RECOMMENDATIONS ON ROCK LOBSTER TACs FOR THE TRISTAN GROUP OF ISLANDS FOR THE 2015/16[1] SEASON

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Executive Summary

OMPs have recently been accepted as the basis to recommend TACs for Inaccessible and Gough islands. Given that for Inaccessible and Gough the recent catch rates have been above the associated OMP's target catch rate, the OMPs indicate increases to the TACs for both islands for the 2015 season:

Inaccessible: 73 MT to **77** MT
Gough: 100 MT to **105** MT

High catch rates continue at Nightingale, with the reasons for these remaining unclear. However, the possible negative impact on recruitment of the OLIVA oil spill is still to be felt in the fishery as those recruits have still to reach catchable size. Nevertheless projections are very positive in the longer term even with a future TAC of 75 MT, so that an increased TAC for the 2015 season is recommended:

Nightingale: 65 MT to **75** MT

A possible alternative and more precautionary approach would be to set the TAC at 65 MT when this season starts, with an increase to be considered in November based on decision rules (which would need to be developed) which will take the 2015 biomass survey and initial CPUE results into account.

The Tristan CPUE for 2014 is below the range anticipated in the testing of the OMP for that island, which leads to the recommendation to augment that OMP by an Exceptional Circumstances metarule, for which a specific suggestion is made. Under these provisions the extended OMP leads to a decrease in the TAC recommendation for the 2015 season:

Tristan 161 MT to **153** MT

This reduction follows given the value for the standardized powerboat CPUE for 2014; this reflects a drop compared to 2013, but in contrast both the Edinburgh CPUE and the biomass survey show increases from 2013 to 2014. However, unless powerboat CPUE increases dramatically in the near future, substantial reductions in the Tristan TAC recommendations are to be expected for the 2016 and 2017 seasons.

As with Nightingale, a possibility if a more conservative approach is desired would be to set the TAC at a lower value than 153 MT when the season starts, with a review to be considered in November in the light both of further consideration of pertinent analyses, and/or of the further biomass survey and initial CPUE data available at that time. This would, however, require more substantial revision of the Tristan OMP in the interim.

[1] The convention used here is that the split season (eg 2015/16) is referred to as the "2015" season.

Inaccessible and Gough

Introduction

OMPs have recently been developed and agreed upon for both Inaccessible and Gough islands and used to set the TACs at these islands for the first time for the 2014 season. Johnston and Butterworth (2014a) provides details of these OMPs. For Inaccessible the "CMP3+metarule 2" is the final agreed OMP, and for Gough it is the "CMP20+metarule1". Both these OMPs are target-based, with the TAC setting formula being of the form:

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

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 (4 for Inaccessible and 4.5 initially for Gough, dropping to 2.8 in 2017), and

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

A rule to control the inter-annual TAC variation is also applied. Normally the percentage 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 $TAC_{y+1} = 0.95TAC_y$ (2)

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

However, in addition an Exceptional Circumstances metarule for both Inaccessible and Gough is applied under certain circumstances, where the 5% TAC decrease constraint is increased to up to 20% if the (catch rate) index drops 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, *α* is set at 4 kg/trap, and for Gough *α* is set at 1.5 kg/trap.

GLM analyses including the most recent (2014) season's CPUE longline data have recently been completed (Johnston, Butterworth and Brandao 2015). These analyses provide the input data used in setting the TACs for the 2015 season for Inaccessible and Gough. Table 1 reports the values used in the calculation of the I_y^{rec} values.

Inaccessible TAC for 2015

The calculation of the 2015 TAC for Inaccessible is as follows:

$$TAC_{2015} = TAC_{2014} + \alpha(I_{2014}^{rec} - I^{tar})$$

$$TAC_{2015} = TAC_{2014} + 2.5(I_{2014}^{rec} - 4)$$

$$TAC_{2015} = 73 + 2.5(6.293 - 4)$$

$$TAC_{2015} = 78.73\ MT$$

This TAC value is greater than the maximum 5% deviation from the previous TAC (73 MT), thus the final TAC recommended for Inaccessible for the 2015 season is 73*1.05=76.65 rounded to **77 MT.** The I_{2014}^{rec} value of 6.293 does not fall below the metarule threshold level (4 kg/trap), so that the final TAC recommended for Inaccessible for 2015 is **77 MT.**

Gough TAC for 2015

The calculation of the 2015 TAC for Gough is similar, and as follows:

$$TAC_{2015} = TAC_{2014} + \alpha(I_{2014}^{rec} - I^{tar})$$

$$TAC_{2015} = TAC_{2014} + 10(I_{2014}^{rec} - 3.93)$$

$$TAC_{2015} = 100 + 10(5.885 - 3.93)$$

$$TAC_{2015} = 119.55\ MT$$

This TAC value is greater than the maximim 5% increase from the previous TAC (100 MT), thus this TAC is adjusted to equal a 5% increase over the 100 MT, which is 105 MT. The I_{2014}^{rec} value of 5.885 does not fall below the metarule threshold level (1.5 kg/trap), so that the final TAC recommended for Gough for 2014 is **105 MT.**

Nightingale

Introduction

For the previous two year's TAC advice for Nightingale, it was pointed out that the situation at Nightingale was unclear given the unexpectedly high CPUE that had been experienced over the immediately preceding season. The need to check how these CPUEs might change over the immediate future before adjusting the TAC was stressed. The hope was that the reasons for these high values would become more evident and hence allow a reliable assessment to be conducted. For 2013, the advice given was to set a PUCL (Precautionary Upper Catch Limit) of 40 MT, which was to be increased during the season on the basis of a comparison of the catch rates achieved to those from immediately before the OLIVA incident. Specific rules were pre-set to govern the increase to be permitted. In the event the catch rates achieved were such as allowed to maximum increase permitted by those rules, which was to 65 MT.

The final TAC for 2014 was set at 65 MT, given the continued high catch rates during that season.

Nightingale TAC for 2015

Table 2 and Figure 2 compare the nominal catch rates achieved at Nightingale over the last three seasons with those immediately before the OLIVA incident (March 2011) as well as the biomass survey abundance indices since 2009 and the GLM standardized CPUE which include the most recent two seasons. As was seen in the 2012 and 2013 seasons, the 2014 CPUE is much higher than was the case before the incident and the survey result is also higher. The

reasons for this remain unclear. In these circumstances, the development of an OMP for Nightingale remains premature. Given the continued very high catch rates, there would hardly be any justification for a 2014 season TAC of less than 65 MT. On the other hand, if the OLIVA oil spill did indeed impact recruitment negatively, that impact is still to be felt in the fishery because of the time needed for those lobsters to grow to catchable size. The biomass survey index values for Nightingale for the recent two seasons are also high (Johnston and Butterworth 2015b). Furthermore, the Nightingale assessment has recently been updated (Johnston and Butterworth 2015c). Using the updated assessment, projections at both future CC of 65 MT and 75 MT have been examined. Results (see Figure 3) show that that neither of these two possible TACs would pose any threat to the sustainability of the Nightingale resource, with fast recovery in the longer term indicated in both cases.

Given that recent CPUE values are well above the five year average of 5.2 kg/trap over the period immediately preceding the OLIVA incident (Figure 4a), together with recent high survey results (Figure 4b) and the updated assessment, there appears no reason not to recommend an increase in the Nightingale TAC for 2015 from 65 MT to **75 MT**.

An alternative, if greater caution is seen to be needed, is that the TAC could be set at 65 MT at the start of the 2015 season, with rules then developed to provide for a possible increase to be recommended in November on the basis of the then recent biomass survey and initial CPUE results.

Tristan

Introduction

TAC advice from OMPs should be reconsidered if new monitoring data fall outside the range anticipated when the OMP was tested. Figure 5 (from Johnston and Butterworth 2013) shows the anticipated envelope for future powerboat CPUE values. The Tristan powerboat GLM standardization has been updated to take most recent season's catch and effort data into account (see Johnston and Butterworth 2015a) and yields a value of 0.650 kg/hour/gear[2] for 2014; this value is clearly below the envelope in Figure 5, so that the OMP cannot continue to be applied without incorporating some Exceptional Circumstances provisions and taking them into account.

Four different Exceptional Circumstance (EC) metarules for consideration as additions to the current OMP for the Tristan Island rock lobster fishery were presented in Johnston and Butterworth (2015d). At the time, whilst having some knowledge of the low catch rates of the current season, the final GLM standardized CPUE for the 2014 season was not available.

Now that this value is known to be 0.65 kg/hour/gear, this document is able to provide the associated TACs for the next three seasons (2015, 2016 and 2017) taking this most recent CPUE value into account, and assuming that the CPUE for the following two seasons (2016 and 2017) will in the range of 0.40 – 0.90 kg/hour/gear. To generate these anticipated TAC values for Tristan the current OMP was used either without an EC rule, or with rules EC1, EC2, EC3 or EC4 (as described in MARAM/TRISTAN/2015/MAR/03). It should be noted that all of the four EC rules showed adequate performance under the quite severe robustness tests considered in Johnston and Butterworth (2015d).

[2] For Tristan powerboat catches, both traps and hoopnets are used, thus the units for CPUE are in terms of "hour/gear".

The current OMP

To recap, the current OMP for Tristan (without any EC rules) is a target-based rule based on the recent commercial CPUE, *viz.:*

$$TAC_{y+1} = TAC_y + \alpha(I_y^{rec} - I^{tar}) \quad (4)$$

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 kg/hour/gear (the average GLM standardised 2010-2012 CPUE at the time of the OMP development), 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 $TAC_{y+1} = 0.95TAC_y$ (5)

If $TAC_{y+1} > 1.05TAC_y$ then $TAC_{y+1} = 1.05TAC_y$ (6)

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 Metarule development for Tristan

If the recent catch rate I_y^{rec} value drops below a threshold level, the TAC may be decreased further than the usual maximum 5% TAC decrease. Figure 6 shows how the maximum percentage the TAC may be reduced from year to year changes from the default of 5% to a value of "maxD", depending on the value of I_y^{rec}.

The four different EC rules (EC1-EC4) which have been proposed vary depending on the I_y^{rec} level below which the EC rule comes into play. Two alternate values of "maxD" are also explored – either 20% or 30%. Table 4 provides these EC rule specifications.

Note that TAC (2015) depends on I_{2014}^{rec}, which in turn is the average of the GLM standardized CPUE values over the 2012, 2013 and 2014 period – a value now known to be 0.858 kg/hour/gear (the average of 1.004, 0.919 and 0.650).

Further EC rule output

Table 5 reports the expected TAC (2015), TAC(2016) and TAC (2017) values respectively for each of the four EC rules, assuming various possible values for Tristan CPUE for the 2015 and 2016 seasons (where it is assumed that the CPUE is same for both seasons). CPUE values for these two years ranging from 0.90 to 0.40 are reported. The known CPUE value of 0.65 for the recently completed 2014 season is taken into account. Note that given this CPUE value, the basic OMP equation (4) indicates a TAC reduction of 4.7%. It is because this value is less than 5% that the EC proposed rules make no difference for the 2015 season, but come into play for the following seasons.

Table 6 reports TAC (2017) percentage decrease compared with the current TAC of 161 MT for each of the four EC rules, assuming various possible values for Tristan CPUE for the 2015 and 2016 seasons as in Table 5. Table 6 shows, for example, that if the low CPUE of 0.65 kg/hour/gear were to persist for a further two seasons, the TAC by 2017 would be reduced by 36% (compared with the current 161 MT) if the EC4 rule was adopted, whereas is no EC rule were to be adopted, this TAC decrease would be only some 14% by the 2017 season.

Figures 7a and b show some plots of CPUE (and resultant I^{rec}) values for the different CPUE scenarios examined (top plots), with the associated TACs shown in the bottom plots. Results shown in Figure 7a are for future CPUE 2015 and 2016 of 0.90, 0.80 or 0.70, while Figure 7b shows results for future CPUEs of 0.60, 0.50 or 0.40.

Tristan TAC for 2015

For the reasons set out above, it is strongly recommended that agreement be reached on an Exceptional Circumstances metarule to be added to the agreed Tristan OMP (which will render this similar to the OMPs agreed to Inaccessible and Gough). In our view, the EC2 metarule is adequate, as it showed satisfactory long term performance under the quite extreme robustness tests considered in Johnston and Butterworth (2015d), though a more conservative option might also be considered.

Irrespective of which metarule is chosen, however, the TAC for 2015 under the OMP would be 153 MT (a 4.7% decrease). The EC provisions would come into play only for 2016, giving decreases greater than 5% unless a considerably improved CPUE materializes for the 2015 season.

A decrease in TAC limited to 4.7% might seem unexpected given the low powerboat CPUE for 2014, which reflects a continuation of a recent generally downward trend. However, the OMP has been designed to also take industrial stability into account, so that it is based on 3-year average values to try to avoid TAC changes that are a response to fluctuations in the data rather than signals of resource trend and hence unnecessarily large. Indeed, Figure 8 shows that while the standardized powerboat CPUE dropped from 2013 to 2014, both the Edinburgh CPUE and the biomass survey results show increases from 2013 to 2014, and paint a somewhat less pessimistic picture than does the powerboat CPUE.

Taking the above into account, it is recommended that:

a) the TAC for Tristan for 2015 be reduced from 161 MT to **153** MT in line with the agreed OMP; and
b) the OMP be augmented by the EC2 Exceptional Circumstances metarule.

Further commentary providing support for this approach may be found in Anon (2015).

Note that unless the powerboat CPUE increases dramatically for the 2015 and 2016 seasons, substantial TAC reductions are to be expected for both the 2016 and the 2017 seasons under these provisions.

Similarly to Nightingale, a possibility if a more conservative approach is desired would be to set the TAC at a lower value than 153 MT when the 2015 season starts, with rules developed in the interim to provide a basis to consider a review in November in the light both of further consideration of pertinent analyses, and/or of the further biomass survey and initial CPUE data which will be available at that time. This would, however, require fairly substantial further analyses, as simply adding an *ad hoc* additional TAC decrease for 2015 to the existing OMP will not provide an adequate basis for longer term resource management. The reasons are first that an Exceptional Circumstances metarule will still be required to deal with the possibility that extremely negative resource conditions occur in the future. Secondly provisions will need to be made for the possibility of increasing the TAC at more than 5% a year following the *ad hoc* TAC decrease, so that if future resource monitoring data indicate recent powerboat CPUE values to have reflected only downward fluctuations in catchability and hence the *ad hoc* TAC decrease to have been unnecessary, the TAC could be increased back towards current levels more speedily so as not to waste the resource. Further simulations will be needed to test the resultant revised OMP.

References

Anon. 2015. Document forwarded by A James to J Glass on 18 June 2015 containing replies to the latter's responses to a series on questions regarding the Tristan island rock lobster resource. 17 pp.

Butterworth, D.S. and Johnston, S.J. 2013. Recommendation regarding a within-season amendment of the TAC for Nightingale for the 2013/14 fishing season. MARAM document, MARAM/TRISTAN/2013/AUG/11.

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

Johnston, S.J. and D.S. Butterworth. 2014b. The TAC for Tristan da Cunha island rock lobster for the 2014 season as calculated using the current OMP. MARAM document, MARAM/TRISTAN/2014/JUN/09.

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

Johnston, S.J., Brandao, A. and D.S. Butterworth. 2015b. Final Tristan Biomass survey Leg1 results including data from the 2014 season. MARAM document, MARAM/TRISTAN/2015/MAY/04.

Johnston, S.J., and Butterworth, D.S. 2015c. Updated 2015 Nightingale rock lobster assessment. MARAM document, MARAM/TRISTAN/2015/MAY/07.

Johnston, S.J. and Butterworth, D.S. 2015d. Initial Tristan island Exceptional Circumstances rule development. MARAM document, MARAM/TRISTAN/2015/MAY/03.

Table 1: The updated (2015) GLMM CPUE (kg/trap) for Inaccessible and Gough to be used for the I_{2014}^{rec} calculations.

Season	Inaccessible	Gough
2012	5.478	5.819
2013	5.826	4.825
2014	7.575	7.011
Average (I_{2014}^{rec})	**6.293**	**5.885**

Table 2: Recent nominal CPUE and 2015 updated GLM CPUE values for the longline fishery and biomass survey results for Nightingale.

Season	Nominal longline CPUE	2015 GLM CPUE	Biomass survey (Leg1) indices
2008	4.827	4.062	
2009	4.237	4.058	16.31
2010	4.862	3.802	14.00
2011*	-	-	4.63
2012	9.62	-	18.10
2013	13.42	13.811	23.50
2014	10.94	11.589	30.92

*The OLIVA incident occurred March 2011

Table 3: The Nightingale monthly nominal CPUE's (in kg/trap) over 2008-2014.

	2008	**2009**	**2010**	**2008-10 average**	**2013**	**2014**
September	3.18	4.52	4.00	3.90	14.24	8.42
October	4.39	3.24	4.21	3.95	11.88	10.68
November (2008-2013) **December 2014**	4.05	4.95	2.56	3.85	15.23	18.12

Table 4: Tristan EC rule specifications (see Figure 6 for definition of symbols).

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%

Table 5: Expected TAC (2015), TAC (2016) and TAC (2017) values respectively for each of the four EC rules (and the absence of such a rule), assuming various possible values for Tristan CPUE for the 2015 and 2016 seasons (where it is assumed CPUE is same for both these seasons). CPUE values for these two years ranging from 0.90 to 0.40 are reported. The observed CPUE value of 0.65 for the recent 2014 season is taken into account.

CPUE assumed for 2015 and 2016	**NO EC rule**			**EC1**			**EC2**			**EC3**			**EC4**		
	2015	**2016**	**2017**	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
0.90	153	146	138	153	141	130	153	146	138	153	146	138	153	138	124
0.80	153	146	138	153	139	125	153	145	134	153	144	131	153	135	116
0.70	153	146	138	153	137	119	153	142	127	153	140	119	153	132	107
0.60	153	146	138	153	136	114	153	140	120	153	136	108	153	119	99
0.50	153	146	138	153	134	109	153	137	113	153	132	198	153	126	92
0.40	153	146	138	153	132	105	153	135	108	153	117	89	153	122	86

Table 6: TAC (2017) percentage decrease compared with the current TAC of 161 for each of the four EC rules (and the absence of such a rule), assuming various possible values for Tristan CPUE for the 2015 and 2016 seasons (where it is assumed CPUE is same for both these seasons). The case where the current CPUE value is maintained for the next two seasons is bolded.

CPUE assumed for 2015 and 2016	**NO EC rule**	**EC1**	**EC2**	**EC3**	**EC4**
0.90	14.3	19.3	14.3	14.3	23.0
0.80	14.3	22.4	16.8	18.6	28.0
0.70	14.3	26.1	21.1	26.1	33.5
0.65	**14.3**	**27.7**	**23.3**	**29.5**	**36.0**
0.60	14.3	29.2	25.5	32.9	38.5
0.50	14.3	32.3	29.8	39.1	42.9
0.40	14.3	34.8	32.9	44.7	46.6

Figure 1: The Exceptional Circumstances metarule implemented for Inaccessible and Gough.

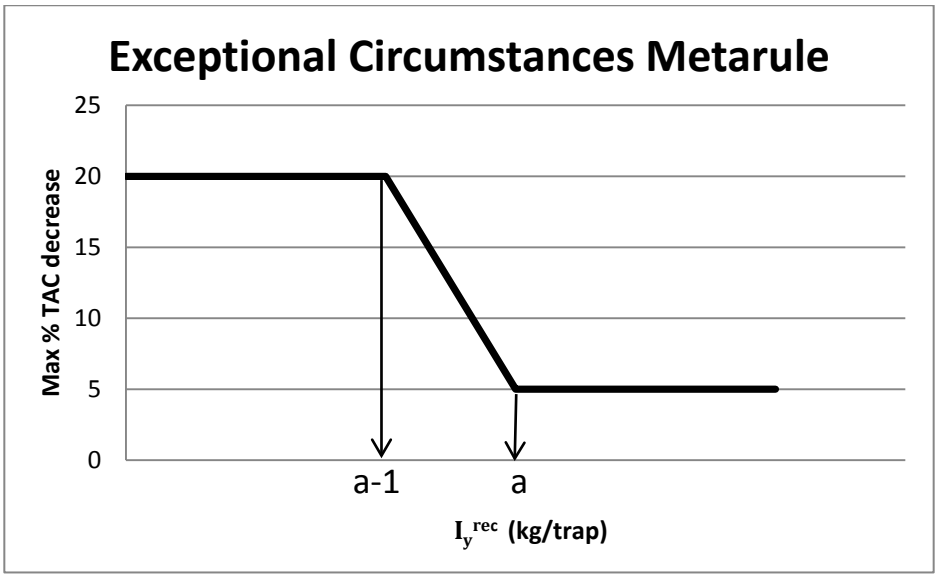

Figure 2: Recent nominal CPUE and 2015 updated GLM CPUE values for the longline fishery and biomass survey results for Nightingale.

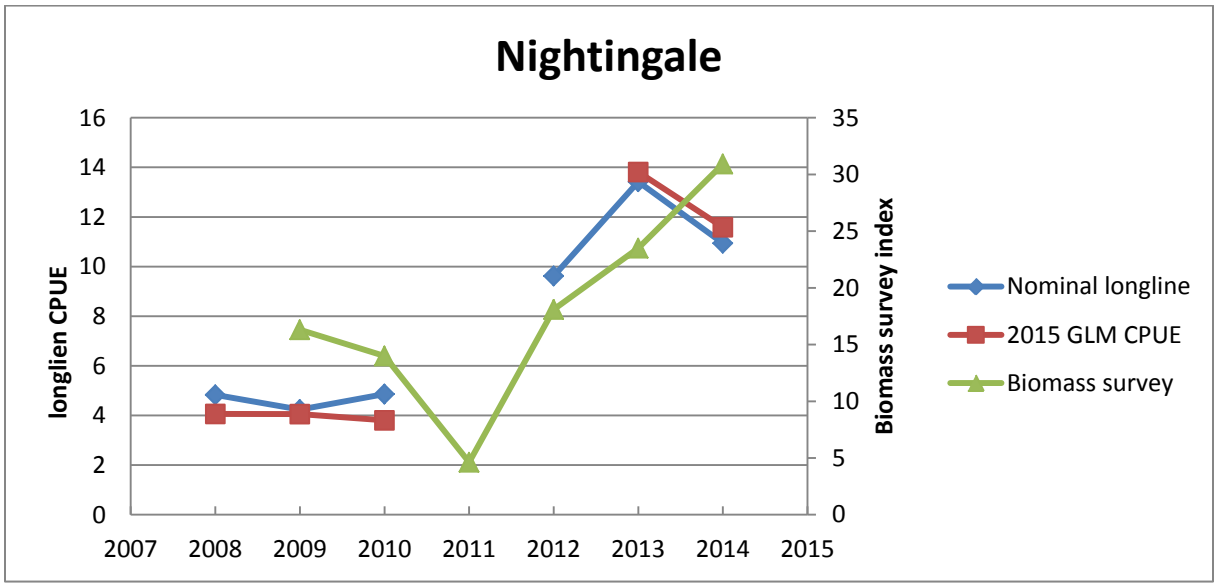

Figure 3: : **RC** projections of the Nightingale resource into the future for levels of constant catch CC=65 MT and CC= 75 MT (see MARAM/TRISTAN/2015/MAY/07). The top plot shows the different catch levels (compared to levels since 1990), the middle plot shows the past and predicted catch rates (CR), and the bottom plot shows the *Bsp/K* ratio.

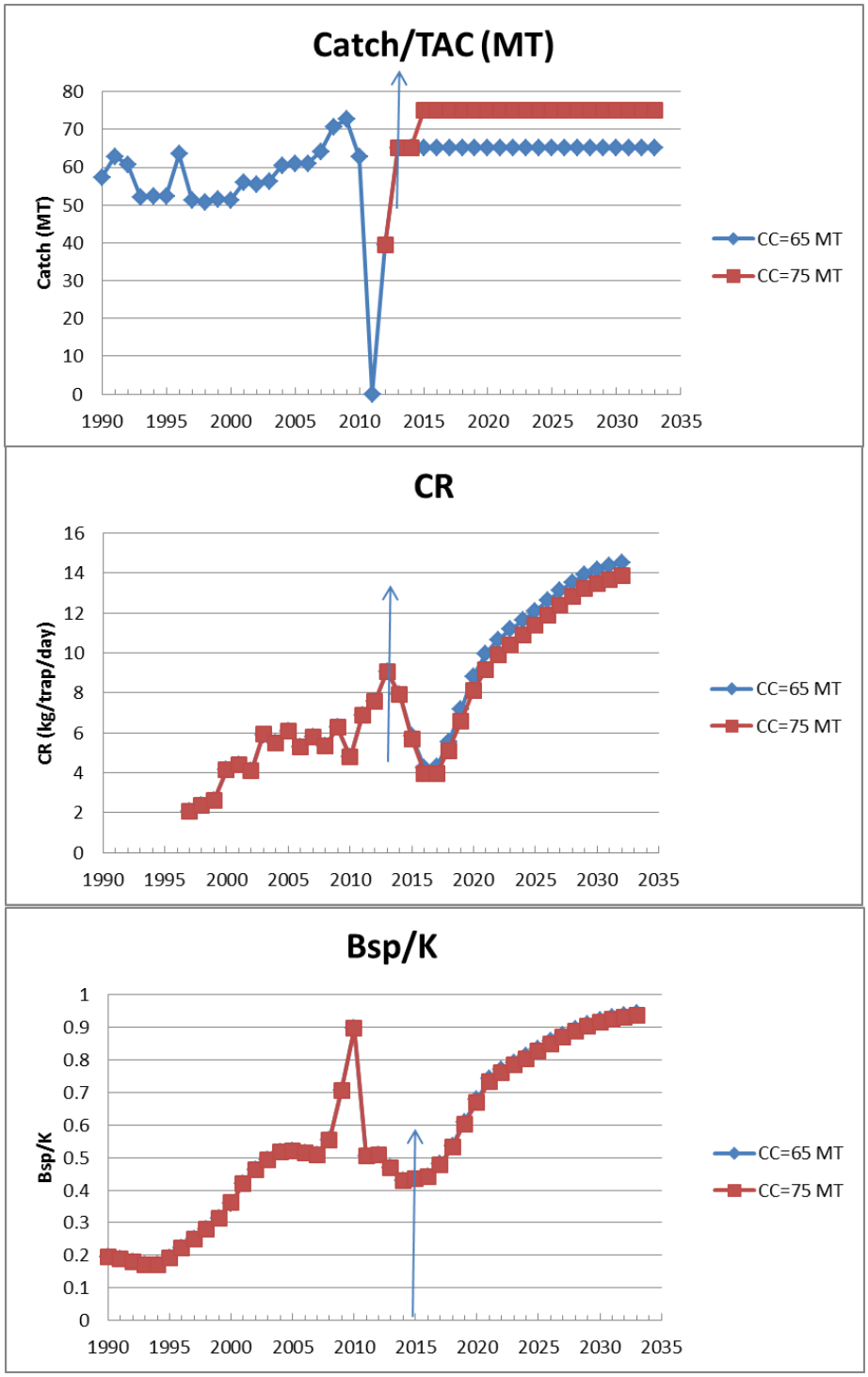

Figure 4a: Nightingale nominal CPUE values. The red horizontal line shows the last five year average immediately prior to the OLIVA incident (5.2 kg/trap).

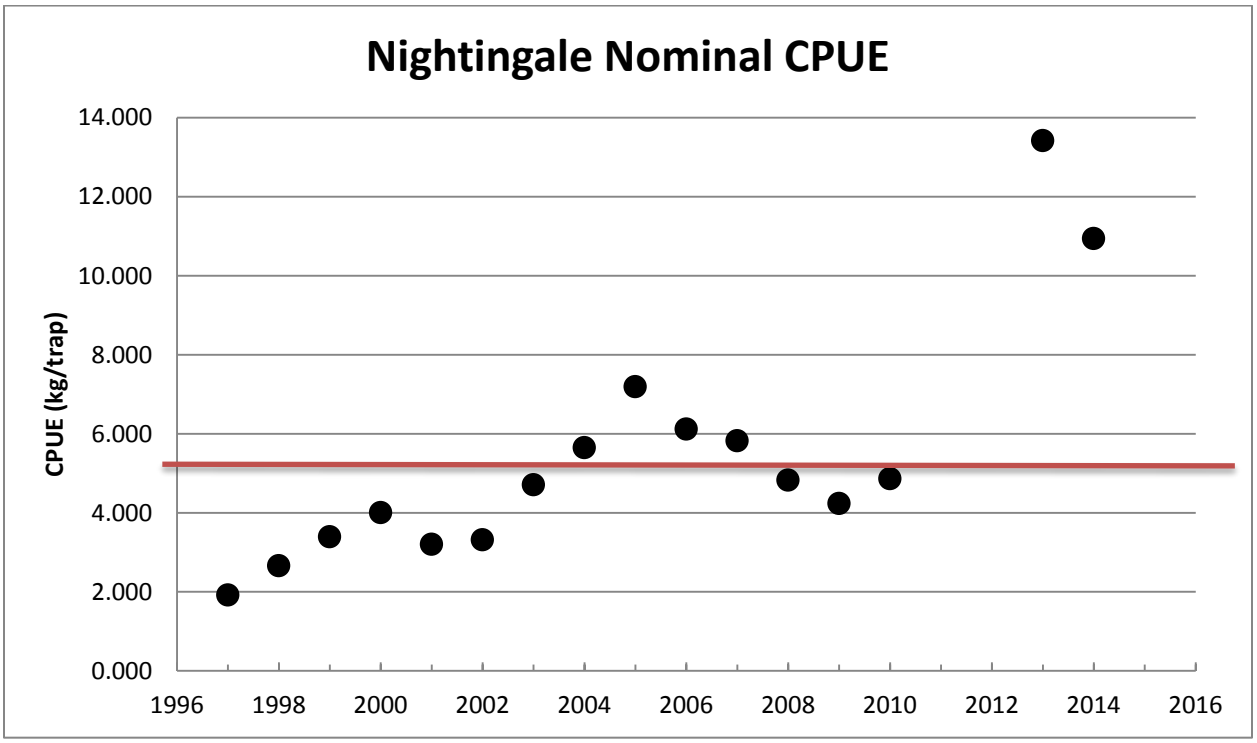

Figure 4b: Biomass indices (in terms on the average mass caught per trap) for the Leg1 surveys for Nightingale. The means and (and assumed log normal) 95% confidence intervals are shown.

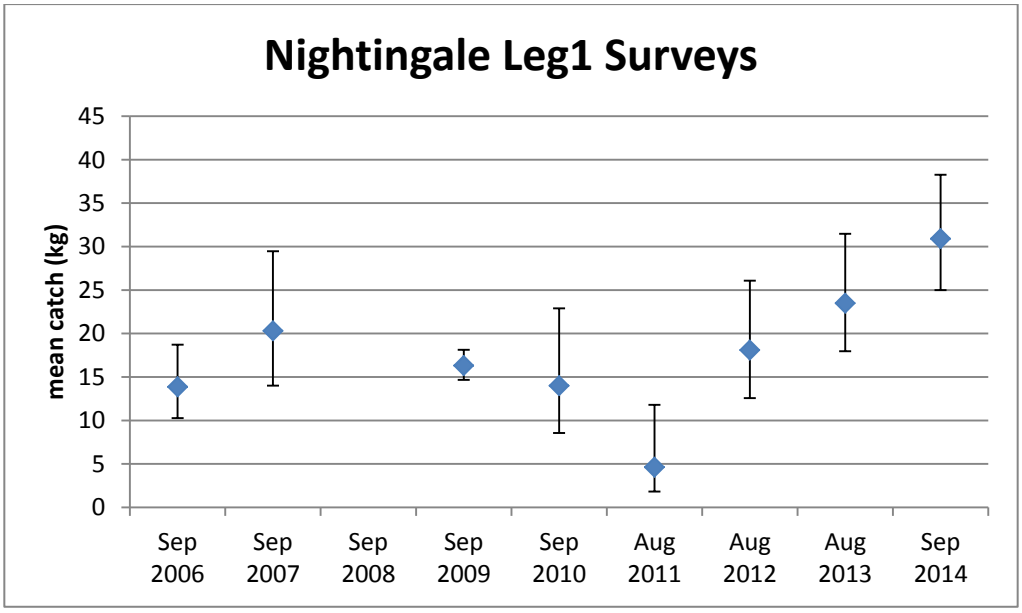

Figure 5: Tristan OMP simulation results of Tristan catch rates. The expected medians, 5th and 95th percentiles are indicated. Vertical arrows show the start of the projection period. The horizontal red line shows the target catch rate (1.163 kg/hour/gear).

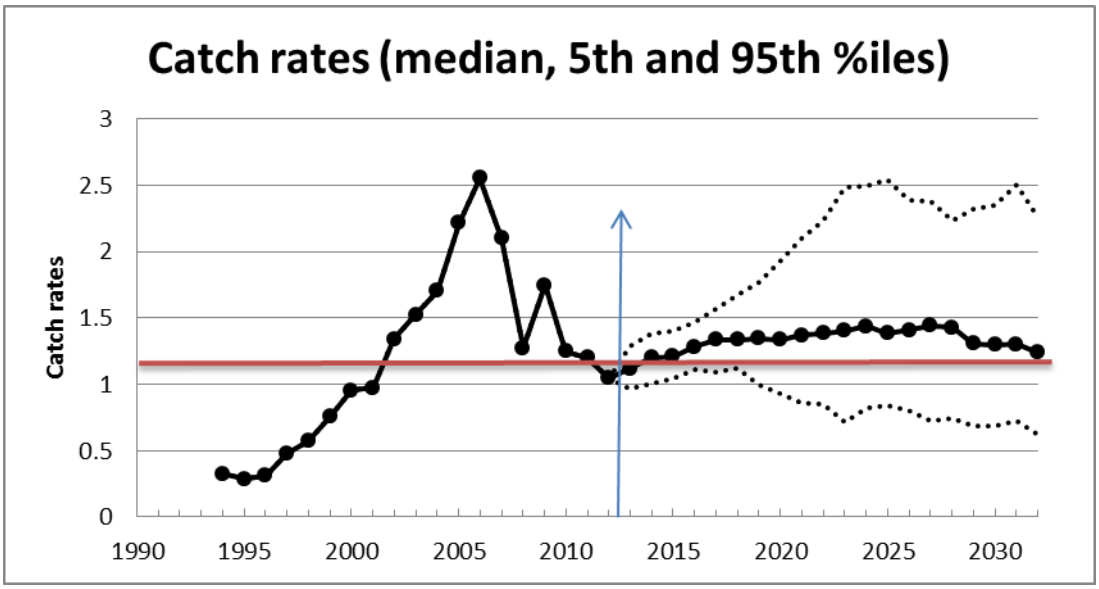

Figure 6: The Exceptional Circumstances metarule proposed for Tristan. [Note this is a more general form of that for Inaccessible and Gough shown in Figure 1.]

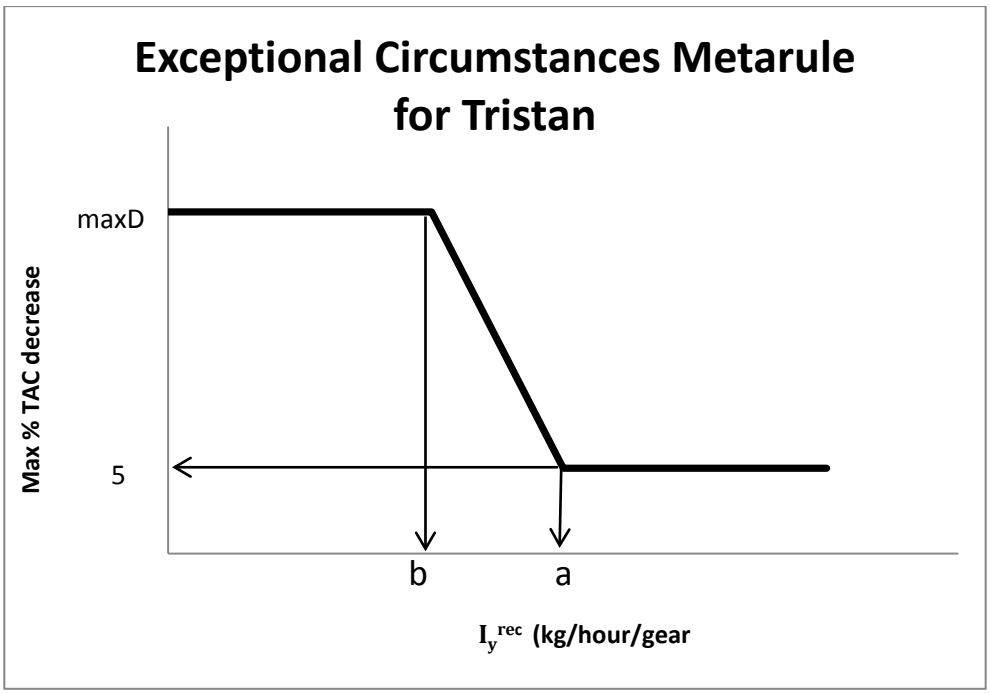

Figure 7a: CPUE (and resultant Irec) values for the different CPUE scenarios examined (top plots), with the resultant TACs shown in the bottom plots. Results shown here are for future CPUE 2015 and 2016 = 0.90, 0.80 or 0.70 (shown as open circles on plots).

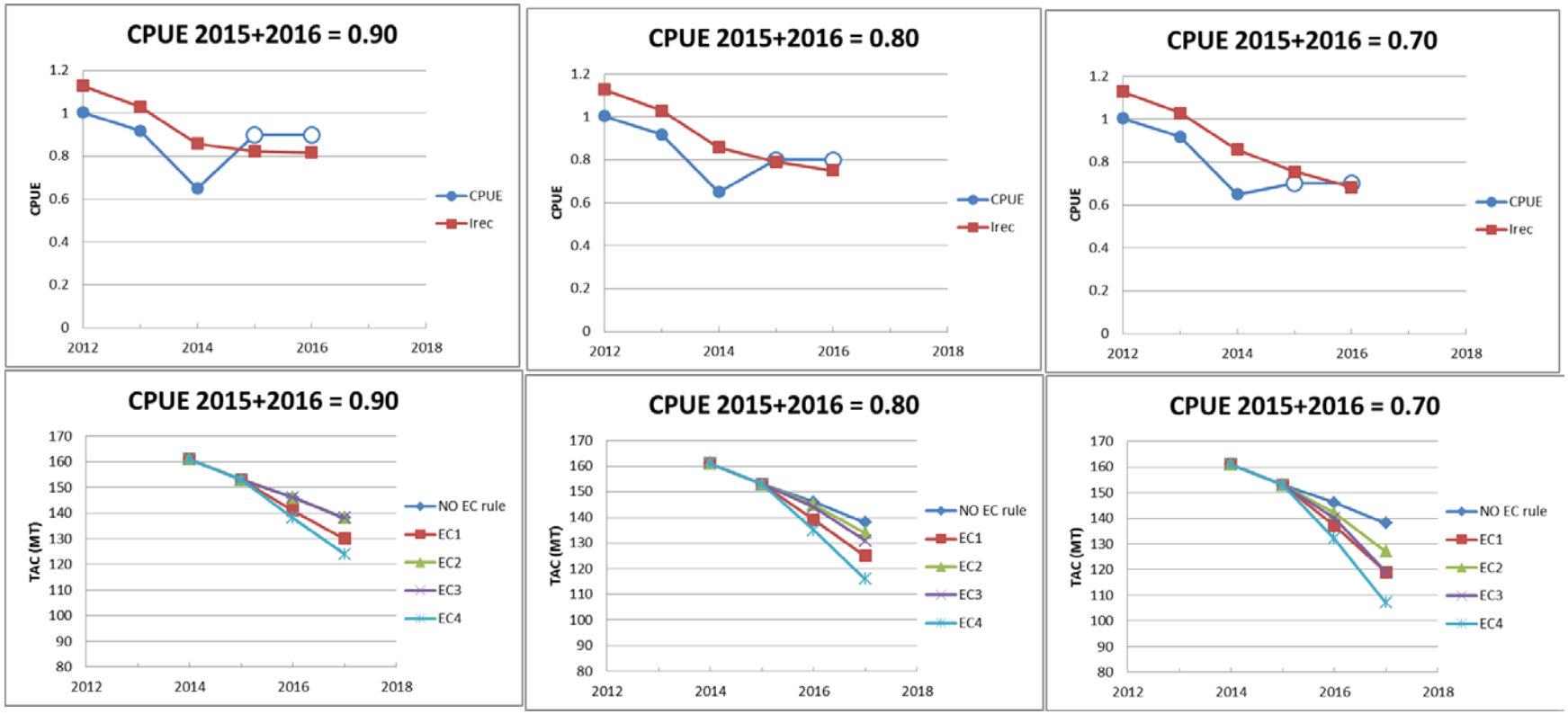

Figure 7b: CPUE (and resultant I^{rec}) values for the different CPUE scenarios examined (top plots), with the resultant TACs shown in the bottom plots. Results shown here are for future CPUE 2015 and 2016 = 0.60, 0.50 or 0.40 (shown as open circles on plots).

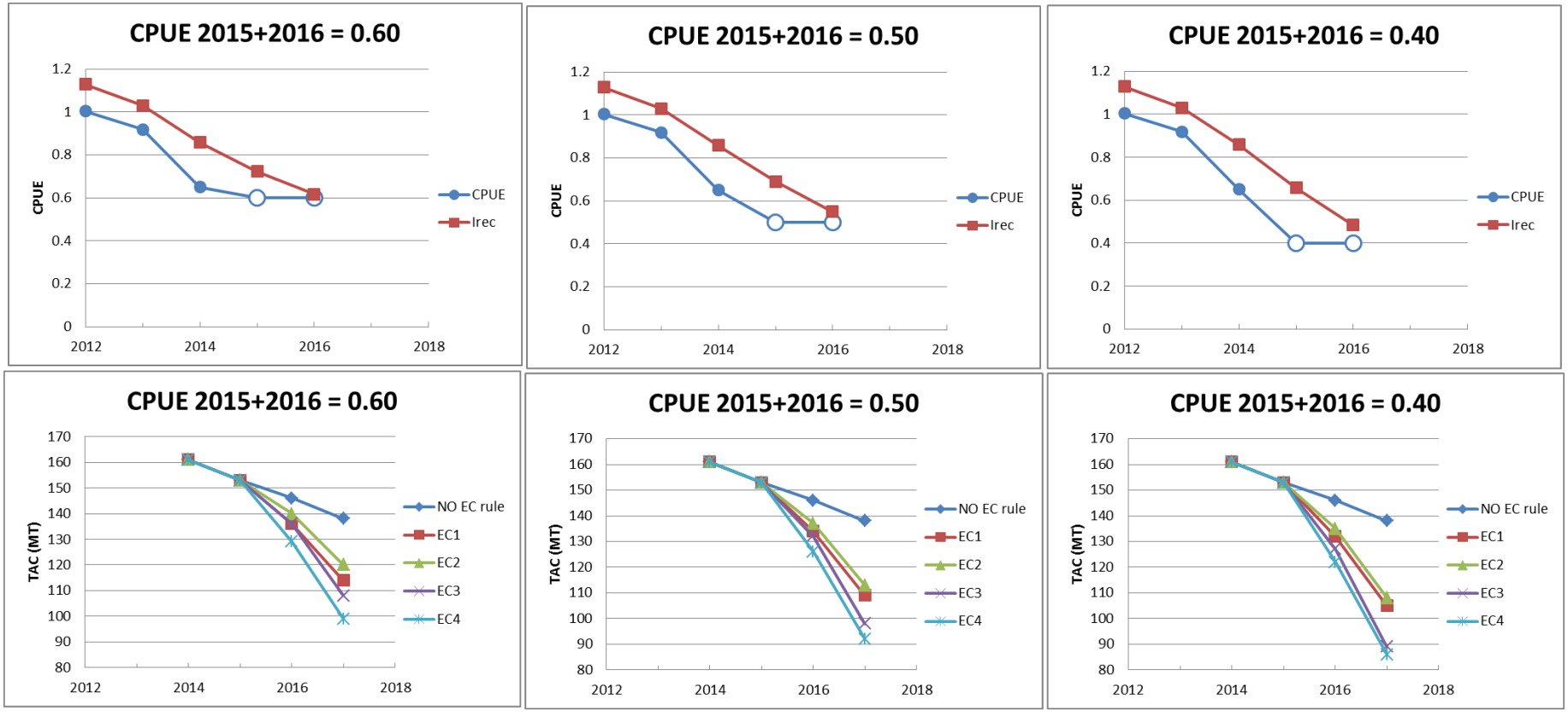

Figure 8: Catch rate series for Tristan from different sources. Each series has been re-normalised so that its average value over the 2009-2014 period is 1.0 (to assist comparison). (For the Edinburgh (James) series, the plot shows monthly values given for the 2011-2014 averaged over the season concerned.