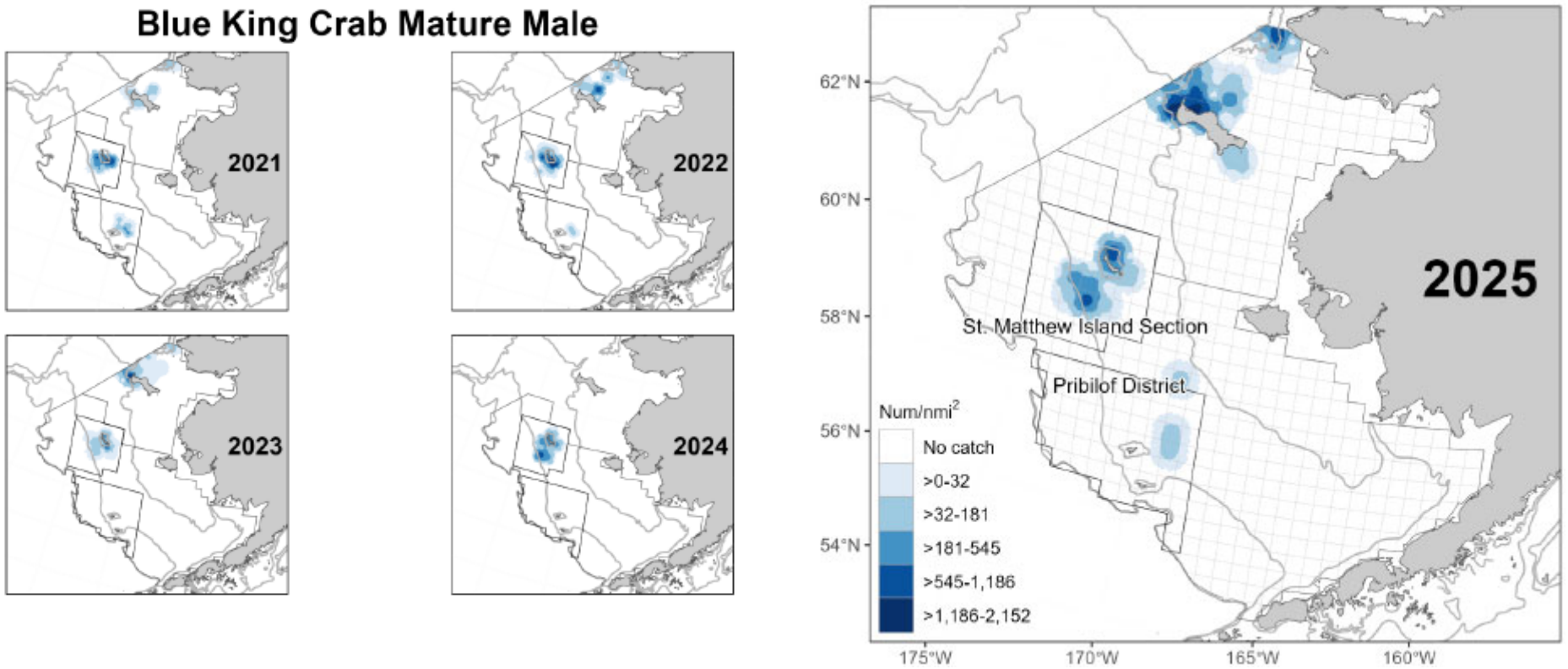
St. Matthew Island blue king crab proposed models

Caitlin Stern and Katie Palof
Crab Plan Team, May 2026

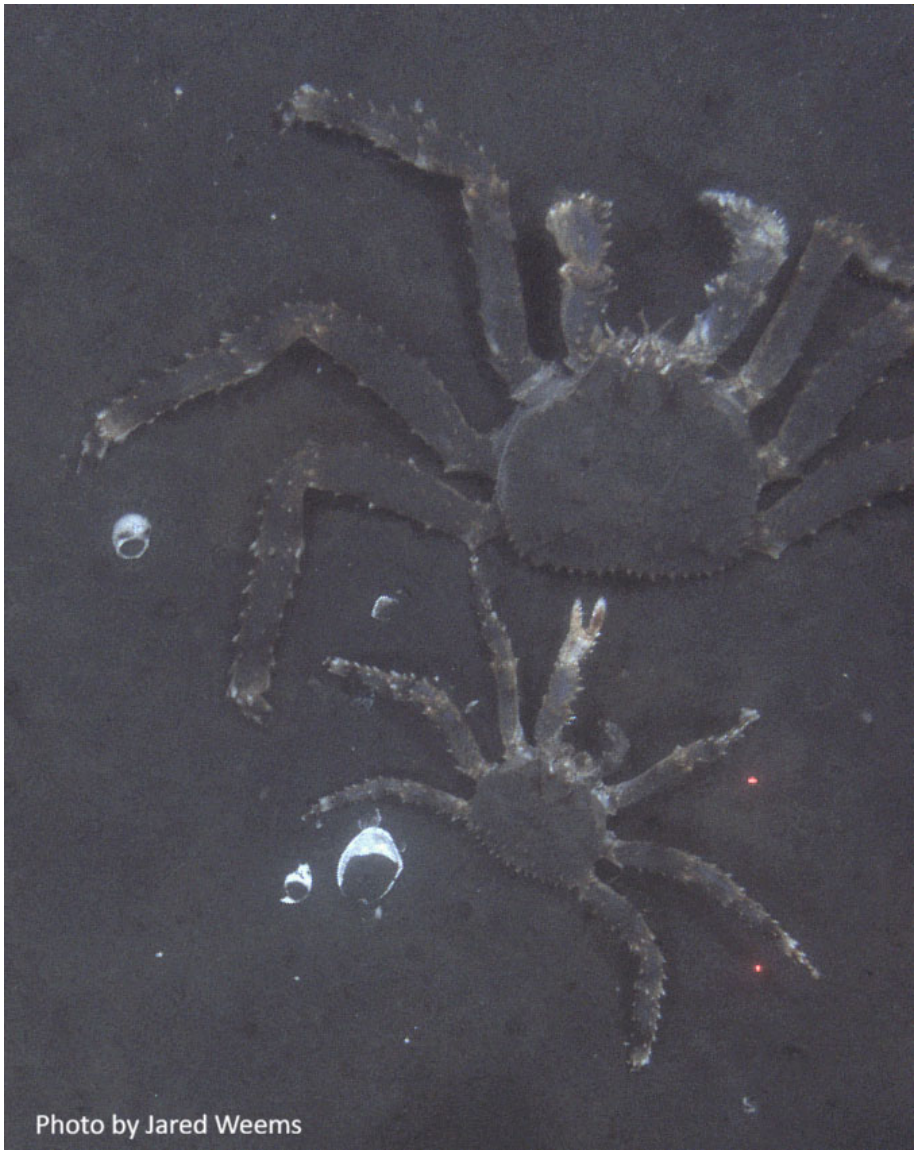
Photo by Cory Lescher

St. Matthew Island blue king crab stock



Zacher et al. (2026) The 2025 Eastern and Northern Bering Sea Continental Shelf Trawl Surveys: Results for Commercial Crab Species.

St. Matthew Island blue king crab stock



Fishery closed since 2016/2017

Declared overfished in fall 2018

Rebuilding plan approved in June 2020

Last full assessment in 2024

Topics

Priorities for the 2026 assessment cycle

Bridging to newer GMACS version

Data updates

Development of a model-based index (MBI)

Proposed models including the MBI

SSC and CPT comments

A significant change occurred in the 2024 NMFS bottom trawl survey, where the "corner stations" around St. Matthew Island were not sampled…This discrepancy deserves further investigation, highlighting the potential benefits of model-based estimates that incorporate historical corner station data to address any biases. For this assessment, using the corner stations prior to 2024 is acceptable, but this issue should be addressed in the next full assessment. This may include developing an integrated pot and trawl index, as suggested in October 2022.

The model-based index for the EBS trawl survey time series, presented here, addresses the change in corner station sampling. We did not integrate the pot survey into this index due to the need for area swept in the current approach. We plan to explore other approaches to developing a single survey index in future.

It was noted that elimination of the NMFS trawl survey corner station sampling increases the importance of future ADF&G pot surveys…it is believed that the ADF&G pot surveys better sample SMBKC due to limitations of the NMFS trawl survey gear in some habitats, such as rocky bottom and nearshore areas… While annual pot surveys are ideal, a 3-year cycle is likely effective in capturing broad population trends.

We include data from the 2025 ADF&G pot survey here. We agree that having another pot survey in 2028 is desirable.

SSC and CPT comments

Continue work to create a single index of abundance integrating data from both trawl and pot surveys using spatiotemporal approaches. The SSC suggests the authors explore the use of these methods for each survey separately before initiating work to combine them. An exploratory spatial analysis, including maps depicting the spatial structure of relevant survey observations, should be provided to support the selection of an appropriate geostatistical approach. In addition to standard diagnostic plots (i.e. Q-Q plot, residual histograms, and observed vs. predicted encounter probabilities), the distribution of spatial residuals should accompany model results.

We have included maps and diagnostics in Appendix C of the proposed models document.

Explore increasing the number of size bins used in the assessment models.

We plan to address this in future.

Examine the likelihood profile on selectivity.

We plan to address this in future.

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2024 accepted model: 24.1

- males $\geq$ 90 mm only, 3 size classes
- catch: pot fishery retained, discards from directed pot, groundfish trawl, groundfish fixed gear fisheries
- relative abundance: EBS trawl survey, ADF&G pot survey
- size comps: pot fishery, EBS trawl survey, ADF&G pot survey
- M = 0.23, estimated for 1998/1999 event
- survey selectivity: max slx at size forced = 1, estimated for size classes 1 and 2
- survey catchability fixed = 1 for EBS trawl survey, estimated for ADF&G pot survey

Model 26.0: 24.1 in GMACS 2.20.34a

Component	24.1	26.0
Catch: fishery retained	-69.0	-69.0
Catch: fishery discarded	4.5	4.5
Catch: trawl bycatch	-9.1	-9.1
Catch: fixed gear bycatch	-9.1	-9.1
Index: EBS trawl survey	1.1	1.1
Index: ADFG pot survey	75.7	75.7
Size comp: pot fishery	-105.1	-105.1
Size comp: EBS trawl survey	-277.2	-277.2
Size comp: ADFG pot survey	-99.9	-99.9
Number of parameters	159	159
Total	-410.3	-410.3

Model 26.0: 24.1 in GMACS 2.20.34a

	24.1	26.0
MMB_{2025}	1530	1530
B_{MSY}	2935	2935
MMB/B_{MSY}	0.52	0.52
F_{OFL}	0.11	0.11
OFL_{2025}	129	129
ABC_{2025}	91	91

units: metric tons

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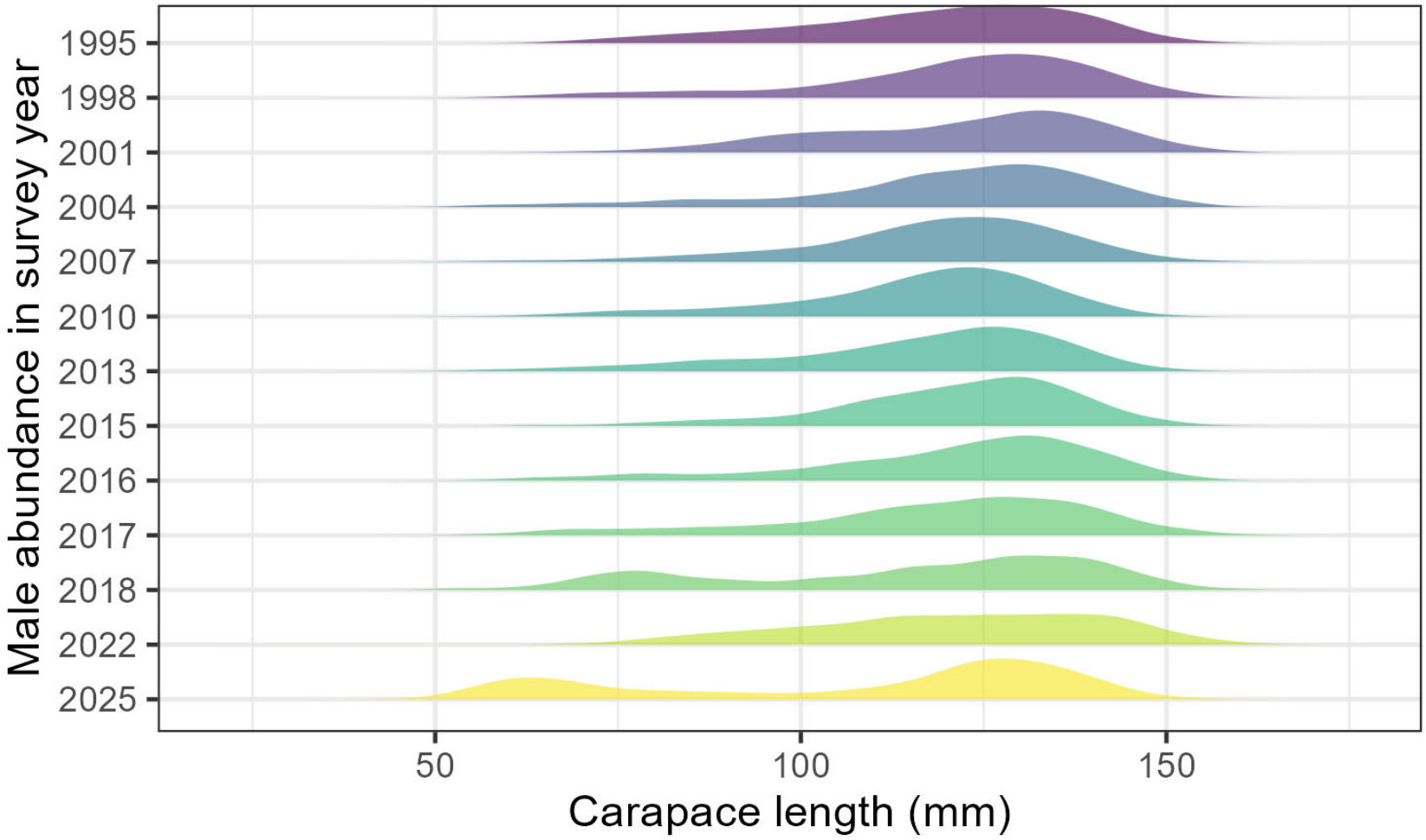
Model 26.1: 26.0 with data updates

2025 EBS trawl survey: biomass and size comp data
2025 ADF&G pot survey: relative abundance and size comp data
2024/2025 groundfish trawl and fixed gear fisheries bycatch



Model 26.1: 26.0 with data updates

Component	26.0	26.1
Catch: fishery retained	-69.0	-69.0
Catch: fishery discarded	4.5	4.4
Catch: trawl bycatch	-9.1	-9.4
Catch: fixed gear bycatch	-9.1	-9.4
Index: EBS trawl survey	1.1	0.3
Index: ADFG pot survey	75.7	74.9
Size comp: pot fishery	-105.1	-105.1
Size comp: EBS trawl survey	-277.2	-283.4
Size comp: ADFG pot survey	-99.9	-109.1
Number of parameters	159	162
Total	-410.3	-425.0

Topics

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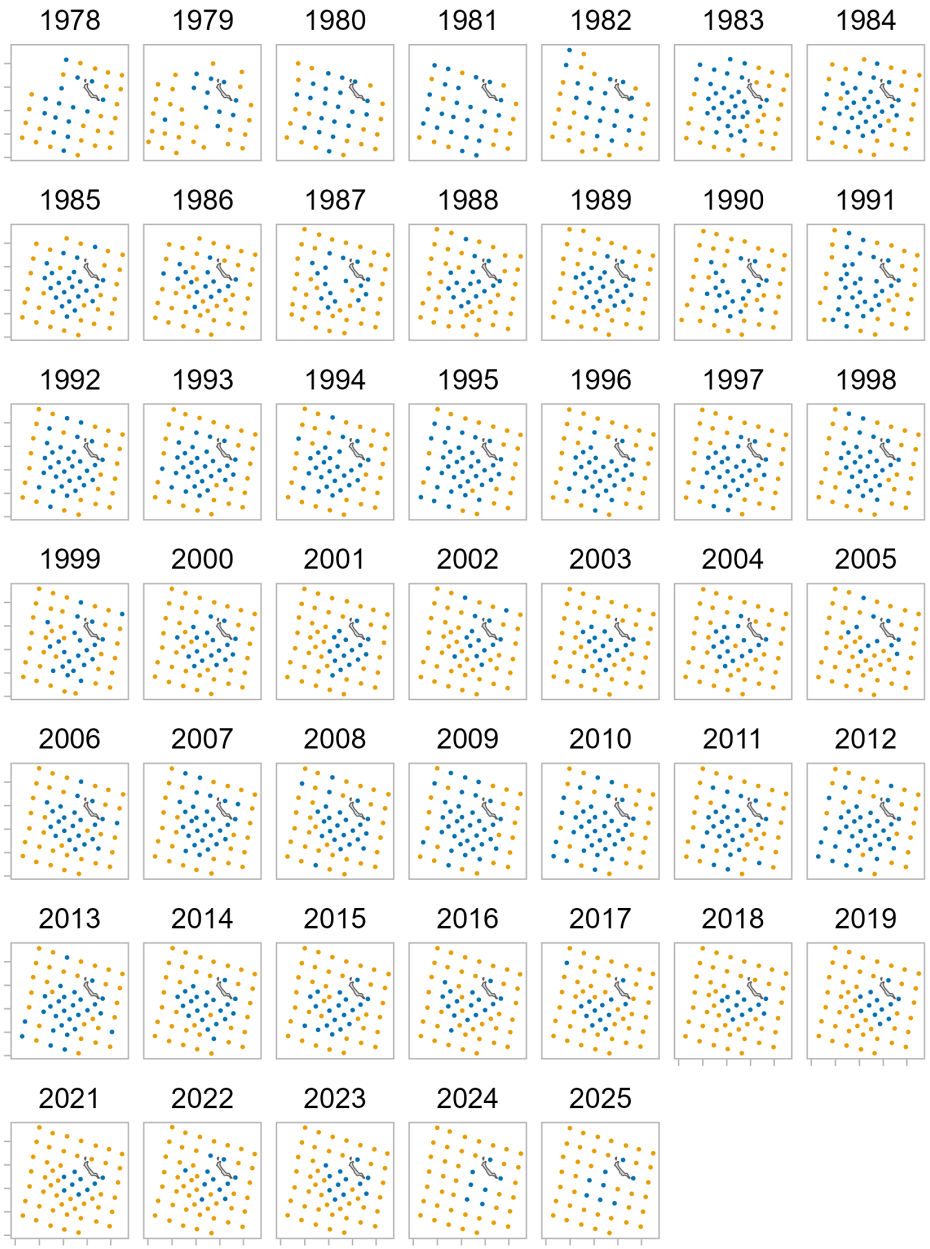
Model-based index development



Corner station sampling ended in 2023

EBS survey time series biomass estimates no longer directly comparable

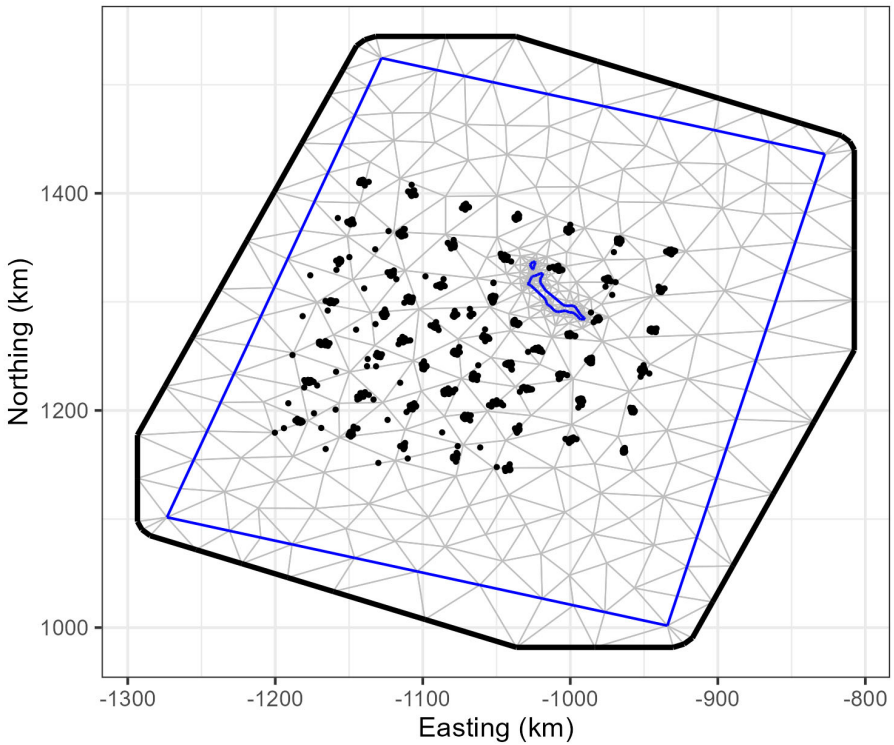
Spatiotemporal model-based index standardization accounts for differences in survey station sampling among years

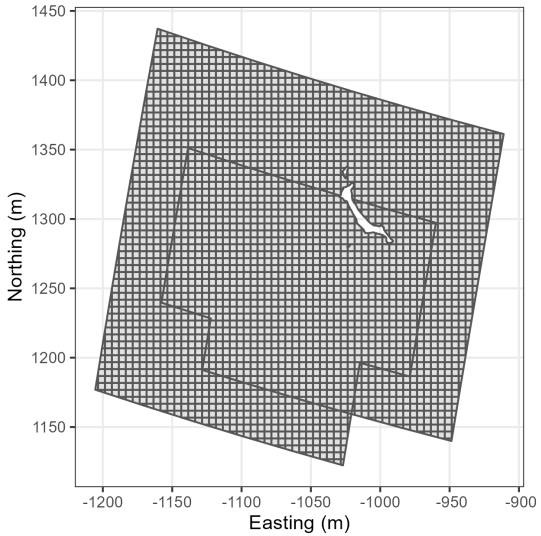
Spatiotemporal model-based index standardization

Fit geostatistical GLMMs with spatiotemporally correlated random effects to survey data using sdmTMB

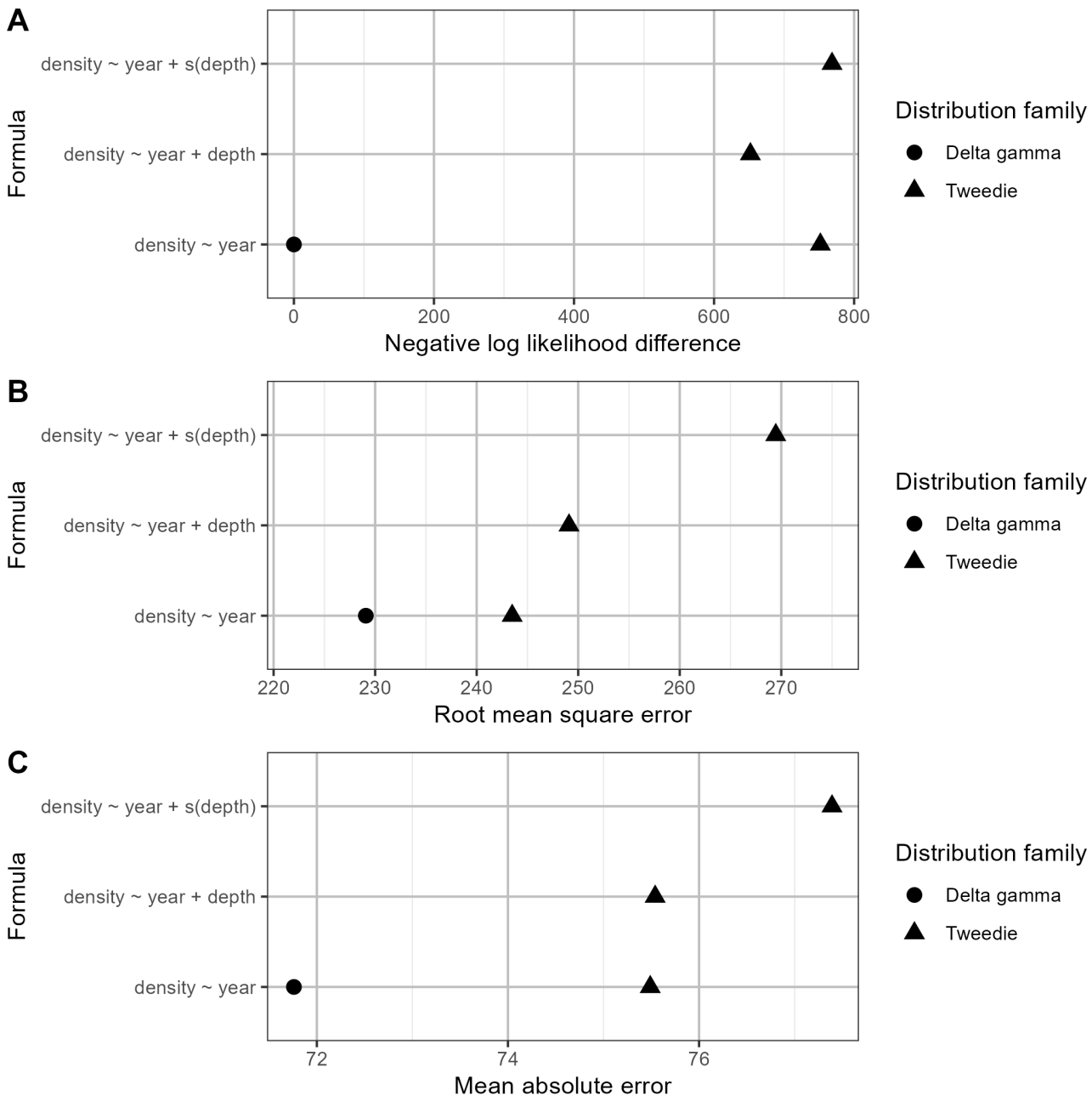
Fixed effects: year, survey, depth

Distribution families: Tweedie, delta gamma, delta lognormal

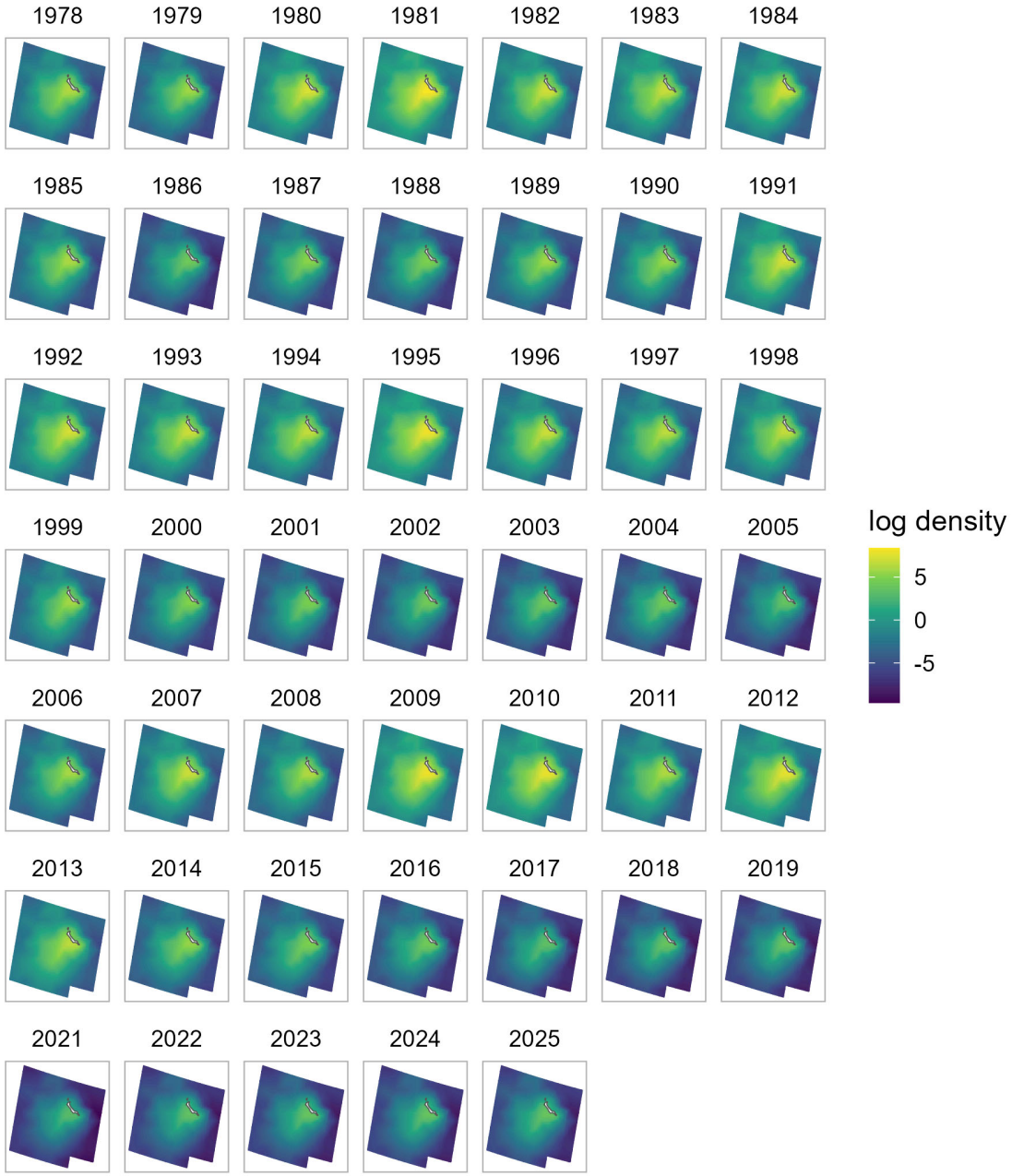




Model selection



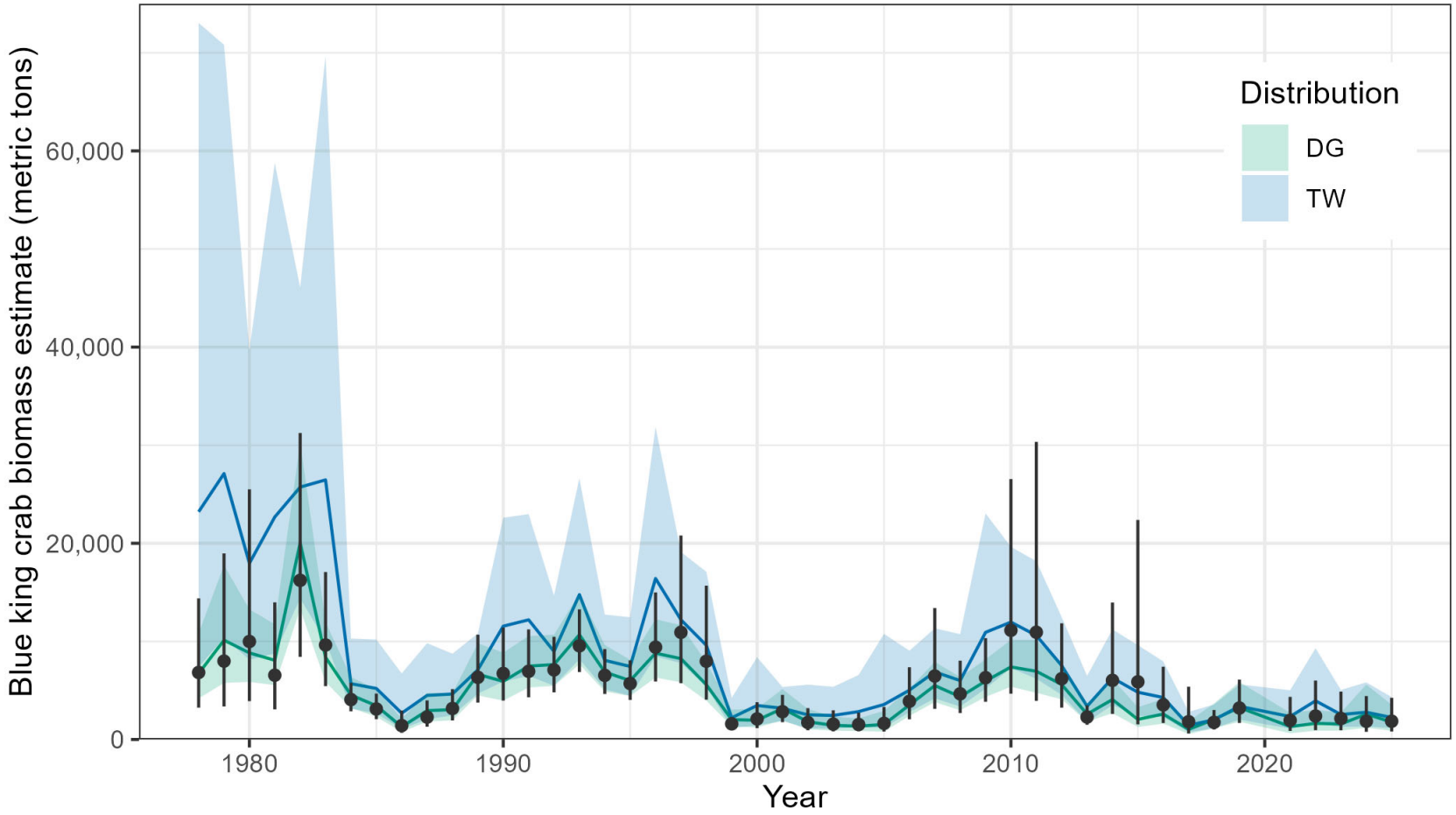
Spatial predictions



Model-based vs. design-based indices

Spatiotemporal model-based biomass index accounts for changes in survey station sampling over time

Produces consistent time series of biomass estimates



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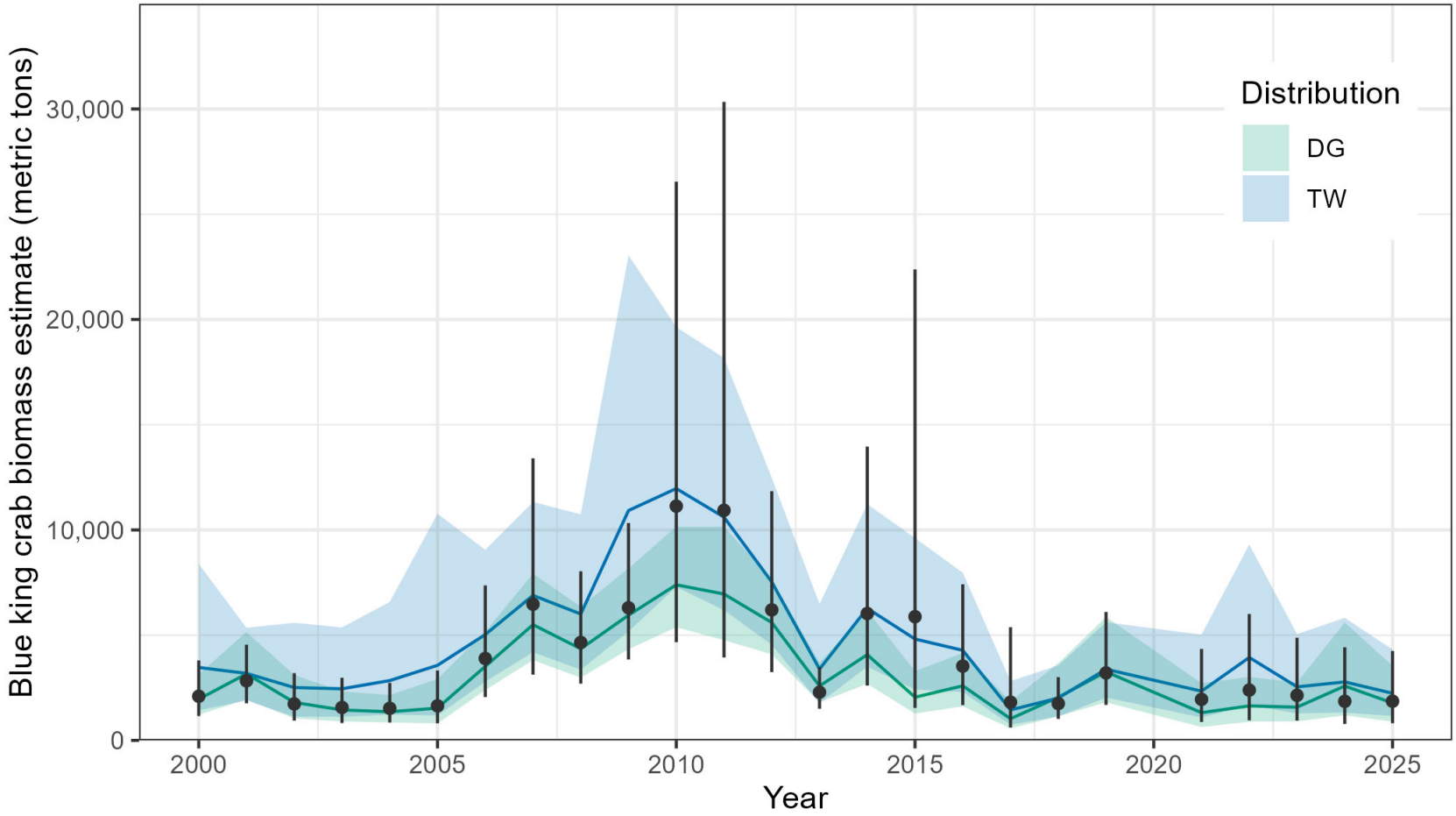


Topics

Priorities for the 2026 assessment cycle

Bridging to newer GMACS version

Data updates

Development of a model-based index (MBI)

Proposed models including the MBI

Proposed models for 2026

26.1: base model with updated GMACS version and data

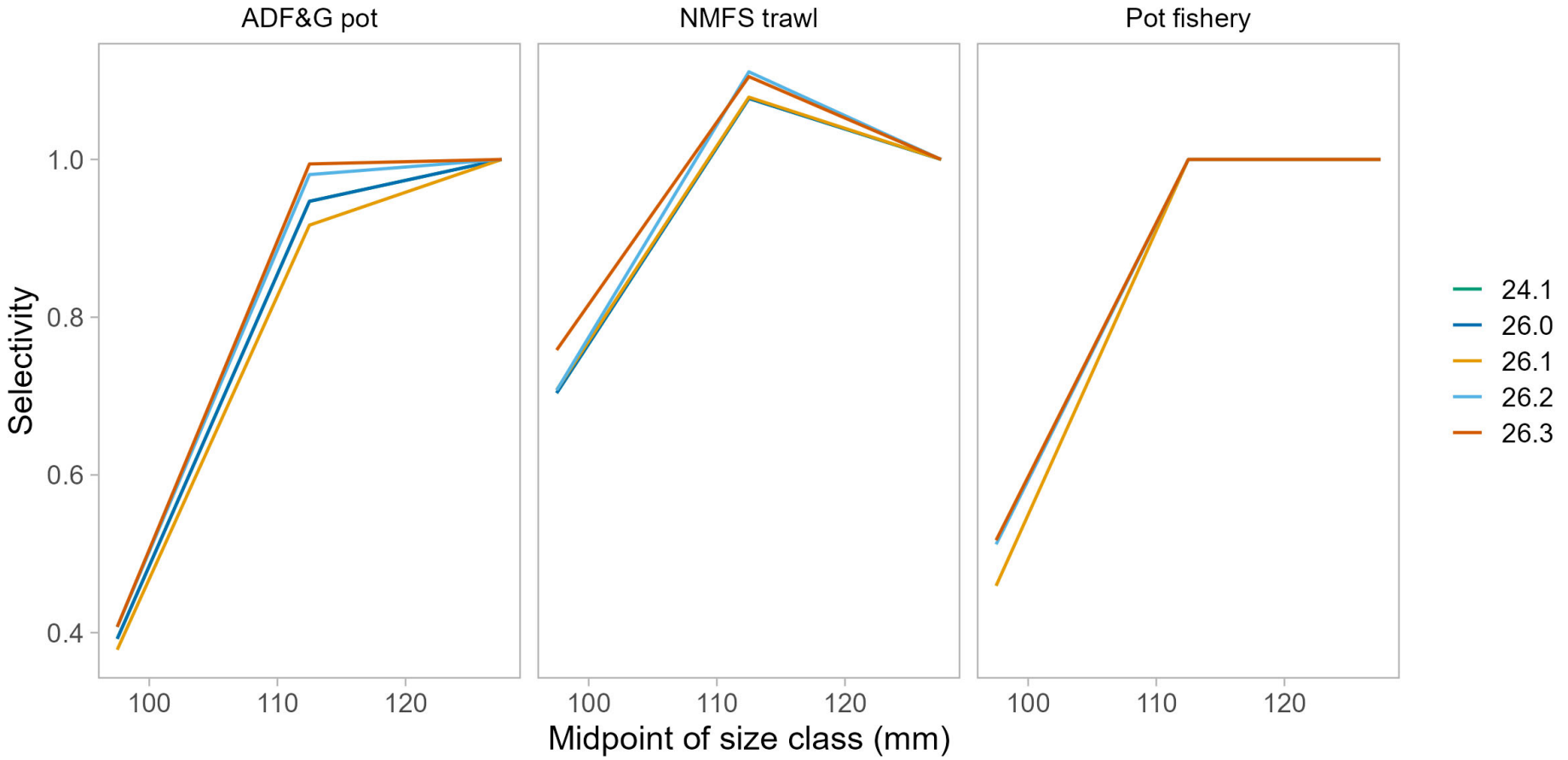
26.2: 26.1 with model-based index; catchability for MBI = 1

26.3: 26.2 with catchability for the MBI estimated

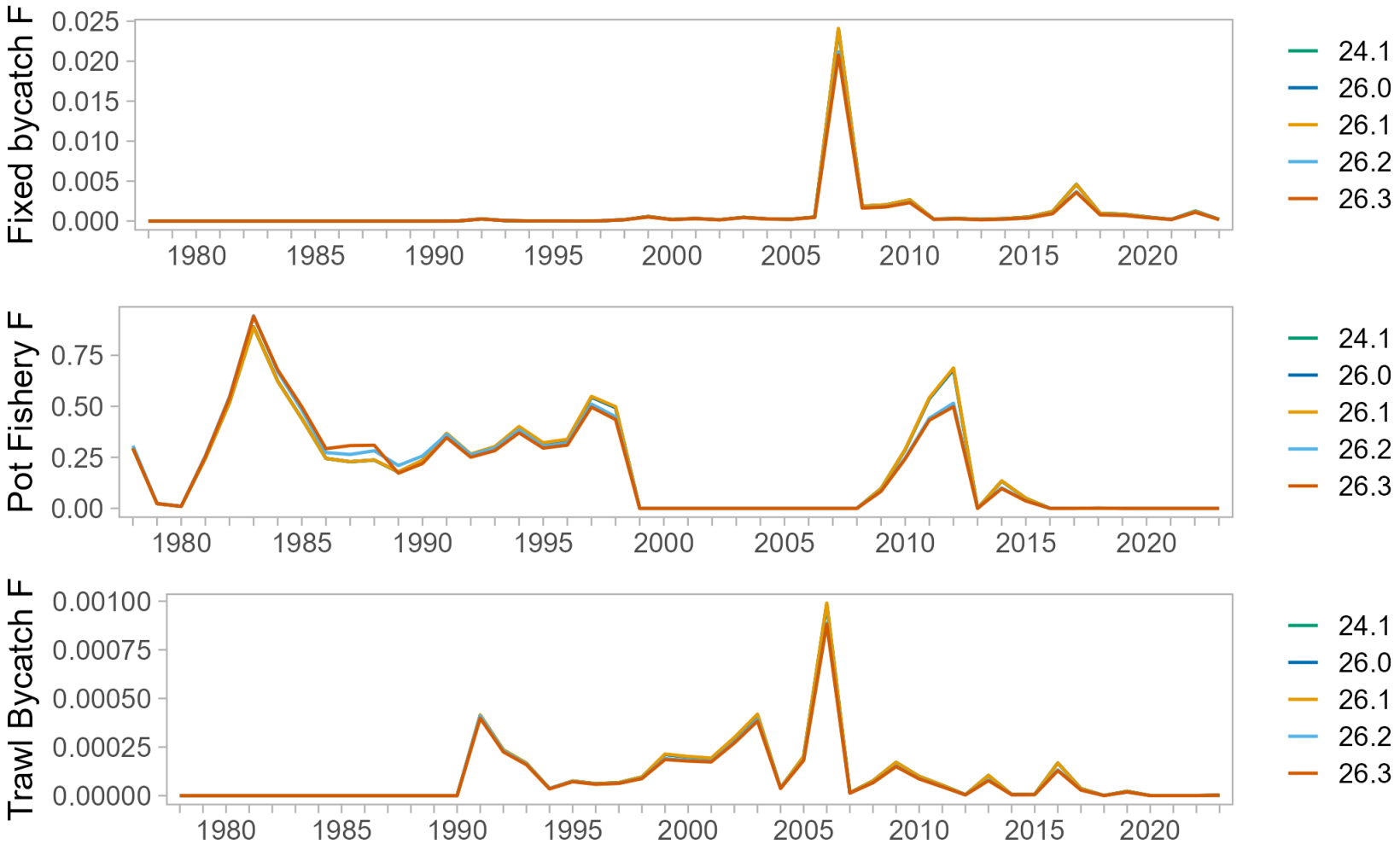
Model results

- Selectivity, fishing mortality, natural mortality
- Fits to time series: catch, indices, size comps
- Recruitment, MMB
- Retrospectives
- Reference points

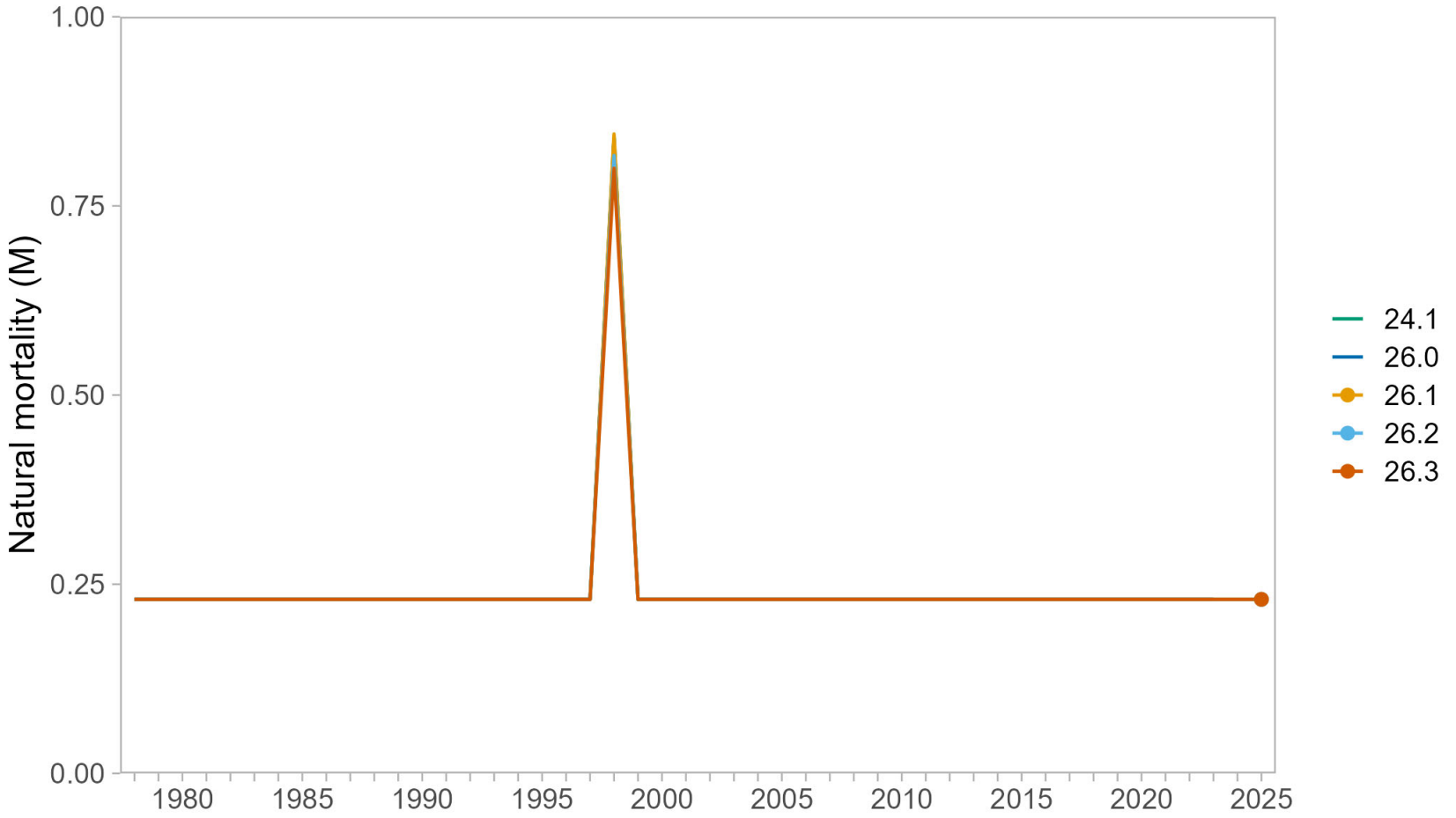
Selectivity



Fishing mortality

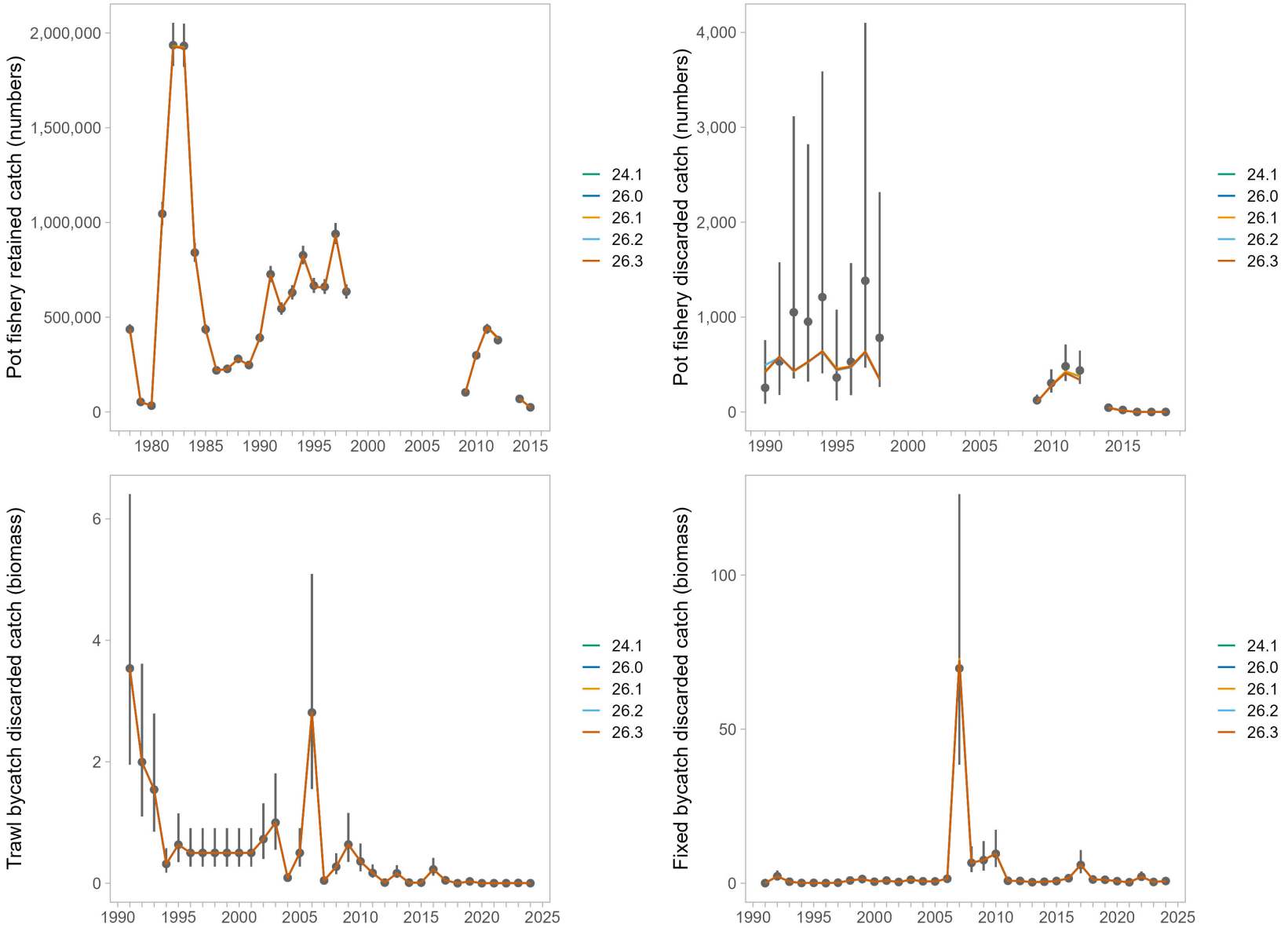


Natural mortality

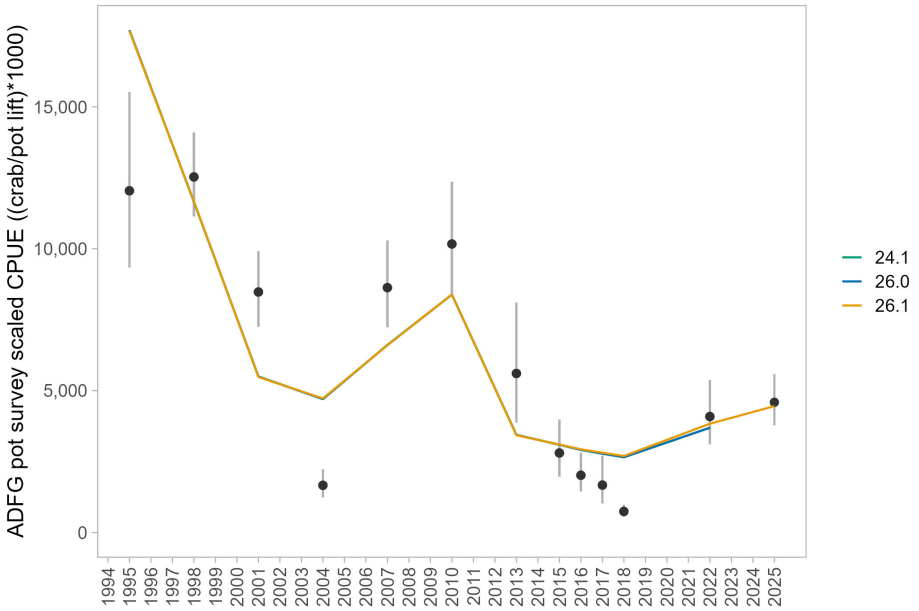


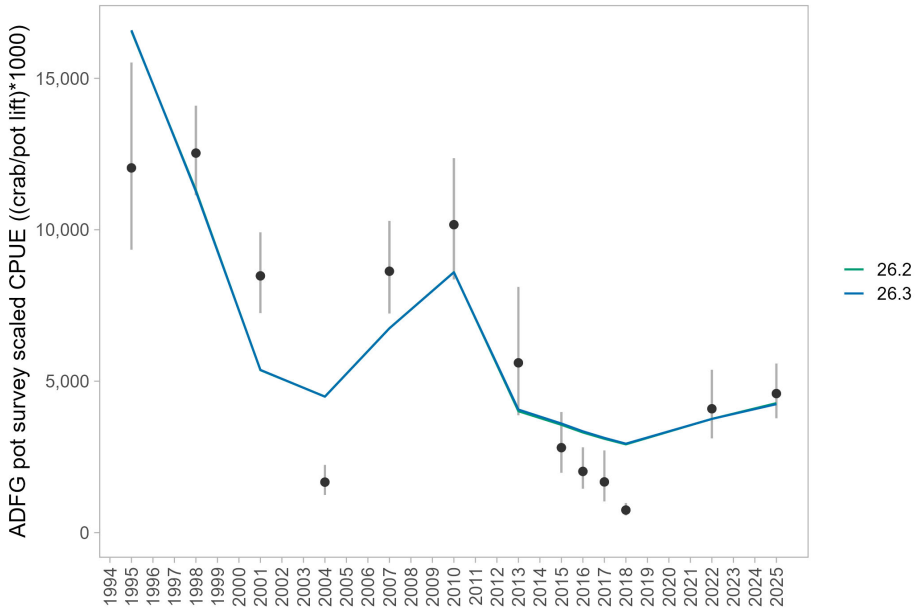
M = 0.23 except for estimated 1998/1999 event

Fits to fishery catch data



Fits to ADF&G pot survey index

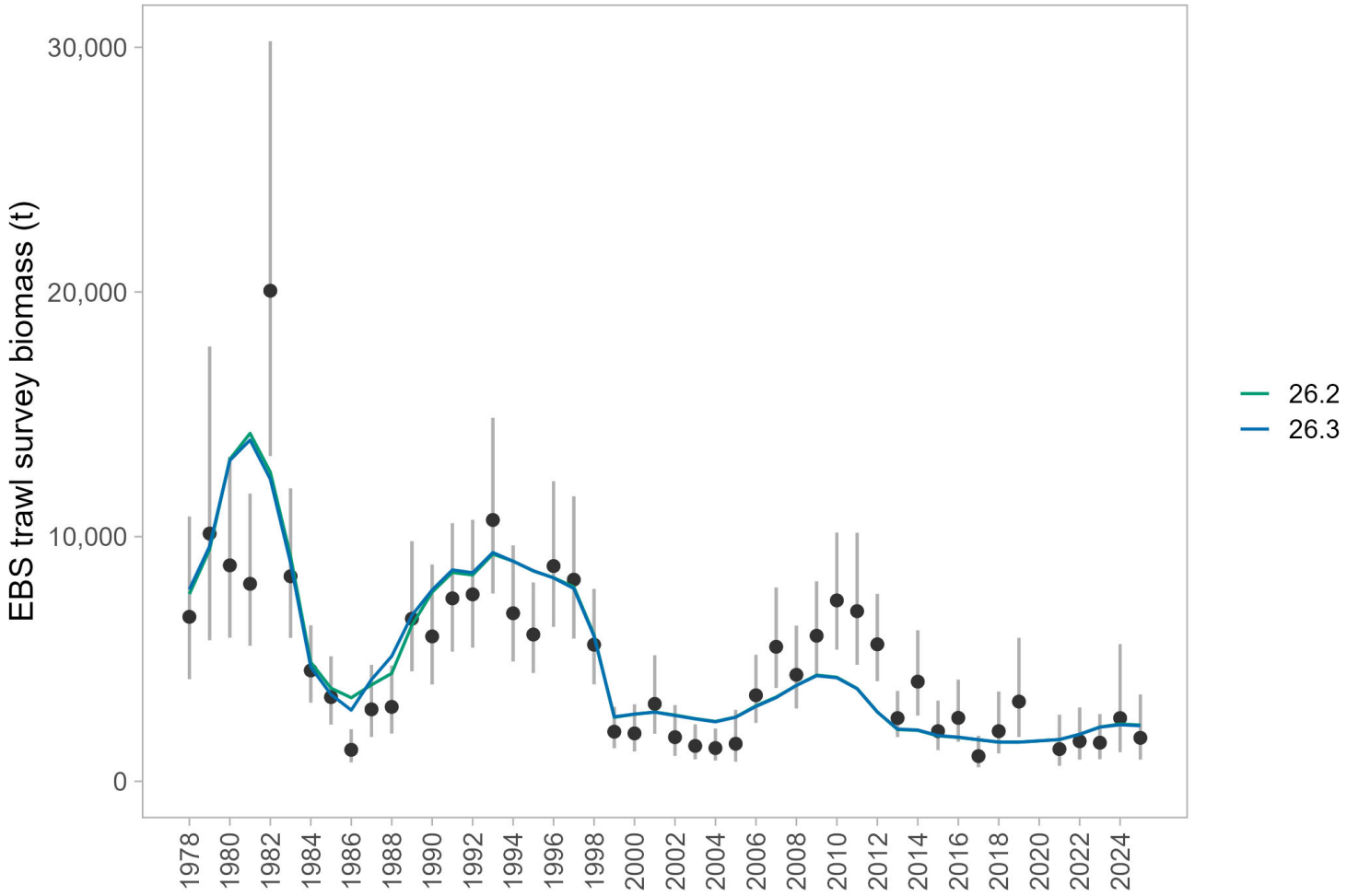




Ranking of fits, best to worst:

26.1 > 26.2 > 26.3

Fits to model-based EBS survey index



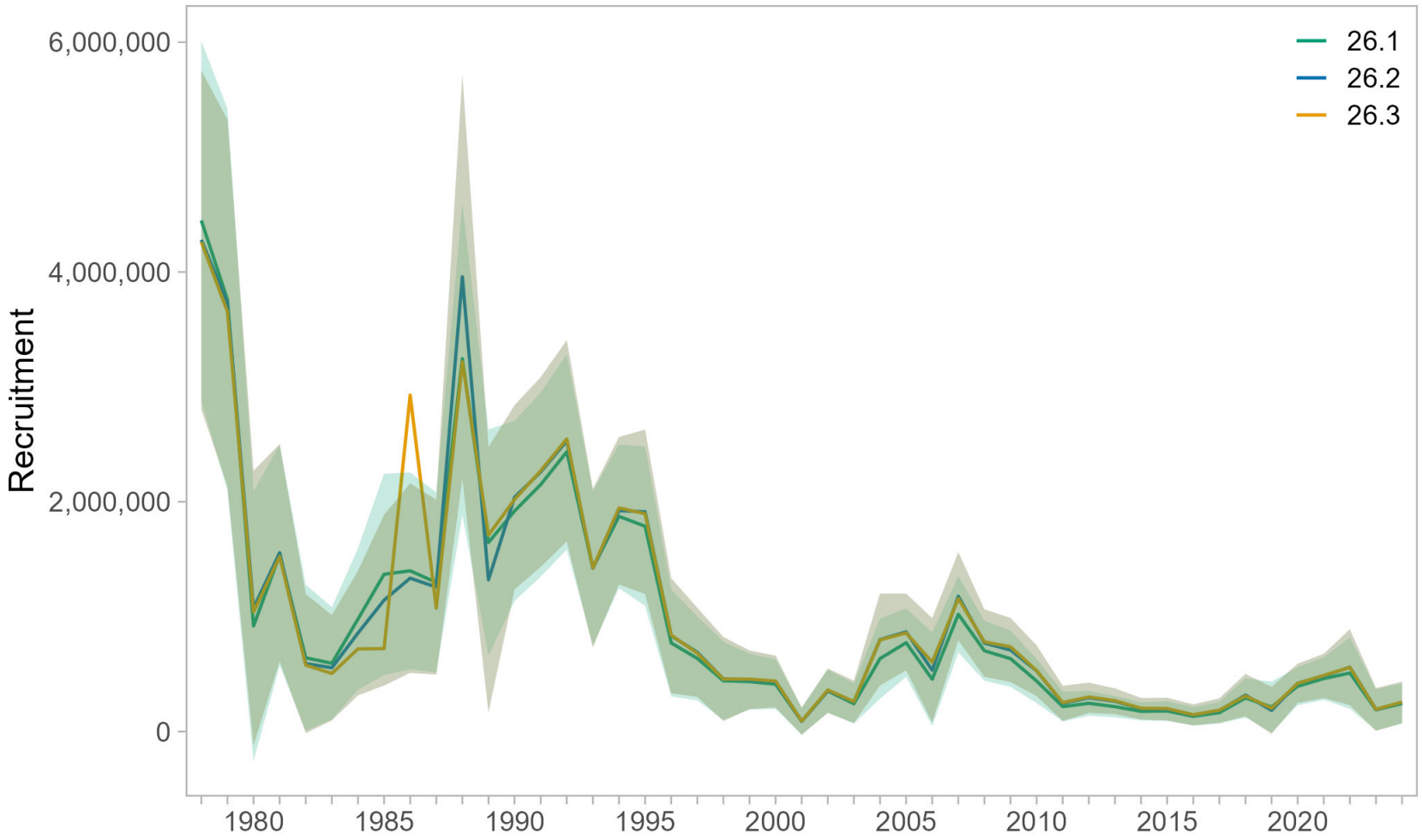
Ranking of fits, best to worst:

26.3 > 26.2

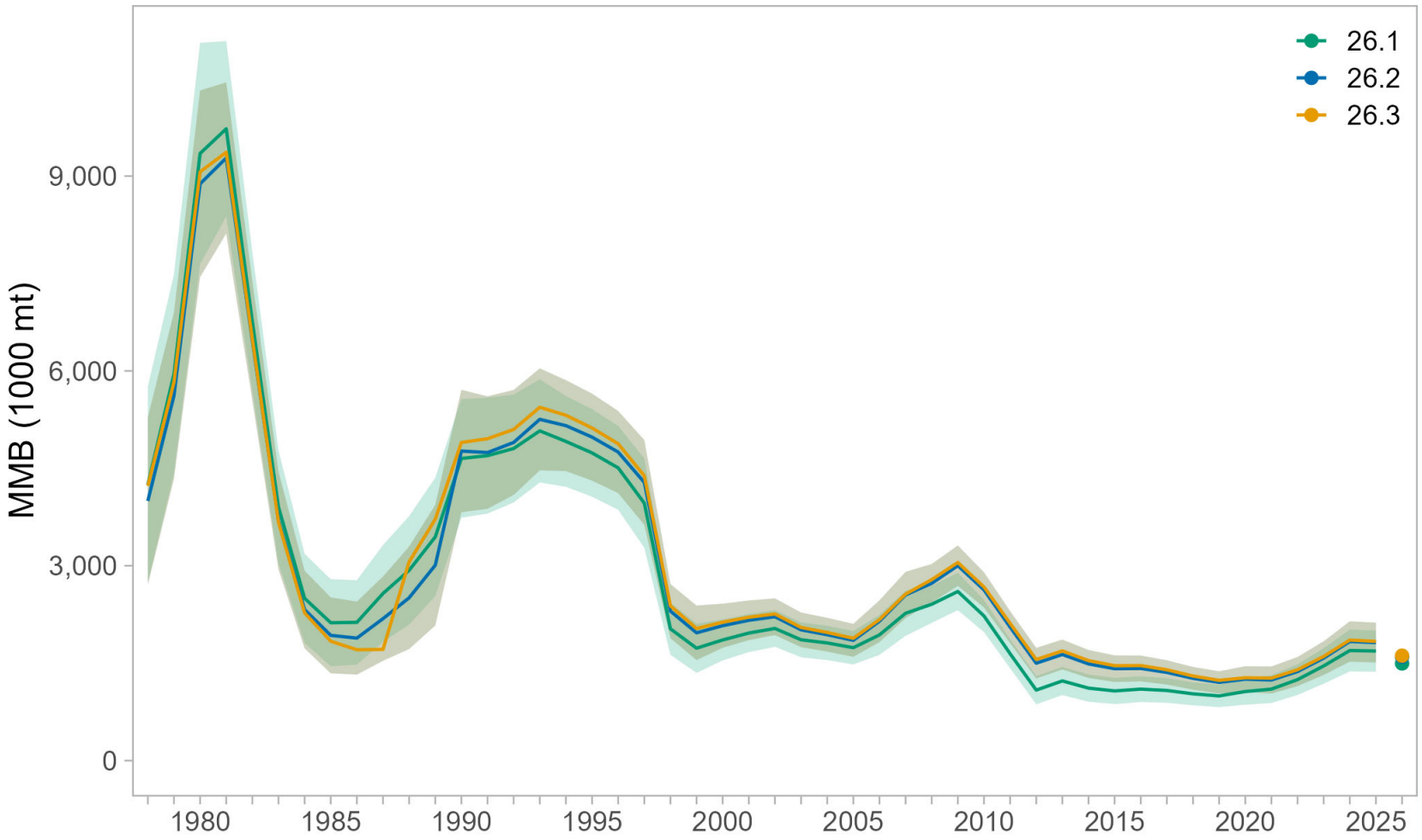
Fits to size comps

Component	26.1	26.2	26.3
Pot fishery	-105.1193	-105.5020	-105.0858
EBS trawl survey	-283.4310	-274.7617	-274.4538
ADFG pot survey	-109.1498	-105.1701	-105.3015

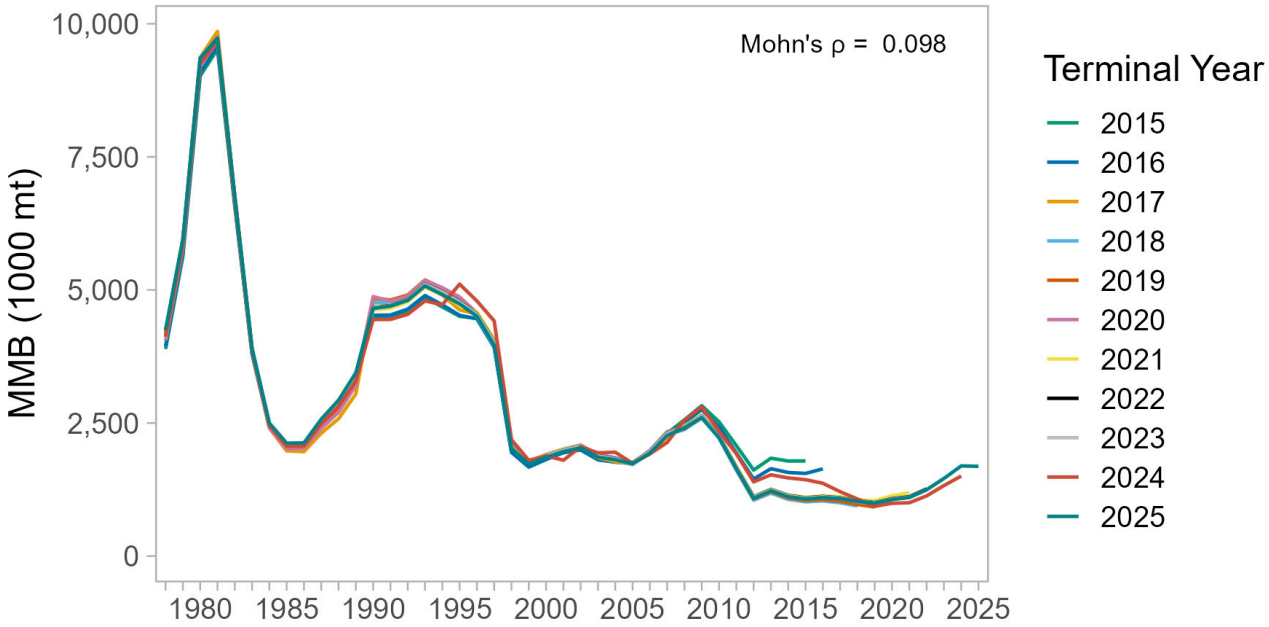
Recruitment

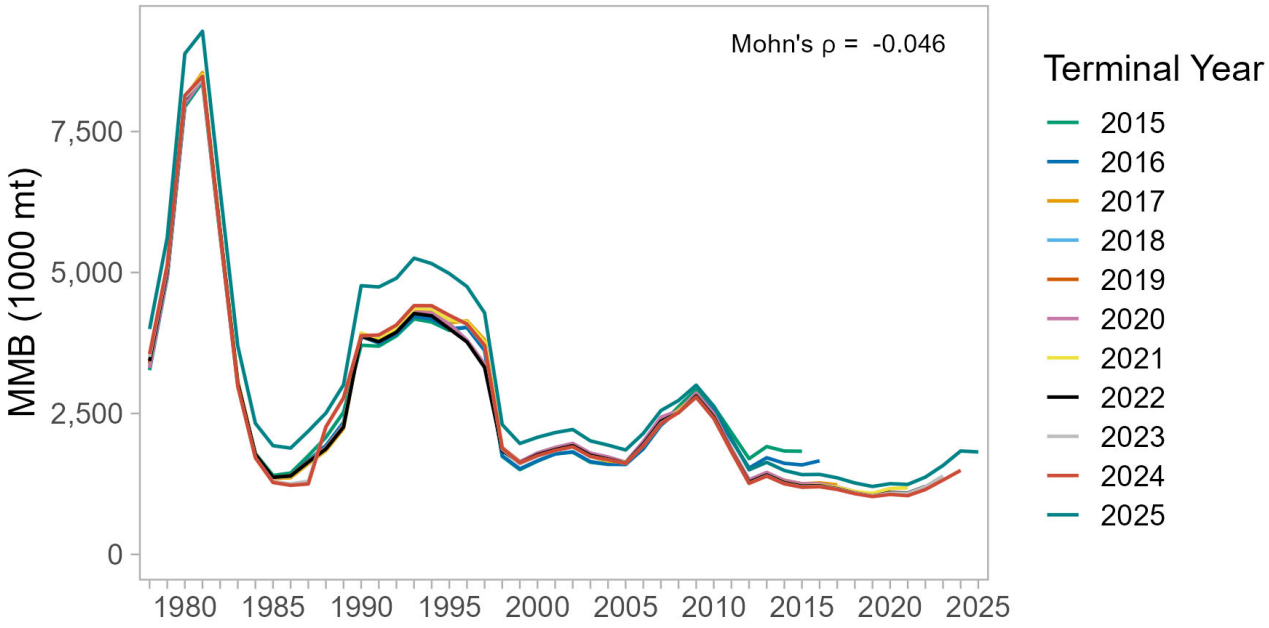


Mature male biomass

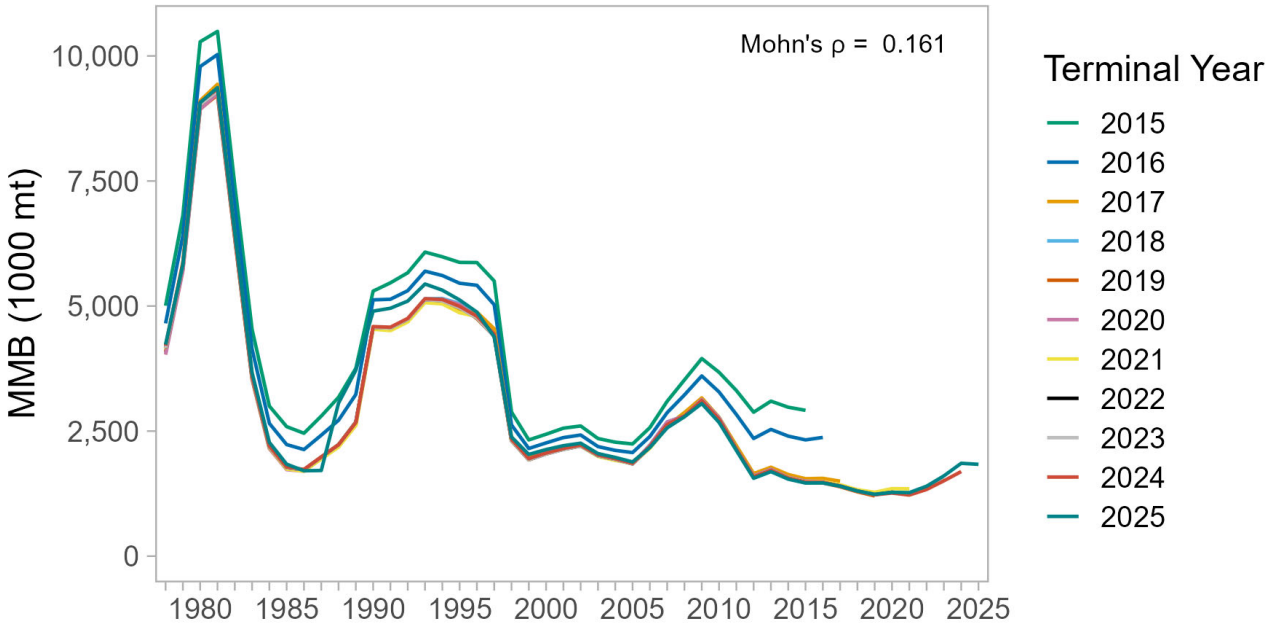


Retrospective analysis - 26.1, 26.2





Retrospective analysis - 26.3



Reference points

	26.1	26.2	26.3
MMB_{2025}	1496	1597	1615
B_{MSY}	2901	2996	3072
MMB/B_{MSY}	0.52	0.53	0.53
F_{OFL}	0.11	0.11	0.11
OFL_{2025}	146	164	163
ABC_{2025}	102	115	114

units: metric tons

Comparison of model scenarios

Model-based index (MBI) of abundance

- accounts for changes in survey station sampling over time
- produces consistent time series of biomass estimates

Models 26.2 and 26.3 include MBI

Model 26.3 estimates q for MBI (q = 0.97, SE = 0.12)

- 26.2 shows improved retrospective pattern compared to 26.1
- 26.3 shows worse retrospective pattern than 26.1
- 26.3 estimates spike in recruitment in 1980's

Author recommendations

Models 26.1 and 26.2

- 26.1: base model with updated GMACS version and data
- 26.2: includes MBI with catchability fixed at 1

Future work

- explore model-based estimation of size compositions
- explore a single model-based index including ADF&G pot survey data
- note: rebuilding update will appear in 2026 SAFE

Thanks!

Jared Weems