GOA rougheye and blackspotted rockfish (operational full)

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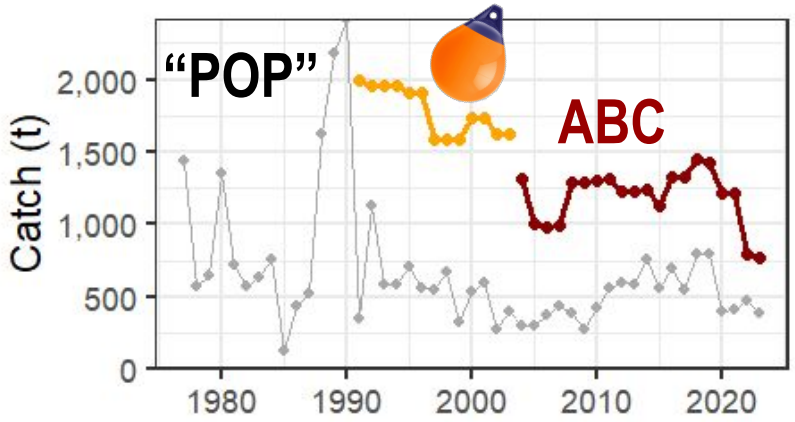
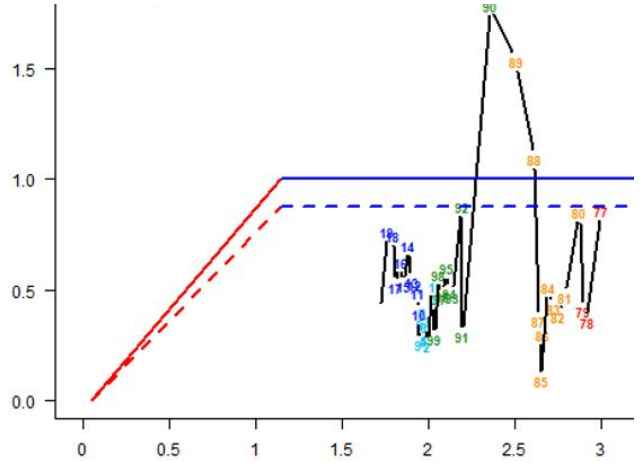
November 2023 Groundfish Plan Team

Nov doc, Sep doc, Sep presentation

RE/BS Background

1. Cryptic species, no directed fishery, lightly exploited, catch << ABC == TAC
2. 2021 assessment: Tier 3a, no model changes since 2015, large retro bias (Mohn's rho=0.6), large drop in population scale and ABC
3. GPT/SSC/author recommended changes to biological assumptions, catchability, selectivity, data (index calculations, fleet structure, comp data), data weighting
4. In Sep 23, proposed staged approach to model dev, starting with new maturity, M, growth, and ageing error
5. Model did not respond well when new data was added in Oct, more work needed





Year	Biomass[1]	OFL	ABC
2020	40,336	1,452	1,209
2021	40,432	1,456	1,212
2022	26,062	947	788
2023	25,957	937	781

Risk Table Summary

Recommend reduction from max ABC
Author-recommended model was not reviewed in September

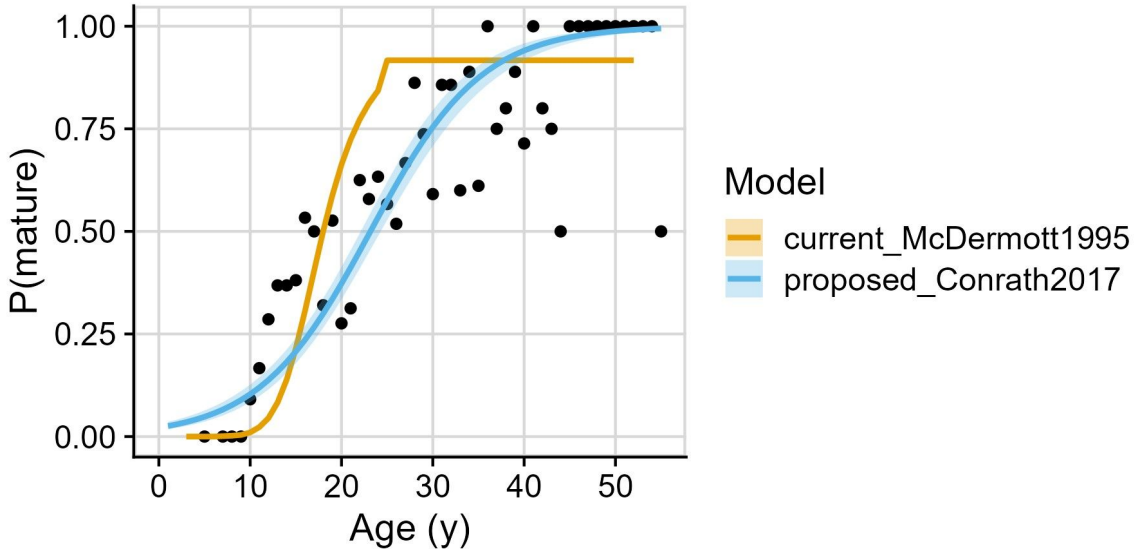
Assessment	Population Dynamics	Ecosystem	Fishery
2 - Major Concern	**2 - Major Concern**	1 - None	1 - None
(Base model) ● Severe one-way positive retrospective bias ● High uncertainty in stock scale **(Recommended model)** ● Improved stability, but poor fit and unable to account for recent declines in survey indices	● Declines in LLS and BTS indices in recent years ● 2023 LLS abundance lowest on record ● 2021 BTS lowest on record	● Average environmental conditions ● Some evidence of long-term declines in structural epifauna	● Incidental catch only ● Catch << ABC ● Not currently constraining target fisheries

LLS = longline survey
BTS = bottom trawl survey

GOA GPT Sep 23 (+SSC): "The Team recommended using the authors approach. Additionally, the **Team recommended alternative methods be explored that take skip spawning into account."**

As discussed in Sep, we plan to address this recommendation in the next assessment.

FYI: it was noted during internal review that samples should be weighted by species-specific abundance. Currently, we assume sampling was proportional to abundance.



GOA GPT Sep 23 (+SSC): "Alternative methods that relied on a more precise prior were discussed such as computing a *distribution based on available ages* and *applying the ageing error matrix* to set the prior. **The Team supported the author's investigation into M but recommended the author explore the application of the prior variance used for M."**

Current prior: Mean=0.03, CV=0.1

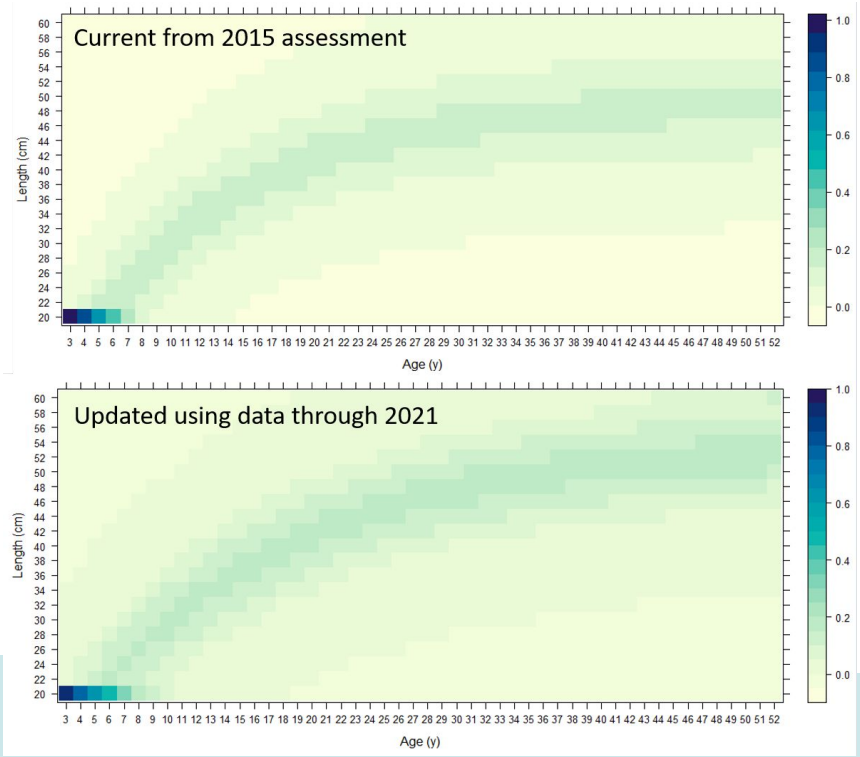
Sep 23: Mean=0.04 (oldest specimen=135 y), CV=0.31 (Hamel and Cope 2022)

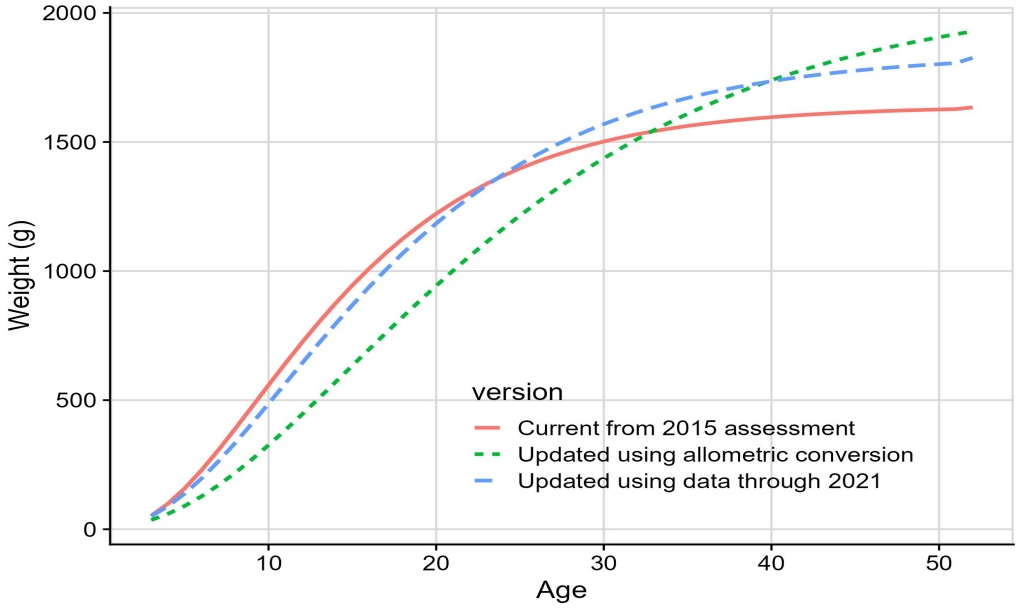
Analysis in response to recommendation: Using the 5 oldest survey and fishery GOA RE/BS specimens (126-135 y) and the age-specific SD from the new ageing error matrix (Punt et al. 2008), we constructed a distribution of Ms using the Hamel and Cope (2022) max age estimator with Mean=0.042, CV=0.058

Nov 23: Author recommended model fixes M at 0.042

SSC Oct 23 (+GPT): "The SSC supports the author and GOA-GPT recommendation to incorporate new data for the aging error matrix, the size-at-age matrix, and weight-at-age vector. "

In the absence of a strong recommendation to use WAA from a weight-based vonB (status quo) or a length-based vonB converted to weight using the weight-length relationship, we decided to remain with the status quo method in order to maintain consistency with the other Tier 3 GOA rockfish.





SSC Oct 21 (+GPT & author): "...because the surveys exhibit inconsistent trends and partition biomass differently among areas, it is unclear if these signals reflect a genuine conservation concern or are the byproduct of survey data conflicts. The SSC concurs with the author and the GOA GPT that it would be prudent to **estimate survey indices using the same depth strata definitions** and to **examine weighting CPUE by a variable other than total geographic area** that may be more relevant to this complex (e.g., Essential Fish Habitat within a stratum)."

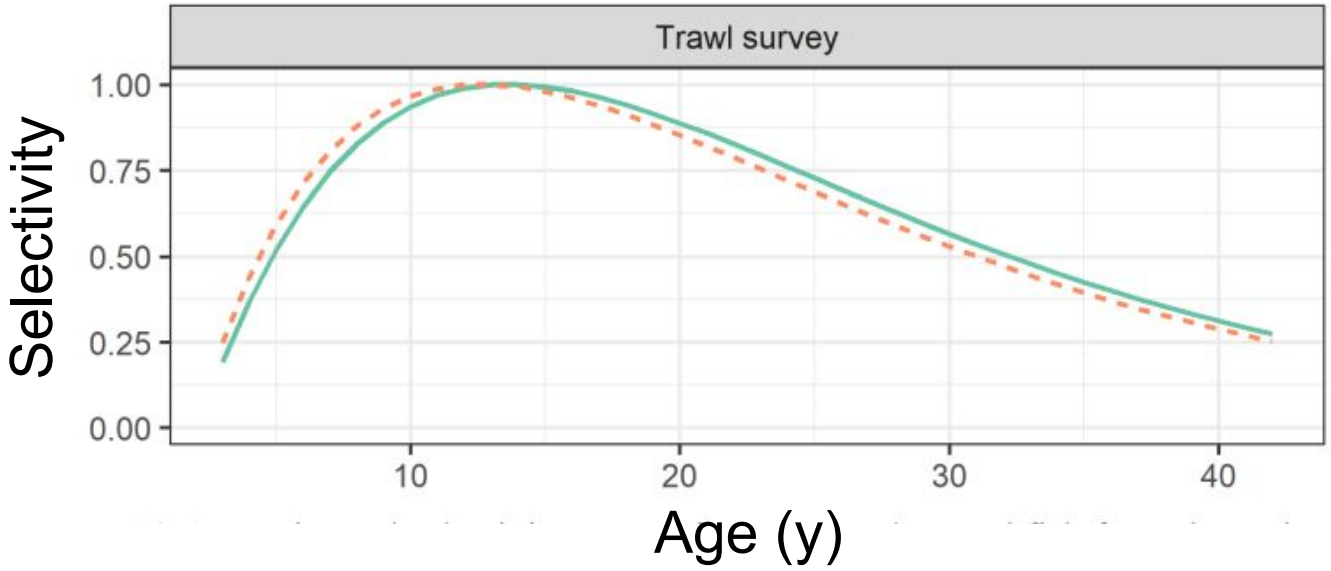
Author recommends no action on this topic at this time for the following reasons:

(1) After digging in more, this is a large task.
(2) EFH is defined using the trawl survey and is therefore not independent

See 2021 assessment for detailed CPUE comparisons by depth and area

SSC Dec 21: "The dome-shaped trawl survey selectivity… the GOA GPT noted it was unclear why 40-year-old fish would be so much less selected than a 30-year-old fish. Future research could consider alternative parameterizations that would allow for more constrained estimates of selectivity at older ages. "

Not addressed in this assessment, and it remains an issue. We welcome additional feedback or suggestions.



Assessment Data Inputs

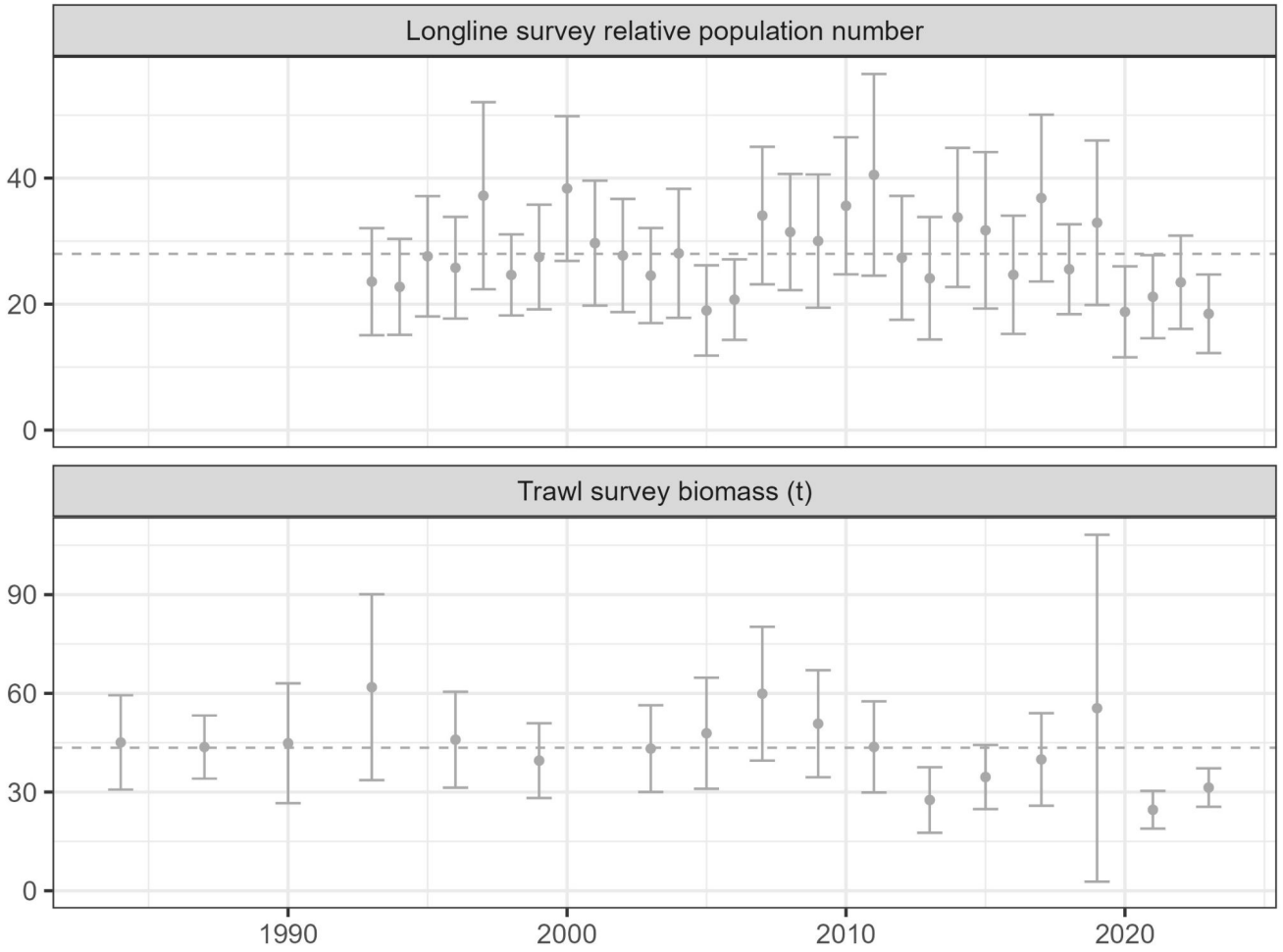
Source	Data	Years
Fisheries	Catch	1977-2021, **2022, 2023**
	Age	1990, 2004, 2006, 2008, 2009, 2010, 2012, 2014, 2018, 2020, **2022**
	Length	1991-1992, 2002-2003, 2005, 2007, 2011, 2013, 2017, 2019, **2021**
AFSC bottom trawl survey	Biomass index	~~1984, 1987,~~ 1990, 1993, 1996, 1999, 2003, 2005, 2009, 2011, 2013, 2015, 2017, 2019, 2021, **2023**
	Age	~~1984, 1987,~~ 1990, 1993, 1996, 1999, 2003, 2005, 2009, 2011, 2013, 2015, 2017, **2019, 2021**
AFSC longline survey	Relative Population Number (RPN)	1993-2019, 2020, 2021, **2022, 2023**
	Length	1993-2019, 2020, 2021, **2022, 2023**

New data in bold

Abundance trends

LLS: 2023 lowest on record, 34% below mean

BTS: increase from 2021, which was the lowest on record, and 28% below mean



Demographic changes

Evidence of declines in mean length and age in recent years

Fishery: at least partially explained by shift away from hook-and-line gear

Alternative Model Configurations

Model	Natural Mortality	Bottom Trawl (BTS) & Longline Survey (LLS) q	Recruitment Variability	Maturity, Growth, Ageing Error
Model 15.4	*Estimated* with lognormal prior Mean=0.03, CV=0.1 McDermott 1994 (GSI estimator)	*Estimated* with lognormal priors BTS Mean=1.0, CV=5.0 LLS Mean=1.0, CV=1.0	*Estimated* with lognormal prior Mean=1.1, CV=0.06	2015 assessment McDermott 1994 length-based maturity converted to age
Model 15.4a				
Model 23.1	*Estimated* with lognormal prior Mean=0.042, CV=0.058 Based on updated prior using longevity estimator			Reviewed in Sep 2023 Conrath 2017 age-based maturity Status quo growth methods with new data Punt et al. 2008 age error
Model 23.1a		*Estimated* with lognormal priors BTS Mean=1.0, CV=0.05 LLS Mean=1.0, CV=0.05	*Fixed* at 1.1	
Model 23.1b (recommended)	*Fixed* at the updated prior mean=0.042			

Selectivity and Comp Data Assumptions

Fishery marginal ages and length comps

- Age-based slx, nonparametric

Longline survey

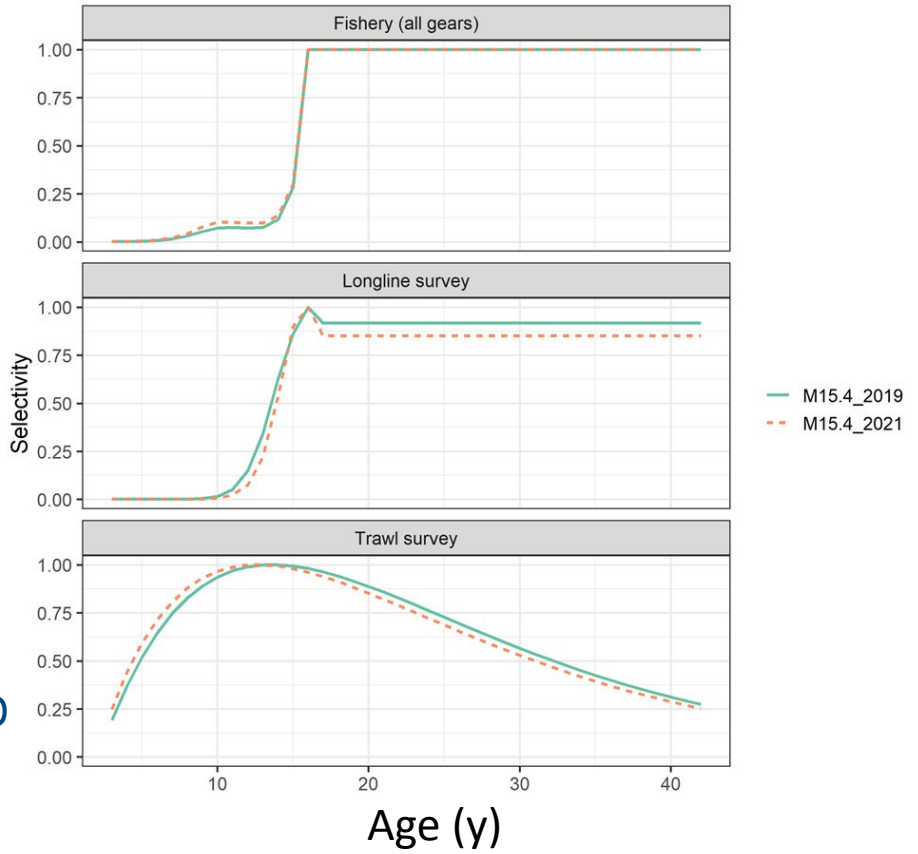
- Age-based slx, nonparametric

Bottom trawl survey

- Age-based slx, dome-shaped

Multinomial likelihood for comp data

- Age input n: sqrt of total n
- Length input n: sqrt of total n scaled to a maximum of 100
- No data weighting algorithms used



Model	Mohn's rho	Key Results	2024 Age-3+ Biomass*	2024 SSB*	2024 ABC*
Model 15.4	1.05	- Severe positive retrospective bias in SSB - Strong retro patterns and high parameter correlation among both *q*'s, *M*, mean recruitment - Unreasonably high estimates of trawl survey *q* (>2) - High reliance on length composition data	29,081	9,642	794
Model 15.4a	1.16	- Same as Model 15.4 but with even worse retro behavior	27,574	9,245	751
Model 23.1	0.42	- Bad retrospective bias in spawning biomass and strong retrospective trends in global scaling parameters - Unreasonably high estimates of both *q*'s (>2) - Biomass scales that significantly lower than any model result to date - Slight improvements in the fits to the index data	16,154	3,890	432
Model 23.1a	0.13	- Greatly improved retro behavior, except for continued retro trends in *M* - Biomass scales that are consistent with Model 15.4 results *before* it started exhibiting retrospective patterns - Degraded fits to index data in recent years - Recent biomass trajectories are inconsistent with survey trends	45,252	11,876	1,460
Model 23.1b	**0.14**	**- Same as Model 23.1a but with no retrospective pattern in *M***	**46,129**	**13,022**	**1,305**

Summary of Results

Model	Mohn's rho	Key Results	2024 Age-3+ Biomass*	2024 SSB*	2024 ABC*
Model 15.4	1.05	- Severe positive retrospective bias in SSB - Strong retro patterns and high parameter correlation among both *q*'s, *M*, mean recruitment - Unreasonably high estimates of trawl survey *q* (>2) - High reliance on length composition data	29,081	9,642	794
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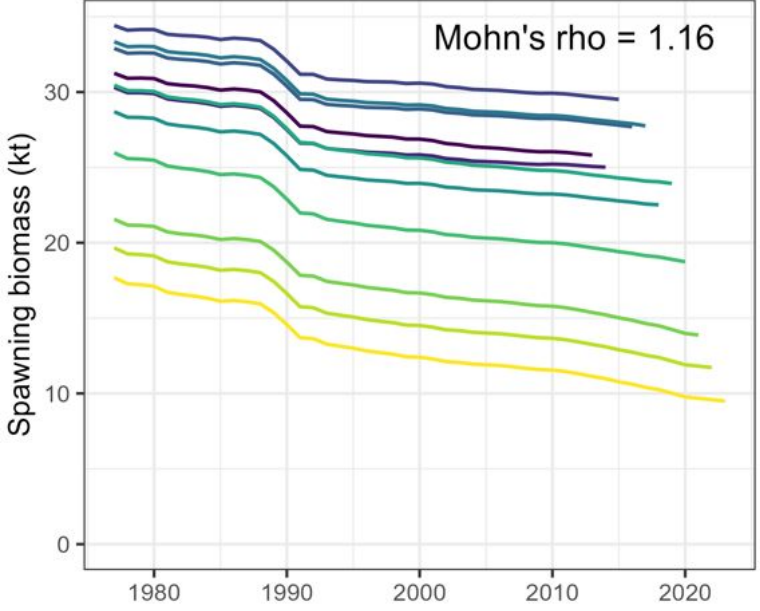
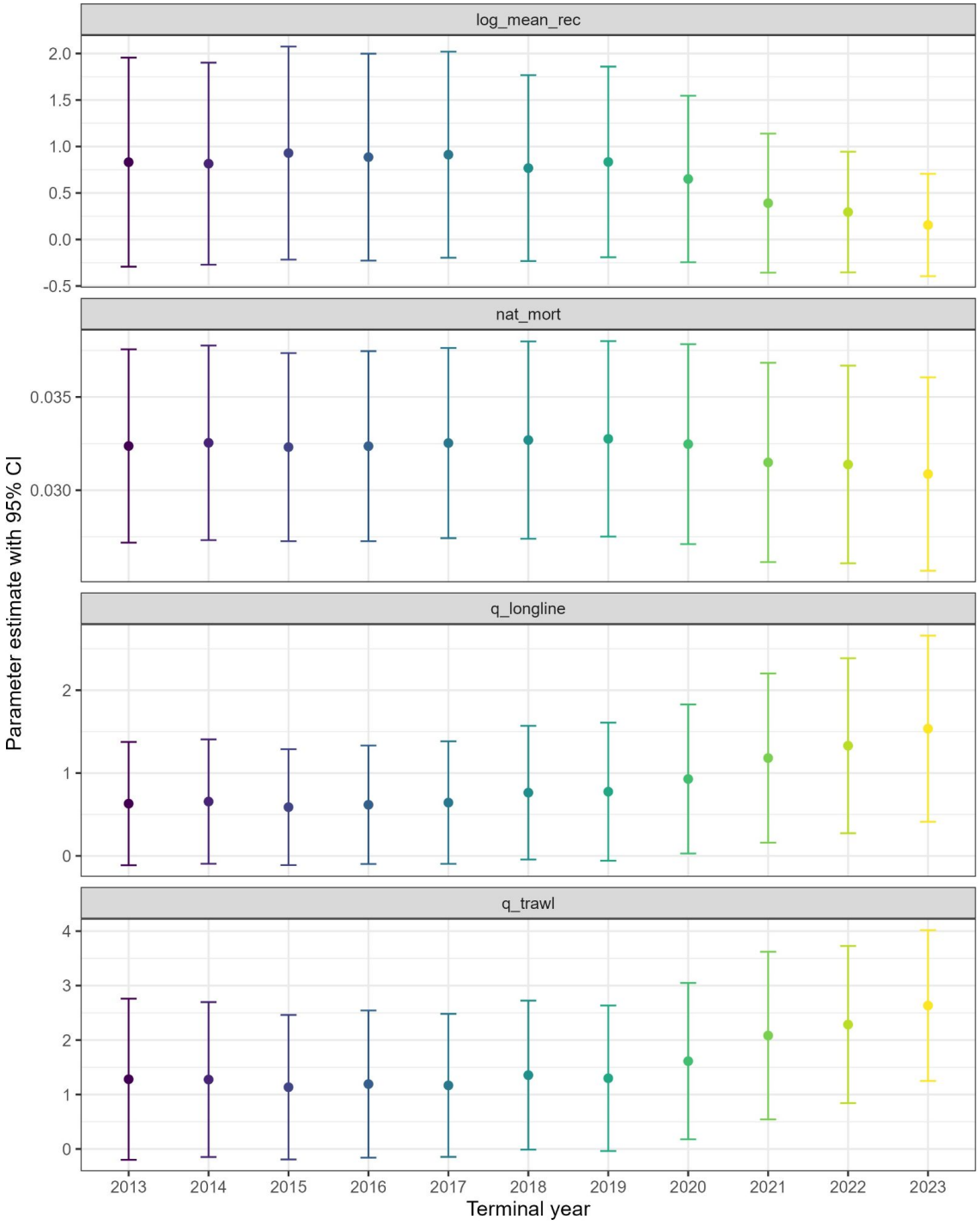


M15.4a

- Large declines in estimates of population productivity/scale (recruitment, M)
- High estimates of q (LLS_q=1.54, BTS_q=2.63)

Figure 13-9, Table 13-15



What are “reasonable” estimates of q?

q < 1.0
Survey underestimates abundance
(e.g., untrawlable habitat)

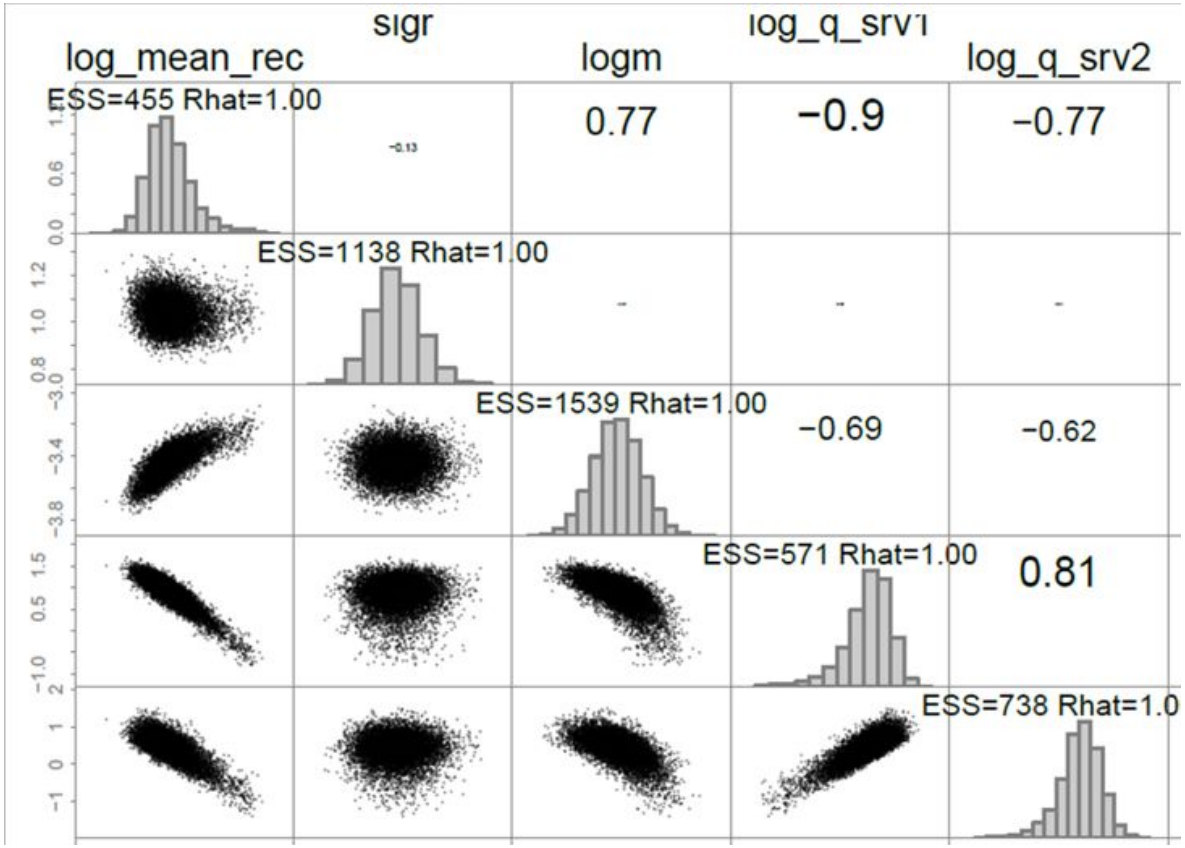
q = 1.0
Survey abundance = True abundance

q > 1.0
Survey overestimates abundance (e.g., herding fish into trawl gear)

- Jones et al. 2021, Somerton et al. 1999, Krieger and Sigler 1996 - no mention of slope rockfish, all highlight the importance of size-selectivity
- No clear mechanism for high q of RE/BS in trawl or longline gear

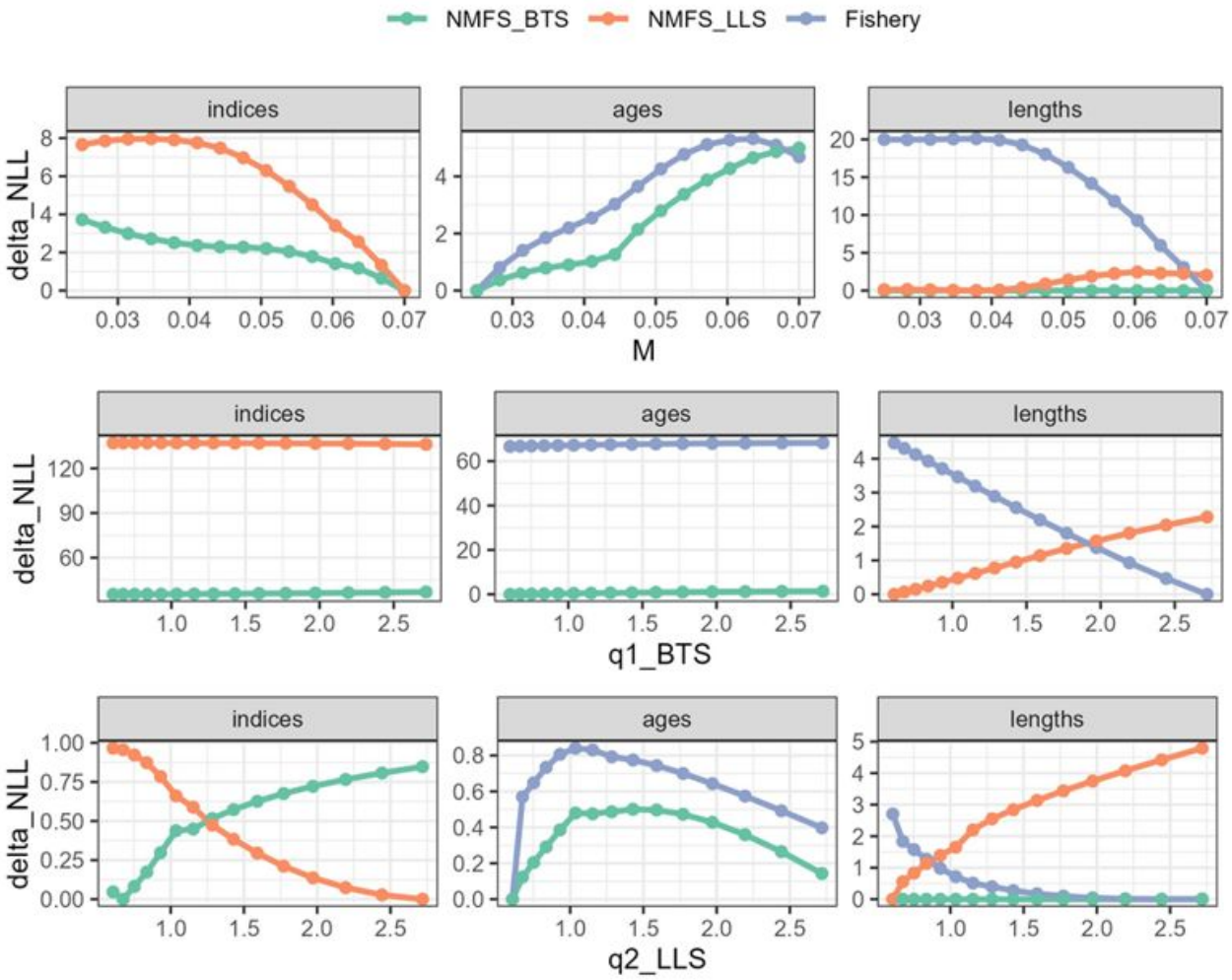
High parameter correlation

M15.4a pairwise plots of the MCMC marginal posterior distributions (Figure 13-10)



What data is informing scale?

M15.4a likelihood profiles/Piner plots (Figure 13-14)



What happens when we update the biological assumptions as proposed in Sep?

Model	Mohn's rho	Key Results	2024 Age-3+ Biomass*	2024 SSB*	2024 ABC*
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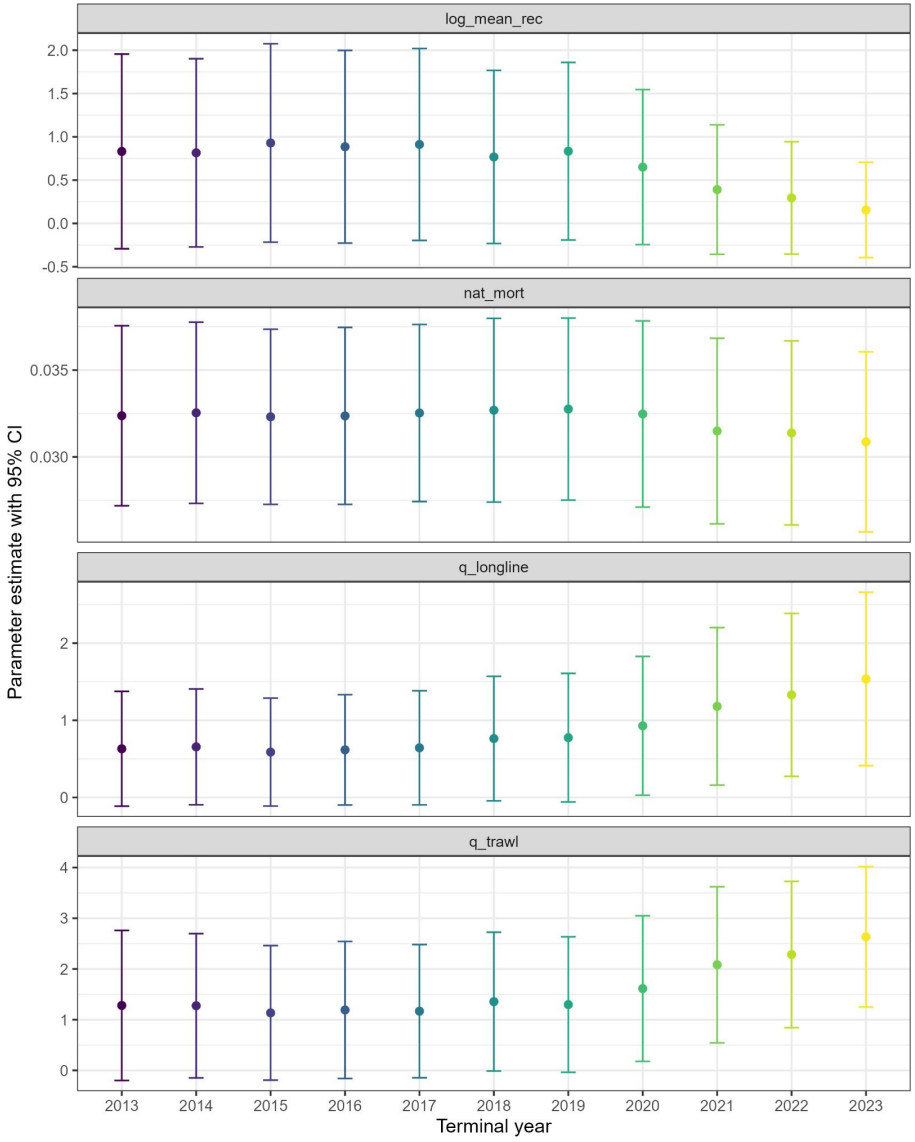
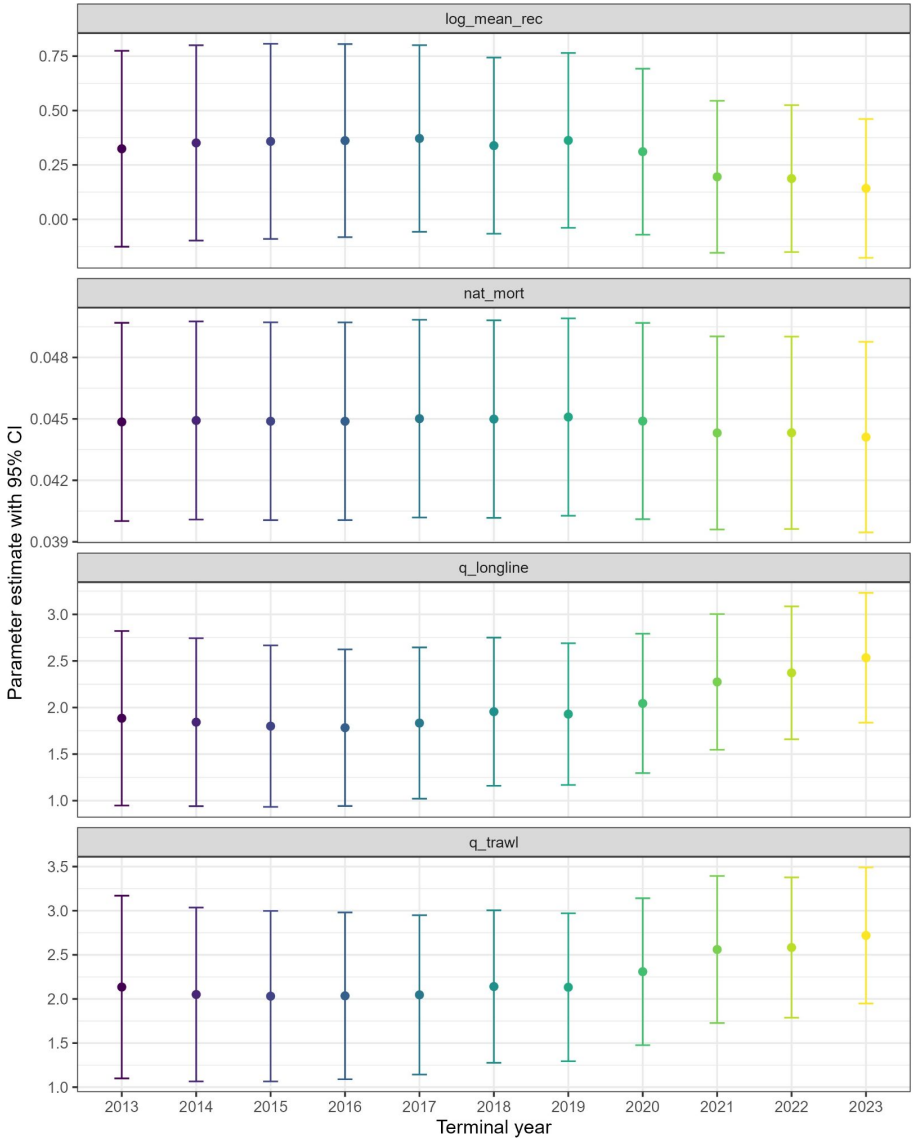
Model 23.1a	0.13	- Greatly improve… trends in *M* - Biomass scales… *before* it started… - Degraded fits to… - Recent biomas…	45,252	11,876	1,460
Model 23.1b	**0.14**	**- Same as Mode…**	**46,129**	**13,022**	**1,305**

M15.4a (drop 1980s BTS)



LLS_q=1.54, BTS_q=2.63

M23.1 (just new bio assumptions)



LLS_q=2.53, BTS_q=2.72

Introducing scale into the RE/BS model:

Constrained q_BTS and q_LLS Mean=1.0, CV=0.05 (BSAI BS/RE, Spencer et al. 2022)

Fixed sigmaR at 1.1 (prior mean)

Model	Mohn's rho	Key Results	2024 Age-3+ Biomass*	2024 SSB*	2024 ABC*
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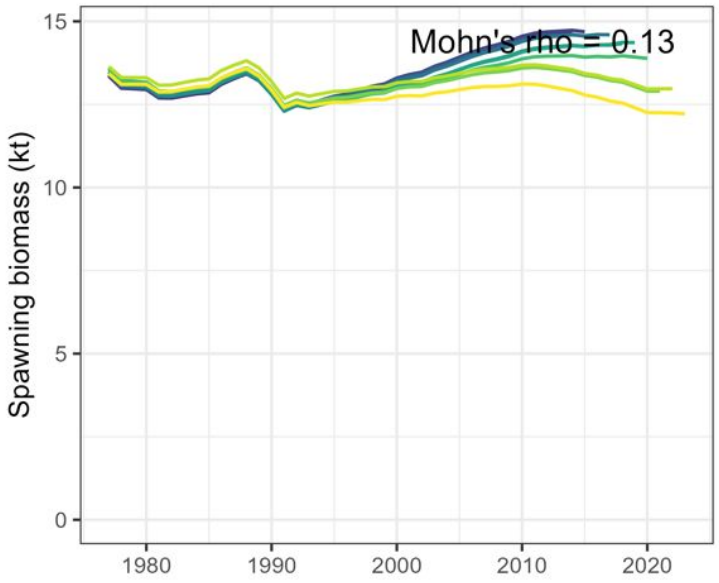
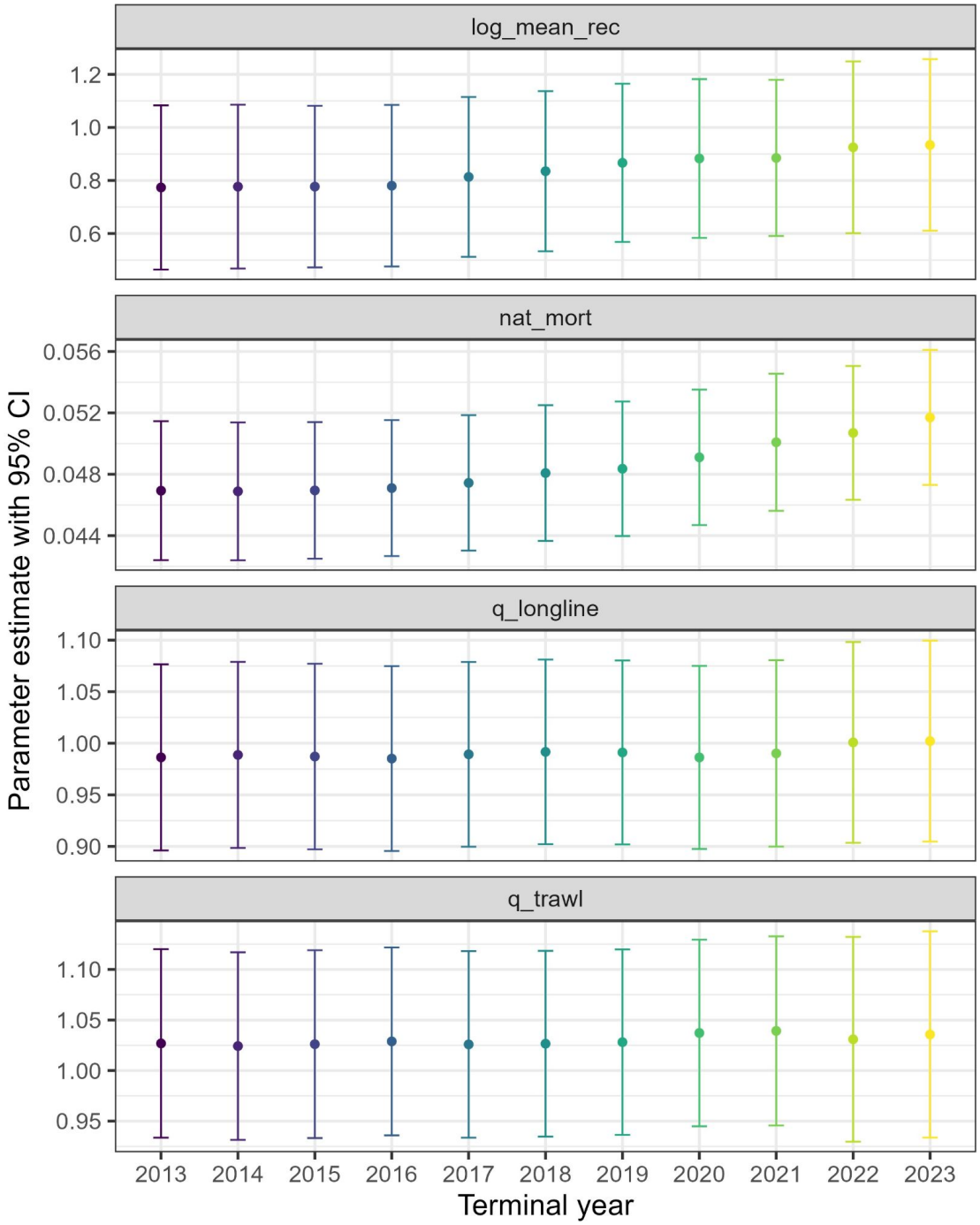


M23.1a

- Improved model stability, biomass estimates similar in scale to what has been estimated in the past
- Retrospective shift (increase) in estimates of population productivity (recruitment, M)

Figure 13-9, Table 13-15



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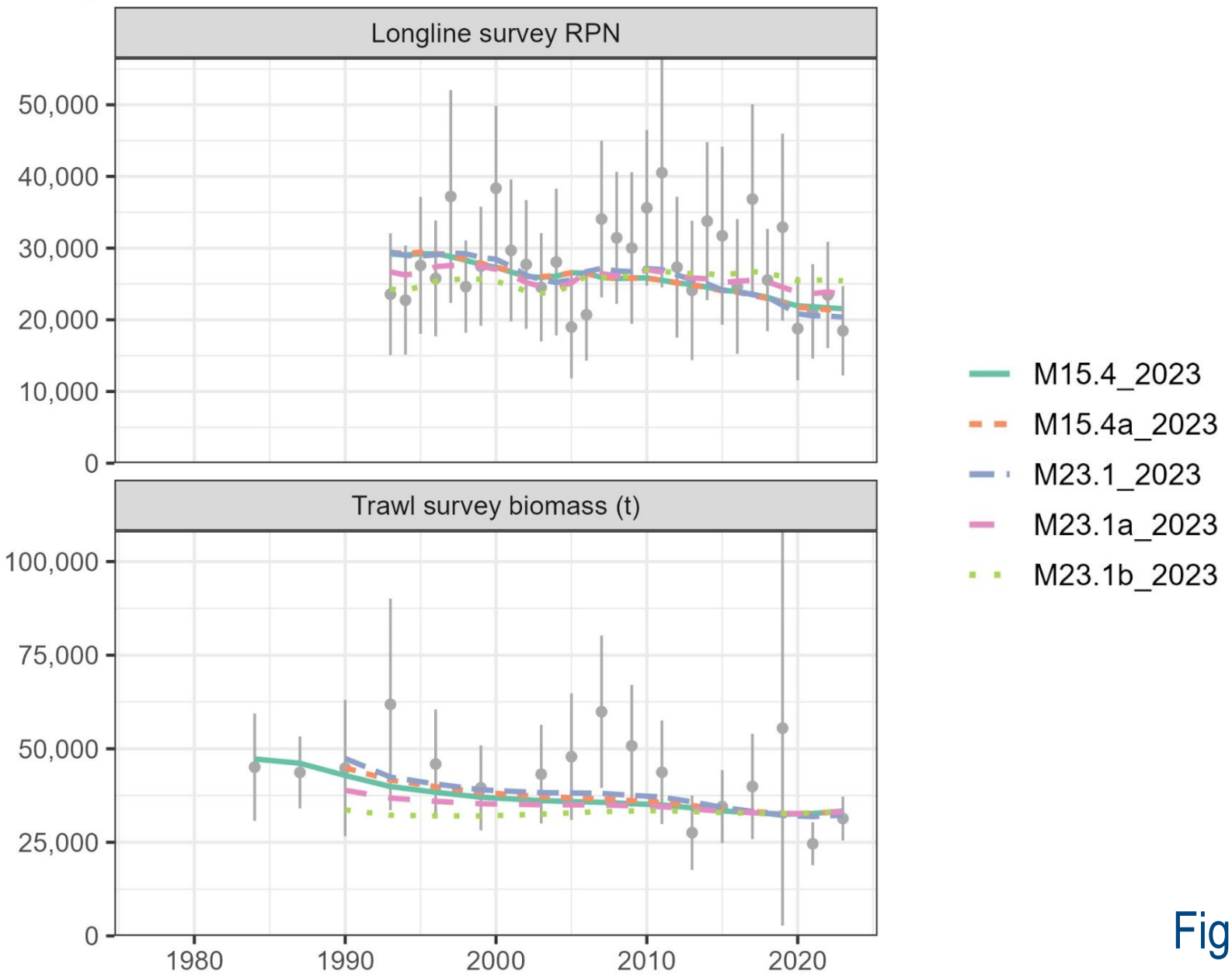
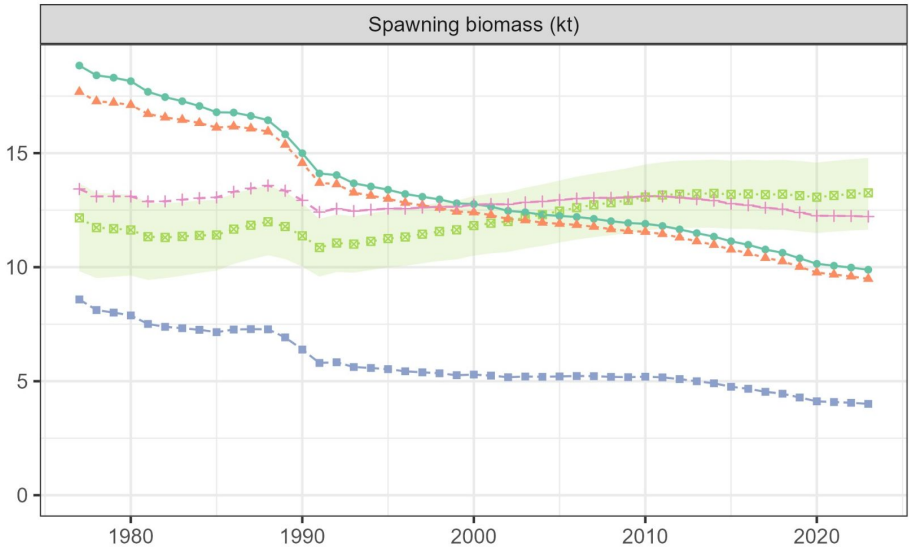
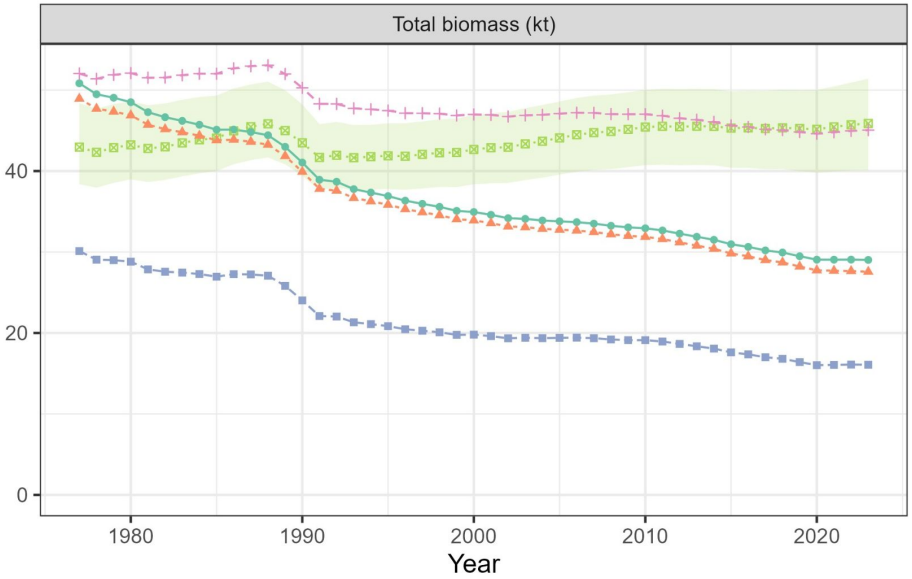
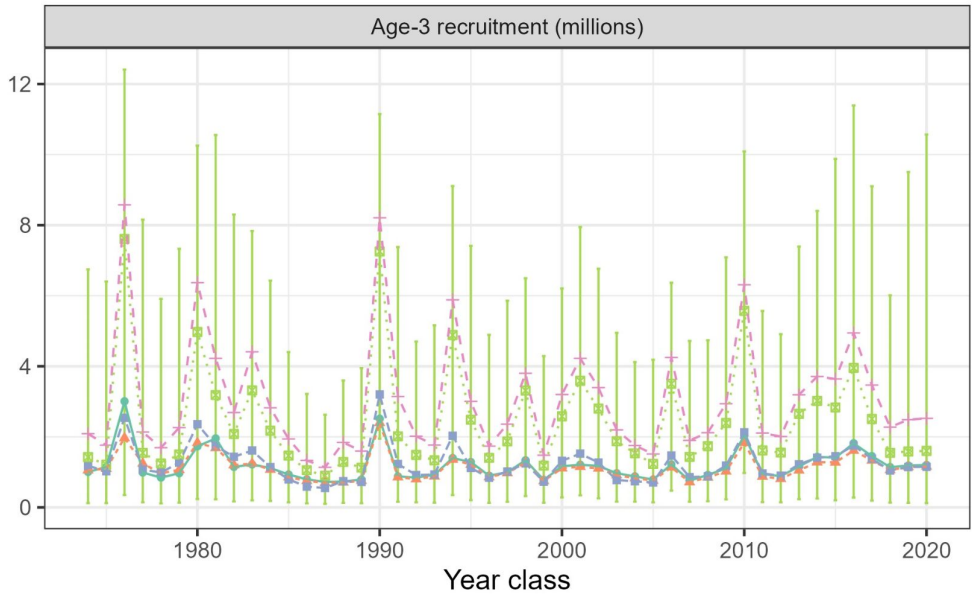

Longline survey RPN
50,000
40,000
30,000
20,000
10,000
0
Trawl survey biomass (t)
100,000
75,000
50,000
25,000
0
1980
1990
2000
2010
2020
M15.4_2023
M15.4a_2023
M23.1_2023
M23.1a_2023
M23.1b_2023

Figure 13-1







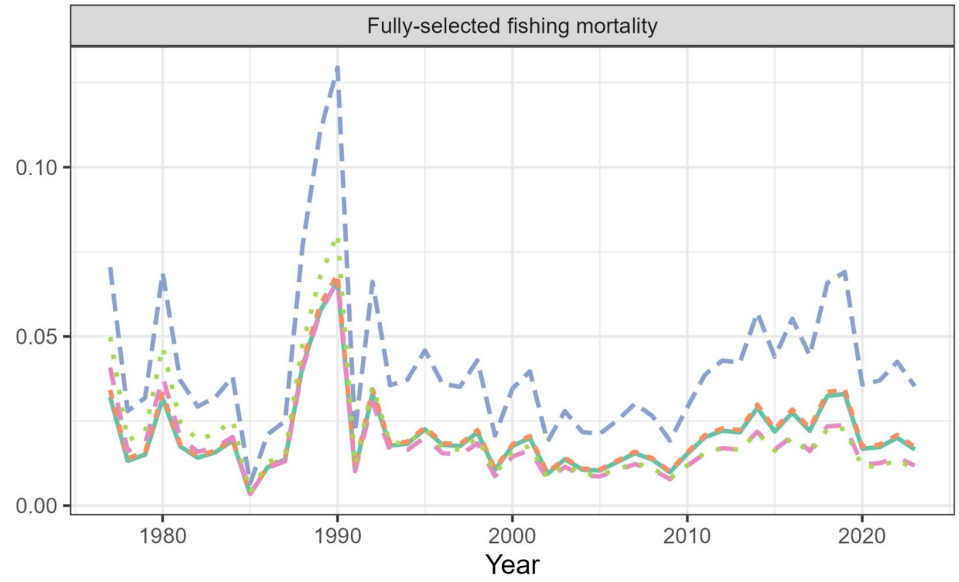
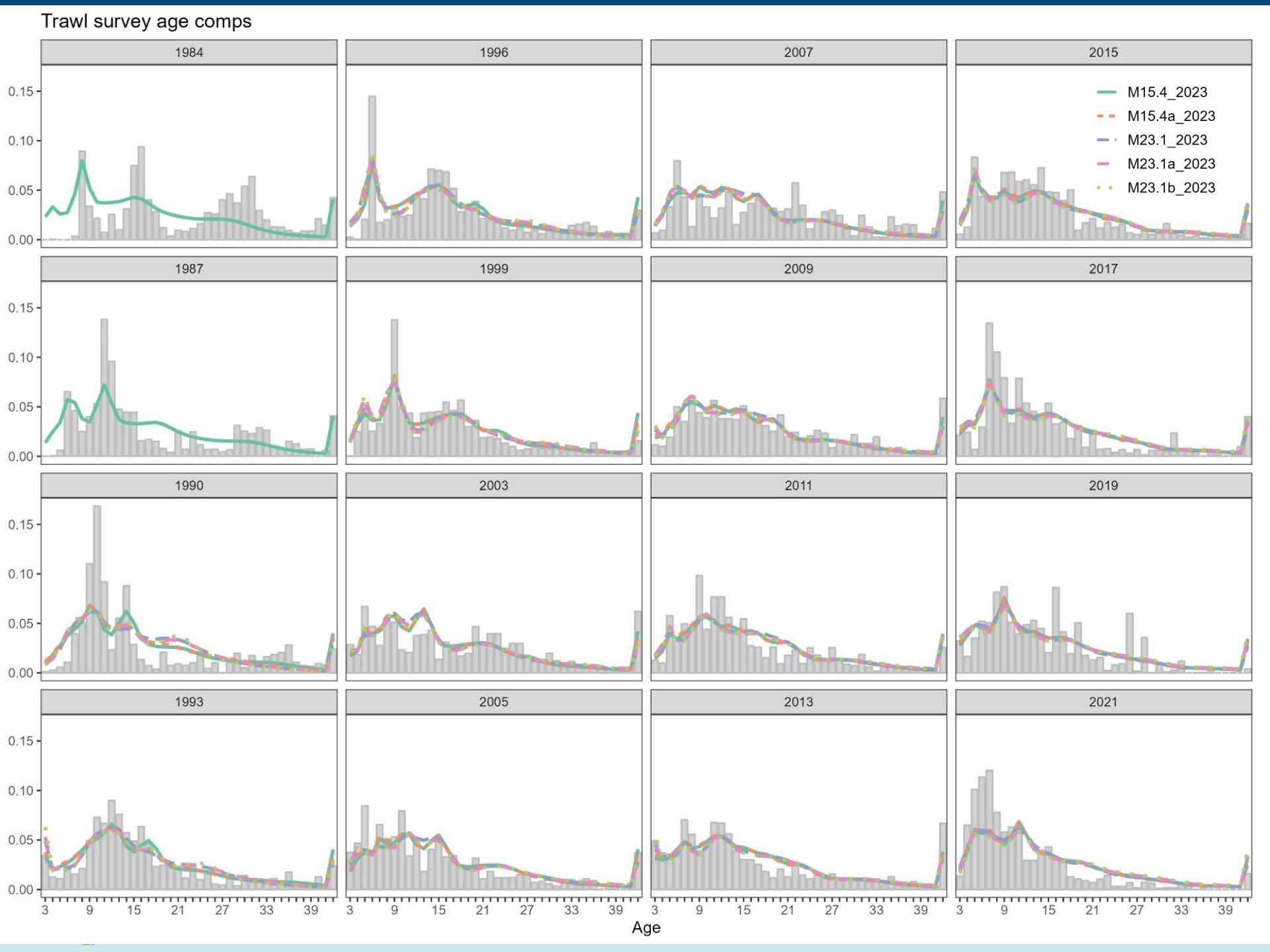


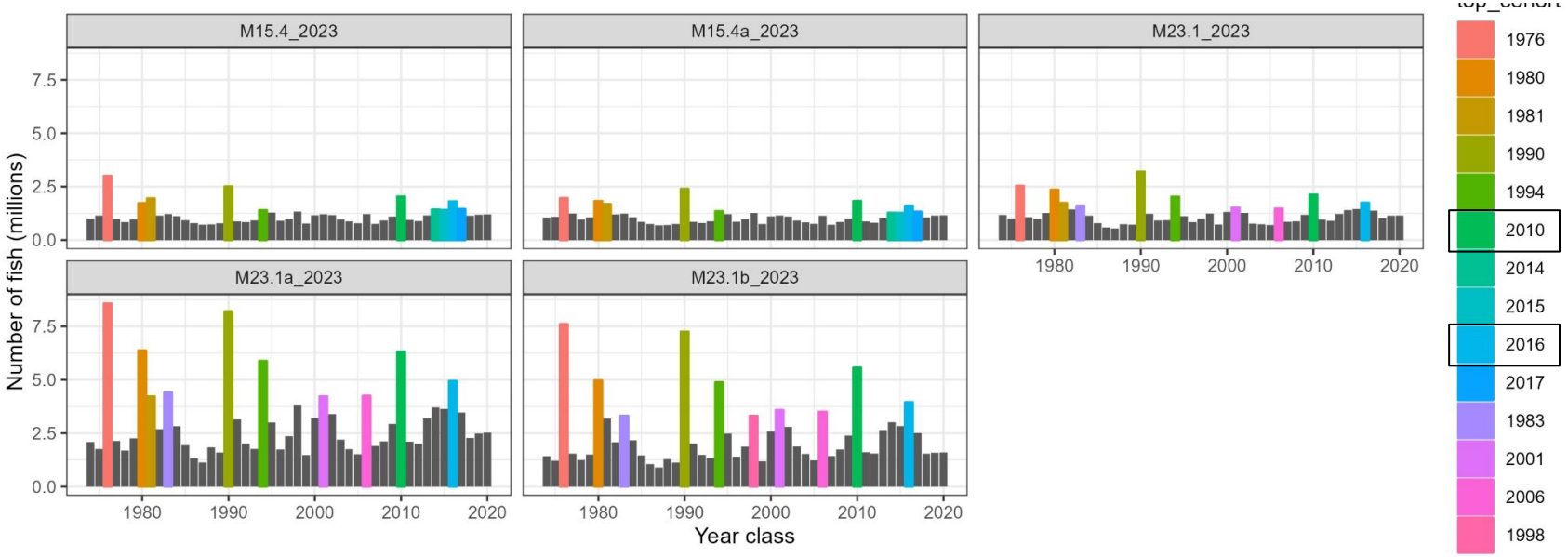
Figure 13-9, Table 13-15

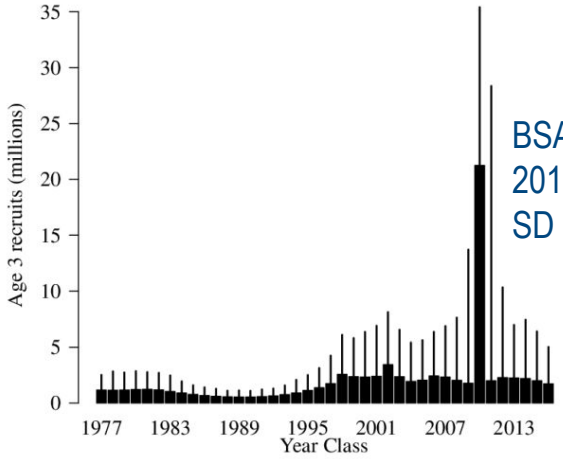
Model	Quantity	MLE Mean	CI-Lower	CI-Upper	MCMC Mean	MCMC Median	BCI-Lower	BCI-Upper
M15.4a_2023	Log Rbar	0.156	-0.394	0.712	-0.073	-0.114	-0.619	0.709
M23.1_2023	Log Rbar	0.142	-0.177	0.464	-0.285	-0.283	-0.676	0.106
M23.1a_2023	Log Rbar	0.934	0.611	1.261	0.581	0.579	0.268	0.898
M23.1b_2023	Log Rbar	0.478	0.249	0.708	0.161	0.162	-0.099	0.419
M15.4a_2023	M	0.031	0.026	0.036	0.032	0.032	0.027	0.038
M23.1_2023	M	0.044	0.039	0.049	0.044	0.044	0.039	0.049
M23.1a_2023	M	0.052	0.047	0.056	0.052	0.052	0.048	0.057
M23.1b_2023	M	0.042	-	-	0.042	0.042	-	-
M15.4a_2023	Longline q	1.54	0.41	2.67	1.64	1.59	0.73	2.84
M23.1_2023	Longline q	2.53	1.84	3.24	2.64	2.64	1.94	3.37
M23.1a_2023	Longline q	1.00	0.90	1.10	1.01	1.01	0.92	1.11
M23.1b_2023	Longline q	1.01	0.92	1.11	1.02	1.02	0.93	1.11
M15.4a_2023	Trawl q	2.63	1.25	4.03	2.54	2.53	1.15	3.96
M23.1_2023	Trawl q	2.72	1.95	3.50	2.70	2.69	1.96	3.52
M23.1a_2023	Trawl q	1.04	0.93	1.14	1.03	1.03	0.94	1.12
M23.1b_2023	Trawl q	1.06	0.97	1.16	1.06	1.05	0.96	1.15
M15.4a_2023	sigmaR	0.78	0.69	0.88	1.04	1.04	0.92	1.17
M23.1_2023	sigmaR	0.81	0.71	0.91	1.08	1.08	0.96	1.22
M23.1a_2023	sigmaR	1.10	-	-	1.10	1.10	-	-
M23.1b_2023	sigmaR	1.10	-	-	1.10	1.10	-	-

Table 13-15

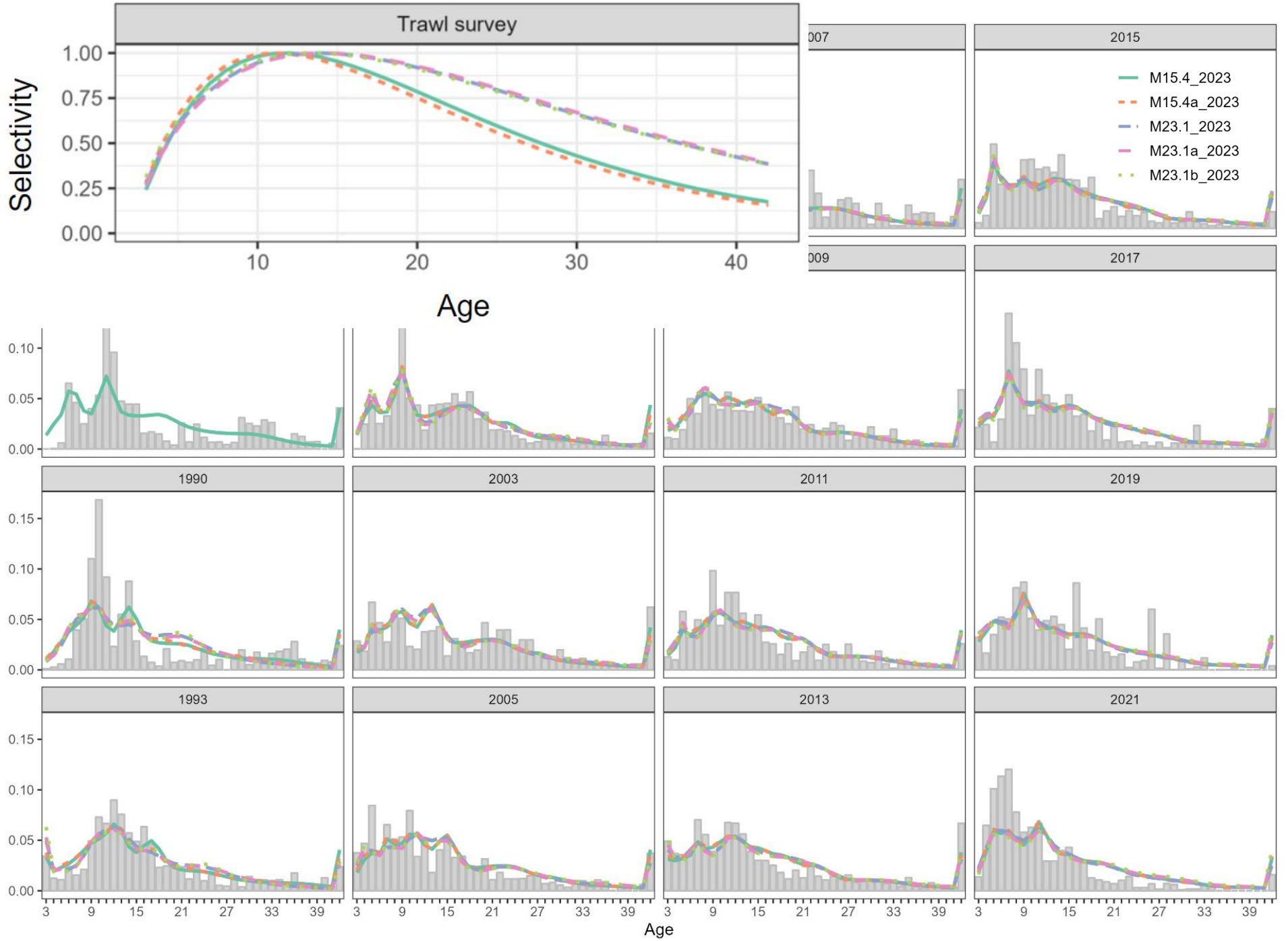

Trawl survey age comps
1984
1996
2007
2015
1987
1999
2009
2017
1990
2003
2011
2019
1993
2005
2013
2021
M15.4_2023
M15.4a_2023
M23.1_2023
M23.1a_2023
M23.1b_2023
0.15
0.10
0.05
0.00
3
9
15
21
27
33
39
Age

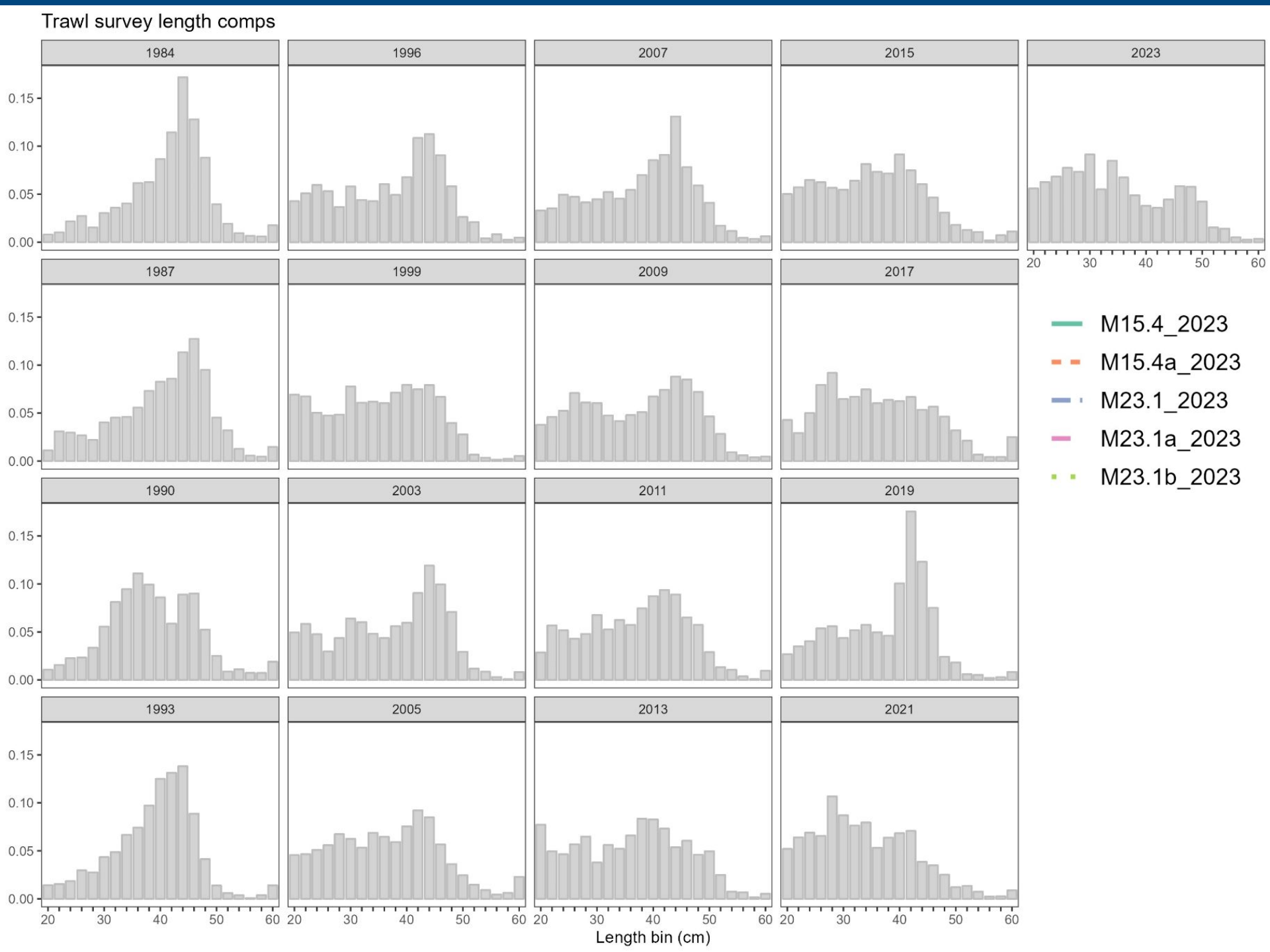
Top cohorts



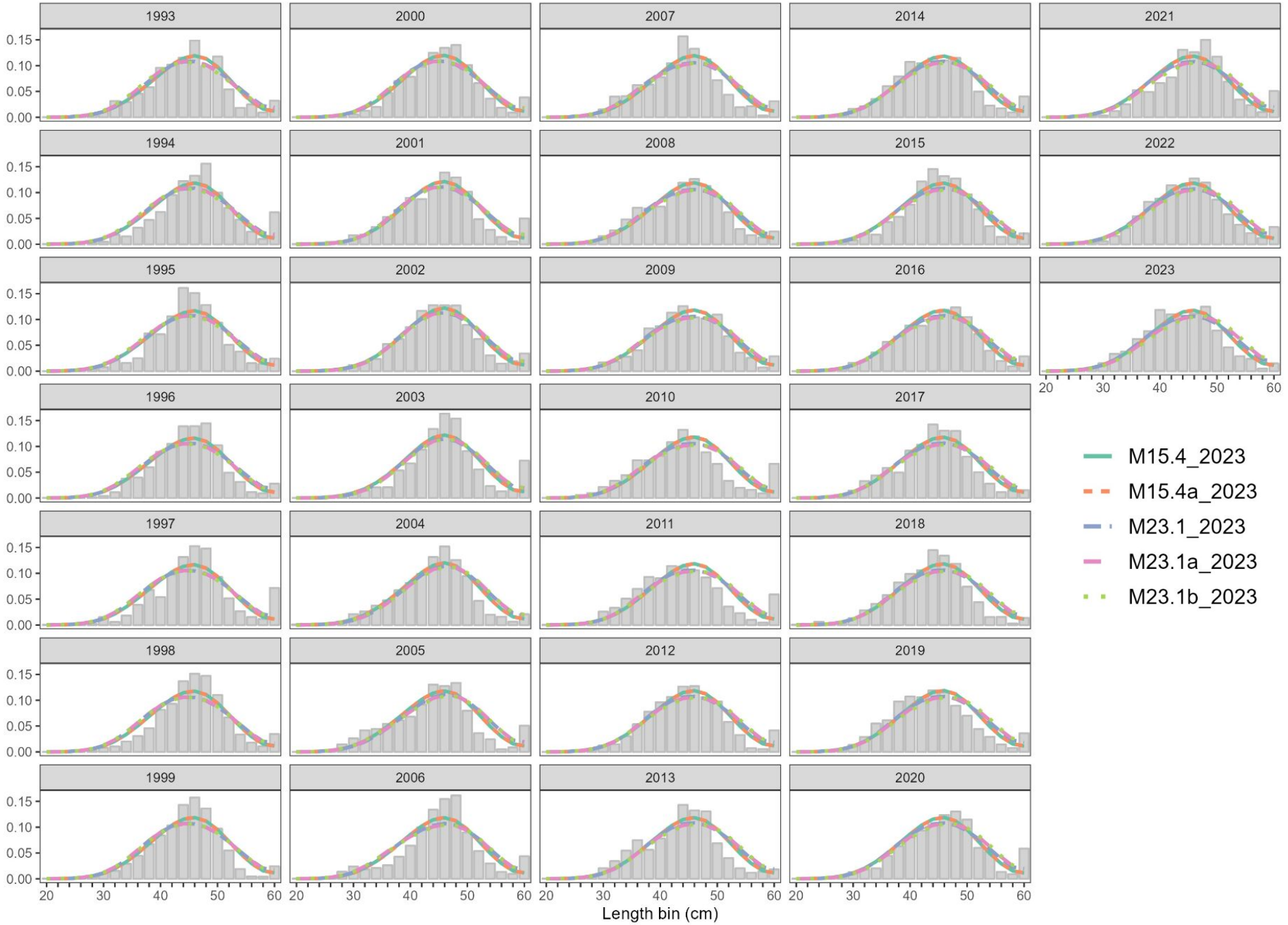


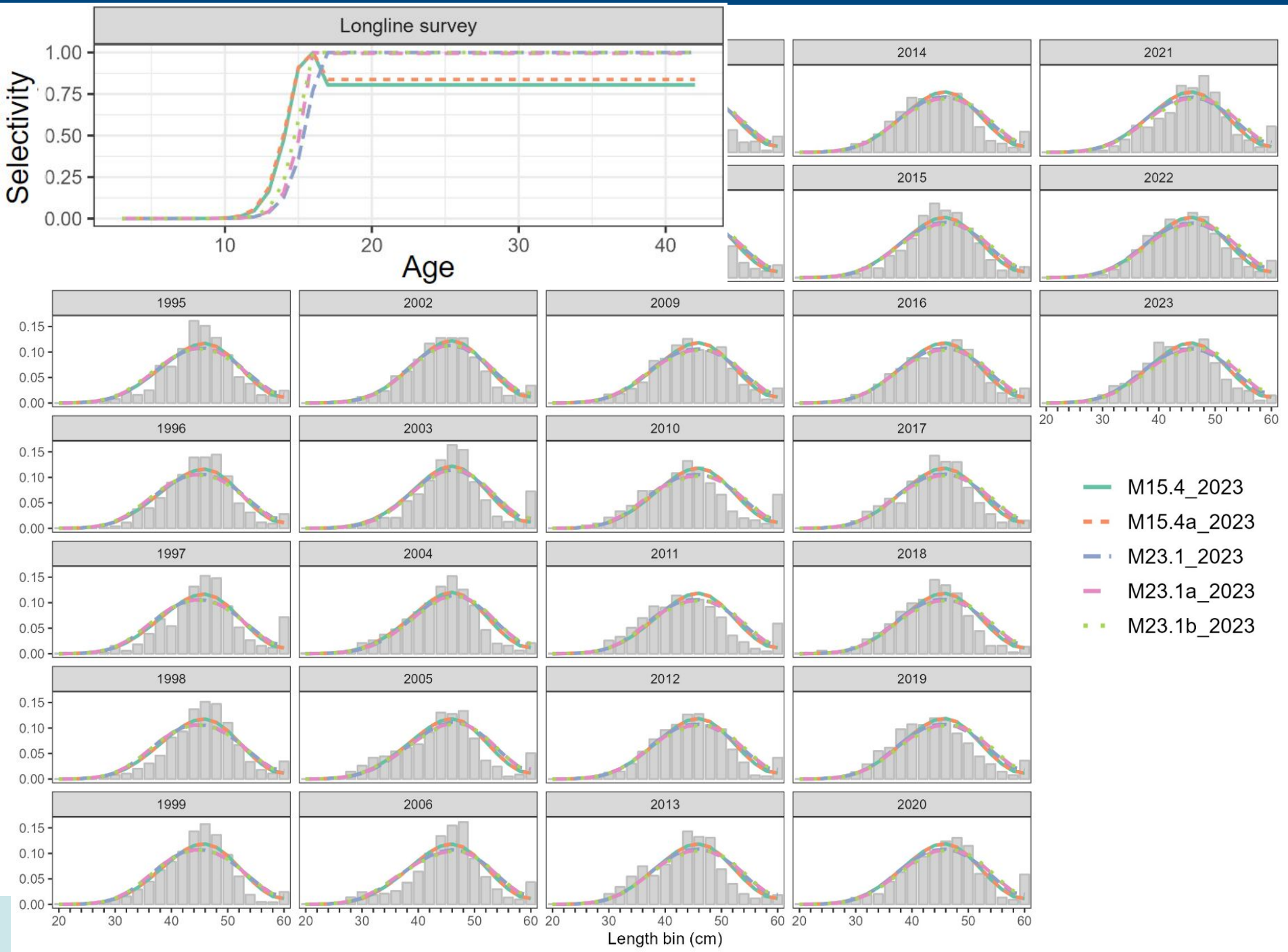
BSAI BS/RE (Spencer et al. 2022)
2010 yc
SD of log fixed at 0.75

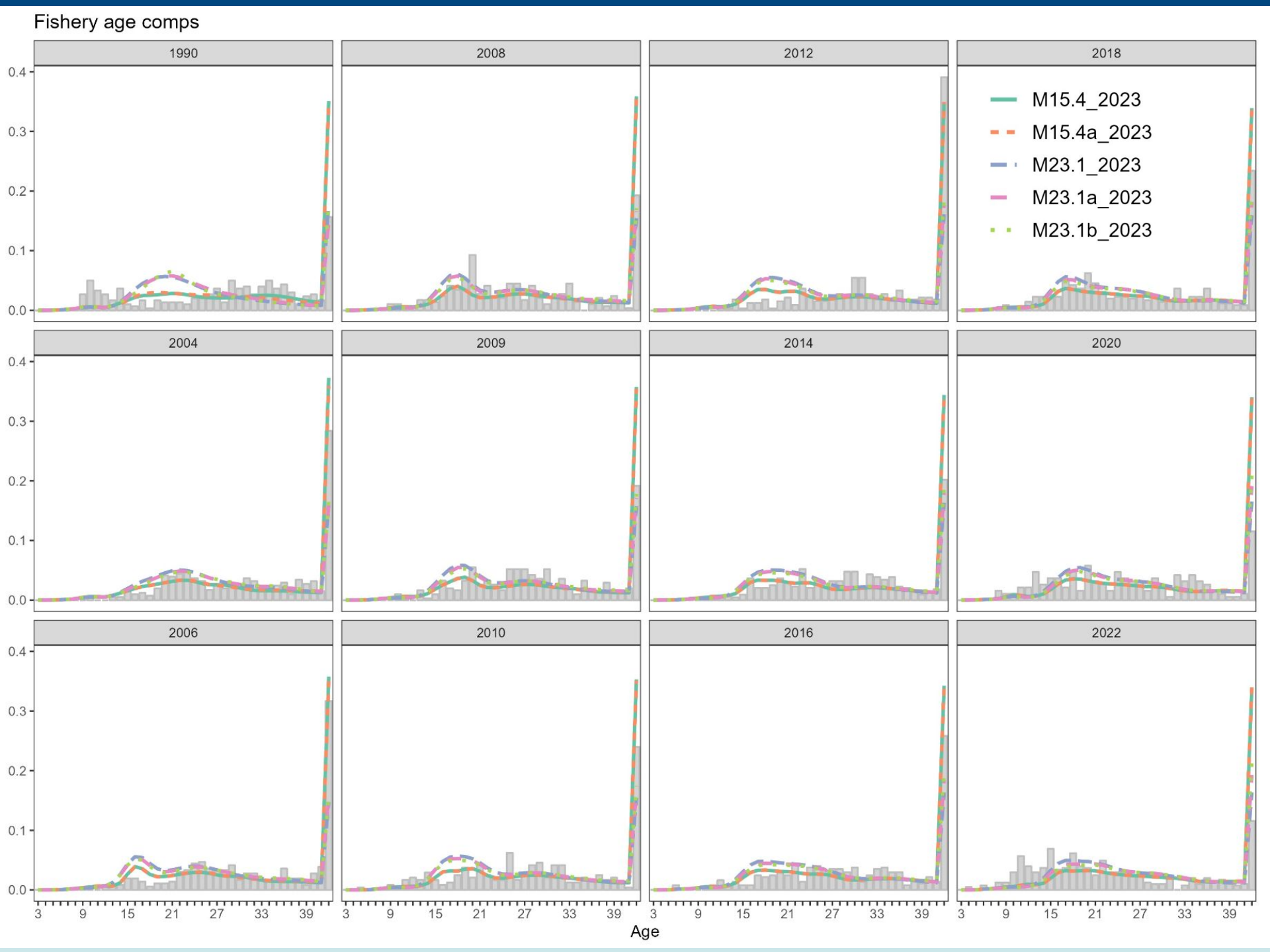

Trawl survey
Selectivity
1.00
0.75
0.50
0.25
0.00
10
20
30
40
Age
M15.4_2023
M15.4a_2023
M23.1_2023
M23.1a_2023
M23.1b_2023
007
2015
009
2017
1990
2003
2011
2019
1993
2005
2013
2021
0.10
0.05
0.00
0.15
3
9
15
21
27
33
39
Age

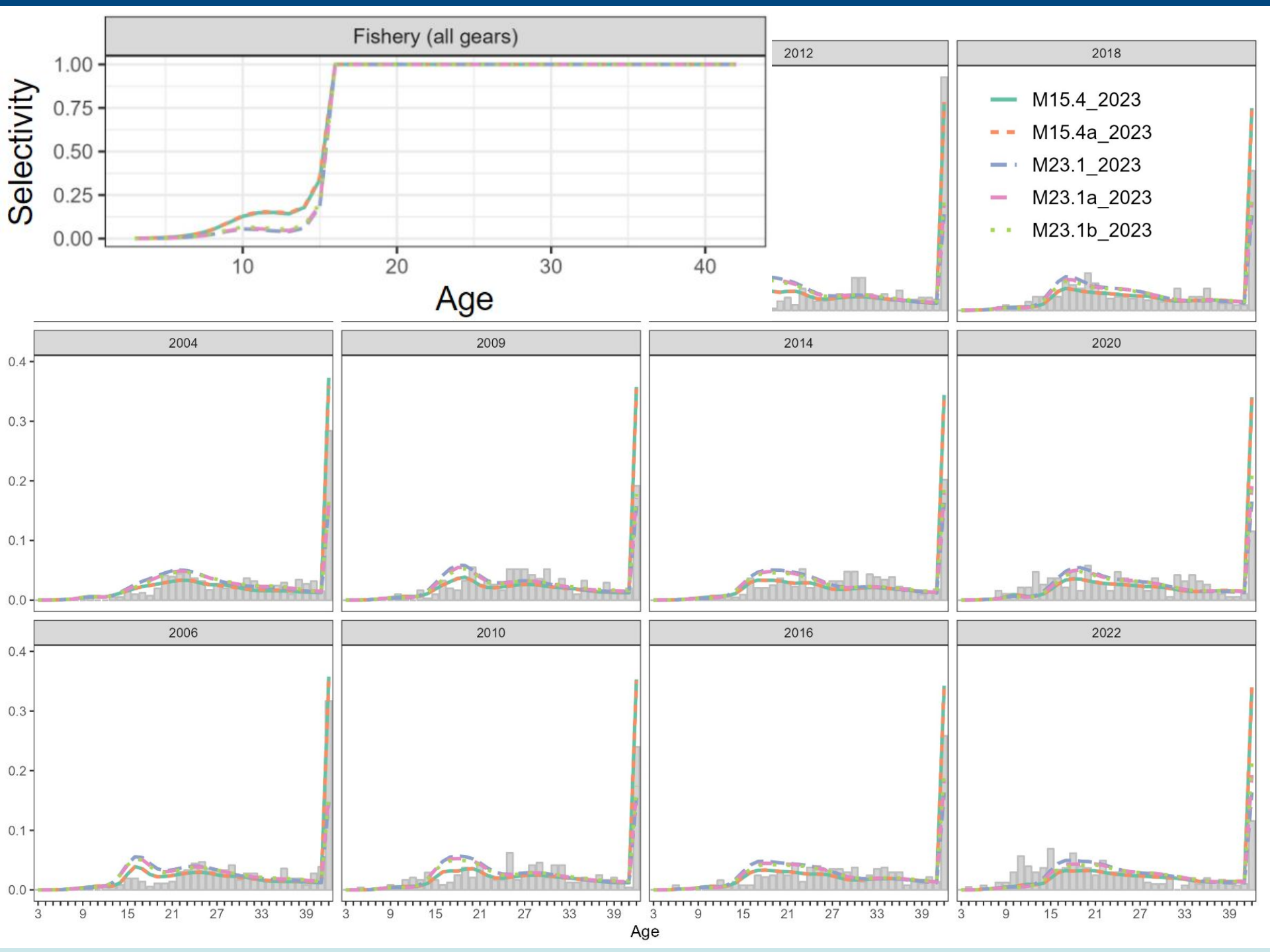

Trawl survey length comps
1984
1996
2007
2015
2023
1987
1999
2009
2017
1990
2003
2011
2019
1993
2005
2013
2021
0.00
0.05
0.10
0.15
20
30
40
50
60
Length bin (cm)
M15.4_2023
M15.4a_2023
M23.1_2023
M23.1a_2023
M23.1b_2023

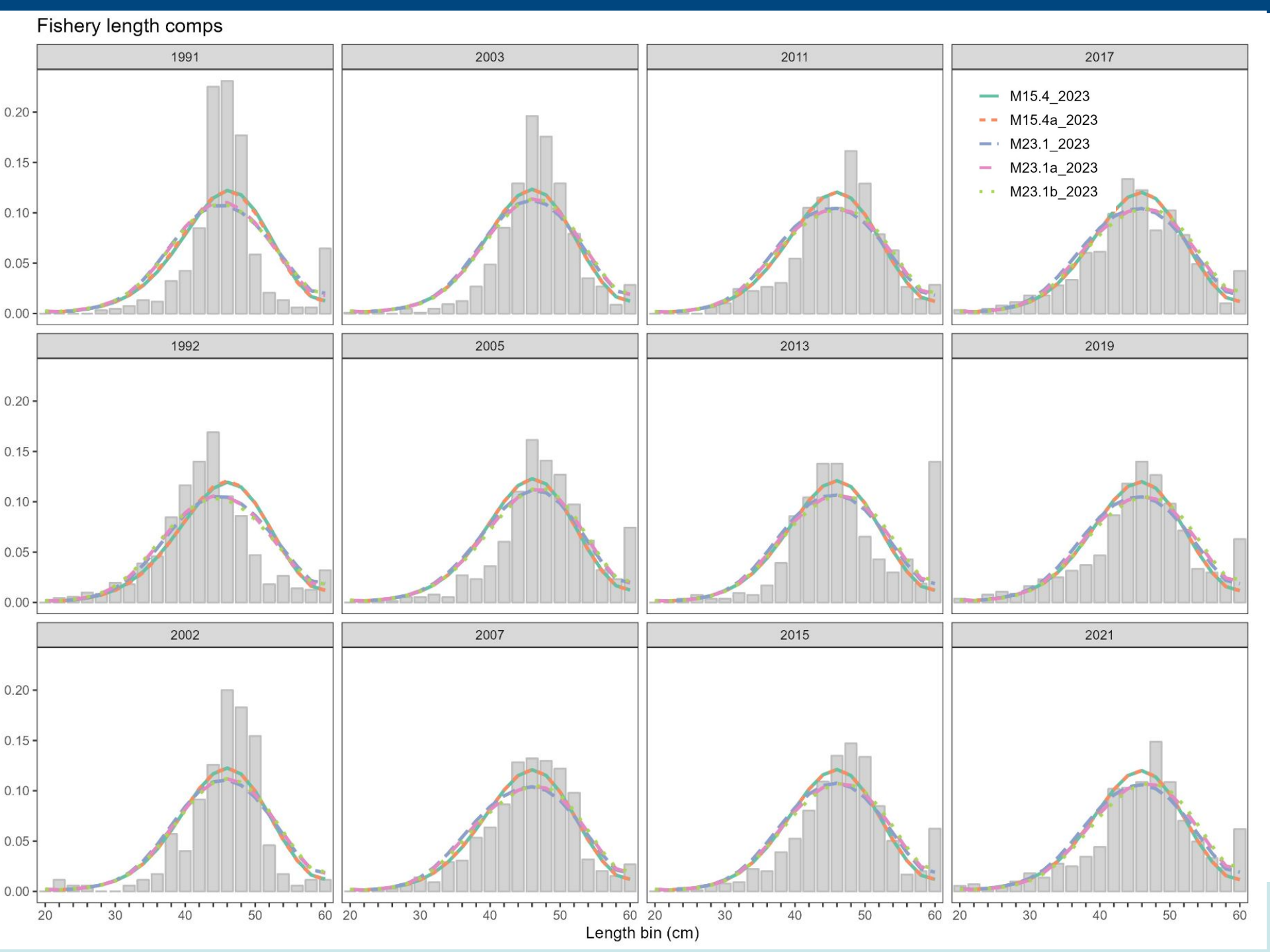
Longline survey length comps




Longline survey
Selectivity
1.00
0.75
0.50
0.25
0.00
10
20
30
40
Age
2014
2021
2015
2022
1995
2002
2009
2016
2023
1996
2003
2010
2017
1997
2004
2011
2018
1998
2005
2012
2019
1999
2006
2013
2020
0.15
0.10
0.05
0.00
20
30
40
50
60
Length bin (cm)
M15.4_2023
M15.4a_2023
M23.1_2023
M23.1a_2023
M23.1b_2023


Fishery age comps
1990
2008
2012
2018
2004
2009
2014
2020
2006
2010
2016
2022
0.0
0.1
0.2
0.3
0.4
3
9
15
21
27
33
39
Age
M15.4_2023
M15.4a_2023
M23.1_2023
M23.1a_2023
M23.1b_2023

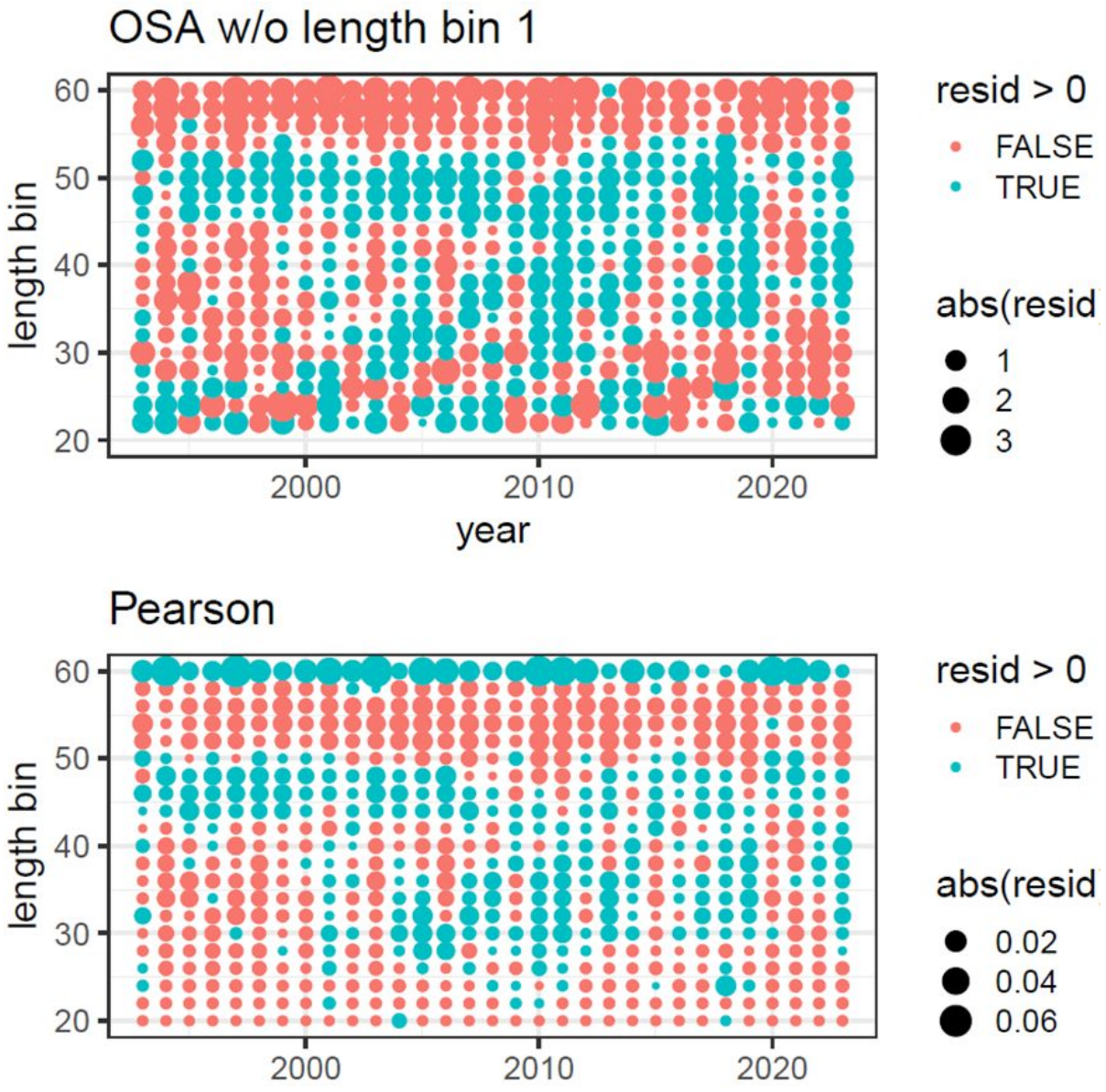

Fishery (all gears)
Selectivity
1.00
0.75
0.50
0.25
0.00
10
20
30
40
Age
2012
2018
M15.4_2023
M15.4a_2023
M23.1_2023
M23.1a_2023
M23.1b_2023
2004
2009
2014
2020
2006
2010
2016
2022
0.4
0.3
0.2
0.1
0.0
3
9
15
21
27
33
39
Age


Fishery length comps
1991
2003
2011
2017
1992
2005
2013
2019
2002
2007
2015
2021
M15.4_2023
M15.4a_2023
M23.1_2023
M23.1a_2023
M23.1b_2023
0.00
0.05
0.10
0.15
0.20
20
30
40
50
60
Length bin (cm)

All around poor fits to comp data

Red = overestimating

Blue = underestimating



Figures 13-11 – 13-14

RE/BS Assessment Summary

- Base model M15.4 first accepted in 2015
- In Sep 2023, we presented new M, maturity, ageing error, and growth
- When new data were added, the retrospective bias went from bad in 2021 (Mohn's rho=0.61) to worse (Mohn's rho=1.05)
- Bias caused by large retrospective patterns in both survey catchabilities (q_trawl>2), M, and recruitment (all estimated in M15.4)
- Constrained scaling parameters in recommended M23.1b stabilized the model (Mohn's rho=0.14); however, M23.1b has degraded fits to the survey data and biomass trajectories that are inconsistent with recent trends in survey abundance
- More work needed to address model misspecification

Recommended reduction from max ABC

Quantity	As estimated or *specified last* year for:		As estimated or *recommended this* year for:	
	2023	2024	2024	2025
M (natural mortality rate)	0.034	0.034	0.042	0.042
Tier	3a	3a	3a	3a
Projected total (ages 3+) biomass (t)	25,837	25,755	46,029	46,109
Projected female spawning biomass (t)	8,554	8,514	12,986	13,005
$B_{100\%}$	14,776	14,776	21,878	21,878
$B_{40\%}$	5,911	5,911	8,751	8,751
$B_{35\%}$	5,172	5,172	7,657	7,657
F_{OFL}	0.046	0.046	0.045	0.045
$maxF_{ABC}$	0.038	0.038	0.038	0.038
F_{ABC}	0.038	0.038	0.030	0.030
OFL (t)	930	927	**1,555**	**1,566**
maxABC (t)	775	772	1,302	1,310
ABC (t)	775	772	**1,037**	**1,041**
Status	As determined *last* year for:		As determined *this* year for:	
	2021	2022	2022	2023
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

Method: Split the difference between last year's and this year's projected ABCs

- A large increase from last year, but 20% less than the 2010-2020 average ABC

Year	OFL	ABC (=TAC)	Catch
2010	1,568	1,302	426
2011	1,579	1,312	557
2012	1,472	1,223	599
2013	1,482	1,232	580
2014	1,497	1,244	760
2015	1,345	1,122	564
2016	1,596	1,328	697
2017	1,594	1,327	553
2018	1,735	1,444	795
2019	1,715	1,428	790
2020	1,452	1,209	398
2021	1,456	1,212	407
2022	947	788	469
2023	930	775	487*
2024	1,555	1,037	

If this was a Tier 5 stock: ABC = 889 t, OFL = 1,185 t

Risk Table Summary

Recommend reduction from max ABC
Author-recommended model was not reviewed in September

Assessment	Population Dynamics	Ecosystem	Fishery
2 - Major Concern	**2 - Major Concern**	1 - None	1 - None
(Base model) ● Severe one-way positive retrospective bias ● High uncertainty in stock scale **(Recommended model)** ● Improved stability, but unable to account for recent declines in survey indices	● Declines in LLS and BTS indices in recent years ● 2023 LLS abundance lowest on record ● 2021 BTS lowest on record	● Average environmental conditions ● Some evidence of long-term declines in structural epifauna	● Incidental catch only ● Catch << ABC ● Not currently constraining target fisheries

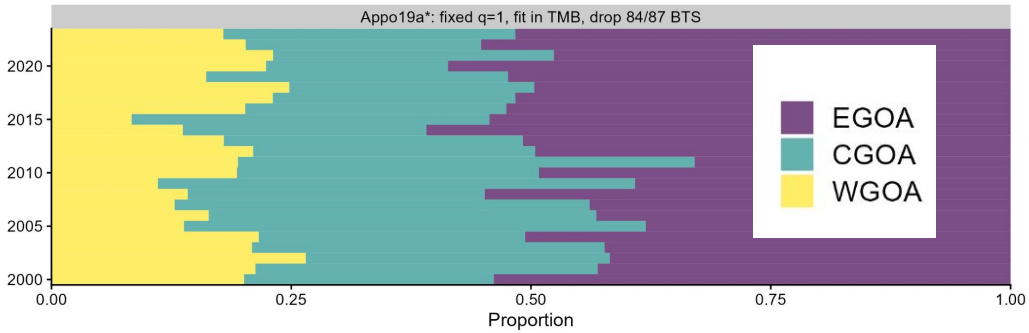
LLS = longline survey
BTS = bottom trawl survey

RE/BS Apportionment Summary

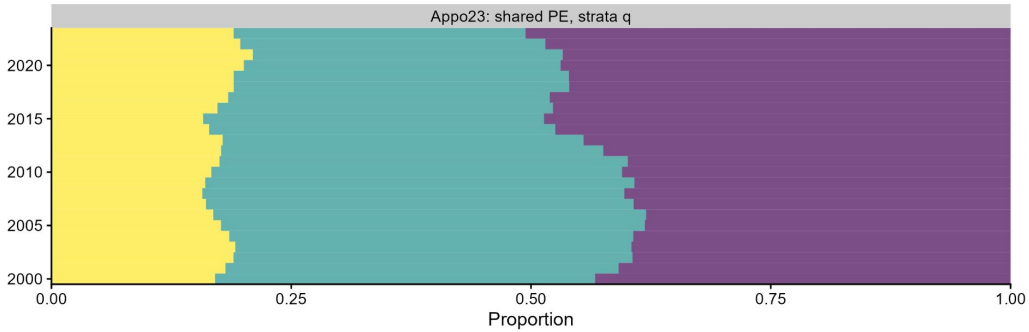
- Two-survey random effects (REMA) model first accepted in 2019
- LLS scaling parameters fixed at 1.0 to balance LLS/BTS data conflict
- Recommend estimating area-specific scaling parameters, greatly improves model performance
- Recommend using the average area-specific proportions of REMA-predicted biomass and REMA-predicted relative population weights from the LLS in order to more appropriately balance BTS/LLS data

Stock/ Assemblage	Area	2023 OFL	2023 ABC	2023 TAC	2023 Catch[2]	2024 OFL	2024 ABC
RE/BS complex	W		180	180	101		197
	C		232	232	135		315
	E		363	363	149		525
	Total	930	775	775	385	1,555	1,037

Apportionment based on fixed q and predicted biomass by area (CURRENT)



Apportionment based on predicted biomass and RPWs by area (PROPOSED)



Planning for 2025+

1. RE/BS model development team
2. Model: q, selectivity, and recruitment
3. Refinement to maturity, survey indices, fisheries data, BTS length comps
4. Evaluation of uncertainty with MCMC
5. Continued organization, documentation, and modernization of code

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Age and Growth: C. Gburski, J. Short, B. Matta

Genetic stock structure: W. Larson

Teammates: B. William, P. Hulson, C. Monnahan, J. Ianelli

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