2017 updated South Coast Rock Lobster assessment results

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Summary

The 2017 assessment of the resource is updated given two further years of data now available. Recruitment is estimated to have increased over the last two seasons compared to the previous three seasons when recruitment was estimated to be poor. The spawning biomass trajectory is steady recent years. Current spawning biomass is estimated to be 32% of K.

Introduction

The most recent South Coast rock lobster assessment that has been reported was that table in 2015 (Johnston and Butterworth 2015). This document reports an update to this assessment, where this 2017 update includes fitting to the following data.

1. GLM standardised CPUE data for each area (A1e, A1W, and A2+3): 1977-2015 (The 2015 assessment included data to 2013 only).
2. Catch-at-length (CAL) data (males and females separately) for each area: 1995-2013 (The 2015 assessment included data to 2013 only). Hence no new CAL data are included in this assessment as they are not yet available.
3. Catch data for each area (1973-2015).

Stock recruit residuals are estimated for the 1974-2008 period (a further two years compared to the 2015 assessment).

Note that for the RC model, CPUE and CAL data receive **equal** weighting and the 1999 and 2006 CAL data are removed from the likelihood because of very small sample sizes. Three sensitivity models are run (as for the 2015 assessment).

- Sen1: CAL data downweighted by a factor of 0.75
- Sen2: CAL data downweighted by a factor of 0.5
- Sen3: CAL data downweighted by a factor of 0.1

Results of updated assessments

The assessment model is essential identical to that used in 2015, except for the addition of new data, and the estimation of two further stock-recruit residuals.

Table 1 reports the results of the 2017 updated RC assessment (with the comparable 2015 RC assessment results provided in the first column for comparative purposes). Table 1 also reports results of the three sensitivity tests where the catch-at-length data are down-weighted in the fitting procedure.

Figures 1a-c compare the 2015 and 2017 RC model fits to CPUE (Figure 1a), the estimated spawning biomass relative to pristine (Figure 1b) and the estimated series of stock-recruit residuals (Figure 1c). Figure 2a compares the model fits to CPUE for the RC and Sen2 and Sen3 sensitivity tests. Figure 2b shows the fits to CPUE for the RC and Sen3 for A2+3 for the 2005+ period only. Figure 2c reports the RC proportional split of recruitment to each area.

Figure 3a shows plots of the exploitable biomass relative to K. Figure 3b shows model estimates of spawning biomass relative to K. Figure 4 shows model estimates of F (the harvest proportion). Figure 5 shows the estimates of the stock-recruitment residuals. All these Figures show the results for the RC, Sen2 and Sen3.

Figure 6a shows the RC estimated selectivity functions for each area (for the 1973-1994 period). Note that the A2+3 seletivity functions vary over time for the period 1995-2013 and these are shown in Figure 6b.

Figures 7a and 7b show the catch at length residuals for the RC and Sen3 respectively.

Discussion

<u>Comparison between the 2015 and 2017 assessment</u>

The updated RC assessment produces slightly more optimistic results than those from the 2015 assessment. In 2015 the spawning biomass in 2011 relative to pristine was estimated to be 0.30, whereas the 2017 updated assessment estimates this to be somewhat higher at 0.32, with current (2016) spawning biomass relative to *K* remaining at 0.32 (see Table 1). The spawning biomass relative to *K* is stable over recent years (Figure 1b). Note also that the additional two stock recruit residuals (Figure 1c) compared to the 2015 assessment are both much higher than the previous three very low estimates.

The exploitable biomass values (relative to pristine) for the three areas are slightly larger than those of the 2015 assessment.

<u>Sensitivity to downweighting the CAL data</u>

Previous assessments have shown that down-weighting the CAL data produces different results from the RC (which gives equal weight to both the CPUE and CAL data). This feature remains evident in the updated 2017 assessments. Downweighting the CAL data produces more optimistic results. As the catch-at-length (CAL) data are downweighted, the fits to the CPUE are improved (see the –lnl CPUE values in Table 1 and Figure 2a) and the fits to the CAL data deteriorate (see –ln SCI CAL values in Table 1 and Figures 7a and b – the later Figure shows stronger systematic patterns in residuals, especially for more recent years.). Figure 2b compares the RC and Sen3 model fits to the A2+3 CPUE data for the 2005+ period, in order to show more clearly the improvement in CPUE fit to A2+3 CPUE when the CAL data are downweighted. Figures 2, 3 and 4 compare the exploitable biomass trends in each area, the overall spawning biomass and the model estimates of *F* (the harvest proportion – catch/exploitable biomass) for the RC, Sen2 and Sen3. The greatest differences are evident for the A2+3 results.

Figure 5 shows that when the CAL data are downweighted, some estimated recent stock recruit residuals are not nearly as low. This again highlights that the CAL data push the assessments towards a more negative appraisal of the resource, and when these data are downweighted in the model fit, the appraisal of the status of the resource improves.

References

Johnston, S.J. and Butterworth, D.S. 2015. 2015 updated south coast rock lobster assessment results. FISHERIES/2015/JUL/SWG-SCRL/04.

Table 1: Estimated model parameters and –*ln*L values for the updated 2017 RC and three sensitivity models. The comparable 2015 RC results are reported in the first column for comparison. Values in parenthesis are σ values.

	2015 RC CAL data received equal weight to CPUE	**2017 RC** CAL data received equal weight to CPUE	**2017 Sen1** CAL data downweighted by factor of 0.75	**2017 Sen2** CAL data downweighted by factor of 0.5	**2017 Sen3** CAL data downweighted by factor of 0.1
	Scl15l.tpl/scl15l.rep	Scl17.tpl/rep	Sen1.tpl	Sen2.tpl	Sen3.tpl
# parameters	244	250	250	250	250
-lnL Total	**-480.09**	**-487.17**	**-384.98**	**-291.29**	**-187.07**
-lnl CPUE	**-115.44**	**-120.23**	**-125.75**	**-134.22**	**-182.594**
-lnl CPUE A1E	-21.71 (0.34)	-24.21 (0.33)	-24.33 (0.32)	-24.34 (0.32)	-24.58 (0.32)
-lnl CPUE A1W	-51.51 (0.15)	-54.92 (0.15)	-57.01 (0.14)	-59.79 (0.13)	-66.67 (0.11)
-lnl CPUE A2+3	-42.22 (0.19)	-41.09 (0.21)	-44.41 (0.19)	-50.09 (0.17)	-91.35 (0.06)
-ln SCI CAL	**-420.46**	**-421.95**	**-394.02**	**-351.83**	**-146.06**
-ln SCI CAL A1E	-13.97 (0.14)	-14.61 (0.14)	-13.08 (0.14)	-11.46 (0.14)	-8.68 (0.14)
-ln SCI CAL A1W	-155.86 (0.08)	-156.93 (0.08)	-153.13 (0.08)	-146.38 (0.08)	-112.00 (0.09)
-ln SCI CAL A2+3	-250.63 (0.06)	-250.41 (0.06)	-227.82 (0.06)	-193.99 (0.06)	-25.37 (0.11)
K	4047	4353	4458	4615	5128
λ^{A1E}	0.15*	0.15	0.15	0.15	0.15
λ^{A1W}	0.25*	0.26	0.26	0.26	0.26
λ^{A2+3}	0.60*	0.59	0.59	0.59	0.59
$B_{sp}(2011)$ $(B_{sp}(2011)/K_{sp})$	1214 (0.30)	1395 (0.32)	1482 (0.33)	1601 (0.35)	1872 (0.36)
$B_{sp}(2014)$ $(B_{sp}(2014)/K_{sp})$	1174 (0.29)	1384 (0.32)	1468 (0.33)	1593 (0.35)	2016 (0.39)
$B_{sp}(2015)$ $(B_{sp}(2015)/K_{sp})$	-	1386 (0.32)	1465 (0.33)	1587 (0.34)	2042 (0.40)
$B_{sp}(2016)$ $(B_{sp}(2016)/K_{sp})$	-	1404 (0.32)	1482 (0.33)	1605 (0.35)	2085 (0.41)
$B_{exp}(2014)$ $(B_{exp}(2014)/K_{exp})$ A1E	116 (0.41)	125 (0.50)	121 (0.47)	118 (0.47)	114 (0.48)
$B_{exp}(2014)$ $(B_{exp}(2014)/K_{exp})$ A1W	280 (0.35)	288 (0.36)	280 (0.36)	271 (0.36)	219 (0.34)
$B_{exp}(2014)$ $(B_{exp}(2014)/K_{exp})$ A2+3	672 (0.27)	840 (0.31)	906 (0.33)	1009 (0.35)	1286 (0.43)
$B_{exp}(2015)$ $(B_{exp}(2015)/K_{exp})$ A1E	-	131 (0.49)	126 (0.49)	122 (0.49)	120(0.50)
$B_{exp}(2015)$ $(B_{exp}(2015)/K_{exp})$ A1W	-	281 (0.36)	276 (0.35)	269 (0.35)	232 (0.36)
$B_{exp}(2015)$ $(B_{exp}(2015)/K_{exp})$ A2+3	-	851 (0.32)	913 (0.33)	1011 (0.35)	1293 (0.43)

*fixed on input

Figure 1a: Comparison of 2017 RC fits to CPUE data for each area, with fits obtained from the 2015 RC1 assessment.

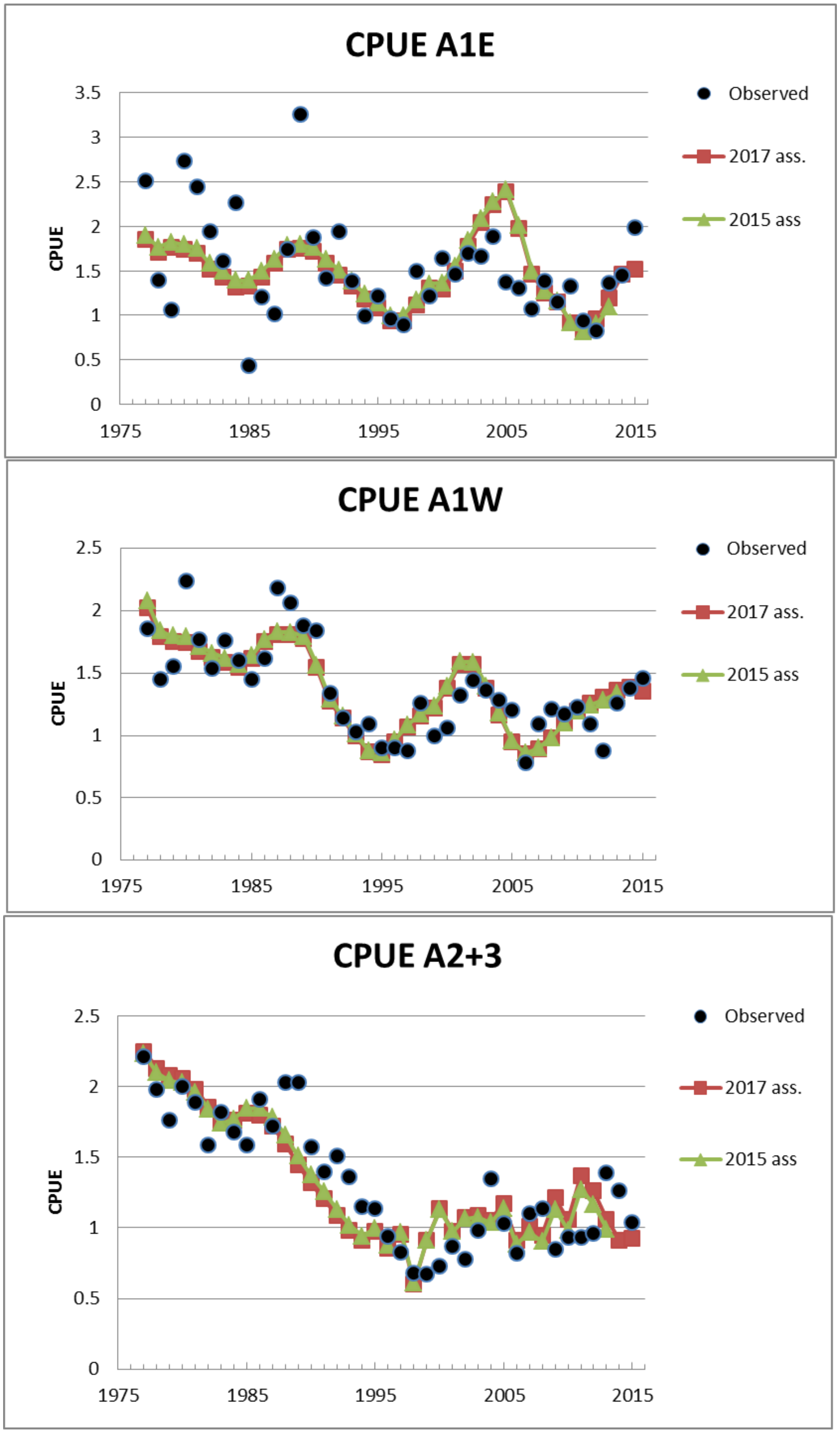


Figure 1b: Comparison of 2017 RC estimated Bsp/K, with the trend obtained from the 2015 RC assessment.

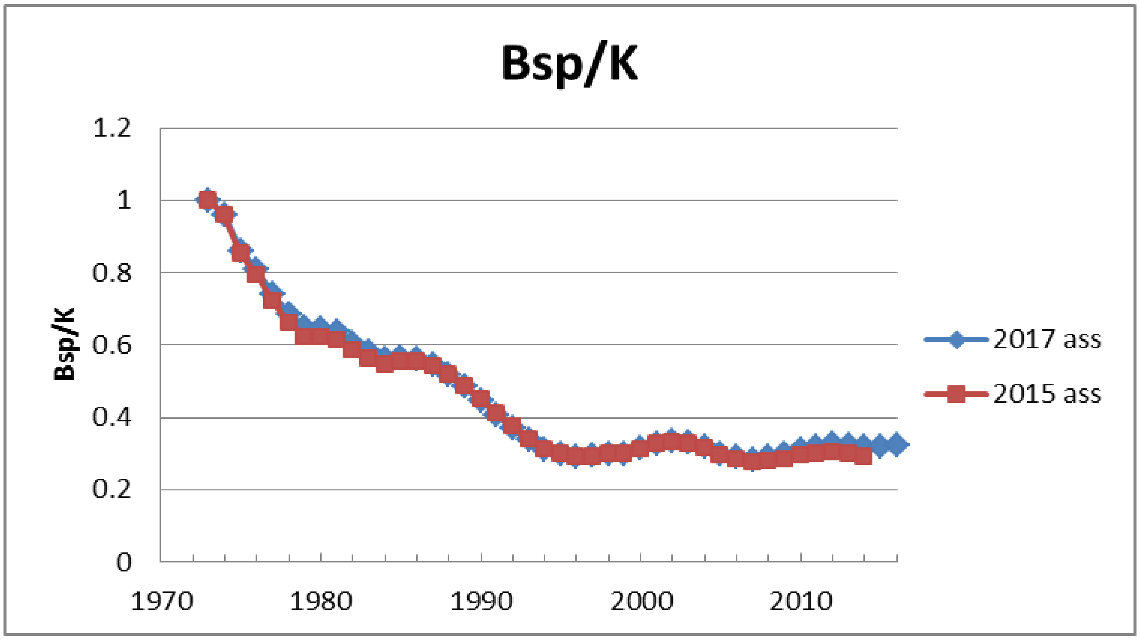


Figure 1c: Comparison of 2015 RC stock-recruitment residuals, with those obtained from the 2015 RC1 assessment.

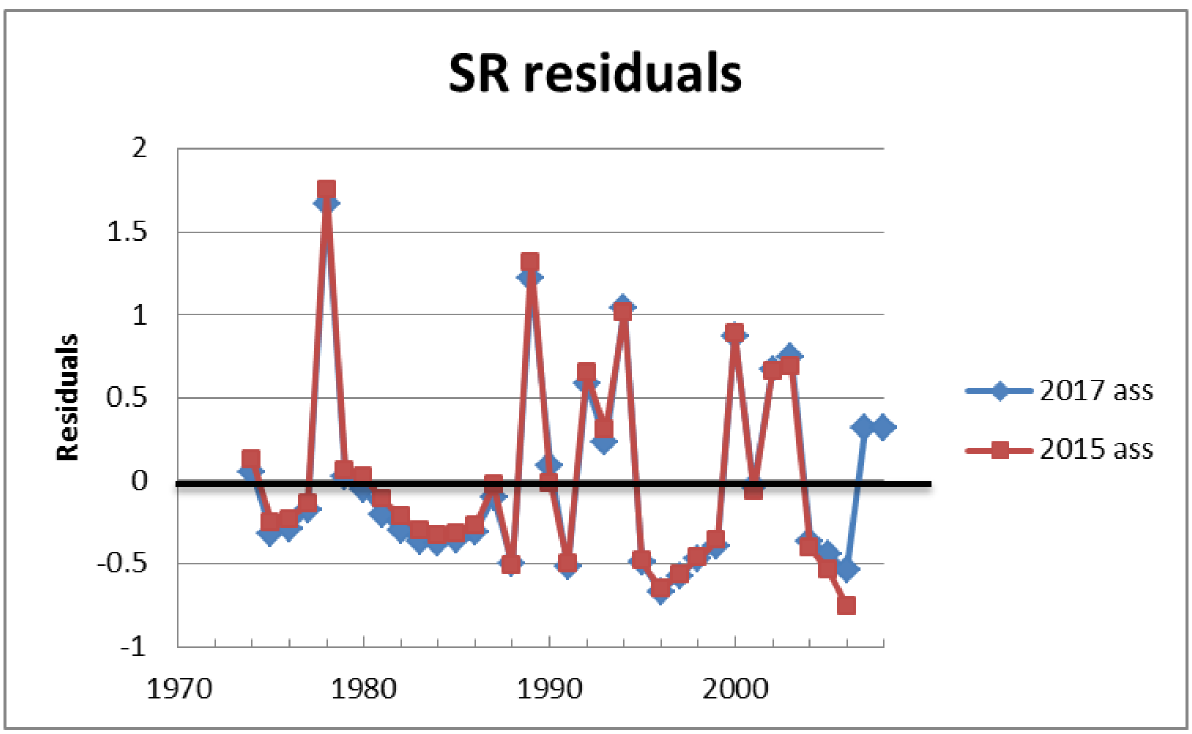


Figure 2a: **Fits to CPUE** for the RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).

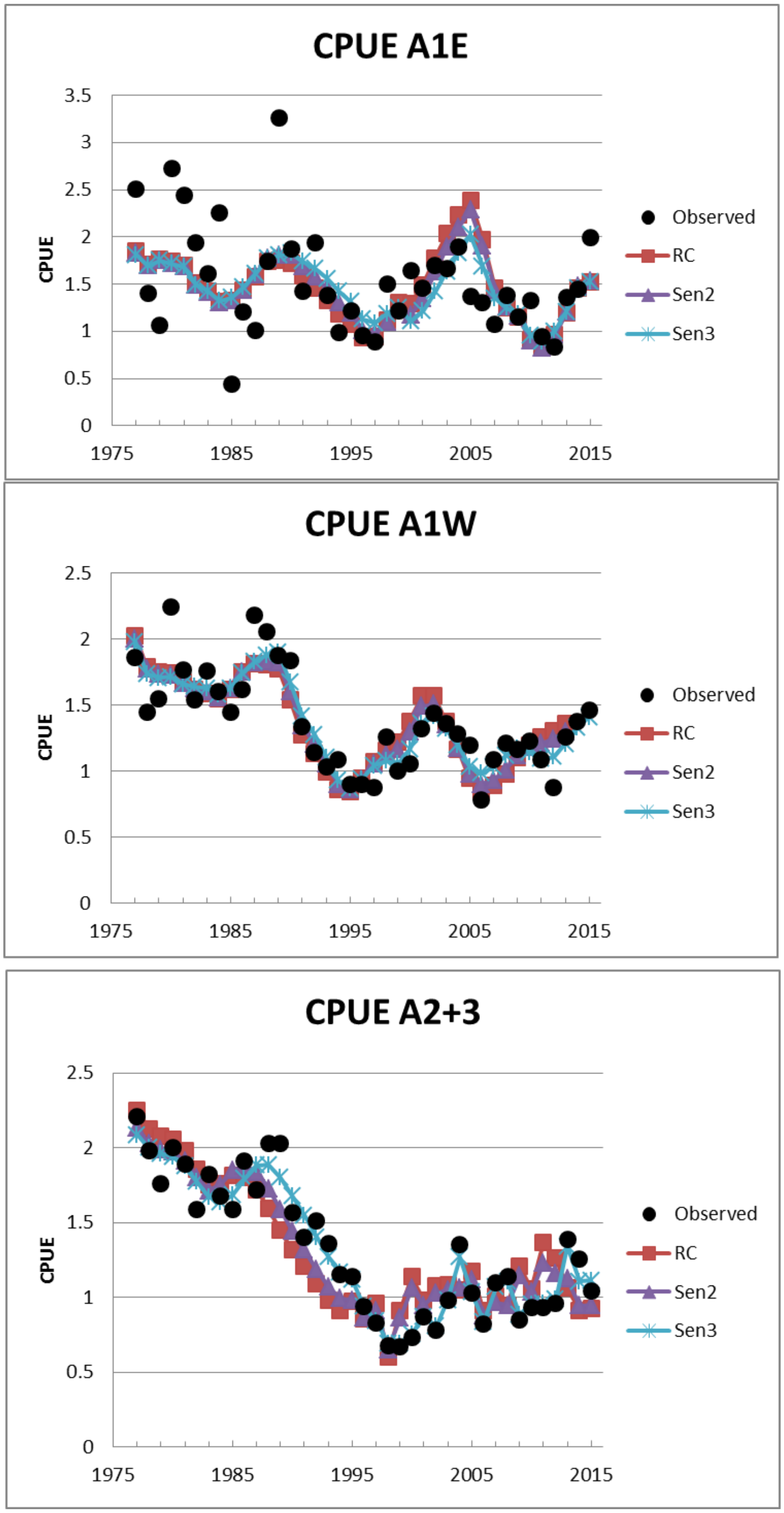


Figure 2b: **Fits to CPUE** for the RC and Sen3 for A2+3 for the 2005+ period only.

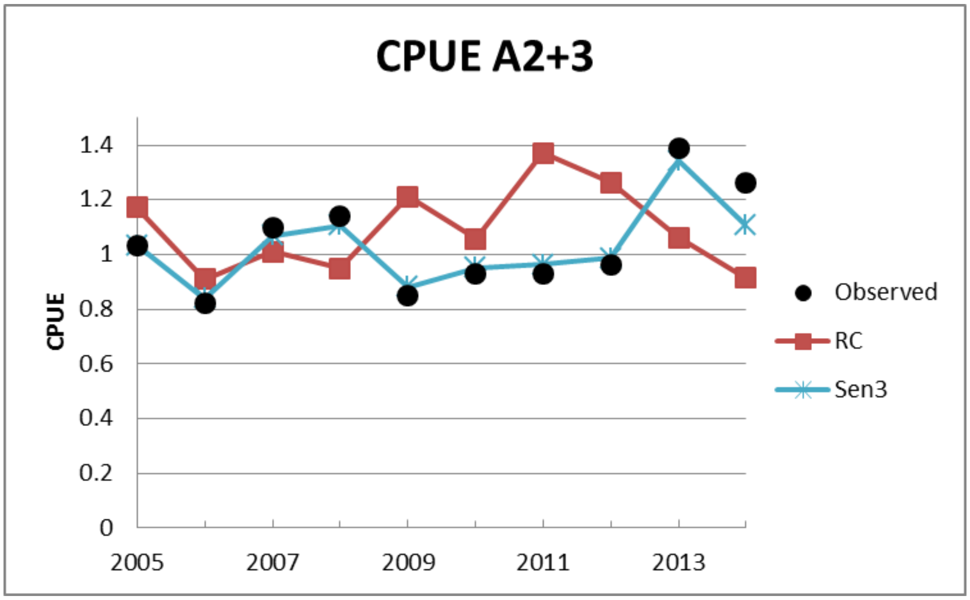


Figure 2c: RC proportional splits of recruitment to each area.

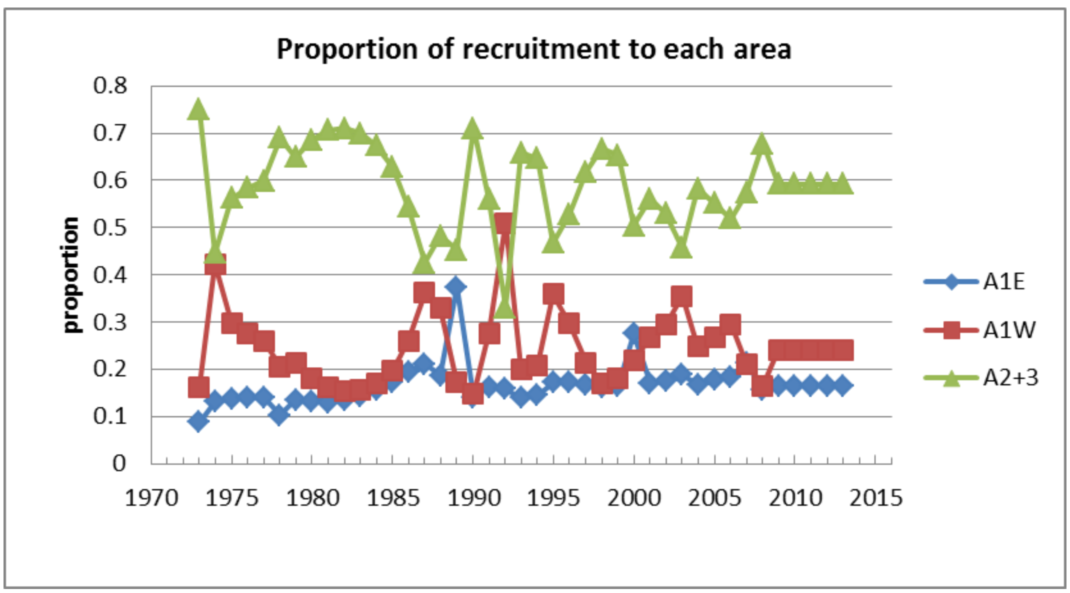


Figure 3a: Model estimates of **exploitable biomass relative to *K*** for the RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).

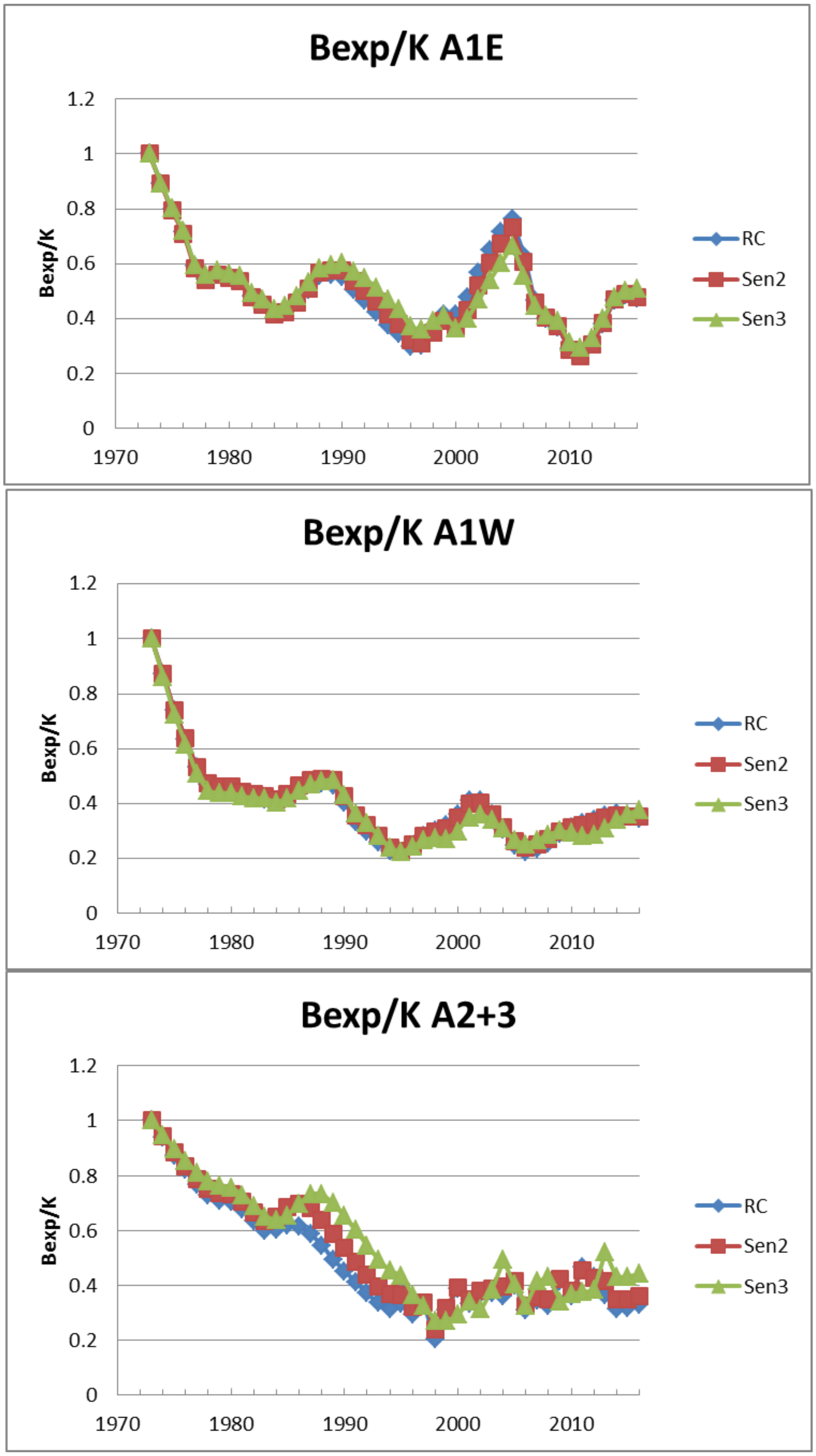


Figure 3b: Model estimates of **spawning biomass relative to *K*** for the RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).

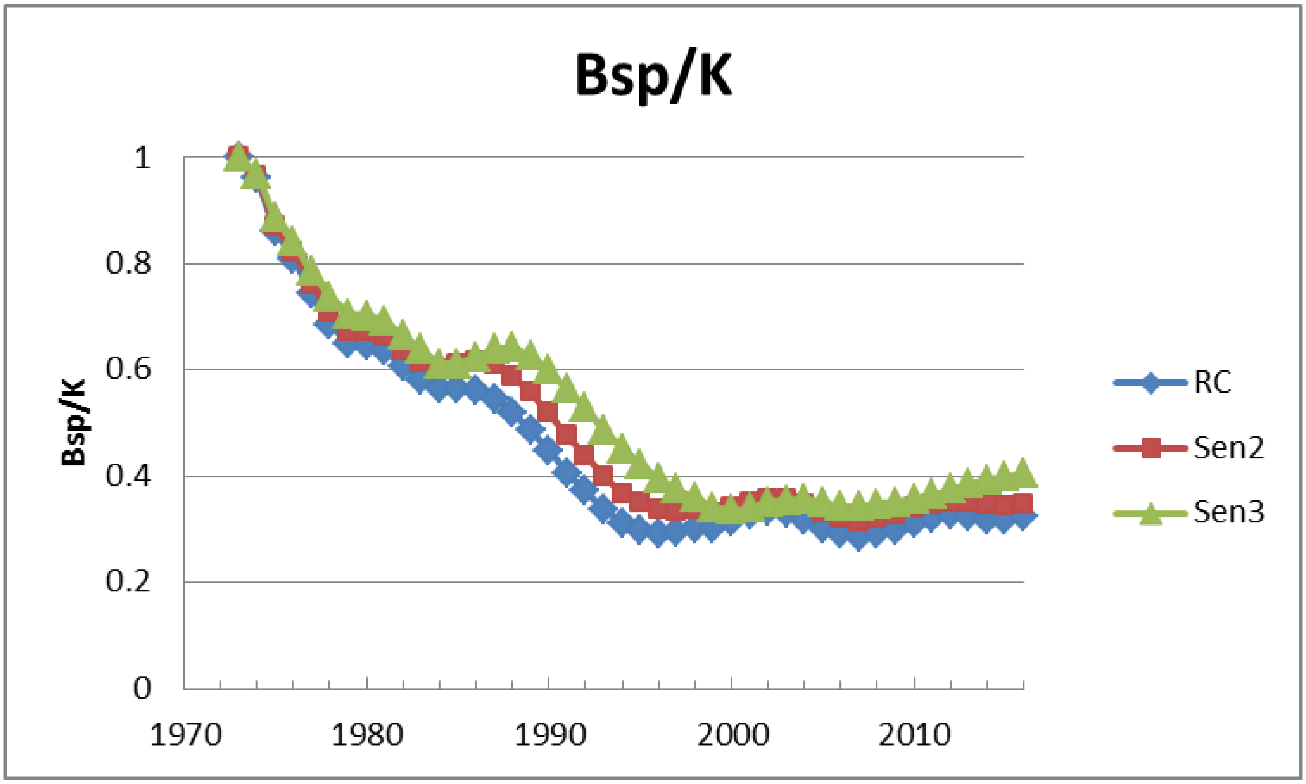


Figure 4: Model estimates of ***F*** (the harvest proportion) for the RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).

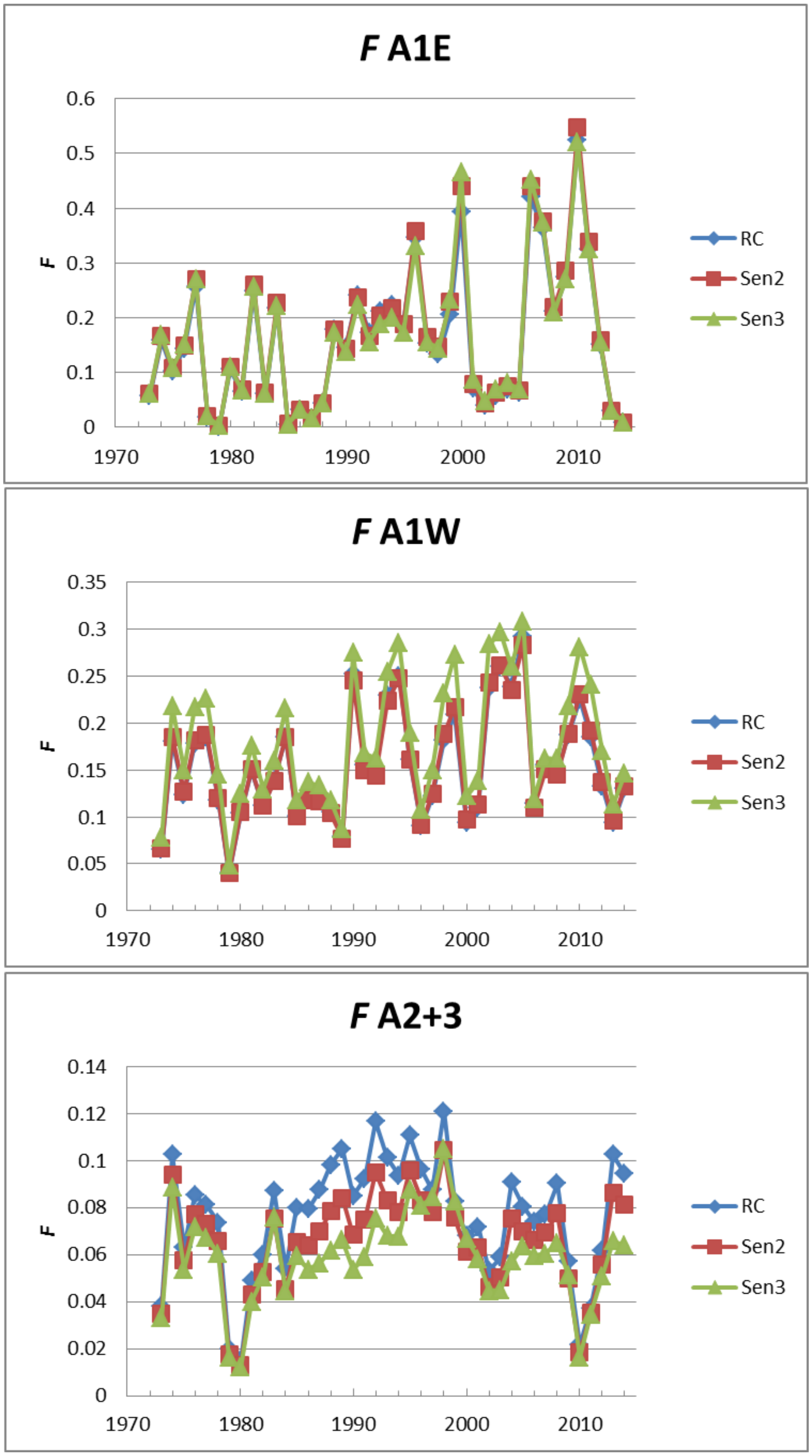


Figure 5: Model estimates of **stock-recruitment residuals** for the RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).

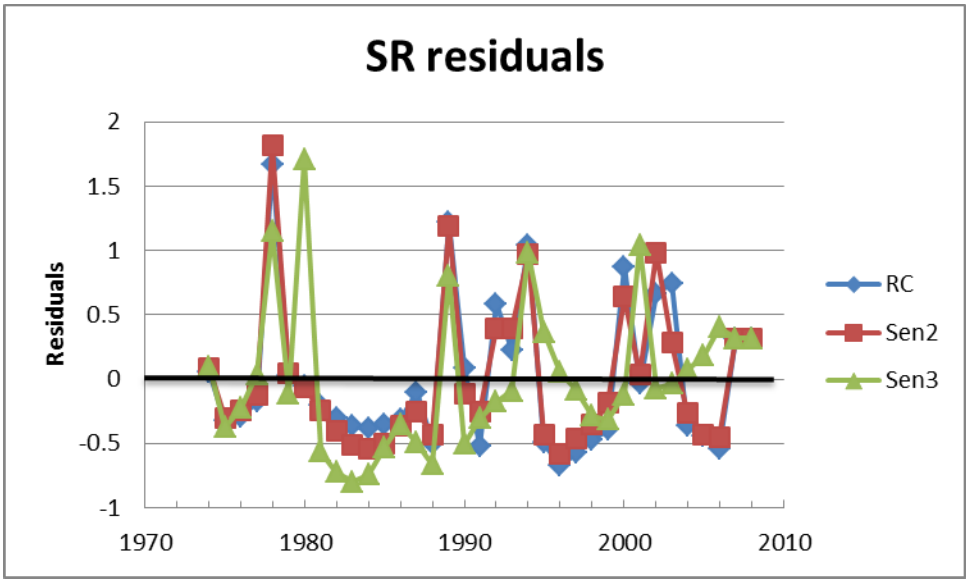


Figure 6a: RC estimated selectivity functions for A1E, A1W and A2+3 (for the1973-1994 period). Note that the A2+3 selectivity functions vary over time for the period 1995-2013 and these are shown in Figure 6b.

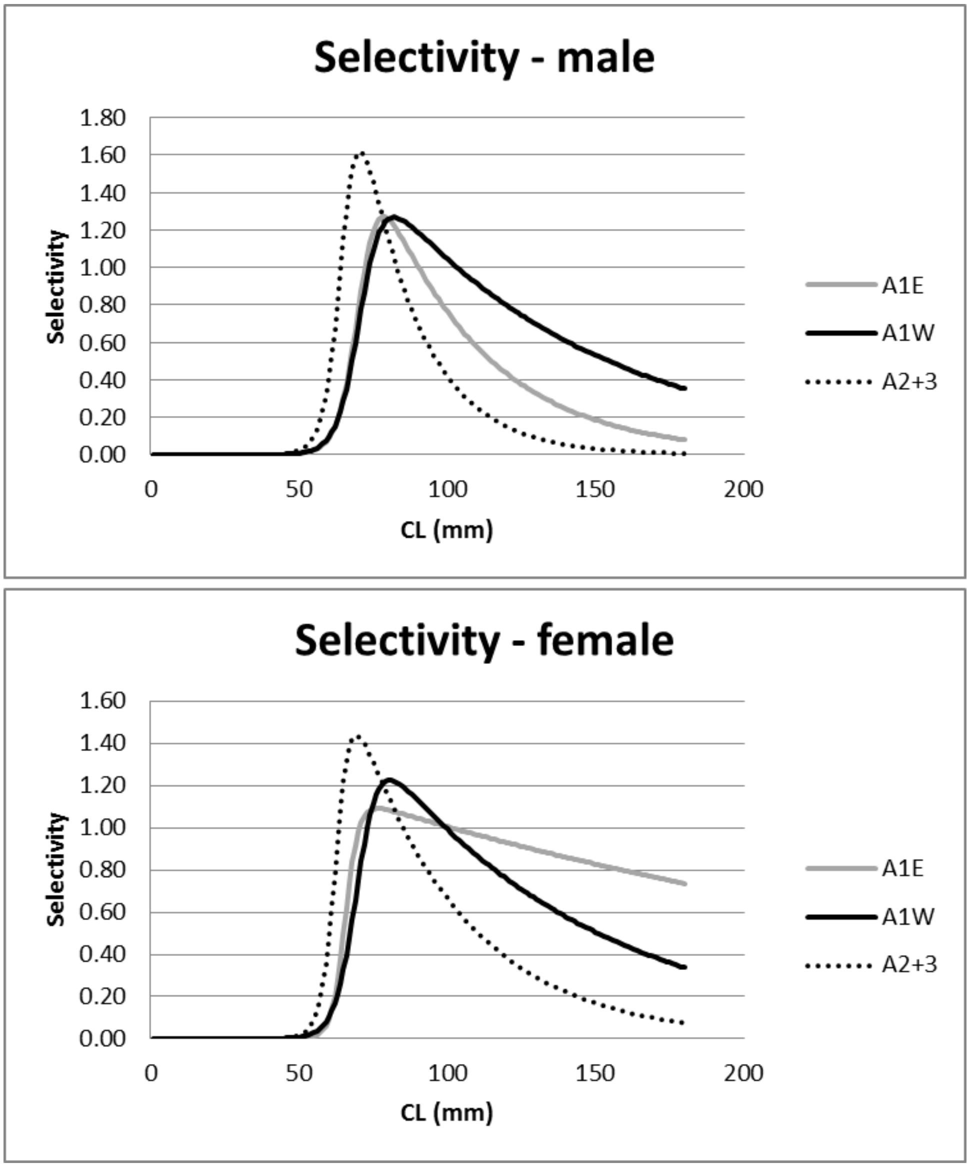
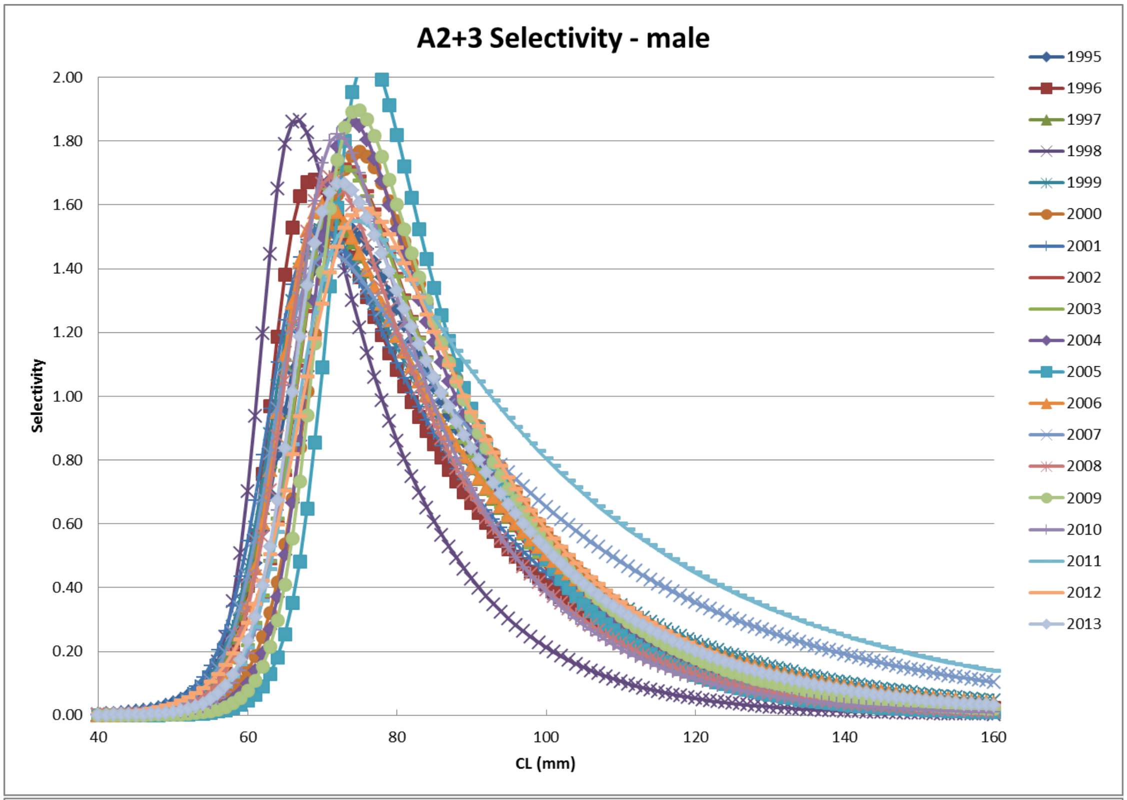


Figure 6b: RC estimated selectivity functions for A2+3 for 1995-2013.



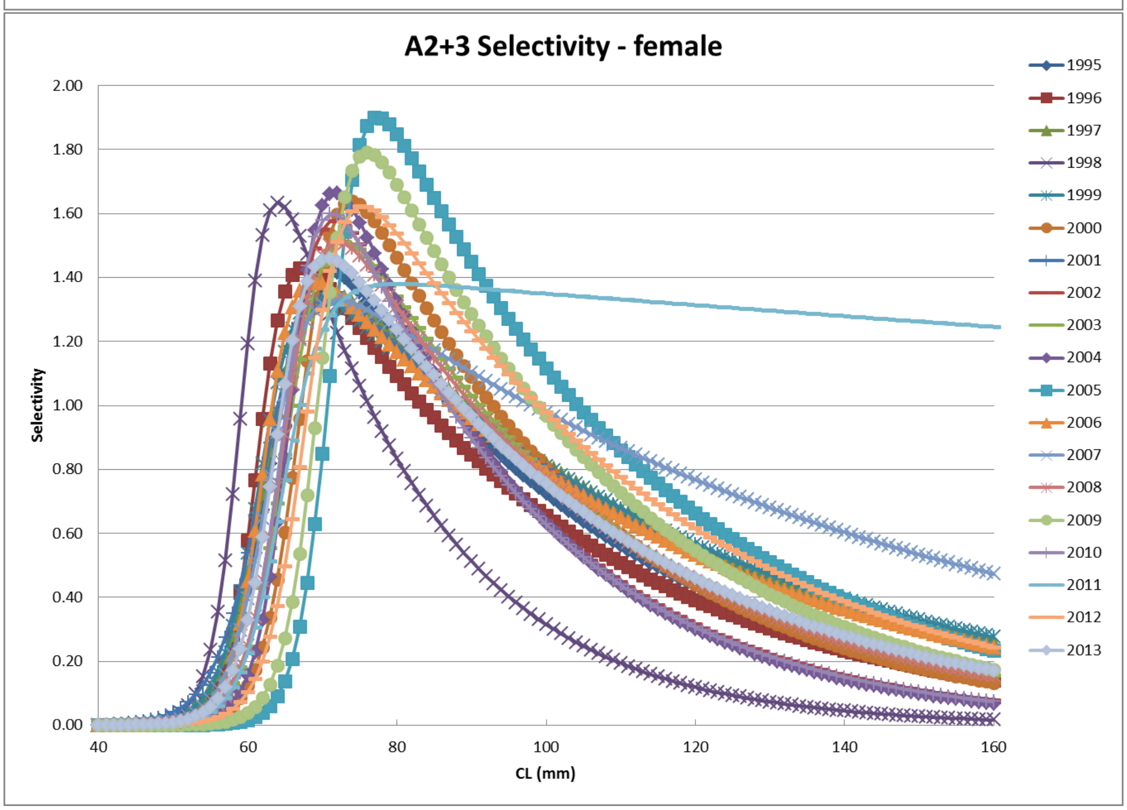


Figure 7a: RC catch-at-length residuals. The dark bubbles reflect positive and the light bubbles reflect negative residuals, with the bubble radii proportional to the magnitudes of the residuals.

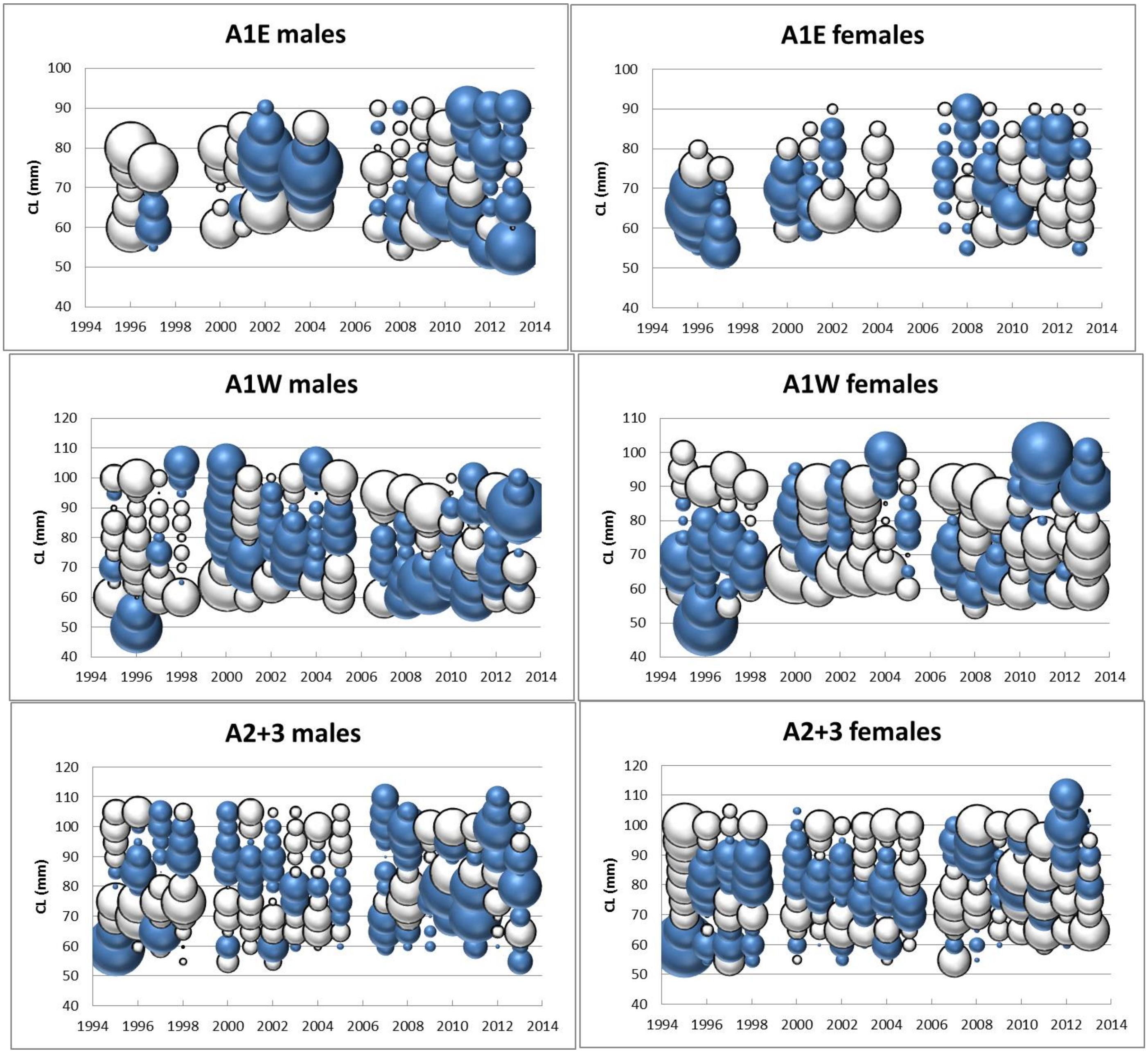


Figure 7b: Sen3 catch-at-length residuals. The dark bubbles reflect positive and the light bubbles reflect negative residuals, with the bubble radii proportional to the magnitudes of the residuals.