

# C1 BSAI CRAB STOCKS

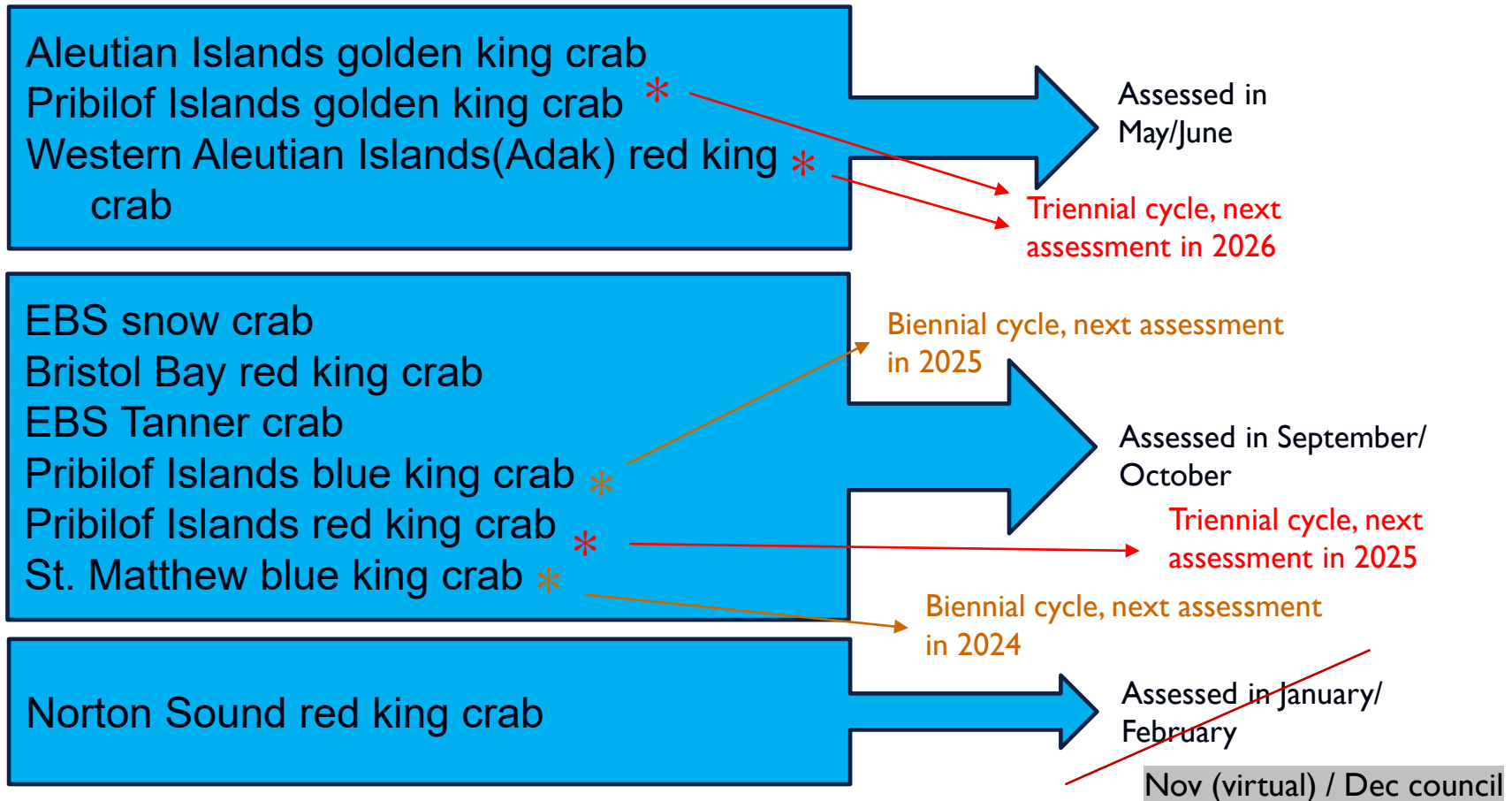
KATIE PALOF & MIKE LITZOW (CPT CO-CHAIRS)

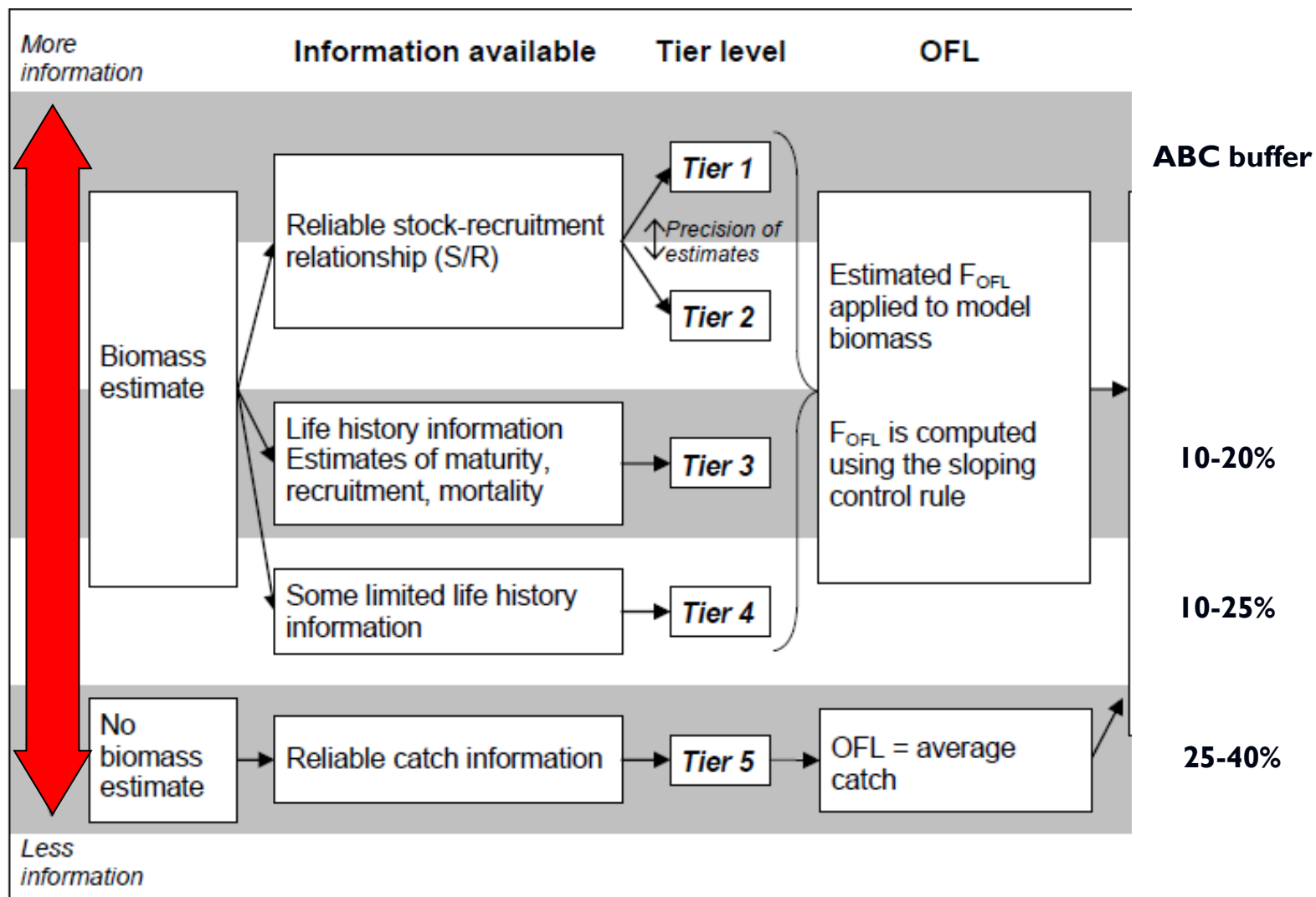
OCTOBER 2024 NPFMC MEETING | ANCHORAGE, AK

CPT MEETING MINUTES – SEPT 9<sup>TH</sup> – 12<sup>TH</sup> | SEATTLE, WA



# BSAI CRAB STOCKS MANAGEMENT TIMING





# SEPTEMBER 2024 AGENDA

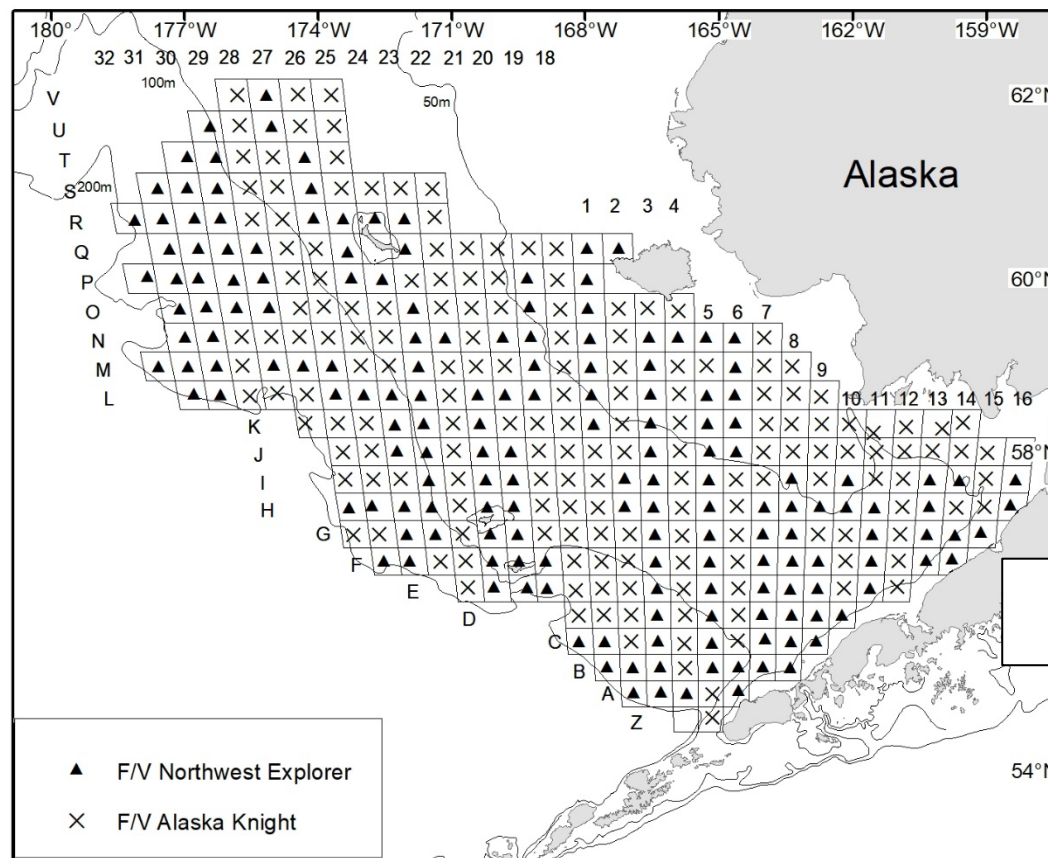
- ✓ Summer trawl survey results
- ✓ 2023/24 fishery season summary (taken up under each stock)
- ✓ **Snow crab final assessment, OFL and ABC**, and ESP report card
- ✓ **Tanner crab final assessment, OFL and ABC**
- ✓ **SMBKC final assessment, OFL and ABC**
- ✓ **BBRKC final assessment, OFL and ABC**, and ESP report card
- ✓ Proposed model runs:
  - ✓ NSRKC
  - ✓ AIGKC
- ✓ Risk table drafts and next steps
- ✓ Overfishing updates on non-assessed stocks
- ✓ Ecosystem status report – AI and BS
- ✓ BSFRF research updates
- ✓ Research updates (see CPT e-agenda)
- ✓ New business/ Jan modeling workshop



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# 2024 BERING SEA BOTTOM TRAWL SURVEY RESULTS



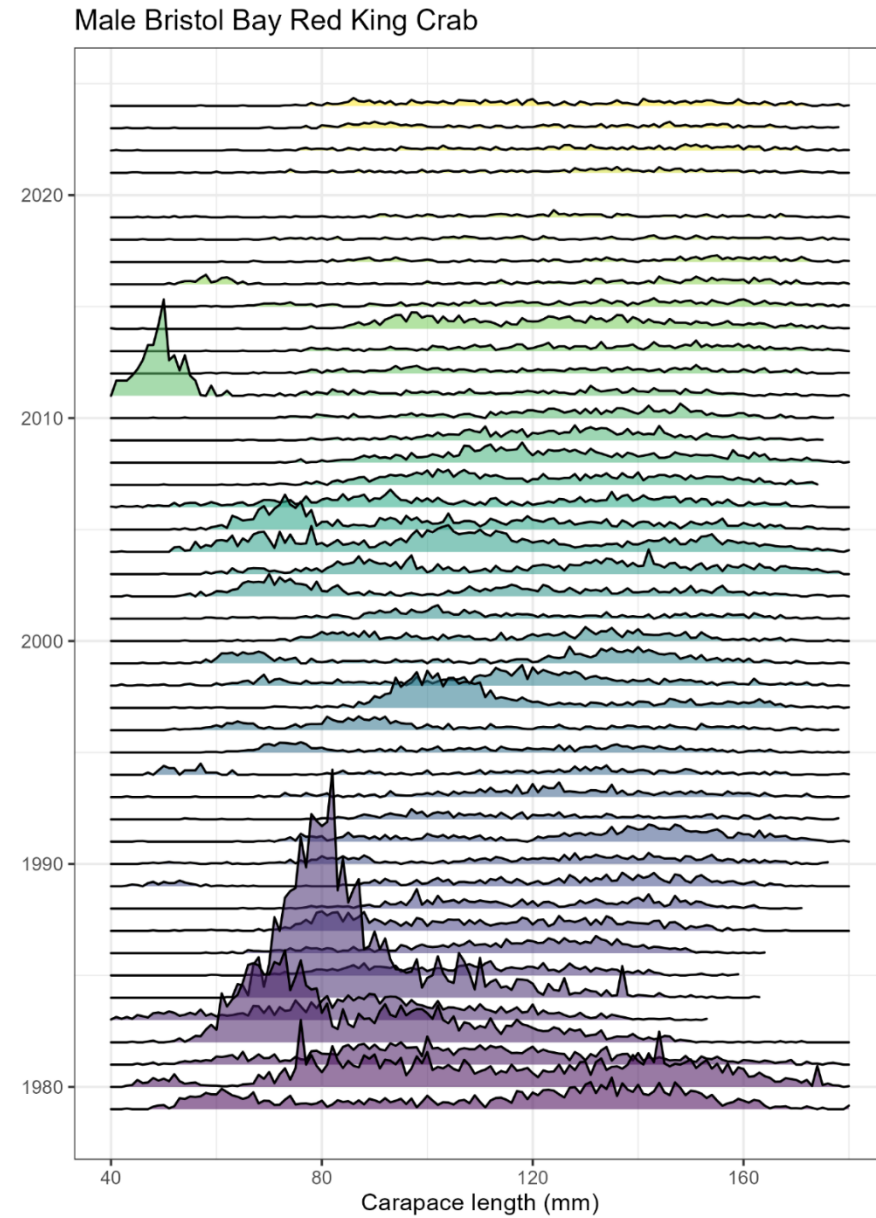
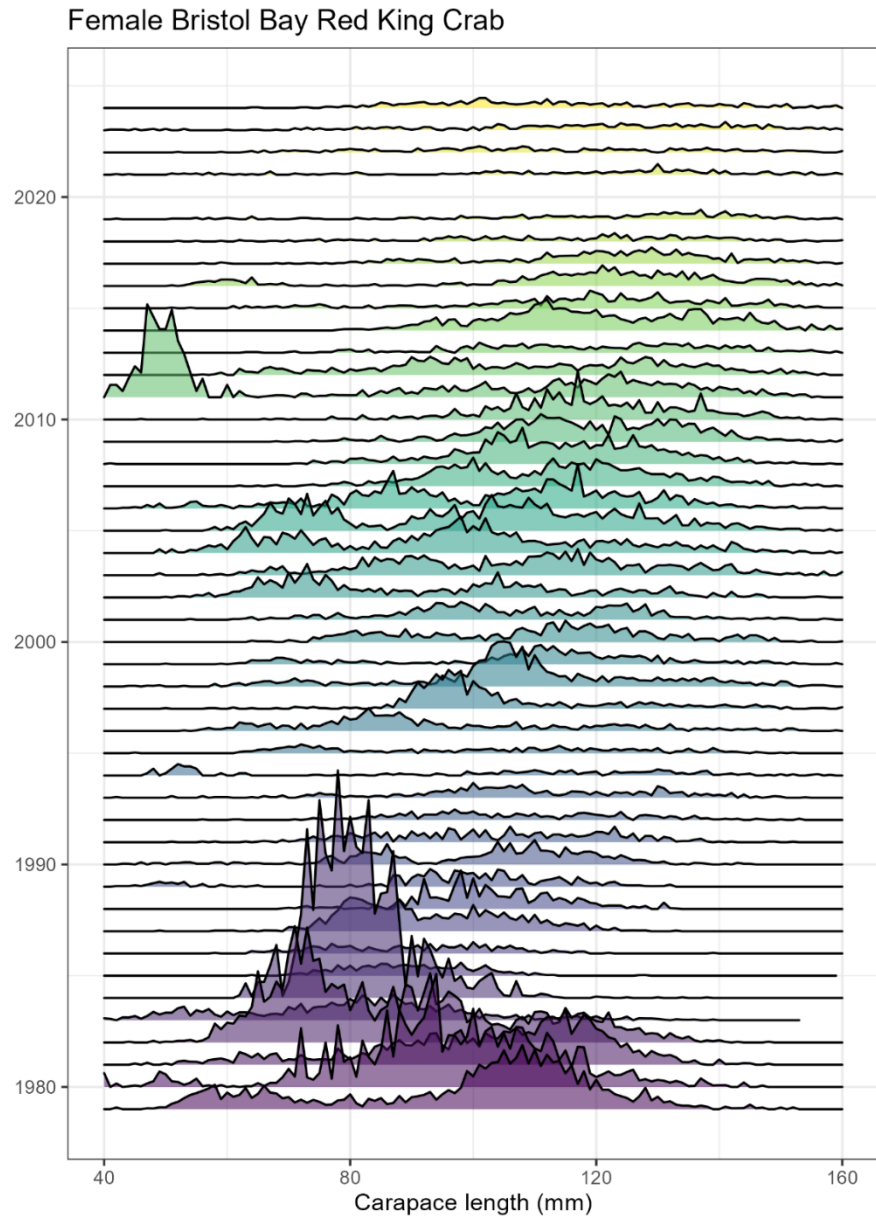


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# KING CRAB



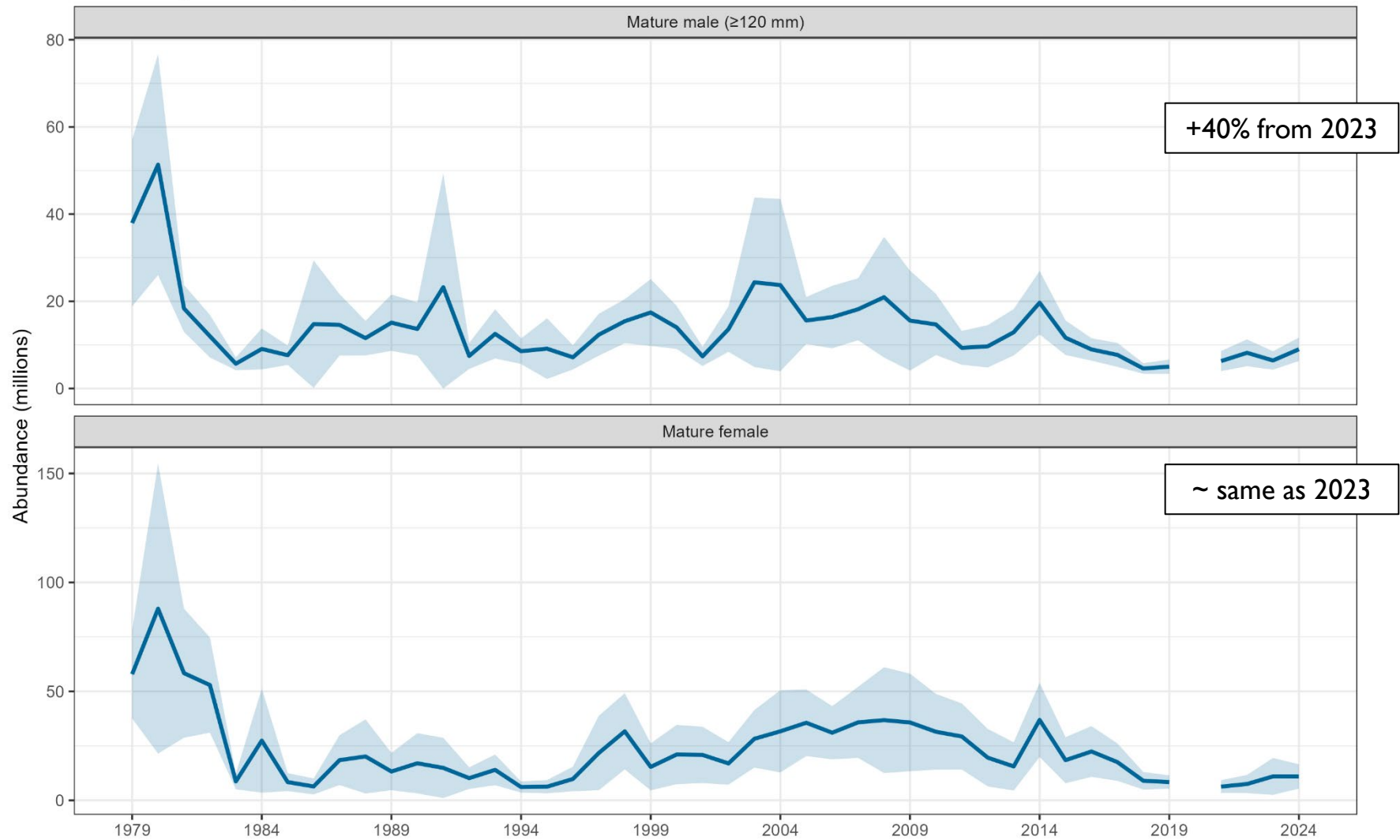
# Abundance by size, 1979-2024





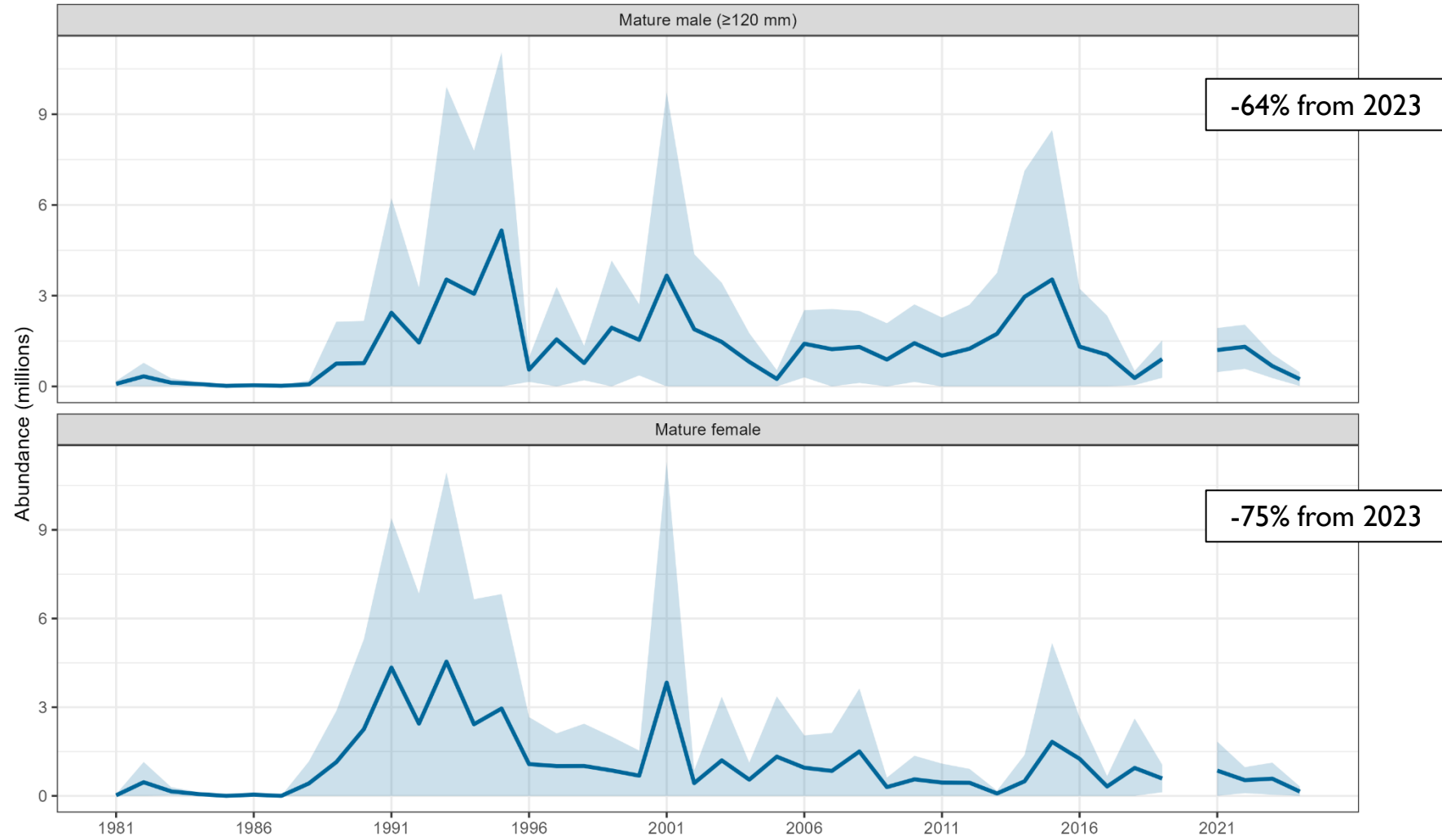
# Bristol Bay Red King Crab

## Estimated abundance



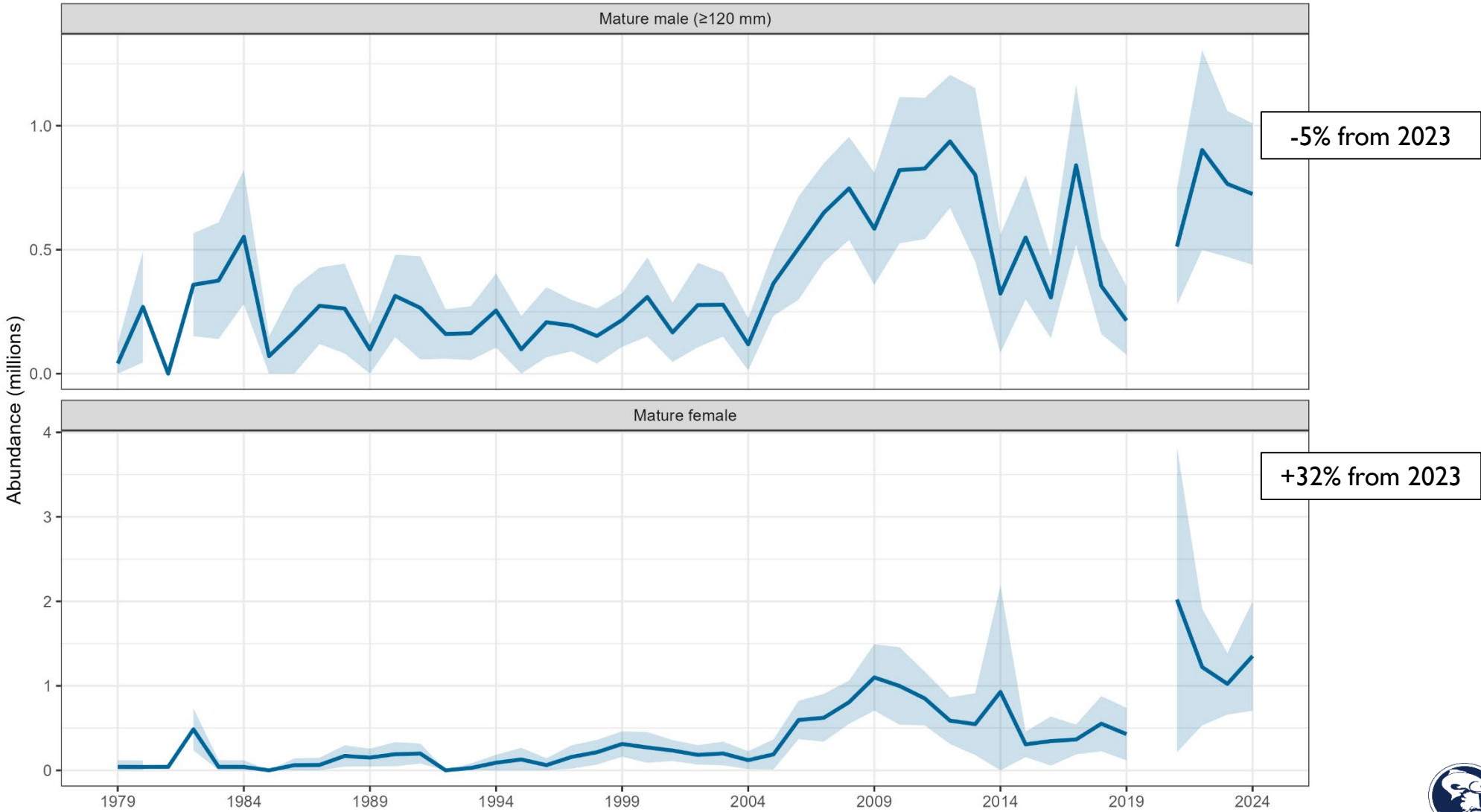
Pribilof Islands Red King Crab

Estimated abundance



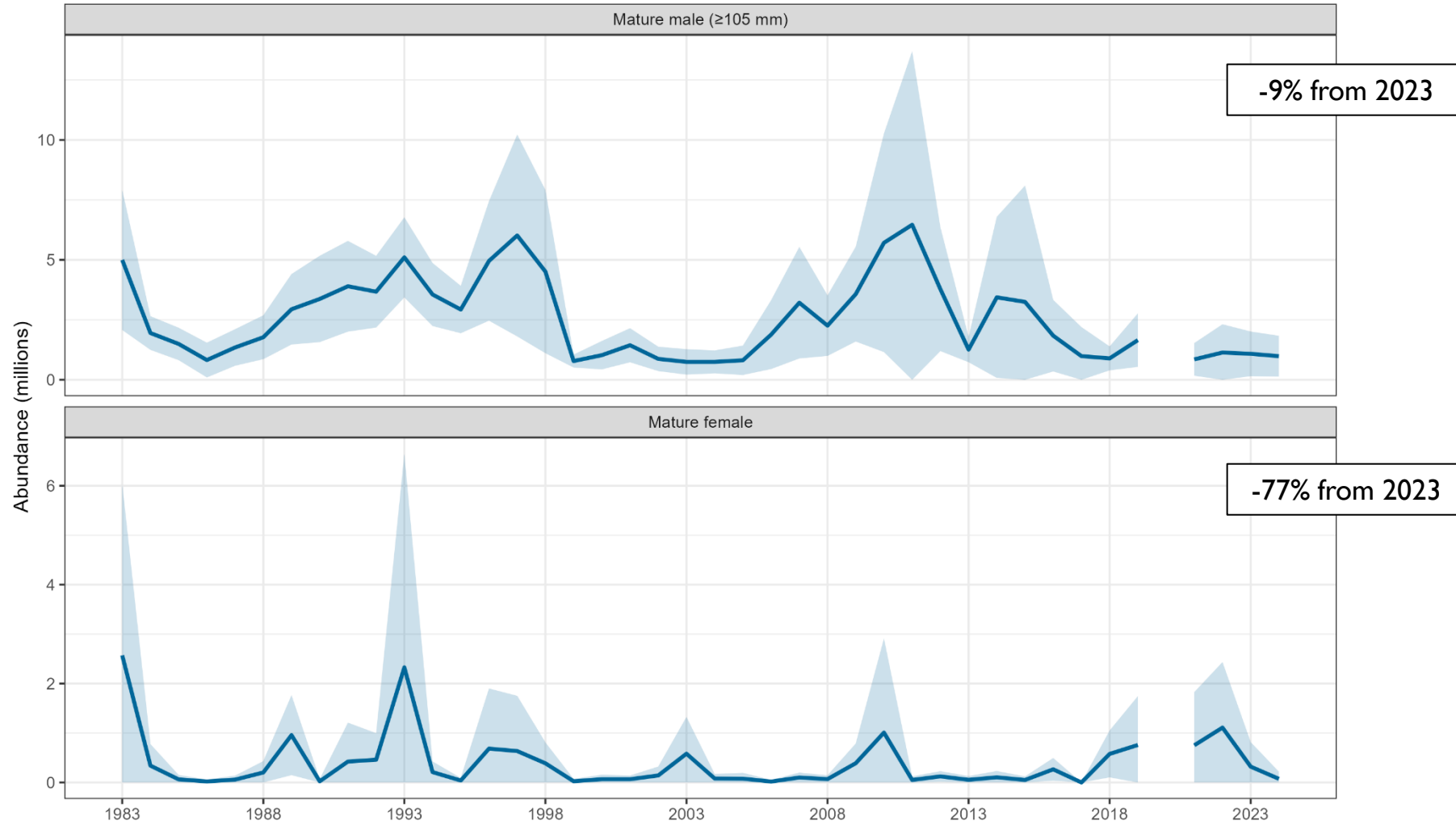
Estimated abundance

Northern District Red King Crab



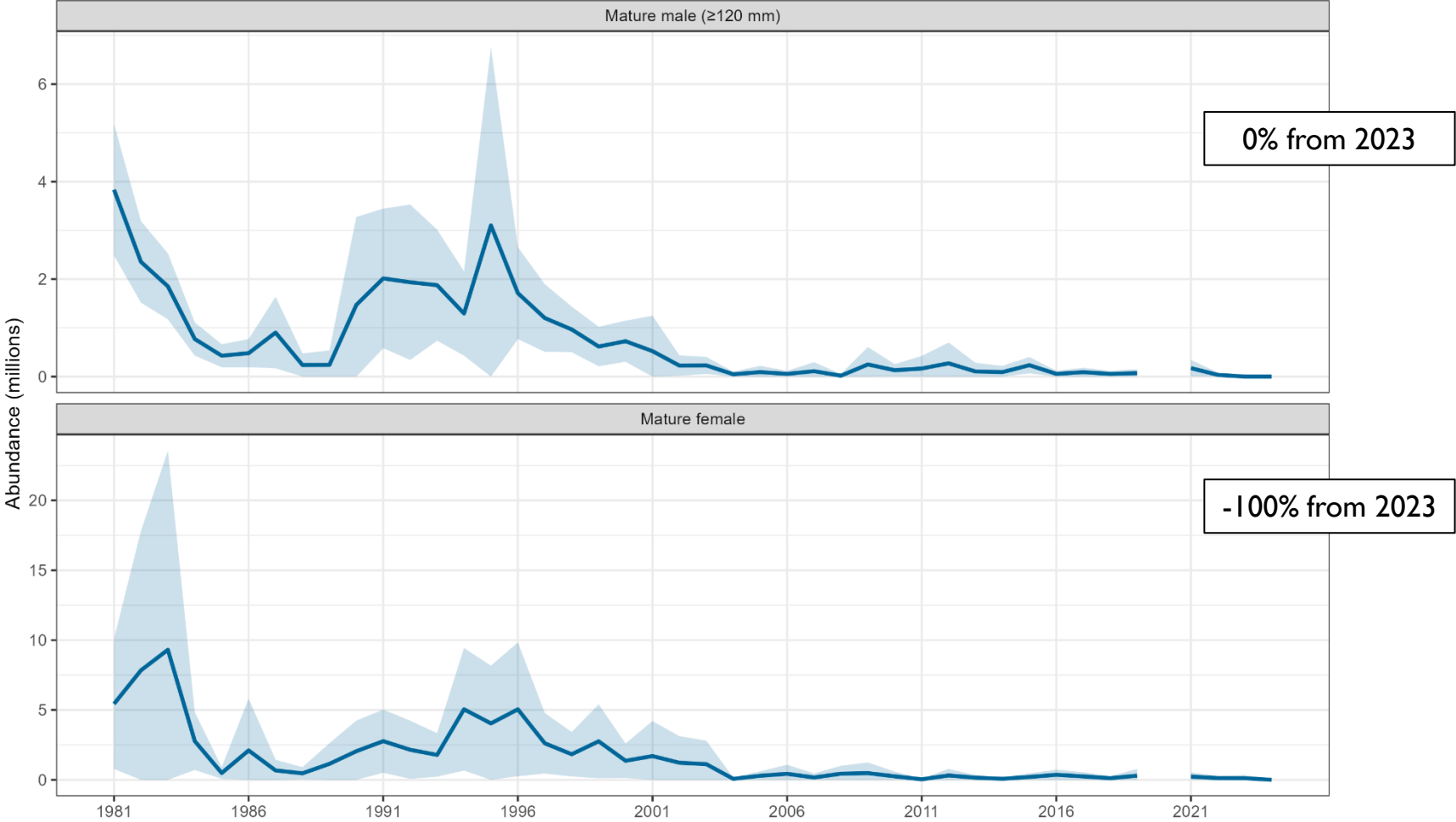
## Estimated abundance

### St. Matthew Island Blue King Crab



Estimated abundance

Pribilof Islands Blue King Crab



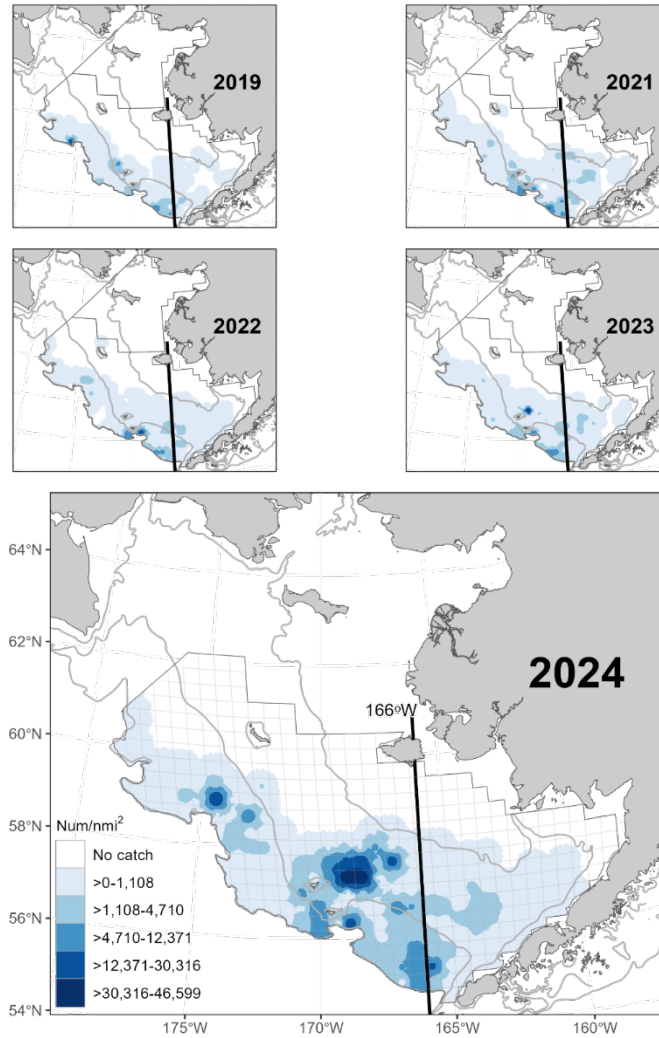
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# TANNER CRAB



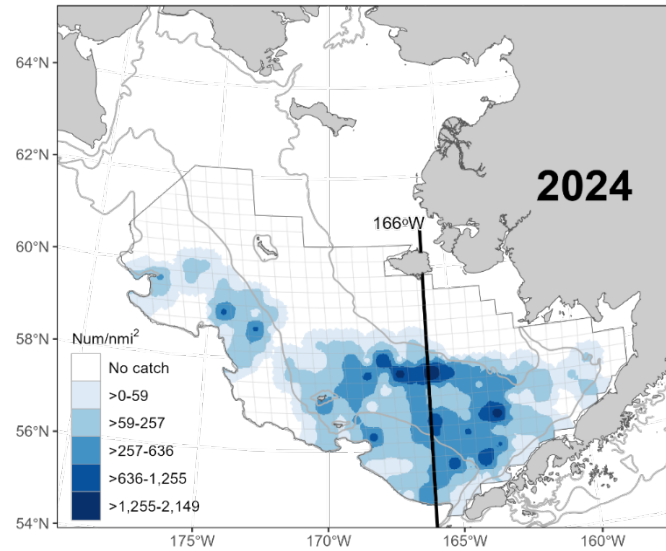
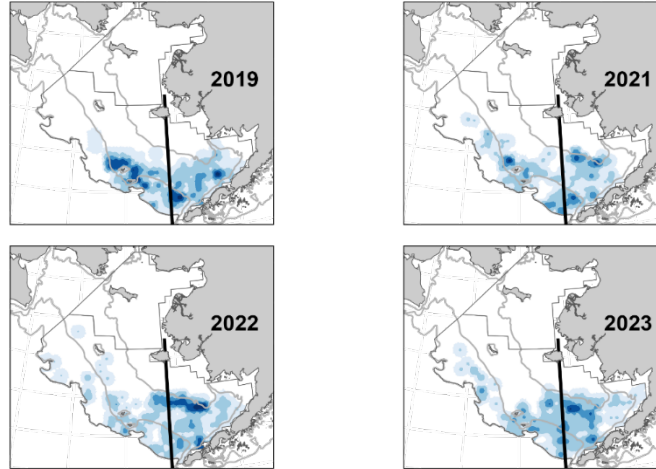
# Distribution by year

## Tanner Crab Mature Female



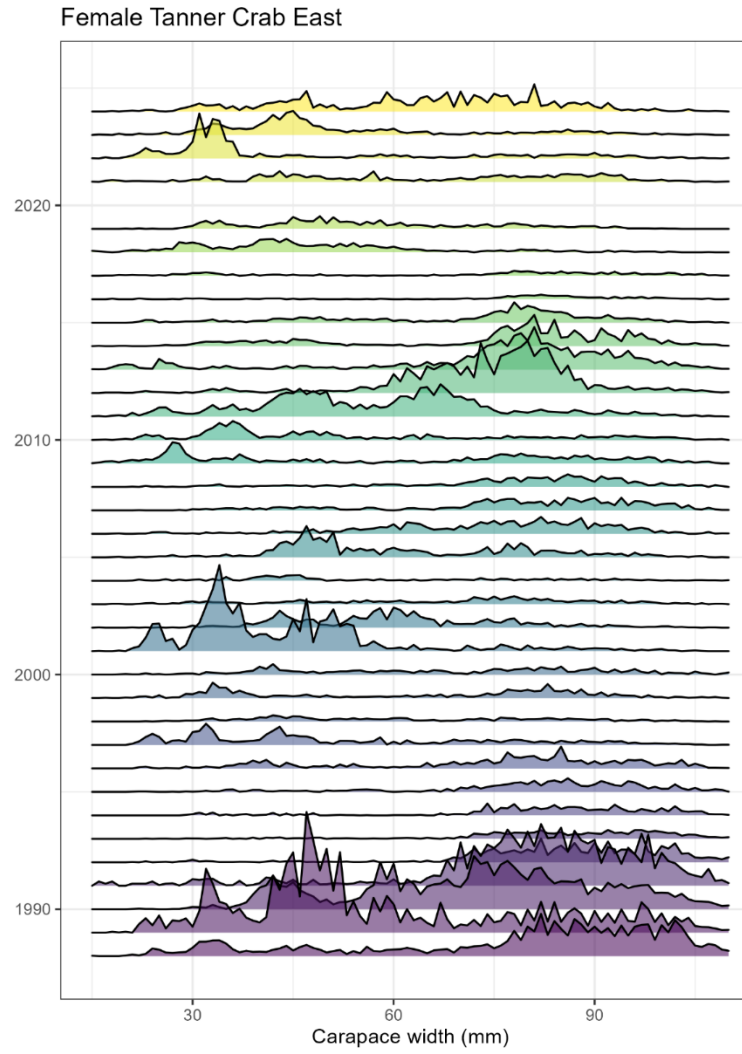
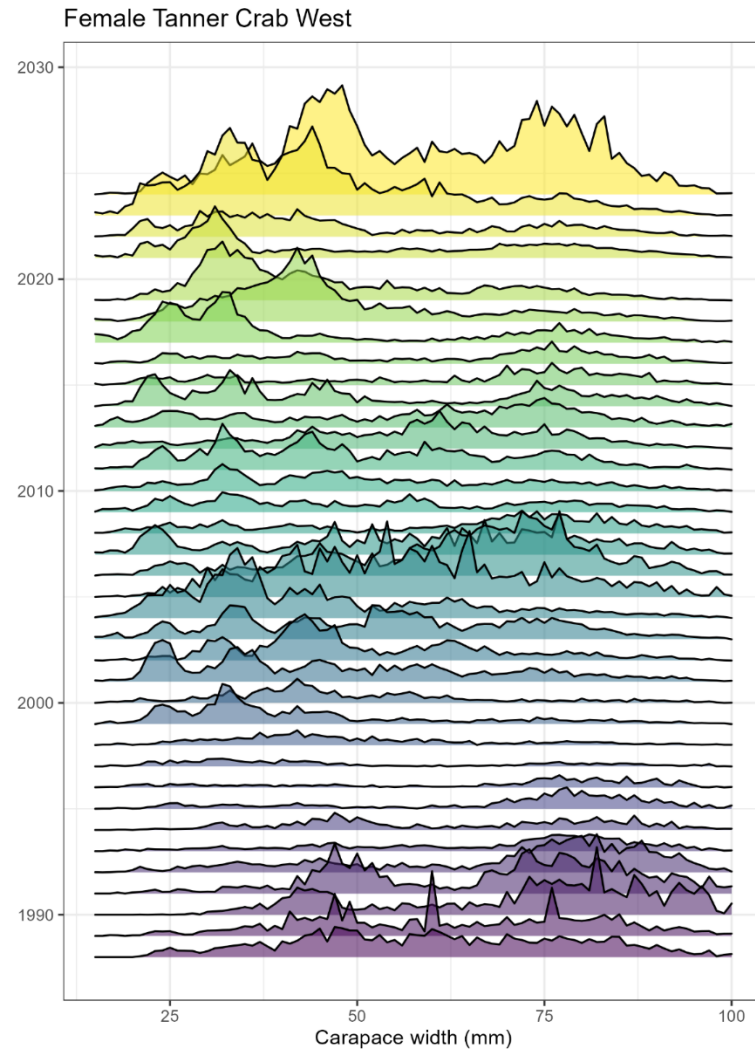
# Distribution by year

## Tanner Crab Industry Preferred Male

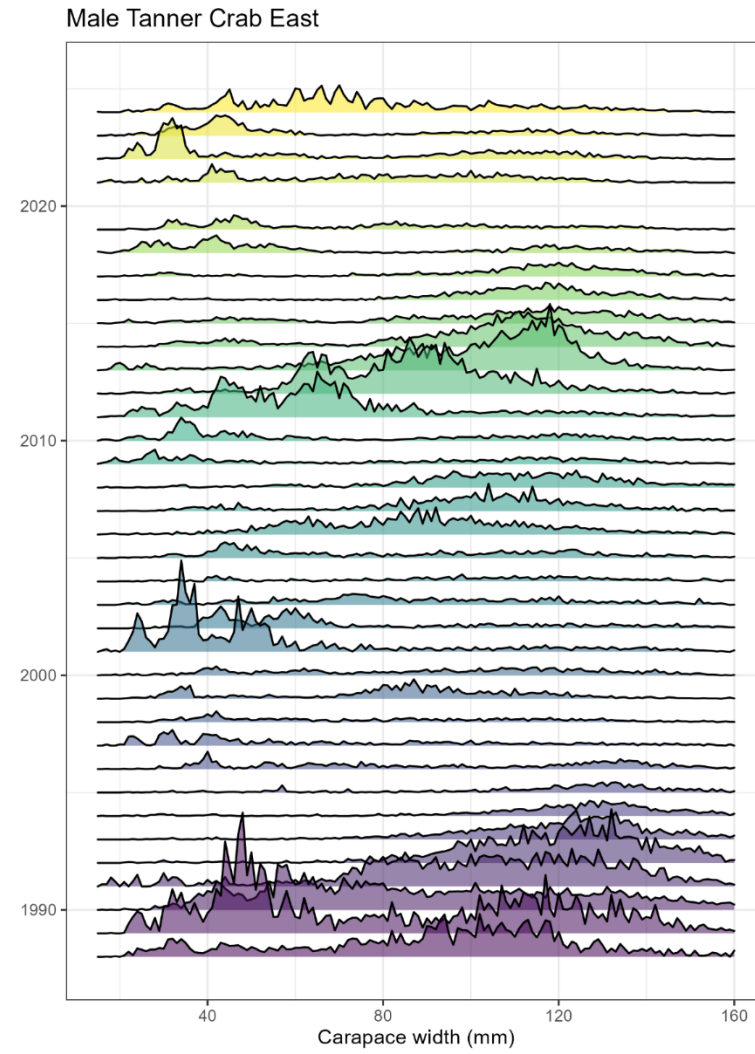
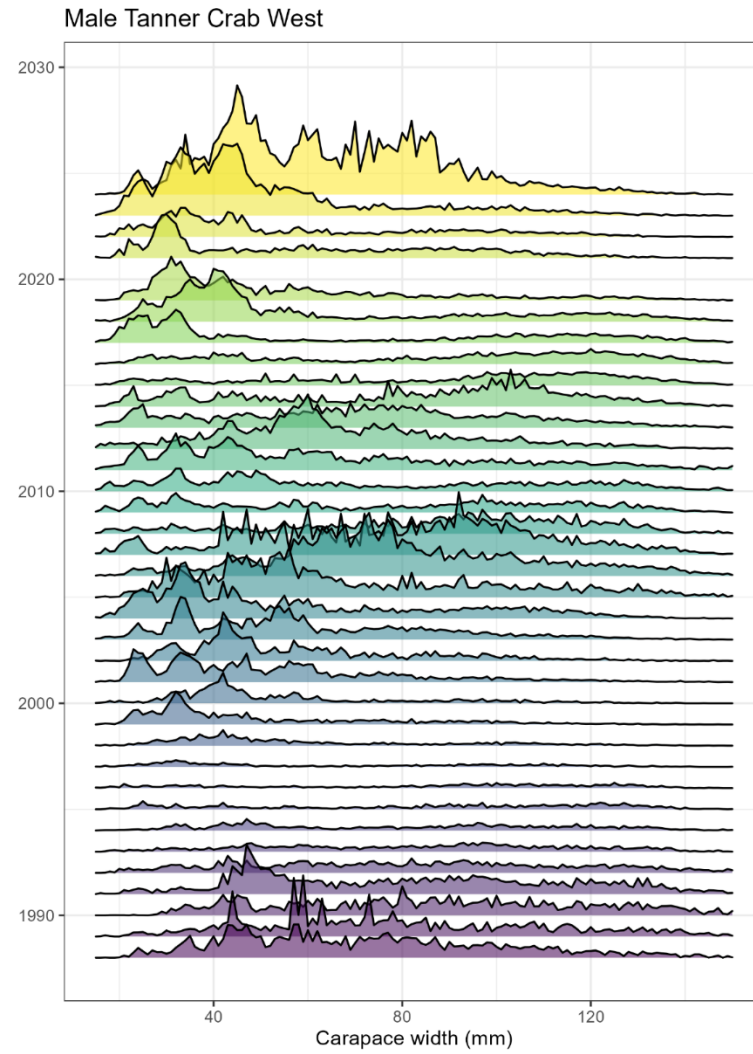




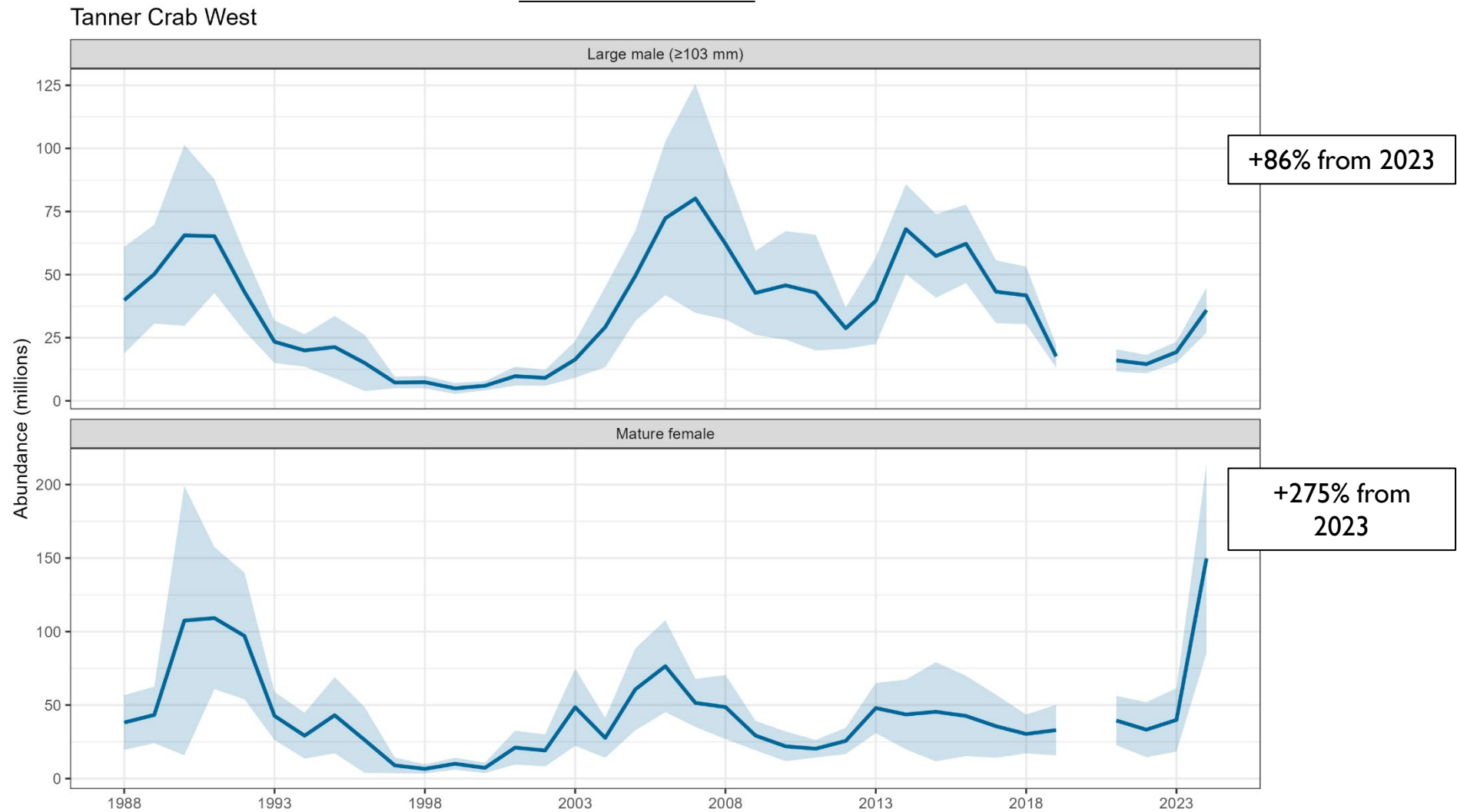
# Abundance by size, 1988-2024



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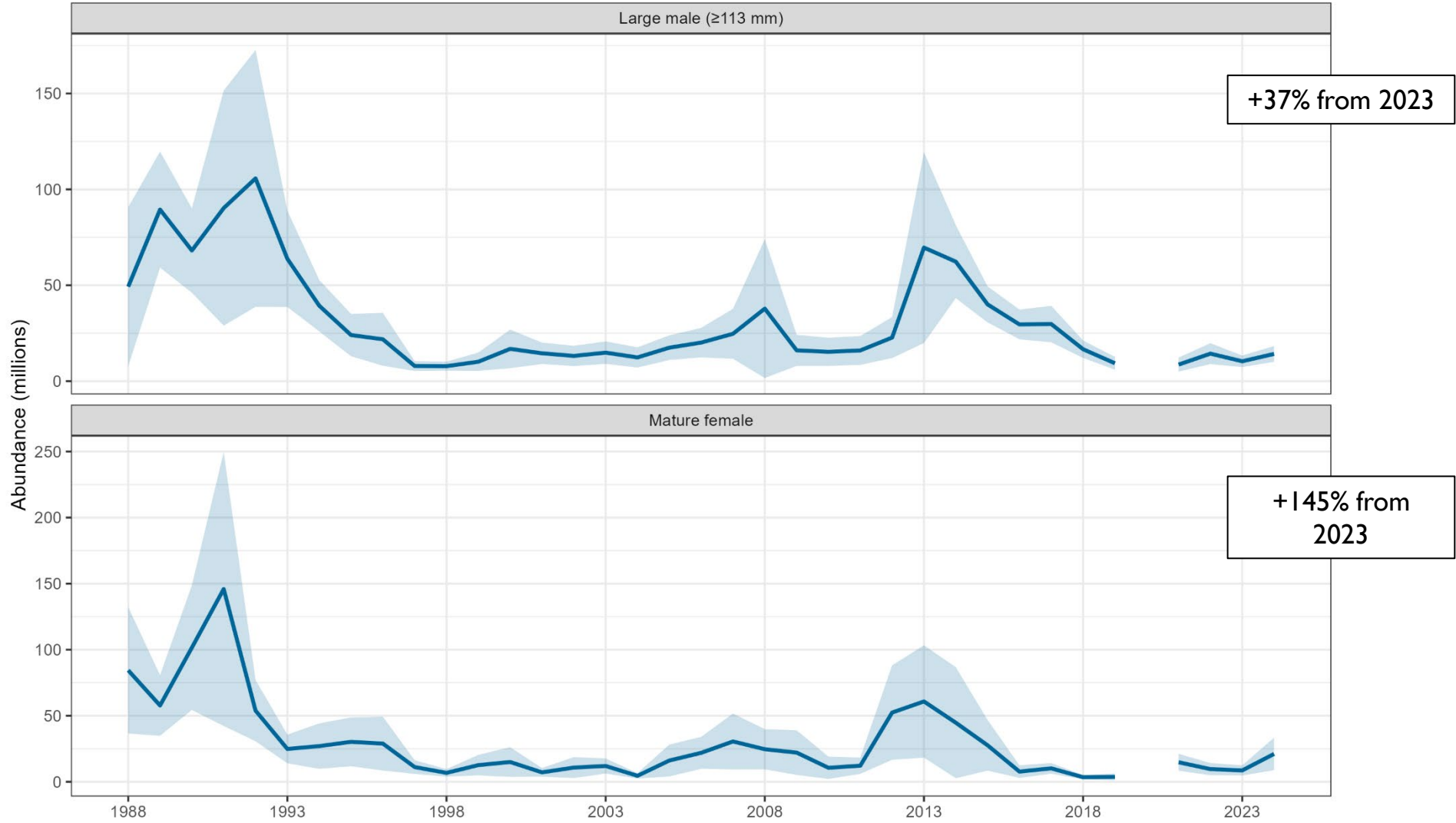


## Estimated abundance



# Tanner Crab East

## Estimated abundance



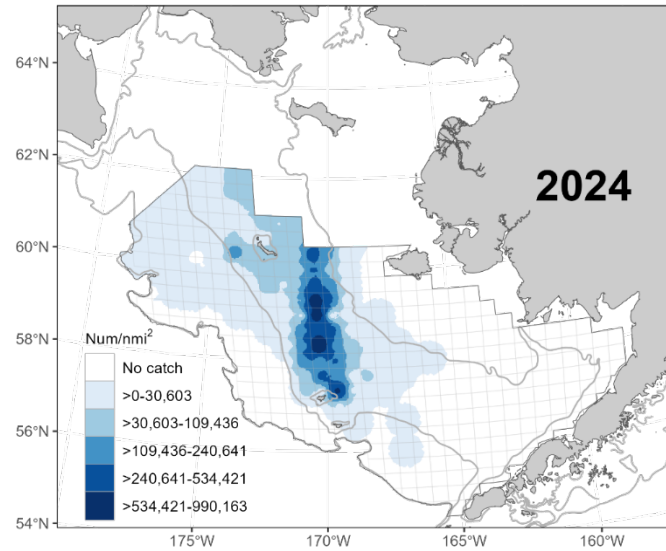
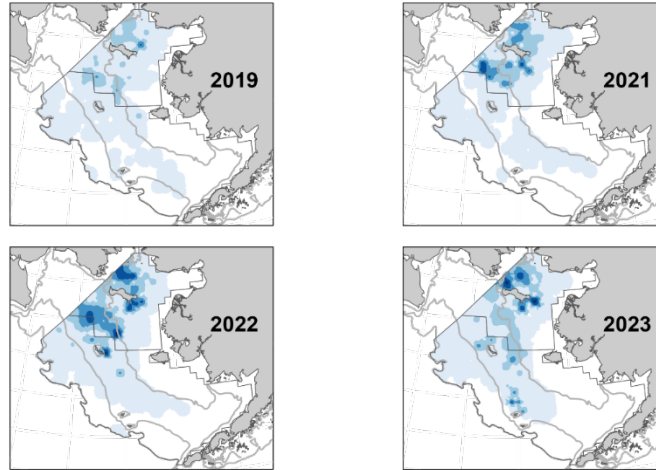
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# SNOW CRAB



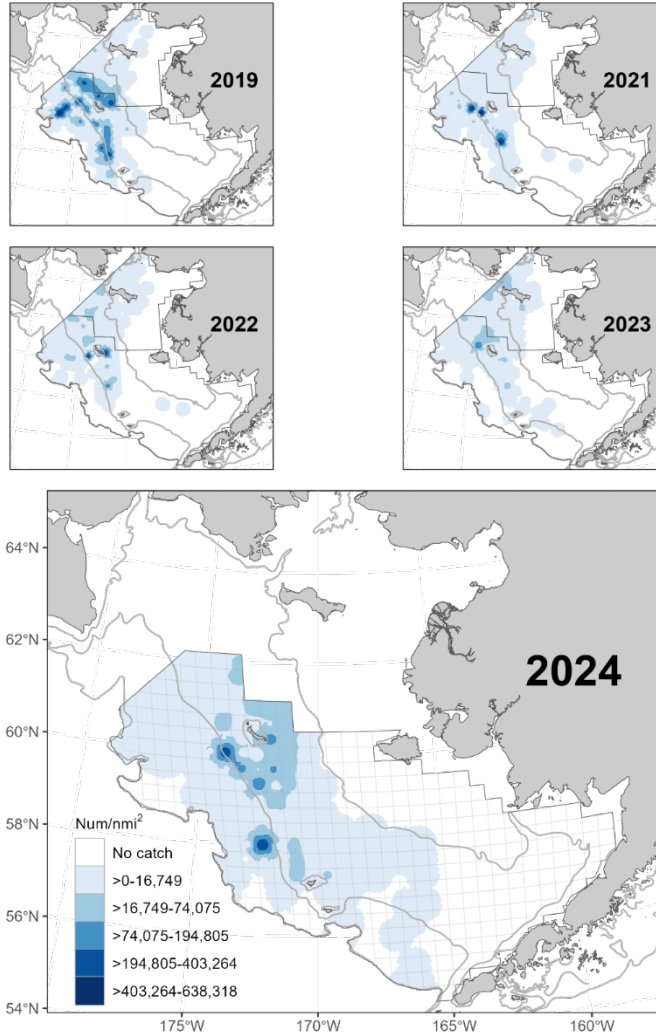
# Distribution by year

## Snow Crab Immature Female



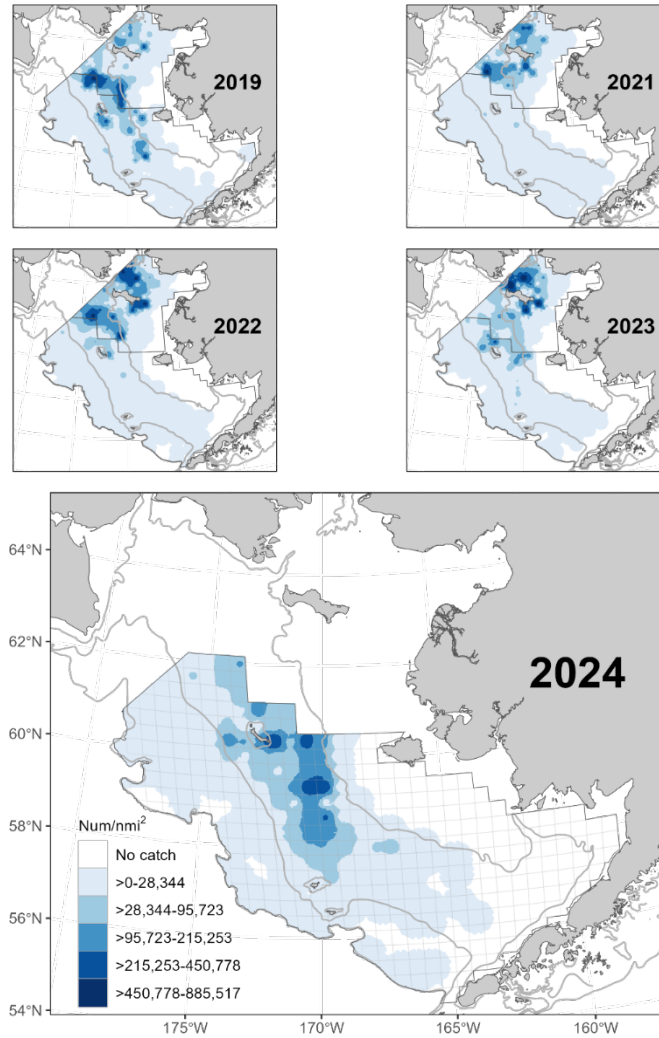
# Distribution by year

## Snow Crab Mature Female



# Distribution by year

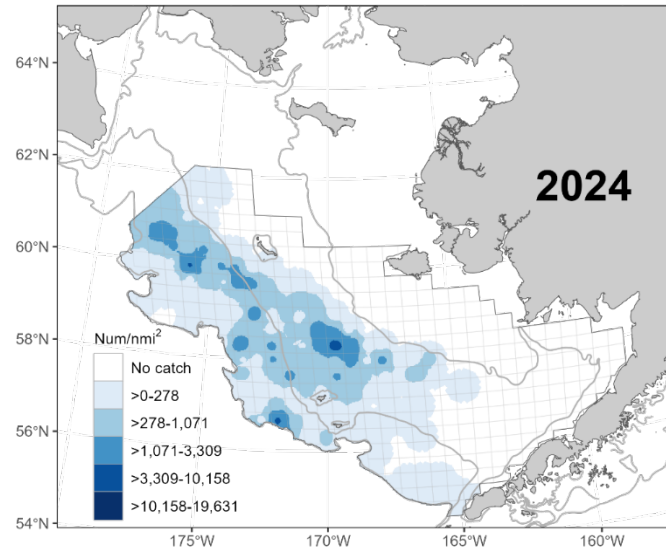
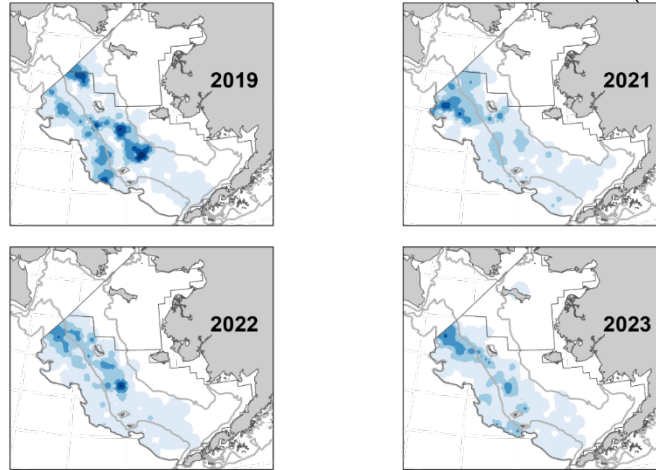
## Snow Crab Small Male (< 95 mm carapace width)



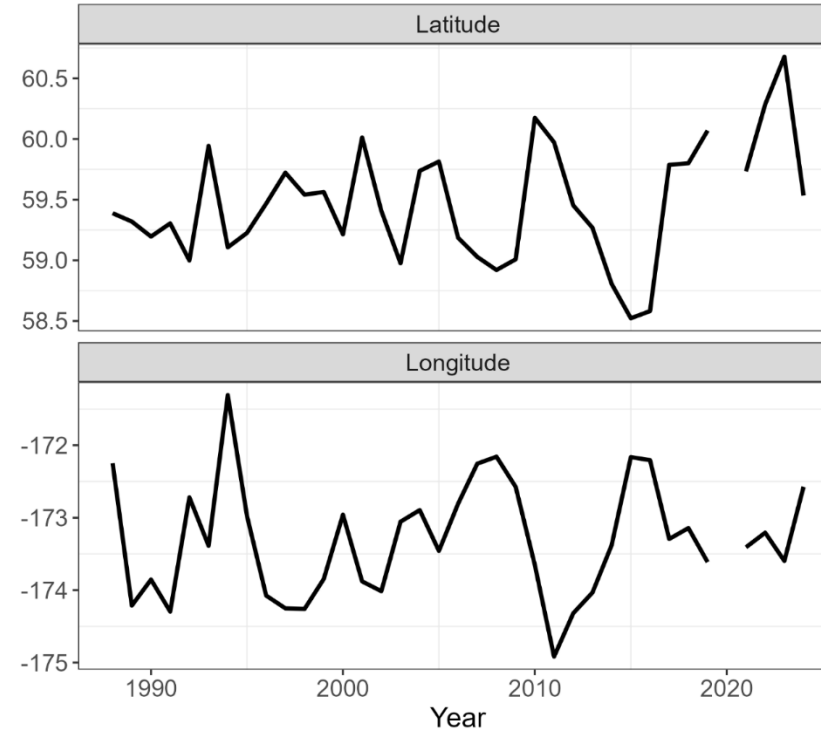
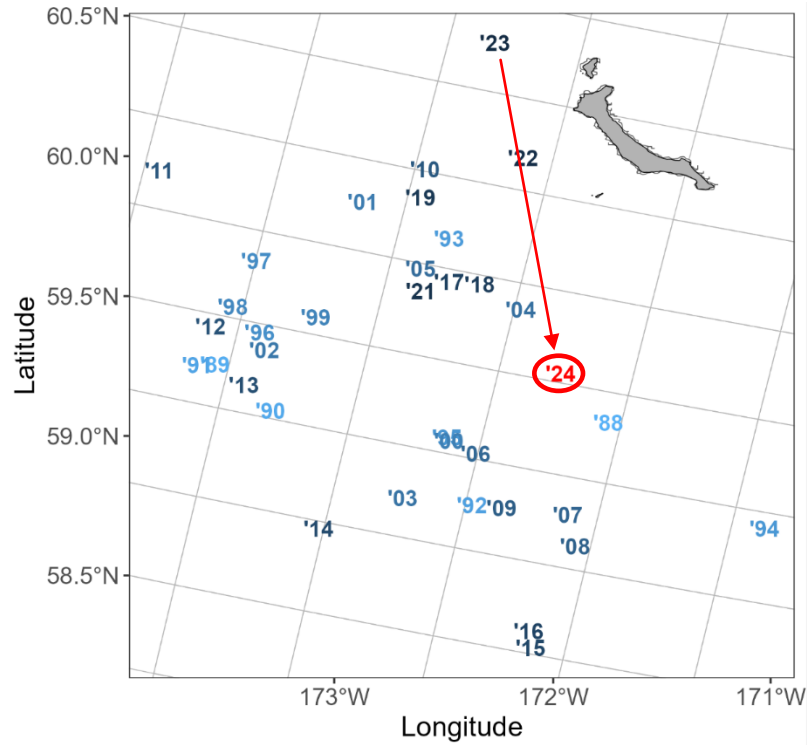


# Distribution by year

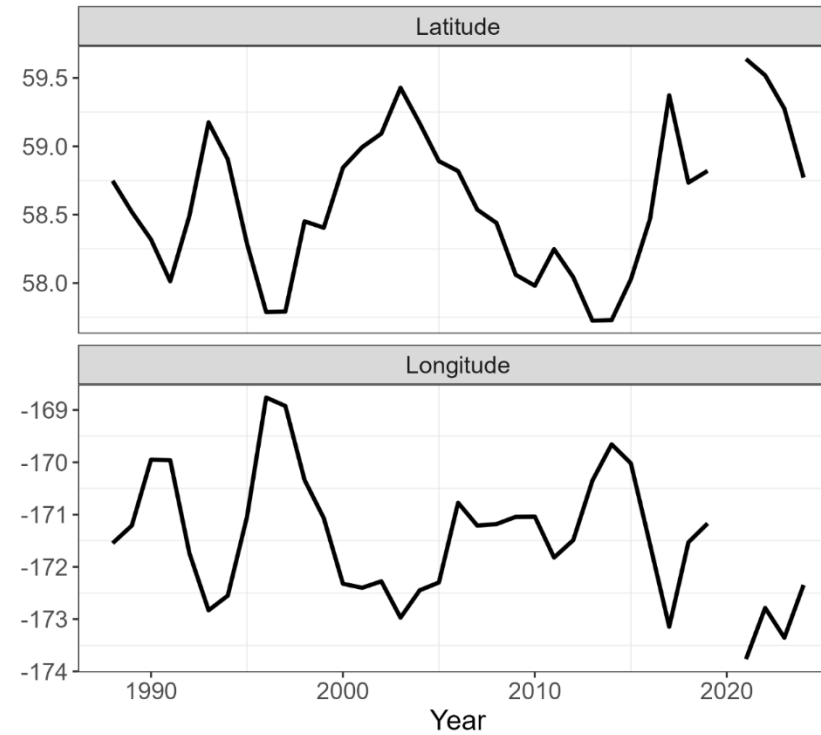
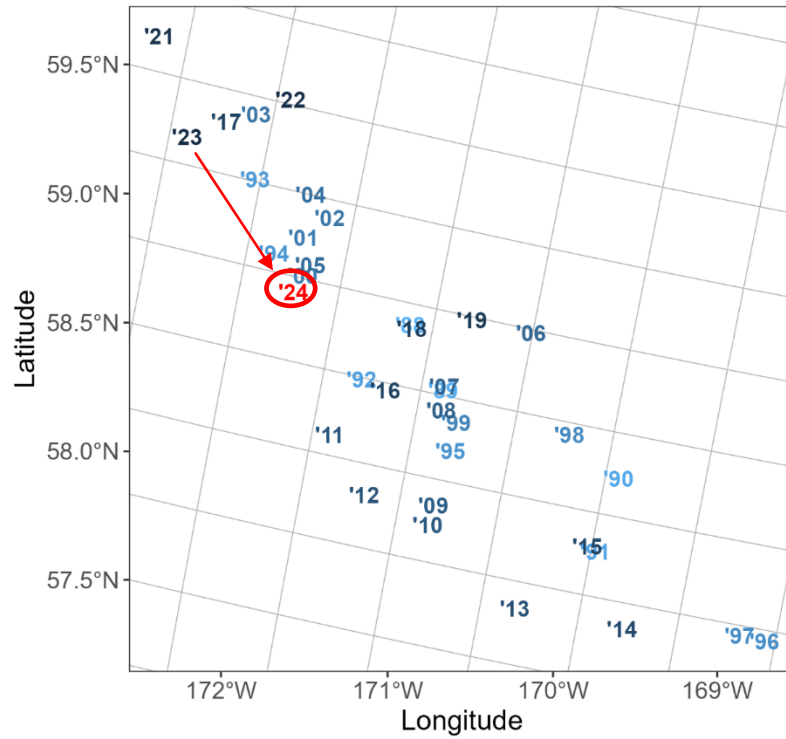
## Snow Crab Industry Preferred Male ( $\geq 102$ mm carapace width)



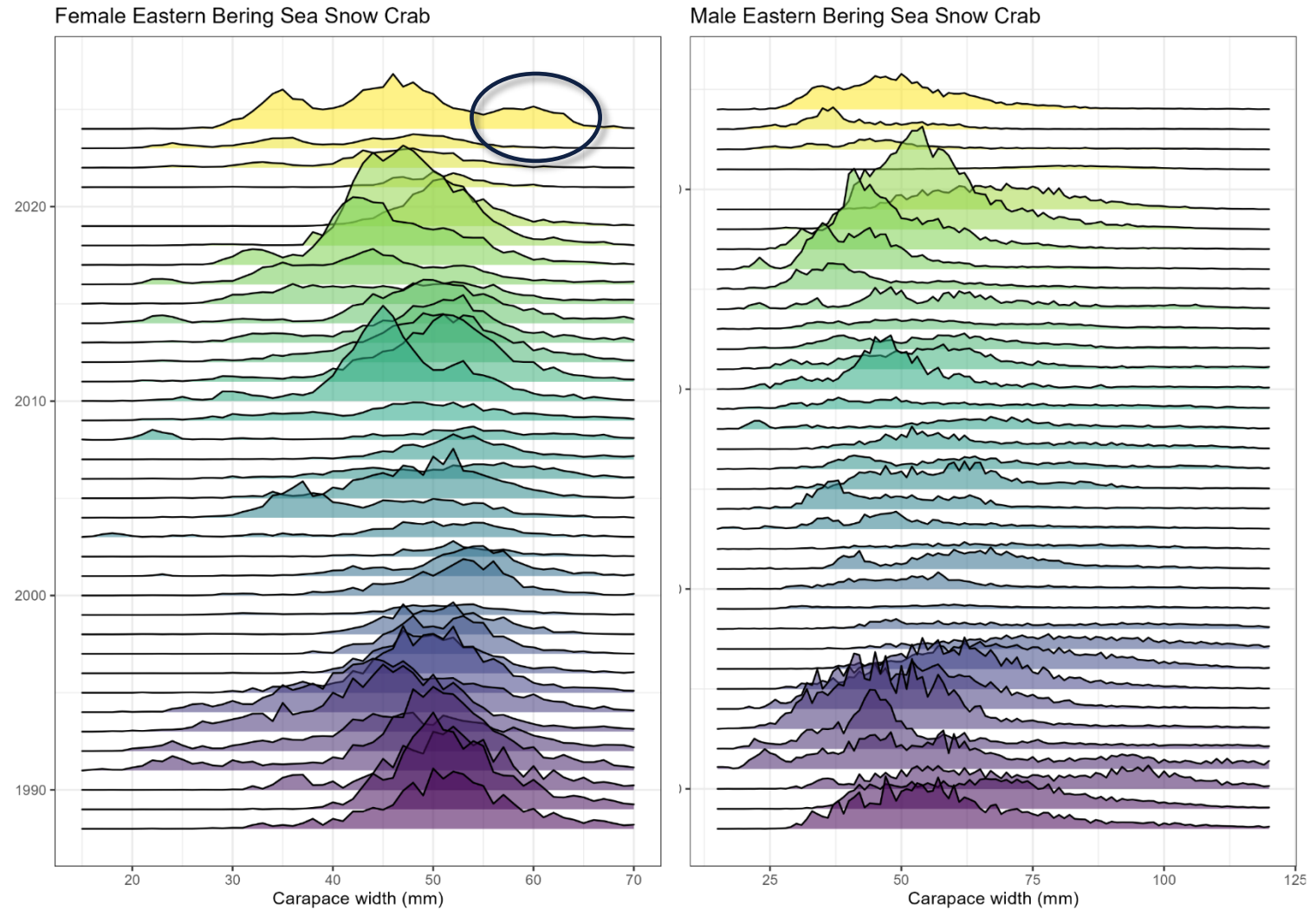
## Snow Crab Mature Female



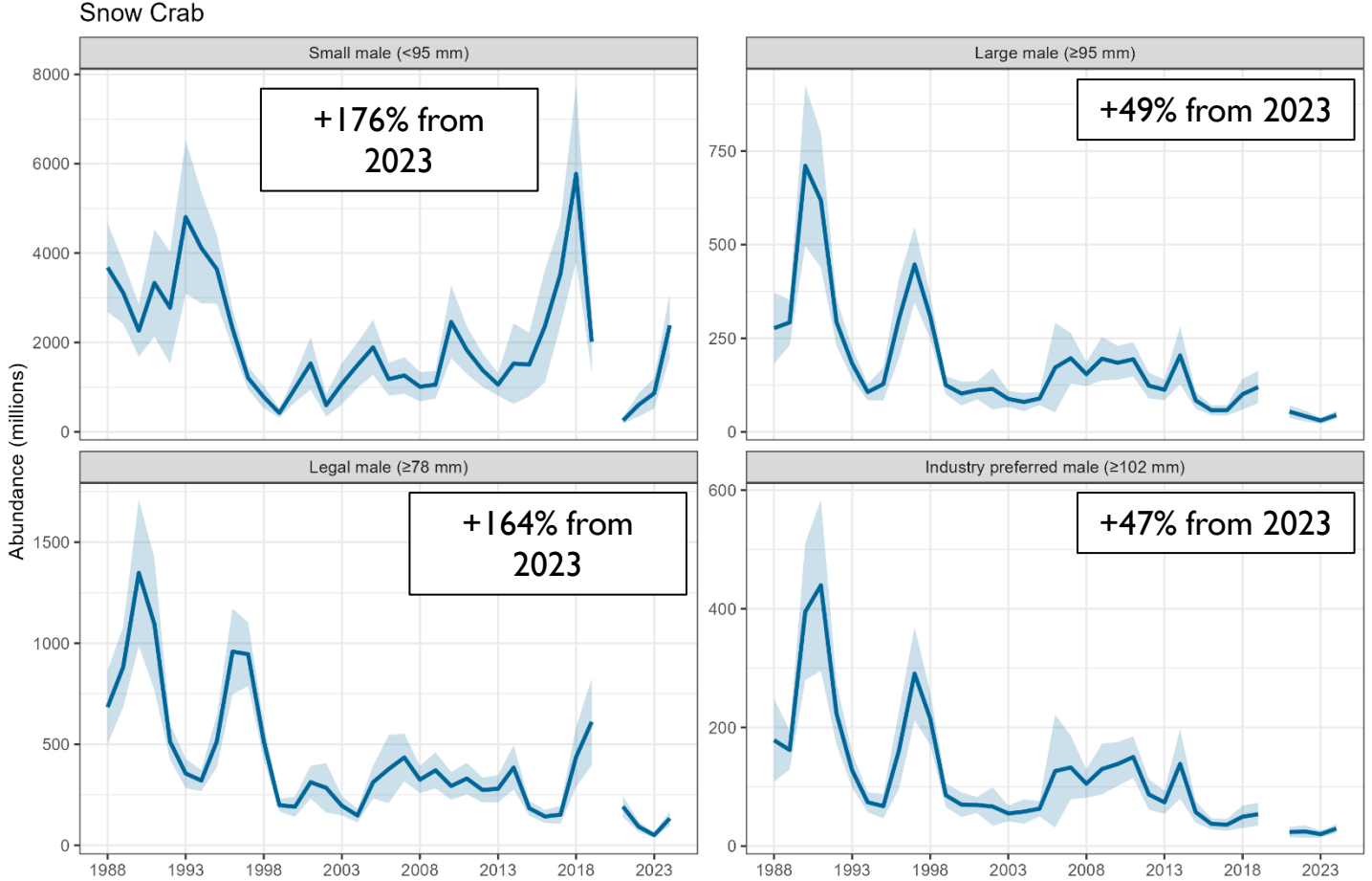
## Snow Crab Industry Preferred Male



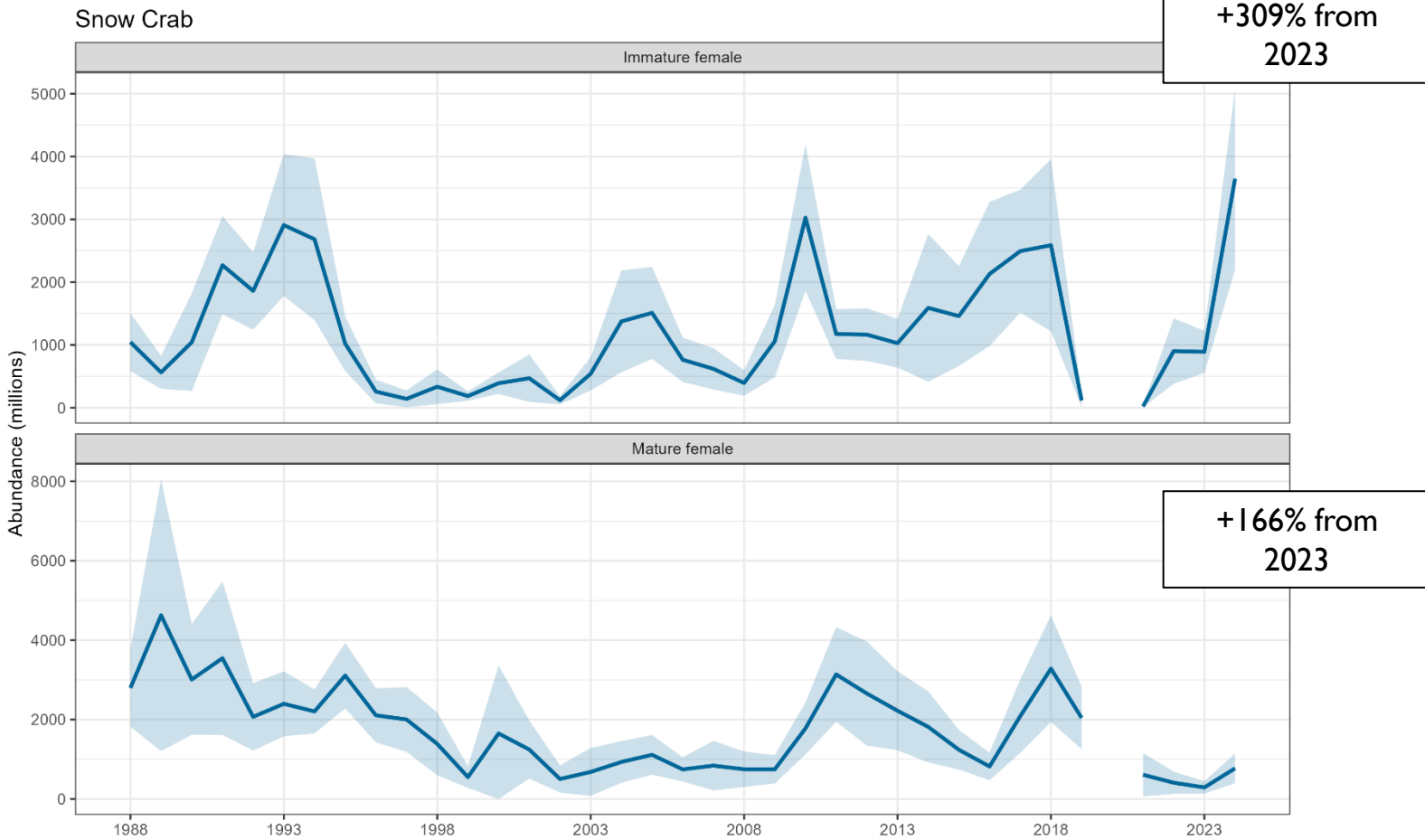
# Abundance by size, 1988-2024 (EBS only)



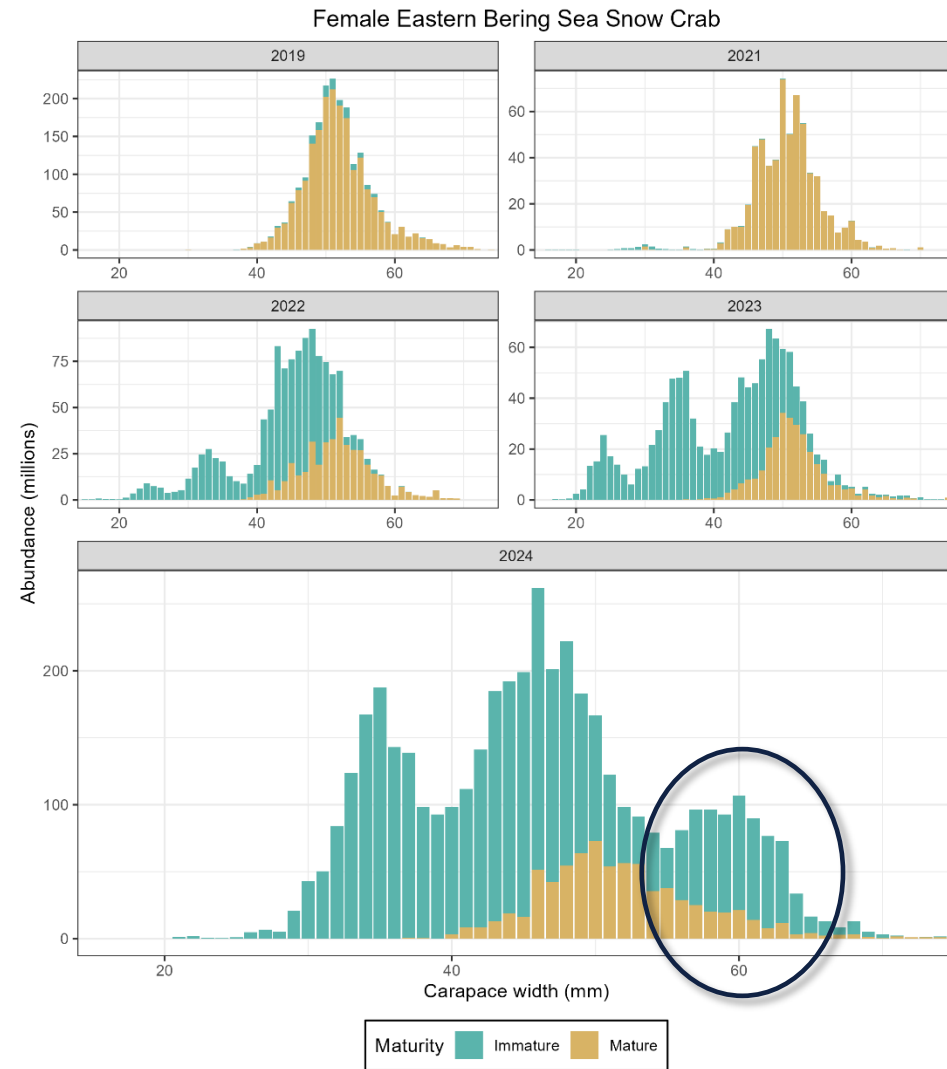
Estimated abundance



Estimated abundance



Abundance by size and shell condition



# SNOW CRAB

FISHERY UPDATE

ECOSYSTEM & SOCIOECONOMIC PROFILE

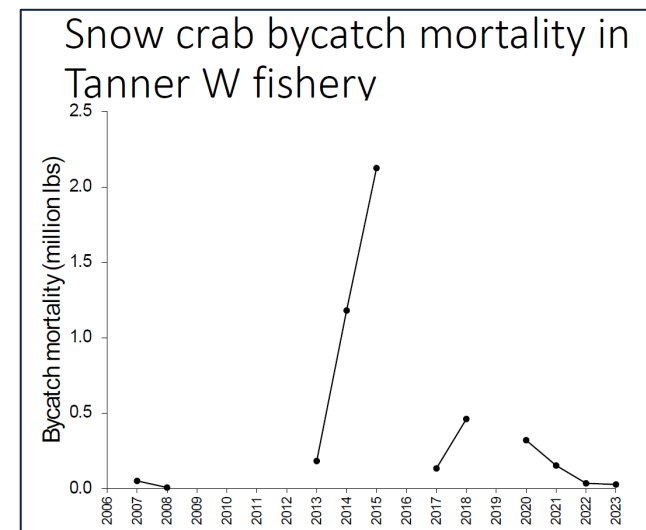
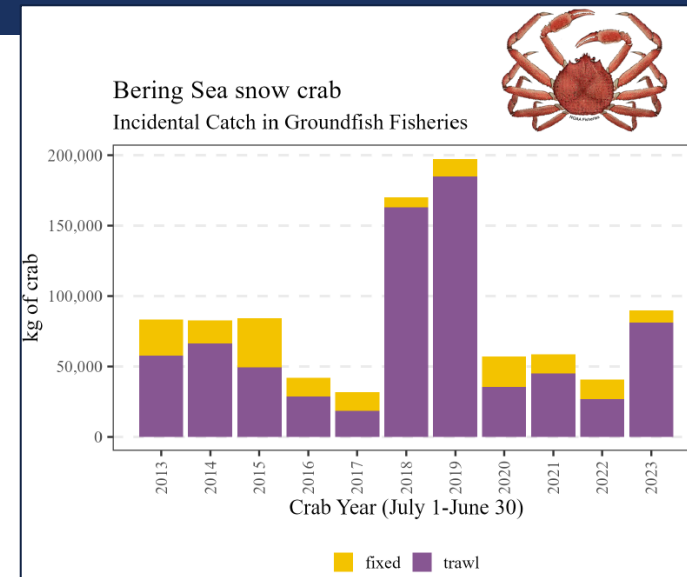
FINAL ASSESSMENT 2024





# FISHERY UPDATE 2023/24 CRAB YEAR

- Directed fishery closed
- Total bycatch mortality 70 t
- Overfishing did not occur
- Most bycatch occurs in groundfish fisheries, down since 2018/2019 abundance peak
- Tanner W has the highest bycatch of any crab fishery, low in recent years



# ECOSYSTEM AND SOCIOECONOMIC PROFILE

- Ecosystem indicators mostly neutral
- 2022-24 reversion to average temperature / ice cover

Indicator category	Indicator	2020 Status	2021 Status	2022 Status	2023 Status	2024 Status
Larval	Chlorophyll <i>a</i> Concentration	neutral	neutral	neutral	low	neutral
	Arctic Oscillation Index	high	neutral	neutral	neutral	neutral
Juvenile	Summer Cold Pool Extent	NA	low	neutral	neutral	neutral
	Juvenile Snow Crab Temperature of Occupancy	NA	high	neutral	neutral	neutral
	Winter Sea Ice Extent	neutral	neutral	neutral	neutral	neutral
	Juvenile Snow Crab Disease Prevalence	NA	neutral	neutral	neutral	neutral
	Juvenile Snow Crab Energetic Condition	NA	neutral	neutral	neutral	neutral
	Summer Pacific Cod Consumption	NA	neutral	neutral	neutral	neutral
Adult	Summer Benthic Invertebrate Density	NA	neutral	neutral	neutral	neutral
	Male Snow Crab Size at Terminal Molt	NA	low	neutral	neutral	neutral
	Summer Male Snow Crab Area Occupied	NA	neutral	neutral	neutral	low
	Summer Male Snow Crab Center of Abundance	NA	high	high	high	neutral
	Female Snow Crab Reproductive Potential	NA	neutral	low	neutral	neutral
	Snow Crab Operational Sex Ratio	NA	neutral	neutral	neutral	neutral



# ECOSYSTEM AND SOCIOECONOMIC PROFILE

- Socioeconomic conditions critically low following closures

Indicator category	Indicator	2020 Status	2021 Status	2022 Status	2023 Status	2024 Status
Fishery Performance	Number of Active Vessels in Snow Crab Fishery	neutral	neutral	low	Closed	Closed
	Annual CPUE of Snow Crab Fishery	neutral	neutral	neutral	Closed	Closed
	Total Potlifts in Snow Crab Fishery	neutral	neutral	neutral	Closed	Closed
	Snow Crab Fishery Centroid	neutral	high	high	Closed	Closed
	Annual Snow Crab Incidental Catch	neutral	neutral	neutral	neutral	NA
Economic	TAC Utilization of Snow Crab Fishery	neutral	neutral	neutral	Closed	Closed
	Ex-vessel Value	neutral	neutral	low	Closed	Closed
	Ex-vessel Price	high	high	high	Closed	Closed
	Ex-vessel Revenue Share	high	high	neutral	Closed	Closed



# OVERVIEW AND OFL/ABC OUTLINE

## Overview

- Tier 3 stock
- Declared overfished in 2021
- Fishery closed in 2022/23 and 2023/24
- Promising indications of abundant young crab on 2024 survey

## Outline

- Stock trends
- Models for consideration
- CPT recommendations:
  - Tier 3 vs. Tier 4 “fallback” options
  - Currency of management
  - $B_{MSY}$  proxy
  - OFL & ABC

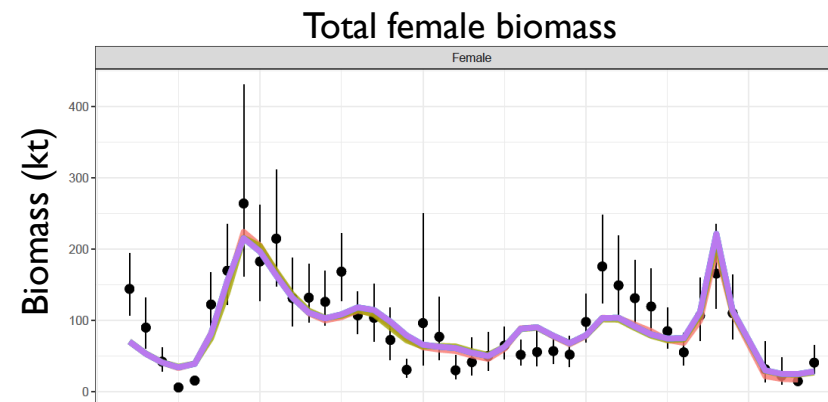


# STOCK TRENDS

OPTIMISM

- Female biomass mostly steady
- Highest immature female abundance ever in 2024 (survey)

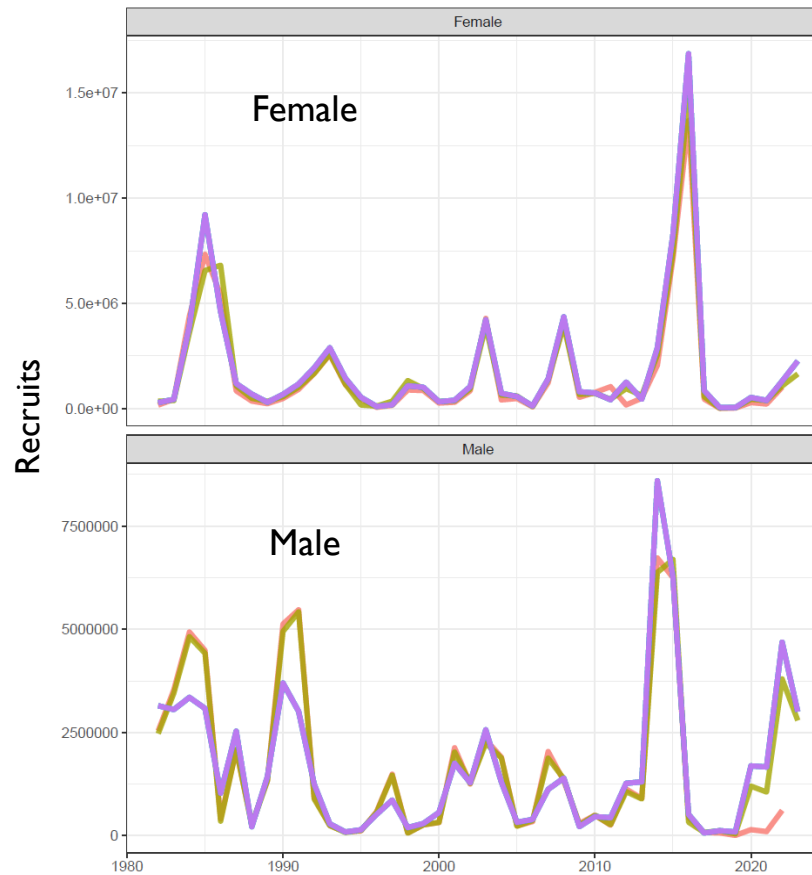
CAUTION



# STOCK TRENDS

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- Recent record recruitment



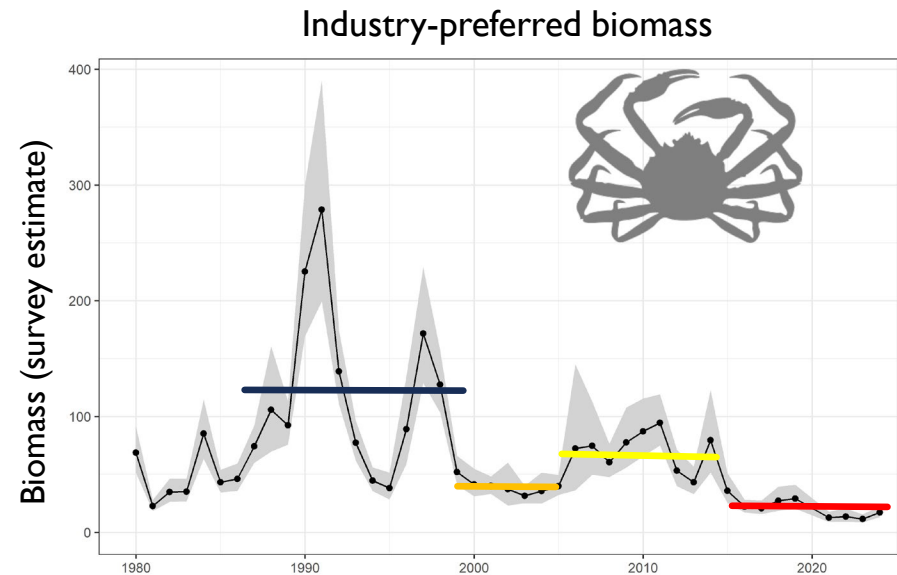
## CAUTION



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## CAUTION

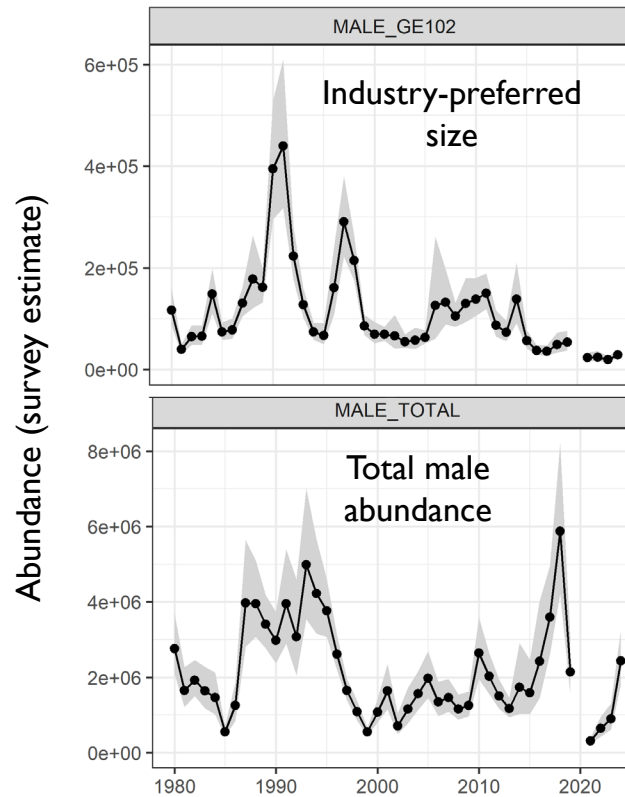
- 8 lowest industry-preferred biomass = last 8 years
- Long slow decline in industry-preferred male biomass



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- Divergent trends in total male and large male biomass

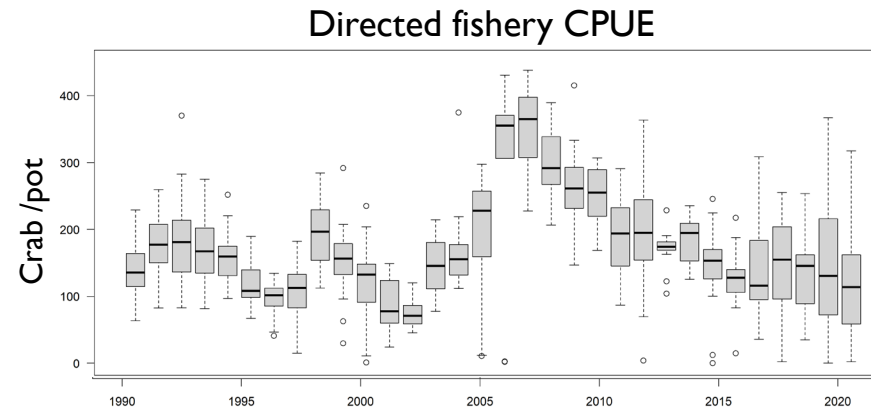




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- Steady decline in fishery CPUE since rationalization



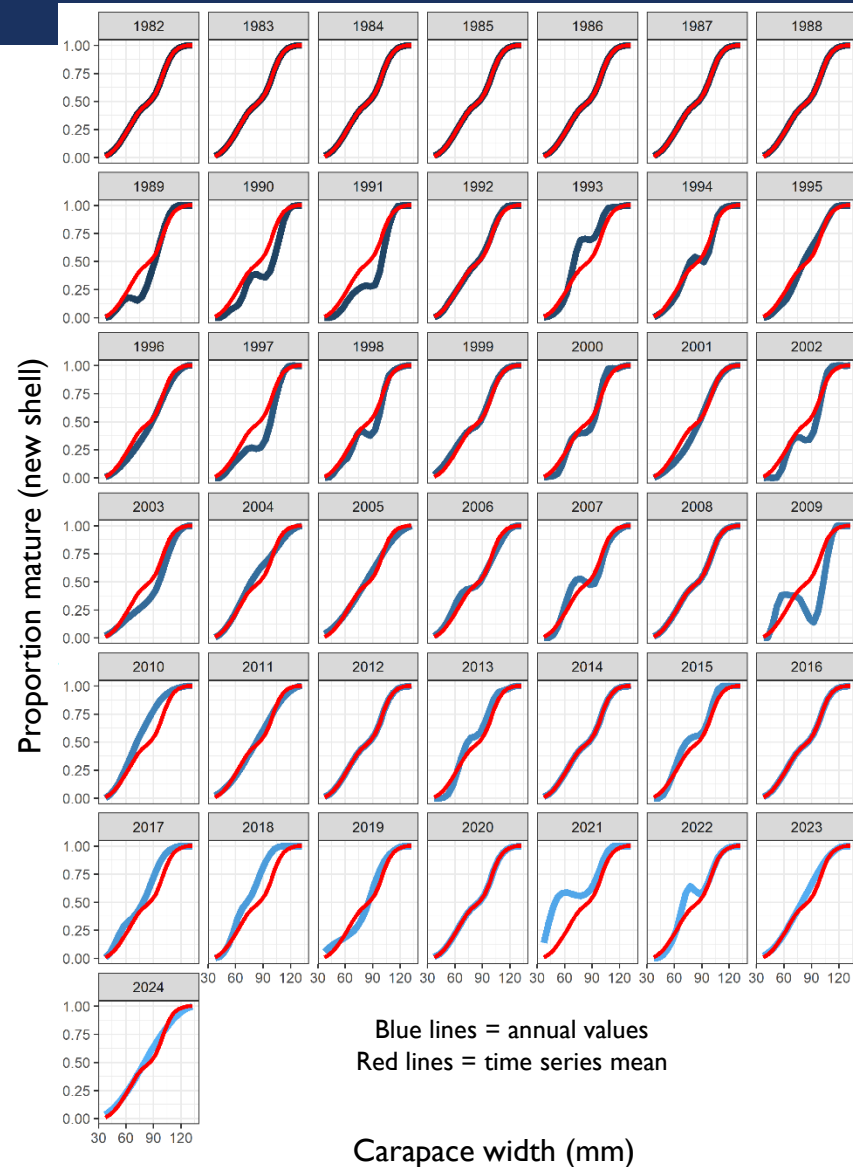
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Proportion mature by size (model)



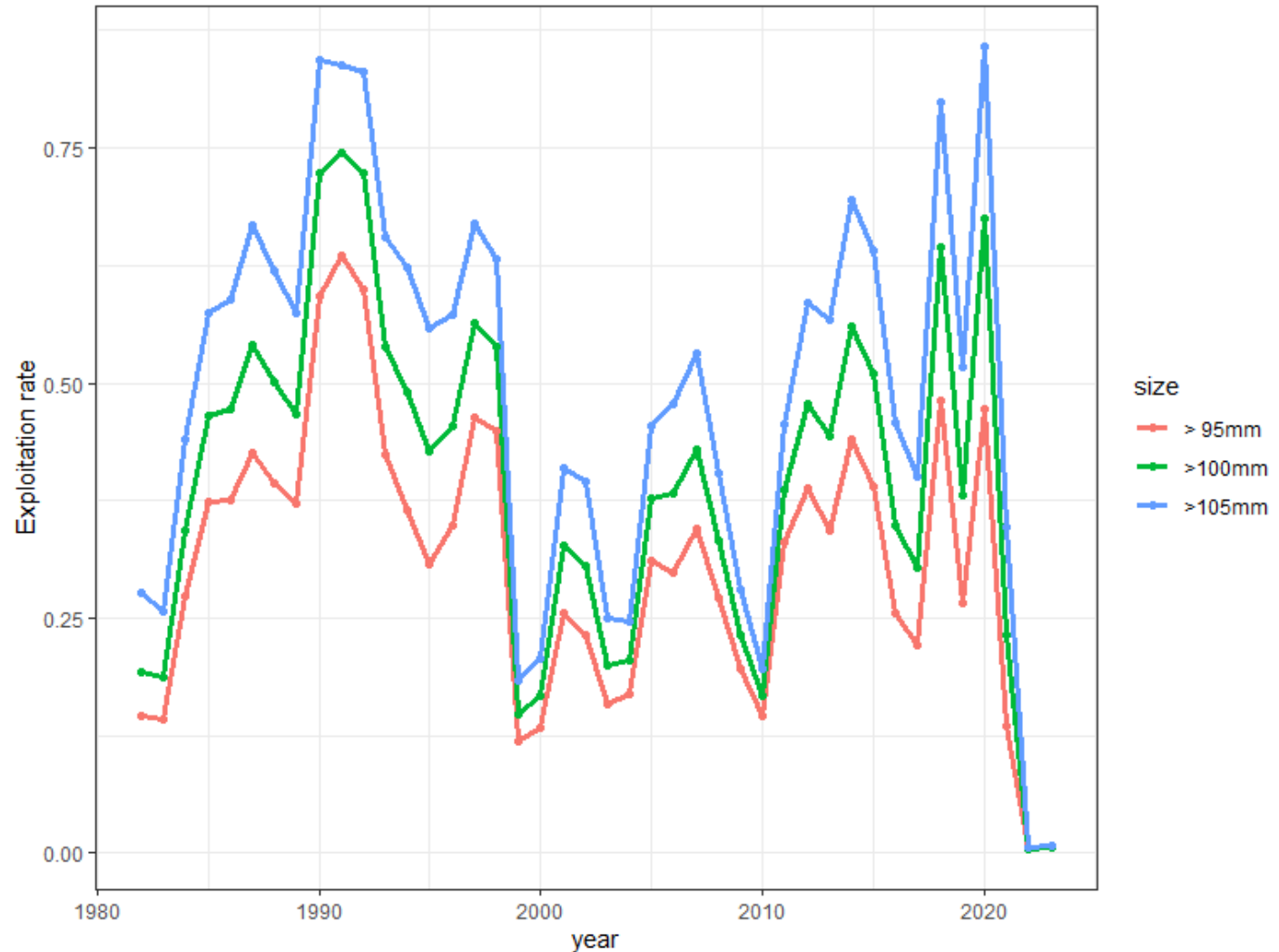
CAUTION

- 8 lowest industry-preferred biomass = last 8 years
- Long slow decline in industry-preferred male biomass
- Divergent trends in total male and large male biomass
- Steady decline in fishery CPUE since rationalization
- Suggestions of density dependence in size at maturity



# EXPLOITATION RATE BY SIZE

- Exploitation rates have increased as CPUE and large male abundance have declined



# MODELS FOR CONSIDERATION

- Tier 3
  - 23.1 – Last year’s accepted model (morphometric mature biomass as MMB)
  - 24.1 – Last year’s model fit to this year’s data
    - 24.1a – 24.1 + correcting an issue with indexing of molting probabilities
    - 24.1b – 24.1a + using  $\geq 95$  mm carapace width biomass as MMB
    - 24.1c – 24.1b + using  $B_{MSY}$  proxy from yield curve analysis
- Tier 4 fallback (both use  $>101$  mm biomass 1982-2022 as  $B_{MSY}$  proxy)
  - Tier 4 “author” - sloped harvest control rule from FMP, biomass decremented by prorated  $M$  prior to fishery
  - Tier 4 “SSC” - no sloped harvest control rule, MMB not decremented by  $M$



# TIER 3 OR TIER 4?

## Tier 3

Model	MMB	B35	F35	FOFL	OFL	M	avg_rec	Status
23.1	128.11	164.05	61.78	24.21	23.40	0.29	154.55	0.78
24.1	115.46	181.01	59.72	26.12	20.15	0.29	167.37	0.64
24.1a	106.52	191.81	49.63	25.07	19.60	0.28	164.98	0.56
24.1b	13.40	94.82	0.81	0.00	0.05	0.28	164.98	0.14
24.1c	13.40	121.91	0.53	0.00	0.05	0.28	164.98	0.11

## Tier 4

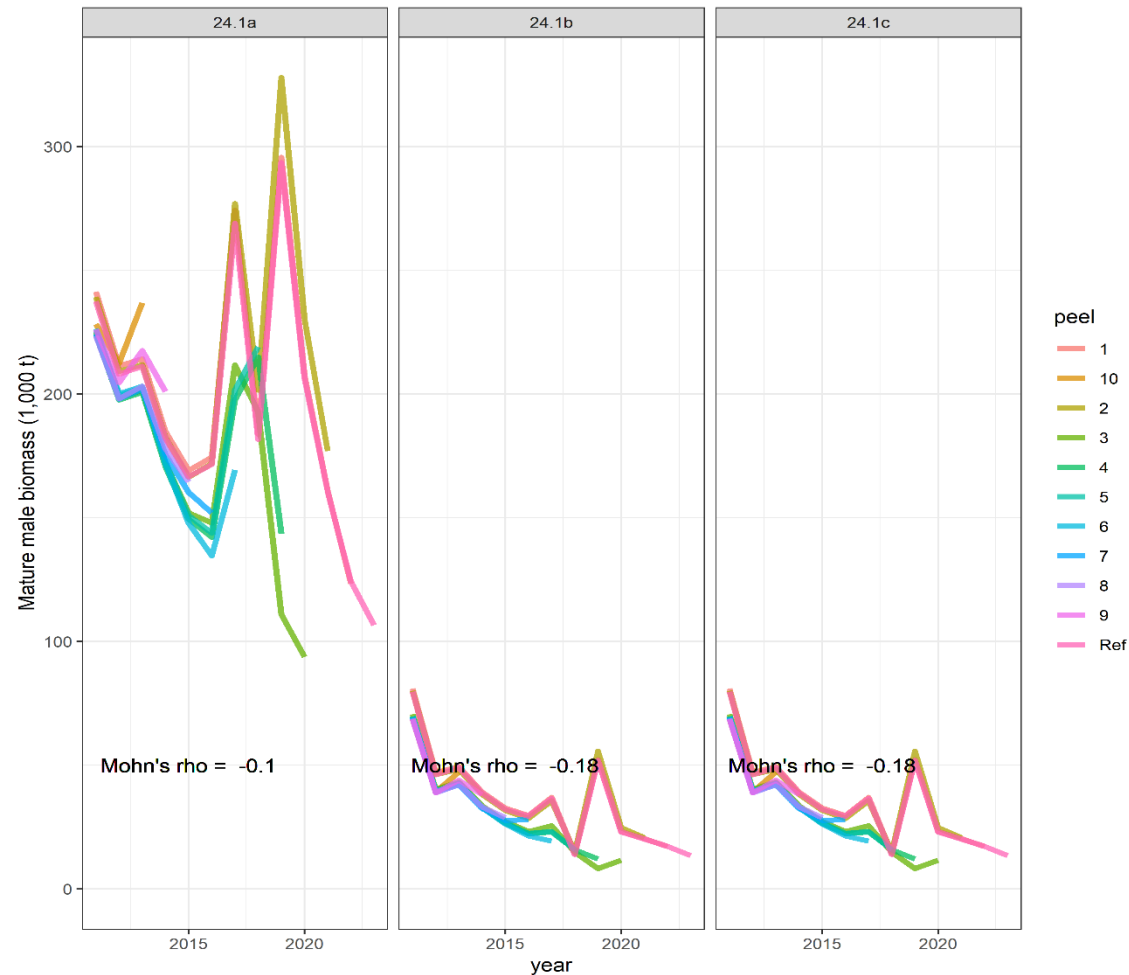
Year	Tier	BMSY	Males_com	Status	FOFL	OFL	Years	M
2023/2024	4_author	57.27	14.58	0.25	0.05	0.66	1982-2022	0.27
2023/2024	4_SSC	NA	16.56	NA	0.27	3.92	NA	0.27

Author recommendation: Tier 4\_author



# TIER 3/4 DECISION - MODEL EVALUATION

- Retrospective pattern not concerning

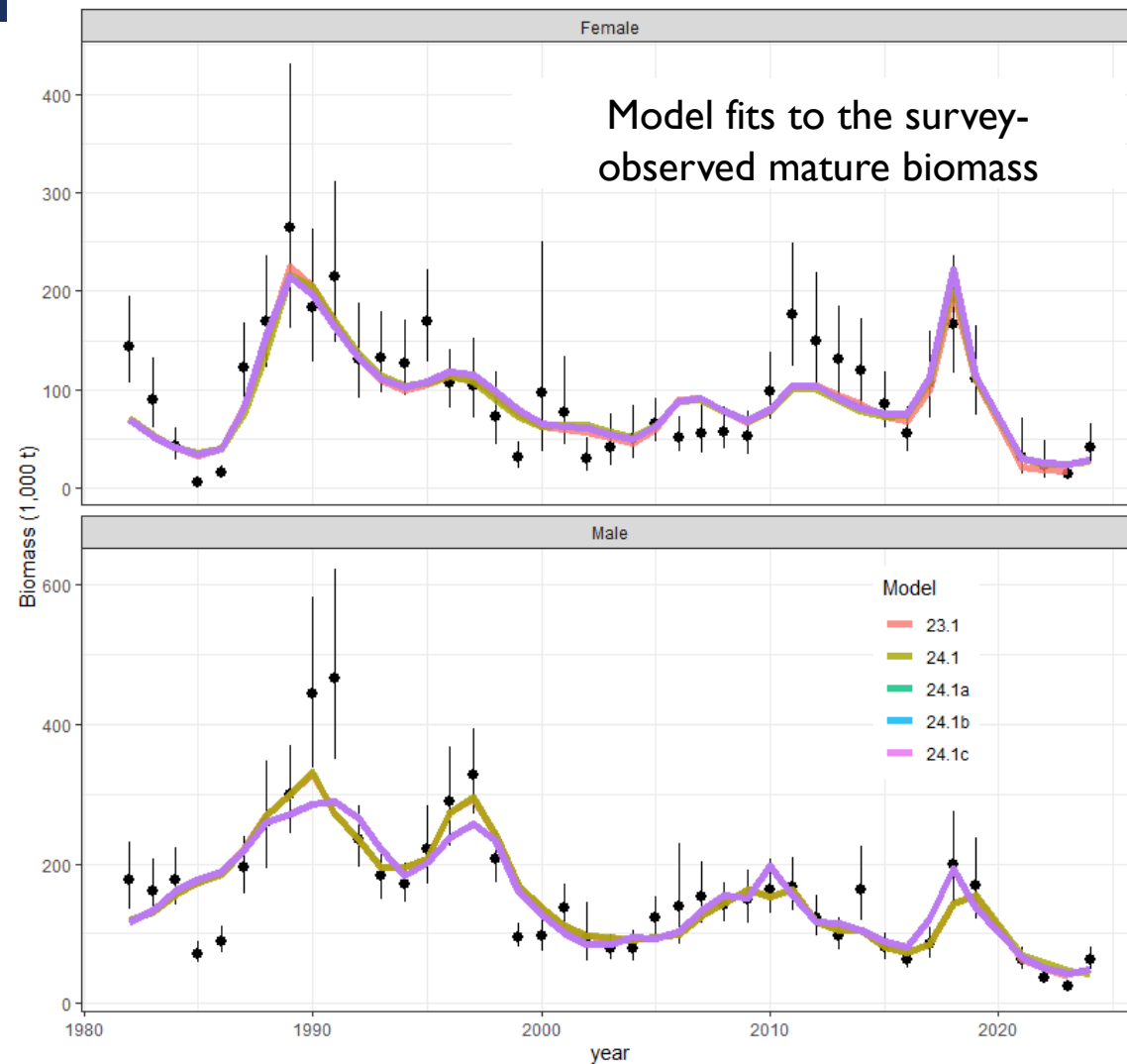


Retrospective patterns in estimated mature male biomass for selected models.



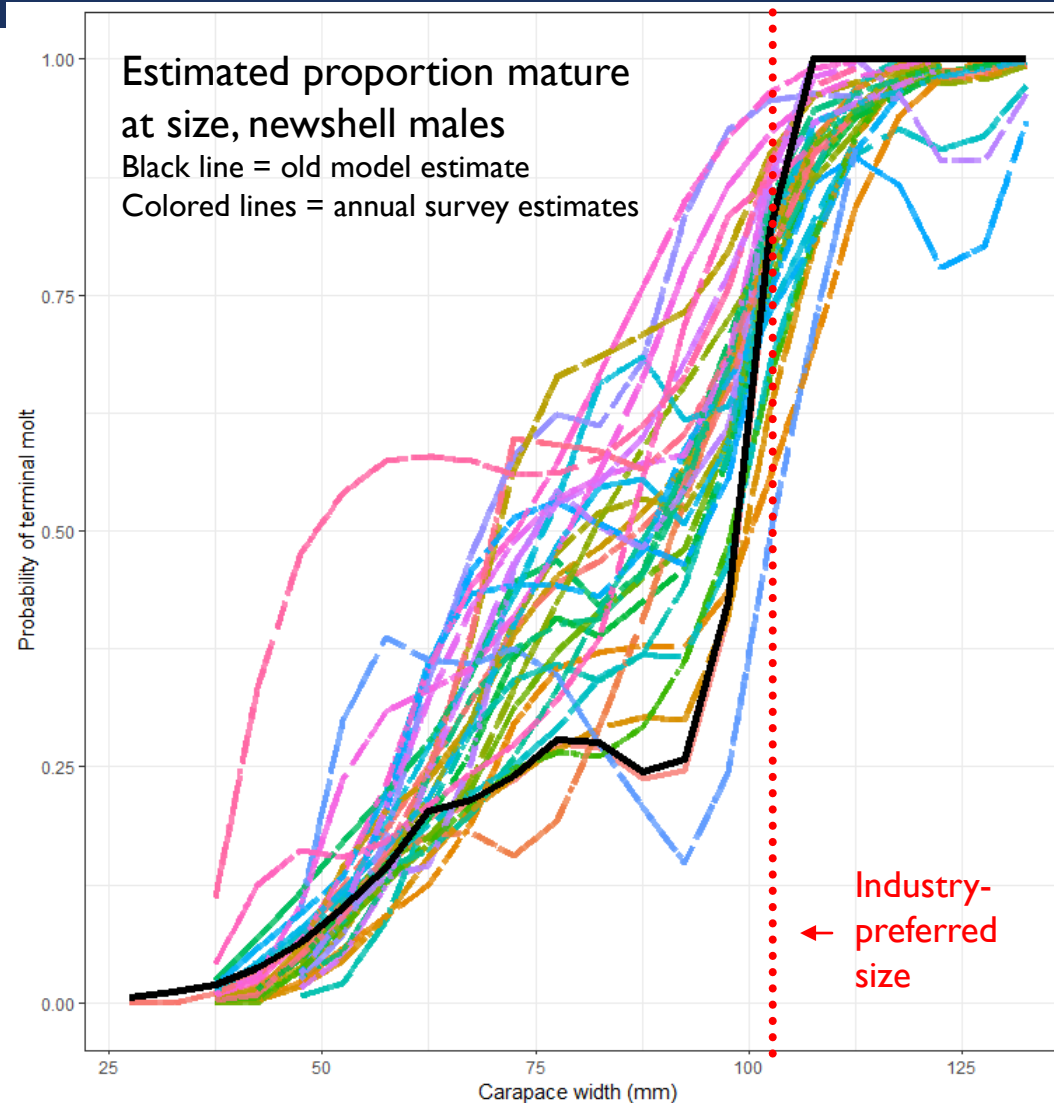
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# TIER 3 DECISION - MODEL EVALUATION

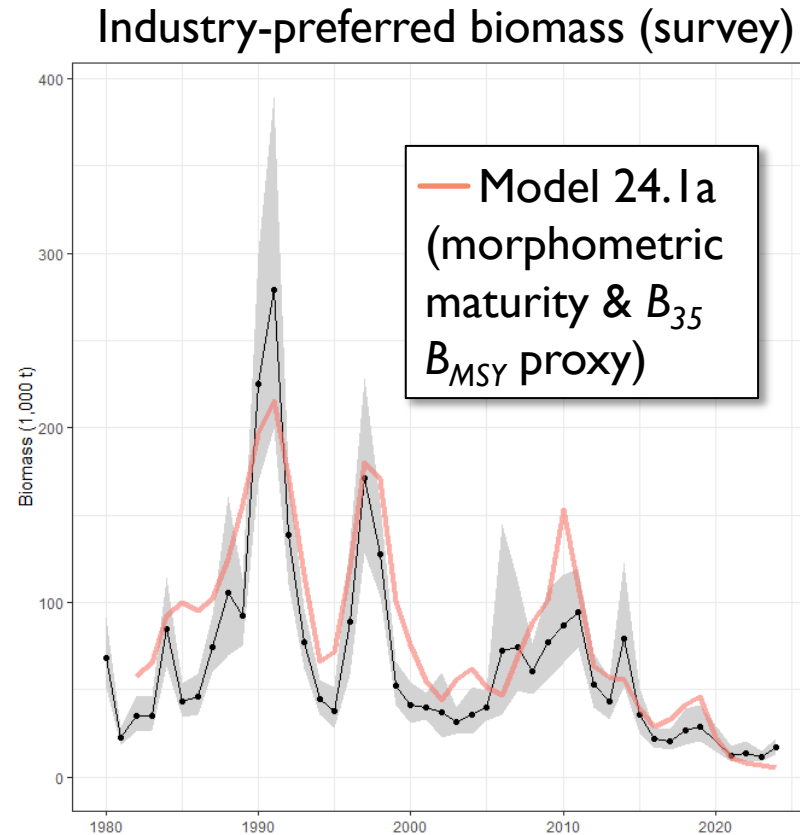
- Retrospective pattern not concerning
- Fits to mature biomass are good
- Model is biologically realistic
  - Improved treatment of survey selectivity
  - Proportion mature males at size estimated outside the model





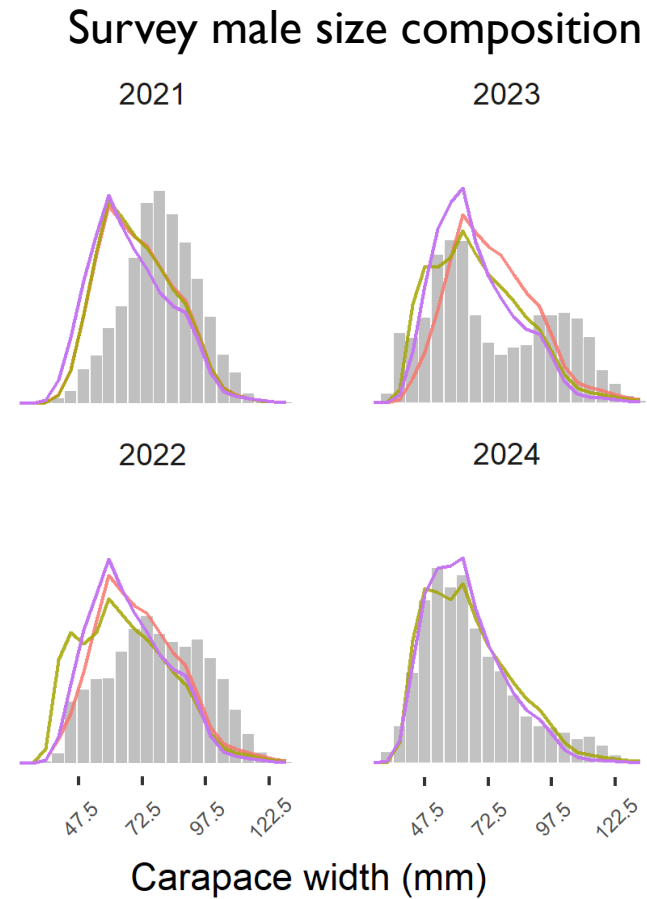
# TIER 3 CONCERNS - MALE SIZE COMPS

- GMACS under-predicts survey biomass of industry-preferred males by ~80% in 2024



# TIER 3 CONCERNS - MALE SIZE COMPS

- GMACS under-predicts survey biomass of industry-preferred males by ~80% in 2024
- Poor fit to large males in survey size comps 2021-2024

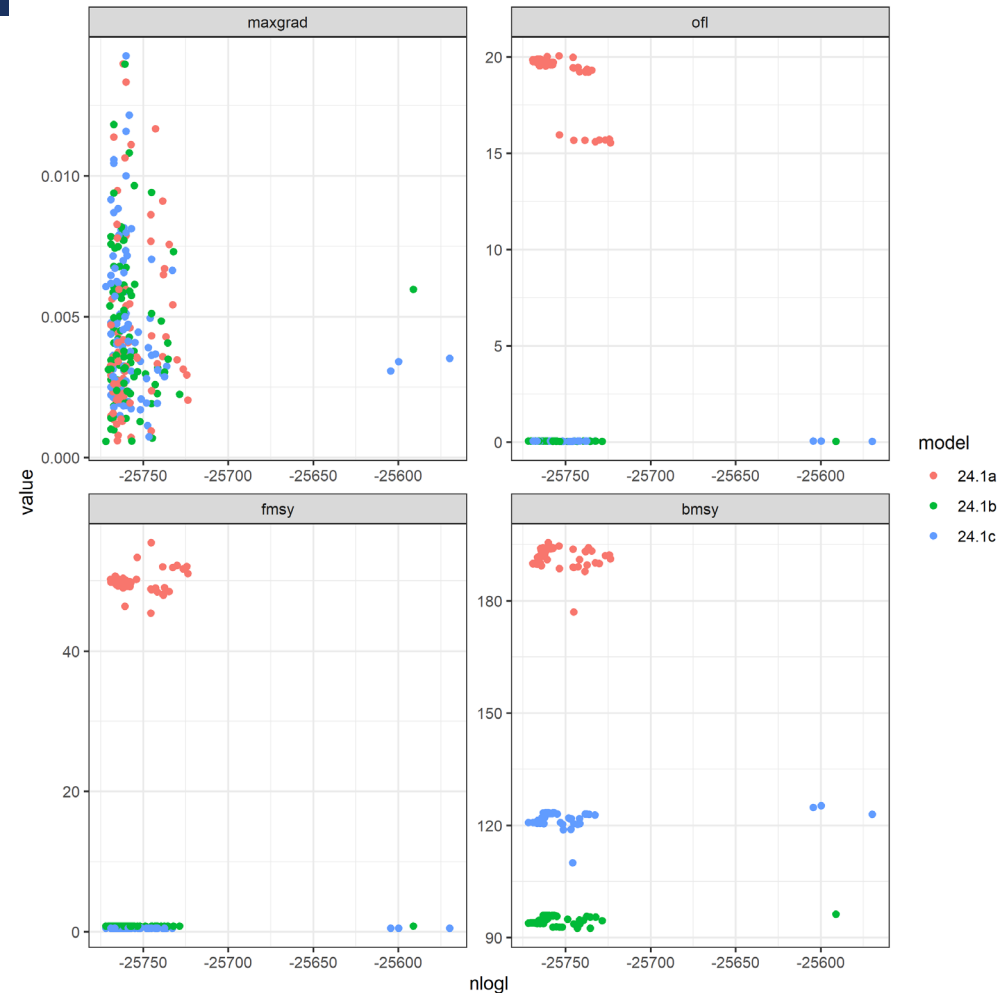


model — 23.1 — 24.1 — 24.1a — 24.1b — 24.1c



# TIER 3 CONCERNS - JITTERING RESULTS

- Larger-than-expected scatter in management quantities
- Only a single jitter run converged to lowest negative log-likelihood
- Author indicated this is a lower-level concern for use of the model
- CPT discussed developing generalized criteria for evaluating jitter results



Output of 100 jittered model fittings for selected models. Top left is the maximum gradient component, top right is the overfishing level, bottom left is F35, and bottom right is B35. Each dot represent an instance of a jittered fitted model and are colored based on the OFL resulting from that run.



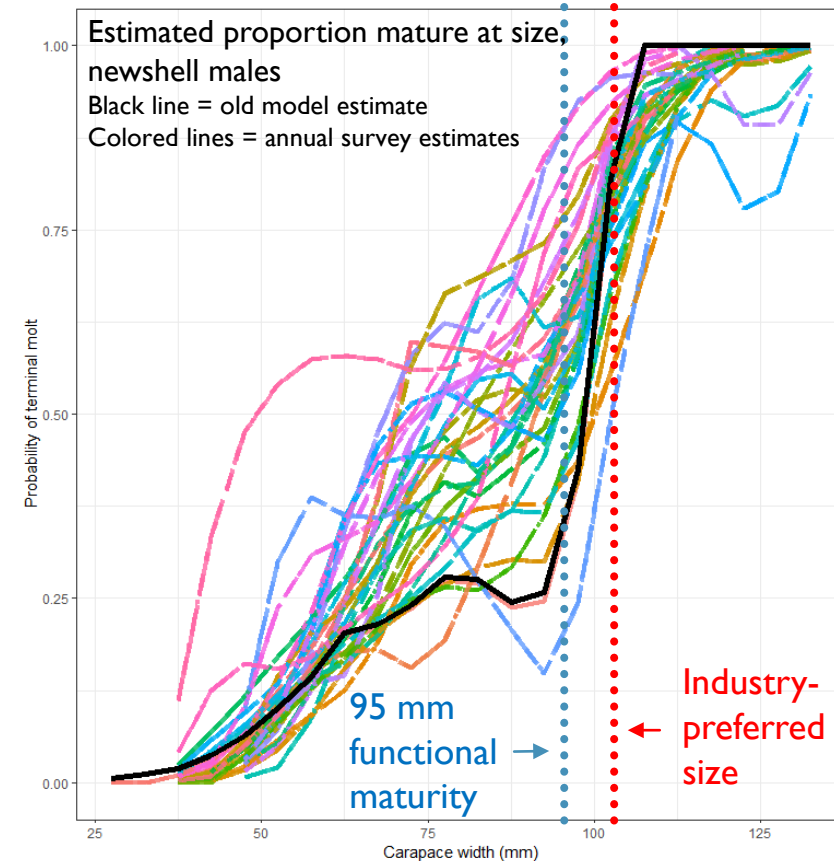
# CPT RECOMMENDATION: TIER 3

- Tier 4 “fallback” should be retained for situations where population dynamics models experience extreme problems that preclude their use for estimating MMB
- Current Tier 3 GMACS model for snow crab is much improved in realistic treatment of terminal molt dynamics
- CPT discussed the value of using a consistent set of criteria for evaluating model suitability - problems with 24.1a,b,c are not unusual compared with model issues for other stocks
- Poor fit to male size comps and jittering results merit further exploration
- CPT recommends retaining snow crab in Tier 3



# CURRENCY OF MANAGEMENT/ $B_{MSY}$ PROXY

- Majority of crab stop growing at less than industry-preferred size
- Potentially very high  $F$  for the fully-selected portion of the population using morphometrically-mature biomass as currency of management
  - Model 24.1a with 65% buffer allows for removal of all large males at ABC
- Two related decisions
  - Change to currency?
  - Change to  $B_{MSY}$  proxy?



# CURRENCY OF MANAGEMENT

## Functional Maturity

- Canadian research indicates >95 mm carapace width (CW) = functional maturity
- Suggests danger in high exploitation rates for larger males
- No information on functional maturity for Bering Sea
- Unique high abundance of very large immature females in 2024 presents additional uncertainty
- Generally *lower* certainty



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## Large Males for Fishery

- Industry-preferred abundance declining
  - Absolute abundance
  - Proportion of population
  - High sorting / discard rates prior to stock collapse
- Canadian research demonstrates density dependence: fewer large males = terminal molt at smaller size
- Survey observations in Bering Sea consistent with density dependence
- Generally *higher* certainty



## RECOMMENDATION: CURRENCY OF MANAGEMENT

- Concern that managing with morphometric currency requires very high buffers that are difficult to select objectively
- Concern that persistent declines in large male abundance and evidence for density dependence in size at maturity indicate shortcomings in status quo
- Recognition that yield curve analysis indicates  $B_{MSY}$  cannot be reached using morphometric currency (next section)
- Considered benefits
  - Preserve potentially important reproductive contribution of large males
  - Preserve the ability of the stock to produce industry-preferred sizes
- CPT recommendation: adopt  $\geq 95$  mm CW as currency of management





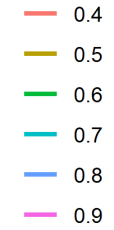
# $B_{MSY}$ PROXY

- Repeat Clark (1991) analyses, but with snow crab life history
- Add another axis to represent uncertainty in the size at which mature crab contribute to reproduction
- Scenarios differ in what sizes are used for ‘spawning biomass’ in recruitment and reference point calculations:
  - Morphometric maturity is determined by chela height
  - Functional maturity (>95 mm)
- Looking for a reference point given uncertainty about reproductive dynamics

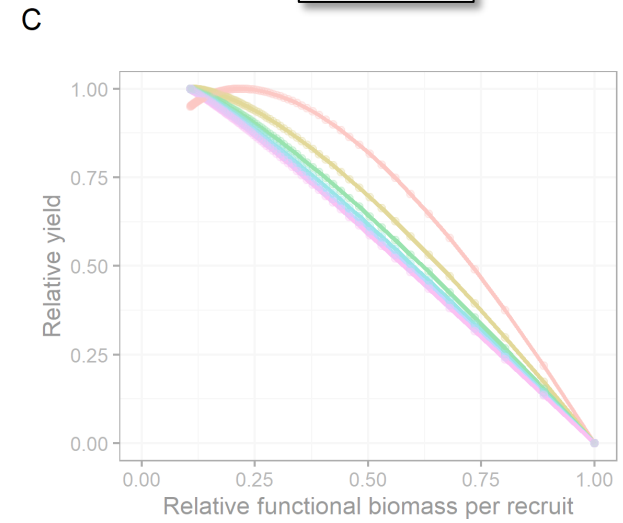
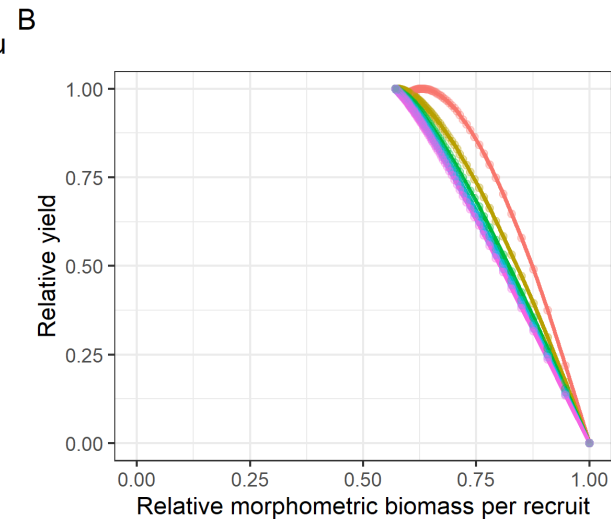
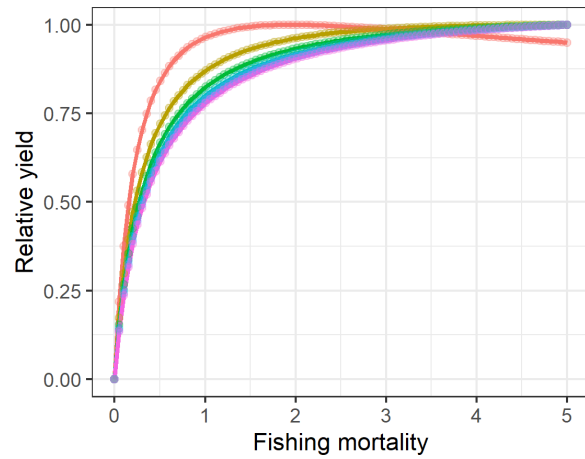


# $B_{MSY}$ PROXY

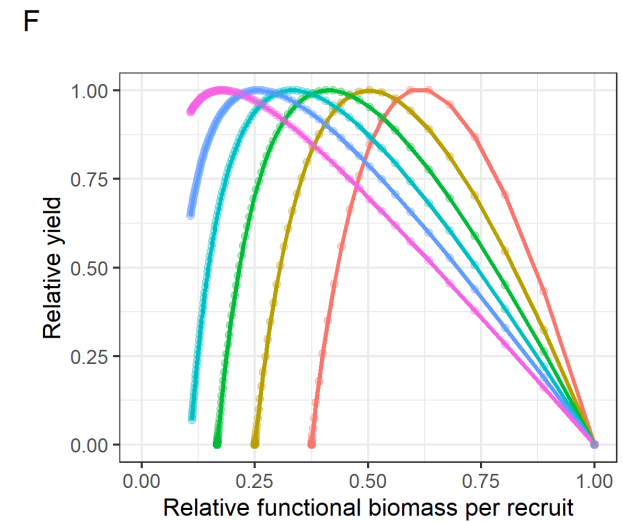
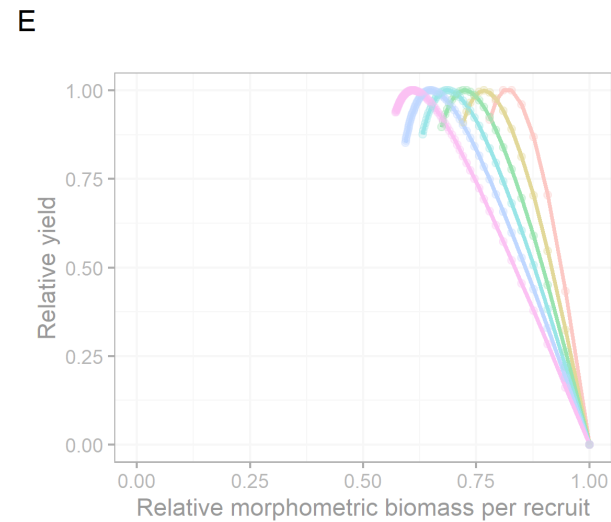
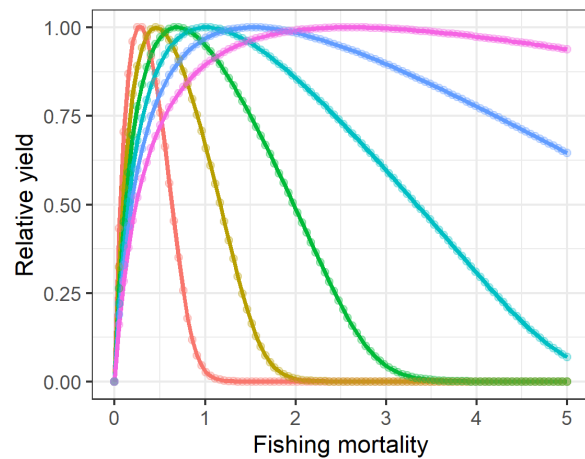
Steepness



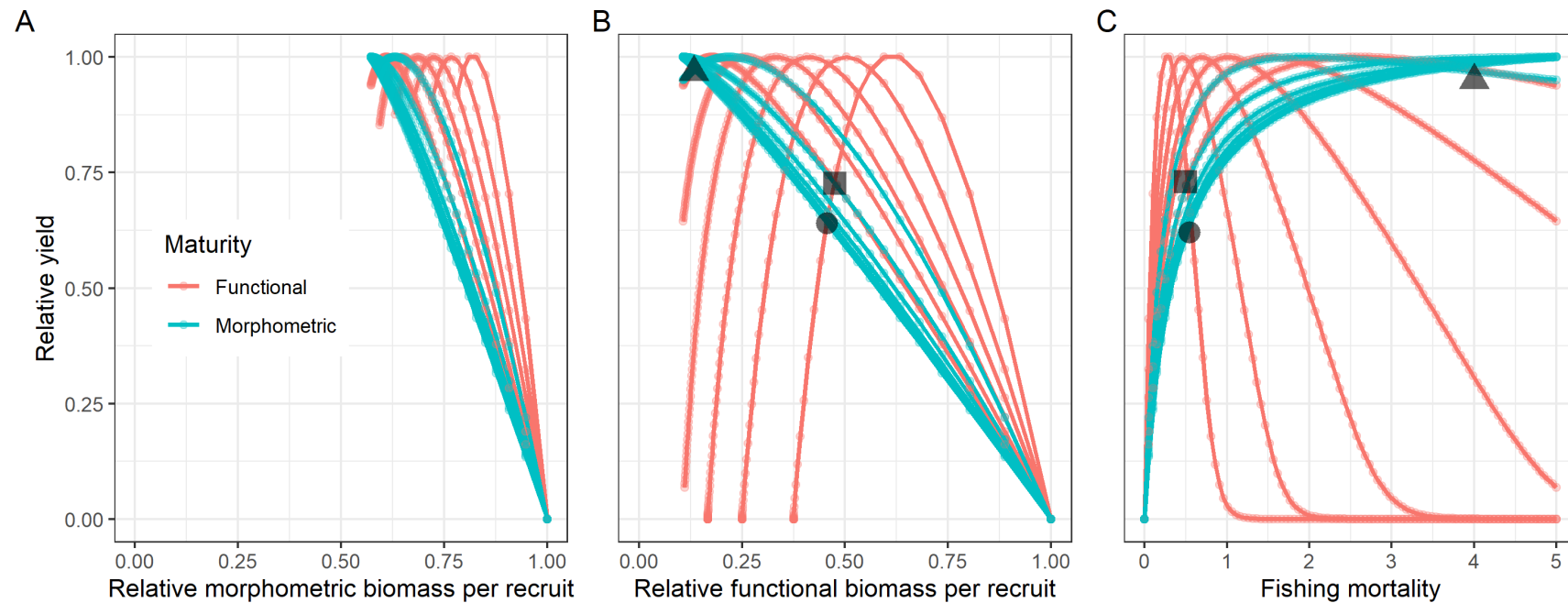
A Morphometric maturity determines recru



D Functional maturity determines recruits



# $B_{MSY}$ PROXY



Triangle = maximin solution for morphometric maturity ( $F_{MSY} \sim 4$ ,  $B_{MSY} = 13\%$  unfished functional SBPR)

Square = maximin solution for functional maturity ( $F_{MSY} \sim 0.5$ ,  $B_{MSY} = 48\%$  unfished functional SBPR)

Circle = maximin solution for both ( $F_{MSY} \sim 0.55$ ,  $B_{MSY} = 45\%$  unfished functional SBPR)



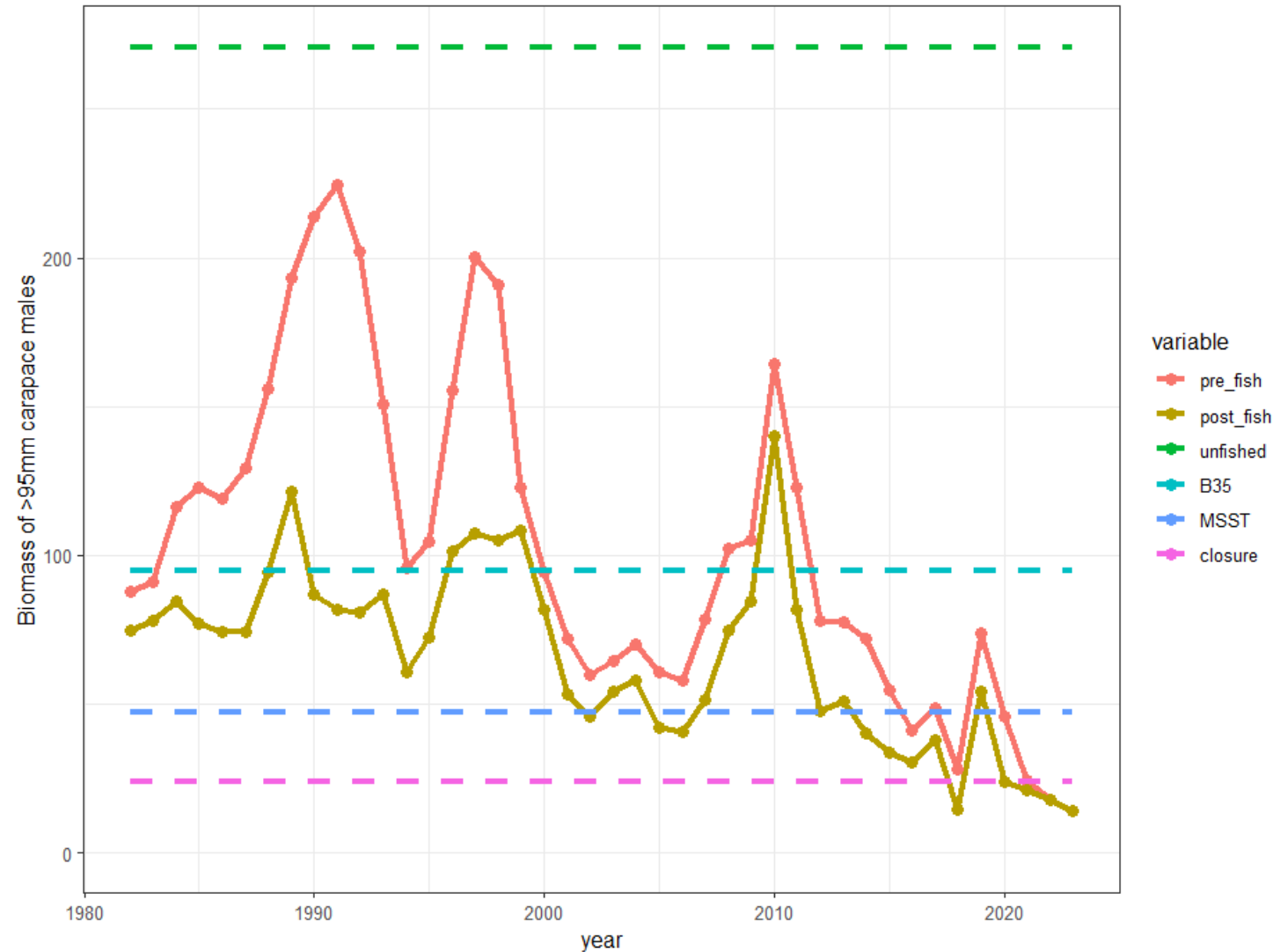
# CPT RECOMMENDATION: $B_{MSY}$ PROXY

- CPT generally supportive of presented analysis, provides appropriate path for selecting  $B_{MSY}$  proxy given snow crab life history
  - Some discussion over whether results were constrained by the strongest candidate density dependence in spawner-recruit relationship
- CPT expressed concern about making two major changes to management in a single year (currency and  $B_{MSY}$  proxy)
- Recommendation: retain  $B_{35\%}$ , but recognize that analysis provides rationale for making the change in a future cycle



# OFL/ABC

- Recommended  $\geq 95$  mm CW currency and B35% proxy: **model 24.1b**
- Produces conservative harvest specs consistent with managing for larger male biomass
- Retrospectively below MSST since 2014, fishery closures in 2018, 2020-present



# OFL/ABC

## Buffer considerations

- Ecosystem conditions in ESP mostly neutral
- Improved modeling of terminal molt; some uncertainty around jittering results and model estimates of industry-preferred biomass
- Concerns around currency of management and downward trajectory in industry-preferred biomass and CPUE addressed in OFL
- Sources of uncertainty otherwise largely similar to last year
- CPT recommends same buffer as last year: **20%**



# OFL/ABC

1000s t

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2020/21	76.7	26.7	20.4	20.4	26.2	95.4	71.6
2021/22	91.6	41.3	2.5	2.5	3.6	7.5	5.6
2022/23	136.9	92.4	Closed	0	0.05	10.3	7.7
2023/24	47.41*	13.4*	Closed	0	0.07	15.4	7.7
2024/25		11.3*				0.05*	0.04*

\*Values reflect  $\geq 95$  mm currency

- CPT also requested OFL projections using different reference period of bycatch  $F$  to reflect the expectation for high bycatch mortality in the upcoming Tanner west fishery
- These were provided as an addendum to the SAFE and were not reviewed by CPT
- A data discrepancy in bycatch inputs was discovered during this process that also changed OFL/ABC
- Addendum OFL/ABC:

Value of bycatch $F$	OFL	ABC
Avg. bycatch $F$ 2011-2021	0.17	0.14
Max bycatch $F$ last 10 yrs (2015)	0.91	0.73



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# TANNER CRAB

FISHERY UPDATE

FINAL ASSESSMENT 2024





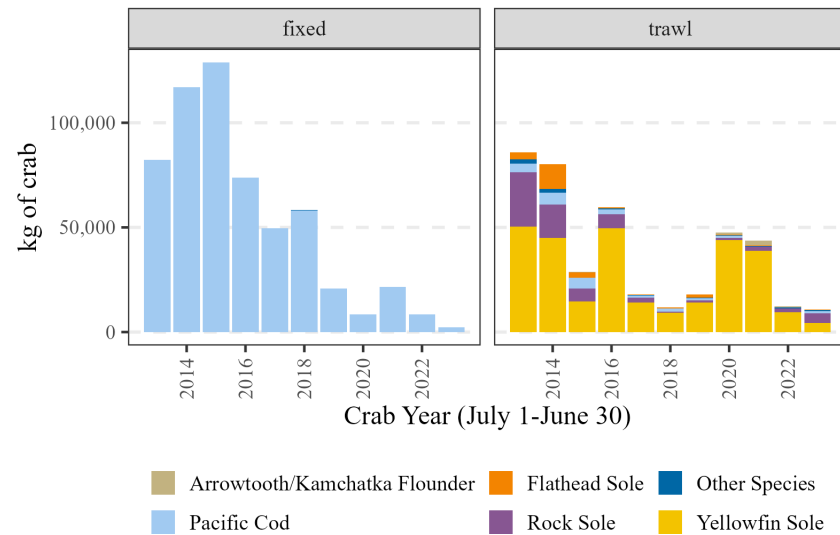
# TANNER CRAB OVERVIEW

- **Annual Tier 3 assessment, not in GMACS**
- Model 22.03b = last year's accepted model
- Work completed this cycle:
  - Updated BSFRF side-by-side data
  - Empirical availability curves
  - Addressed estimated sample size parameters hitting bounds
- Survey abundance up for all size-sex categories in east and west in 2024
- VAST/sdmTMB model-based indices of the three trawl surveys planned for presentation at January modeling workshop



# FISHERY UPDATE

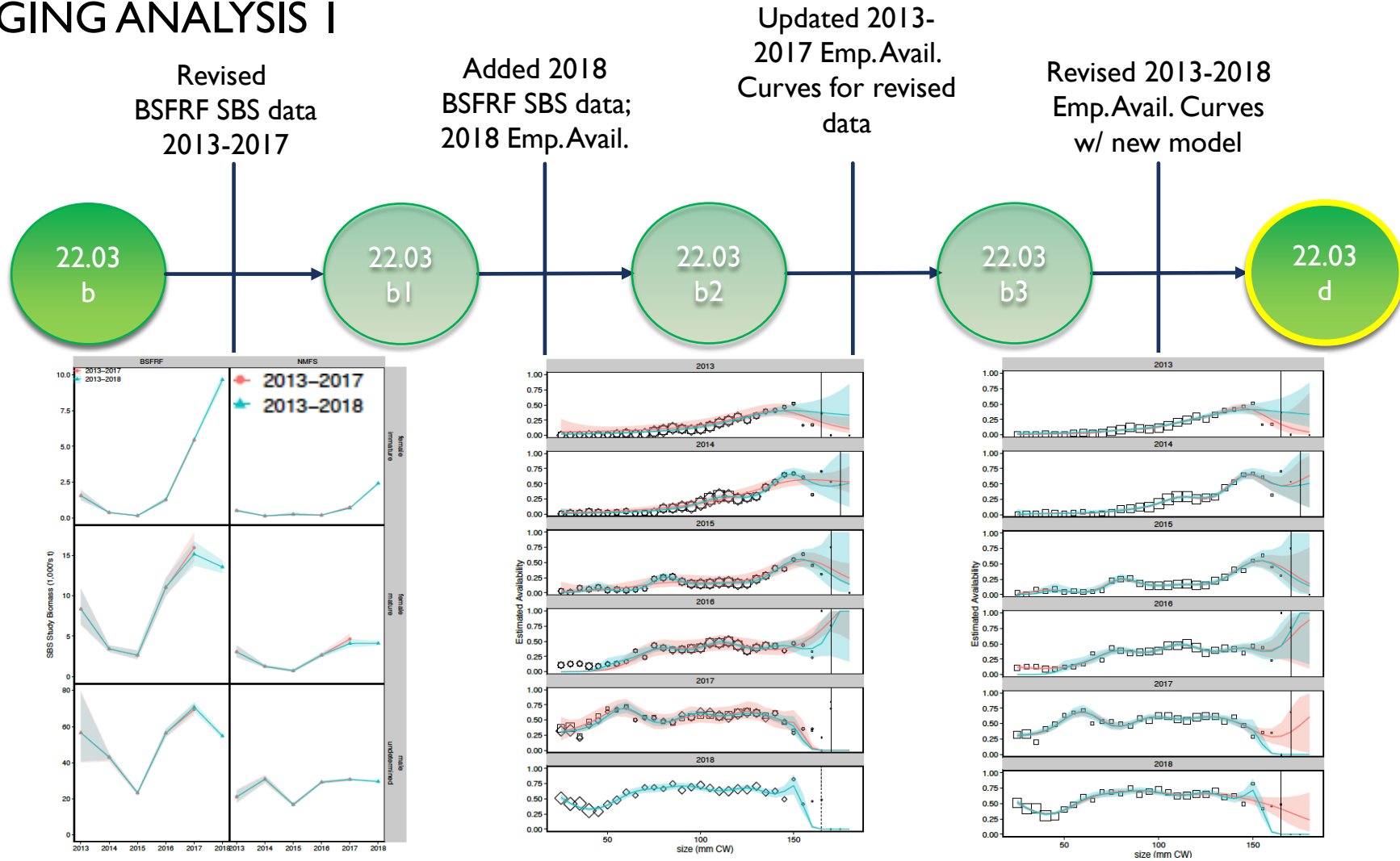
Eastern Bering Sea Tanner crab  
Incidental Catch by Trip Target



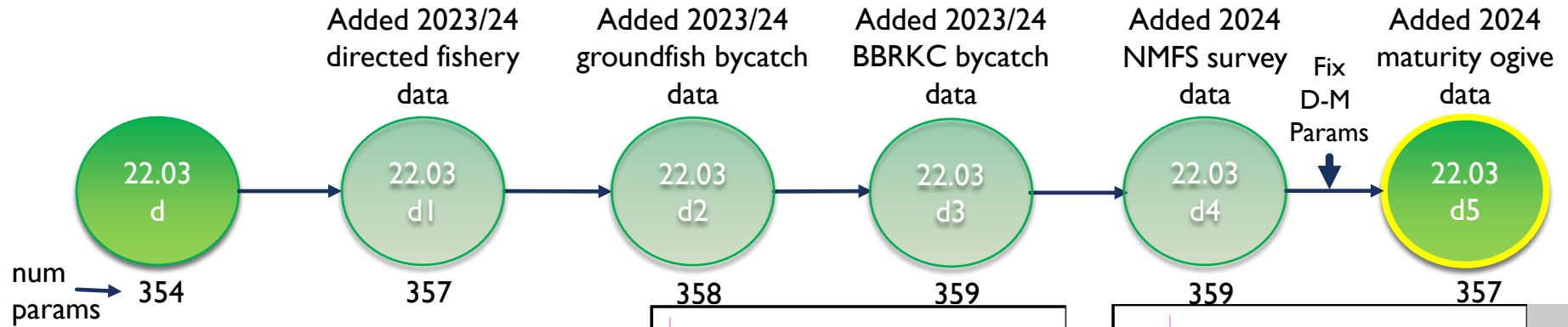
- 2023/24 retained catch: 344 t east, 597 t west
- Overfishing did not occur
- Pacific cod fixed gear bycatch decreasing since 2015
- Trawl bycatch primarily from yellowfin fishery



# BRIDGING ANALYSIS I

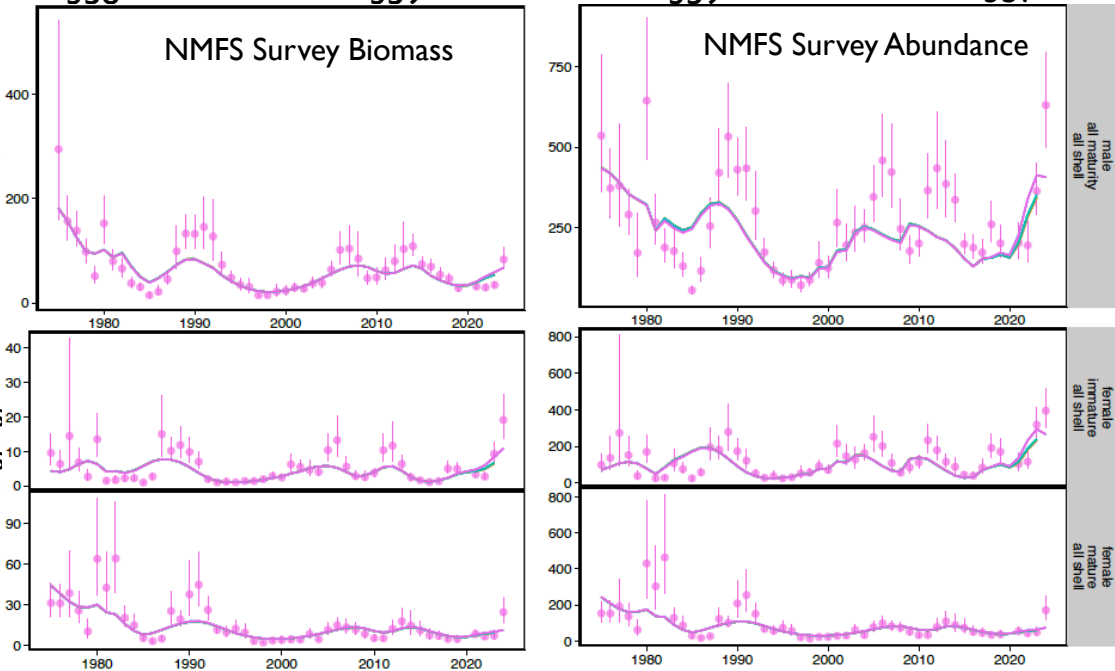


# BRIDGING ANALYSIS 2



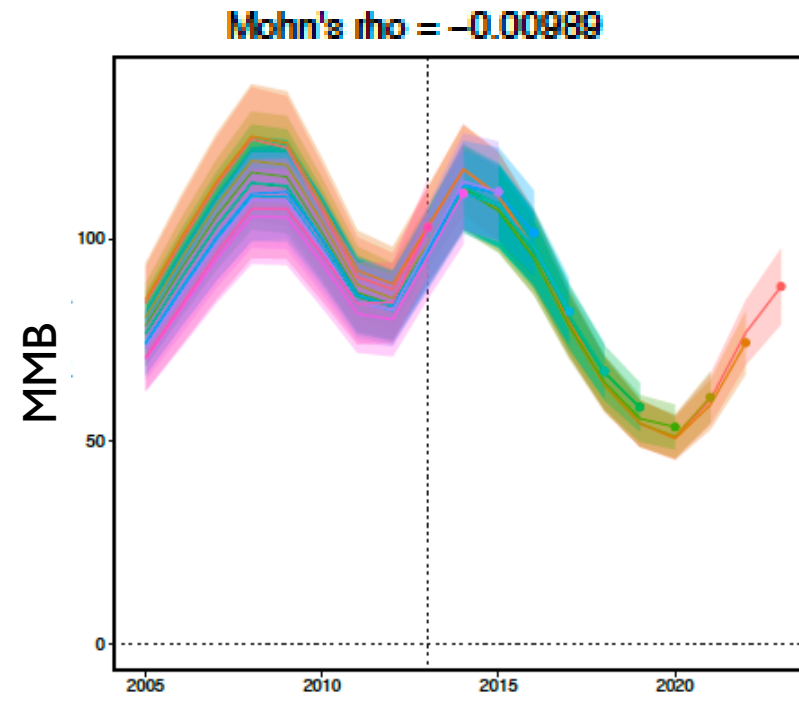
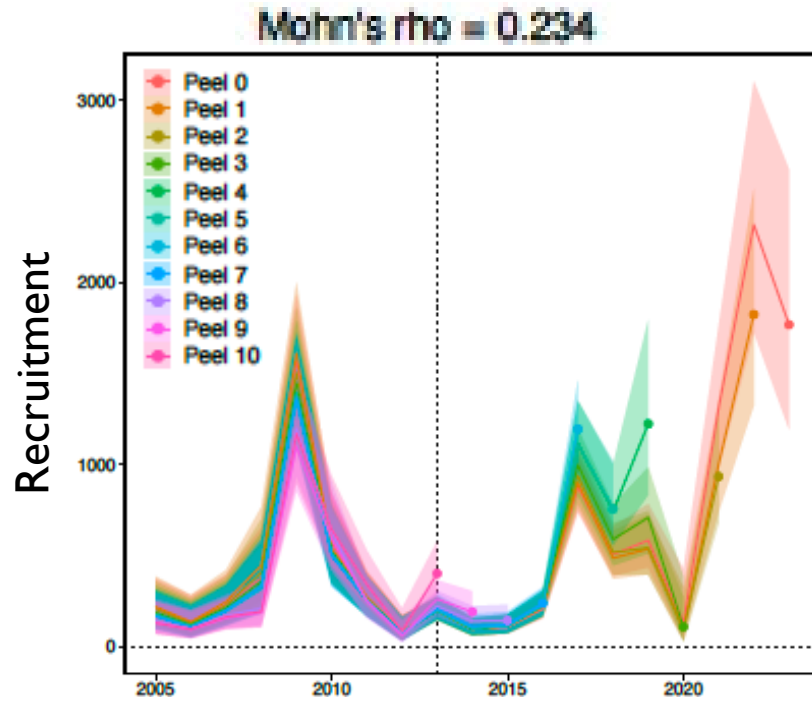
## Results

- all converged with small maximum gradients
- uncertainty estimates were obtained for all models
- D-M effective sample sizes hit upper bounds for
  - 22.03d2: female BSFRF size comps
  - 22.03d3: BSFRF size comps – both sexes
  - 22.03d4: BSFRF size comps – both sexes
- 22.03d5: fixed D-M effective sample parameters to obtain model with no parameters estimated at a bound
  - essentially multinomial likelihoods



CPT recommends model 22.03d5

# RETROSPECTIVE PATTERNS



# OFL/ABC

- Recommended ABC buffer: 20% (SSC adopted 20% last year)
  - Continuing concern over model performance
    - Abundance of large crab overestimated
    - OFL too optimistic
  - Continuing concern over  $F_{35\%}$ ,  $B_{35\%}$  as metrics for a sustainable fishery
  - Reduced concern over movement of recruits into larger sizes

1,000s t

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2020/21	17.97	56.34	1.07	0.66	0.96	21.13	16.90
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	NA	56.06	NA	NA	NA	41.29	33.03



# ST MATTHEW ISLAND BLUE KING CRAB (SMBKC)

FINAL ASSESSMENT 2024



# SMBKC OVERVIEW

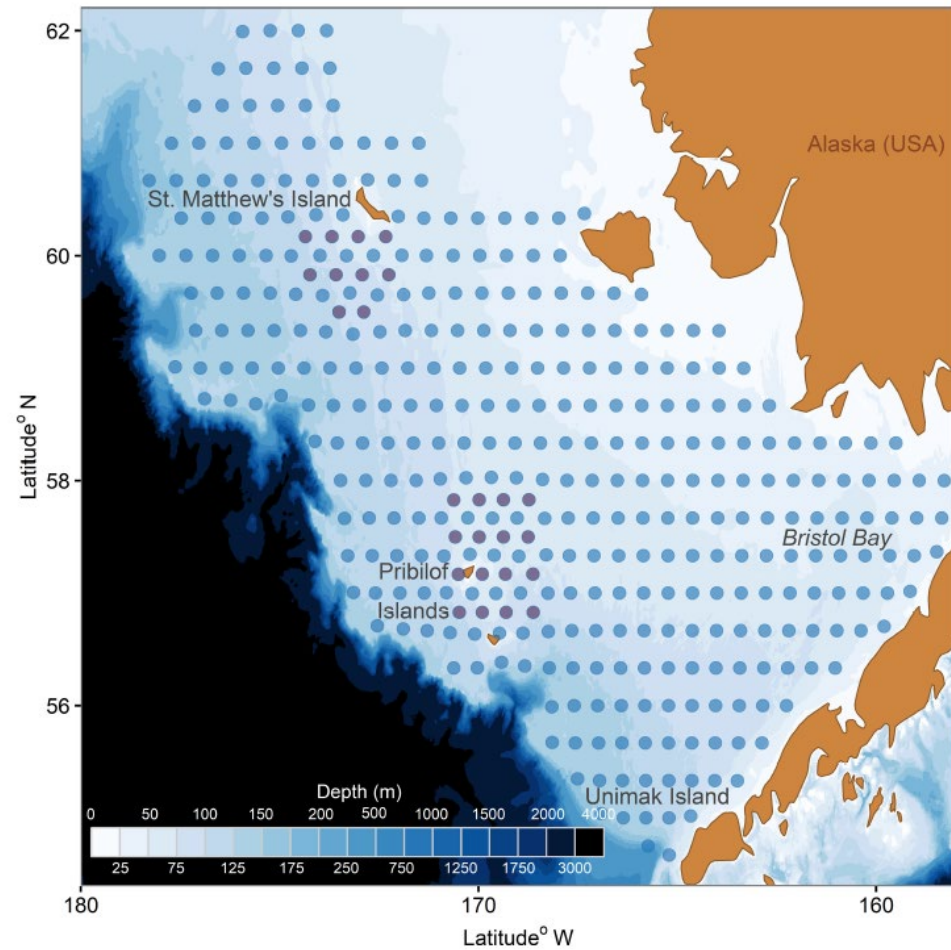
- **Tier 4 biannual stock assessment, GMACS assessment** framework since 2016
- Stock is under a rebuilding plan since 2020 (declared overfished in 2018), assessed on a two-year cycle
- Directed fishery closed since 2015, limited bycatch in groundfish fisheries.
  - Groundfish bycatch is primarily fixed gear due to trawl closure areas and has been below 2,000 kg of crab since 2018
  - Total catch < OFL therefore overfishing did not occur in 2023/24
- Recent model issues:
  - Difference in last 2010s trend between ADFG pot and NMFS trawl surveys (ongoing)
  - Poor fit to 2010+ survey data (ongoing)
  - Change to NMFS trawl survey data with removal of high-density corner stations (new)
- Models included changes to natural mortality (24.1:  $M = 0.23$  from BBRKC) and sensitivity to lose of the high-density corner stations (16.1a and 24.1a)



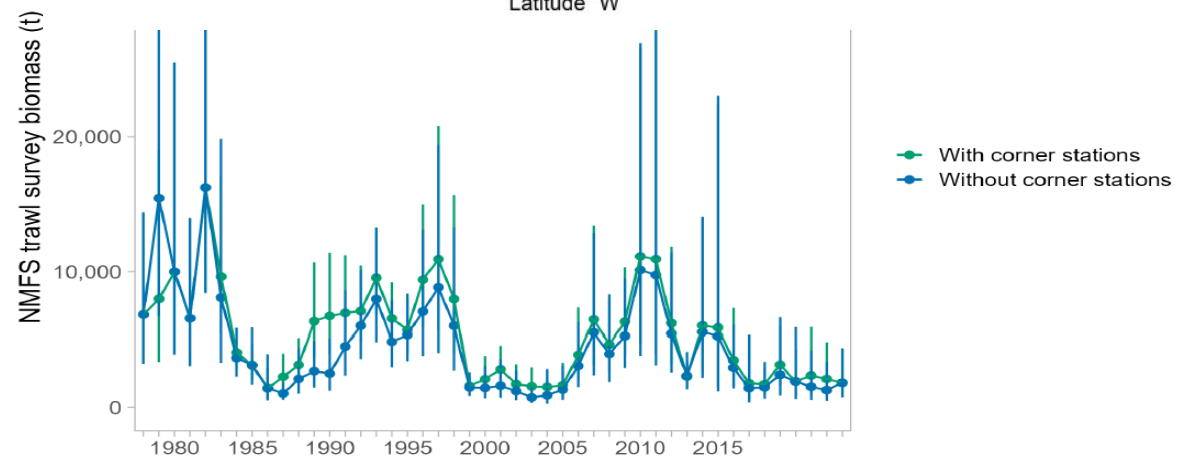


# SMBKC CORNER STATIONS

- Mean biomass (1983 – 2023) without corner stations is 79% of mean biomass with those stations included.
- Size comp data very similar
- Solution: standardization of the index using spatio-temporal analysis to allow for differences in the time series (update at Jan modeling workshop)

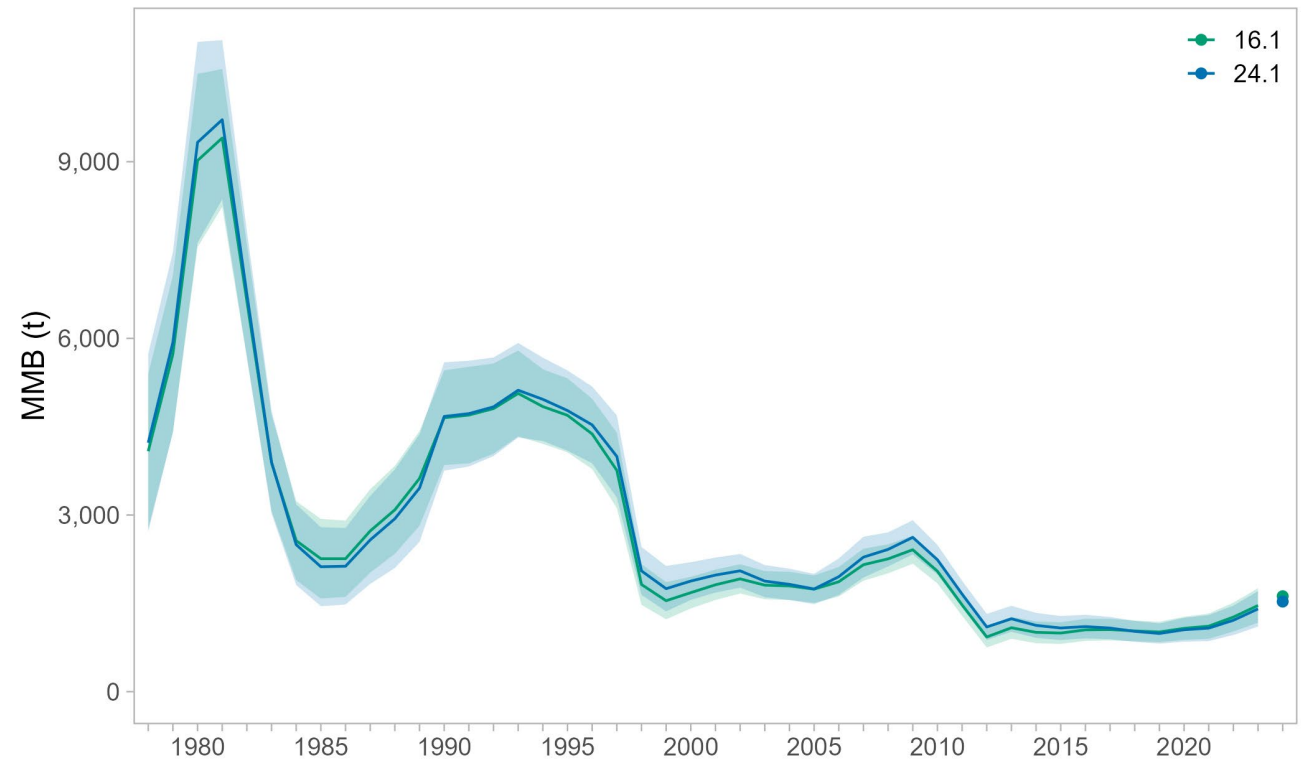


Source:  
DePhilippo et al. (2023)  
*Front. Mar. Sci.*  
10:1219283



# CPT MODEL RECOMMENDATION

- Model 24.1 recommended by author and CPT
- Retrospective patterns still strong for MMB
- Recruitment at low levels
- Rebuilding update:
  - 2023/24 status close to MSST (24.1)
  - 2024/25 projected status above MSST (24.1)
  - Stock is still under rebuilding plan but when it hits MSST ( $0.5 B_{MSY}$ ) it will not be overfished
  - Without substantial recruitment event recent recruitment will not rebuild the stock to  $B_{MSY}$  in rebuilding plan (1983 – 2023 average MMB)



## SMBKC SPECIFICATIONS AND BUFFER

- Model 24.1 ( $M = 0.23$  based on BBRKC)
- Buffer – 25%
  - Rebuilding plan
  - Retrospective pattern for MMB
  - Life history information limited to inform population processes
  - ADFG pot survey data only every 3 years – tracks population better
  - Trend differences between ADFG and NMFS surveys
  - Loss of corner stations (adds bias but not uncertainty)

Table 2: Status and catch specifications (1,000 t) for model 24.1, with  $M = 0.23$ .

Year	MSST	Biomass ( $MMB_{\text{mating}}$ )	TAC	Retained catch	Total male catch	OFL	ABC
2020/21	1.65	1.14	0.00	0.00	0.001	0.05	0.04
2021/22	1.63	1.18	0.00	0.00	0.001	0.05	0.04
2022/23	1.5	1.31	0.00	0.00	0.001	0.066	0.05
2023/24	1.48	1.41	0.00	0.00	0.005	0.066	0.05
2024/25		1.53				0.129	0.097

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# BRISTOL BAY RED KING CRAB (BBRKC)

FINAL ASSESSMENT 2024



# ESP REPORT CARD 2024:

## Ecosystem considerations:

- Bottom temperatures remained near-average in Bristol Bay.
- Cold pool did not extend into central Bristol Bay in 2024.
- Red king crab have experienced a steady decline in bottom water pH in the past two decades, however increased slightly in 2024
- High sockeye salmon (above average) and low chlorophyll-a – suggest poor larval feeding conditions and survival to settlement
- Mature female spatial extent smaller in recent years due to high survey catches north of Port Moller and overall SE shift in centroids of abundance since 2019.
- Potential northern expansion since 2021, depends on aspect of the stock (males, females, juveniles, etc.)

## Proposed new indicators:

- ✓ Female reproductive potential
- ✓ Northern district ratio
- ✓ Protected area proportion



## Socioeconomic considerations:

- Fishery open after two seasons of closures
- Fleet consolidation from 47 vessels in 2020 to 31 in 2023 (likely reflects the importance of snow crab fishery and consequences of closure and reductions in TAC)
- Declining ex-vessel value over the most recent five open BBRKC seasons
- Incidental catch at near-average levels

## Community indicators from skipper survey:

- 61% skippers used longer soak times to reduce sorting and bycatch
- Anecdotal comments: mature females further east of fishing grounds, attempts for skippers to stay off of female hot spots

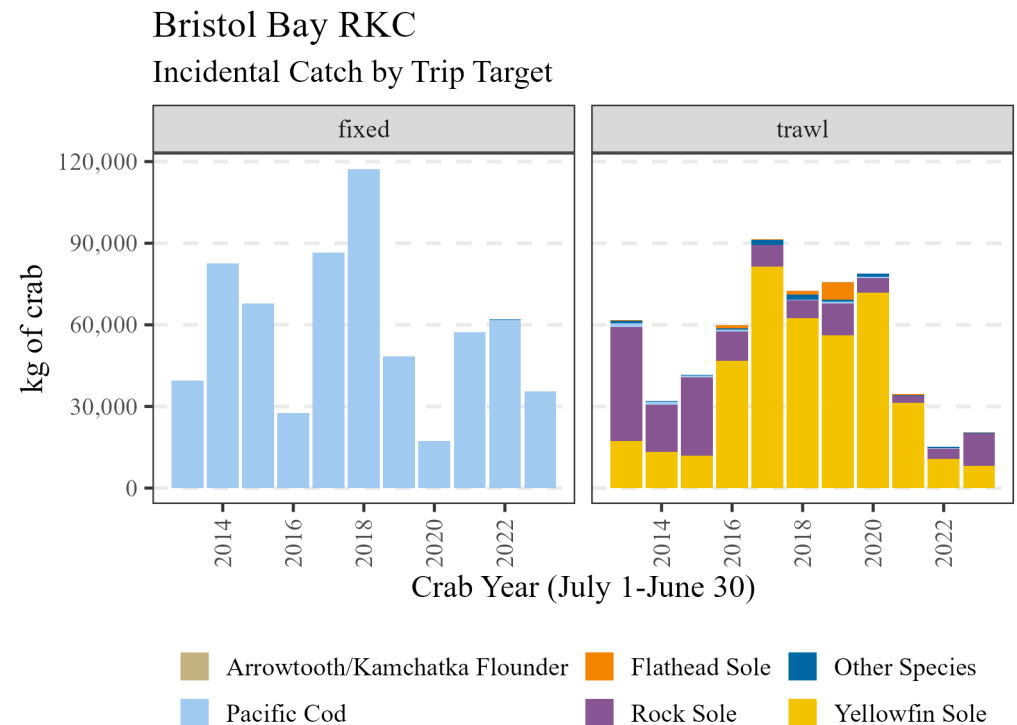
# BBRKC OVERVIEW

- **Tier 3 annual stock assessment, GMACS assessment** framework since 2018
- Mature male biomass increased from 2023, still low compared to long term average
- Directed fishery was open in 2023/24 after two seasons of closures (2021/22 and 2022/23) due to low mature female abundance.
- Estimated mature female biomass is higher than recent years but still lower than it's been since the mid-90s
- 2024 area-swept and State of Alaska LBA model estimates of mature female abundance are above the State Harvest strategy thresholds (8.4 million) this year.
- Low recruitment in recent years (last 8-12 years), projected decline in biomass without a large recruitment event



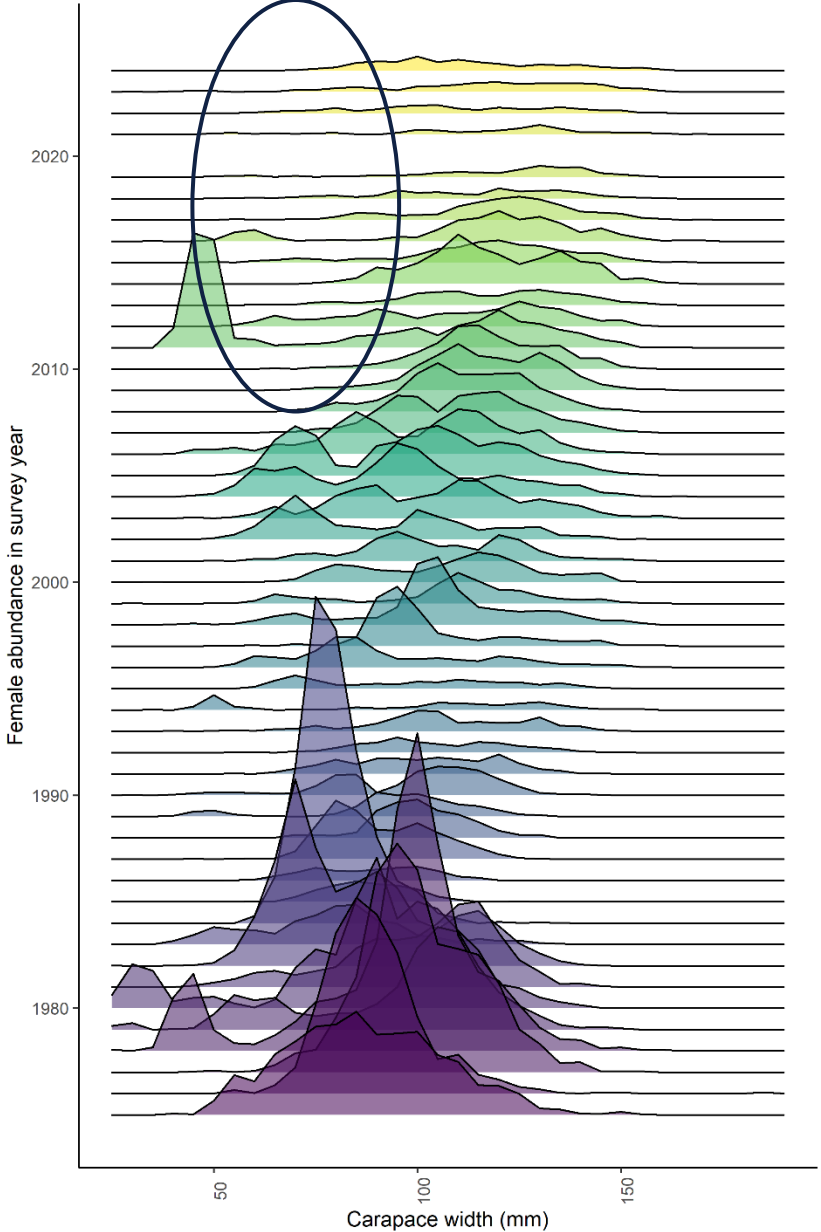
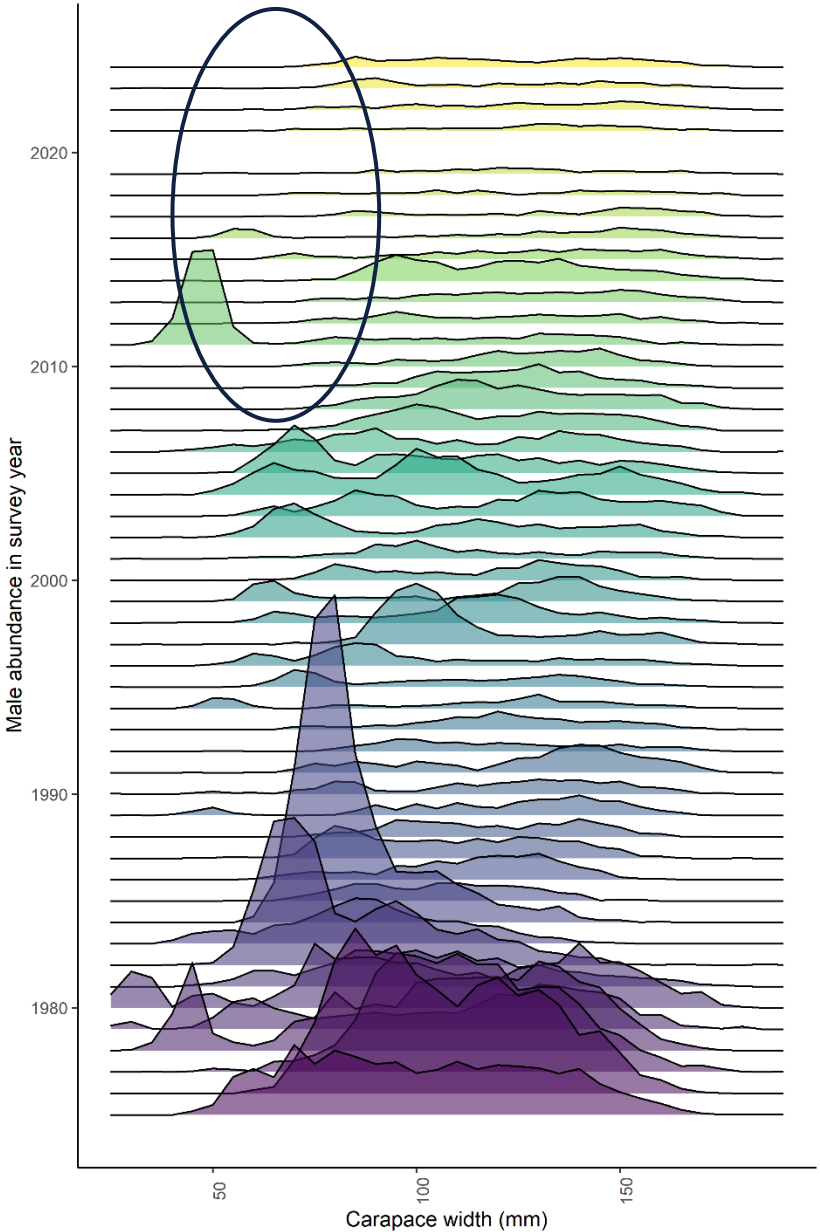
# FISHERY OVERVIEW – DIRECTED AND INCIDENTAL

- Directed fishery open after 2 years of closures
- Retained catch was near TAC at 2.14 million lbs
- Weighted catch center of fishery average area
- CPUE was close to last opening in 2020, most catch taken in first two weeks of opening
- Total catch mortality (directed + bycatch) < OFL therefore overfishing did not occur in 2023/24

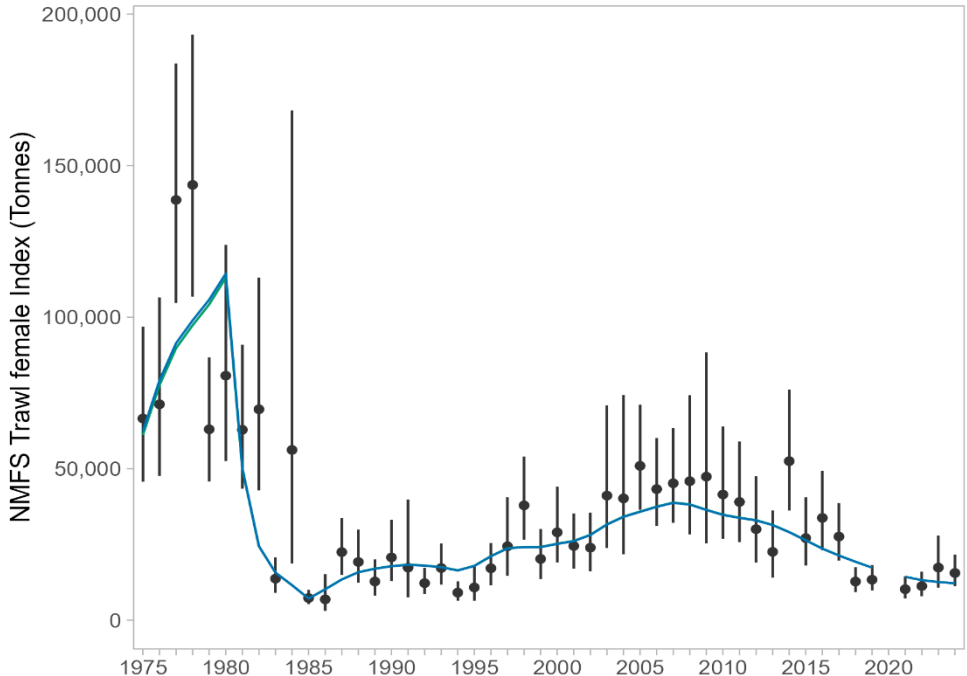


Taken from fishery updates presentation to CPT – see e-agenda

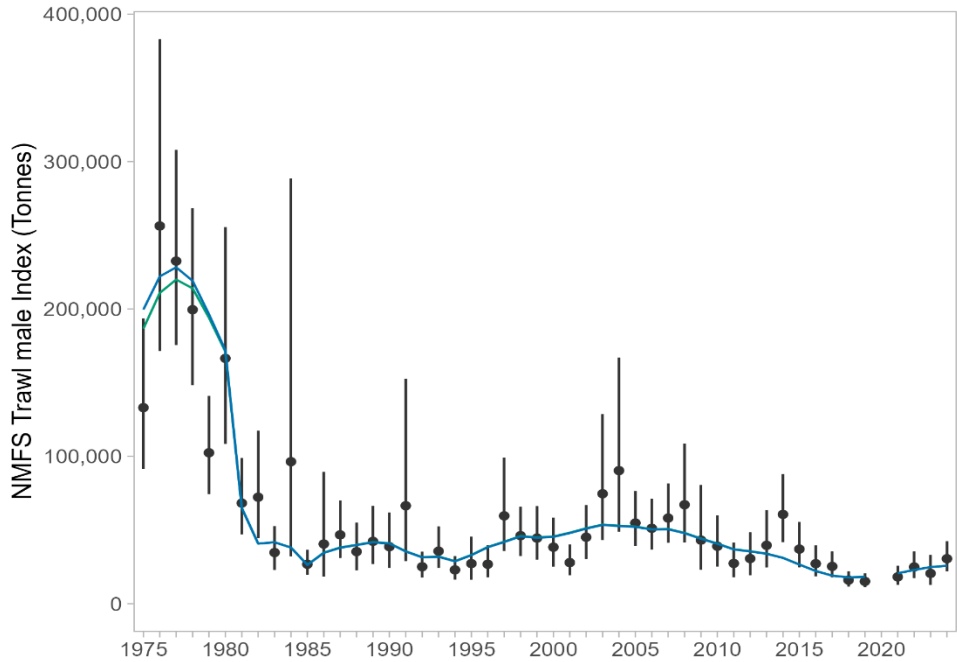
# LENGTH COMPOSITION FROM NMFS SURVEY







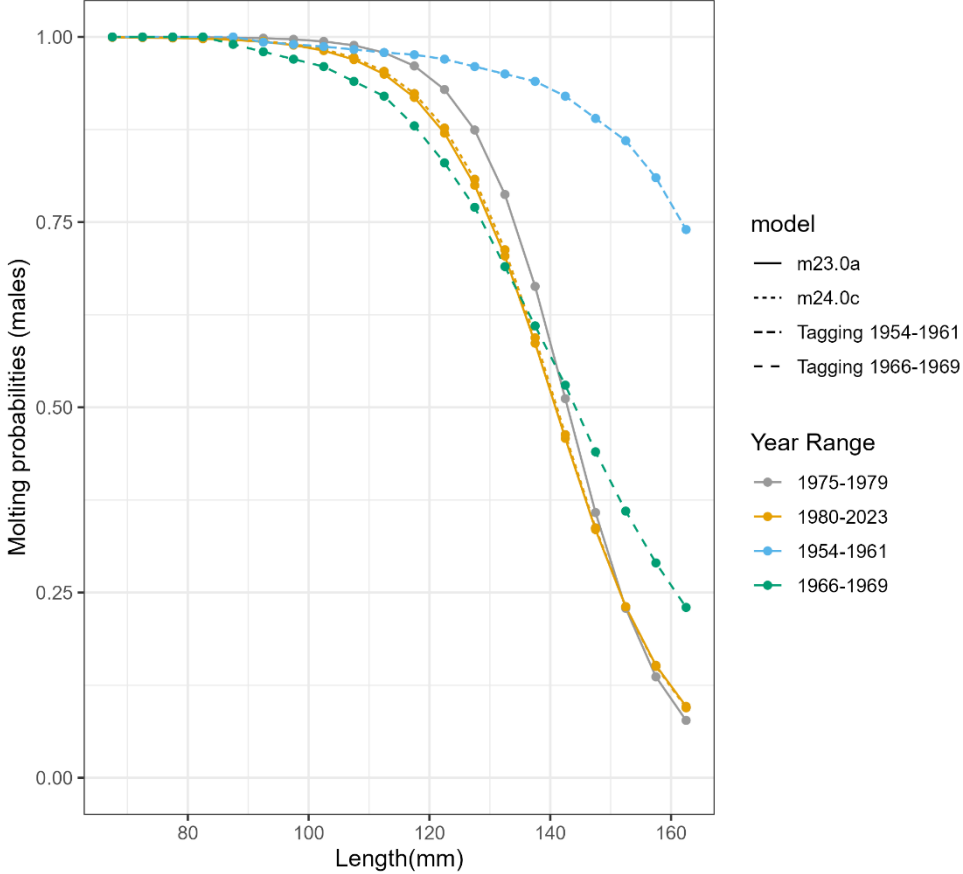
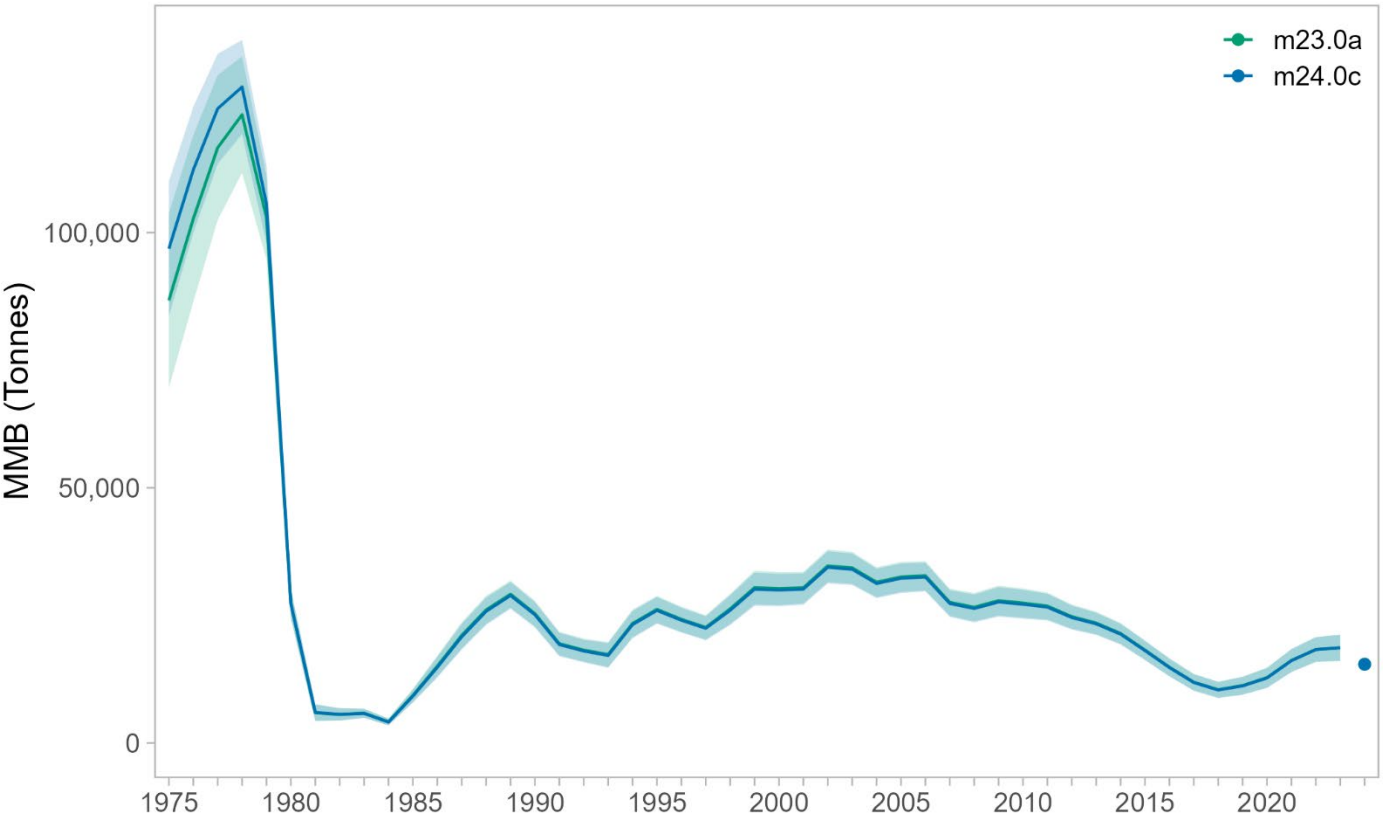
m23.0a  
m24.0c



m23.0a  
m24.0c

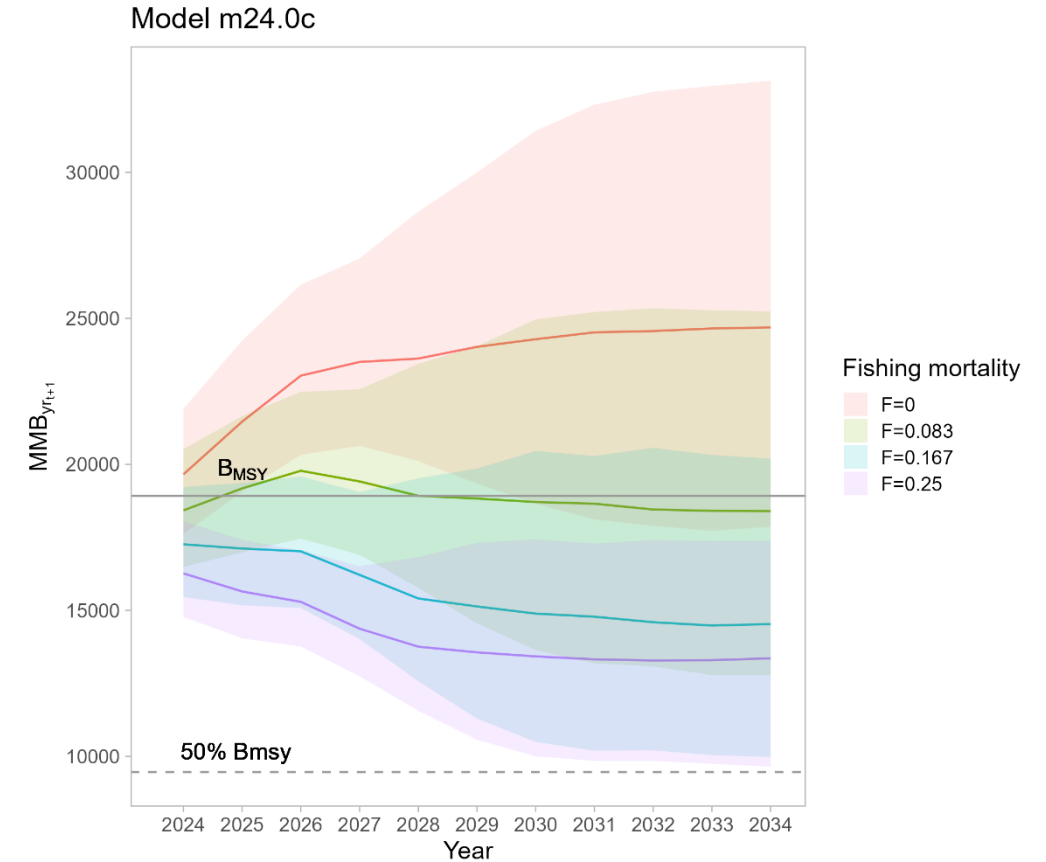
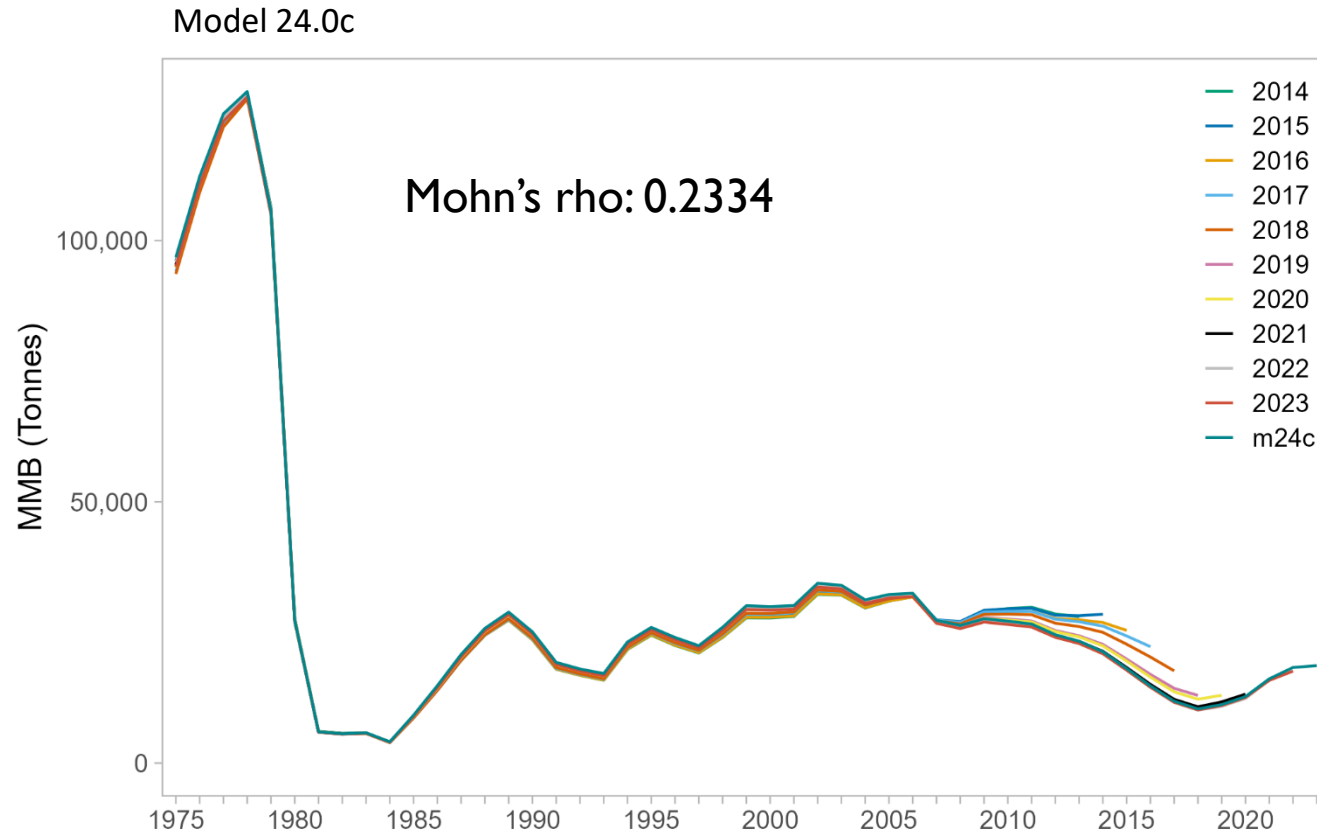
- ✓ Models evaluated:
  - ✓ Model 23.0a – 2023 base model with estimated base M for males
  - ✓ Model 24.0c – 23.0a without the time block for molting probability
    - ✓ Model results are nearly identical
  - ✓ Tier 4 REMA fallback
- ✓ Females still declining in modeled survey estimate (top), despite survey increase
- ✓ Males had a small increase in modeled survey (bottom) and trawl survey results





- ✓ Model differences were on molt probability time block from 1975 to 1980.
- ✓ Divergence in MMB for that period, otherwise model output nearly identical

# RETROSPECTIVE PATTERNS



- ✓ Retrospective pattern in MMB still strong
- ✓ Projections under recent recruitment expectations (2013 – 2023) have declining stock at mid to high exploitation rates ( $> F \sim 0.08$ )

Table 1: Status and catch specifications (1000 t) for the CPT recommended model (24.0c).

Year	MSST	Biomass		Retained	Total	OFL	ABC
		( $MMB_{\text{mating}}$ )	TAC	Catch	Catch		
2020/21	12.12	13.96	1.20	1.26	1.57	2.14	1.61
2021/22	12.01	16.64	0	0.02	0.10	2.23	1.78
2022/23	9.68	18.34	0	0.02	0.11	3.04	2.43
2023/24	9.35	18.65	0.975	0.96	1.34	4.42	3.54
2024/25		15.43				5.02	4.02

CPT recommendation: Model 24.0c, ABC buffer 20%  
 Author recommended 24.0c – but either model would be ok.

Buffer considerations:

- Recommend staying with 20% for upcoming year (no large changes or improvements in uncertainty)
- Cold pool distributional shifts
- Declining trend or low levels of mature male biomass and mature female biomass
- Lack of recruitment events in recent years (not incorporated in the model since model expects recruitment events using 1984 to 2023)
- Retrospective pattern in MMB



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# NORTON SOUND RED KING CRAB (NSRKC)

PROPOSED MODEL RUNS



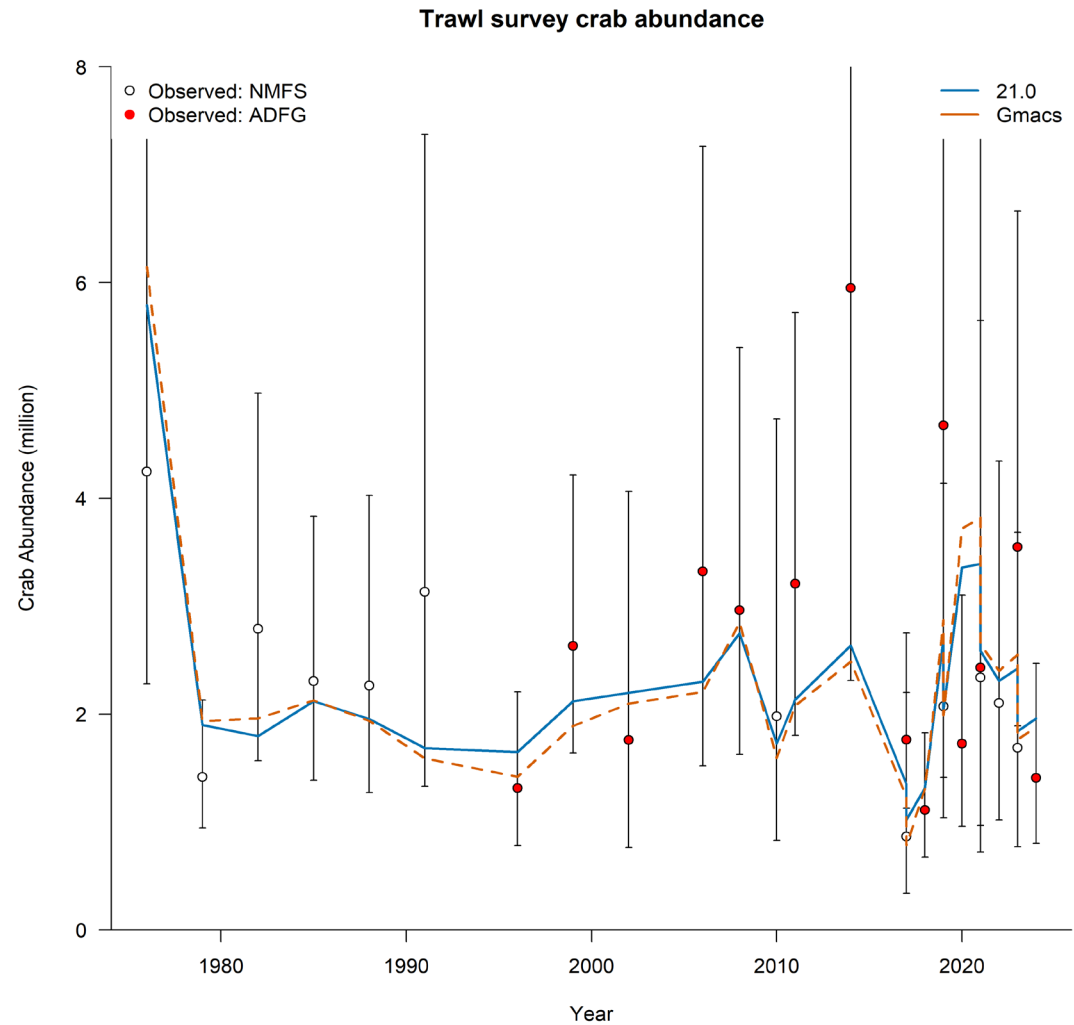
# NORTON SOUND RED KING CRAB (NSRKC) PROPOSED MODEL RUNS

## Overview

- **Annual Tier 4 assessment, not in GMACS**
- Final specs: November virtual CPT meeting, December Council meeting
- Model 21.0 = accepted model
- Proposed model 24.0 = GMACS version of 21.0
- VAST/sdmTMB model-based indices of the three trawl surveys planned for presentation at January modeling workshop

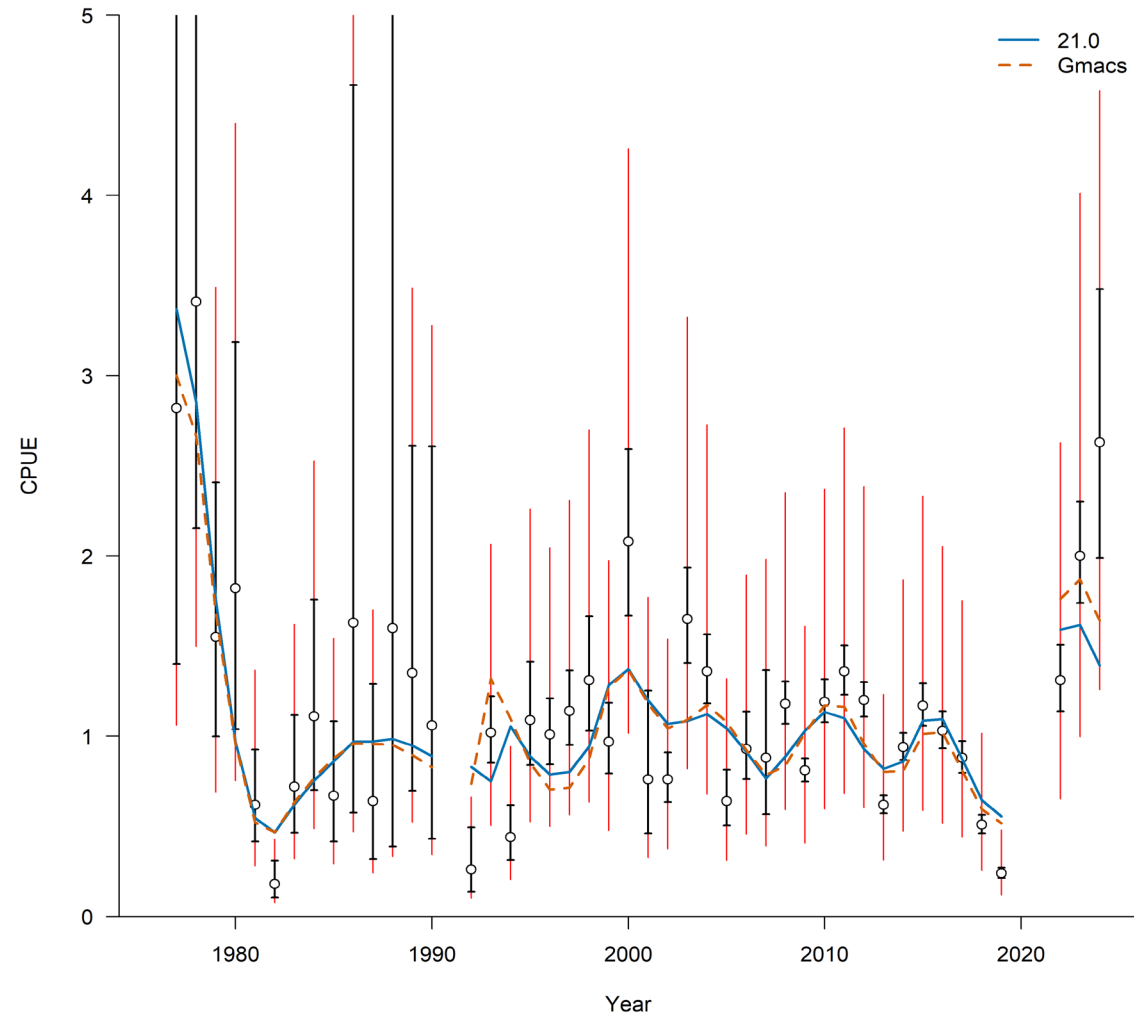


# SURVEY FITS: 21.0 VS. GMACS



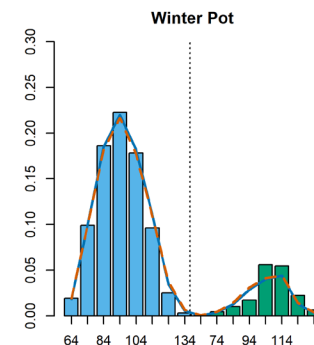
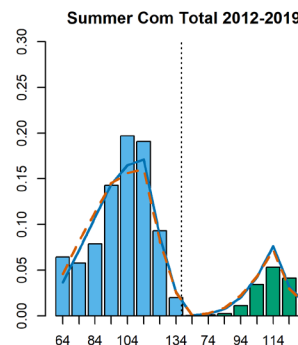
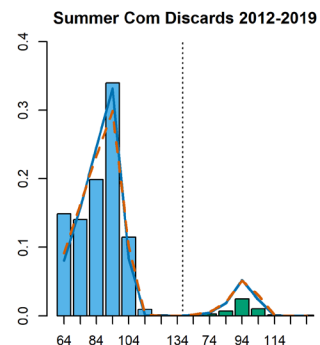
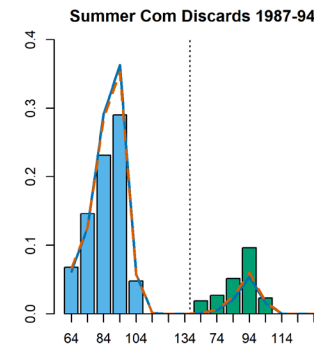
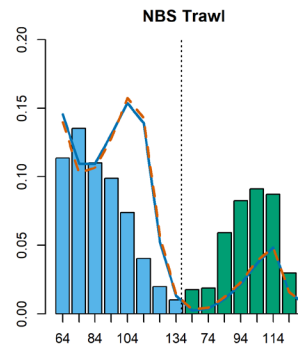
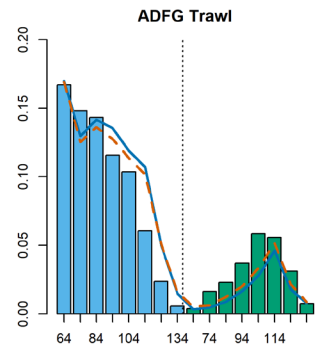
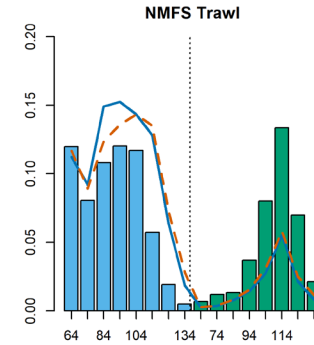
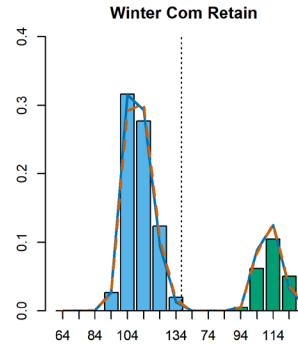
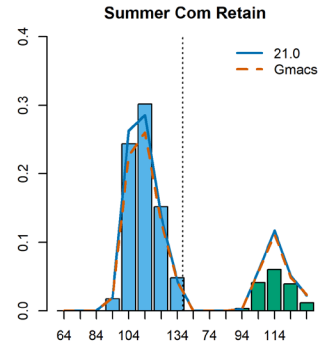
# CPUE FIT: 21.0 VS. GMACS

Summer commercial standardized cpue



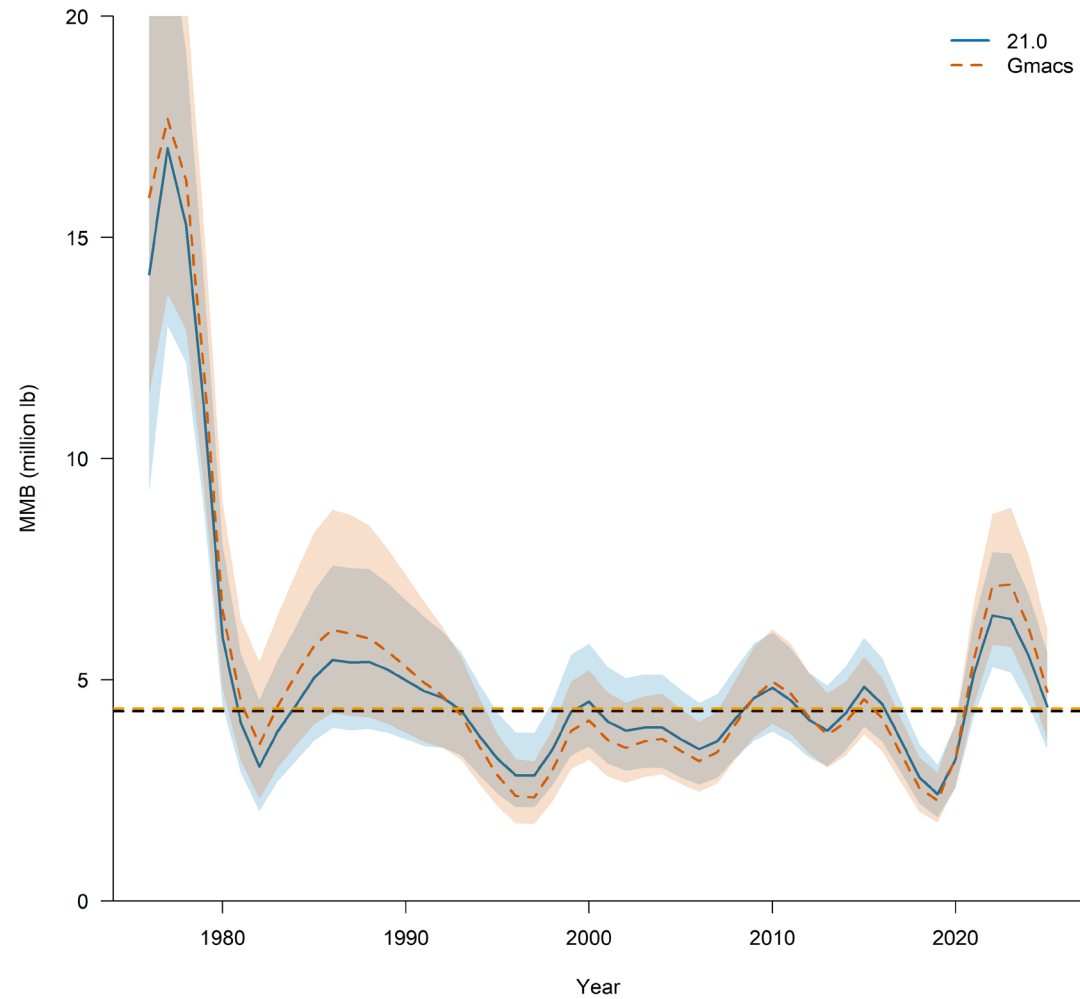


# SIZE COMPS: 21.0 VS. GMACS



# MMB: 21.0 VS. GMACS

MMB Feb 01



# OFL: 21.0 VS GMACS

	<b>Model 21.0</b>	<b>GMACS</b>
BMSY (mil lb)	4.28	4.34
MMB (2025) (mil lb)	4.39	4.72
B/BMSY	1.03	1.09
OFL	0.58	0.63
FOFL	0.18	0.18



# CPT REQUESTS & RECOMMENDATION

- Implement OFL for multiple directed fleets in GMACS
- Conduct retrospective and jittering analysis for GMACS model
- Plot fits to different trawl time series separately
- Bring forward 21.0 and 24.0 (GMACS) for final specs, with intention of accepting 24.0

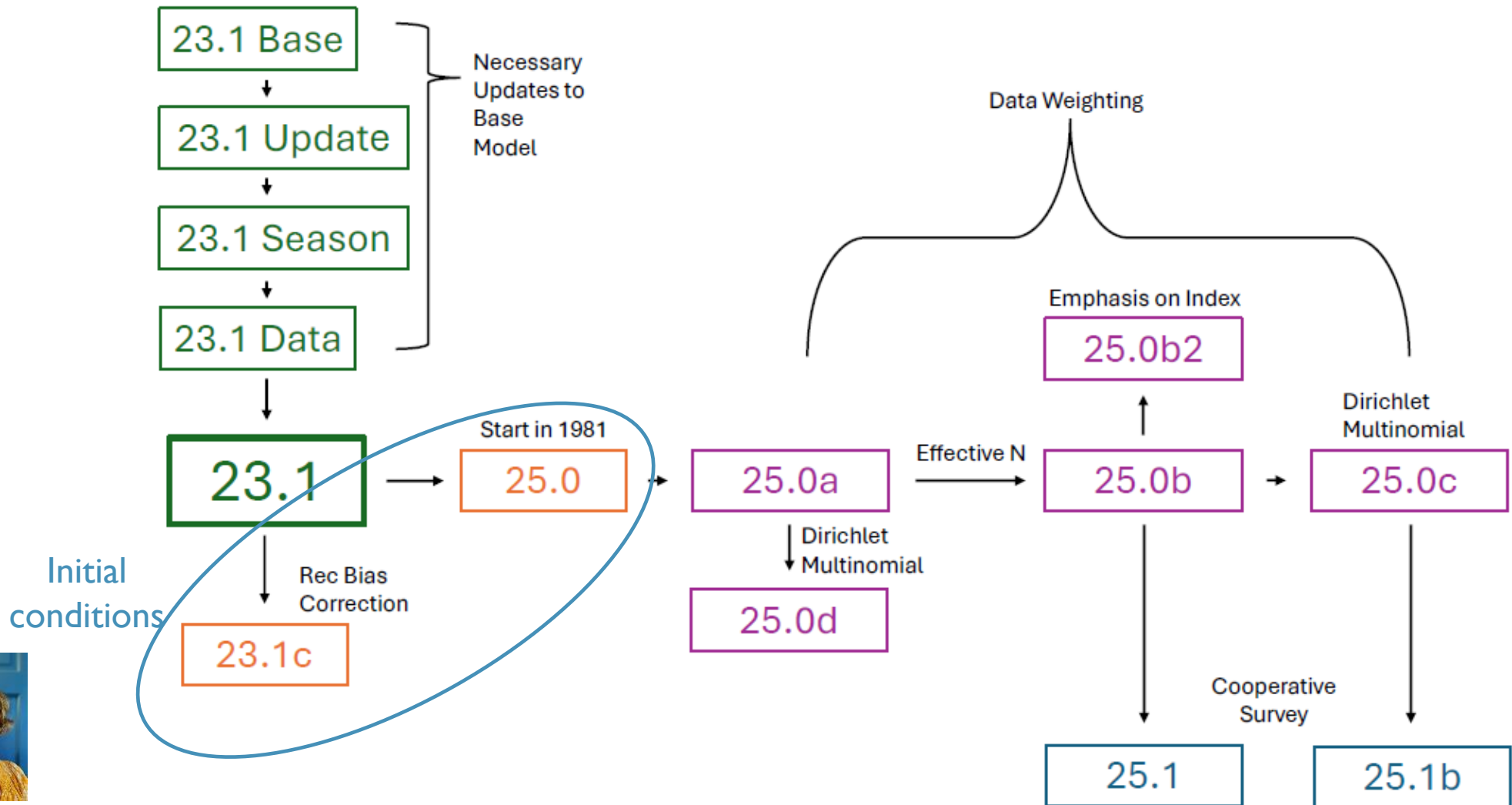


# AIGKC MODEL EXPLORATIONS

- Author addressed many CPT and SSC comments
- Focused on:
  - Data clarifications and updates
    - Questions on 1993/94 season catch and size comps
      - EAG – data issues due to no observer coverage this year, included in retained catch but not total
      - WAG – observer pots had been removed due to pot differences but after research kept these in the size composition data
  - Initial conditions
    - Status quo with bias correction – build up stock from 1960 (data is not available until 1981)
    - Start model in non-equilibrium conditions in 1981
  - Data Weighting
    - Variety of models looking at both emphasis factors on likelihood components and effective sample sizes for data inputs
  - EAG models with cooperative survey data (Appendix A)
    - Better incorporation of this data as an additional fleet
    - Still need to investigate data assumptions and implementation of these as a fleet in the model.



# AIGKC MODEL EXPLORATIONS



# AIGKC MODEL RECOMMENDATIONS

- Author recommended:

- Model 23.1c as base model, preferred over 23.1
- Model 25.0b as alternative
  - Begins in 1981, non-equilibrium
  - Equal likelihood weighting
  - Size composition weights based on variability in data

CPT recommended for May 2025

- Model 25.1

- **Unlikely to be selected as final model in May 2024 – should resolve data conflict before adding complexity**
- Would set back burner if necessary

- CPT recommends models 23.1c and 25.0b but that the author NOT bring forward 25.1 since it would not be an option for specification setting.

- Future recommendations: simulations studies (looking at time-varying parameters in EAG specifically, revisit size at maturity, examine spatial/vessel effects in post-rationalized fishery data)





# BALANCE OF CPT REPORT





# RISK TABLE APPLICATION TO CRAB STOCKS

- CPT viewed drafts of risk tables for BBRKC, snow, and tanner
- CPT considered these a good start but need a better understanding of general risk table SOPs
- Agenda item in May 2025 with goal of developing Risk table guidelines as they pertain to crab stocks (adapted from groundfish)
  - Consider bringing in a groundfish representative to present on their process?
- Topics to address will be:
  - Information used in risk tables (ESP and ESR information)
  - Standardize scoring among crab stocks (e.g. score would be relative to ideal baseline or current status)
  - Should score relate to historic buffer setting? If so how to relative these.



# OVERFISHING STATUS UPDATES (2023/24 TOTAL CATCH)

- WAIRKC – Tier 5, directed fishery closed, total catch mortality was 0.13t (bycatch in AIGKC and groundfish)
  - 0.13t << OFL (56t) therefore overfishing did NOT occur
- PIRKC – directed fishery closed, total catch mortality was 3.95 t
  - 3.95t << OFL (685t) therefore overfishing did NOT occur
- PIBKC – under rebuilding plan, directed fishery closed, total catch mortality was 0.102 t
  - 0.102t << OFL (1.16t) therefore overfishing did NOT occur
- PIGKC – directed fishery was open (2 vessels so confidential), TAC was set below ABC
  - Total catch mortality < OFL (93t) therefore overfishing did NOT occur
- AIGKC
  - Total catch mortality 2.76 mt < 4.18 mt OFL therefore overfishing did NOT occur



# QUESTIONS?

- Thanks to all CPT members and crab assessment authors.

