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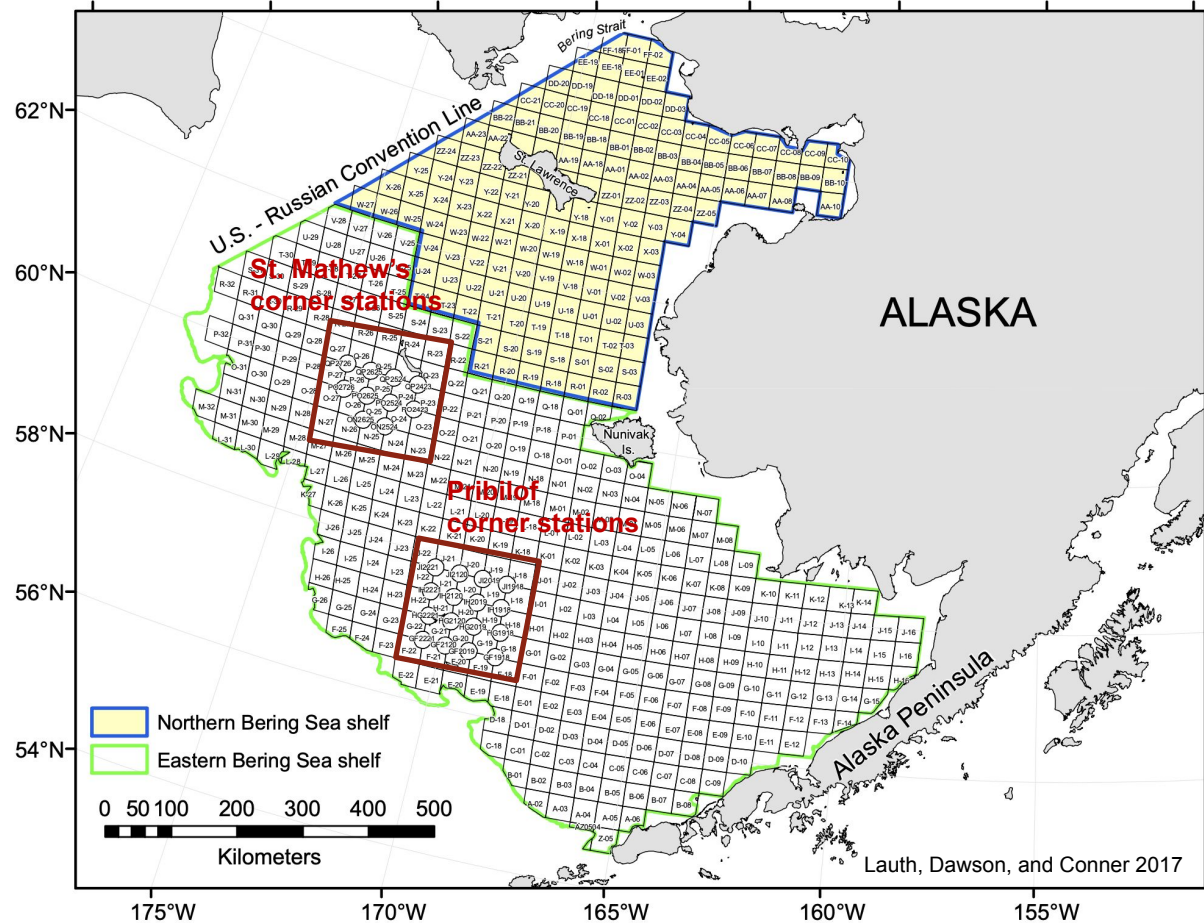
Effects of removing the St. Mathew and Pribilof Island corner stations from the EBS survey grid

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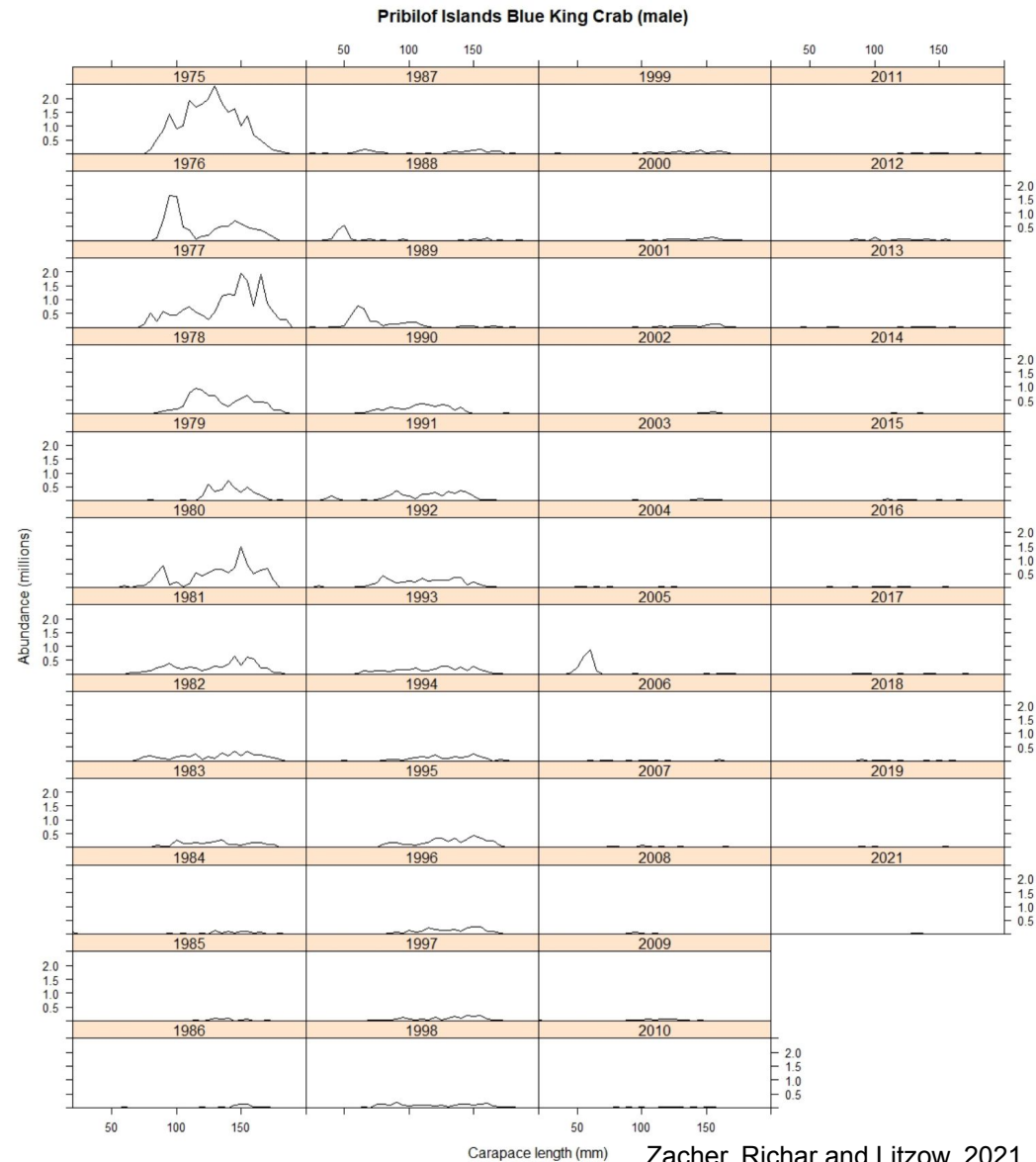
Background

- Blue king crab (*Paralithodes platypus*)
- Populations associated with St. Mathew's 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 may be better used elsewhere

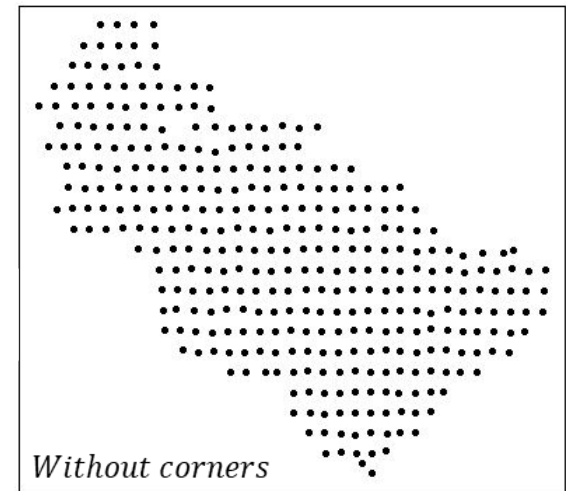
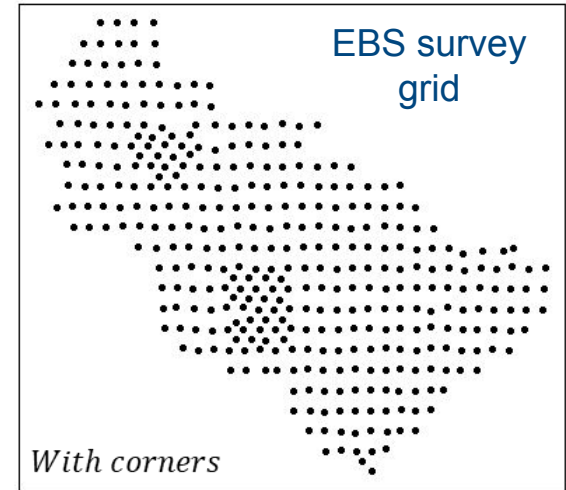


Question

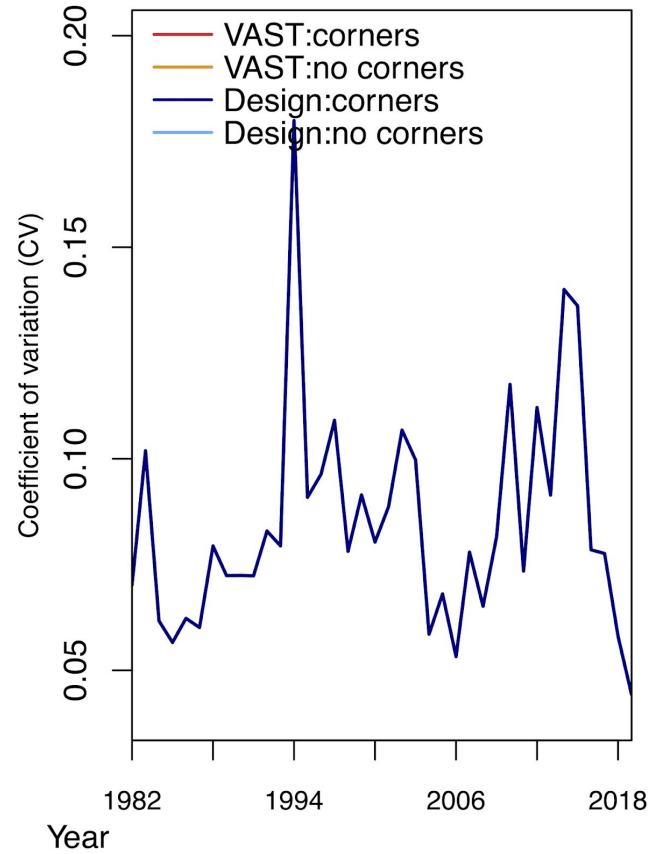
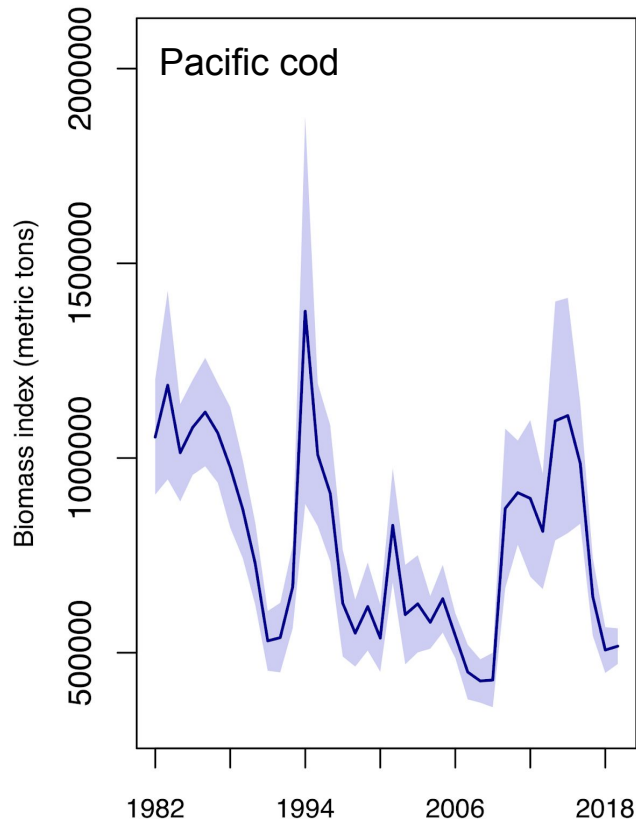
- What are the effects of removing the Pribilof and St. Mathew's Island corner stations on the precision and accuracy of design and model-based abundance estimates for EBS groundfish species?

Approach: Empirical analysis

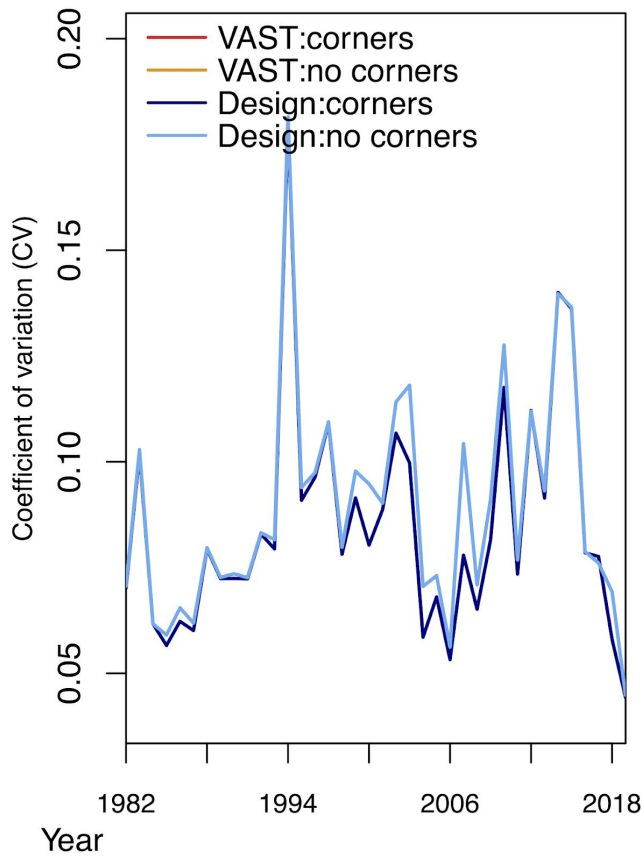
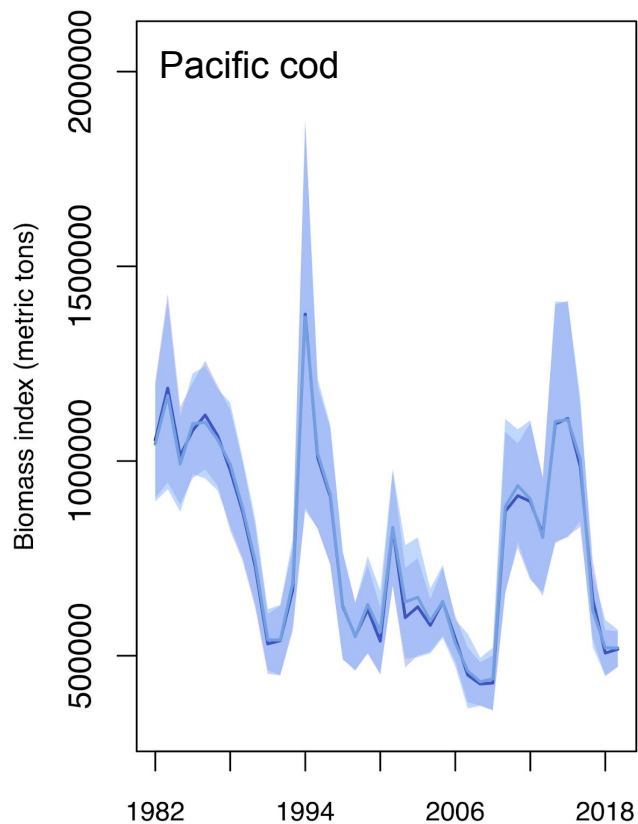
- Compare retrospective biomass estimates and CVs across four scenarios:
 - 1) Design-based, corner stations included
 - 2) Design-based, corner stations removed
 - 3) Model-based (VAST), corner stations included
 - 4) Model-based (VAST), corner stations removed



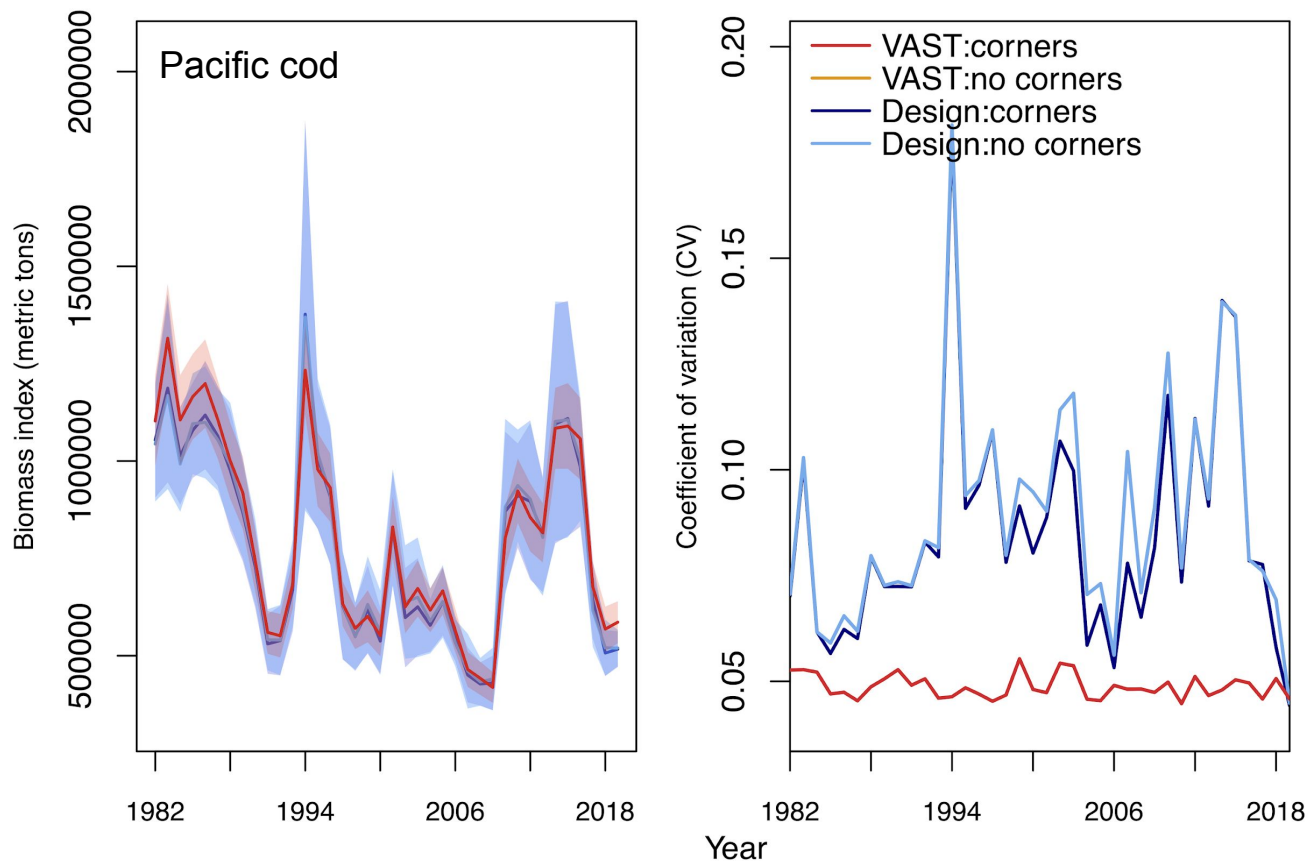
Results: Empirical analysis



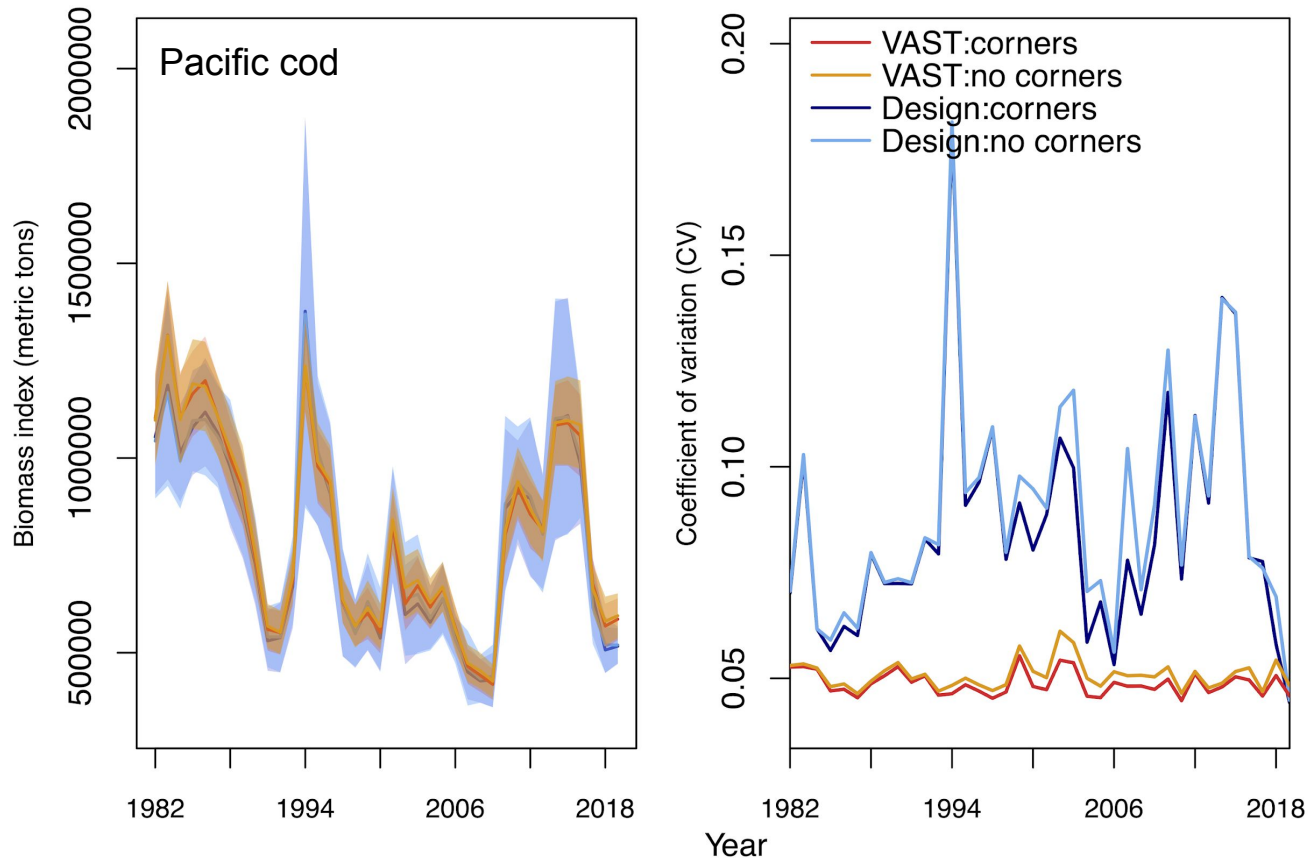
Results: Empirical analysis

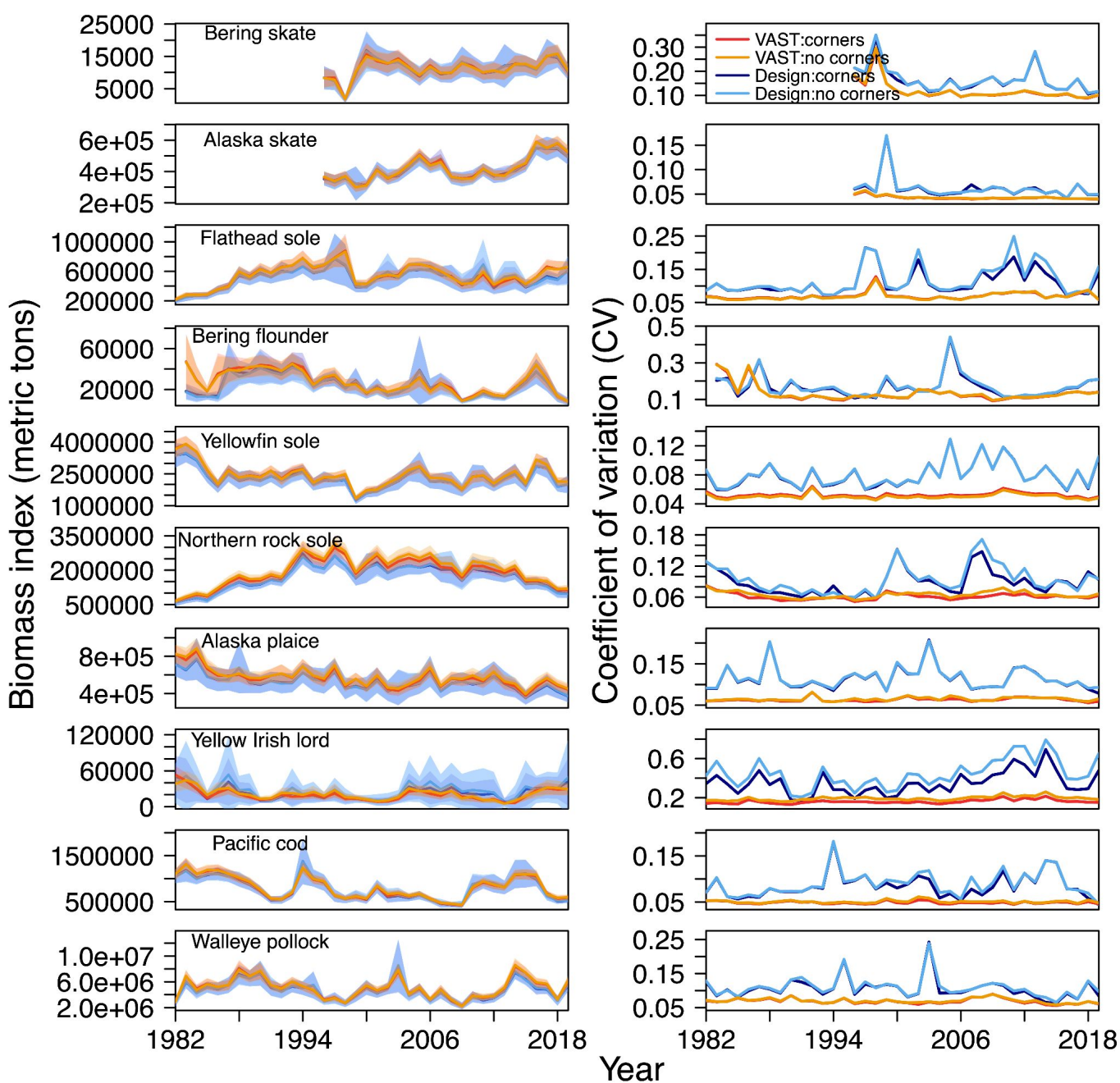


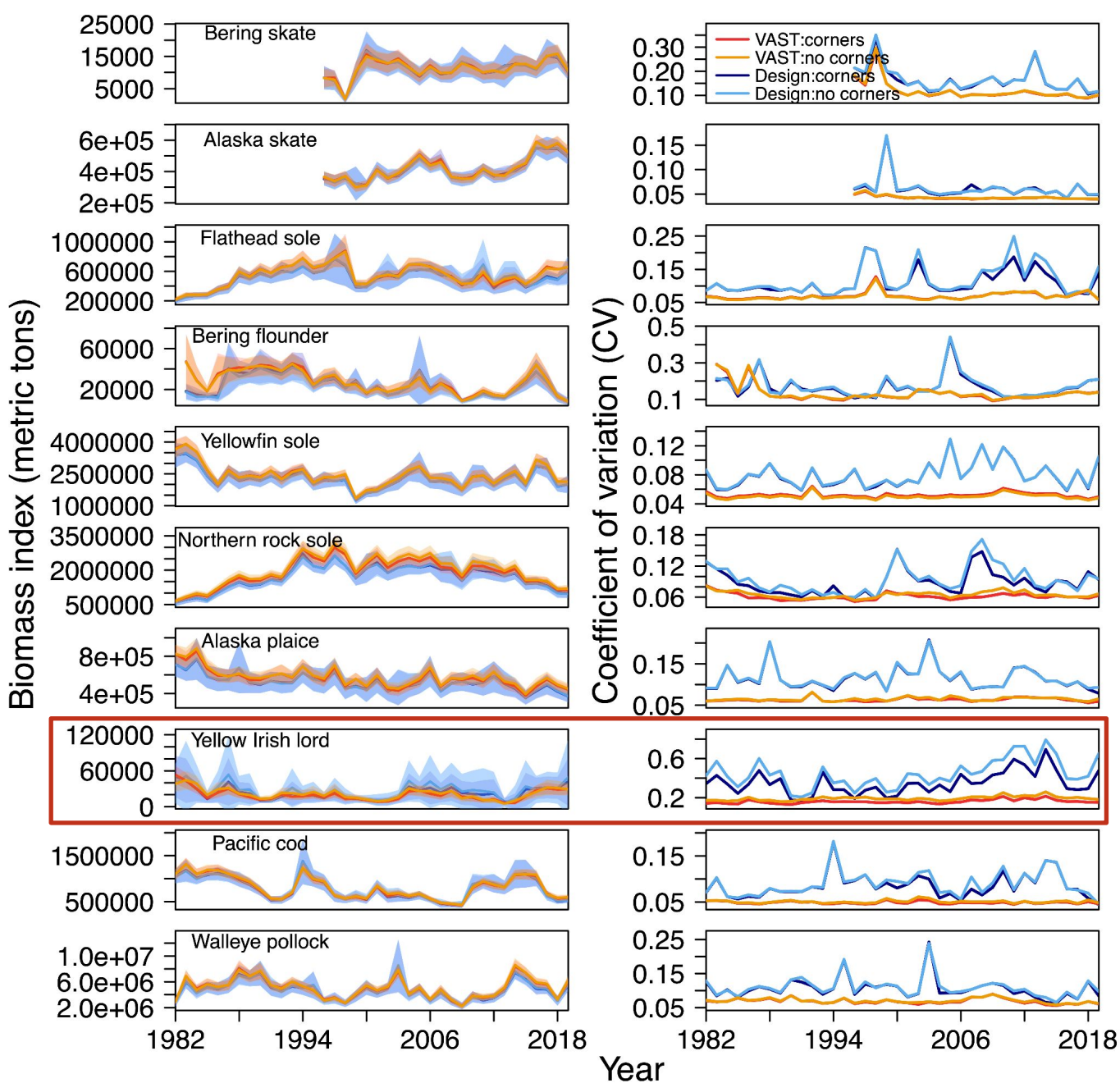
Results: Empirical analysis



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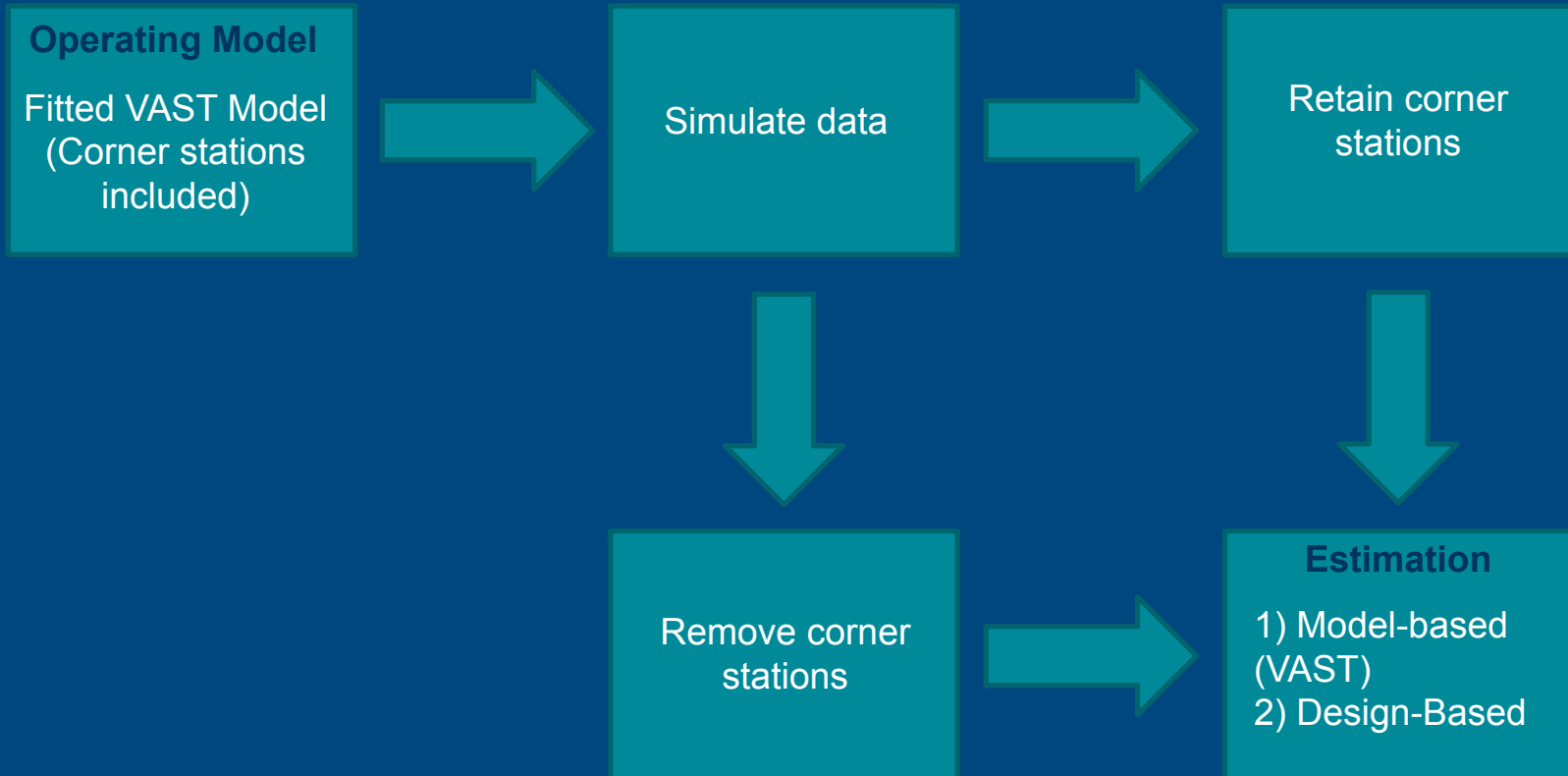




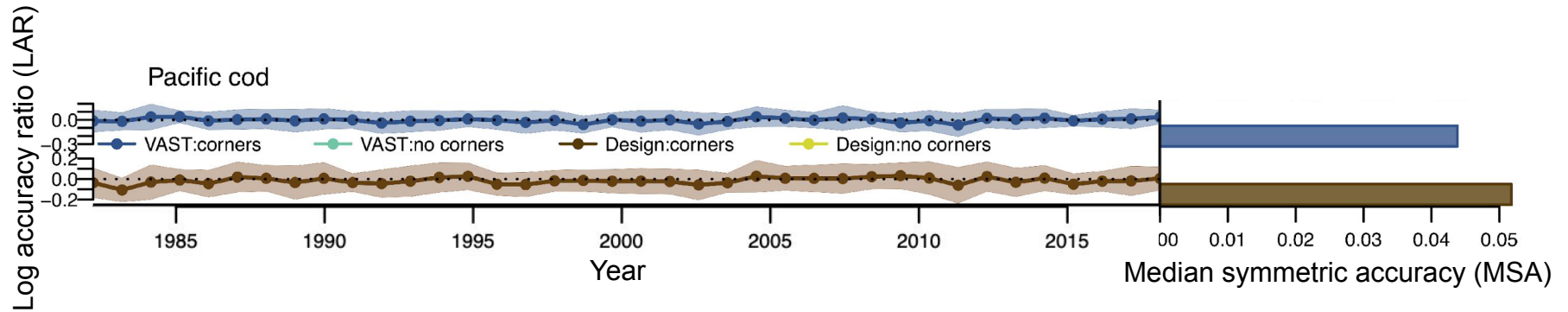
Species	Estimator	Mean CV (corners)	Mean CV (no corners)	Δ CV	% Δ CV
Bering skate	Design-based	0.165	0.167	0.002	1.2%
	Model-based	0.119	0.120	0.001	<1%
Alaska skate	Design-based	0.061	0.062	0.001	1.6%
	Model-based	0.043	0.043	0	0%
Flathead sole	Design-based	0.110	0.118	0.008	7.3%
	Model-based	0.070	0.069	0.001	1.4%
Bering flounder	Design-based	0.169	0.173	0.004	2.4%
	Model-based	0.133	0.135	0.002	1.5%
Yellowfin sole	Design-based	0.080	0.080	0	0%
	Model-based	0.052	0.050	-0.002	-3.8%
Northern rock sole	Design-based	0.088	0.094	0.006	6.8%
	Model-based	0.061	0.065	0.004	6.6%
Alaska plaice	Design-based	0.115	0.116	0.001	<1%
	Model-based	0.063	0.065	0.002	3.2%
Yellow Irish lord	Design-based	0.350	0.446	0.096	27.4%
	Model-based	0.159	0.192	0.033	21%
Pacific cod	Design-based	0.085	0.089	0.004	4.7%
	Model-based	0.049	0.051	0.002	4.1%
Walleye pollock	Design-based	0.106	0.109	0.003	2.8%
	Model-based	0.068	0.070	0.002	2.9%

Approach: Simulation analysis

Simulation-estimation design



Results: Simulation analysis

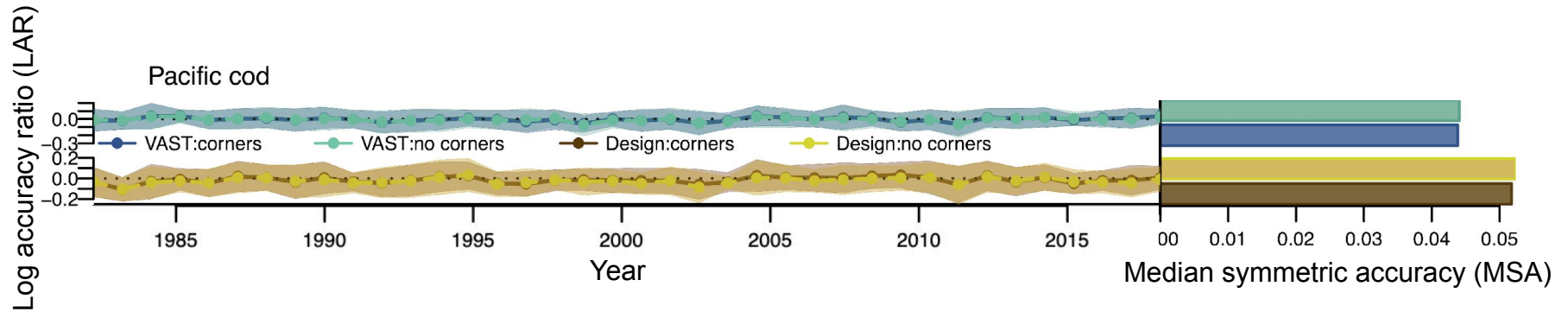


$$LAR(t, r) = \log\left(\frac{\hat{B}(t, r)}{B(t, r)}\right)$$

↗ Biomass estimate
↘ 'True' biomass

$$MSA = (\exp(M(|LAR|)) - 1)$$

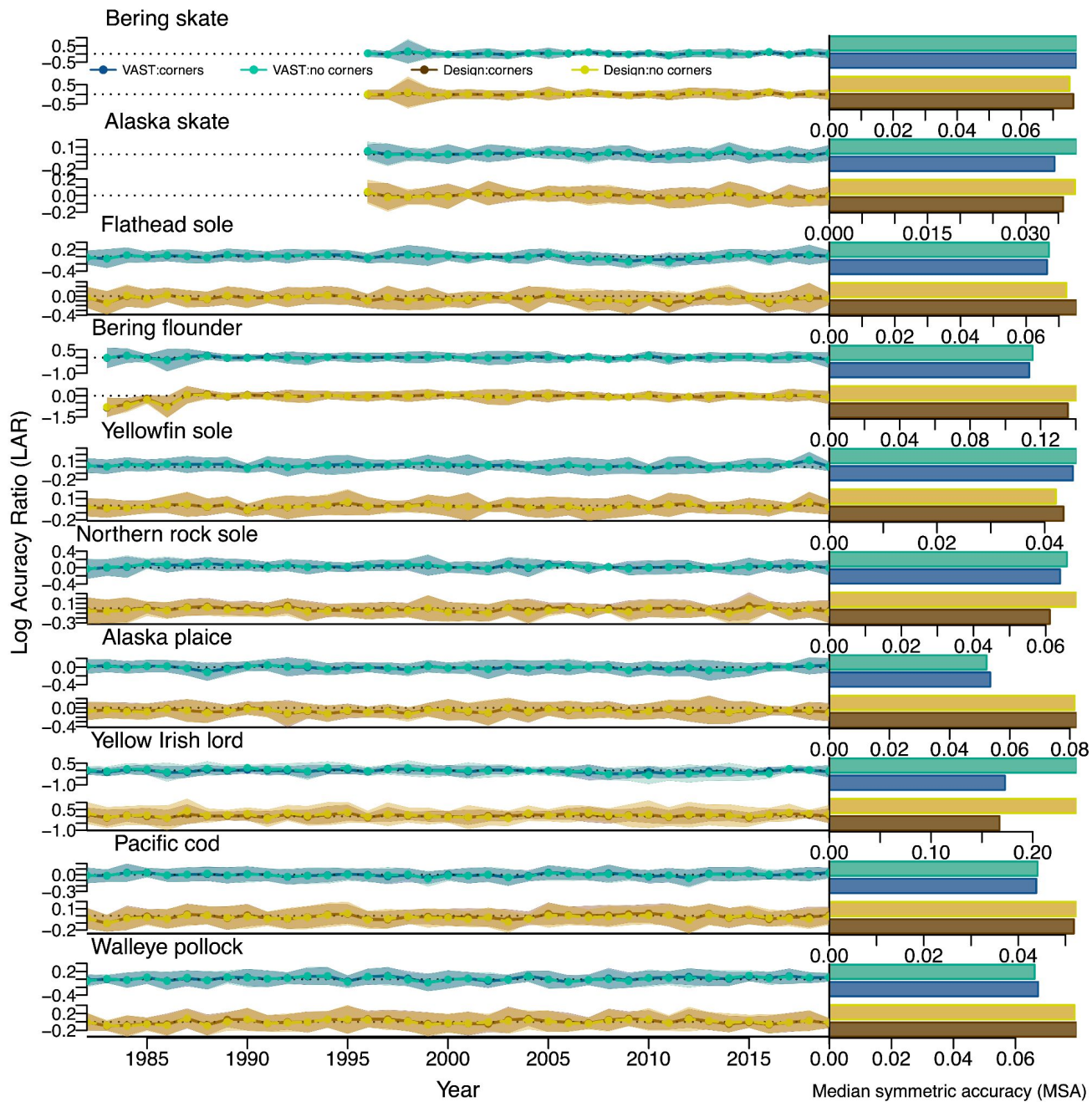
Results: Simulation analysis

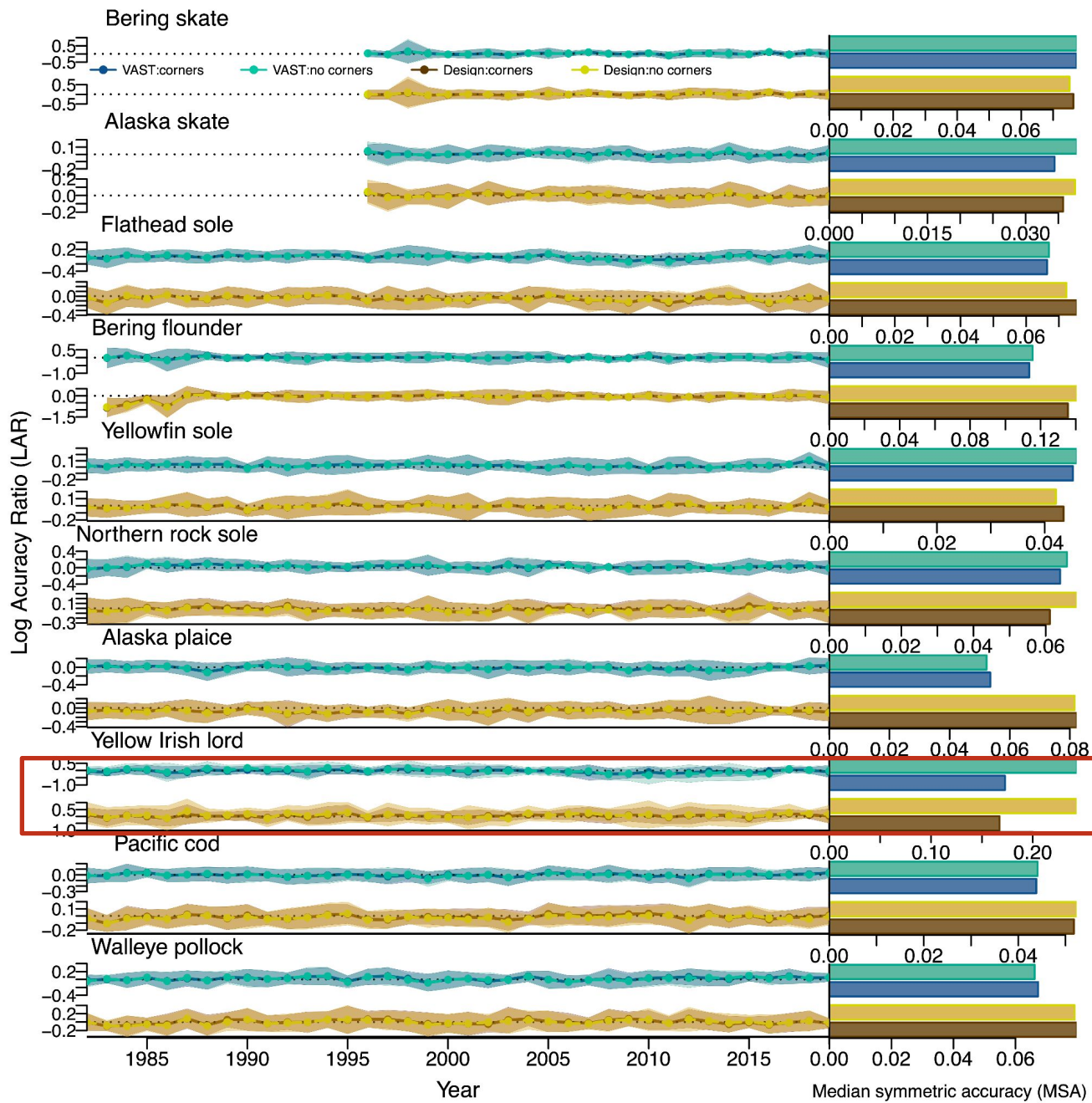


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↗ Biomass estimate
↘ 'True' biomass

$$MSA = (\exp(M(|LAR|)) - 1)$$





Species	Estimator	MSA (corners)	MSA (no corners)	Δ MSA	% Δ MSA
Bering skate	Design-based	0.076	0.075	-0.001	-1.32%
	Model-based	0.077	0.077	0	0%
Alaska skate	Design-based	0.036	0.038	0.002	5.56%
	Model-based	0.034	0.038	0.004	11.76%
Flathead sole	Design-based	0.075	0.072	-0.003	-4%
	Model-based	0.066	0.067	0.001	1.52%
Bering flounder	Design-based	0.135	0.141	0.006	4.44%
	Model-based	0.109	0.111	0.002	1.83%
Yellowfin sole	Design-based	0.043	0.042	-0.001	-2.33%
	Model-based	0.045	0.046	0.001	2.22%
Northern rock sole	Design-based	0.061	0.069	0.008	13.11%
	Model-based	0.057	0.059	0.002	3.51%
Alaska plaice	Design-based	0.082	0.082	0	0%
	Model-based	0.054	0.052	-0.002	-3.70%
Yellow Irish lord	Design-based	0.167	0.243	0.076	45.51%
	Model-based	0.12	0.169	0.049	40.83%
Pacific cod	Design-based	0.052	0.052	0	0%
	Model-based	0.043	0.044	0.001	2.33%
Walleye pollock	Design-based	0.08	0.079	-0.001	-1.25%
	Model-based	0.067	0.066	-0.001	-1.49%

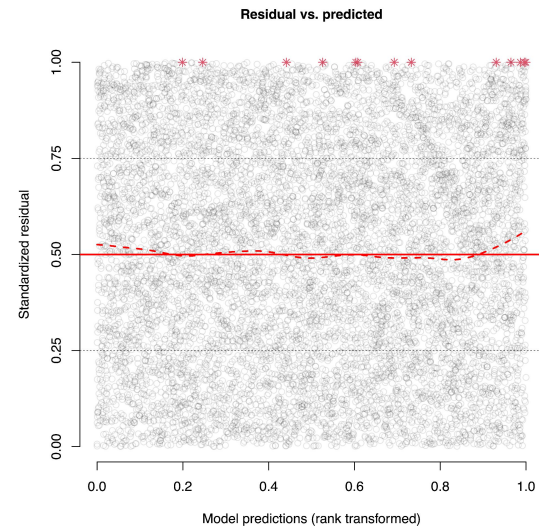
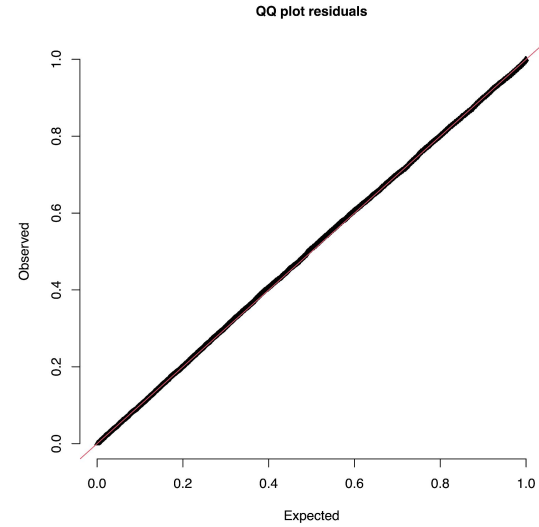
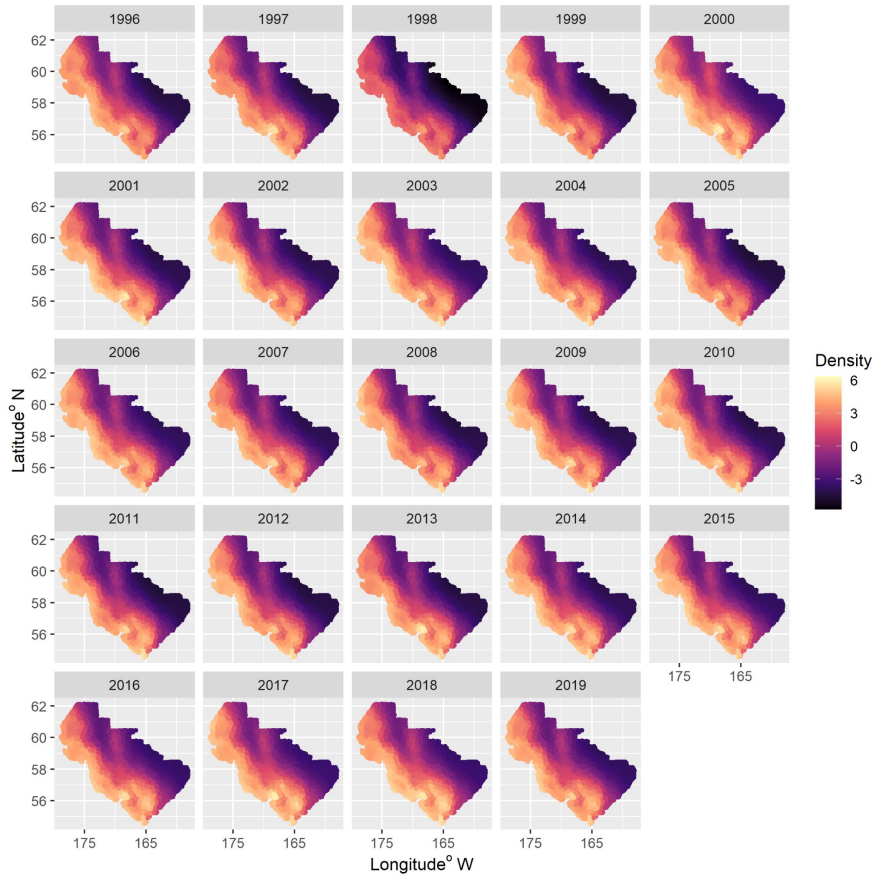
Conclusions

- Removal of corner stations had little qualitative effect on biomass time-series
- Removing corner stations had little effect on the precision and accuracy of abundance estimates for most groundfish species considered
- Yellow Irish lord only notable exception (reductions in both precision and accuracy with corner station removal); this species also had least precise and accurate biomass estimates in general
- Precision of VAST abundance estimates more robust to removal of corner stations

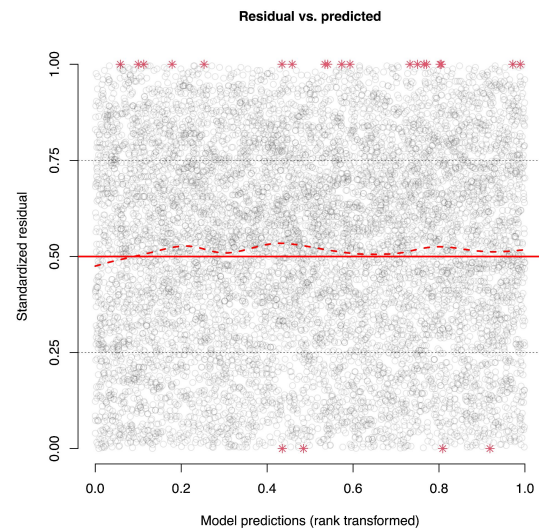
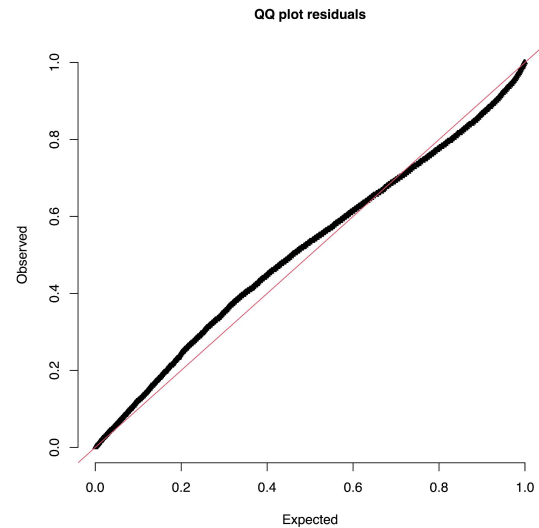
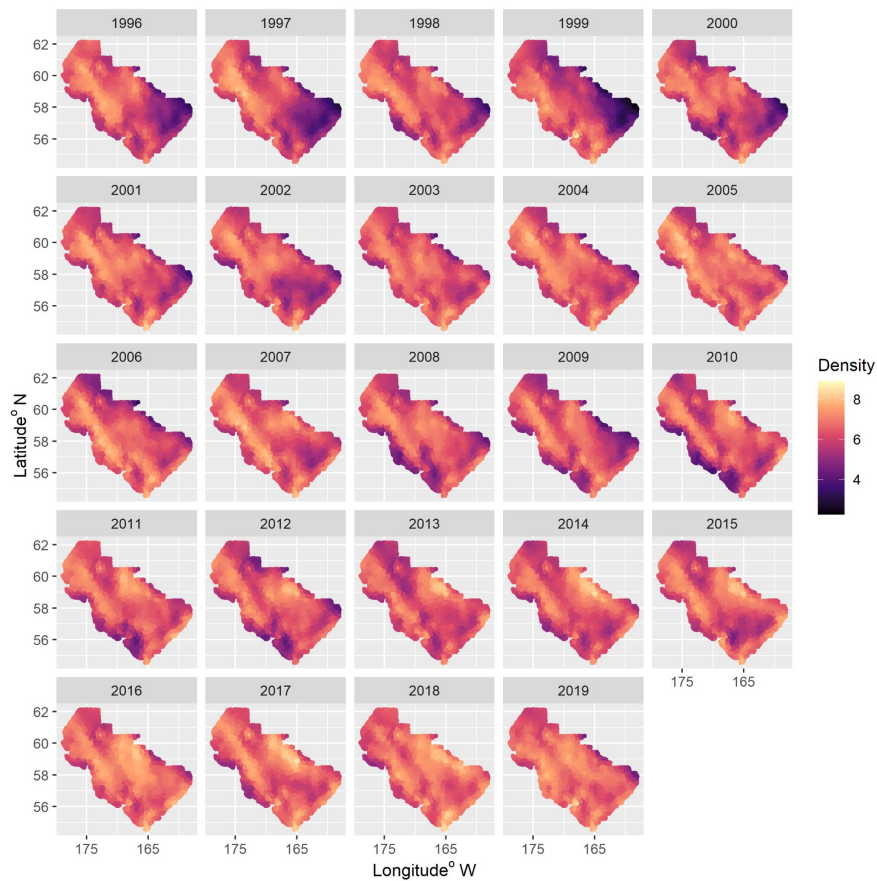
Questions for Groundfish Plan Team:

- Pending input from the crab plan team, can the St. Mathew's and Pribilof Island corner stations be removed from the EBS survey grid as early as 2022?

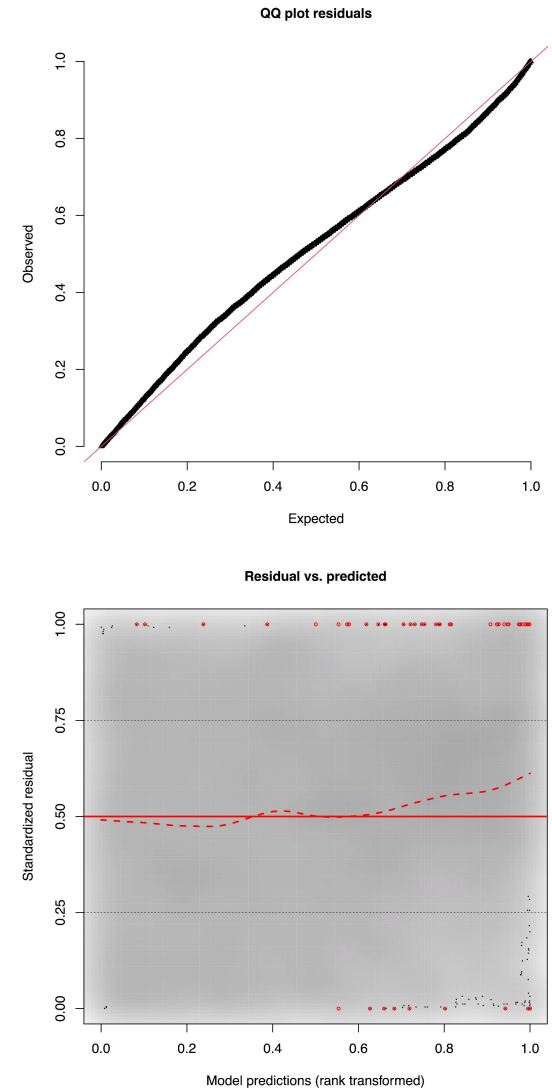
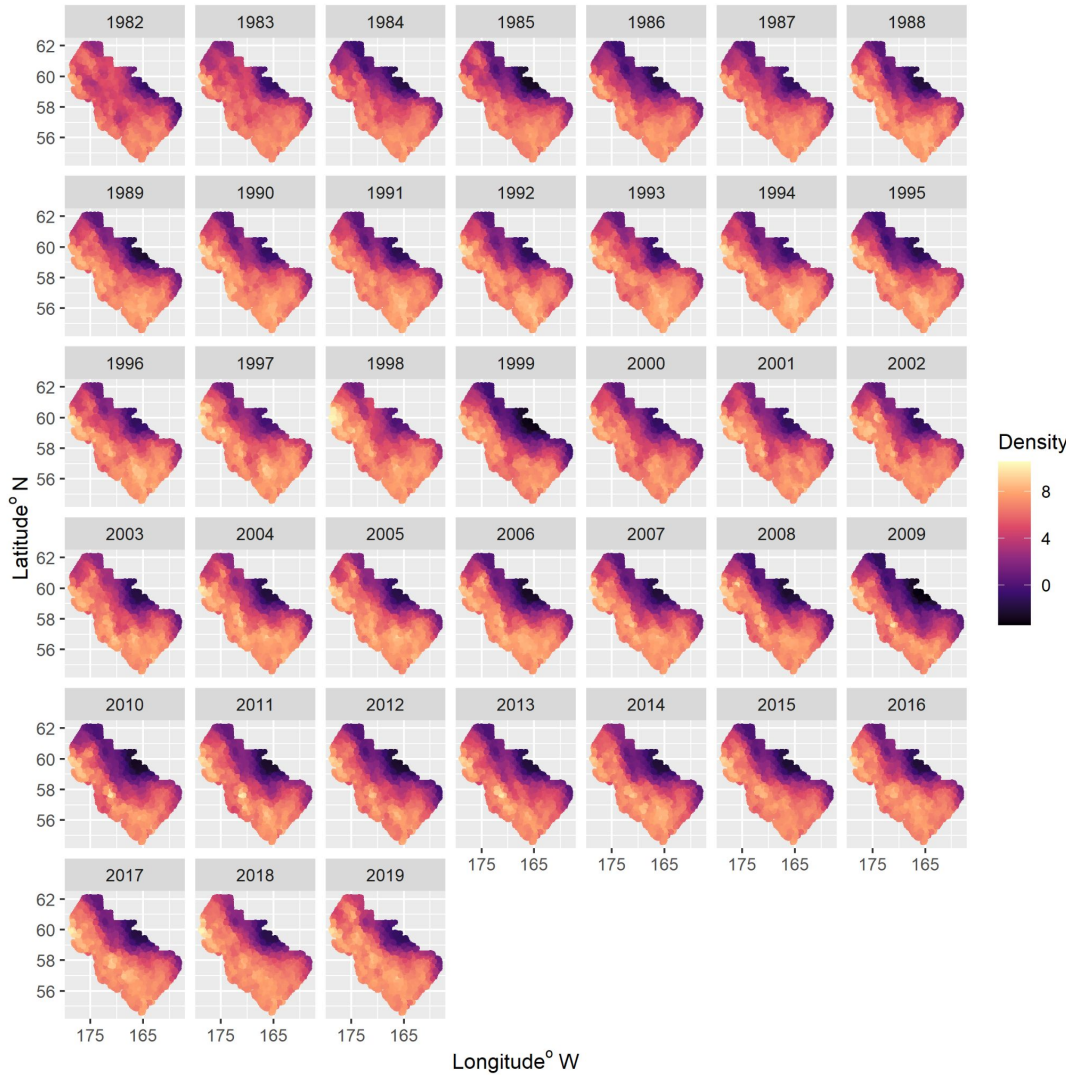
Bering skate



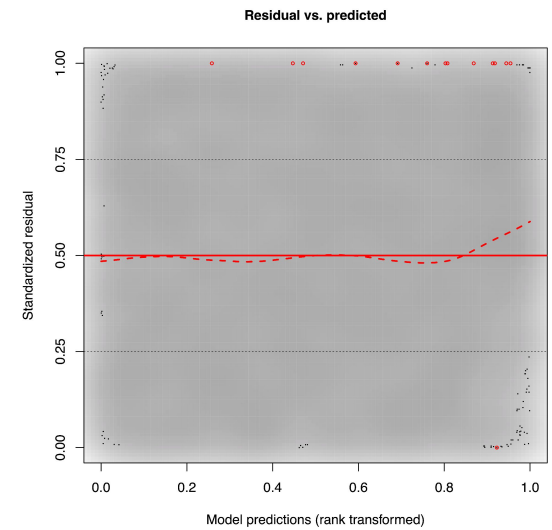
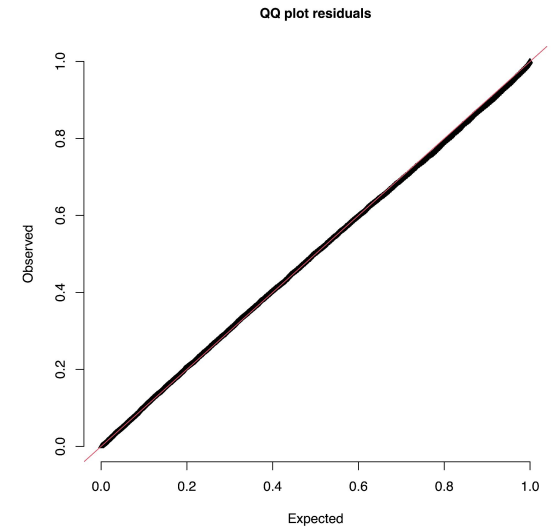
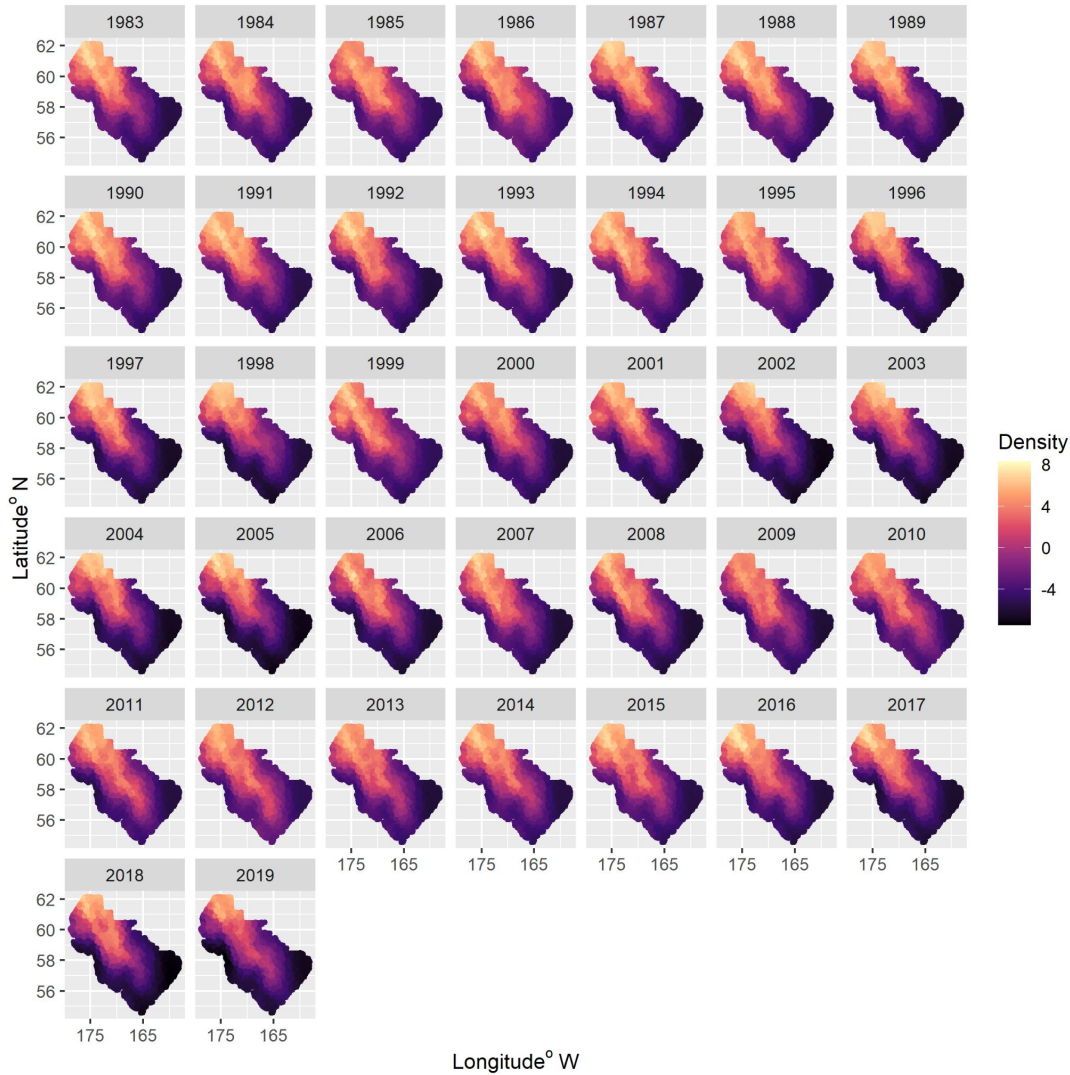
Alaska skate



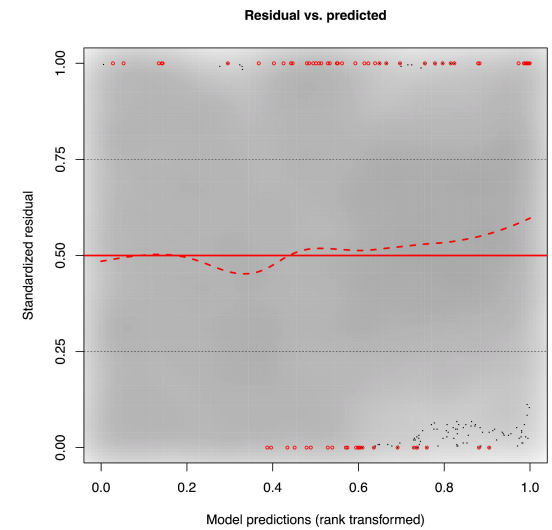
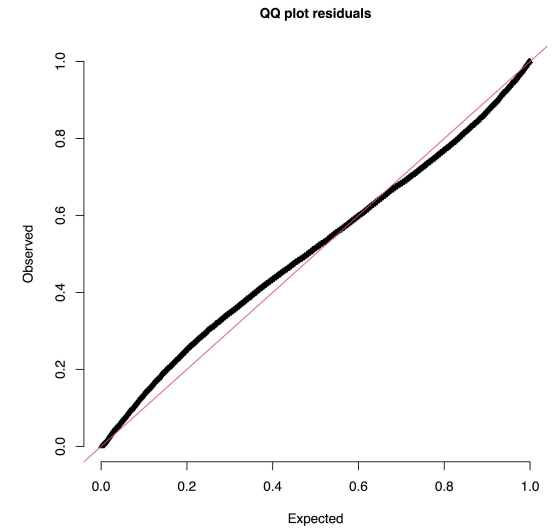
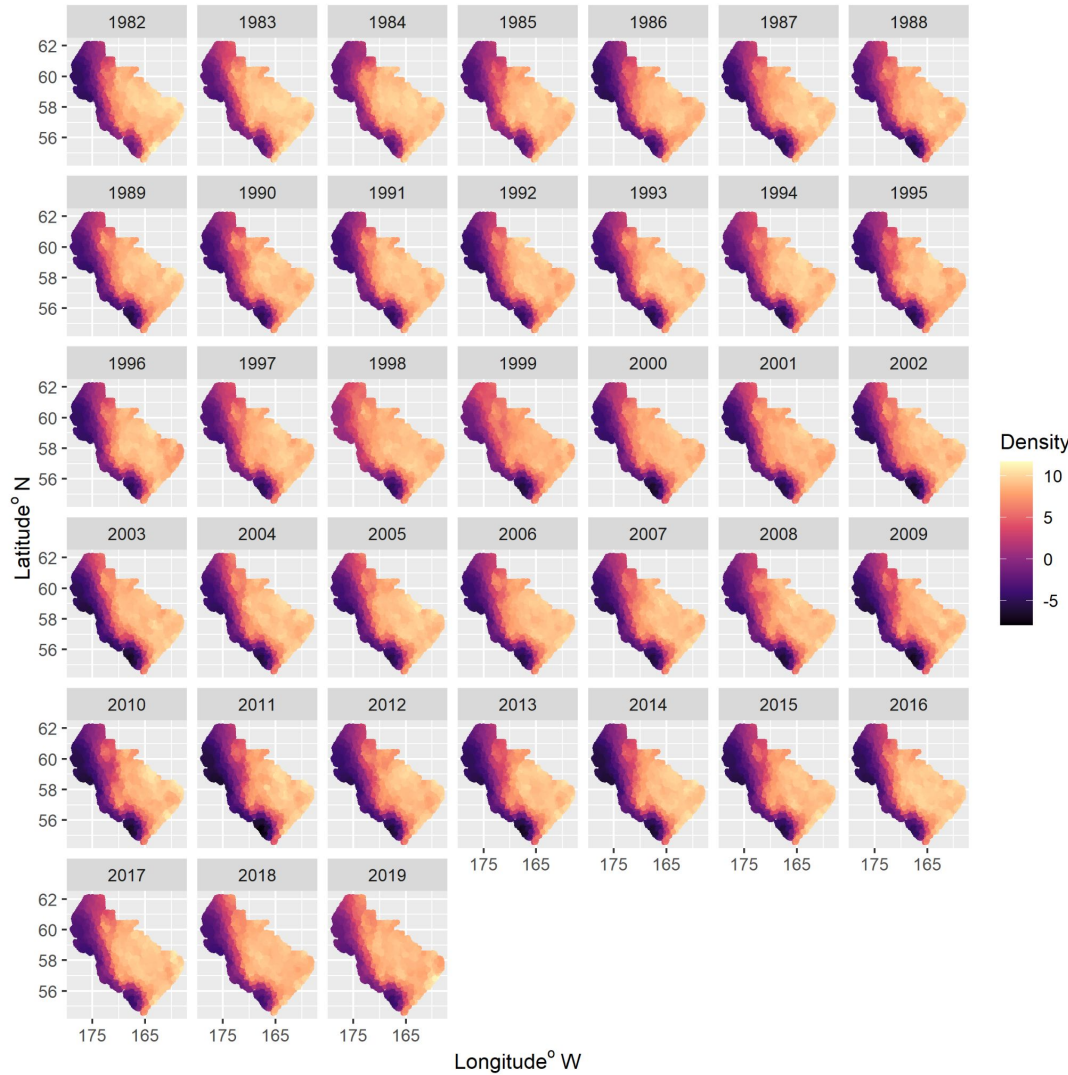
Flathead sole



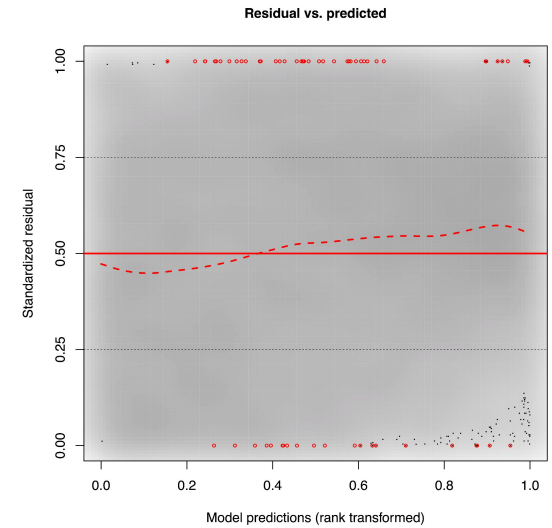
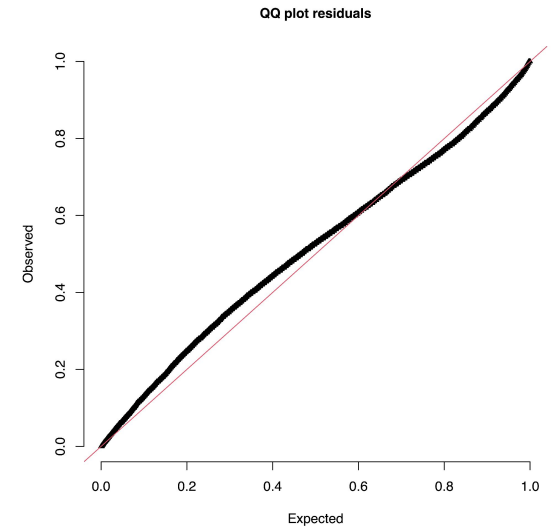
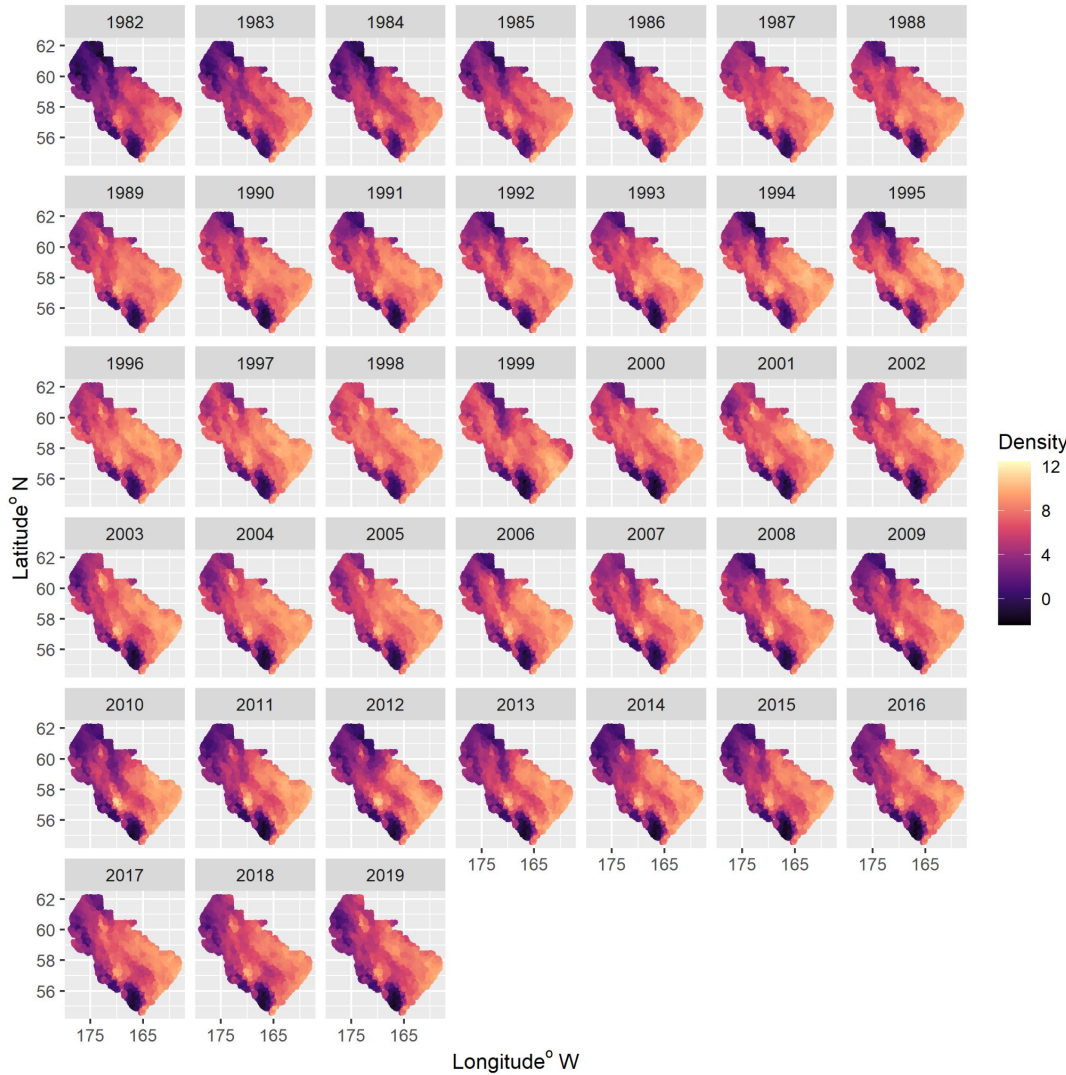
Bering flounder



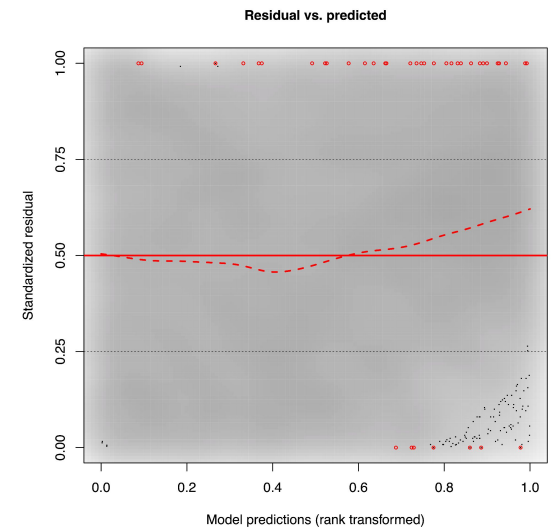
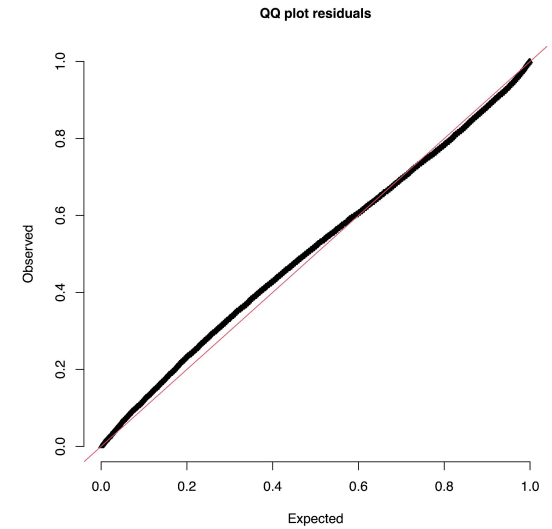
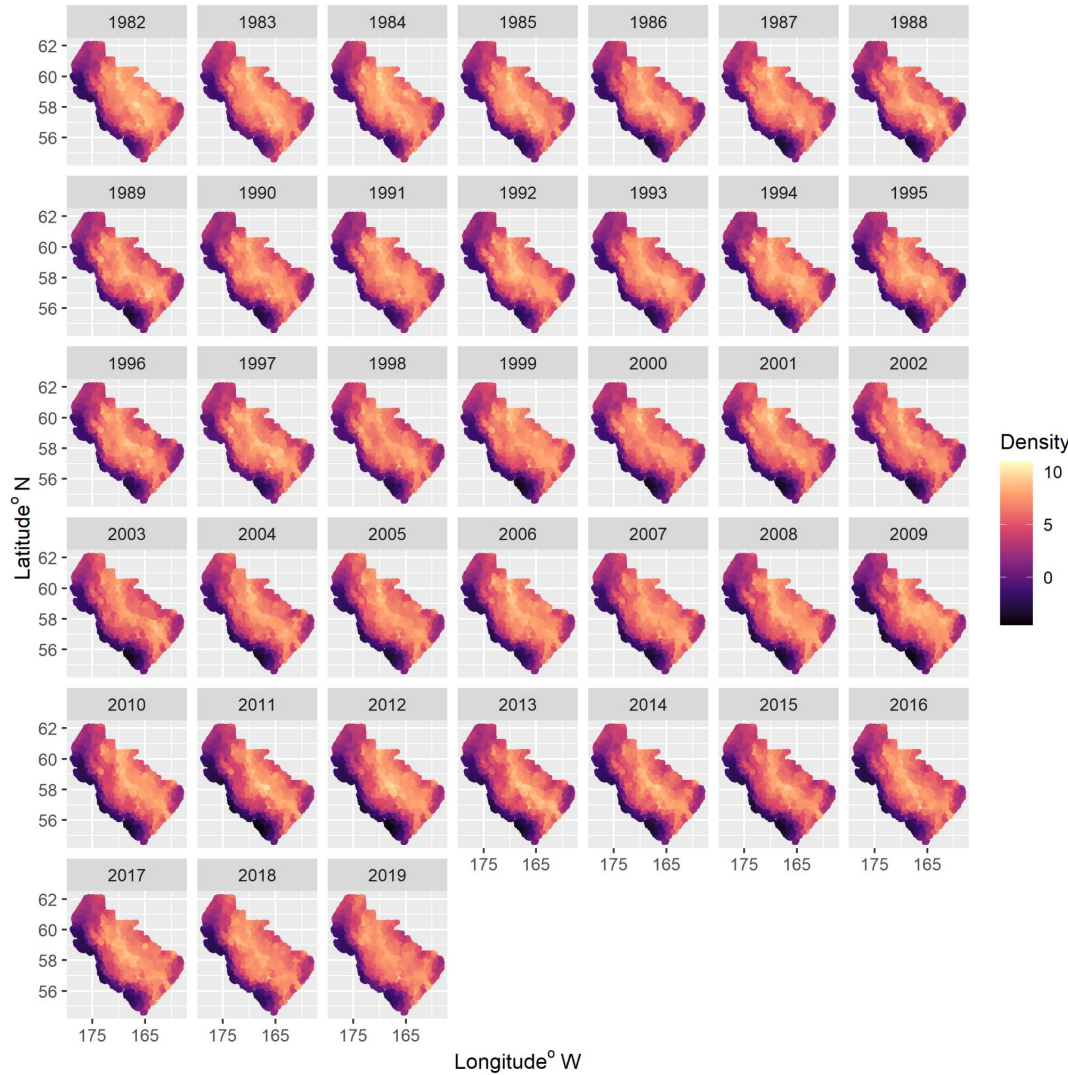
Yellowfin sole



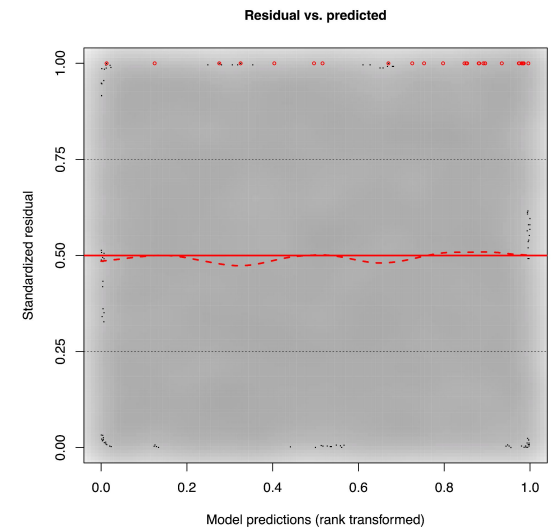
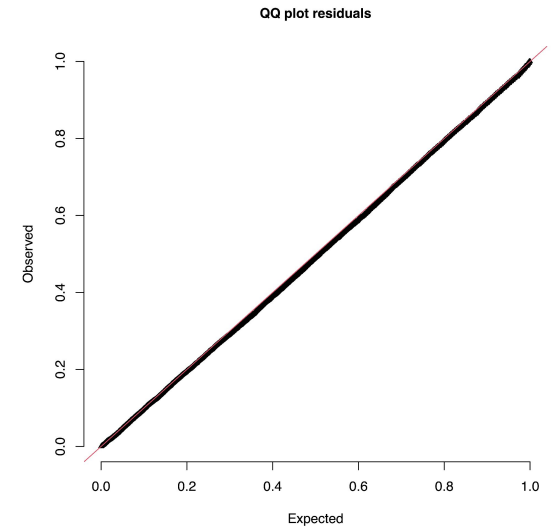
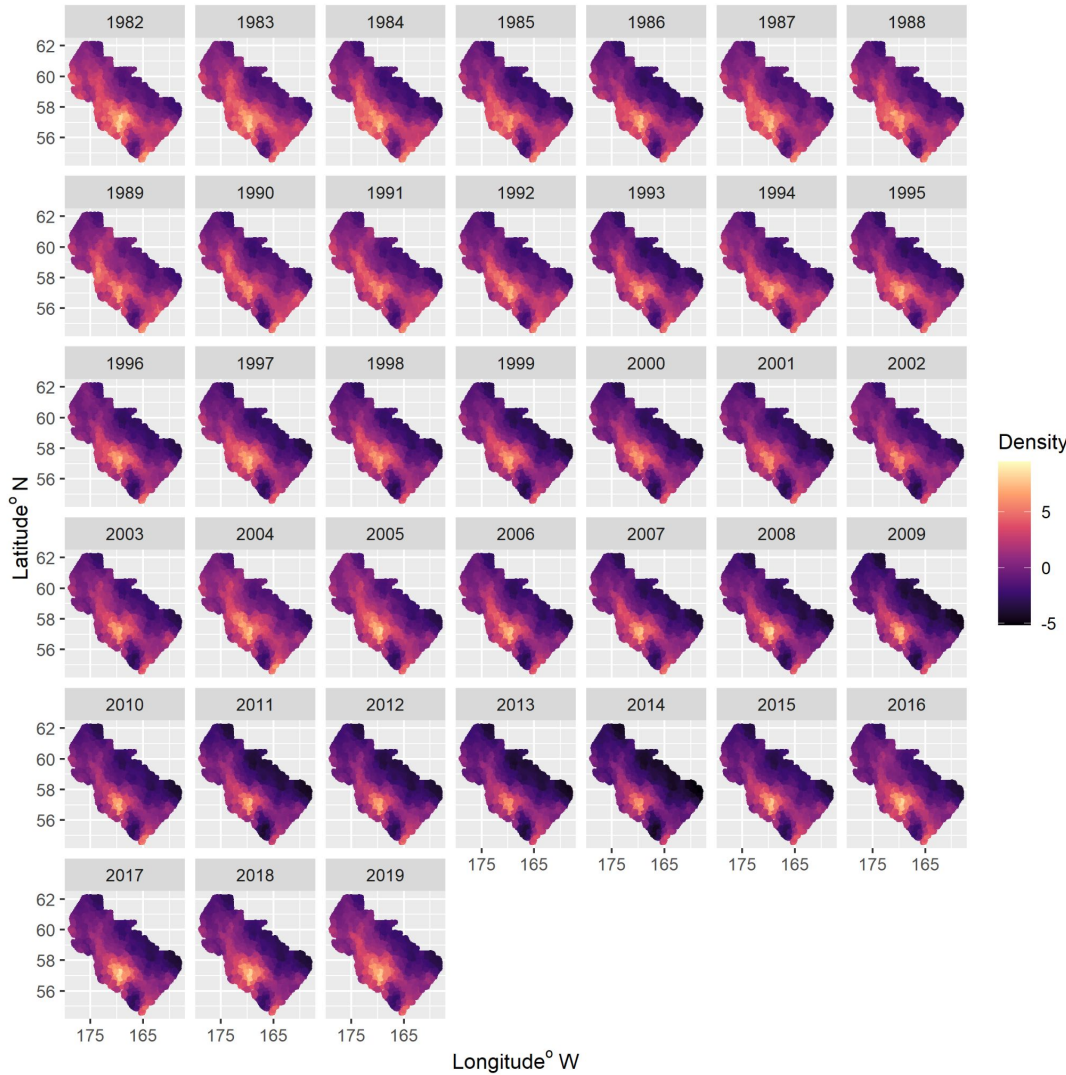
Northern rock sole



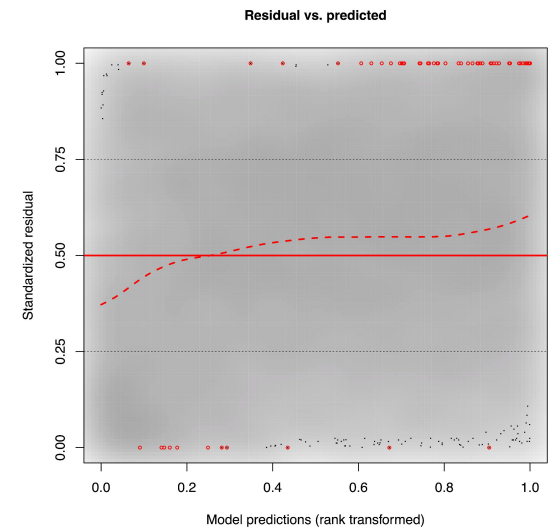
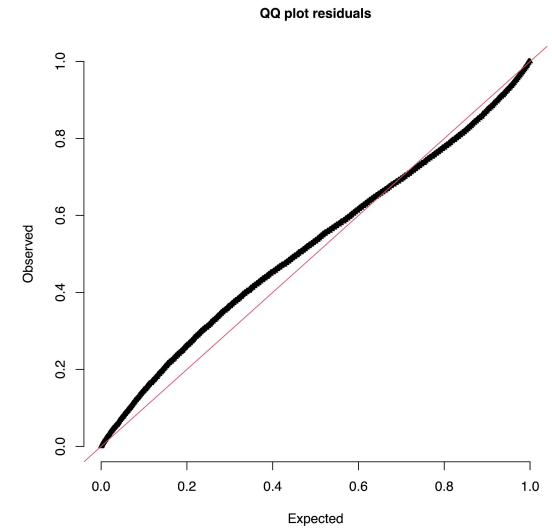
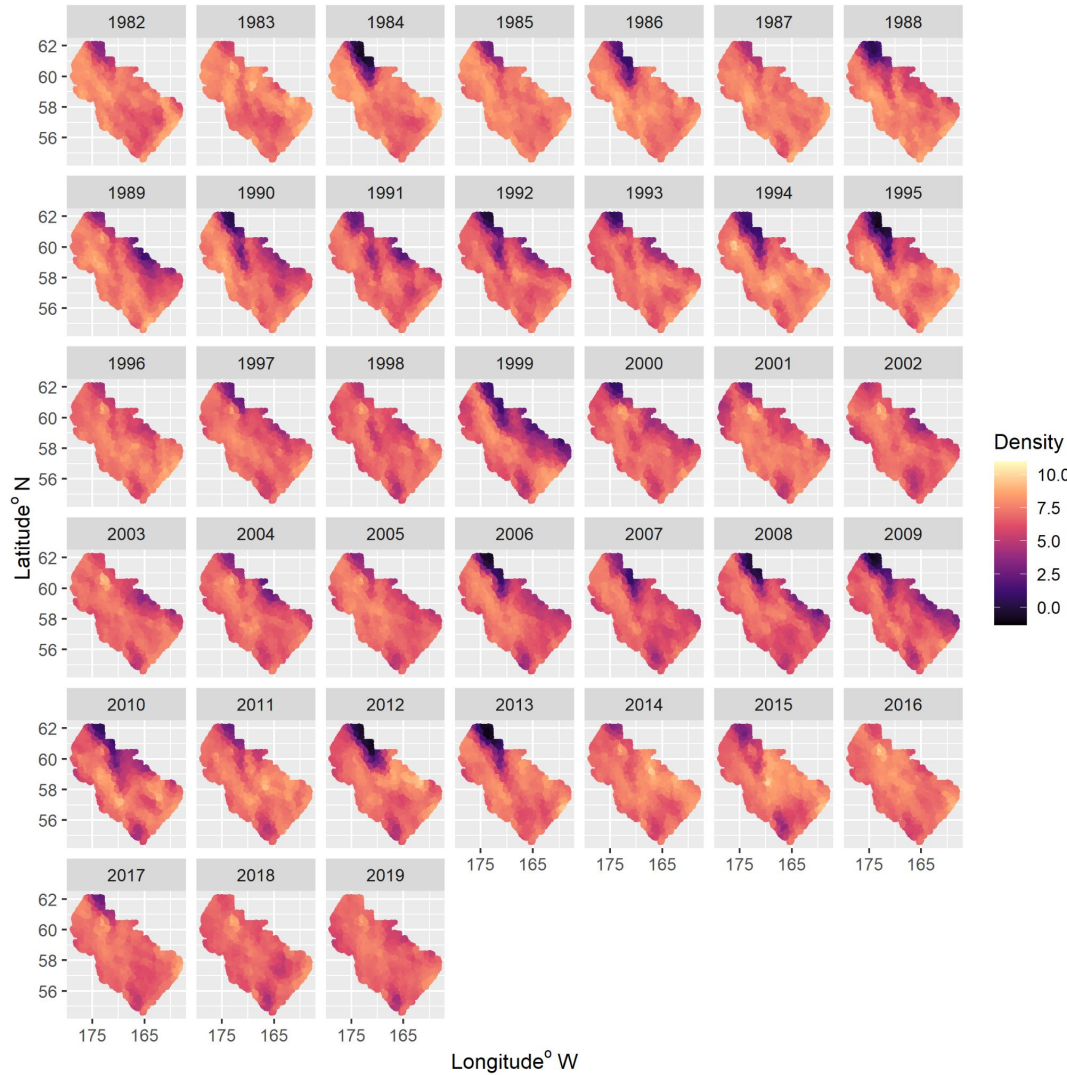
Alaska plaice



Yellow Irish lord



Pacific cod



Walleye pollock

