Final SCRL OMP candidates

S.J. Johnston and D.S. Butterworth

MARAM, DEPARTMENT OF MATHEMATICS AND APPLIED MATHEMATICS, UNIVERSITY OF CAPE TOWN

At the SWG SCRL meeting on 13 June 2014, it was requested that further OMP results be presented for the following:

Bsp(2025/2006) median tunings: values of **1.20**, **1.30** and **1.40** would be presented. (Note that details of the OMP are provided in the Appendix.)

The results for the three tunings above are reported for the following scenarios:

1) Scenario 1 (RC): TAC is not constrained in first two years and no TAC constraint in A1E imposed.
2) Scenario 2: TAC is constrained to not decrease in first two seasons (2014 and 2015) but no TAC constraint in A1E imposed.
3) Scenario 3: TAC is not constrained in first two years and a maximum TAC constraint in A1E of 50 MT imposed.

Results and Output statistics

Tables 1a-c report results for the three OMP candidates for three different scenarios.

Note that the units of the target CPUE are "standardised" units, and that by multiplying by 259, one can easily convert the CPUE target into tails kg per day which is more meaningful to the industry. Output statistics reported are:

- $CPUE_{targ}$: Catch per unit effort in GLM units (kgs per trap)
- $CPUE_{targ}$ in industry units: $CPUE_{targ}$ x 259 (unit are kg tails per day)
- CPUE threshold: the CPUE level (in industry units) in an area below which it is assumed in the projections that catches are transferred out of that area to the other areas (details in FISHERIES/2014/JUNE/SWG_SCRL/02).
- CPUE(2025): the median estimated CPUE in 2015.
- Bsp(2025/2006): the spawning biomass in 2025 relative to 2006 (this values is used to tune the different OMP candidates).
- Bsp(2025/K): the spawning biomass in 2025 relative to the unfished (pristine) spawning biomass.
- Cave(2014-2025): the average catch over the 2014-2025 period.
- AAV: the average (over 2014-2015) inter-annual catch variation (expressed as %). Note that all OMPs presented assume a maximum inter-annual TAC change constraint of 5%.
- $B^{exp}(2025)/K$: the exploitable biomass in 2025 relative to the unfished pristine exploitable biomass (reported for each area).

- Effort(2025/2014): the effort in 2025 relative to the effort in 2014.

New statistics presented are:

- CPUE(2025): the median estimated CPUE in 2025.
- Effort(2025/2014): the effort in 2025 relative to the effort in 2014. Here effort is simply calculated as "Catch/CPUE".
- Size structure of the catch in 2014 and 2015. The idea here is to see if there is a change in the expected catch size composition over time. Size structures are reported for each area individually. The catch proportions for each size class are averaged over the 1000 simulations, and the male and female proportions are summed.

Figure 1 reports results for the three different CPUE target tunings (1.2, 1.3 and 1.4) for the RC scenario (Scenario 1). The second bottom plot shows the 3-year average CPUE scaled to industry nominal values, and the bottom plots shows the effort trajectories, where effort is scaled to the 2014 values. Figure 2 reports results for M2a (CPUE target of 1.3) where the left plots show the median trajectories along with the 5^{th} and 95^{th} percentiles. The right hand plots show the results of the first six (of 1000) simulations. Figure 3 reports results for M2a (CPUE target of 1.3) where the left plots show the absolute exploitable biomass and the right side shows exploitable biomass relative to pristine levels. Plots for each of the three areas, as well as for the resource as a whole are shown. Figure 4 reports results for M2a (CPUE target of 1.3) where the left plots show the median, 5^{th} and 95^{th} percentiles of the expected TAC trajectories, and the right plots show the TACs for the first six simulations. Figure 5 is similar, i.e. reports results for M2awhere the left plots show the median, 5^{th} and 95^{th} percentiles of the expected trajectories, and the right plots show the TACs for the first six simulations, although here it is the $CPUE_{industry}$ values that are shown. Finally, Figure 6 compares the average catch size structures in 2025 with those of 2014for each area for M2a.

Some brief comments

The main features of the results as the tuning level is increased are (Table 1a):

- Lower catches
- Faster biomass increase
- Higher CPUE
- Reduced risk of higher depletion for A1E
- Less increase in effort

If the TAC is restricted not to decrease in the risk two years, catches increase slightly, and there is a small increase only in the depletion risk (Table 1b).

If further a maximum TAC of 50 MT is imposed for A1E, depletion risk decreases for A1E, more so for the higher tunings.

The catch size structure for each area under the central tuning considered is indicated to be little changed in 10 years from that at present.

After agreement on the basic OMP, Exceptional Circumstances provisions will be developed. These will include conditions of low CPUE in which the 5% maximum inter-annual TAC decrease may be overridden.

Table 1a: Scenario 1 (RC) results presented for three candidate OMPs (M1a-M3a). The TAC is not constrained in first 2 years, and NO TAC constraint on A1E TAC is assumed. Values reported are medians, with the 5th and 95th percentiles shown in parentheses for some statistics.

	$\mathbf{CPUE_{targ}}$*	$\mathbf{CPUE_{targ}}$ in industry units(tails kg per day)	CPUE threshold (tails kg per day)	CPUE (2025)	CPUE (2025) in industry units (tails kg per day)	Bsp(2025/06)	Bsp(2025/K)	Cave (2014-2025)	AAV (2014-2025)	A1E B^{exp}(2025)/K Lower 5th%ile	A1W B^{exp}(2025)/K Lower 5th%ile	A2+3 B^{exp}(2025)/K Lower 5th%ile	Effort (2025/2014)
M1a	**1.08**	280	180	1.31	339	**1.20** (0.65; 2.72)	0.38 (0.21; 0.88)	438 (335; 476)	4.74	0.13	0.20	0.18	1.50
M2a	**1.173**	304	180	1.44	373	**1.30** (0.74; 2.80)	0.41 (0.24; 0.90)	407 (299; 463)	4.71	0.15	0.24	0.21	1.25
M3a	**1.275**	330	180	1.53	396	**1.40** (0.85; 2.92)	0.45 (0.27; 0.93)	374 (263; 431)	4.67	0.16	0.28	0.24	1.01

*The 2011 area-weighted GLM CPUE value is 0.964

Table 1b: Scenario 2 results presented for three candidate OMPs (M1b-M3b) where the TAC is not allowed to decrease in the first 2 years, and NO TAC constraint on A1E TAC is assumed. Values reported are medians, with the 5th and 95th percentiles shown in parentheses for some statistics.

	$\mathbf{CPUE_{targ}}$	$\mathbf{CPUE_{targ}}$ in industry units(tails kg per day)	CPUE threshold (tails kg per day)	CPUE (2025)	CPUE (2025) in industry units (tails kg per day)	Bsp(2025/06)	Bsp(2025/K)	Cave (2014-2025)	AAV (2014-2025)	A1E B^{exp}(2025)/K Lower 5th%ile	A1W B^{exp}(2025)/K Lower 5th%ile	A2+3 B^{exp}(2025)/K Lower 5th%ile	Effort (2025/2014)
M1b	**1.08**	280	180	1.28	332	1.18 (0.65; 2.71)	0.37 (0.21; 0.87)	451 (345; 476)	4.58	0.12	0.20	0.18	1.55
M2b	**1.173**	304	180	1.35	350	1.25 (0.72; 2.73)	0.40 (0.23; 0.88)	430 (312; 463)	4.18	0.14	0.23	0.20	1.37
M3b	**1.275**	330	180	1.45	376	1.33 (0.81; 2.83)	0.43 (0.26; 0.91)	401 (283; 452)	4.02	0.15	0.26	0.23	1.14

Table 1c: Scenario 3 results presented for three candidate OMPs (M1c-M3c). The TAC is not constrained in first 2 years, and a maximum TAC constraint on A1E TAC of 50 MT is imposed. Values reported are medians, with the 5th and 95th percentiles shown in parentheses for some statistics.

	$\mathbf{CPUE}_{targ}$	$\mathbf{CPUE}_{targ}$ in industry units(tails kg per day)	CPUE threshold (tails kg per day)	CPUE (2025)	CPUE (2025) in industry units (tails kg per day)	Bsp(2025/06)	Bsp(2025/K)	Cave (2014-2025)	AAV (2014-2025)	A1E B^{exp}(2025)/K Lower 5th%ile	A1W B^{exp}(2025)/K Lower 5th%ile	A2+3 B^{exp}(2025)/K Lower 5th%ile	Effort (2025/2014)
M1c	**1.08**	280	180	1.24	321	1.19 (0.67; 2.70)	0.38 (0.21; 0.87)	436 (331; 476)	4.73	0.14	0.21	0.17	1.56
M2c	**1.173**	304	180	1.36	352	1.30 (0.75; 2.80)	0.41 (0.25; 0.89)	404 (296; 461)	4.70	0.18	0.26	0.20	1.29
M3c	**1.275**	330	180	1.49	386	1.39 (0.86; 2.89)	0.45 (0.27; 0.93)	369 (261; 431)	4.68	0.21	0.29	0.23	1.00

Figure 1: Results for three different Bsp(2025/2006) target levels for the Scenario 1 (RC) (median shown). The bottom plot shows the 3-year average CPUE (kg tails per day) scaled to industry nominal values.

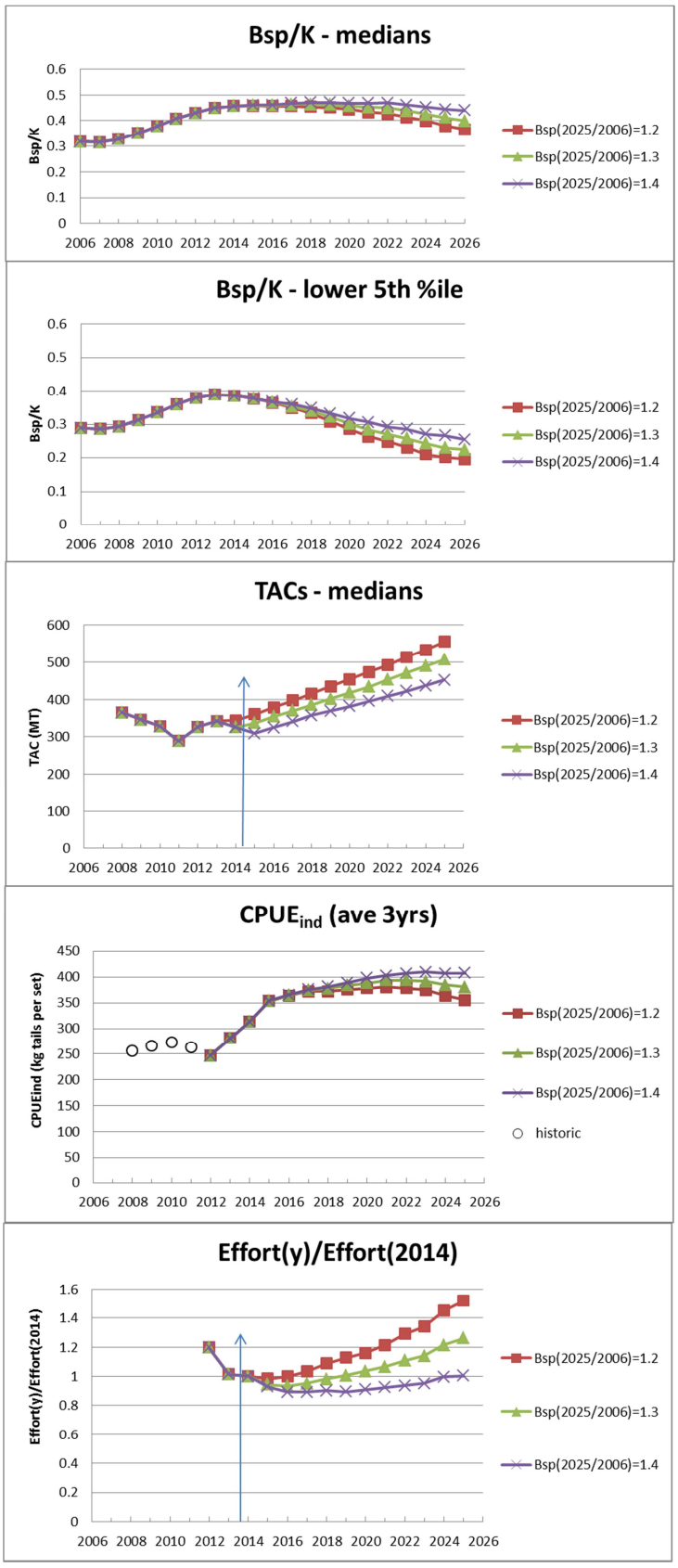


Figure 2: Median Bsp(2025/2006) = 1.3 tuning (Scenario 1 (RC) – M2a). The left hand plots show the medians (solid dots) with the 5th and 95th %iles as dashed lines. The right hand side plots show results for the first six (of 1000) simulations run (except for the top fight plot which is identical to the top left plot but for a shorter time period).

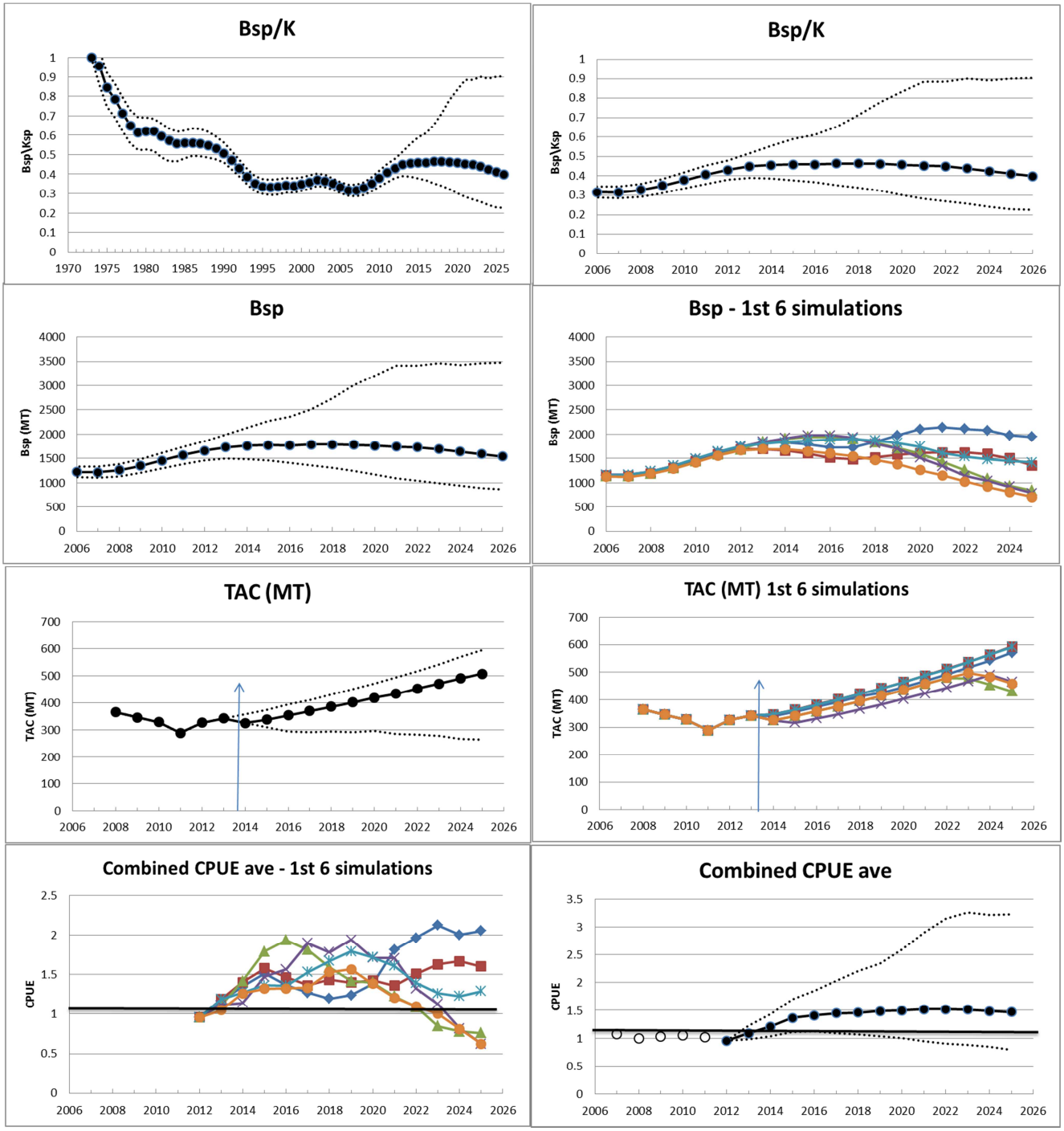


Figure 3: Estimated exploitable biomass trajectories for median Bsp(2025/2006)= 1.3 tuning (Scenario 1 (RC) i.e. M2a). The plots show the medians (solid dots) with the 5th and 95th %iles as dashed lines. The top three plots are for the three fishing areas, with the bottom plot showing results for the resource as a whole.

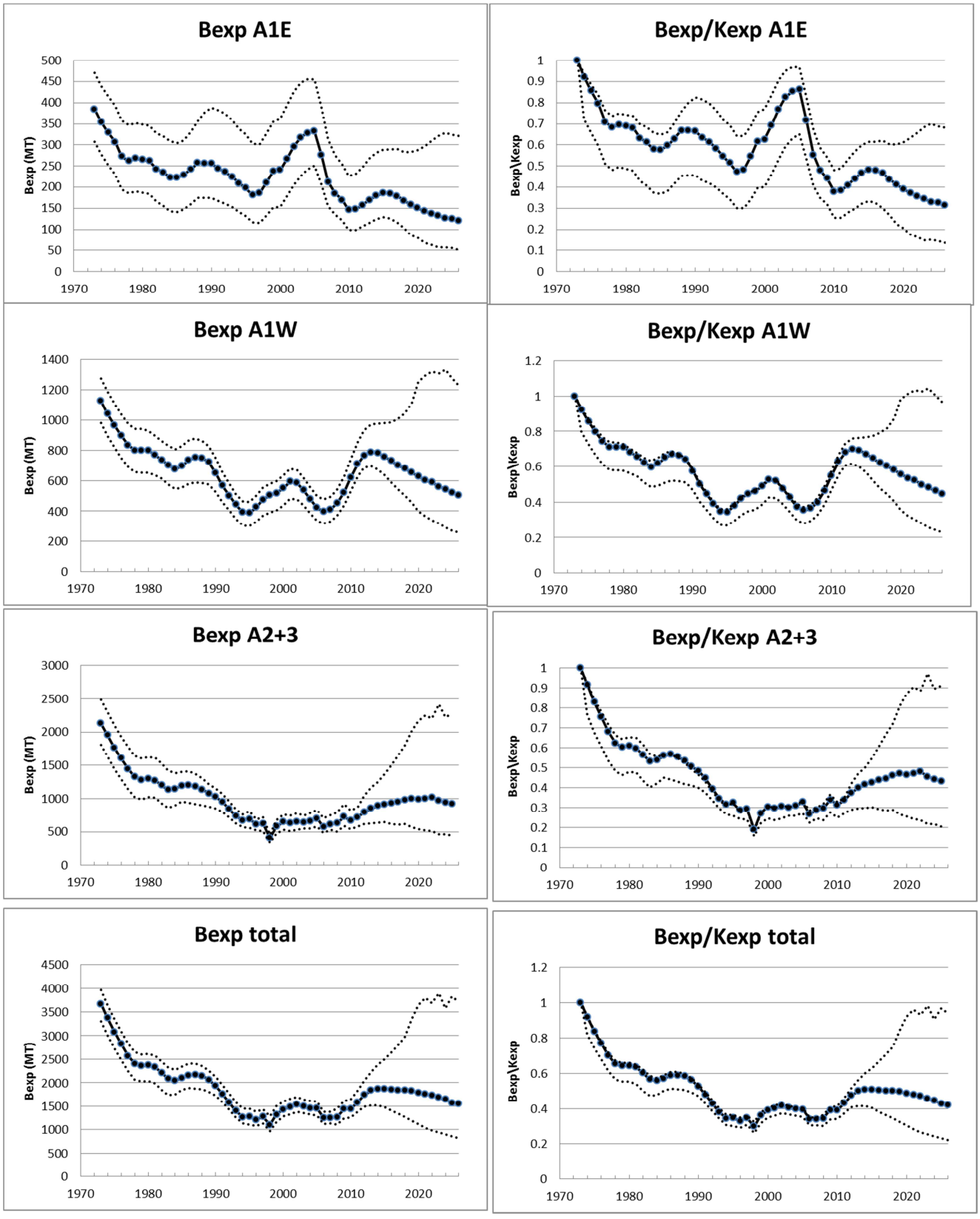


Figure 4: TAC trajectories for median Bsp(2025/2006)= 1.3 tuning (Scenario 1 (RC) i.e. M2a) for each area. The left hand plots show the medians (solid dots) with the 5th and 95th %iles as dashed lines. The right hand side plots show results for the first six (of 1000) simulations run.

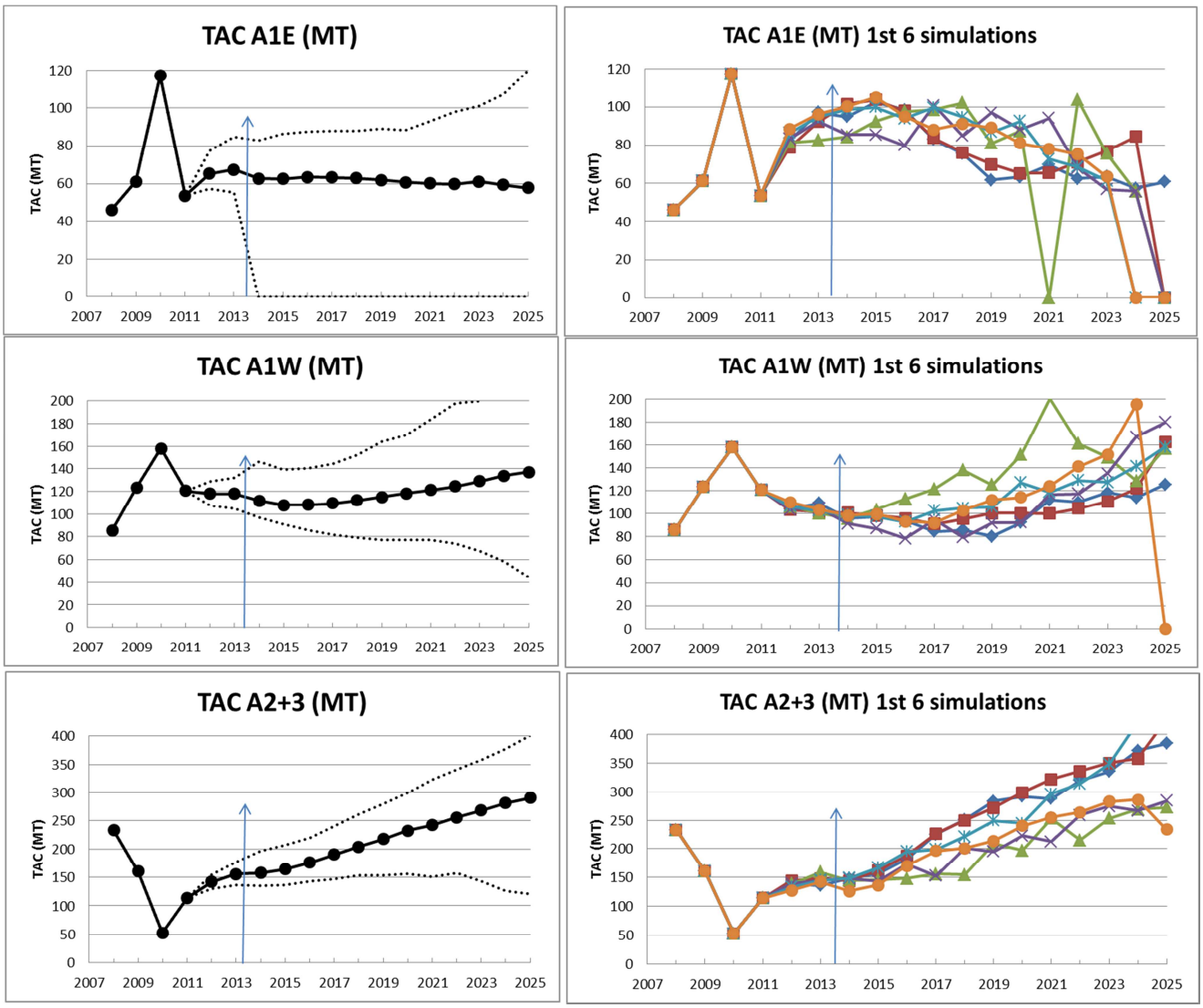


Figure 5: $CPUE_{ind}$ trajectories for median Bsp(2025/2006) = 1.3 tuning for each area (for Scenario 1 (RC). The left hand plots show the medians (solid dots) with the 5th and 95th %iles as dashed lines. The right hand side plots show results for the first six (of 1000) simulations run. The solid black line on the right hand plots indicates a CPUE value of 180. In some cases CPUE drops below the threshold level of 180 kg tails per day; in these cases the simulations take no catch from that area, but transfer it elsewhere. [Note TAC(y+1) depends on CPUE(y-1).]

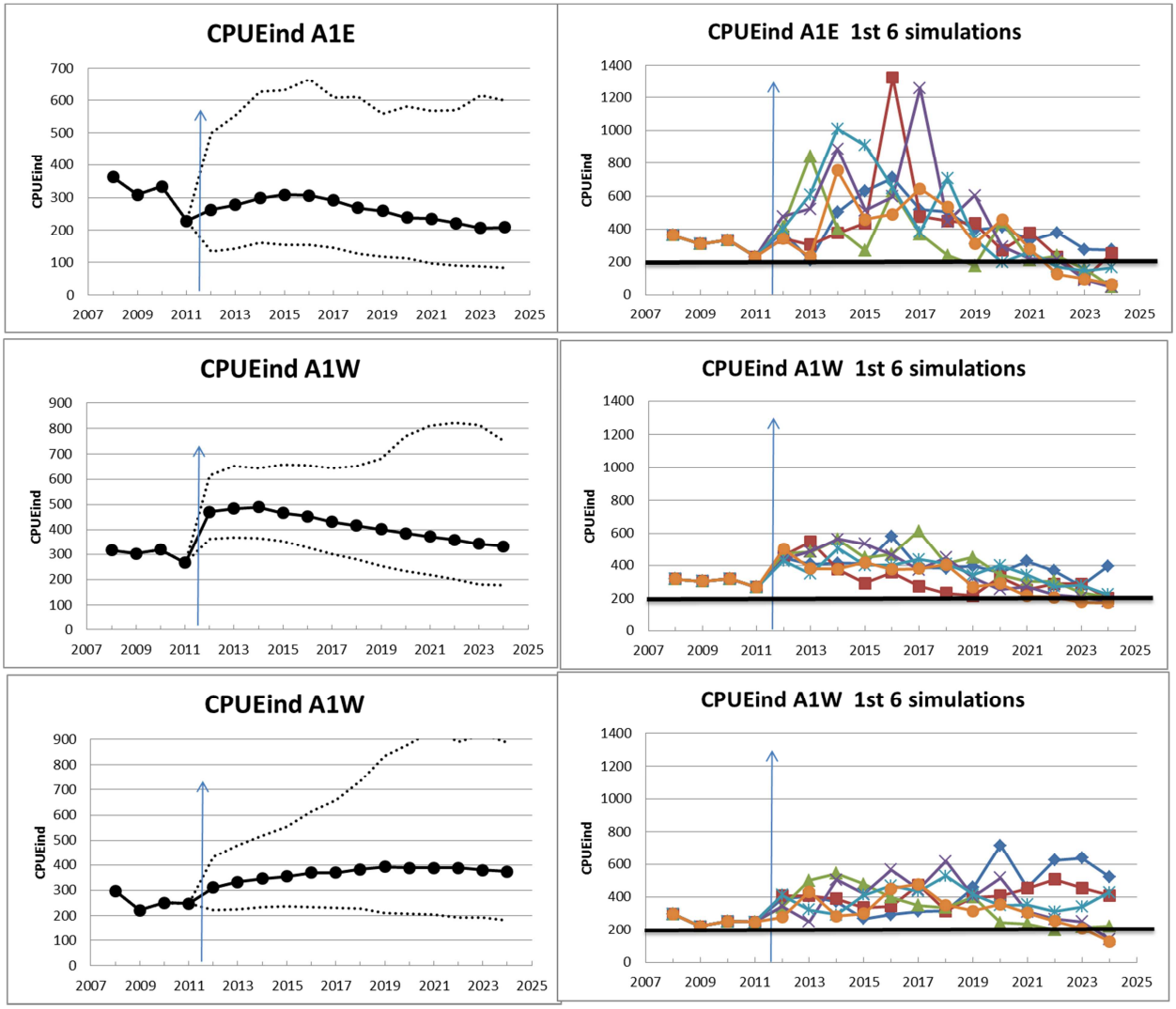
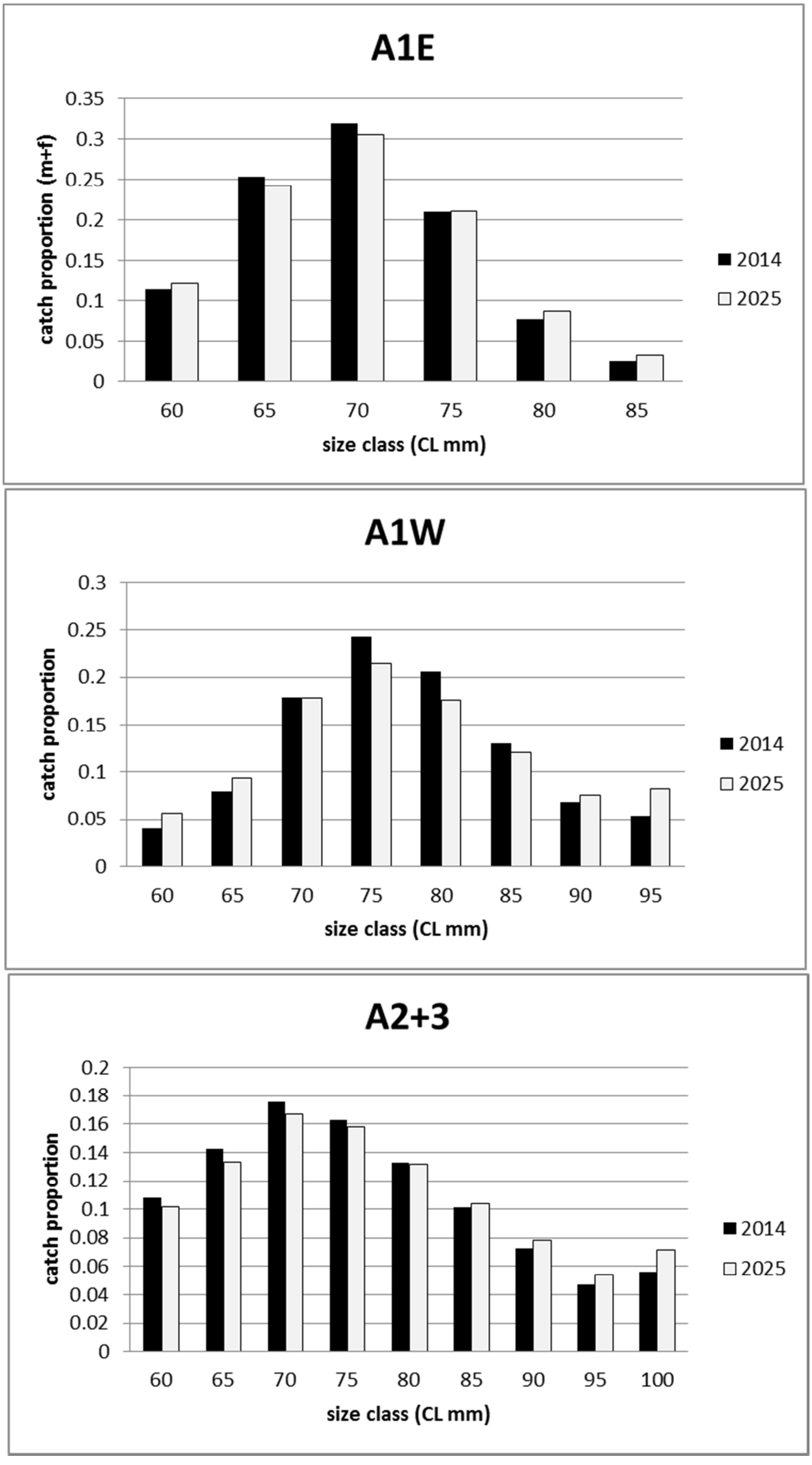


Figure 6: Catch size structures in 2014 and 2025 for each area for the median Bsp(2025/2006) = 1.3 tuning for Scenario 1 (RC).



Appendix: OMP 2013 for South Coast rock lobster

OMP 2013 is a **target** based OMP. The decision whether to increase or decrease the TAC depends on where recent CPUE values are relative to a particular pre-specified target CPUE value. The TAC setting equation is:

$$TAC_{y+1} = TAC_y[1 + \alpha \frac{\overline{CPUE}_y - CPUE_{targ}}{CPUE_{targ}}] \quad \text{(A1)}$$

where

$$\overline{CPUE}_y = \frac{1}{3} \sum_{y'=y-3}^{y-1} \sum_{A=1}^{3} \lambda_A CPUE_{y'}^{A} \text{ (as for previous OMP)} \quad \text{(A2)}$$

and $CPUE_{targ}$ is the selected target CPUE of the OMP.

The parameter α controls how responsive the OMP is to CPUE deviations from the CPUE target and is set = 1.0 for OMP 2013.

Note that

$$\lambda_1 = 0.003$$
$$\lambda_2 = 0.128$$
$$\lambda_3 = 0.868.$$

The CPUE weighting factors, λ_1, λ_2 and λ_3 relate to relative biomass in each area, and were calculated as follows. Using the estimated values of *q* and B^{exp} for 2011 from the RC model:

	q	B^{exp} (MT)
Area A1E	0.01211	45
Area A1W	0.00357	505
Area 2+3	0.00101	959

The relative biomass weights are thus: Area A1E = 45/1508 = 0.03

Area A1W = 504/1508 = 0.33

Area 2+3 = 959/1508 = 0.64

In terms of CPUE what is therefore required is:

$$
\begin{aligned}
&0.03\,B^1 + 0.33\,B^2 + 0.64\,B^3 \\
&= 0.03\frac{CPUE^1}{q_1} + 0.33\frac{CPUE^2}{q_2} + 0.64\frac{CPUE^3}{q_3} \\
&= 2.46CPUE^1 + 93.61CPUE^2 + 632.73CPUE^3
\end{aligned}
\qquad \text{(A3)}
$$

As the CPUE weights must sum to 1, it follows that the appropriate weighted average for CPUE is given by:

$$0.003\,CPUE^1 + 0.128\,CPUE^2 + 0.868\,CPUE^3$$

Taking account of the TAE restriction

The total TAC for the resource set using the OMP is TAC_y (from equation A1). An average of the "observed" CPUEs (weighted average of CPUE values for three areas) over y-2, y-3 and y-4 period) is denoted by $\overline{CPUE}$. The threshold CPUE is $\frac{\overline{CPUE}}{D}$=$\frac{\overline{CPUE}}{1.555369}$=$CPUE_{thresh}$, where the value of *D* is as used in OLRAC TAE calculations. During the simulations, $CPUE_y$ is generated from operating model including error. Then:

IF $CPUE_y > CPUE_{thresh}$ $\qquad TAC_y \rightarrow TAC_y$

IF $CPUE_y \leq CPUE_{thresh}$ $\qquad TAC_y \rightarrow TAC_y * \frac{CPUE_y}{CPUE_{thresh}}$ (A4)

so that the TAE limitation is respected.

Inter-annual TAC constraint

A rule to restrict the inter-annual TAC variation to no more than 5% up or down from season to season is applied, i.e.:

$$\text{if } TAC_{y+1} > 1.05\,TAC_y \qquad TAC_{y+1} = 1.05\,TAC_y \qquad \text{(A5)}$$

$$\text{if } TAC_{y+1} < 0.95\,TAC_y \qquad TAC_{y+1} = 0.95\,TAC_y$$

Simulated TAC split between areas

For 2012+, the total TAC for each season is initially split between the three areas as follows:

$$C_y^A = C_y^T \frac{\bar{F}^A B_{exp,y}^A}{(\bar{F}^{A1E} B_{exp,y}^{A1E} + \bar{F}^{A1W} B_{exp,y}^{A1W} + \bar{F}^{A2+3} B_{exp,y}^{A2+3})} \qquad \text{(A6)}$$

where

$$\bar{F}^A = \frac{\sum_{y=2007}^{y=2011} F_y^A}{5}$$

Fleet movement if CPUE in an area is too small to be economically viable

OLRAC provided data showing the % of total SCRL effort from each area against the catch (kg tails) per day for that area. This plot suggests that industry would move out of an area if catch rates dropped below 180 kg tails per day. The rules reported in Table A1 have been developed on this basis for use of splitting the total TAC between the three areas.

Note that these rules are for simulation purposes only, and that no regulation of TAC at an area level is recommended at this stage.

Table A1: Rules for shifting TAC in areas where catch rates are below 180 kg tails per day (for simulation purposes).

Senario	CPUE_ind (y-1) (kg tails per day)			Catch (y+1)		
	A1E	A1W	A23	A1E	A1W	A23
1	<=180	<=180	<=180	0	0	0
2	<=180	<=180	>180	0	0	A1E+A1W+A23
3	<=180	>180	<=180	0	A1E+A1W+A23	0
4	<=180	>180	>180	0	A1W+($A1E * \frac{A1W}{A1W+A23}$)	A2+3+($A1E * \frac{A23}{A1W+A23}$)
5	>180	<=180	<=180	A1E+A1W+A23	0	0
6	>180	>180	>180	A1E	A1W	A2+3
7	>180	<=180	>180	A1E+($A1W * \frac{A1E}{A1E+A23}$)	0	A2+3+($A1W * \frac{A23}{A1E+A23}$)
8	>180	>180	<=180	A1E+($A23 * \frac{A1E}{A1E+A1W}$)	A1W+($A23 * \frac{A1W}{A1E+A1W}$)	0