C1 BSAI CRAB STOCKS

KATIE PALOF & MIKE LITZOW (CPT CO-CHAIRS)

JUNE 2023 NPFMC MEETING

CPT MEETING MINUTES – MAY 16TH – 18TH, JUNEAU, AK

BSAI CRAB STOCKS MANAGEMENT TIMING

Aleutian Islands golden king crab
Pribilof Islands golden king crab *
Western Aleutian Islands(Adak) red king crab *

→ Assessed in May/June

→ Triennial cycle, next assessment in 2023

EBS snow crab
Bristol Bay red king crab
EBS Tanner crab
Pribilof Islands blue king crab *
Pribilof Islands red king crab *
St. Matthew blue king crab *

→ Biennial cycle, next assessment in 2023

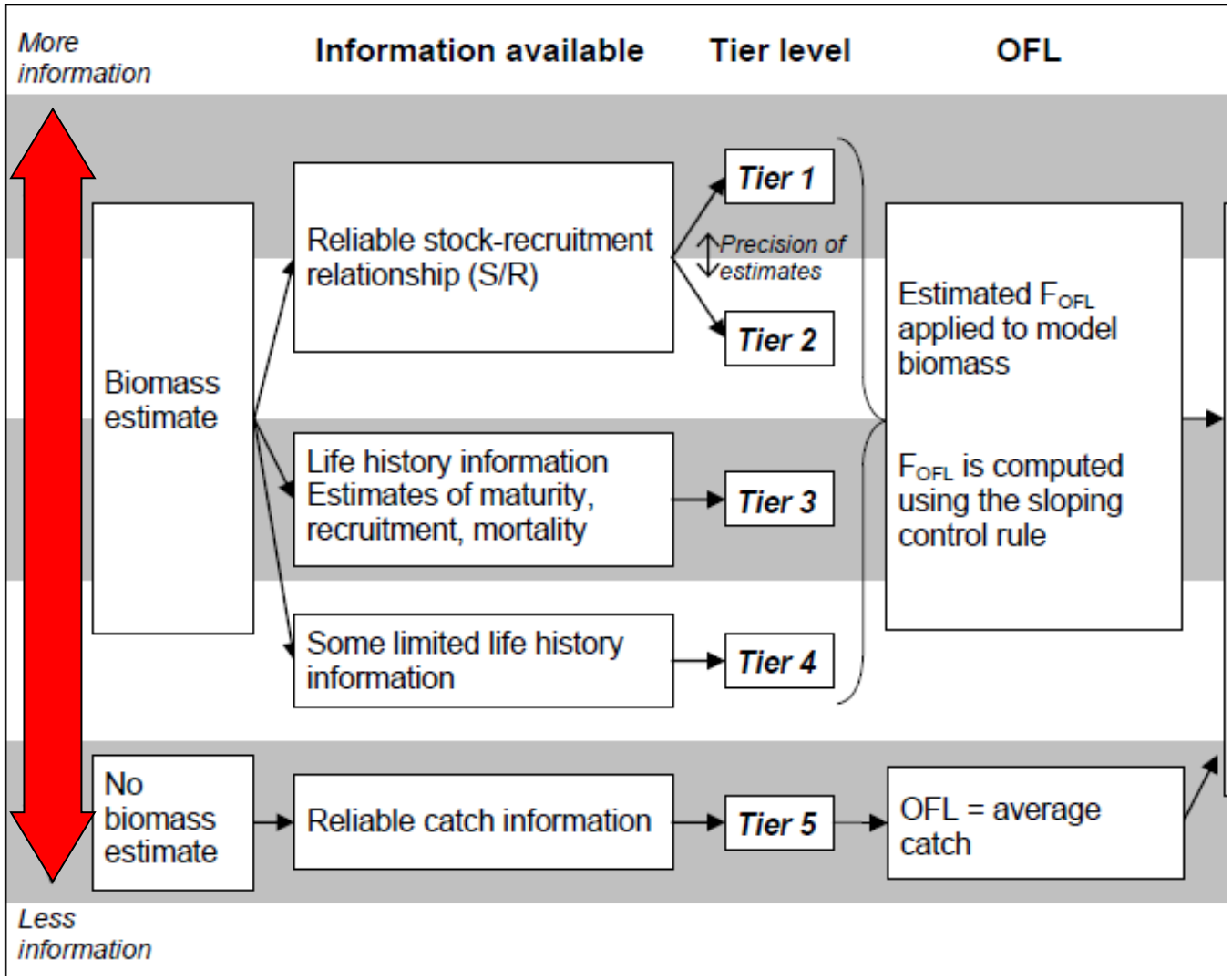
→ Assessed in September/ October

→ Triennial cycle, next assessment in 2025

→ Biennial cycle, next assessment in 2024

Norton Sound red king crab

→ Assessed in January/ February



ABC buffer

10-20%

10-25%

25-40%

MAY 2023 AGENDA

- ✓ **AIGKC final assessment, OFL and ABC**
- ✓ **PIGKC final assessment, OFL and ABC**
- ✓ **WAIRKC final assessment, OFL and ABC**
- ✓ Proposed model runs:
  - ✓ PIBKC
  - ✓ Tanner
  - ✓ Snow
  - ✓ BBRKC
- ✓ Simpler models workshop report
- ✓ Bering Sea red king crab stock structure template
- ✓ Catch accounting and EM (informational)
- ✓ Unobserved mortality workshop scoping
- ✓ BSFRF research updates and spring BBRKC sampling (informational)
- ✓ ABSC /NOAA collaboration on climate resilient fisheries (informational)
- ✓ ESP updates, GMACS updates

Simpler Modeling Workshop

- 1st Working Group meeting: **03/27-03/28**
- Objectives defined prior
- 3 main discussion topics:
  - I. Steps to create a more robust Tier 3 model for each stock
    - 3 commonalities among stocks:
      - Specify growth and maturity relationships outside of the model rather than estimating within the model.
      - Consider using the BSFRF data to inform a prior on Q and/or selectivity instead of modeling it directly.
      - Collapse all small sources of mortality, such as bycatch fisheries, into one 'fleet' (holding bin) and estimate or fix selectivity.
    - Priority in moving models into GMACS, no need for a bridging legacy features to GMACS
  - II. State and Federal Harvest Specifications Process
  - III. Proposed "Fallback" model options

Steps to create a more robust Tier 3 model

- **Snow Crab:** Issues with the currency of management
  - Producing a model that incorporates the best available information on biological processes but establishes F=M on the exploitable biomass
  - Place assessment in Tier 4 based on Tier 3 calculations being incompatible with maturity occurring largely prior to fishery selectivity and therefore generating F proxies at unreasonably high values.
- **Tanner Crab:** 3 commonalities + building a simpler (more focused) model in GMACS
- **BBRKC:** Issues with estimation of Q for the NMFS trawl survey and retrospective patterns
  - Explore 3 commonalities + the origin of the current prior on Q and prior configurations

Proposed “Fallback” model options – Tier 4

- WG concluded that the most simple model to bring forward would be a **basic Tier 4 approach in which B= survey-estimated (ideally using the REMA package) vulnerable male biomass (male crabs likely to be susceptible to both directed and incidental catch fisheries), OFL= M (adjusted by stock status)*B, ABC= buffer*(OFL)**, where the ABC buffer would be determined by guidance in the FMP and the common practice of buffering the ABC based on model uncertainties that has been documented by the CPT/SSC in meeting reports.
- The WG supported bringing forward the proposed alternative model for all three stocks (snow, Tanner, BBRKC) at the May 2023 CPT meeting during the discussion of proposed model runs.
- This would not be the preferred option, and the assessment authors will continue to work on making adjustments to their assessment model, but this alternative approach would allow the reviewing bodies to have a fallback option should the more complex models not converge during the fall meetings where OFL and ABC specifications need to be set.

Simpler modeling workshop

- CPT agreed with working group recommendations
- What does a “failed” assessment mean? When should we use these fallback options?
- Caution in specifying parameters outside the model where the data may inform other parameters – idea of “sufficient statistics”
- Modeling workshop a good avenue for future development on some common areas in these models
- Results from this workshop present in the proposed model runs at this meeting

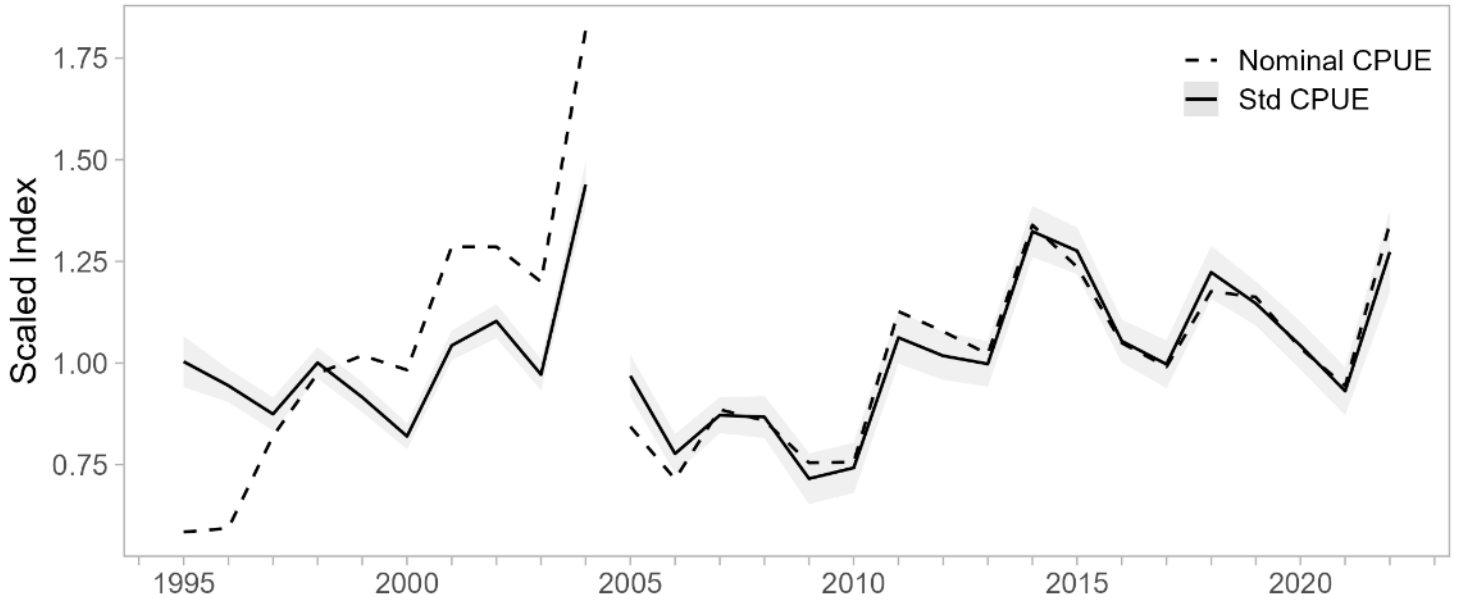
ALEUTIAN ISLAND GOLDEN KING CRAB (AIGKC)

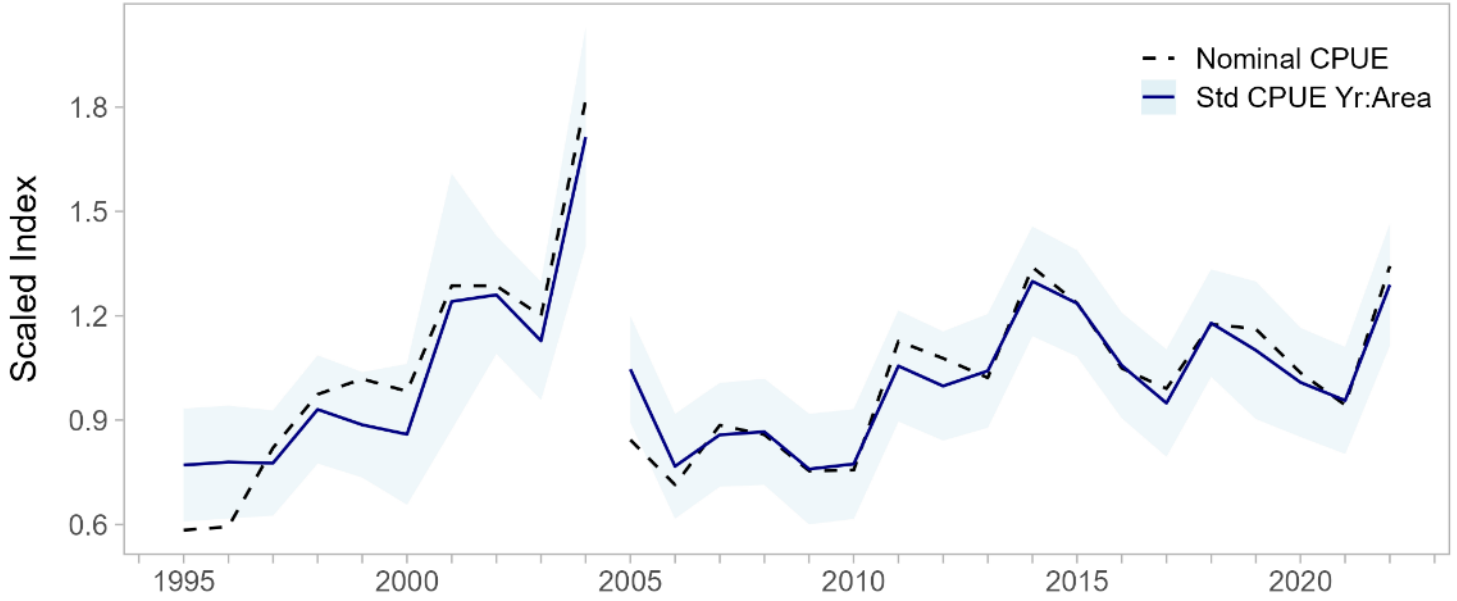
FINAL ASSESSMENT 2023

AIGKC OVERVIEW

- **GMACS assessment** framework approved in Jan/Feb 2023
- **Changes in authorship –** welcome Tyler Jackson (ADF&G) as primary author after Siddeek Sharif's retirement this spring
- **Tier 3 annual stock assessment based completely on fishery-dependent data**
- OFL/ABC set for AIGKC stock but modeled as two separate stocks – EAG and WAG
- Updates to **input data**
  - 2022/23 retained catch (not completed at time of assessment)
  - CPUE standardization updates – year effect (model 21.1e2) or year:block effect (model 22.1f)
  - Industry- cooperative survey results for EAG
- **Model presented:**
  - **Model 22.9c** - 2022 accepted model (22_1e2) with modifications for GMACS transition
  - **Model 21.1e2 -** Model 22.9c in GMACS (w/o Yr:Block)
  - **Model 22.1f -** Model 22.1e2 (w/ Yr:Block)
  - **Models 22.1g and 22.1h –** only for EAG with co-op survey 2015-2022

EAG


Nominal CPUE
Std CPUE
Scaled Index
1.75
1.50
1.25
1.00
0.75
1995
2000
2005
2010
2015
2020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Std CPUE Yr:Area
Scaled Index
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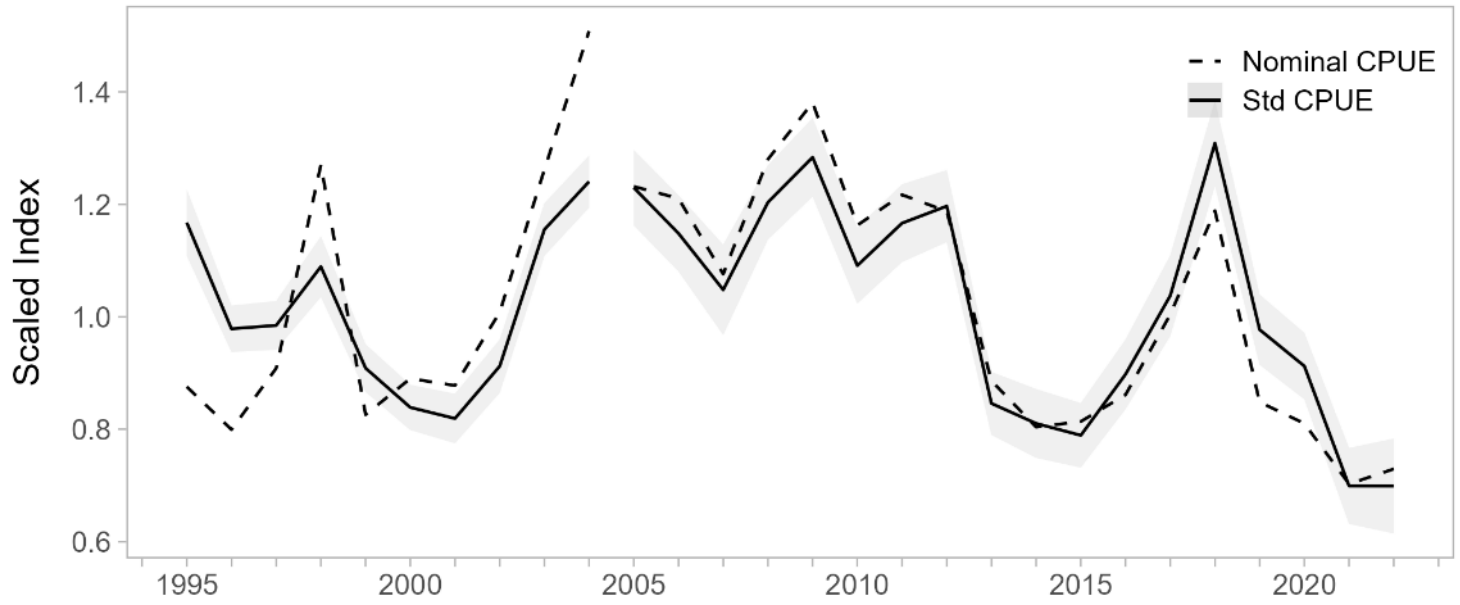
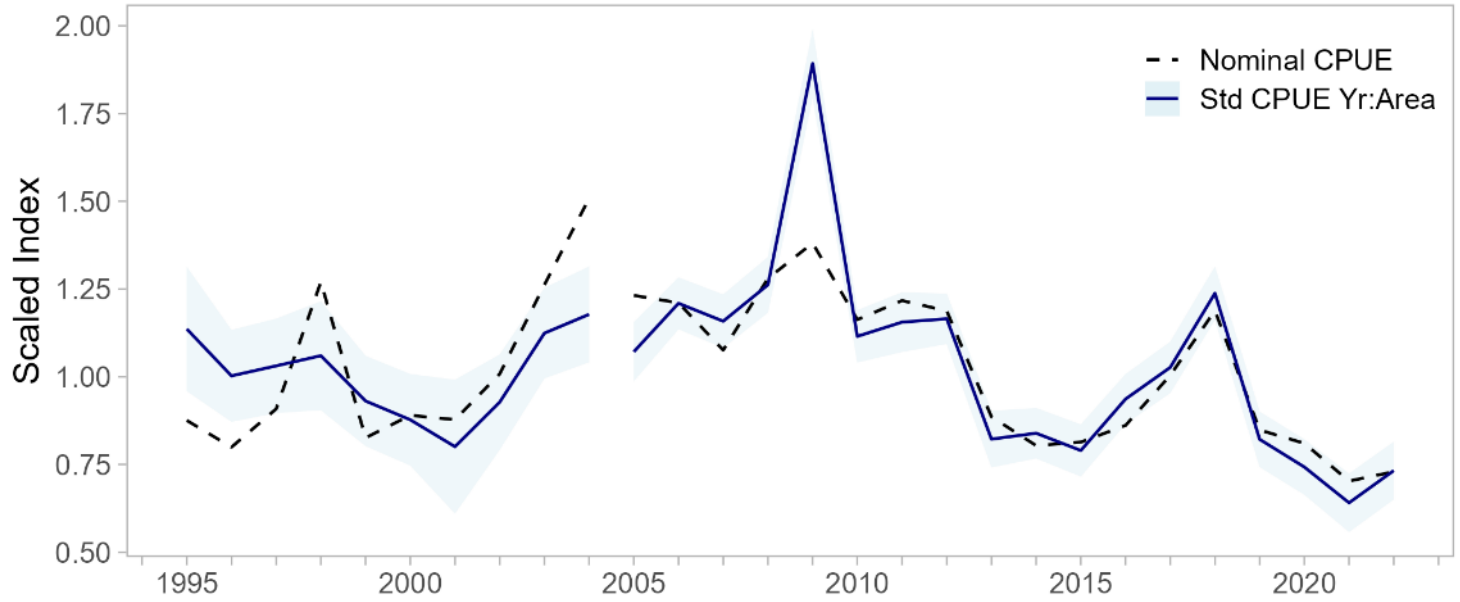
1.5
1.2
0.9
0.6
1995
2000
2005
2010
2015
2020

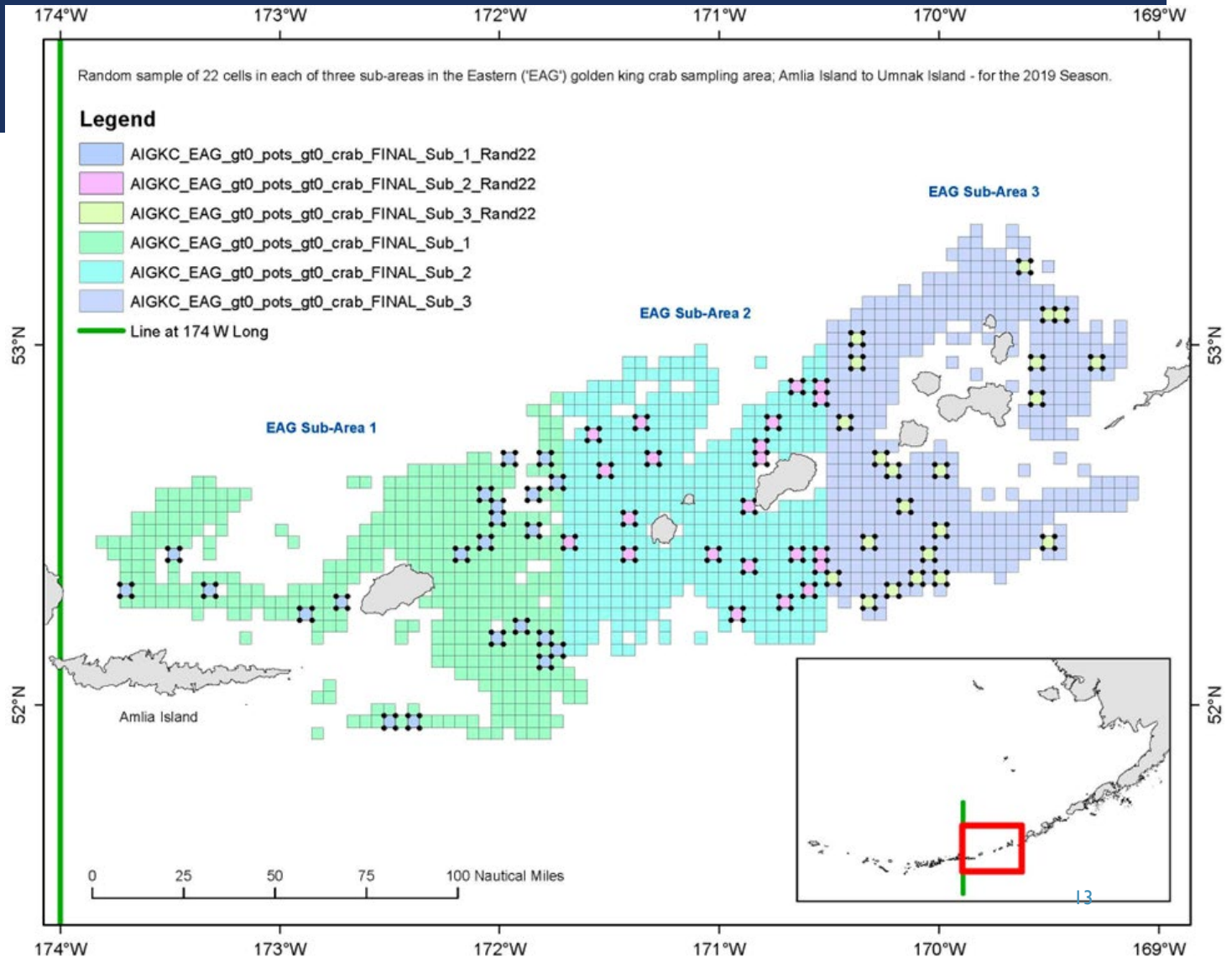
WAG


Nominal CPUE
Std CPUE
Scaled Index
1.4
1.2
1.0
0.8
0.6
1995
2000
2005
2010
2015
2020

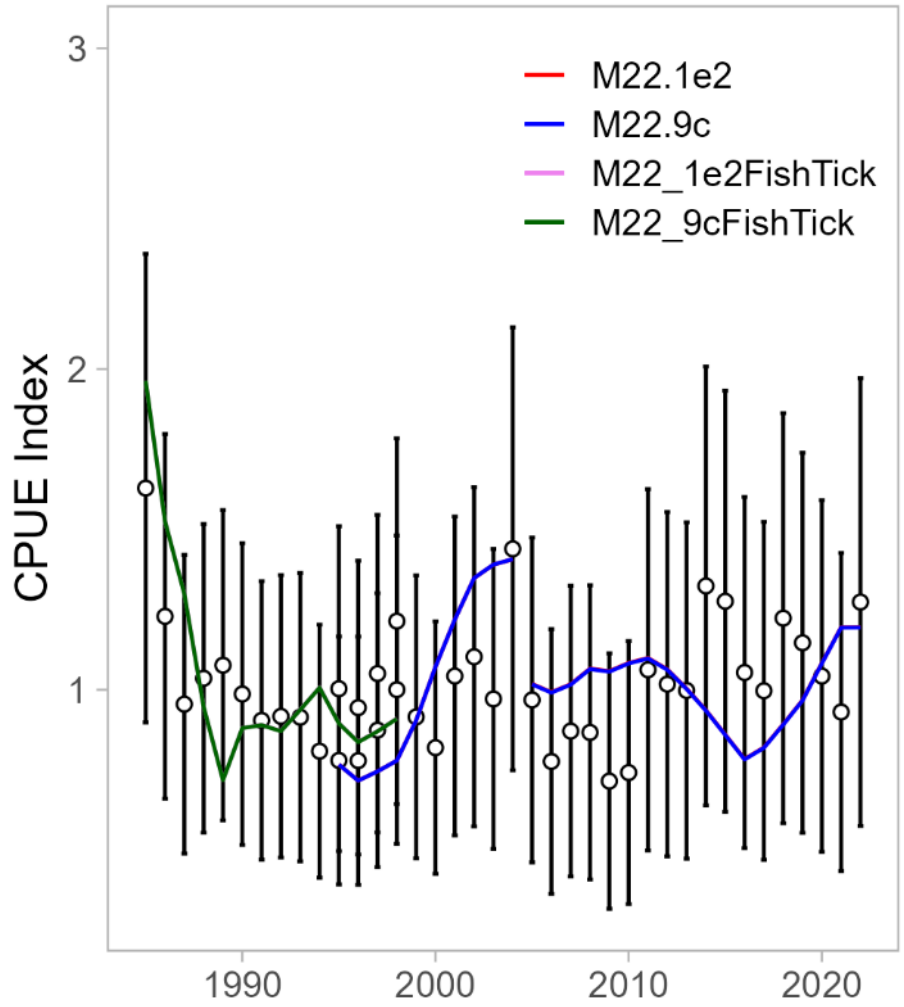

Nominal CPUE
Std CPUE Yr:Area
Scaled Index
2.00
1.75
1.50
1.25
1.00
0.75
0.50
1995
2000
2005
2010
2015
2020

COOPERATIVE SURVEY (APPENDIX C)

- EAG cooperative survey from 2015 to 2022
- Current runs replace observer CPUE with this time series
- CPT discussed more appropriate way would be for this survey to be its own "fleet" in the model.
- More work expected in the future on these models, they are not ready for specifications.



EAG



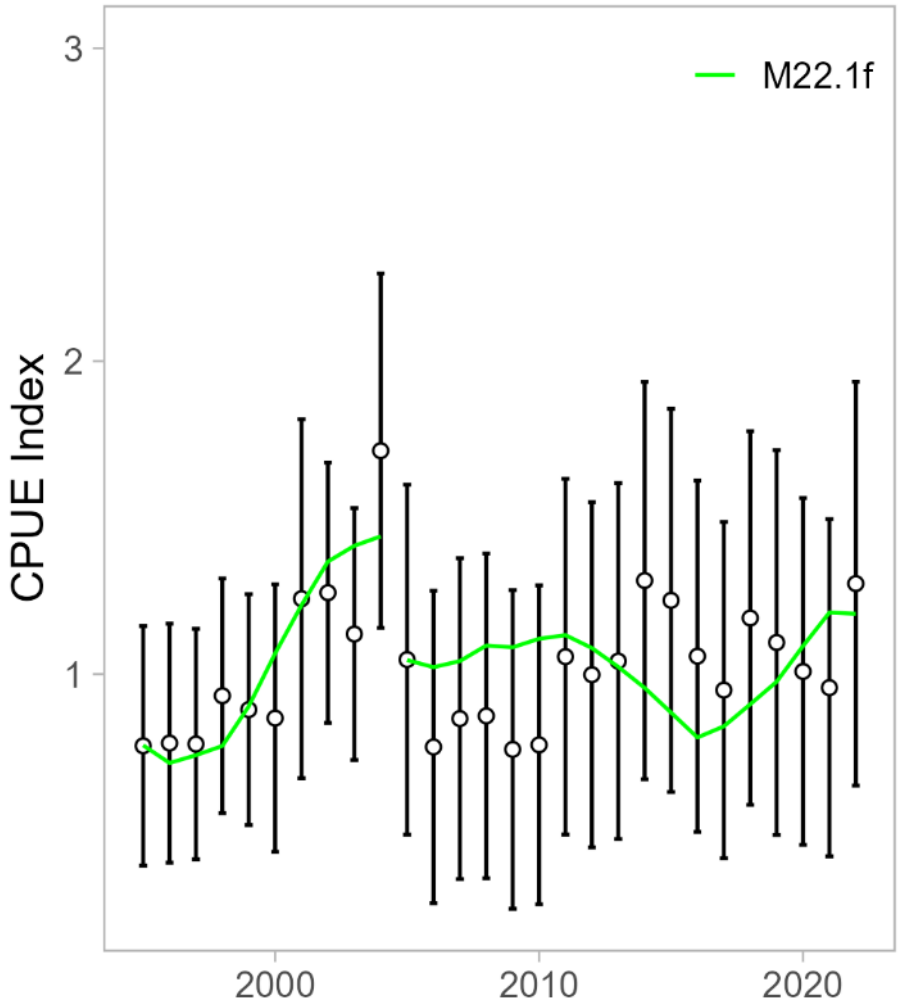
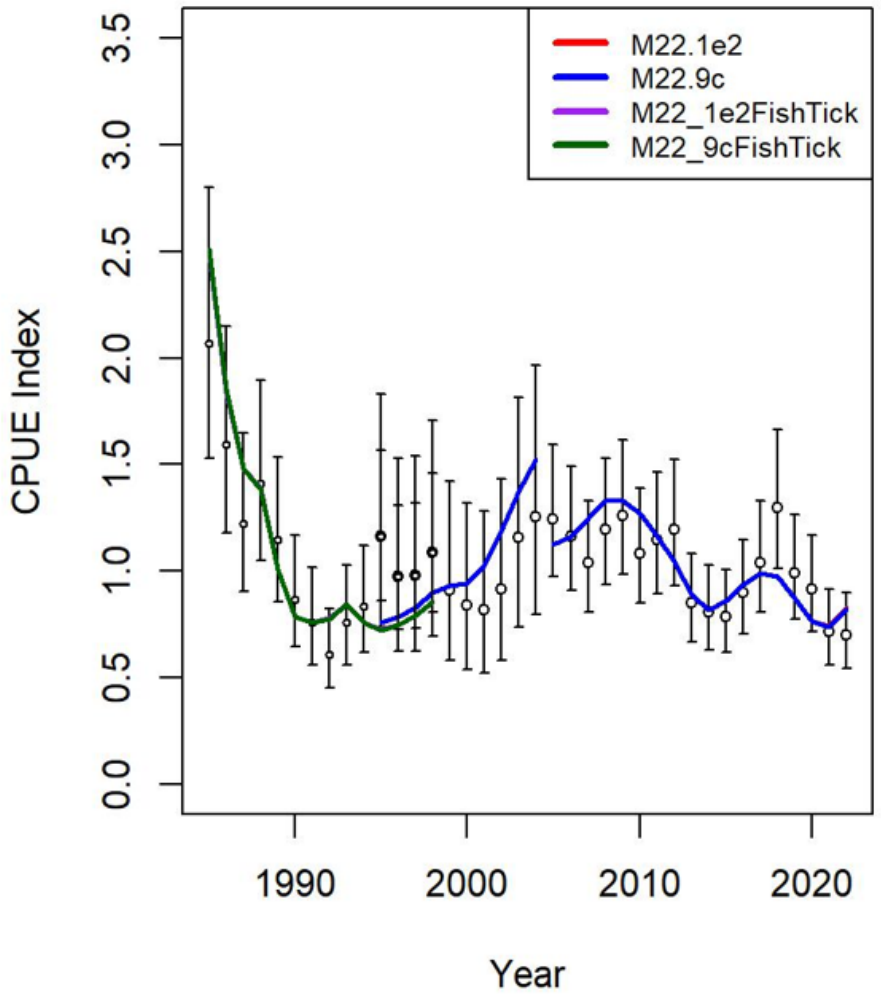


Figure 19, pg 79

WAG



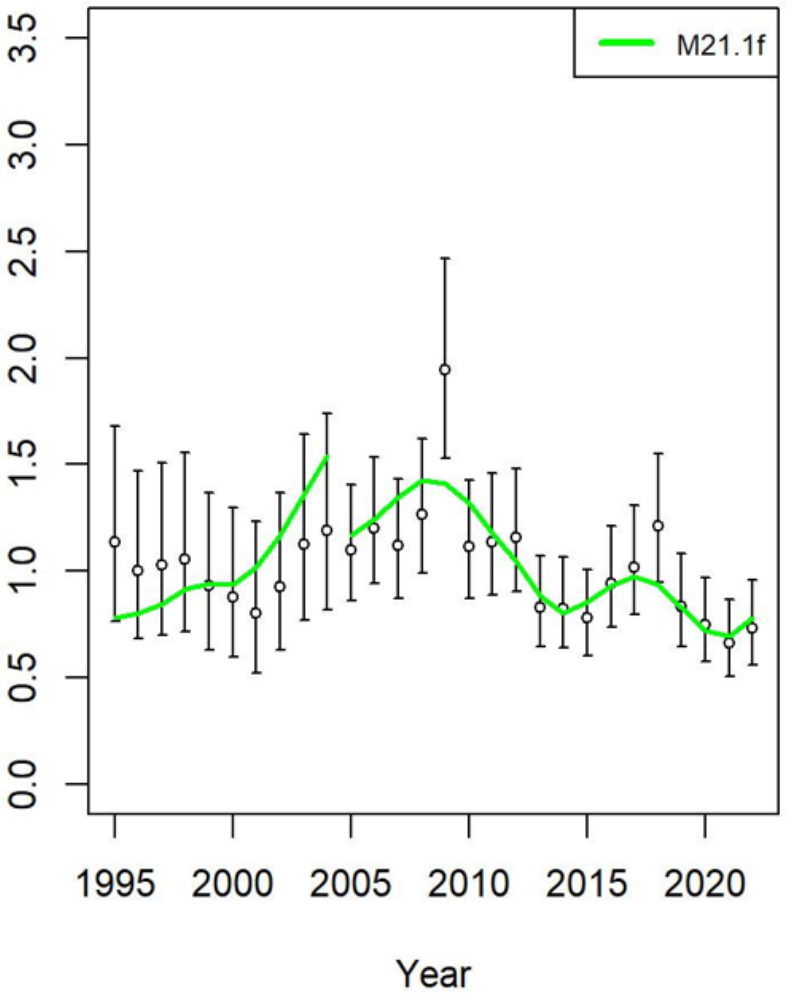
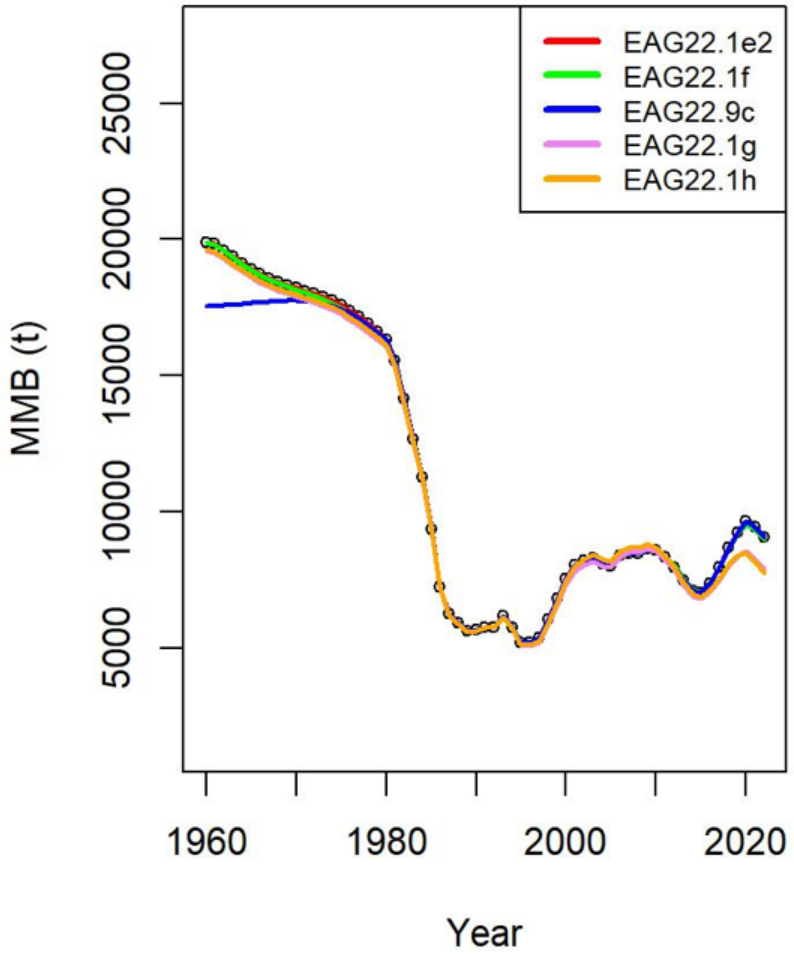


Figure 33, pg 94

EAG



WAG

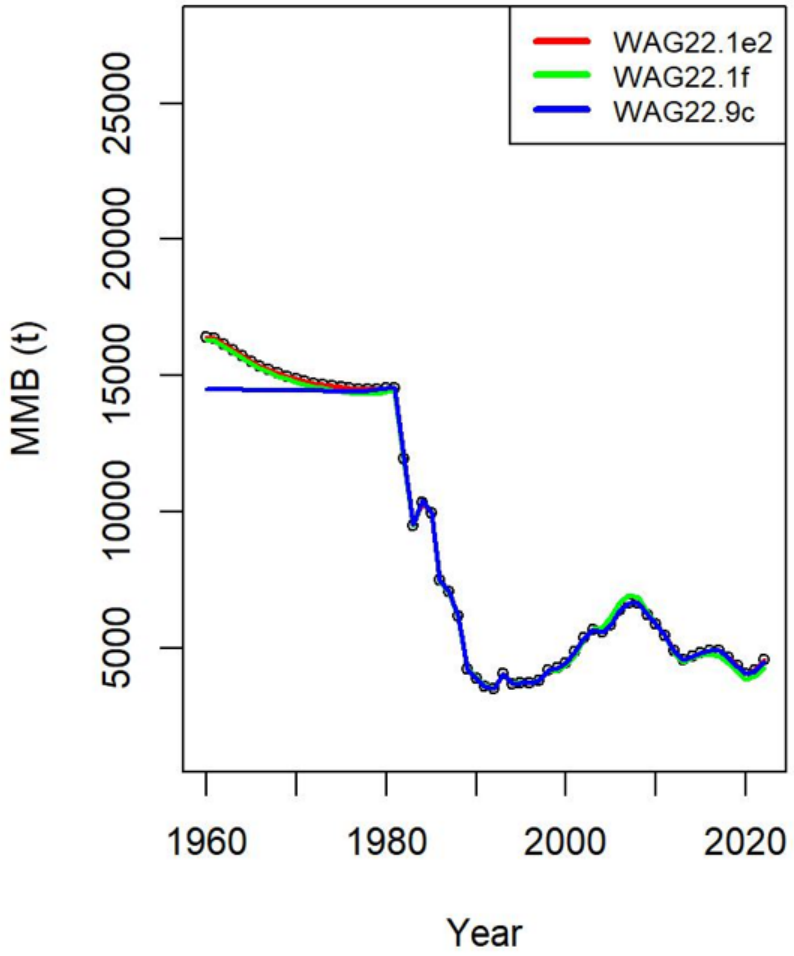


Figure 22a, pg 82

CPT RECOMMENDATIONS

- **Author recommended** model 22.1e2 for EAG and model 22.1f for WAG
  - More of a case for including year:block interation in WAG
- CPT recommended using **model 22.1e2** for both areas
  - Issues with year:block standardization, including large spike in CPUE in 2009 in block 5
  - Tier 3 stock with stock status determined as a combined stock
- Recommendations for further model development
  - Model cooperative survey as a separate fleet (EAG)
  - Retrospective patterns (EAG)
  - Additional recommendations detailed in minutes
- New author provides a new set of eyes on model assumptions and structure

CPT RECOMMENDATIONS

22.1e2 1,000 tons

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch[a]	OFL	ABC[b]
2019/20	5.915	16.386	3.257	3.319	3.729	5.249	3.937
2020/21	6.014	15.442	2.999	3.000	3.520	4.798	3.599
2021/22	5.715	13.581	2.690	2.699	3.056	4.817	3.372
2022/23	5.832[d]	13.600[d]	2.291	2.369*	2.612*	3.761[c]	2.821[c]
2023/24		12.069[d]				4.182[d]	3.137[d]

- **Buffer – 25%** (same as 2022/23)
  - Only assessment using only fishery CPUE as an index
  - Small number of vessels in fishery and limited spatial coverage compared to the stock
  - Retrospective patterns

PRIBILOF ISLANDS GOLDEN KING CRAB (PIGKC)

FINAL ASSESSMENT 2023

PIGKC OVERVIEW

- Tier 5 stock
- Managed on calendar year basis (January 1 – December 31)
- Triennial assessment
- Guideline Harvest Level (GHL) of 59 t since 2015
- Participation is sporadic; CPUE data difficult to compare across vessels
- Updates to **input data**
  - Directed fishery retained and discarded catch through 2022
  - Bycatch estimates through 2022

PIGKC OVERVIEW

Models presented:

- **Tier 5** – approach used since 2012
  - OFL = mean estimated total catch for 1993-1998
- **Tier 4** incorporating slope survey data
  - Models 23.0, 23.0a, 23.1, 23.1a, 23.1b
  - Differences in: survey years included in MMB calculation, CV for MMB, penalty to likelihood, prior on process error
  - Random-effects approach using R package *rema*
  - All models fit with M = 0.18 yr^{-1} and 0.22 yr^{-1}
- **Tier 5 using Tier 4 approach for calculating OFL** – based on spiny dogfish example
  - OFL = average slope survey MMB 2002-2016 × M
  - Fit with M = 0.18 yr^{-1} and 0.22 yr^{-1}

CPT RECOMMENDATIONS

- **Tier 4 and Tier 4/5 approaches not justified at this time**
  - Tier 4 does appropriately increase uncertainty as most recent fishery-independent data ages
  - But without any new survey data since 2016 uncertainty will continue to increase monotonically
  - Revisit these approaches when new data become available
- **Continue with Tier 5 approach**
  - Provides management consistency
  - Appropriate for stock without good fisheries-dependent or fisheries-independent data

CPT RECOMMENDATIONS

- **25% buffer**
  - Consistent with other Tier 5 stocks
  - In place since 2014, no new information to motivate change

Values in t

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2019			59	Conf.	Conf.	93	70
2020			59	49	52	93	70
2021			59	16	21	93	70
2022			59	Conf.	Conf.	93	70
2023			59			93	70
2024						95	71
2025						95	71
2026						95	71

  - Updated bycatch time series resulted in slight change to OFL/ABC
  - Total catch below OFL in 2020-2021; overfishing did not occur

WESTERN ALEUTIAN ISLANDS RED KING CRAB (WAIRKC)

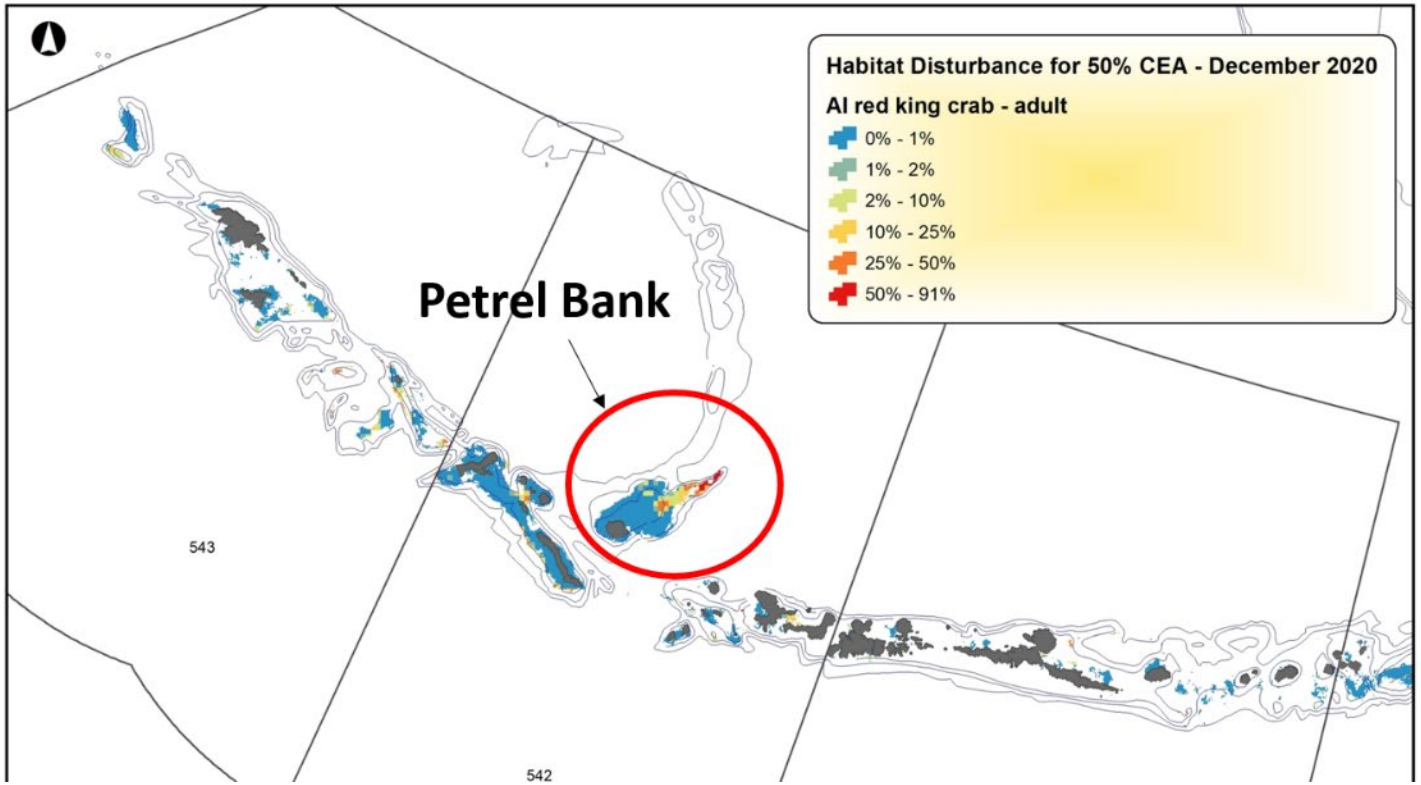
FINAL ASSESSMENT 2023

WAIRKC OVERVIEW

- Fishery closed since 2003/04
- Triennial assessment
- Survey data for Petrel Bank (2006, 2009, 2016) and Adak (2002, 2015) indicate stock is severely depressed
- Tier 5 stock
- OFL based on estimated total catch during 1995/96 – 2007/08

STOCK STATUS DISCUSSION

- Extremely low fishery and survey CPUE since 2002 indicate the stock is in fact overfished
- Formal overfished declaration not possible for Tier 5 stock
- Conservation measures such as habitat protection could be evaluated
    - Author notes habitat disturbance in areas of Petrel Bank with historical RKC occurrence



CPT RECOMMENDATIONS

- **75% buffer**
  - In place since 2017
  - No new information
  - Stock severely depressed

Values in t

Fishing Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2018/19			Closed	0	<1	56	14
2019/20			Closed	0	<1	56	14
2020/21			Closed	0	<1	56	14
2021/22			Closed	0	<1	56	14
2022/23			Closed	0	<1	56	14
2023/24						56	14
2024/25						56	14
2025/26						56	14

- Total catch below OFL in 2020/21, 2021/22, 2022/23; overfishing did not occur

PRIBILOF ISLANDS BLUE KING CRAB (PIBKC): PROPOSED MODEL RUNS 2023

- Tier 4 stock, biennial assessment
- Current approach uses bespoke state-space random walk model in ADMB
- Concerns with survey data
  - Design-based indices have large CVs
  - VAST indices have possible issues with island effects and limited BKC catch/distribution
- Author proposed moving current model to R package *rema*
  - Change to modeling platform, not model structure
  - Larger user community for future development
  - Fits to survey data very similar for *rema* and ADMB versions
- CPT supports bringing forward *rema* version in September

TANNER CRAB: PROPOSED MODEL RUNS 2023

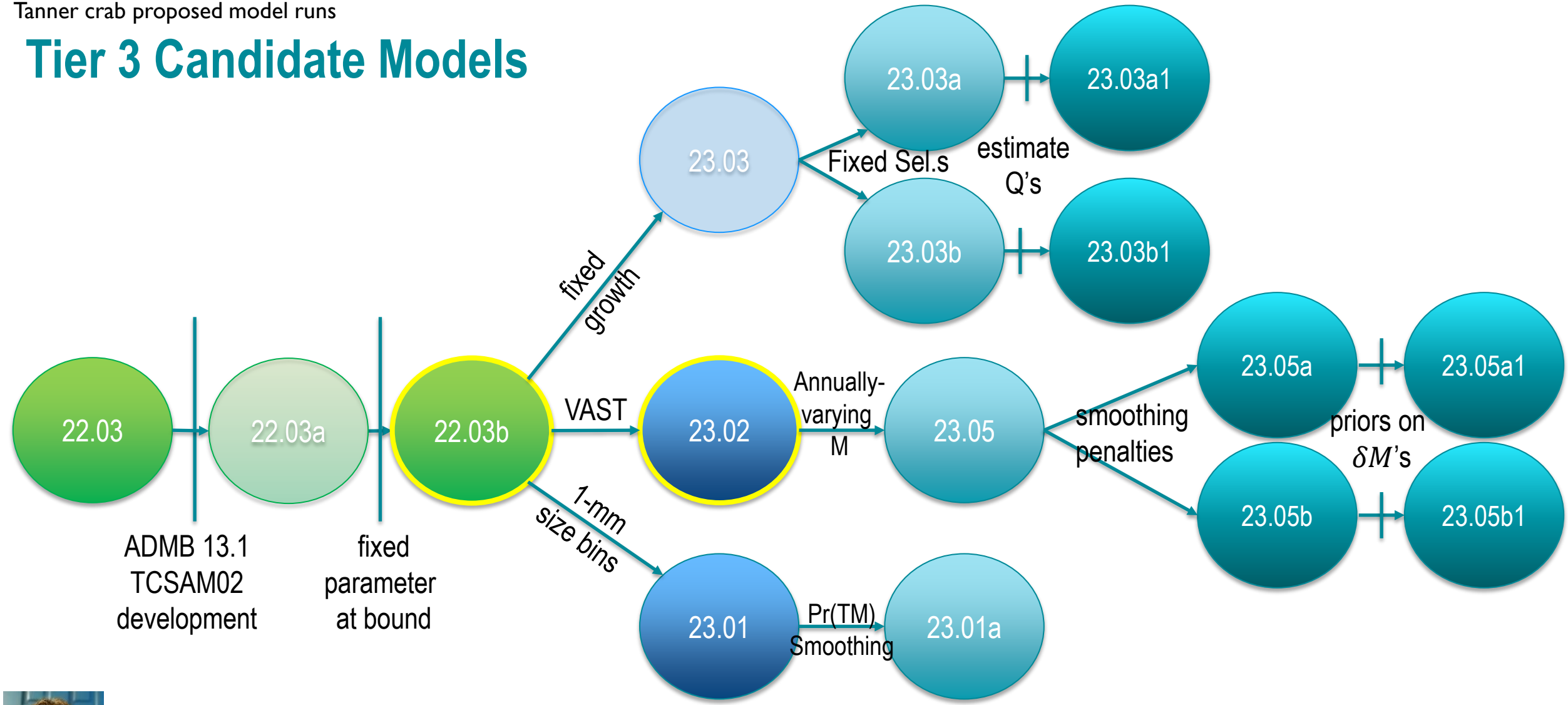
- Updates to most recent ADMB version and fixing one parameter still at a bound – model 22.03b
  - Accepted as "base" model for fall 2023
- Tier 3 model explorations in 3 branches

  1) 1-mm size bins for population length structure

  2) VAST survey estimates and time varying M

  3) Fixed growth and fixed selectivity – pre-specified outside the model (simpler modeling workshop suggestion)
- Tier 4 option
  - More advanced "fallback"

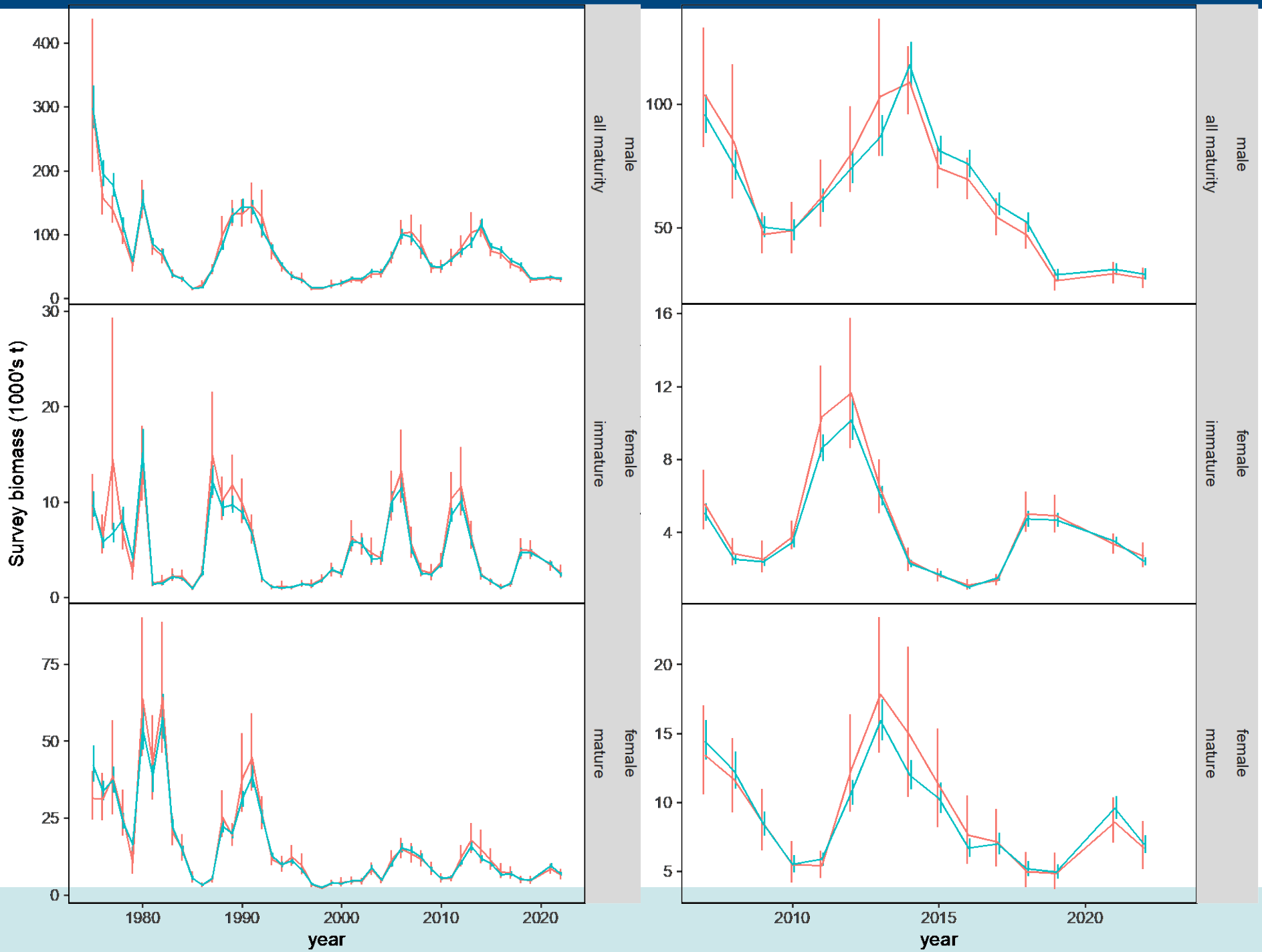
Tier 3 Candidate Models



Tanner crab proposed model runs

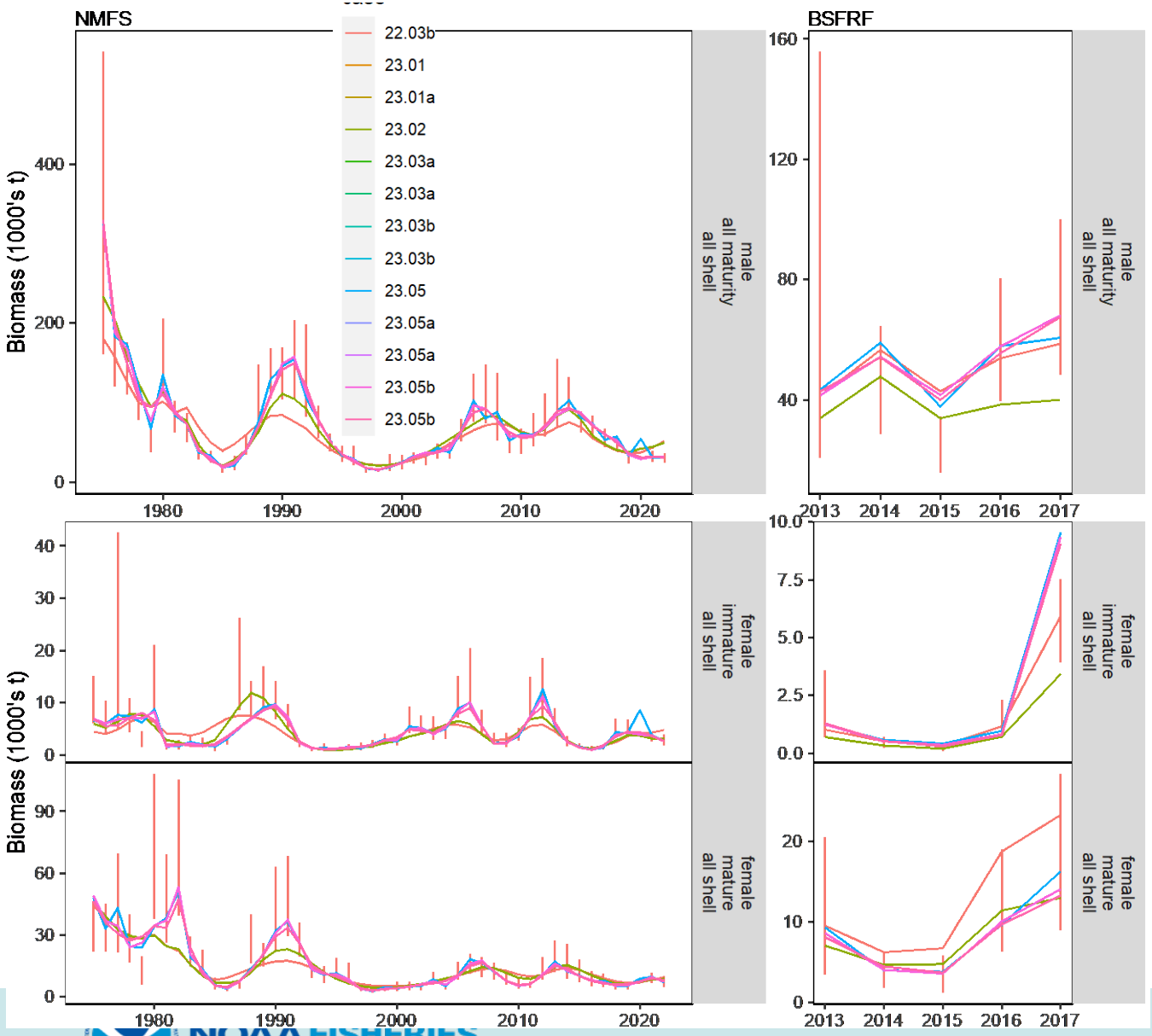
23.02

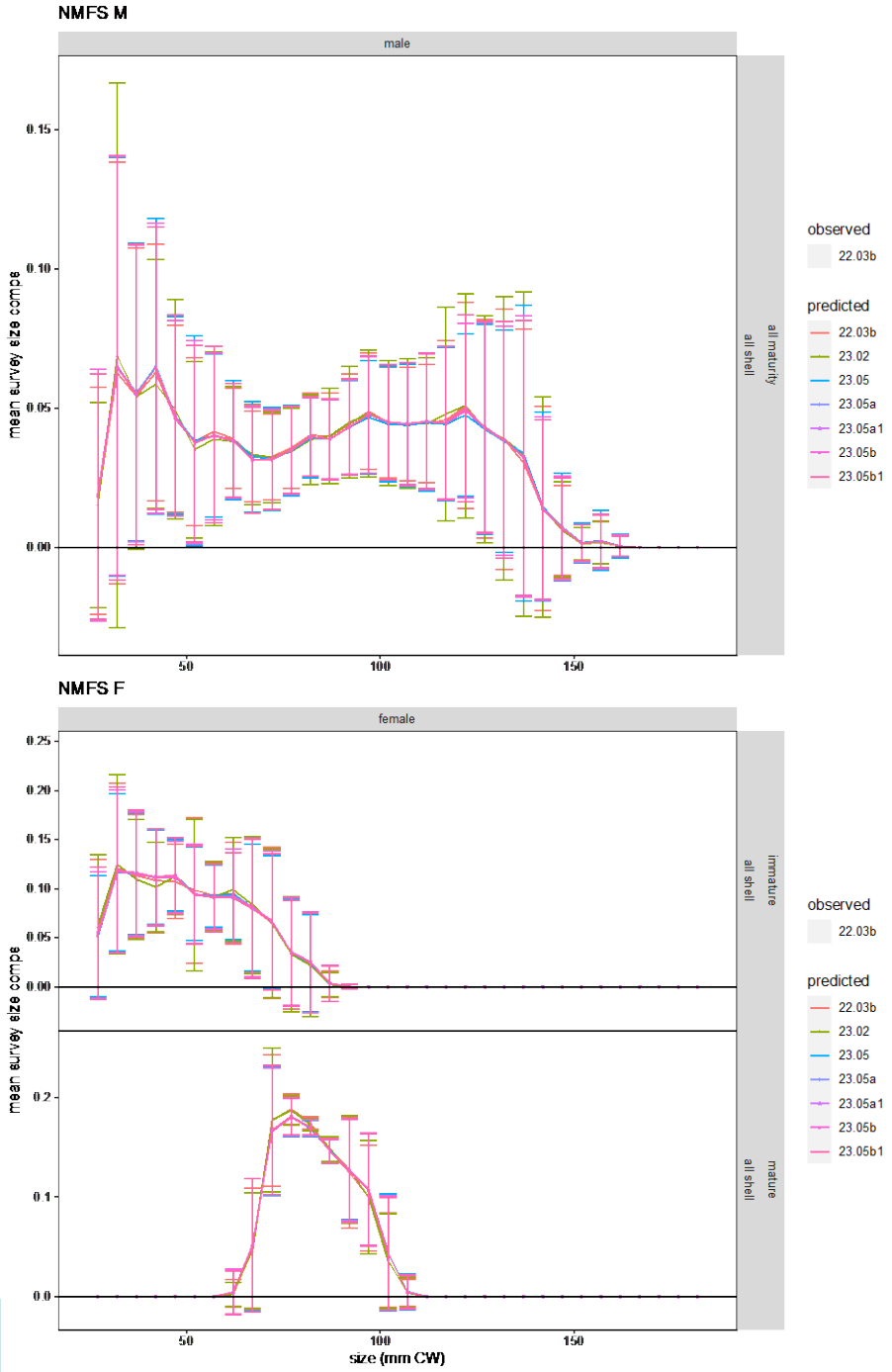
- Fits to VAST model-based biomass time series from NMFS EBS shelf survey



Tanner crab proposed model runs

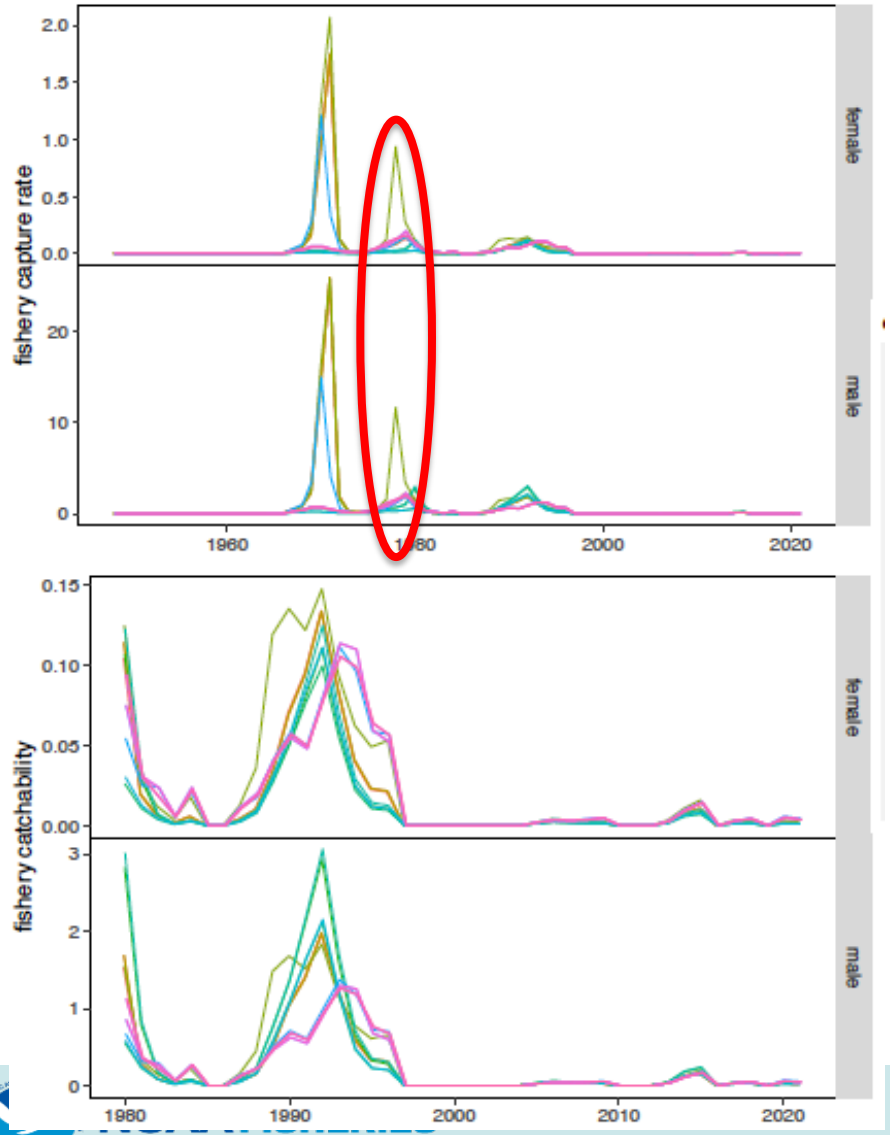
23.02 + 23.05's: Fits to NMFS EBS Survey



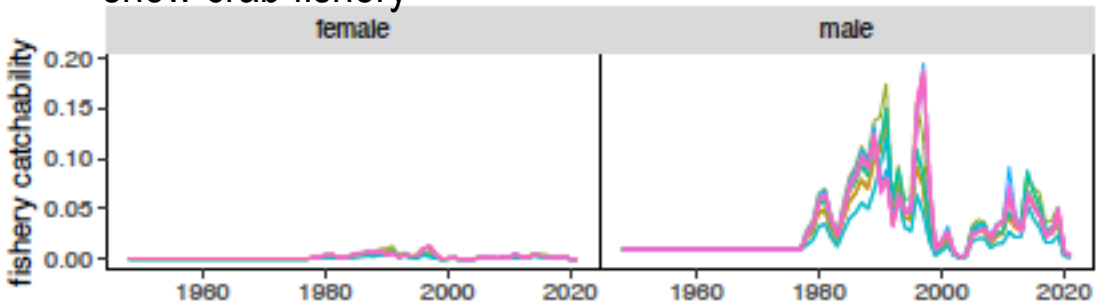


Estimated capture rates

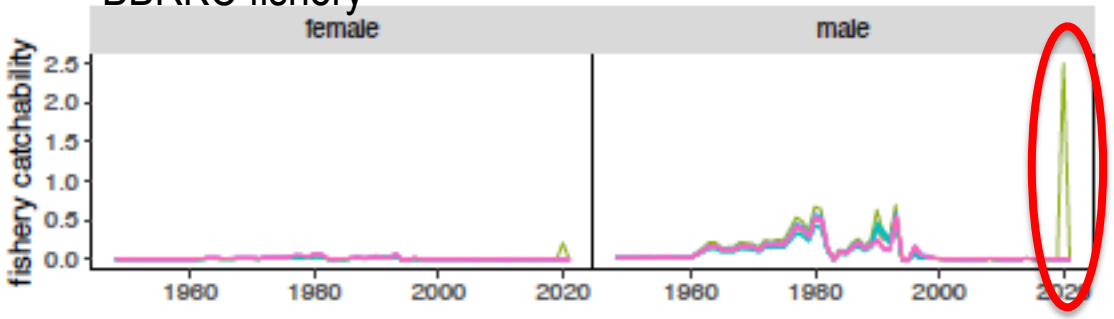
directed fishery



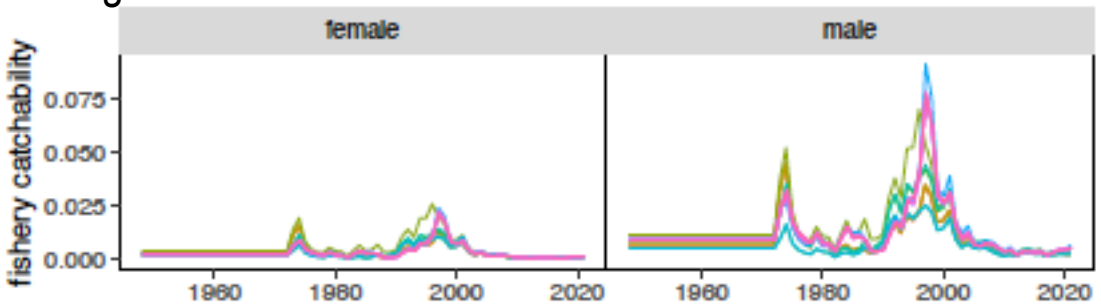
snow crab fishery

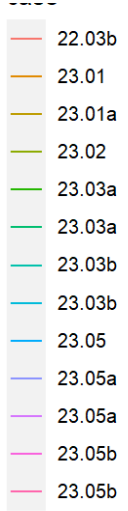


BBRKC fishery

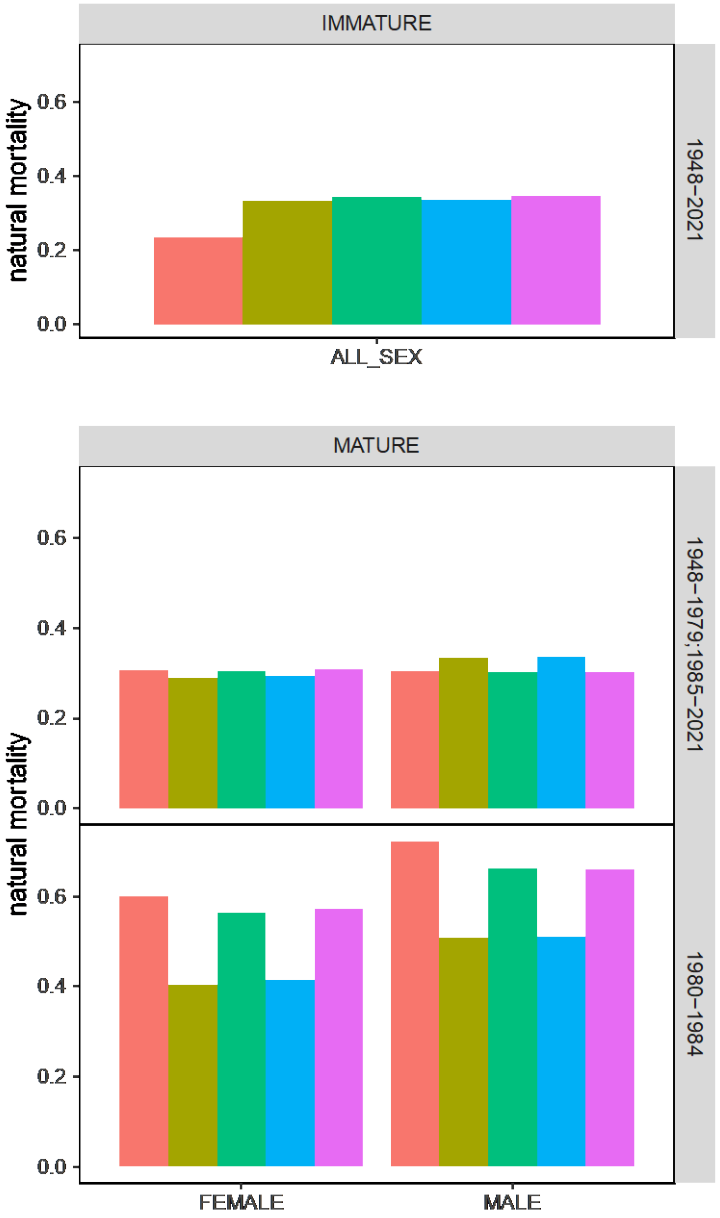


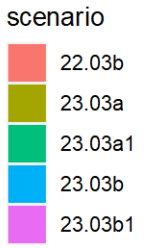
groundfish fisheries

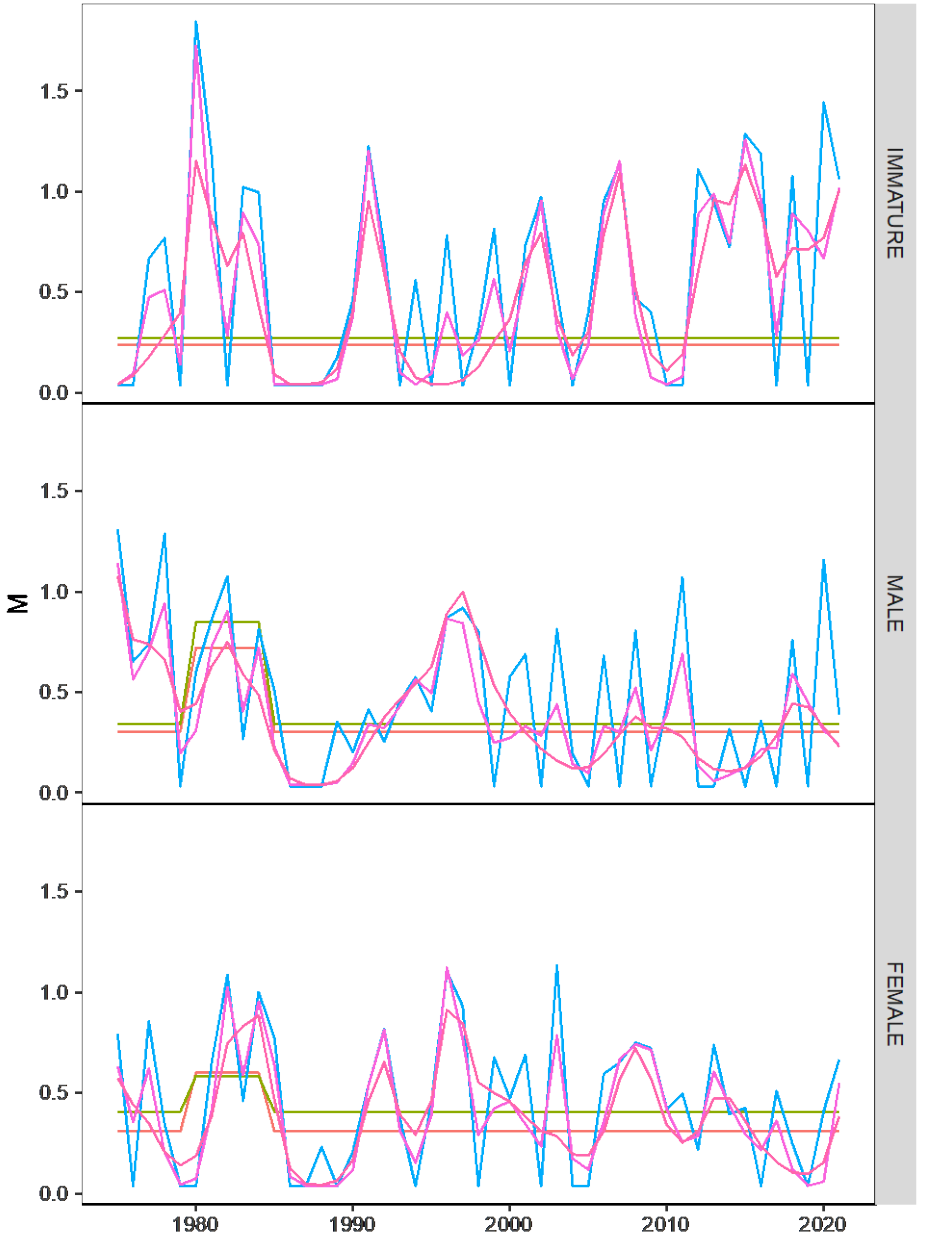




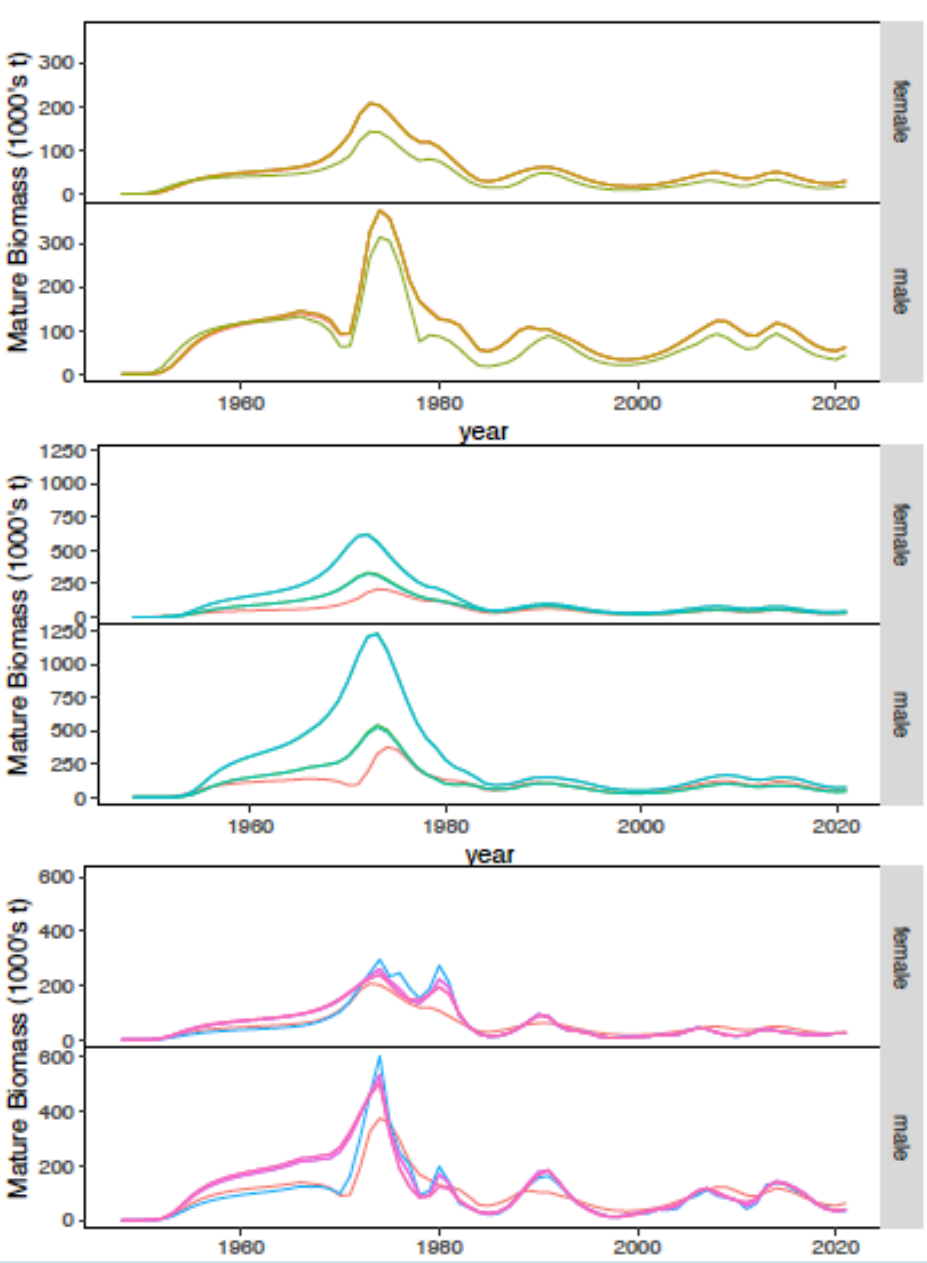
M

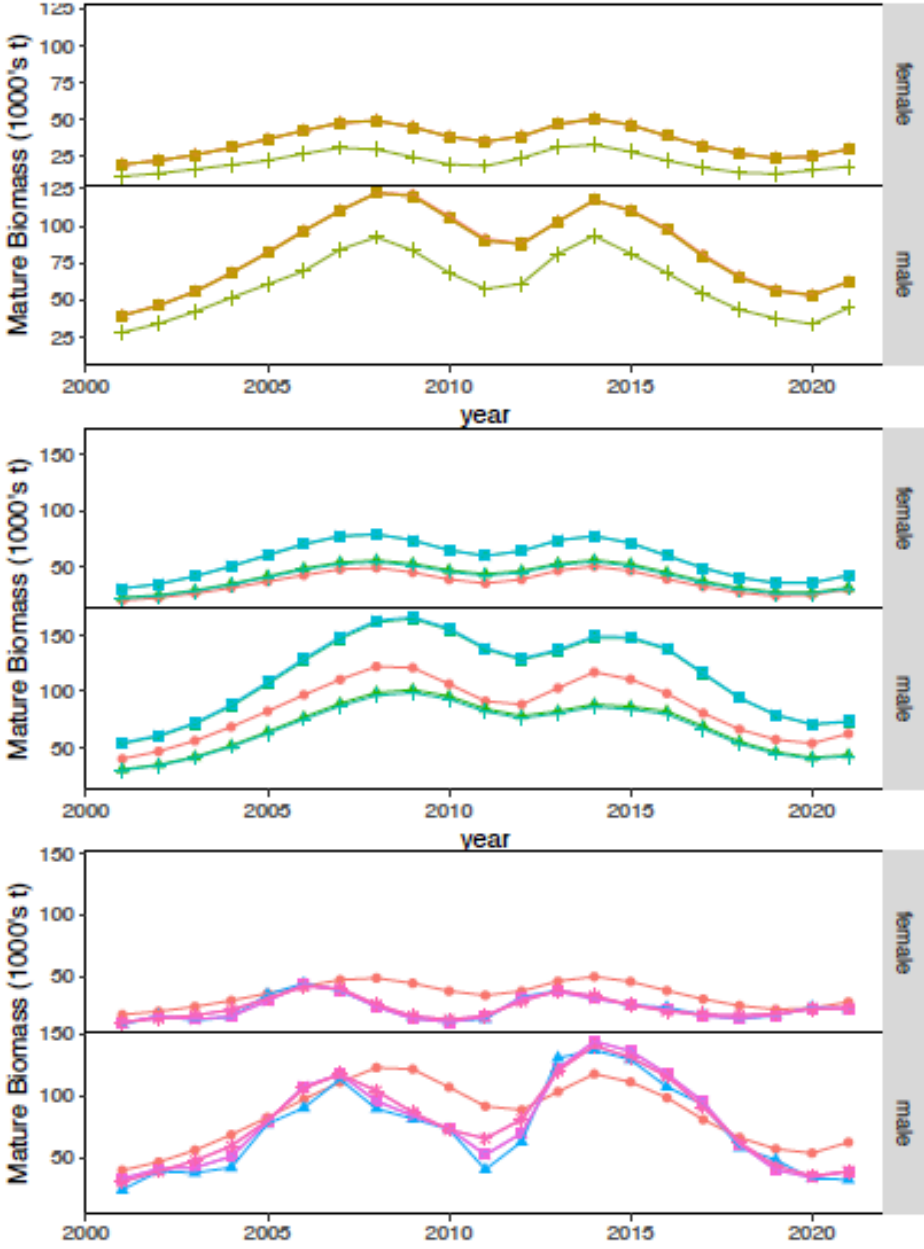

IMMATURE
natural mortality
0.0
0.2
0.4
0.6
ALL_SEX
1948–2021
MATURE
natural mortality
0.0
0.2
0.4
0.6
FEMALE
MALE
1948–1979;1985–2021
1980–1984


scenario
22.03b
23.03a
23.03a1
23.03b
23.03b1


M
0.0
0.5
1.0
1.5
1980
1990
2000
2010
2020
IMMATURE
MALE
FEMALE
case
22.03b
23.02
23.05
23.05a
23.05a1
23.05b
23.05b1

Estimated MMB





TANNER: PROPOSED MODEL RUNS 2023

- Models with 1-mm size bins had similar but slightly worse fits with substantial increase in parameters – not seen as viable candidates moving forward
- VAST model
  - Good fit to survey but at cost of fit to size-composition
  - Convergence issues – might be at a local minimum?
  - High F values in early years of the fishery that were not supported by the data
- VAST models with time varying M
  - Better than VAST models without time varying M, needs smoothers to converge well
  - Time varying M might be better paired with pre-specified growth in future runs
  - Good explorations but not viable candidate models
- Models with pre-specified growth or selectivity
  - Generally worse than base model

TANNER: TIER 4 OPTIONS

- Tier 4 option
  - More complex than needed for a "fallback" option, no desire to build a new Tier 4 model
  - CPT suggested author bring forward the basic "fallback" option using survey data and the REMA model
  - Years for Bmsy proxy were discussed and the author will determine which years were used the last time Tanner was a Tier 4 assessment

TANNER RECOMMENDATIONS

- Commend author for the large amount of work
- Models for fall 2023
  - 22.03b – base model
  - 23.02 – good alternative, if the author can determine convergence issues
  - Tier 4 "fallback" – survey data using REMA package
- Future work
  - Develop models with annually-varying M
  - Work on using BSFRF study to inform on selectivity (potential modeling workshop topic)

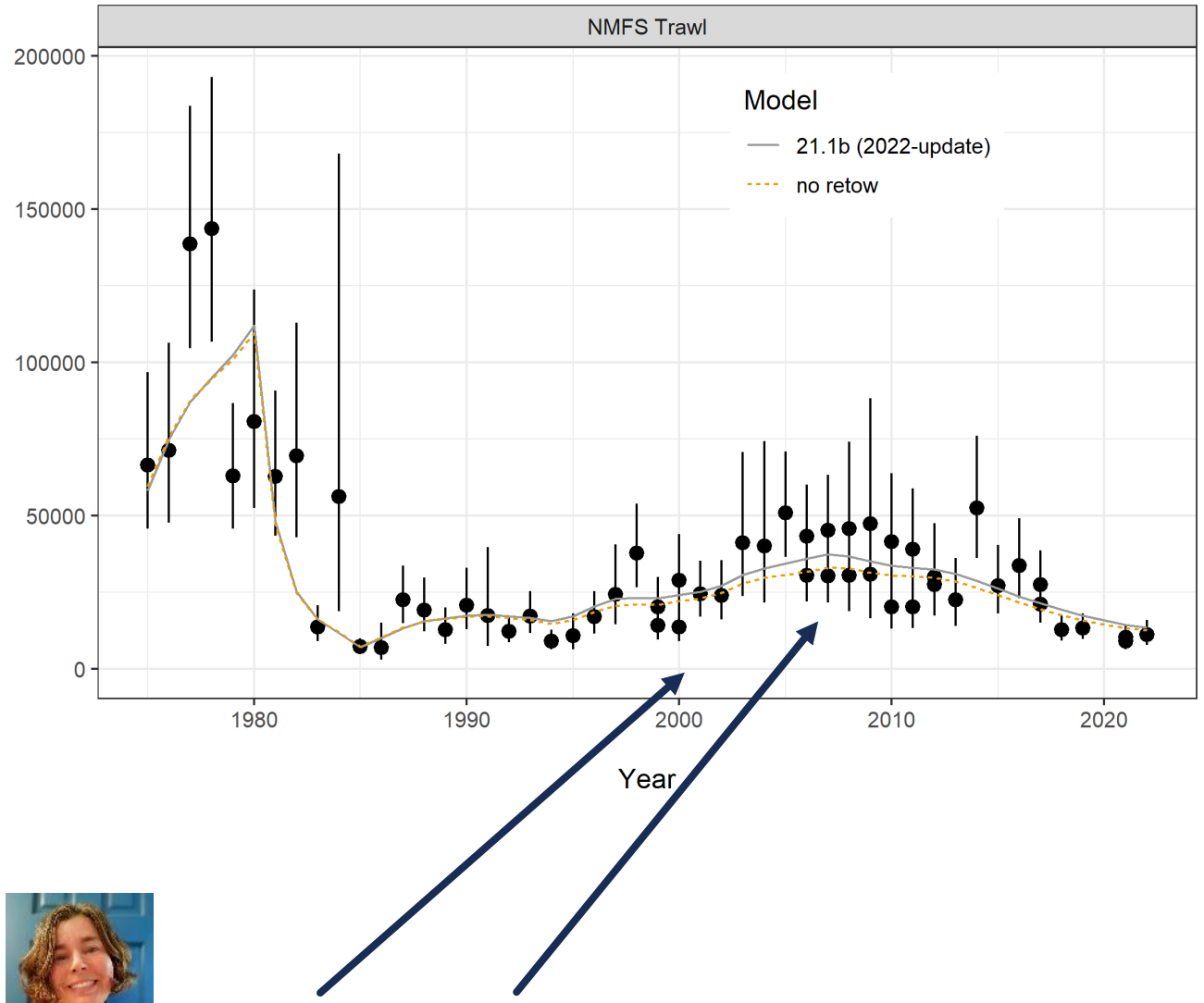
BBRKC: PROPOSED MODEL RUNS 2023

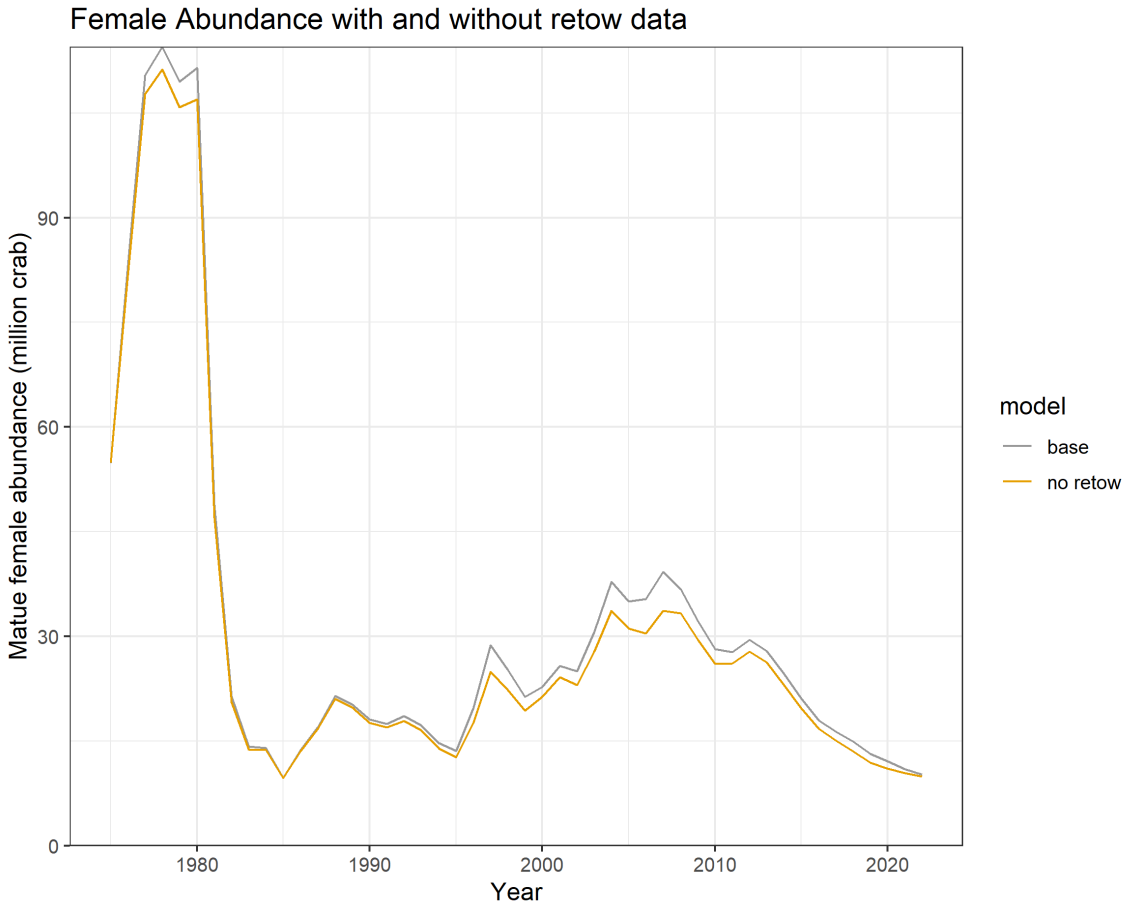
- Stable model in GMACS since 2018
- Directed fishery was closed in 2021/22 and 2022/23 season due to low mature female abundance.
- Low recruitment in recent years (last 8-12 years), projected decline in biomass without a large recruitment event
- Model explorations around a few themes:
  - GMACS updates
  - Start year for model (1975 vs 1985) (model 22.0)
  - Natural mortality (models 23.0, 23.0a, 23.0b, 23.3)
  - Q for NMFS trawl survey (models 23.1a, 23.3)
  - Sensitivity to female resample data (model 23.2)

FEMALE RE-TOW / RESAMPLING EXPLORATION

- Historic rationale:
  - Characterize the reproductive status of BBRKC mature females given temperature-driven delays in the molt/mate cycle
  - Accurately assess the relative abundance of BBRKC mature females given that females may be outside the surveyed area when the cycle is delayed
- Current rationale clarifications:
  - Improve accurate of size composition data post-molt for females
  - Abundance estimate of mature females (same as previous)
- Resampling occurred in 1999, 2000, 2006 to 2012, 2017, 2021
  - All except 2021 had at least 25% of mature females that did NOT complete the molt-mate cycle
- Model 23.2
  - Remove "re-tow" data from the base model by estimating the base model (21.1b) with only leg 1 survey data – both biomass and size compositions.
- Continuation of re-tow vital in years where large number of females haven't completed molt-mate cycle to ensure females are sampled to follow population dynamics model.
- Did NOT address the 10% threshold or affect of retows on SOA harvest strategy

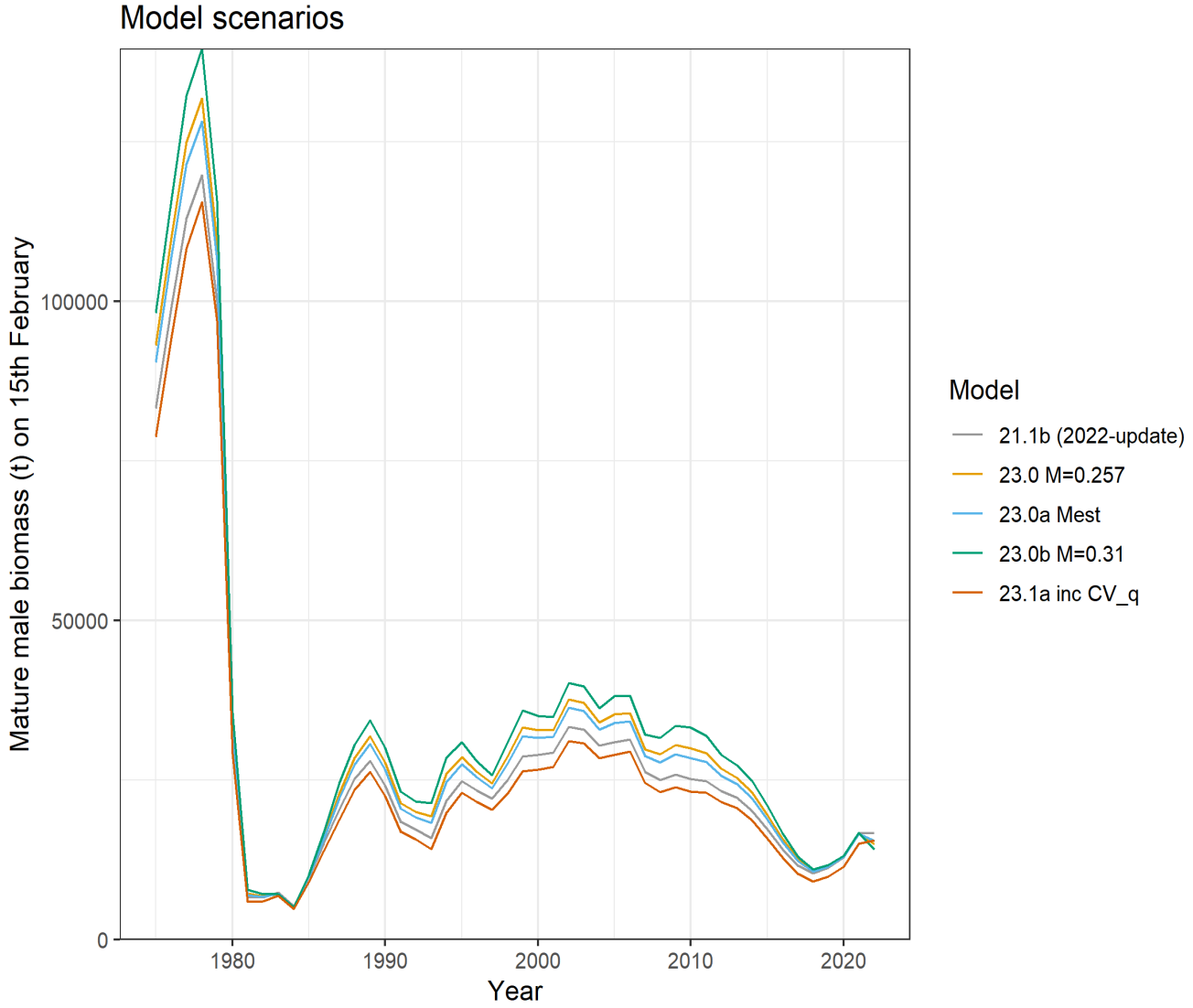
BBRKC proposed model runs

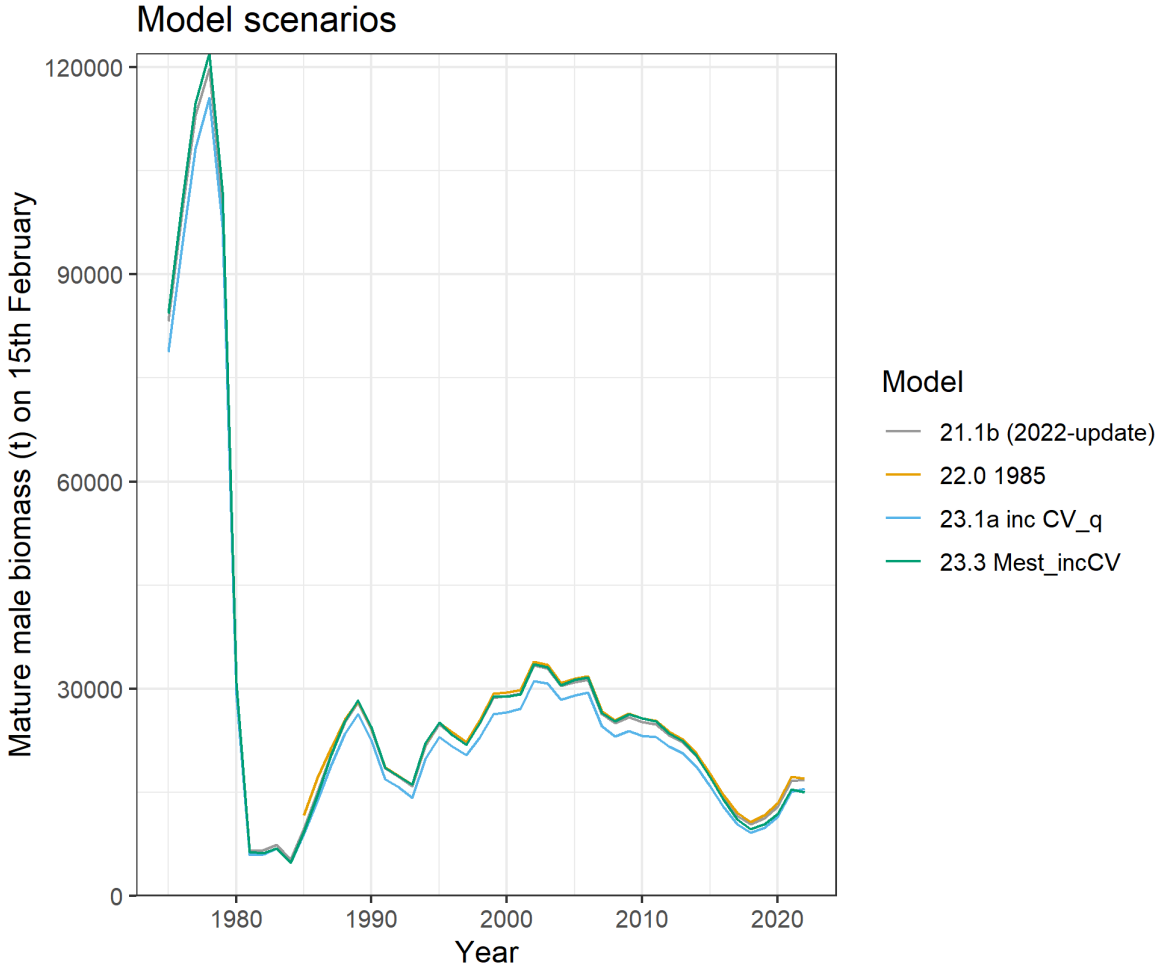




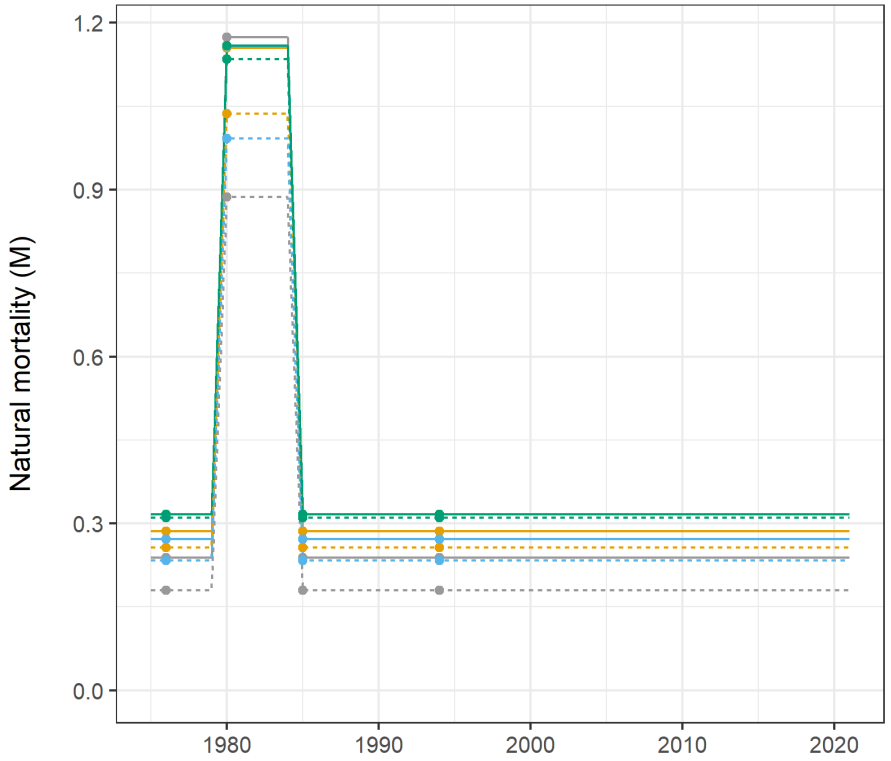
1999, 2000, 2006 to 2012, 2017, 2021

BBRKC MATURE MALE BIOMASS





BBRKC proposed model runs



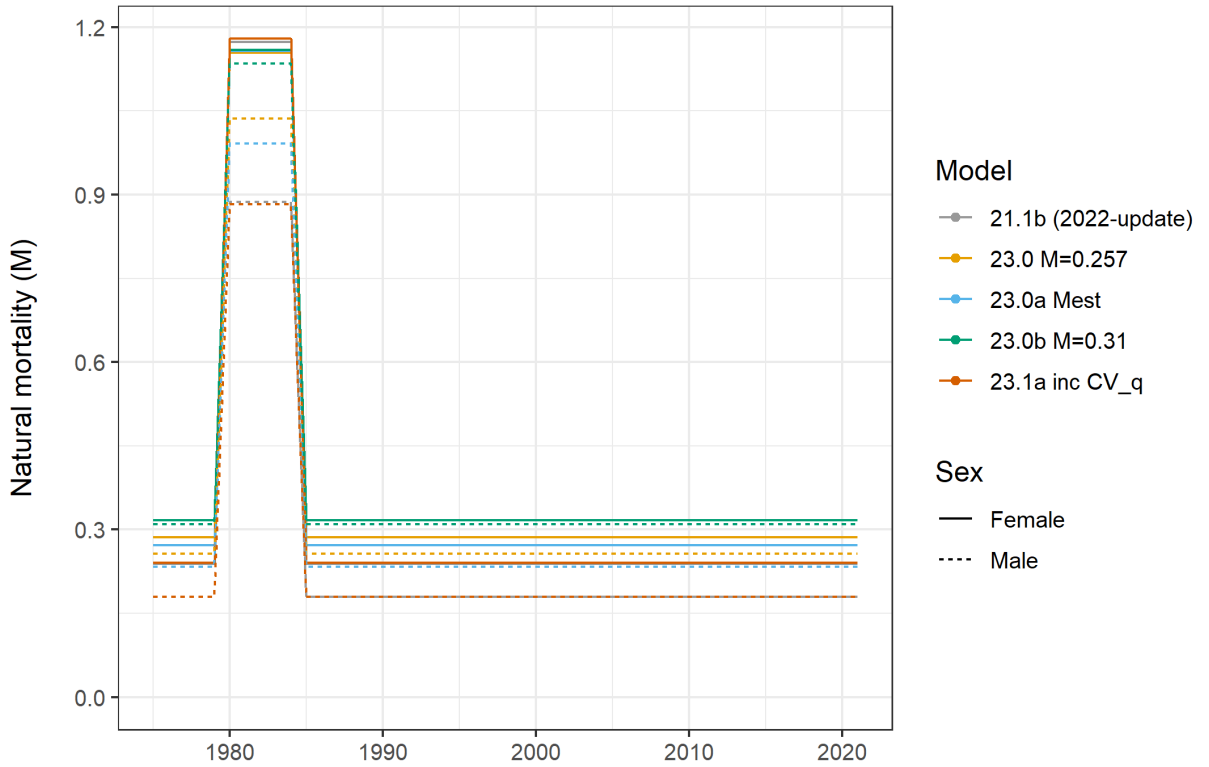
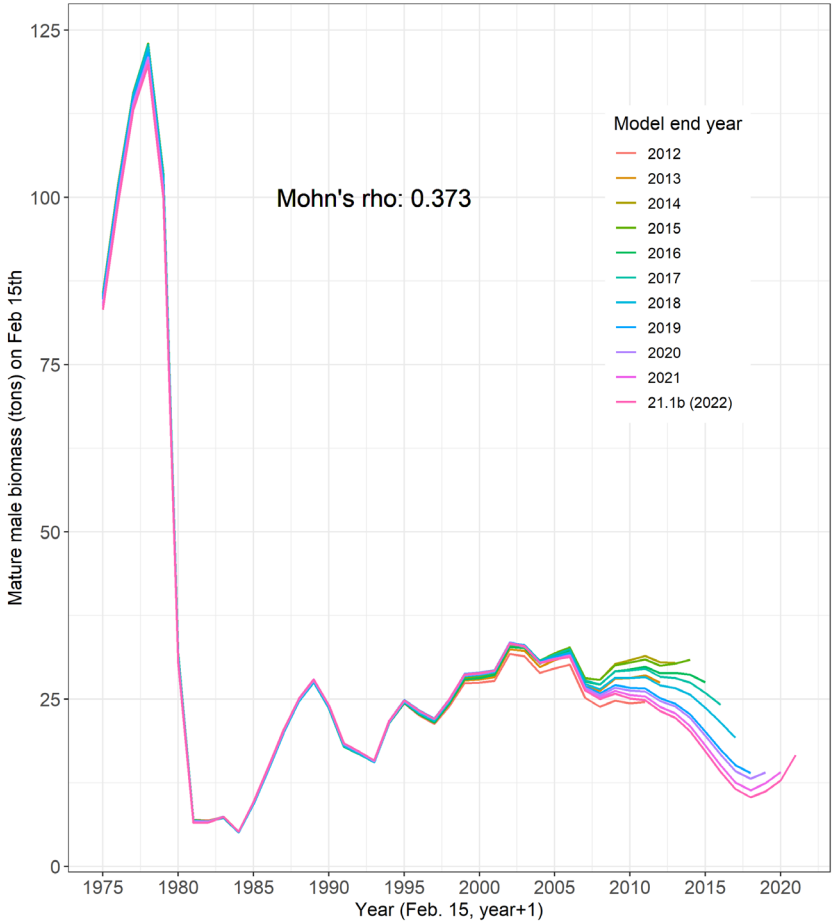


Table 3: Natural mortality estimates for model scenarios during different year blocks.

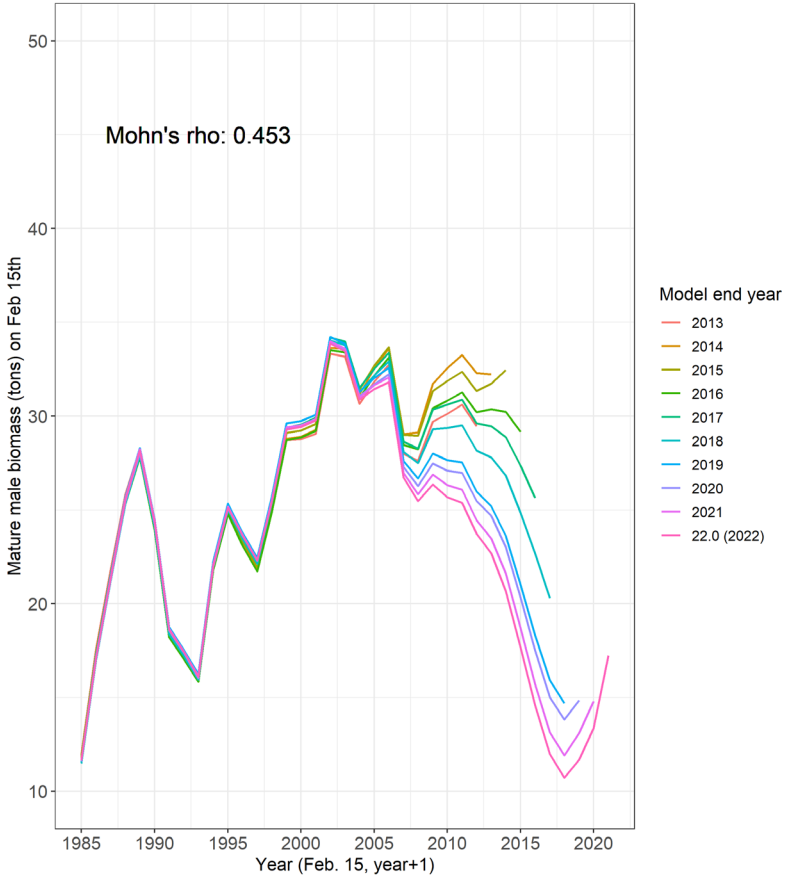
Model	Sex	baseM	1980-84	1985-22
21.1b (2022-update)	Female	0.24	1.17	
21.1b (2022-update)	Male	0.18	0.89	
22.0 1985	Female			0.23
22.0 1985	Male			0.18
23.0 M=0.257	Female	0.29	1.15	
23.0 M=0.257	Male	0.26	1.04	
23.0a Mest	Female	0.27	1.16	
23.0a Mest	Male	0.23	0.99	
23.0b M=0.31	Female	0.32	1.16	
23.0b M=0.31	Male	0.31	1.13	
23.1a inc CV q	Female	0.24	1.18	
23.1a inc CV q	Male	0.18	0.88	
23.3 Mest incCV	Female	0.26	1.17	
23.3 Mest incCV	Male	0.22	0.96	

BBRKC RETROSPECTIVE PATTERNS

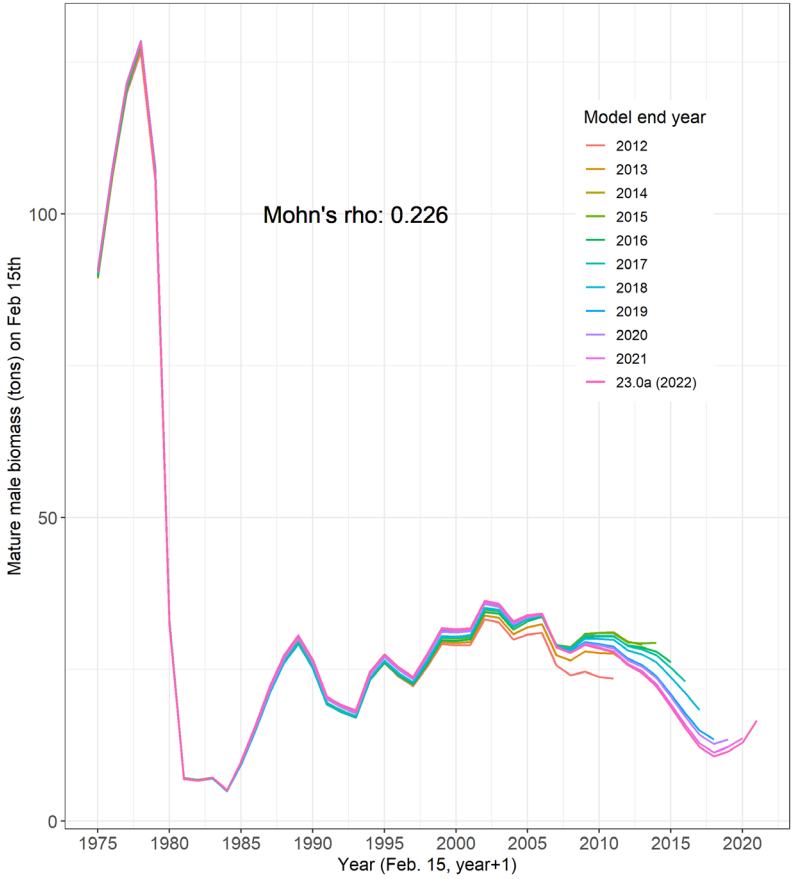
Model 21.1b



Model 22.0



Model 23.0a

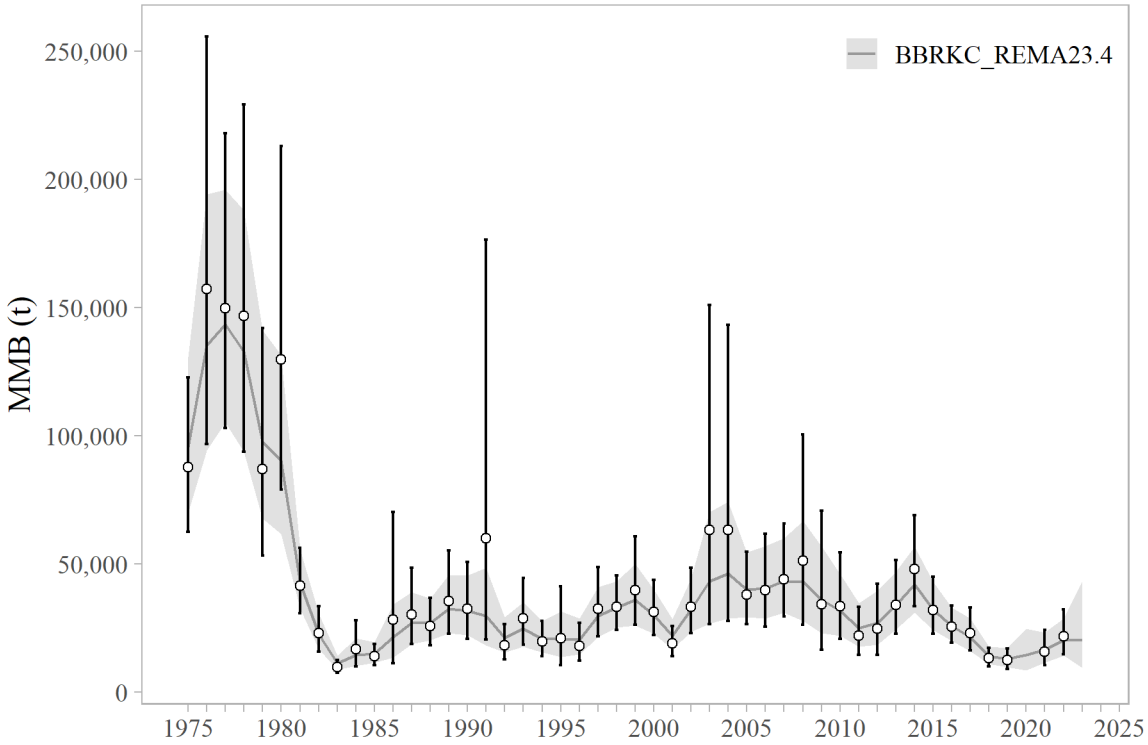


BBRKC PROPOSED MODEL RESULTS

- GMACS version update, slight differences in projections
- Model 21.1b represents updated base – updates to GMACS and bycatch data
- Reducing the data time series produces similar results without complicated of M time block (late 70s/ early 80s)
  - Higher retrospective pattern not well understood
- Estimating M results in higher M and higher $F_{35\%}$, confounding issues
- Estimating M results in higher M for males but also reduced retrospective pattern (Mohn's rho reduced from 0.373 to 0.226)
- Recommendations:
  - Base model 21.1b
  - Model 23.0a – estimating M, reduces retrospective pattern, likely more accurate higher M
  - Model 22.0 – appealing but concern over retrospective pattern

BBRKC TIER 4 SIMPLE MODELING WORKGROUP OPTION

- Based on the simpler modeling working group discussions
- Mature male biomass (legal size + one growth increment below = mature for BBRKC)
- Average B – calculated using MMB from 1984 to 2021 (matches current Tier 3 assessment $B_{35\%}$ calcs)
- Assume 20% buffer – likely this would be different if we went with a Tier 4 option.



avgB (t)	Current B	MMB/B_{msy}	M	F_{OFL}	OFL	ABC
28443.11	20328.15	0.71	0.18	0.12	2499.12	1999.30

SNOW CRAB: PROPOSED MODEL RUNS 2023

- Past problems:
  - Convergence issues and bimodality in management quantities
  - Multiple plausible modeled population trajectories for stock collapse
  - Inability to fit survey index and size compositions
  - Retrospective patterns
  - Unrealistic biology (e.g. probability of terminal molt)
  - Unrealistic catch advice
- Response:
  - Let the biology lead modeling decisions
  - Think outside historical decisions

SNOW CRAB: PROPOSED MODEL RUNS 2023

Five models presented:

- Status quo (2022 GMACS model)
- Research model (not in GMACS)
  - Male only, non-directed fisheries excluded
  - From "what happened?" research attempting to understand the collapse
- Two bridging models (in GMACS)
  - Combine aspects of research model with status quo
  - One with offset *M* in 2018/2019, one with time-varying *M*
- Tier 4 fallback approach
  - B_{MSY} proxy = mean survey biomass of >95mm carapace width males 1982-2021
  - F_{MSY} proxy = *M* of 0.27 yr^{-1} based on assumed maximum age of 20 years

SNOW CRAB: PROPOSED MODEL RUNS 2023

	Status quo	Research model (male only)	Bridge (focused)	Bridge (focused + vary *M*)
Maturity	Single estimated ogive	Input as yearly data	Input as yearly data	Input as yearly data
BSFRF data	Treated as an additional survey with estimated availability	Treated as prior on survey selectivity	Treated as prior on survey selectivity	Treated as prior on survey selectivity
Survey selectivity	Logistic (1982-1988; 1989-present	Non-parametric	Non-parametric	Non-parametric
Growth	Estimated	Specified	Estimated	Estimated
M	Offset in 2018 and 2019	Time-varying	Offset in 2018 and 2019	Time-varying

RESEARCH MODEL

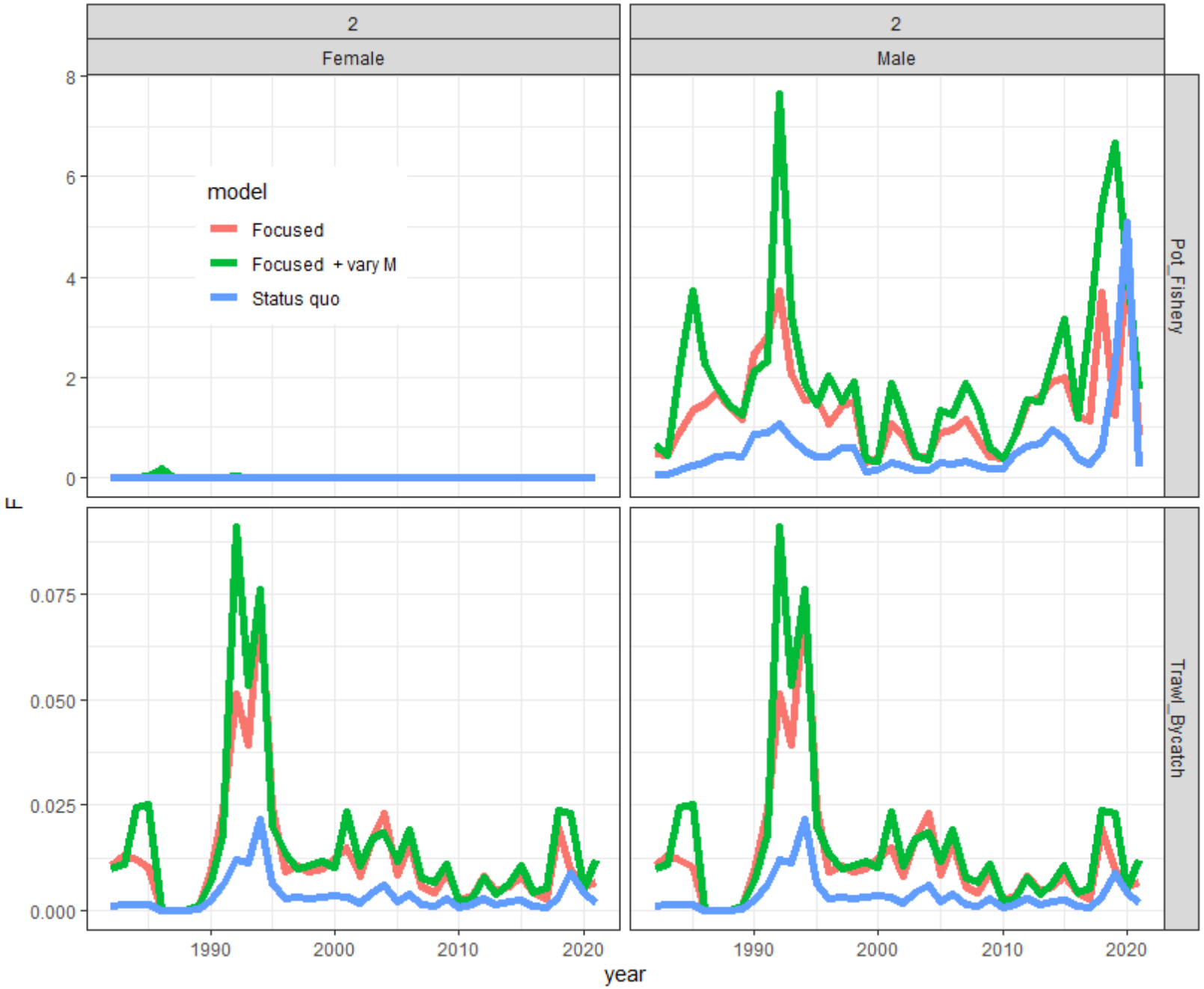
- Generally fits data well; improves treatment of biology (e.g. probability of terminal molt); time-varying *M* appears reasonable
- Male-only model
  - Reduces tension between fits to male and female data
  - Does not produce mature female estimates for use in State TAC-setting
- Counter to general transition towards GMACS models
- CPT does not recommend bringing forward in September for setting fishery specifications

STATUS QUO AND BRIDGE MODELS

- Similarities:
  - Fits to survey biomass (some differences among years)
  - Fits to catch time series and catch size composition
  - Fits to growth data
- Differences:
  - Fits to survey size composition (especially 1982-1988)
  - Higher estimated *F* for bridge models
  - More realistic treatment of terminal molt in bridge models
  - Different MMB trajectories
  - Smaller retrospective patterns for bridge models
  - No bimodality in management quantities for bridge models

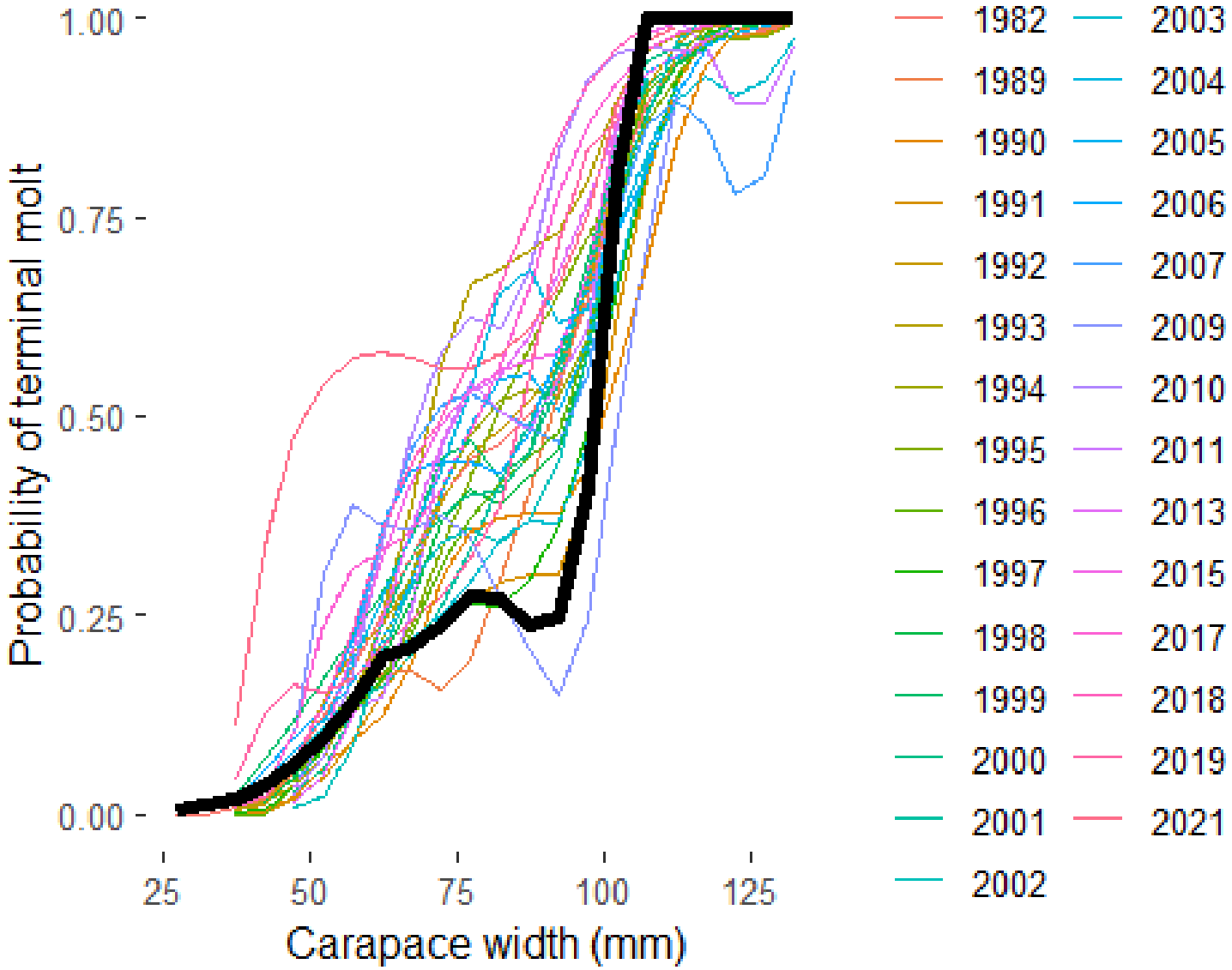
STATUS QUO AND BRIDGE MODELS

- Estimated fishing mortality is much higher for bridge models
- Especially for varying *M* version



STATUS QUO AND BRIDGE MODELS

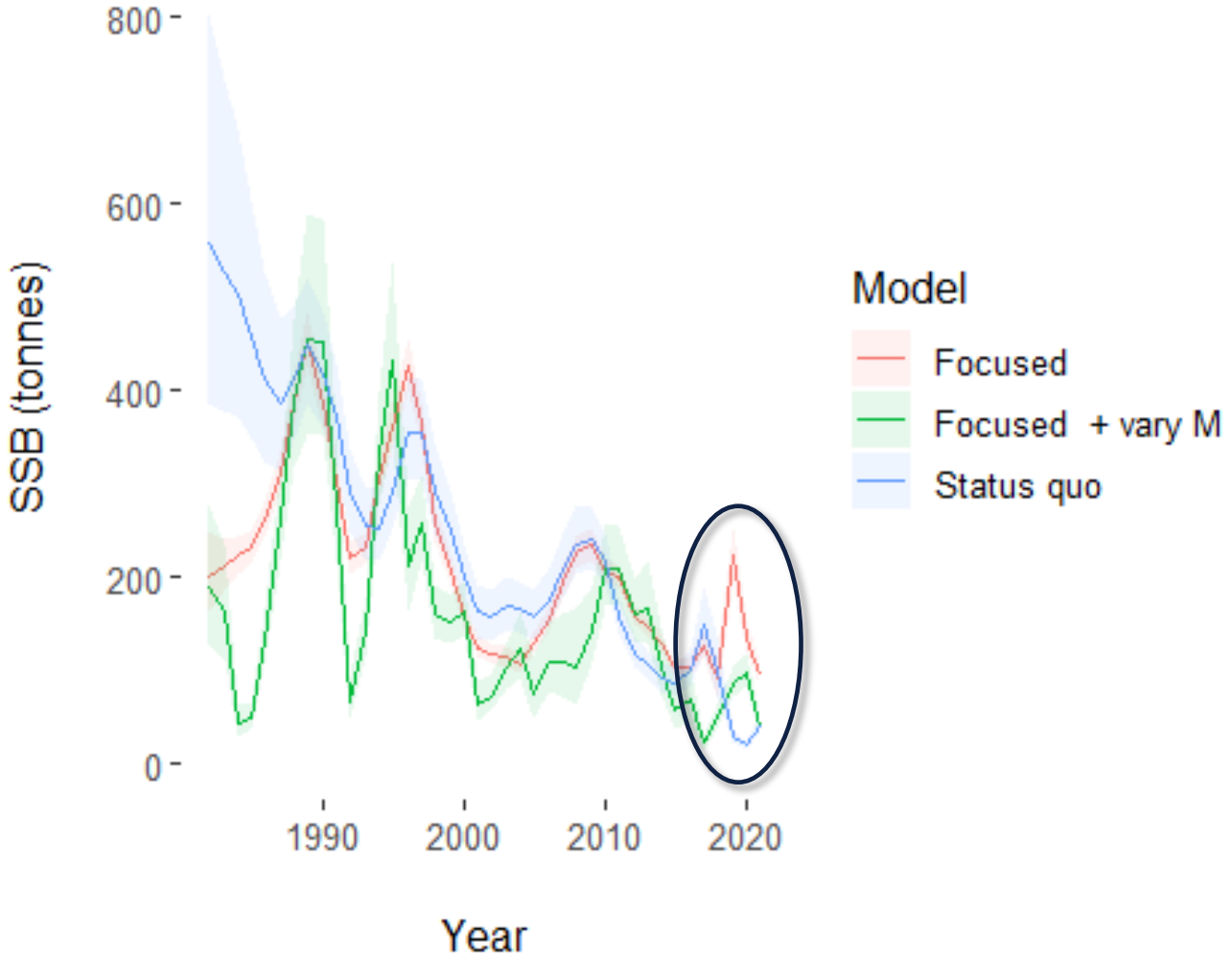
- Status quo underestimates probability of terminal molt for smaller males



Black line = status quo model estimate
Colored lines = specified probabilities from survey data

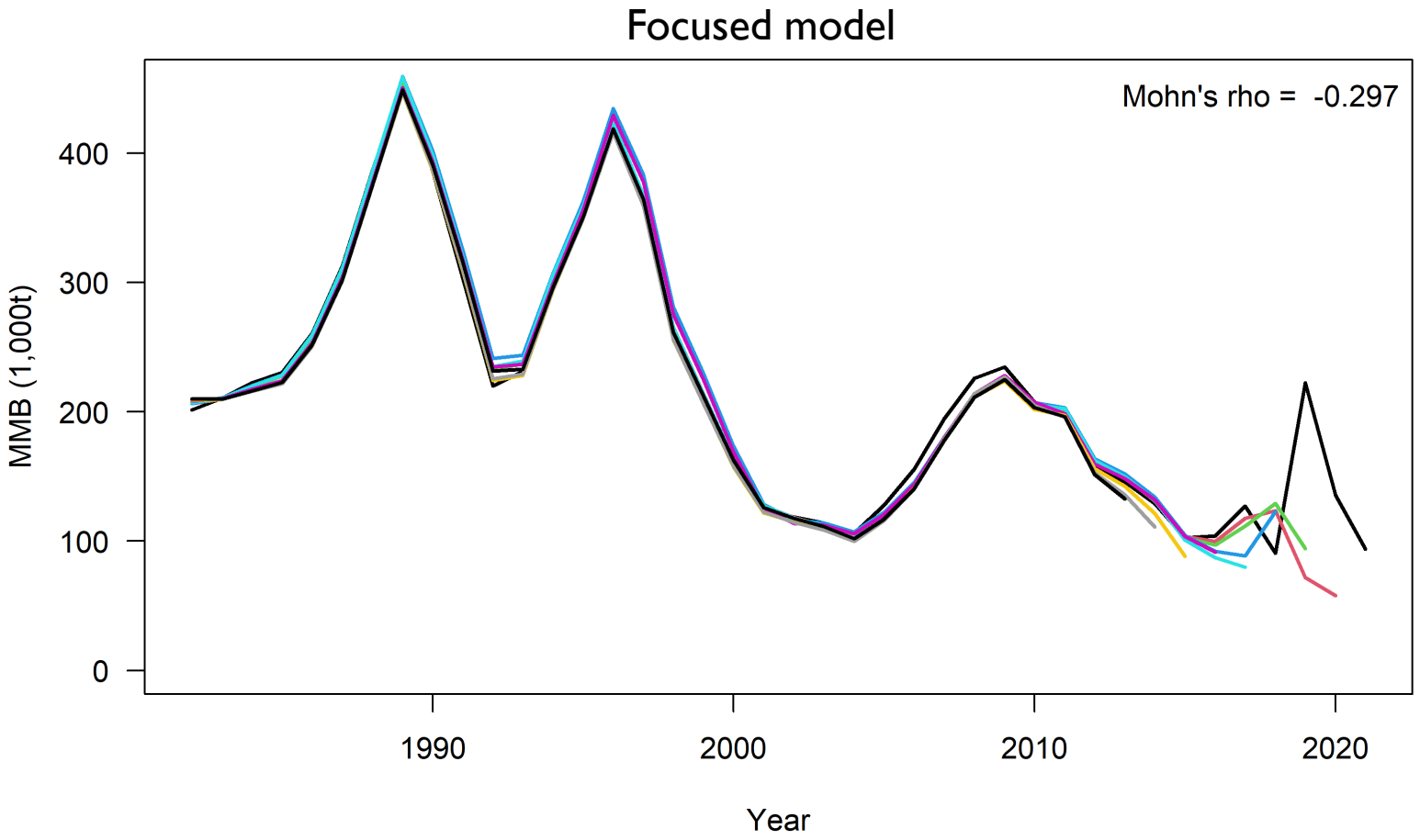
STATUS QUO AND BRIDGE MODELS

- MMB trajectories quite different across models



STATUS QUO AND BRIDGE MODELS

- Retrospective patterns smaller than status quo and in opposite direction



BRIDGE MODELS - DRAWBACKS

- Bridge models did not achieve all of the improvements of research model
- Very high estimated *F* in some years (especially varying *M* model)
- Convergence issues when survey selectivity is estimated
- Problem may be continued tension between fits to male and female data

FISHERY SPECIFICATIONS WITH TIER 3 AND TIER 4 APPROACHES

- Calculated reference points for status quo and bridging models with Tier 3 and Tier 4 approaches (i.e., $F_{MSY} = M$)
- Author recommendation: "Tier 4 is the only available option in the tier system that makes sense when maturity is specified appropriately"

Model	MMB	B35	F35	FOFL	OFL
Status quo	41.2	183.1	1.5	0.32	10.32
Focused	93.9	80.3	83.8	41.43	21.87
Focused + vary M	39.4	44.9	127.8	21.13	8.19
Status quo (tier 4)	41.4	249.1	0.28	0.000	0.11
Focused (tier 4)	93.9	215.3	0.41	0.092	0.50
Focused + vary M (tier 4)	39.4	162.4	0.19	0.000	0.03

CPT RECOMMENDED RESEARCH DIRECTIONS

- Simple male-only model with no groundfish bycatch
  - Goal is to minimize conflicts from fitting both sexes and groundfish bycatch
- Model including both sexes with no groundfish bycatch
  - Penalty on recruitment differences between sexes
  - Parameterized to reduce possibility that misfits to females will impact results for males
- Models for which growth is pre-specified
- Models excluding survey size composition for 1982-1988
  - Current models fit these data poorly
  - Incomplete spatial survey coverage may produce biased size composition data in these years
- CPT commends the author for the impressive progress made to date

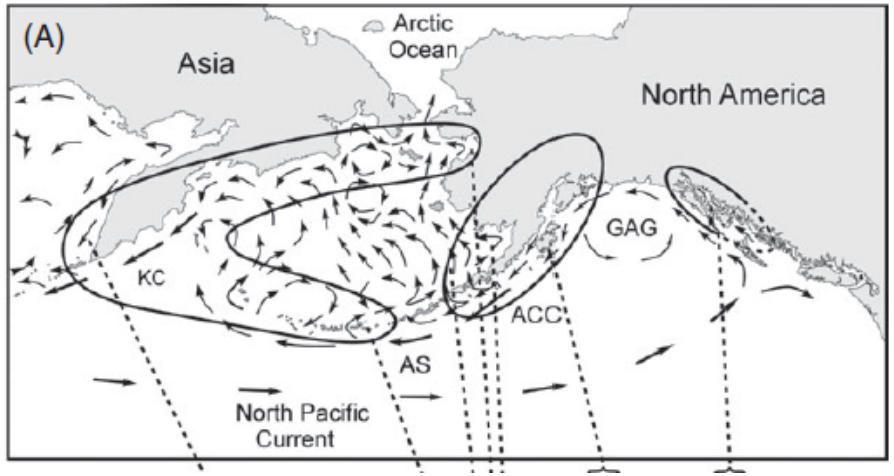
CPT RECOMMENDED MODELS 2023

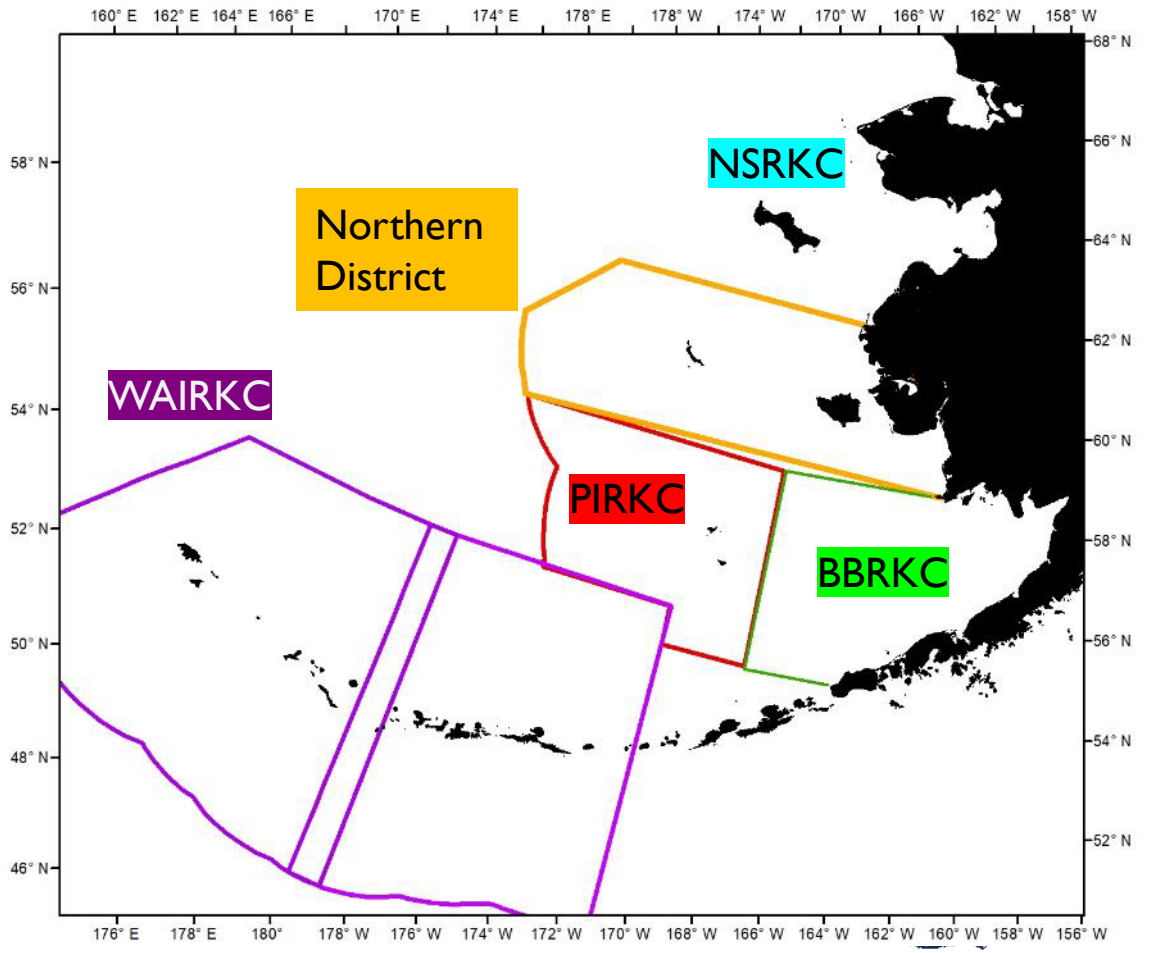
- Status quo
- Focused bridging model
  - *M* time-invariant except for 2018-2019
  - Only to be brought forward in September if convergence issues can be addressed
- Tier 4 fallback

BALANCE OF CPT REPORT

BERING SEA RED KING CRAB: STOCK STRUCTURE TEMPLATE

- Bering Sea red king crab –
  - Bristol Bay, PIRKC, WAIRKC, Northern district, NSRKC
  - WAIRKC and NSRKC genetically distinct from other three stocks
  - No genetic information on Northern district
  - Tagging studies on going – some movement within BB and Northern area





Grant and Cheng 2012

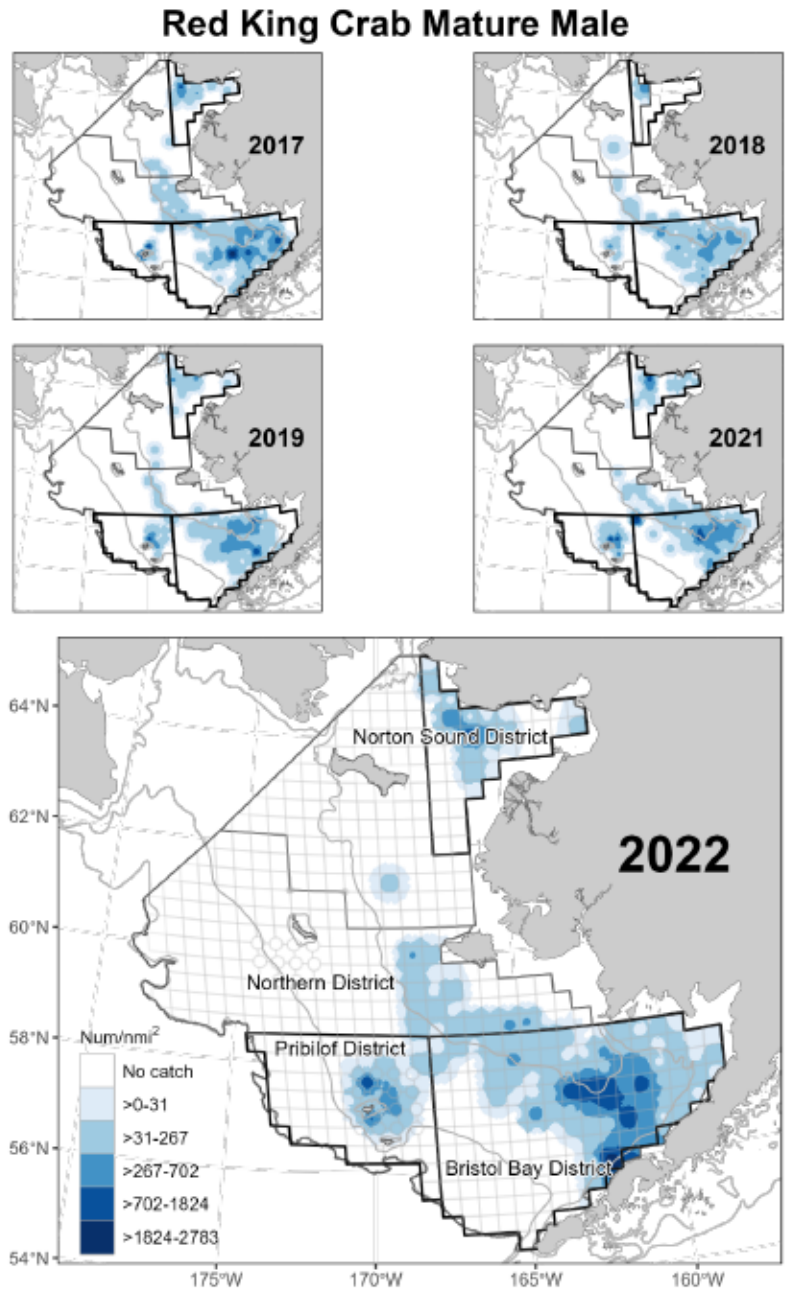


Figure 28. -- Estimated total density of mature-sized (≥ 120 mm carapace length in EBS and ≥ 94 mm in NBS) male red king crab (*Paralithodes camtschaticus*) for the past five survey years. Outlined areas depict management districts.

2022 Tech Memo
NOAA trawl
surveys

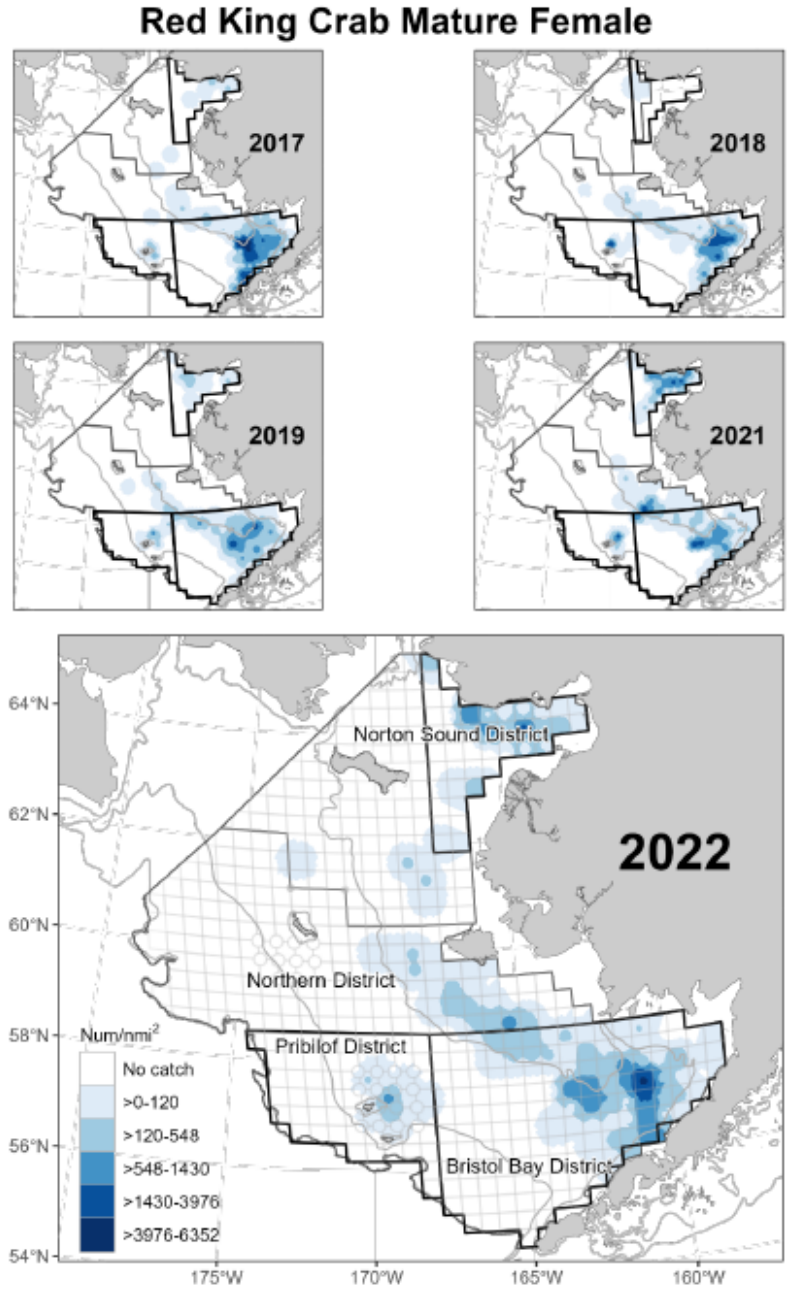


Figure 30. -- Estimated total density of mature female red king crab (*Paralithodes camtschaticus*) for the past five survey years. Outlined areas depict management districts. In years when a subset of stations were resampled, the resample stations replace data from the original stations.

RKC STOCK STRUCTURE FUTURE WORK / NEXT STEPS

- Draft template presented here
  - Focus on Southeastern Bering Sea stocks
    - NS and WAI distinct stocks based on genetics and growth, size, etc.
  - Improved plotting of available survey data – specifically for PIRKC, BBRKC, northern district
  - Summary of tagging data that exists around Bristol Bay
  - Objective of determining if Northern district red crab are part of the functional BBRKC stock? Or alternative objective for this area
- Future work
  - Increased genetic sampling around Bristol Bay
  - Oceanographic information and potential larval flow?

CATCH ACCOUNTING UPDATE ON ELECTRONIC MONITORING (EM) AND CRAB

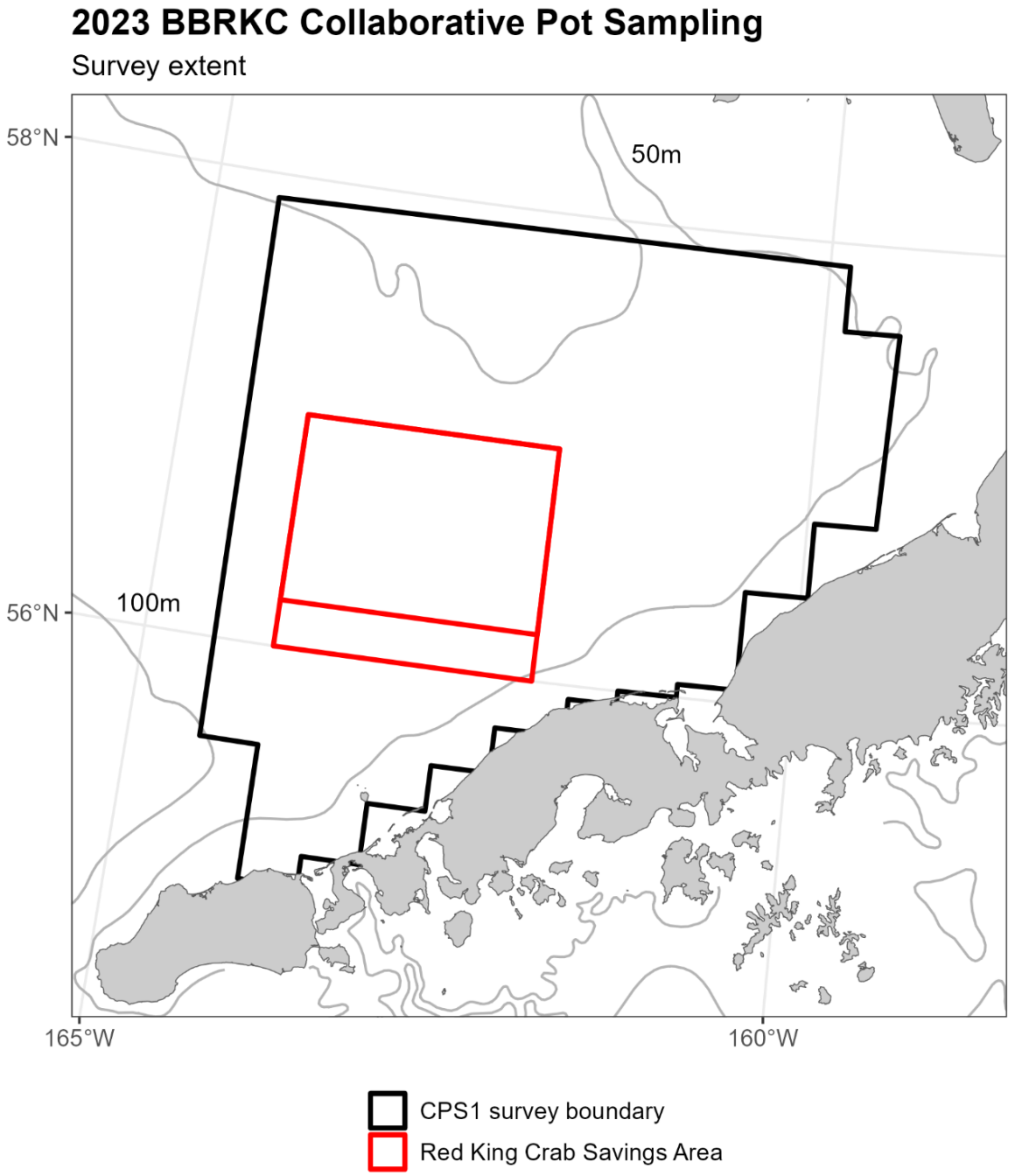
- Requested update to understand how crab are accounted for in EM
- EM on pelagic trawl – very little crab interaction or crab observed in offloads
- EM on hook-and-line and pot gear
  - Crab discarded, however large % are not able to be ID to species and therefore not counted
  - Lag in EM data so cannot be used for in season management
  - Currently a small percentage of fleet and not expected to expand
- CPT continues to be interested in accounting for these "unidentified" crab, even if they are not a large amount of the bycatch

BERING SEA FISHERIES RESEARCH FOUNDATION (BSFRF) UPDATE

Collaborative Pot Sampling (CPS) of Bristol Bay red king cra

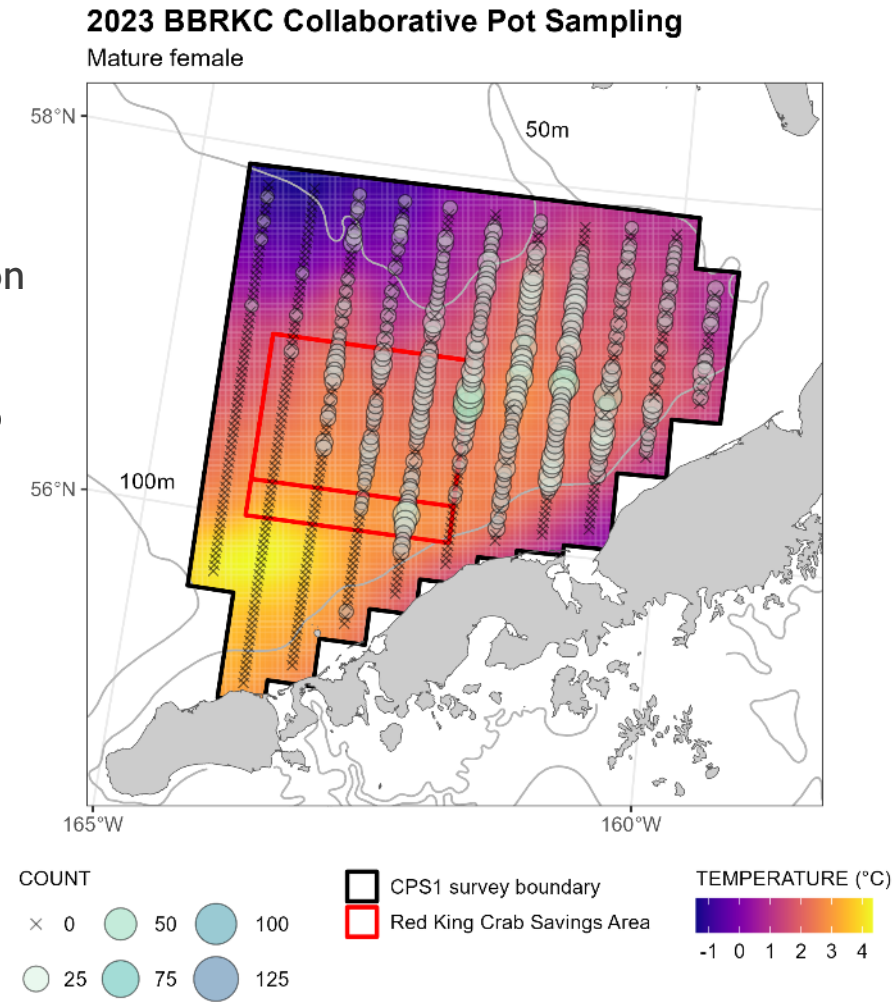
- Cooperative ADF&G, NOAA, BSFRF effort
- 2 vessels, ~ 25 days each, March-early April
- Goals:
  - Winter distribution data
  - Tagging data to connect winter and summer distribution
- 636 potlifts
- 10,191 RKC captured
- 100 satellite tags deployed
- Distribution data publicly available:

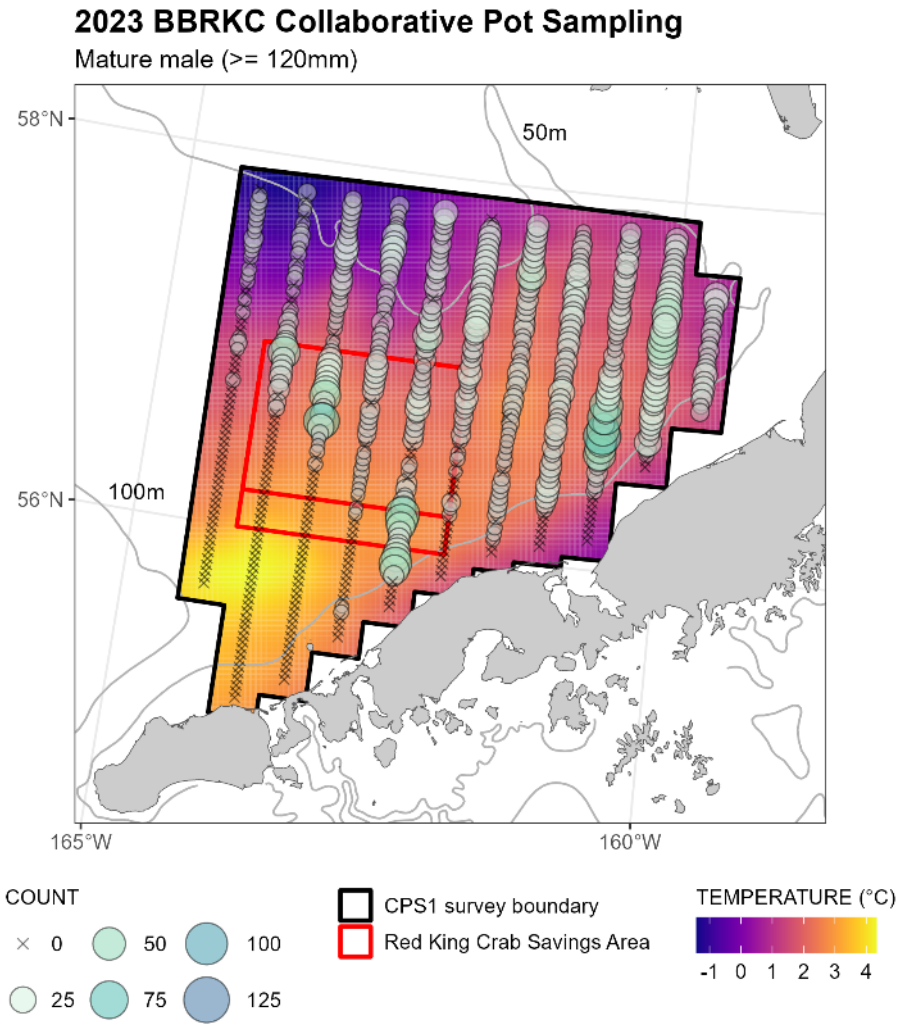
https://github.com/AFSC-Shellfish-Assessment-Program/CPS1



COLLABORATIVE POT SAMPLING

- Catch 23% female, 77% male
  - Molt timing or distribution difference?
- Tags currently popping up (coinciding with summer survey)
- Tentative plans for two more years





UNOBSERVED CRAB MORTALITY: NEXT STEPS

- SSC recommends working group (October 2022): "to develop a framework for how to estimate the magnitude of unobserved mortality for crab stocks and how these estimates may be utilized in BSAI crab assessments"
- Supported by Council (December 2022)
- CPT discussion:
  - Possible use of unobserved mortality estimates inside and outside assessments (e.g. for conservation)
  - Could review available data and guide future research
  - Could guide planned research on fishing interactions with specific life history stages (Erin Fedewa, AFSC)
  - Suggested initial interagency working group with subsequent public workshop
  - Possible expertise / personnel / groups to include were discussed
  - Tentative start date: early 2024

QUESTIONS?

- Thanks to all CPT members and crab authors.