Output from the South African Hake OMP-2022 for the 2023 TAC recommendation

A. Ross-Gillespie and D.S. Butterworth[1]

October 2022

Summary

The TAC output from the South African hake OMP-2018 for 2022 is **138 760t**, an increase of 5% from the 2022 TAC. All abundance indices show either an improvement or a roughly similar level when compared to recent years.

Keywords: South African Hake, OMP-2022, 2023 TAC recommendation

1. OMP-2022 formulae application

The formula for computing the TAC recommendation under OMP-2022 is as follows:

$$TAC_{y+1} = C_{y+1}^{para} + C_{y+1}^{cap} \quad (1)$$

with

$$C_{y+1}^{spp} = b^{spp}\left(J_y^{spp} - J_0^{spp}\right) \quad (2)$$

where

TAC_y is the total TAC recommended for year *y*,

C_y^{spp} is the intended species-disaggregated TAC for species *spp* year *y*,

J_0^{spp} and b^{spp} are tuning parameters (see Table 1), and

J_y^{spp} is a measure of the immediate past level in the abundance indices for species *spp* that is available to use for calculations for year *y.*

J_y^{spp} for the abundance indices is computed as follows:

$$J_y^{par} = \frac{1.0J_y^{WC\_CPUE,par} + 0.75J_y^{SC\_CPUE,par} + 0.5\left(\frac{n_{WC\_surv}}{3}\right)J_y^{WC\_surv,par} + 0.25\left(\frac{n_{SC\_surv}}{3}\right)J_y^{SC\_surv,par}}{1 + 0.75 + 0.5\left(\frac{n_{WC\_surv}}{3}\right) + 0.25\left(\frac{n_{SC\_surv}}{3}\right)} \quad (3)$$

$$J_y^{cap} = \frac{1.0J_y^{WC\_CPUE,cap} + 0.75J_y^{SC\_CPUE,cap} + 0.5\left(\frac{n_{WC\_surv}}{3}\right)J_y^{WC\_surv,cap} + 1.0\left(\frac{n_{SC\_surv}}{3}\right)J_y^{SC\_surv,cap}}{1 + 0.75 + 0.5\left(\frac{n_{WC\_surv}}{3}\right) + 1.0\left(\frac{n_{SC\_surv}}{3}\right)} \quad (4)$$

with

$$J_y^{WC/SC\_CPUE,spp} = \sum_{y'=y-3}^{y-1} I_y^{WC/SC\_CPUE,spp} \Big/ \sum_{y=2011}^{2020} I_y^{WC/SC\_CPUE,spp} \quad (5)$$

$$J_y^{WC/SC\_surv,spp} = \sum_{y'=y-2}^{y} I_y^{WC/SC\_surv,spp} \Big/ \sum_{y=2012}^{2021} I_y^{WC/SC\_surv,spp} \quad (6)$$

[1] Marine Resource Assessment and Management Group, Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch, 7701.

and where n_{WC_surv} and n_{SC_surv} are the number of surveys which took place in these last three years, i.e., the survey index will effectively be down-weighted if not all three surveys took place.

Thus, the weighting of the different indices (denoted by *I*) is taken to be the same as for OMP-2018. The normalization approach, however, has been updated from that used for OMP-2018. For OMP-2022, the indices are normalised relative to the data available over the last 10 years (2011 to 2020 for CPUE data and 2012-2021 for survey data), rather than three years in the 2010-2013 period as was done for OMP-2018 (2010-2012 for CPUE data and 2011-2013 for survey data).

Table 2 reports the GLM-standardised CPUE series (J. Glazer *pers. comm.*) and survey biomass abundance estimates (Fairweather, 2022), with the J^{i}_{2022} and J_{2022} values (from equations 3 to 6). The 2013 to 2016 survey biomass estimates are from industry vessels (with the exception of the 2016 spring survey, which was conducted by the *Africana*) and are taken to have the same *q* as the *Africana* New Gear. The 2017 to 2022 surveys have been conducted by the *Africana* using the New Gear.

The J^{spp}_{2021} values are then computed as:

$$J^{para}_{2021} = \frac{1.0(0.964)+0.75(0.959)+0.5\left(\frac{2}{3}\right)(0.931)+0.25\left(\frac{1}{3}\right)(0.712)}{1.0+0.75+0.5\left(\frac{2}{3}\right)+0.25\left(\frac{1}{3}\right)} = 0.948$$

$$J^{cap}_{2021} = \frac{1.0(1.174)+0.75(1.151)+0.5\left(\frac{2}{3}\right)(1.324)+1.0\left(\frac{1}{3}\right)(1.004)}{1.0+0.75+0.5\left(\frac{2}{3}\right)+1.0\left(\frac{1}{3}\right)} = 1.167$$

and the catch by species is then:

$$C^{para}_{2021} = 88.02(0948 - (-0.268)) = 107.013$$

$$C^{cap}_{2021} = 35(1.167 - (-0.160)) = 46.446$$

so that the TAC recommendation before applying the constraints on maximum allowable annual change, would be 153.46 thousand tons.

1.1 Maximum allowable annual change

The maximum allowable annual increase in TAC is 5%, and the maximum allowable annual decrease in TAC is 5% unless the *M. paradoxus* average biomass index falls too low, in which case the maximum allowable annual decrease becomes:

$$MaxDecr_y = \begin{cases} 5\% & \text{if } J_y \geq J^{thresh1} \\ \text{linear between x\% and 5\%} & \text{if } J^{thresh2} \leq J_y < J^{thresh1} \\ \text{x\%} & \text{if } J_y < J^{thresh2} \end{cases} \quad (7)$$

x, $J^{thresh1}$ and $J^{thresh1}$ are tuning parameters (see Table 1).

Here, the *M. paradoxus* average biomass index (0.948) is above $J^{thresh1}$ (0.75), so that the maximum allowable increase of 5% would apply: the TAC recommendation after applying the constraint is hence 138 760t (an increase 5% from a 2021 TAC of 132 154t).

1.2 Upper cap and fixed TAC

Two further rules are included in OMP-2022:

i. An upper cap on the TAC is imposed, so that the TAC cannot exceed 160 000t.

ii. The TAC for 2023 is fixed at 138 760 tons (a 5% increase of the 2022 TAC). The TAC for 2024 is at least 138 760 tons, i.e., the 2024 TAC may be above the 2023 TAC, but may not be reduced below the 2023 TAC.

Hence the final TAC recommendation for 2022 is 138 760t.

2. Additional points for discussion

The recent data are compared to the projections under OMP-2022 for the Reference Set of Operating Models (RS) in Figure 1 (commercial CPUE), Figure 2 (survey indices) and Figure 3 (proportion of *M. capensis* in the offshore trawl catch). The most recent data points for CPUE and survey indices all lie within the probability envelope bounds projected; consequently, they indicate no need for Exceptional Circumstances to be triggered. In 2022, the summer west coast survey took place, but not the autumn south coast survey. The *M. paradoxus* west coast survey index is roughly the same as the 2020 estimate while the *M. capensis* west coast index higher than the 2020 value. All of the four 2021 CPUE indices show an increase from their 2020 values.

The recent proportions of *M. capensis* in the offshore trawl fishery catch (Figure 3) lie below the probability envelopes for 2021. The west coast proportion is only slightly below the lower bound of the probability envelope, but the south coast proportion lies below the bound more markedly. Noting that (a) the south coast value is now more similar to that in 2017 and previously before a notable increase took place over 2018-2020, and (b) the 2021 south coast value would lie within the projected bounds in a year or two if it does not decrease further, it would seem defensible not to trigger Exceptional Circumstances at this time on this basis.

References

Fairweather, T.P. 2022. Standardised abundance estimates for key commercial species 2016-2022. DEFF Fisheries document: FISHERIES/2022/SEP/SWG-DEM/19: 2pp.

Table 1: Tuning parameters for OMP-2022.

	M. paradoxus	*M. capensis*
J_0	-0.268	-0.16
b	88.02	35.00
$J^{thresh1,para}$	0.75	
$J^{thresh2,para}$	0.65	
$J^{thresh,cap}$		0.60
x	25	

Table 2: GLM standardised CPUE series and west coast summer and south coast autumn survey abundance estimates.

	M. paradoxus				*M. capensis*			
	WC CPUE	SC CPUE	Summer survey	Autumn survey	WC CPUE	SC CPUE	Summer survey	Autumn survey
2007	6.501	2.816	407.38	102.20	1.644	2.868	73.23	65.94
2008	7.033	2.813	238.14	33.03	2.020	3.770	52.58	102.17
2009	7.227	3.292	310.76	45.03	2.953	6.472	140.44	111.19
2010	8.052	3.543	653.28	53.16	2.637	5.234	249.08	261.14
2011	7.849	4.070	380.19	21.05	3.129	5.956	89.10	105.42
2012	6.872	3.718	405.87		2.663	3.943	84.75	
2013	6.881	4.154	136.26		2.724	3.948	30.38	
2014	6.935	3.853	269.48	62.93	2.230	2.850	219.76	63.39
2015	9.007	3.712	207.58	111.41	2.765	2.922	65.09	76.06
2016	9.112	3.884	312.88	94.18	2.754	3.865	115.06	83.20
2017	8.182	4.152	319.02		2.823	5.195	69.29	
2018	7.204	4.685			2.904	9.388		
2019	6.585	3.629	243.56	33.18	2.836	7.010	62.56	132.10
2020	7.405	3.609	243.09		3.219	4.963	109.98	
2021	8.006	4.118		50.06	3.827	5.437		89.12
2022			254.72				140.57	
J^i_{2022}	0.964	0.959	0.931	0.712	1.17446	1.15975	1.32419	1.00390
w^i	1.000	0.750	$0.500\left(\frac{2}{3}\right)$	$0.250\left(\frac{1}{3}\right)$	1.000	0.750	$0.500\left(\frac{2}{3}\right)$	$1.00\left(\frac{1}{3}\right)$
J_{2022}	0.948				1.167			

* The 2013 to 2016 survey results are from industry vessels (excepting the 2016 spring survey, which was conducted by the *Africana*), and are taken to have the same *q* as the *Africana* New Gear.

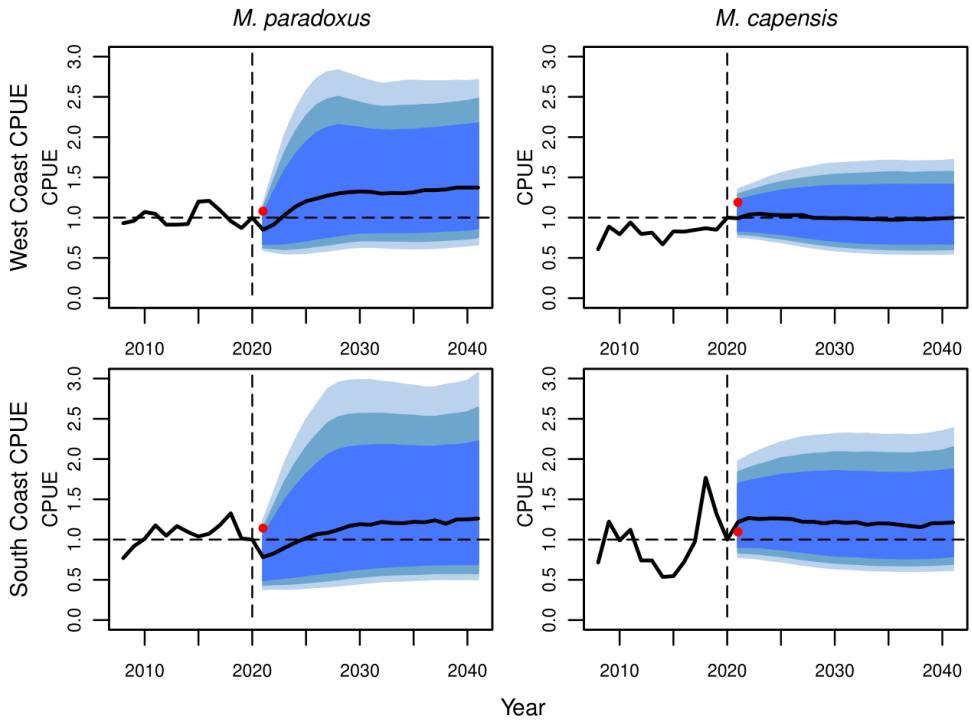

Figure 1: 95, 90, 80% probability envelopes (PEs) and medians for the projected GLM-standardised CPUE for *M. paradoxus* and *M. capensis* for the updated RS under OMP-2022 (from FISHERIES/2022/OCT/SWG-DEM/34). The red dots show the 2021 CPUE indices, which have been standardised relative to the 2020 value in the updated GLM series.

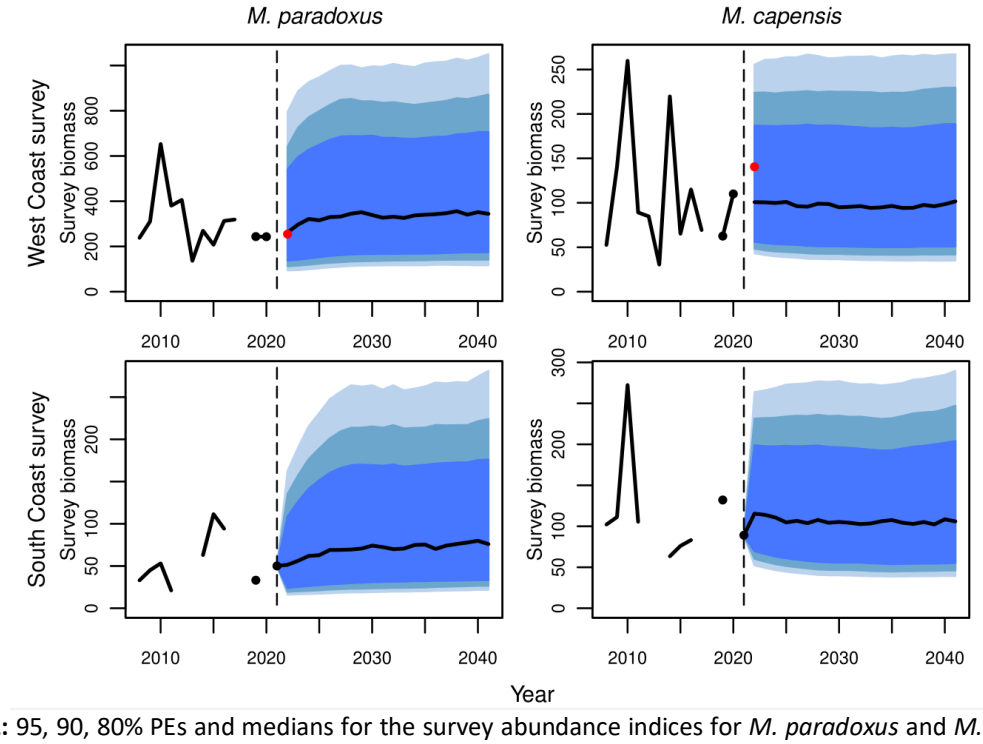

Figure 2: 95, 90, 80% PEs and medians for the survey abundance indices for *M. paradoxus* and *M. capensis* for the updated RS under OMP-2022. Gaps in the median trajectories reflect years for which surveys did not take place. Estimates from the 2022 summer survey are indicated by red dots. Note: future surveys are assumed to be carried out using the New Gear on the *Africana*; if an industry vessel is used instead, the resultant estimates must be multiplied by 1.25 before comparison with the bounds in these plots.

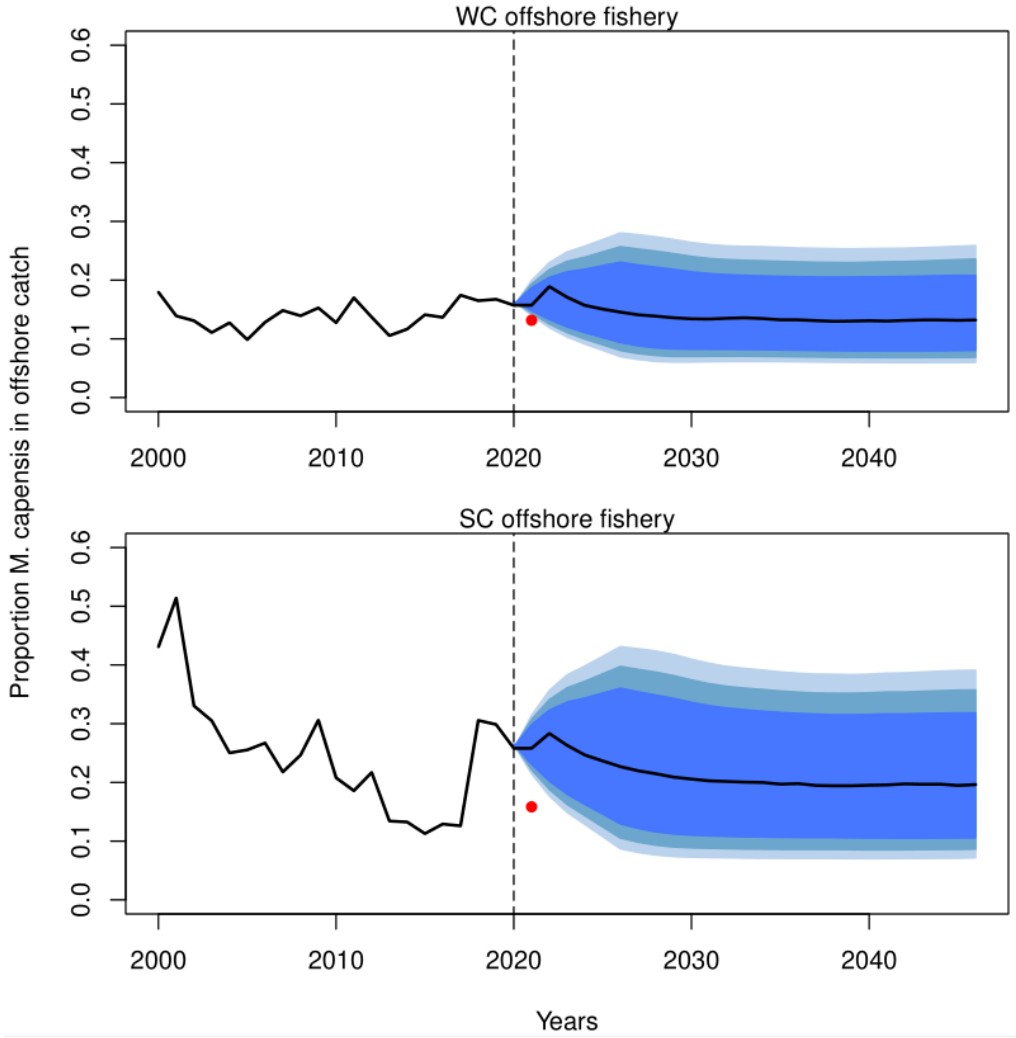

Figure 3: 95, 90, 80% PEs and median for the proportion *M. capensis* in the offshore trawl catch, with the 2021 observed proportions indicated by the red dots.