C1 BSAI CRAB STOCKS

KATIE PALOF & MIKE LITZOW (CPT CO-CHAIRS)

OCTOBER 2023 NPFMC MEETING

CPT MEETING MINUTES – SEPT. 12TH – 14TH, SEATTLE, WA

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

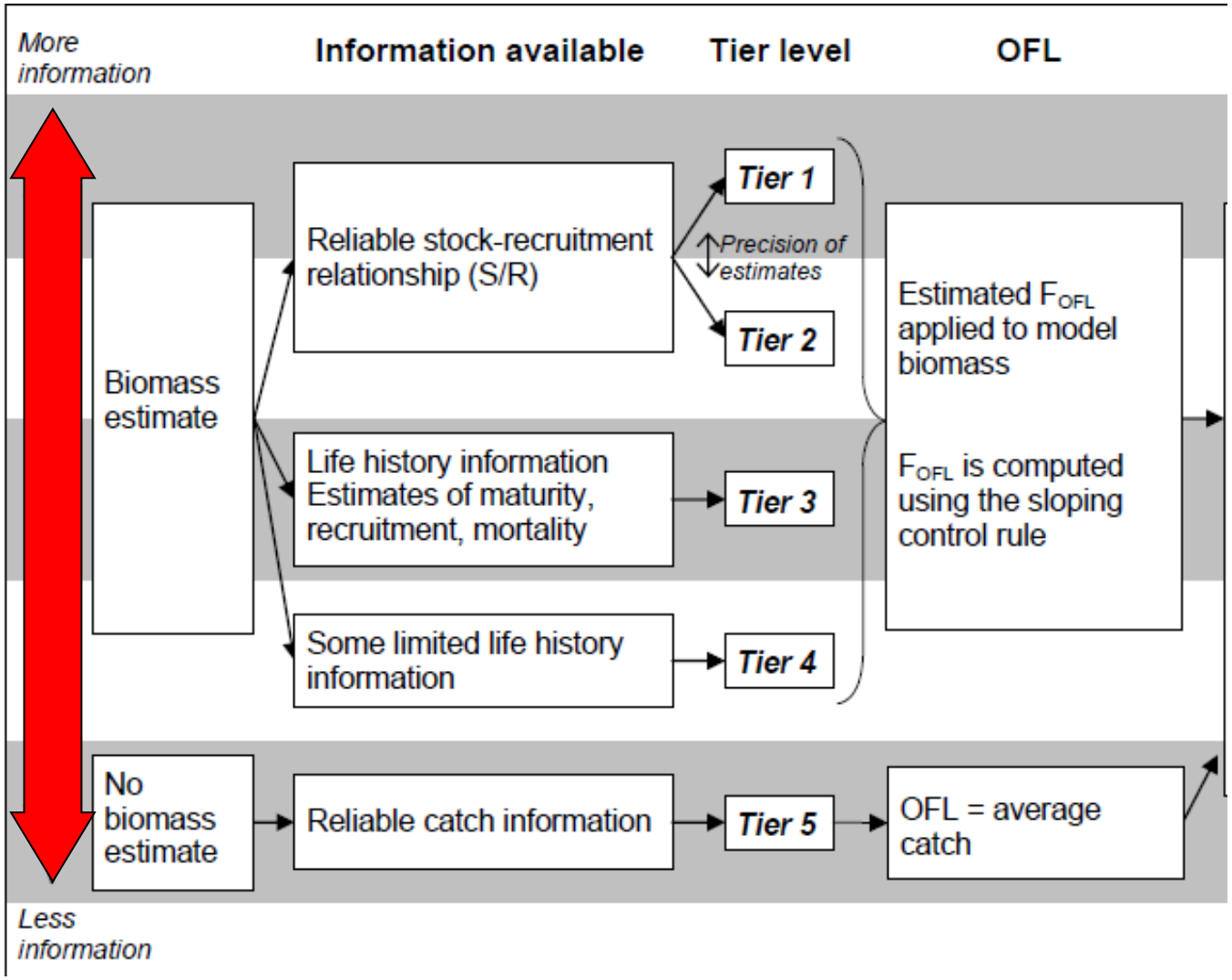
→ Assessed in September/ October

→ 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%

SEPTEMBER 2023 AGENDA

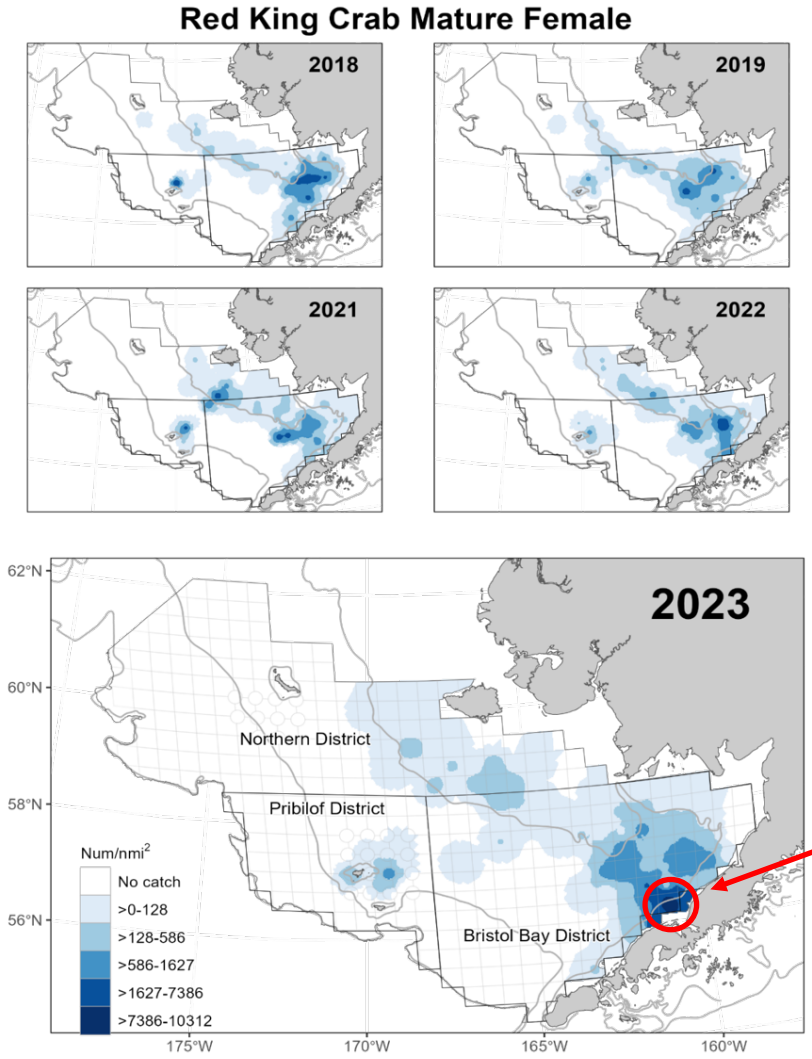
- ✓ Summer trawl survey results
- ✓ 2022/23 fishery season summary
- ✓ **BBRKC final assessment, OFL and ABC**
- ✓ **Tanner crab final assessment, OFL and ABC**
- ✓ **Snow crab final assessment, OFL and ABC**
- ✓ **PIBKC final assessment, OFL and ABC**
- ✓ Proposed model runs: NSRKC
- ✓ Bering Sea red king crab stock structure template
- ✓ Overfishing updates on non-assessed stocks
- ✓ BSFRF research updates and spring BBRKC sampling (informational)
- ✓ Ecosystem status report (crab update)
- ✓ Economic status of the crab fisheries
- ✓ Research priority planning (Dec / Jan meeting)
- ✓ Survey modernization (informational)
- ✓ New business / Jan modeling workshop planning / Member vacancies

2023 BERING SEA BOTTOM TRAWL SURVEY UPDATE

2023 SURVEY: TAKE-HOME RESULTS

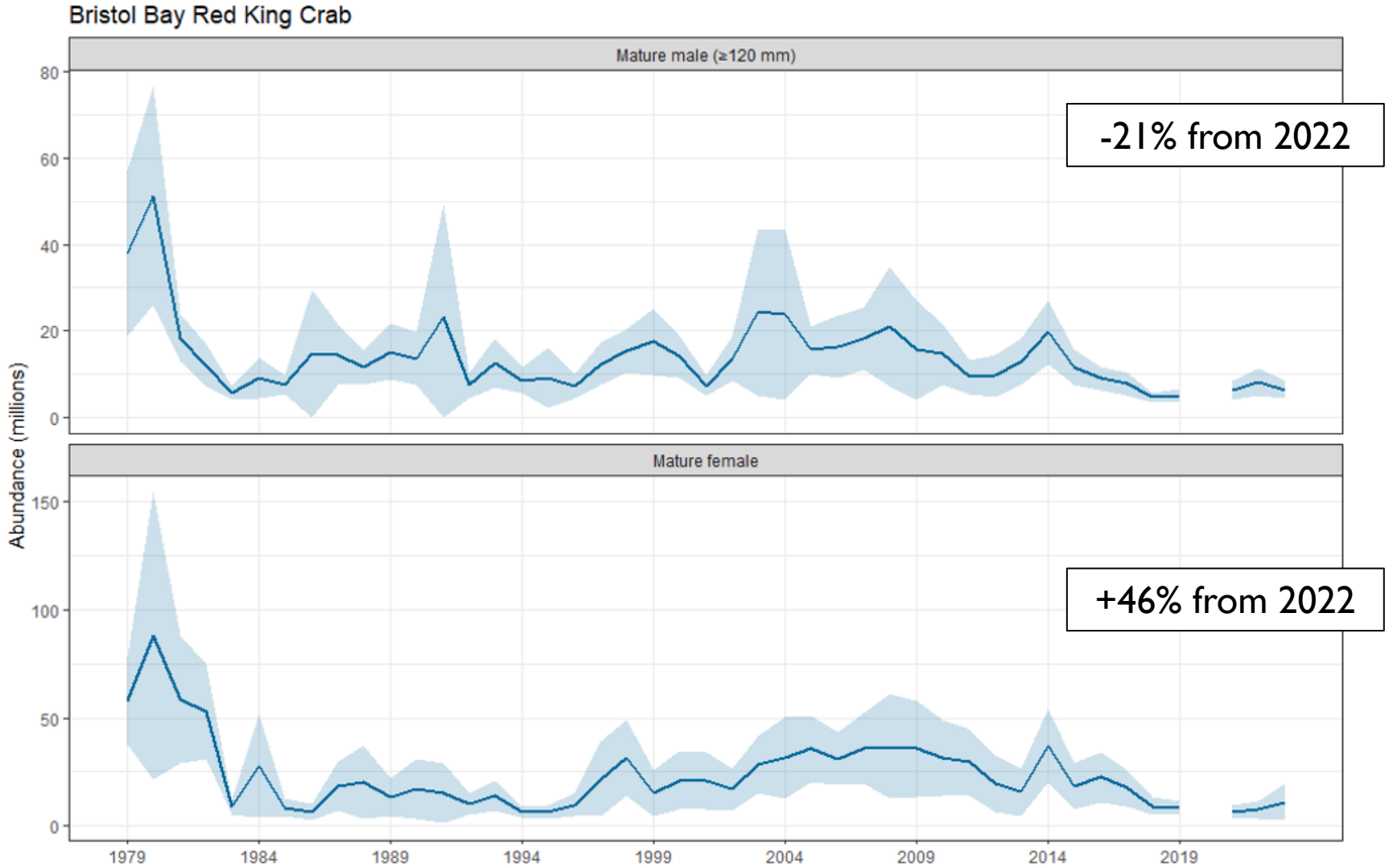
- Bristol Bay red king crab mature female abundance *up*
- Snow crab mature female and commercial-size male abundance at *all-time low*
- Largest Tanner crab recruitment event in time series history

BBRKC MATURE FEMALE ABUNDANCE

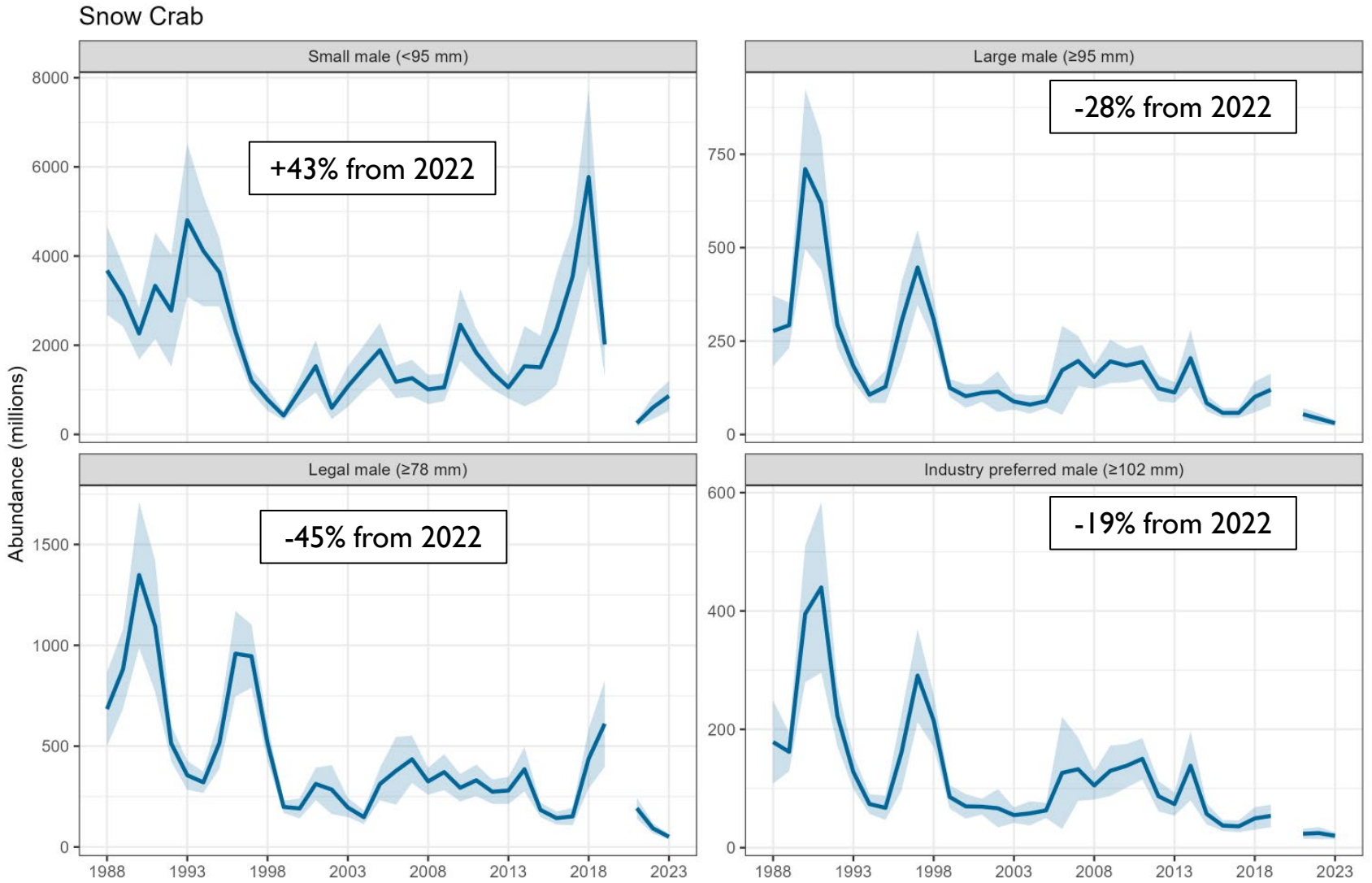


2023: 37% of BBRKC mature females caught at one station

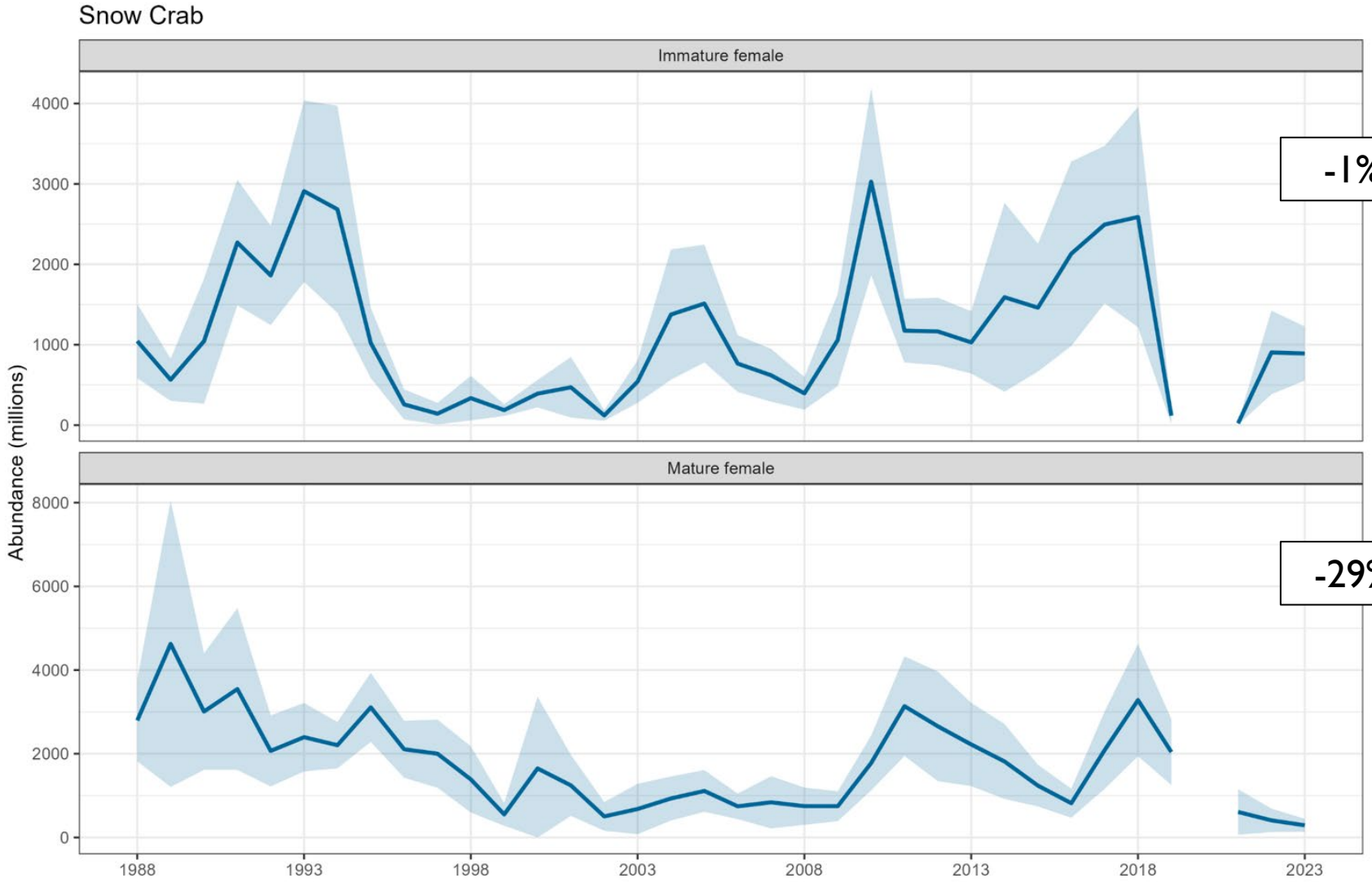
BBRKC LEGAL MALE / MATURE FEMALE ABUNDANCE



MALE SNOW CRAB ABUNDANCE



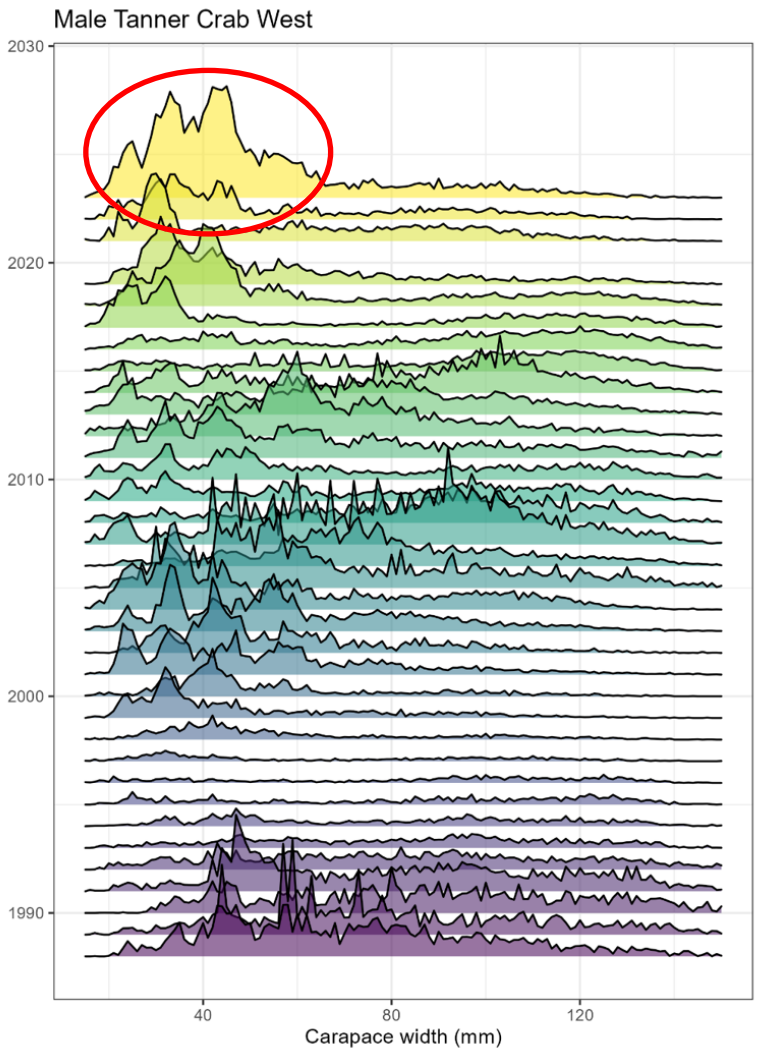
FEMALE SNOW CRAB ABUNDANCE

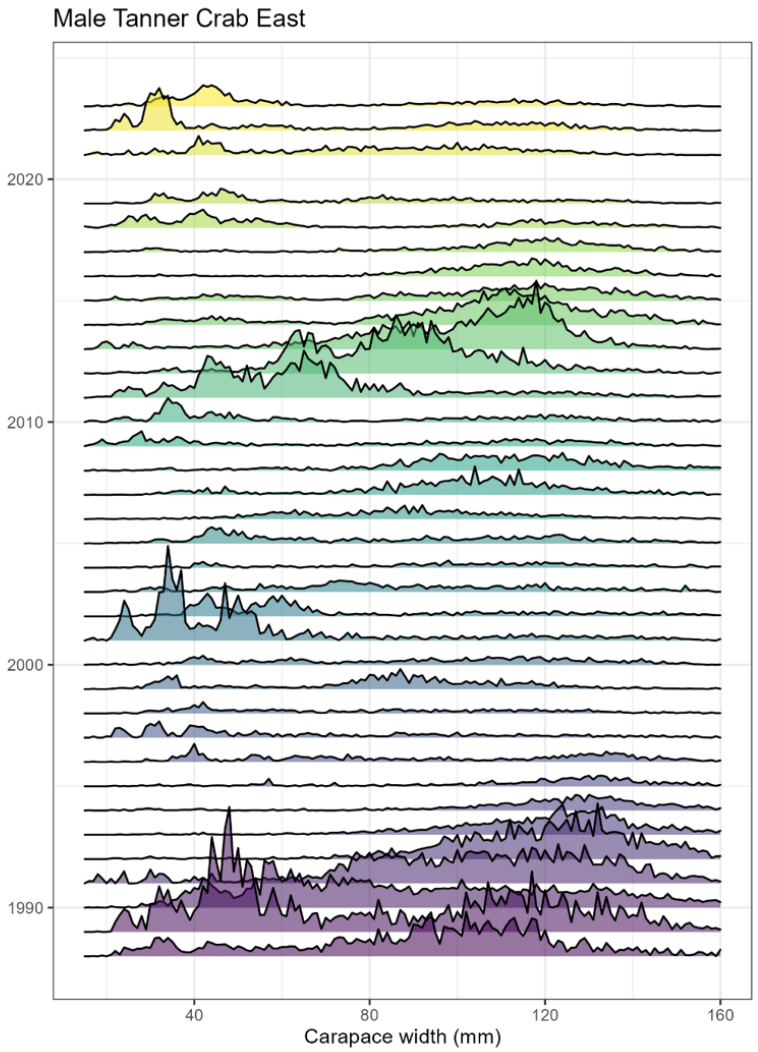


-1% from 2022

-29% from 2022

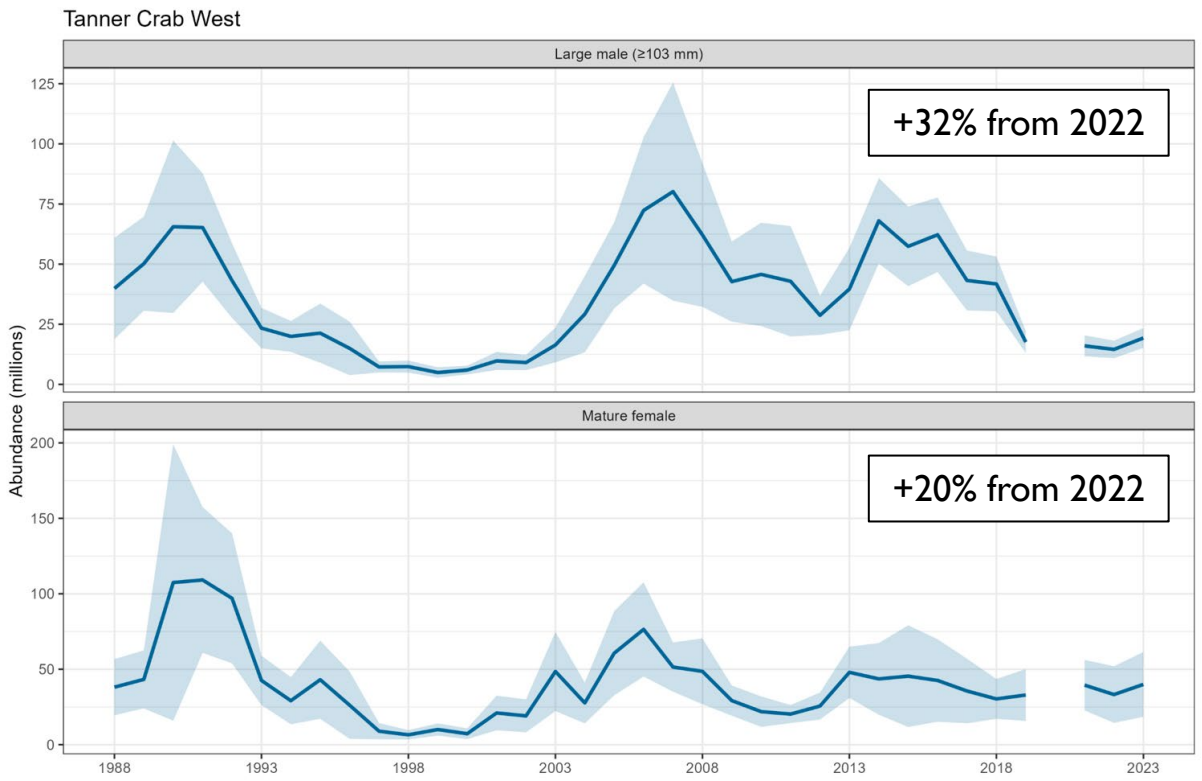
MALE TANNER CRAB ABUNDANCE AT SIZE

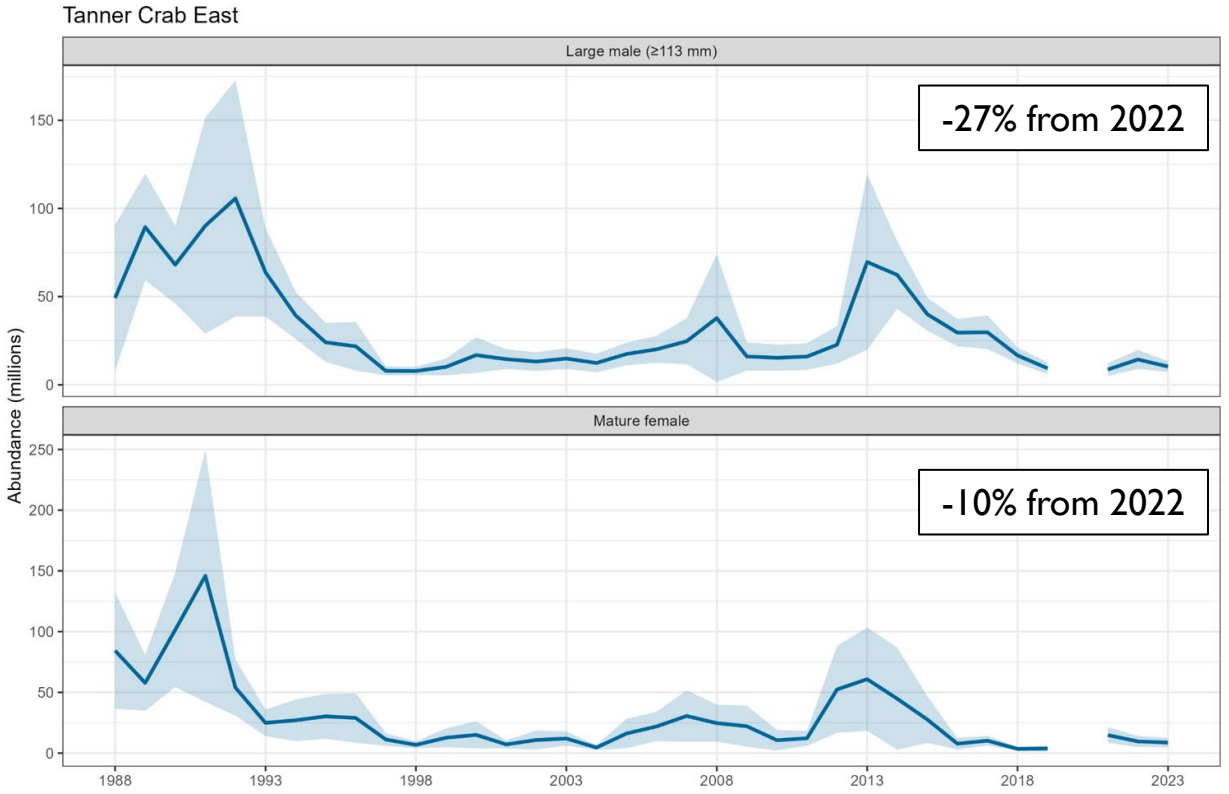




2023: Largest recruitment pulse in time series

TANNER CRAB ABUNDANCE: *UP* IN THE WEST, *DOWN* IN THE EAST





2022 FISHERY SUMMARY: DIRECTED AND BYCATCH

FISHERY SUMMARY

- Bristol Bay red king crab
  - Directed fishery closed
  - Total bycatch low
- Snow crab
  - Directed fishery closed
  - Low bycatch in Tanner crab fishery
  - Total bycatch in groundfish fisheries low (43 t)
- Tanner Crab
  - Total retained catch in eastern and western fisheries 2.013 million lbs (913 t)
  - Very low bycatch in other crab fisheries (snow & BBRKC closed)
  - Low bycatch in groundfish fisheries for eastern Tanner (22 t)
  - Relatively high bycatch in groundfish fisheries for western Tanner (73 t), mostly yellowfin sole trawl fishery

FISHERY SUMMARY

- Aleutian Islands golden king crab
  - Retained catch in western Aleutians lowest since 1998, eastern Aleutians close to 10-year mean
  - Groundfish bycatch very low (< 7 t in each area)
- Western Aleutians red king crab
  - Directed fishery closed
  - Bycatch very low

BRISTOL BAY RED KING CRAB (BBRKC)

FINAL ASSESSMENT 2023

ESP REPORT CARD:

Ecosystem considerations 2023:

- Bottom temperatures and the spatial extent of the cold pool remained near-average in Bristol Bay. Summer bottom temperatures were well-within the thermal range of juvenile and adult red king crab.
- Red king crab have experienced a steady decline in bottom water pH in the past two decades, reaching 7.91 in 2023. Threshold pH levels of 7.8 could negatively affect juvenile red king crab growth, shell hardening and survival
- Sockeye salmon abundance in the eastern Bering Sea continues to remain well above average, and may represent increased predation on larval BBRKC. Anomalously low levels of chlorophyll-a in 2023 indicate a less pronounced spring bloom and poor feeding conditions for larval BBRKC
- Mature female spatial extent has remained above-average since 2019. The relatively large spatial footprint of mature females in recent years can be attributed to an increased use of habitats in central Bristol Bay that have historically been avoided in years when <1°C waters extended into Bristol Bay

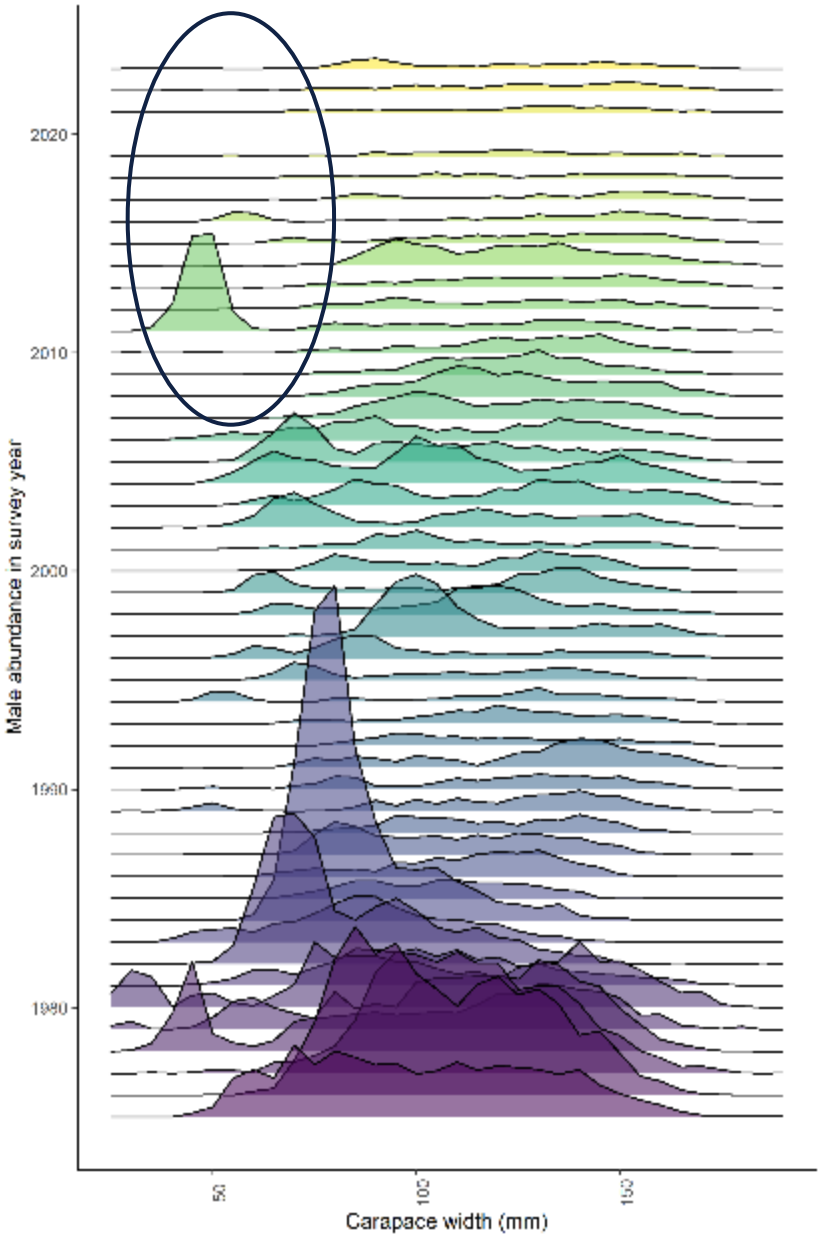
Socioeconomic considerations:

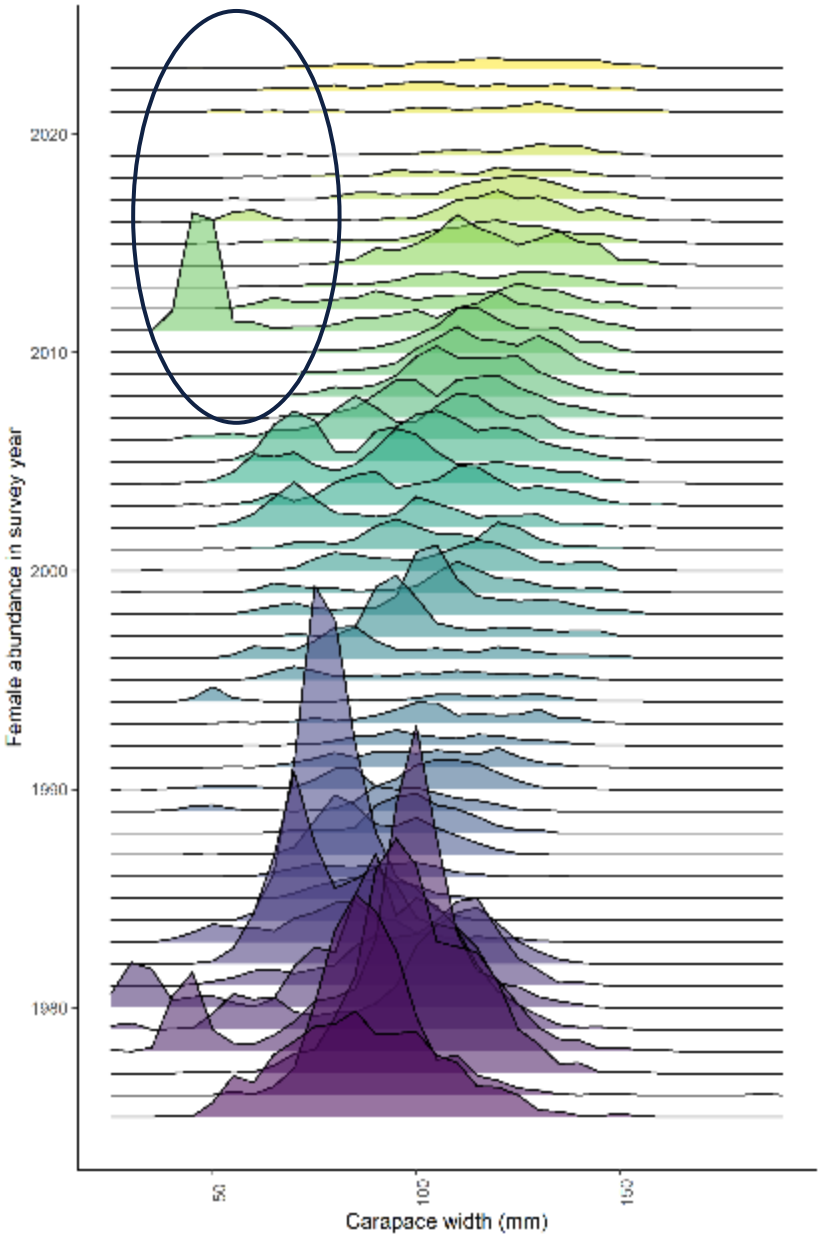
- Fishery closed – difficult to assess indicators without the fishery data (Is there a better way to incorporate the closure?)
- Incidental catch at near-average levels

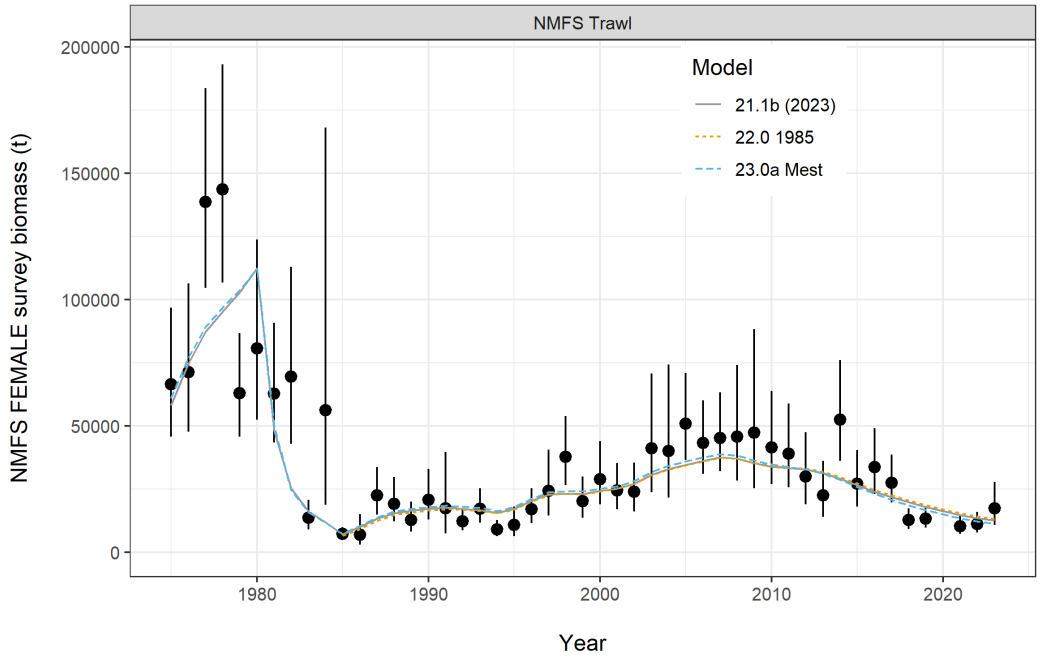
BBRKC OVERVIEW

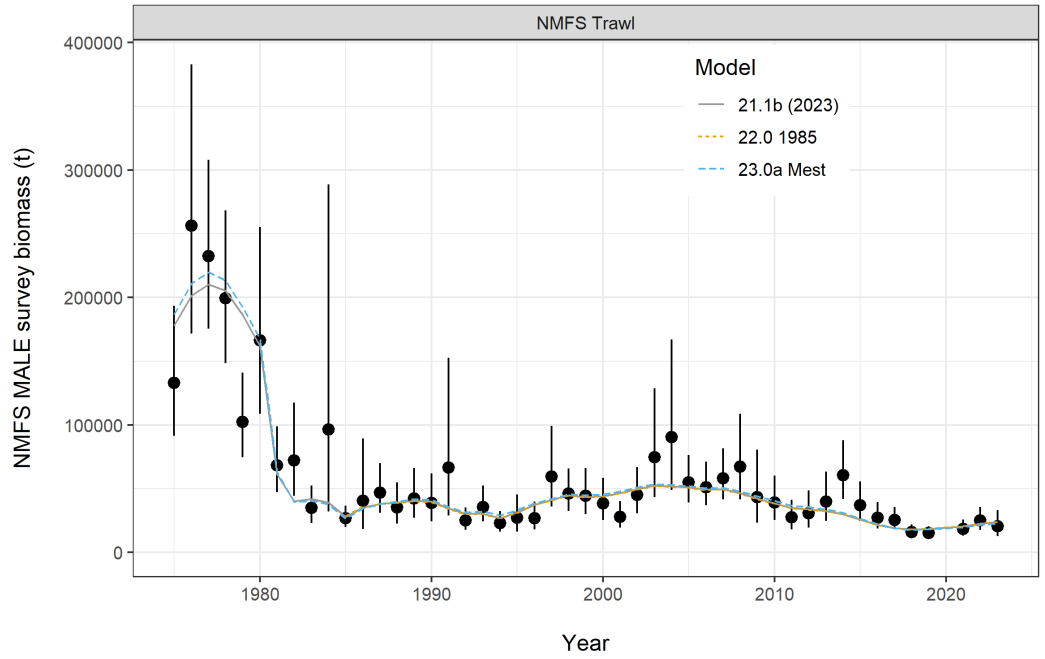
- **Tier 3 annual stock assessment, GMACS assessment** framework since 2018
- Mature male biomass decreased from 2022, still low compared to long term average
- Directed fishery was closed in 2021/22 and 2022/23 seasons due to low mature female abundance.
- Estimated mature female biomass up from recent years but still lower than it's been since the mid-90s
- 2023 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.
  - ADF&G will complete the process of determining an appropriate TAC, if applicable, after the CPT and Council process.
- Low recruitment in recent years (last 8-12 years), projected decline in biomass without a large recruitment event

LENGTH COMPOSITION FROM NMFS SURVEY









- ✓ Model fits to survey data are similar in all 3 models.
- ✓ Mature females still declining in modeled survey estimate (top), despite survey increase
- ✓ Mature males small increase in modeled survey (bottom)

MATURE MALE BIOMASS – FEB 15TH

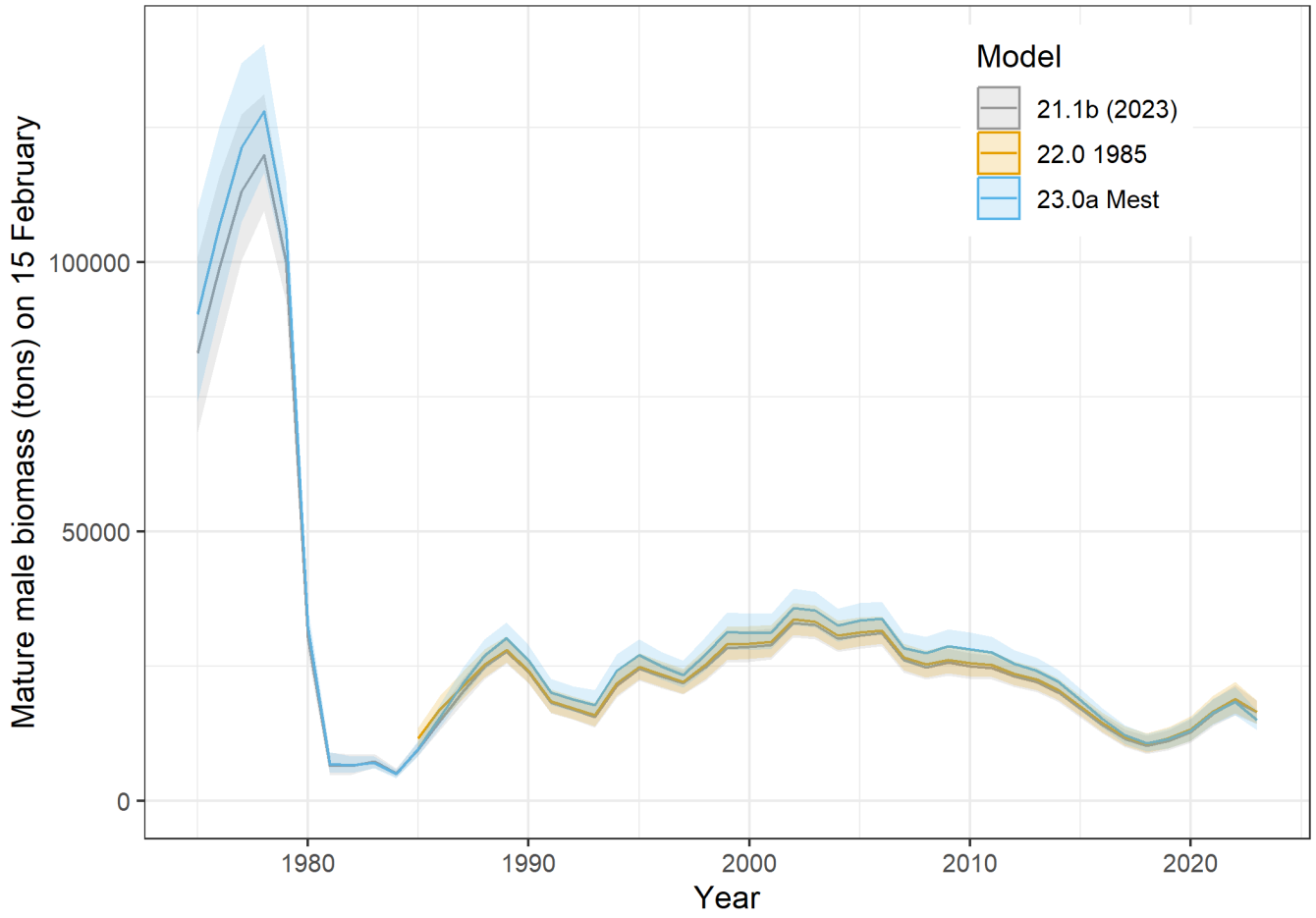


Table 1: Status and catch specifications (1000 t) for the CPT recommended model (23.0a).

Year	MSST	Biomass (MMB_{mating})	TAC	Retained Catch	Total Catch	OFL	ABC
2019/20	12.72	14.24	1.72	1.78	2.22	3.40	2.72
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	0.07	3.04	2.43
2023/24		14.98				4.42	3.54

Table 3: Basis for the OFL (1000 t) from the CPT recommended model (23.0a).

Year	Tier	B_{MSY}	Biomass (MMB_{mating})	B/B_{MSY}	F_{OFL}	Basis for B_{MSY}	Natural mortality
2019/20	3b	21.2	16.0	0.75	0.22	1984-2018	0.18
2020/21	3b	25.4	14.9	0.59	0.16	1984-2019	0.18
2021/22	3b	24.2	14.9	0.62	0.17	1984-2020	0.18
2022/23	3b	24.03	17.0	0.71	0.20	1984-2021	0.18
2023/24	3b	19.36	14.98	0.77	0.302	1984-2022	0.23

- Model choice: 23.0a
- Natural mortality for males now @ 0.23
  - Consistent with biology and other RKC stocks throughout State
- Buffer 20% (consistent)

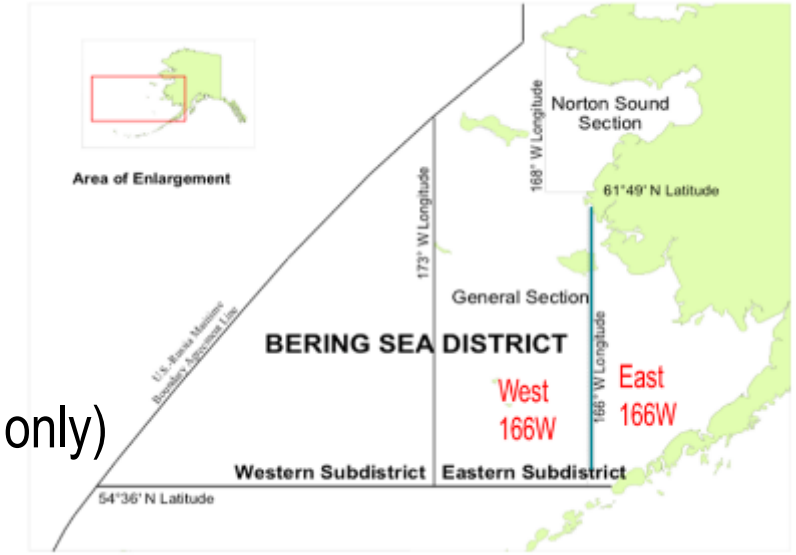
CPT/SSSC recommendation: Model 23.0a, base ABC buffer 20% (similar reasoning to previous years)
Author recommended model 21.1b or 23.0a

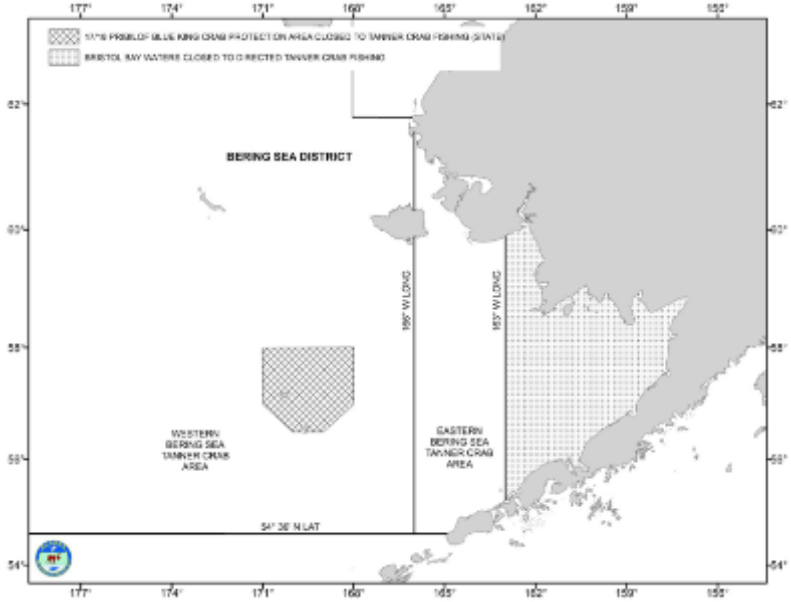
TANNER CRAB

FINAL ASSESSMENT 2023

Overview

- ADFG manages fishery in two areas
  - **fishery open in both areas**
  - East: TAC: 528 t. RC: 528 t
  - West: TAC: 386 t. RC: 384 t
  - Last year: TAC: 499 t. RC: 494 t (W only)
- 2023 NMFS EBS Shelf Survey Biomass
  - male biomass: 35kt (-E,+W,+T)
  - IP male biomass: 6kt (-E,+W,~T)
  - female biomass: 17kt (+E,+W,+T)
  - **large recruitment event in W area**
- 2022/23 OFL: 32,810 t
  - Total catch mortality: 1,187 t
  - overfishing not occurring
- 2023 assessment
  - Tier 3a ($B>B_{MSY}$; not overfished)
  - OFL: 36,200 t, ABC: 27,150 t

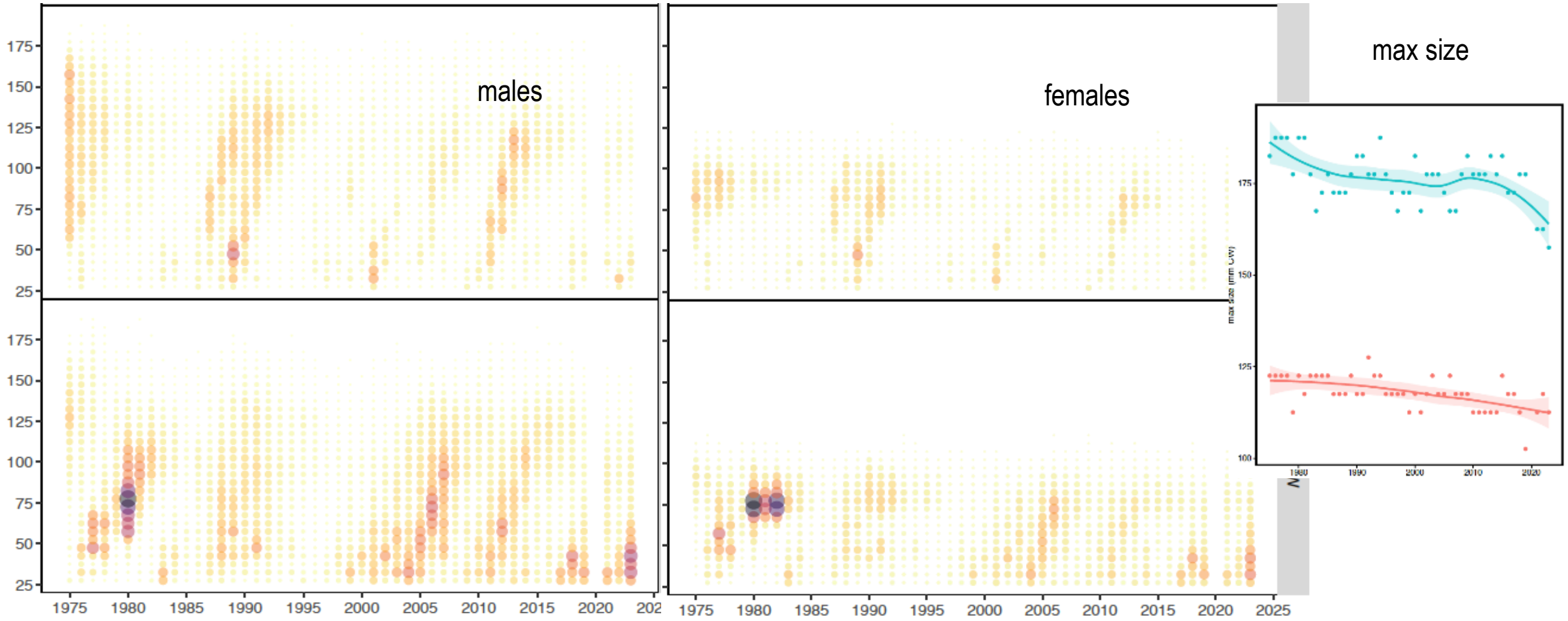




Concerns

- recent recruitment **does not** move into larger size classes
- assessment model **overly-optimistic**

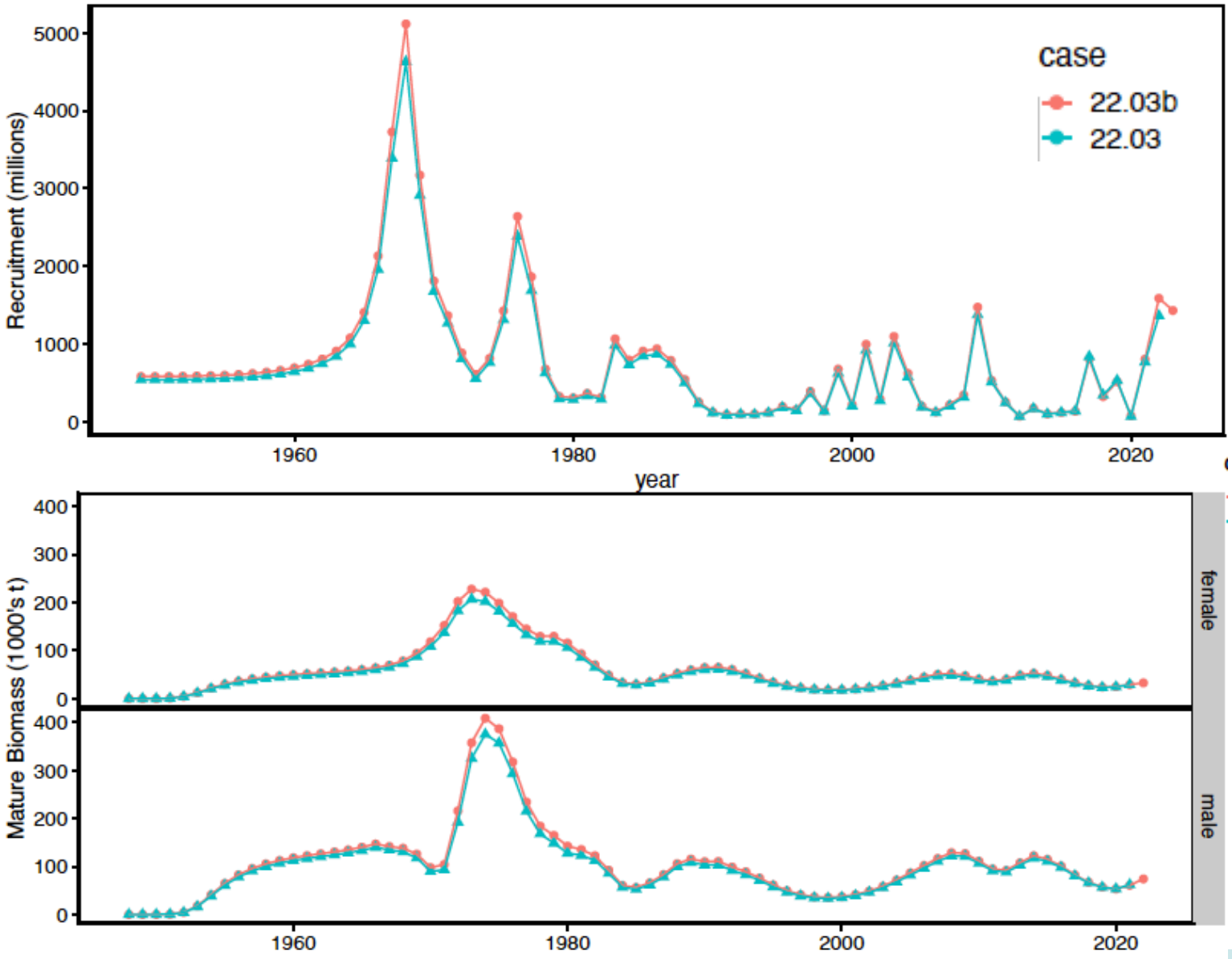
Survey Size Comps



Estimated Population Quantities

recruitment

mature biomass



TANNER 2023 FINAL SAFE RECOMMENDATIONS

- Tier 3a Model 22.03b
  - Based on previously-adopted assessment model
  - No convergence issues
  - No parameter-at-bounds
  - Results similar to 2022 assessment
  - but not much improvement on previous assessment
    - abundance of large crab overestimated
    - terminal year recruitment consistently overestimated
- ABC buffer: CPT recommended 25%; SSC recommended 20% (same as last year)
  - continuing concern over model inadequacies
  - continuing concern over F35%, B35% as metrics for a sustainable fishery
  - concern over lack of recruitment pulses into larger sizes

SNOW CRAB

FINAL ASSESSMENT 2023

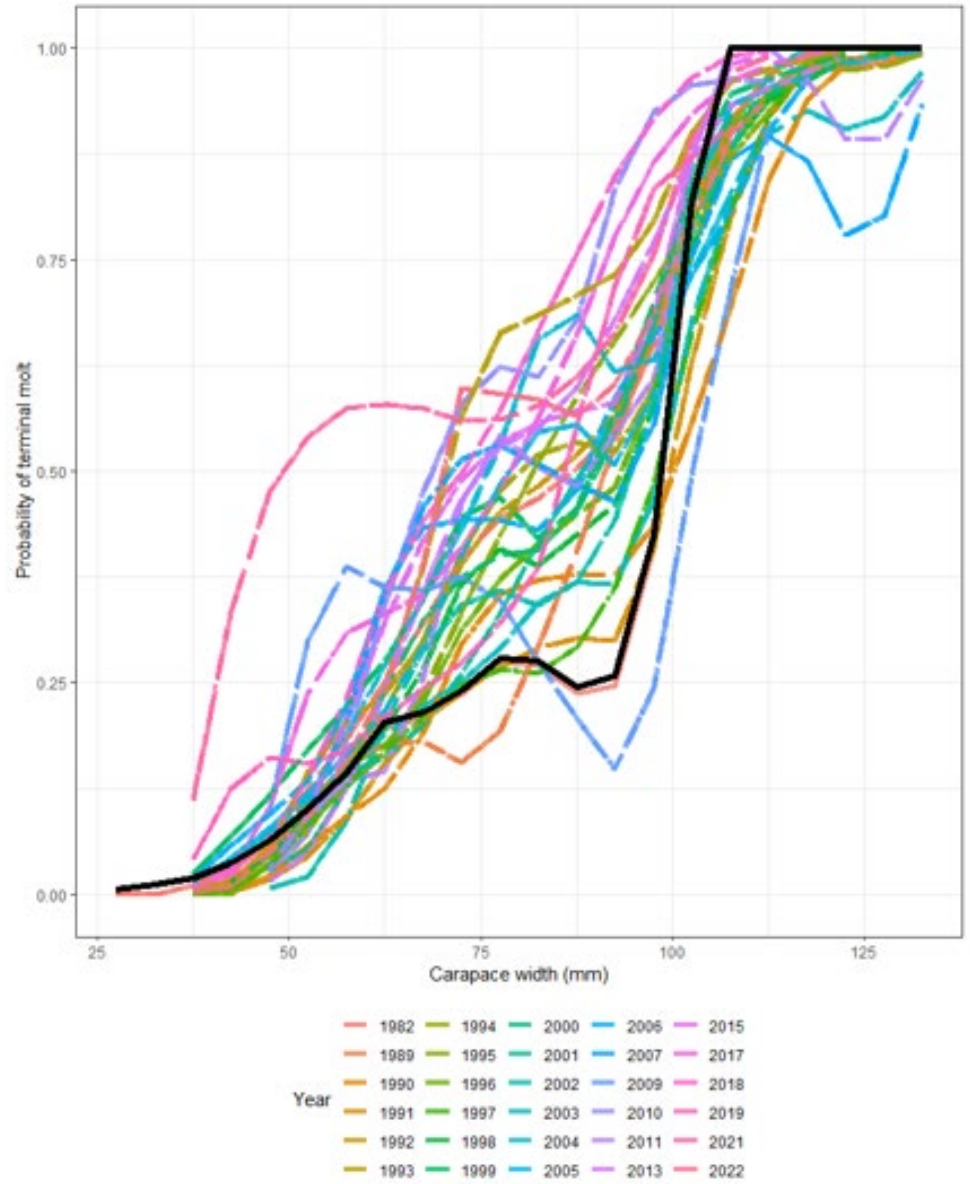
SNOW CRAB ECOSYSTEM CONSIDERATIONS

- Summer bottom temperatures and the spatial extent of the cold pool remained near-average
- Optimal cold-water habitat available for predator refuge
- Anomalously low spring bloom suggests poor feeding conditions for larval snow crab
- Bitter crab syndrome prevalence near-average.
- Pacific cod consumption of snow crab near-average in 2021 and 2022
- Mature male center of abundance more northerly than average
- Poor juvenile body condition in 2019 (beginning of collapse); 2021-2023 condition near-average
- Socioeconomic considerations: Fishery closed in 2022/23, many indicators missing or = 0, reflecting severe economic impacts on harvesters, processors, communities

SNOW CRAB ASSESSMENT OVERVIEW

- **Tier 3 annual stock assessment, GMACS modeling framework**
- Declared overfished in 2021
- Fishery closed in 2022/23
- **Two decisions:**
  - Model choices
    - Snow crab models have had problems with convergence (arriving at a single best solution), sometimes produce more than one OFL
    - Fixing this requires improved modeling of biology and survey selectivity
  - Management choices
    - Improving the model then brings up a problem with the currency of management
    - Many (or most) male crab stop growing before reaching commercial size
    - Results in unacceptably high fisheries mortality (*F*) for the crab that are commercial size
    - Simpler Modeling Working Group suggested using elements of Tier 4 harvest control rules as a solution

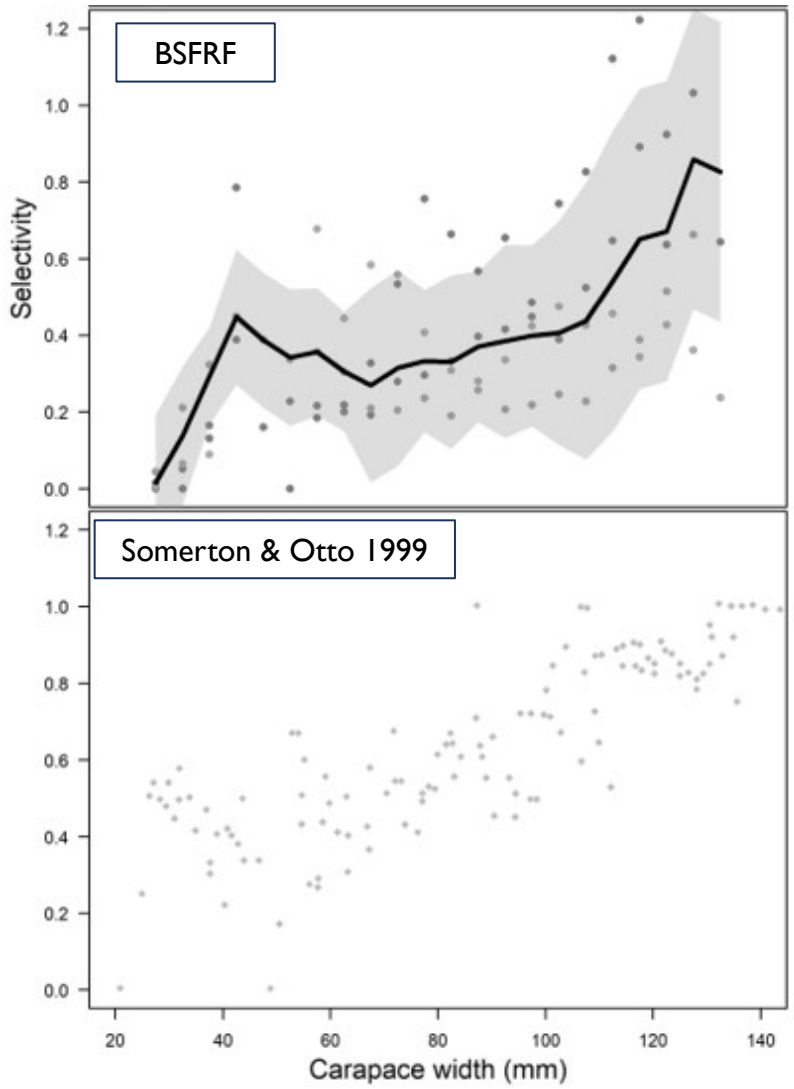
Snow crab final assessment 2023: Model changes



Size-dependent probability of maturity: survey data (colors) and status-quo model estimate (black)

Inputting the observed probability of having undergone terminal molt

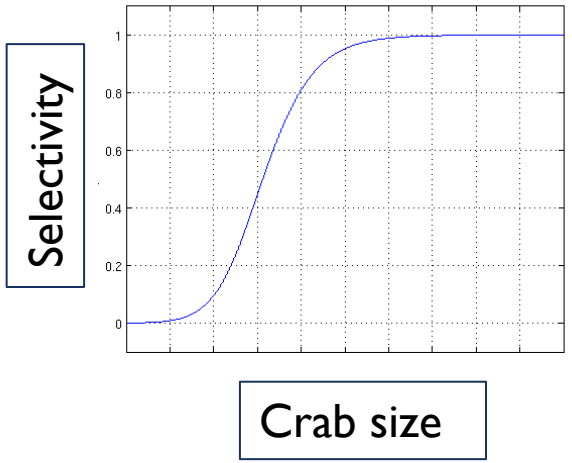
- Growth stops after a molt to maturity
- What size this happens at has large effects on reference points



Size-specific selectivity

Survey selectivity

- Selectivity (chance of being captured by the survey gear for different size crabs) is treated as a logistic function in the status quo model:



- But two studies (left) suggest this isn't the case

Snow crab final assessment 2023: Model changes

CPT and SSC support author-recommended model (23.3a)

- Simpler model that uses data rather than model estimates to fix problems with maturity and selectivity
- Appears to solve the problems with model convergence and multiple recommended reference points (OFL)
- But leaves the recognized problem of very high *F* resulting from many mature crabs being protected from the fishery
- Long-term solution: change the currency of management (morphometrically mature male biomass)
- Short-term solution from Simpler Modeling Working Group: use Tier 4 approach for setting specs

Strategies considered for setting management reference points.

Strategy	Fishing mortality target	Biomass target	Biomass currency
Tier 3	F35%	B35%	Morphometrically mature males (model)
Tier 4_ssc	Natural mortality	B35%	Morphometrically mature males (model)
Tier 4_specs	Natural mortality	Average from 1982-2022	Morphometrically mature males (model)
Tier 4_survey	Natural mortality	Average from 1982-2022	>101 mm carapace width (survey)

MANAGEMENT CHOICES: CPT DISCUSSION

- Tier 4_specs **(CPT recommendation)**
- CPT recommends with 20% buffer (change from 25% last year)
  - Reduced uncertainty over model convergence and bimodality
  - Change to Tier 4 harvest control rules

- **SSC recommendation:**
  - Use Tier 3 approach for F_{OFL} and B_{MSY} proxies
  - Set buffer = 50% to account for uncertainty around resulting high *F* values
  - Resulting OFL = 15.44 kt, ABC = 7.72 kt

PRIBILOF ISLANDS BLUE KING CRAB (PIBKC)

FINAL ASSESSMENT 2023

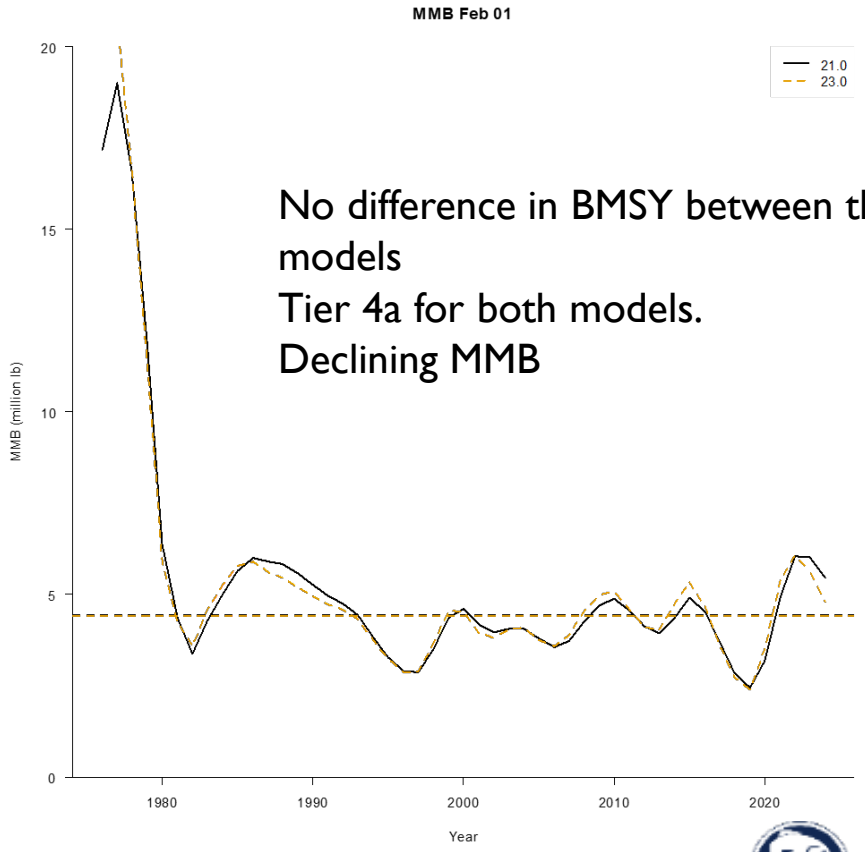
PIBKC SUMMARY

Chapter	Stock	Tier	FOFL	BMSY or BMSYproxy	BMSY basis years	2023/2024 MMB	2023/24 MMB / MMBMSY	Natural Mortality (M)	2023/24 OFL
4	Pribilof Is. blue king crab	4c	0	4.20	1980/81-1984/85; 1990/91-1997/98	0.18	0.04	0.18	0.00116

- Status = 4.3% of B_{MSY}, stock remains overfished
- 2022/23 total removals = 0.26 t, 2022/23 OFL = 1.16 t, overfishing did not occur
- 2023 recommendations: **OFL = 1.16 t**, CPT recommends 25% buffer, **ABC = 0.87 t**
- Rebuilding progress:
  - Revised rebuilding plan does not include a target rebuilding date
  - Low recruitment may be related to environmental drivers (e.g. temperature)
  - April 2022, Regional Administrator determined that stock was “not making inadequate progress” towards rebuilding

NSRKC: PROPOSED MODEL RUNS 2023

- Two models presented:
  - 21.0 – status quo model (length dependent M – 0.18 <124mm CL, and estimates M for crab >124mm CL)
  - 23.0 – estimates single M (~ 0.41)
- Review of work on recent SSC/CPT comments
  - Limited funding focused on ADF&G trawl survey (observer program logistics and bias reduce priority of this data collection)
  - GMACS – in progress.
- Bring forwards both models in Jan 2024
- Future recommendations:
  - ADF&G survey review
  - Maturity and growth research ongoing – incorporate sensitivities to reflect these
  - Natural mortality literature review



No difference in BMSY between the two models
Tier 4a for both models.
Declining MMB

BALANCE OF CPT REPORT

OVERFISHING STATUS UPDATES

- 2022/23 total catch:
  - WAIRKC = 1.2 t
  - PIRKC = 4 t
  - AIGKC = 2.57 kt
  - SMBKC = 2 t
  - PIGKC catch is confidential
  - Catch for all stocks below OFL; overfishing did not occur
- Stock status:
  - PIRKC & AIGKC: MMB > MSST, stocks are not overfished
  - SMBKC: MMB < MSST, stock is overfished
  - WAIRKC & PIGKC: Tier 5, status determination not possible because biomass cannot be estimated

BSFRF UPDATE / SURVEY AND RESEARCH UPDATES

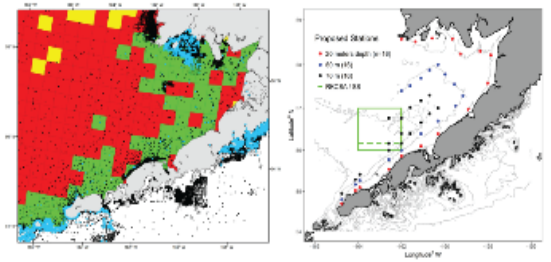
- Update on current & proposed research
  - Results of CPS1 (spring pot sampling) summarized in talk to CPT, draft write up expected Jan 2024
- Directly influenced by CPT / SSC / Council process research priorities
- Importance of research priorities to guide crab research now and upcoming
  - Influx of congressional money to BSFRF
  - Influx of research allocation from disaster relief funds (BBRKC, snow, tanner)

➢ Focused Research Areas

HABITAT & RECRUITMENT RESEARCH – understanding of specific areas of crab habitat is lacking context with recent ecosystem and climate changes, and current fishing activities. Surveys, tagging, and new research may reflect important breeding, nursery, and/or juvenile areas. This research will help to fill huge gaps in knowledge about important recruitment areas. **Focus species: BBRKC, snow crab, Tanner crab, other king crab stocks**

Research is a blend of current plans on tagging/movement/survey work, and focused NPRB projects that are pending (start in early 2024)

HABITAT & RECRUITMENT RESEARCH
Research is a blend of current plans on tagging/movement/survey work, and focused NPRB projects that are pending (start in early 2024)



BSFRF charters are part of this project plan…

BYCATCH RESEARCH – there are estimates of handling and discard mortality for crabs in target and non-target fisheries. Given poor stock status, further focus on bycatch and fishing impacts would provide more precision. **Focus species: all BSAI crab stocks**

Unobserved Fishing Mortality – UFM research
BREP/Similar Projects – specific gear research
Camera/Sensors - gear performance/some working ideas
Collaborative approaches with other sectors

CRAB PREDATION – understanding is limited for how much crab are eaten by groundfish (cod). Major gaps in time and space requires a focus on molting periods, when crab are most vulnerable, nearshore areas with young crab that have not been studied - this is particularly critical now given changing conditions that are affecting the overlap of groundfish predators with crab. **Focus species: all BSAI crab stocks – parts of this are connected to Madi's research**

QUESTIONS?

- Thanks to all CPT members and crab assessment authors.
- Thanks to Miranda Westphal for her contributions as a CPT member