2015 updated South Coast Rock Lobster assessment results

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Summary

The 2013 assessment of the resource is updated given three further years of data now available. Recruitment is estimated to have been poor over the further three seasons for which this can now be estimated. The spawning biomass trajectory has flattened after a preceding increase, and is now showing a slight downward trend.

Introduction

The most recent South Coast rock lobster assessment that has been reported was that from 2013 (Johnston and Butterworth 2013). This document reports an update to this assessment, where the 2015 updated assessment includes fitting to the following data.

1. GLM standardised CPUE data for each area: 1977-2013 (2013 assessment included data up to 2010 only).
2. Catch-at-length (CAL) data (males and females separately) for each area: 1995-2013 (2013 assessment included data up to 2010 only).
3. Catch data for each area (1973-2014).

Stock recruit residuals are estimated for the 1974-2006 period (a further three years).

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. Three sensitivity models are run (as for the 2013 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 primary assessment model presented in 2013 (termed RC1 then, and used for subsequent OMP testing) accorded the CAL data equal weighting to the CPUE data (although sensitivity tests examined down-weighting of the CAL data), and the 1999 and 2006 CAL data were excluded from the likelihood because of anomalous features. This model included the A1E pre-1990 CPUE data in the likelihood, whereas a sensitivity (called RC2 at that time) excluded those data from the likelihood.

The 2015 assessment methodology has duplicated that of the primary assessment of 2013, but with one modification. Recall that for each Area A, the proportional split of recruitment, $\lambda_y^{*,A}$, is given by:

$$R_y^A = \lambda_y^{*,A} R_y \tag{1}$$

where

$$\lambda_y^{*,A} = \frac{\lambda^A e^{\varepsilon_{A,y}}}{\sum_A \lambda^A e^{\varepsilon_{A,y}}} \tag{2}$$

and the λ^A values can now be estimated based on the period from **1973** to **2006.** However, while in 2013 this process yielded stable estimates for these λ^A values, some became unstable given the additional data now available. Accordingly the decision was made to fix them at their 2013 values:

λ^{A1E}=0.15

λ^{A1W}=0.25

λ^{A2+3}=0.60

Note that the model still allows for annual variability (see $e^{\varepsilon_{A,y}}$ in equation (2) above) around these "fixed" proportions.

Table 1 reports the results of the 2015 updated RC assessment (with the comparable 2013 RC1 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 2013 and 2015 RC model fits to CPUE (Figure 1a), the estimated spawning biomass relative to pristine (Figure 1b) and the estimated stock-recruit residuals (Figure 1c). Figure 2a compares the models fits to CPUE for the RC and Sen2 and Sen3 sensitivity tests. Figure 2c reports the RC proportional split of recruitment to each area.

Discussion

Comparison between the 2013 and 2015 assessment

The updated RC assessment produces somewhat different results to those produced in 2013. In 2013 the spawning biomass in 2011 relative to pristine was estimated to be 0.35, whereas the 2015 updated assessment estimates this to be somewhat lower at 0.30, with current (2014) spawning biomass relative to K at 0.29 (see Figure 1a). Rather than continuing the increase over the 2007-2011 period, the spawning biomass relative to K has subsequently stabilised and is decreasing somewhat (Figure 1b).

Note also that the additional three stock recruit residuals (Figure 1c) from the 2015 assessment are all very low.

The exploitable biomass trends (relative to pristine) across the three areas are also slightly different, with the 2015 assessment estimating higher levels for A2+3, and lower levels for A1E and A1W (see Table 1). This is also seen in the slightly different fits to the CPUE data (Figure 1a).

Sensitivity to downweighting the CAL data

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 2015 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). 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 seen in the A2+3 results.

Figure 5 shows that when the CAL data are downweighted, the 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.

A final figure (Figure 8) reports the observed mean size of catch and the percentage females in catch for each of the three areas. There is a recent upward trend in the mean size of the catch for A1W and A2+3.

References

Johnston, S.J. and Butterworth, D.S. (2013). Final 2013 updated south coast rock lobster assessment results and description of OMP simulation framework. FISHERIES/2013/JUN/SWG-SCRL/06.

Table 1: Estimated model parameters and $-ln$L values for the updated 2015 RC and three sensitivity models. The comparable 2013 RC1 results are reported in the first column for comparison. Values in parenthesis are σ values.

	2013 RC1 CAL data received equal weight to CPUE	2015 RC CAL data received equal weight to CPUE	2015 Sen1 CAL data downweighted by factor of 0.75	2015 Sen2 CAL data downweighted by factor of 0.5	2015 Sen3 CAL data downweighted by factor of 0.1
	Scl.tpl/n5a.rep	Scl15l.tpl/scl15l.rep	Sen1.tpl	Sen2.tpl	Sen3.tpl
# parameters	219	244	244	244	244
-lnL Total	**-427.49**	**-480.09**	-	-	-
-lnl CPUE	**-113.53**	**-115.44**	**-121.08**	**-129.77**	**-173.44**
-lnl CPUE A1E	-17.87	-21.71 (0.34)	-21.80 (0.34)	-21.81 (0.34)	-21.94 (0.34)
-lnl CPUE A1W	-50.42	-51.51 (0.15)	-54.03 (0.14)	-57.16 (0.13)	-62.13 (0.11)
-lnl CPUE A2+3	-45.23	-42.22 (0.19)	-45.25 (0.18)	-50.79 (0.15)	-89.37 (0.05)
-ln SCI CAL	**-361.31**	**-420.46**	**-392.53**	**-349.89**	**-159.83**
-ln SCI CAL A1E	-11.46	-13.97 (0.14)	-12.40 (0.14)	-10.66 (0.14)	-6.87 (0.14)
-ln SCI CAL A1W	-151.21	-155.86 (0.08)	-151.76 (0.08)	-144.70 (0.08)	-116.51 (0.09)
-ln SCI CAL A2+3	-198.65	-250.63 (0.06)	-228.37 (0.06)	-194.53 (0.07)	-36.44 (0.10)
K	4895	4047	4186	4350	4960
λ^{A1E}	0.153	0.15*	0.15*	0.15*	0.15*
λ^{A1W}	0.256	0.25*	0.25*	0.25*	0.25*
λ^{A2+3}	0.592	0.60*	0.60*	0.60*	6.50*
$B_{sp}(2011)$ $(B_{sp}(2011)/K_{sp})$	1650 (0.34)	1214 (0.30)	1291 (0.31)	1392 (0.32)	1833 (0.33)
$B_{sp}(2014)$ $(B_{sp}(2014)/K_{sp})$	-	1174 (0.29)	1239 (0.30)	1334 (0.31)	2175 (0.40)
$B_{exp}(2011)$ $(B_{exp}(2011)/K_{exp})$ A1E	45 (0.16)	74 (0.26)	70 (0.26)	66 (0.26)	70 (0.28)
$B_{exp}(2011)$ $(B_{exp}(2011)/K_{exp})$ A1W	504 (0.58)	255 (0.32)	247 (0.32)	236 (0.31)	193 (0.29)
$B_{exp}(2011)$ $(B_{exp}(2011)/K_{exp})$ A2+3	959 (0.35)	1056 (0.43)	1076 (0.42)	1100 (0.41)	1013 (0.36)
$B_{exp}(2014)$ $(B_{exp}(2014)/K_{exp})$ A1E	-	116 (0.41)	110 (0.41)	105 (0.40)	99 (0.40)
$B_{exp}(2014)$ $(B_{exp}(2014)/K_{exp})$ A1W	-	280 (0.35)	266 (0.34)	248 (0.33)	206 (0.31)
$B_{exp}(2014)$ $(B_{exp}(2014)/K_{exp})$ A2+3	-	672 (0.27)	725 (0.28)	805 (0.30)	1017 (0.36)

*fixed on input

Figure 1a: Comparison of 2015 RC fits to CPUE data from each area, with fits obtained from the 2013 (RC1) assessment.
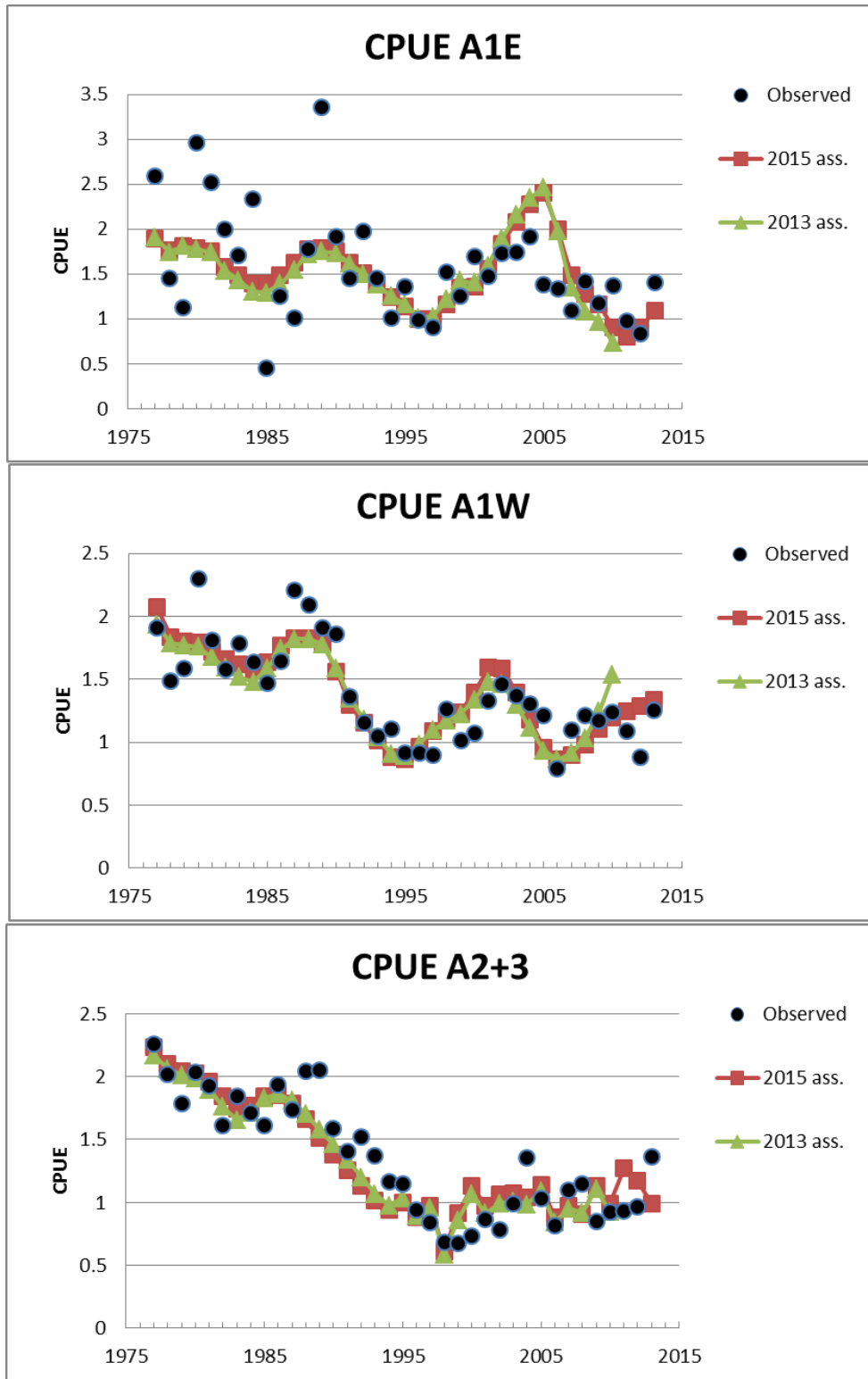
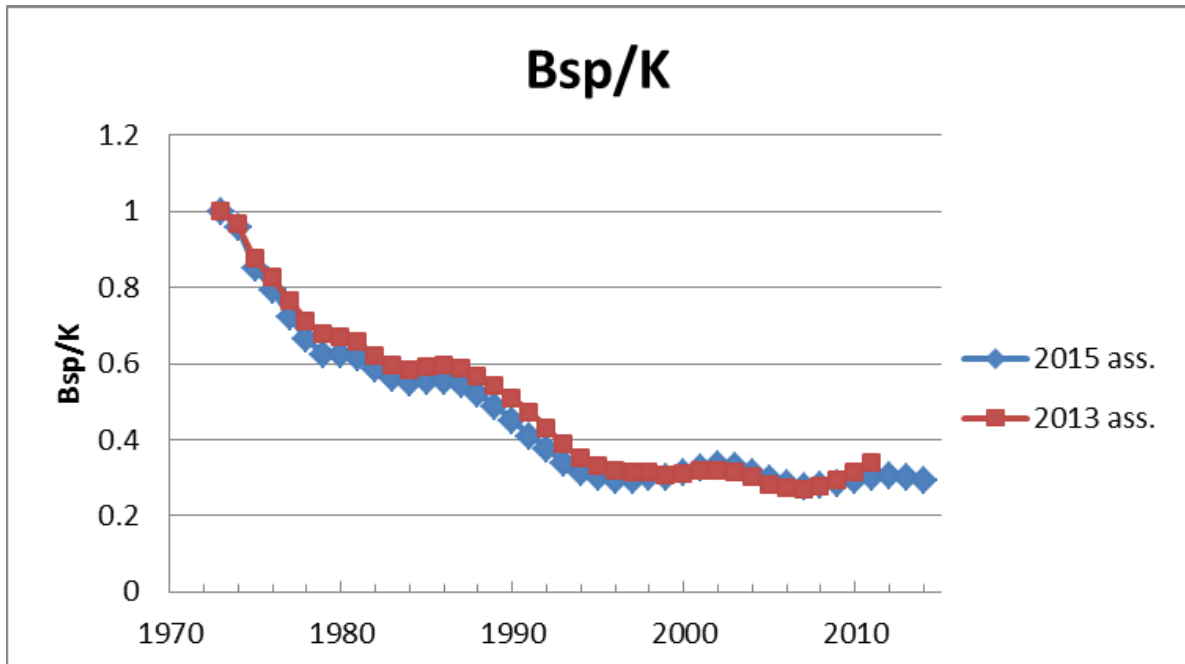Figure 1b: Comparison of 2015 RC estimated Bsp/K, with the trend obtained from the 2013 (RC1) assessment.

Figure 1c: Comparison of 2015 RC stock-recruitment residuals, with those obtained from the 2013 (RC1) assessment.
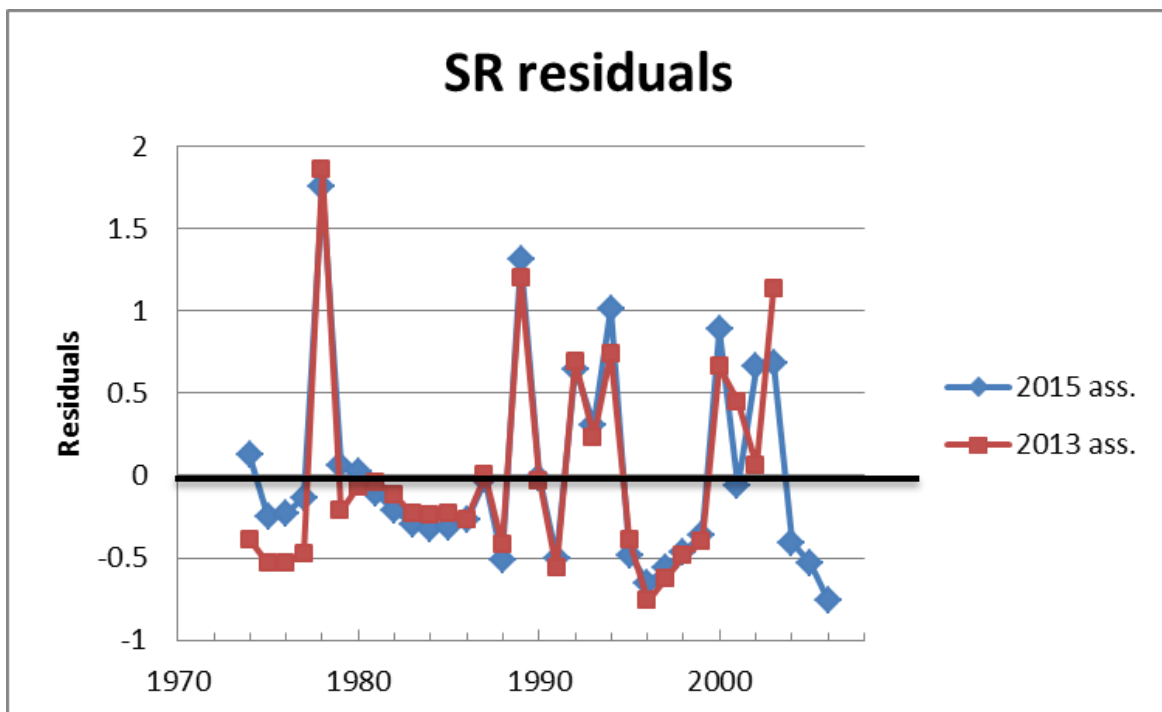
Figure 2a: **Fits to CPUE** for the RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).
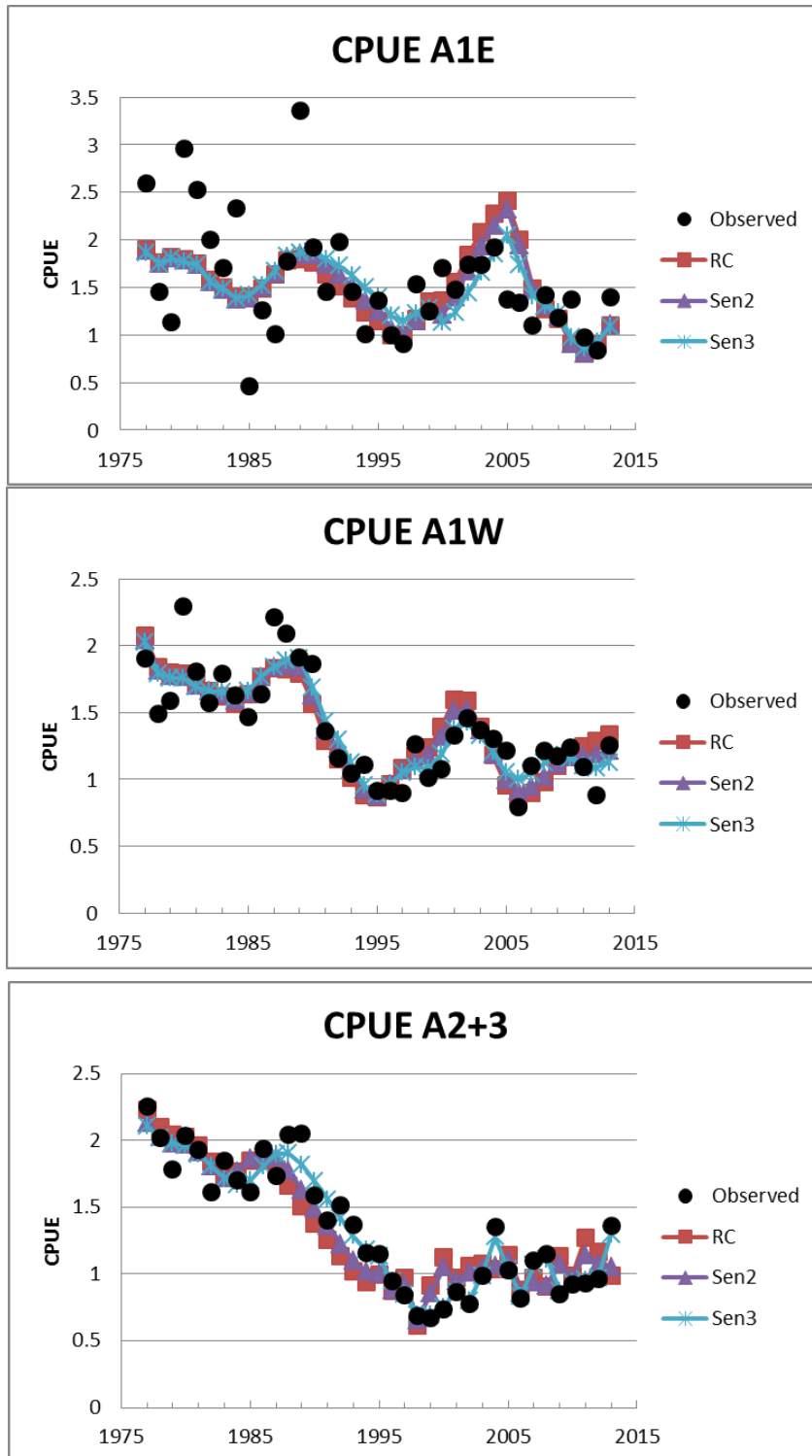
Figure 2b: **Fits to CPUE** for the RC and Sen3 for A2+3 for the 2005+ period only.
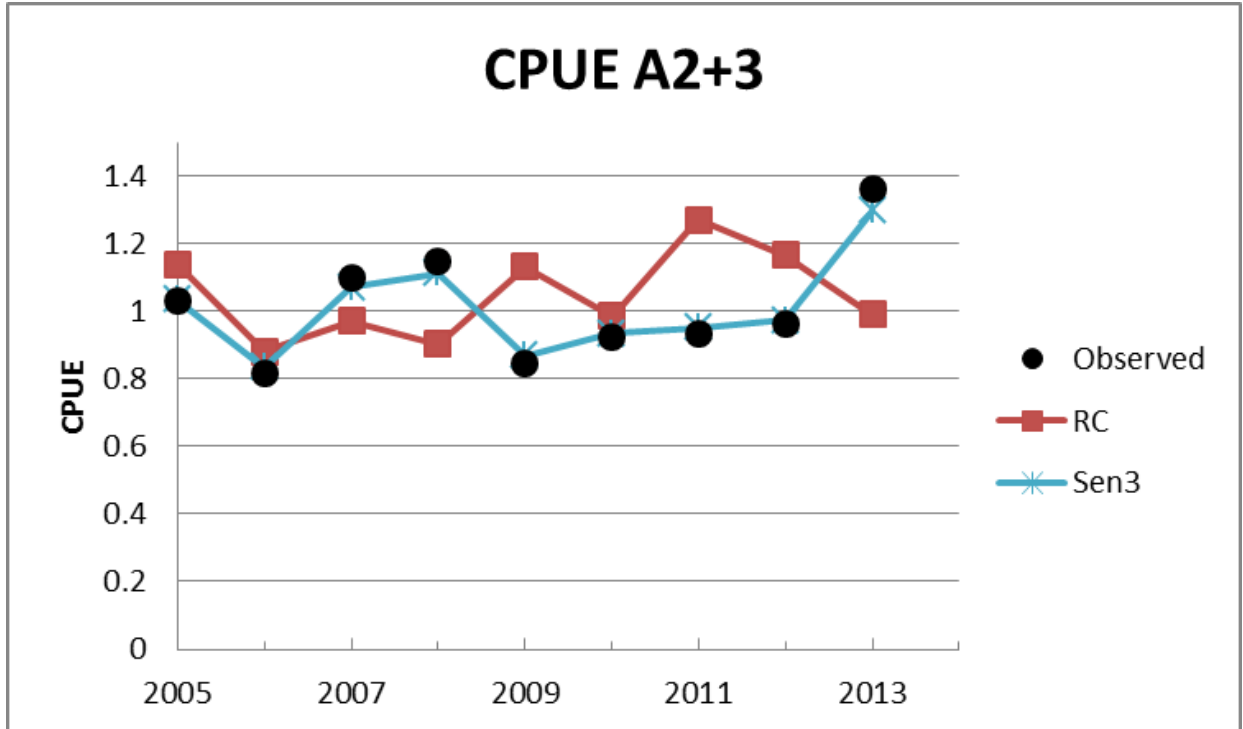
Figure 2c: RC proportional splits of recruitment to each area.
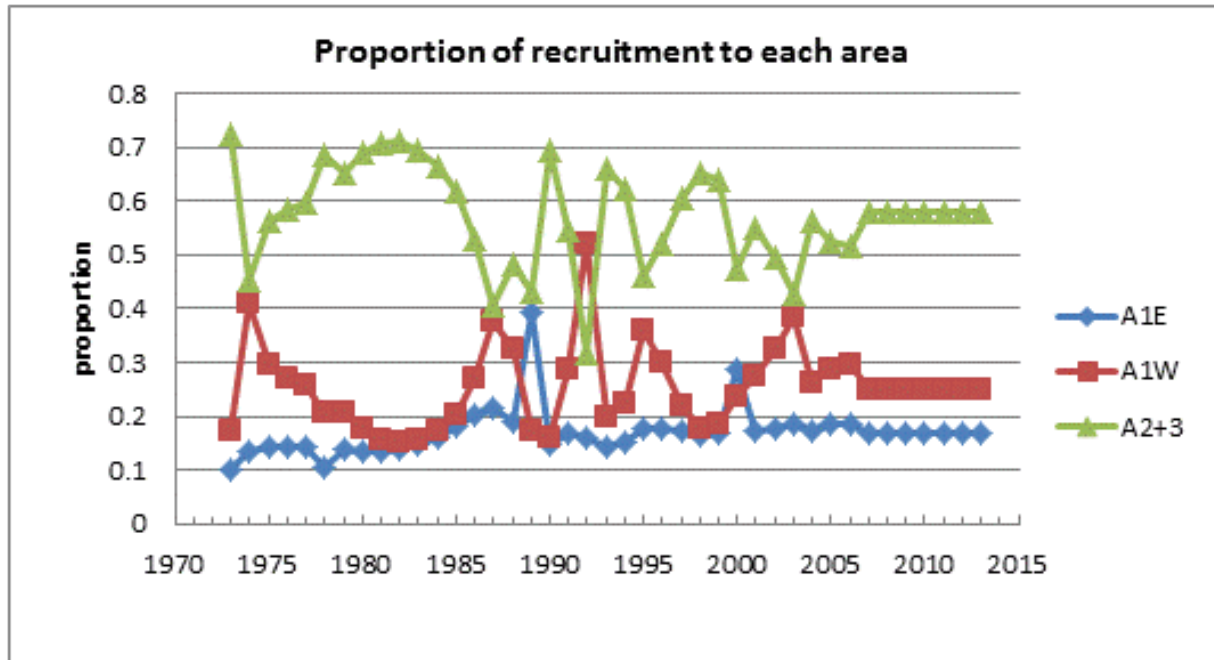
Figure 3a: Model estimates of **exploitable biomass relative to _K_** for RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).
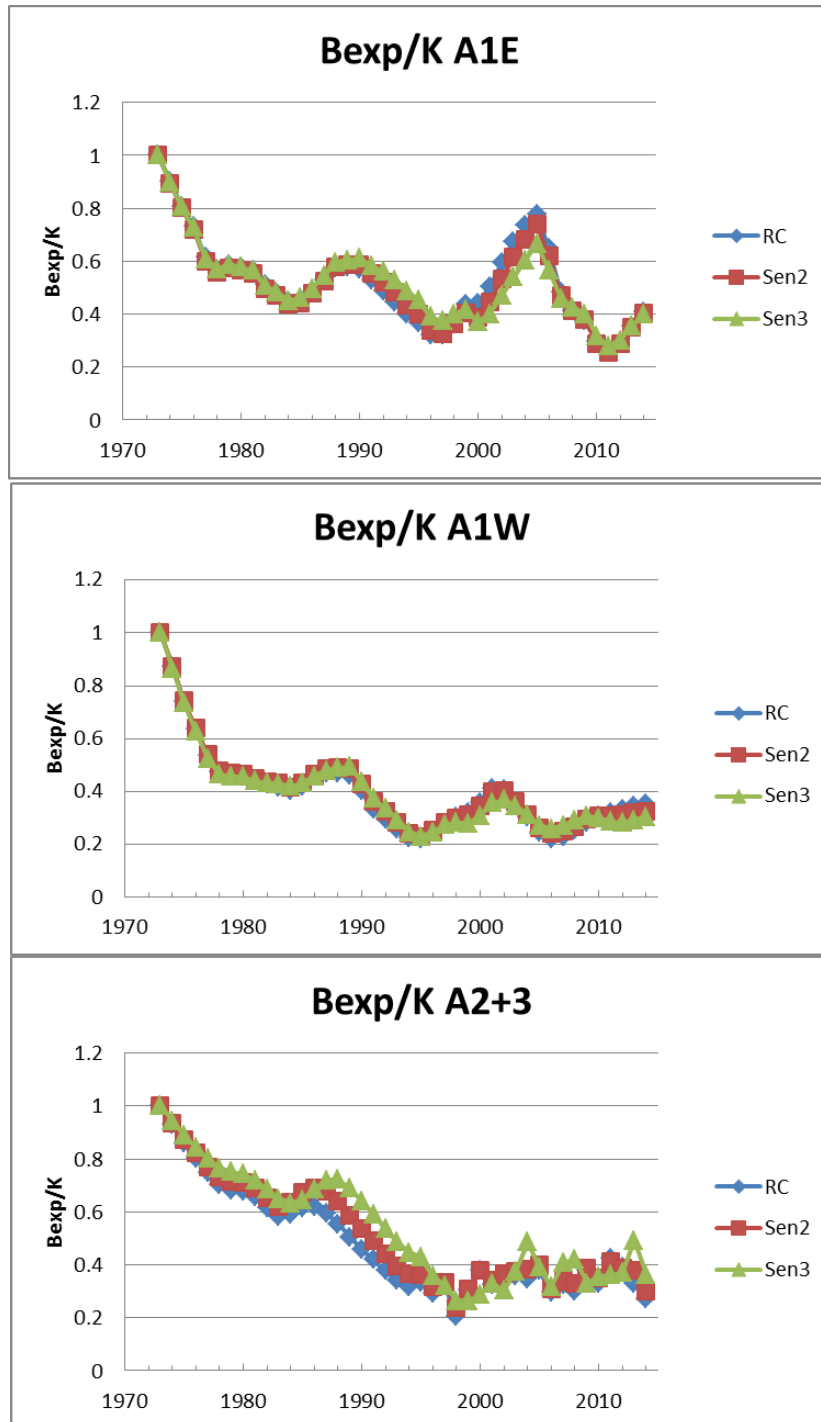
Figure 3b: Model estimates of **spawning biomass relative to *K*** for RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).
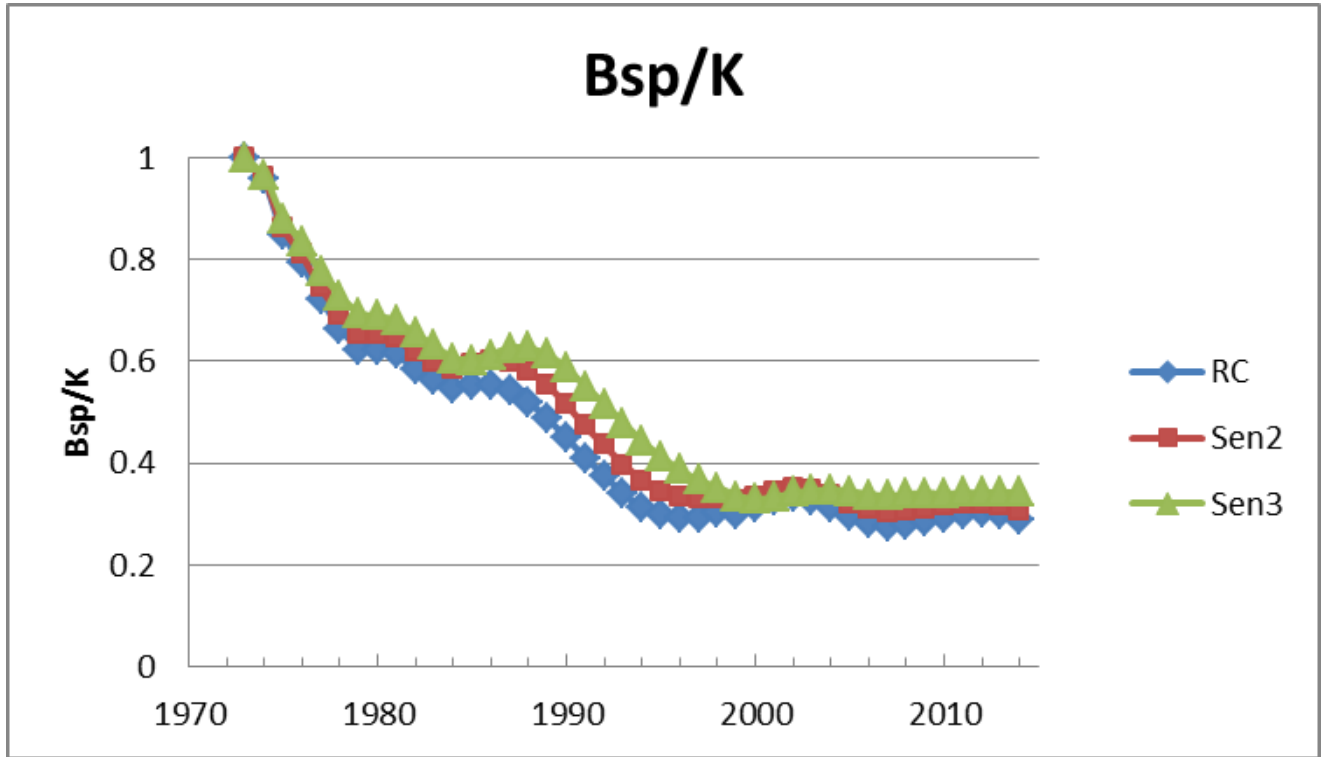
Figure 4: Model estimates of *F* (the harvest proportion) for RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).
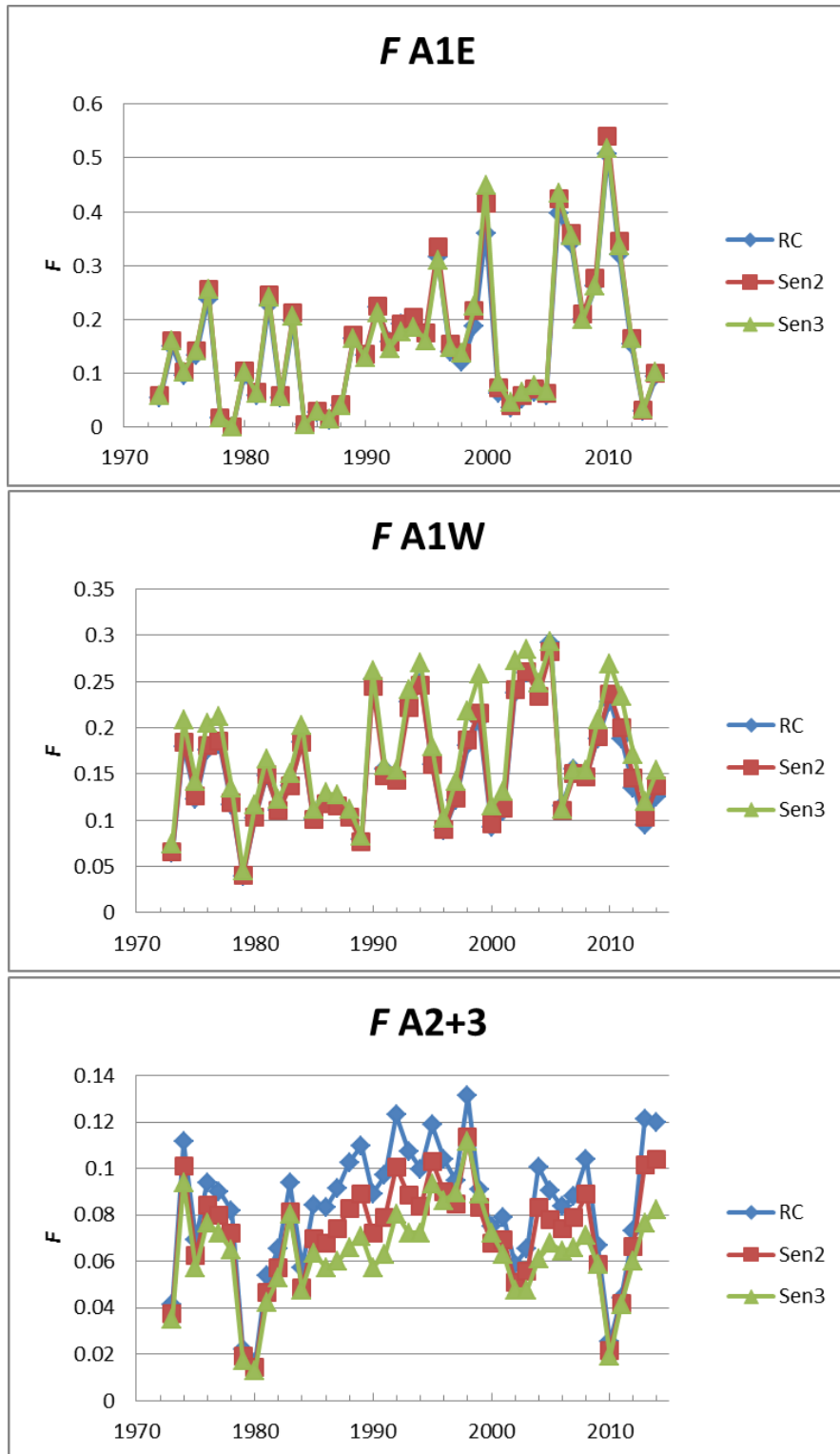
Figure 5: Model estimates of **stock-recruitment residuals** for the RC, Sen2 (RC but downweights CAL data by 0.5) and Sen3 (RC but downweights CAL data by 0.10).
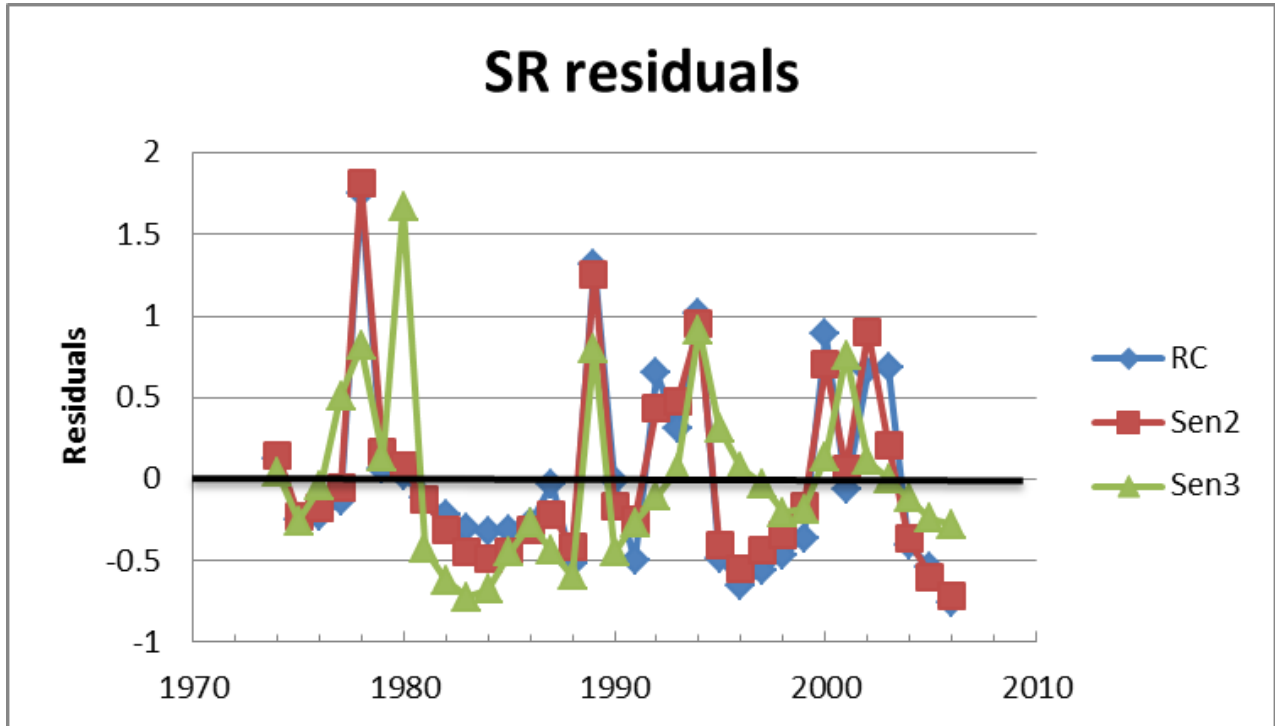
Figure 6a: RC estimated selectivity functions for A1E, A1W and A2+3 (for the1973-1994 period). Note that the A2+3 selectivity functions vary over time for the period 1995-2013 and these are shown in Figure 6b.
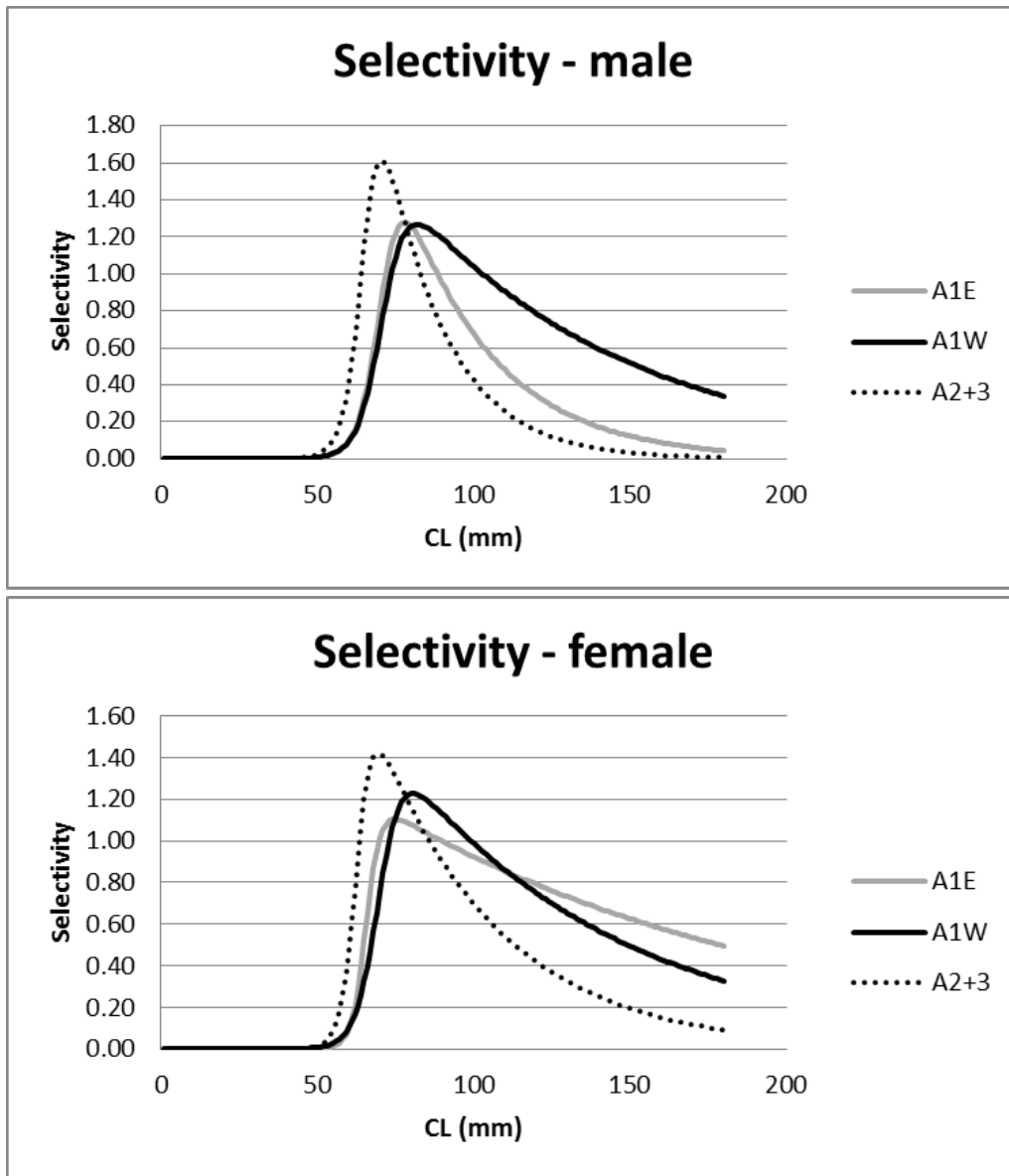
Figure 6b: RC1 estimated selectivity functions for A2+3 for 1995-2013.
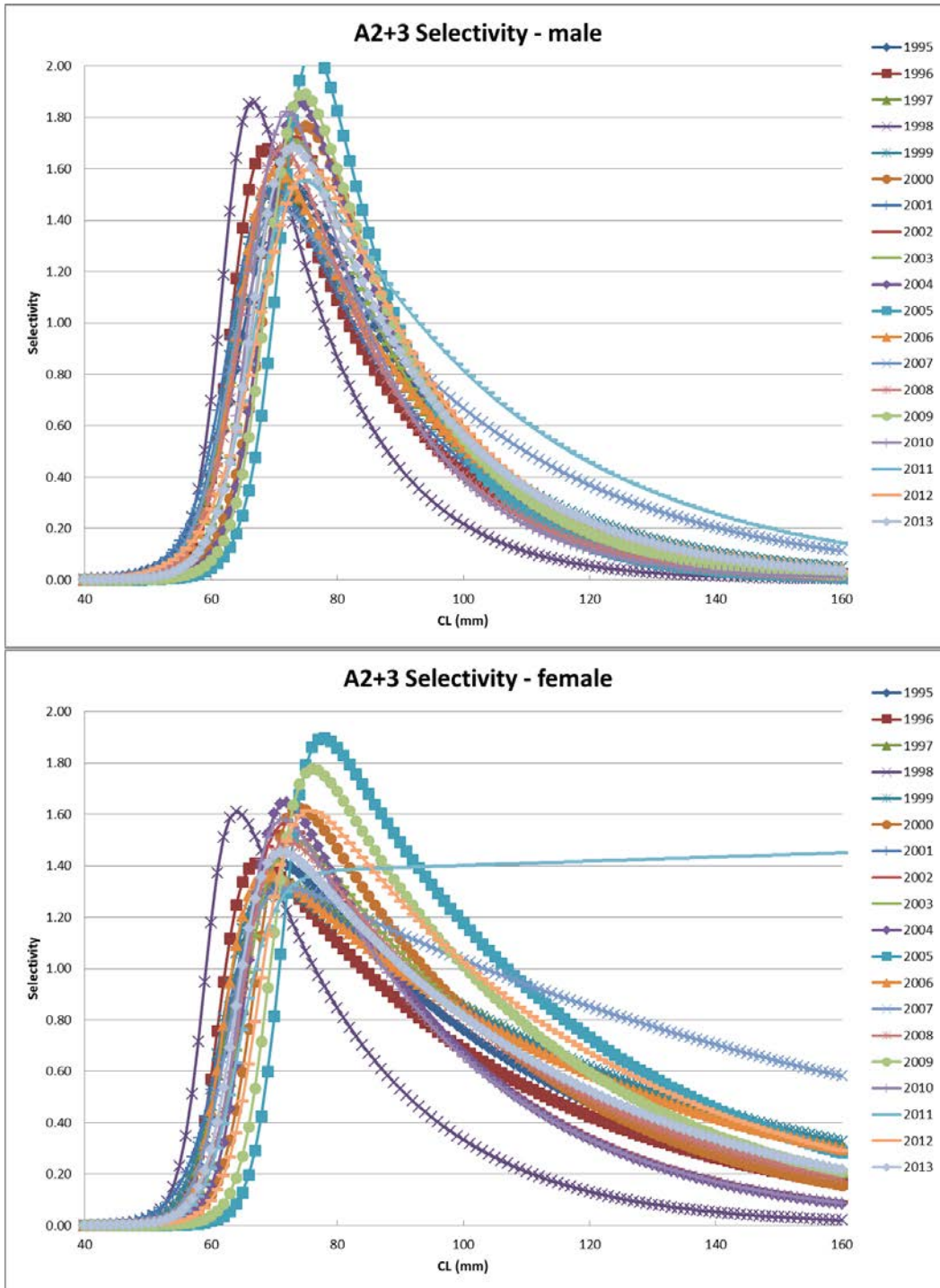
Figure 7a: RC catch-at-length residuals. The dark bubbles reflect positive and the light bubbles reflect negative residuals, with the bubble radii proportional to the magnitudes of the residuals.
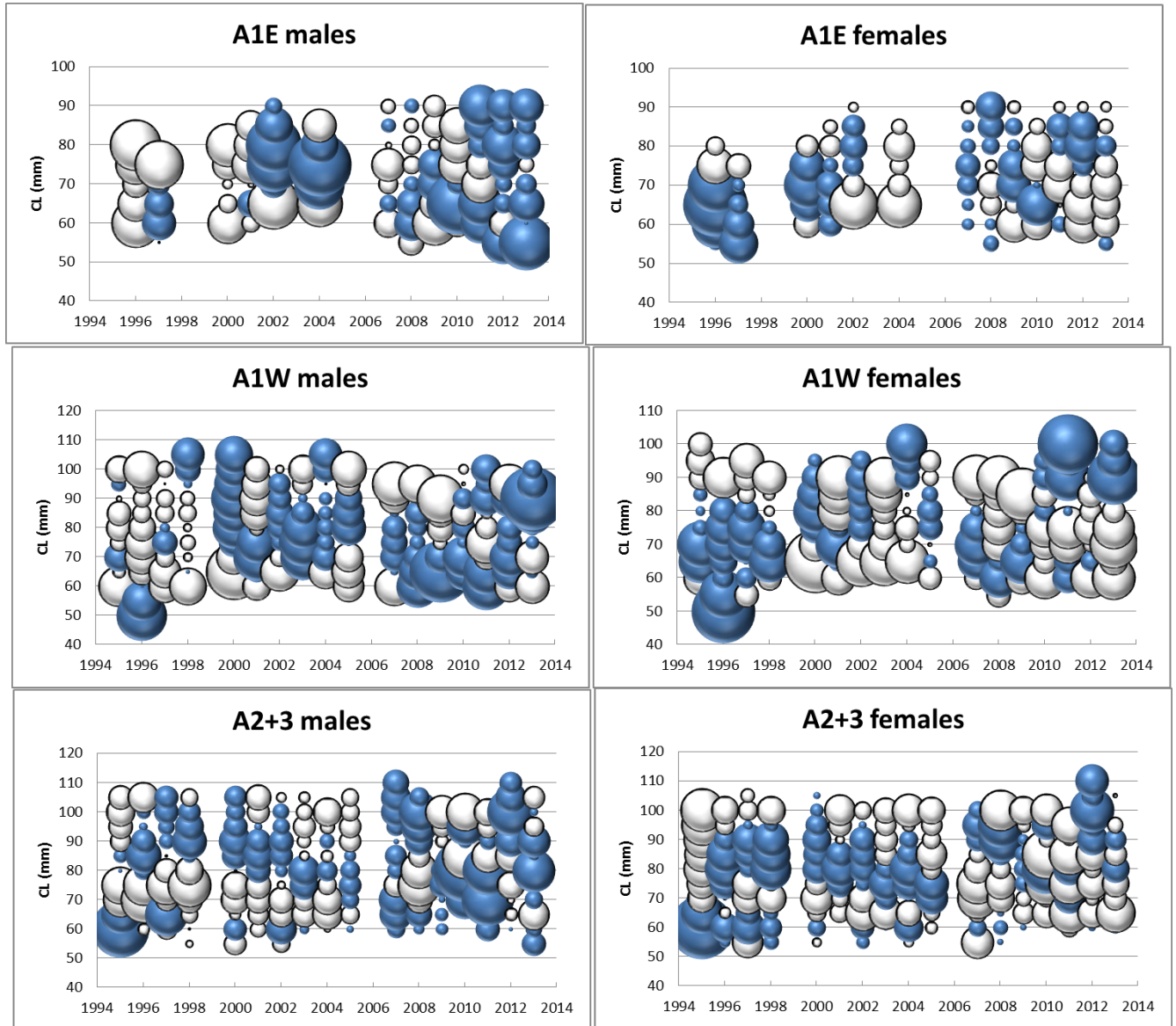
Figure 7b: Sen3 catch-at-length residuals. The dark bubbles reflect positive and the light bubbles reflect negative residuals, with the bubble radii proportional to the magnitudes of the residuals.
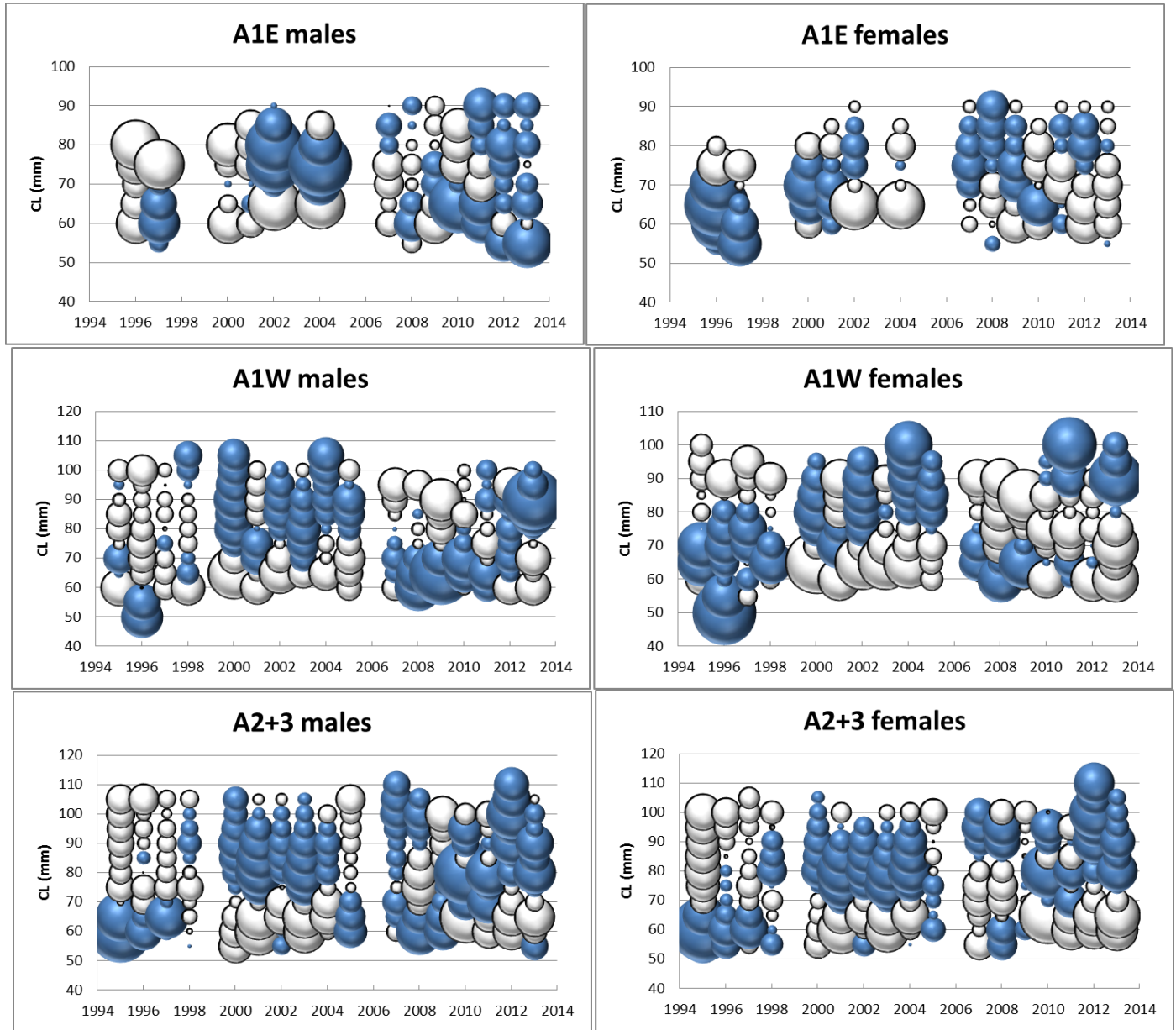
Figure 8: Mean size of catch and the percentage females of the catch for each area from 1995.