Results from Trials of Variants of Candidate OMP1 for the South African Hake Resource to Illustrate Trade-offs

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Introduction

This paper presents results to illustrate the trade-offs in performance that can be achieved by varying the control parameters of candidate OMP1 (see WG/07/06/D:H:21) for the hake resource.

There are two key trade-offs concerning which stakeholders will need to make decisions:

a) the extent of recovery sought for the *M. paradoxus* population: higher recovery targets mean lesser anticipated TACs (on average) in the medium term; and
b) the limitations placed on the extent of the hake TAC change allowed from one year to the next: for the same level of risk, greater limitations will generally mean lesser TACs on average.

To assist stakeholders to obtain a sense of the likely magnitude of these trade-offs, a three by three matrix of OMP1 variants has been developed by considering:

a) three different recovery tunings (median final depletions for *M. paradoxus* of approximately 20, 30 and 40% (of K^{sp}) in 2005); and
b) three limitations on the maximum allowed interannual TAC change of 3%, 5% and 10%.

To compare across comparable levels in terms of risk, the three recovery tunings are to three fixed values for the lower 5%-ile of the spawning biomass depletion for *M. paradoxus*.

Computations are carried out for the current Reference Set (RS) of trials, with equal weighting over its constituent 48 scenarios. The relative weighting of the two options for future recruitment will be reconsidered given updated assessments, and may be amended before the results upon which a final OMP variant choice is to be based, are presented.

Results

The tuning parameters of each of the nine variants of candidate OMP1 are given in Table 1.

A summary of the performance statistics for the Reference Set (RS) for each of these variants is given in Fig. 1 and Table 2[1].

Fig. 2 shows trajectories of resource abundance, CPUE and catch for an application of candidate OMP1b (central recovery tuning) with a maximum allowable change in TAC of ±5%..

Fig. 3 compares the medians and 90% PI envelopes for the three values of maximum allowable change in TAC for the central recovery tuning (OMP1b).

Fig. 4 compares the medians and 90% PI envelopes for the three different tunings for the *M. paradoxus* recovery values with a maximum allowable change in TAC of ±5%.

Note: In final appraisals, results for robustness tests as well as for the RS will need to be taken into account in making a selection between OMP1 variants.

[1] In WG/07/06/D:H: 21, the change in the survey catchability (from 2003 for the south coast survey and from 2004 for the west coast survey) due to the change in gear was not taken into account. This error, which affected only the 2007 and 2008 TAC recommendations by small amounts, has been corrected in this paper.

Table 1: Tuning parameters for each candidate OMPs presented in this paper. δ_1, δ_2 and δ_3 are the parameters of the year-dependent tuning parameter, λ_y .

	Max annual change	p	δ_1	δ_2	δ_3	Yr_join	target para	target cap	Y
OMP1a	+-3%	5	0.1	4	1.1	10	9.7%	0%	12
	+-5%	5	0.1	4	1.1	10	8.6%	0%	12
	+-10%	5	0.1	4	1.1	10	7.1%	0%	12
OMP1b	+-3%	5	0.5	2	1.1	10	6.3%	0%	10
	+-5%	5	0.5	2	1.1	10	5.8%	0%	10
	+-10%	5	0.5	2	1.1	10	5.5%	0%	10
OMP1c	+-3%	5	1.59	1.1	1.1	10	0.0%	0%	10
	+-5%	5	1.1	2	1.1	10	0.4%	0%	10
	+-10%	5	1.1	2	1.1	10	1.7%	0%	10

Table. 2: Summary of performance statistics for three values of maximum allowable change in TAC from one year to the next for candidate OMP1, tuned to three different recovery levels for *M. paradoxus*, for the RS. For each parameter, the median and 90% PIs are shown, as well as the 90% PI range. Within each recovery tuning, the three OMPs have been tuned to the lower 90% PI for *M. paradoxus* recovery (shown in bold).

		OMP1a (40% recovery)			OMP1b (30% recovery)			OMP1c (20% recovery)		
		+-3%	+-5%	+-10%	+-3%	+-5%	+-10%	+-3%	+-5%	+-10%
	avTAC	145.0 133.9 20.7 154.6	144.6 130.0 27.2 157.2	142.9 128.2 36.7 164.9	156.4 141.7 29.2 170.9	159.7 142.0 36.9 178.9	158.0 140.4 43.4 183.8	169.3 155.2 28.3 183.5	173.0 154.2 42.6 196.8	176.0 154.0 54.6 208.6
	AAV	2.38 1.911 0.828 2.739	3.21 2.390 1.488 3.878	4.33 2.636 3.321 5.957	2.46 2.081 0.737 2.817	3.38 2.560 1.564 4.124	4.56 2.797 3.264 6.061	2.56 2.191 0.687 2.878	3.64 2.866 1.478 4.344	4.98 3.520 3.593 7.113
M. paradoxus	B_{2025}/K	0.402 **0.262** 0.296 0.557	0.399 **0.263** 0.290 0.554	0.397 **0.263** 0.275 0.538	0.309 **0.189** 0.295 0.484	0.302 **0.189** 0.276 0.465	0.304 **0.189** 0.260 0.449	0.217 **0.092** 0.327 0.419	0.201 **0.092** 0.269 0.361	0.198 **0.091** 0.230 0.320
	B_{2025}/B_{2005}	3.923 2.089 4.248 6.337	3.958 2.176 3.880 6.056	3.927 2.357 3.584 5.940	3.274 1.607 3.333 4.939	3.081 1.635 3.075 4.710	2.986 1.828 2.647 4.475	2.179 0.944 2.983 3.927	1.895 0.952 2.304 3.256	1.712 1.005 1.841 2.847
	$CPUE_{2010}/CPUE_{2001\text{-}2003}$	1.663 0.923 1.754 2.677	1.689 0.944 1.720 2.665	1.704 1.005 1.644 2.649	1.647 0.909 1.714 2.623	1.649 0.943 1.627 2.570	1.680 0.988 1.571 2.559	1.584 0.857 1.745 2.602	1.567 0.825 1.699 2.524	1.548 0.845 1.489 2.335
	$CPUE_{2015}/CPUE_{2001\text{-}2003}$	2.118 1.162 2.060 3.222	2.102 1.331 1.852 3.183	2.155 1.472 1.685 3.157	1.921 1.117 1.872 2.989	1.885 1.207 1.692 2.899	1.940 1.341 1.538 2.878	1.627 0.767 2.014 2.781	1.557 0.830 1.708 2.538	1.441 0.853 1.382 2.235
	Min B_{2025}/B_{2005} over proj. period	1.000 0.726 0.274 1.000	1.000 0.729 0.271 1.000	1.000 0.729 0.271 1.000	1.000 0.726 0.274 1.000	1.000 0.729 0.271 1.000	1.000 0.729 0.271 1.000	1.000 0.598 0.402 1.000	1.000 0.493 0.507 1.000	0.998 0.494 0.506 1.000
M. capensis	B_{2025}/K	0.715 0.625 0.272 0.898	0.711 0.621 0.272 0.893	0.704 0.616 0.280 0.896	0.676 0.592 0.275 0.867	0.663 0.577 0.285 0.862	0.660 0.560 0.301 0.861	0.628 0.534 0.260 0.794	0.614 0.495 0.304 0.800	0.601 0.478 0.322 0.800
	B_{2025}/B_{2005}	1.585 1.249 0.833 2.082	1.599 1.266 0.810 2.076	1.605 1.270 0.786 2.057	1.531 1.181 0.765 1.946	1.524 1.176 0.758 1.934	1.515 1.207 0.723 1.930	1.435 1.120 0.678 1.798	1.410 1.119 0.622 1.741	1.380 1.108 0.581 1.688
	$CPUE_{2010}/CPUE_{2001\text{-}2003}$	1.360 1.131 0.528 1.660	1.363 1.134 0.523 1.657	1.363 1.137 0.528 1.664	1.353 1.126 0.520 1.646	1.350 1.127 0.516 1.643	1.350 1.131 0.531 1.662	1.335 1.104 0.531 1.635	1.329 1.108 0.520 1.628	1.320 1.098 0.531 1.629
	$CPUE_{2015}/CPUE_{2001\text{-}2003}$	1.525 1.243 0.564 1.808	1.528 1.260 0.537 1.797	1.522 1.290 0.463 1.753	1.484 1.222 0.524 1.746	1.476 1.225 0.502 1.728	1.493 1.239 0.509 1.748	1.398 1.146 0.503 1.649	1.376 1.138 0.476 1.614	1.348 1.107 0.482 1.588
	Min B_{2025}/B_{2005} over proj. period	1.000 0.985 0.015 1.000	1.000 0.985 0.015 1.000	1.000 0.985 0.015 1.000	1.000 0.985 0.015 1.000	1.000 0.985 0.015 1.000	1.000 0.985 0.015 1.000	1.000 0.982 0.018 1.000	1.000 0.978 0.022 1.000	1.000 0.972 0.028 1.000

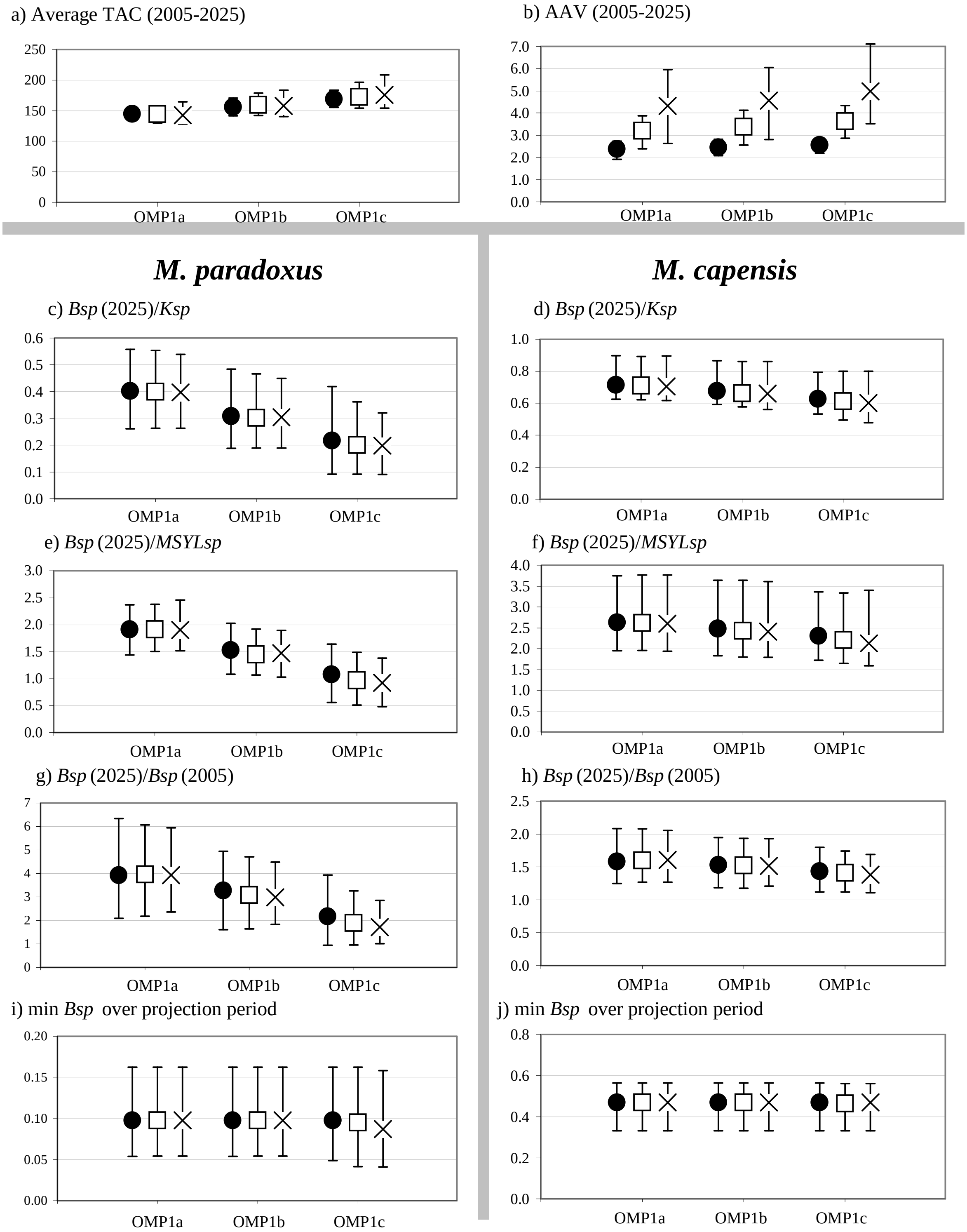

Fig. 1: Graphical summary of performance statistics for three values of maximum allowable change in TAC from one year to the next (black circle for 3%, white square for 5% and cross for 10%) for candidate OMP1, tuned to three different recovery levels for *M. paradoxus*, for the RS. Each panel shows medians together with 90% PIs.

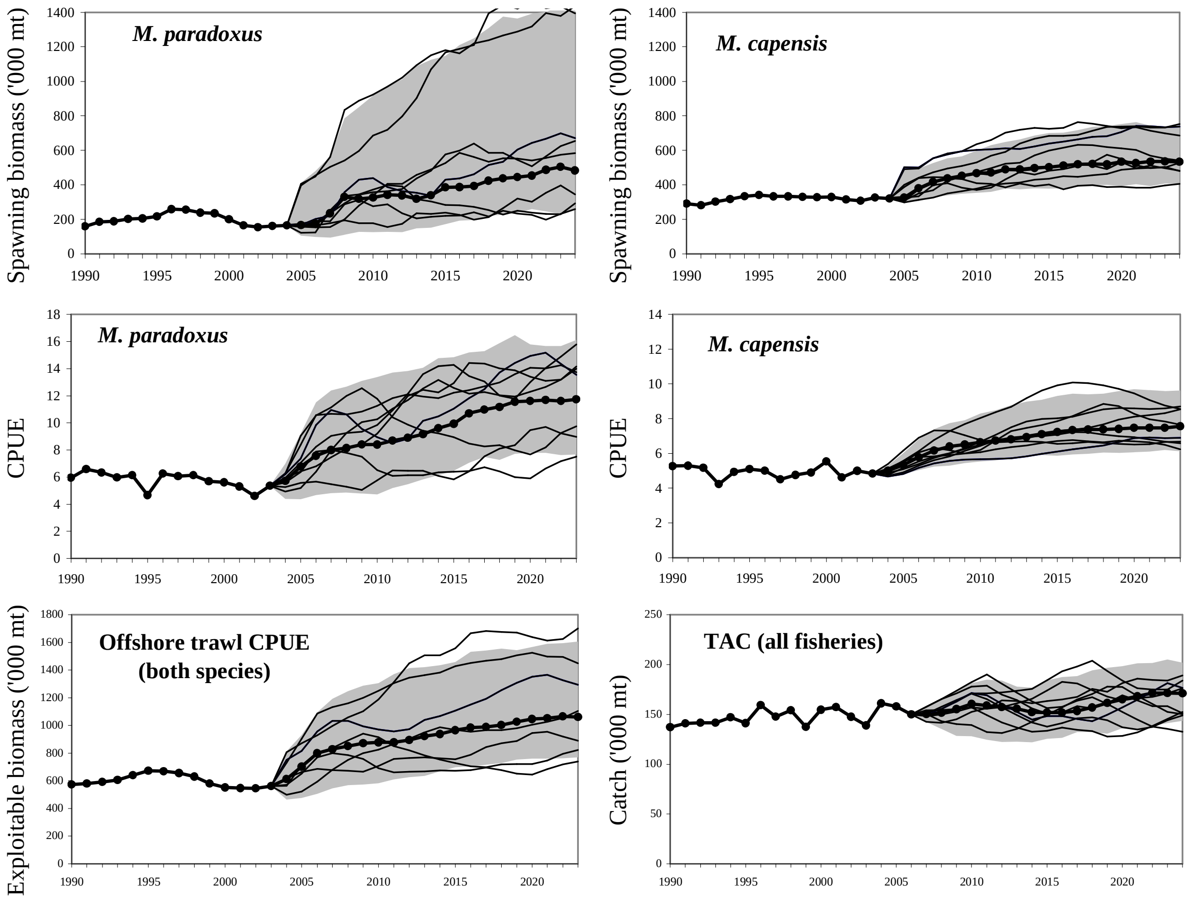

Fig. 2: Trajectories of resource abundance and catch for an application of candidate **OMP1b** (*M. paradoxus* median depletion recovery of about 30% in 2025) to the RS. The maximum allowable change in TAC from one year to the next is **±5%**. Ten individual trajectories are shown, with the median a dark dotted line; the shaded areas show 90% probability envelopes. Note units for species combined CPUE are those of the exploitable biomass to which it corresponds. Pre-2005, the median spawning biomass and species combined CPUE trajectories of the RS and the actual species disaggregated CPUE and total catch are also shown.

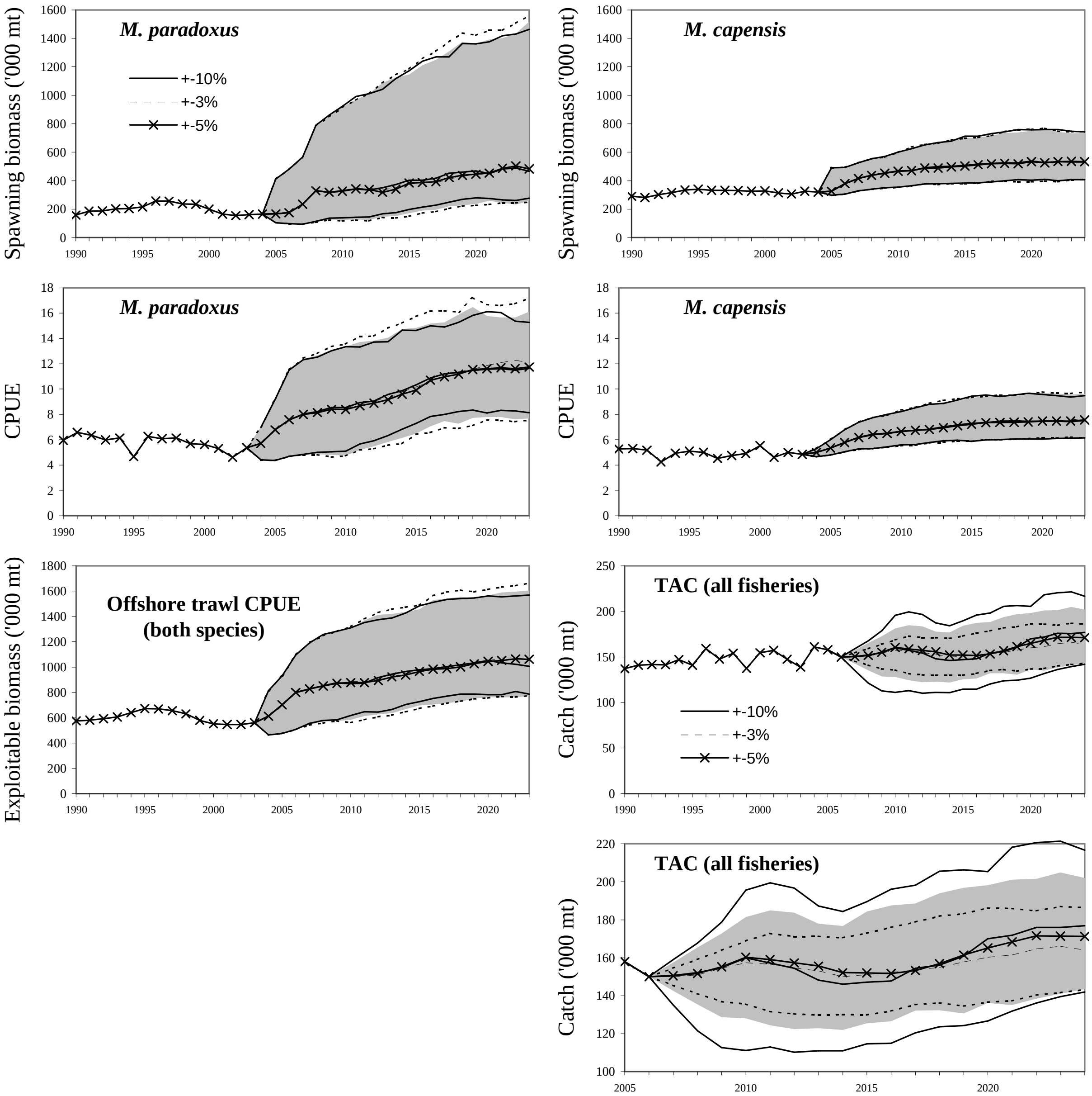

Fig. 3: Trajectories of resource abundance and catch for an application of candidate **OMP1b** to the RS. The medians and 90% PIs are shown for three values for the maximum allowable change in TAC from one year to the next (dotted lines for ±3%, full lines and shaded area for ±5% and line with crosses for ±10%). Note units for species combined CPUE are those of the exploitable biomass to which it corresponds. Pre-2005, the median spawning biomass and species combined CPUE trajectories of the RS and the actual species disaggregated CPUE and total catch are also shown.

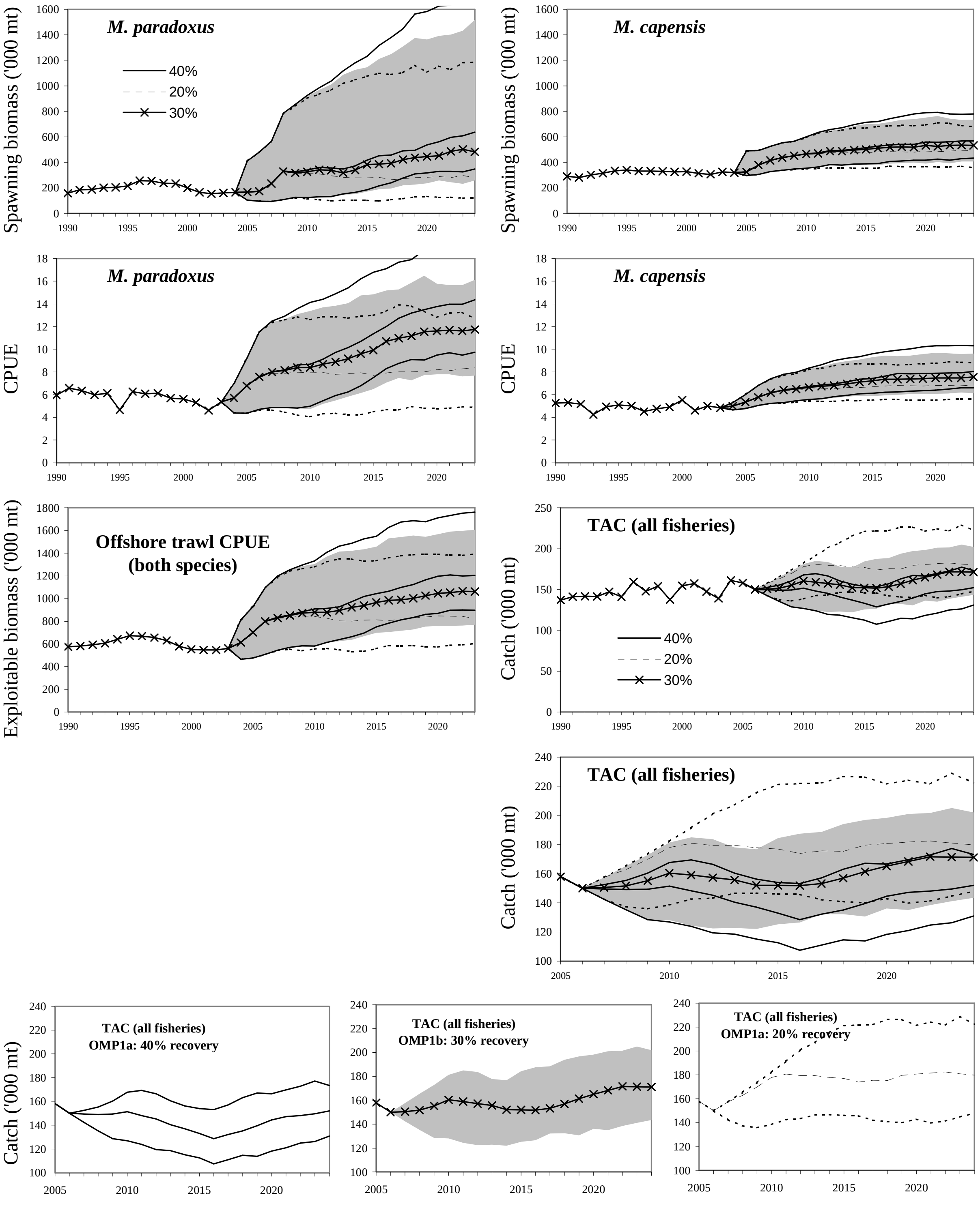

Fig. 4: Trajectories of resource abundance and catch for an application of candidate **OMP1** with **5%** maximum allowable change in TAC from one year to the next to the RS. The medians and 90% PIs are shown for three different recovery levels for *M. paradoxus* (dotted lines for 20%, full lines and shaded area for 30% and line with crosses for 40% of pre-exploitation spawning biomass). Note units for species combined CPUE are those of the exploitable biomass to which it corresponds. Pre-2005, the median spawning biomass and species combined CPUE trajectories of the RS and the actual species disaggregated CPUE and total catch are also shown. Note: Strictly the tuning is to the lower 5%-ile of the *M. paradoxus* depletion, but is expressed here in terms of the median which is approximately constant across these tunings.