Northern Rockfish
GOA Groundfish Plan Team

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November, 2024

NOAA FISHERIES

Teams or SSC Comments

"…transition from the ADMB RE variants to the rema framework…"(SSC, Oct 2022)

- We propose using VAST-based area biomass estimates for determining apportionment.

"…investigate potential mechanisms for the underlying pattern [to the fishery length composition] …." (SSC December 2022)

- Ongoing

"The SSC requests the authors investigate a model run with a fixed M." (SSC December 2022)

- Estimates of *q* appear better behaved in the current assessment. Examined a fixed *M* model run, though with the tight CV on the *M* prior results were essentially the same (not presented).

"The SSC also requests …bubble plots of Pearson residuals for all age and length data… and inclusion of a figure showing changes in previous VAST estimates due to updating with new survey information." (SSC December 2022)

- Pearson and one-step ahead residual plots are presented, as well as a figure showing previous VAST estimates.

"The SSC reiterates its past support of empirical research projects on maturity and skip spawning..."(SSC December 2022)

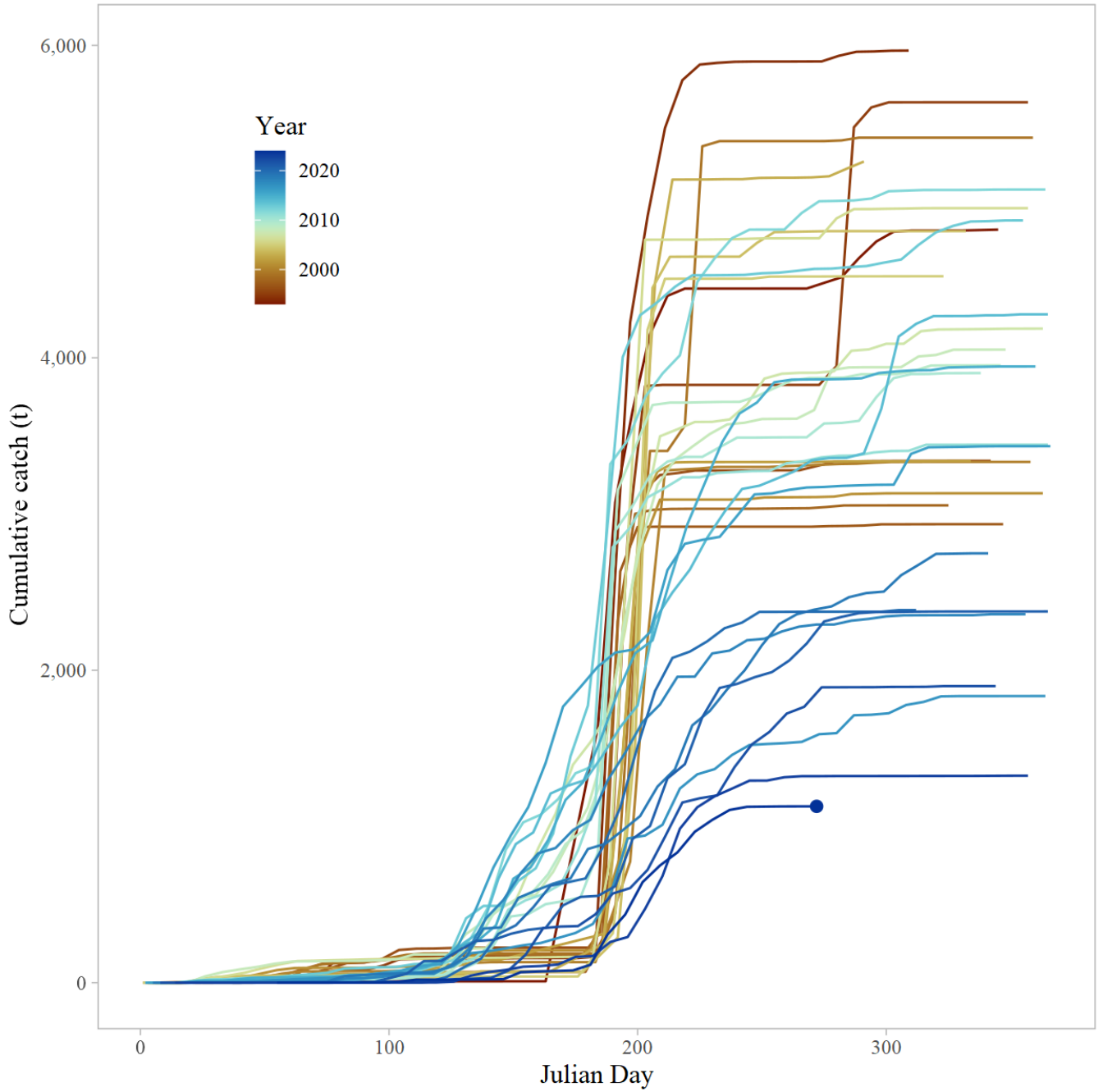
Ongoing. Updated biological maturity ogive with additional data (Conrath 2019) and maturity estimation has been moved out of the model to facilitate future examinations of functional (skip spawning) rates on model outputs.

Data Summary

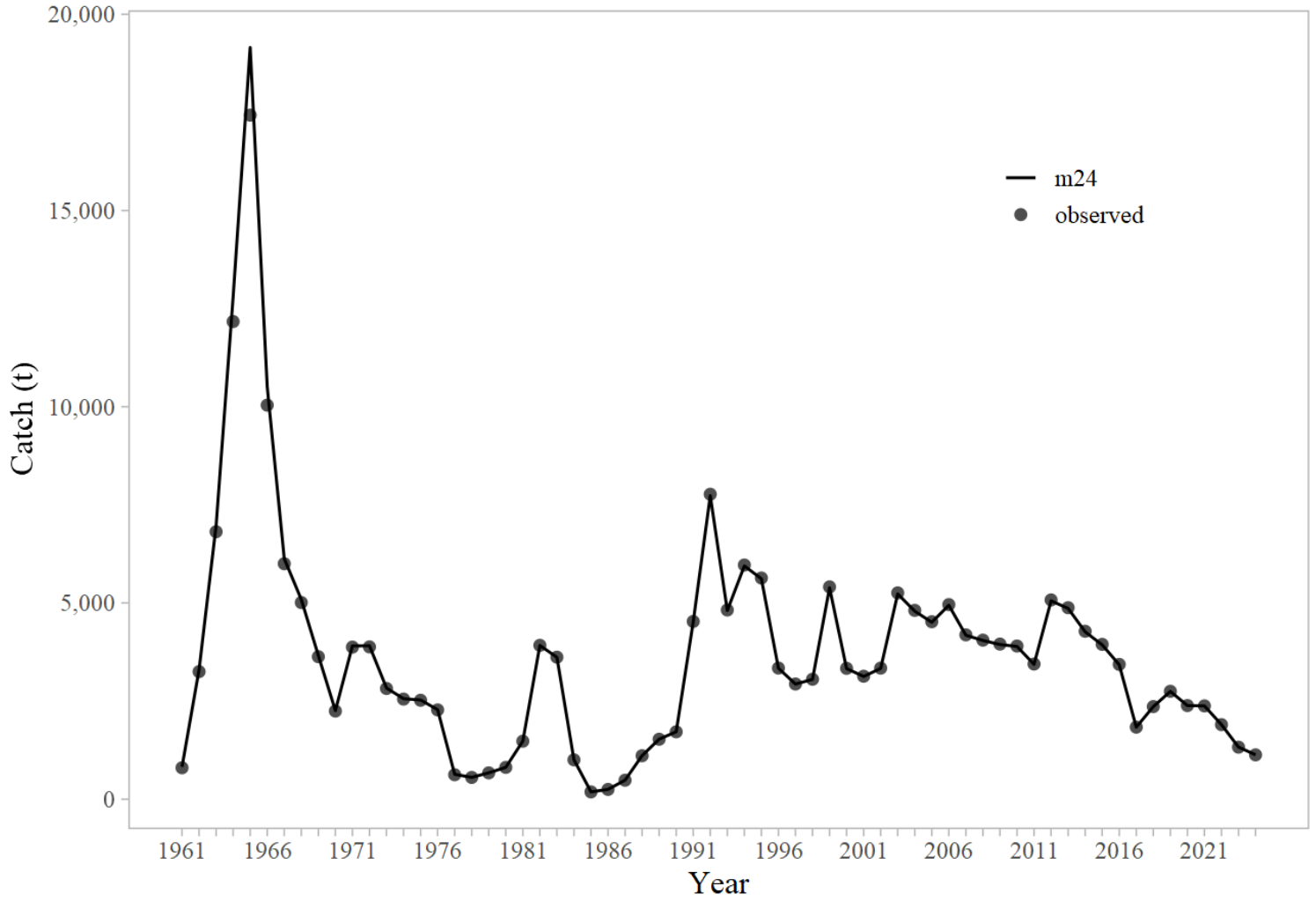
Source	Data	Years
NMFS Groundfish survey	Survey biomass	1990-1999 (triennial), 2001-2021 (biennial), **2023**
	Age composition	1990-1999 (triennial), 2003-2021 (biennial), **2023**
U.S. trawl fishery	Catch	1961-2020, **2023-2024**
	Age composition	1998-2002, 2004-2006, 2008-2020 (biennial), **2022**
	Length composition	1991-1997, 2003, 2007-2021 (biennial), **2023**
Also:		
afscISS	Survey ISS	
Conrath 2019	Maturity	

Inputs
Catch

- Substantial decrease in catch in recent years (market conditions)
- Plot shows 1993-2024



Inputs
Catch

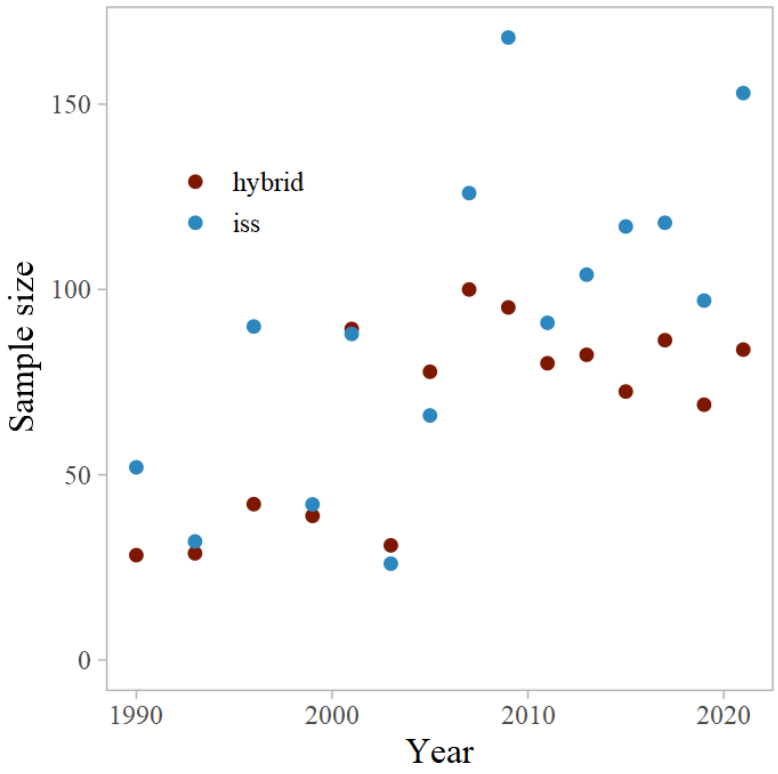


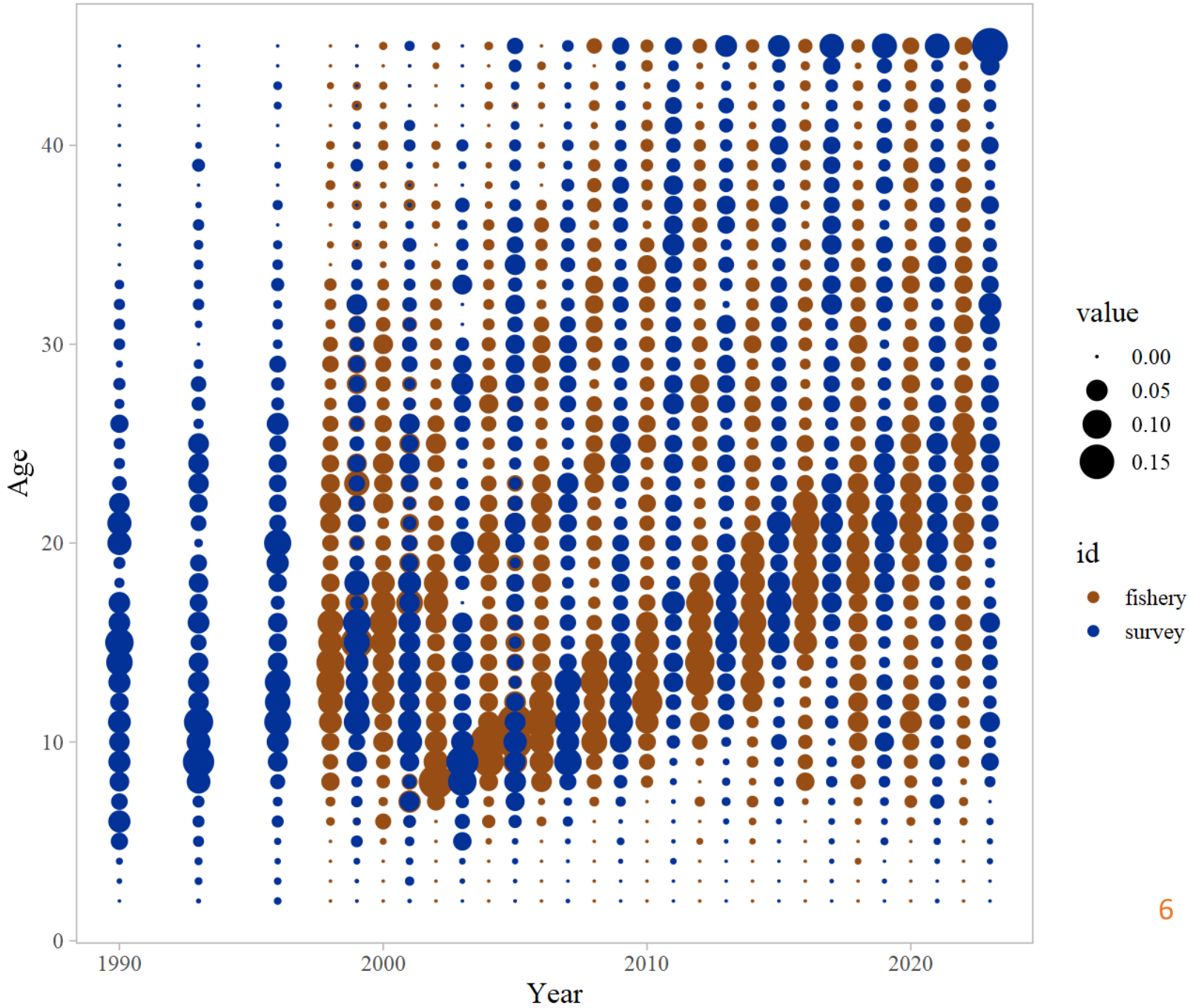
Data weighting: 5, 50

Inputs
age composition

Data weighting: 0.5

Survey comp ISS



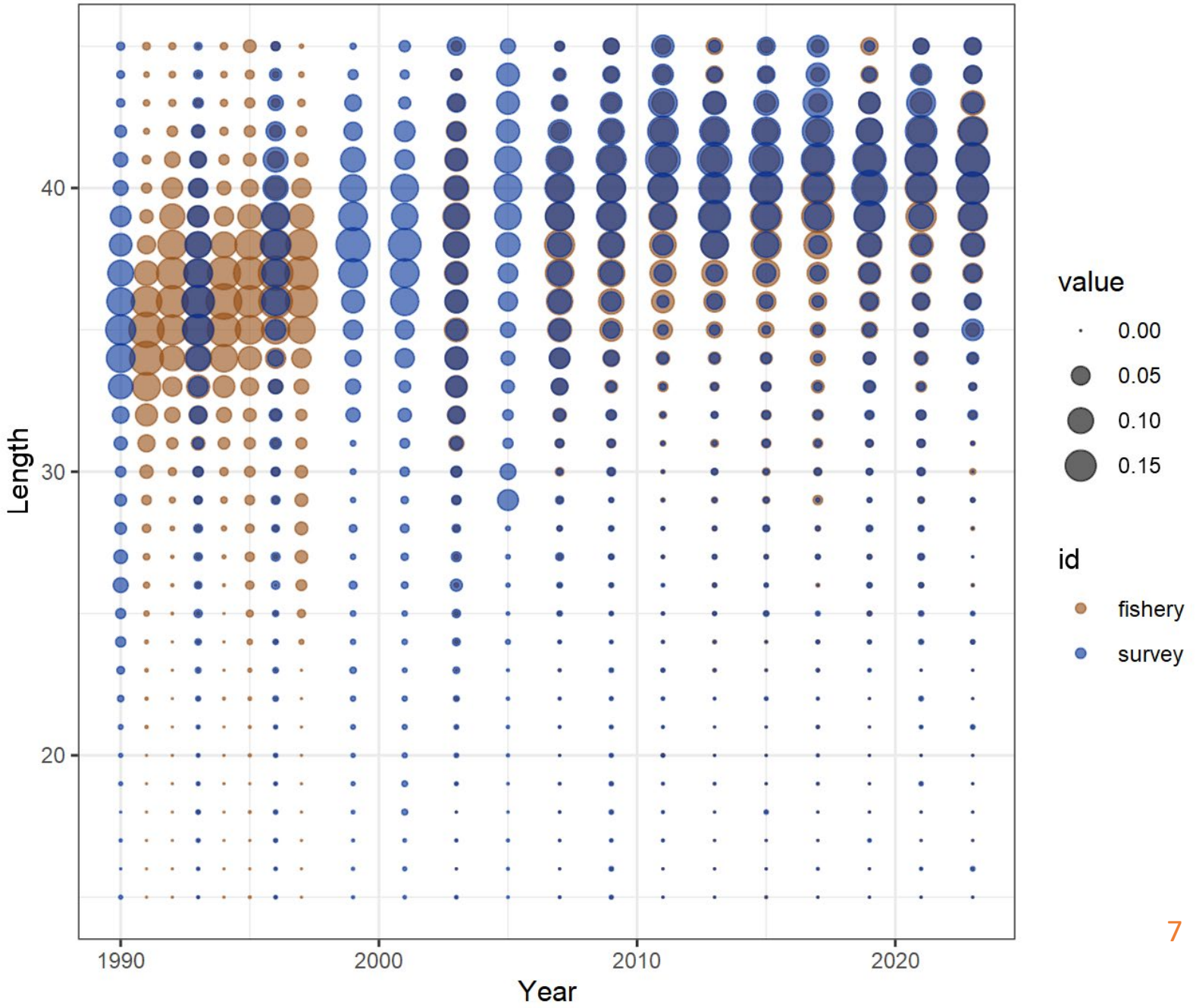


Inputs
size composition

Survey size compositions are not used in the model

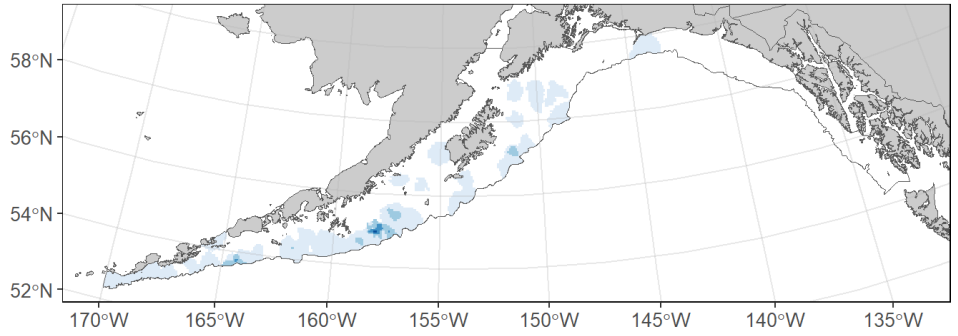
Note mismatch in lengths and ages from pre-1999

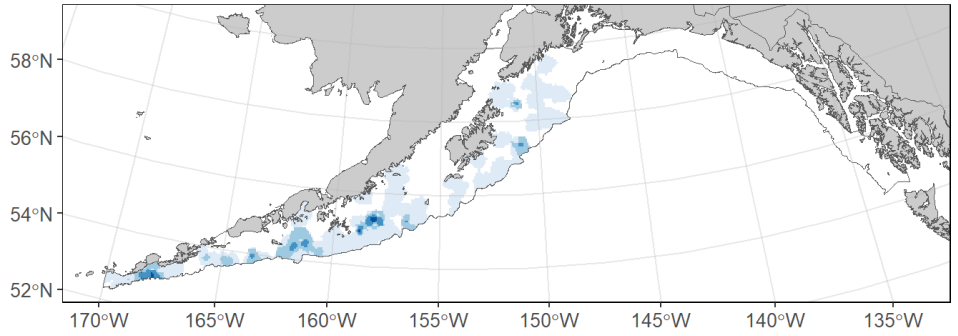
Data weighting: 0.5

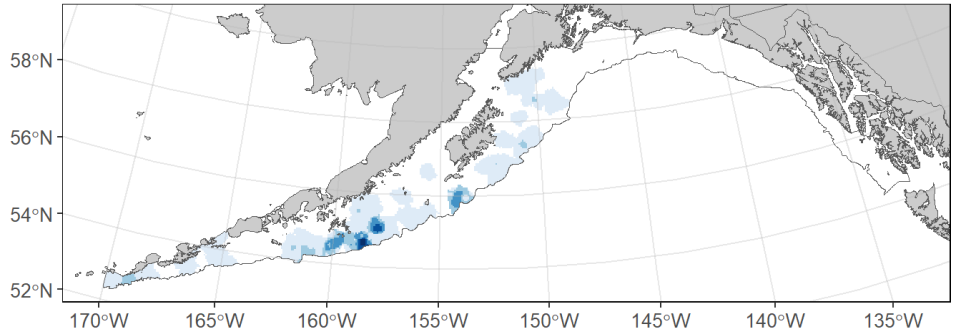


Survey - biomass

Patchy distribution, trawl survey has had variable effectiveness (or large population swings?)



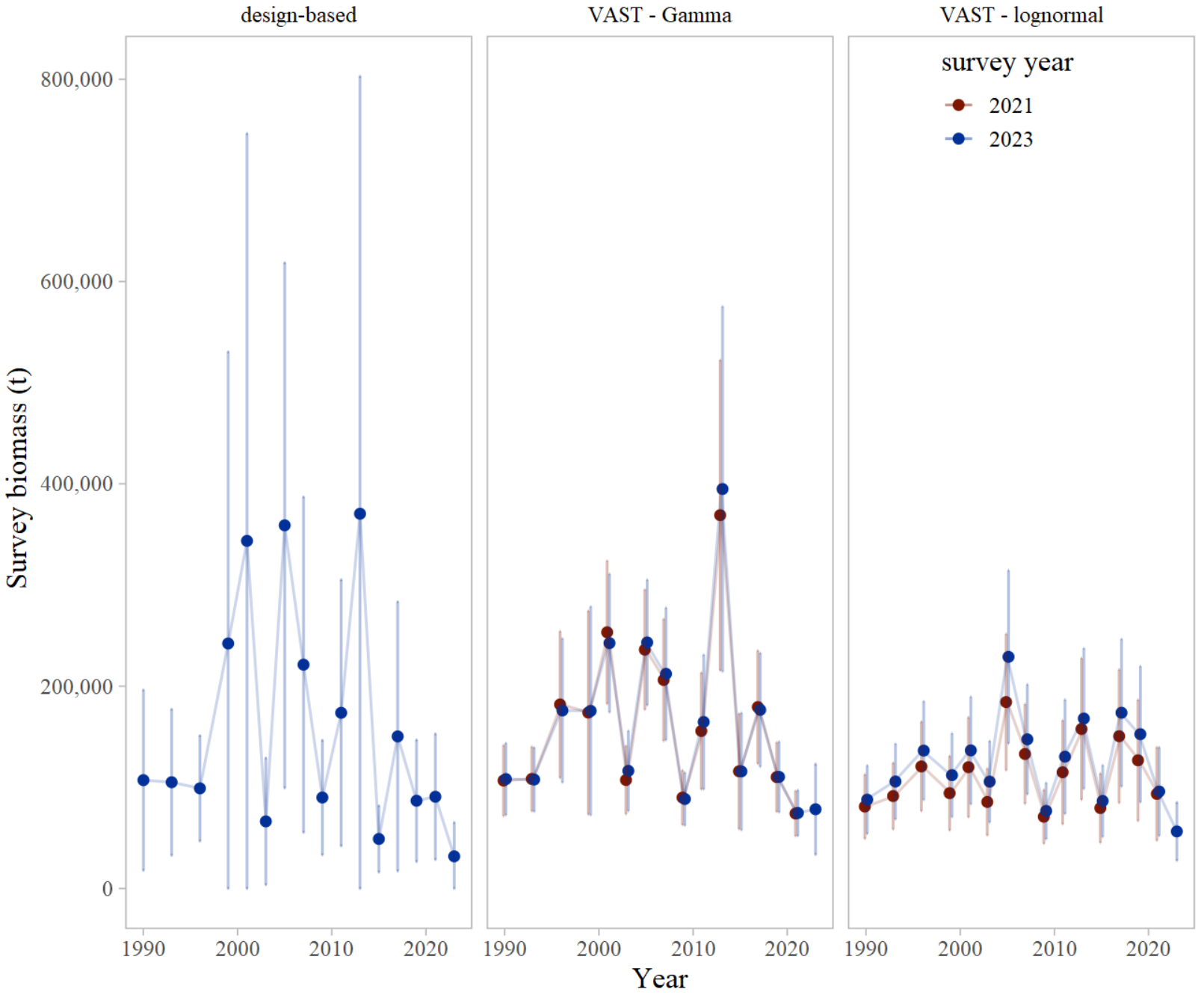




Survey - biomass

Data weighting: 0.25

Changed from design-based to VAST-based in 2018

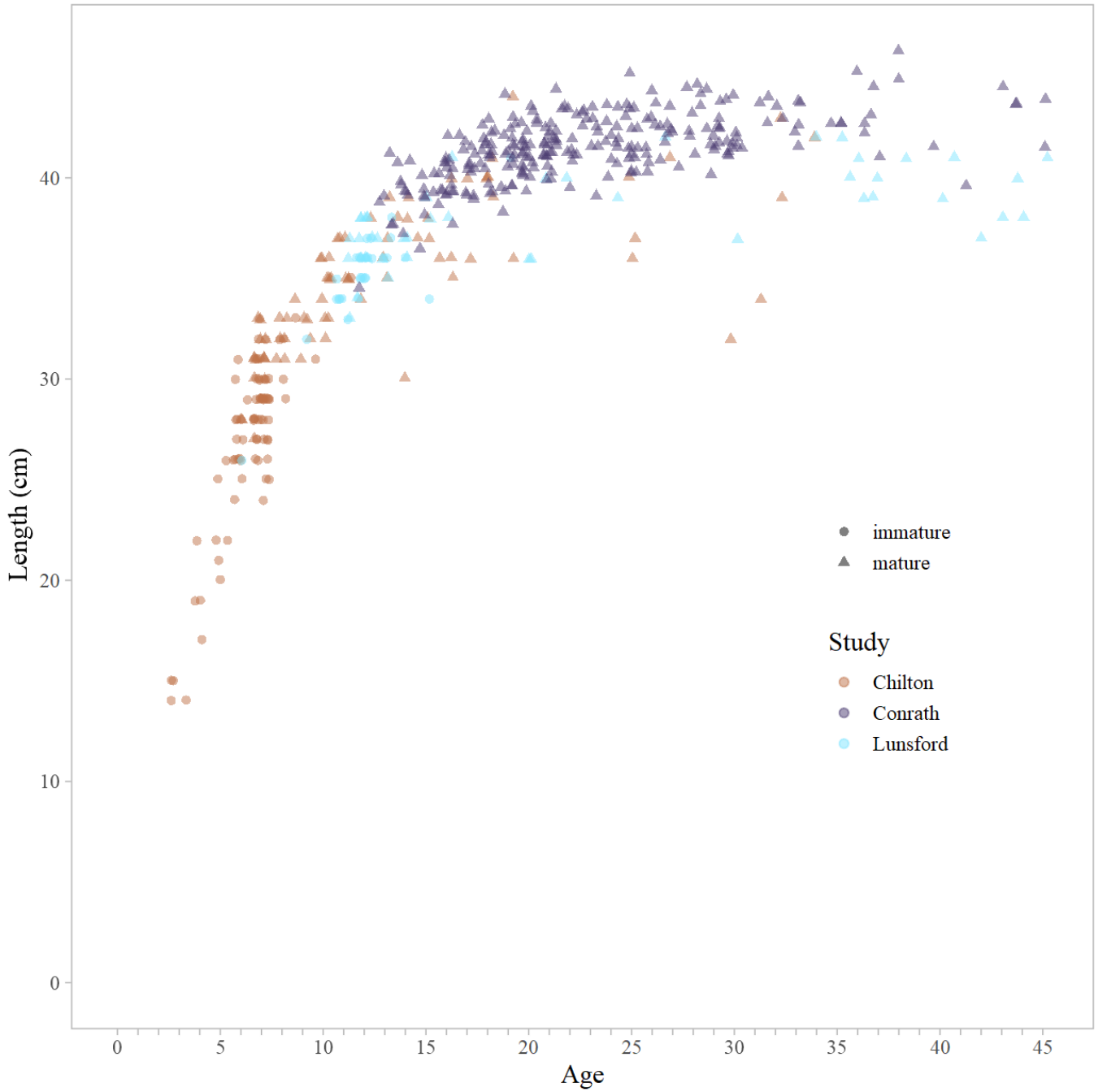


Maturity

All fish from Conrath (2019) are >age-11 and mature

Sample sizes:
- Chilton (2007) – 157
- Lunsford (1997) – 75
- Conrath (2019) – 274

Conrath (2019) data also include a measure of skip spawning – simulation analysis forthcoming



Maturity

All fish from Conrath (2019) are >age-11 and mature

Sample sizes:
- Chilton (2007) – 157
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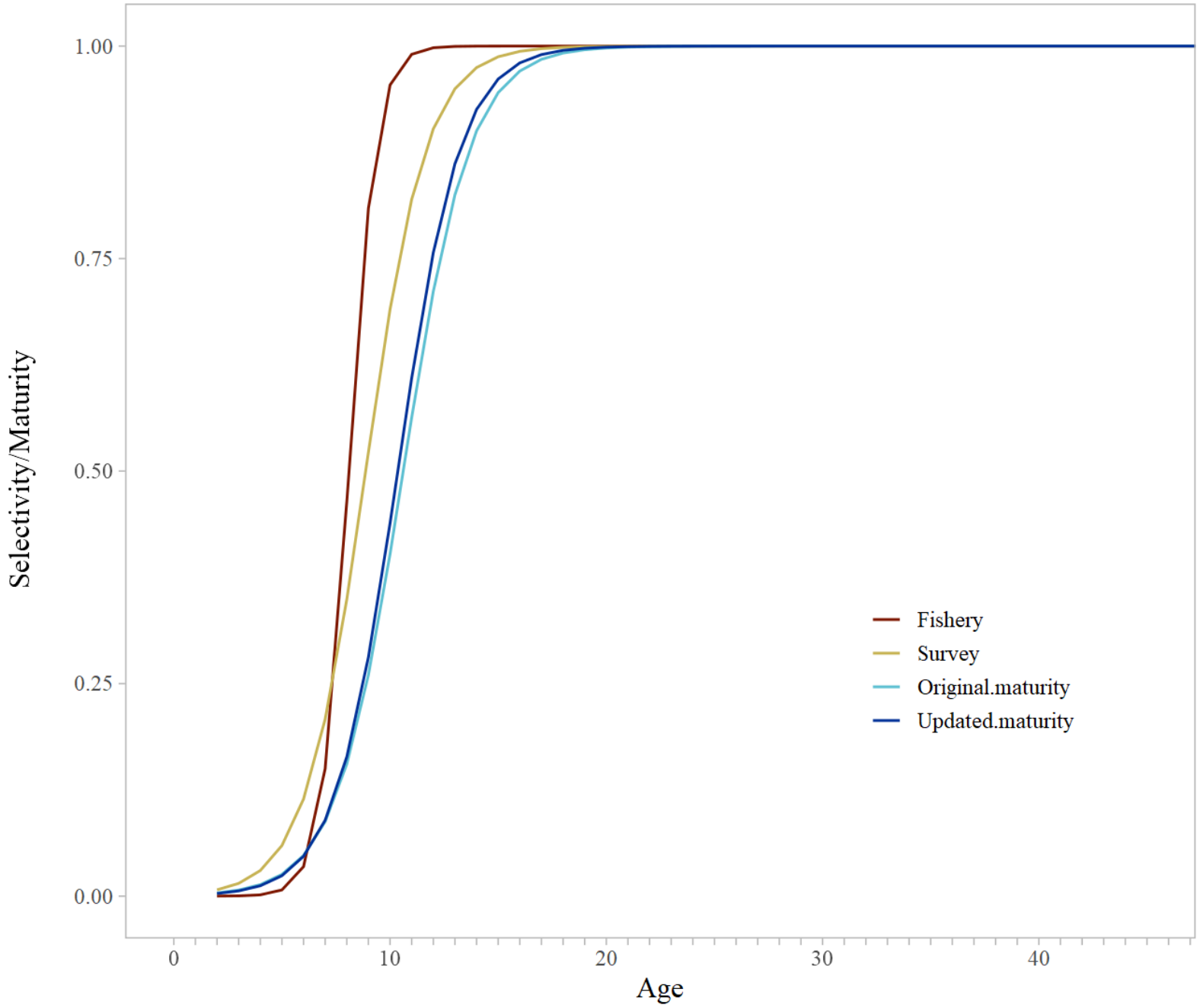
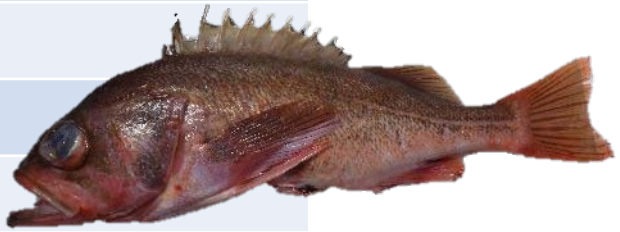
Minimal change to biological maturity-at-age ogive



Model Variants

Model	Description
base	**2022 model (m22.1) – ADMB/RTMB**
m22.1	base model w/data updated through 2024 - RTMB
M22.1a	m22.1 change to lognormal survey NLL
m22.1b	m22.1a change survey age comp ISS
m22.1c	m22.1b change to lognormal VAST
m24	m22.1c w/additional maturity data



ADMB -> RTMB

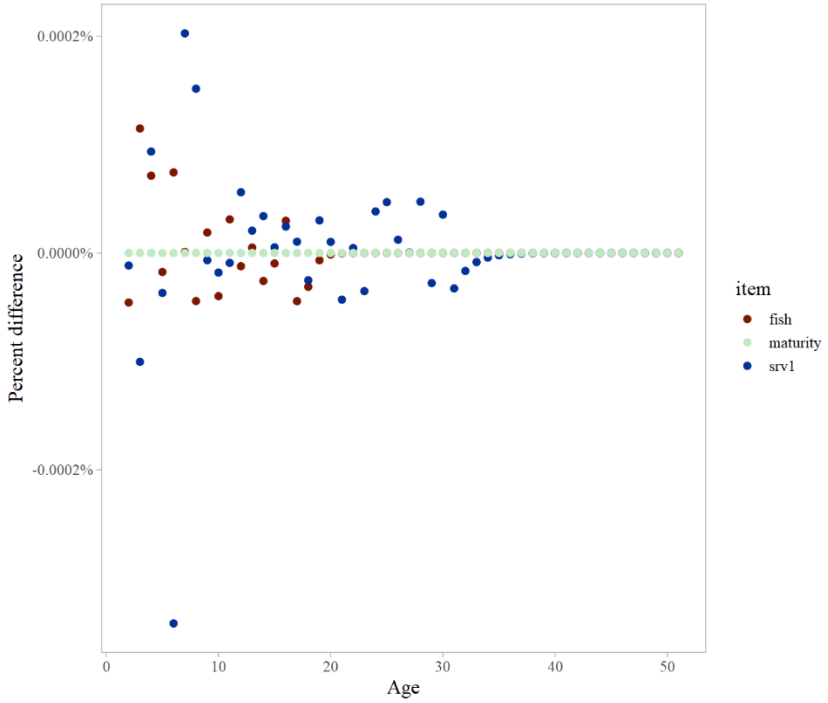
Likelihood	RTMB	ADMB	Difference
Catch	0.0907	0.0907	0.0000
Survey	6.0219	6.0219	0.0000
Fish age	40.1766	40.1766	0.0000
Survey age	69.1597	69.1598	0.0001
Fish size	67.9073	67.9072	-0.0001
Recruitment	8.6402	8.6402	0.0000
F regularity	5.4574	5.4574	0.0000
SPR penalty	0.0000	0.0000	0.0000
M prior	0.0140	0.0140	0.0000
q prior	0.0520	0.0520	0.0000
Sub total	197.5198	197.5198	0.0000
L maturity		23.5012	
C maturity		46.7265	
Sum maturity		70.2277	

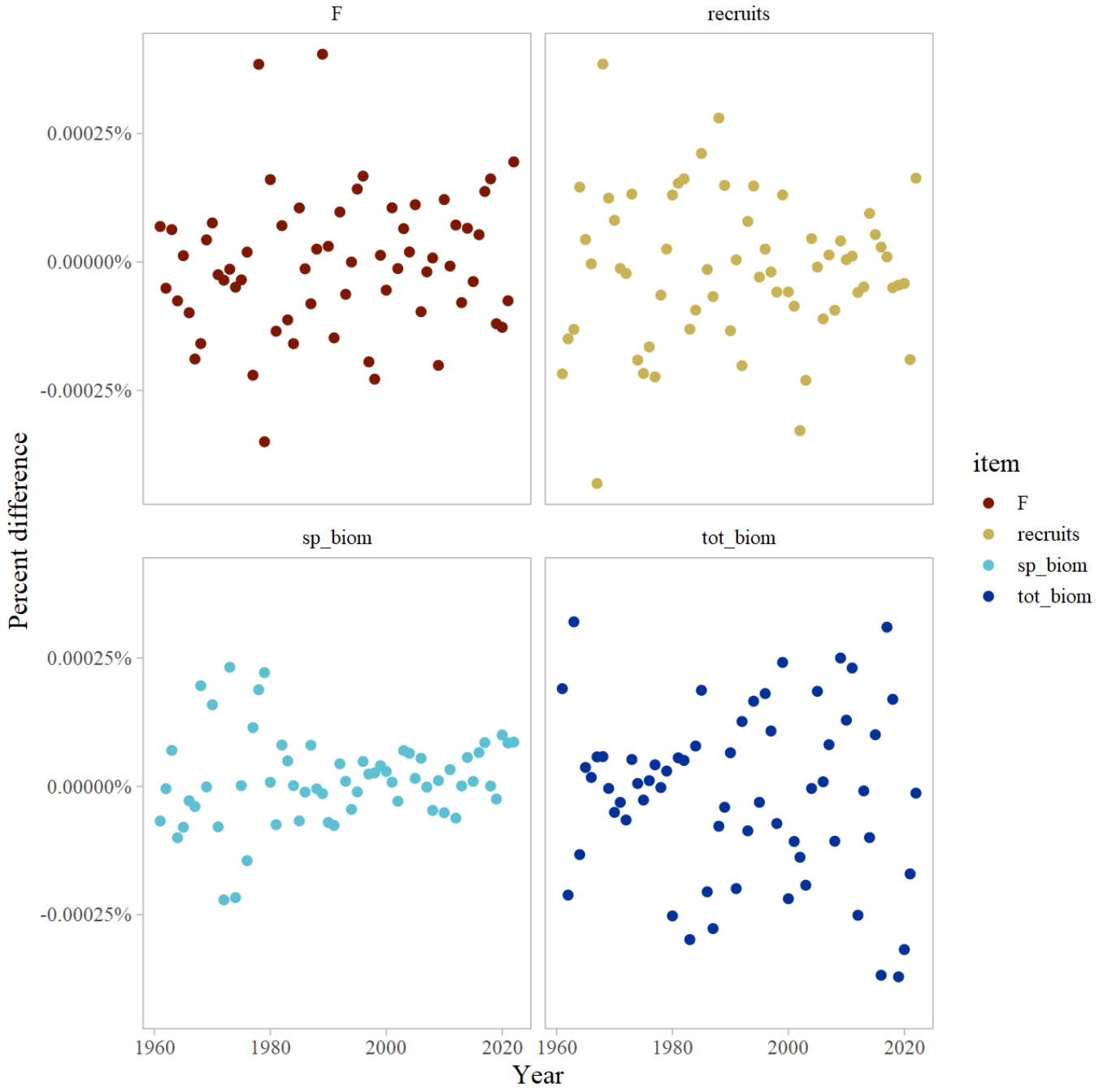
Item	RTMB	ADMB	Difference
M	0.0595	0.0595	0.0000
q	0.8649	0.8649	0.0000
Log mean recruitment	3.5039	3.5039	0.0000
Log mean F	-3.5839	-3.5839	0.0000
A50 fishery	8.2372	8.2372	0.0000
Delta fishery	1.9187	1.9187	0.0000
A50 survey	9.0936	9.0936	0.0000
Delta survey	4.3192	4.3192	0.0000
2023 Total biomass	95,559.2189	95,559.2000	-0.0189
2023 Spawning biomass	39,462.5860	39,462.6000	0.0140
2023 OFL	5,935.1641	5,935.1600	-0.0041
2023 FOFL	0.0736	0.0736	0.0000
2023 ABC	4,971.6482	4,971.6500	0.0018
2023 FABC	0.0613	0.0613	0.0000

Maturity is estimated outside the model with RTMB

ADMB -> RTMB

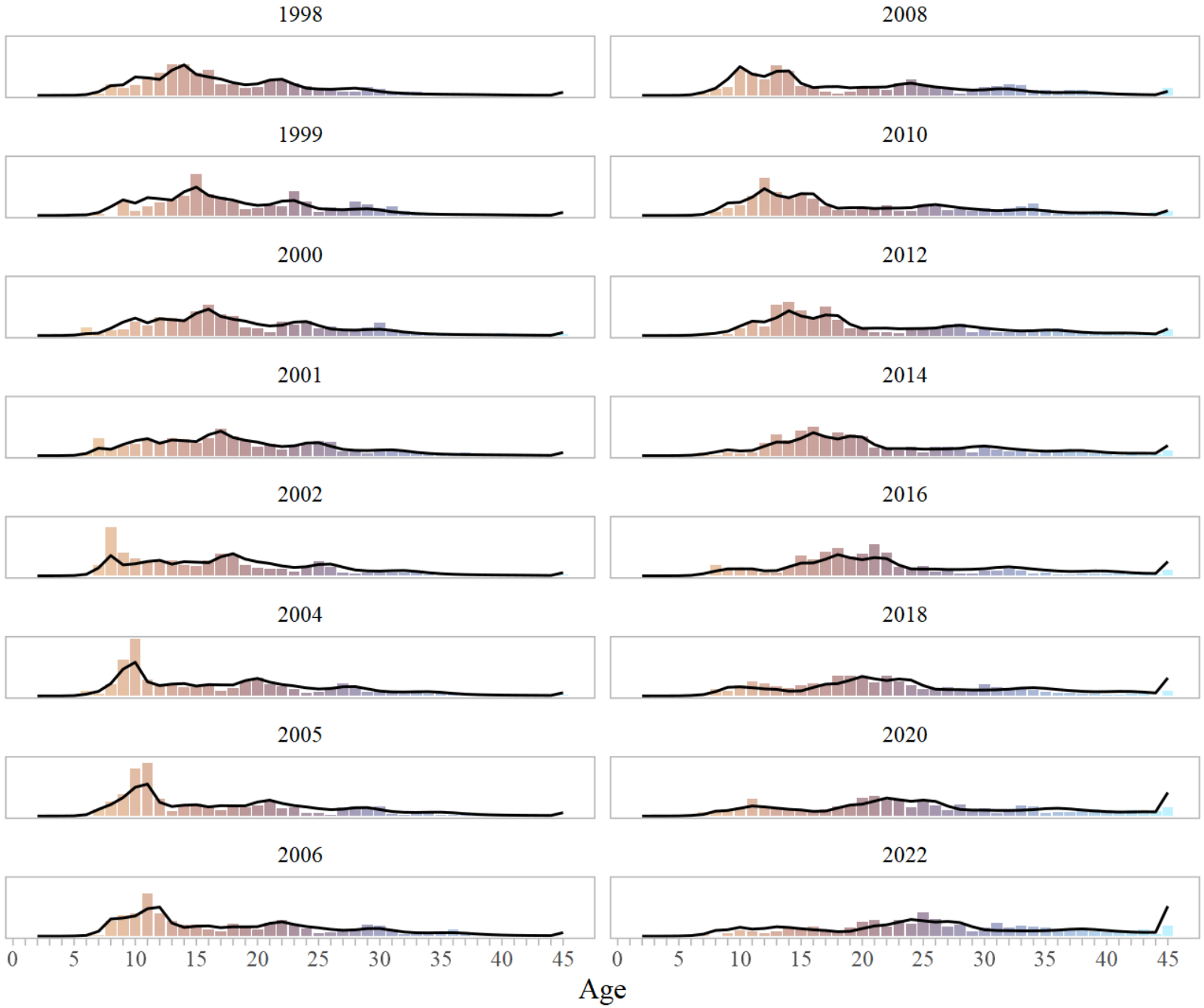
- No discernible differences between model selectivities, biomass estimates, F, recruits, and composition data
- Percent differences between models are < 0.0005%





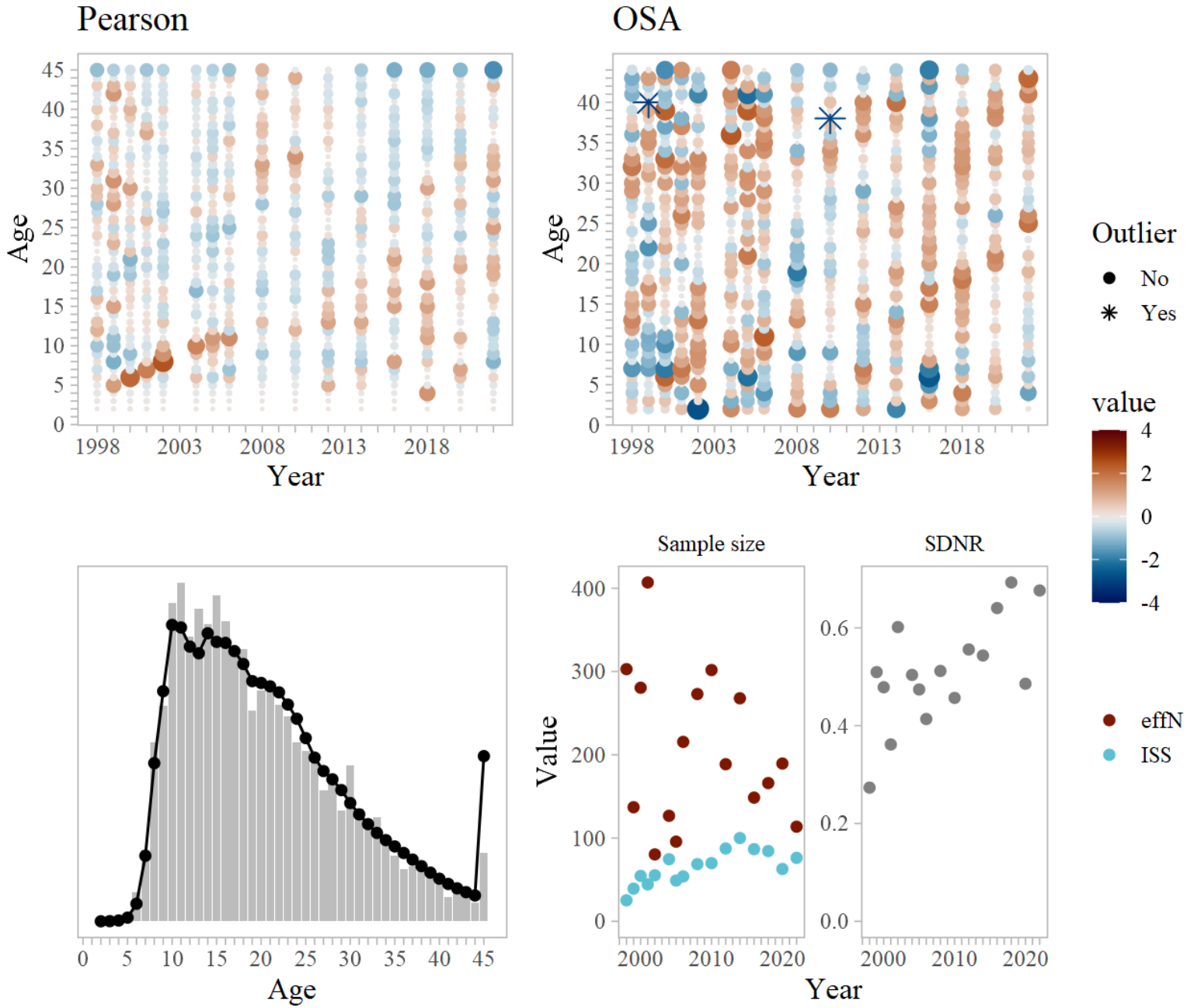
Model Fit (m24) Fishery age

Overshoots plus group, particularly in more recent years



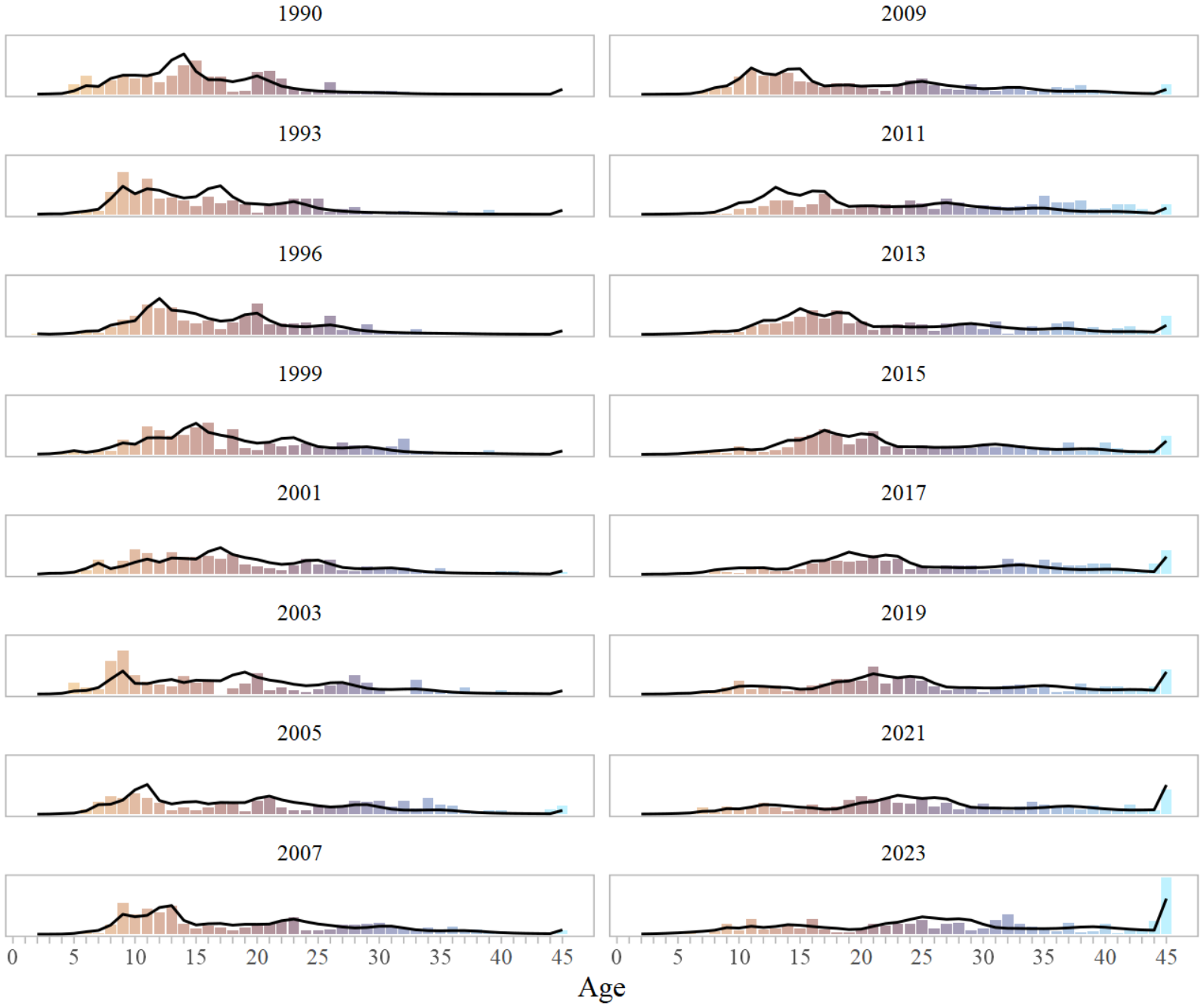
Model Fit (m24)
Fishery age

Overshoots plus group



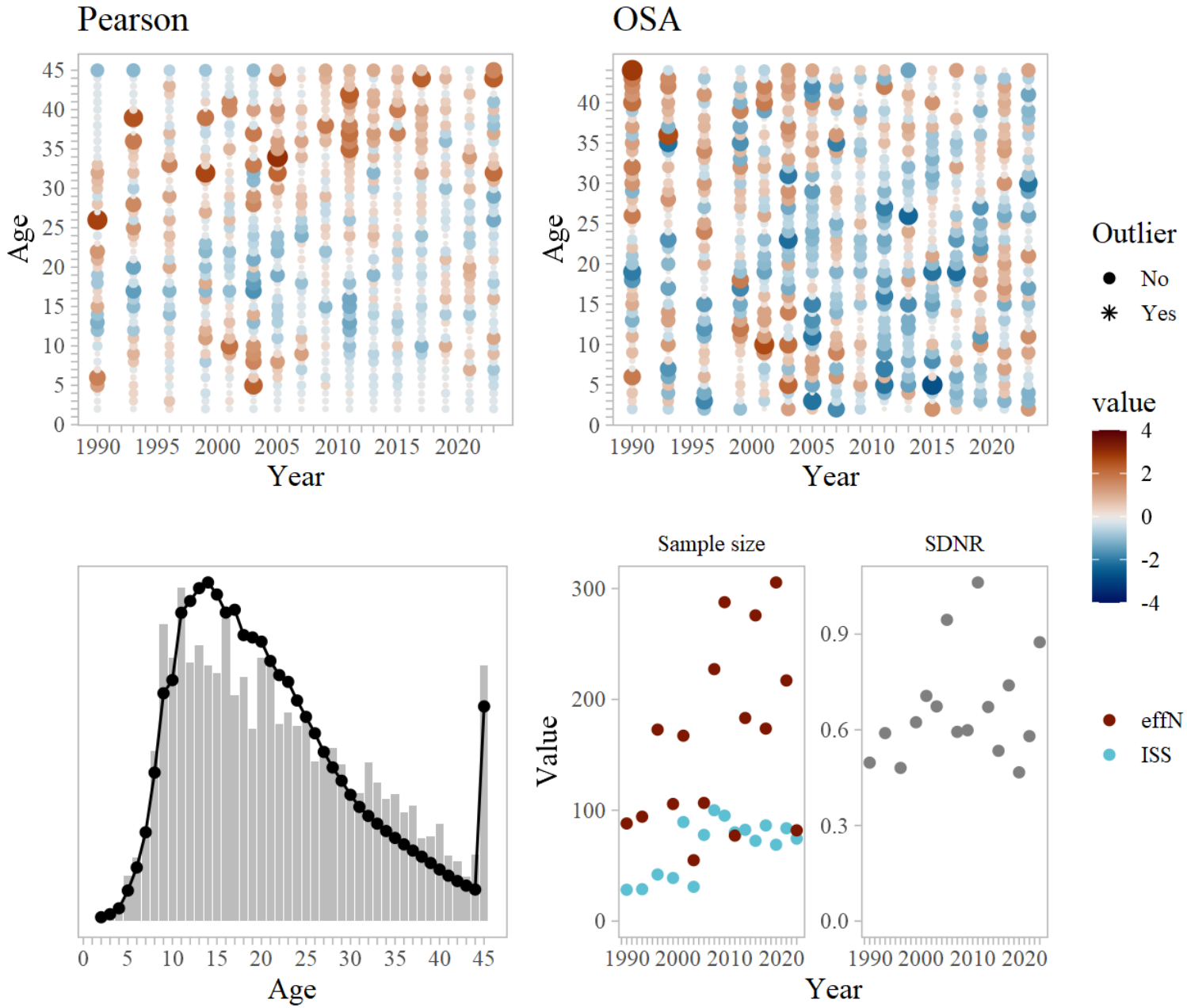
Model Fit (m24)
Survey age

Overshoots ages 10-20, particularly in earlier years
Undershoots plus group, particularly in more recent years



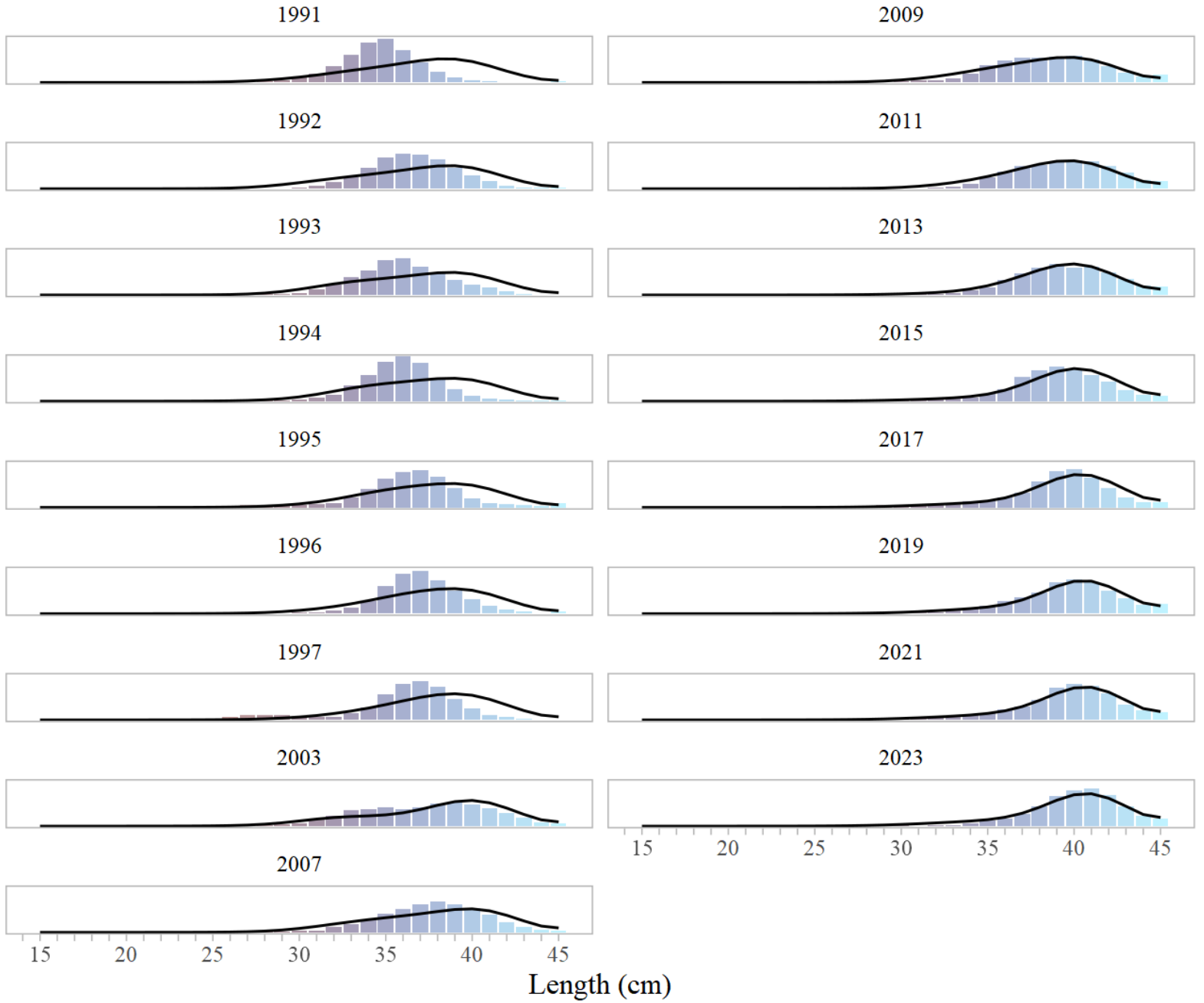
Model Fit (m24)
Survey age

Overshoots ages 10-20
Undershoots plus group



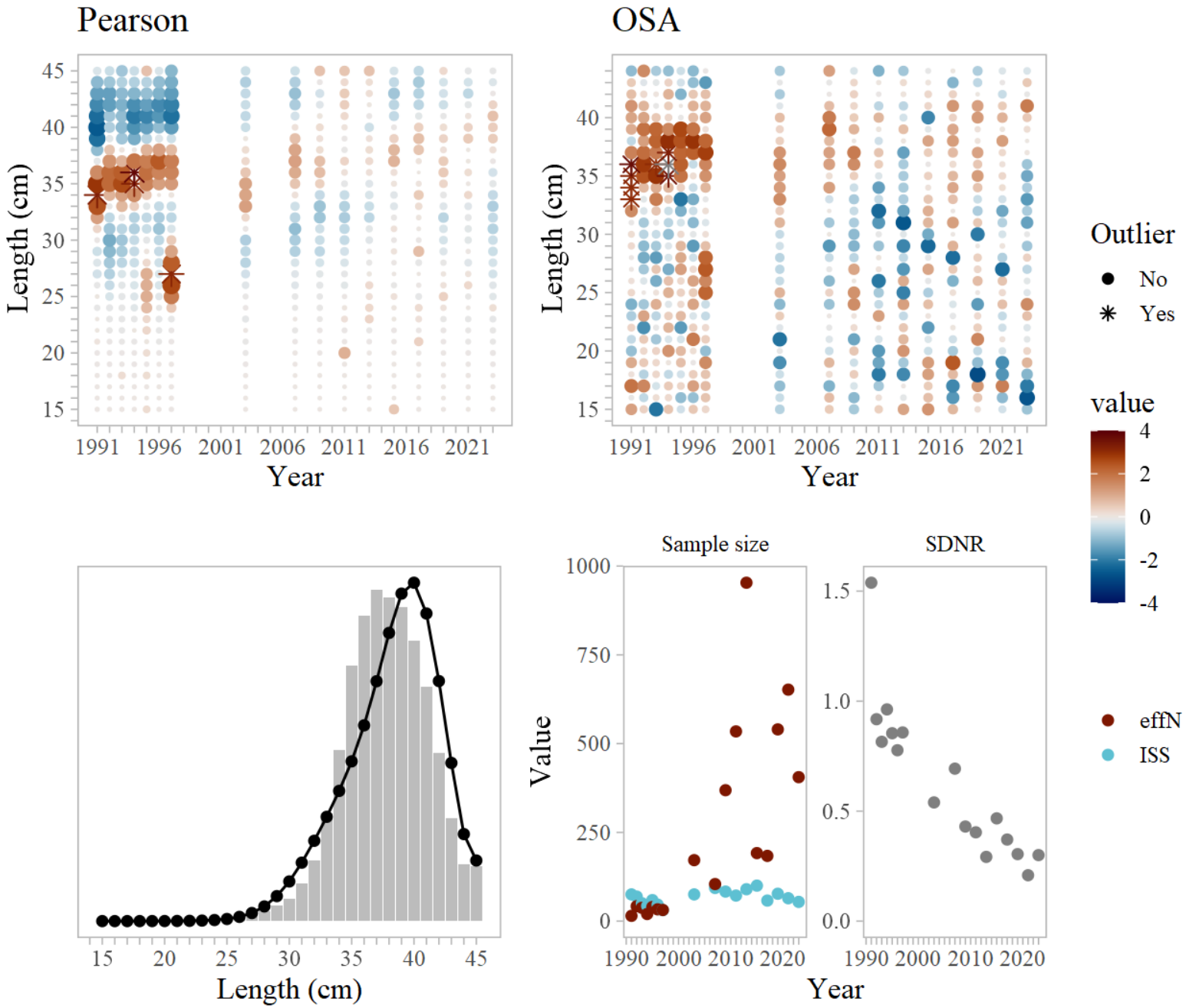
Model Fit (m24)
Fishery length

Poor fits to 1990s data

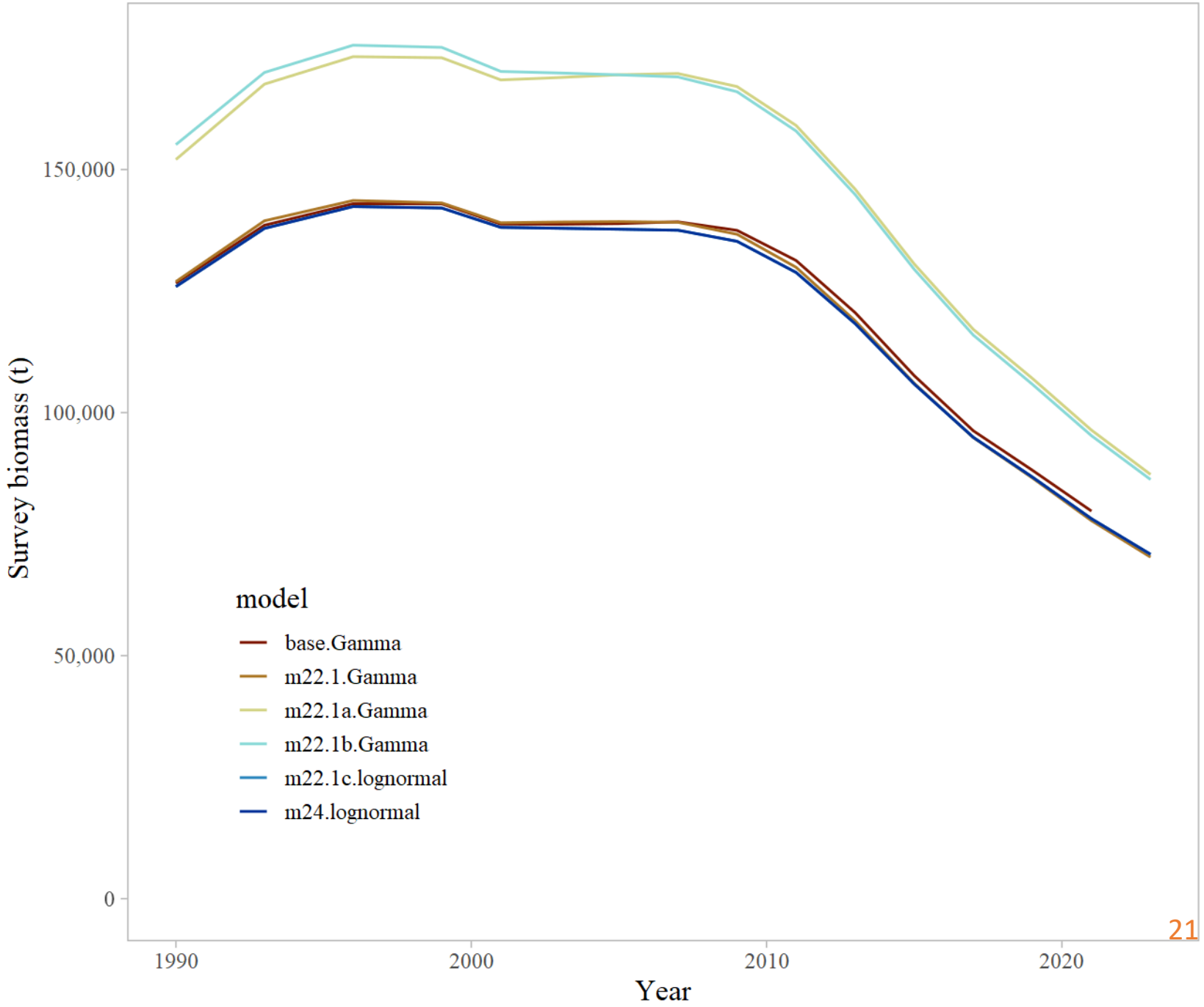


Model Fit (m24) Fishery length

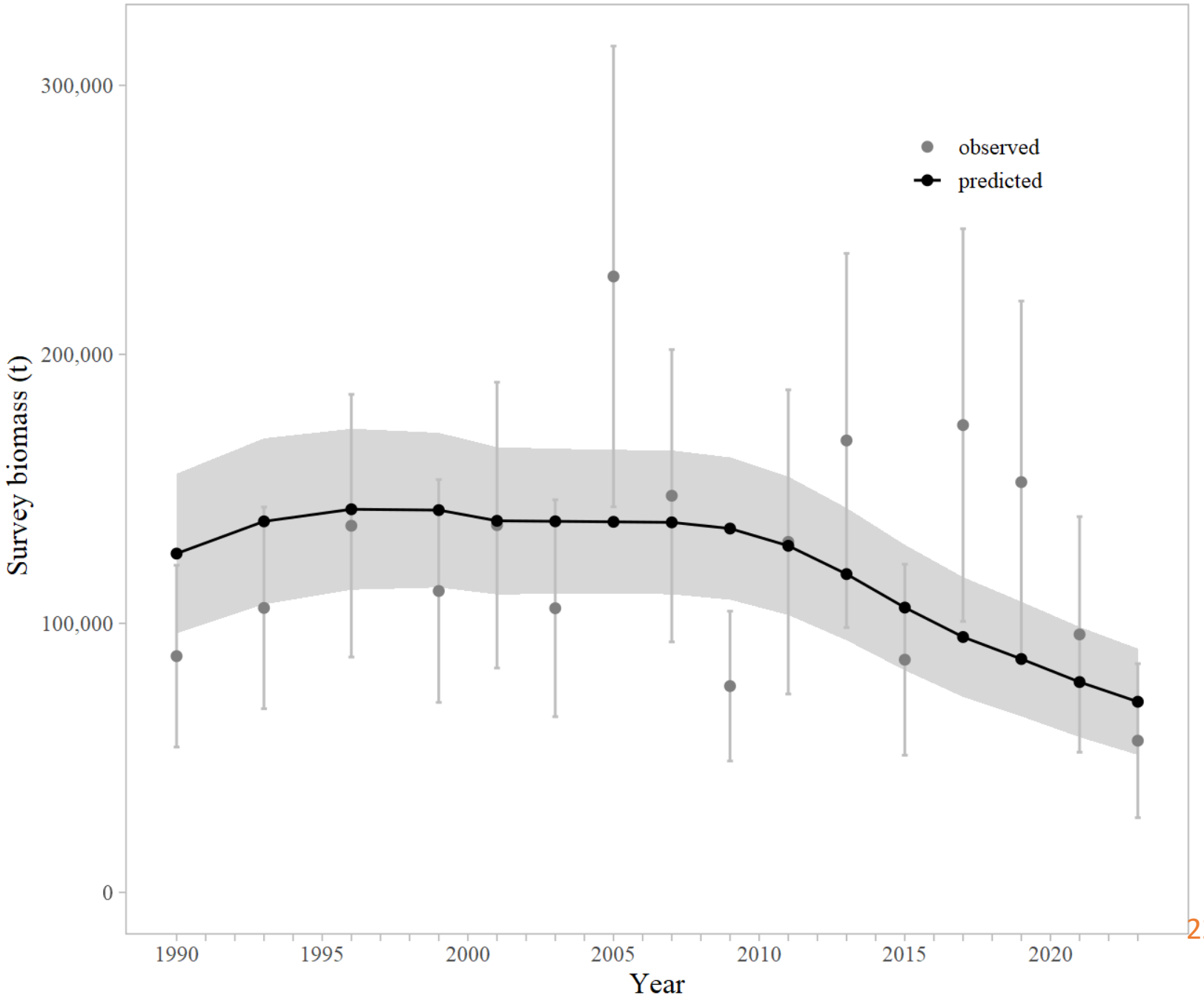
Poor fits to 1990s data, skews aggregate fit



Model Fit
Survey biomass

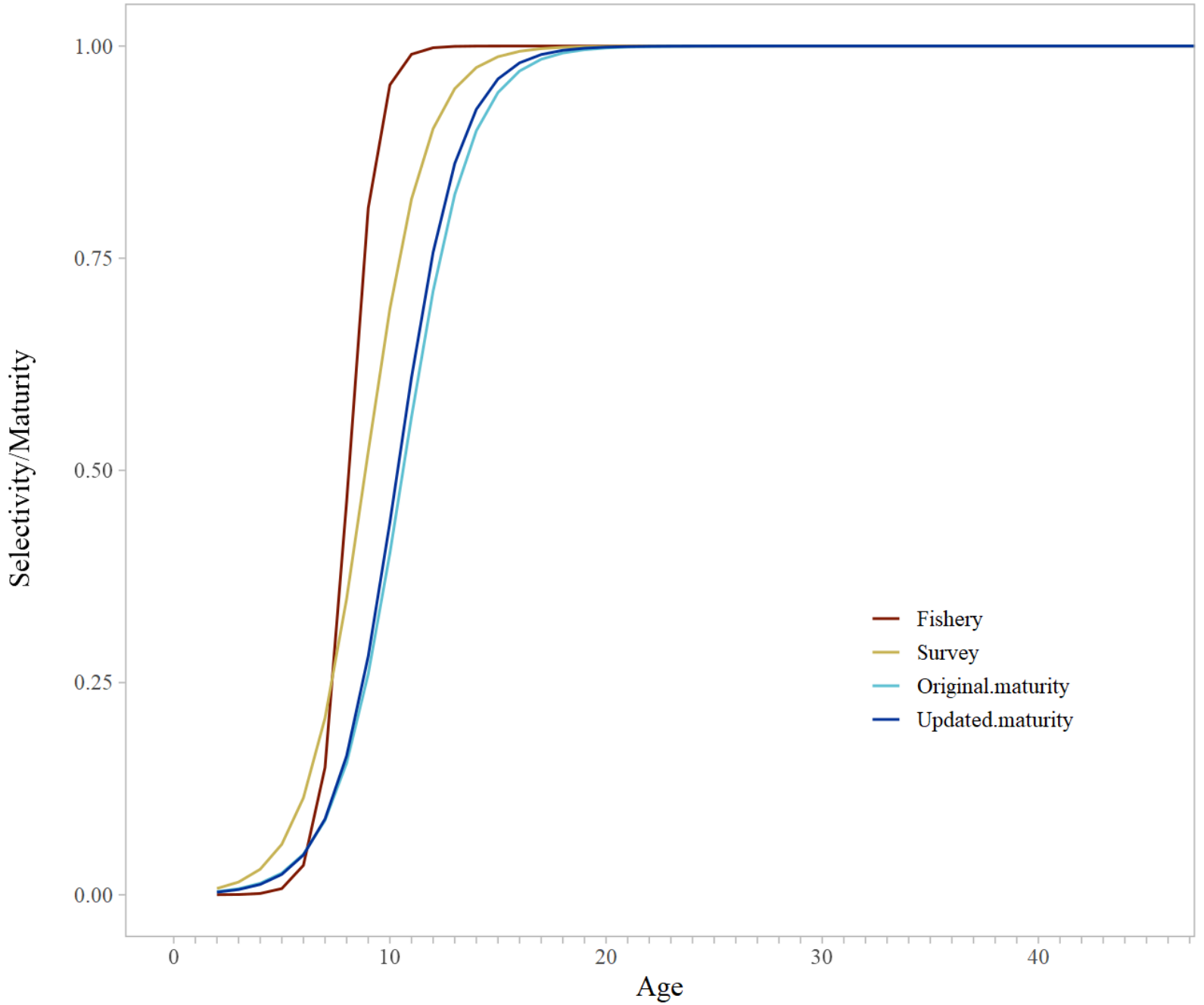


Model Fit (m24)
Survey biomass

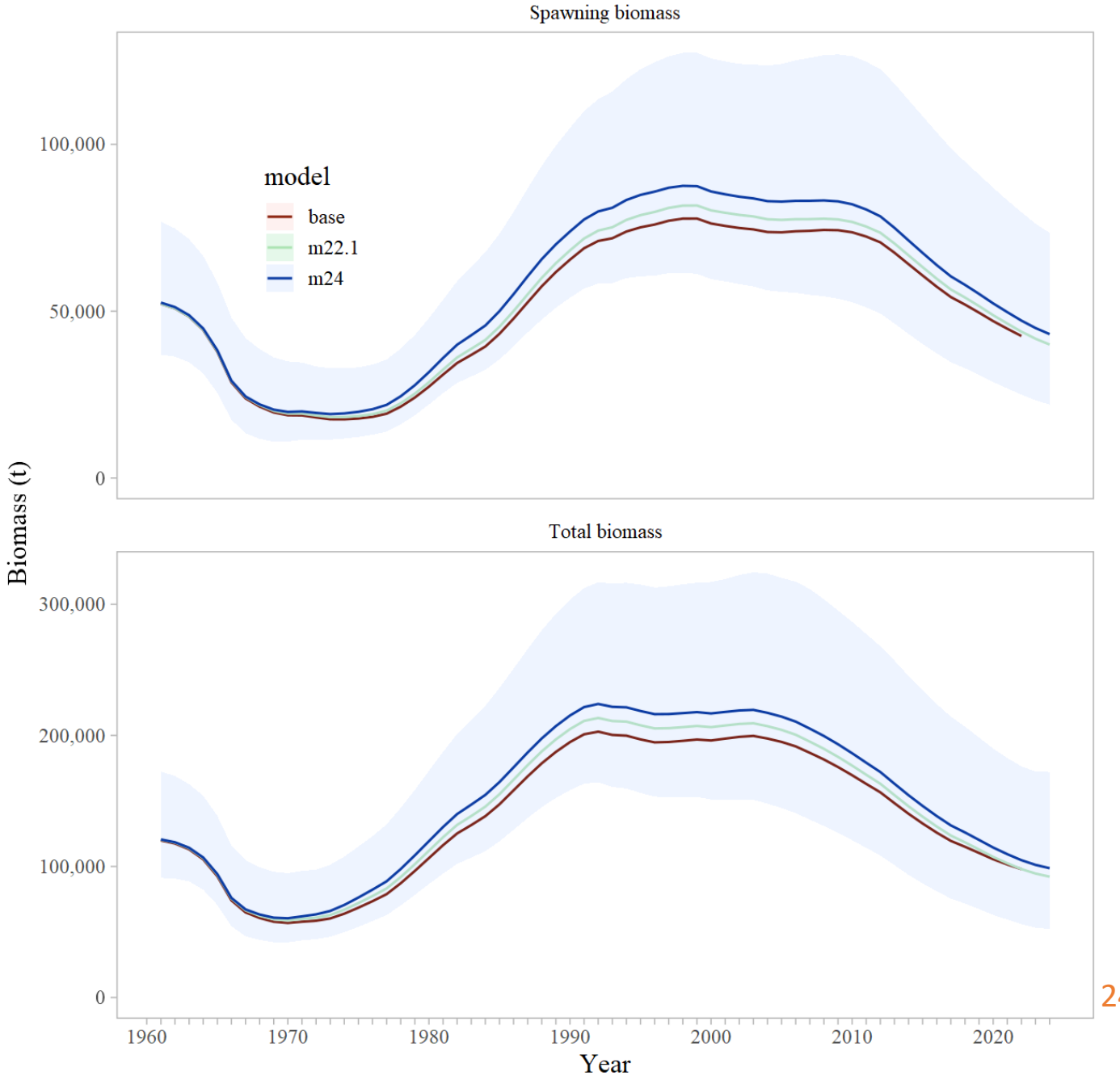


Model Fit (m24) Selectivity

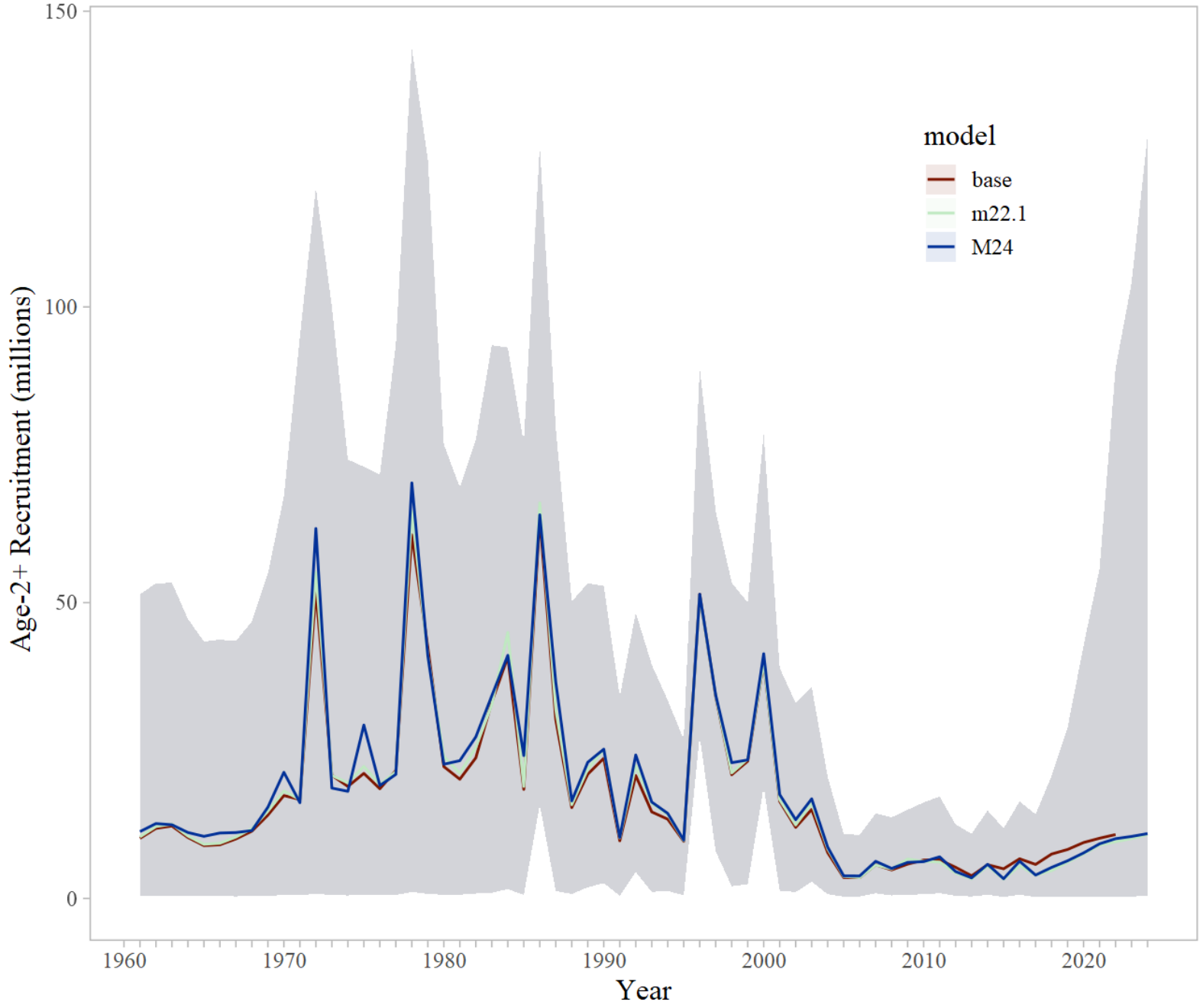
All models examined have very similar selectivites



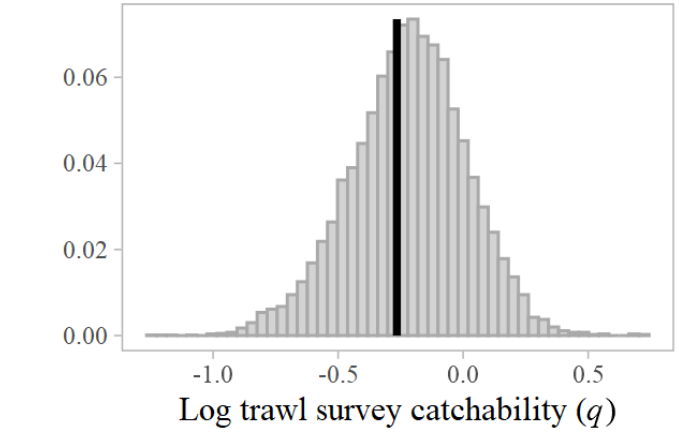
Model Fit (m24)
Biomass

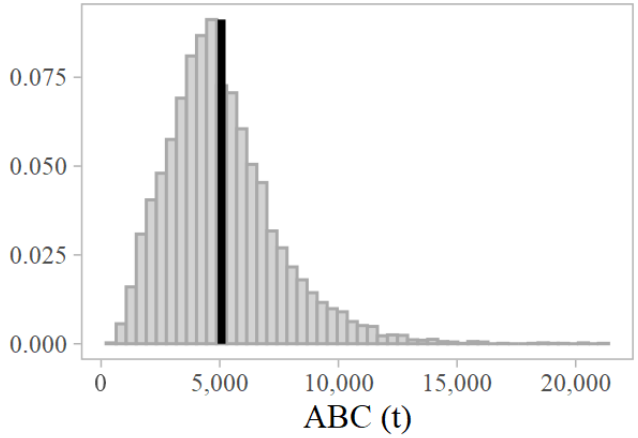


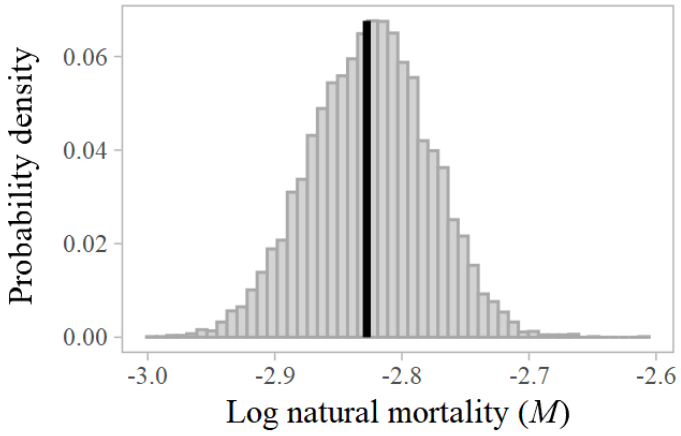
Model Fit (m24) Recruitment

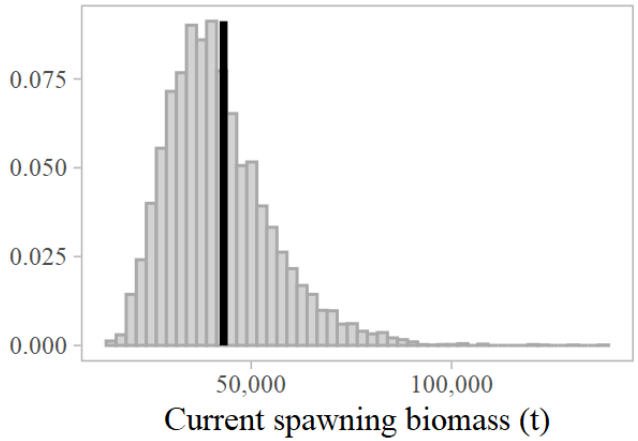


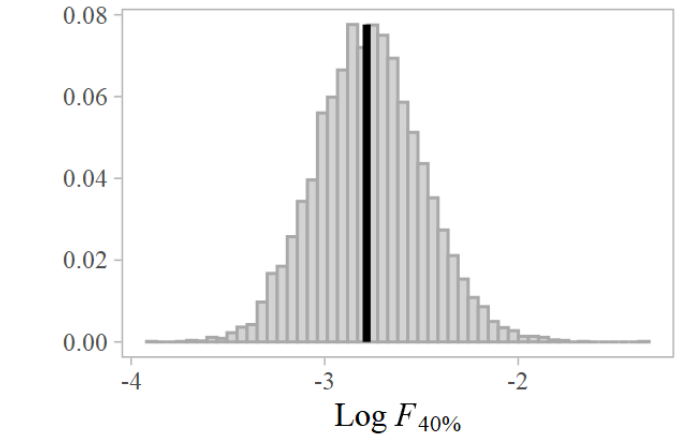
Model Fit (m24) Parameters

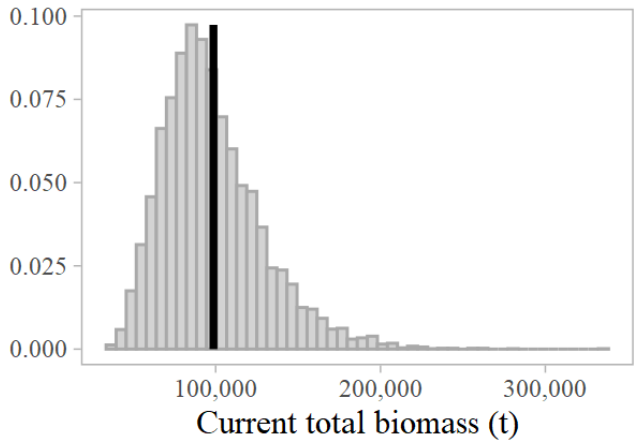












Model comparisons - Likelihood

Likelihood	Base*	M22.1	M22.1a	M22.1b	M22.1c	M24
Catch	0.0907	0.073	0.077	0.094	0.099	0.099
Survey	6.0219	8.112	3.207	3.321	-0.644	-0.644
Fish age	40.1766	45.196	45.220	46.563	46.370	46.370
Survey age	69.1597	72.936	73.050	84.160	84.339	84.339
Fish size	67.9073	61.345	61.224	63.048	63.140	63.140
Recruitment	8.6402	9.662	9.701	9.975	9.913	9.913
F regularity	5.4574	5.593	5.621	5.783	5.779	5.779
SPR penalty	0.0000	0.000	0.000	0.000	0.000	0.000
M prior	0.0140	0.025	0.014	0.015	0.041	0.041
q prior	0.0520	0.104	0.008	0.010	0.173	0.173
Objective function	197.520	203.045	198.122	212.969	209.209	209.209

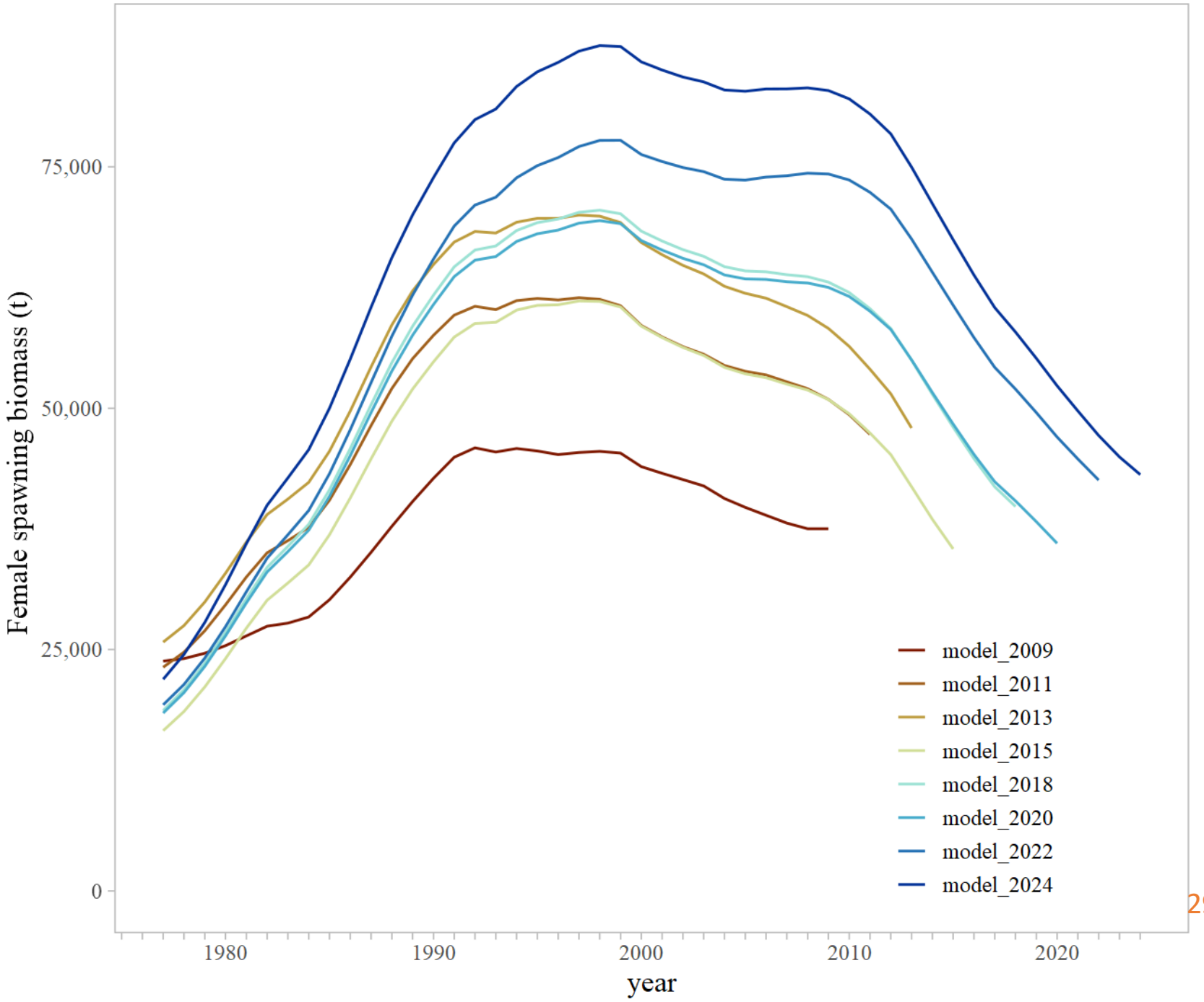
*Base model shows 2022 results

Model comparisons - Outputs

Parameter/Estimate	Base*	M22.1	M22.1a	M22.1b	M22.1c	M24
M	0.059	0.059	0.060	0.059	0.059	0.059
q	0.865	0.815	0.943	0.937	0.767	0.767
Log mean recruitment	3.504	3.503	3.534	3.528	3.518	3.518
Log mean F	-3.584	-3.649	-3.691	-3.703	-3.699	-3.699
A50 fishery	8.237	8.128	8.125	8.085	8.091	8.091
Delta fishery	1.919	1.875	1.873	1.846	1.851	1.851
A50 survey	9.094	8.830	8.822	8.855	8.875	8.875
Delta survey	4.319	4.058	4.045	4.110	4.132	4.132
2025 Total biomass	95,559	90,674	96,979	96,614	96,992	96,992
2025 Spawning biomass	39,462	37,429	40,193	39,979	40,189	40,485
2025 OFL	5,935.	5,592	6,012	5,967	5,976	6,112
2025 FOFL	0.074	0.074	0.074	0.073	0.073	0.075
2025 ABC	4,972	4,686	5,037	5,001	5,008	5,115
2025 FABC	0.061	0.061	0.061	0.061	0.061	0.062

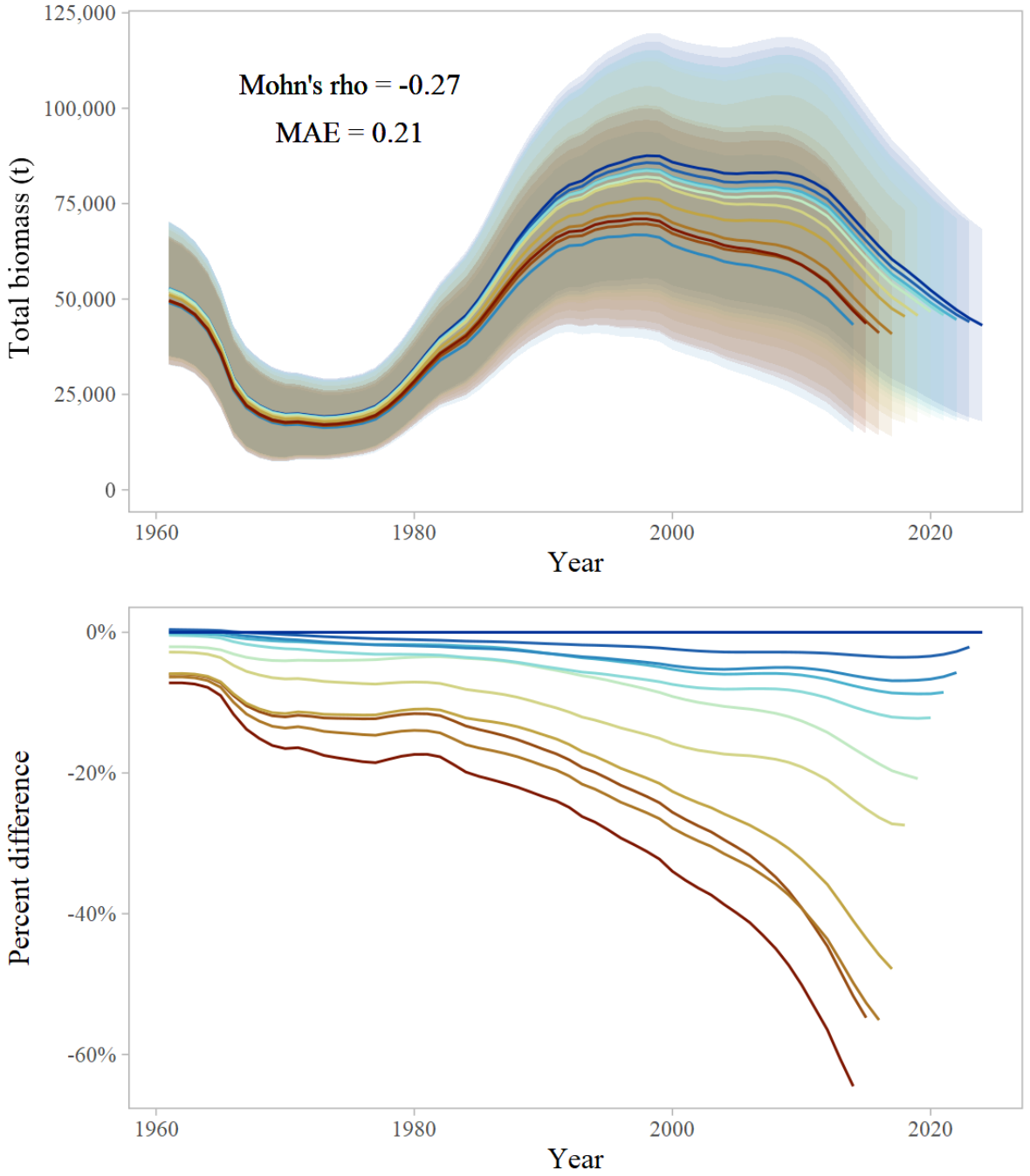
Model Fit (m24) Retrospective

Accepted assessment spawning biomass



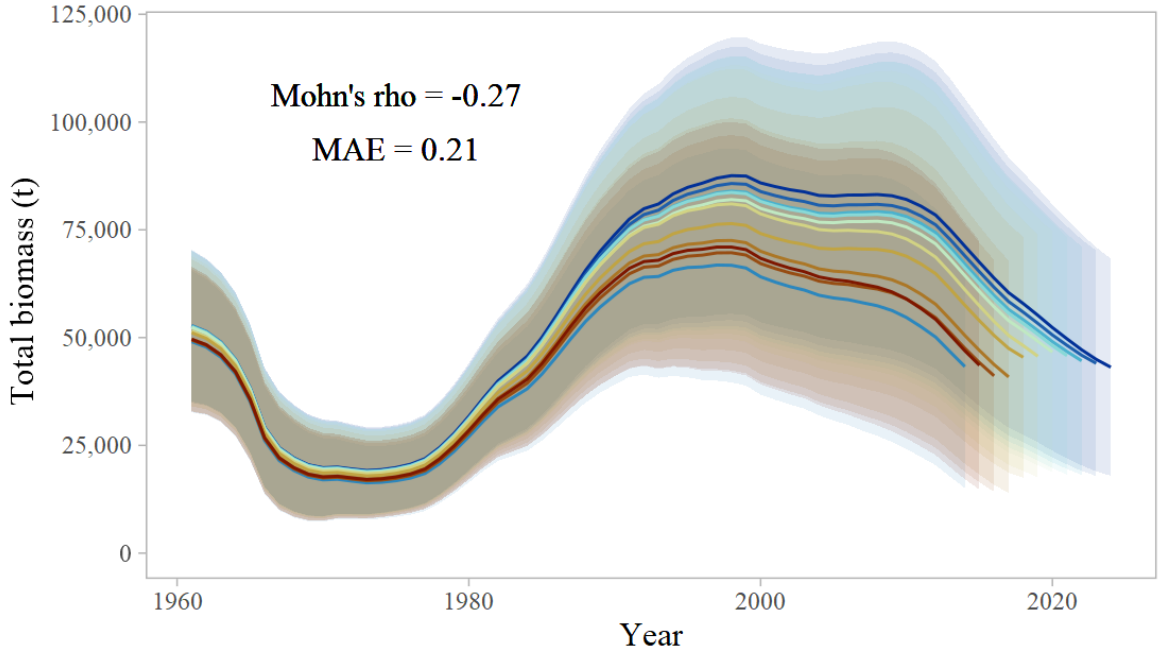
Model Fit (m24) Retrospective

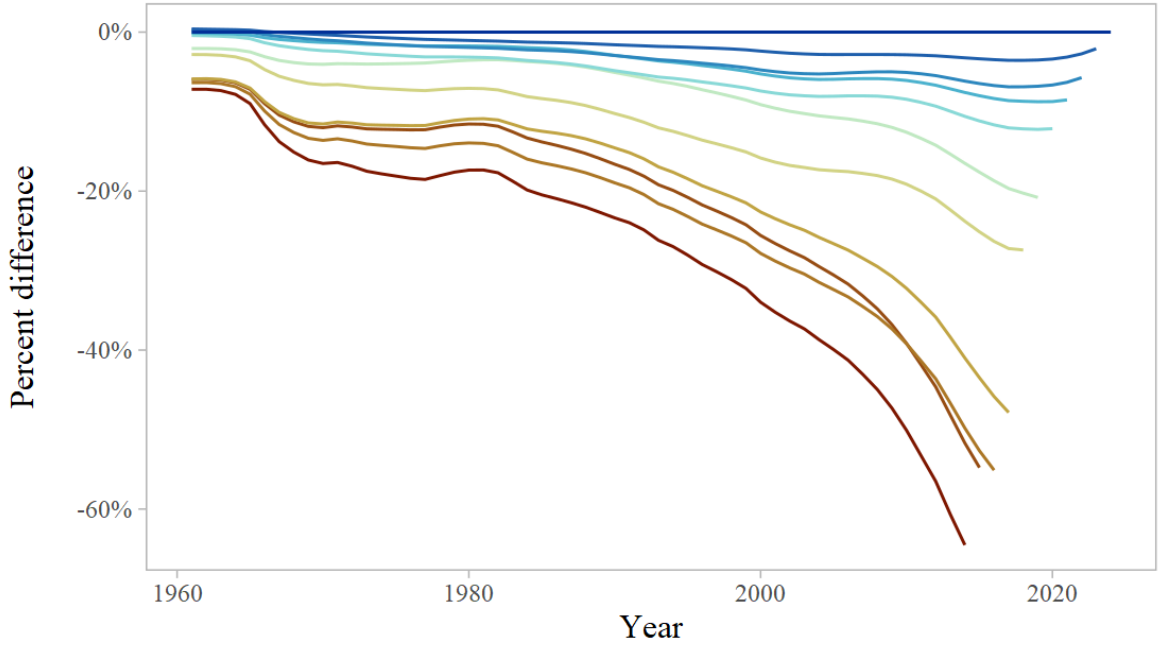
Spawning biomass

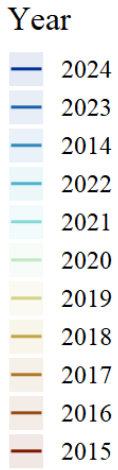


Model Fit (m24) Retrospective

Total biomass

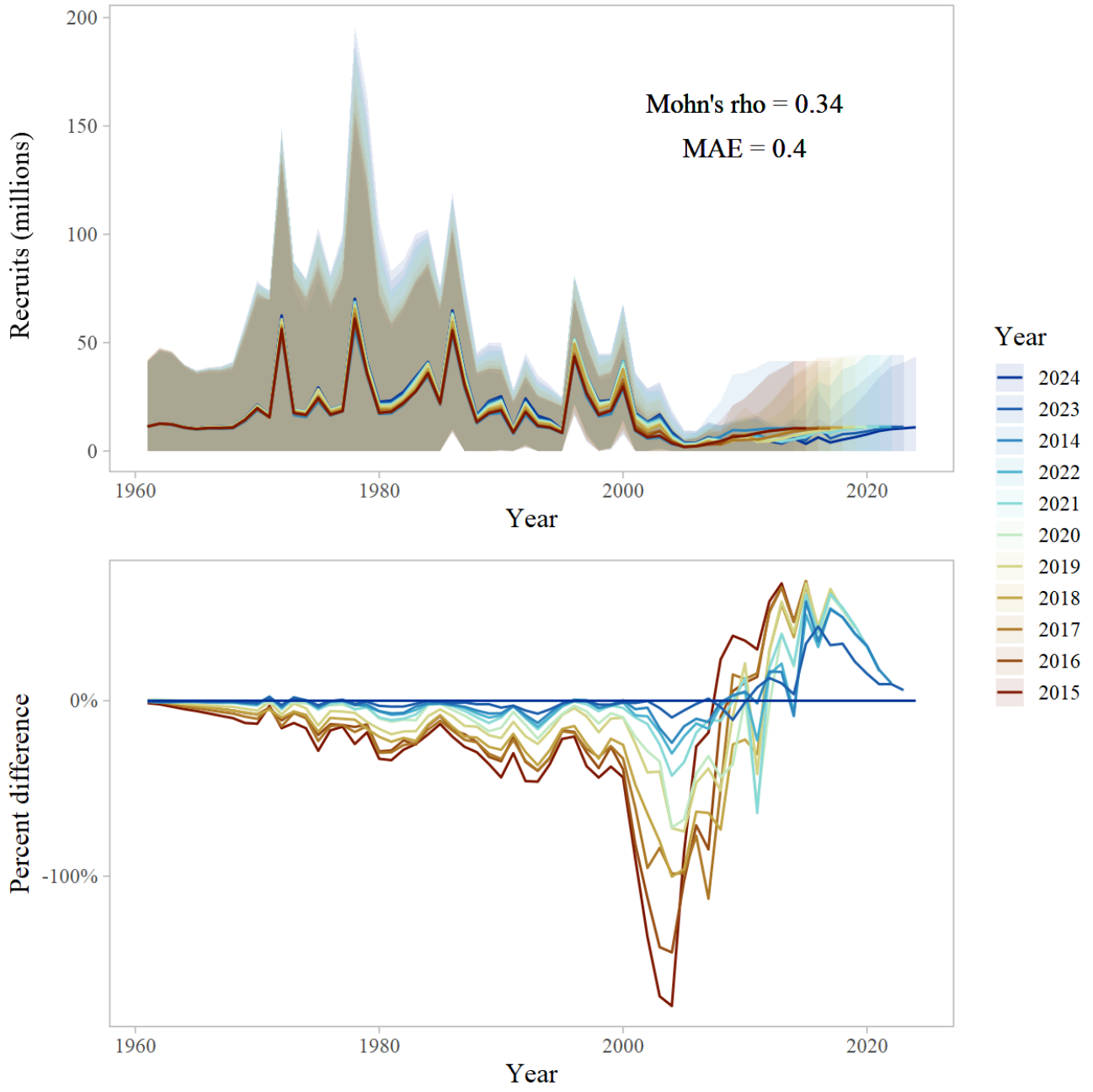




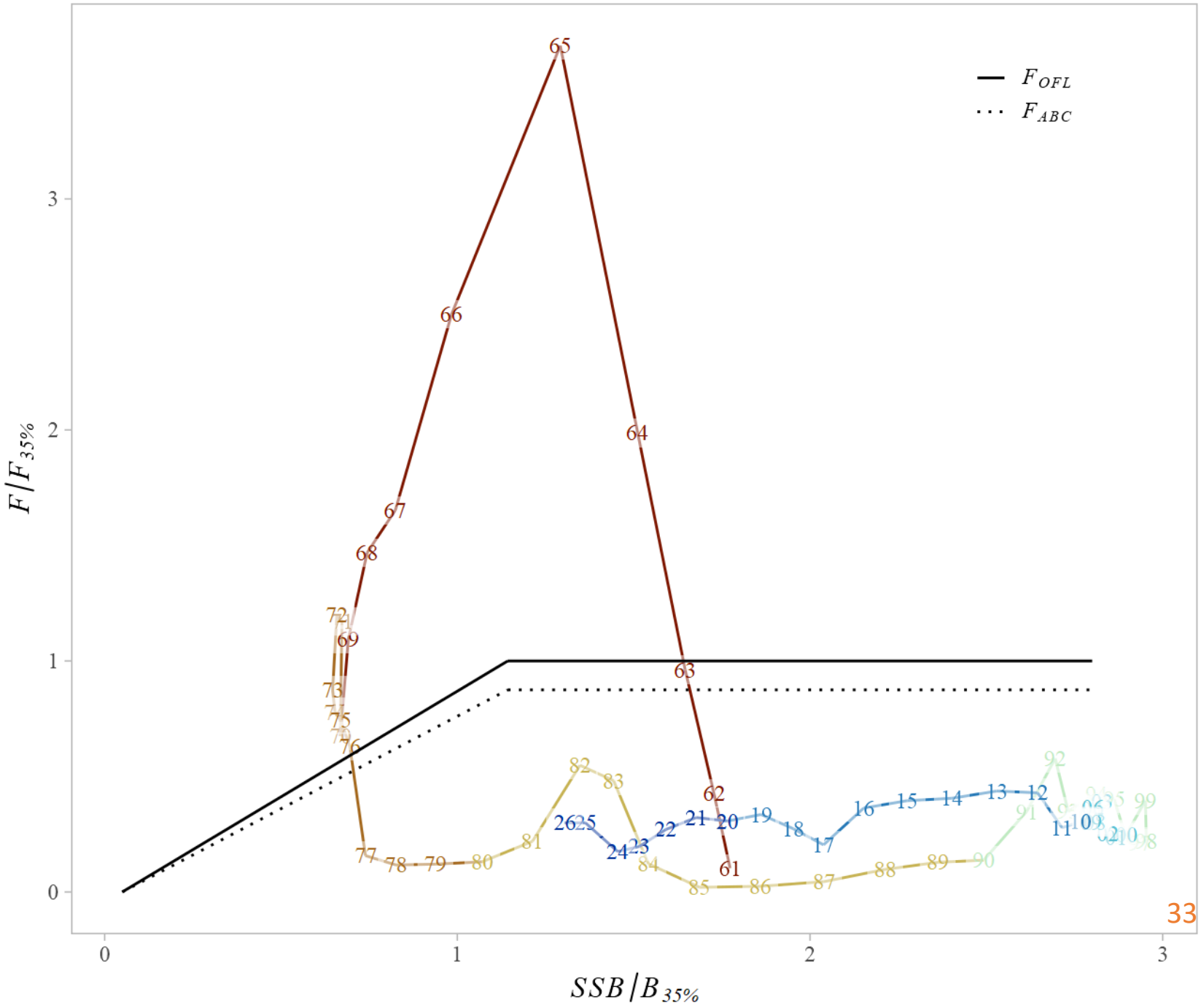


Model Fit (m24) Retrospective

Recruits

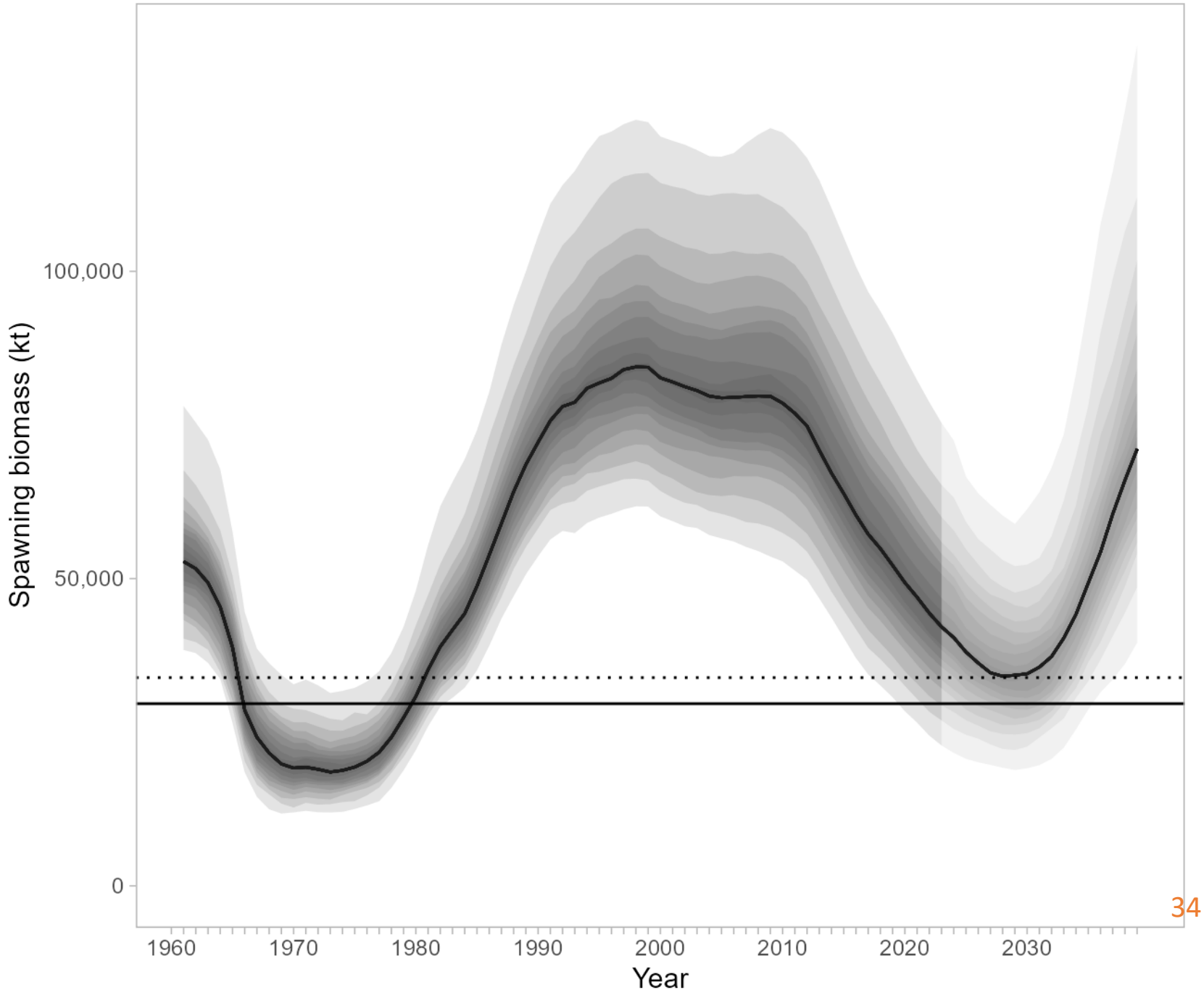


Model Fit (m24)
Phase Plane



Model Fit (m24) Projection

MCMC credible intervals – each shade is 10% of the posterior distribution



Risk Table

Assessment-related considerations	Population dynamics considerations	Environmental/ ecosystem considerations	Fishery Performance
Level 1: No increased concerns	**Level 2**: Substantially increased concerns	Level 1: No increased concerns	Level 1: No increased concerns

Assessment – Changing from a design-based model to a VAST-based estimate has made the survey biomass estimates more realistic (less overall fluctuation) though the model continues to fit these data poorly. Continued length composition issues.

Population dynamics – consistent low recruitment, skip spawning has been observed for this stock, levels unknown

Environmental - environmental mechanisms for changes in survival and productivity of dusky rockfish remain unknown, though indication that structural epifauna habitat may be decreasing

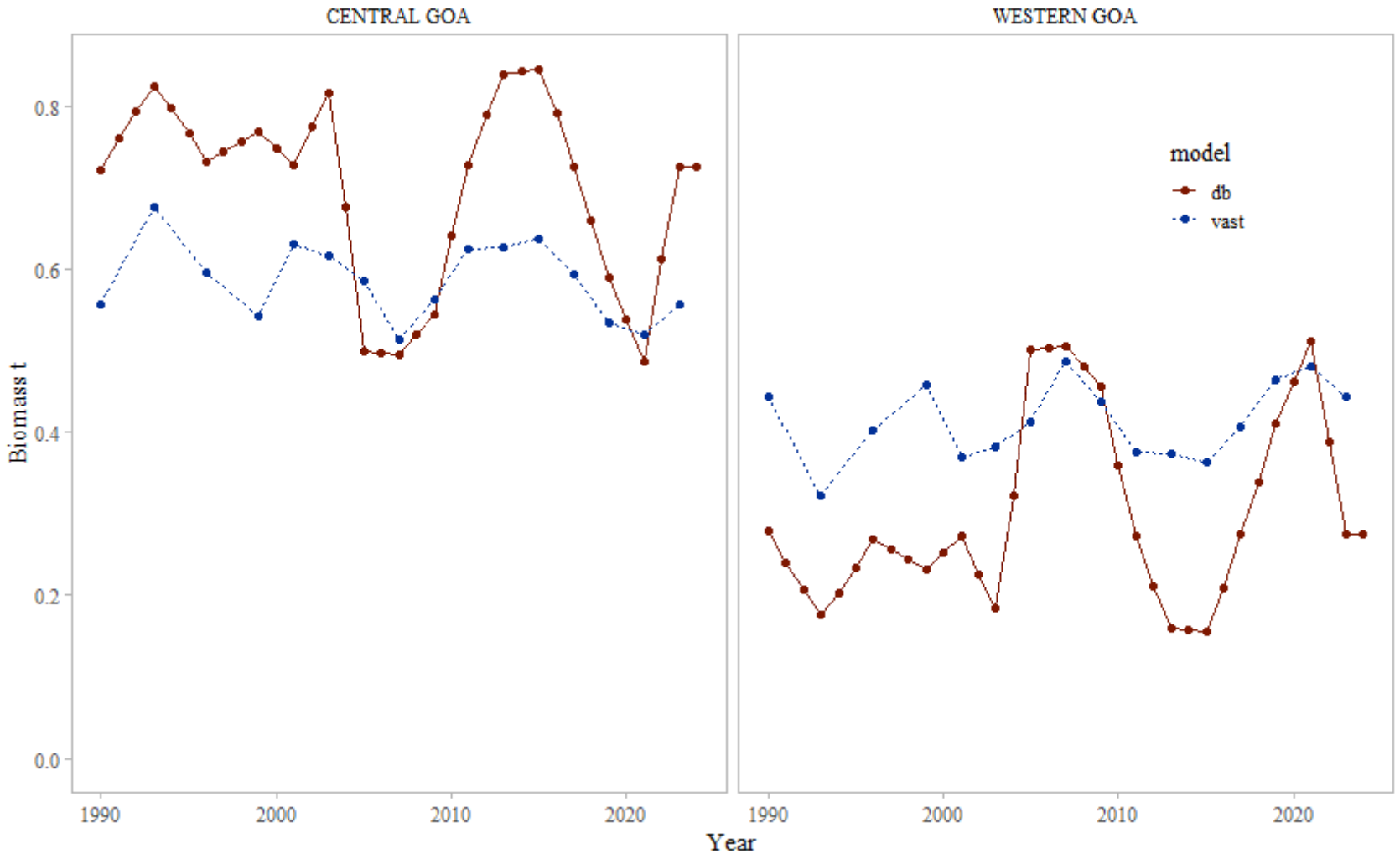
Fishery performance - catches are well below ABC

M24
Harvest Recommendation

	As estimated or specified last year for:		As estimated or recommended this year for:	
Quantity/Status	2024	2025	2025*	2026*
M (natural mortality)	0.059	0.059	0.059	0.059
Tier	3a	3a	3a	3a
Projected total (age 2+) biomass (t)	94,319	93,088	96,967	95,374
Projected female spawning biomass (t)	38,118	36,510	40,392	38,675
$B_{100\%}$	82,350	82,350	84,695	84,695
$B_{40\%}$	32,940	32,940	33,878	33,878
$B_{35\%}$	28,822	28,822	29,643	29,643
F_{OFL}	0.074	0.074	0.074	0.074
$maxF_{ABC}$	0.061	0.061	0.062	0.062
F_{ABC}	0.061	0.061	0.062	0.062
OFL (t)	5,750	5,548	**6,064**	5,848
maxABC (t)	4,816	4,647	5,077	4,896
ABC (t)	4,816	4,647	**5,077**	4,896
	As determined last year for:		As determined this year for:	
Status	2023	2024	2024	2025
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

Apportionment

- Eastern GOA is allocated 1t which is oved to OROX
- Design-based model w/random effects (REMA) jumps around – red line
- VAST-based model is more stable – blue line



Apportionment

- Substantial difference in abundance by area from last survey

		Proportions	
		Design-based	
Year	Area	w/REMA	VAST
2021	Western	51.3	48.0
	Central	48.7	52.0
2022	Western	38.7	48.0
	Central	61.3	52.0
2023	Western	27.5	44.3
	Central	72.5	55.7
2024	Western	27.5	44.3
	Central	72.5	55.7

		Biomass	
		Design-based	
Year	Area	w/REMA	VAST
2025	Western	1,396	2,249
	Central	3,680	2,827
2026	Western	1,346	2,168
	Central	3,549	2,727

Change from 2022 assessment
Central 52.65% --> 55.71%
Western 47.33% --> 44.28%

Conclusions

- Recommendation
  - About due for a CIE?…
- Data Gaps and Future Research Priorities
  - We have no information on larval, post-larval, or early-stage juvenile northern rockfish
  - Habitat requirements are either unknown or anecdotal – research to identify HAPC
  - Aging is a continual issue (challenging to age well) **Working with FT-NIRS group**
  - Reproductive biology is poorly understood, though skip spawning has been observed – the spatial and temporal extent of skip spawning should be a research priority
  - Exploration of data weighting, possibly the inclusion of a variance inflation parameter to increase the variance on VAST estimated trawl surveys
  - Explore time varying selectivity, or possibly length-based early selectivity, and size-at-age matrix

Of note - PSC

species	2020	2021	2022	2023	2024
Bairdi Tanner Crab	1,146	2,279	191	681	30
Blue King Crab	-	-	-	-	-
Chinook Salmon	655	1,042	1,137	1,199	1,086
Golden (Brown) King Crab	60	114	136	596	4,213
Halibut	111	179	129	55	61
Herring	-	-	1	-	-
Non-Chinook Salmon	723	1,628	**4,002**	2,745	**6,422**
Opilio Tanner (Snow) Crab	-	-	-	-	-
Red King Crab	-	-	-	-	-

*These values are for all rockfish fisheries (POP has a lot of influence)

QUESTIONS?

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