

Initial Results in the Development of a Revised OMP for Tristan da Cunha island rock lobster

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An OMP for setting the TAC for the rock lobster fishery at Tristan da Cunha island was developed and implemented in 2013 (Johnston and Butterworth 2013). The operating model (i.e. the underlying stock assessment model used to simulation test the candidate OMPs) at the time (OM_2013) was fitted to GLM standardized CPUE for the period 1994-2012. This OM predicted catch rates for the fishery into the future (2013+) for the final selected OMP (OMP 2013).

Recently, an updated GLM CPUE analysis (Johnston et al. 2015) has provided GLM standardized CPUE value for 2013 and 2014 – which are outside the 90% CI predicted by OM_2013. Table 1 and Figure 1 (top plot) report this discrepancy. This constitutes “exceptional Circumstances”, and requires initiation of a revision of OMP 2013.

To initiate this process, results of the current OMP (OMP 2013) and variants thereof are reported here for three different OMs:

- 1) **OM_2013**: the original OM used to simulation test the OMP and which fitted to CPUE only up to 2012),
- 2) **ALT1**: OM_2013 but where a proportion of all lobsters is assumed to die at the start of 2013 and 2014 in order to match the observed 2015 updated CPUE, and
- 3) **ALT2**: OM_2013 but where a proportion of all lobsters is assumed to die at the start of 2013 and 2014 in order to match CPUE values mid-way between the 2015 updated CPUE and the original predicted CPUE for 2013 and 2014.

A range of OMPs are used to set the TAC for 2016+ and project the resource forwards. Note that following catches (equal to TACs) are assumed:

TAC(2013)=165 MT

TAC(2014)=161 MT

TAC(2015)=120 MT

OMP 2013

The OMP is a target-based rule based on the recent commercial CPUE, viz.

$$TAC_{y+1} = TAC_y + \alpha(I_y^{rec} - I^{tar}) \quad (1)$$

where

I_y^{rec} is the average of the GLM standardized CPUE over the last three years ($y-2, y-1, y$),

I^{tar} is the CPUE target index of 1.163 (the average GLM standardised 2010-2012 CPUE), and

$$\alpha = 25$$

A rule to control the inter-annual TAC variation is also applied. The % TAC change relative to the previous year is restricted to a maximum of either up 5% down 5%, i.e.

$$\text{If } TAC_{y+1} < 0.95TAC_y \quad \text{then } TAC_{y+1} = 0.95TAC_y \quad (2)$$

$$\text{If } TAC_{y+1} > 1.05TAC_y \quad \text{then } TAC_{y+1} = 1.05TAC_y \quad (3)$$

OMP variants

A number of variants of OMP 2013 are reported here, where changes are made to the inter-annual TAC constraints.

OMP 2013: +5%, -5% maximum inter-annual TAC change constraint

VAR1: +10%, -5% maximum inter-annual TAC change constraint

VAR2: +10%, -0% maximum inter-annual TAC change constraint (i.e. TAC cannot be reduced)

VAR3: +5%, -0% maximum inter-annual TAC change constraint (i.e. TAC cannot be reduced)

Results

Table 1 reports the 2015 updated GLM CPUE value for 2013 and 2014, and the median predicted CPUE from OM-2013 for the current OMP. Table 2 reports the CPUE values for OM_2013, ALT1 and ALT2 and the extra proportion of lobster deaths in 2013 and 2014 required to achieve these CPUE values.

Table 3 reports simulation results of for a number of OM-OMP combinations. Note that catches projected for the next decade under the OMPs considered are appreciably lower than anticipated when OMP 2013 was adopted.

Figure 1 shows the catch rates (median, 5th and 95th percentiles) as predicted for OMP 2013 assuming either the original OM_2013, OM_2013_ALT1 (where the OM catch rates are forced to equal the 2015 updated CPUE, and OM_2013_ALT2 (where the OM catch rates are forced equal to the mid-point between the 2015 updated CPUE and the OM_2013 median predicted values). The red circles in each plot show the 2015 updated 2013 and 2014 CPUE values.

Figure shows the TAC, catch rate (CR) and Bsp/K trajectories into the future for assuming three different underlying assessment models (OM 2013, ALT1 and ALT2). Results are shown for the current or RC OMP and three variants thereof (VAR1, VAR2, and VAR3).

Figures 3a-d show the TAC, catch rate (CR) and Bsp/K trajectories into the future for the RC OMP, VAR1, VAR2 and VAR3 OMPs respectively. Results in each plot are compared for three different operating models (OM 2013_RC, ALT1 and ALT2).

Discussion

Certainly a revised OMP will need to show acceptable performance under the ALT1 OM (or a similar assessment) which is able to reflect recent lower CPUE values. However the performances of the variants considered in this paper under ALT1, as reflected in Figure 2 (and see also Table 3), are not particularly satisfactory:

- Unless the downward TAC change constraint is set at zero, so that the current TAC of 120 MT cannot be reduced, the TAC is forecast to drop to less than 90 MT within the next decade.
- While setting that constraint to zero results in acceptable performance under the OMs considered, this is unlikely to be the case for more probing robustness tests.
- Allowing the TAC to drop below 120 MT does not lead to better depletion or recovery performance for the spawning biomass compared to OMP variants which exclude that possibility.

This suggests that more substantial changes will be necessary for the revised OMP than reflected by the limited set of OMP variants considered in this paper.

References

Johnston, S.J and Butterworth, D.S. 2013. An operational management procedure for the Tristan da Cunha rock lobster fishery. MARAM document, MARAM/Tristan/2013/OCT/14.

Johnston, S.J., Brandao, A. and Butterworth, D.S. 2013. Updated 2015 GLMM- and GLM-standardised lobster CPUE from the Tristan da Cunha group of islands. MARAM document, MARAM/Tristan/2015/MAY/06.

Table 1: Updated GLM CPUE value for 2013 and 2014, and the median predicted CPUE from OM-2013 for the current OMP.

	2015 GLM CPUE	Predicted CPUE from OM-2013
2013	0.919	1.119
2014	0.650	1.198

Table 2: CPUE values for OM_2013, ALT1 and ALT2 and the extra proportion of lobster deaths in 2013 and 2014 required to achieve these CPUE values.

	OM_2013		ALT1		ALT2	
	CPUE	Proportion of extra deaths	CPUE	Proportion of extra deaths	CPUE	Proportion of extra deaths
2013	1.119	0	0.919	0.157	1.019	0.078
2014	1.198	0	0.650	0.278	0.924	0.128

Table 3: Simulation results for a number of OM-OMP combinations. All statistics reported below are median values unless otherwise stated. Note RC(original) refers to the OMP as developed and simulation tested in 2013. RC* is the same OMP, but fixing catches at the values finally decided upon (e.g. TAC(2015)=120 MT).

OM	OMP	Inter-annual maximum TAC constraint	CR(2022) (kg/gear/hour)	CR(2025) (kg/gear/hour)	CR(2032) (kg/gear/hour)	C _{ave} 10 (13-22) (MT)	C _{ave} 10 (16-25) (MT)	Lower 5%ile B _{sp} (2033/K)	Lower 5%ile B _{lowest}
2013	RC original	+5%,-5%	1.38	1.39	1.24	171	181	0.57	0.57
2013	RC*	+5%,-5%	1.57	1.53	1.31	140	147	0.59	0.59
2013	VAR1	+10%,-5%	1.51	1.44	1.19	144	158	0.57	0.57
2013	VAR2	+10%,-0%	1.51	1.43	1.15	144	158	0.57	0.57
2013	VAR3	+5%,-0%	1.56	1.53	1.29	140	147	0.59	0.59
ALT1	RC	+5%,-5%	1.42	1.74	1.59	114	97	0.64	0.47
ALT1	VAR1	+10%,-5%	1.42	1.71	1.49	114	98	0.63	0.47
ALT1	VAR2	+10%,-0%	1.31	1.61	1.34	129	122	0.61	0.47
ALT1	VAR3	+5%,-0%	1.31	1.61	1.45	129	121	0.63	0.47
ALT2	RC	+5%,-5%	1.51	1.64	1.45	122	117	0.62	0.57
ALT2	VAR1	+10%,-5%	1.51	1.59	1.37	123	120	0.60	0.57
ALT2	VAR2	+10%,-0%	1.47	1.54	1.30	130	129	0.59	0.57
ALT2	VAR3	+5%,-0%	1.47	1.60	1.39	130	128	0.60	0.57

Figure 1: Catch rates (median, 5th and 95th percentiles) as predicted for OMP 2013 assuming either the original OM_2013, OM_2013_ALT1 (where the OM catch rates are forced to equal the 2015 updated CPUE, and OM_2013_ALT2 (where the OM catch rates are forced equal to the mid-point between the 2015 updated CPUE and the OM_2013 median predicted values). The red circles in each plot show the 2015 updated 2013 and 2014 CPUE values.

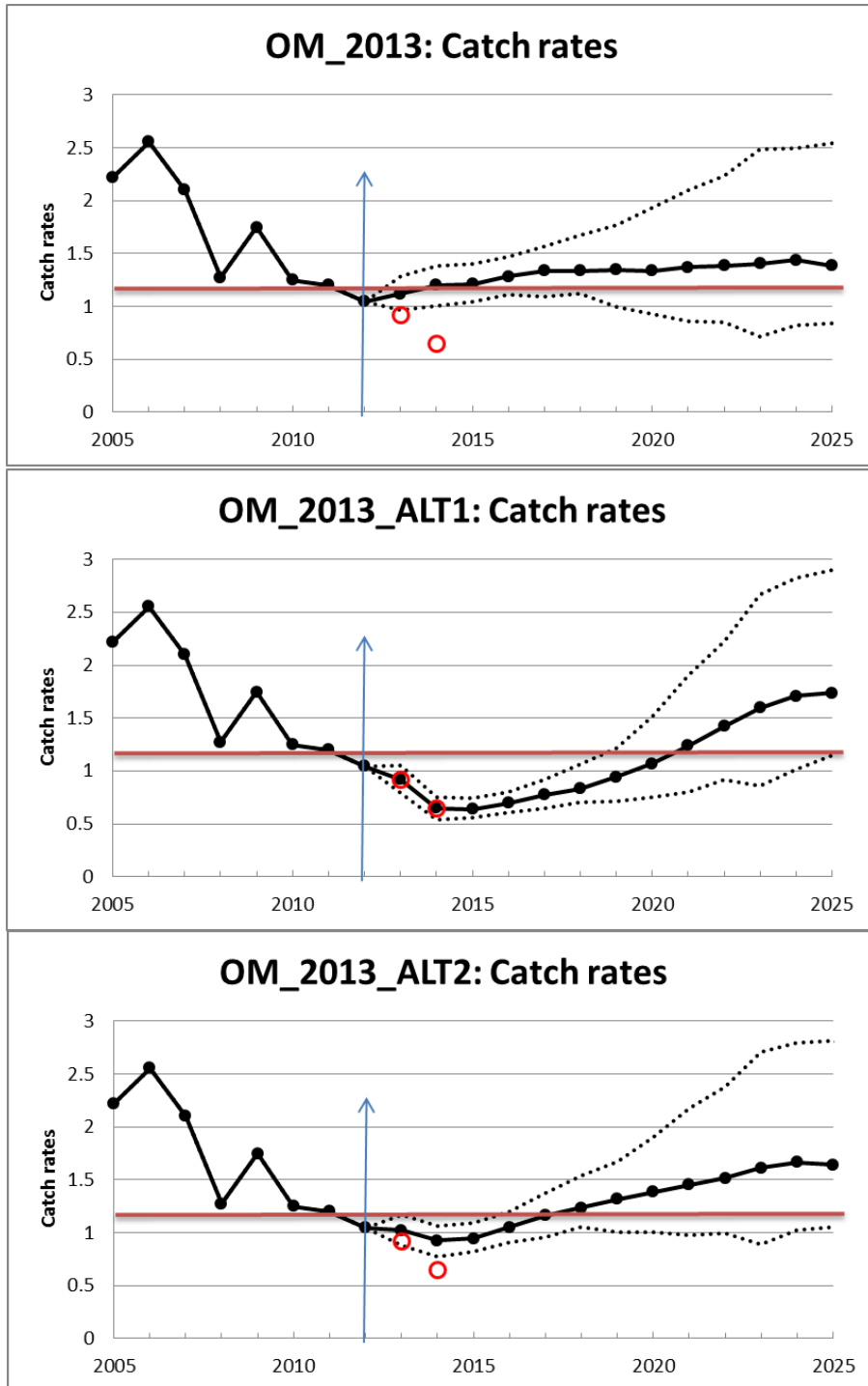


Figure 2: Median TAC, catch rate (CR) and Bsp/K trajectories into the future for assuming three different underlying assessment models (OM 2013, ALT1 and ALT2). Results are shown for the current or RC OMP and three variants thereof (VAR1, VAR2, and VAR3).

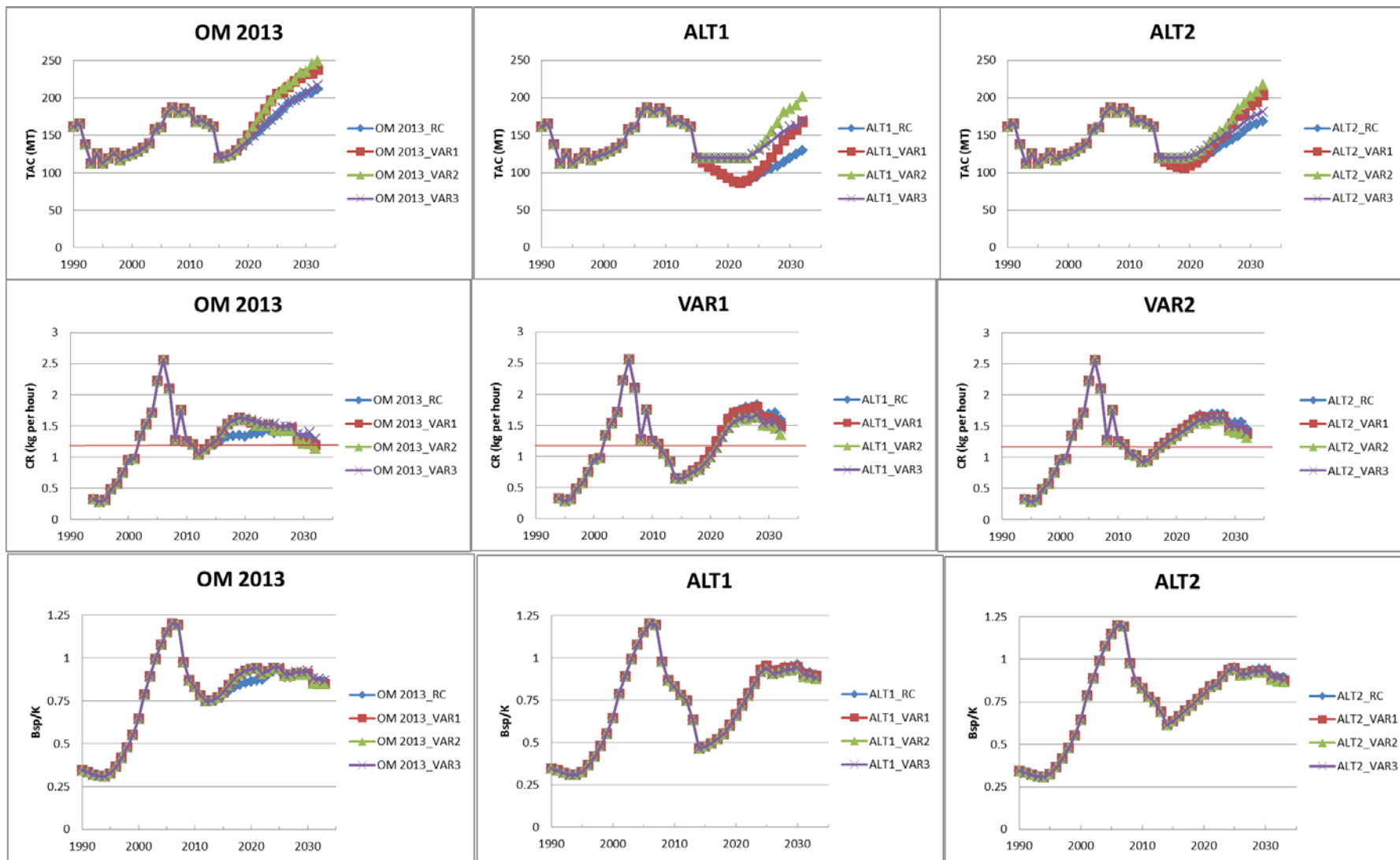


Figure 3a: Median TAC, catch rate (CR) and Bsp/K trajectories into the future for the RC OMP. Results are compared for three different operating models (OM 2013_RC, ALT1 and ALT2).

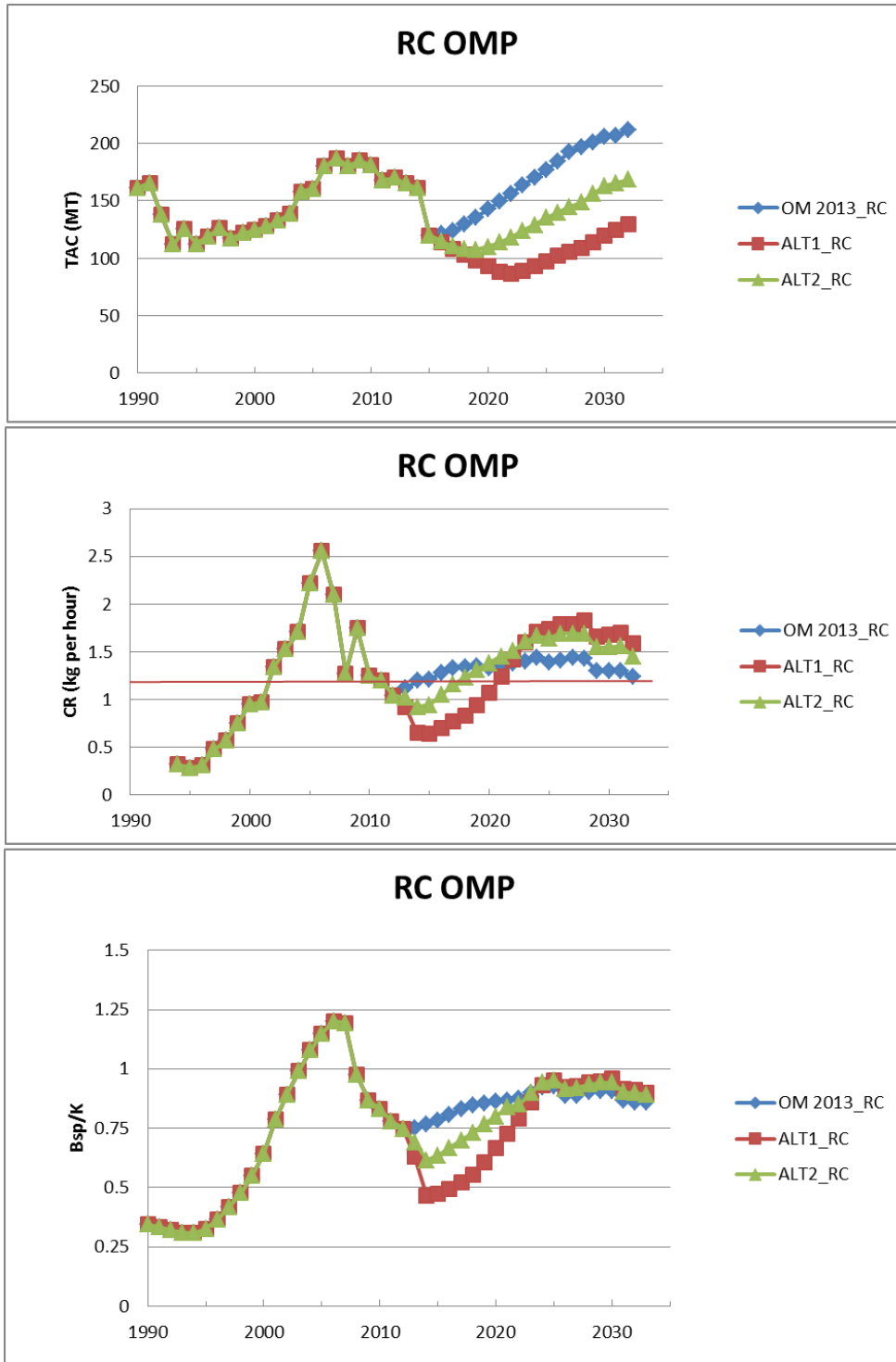


Figure 3b: TAC, catch rate (CR) and Bsp/K trajectories into the future for VAR1 OMP. Results are compared for three different operating models (OM 2013_RC, ALT1 and ALT2).

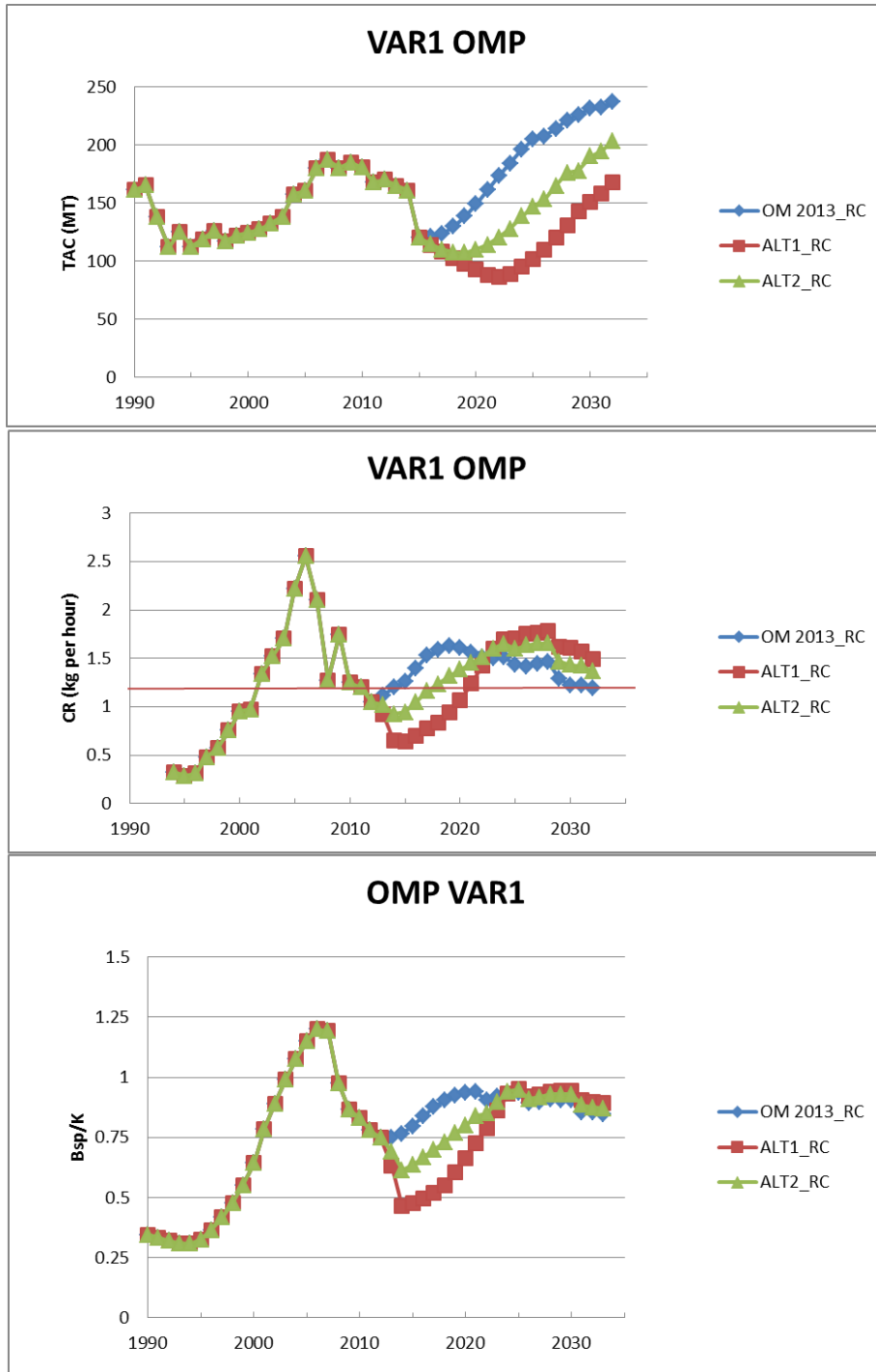


Figure 3c: Median TAC, catch rate (CR) and Bsp/K trajectories into the future for VAR2 OMP. Results are compared for three different operating models (OM 2013_RC, ALT1 and ALT2).

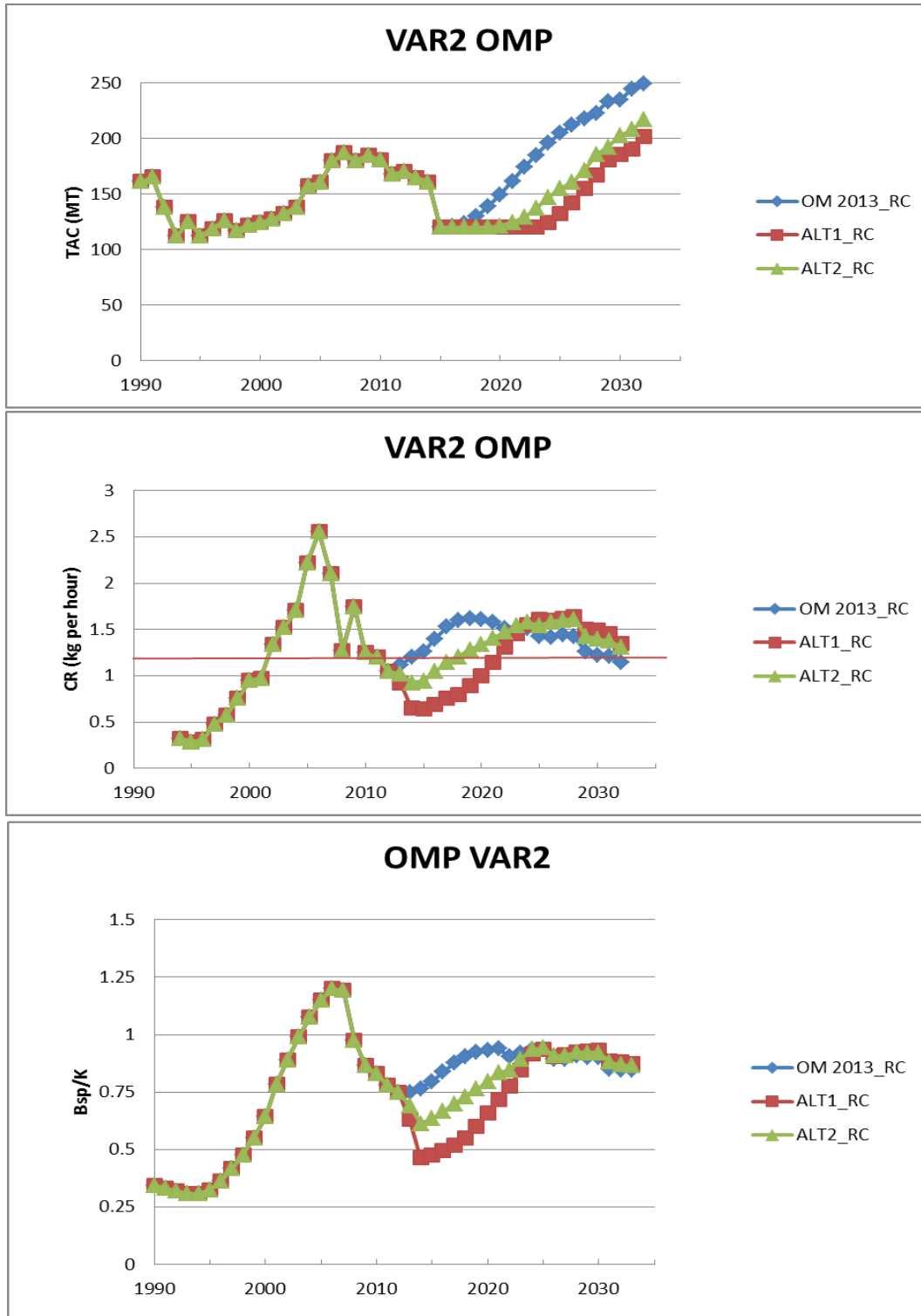


Figure 3d: Median TAC, catch rate (CR) and Bsp/K trajectories into the future for VAR3 OMP. Results are compared for three different operating models (OM 2013_RC, ALT1 and ALT2).

