Preliminary assessment of northern and southern rock sole (*Lepidopsetta polyxstra and bilineata*) in the Gulf of Alaska

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Outline

- Where we left off in 2021
- Species specific catch
- Analysis of spatial length at age data
- Northern rock sole model and results
- Southern rock sole models and results

Where we left off in 2021

- Growth morph models for NRS and SRS
  - Split was between western GOA and central-eastern GOA

Data source	Years
Fishery catch (assumed 50% NRS, 50% SRS)	1977-2021
NMFS GOA groundfish survey biomass and SE	1996, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017, 2019, 2021
Fishery length composition	1997-2021
NMFS GOA groundfish survey length composition	1996, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017, 2019
NMFS GOA groundfish survey CAAL (2019 age data were not available for NRS, but have been aged since the 2021 assessment and will be added to the model for November, as well as the 2023 CAAL)	1996, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2017, 2019*

Where we left off in 2021

- Start year – 1977
- Natural mortality (sex and area-specific)
  - Female - 0.2 (fixed)
  - Male – estimated
- Von Bertalanffy growth
  - Sex and area-specific growth estimated

Where we left off in 2021

- Recruitment
  - Mean recruitment – estimated
  - Regime parameter – estimated
  - Recruitment distribution - estimated
  - sigmaR – 0.6 (fixed)
  - Early recruitment deviations – estimated to initialize numbers at age
  - Main recruitment deviations – estimated (1977 – 2018)
- Length based selectivity
  - Fleet, area and sex-specific
    - Fleets – fishery and survey
    - Male selectivity offset from females
  - Double normal pattern

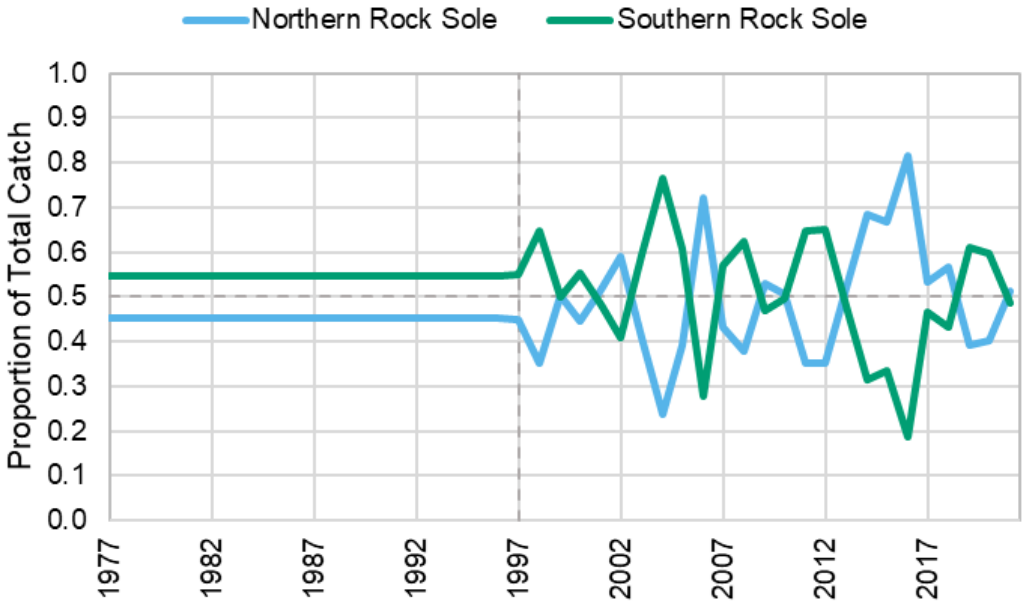
Catch split

- Catch is reported as 'rock sole'
- Previous assumption – 50% split
- PT and SSC requested that we use the observer data to better partition the catch
- Following what is done for Arrowtooth and Kamchatka in the BSAI

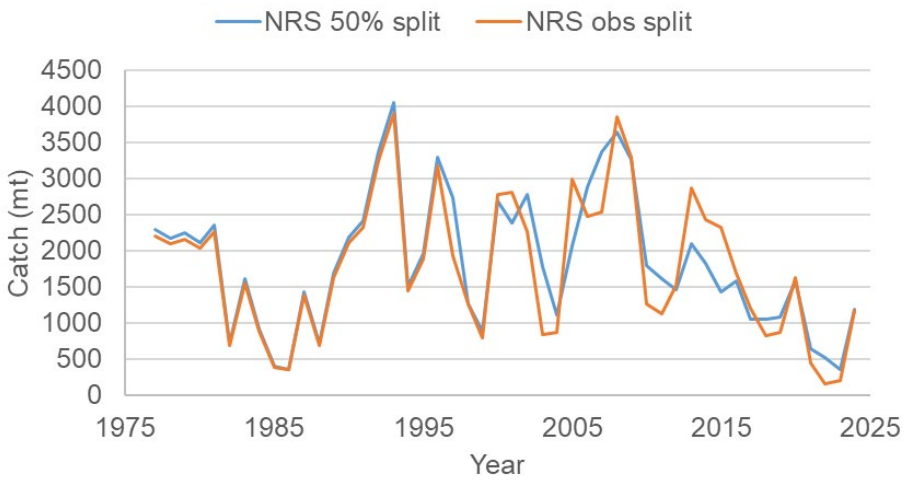
$$CP_{y,s} = \frac{\sum_1^H w_{y,s,h}}{\sum_{s=1}^S \sum_{h=1}^H w_{y,s,h}}$$

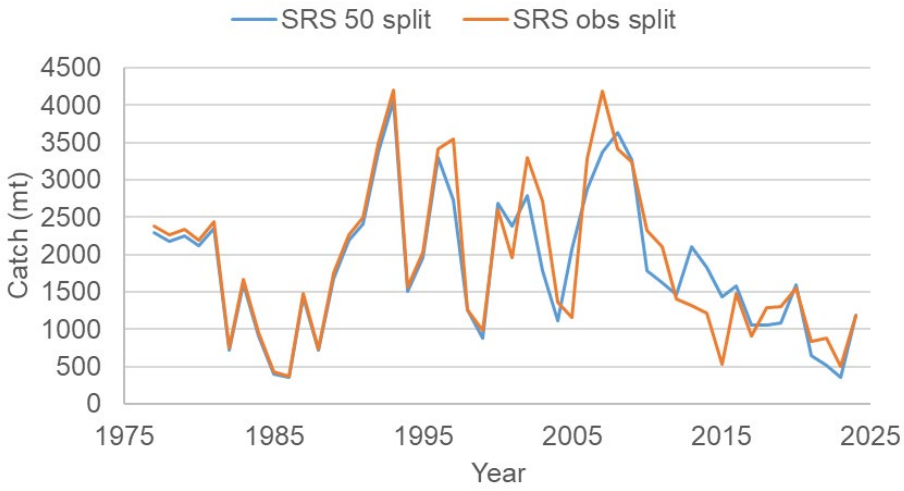
- Species-specific observations start in 1997

Species specific catch split

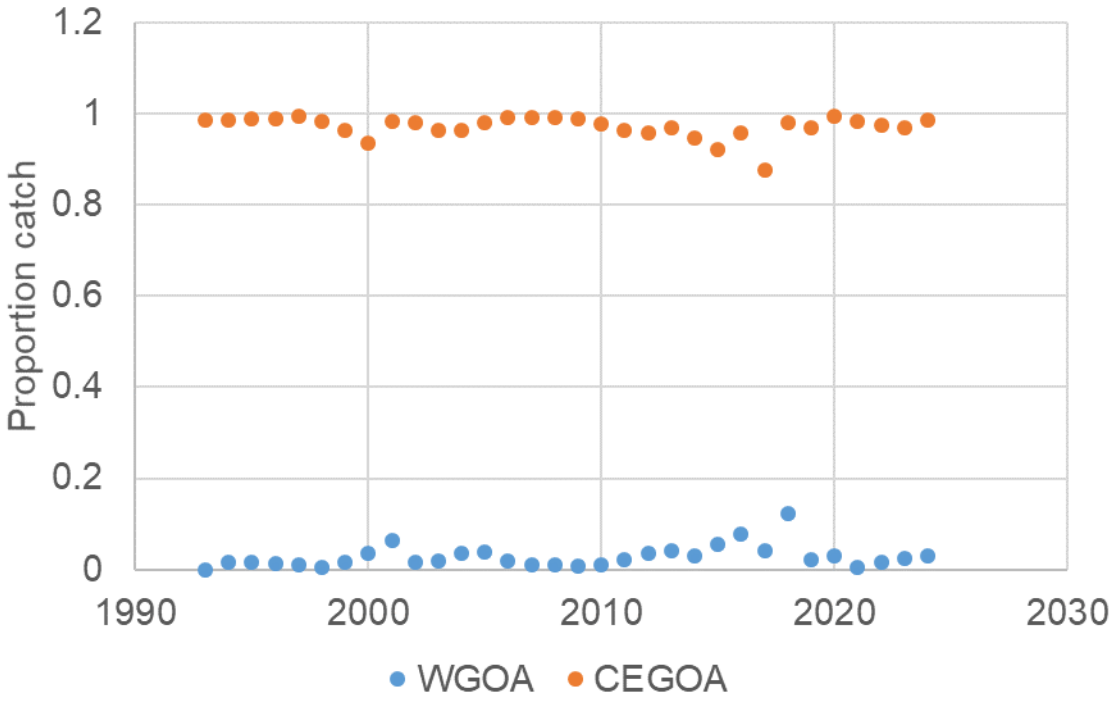


- Pre – 1997 is the average of the first five years of observations
  - 55% SRS
  - 45% NRS





Area specific catch split



Average of time series is:

- 97% Central-eastern GOA
- 3% western GOA

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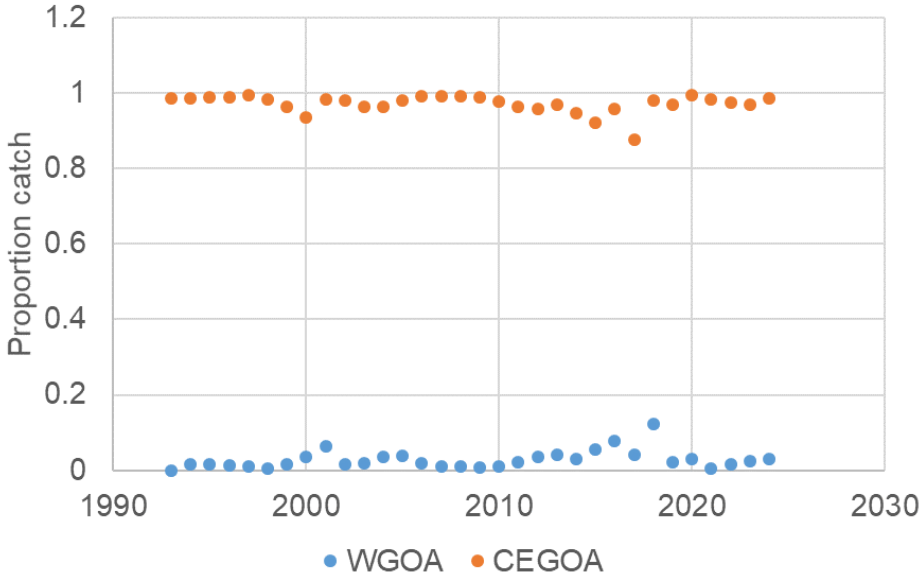
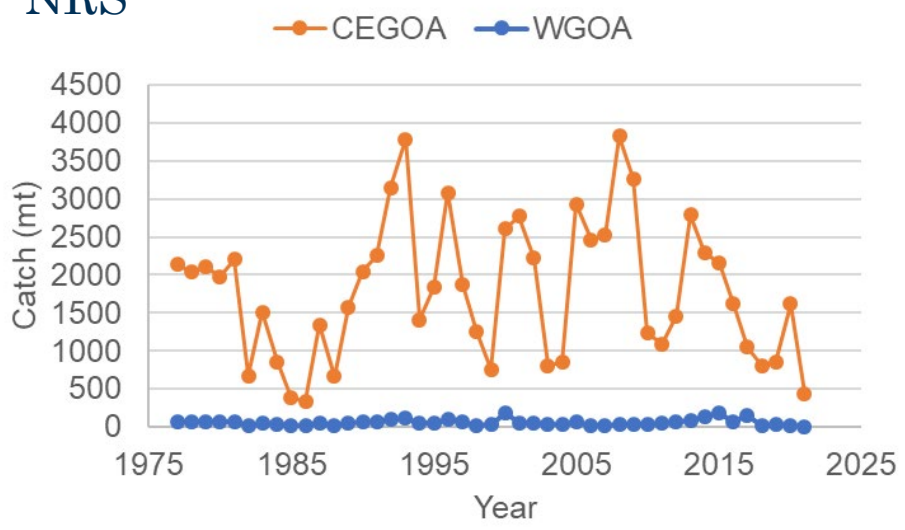
Area specific catch split

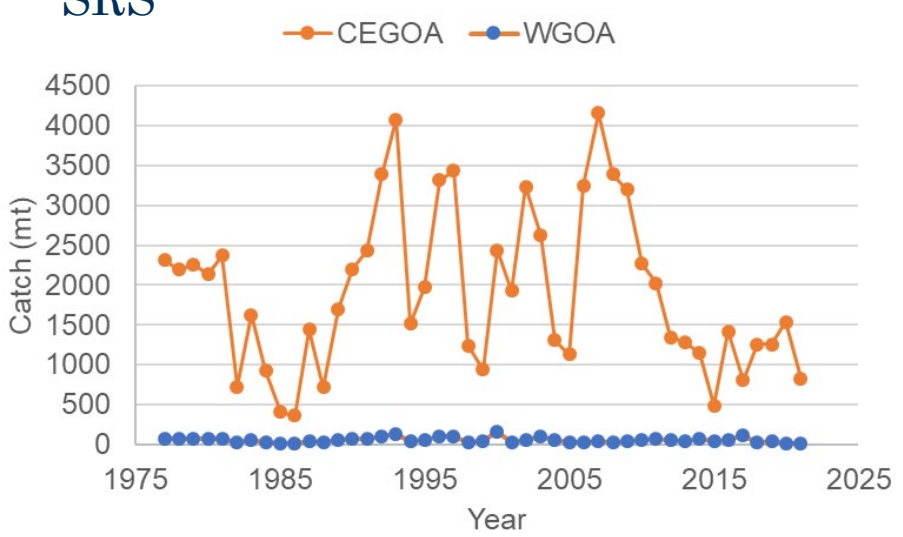


- Average of time series is:
  - 97% Central-eastern GOA
  - 3% western GOA

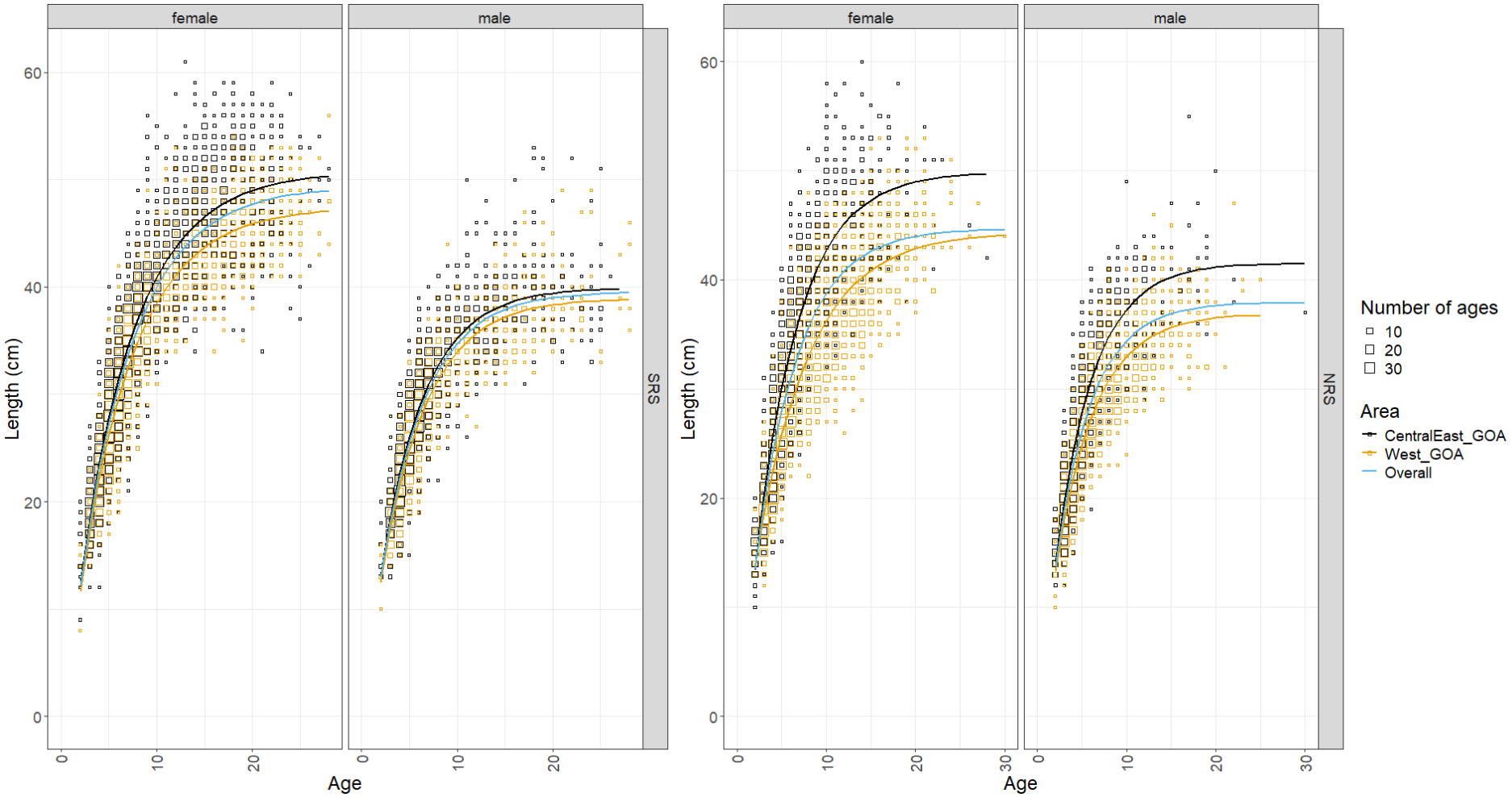
NRS



SRS



Spatial analysis of length at age



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Spatial analysis of length at age

Stock	Hypothesis	AIC	Delta AIC
Southern rock sole: female	H2: growth coefficient equal	23401.34	0
	H3: t0 equal	23401.55	0.21
	H0: Growth not equal	23403.22	1.88
	H1: Linfinity equal	23446.51	45.17
	H4: Growth equal	23764.76	363.416
Southern rock sole: male	H3: t0 equal	12846.69	0
	H2: growth coefficient equal	12847.25	0.56
	H0: Growth not equal	12848.62	1.93
	H1: Linfinity equal	12851.66	4.97
	H4: Growth equal	12920.02	73.334

Spatial analysis of length at age

Stock	Hypothesis	AIC	Delta AIC
Northern rock sole: female	H0: Growth not equal	17845.01	0
	H2: growth coefficient equal	17862.32	17.31
	H3: t0 equal	17866.64	21.63
	H1: Linfinity equal	17885.92	40.91
	H4: Growth equal	18775.82	930.813
Northern rock sole: male	H2: growth coefficient equal	11675.81	0
	H0: Growth not equal	11676.9	1.09
	H3: t0 equal	11677.16	1.35
	H1: Linfinity equal	11718.55	42.74
	H4: Growth equal	12123.98	448.172

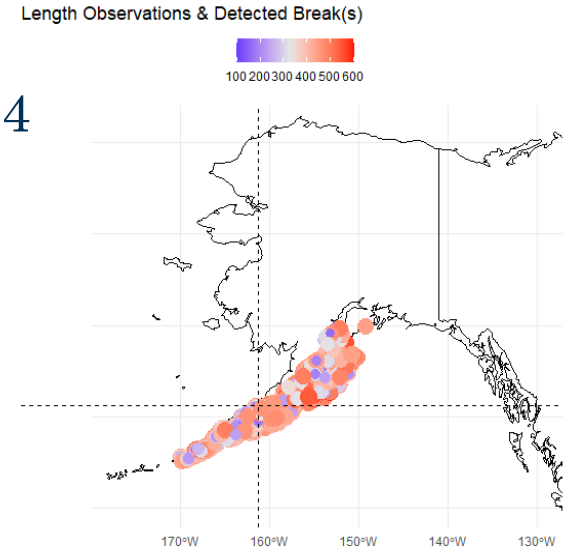
Spatial analysis of length at age

- growthbreaks R package based on Kapur et al. 2020 has become available since 2021
  - GAM fit to length observations at individual age
  - Predictors: latitiude, longitude, and year
- Used to validate location of assumed break in the last assessment

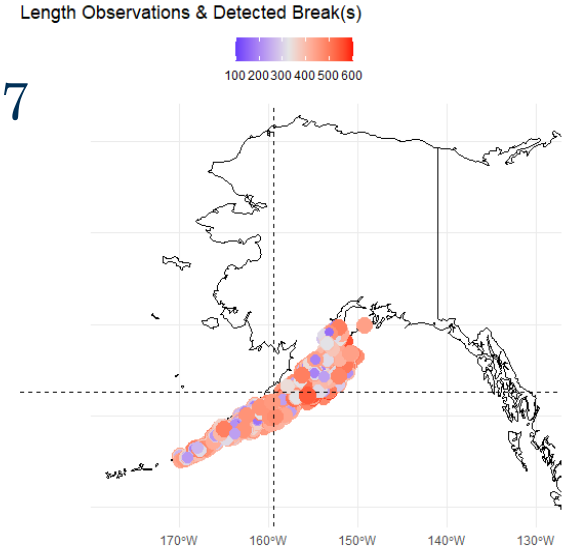
Spatial analysis of length at age

- NRS females

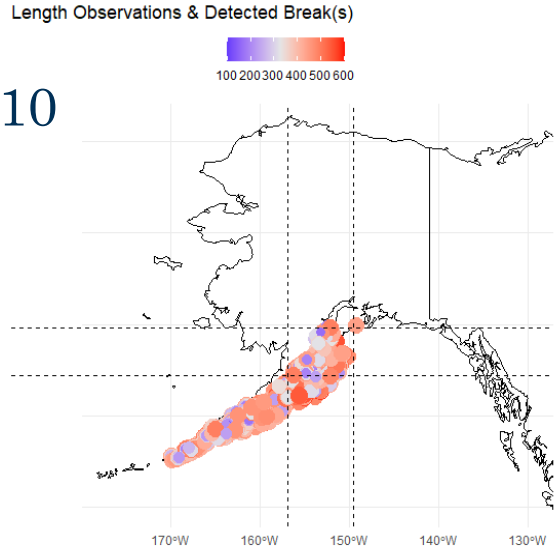
Age 4



Age 7



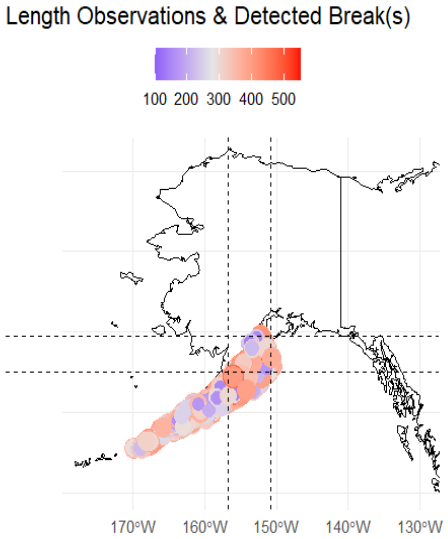
Age 10



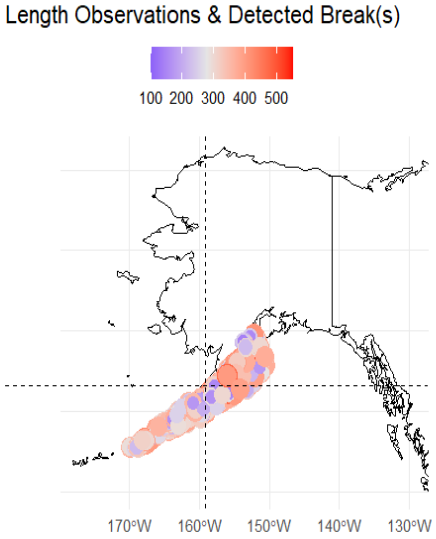
Spatial analysis of length at age

- NRS males

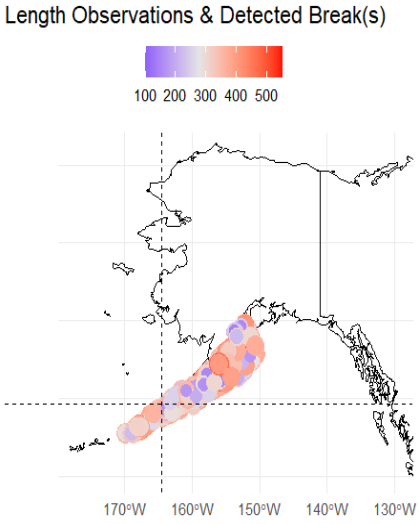
Age 4



Age 7



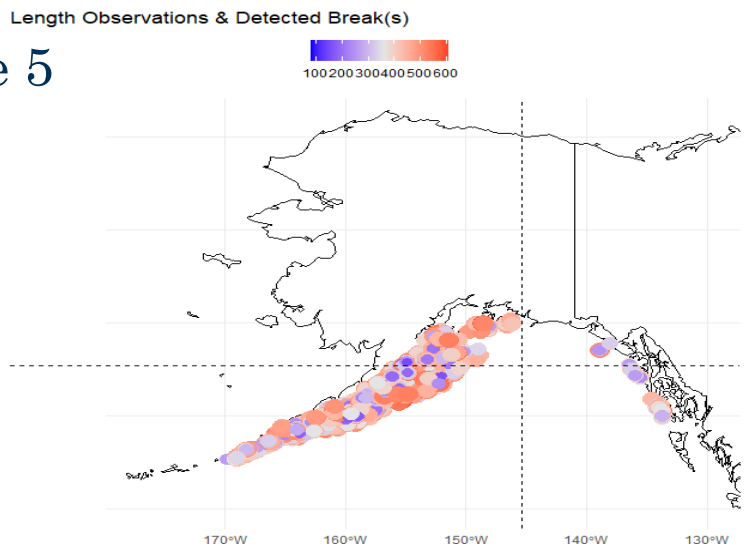
Age 10



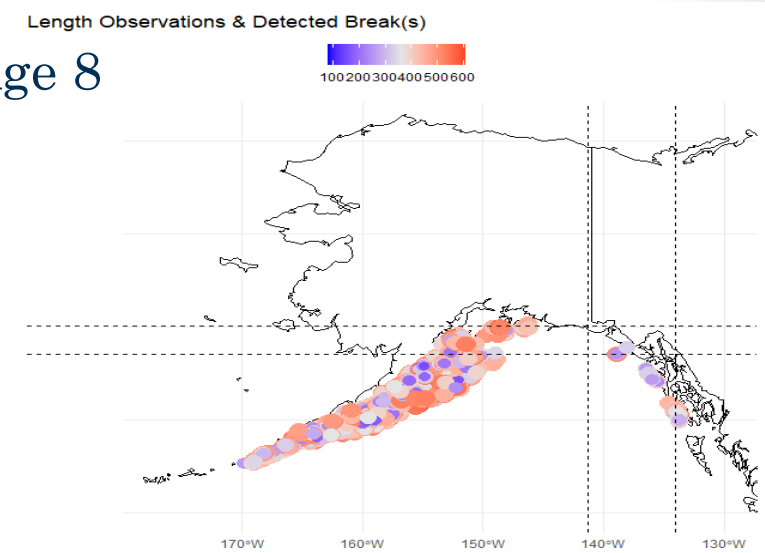
Spatial analysis of length at age

- SRS females

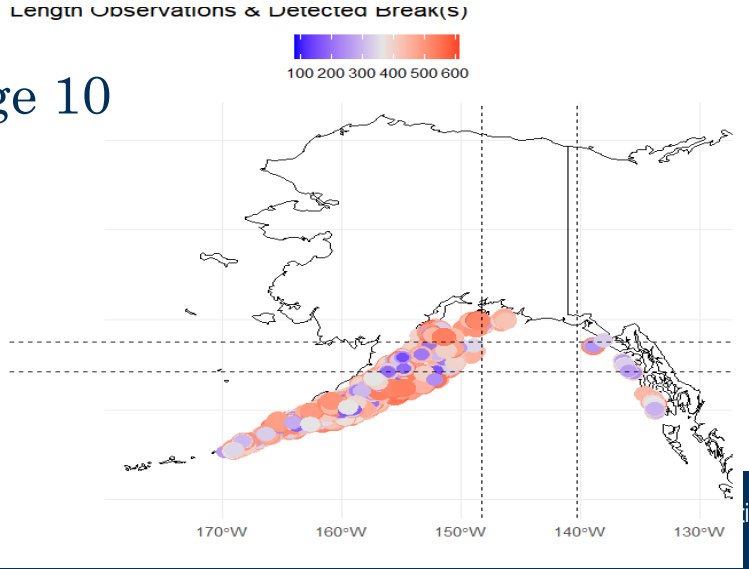
Age 5



Age 8



Age 10



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Spatial analysis of length at age

- NRS
  - Growthbreaks analysis suggests the break between WGOA and CEGOA seems reasonable
  - This in combination with the AIC results suggests a 2-area growth morph model is reasonable for this stock
- SRS
  - AIC results suggest some support for the split assumed by the last assessment model
  - Break identified using growthbreaks does not match with WGOA and CEGOA
  - Qualitative difference in the estimated growth curves suggests growth is small
  - Recommend using a single area model

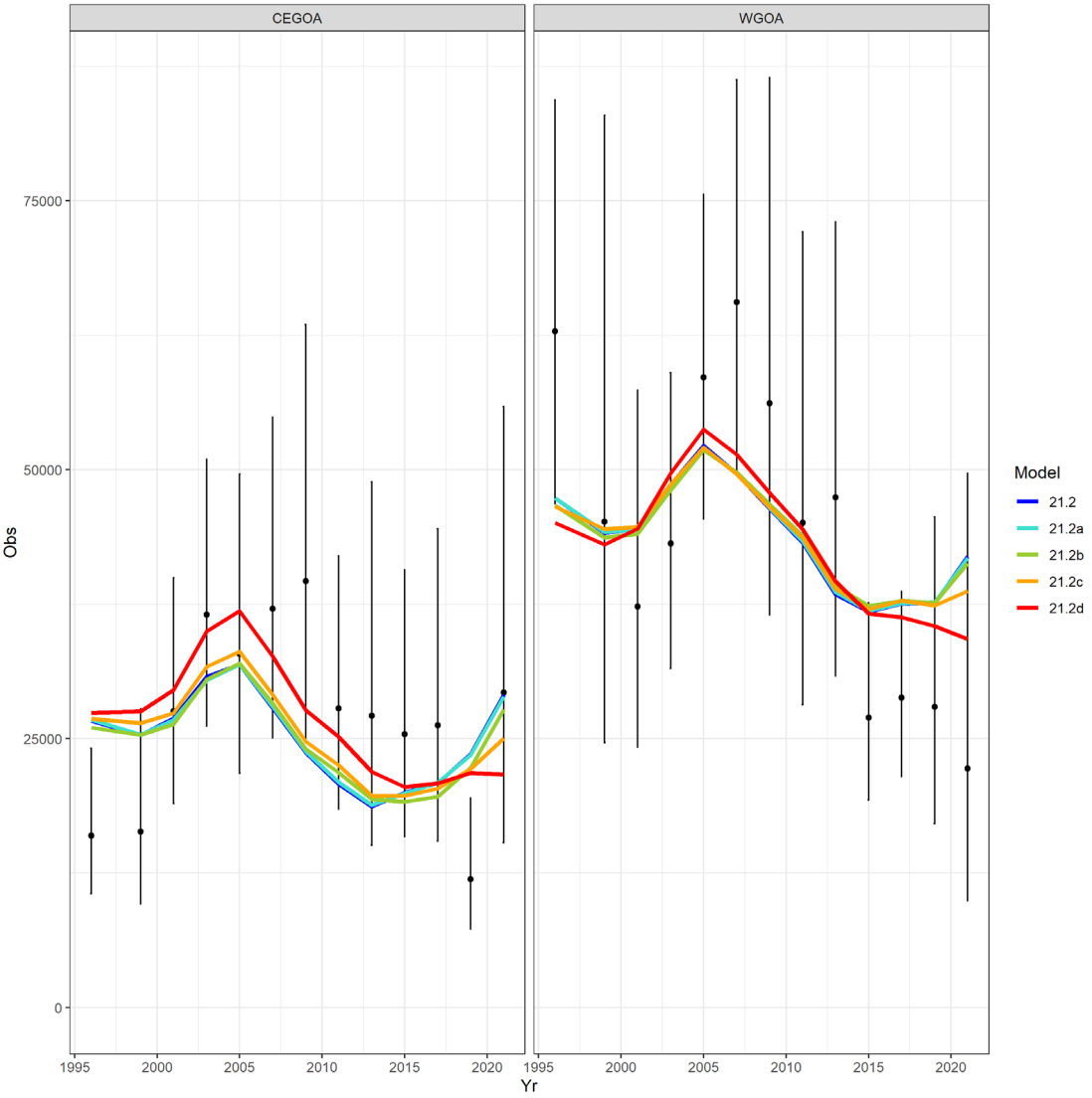
NRS model updates

Model	Change in model
21.2a	Revised length-weight relationship
21.2b	Revised catch estimated
21.2c	Revised input sample size for length composition
21.2d	21.2c with Francis reweighting

NRS model updates

Year	Fleet	NRS input sample size 21.2	21.2c	Adjusted sample size 21.2d
1996	CEGOA	9	71	71
1999	survey	11	79	79
2001		60	106	106
2003		32	128	128
2005		19	134	134
2007		36	141	141
2009		30	135	135
2011		31	105	105
2013		26	91	91
2015		29	111	111
2017		46	76	76
2019		22	74	74
2021		19	67	67
1996	WGOA survey	13	123	31.98
1999		20	100	26
2001		41	91	23.66
2003		33	165	42.9
2005		36	122	31.72
2007		41	146	37.96
2009		24	141	36.66
2011		42	116	30.16
2013		35	97	25.22
2015		22	110	28.6
2017		28	87	22.62
2019		36	81	21.06
2021		29	72	18.72

Northern rock sole



Model	RMSE	fleetname
21.2	0.35	Central
	0.27	West
21.2b	0.34	Central
	0.27	West
21.2c	0.34	Central
	0.26	West
21.2d	0.32	Central
	0.23	West

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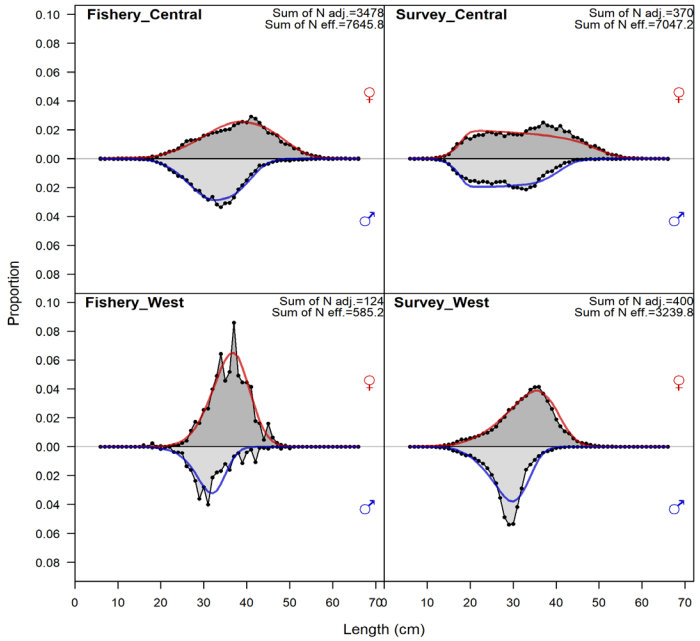
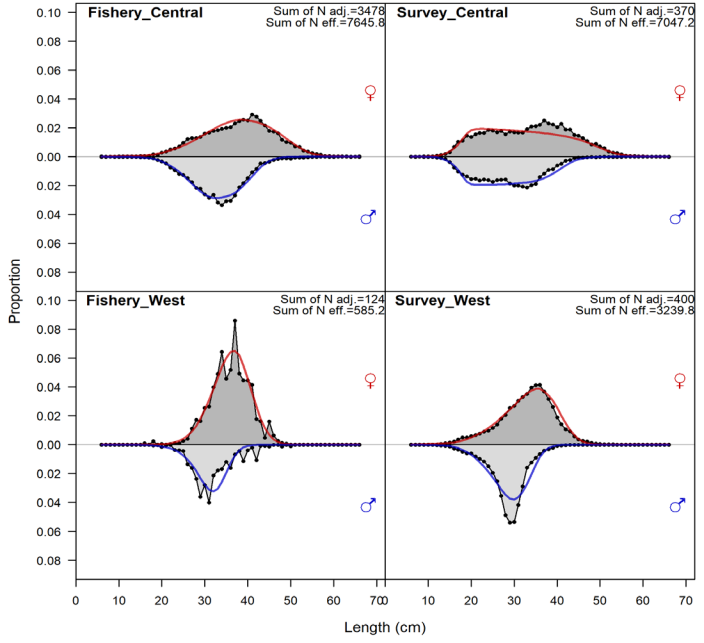
Northern rock sole

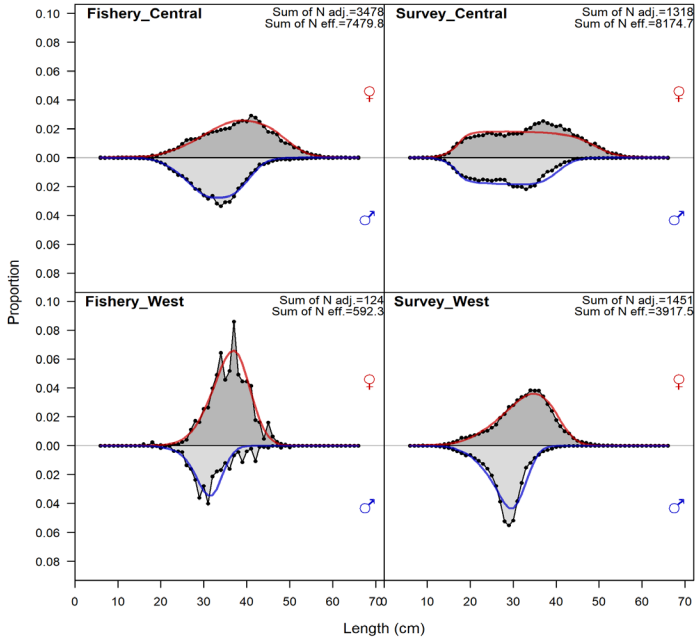
21.2



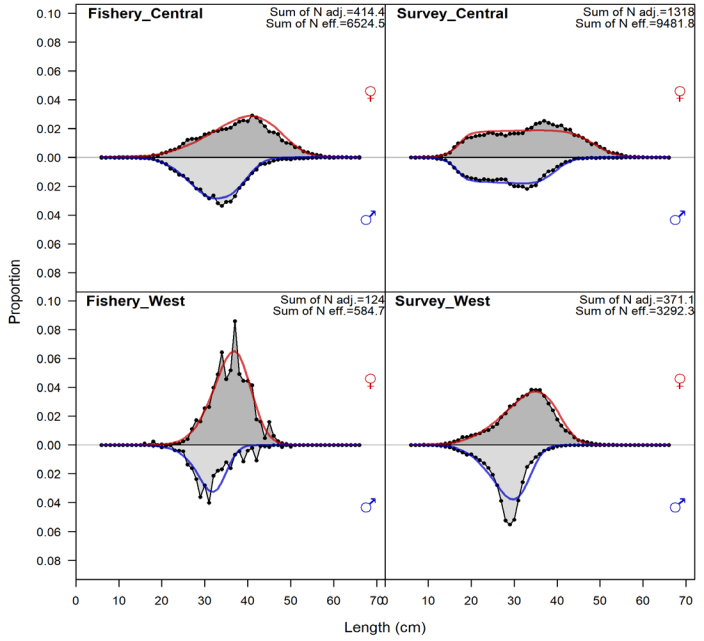
21.2b



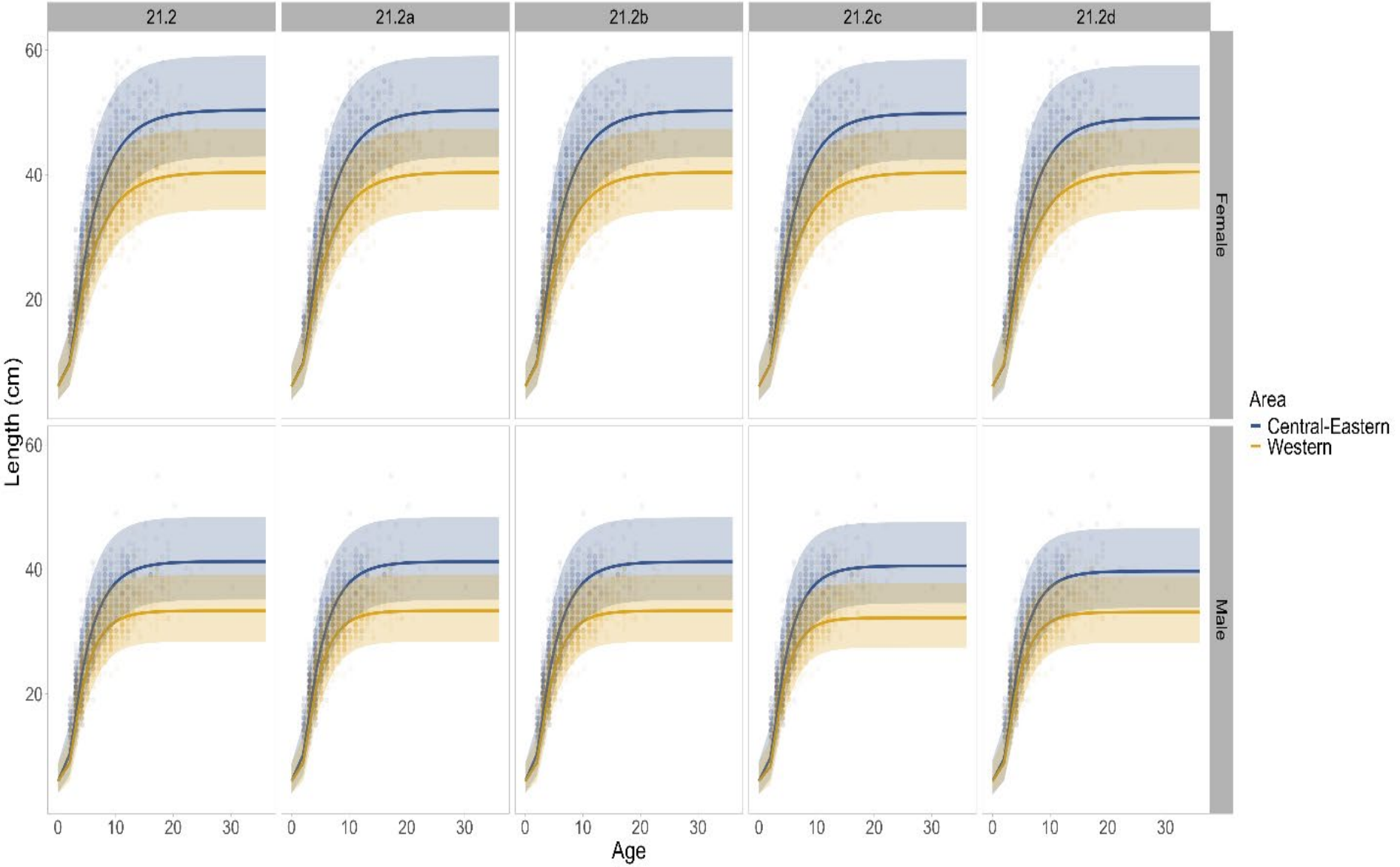
21.2c



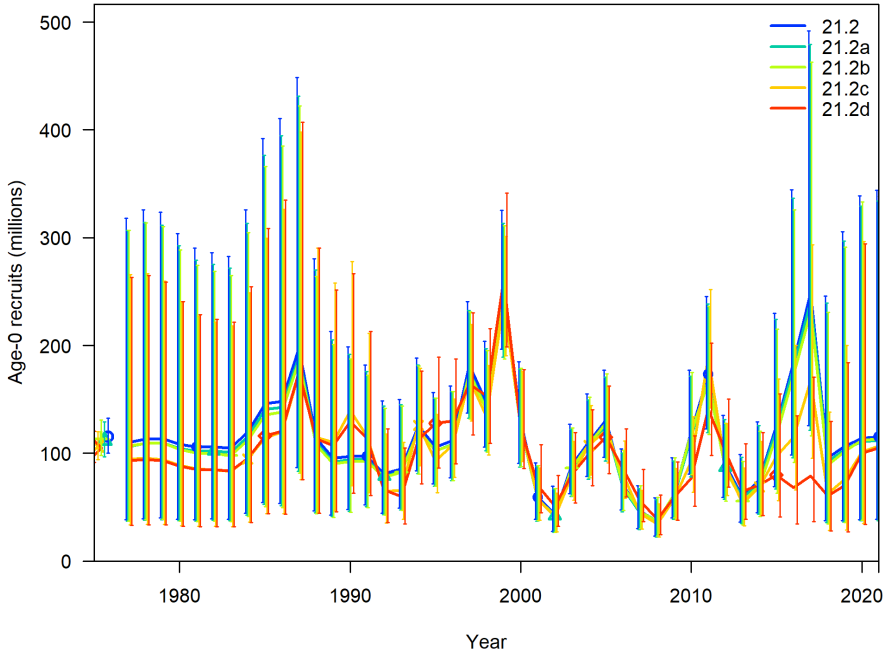
21.2d

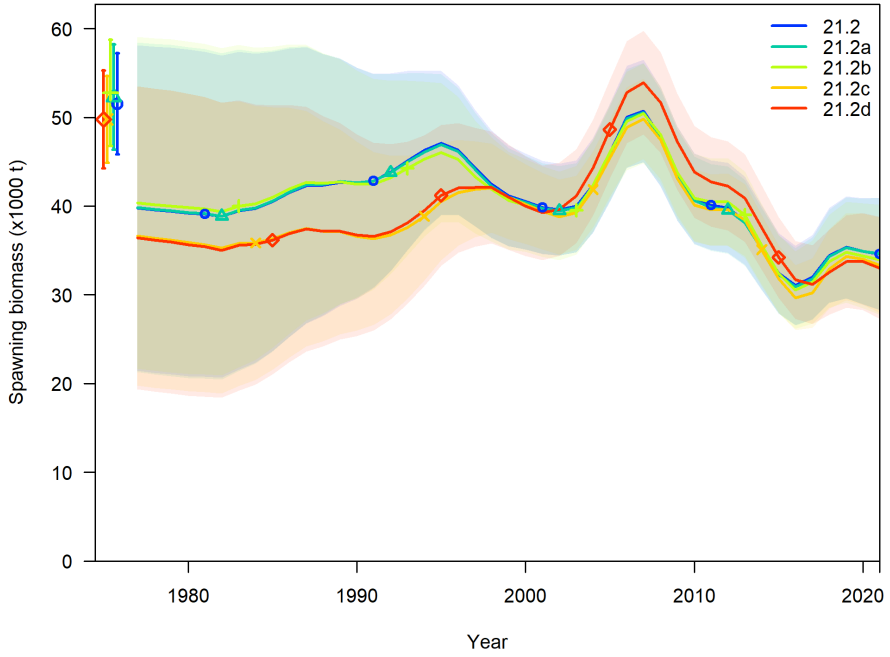


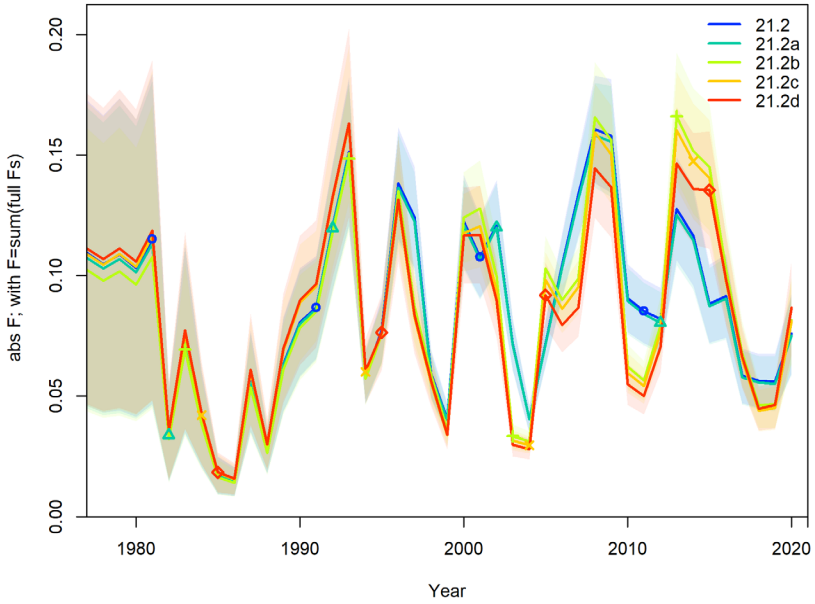
Northern rock sole



Northern rock sole







- We recommend bringing model 21.2c forward in November.
  - The length comp ISS better reflects length sample and fits to the data are generally similar to model 21.2

SRS model updates

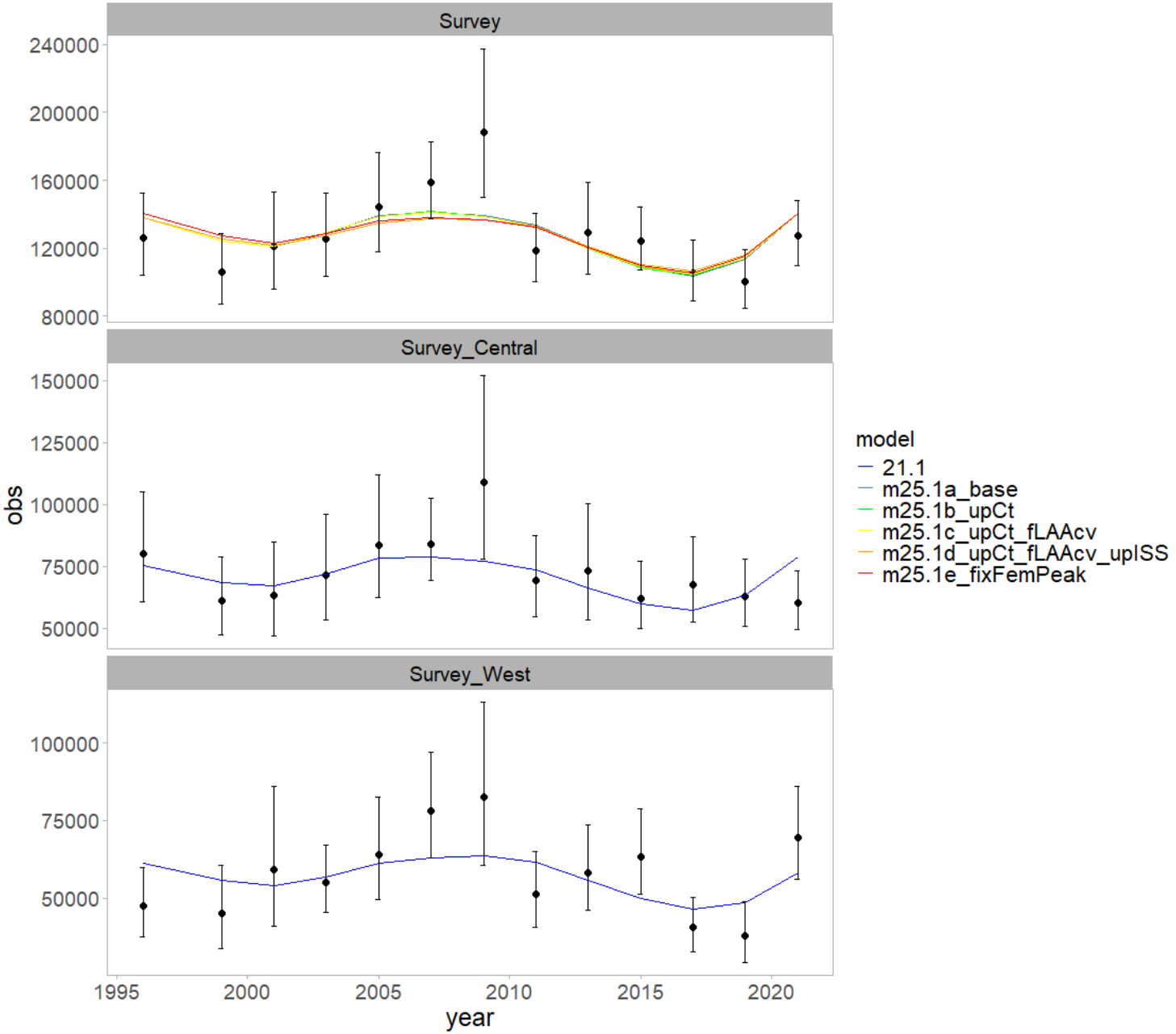
Model	Change in model
25.1a	Single area model with 50% catch split
25.1b	Revised southern rock sole catch estimates
25.1c	Uncertainty in length-at-age modeled as CV similar to the 2-area model
25.1d	Updated survey length composition input sample size
25.1e	Updated survey length composition input sample size with fixed female peak selectivity parameter for the survey

SRS model updates

Model	Change in model
25.1d	Updated survey length composition input sample size

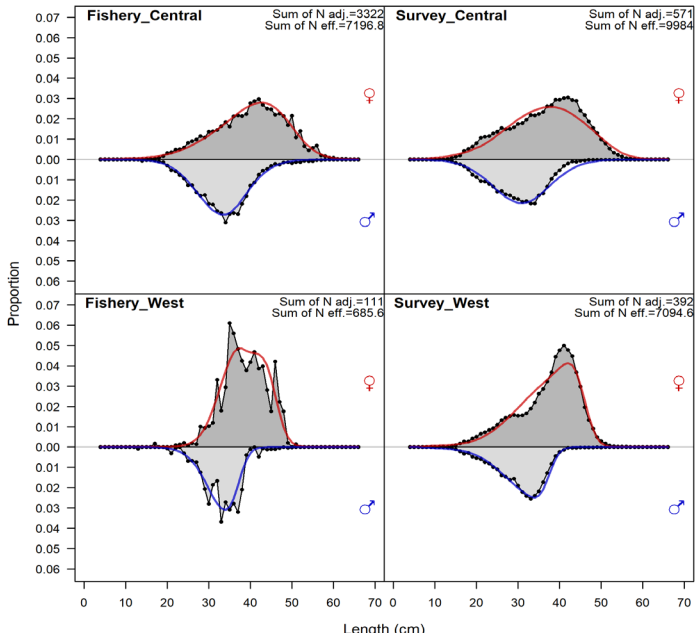
		SRS input sample size	
Year	Fleet	21.2	25.1d
1996	GOA survey	39	277
1999	GOA survey	36	254
2001	GOA survey	107	232
2003	GOA survey	67	348
2005	GOA survey	61	322
2007	GOA survey	75	332
2009	GOA survey	56	333
2011	GOA survey	71	256
2013	GOA survey	62	210
2015	GOA survey	46	275
2017	GOA survey	81	187
2019	GOA survey	124	202
2021	GOA survey	138	217

Southern rock sole

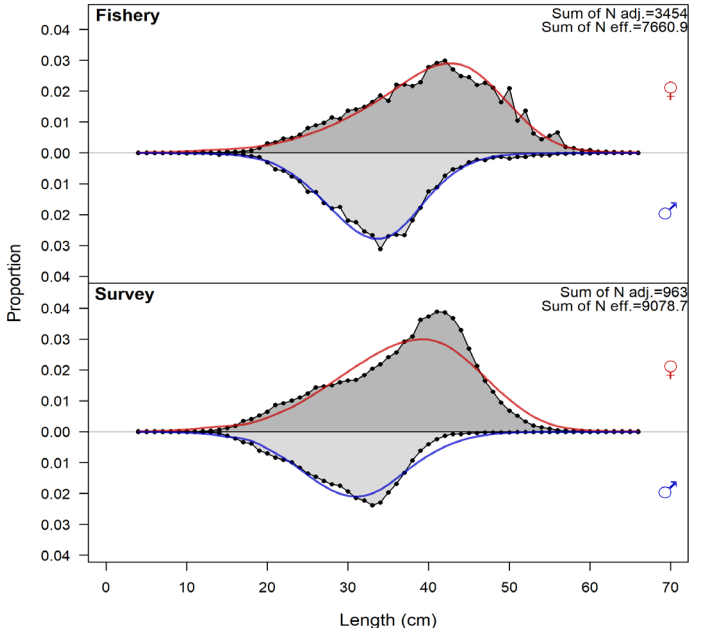


Southern rock sole

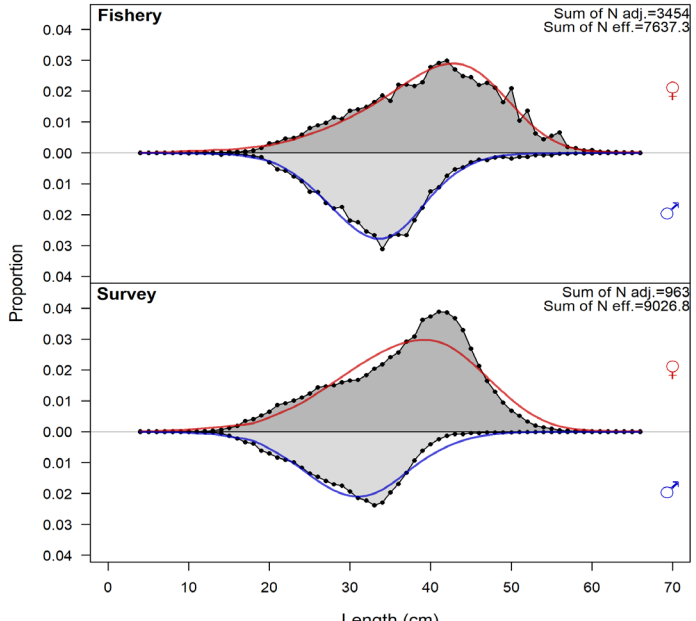
21.1



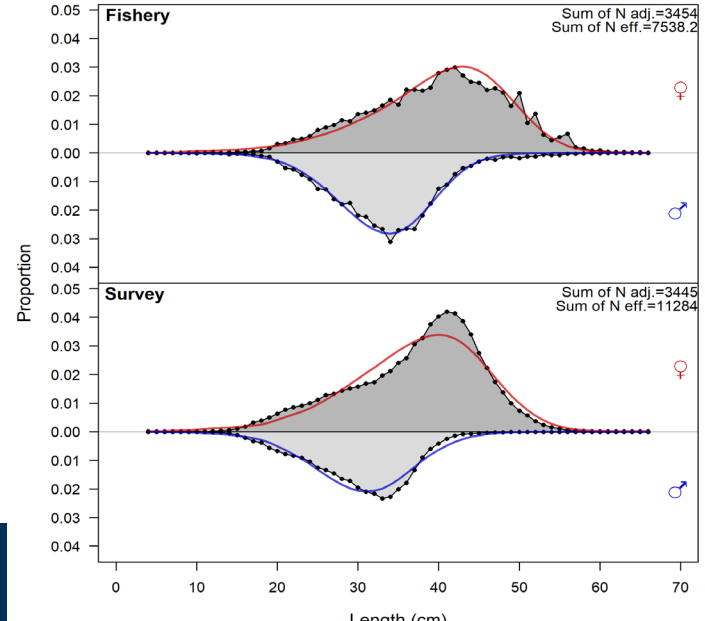
25.1b



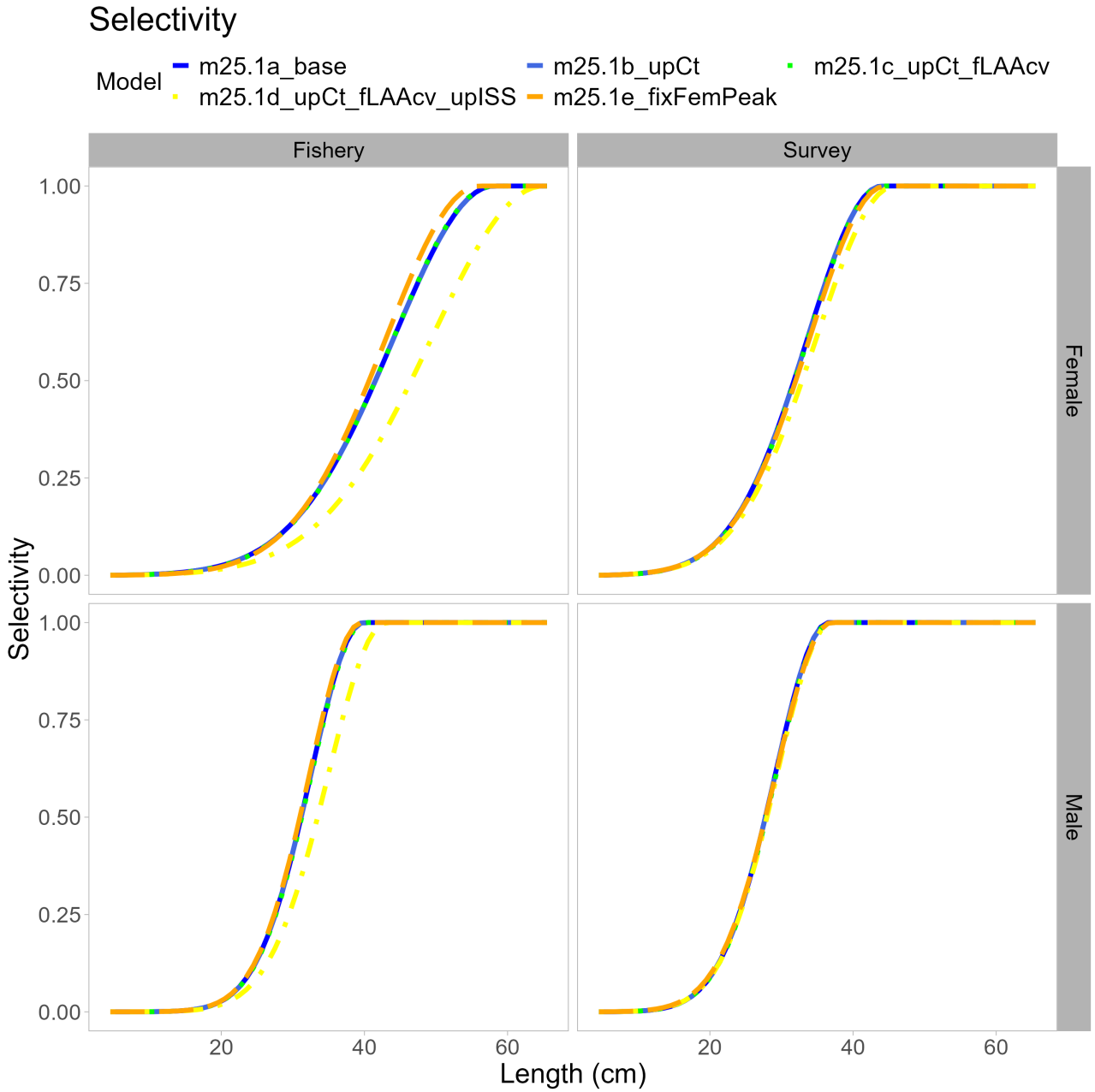
25.1c



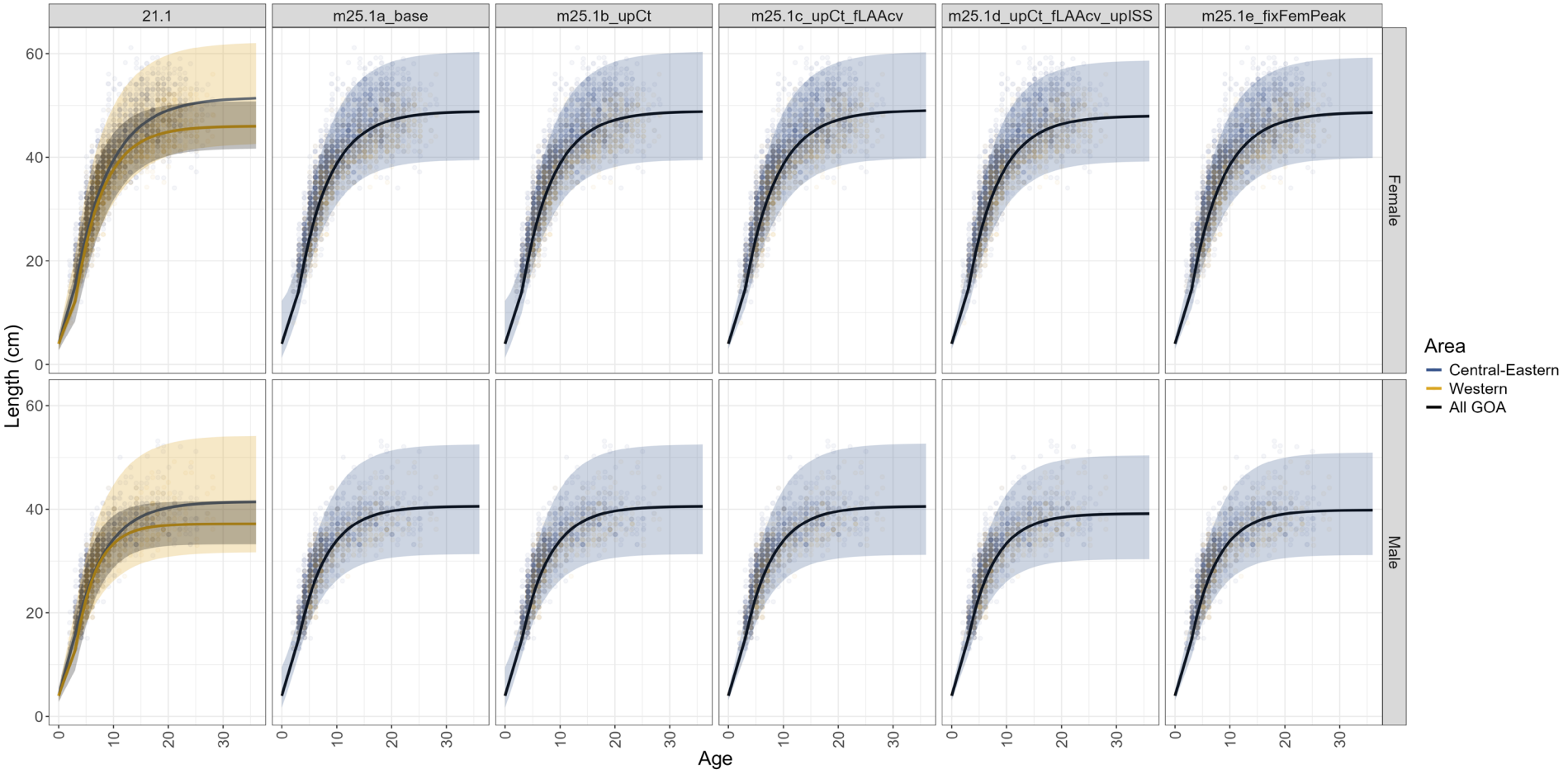
25.1d



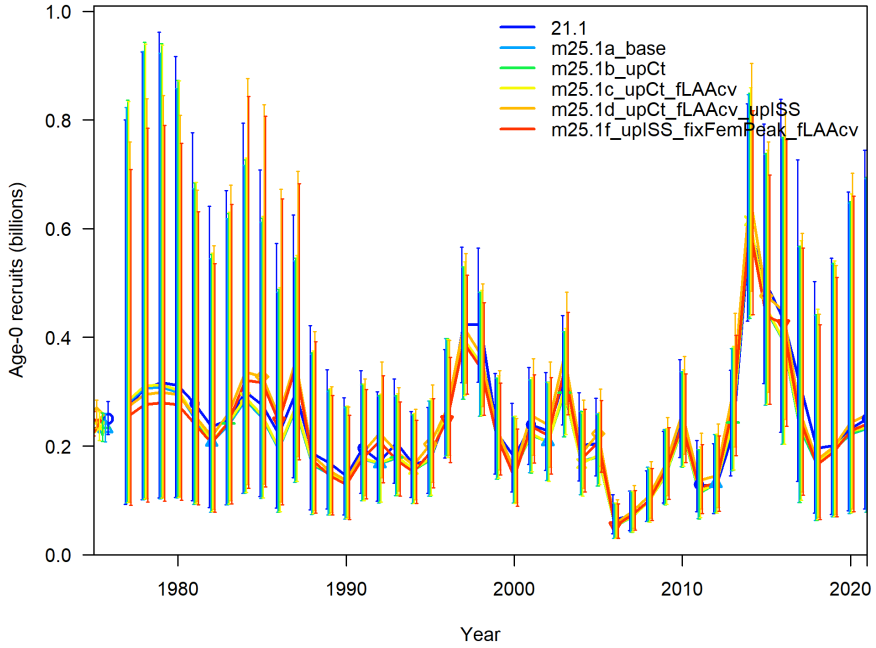
Southern rock sole

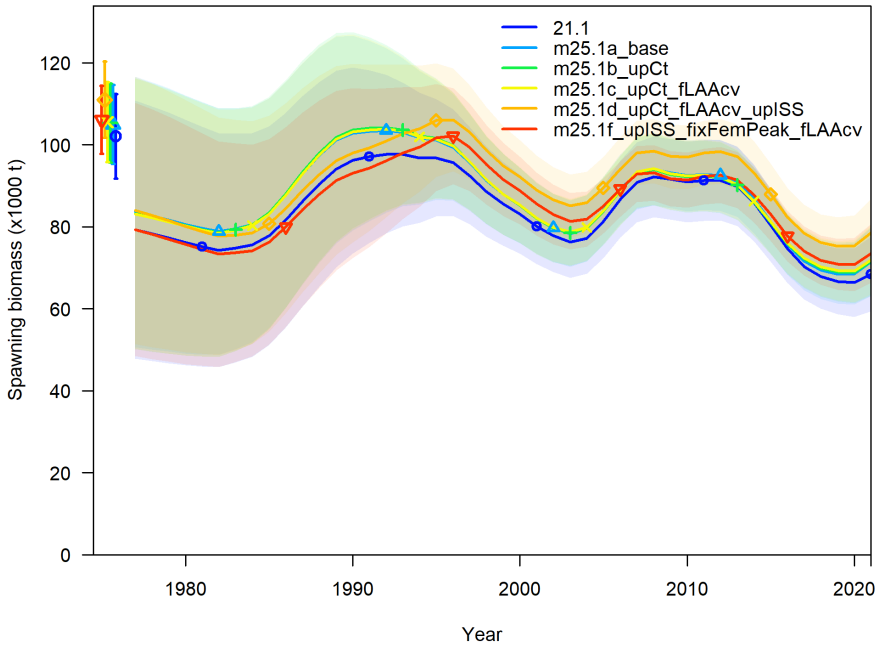


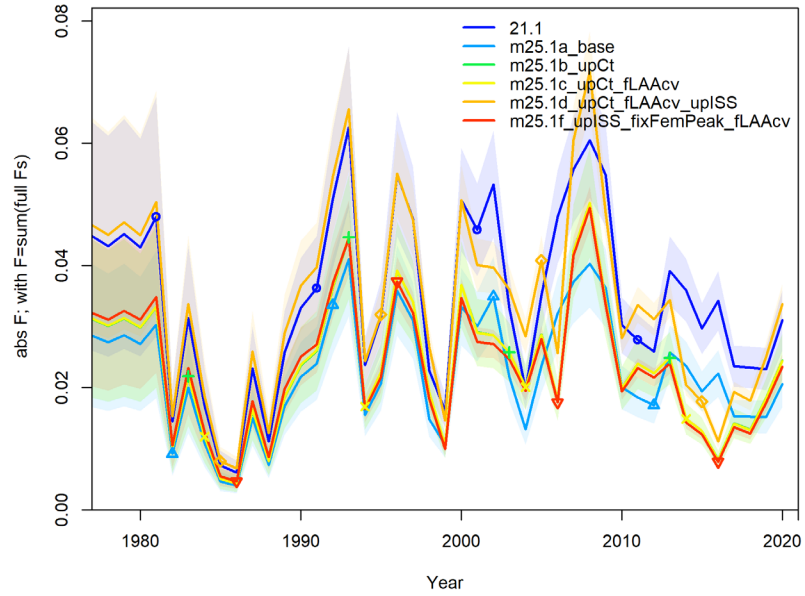
Southern rock sole



Southern rock sole







- We recommend bringing model 21.1d forward in November.
  - Incorporates observed proportions of species specific catch
  - The length comp ISS better reflects length sample
  - Fits to the data are generally similar to model 21.1