Bristol Bay red king crab

Proposed models for 2026

May 2026

Katie Palof

ADF&G

katie.palof@alaska.gov

Summary

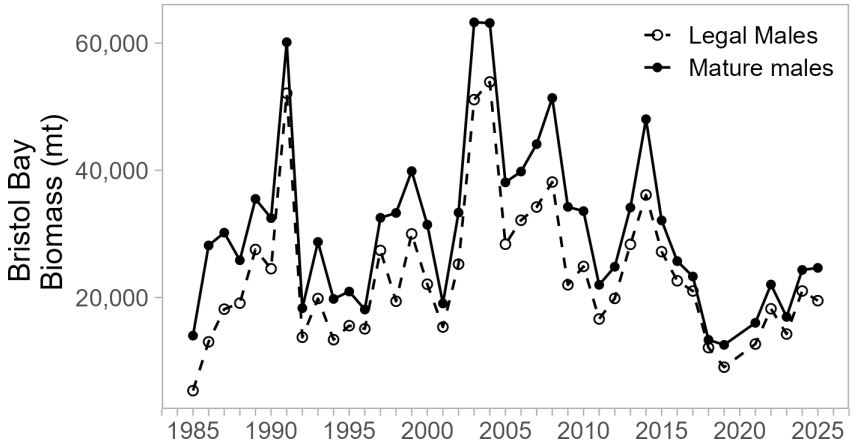
- Stable model in GMACS since 2018
- Directed fishery was open the last 3 seasons (2024/25, 2023/24, 2025/26) after being closed for 2 seasons (2021/22, 2022/23) due to low mature female abundance
- 2025/2026 fishery CPUE similar to previous season and above last five-year average
- Recruitment has been low in recent years (last ~15 years), projected decline in biomass without a large recruitment event/ favorable recruitment conditions
- Model explorations:
  - GMACS updates
  - Extended size bins to accommodate “build up” of plus group

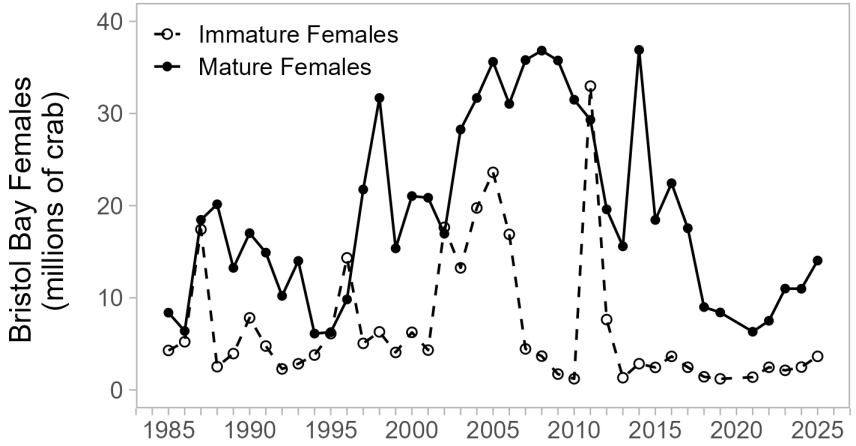
CPT / SSC comments

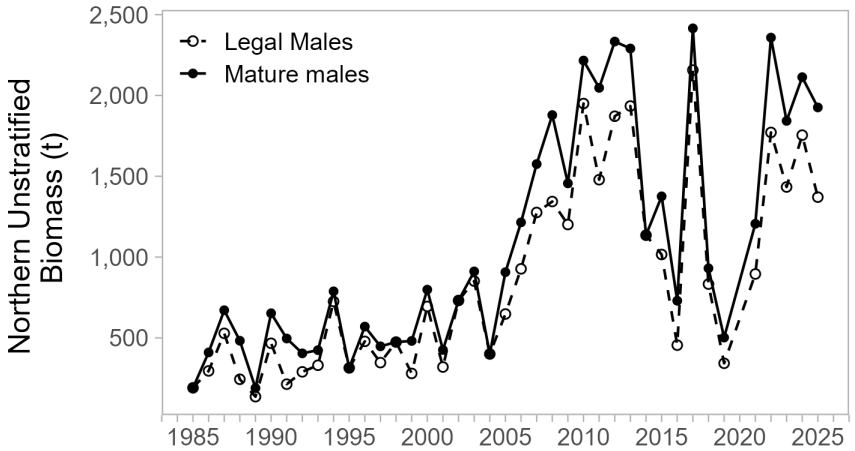
- Housekeeping comments
  - Updates to figures, SAFE, etc. will be addressed in next full SAFE
- Northern area RKC – review of stats presented in SAFE, prelim work on sdmTMB modeling
- Size composition plus group expansion – build up of larger sizes
  - Size bins expanded in model 26.0, doesn't add much to model since growth and molting probability are assumed to be the same as the plus group but fits nicer
- Survey selectivity work paused (review 2025 doc for most recent work)
- Retrospective patterns
  - High priority on source of these, but unable to unearth the cause yet
  - Decreases some with estimated M (adopted in 2023)
- Other comment themes not yet addressed: initial conditions, design-based indices, likelihood profiles, evaluation of growth parameters, and closer look at fishery dynamics

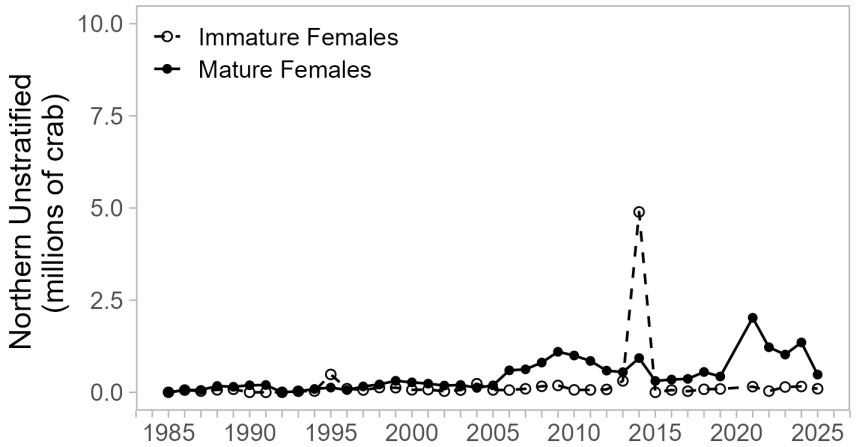
Northern area red king crab

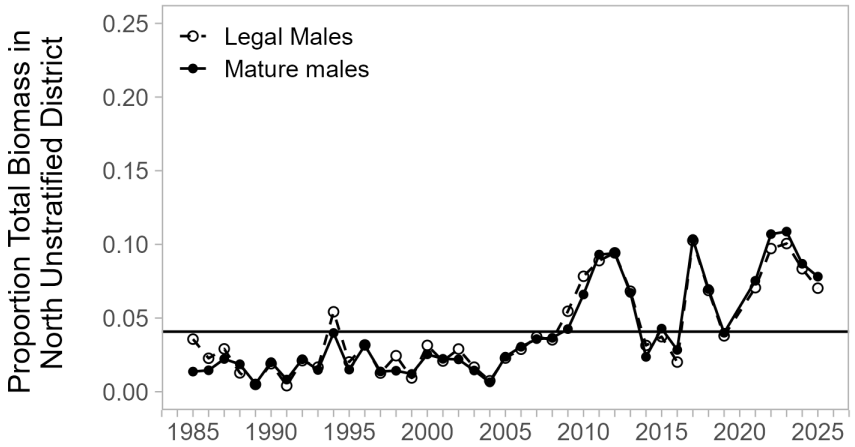
- Tracking survey biomass in annual SAFE document
- Males – variable since ~2007
- Mature females – proportionally more the last few years
- Are these crab part of the reproductive stock in Bristol Bay?
- Next steps:
  - Model based indices that can include these crab in prediction grid but ONLY estimate over Bristol Bay

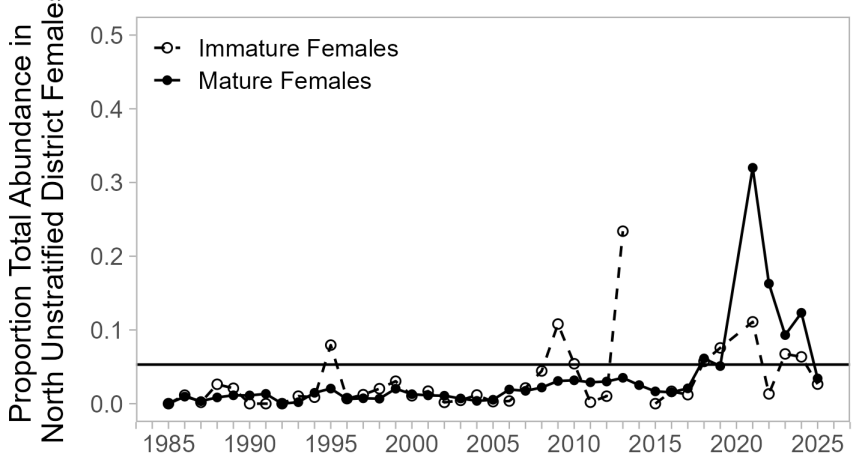




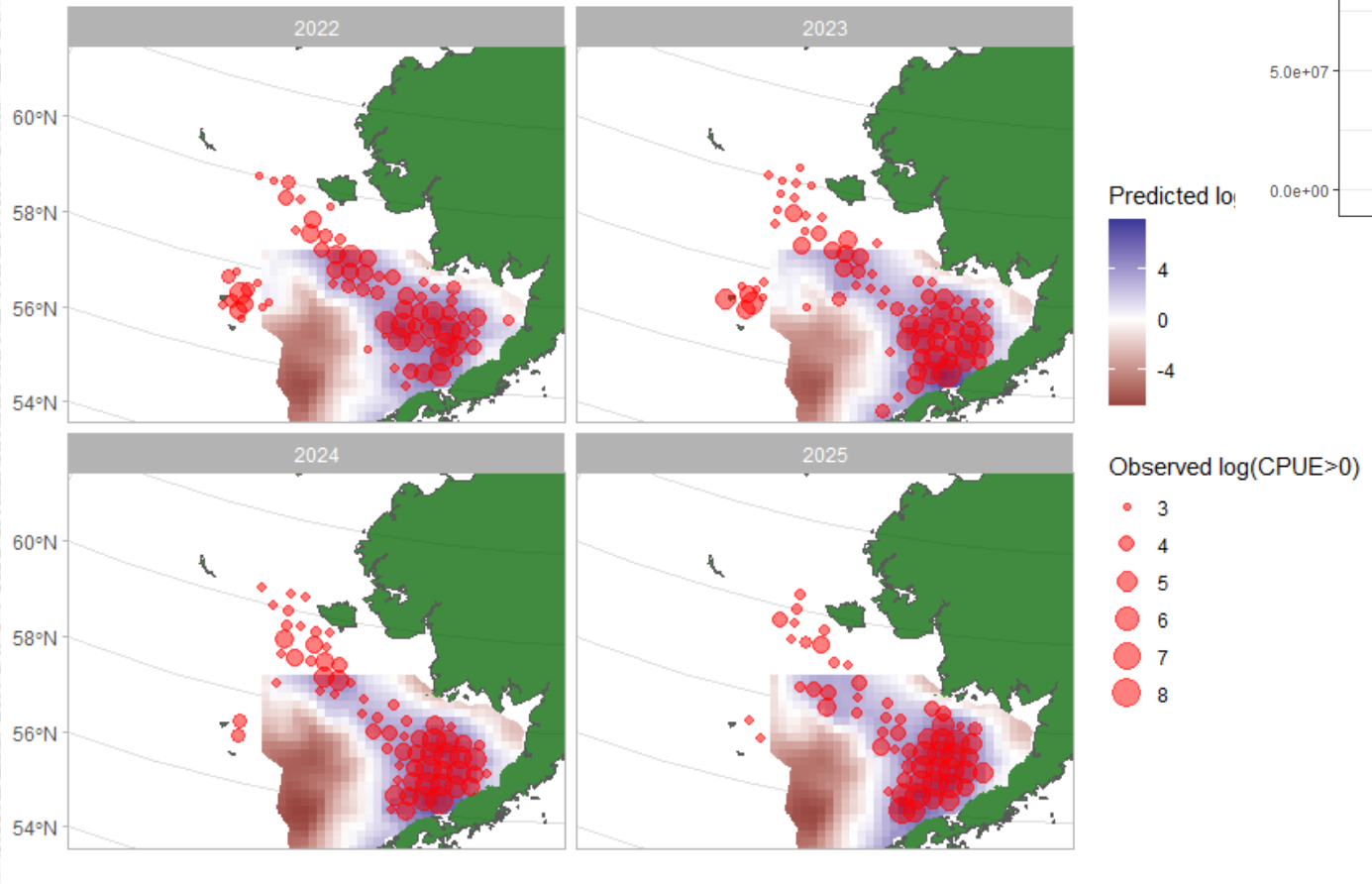


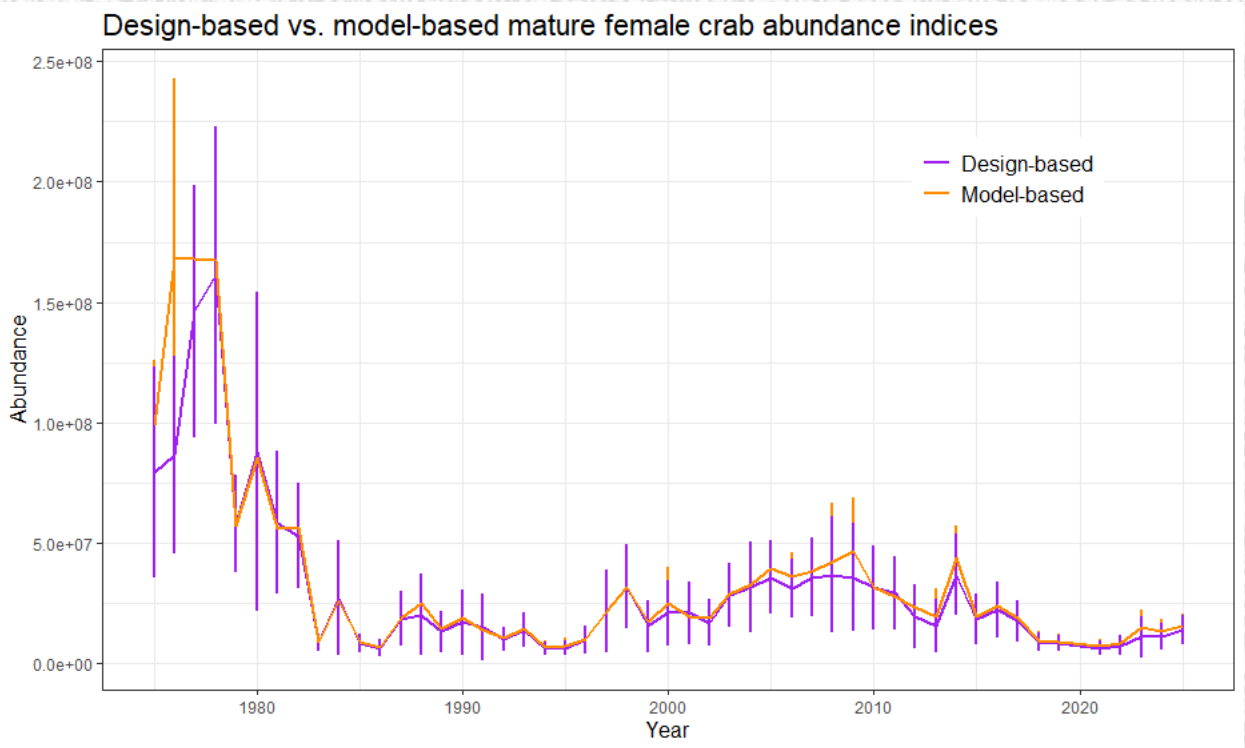






Mature females – preliminary look

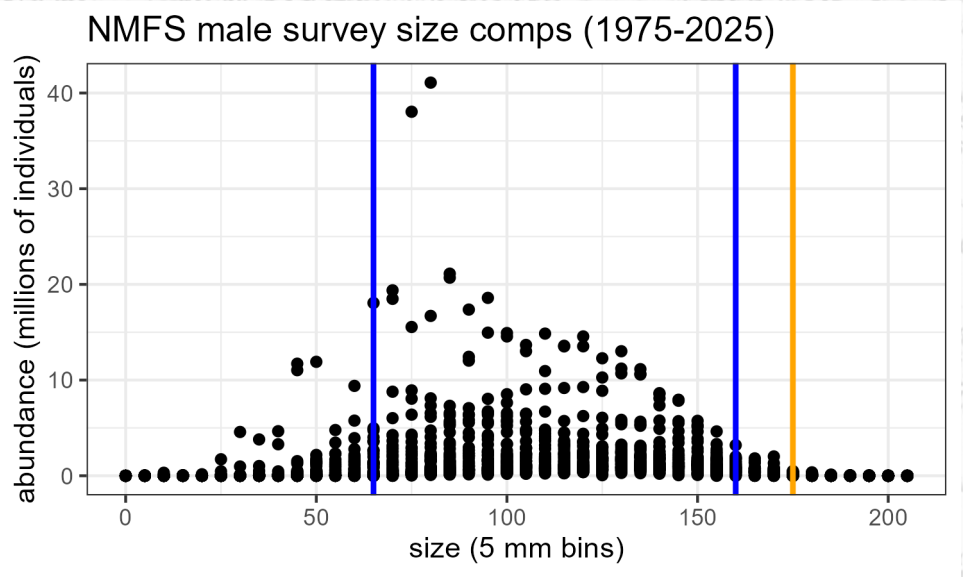


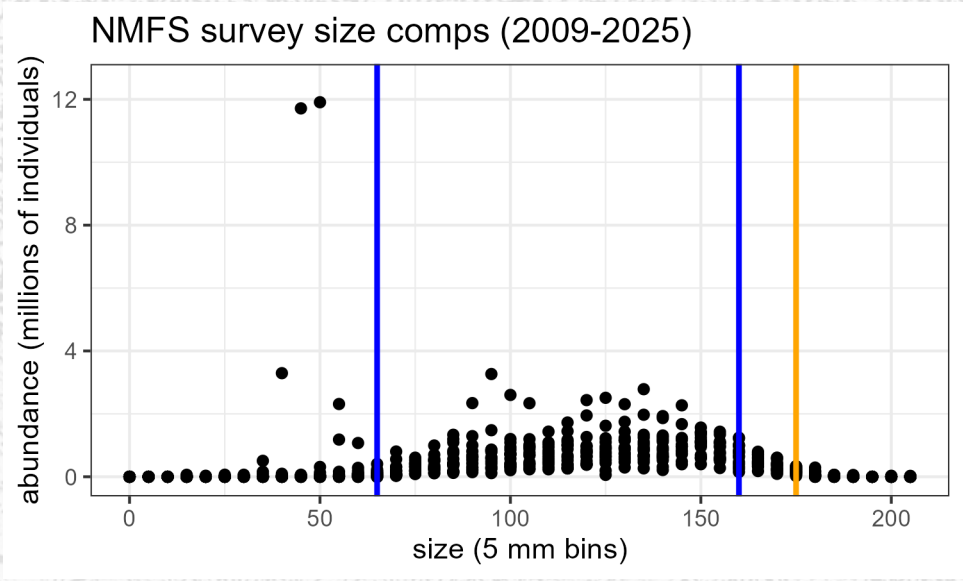


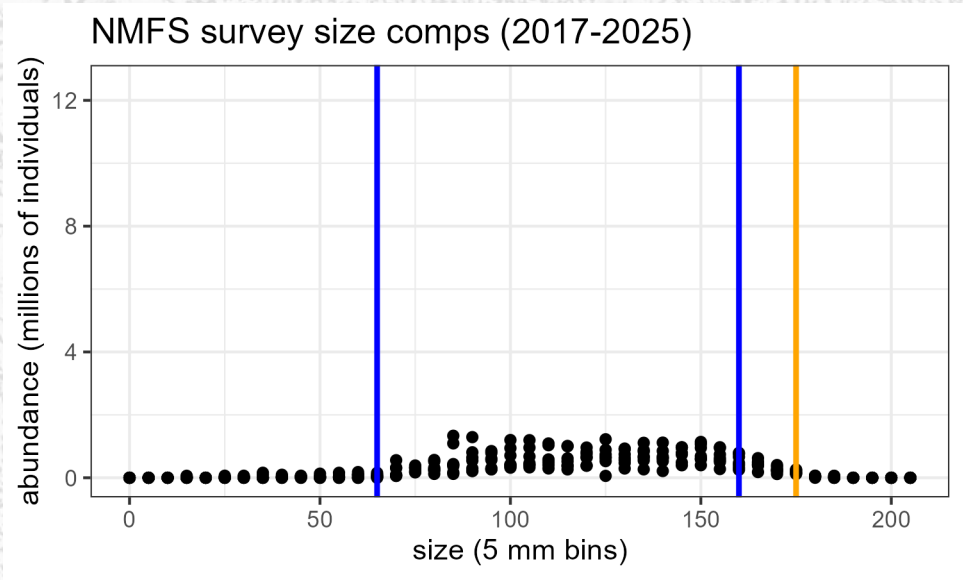
- Observed log(CPUE) of mature females for all EBS survey vs. predicted ONLY in Bristol Bay area
- Needs more fine-tuning of spatio-temporal model
- Time series of design-based estimates vs model based for mature females (top)
- Next steps – work on estimation of assessment model inputs

Size bins - males

- Size bins in model did capture the majority of crab (all years of survey data)
- Recent years have less recruitment and potentially larger individuals.
- Orange lines reflect extended size bins (≥160 to ≥175 mm)

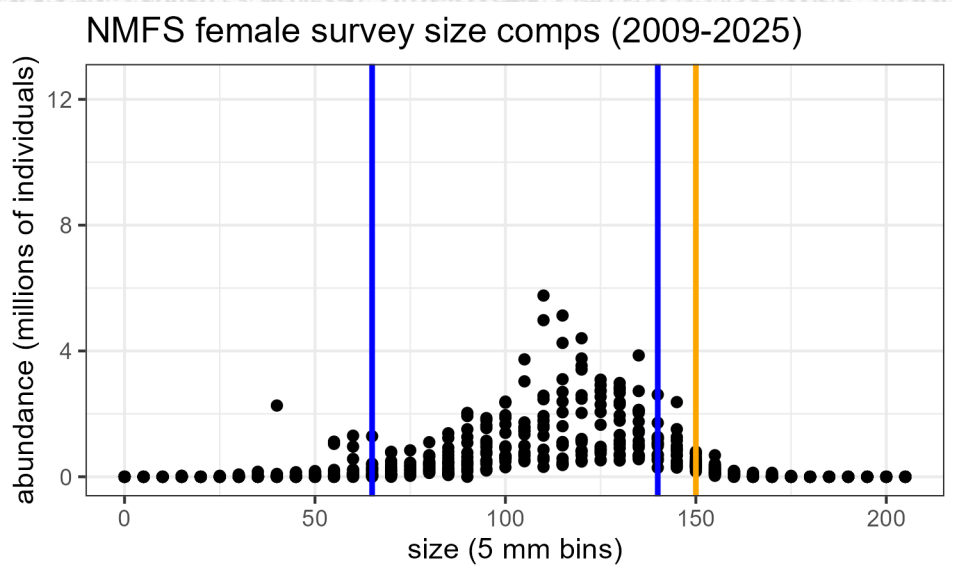


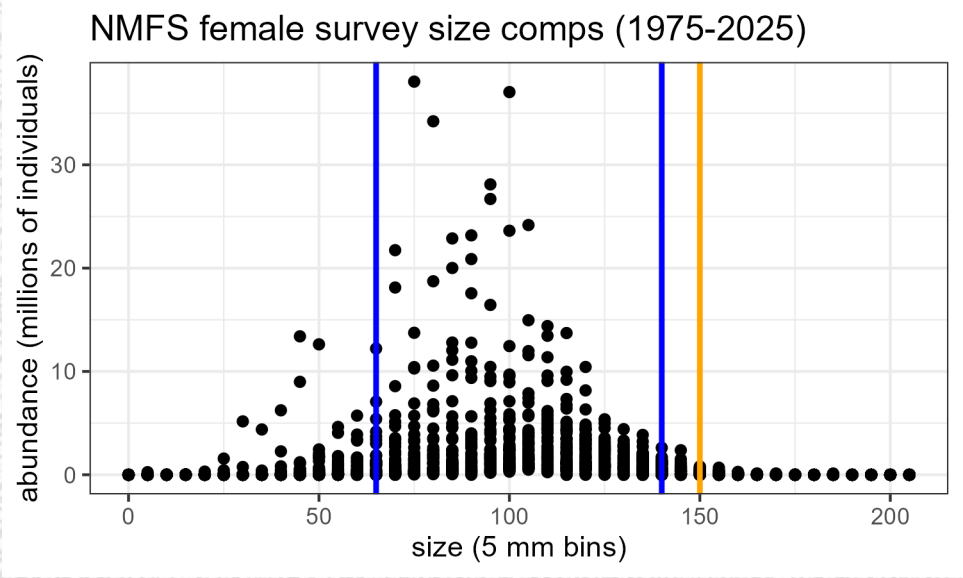


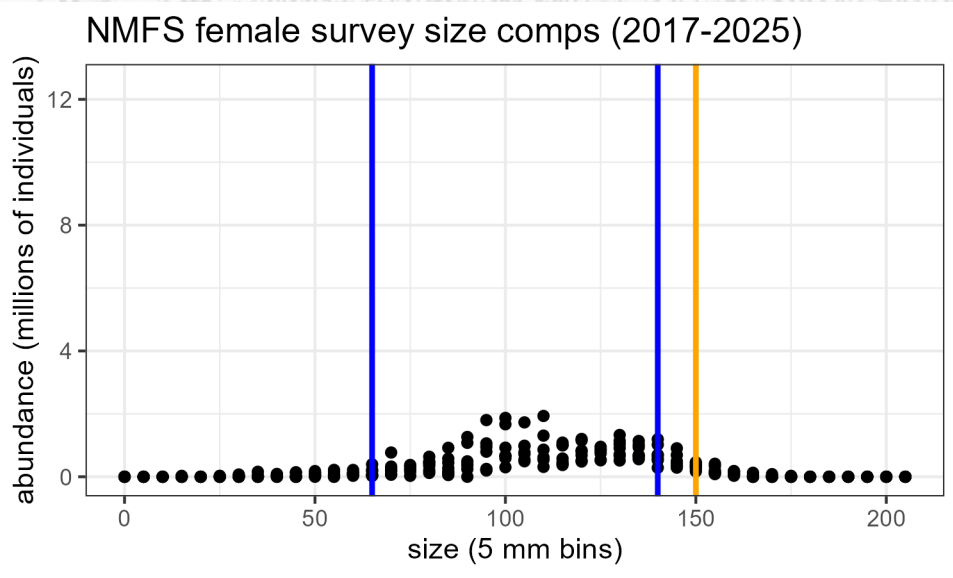


Size bins - females

- Size bins in model did capture the majority of crab (all years of survey data)
- Recent years show potential shift in distribution.
- Orange lines reflect extended size bins (≥140 to ≥150 mm)







2026 Model explorations

24.0c.2: the base model from September 2025 (estimates a constant *M* for males with tight prior, molt time block removed) + removal of shell condition placeholders from input files

+ updated version of GMACS

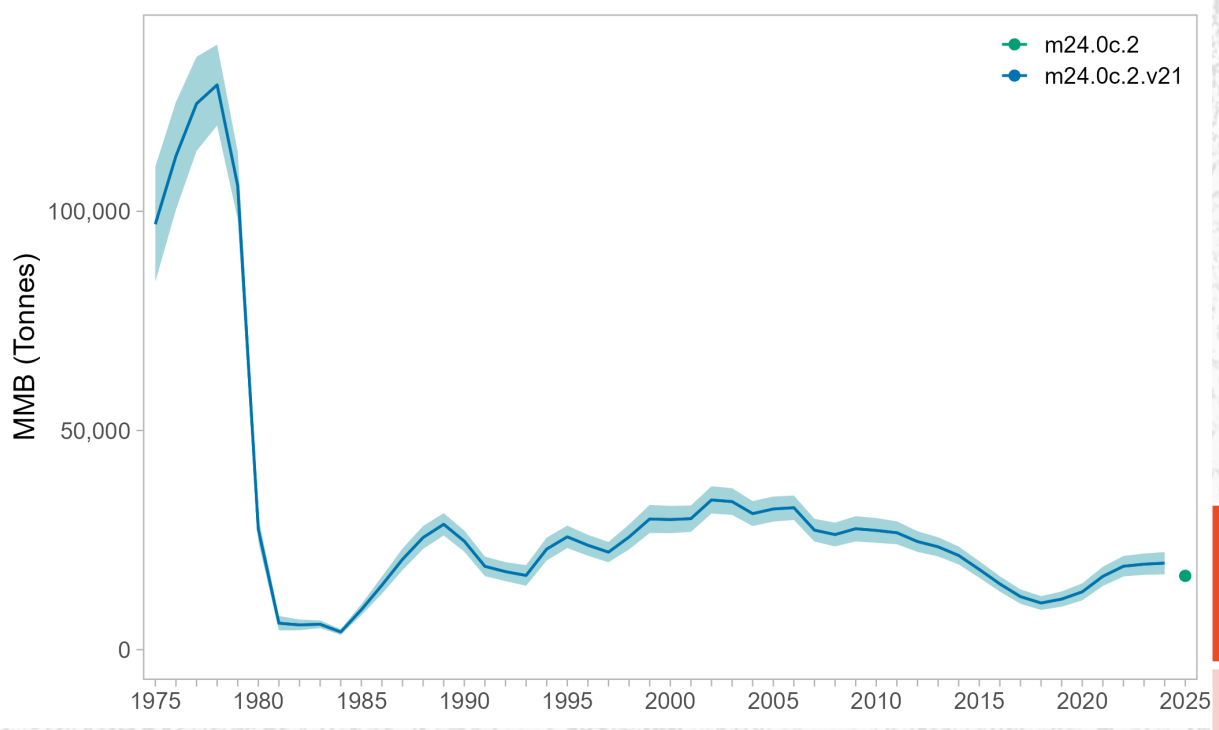
26.0: model 24.0c.2 (base model) + extended size bins for males and females

- assumes growth and molting probability are the same as the former plus group

- initial conditions of these size bins was started at same value as previous plus group

26.0a: model 24.0c.2 (base model) + updated bycatch size comp data for groundfish and non-directed crab fisheries

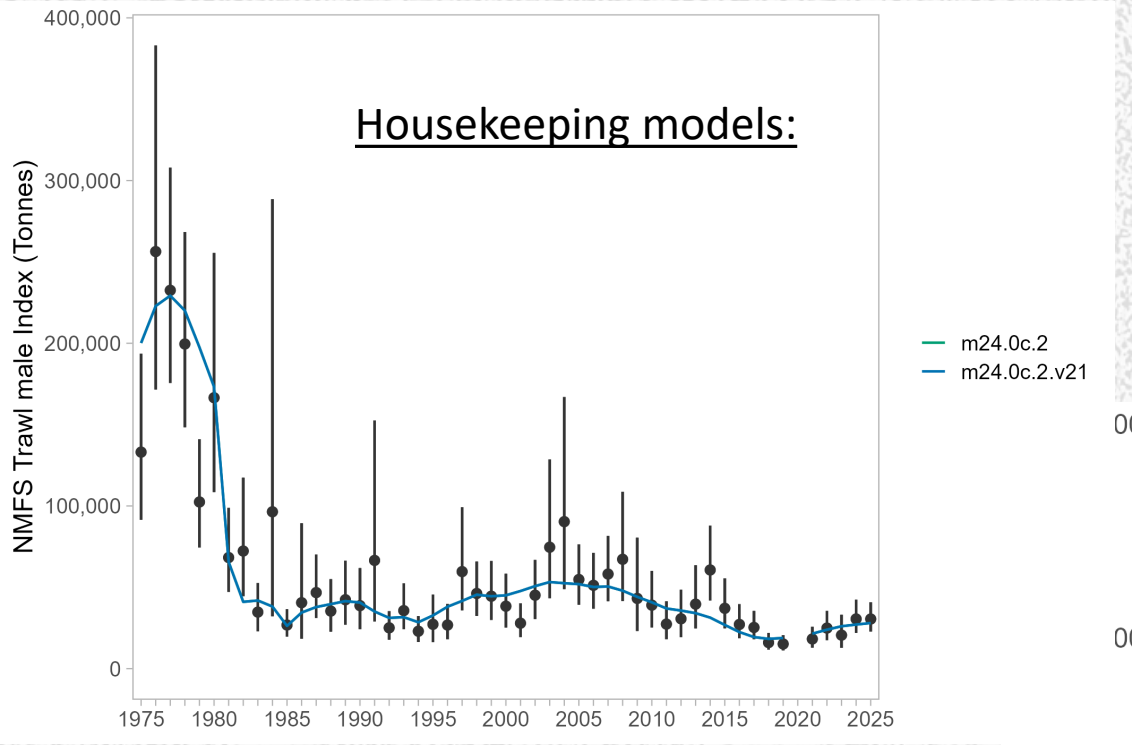
Update GMACS

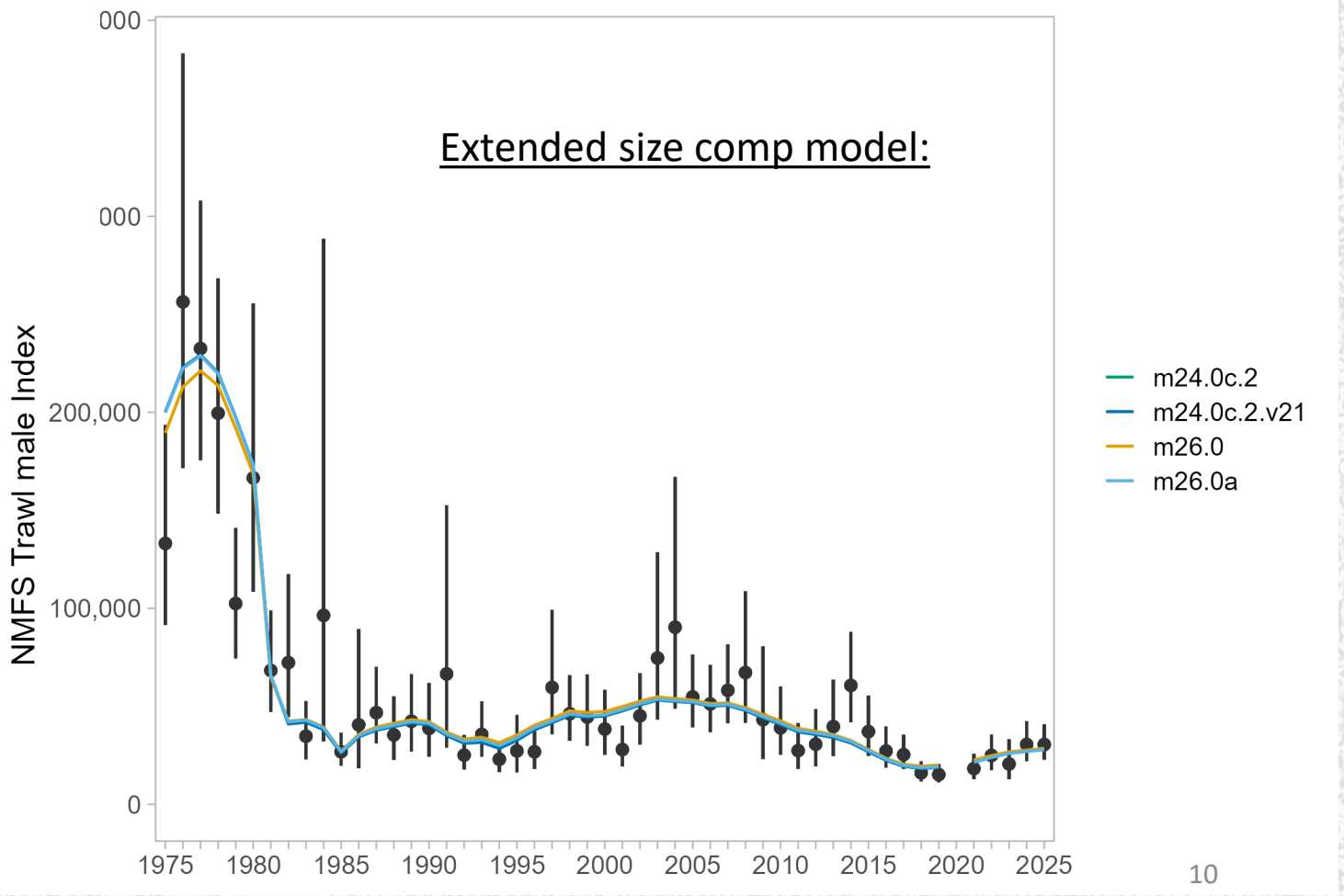


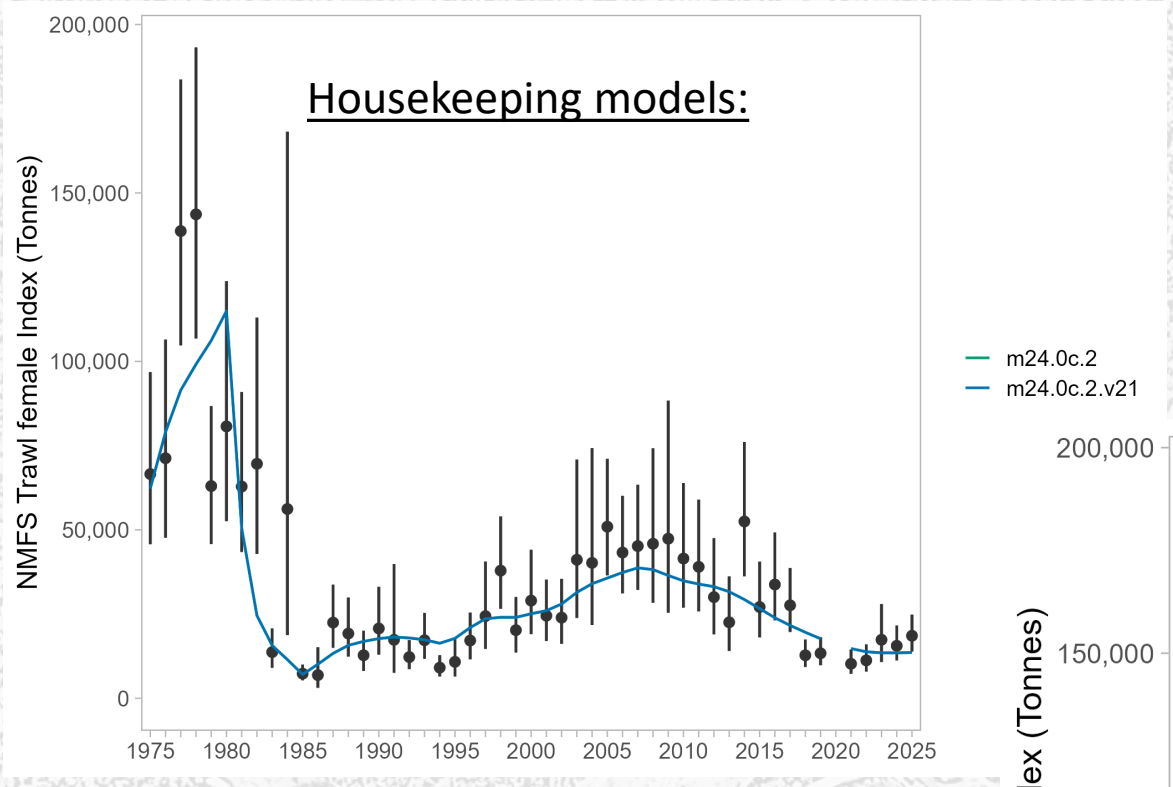
- Likelihoods similar (Table 4)
- No changes in MMB trend or estimation.
- Reference points same

Model	Current MMB	$B_{35\%}$	MMB $/B_{MSY}$	$F_{35\%}$	F_{OFL}	OFL
24.0c.2 (2025 SAFE)	16.84	18.52	0.83	0.40	0.36	5.85
24.0c.2 (version 34a)	16.84	18.52	0.83	0.40	0.36	5.85

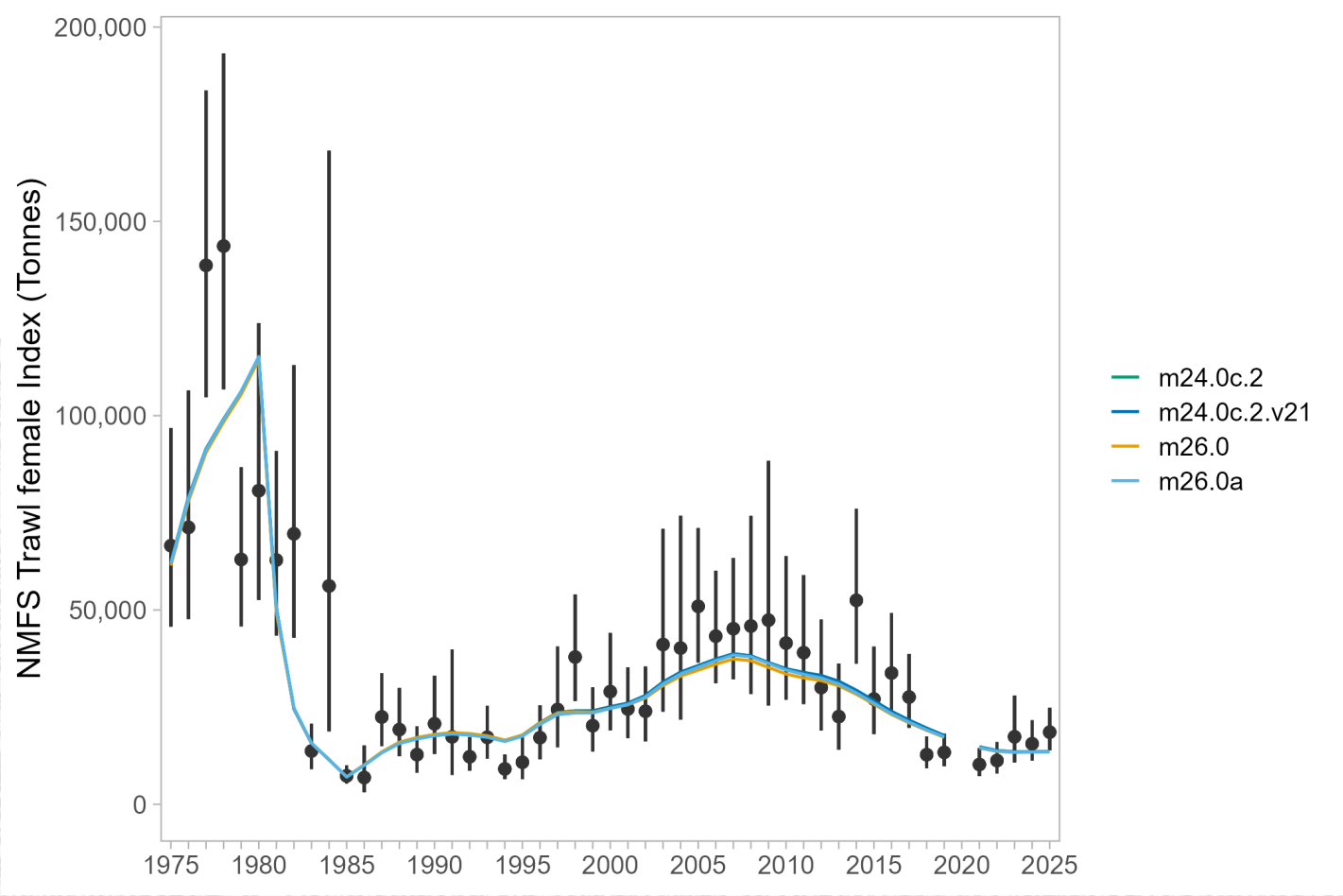
- Model fits to NMFS **male** trawl survey data are similar.





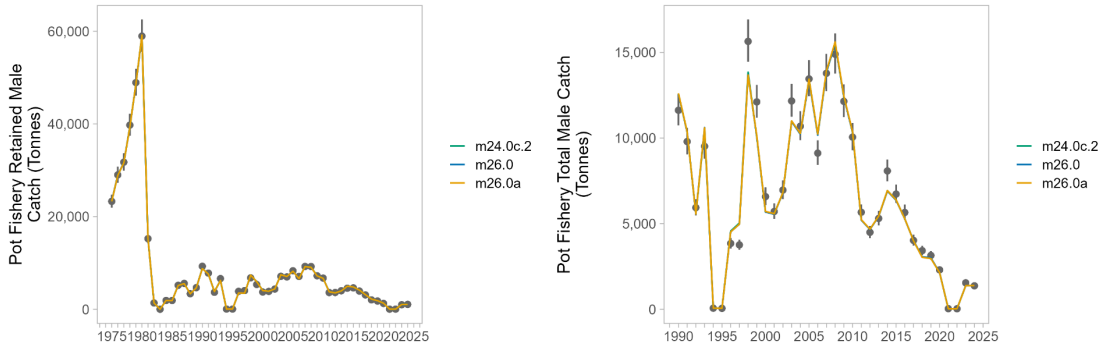


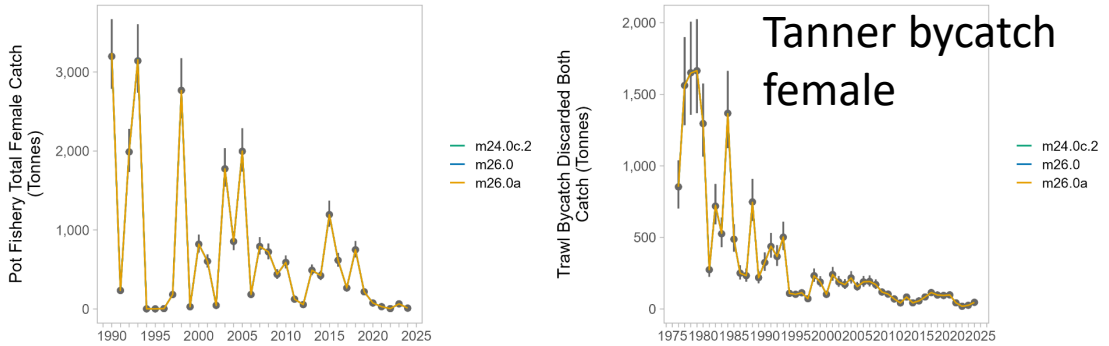
- Model fits to NMFS **female** trawl survey data.
- BSFRF survey data fits not shown due to similarities between models.



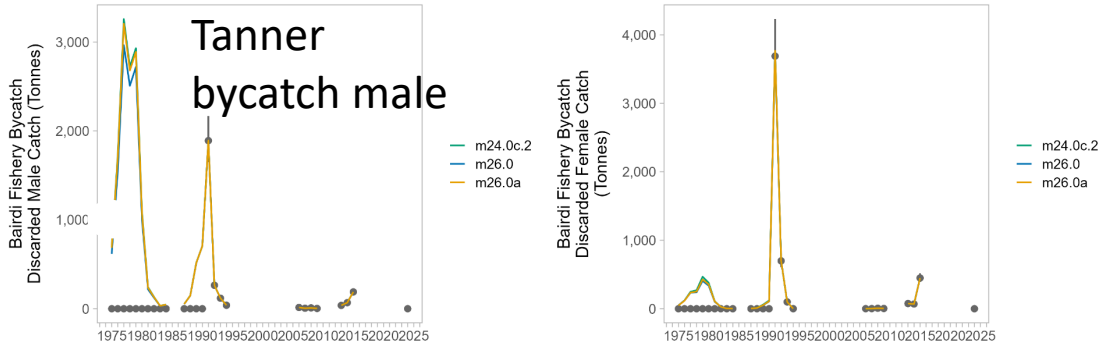
Catch data fits

Small differences in size comp bycatch data – minimal differences

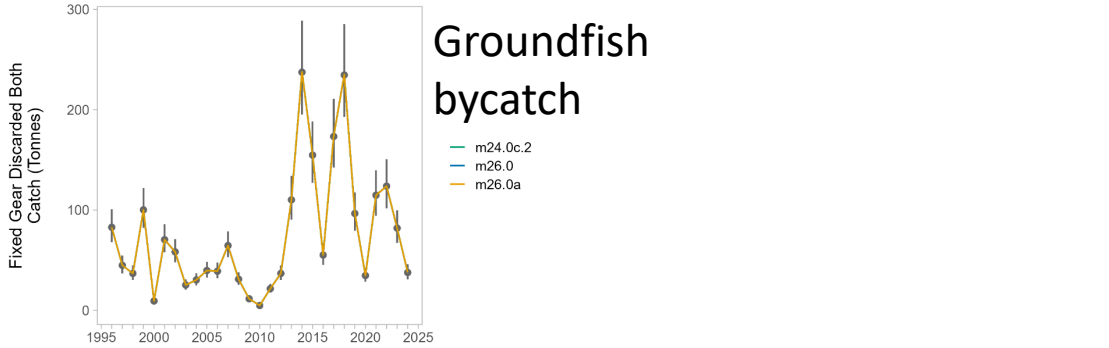




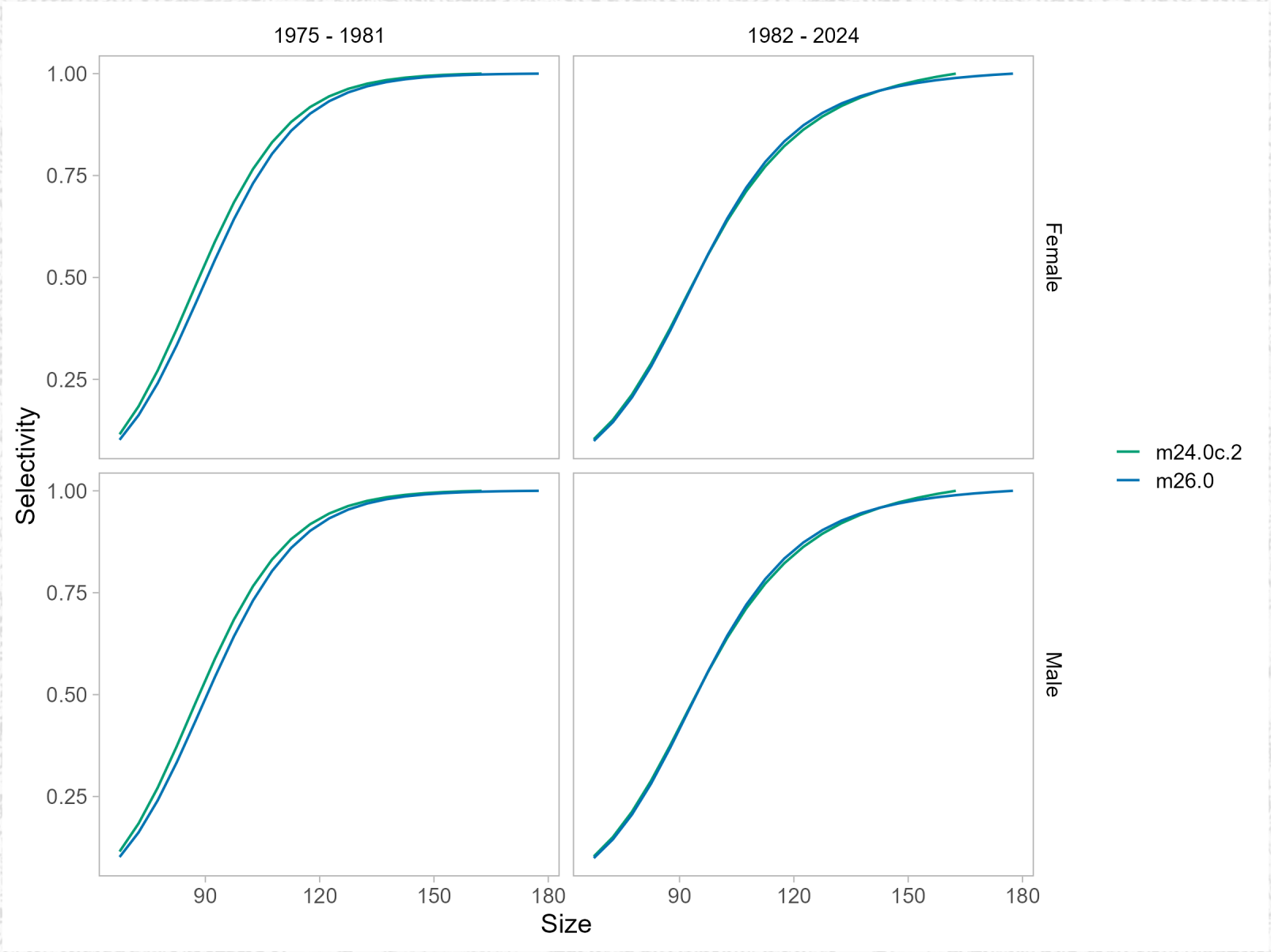
Tanner bycatch female



Tanner bycatch male



Groundfish bycatch

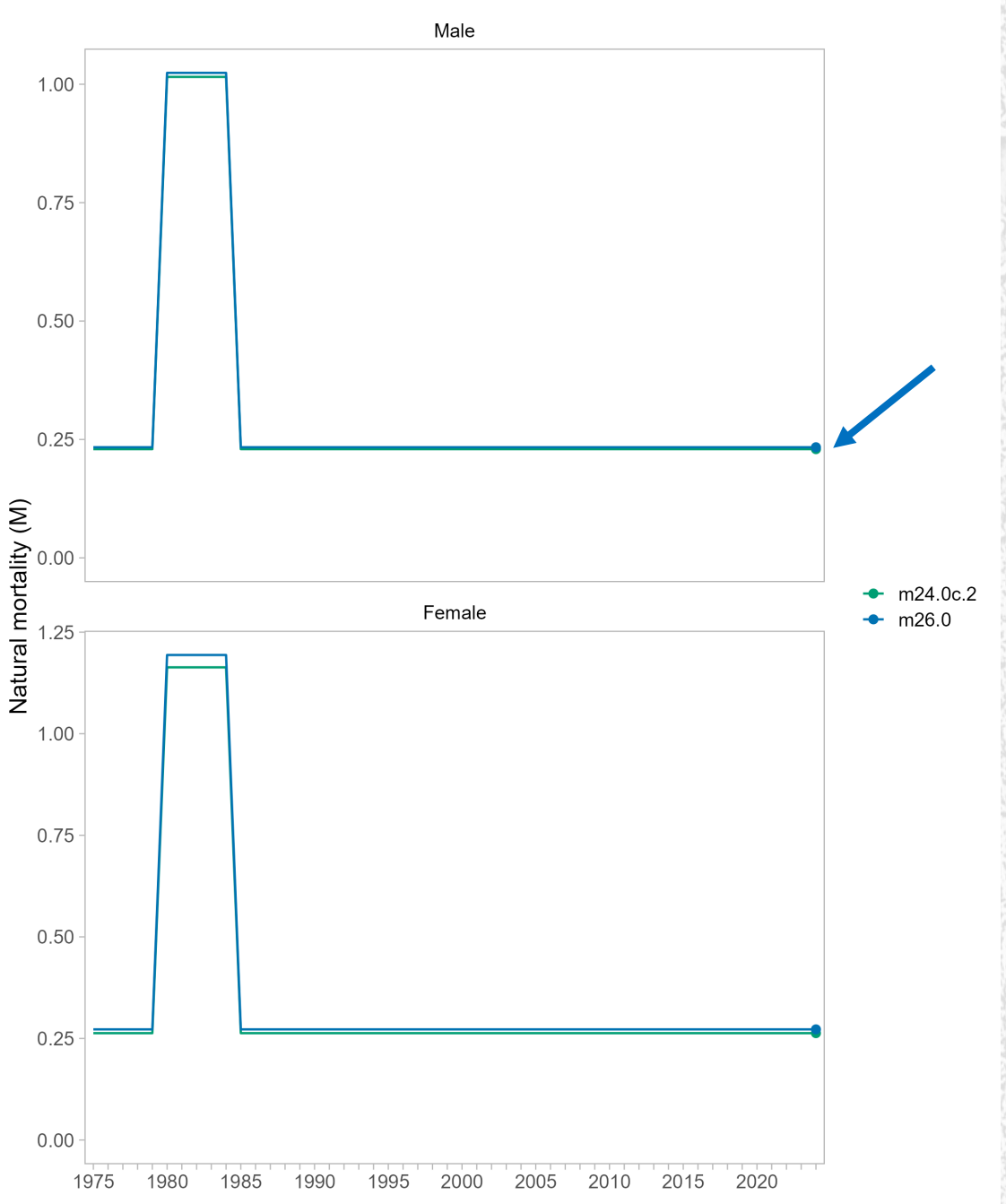


NMFS trawl survey selectivity: small differences with extended size bin model

Natural Mortality

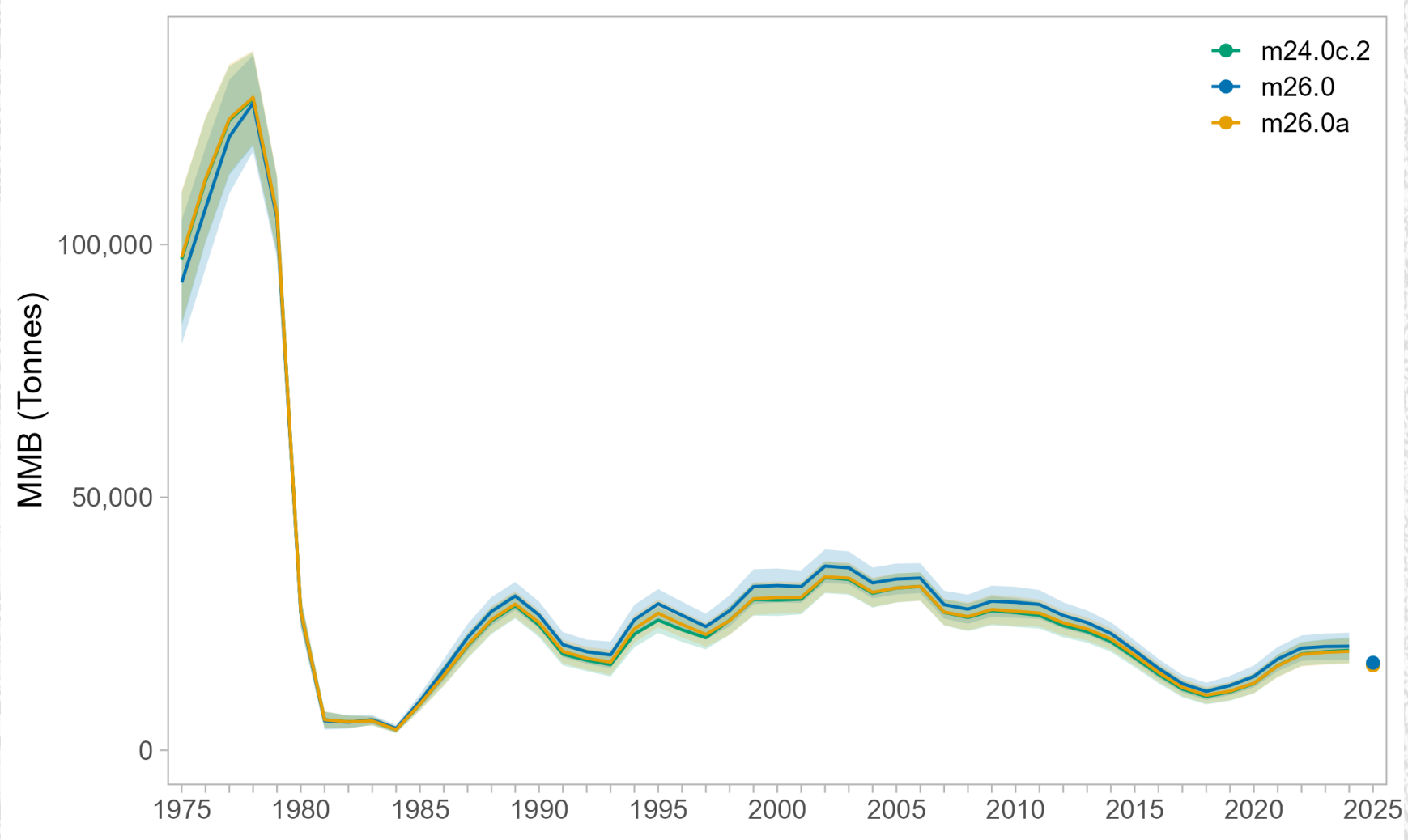
- No differences in male M
- Female offset has slight difference sin model 26.0

Model	Sex	baseM	1980-84
m24.0c.2	female	0.26	1.16
m24.0c.2	male	0.23	1.02
m26.0	female	0.27	1.19
m26.0	male	0.23	1.02
m26.0a	female	0.26	1.17
m26.0a	male	0.23	1.02



Mature male biomass

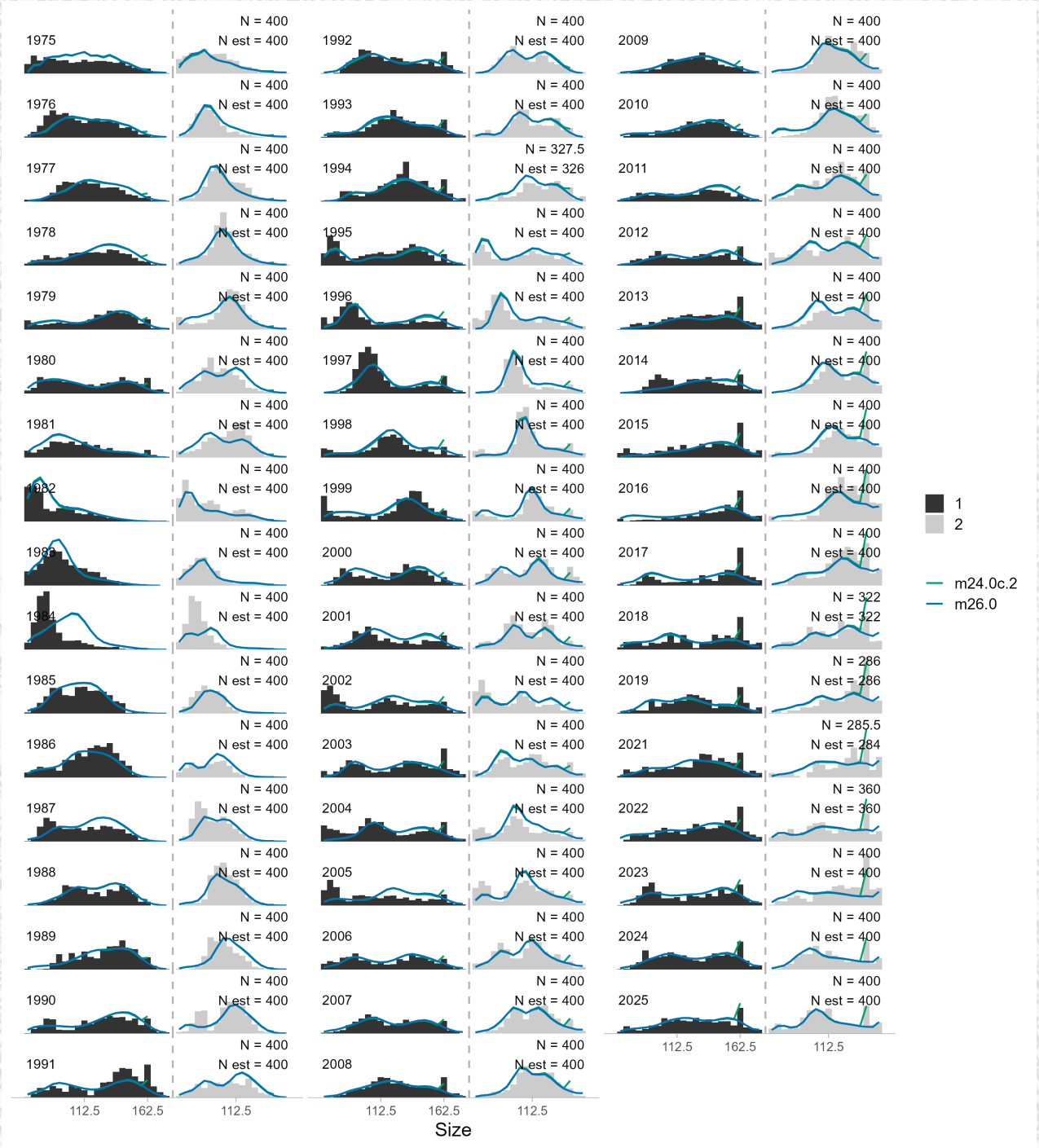
- Trends are the same

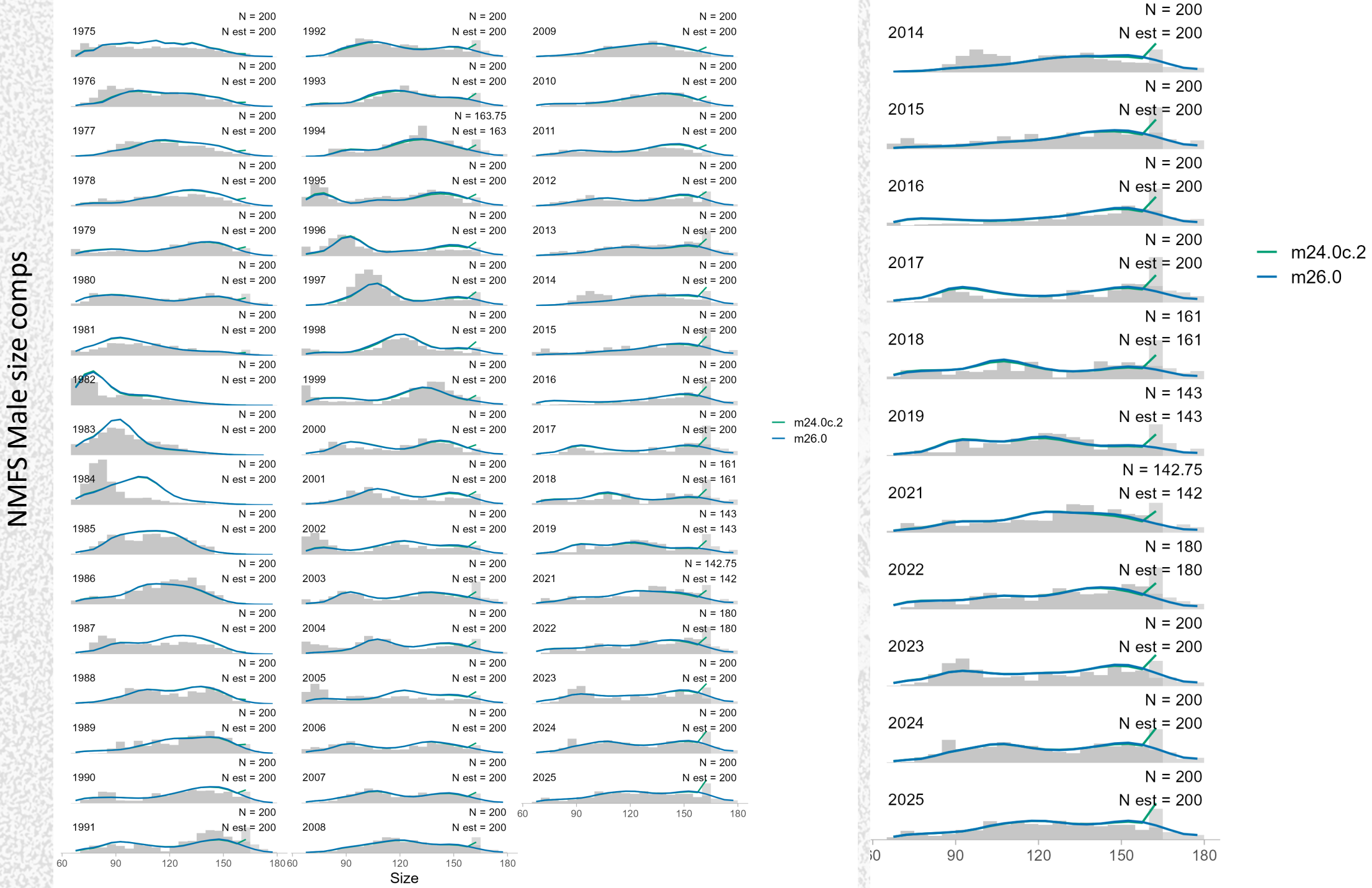


Size composition fit

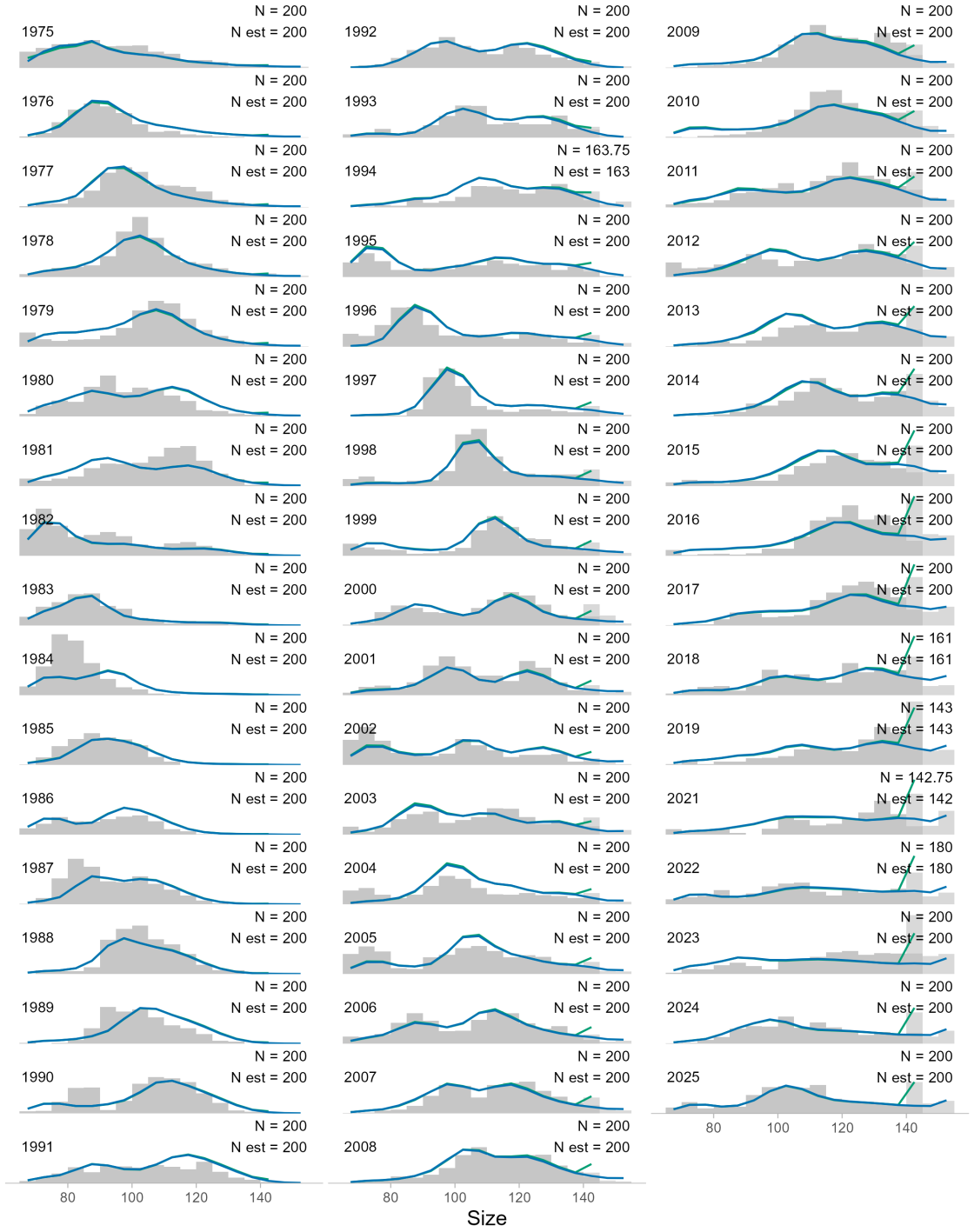
- Overall size composition fits looks better due to less “build” up in plus group size bin.
- Need to work on graphing of size comp data sets to be clearer in aggregated size comp data sets

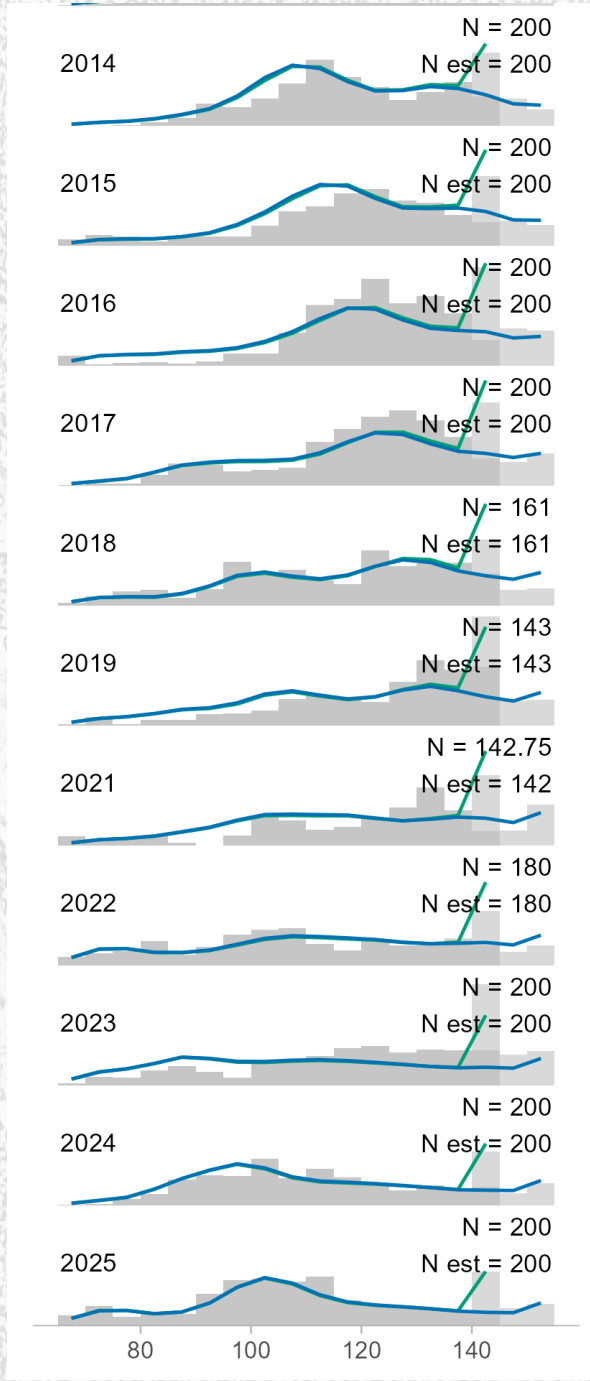
NMFS trawl survey Males (1) and females (2)



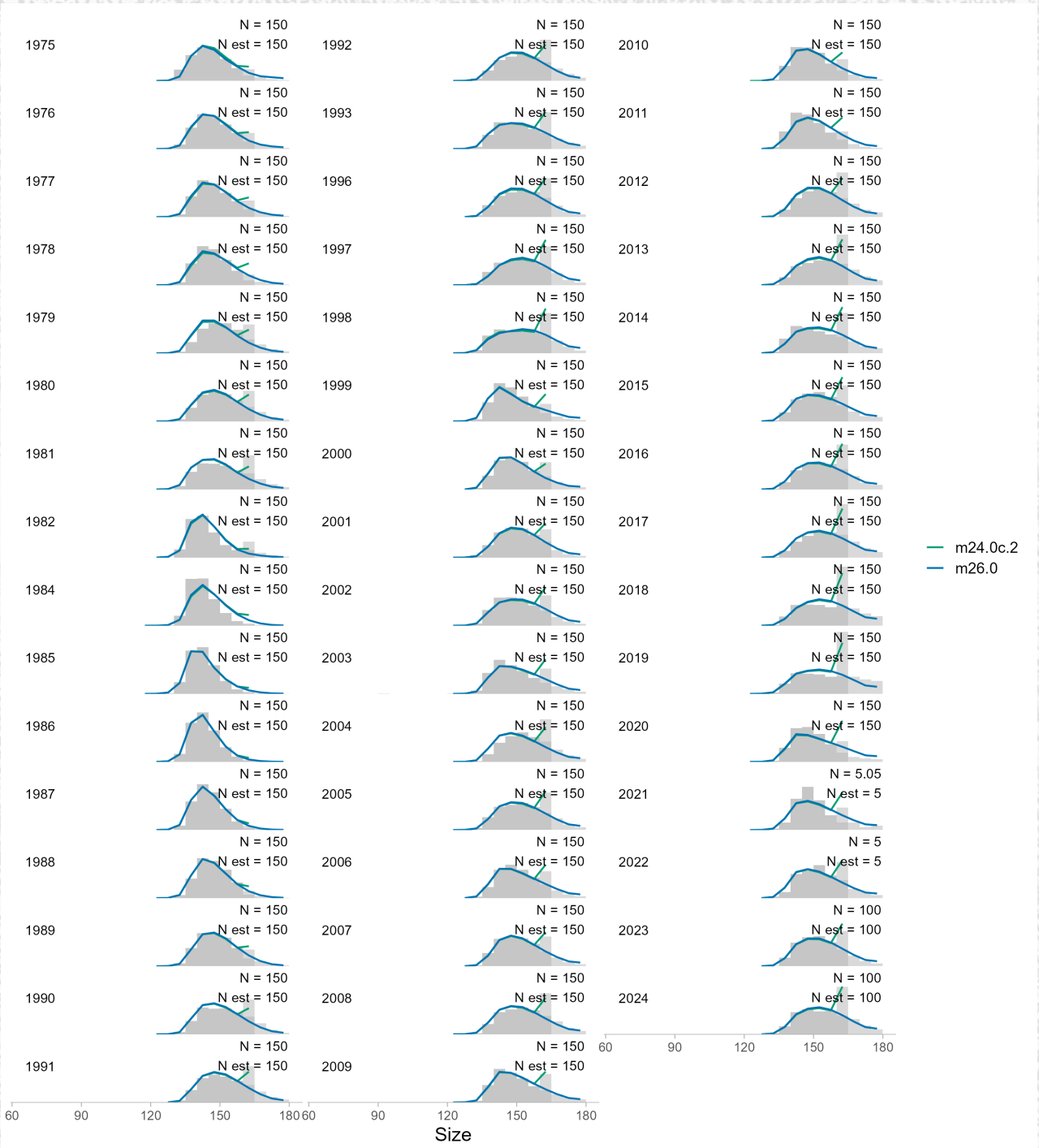

NMFS Male size comps
1975 N = 200 N est = 200
1976 N = 200 N est = 200
1977 N = 200 N est = 200
1978 N = 200 N est = 200
1979 N = 200 N est = 200
1980 N = 200 N est = 200
1981 N = 200 N est = 200
1982 N = 200 N est = 200
1983 N = 200 N est = 200
1984 N = 200 N est = 200
1985 N = 200 N est = 200
1986 N = 200 N est = 200
1987 N = 200 N est = 200
1988 N = 200 N est = 200
1989 N = 200 N est = 200
1990 N = 200 N est = 200
1991 N = 200 N est = 200
1992 N = 200 N est = 200
1993 N = 200 N est = 200
1994 N = 163.75 N est = 163
1995 N = 200 N est = 200
1996 N = 200 N est = 200
1997 N = 200 N est = 200
1998 N = 200 N est = 200
1999 N = 200 N est = 200
2000 N = 200 N est = 200
2001 N = 200 N est = 200
2002 N = 200 N est = 200
2003 N = 200 N est = 200
2004 N = 200 N est = 200
2005 N = 200 N est = 200
2006 N = 200 N est = 200
2007 N = 200 N est = 200
2008 N = 200 N est = 200
2009 N = 200 N est = 200
2010 N = 200 N est = 200
2011 N = 200 N est = 200
2012 N = 200 N est = 200
2013 N = 200 N est = 200
2014 N = 200 N est = 200
2015 N = 200 N est = 200
2016 N = 200 N est = 200
2017 N = 200 N est = 200
2018 N = 161 N est = 161
2019 N = 143 N est = 143
2021 N = 142.75 N est = 142
2022 N = 180 N est = 180
2023 N = 200 N est = 200
2024 N = 200 N est = 200
2025 N = 200 N est = 200
60 90 120 150 180
Size
m24.0c.2
m26.0

NMFS Female size comps

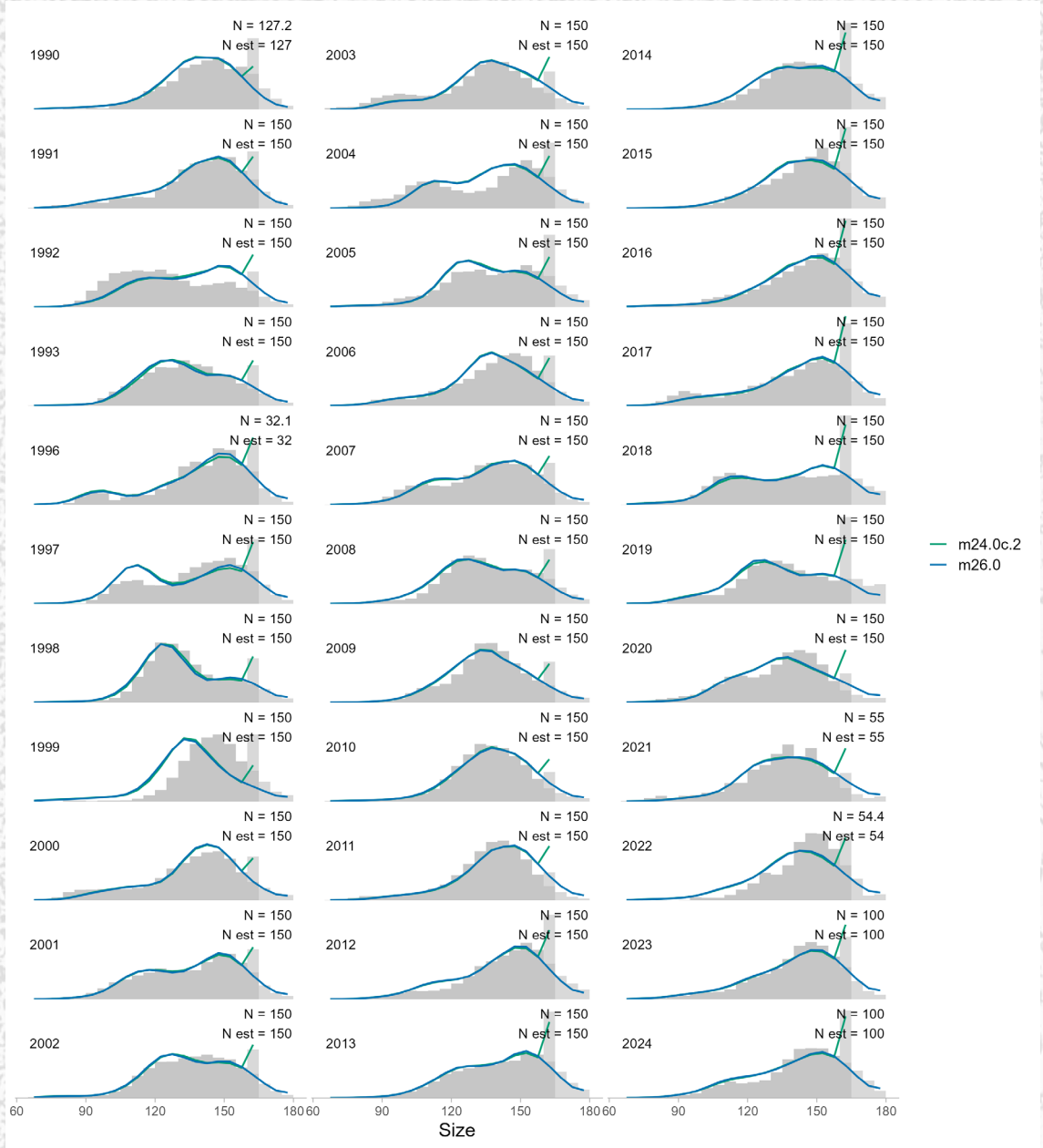




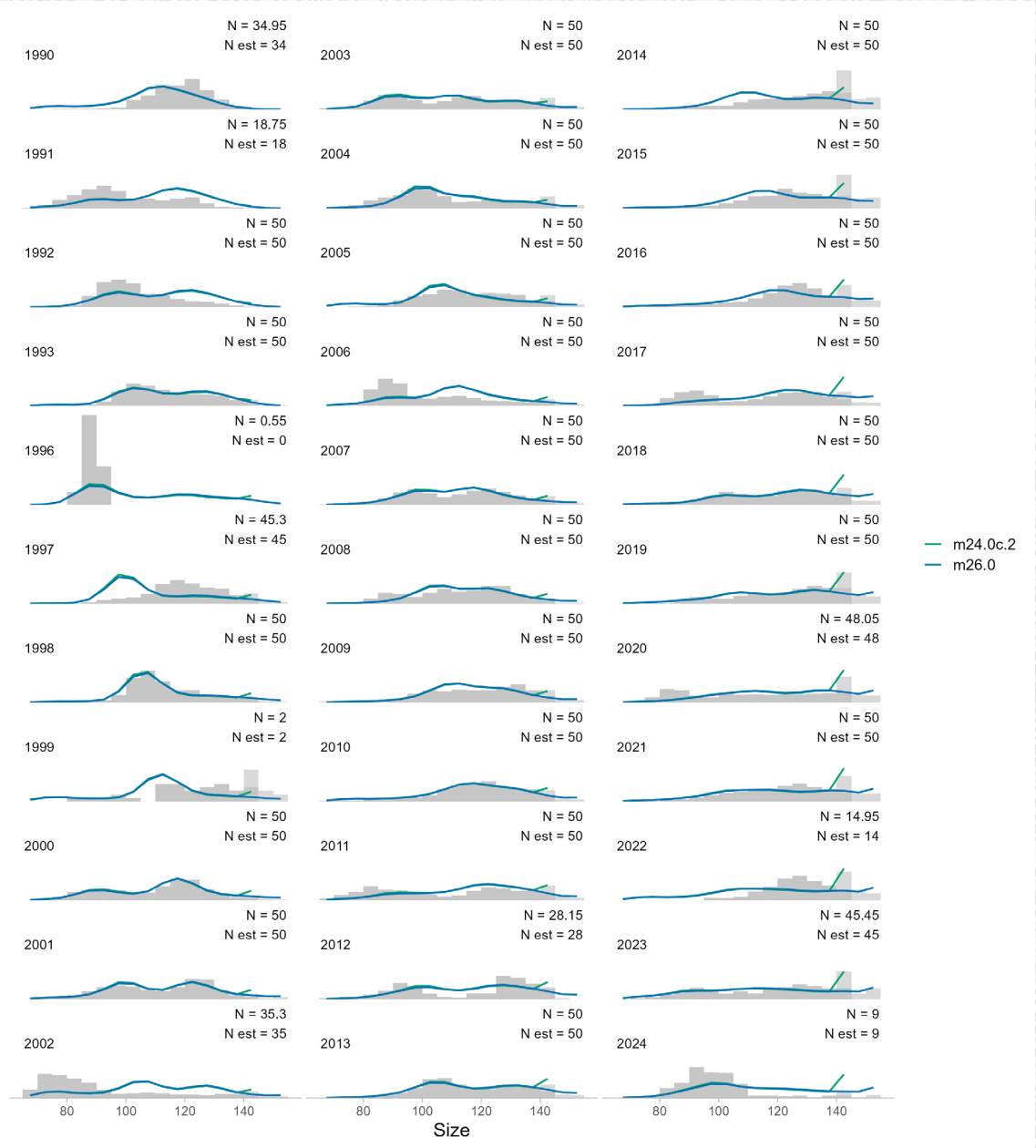
Directed Pot fishery retained



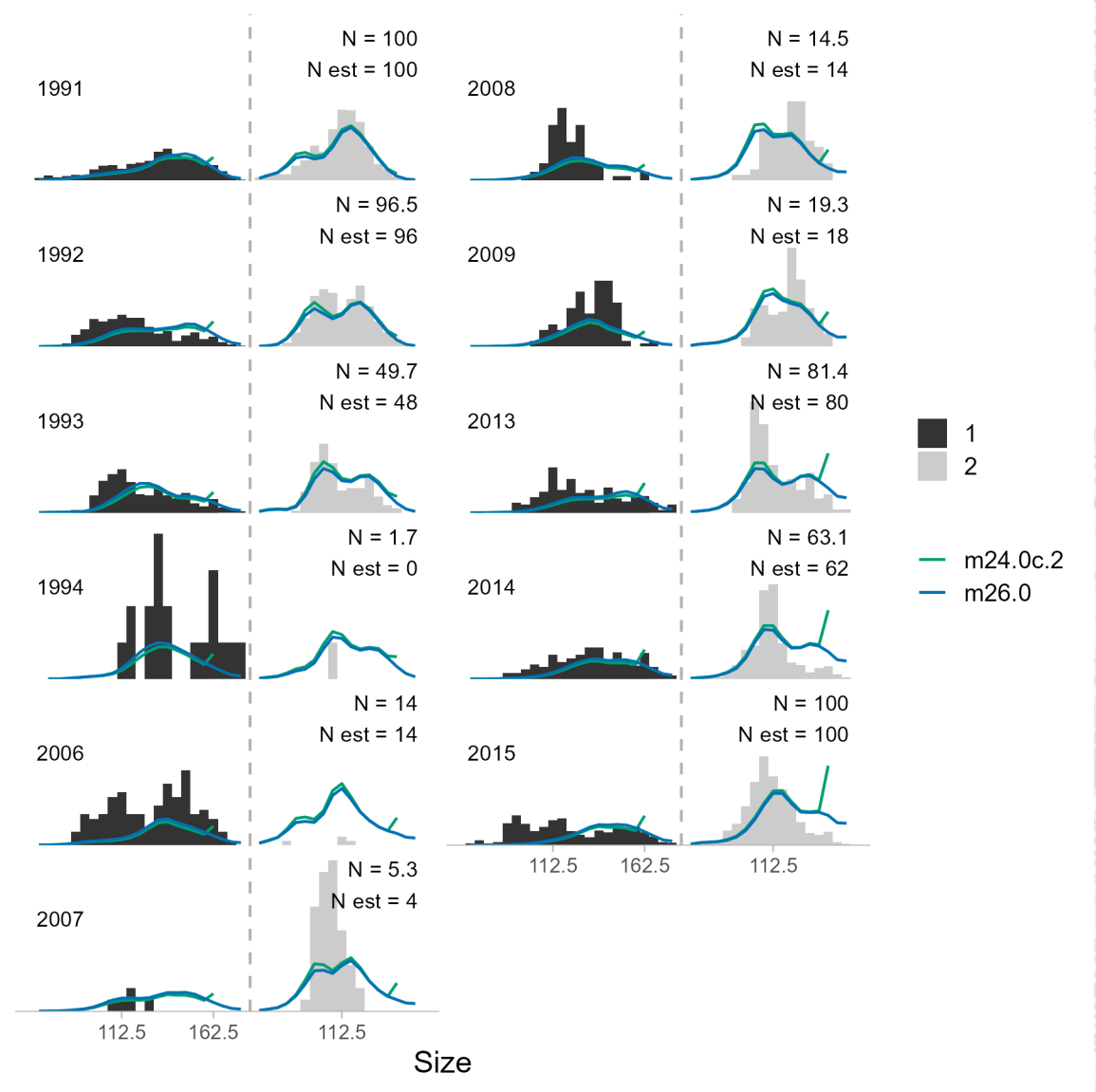
Directed fishery – total males



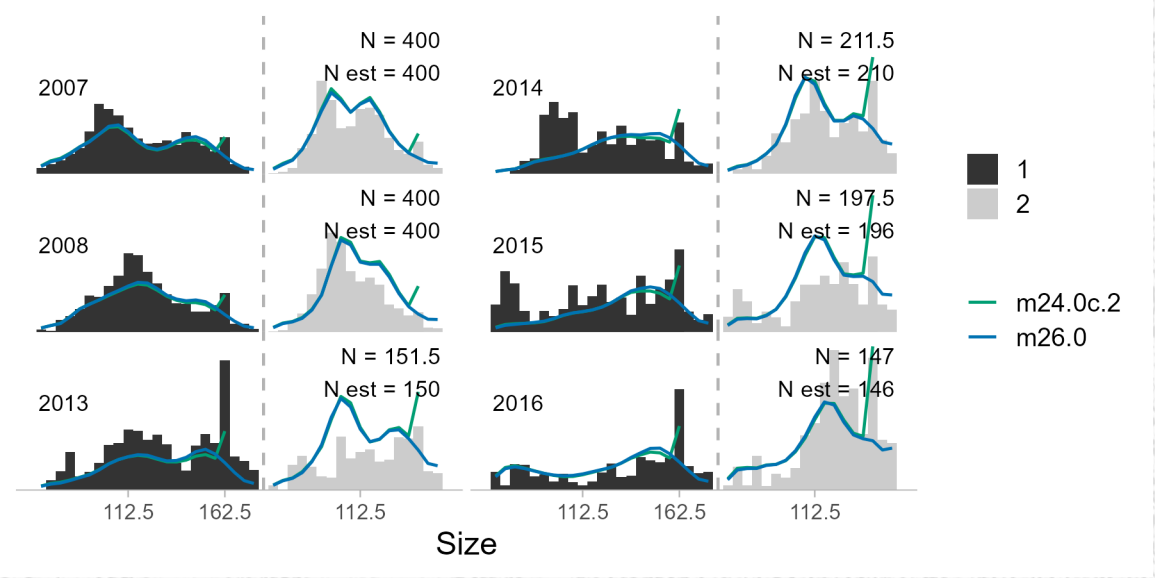
Directed fishery – total females



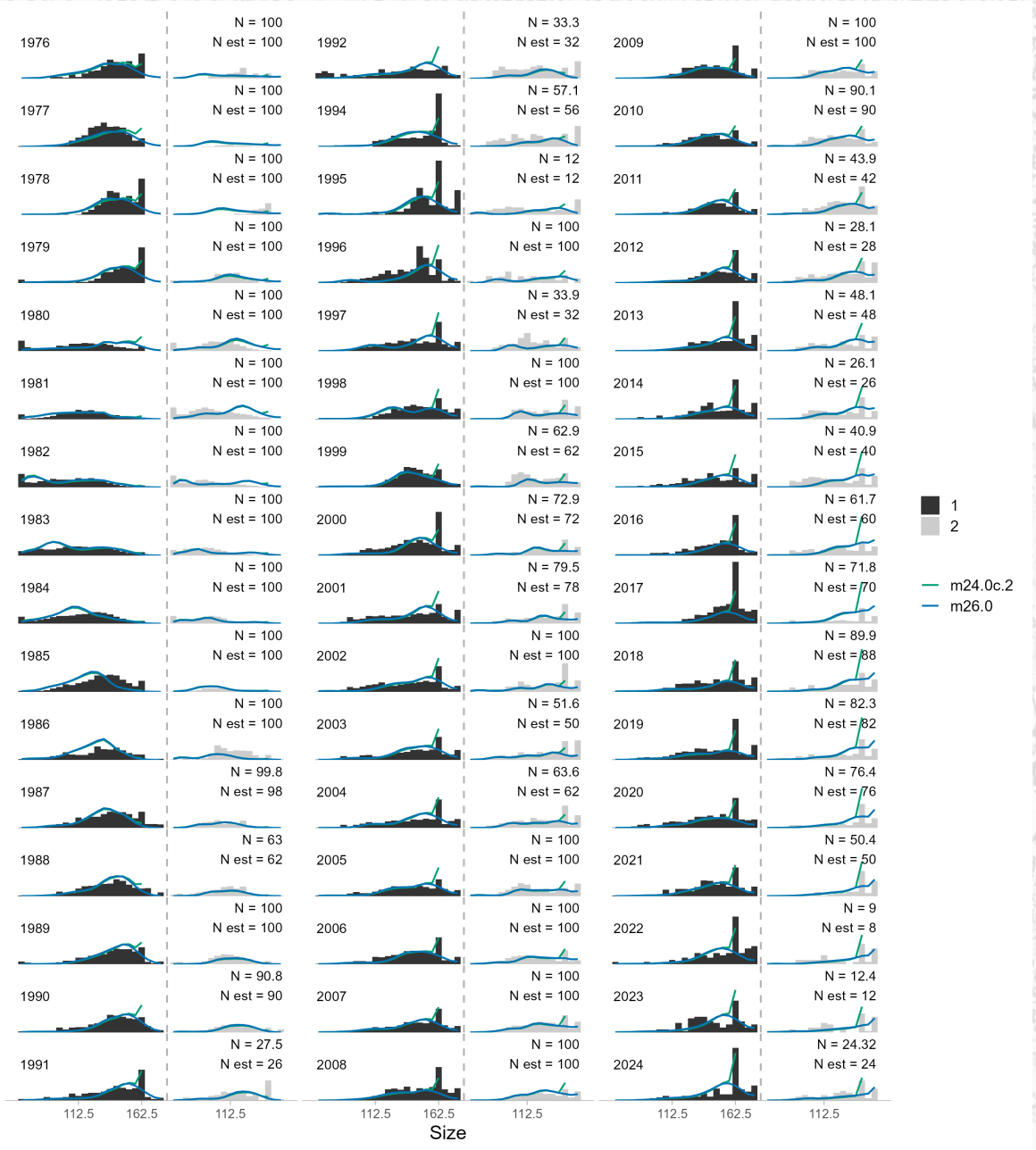
Tanner crab bycatch



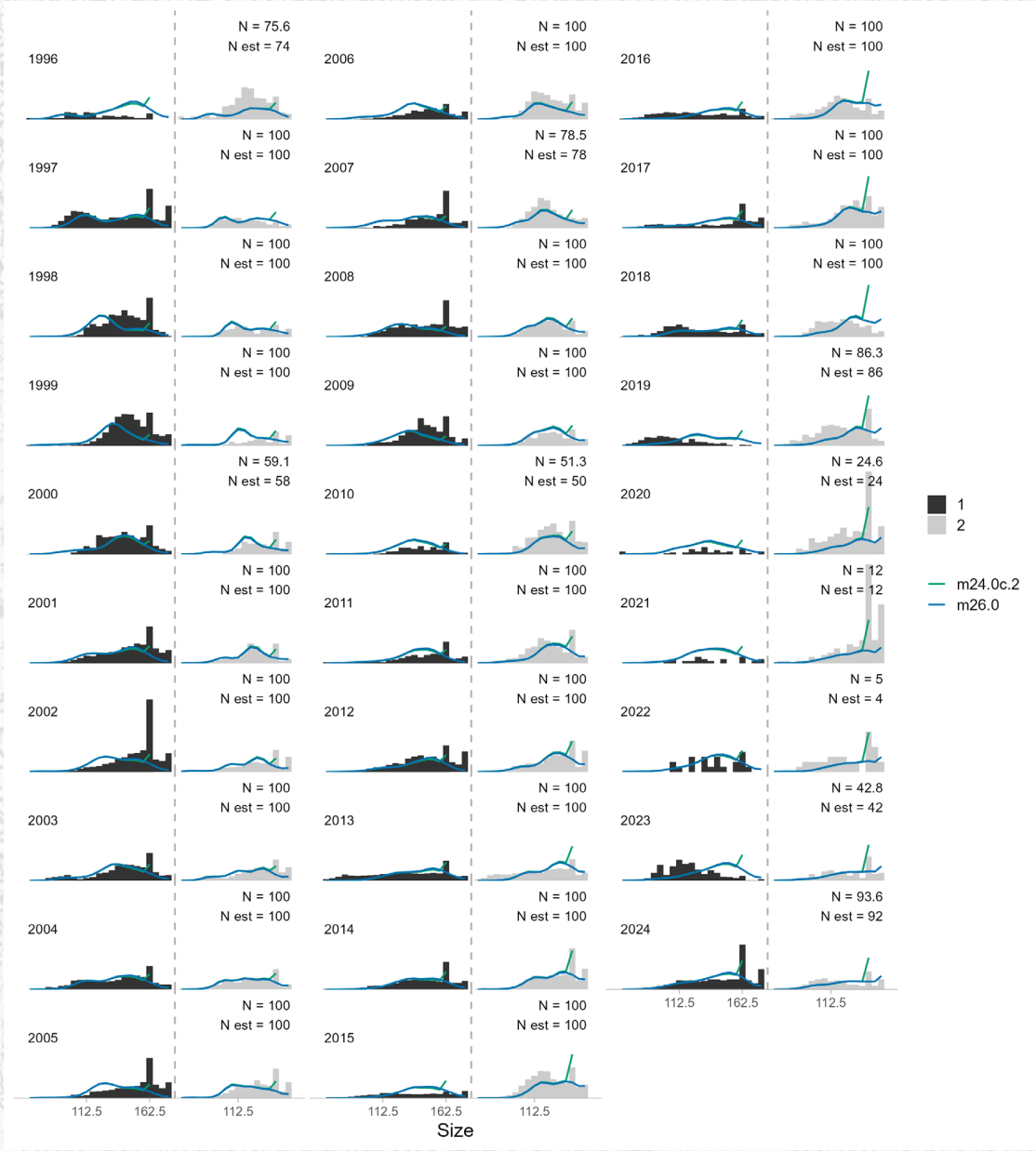
BSFRF



Trawl bycatch groundfish - males (1) and females (2)

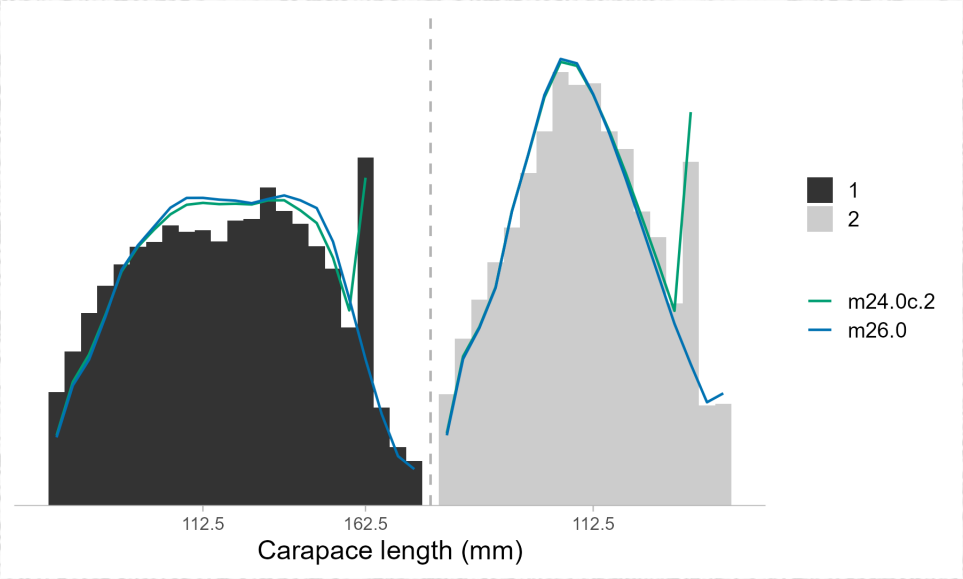


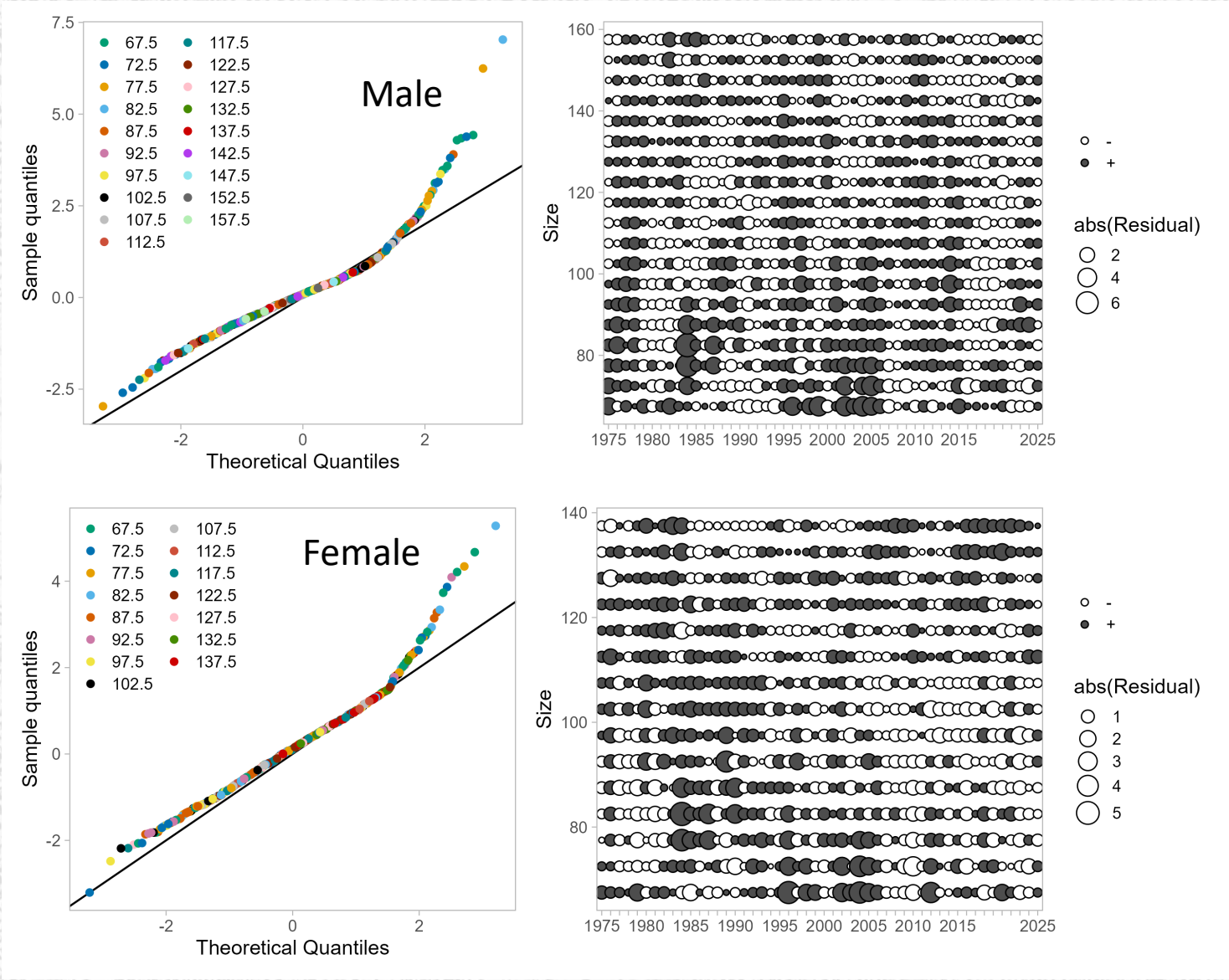
Fixed bycatch groundfish - males (1) and females (2)



Model 24.0c.2

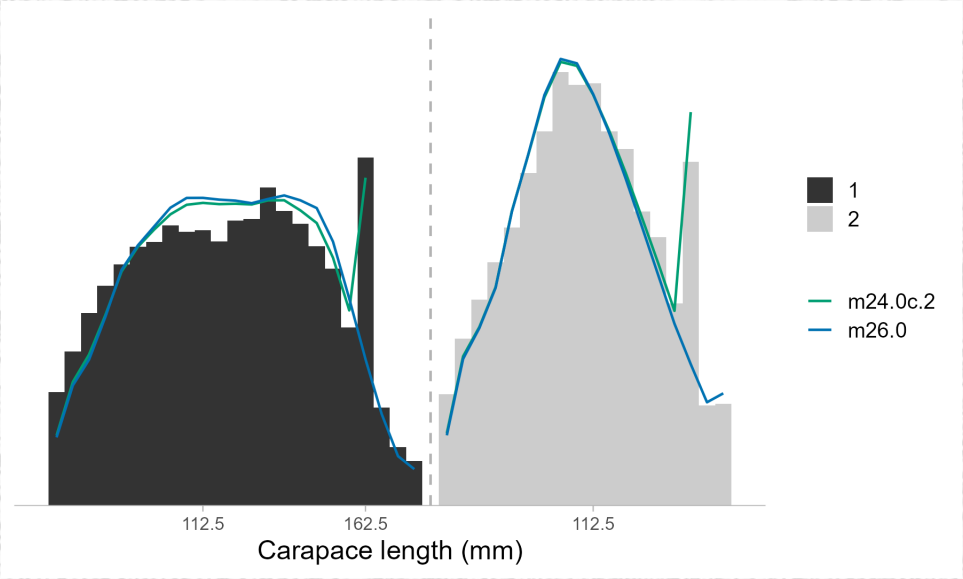
- NMFS trawl survey one-step-ahead residuals - males (1), females (2)
- Aggregated size comp over all years

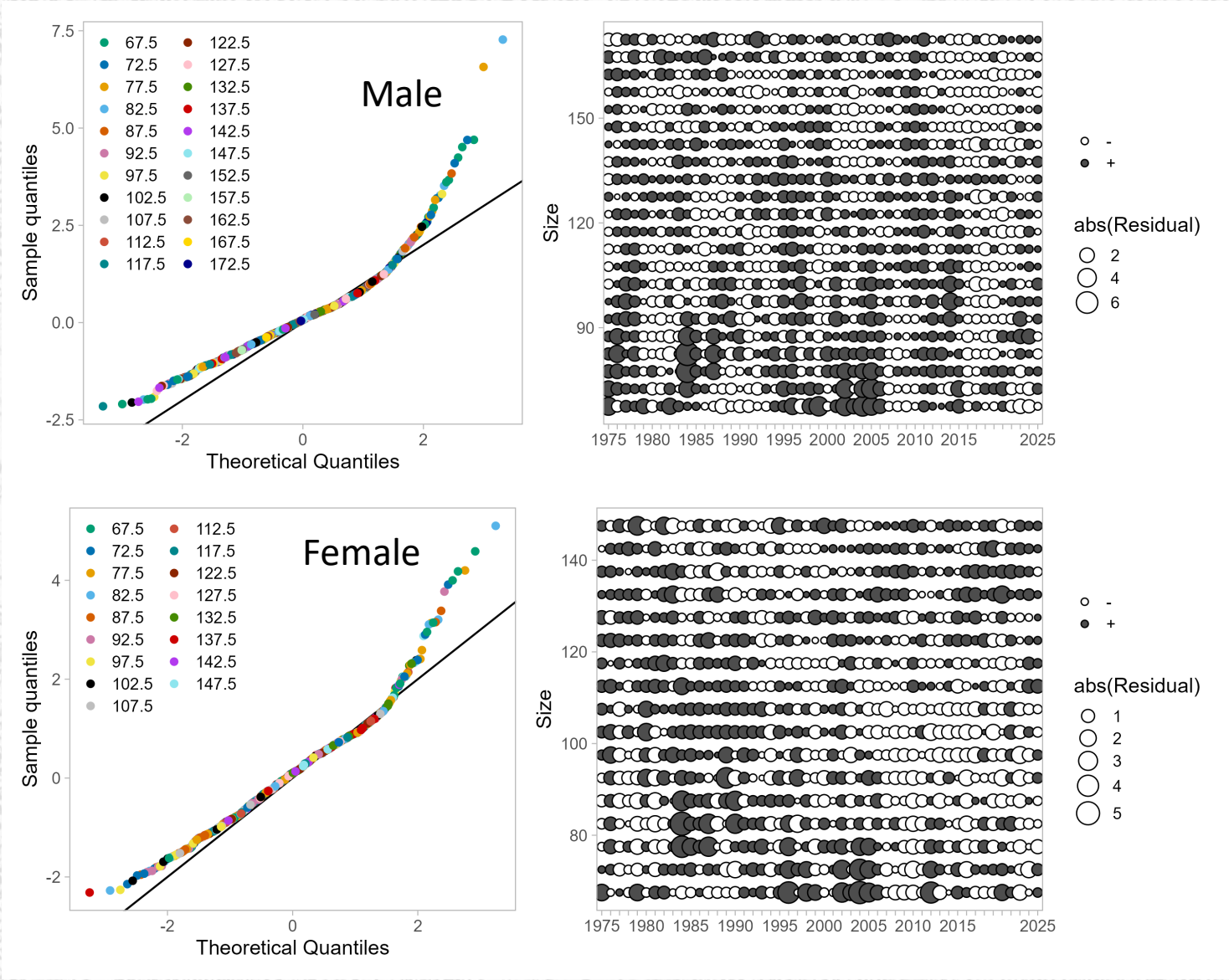




Model 26.0

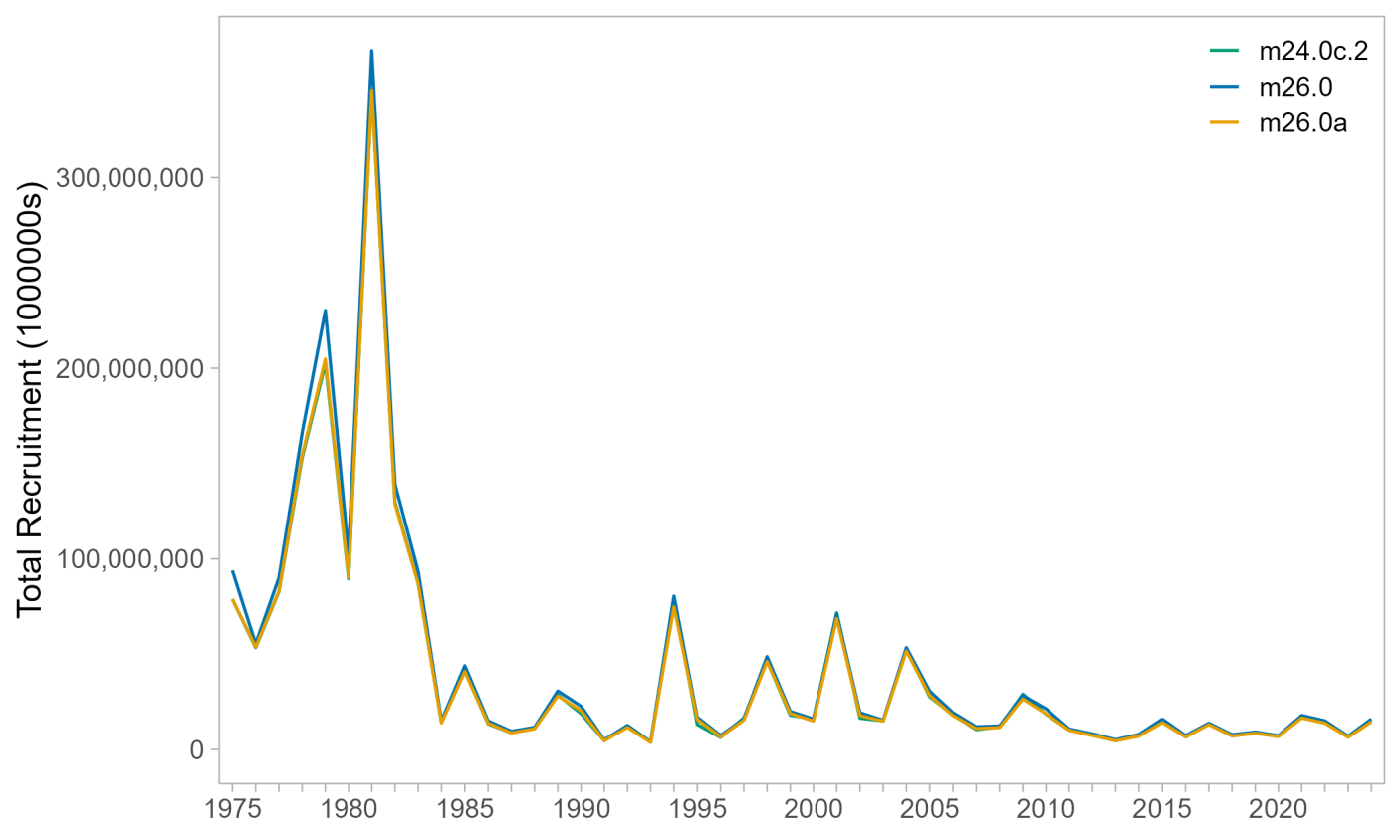
- NMFS trawl survey one-step-ahead residuals - males (1), females (2)
- Aggregated size comp over all years





Recruitment

Small differences in early model time series



Highlighted cells show prior density values and total negative likelihood values. These are NOT all comparable due to data and parameter differences.

Table 4: Comparisons of negative log-likelihood values and some parameters for all model scenarios.

Component	m24.0c.2(ref)	m24.0c.2(v34)	m26.0a	m26.0
Pot-ret-catch	-63.56	-63.56	-64.87	-64.98
Pot-totM-catch	28.82	28.82	27.13	27.56
Pot-F-discC	-60.93	-60.93	-60.93	-60.94
Trawl-discC	-67.91	-67.91	-67.91	-67.90
Tanner-M-discC	-45.28	-45.28	-45.28	-45.28
Tanner-F-discC	-45.24	-45.24	-45.24	-45.24
Fixed-discC	-40.20	-40.20	-40.20	-40.20
Traw-suv-bio	-41.39	-41.39	-41.09	-38.52
BSFRF-sur-bio	-5.13	-5.13	-5.22	-5.81
Pot-ret-comp	-4173.13	-4173.13	-4170.78	-4808.88
Pot-totM-comp	-2603.18	-2603.18	-2599.35	-3045.89
Pot-discF-comp	-1583.69	-1583.69	-1582.79	-1832.65
Trawl-disc-comp	-6171.05	-6171.05	-6168.79	-7070.20
Tanner-disc-comp	-1276.73	-1276.73	-1264.37	-1487.69
Fixed-disc-comp	-3734.15	-3734.15	-3748.45	-4301.64
Trawl-sur-comp	-7440.87	-7440.87	-7443.27	-8724.29
BSFRF-sur-comp	-844.86	-844.86	-847.64	-988.86
Recruit-dev	74.65	74.65	74.74	74.54
Recruit-ini	0.00	0.00	0.00	0.00
Recruit-sex-R	82.02	82.02	81.95	81.98
Sex-specific-R	0.07	0.07	0.10	0.05
Ini-size-struct	33.36	33.36	33.35	70.85
PriorDensity	223.68	223.68	223.73	242.11
Tot-likelihood	-27754.69	-27754.69	-27755.18	-32131.88
Tot-parms	391.00	390.00	390.00	395.00
MMB35	18524.40	18524.40	18700.91	18911.08
MMB-terminal	16836.02	16836.02	16757.97	17309.41
F35	0.40	0.40	0.40	0.40
$Fofl$	0.36	0.36	0.35	0.36
OFL	5851.79	5851.79	5674.62	6165.62

Table 2: Changes in management quantities for each scenario explored. Report quantities are derived from maximum likelihood estimates. Average recruitment is males in millions of animals.

Model	Current MMB	B35	F35	F_{OFL}	OFL	avg male rec
m24.0c.2	16.84	18.52	0.40	0.36	5.85	9.69
m26.0a	16.76	18.70	0.40	0.35	5.67	9.68
m26.0	17.31	18.91	0.40	0.36	6.17	10.26

Model description
24 accepted (updated GMACS)
Updated bycatch size comps
Extended size comps

Summary and Recommendations

- Model 24.0c.2 represents updated base – GMACS updates
- Extended size bins fit size comp data better visually, provide steps towards incorporating any new data on larger size growth differences
- Recommendations:
  - Base model 24.0c.2 and model 26.0
  - Tier 4 option from 2024 (REMA model on mature males in NMFS survey data) will be brought forward in Sept.

Future work

- Quality check for aggregated size comps in GMACS recent version
- Selectivity explorations – Other suggestions?
- Revisit growth assumptions
- Focus on retrospective pattern
- Initial conditions – explorations on these and suggestions for what to look at
- Model based indices – explore including northern area crab via this method

Questions?