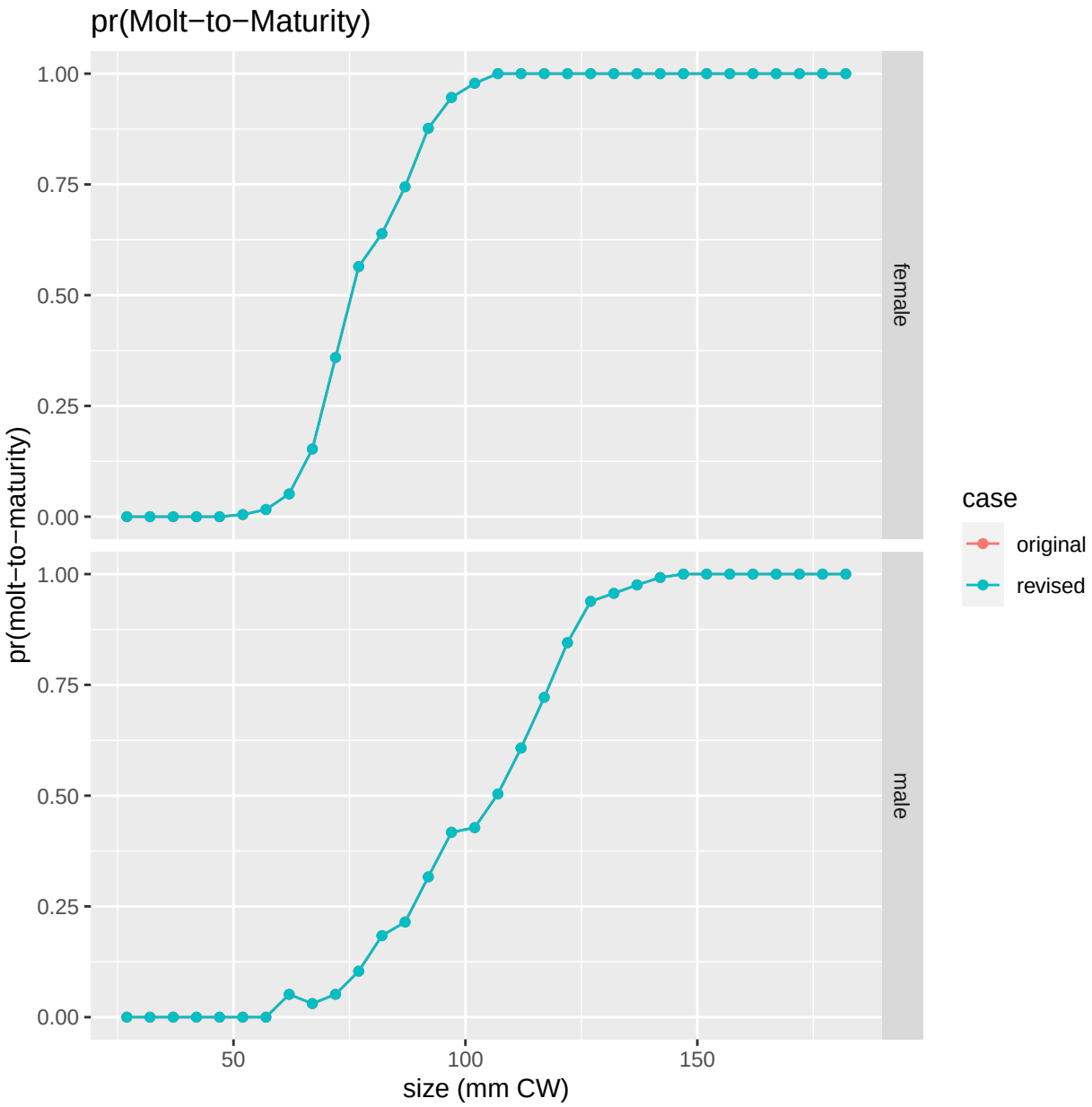

Figure 8: Probability of terminal molt.

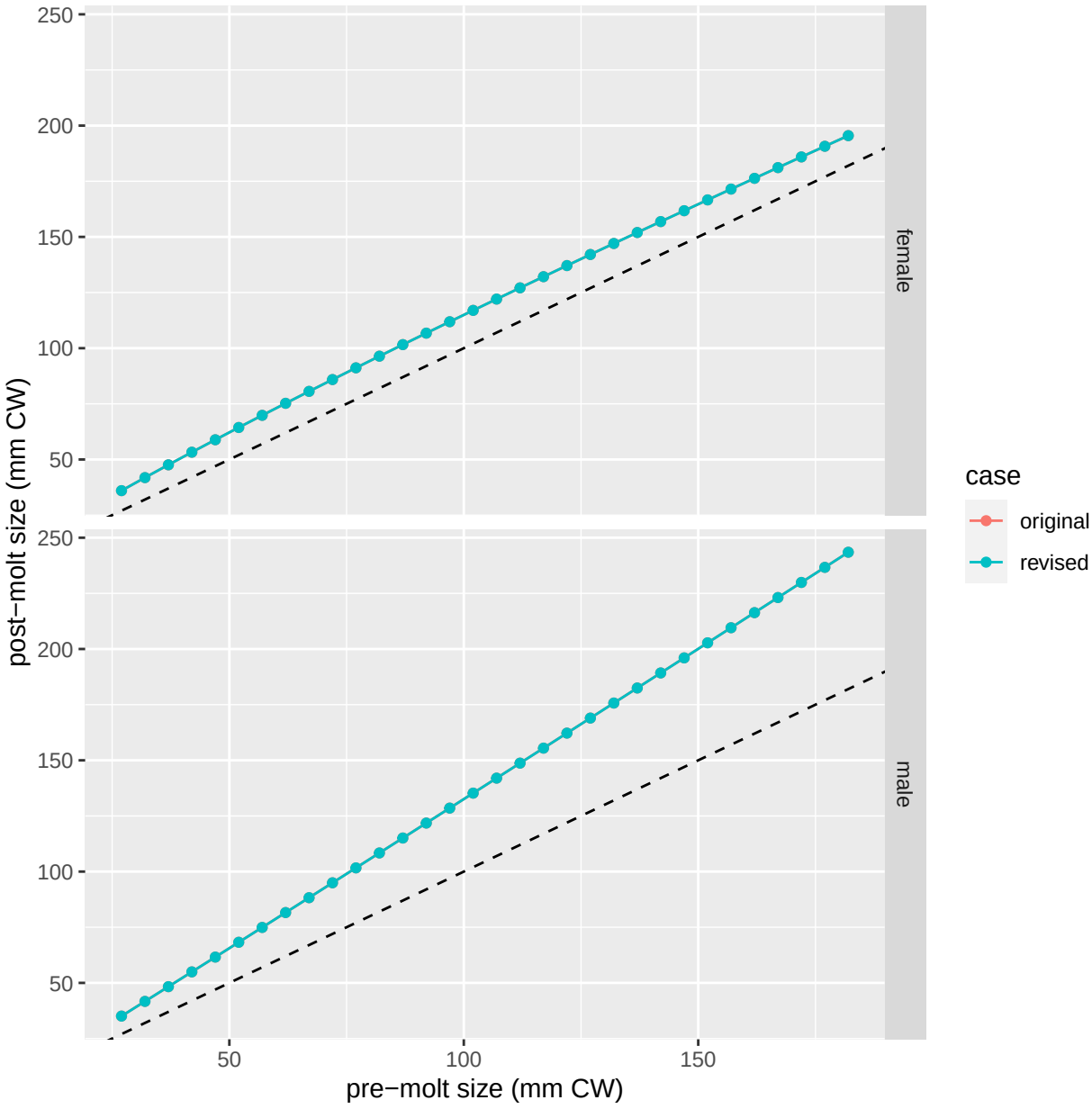

Figure 9: Mean growth.

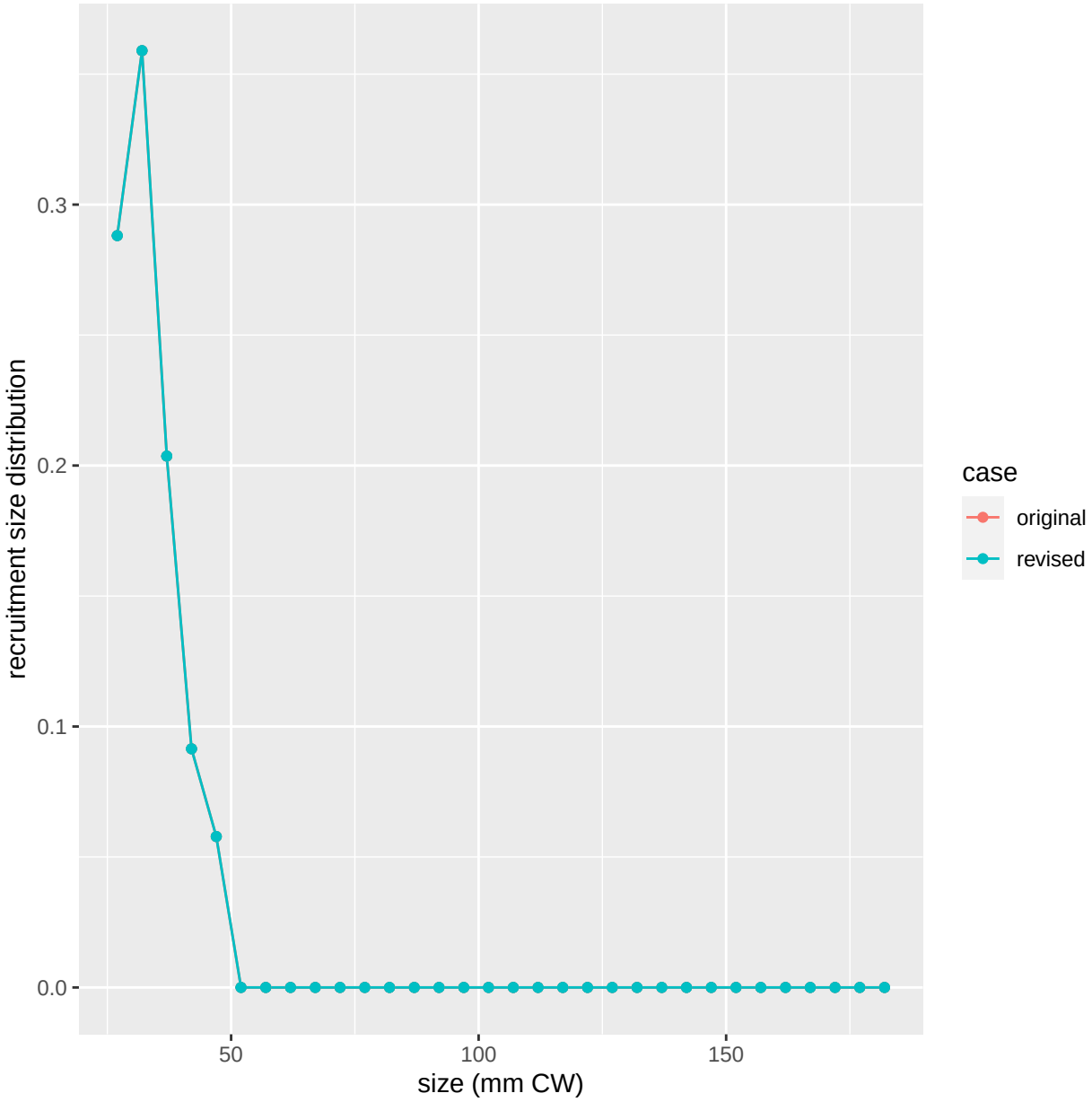

Figure 10: Size distribution for recruits.

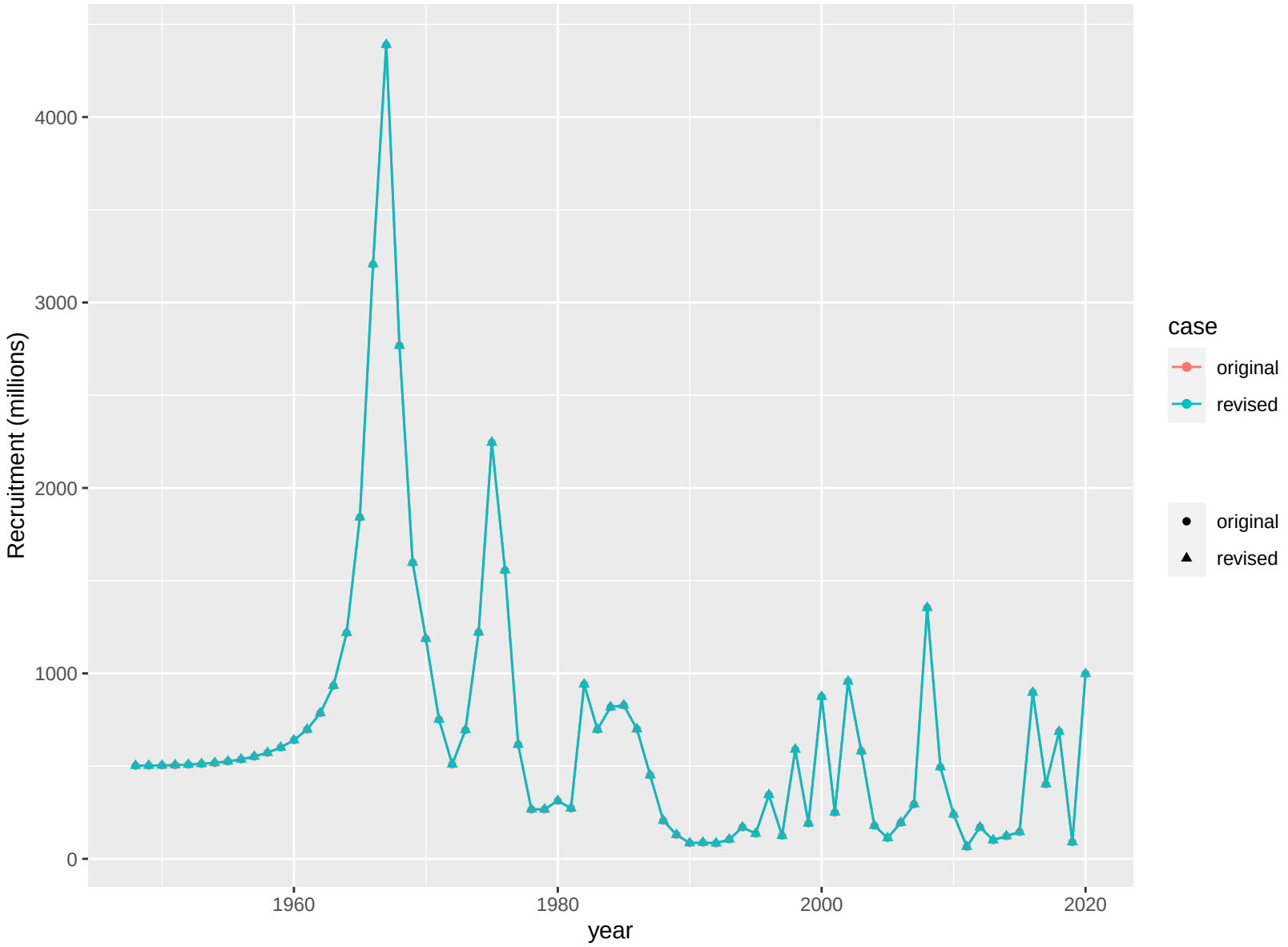

Figure 11: Estimated annual recruitment.

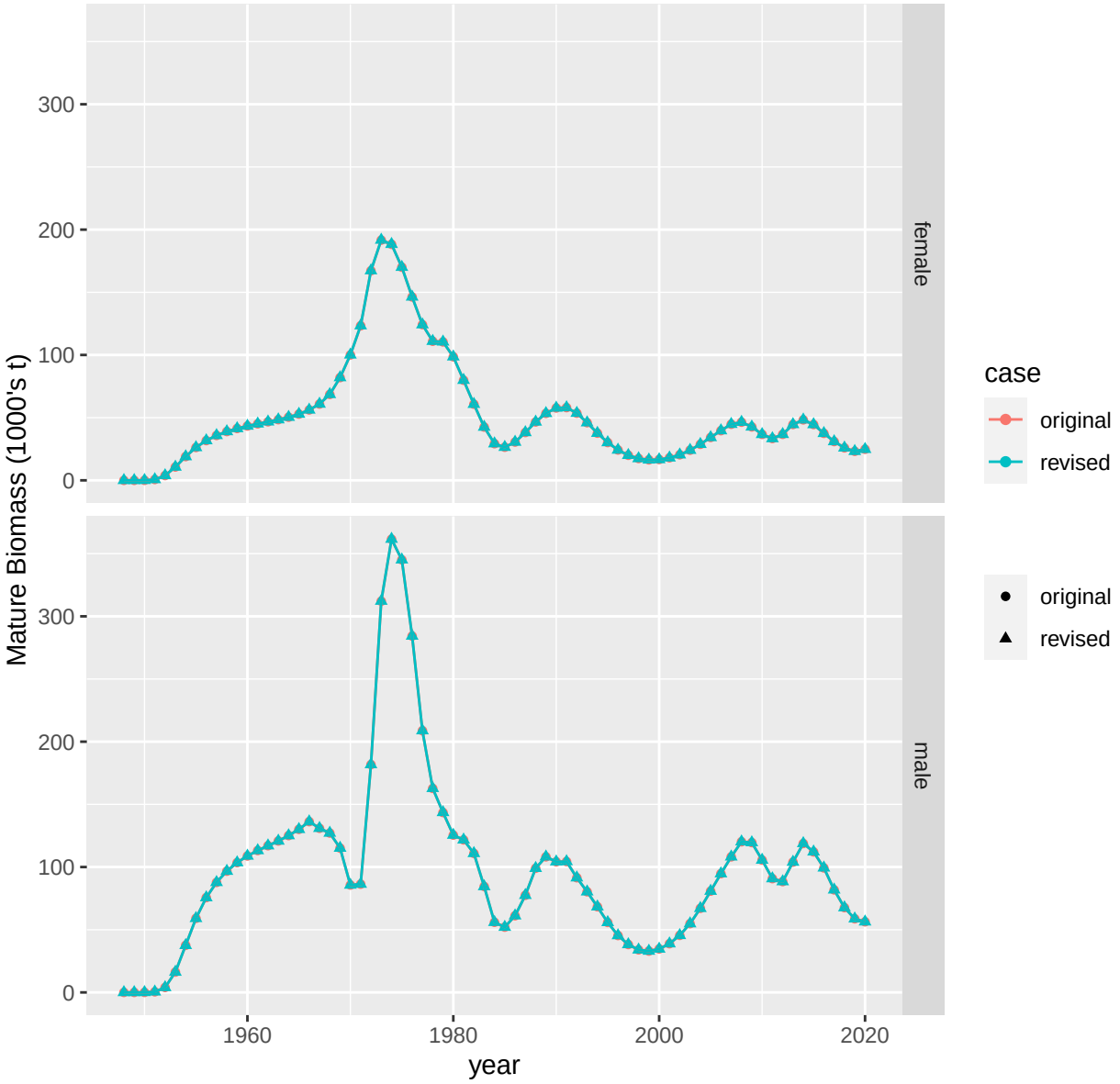

Figure 12: Estimated annual mature biomass.

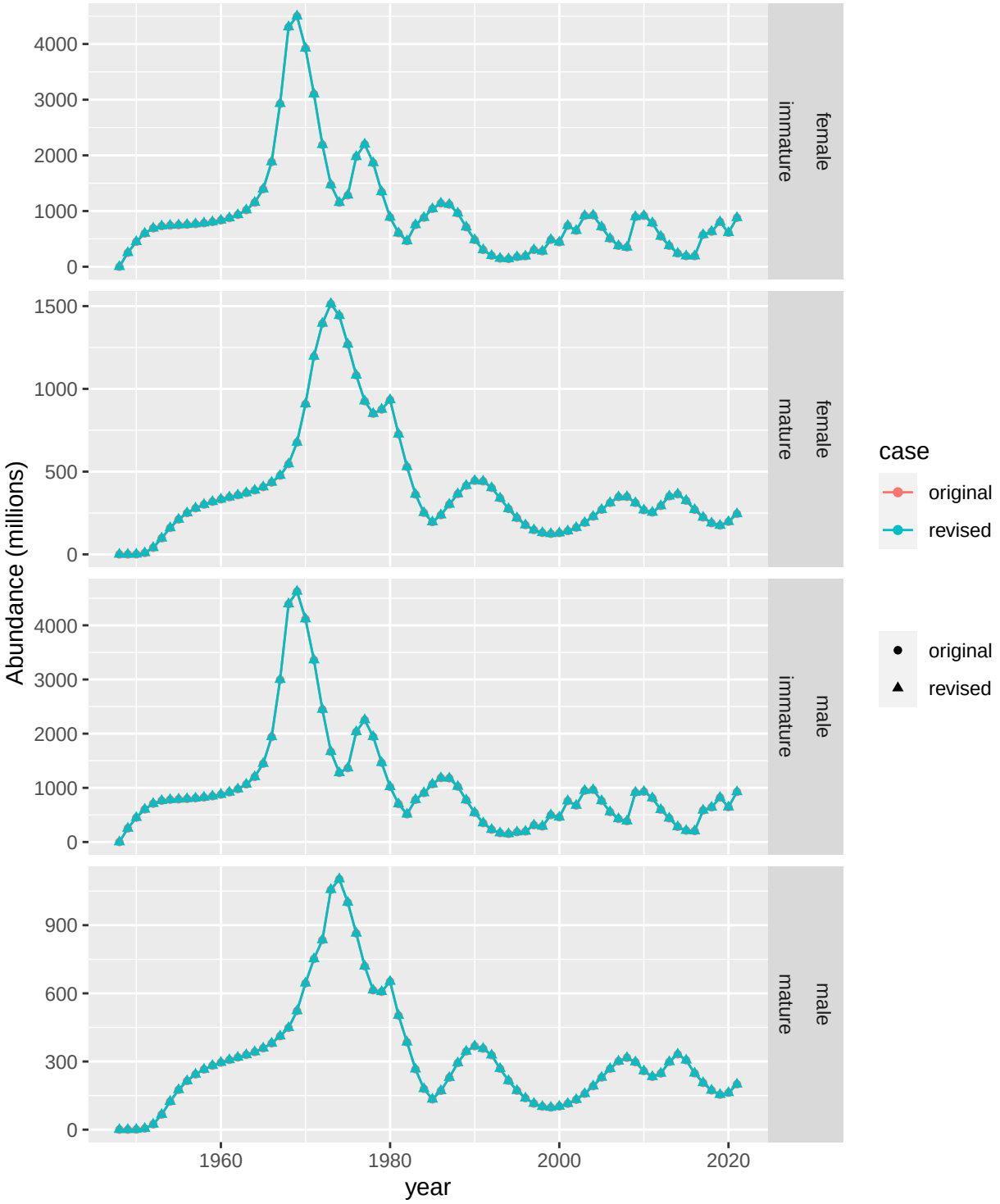

Figure 13: Population abundance trends.

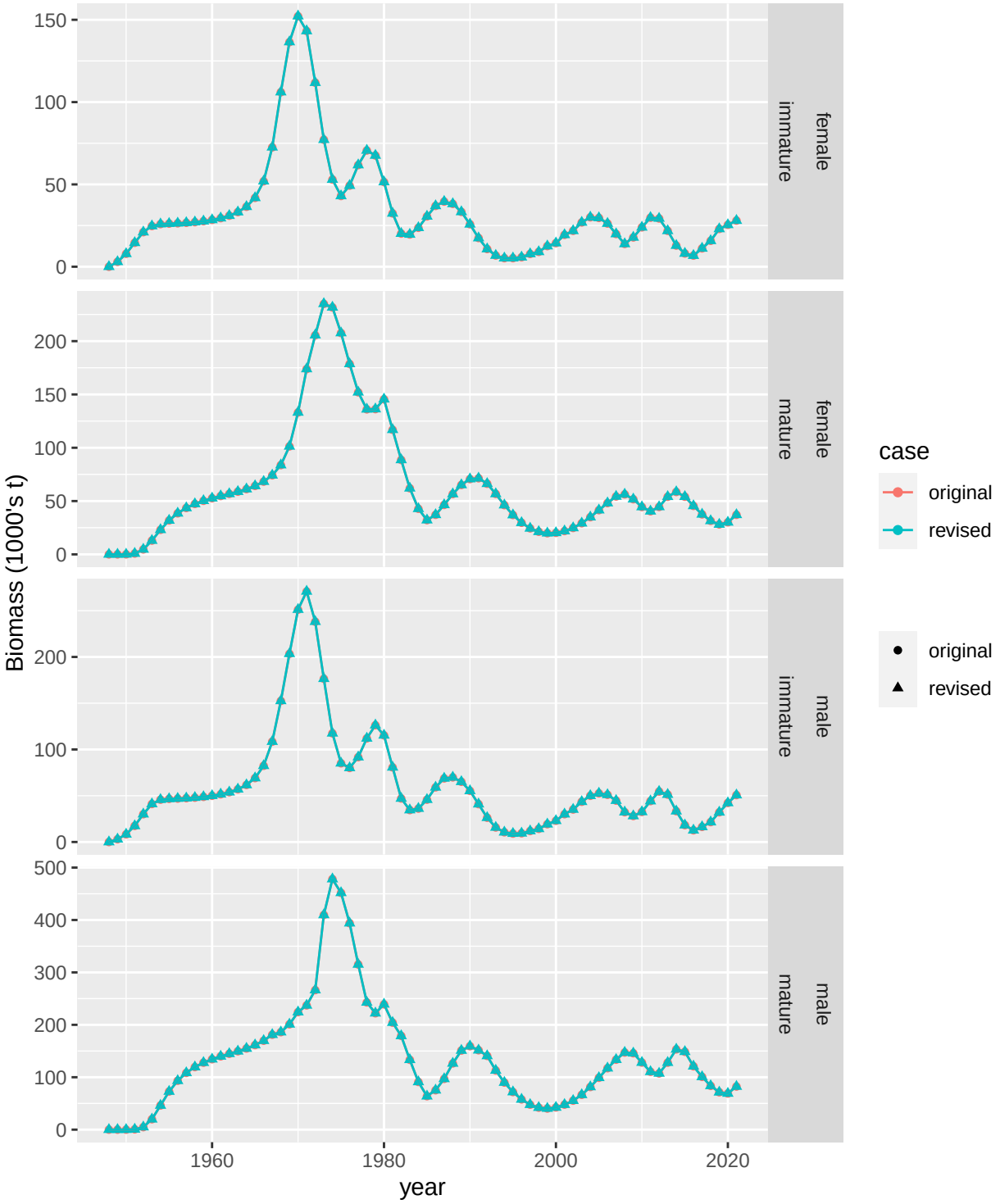

Figure 14: Population biomass trends.