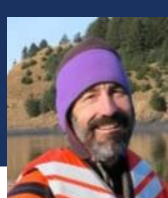
C3 BSAI CRAB STOCKS

KATIE PALOF & MIKE LITZOW,

CPT MEETING MINUTES – MAY 16 – 19TH, 2022



BSAI CRAB STOCKS MANAGEMENT TIMING

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

Biennial cycle, next assessment in 2023

Assessed in May/June

Triennial cycle, next assessment in 2023

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

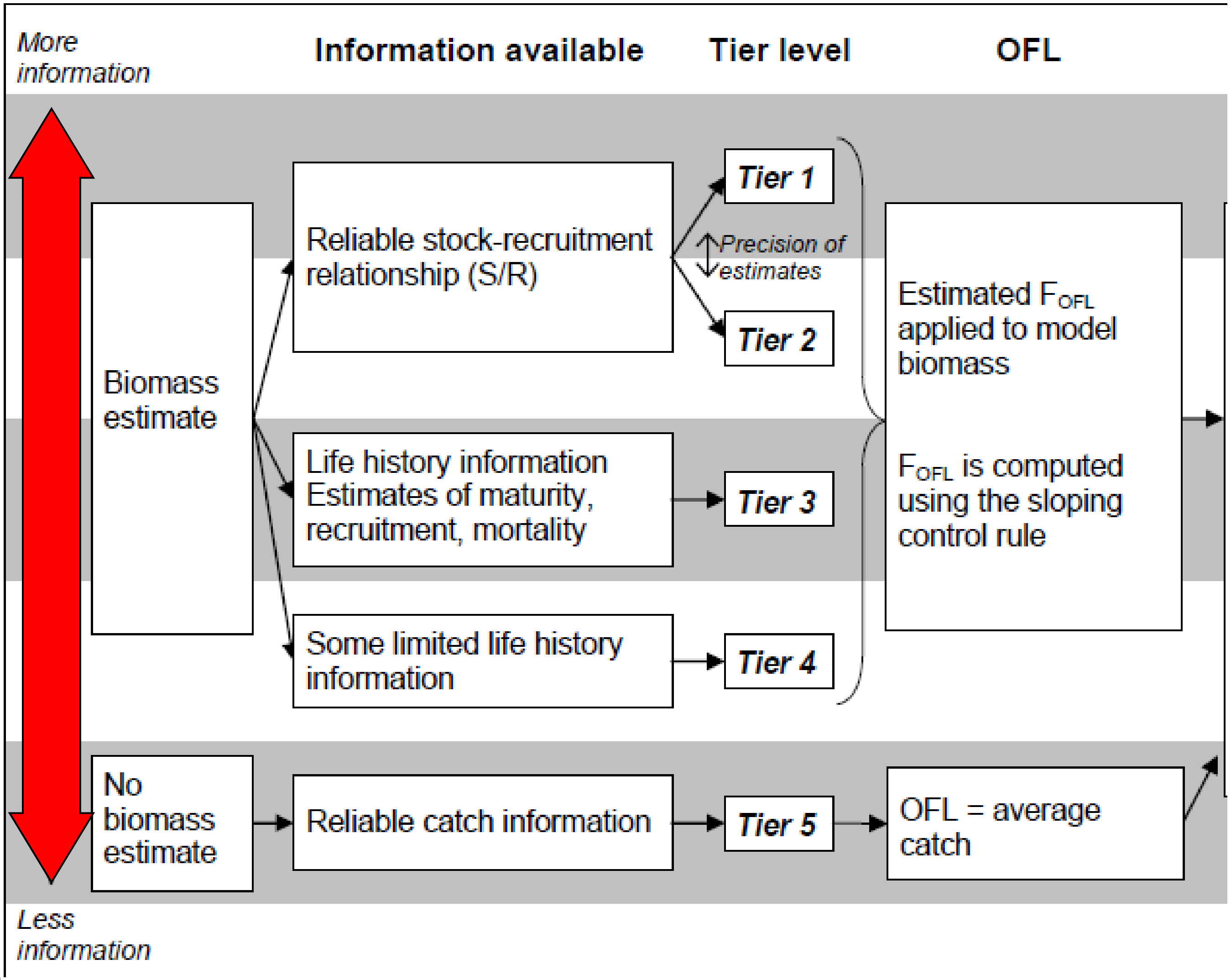
Assessed in September/ October

Triennial cycle, next assessment in 2022

Biennial cycle, next assessment in 2022

Norton Sound red king crab

Assessed in January/ February



ABC buffer

10-20%

10-25%

25-40%

MAY 2022 AGENDA

AIGKC final assessment, OFL and ABC

Proposed model runs for September:

- BBRKC, Tanner, SMBKC, PIRKC

Proposed model runs/GMACS adoption for snow crab

Snow crab rebuilding plan

Survey updates – corner station removal & BBRKC resampling protocols

Draft risk table updates - BBRKC

Research presentations – spatial assessment model for snow crab, snow crab IBM, BSFRF research projects

EFH next steps

Discussion on F35% and potential future alternatives

Timing of crab assessments discussion

BBRKC discussion paper planning (Oct)

Crab handling morality rate review

ALEUTIAN ISLAND GOLDEN KING CRAB (AIGKC)

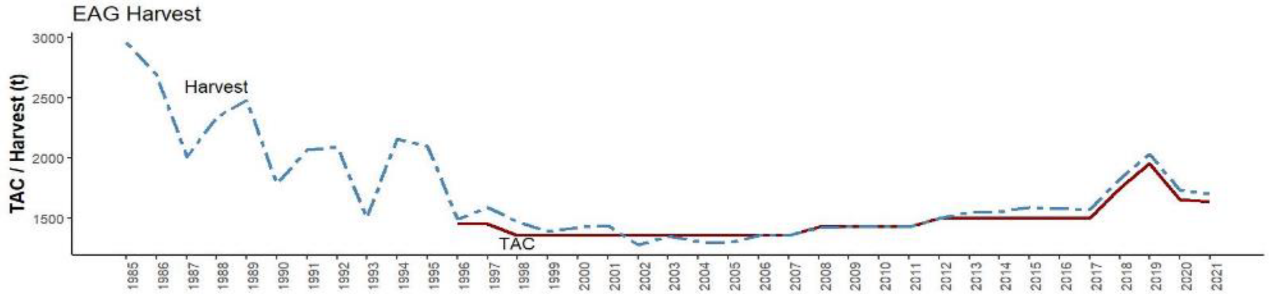
FINAL ASSESSMENT 2022

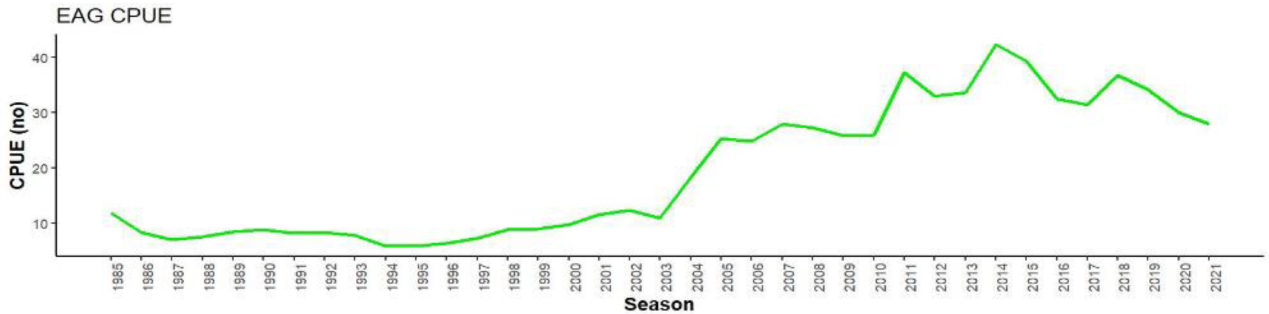
AIGKC MODELING APPROACH AND COMMENTS ADDRESSED

- Model approach:
  - Male-only, fitted to fishery dependent catch and CPUE data.
  - *Constant M* of 0.21yr^{-1}.
- 5 models with **GMACS** (Appendix E) counterparts for EAG and WAG.
  - Good progress with GMACS, very close to adopting
- Knife-edge size at maturity updates:
  - 111 mm CL (status quo)
  - 116 mm CL maturity size (new data) (Appendix C)
- Updated model structure with 3 catchability coefficients (base model assumes catchability is the same for fish ticket and early observer CPUE series)

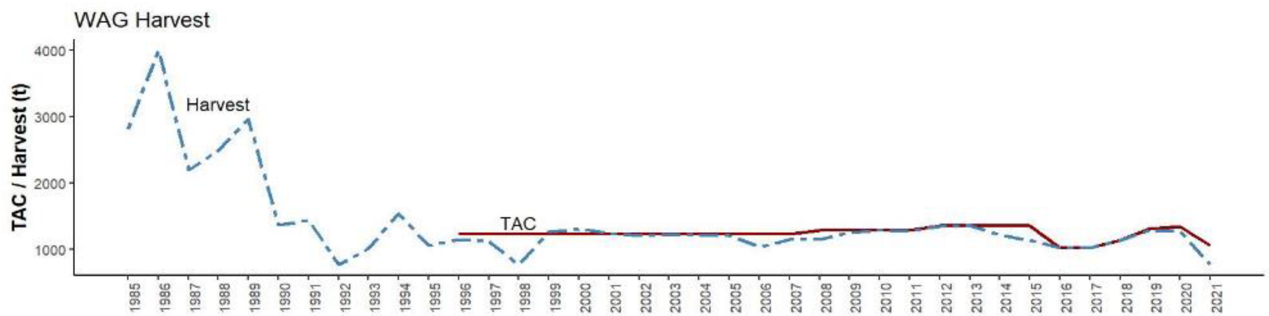
Catch (t) and CPUE (number of crab per pot lift), 1985/86–2021/22

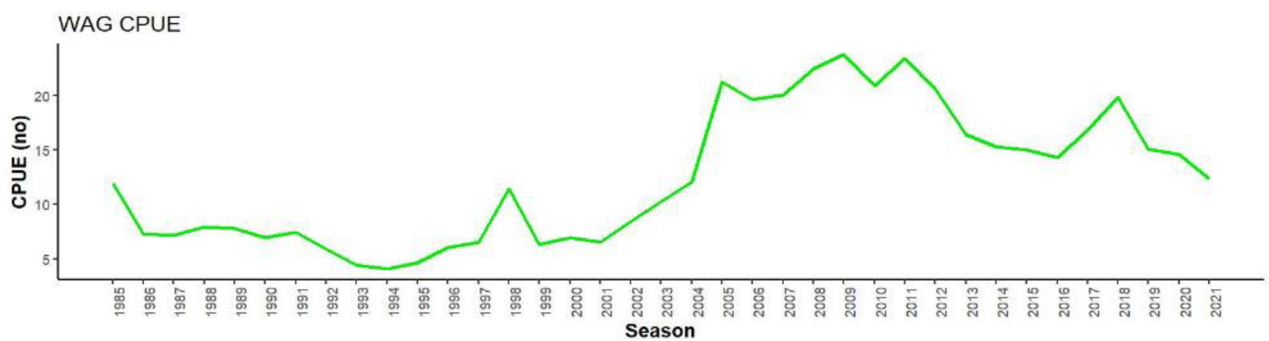
EAG





WAG





TACs :
2021/22:
(1) EAG: 3.61 million lbs
(2) WAG: 2.32 million lbs

*As of March 13, 2022, WAG fishery is ongoing (73%TAC harvested)

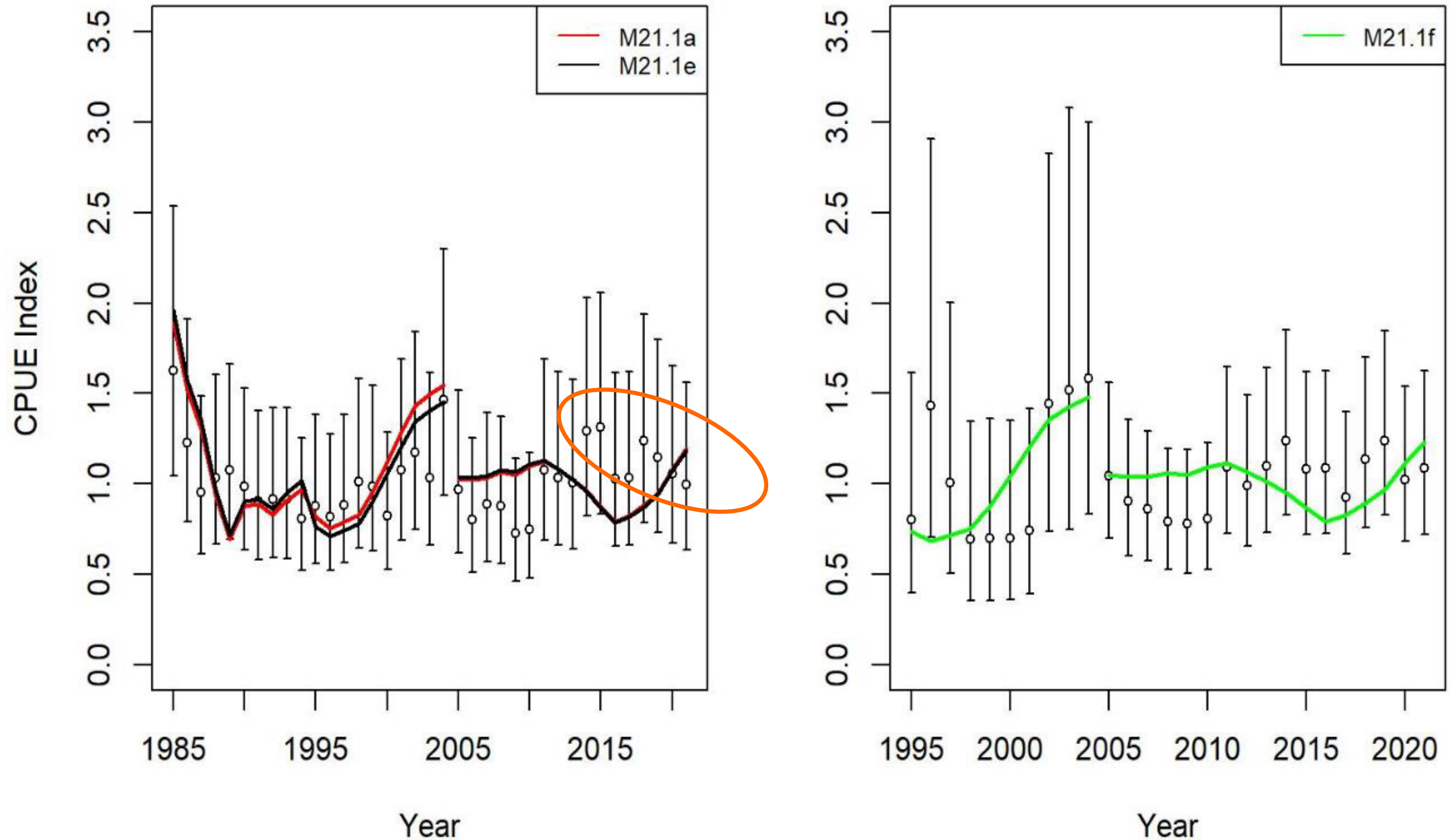


Figure 22. Comparison of input CPUE indices [open circles with +/- 2 SE for model 21.1a (left) and model 21.1f (right)] with predicted CPUE indices (colored solid lines) under 21.1a (red) and 21.1e (black)[left]; and 21.1f (green) [right] for EAG golden king crab data, 1985/86–2021/22. Model estimated additional standard error was added to each input standard error.

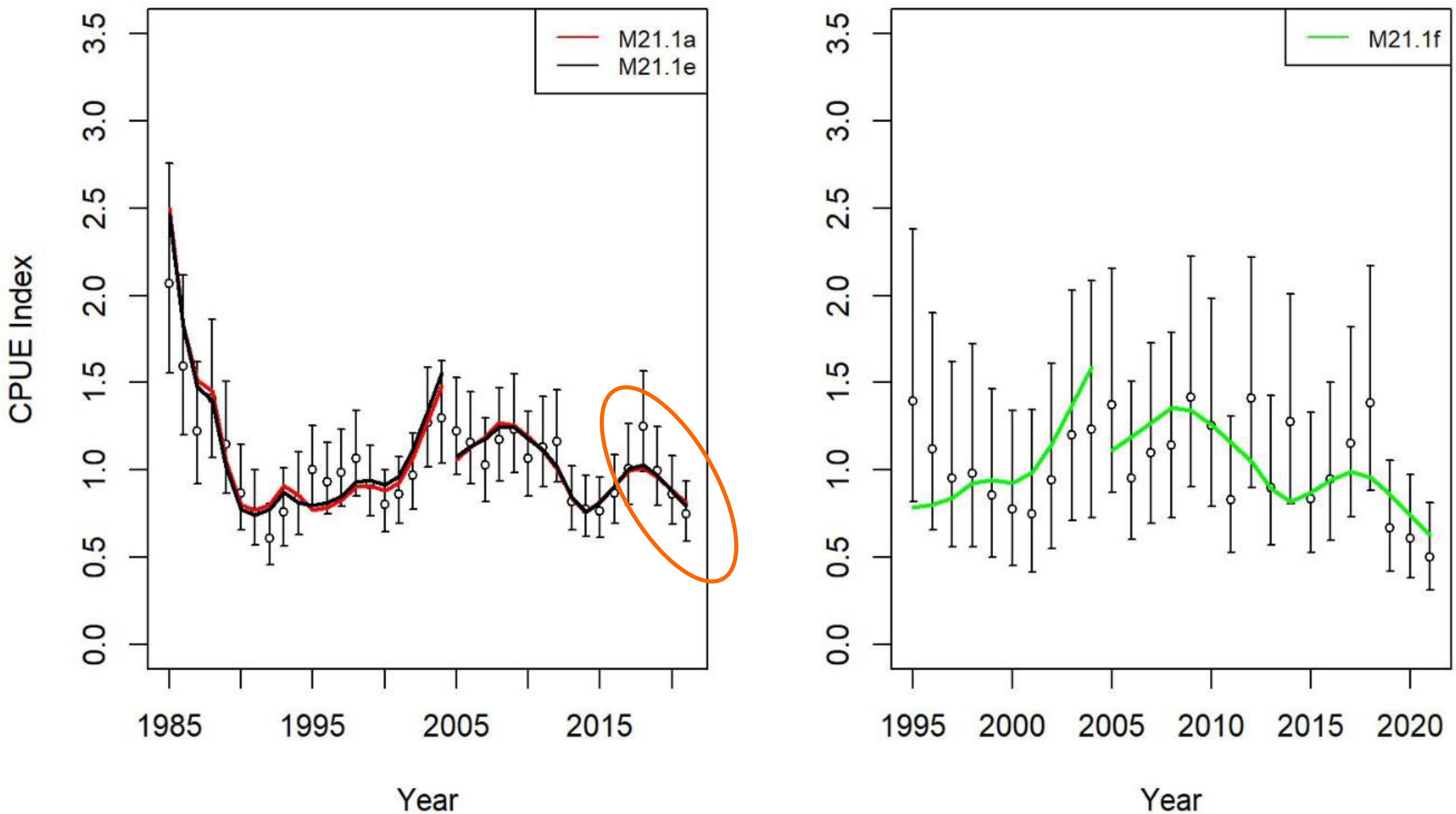


Figure 38. Comparison of input CPUE indices [open circles with +/- 2 SE for model 21.1a (left) and model 21.1f (right)] with predicted CPUE indices (colored solid lines) under 21.1a (red) and 21.1e (black)[left]; and 21.1f (green) [right] for WAG golden king crab data, 1985/86–2021/22. Model estimated additional standard error was added to each input standard error.

FIGURE 21. RETROSPECTIVE FITS OF MMB (WITH 9 PEELS) - 21.1A, 21.1E, AND 21.1EQ (VARIABLE CATCHABILITY DURING THE POST-RATIONALIZATION PERIOD) FOR GOLDEN KING CRAB IN THE EAG, 1961–2022.

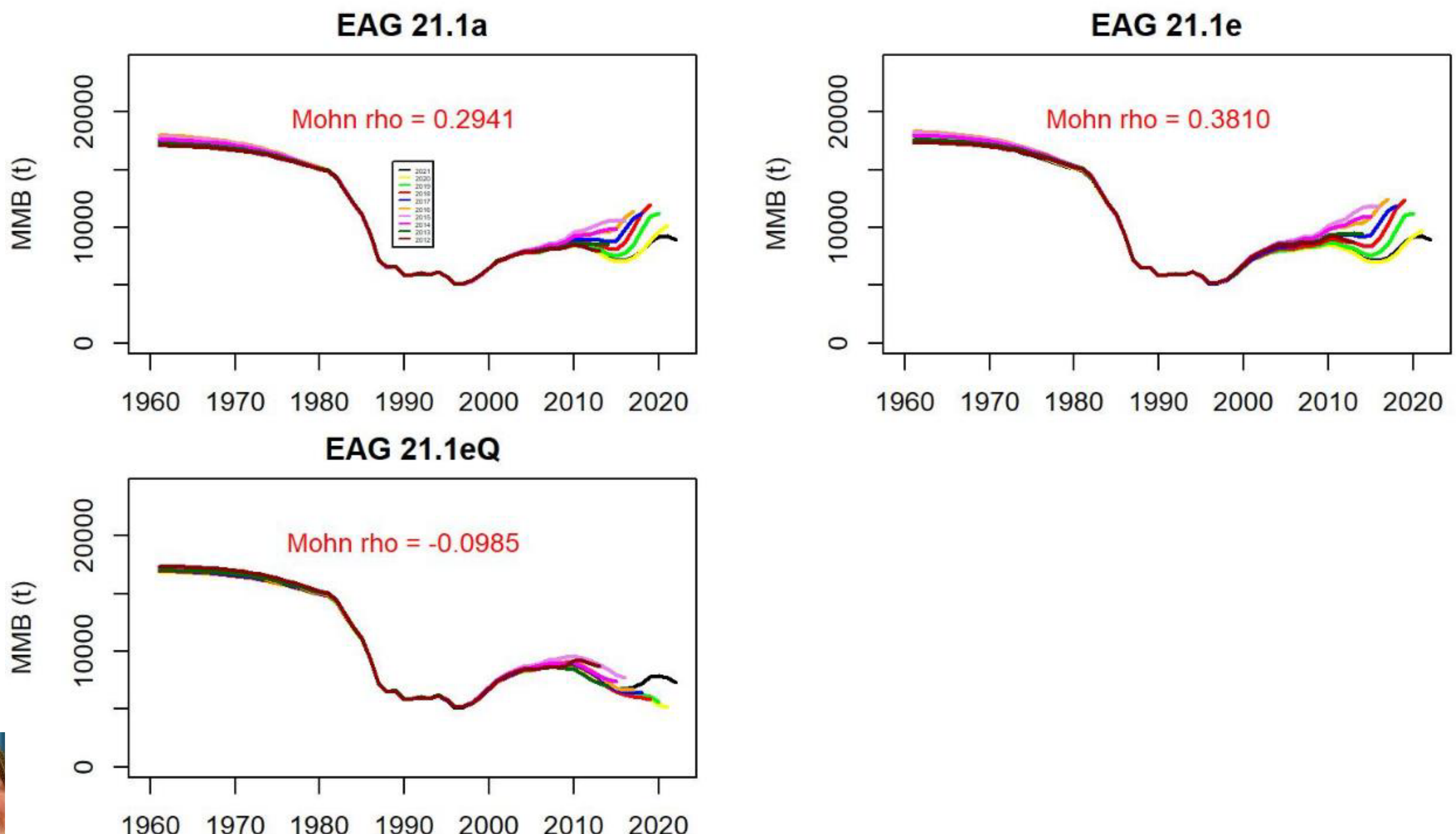
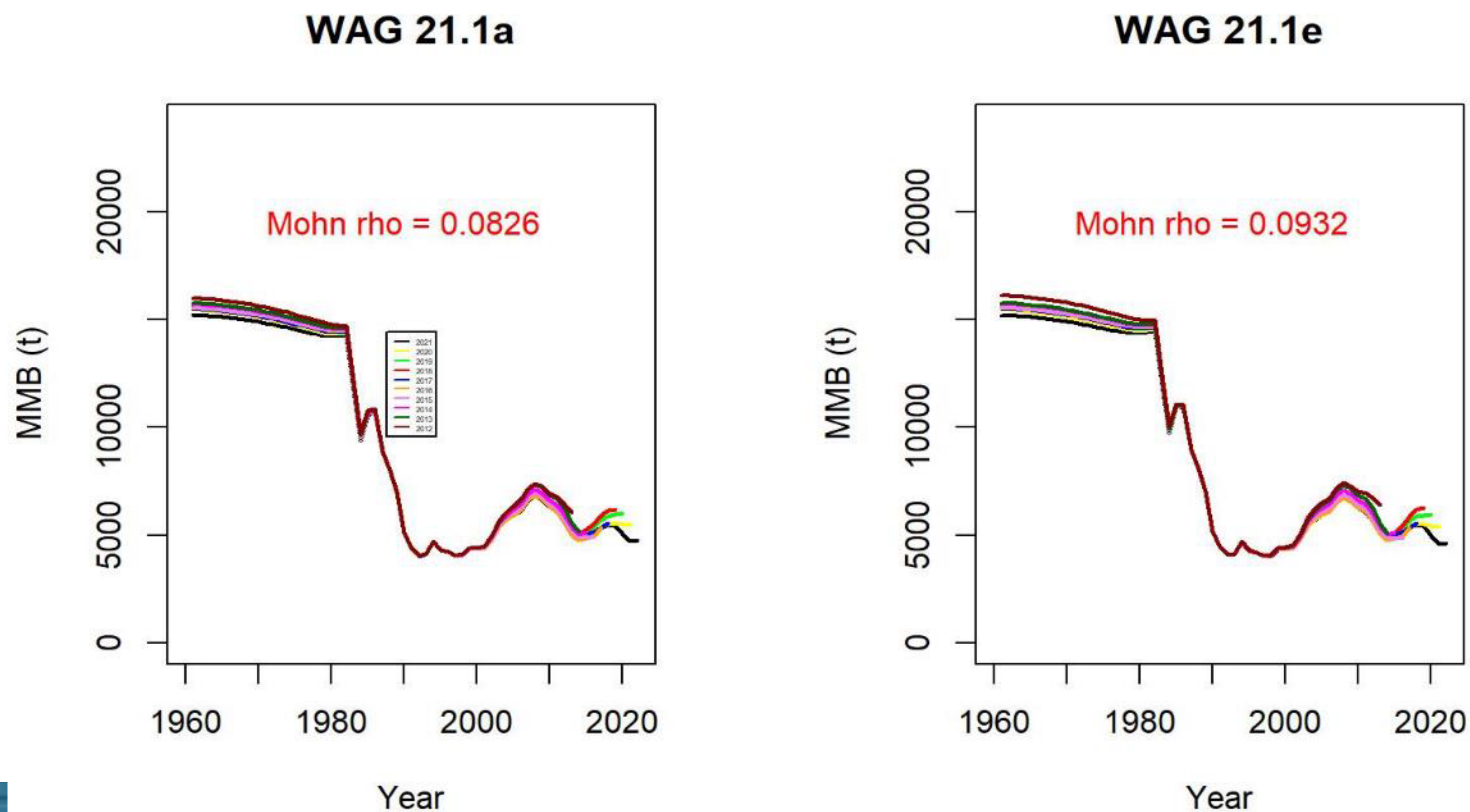
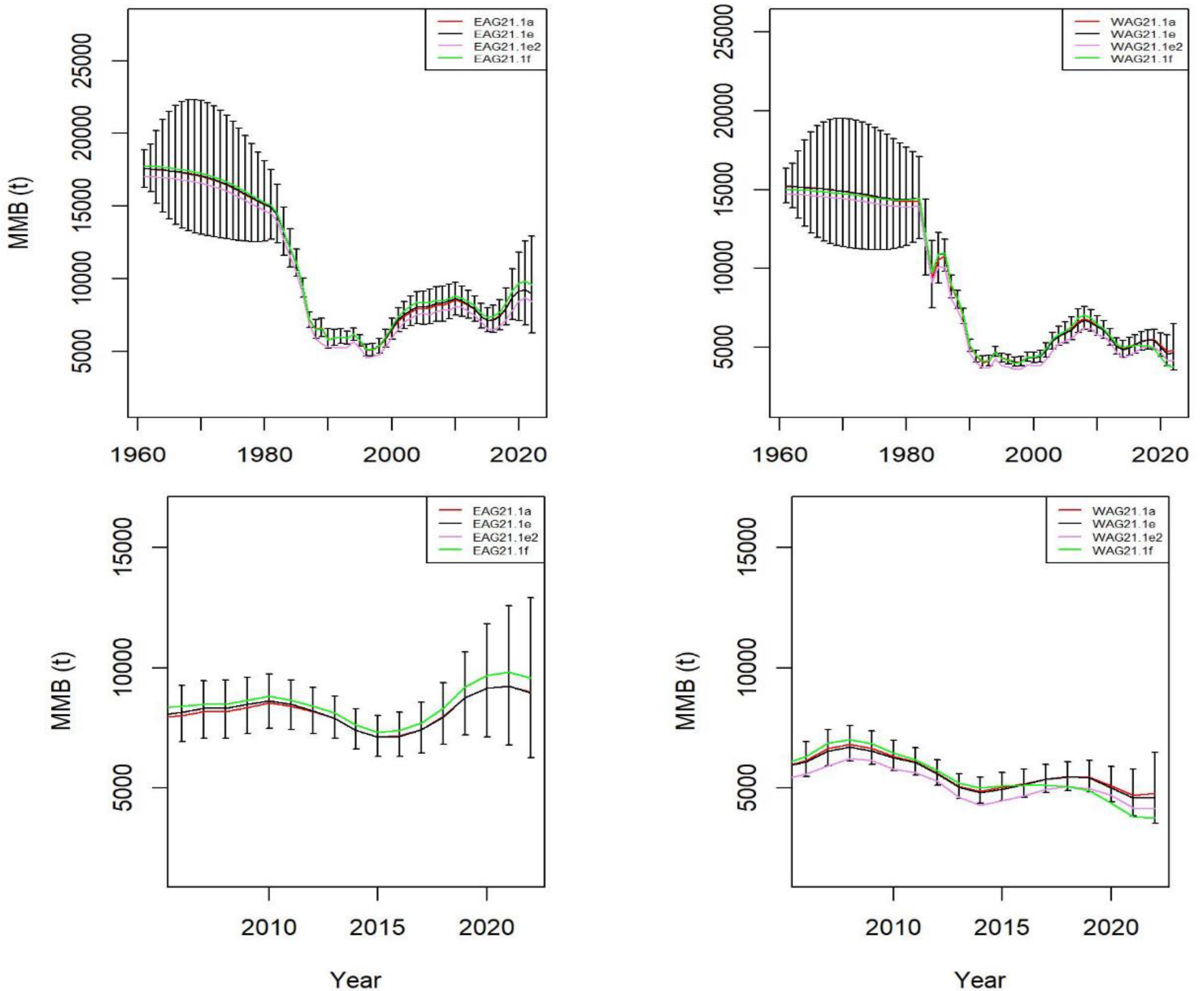


FIGURE 37. RETROSPECTIVE FITS OF MMB (WITH 9 PEELS) FOLLOWING REMOVAL OF TERMINAL YEAR DATA UNDER MODELS 21.1A AND 21.1E FOR GOLDEN KING CRAB IN THE WAG, 1961–2022.



AIGKC final assessment 2022



AIGKC RECOMMENDATIONS

- Model 21.1e2 chosen as recommended model by CPT
  - 3 catchability parameters (improvement to base model)
  - 116 mm CL size-at-maturity
    - Sample size increased (new data 10,815 vs. old data 3,755)
- Buffer 25%
  - "base" buffer from last year
  - Similar concerns from the past year with some improvements but none to lower buffer
- Future recommendations (more in minutes):
  - Transition to GMACS
  - Cooperative survey index included in EAG model
  - Investigate retrospective pattern in EAG

Status and catch specifications for the entire Aleutian Islands fisheries (million lb)

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch[a]	OFL	ABC[b]
2018/19	12.964	39.348	6.356	6.536	7.433	12.157	9.118
2019/20	13.041	36.124	7.180	7.317	8.222	11.572	8.679
2020/21	13.259	34.043	6.610	6.614	7.759	10.579	7.934
2021/22	12.917[c]	27.760[c]	5.930	5.460	6.007	10.620[d]	7.434[d,e]
2022/23		26.326[c]				8.291[c]	6.219[c,f]

a. Total retained catch plus estimated bycatch mortality of discarded bycatch during crab fisheries and groundfish fisheries.

b. 25% buffer was applied to total catch OFL to determine ABC.

c. Model 21.1e2 with hypothetical completed fisheries data from WAG was used to estimate MSST, MMB, and MMB projection for 2022/23.

d. OFL and ABC were estimated by the accepted model 21.1a in May 2021 assessment when the WAG fishery was not completed.

e. 30% buffer was applied to total catch OFL to determine ABC for the 2021/22 fishing season after SSC/Council's recommendation.

f. A proposed 25% buffer was applied to total catch OFL to determine ABC for the 2022/23 fishing season.

BBRKC PROPOSED MODEL RUNS

- Change in authorship
- Model scenarios explored:
  - Starting date for time series (status quo vs **1985**)
  - M assumptions
    - Fixed or **estimated** in model
    - Additional mortality periods (late 70s/early 80s, 2015-2018)
  - Impacts of BSFRF data – specifically on selectivity
    - Q potentially higher than 1 due to herding

TANNER PROPOSED MODEL RUNS

- Impacts on assessment
  - New data or data updates
- Model simplifications
  - Simplify number of parameters and characterizations (improvement of model)
  - Change in start in 1982 to avoid
    - uncertain foreign fleet catch data
    - No elevated mortality period
    - major changes in survey gear, areal coverage
    - long initialization period
  - Changes to initial conditions with new start data (model start date & initial condition change)

SMBKC PROPOSED MODEL RUNS

- Last full assessment Sept. 2020 (moved to biennial cycle, currently a GMACS model)
- Overfished & under a rebuilding plan to be updated this fall (2022)
- Core model issues
  - Discrepancies in trends between pot survey and trawl survey
  - Spatial hot spots in surveys
  - Poor fit of models to recent years survey data (2010+)
- Model options
  - Reviewed sensitivity on M estimates and assumptions of morality event in 1998
  - “Base” model recommended for Sept – consistency in model structure during rebuilding plan

PIRKC PROPOSED MODEL RUNS

- Triennial assessment cycle, current GMACS model (accepted in 2019)
- B_{MSY} redefined in 2019 as 35% of the average MMB observed from 2000 – present
- New input data:
  - Survey & bycatch data updated for 2019, 2020
  - Data for 2021/22 will be incorporated in Sept.
- Bering Sea wide exploration of RKC – stock structure (started in this document)
- Summary:
  - Trends in SSB and overall model fit were similar, slight decline in biomass from 2019
  - Healthy B_{MSY} proxy (3.25) – No overfishing
  - Recommended base model from 2019 as well as some models with potential improvements

SNOW CRAB PROPOSED MODELS – TRANSITION TO GMACS

Author provided a transition comparison to adopt the GMACS version of the status quo (base) model

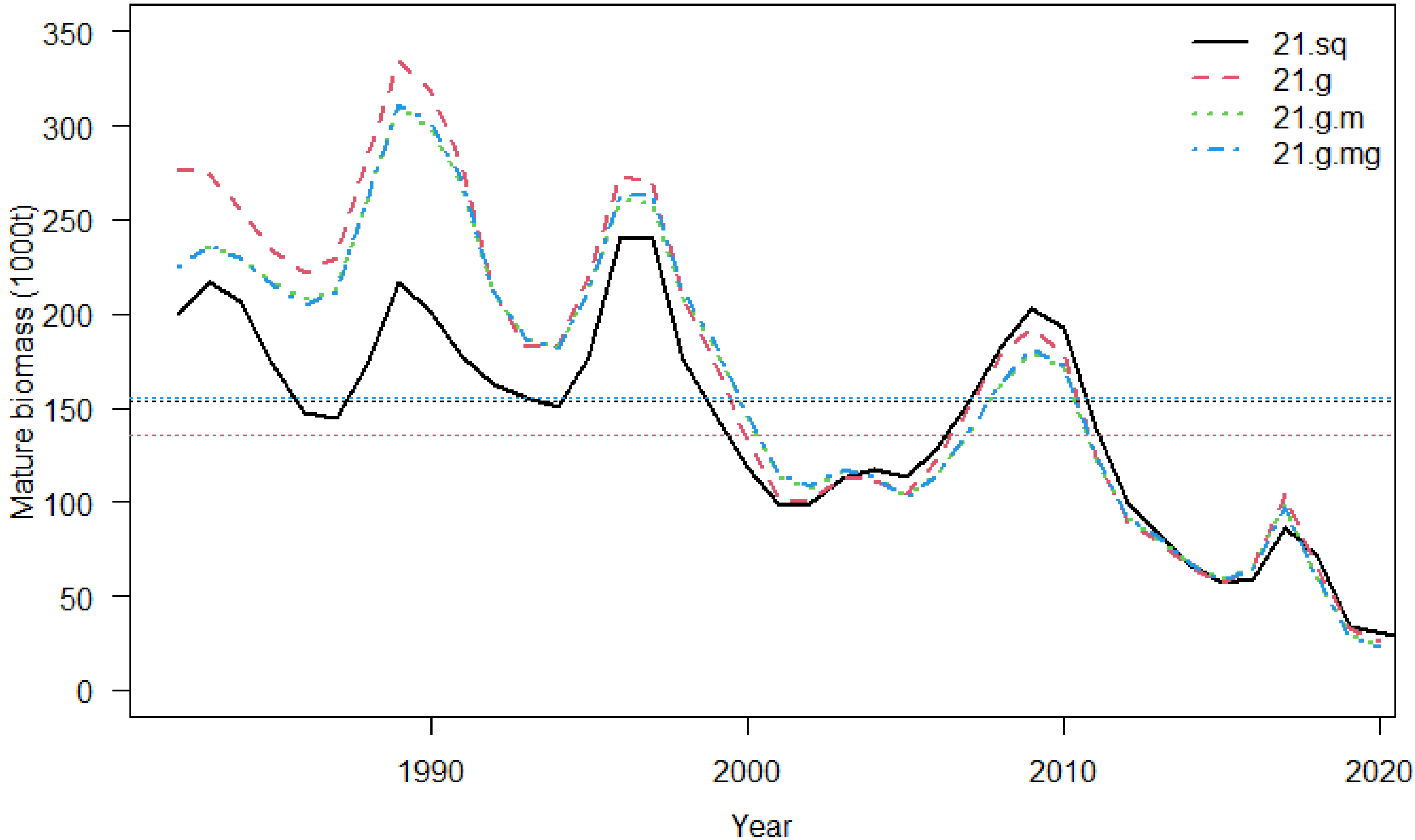
Author and CPT recommended using GMACS based on:

- Superior convergence statistics
- Improved model assumptions
- Better fits to data sources
- GMACS has the ability to perform projections (can be used in rebuilding)
- Improvements in transparency and reproducibility
- The improvements of GMACS over the status-quo model substantially outweigh the minor concerns with the GMACS model.

Sept model options include:

- Model that uses prior on M similar to the status quo

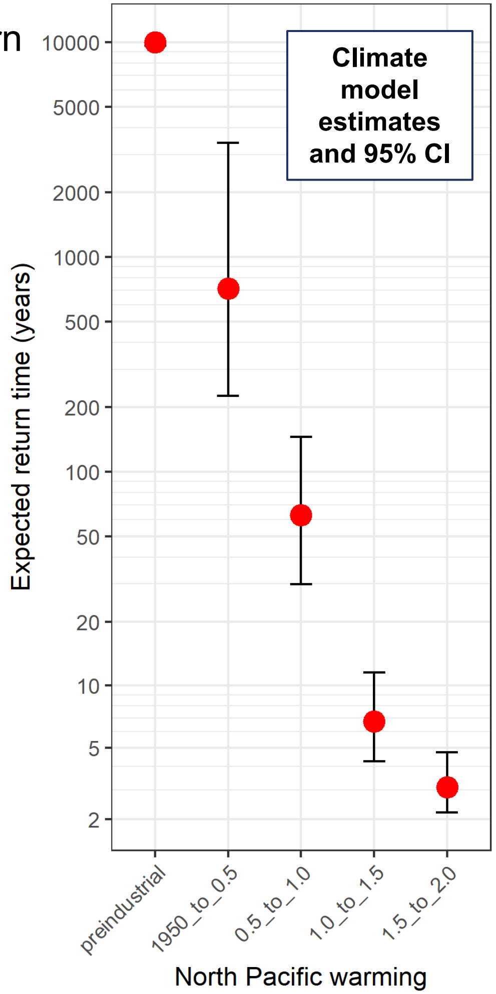
GMACS VS. STATUS QUO



SNOW CRAB REBUILDING


CONTEXT – CLIMATE OUTLOOK

Expected return time for EBS SST ≥ 2016, 2018-2020 values

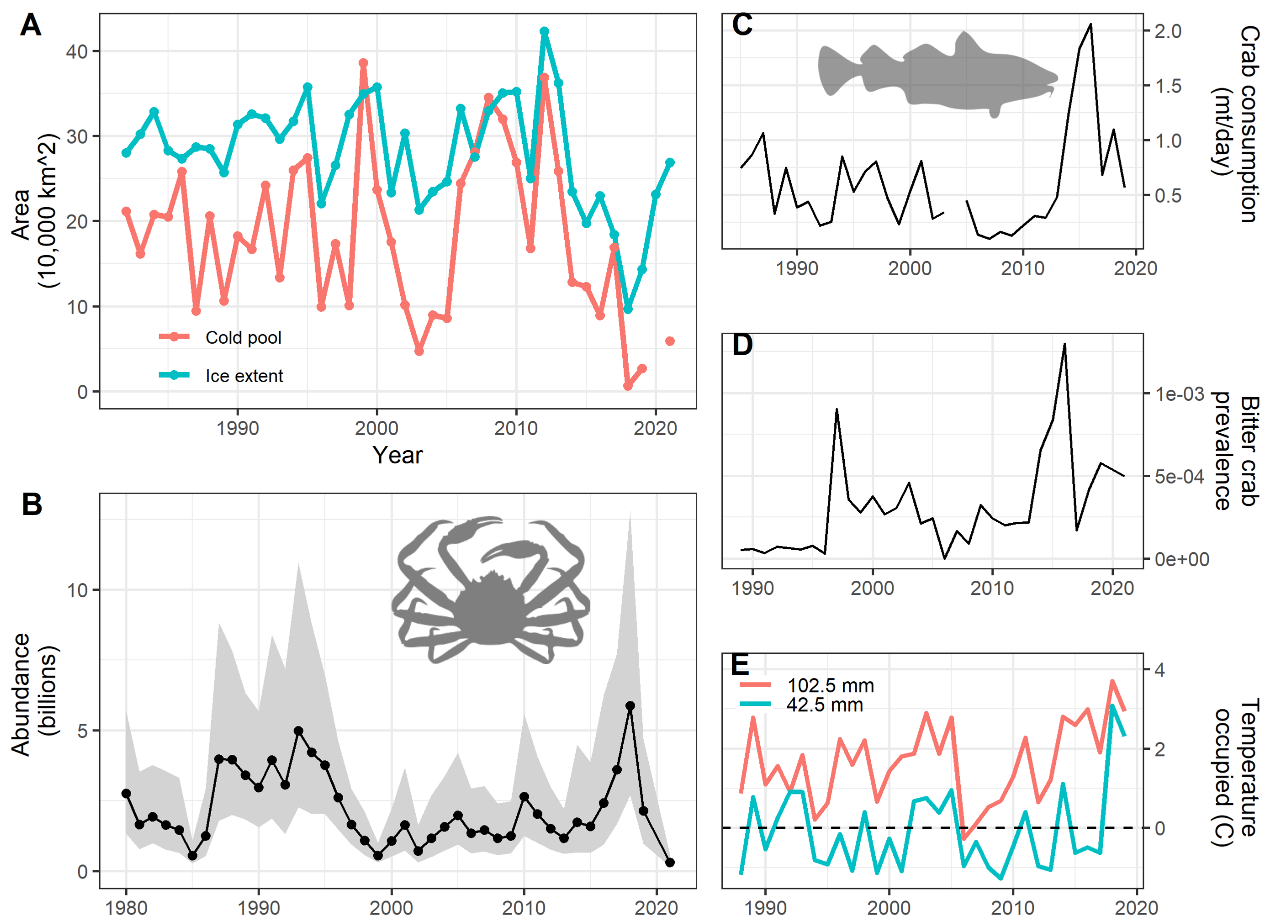


- Apparent snow crab collapse was associated with an index of EBS borealization
- ~100% of risk for EBS temperature as warm as 2014-2020 is human-induced
- Expected return time for extreme temperatures has declined dramatically
  - every ~ 65 years in 2003-2019 climate
  - every ~ 7 years in current climate
  - every ~ 3 years by 2030s/2040s, depending on emissions scenarios

CONTEXT – WHAT HAPPENED?

High temperatures seem to be the best correlate with mortality in 2018 and 2019

This is somewhat unsatisfying because it does not provide a mechanism



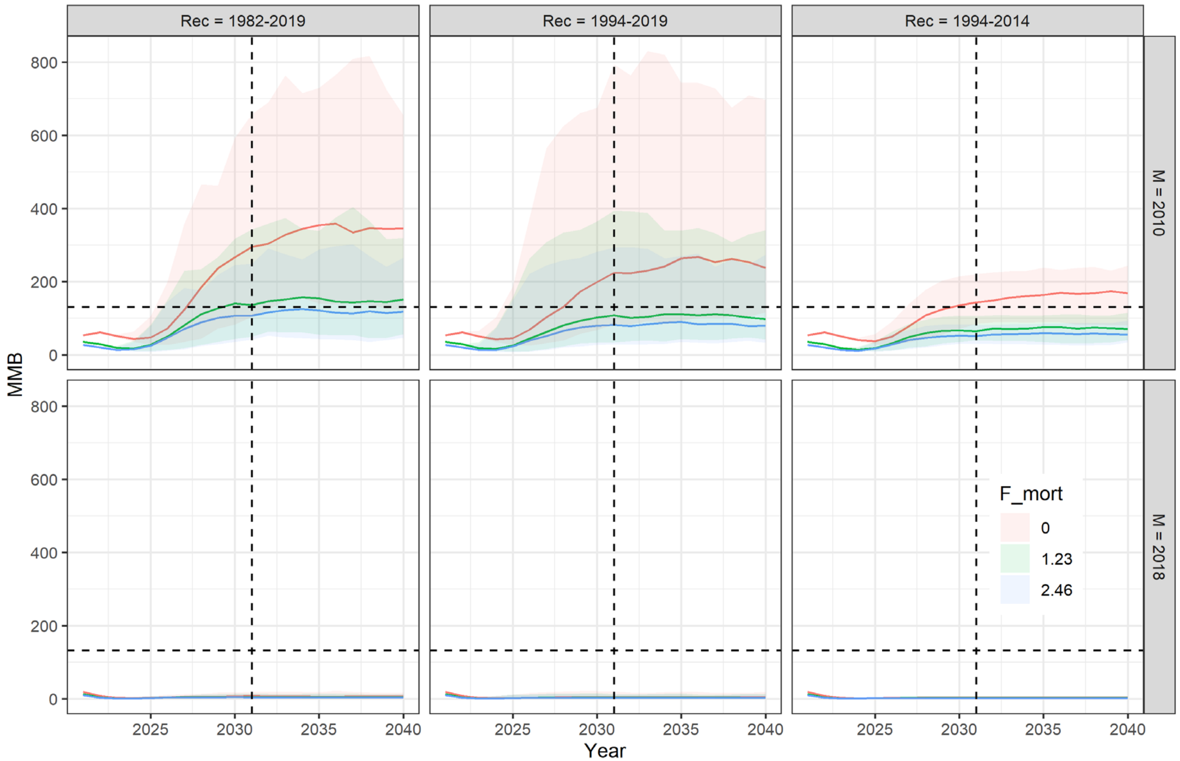
CONTEXT - UNOBSERVED MORTALITY

- Unobserved mortality from bottom trawls
  - 15 – 100+ times more crab contact gear than are caught as bycatch
  - Mortality rate for unobserved contact much lower than for bycatch
  - Total unobserved mortality could be as large as observed mortality
  - Range of possible unobserved : observed mortality ratios is large and imprecise
- Unobserved mortality from pelagic gear
  - No estimates are available
- Post-molt crab especially vulnerable to observed and unobserved mortality

REBUILDING PLAN: CPT DISCUSSION & RECOMMENDATION

- CPT discussion on “levers” in rebuilding projection scenarios:
  - Period for generating future recruitment (R)
  - Period for calculating proxy for B_{MSY} (here $B_{35\%}$)
    - All projections available use the same value
  - Values for future M (natural / non-fishing mortality)
  - Harvest strategies (ranges of fishing mortality (F) values) to consider in the analysis
- Uncertainty regarding appropriate choices for recruitment and M in projections
  - Do these reflect population and climate considerations
- CPT made recommendations on preferred R, M, and F options
- SSC provided further guidance on projection options to encompass expected climate and population expectations during the projection timeline


PRELIMINARY BIOMASS PROJECTIONS



- Two estimates of *M*
  - 1982-2017 mean
  - Peak (2018 estimate)
- The two estimates are bounds on likely values
- 1982-2017 estimate more appropriate than 2018
- SST provided input, requested larger set of population parameter values

- Dashed horizontal lines = B_{MSY} proxy
- Dashed vertical lines = 2031

CPT DISCUSSION & RECOMMENDATION

- CPT discussed the likelihood that bycatch in groundfish fisheries has a greater effect during rebuilding than when stock above B_{MSY}
- CPT discussed the fact that unobserved mortality is absent from bycatch estimates and may be an important consideration in rebuilding
- CPT recommends sensitivity analyses for broad range of possible unobserved : observed mortality ratios
- CPT recommends research to improve estimates of unobserved mortality in bottom and pelagic trawls
- Council could also consider:
  - Expanding COBLZ boundary
  - Revising PSC limits (currently independent of abundance below 4.5 billion crabs)
  - Revise PSC formulas to focus on size-classes and molt stages more vulnerable to bycatch


BALANCE OF THE CPT REPORT

MAY 2022

REVIEW OF HANDLING MORTALITY RATES

- Most of the rates for crab fisheries were based on research conducted during the 1990s and 2000s
- Review of values and research
- Recommendations for future work was not part of this discussion

Targeted stock	Directed HM	Indirect HM	GF – trawl	GF – fixed
BBRKC	20%	Tanner 25%	80%	50%
Snow	30%	na	80%	50%
Tanner	32.1%	Snow 32.1% BBRKC 32.1%	80%	50%
AIGKC	20%	na	80%	50%

QUESTIONS?

Thanks to:

- CPT members and crab authors
- Presenters
- Members of the public and industry