

SAP - VAST update May 2021



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Major items from January 2021 meeting

1.) *Use DHARMA diagnostics, but also provide maps of spatial Pearson's residuals (the latter are more easily interpreted than DHARMA's spatial residuals).*

Not implemented for spring hindcasts due to time, but will be for fall

2.) *Scale maps comparing spatial residuals between models to the same scale.*

Not implemented for spring hindcasts due to time constraints

3.) *Increase the size of spatial residual maps for better visual clarity.*

Implemented in some spring hindcasts, and added in all codes for fall

4.) *Continue to evaluate how to better define model acceptability.*

Work here is ongoing

5.) *VAST expert review committee*

Review committee formed and used for spring hindcast process

6.) *Visualization for barrier approach*

Visualization approach implemented for SMBKC

7.) *Follow-up on DHARMA p-values*

Feedback obtained from Cole Monnahan

8.) *Provide VAST output to authors in time for May meeting*

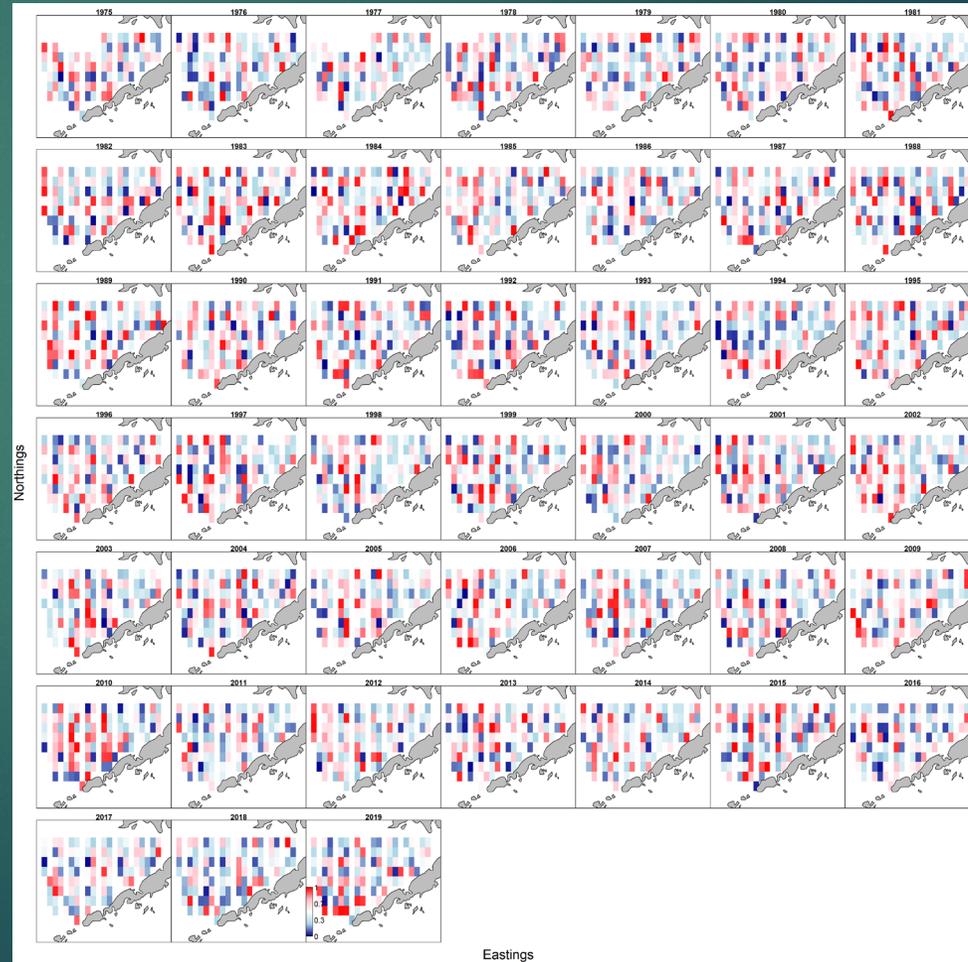
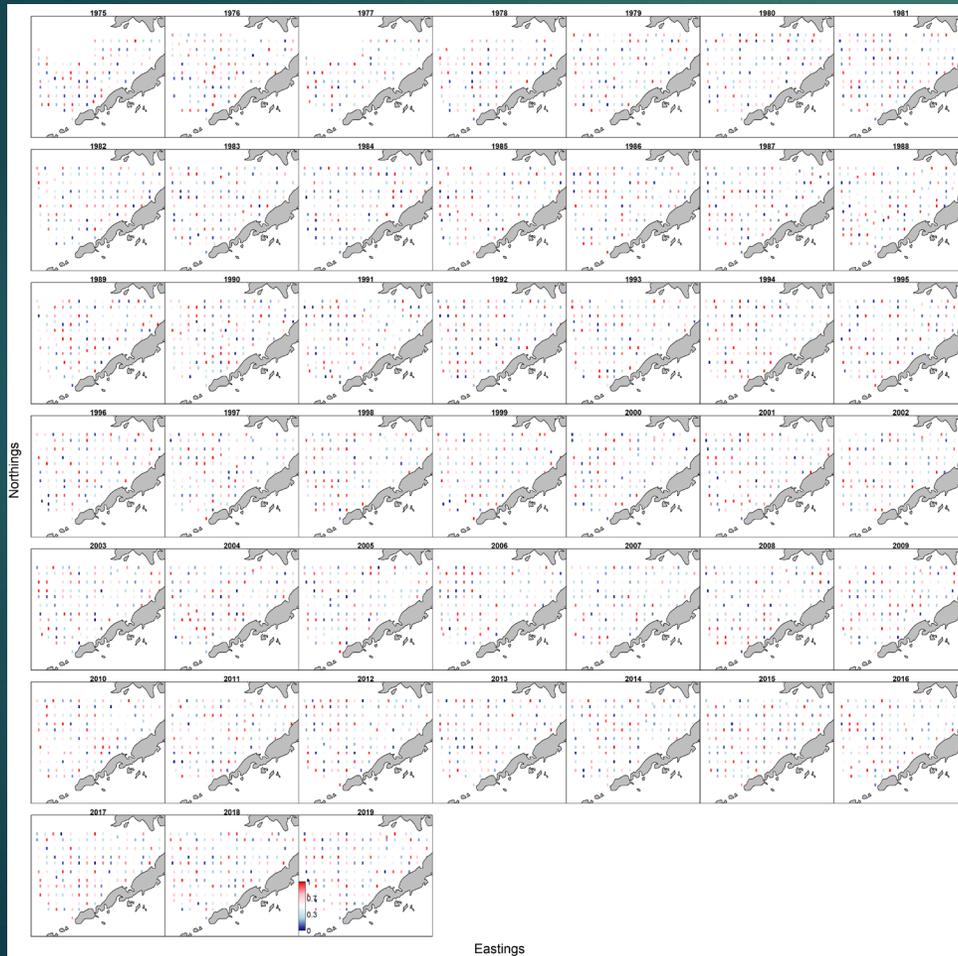
25 hindcasts produced and provided to authors



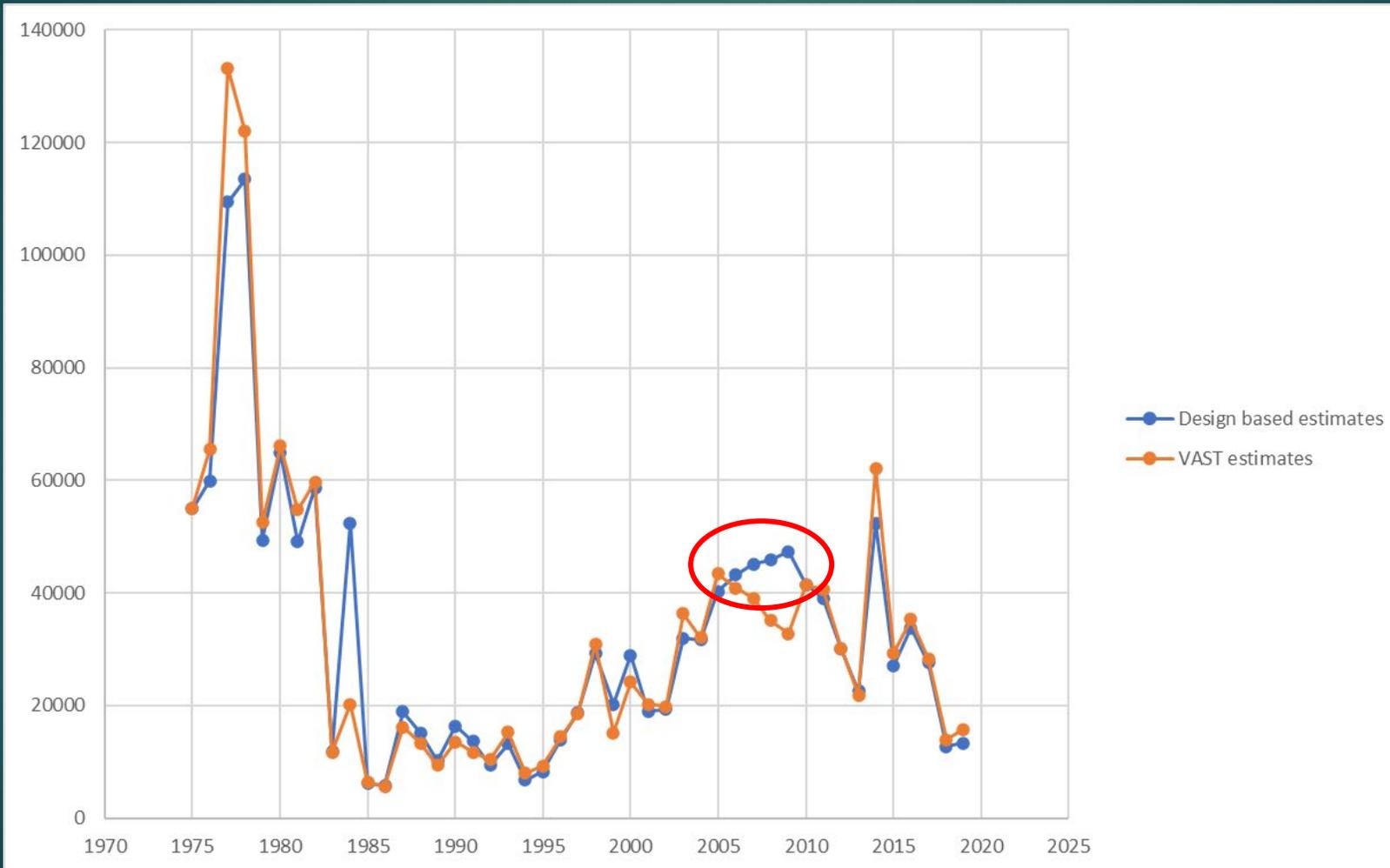
Item 3: *Increase the size of spatial residual maps*

Original

Current iteration



Item 4: Evaluation of model acceptability



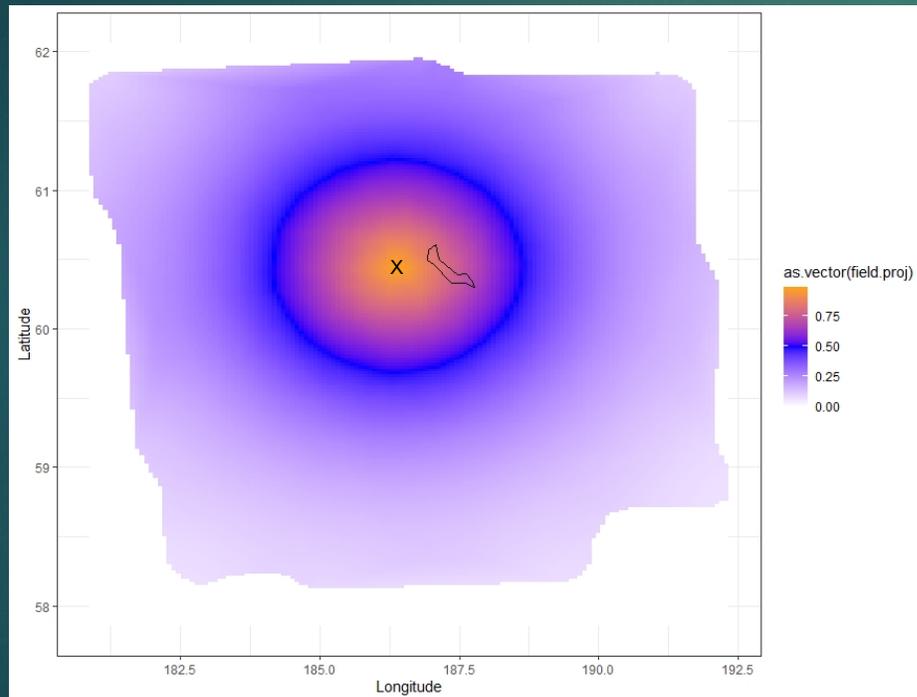
Item 5: VAST expert review committee

- ▶ Recommended in January
- ▶ James Thorson and Jason Conner agreed to staff initial iteration
- ▶ Provided review for spring 2021 hindcasts prior to their being provided to authors

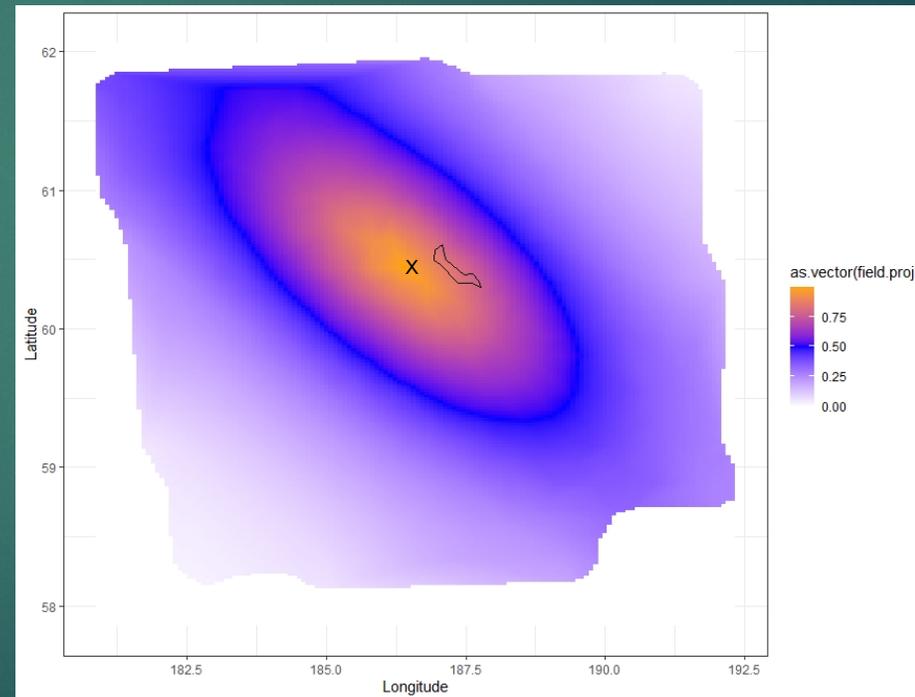


Item 6: Barrier approach visualization

Barrier disabled



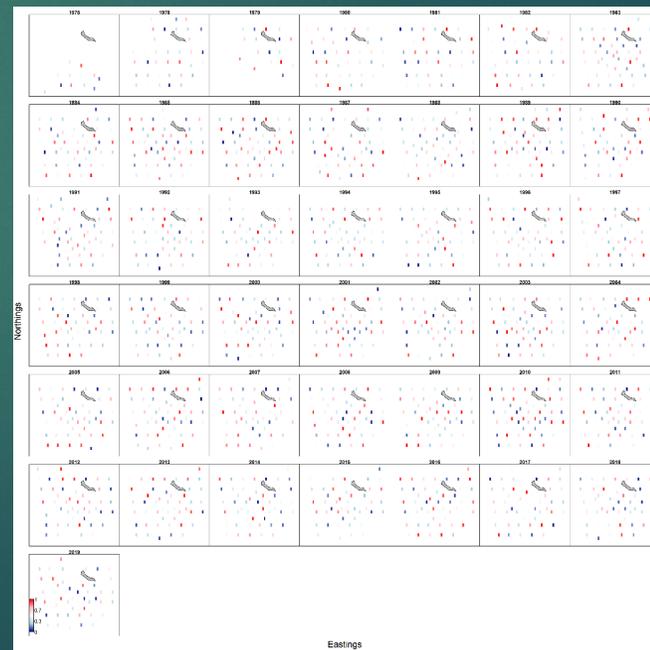
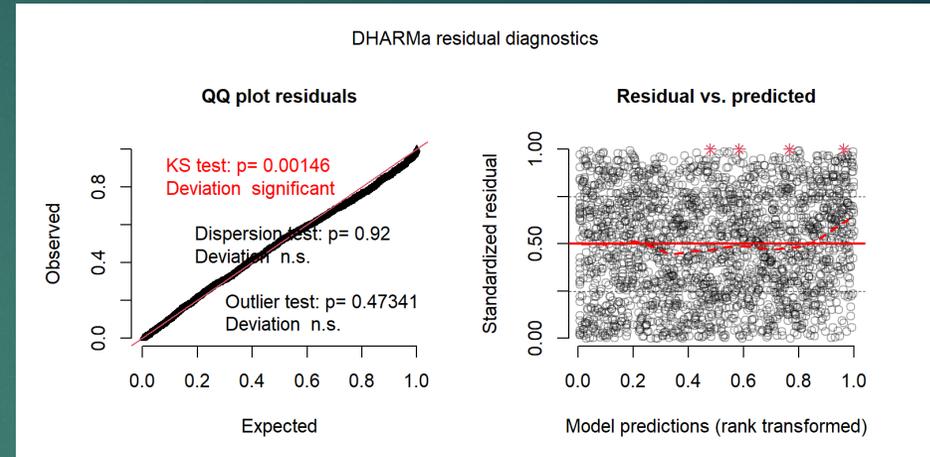
Barrier enabled



Item 7: DHARMA p-values



- ▶ Recommended by Cole Monnahan and Andrea Havron at SAFS seminar
- ▶ New data simulated from the fitted model for each observation in original data
- ▶ Residuals summarized as the probability density of the eCDF generated by simulation corresponding to the observed value
- ▶ Output
 - ▶ QQ-plot with relevant statistical tests
 - ▶ Plot of how residuals vary with magnitude of the predictions
 - ▶ Spatial map of quantile residuals



- ▶ *“A couple of key takeaways are (1) you cannot trust the p-values printed on the DHARMA plots, which test normality and outliers (I think). These are not well-calibrated meaning both that a low p-value does not necessarily mean to reject the Hypothesis, nor does a high one mean not to reject it. (2) It is probably still a good idea to produce these residuals, but instead just look at them visually and if some of them are really bad, then that's worth looking into. (3) All options (conditional, unconditional and the joint-precision) were unreliable in some way. Frustratingly the unconditional ones seemed to work a little better for the spatial model but worse for other model types. ”*





Item 8: Provide VAST estimates



VAST output

- ▶ 26 model indices requested, for EBS opilio, BBRKC, and bairdi (EBS, E166 and W166)
- ▶ Successful completion required >75 model runs
 - ▶ 2.5 weeks
 - ▶ Female BBRKC and E166 bairdi
 - ▶ 10 day production period should be adequate
- ▶ Began with standardized settings
 - ▶ Multiple models required specific settings to run (#knots, parameters disabled)



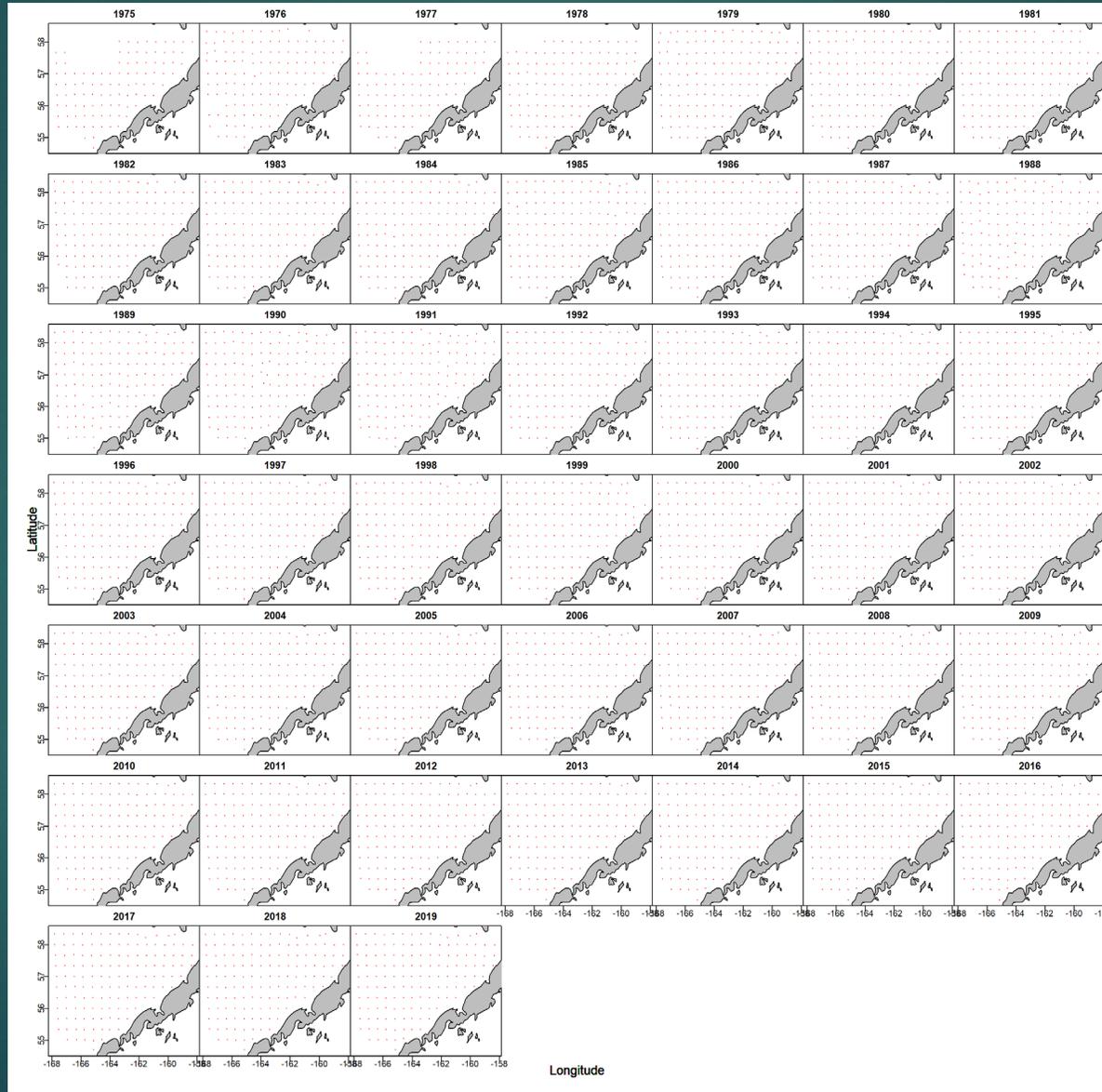
Sex	class	index	Machine	ObsModel	#knots
		<u>BBRKC</u>			
Females	GE65	biomass	Kvasir	2_1	500kts
Males	GE65	biomass	Kvasir	2_1	500kts
Males+females	GE65	biomass	Kvasir	2_1	500 kts
		<u>Opilio</u>			
Females	mature	biomass	Kvasir	2_1	500kts and 750kts
Males	Legal	biomass	Work1	2_1	750 kts
Males	Total	abundance	Kvasir	2_1	500kts and 750kts
Females	Total	abundance	Kvasir	2_1	500kts and 750kts
		<u>Bairdi</u>			
		<u>EBS</u>			
Female	Immature	biomass	Kvasir	2_1	750kts
Female	Mature	biomass	Kvasir	2_1	750kts
Male	Total	biomass	Work1 and Kvasir	2_1	750kts
Male	GE125	biomass	Kvasir	2_1	500kts
Female	Immature	abundance	Kvasir	2_1	750kts
Female	Mature	abundance	Kvasir	2_1	750kts
Male	Total	abundance	Work1	2_1	250kts
		<u>E166</u>			
Male	Total	biomass	Work1	2_1	750kts
Male	GE125	biomass	Work1	2_1	500kts
Female	Immature	biomass	Work1	2_1	750kts
Female	Mature	biomass	Work1	2_1	350kts
Female	Immature	abundance	Work1	2_1	100kts
Female	Mature	abundance	Work1	2_1	150kts
		<u>W166</u>			
Male	Total	biomass	Work1/VM1	2_1	750kts
Male	GE125	biomass	VM1	2_1	250 knots
Female	Immature	biomass	Kvasir	2_1	500 and 750kts
Female	Mature	biomass	Kvasir	2_1	350kts
Female	Immature	abundance	VM1/Kvasir	2_1	500kts
Female	Mature	abundance	Kvasir	2_1	250kts



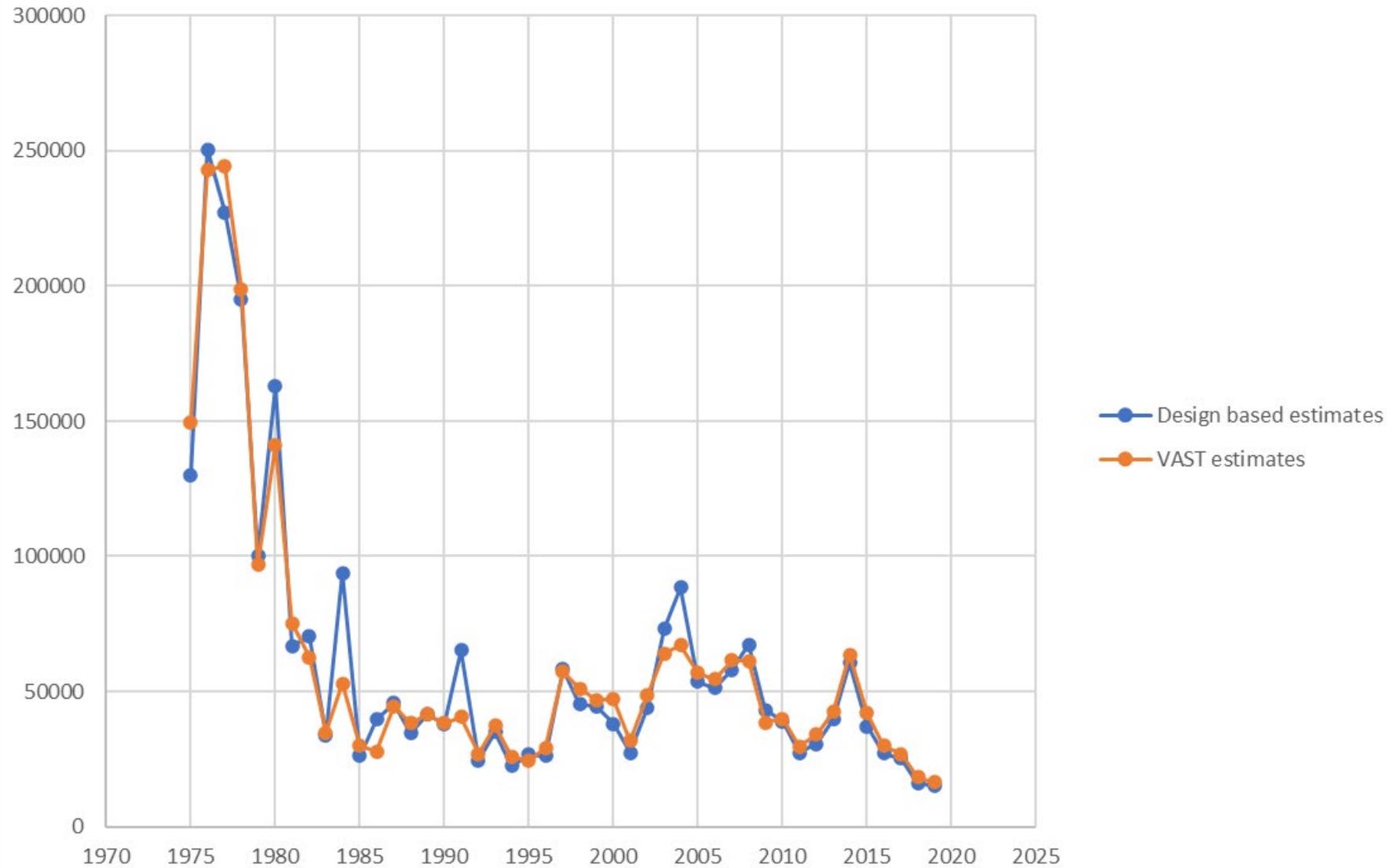
Bristol Bay red king crab



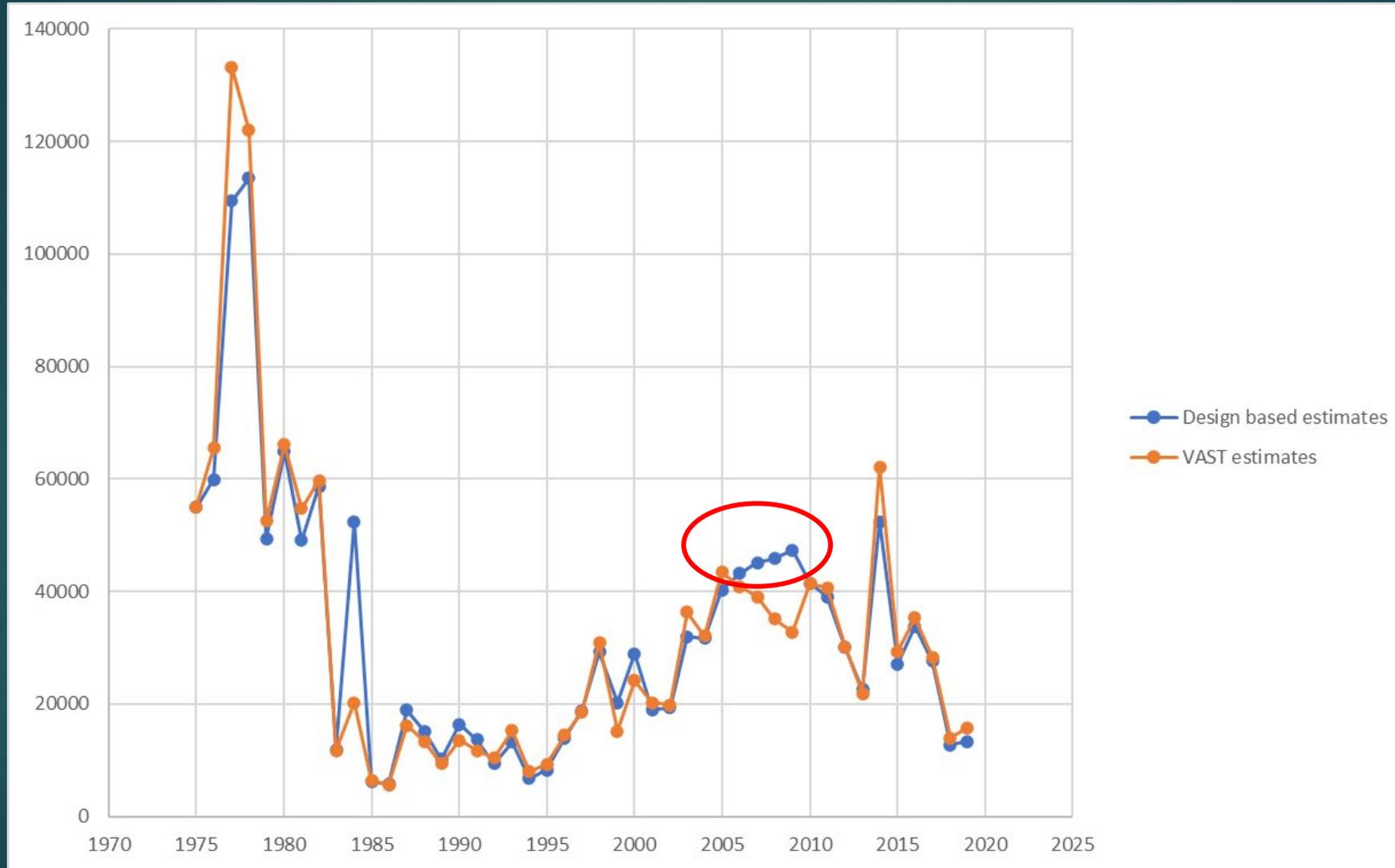
Data by year



Male GE65 biomass

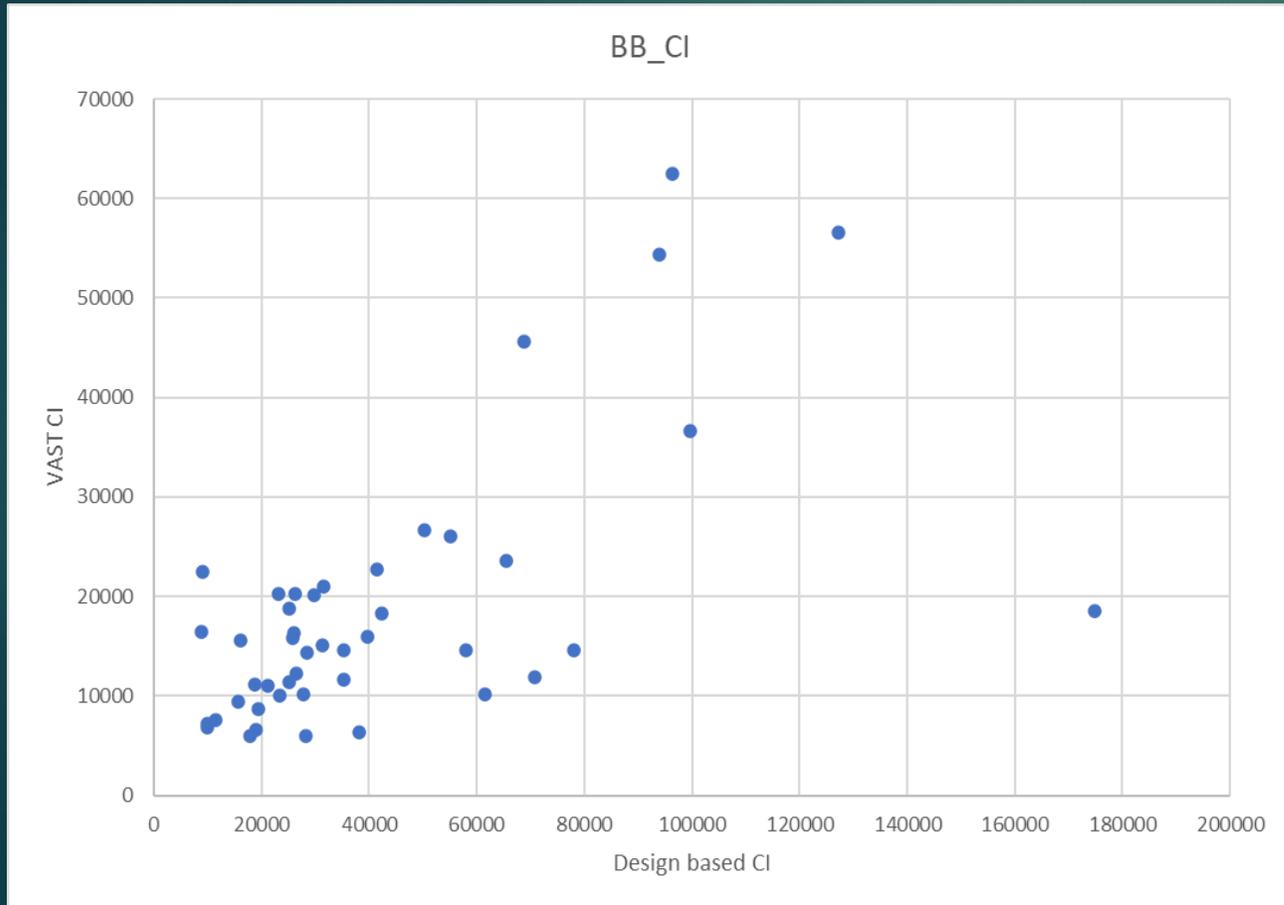


Female GE65 biomass

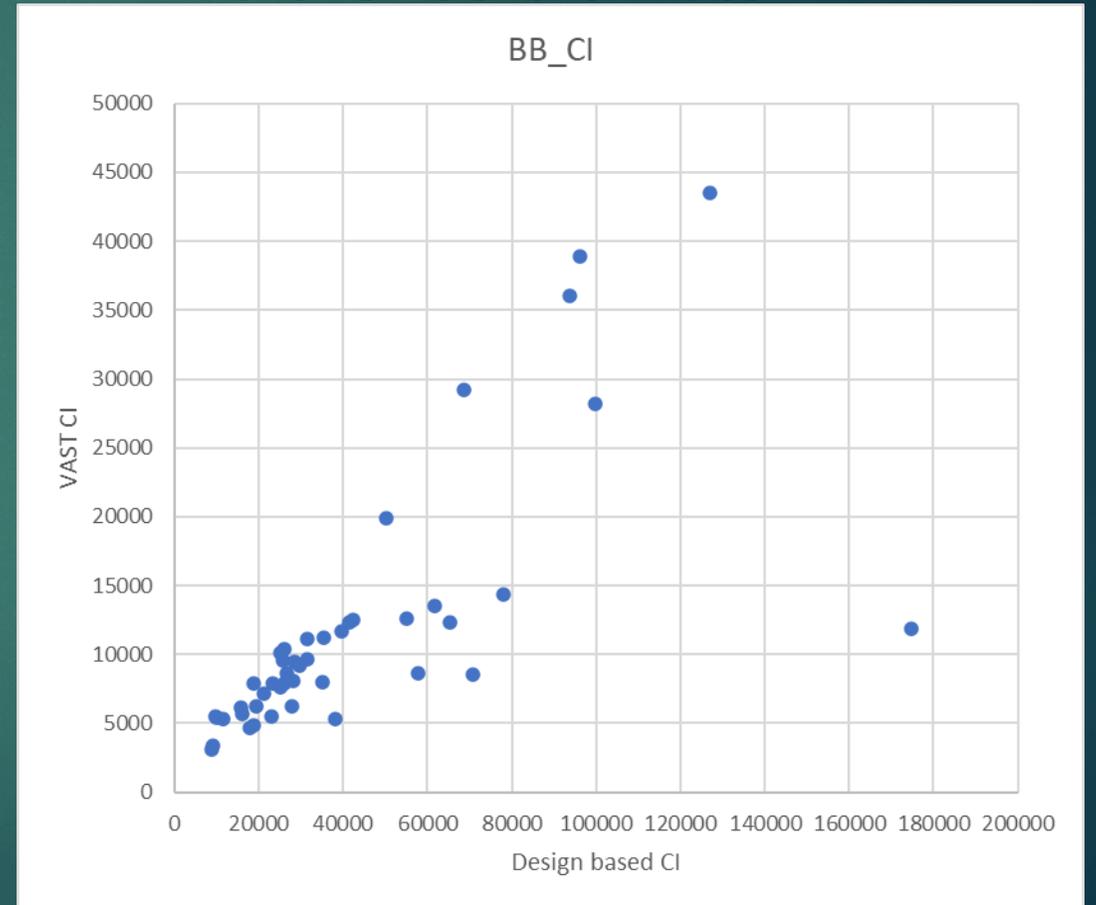


CI

Total GE65 biomass



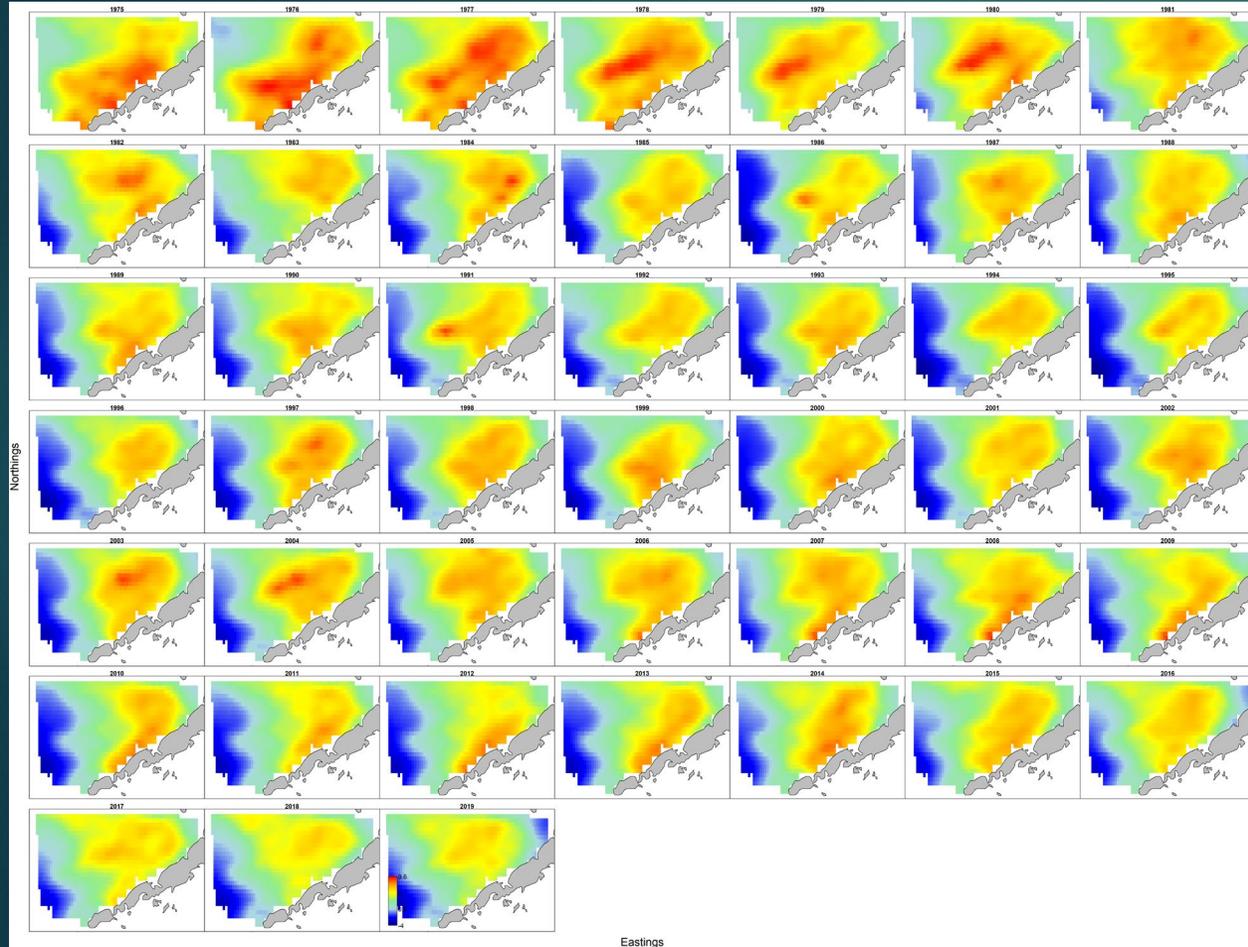
Male GE65 biomass



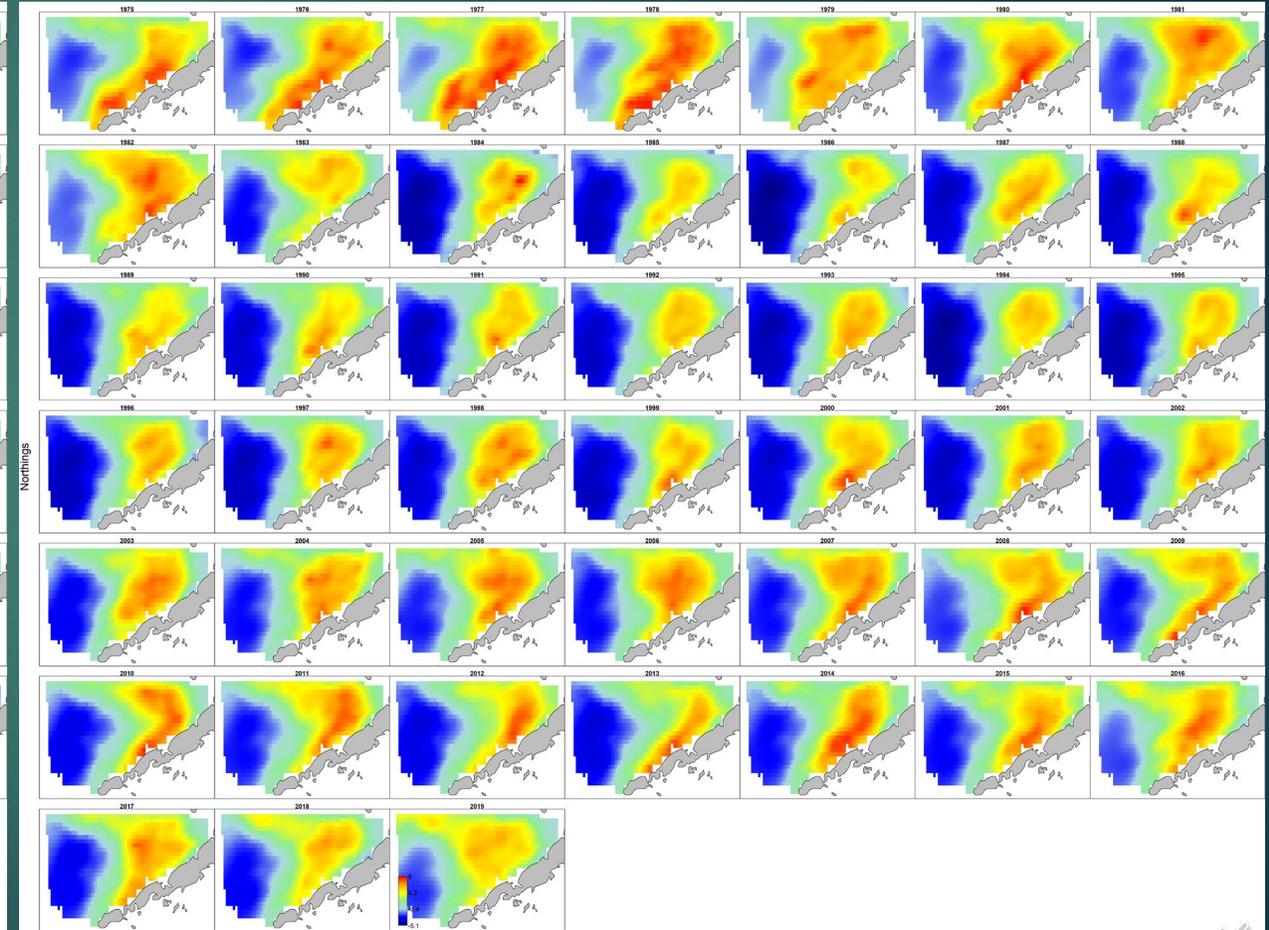
Density maps

Males GE65

Females GE65



Eastings



Eastings

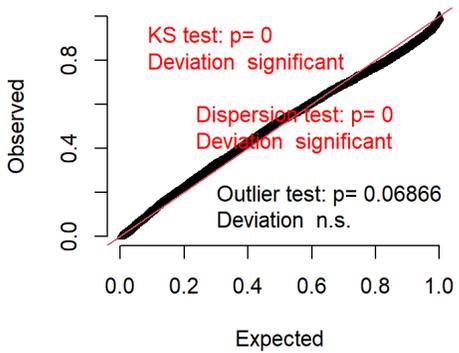


Quantile residuals

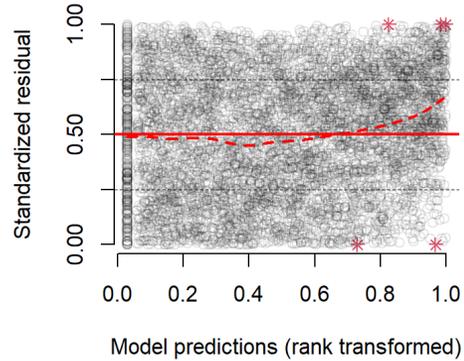
Total GE65

DHARMA residual diagnostics

QQ plot residuals



Residual vs. predicted

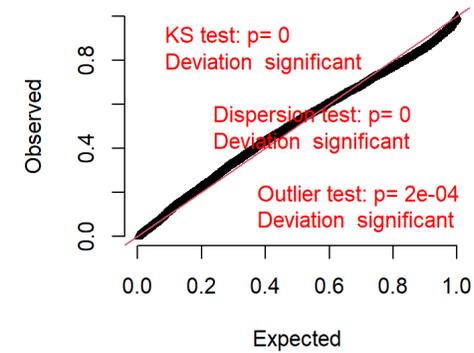


Females GE65

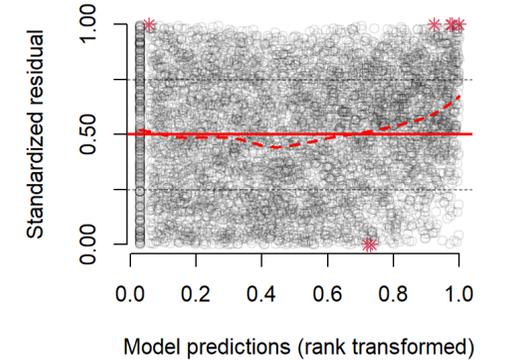
Males GE65

DHARMA residual diagnostics

QQ plot residuals

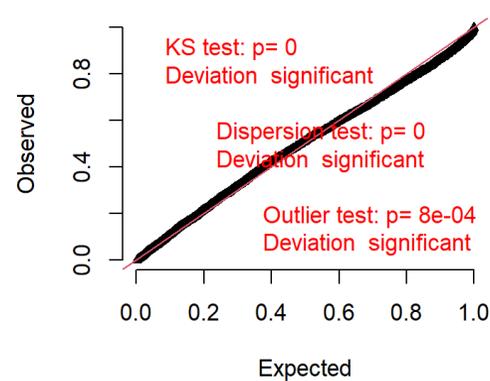


Residual vs. predicted

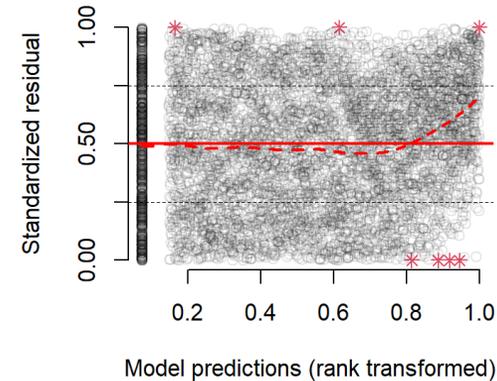


DHARMA residual diagnostics

QQ plot residuals

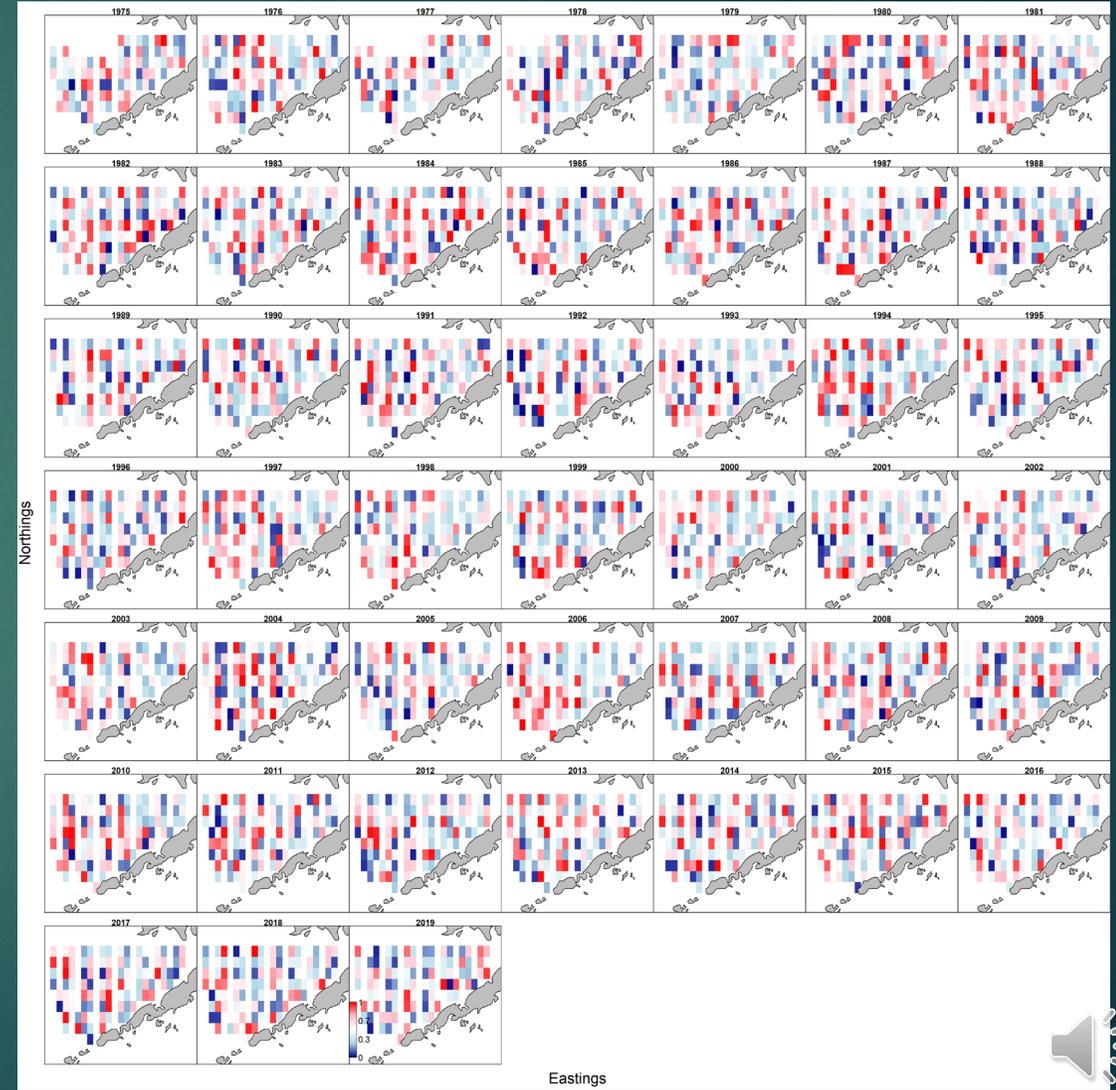
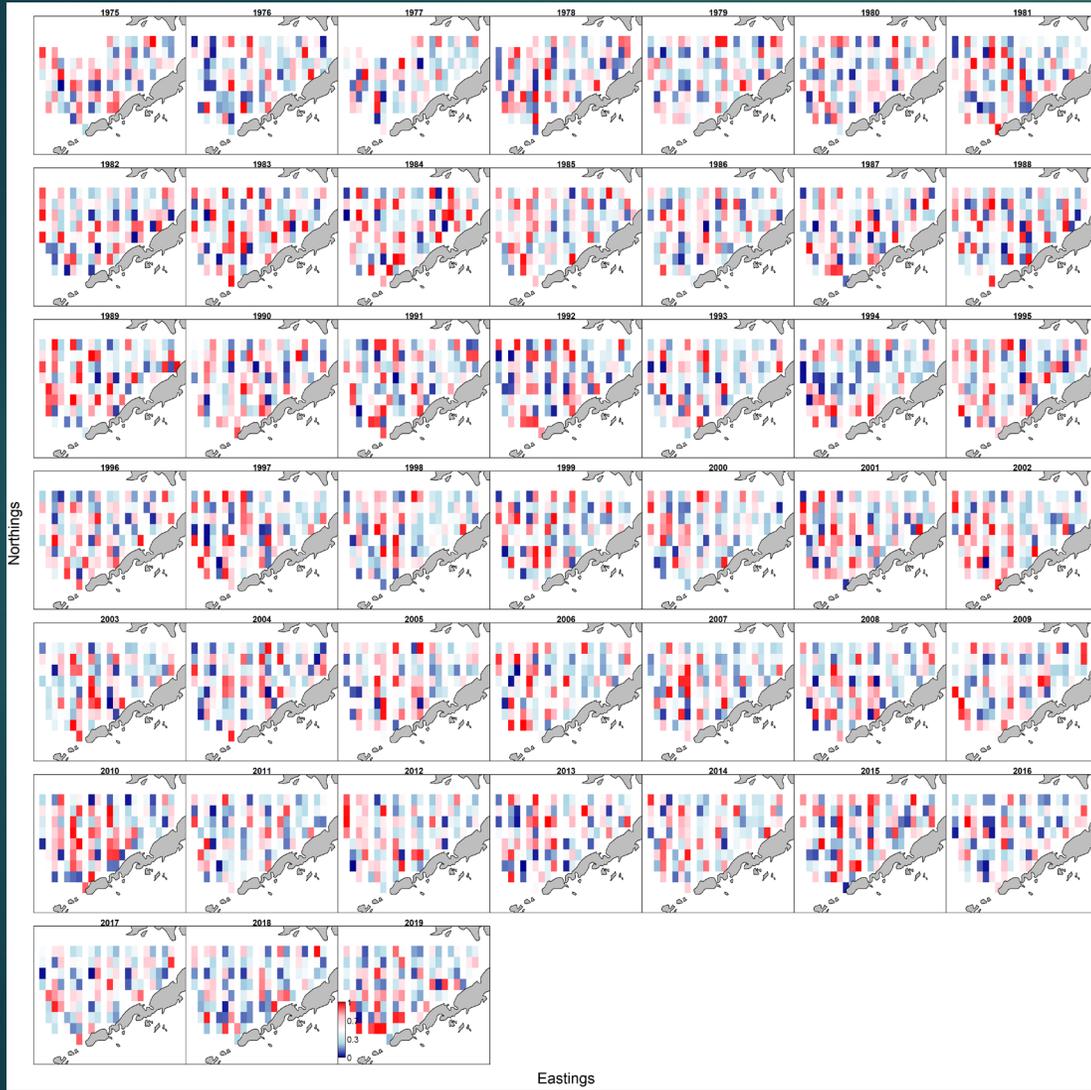


Residual vs. predicted



Total GE65

Males GE65



Summary- BBRKC

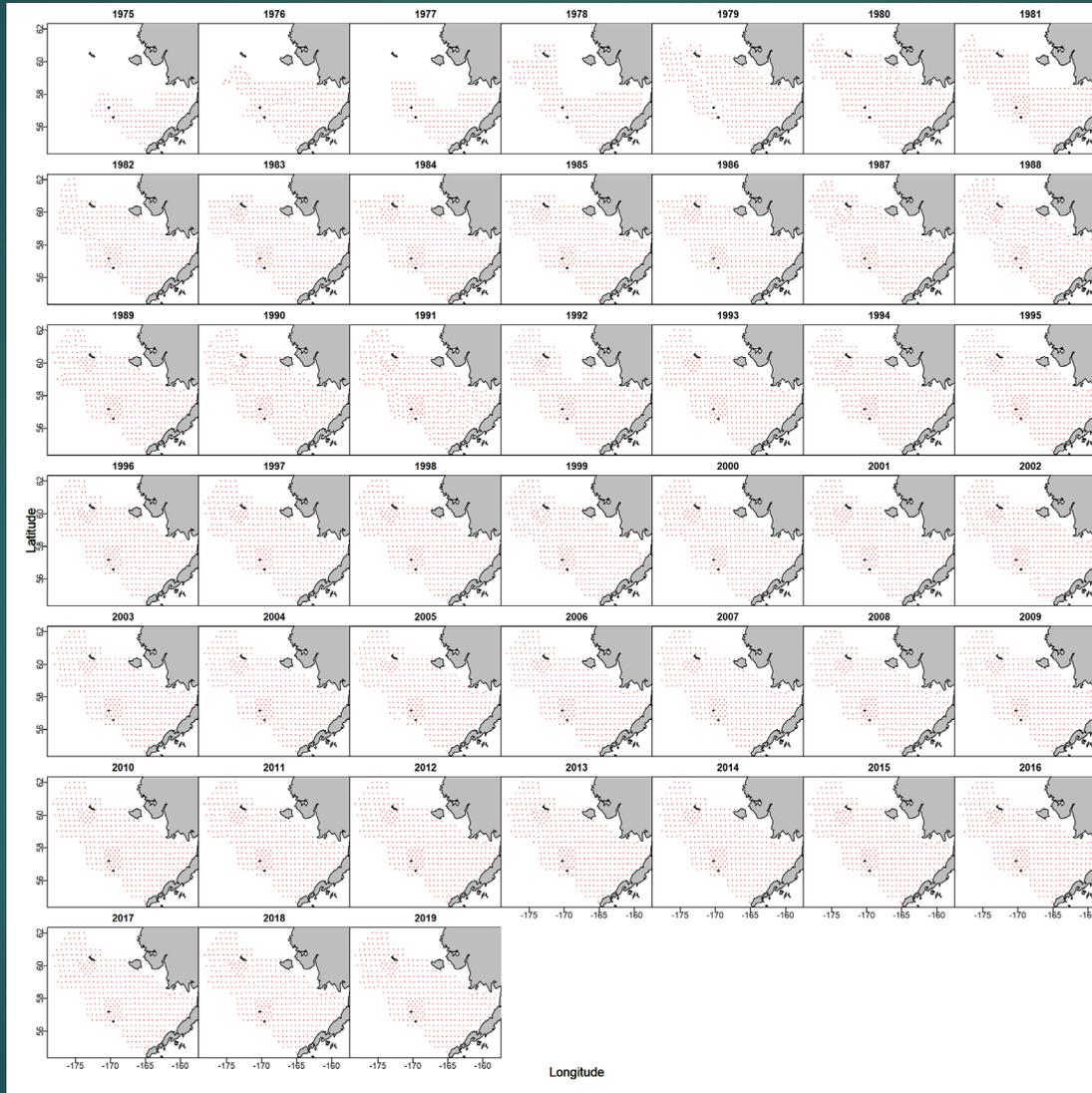
- ▶ Total and Male GE65 biomass models performed well
 - ▶ Diagnostics
 - ▶ Population trends
- ▶ Female GE65 biomass model did not
 - ▶although diagnostics did look good
 - ▶ Difficulty fitting
 - ▶ Spatial distribution
 - ▶ Aberrant population trend in late 2000s



EBS Bairdi

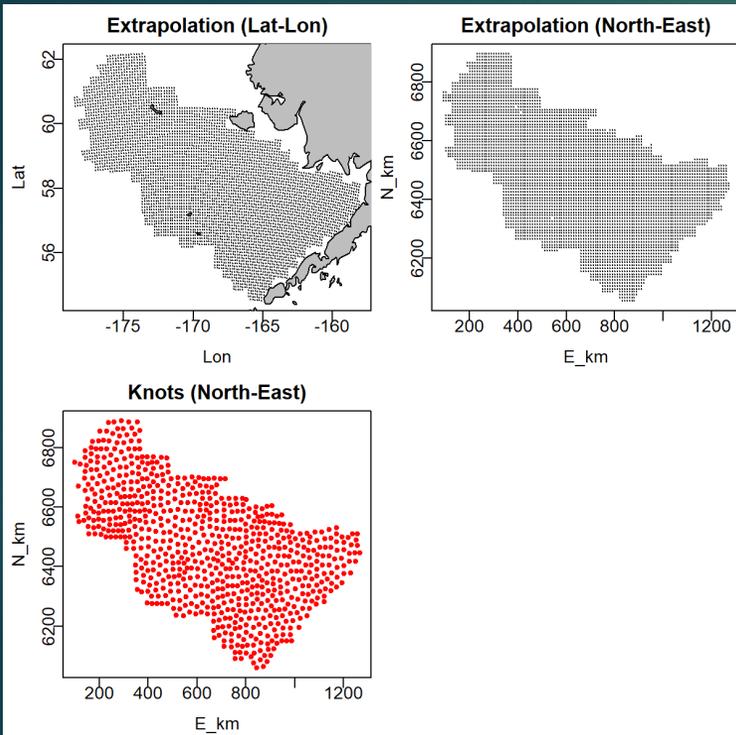


Data by year

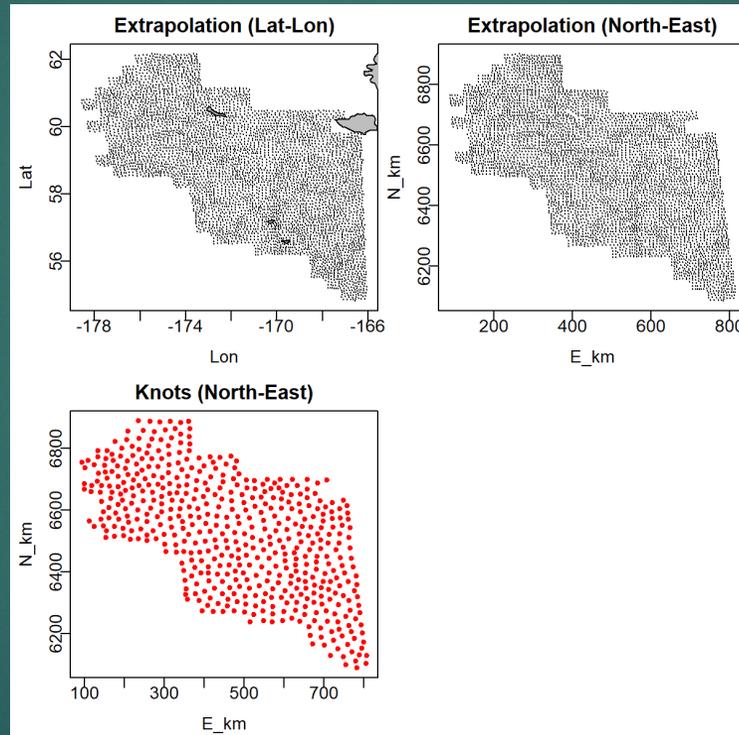


Extrapolation area/knots

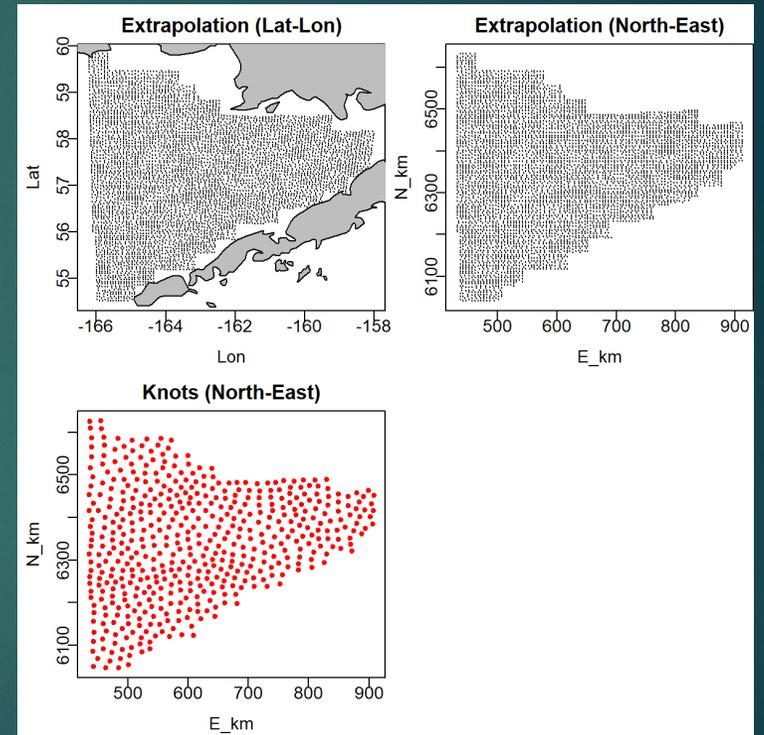
EBS



Western

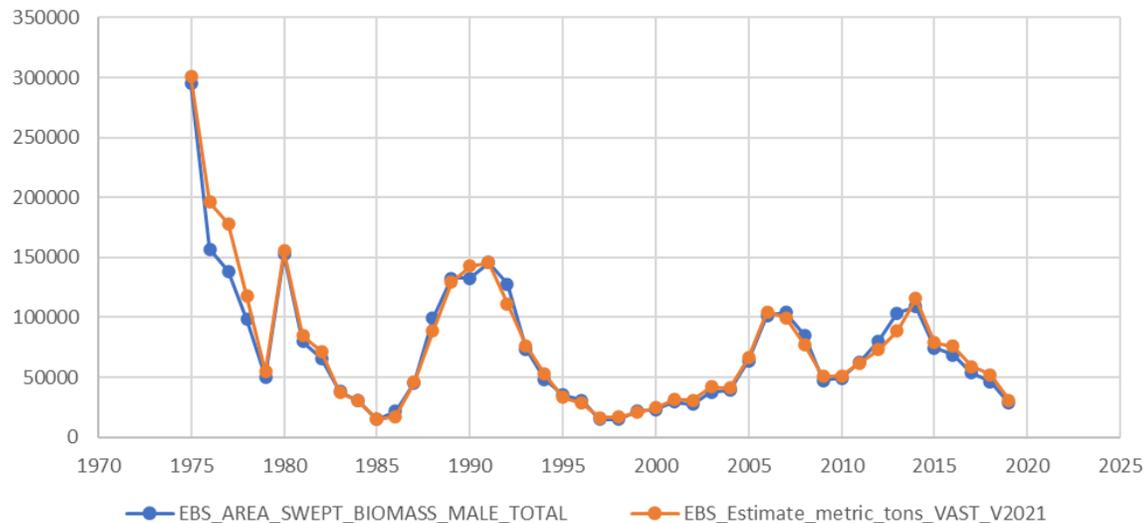


Eastern

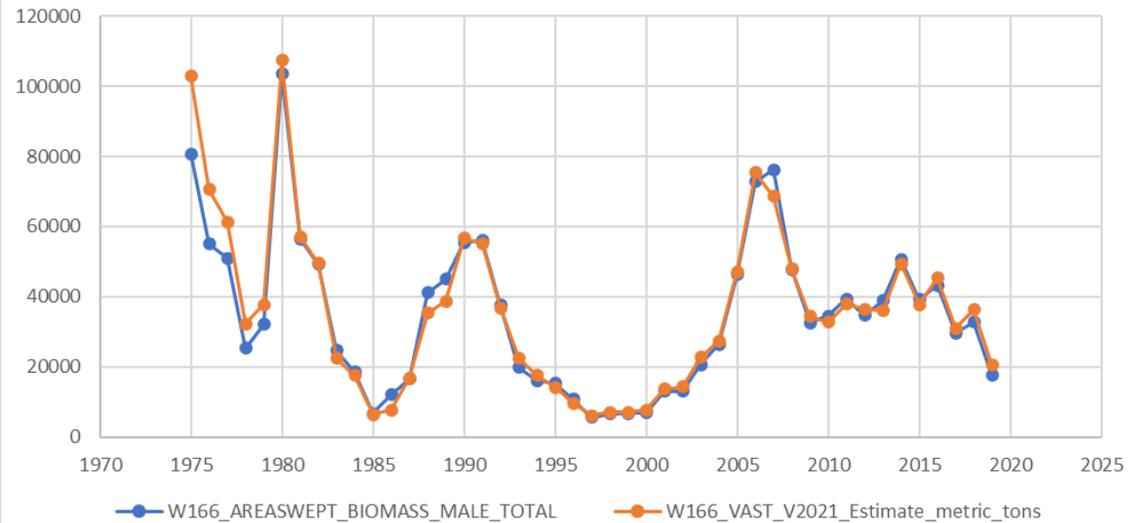


Total male biomass estimates

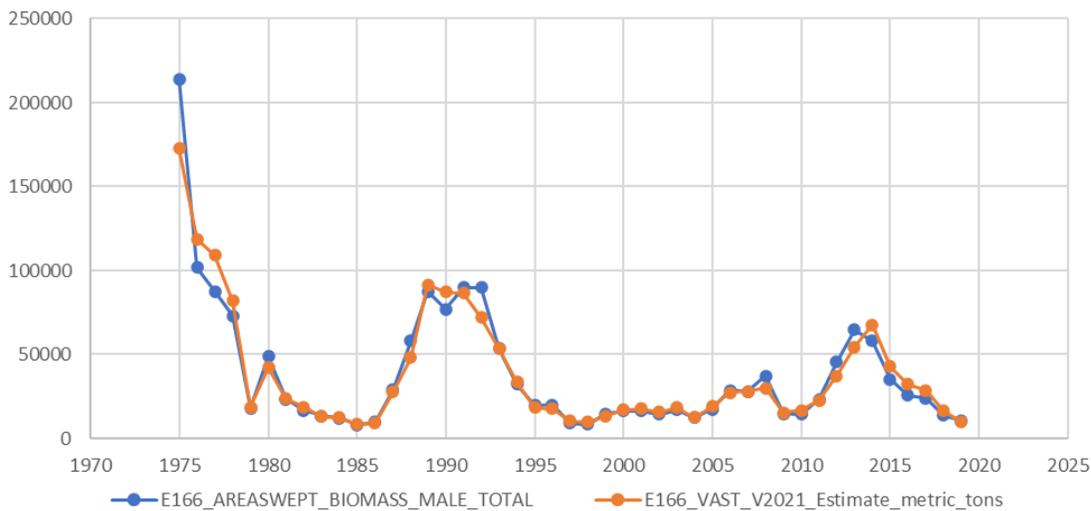
EBS



W166

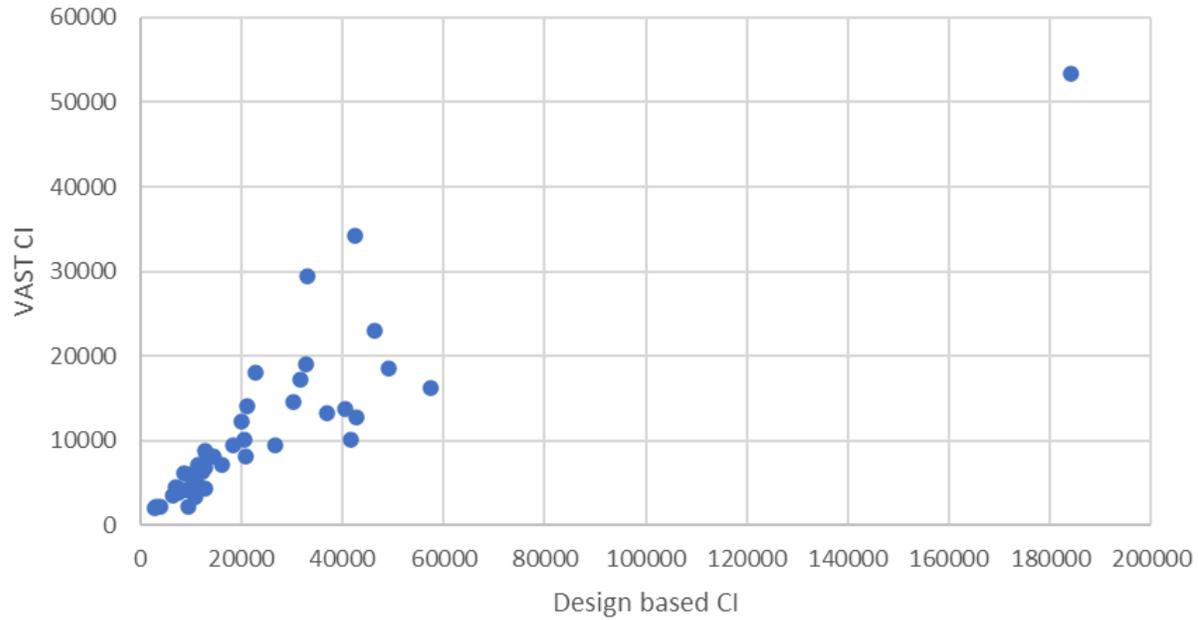


E166

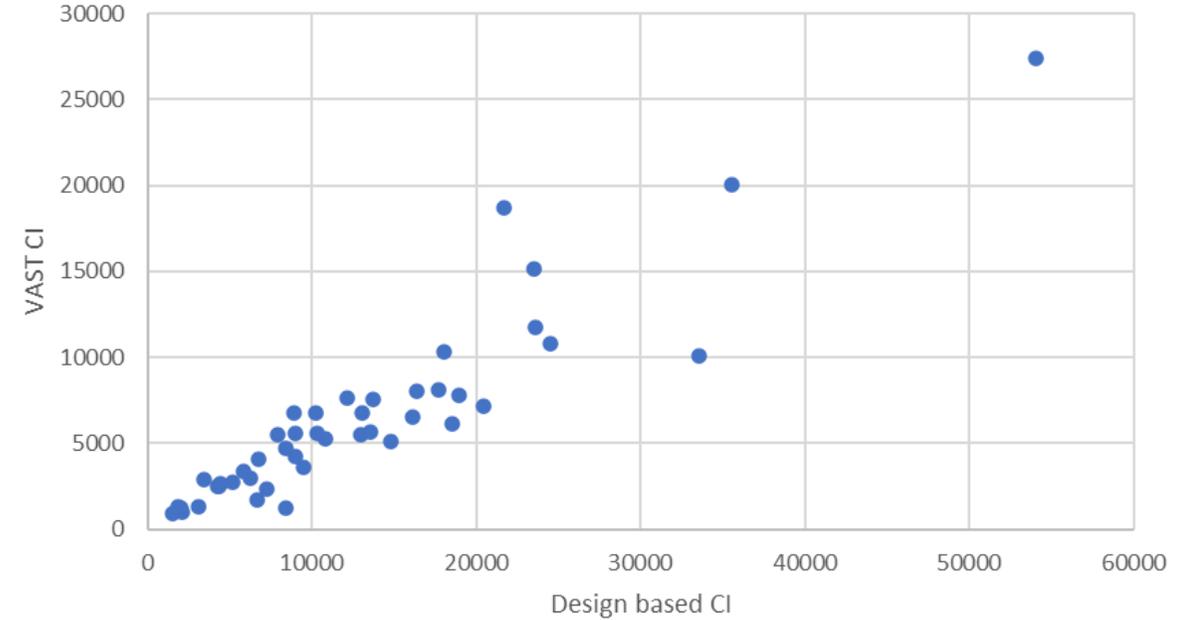


Total male biomass CIs

EBS_CI

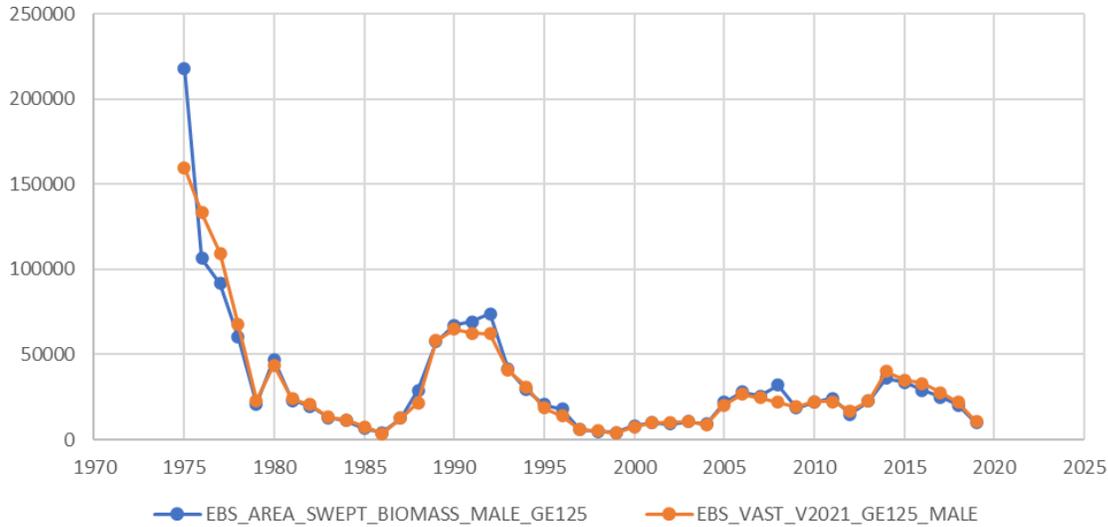


W166_CI

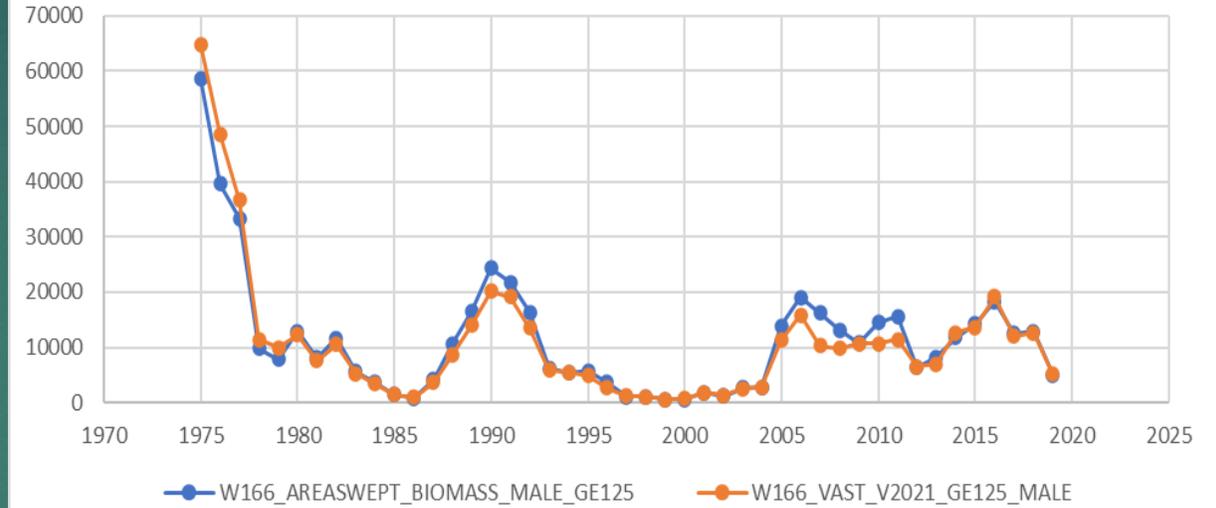


Male GE125 biomass

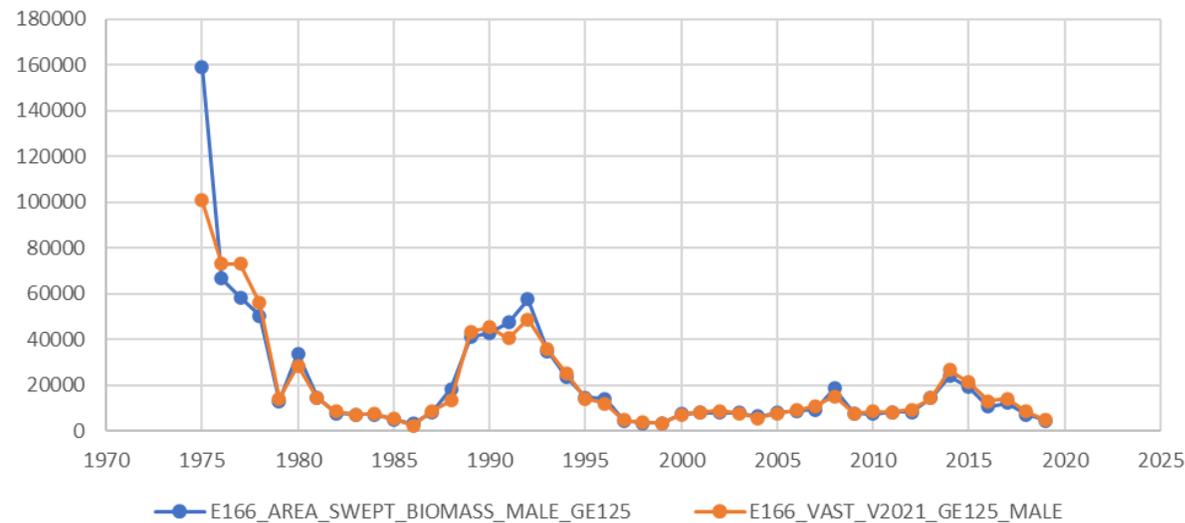
EBS



W166

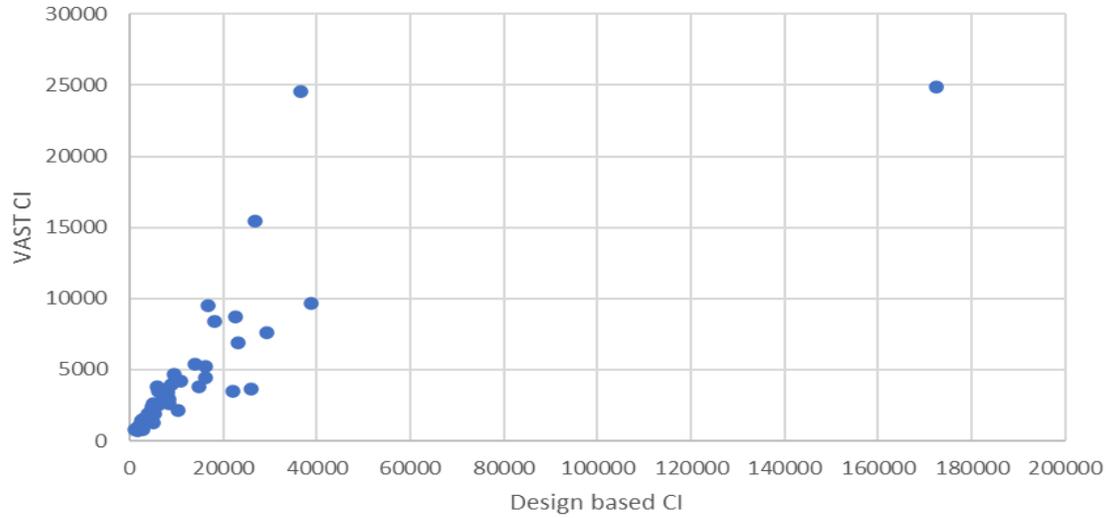


E166

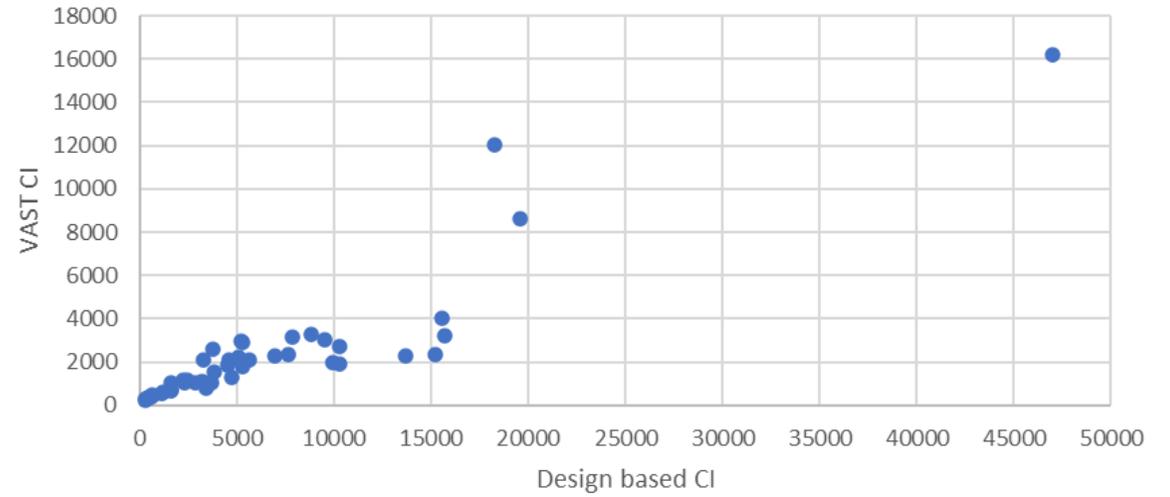


Male GE125 CIs

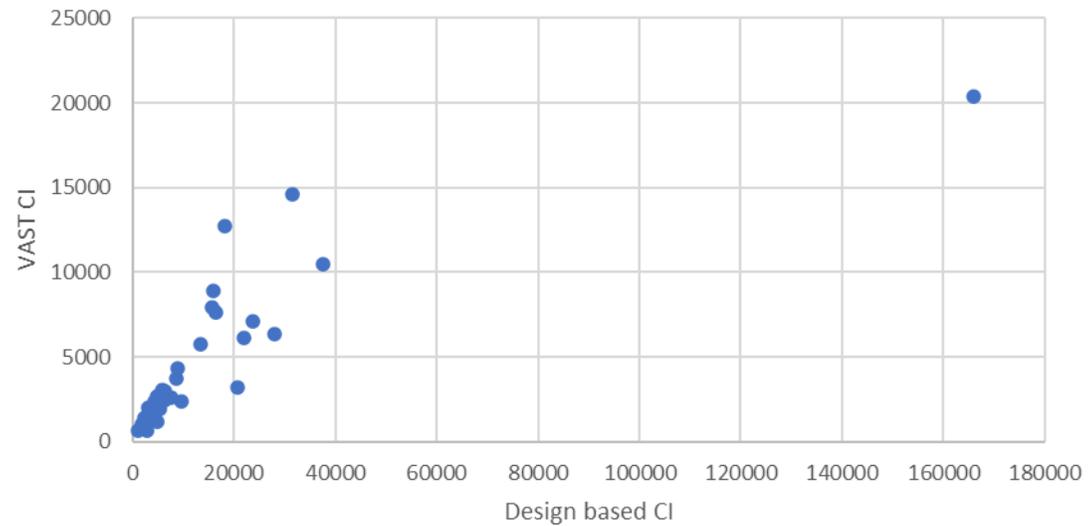
EBS_CI



W166_CI

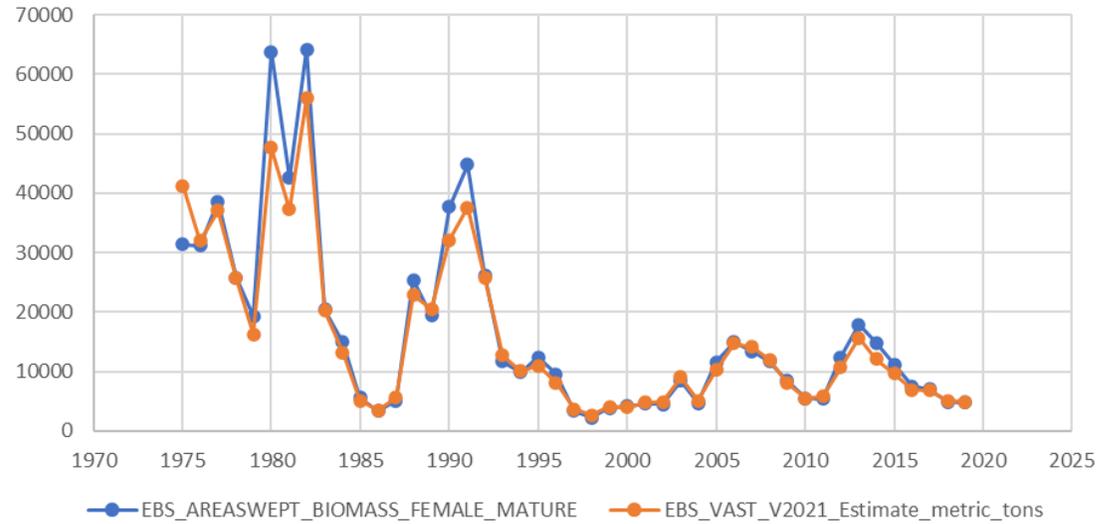


E166_CI

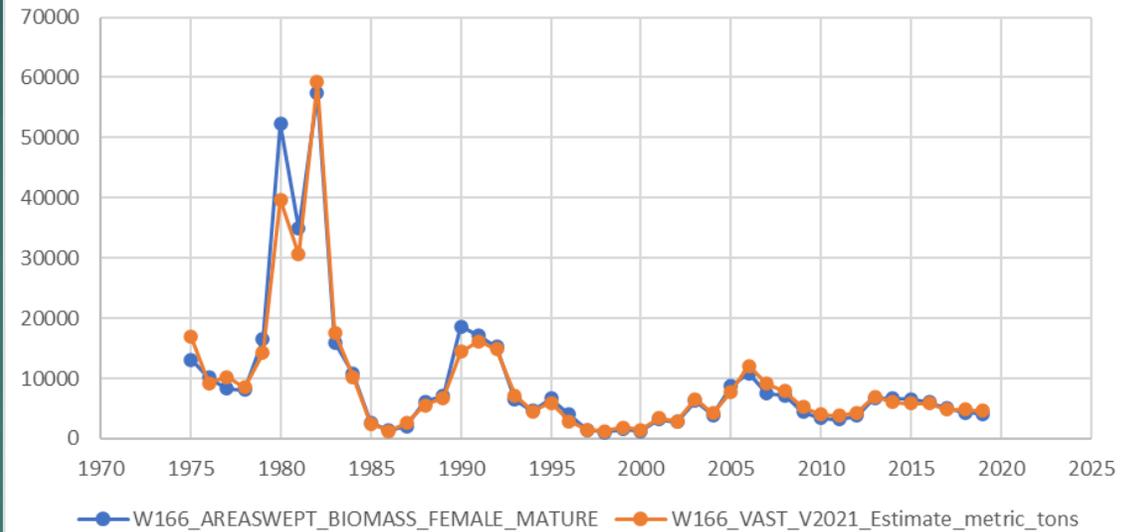


Mature female biomass

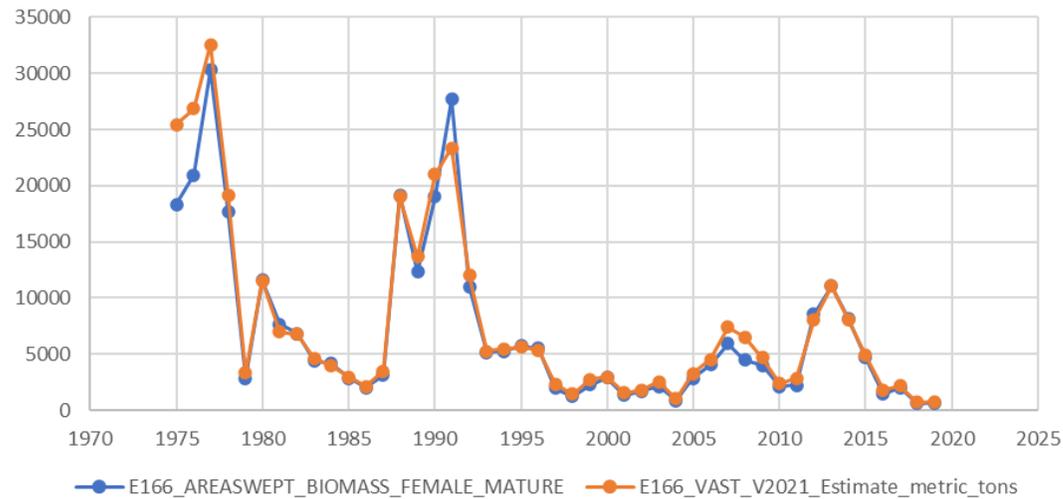
EBS



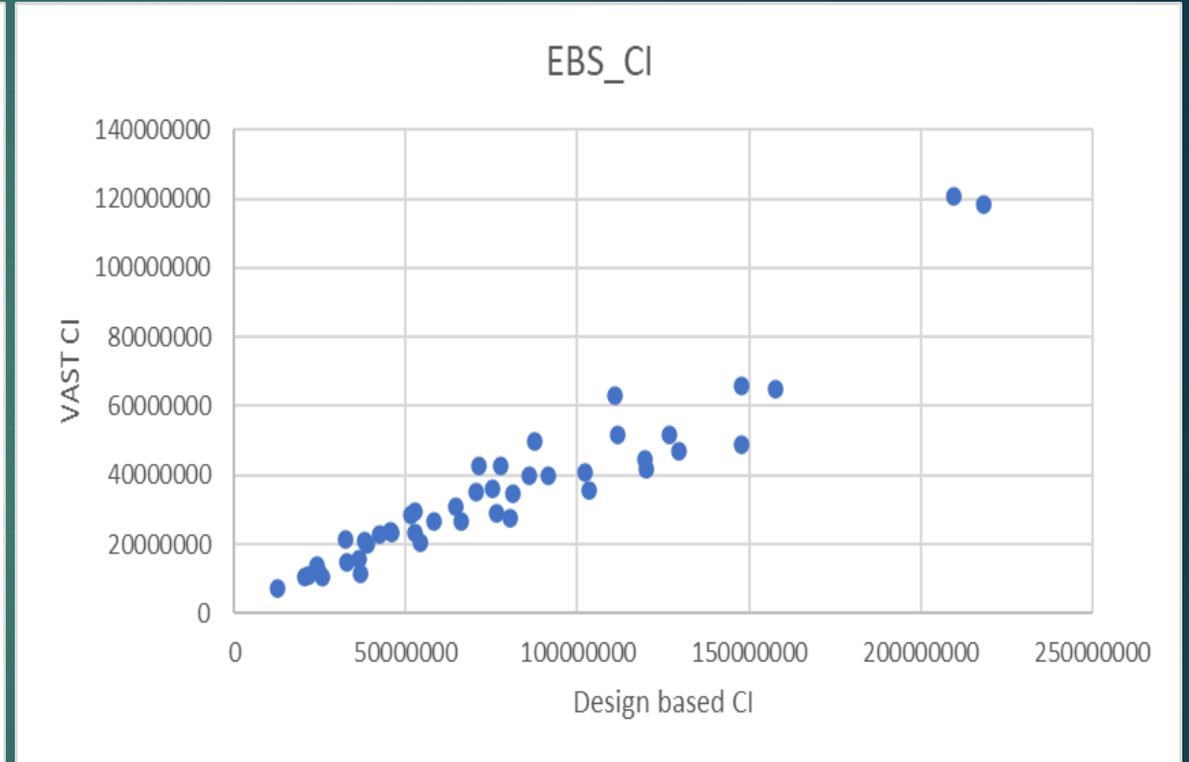
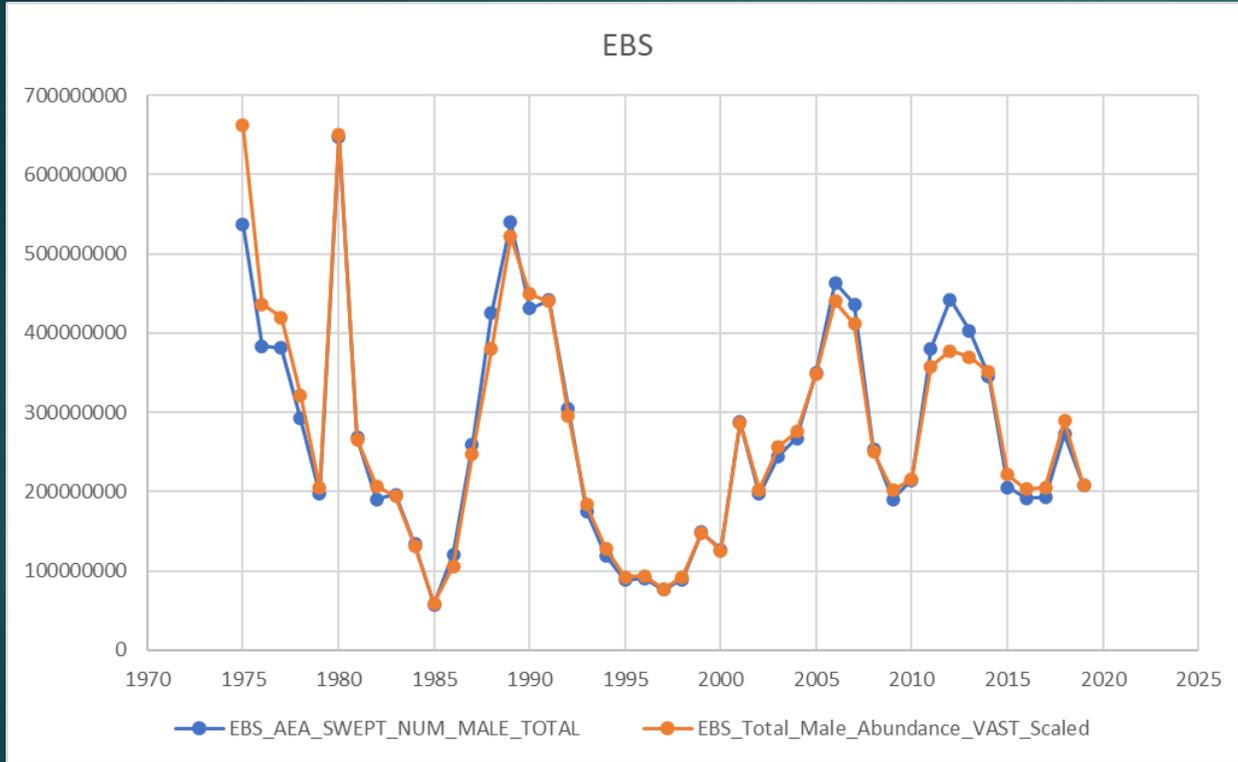
W166



E166

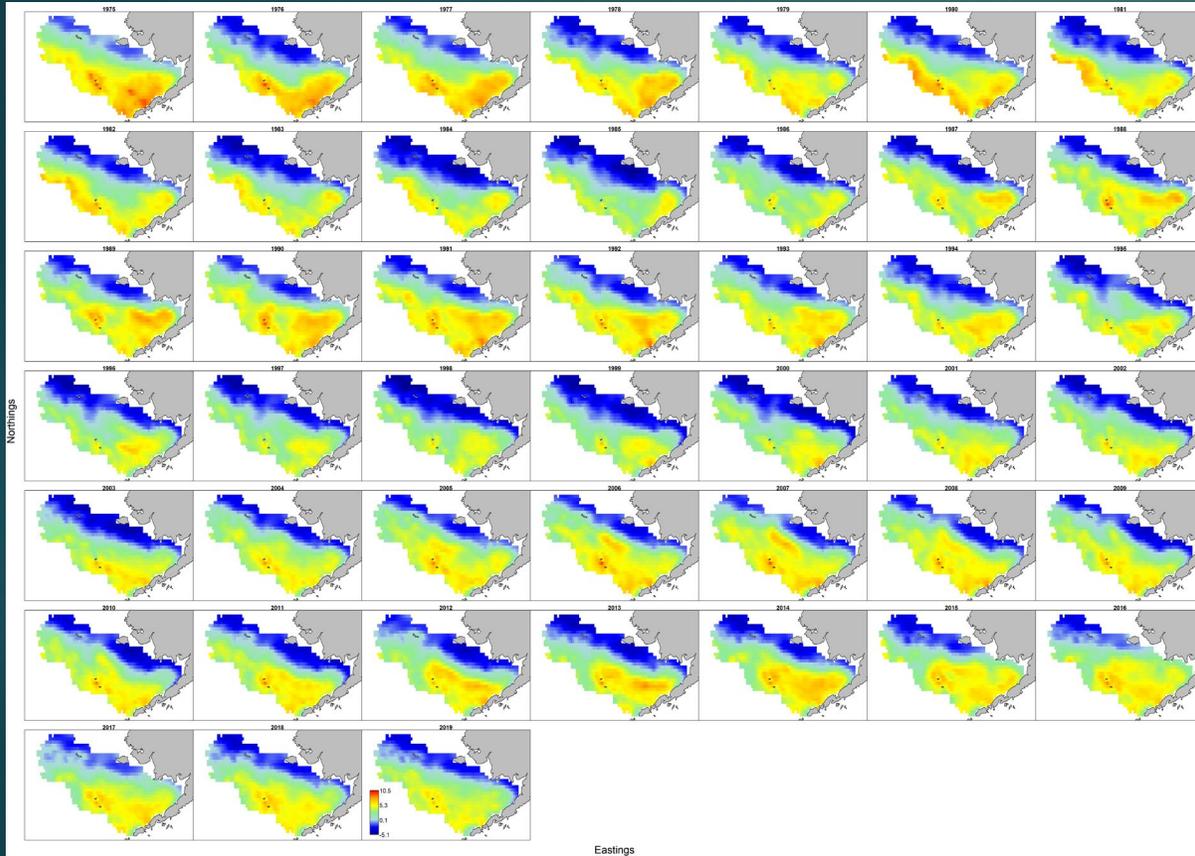


EBS total male abundance

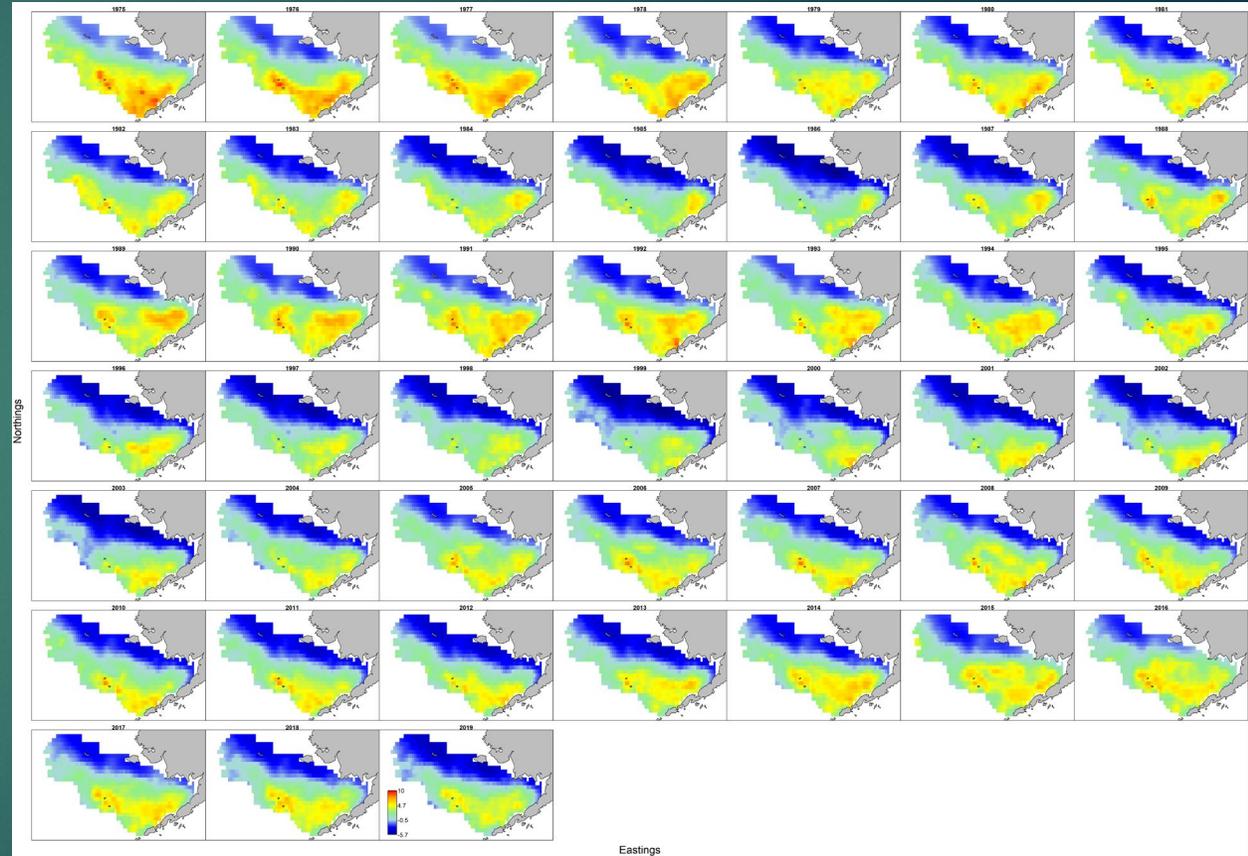


Density maps

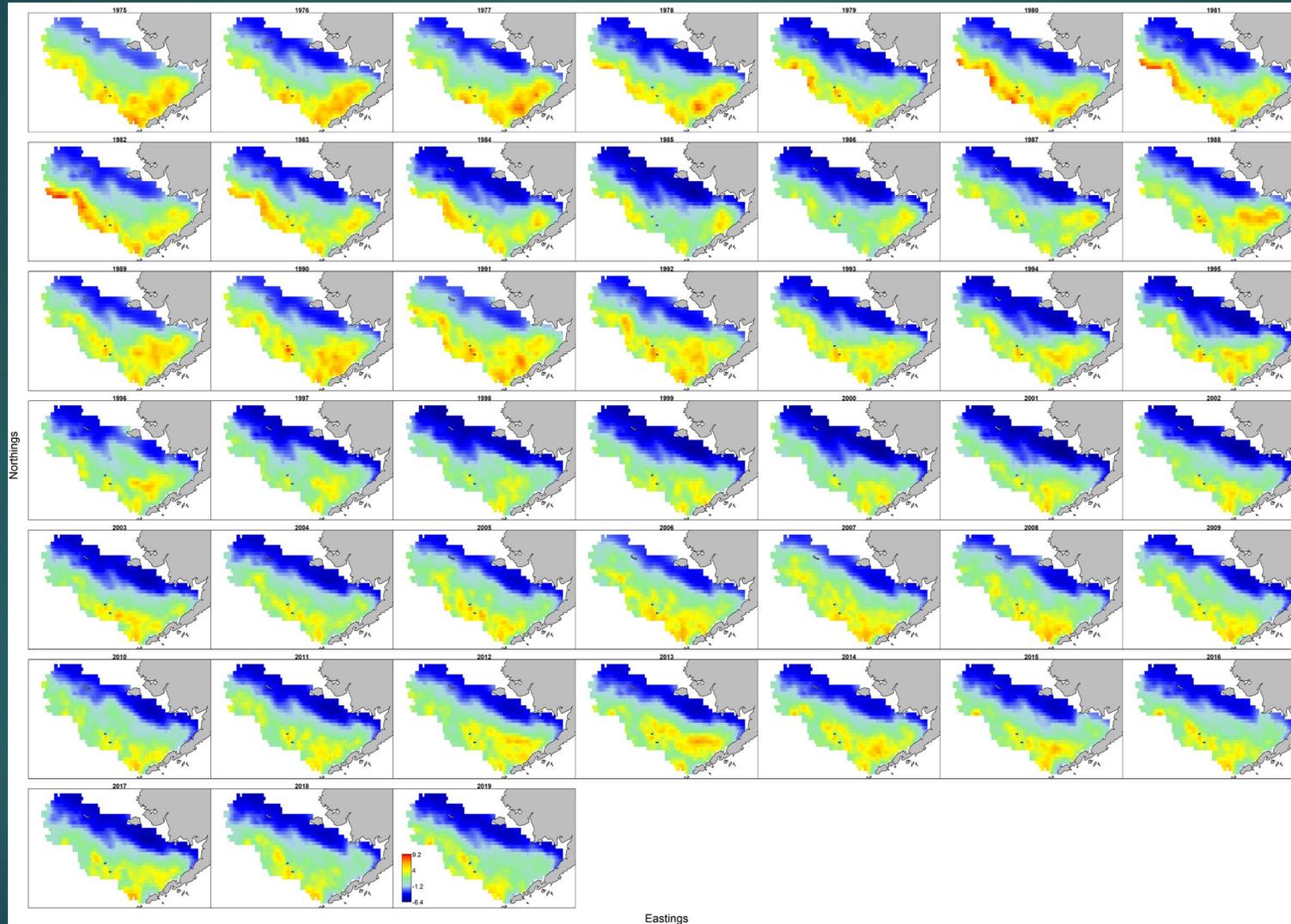
EBS- Total male



EBS -Male GE125



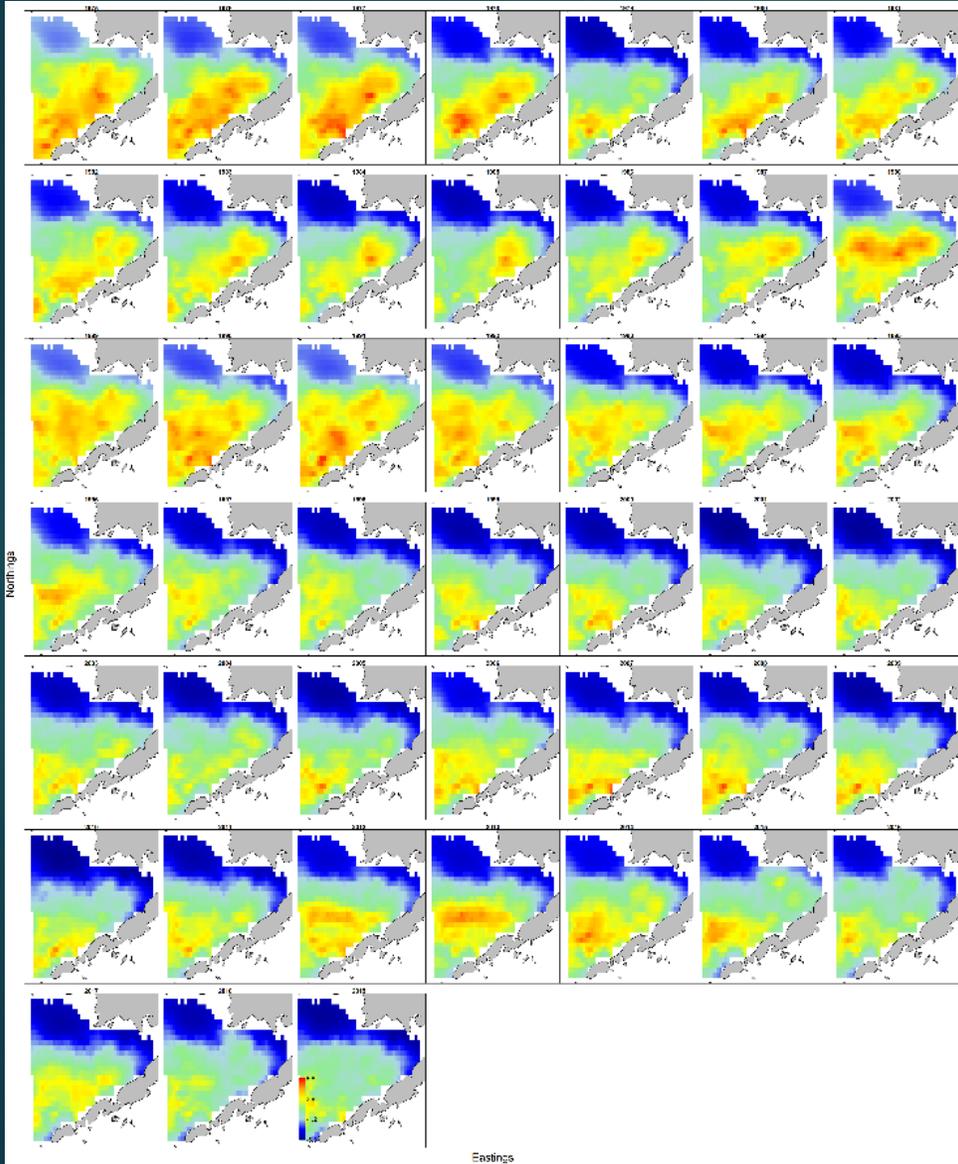
EBS- Mature female



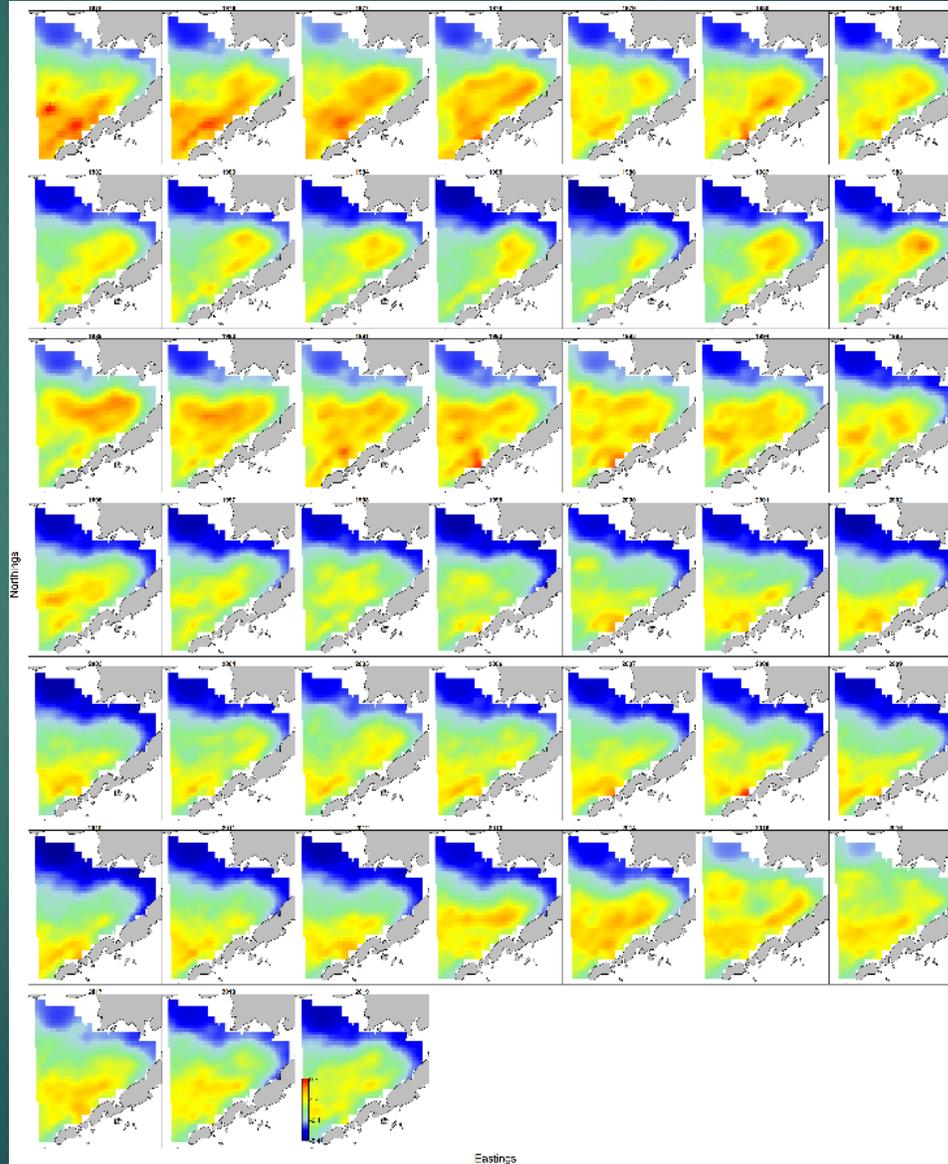
Easting



E166-mature female



E166-male GE125



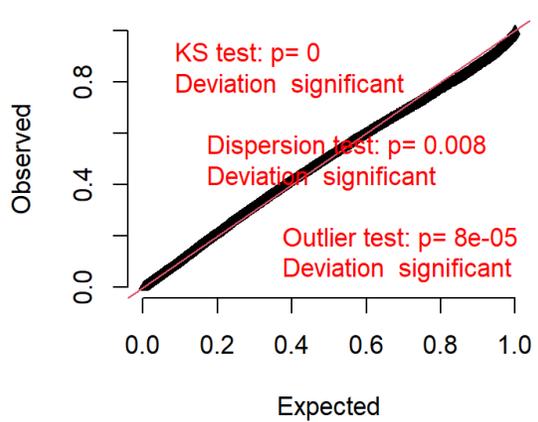
Quantile residuals - EBS

EBS Male GE125 biomass

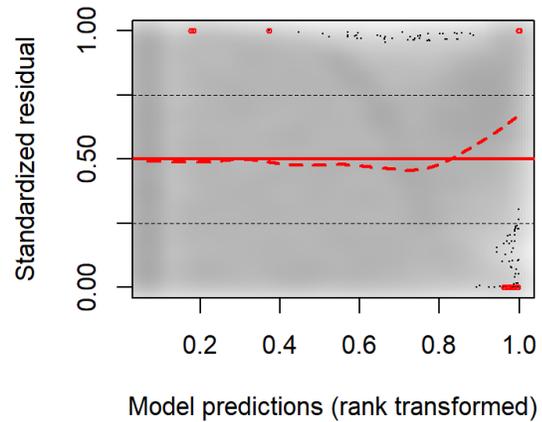
EBS Male total biomass

DHARMA residual diagnostics

QQ plot residuals

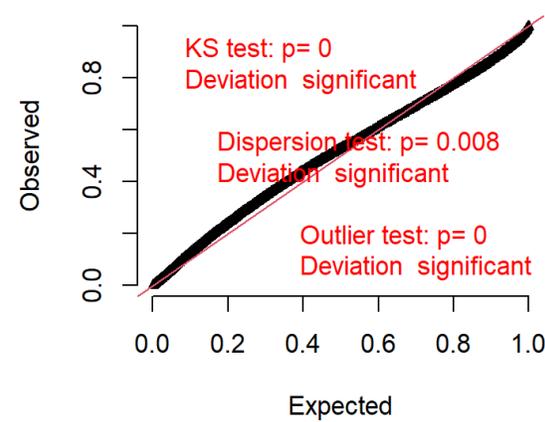


Residual vs. predicted

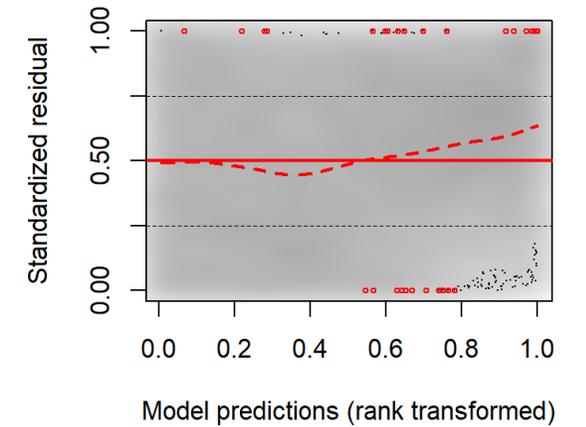


DHARMA residual diagnostics

QQ plot residuals

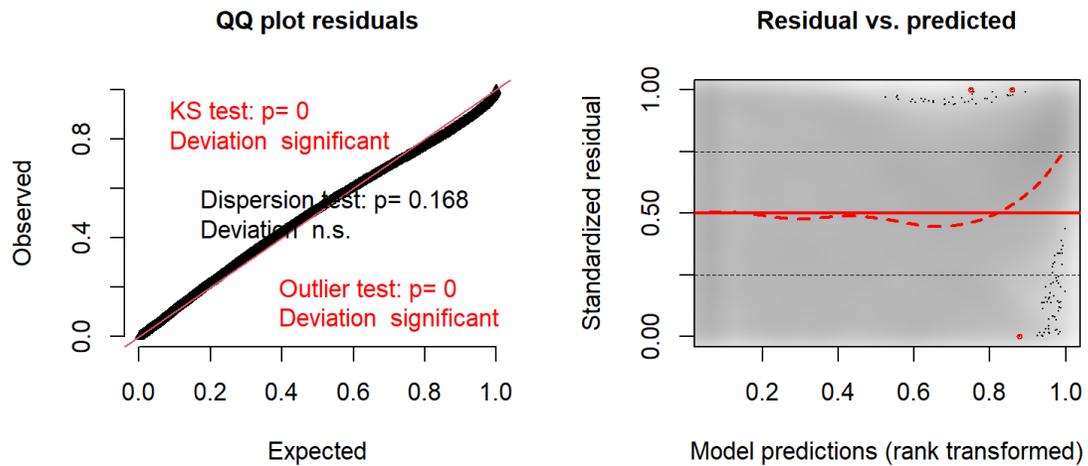


Residual vs. predicted



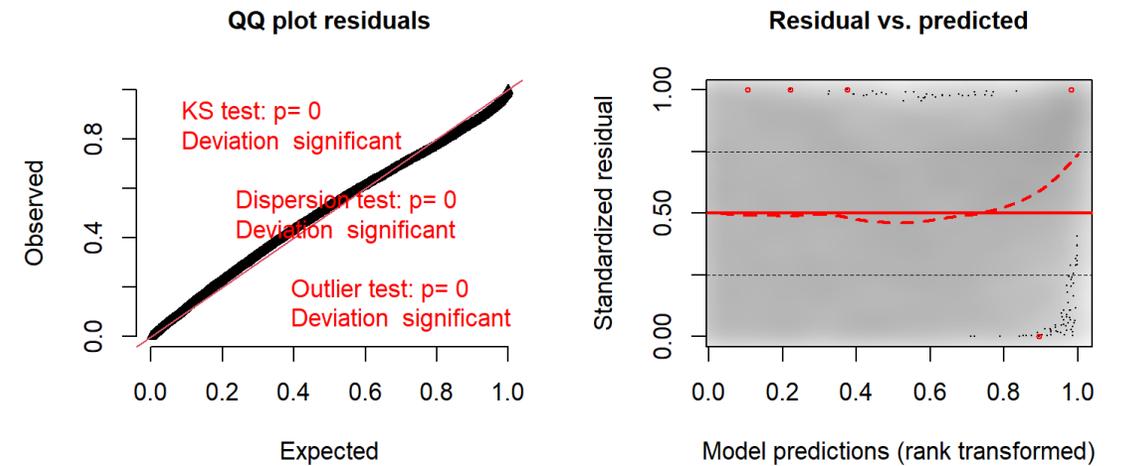
EBS mature female biomass

DHARMA residual diagnostics



EBS immature female biomass

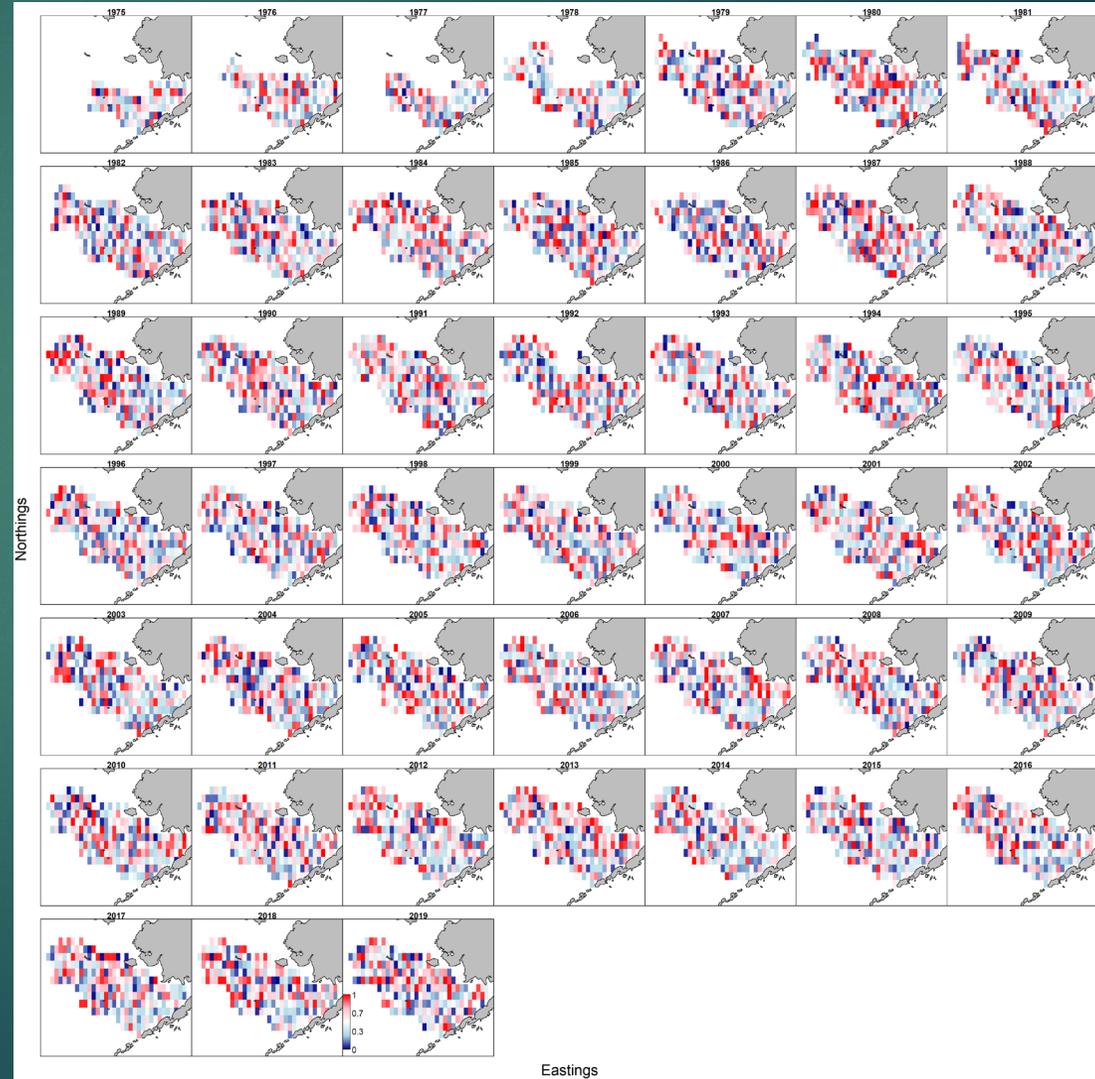
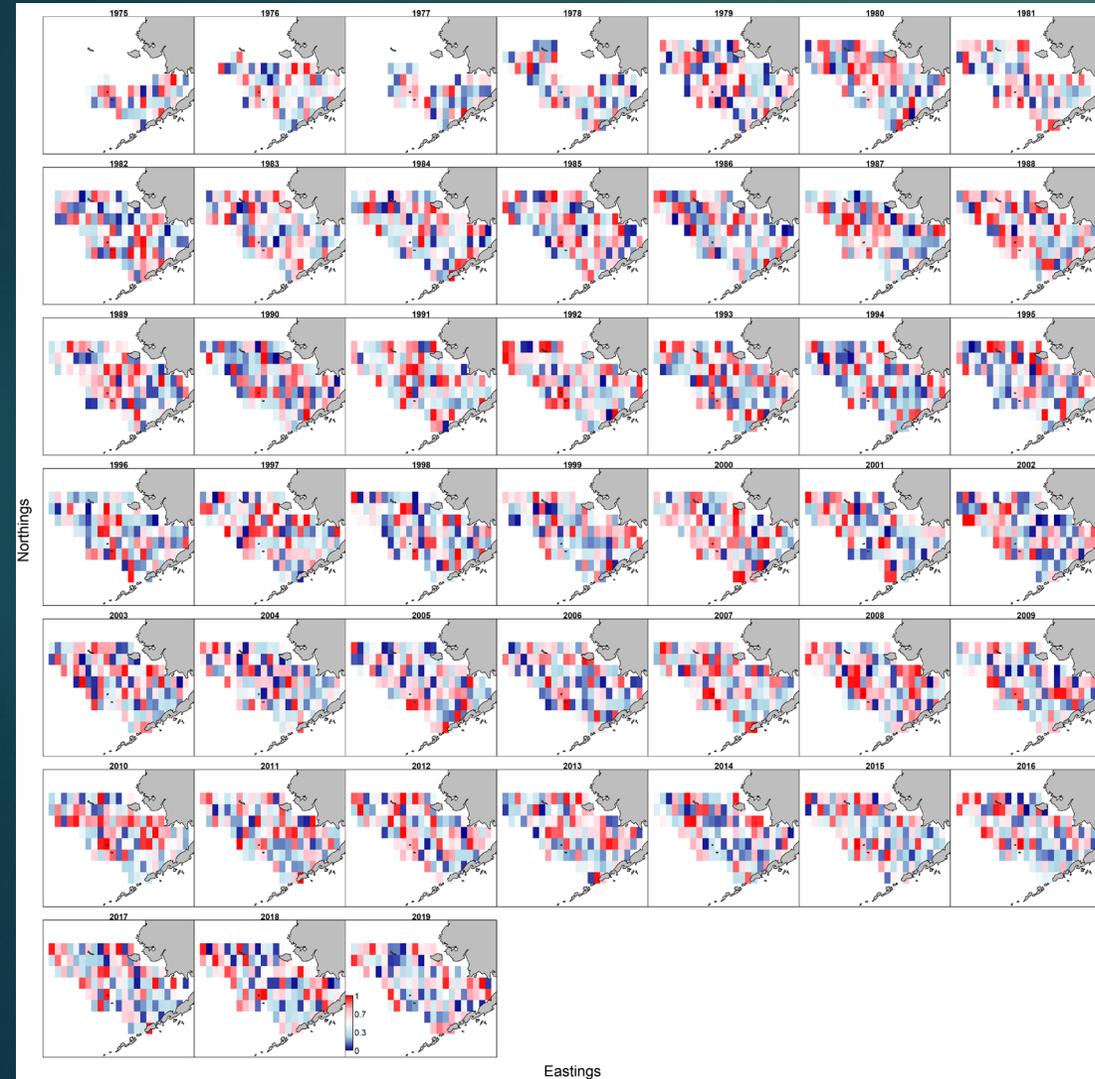
DHARMA residual diagnostics



Male GE125 spatial residuals

550 cells

1200 cells



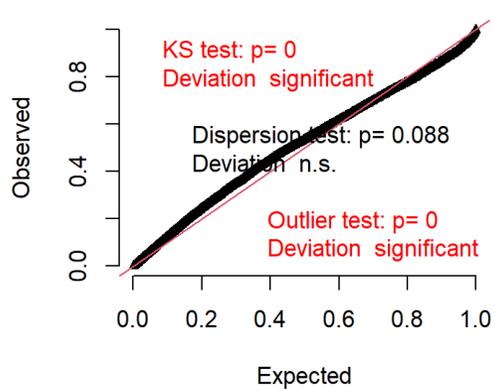
Quantile residuals – W166

W166 total male biomass

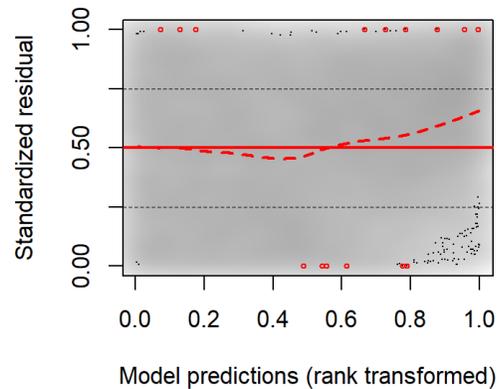
W166 mature female biomass

DHARMA residual diagnostics

QQ plot residuals

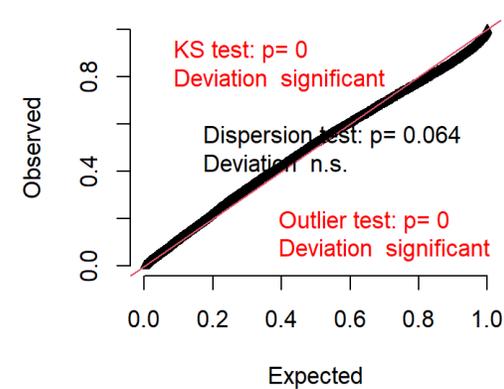


Residual vs. predicted

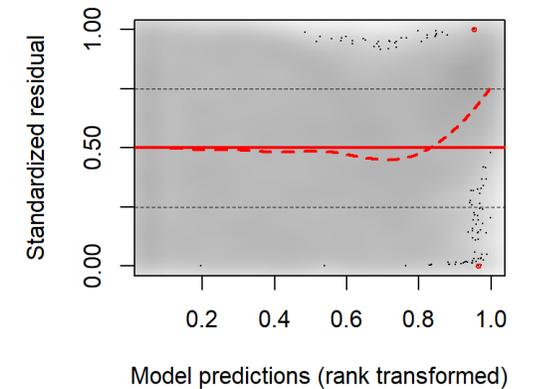


DHARMA residual diagnostics

QQ plot residuals



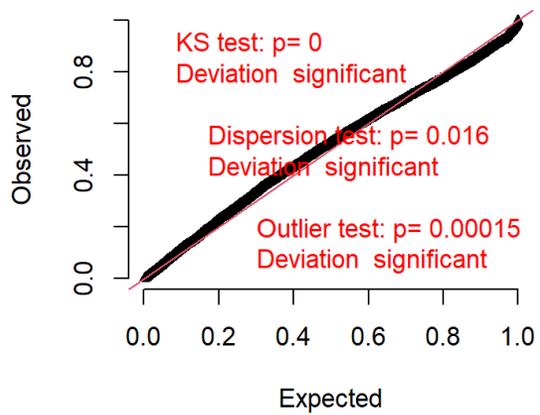
Residual vs. predicted



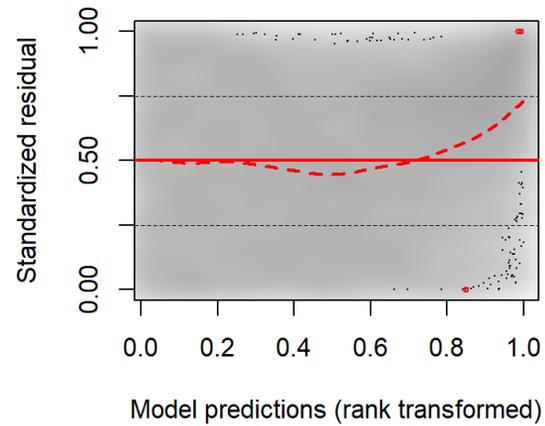
W166 immature female biomass

DHARMA residual diagnostics

QQ plot residuals



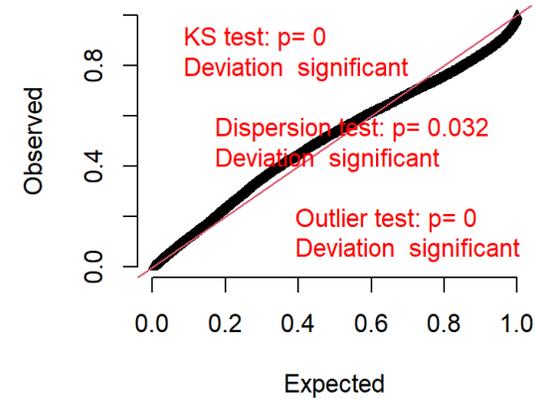
Residual vs. predicted



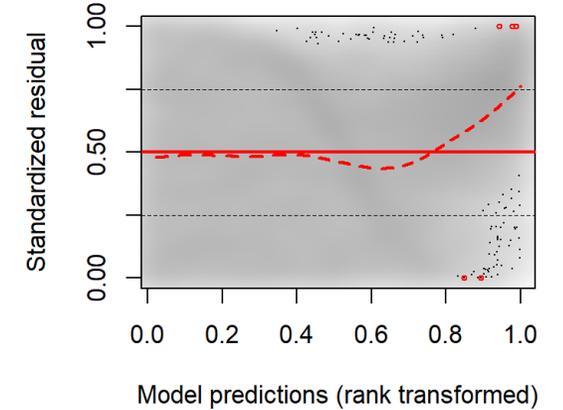
W166 immature female abundance

DHARMA residual diagnostics

QQ plot residuals



Residual vs. predicted

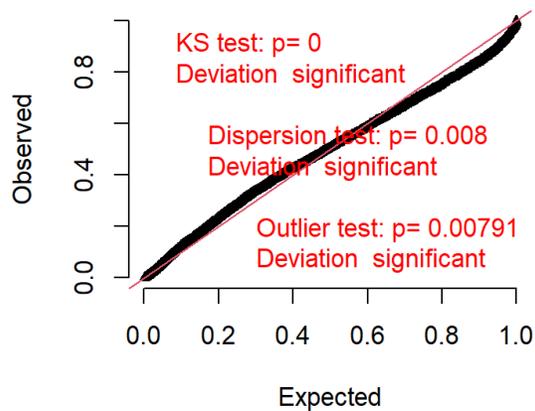


Quantile residuals – E166

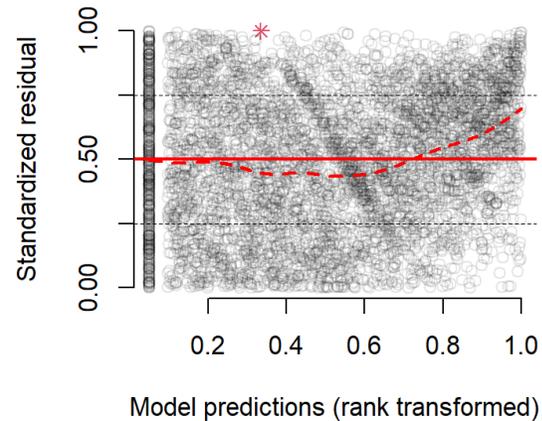
E166 male GE125 biomass

DHARMA residual diagnostics

QQ plot residuals



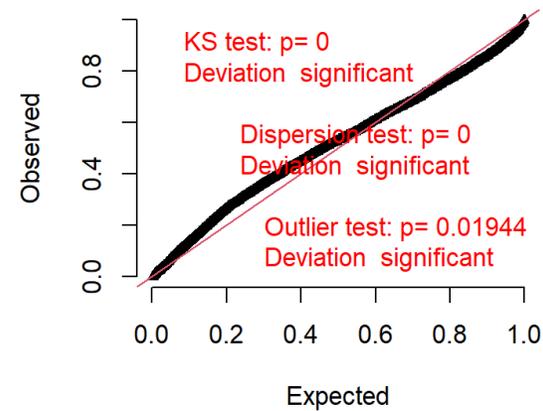
Residual vs. predicted



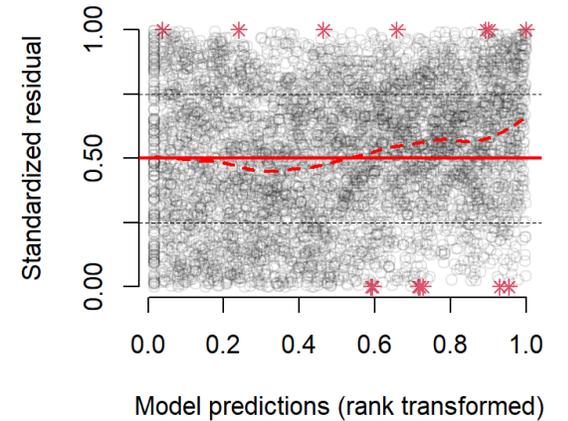
E166 total male biomass

DHARMA residual diagnostics

QQ plot residuals



Residual vs. predicted

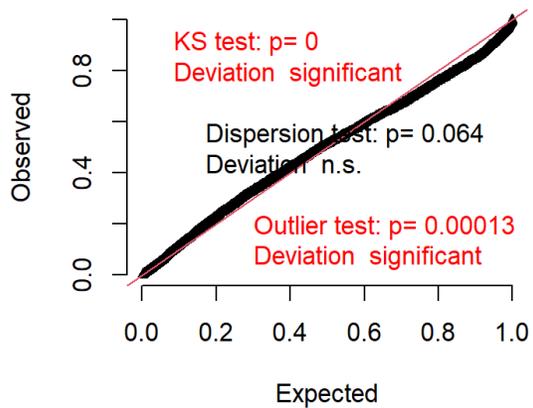


E166 mature female biomass

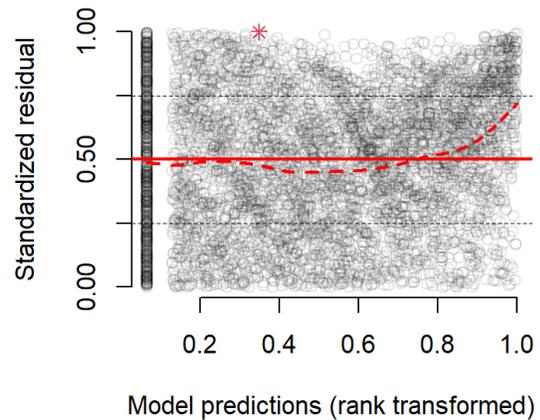
E166 immature female abundance

DHARMA residual diagnostics

QQ plot residuals

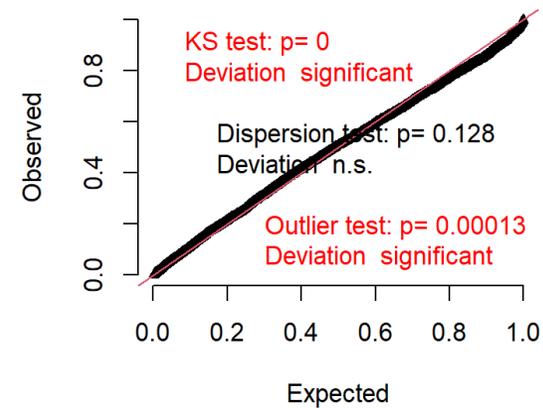


Residual vs. predicted

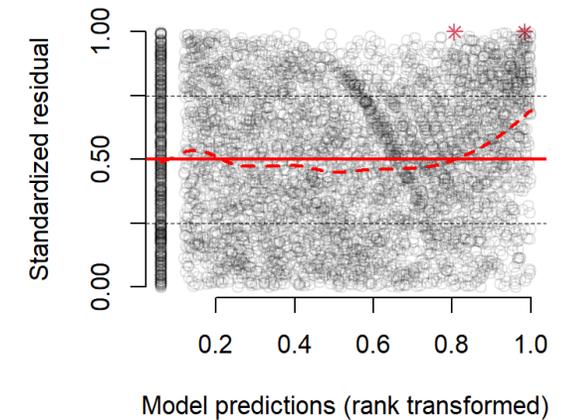


DHARMA residual diagnostics

QQ plot residuals



Residual vs. predicted



Bairdi summary

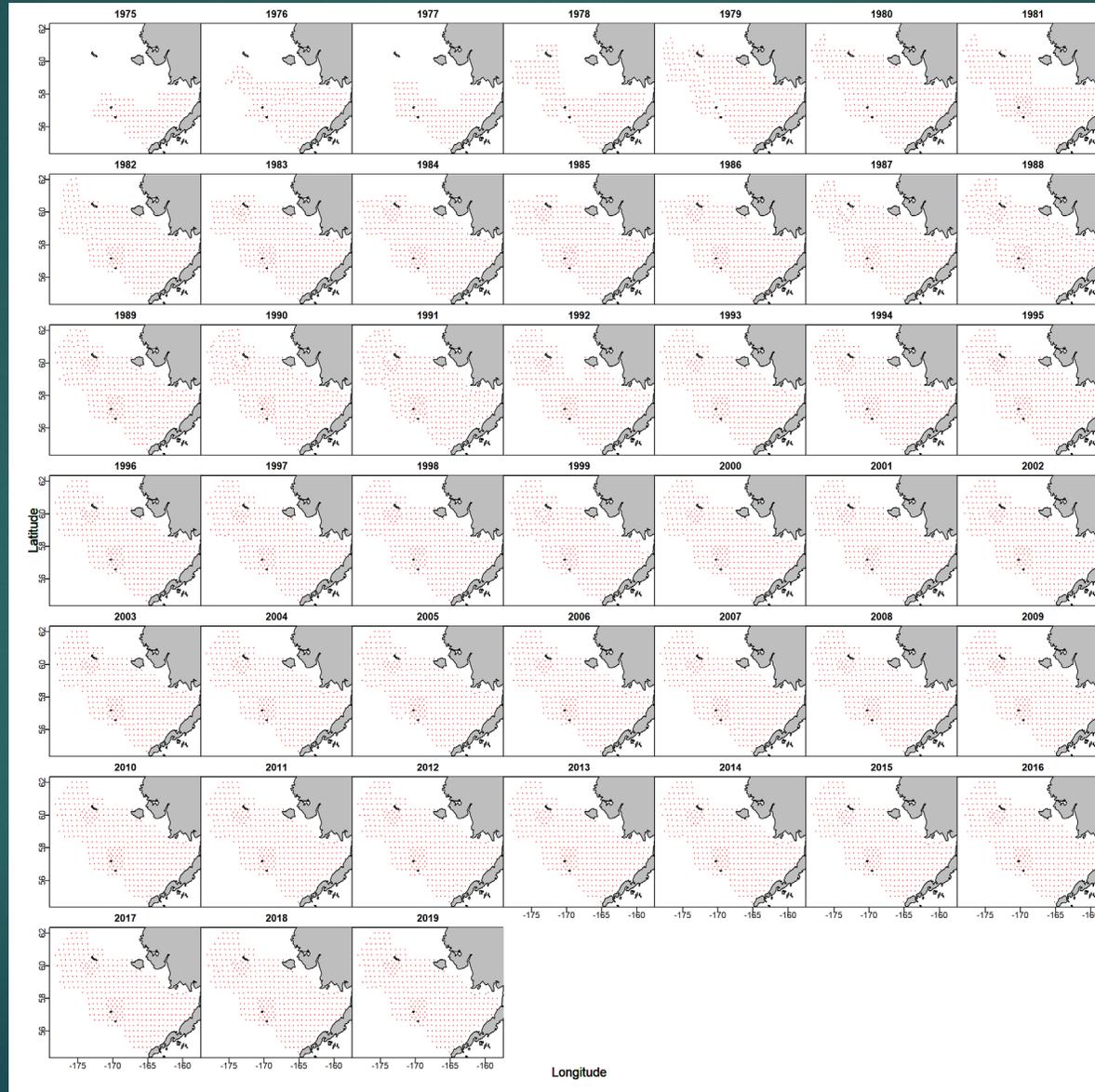
- ▶ Overall, diagnostics looked good
- ▶ DHARMA residual plots
 - ▶ Positive trends at highest observations/prediction
 - ▶ Model underestimating
- ▶ Some models problematic to fit
 - ▶ Eastern district females



EBS opilio

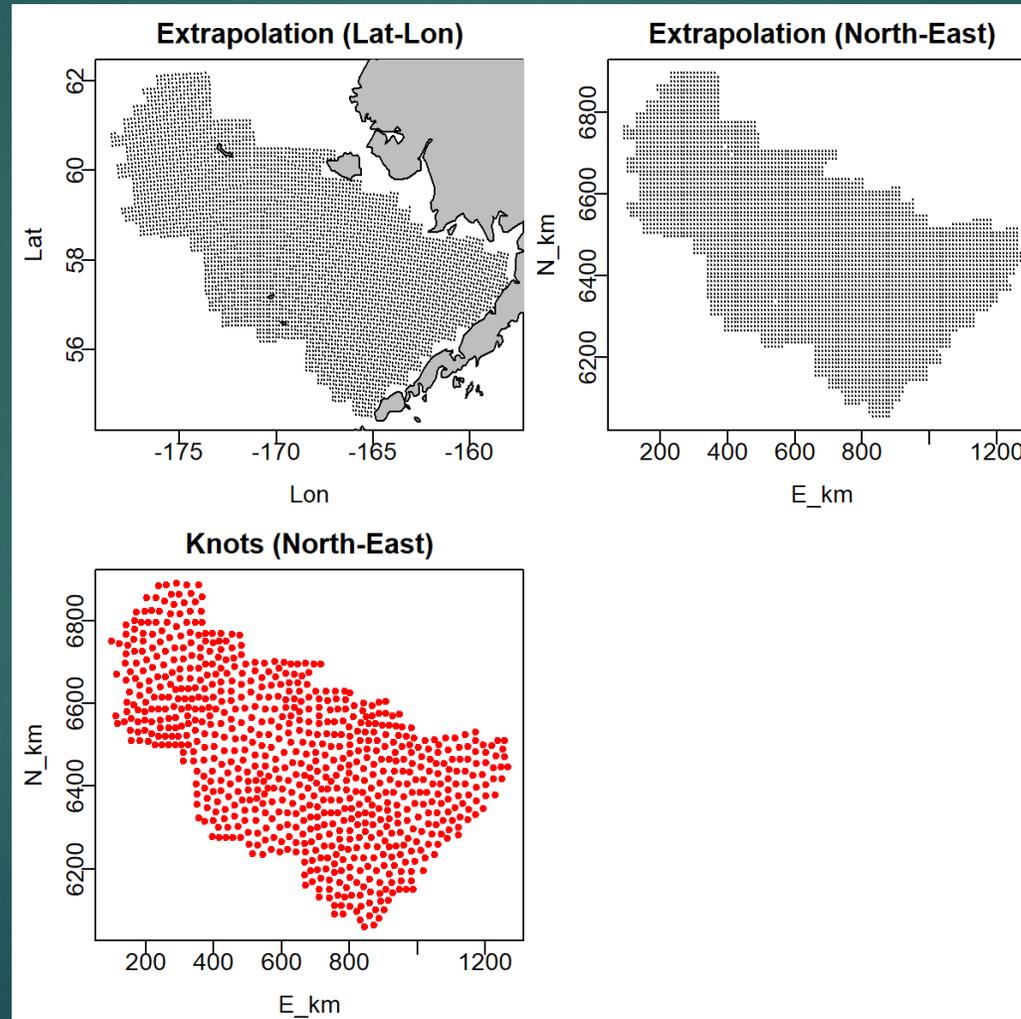


Data by year



Extrapolation area/knots

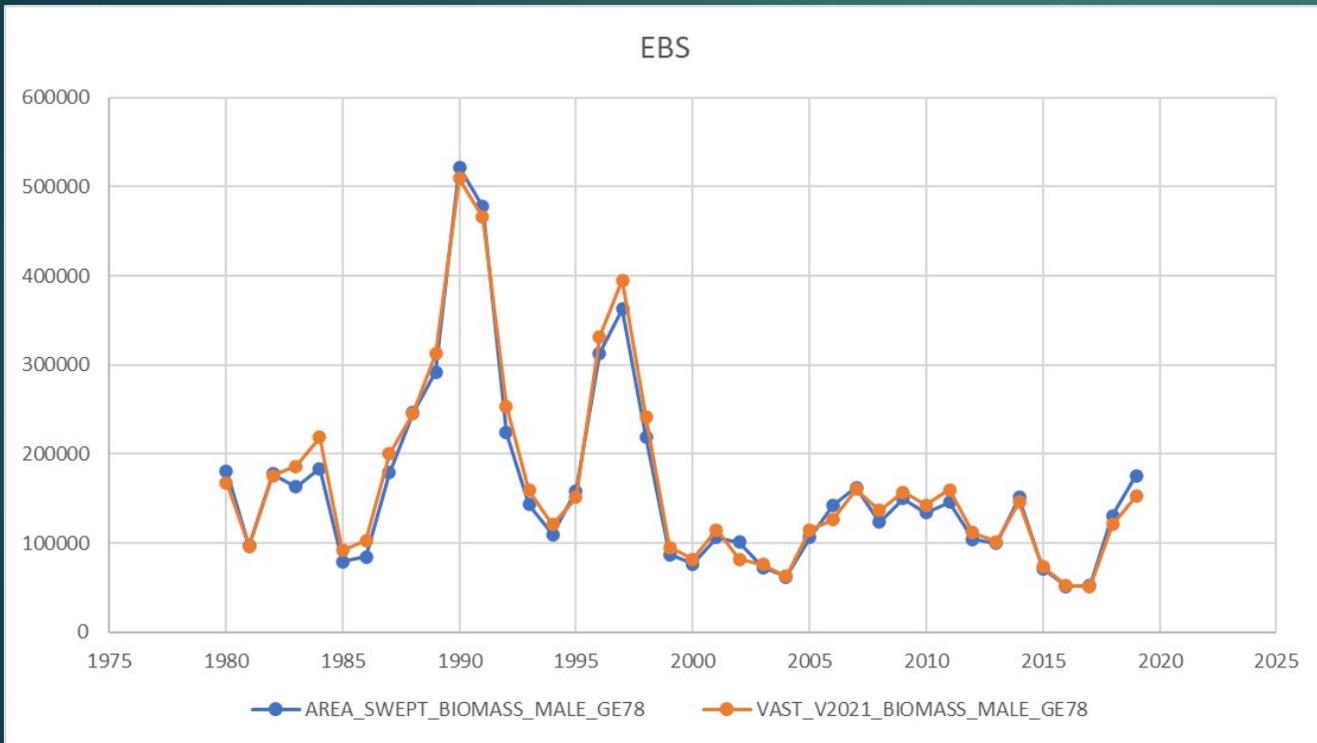
750 knots



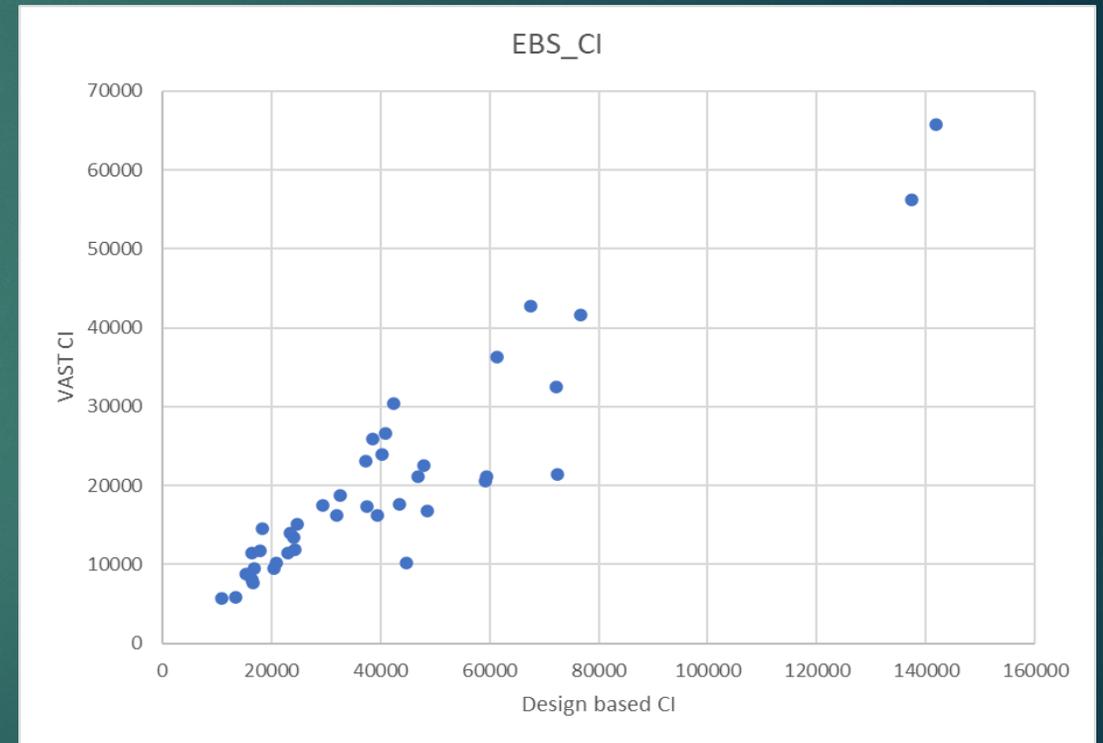
Biomass estimates



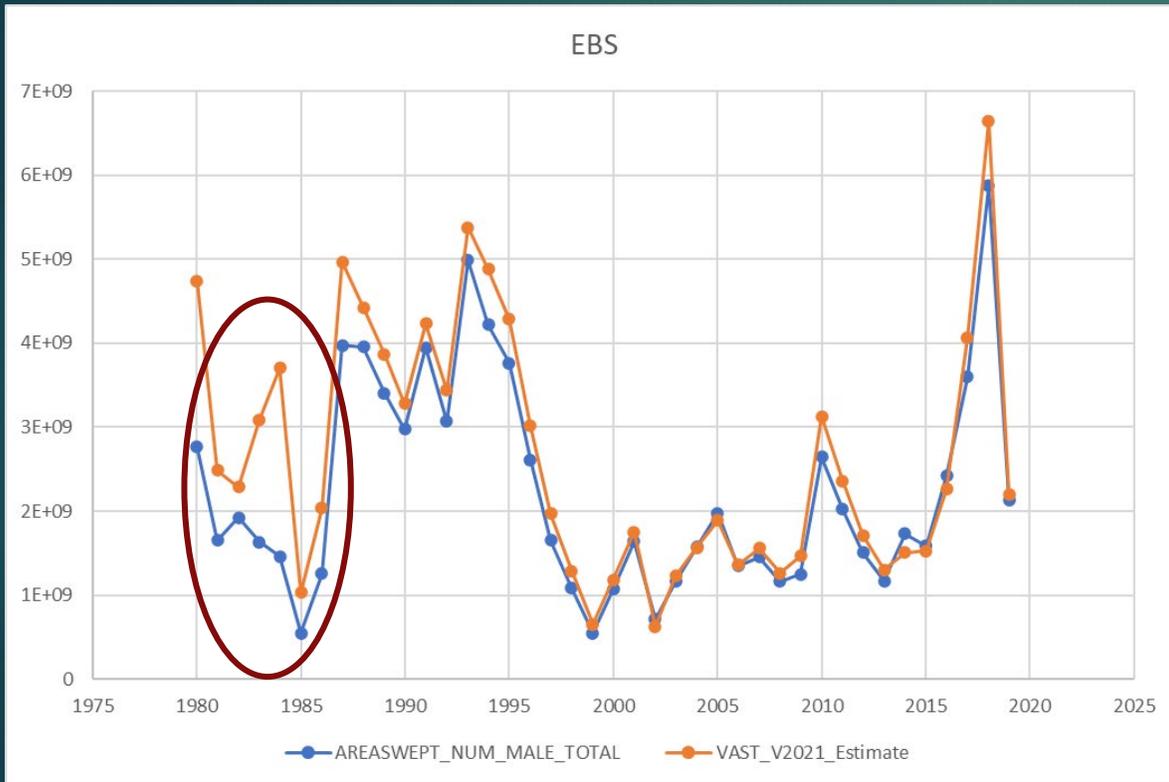
Legal male biomass



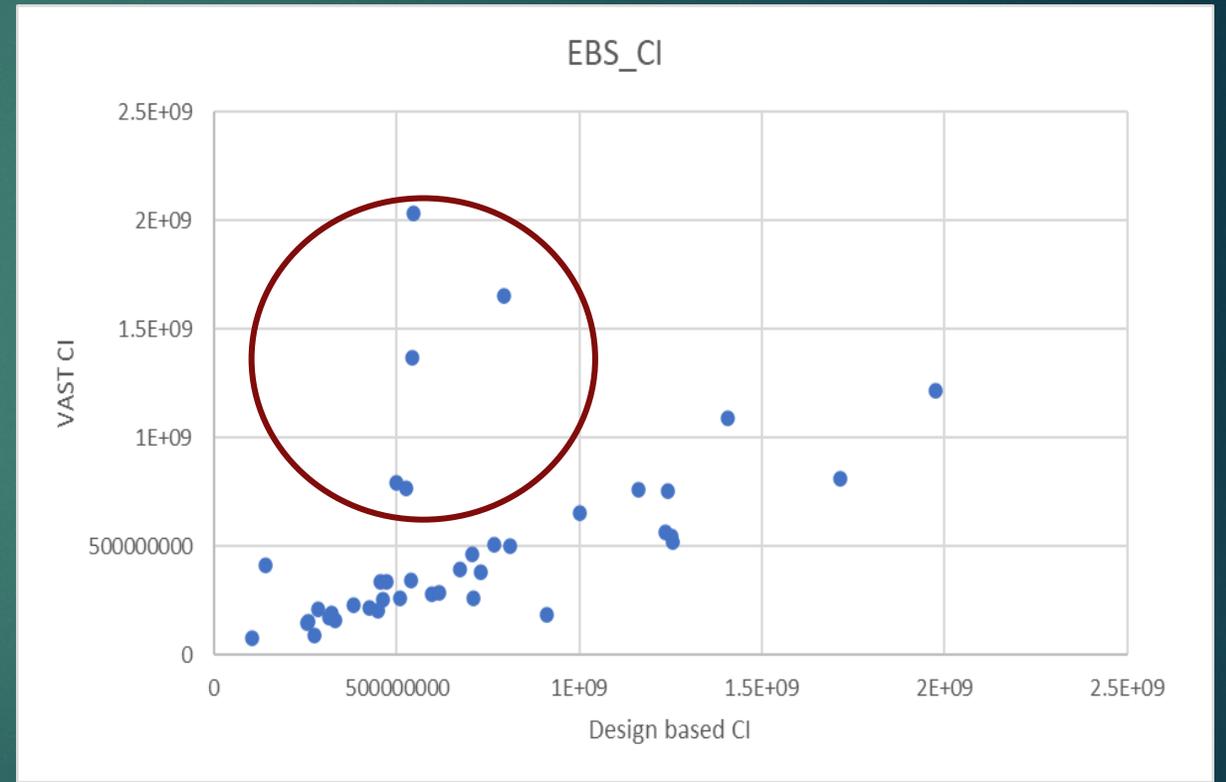
Legal male biomass CI



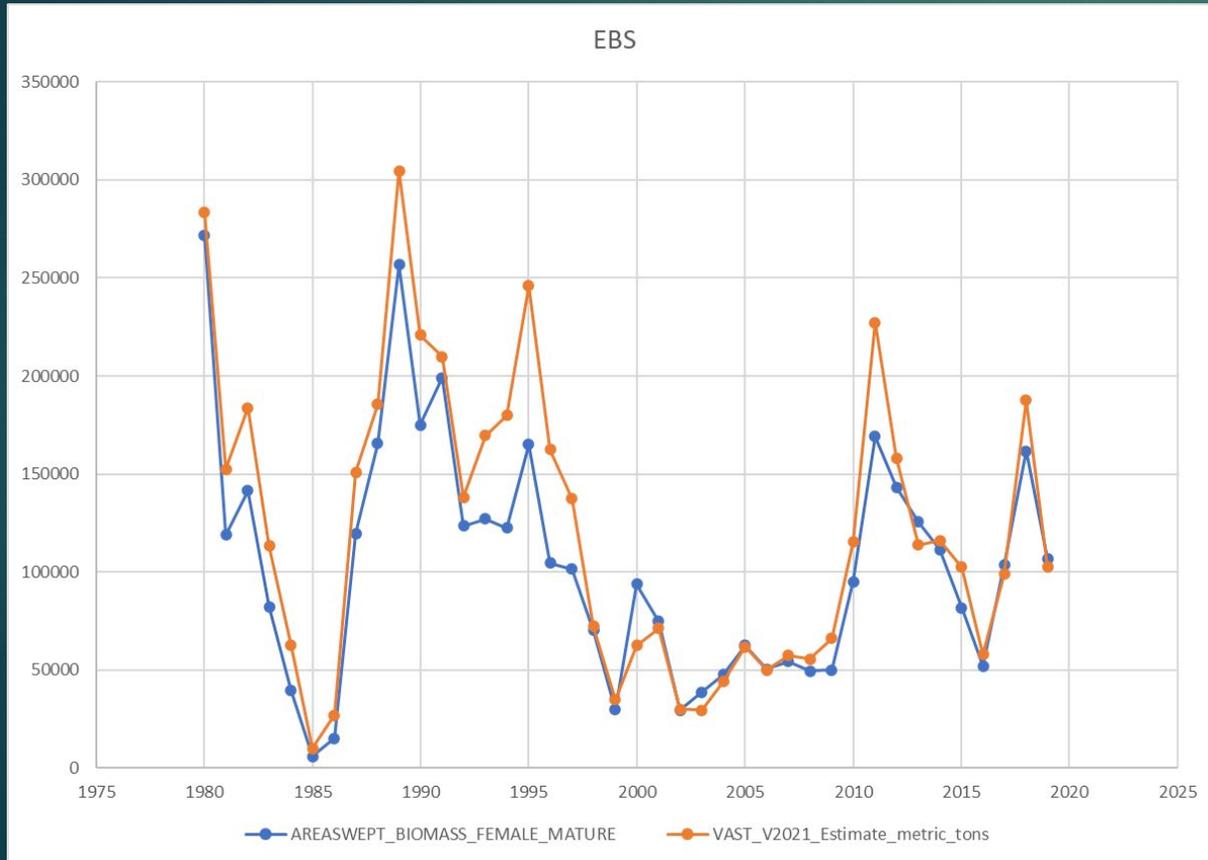
Total male abundance



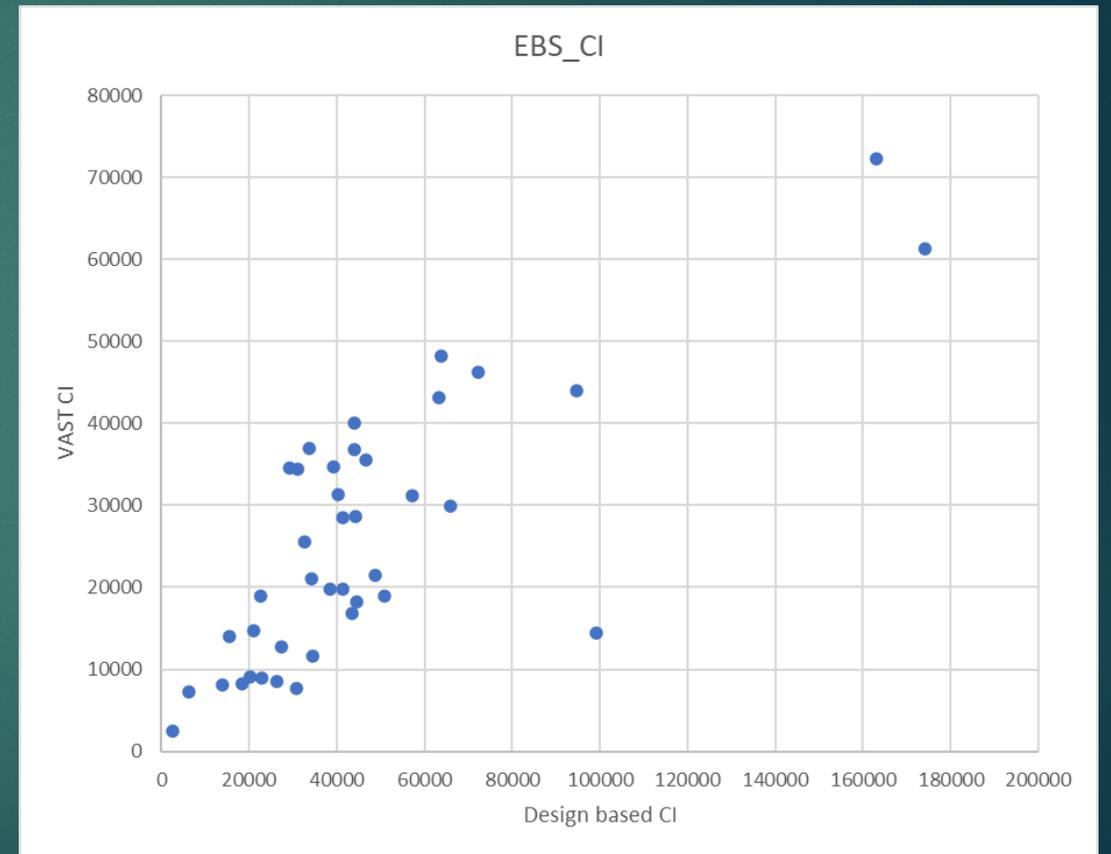
Total male abundance CI



Mature female biomass



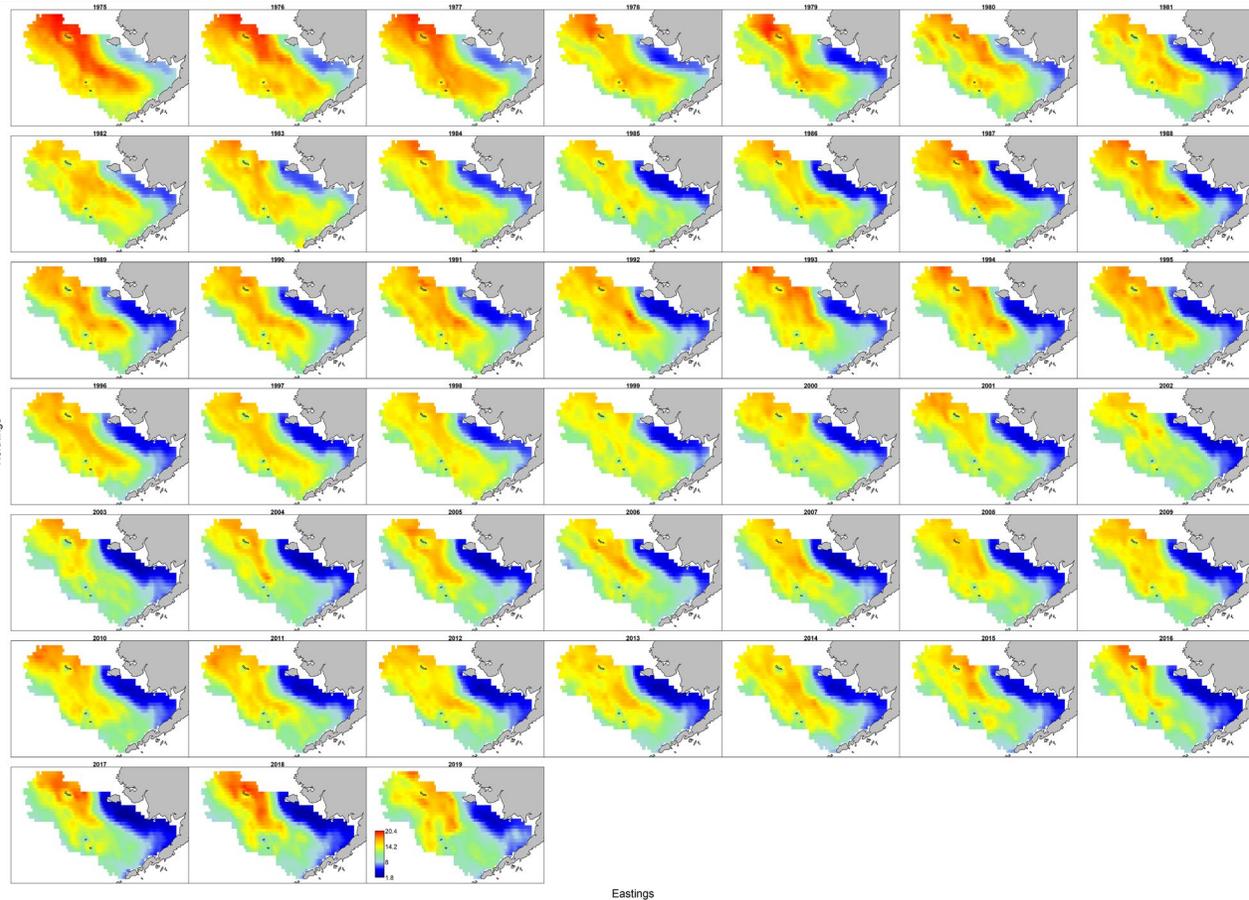
Mature female biomass CIs



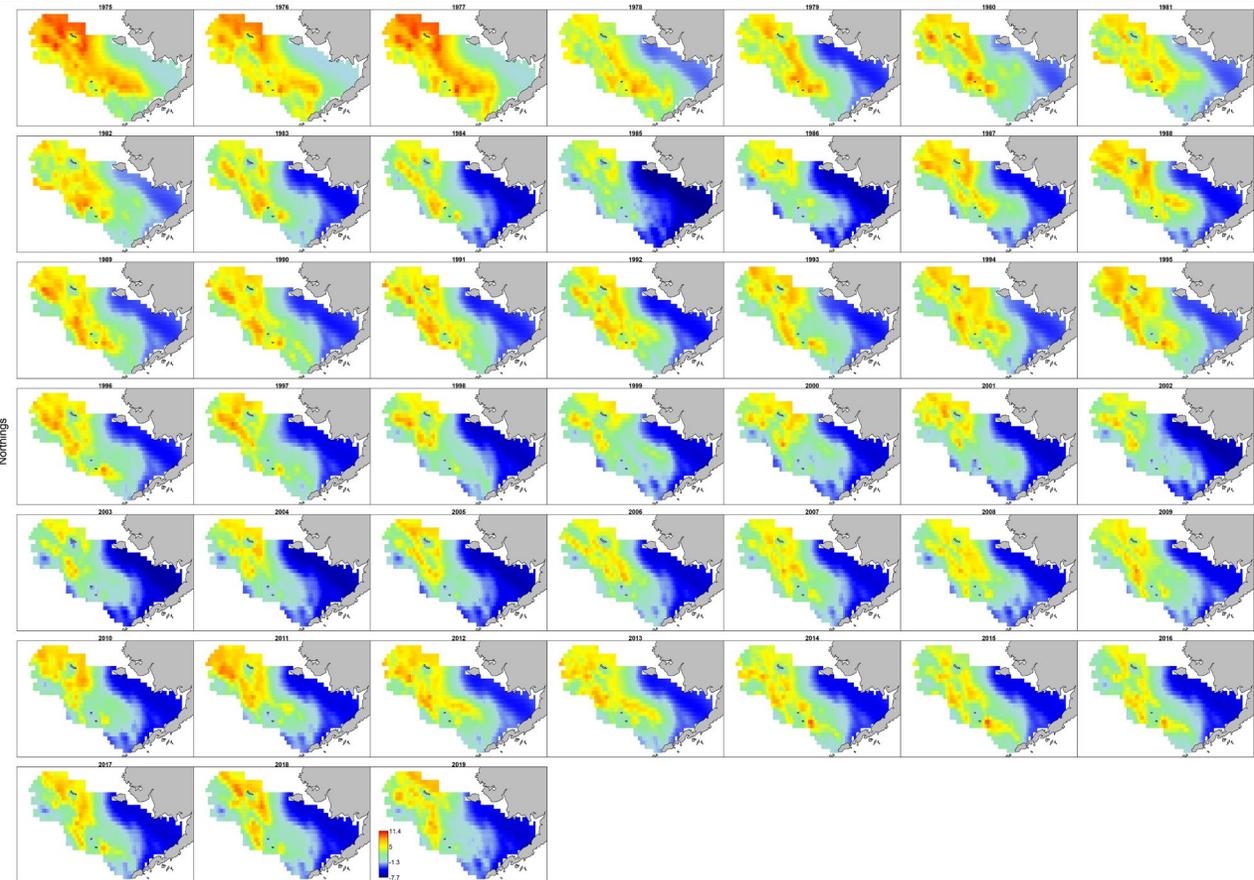
Density maps

Total male abundance

Mature female biomass



Eastings



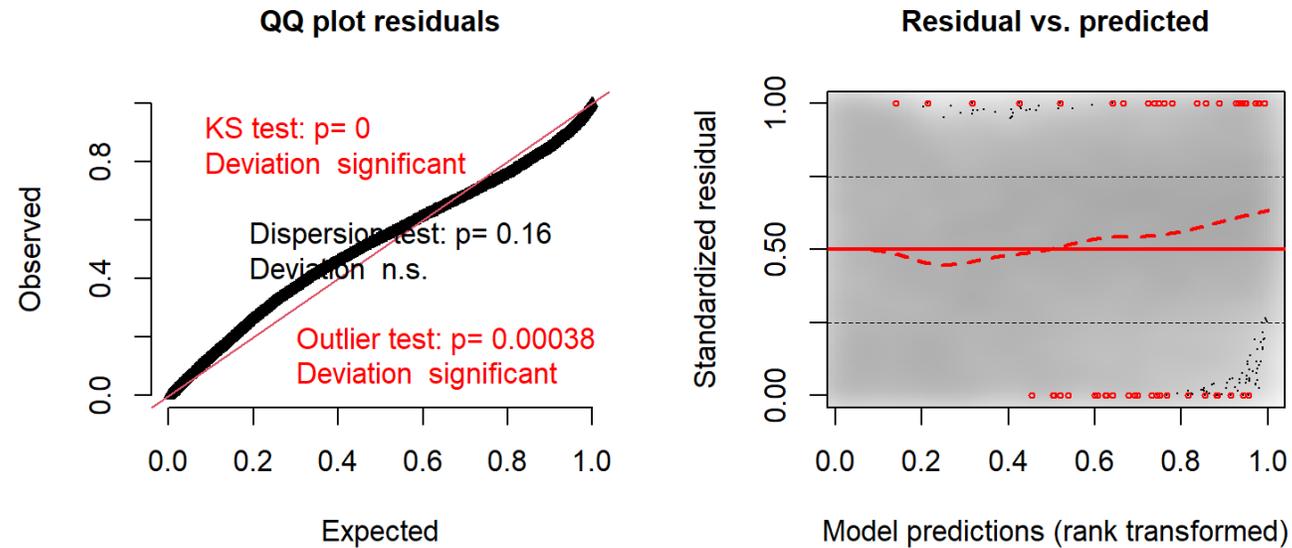
Eastings



Quantile residuals

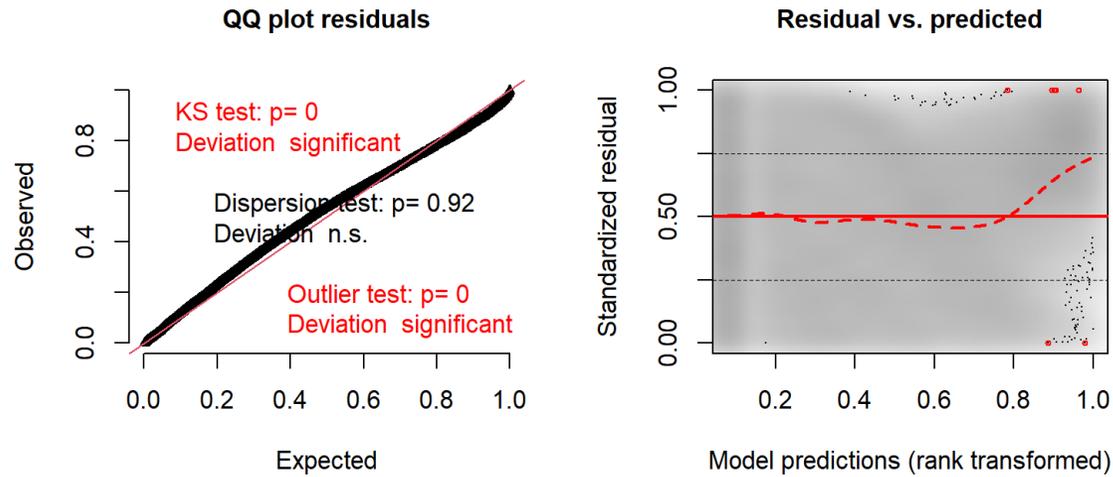
Total male abundance

DHARMA residual diagnostics



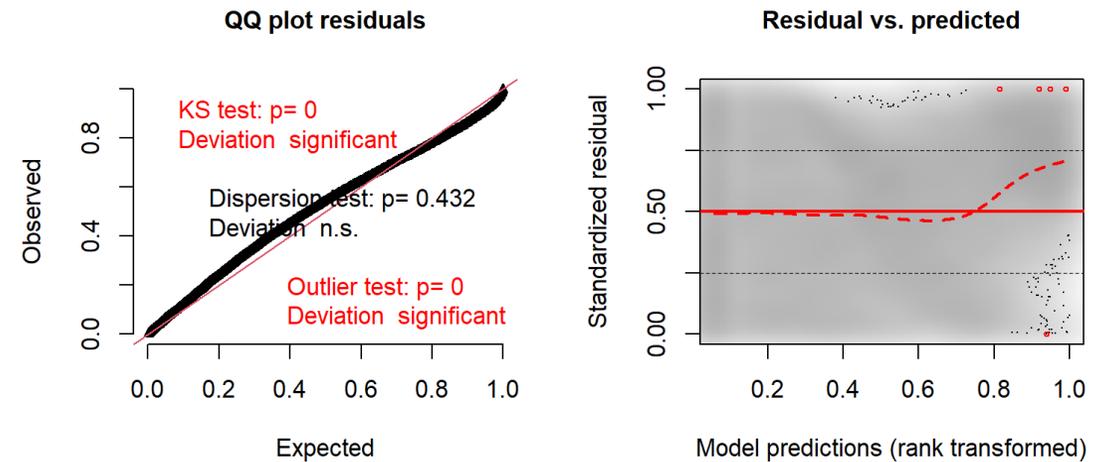
Mature female biomass

DHARMA residual diagnostics



Total female abundance

DHARMA residual diagnostics



Summary: opilio

- ▶ Diagnostics were more problematic
 - ▶ QQ plots: Heavy tails
 - ▶ As was case with Bairdi models trend in Residual vs. Predicted plots
 - ▶ Model underestimated at highest observations
- ▶ Males
 - ▶ Close correspondence between design and model based estimates
- ▶ Females
 - ▶ Less correspondence with design based



Item 8 overall summary

- ▶ VAST indices: generally similar (often very much so) trends to design-based, but much improved CIs
- ▶ Model run process took longer than expected
 - ▶ 10-day production period
- ▶ EBS Bairdi, and male/total BBRKC models performed best
- ▶ Eastern/Western Bairdi models temperamental, but decent diagnostics
- ▶ Opilio models performed well, but diagnostics marginally worse than bairdi



Questions?

