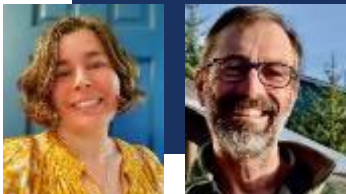


C1 BSAI CRAB STOCKS

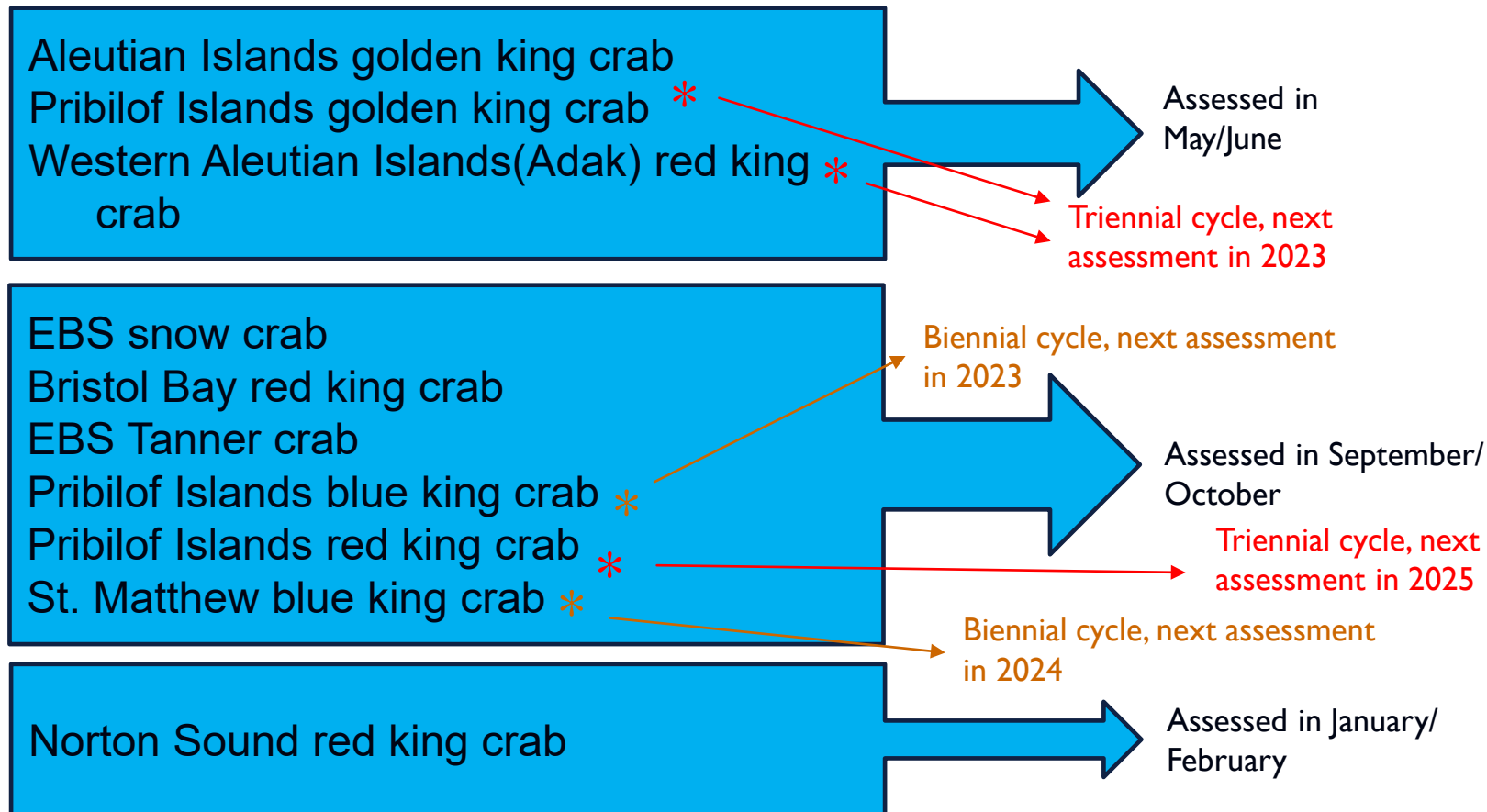
KATIE PALOF & MIKE LITZOW (CPT CO-CHAIRS)

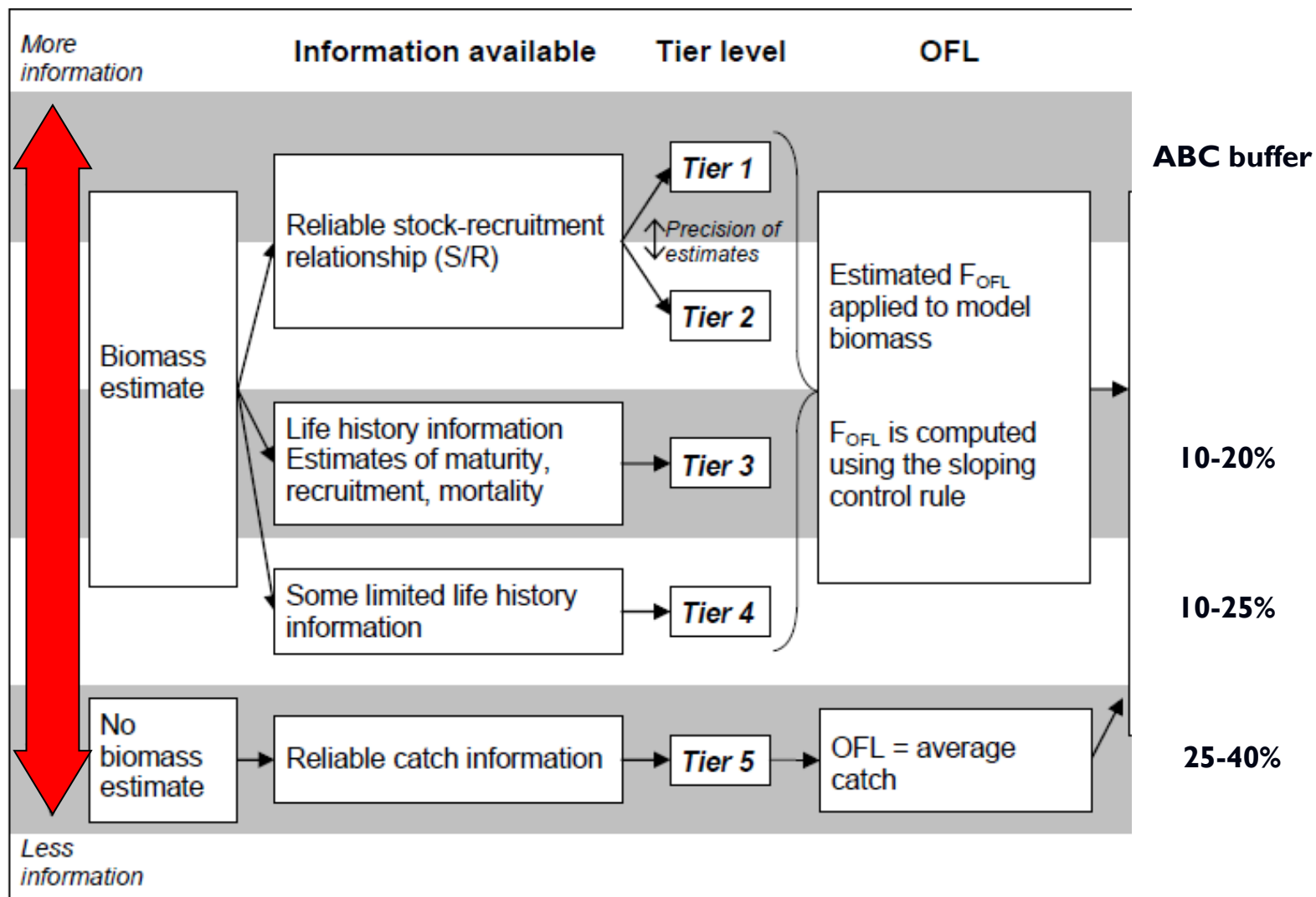
OCTOBER 2023 NPFMC MEETING

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



BSAI CRAB STOCKS MANAGEMENT TIMING





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



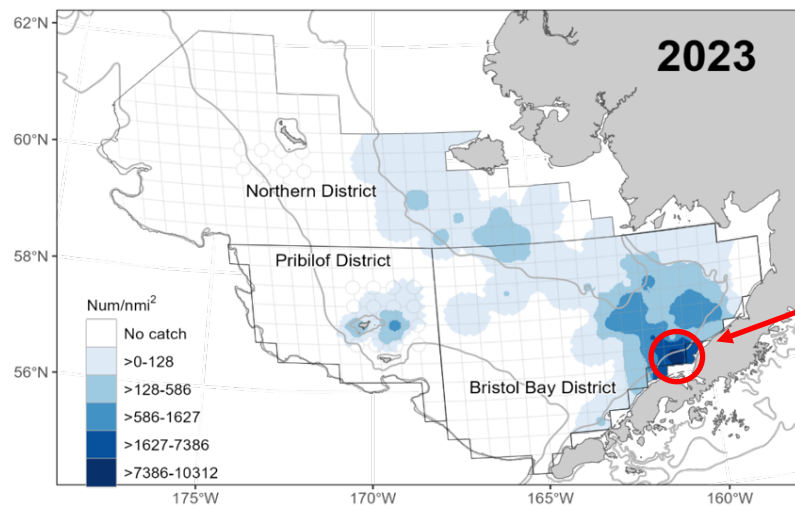
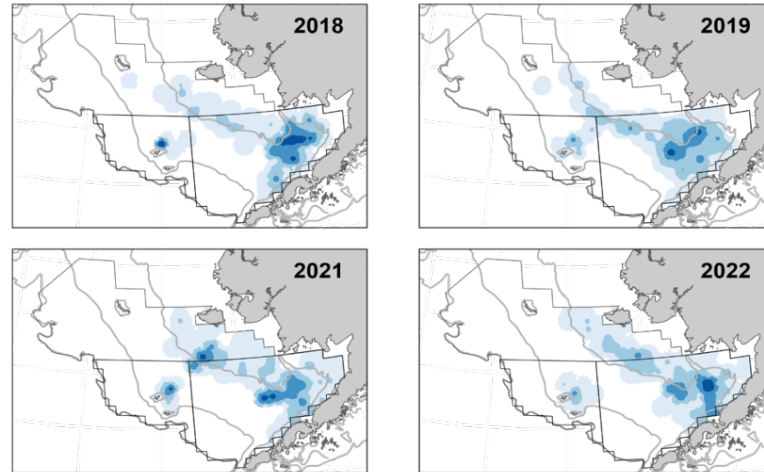
2023 SURVEY: TAKE-HOME RESULTS

- 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

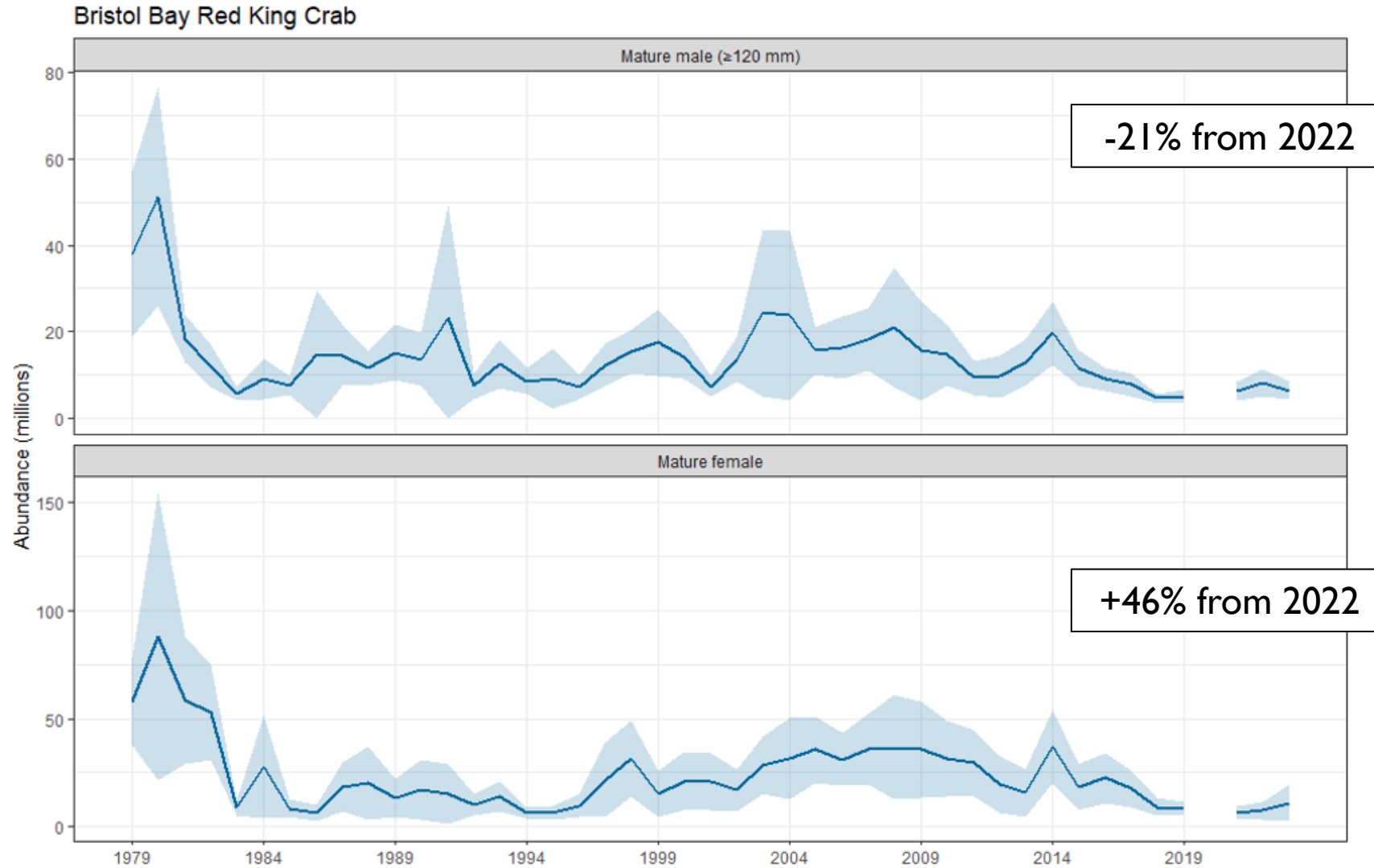
Red King Crab Mature Female



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

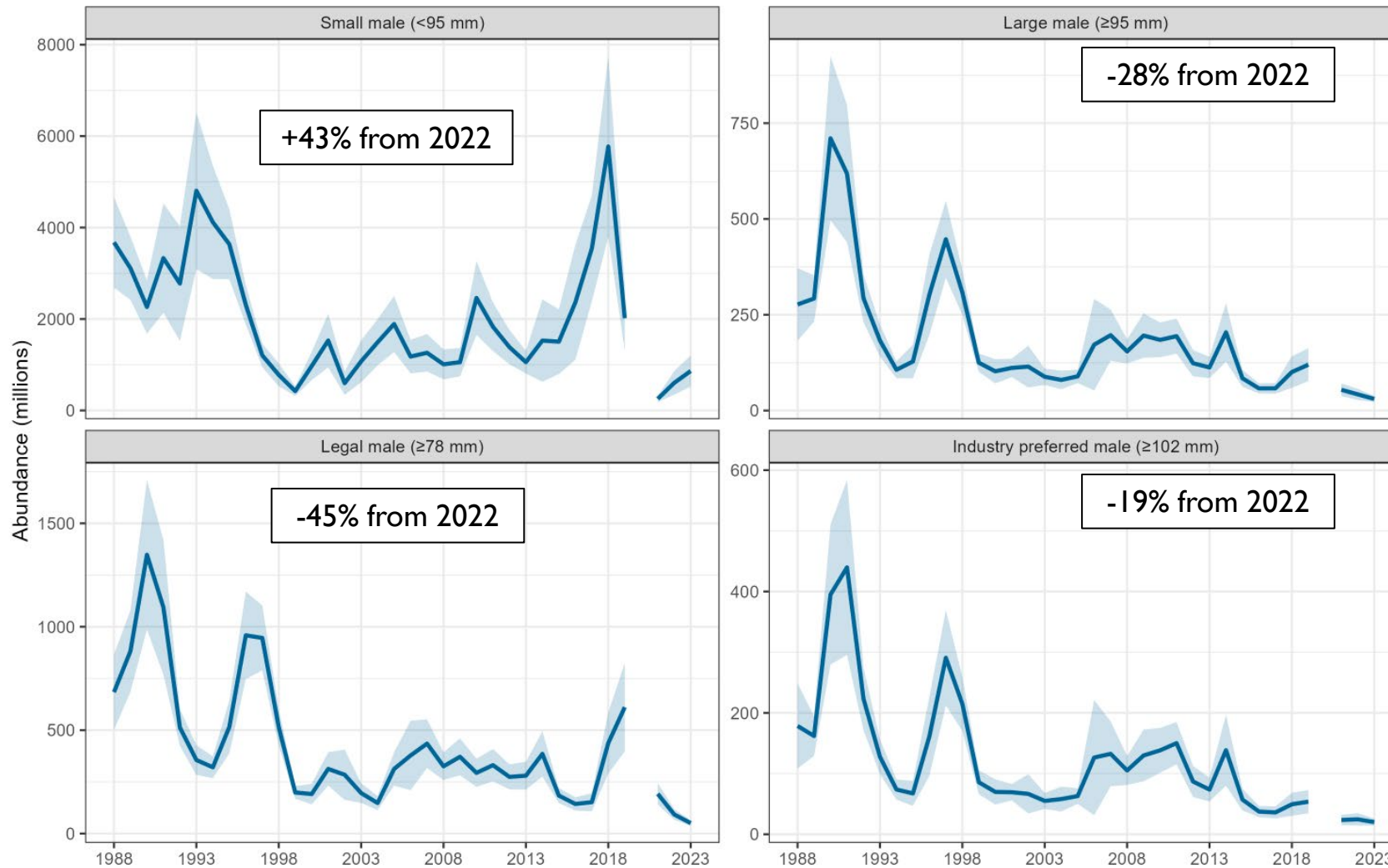


BBRKC LEGAL MALE / MATURE FEMALE ABUNDANCE



MALE SNOW CRAB ABUNDANCE

Snow Crab

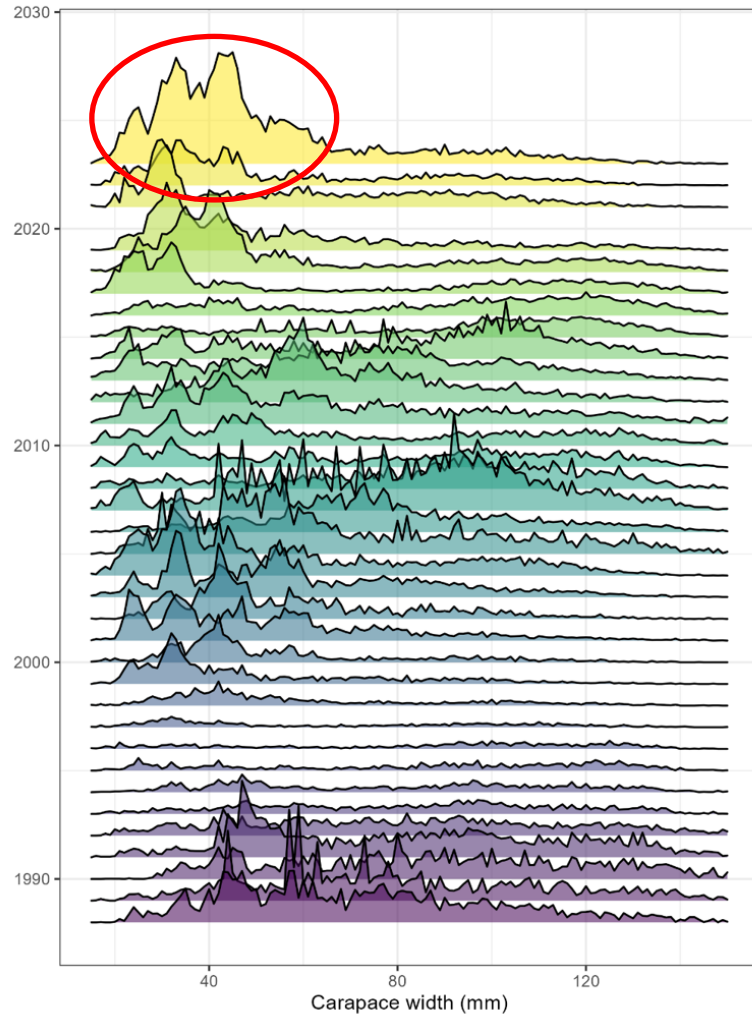


FEMALE SNOW CRAB ABUNDANCE

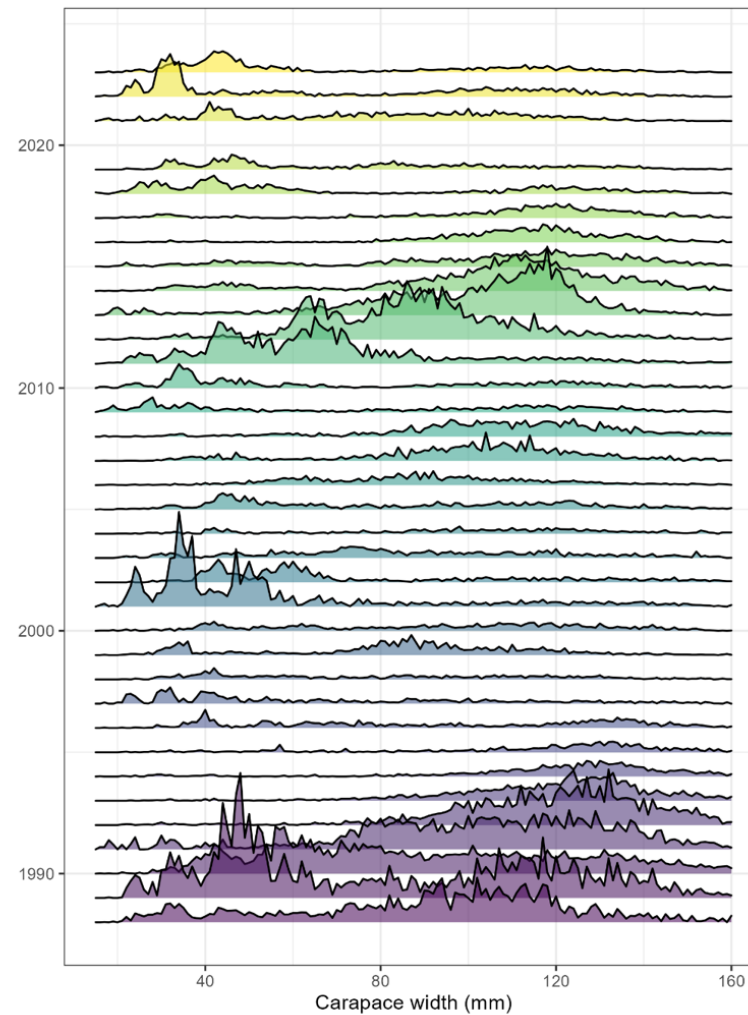


MALE TANNER CRAB ABUNDANCE AT SIZE

Male Tanner Crab West



Male Tanner Crab East

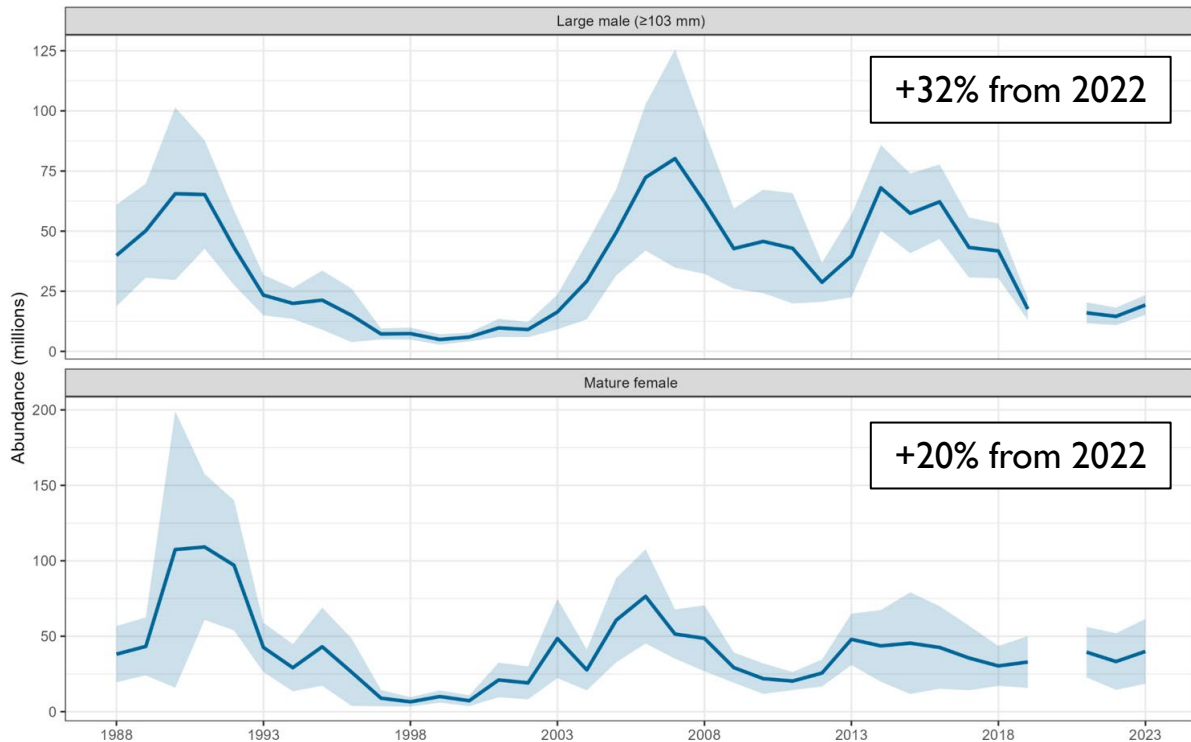


2023: Largest recruitment pulse in time series

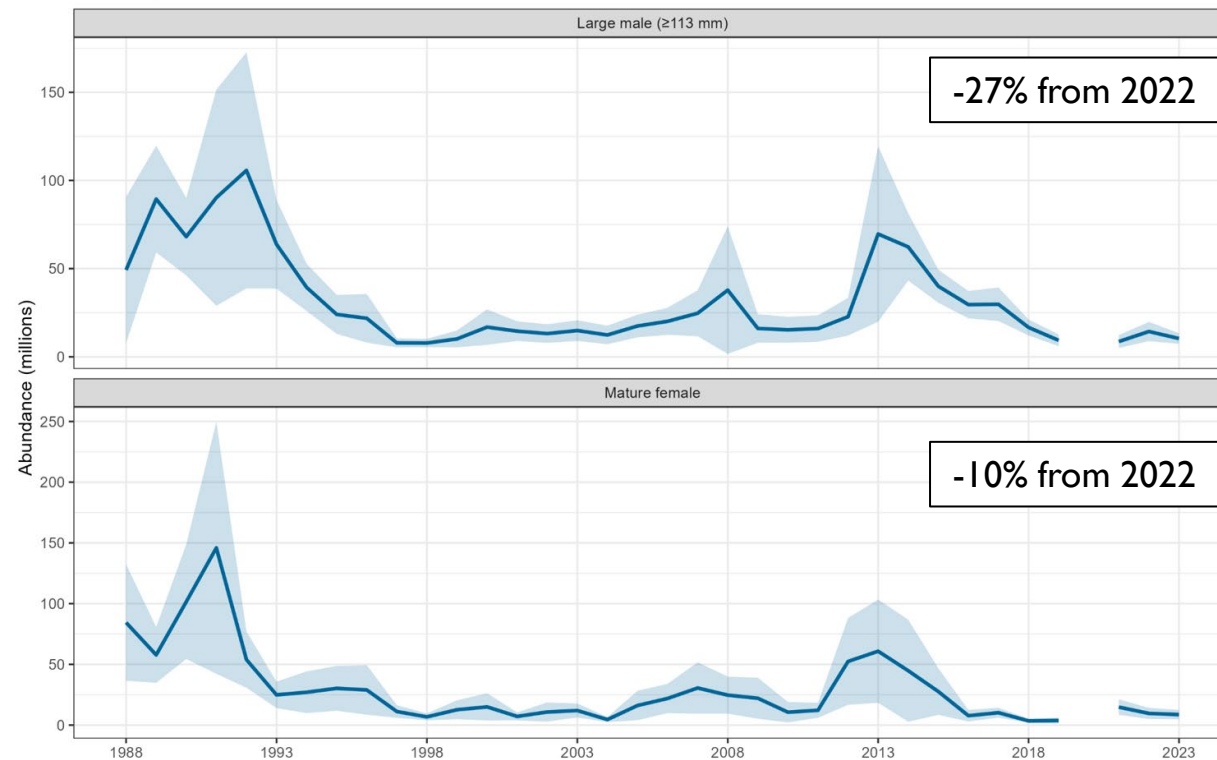


TANNER CRAB ABUNDANCE: *UP* IN THE WEST, *DOWN* IN THE EAST

Tanner Crab West



Tanner Crab East



2022 FISHERY SUMMARY: DIRECTED AND BYCATCH



FISHERY SUMMARY

- Bristol Bay red king crab
 - Directed fishery closed
 - Total bycatch in groundfish fisheries 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.
- Declining 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 $<1^{\circ}\text{C}$ 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



MATURE MALE BIOMASS – FEB 15TH

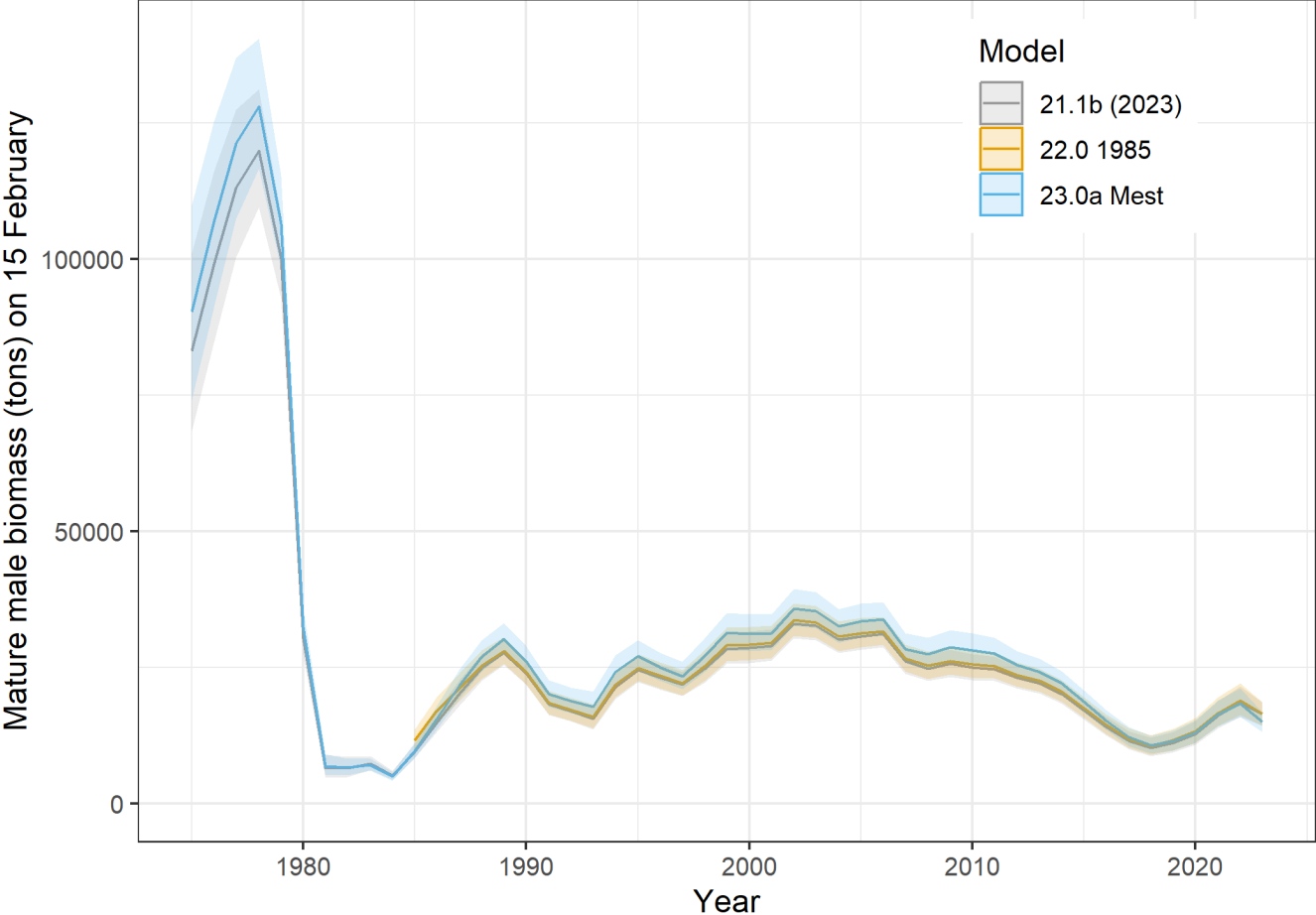


Table 1: Status and catch specifications (1000 t) for the CPT recommended model (23.0a).

Year	MSST	Biomass (MMB_{maturing})	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

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

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

Year	Tier	B_{MSY}	Biomass (MMB_{maturing})	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

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

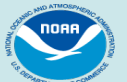
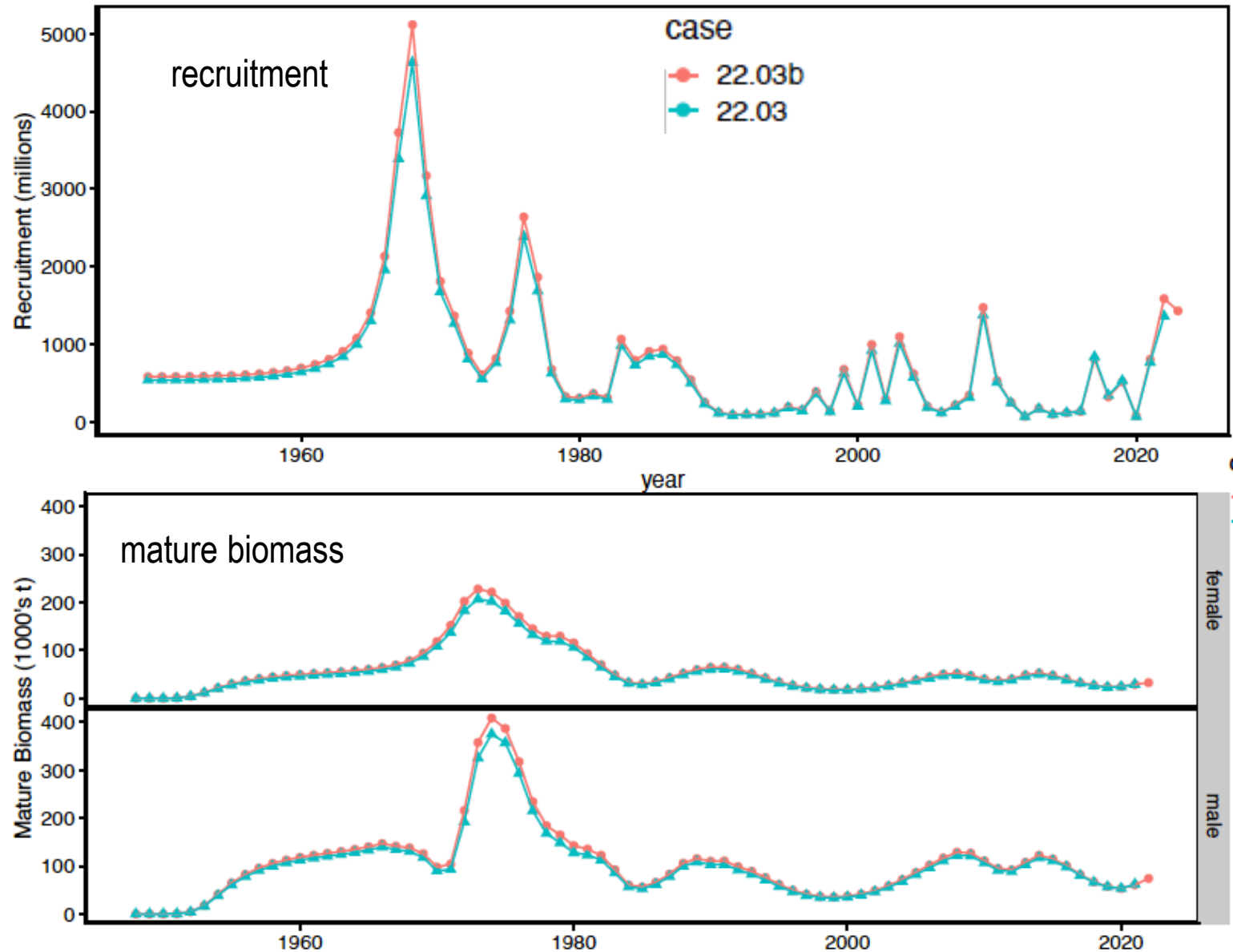


Tanner crab:

- Tier 3 annual stock assessment
- Model stable from last year
- Increase in recruitment in western area



Estimated Population Quantities



TANNER 2023 FINAL SAFE RECOMMENDATIONS

- Tier 3a ($B > B_{msy}$) Model 22.03b (Table in 1000 t)

- Based on previously-adopted assessment model
- No convergence issues or parameters-at-bounds
- Results similar to 2022 assessment
- but not much improvement on previous assessment
 - abundance of large crab overestimated
 - terminal year recruitment consistently overestimated

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		48.77				36.20	28.96

ABC buffer:

CPT recommended 25%; SSC recommended 20% (same as last year)



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, currently under a rebuilding plan
- 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



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



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 (PIBKCR)

FINAL ASSESSMENT 2023



PIBKC SUMMARY

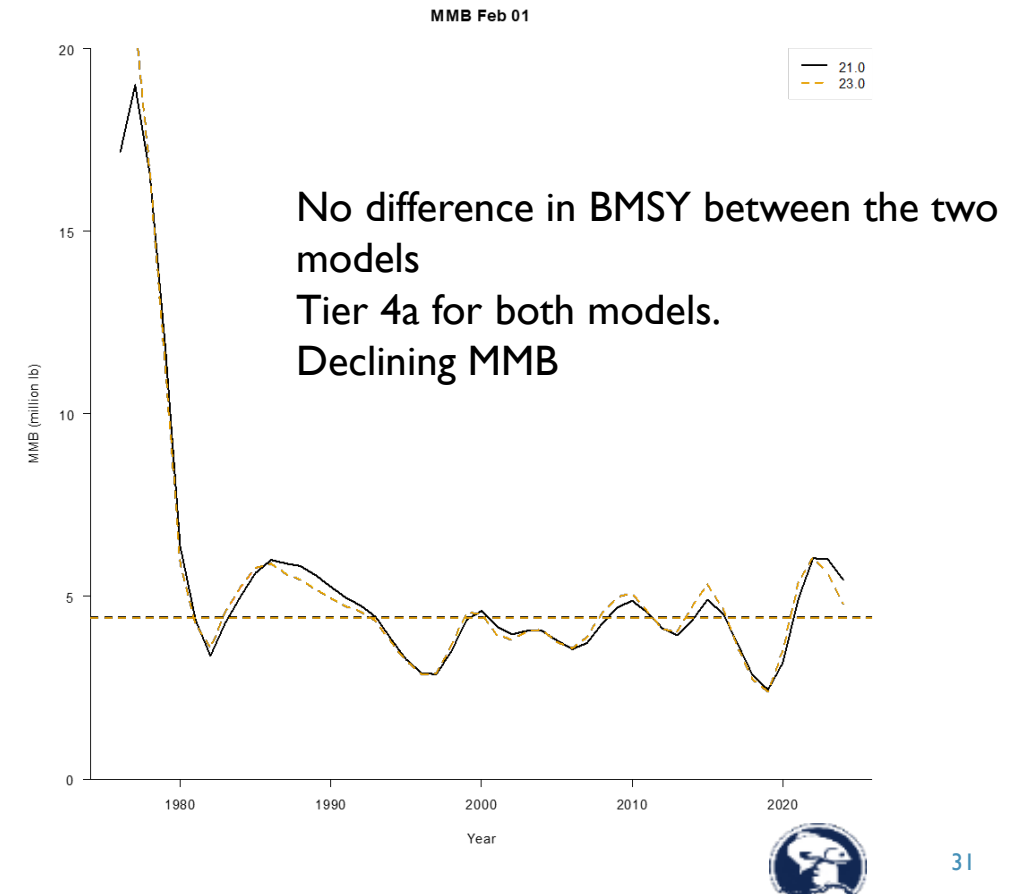
Chapter	Stock	Tier	FOFL	BMSY or BMSYproxy	BMSY basis years	2023/2024 MMB	2023/24 MMB / MMBBMSY	Natural Mortality (M)	2023/24 OFL
4	Pribilof Is. blue king crab	4c	0	4.20	1980/81-1984/85; 1990/91-1997/98	0.18	0.04	0.18	0.00116

- 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 – focus on natural mortality assumptions
- 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



BALANCE OF CPT REPORT



OVERFISHING STATUS UPDATES

2022/23 total catch

- BBRKC = 0.07 kt
- Snow crab = 0.05 kt
- Tanner crab = 2.62 kt
- 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

- BBRKC, Tanner crab, PIRKC, AIGKC: **MMB > MSST, stocks are not overfished**
- Snow crab (using SSC-recommended B_{MSY}):
 - **MMB > MSST, stock not overfished**
 - **MMB < B_{MSY} , stock not rebuilt**
- 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 CPSI (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**

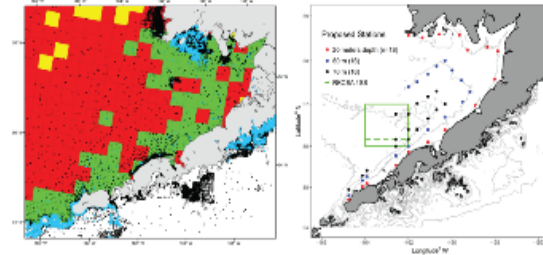
Research is a blend of current plans on tagging/movement/survey work, and focused NPRB projects that are pending (start in early 2024)

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



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...

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

