Aleutian Islands Golden King Crab 2023 Final Assessment

CPT May 2023

Siddeek, MS, B Daly, **T Jackson**

Response to Comments, Jan 2023

CPT #2: “*The time-period for setting the years that define average recruitment should be justified, for example using a plot of years versus the variances of the recruitment deviations. This type of analysis should be included in all future assessments.*”

The time for setting the years that define average recruitment was brought up by the SSC in February 2022 and we responded to this question by showing that there were very little differences in the MMB trends and reference point estimates between two hypothetical periods.

The variance analysis is a good suggestion. However, because of limited time available we postpone this analysis to the next assessment cycle. Can explore in Jan 2024.

Response to Comments, Jan 2023

CPT #3: "*The fits to the three CPUE series should be reported on separate plots.*"

Done. See Figures 19, 20, and 33.

CPT #4: "*The combined model (i.e., fitting the data for the EAG and WAG as a single-area model) led to an OFL that is similar to the sum of those for the assessments of the EAG and WAG separately for the model 21.1e2 specifications. However, no fit diagnostics were provided for the combined model so the 2023 assessment should include an appendix with the fit diagnostics.*"

Because of limited time available we did not take up this analysis in this assessment cycle. Will explore in Jan 2024.

Response to Comments, Jan 2023

CPT #5: "*The rationale for considering model 21.1f should be included in the assessment document, along with plots that show the extent to which the trend in CPUE varies among locations.*"

We have provided the rationale for including the Year:Area interaction CPUE model in Appendix B. Because of limited time between January and May, we did not explore the extent to which the trend in CPUE varies among location. This can be done in the next assessment cycle.

Response to Comments, Jan 2023

CPT #8: “*Recommendation for 2024 assessment:*

Models 21.1e2CPUE5Wt and 21.1fCPUE5Wt fit the CPUE data for the EAG much better than the base model (as expected) but without an obvious visual change in the fit to the size-composition data. Models that are forced to achieve better fits to the CPUE indices should be explored; in particular it is necessary to conduct analyses to identify the data sources that preclude the model fitting the CPUE index data well.”

Will revisit in Jan 2024.

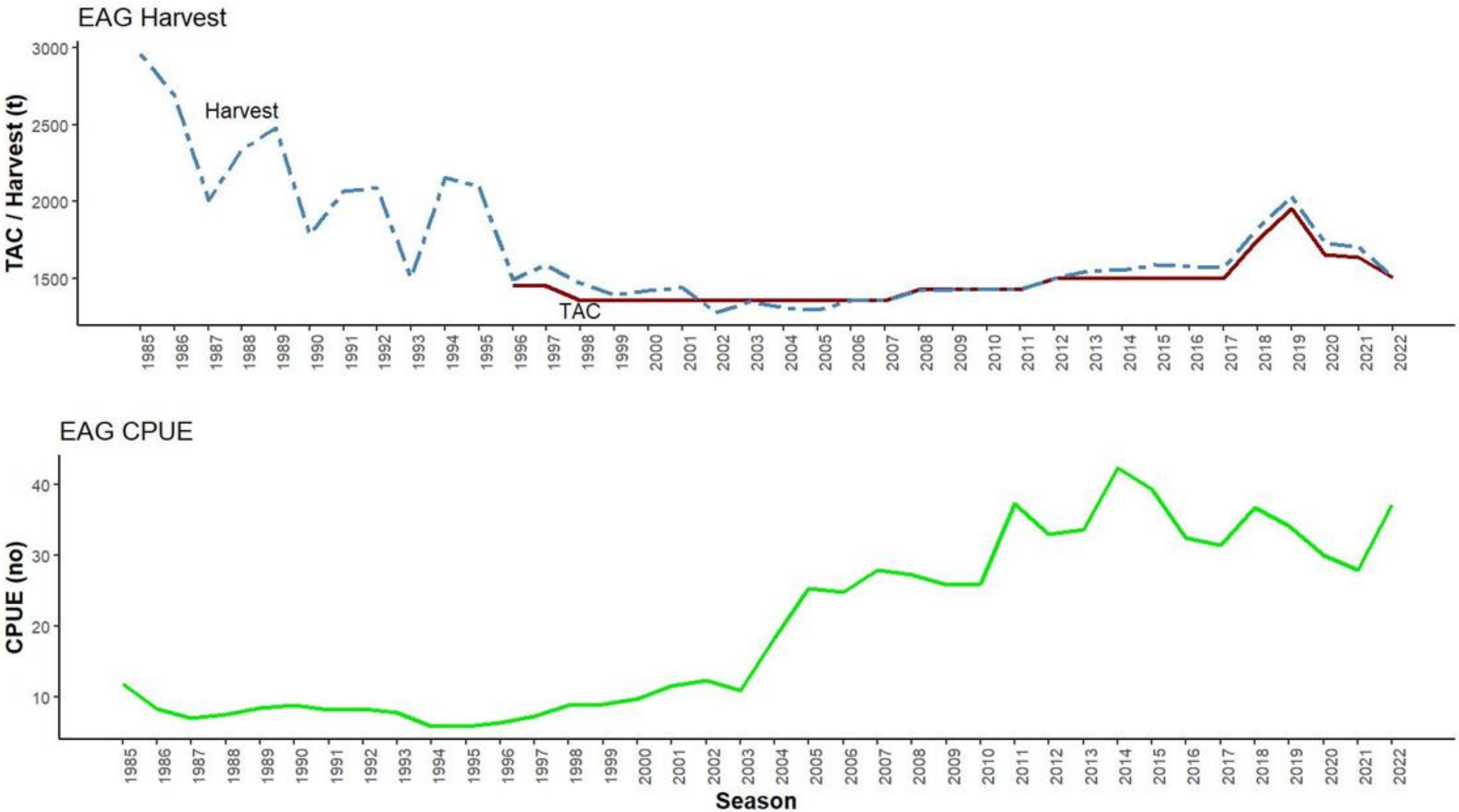


Figure 6. Historical commercial harvest (from fish tickets; metric tons), total allowable catch (TAC), and catch-per-unit effort (CPUE, number of crab per pot lift) of golden king crab in EAG, 1985/86–2022/23 (note: 1985 refers to the 1985/86 fishing year).

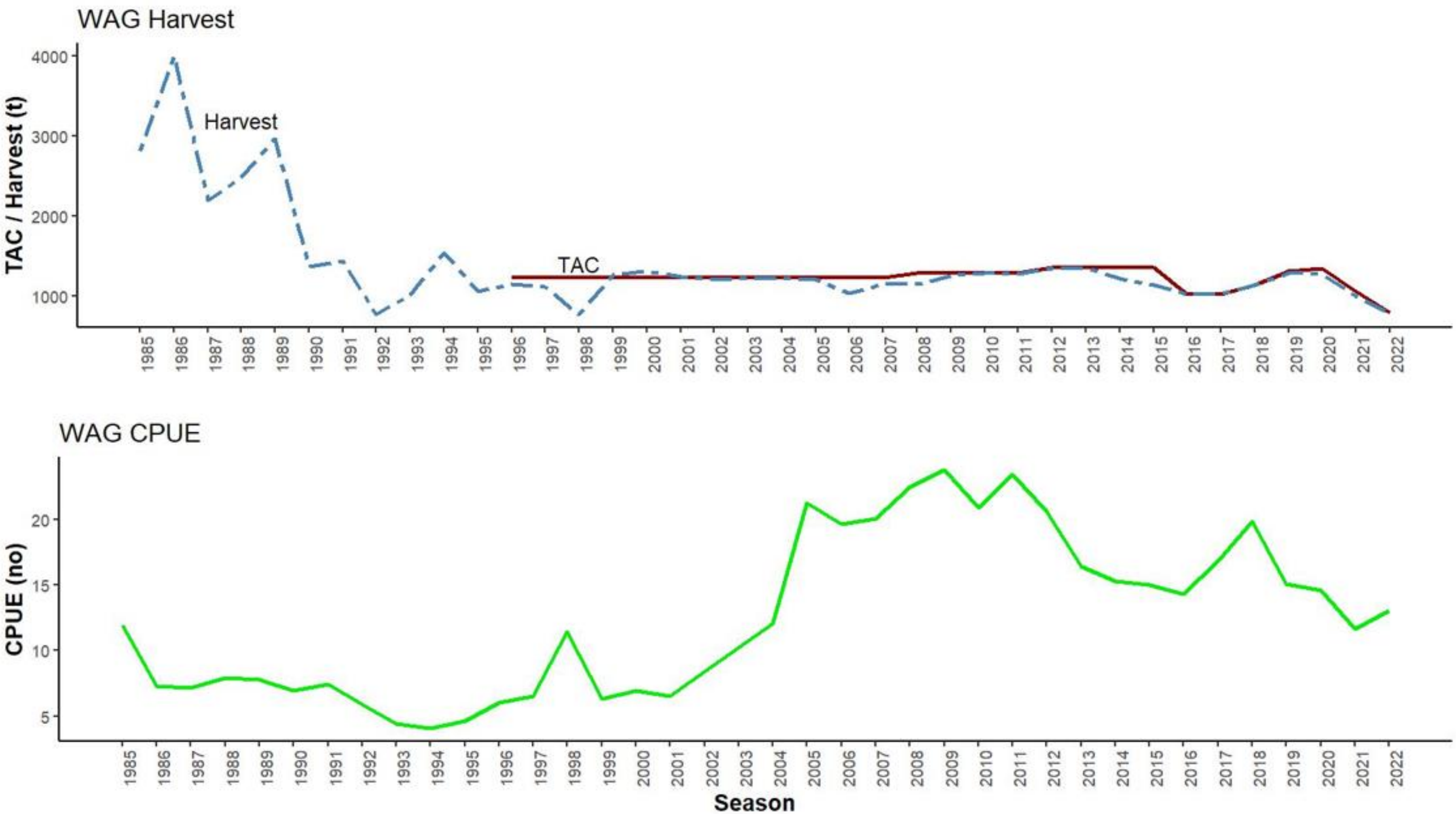


Figure 7. Historical commercial harvest (from fish tickets; metric tons)), total allowable catch (TAC), and catch-per-unit effort (CPUE, number of crab per pot lift) of golden king crab in WAG, 1985/86–2022/23 (note: 1985 refers to the 1985/86 fishing year).

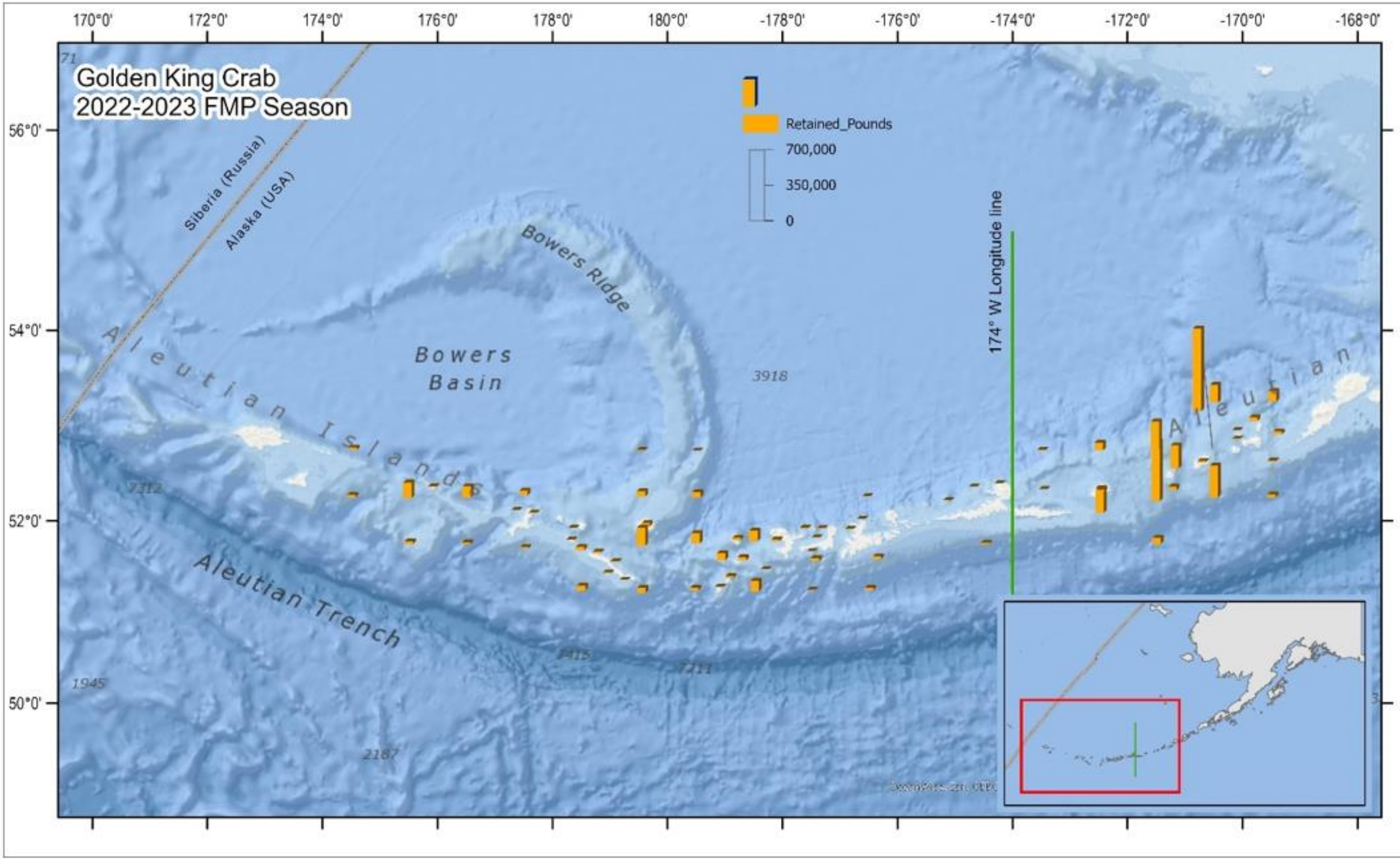


Figure 8. Catch distribution by statistical area in 2022/23.

CPUE Standardization (Appendix B)

Negative Binominal GLM

<u>Null Model</u>

$\ln(\mathrm{CPUE_i}) = \mathrm{Year}_{y_i}$

<u>Full Model</u>

$\ln(\mathrm{CPUE_I}) = \mathrm{Year}_{y_i} + \mathrm{ns}(\mathrm{Soak}_{si}, \mathrm{df}) + \mathrm{Month}_{m_i} + \mathrm{Vessel}_{vi} + \mathrm{Captain}_{ci} + \mathrm{Block}_{ai} + \mathrm{Gear}_{gi} + \mathrm{ns}(\mathrm{Depth}_{di}, \mathrm{df}),$

Negative Binominal GLM w/ interaction

<u>Null Model</u>

$\ln(\mathrm{CPUE_i}) = \mathrm{Year}_{y_i}\mathrm{:Block}_{ai}$

<u>Full Model</u>

$\ln(\mathrm{CPUE_I}) = \mathrm{Year}_{y_i}\mathrm{: Block}_{ai} + \mathrm{ns}(\mathrm{Soak}_{si}, \mathrm{df}) + \mathrm{Month}_{m_i} + \mathrm{Vessel}_{vi} + \mathrm{Captain}_{ci} + \mathrm{Gear}_{gi} + \mathrm{ns}(\mathrm{Depth}_{di}, \mathrm{df})$

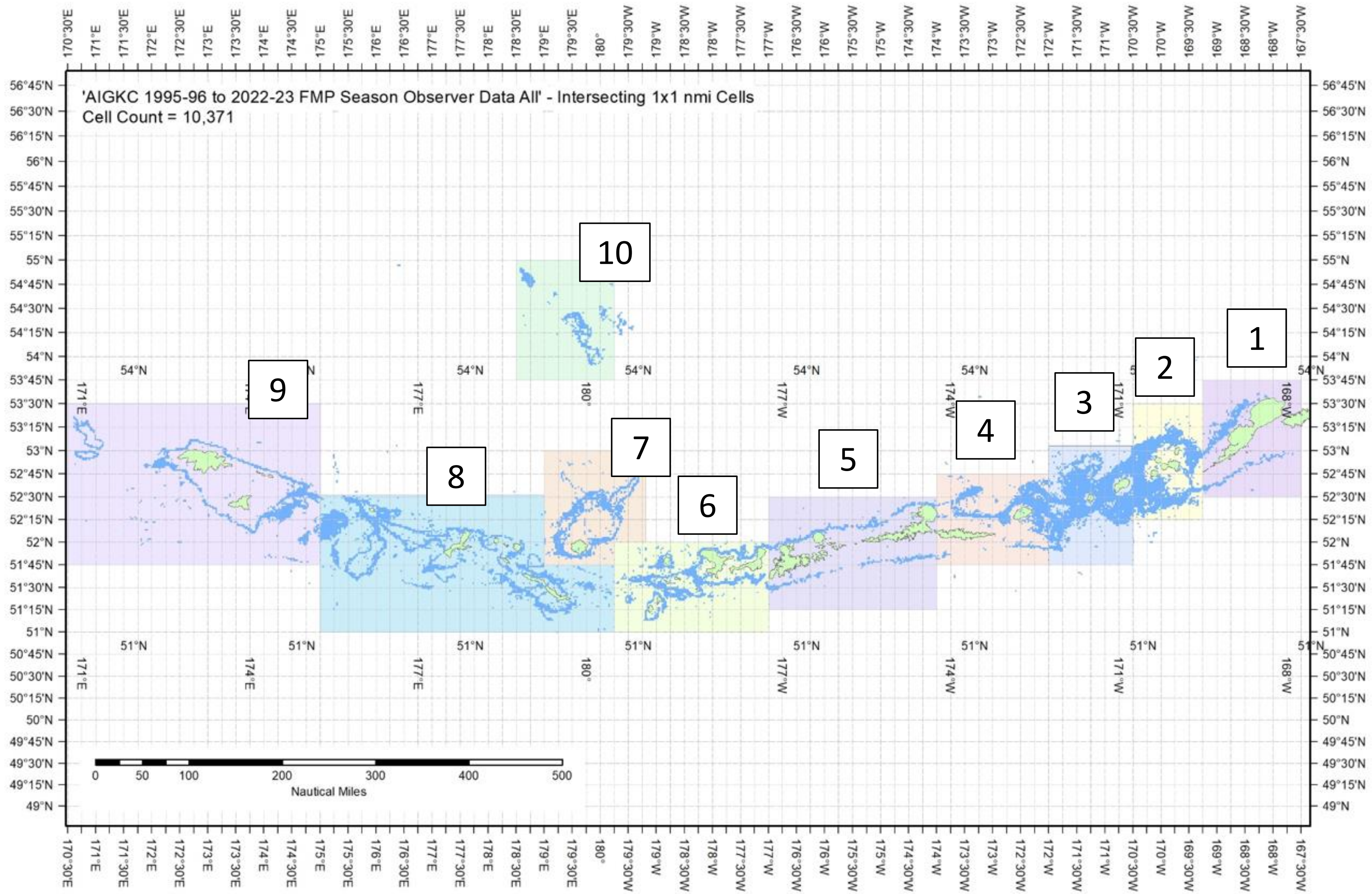


Figure B.1. The 1995/96–2022/23 observer pot samples enmeshed in 10 blocks for the Aleutian Islands golden king crab.

1x1 cells fished within blocks (Table B.2)

Block	N_{ever}
1	375
2	1,364
3	1,765
4	915
5	452
6	1,026
7	812
8	2,172
9	1,042
10	334

CPUE Index w/ Year:Block

- $CPUE_{ij} = \ e^{YB_{ij} + \ \sigma_{ij}^2/2}$

- $B_i = \sum B_{ij} = \ \sum N_{ever_j} CPUE_{ij}$

- If there is no fishing in a block within year i, *a* log-linear model is fit to estimate $\widehat{B_{i,j}}$

$$ln(\hat{B}_{i,j}) = \ Year_i + \ Block_j$$

- $I_i = \frac{B_i}{\sqrt[n]{\prod_{i=1}^{n} B_i}}$

EAG CPUE Standardization

w/o Yr:Block

Initial selection by stepAIC:

$$\ln(\text{CPUE}) = \text{Year} + \text{Gear} + \text{Captain} + \text{ns}(\text{Soak}, 4) + Month$$

AIC=203,808

Final selection by stepCPUE:

$$\ln(\text{CPUE}) = \text{Year} + \text{Captain} + \text{ns}(\text{Soak}, 4) + \text{Month} \tag{B.4}$$

for the 1995/96–2004/05 period [θ=1.38, $R^2 = 0.2205$]

Initial selection by stepAIC:

$$\ln(\text{CPUE}) = \text{Year} + \text{Captain} + \text{Gear} + \text{ns}(\text{Soak}, 10) + Month$$

AIC=81,580

Final selection by stepCPUE:

$$\ln(\text{CPUE}) = \text{Year} + \text{Captain} + \text{ns}(\text{Soak}, 10) + Gear \tag{B.5}$$

for the 2005/06–2022/23 period [$\theta = 2.34$, $R^2 = 0.1103$].

EAG CPUE Standardization

w/ Yr:Block

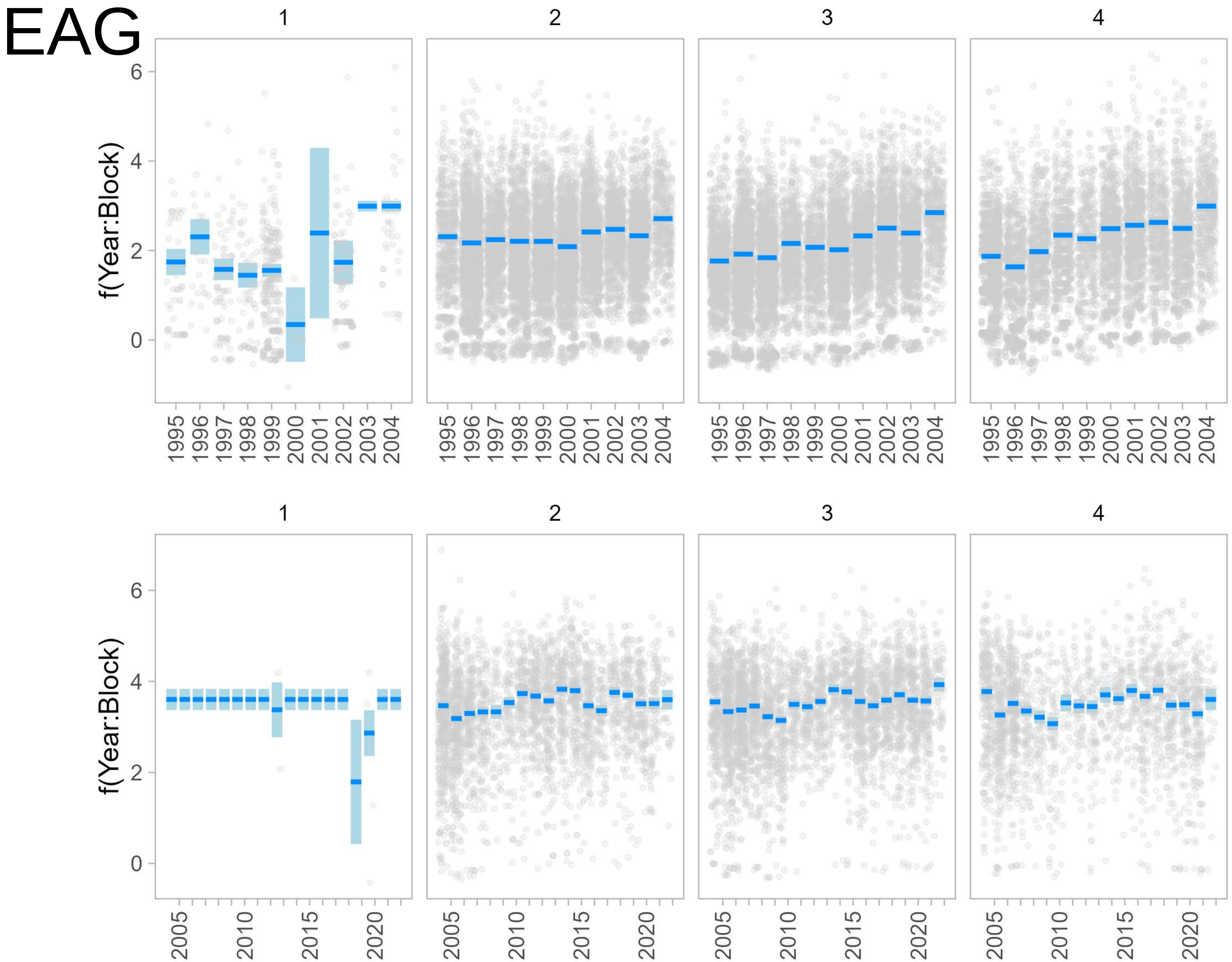
Initial selection by stepAIC:
$\ln(\text{CPUE}) = \text{Gear} + \text{Captain} + \text{ns}(\text{Soak}, 4) + \text{Month} + Year{:}Block$

AIC=203,851

Final selection by stepCPUE:
$\ln(\text{CPUE}) = \text{Gear} + \text{Captain} + \text{ns}(\text{Soak}, 4) + Year{:}Block$ (B.10)
for the 1995/96–2004/05 period [θ=1.38, $R^2 = 0.2235$]

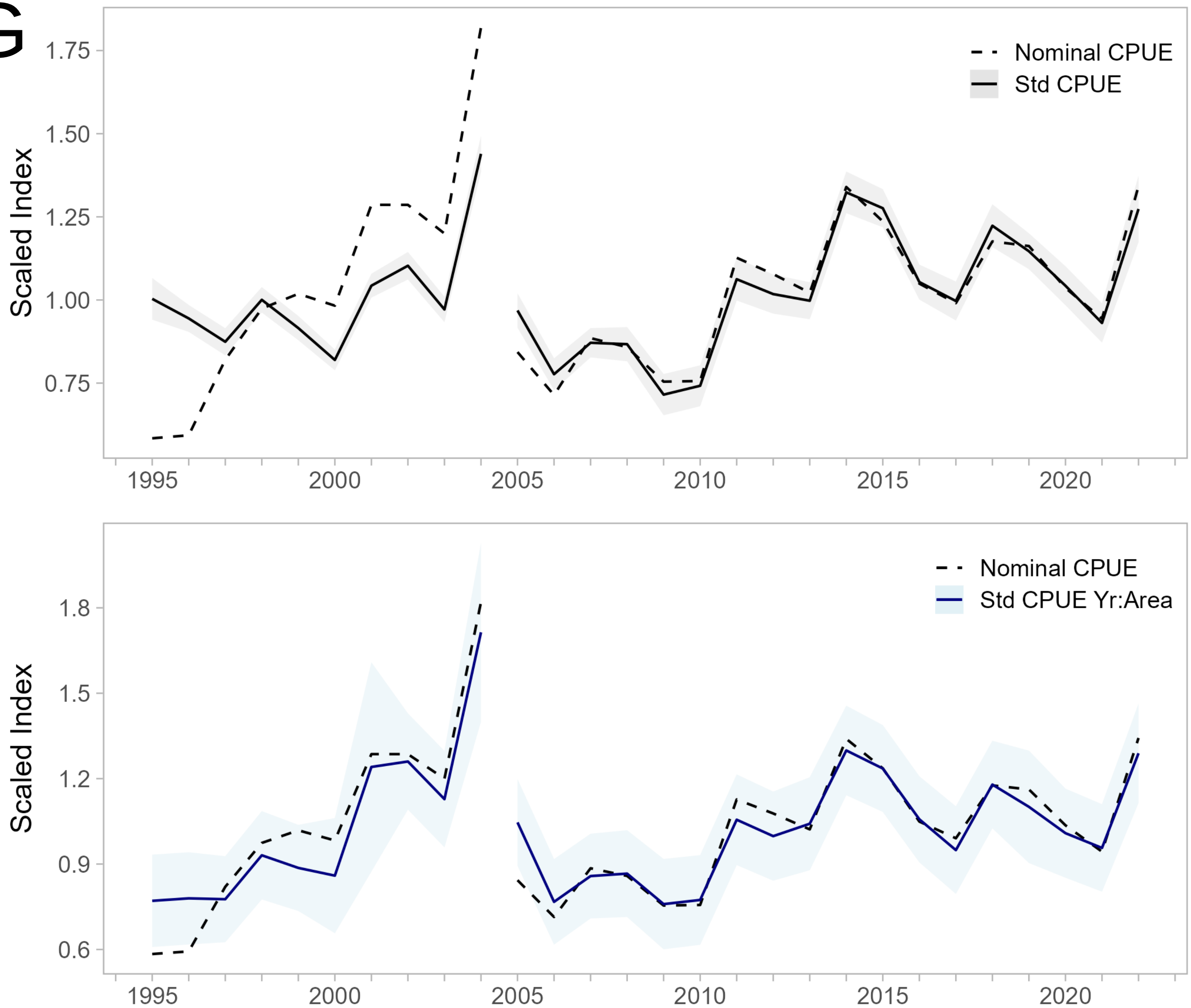
Initial selection by stepAIC:
$\ln(\text{CPUE}) = \text{Vessel} + \text{Gear} + \text{ns}(\text{Soak}, 10) + \text{Month} + Year{:}Block$
AIC=81,772

Final selection by stepCPUE:
$\ln(\text{CPUE}) = \text{Vessel} + \text{ns}(\text{Soak}, 10) + Gear + Year{:}Block$ (B.11)
for the 2005/06–2022/23 period [$\theta = 2.34$, $R^2 = 0.1201$].



EAG
1
2
3
4
f(Year:Block)
0
2
4
6
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2010
2015
2020

EAG



Nominal CPUE
Std CPUE
Scaled Index
1.75
1.50
1.25
1.00
0.75
1995
2000
2005
2010
2015
2020
Nominal CPUE
Std CPUE Yr:Area
Scaled Index
1.8
1.5
1.2
0.9
0.6
1995
2000
2005
2010
2015
2020

WAG CPUE Standardization

w/o Yr: Block

Initial selection by stepAIC:
$\ln(\text{CPUE}) = \text{Year} + \text{Captain} + \text{ns}(\text{Soak}, 7) + \text{Gear} + Area + Month + Vessel$

AIC=191,025

Final selection by stepCPUE:
$\ln(\text{CPUE}) = \text{Year} + \text{Captain} + \text{ns}(\text{Soak}, 7) + Gear$ (B.6)
for the 1995/96–2004/05 period [θ=0.97, $R^2 = 0.1681$]

Initial selection by stepAIC:
$\ln(\text{CPUE}) = \text{Year} + \text{Captain} + \text{Gear} + \text{Month} + \text{ns}(\text{Soak}, 3)$
AIC=130,731

Final selection by stepCPUE
$\ln(\text{CPUE}) = \text{Year} + \text{Gear} + \text{ns}(\text{Soak}, 2)$ (B.7)
for the 2005/06–2022/23 period [$\theta = 1.11$, $R^2 = 0.0749$, Soak forced in].

WAG CPUE Standardization

w/ Yr: Block

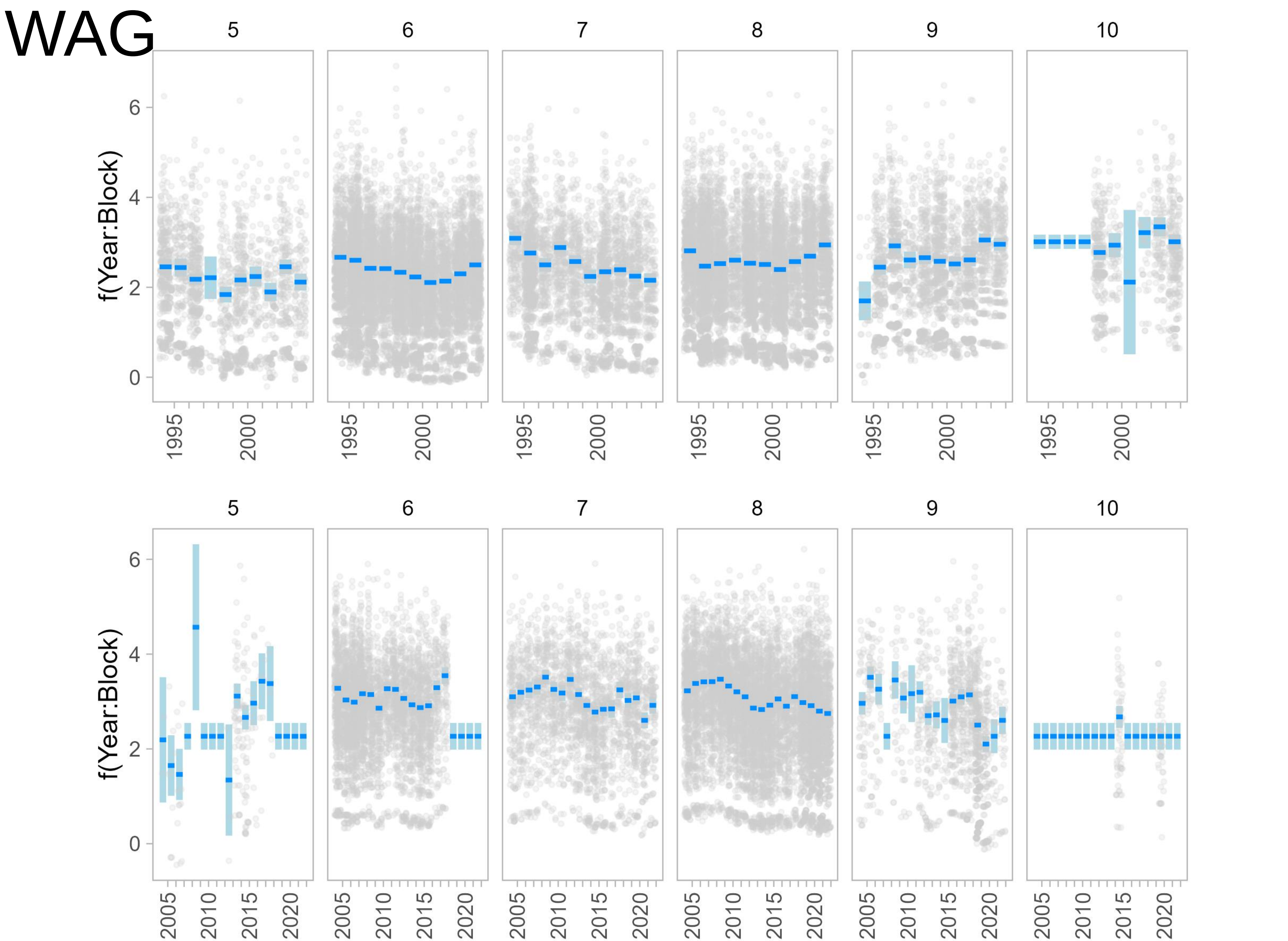
Initial selection by stepAIC:
$\ln(\text{CPUE}) = \text{Vessel} + \text{ns}(\text{Soak}, 7) + Gear + Month + Year{:}Block$

AIC=191,060

Final selection by stepCPUE:
$\ln(\text{CPUE}) = \text{Vessel} + \text{ns}(\text{Soak}, 7) + \text{Gear} + Year{:}Block$ (B.12)
for the 1995/96–2004/05 period [θ=0.97, $R^2 = 0.1719$]

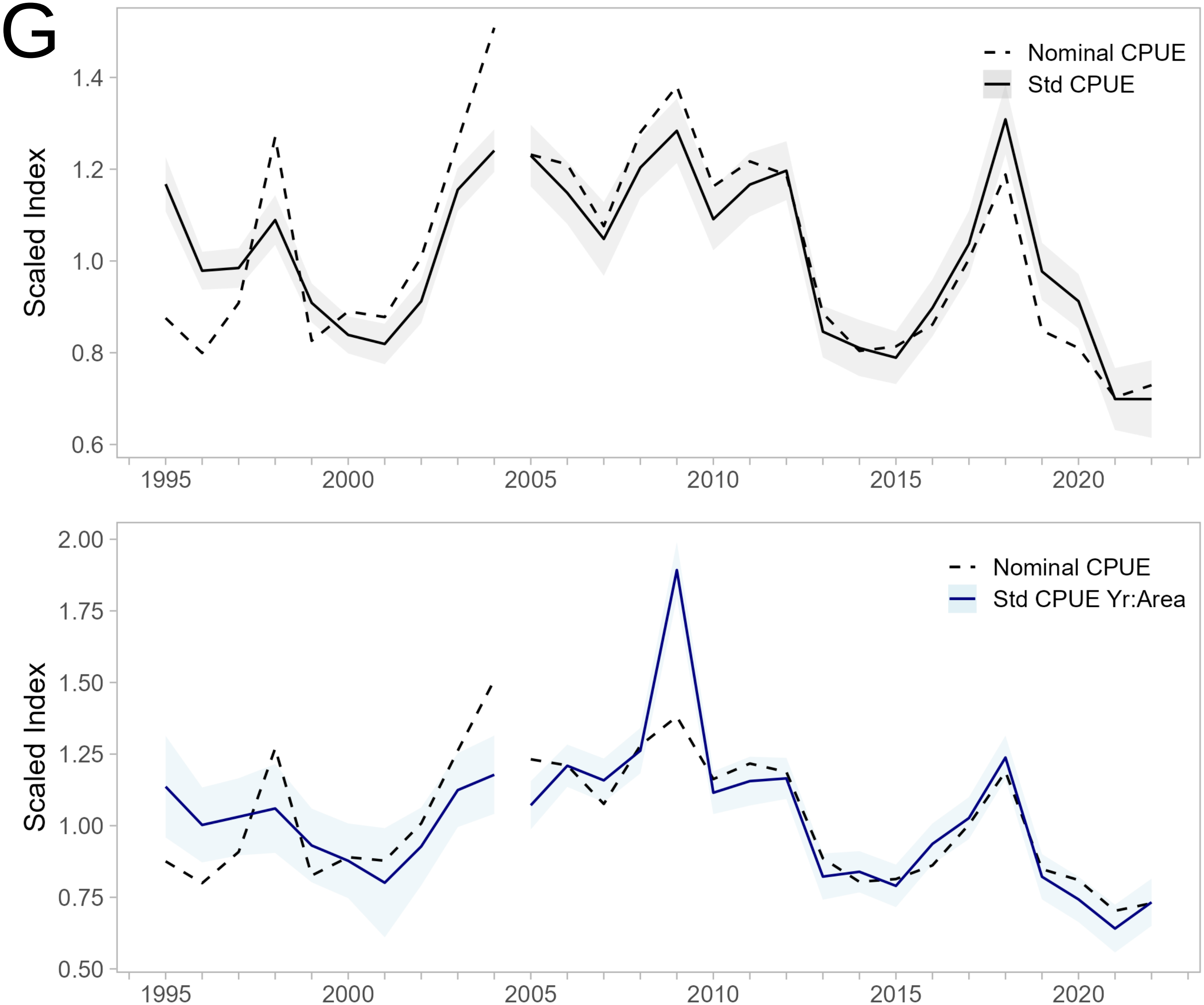
Initial selection by stepAIC:
$\ln(\text{CPUE}) = \text{Gear} + \text{Month} + \text{Vessel} + \text{ns}(\text{Soak}, 3) + Year{:}Block$
AIC=131,060

Final selection by stepCPUE:
$\ln(\text{CPUE}) = \text{Gear} + Month + Year{:}Block + ns(Soak, 3)$ (B.13)
for the 2005/06–2022/23 period [$\theta = 1.11$, $R^2 = 0.0897$, Soak forced in].



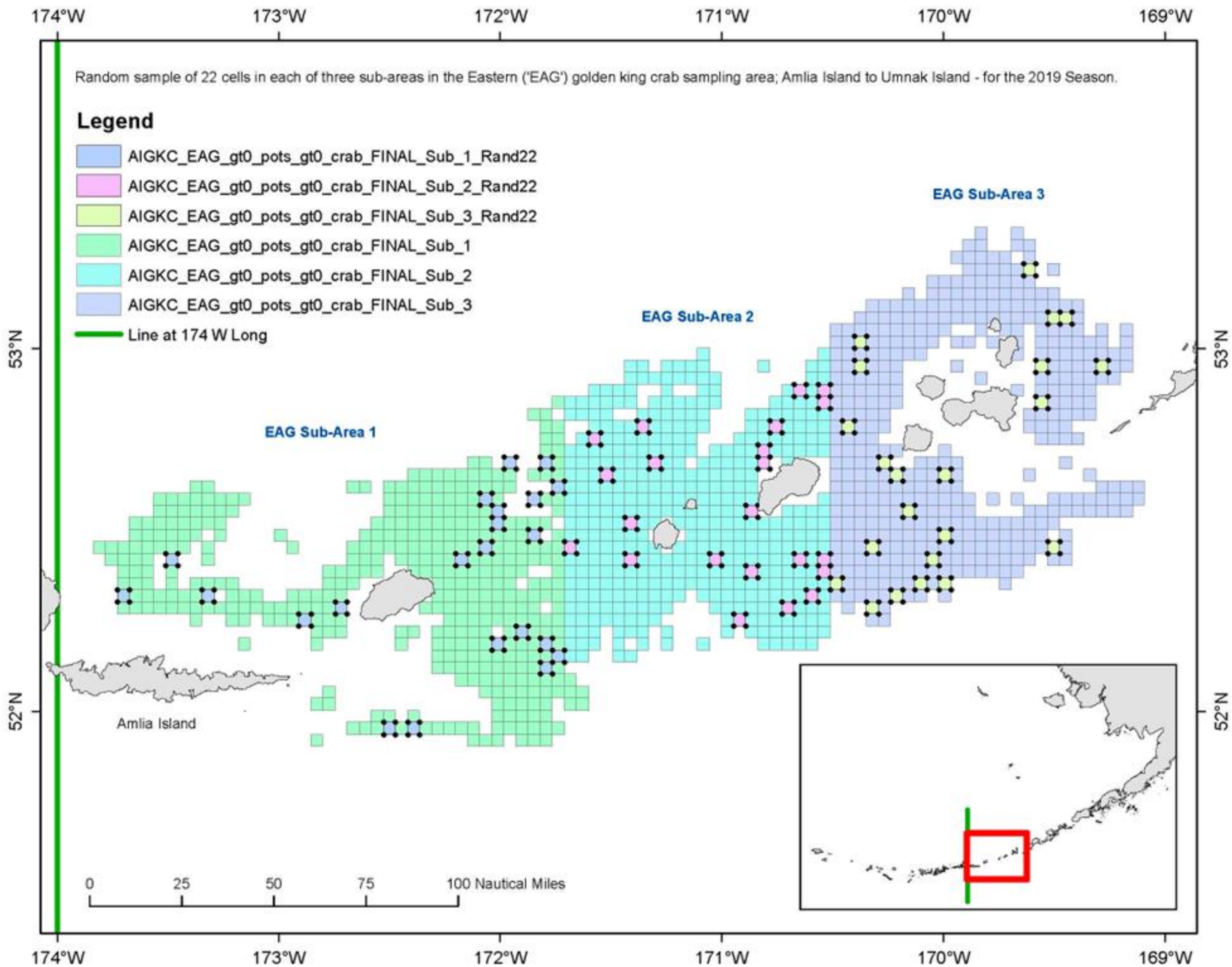
WAG
5
6
7
8
9
10
f(Year:Block)
0
2
4
6
1995
2000
2005
2010
2015
2020

WAG



Nominal CPUE
Std CPUE
Scaled Index
1.4
1.2
1.0
0.8
0.6
1995
2000
2005
2010
2015
2020
Nominal CPUE
Std CPUE Yr:Area
Scaled Index
2.00
1.75
1.50
1.25
1.00
0.75
0.50
1995
2000
2005
2010
2015
2020

Cooperative Survey (Appendix C)



Cooperative Survey (Appendix C)

- Excluded small mesh pots, extreme quantiles of soak time and depth

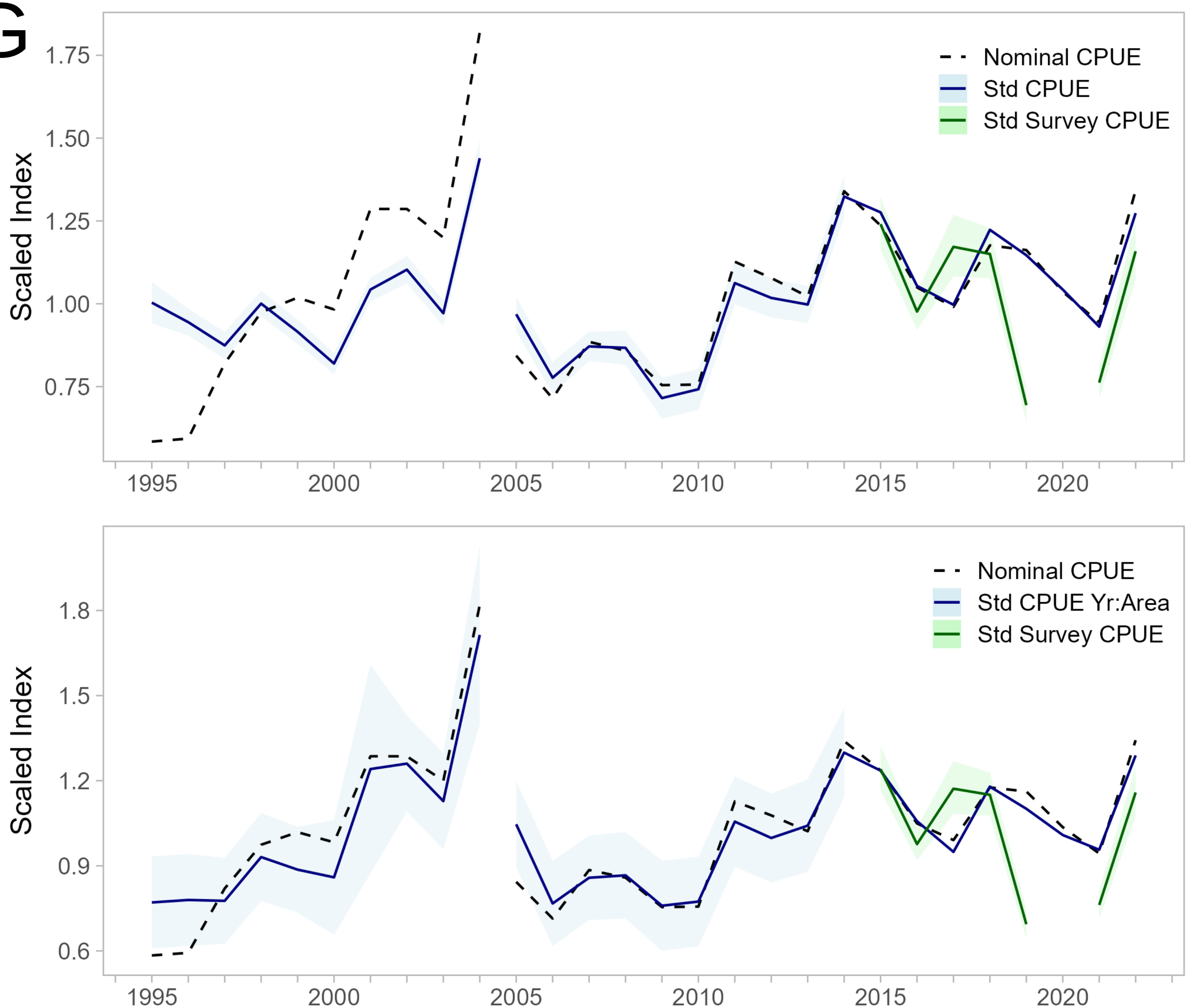
- Standardized index of legal males (> 135 mm) to replace observer CPUE index from 2015-2022 in EAG (except 2020)

$$\ln(\mathrm{CPUE_I}) = \mathrm{Year}_{y_i} + \mathrm{ns}(\mathrm{Depth}_{di}, 9) + \mathrm{ns}(\mathrm{Soak}_{si}, 3) + \mathrm{Captain}_{ci} + (1| \frac{\mathrm{Block}}{\mathrm{VesselString}})$$

Family = Neg. Binomial (θ = 3.01)

- No size composition data included

EAG



Scaled Index
1.75
1.50
1.25
1.00
0.75
1995
2000
2005
2010
2015
2020
Nominal CPUE
Std CPUE
Std Survey CPUE
Scaled Index
1.8
1.5
1.2
0.9
0.6
1995
2000
2005
2010
2015
2020
Nominal CPUE
Std CPUE Yr:Area
Std Survey CPUE

Model Scenarios (Table T1, pg42)

EAG and WAG

- **22.9c** – 2022 accepted model (22_1e2) with modifications for GMACS transition
- **22.1e2** – Model 22.9c in GMACS (w/o Yr:Block)
- **22.1f** – Model 22.1e2 (w/ Yr:Block)

EAG only

- **22.1g** – Model 22.1e2 with co-op survey 2015 – 2022
- **22.1h** – Model 22.1f with co-op survey 2015 – 2022

EAG

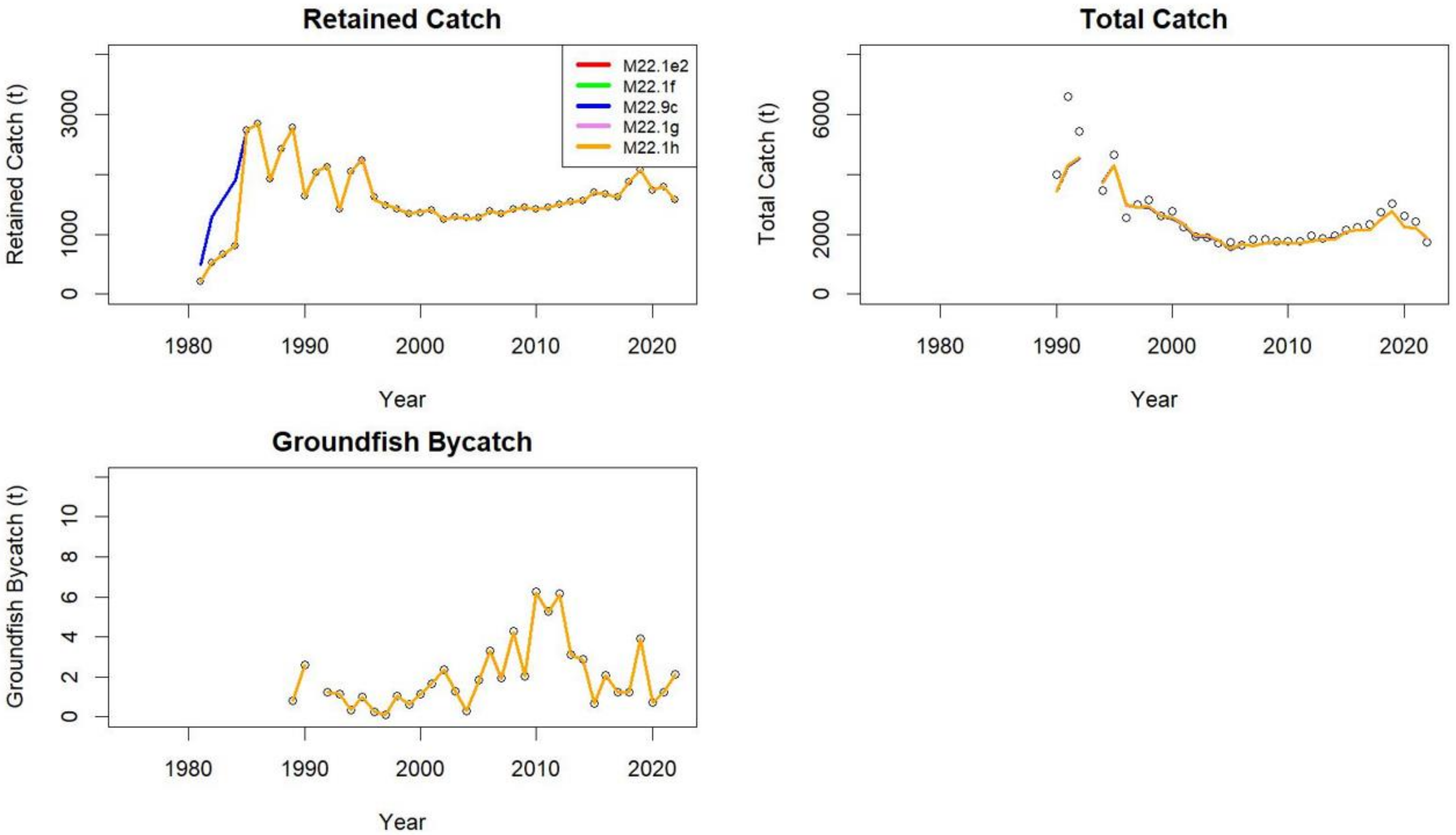


Figure 16, pg 77

EAG

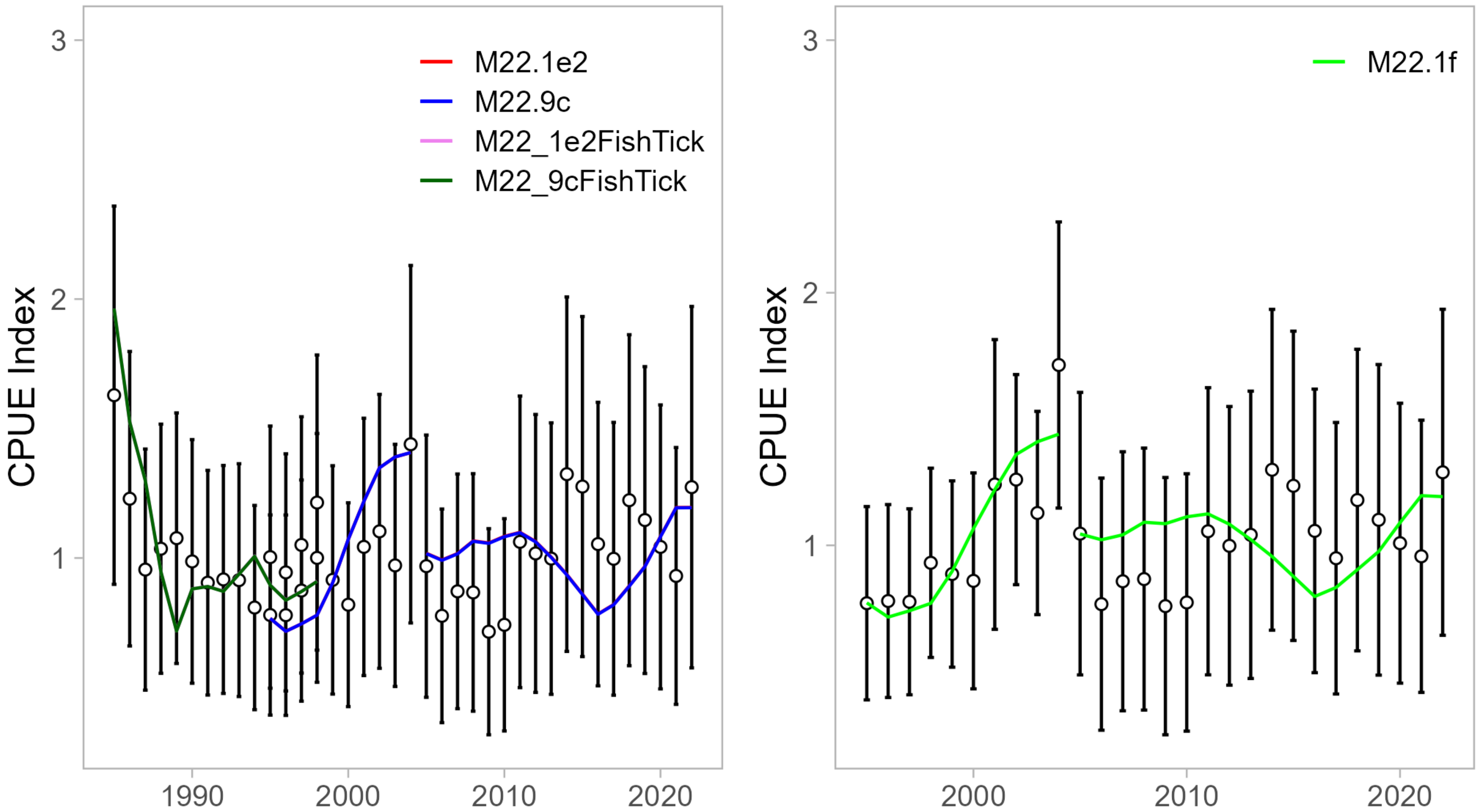


Figure 19, pg 79

EAG

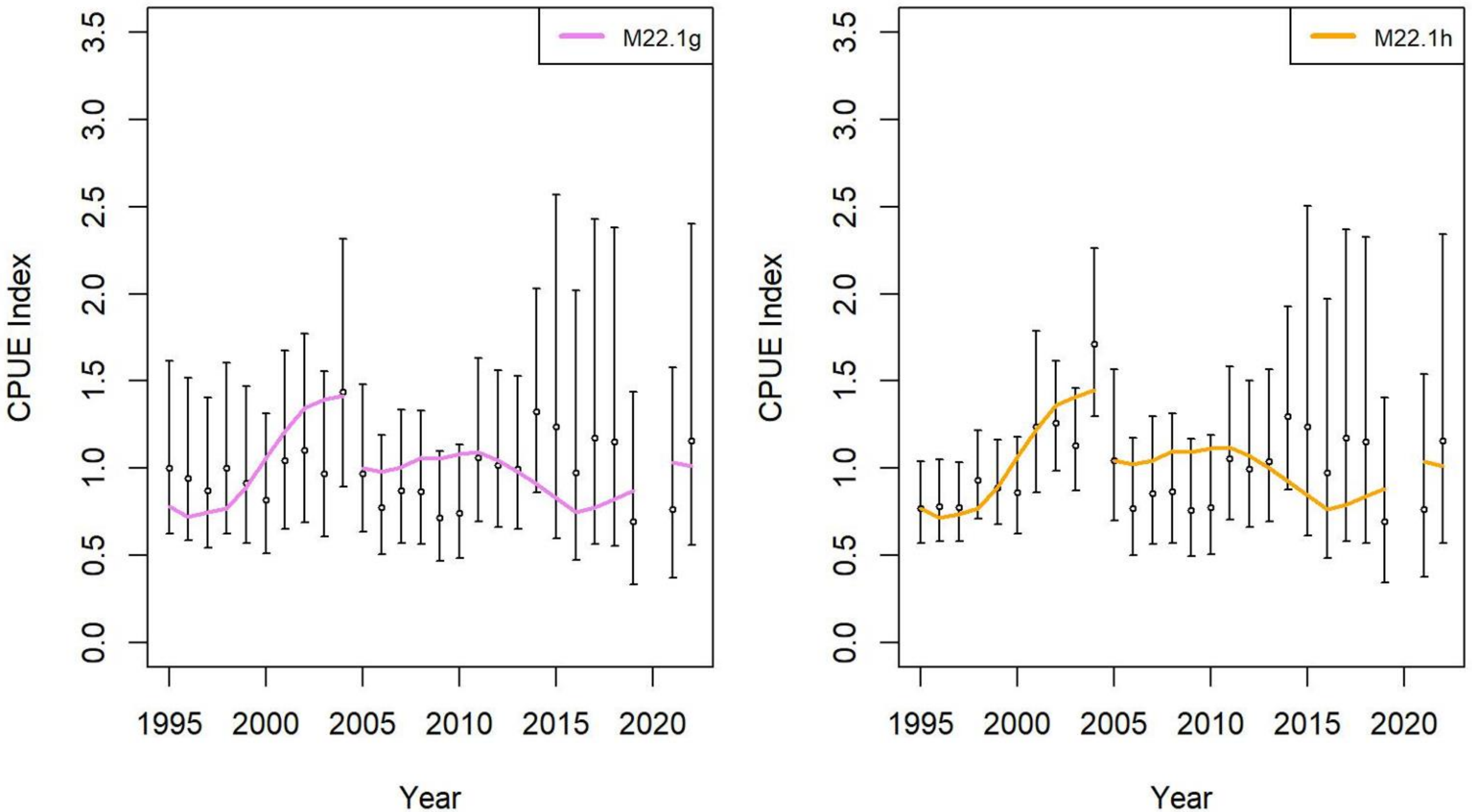
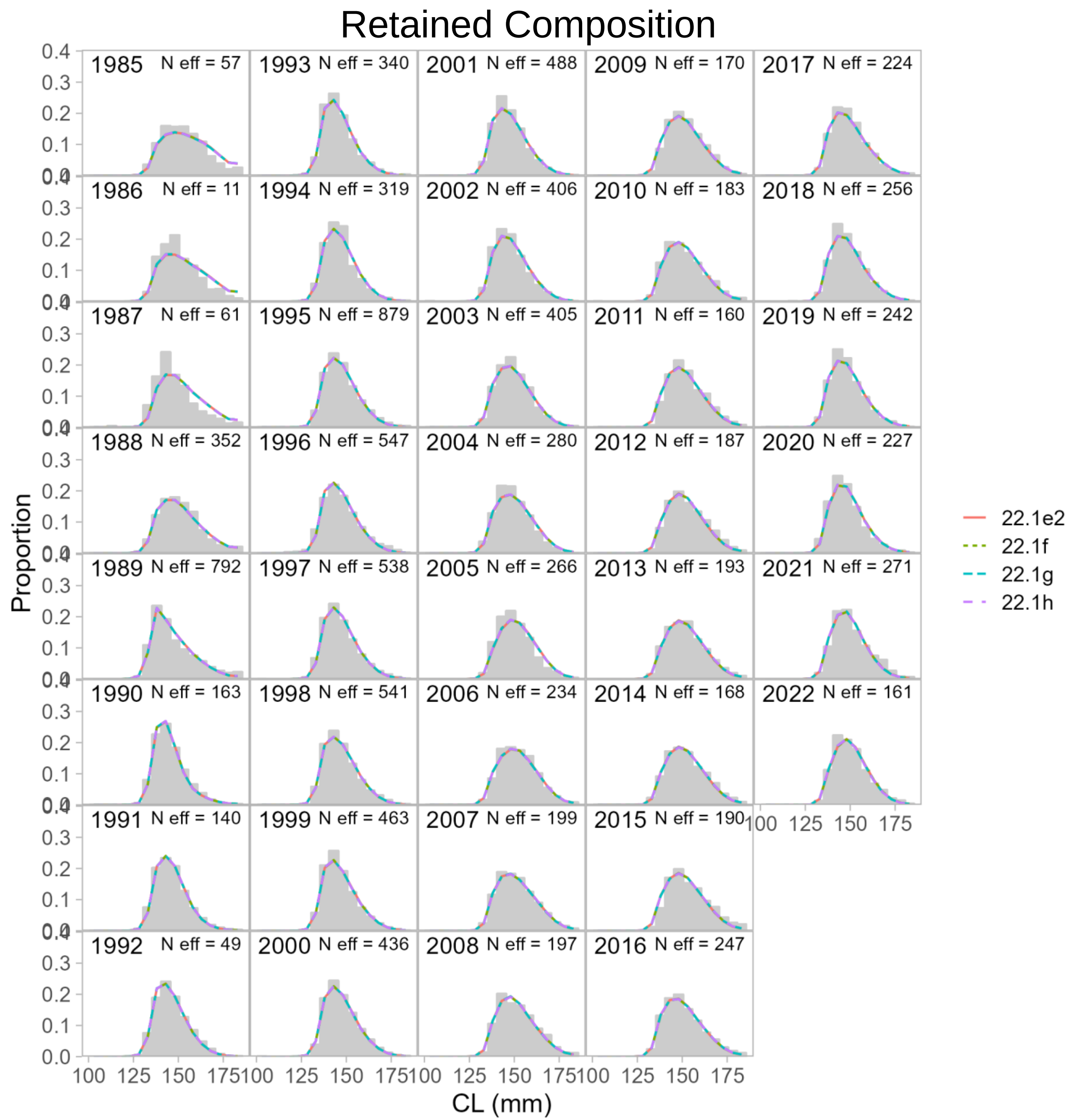


Figure 20, pg 80

EAG


Retained Composition
1985 N eff = 57
1993 N eff = 340
2001 N eff = 488
2009 N eff = 170
2017 N eff = 224
1986 N eff = 11
1994 N eff = 319
2002 N eff = 406
2010 N eff = 183
2018 N eff = 256
1987 N eff = 61
1995 N eff = 879
2003 N eff = 405
2011 N eff = 160
2019 N eff = 242
1988 N eff = 352
1996 N eff = 547
2004 N eff = 280
2012 N eff = 187
2020 N eff = 227
1989 N eff = 792
1997 N eff = 538
2005 N eff = 266
2013 N eff = 193
2021 N eff = 271
1990 N eff = 163
1998 N eff = 541
2006 N eff = 234
2014 N eff = 168
2022 N eff = 161
1991 N eff = 140
1999 N eff = 463
2007 N eff = 199
2015 N eff = 190
1992 N eff = 49
2000 N eff = 436
2008 N eff = 197
2016 N eff = 247
Proportion
CL (mm)
22.1e2
22.1f
22.1g
22.1h

EAG

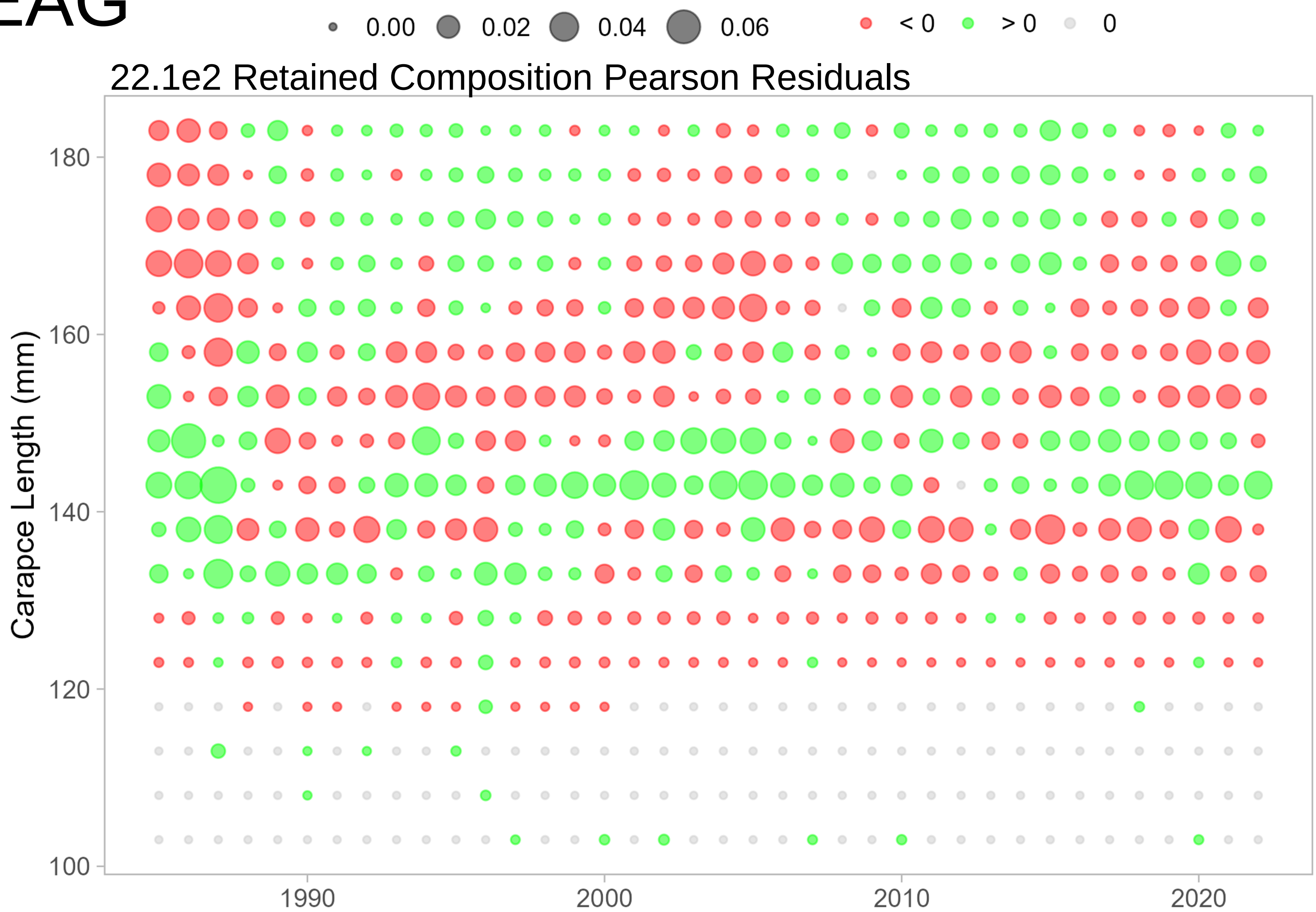
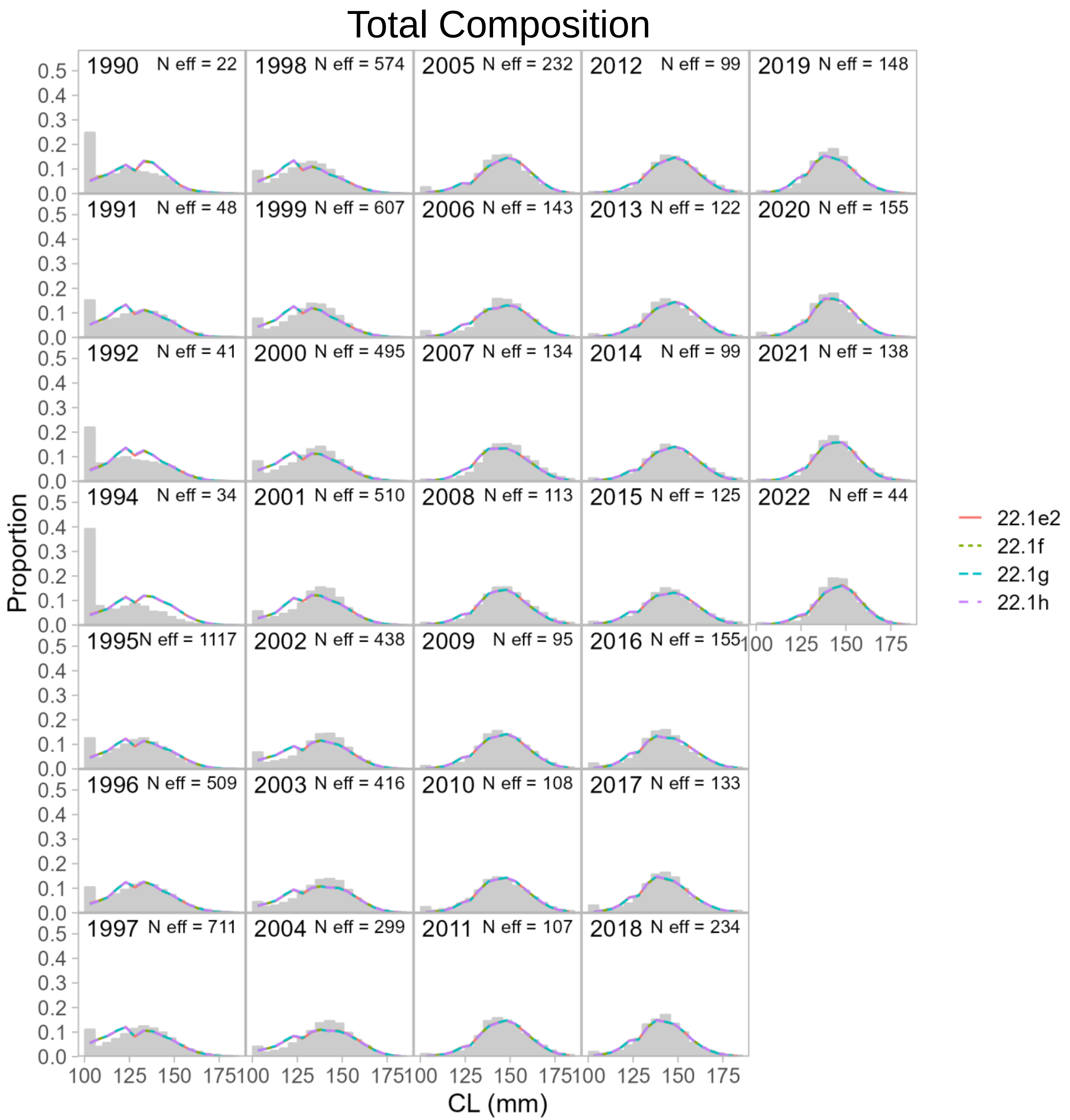


Figure 17, pg 78 shows 22.9c std residuals

EAG


Total Composition
1990 N eff = 22
1998 N eff = 574
2005 N eff = 232
2012 N eff = 99
2019 N eff = 148
1991 N eff = 48
1999 N eff = 607
2006 N eff = 143
2013 N eff = 122
2020 N eff = 155
1992 N eff = 41
2000 N eff = 495
2007 N eff = 134
2014 N eff = 99
2021 N eff = 138
1994 N eff = 34
2001 N eff = 510
2008 N eff = 113
2015 N eff = 125
2022 N eff = 44
1995 N eff = 1117
2002 N eff = 438
2009 N eff = 95
2016 N eff = 155
1996 N eff = 509
2003 N eff = 416
2010 N eff = 108
2017 N eff = 133
1997 N eff = 711
2004 N eff = 299
2011 N eff = 107
2018 N eff = 234
Proportion
CL (mm)
22.1e2
22.1f
22.1g
22.1h

EAG

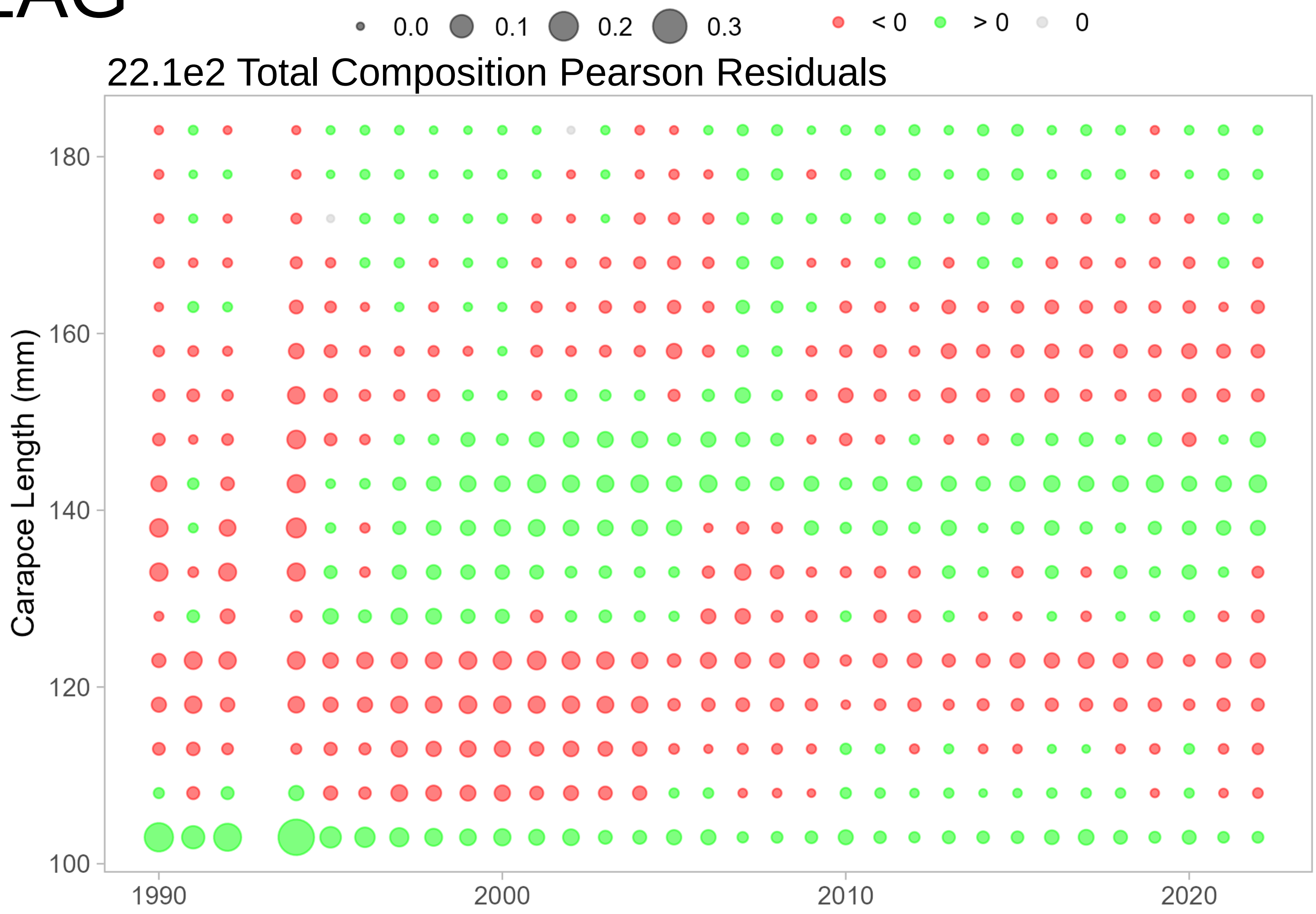


Figure 18, pg 78 shows 22.9c std residuals

EAG

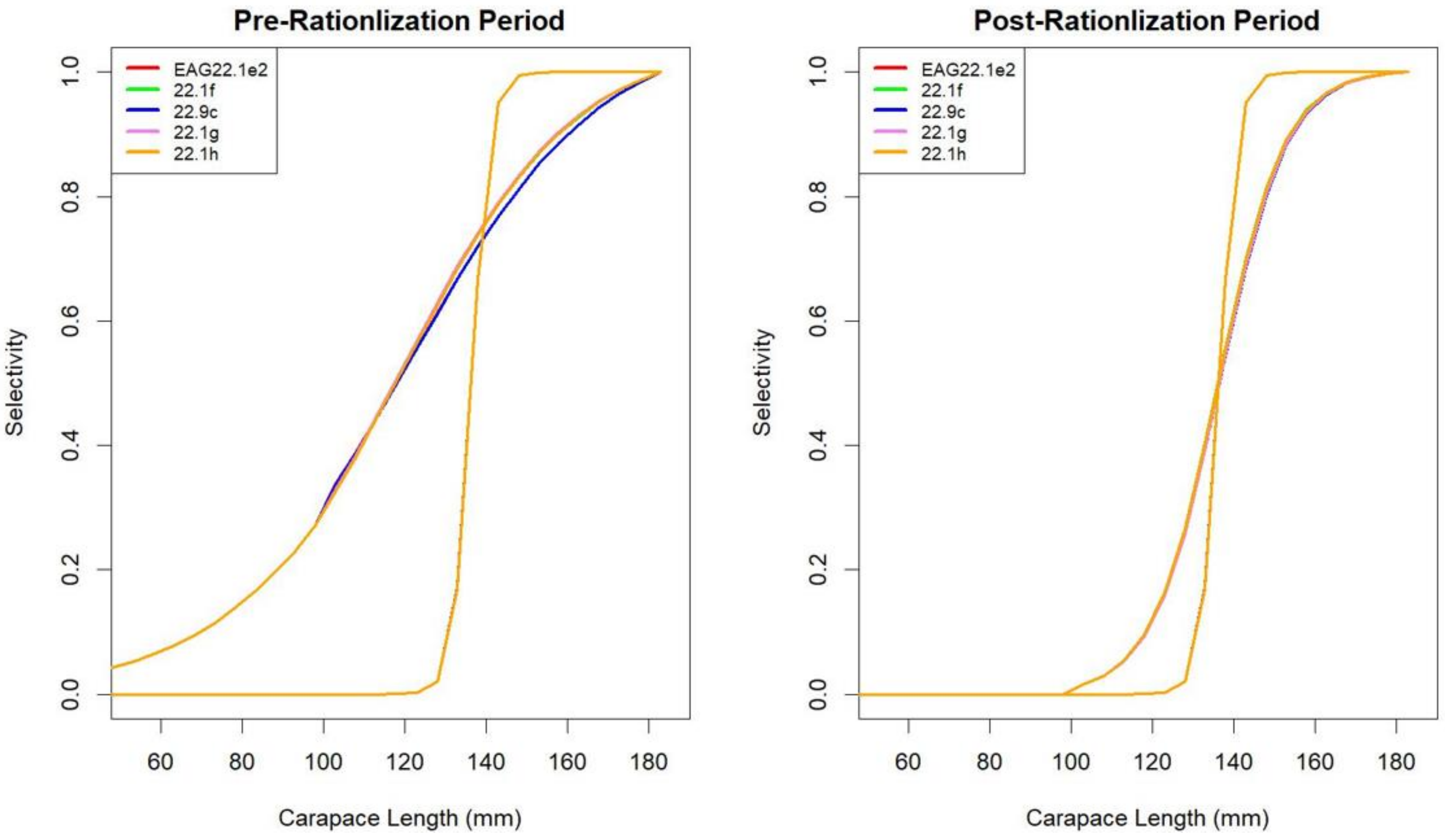


Figure 11, pg 73

WAG

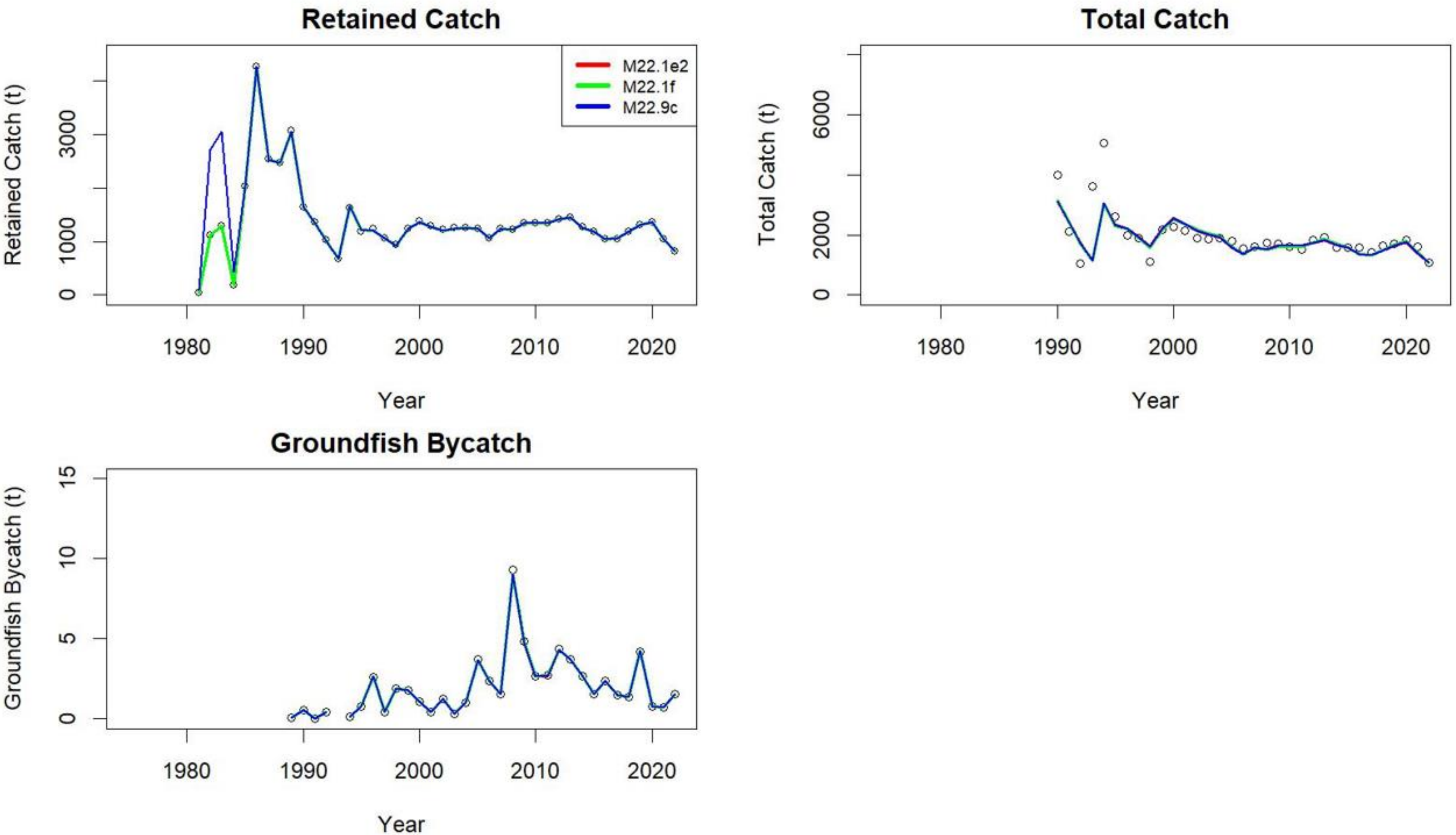


Figure 30, pg 92

WAG

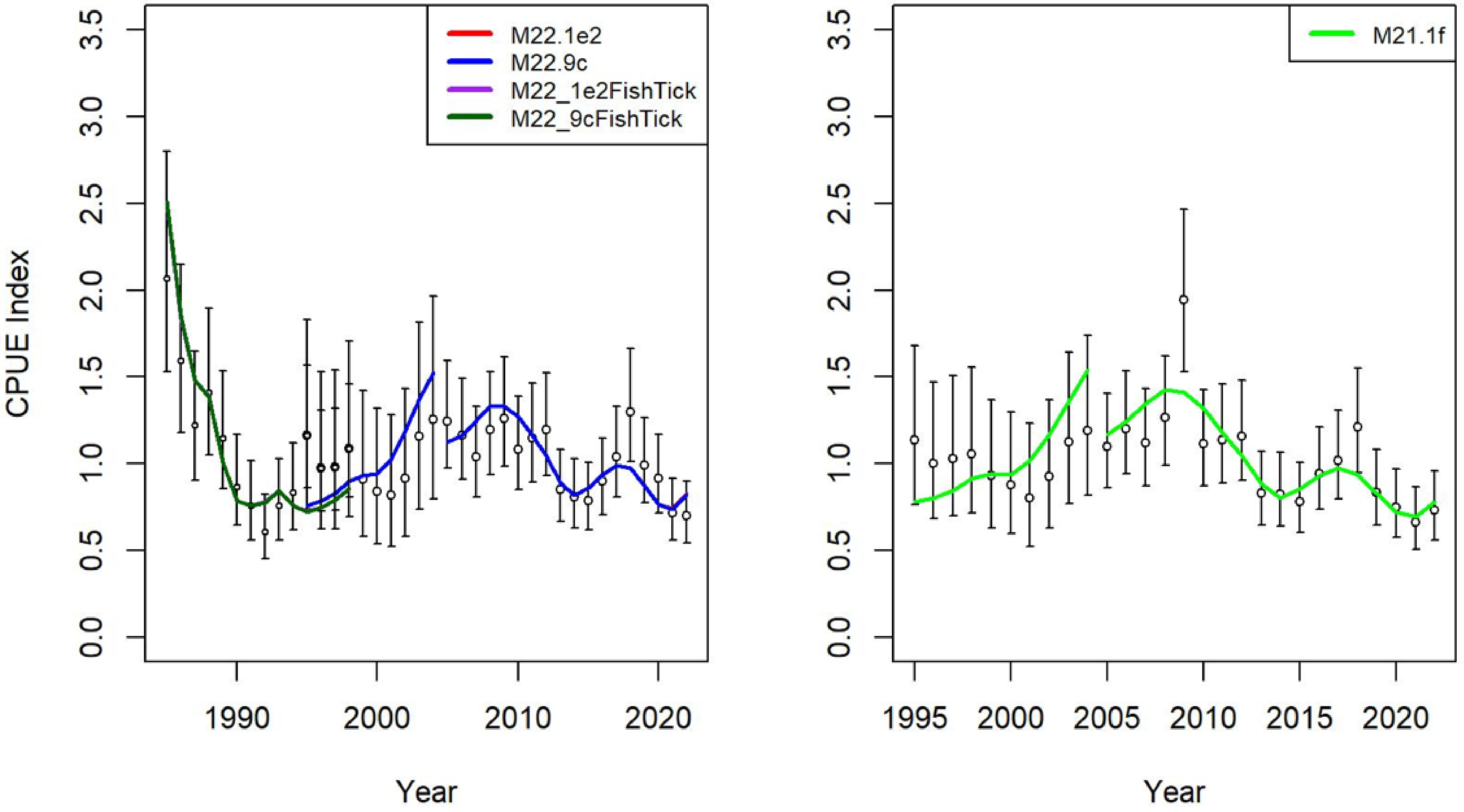
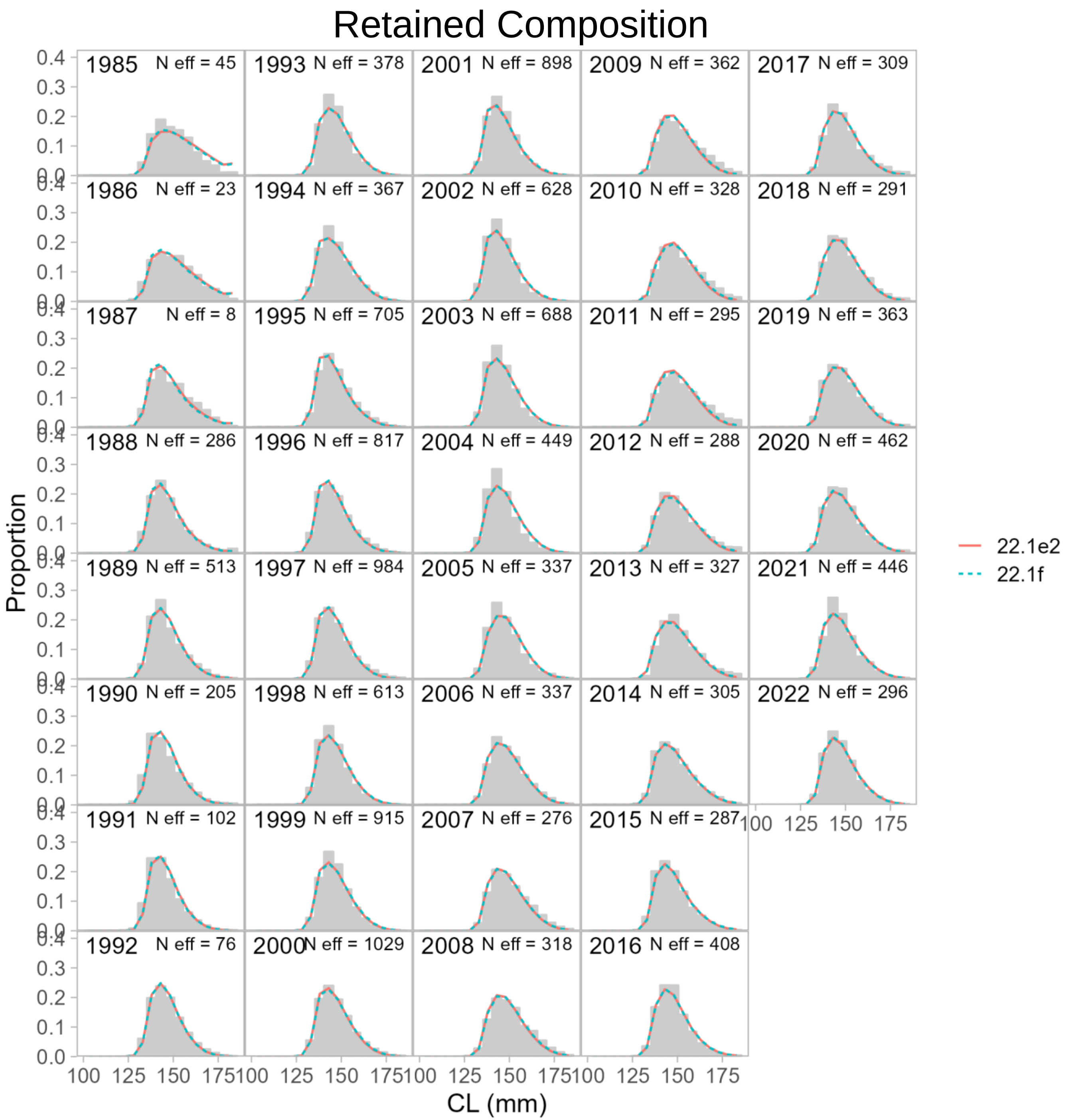


Figure 33, pg 94

WAG



Retained Composition
1985 N eff = 45
1993 N eff = 378
2001 N eff = 898
2009 N eff = 362
2017 N eff = 309
1986 N eff = 23
1994 N eff = 367
2002 N eff = 628
2010 N eff = 328
2018 N eff = 291
1987 N eff = 8
1995 N eff = 705
2003 N eff = 688
2011 N eff = 295
2019 N eff = 363
1988 N eff = 286
1996 N eff = 817
2004 N eff = 449
2012 N eff = 288
2020 N eff = 462
1989 N eff = 513
1997 N eff = 984
2005 N eff = 337
2013 N eff = 327
2021 N eff = 446
1990 N eff = 205
1998 N eff = 613
2006 N eff = 337
2014 N eff = 305
2022 N eff = 296
1991 N eff = 102
1999 N eff = 915
2007 N eff = 276
2015 N eff = 287
1992 N eff = 76
2000 N eff = 1029
2008 N eff = 318
2016 N eff = 408
Proportion
0.0
0.1
0.2
0.3
0.4
100 125 150 175
CL (mm)
22.1e2
22.1f

WAG

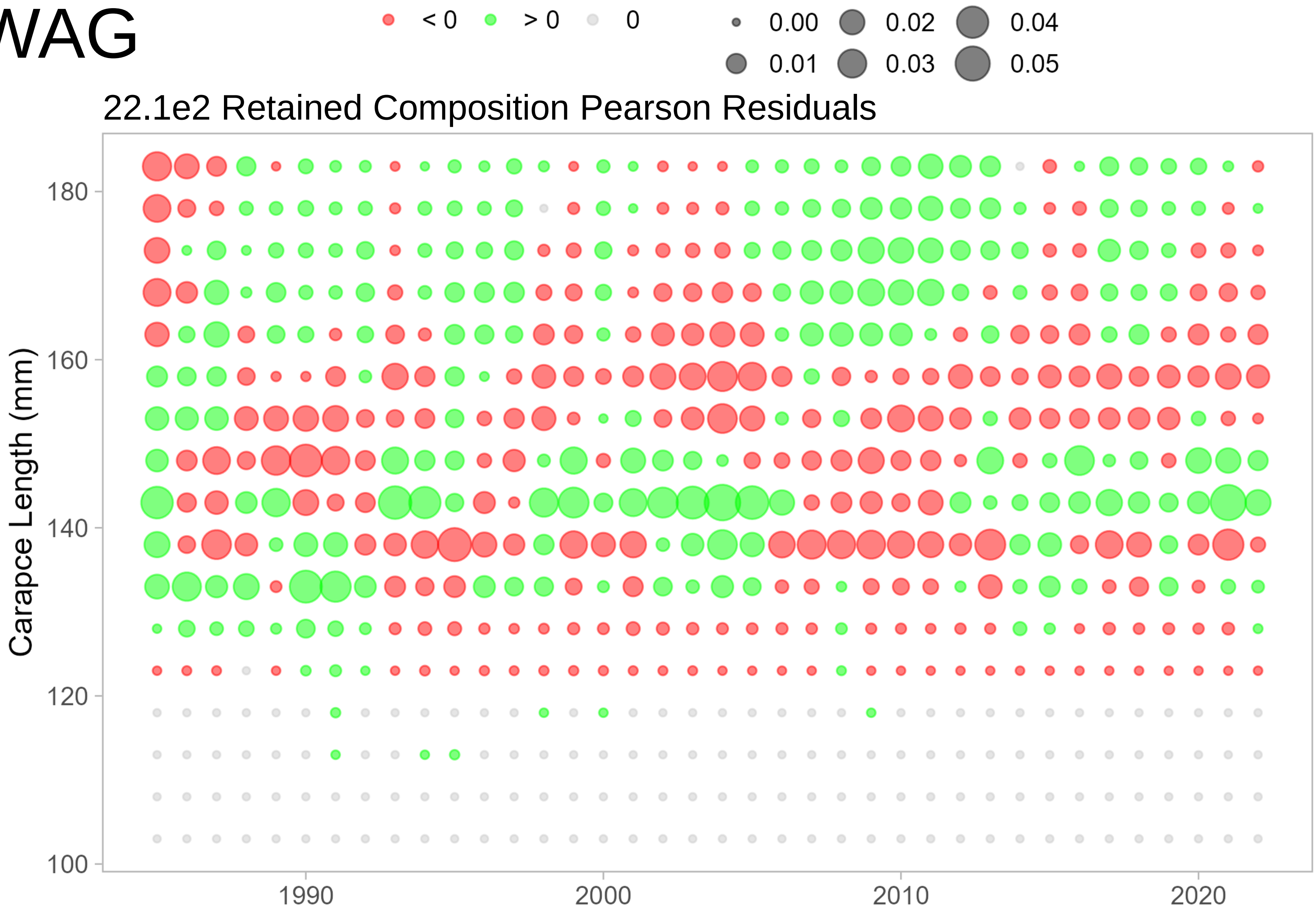
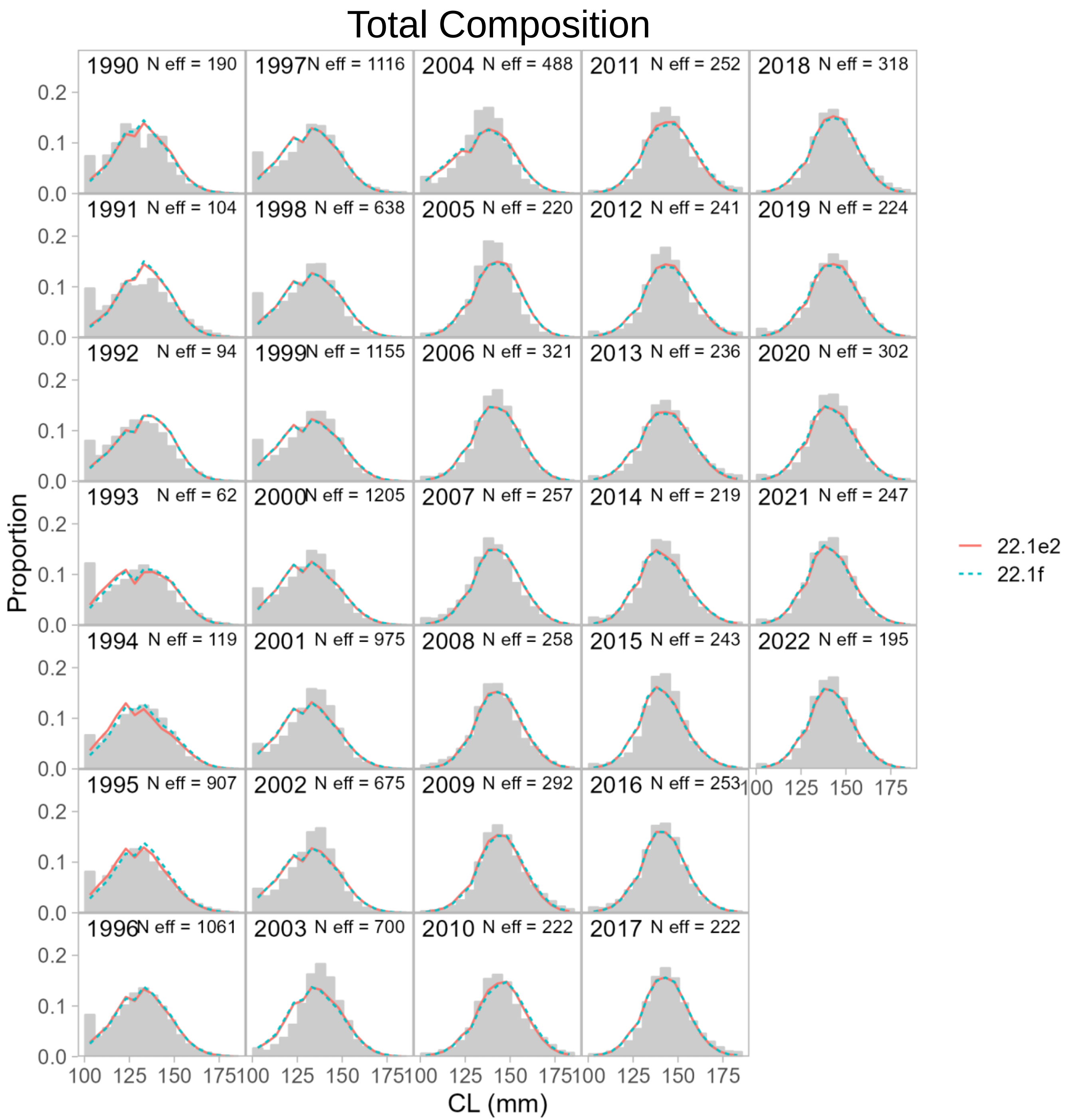


Figure 31, pg 93 shows 22.9c std residuals

WAG



Total Composition
1990 N eff = 190
1997 N eff = 1116
2004 N eff = 488
2011 N eff = 252
2018 N eff = 318
1991 N eff = 104
1998 N eff = 638
2005 N eff = 220
2012 N eff = 241
2019 N eff = 224
1992 N eff = 94
1999 N eff = 1155
2006 N eff = 321
2013 N eff = 236
2020 N eff = 302
1993 N eff = 62
2000 N eff = 1205
2007 N eff = 257
2014 N eff = 219
2021 N eff = 247
1994 N eff = 119
2001 N eff = 975
2008 N eff = 258
2015 N eff = 243
2022 N eff = 195
1995 N eff = 907
2002 N eff = 675
2009 N eff = 292
2016 N eff = 253
1996 N eff = 1061
2003 N eff = 700
2010 N eff = 222
2017 N eff = 222
Proportion
0.0
0.1
0.2
100 125 150 175
CL (mm)
22.1e2
22.1f

WAG

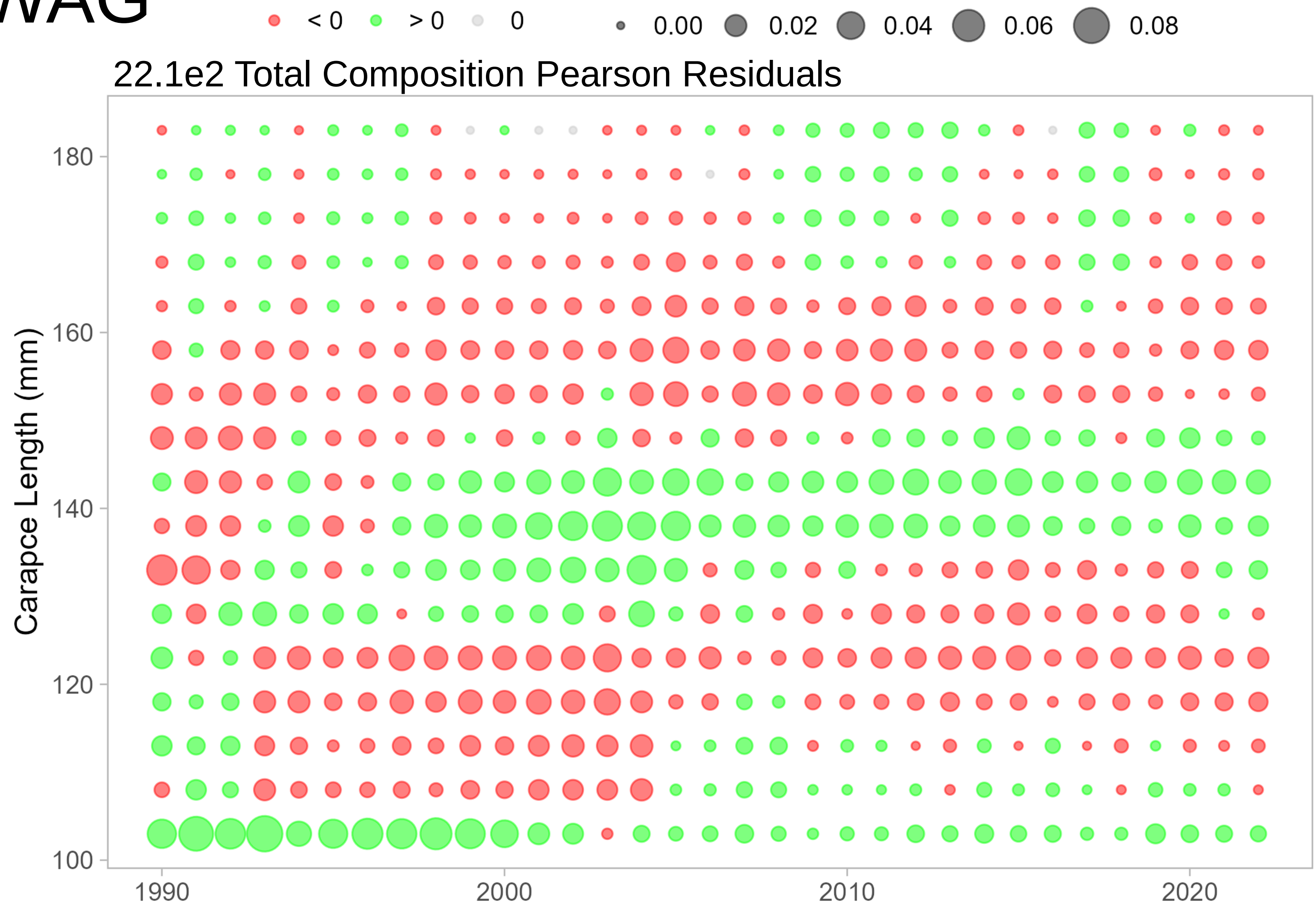


Figure 32, pg 93 shows 22.9c std residuals

WAG

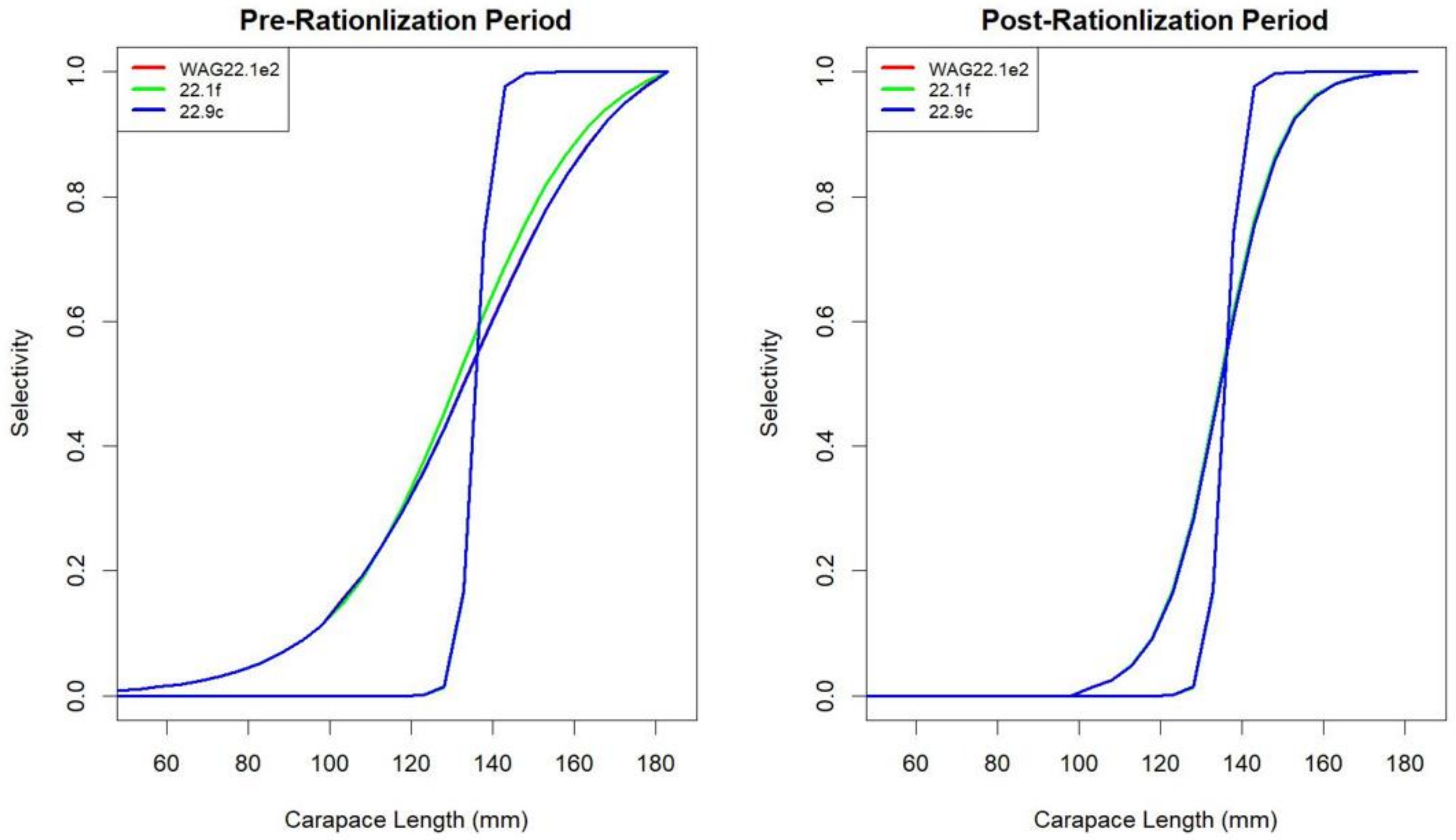
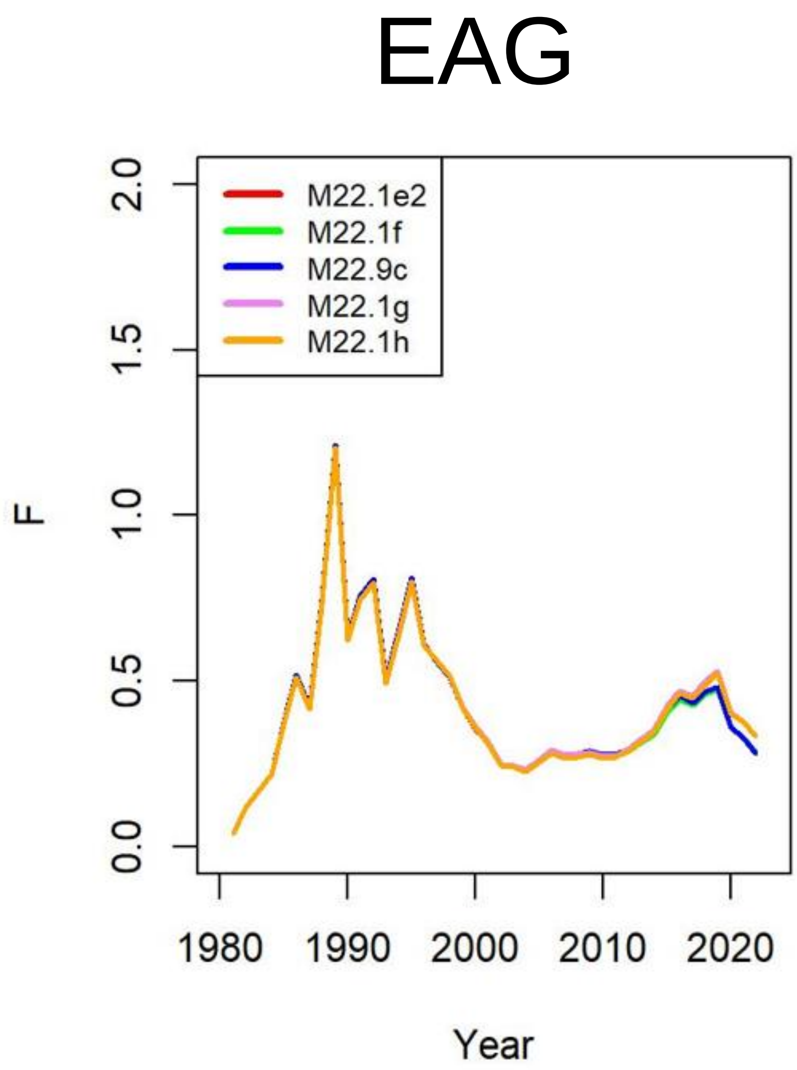


Figure 25, pg 88



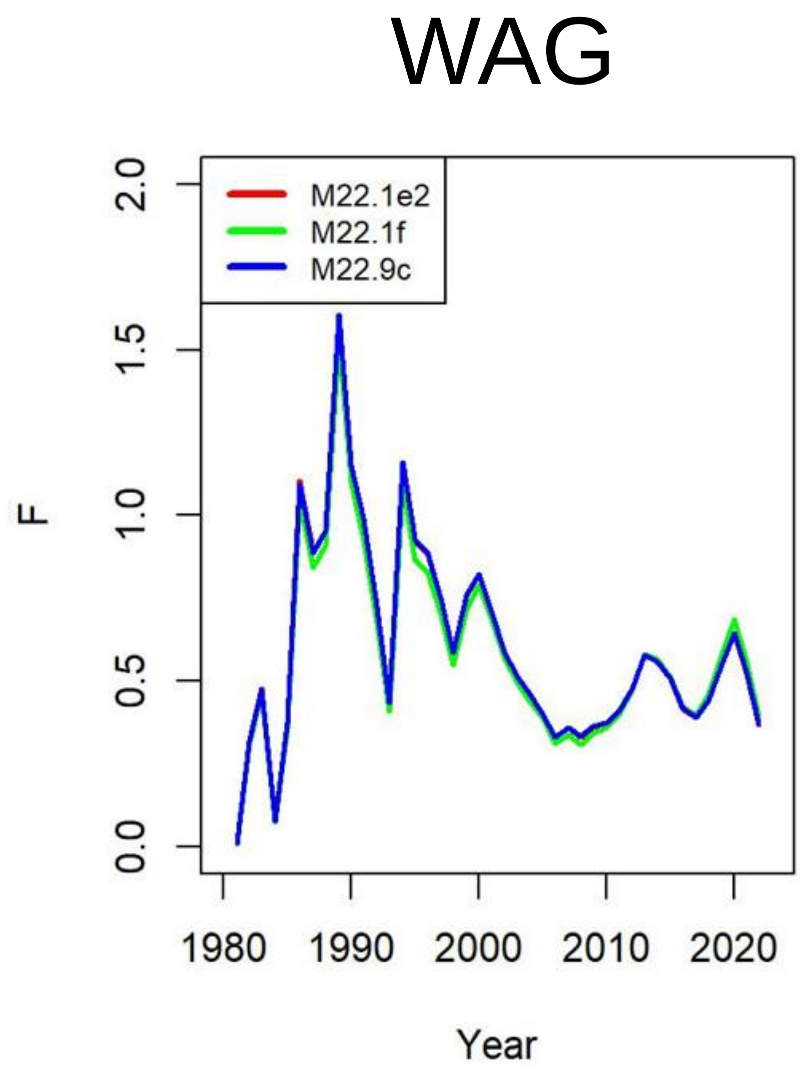
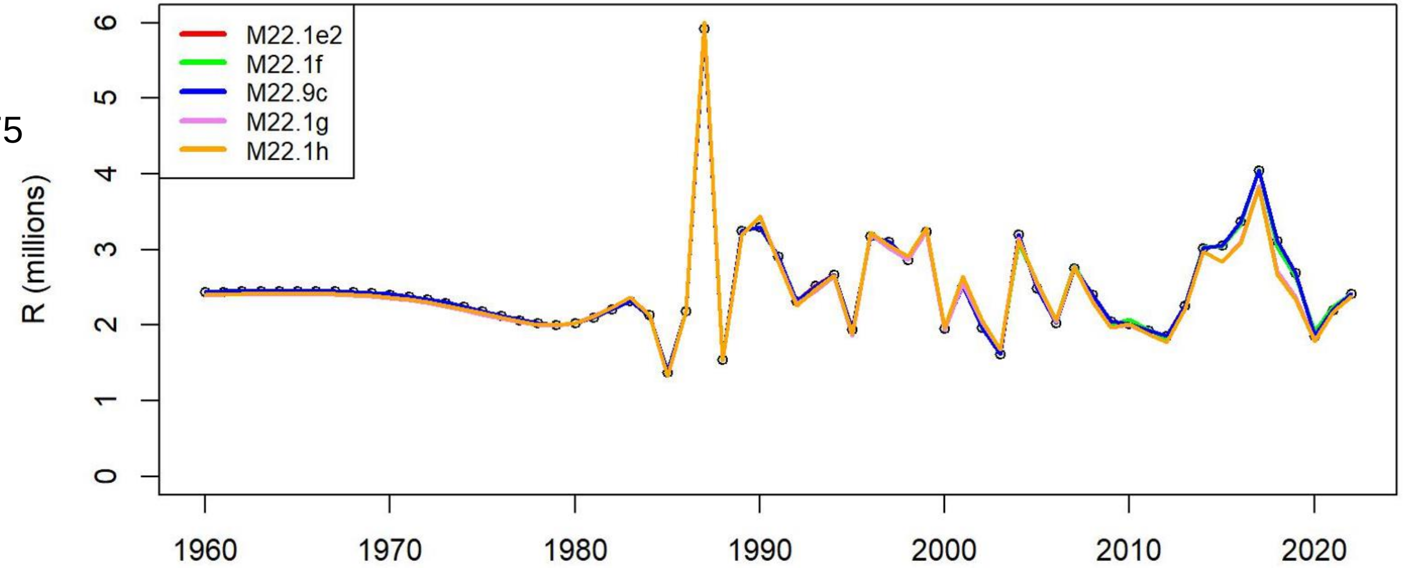


Figure 21, pg 81

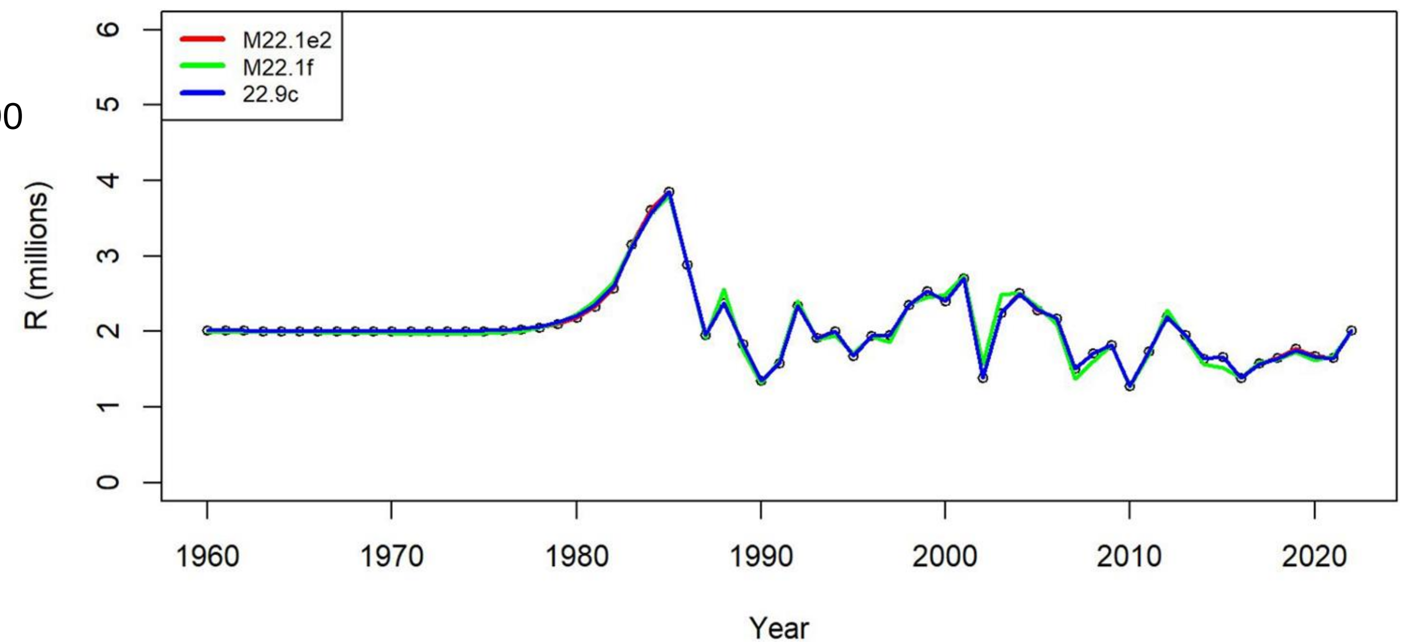
EAG

Figure 13, pg 75



WAG

Figure 27, pg 90



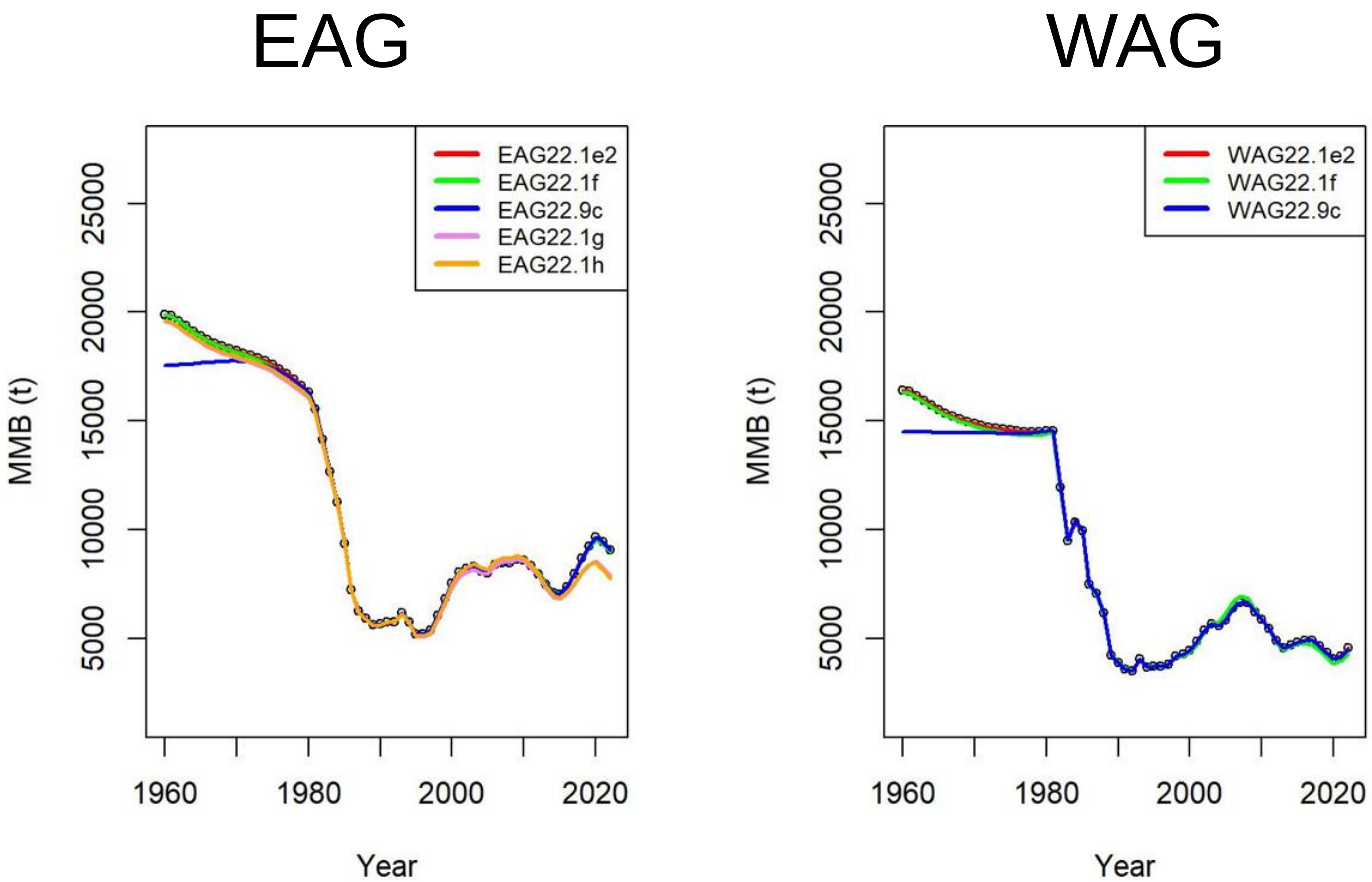
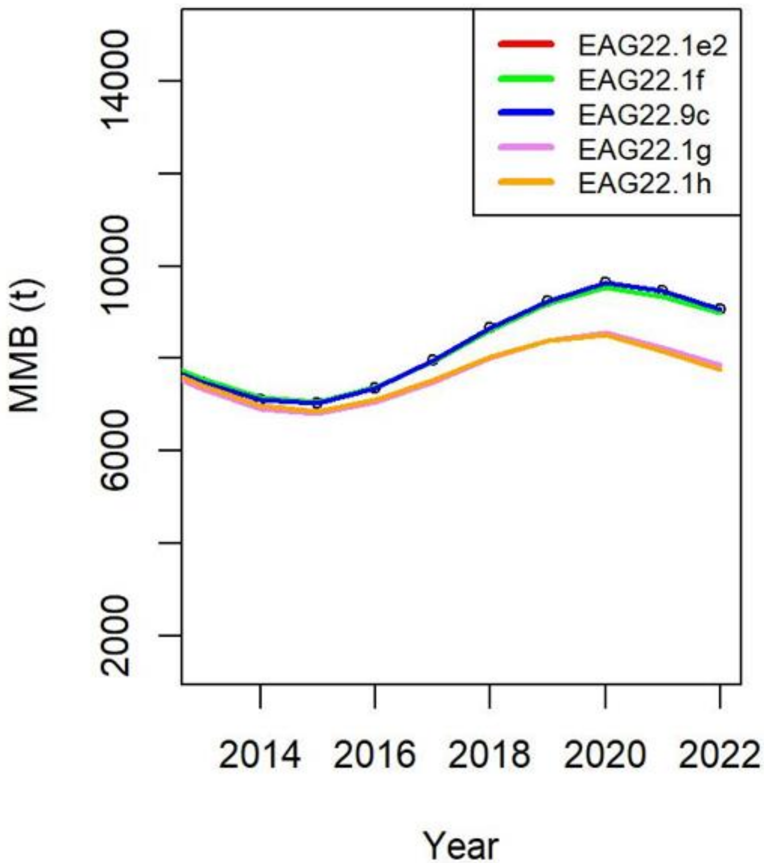


Figure 22a, pg 82

EAG



WAG

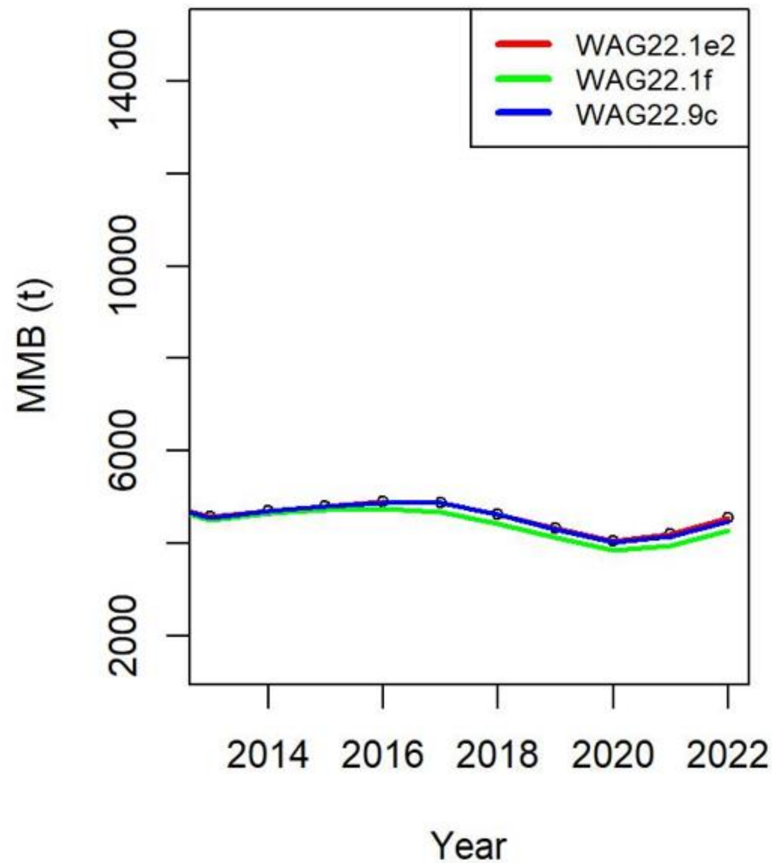


Figure 22b, pg 83

EAG

WAG

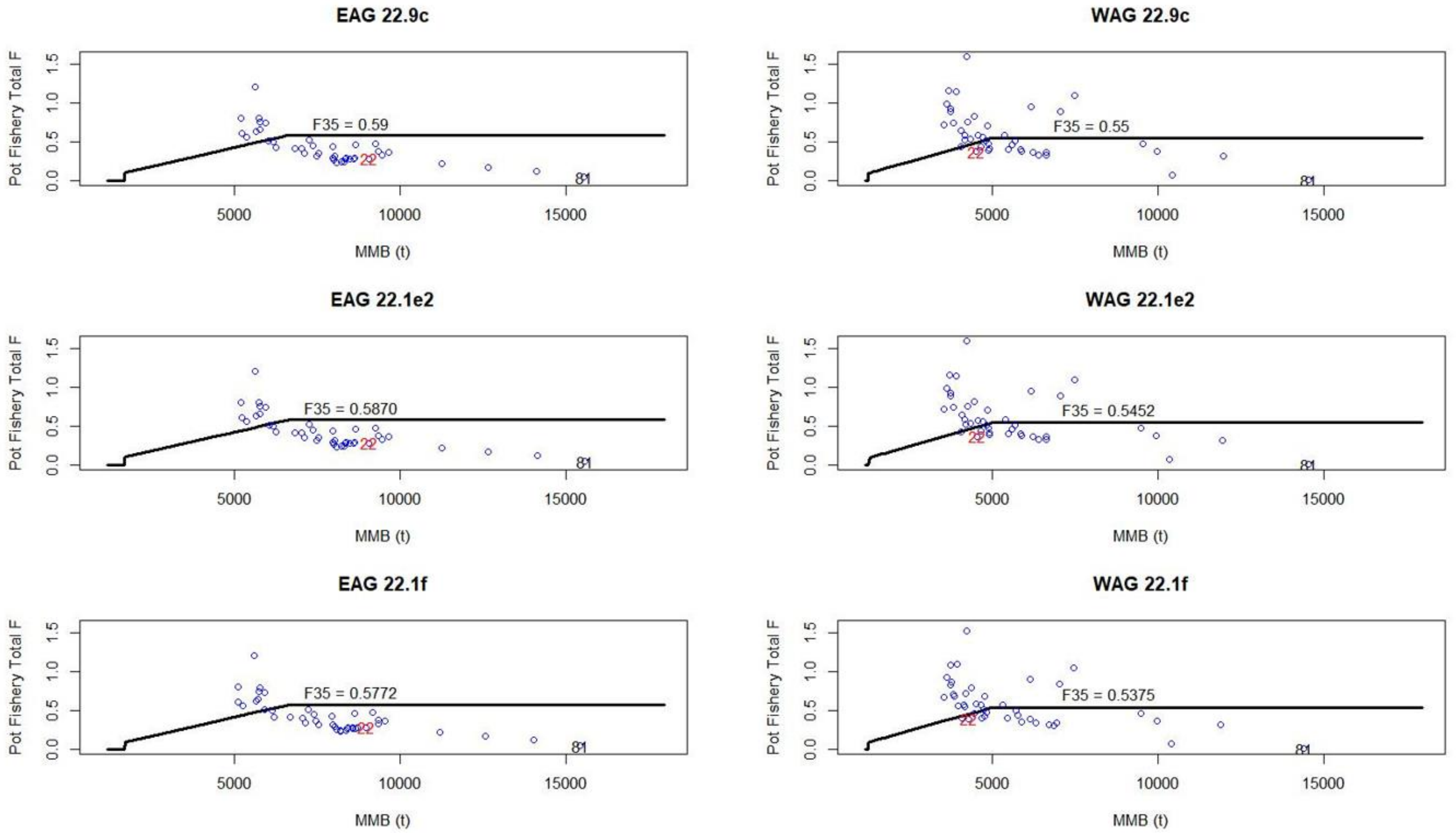


Figure 34, pg 95

EAG

Parameter	**Model 22.9c**	**Model 22.1e2**	**Model 22.1f**	**Model 22.1g**	**Model 22.1h**	Limits
log_ω_1 (growth incr. intercept)	2.513	2.513	2.518	2.518	2.518	1.0, 4.5
ω_2 (growth incr. slope)	-12.951	-12.947	-12.177	-12.132	-12.146	-15.0, 5.0
log_a (molt prob. slope)	-2.542	-2.542	-2.537	-2.540	-2.537	-4.61, -1.39
log_b (molt prob. L50)	4.952	4.952	4.953	4.953	4.953	3.869, 5.05
σ (growth variability std)	3.681	3.681	3.678	3.679	3.679	0.1, 12.0
log_total sel deltaθ, 1985–04	4.238	4.237	4.137	4.128	4.132	0.0, 4.4
log_ total sel deltaθ, 2005–22	3.186	3.186	3.168	3.176	3.171	0.0, 4.4
log_ ret. sel deltaθ, 1985–22	1.867	1.867	1.863	1.863	1.863	0.0, 4.4
log_tot sel θ_{50}, 1985–04	4.798	4.798	4.786	4.783	4.786	4.0, 5.0
log_tot sel θ_{50}, 2005–22	4.917	4.917	4.914	4.917	4.915	4.0, 5.0
log_ret. sel θ_{50}, 1985–22	4.916	4.916	4.916	4.916	4.916	4.0, 5.0
log_β_r (rec.distribution par.)	0.480	0.480	0.394	0.397	0.392	-12.0, 12.0
logq1 (fishery catchability, 1985–98)	-0.469	-0.469	-0.478	-0.479	-0.478	-9.0, 2.25
logq2 (fishery/observer catchability, 1985–04)	-0.624	-0.625	-0.626	-0.620	-0.629	-9.0, 2.25
logq3 (observer catchability, 2005–22)	-0.806	-0.805	-0.804	-0.814	-0.812	-9.0, 2.25
log_mean_rec (mean rec.)	0.883	1.008	1.006	0.990	0.994	0.01, 5.0
log_mean_Fpot (Pot fishery F)	-1.005	-1.005	-1.017	-0.991	-1.003	-15.0, -0.01
log_mean_Fground (GF byc. F)	-8.431	-8.431	-8.431	-8.404	-8.412	-15.0, -1.6
$\log SE1$ (fishery CPUE additional std, 1985–98)	-1.629	-1.622	-1.596	-1.590	-1.595	-8.0, 1.0
$\log SE2$ (fishery/observer CPUE additional std, 1985–04)	-1.489	-1.489	-2.170	-1.504	-2.169	-8.0, 0.15
$\log SE3$ (observer CPUE additional std, 2005–22)	-1.427	-1.428	-1.600	-1.299	-1.351	-8.0, 0.15
2022 MMB	9,059	9,055	8,981	7,864	7,765	

WAG

Parameter	Model 22.9c	Model 22.1e2	Model 22.1f	Limits
log_ω_1 (growth incr. intercept)	2.506	2.506	2.518	1.0, 4.5
ω_2 (growth incr. slope)	-13.156	-13.156	-11.550	-15.0, 5.0
log_a (molt prob. slope)	-2.706	-2.706	-2.693	-4.61, -1.39
log_b (molt prob. L50)	4.951	4.951	4.952	3.869, 5.05
σ (growth variability std)	3.672	3.672	3.667	0.1, 12.0
log_total sel deltaθ, 1985–04	3.979	3.978	3.857	0.0, 4.4
log_ total sel deltaθ, 2005–22	3.069	3.069	3.062	0.0, 4.4
log_ ret. sel deltaθ, 1985–22	1.708	1.708	1.705	0.0, 4.4
log_tot sel θ_{50}, 1985–04	4.909	4.909	4.885	4.0, 5.0
log_tot sel θ_{50}, 2005–22	4.904	4.904	4.902	4.0, 5.0
log_ret. sel θ_{50}, 1985–22	4.913	4.913	4.913	4.0, 5.0
log_β_r (rec.distribution par.)	-0.074	-0.074	-0.211	-12.0, 12.0
logq1 (fishery catchability, 1985–98)	0.040	0.039	-0.015	-9.0, 2.25
logq2 (fishery/observer catchability, 1985–04)	0.089	0.087	0.045	-9.0, 2.25
logq3 (observer catchability, 2005–22)	-0.315	-0.316	-0.310	-9.0, 2.25
log_mean_rec (mean rec.)	0.700	0.825	0.819	0.01, 5.0
log_mean_Fpot (Pot fishery F)	-0.695	-0.696	-0.723	-15.0, -0.01
log_mean_Fground (GF byc. F)	-8.174	-8.175	-8.172	-15.0, -1.6
$\log SE1$ (fishery CPUE additional std, 1985–98)	-1.938	-1.955	-1.964	-8.0, 1.0
$\log SE2$ (fishery/observer CPUE additional std, 1985–04)	-1.496	-1.494	-1.587	-8.0, 0.15
$\log SE3$ (observer CPUE additional std, 2005–22)	-2.135	-2.124	-2.047	-8.0, 0.15
2022 MMB	4,495	4,545	4,288	

EAG

	Base	GMACS			
Likelihood Component	**22.9c**	**22.1e2**	**22.1f**	**22.1g**	**22.1h**
Retlencomp	286.2230	286.2369	265.4302	262.7069	262.3774
Totallencomp	520.2600	520.2876	553.999	555.5594	554.3931
Observer cpue	-26.7588	-26.7606	-32.6846	-23.8624	-28.4356
Fishery cpue	-15.5853	-15.5297	-15.1827	-15.1038	-15.177
RetdcatchB	-421.9470	-421.953	-422.049	-422.125	-422.053
TotalcatchB	-40.9361	-40.9455	-41.384	-41.4766	-41.3155
GdiscdcatchB	30.3249	30.32492	30.3248	30.3248	30.3247
Rec_dev	22.7112	20.7514	20.8089	20.6410	20.6312
Pot F_dev	0.0135				
Gbyc_F_dev	0.0239				
Sum (Pot F_dev+ Gbyc_F_dev)	0.0374	0.0373	0.0371	0.0371	0.0373
Tag	2701.2600	2701.2579	2700.409	2700.569	2700.389
Total	3055.5900	3079.43181	3085.433	3092.9951	3086.8961

WAG

	Base	GMACS	
Likelihood Component	**22.9c**	**22.1e2**	**22.1f**
Retlencomp	363.7120	363.8280	313.3108
Totallencomp	435.9380	436.0861	478.6189
Observer cpue	-38.6873	-38.5262	-37.7272
Fishery cpue	-19.6942	-19.8406	-19.9340
RetdcatchB	-420.4380	-420.436	-420.458
TotalcatchB	14.1469	14.13333	12.9985
GdiscdcatchB	30.3262	30.32618	30.3258
Rec_dev	21.5391	19.5703	20.0221
Pot F_dev	0.0264		
Gbyc_F_dev	0.0428		
Sum (Pot F_dev+ Gbyc_F_dev)	0.0692	0.0692	0.0692
Tag	2705.5800	2705.561	2703.436
Total	3092.5000	3115.8015	3105.693

EAG

1,000 tons

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	Recruitment Years to Define $MMB_{35\%}$	$F_{35\%}$	Natural Mortality	OFL	ABC (0.75*OFL)
EAG22.9c	3a	6.665	7.487	1.12	0.59	1987–2017	0.59	0.22	2.952	2.214
EAG22.1e2	3a	6.682	7.494	1.12	0.59	1987–2017	0.59	0.22	2.939	2.204
EAG22.1f	3a	6.691	7.489	1.12	0.58	1987–2017	0.58	0.22	2.899	2.174
EAG22.1g	3a	6.612	6.782	1.03	0.58	1987–2017	0.58	0.22	2.520	1.890
EAG22.1h	3a	6.637	6.718	1.01	0.58	1987–2017	0.58	0.22	2.485	1.863

1,000,000 pounds

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	Recruitment Years to Define $MMB_{35\%}$	$F_{35\%}$	Natural Mortality	OFL	ABC (0.75*OFL)
EAG22.9c	3a	14.695	16.506	1.12	0.59	1987–2017	0.59	0.22	6.507	4.881
EAG22.1e2	3a	14.731	16.521	1.12	0.59	1987–2017	0.59	0.22	6.479	4.860
EAG22.1f	3a	14.751	16.511	1.12	0.58	1987–2017	0.58	0.22	6.390	4.793
EAG22.1g	3a	14.577	14.951	1.03	0.58	1987–2017	0.58	0.22	5.555	4.166
EAG22.1h	3a	14.633	14.811	1.01	0.58	1987–2017	0.58	0.22	5.477	4.108

WAG

1,000 tons

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	Recruitment Years to Define $MMB_{35\%}$	$F_{35\%}$	Natural Mortality	OFL	ABC (0.75*OFL)
WAG22.9c	3a	4.960	4.532	0.914	0.50	1987–2017	0.55	0.22	1.232	0.924
WAG22.1e2	3a	4.982	4.575	0.918	0.50	1987–2017	0.55	0.22	1.243	0.933
WAG22.1f	3a	4.980	4.444	0.892	0.47	1987–2017	0.54	0.22	1.131	0.848

1,000,000 pounds

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	Recruitment Years to Define $MMB_{35\%}$	$F_{35\%}$	Natural Mortality	OFL	ABC (0.75*OFL)
WAG22.9c	3a	10.934	9.991	0.914	0.50	1987–2017	0.55	0.22	2.716	2.037
WAG22.1e2	3a	10.983	10.086	0.918	0.50	1987–2017	0.55	0.22	2.741	2.056
WAG22.1f	3a	10.980	9.798	0.892	0.47	1987–2017	0.54	0.22	2.493	1.870

Catch specs for all Aleutian Is.

22.1e2

1,000 tons

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch[a]	OFL	ABC[b]
2019/20	5.915	16.386	3.257	3.319	3.729	5.249	3.937
2020/21	6.014	15.442	2.999	3.000	3.520	4.798	3.599
2021/22	5.715	13.581	2.690	2.699	3.056	4.817	3.372
2022/23	5.832[d]	13.600[d]	2.291	2.369*	2.612*	3.761[c]	2.821[c]
2023/24		12.069[d]				4.182[d]	3.137[d]

22.1f

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch[a]	OFL	ABC[b]
2019/20	5.915	16.386	3.257	3.319	3.729	5.249	3.937
2020/21	6.014	15.442	2.999	3.000	3.520	4.798	3.599
2021/22	5.715	13.581	2.690	2.699	3.056	4.817	3.372
2022/23	5.836[d]	13.269[d]	2.291	2.369*	2.612*	3.761[c]	2.821[c]
2023/24		11.934[d]				4.029[d]	3.022[d]

a. Total catch was sum of retained catch and estimated bycatch mortality of discarded bycatch during crab fisheries and groundfish fisheries.
b. 25% buffer was applied to total catch OFL to determine ABC except 2021/22, during which 30% buffer was applied.
c. OFL, and ABC were estimated by the accepted model 21.1e2 in May 2022 assessment when the WAG fisheries was not completed.
d. MSST, MMB, OFL, and ABC were estimated in May 2023 assessment with data cutoff on Mar 8 when the EAG and WAG fisheries were not completed.

Catch specs for all Aleutian Is.

22.1e2 1,000,000 lb

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch[a]	OFL	ABC[b]
2019/20	13.040	36.125	7.18	7.317	8.221	11.572	8.680
2020/21	13.259	34.044	6.61	6.614	7.760	10.578	7.934
2021/22	12.599	29.941	5.93	5.951	6.737	10.620	7.434
2022/23	12.857[d]	29.983[d]	5.05	5.223*	5.758*	8.292[c]	6.219[c]
2023/24		26.608[d]				9.220[d]	6.916[d]

22.1f

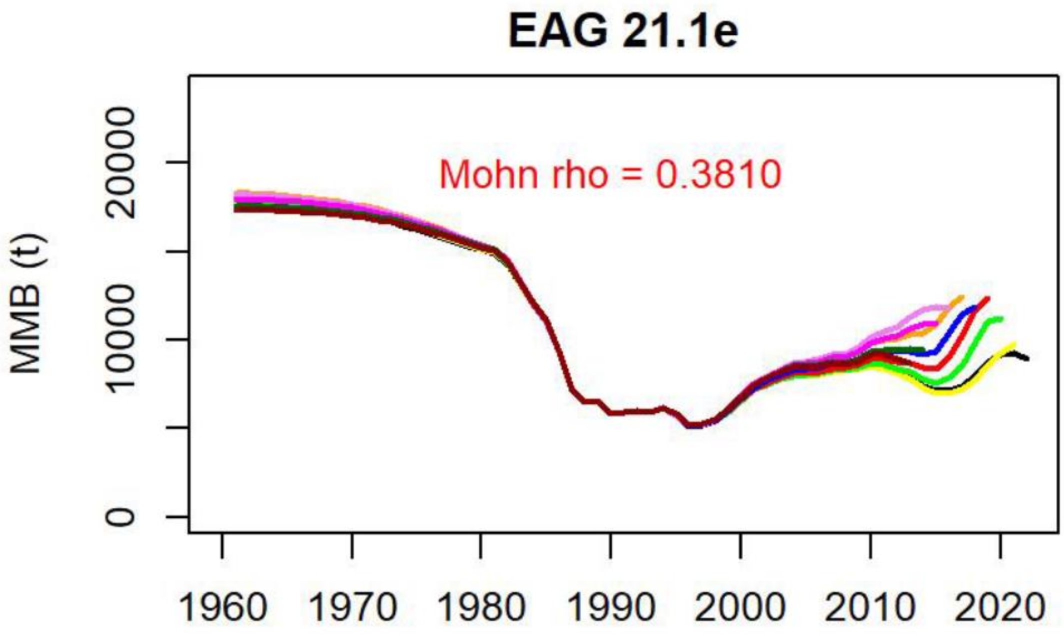
Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch[a]	OFL	ABC[b]
2019/20	13.040	36.125	7.18	7.317	8.221	11.572	8.680
2020/21	13.259	34.044	6.61	6.614	7.760	10.578	7.934
2021/22	12.599	29.941	5.93	5.951	6.737	10.620	7.434
2022/23	12.866[d]	29.253[d]	5.05	5.223*	5.758*	8.292[c]	6.219[c]
2023/24		26.310[d]				8.882[d]	6.662[d]

a. Total catch was sum of retained catch and estimated bycatch mortality of discarded bycatch during crab fisheries and groundfish fisheries.
b. 25% buffer was applied to total catch OFL to determine ABC except 2021/22, during which 30% buffer was applied.
c. OFL, and ABC were estimated by the accepted model 21.1e2 in May 2022 assessment when the WAG fisheries was not completed.
d. MSST, MMB, OFL, and ABC were estimated in May 2023 assessment with data cutoff on Mar 8 when the EAG and WAG fisheries were not completed.

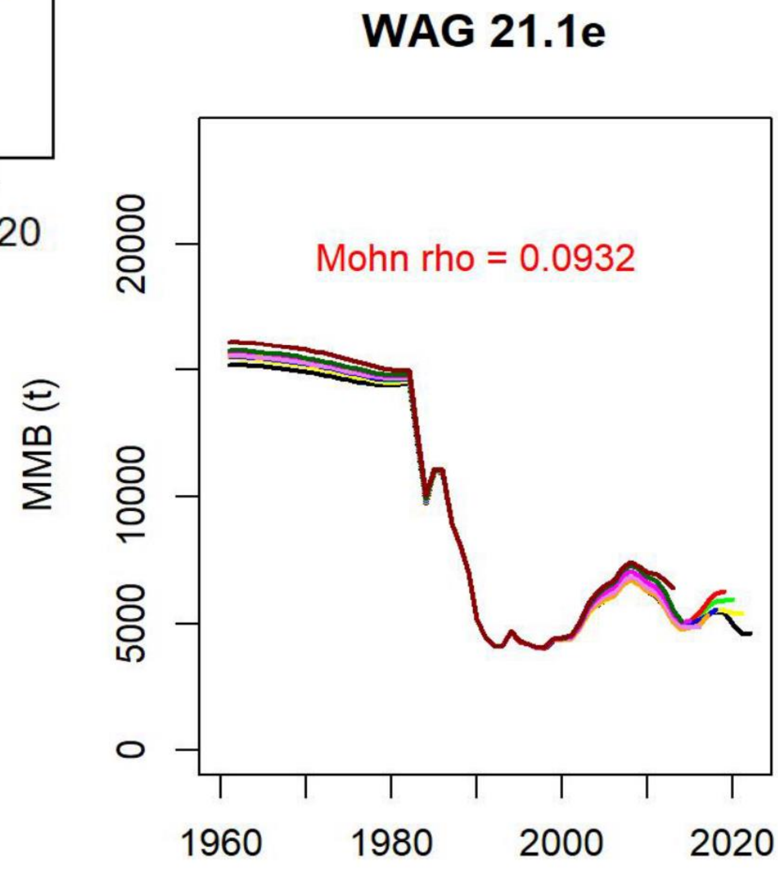
ABC Buffer

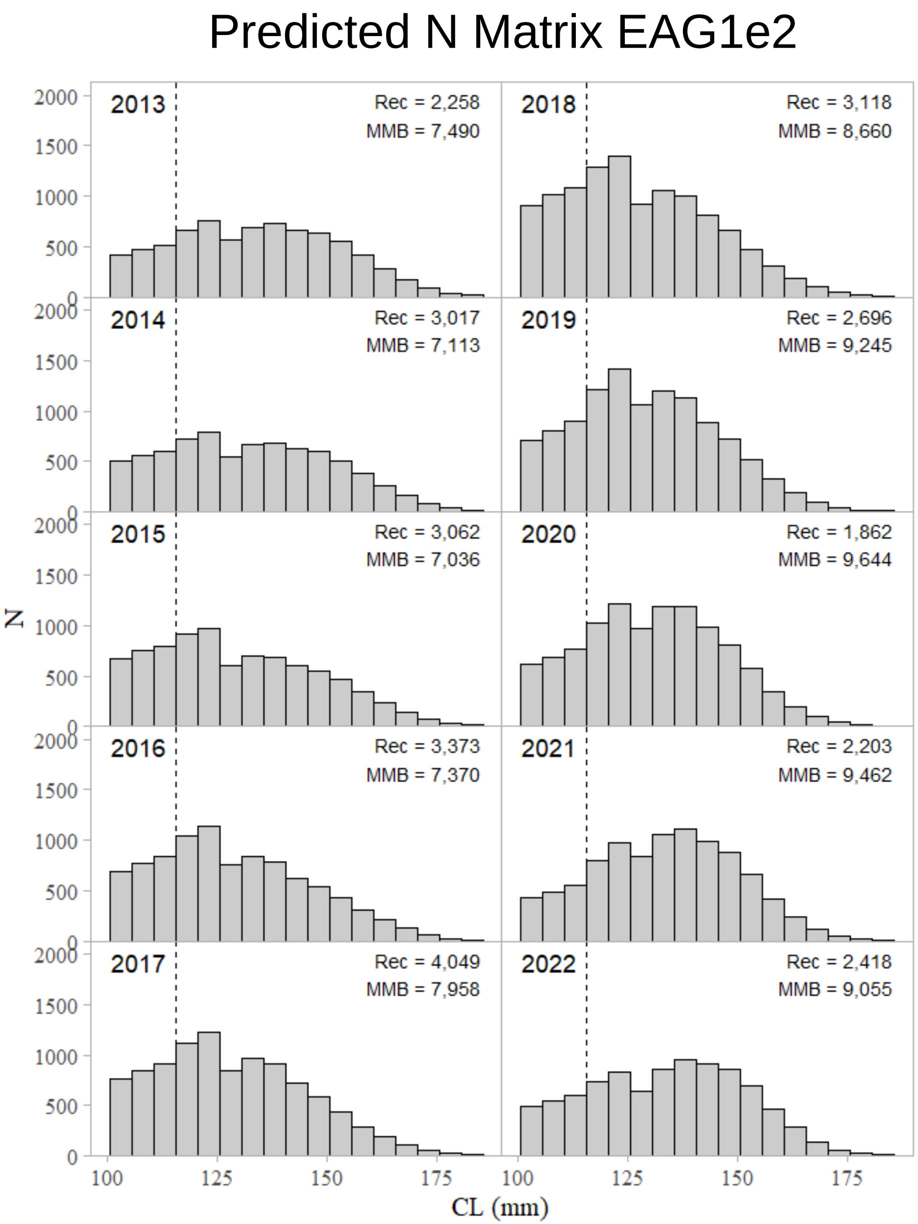
- 2019/20 – 2020/21 & 2022/23 used a 25% buffer for ABC
- 2021/22 used a 30% buffer for ABC
- Do any model concerns warrant a buffer greater than 25%?

questions

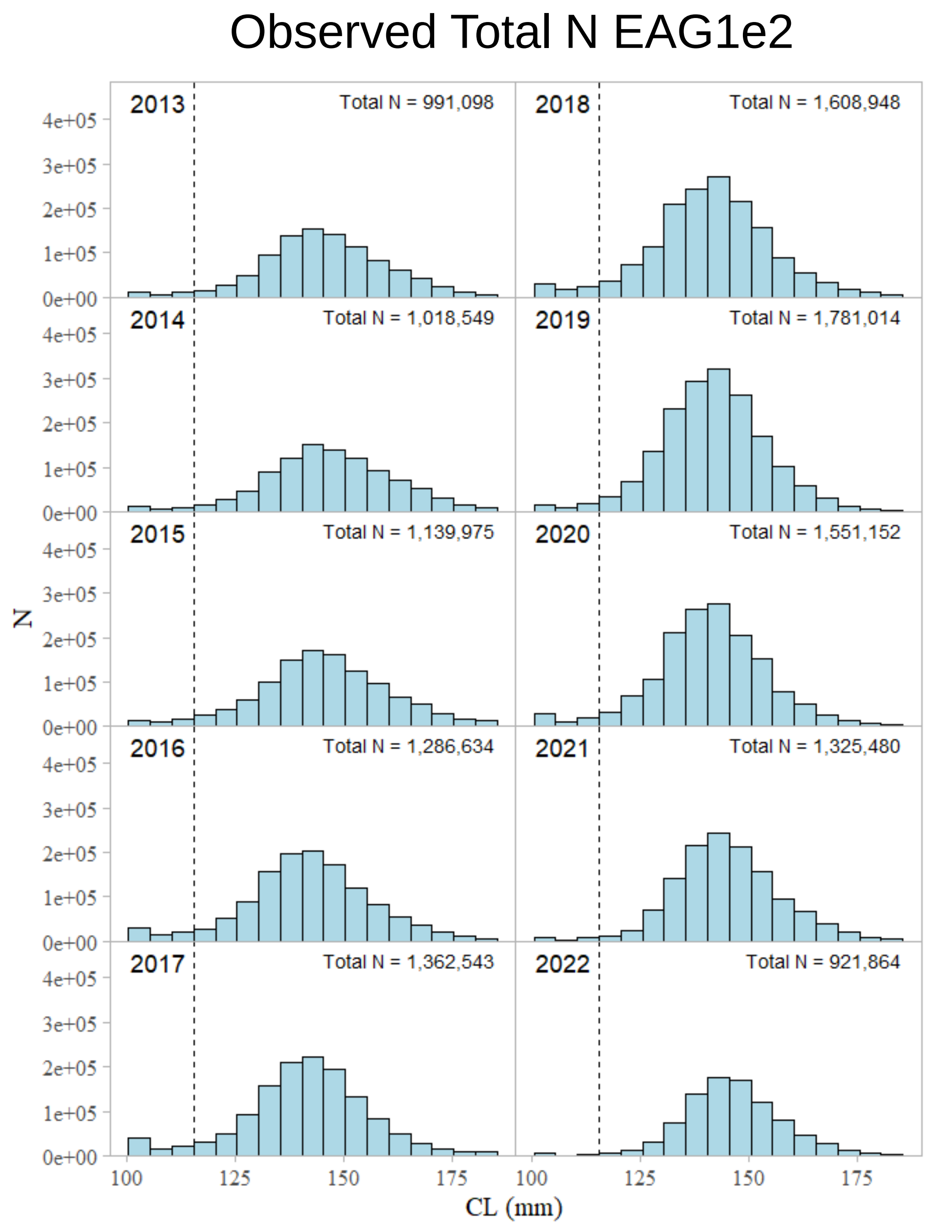


FROM
JANUARY





Predicted N Matrix EAG1e2
2013
Rec = 2,258
MMB = 7,490
2018
Rec = 3,118
MMB = 8,660
2014
Rec = 3,017
MMB = 7,113
2019
Rec = 2,696
MMB = 9,245
2015
Rec = 3,062
MMB = 7,036
2020
Rec = 1,862
MMB = 9,644
2016
Rec = 3,373
MMB = 7,370
2021
Rec = 2,203
MMB = 9,462
2017
Rec = 4,049
MMB = 7,958
2022
Rec = 2,418
MMB = 9,055
N
CL (mm)



Observed Total N EAG1e2
2013
Total N = 991,098
2018
Total N = 1,608,948
2014
Total N = 1,018,549
2019
Total N = 1,781,014
2015
Total N = 1,139,975
2020
Total N = 1,551,152
2016
Total N = 1,286,634
2021
Total N = 1,325,480
2017
Total N = 1,362,543
2022
Total N = 921,864
N
CL (mm)