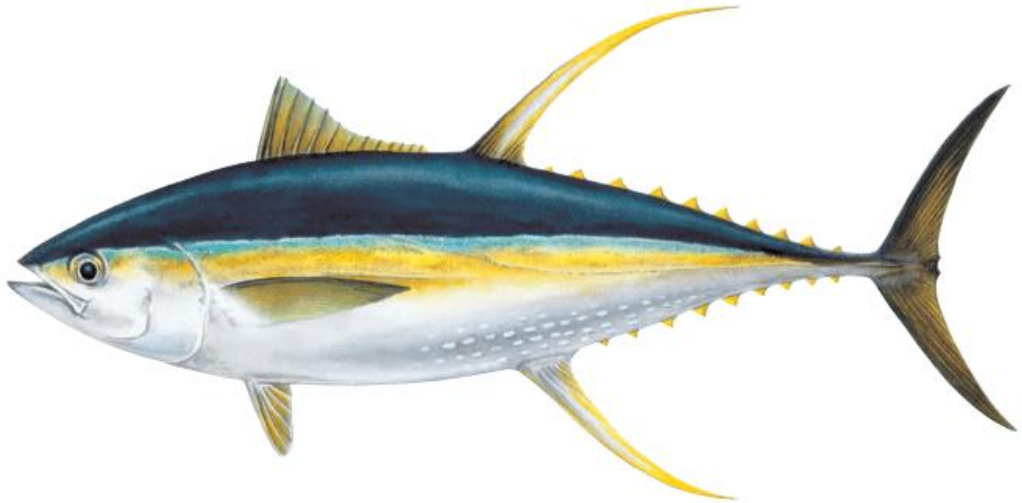
Pacific Community
Communauté du Pacifique

Model Development and Initial Results for Yellowfin Tuna

P14 – Arni Magnusson



Catch Conditioning and Hessian

Initial model development conducted so far has revolved mainly around two important technical improvements that have been encouraged at previous PAW and SC meetings:

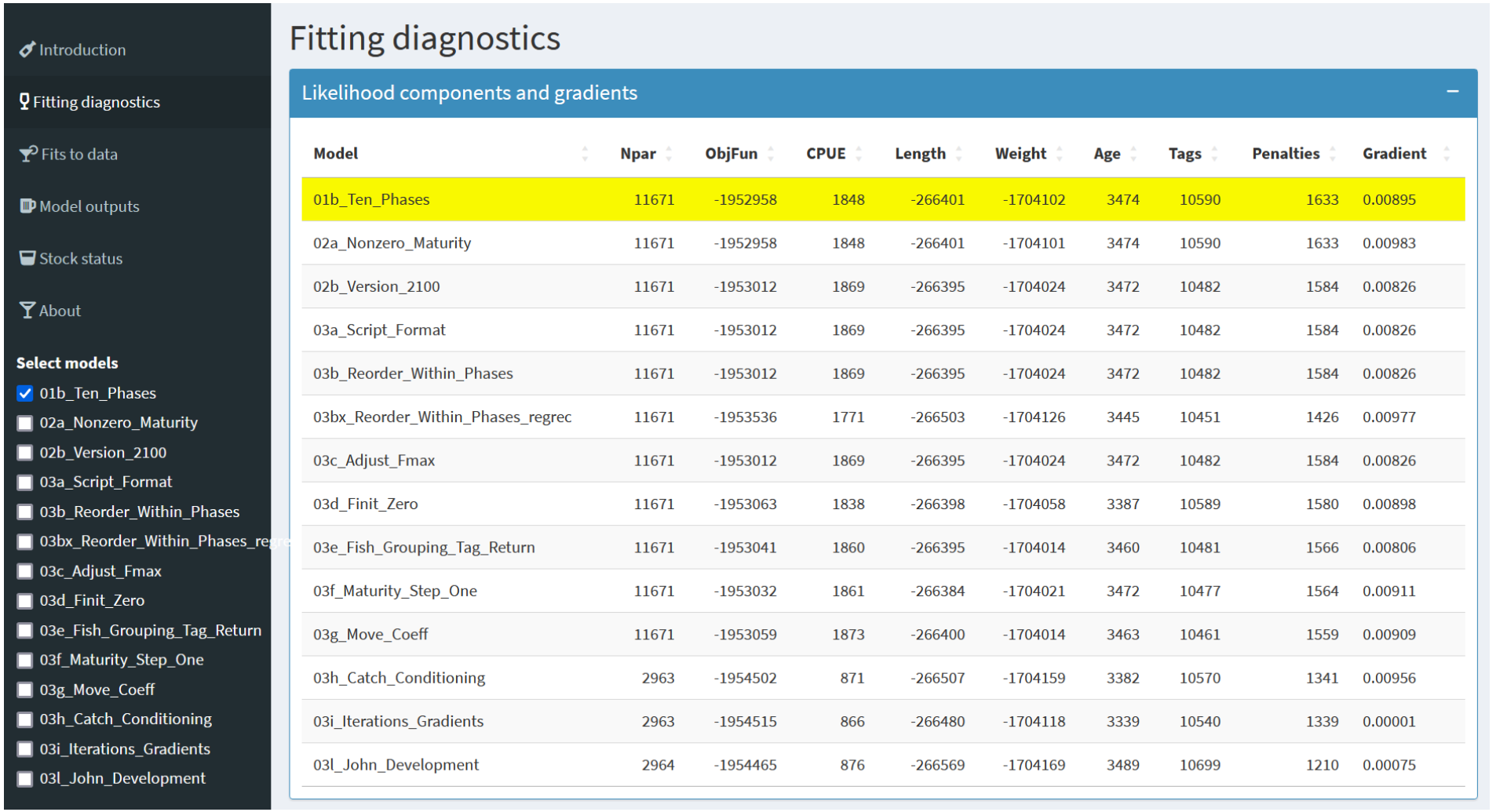
- Catch conditioning and survey index likelihood for CPUE
- Application of techniques that can help achieve a positive definite Hessian convergence

Catch Conditioning and Hessian

The 2022 SKJ assessment implemented catch conditioning and during follow-up work after that assessment, John Hampton achieved a positive definite Hessian convergence for newly developed SKJ model runs

Following these successes, he has made similar improvements to exploratory BET and YFT runs

Shiny Demo



Model	Npar	ObjFun	CPUE	Length	Weight	Age	Tags	Penalties	Gradient
01b_Ten_Phases	11671	-1952958	1848	-266401	-1704102	3474	10590	1633	0.00895
02a_Nonzero_Maturity	11671	-1952958	1848	-266401	-1704101	3474	10590	1633	0.00983
02b_Version_2100	11671	-1953012	1869	-266395	-1704024	3472	10482	1584	0.00826
03a_Script_Format	11671	-1953012	1869	-266395	-1704024	3472	10482	1584	0.00826
03b_Reorder_Within_Phases	11671	-1953012	1869	-266395	-1704024	3472	10482	1584	0.00826
03bx_Reorder_Within_Phases_regrec	11671	-1953536	1771	-266503	-1704126	3445	10451	1426	0.00977
03c_Adjust_Fmax	11671	-1953012	1869	-266395	-1704024	3472	10482	1584	0.00826
03d_Finit_Zero	11671	-1953063	1838	-266398	-1704058	3387	10589	1580	0.00898
03e_Fish_Grouping_Tag_Return	11671	-1953041	1860	-266395	-1704014	3460	10481	1566	0.00806
03f_Maturity_Step_One	11671	-1953032	1861	-266384	-1704021	3472	10477	1564	0.00911
03g_Move_Coeff	11671	-1953059	1873	-266400	-1704014	3463	10461	1559	0.00909
03h_Catch_Conditioning	2963	-1954502	871	-266507	-1704159	3382	10570	1341	0.00956
03i_Iterations_Gradients	2963	-1954515	866	-266480	-1704118	3339	10540	1339	0.00001
03l_John_Development	2964	-1954465	876	-266569	-1704169	3489	10699	1210	0.00075

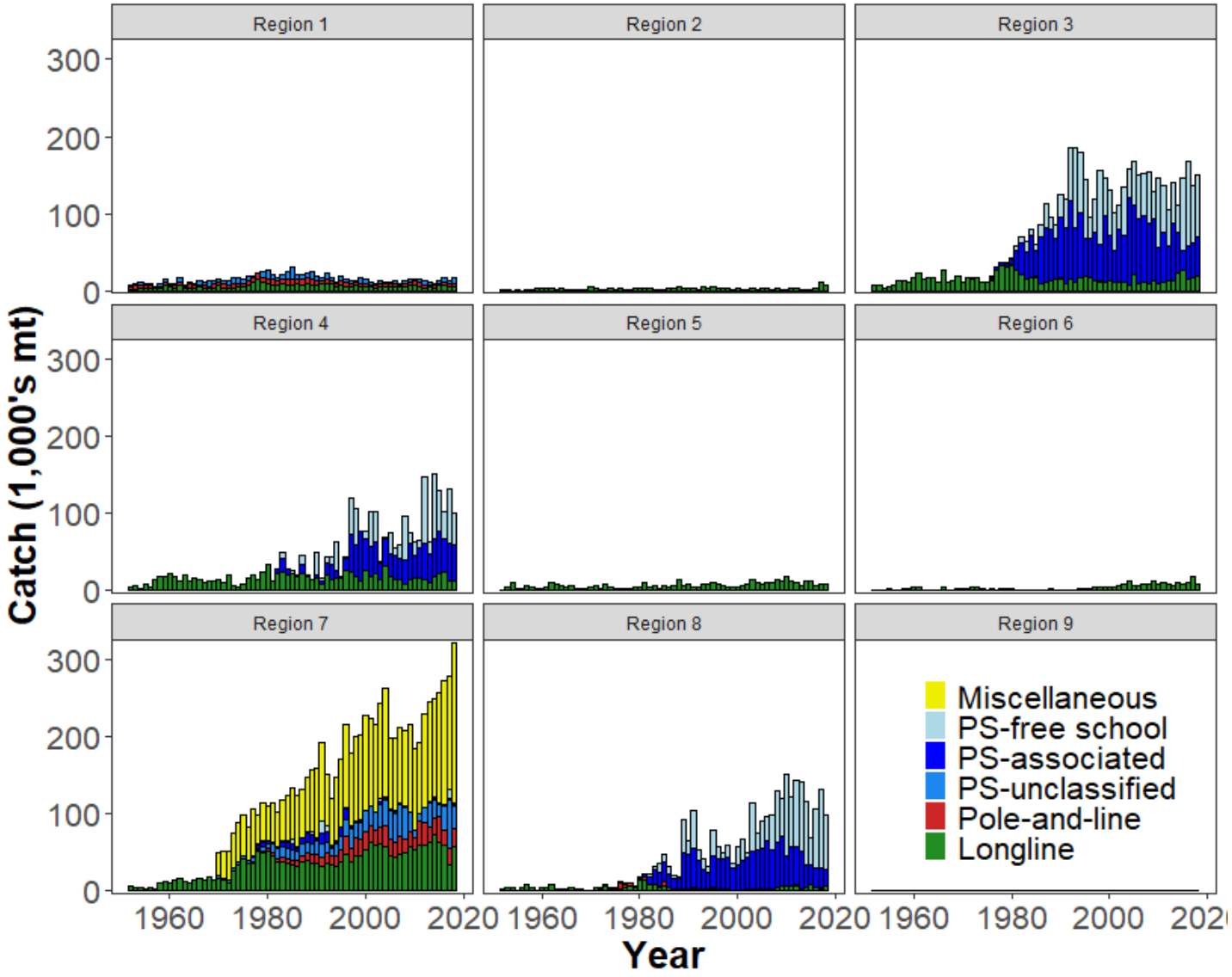
Two Focus Topics

We have compiled recommendations provided by the Peer Review panel (Punt et al. 2023), the previous stock assessor (Vincent et al. 2020, Section 8.4), along with PAW and SC feedback, which have guided our internal discussions and exploratory analyses

So far, the SAM team has prioritized two focus topics for the YFT 2023 assessment that have formed a broad theme for the ongoing analyses presented at our weekly technical meetings:

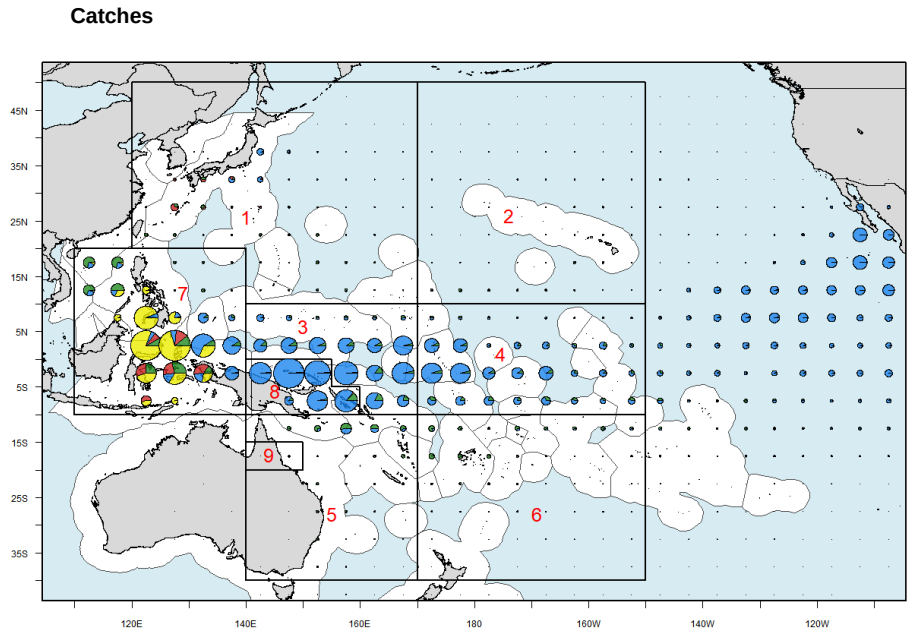
1. Regional scaling
2. Spatial structure

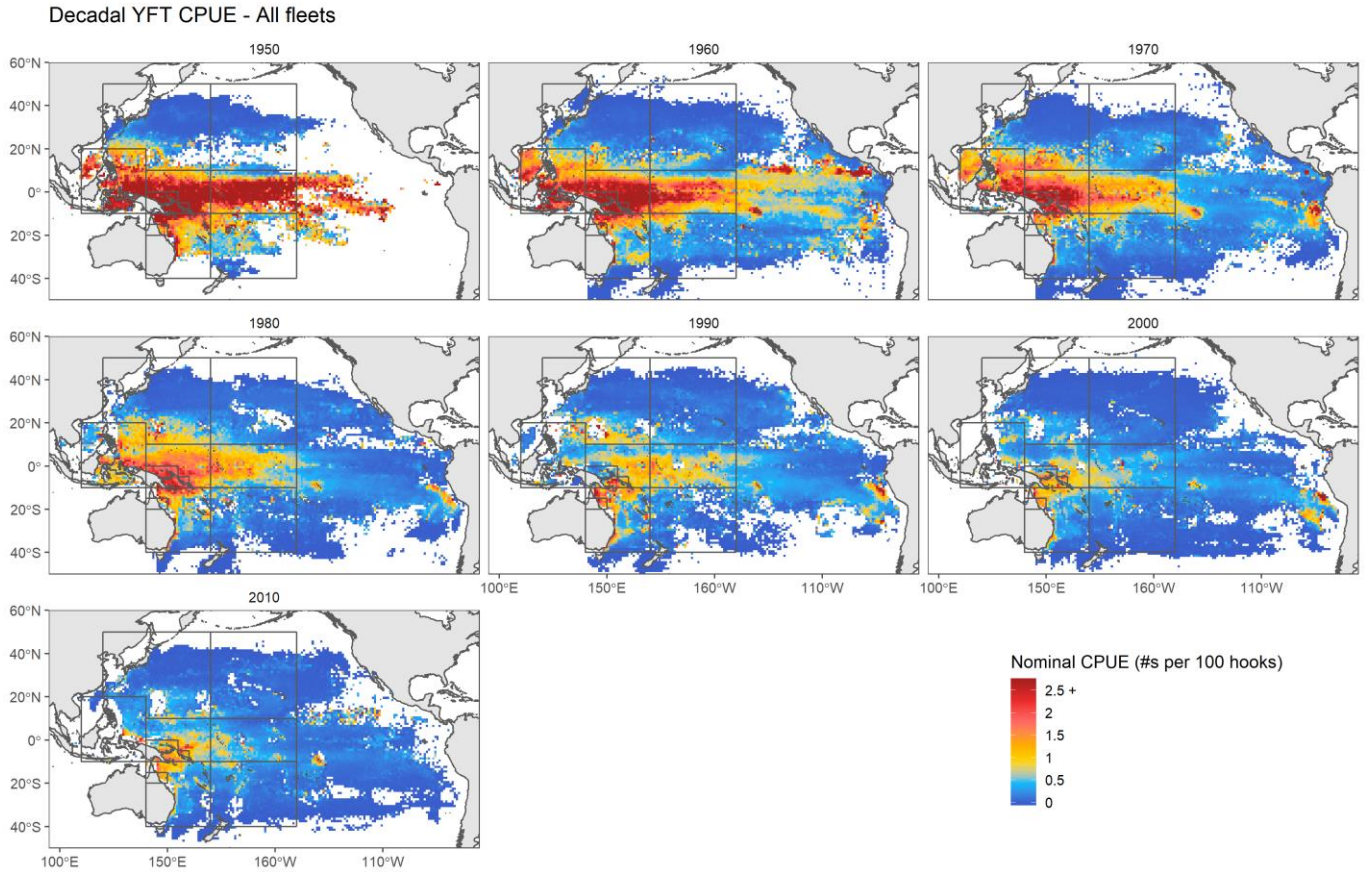
Regional Scaling



The vast majority of catches are caught in the Equatorial regions (3, 4, 7, and 8)

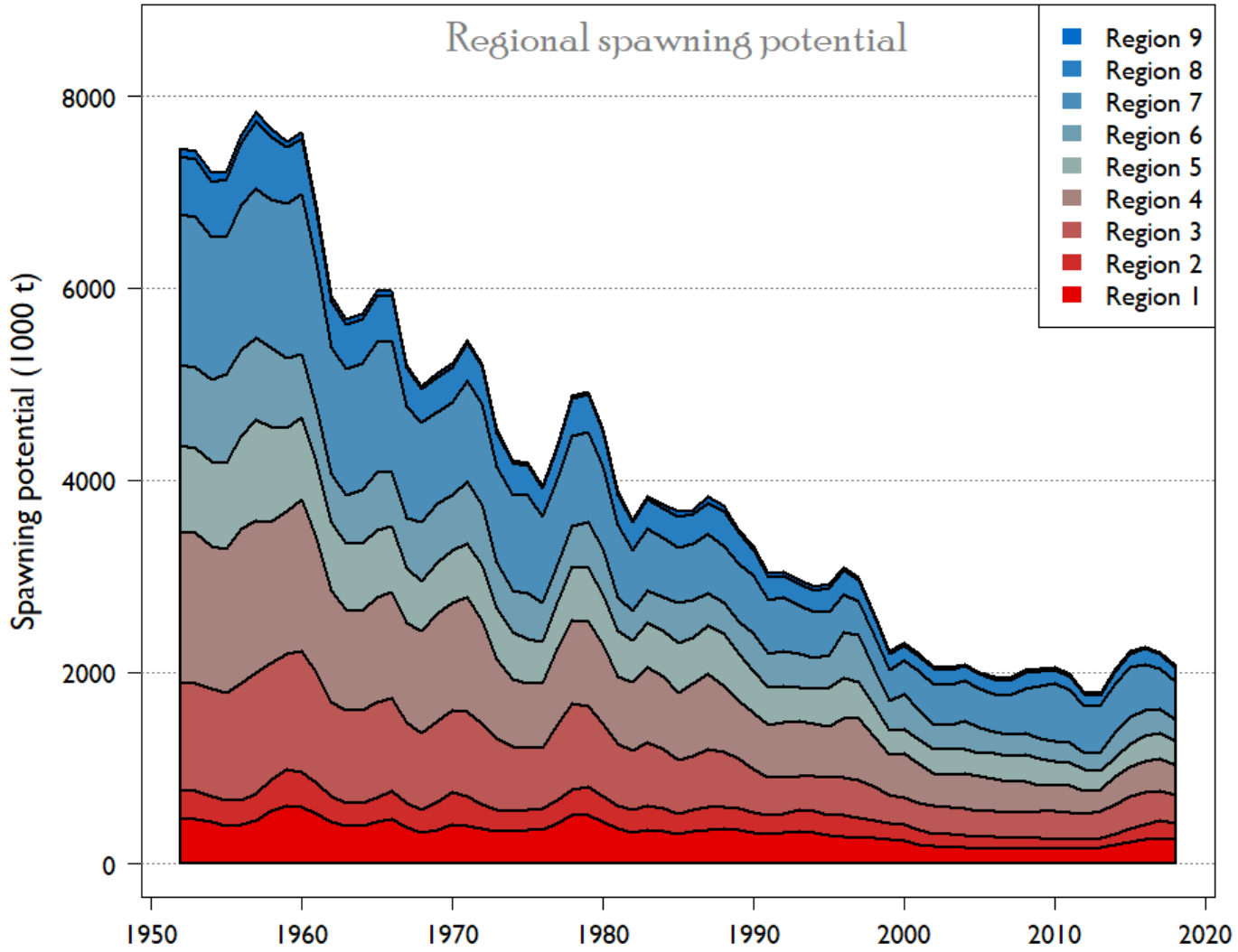
Regional Scaling





Catch and CPUE data indicate that around 80% are in the Equatorial regions, and around 20% are in the Northern & Southern regions

Regional Scaling

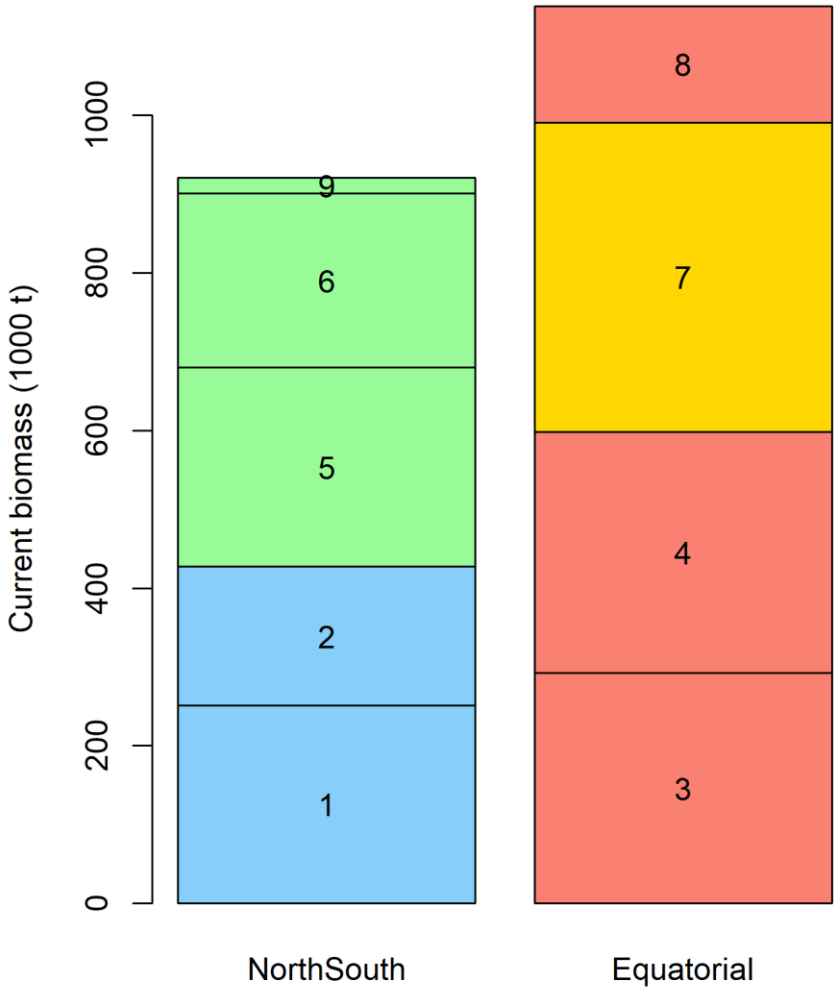


What does the model say about the proportion of the biomass that is in the Equatorial regions?

80% perhaps?

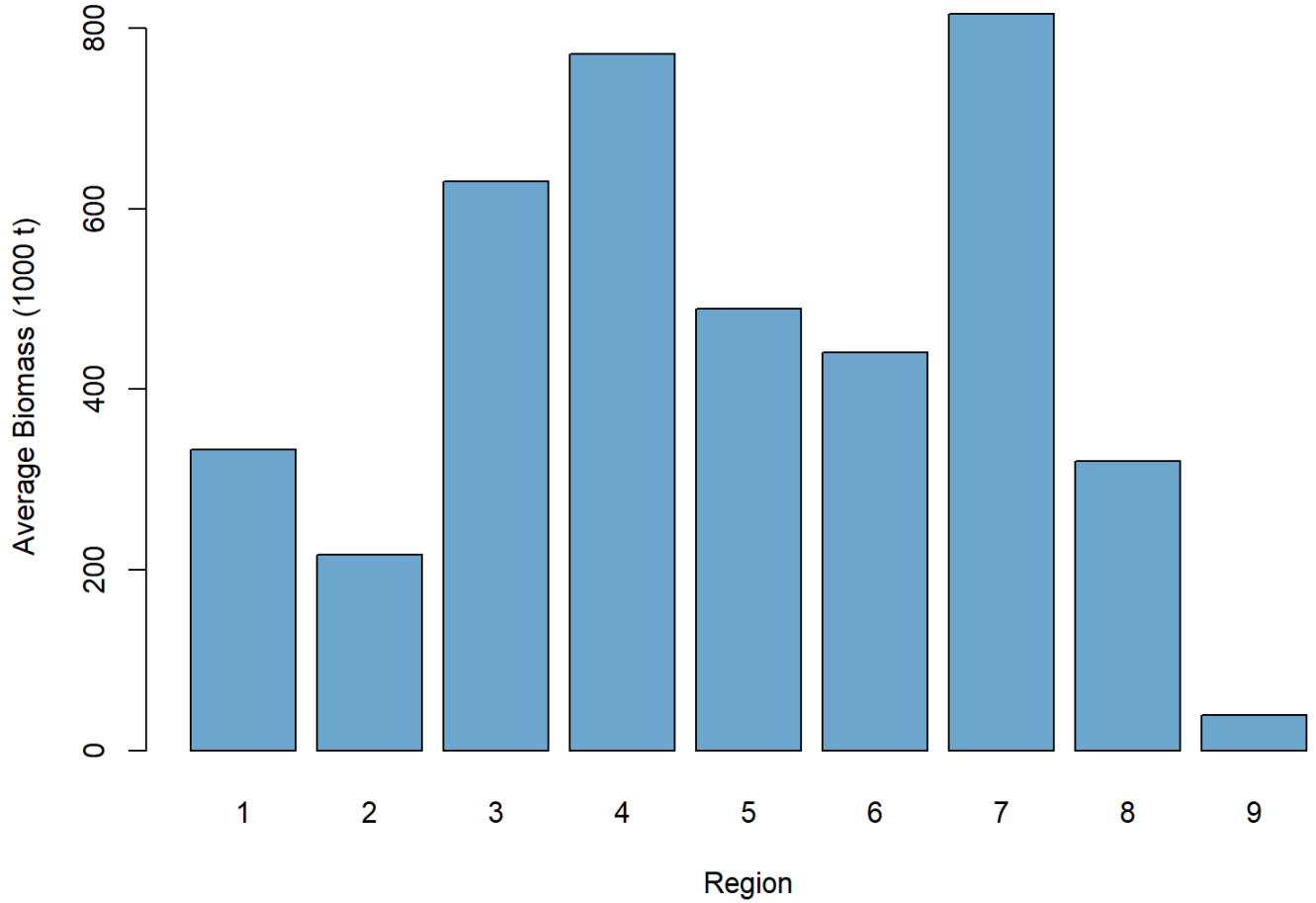
Regional Scaling

45% of the biomass is in the Northern & Southern regions

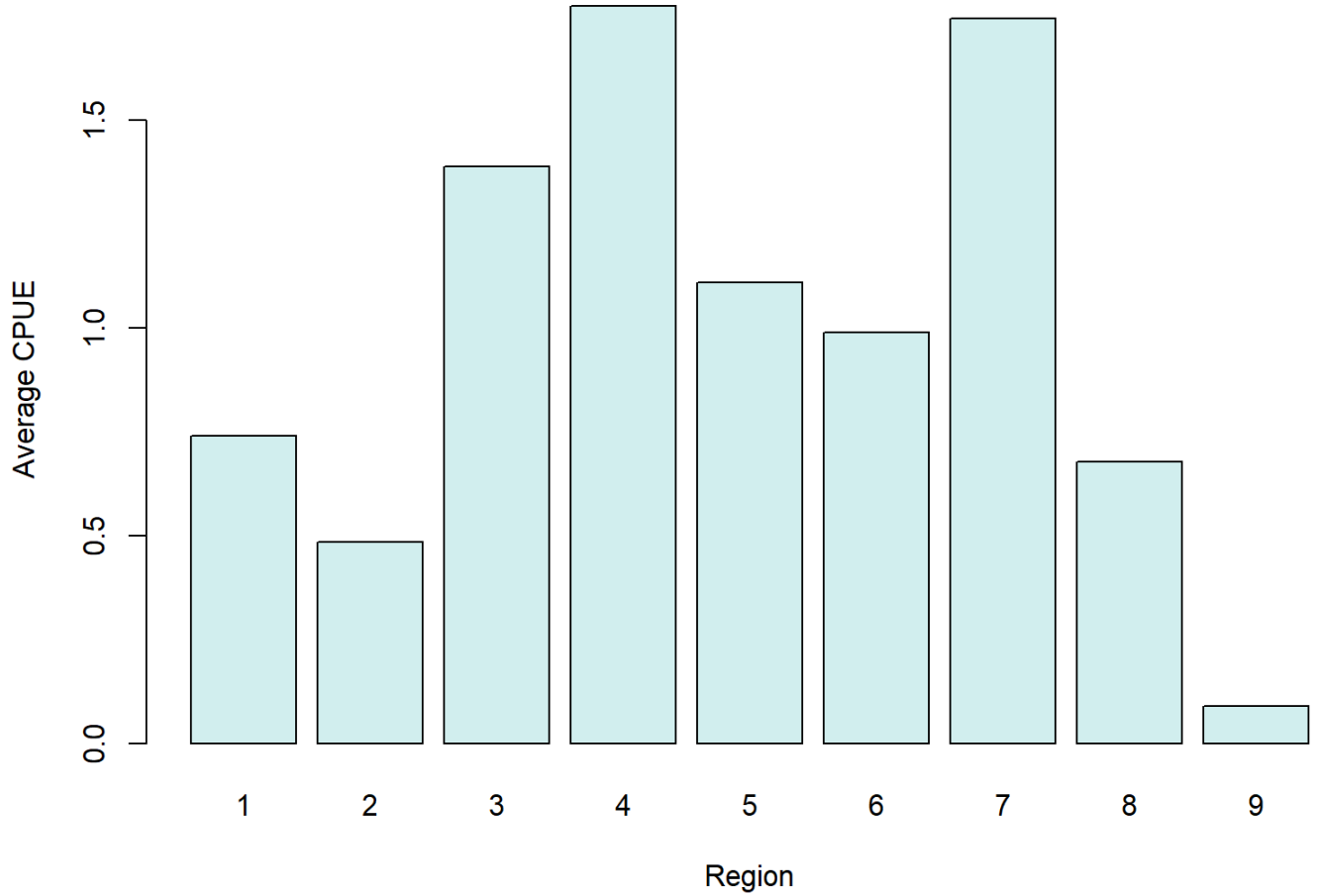


55% of the biomass is in the Equatorial regions

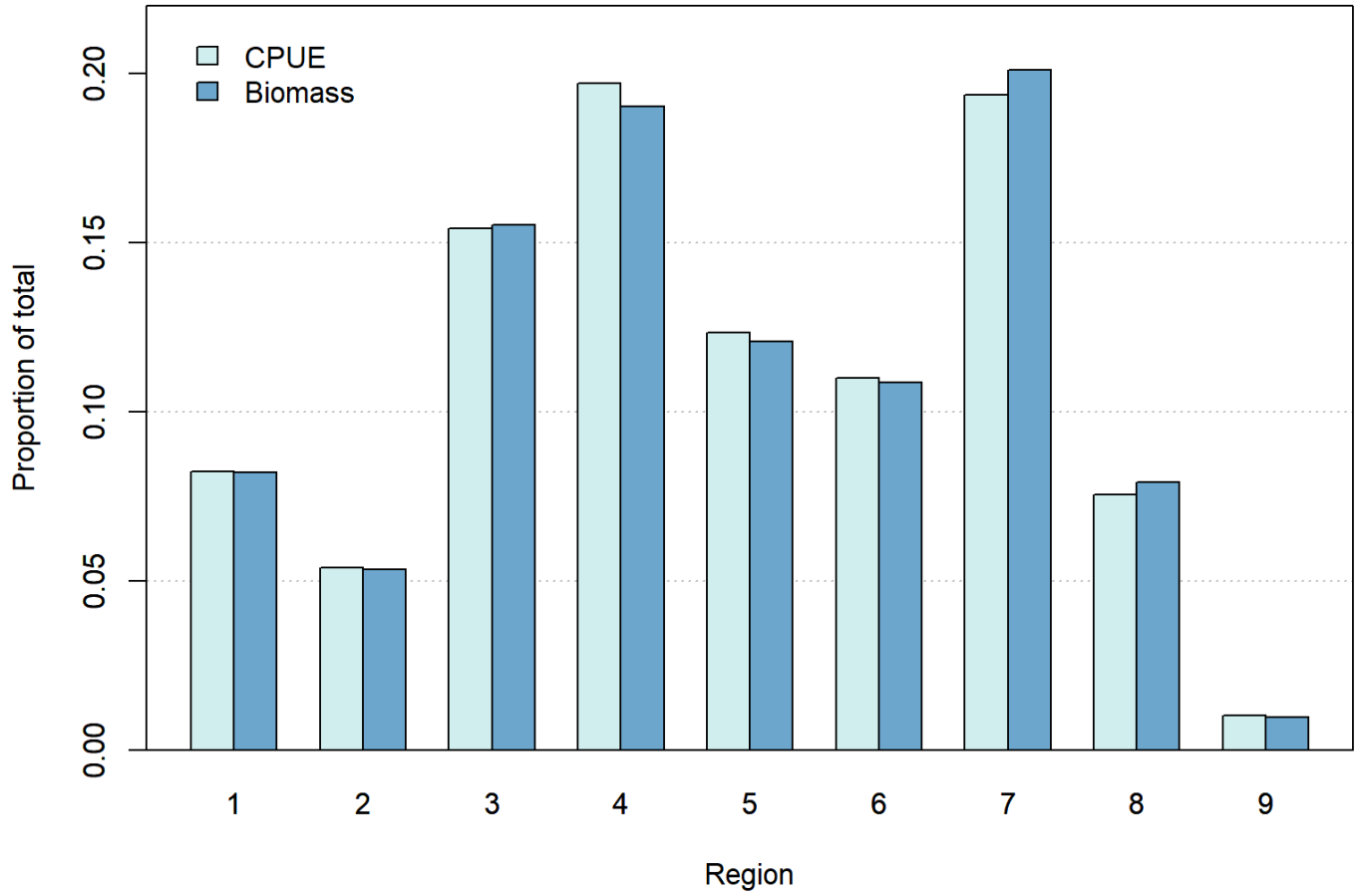
Regional Scaling



Regional Scaling



Regional Scaling



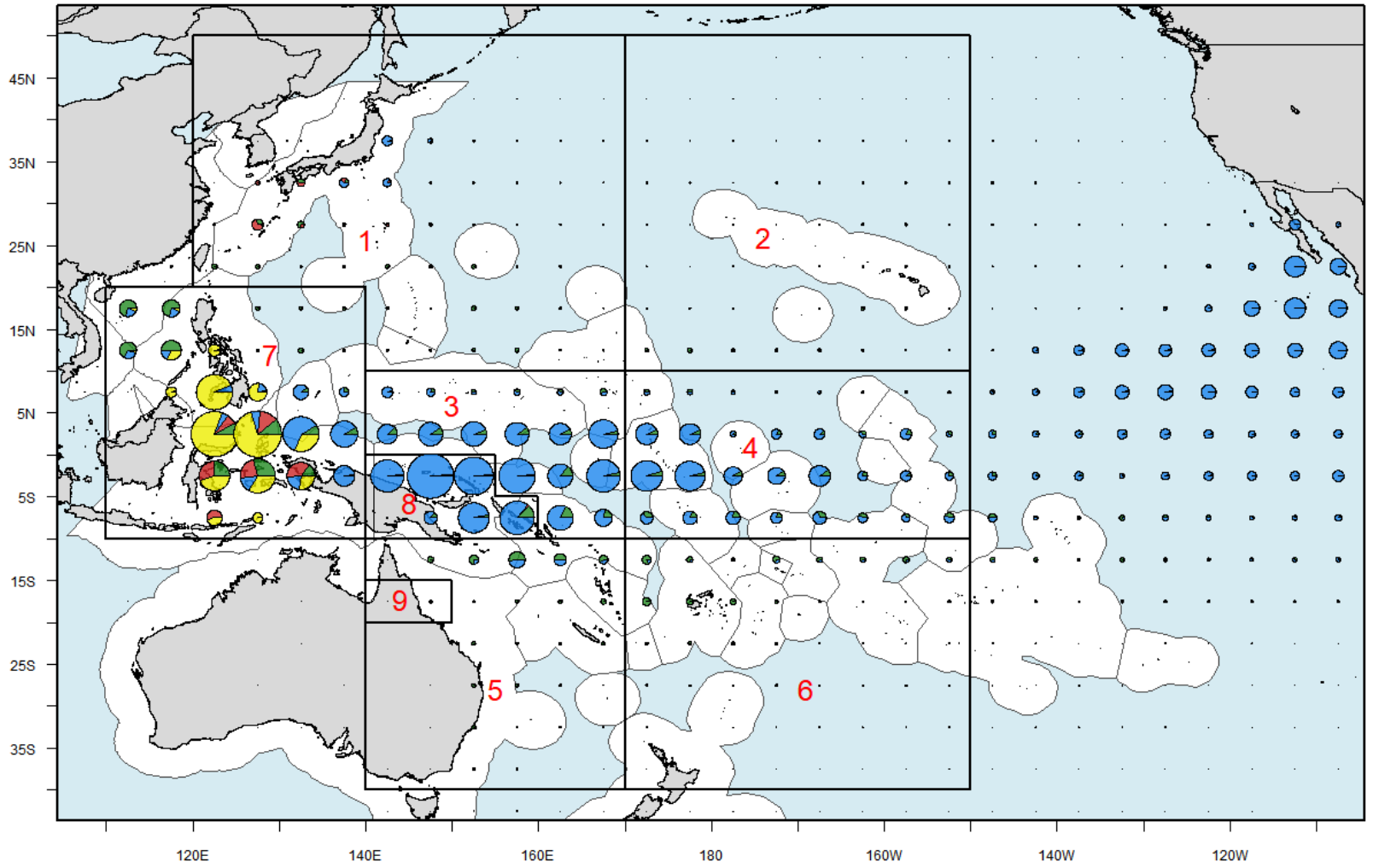
Regional Scaling

To a great extent, the stock assessment estimation of population trends and spatial distribution are determined by the analytical approach used to produce the CPUE indices

The spatial distribution in the YFT 2020 assessment is considerably different from the general indications in the data, as the model puts too much biomass in the North and South areas

This could introduce a bias in the stock status estimates and thus undermine the reliability of the management advice; we are therefore exploring alternative analytical approaches to produce the CPUE indices

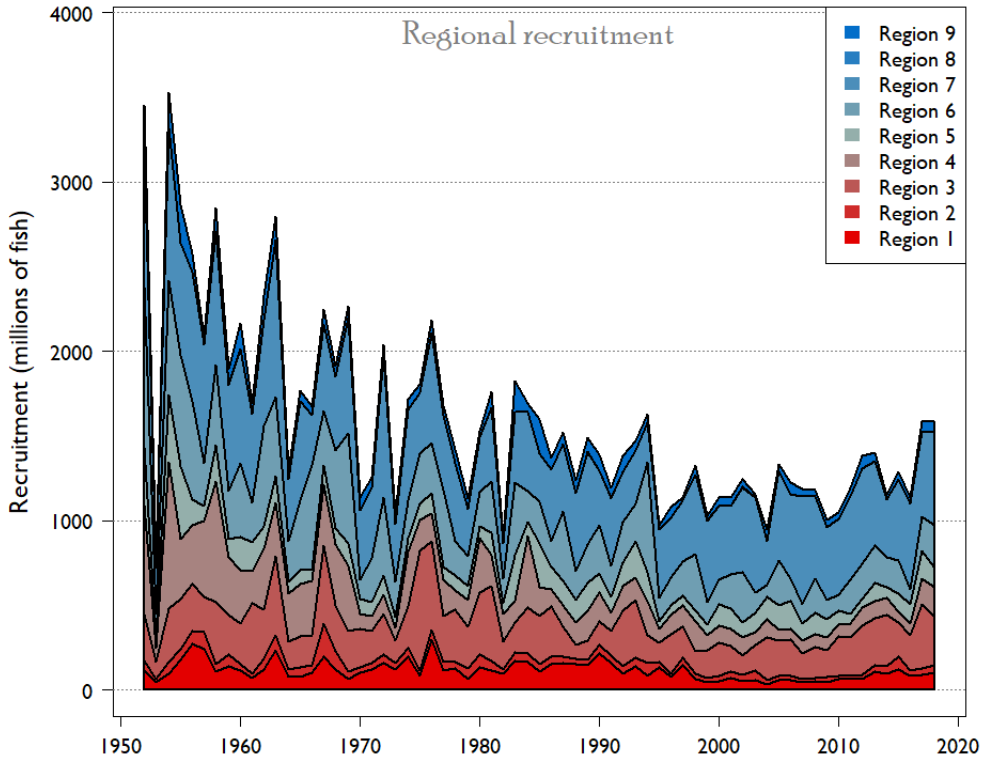
Recruitment by Region

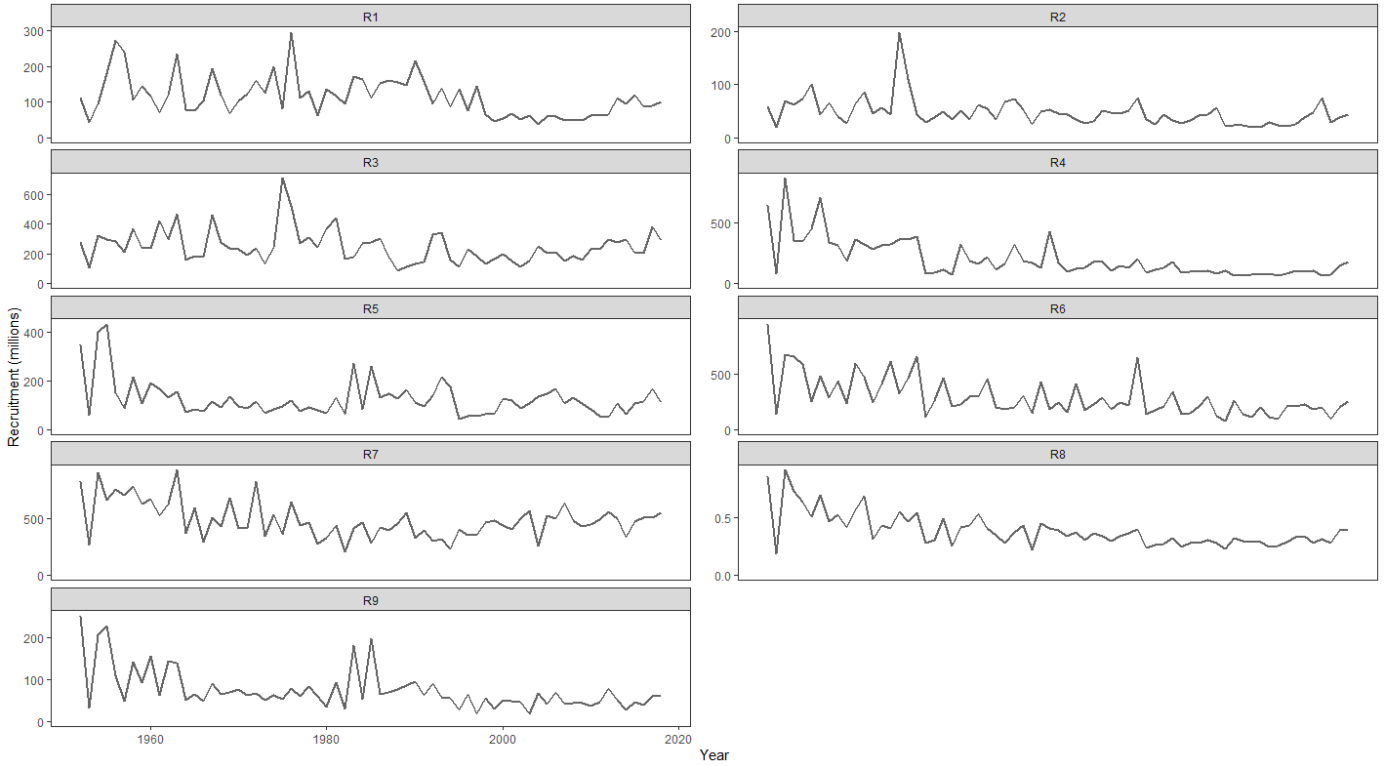


Enough about biomass by region...

Let's revisit recruitment by region

Recruitment by Region





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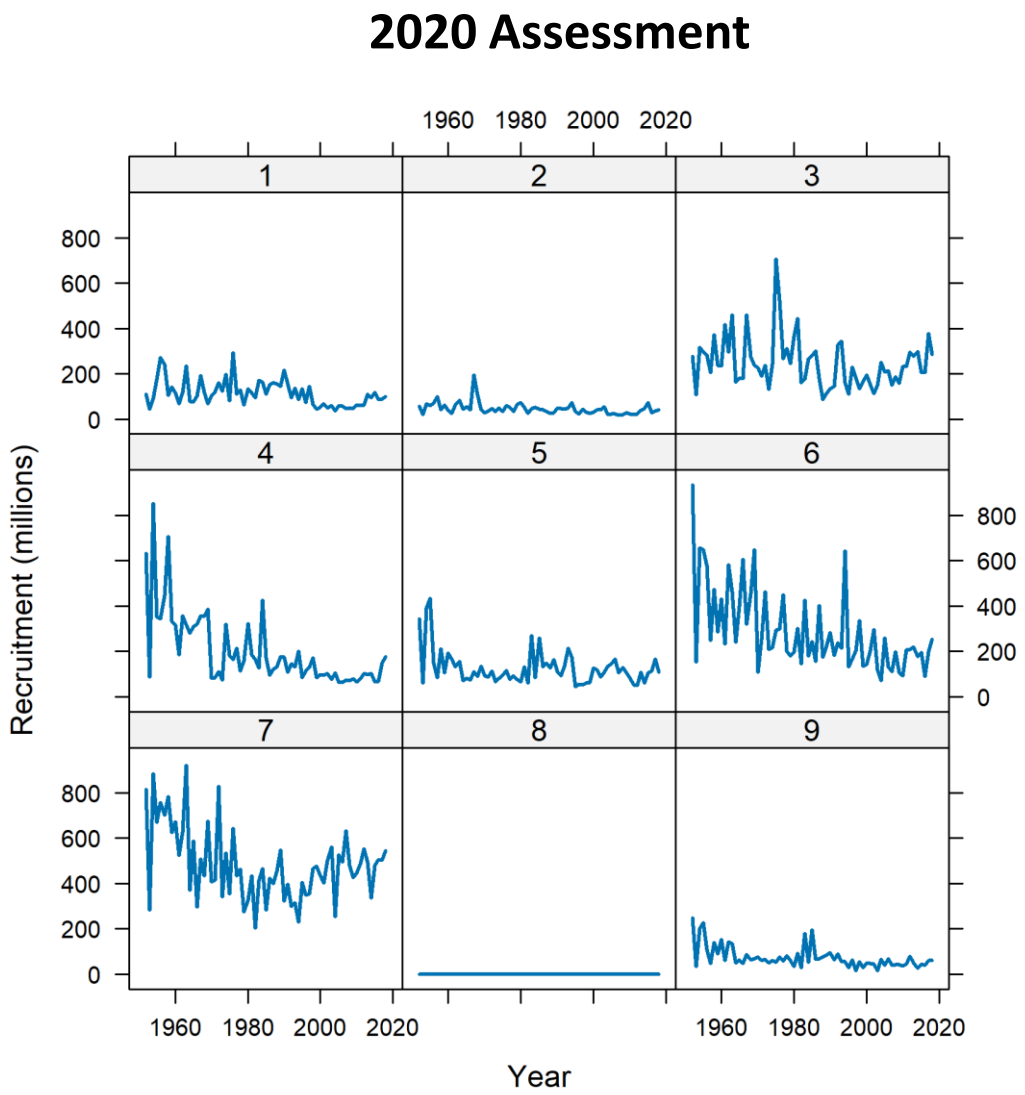
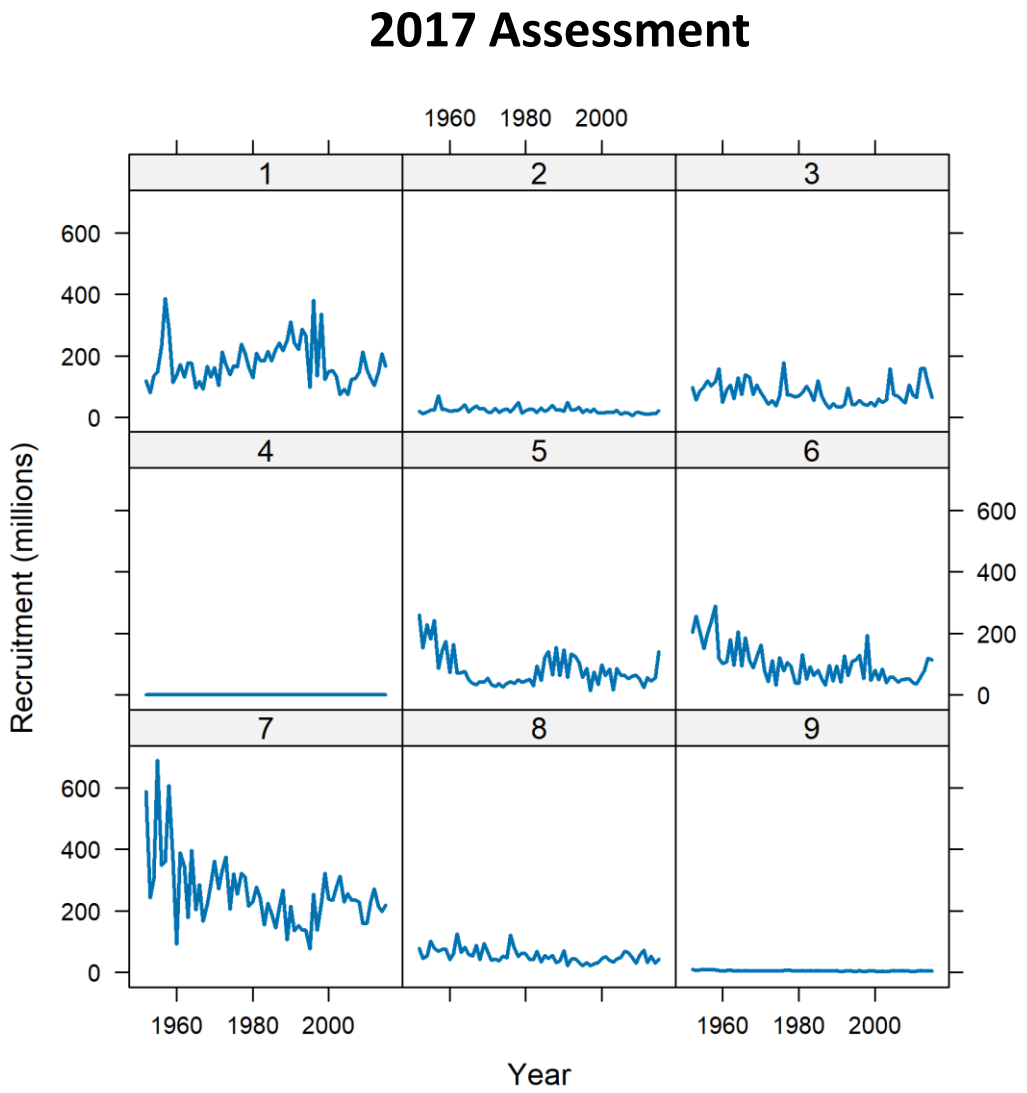


2020 assessment - no recruitment in region 8

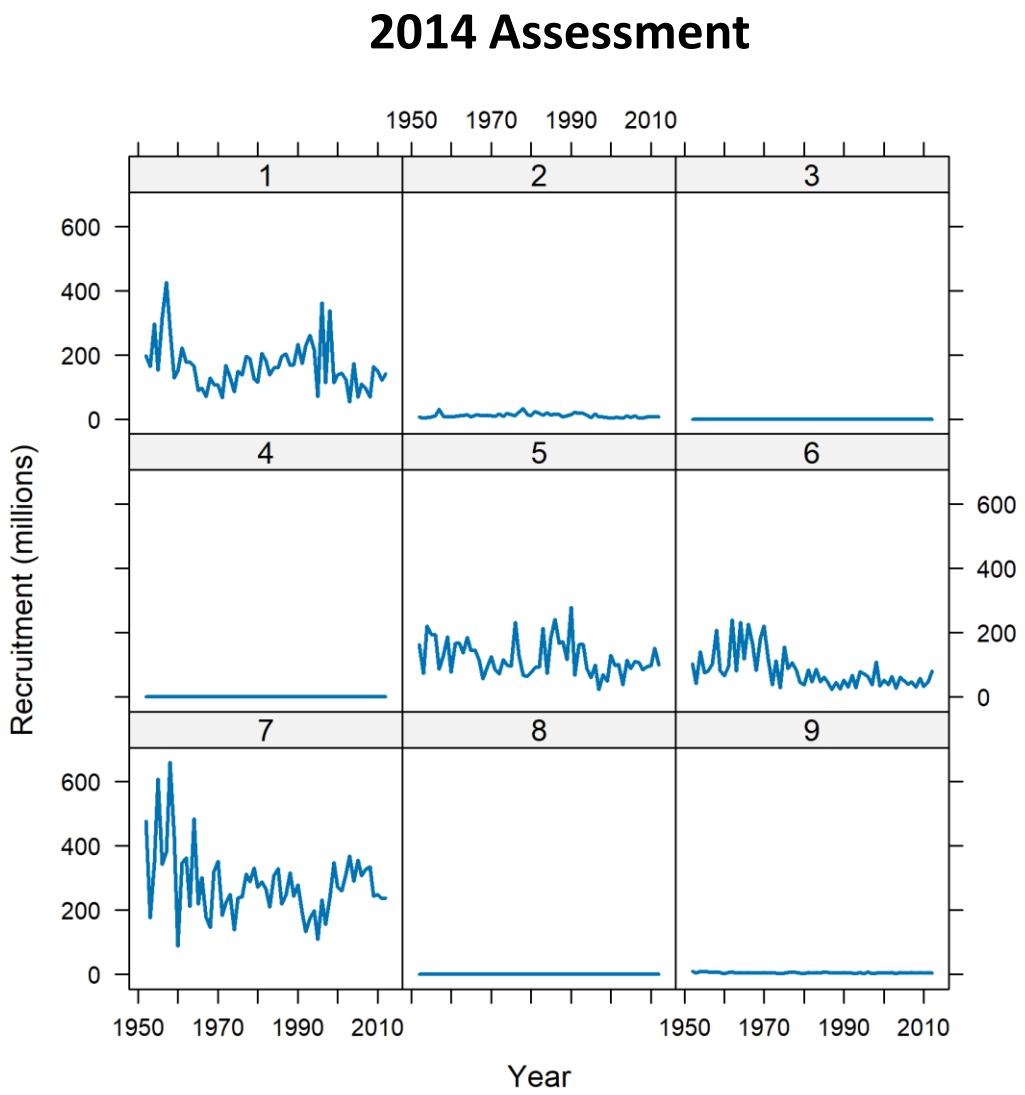
Recruitment by Region



2017 assessment - no recruitment in region 4

2020 assessment - no recruitment in region 8

Recruitment by Region



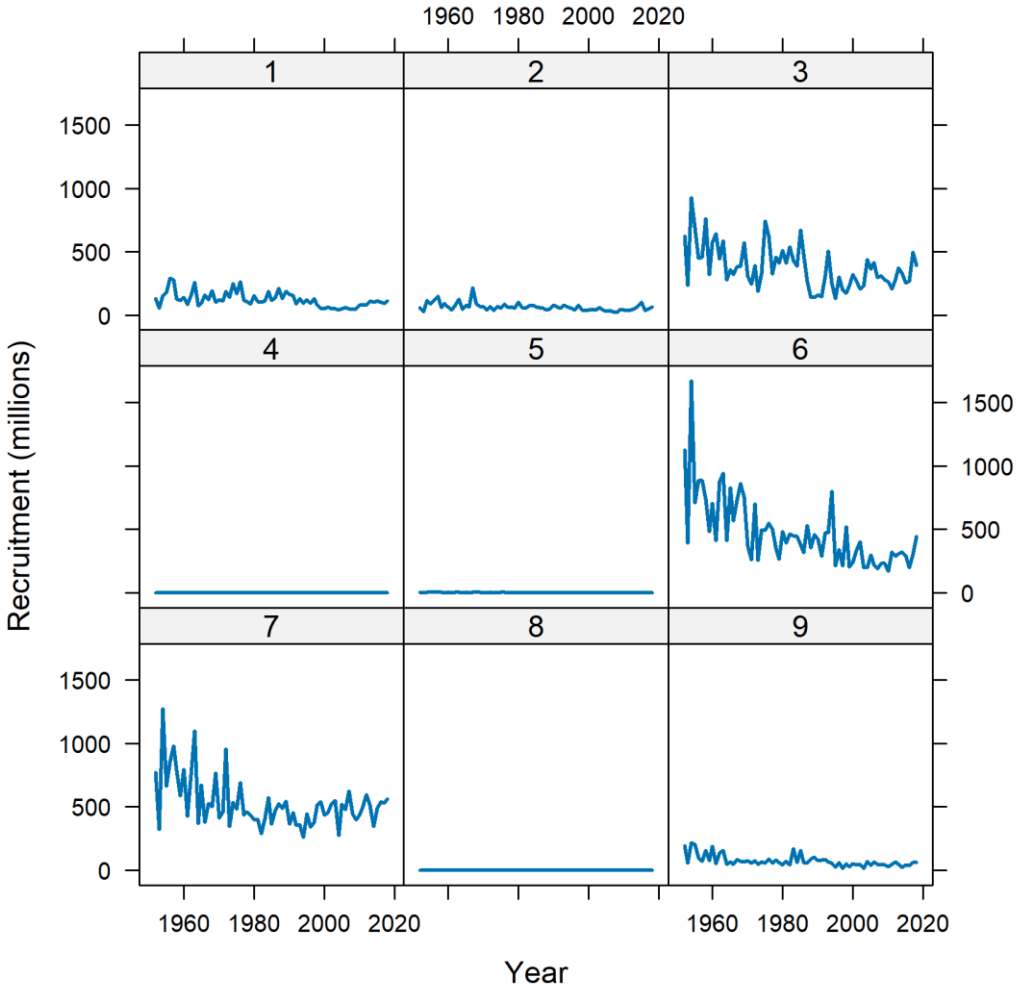
2014 assessment - no recruitment in region 3, 4, 8

2017 assessment - no recruitment in region 4

2020 assessment - no recruitment in region 8

Recruitment by Region

2023 Assessment*



2014 assessment - no recruitment in region 3, 4, 8

2017 assessment - no recruitment in region 4

2020 assessment - no recruitment in region 8

2023 assessment - no recruitment in region 4, 5, 8

Spatial Structure

As pointed out in recommendations regarding the YFT 2020 assessment, there are indications that the high complexity of the model makes the statistical estimation unstable

As a result, some of the model predictions fluctuate between uncrealistic scenarios in a manner that could undermine the reliability and usefulness of the model as a basis for providing management advice

It appears that the estimation of processes such as recruitment and movement between 9 regions would require more informative data than what is available

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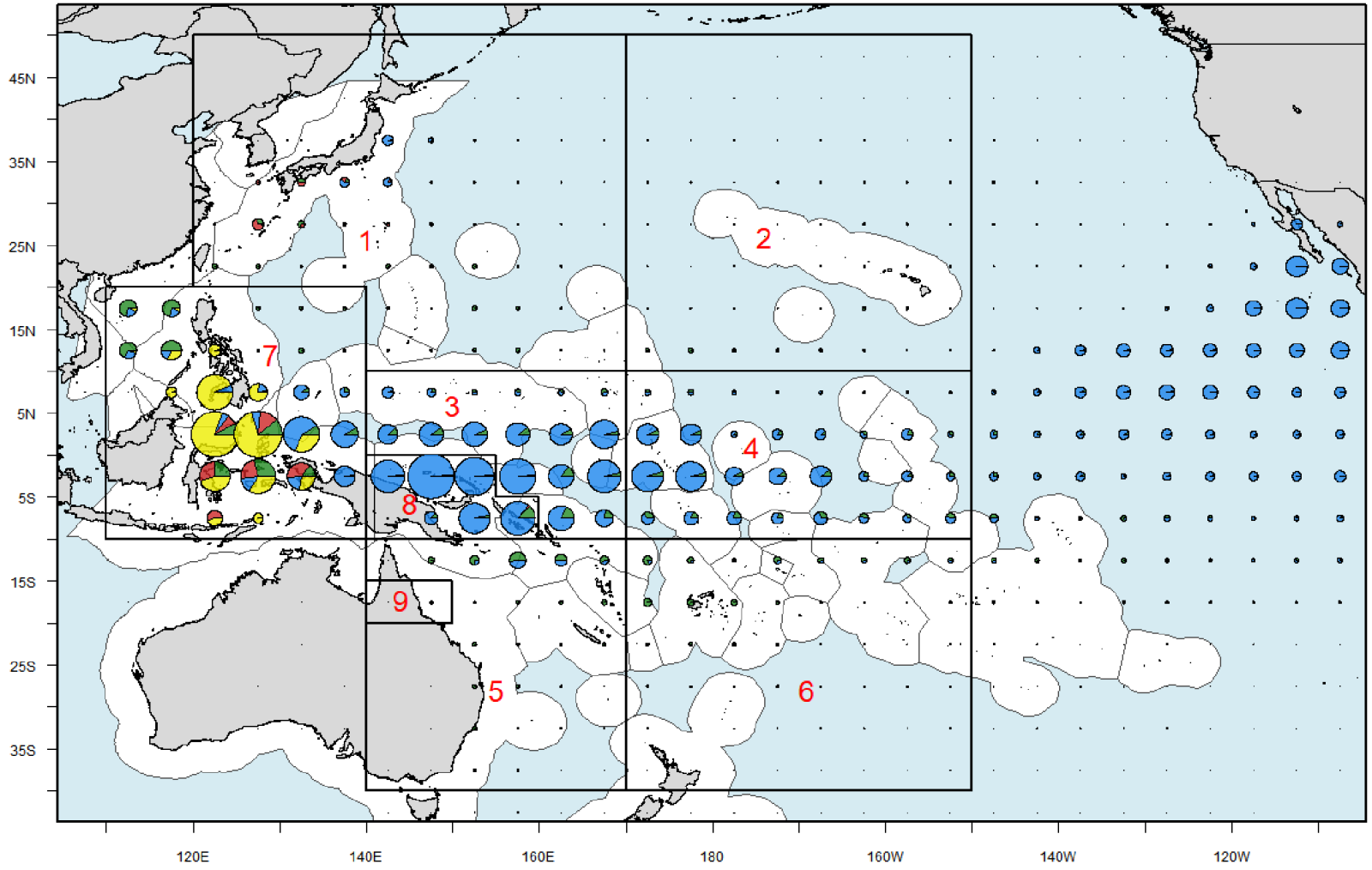
Model Complexity

With the YFT 2020 assessment model, often a small change in the model settings causes large differences in the model fit and the estimated stock status, or prevents model convergence

The high sensitivity to small changes in model assumptions, as well as a general instability when fitting the model, are signs that the model complexity is too high given the modest information in the data

Simplifying the model to have 4 or 5 regions could results in a model that is better estimable and robust to small changes in assumptions - a more reliable tool for providing management advice

Regions: 9, 4, or 5?



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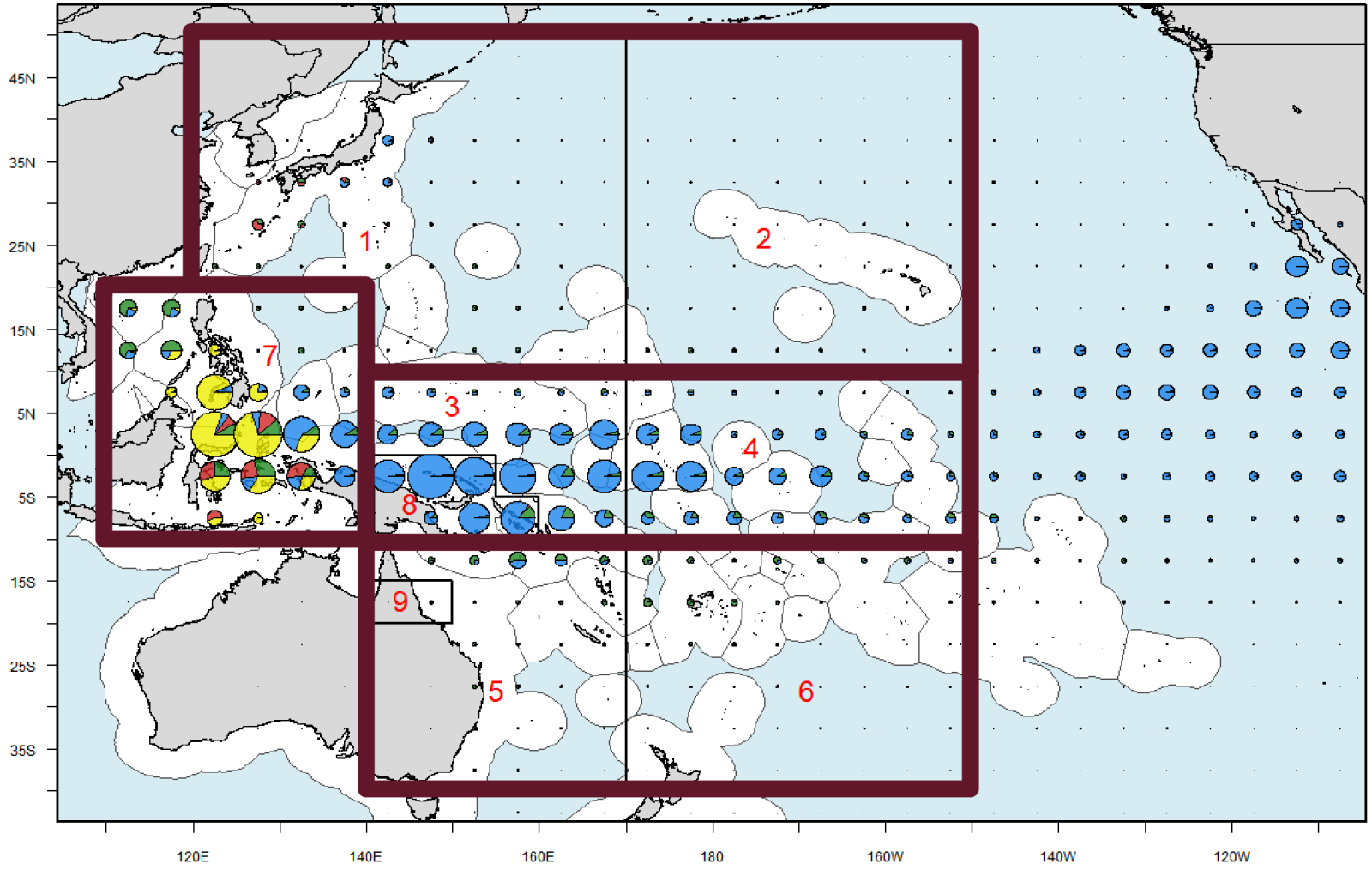

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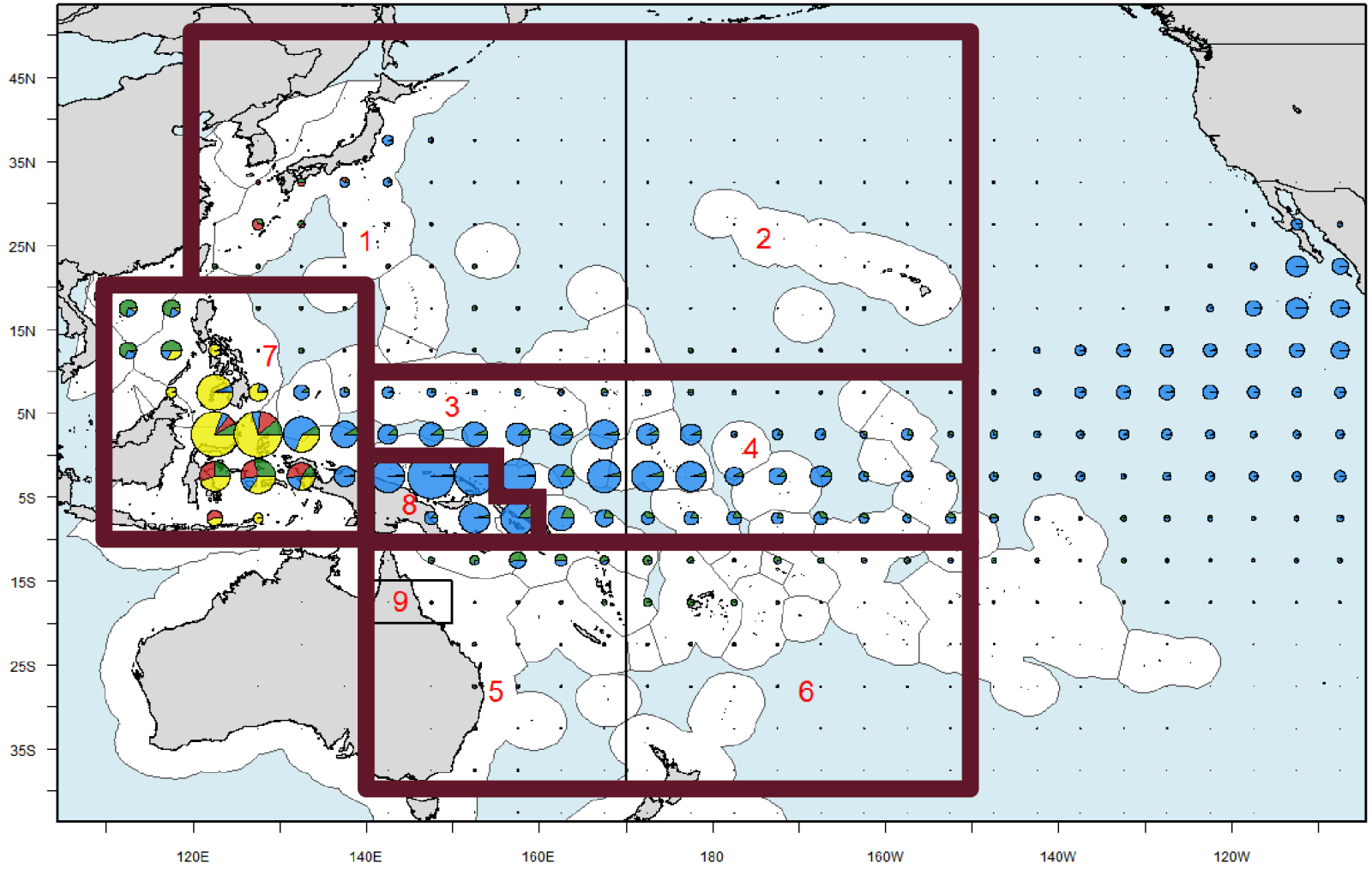
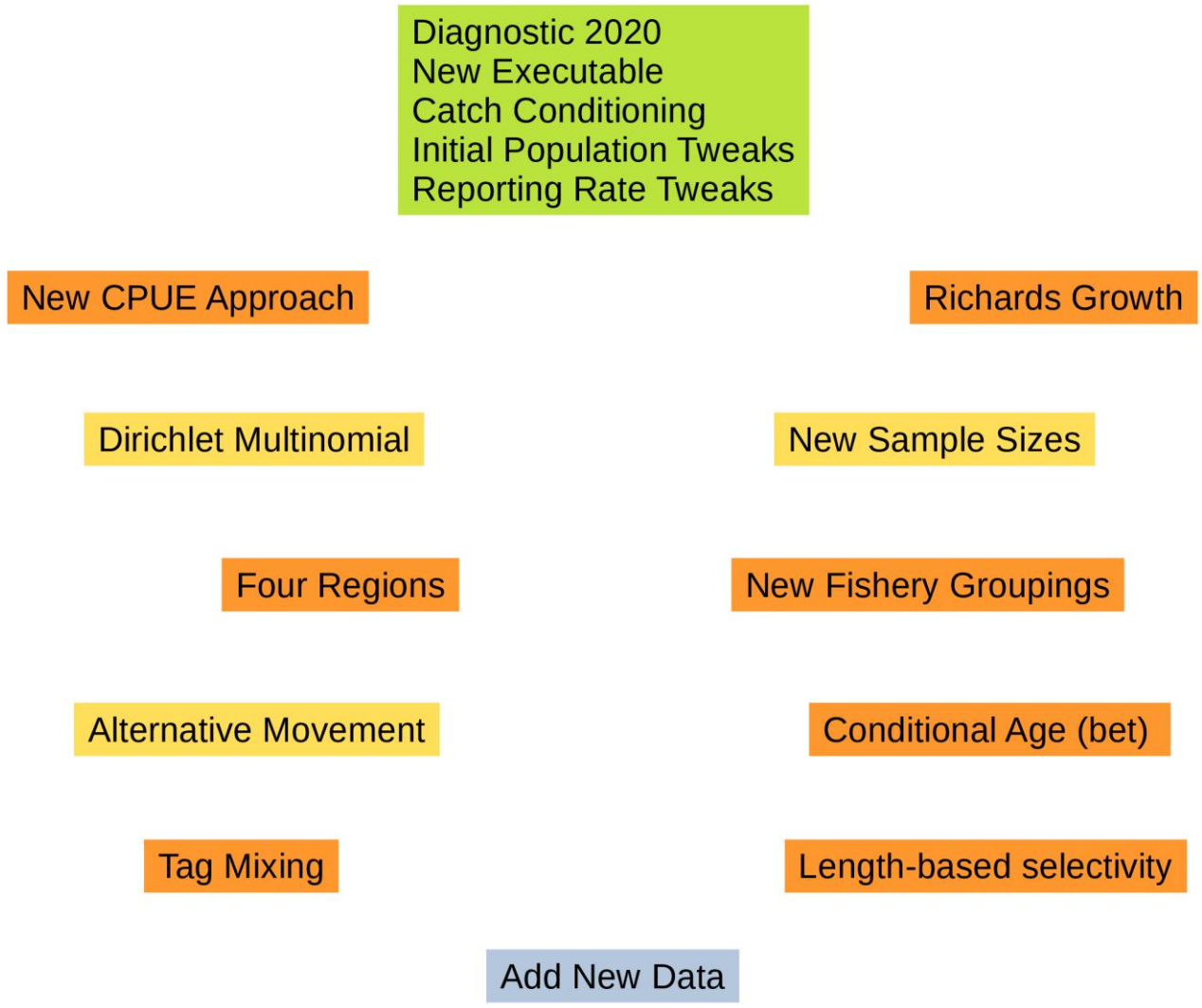


Exploratory Model Runs



Improvements in the Toolchain

Tool	Purpose	Feature	Improvement
MFCL	Fit model	Objective function	Consistent +/- sign of objfun, also in .par
FLR4MFCL	R-to-MFCL	MFCLLikelihood	Reads in negative objfun, reads in Age likelihood
"		Parameter correlation	read.MFCLCor, mat2MFCLCor, corFilter, corLabel
"		Compare flags	diffFlags, diffFlagsStepwise, flagMeaning
"		Find model results	finalPar, finalRep
Shiny	Explore runs	Code reorganization	Easier to adapt to new stock, common trunk
"		Likelihood table	Includes CPUE and Age
"		Official app collection	In one place, ofp-sam-shinyMFCL
condor	R-to-Condor	Package on CRAN	User scripts become much shorter
"		Submit/list/download	Efficient and reliable Condor runs: stepwise and grid
makeit	Automation	Package on CRAN	One R script runs other R scripts when needed
"		Run R scripts if needed	Efficient and reliable R jobs: all plots and tables
Proper	Project mgmt	Standard dir structure	Allows us to develop and use shared tools across stocks
"		"	Guarantee that next assessor can find and reuse all components
"		R script checks	Strengthens reproducibility of analyses