INITIAL TRISTAN ISLAND EXCEPTIONAL CIRCUMSTANCES RULE DEVELOPMENT

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Summary

The addition of Exceptional Circumstances (EC) provisions to the current OMP for Tristan island is investigated. Four EC options are considered, each allowing interannual TAC decreases in excess of 5% if the recent average CPUE drops below a specified level. These are tested against three bad scenarios for the resource, involving either a substantial mortality event or a large run of poor recruitments. Under the tests, all four EC options achieve better CPUE and lower 5%-ile for spawning biomass by 2032 than does the existing OMP without these EC provisions. All of the EC scenarios considered therefore seem to provide adequate safeguards for the resource. Accordingly, the least severe of the four in expected TAC reduction terms, EC2, is suggested for incorporation into the OMP.

Introduction

The OMPs developed for the Inaccessible and Gough rock lobster fisheries had, as part of their rules, Exceptional Circumstances" or "Metarules" provisio (see Johnston and Butterworth 2014). The OMP currently in place for setting the TACs at the Tristan island (see Johnston and Butterworth 2013) does not, however, have Exceptional Circumstances (EC) rules. This document presents results of some initial EC rules for consideration for Tristan island.

Note that the input to the OMP is based on a three year average of the most recent CPUE (obtained from GLM analyses of the powerboat CPUE data), which is termed "I_{rec}". Whilst the 2012 and 2013 CPUE values are available, we await the completion of the 2014 season before being able to compute the final 2014 CPUE value. Nevertheless, it has been observed in this fishery that to date for this season, that catch rates from the powerboats have been very poor. It is therefore possible to make a reasonable inference for a plausible range of what the final 2014 CPUE value might be (here the range of 0.40-0.90 is considered).

Current Tristan OMP

To recap, the current OMP for Tristan (without any EC rules) is as follows.

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.:

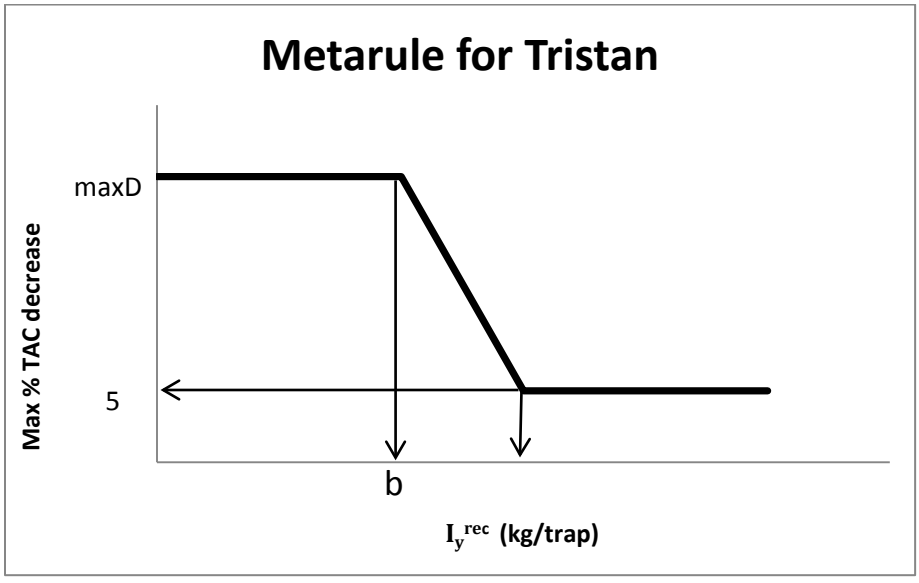
If $TAC_{y+1} < 0.95TAC_y$ then $TAC_{y+1} = 0.95TAC_y$

If $TAC_{y+1} > 1.05TAC_y$ then $TAC_{y+1} = 1.05TAC_y$

Note that for the final selected OMP is was also decided to fix the TAC for the first year for which the OMP was applied (2013) to 165 MT.

Exceptional Circumstances (or Metarule) development for Tristan

The OMPs for both Inaccessible and Gough have a "metarule" such that if the recent catch rate I_y^{rec} value drops below a threshold level, the TAC may decrease further than the usual maximum 5% TAC decrease. A similar EC rule is proposed for Tristan. The figure below shows how the maximum % the TAC may be reduced from year to year may change from the default of 5% to a value of "maxD", depending on the value of I_y^{rec}.



We report on four different EC rules (EC1-EC4) which vary depending on the I_y^{rec} level below which the EC rule kicks in. Two alternate values of "maxD" are also explored – either 20% or 30%.

EC rule	a	b	maxD (maximum interannual % TAC decrease)
EC1	0.9	0.5	20%
EC2	0.8	0.5	20%
EC3	0.8	0.5	30%
EC4	0.9	0.5	30%

In order to test the effectiveness of the metarule, three robustness trials reflecting bad future scenarios were developed. These simulate a consequential decrease of lobster biomass (and hence CPUE) in the future as follows:

- **ROB1**: 60% of all lobster die at the end of the 2013 season;
- **ROB2**: recruitment drops to half the current level for the period 2006-2019 (then the normal stock-recruit relationship is assumed to apply again); and
- **ROB3**: recruitment drops to half the current level for the period 2006-2014 (then the normal stock-recruit relationship is assumed to apply again).

Results are also reported for the Reference Case (RC) to ease comparisons.

Results

Table 1 is provided to show the expected performance statistics of the current OMP assuming the most recent updated 2015 operating model (Johnston and Butterworth 2015).

Tables 2a-d report results following simulation studies of the current OMP with a number of alternate EC rules (EC1-EC4). Results are reported for the RC (Table 2a), as well as for the three robustness tests (Tables 2b-d) which simulate biomass declines in the future.

Figures 1a-c compare the four EC rules with "No EC rule" as well as for a "zero future TAC" (which thus reflects the best resource performance possible). In each plot the median spawning biomass, TAC and catch rate (CR) trajectories are plotted. Figure 1a reports results for the RC, Figure 1b for ROB1 (where it is assumed 60% of lobsters die in 2013), Figures 1c-d for ROB2-3 where recruitment is assumed to decline for a period.

Table 3a provides the values of the expected TAC(2015) for each of the four EC rules, assuming a range of possible Tristan CPUE performance in the current (2014) season. Johnston *et al.* (2014) provides the most recent GLM analysis of the Tristan CPUE data – which ended with the 2013 season. As soon as the 2014 fishing season is completed, this document will be updated to include the CPUE data from the 2014 season. Nominal CPUE values from the powerboats are however available for the first portion of the season, and these have been very low. Here a number of ranges of possible CPUE values for the 2014 season are explored in order to show what the result would be on the 2015 TAC estimate. Note that CPUE(2012)=0.992 and CPUE(2013)=0.905. The OMP uses an average of the three most recent years CPUE values as input to OMP to calculate the TAC (I_y^{rec}). Thus I_{2014}^{rec} to be used for setting TAC(2015) will be the average of 0.992, 0.905 and the value of CPUE(2014).

Table 3b reports the expected TAC decrease (as a % of the 2014 TAC) for each of the TACs in Table 3a.

Table 4a reports expected TAC(2016) values if one takes this approach one year further, by assuming a range of possible CPUE values for the 2015 season. Here, for simplicity purposes, for each scenario, the 2014 and 2015 CPUE values are assumed to be the same, and again cover the range of 0.40-0.90. Table 4b then reports the expected TAC decrease (as a % of the 2015 TAC) for each of the TACs in Table 4a. In Tables 3a-4b, the cells shaded grey indicate where the TAC decrease is greater than the current maximum of 5%.

Finally, Figure 2 plots these results for three of the possible CPUE values assumed for 2014+2015 (0.60, 0.50 and 0.40). In each case the CPUE and resultant I_y^{rec} values are plotted in the top plot, with the resultant TACs for 2015 and 2016 plotted below (along with the 2014 TAC of 161 MT).

Discussion

Probably Figures 1b-d provide the readiest summary of the performance of the EC rules suggested when resource status is poor. In all cases the TAC drops much faster than would have been the case without the EC provisions. The TAC does increase again slowly later as the resource recovers, though for the most severe of the tests (ROB2) this TAC recovery commences only by 2030. There is little difference in spawning biomass trends between the highest to the lowest TAC options except for ROB2. Differences are more evident for the CPUE projections, where under the EC provisions CPUE recovery takes place faster than when there are no EC provisions.

The plots in Figures 1b-d provide insufficient discrimination to choose amongst the four EC options. From Tables 2 a-d it is evident that under any of the EC rules, by 2032 both the lower 5%-ile for the spawning biomass and the CPUE are higher than for the OMP without EC provisions. It thus seems that even the least severe (EC2) of the EC options considered provides more than adequate protection in the face of some extremely poor future scenarios for the resource. Accordingly, EC2 is suggested for incorporation in the Tristan island OMP.

References

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

Johnston, S.J. and Butterworth, D.S. 2014. Initial OMP candidates for the Inaccessible and Gough rock lobster fisheries. MARAM/TRISTAN/2014/FEB/03.

Johnston, S.J. and Butterworth, D.S. 2015. Updated 2015 Tristan da Cunha rock lobster assessment. MARAM/TRISTAN/2015/FEB/01.

Johnston, S.J., Brandao, A. and Butterworth, D.S. 2014. Updated 2014 GLMM- and GLM-standardised lobster CPUE from the Tristan da Cunha group of islands. MARAM/TRISTAN/2014/MAY/08.

Table 1: Comparison of final selected OMP (CMP1*) expected performance results between the OCT 2013 operating models, and the newly updated 2015 operating model. All statistics reported below are median values unless otherwise stated. Note – NO EC rule in place yet. Also note that the 2013 catch is "past" and the 2014 catch is fixed/assumed to be 161 MT (the TAC set).

OM OMP	α	Inter-annual maximum TAC constraint	CR(2022) (kg/gear/hour)	CR(2032) (kg/gear/hour)	C_{ave} 10 (MT) (13-22 ave)	Lower 5%ile C_{ave} 10	V10 (%)	Lower 5%ile Bsp(2032/K)
Oct 13 CMP1*	25	+5%,-5%	1.38	1.24	171	163	1.90	0.57
Feb 15 CMP1*	25	+5%,-5%	1.34	1.27	156	151	1.58	0.55

Table 2a: Comparison of OMP with four EC options – results for RC.

	a	b	Inter-annual maximum TAC constraint	CR(2017) (kg/gear/hr)	CR(2022) (kg/gear/hr)	CR(2032) (kg/gear/hr)	C_{ave} 10 (MT) (13-22 ave)	Lower 5%ile C_{ave} 10	V10 (%)	Lower 5%ile Bsp(2032/K)
Zero catch	-	-	-	1.66	1.92	1.89	33	33	-	0.66
No EC			+5%,-5%	1.22	1.34	1.27	156	151	1.58	0.55
EC1	0.9	0.5	+5%,**-20%**	1.22	1.34	1.29	156	151	1.58	0.57
EC2	0.8	0.5	+5%,**-20%**	1.22	1.34	1.28	156	151	1.58	0.57
EC3	0.8	0.5	+5%,**-30%**	1.22	1.34	1.28	157	151	1.58	0.57
EC4	0.9	0.5	+5%,**-30%**	1.22	1.34	1.29	156	151	1.58	0.57

Table 2b: Comparison of OMP with four EC options – results for ROB1 (60% of all lobsters die at end of 2013 season).

	a	b	Inter-annual maximum TAC constraint	CR(2017) (kg/gear/hr)	CR(2022) (kg/gear/hr)	CR(2032) (kg/gear/hr)	C_{ave} 10 (MT) (13-22 ave)	Lower 5%ile C_{ave} 10	V10 (%)	Lower 5%ile Bsp(2032/K)
Zero catch	-	-	-	0.74	1.43	1.46	33	33	-	0.66
No EC			+5%,-5%	0.25	1.13	1.46	135	135	4.0	0.60
EC1	0.9	0.5	+5%,**-20%**	0.29	1.48	1.71	93	92	13.38	0.64
EC2	0.8	0.5	+5%,**-20%**	0.28	1.47	1.71	95	95	12.85	0.64
EC3	0.8	0.5	+5%,**-30%**	0.32	1.58	1.80	79	78	18.03	0.65
EC4	0.9	0.5	+5%,**-30%**	0.33	1.59	1.81	77	76	18.86	0.65

Table 2c: Comparison of OMP with four EC options – results for ROB2 (recruitment drops to 50% of current level from 2006-2019).

	a	b	Inter-annual maximum TAC constraint	CR(2017) (kg/gear/hr)	CR(2022) (kg/gear/hr)	CR(2032) (kg/gear/hr)	C_{ave} 10 (MT) (13-22 ave)	Lower 5%ile C_{ave} 10	V10 (%)	Lower 5%ile Bsp(2032/K)
Zero catch	-	-	-	0.83	0.96	1.91	33	33	4.00	0.66
No EC			+5%,-5%	0.42	0.47	1.62	136	136	4.00	0.63
EC1	0.9	0.5	+5%,**-20%**	0.47	0.73	1.83	101	98	13.04	0.65
EC2	0.8	0.5	+5%,**-20%**	0.46	0.72	1.81	103	101	12.67	0.65
EC3	0.8	0.5	+5%,**-30%**	0.48	0.81	1.85	90	87	16.91	0.65
EC4	0.9	0.5	+5%,**-30%**	0.46	0.72	1.81	103	101	12.67	0.65

Table 2d: Comparison of OMP with four EC options – results for ROB3 (recruitment drops to 50% of current level from 2006-2014).

	a	b	Inter-annual maximum TAC constraint	CR(2017) (kg/gear/hr)	CR(2022) (kg/gear/hr)	CR(2032) (kg/gear/hr)	C_{ave} 10 (MT) (13-22 ave)	Lower 5%ile C_{ave} 10	V10 (%)	Lower 5%ile Bsp(2032/K)
Zero catch	-	-	-	0.83	1.31	1.91	33	33	-	0.66
No EC			+5%,-5%	0.42	0.84	1.50	136	136	4.00	0.61
EC1	0.9	0.5	+5%,**-20%**	0.47	1.09	1.75	101	98	12.63	0.64
EC2	0.8	0.5	+5%,**-20%**	0.46	1.08	1.74	103	101	12.09	0.64
EC3	0.8	0.5	+5%,**-30%**	0.48	1.16	1.80	90	87	16.03	0.65
EC4	0.9	0.5	+5%,**-30%**	0.50	1.18	1.82	88	83	17.11	0.65

Table 3a: Expected TAC(2015) values for each of the four EC rules, assuming various possible values for Tristan CPUE in 2014 season. I_{2014}^{rec} is the average of the 2012 (0.992), 2013 (0.905) and 2014 CPUE values. Shaded cells show TAC reductions greater than 5%.

Tristan GLM CPUE 2014 season	I_{2014}^{rec}	**NO EC rule**	**EC1**	**EC2**	**EC3**	**EC4**
0.90	0.932	155	155	155	155	155
0.80	0.899	154	154	154	154	154
0.70	0.866	154	154	154	154	154
0.60	0.832	153	149	153	153	146
0.50	0.799	153	147	153	153	143
0.40	0.766	153	145	150	148	139

Table 3b: The % TAC decrease (for the 2015 season) associated with the four EC rules and a range of possible CPUE(2014) values. Shaded cells show TAC reductions greater than 5%.

Tristan GLM CPUE 2014 season	I_{2014}^{rec}	**NO EC rule**	**EC1**	**EC2**	**EC3**	**EC4**
0.90	0.932	3.73	3.73	3.73	3.73	3.73
0.80	0.899	4.35	4.35	4.35	4.35	4.35
0.70	0.866	4.35	4.35	4.35	4.35	4.35
0.60	0.832	5.00	7.45	5.00	5.00	9.32
0.50	0.799	5.00	8.70	5.00	5.00	11.18
0.40	0.766	5.00	9.94	6.83	8.07	13.66

Table 4a: Expected TAC(2016) values for each of the four EC rules, assuming various possible values for Tristan CPUE in 2014 and 2015 season (where it is assumed CPUE is same for both seasons). I_{2015}^{rec} is the average of the 2013 (0.905), 2014 and 2015 CPUE values. Shaded cells show TAC reductions greater than 5%.

Tristan GLM CPUE 2014 and 2015 seasons	$\boldsymbol{I_{2015}^{rec}}$	**NO EC rule**	**EC1**	**EC2**	**EC3**	**EC4**
0.90	0.902	149	149	149	149	149
0.80	0.835	147	143	147	147	140
0.70	0.768	146	138	143	142	133
0.60	0.702	145	130	138	133	121
0.50	0.635	145	125	133	124	112
0.40	0.568	145	120	125	112	104

Table 4b: The % TAC decrease (for the 2016 season) associated with the four EC rules and a range of possible CPUE(2014+2015) values. Shaded cells show TAC reductions greater than 5%.

Tristan GLM CPUE 2014 and 2015 seasons	$\boldsymbol{I_{2015}^{rec}}$	**NO EC rule**	**EC1**	**EC2**	**EC3**	**EC4**
0.90	0.902	3.87	3.87	3.87	3.87	3.87
0.80	0.835	4.55	7.14	4.55	4.55	9.09
0.70	0.768	5.00	10.39	7.14	7.79	13.64
0.60	0.702	5.00	12.75	9.80	13.07	17.12
0.50	0.635	5.00	14.97	13.07	18.95	21.68
0.40	0.568	5.00	17.24	16.67	24.32	25.18

Figure 1a: **RC** median Bsp, TAC and CR trajectories for the OMP with NO EC, ZERO TAC and four EC candidates.

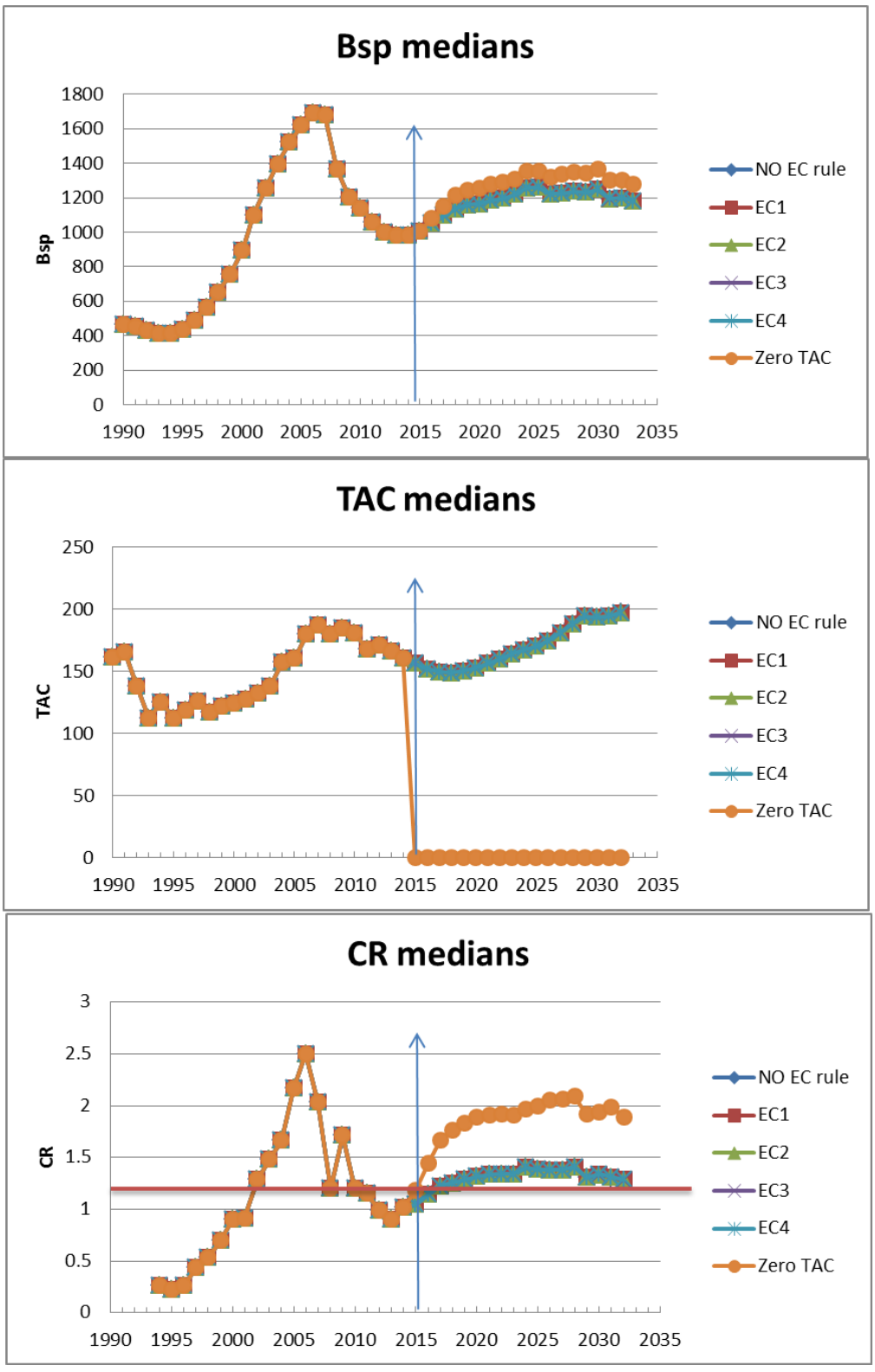


Figure 1b: ROB2 (60% lobster die at end of 2013) median Bsp, TAC and CR trajectories for the OMP with NO EC, and four EC candidates.

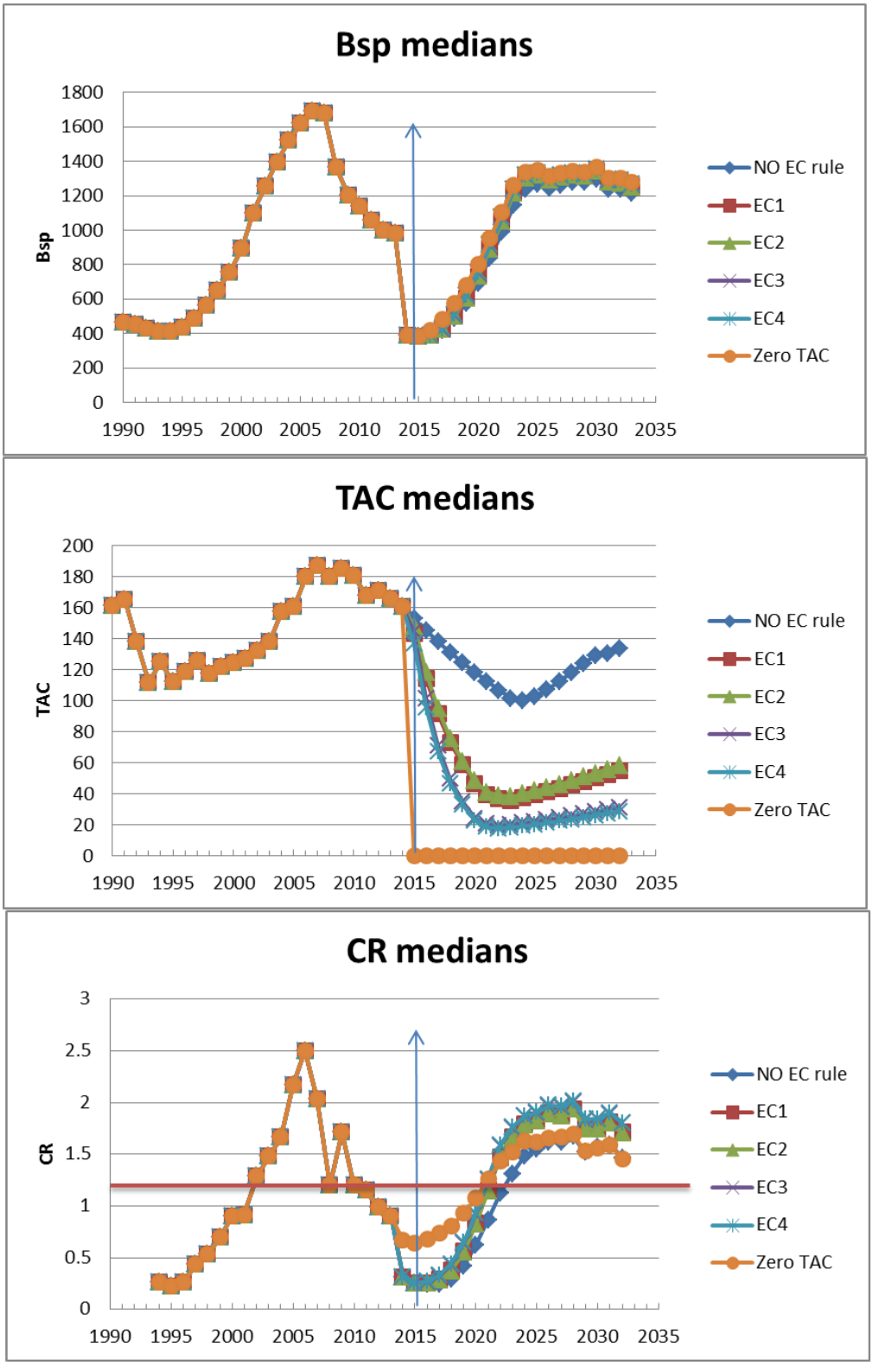


Figure 1c: ROB2 (recruitment drops 50% of current level from 2006 then recovers to normal in **2020**) median Bsp, TAC and CR trajectories for the OMP with NO EC, ZERO TAC and four EC candidates.

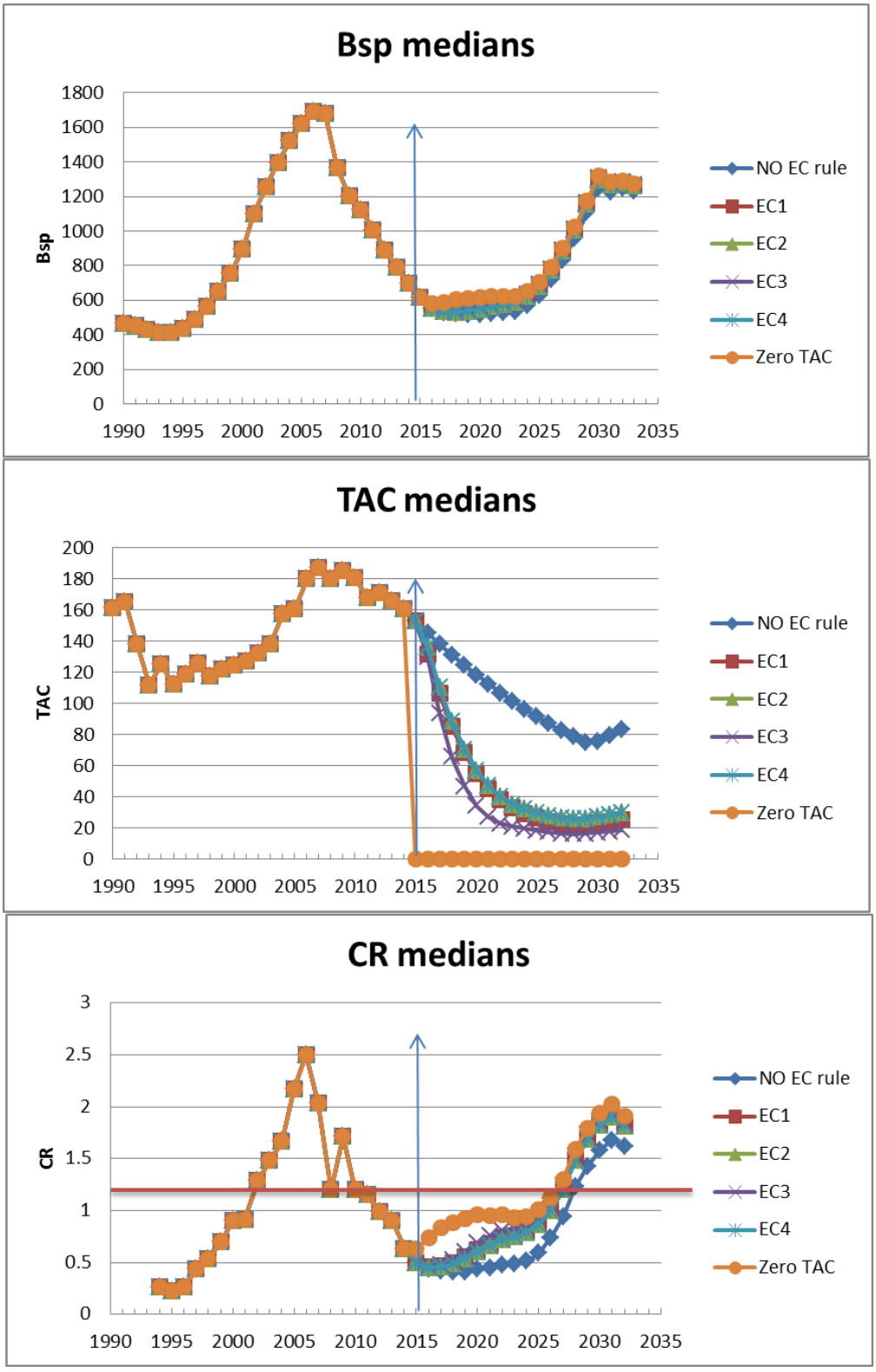


Figure 1d: ROB3 (recruitment drops 50% of current level from 2006 then recovers to normal in **2015**) median Bsp, TAC and CR trajectories for the OMP with NO EC, ZERO TAC and four EC candidates.

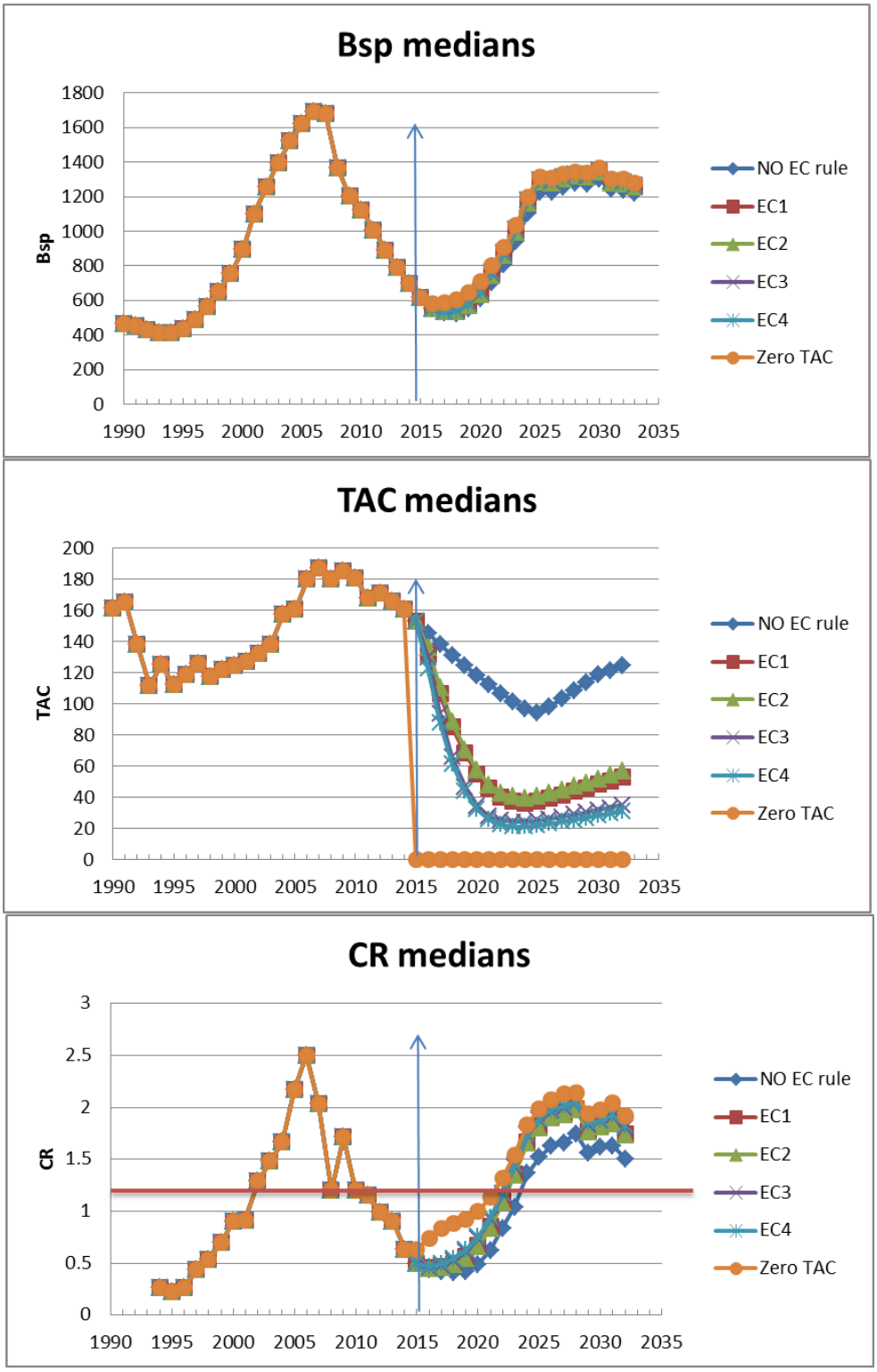


Figure 2: Plots of CPUE and I_{rec} (top plots) for a range of either 0.60, 0.50 or 0.40 assumed for the 2014 and 2015 CPUE at Tristan, and the resultant TACs for a range of EC rules (bottom plots). Note that for clearer distinction in the lower plots, the horizontal axis is for a TAC from 100 MT rather than zero.