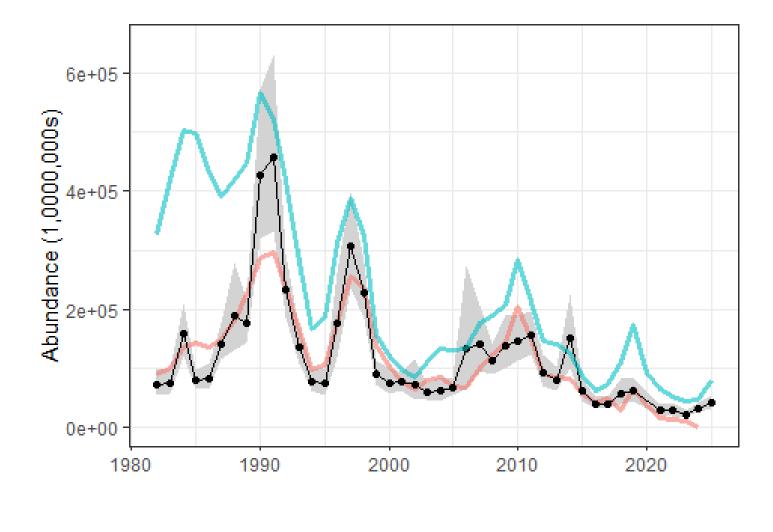


- Small increase in preferred males
 - 7th lowest on record
 - 8% of the maximum observed
- Last 9 years are the lowest on record
 - In order: 2023, 2021, 2022, 2024, 2017, 2016, 2025, 2018, 2019

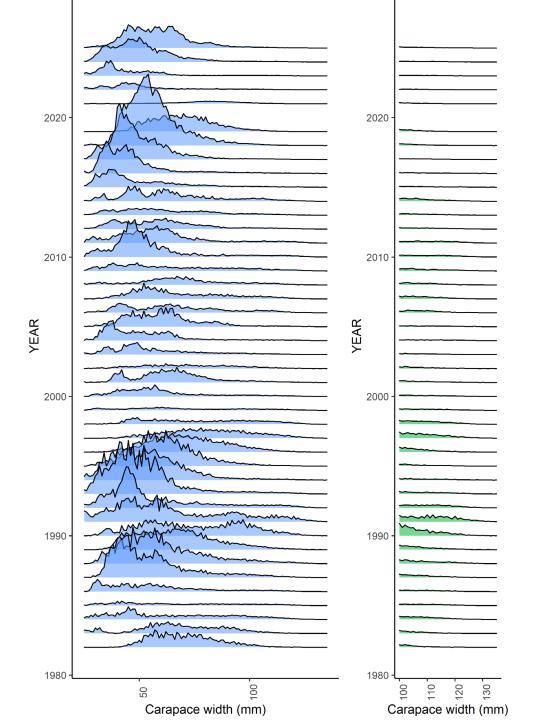




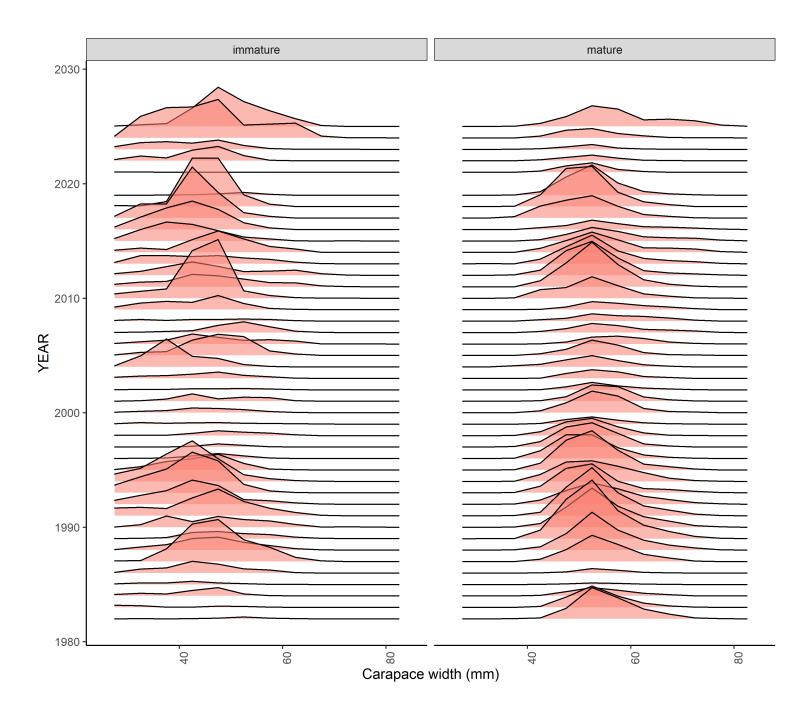
24.1 status quo ____ 25.1 gmacs (>95mm)

• Terminal molt issues

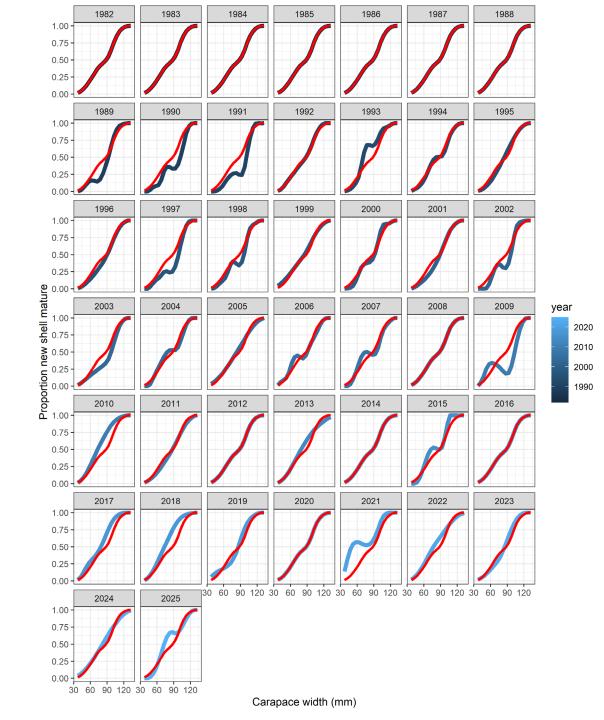
- Small increase in preferred males
 - 7th lowest on record
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- Last 9 years are the lowest on record
 - In order: 2023, 2021, 2022, 2024, 2017, 2016, 2025, 2018, 2019
- Large numbers of medium sized males
- Terminal molt issues



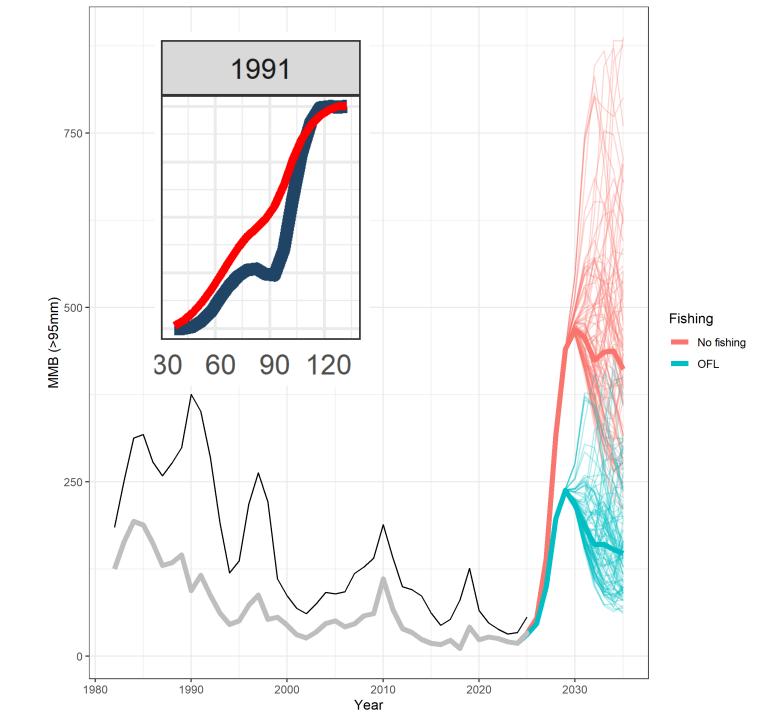
- Small increase in preferred males
 - 7th lowest on record
 - 8% of the maximum observed
- Last 9 years are the lowest on record
 - In order: 2023, 2021, 2022, 2024, 2017, 2016, 2025, 2018, 2019
- Large numbers of medium sized males
- Terminal molt issues



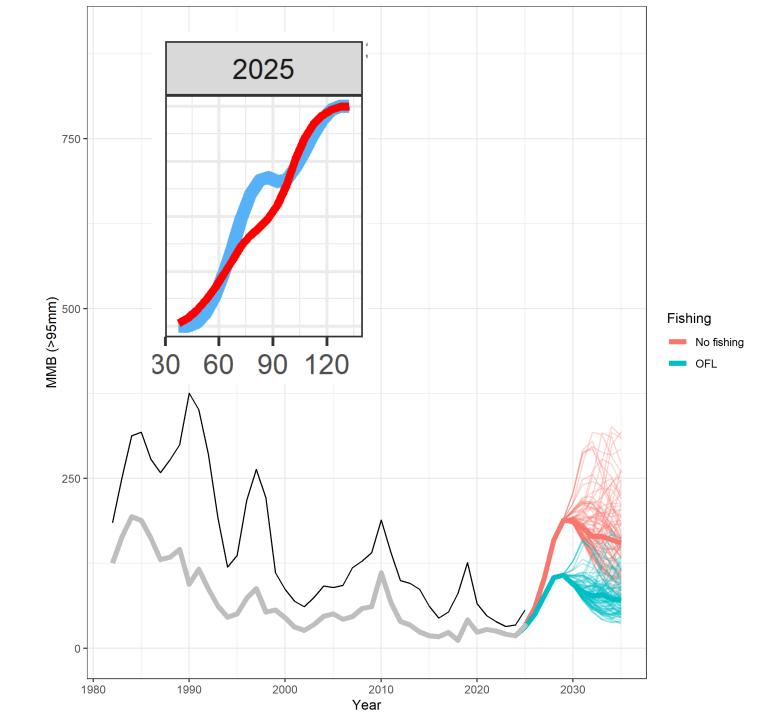
- Small increase in preferred males
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- Last 9 years are the lowest on record
 - In order: 2023, 2021, 2022, 2024, 2017, 2016, 2025, 2018, 2019
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- Terminal molt issues



- Small increase in preferred males
 - 7th lowest on record
 - 8% of the maximum observed
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 - In order: 2023, 2021, 2022, 2024, 2017, 2016, 2025, 2018, 2019
- Large numbers of medium sized males
- Terminal molt issues

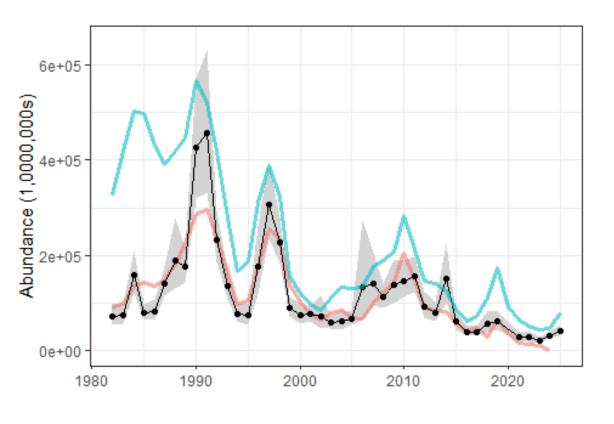


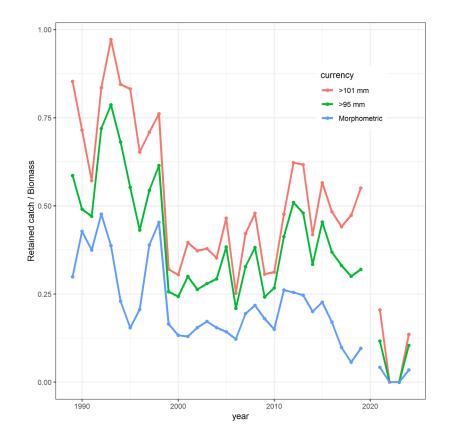
- Small increase in preferred males
 - 7th lowest on record
 - 8% of the maximum observed
- Last 9 years are the lowest on record
 - In order: 2023, 2021, 2022, 2024, 2017, 2016, 2025, 2018, 2019
- Large numbers of medium sized males
- Terminal molt issues



Recommendations

- Tier 3: B35% + large males currency (>95 mm)
- OFL = 3.26 kt
- ABC = 2.63 kt (20% buffer)

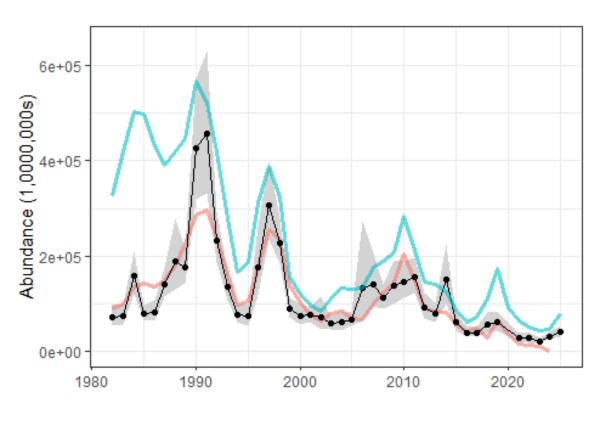


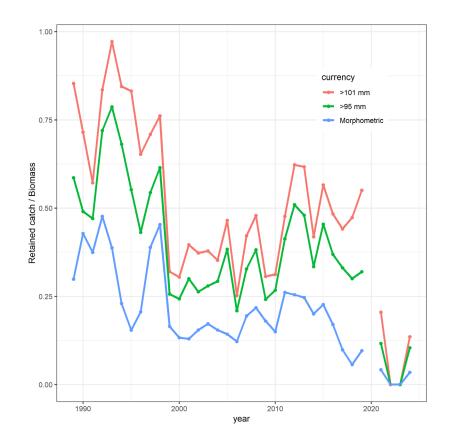


Recommendations

Rationale

- Even with a much more conservative HCR from the state, the stock is on a downward spiral.
- An overfishing level that allows complete removal of large males is non-sensical.

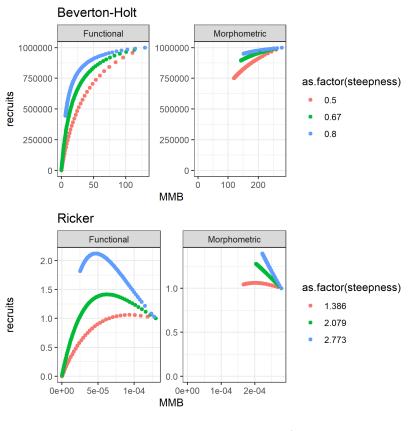


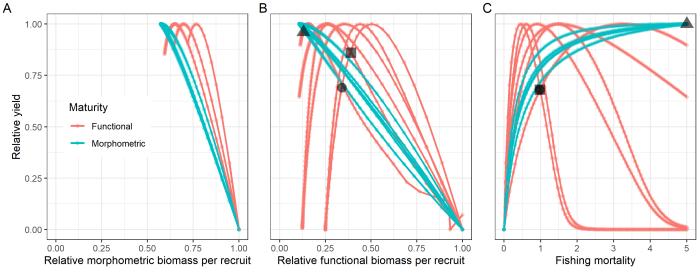


Overview

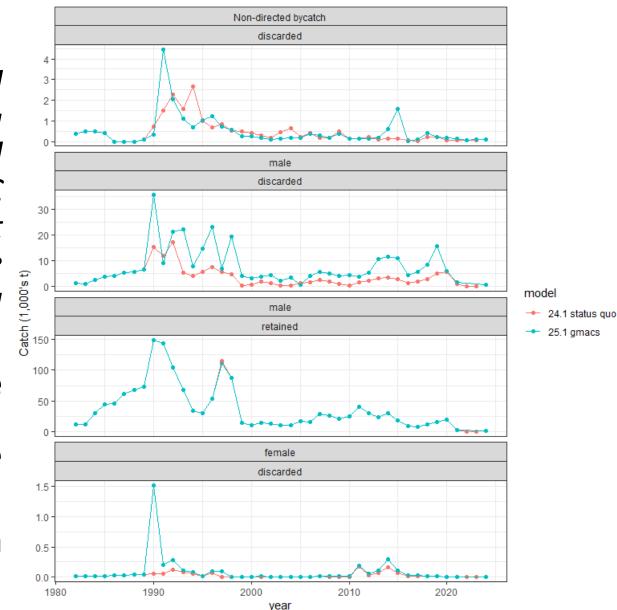
- Review of key changes to data
 - Catch data
 - Survey data
- Assessment scenarios
 - Diagnostics
 - Fits and OFLs
- Management recommendations
 - Tier 3 vs 4
 - Model-based vs. observed estimates of biomass

- *SSC comment: The maximin analysis should be completed assuming a Ricker stock-recruitment relationship, but including the same compensation ratios as the original Clark (1991) analysis. *
- This was done and changed the SBPR% changed from 36% to 34% when using >95mm as currency.

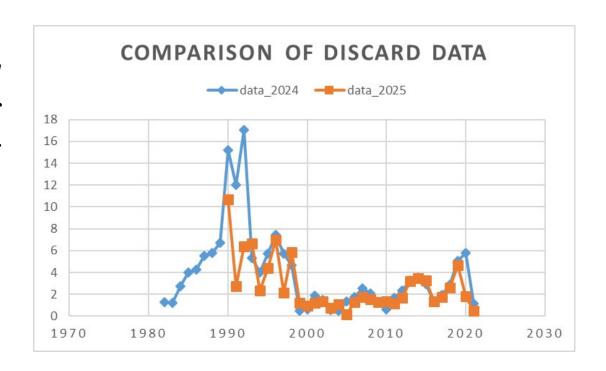




- *SSC comment: As the figures presented on the updated 1991+ catch data appear to indicate substantial differences in male discards, the SSC requests that the September document more clearly describe changes in the discard estimation and accounting process. *
- The change in discards came from the way in which mortality was accounted for (i.e. before data input or within the model).
- Larger differences farther back (with a couple of exceptions).



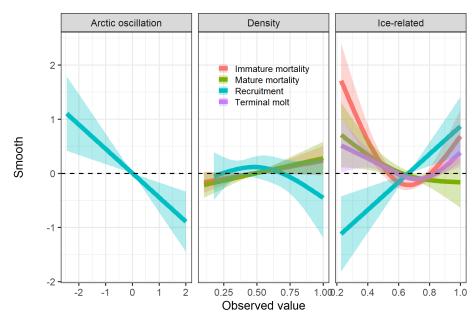
- *SSC comment: As the figures presented on the updated 1991+ catch data appear to indicate substantial differences in male discards, the SSC requests that the September document more clearly describe changes in the discard estimation and accounting process. *
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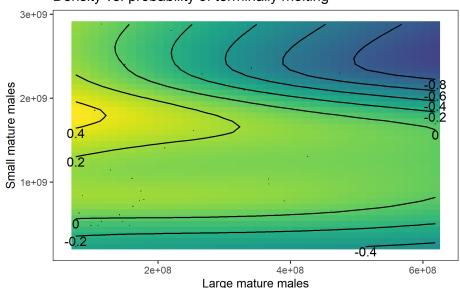
*SSC comment: Given the findings described in Mullowney and Baker (2021) from Canadian research indicating that the molt to maturity may occur at smaller sizes when lower densities of large males are present, it would be useful to determine if there is evidence for the same process occurring in EBS snow crab, and whether fishing mortality on the large males is consistently high enough to result in a strong effect. Further, it would be useful to evaluate whether clutch fullness may be related to size at maturity or the abundance of large-sized crab.

Given that natural mortality events seem to switch among years and sexes depending on the model or input data, it would be prudent to investigate whether it is possible to estimate a direct link between natural mortality and a bottom temperature covariate of appropriate spatial and temporal scale*

Done for males in May 2024—in review at Journal of Applied Ecology

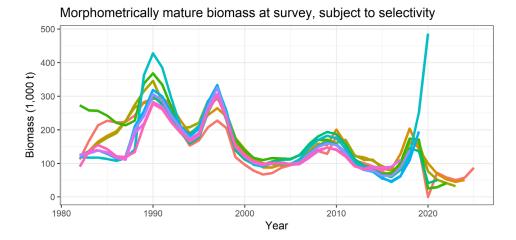


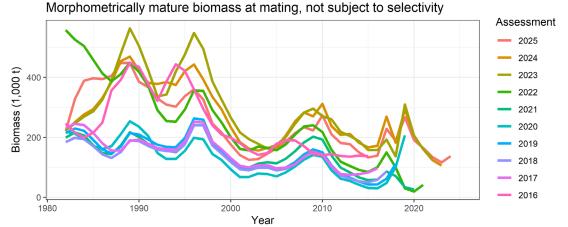
Density vs. probability of terminally molting

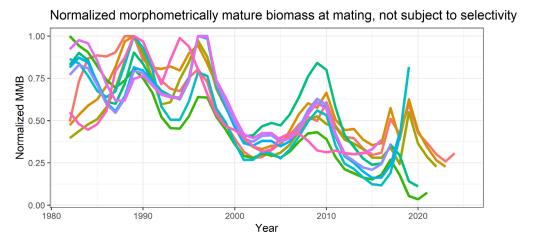


- *SSC comment: include historical bias plots *
- See right.

- *SSC comment: To explore development of an ABC control rule, the SSC requests that a yield per recruit analysis be developed for snow crab. *
- No time



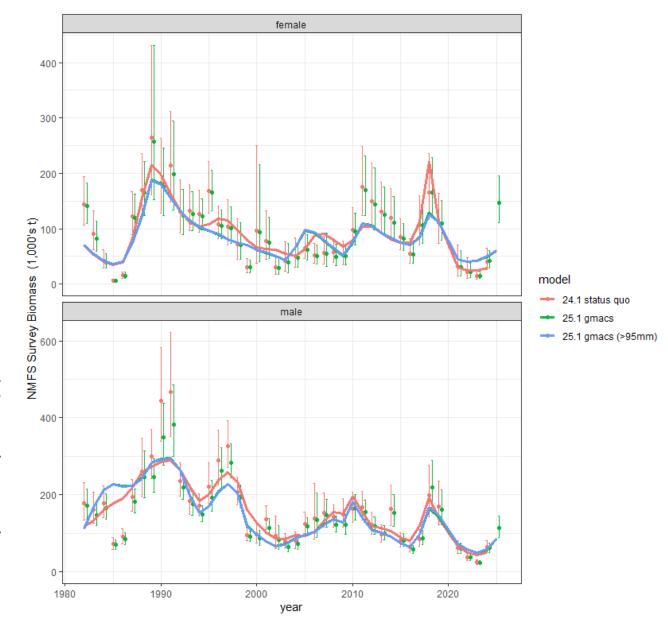




Data changes

- Catch data
 - (discussed above)

- Survey data
 - Both sexes updated
 - Large changes for males in some years
 - Incorporating the time-varying probability of terminal molt
 - Early data points were historically difficult to fit
 - Updates did not change the trajectory of estimates significantly



Assessment model

Key assumptions

- the probability of terminally molting at size varies over time and size and is specified based on observations from the survey data
- survey selectivity is estimated by era (1982-88; 1989-present) and sex as a non-parametric curve subject to priors based on the BSFRF survey efficiency experiment data
- growth is a linear function of pre-molt carapace width with a specified variability around post-molt size
- all immature crab molt
- natural mortality is estimated by sex and maturity state with additional mortality events estimated in 2018 and 2019 and subject to a prior based on an assumed longevity of 20 years
- total and retained fishery selectivity are estimated logistic curves
- all non-directed bycatch (e.g. snow crab caught in the Tanner crab fishery or crab caught in the non-pelagic trawl fisheries) is lumped into a single 'fishery' for which a single selectivity is estimated
- recruitment is estimated separately for females and males and is allocated in the first 3 size bins

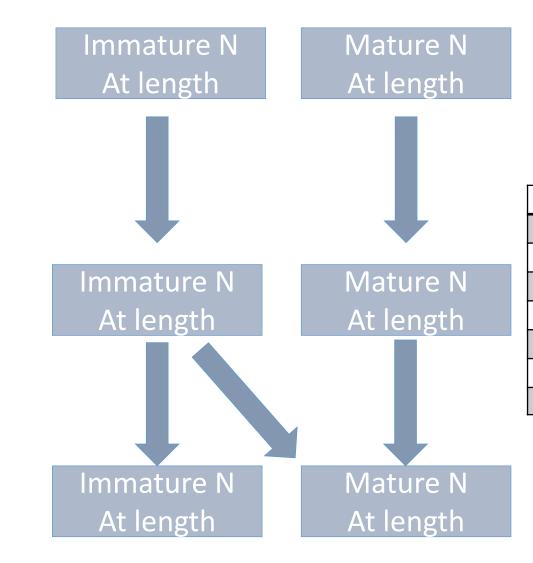
(7/15)

Fishery

(2/15)

Mating

(2/15)



		_							
	27.5	32.5	37.5	42.5	47.5	52.5	57.5	62.5	••••
1982									
1983									
1984									
1985									
1986									
1987									

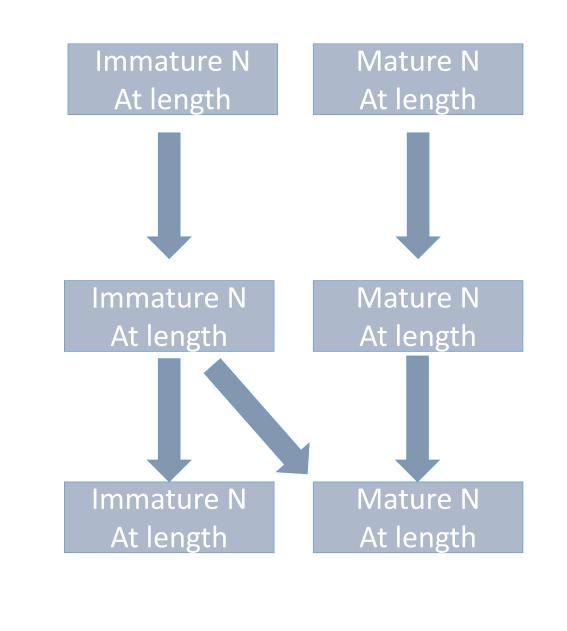
(7/15)

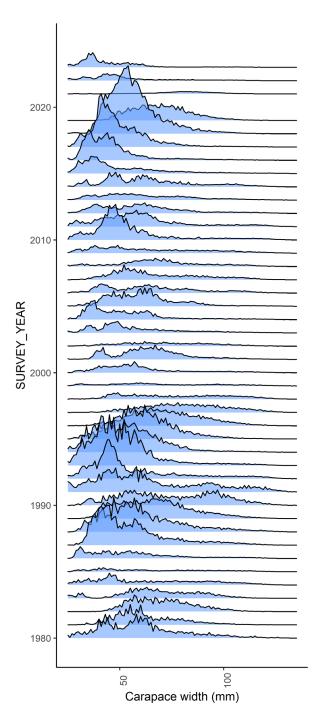
Fishery

(2/15)

Mating

(2/15)





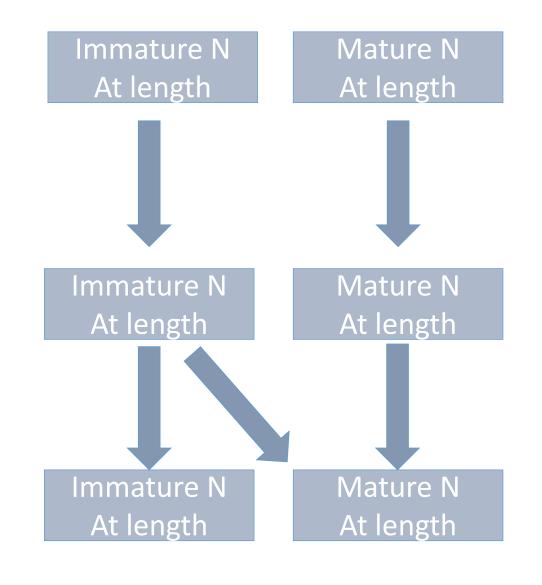
(7/15)

Fishery

(2/15)

Mating

(2/15)



Survey data collected with an estimated selectivity

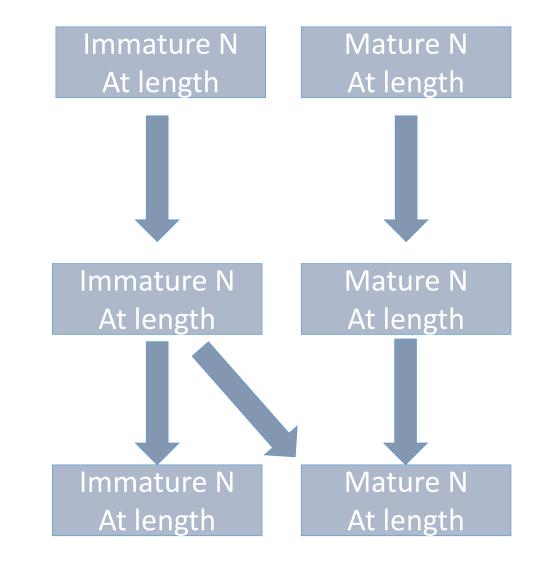
(7/15)

Fishery

(2/15)

Mating

(2/15)



Natural mortality occurs (estimated by sex and maturity state + events)

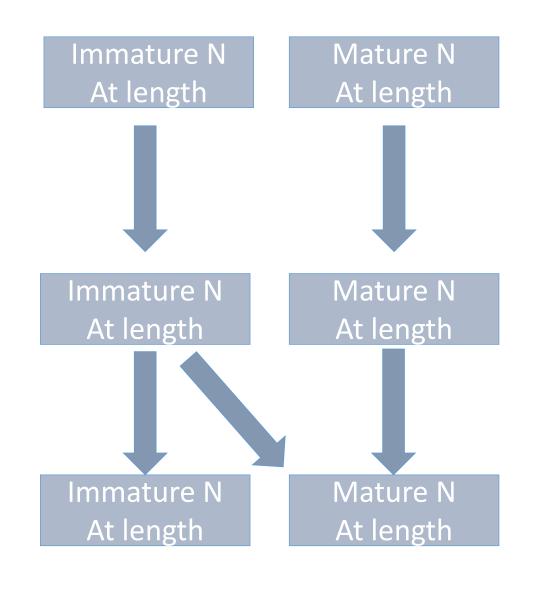
(7/15)

Fishery

(2/15)

Mating

(2/15)



Directed and non-directed fishery occur with sex and fishery specific selectivity.

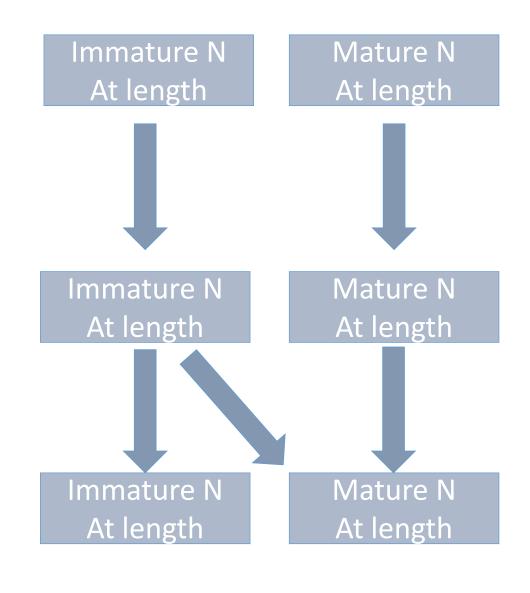
(7/15)

Fishery

(2/15)

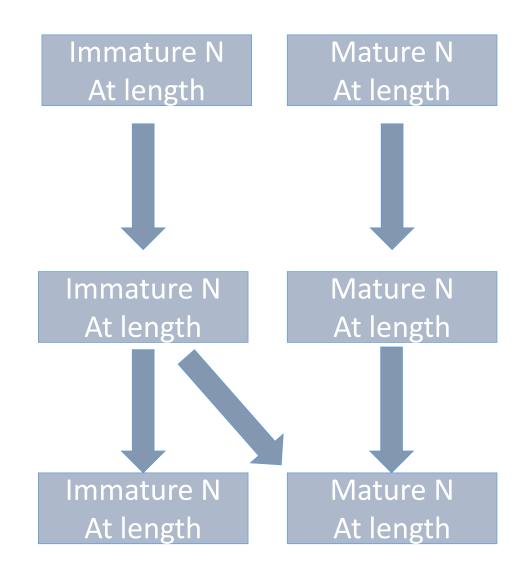
Mating

(2/15)

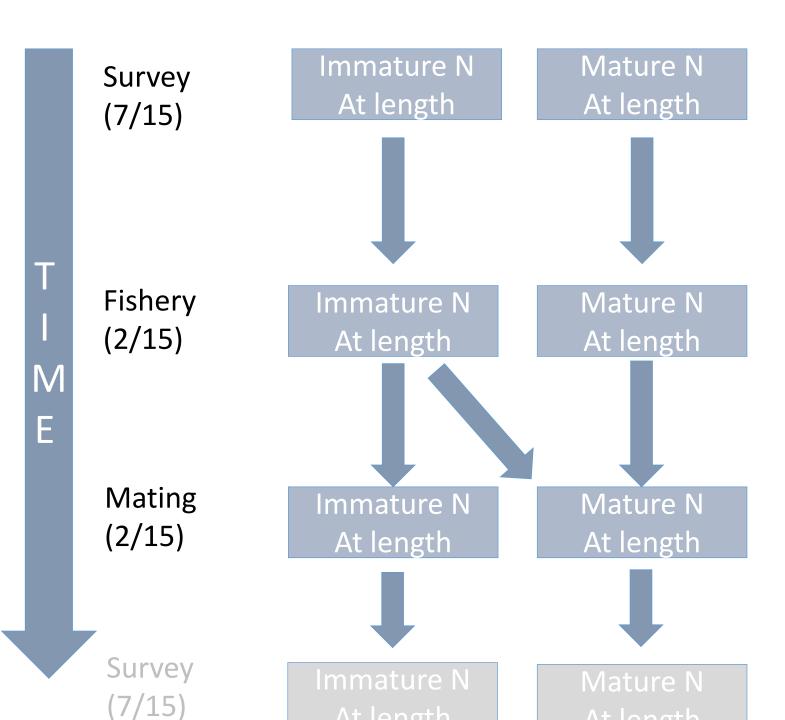


Growth occurs

After growth previously immature animals are allocated to immature or mature size bins based on a probability of having undergone terminal molt.

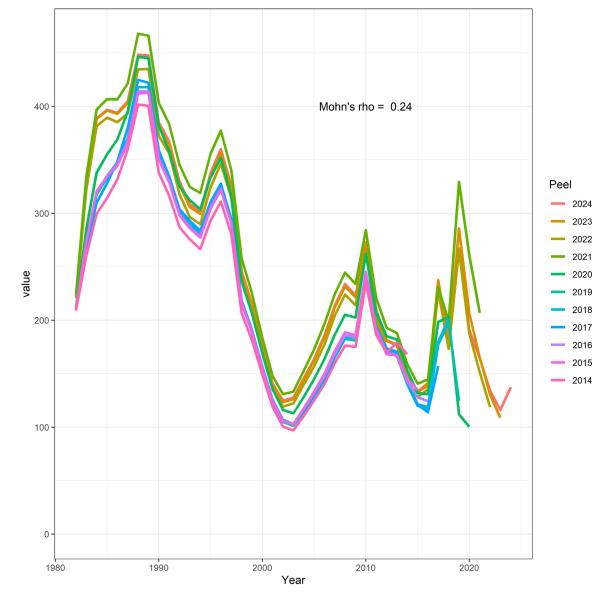


Recruitment occurs and is primarily allocated to the first three size bins.



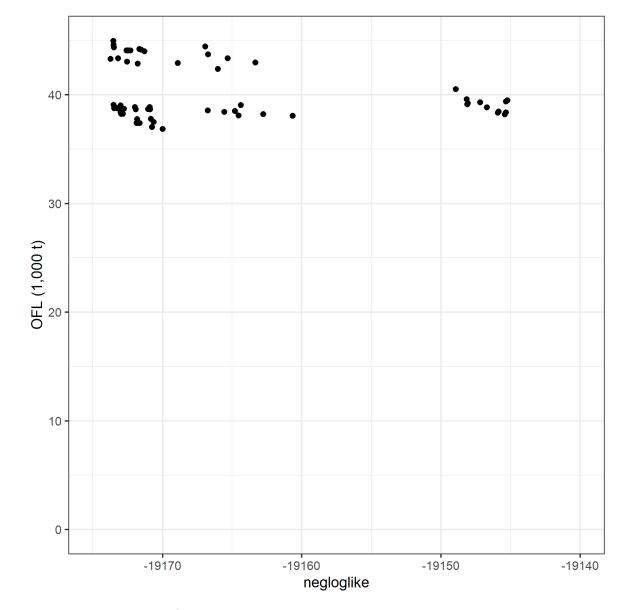
Remaining natural mortality applied before the next survey.

Retrospective patterns not terribly concerning



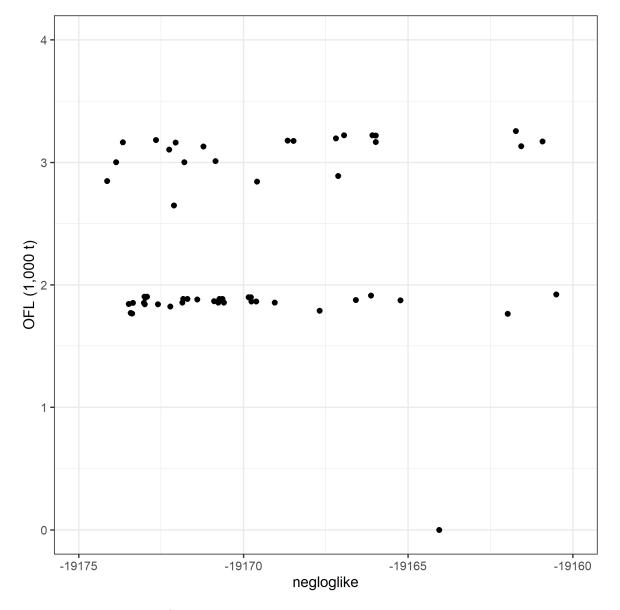
Retrospective patterns in estimated mature male biomass for selected models.

- Retrospective patterns not terribly concerning
- Jittering patterns are concerning



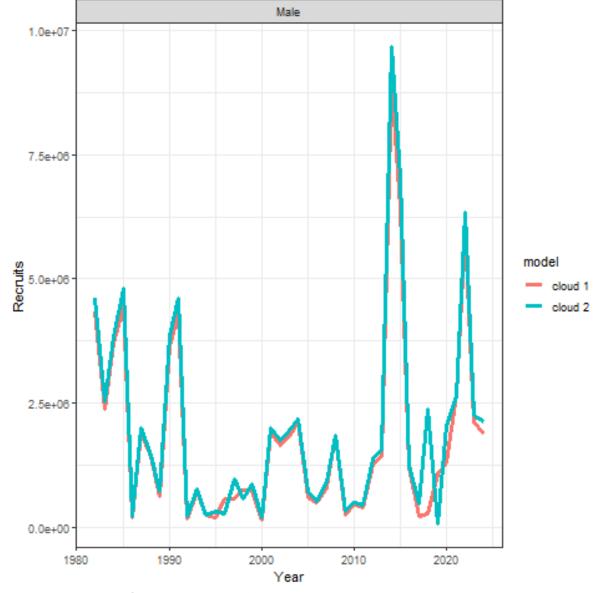
Jittered runs for model 25.1. Each dot represents a 'converged' model run.

- Retrospective patterns not terribly concerning
- Jittering patterns are concerning



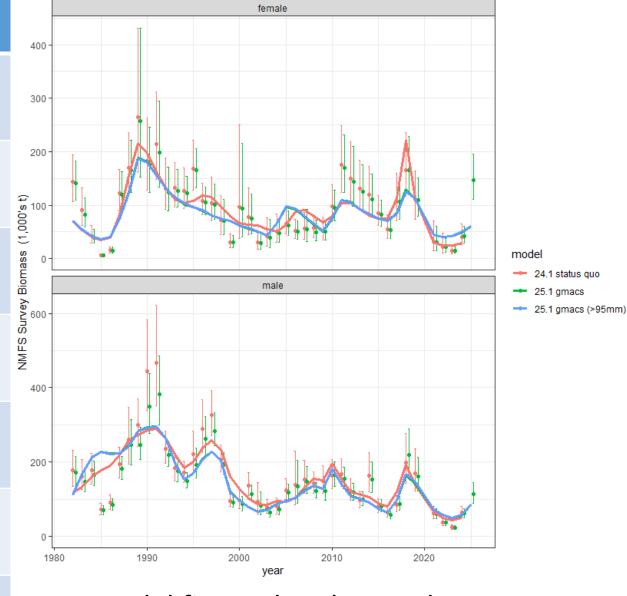
Jittered runs for model 25.1. Each dot represents a 'converged' model run.

- Retrospective patterns not terribly concerning
- Jittering patterns are concerning
- Differences in terminal year come from differences in estimated recruitment several years prior



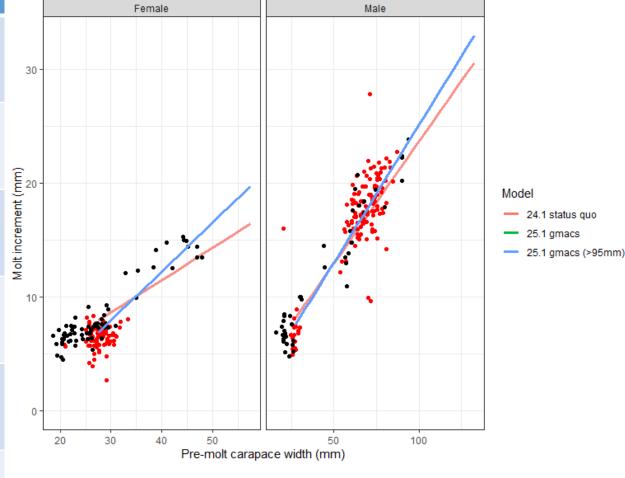
Jittered runs for model 25.1. Each dot represents a 'converged' model run.

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	
Catch biomass	
Catch size composition	
Survey size composition	
BSFRF priors	



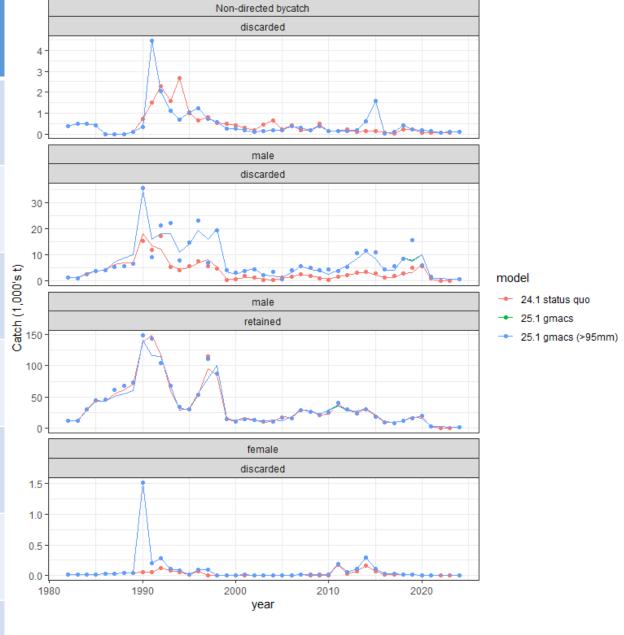
Model fits to the observed mature biomass at survey.

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	
Catch size composition	
Survey size composition	
BSFRF priors	



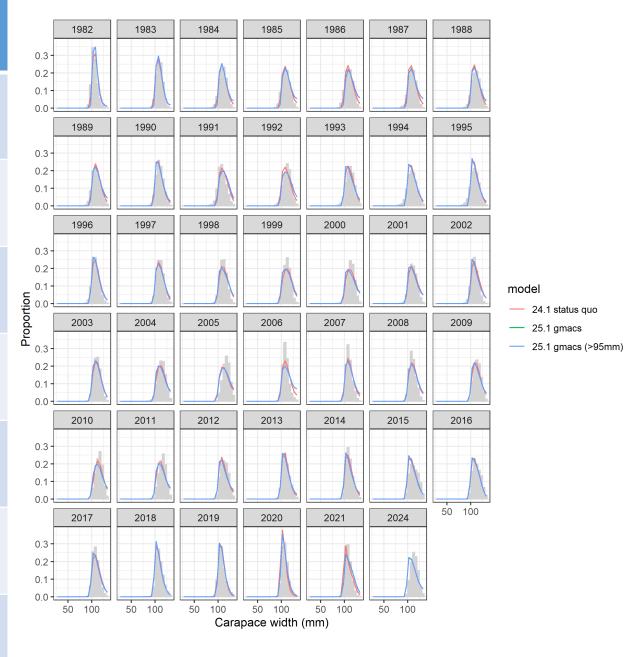
Model fits (colored lines) to the growth data (dots).

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	
Survey size composition	
BSFRF priors	



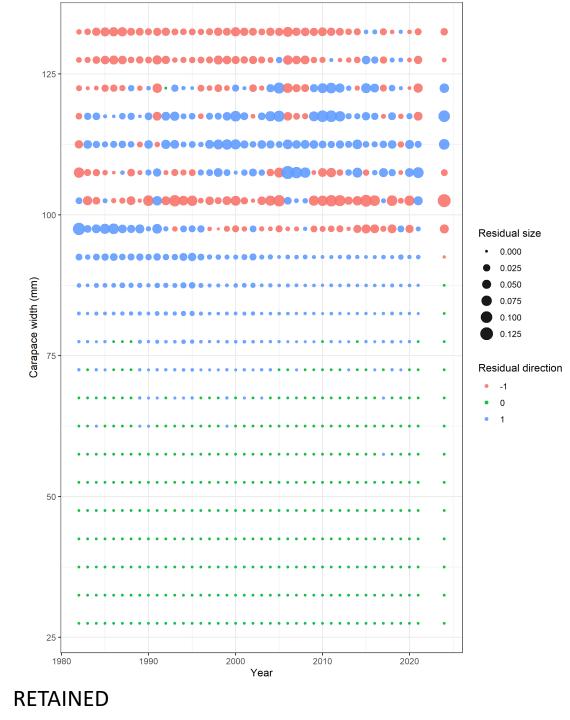
Model fits to catch data.

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	
BSFRF priors	



RETAINED

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	
BSFRF priors	



					1001	1005	
Data source	comments		1992	1993	1994	1995	1996
		0.2 -					
FMB index	Improved fits to growth resulted in large	0.0 -	1998	1999	2000	2001	2002
	changes to FMB fits	0.2 -					
MMB index	Fits changed little in spite of big changes in	0.0					
	early years of survey biomass		2004	2005	2006	2007	2008
		0.2 -	A	A	A		
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	0.1 - UO <u>Q</u> 0.0 -					
		Proportion -	2010	2011	2012	2013	2014
		0.2	A	A	A	A	
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	0.1 -					
	and generally training		2016	2017	2018	2019	2020
Catch size composition	Generally well fit with some differences in updated data.	0.2 -					
, , , , , , , , , , , , , , , , , , ,		0.0 -	2024	50 100	50 100	50 100	50 1
		0.2					
Survey size		0.1					
composition		0.0-	50 100				
BSFRF priors		Carapace width (mm)					
201111 101010							
		-	TOTAL				

1997

2003

2009

2015

2021

50 100

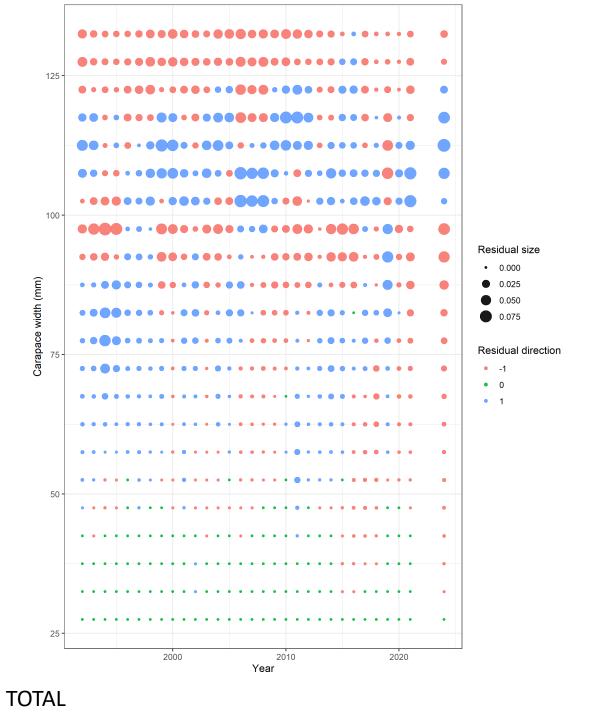
model

— 24.1 status quo

-- 25.1 gmacs (>95mm)

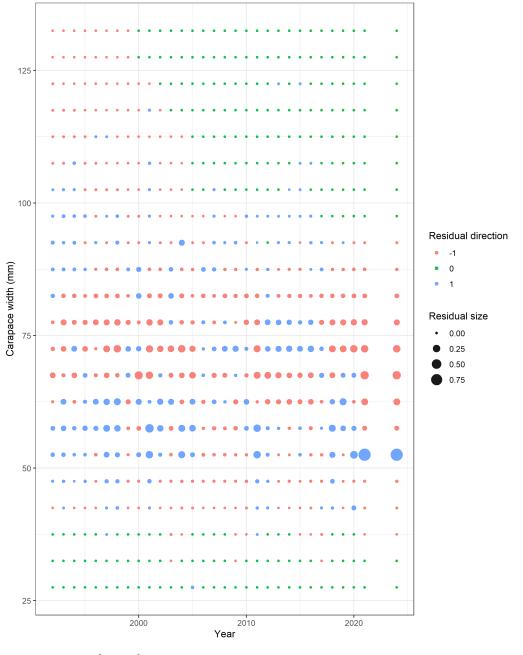
— 25.1 gmacs

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	
BSFRF priors	



Data source	comments	1992 1.00 0.75 0.50 0.25	1993	1994	1995	1996	1997	
FMB index	Improved fits to growth resulted in large changes to FMB fits	0.00 - 1998 1.00 - 0.75 - 0.50 -	1999	2000	2001	2002	2003	
MMB index	Fits changed little in spite of big changes in early years of survey biomass	0.25 0.00 2004 1.00 0.75	2005	2006	2007	2008	2009	
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	0.50 0.25 0.00 2010 1.00 0.75	2011	2012	2013	2014	2015	model — 24.1 status quo — 25.1 gmacs — 25.1 gmacs (>95mm)
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	0.73 0.50 0.25 0.00 2016	2017	2018	2019	2020	2021	
Catch size composition	Generally well fit with some differences in updated data.	0.75 0.50 0.25 0.00	50 100	50 100	50 100	50 100	50 100	
Survey size composition		1.00 0.75 0.50 0.25 0.00						
BSFRF priors				Carapace	width (mm)			
		FEMA	LE (DIR)					

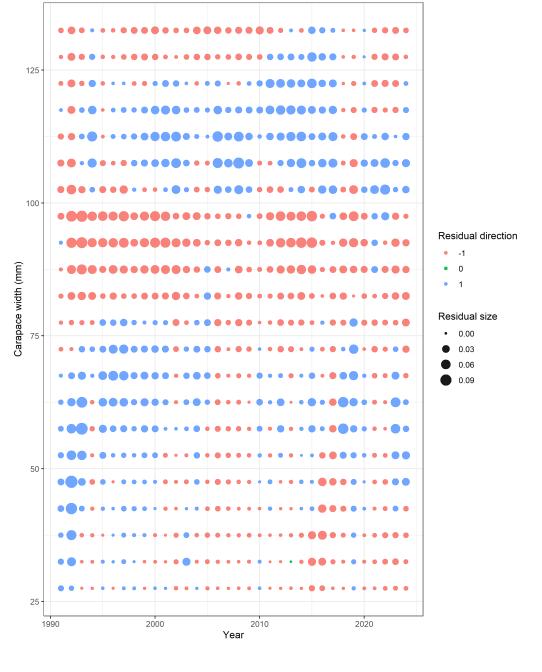
Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	
BSFRF priors	



FEMALE (DIR)

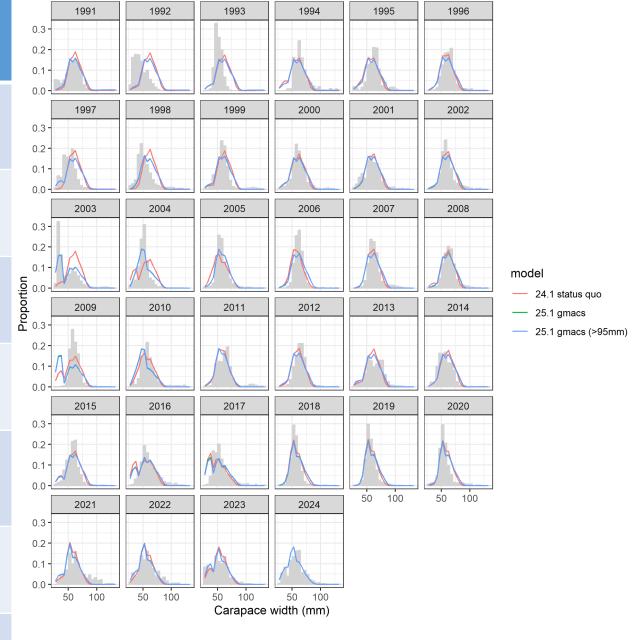
changes to FMB fits MMB index Fits changed little in spite of big changes in early years of survey biomass Growth Improved fits to large females w/ lower CV;	1996
Improved fits to growth resulted in large changes to FMB fits MMB index Fits changed little in spite of big changes in early years of survey biomass Growth Improved fits to large females w/ lower CV; slight changes to males with new data	
MMB index Fits changed little in spite of big changes in early years of survey biomass Growth Improved fits to large females w/ lower CV; slight changes to males with new data	2002
slight changes to males with new data	2008
	model — 24.1 status quo — 25.1 gmacs — 25.1 gmacs (>95mm)
	2020
Catch size composition Generally well fit with some differences in updated data.	50 100
Survey size composition Carapace width (mm)	
BSFRF priors NONDIRECTED (M)	

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	
BSFRF priors	



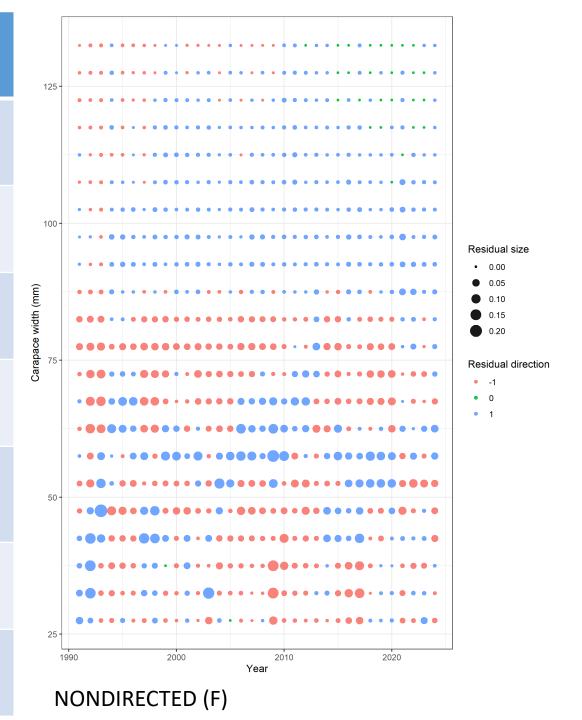
NONDIRECTED (M)

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	
BSFRF priors	

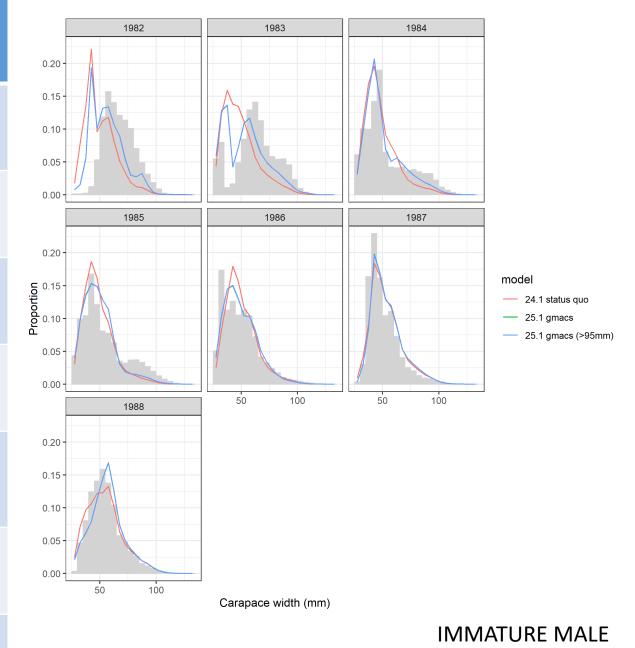


NONDIRECTED (F)

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	
BSFRF priors	

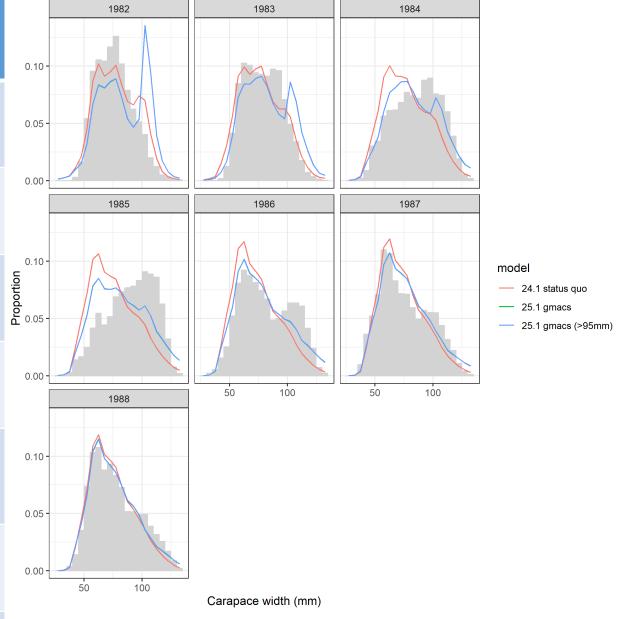


Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	Some issues with early males; updated growth hampered fits to small females.
BSFRF priors	



Data source	comments		
FMB index	Improved fits to growth resulted in large changes to FMB fits	125	
MMB index	Fits changed little in spite of big changes in early years of survey biomass	100-	Residual direction
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	Carapace width (mm)	-1 0 1
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	Carabace 75	Residual size
Catch size composition	Generally well fit with some differences in updated data.	50	
Survey size composition	Some issues with early males; updated growth hampered fits to small females.		
BSFRF priors		1982 1984 1986 Year	1988

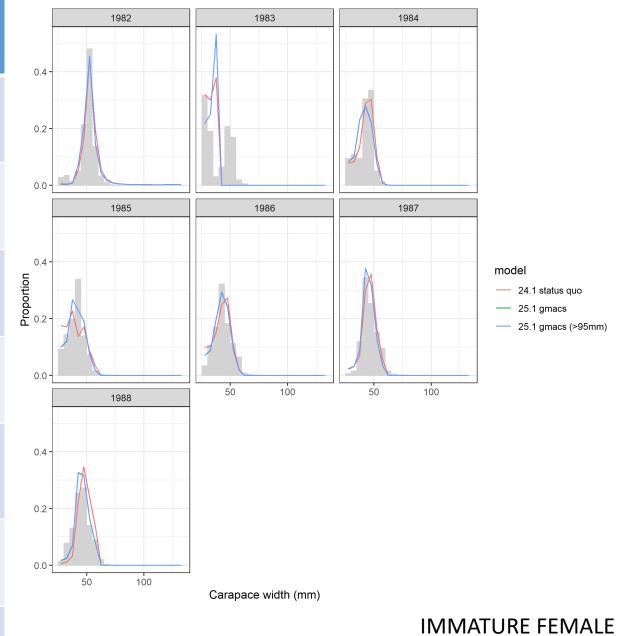
Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	Some issues with early males; updated growth hampered fits to small females.
BSFRF priors	



MATURE MALE

Data source	comments		•							
		125								
FMB index	Improved fits to growth resulted in large changes to FMB fits									
MMB index	Fits changed little in spite of big changes in early years of survey biomass	100								Residual size
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	Carapace width (mm)			,					• 0.000 • 0.025 • 0.050 • 0.075
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	Carabac 75	•	•			•			Residual direction -1 0 1
Catch size composition	Generally well fit with some differences in updated data.	50								
Survey size composition	Some issues with early males; updated growth hampered fits to small females.									
BSFRF priors		25 [.]	1022	•	41	984		986	19	
			1982		19		₁ ∕ear	900	19	88

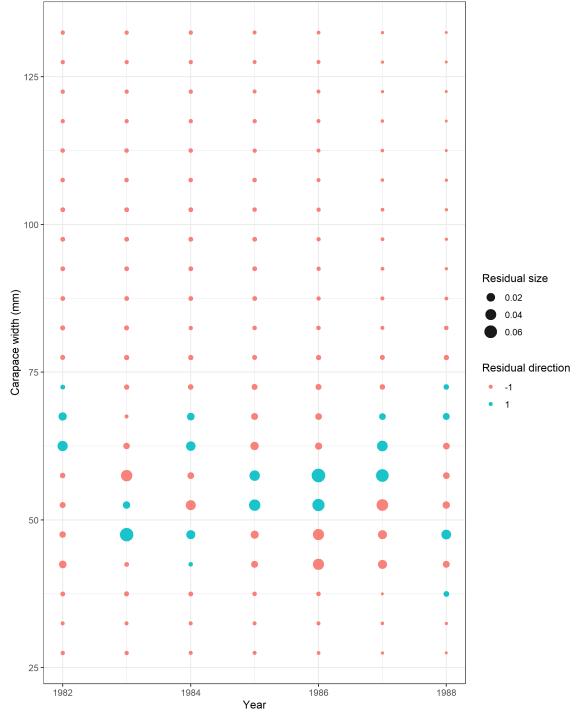
Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	Some issues with early males; updated growth hampered fits to small females.
BSFRF priors	



Data source	comments		•	•	•	•	•		
		125 -	•	•	•		•		
FMB index	Improved fits to growth resulted in large changes to FMB fits								
MMB index	Fits changed little in spite of big changes in early years of survey biomass	100 -							Residual direction
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	Carapace width (mm)							0 1 Residual size 0.0
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	Carapao 75	•			•			0.1 0.2 0.3 0.4 0.5
Catch size composition	Generally well fit with some differences in updated data.	50 -							0.5
Survey size composition	Some issues with early males; updated growth hampered fits to small females.								
BSFRF priors		25 -	1982	•	1984	1 ear	986	1988	

			1982	1983	1984	
Data source	comments	0.4 -				
FMB index	Improved fits to growth resulted in large changes to FMB fits	0.2 -				
MMB index	Fits changed little in spite of big changes in early years of survey biomass	0.0 -	1985	1986	1987	
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	Droportion 0.2 - 0.1 - 0.1 -				model — 24.1 status quo — 25.1 gmacs — 25.1 gmacs (>95mm)
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	0.0	1988	50 100	50 100	
Catch size composition	Generally well fit with some differences in updated data.	0.4 -		-		
Survey size composition	Some issues with early males; updated growth hampered fits to small females.	0.1 -	50 100	Carapace width (mm)		
BSFRF priors					MATUF	RE FEMALE

Data source	comments			•	•	•
		125 -				
FMB index	Improved fits to growth resulted in large changes to FMB fits					
MMB index	Fits changed little in spite of big changes in early years of survey biomass	100 -				•
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	Carapace width (mm)				
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	Carabac				•
Catch size composition	Generally well fit with some differences in updated data.	50 -				
Survey size composition	Some issues with early males; updated growth hampered fits to small females.					
BSFRF priors		25 -		•	•	•
			1982	19	984 Y	ear



Data source	comments	1989	1990	1991	1992	1993	
		0.3 - 0.2 - 0.1 -		Aa			
FMB index	Improved fits to growth resulted in large changes to FMB fits	0.0 - 1995 0.4 - 0.3 - 0.2	1996	1997	1998	1999	
MMB index	Fits changed little in spite of big changes in	0.1 - 0.0 -		M	M		/
	early years of survey biomass	0.4 - 0.3 -	2002	2003	2004	2005	
Growth	Improved fits to large females w/ lower CV;	0.2 0.1 0.0 0.0	M	1		1	
	slight changes to males with new data	0.1 0.0 0.0 2007	2008	2009	2010	2011	
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	0.3 0.2 0.1		A	1		1
	but generally well in	2013	2014	2015	2016	2017	
Catch size composition	Generally well fit with some differences in updated data.	0.3 0.2 0.1		1			
		2019	2021	2022	2023	2024	
Survey size composition	Some issues with early males; updated growth hampered fits to small females.	0.4 0.3 0.2 0.1		A			
		50 100	50 100	50 100 Carapace	50 100 width (mm)	50 100	
BSFRF priors							
							ı

IMMATURE MALE

1994

2000

2006

2012

2018

2025

model

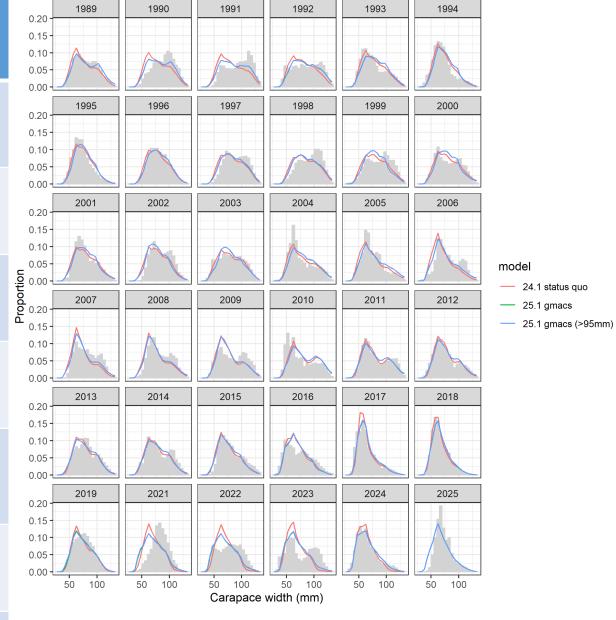
— 24.1 status quo

— 25.1 gmacs (>95mm)

— 25.1 gmacs

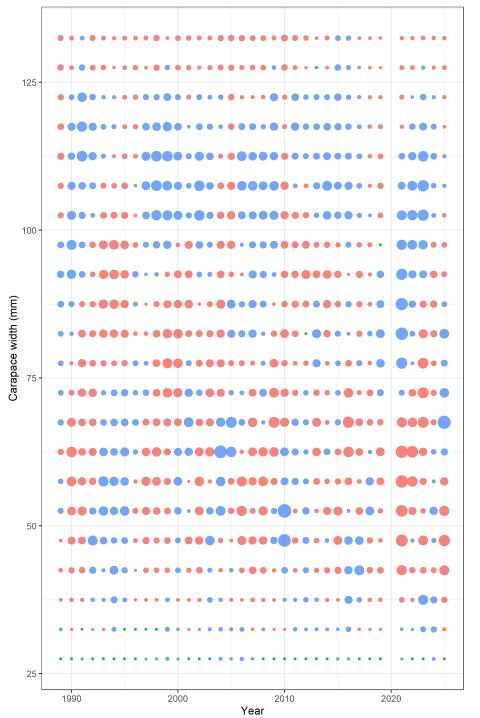
Data source	comments	125-
FMB index	Improved fits to growth resulted in large changes to FMB fits	
MMB index	Fits changed little in spite of big changes in early years of survey biomass	100-
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	Residual size • 0.0 • 0.1 • 0.2 Residual direction
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	Residual direction -1 0 1
Catch size composition	Generally well fit with some differences in updated data.	50
Survey size composition	Some issues with early males; updated growth hampered fits to small females.	
BSFRF priors		1990 2000 2010 2020 Year

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	Some issues with early males; updated growth hampered fits to small females.
BSFRF priors	



MATURE MALE

Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	Some issues with early males; updated growth hampered fits to small females.
BSFRF priors	



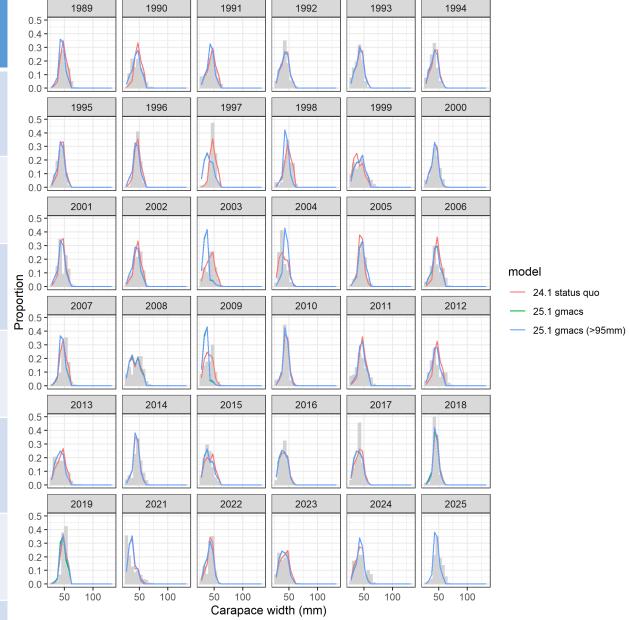
Residual direction

- -1
- 0
- 1

Residual size

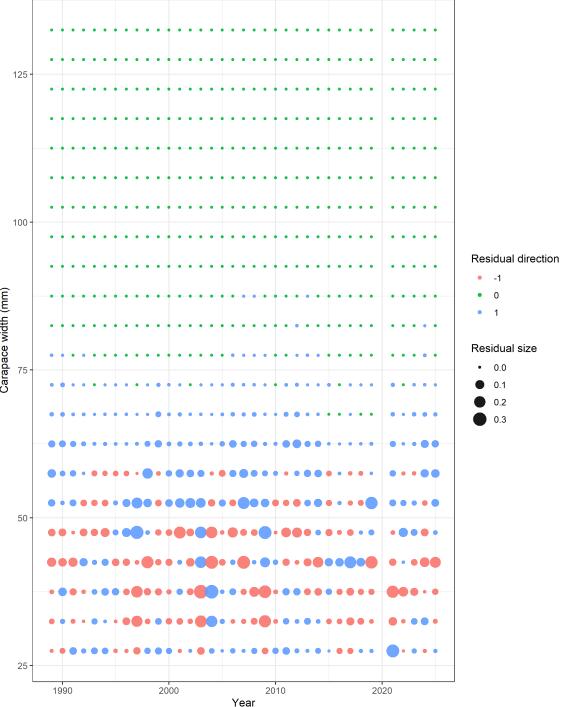
- 0.00
- 0.02
- 0.04
- 0.06
- 0.08

Data source	comments	0.5 0.4 0.3 0.2	1990	19
FMB index	Improved fits to growth resulted in large changes to FMB fits	0.1 0.0 1995 0.5 0.4 0.3	1996	19
MMB index	Fits changed little in spite of big changes in early years of survey biomass	0.2 - 0.1 - 0.0 - 2001	2002	20
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	0.3 0.2 0.1 0.0 0.0 2007	2008	20
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	0.3 - 0.2 - 0.1 - 0.0 - 2013	2014	20
Catch size composition	Generally well fit with some differences in updated data.	0.5 0.4 0.3 0.2 0.1		A
Survey size composition	Some issues with early males; updated growth hampered fits to small females.	0.5 0.4 0.3 0.2 0.1	2021	20
BSFRF priors		50 100	50 100	50 Car



IMMATURE FEMALE

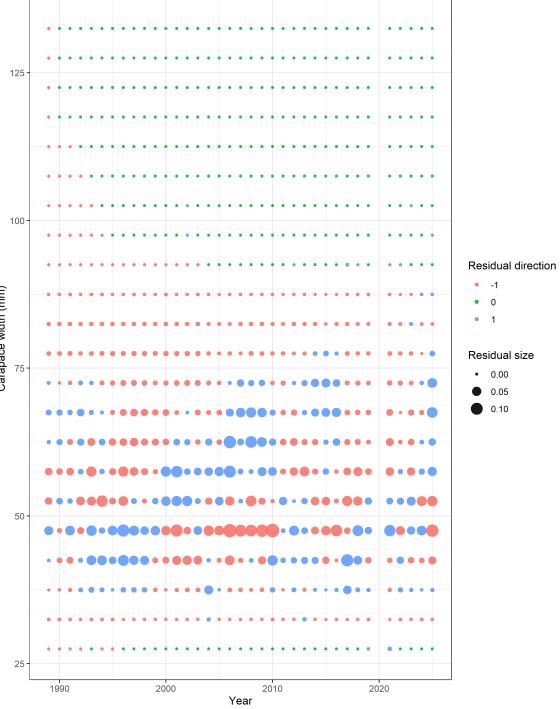
Data source	comments	
FMB index	Improved fits to growth resulted in large changes to FMB fits	125
MMB index	Fits changed little in spite of big changes in early years of survey biomass	100-
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	Carapace width (mm)
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	Carabage 75
Catch size composition	Generally well fit with some differences in updated data.	50-
Survey size composition	Some issues with early males; updated growth hampered fits to small females.	
BSFRF priors		25- 1990 2000 Y



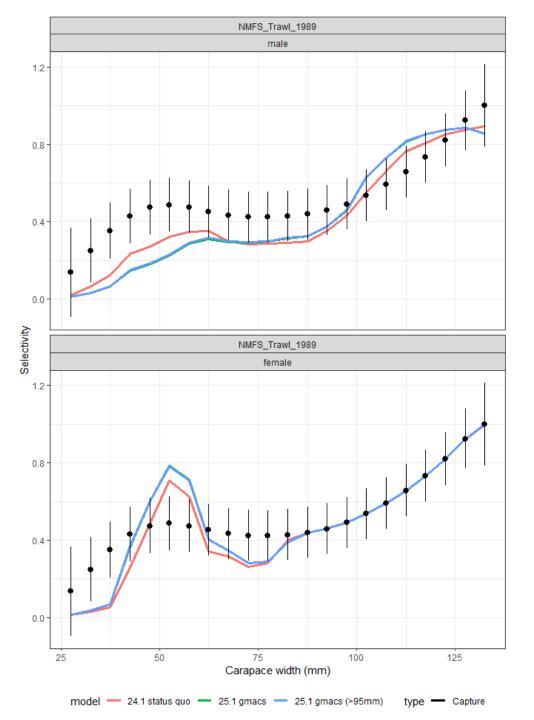
• 0

			1989	1990	1991	1992	1993	1994	
Data source	comments	0.4 - 0.3 - 0.2 - 0.1 - 0.0 -							
FMB index	Improved fits to growth resulted in large changes to FMB fits	0.4 - 0.3 - 0.2 - 0.1 -	1995	1996	1997	1998	1999	2000	
MMB index	Fits changed little in spite of big changes in early years of survey biomass	0.0 - 0.4 - 0.3 - 0.2 - 0.2 - 0.3	2001	2002	2003	2004	2005	2006	
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data	0.1 - 0.0 Looportion 0.4 - 0.3 - 0.3 - 0.3 - 0.4 - 0.3	2007	2008	2009	2010	2011	2012	model — 24.1 status quo — 25.1 gmacs — 25.1 gmacs (>95mm
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit	0.2 - 0.1 - 0.0 - 0.4 -	2013	2014	2015	2016	2017	2018	
Catch size composition	Generally well fit with some differences in updated data.	0.3 - 0.2 - 0.1 - 0.0 -							
Survey size	Some issues with early males; updated	0.4 - 0.3 - 0.2 -	2019	2021	2022	2023	2024	2025	
composition	growth hampered fits to small females.	0.1	0 100	50 100	50 100 Carapace	50 100 width (mm)	50 100	50 100	
BSFRF priors								MATUR	E FEMALE

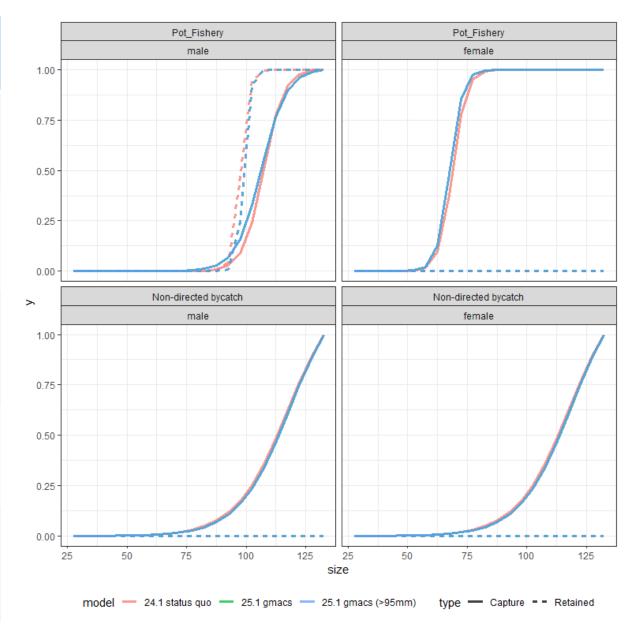
Improved fits to growth resulted in large changes to FMB fits Fits changed little in spite of big changes in early years of survey biomass Improved fits to large females w/ lower CV; slight changes to males with new data Slightly poorer fits to updated discard data, but generally well fit Generally well fit with some differences in updated data. Some issues with early males; updated growth hampered fits to small females.	125 -	100-	Carapace width (mm)	Carabac	50-		25
	comments		•		•	•	



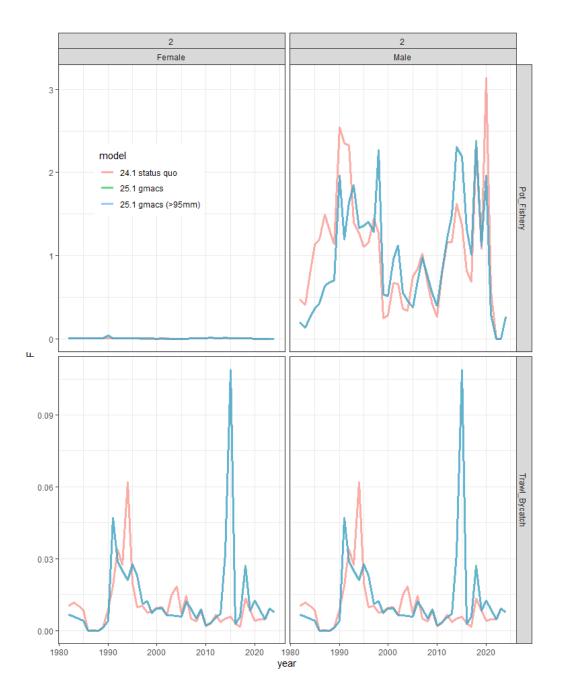
Data source	comments
FMB index	Improved fits to growth resulted in large changes to FMB fits
MMB index	Fits changed little in spite of big changes in early years of survey biomass
Growth	Improved fits to large females w/ lower CV; slight changes to males with new data
Catch biomass	Slightly poorer fits to updated discard data, but generally well fit
Catch size composition	Generally well fit with some differences in updated data.
Survey size composition	Some issues with early males; updated growth hampered fits to small females.
BSFRF priors	Small changes in response to updated growth data



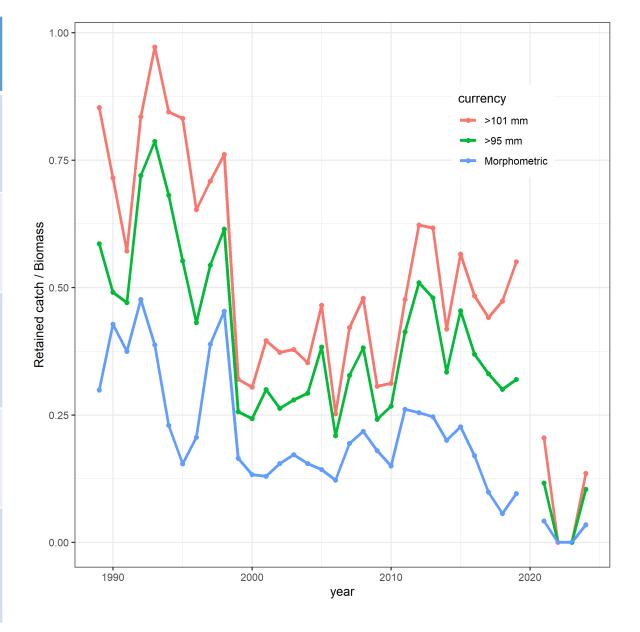
Population process	comments
Selectivity	Slight difference between estimated directed fishery selectivity with update
Fishing mortality	
Recruitment	
Natural mortality	
Maturity	



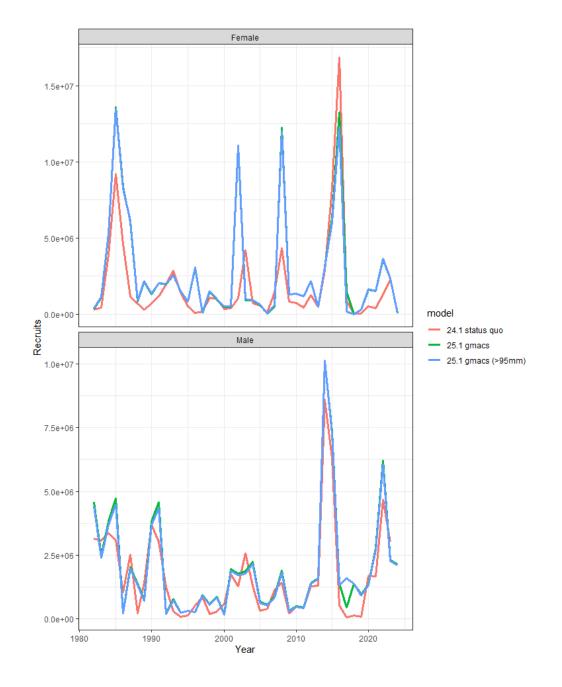
Population process	comments
Selectivity	Slight difference between estimated directed fishery selectivity with update
Fishing mortality	Changes in estimated F reflect changes in input data
Recruitment	
Natural mortality	
Maturity	



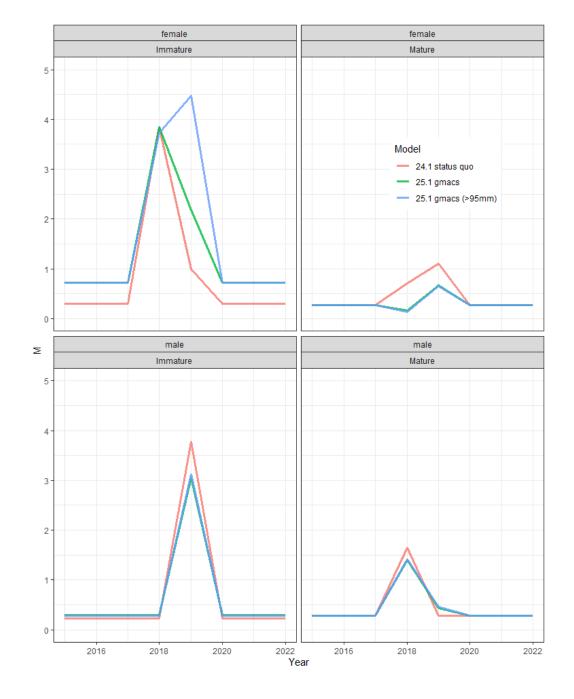
Population process	comments
Selectivity	Slight difference between estimated directed fishery selectivity with update
Fishing mortality	Changes in estimated F reflect changes in input data; observed retained/survey biomass low
Recruitment	
Natural mortality	
Maturity	



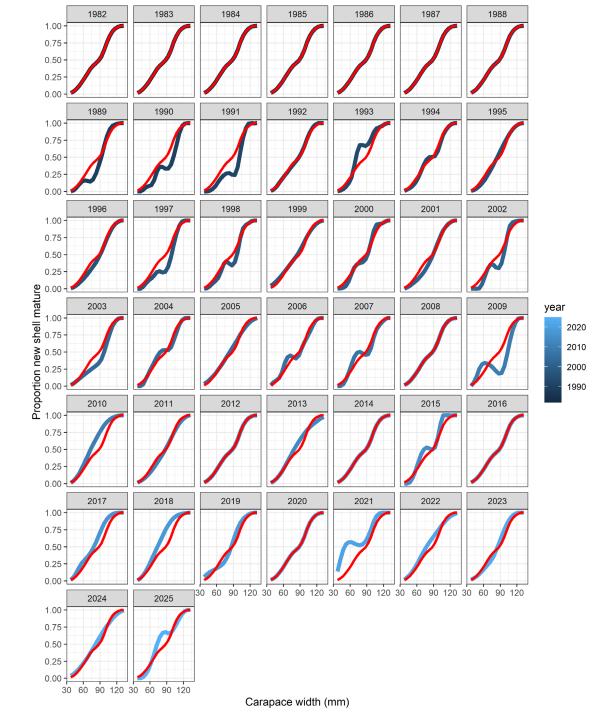
Population process	comments
Selectivity	Slight difference between estimated directed fishery selectivity with update
Fishing mortality	Changes in estimated F reflect changes in input data; observed retained/survey biomass low
Recruitment	Large differences with update growth for females; smaller for males. Estimates of recruitment source of instability in jitters.
Natural mortality	
Maturity	



Population process	comments
Selectivity	Slight difference between estimated directed fishery selectivity with update
Fishing mortality	Changes in estimated F reflect changes in input data; observed retained/survey biomass low
Recruitment	Large differences with update growth for females; smaller for males. Estimates of recruitment source of instability in jitters.
Natural mortality	Immature female mortality increased with new growth data; male similar with update
Maturity	



Population process	comments
Selectivity	Slight difference between estimated directed fishery selectivity with update
Fishing mortality	Changes in estimated F reflect changes in input data; observed retained/survey biomass low
Recruitment	Large differences with update growth for females; smaller for males. Estimates of recruitment source of instability in jitters.
Natural mortality	Immature female mortality increased with new growth data; male similar with update
Maturity	Increased observed probability of terminally molting in 2025 for males



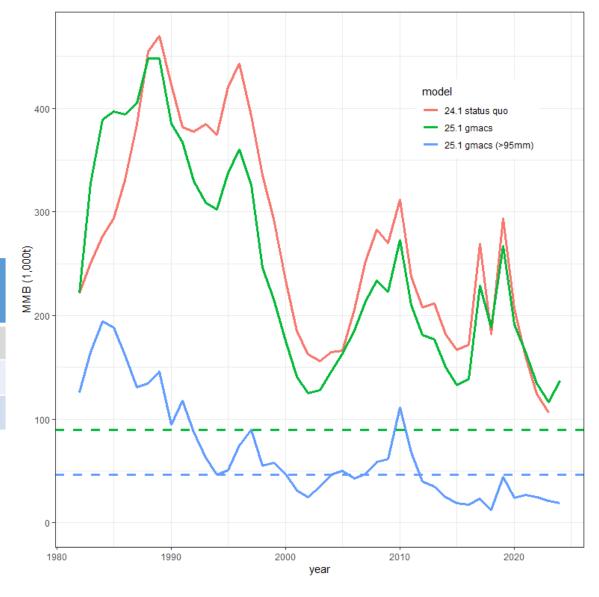
Harvest control rules

GMACS + tier 3

25.1: Morphometric mature biomass; B35%

25.1: >95mm mature biomass; B35%

	BMSY	status	OFL (tot)	Fmsy	Fofl
24.1 Status quo	191.81	0.56	19.60	49.63	25.07
25.1 gmacs	180.06	0.88	44.29	39.52	34.37
25.1 gmacs (>95mm)	93.52	0.32	3.26	0.73	0.18



* Dashed lines are MSST, not B35%

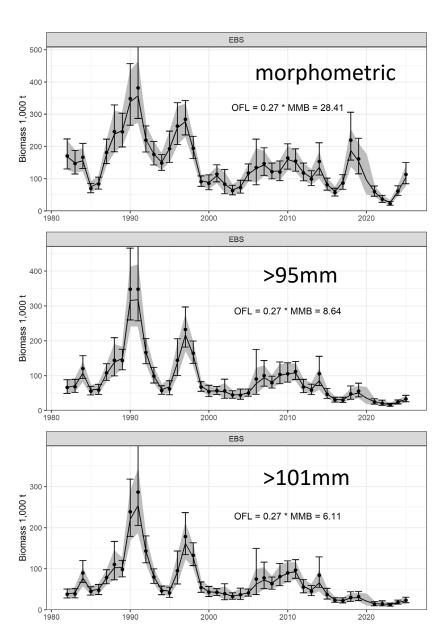
GMACS + tier 3

25.1: Morphometric mature biomass; B35%

25.1: >95mm mature biomass; B35%

	BMSY	status	OFL (tot)	Fmsy	Fofl
24.1 Status quo	191.81	0.56	19.60	49.63	25.07
25.1 gmacs	180.06	0.88	44.29	39.52	34.37
25.1 gmacs (>95mm)	93.52	0.32	3.26	0.73	0.18

Survey biomass + tier 4



Risk table

TOPIC	COMMENT	SCORE
Assessment	Biology good Reference points bad Jittering bad	Increased concern (2)
Population dynamics	Large males downward trajectory Recent population collapse Potential for density dependence in terminal molt	Increased concern (2)
Environmental/ecosystem	ESP indicators mostly neutral	Normal (1)
Fishery performance	Fishery closure opened CPUE increased	Normal (1)

Recommendations

2024 OFL

- Author: Tier 4, 95mm = 0.66 (20%)
- CPT: Tier 3, 95mm = 0.05 (20%)
- SSC: Tier 3, morph = 19.6 (60%)

Author/CPT Rationale

- No big crab == no fishery
 - "Optimal yield"
- Preferred abundance trend strongly negative under conservative management
- Potential biological risks
 - Density dependent maturity
 - Large males important in reproduction
 - Genetic component

2025 OFL

- Author: Tier 3, 95mm = 3.26 (20%)
- CPT:
- SSC:

Author/CPT Rationale

No change

Final thoughts

- Stock is in bad shape in spite of conservative harvest from the state, but with potential reasons for optimism
- Assessment model represents the best available information on biology
- Models are the best tools we have to:
 - try to understand the drivers of the stocks (e.g. why did the stock collapse?),
 - ask hypotheticals (e.g. what if we change selectivity?),
 - incorporate multiple data sources (e.g. BSFRF data)
- Management options were not designed with snow crab biology in mind
- Uncertainties around biology represent potentially large risks
- Harmonizing state and federal rules would be useful for communicating with stakeholders
- Agreeing on a good way to quantify tradeoffs, justify decisions under variable levels of uncertainty and risk, and communicate both of these points would be useful