

Initial Gough CMP results

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Summary

This document provides results for some initial OMP candidates to be considered in the development of a new OMP for the Tristan rock lobster fishery at Gough island.

KEY WORDS: Tristan rock lobster, Operational management Procedure, Gough island

Introduction

An OMP was first developed and agreed upon for Gough island in 2014, and used to set the TAC at this island for the first time in that season and again for the following 2015-2017 seasons. Johnston and Butterworth (2014) provides details of this OMP. The Gough OMP was updated in 2018 (Johnston and Butterworth 2018). 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 (OMP 2018 value = 6.0 kg/trap), and

α is the tuning parameter (OMP 2018 value =10).

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 Gough (and Inaccessible) was to be applied under certain circumstances, where the 5% TAC decrease constraint could be widened 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 inter-annual maximum 5% decrease, as shown in Figure 1. For the Gough OMP 2018 the Ilim value was set at 3.0 kg/trap.

Candidate OMPs (CMPs) considered here

Four CMPs (each with two variants) are considered here:

- 1) CMP1a and CMP1b: these are identical to current OMP-2018 ($I_{tar}=6$ kg/trap).
- 2) CMP2.1a and CMP2.1b: these are slightly more positive with I_{tar} reduced to 5.5 kg/trap.
- 3) CMP2.2a and CMP2.2b: these are more positive with I_{tar} reduced to 5 kg/trap.
- 4) CMP4a and CMP4b: these are identical to current OMP-2018 but allow for rollovers of 5t per annum for the next four years (2021-2024) [i.e. a total of 20t above what the CMP sets]. $I_{tar}=6$ kg/trap.
- 5) CMP5a and CMP5b: as above, i.e. allow for rollovers but here $I_{targ}=5.5$ kg/trap.

CMP1a, CMP2.1a, CMP2.2a, CMP4a and CMP5a are variants where $TAC(2021)$ is allowed to exceed 100t in 2021. Given that $I_{rec}(2020)=6.19$ kg/trap, the current OMP would indicate only a small increase in TAC above the current 100t. In contrast, CMP1b, CMP2.1b, CMP2.2b, CMP4b and CMP5b are variants where $TAC(2021)$ is nevertheless forced to be maximum of 100t. Table 1 lists these CMPs. Note that as the Gough CPUE GLMM has recently been updated (since the 2021 assessment), the updated Gough standardised CPUE value (6.18 kg/trap) for 2020 is assumed in these calculations (i.e. simulated future CPUE values are for the 2021+ period).

The CMPs reported here include only vessel/commercial CPUE as input into the OMP. These CMPs will be expanded shortly to include the biomass survey index data as well (as has been done for Tristan). As for Tristan, the biomass survey data will receive relatively little weight in the TAC generating formula.

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.
- $TAC(2021)$ = the TAC for the 2021 season.
- $C_{ave\ 5}$ = average annual catch (in MT) over the next 5 years (2021-2025).
- $C_{ave\ 10}$ = average annual catch (in MT) over the next 10 years (2021-2030).
- 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 has been run for 100 simulations. The medians, and the 5th and 95th percentiles, of various management quantities of interest are reported.

Discussion

Table 2 reports comparisons of **Gough** candidate OMPs expected performance results. All statistics reported below are median values unless otherwise stated. The OMP-2014 and OMP-2018 performance results as evaluated in 2014 and 2018 respectively are given in the two top rows. Figure 2 shows the catch, B_{sp}/K and catch rate (CR) trajectories for each of the ten CMPs considered here. Table 3 reports the predicted median TAC values (MT) for the first 10 seasons (2021-2030) for the ten different CMPs, with Table 3 reporting the median and lower 5th %ile $B_{sp}/K(2033)$ values. Some summary points:

- $TAC(2021)$ values range from 100 MT – 109 MT.
- All the CMPs considered will result in $B_{sp}/K(2033)$ median values of 0.77 and larger (the lower 5th percentile $B_{sp}/K(2033)$ results in values of 0.46 and larger). For all ten CMPs, these values are considerable higher than the target levels adopted for the previous OMP-2018.
- Lower I_{tar} value (to either 5.5 or 5 kg/trap) will result in ~15-30% more catch in the next 10 years (compared with current $I_{tar}=6$ kg/trap).
- Catch rates are expected to stabilise to between 5-6 kg/trap by the time of the 2034 season under an $I_{tar}=6$ kg/trap. Catch rates will be somewhat reduced to at or below 5 kg/trap for the lower I_{tar} CMPs.

An obvious feature to notice is that the 2021 updated Gough assessment leads to far more optimistic than the assessment model used to evaluate Gough OMPs in 2018. OMP-2018 as evaluated in 2018 predicted a median Bsp(2033/K) of **0.66**, whereas the exact same OMP evaluated with the new 2021 updated assessment predicts a median Bsp(2033/K) of **0.84**. If aiming for a similar level of risk when developing the new OMP-2021, then there is clearly scope for greater catches (which could be achieved by reducing the Itar value below 6 kg/trap).

Figure 3 shows the OMP-2018 catch rate predictions (for 2018+) (medians with 5th and 95th percentiles are shown). The 2018-2020 actual CPUE values are shown as purple squares on the same plot; it is clear that the 2018+ CPUE values are substantially larger than predicted by the somewhat more pessimistic 2018 assessment. That 2018 assessment was strongly influenced by the sharply decreasing trend between 2015-2017 observed at the time when it was carried out (this trend has subsequently reversed).

Figure 4 is a plot showing the trade-offs between the median Cave(10) catches and the Bsp/K(2033) median and lower 5th %iles for each of the eight CMPs.

Trade-off between future TACs and CPUEs

Figure 5 is a schematic plot showing sustainable yield as a function spawning biomass (relative to K) curve. At some point, the MSY would be achieved (likely somewhat below 0.5K). We currently estimate the resource to be at point A (0.88 K), a very healthy state, but one for which the SY is relatively low. In order to increase the sustainable catches, the resource can be moved safely to the left (say to around 0.8K, as results the CMPs in this report). At this point B one can expect larger sustainable yields (TACs), but as CPUE is proportional to biomass, at point B one would see lower catch rates than at point A. Therein lies the tradeoff: larger TACs at somewhat smaller CRs, or *vice versa*.

Other aspects

A negative feature of the current results for lower Itar values is that the TAC is expected to first increase but later decrease over the next 10 years (see Figure 2). Further work will aim

to change these patterns into steady continued increases through lessening the extent of the TAC increase for the initial few years.

Allowing for rollovers, or admitting TACs in excess of 100t for the 2021 season, has very little impact on medium terms biomass trends (see Figure 2).

References

- 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.
- Johnston, S.J. and Butterworth, D.S. 2018. Initial updated 2018 OMPs for the Inaccessible and Gough islands. MARAM document, MARAM/Tristan/2018/JUL/09.

Table 1: Candidate OMPs (CMPs) presented here.

	Can exceed 100t in 2021	TAC(2021) <= 100t
OMP-2018 Itar=6 kg/trap	CMP1a (ompg21.tpl)	CMP1b (ompg21x.tpl)
Slightly more positive Itar=5.5 kg/trap	CMP2.1a (ompg21c.tpl)	CMP2.1b (ompg21d.tpl)
More positive Itar=5 kg/trap	CMP2.2a (ompg214a.tpl)	CMP2.2b (ompg214b.tpl)
Allow rollovers of 5t for the period 2021-2024 (20t rollover) Itar=6 kg/trap	CMP4a (ompg21a.tpl)	CMP4b (ompg21b.tpl)
Allow rollovers of 5t for the period 2021-2024 (20t rollover) Itar=5.5 kg/trap	CMP5a (ompg7.tpl)	CMP5b (ompg8.tpl)

MARAM/TRISTAN/2021/JUN/08

Table 2: Comparison of **Gough** candidate OMPs expected performance results. All statistics reported below are median values unless otherwise stated. The OMP-2014 and OMP-2018 performance results, as evaluated in 2014 and 2018 respectively, are given in the two top rows.

CMP	I^{tar} (kg/trap)	α	Inter-annual max TAC constraint	lilim value (kg/trap)	CR(2022) (kg/trap)	CR(2032) (kg/trap)	TAC(2021) (MT)	C _{ave} 5 (MT)	C _{ave} 10 (MT)	Lower 5%ile C _{ave} 10	Median and Lower 5%ile Bsp(2033/K)
OMP-2014 [#]	4.50-2.80	10	+5%,-5 to -20%	1.5	2.71 [#]	2.47 [#]	-		100.44 [#]	90.22 [#]	0.69 [#] (0.39)
OMP-2018 [#]	6.0	10	+5%,-5 to -20%	3.0	3.86	4.28	95	82	89	89	0.66 (0.33)
CMP1a [identical to OMP 2018] Allows TAC(2021)>100t	6.0	10	+5%,-5 to -20%	3.0	5.83	5.68	102	98	90	89	0.84 (0.50)
CMP1b [identical to OMP 2018] TAC(2021)<=100t	6.0	10	+5%,-5 to -20%	3.0	5.89	5.68	100	96	89	88	0.84 (0.51)
CMP2.1a Itar=5.5 kg/trap Allows TAC(2021)>100t	5.5	10	+5%,-5 to -20%	3.0	5.75	4.97	105	110	106	105	0.81 (0.47)
CMP2.1b Itar=5.5 kg/trap TAC(2021)<=100t	5.5	10	+5%,-5 to -20%	3.0	5.83	4.96	100	106	104	102	0.81 (0.48)
CMP2.2a Itar=5 kg/trap Allows TAC(2021)>100t	5.0	10	+5%,-5 to -20%	3.0	5.72	4.31	105	116	119	116	0.77 (0.46)
CMP2.2b Itar=5 kg/trap TAC(2021)<=100t	5.0	10	+5%,-5 to -20%	3.0	5.81	4.34	100	110	116	112	0.78 (0.46)
CMP4a Itar=6 kg/trap Add 20t rollovers Allows TAC(2021)>100t	6.0	10	+5%,-5 to -20%	3.0	5.72	5.81	102+5= 107	97+4 =101*	87+2 =89*	87+2 =89*	0.84 (0.51)
CMP4b Itar=6 kg/trap Add 20t rollovers TAC(2021)<=100t	6.0	10	+5%,-5 to -20%	3.0	5.76	5.82	100+5= 115	95+4 =99*	86+2 =88*	86+2 =88*	0.85 (0.51)
CMP5a Itar=5.5 kg/trap Add 20t rollovers Allows TAC(2021)>100t	5.5	10	+5%,-5 to -20%	3.0	5.63	5.09	105+5= 110	109+4 =113	103+2= 105	102+2= 104	0.81 (0.48)
CMP5b Itar=5.5 kg/trap Add 20t rollovers TAC(2021)<=100t	5.5	10	+5%,-5 to -20%	3.0	5.72	5.11	100+5= 115	104+4 =104	101+2= 103	99+2= 101	0.82 (0.48)

[#] as evaluated in 2014 and 2018 respectively;

*Here the first figure is the OMP TAC, the second is the rollover amount, the final is the combination of the two.

Table 3: Predicted median TAC values (MT) for the first 10 seasons (2021-2030) for the ten different CMPs.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CMP1a Itar=6 kg/trap Allows TAC(2021)>100t	102	99	99	97	93	89	85	81	77	76
CMP1b Itar=6 kg/trap TAC(2021)<=100t	100	97	97	95	92	88	84	80	77	76
CMP2.1a Itar=5.5 kg/trap Allows TAC(2021)>100t	105	107	111	113	113	111	107	102	98	95
CMP2.1b Itar=5.5 kg/trap TAC(2021)<=100t	100	102	107	109	110	109	106	103	99	97
CMP2.2a Itar=5 kg/trap Allows TAC(2021)>100t	105	110	116	122	126	127	126	123	120	116
CMP2.2b Itar=5 kg/trap TAC(2021)<=100t	100	105	110	116	121	124	124	123	121	118
CMP4a Itar=6 kg/trap Add 20t rollovers Allows TAC(2021)>100t	102+5	99+5	98+5	95+5	90	86	81	77	74	74
CMP4b Itar=6 kg/trap Add 20t rollovers TAC(2021)<=100t	100+5	97+5	96+5	93+5	89	85	80	76	74	74
CMP5a Itar=5.5 kg/trap Add 20t rollovers Allows TAC(2021)>100t	105+5= 110	107+5= 112	110+5= 115	111+5= 116	110	106	102	97	93	91
CMP5b Itar=5.5 kg/trap Add 20t rollovers TAC(2021)<=100t	100+5= 115	102+5= 107	106+5= 111	107+5 112	107	105	101	98	94	93

Table 4: Predicted median Bsp/K(2033) values for the ten different CMPs.

CMP	Median and Lower 5%ile Bsp(2033/K)
OMP-2014 [#]	0.69 [#] (0.39)
OMP-2018 [#]	0.66 (0.33)
CMP1a [identical to OMP 2018] Allows TAC(2021)>100t	0.84 (0.50)
CMP1b [identical to OMP 2018] TAC(2021)<=100t	0.84 (0.51)
CMP2.1a Itar=5.5 kg/trap Allows TAC(2021)>100t	0.81 (0.47)
CMP2.1b Itar=5.5 kg/trap TAC(2021)<=100t	0.81 (0.48)
CMP2.2a Itar=5 kg/trap Allows TAC(2021)>100t	0.77 (0.46)
CMP2.2b Itar=5 kg/trap TAC(2021)<=100t	0.78 (0.46)
CMP4a Itar=6 kg/trap Add 20t rollovers Allows TAC(2021)>100t	0.84 (0.51)
CMP4b Itar=6 kg/trap Add 20t rollovers TAC(2021)<=100t	0.85 (0.51)
CMP5a Itar=5.5 kg/trap Add 20t rollovers Allows TAC(2021)>100t	0.81 (0.48)
CMP5b Itar=5.5 kg/trap Add 20t rollovers TAC(2021)<=100t	0.82 (0.48)

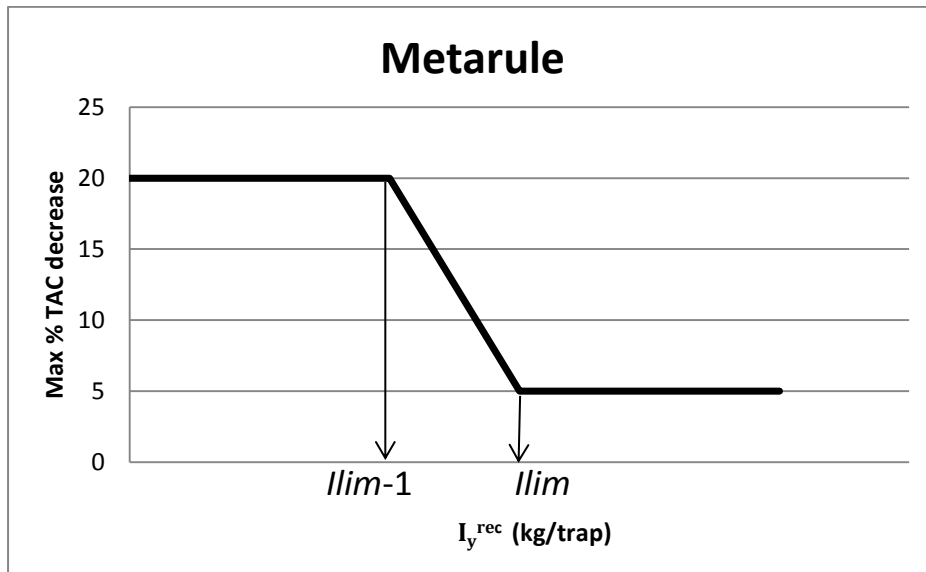


Figure 1: The metarule used as part of the CMPs.

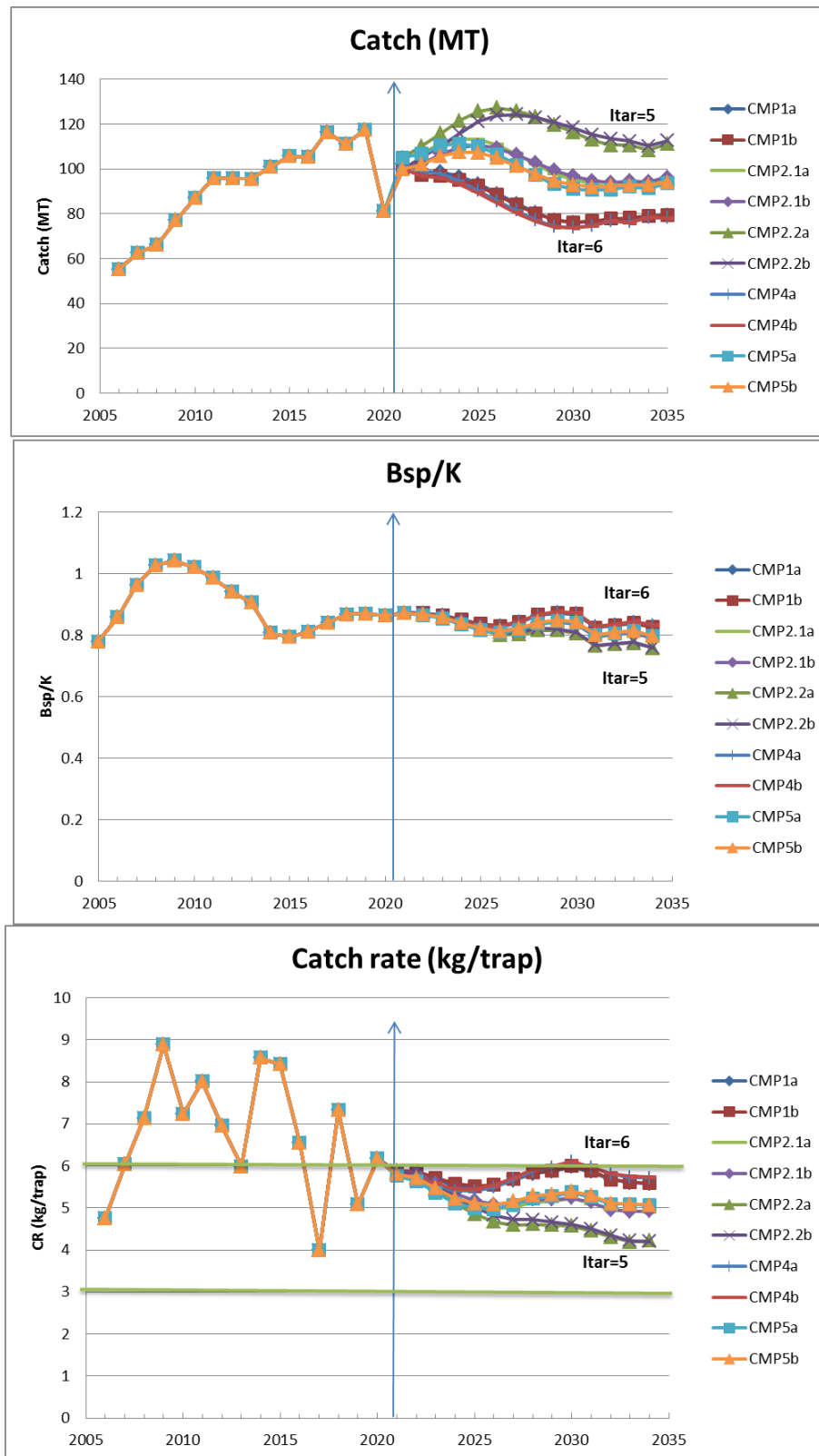


Figure 2: The Catch (MT), Bsp/K and catch rate (kg/trap) trajectories for each of the ten CMPs. (Note that the Catch of 81MT taken in 2020 is reflected in the catch plot, but the OMP algorithm uses TAC and hence an initial input value of TAC(2020)=100 MT.)

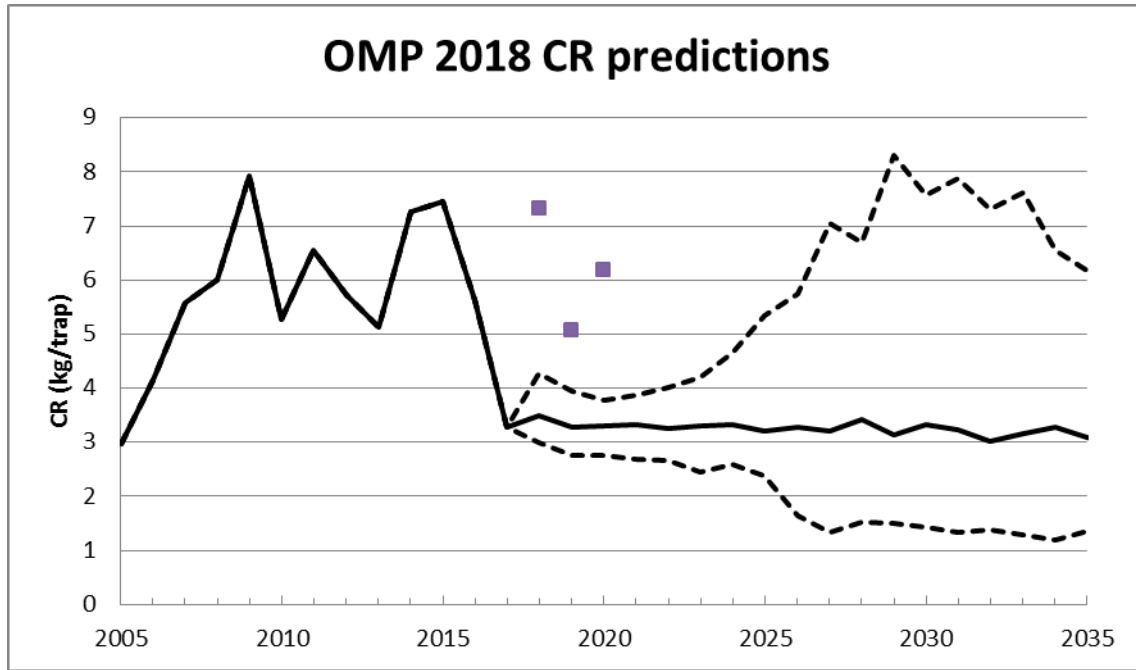


Figure 3: OMP-2018 catch rate predictions (for 2018+): medians with 5th and 95th percentiles are shown. The 2018-2020 actual CPUE values are shown as purple squares.

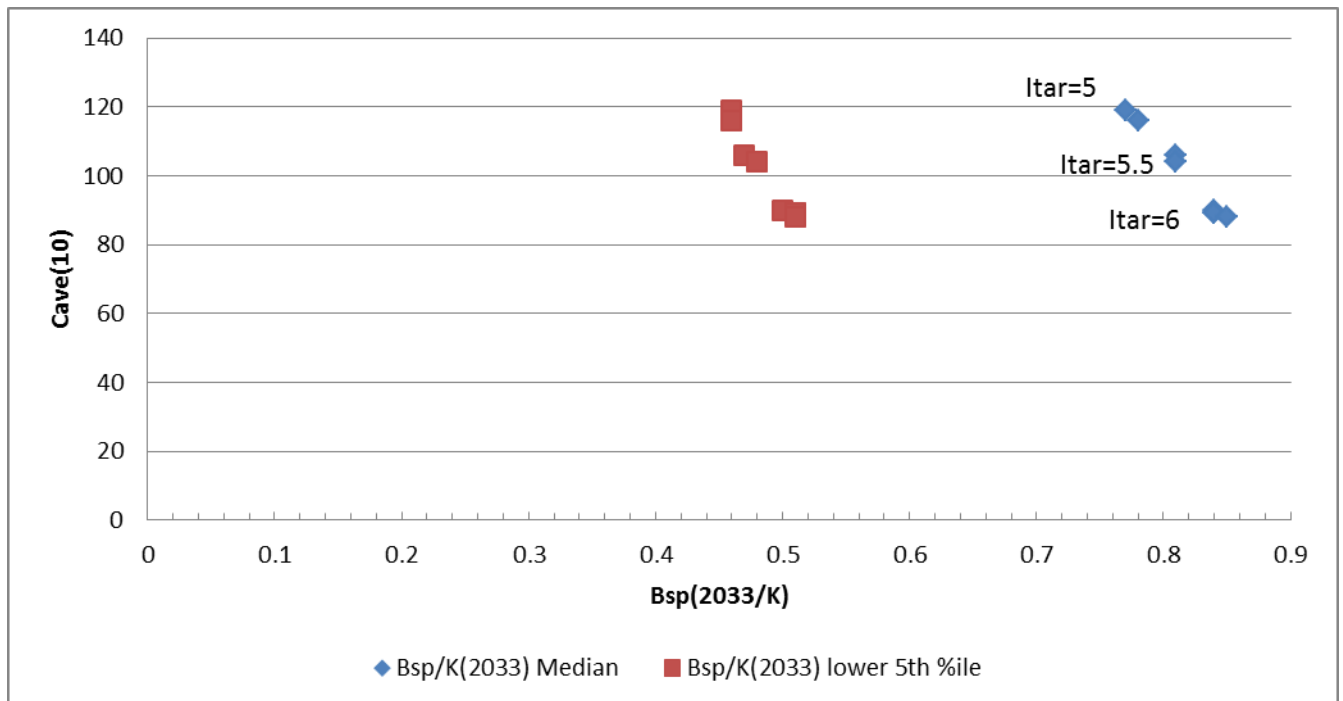


Figure 4: Plot showing the trade-offs between the median Cave(10) catches and the Bsp/K(2033) median (blue diamonds) and lower 5th %iles (red squares) for the different CMPs.

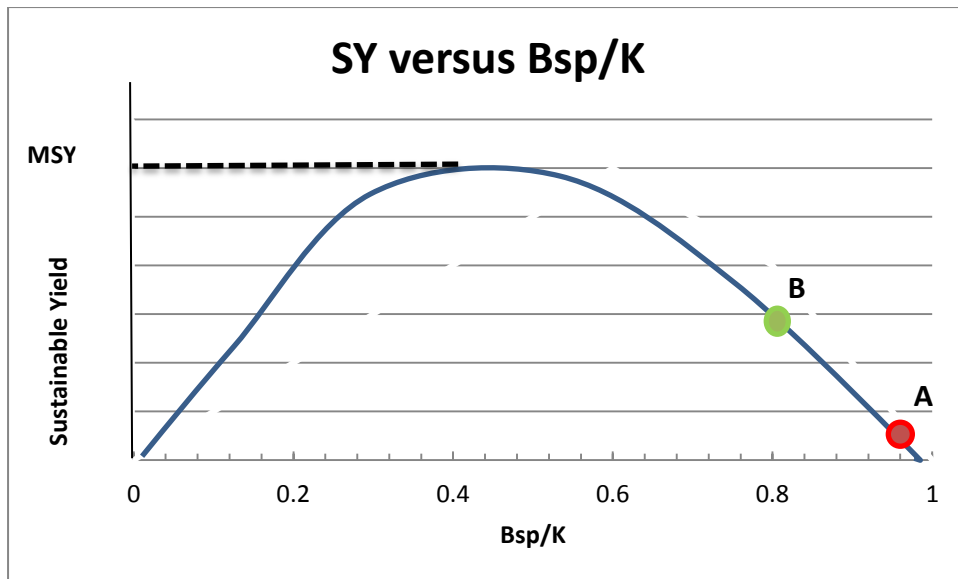


Figure 5: A schematic plot to illustrate the relationship between SY (future sustainable TACs) and CPUE.