



NOAA
FISHERIES

Effects of removing the St. Matthew and Pribilof Island corner stations from the EBS survey grid: size composition and stock assessment outcomes

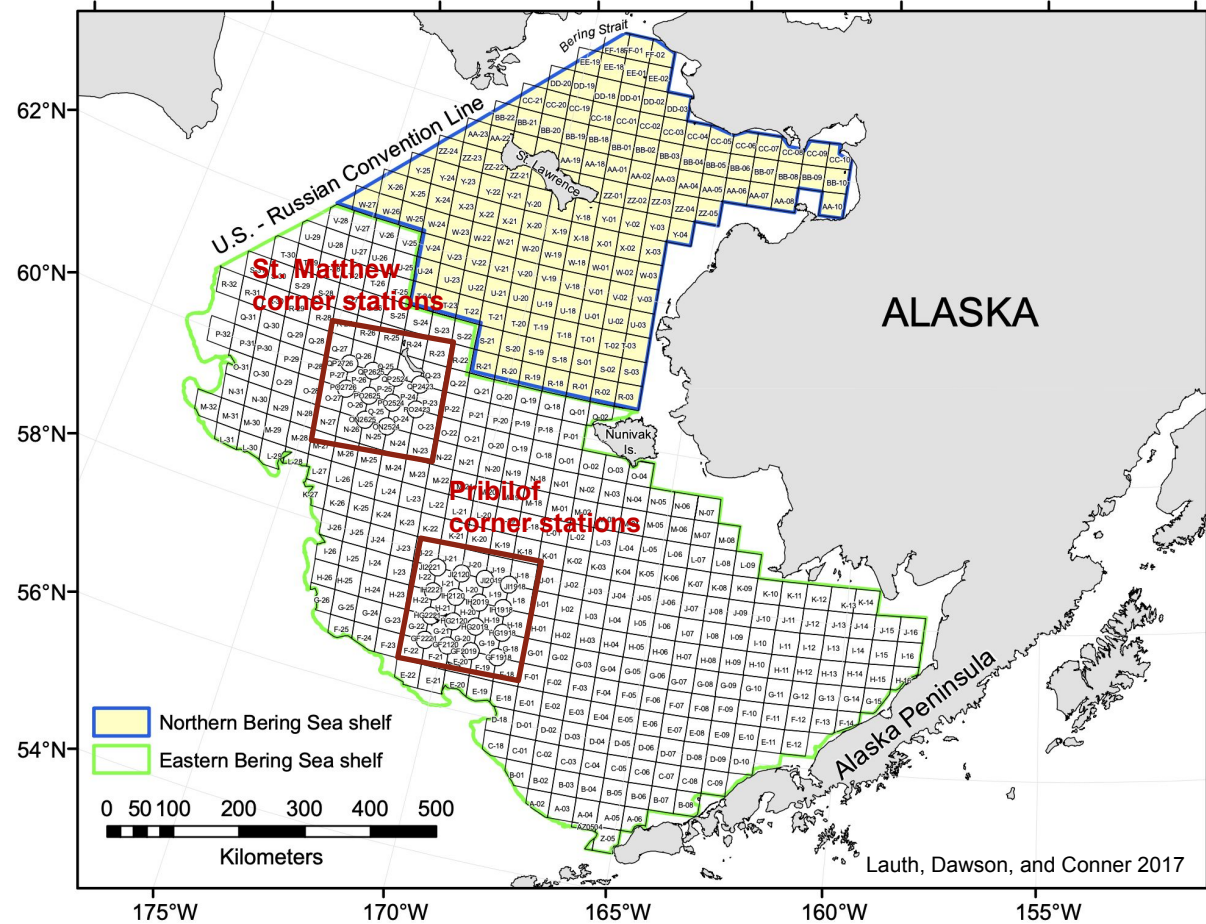
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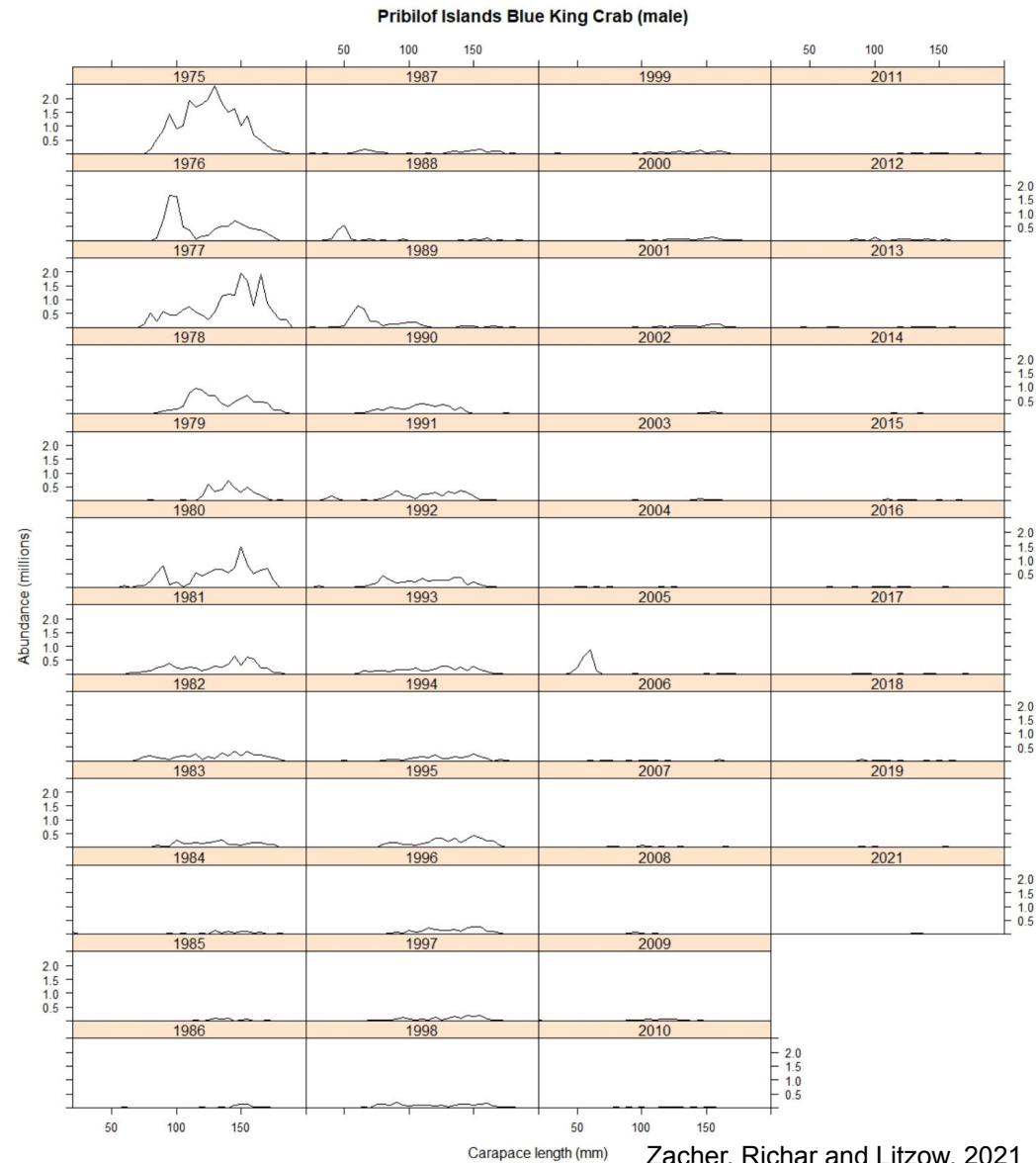
Background

- Blue king crab (*Paralithodes platypus*)
- Populations associated with St. Mathew and Pribilof Islands historically supported commercial fisheries
- Sparse, patchy distribution; large variance in abundance estimates
- High density sampling of grid corners in addition to centers
 - 1) Improved ability to encounter high density patches
 - 2) Increased sample size



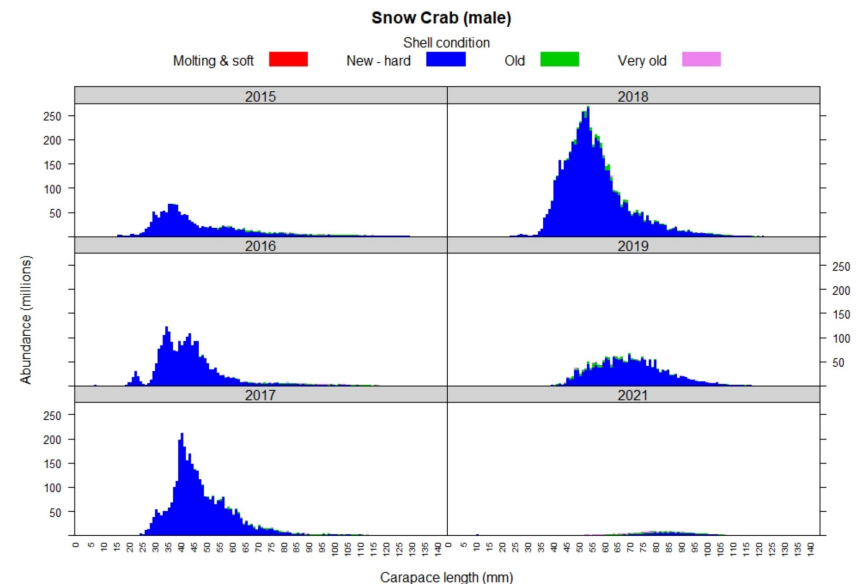
Background

- Pribilof blue king crab stock closed to fishing since 2000
- St. Mathew stock closed to fishing in 1999, opened in 2009 and closed again since 2016
- Fisheries for either stock not likely in the near future
- 26 corner stations, requires 6-7 vessel days (~\$100,000)
- In the absence of active blue king crab fisheries, effort/funds could be re-directed elsewhere



Background

- Snow crab (*Chionoecetes opilio*)
- **2018** → increases in biomass, particularly for mature (47,054 tons, a 60% increase from 2017) and immature males (458,902 tons, an >140% increase from 2017)
- **2019** → reduction in biomass for immature males (down to 284,181 tons) and an increase in mature males (to 54,550 tons)
- **2020** → no survey (covid)
- **2021** → steep declines for immature males (down >80% to 49,158 tons), and mature males (down >50% to 24,387 tons)
- Mortality or migration beyond survey extent?

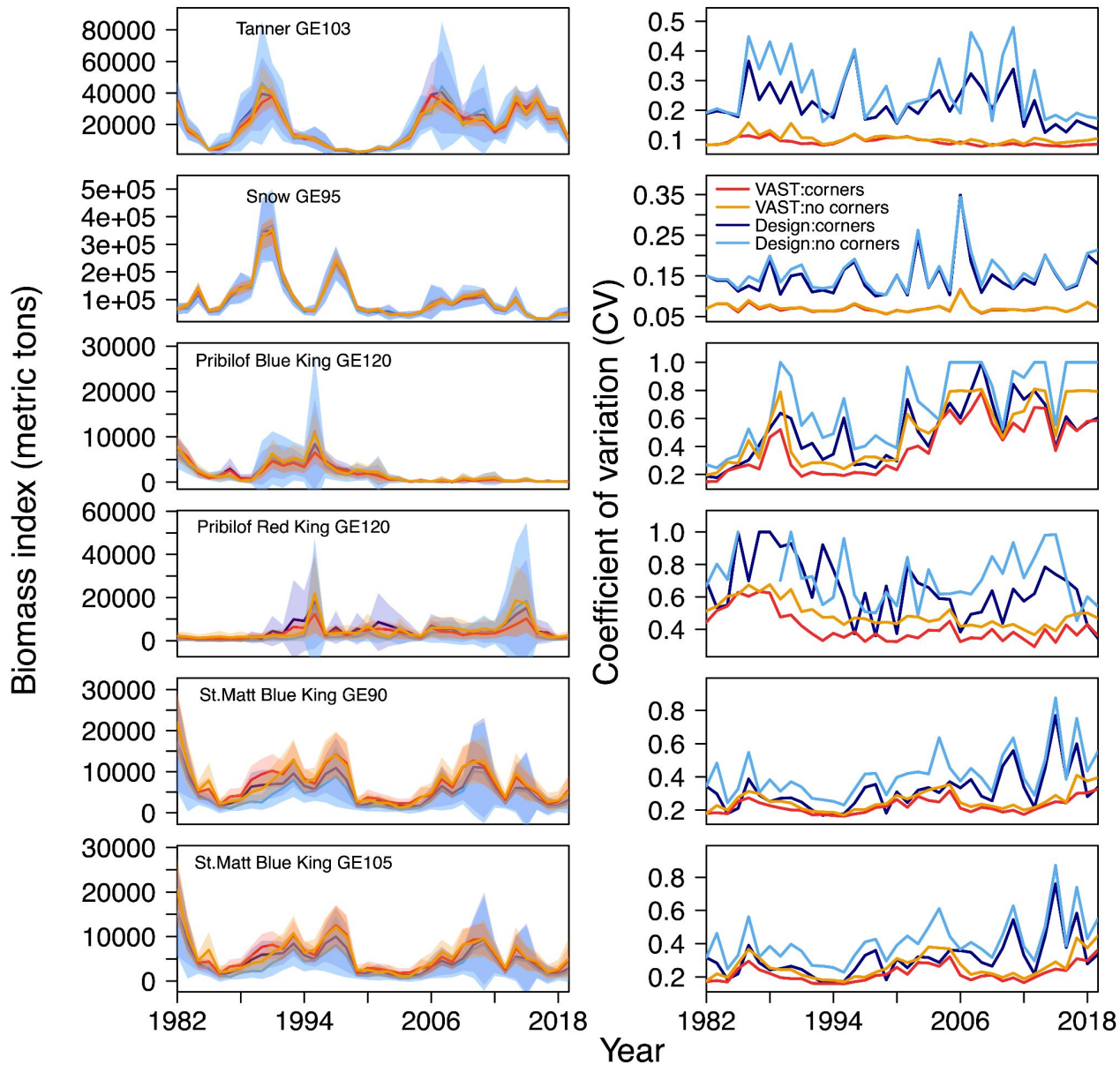


Zacher, Richar and Litzow, 2021

Question

- What are the effects of removing the Pribilof and St. Matthew Island corner stations?
 - 1) Abundance estimates
 - 2) Length composition estimates
 - 3) Stock assessment output

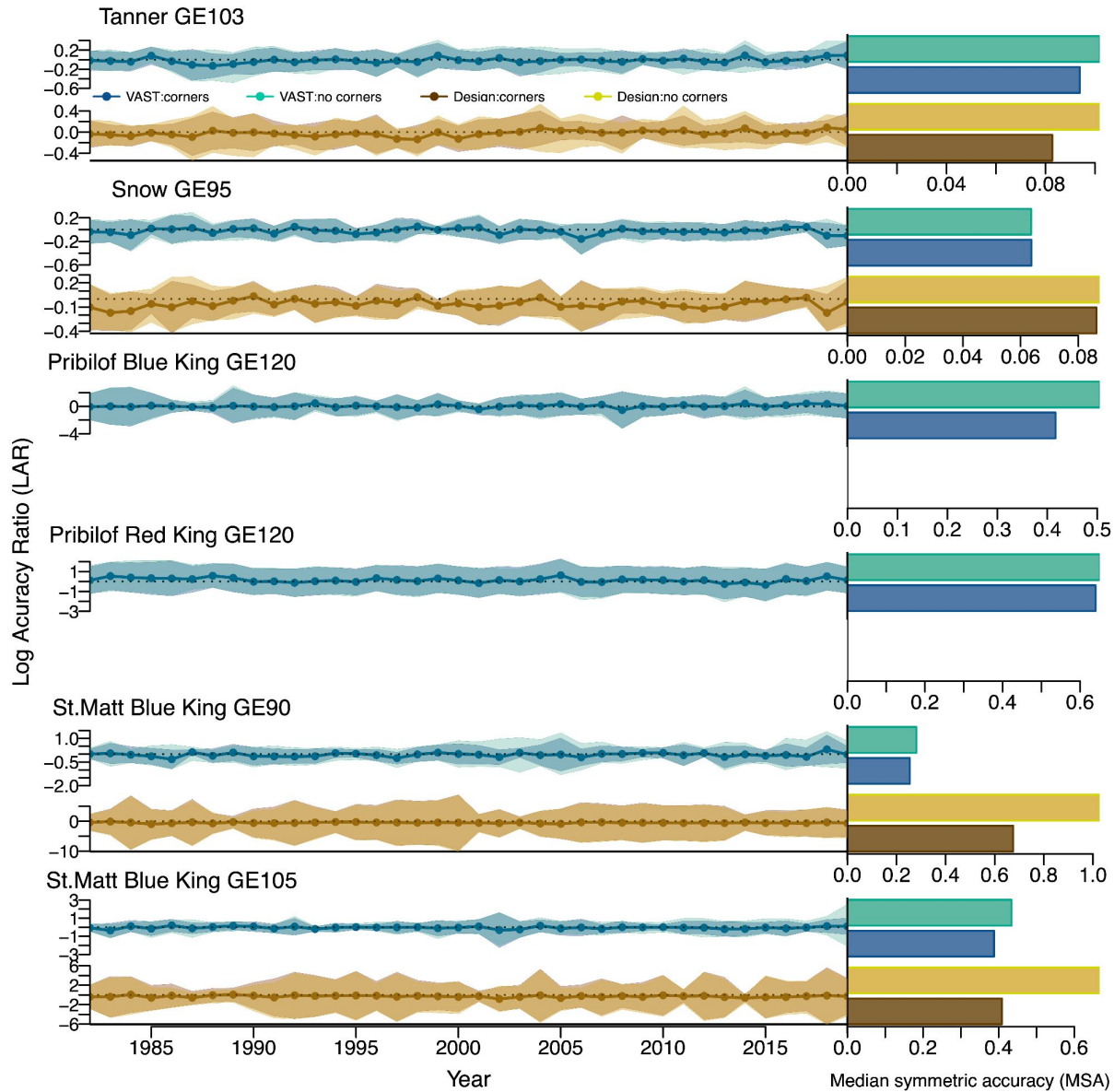
Recap: abundance estimates → empirical data



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Species/Size Class	Estimator	Mean CV (corners)	Mean CV (no corners)	Δ CV	% Δ CV
Tanner GE103	Design-based	0.22	0.27	0.05	22.73%
	Model-based	0.09	0.10	0.01	11.11%
Snow GE95	Design-based	0.15	0.16	0.01	6.67%
	Model-based	0.07	0.07	0	0%
Prib Blue King GE120	Design-based	0.50	0.69	0.19	38%
	Model-based	0.40	0.51	0.11	27.50%
Prib Red King GE120	Design-based	0.65	0.72	0.07	10.77%
	Model-based	0.41	0.49	0.08	19.51%
St. Matt Blue King GE90	Design-based	0.32	0.42	0.1	31.25%
	Model-based	0.22	0.25	0.03	13.64%
St. Matt Blue King GE105	Design-based	0.31	0.41	0.1	32.26%
	Model-based	0.22	0.26	0.04	18.18%

Recap: abundance estimates → Simulation results



Conclusions: abundance estimates

Removal of corner stations had little qualitative effect on biomass estimates

Small effects on precision + accuracy for tanner and snow crab

Larger effects on precision + accuracy for Pribilof, St. Matthew king crab stocks, particularly design-based estimates

Biggest effects were generally for species/estimators in which the precision/accuracy was low, regardless of corner station inclusion

Often declines in precision/ accuracy from corner stations removal could be mitigated by using model-based estimates

Similar analysis for groundfish species found little effect from removing corner stations (<https://meetings.npfmc.org/Meeting/Details/2673>)



Crab Plan Team Recommendations:

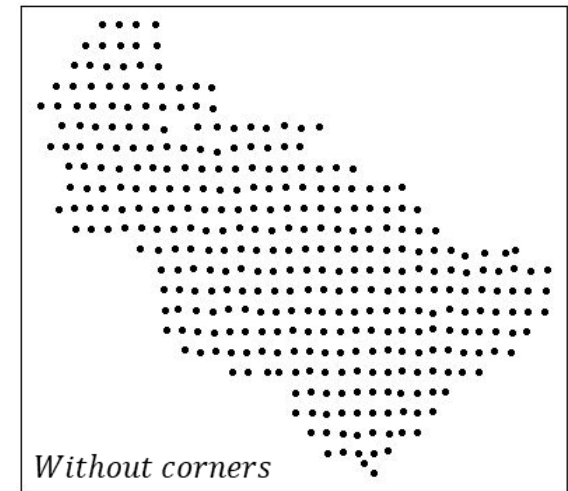
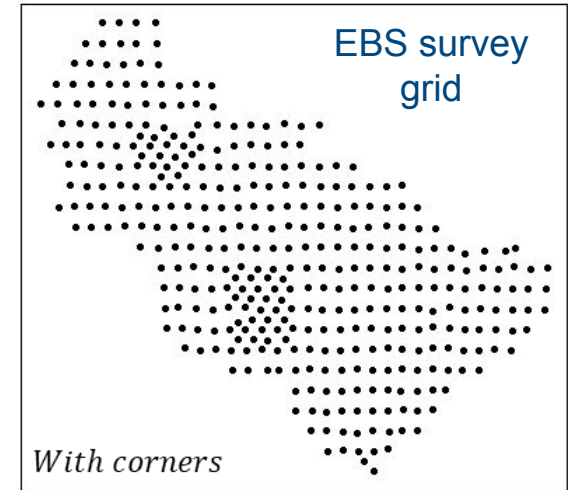
Explore effects of corner station removal on:

- **Length composition data products**
- **Stock assessment outputs**

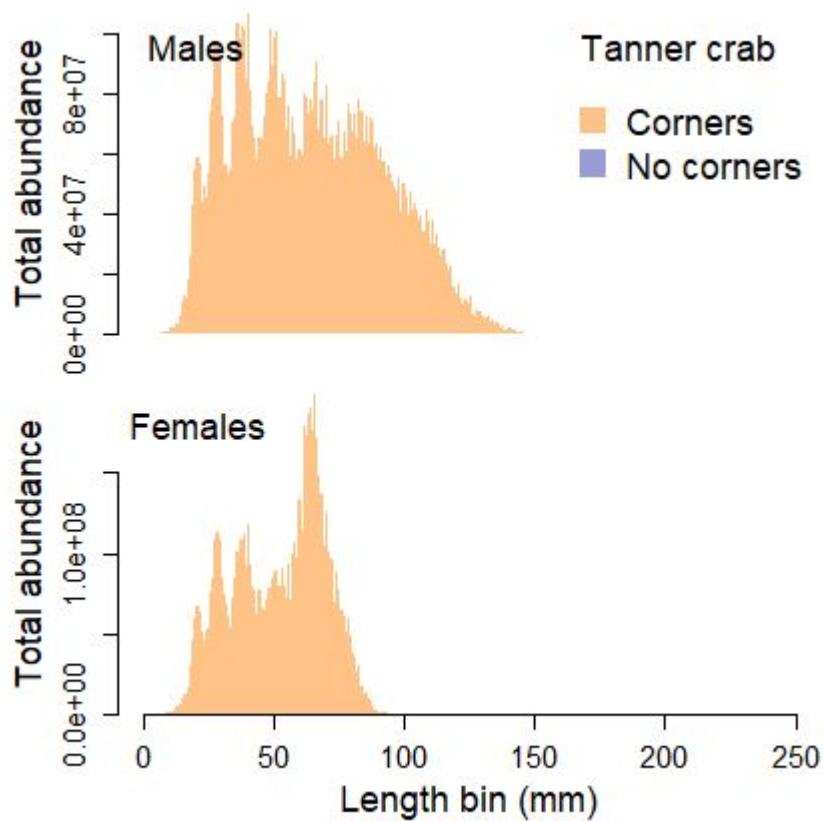


Approach: Length composition

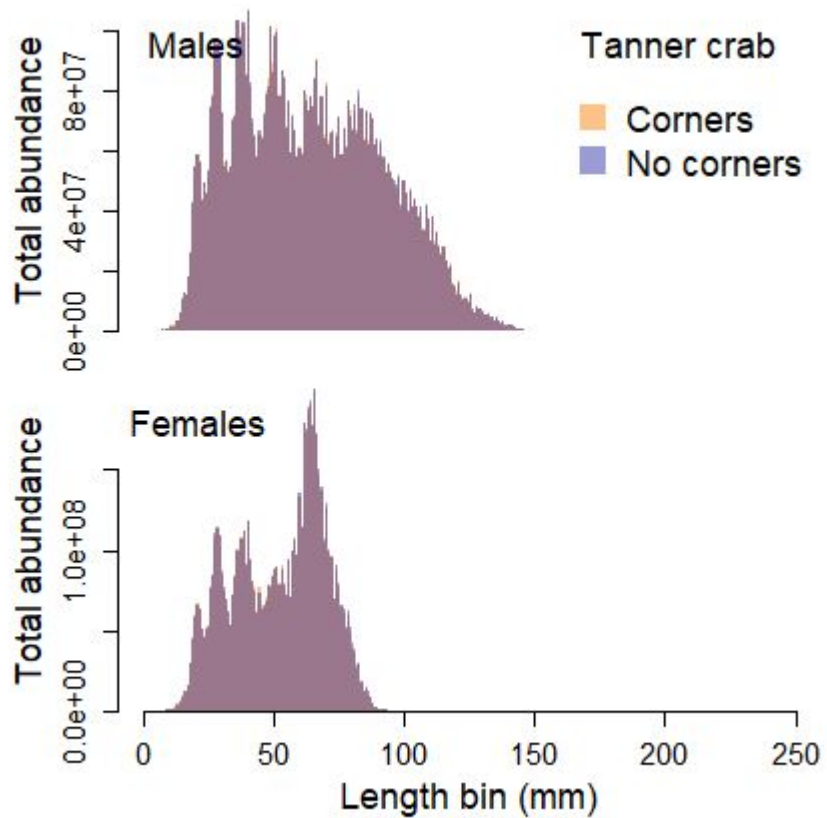
- Compare retrospective design-based size composition estimates and CVs with and without corner stations
- EBS crab stocks:
 - 1) Tanner crab
 - 2) Snow crab
 - 3) St. Matthew Blue King Crab
 - 4) Pribilof Blue King Crab
 - 5) Pribilof Red King Crab



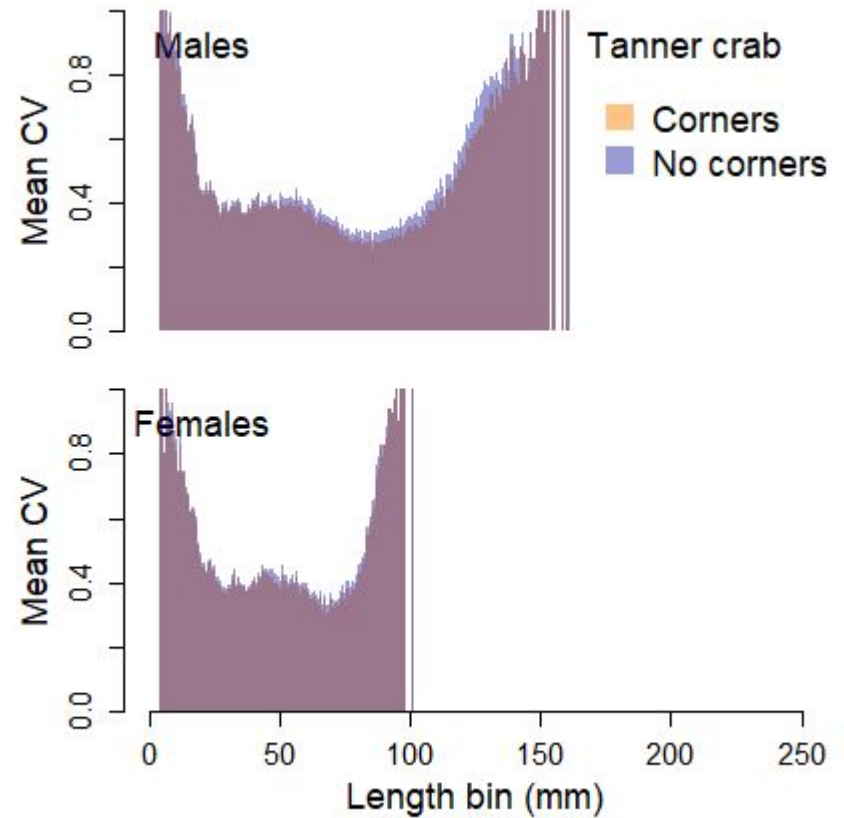
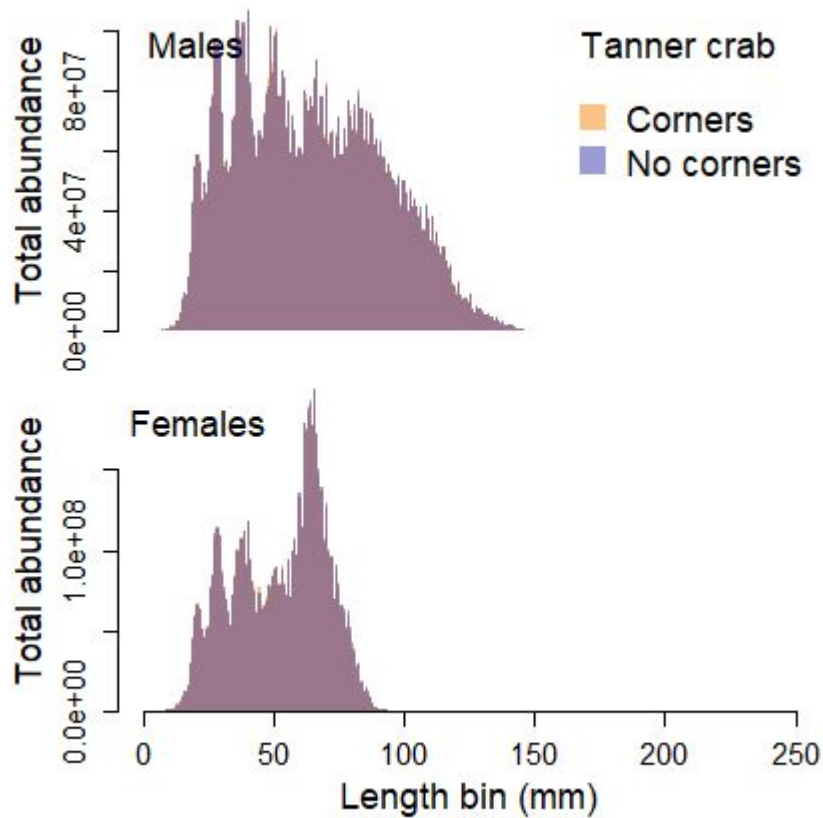
Results: length composition



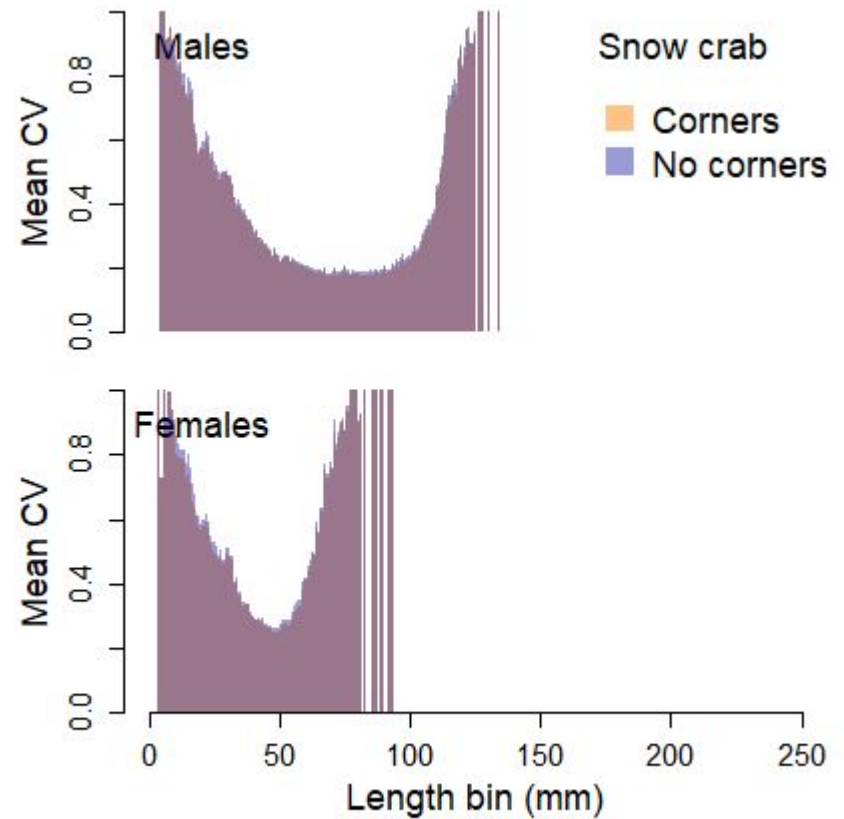
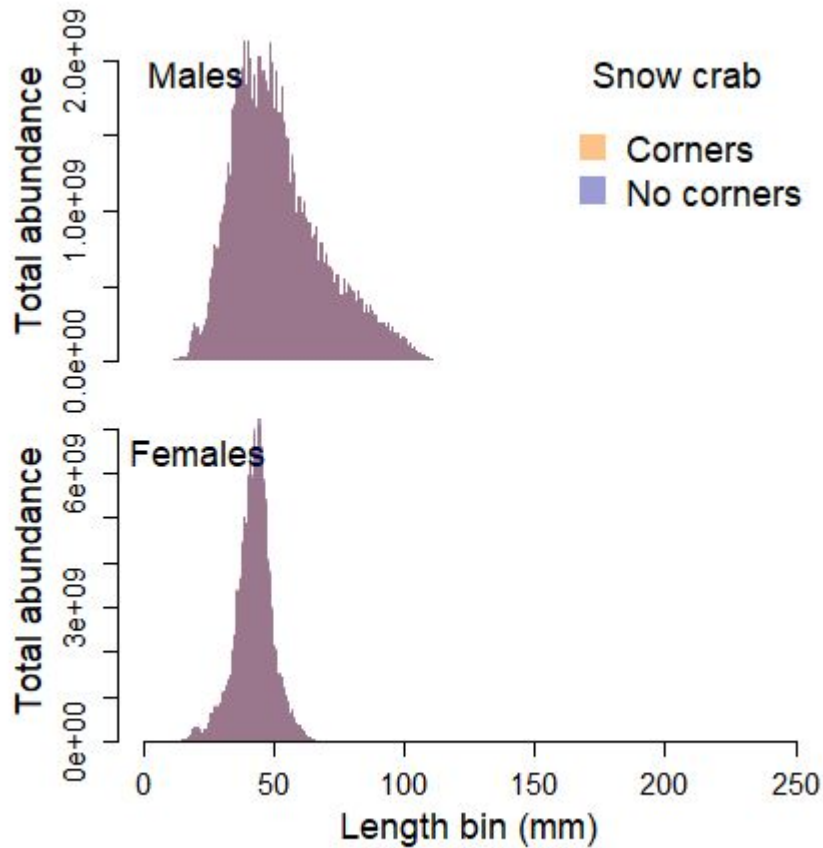
Results: length composition



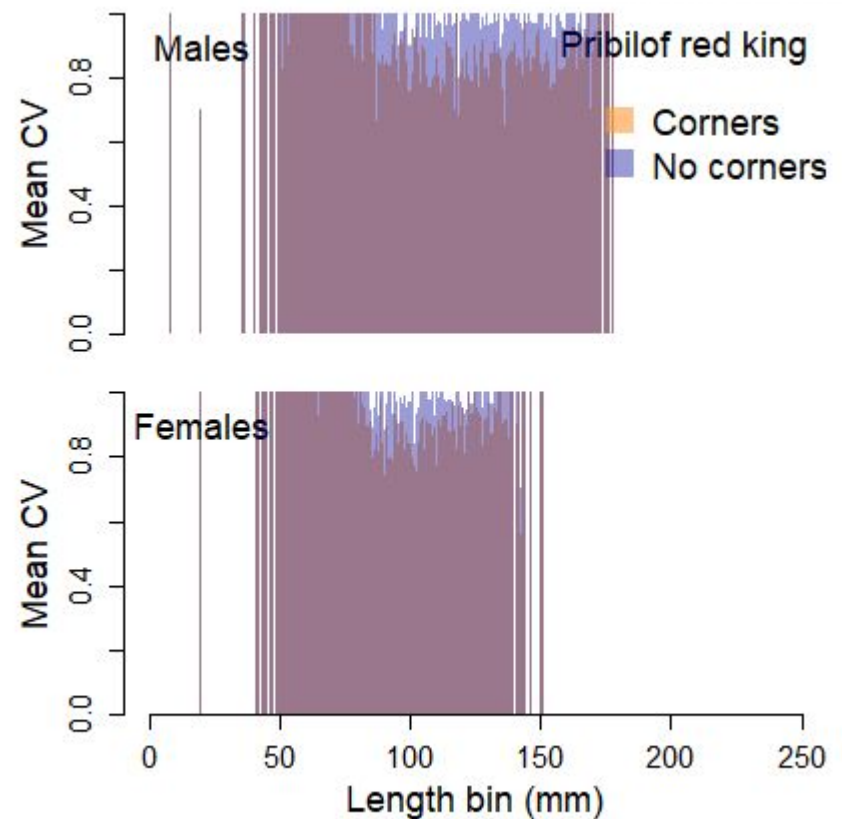
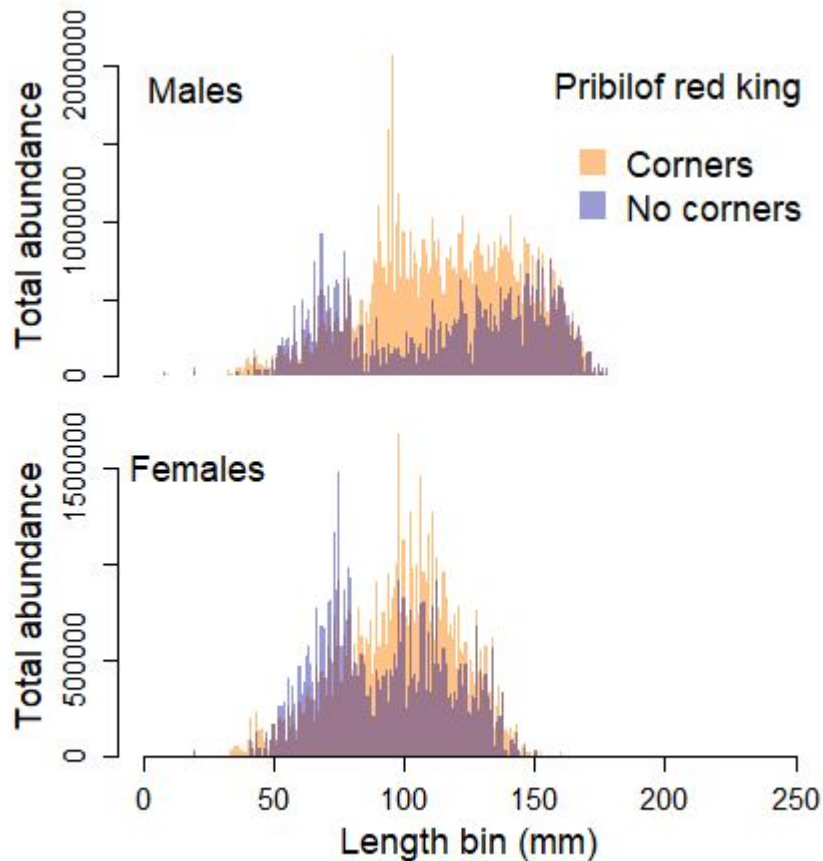
Results: length composition



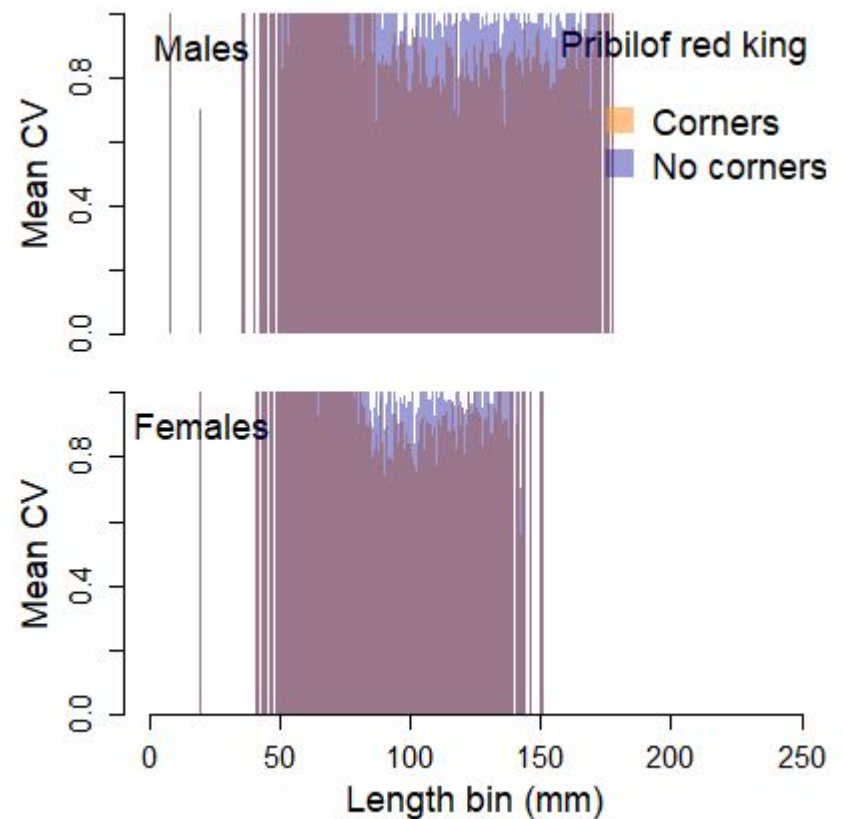
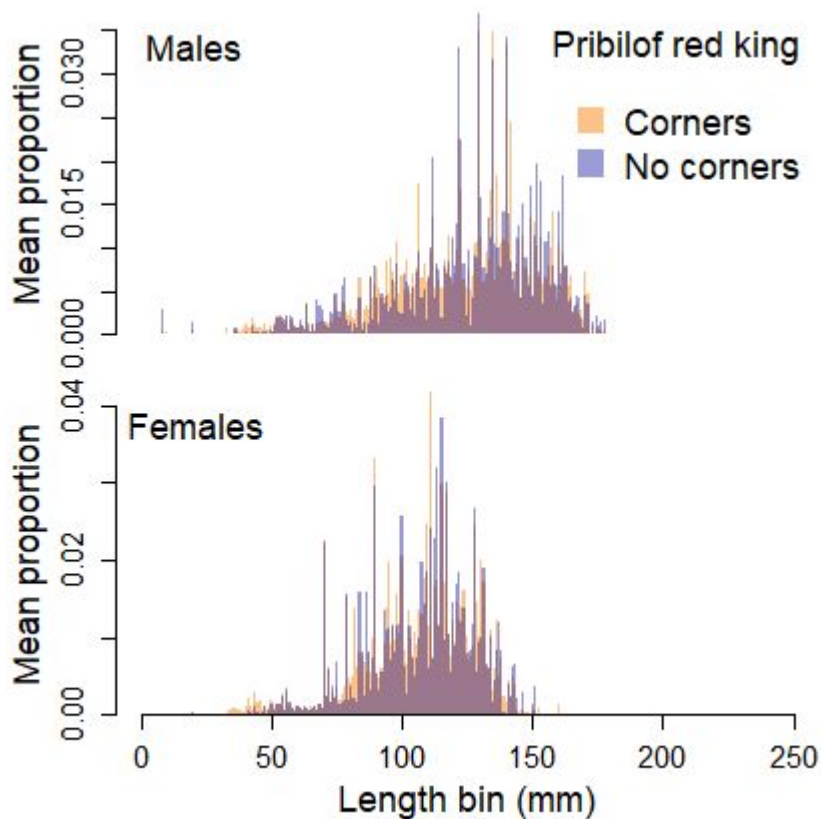
Results: length composition



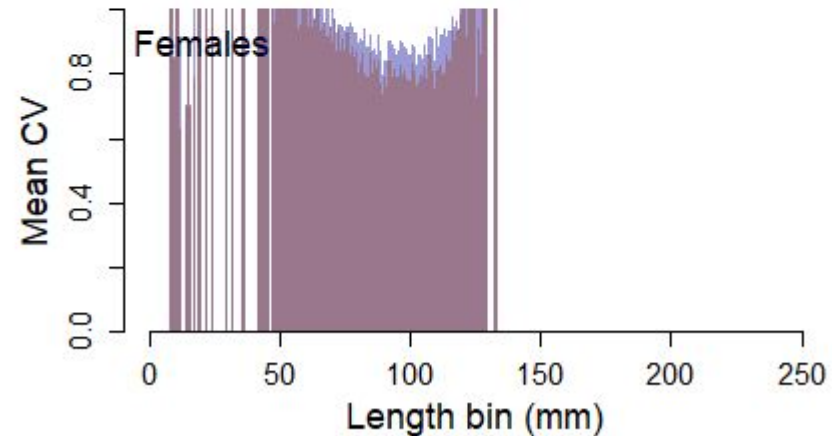
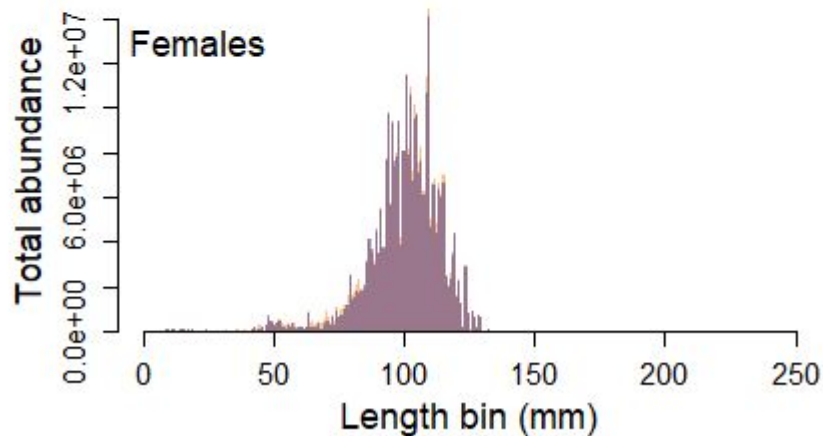
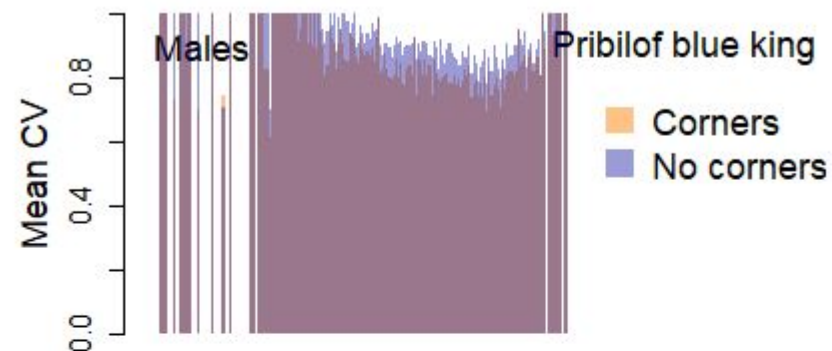
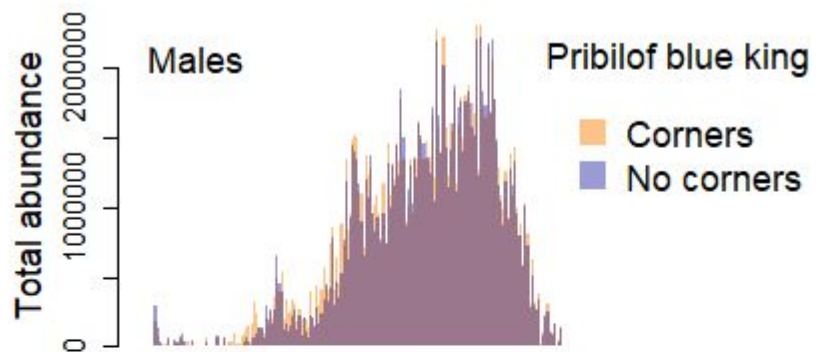
Results: length composition



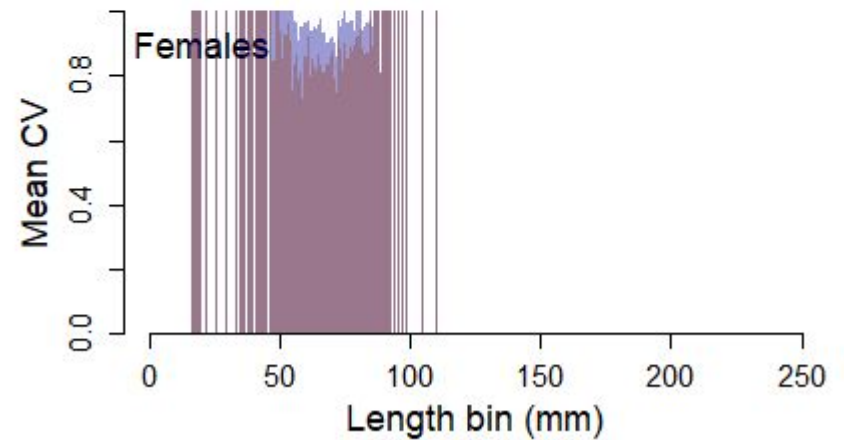
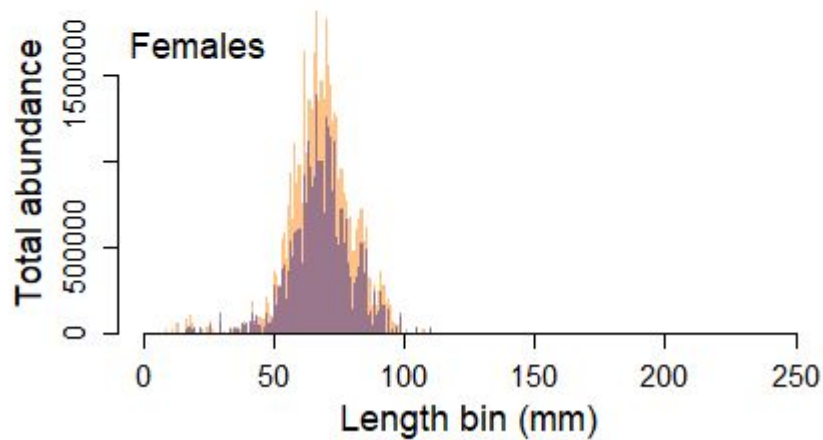
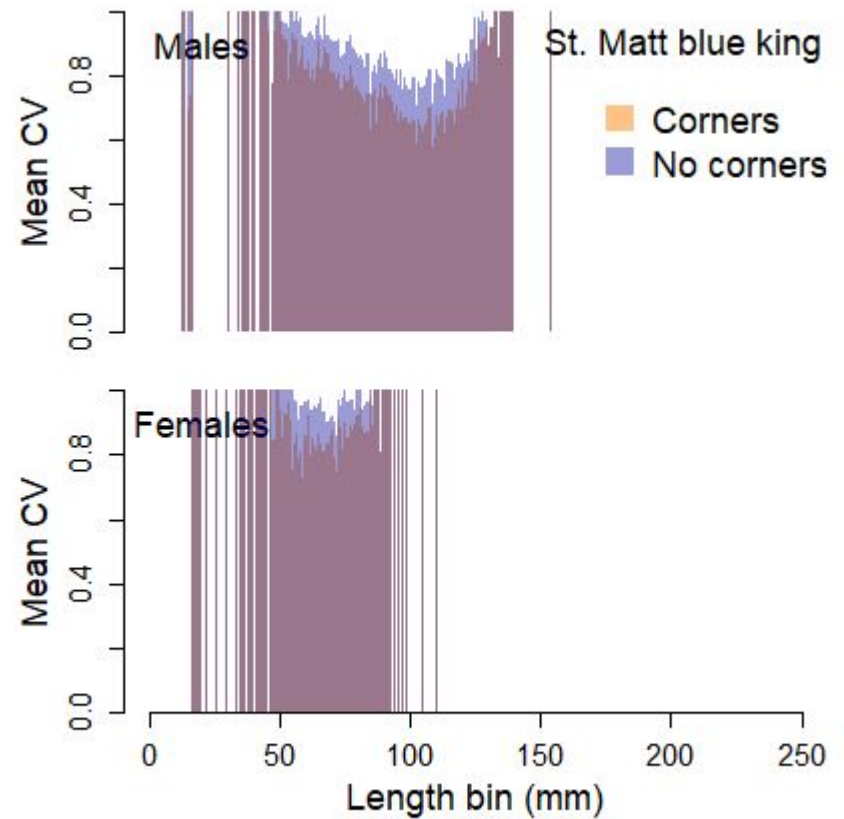
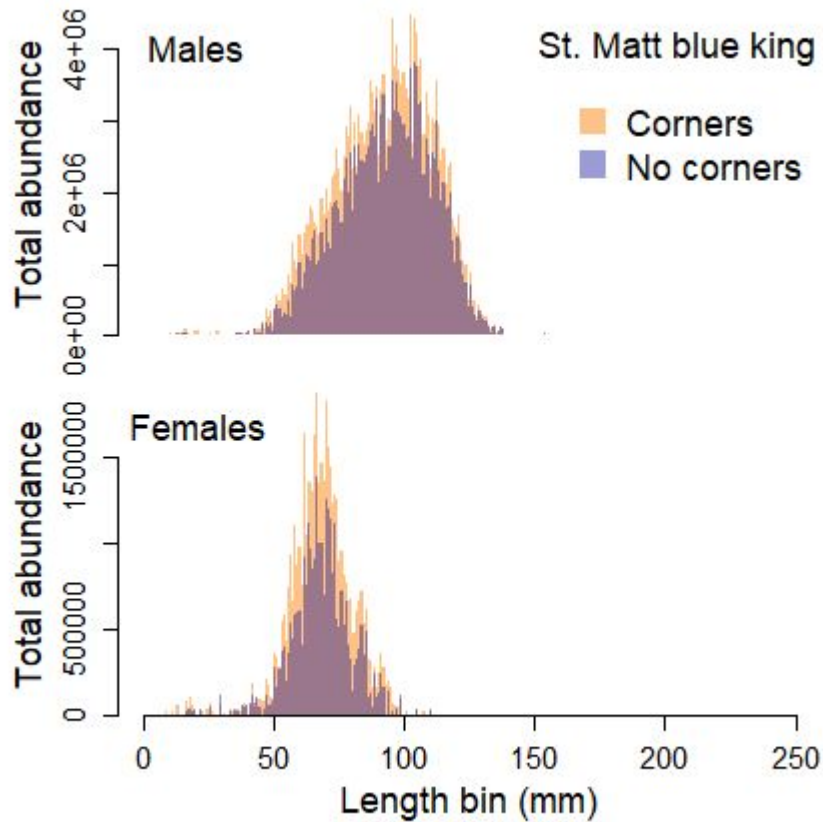
Results: length composition



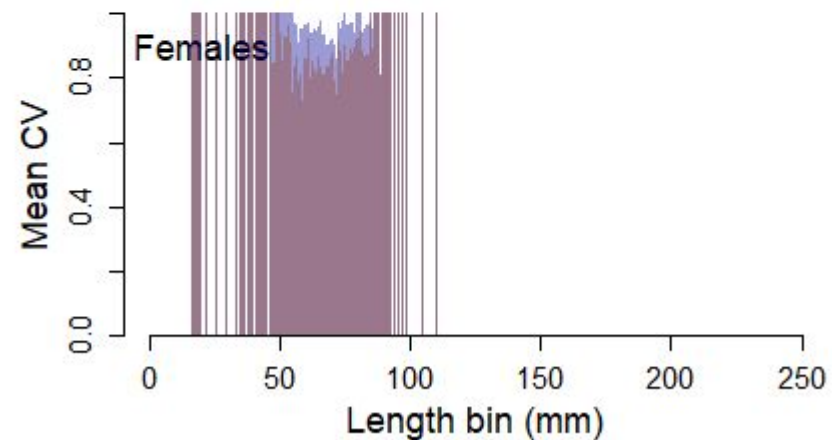
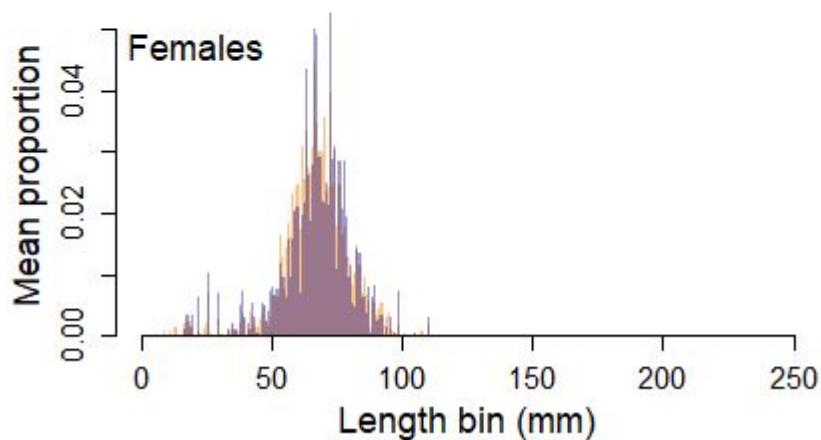
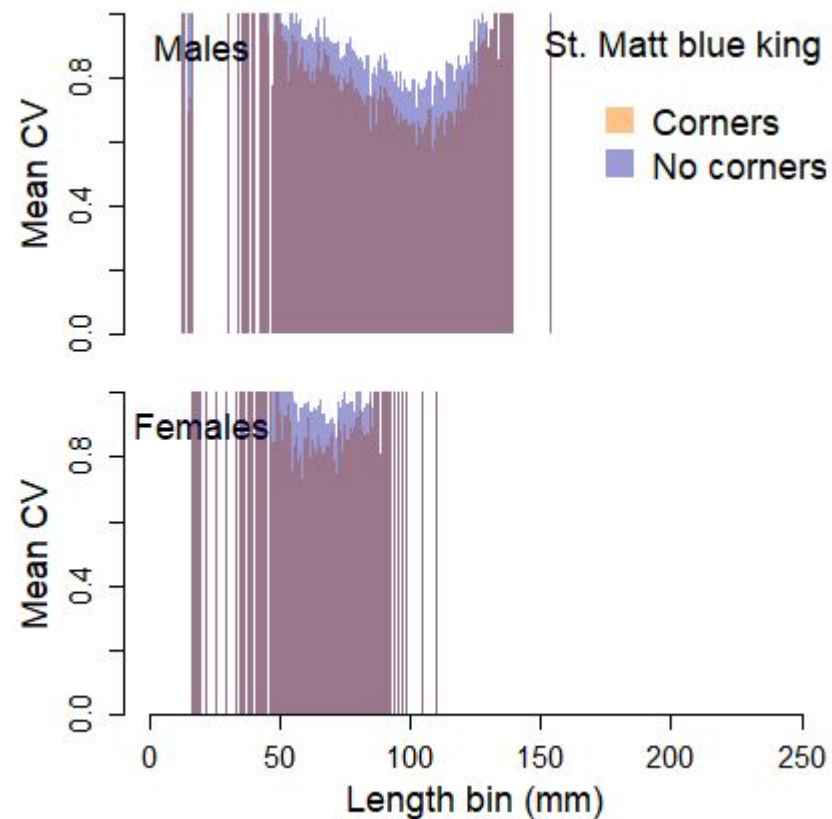
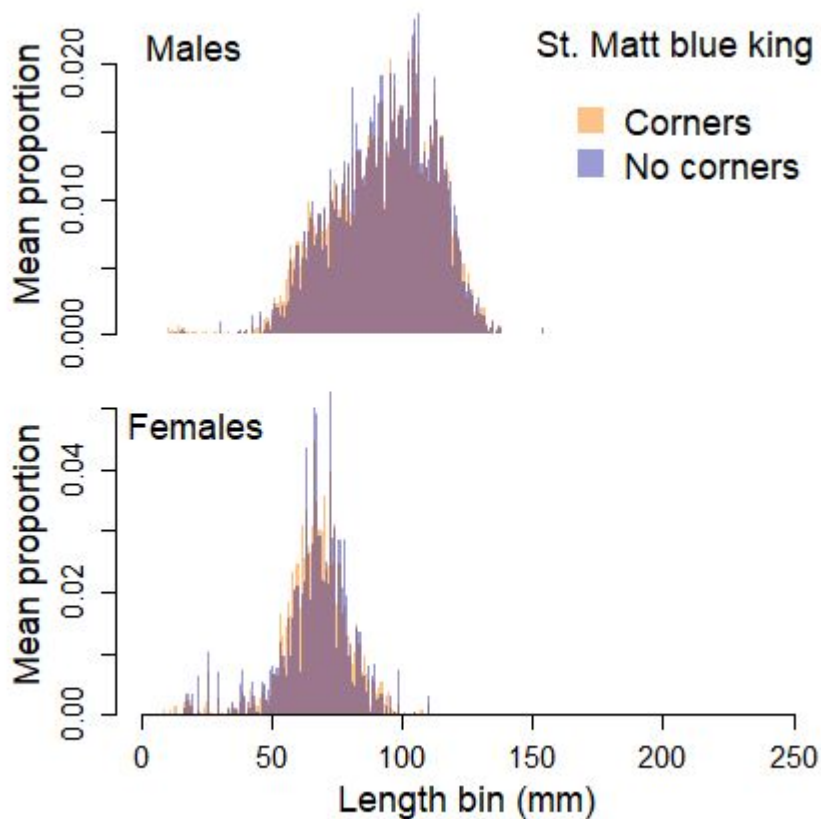
Results: length composition



Results: length composition



Results: length composition



Conclusions: length composition

- Little qualitative effects on size composition estimates from with corner station removal
- Increases in uncertainty associated with corner station removal for red and blue king crab stocks → estimates highly uncertain to begin with



Stock assessment outcomes



St. Matt Blue King



Tanner crab

WITH corner stations

Size composition estimates

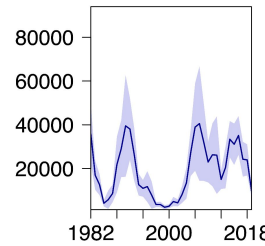
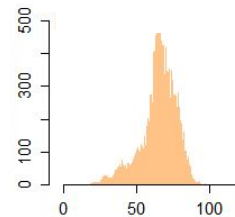
Abundance estimates

Stock assessment model

Fitted WITH corner station data

Stock status

WITHOUT corner stations



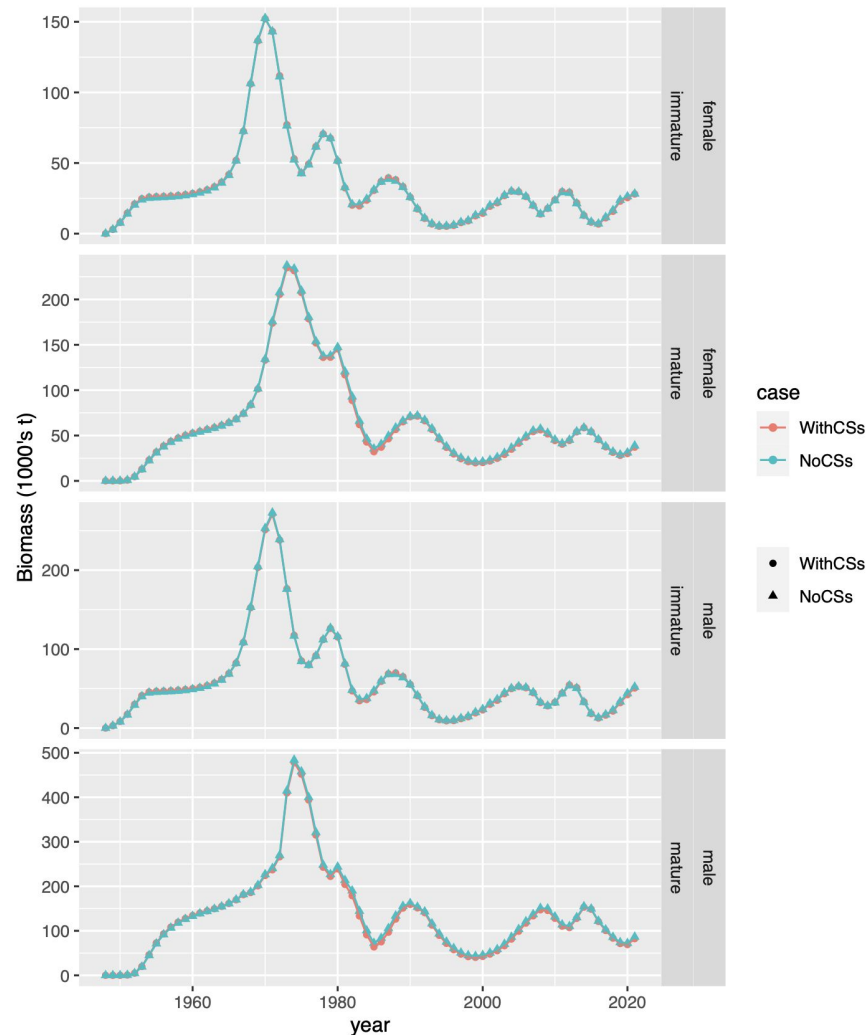
Fitted WITHOUT corner station data

Stock status

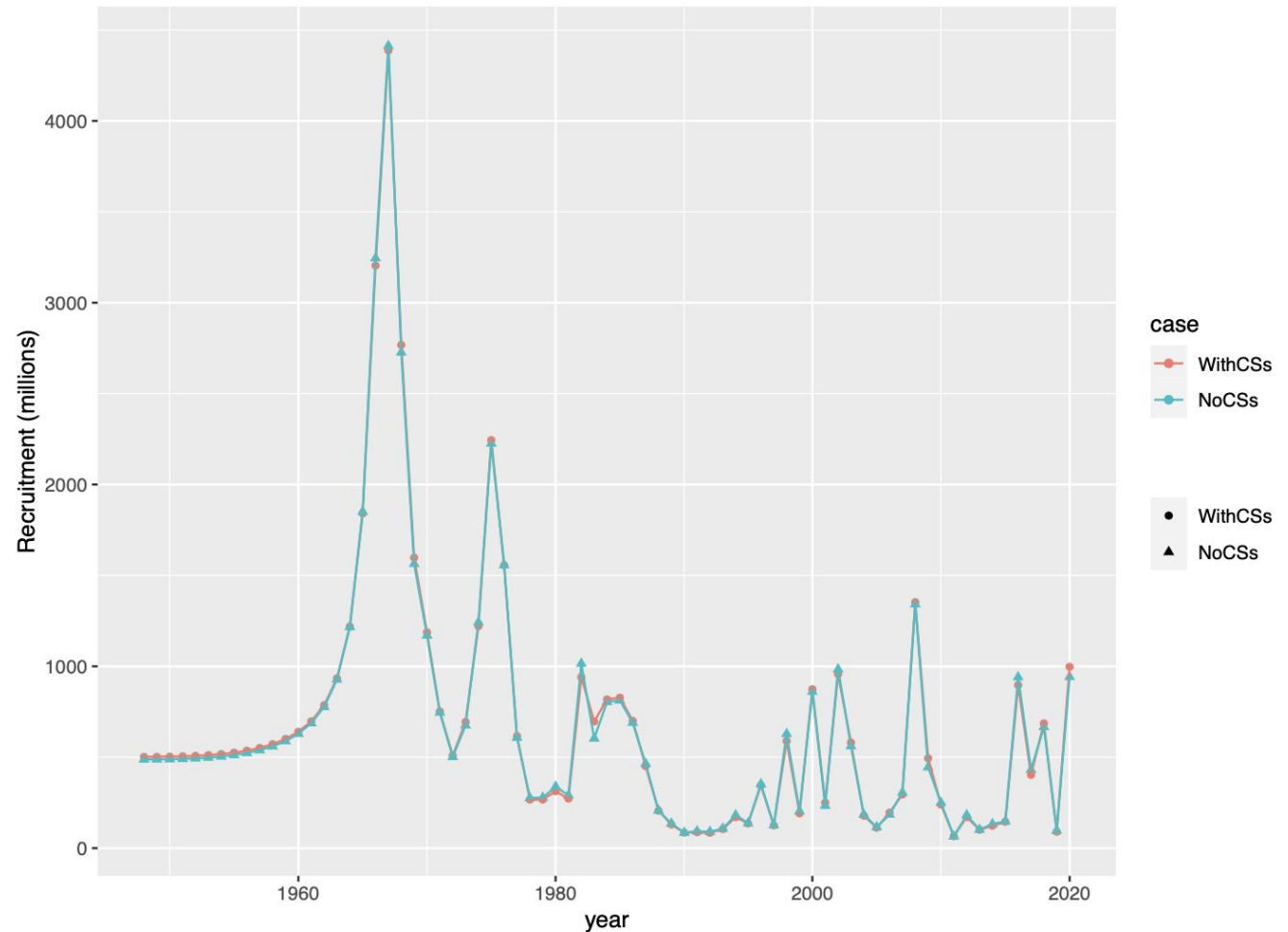
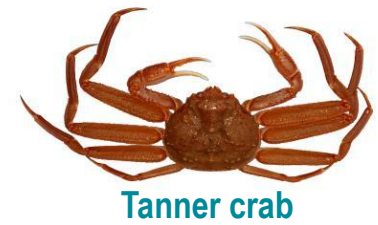
Stock assessment outcomes: Biomass



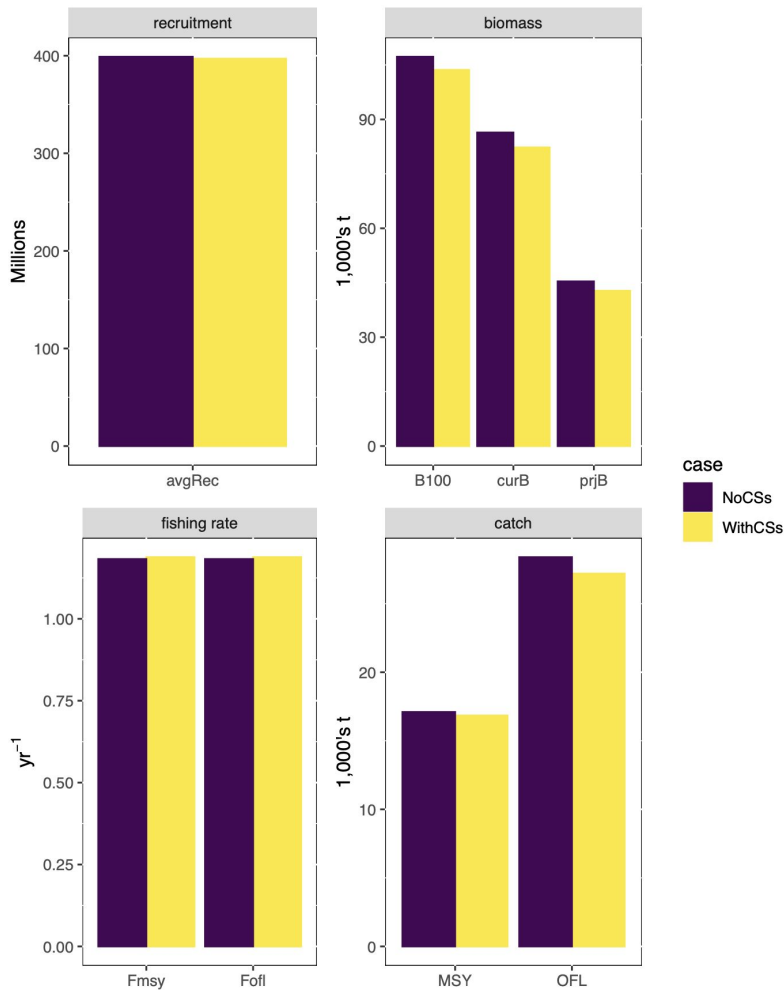
Tanner crab



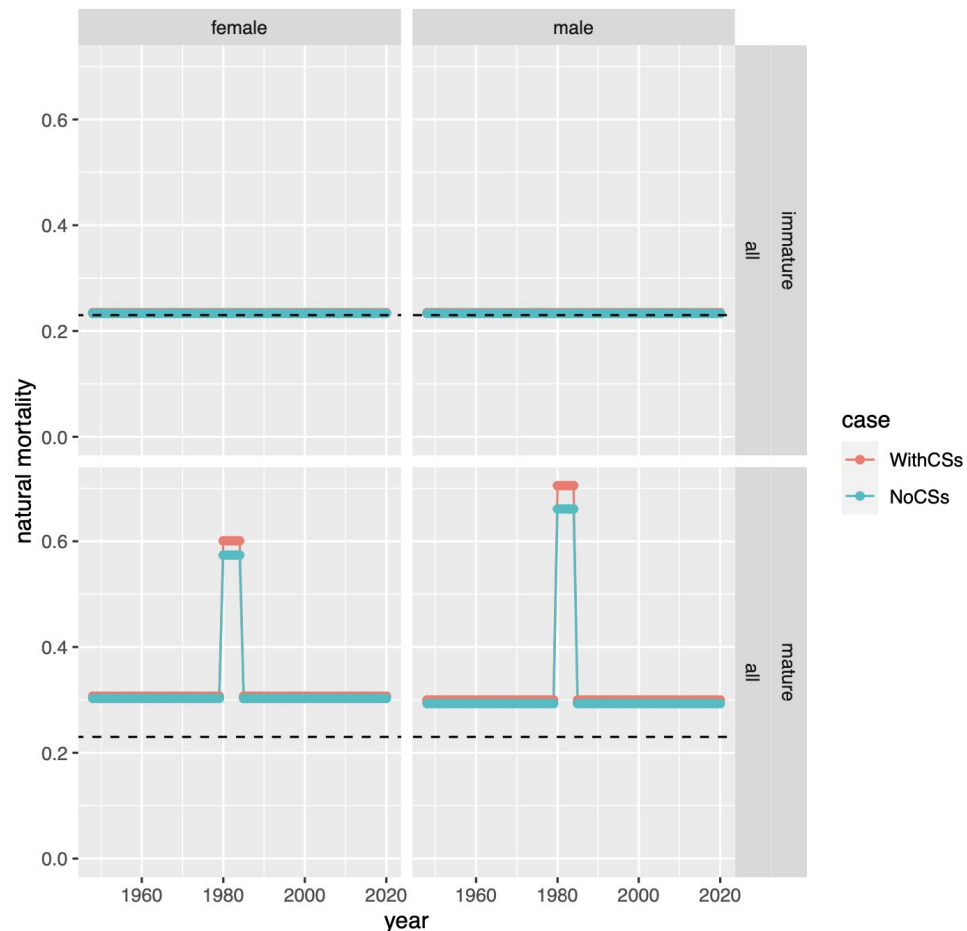
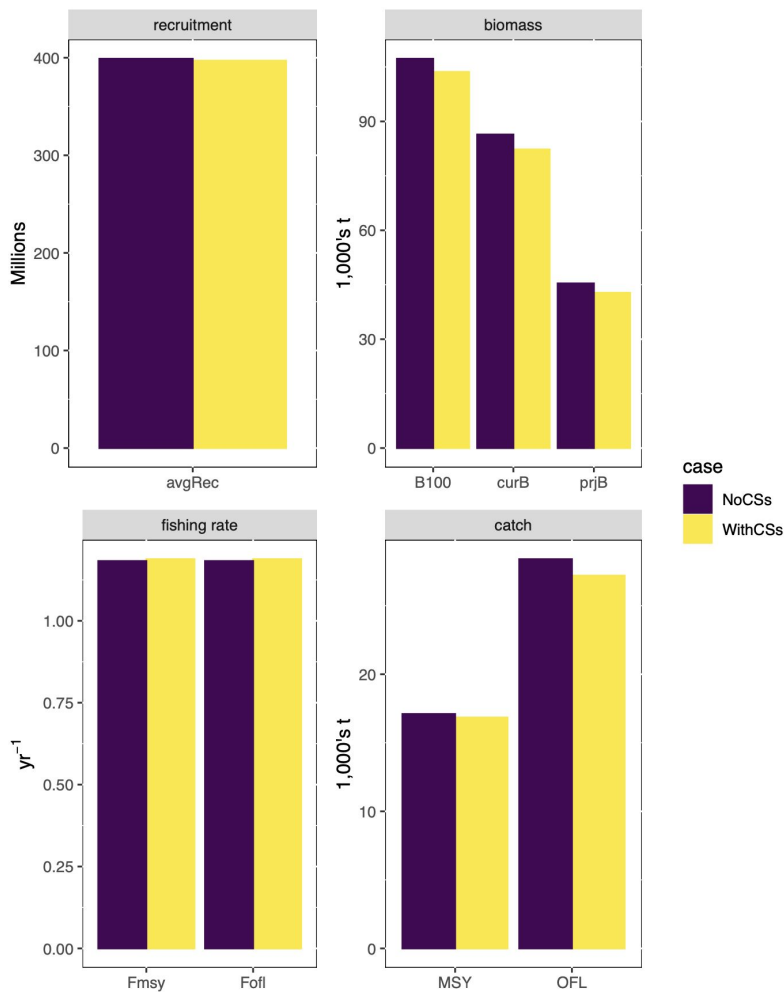
Stock assessment outcomes: Recruitment



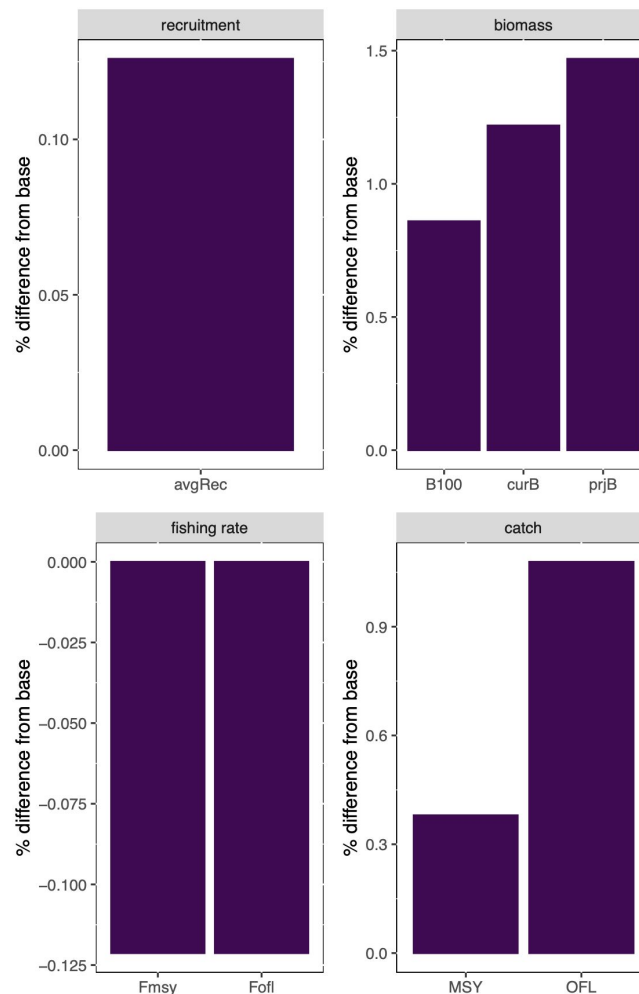
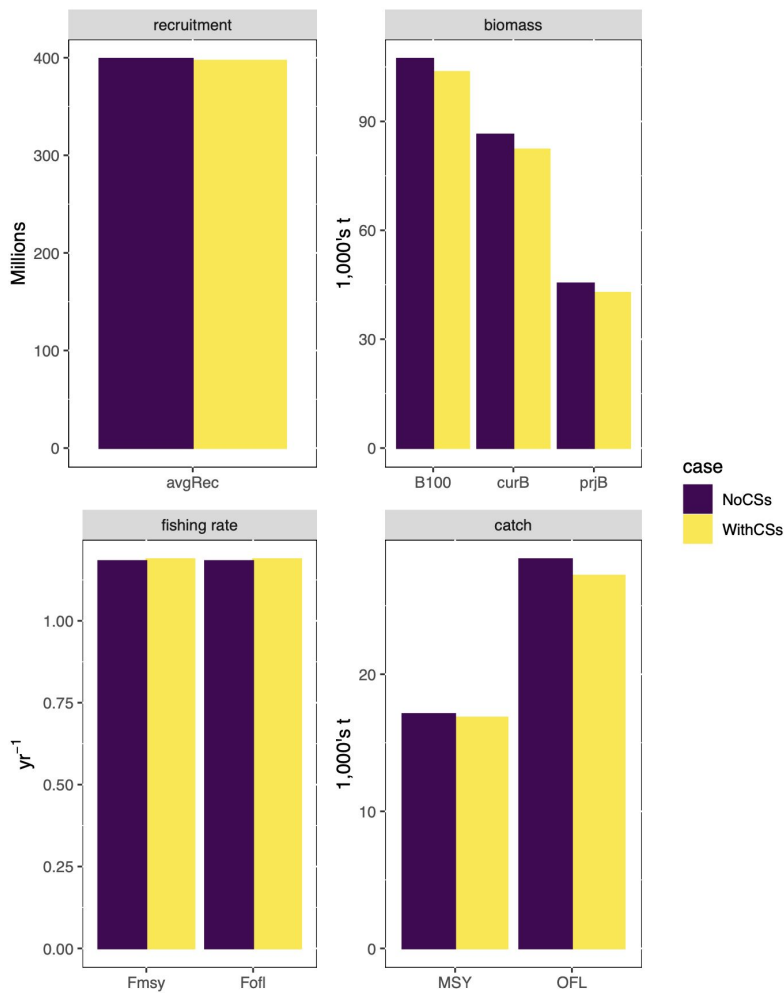
Stock assessment outcomes: Management quantities



Stock assessment outcomes: Management quantities



Stock assessment outcomes: Management quantities



Stock assessment outcomes: Biomass



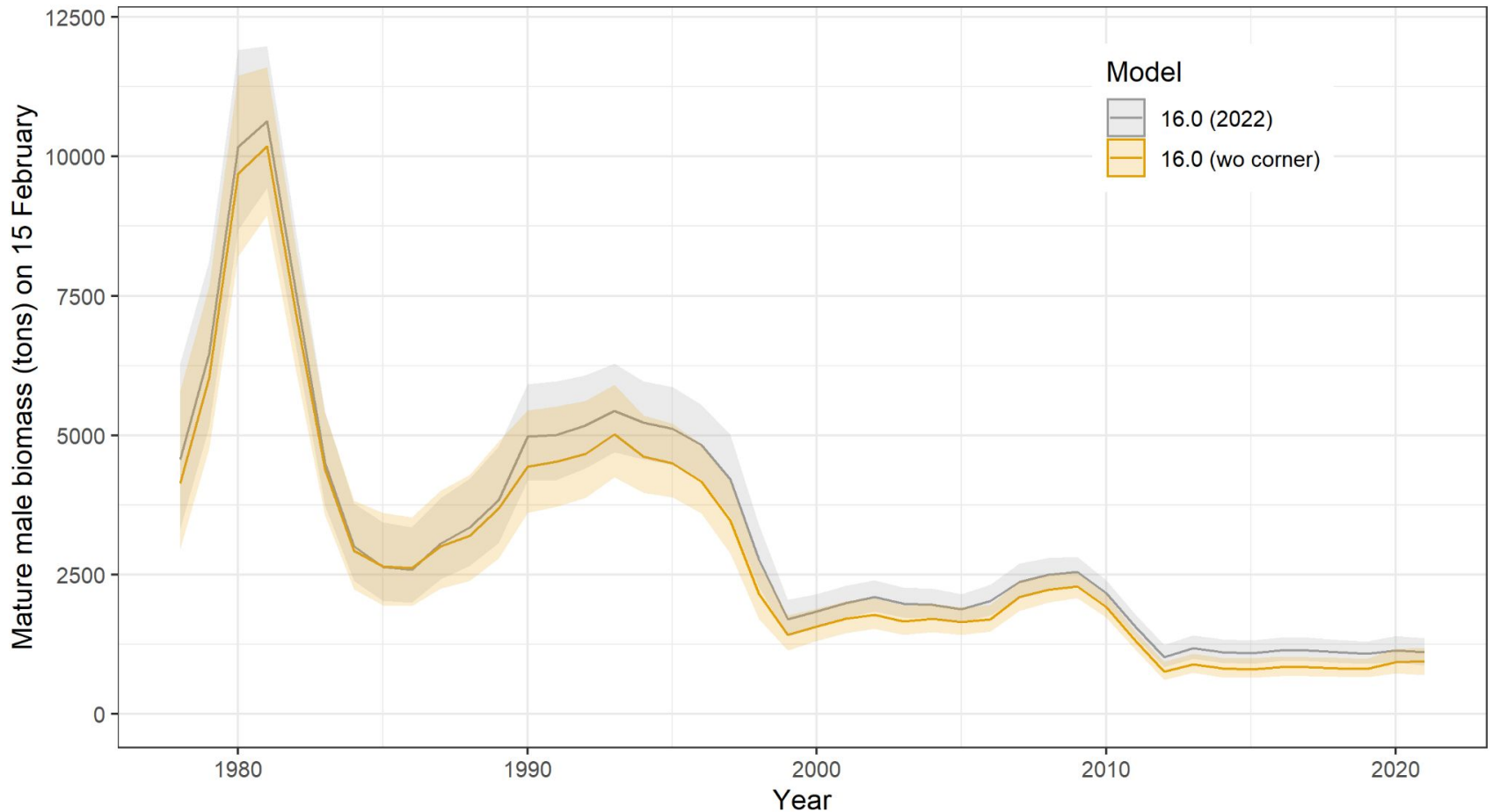
St. Matt Blue King



Stock assessment outcomes: Biomass



St. Matt Blue King

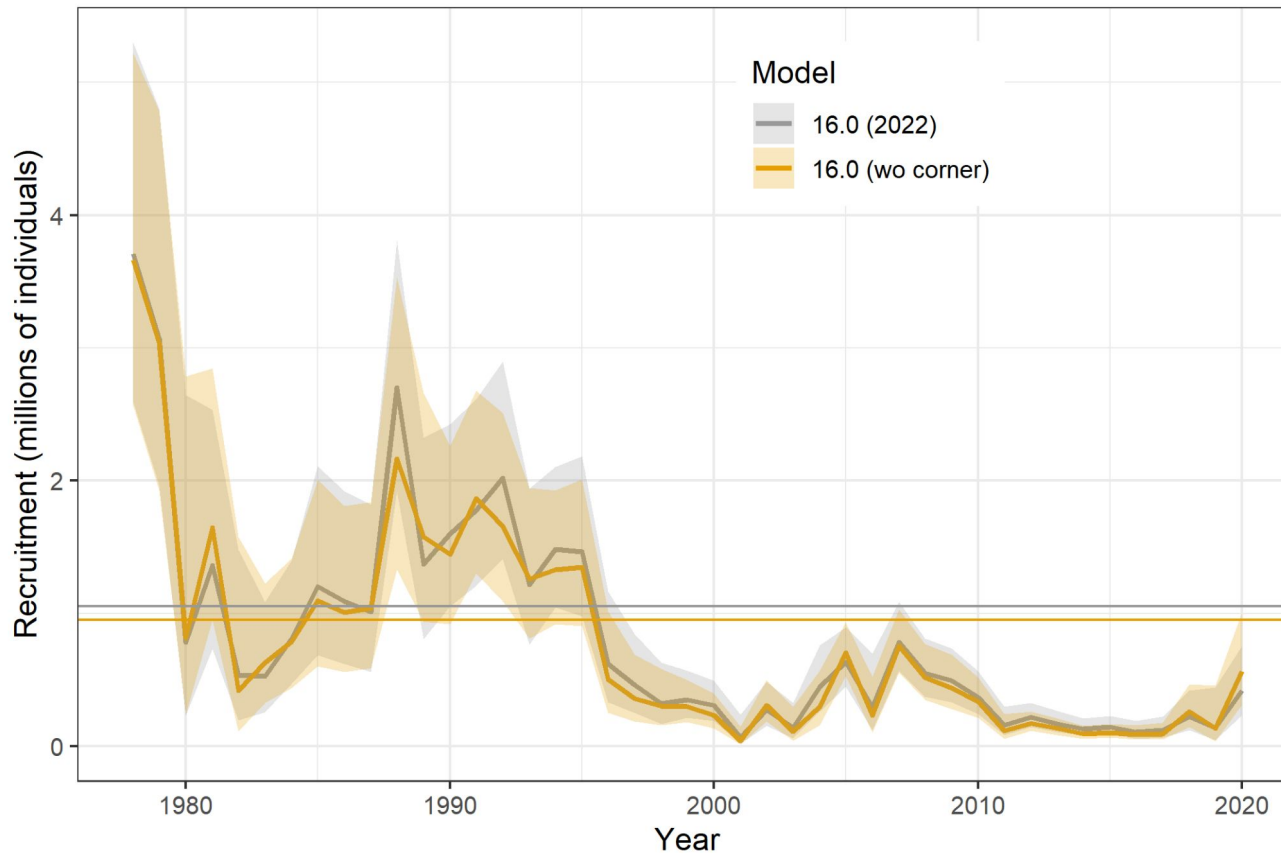


Stock assessment outcomes: Recruitment



St. Matt Blue King

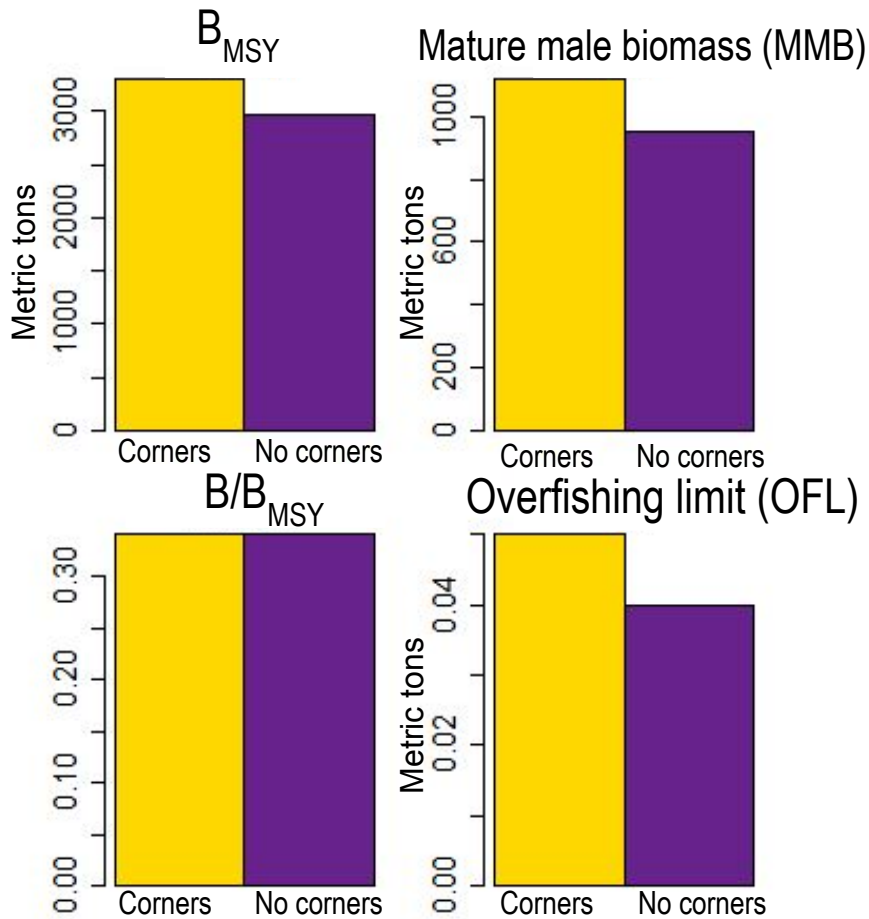
Recruitment reference model



Stock assessment outcomes: Management quantities



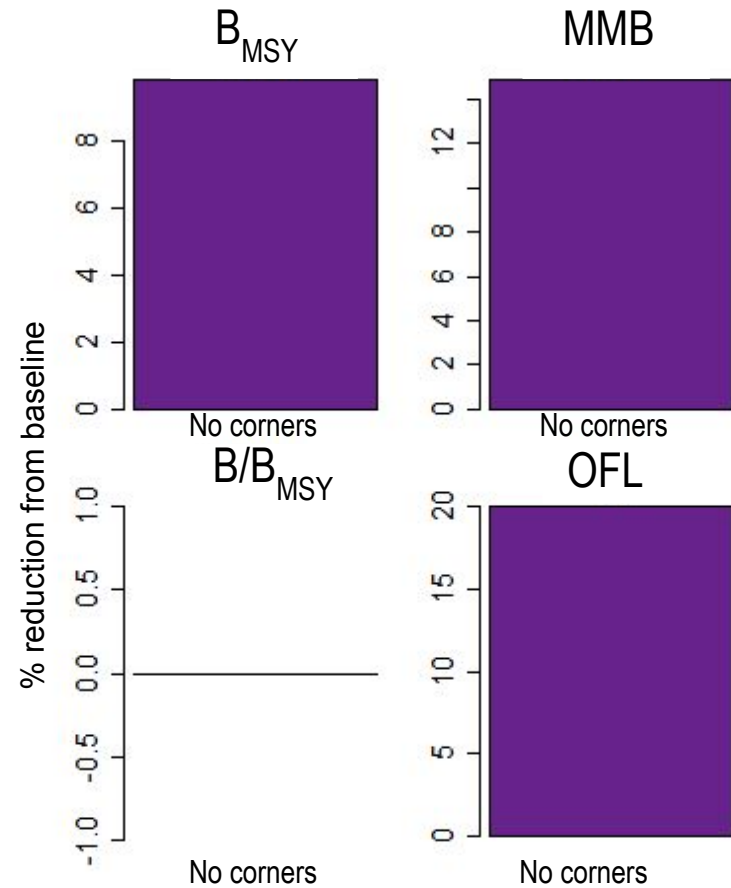
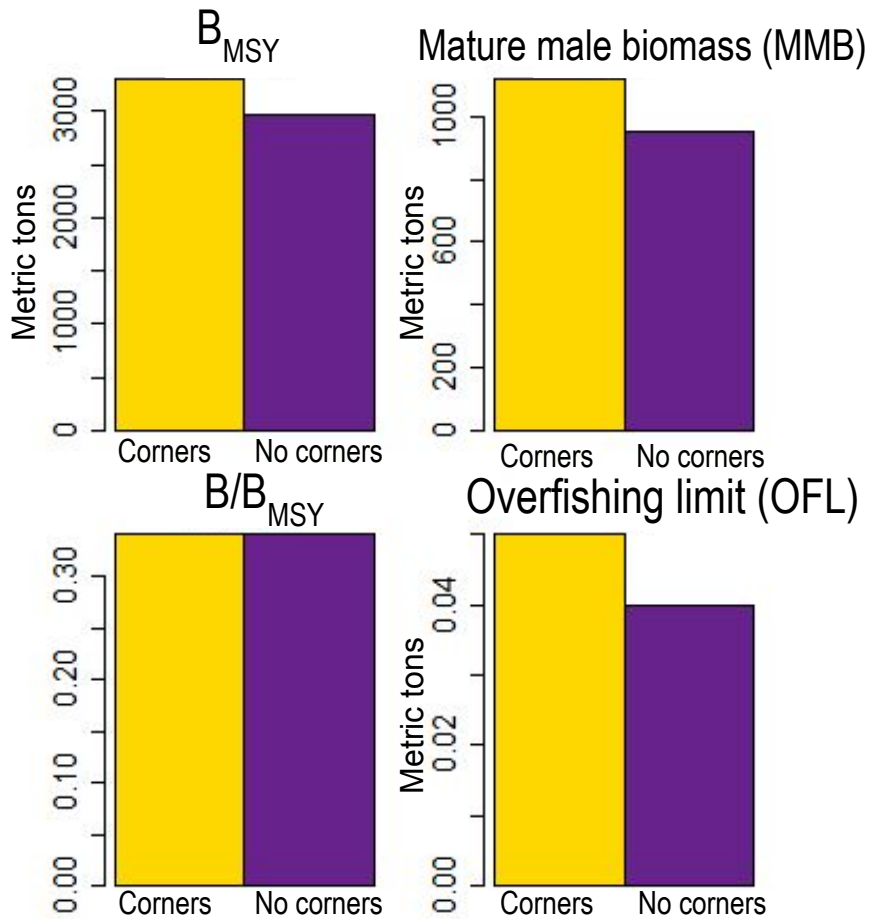
St. Matt Blue King



Stock assessment outcomes: Management quantities



St. Matt Blue King



Stock assessment outcomes: Conclusions

- Tanner crab
 - Slightly greater estimates for biomass and associated reference points without corner stations due to lower estimates of natural mortality
- St. Matthew Blue king
 - Lower biomass and associated reference points without corner stations
 - No difference in stock trajectory, biomass trends etc.



Tanner crab

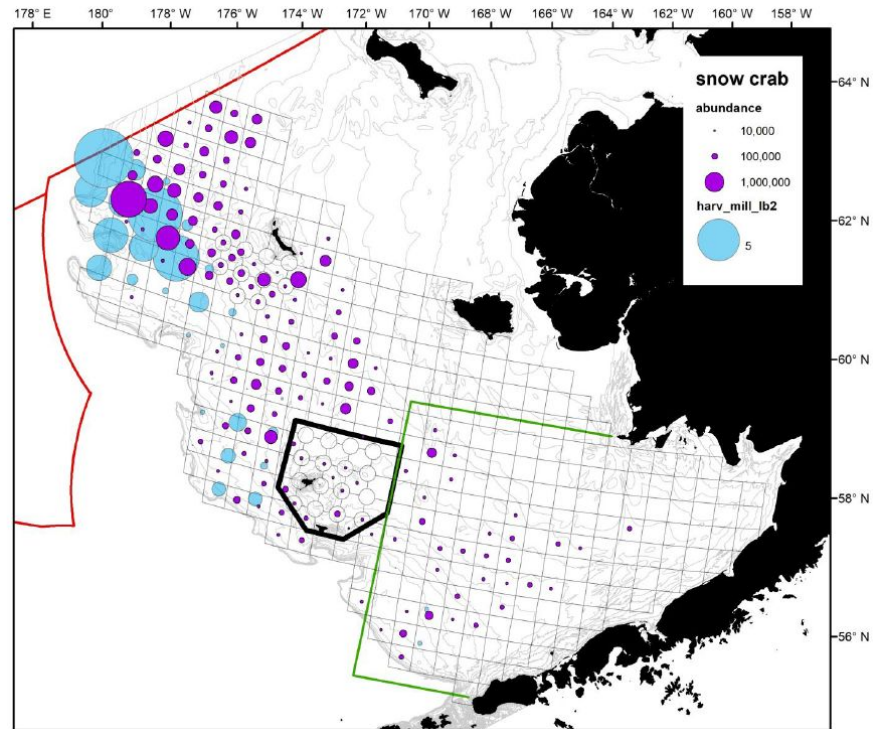


St. Matt Blue King

Survey abundance vs. fishery harvest

~50% of harvest occurred in March + April

Survey occurs in June+ July

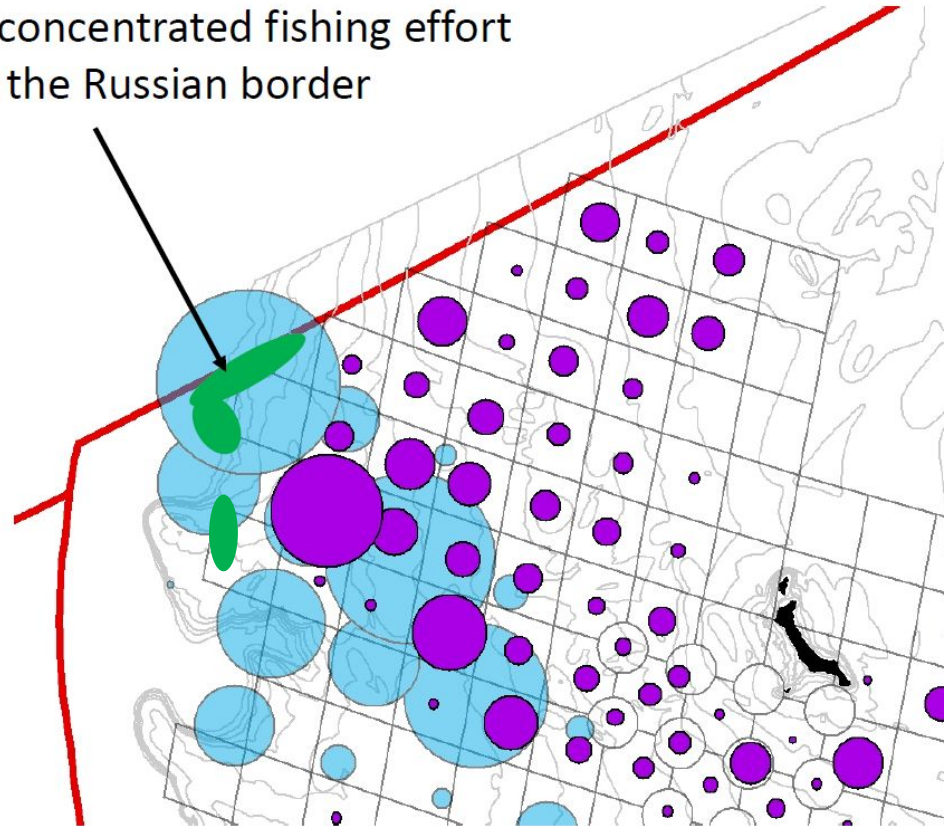


Purple = 2021 survey abundance 4 inch males

Blue = 2020/21 fishery harvest

Survey abundance vs. fishery harvest

Lots of concentrated fishing effort
right at the Russian border



Considerations for adding deeper stations

- Need to commit to long-term sampling for quantitative value
- Is there also qualitative value for informing decision-making before new stations are sampled multiple years?
- How do we account for seasonal migrations between survey and fishery when allocating targeted effort?
- How do we allocate limited sampling effort in a rapidly changing system?
- What are the costs to changing long-term sampling design during rapid ecosystem change?

Adding deeper survey stations

Proposed plan – 2022 survey

- Drop some / all corner stations
- Add 10 stations to NW border ★
- Randomly select area within grid cells at depths $\leq 200\text{m}$
- Use as exploratory effort for evaluating possible long-term sites

CPT recommendation?

