

# The impact on assessments of and projections for the West Coast Rock lobster resource if poaching levels are substantially larger than assumed for the present Reference Case assessment

S.J. Johnston and D.S. Butterworth

## Summary

The current Reference Case assessment of the West Coast rock lobster resource is repeated for the scenarios for which recent levels of poaching are five (x5) and ten (x10) times larger than those presently assumed, and forward projections for these scenarios are conducted under the assumptions that both the current legal and illegal components of the catch remain unchanged. Absolute values of the present male biomass above 75 mm carapace length are not appreciably changed for these scenarios, essentially because the associated recent larger recruitments which they suggest are largely offset by the removals of lobster of sub-legal size by the poachers. It is evident from the projections that although the resource is sustained under the RC and the x5 poaching scenario, it shows a steady downward trend in the biomass of male lobsters of legal size under the x10 poaching scenario. This increases the importance of obtaining an improved estimate of the present level of poaching.

---

Following initial indications from information from Amahlo that current poaching of West Coast rock lobster may be considerably higher than is currently assumed for the Reference Case (RC) assessment of the resource, the impact of increased levels of poaching is examined here on the assessment of and projections for each of the four Super-areas for West Coast rock lobster where poaching is assumed to occur. Note that poaching is assumed to be zero for Super-area A1+2 – the most northern Super-area – so that results quoted here are as for the existing assessment. Two scenarios are considered.

**Incr Poaching (10x):** Levels of poaching remain as currently defined for the Reference Case assessment (RC) until 1985. From 1995 poaching is assumed to become larger so that at present it is **ten-fold** that for the RC. A linear increase between 1985 and 1995 is assumed.

**Incr Poaching 5x:** A further scenario of poaching larger than currently assumed is examined here, with results presented for the resource as a whole only. Levels of poaching remain as currently defined for the RC until 1985. From 1995 poaching is assumed to become larger so that at present it is **five-fold** that for the RC. Again a linear increase between 1985 and 1995 is assumed.

The bottom right side plots in Figures 1a-4a compare catches for the RC and the x10 greater poaching scenario.

## Projections

In order to provide indications of what the impact of larger poaching than currently assumed for the RC (at both x5 and x10 levels) will have on the projected biomass, the resource in each Super-area is projected forwards under the current average catch over the poaching scenarios assumed in past assessments (and used for OMP development) for the cases where this is either five-fold or ten-fold greater. Legal catches are assumed to remain at their current (2015) levels for all sectors.

## Results

Table 1 compares some key estimable parameters for the RC and the increased poaching (x10) scenario. Table 2b reports the total  $-\ln L$  value for the RC 2015 updated assessments compared to the assessments which allow for larger poaching (x5 and x10) – the details of the  $-\ln L$  components for each Super-area are reported in Tables 2b-2e. Figures 1a-4a compare the output for the two models (for each Super-area) graphically, whilst Figures 1b-4b show key plots for the 1980+ period (for clarity). Figures 5a and b show these results for the resource as a whole.

Figure 6a compares the total legal take with the RC poaching scenario, and both the Increased poaching (10x) and Increased poaching (5x) scenarios.

Figures 6b and c compare assessment results for the resource as a whole between the RC, larger poaching (5x) and larger poaching (10x) scenarios. Results are shown for the 1980+ period only for clarity.

Figure 7 reports projected exploitable male biomass trends for Super-areas 3+4, 5+6, 7 and 8+ assuming the larger poaching scenario (x10) continues into the future, and that catches in all sectors remain at current levels. The results are shown as absolute male exploitable biomass (first column), B75m relative to pristine (middle column) and finally B75m relative to 2006 (last column). The red dots in the plots of the last column indicate the median biomass recovery anticipated for 2021 under the current OMP.

Figures 8a and b show the projected exploitable male biomass relative to 2006 trend for **combined** Super-areas assuming the larger poaching levels (x5) (Figure 8a) or (x10) (Figure 8b) continue into the future, and that legal catches for all sectors remain at current (2015) levels. The red dots here indicate the median biomass recovery for the resource anticipated for 2021 under the current OMP.

Figure 8c provides a comparison of male exploitable biomass projected trends (relative to 2006) assuming current legal catch levels stay constant into the future for all sectors, for three different levels of poaching (current poaching trend, increased poaching to five-fold and increased poaching to ten-fold). In each case the resource assessments associated with each poaching scenario are used for the respective projections. The dotted vertical line shows the start of the projected period (2015).

## Discussion

For the x10 larger poaching scenario, male biomass above 75 mm carapace length is only slightly greater than for the RC in absolute terms for the resource as a whole. However, in terms of depletion, the status is estimated to be worse as the pre-exploitation abundance is estimated to be higher (Table 1 and Figure 1a).

In terms of log-likelihood for the x10 scenario, fits to the data are somewhat better for Super-areas A3+4 and A5+6, marginally better for A8+, and considerably worse for A7. The last is primarily a reflection of poorer fits to the trap CPUE and the FIMS CAL data.

Figure 5a shows that the larger poaching scenarios are accommodated in the assessments by increasing the estimates of recruitment over the last 30 years. However Figure 5b shows that for the x10 scenario, the male biomass >75 mm has been dropping over the last four years. This compares with an increase under the RC, or rough stability for the x5 scenario. Figure 5c shows that in contrast to the >75 mm male biomass, the biomass > 60 mm is much larger for the x10 scenario than for the RC. The reason for this is that the poaching removes lobsters of sub-legal size, so that the increased recruitment effects for the x10 scenario have been largely offset by the time the lobster reach a size of 75 mm.

Figure 8c summarises projections to 2021 for the various scenarios under the assumption that both legal and illegal components of the catch remain the same. What is evident is that although the resource is sustained under the RC and the x5 scenario, male biomass > 75 mm carapace length shows a steady downward trend under the x10 scenario. This points to the importance of obtaining an improved estimate of the present level of poaching.

Table 1: Some key estimable parameters of the RC assessment compared with the larger poaching scenarios.

		RC	Incr P (x5)	Incr P (x10)
B75m(2015)	Super-area 1+2	585	585	585
	Super-area 3+4	5573	5 567	4 497
	Super-area 5+6	3 760	3 981	4 353
	Super-area 7	5 573	4 465	5 522
	Super-area 8+	10 091	12 716	11 165
	Total	25 582	27 314	26 122
B75m(2015)/K	Super-area 1+2	0.010	0.010	0.010
	Super-area 3+4	0.030	0.029	0.024
	Super-area 5+6	0.015	0.014	0.014
	Super-area 7	0.030	0.021	0.025
	Super-area 8+	0.051	0.042	0.032
	Total	0.031	0.026	0.023

Table 2a: The total  $-\ln L$  value for the RC 2015 updated assessments compared to the assessments which allow for larger poaching (x5 and x10). The lowest  $-\ln L$  for each super-area (indicating the best fit to data) is bolded.

	2015 RC assessment	Increased poaching (x5)	Increased poaching (x10)
Super-area 1+2	-10.16	-10.16	-10.16
Super-area 3+4	101.63	103.41	<b>96.19</b>
Super-area 5+6	81.97	73.89	<b>73.34</b>
Super-area 7	<b>68.82</b>	84.70	84.89
Super-area 8+	-72.59	-73.52	<b>-75.14</b>
Total	169.67	178.32	<b>169.12</b>

Table 2b: Details of the Super-area A3+4 -lnL components for the RC 2015 updated assessment compared to the assessments which allow for larger poaching (x5 and x10).

	<b>2015 RC assessment</b>	<b>Increased poaching (x5)</b>	<b>Increased poaching (x10)</b>
-lnL total	101.63	103.41	96.19
Trap CPUE -lnL	-1.10	-4.07	-2.66
Hoop CPUE -lnL	-6.63	-2.89	-5.44
FIMS CPUE -lnL	20.43	20.35	20.50
Trap CAL male -lnL	9.26	21.68	6.44
Trap CAL female -lnL	20.54	17.69	17.01
Hoop CAL male -lnL	56.22	85.80	49.64
Hoop CAL female -lnL	49.94	47.13	45.93
FIMS CAL male -lnL	102.52	123.35	112.00
FIMS CAL female -lnL	194.26	180.81	185.72
Trap %F -lnL	13.32	11.20	11.64
Hoop %F -lnL	11.54	9.10	10.22
FIMS %F -lnL	20.79	22.07	20.25

Table 2c: Details of the Super-area A5+6 -lnL components for the RC 2015 updated assessment compared to the assessments which allow for larger poaching (x5 and x10).

	<b>2015 RC assessment</b>	<b>Increased poaching (x5)</b>	<b>Increased poaching (x10)</b>
-lnL total	81.97	73.89	73.34
Trap CPUE -lnL	-6.82	-6.09	-6.51
Hoop CPUE -lnL	-11.11	-15.52	-14.10
FIMS CPUE -lnL	11.31	13.13	12.73
Trap CAL male -lnL	-25.39	-34.34	-35.55
Trap CAL female -lnL	146.39	140.91	139.69
Hoop CAL male -lnL	14.25	-43.16	-46.95
Hoop CAL female -lnL	221.00	217.30	214.74
FIMS CAL male -lnL	137.31	112.89	116.82
FIMS CAL female -lnL	121.88	112.27	111.14
Trap %F -lnL	8.64	9.51	8.97
Hoop %F -lnL	16.75	20.18	20.45
FIMS %F -lnL	1.65	2.07	2.01

Table 2d: Details of the Super-area A7 –InL components for the RC 2015 updated assessment compared to the assessments which allow for larger poaching (x5 and x10).

	<b>2015 RC assessment</b>	<b>Increased poaching (x5)</b>	<b>Increased poaching (x10)</b>
-InL total	68.82	84.70	84.89
Trap CPUE –InL	-10.99	-2.63	-1.29
Hoop CPUE –InL	-	-	-
FIMS CPUE -InL	6.14	5.13	5.28
Trap CAL male –InL	68.96	43.55	46.34
Trap CAL female -InL	88.73	88.18	84.26
Hoop CAL male –InL	17.87	20.10	20.89
Hoop CAL female -InL	7.51	7.84	8.02
FIMS CAL male –InL	88.89	94.91	95.83
FIMS CAL female -InL	92.30	113.69	115.33
Trap %F –InL	15.45	11.99	11.85
Hoop %F –InL	1.25	1.64	1.76
FIMS %F -InL	20.55	16.77	16.46

Table 2e: Details of the Super-area A8+ –InL components for the RC 2015 updated assessment compared to the assessments which allow for larger poaching (x5 and x10).

	<b>2015 RC assessment</b>	<b>Increased poaching (x5)</b>	<b>Increased poaching (x10)</b>
-InL total	-72.59	-73.52	-75.14
Trap CPUE –InL	-32.69	-31.87	-33.01
Hoop CPUE –InL	-35.34	-37.58	-38.64
FIMS CPUE -InL	-13.05	-13.73	-13.64
Trap CAL male –InL	12.50	20.58	15.79
Trap CAL female -InL	26.05	24.05	20.06
Hoop CAL male –InL	-4.96	-5.24	-6.01
Hoop CAL female -InL	5.78	4.70	4.74
FIMS CAL male –InL	-72.99	-70.53	-61.33
FIMS CAL female -InL	-40.18	-35.46	-32.11
Trap %F –InL	5.57	4.67	4.47
Hoop %F –InL	1.86	1.79	1.81
FIMS %F -InL	8.57	9.17	8.67

Figure 1a: Super-area 3+4 assessment results for the RC and the larger poaching (10x) scenario.

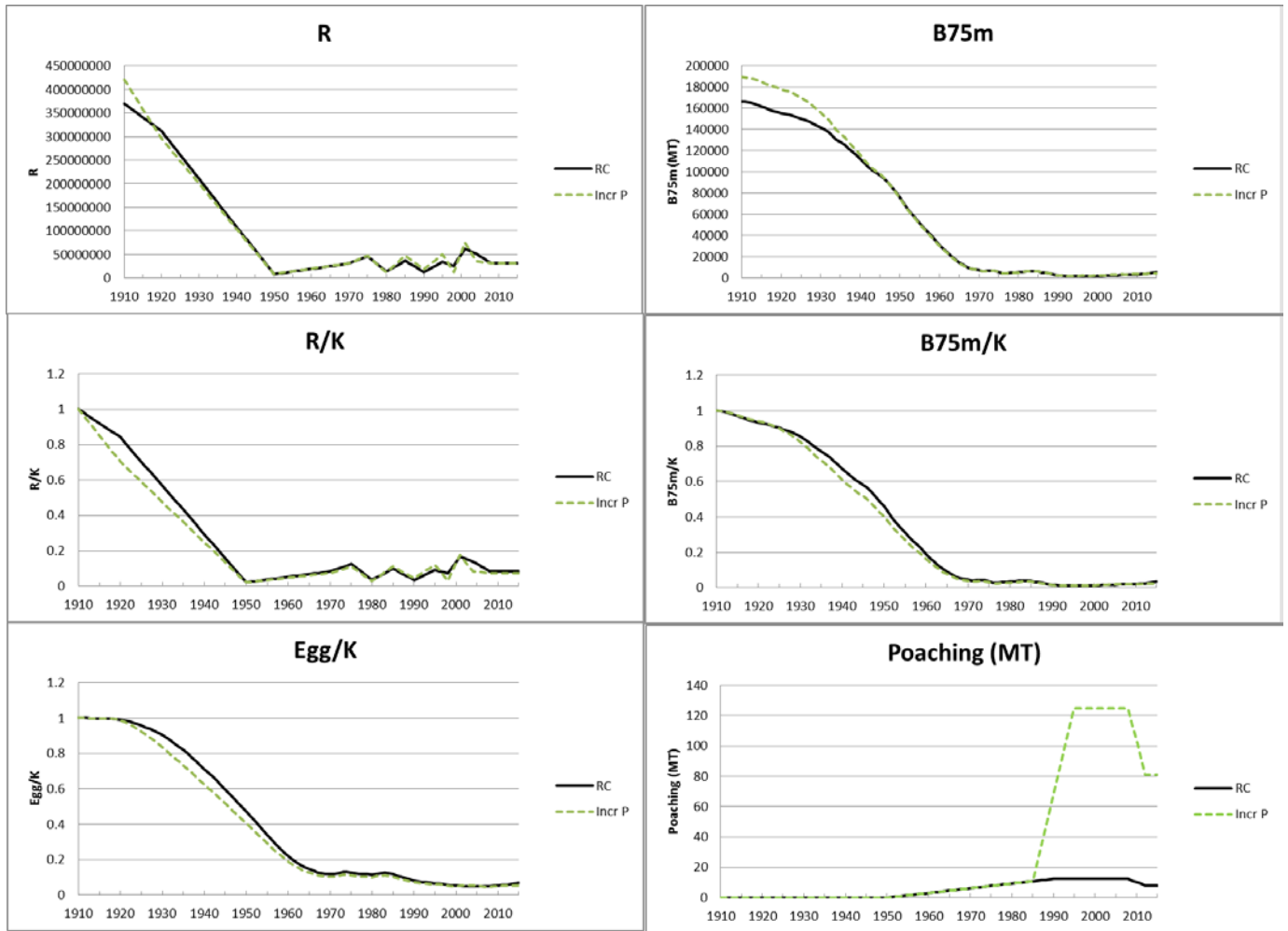


Figure 1b: Super-area 3+4 assessment results for the RC and the larger poaching (10x) scenario – 1980+ period shown only for clarity.

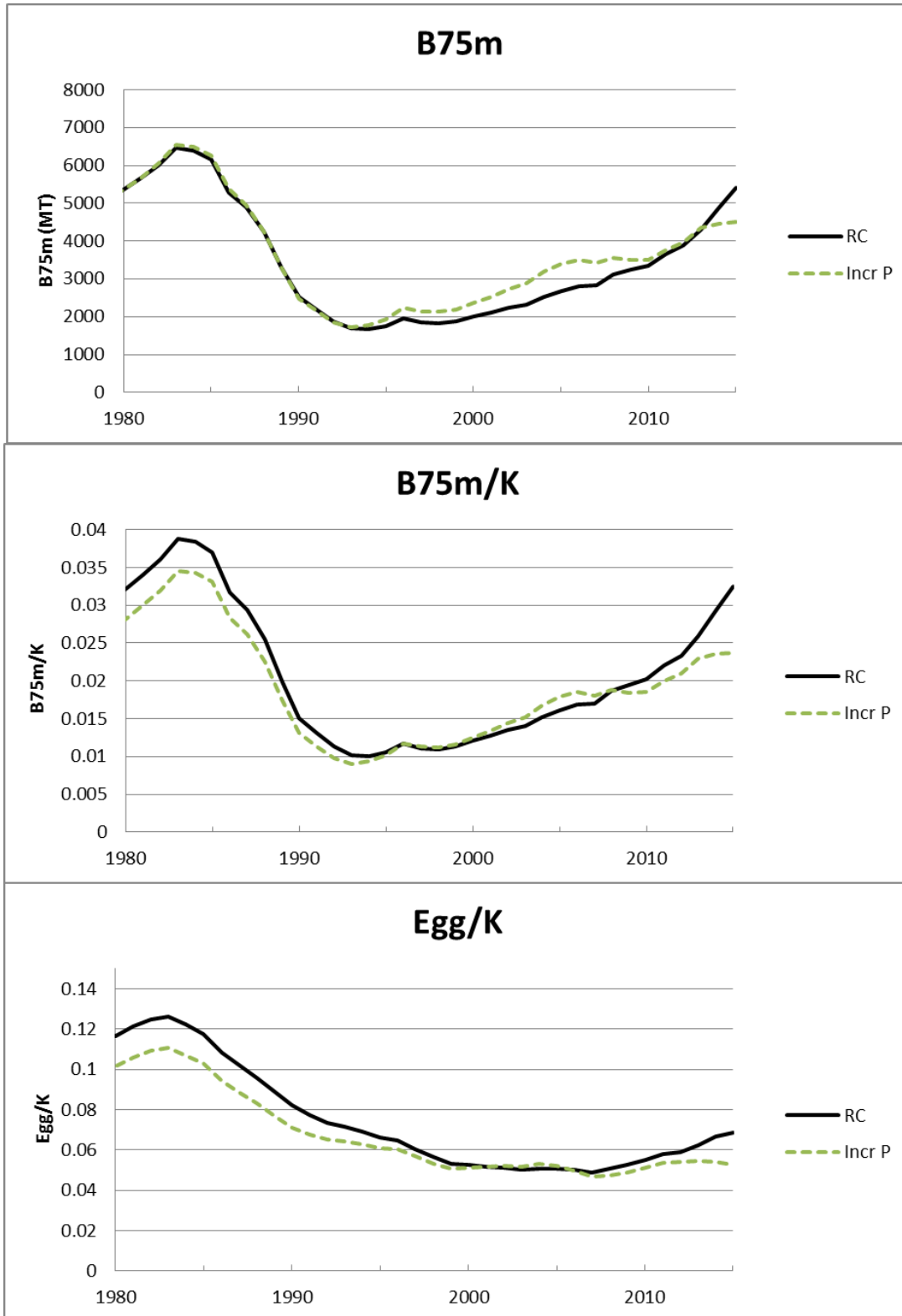




Figure 2a: Super-area 5+6 assessment results for the RC and the larger poaching (10x) scenario.

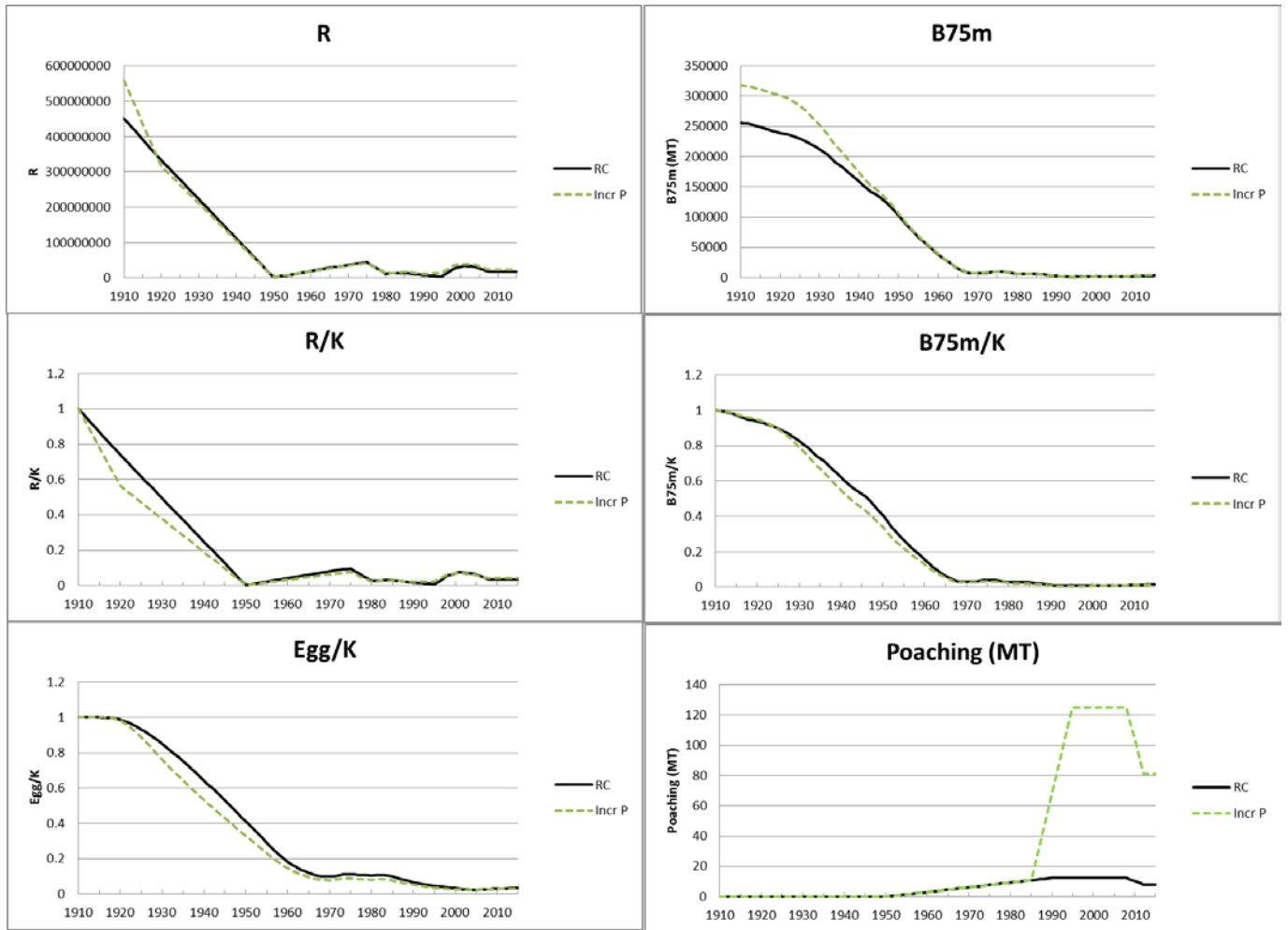


Figure 2b: Super-area 5+6 assessment results for the RC and the larger poaching (10x) scenario – 1980+ period shown only for clarity.

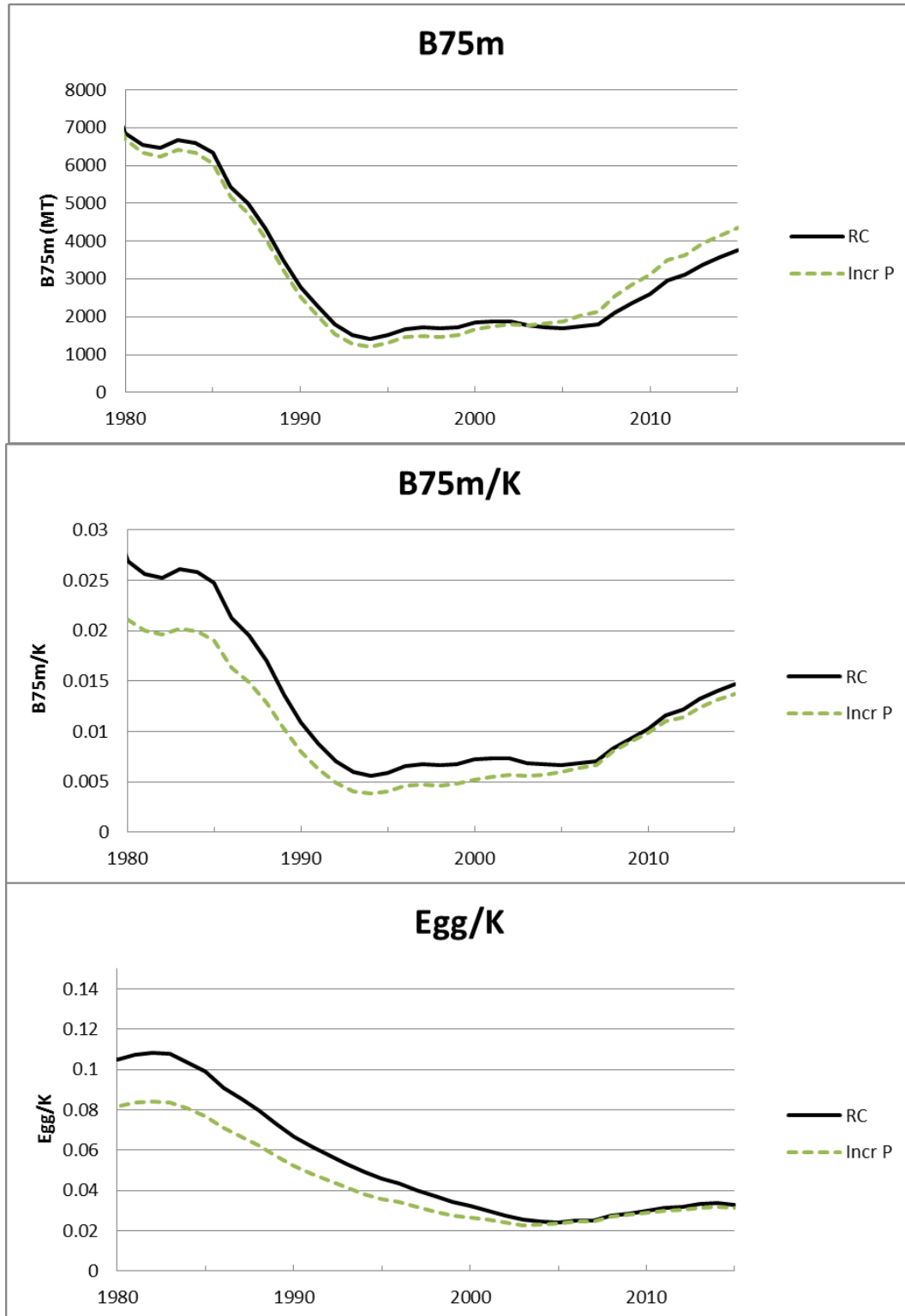


Figure 3a: Super-area 7 assessment results for the RC and the larger poaching (10x) scenario.

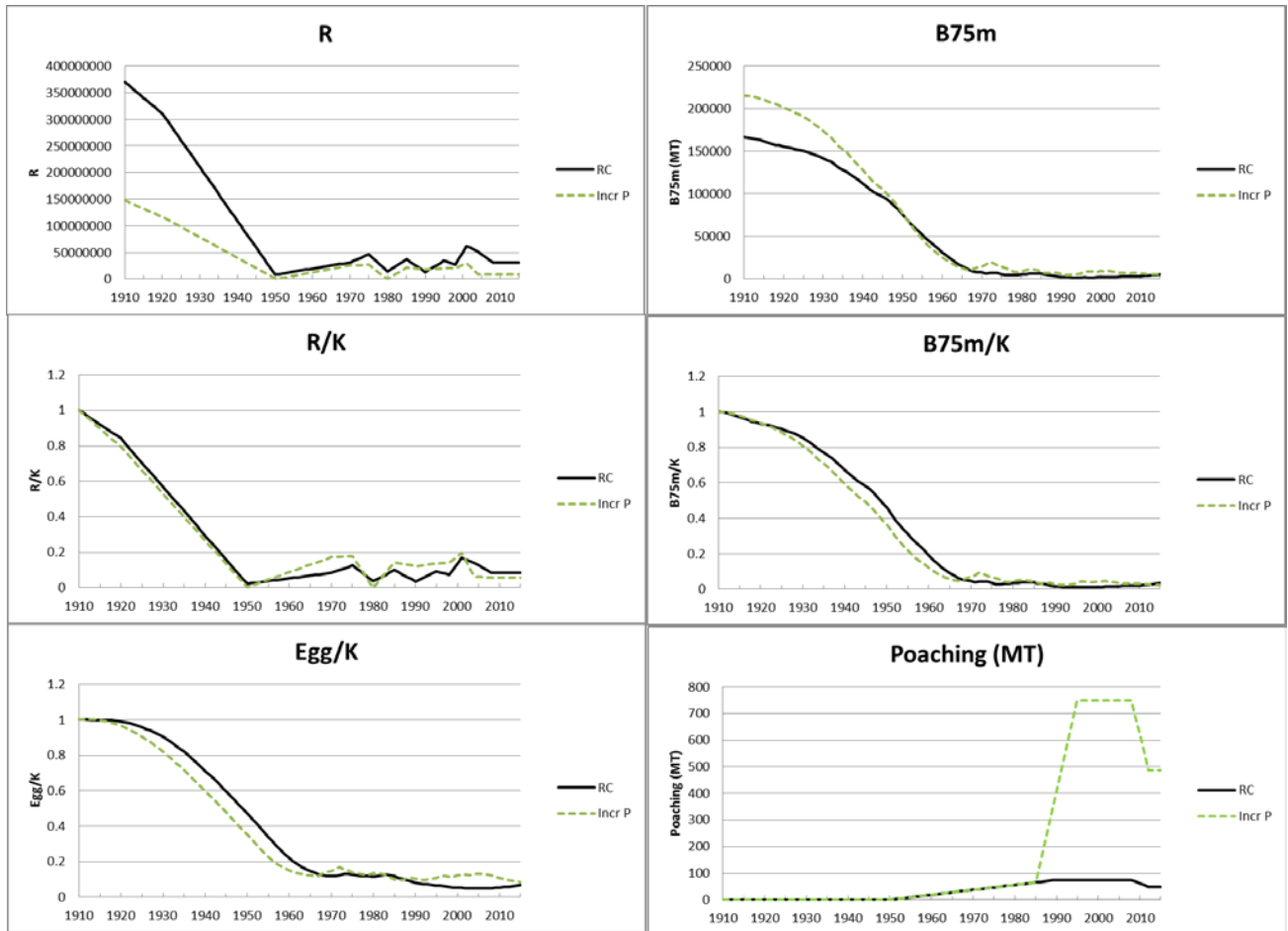


Figure 3b: Super-area 7 assessment results for the RC and the larger poaching (10x) scenario – 1980+ period shown only for clarity.

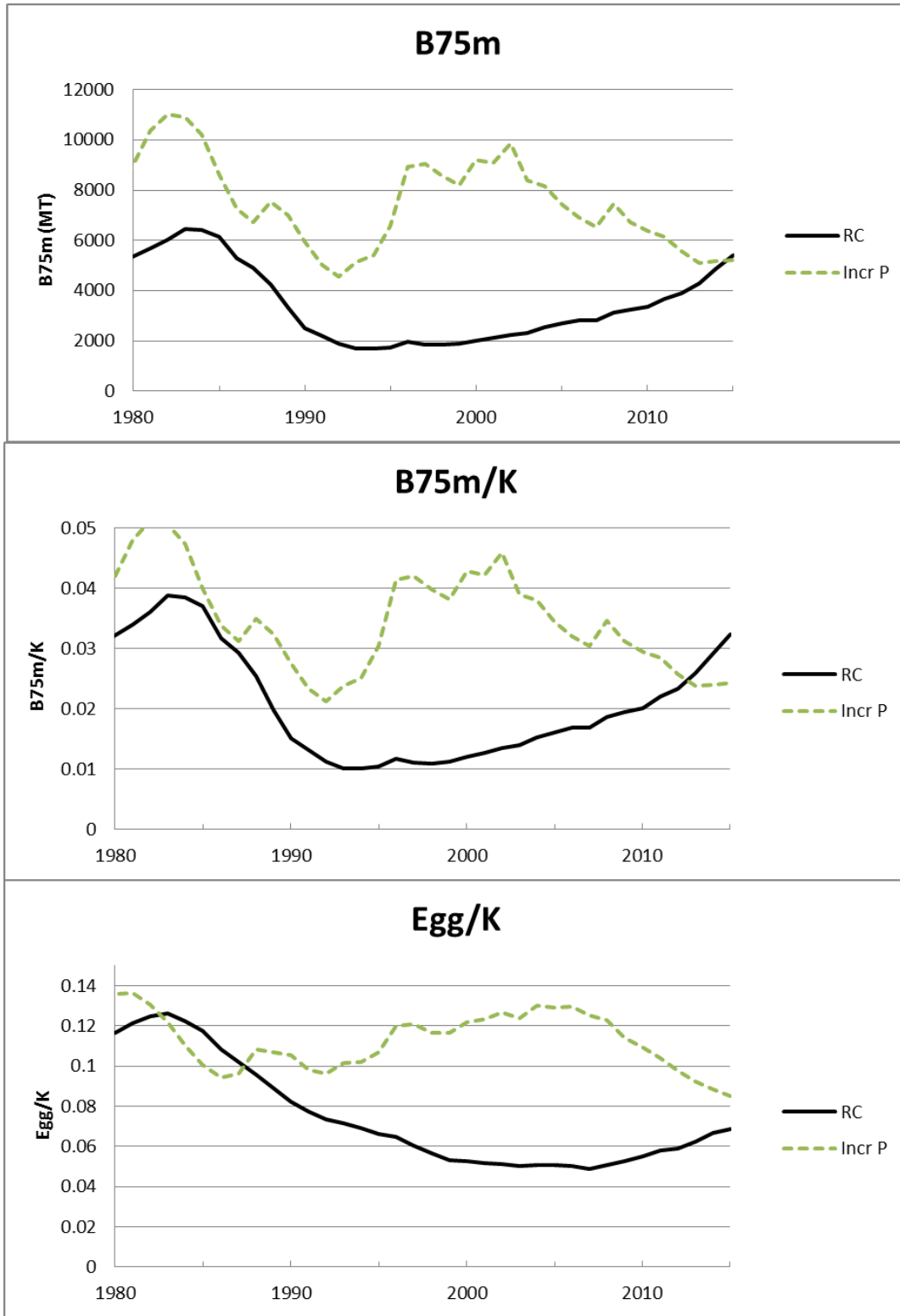


Figure 4a: Super-area 8+ assessment results for the RC and the larger poaching (10x) scenario.

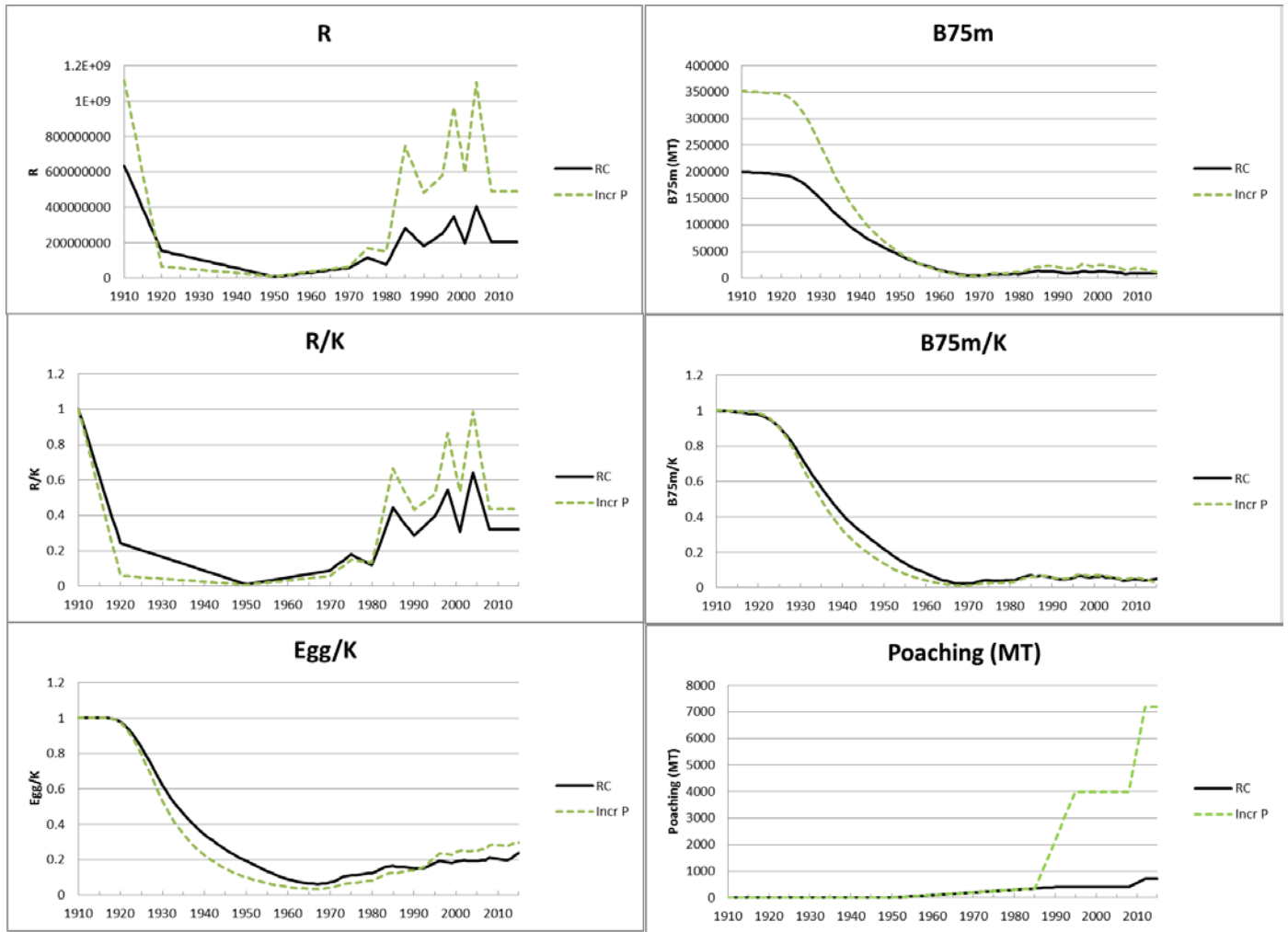


Figure 4b: Super-area 8+ assessment results for the RC and the larger poaching (10x) scenario – 1980+ period shown only for clarity.

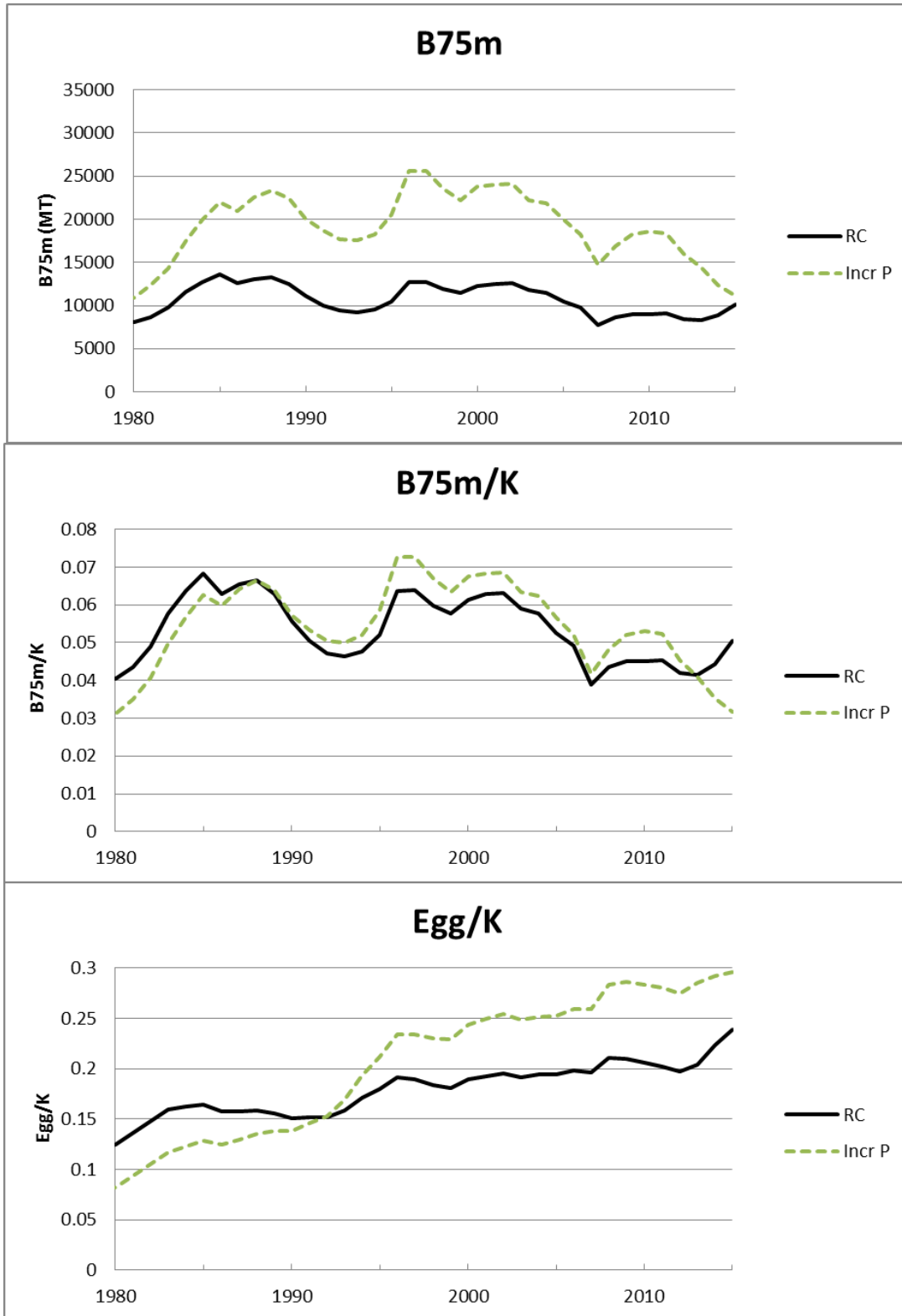


Figure 5a: Assessment results for the combined Super-areas for the RC and the larger poaching (10x) scenario.

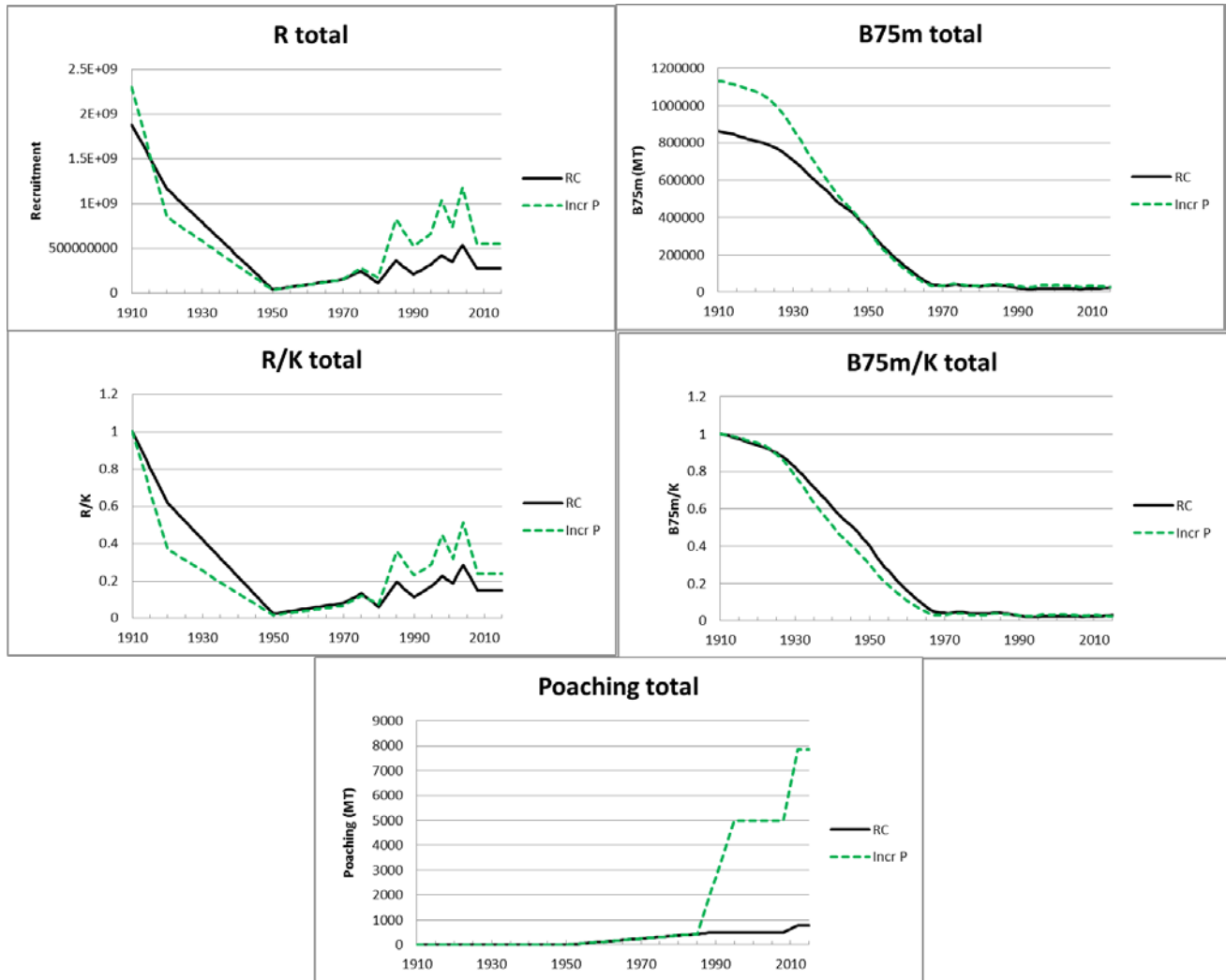


Figure 5b: Assessment results for the B75m and B75m/K estimates for the combined Super-areas for the RC and the larger poaching (10x) scenario – 1980+ period shown only for clarity.

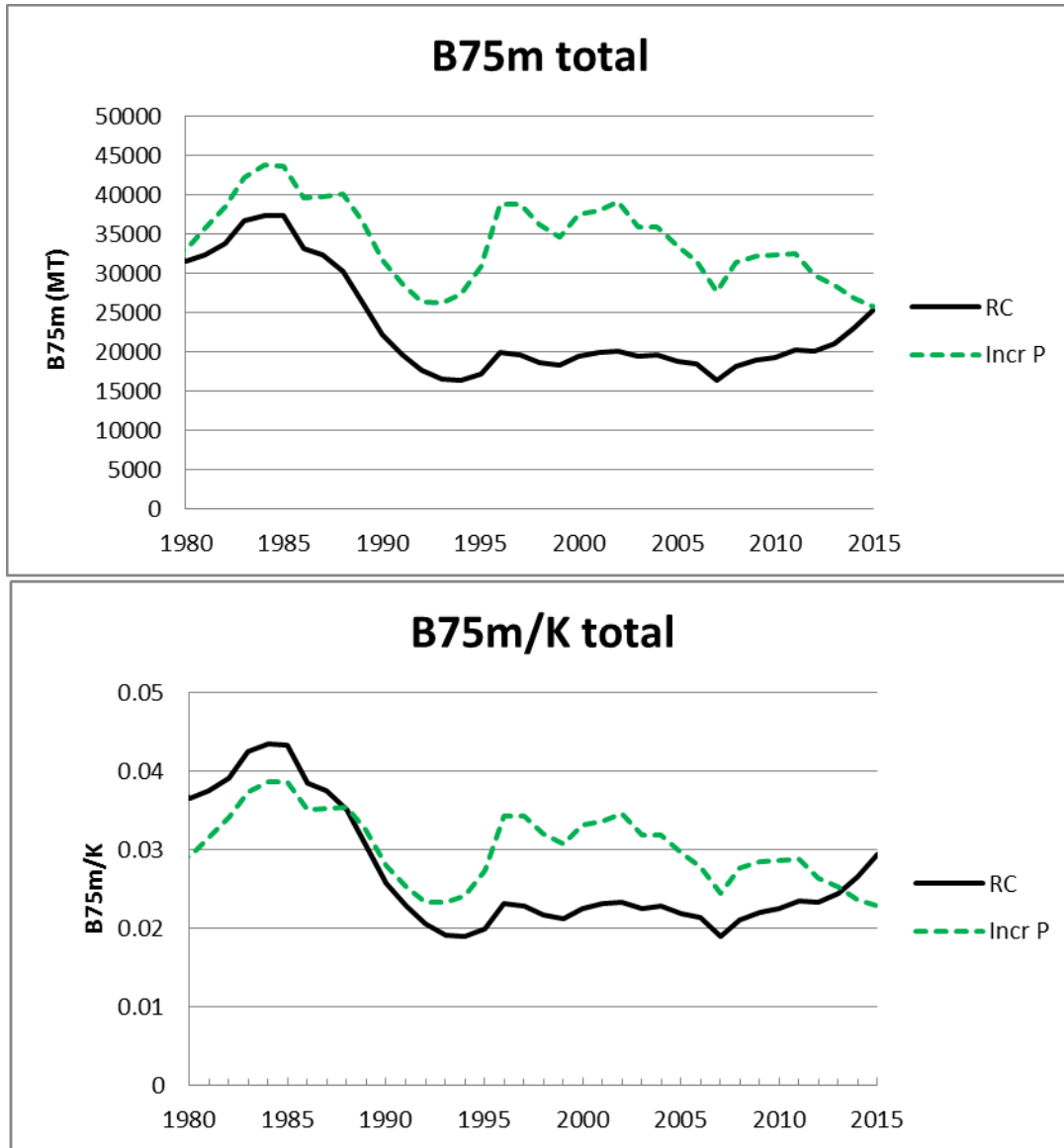




Figure 5c: Assessment results for the **B60m** and **B60m/K** estimates for the combined Super-areas for the RC and the larger poaching (10x) scenario (1980+ period shown only for clarity on RHS).

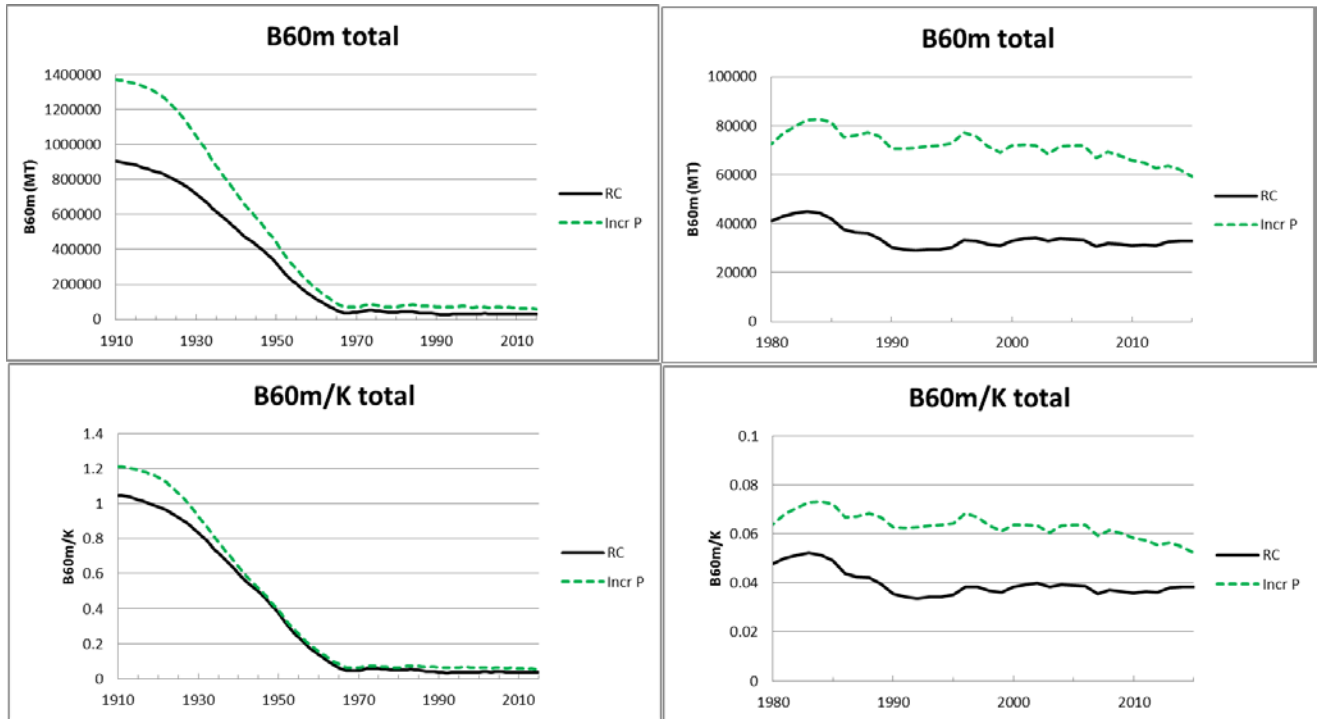


Figure 6a: A further larger poaching scenario (5x) is shown along with the original larger poaching (10x) scenario, the RC or baseline poaching scenario and the legal take over time.

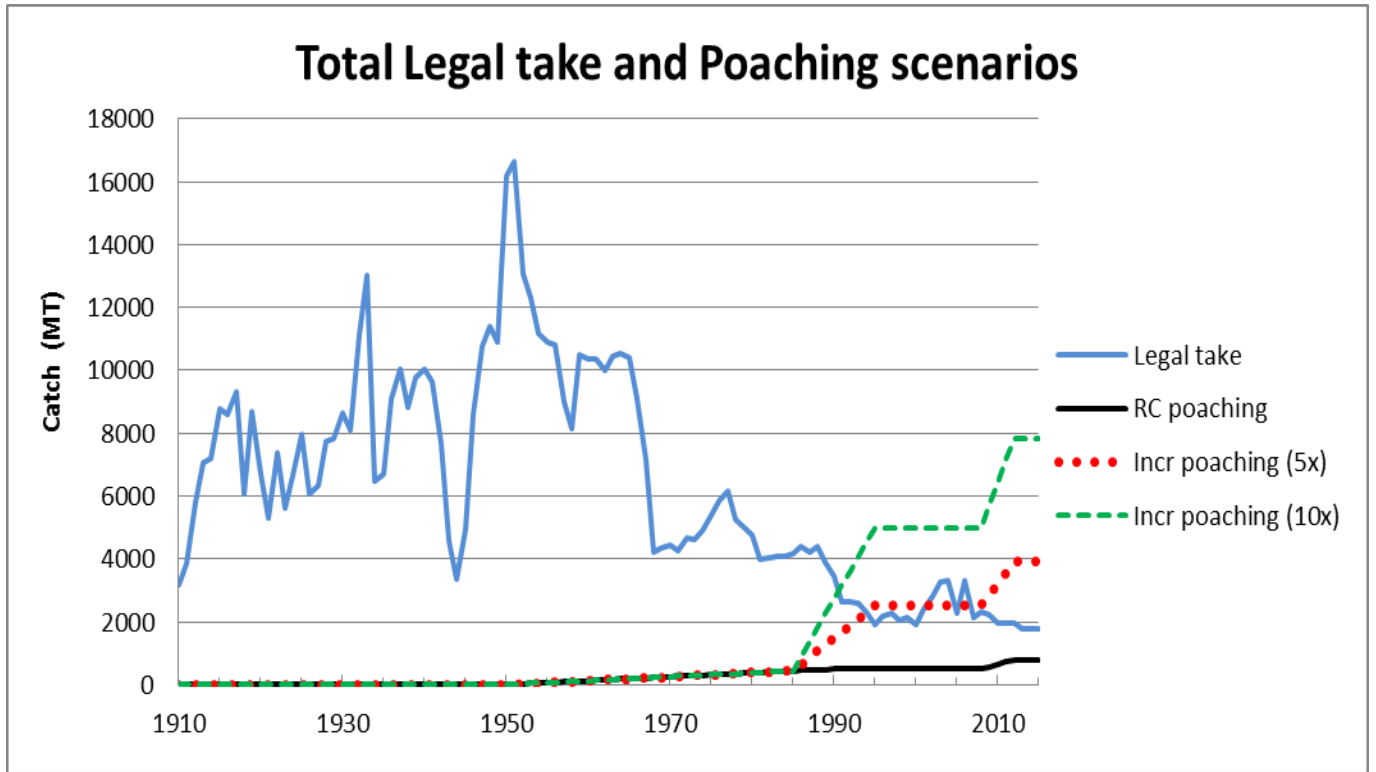


Figure 6b: Assessment results for the B75m and B75m/K estimates for the combined Super-areas for the RC and two alternate poaching scenarios (larger poaching 10x and 5x) – the 1980+ period is shown only for clarity.

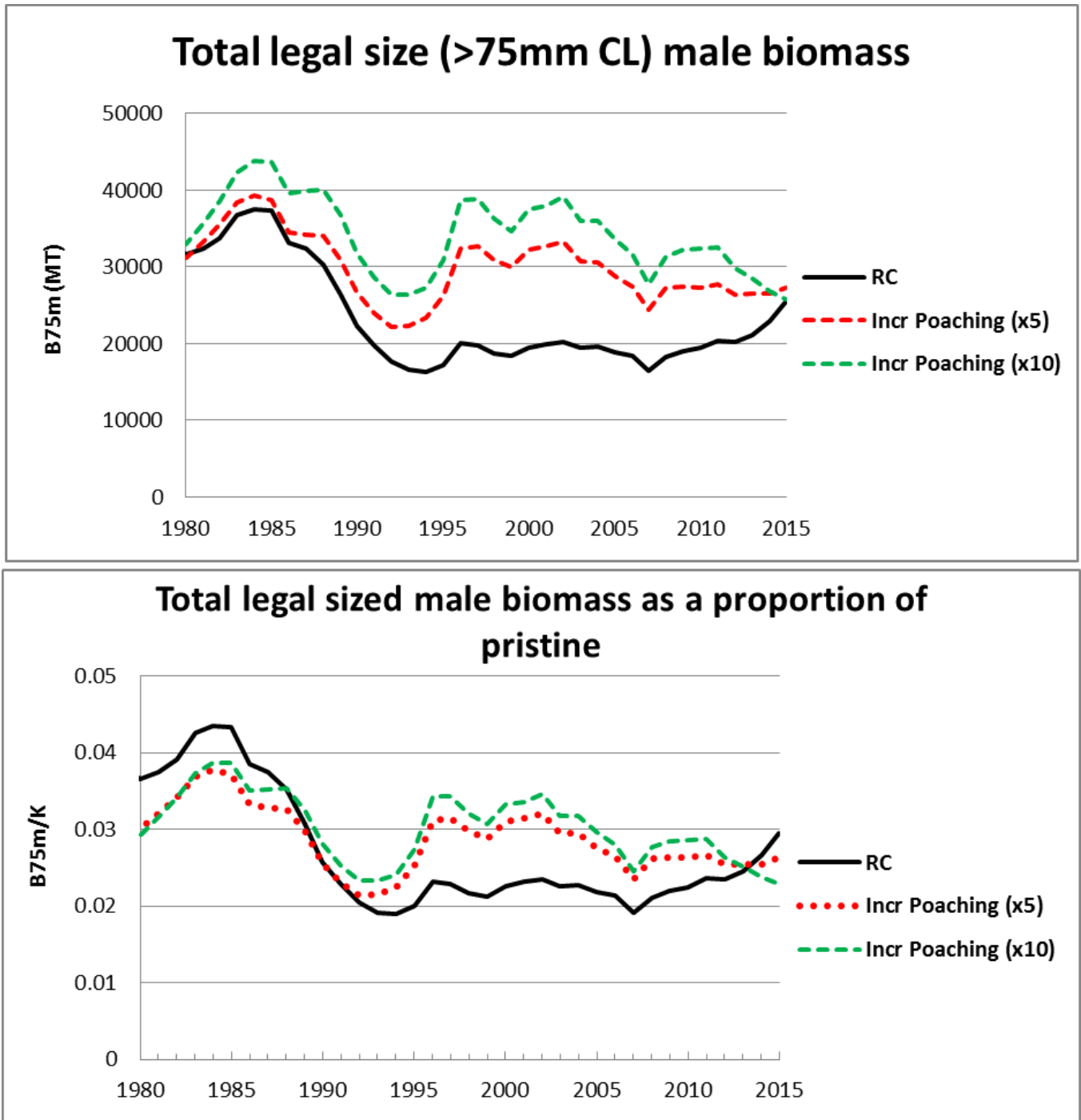


Figure 6c: Assessment results of the **B60m** and **B60m/K** estimates for the combined Super-areas for the RC and two alternate poaching scenarios (larger poaching 10x and 5x) – the 1980+ period is shown only for clarity.

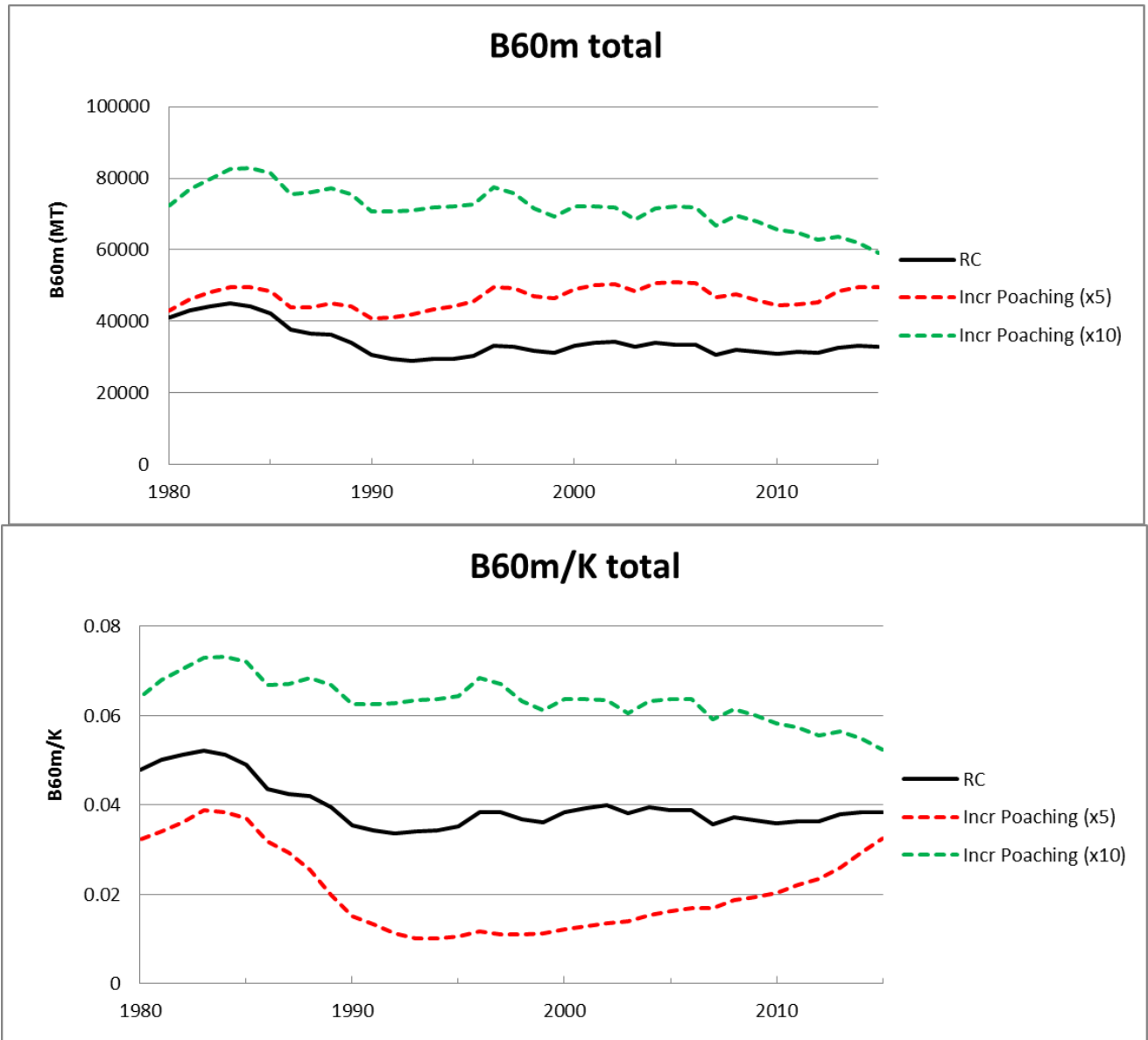


Figure 7: Projected exploitable male biomass trends for Super-areas 3+4, 5+6, 7 and 8+ assuming the larger poaching scenario (x10) continues into the future, and that legal catches in all sectors remain at current (2015) levels. The results are show as absolute biomass (first column), B75m relative to pristine (middle column) and finally B75m relative to 2006 (last column). The red dots in the plots of the last column indicate the median biomass recovery anticipated by 2021 under the current OMP.

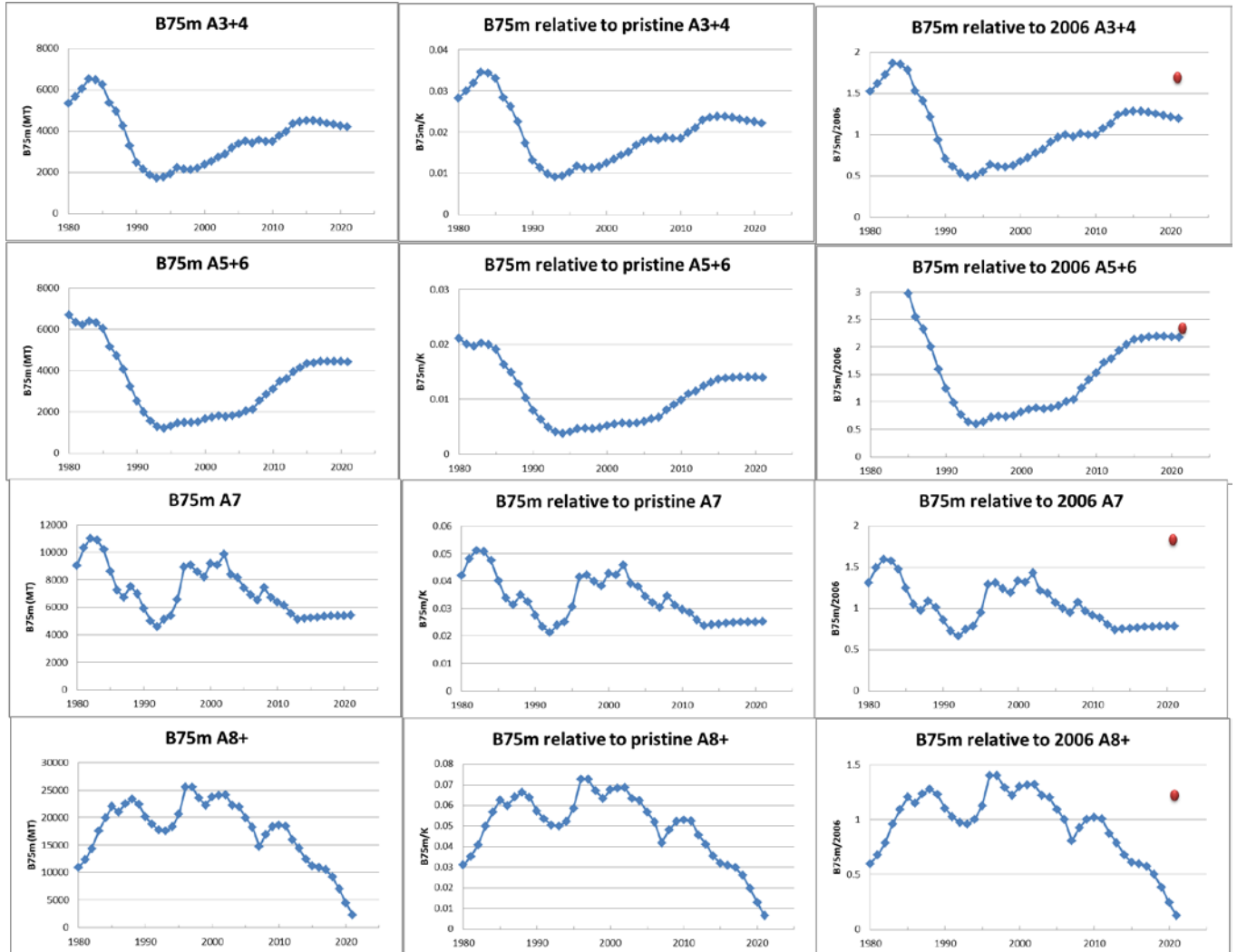


Figure 8a: Projected exploitable male biomass relative to 2006 for **combined** Super-areas assuming the larger poaching scenario (**x5**) continues into the future, and that legal catches in all sectors remain at current levels. The red dot indicates the median biomass recovery for the resource anticipated by 2021 under the current OMP.

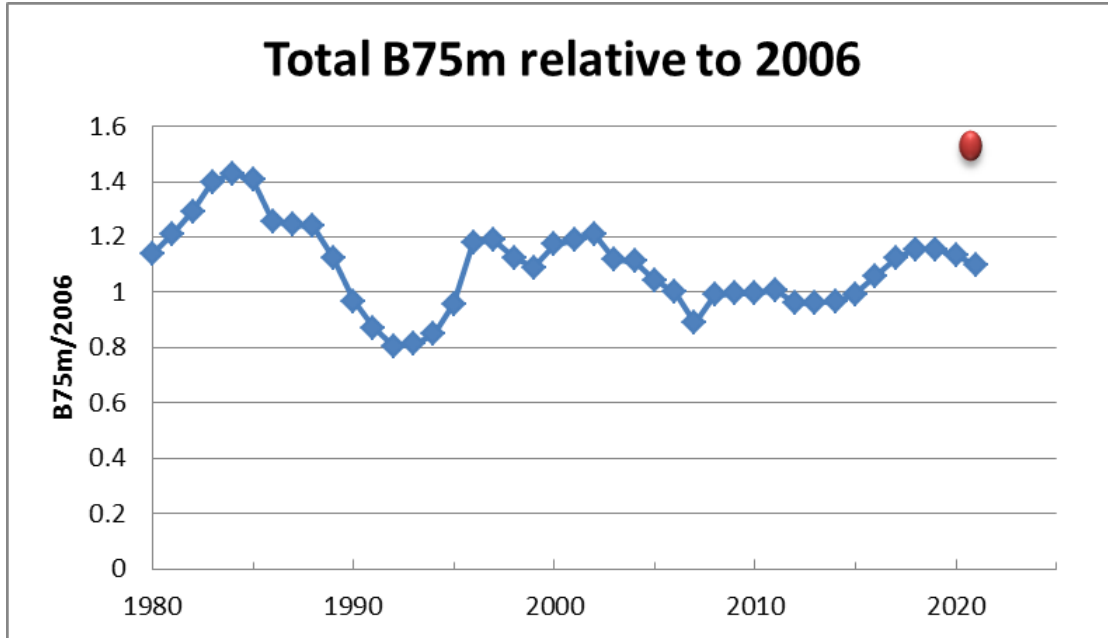


Figure 8b: Projected exploitable male biomass relative to 2006 trend for **combined** Super-areas assuming the larger poaching scenario (**x10**) continues into the future, and that legal catches in all sectors remain at current levels. The red dot indicates the median biomass recovery for the resource anticipated by 2021 under the current OMP.

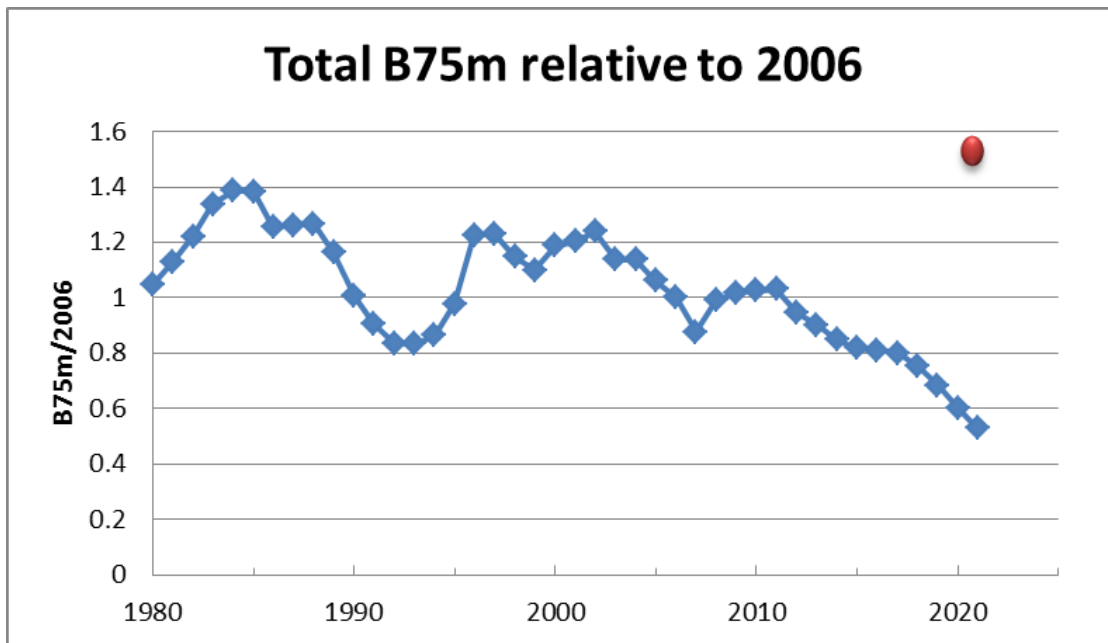


Figure 8c: Comparison of projections assuming current catch levels stay constant into the future for all sectors, for three different levels of poaching (current poaching level, larger poaching by five-fold and larger poaching by ten-fold). In each case the resource assessments associated with each poaching scenario are used for the respective projections. The dotted vertical line shows the start of the projection period (2015). Note that the projection for the poaching level assumed for the RC assessment is not identical to the current OMP projection shown in previous Figures because under the latter the sizes of the legal components of the catch change in future.

