Updated 2014 assessments for West Coast rock lobster

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This document reports the updated assessment of the five super-areas of the west coast rock lobster resource. The previous assessment was conducted in 2013 (see Johnston 2013). Data which are included in this 2014 update are:

- Commercial catches – (Danie van Zyl, DAFF, pers. commn).
- Estimates of recreational takes – see FISHERIES/2014/JUN/SWG-WCRL/01.
- Updated poaching scenarios – see FISHERIES/2014/JUN/SWG-WCRL/08.
- Interim relief estimates – (C. Smith, DAFF, pers. commn)
- Commercial CPUE – see FISHERIES/2014/JUN/SWG-WCRL/4, 5 AND 6 (excludes Area 8).
- FIMS CPUE – see FISHERIES/2014/JUL/SWG-WCRL/11
- Somatic growth rate – see FISHERIES/2014/JUN/SWG-WCRL/02.

The catch-at-length data have not been updated due to time constraints.

Estimation and projection of recruitment

The recruitment trend is modeled as for the 2013 assessment, by assuming recruitment is linear between a set of estimated recruitment values over time. Recruitment is estimated for the following years:

R1910, R1920, R1950, R1970, R1975, R1980, R1985, R1990, R1995, R1998, R2001 and R2004

- R2008+ is set equal to the geometric mean ($\bar{R}$) of the R1975, R1980, R1985, R1990, R1995, R1998, R2001 and R2004 estimated values.
- The R2004 value is constrained by a penalty added to the –*ln*L based on the geometric mean as follows:

$$pen = \frac{1}{2}\frac{(lnR_{2004}-ln\bar{R})^2}{\sigma_R^2} \qquad \text{where}$$

$$\sigma_R^2 = \frac{\sum_{y=1975}^{y=2000}(lnR_y - ln\bar{R})^2}{5}$$

- All recruitments are constrained to be less than R1910.

Note that values assumed for recruitment after 2008 do not affect the assessment results shown, but would impact future projections.

Results

Tables 1-5 report the updated 2014 assessment results for each of the five super-areas respectively. Both the RC1 (total historic poaching = 500 MT) and RC2 (total historic poaching = 250 MT) results are reported, as well as the previous 2013 assessment results for comparison. Table 6 gives summary statistics of the $B75m(2014)/K$ and $B75m(2014)/B75m(2006)$ for each super-area (with RC1 having 65% weight and RC2 having 0.35% weight), and also gives these results for 2012 for this assessment together with comparative values for the 2013 assessment (Johnston 2013). Statistics for the resource as a whole are also given.

Figures 1-5 show the RC1 model fits to CPUE data, as well as Egg%, recruitment and B75m trends for each super-area. Figure 6a compares the RC1 B75m trends for each super-area between the 2011, 2013 and 2013 assessments. Figure 6b shows the total male biomass trends for the resource as a whole between the 2011, 2013 and 2014 assessments (both in absolute tonnage and biomass relative to pristine). Figure 6c compares the B75m contribution from each area to the overall total resource biomass. Finally, Figure 7 compares the 2011, 2013 and 2014 estimated biomass trends (B75m) in recent years, with the current OMP predicted biomass trend that would get the resource to the required $B75m(2021)/B75m(2006)$ target of 1.35.

Reference

Johnston, 2013. Updated 2013 assessments for West Coast rock lobster. DAFF document, FISHEREIS/2013/AUG/SWG_WCRL24.

Table 1: Updated 2014 assessment results for super-area A1+2.

	2013 Historic Poaching= 500 MT	2013 Historic Poaching= 250 MT	2014 Historic Poaching= 500 MT	2014 Historic Poaching= 250 MT
$B_{75}^m(1910)$ MT	51 119	48 819	49 841	49 650
$B_{75}^m(2010)$ MT	472	373	314	311
$B_{75}^m(2012)$ MT	445	328	289	287
$B_{75}^m(2014)$ MT	-	-	274	273
$B_{75}^m(2010)/ B_{75}^m(1910)$	0.092	0.008	0.006	0.006
$B_{75}^m(2012)/ B_{75}^m(1910)$	0.009	0.007	0.006	0.006
$B_{75}^m(2014)/ B_{75}^m(1910)$	-	-	0.006	0.005
$B_{75}^m(2010)/ B_{75}^m(1996)$	1.462	1.262	1.233	1.274
$B_{75}^m(2012)/ B_{75}^m(1996)$	1.382	1.104	1.137	1.177
$B_{75}^m(2014)/ B_{75}^m(1996)$	-	-	1.077	1.117
$B_{75}^m(2010)/ B_{75}^m(2006)$	1.379	1.107	0.883	0.885
$B_{75}^m(2012)/ B_{75}^m(2006)$	0.866	0.766	0.814	0.817
$B_{75}^m(2014)/ B_{75}^m(2006)$	-	-	0.772	0.775
Egg (2010)/Egg (1910)	0.019	0.017	0.016	0.015
Egg (2012)/Egg (1910)	0.018	0.015	0.014	0.014
Egg (2014)/Egg (1910)	-	-	0.014	0.014

Table 2: Updated 2014 assessment results for super-area A3+4.

	2013 Historic Poaching= 500 MT	2013 Historic Poaching= 250 MT	2014 Historic Poaching= 500 MT	2014 Historic Poaching= 250 MT
$B_{75}^m(1910)$ MT	143 338	143 764	145 413	145 466
$B_{75}^m(2010)$ MT	3 702	3 737	3 831	3 943
$B_{75}^m(2012)$ MT	3 771	3 794	4279	4398
$B_{75}^m(2014)$ MT	-	-	4754	4888
$B_{75}^m(2010)/ B_{75}^m(1910)$	0.026	0.026	0.026	0.027
$B_{75}^m(2012)/ B_{75}^m(1910)$	0.026	0.026	0.029	0.030
$B_{75}^m(2014)/ B_{75}^m(1910)$	-	-	0.033	0.034
$B_{75}^m(2010)/ B_{75}^m(1996)$	1.640	1.632	1.637	1.666
$B_{75}^m(2012)/ B_{75}^m(1996)$	1.671	1.657	1.829	1.857
$B_{75}^m(2014)/ B_{75}^m(1996)$	-	-	2.032	2.964
$B_{75}^m(2010)/ B_{75}^m(2006)$	0.961	0.960	0.967	0.969
$B_{75}^m(2012)/ B_{75}^m(2006)$	0.979	0.974	1.081	1.081
$B_{75}^m(2014)/ B_{75}^m(2006)$	-	-	1.201	1.201
Egg (2010)/Egg (1910)	0.060	0.060	0.061	0.061
Egg (2012)/Egg (1910)	0.061	0.060	0.061	0.062
Egg (2014)/Egg (1910)	-	-	0.062	0.063

Table 3: Updated 2014 assessment results for super-area A5+6.

	2013 Historic Poaching= 500 MT	2013 Historic Poaching= 250 MT	2014 Historic Poaching= 500 MT	2014 Historic Poaching= 250 MT
$B_{75}^{m}(1910)$ MT	197 025	197 025	196 491	191 931
$B_{75}^{m}(2010)$ MT	4 689	4 840	3 252	2 987
$B_{75}^{m}(2012)$ MT	5 174	5 315	3 766	3303
$B_{75}^{m}(2014)$ MT	-	-	4 194	3701
$B_{75}^{m}(2010)/ B_{75}^{m}(1910)$	0.024	0.024	0.017	0.016
$B_{75}^{m}(2012)/ B_{75}^{m}(1910)$	0.026	0.027	0.019	0.017
$B_{75}^{m}(2014)/ B_{75}^{m}(1910)$	-	-	0.021	0.019
$B_{75}^{m}(2010)/ B_{75}^{m}(1996)$	1.751	1.749	1.708	1.600
$B_{75}^{m}(2012)/ B_{75}^{m}(1996)$	1.932	1.921	1.978	1.770
$B_{75}^{m}(2014)/ B_{75}^{m}(1996)$	-	-	2.203	1.984
$B_{75}^{m}(2010)/ B_{75}^{m}(2006)$	1.294	1.279	1.166	1.104
$B_{75}^{m}(2012)/ B_{75}^{m}(2006)$	1.428	1.404	1.350	1.221
$B_{75}^{m}(2014)/ B_{75}^{m}(2006)$	-	-	1.504	1.369
Egg (2010)/Egg (1910)	0.054	0.054	0.040	0.037
Egg (2012)/Egg (1910)	0.054	0.054	0.041	0.038
Egg (2014)/Egg (1910)	-	-	0.043	0.040

Table 4: Updated 2014 assessment results for super-area A7.

	2013 Historic Poaching= 500 MT	2013 Historic Poaching= 250 MT	2014 Historic Poaching= 500 MT	2014 Historic Poaching= 250 MT
$B_{75}^m(1910)$ MT	117 147	115 839	120 042	121 319
$B_{75}^m(2010)$ MT	767	607	835	1401
$B_{75}^m(2012)$ MT	226	142	197	948
$B_{75}^m(2014)$ MT	-	-	249	1020
$B_{75}^m(2010)/ B_{75}^m(1910)$	0.006	0.005	0.006	0.015
$B_{75}^m(2012)/ B_{75}^m(1910)$	0.002	0.001	0.002	0.008
$B_{75}^m(2014)/ B_{75}^m(1910)$			0.002	0.008
$B_{75}^m(2012)/ B_{75}^m(1996)$	0.045	0.029	0.040	0.091
$B_{75}^m(2014)/ B_{75}^m(1996)$			0.051	0.206
$B_{75}^m(2010)/ B_{75}^m(2006)$	0.329	0.301	0.400	0.624
$B_{75}^m(2012)/ B_{75}^m(2006)$	0.097	0.071	0.094	0.422
$B_{75}^m(2014)/ B_{75}^m(2006)$			0.120	0.455
Egg (2010)/Egg (1910)	0.077	0.073	0.078	0.084
Egg (2012)/Egg (1910)	0.062	0.059	0.059	0.065
Egg (2014)/Egg (1910)			0.054	0.060

Table 5: Updated 2014 assessment values of contributions to the $-\ln L$ value, sigma values, biomass and egg production estimates for super-area A8+.

	2013 Historic Poaching= 500 MT	2013 Historic Poaching= 250 MT	2014 Historic Poaching= 500 MT	2014 Historic Poaching= 250 MT
$B_{75}^{m}(1910)$ MT	193 566	182 038	190 368	176 789
$B_{75}^{m}(2010)$ MT	9 001	8 524	9 113	8 580
$B_{75}^{m}(2012)$ MT	8 628	8 328	8 062	7 850
$B_{75}^{m}(2014)$ MT	-	-	9 189	9 223
$B_{75}^{m}(2010)/ B_{75}^{m}(1910)$	0.047	0.047	0.048	0.048
$B_{75}^{m}(2012)/ B_{75}^{m}(1910)$	0.045	0.046	0.042	0.044
$B_{75}^{m}(2014)/ B_{75}^{m}(1910)$	-	-	0.048	0.052
$B_{75}^{m}(2010)/ B_{75}^{m}(1996)$	0.743	0.738	0.702	0.690
$B_{75}^{m}(2012)/ B_{75}^{m}(1996)$	0.707	0.721	0.621	0.631
$B_{75}^{m}(2014)/ B_{75}^{m}(1996)$	-	-	0.708	0.741
$B_{75}^{m}(2010)/ B_{75}^{m}(2006)$	0.955	0.939	0.898	0.874
$B_{75}^{m}(2012)/ B_{75}^{m}(2006)$	0.909	0.917	0.795	0.800
$B_{75}^{m}(2014)/ B_{75}^{m}(2006)$	-	-	0.906	0.940
Egg (2010)/Egg (1910)	0.215	0.209	0.206	0.201
Egg (2012)/Egg (1910)	0.208	0.204	0.187	0.184
Egg (2014)/Egg (1910)	-	-	0.188	0.185

Table 6a: Summary statistics for the combined RC1 (65% weight) and RC2 (35% weight) resource trends in each super-area and the resource combined as a whole for the 2014 assessment.

	B75m(2014)/K	B75m(2014)/B75m(2006)
A1+2	0.005	0.773
A3+4	0.033	1.201
A5+6	0.021	1.457
A7	0.004	0.243
A8	0.050	0.917
Total resource	**0.027**	**0.976**

Table 6b: Comparison of summary statistics for the combined RC1 (65% weight) and RC2 (35% weight) resource trends in each super-area and the resource combined as a whole (for 2012) between the 2013 and the 2014 assessments.

	B75m(2012)/K	B75m(2012)/K	B75m(2012)/B75m(2006)	B75m(2012)/B75m(2006)
	2013 assessment	2014 assessment	2013 assessment	2014 assessment
A1+2	0.008	0.006	0.835	0.835
A3+4	0.026	0.028	0.977	1.021
A5+6	0.027	0.018	1.420	1.306
A7	0.002	0.005	0.089	0.291
A8	0.045	0.045	0.916	0.829
Total resource	0.026	0.024	0.925	0.870

Figure 1a: Fits to A1+2 CPUE data.
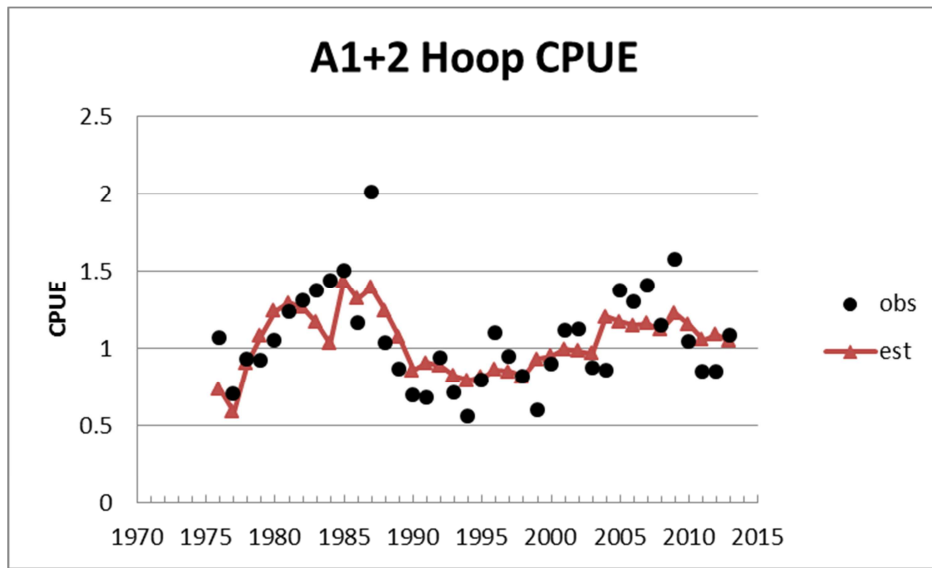
Figure 1b: A1+2 B75m and Bsp estimated trends. The plots on the left are for the period 1910+, whereas those on the right are for 1975+. In the second plot on the RHS, the circles indicate the estimated recruitment values – solid circles are those used in the geometric mean value (R2008+ - see main text) to be used in projections which is shown as a dashed line.
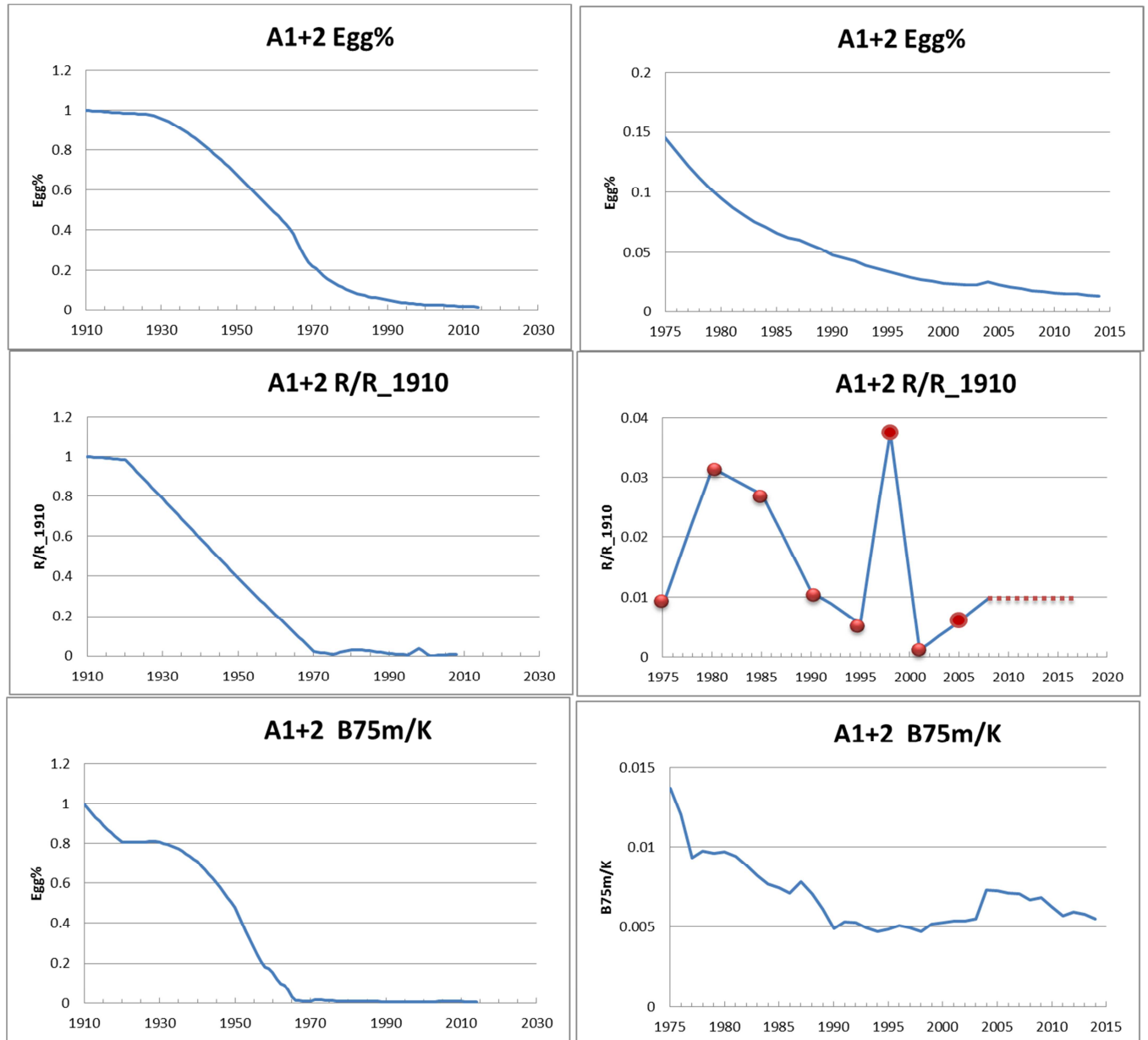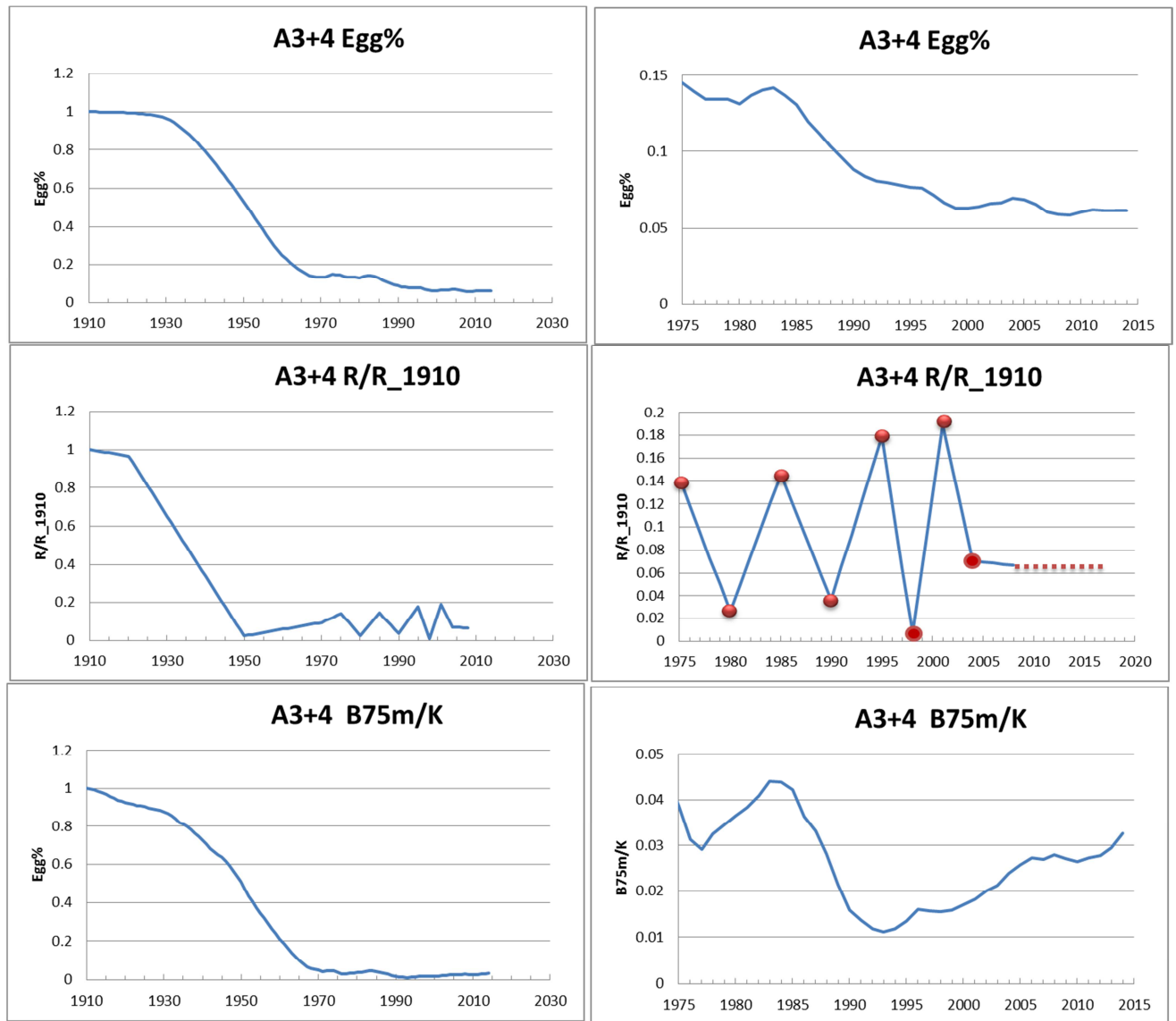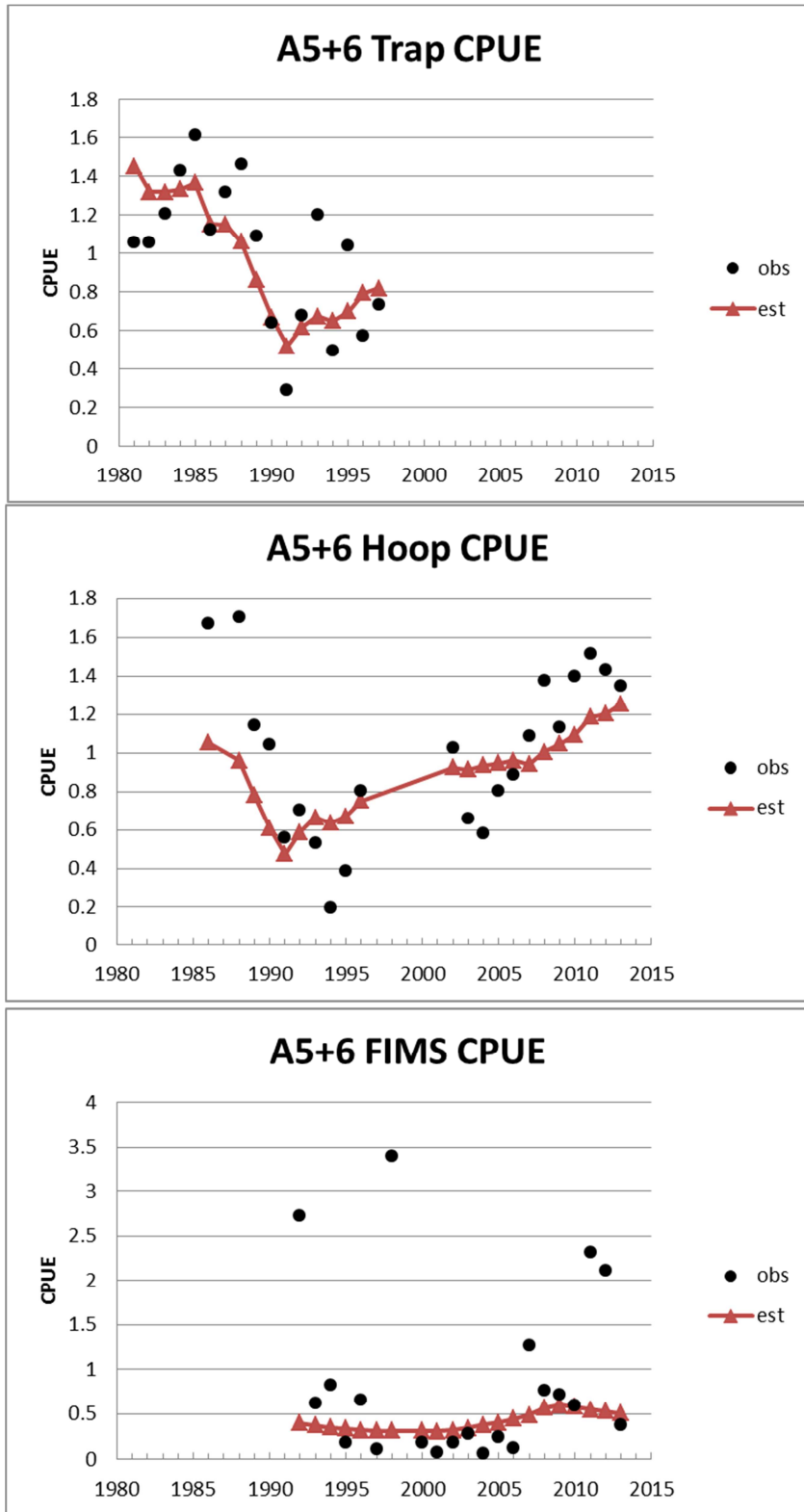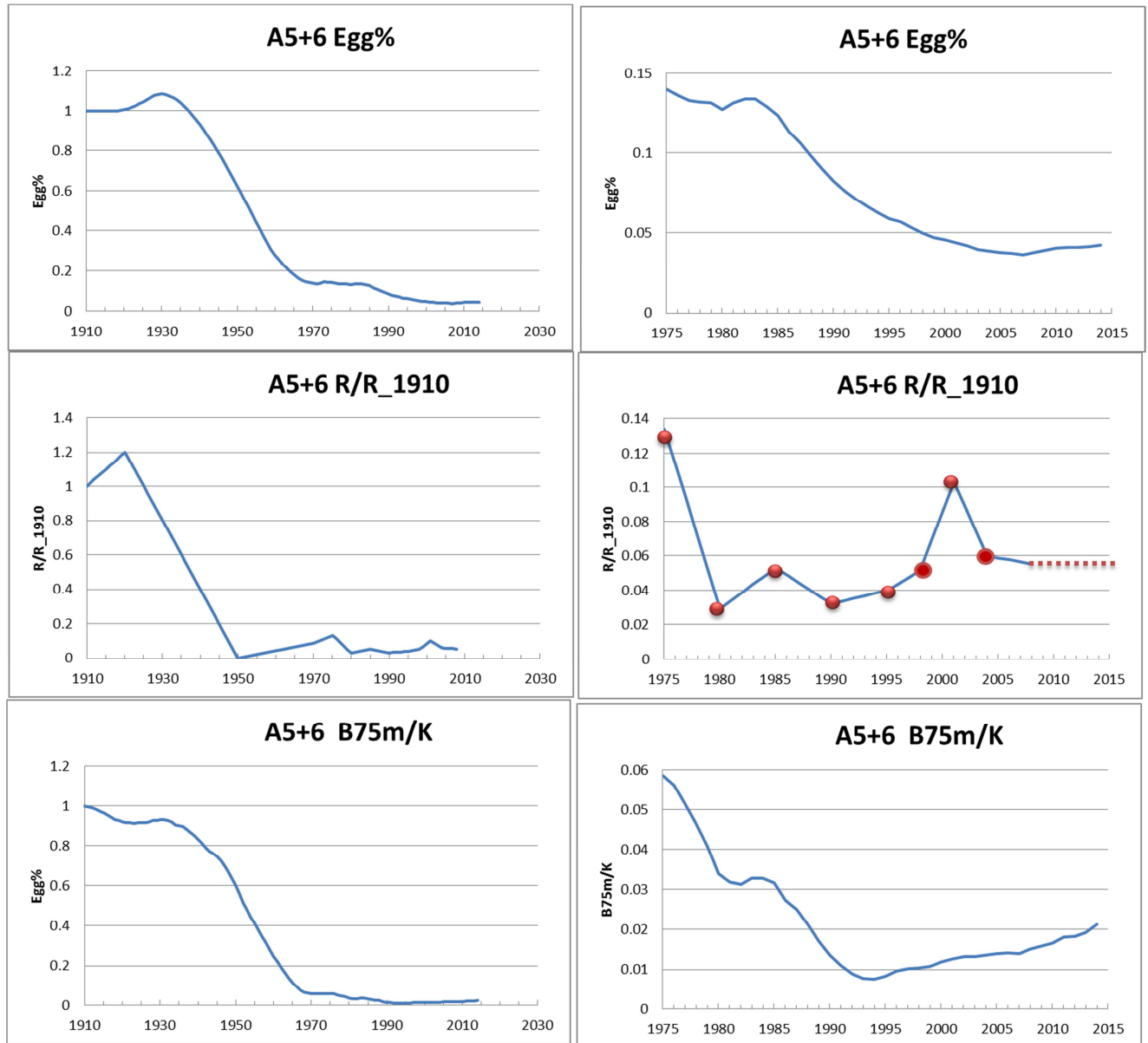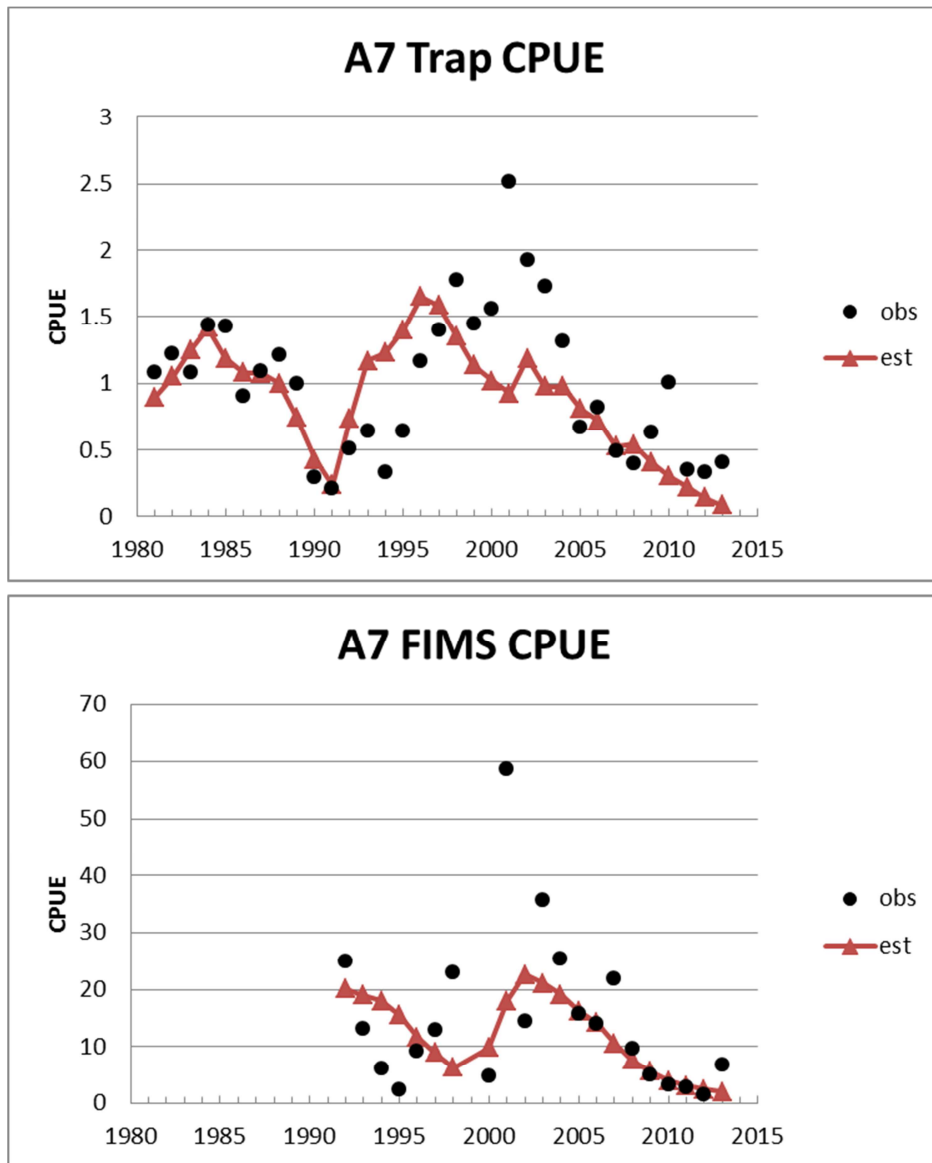
Figure 2a: Fits to A3+4 CPUE data.
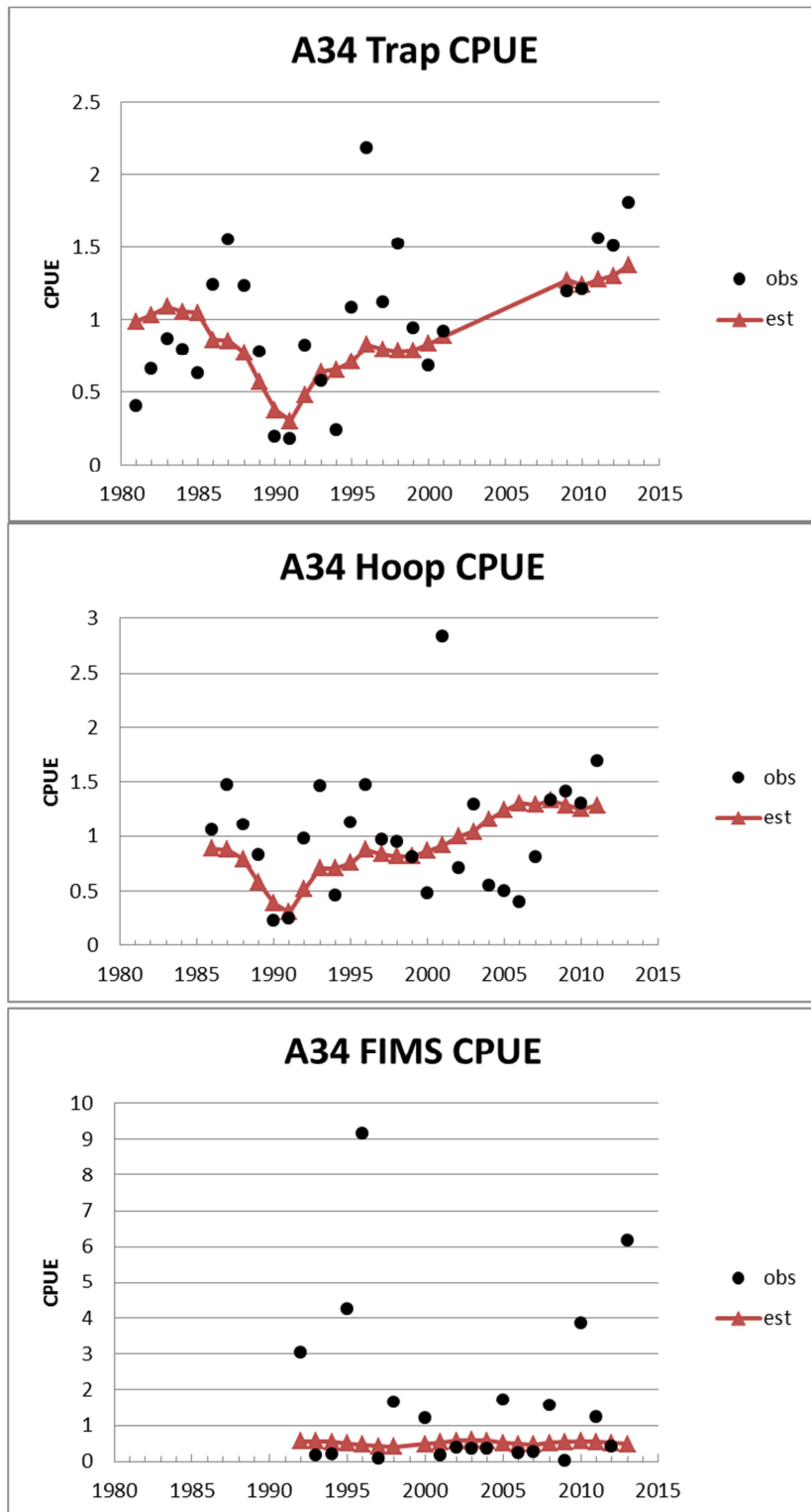
Figure 2b: A3+4 B75m and Bsp estimated trends. The plots on the left are for the period 1910+, whereas those on the right are for 1975+. In the second plot on the RHS, the circles indicate the estimated recruitment values – solid circles are those used in the geometric mean value (R2008+ - see main text) to be used in projections which is shown as a dashed line.
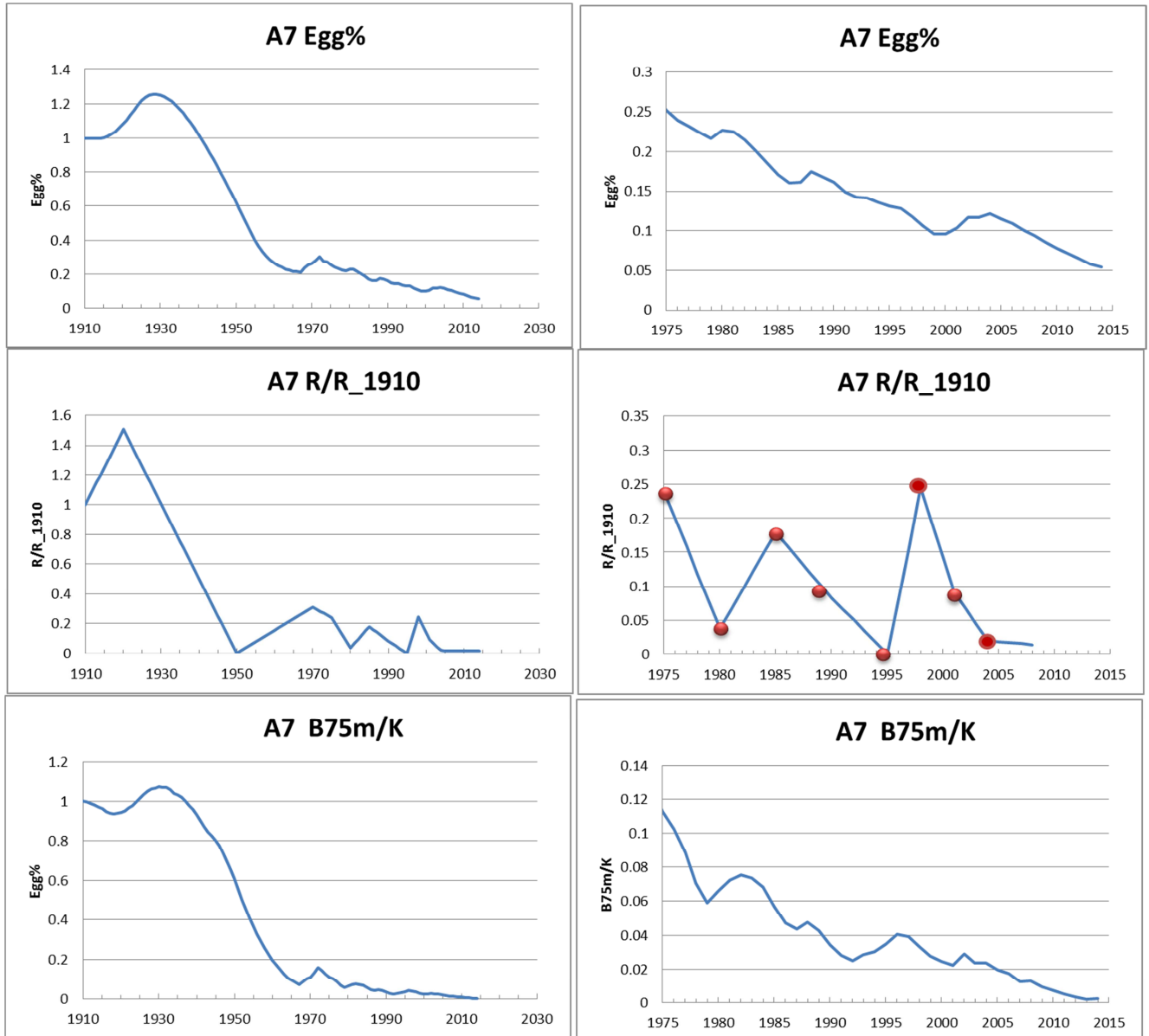
Figure 3a: Fits to A5+6 CPUE data.

Figure 3b: A5+6 B75m and Bsp estimated trends. The plots on the left are for the period 1910+, whereas those on the right are for 1975+. In the second plot on the RHS, the circles indicate the estimated recruitment values – solid circles are those used in the geometric mean value (R2008+ - see main text) to be used in projections which is shown as a dashed line.

Figure 4a: Fits to A7 CPUE data.

Figure 4b: A7 B75m and Bsp estimated trends. The plots on the left are for the period 1910+, whereas those on the right are for 1975+. In the second plot on the RHS, the circles indicate the estimated recruitment values – solid circles are those used in the geometric mean value for 2008+ (see main text). Because of the uncertainties about the situation in A7, no proposed set of recruitment for projections is shown.
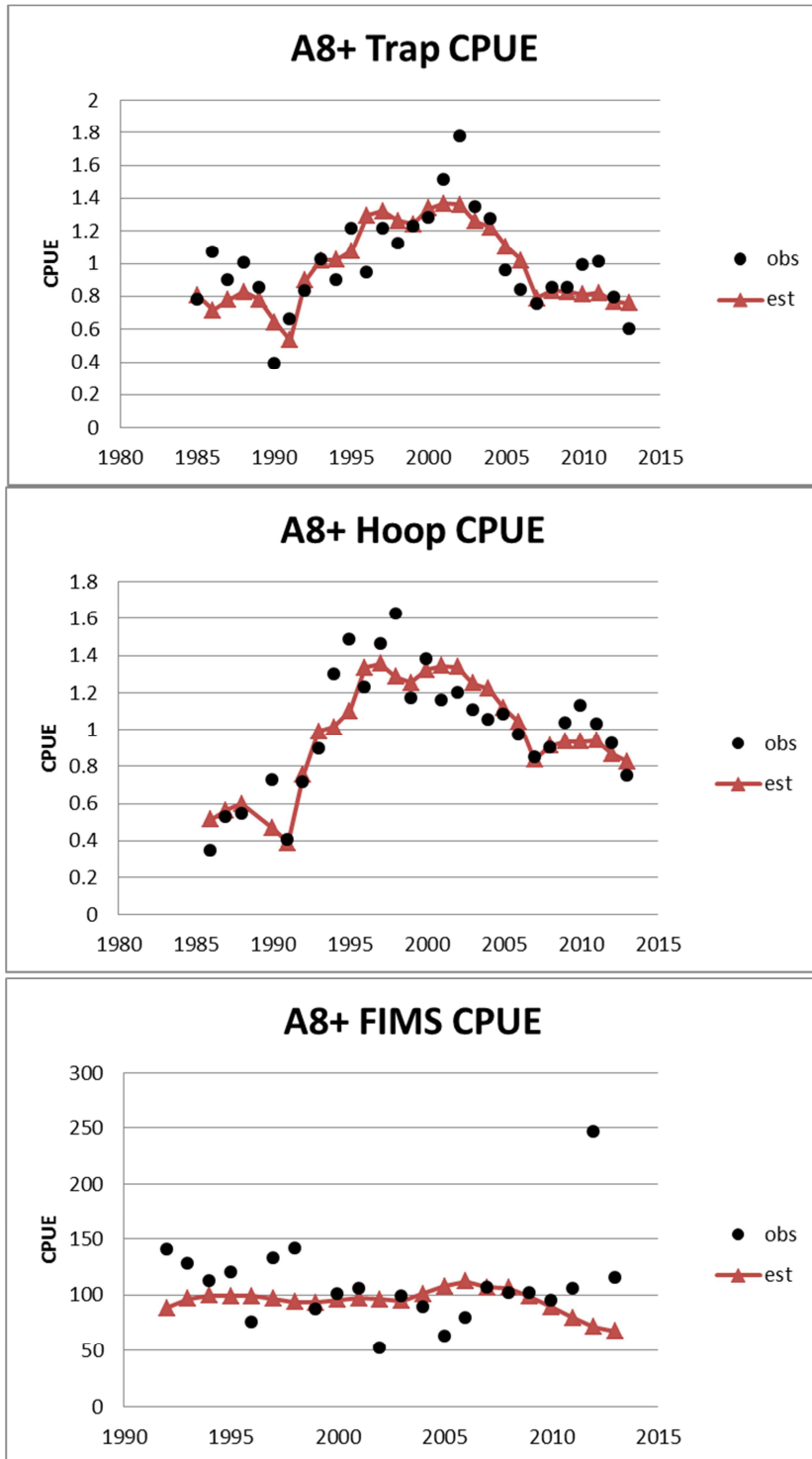
Figure 5a: Fits to A8+ CPUE data.

Figure 5b: A8+ Egg%, recruitment and B75m estimated trends. The plots on the left are for the period 1910+, whereas those on the right are for 1975+. In the second plot on the RHS, the circles indicate the estimated recruitment values – solid circles are those used in the geometric mean value (R2008+ - see main text) to be used in projections which is shown as a dashed line.
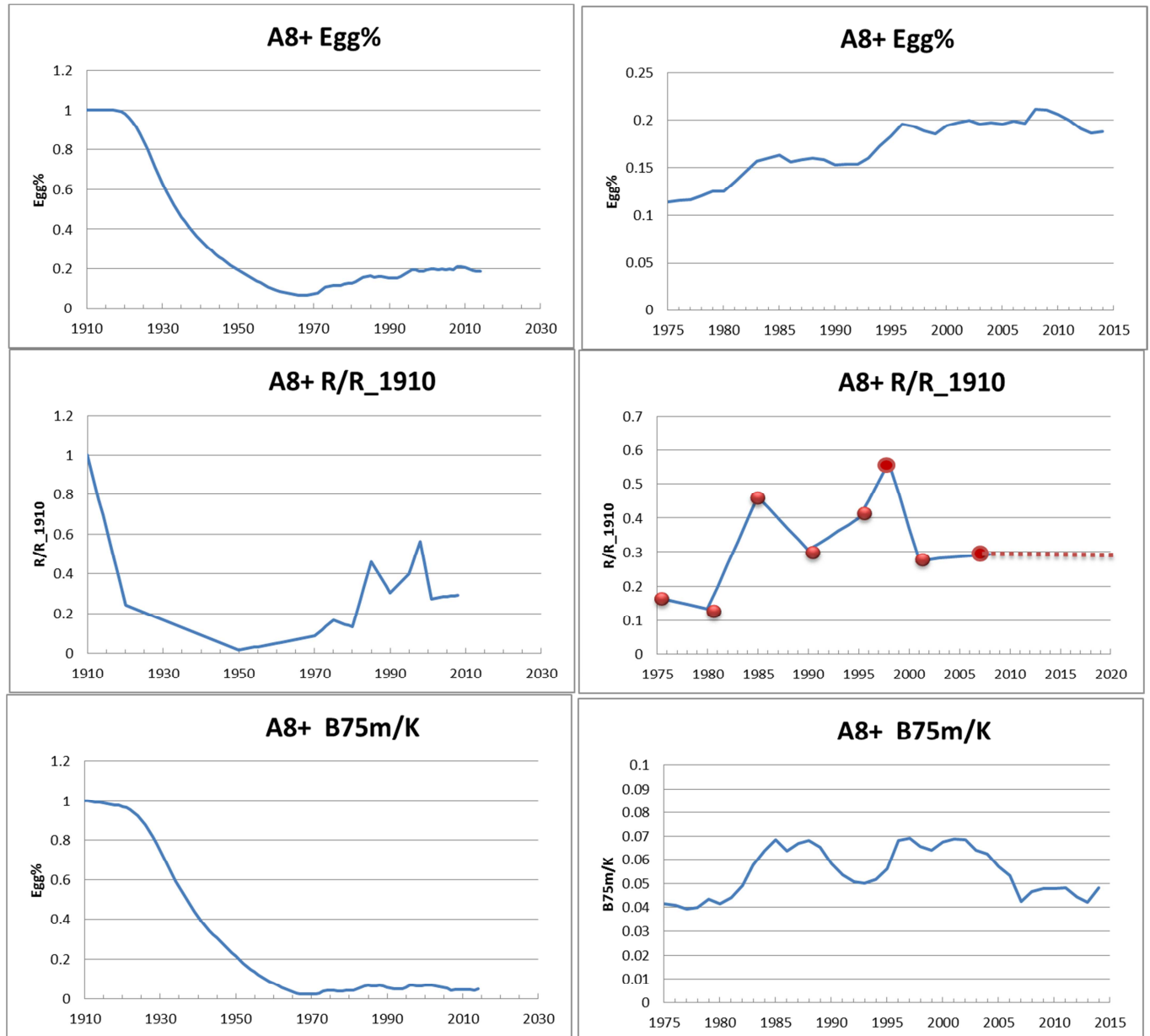
Figure 6a: Comparison of male exploitable biomass trends for each super-area between the 2011, 2013 assessments and the updated 2014 assessments.
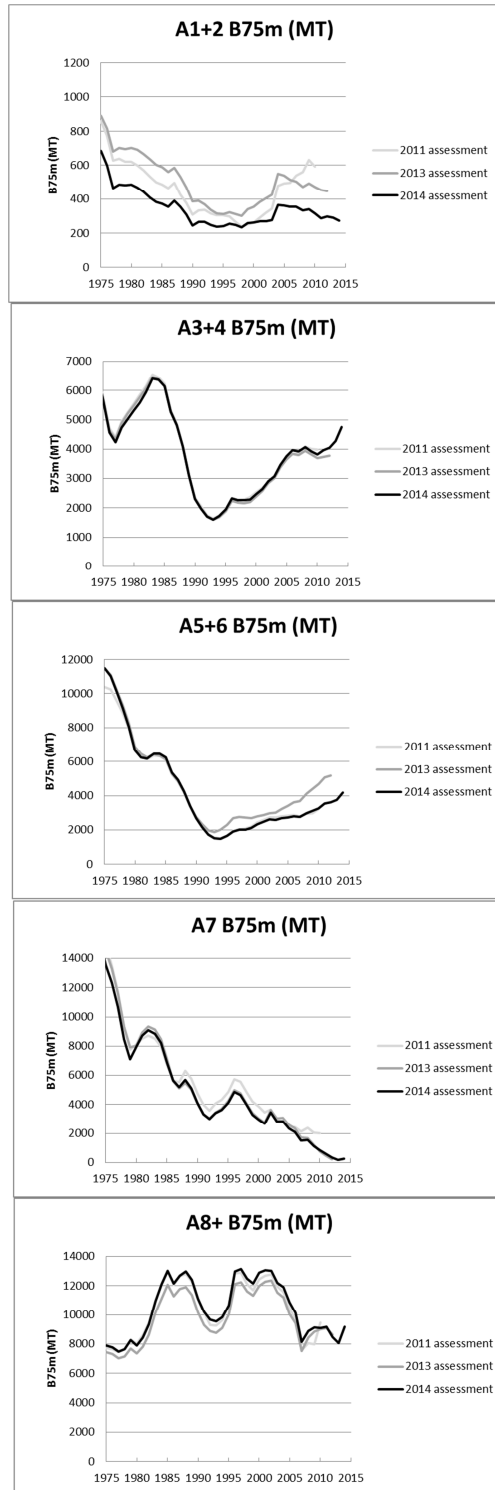
Figure 6b: Comparison of total male exploitable biomass trends for the resource as a whole between the 2011 and 2013 assessments and the updated 2014 assessments. The top plots show absolute tonnages, whereas the bottom plots show the biomass relative to pristine.
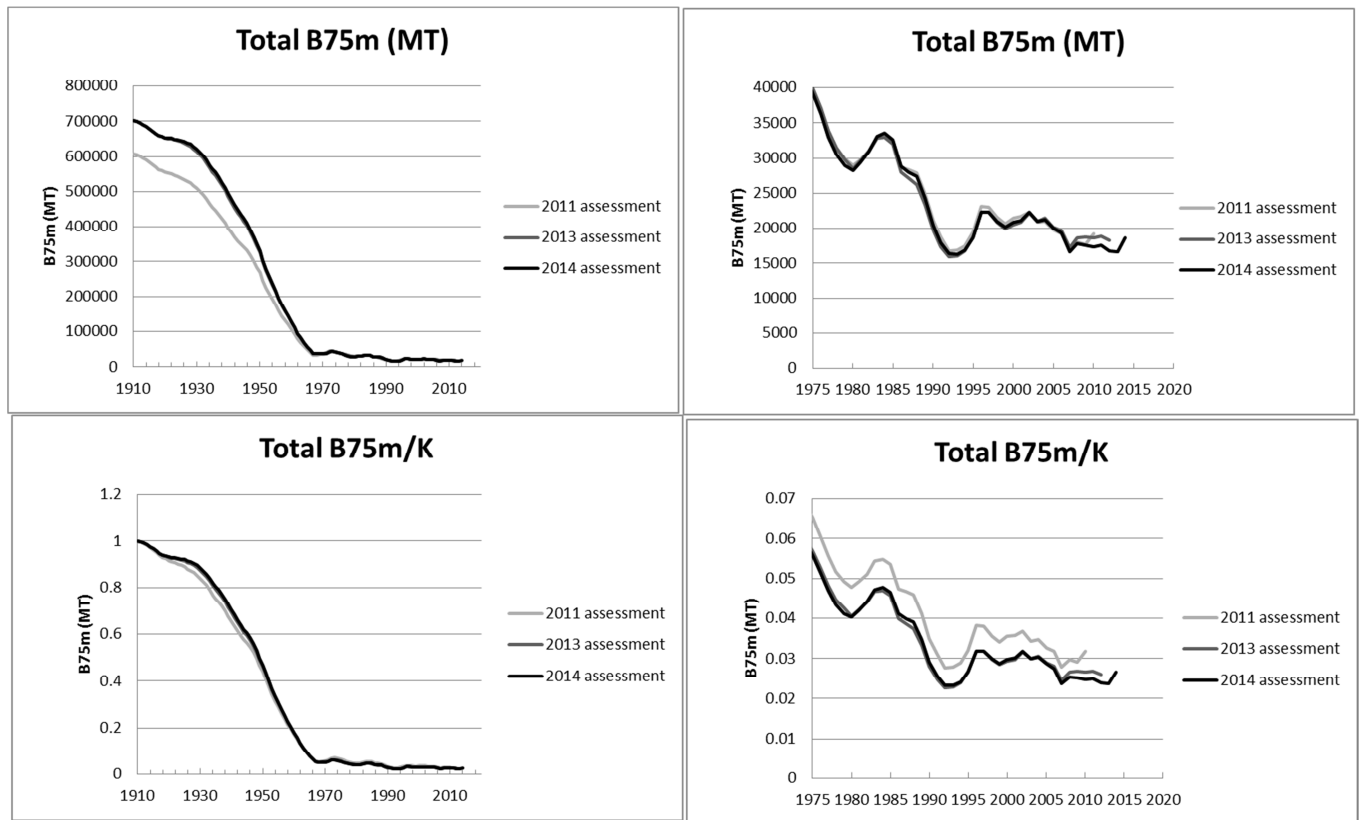
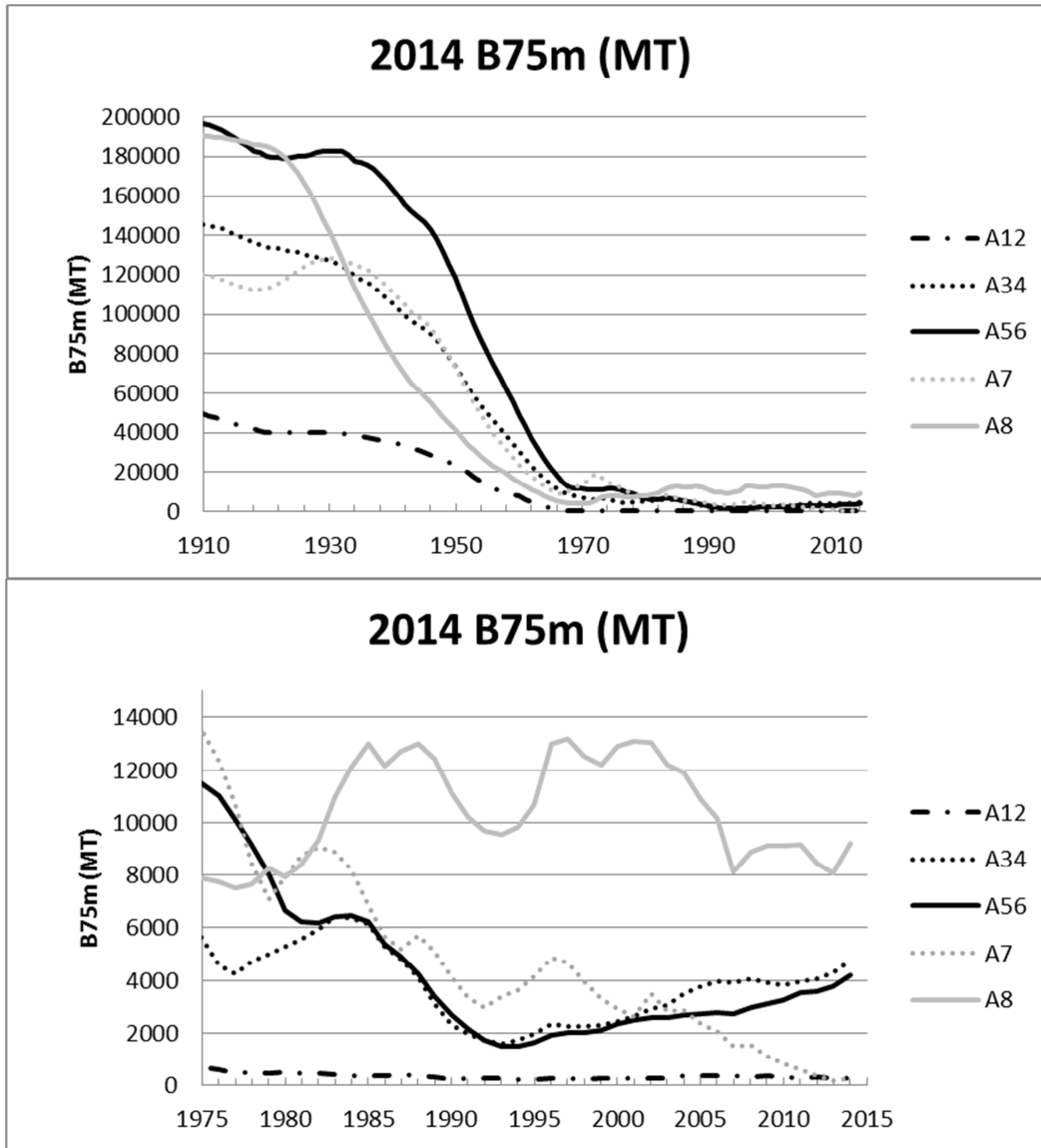Figure 6c: Comparison of each super-area B75m contribution to overall resource biomass for the 2014 assessments.

Figure 7: Comparison between the 2011, 2013 and 2014 estimated biomass trends (B75m) and the biomass recovery target. The OMP predicted trend is as calculated earlier in 2013 following retuning of the OMP to take account of the 2012 decision not to reduce the TAC as per the recommendation from the OMP at that time.