2025-05 Tanner Crab Report

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AFSC/NMFS/NOAA
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Topics

- New Analyses
- GMACS Tanner model development
- TCSAM02 alternative models
- Proposed models for 2025 assessment
- Likelihood profiles (if time permits)

Recent Work

SSC/CPT Requests Addressed

- Develop GMACS model that matches current assessment model
  - substantial progress (but not completely finished)
- Use BSFRF SBS selectivity analysis to provide priors on NMFS selectivity
  - partial: model 25_02 uses estimated capture probability curves
- Show OSA residuals and diagnostics for size compositions
- Develop likelihood profiles for model(s)
- Compare “successful” and “unsuccessful” cohorts

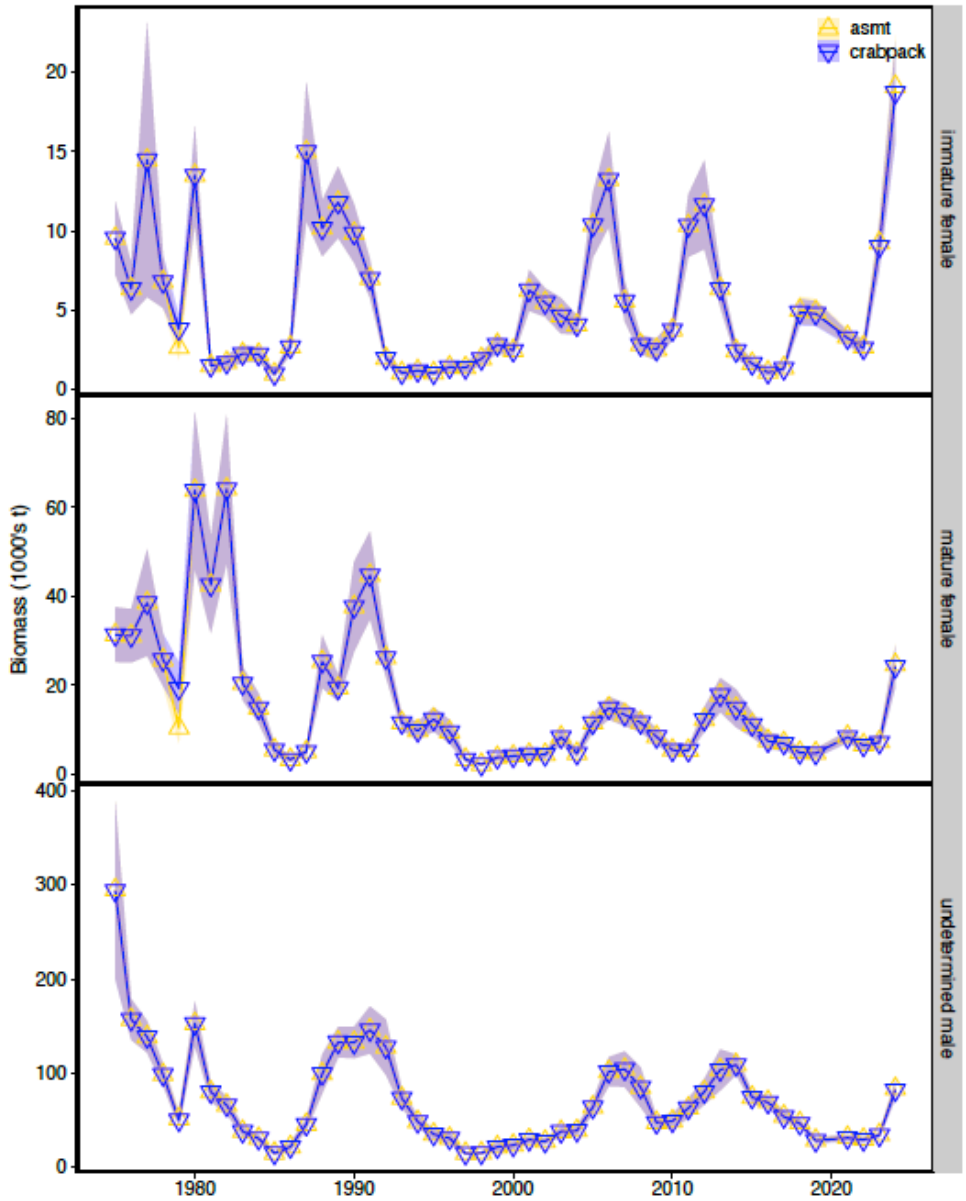
Other

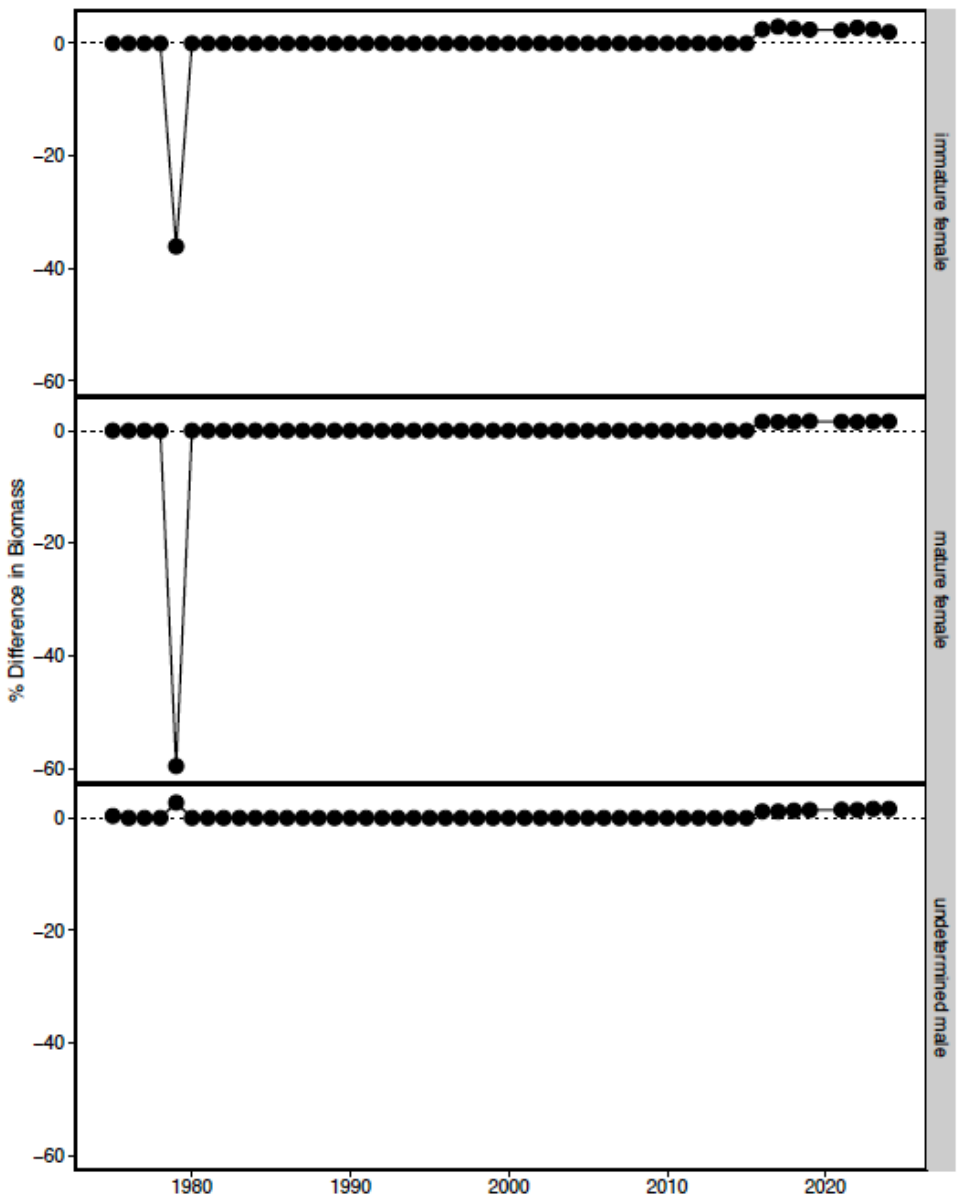
- Compare AKFIN and crabpack data pulls (SAP request)
- GMACS code
  - fixed issues with time blocks for survey catchability
  - added “zero pop” start option to match TCSAM02
  - added ascending normal selectivity curve option

crabpack comparisons

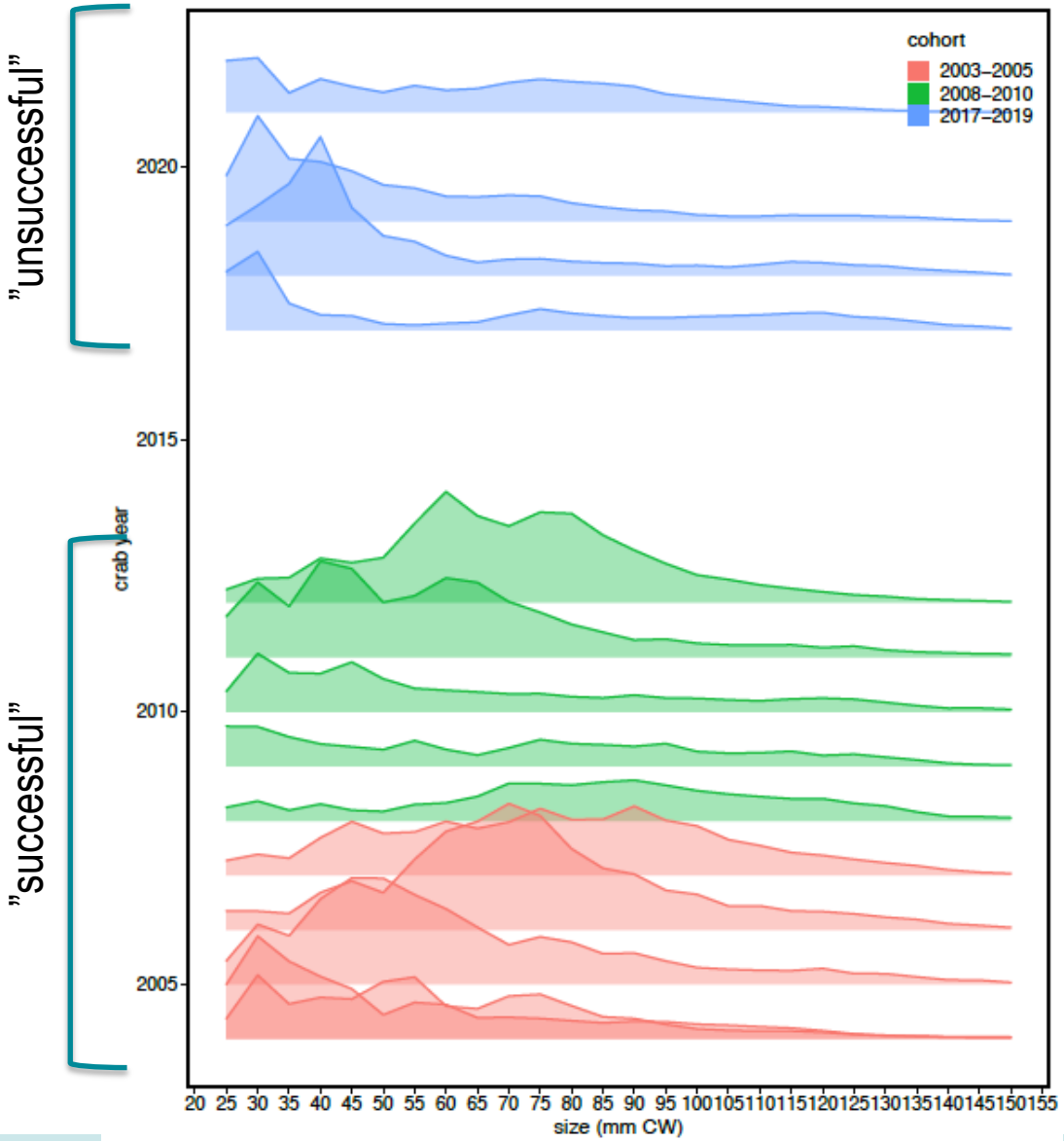
Recommendations

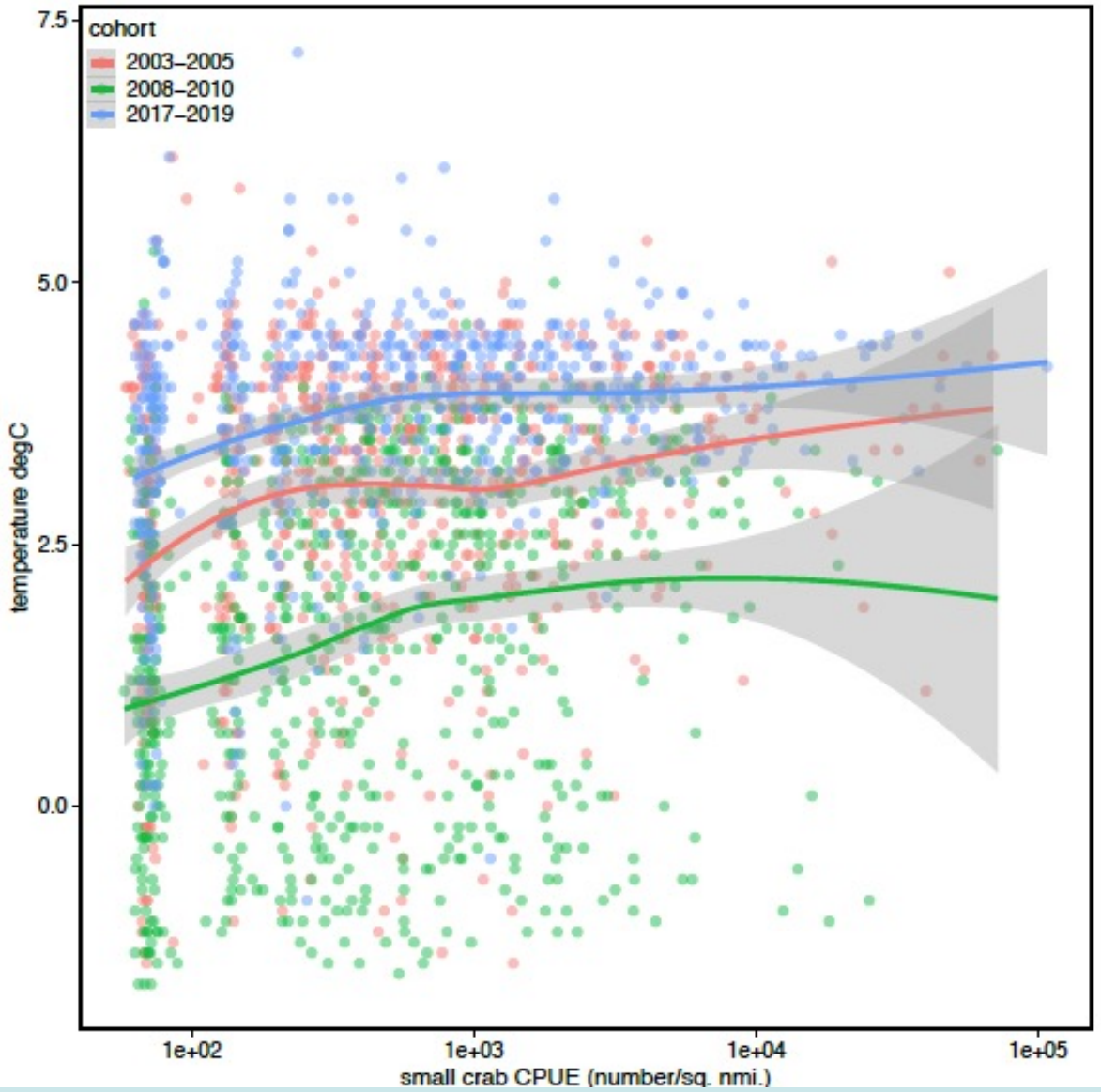
- 1979: use standard stations
- 2016+: use best precision to convert CW to weight





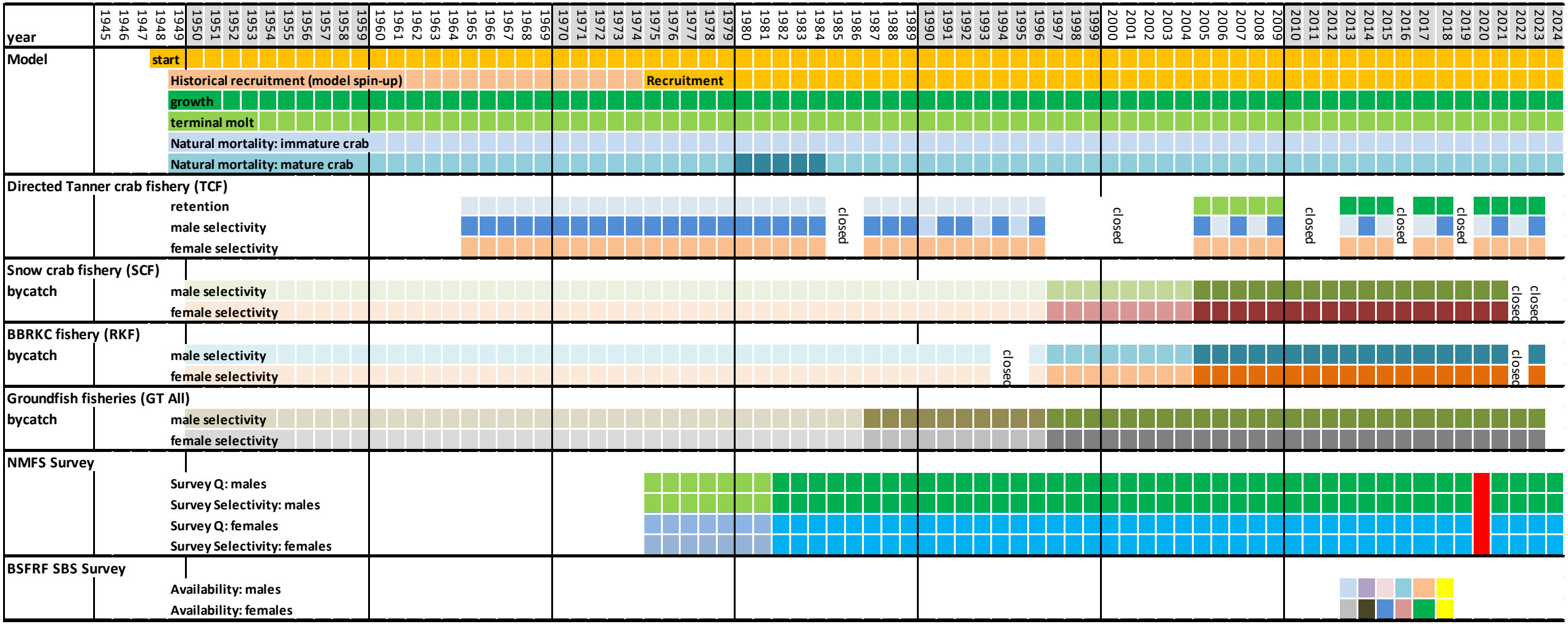
“successful” cohorts



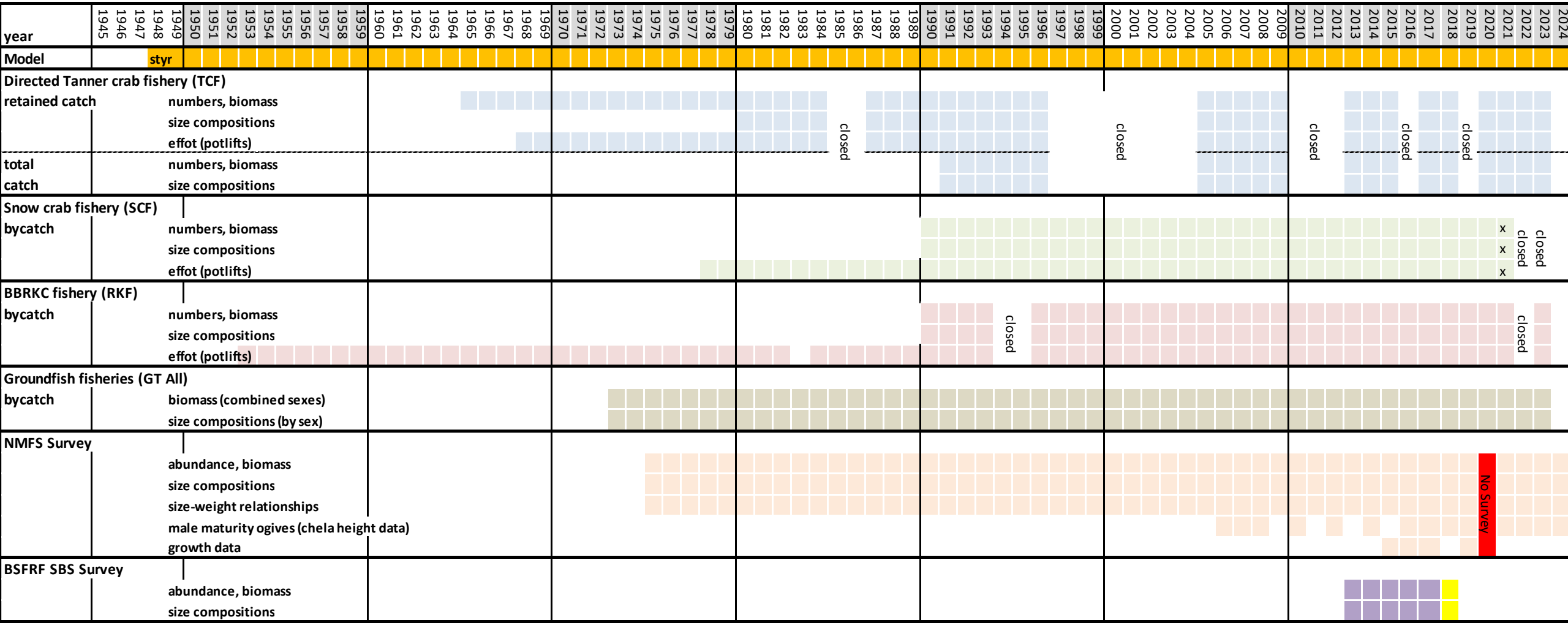


Progress toward a GMACS model for Tanner crab

2024 assessment model time frames: model processes

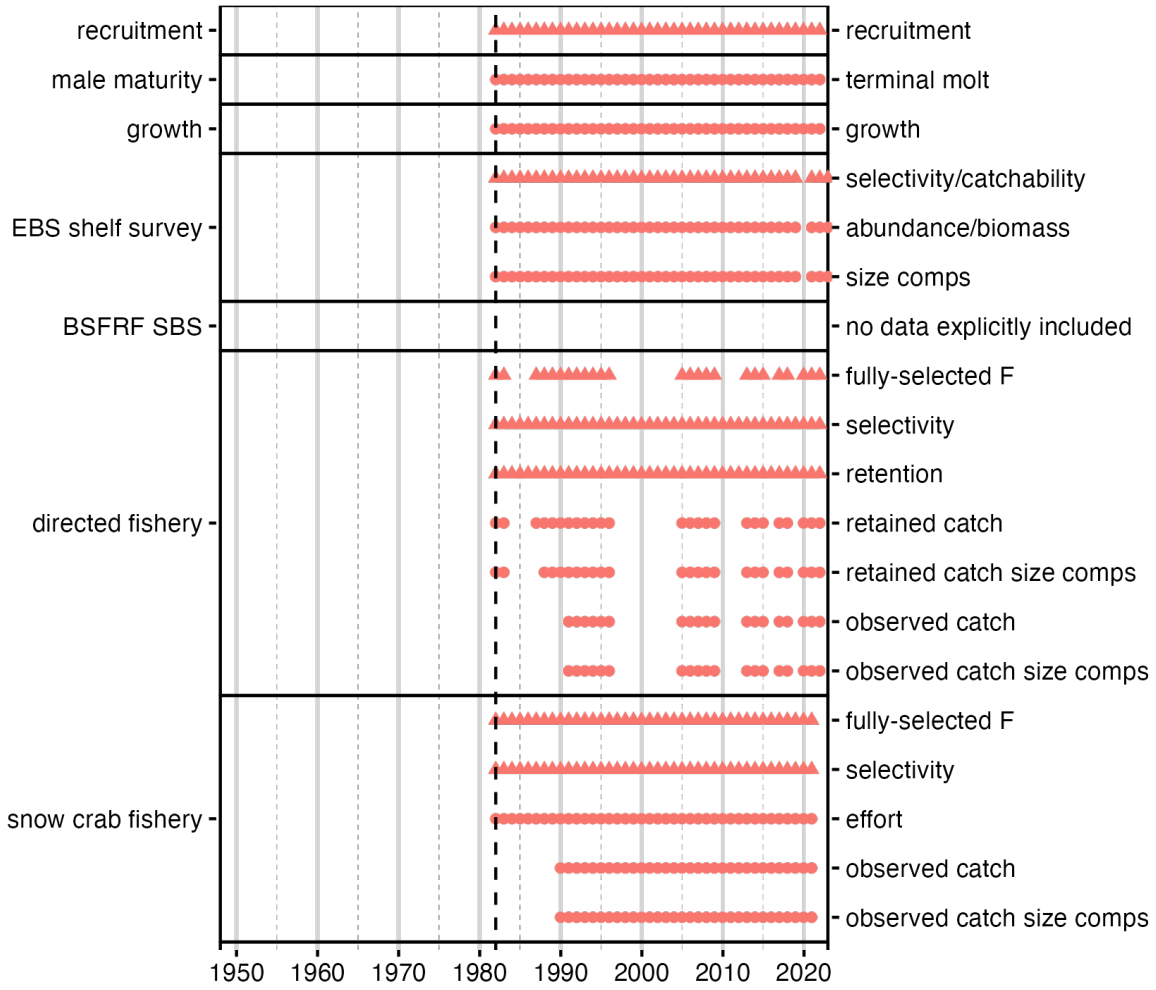


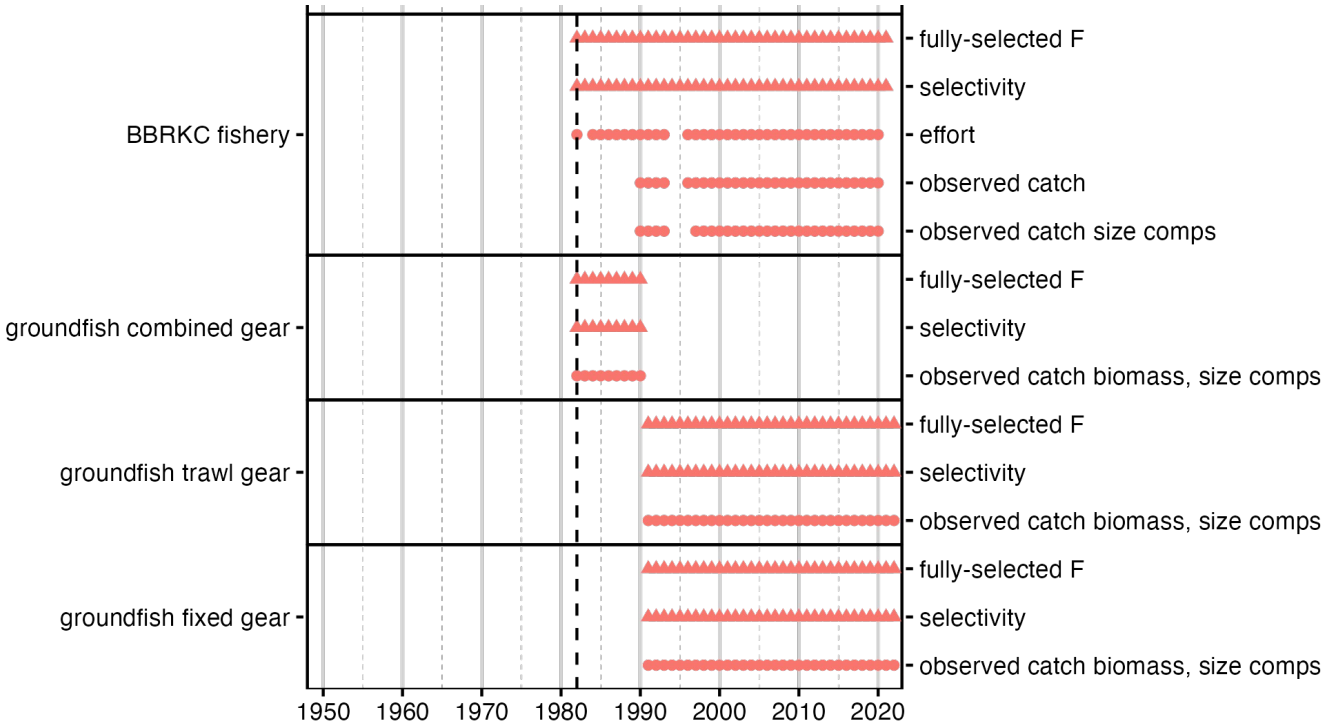
2024 assessment model: data time frames



NOAA FISHERIES

May 2024: simplified GMACS model





Population dynamics

process	time blocks	G25_05 description	time blocks	22.03d5 description
Population rates and quantities				
Population built from annual recruitment				
Recruitment	1949+	ln-scale mean + annual devs	1949-1974	ln-scale mean + annual devs constrained as AR1 process
			1975+	ln-scale mean + annual devs
	1949+	sigma-R fixed, sex ratio fixed at 1:1	1949+	sigma-R fixed, sex ratio fixed at 1:1
Growth	1949+	sex-specific, pre-specified	1949+	sex-specific
		mean post-molt size: power function of pre-molt size		mean post-molt size: power function of pre-molt size
		post-molt size: gamma distribution conditioned on pre-molt size		post-molt size: gamma distribution conditioned on pre-molt size
Maturity	1949+	sex-specific, pre-specified	1949+	sex-specific
		size-specific probability of having undergone terminal molt		size-specific probability of terminal molt
				logit-scale parameterization
Natural mortalty	1949-1979,	estimated sex/maturity state-specific multipliers on mature male	1949-1979,	estimated sex/maturity state-specific multipliers on base rate
	1985+	priors on base and multipliers based on uncertainty in max age	1985+	priors on multipliers based on uncertainty in max age
	1980-1984	estimated "enhanced mortality" period multipliers	1980-1984	estimated "enhanced mortality" period multipliers

Fisheries

Fishery/process	time blocks	G25_05 description	22.03d5 description
TCF	directed Tanner crab fishery		
capture rates	pre-1965		male nominal rate
	1965+	male ln-scale mean + annual devs	male ln-scale mean + annual devs
	1949+	ln-scale female offset	ln-scale female offset
male selectivity	1949-1990	ascending logistic	ascending logistic
	1991-1996	annually-varying ascending logistic	annually-varying ascending logistic
	2005+	annually-varying ascending logistic	annually-varying ascending logistic
female selectivity	1949+	ascending logistic	ascending logistic
male retention	1949-1990; 1991-1996; 2005-2009; 2013+	ascending logistic	ascending logistic
% retained	pre-1988	fixed at 100%	fixed at 100%
	1991-1996	fixed at 100%	fixed at 100%
	2005-2009	fixed at 100%	fixed at 100%
	2013+	fixed at 100%	fixed at 100%
SCF	bycatch in snow crab fishery		
capture rates	pre-1978		nominal rate on males
	1979-1991	extrapolated from effort	extrapolated from effort
	1992+	male ln-scale mean + annual devs	male ln-scale mean + annual devs
	1949+	ln-scale female offset	ln-scale female offset
male selectivity	1949-1996	dome-shaped (double normal)	dome-shaped (double normal)
		--plateau width fixed to 0	--plateau width fixed to 0
		--descending limb width fixed to 1	--descending limb width fixed to 1
	1997-2004	dome-shaped (double normal)	dome-shaped (double normal)
	2005+	dome-shaped (double normal)	dome-shaped (double normal)
female selectivity	1949-1996	ascending logistic	ascending logistic
	1997-2004	ascending logistic	ascending logistic
	2005+	ascending logistic	ascending logistic

Fisheries

Fishery/process	time blocks	G25_05 description	22.03d5 description
RKF	bycatch in BBRKC fishery		
capture rates	pre-1952		nominal rate on males
	1953-1991	extrapolated from effort	extrapolated from effort
	1992+	male ln-scale mean + annual devs	male ln-scale mean + annual devs
	1949+	ln-scale female offset	ln-scale female offset
male selectivity	1949-1996	ascending normal, asymptote fixed	ascending normal, asymptote fixed
	1997-2004	ascending normal, asymptote fixed	ascending normal, asymptote fixed
	2005+	ascending normal, asymptote fixed	ascending normal, asymptote fixed
female selectivity	1949-1996	ascending normal, asymptote fixed	ascending normal, asymptote fixed
	1997-2004	ascending normal	ascending normal
	2005+	ascending normal	ascending normal
GF All	bycatch in groundfish fisheries		
capture rates	pre-1973	male ln-scale mean from 1973+	male ln-scale mean from 1973+
	1973+	male ln-scale mean + annual devs	male ln-scale mean + annual devs
	1973+	ln-scale female offset	ln-scale female offset
male selectivity	1949-1986	ascending logistic	ascending logistic
	1987-1996	ascending logistic	ascending logistic
	1997+	ascending logistic	ascending logistic
female selectivity	1949-1986	ascending logistic	ascending logistic
	1987-1996	ascending logistic	ascending logistic
	1997+	ascending logistic	ascending logistic

Surveys

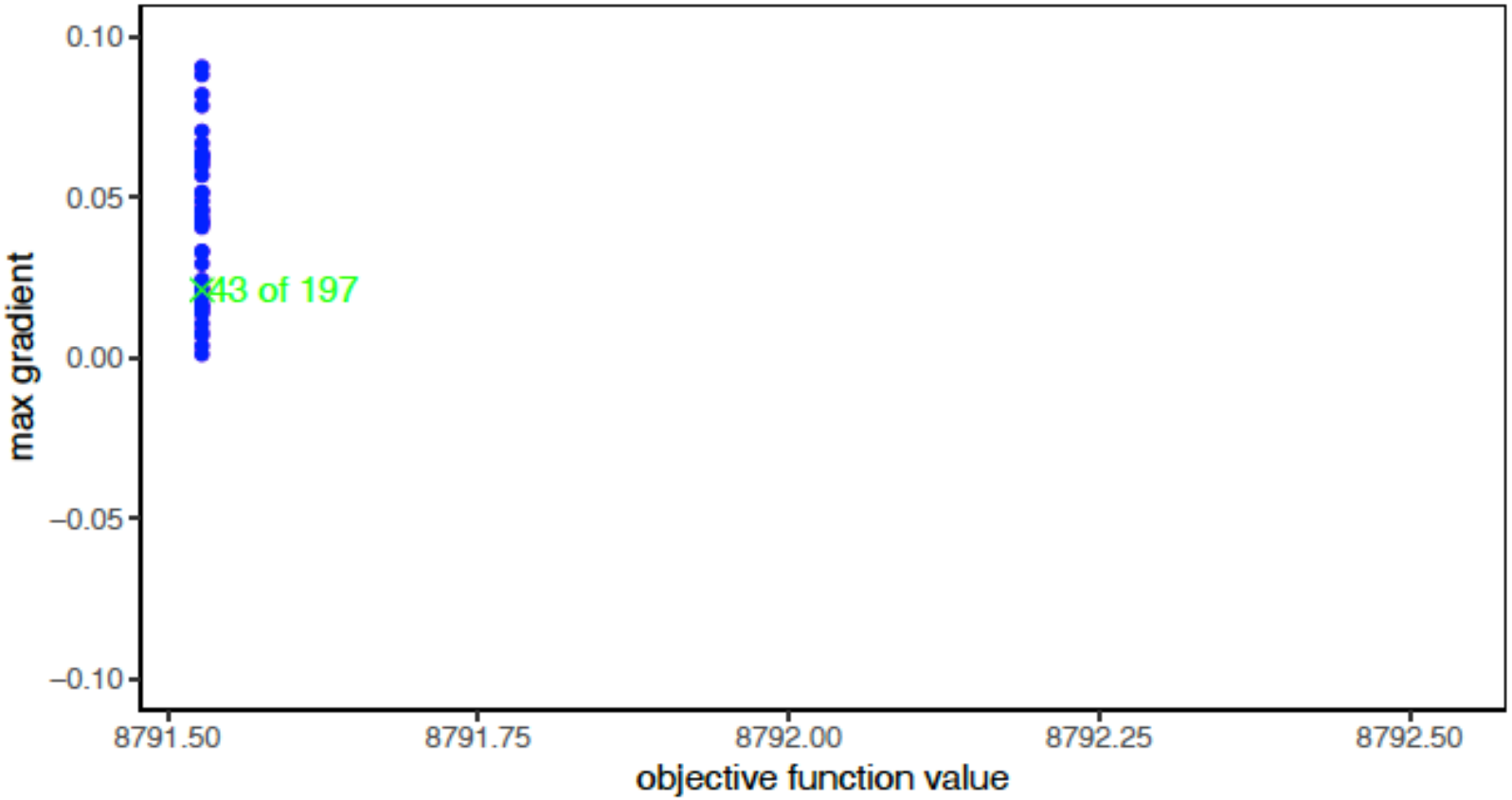
Survey/process	time blocks	G25_05	22.03d5 description
NMFS EBS trawl survey			
male survey q	1975-1981	ln-scale	ln-scale
	1982+	ln-scale w/ prior based on Somerton's underbag experiment	ln-scale w/ prior based on Somerton's underbag experiment
female survey q	1975-1981	ln-scale	ln-scale
	1982+	ln-scale w/ prior based on Somerton's underbag experiment	ln-scale w/ prior based on Somerton's underbag experiment
male selectivity	1975-1981	ascending normal, fixed fully-selected size at 180	ascending normal, fixed fully-selected size at 180
	1982+	ascending normal, fixed fully-selected size at 180	ascending normal, fixed fully-selected size at 180
female selectivity	1975-1981	ascending normal, fixed fully-selected size at 130	ascending normal, fixed fully-selected size at 130
	1982+	ascending normal, fixed fully-selected size at 130	ascending normal, fixed fully-selected size at 130
BSFRF SBS trawl surveys			
male catchability	2013-2018	fixed at 1 for all sizes	fixed at 1 for all sizes
male availability	2013-2018	empirically-determined outside the model	empirically-determined outside the model
female catchability	2013-2018	fixed at 1 for all sizes	fixed at 1 for all sizes
female availability	2013-2018	empirically-determined outside the model	empirically-determined outside the model

Likelihoods

- Penalties??

		G25_05			22.03d5		
Component	Type	included in optimization	Fits	Likelihood distribution	included in optimization	Fits	Likelihood distribution
TCF: retained catch	biomass	yes	males only	lognormal	yes	males only	lognormal
	size comp.s	yes	males only	multinomial	yes	males only	multinomial
TCF: total catch	biomass	yes	total	lognormal	yes	total	lognormal
	size comp.s	yes	by sex (extended)	multinomial	yes	by sex (extended)	multinomial
SCF: total catch	biomass	yes	total	lognormal	yes	total	lognormal
	size comp.s	yes	by sex (extended)	multinomial	yes	by sex (extended)	multinomial
RKF: total catch	biomass	yes	total	lognormal	yes	total	lognormal
	size comp.s	yes	by sex (extended)	multinomial	yes	by sex (extended)	multinomial
GF All: total catch	abundance	yes	total	lognormal	yes	total	lognormal
	biomass	yes	total	lognormal	yes	total	lognormal
	size comp.s	yes	by sex	multinomial	yes	by sex	multinomial
NMFS "M" survey (males only, no maturity)	biomass	yes	males only	lognormal	yes	males only	lognormal
	size comp.s	yes	males only	multinomial	yes	males only	multinomial
NMFS "F" survey (females only, w/ maturity)	biomass	yes	by maturity classification	lognormal	yes	by maturity classification	lognormal
	size comp.s	yes	by maturity classification	multinomial	yes	by maturity classification	multinomial
BSFRF "M" survey (males only, no maturity)	biomass	yes	males only	lognormal	yes	males only	lognormal
	size comp.s	yes	males only	D-M	yes	males only	D-M
BSFRF "F" survey (females only, w/ maturity)	biomass	yes	by maturity classification	lognormal	yes	by maturity classification	lognormal
	size comp.s	yes	by maturity classification	D-M	yes	by maturity classification	D-M
growth data	EBS only	no			yes	by sex	gamma
male maturity ogive data	EBS only	no			yes	males only	binomial

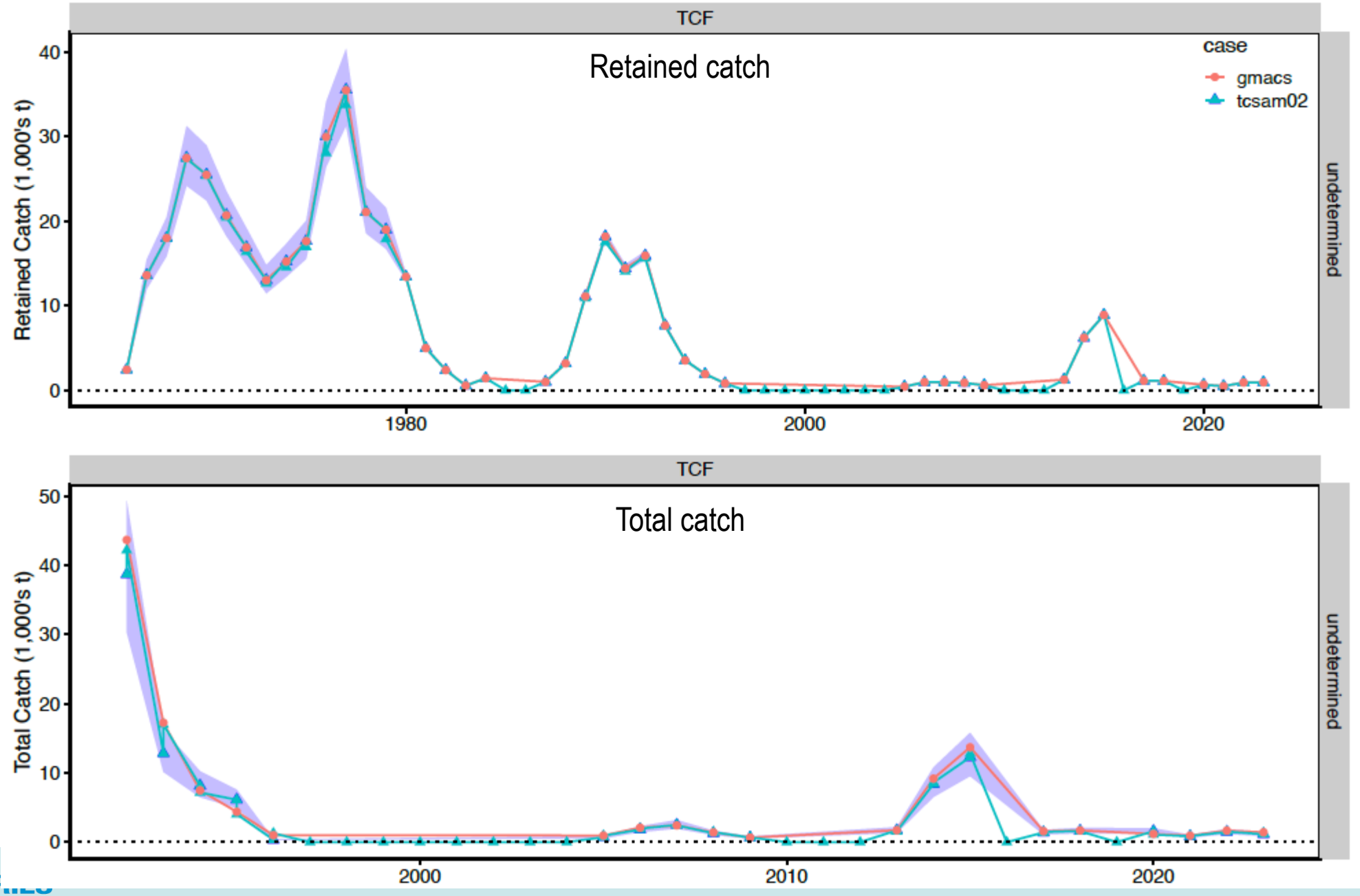
GMACS Model



parameter description	bound	lb	ub	GMACS
Sel NMFS male Ascending normal par 1 block group 2 block 1	upper	0.00	3.91	3.91
Sel SCF female Logistic mean block group 6 block 2	upper	1.61	5.01	5.01
Sel NMFS female base Ascending normal par 2	upper	1.61	5.01	5.01
Sel NMFS female Ascending normal par 1 block group 2 block 1	upper	0.00	3.91	3.91

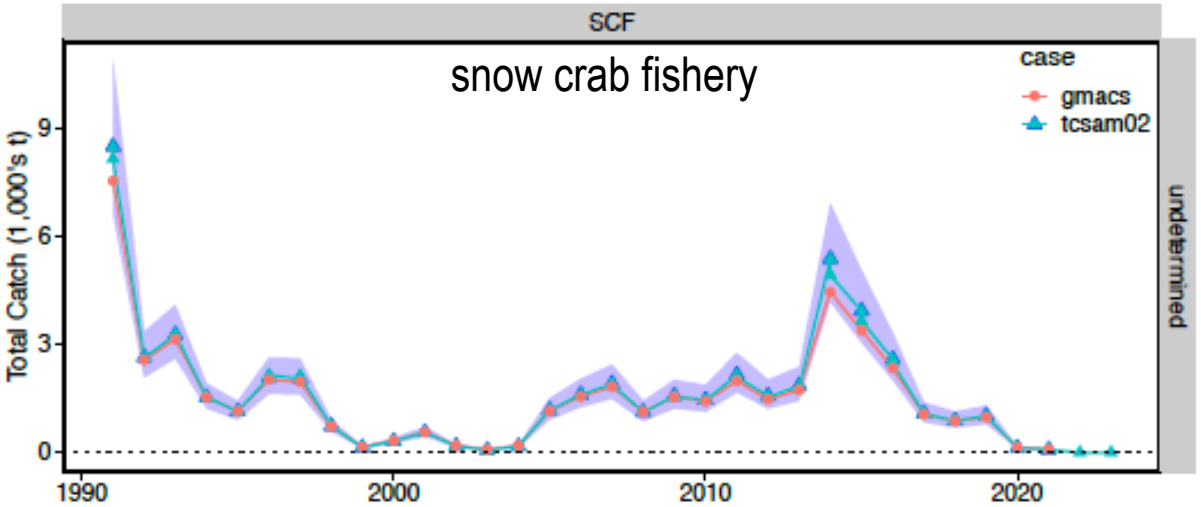
GMACS Model

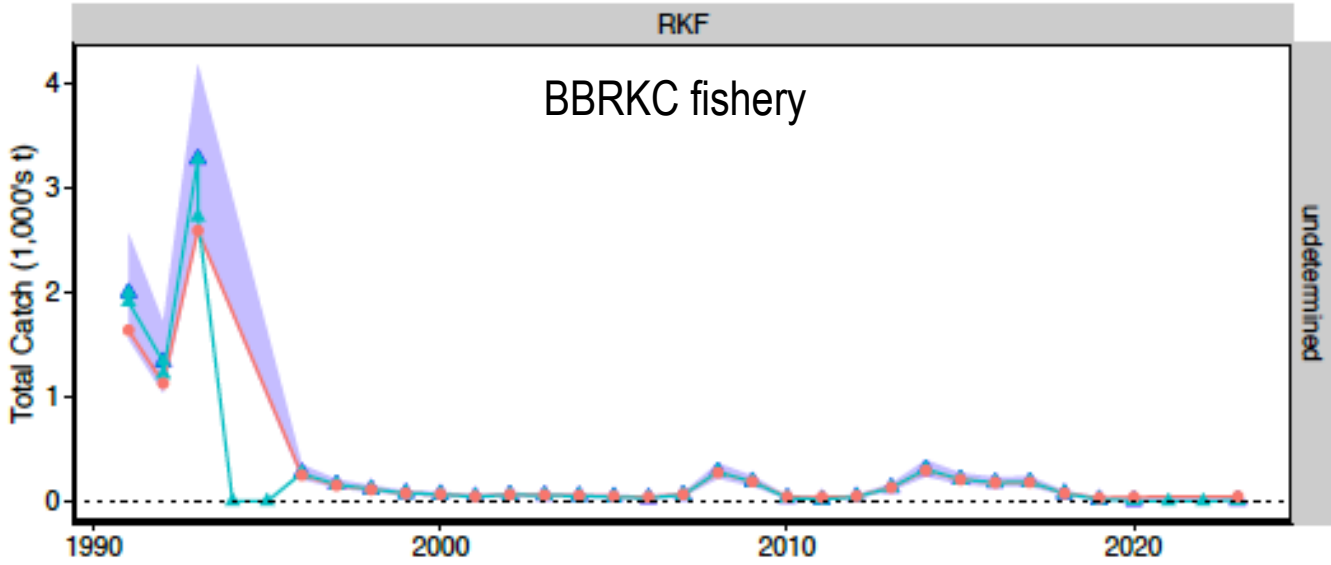
Fits to Directed Fishery Catch Biomass

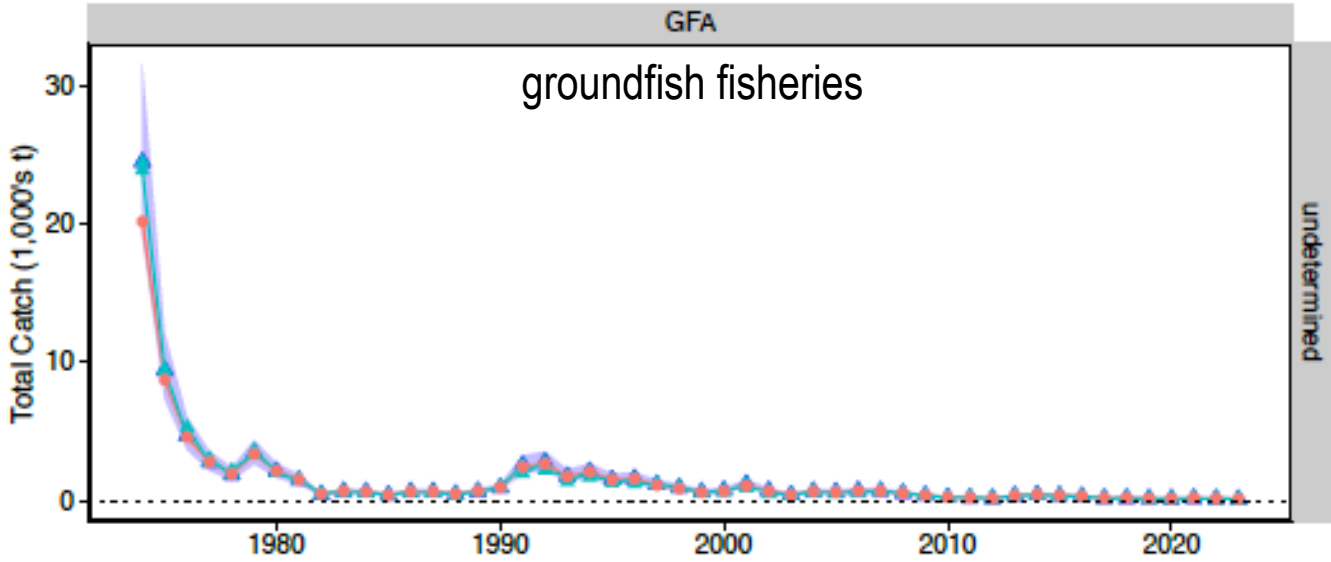


GMACS Model

Fits to total bycatch

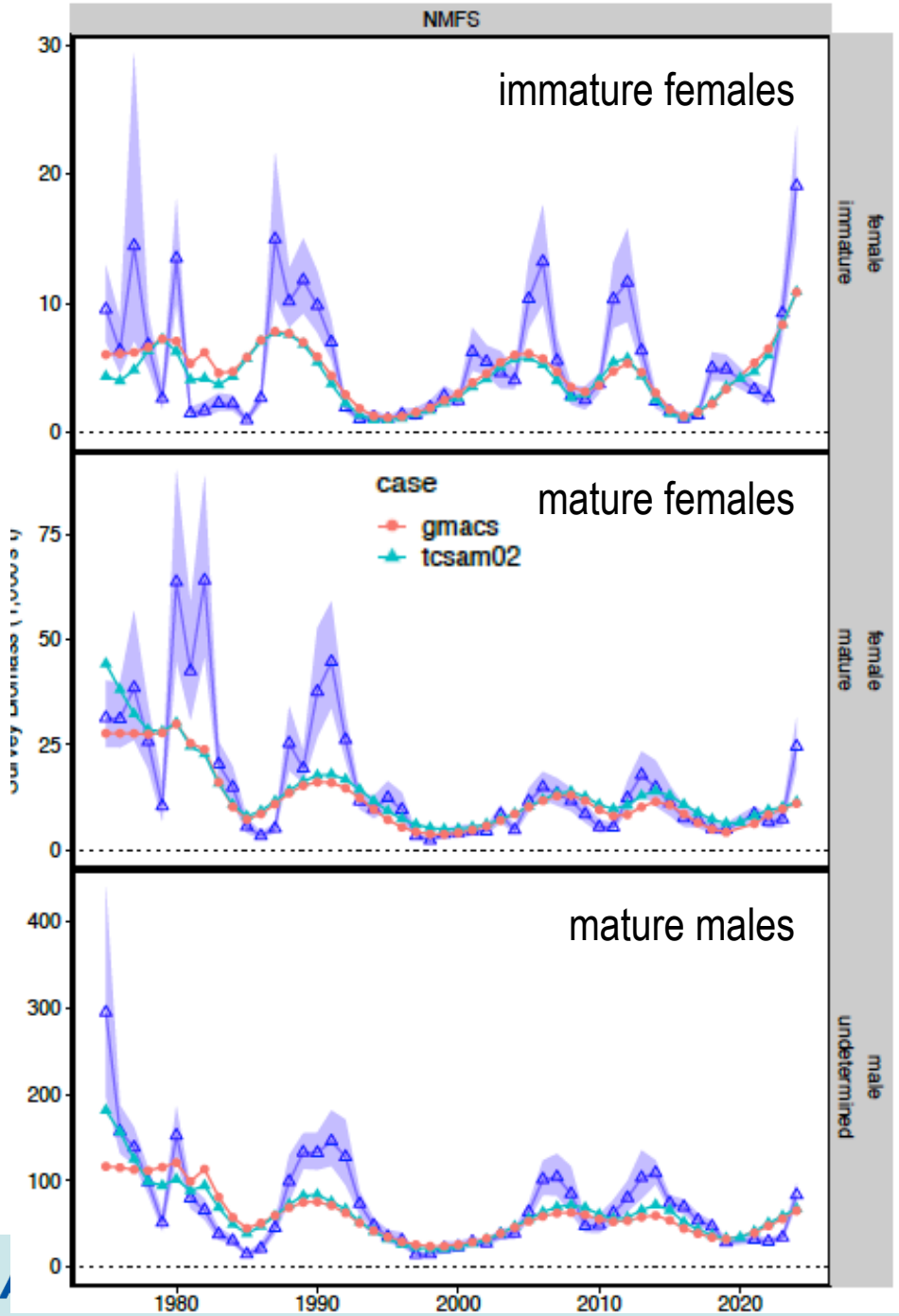


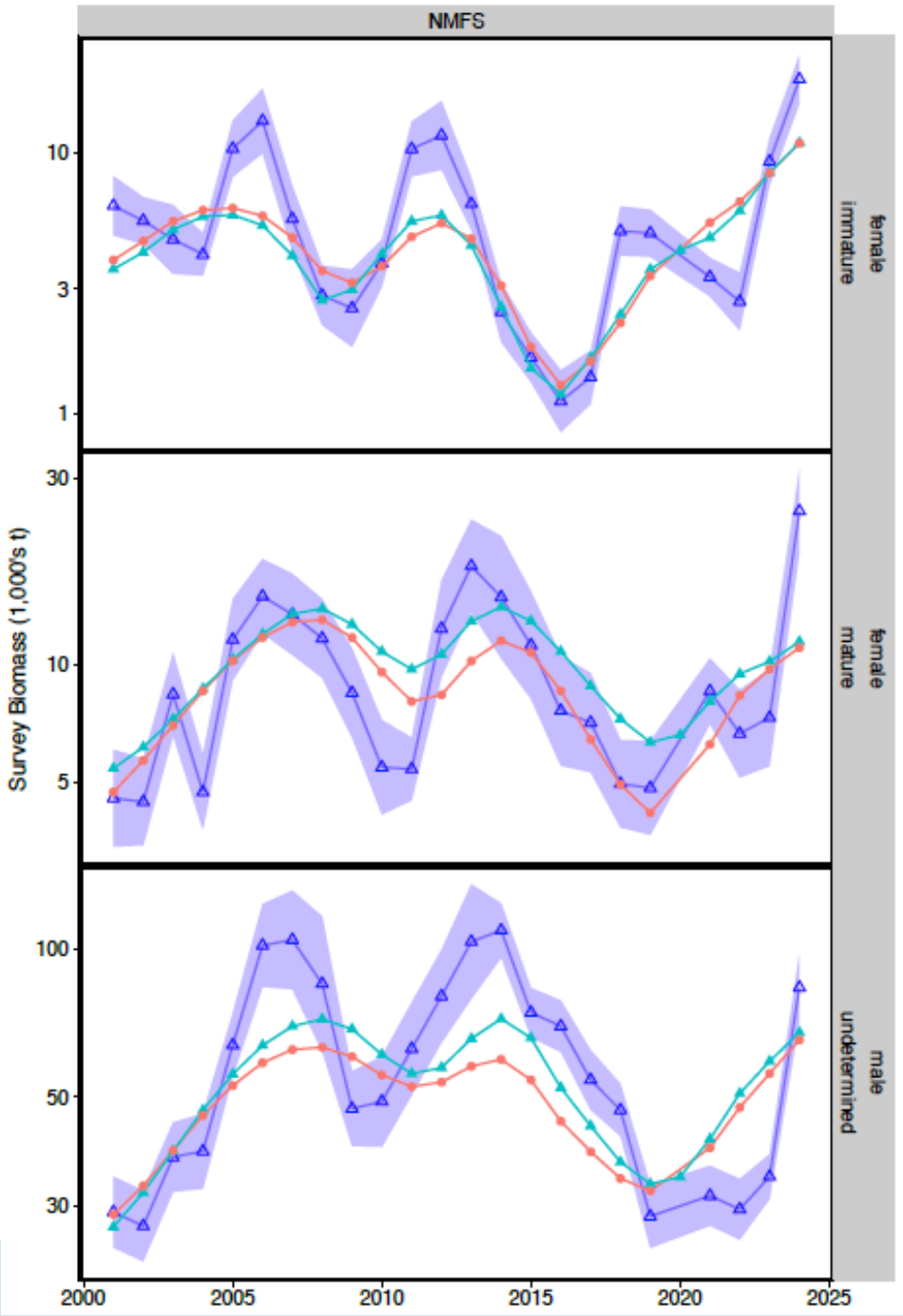




GMACS Model

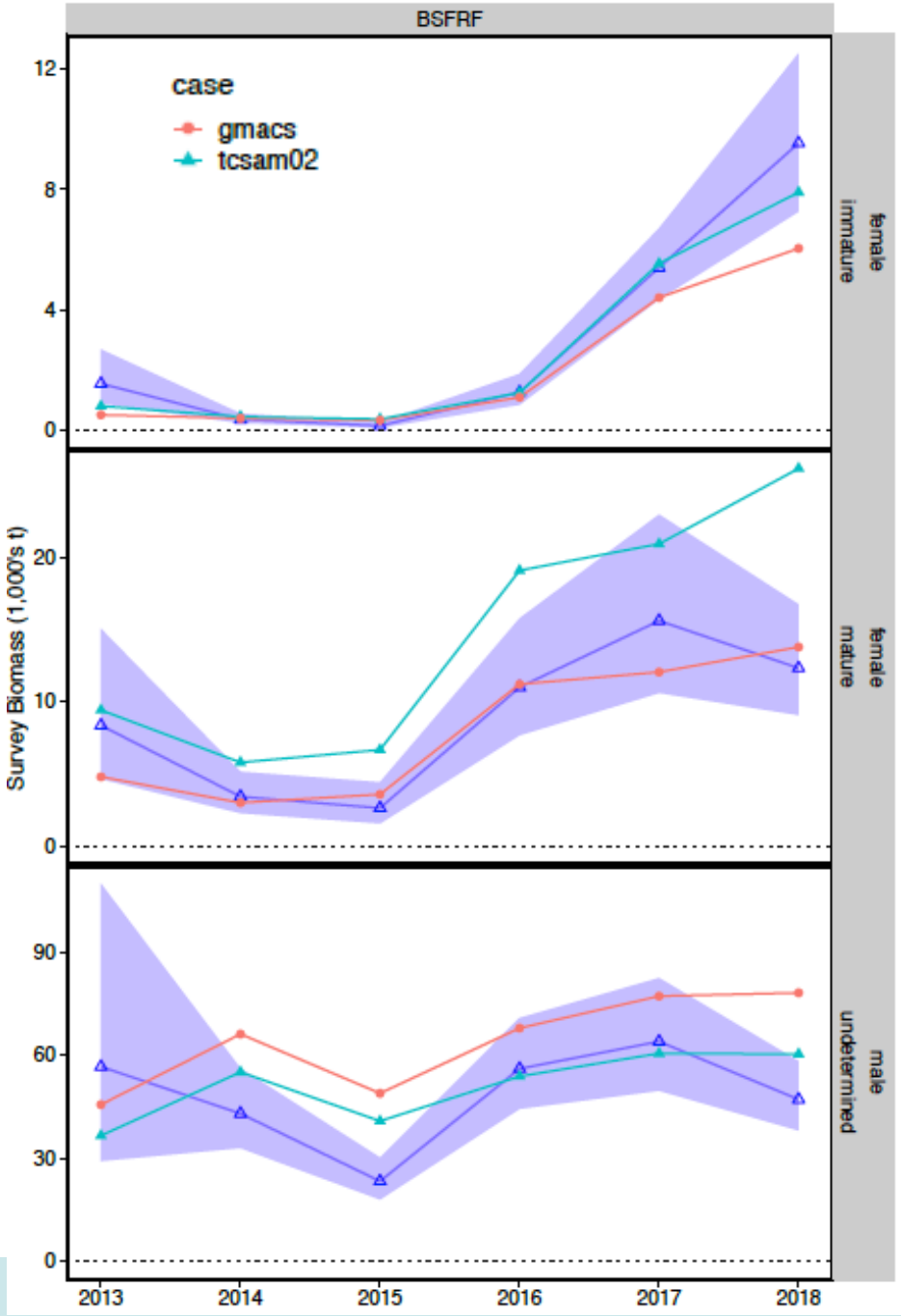
NMFS Survey Biomass





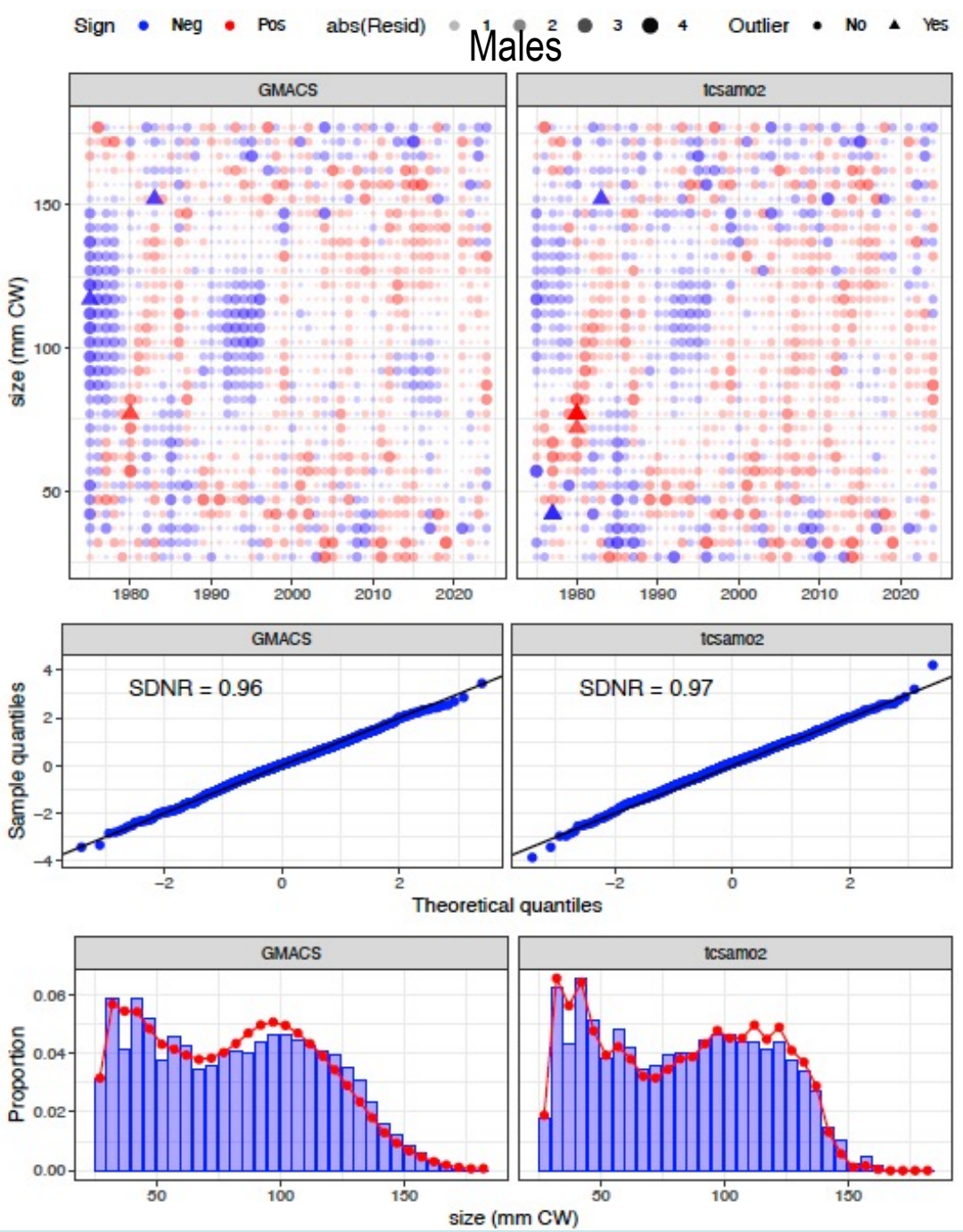
GMACS Model

BSFRF
Survey
Biomass



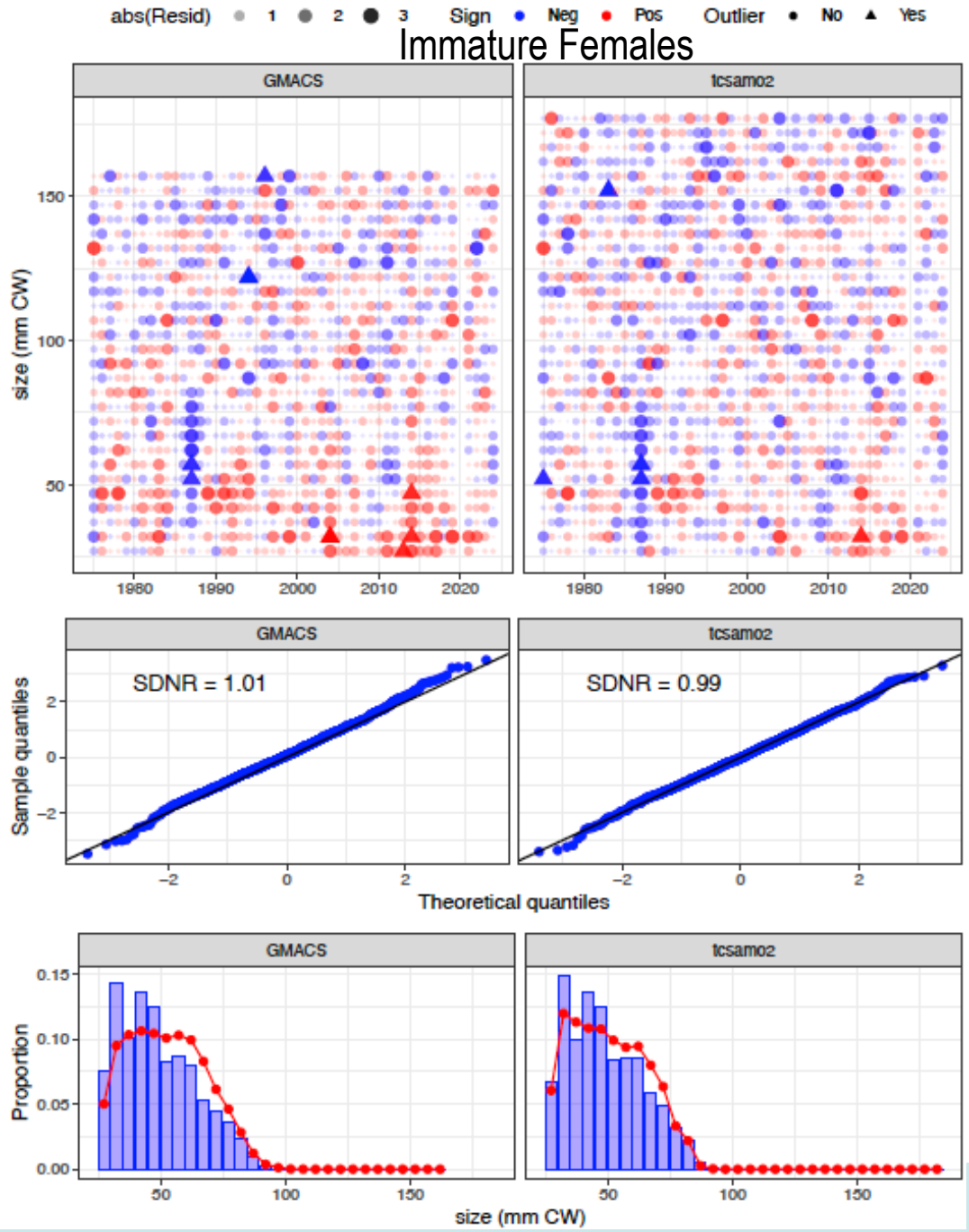
GMACS Model

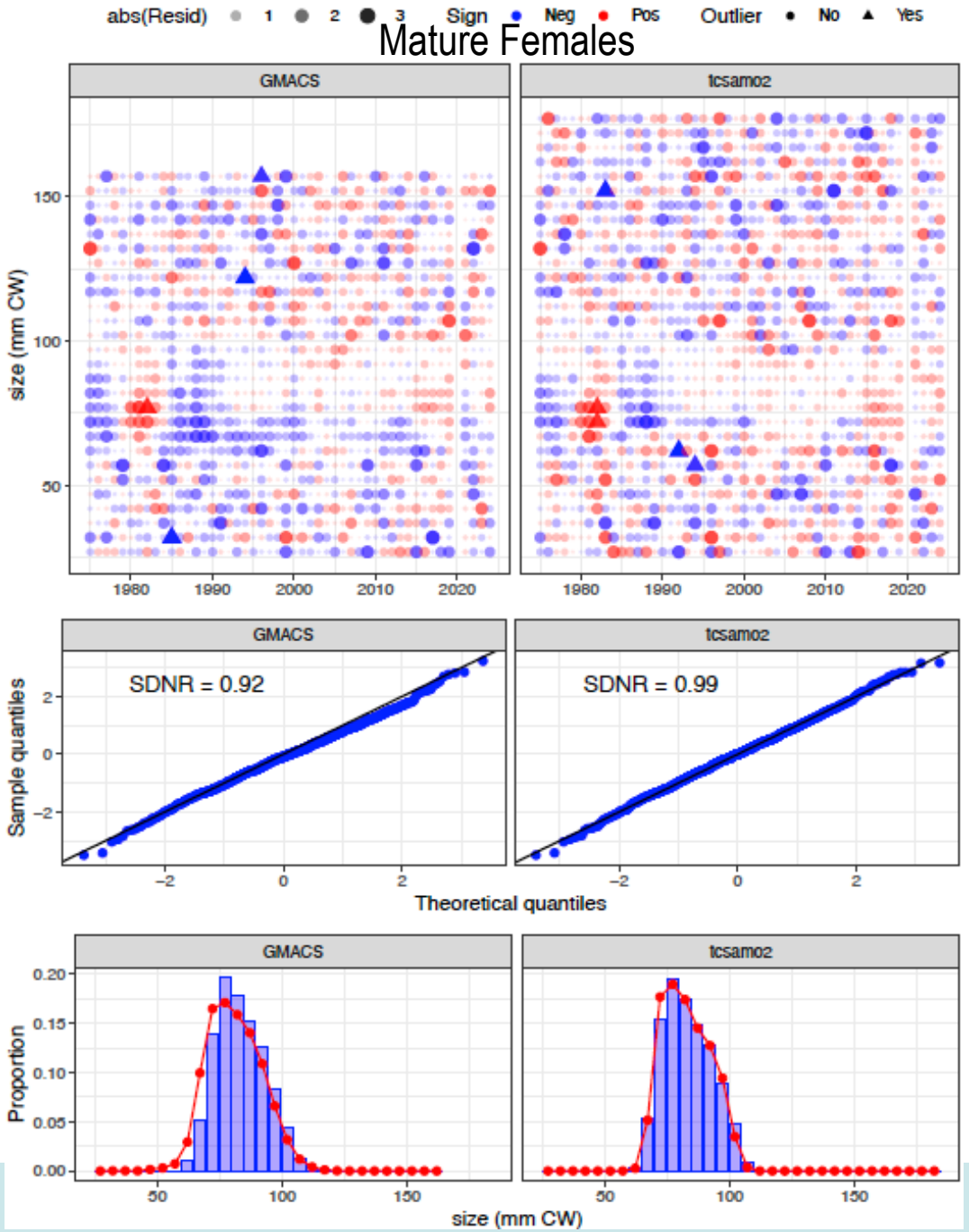
NMFS Survey Size Comps



GMACS Model

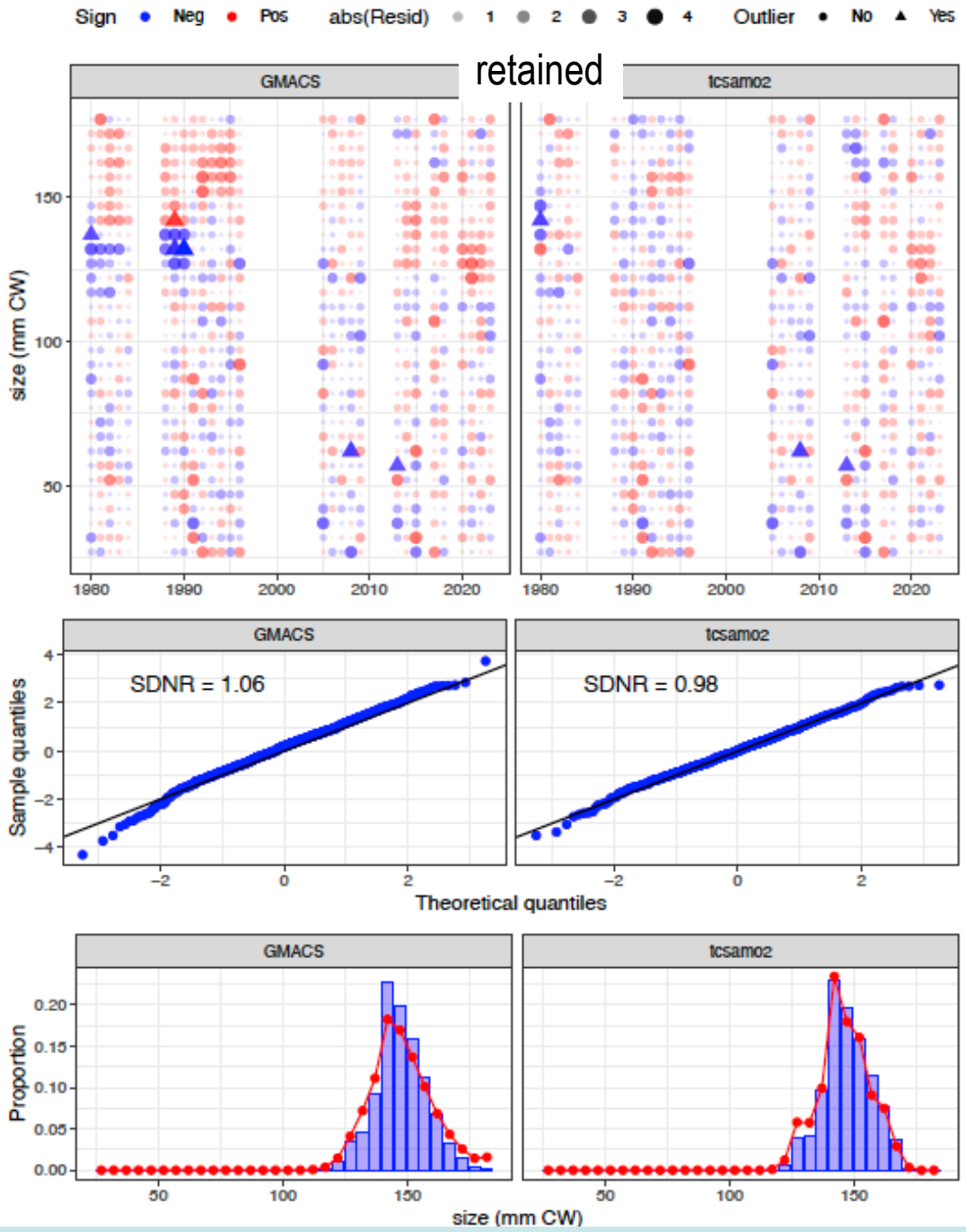
NMFS Survey Size Comps

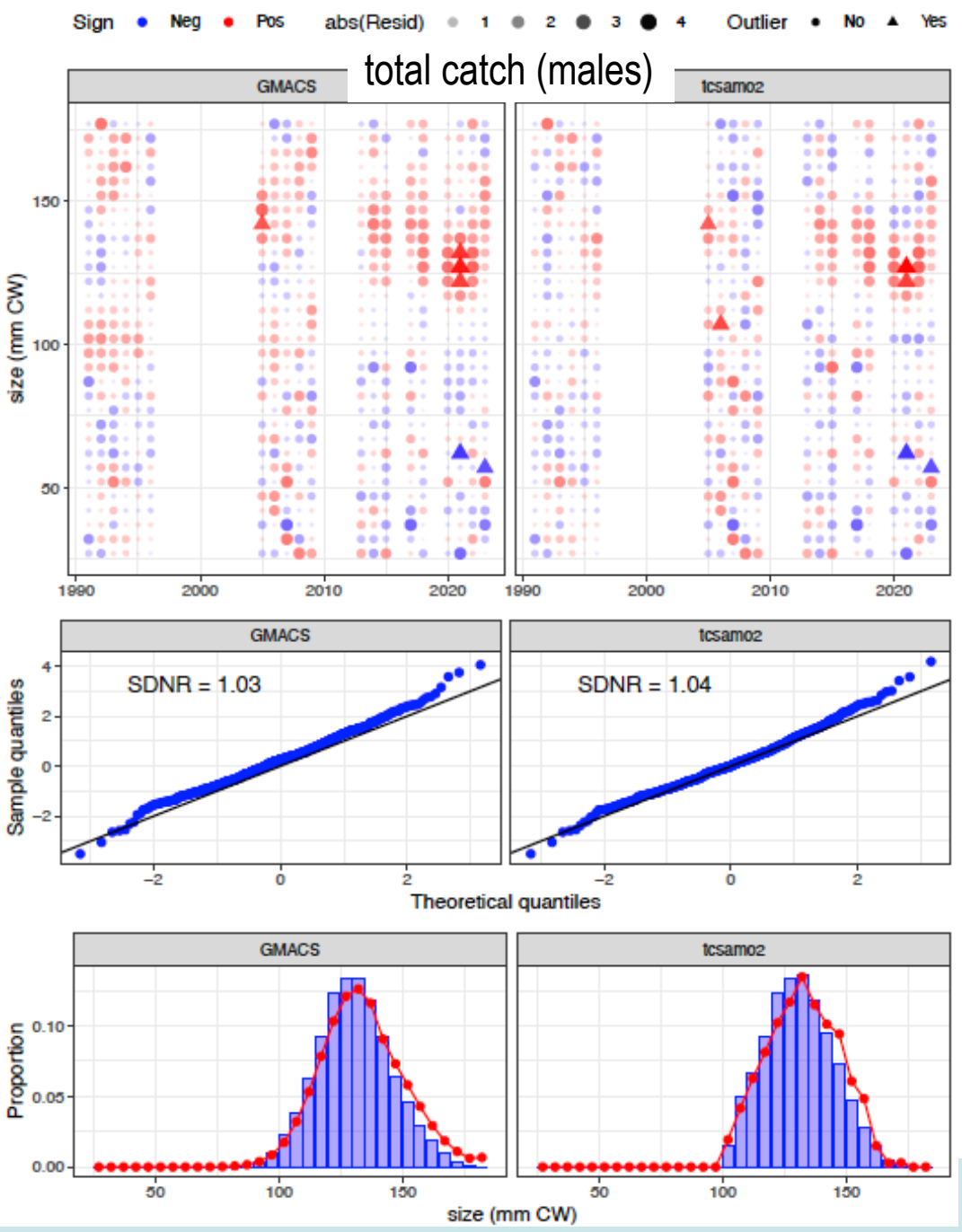




GMACS Model

Directed Fishery Size Comps

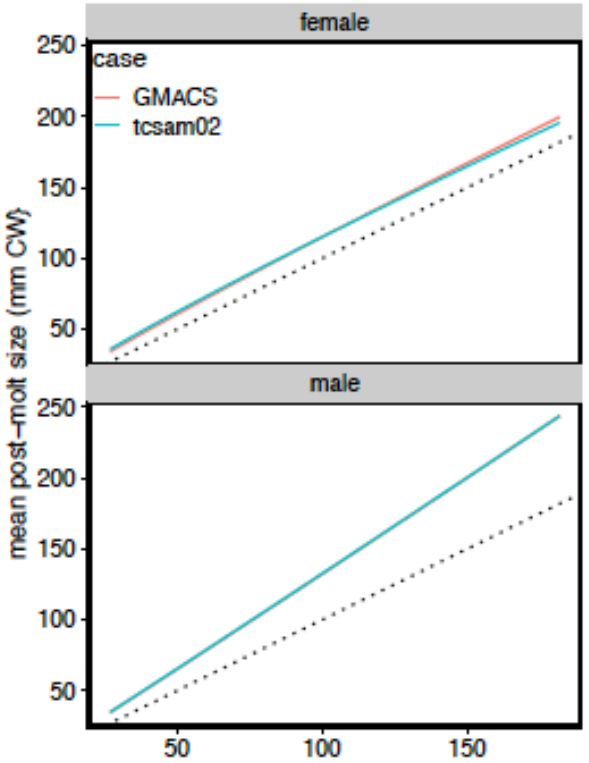




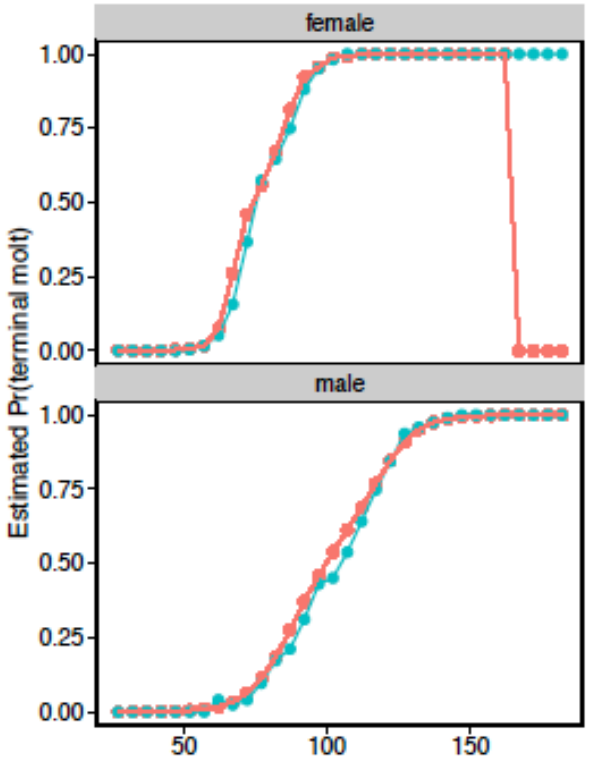
GMACS Model

Model Processes

growth

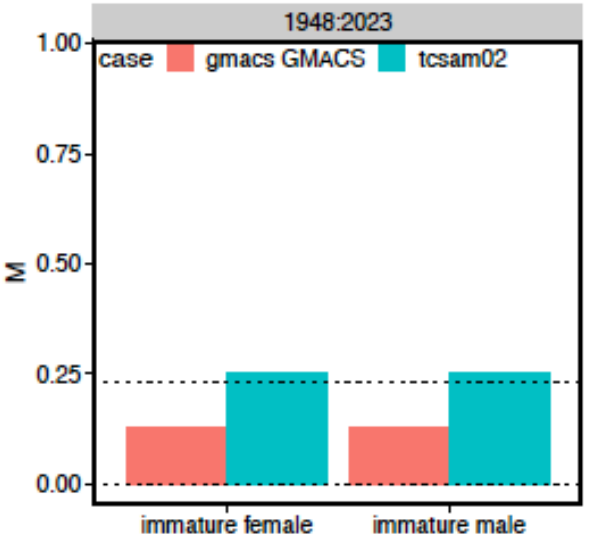


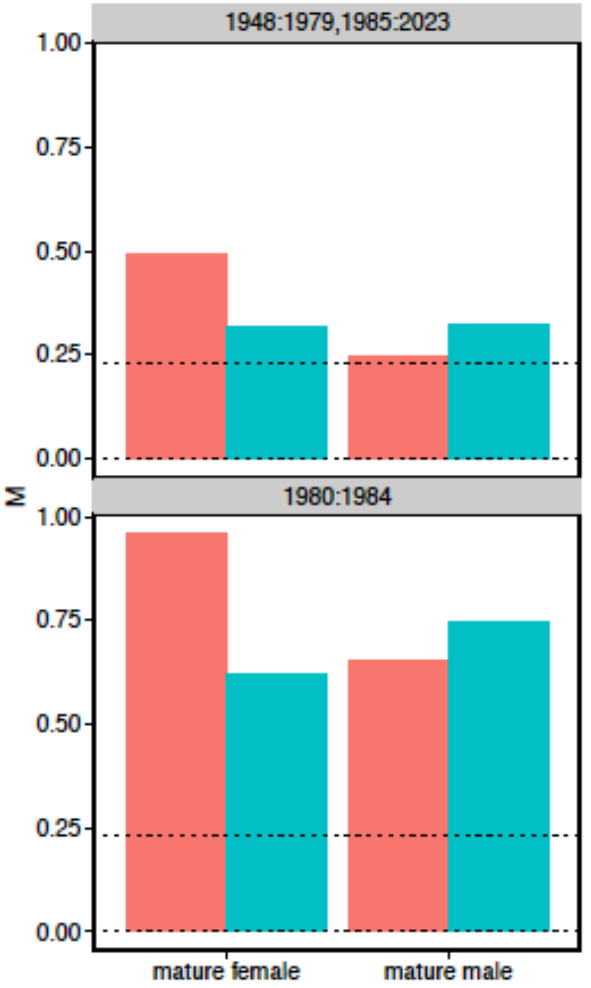
molt to maturity



size (mm CW)

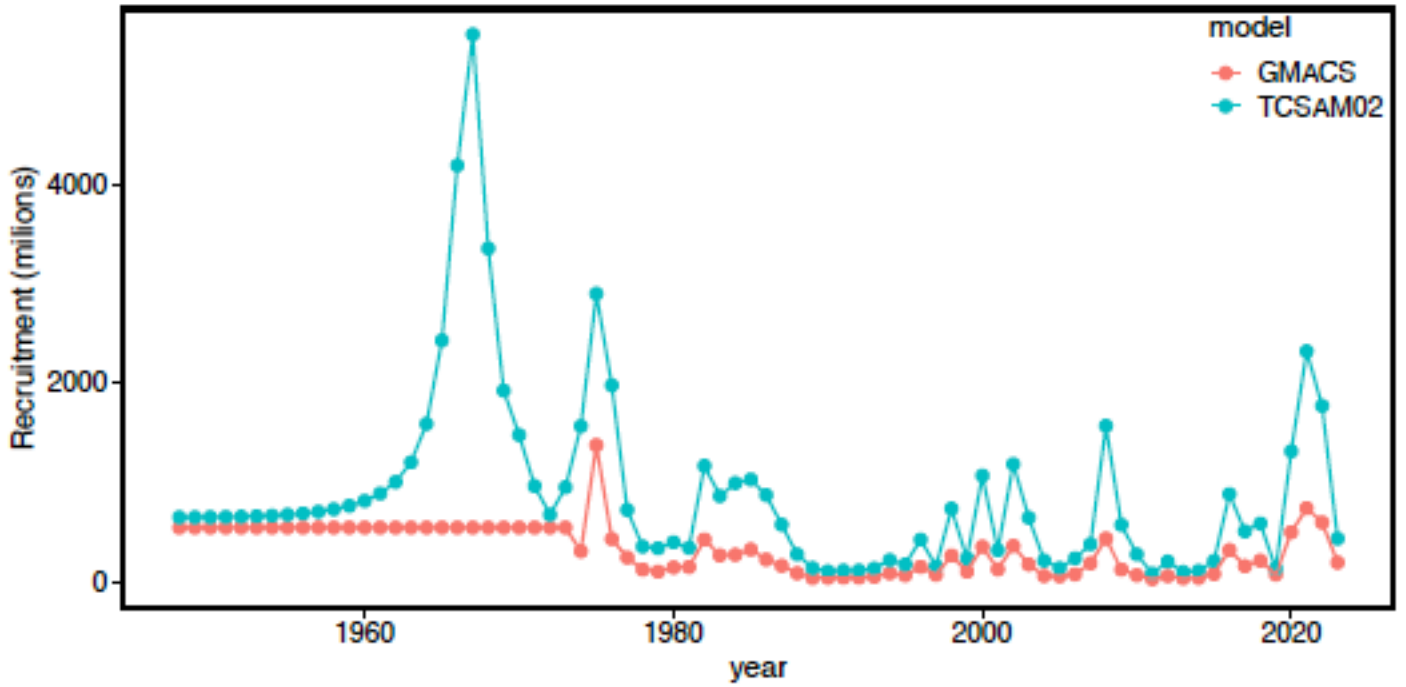
natural mortality



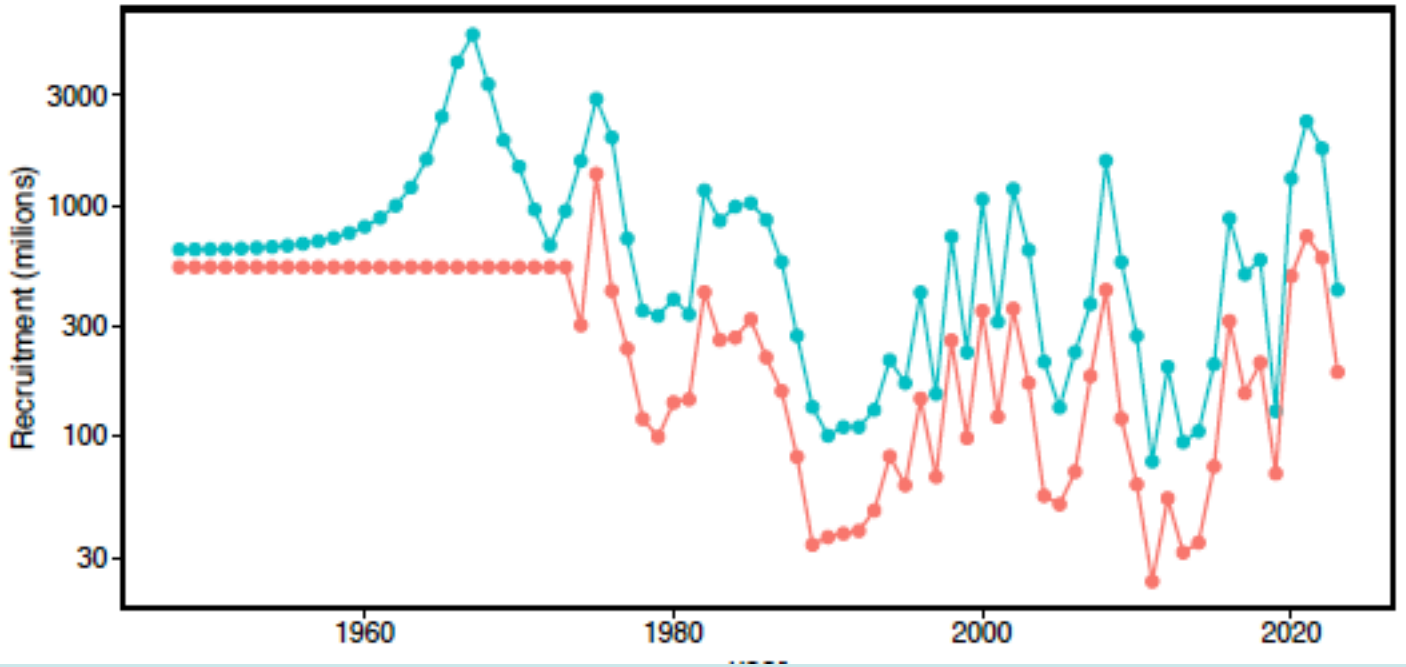


GMACS Model

Estimated Recruitment



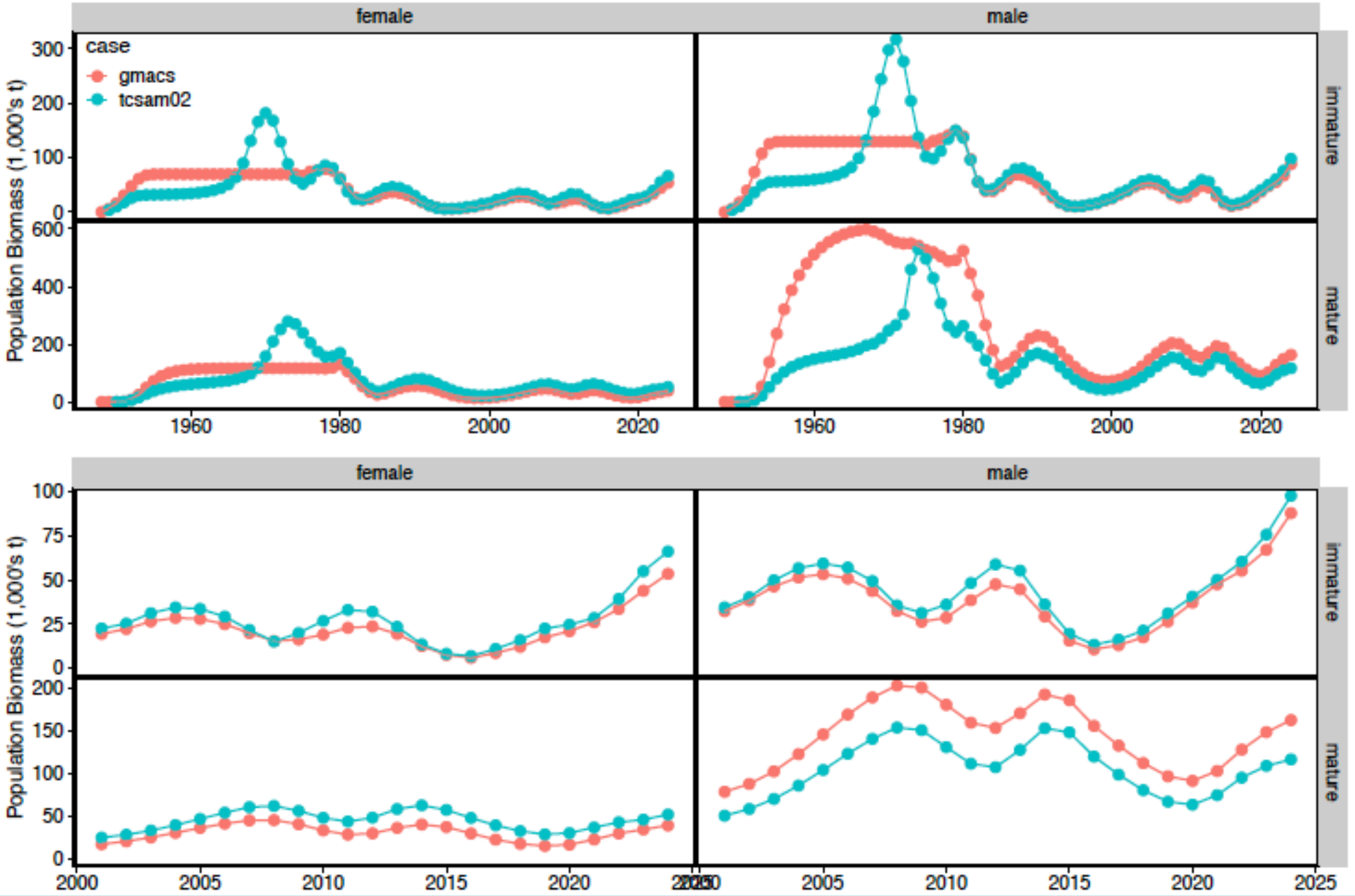
arithmetic scale



log-scale

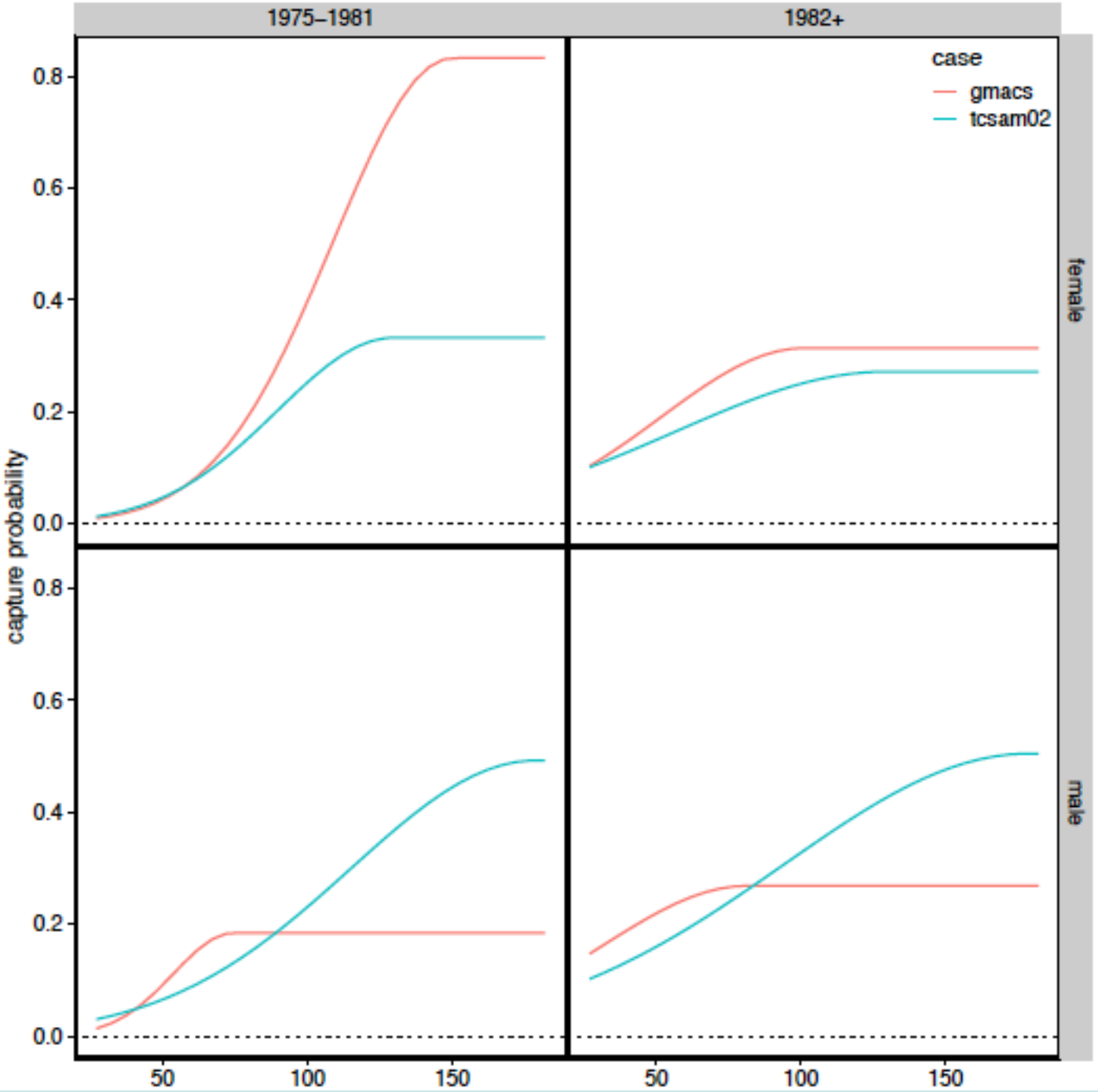
GMACS Model

Estimated Population Biomass



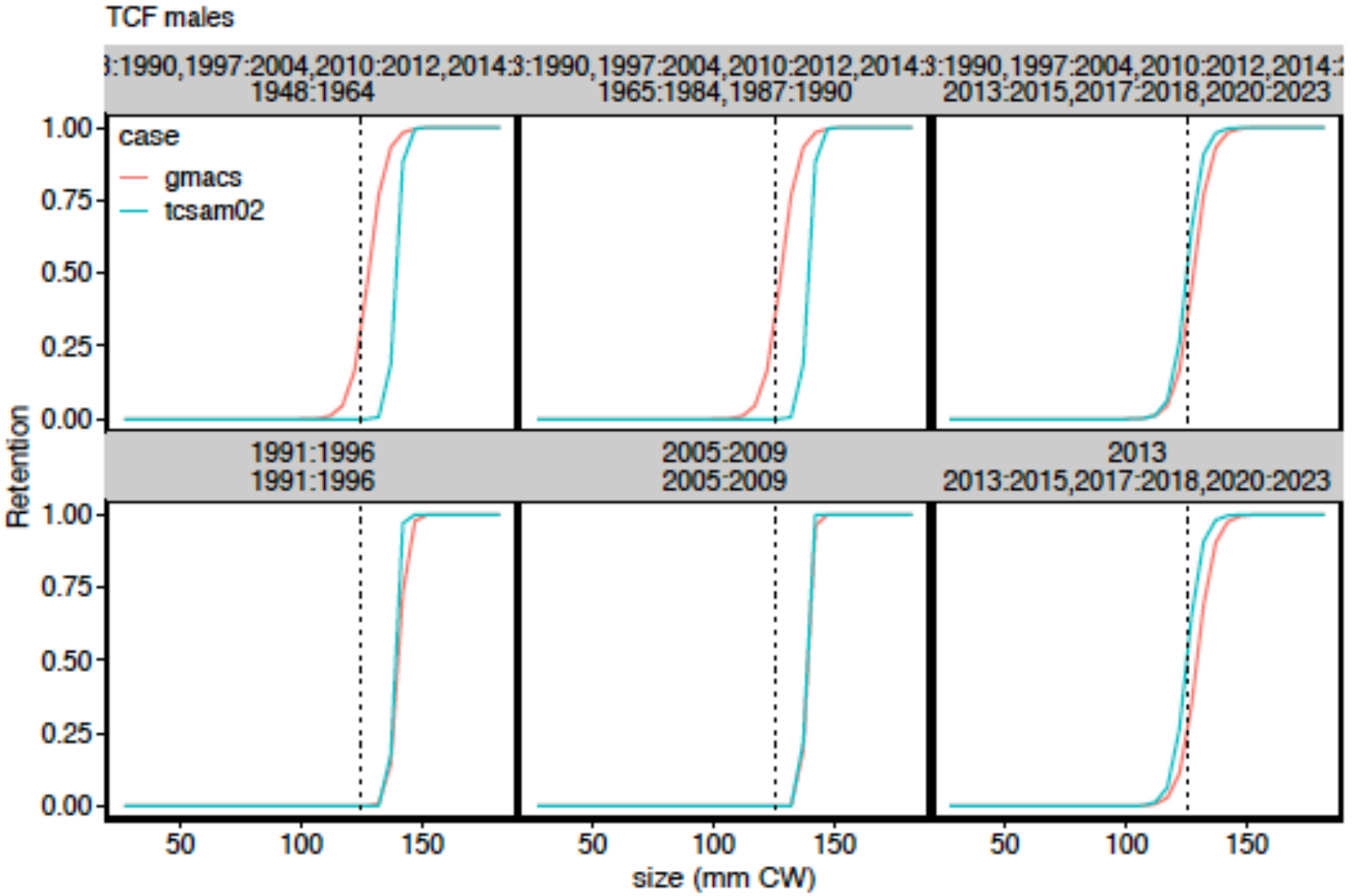
GMACS Model

Estimated NMFS Survey Capture Probability Curves



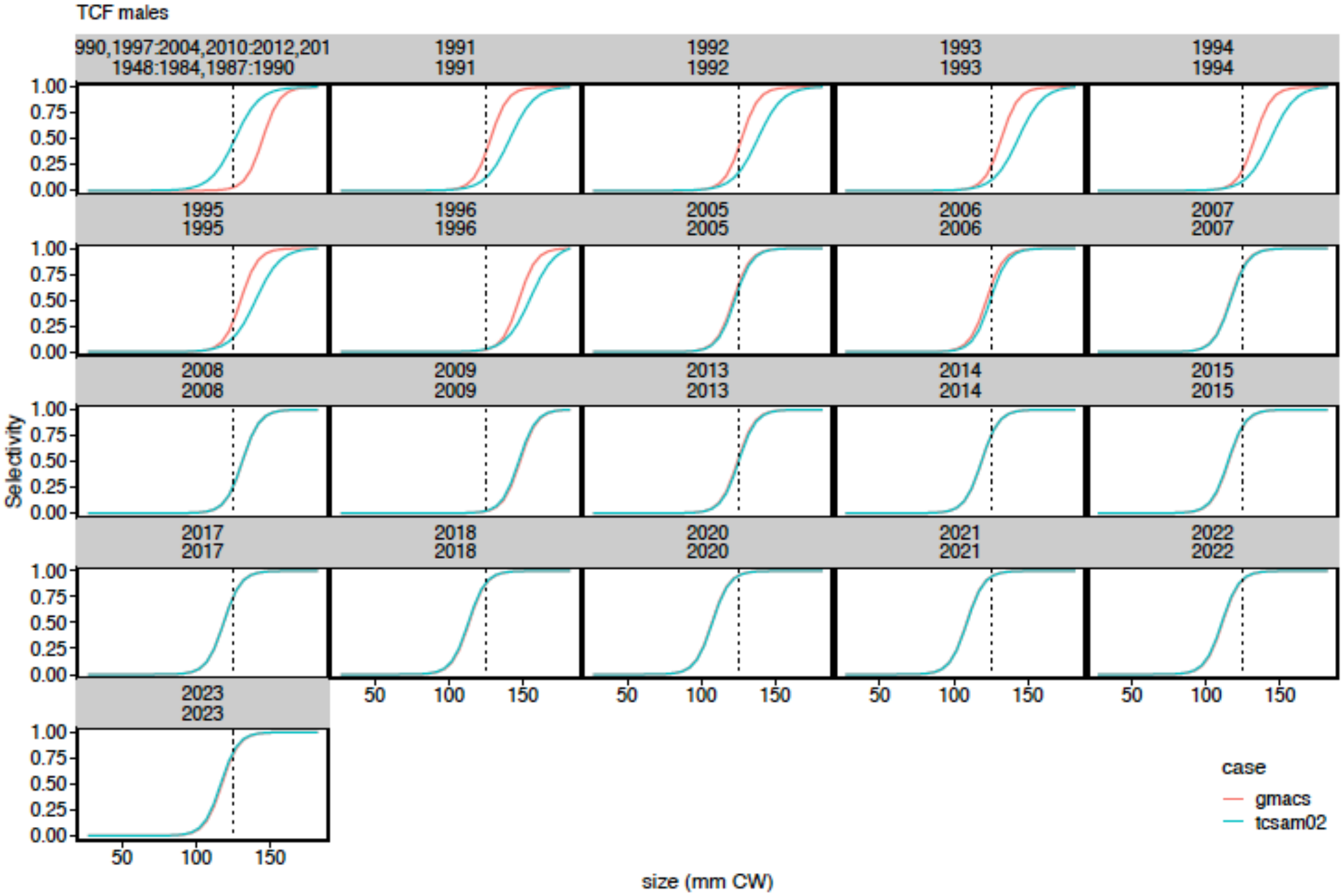
GMACS Model

Estimated Directed Fishery Retention Curves



GMACS Model

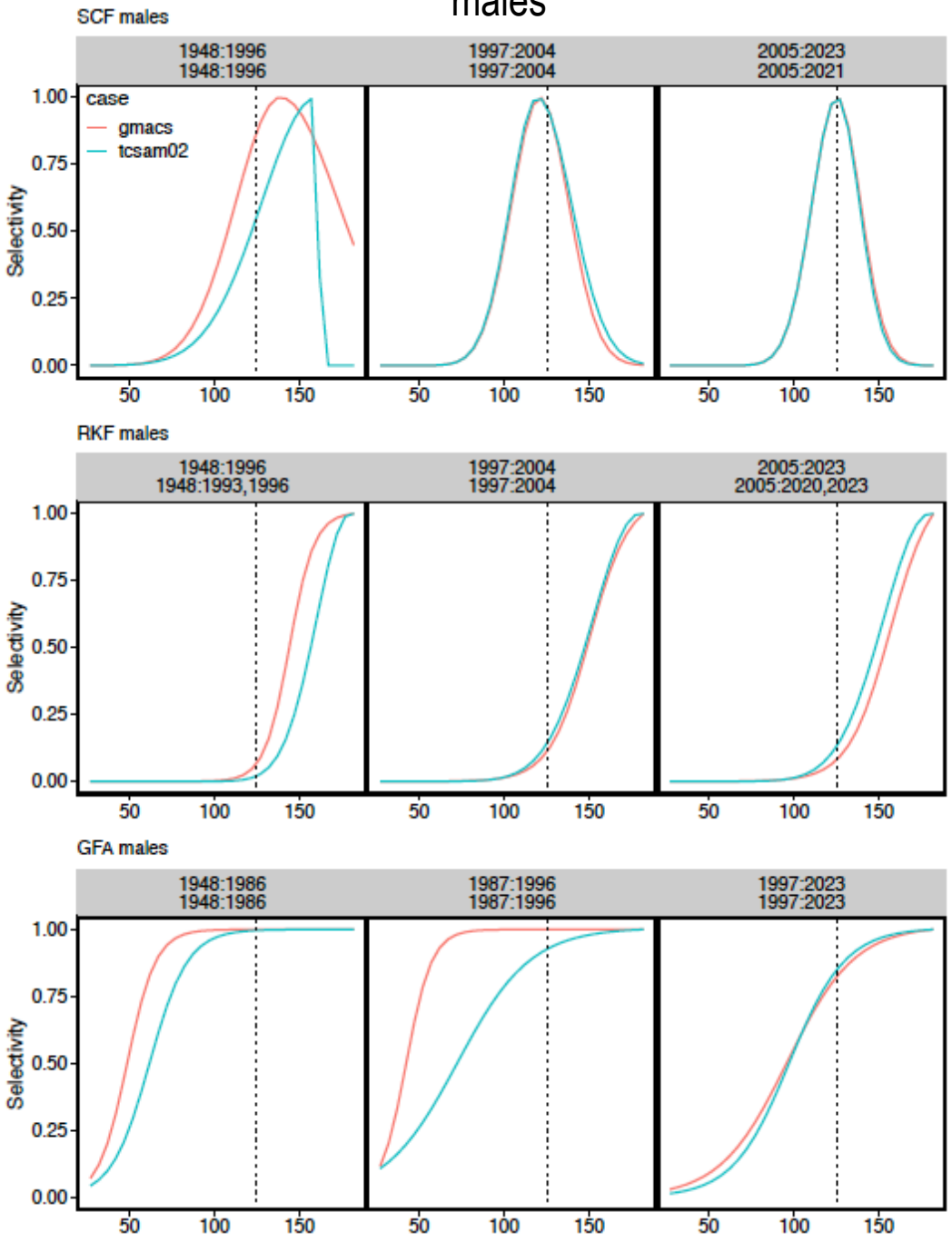
Estimated Directed Fishery Selectivity Curves (males)



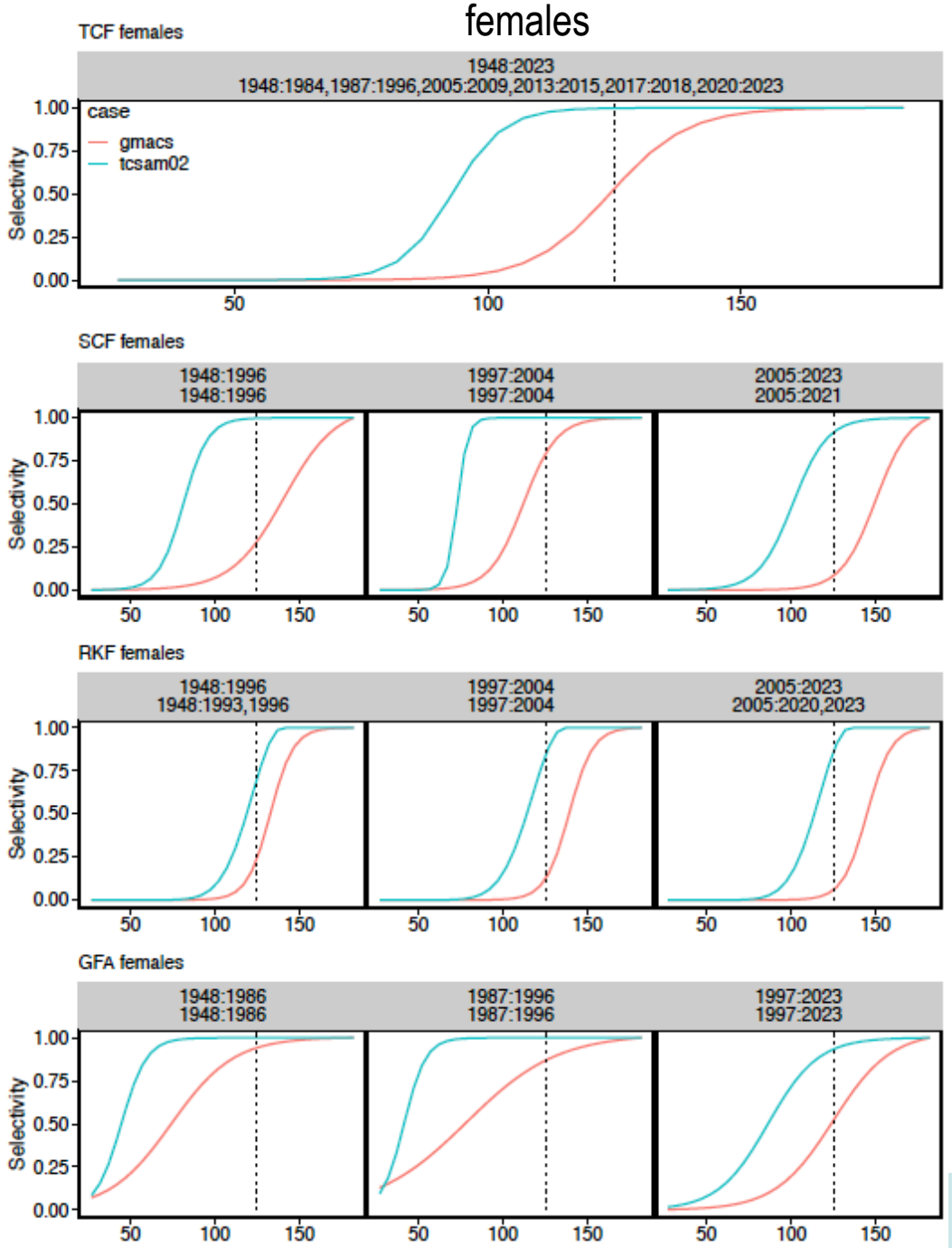
GMACS Model

Estimated Bycatch Selectivity Curves

males

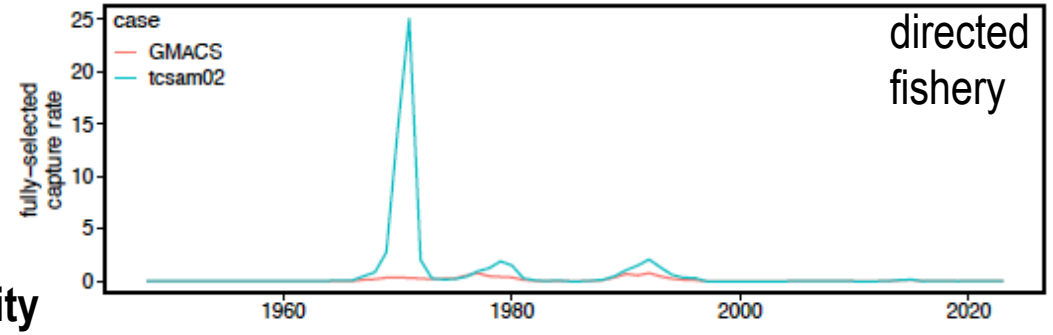


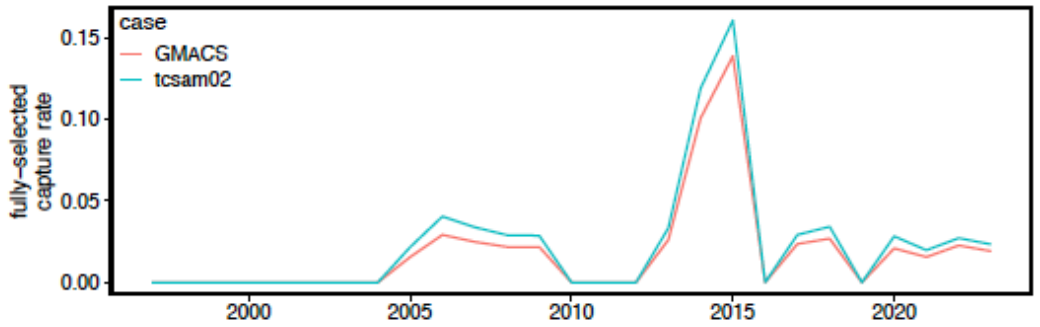
females

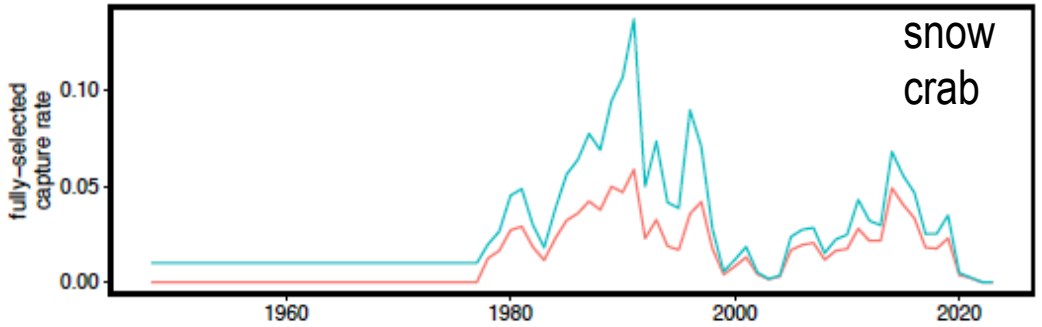


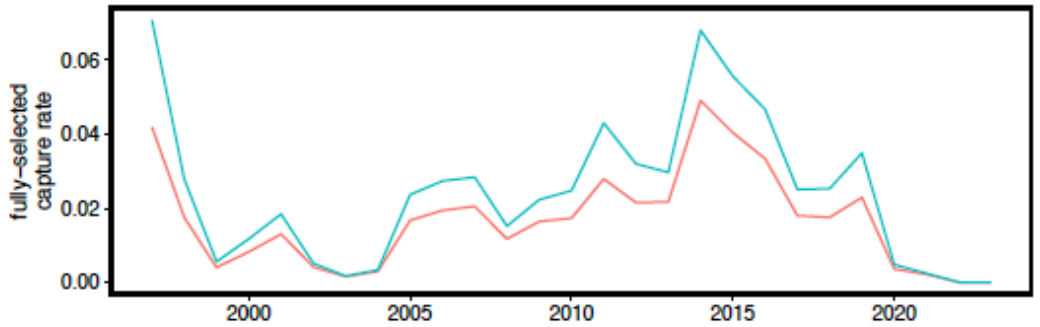
GMACS Model

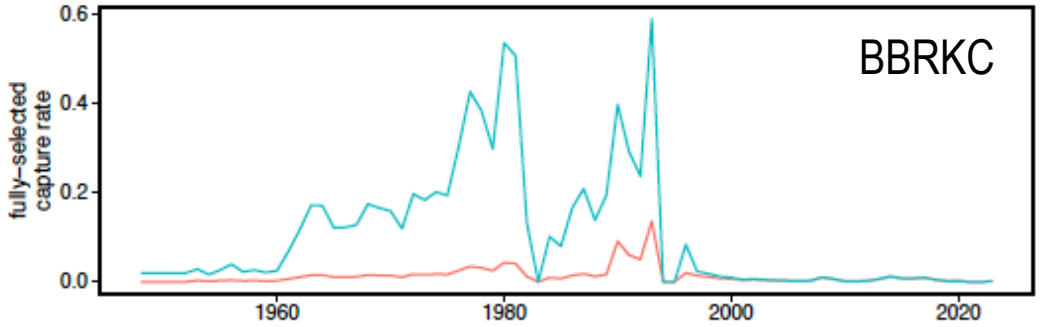
Estimated Fishing Mortality Rates

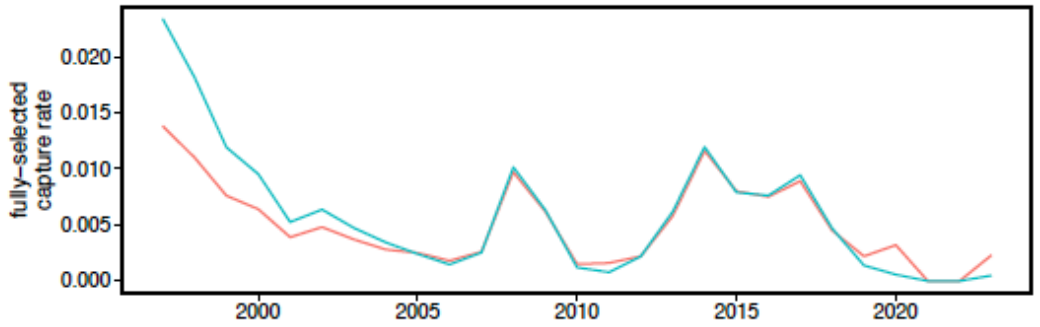


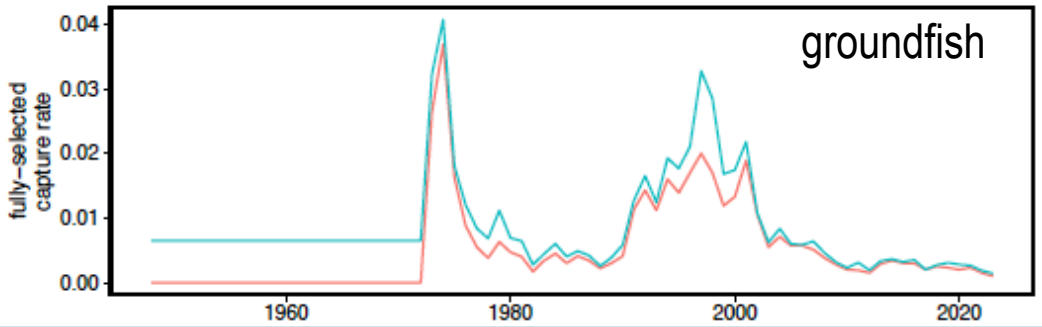


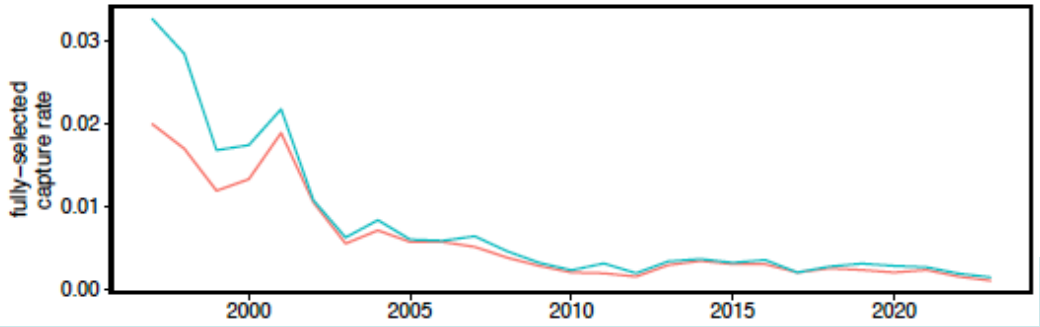










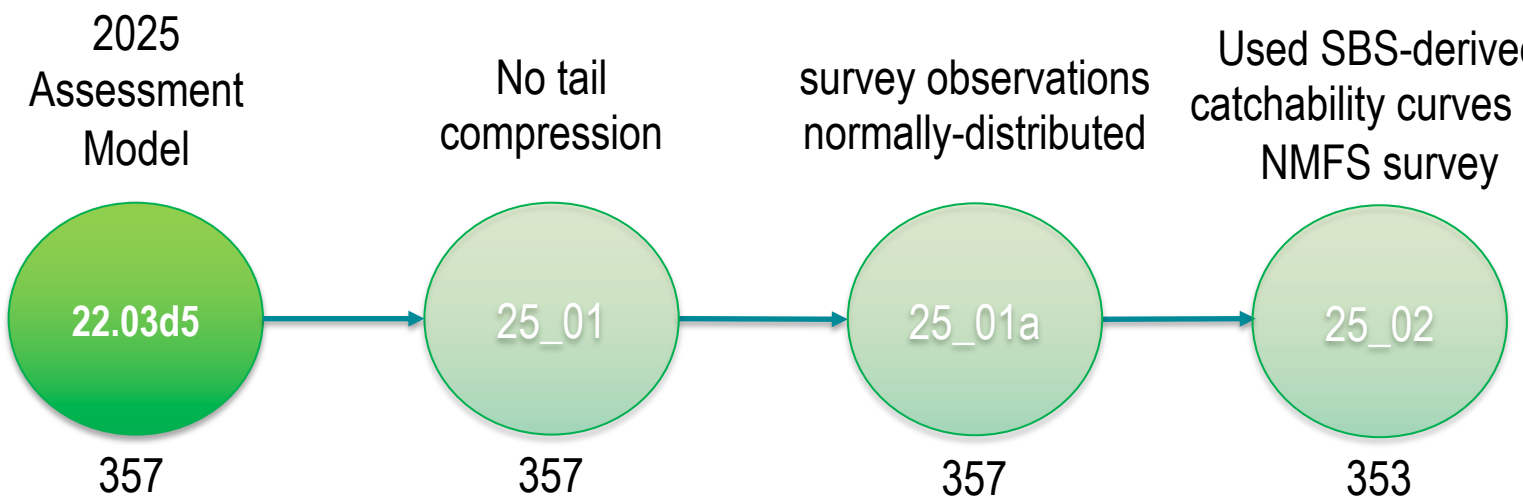


Summary

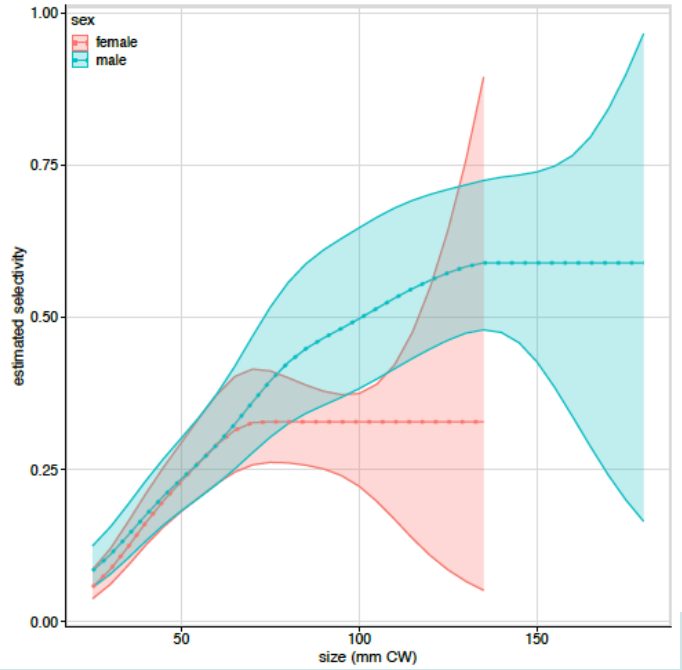
- Model structures are pretty well matched
  - similar time blocks
  - similar parameters and functions
- Model fits to data are similar
- Estimated temporal population variability/trends are similar
- Overall scales are mismatched
- Issues appear related to
  - differences with treatment of recruitment during model “spin-up”
  - selectivity/catchability estimation
- Differences in penalties??

TCSAM02 Models

TCSAM02 Models

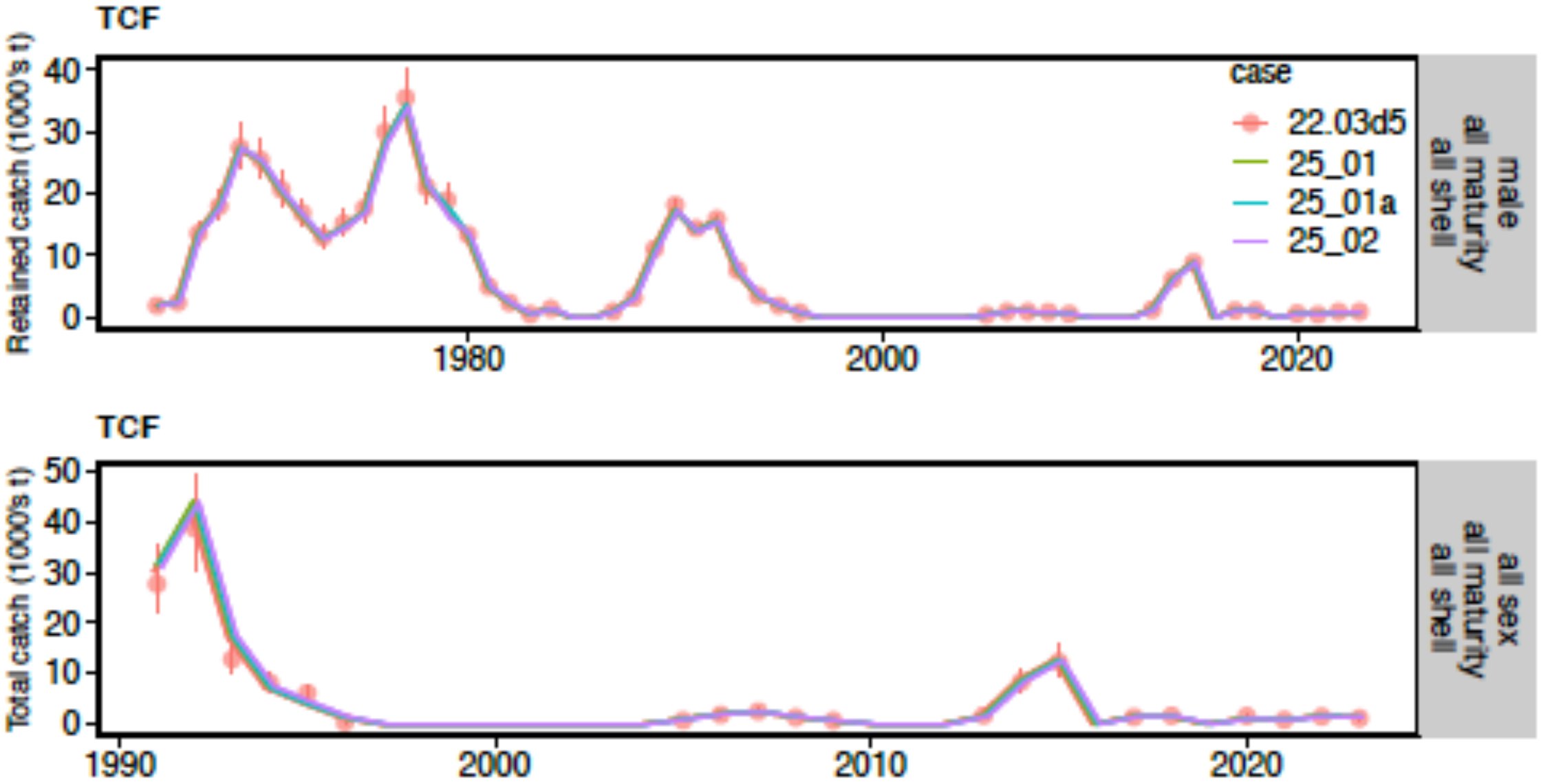


model configuration	number of parameters	no. of param.s at bounds	objective function value	max gradient	invertible for std. devs?
22_03d5	357	0	3182.00	1.78E-02	yes
25_01	357	0	3452.13	0.00E+00	yes
25_01a	357	1	3836.80	0.00E+00	yes
25_02	353	0	3057.96	0.00E+00	yes



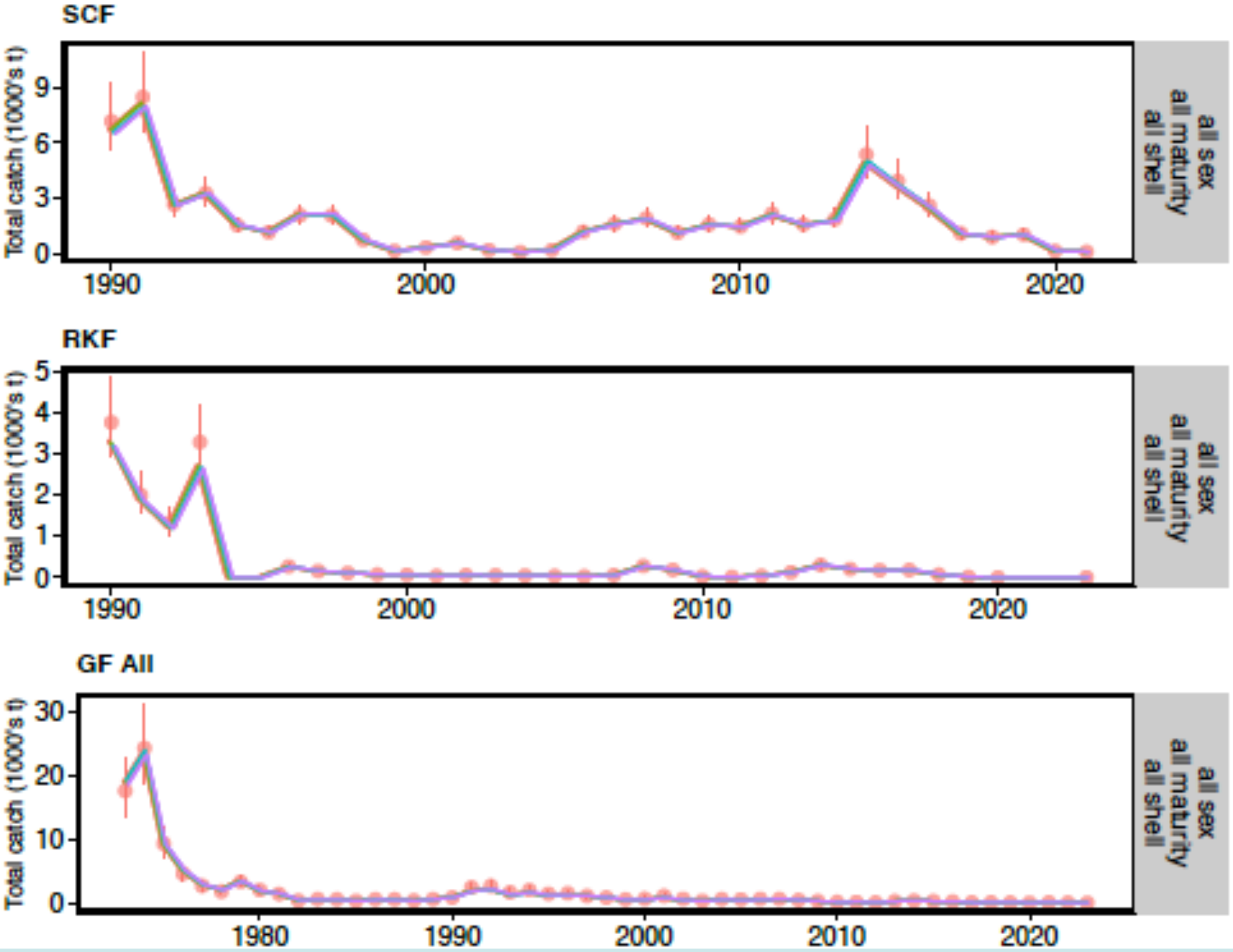
TCSAM02 Models

Fits to directed fishery catch biomass



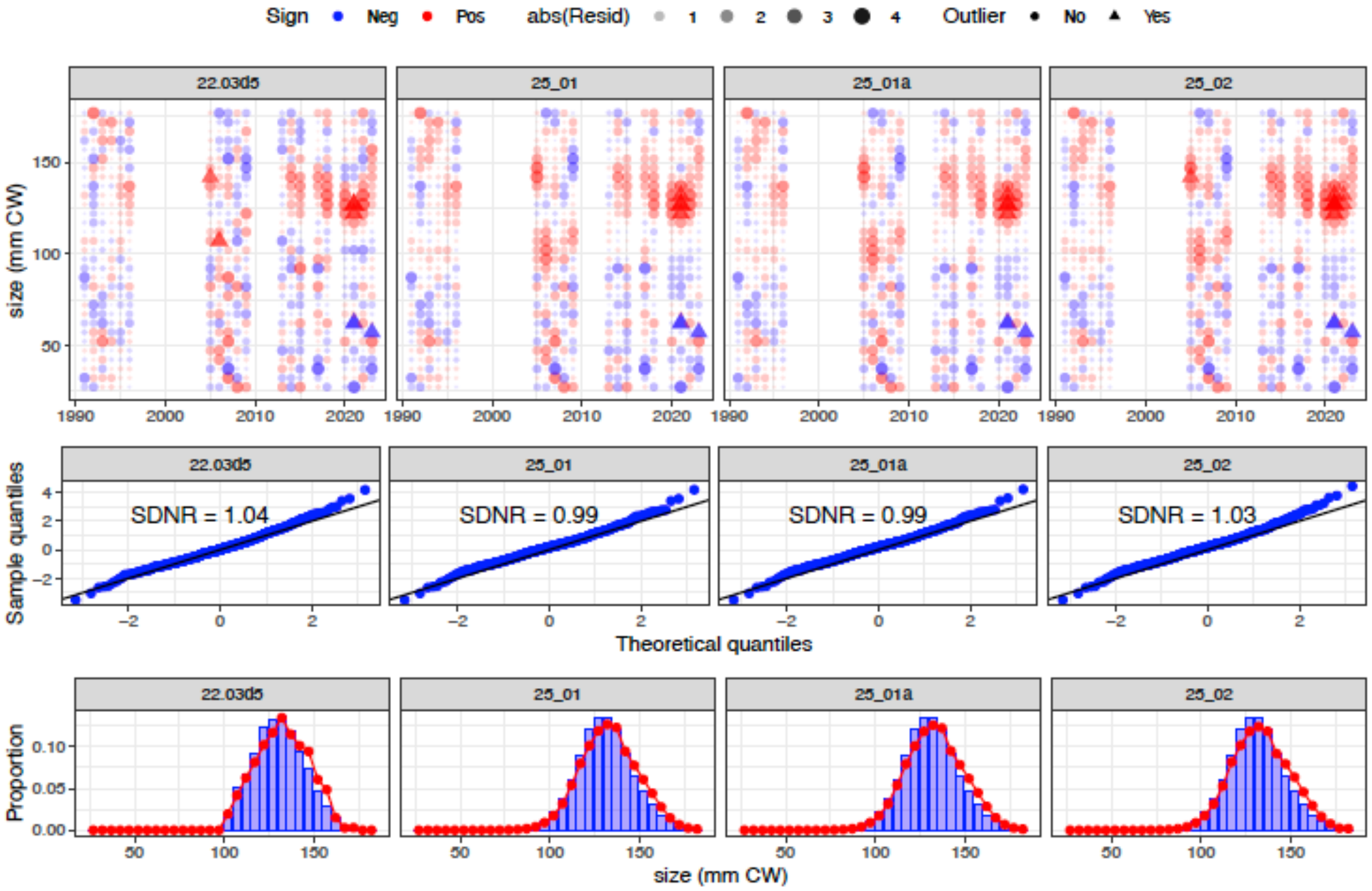
TCSAM02 Models

Fits to
catch biomass
in bycatch fleets



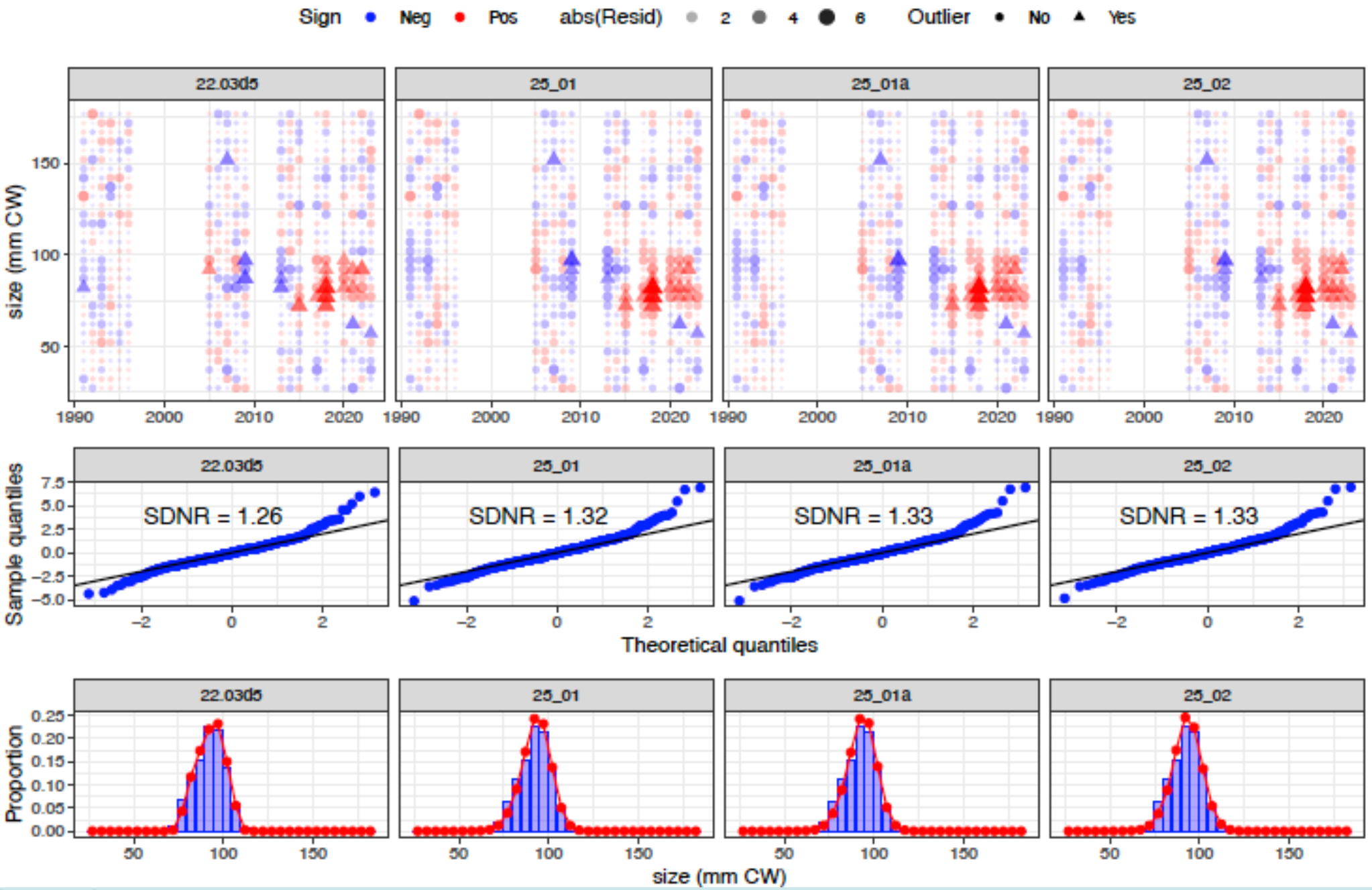
TCSAM02 Models

Fits to male size comps in directed fishery



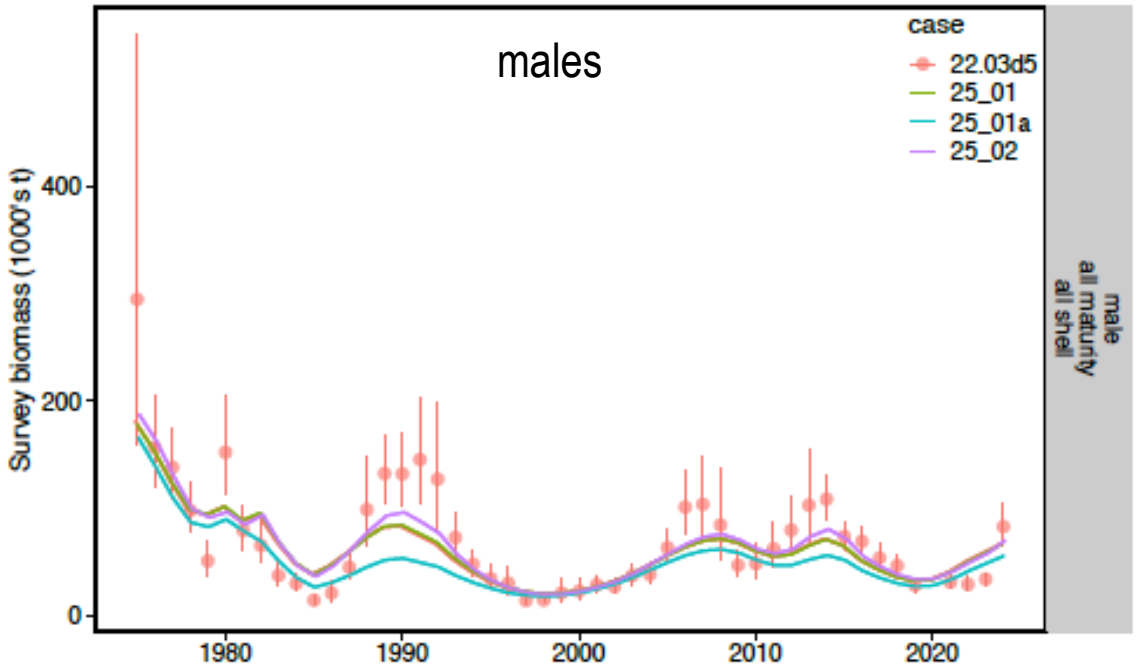
TCSAM02 Models

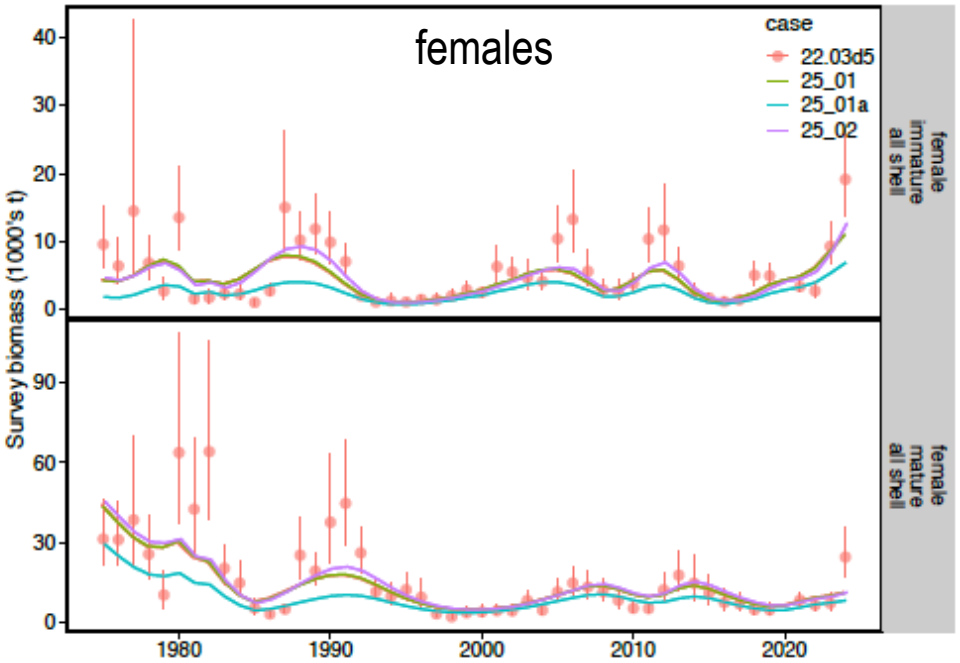
Fits to female size comps in directed fishery

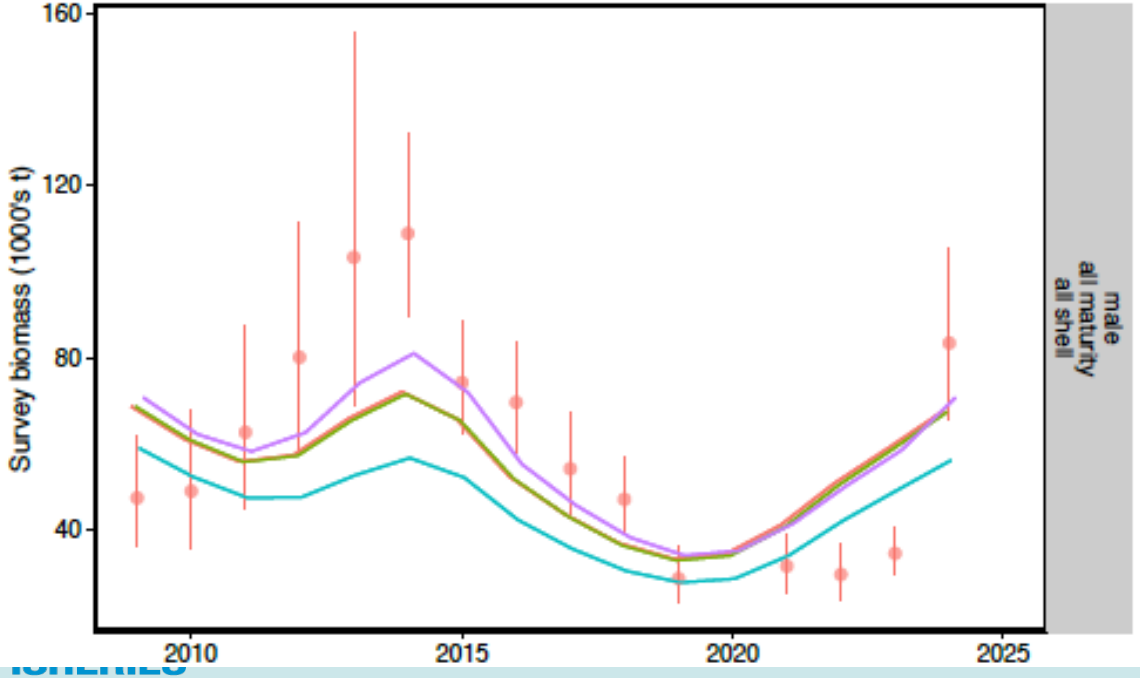


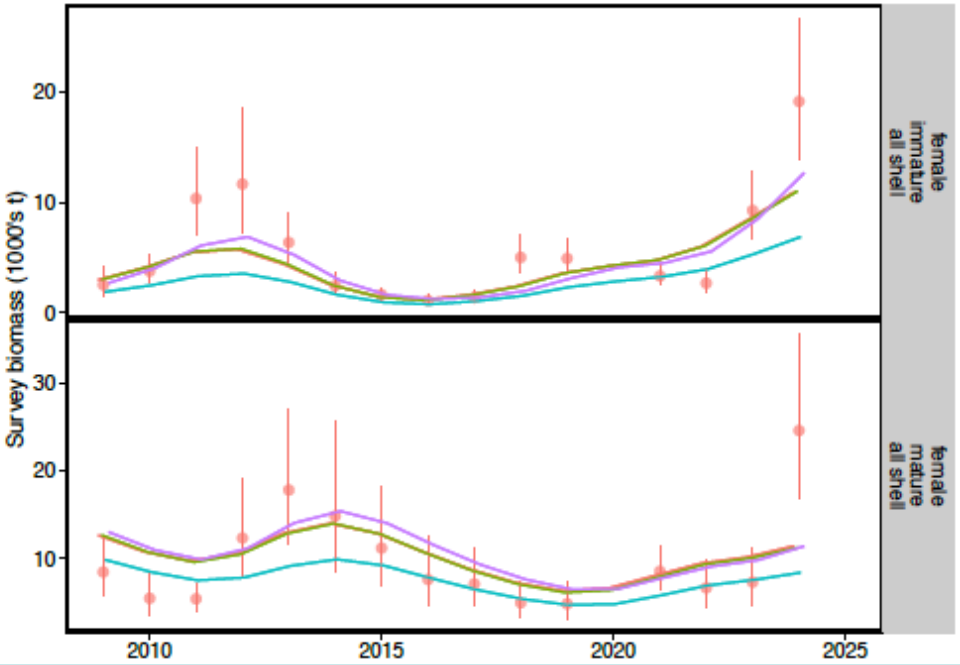
TCSAM02 Models

Fits to NMFS survey biomass



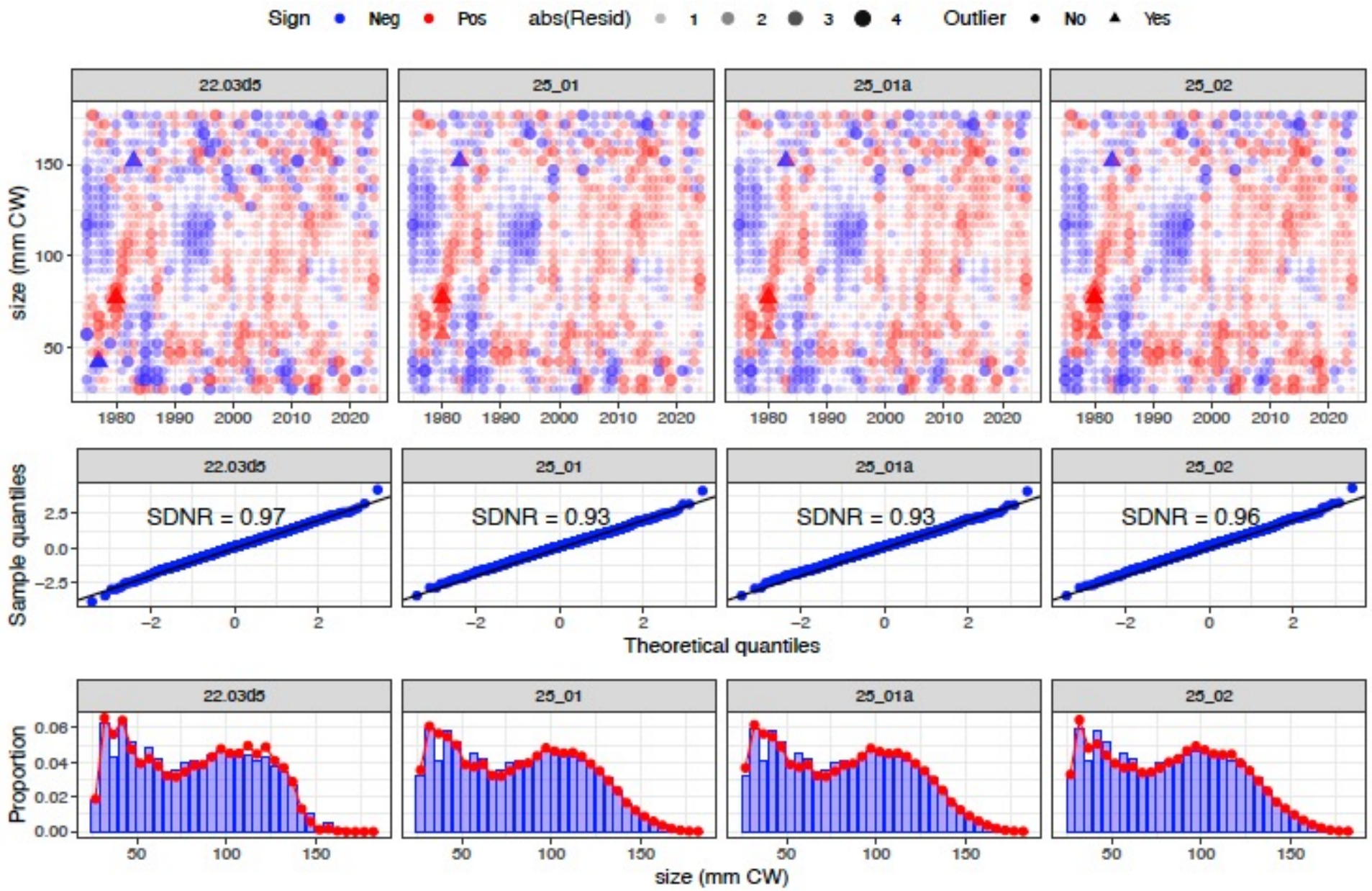






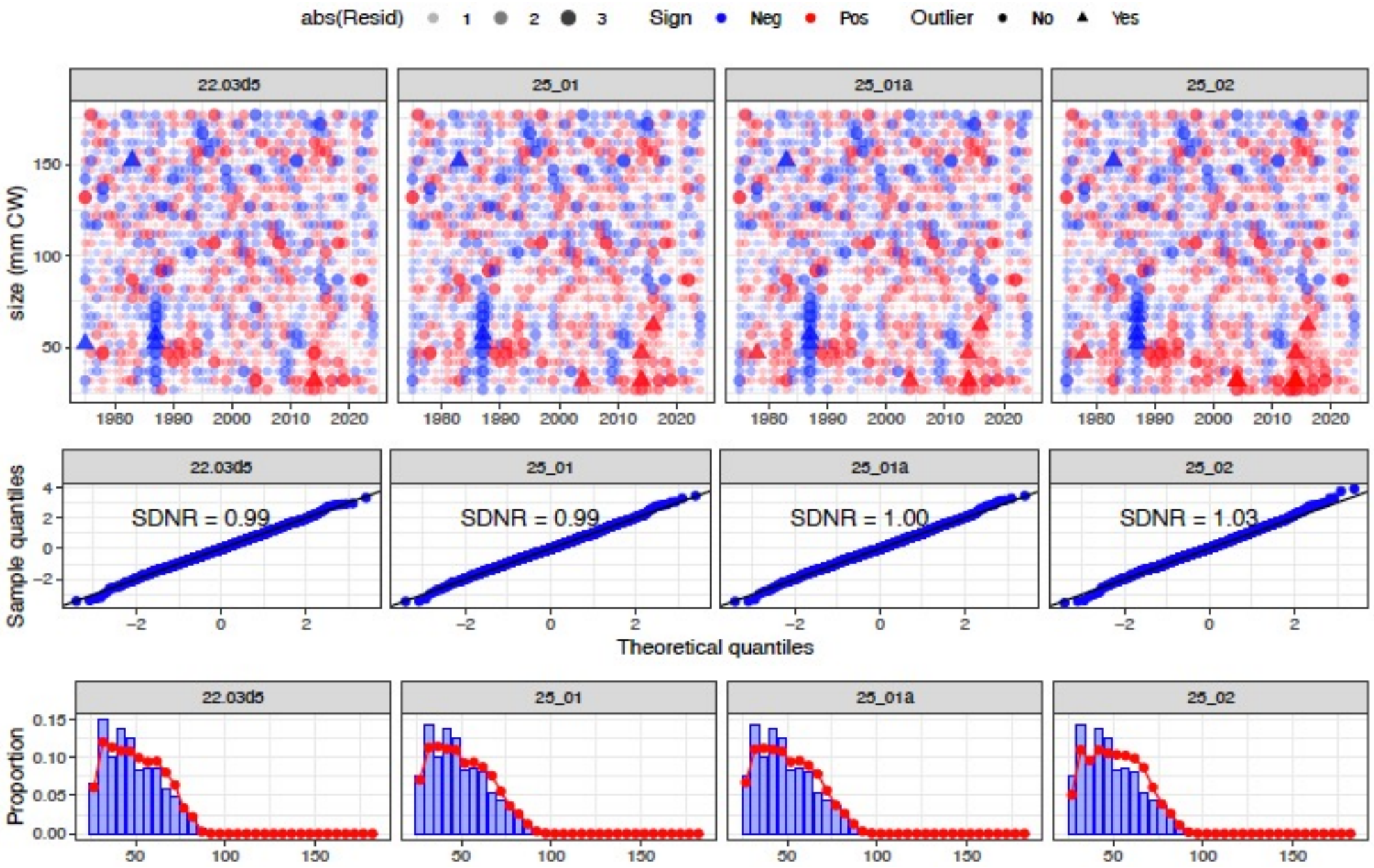
TCSAM02 Models

Fits to male size comps in NMFS survey



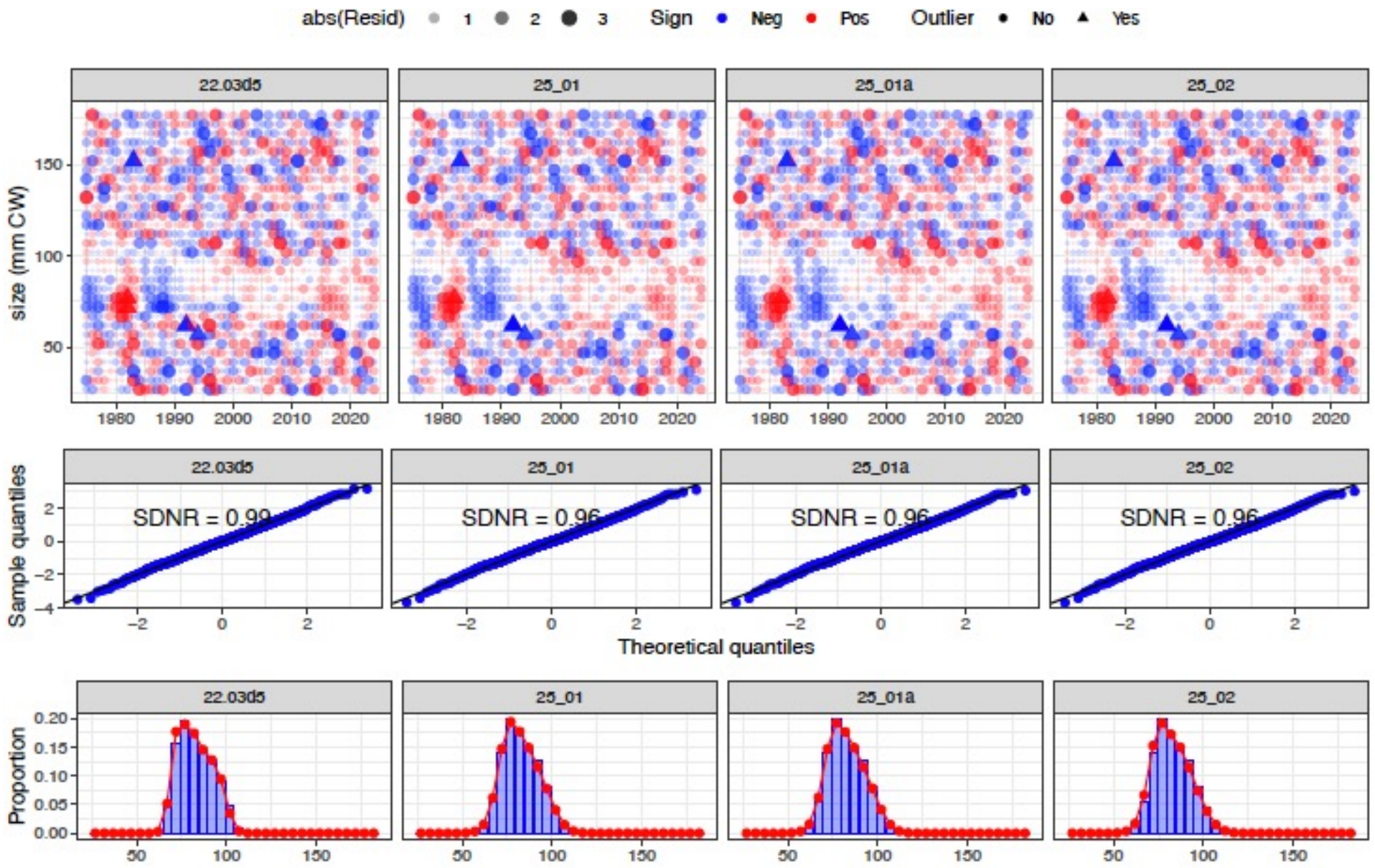
TCSAM02 Models

Fits to immature female size comps in NMFS survey



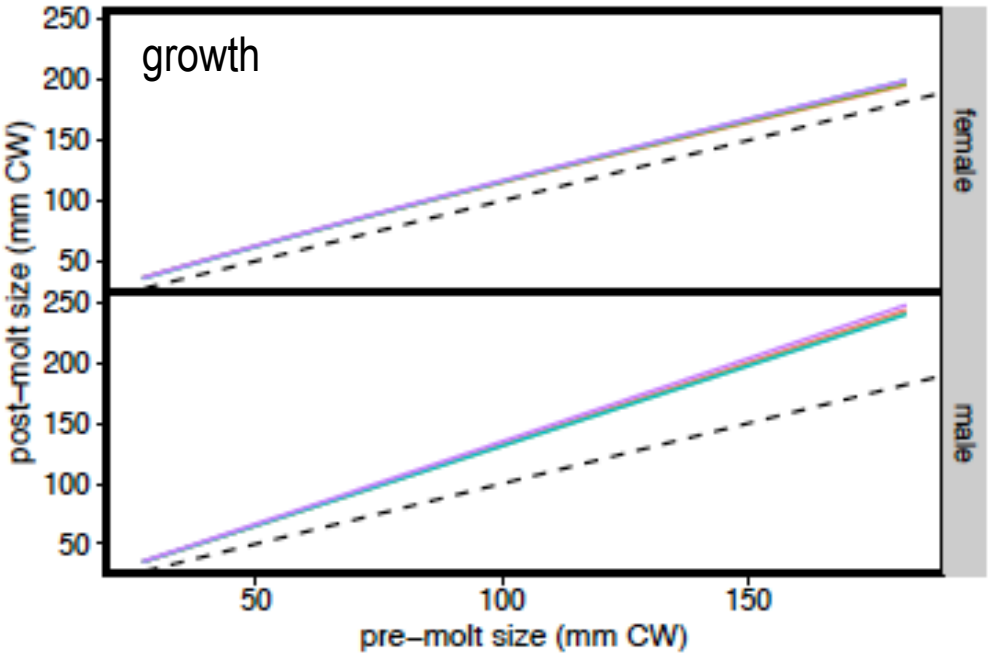
TCSAM02 Models

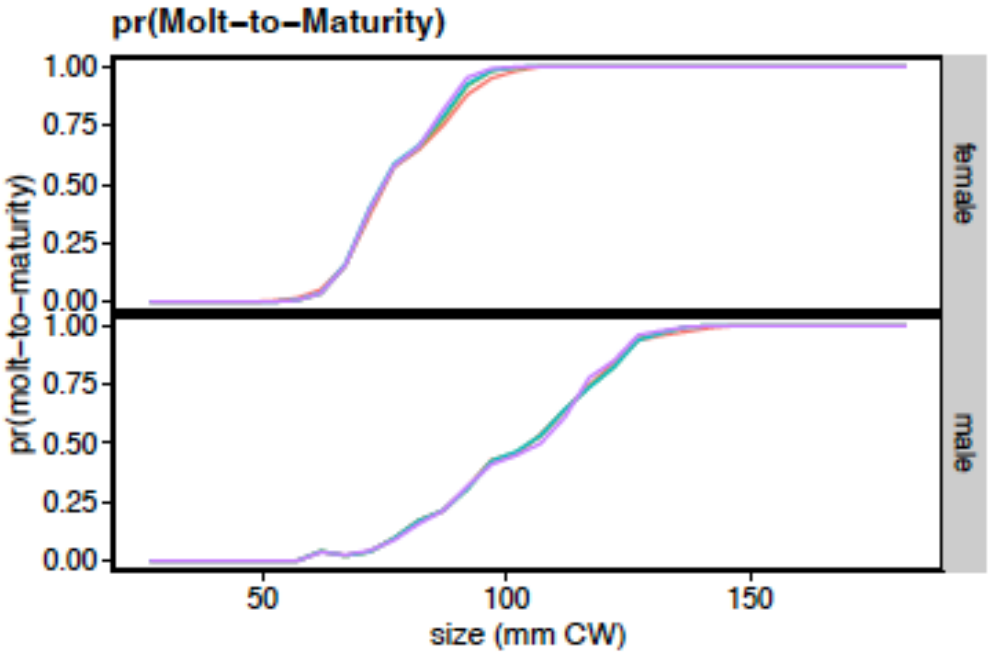
Fits to mature female size comps in NMFS survey

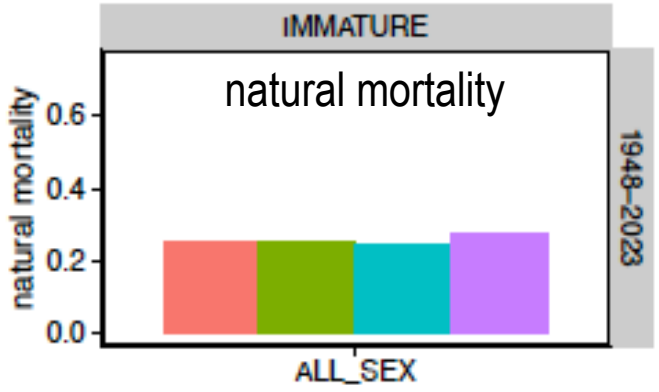


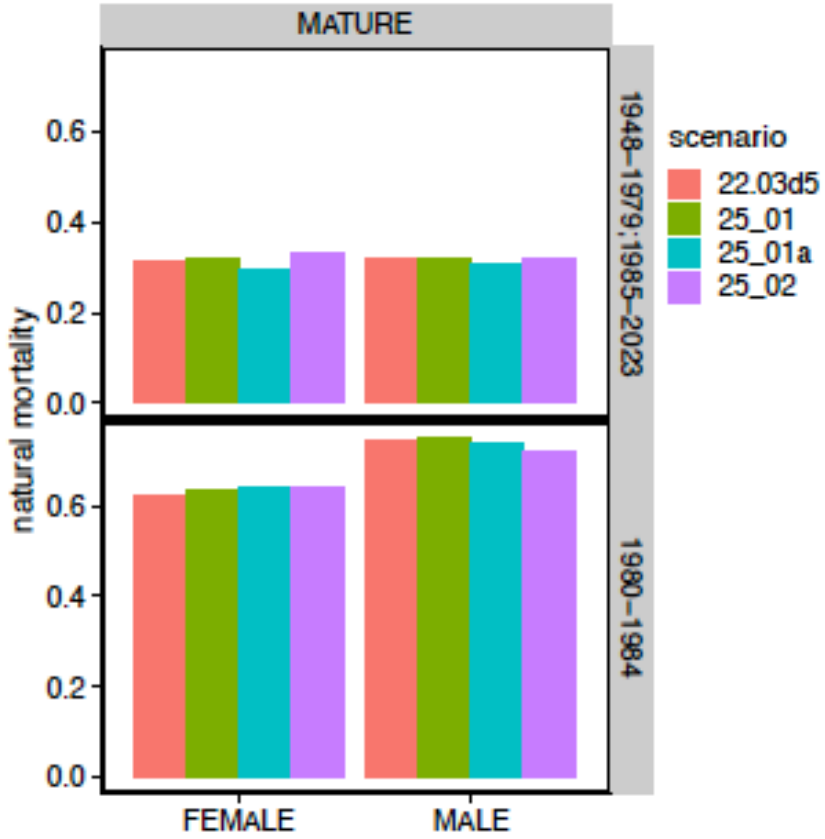
TCSAM02 Models

Estimated model processes



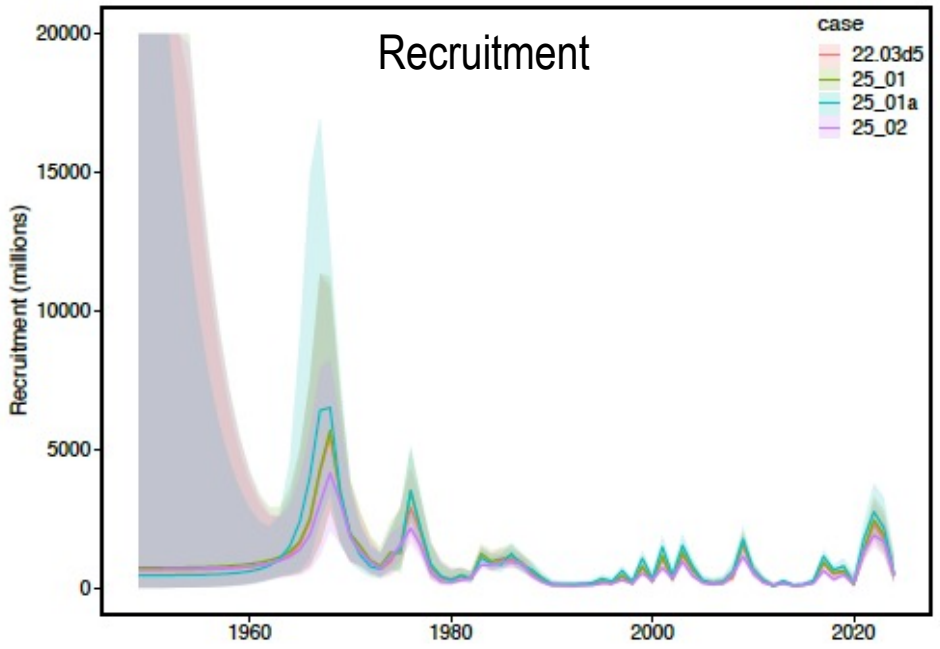


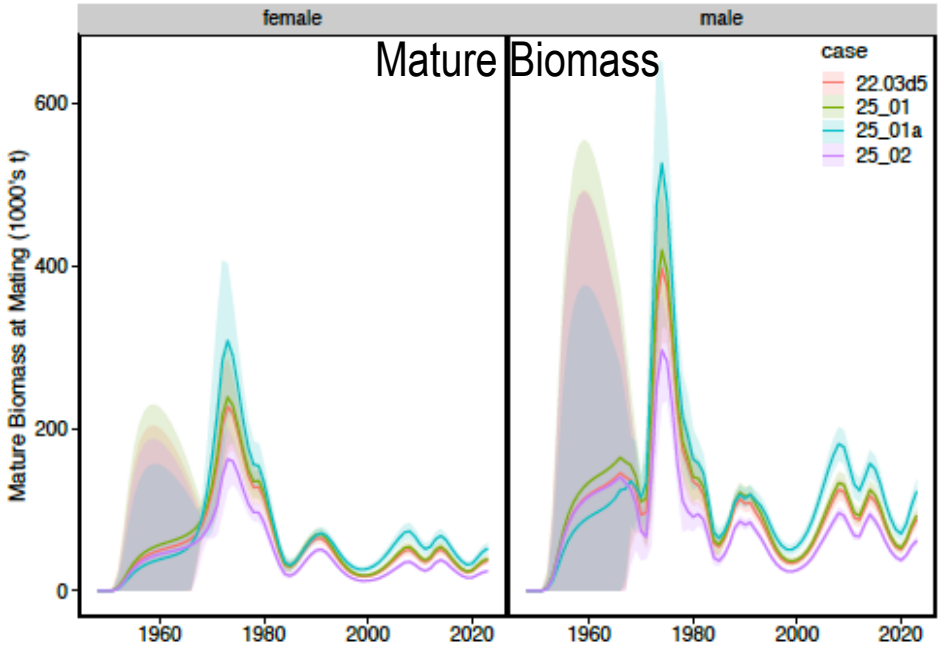


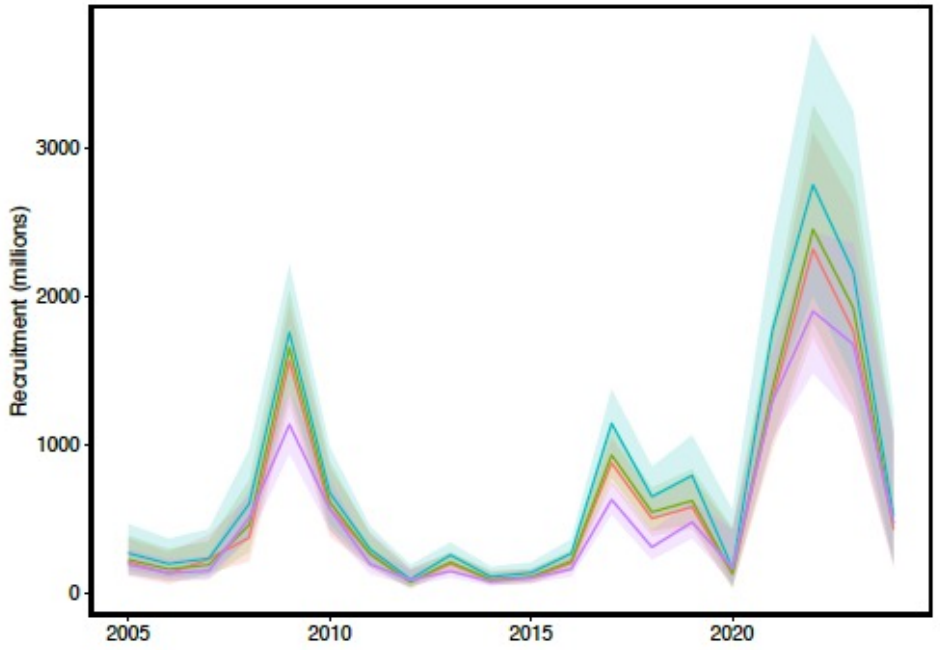


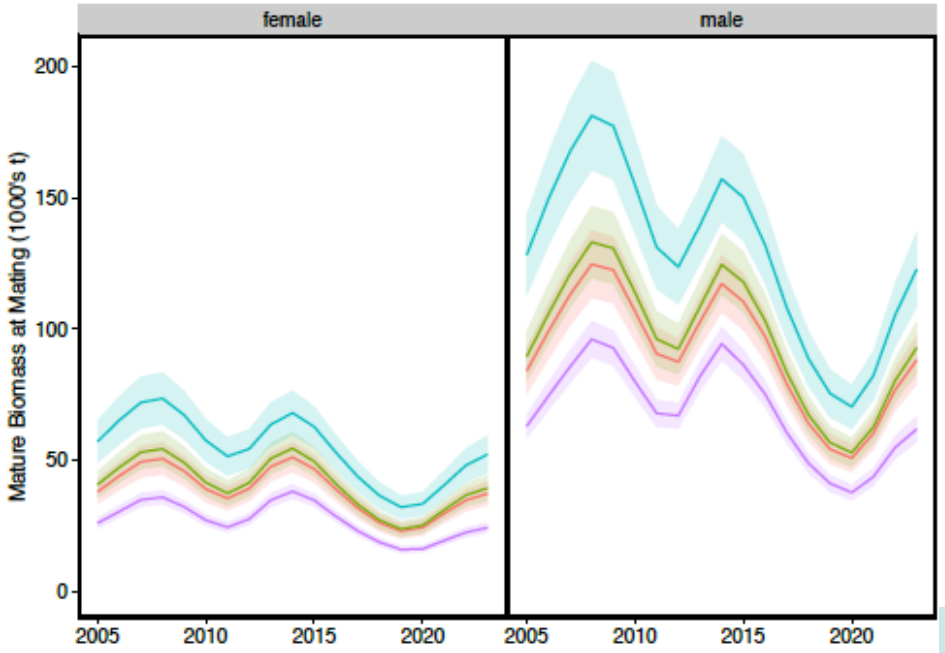
TCSAM02 Models

Estimated model processes



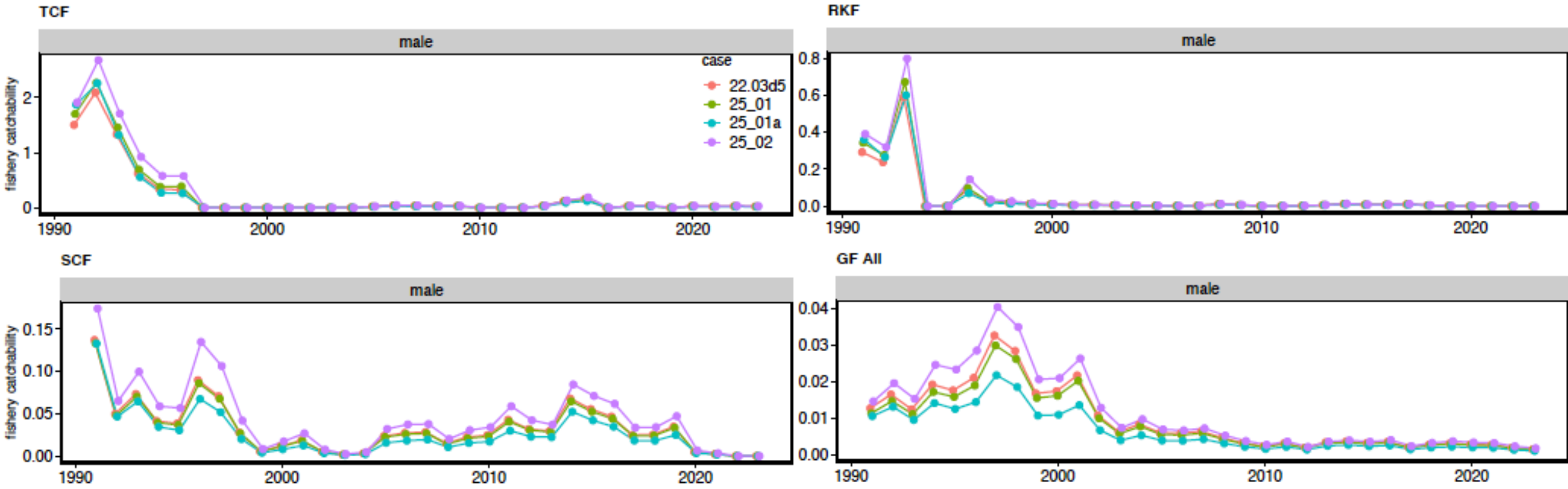






TCSAM02 Models

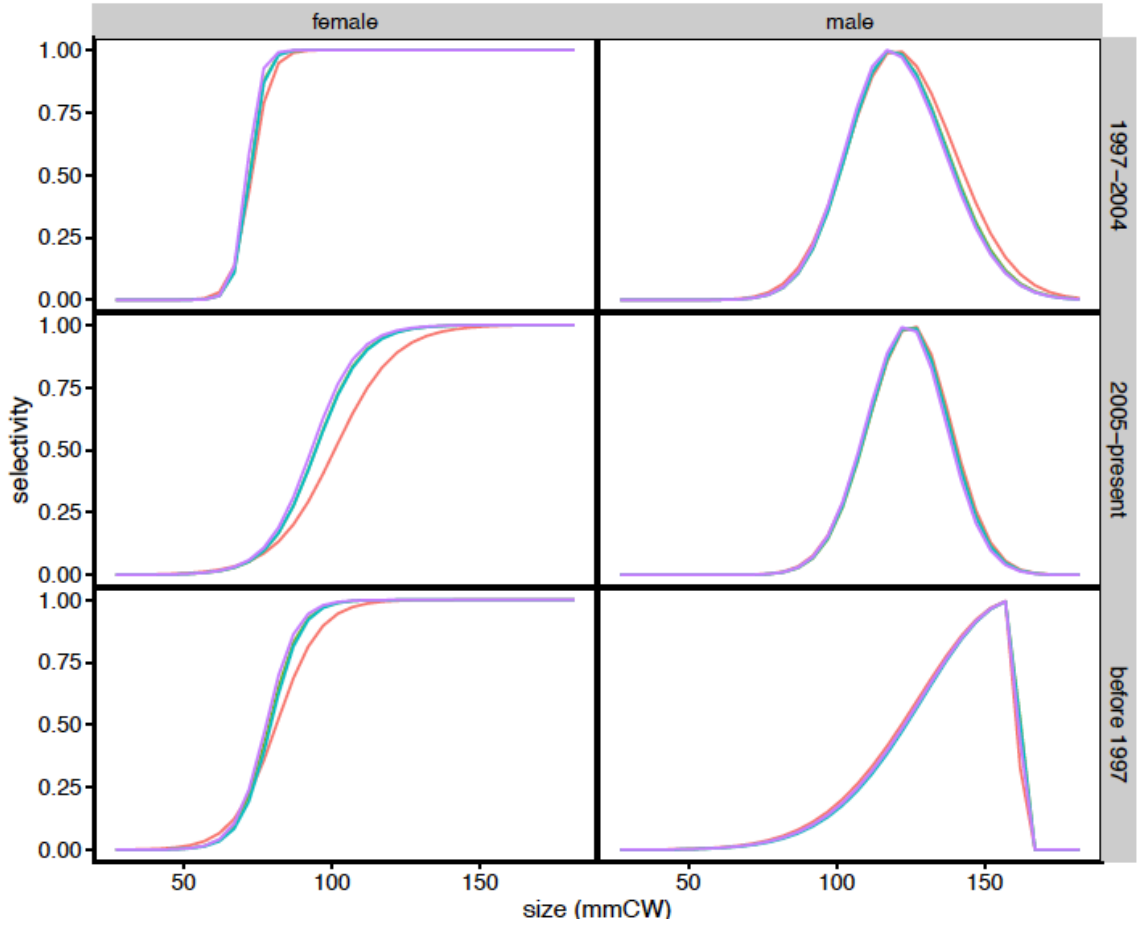
Fishery Catchability

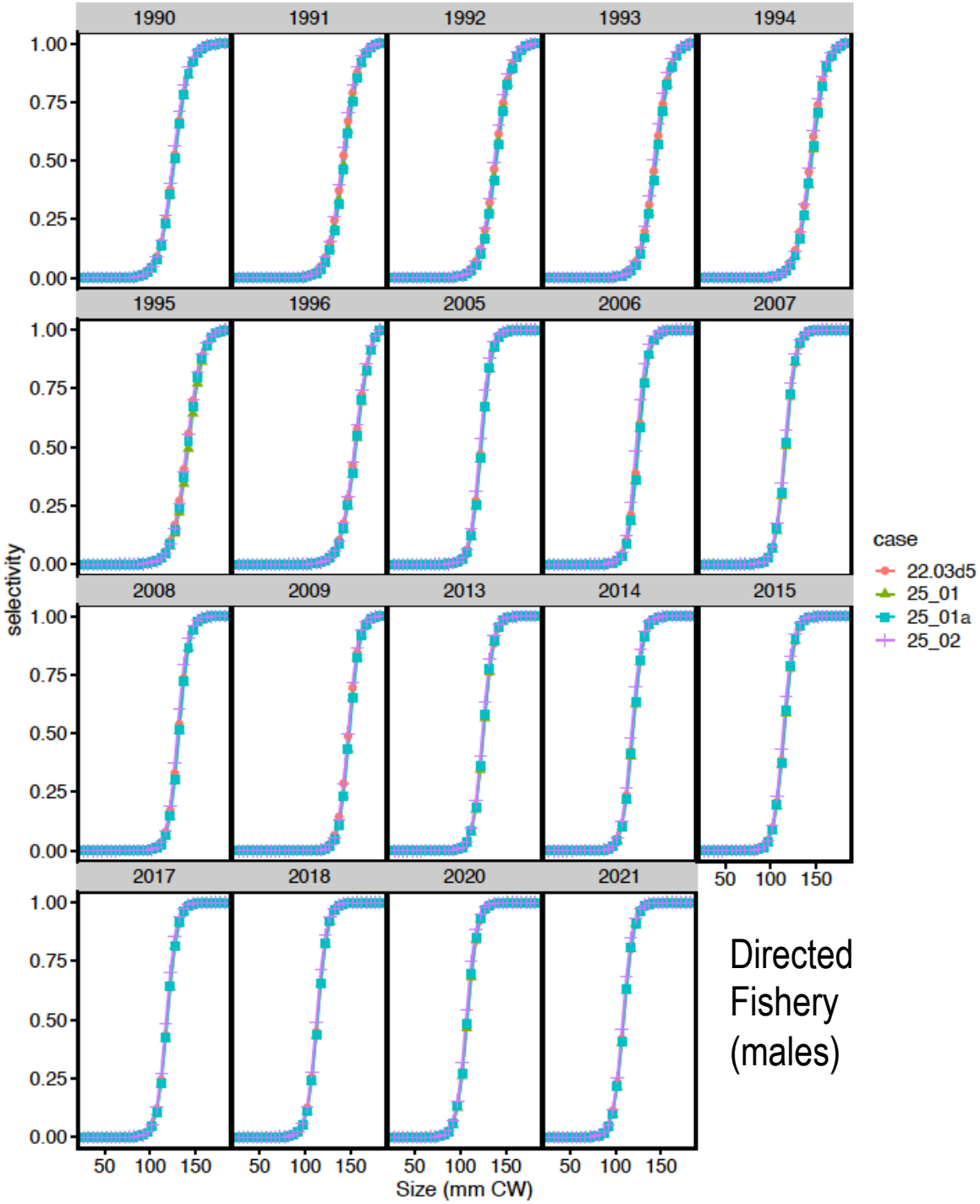


TCSAM02 Models

Fishery Selectivity

Snow Crab Fishery

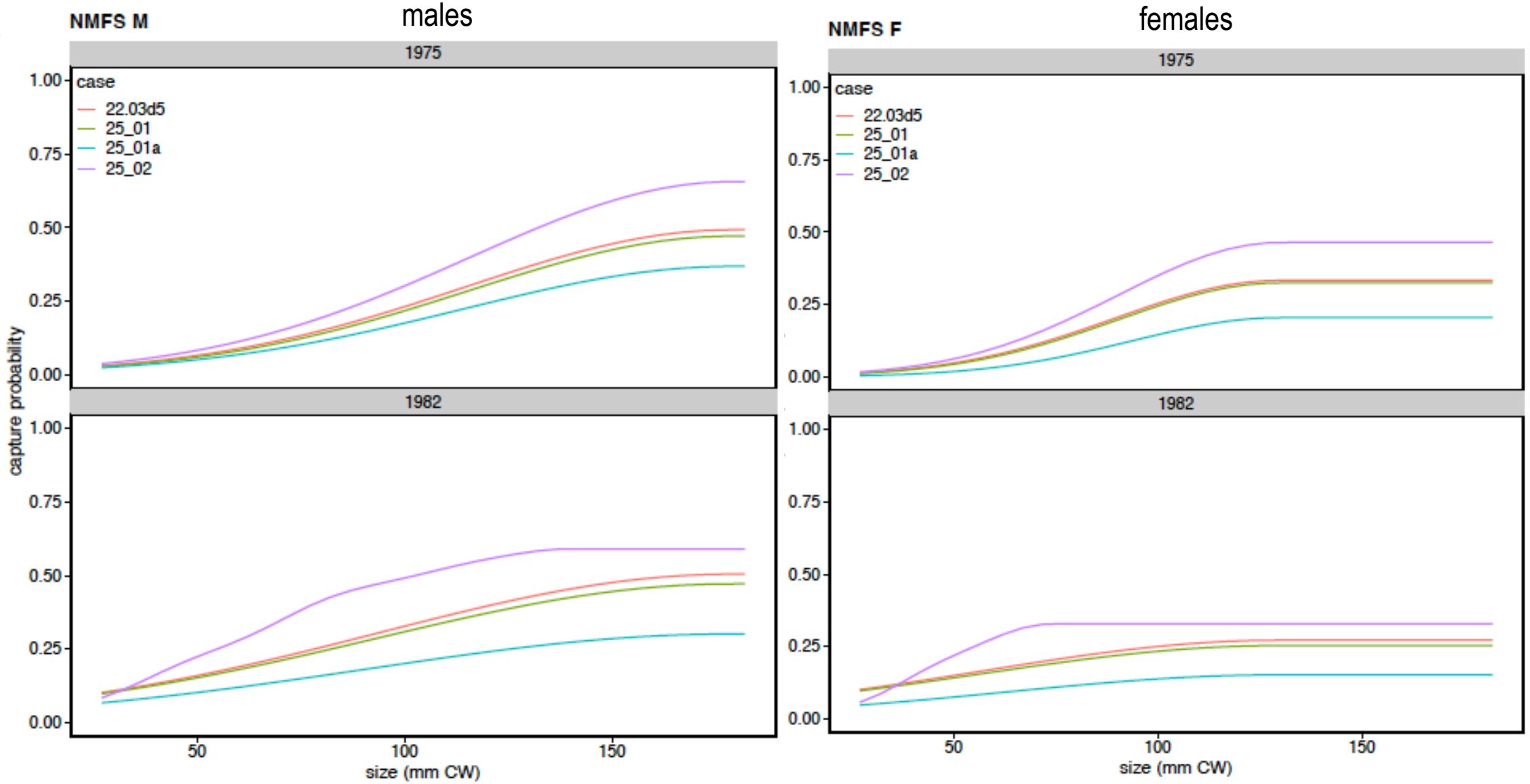




Directed Fishery (males)

TCSAM02 Models

Estimated NMFS Survey Capture Probability Curves



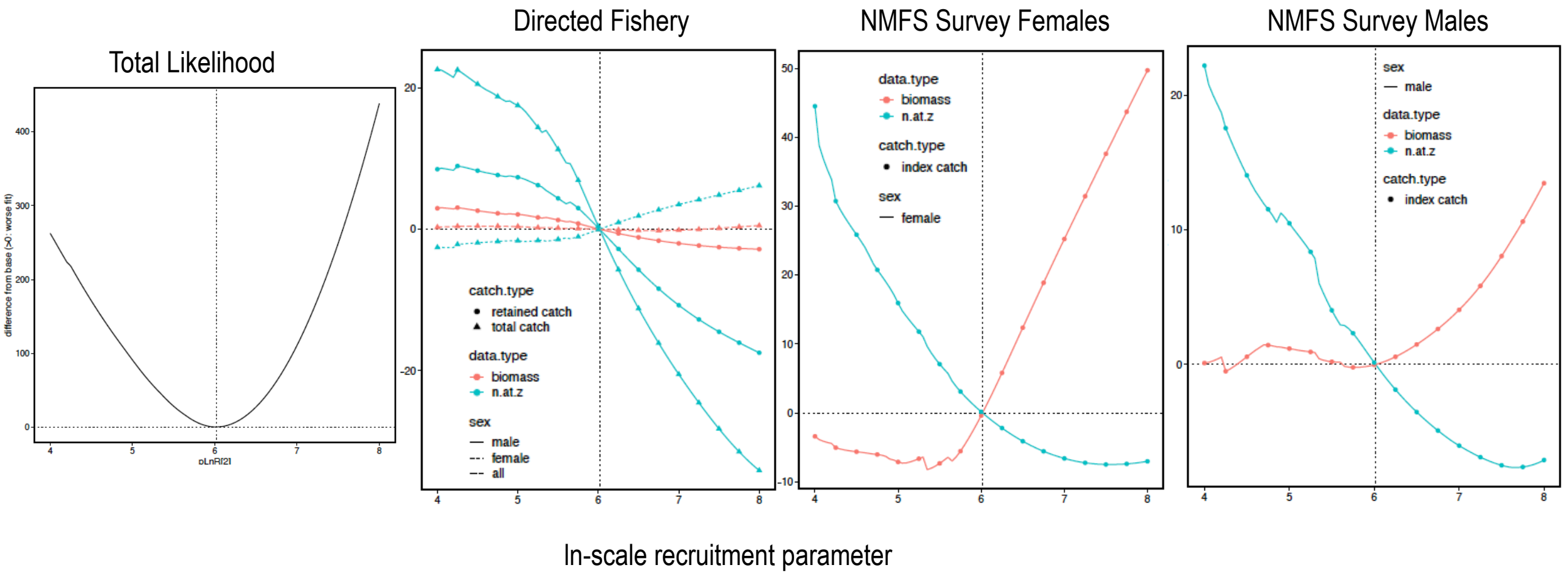
Summary

- 25_01: tail compression has little effect on estimated quantities
- 25_01a: normal error distributions result in poor fits
- 25_02: SBS-derived NMFS survey capture probabilities result in
  - lower scales for population estimates
  - higher scale for fishery catchability estimates
  - otherwise, fits and estimates are similar to those of the assessment model

Proposed Tier 3 models for September

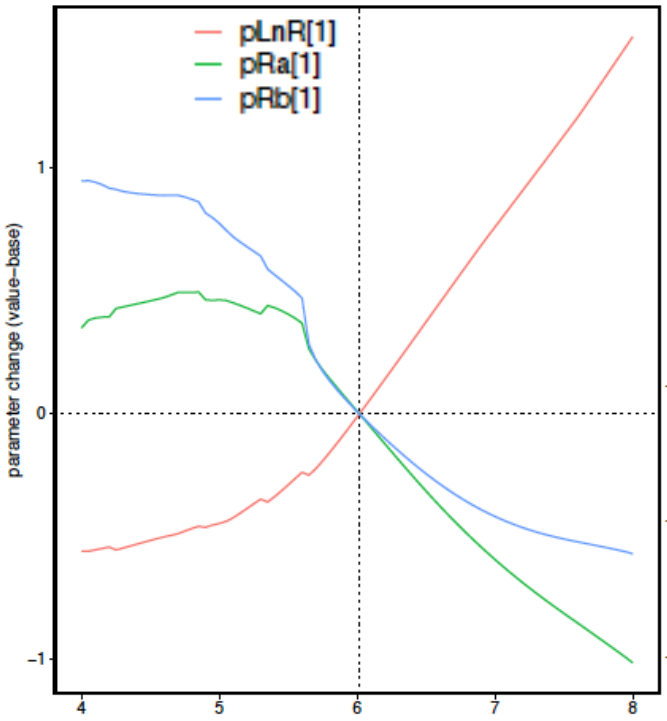
- 2024 assessment model (TCSAM02 22.03d5) is “base” model
  - update with 2024/25 fishery/survey data
- TCSAM02 25_02 model
  - with SBS-derived NMFS survey capture probabilities
- GMACS G25_05
  - resolve scaling differences with TCSAM02 model
  - provide complete analysis
    - management quantities,
    - retrospective patterns, etc

2024 Assessment Model: Likelihood Profiles

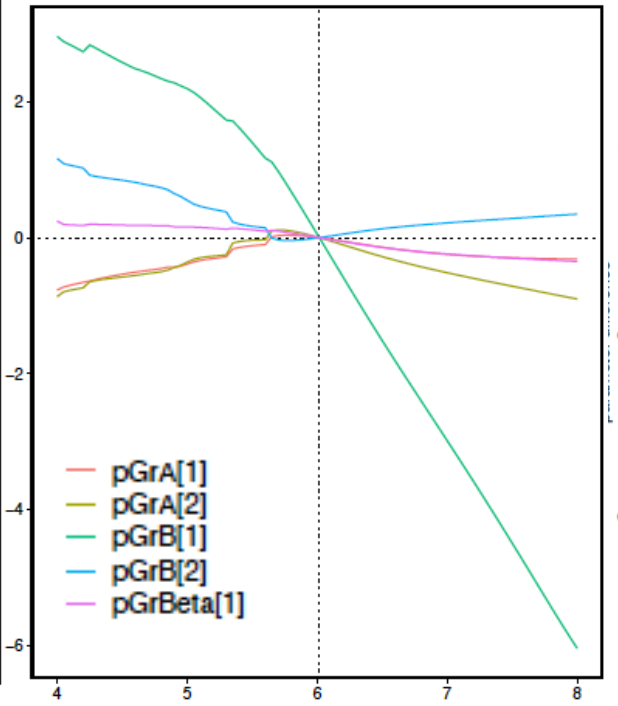


2024 Assessment Model: : Likelihood Profiles

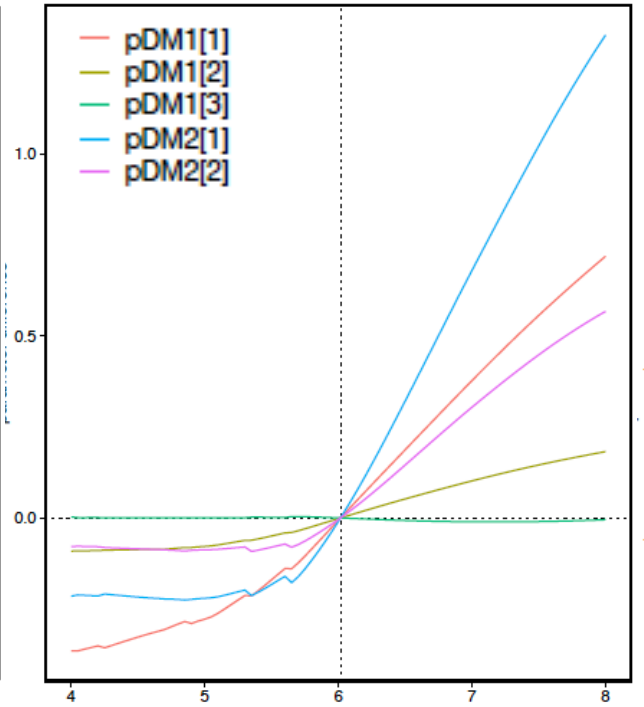
recruitment parameters



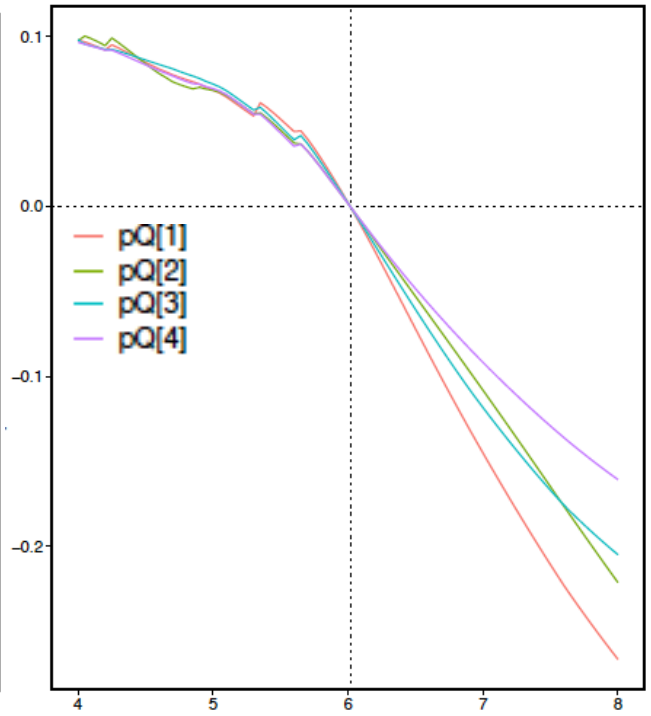
growth parameters



natural mortality parameters

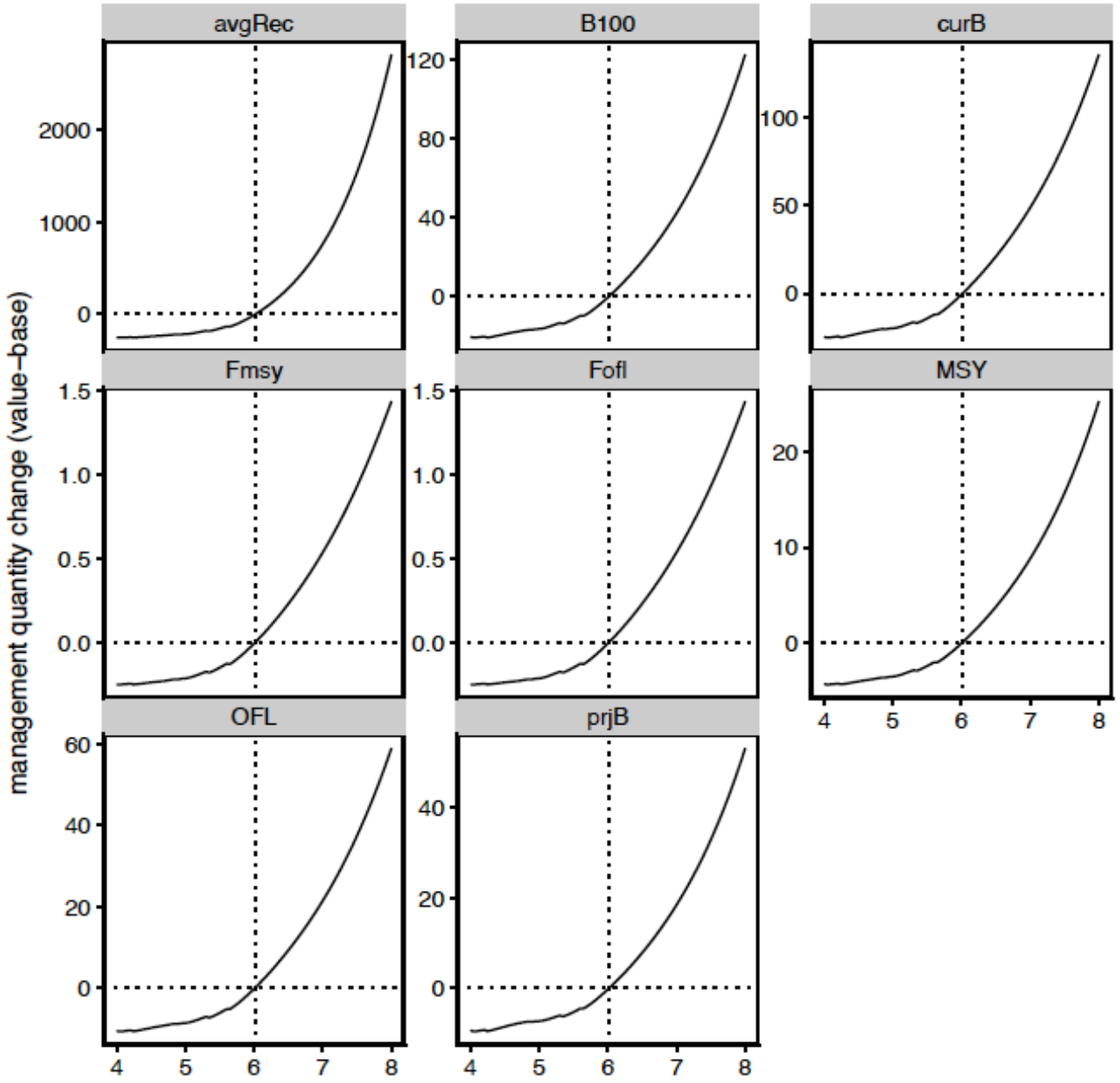


survey catchability parameters



ln-scale recruitment parameter

2024 Assessment Model: LPs



ln-scale recruitment parameter