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Gulf of Alaska Pacific Ocean Perch

September 2025 - Groundfish Plan Team

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GOA Pacific ocean perch - Overview

- Age structured SCAA in ADMB
- 1 area/fleet/survey
- Sex aggregated
- 2 growth time blocks
- 4 fishery selectivity time blocks
- Estimated:
 - M (prior mean 0.0614, CV 0.1)
 - q (1.15, 0.45)
 - σ_r (1.7, 0.2)
- Assumed yearly deviations from average recruitment



GOA Pacific ocean perch - Overview

- Change in lead author
- Framework change ADMB to RTMB (Model 25.0)
 - Full form of nLL for catch and survey biomass (Model 25.1)
 - Change the 2nd fishery selectivity time block to a gamma function (Model 25.2)
 - Implement Francis reweighting (Model 25.Xa)



GOA Pacific ocean perch – RTMB (Model 25.0)

- Bridge model to RTMB
 - Base ([Model 2020.1](#)) using 2023 data inputs

The RTMB assessment model and the associated comparison code are available on GitHub.

- [RTMB Model Code](#)
- [ADMB vs. RTMB Comparison Code](#)



GOA Pacific ocean perch - RTMB (Model 25.0)

- RTMB Framework Change
 - Maturity estimation moved outside the model
 - Same parameter inputs as the ADMB model, though unbounded in RTMB
- Key outputs
 - Total biomass, spawning biomass, etc. are equivalent
 - Standard deviations and nLL values are near identical, differing by a few decimal points due to numerical precision



GOA Pacific ocean perch - RTMB (Model 25.0)

Item	ADMB	RTMB	Difference
M	0.0743	0.0743	0.0000
q	1.7361	1.7361	0.0000
Log mean recruitment	4.4492	4.4492	0.0000
Log mean F	-2.6131	-2.6131	0.0000
a50_1	6.2965	6.2965	0.0000
delta_1	1.9582	1.9582	0.0000
a50_3	2.5239	2.5239	0.0000
delta_3	5.0275	5.0275	0.0000
a50_4	2.7987	2.7987	0.0000
delta_4	9.6824	9.6824	0.0000
a50_survey	5.4801	5.4801	0.0000
delta_survey	5.8192	5.8192	0.0000
2024 Total biomass	649,941.00	649,941.11	-0.1070
2024 Spawning biomass	227,991.00	227,991.19	-0.1945
B40	137,447.00	137,447.18	-0.1781
2024 OFL	47,466.30	47,466.28	0.0154
2024 F OFL	0.1192	0.1192	0.0000
2024 ABC	39,718.90	39,718.89	0.0104
2024 F ABC	0.0990	0.0990	0.0000

Parameter standard deviations are the same between ADMB and RTMB (not shown)



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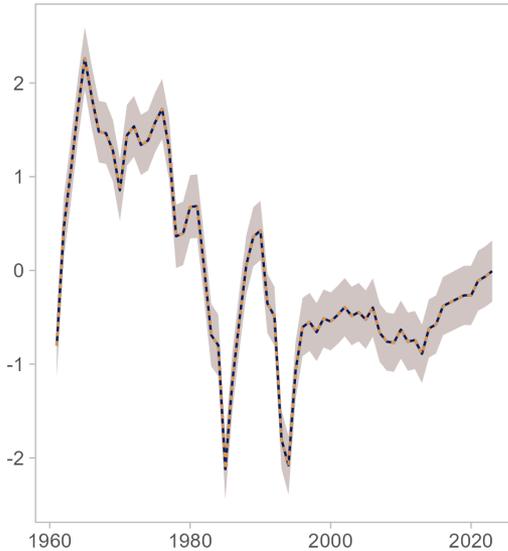
GOA Pacific ocean perch - RTMB (Model 25.0)

nLL	ADMB	RTMB	Difference
Catch	0.2181	0.2181	0.0000
Survey biomass	16.4416	16.4416	0.0000
Fishery age comp	25.0028	25.0028	0.0000
Survey age comp	29.2822	29.2822	0.0000
Fishery length comp	66.2258	66.2259	-0.0001
Recruitment devs	10.6027	10.6027	0.0000
F regularity	6.1405	6.1405	0.0000
SPR penalty	0.0000	0.0000	0.0000
M prior	1.8299	1.8299	0.0000
q prior	0.4241	0.4241	0.0000
Sigma R prior	7.9849	7.9849	0.0000
Sub total	164.1526	164.1527	-0.0001

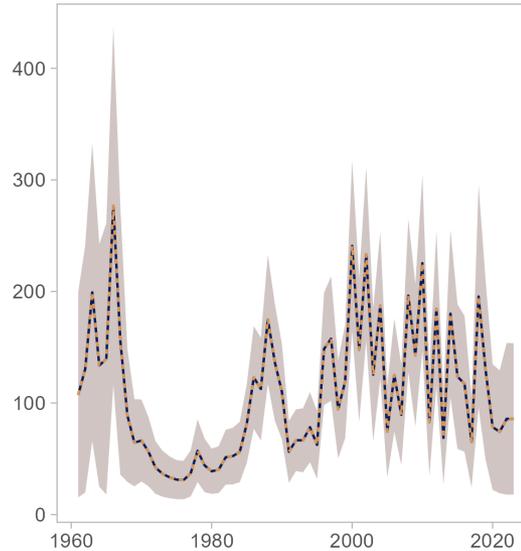


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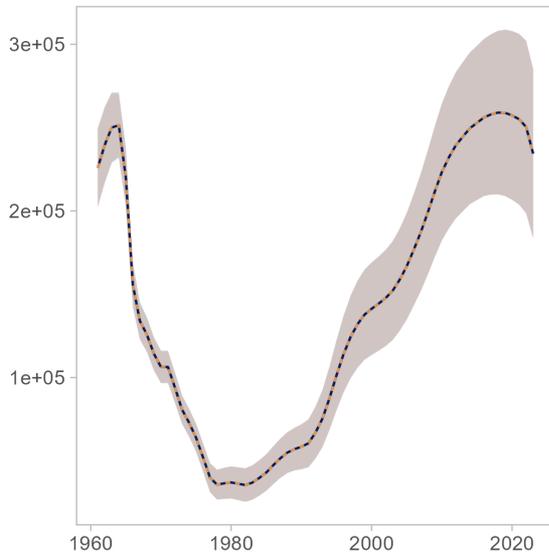
Log Fishing Mortality Devs



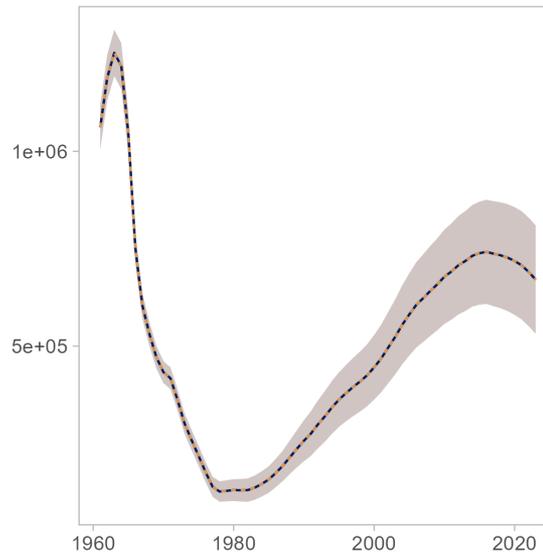
Recruitment



Spawning Biomass



Total Biomass



Trends and standard deviations are the same between ADMB and RTMB

Model

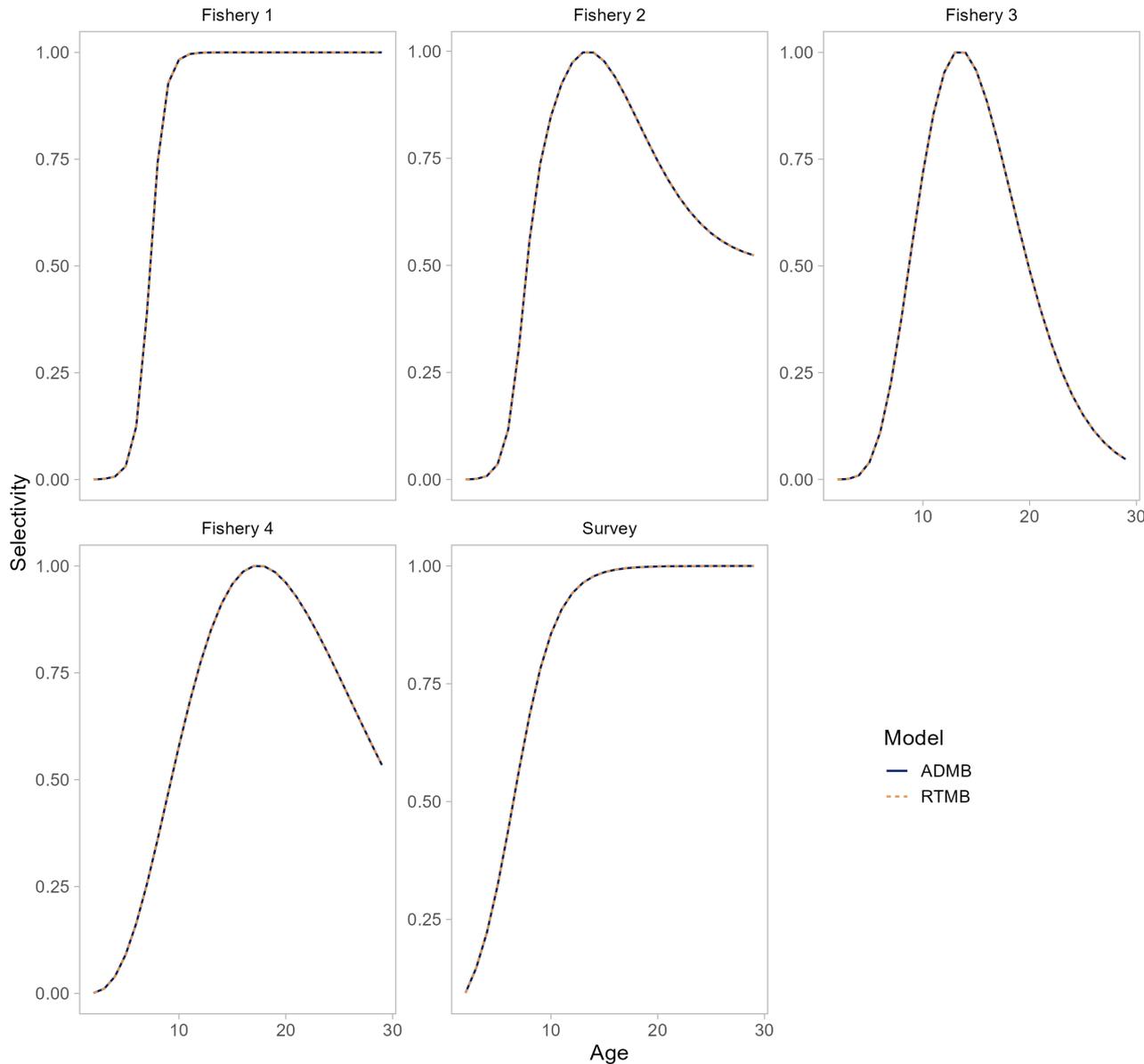


Year



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GOA Pacific ocean perch - RTMB (Model 25.0)



Fishery and survey selectivity are the same between ADMB and RTMB



GOA Pacific ocean perch - RTMB (Model 25.0)

The ADMB and RTMB models are equivalent

- Recommend moving to RTMB

The following model changes are iteratively added to the RTMB model

- Full form of nLL for catch and survey biomass (Model 25.1)
- Change the 2nd fishery selectivity time block to a gamma function (Model 25.2)
- Francis reweighting of compositional data (Model 25.Xa)



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Model updates - Catch nLL (Model 25.1)

Historically: catch calculated as a simplified weighted sum-of-squares on lognormal distributed data

$$nll = \lambda \sum_y \left(\log(C_y) - \log(\hat{C}_y) \right)^2$$

Where the annual weight $\lambda=50$

$$nll = \lambda \sum_y \log(\sigma_c) + \frac{1}{2(\sigma_c)^2} \left(\log(C_y) - \log(\hat{C}_y) \right)^2$$

Where the standard deviation of the catch on the log scale is:

$$\sigma_c = \sqrt{\log(1 + CV_{catch}^2)}$$

The annual $\lambda=50$ is equivalent to $CV=0.10$



Model updates - Survey nLL (Model 25.1)

Historically: simplified nLL :

$$\text{nll} = \lambda \sum_y \frac{(\log(I_y) - \log(\hat{I}_y))^2}{2 \left(\frac{SE(I_y)}{I_y} \right)^2}$$

Updated: full form of the lognormal nLL, incorporates a bias correction:

$$\text{nll} = \lambda \sum_y \left[\log(\sigma_y) + \frac{1}{2} \left(\frac{\log\left(\frac{I_y}{\hat{I}_y^{bc}}\right)}{\sigma_y} \right)^2 \right]$$

where, σ_y is the standard deviation on the log scale, and \hat{I}_y^{bc} is the bias-

corrected model prediction. $\sigma_y = \sqrt{\log\left(1 + \frac{SE(I_y)^2}{I_y^2}\right)}$ and

$$\hat{I}_y^{bc} = \hat{I}_y \times \exp\left(\frac{\sigma_y^2}{2}\right)$$



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Model updates – Fishery Selectivity (Model 25.2)

Four fishery selectivity time blocks:

- 1961-1976: Massive catches and overexploitation, foreign fisheries. Age data generally unavailable.
- 1977-1995: Change from foreign to domestic fleet, dominated by large factory trawlers, generally towed deeper and further from port.
- 1996-2006: Emergence of smaller catcher-boats, semi-pelagic trawling and fishing cooperatives. The length of the fishing season was also greatly expanded.
- 2007-Present: This period coincides with the Rockfish Program in the Central Gulf, a fishing cooperative that has influenced the behavior and fleet composition of the fishery.

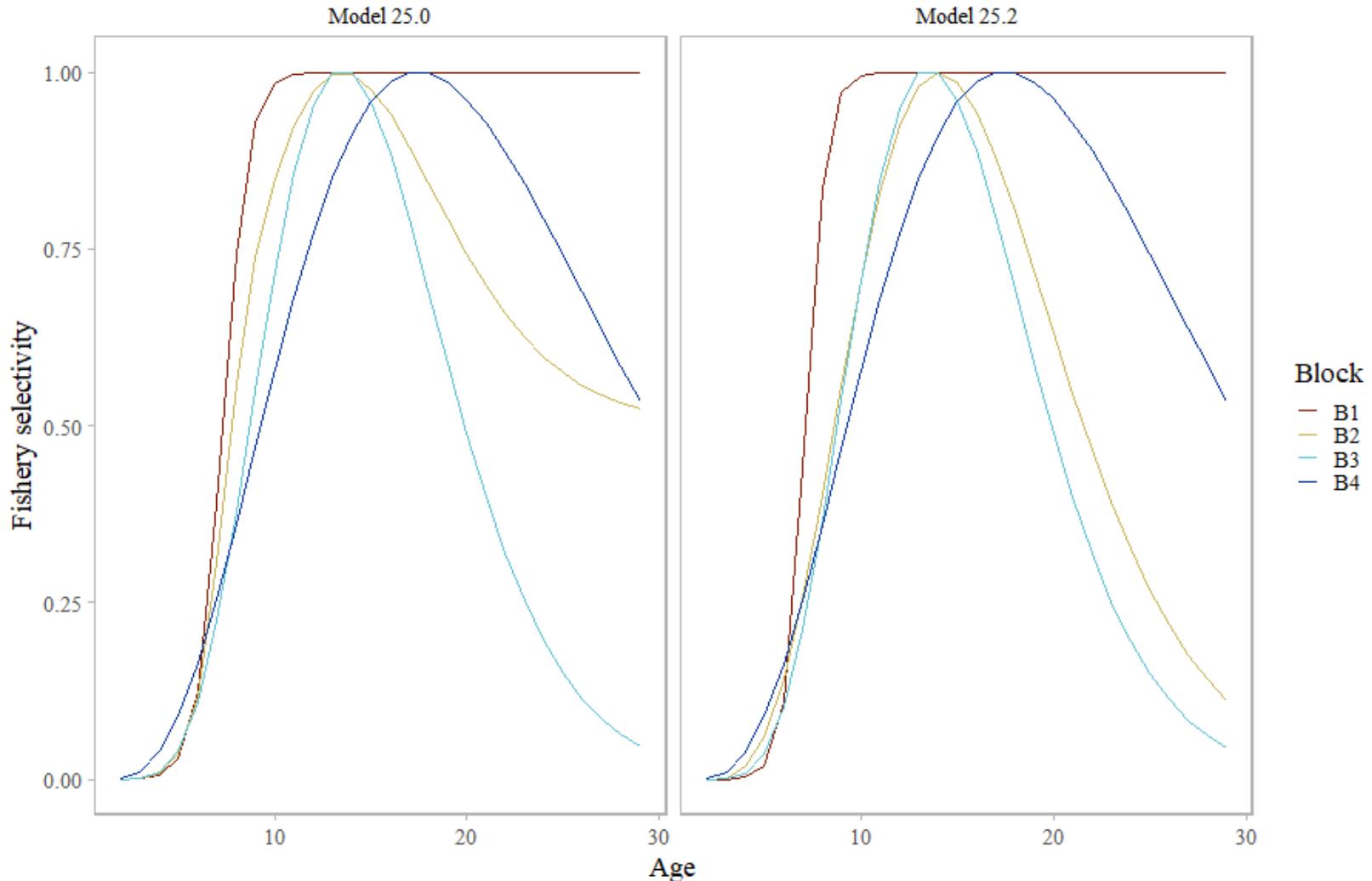


Model updates – Fishery Selectivity (Model 25.2)

- Block 1 (≤ 1976): Estimated using a logistic selectivity curve.
- Block 2 (1977–1995): Calculated as the average of the curves from Block 1 and Block 3.
- Block 3 (1996–2006): Estimated using a gamma function (dome-shaped) selectivity curve.
- Block 4 (≥ 2007): Estimated using a gamma function selectivity curve.
- By averaging two curves, Block 2 is imposing a shape that may not accurately reflect the true selectivity during that period.



Model updates – Fishery Selectivity (Model 25.2)



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Model updates – Francis reweight (“a” Models)

The Francis reweighting method (Francis 2011; TA1.8) was used to rebalance the influence of the age and size composition data. All composition data components were initially given a weight of 1.0.

Results

- Fishery age composition: ~2.8
- Survey age composition: ~2.0
- Fishery size composition: ~0.5



Results

nLL	Reweighted					
	m25.0	m25.1	m25.2	m25.0a	m25.1a	m25.2a
Catch	0.2180	-87.1079	-87.1519	0.1346	-87.1916	-87.1940
Survey	16.4416	7.1398	7.2336	17.1892	7.9515	7.9359
Fish age	25.0028	25.0405	26.6269	64.6063	64.2468	65.4342
Survey age	29.2822	29.3050	29.4795	54.0828	53.7983	53.1489
Fish size	66.2259	66.2495	65.7574	38.5566	38.5669	39.1706
Recruitment	10.6027	10.4306	8.8914	12.2152	11.9558	13.6457
F regularity	6.1405	6.1610	6.0169	6.3002	6.3238	5.7957
SPR penalty	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
M prior	0.4241	0.4524	0.2830	0.1485	0.1651	0.1829
q prior	1.8299	1.8760	2.5295	0.6144	0.6499	0.6904
Sigma R prior	7.9849	8.0188	8.3253	7.6706	7.7207	7.3971
Sub total	164.1527	67.5657	67.9916	201.5183	104.1873	106.2074
# Parameters	168	168	170	168	168	170

Note: m25.0(a) is not directly comparable to the other models due to structural likelihood changes



Results

Item	m25.0	m25.1	m25.2	m25.0a	m25.1a	m25.2a
M	0.0743	0.0745	0.0769	0.0686	0.0688	0.0691
a50-1	6.2965	6.2958	6.1283	6.1884	6.1881	6.0098
a50-2	2.5239	2.5228	2.5690	2.5148	2.5141	2.6210
a50-3	2.7987	2.7987	2.5286	2.7460	2.7461	2.5202
a50-4	N/A	N/A	2.8002	N/A	N/A	2.7496
delta-1	1.9582	1.9563	1.5857	1.8663	1.8655	1.4743
delta-2	5.0275	5.0222	5.9092	4.9106	4.9064	6.4689
delta-3	9.6824	9.6681	4.9872	9.2424	9.2347	4.9449
delta-4	N/A	N/A	9.6805	N/A	N/A	9.2765
a50 survey	5.4801	5.4723	5.4425	4.9025	4.8998	4.9312
delta survey	5.8192	5.8043	5.7522	5.2794	5.2732	5.3115
q	1.7361	1.7598	1.6100	1.4673	1.4870	1.5072
sigma R	0.7644	0.7631	0.7517	0.7767	0.7747	0.7877
Log mean recruitment	4.4492	4.4562	4.5778	4.4765	4.4845	4.4737
Log mean F	-2.6131	-2.6188	-2.6663	-2.7271	-2.7330	-2.6963
2024 Total biomass	649,939	654,617	720,106	734,920	739,725	731,703
2024 Spawning biomass	227,991	229,412	251,853	268,324	269,872	266,341
2024 OFL	47,466	47,883	53,959	49,483	49,909	49,574
2024 F OFL	0.1192	0.1196	0.1229	0.1078	0.1081	0.1086
2024 ABC	39,719	40,066	45,133	41,659	42,016	41,718
2024 F ABC	0.0990	0.0993	0.1020	0.0901	0.0904	0.0907



Results

M consistent across models
decreases with reweighting

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M	0.0743	0.0745	0.0769	0.0686	0.0688	0.0691
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Results

q drops with selectivity change
decreases with reweighting

Item	m25.0	m25.1	m25.2	m25.0a	m25.1a	m25.2a
M	0.0743	0.0745	0.0769	0.0686	0.0688	0.0691
a50-1	6.2965	6.2958	6.1283	6.1884	6.1881	6.0098
a50-2	2.5239	2.5228	2.5690	2.5148	2.5141	2.6210
a50-3	2.7987	2.7987	2.5286	2.7460	2.7461	2.5202
a50-4	N/A	N/A	2.8002	N/A	N/A	2.7496
delta-1	1.9582	1.9563	1.5857	1.8663	1.8655	1.4743
delta-2	5.0275	5.0222	5.9092	4.9106	4.9064	6.4689
delta-3	9.6824	9.6681	4.9872	9.2424	9.2347	4.9449
delta-4	N/A	N/A	9.6805	N/A	N/A	9.2765
a50 survey	5.4801	5.4723	5.4425	4.9025	4.8998	4.9312
delta survey	5.8192	5.8043	5.7522	5.2794	5.2732	5.3115
<i>q</i>	1.7361	1.7598	1.6100	1.4673	1.4870	1.5072
sigma R	0.7644	0.7631	0.7517	0.7767	0.7747	0.7877
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Results

Sigma R consistent throughout

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Results

Total and spawning biomass increase by model iteration Are consistent when reweighted

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Results –nLL

Model 25.0 → Model 25.1

- nLL is not directly comparable
- Slight increase in total & spawning biomass, OFL and ABC
- No substantive changes in parameters



Results – change fishery selectivity

Model 25.1 → Model 25.2

- Adds 2 parameters to estimate selectivity
- Increase in total & spawning biomass, OFL and ABC
- q decreases from 1.76 to 1.61
- M remains at 0.0769 (somewhat elevated for a long-lived species)



Results – Reweight

For all models

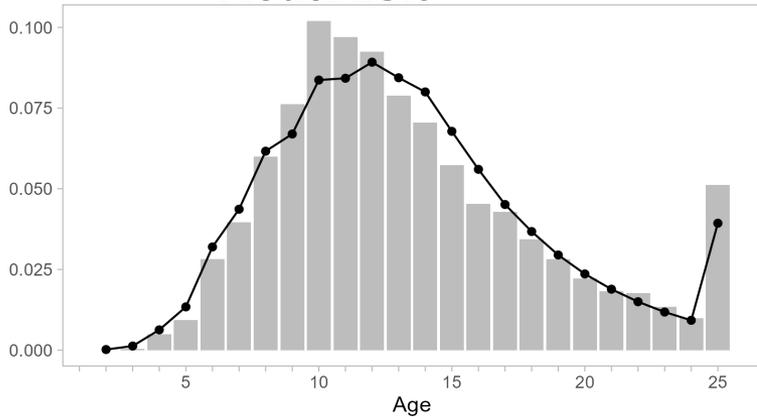
- M & q decrease
- Total & spawning biomass, OFL, and ABC are stable between all models
- Survey selectivity is shifted to younger ages
- *Note: When reweighting on peels (retrospective data) all comp weights < 1*

The last year of composition data is highly influential & there is a conflict between ages and length data

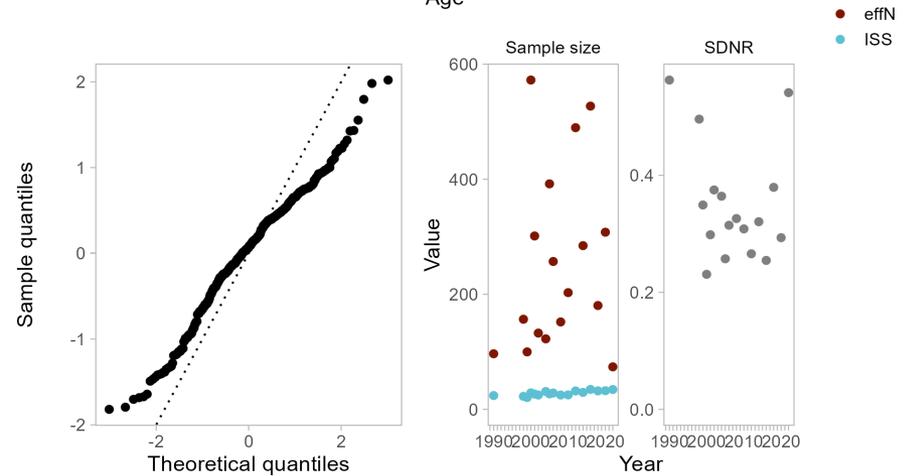
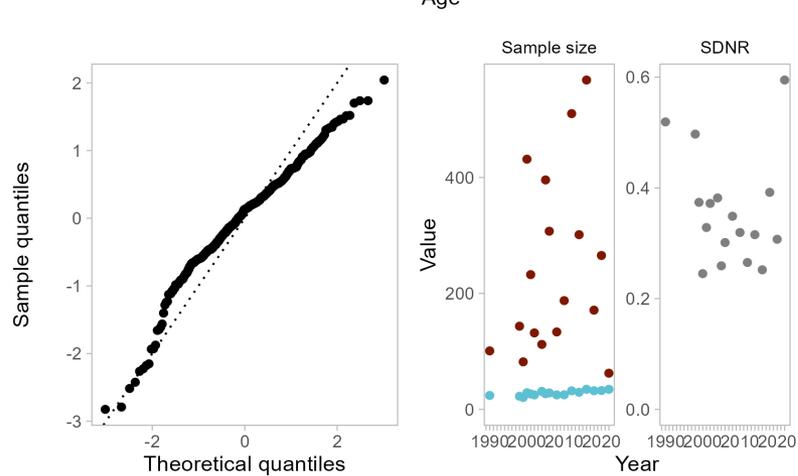
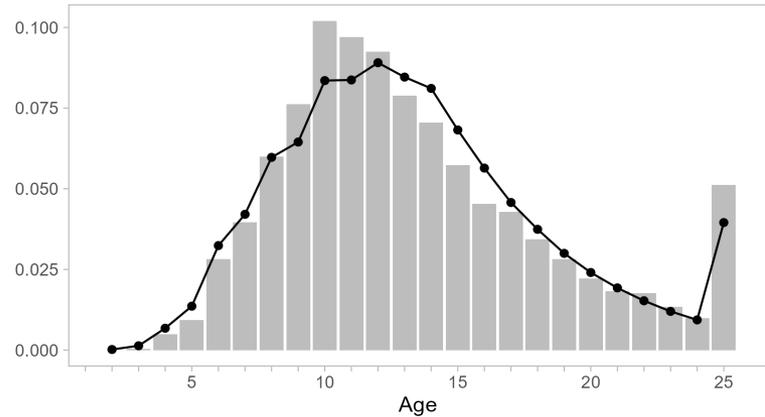


Results – Fishery age comps

Model 25.0



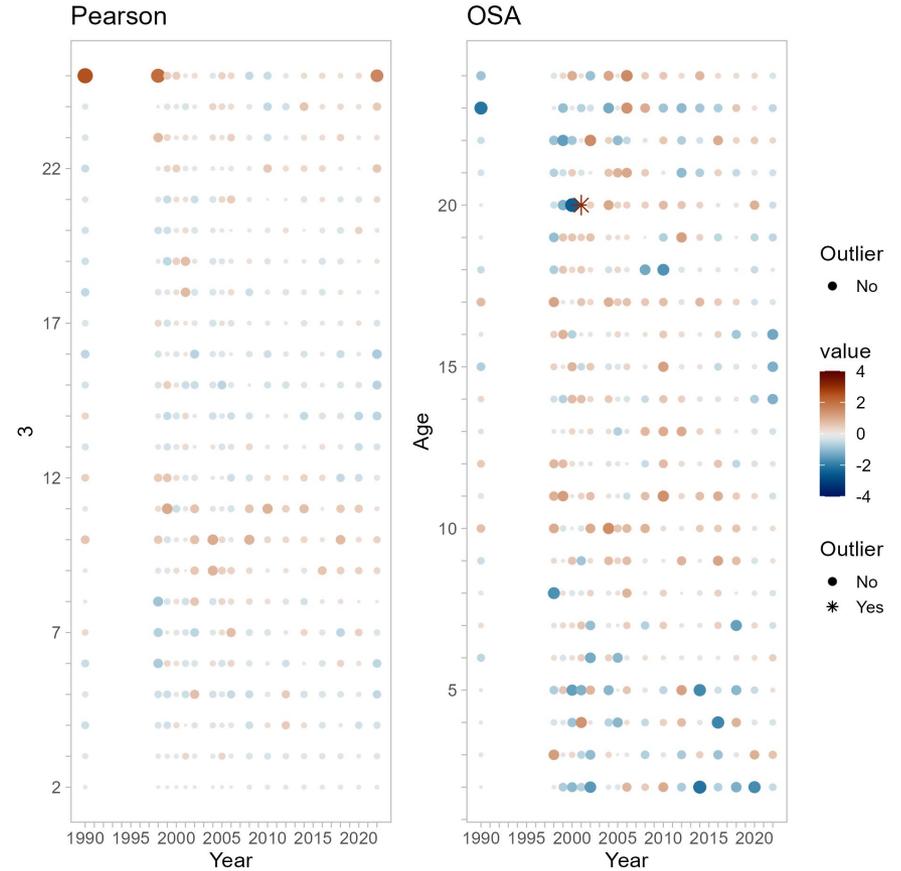
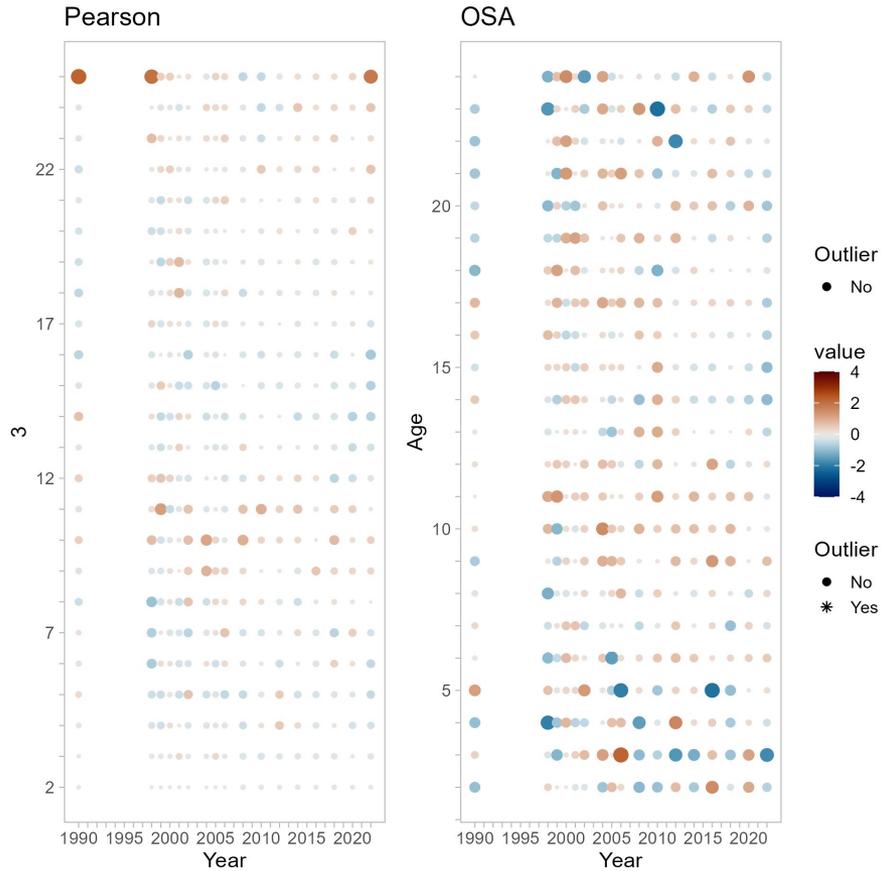
Model 25.2a



Results – Fishery age comps

Model 25.0

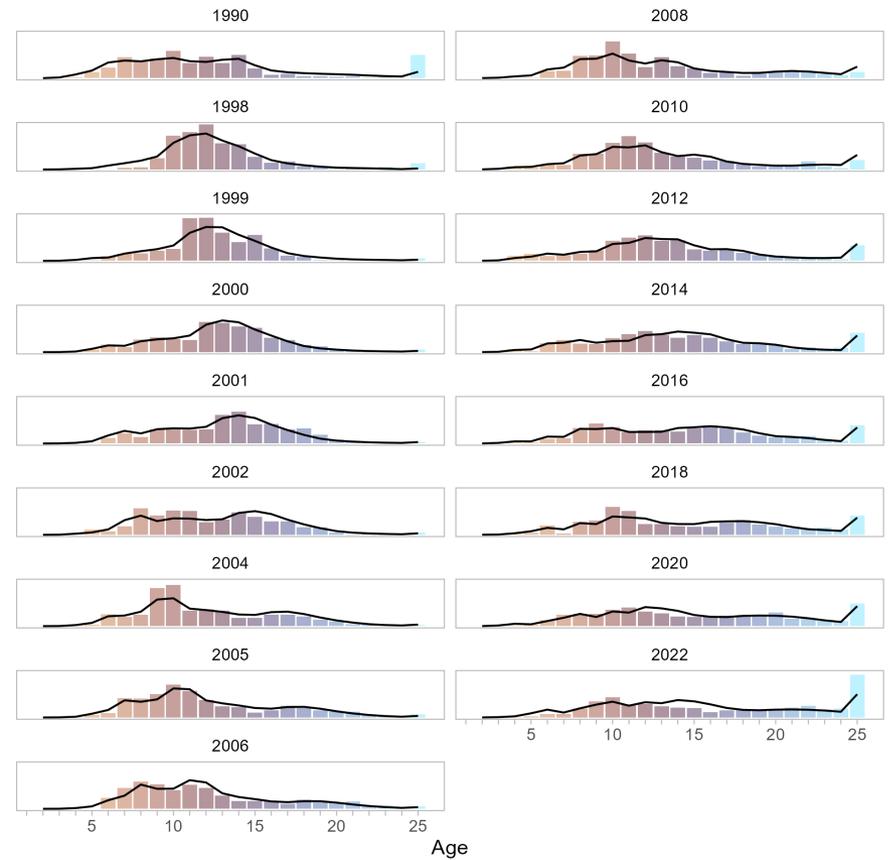
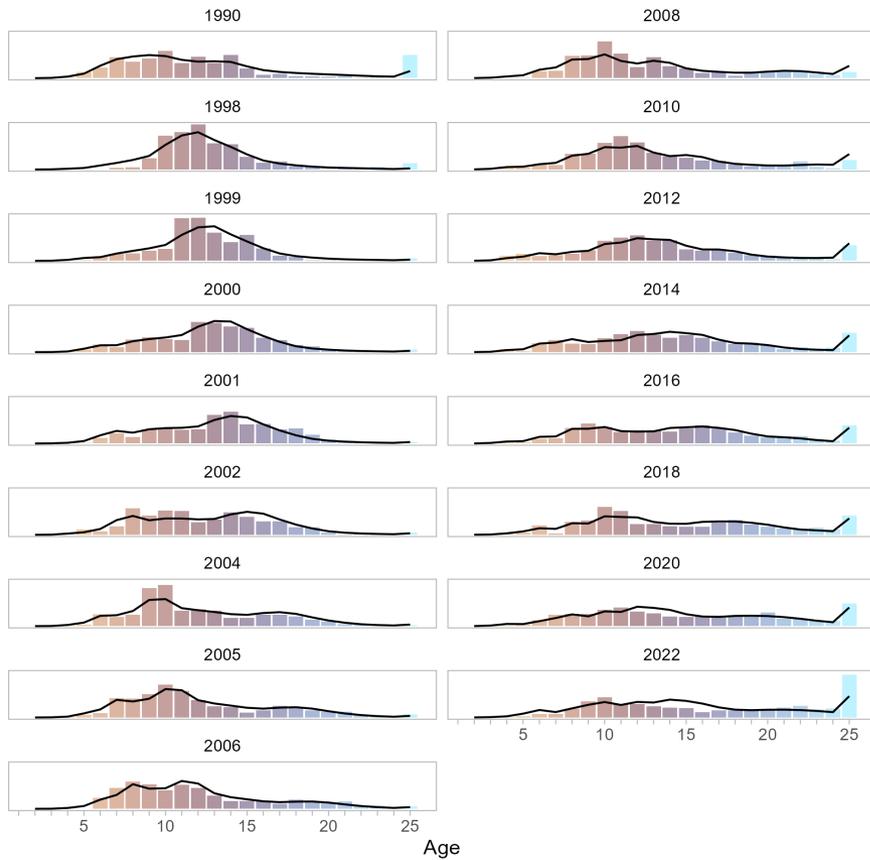
Model 25.2a



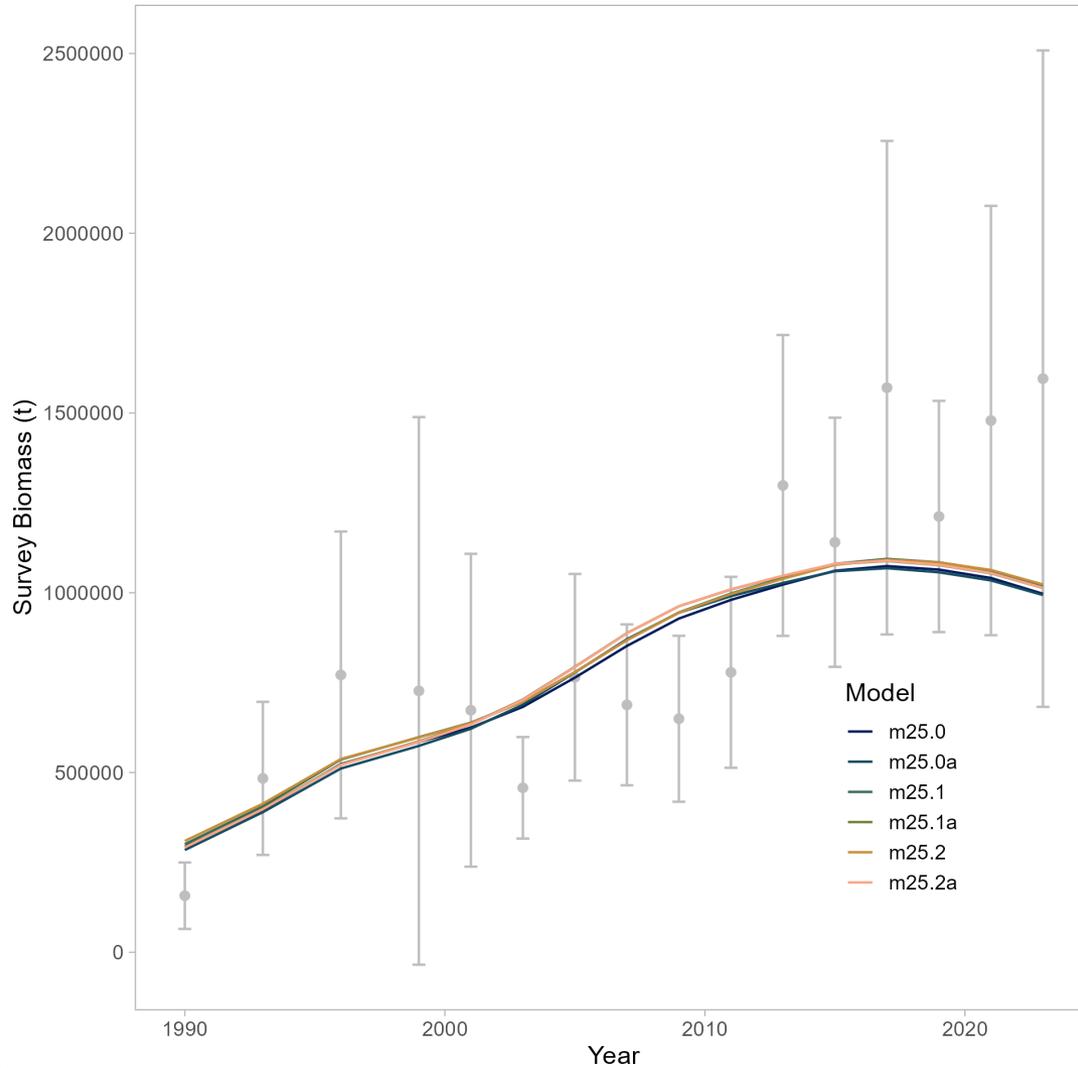
Results – Fishery age comps

Model 25.0

Model 25.2a

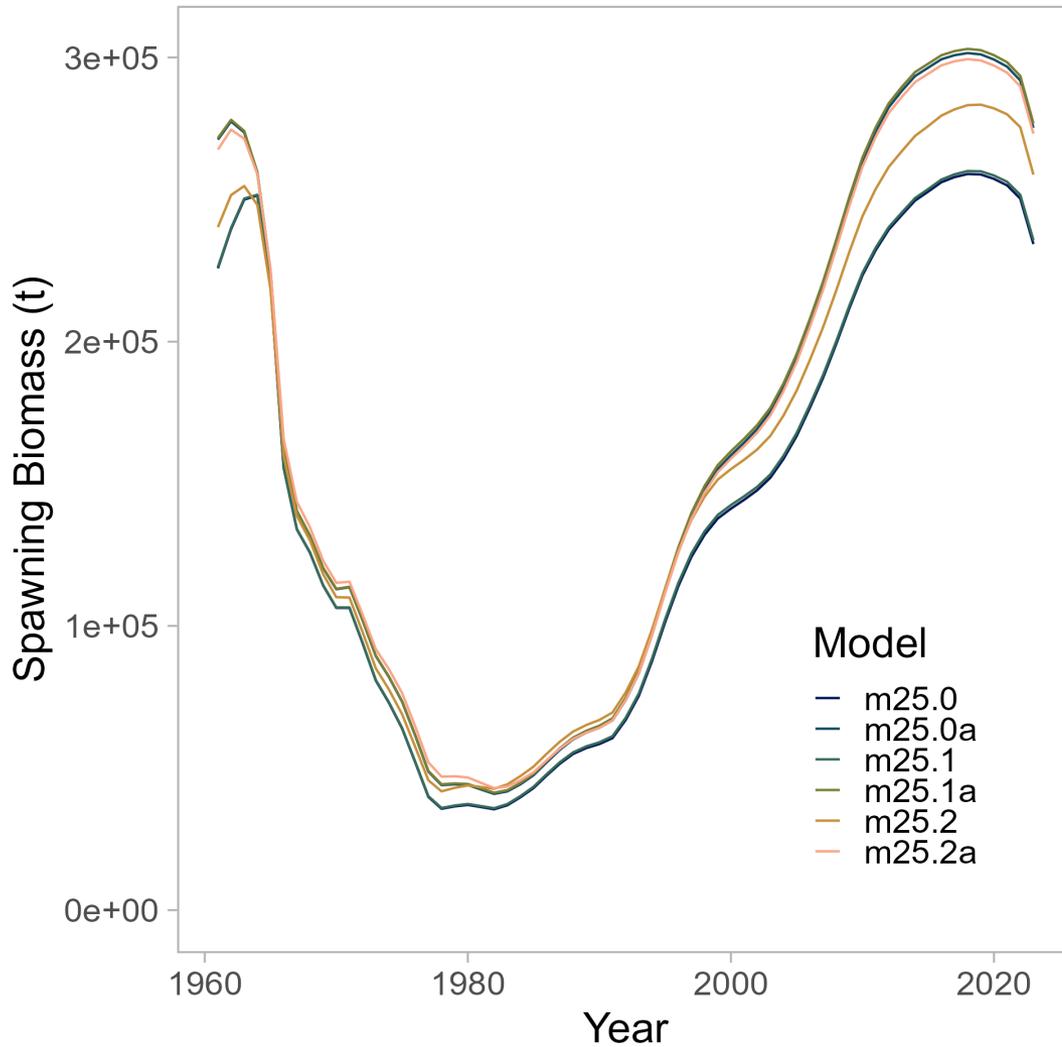


Results – Survey Biomass



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Results – Spawning Biomass



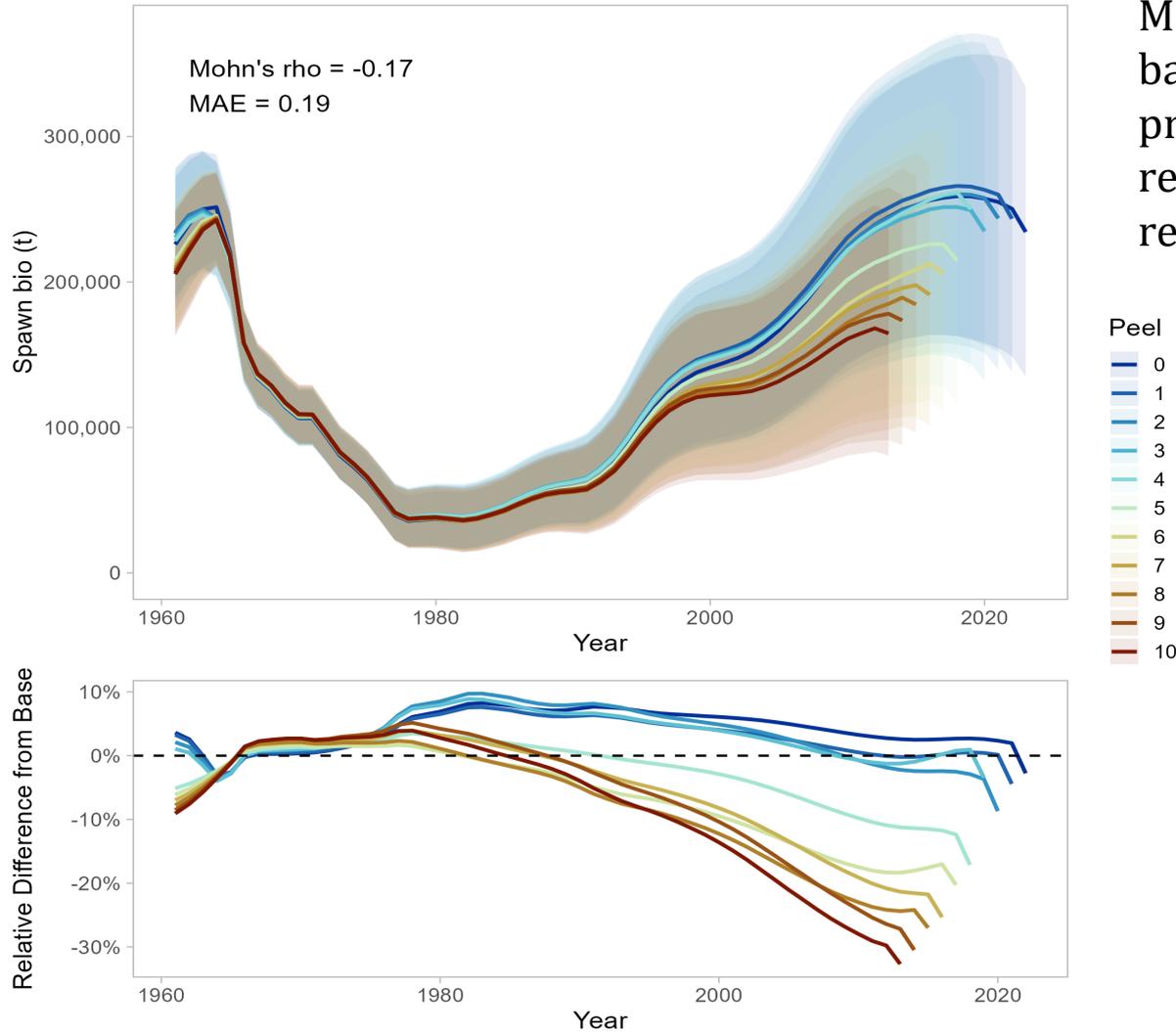
Results – Retrospective

- Note the document retro was incorrect...
- ADMB retro uses the mean MCMC values, the document shows the retro based upon MLE values
- Additionally, the ADMB retro filters for any “current year” fishery age comp.
- The RTMB code has been updated to filter data in the same manner, also the code can run Francis reweighting
 - Can also estimate sigmaR, but some peels do not converge when reweighting



Results – Retrospective

Retrospective Pattern: Spawn bio

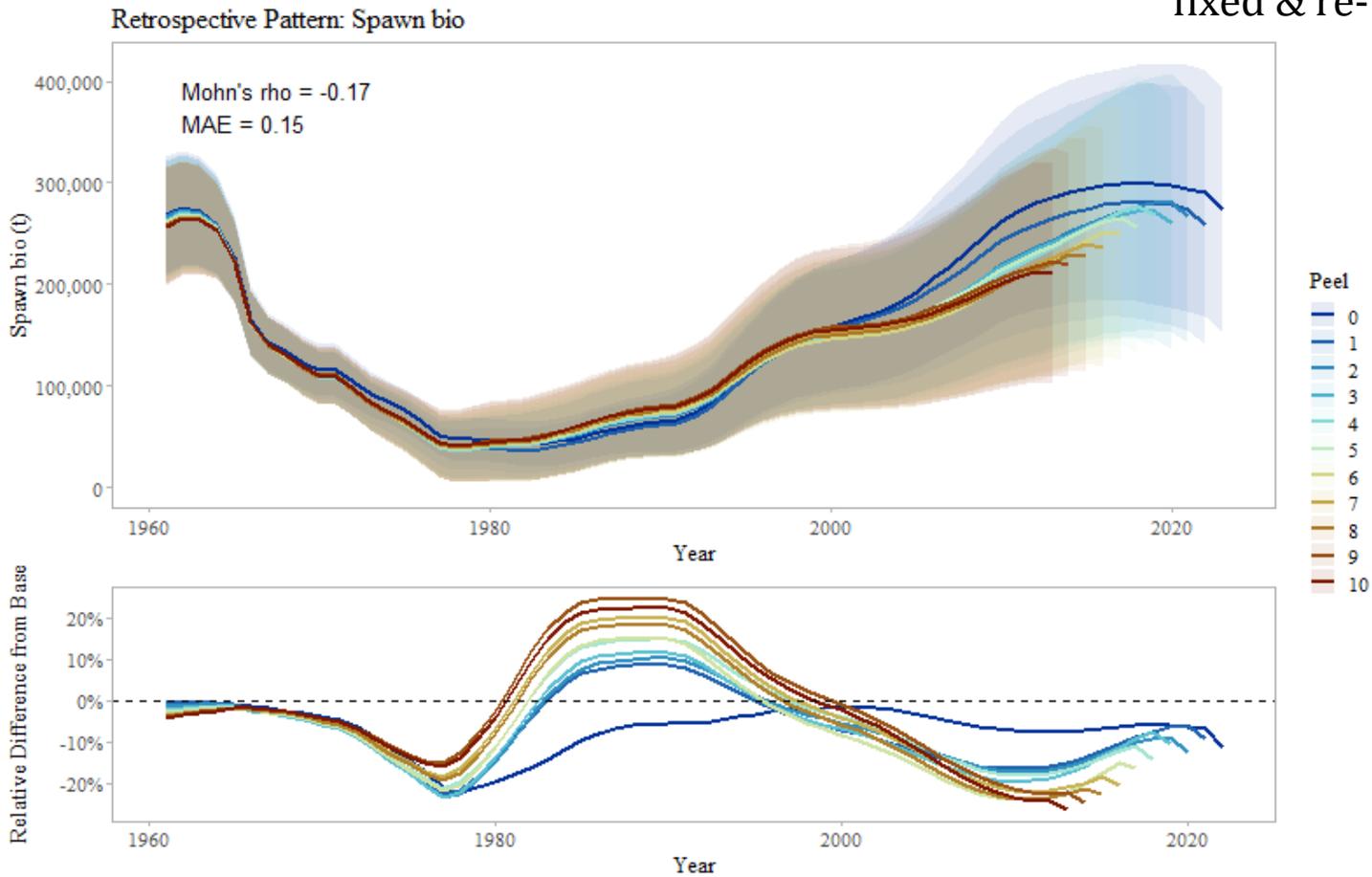


Model 25.0 retrospective based on MLE values – produces the same results as ADMB model retro based upon MLE



Results – Retrospective

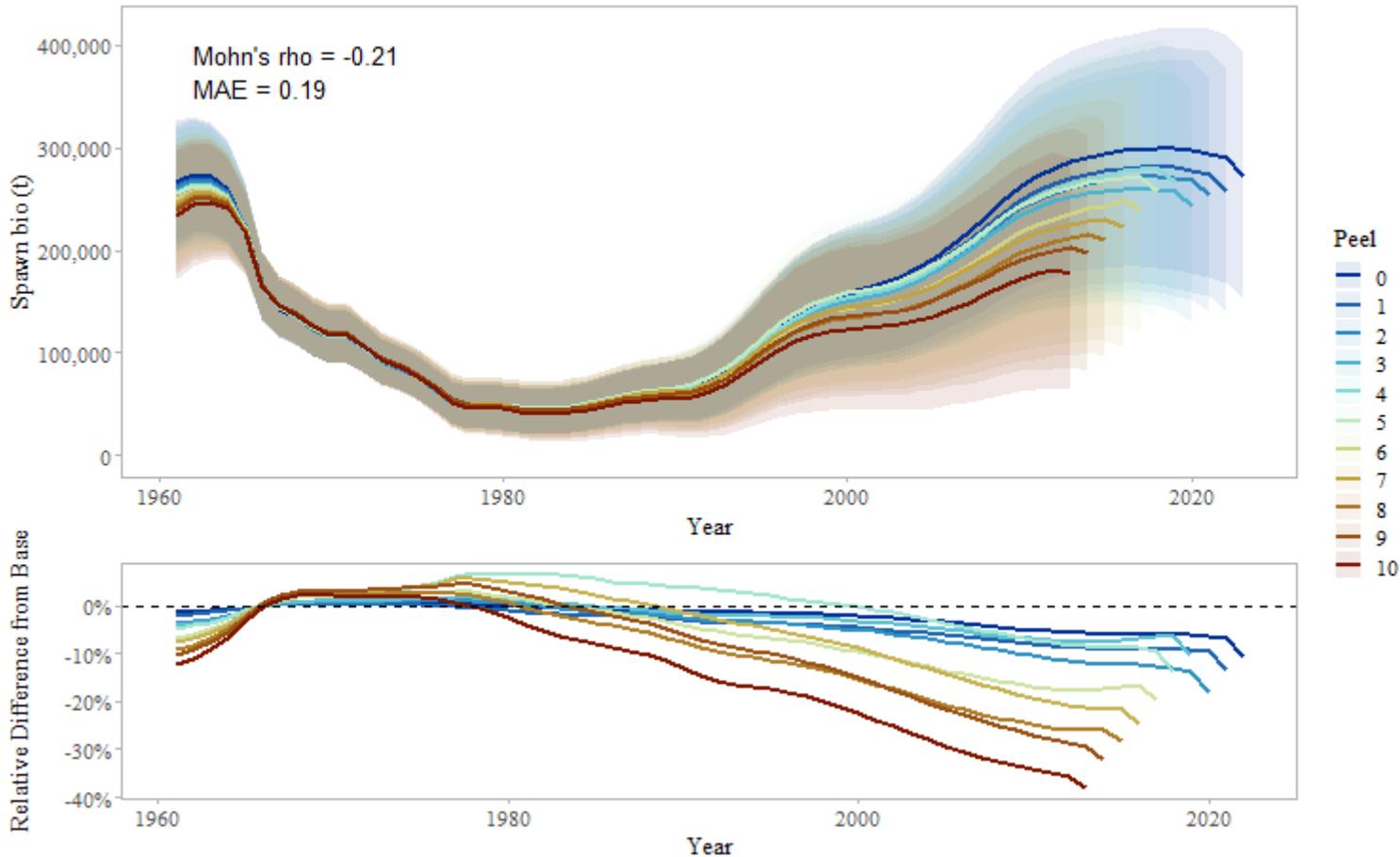
Model 25.2a
retrospective, sigmaR
fixed & re-weighting



Results – Retrospective

Model 25.2a
retrospective, estimated
 σ_R , no reweighting

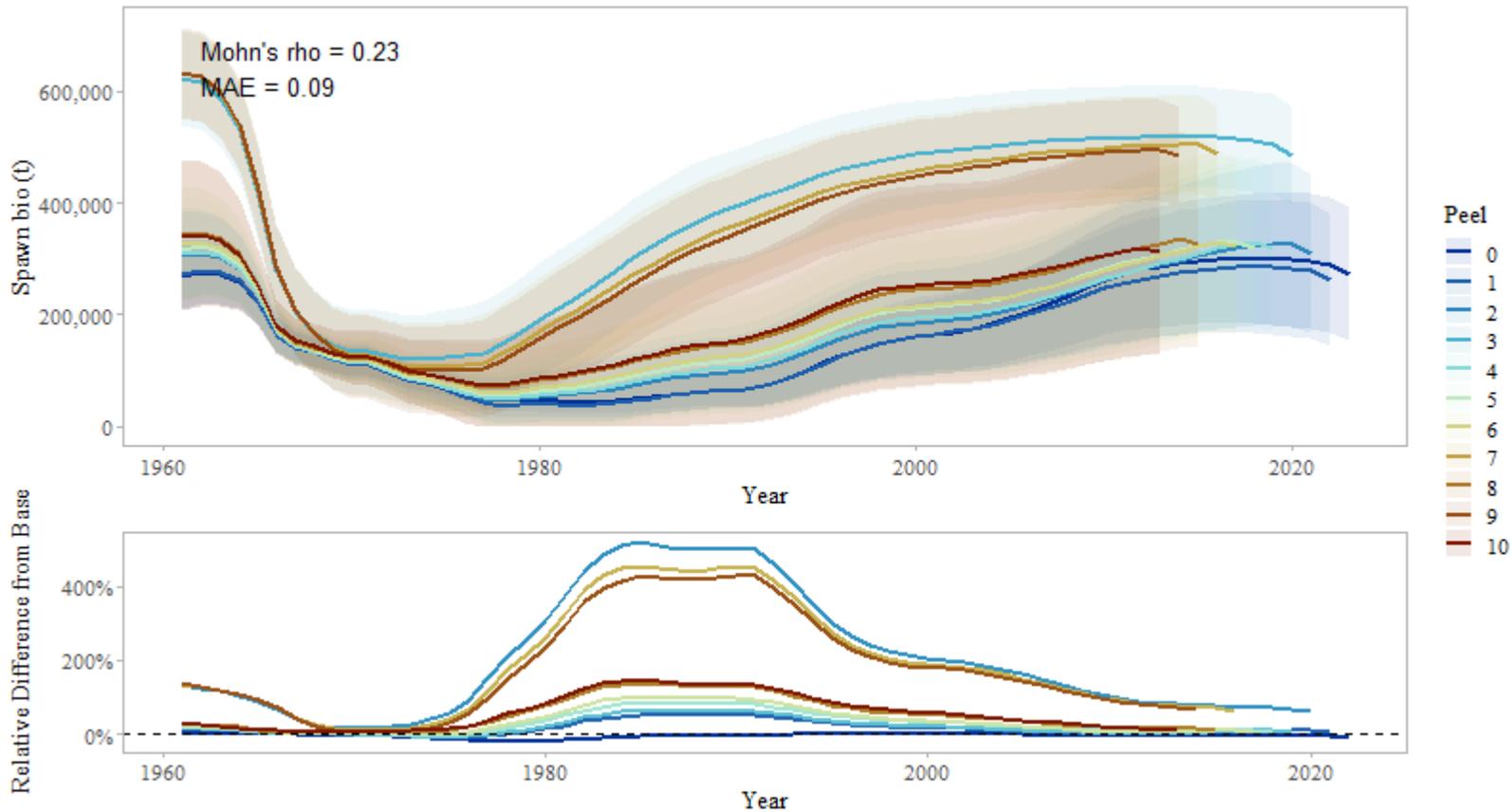
Retrospective Pattern: Spawn bio



Results – Retrospective

Model 25.2a
retrospective, estimated
sigmaR, reweighting –
some lack convergence

Retrospective Pattern: Spawn bio



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Results – Reweight

Item	m25.0	m25.1	m25.2	m25.0a	m25.1a	m25.2a
M	0.0743	0.0745	0.0769	0.0686	0.0688	0.0691
a50-1	6.2965	6.2958	6.1283	6.1884	6.1881	6.0098
a50-2	2.5239	2.5228	2.5690	2.5148	2.5141	2.6210
a50-3	2.7987	2.7987	2.5286	2.7460	2.7461	2.5202
a50-4	N/A	N/A	2.8002	N/A	N/A	2.7496
delta-1	1.9582	1.9563	1.5857	1.8663	1.8655	1.4743
delta-2	5.0275	5.0222	5.9092	4.9106	4.9064	6.4689
delta-3	9.6824	9.6681	4.9872	9.2424	9.2347	4.9449
delta-4	N/A	N/A	9.6805	N/A	N/A	9.2765
a50 survey	5.4801	5.4723	5.4425	4.9025	4.8998	4.9312
delta survey	5.8192	5.8043	5.7522	5.2794	5.2732	5.3115
q	1.7361	1.7598	1.6100	1.4673	1.4870	1.5072
sigma R	0.7644	0.7631	0.7517	0.7767	0.7747	0.7877
Log mean recruitment	4.4492	4.4562	4.5778	4.4765	4.4845	4.4737
Log mean F	-2.6131	-2.6188	-2.6663	-2.7271	-2.7330	-2.6963
2024 Total biomass	649,939	654,617	720,106	734,920	739,725	731,703
2024 Spawning biomass	227,991	229,412	251,853	268,324	269,872	266,341
2024 OFL	47,466	47,883	53,959	49,483	49,909	49,574
2024 F OFL	0.1192	0.1196	0.1229	0.1078	0.1081	0.1086
2024 ABC	39,719	40,066	45,133	41,659	42,016	41,718
2024 F ABC	0.0990	0.0993	0.1020	0.0901	0.0904	0.0907



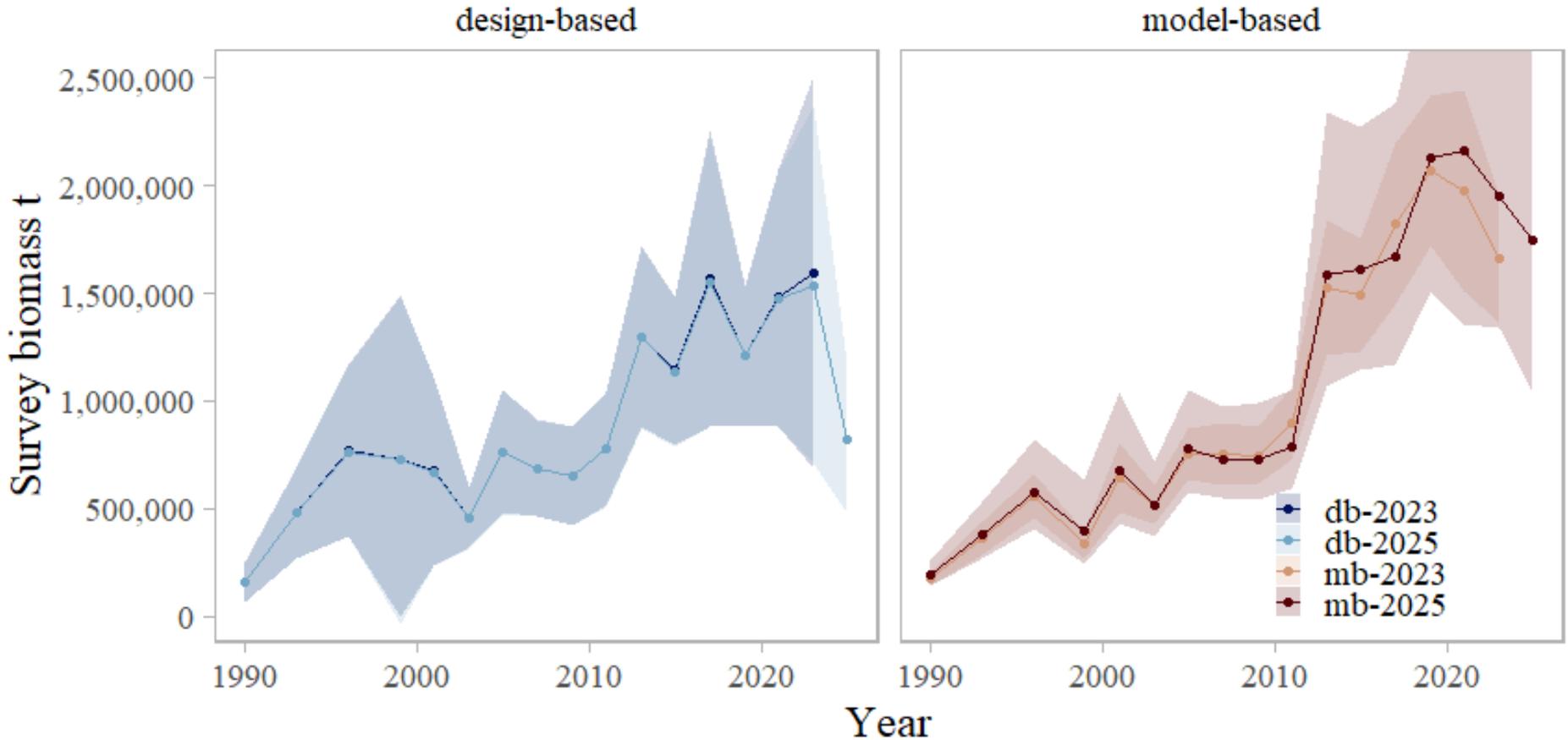
Results – Propose

Bring forward Model 25.2a in November

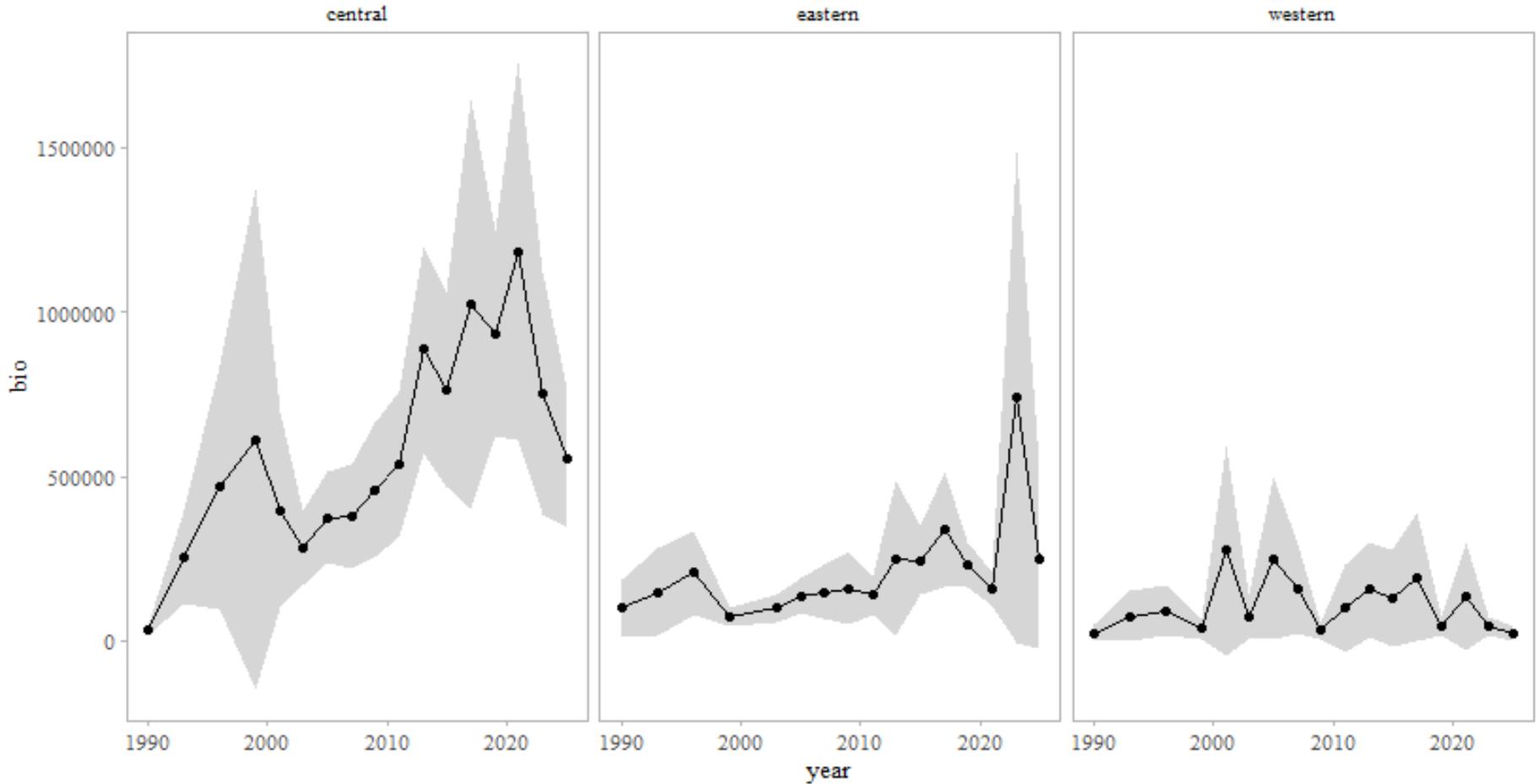
- RTMB
- Changes to nLL
- Estimates 2nd fishery selectivity time block
- Francis reweighting



Heads-up: survey biomass



Heads-up: survey biomass



Questions?



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