

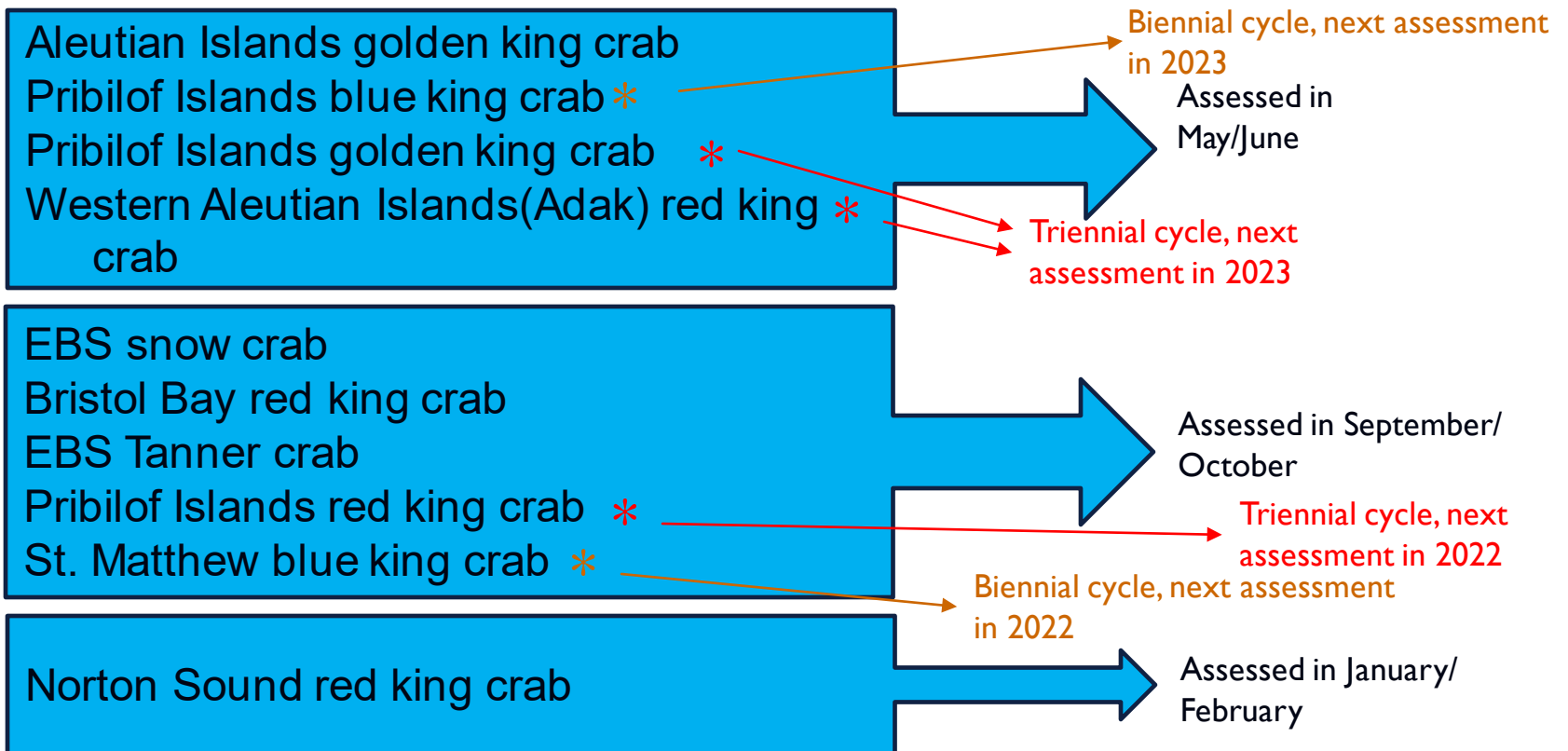
C2 BSAI CRAB STOCKS

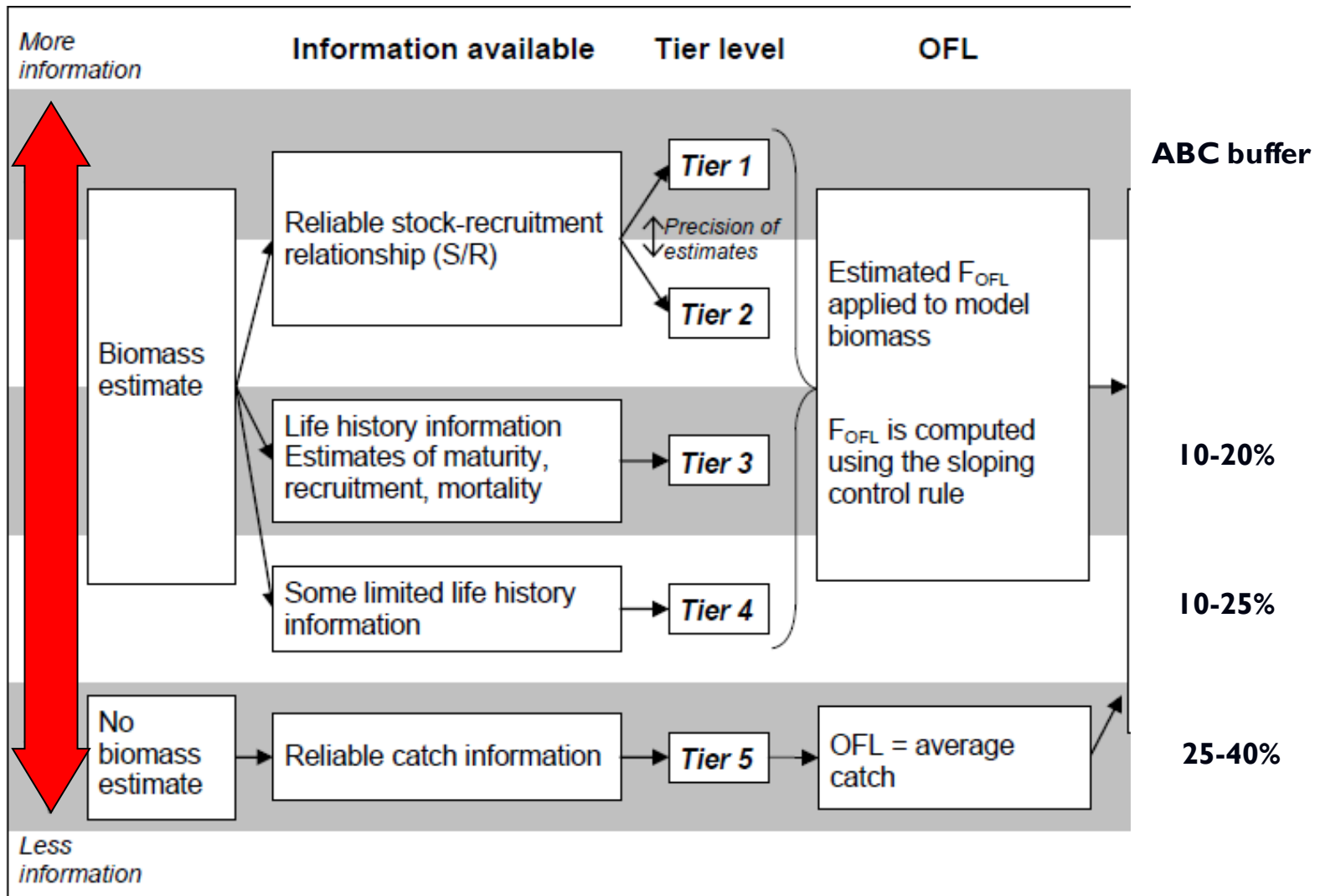
KATIE PALOF & MIKE LITZOW,

CPT MEETING MINUTES – JANUARY 10 – 15TH, 2022



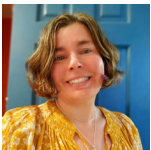
BSAI CRAB STOCKS MANAGEMENT TIMING





JANUARY 2022 AGENDA

- ✓ **NSRKC final assessment, OFL and ABC**
- ✓ Modeling workshop/GMACS updates and progress
- ✓ AIGKC proposed model runs for May/June
- ✓ Bering Sea trawl survey updates
- ✓ EFH components 1 & 2 feedback
- ✓ Updating TOR for crab SAFEs
- ✓ Snow crab rebuilding progress update
- ✓ Crab Economic SAFE
- ✓ ESP snow crab indicators updates
- ✓ Discussion on F35% origin and potential future alternatives
- ✓ ACLIM management scenarios for Bering Sea stocks
- ✓ Research updates: BSFRF research projects
- ✓ Risk table draft planning



NORTON SOUND RED KING CRAB (NSRKC)

FINAL ASSESSMENT 2022



NSRKC MODELING APPROACH

- Male only assessment
- Seven size bins
- Fit to NMFS bottom trawl survey and ADF&G trawl survey in Norton Sound
- $M = 0.18$ for length class 1-6, higher mortality for length classes 7 and 8
- Discard mortality = 0.2
- Fishery harvests occur instantaneously:
 - Winter fishery: Feb 01: Nov – May
 - Summer fishery: July 01: Jun – Sept
- Models presented here encompass updates to standardized CPUE calculations and exploration of natural mortality alternatives



FISHERY & SURVEY DATA

Winter fishery 2021

- Commercial: 320
- Subsistence: 4655 (total), 2892 (retained)
- Retained data: Not collected

Summer commercial fishery 2021

- 6/25-9/03: 0
- Discards 0, Bycatch from other fisheries: 0.
- No tag recovery

Total harvest: **0.007** mill. lb < ABC (0.35 mill. lb.)

- No overfishing occurred in 2021.

Standardized CPUE **Appendix B**

ADF&G 2021 Summer trawl survey

- **7/19-8/03: 2400.0 k, CV = 0.60**

NOAA 2021 NBS trawl survey

- **7/29-8/7: 2370.0 k, CV = 0.43**



MODEL OPTIONS

- Model 19.0e: with updated data (base with “proportional” discard estimate)
- **Model 21.0: Model 19.0e+ St CPUE with 3q’s + 2 summer commercial retention probabilities**
- Model 21.1: Model 21.0 with $M = 0.18$ for all length size classes (constant M)
- Model 21.2: Model 19.0e + St CPUE data updated with 3qs. (bridging 1)
- Model 21.3: Model 19.0e + 2 summer commercial retention probability (bridging 2)
- Model 21.4: Model 21.0 with M estimated equally for all length size classes (estimated constant M for all size classes)
- Model 21.5: Model 21.0 with M estimated for two length size classes (< 124mm, >123mm CL). (estimated M for two groups of size bins)

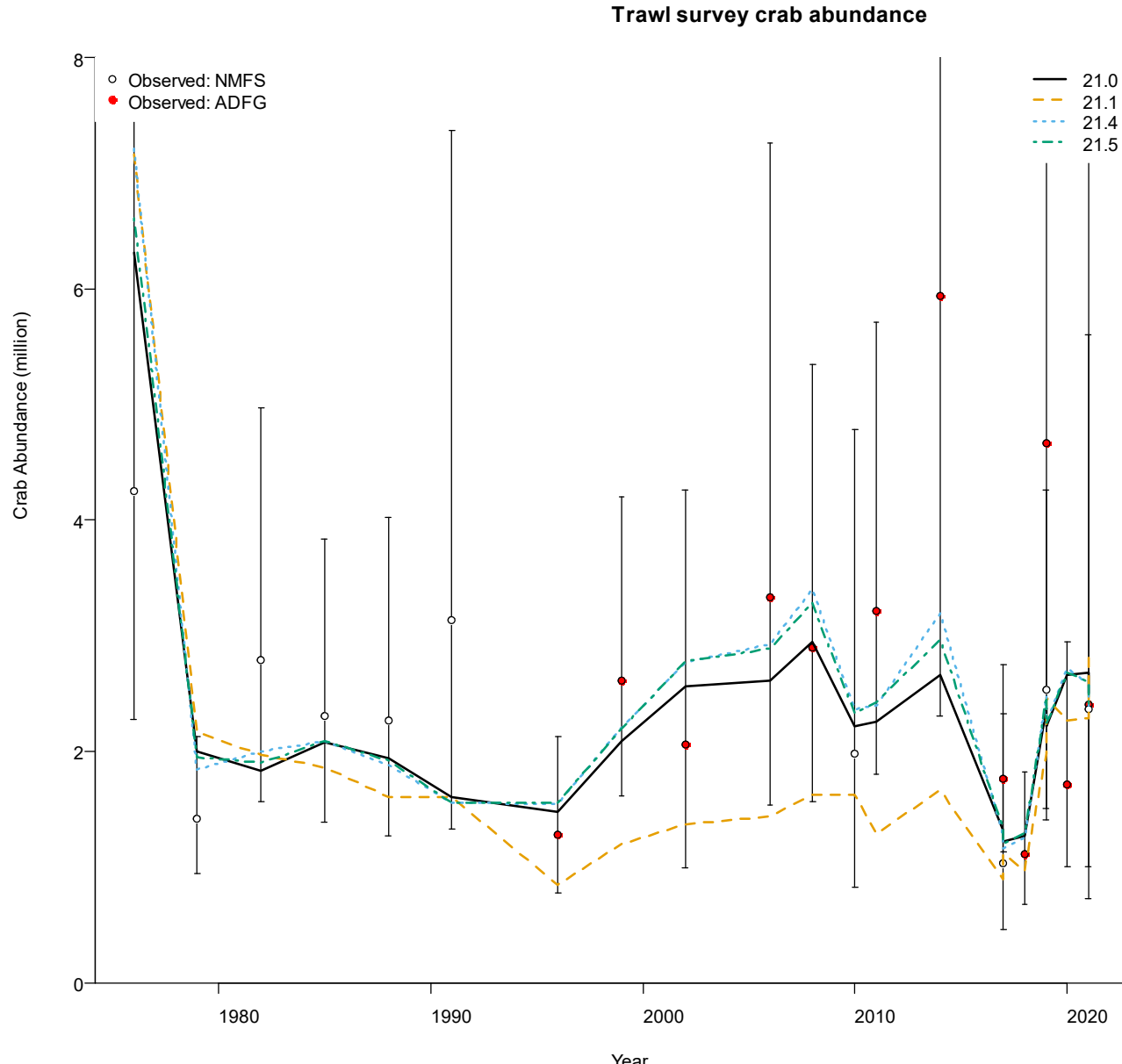


NSRKC FINAL ASSESSMENT MODELS: SUMMARY

- Explore M : Model 21.0, 21.1, 21.4, 21.5:
 - (rehash of NPFMC 2019 model alternatives).
 - No changes in overall results (as expected)
- Length-independent $M = 0.18$ (21.1) generates the poorest model fit.
- Length-independent higher M (21.4) moderately improves model fit.
- Length-dependent M (21.0) showed great improvement in model fit.
- Length-dependent higher M (21.5) had the best model fit.
- **None of the model alternatives greatly reduced misfit.**
 - **Large crabs, Oldshell crabs**

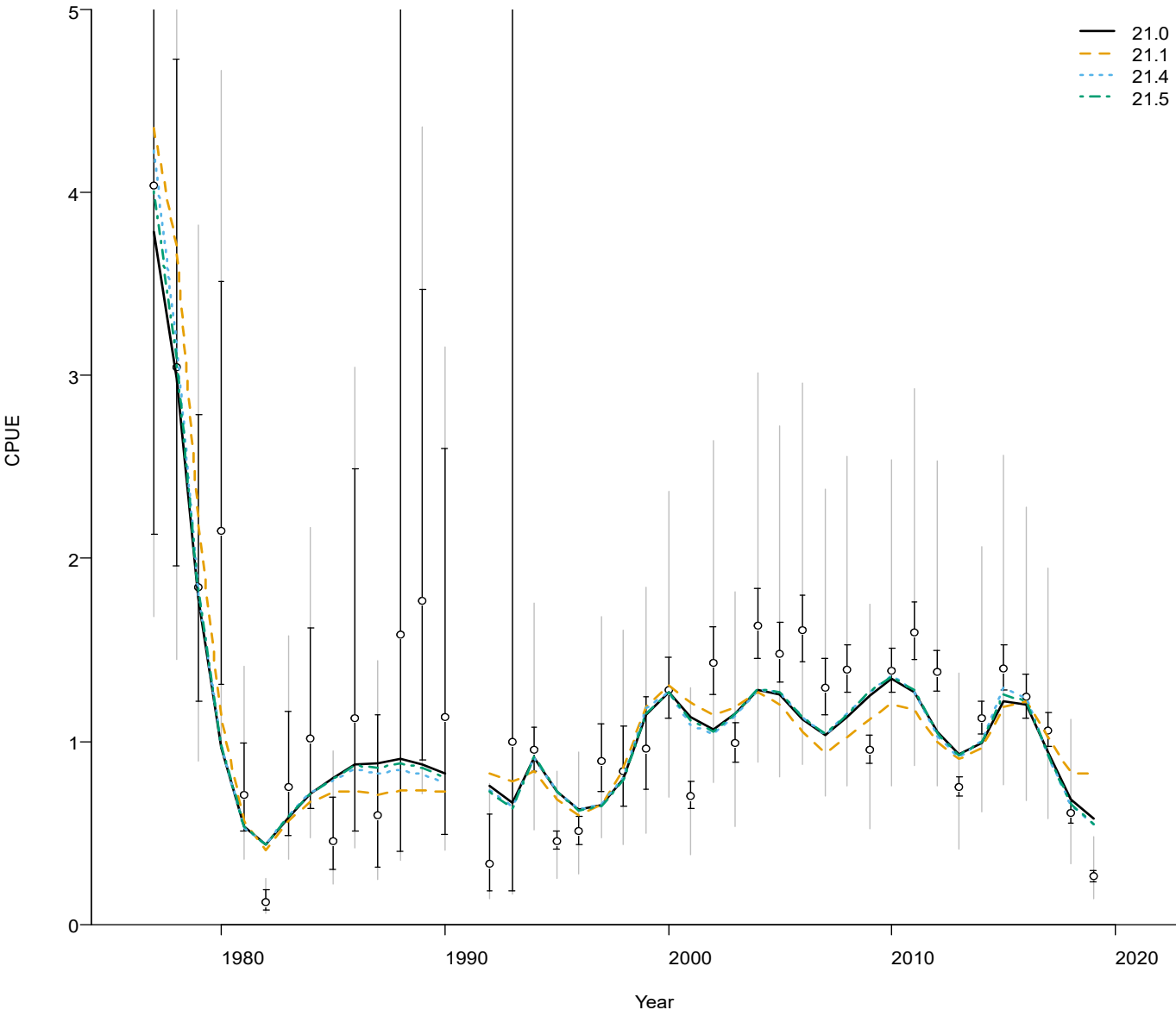


TRAWL SURVEY: HIGHER M SLIGHTLY BETTER FIT



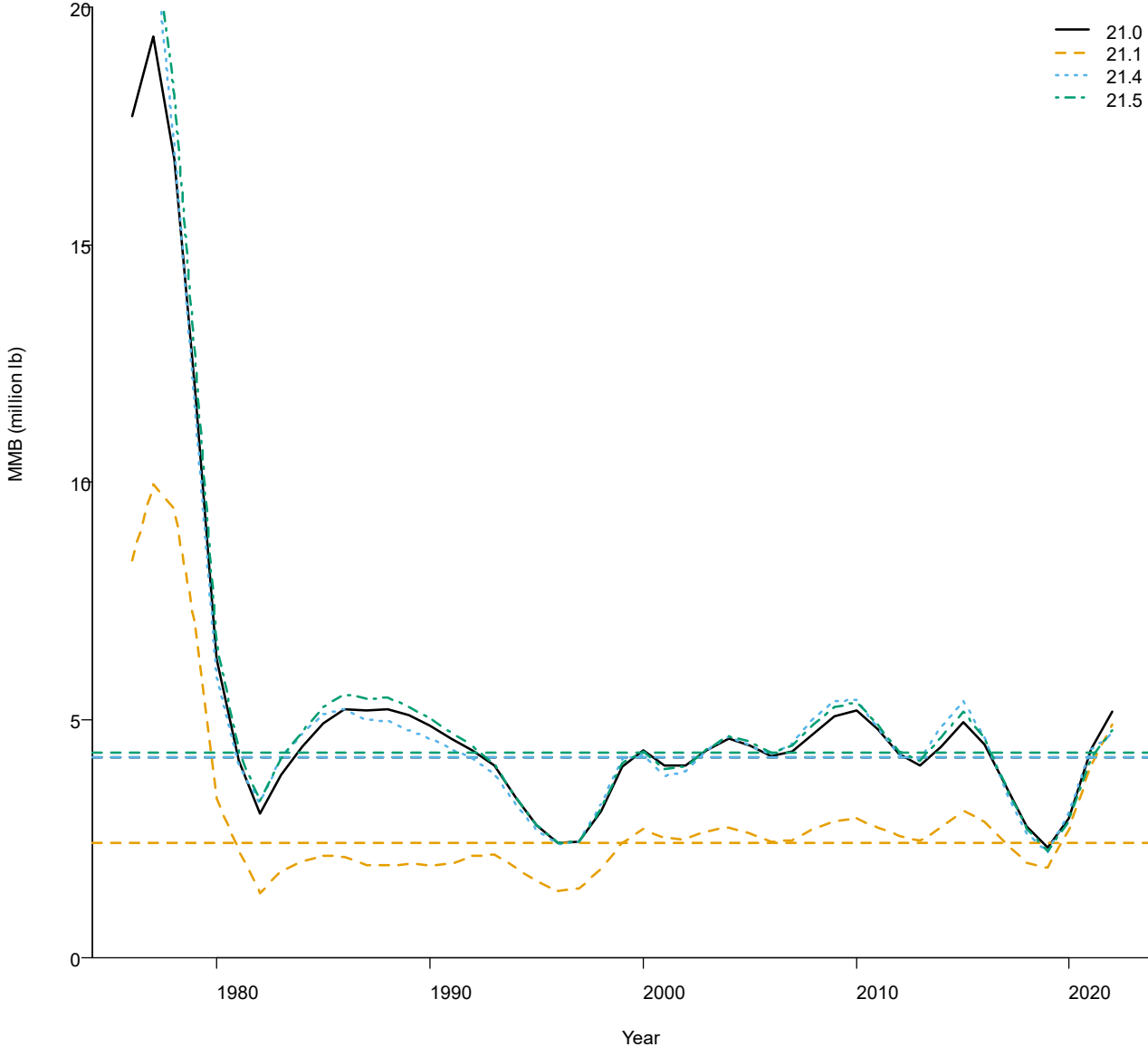
CPUE

Summer commercial standardized cpue



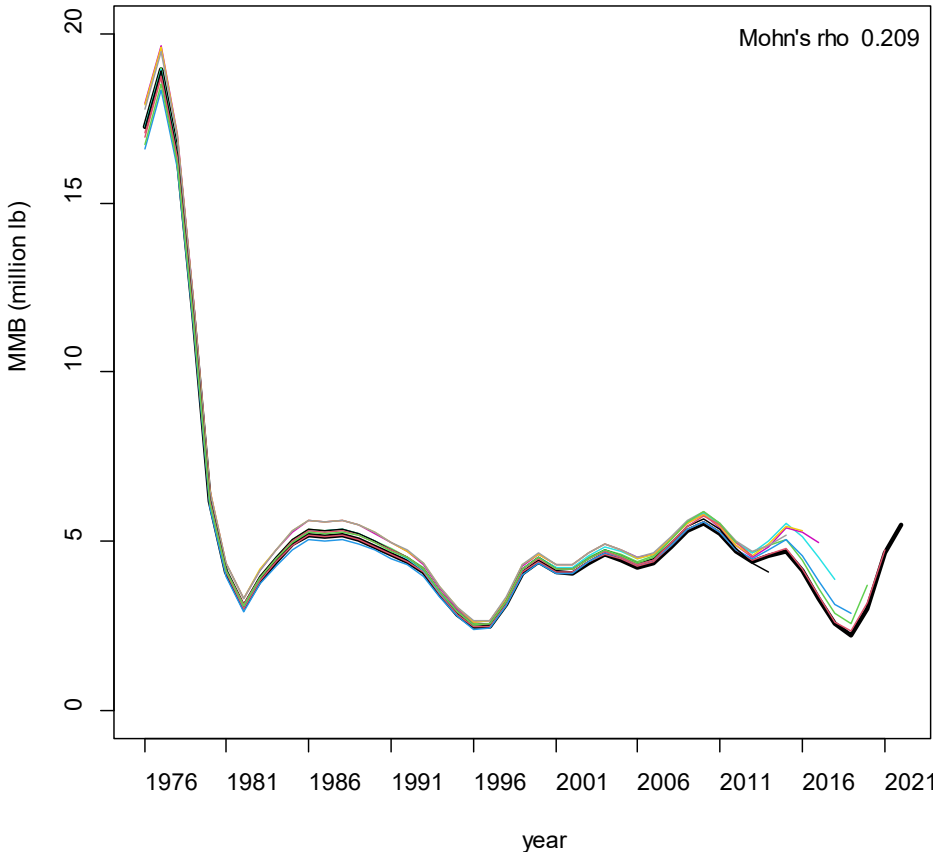
MMB

MMB Feb 01

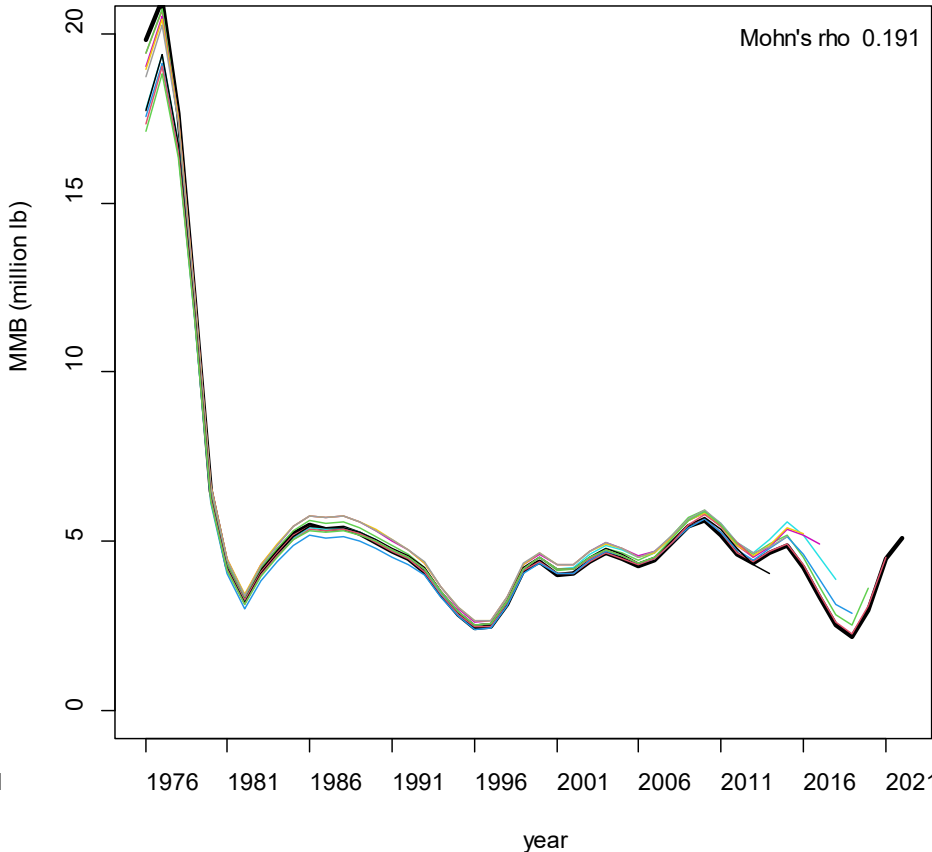


RETROSPECTIVE

Retrospective Analysis Model 21.0



Retrospective Analysis Model 21.1



NSRKC: CPT RECOMMENDATIONS

- Author recommended model 21.0 or 21.5 and length-dependent OFL
 - Consistent with model structure
 - Deal with uncertainty about length-dependent M in ABC buffer
- CPT recommended model 21.0 and length independent OFL
 - Concern that estimating two M's in model 21.5 was an overreach of the depth of the data available for this model
 - CPT would like to review length-dependent OFL calcs before moving to them; Tier 4 control rule does not cover this situation currently
- Buffer considerations (see Table in CPT minutes):
 - Some improvement in the stock but many concerns unresolved
 - Retrospective patterns, shortage of discard data, high M for large size classes, low fishery CPUE, some evidence of recruitment in survey size comps, selectivity parameters hitting bounds
 - Adopt 40% buffer that was adopted in 2021



NSRKC FINAL OFL/ABC

⊕ *Status and catch specifications (million lb.)* ⊕

Year	MSST	Biomass (MMB)	GHL	Retained Catch Mortality ¹	Total Catch Mortality ²	OFL ³	ABC ³
2018	2.41	4.08	0.30	0.31	0.34	0.43	0.35
2019	2.24	3.12	0.15	0.08	0.08	0.24	0.19
2020	2.28	3.67	0.17	Conf.	Conf.	0.29	0.20
2021	2.26	5.00	0.31	0.007	0.007	0.59	0.35
2022	2.08	5.33				0.67	0.40

Status and catch specifications (1000 t)

Year	MSST	Biomass (MMB)	GHL	Retained Catch Mortality ¹	Total Catch Mortality ²	OFL ³	ABC ³
2018	1.09	1.85	0.13	0.14	0.15	0.20	0.16
2019	1.03	1.41	0.07	0.04	0.04	0.11	0.09
2020	1.04	1.66	0.08	Conf.	Conf.	0.13	0.09
2021	1.03	2.27	0.14	0.003	0.003	0.20	0.16
2022	0.95	2.42				0.30	0.18

Notes:

¹2018:2020: Refers to commercial fisheries only; 2021: refers to all (commercial + subsistence) retained catch

²2018:2020: Does not include discard mortality (total retained catch only; 2021: includes estimated discard mortality)

³OFL/ABC are total catch values starting 2021. (These were retained catch OFL/ABCs in previous years)



MODELING WORKSHOP: GMACS UPDATES

- AIGKC GMACS model will be presented as an option in May 2022
 - N matrix replicated, bridging model presented during modeling workshop
- Post-doc for GMACS (Mathieu Veron) – progress report in May 2022
 - Goal of unifying the king crab branch of GMACS with terminally molting branch
 - Documentation
 - Improved output/visualization package for R
- GMACS improvements
 - Size composition data modeling updates (can now choose survey or catch)
 - Jittering and retrospective option in GMACS were tested and appear to be working on SMBKC and BBRKC
 - Updated projection module to allow for differing conditions in terminal year OFL calc and projections (e.g. natural mortality, selectivity)
 - Projection module documentation and output was improved



AIGKC MODELING APPROACH

- Integrated male-only length-based models fitted to fishery dependent catch and CPUE data.
- *Constant M* of 0.21yr^{-1} .
- 5 models for **EAG** and 6 models for **WAG**.
- CPT/SSC comments / concerns:
 - Maturity analysis – repeated in Appendix B
 - 116 mm CL vs 111 mm CL (currently used in assessment)
 - CPT requested more background on the 111 mm CL for May
 - Pre-lim look at NMFS Aleutian Islands trawl survey data – Appendix D
 - No sex or size data available
 - There is spatial overlap
 - CPUE standardization
 - Some additional plots and comparisons needed for May to adopt inclusion of year*area interactions

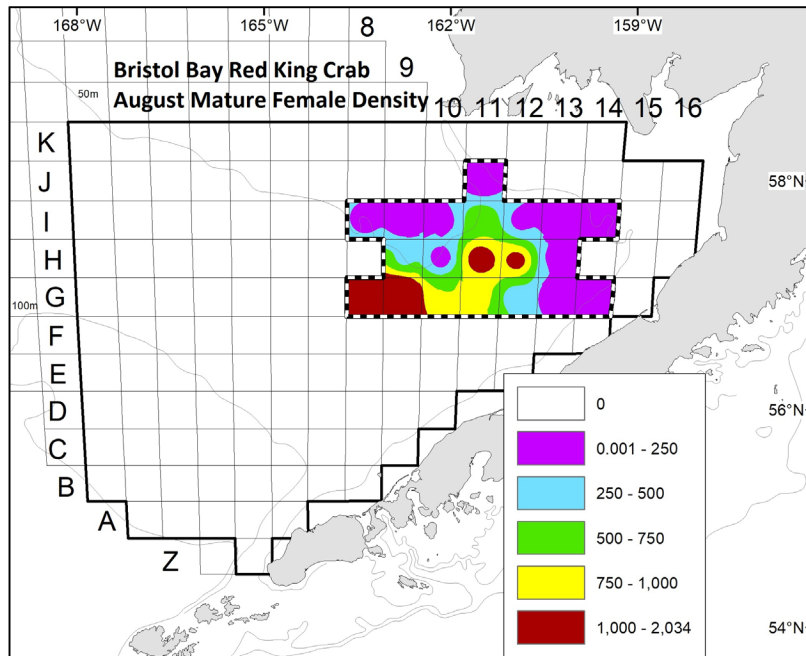


AIGKC MODELING

- Modeling options presented in Jan include:
 - Updates to standardized CPUE calcs to include year*area interactions
 - Parameterizations of catchability on the fish ticket and observer CPUE time series
 - Sensitivity analysis on WAG fleet
 - Updates to size at maturity using new data (collected in conjunction with fishery survey)
- Models for May include:
 - Base model from 2021
 - Updated base with changes to catchability parameterization, changes to st. CPUE calcs, and maturity options
 - GMACS versions of these models



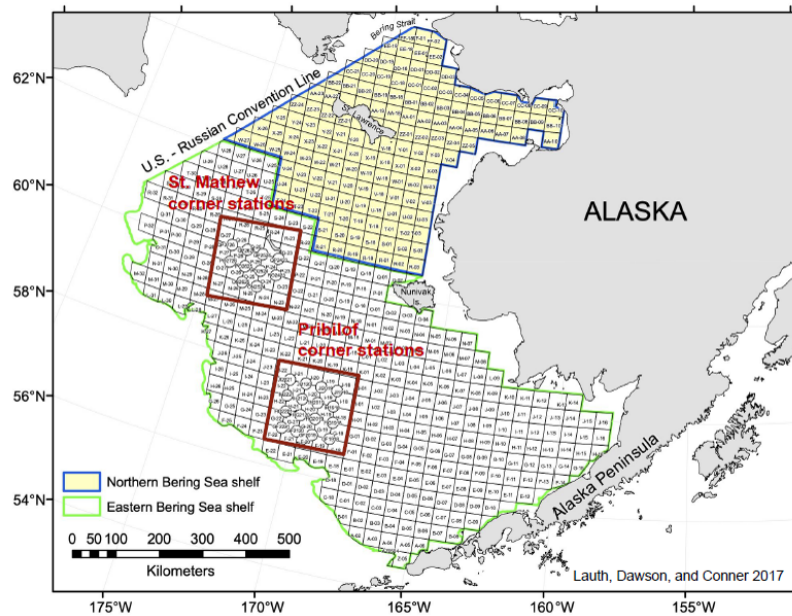
SURVEY UPDATE – BRISTOL BAY RESAMPLING



- Evaluation of 10% threshold for resampling female red king crab
- CPT feedback:
 - Distinguish two goals: evaluating female reproductive status and abundance
 - Evaluate impact different threshold would have had on resampling decision in past years
 - Evaluate effects of resampling on reproductive status and abundance data
 - Consider standardizing station selection for resampling
 - Additional presentation and possible decision in May 2022



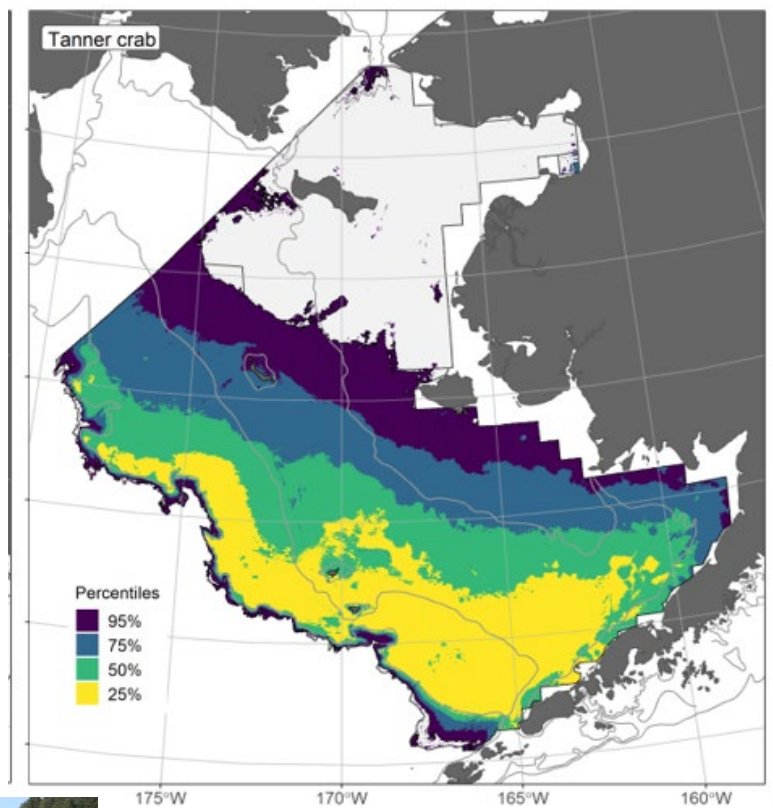
SURVEY UPDATE – CORNER STATIONS



- Analysis of dropping St. Matthew and Pribilof Islands corner stations
- CPT feedback:
 - Concerns about survey reduction and comparability over time
 - Extend analysis to size compositions and stock assessments
 - Additional presentation requested for May 2022



ESSENTIAL FISH HABITAT UPDATE



- Five-year review: EFH description and assessment of fishing effects
- CPT feedback on fishing effects model:
 - Requests a flowchart for evaluating fishing effects on overfished crab stocks
 - Requests SSC to discuss potentially reducing 10% CEA threshold for overfished stocks
 - Further research on contact adjustment and gear footprint
 - Include non-fishing effects and Alaska-specific gear effects
 - Split out EFH products by management area



SNOW CRAB PROGRESS AND REBUILDING UPDATES

DISCUSSION ITEMS FOR SNOW CRAB REBUILDING PLAN

Necessary items for developing rebuilding alternatives for analysis:

- Projections for T_{min} and T_{max}
- to be considered in May
- Additional considerations for rebuilding plan: To be discussed under C3 progress report (this meeting) and in June on development of alternatives:
 - Bycatch in groundfish fisheries?
 - Trawl limit under COBLZ
 - Fixed gear no limit
 - Habitat considerations?

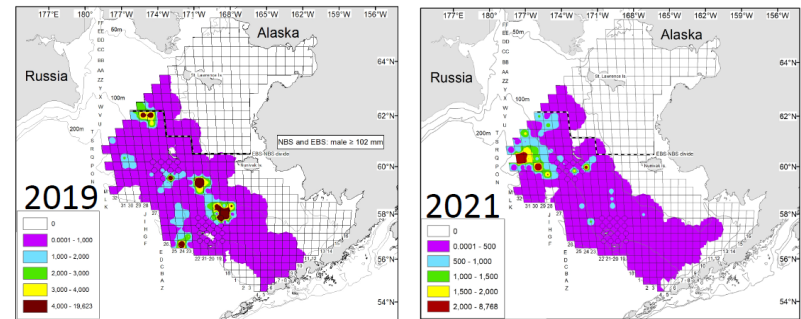


OCTOBER CONCLUSIONS FOR SNOW CRAB

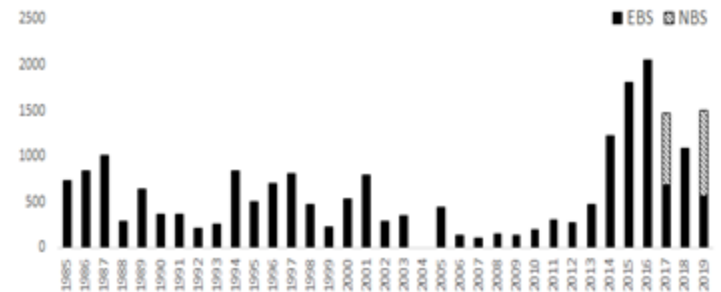
- Hypotheses for dramatic decline in population
 - **The crab are dead: large mortality event**
 - The crab are alive: movement out of survey area or survey misspecification
- **Mortality event most likely**
 - Large loss of all aspects of population – mature and immature
 - Predation increase
 - Disease
 - Cannibalism



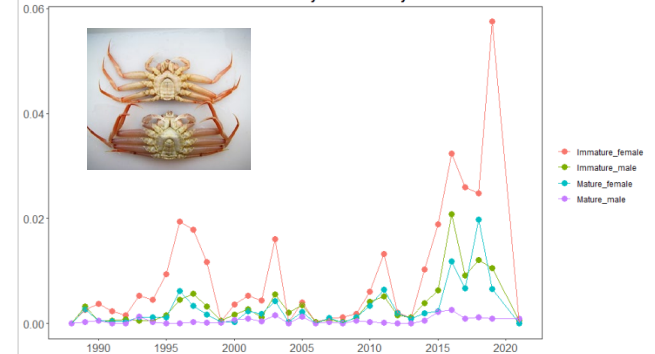
INDUSTRY PREFERRED MALES



Consumption of *C. opilio* by Pacific cod (mt/day)



Disease Prevalence by Sex & Maturity



ACTIVITIES SINCE OCTOBER

What happened?

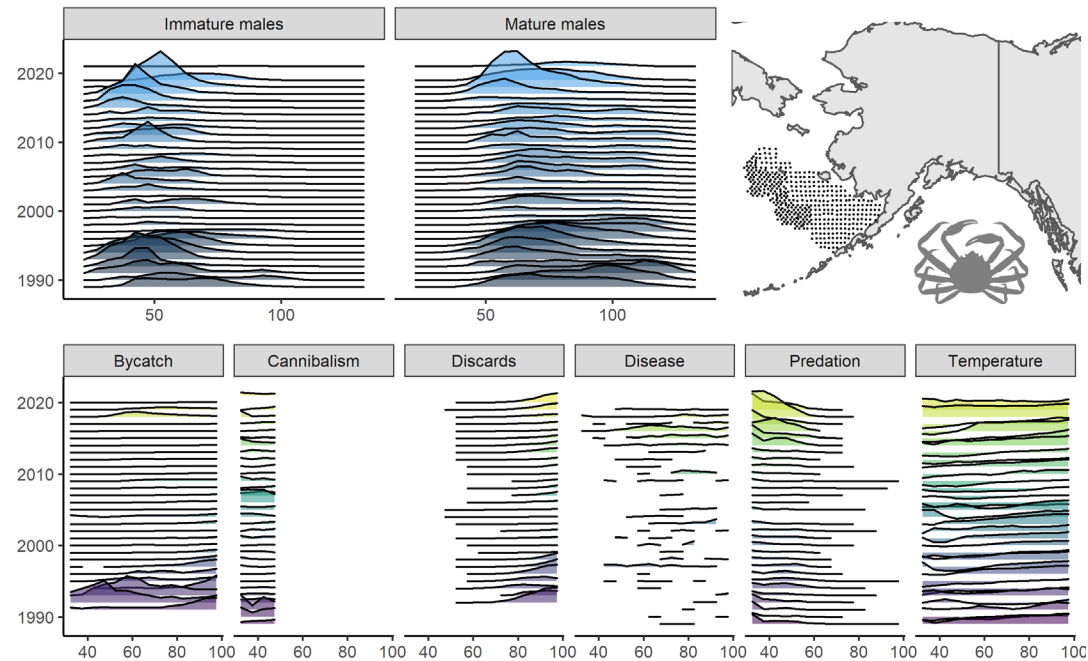
- Male only population dynamics model + GAM
- Predation, temperature, disease, cannibalism, fishery effects

GMACS

- Time-varying natural mortality
- Renewed adoption

Rebuilding

- Projections
- Recruitment, natural mortality, other potential scenarios



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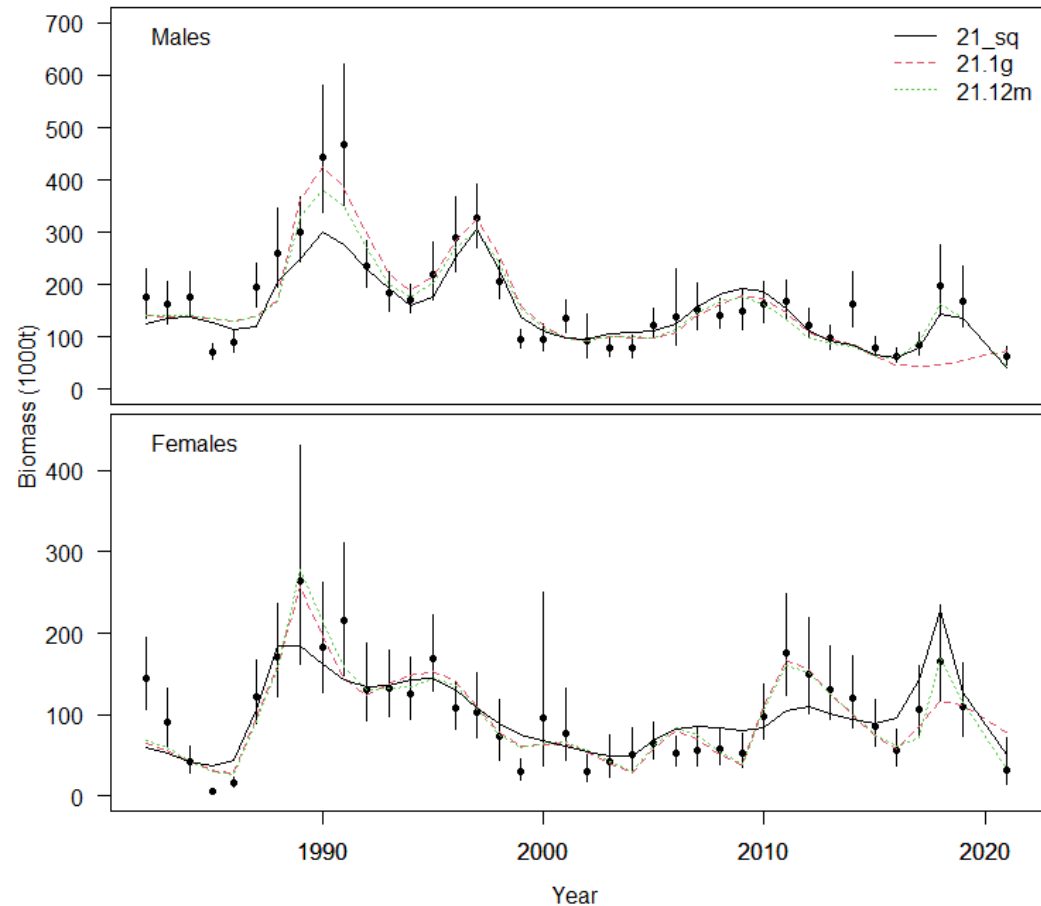
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- **Time-varying natural mortality**
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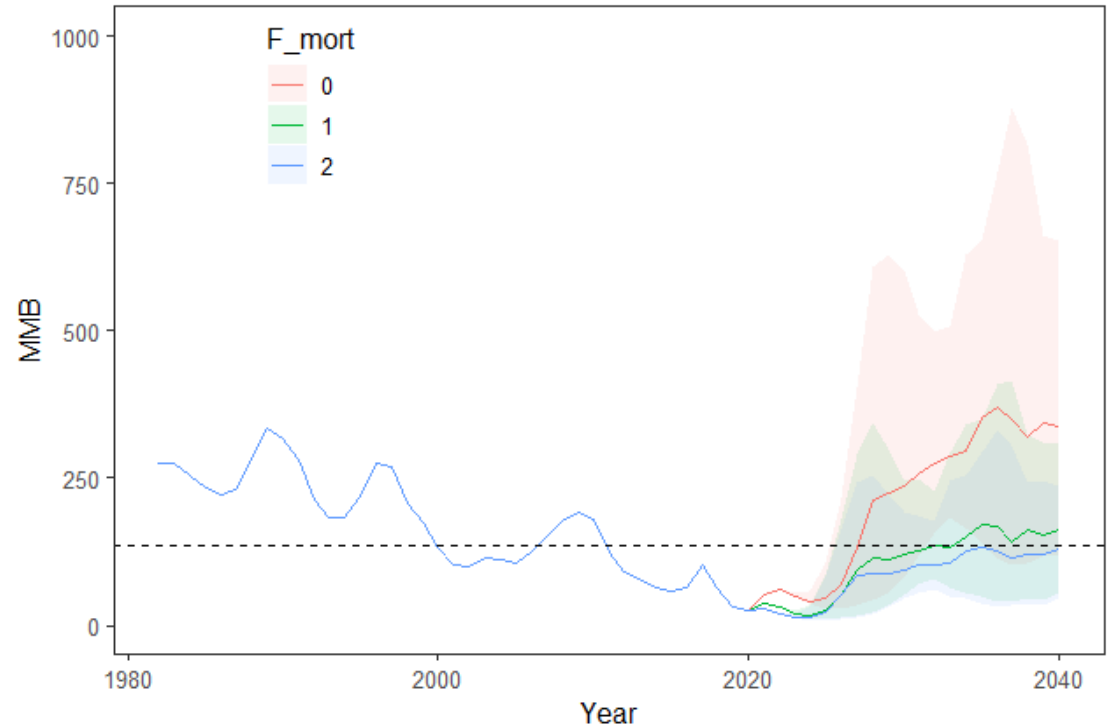
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GMACS

- Time-varying natural mortality
- Renewed adoption

Rebuilding

- **Projections**
- **Recruitment, natural mortality, other potential scenarios**



EXPECTATIONS FOR MAY/JUNE

- Summary of analysis to examine the dramatic snow crab decline
- GMACS model adoption (bridging analysis with status quo)
- Projections for rebuilding time frames, includes variations on:
 - Recruitment expectations for the future
 - Natural mortality expectations
 - Still increased? Or back to base level?
 - Fishing mortality options
 - No fishing
 - Bycatch only fishing
 - Range of possibilities that mimic the State of Alaska harvest strategy
- Rebuilding alternatives that include projection output (T_{\min} , T_{\max}) and other alternatives



QUESTIONS?

- Thanks to all CPT members and crab authors.
- Many thanks to Martin Dorn for his time served as CPT co-chair

