Further SCRL OMP development

S.J. Johnston and D.S. Butterworth

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

On the 30 April 2014, a TG consisting of Bergh, Butterworth and Johnston met to discuss further development of appropriate candidate OMPs for South Coast rock lobster. Information provided by OLRAC enabled progress to be made regarding the scaling of "model" (and GLM-standardised) CPUE values to units that are more meaningful to industry, *viz*. tails kg per day. Results of such investigations are reported below, together with those for some other aspects of the OMP evaluation.

1. A CPUE measure more meaningful to industry

   A multiplier is required to scale the model (and GLM standardised) CPUE values to a measure which industry finds more meaningful, *viz*. "tails kg per day". OLRAC provided the information in Table 1. The CPUE values for the period up to 2011 (Glazer 2013) were standardised (weighted over areas). Thus to calculate a scaling factor:

   $$F_{\text{industy scalar}} = \frac{[\sum_{2008}^{2011} Industry\ nominal\ CPUE]/4}{[\sum_{2008}^{2011} GLM\ standardised\ CPUE]/4} = \mathbf{259}.$$

   Thus when reporting results of alternate OMP candidates, CPUE will be reported as in units of "tails per kg day". This will be achieved by multiplying the "model" CPUE values by **259**.

2. Taking account of the TAE restriction

   The total TAC for the resource set using the OMP is TAC_y. 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 $CPUE_y > CPUE_{thresh}$ $\quad TAC_y \rightarrow TAC_y$

   IF $CPUE_y \leq CPUE_{thresh}$ $\quad TAC_y \rightarrow TAC_y * \frac{CPUE_y}{CPUE_{thresh}}$

   so that the TAE limitation is respected.

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

   OLRAC provided the data shown in Figure 1 - a plot 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 2 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.

Further OMP development

Table 3 reports results for a number of OMP candidates. V0-V4 vary with respect to the target CPUE level. Candidate V08 is also reported, as this OMP results in a median Bsp(2025/2006)=1.20 – the previous/current OMP target.

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.

Candidate OMP V6 is identical to V3 (i.e. it has a CPUE target of 1.3), but further constraints on the maximum TACs allowed (during the simulations) in areas A1E and A1W are imposed. These are:

Max TAC A1E = 50 MT

MAX TAC A1W = 100 MT

Candidate OMP V7 is identical to V3 (i.e. has a CPUE target of 1.3) but V7 does not allow the total TAC to decrease in the first two seasons (2014 and 2015). The rationale for this OMP is that the V3 median TAC trajectory predicts a TAC decline in the first few years, and then a steady increase thereafter. It would perhaps be more sensible to keep TACs constant for those initial years, prior to the expected TAC increase.

Figure 2 reports results for five different CPUE target levels ranging from 1.0 to 1.4. The bottom plot shows the 3-year average CPUE scaled to industry nominal values. Figure 3 reports results for V3 (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 4 reports results for V3 (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 5 reports results for V3 (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 6 is similar, i.e. reports results for V3 (CPUE target of 1.3) where 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.

Table 1: Industry nominal catch rates (average kg tails per day). The values at the bottom are averages over the areas for each season. The pink shaded blocks show catch rates < 180 kgs per day.

	Catch per day (kg tails)					
Area	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2	272	293	236	229	228	232
3	340	376	208	71	45	222
1E	218	277	272	298	191	157
1W	231	255	283	302	209	194
ave	265	300	250	225	168	201

Table 2: 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

Table 3: Results presented for the rules discussed above, except for first row results which are from document SCRL/01. The yellow highlights the OMP variants which all have CPUEtarg=1.3 in common, but differ in other respects. Values reported are medians, with the 5th and 95th percentiles shown in parentheses for some statistics.

Note: The TAC is not constrained in first 2 years.

	$CPUE_{targ}$	$CPUE_{targ}$ in industry units(tails kg per day)	CPUE threshold (tails kg per day)	Inter-annual TAC variability constraint	Constraint on A1E and A1W TACs	Bsp(2025/2006)	Bsp(2025/K)	Cave (2014-2025)	AAV(2014-2025)	A1E Bexp(2025)/K Lower 5th%ile	A1W Bexp(2025)/K Lower 5th%ile	A2+3 Bexp(2025)/K Lower 5th%ile
SCRL01 CMP5	**1.32**	342	-	5% ↑↓	TAC A1E max 50MT TAC A1W max 100 MT	1.44 (0.91; 2.93)	0.46 (0.29; 0.95)	354 (253; 428)	4.67 (3.89; 5.00)	0.15	0.33	0.22
V0	**1.0**	259	180	5% ↑↓	NO	1.13 (0.60; 2.66)	0.36 (0.19; 0.86)	471 (374; 476)	4.98 (4.24; 5.00)	0.11	0.17	0.17
V08	**1.08**	280	180	5% ↑↓	NO	1.20 (0.65; 2.72)	0.38 (0.21; 0.88)	438 (335; 476)	4.74 (4.06; 5.00)	0.13	0.20	0.18
V1	**1.1**	285	180	5% ↑↓	NO	1.22 (0.68; 2.73)	0.39 (0.22; 0.88)	431 (322; 476)	4.72 (4.02; 5.00)	0.13	0.21	0.19
V2	**1.2**	311	180	5% ↑↓	NO	1.33 (0.78; 2.86)	0.42 (0.25; 0.92)	396 (286; 452)	4.70 (3.87; 5.00)	0.15	0.25	0.22
V3	**1.3**	337	180	5% ↑↓	NO	1.42 (0.88; 2.93)	0.45 (0.28; 0.94)	362 (257; 430)	4.49 (3.88; 5.00)	0.18	0.29	0.25
V4	**1.4**	363	180	5% ↑↓	NO	1.50 (0.96; 3.02)	0.48 (0.31; 0.96)	329 (248; 409)	4.70 (3.79; 5.00)	0.19	0.32	0.28
V6	**1.3**		180	5% ↑↓	**TAC A1E max 50MT TAC A1W max 100 MT**	1.46 (0.92; 2.91)	0.47 (0.30; 0.94)	354 (231; 427)	4.72 (3.94; 9.51)	0.23	0.33	0.22
V7*	**1.3**		180	5% ↑↓	NO	1.35 (0.83; 2.83)	0.43 (0.26; 0.91)	394 (279; 451)	3.98 (3.14; 4.58)	0.16	0.27	0.23

*TAC may not decrease in first two seasons (2014 and 2015)

Figure 1: Plot showing the % of total SCRL effort from each area versus the catch (kg tails) per day (for the last six years). [Original plot provided by OLRAC].

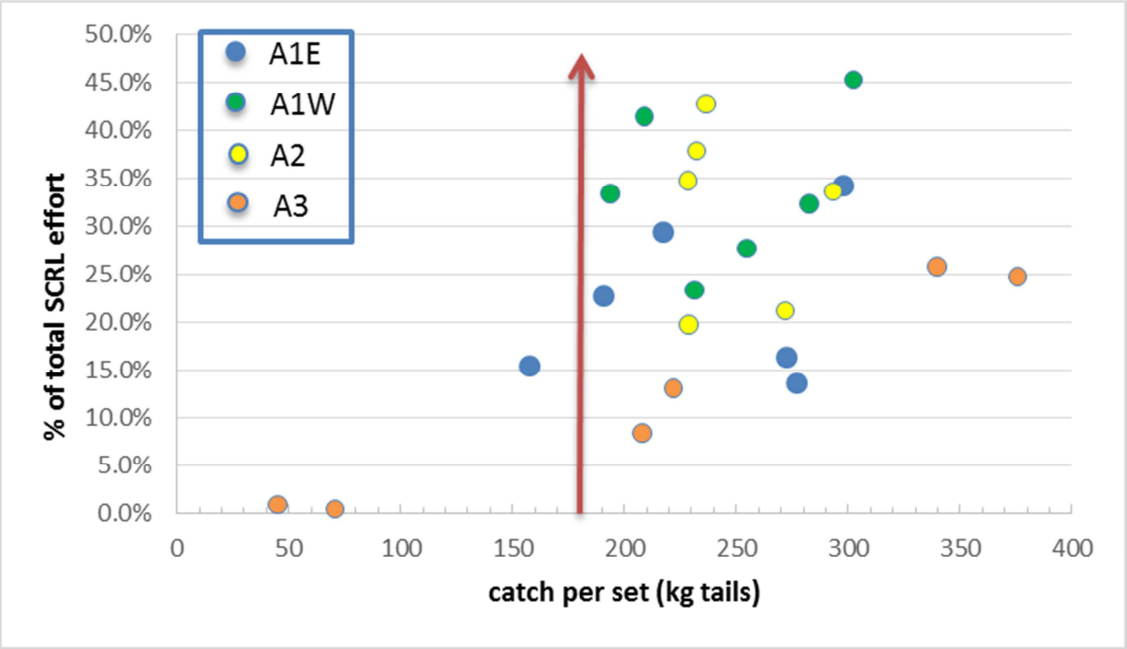

Figure 2: Results for five different CPUE target levels. The bottom plot shows the 3-year average CPUE (kg tails per day) scaled to industry nominal values.

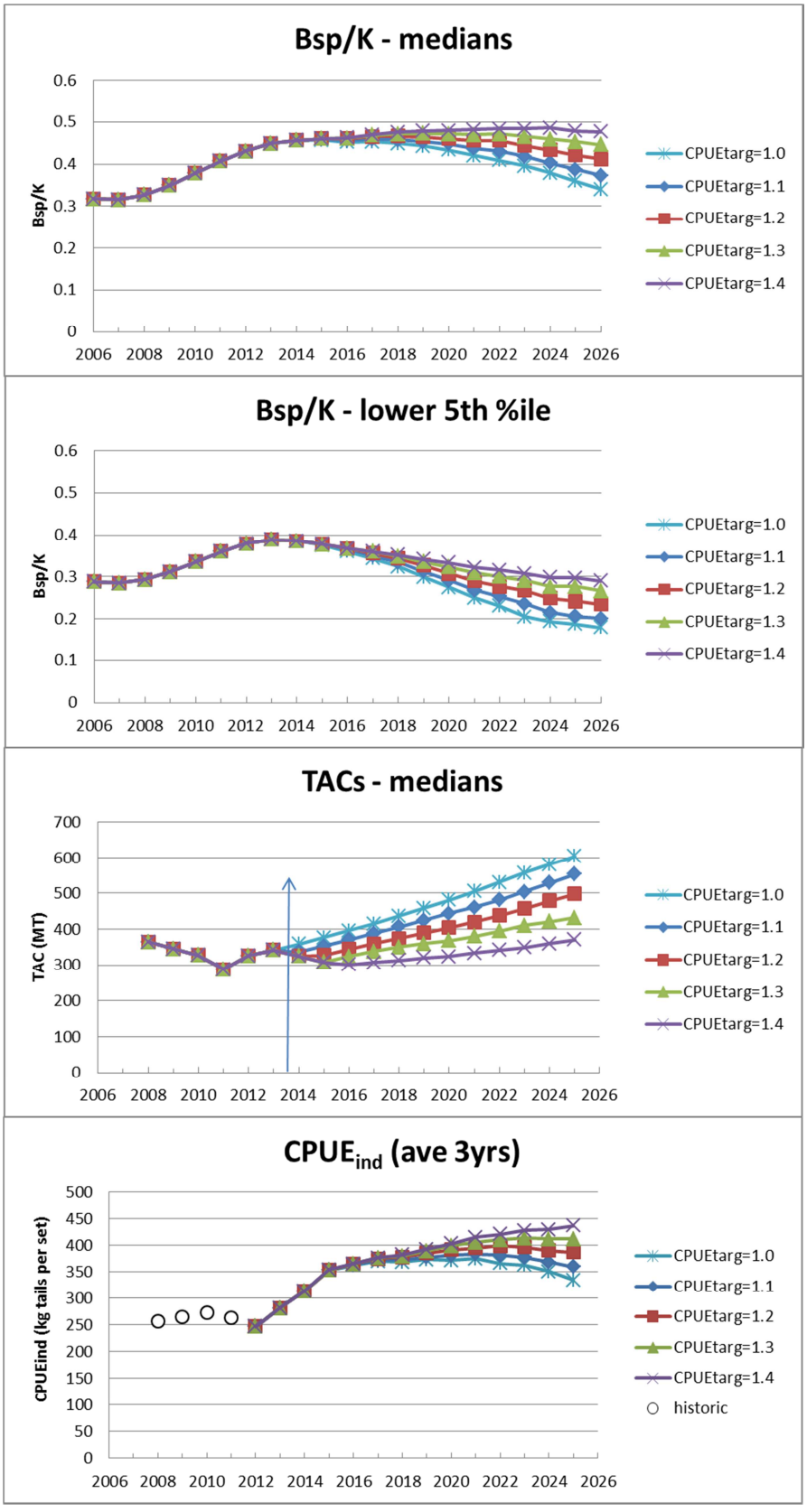

Figure 3: CPUE targ = 1.3 (V3). . The left hand plots show the medians (solid dots) with the 5th and 95th %iles as dashed lines. The right hand side plots show results for the first six (of 1000) simulations run (except for the top fight plot which is identical to the top left plot but for a shorter time period)..

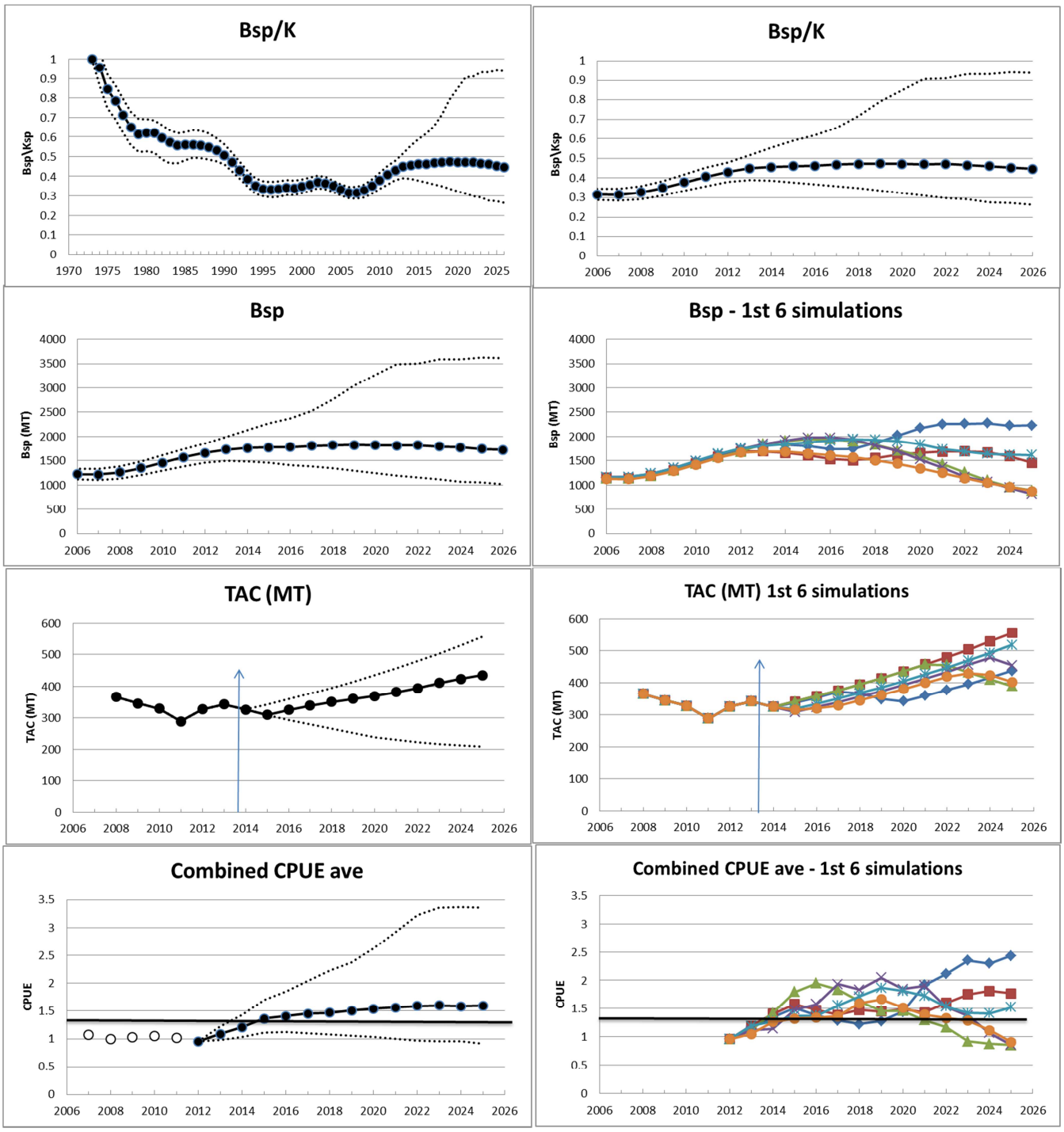

Figure 4: Estimated exploitable biomass trajectories under OMP V3 - $CPUE_{targ}$ = 1.3. . The plots show the medians (solid dots) with the 5th and 95th %iles as dashed lines. The top three plots are for the three fishing areas, with the bottom plot showing results for the resource as a whole.

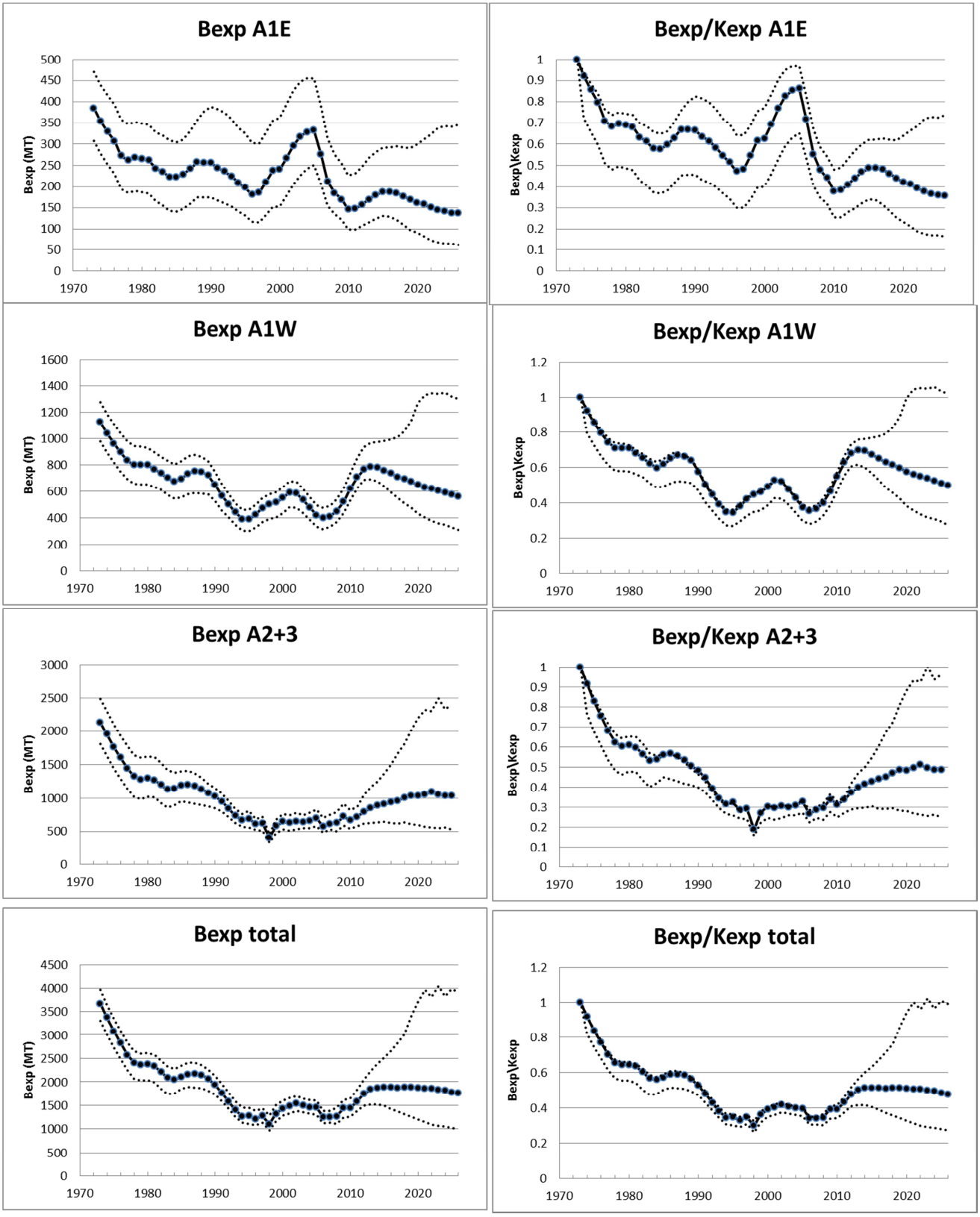

Figure 5: TAC trajectories for OMP V3 ($CPUE_{targ}$ = 1.3) for each area. The left hand plots show the medians (solid dots) with the 5th and 95th %iles as dashed lines. The right hand side plots show results for the first six (of 1000) simulations run.

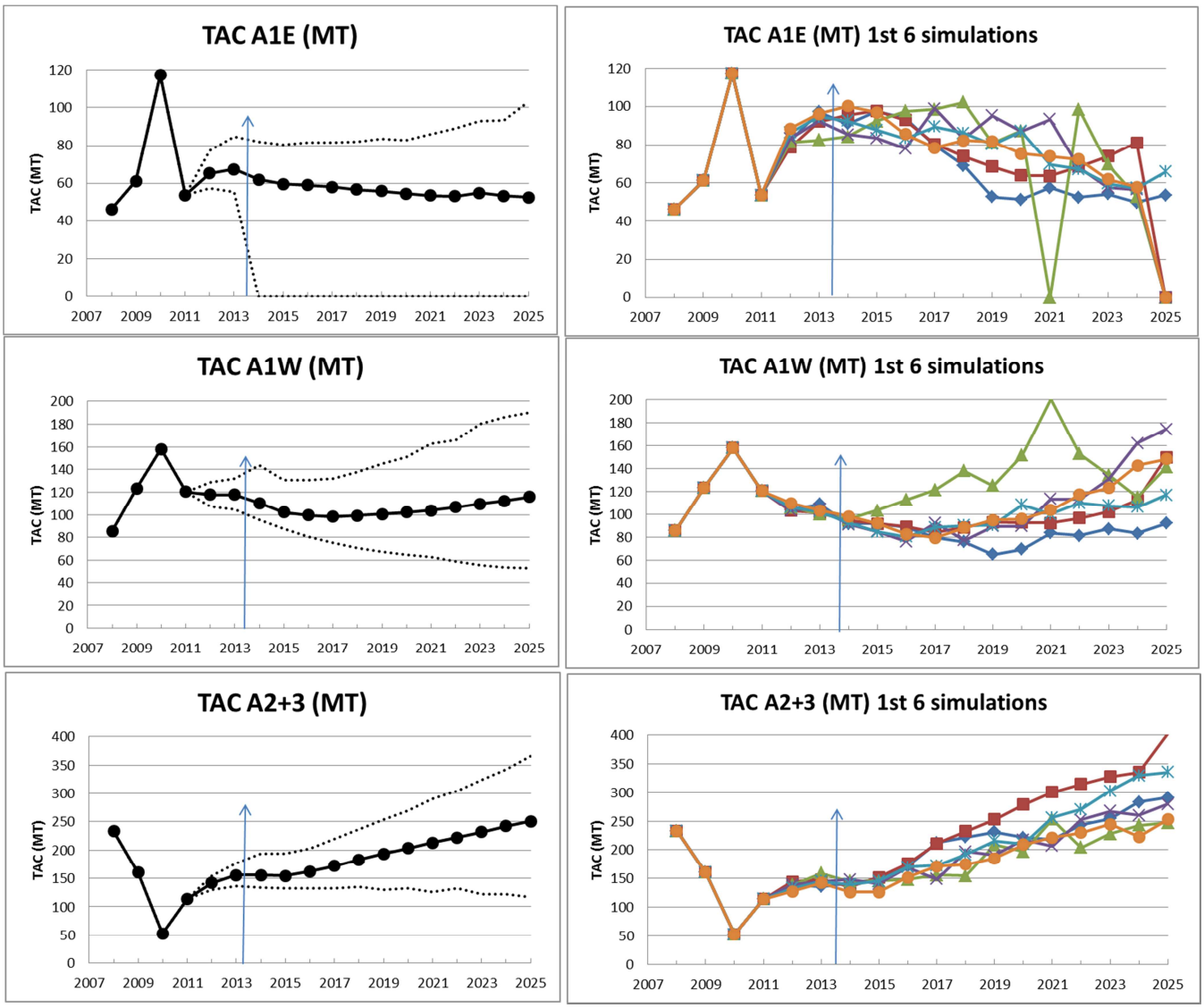

Figure 6: $CPUE_{ind}$ trajectories for OMP V3 ($CPUE_{targ}$ = 1.3) for each area. The left hand plots show the medians (solid dots) with the 5th and 95th %iles as dashed lines. The right hand side plots show results for the first six (of 1000) simulations run. The solid black line on the right hand 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)].