

INITIAL UPDATED 2018 OMPs FOR THE INACCESSIBLE AND GOUGH ISLANDS

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ABSTRACT

This document first examines how well the models used to choose the 2014 OMPs for these two islands performed in projecting future CPUE values. Generally the subsequent CPUEs were higher than projected in 2014, suggesting that the productivity for these islands was underestimated earlier. Potential revisions for those OMPs are evaluated, based on updated assessments of the two resources. Only a minor change is suggested to the OMP for Inaccessible, for which projections are very similar to those made in 2014. However, changes are needed for Gough, for which continuation of the current OMP would result in the resource being reduced well below the levels previously (i.e. in 2014) considered acceptable. For results more similar to those earlier ones, an increase in the I^{tar} target abundance value from the current 2.8 to 5.75 is recommended. This will result in some immediate decrease to the TAC. Further work on these OMPs to take account of biomass survey as well as CPUE data is planned, and could result in some further OMP refinements being put forward a year hence.

INTRODUCTION

OMP were developed and agreed upon for both Inaccessible and Gough islands in 2014, and used to set the TACs at these islands for the first time in that season and again for the following 2015-2017 seasons. Johnston and Butterworth (2014) provides details of these OMPs. For Inaccessible the “CMP3+metarule 2” was the final agreed OMP, and for Gough the “CMP20+metarule1”. Both these OMPs were target-based, with the TAC setting formula having the form:

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

where

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

I^{tar} is the CPUE target (4 for Inaccessible and 4.5 initially for Gough, dropping to 2.8 in 2017), and

α is the tuning parameter (2.5 for Inaccessible and 10 for Gough).

A rule to control the inter-season TAC variation was also applied. Normally the percentage TAC change relative to the previous season 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 $TAC_{y+1} = 1.05TAC_y$

However, in addition, an Exceptional Circumstances metarule for each of Inaccessible and Gough was to be applied under certain circumstances, where the 5% TAC decrease constraint was increased to as much as 20% if the (catch rate) index dropped below a threshold level. This metarule allows for the TAC to be reduced further than the usual maximum 5% decrease, as shown in Figure 1. For Inaccessible, a is currently set at 4 kg/trap, and for Gough a is set at 1.5 kg/trap.

GLMM analyses including the most recent (2017) season's CPUE longline data have recently been completed (Johnston *et al.* 2018). These analyses will provide the input data used in setting the TACs for the 2018 season for Inaccessible and Gough in conjunction with the new OMPs. Table 1 reports the values used in the calculation of the I_y^{rec} values.

How well have the 2014 OMPs performed with respect to their predictions regarding future TACs, Catch Rates and Bsp trend?

In 2014 at the time of the last OMP selection, predictions were made of how the OMP would perform in the future. These OMPs have now been used for a period of four seasons, so that it is possible to compare the 2014 OMP predictions with what has actually occurred in these fisheries.

Figure 2 shows the simulation results for Inaccessible under the selected OMP. Median, 5th and 95th percentiles are indicated with the arrow showing the start of the projection period. Results are shown for TACs and Catch Rates. Figure 3 shows similar plots for Gough. Note that catch rates have been higher than were previously projected, indicating that the productivity of these resources was previously underestimated.

DEVELOPMENT OF REVISED OMPS

The revised 2018 candidate OMPs (CMPs) presented here are essentially of the same format as those developed in 2014. CMP variants differ in terms of the CPUE target value (I^{tar}), the tuning parameter α , and the metarule “a” values.

Generation of future (2016+) stock-recruit residuals

The model estimates stock-recruit residuals for 1992-2015. Future values need to be generated for the CMP testing process. For 2016+ recruitment is set equal to its expected value given the fitted stock-recruit relationship; to provide mean unbiased results this is multiplied by lognormally distributed error. This relationship is:

$$R_y = \frac{\alpha B_y^{sp}}{\beta + B_y^{sp}} e^{\varepsilon_y - \sigma_R^2/2} \quad (2)$$

where $\varepsilon_y \sim N(0, \sigma_R^2)$ and $\sigma_R = 0.8$. This means that the expected recruitment is:

$$E[R_y] = \frac{\alpha B_y^{sp}}{\beta + B_y^{sp}}$$

However, given indications of some temporal auto-correlation in the stock recruit residuals, an AR(1) process is assumed. The associated auto-correlation s_R is estimated by:

$$s_R = \sum_{1992}^{2014} \hat{\varepsilon}_{y+1} \hat{\varepsilon}_y / \sum_{1992}^{2014} \hat{\varepsilon}_y^2 \quad (3)$$

Hence instead of generating the ε_y from $N(0, \sigma_R^2)$, we use

$$\varepsilon_{y+1}^s = s_R \varepsilon_y^s + \sqrt{1 - s_R^2} \eta_y^s \quad \eta_y^s \sim N(0, \sigma_R^2) \quad (4)$$

This equation is first applied for $y=2016$ to provide ε_{2016}^s with an input of $\varepsilon_{2015}^s = \hat{\varepsilon}_{2015}$, i.e. the value estimated in the assessment.

Generation of future (2017+) CPUE values

Future CPUE values need also to be generated for CMP testing. For each assessment model there is a model estimate for $CPUE_y$ for past years. Projected into the future, the model provides expected \hat{CPUE}_y values for each year. Future (2017+) CPUE values for simulation s are generated from:

$$CPUE_y^s = \hat{CPUE}_y^s \exp(\varepsilon_y^s) \quad \varepsilon_y^s \sim N(0, (\sigma_{CPUE})^2) \quad (5)$$

where the $\sigma_{CPU\bar{E}}$ value is as estimated in the corresponding assessment.

Summary statistics

A number of summary statistics have been developed in order to compare the trade-offs and performances of alternate revised CMPs. Again, these are very similar to those used for the previous selection of prior OMPs.

- CR(2032) = catch rate expected in 2032 (in kg/gear/hour) in terms of the standardised GLMM
- CR(2022) = catch rate expected in 2022 (in kg/gear/hour) in terms of the standardised GLMM
- $C_{ave\ 10}$ = average annual catch (in MT) over the next 10 years (2018¹-2027) although note for the previous OMP 2014 this 10 year average was over the 2014-2023 period
- V10 = average TAC change from the previous year over next 10 years (2018-2017) (expressed as a %)
- The $B_{sp}(2032)/K$ = the spawning biomass at the start of 2033 relative to the pristine level (K). The median and lower 5%ile values are reported.

Each candidate CMP was run for 100 simulations. The medians, and the 5th and 95th percentiles, of various management quantities of interest are reported.

Inaccessible CMPs

Results for the following Inaccessible CMPs are reported here (evaluated based on the updated 2018 assessment model):

(Current) OMP-2014: Results shown are as evaluated in 2014 using a baseline OM corresponding to the 2014 assessment at that time.

CMPI1-2018 (identical to current OMP-2014 but assessed using the updated 2018 operating model): $I^{tar}=4.0$; $\alpha = 10$; +5%, -5% maximum inter-annual TAC change constraint; metarule which sets “ a ” in Figure 1 at a value of 4.0.

¹ The split season is index by the first year, i.e. 2018 refers to the 2018/2019 season

CMPI2-2018: CMPI1 but metarule which sets “ a ” in Figure 1 at a value of **3.0**.

CMPI3-2018: CMPI1 but with $I^{tar}=5.0$.

Note that the “metarule” comes into play if the recent catch rate I_y^{rec} value drops below a threshold level. This metarule allows for the TAC to decrease further than the usual maximum 5% TAC decrease, as shown in Figure 1 below. Thus for CMPI1-2018 (identical to OMP-2014), the amount by which the interannual TAC may decrease annually is allowed to alter (increase) for any values of I_y^{rec} less than 4 kg/trap, whereas for CMPI2-2018, the metarule will apply only for I_y^{rec} values less than 3 kg/trap.

Gough CMPs

The current OMP-2014 for Gough has an I^{tar} value that started at 4.5 kg/trap in 2014 and decreased linearly to 2.8 kg/trap in 2017. James Glass (pers. comm.) has requested that new CMPs should explore an I^{tar} value of 4 kg/trap.

Results for the following candidate Gough CMPs are thus reported here (evaluated based on the updated 2018 assessment model):

(Current) OMP-2014: Results shown are as evaluated in 2014 using a baseline OM corresponding to the 2014 assessment at that time but assessed (and reported in 2014) using the 2014 assessment model, i.e. $I^{tar}=2.8$; $\alpha = 10$; +5%, -5% maximum inter-annual TAC change constraint; metarule “1” which sets “ a ” in Figure 1 at a value of 1.5 kg/trap.

CMPG1-2018 (identical to current OMP-2014 but assessed using the updated 2018 operating model): $I^{tar}=2.8$; $\alpha = 10$; +5%, -5% maximum inter-annual TAC change constraint; metarule which sets “ a ” in Figure 1 at a value of 1.5 kg/trap.

CMPG2-2018: CMPG1 but with $I^{tar}=4.0$, i.e. the value of I^{tar} is increased to the value requested by James Glass.

CMPG3-2018: CMPG1 but with $I^{tar}=5.0$.

CMPG4-2018: CMPG1 but with $I^{tar}=5.5$. and the metarule which sets “ a ” in Figure 1 at a value of **3.0** kg/trap.

CMPG5-2018: CMPG1 but with $I^{tar}=5.75$ and the metarule which sets “ a ” in Figure 1 at a value of **3.0** kg/trap.

CMPG6-2018: CMPG1 but with $I^{tar}=6.0$ and the metarule which sets “ a ” in Figure 1 at a value of **3.0** kg/trap.

Results

Inaccessible

Table 2 compares the expected performance statistics of the Inaccessible initial candidate OMPs. Results as computed in 2014 for the current OMP-2014 are reported in the top row. Figure 4 plots the medians, 5th and 95th percentile of the expected TACs, CRs and Bsp/K trajectories for CMPI2 on the left hand side. The right hand plots report the trajectories as computed in 2014 for the current OMP-2014.

Gough

Table 3 compares the expected performance statistics of the initial Gough candidate OMPs. Results as computed in 2014 for the current OMP-2014 are reported in the top row. Figure 5 plots the medians, 5th and 95th percentile of the expected TACs, CRs and Bsp/K trajectories for CMPG5 on the left hand side. The right hand plots report the trajectories as computed in 2014 for the current OMP-2014.

Discussion

Inaccessible

The projections for Inaccessible are hardly changed from those in 2014, which suggests no need for major changes to the OMP formulae. Only one minor modification is recommended: reducing the “ a ” value from 4 to 3 so that the metarule overriding the 5% maximum TAC change does not come into play immediately the aggregated catch rate drops below I^{tar} . Table 2 indicates that such a change would not have any noticeable impact on the future resource level. **Accordingly we recommend the adoption of CMPI2.**

Gough

The situation for Gough is not as satisfactory. Even if I^{tar} is increased to 4.0 (see CMPG2 in Table 3), both median and lower 5% levels for the resource projected for 15

years (to 2033) are well below what was considered acceptable in 2014 (see last column in Table 3). For better performance we advocate increasing I^{tar} further and also increasing the value of “ a ” below which TAC decreases of more than 5% are admitted. Table 3 and Figure 6 show results for some such possibilities. We consider that the choice should be made amongst CMPG4, 5 and 6. **We recommend CMPG5 with $I^{tar}=5.75$, noting from Figure 6 that this will result in some immediate TAC decrease.**

Future work

The recommendations above are intended to be interim, for this season only. We consider that these CMPs can be further improved by including the annual surveys as well as the CPUE results in the OMP computations. Especially for Gough, we anticipate that this will reduce the possibility of unintended depletion, and hence we will be pursuing work further with the intent of proposing refinements of these OMPs for implementation next year.

Reference

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

Table 1: The updated (2018) GLMM CPUE (kg/trap) series for Inaccessible and Gough to be used for the I_{2018}^{rec} calculations.

Season	Inaccessible	Gough
2015	5.915	7.453
2016	7.540	5.619
2017	8.245	3.277
Average (I_{2018}^{rec})	7.233	5.450

Figure 1: The metarule used as part of the OMPs.

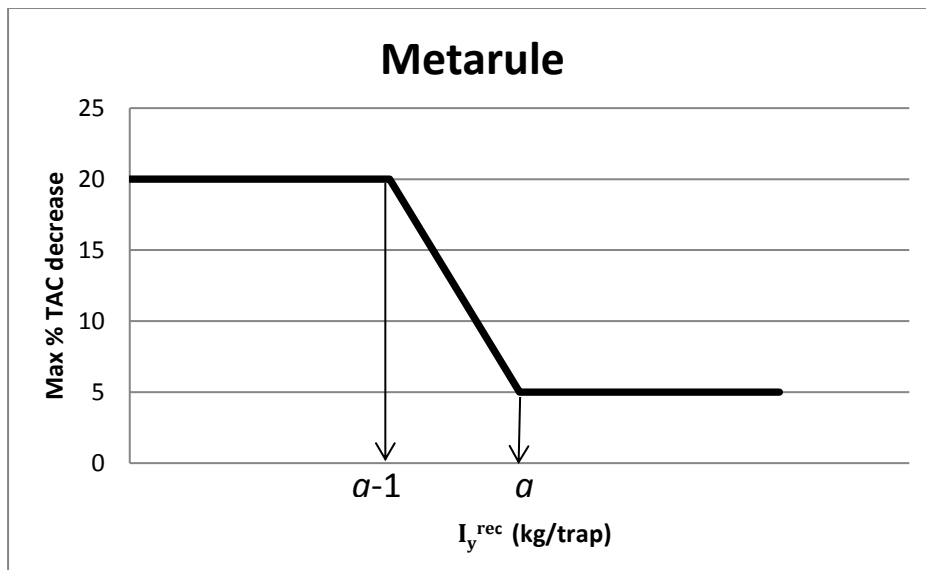


Table 2: Comparison of **Inaccessible** candidate OMPs expected performance results. All statistics reported below are median values unless otherwise stated. The OMP recommended, together with its results, is shown in **bold italics**.

CMP	I^{tar} (kg/trap)	α	Inter-annual maximum TAC constraint	Metarule “a” value	CR(2022) (kg/trap)	CR(2032) (kg/trap)	$C_{ave\ 10}$ (MT)	Lower 5%ile $C_{ave\ 10}$	V10 (%)	Median and Lower 5%ile $B_{sp}(2033/K)$
OMP-2014 (selected in 2014 using the 2014 assessment model)	4.0	2.5	+5%,-5 to -20%	4	5.62 [#]	4.51 [#]	84.46 [#]	78.20 [#]	3.44 [#]	0.91 [#] (0.56)
CMPI1-2018	4.0	2.5	+5%,-5 to -20%	4	5.96	4.75	110	107	4.25	0.86 (0.51)
<i>CMPI2-2018</i>	<i>4.0</i>	<i>2.5</i>	<i>+5%,-5 to -20%</i>	<i>3</i>	<i>5.96</i>	<i>4.75</i>	<i>110</i>	<i>107</i>	<i>4.25</i>	<i>0.86 (0.51)</i>
CMPI3-2018	5.0	2.5	+5%,-5 to -20%	4	5.97	5.03	104	99	2.99	0.87 (0.52)

[#] statistics given at the time of the OMP-2014 development relate to the 2014-2023 period. CR (Catch rate i.e. CPUE) values are in terms of the OLD standardised CPUE.

Table 3: Comparison of **Gough** candidate OMPs expected performance results. All statistics reported below are median values unless otherwise stated. The OMP recommended, together with its results, is shown in **bold italics**.

CMP	I^{tar} (kg/trap)	α	Inter-annual maximum TAC constraint	Metarule "a" value	CR(2022) (kg/trap)	CR(2032) (kg/trap)	C_{ave} 10 (MT)	Lower 5%ile C_{ave} 10	V10 (%)	Median and Lower 5%ile $Bsp(2033/K)$
OMP-2014 (selected in 2014 using the 2014 assessment model)	4.50-2.80	10	+5%,-5 to -20%	1.5	2.71 [#]	2.47 [#]	100.44 [#]	90.22 [#]	3.19 [#]	0.69 [#] (0.39)
CMPG1-2018	2.8	10	+5%,-5 to -20%	1.5	2.69	2.05	135	130	3.14	0.40 (0.23)
CMPG2-2018	4.0	10	+5%,-5 to -20%	1.5	3.28	3.35	105	103	4.32	0.56 (0.27)
CMPG3-2018	5.0	10	+5%,-5 to -20%	1.5	3.58	3.87	97	97	4.89	0.62 (0.31)
CMPG4-2018	5.5	10	+5%,-5 to -20%	3.0	3.72	4.07	93	93	4.54	0.64 (0.32)
<i>CMPG5-2018</i>	<i>5.75</i>	<i>10</i>	<i>+5%,-5 to -20%</i>	<i>3.0</i>	<i>3.79</i>	<i>4.21</i>	<i>100</i>	<i>100</i>	<i>4.76</i>	<i>0.65 (0.33)</i>
CMPG6-2018	6.0	10	+5%,-5 to -20%	3.0	3.86	4.28	89	89	4.97	0.66 (0.33)

[#] statistics given at the time of the OMP-2014 development relate to the 2014-2023 period, CR (Catch rate i.e. CPUE) values are in terms of the OLD standardised CPUE.

Figure 2: Inaccessible simulation results from 2014 projecting under OMP-2014 selected at that time for the baseline operating model. Median, 5th and 95th percentiles are indicated with the arrow showing the start of the projection period. The red squares show subsequent reality.

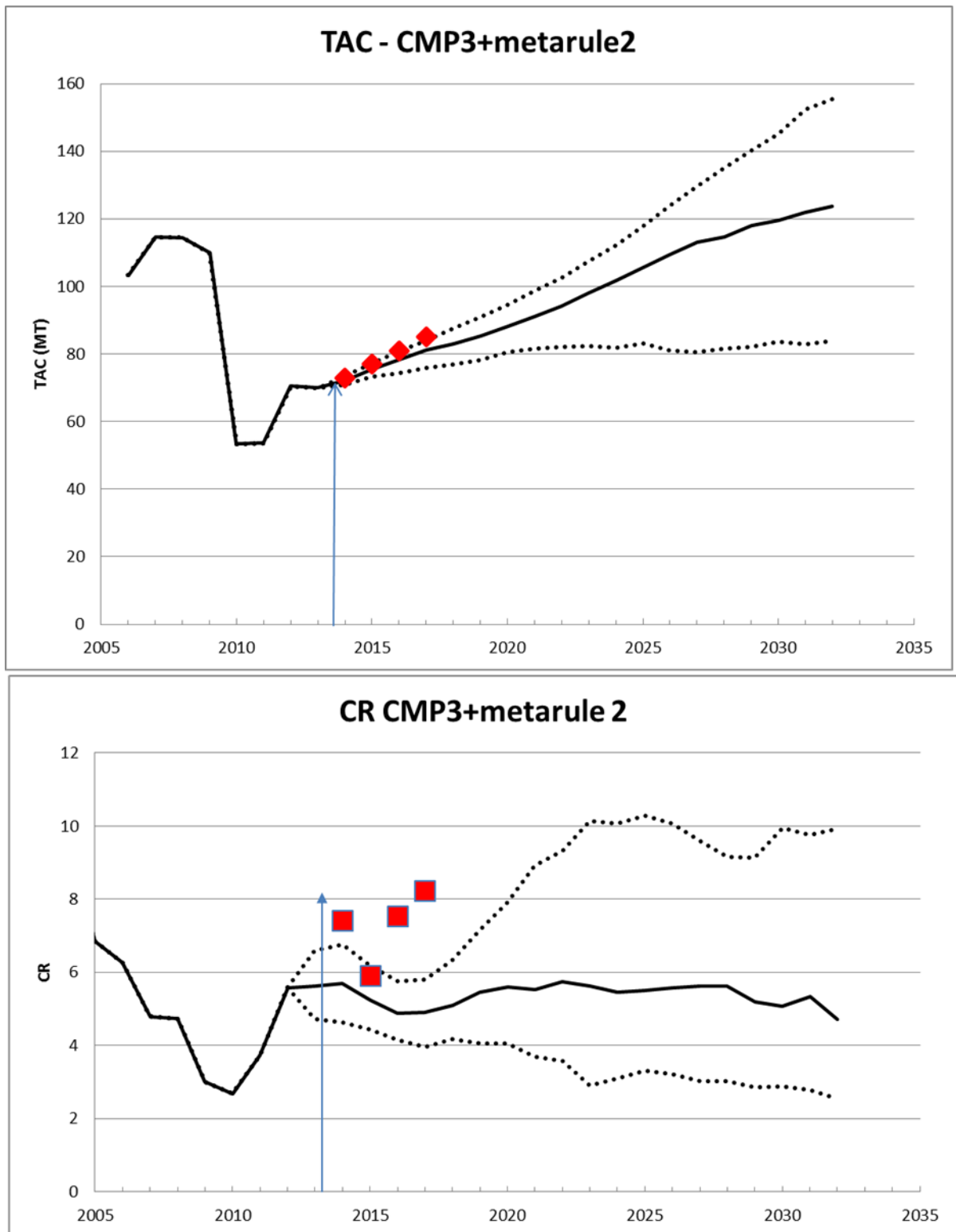


Figure 3: Gough simulation results from 2014 projecting under OMP-2014 selected at that time for the baseline operating model. Median, 5th and 95th percentiles are indicated with the arrow showing the start of the projection period. The red squares show subsequent reality.

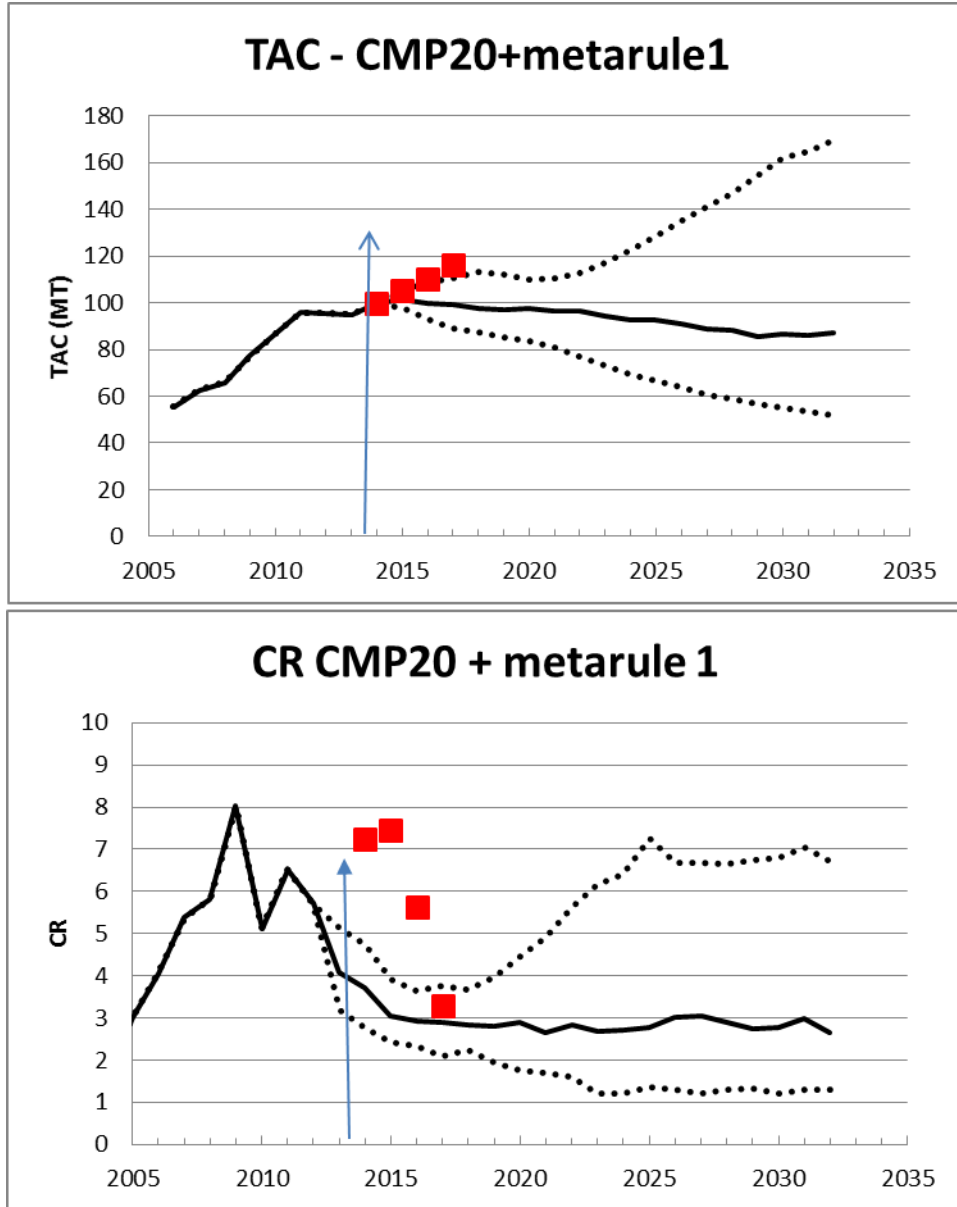


Figure 4: Inaccessible 2018 simulation results for **CMPI2-2018** (LHS). The right hand plots are the current OMP-2014 (as evaluated and finally selected in 2014).

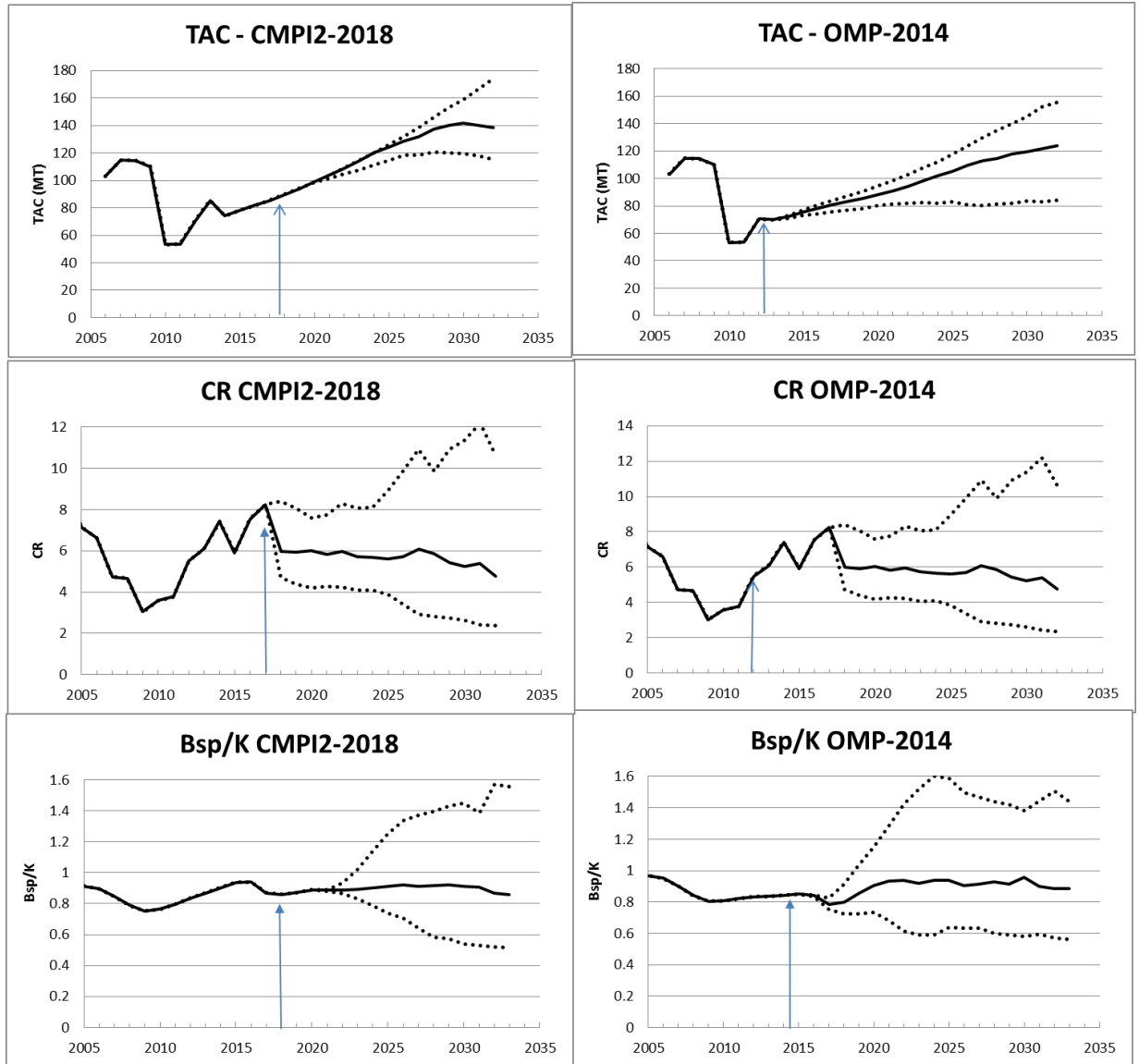


Figure 5: Gough 2018 simulation results for **CMPG5-2018** (i.e. Itar=5.75 kg/trap) (LHS). The right hand plots are the current OMP-2014 (as evaluated and finally selected in 2014).

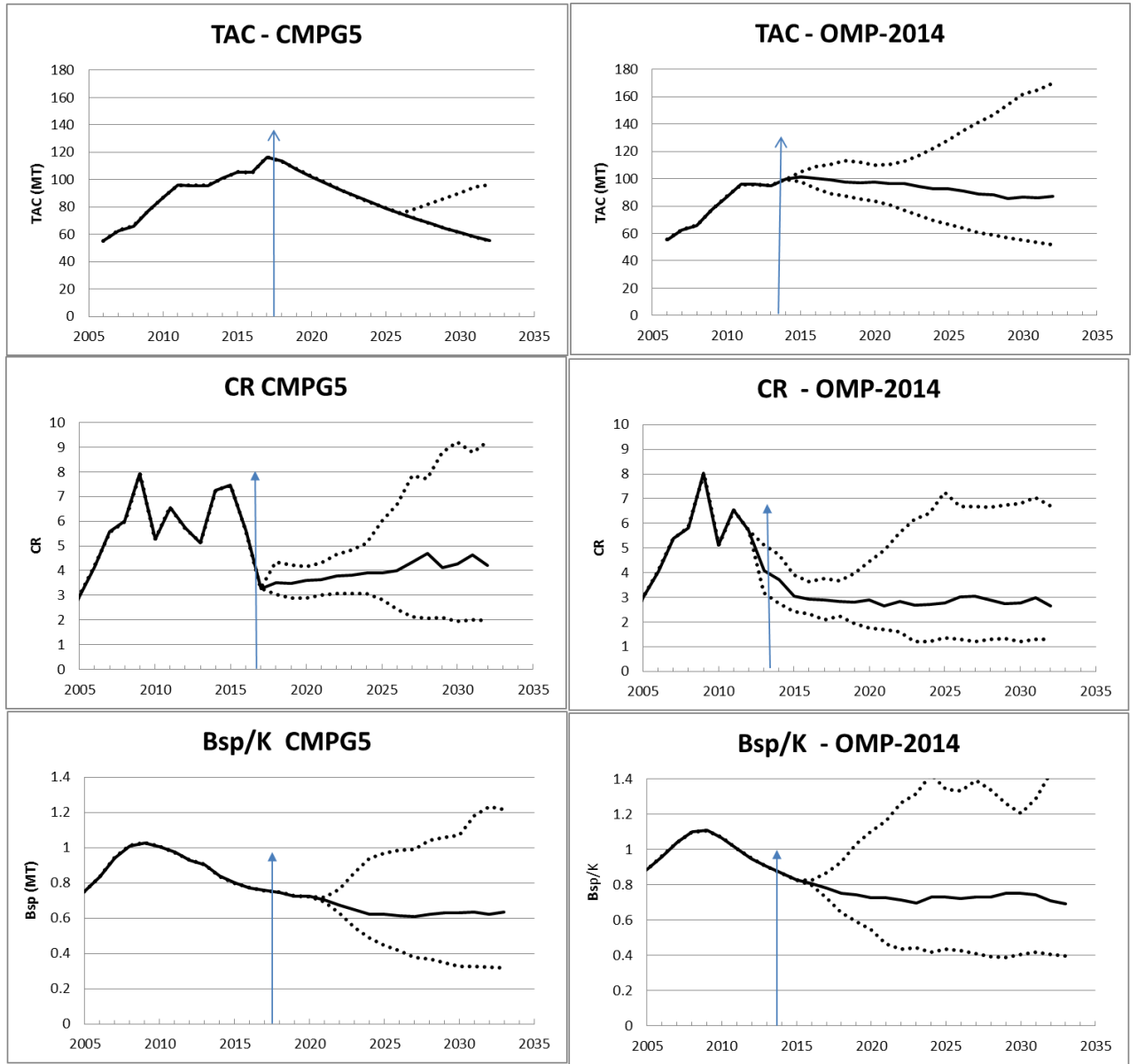


Figure 6: Gough 2018 median simulation results for **CMPG2-2018** (Itar=4, “a”=1.5), **CMPG4-2018** (Itar=5.5, “a”=3), **CMPG5-2018** (Itar=5.75, “a”=3) and **CMPG6-2018** (Itar=6, “a”=3).

