2025 Tanner Crab Stock Assessment

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AFSC

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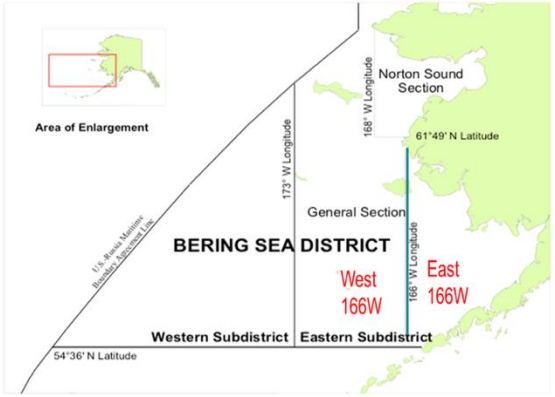
Overview

- ADFG manages fishery in two areas
  - **fishery open in both areas**
  - East 166W: TAC: 803 t. RC: 803 t
  - West 166W: TAC: 2,041 t. RC: 2,049 t
- 2025 NMFS EBS Shelf Survey Biomass
  - male biomass: 111 kt (-E, +W, +T)
  - IP male biomass: 16 kt (-E, +W, +T)
  - imm fem biomass: 12 kt (-E, -W, -T)
  - mat fem biomass: 29 kt (-E,+W,+T)
  - **2023 recruitment moving into larger sizes**



- 2023/24 OFL: 41.29 kt
  - Total catch mortality: 3.09 kt
  - **overfishing did not occur**
- 2025 assessment
  - Same Tier 3 model as 2024 (22.03d5)
  - Tier 3a ($B>B_{MSY}$; **not overfished**)
  - OFL: 51.02 kt; ABC: 40.81 kt
  - Concerns: model **overly-optimistic**

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2021/22	17.37	62.05	0.50	0.49	0.78	27.17	21.74
2022/23	18.19	74.17	0.91	0.91	1.19	32.81	26.25
2023/24	20.00	88.21	0.94	0.94	1.09	36.20	27.15
2024/25	21.61	99.53	2.84	2.85	3.09	41.29	33.03
2025/26	NA	75.96	NA	NA	NA	51.02	40.81

In 1,000's metric tons

12.54 10.66 TIER 4

Why One Tier 3 Model?

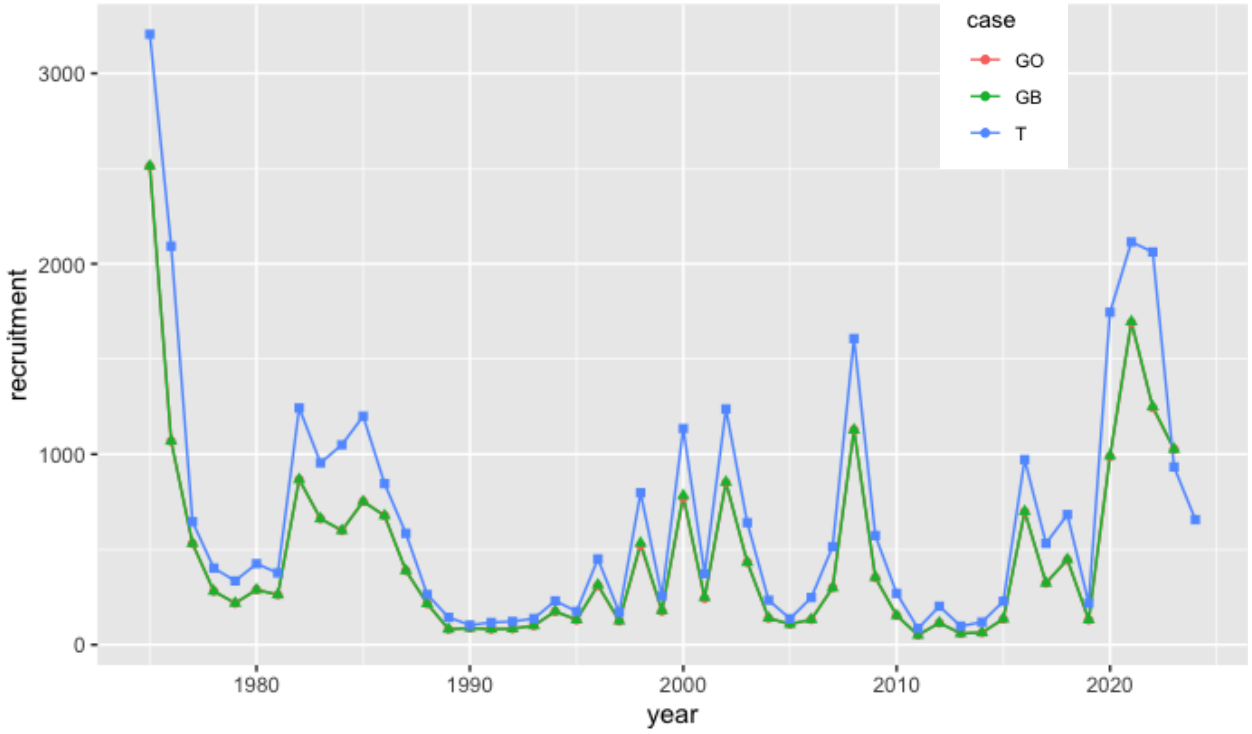
CPT/SSC (5/6-2025):…recommended bringing forward only the base model (22.03d5) and the GMACS model (G25.05) so that more effort can be placed on bridging to GMACS.
Response: The base model, 22.03d5, has been updated with 2024/25 data and provides the basis for this assessment.

CPT(5-2025): With regards to GMACS, the CPT suggested:
* starting from inputting parameters via a .PIN file in the bridging analyses and then work towards estimating parameter values
* it might also be useful to consider how selectivity is being estimated. A closer look at how priors were placed on the NMFS survey selectivity seems warranted given large differences between estimates from each model.

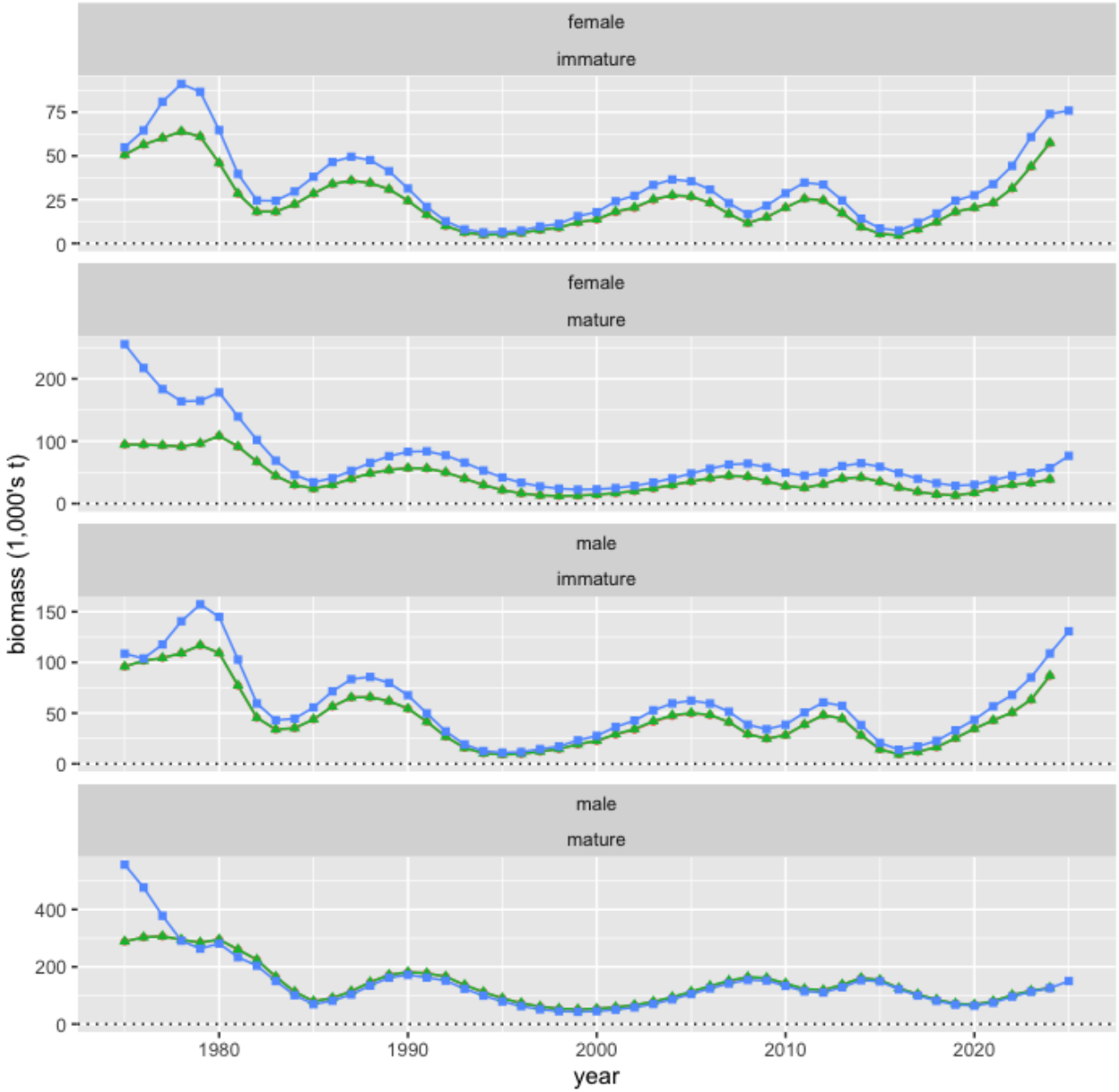
Response: *Since May, several Tanner-specific features have been added to GMACS (e.g., additional selectivity options, growth options, etc.) to facilitate the comparison using a directly-comparable pin file. One major stumbling block to this approach is the difference in how recruitment is handled in each model. A work-around may be to start the GMACS model in 1975 but initialized with the population structure from the bespoke model for 1975, as well as other bespoke model-equivalent parameters and processes, but this has not been implemented yet. Another issue is that* ***the GMACS model, when run from a pin file that is thought to provide the best match to the bespoke model, generates an invalid gradient structure (i.e., a vector of NaNs) after ~150 optimization steps and the reason for this has not yet been identified. As a consequence, no GMACS models are discussed in this document.***

Update: GMACS progress

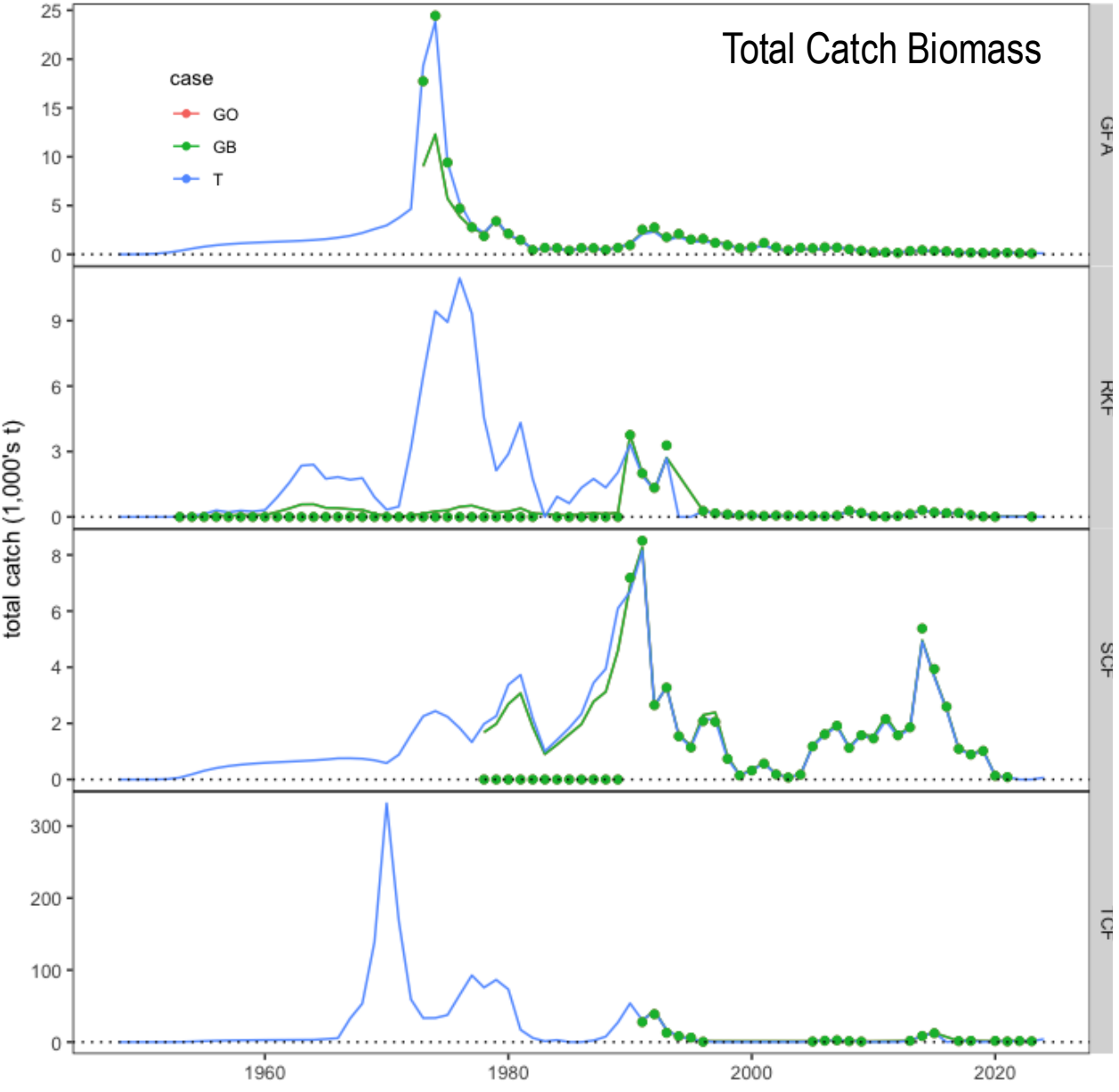
- goal: match 2024 assessment model
- can't build up population in same way
- some parameters aren't constructed in same way
- penalties applied differently

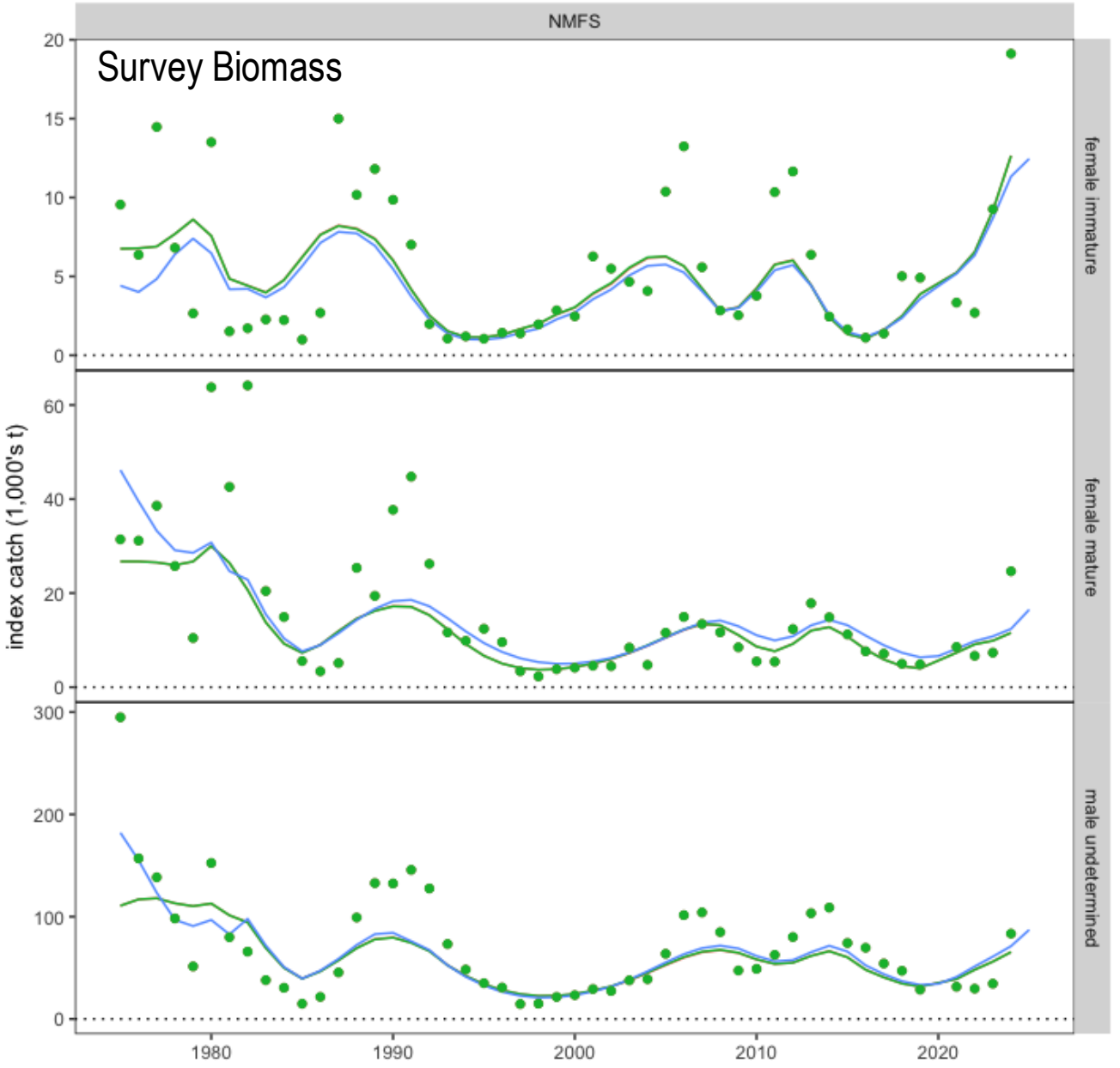


	OFL	Fofl	Bmsy	B/Bmsy
GMACS	43.62	1.66	49.9	1.2
TCSAM02	41.29	1.23	40.01	1.4



GMACS progress





Responses to Comments (Highlights)

CPT(5-2025): …. The CPT agreed with using the high-precision carapace width data but recommended using the full set of 1979 stations provided in `crabpack`.
Response: *done.*

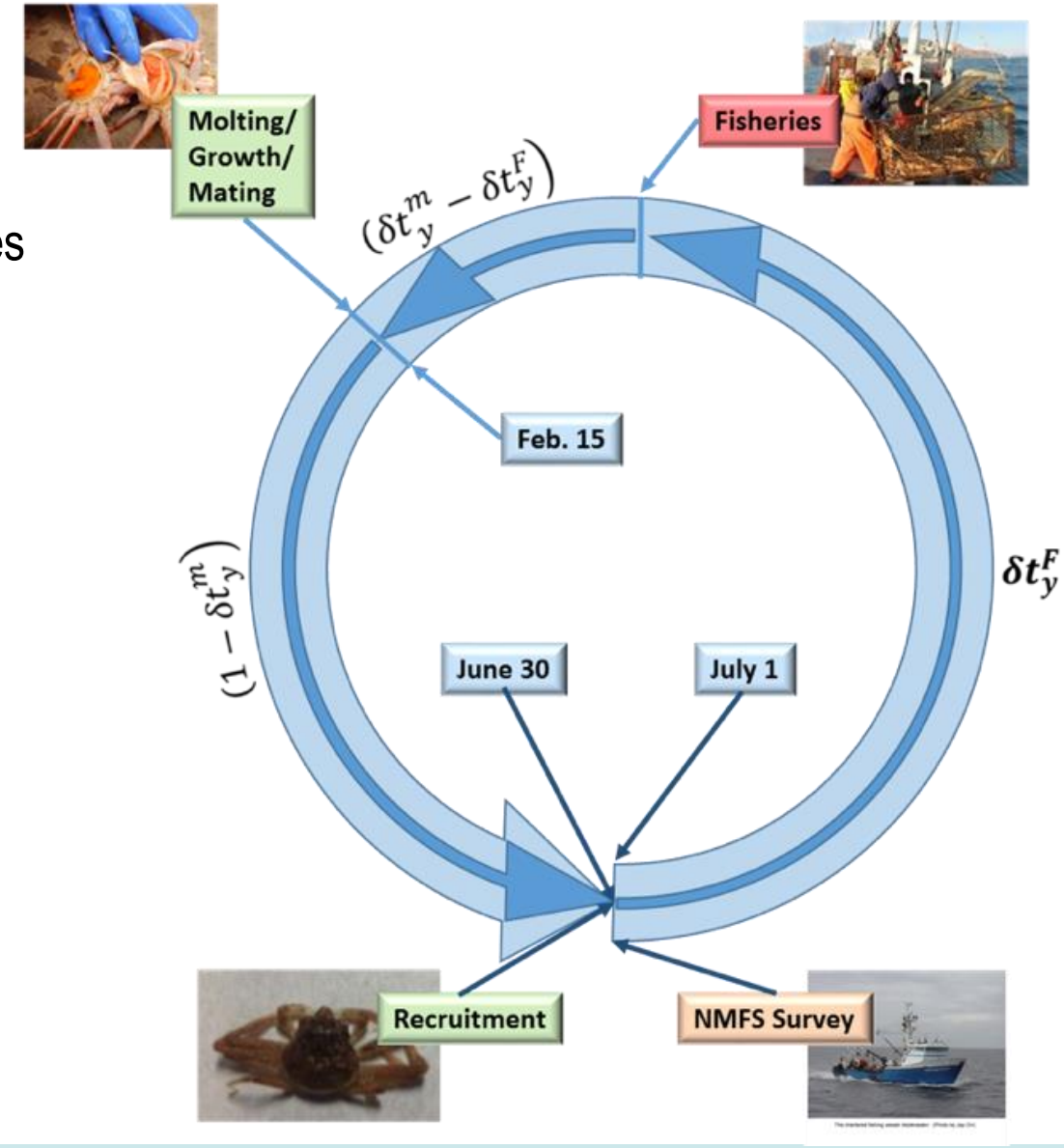
CPT(5-2025):…likelihood profiles over the OFL would be an interesting addition to the currently presented analyses.
Response: *Time constraints did not allow this suggestion to be pursued, although the dependence of the OFL on several parameters which were themselves profiled is illustrated in the stand-alone Appendix A to this document*

SSC (6-2025):…recommends bringing forward a Tier 4 calculation similar to 2024 and consistent with methods used for BBRKC and EBS snow crab.
Response: *Done.*

SSC (6-2025): focus should remain on transitioning this assessment into the GMACs framework and recommends developing a list of clear milestones for the transition for the October meeting.
Response: *see GMACS-relevant responses above. A list of milestones would include: 1) agreement between GMACS and the bespoke model when the former is started in 1975 with a pin file derived from the bespoke model that includes the bespoke model's estimates of population structure in 1975; 2) successful optimization of the GMACS model (a current point of failure, as noted in responses above); 3) comparison of all likelihood components between the two models; 4) adjustment of priors and penalties to achieve model configurations that are as close as possible; 5) evaluation of the final comparison.*

Tier 3 Assessment Model

- Tier 3 size-structured model
  - Survey data
    - NMFS EBS shelf survey: 1975-present
    - BSFRF 2013-2018 side-by-side haul studies
  - Fishery data
    - directed fishery (areas combined)
      - retained catch
      - total catch
    - bycatch in
      - snow crab fishery
      - BBRKC fishery
      - groundfish fisheries
  - Estimates:
    - Annual recruitment
    - Annual numbers-at-size (M,F)
    - mature biomass (MMB, MFB)
  - Determines:
    - F_{MSY}, B_{MSY}, F_{OFL}, OFL

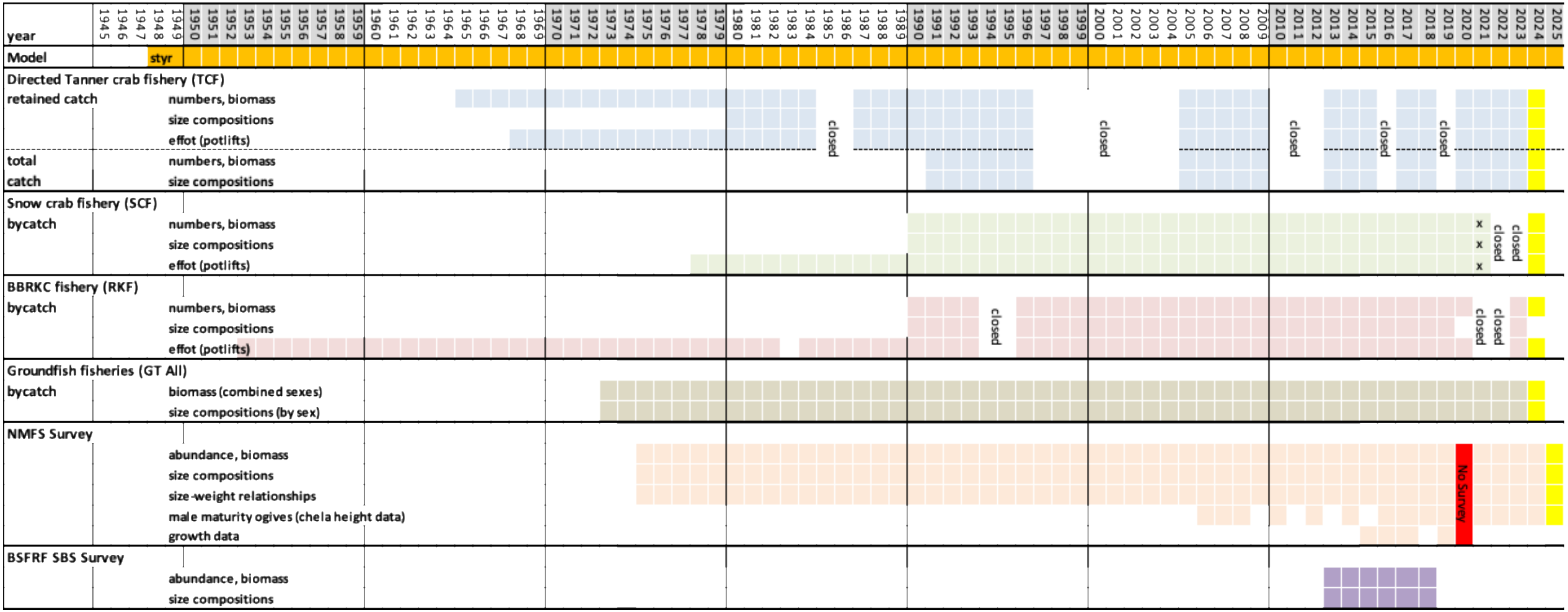


Major Changes to Assessment from 2024

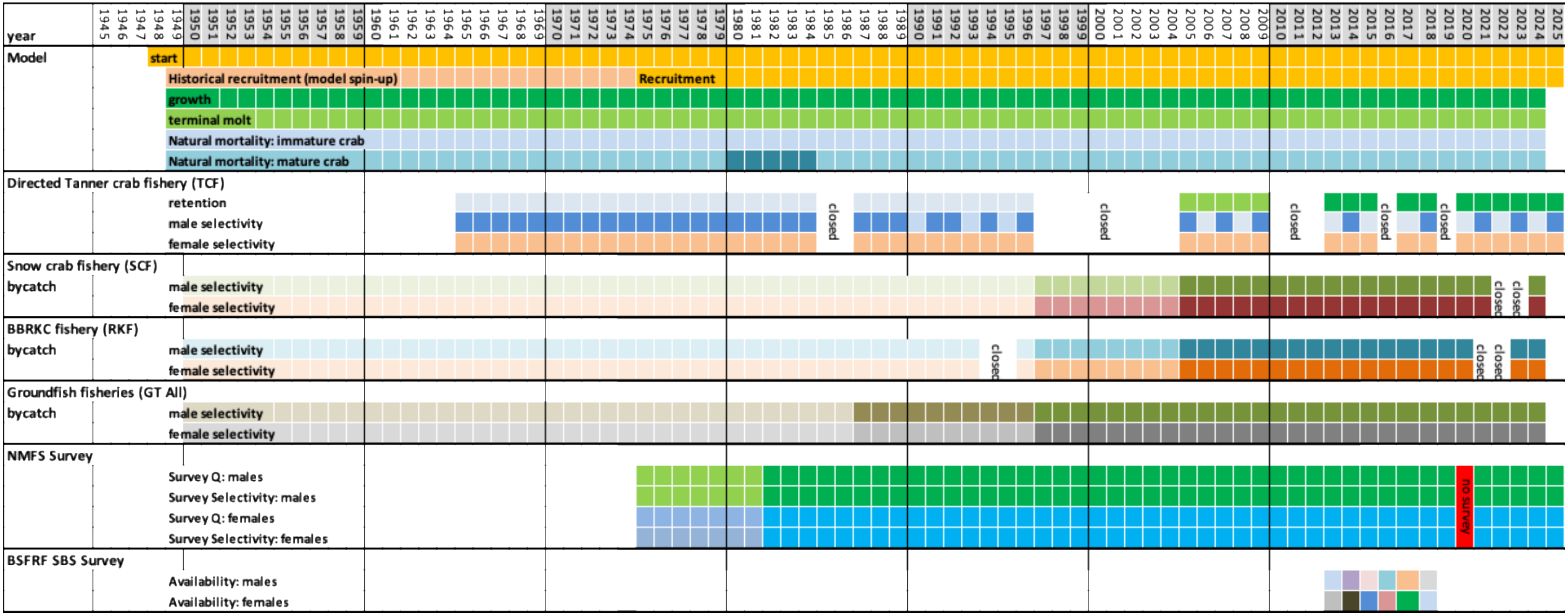
- 2024/25 data added
  - directed fisheries (combined areas) retained & total catch biomass, size comp.s
  - snow crab and BBRKC Tanner crab bycatch biomass & size comp.s
  - groundfish fisheries (combined gears) Tanner crab bycatch biomass & size comp.s
  - 2025 NMFS EBS survey biomass indices and size compositions (using ***crabpack***)
  - 2025 male maturity ogives

- Models
  - 22.03d5: same as 2024 assessment
  - no candidate GMACS models (fixed last week though!)
  - Tier 4 “fallback” model

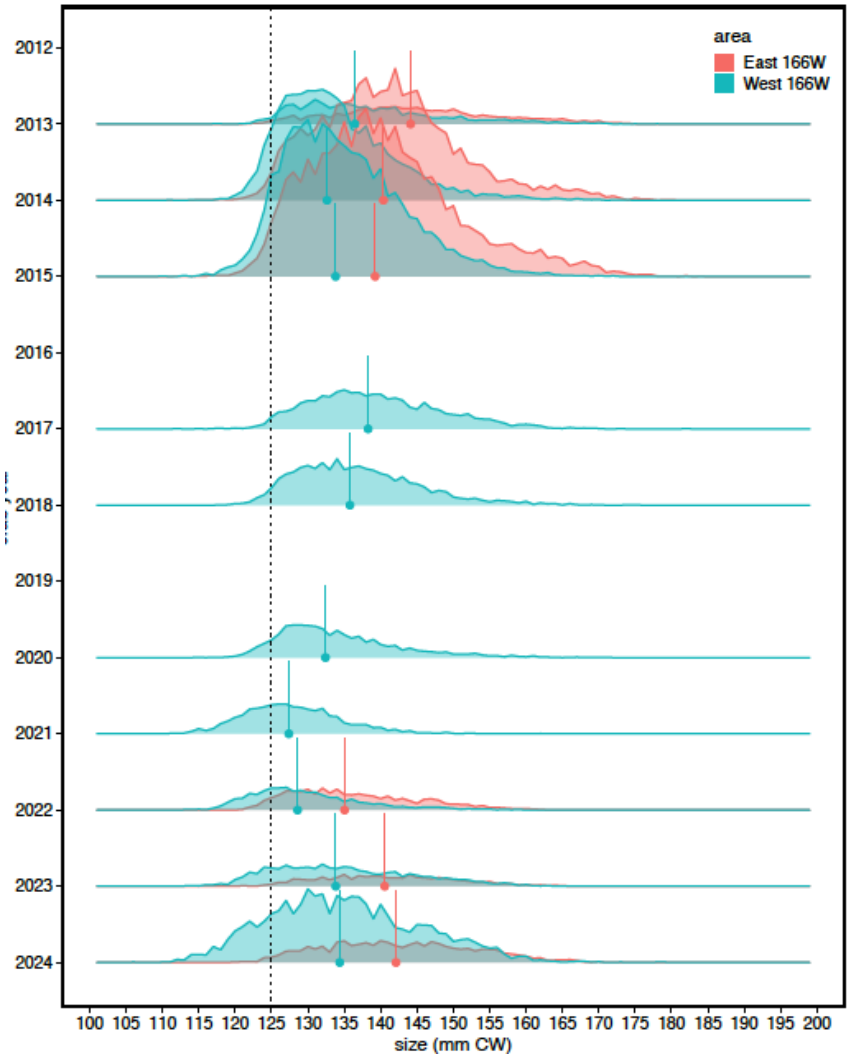
Assessment time frames: data

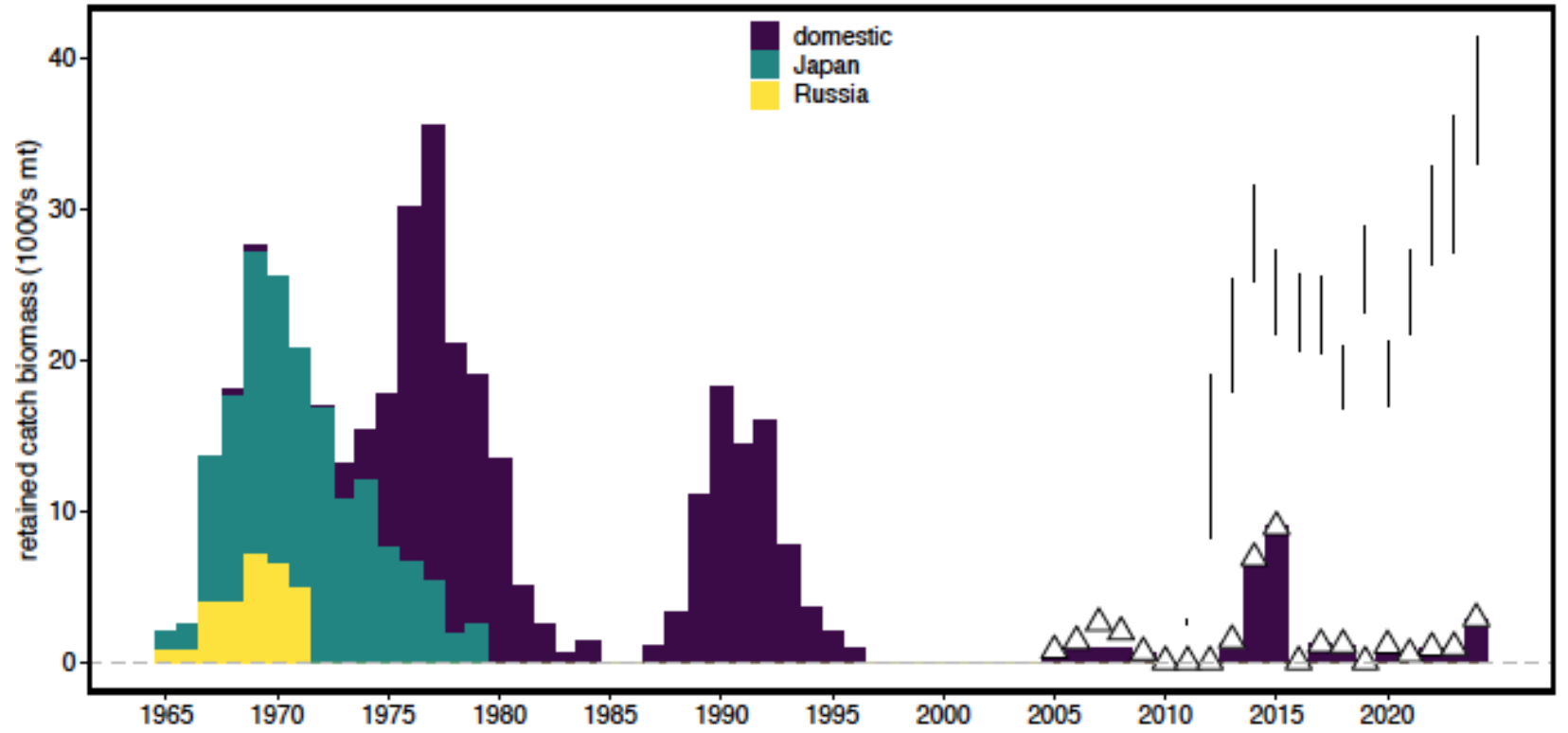


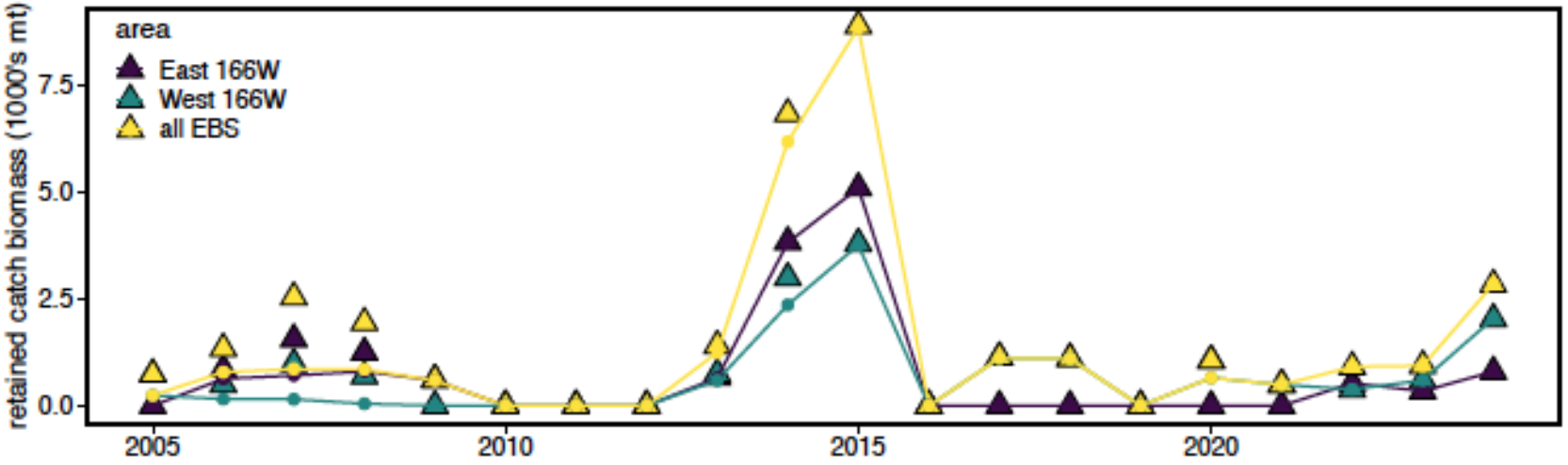
Assessment time frames: model processes



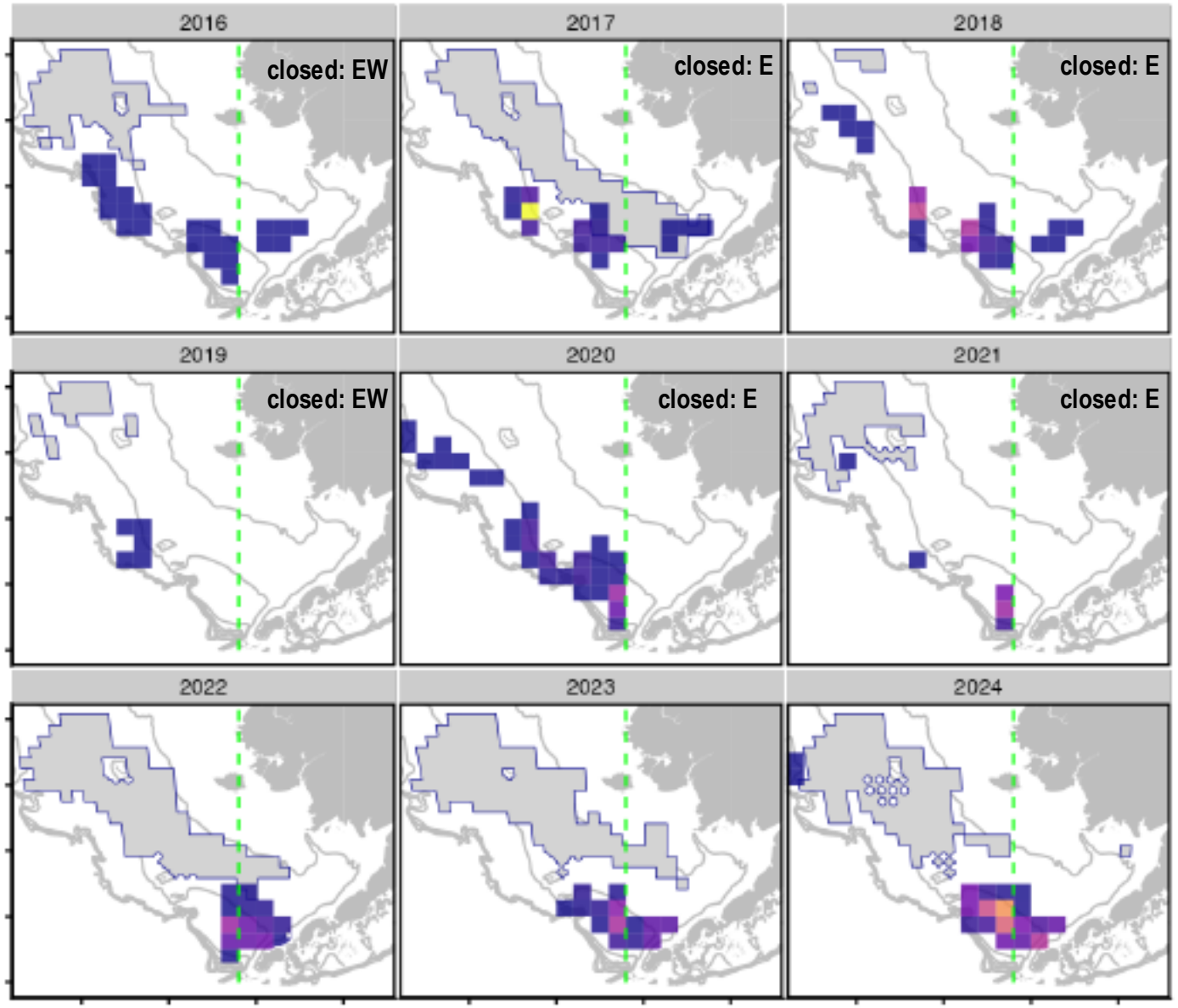
Retained catch



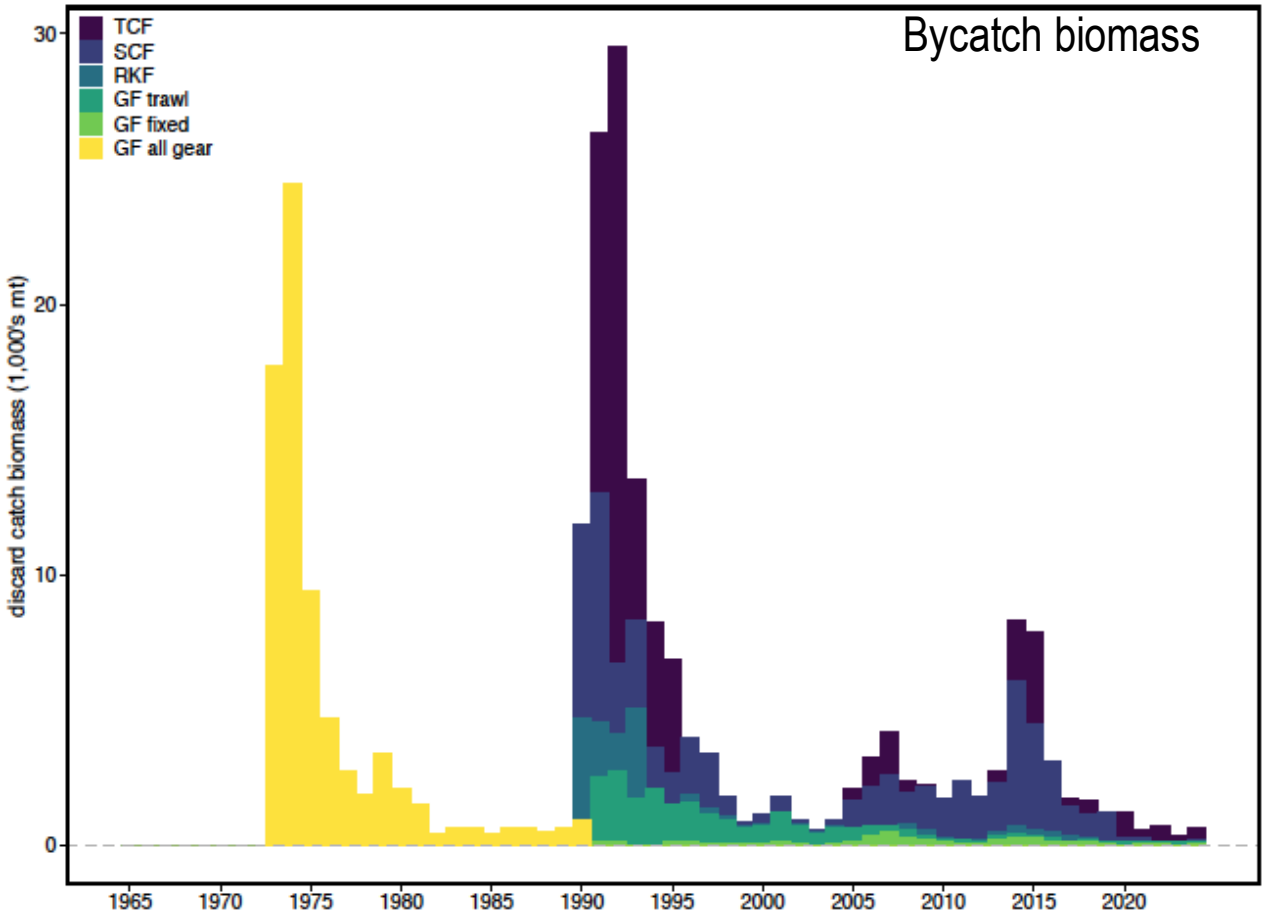


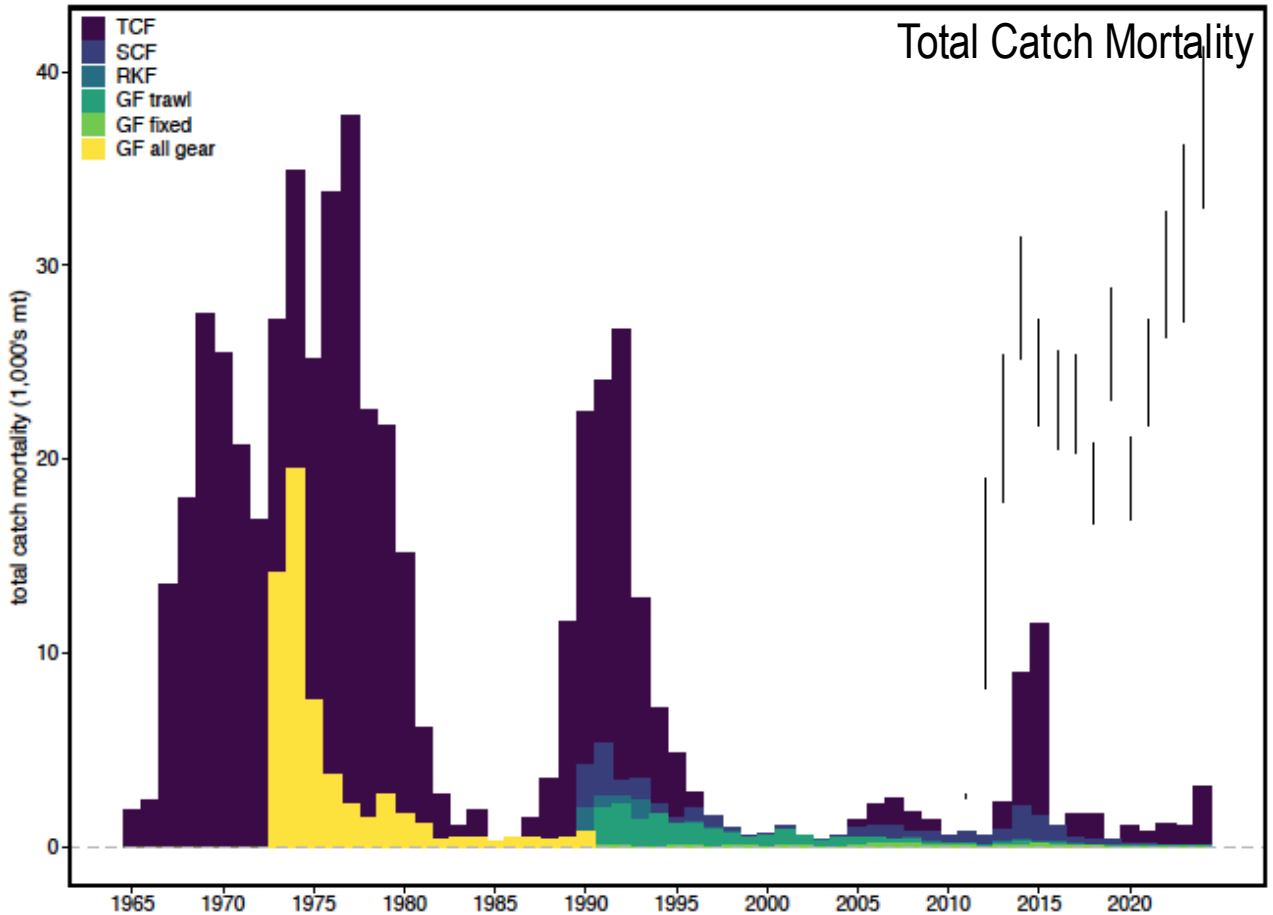


Retained catch



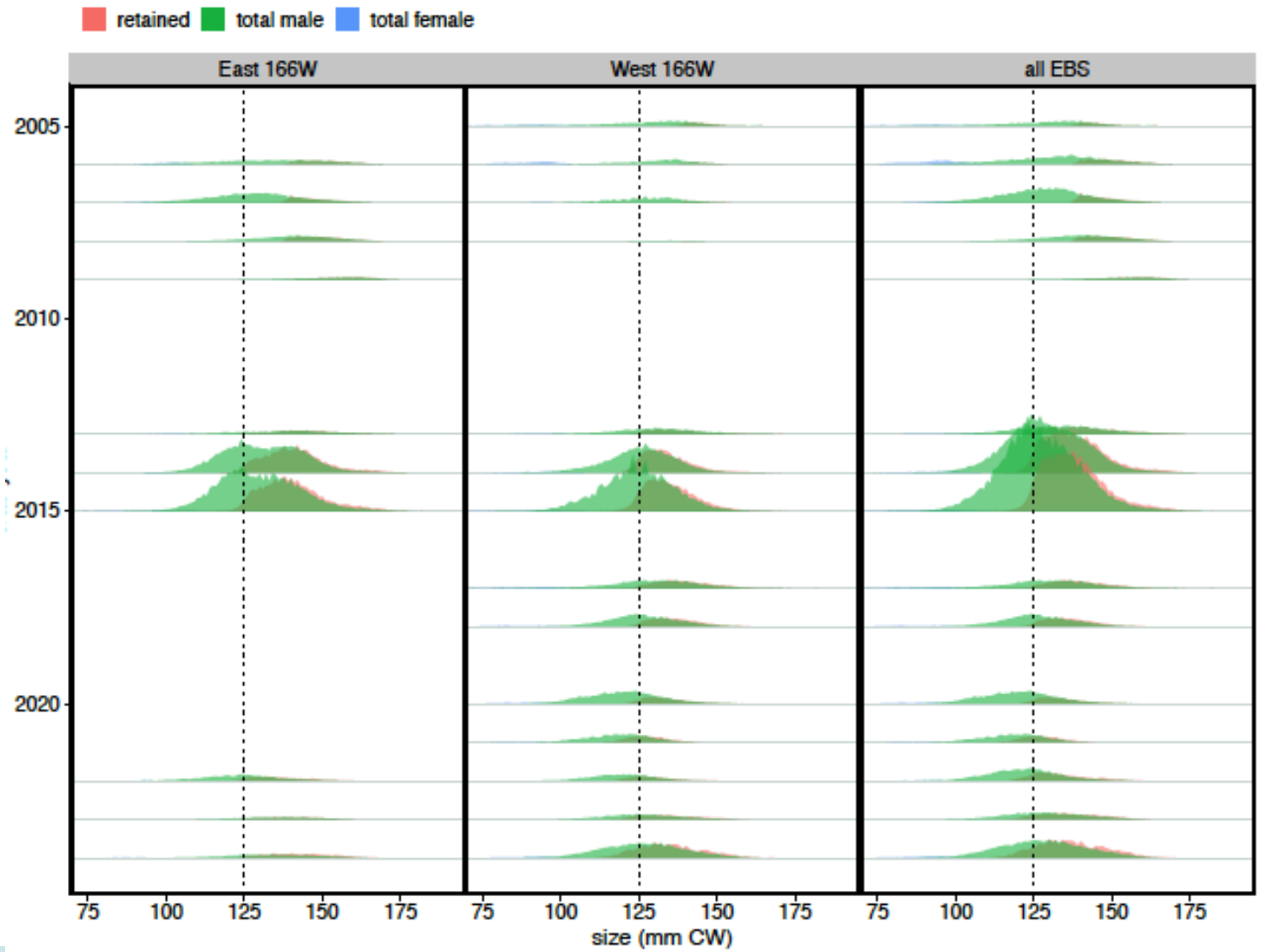
Bycatch and total catch mortality



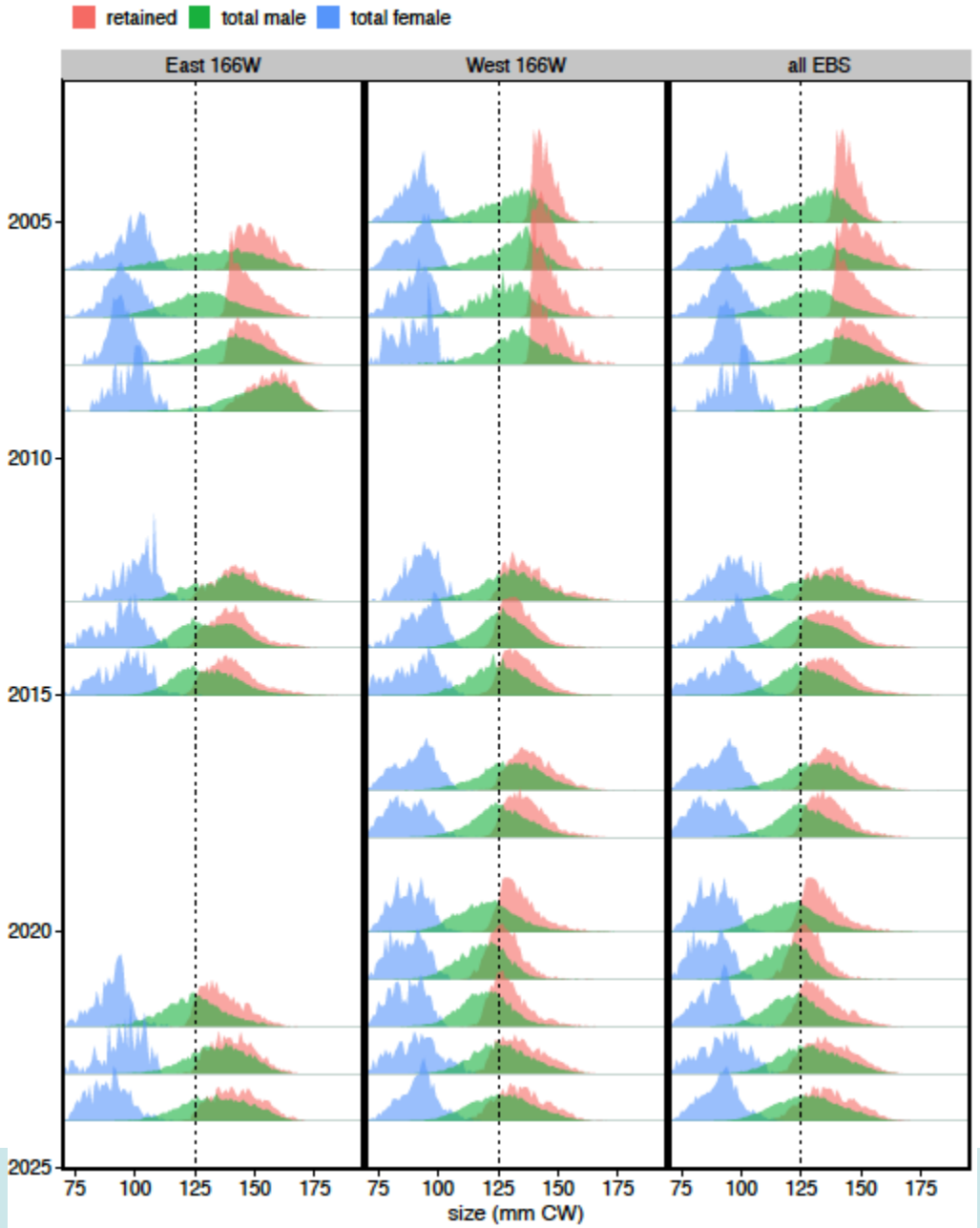


Catch in the directed fishery

estimated numbers caught

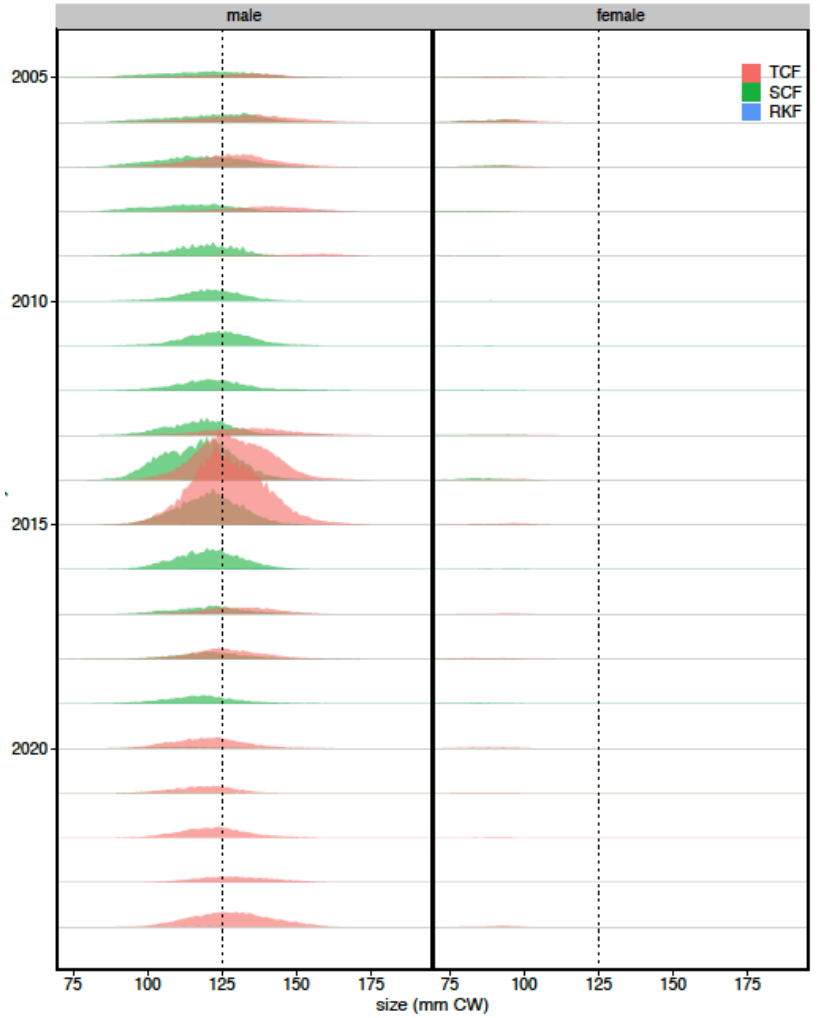


individual components normalized

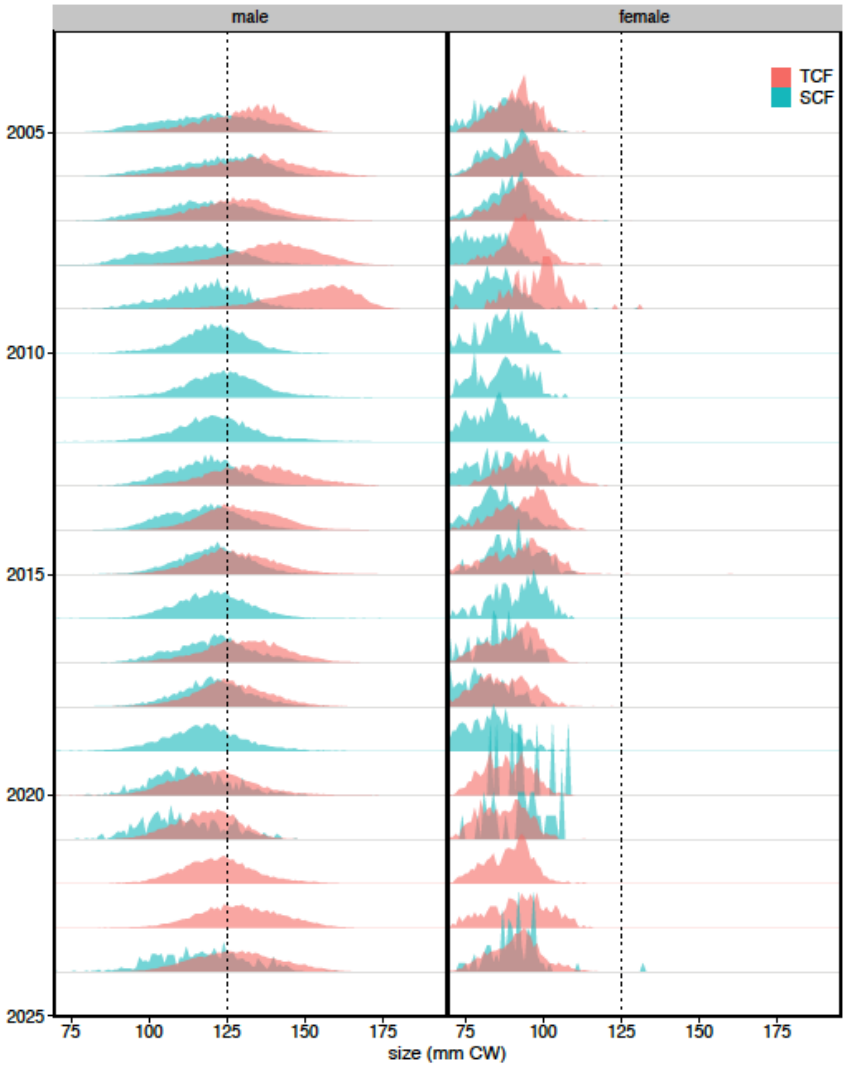


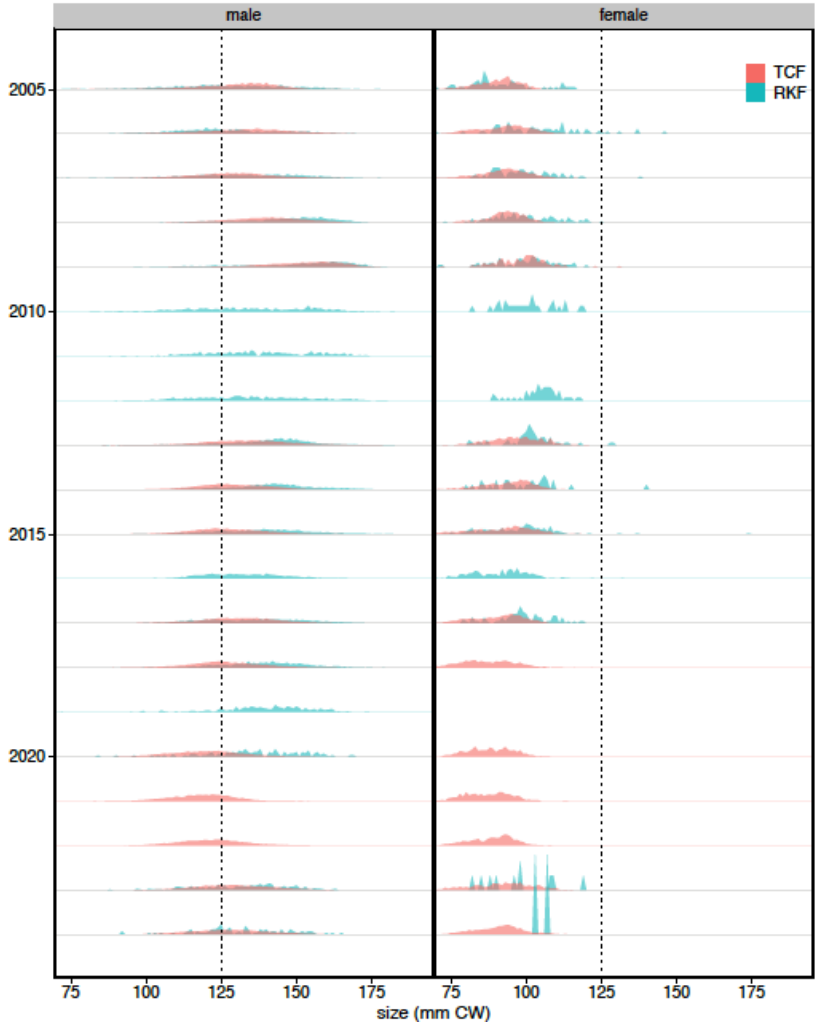
Total catch comparisons: bycatch in snow crab and BBRKC fisheries

estimated numbers caught



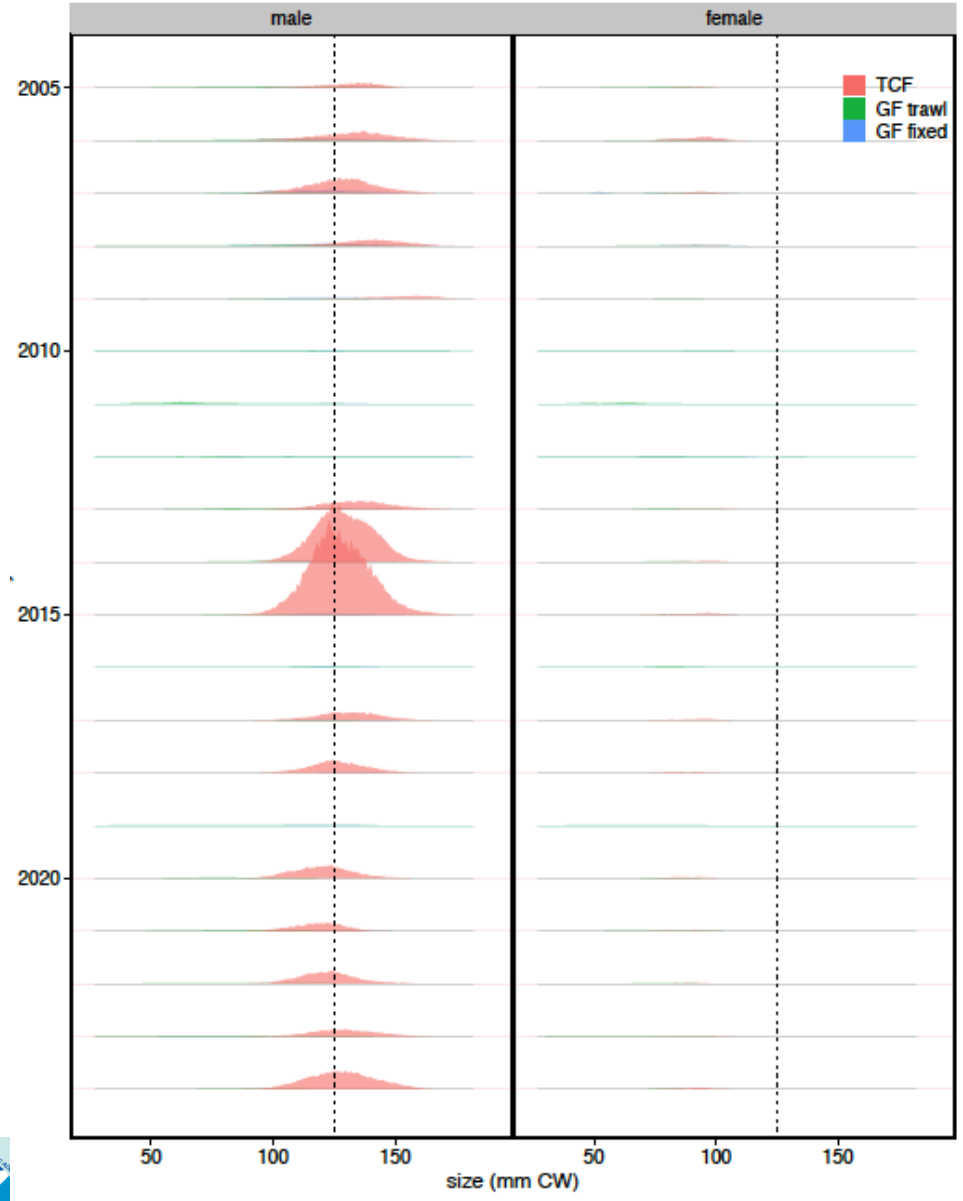
individual components normalized



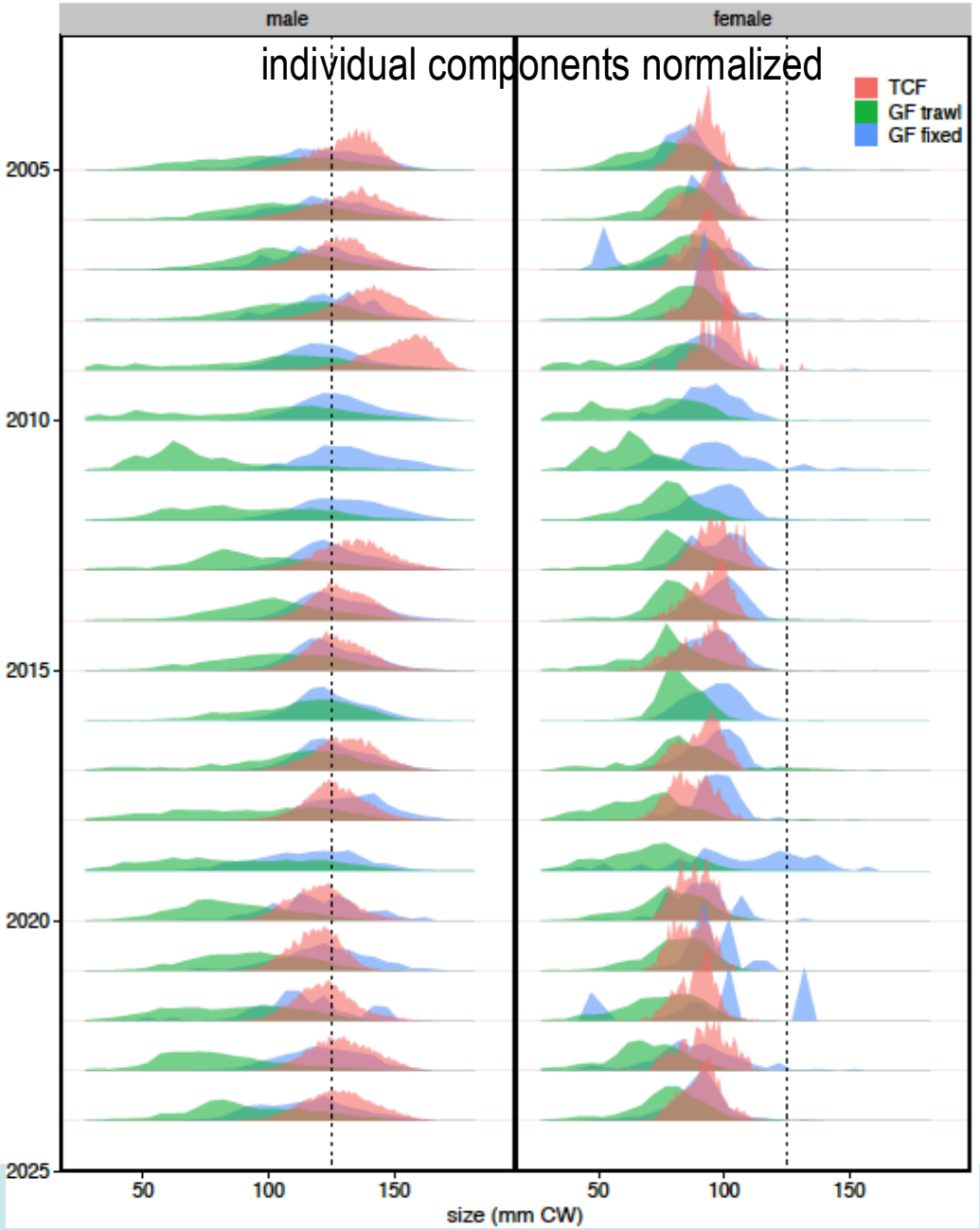


Total catch comparisons: bycatch in groundfish fisheries

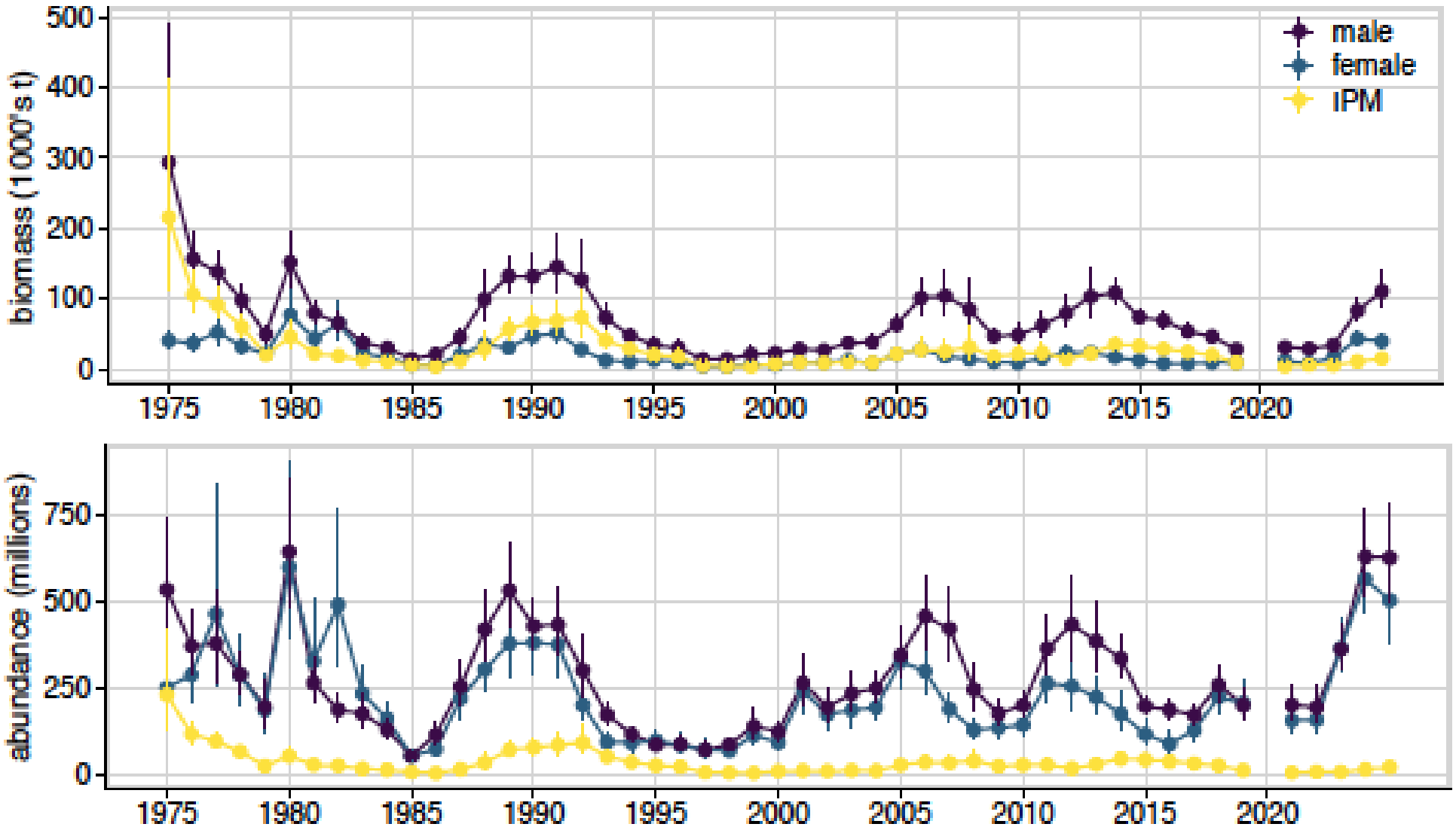
estimated numbers caught



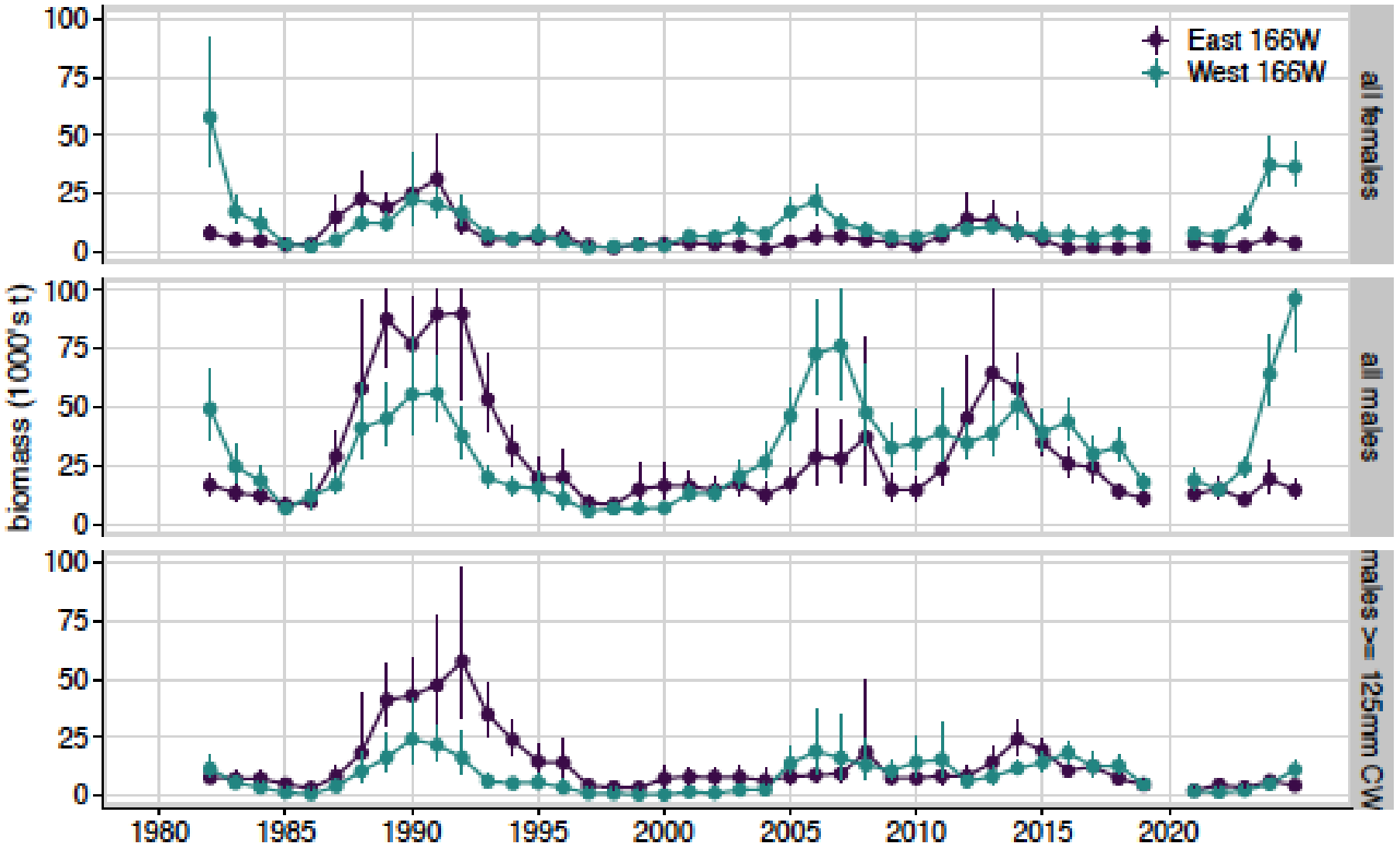
individual components normalized



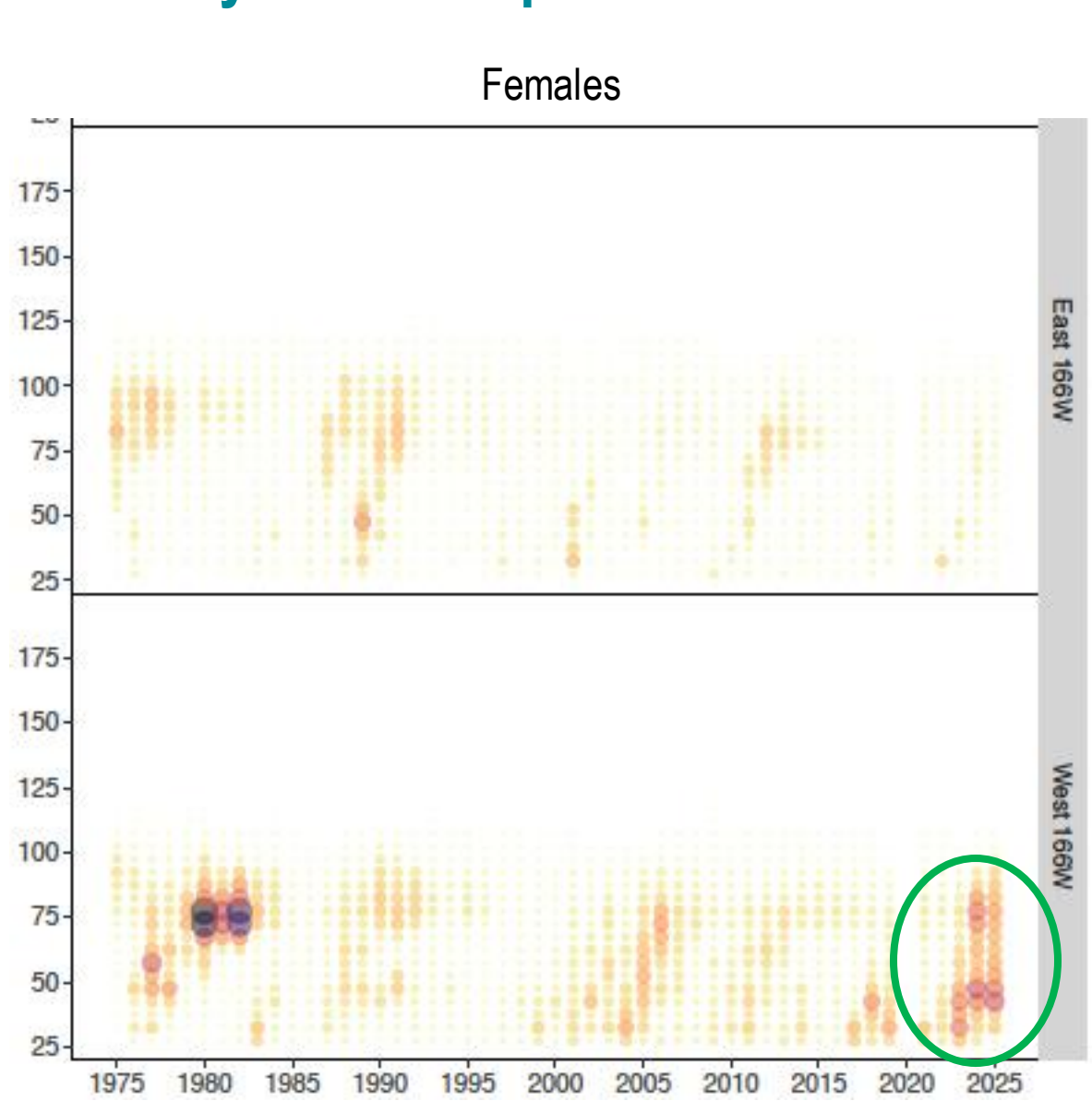
NMFS EBS Survey Data

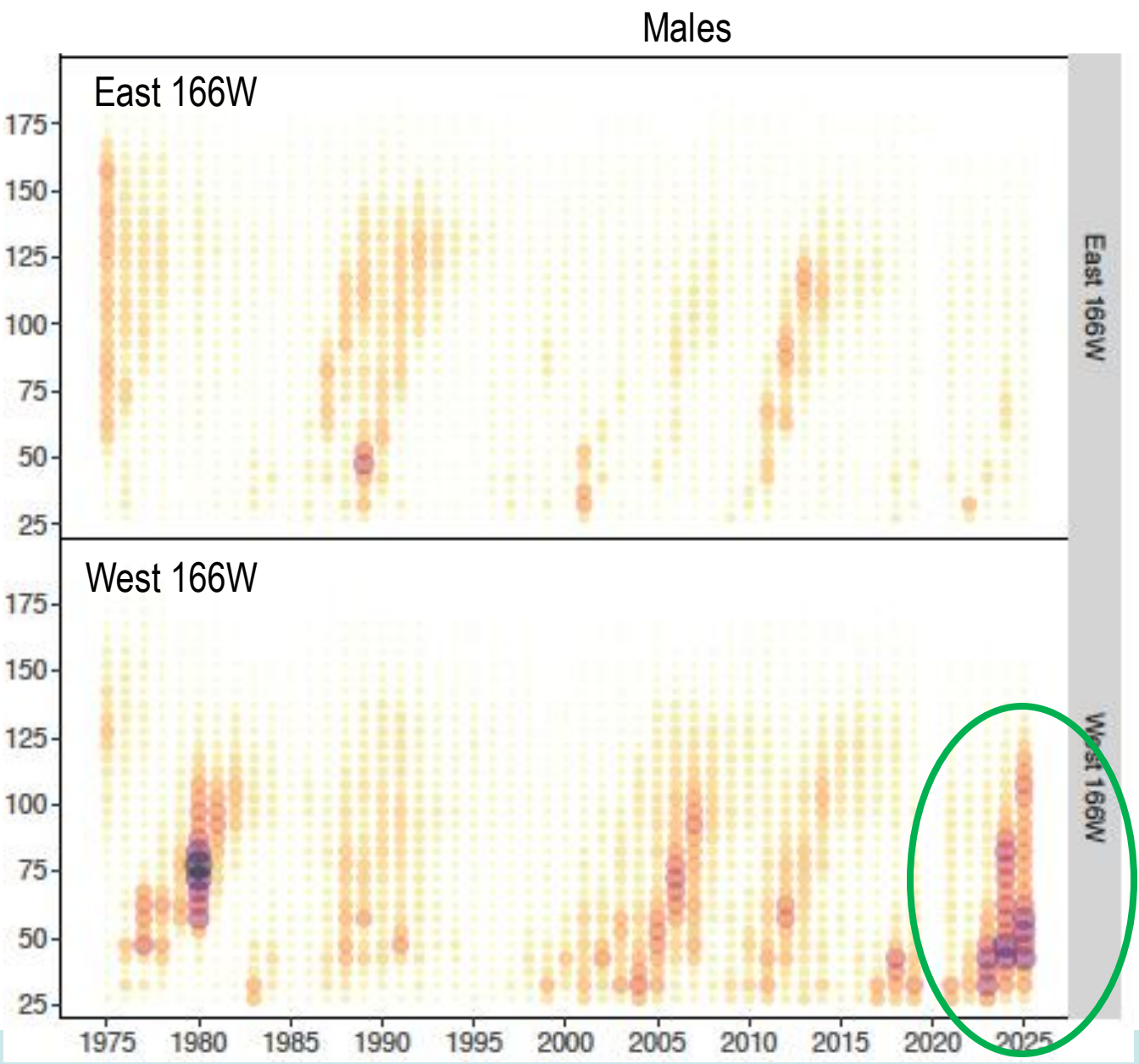


Survey Data By Management Region

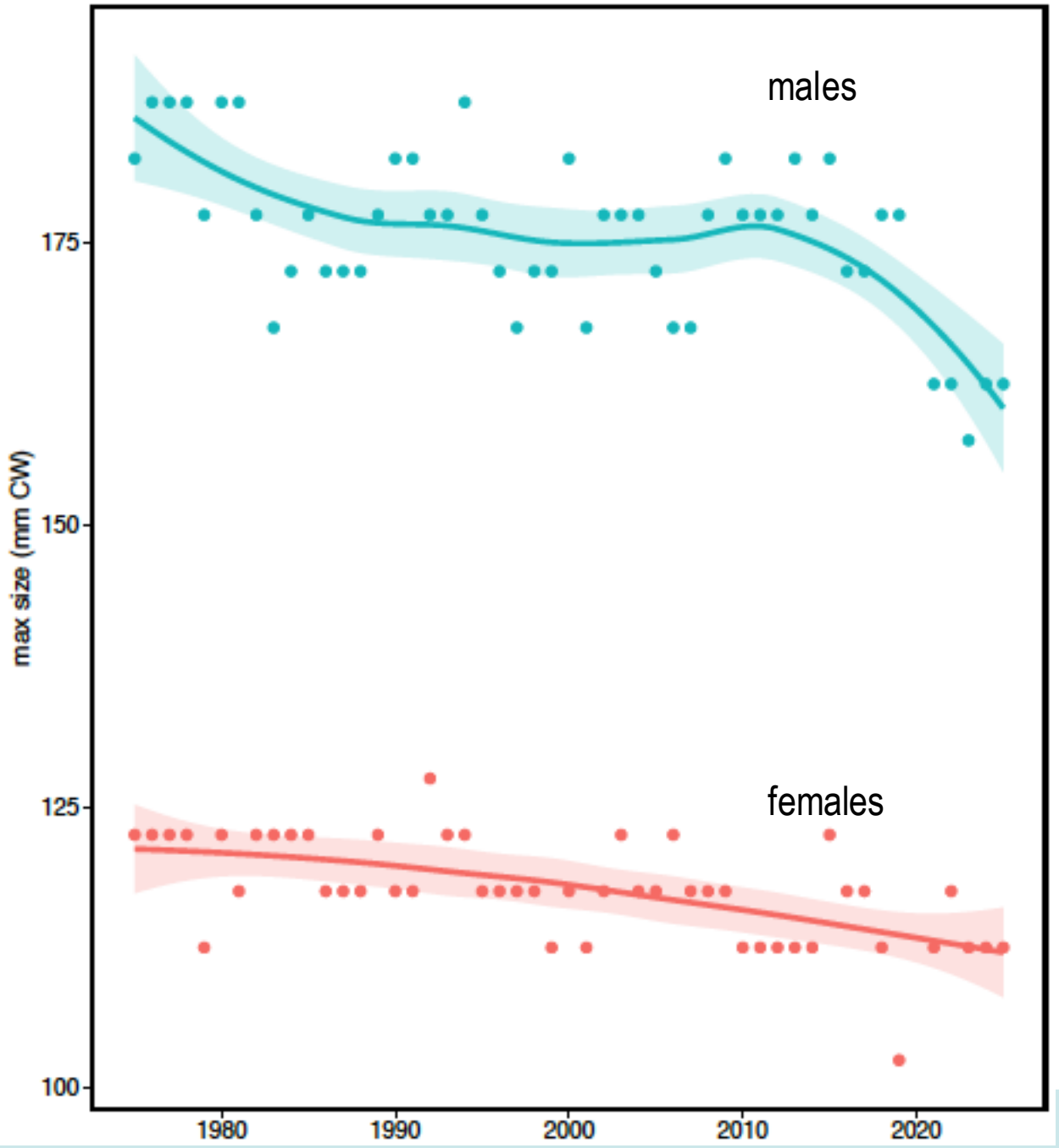


Survey Size Comps





Survey Max Sizes

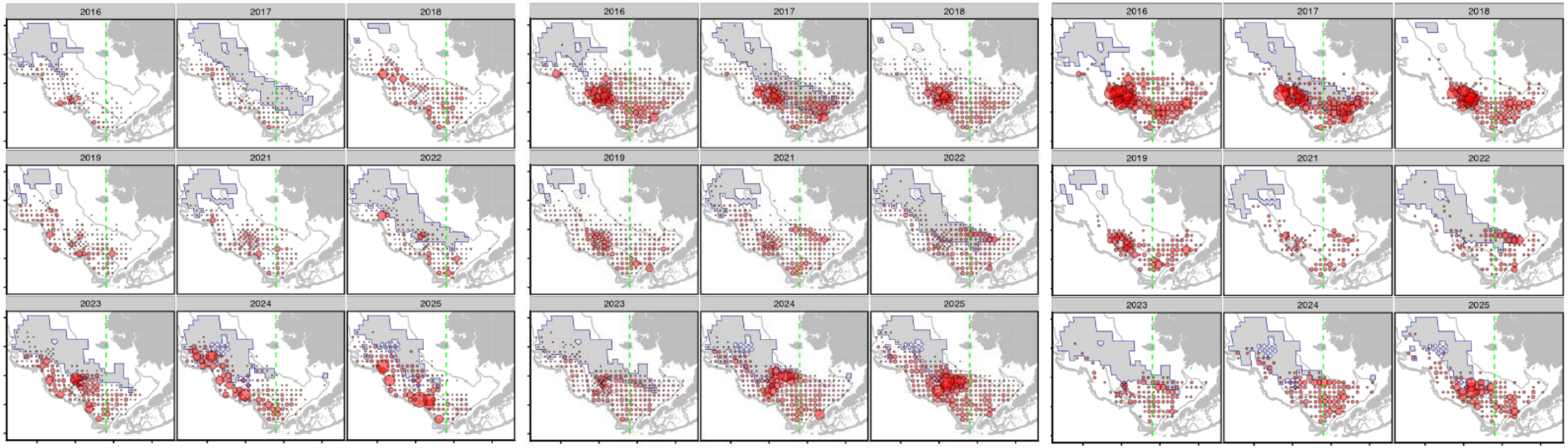


Survey Spatial Patterns

small males (< 60 mm CW)

large males (> 60 mm CW)

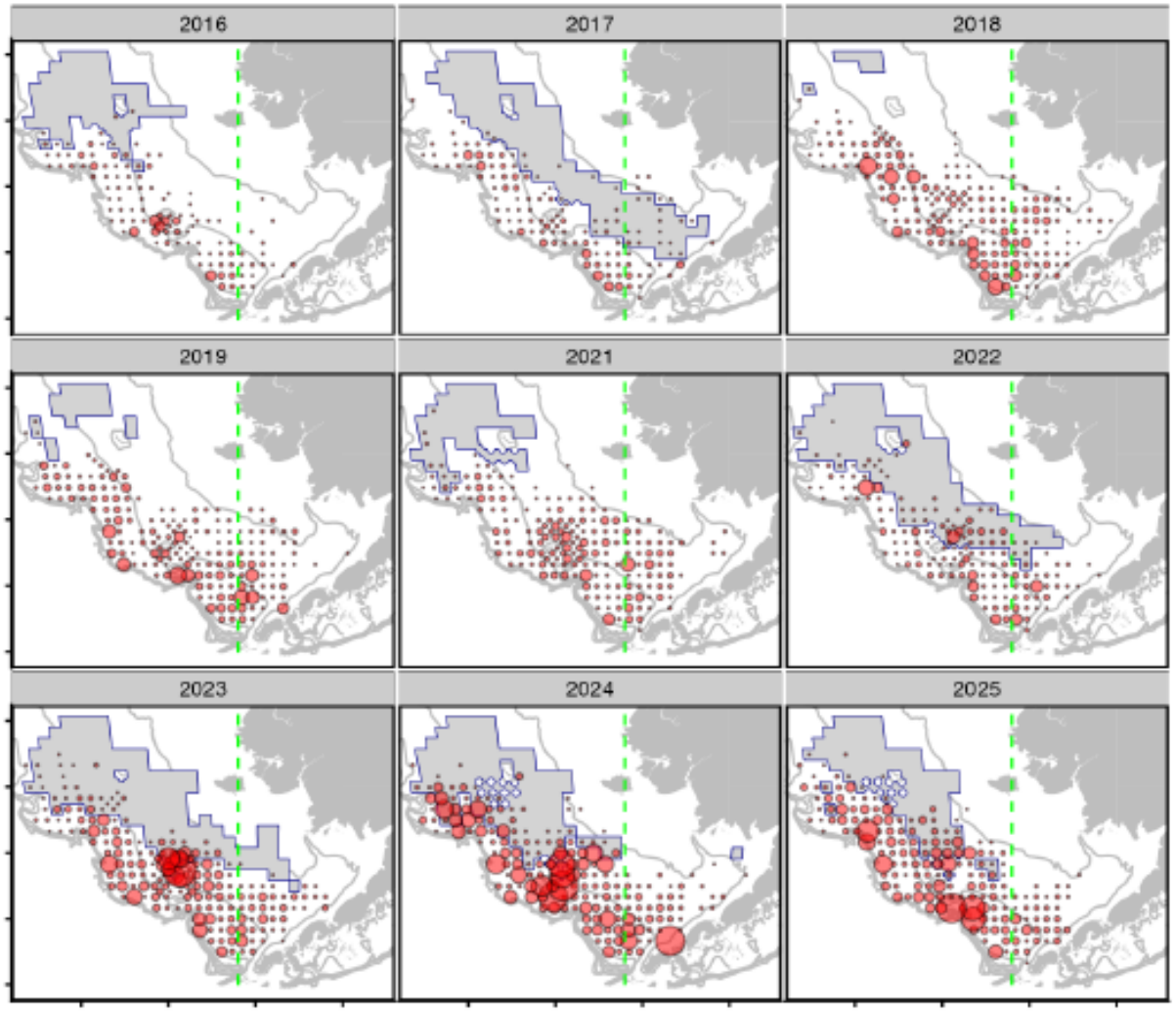
IPMs



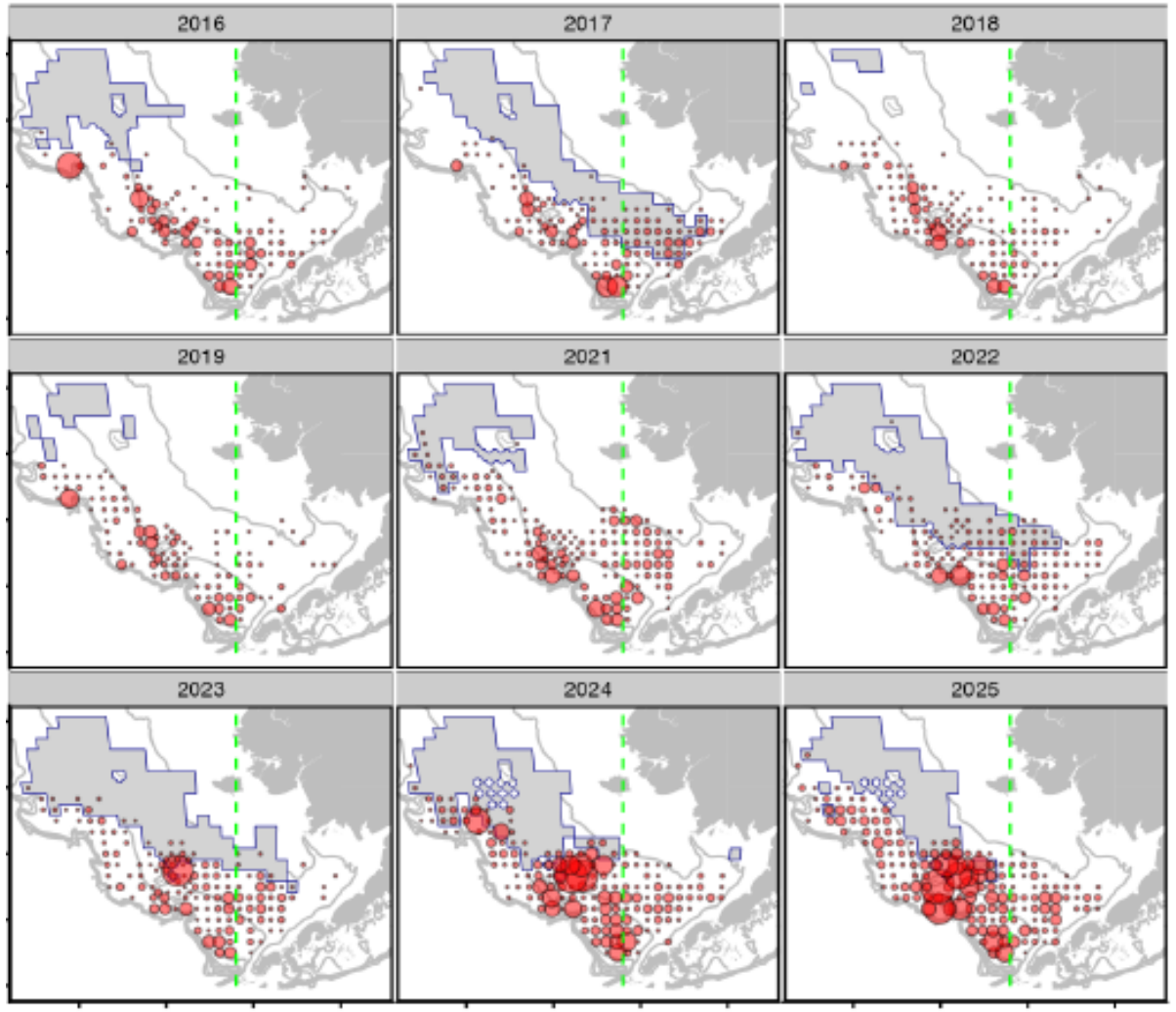
different groups: different scales

Survey Spatial Patterns

immature females

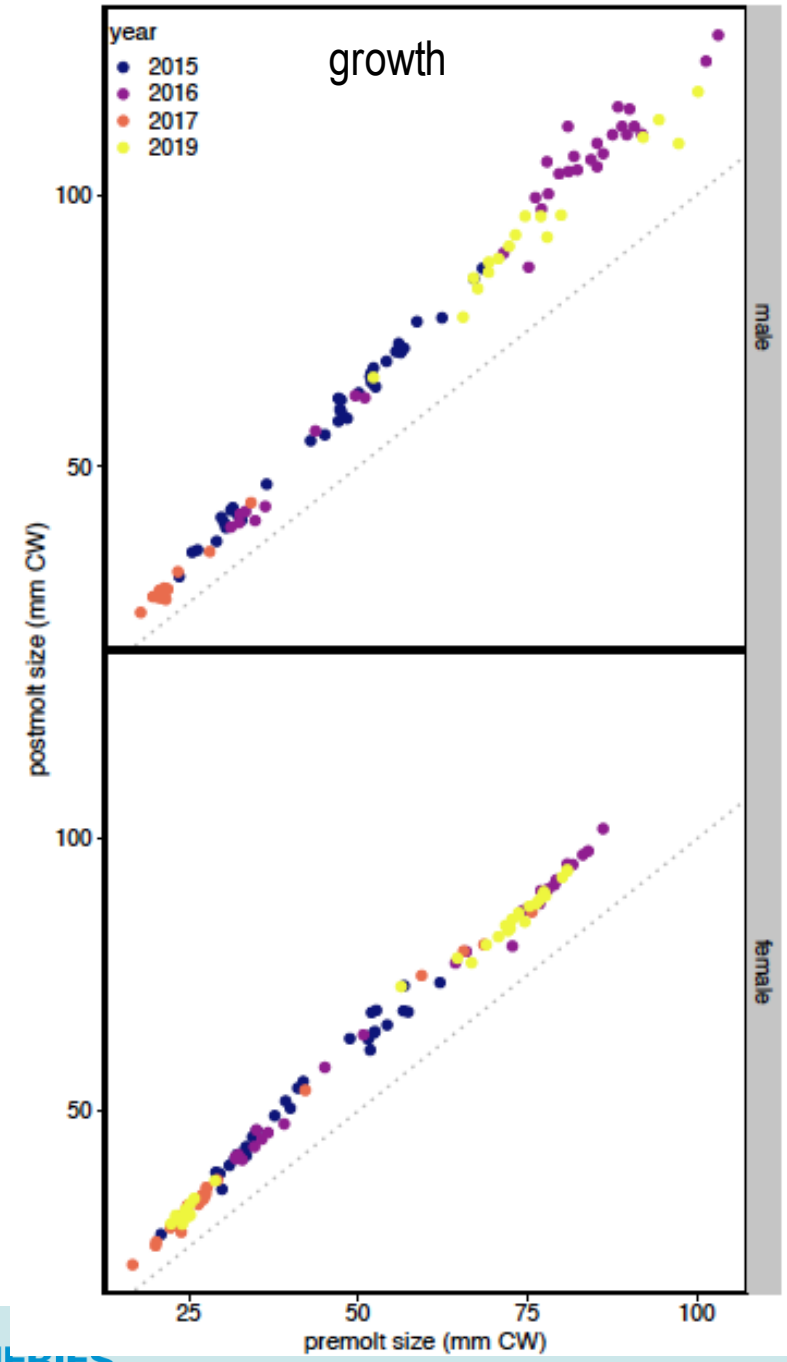


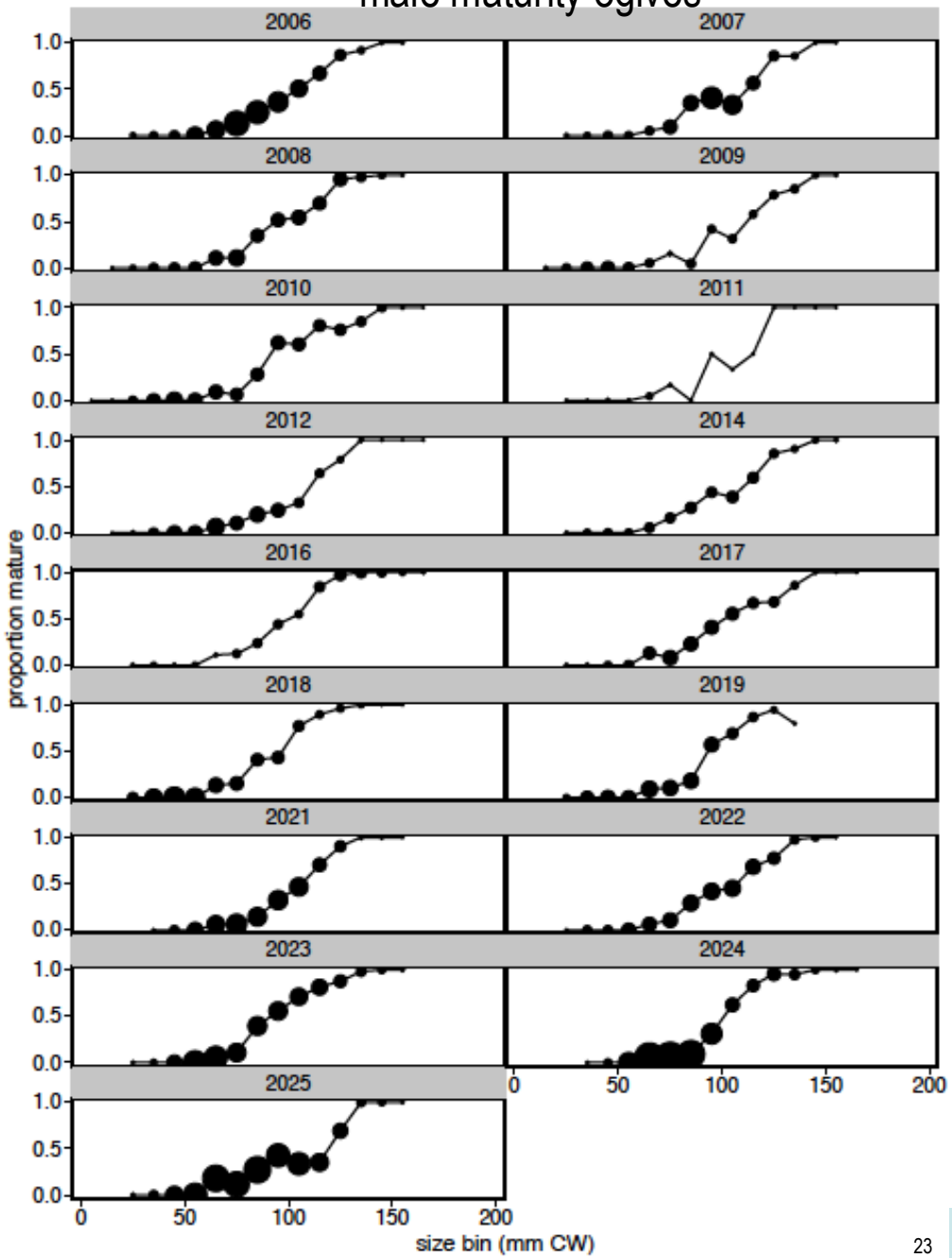
mature females



different groups: different scales

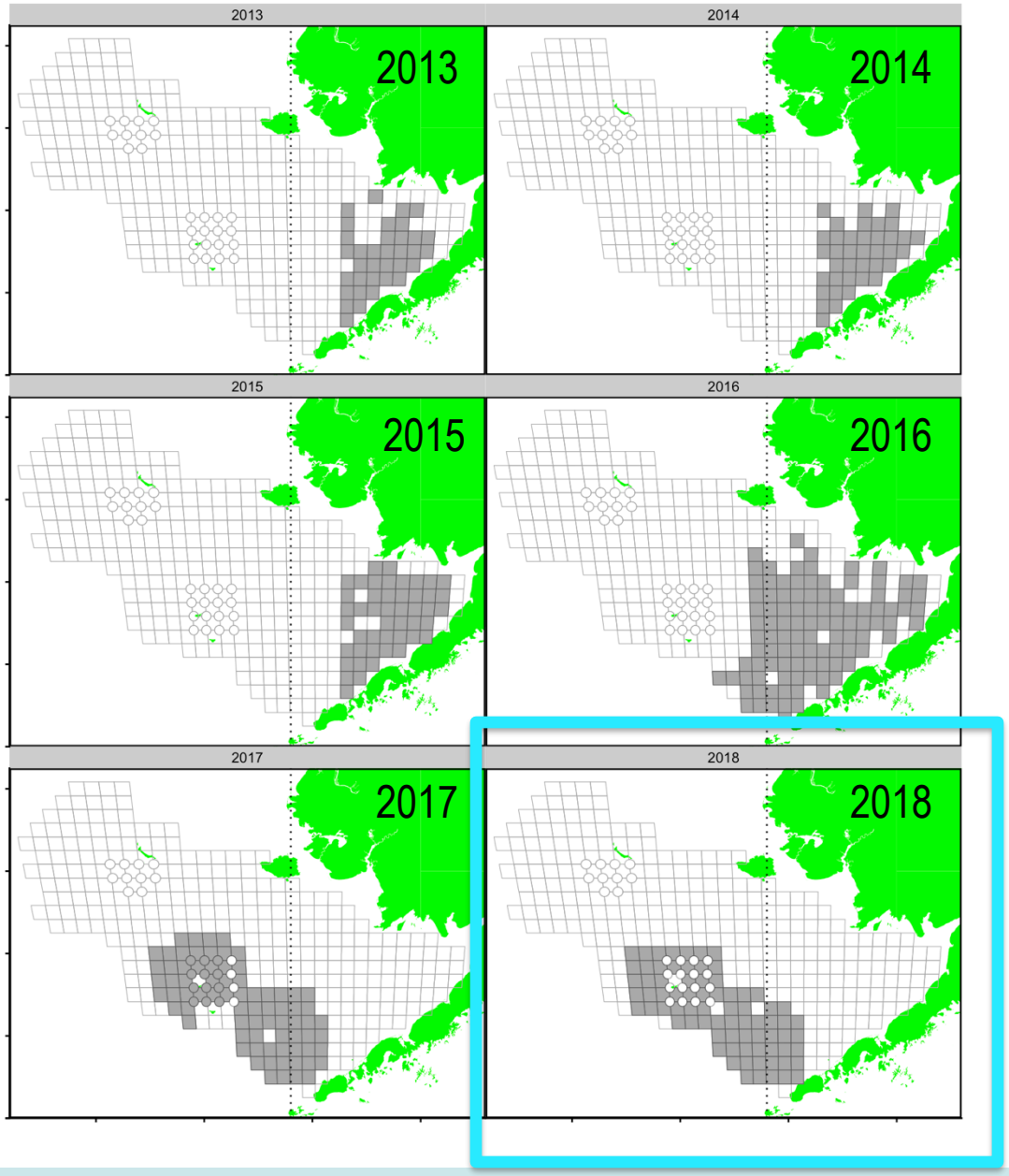
Other Data


growth
year
2015
2016
2017
2019
postmolt size (mm CW)
premolt size (mm CW)
male
female
25
50
75
100


male maturity ogives
2006
2007
2008
2009
2010
2011
2012
2014
2016
2017
2018
2019
2021
2022
2023
2024
2025
proportion mature
size bin (mm CW)
0.0
0.5
1.0
0
50
100
150
200

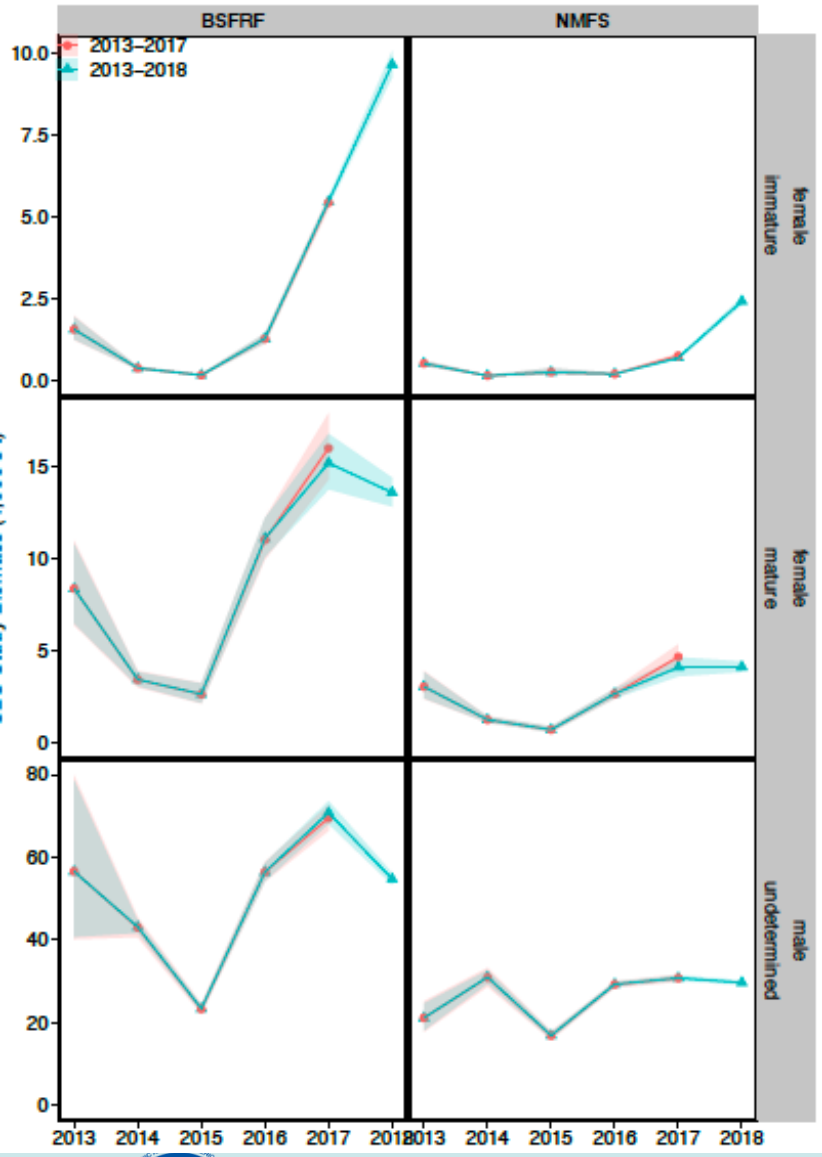
2013-2018 BSFRF SBS Data

- BSFRF-NMFS collaborative studies to estimate NMFS survey selectivity for BBRKC, Tanner crab
- BSFRF nephrops gear assumed to catch all crab in area swept; allows estimates of
  - *absolute* NMFS haul-level selectivity
- Scale up to NMFS survey-level selectivity by
  - estimating year-specific ***availability***
- **NEW for 2024:**
  - 2018 biomass indices and size comps added
  - 2013-2017 dataset slightly revised
  - smooth curves for ***availability*** re-evaluated

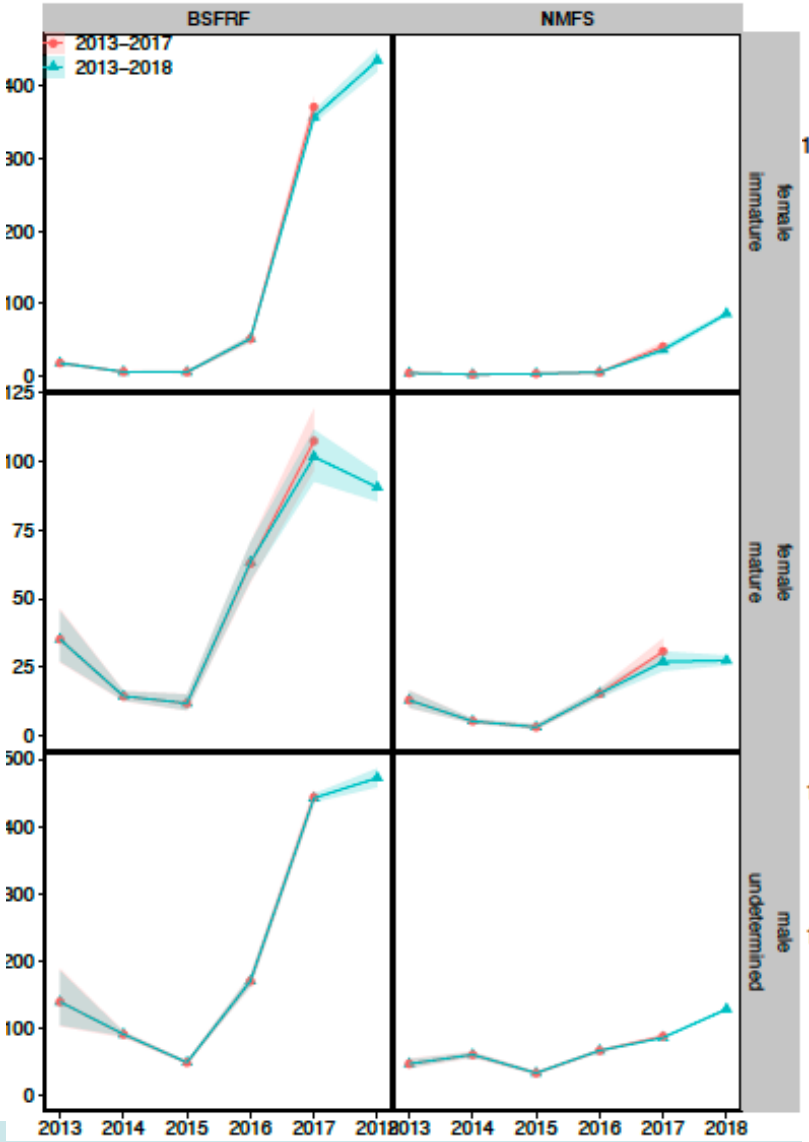


BSFRF data

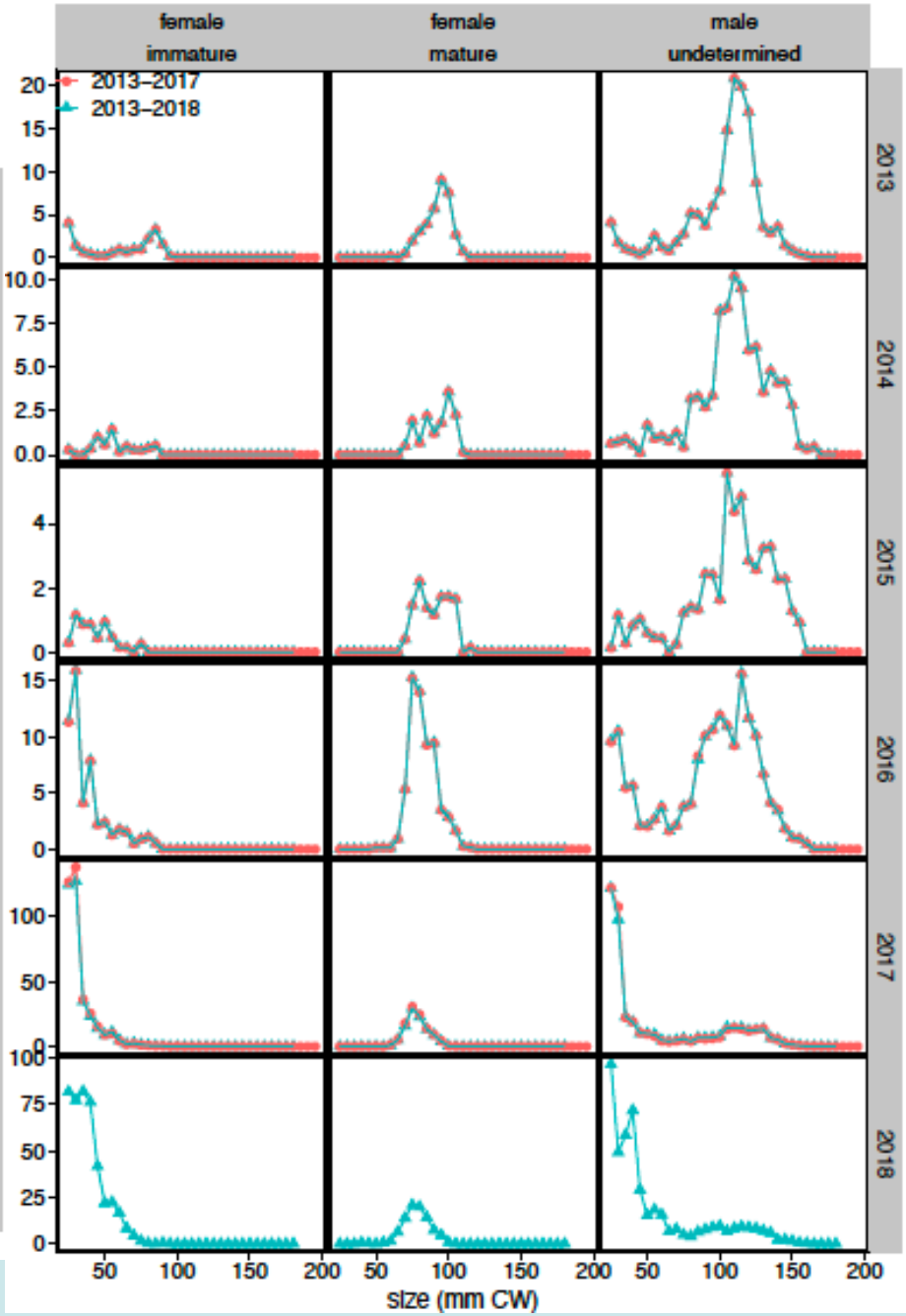
biomass



abundance



size comps



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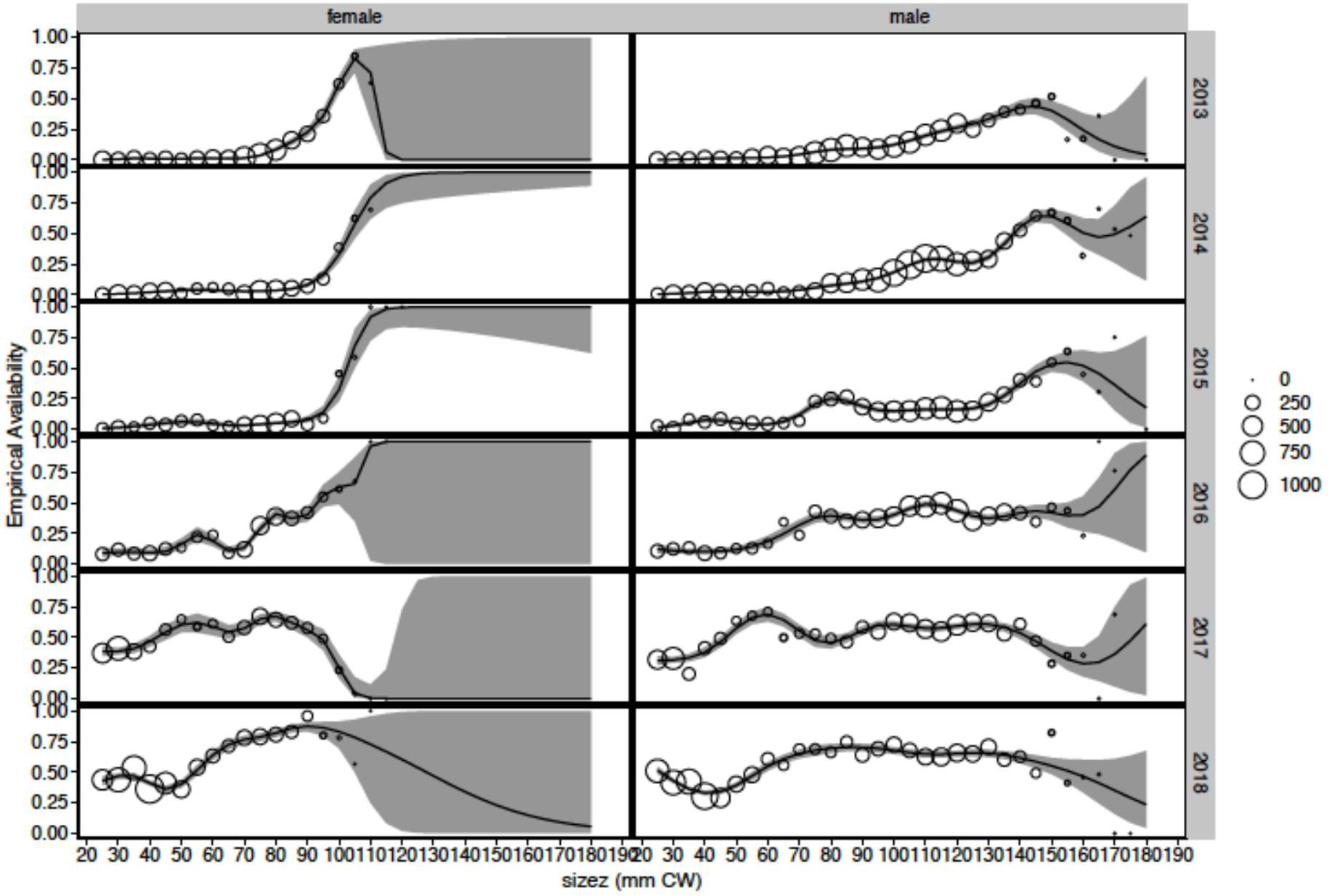
Empirical Availability

$$A_x(z) = \frac{N_x^a(z)}{N_x^t(z)} \quad \frac{\text{BSFRF}}{\text{TOTAL}}$$

$$\frac{log(A_{y,z})}{log(1 - A_{y,z})} = c_y + s(z, by = y)$$

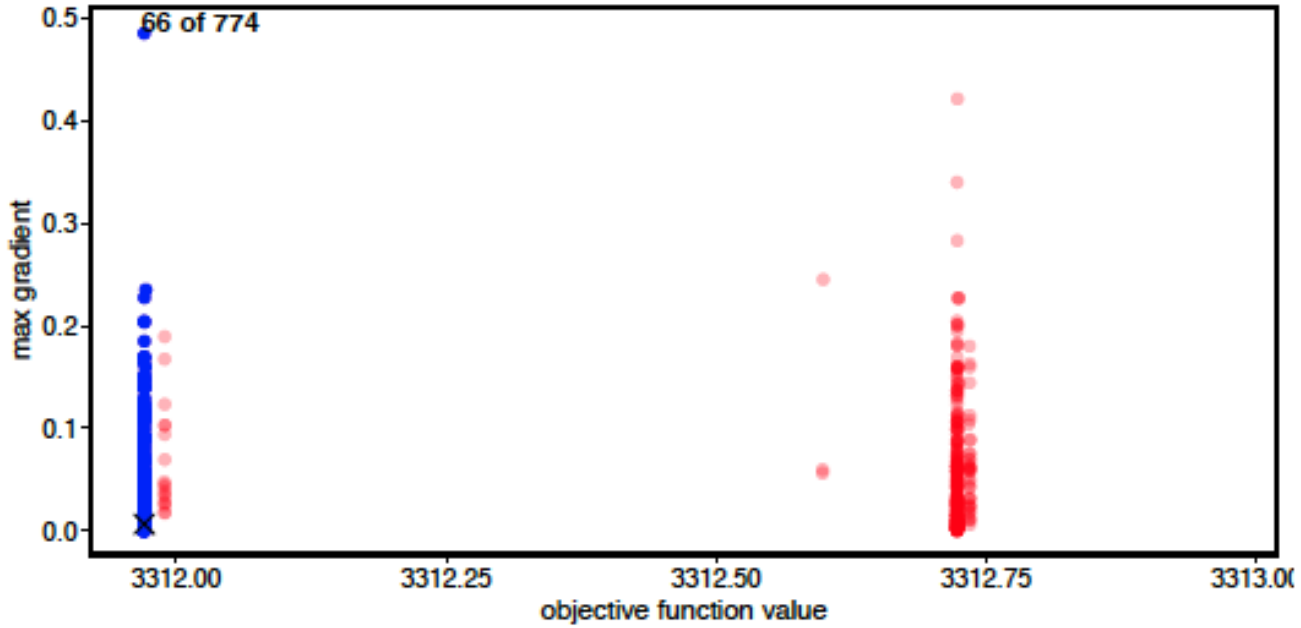
- weighted by number of crab

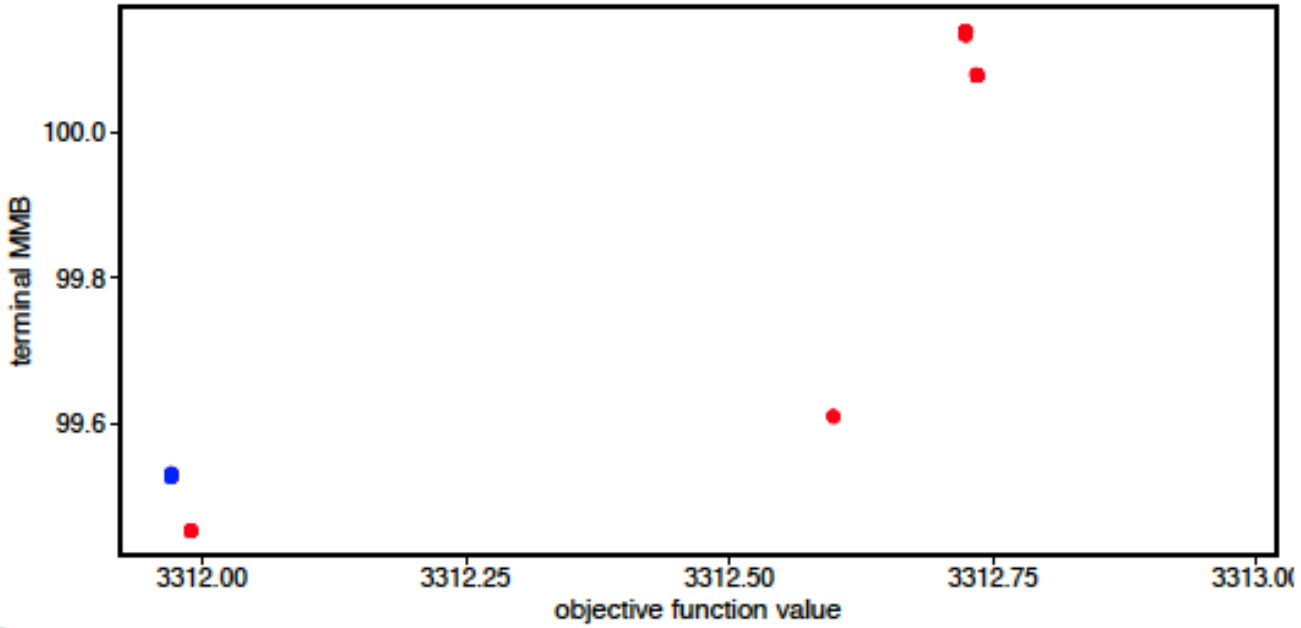


Model Evaluation

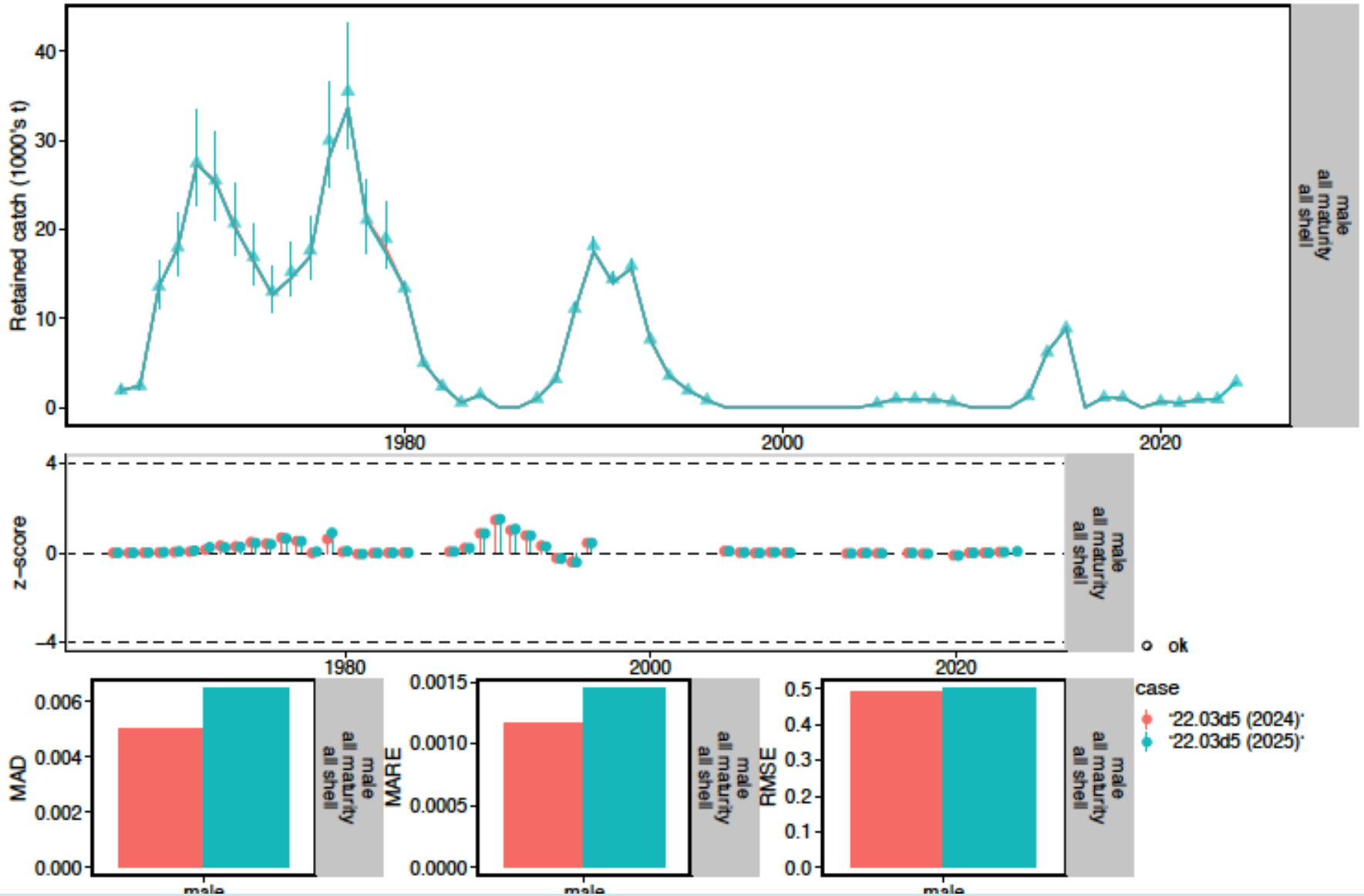
Model Convergence: 22.03d5

- 66 out of 800 jitter runs converged to MLE
- final max. gradient at MLE: 0.0000
- no parameters at bounds

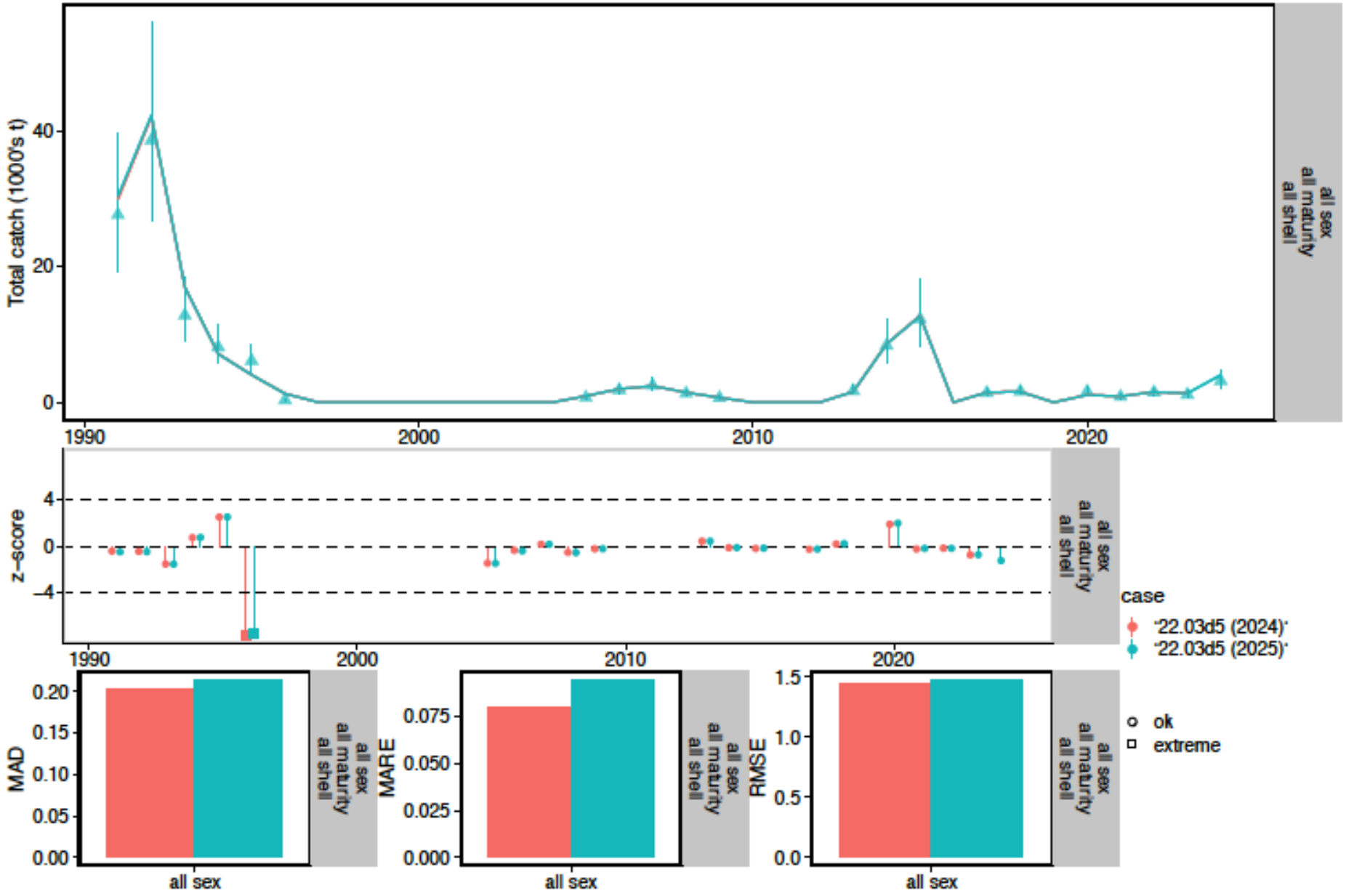




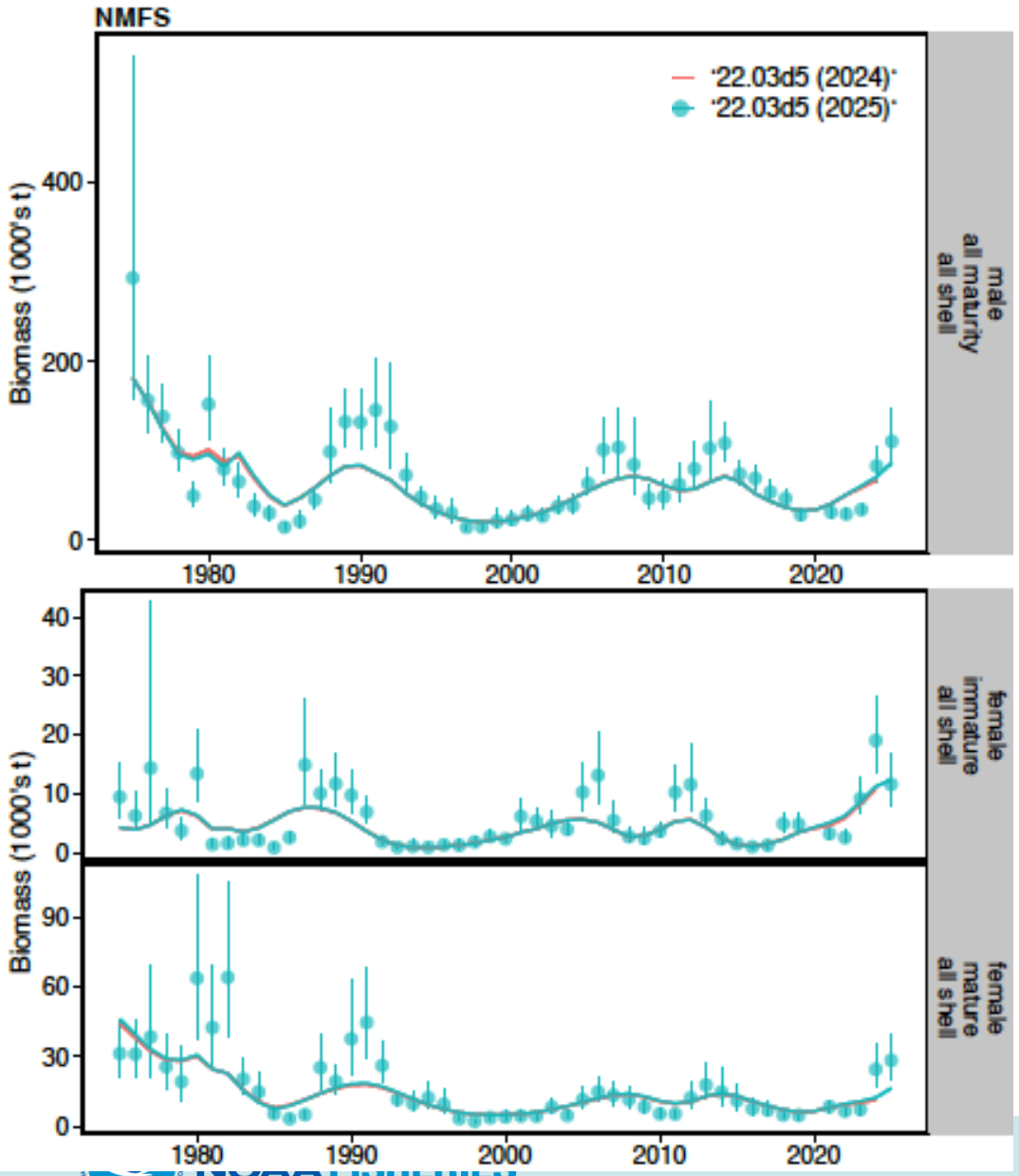
Fits to Retained Catch in Directed Fishery

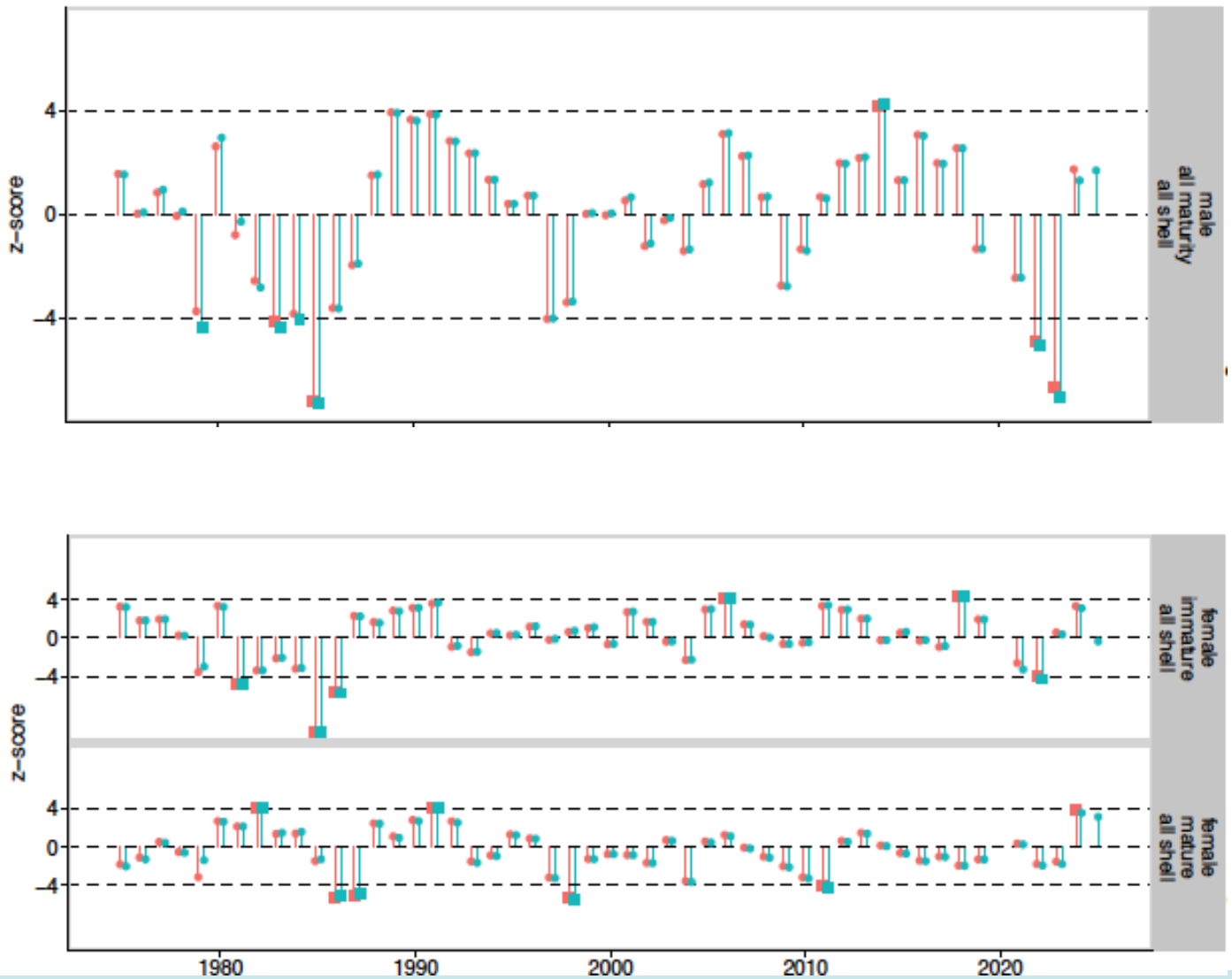


Fits to Total Catch in Directed Fishery

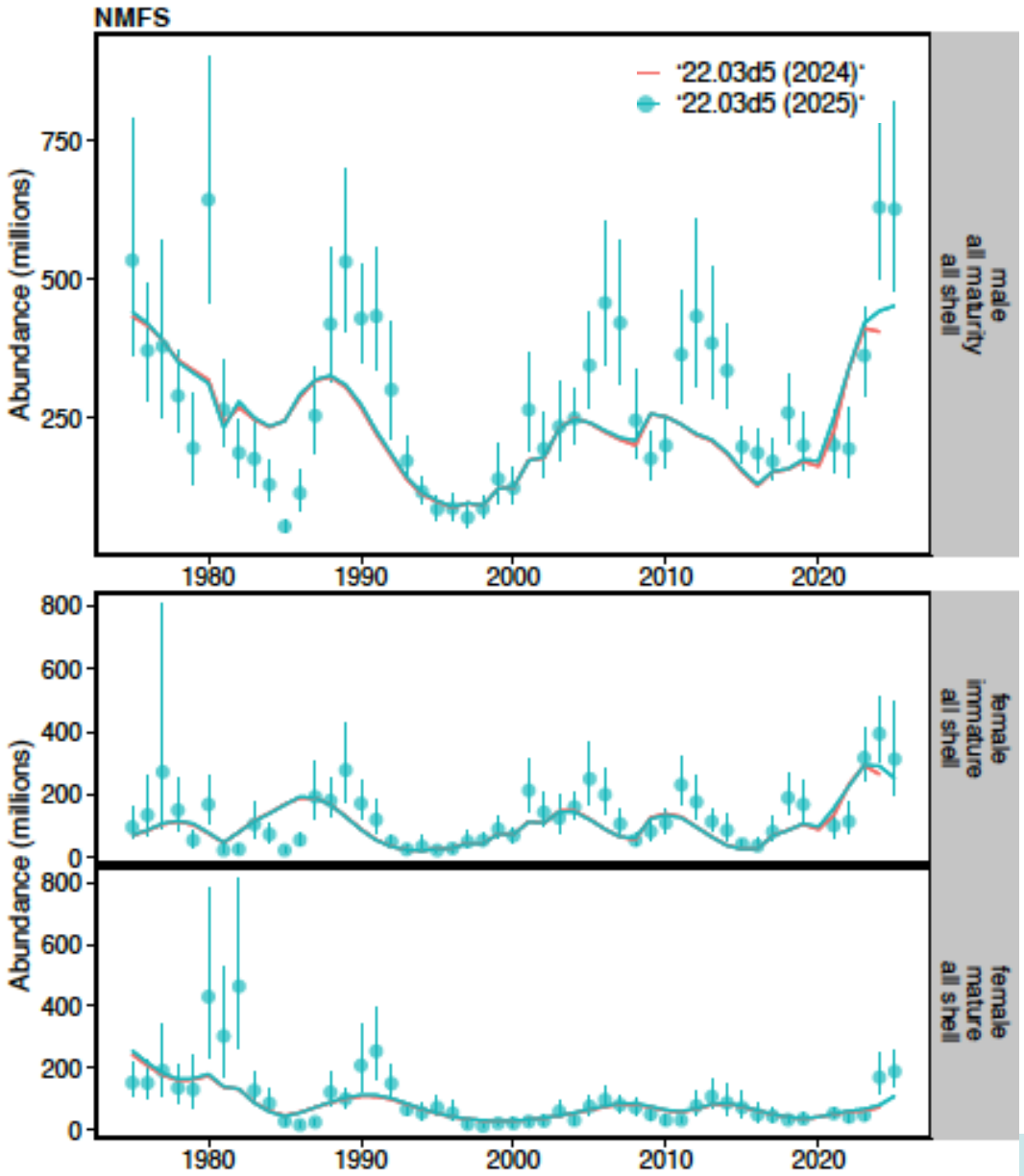


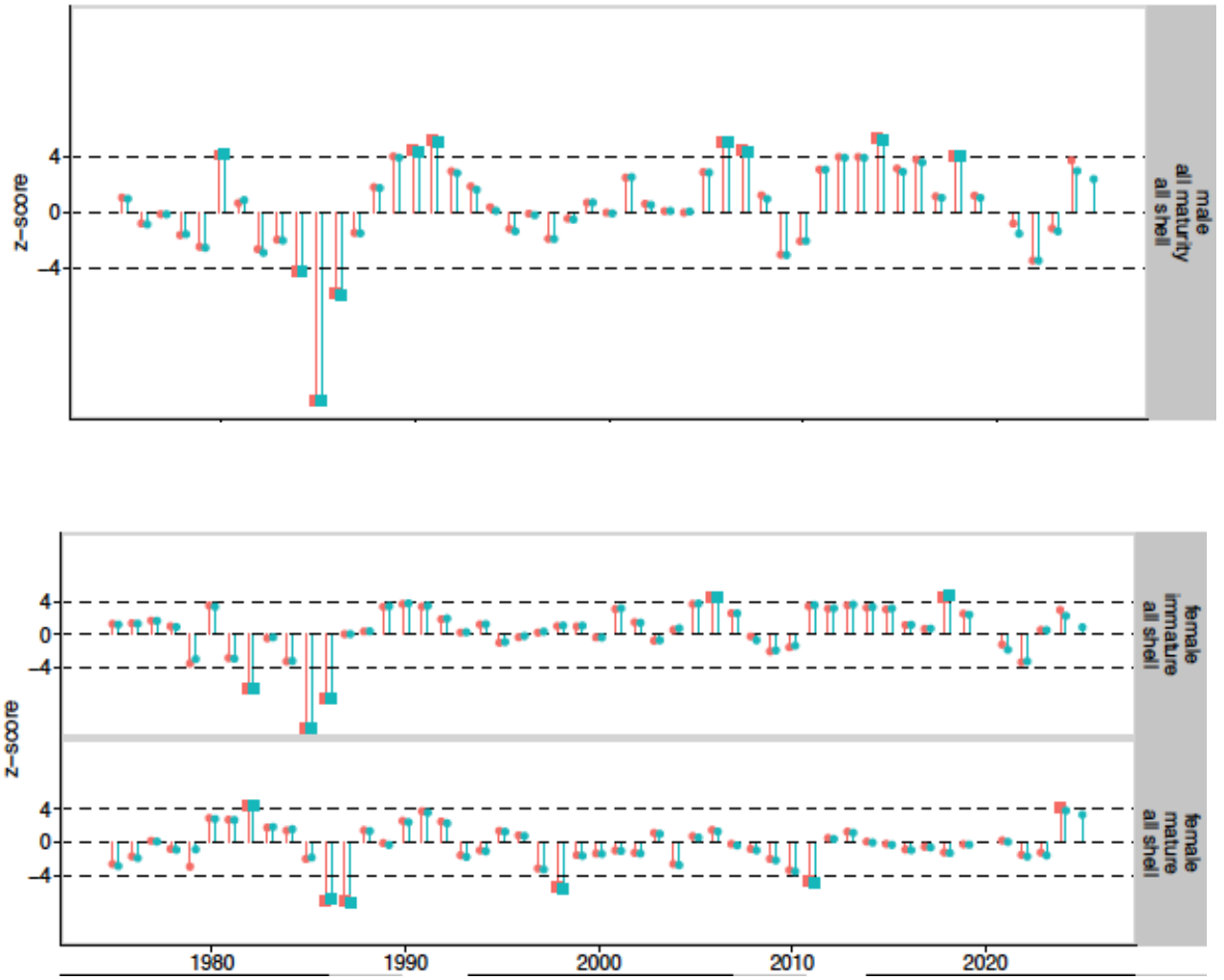
Fits to NMFS Survey Biomass





“Fits” to NMFS Survey Abundance





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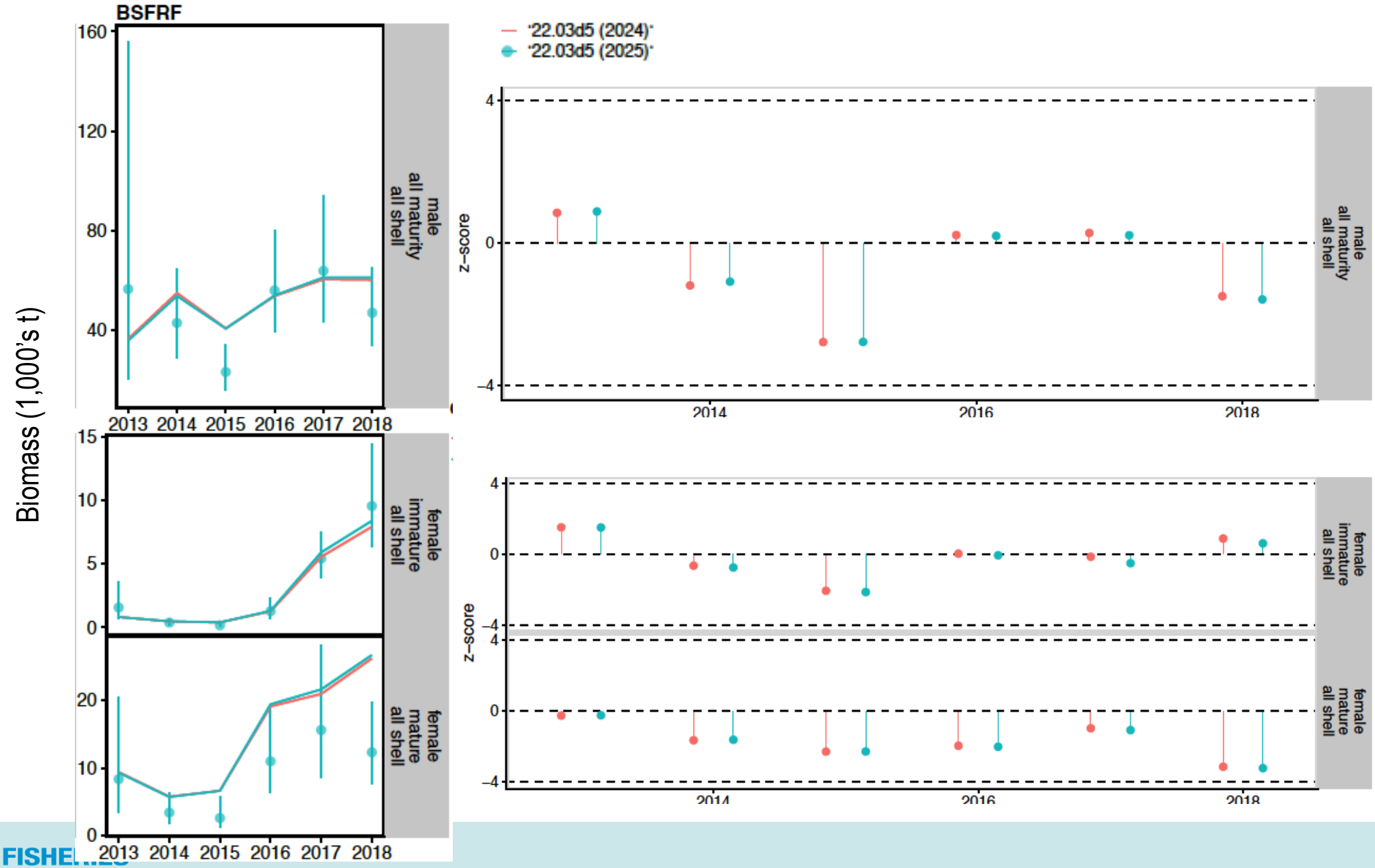
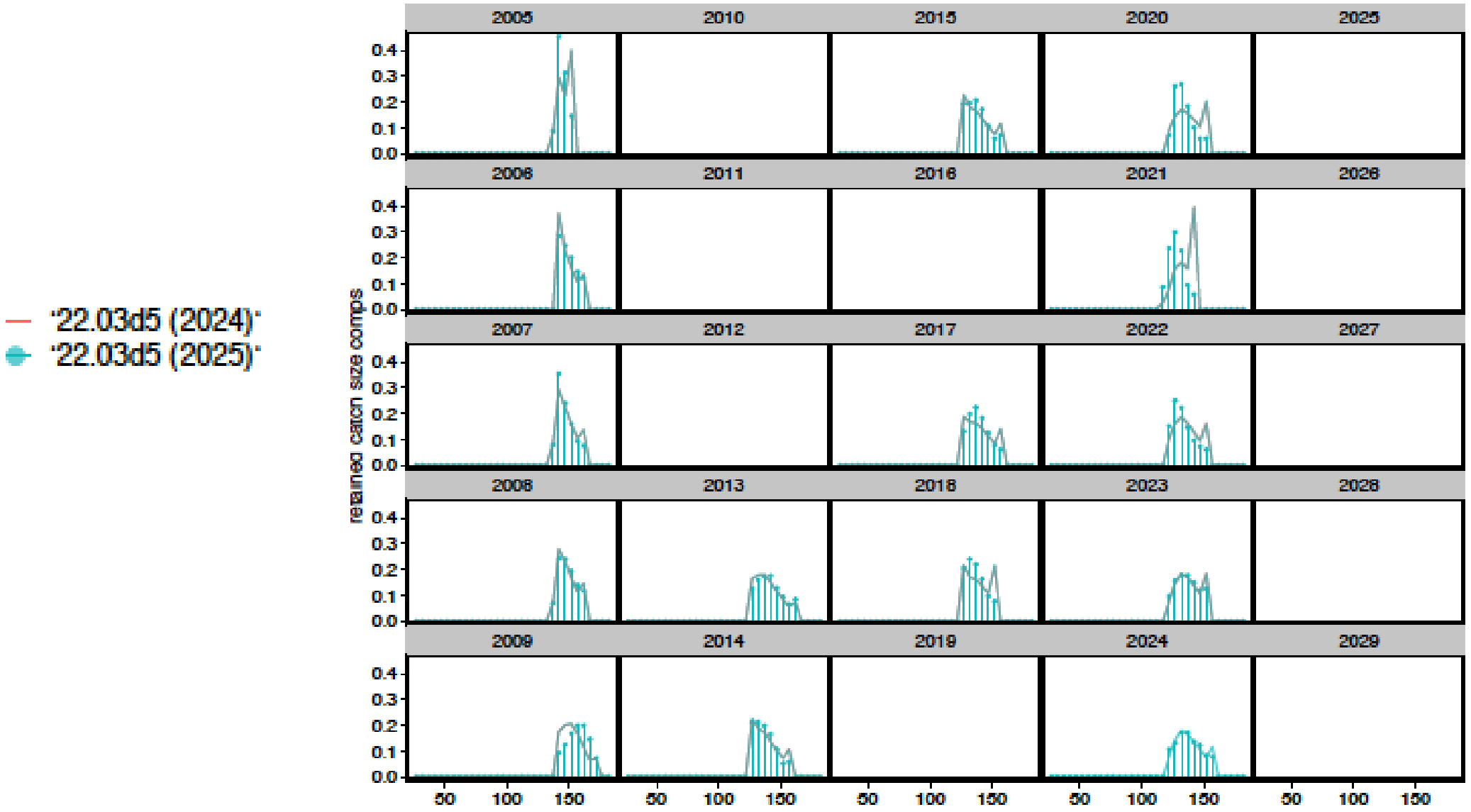
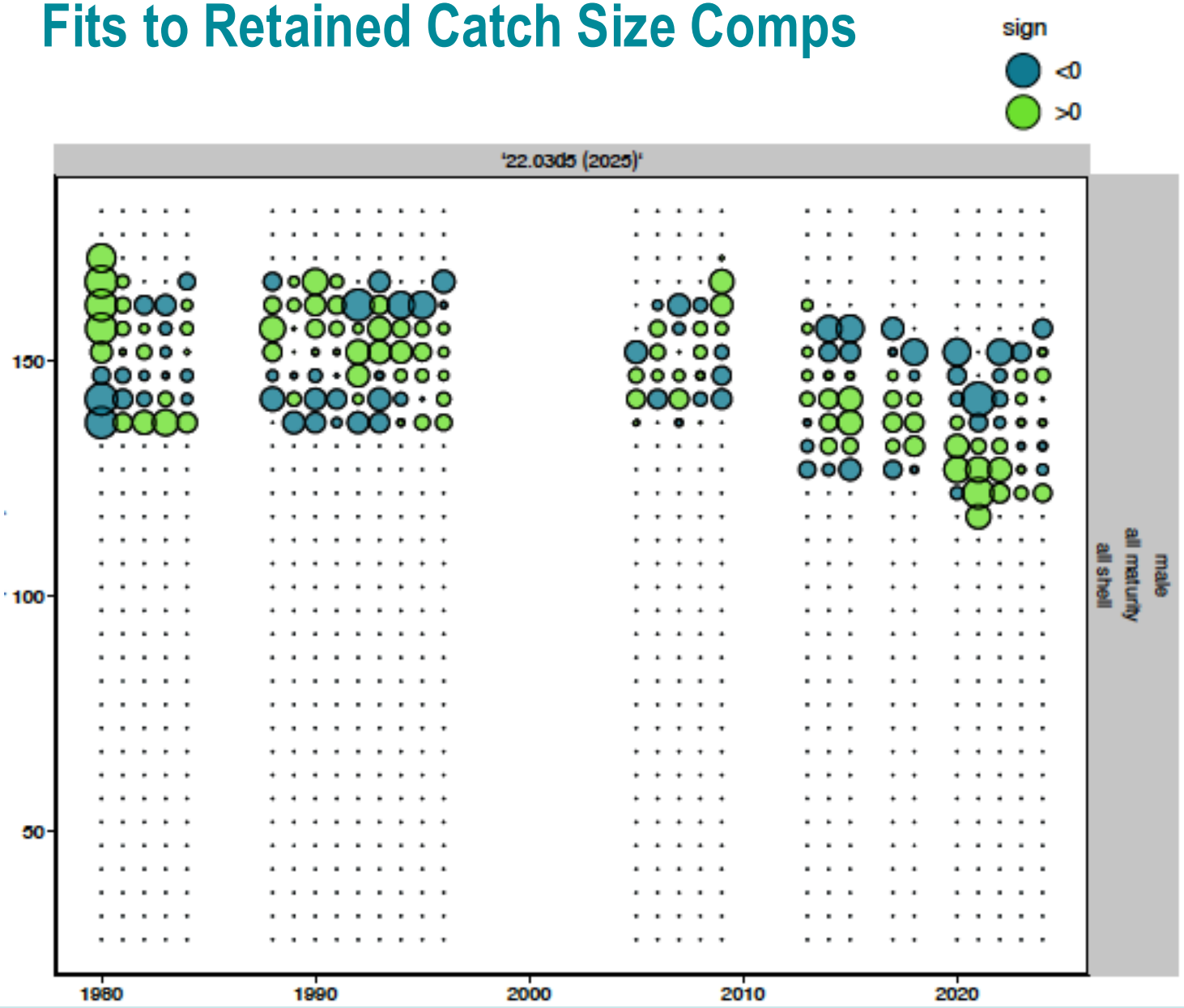
Fits to BSFRF Biomass Indices

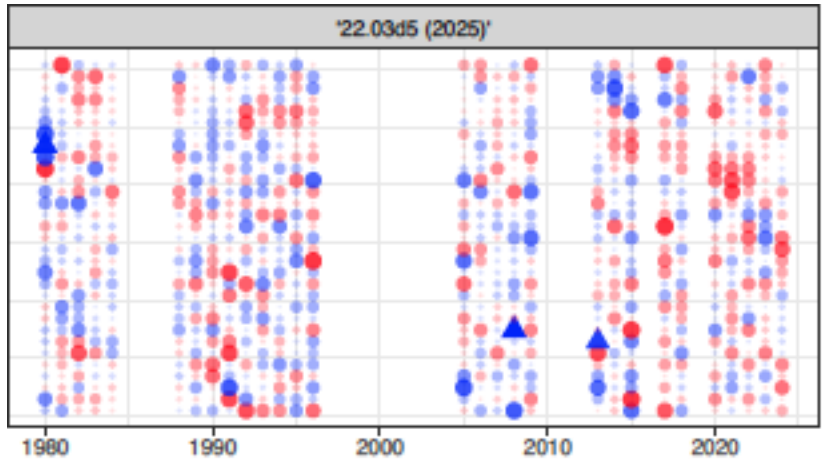


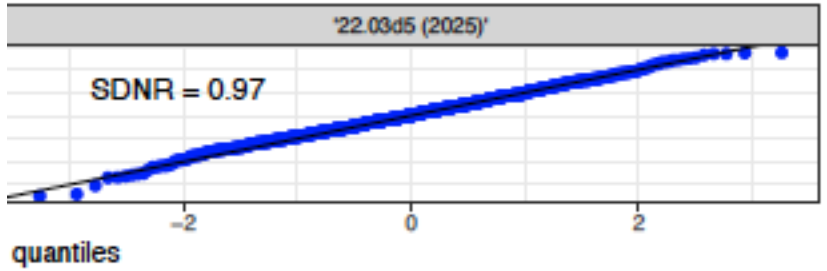
Fits to Retained Catch Size Comps

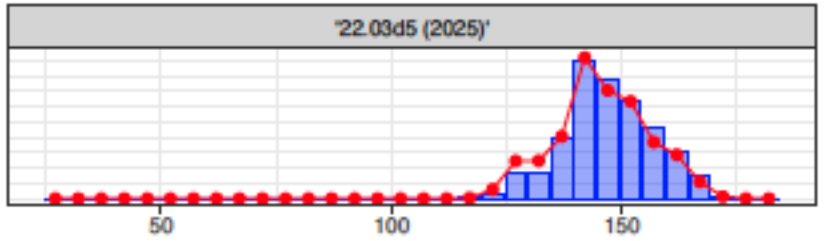


Fits to Retained Catch Size Comps

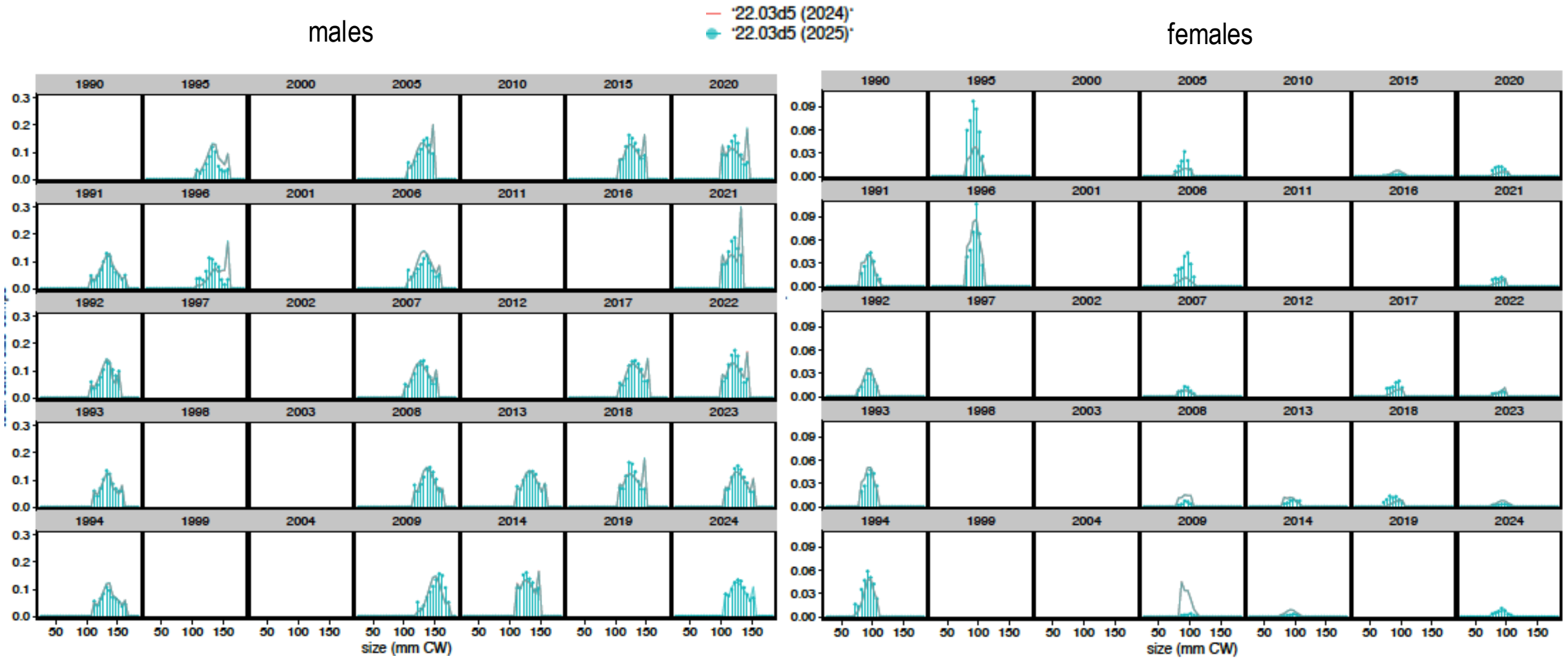




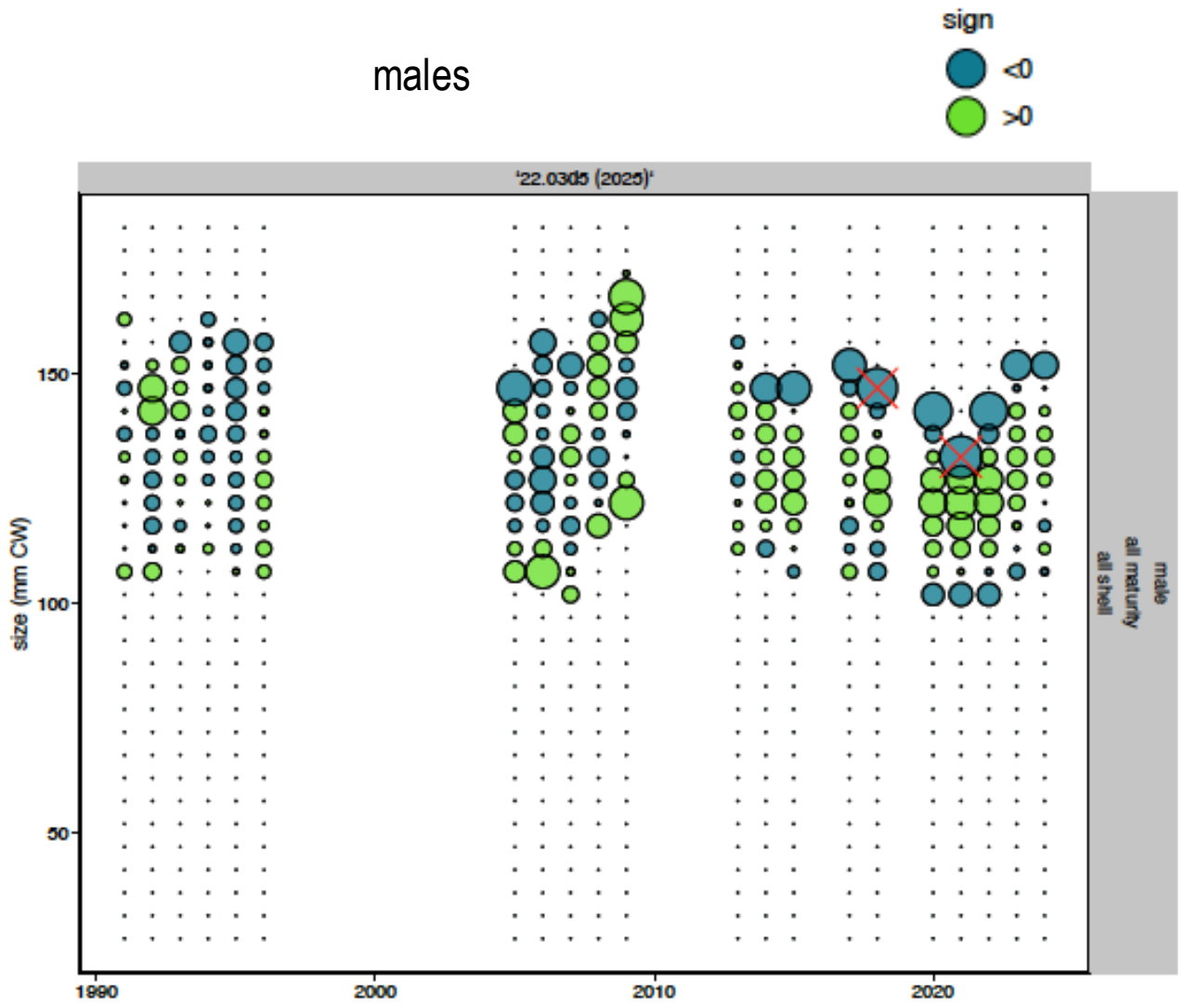


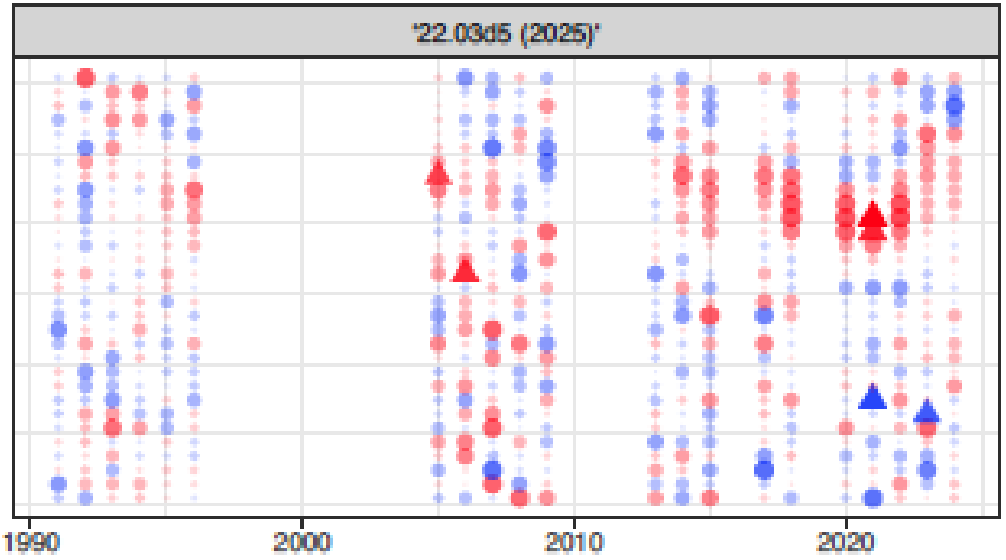


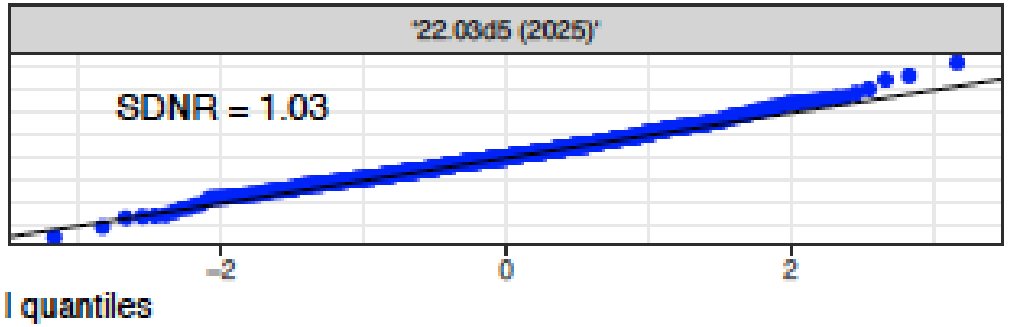
Fits to Directed Fishery Total Catch Size Comps



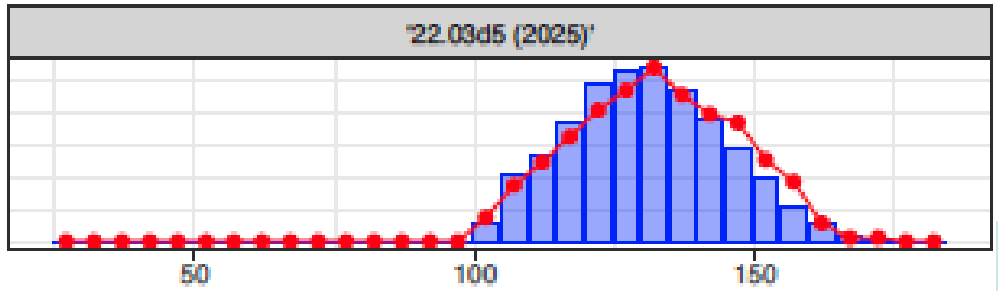
Residuals to Directed Fishery Total Catch Size Comps





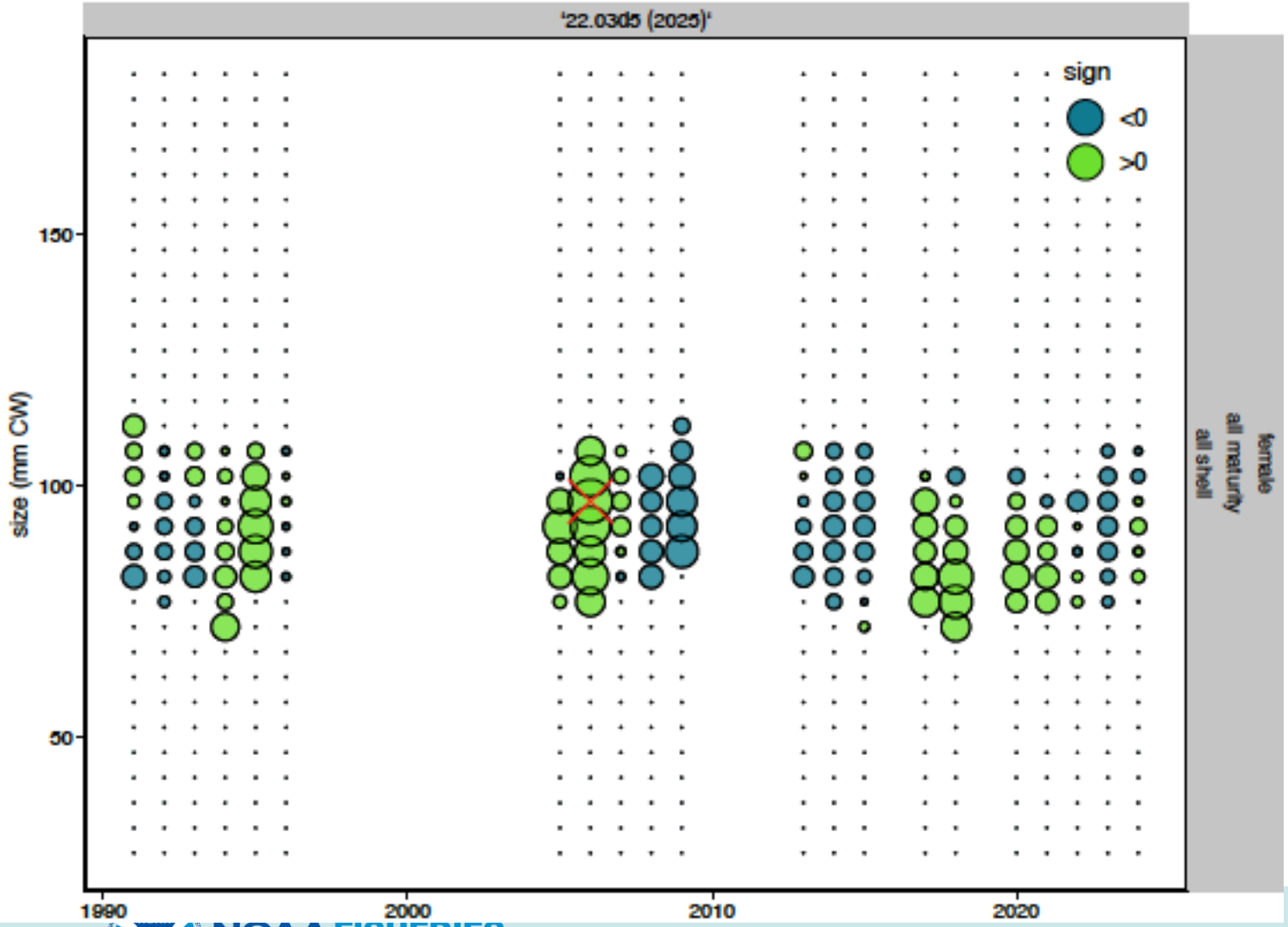


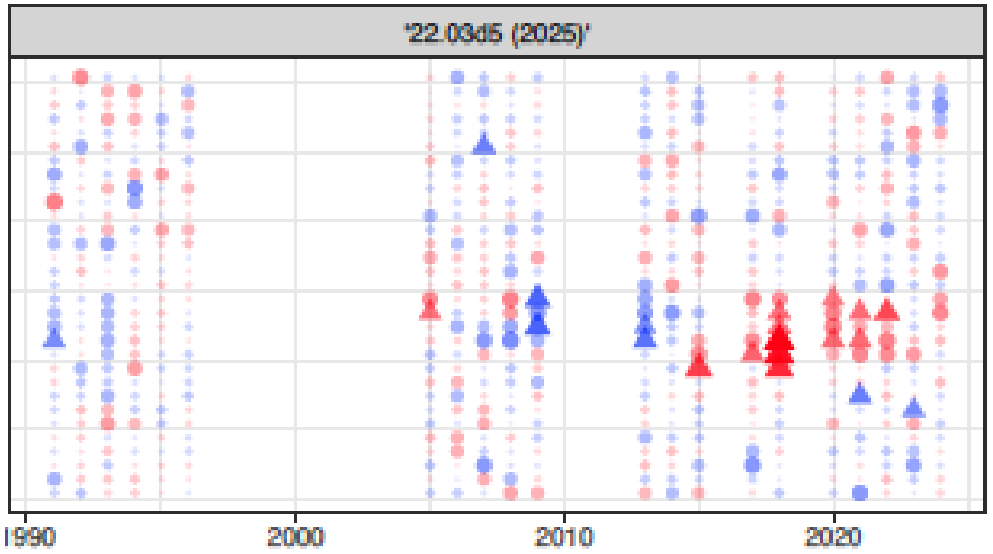
l quantiles

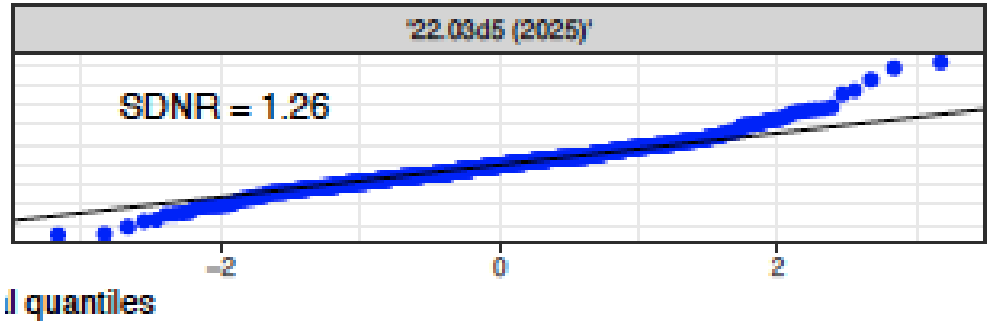


Residuals to Directed Fishery Total Catch Size Comps

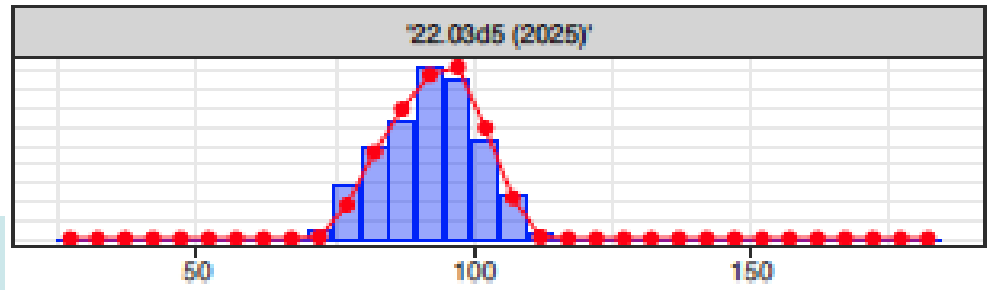
females



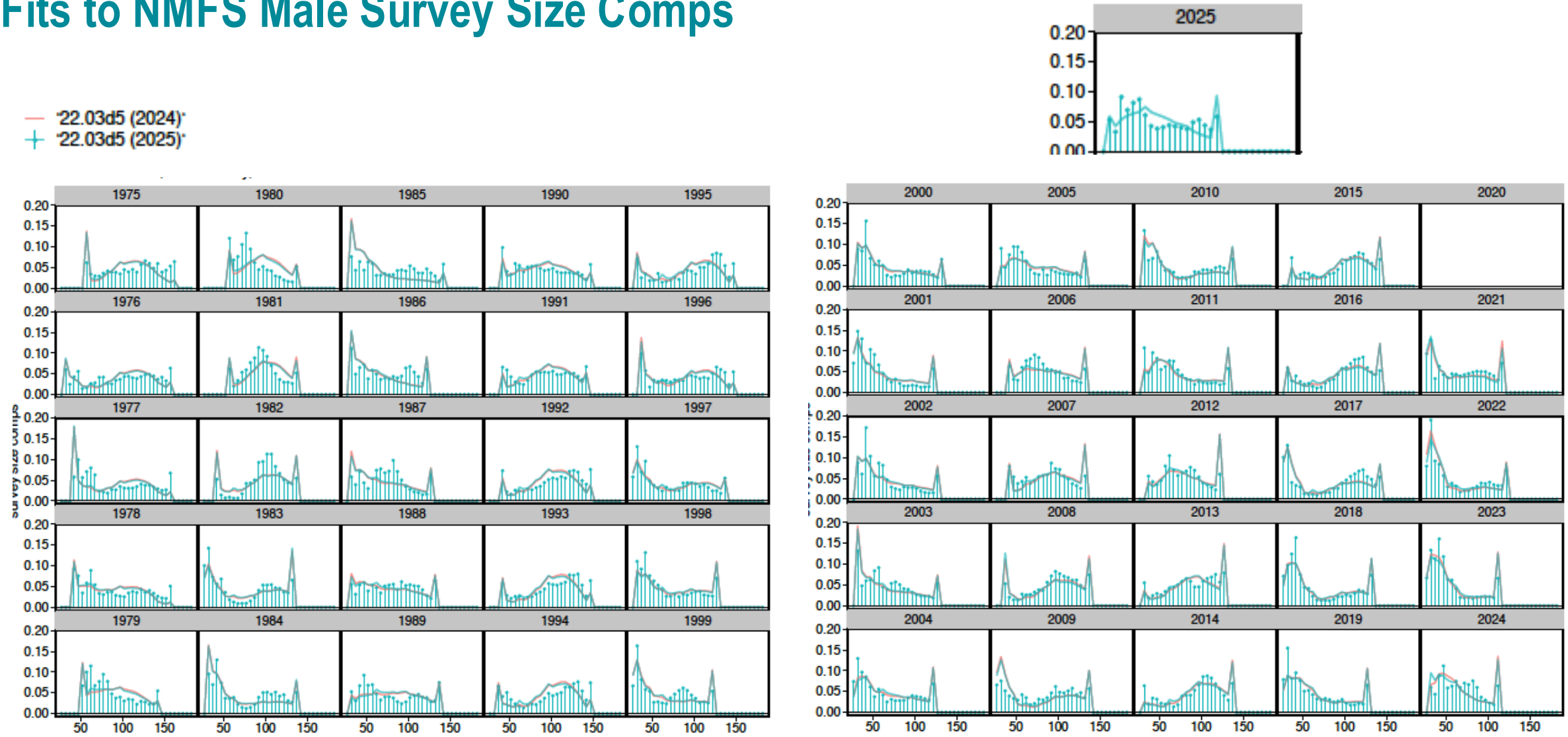




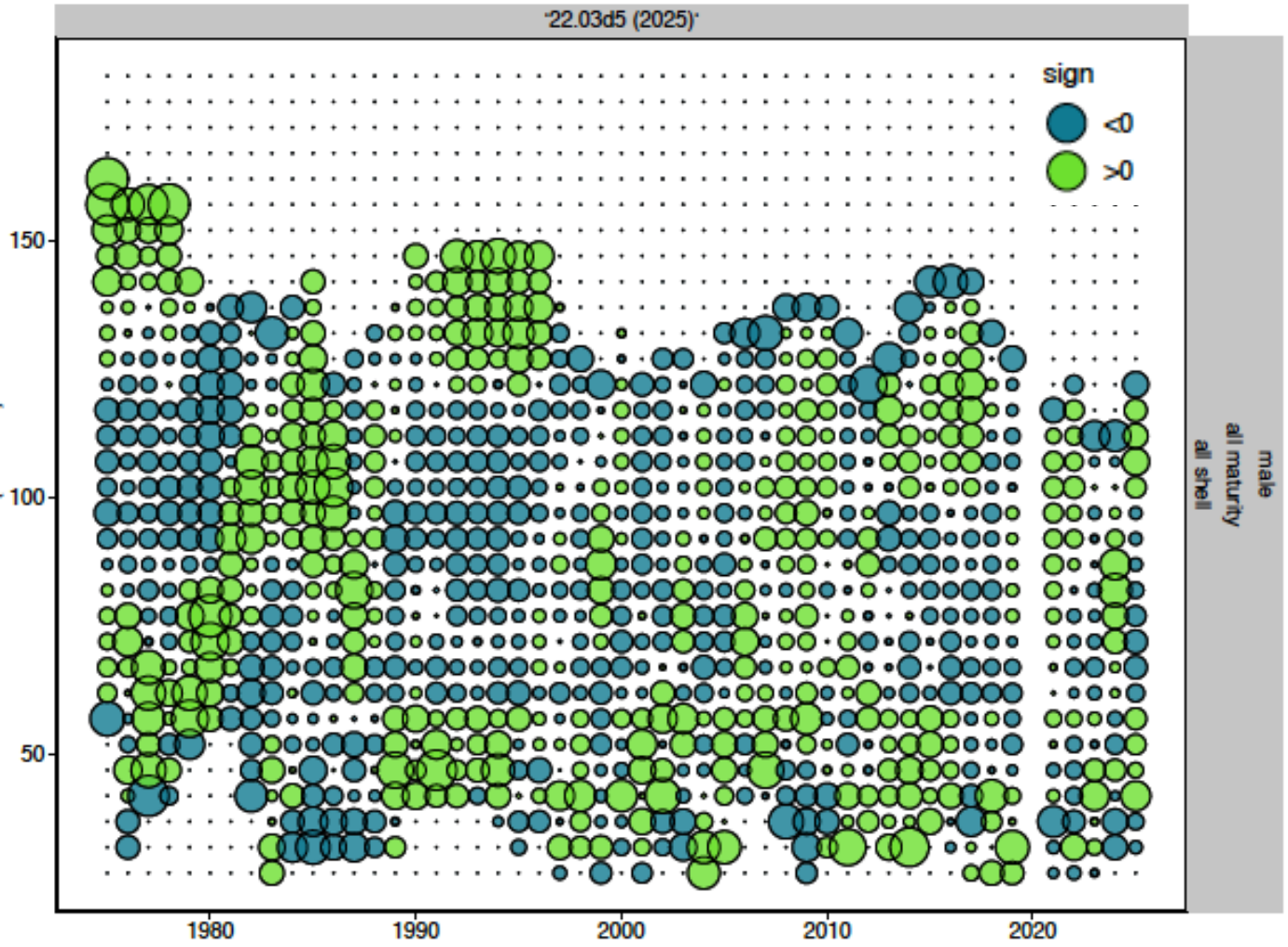
l quantiles



Fits to NMFS Male Survey Size Comps

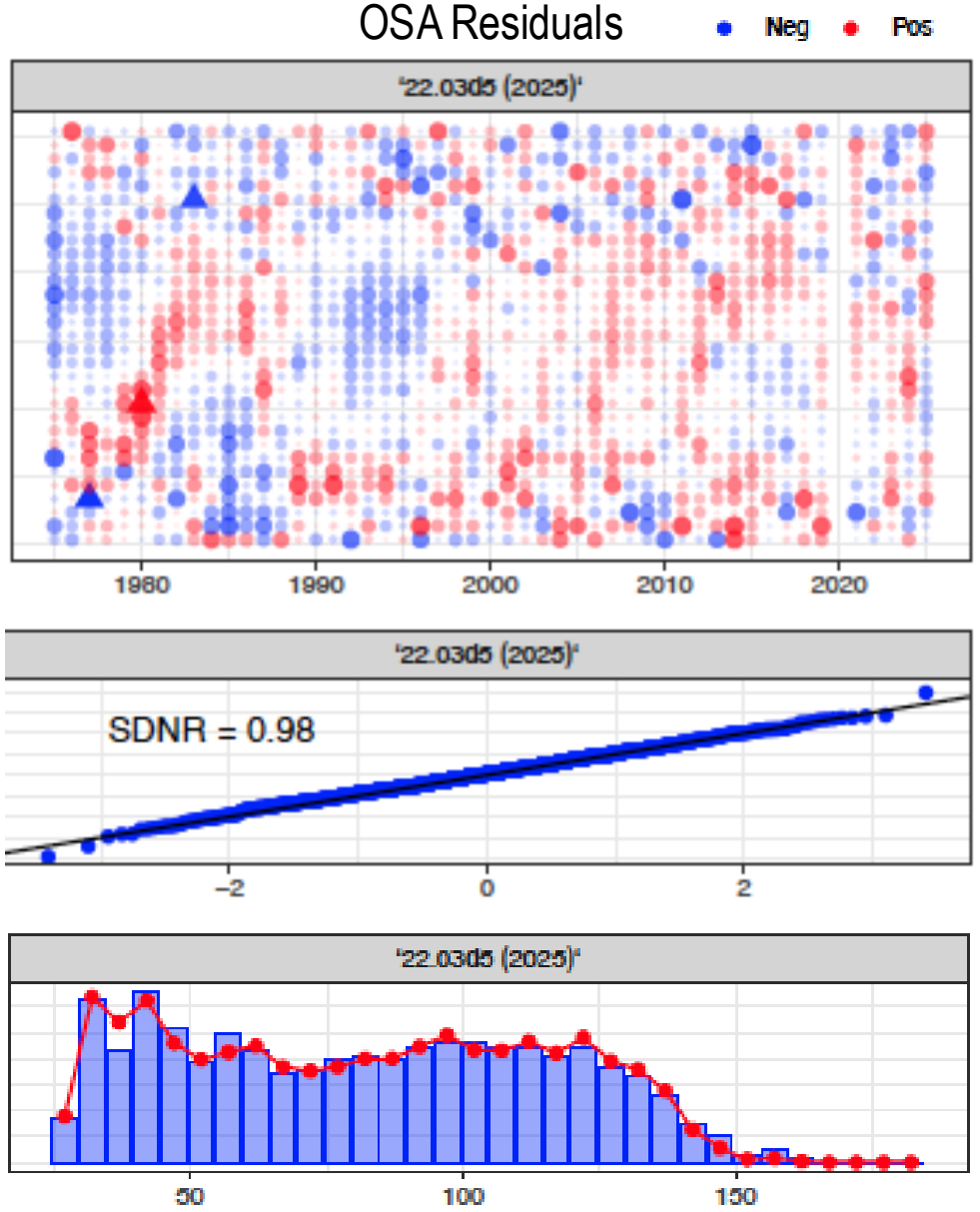


Residuals to NMFS Survey Size Comps (males)

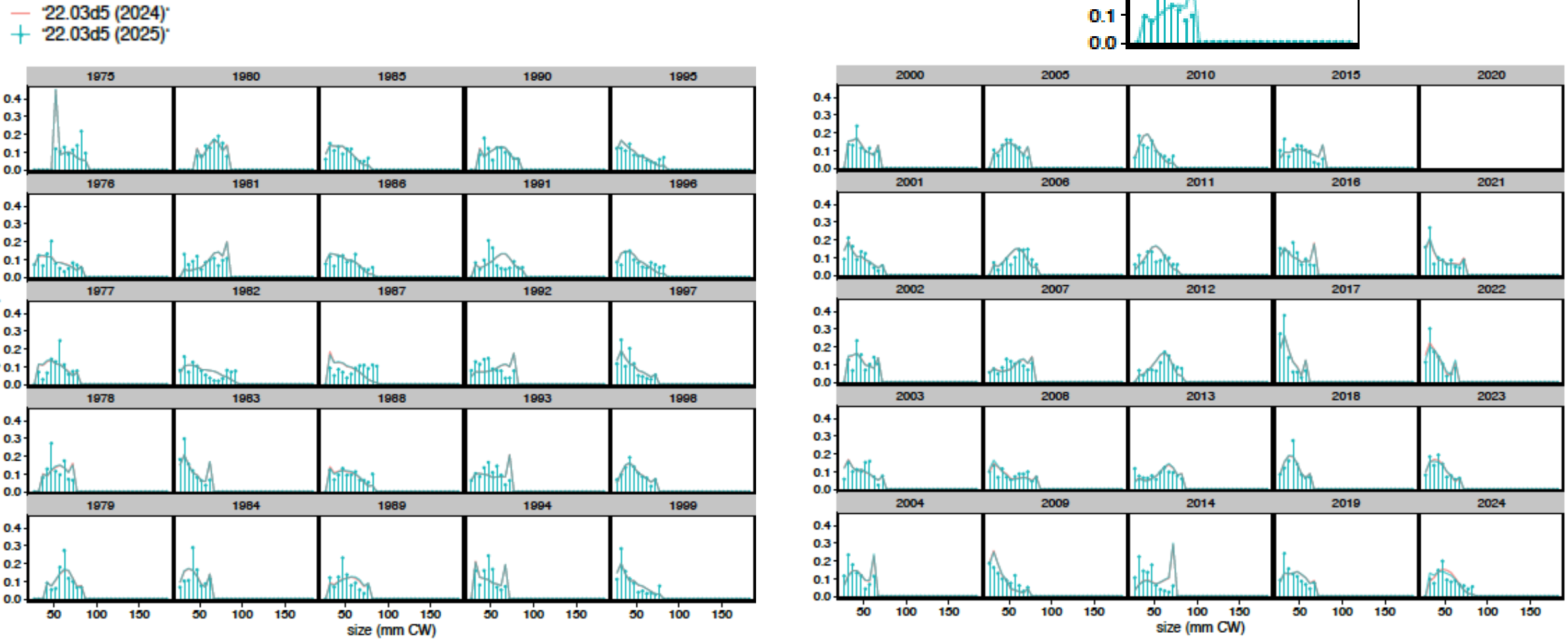


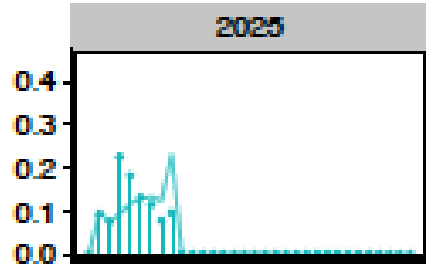
Pearson's Residuals

OSA Residuals

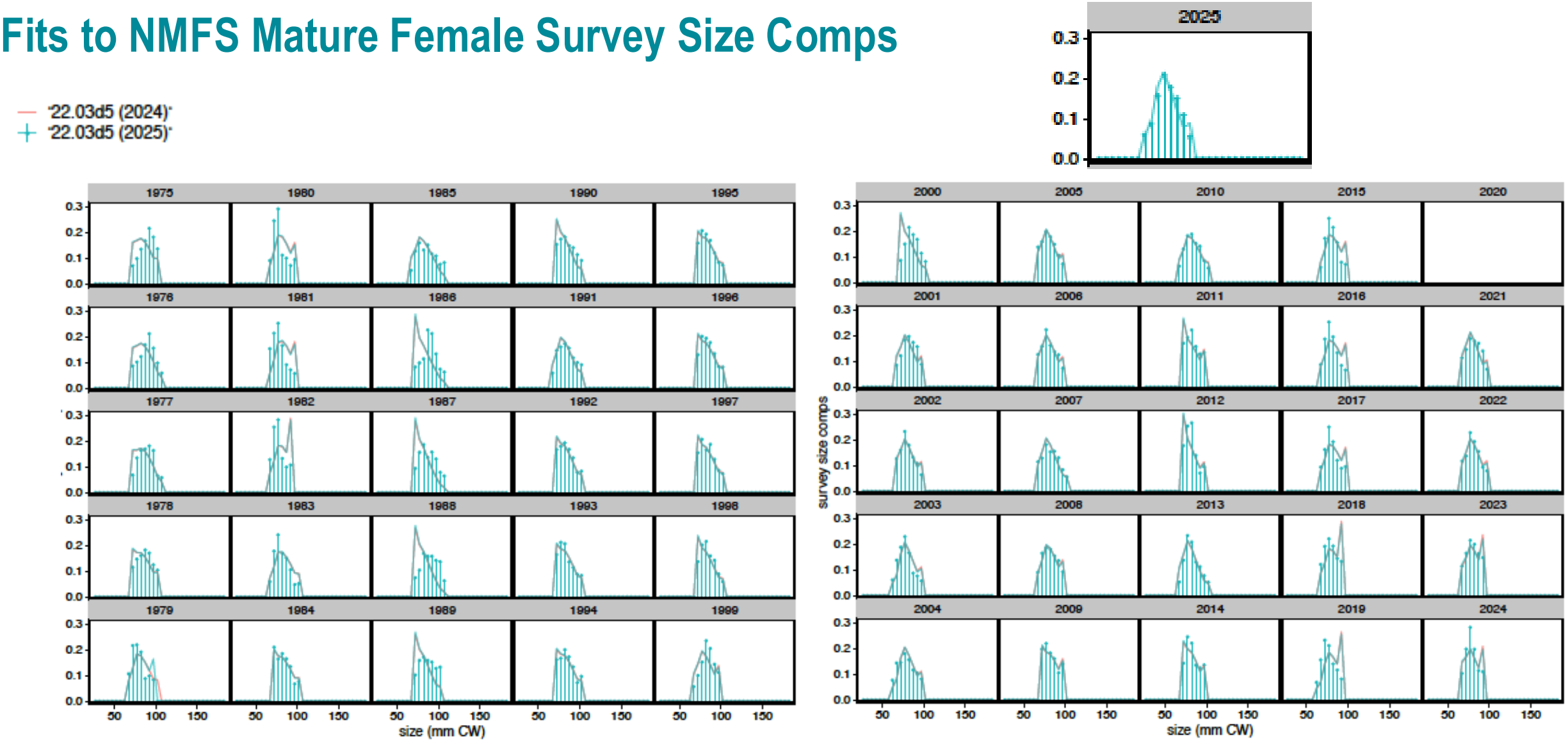


Fits to NMFS Immature Female Survey Size Comps

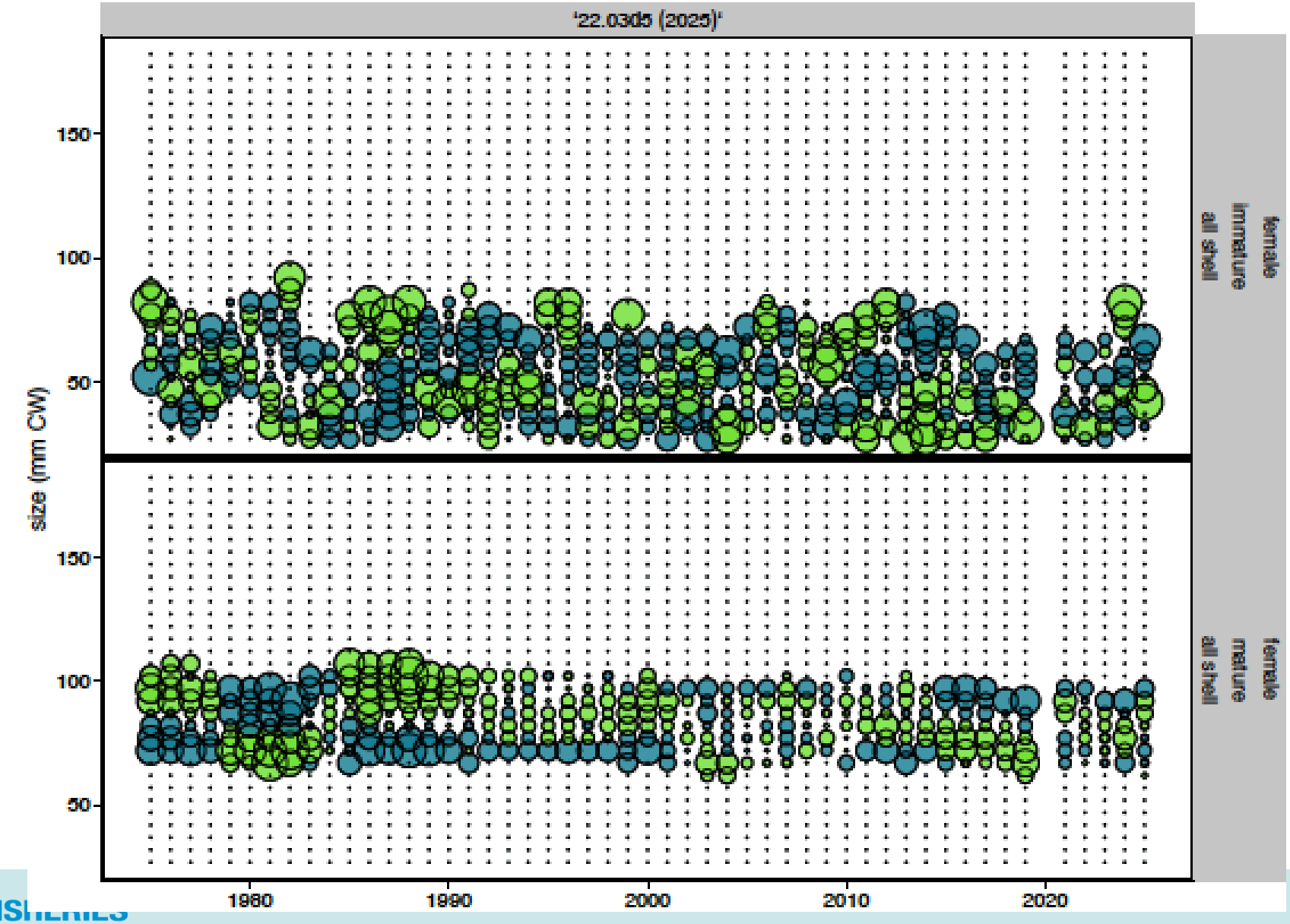




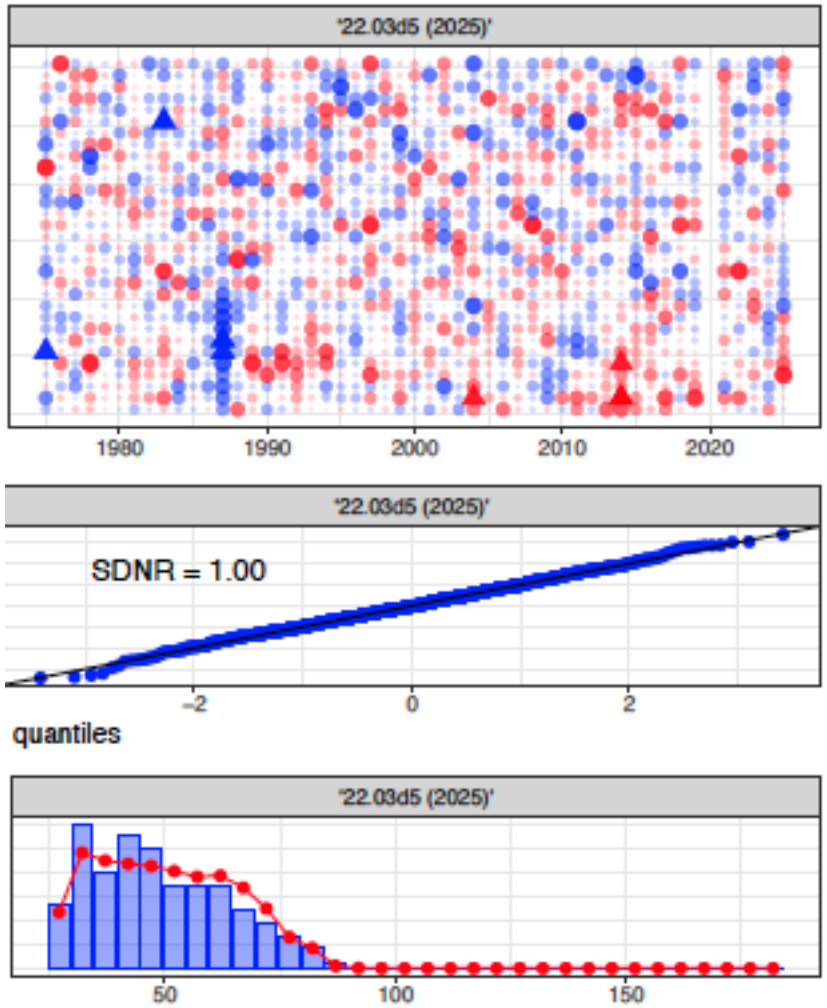
Fits to NMFS Mature Female Survey Size Comps

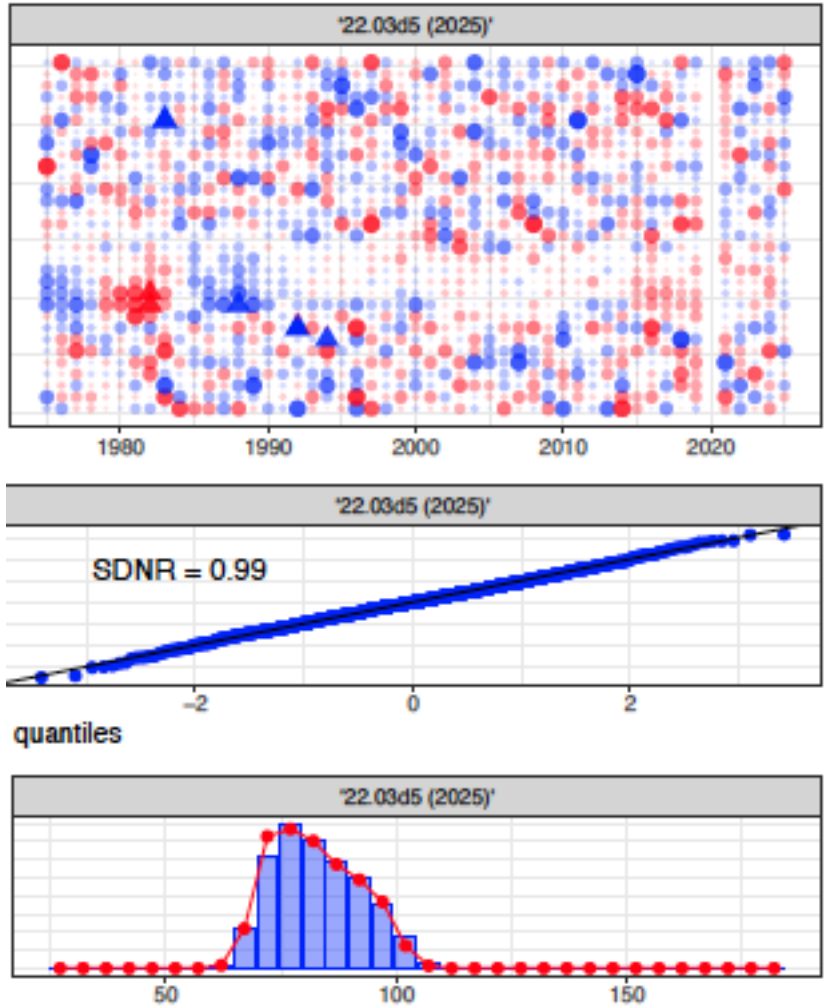


Pearson's Residuals to Females NMFS Survey Size Comps

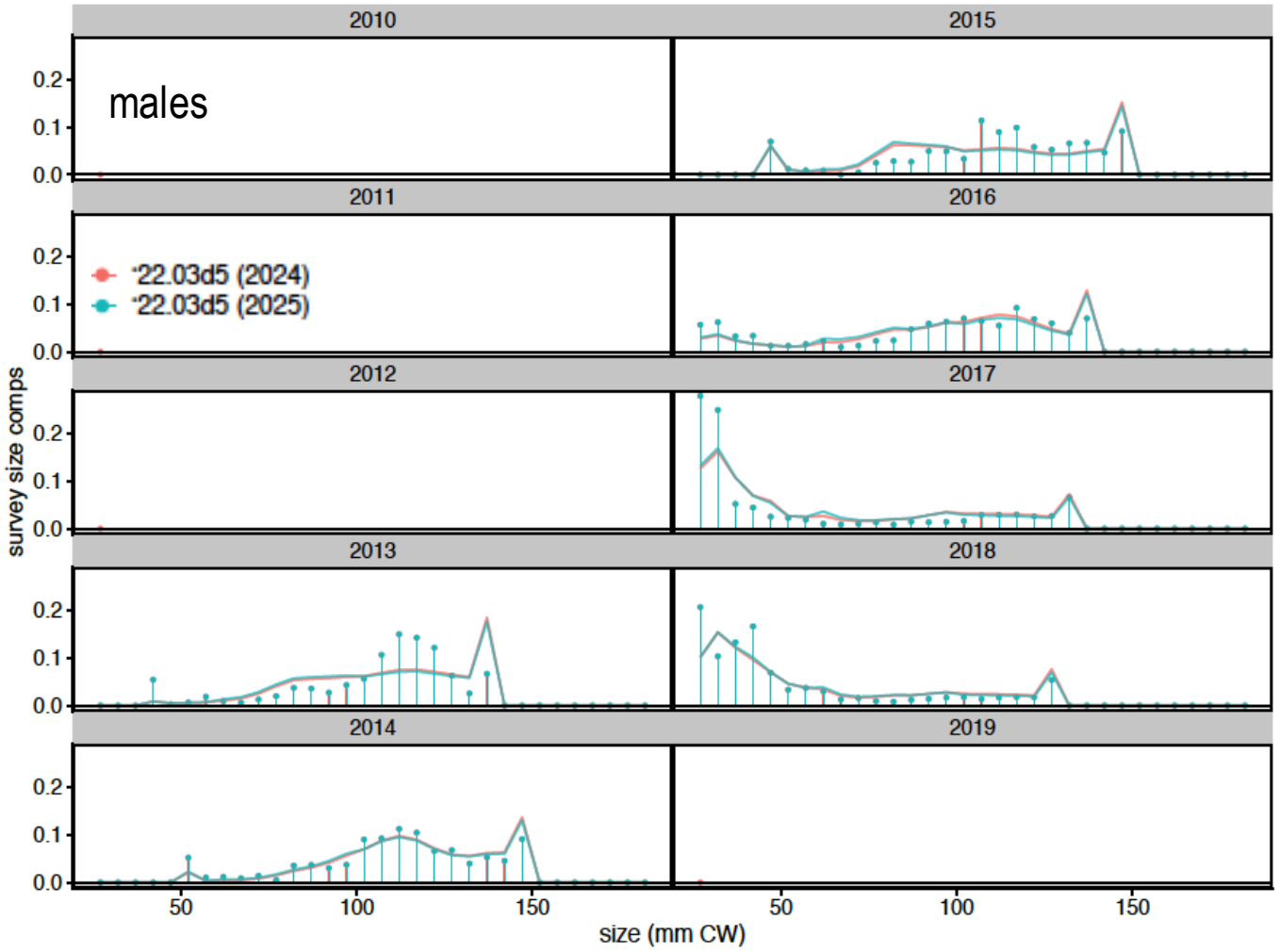


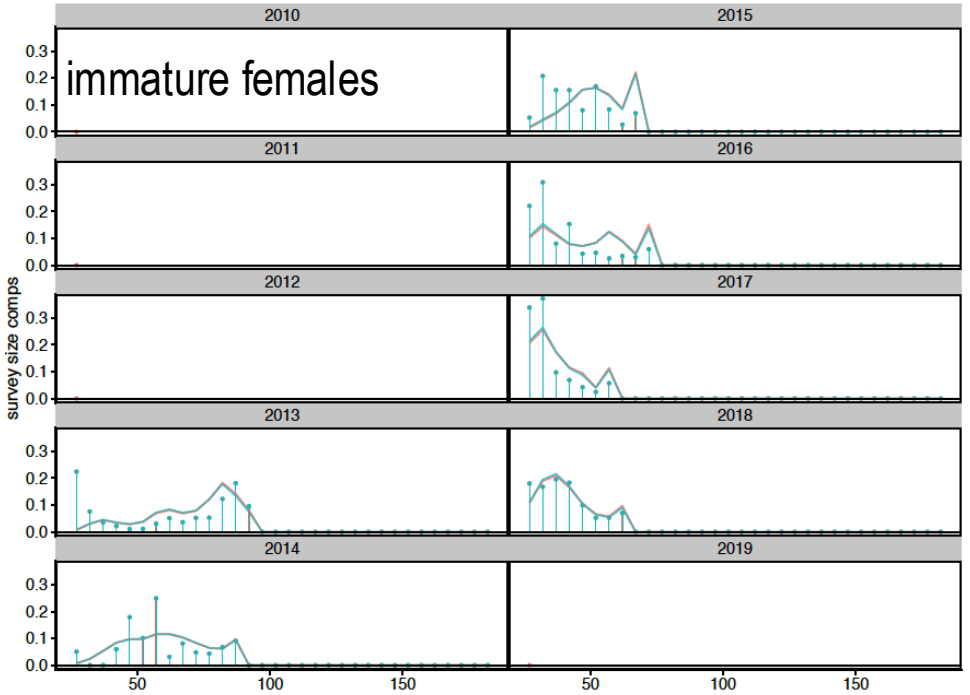
Residuals to Mature Females NMFS Survey Size Comps

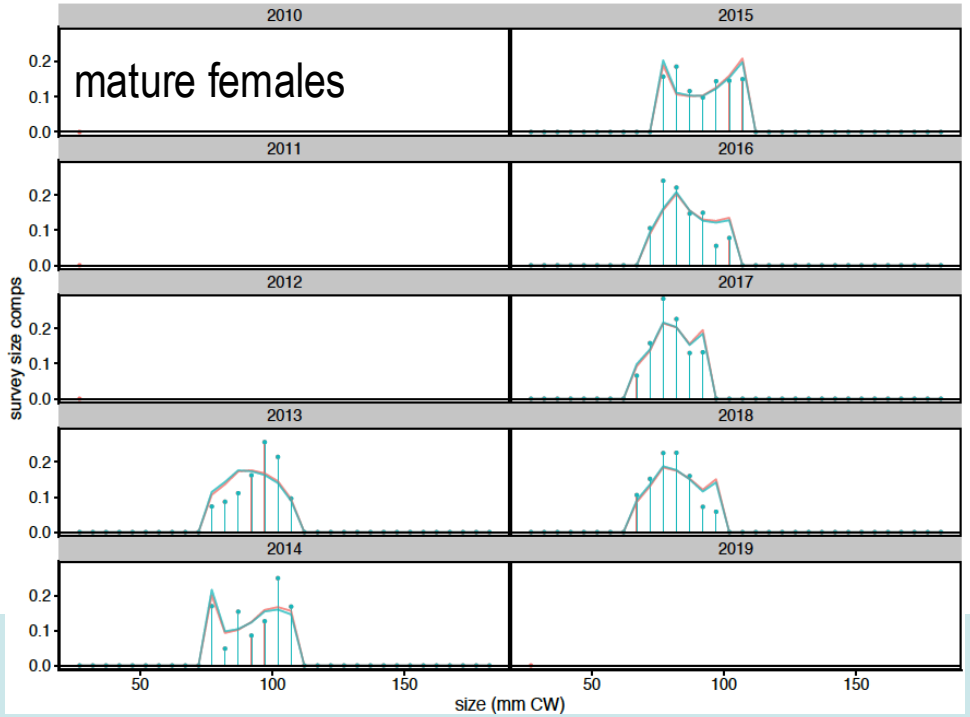




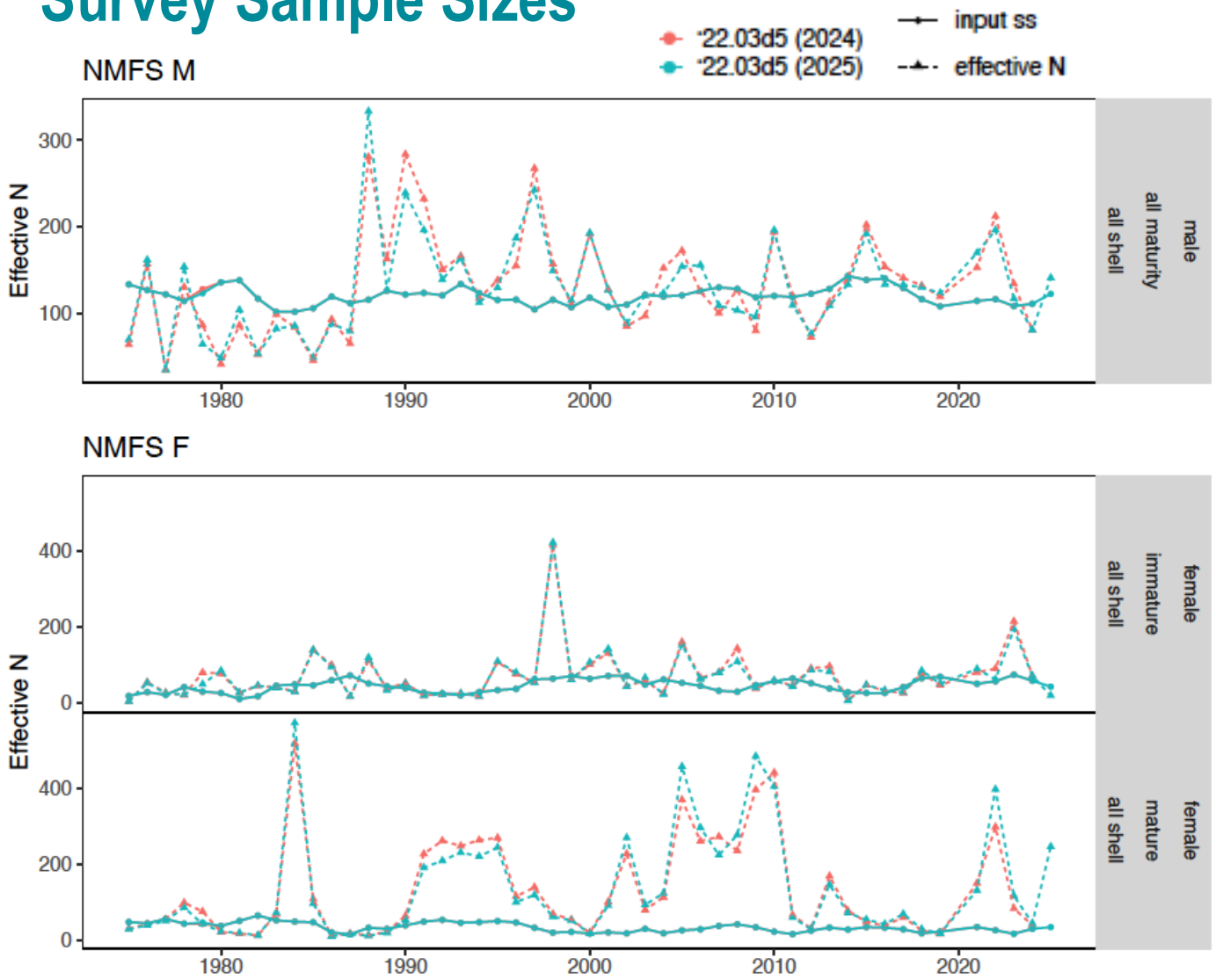
Fits to BSFRF Survey Size Comps

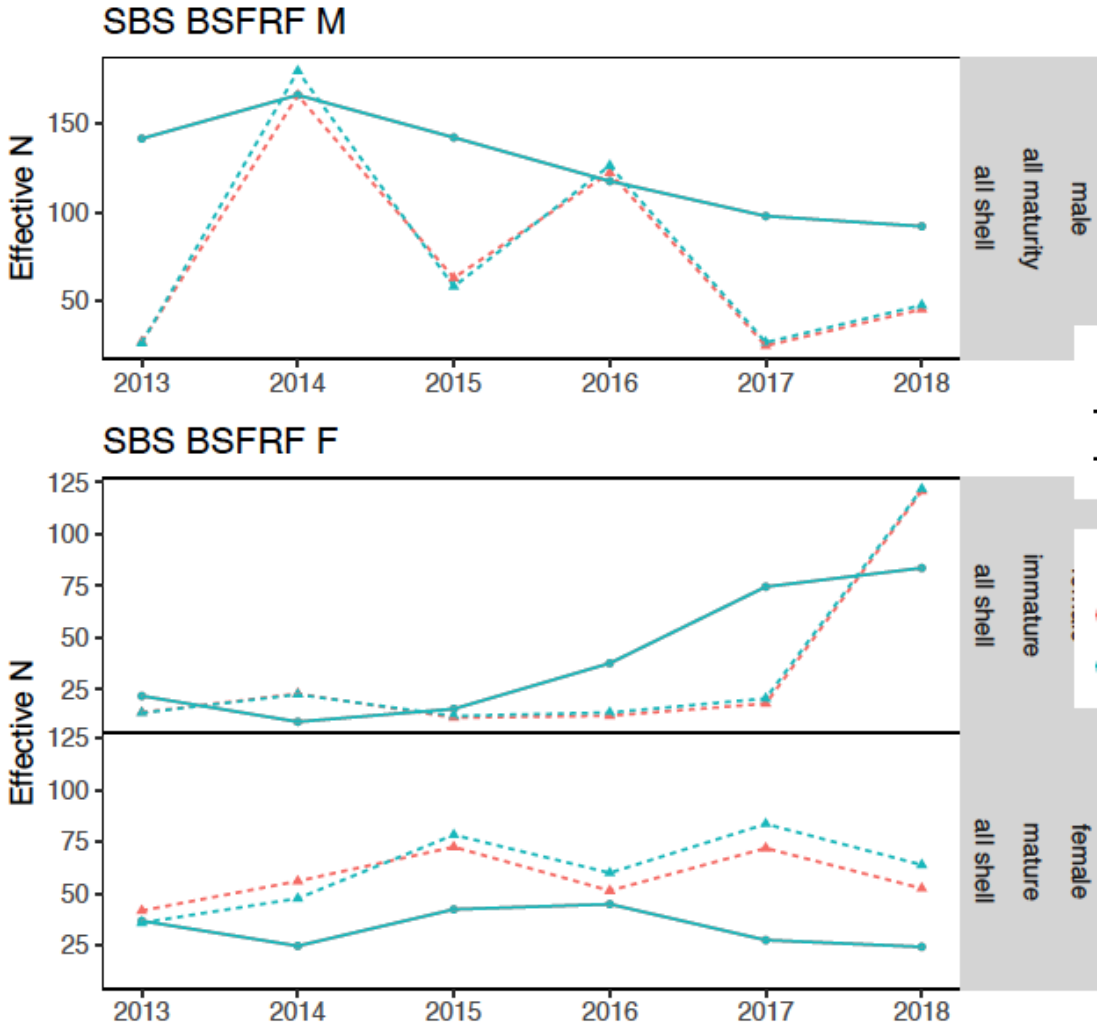




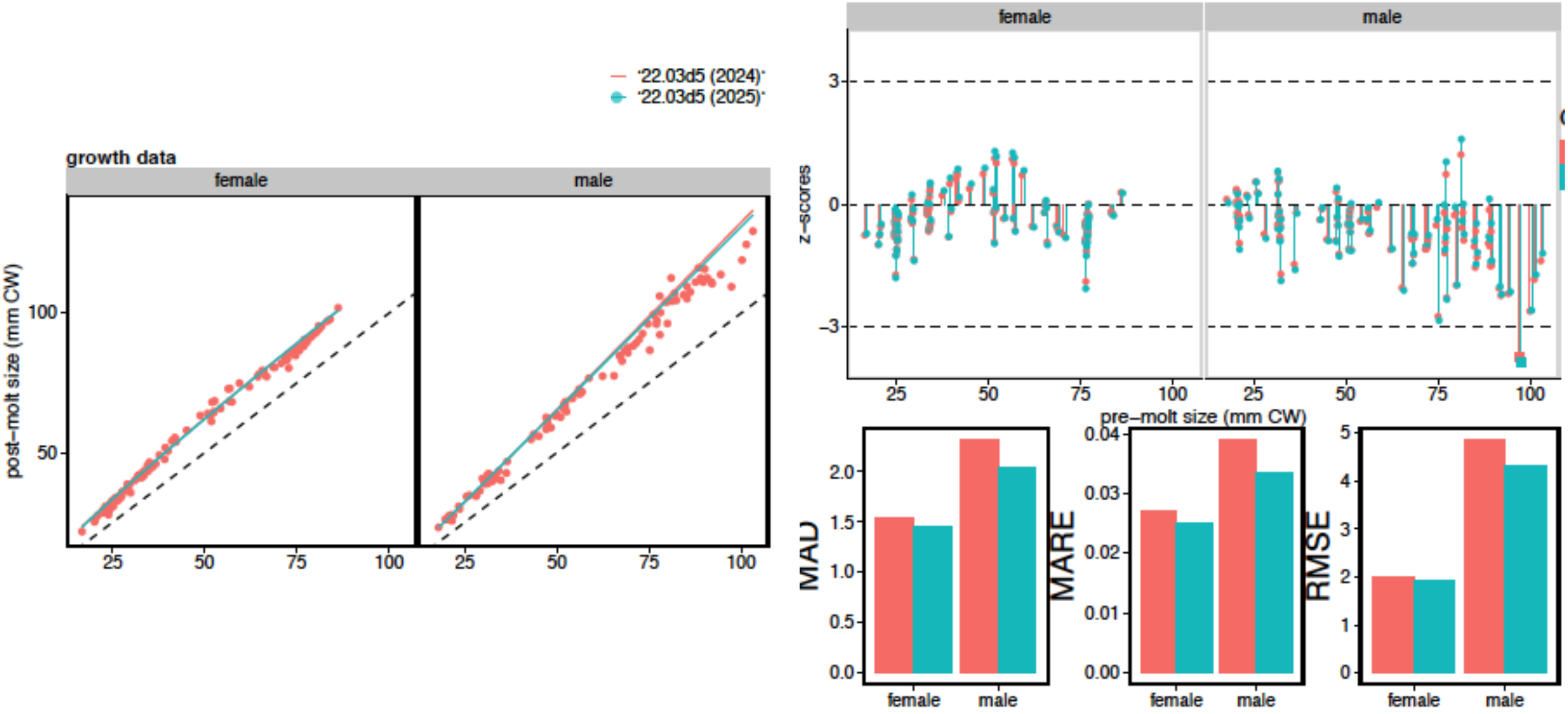


Survey Sample Sizes

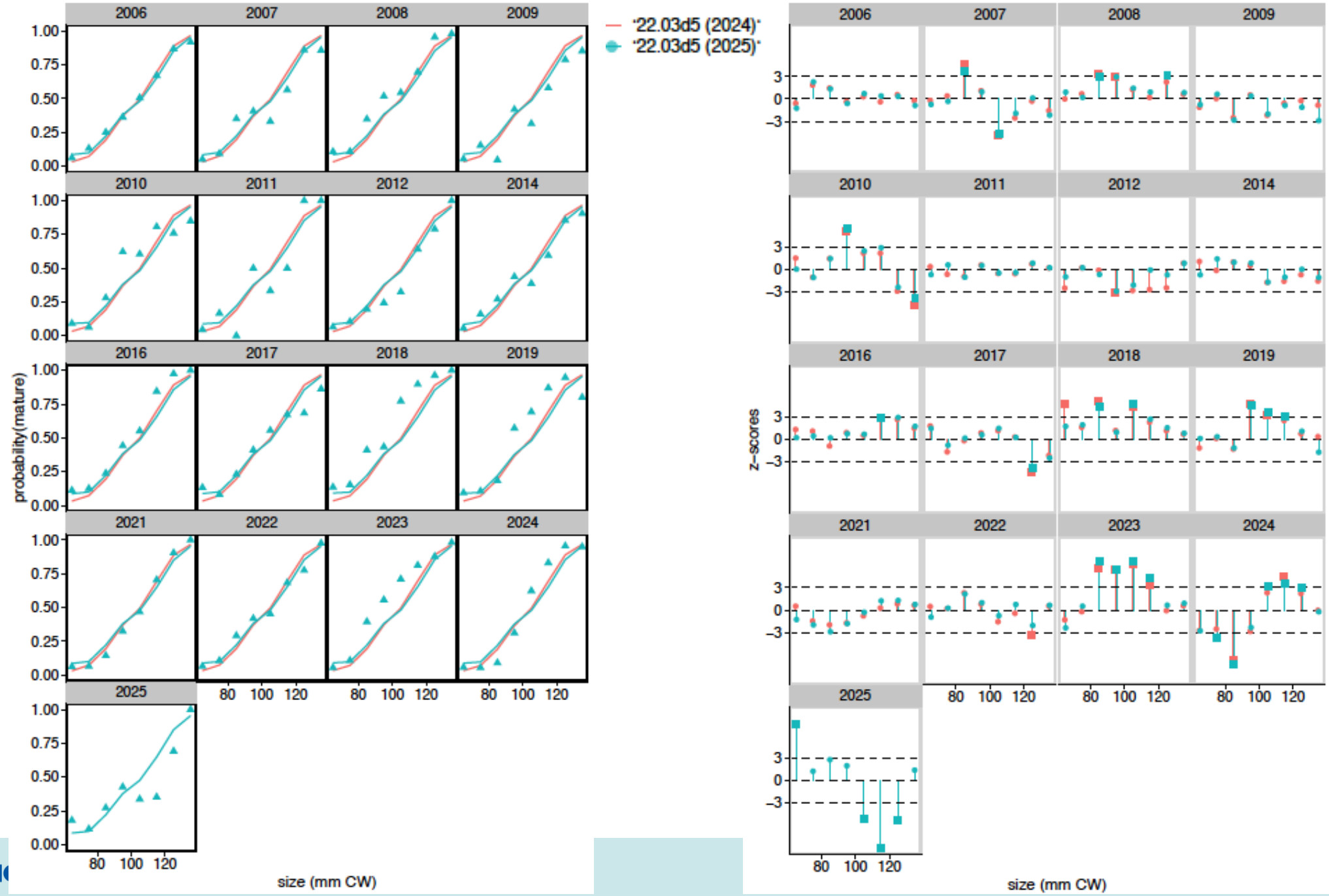




Fits to Growth Data



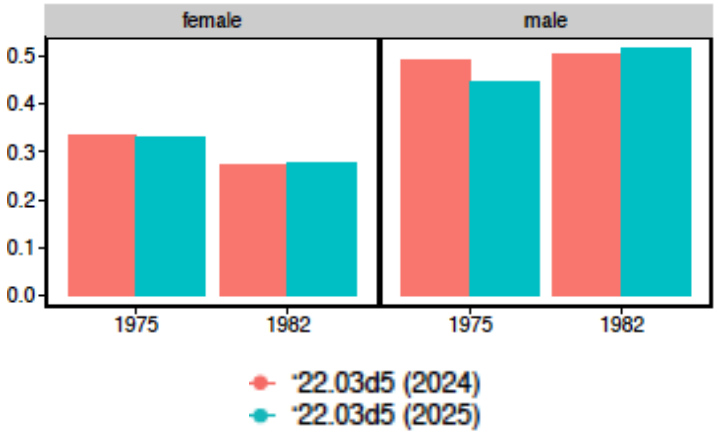
Fits to Male Maturity Ogives



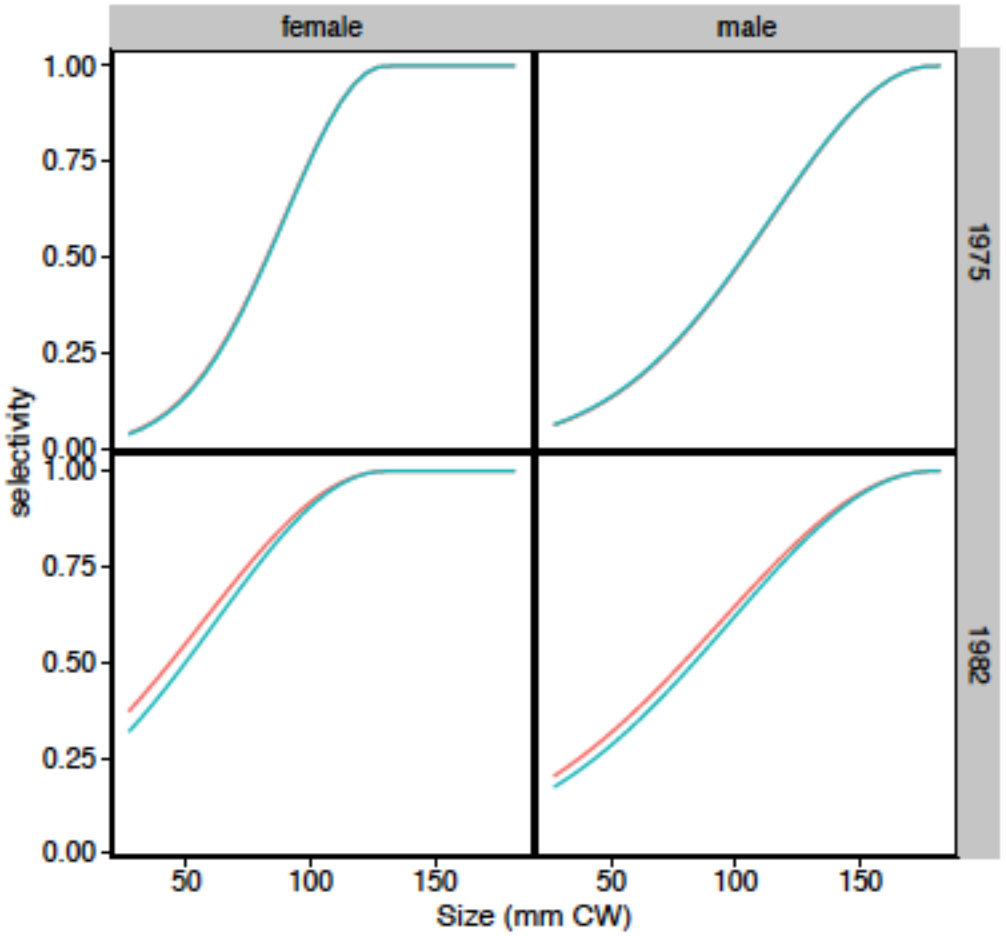
Model Estimates

Estimated Quantities: NMFS Survey Catchability/Selectivity

NMFS survey Q



NMFS survey selectivity



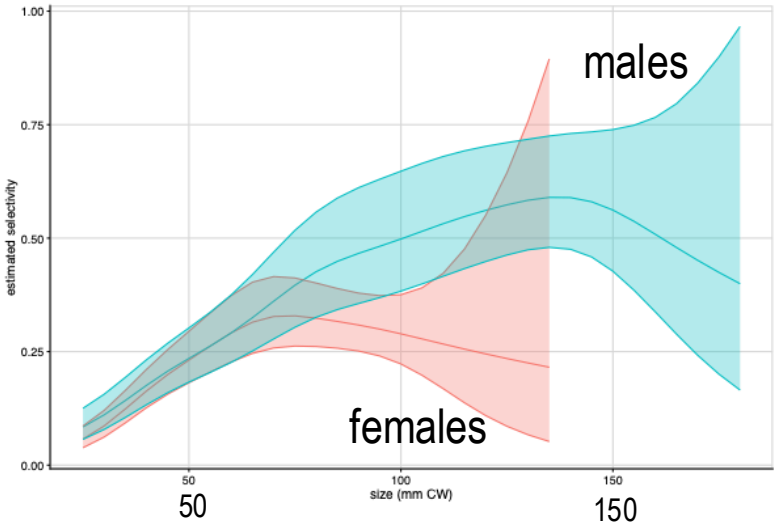


Fig. 60

Estimated Quantities: Directed Fishery

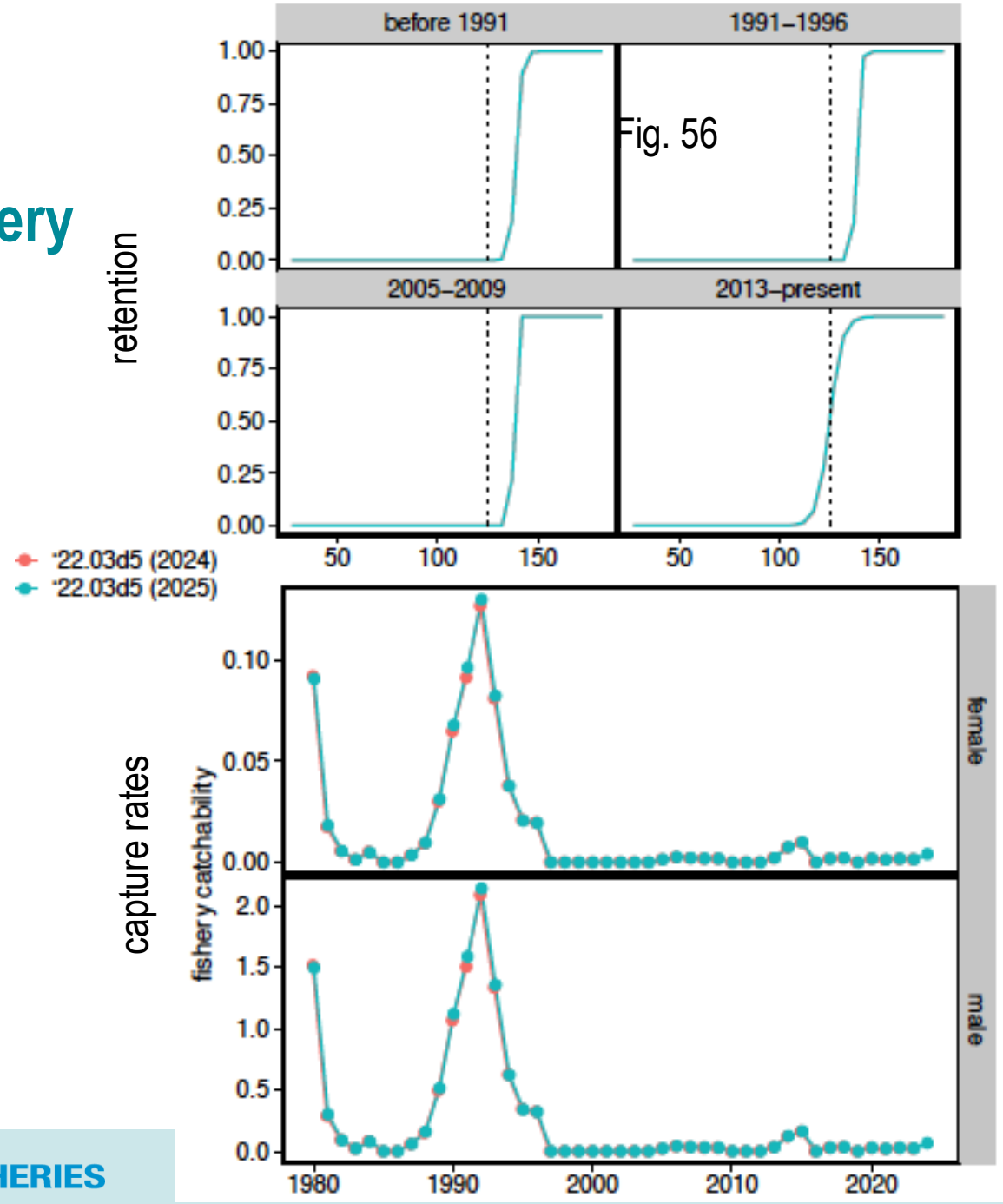


Fig. 56

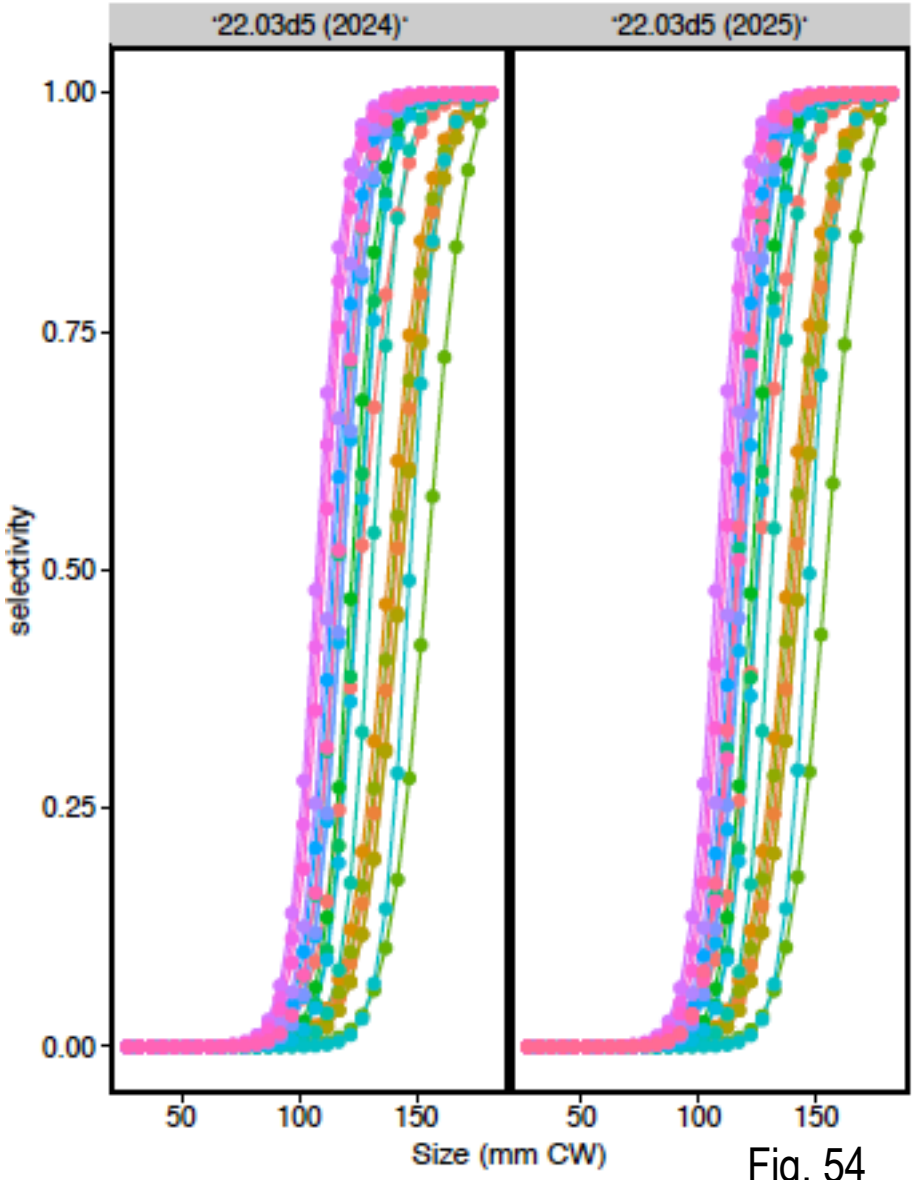
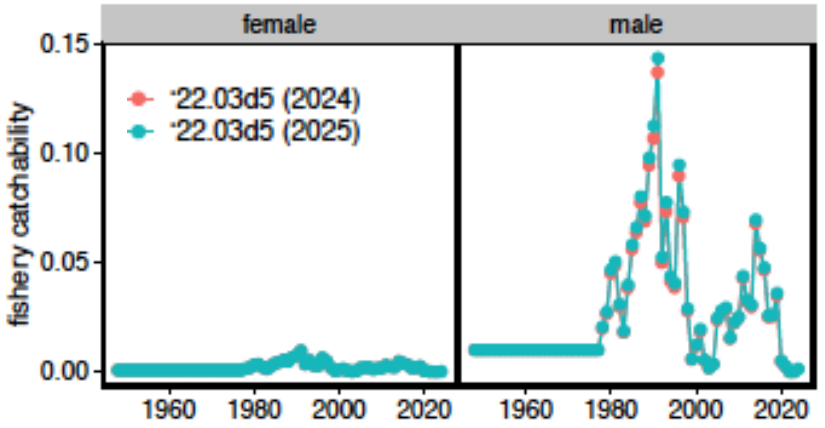


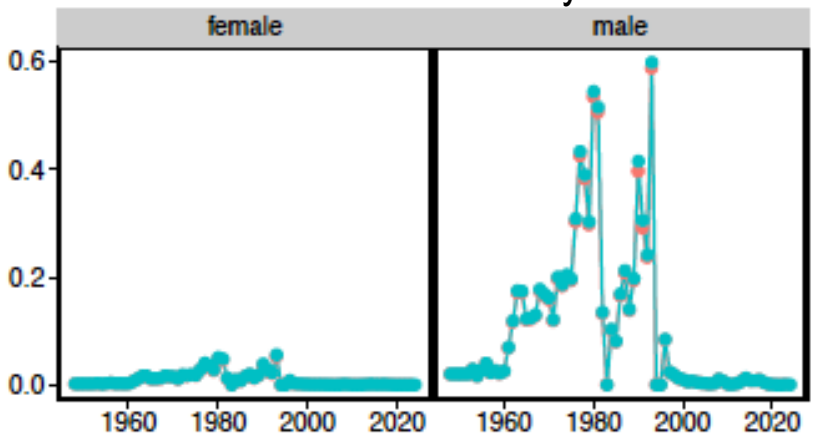
Fig. 54

Estimated Quantities: Bycatch Fisheries

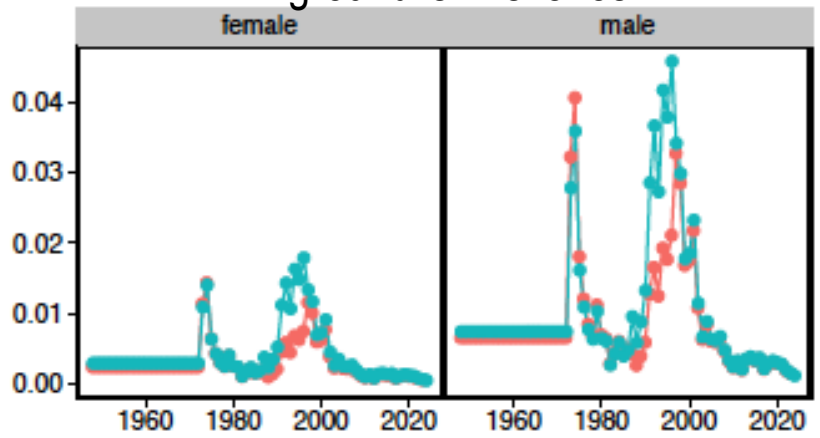
snow crab fishery

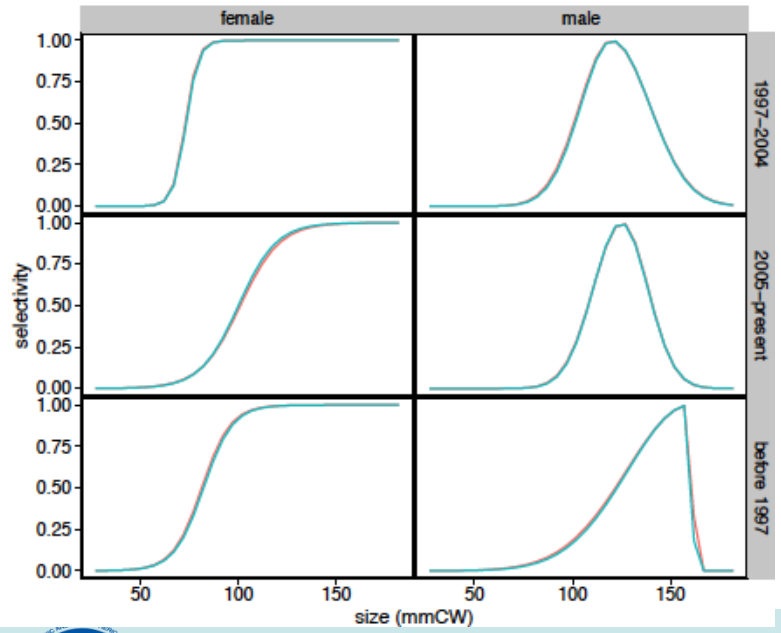


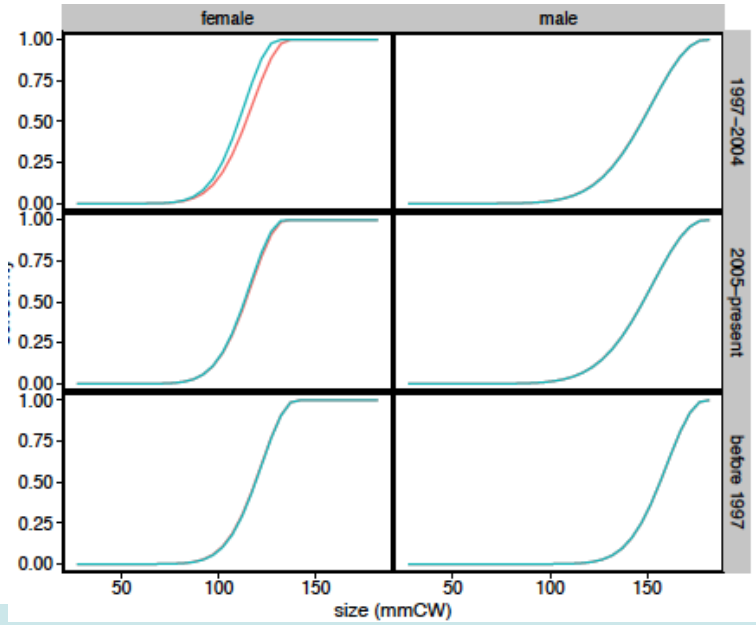
BBRKC fishery



groundfish fisheries







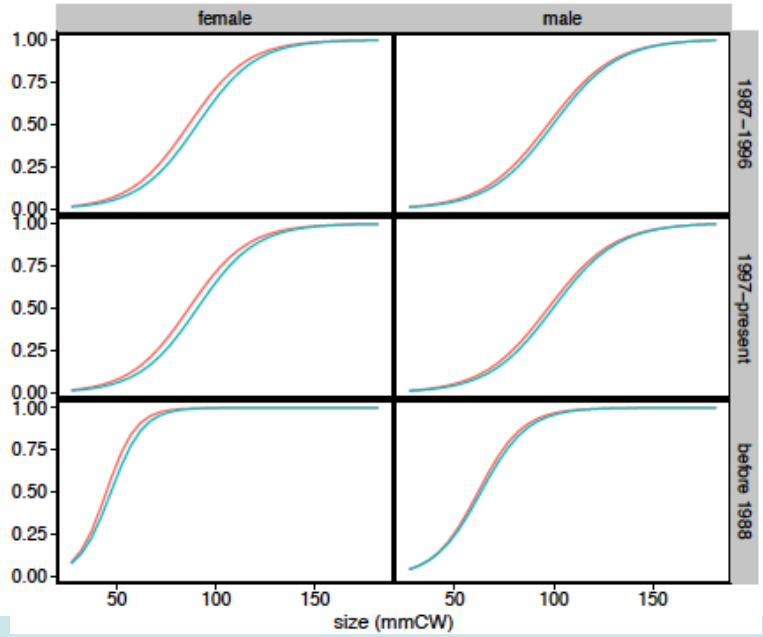


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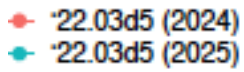
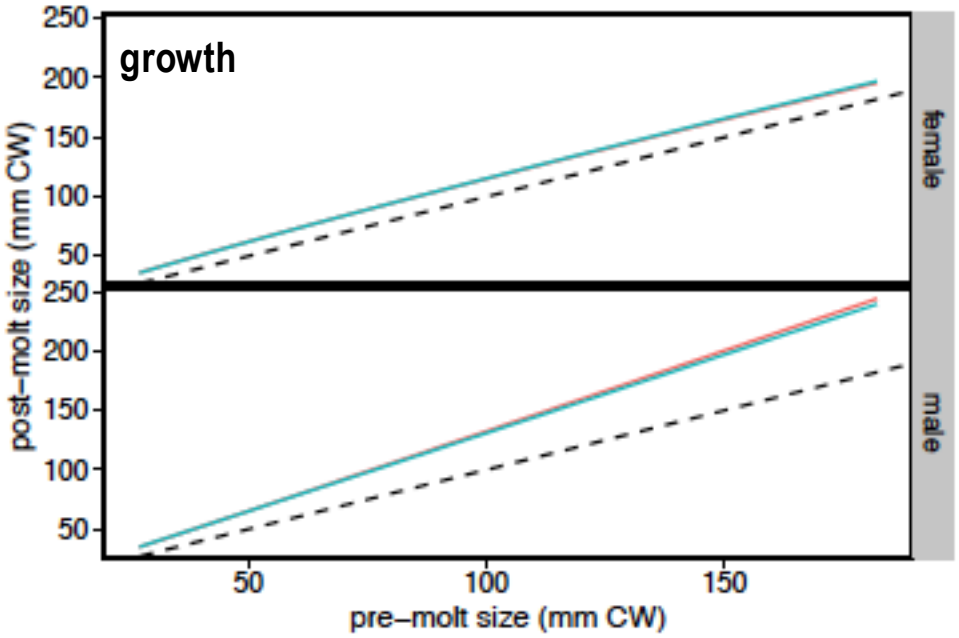
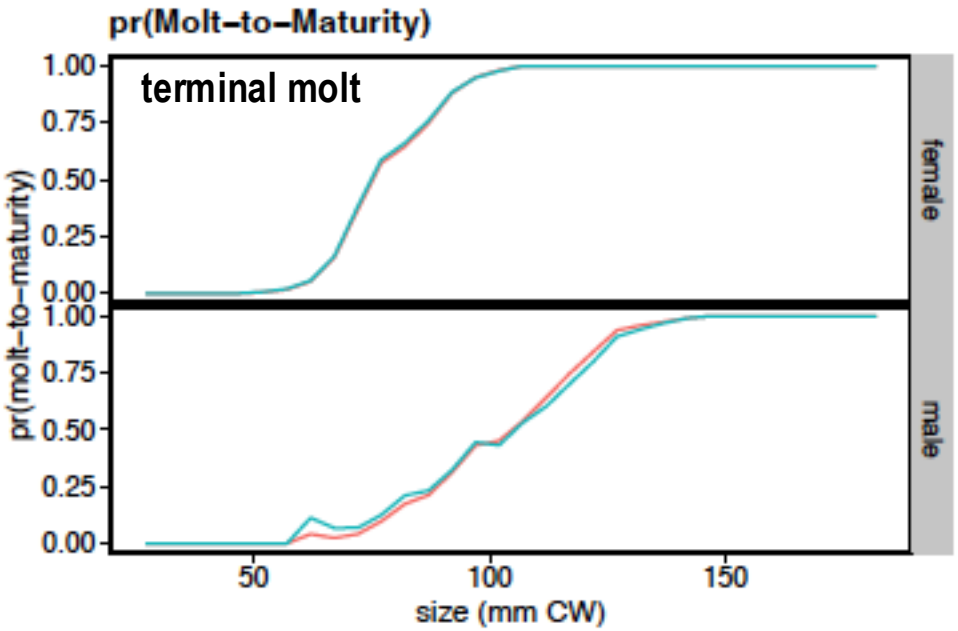
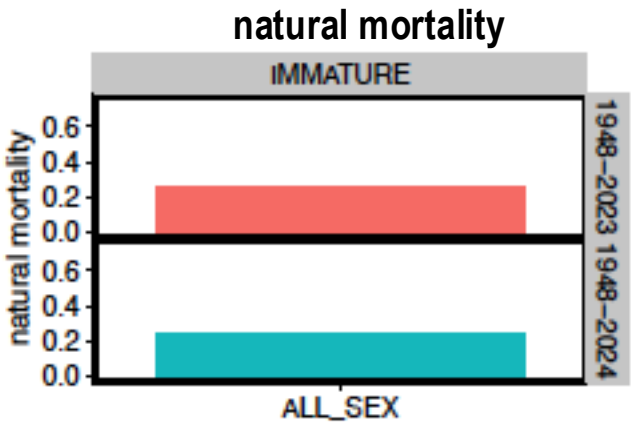
Fig. 57-59

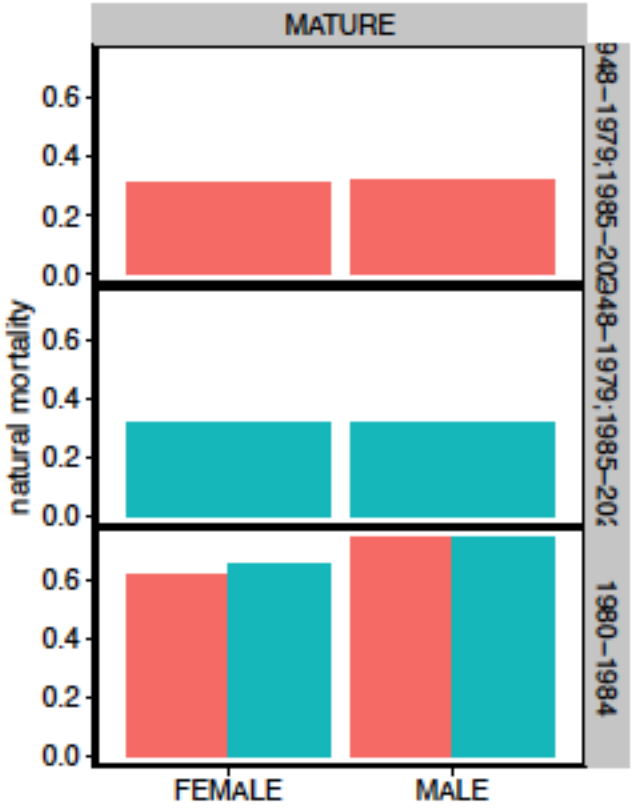
Estimated Population Processes









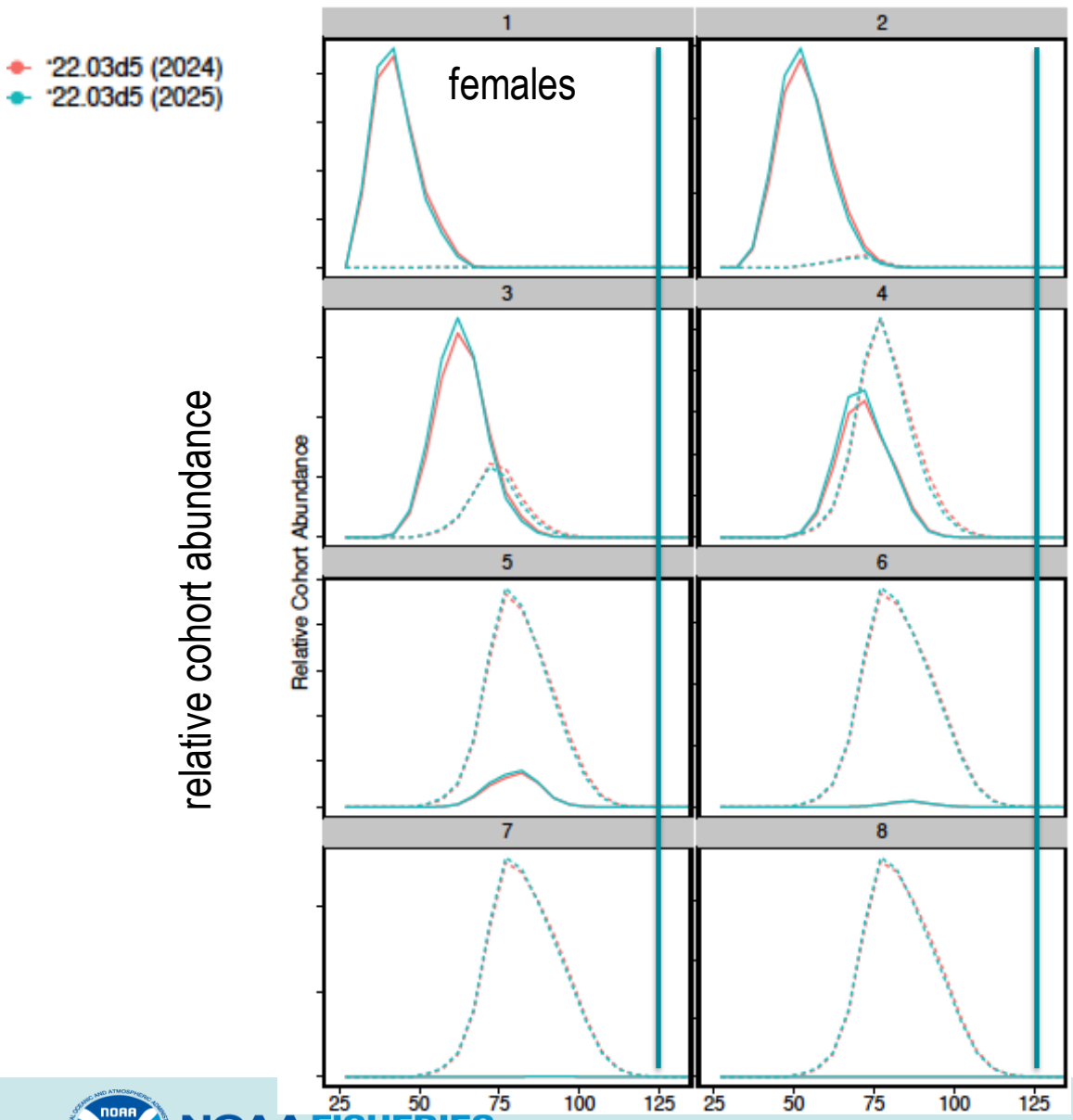


NOAA FISHERIES

Fig. 61

Estimated (Pseudo) Cohort Progression

SCALES ARE RELATIVE



— Immature all
--- mature all

about 10% left at post-recruitment age 8

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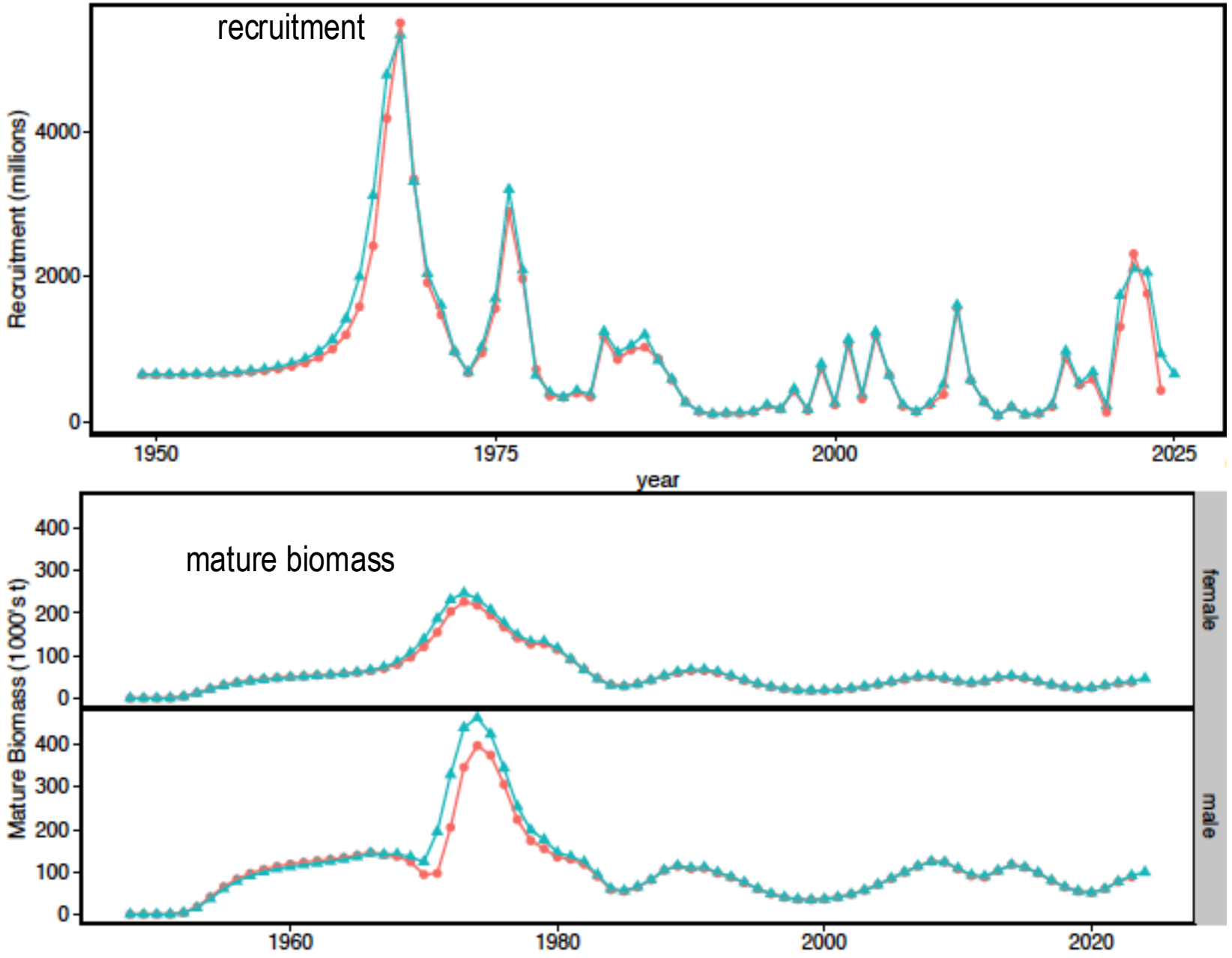
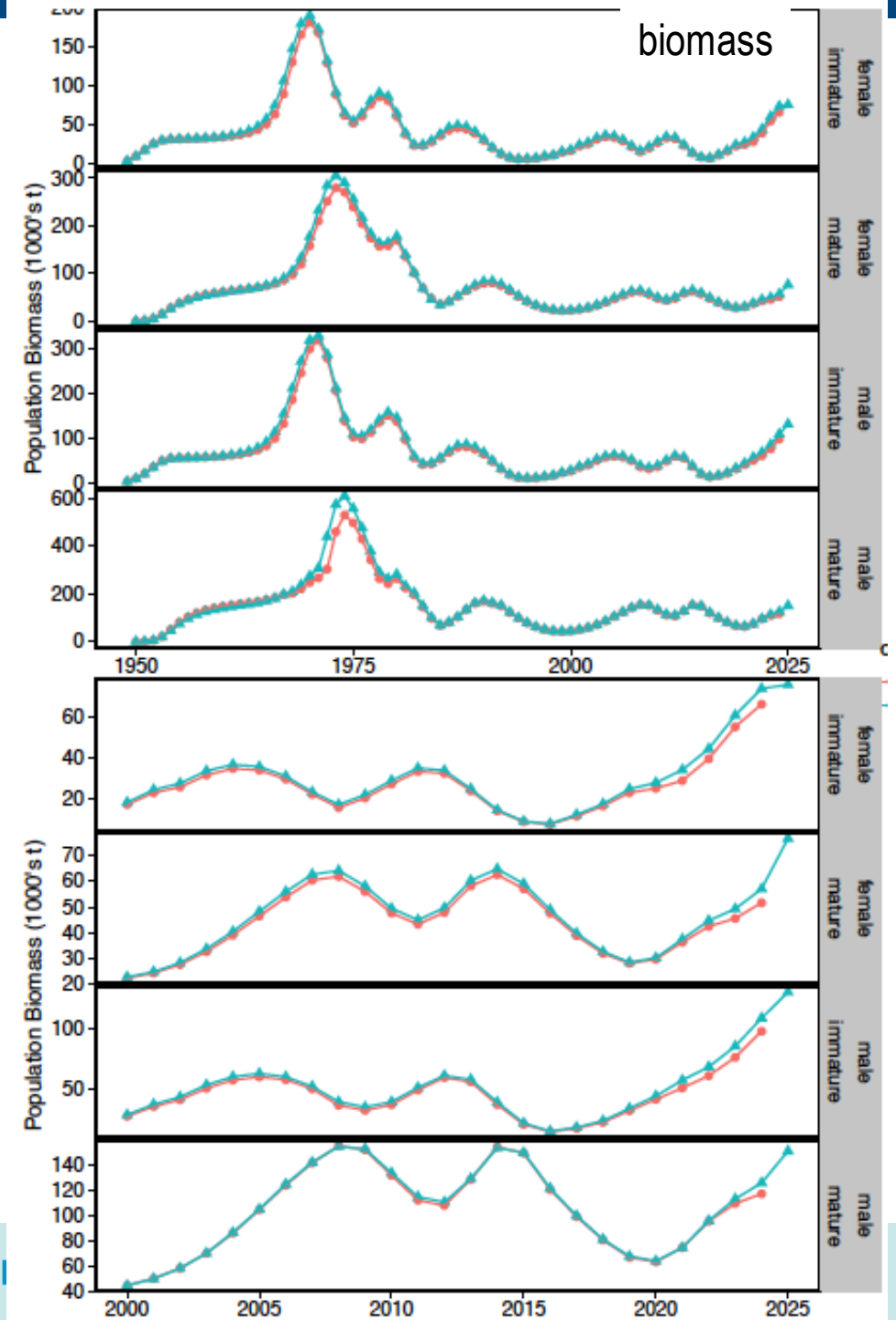
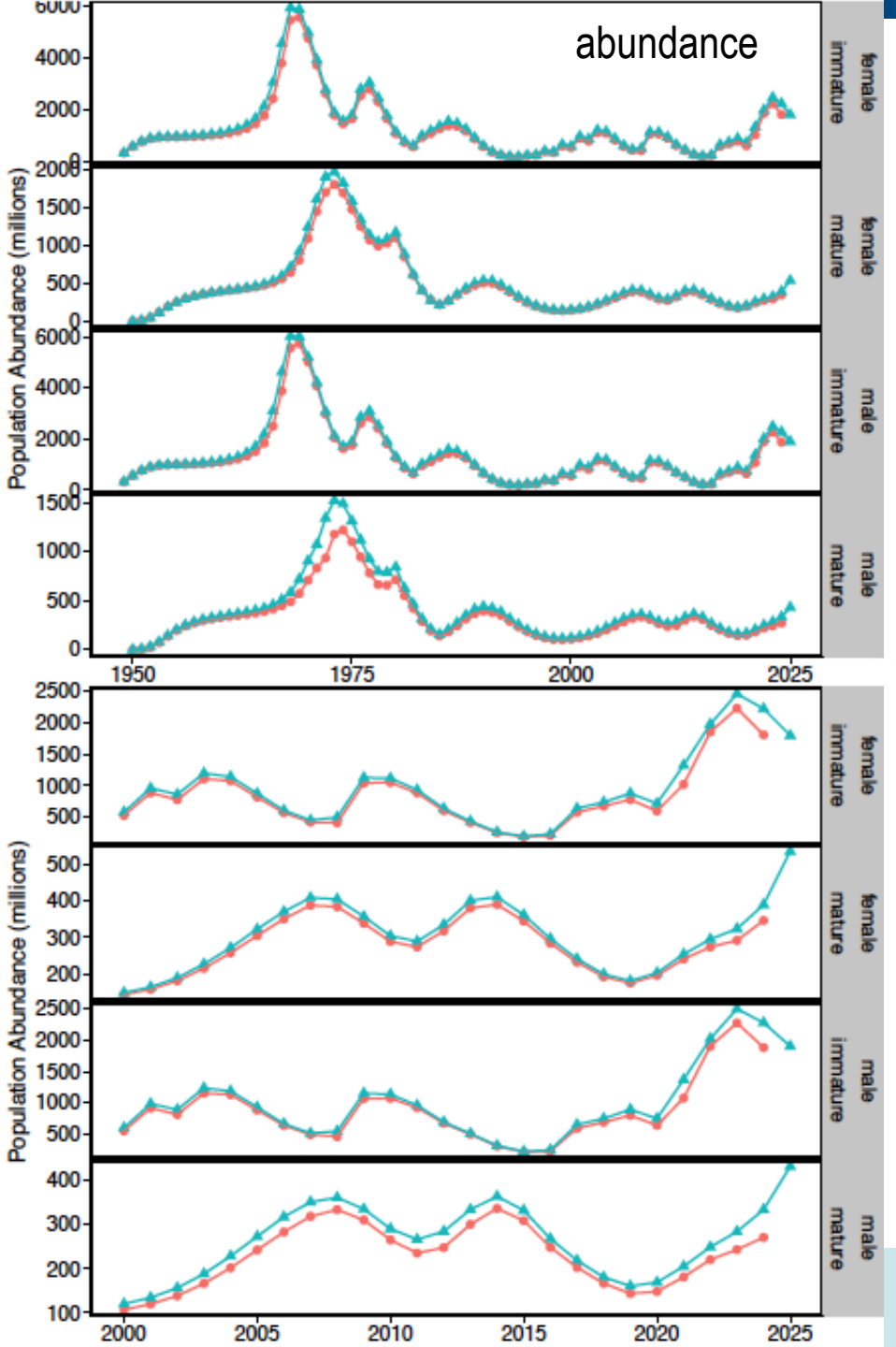
Fig.s 63 & 64

Estimated Population Quantities



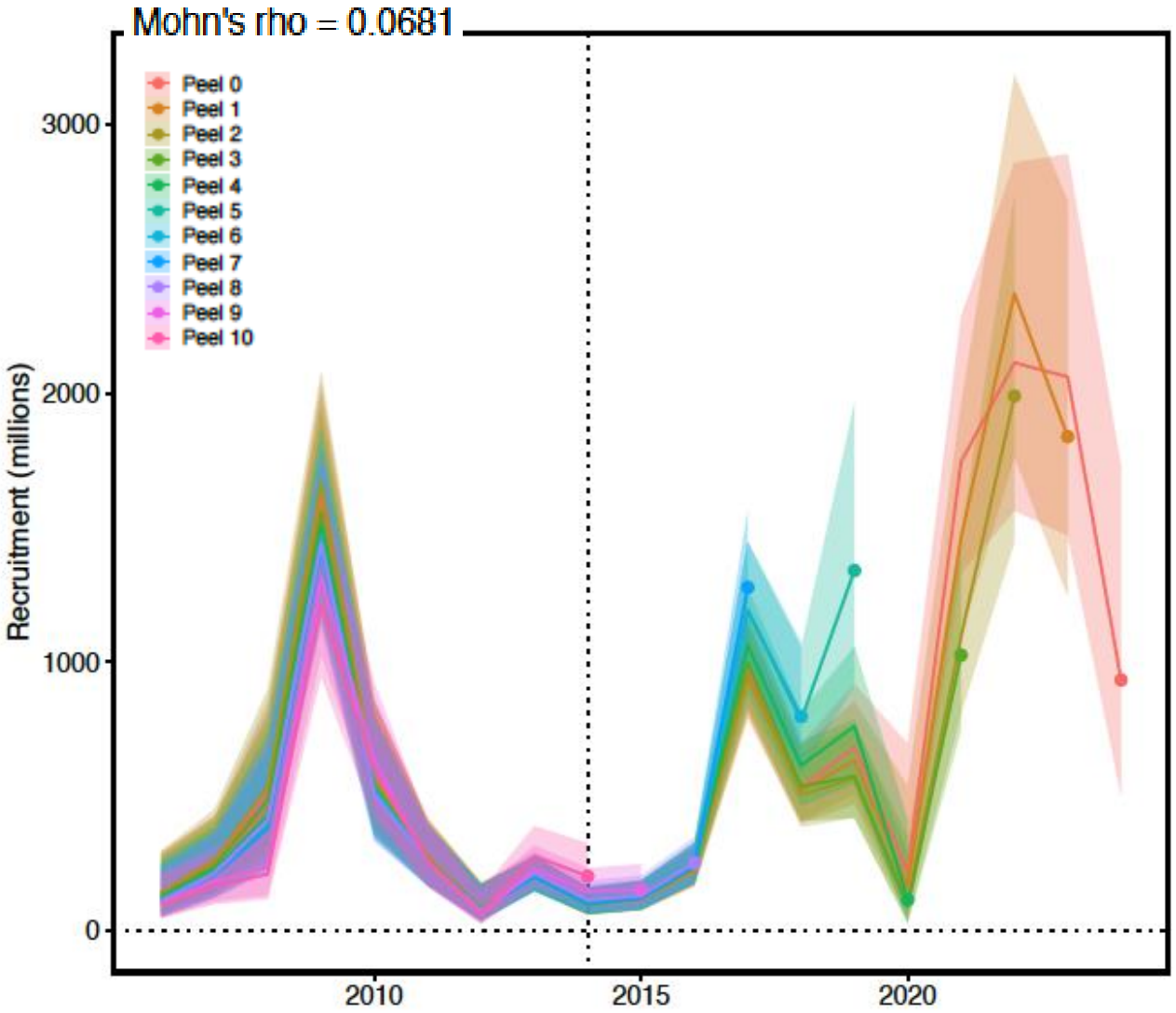
Estimated Population Quantities

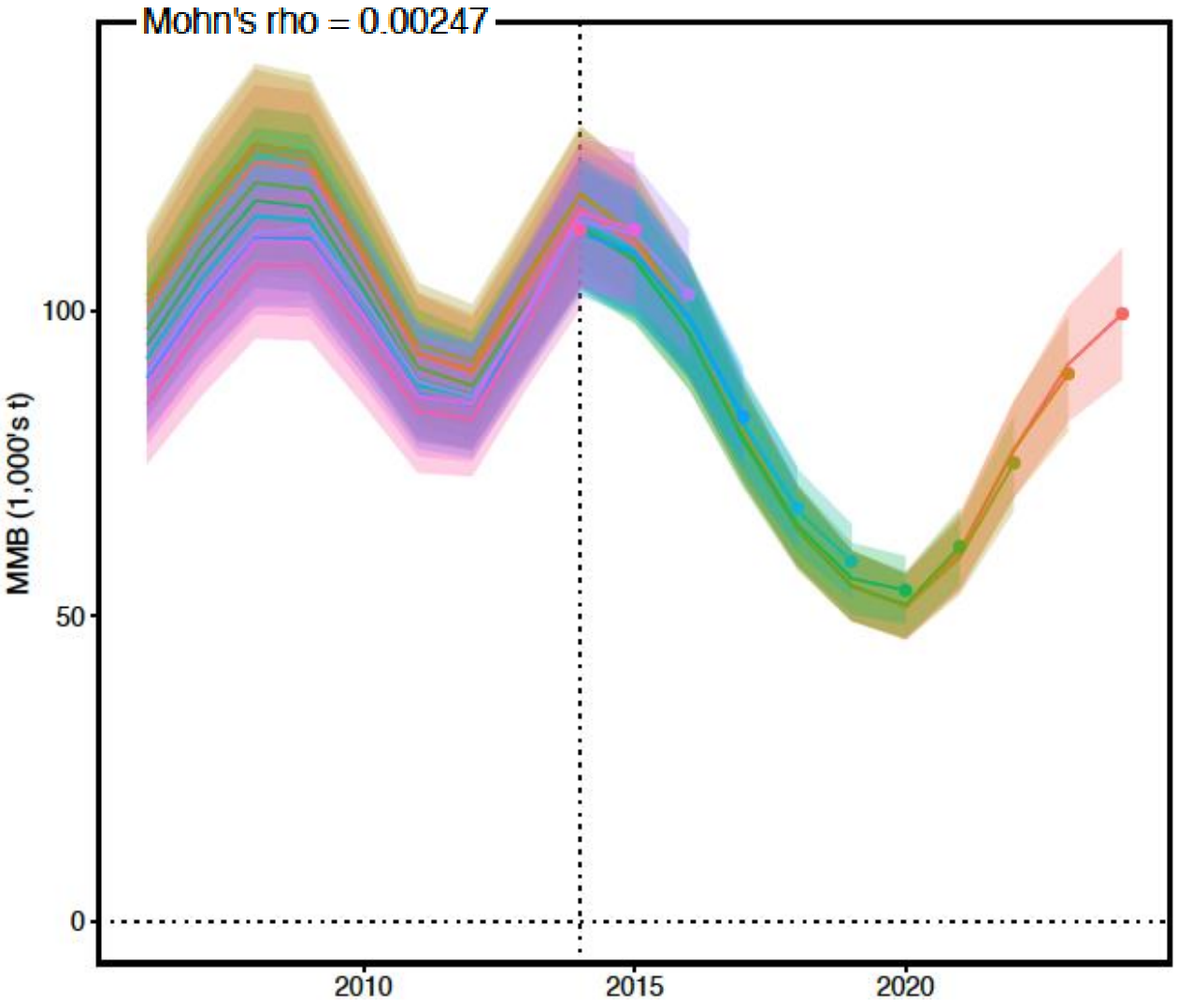




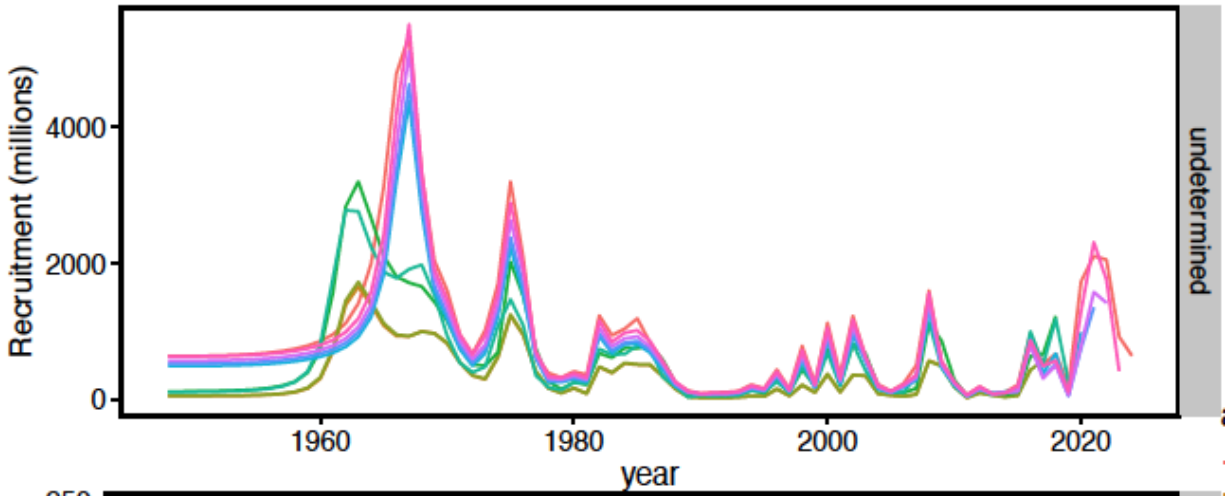
'22.03d5 (2024)
'22.03d5 (2025)

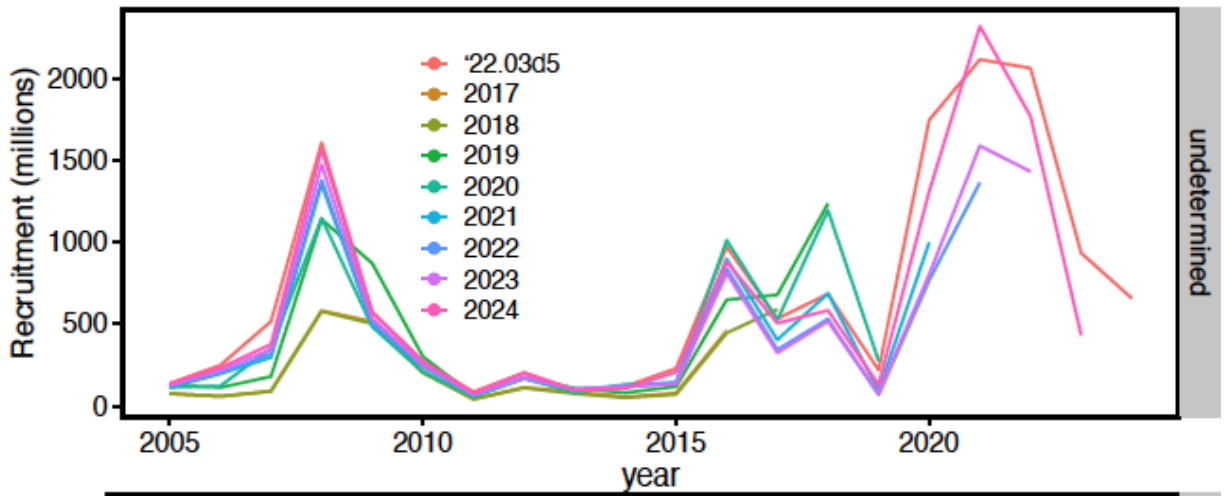
Retrospective Patterns

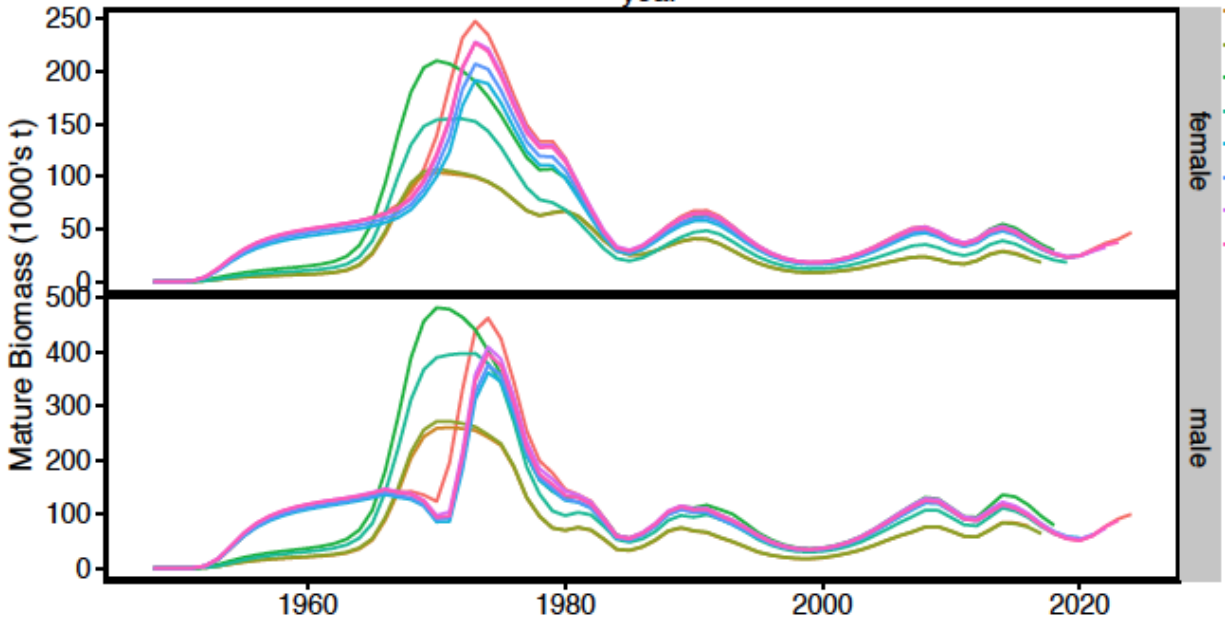


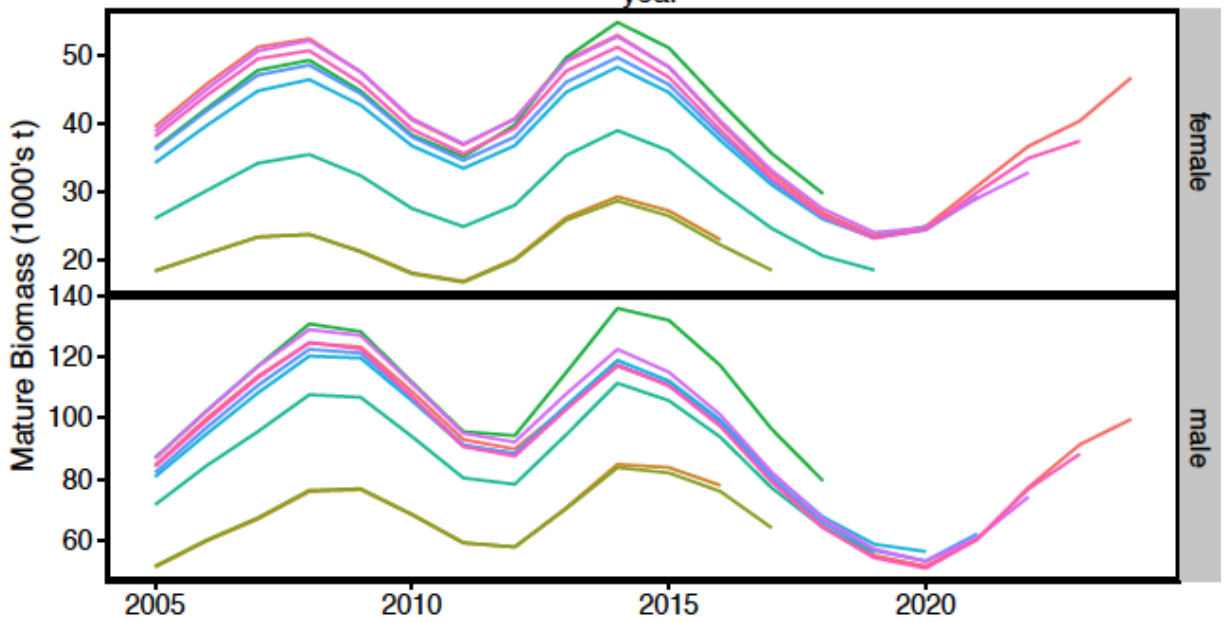


Historical Comparisons (different accepted models)







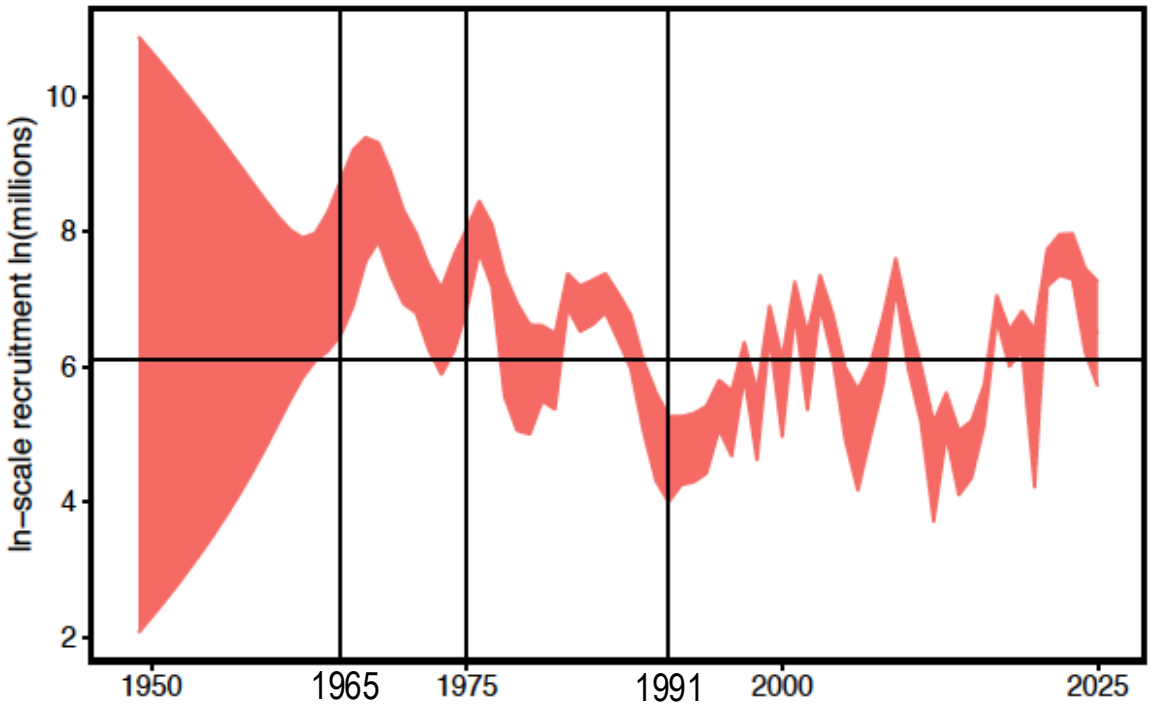


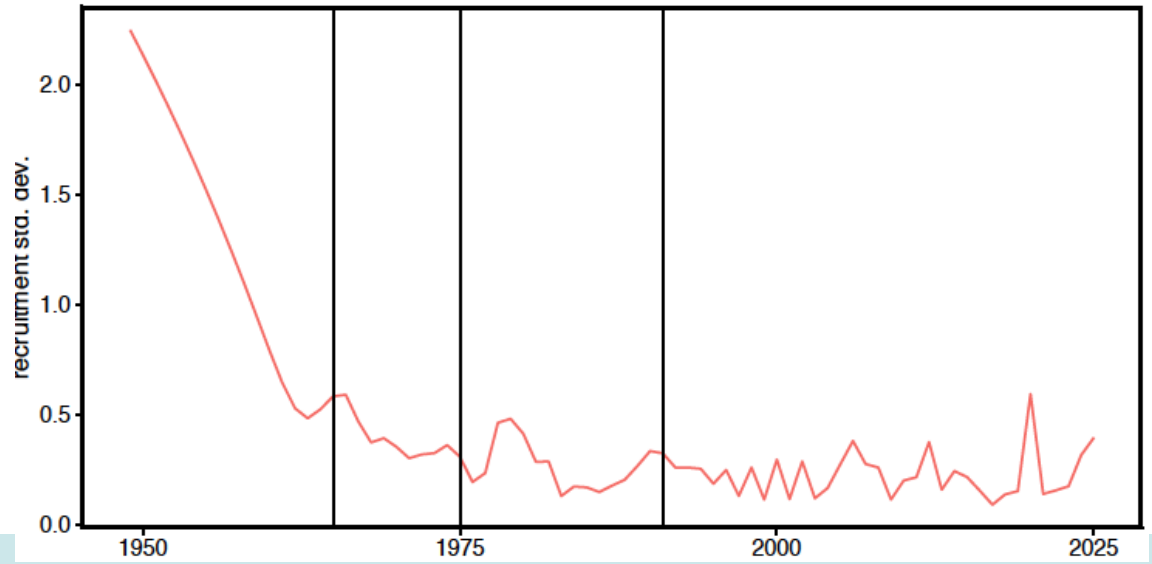
Average recruitment time period

Author's recommendation

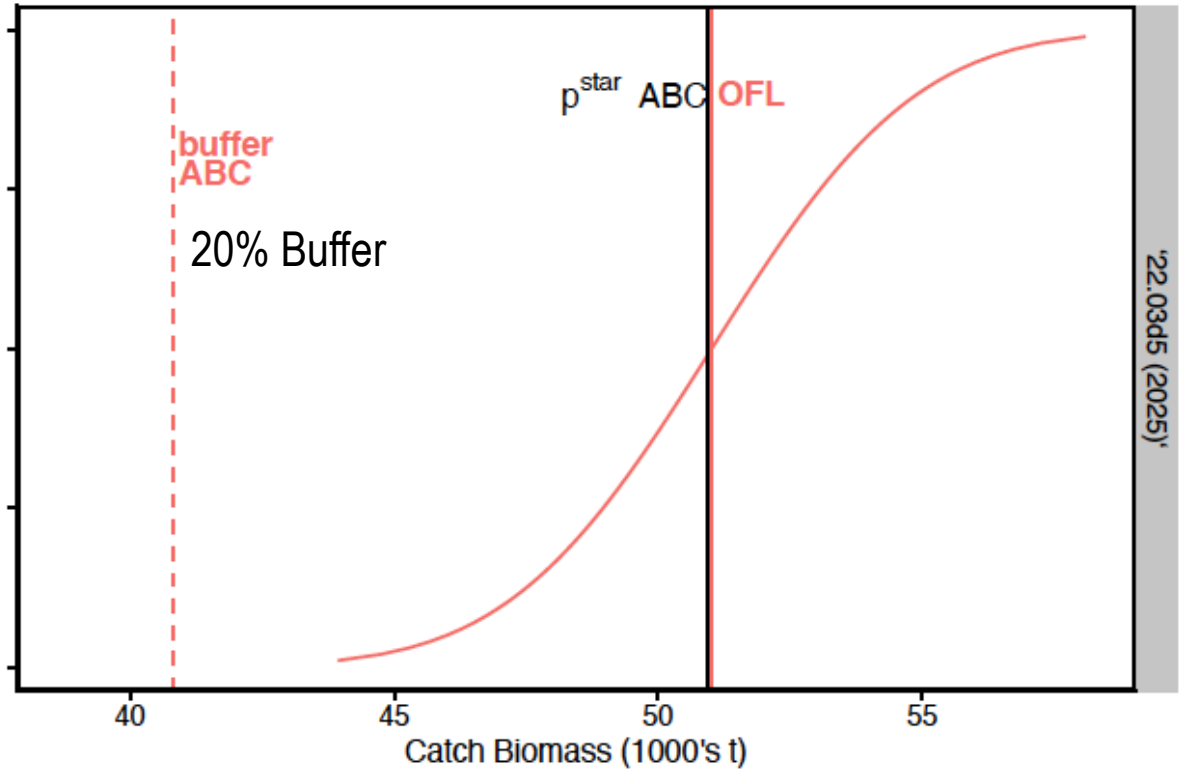
- Drop terminal year estimate
  - larger uncertainty
  - consistent with other assessments
  - consistent with last year

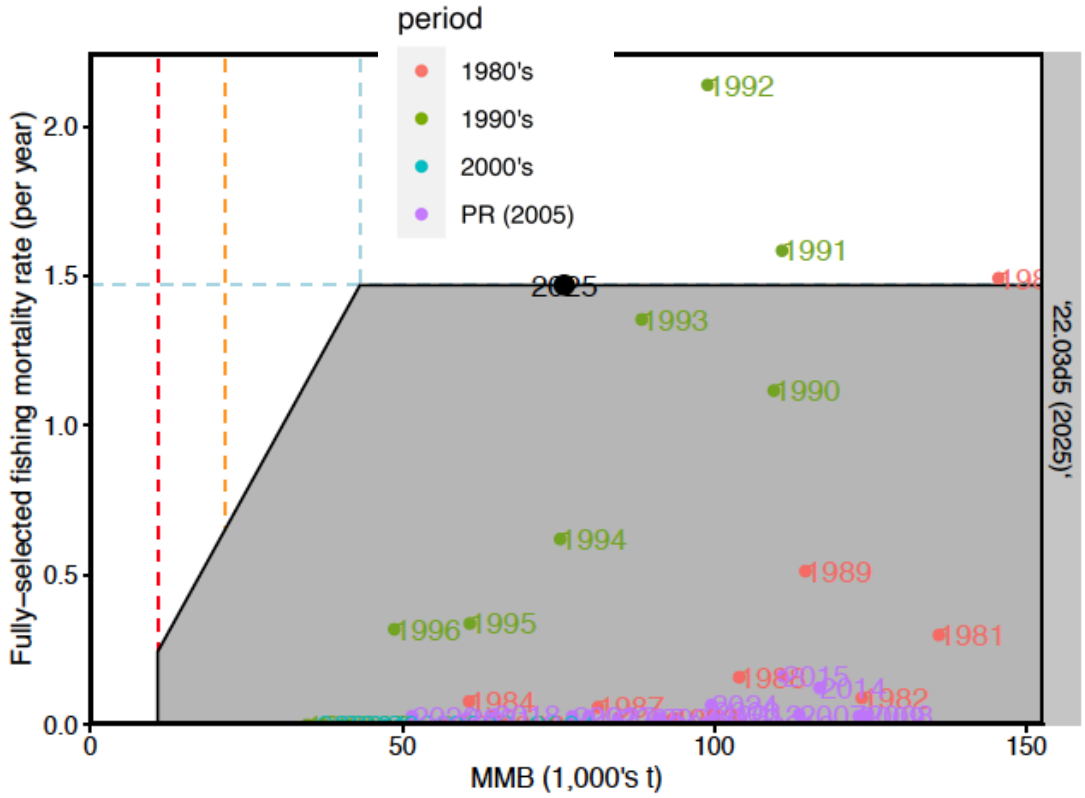
- time period: 1982-2024 (year of entry into population)





Stock Status: Tier 3a

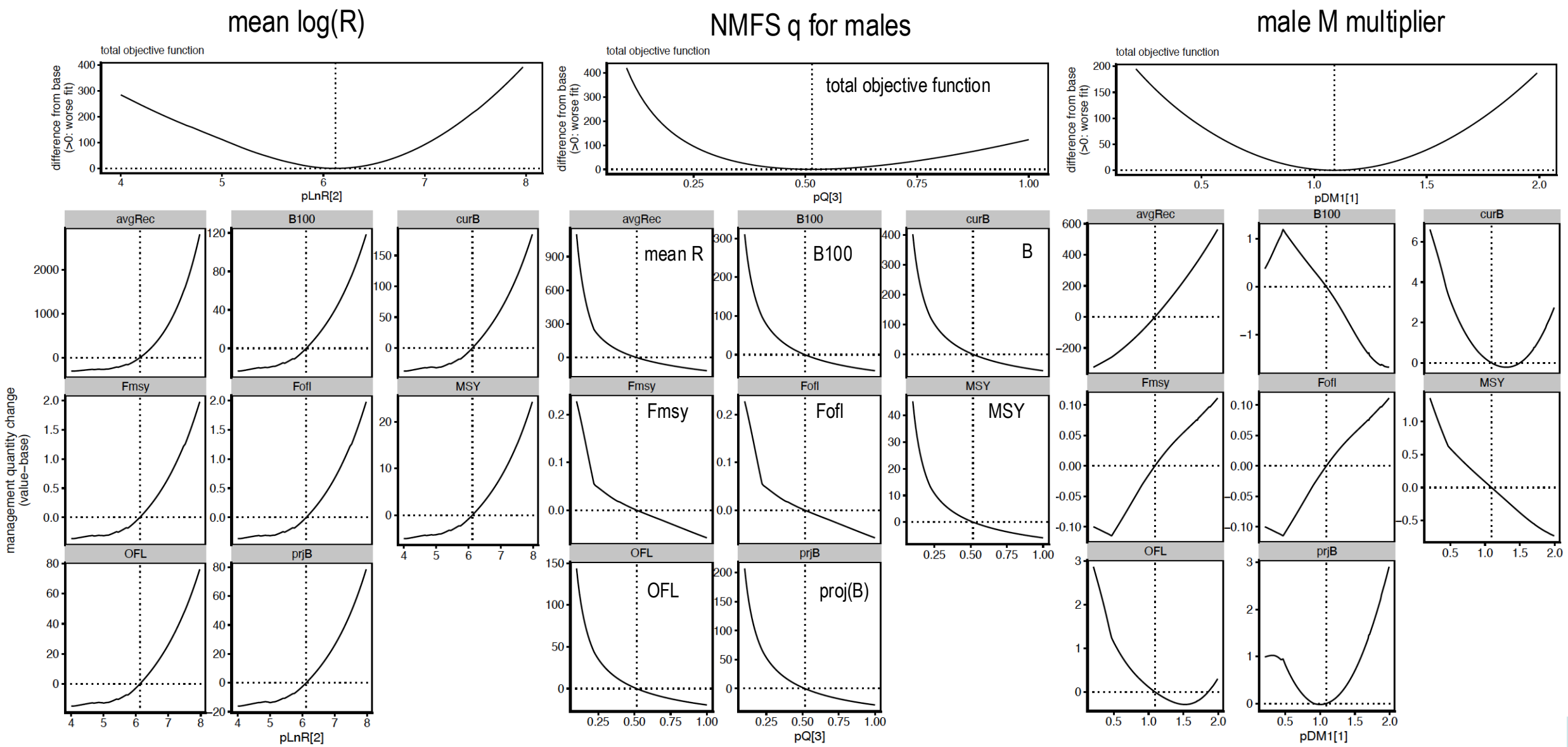




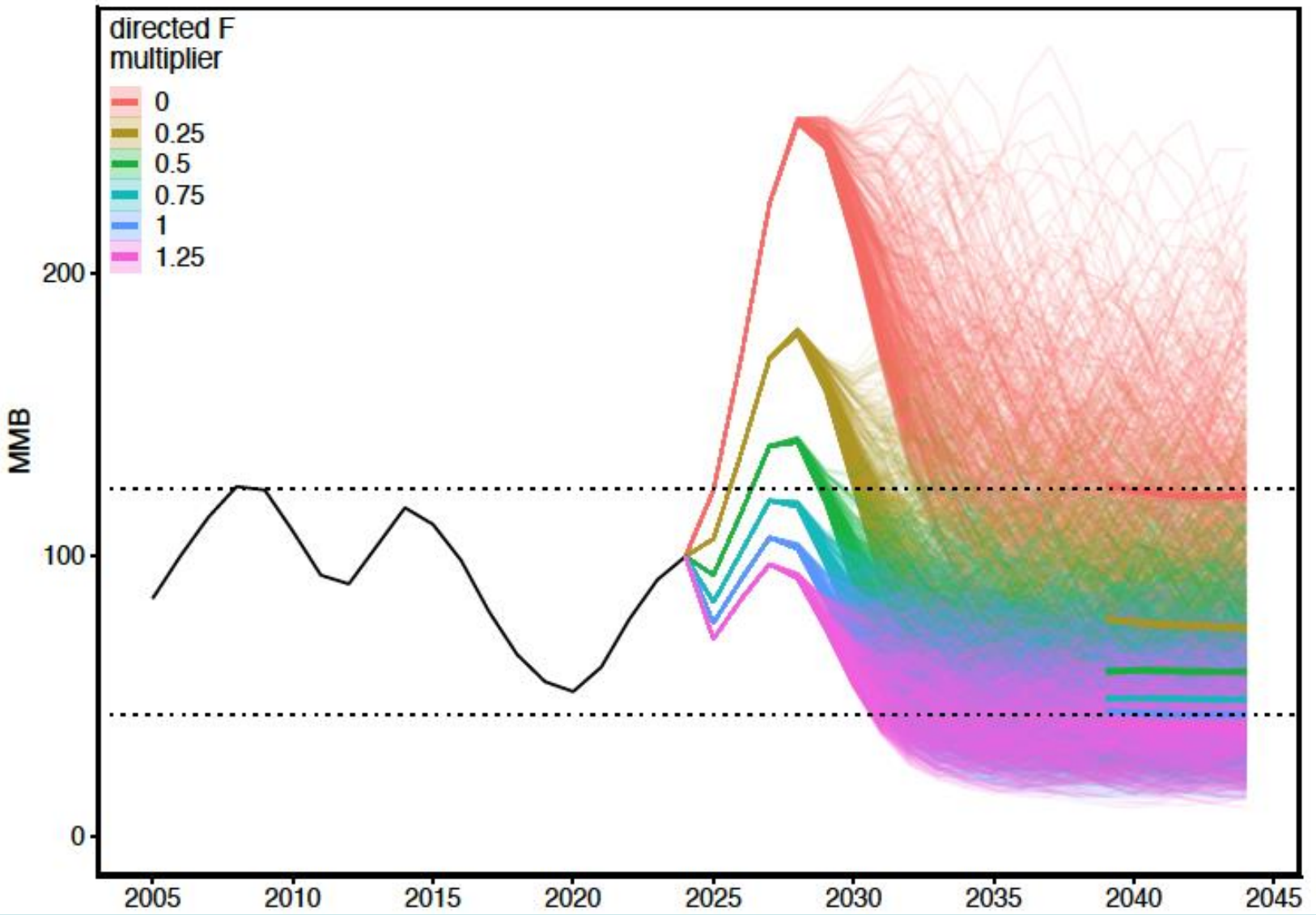
Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2021/22	17.37	62.05	0.50	0.49	0.78	27.17	21.74
2022/23	18.19	74.17	0.91	0.91	1.19	32.81	26.25
2023/24	20.00	88.21	0.94	0.94	1.09	36.20	27.15
2024/25	21.61	99.53	2.84	2.85	3.09	41.29	33.03
2025/26	NA	75.96	NA	NA	NA	51.02	40.81

In 1,000's metric tons

Likelihood Profiles



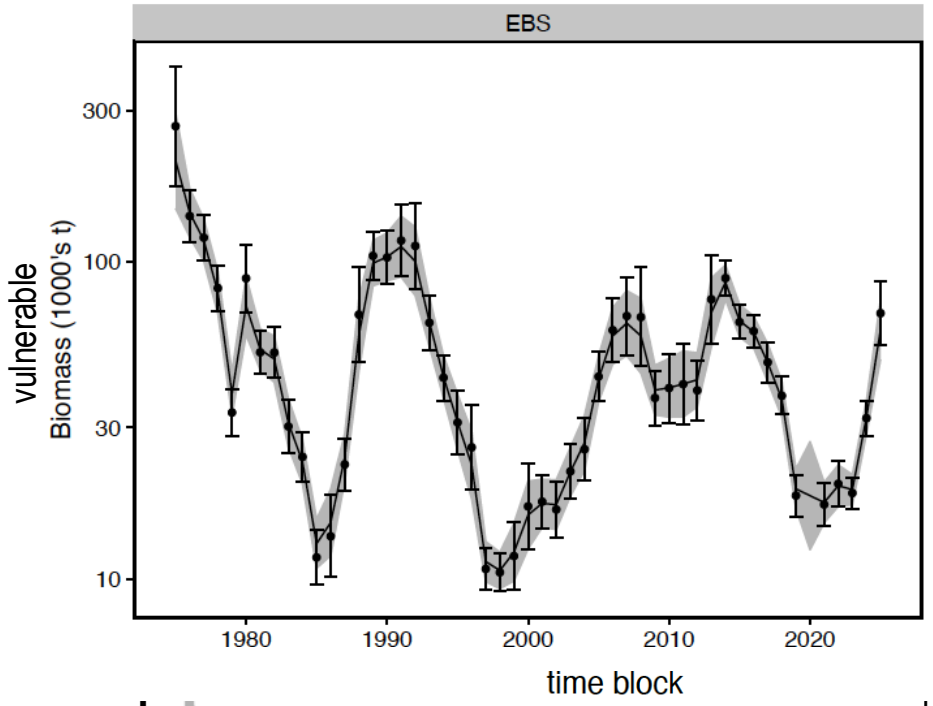
Projections from the MLE

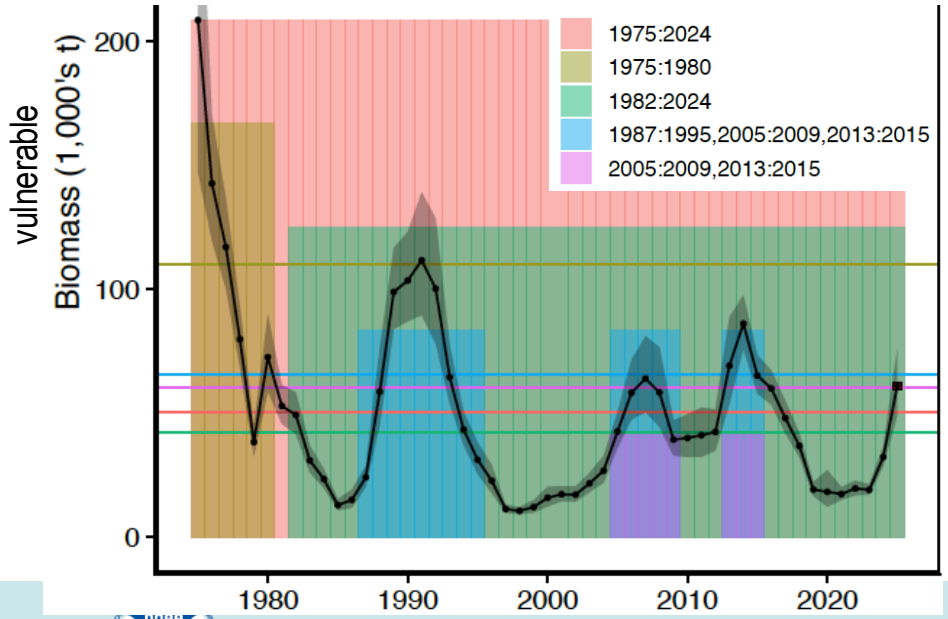


B_{100}

$B_{35\%}$

Tier 4 "Fallback"





time block	M	B	B_{MSY}	status	F_{OFL}	OFL
1975:2025	0.23	61.04	50.50	1.21	0.23	12.54
1975:1980	0.23	61.04	109.90	0.56	0.12	6.71
1982:2025	0.23	61.04	42.34	1.44	0.23	12.54
1987:1995,2005:2009,2013:2015	0.23	61.04	65.88	0.93	0.21	11.62
2005:2009,2013:2015	0.23	61.04	60.42	1.01	0.23	12.54

biomass units: 1000's t

- OFL: 12.5 thousand t
- ABC buffer
  - cv on model-estimated terminal biomass (17%), rounded to 5% intervals (15%), as basis
  - buffer = 85%
- ABC = 10.7 thousand t

Risk Table

	Assessment-related considerations	*Population dynamics considerations*	*Environmental/ecosystem considerations*	*Fishery Performance*
Level 1: Normal	Typical to moderately increased uncertainty/minor unresolved issues in assessment.	Stock trends are typical for the stock; recent recruitment is within normal range.	No apparent environmental/ecosystem concerns	No apparent fishery/resource-use performance and/or behavior concerns
Level 2: Increased concern	Major problems with the stock assessment; very poor fits to data; high level of uncertainty; strong retrospective bias.	Stock trends are highly unusual; very rapid changes in stock abundance, or highly atypical recruitment patterns.	Multiple indicators showing consistent adverse signals a) across the same trophic level as the stock, and/or b) up or down trophic levels (i.e., predators and prey of the stock)	Multiple indicators showing consistent adverse signals a) across different sectors, and/or b) different gear types
Level 3: Extreme concern	Severe problems with the stock assessment; severe retrospective bias. Assessment considered unreliable.	Stock trends are unprecedented; More rapid changes in stock abundance than have ever been seen previously, or a very long stretch of poor recruitment compared to previous patterns.	Extreme anomalies in multiple ecosystem indicators that are highly likely to impact the stock; Potential for cascading effects on other ecosystem components	Extreme anomalies in multiple performance indicators that are highly likely to impact the stock

Risk Table

Assessment-related considerations	*Population dynamics considerations*	*Environmental/ecosystem considerations*	*Fishery Performance*
Level 2: increased concern	*Level 1: Normal*	*Level 1: Normal*	*Level 1: Normal*

Same as last year

- maybe Level 1??
- Reproductive potential?
- Management proxies? $F_{35\%}$, $B_{35\%}$
- Large crab overestimated?

Same as last year

- strong cohorts
- no red flags for stock-specific indicators
- impact of bitter crab disease on population unknown

Same as last year

- warm winter, reduced sea ice
- forecast suggest same for 2026
- Corrosive bottom waters remain a concern for growth and survival.

Same as last year

- both areas open
- Fishery-informed indicators generally support stable stock condition

Recommendations

- Tier 3a Model 22.03d5
  - Same as previously-adopted assessment model
  - jitter analysis successful in identifying MLE
  - 0 max gradient at MLE
  - no parameter-at-bounds
  - all results similar to 2024 assessment

- ABC buffer: 20% (SSC adopted 20% last year)
  - continuing concern over model performance
    - abundance of large crab still overestimated
  - continuing concern over MMB as index of reproductive potential
  - continuing concern over $F_{35\%}$, $B_{35\%}$ as metrics for a sustainable fishery
  - continued bright spot: movement of recruits into larger sizes

Plans (top priority)

- GMACS
  - finish head-to-head comparison with TCSAM02 assessment model
  - present comparison at January Modeling Workshop
  - complete “working” next gen RTMB GMACS prototype

- Complete BSFRF/NMFS *selectivity* analysis for Tanner crab and BBRKC
  - wrap up selectivity analysis (Tech Memo in development)
  - present analysis at January Modeling Workshop

- Undergo CIE Review
  - opportunity for CPT/SSC to weigh in on
    - timing
    - specific issues

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