

Recommendation for the 2014 TAC for the Horse Mackerel Directed Midwater Fishery

L.B. Furman
Marine Resource Assessment and Management Group (MARAM)
Department of Mathematics and Applied Mathematics
University of Cape Town

Summary

The control rule for the horse mackerel midwater TAC indicates a 10% increase from 2013 to 2014 corresponding to a TAC of 38115 tonnes.

The 2013 TAC for the horse mackerel directed midwater fishery was set at 34650 tonnes using a rule of the form:

$$TAC_{mw}(y+1) = \Delta(y)TAC_{mw}(y)$$

where

$$\Delta(y) = \begin{cases} 1 - X_{decr} & \text{for } I(y) < I_{decr} \\ 1 - X_{decr} + \frac{X_{incr} + X_{decr}}{I_{incr} - I_{decr}}(I(y) - I_{decr}) & \text{for } I_{decr} \leq I(y) < I_{incr} \\ 1 + X_{incr} & \text{for } I(y) \geq I_{incr} \end{cases}$$

and $X_{decr} = 15\%$, $X_{incr} = 10\%$, $I_{decr} = 0.55$ and $I_{incr} = 1.26$. $I(y)$ is a combined index that compares recent CPUE and survey abundance indices to their historical averages over the period 2003-2009. It is given by:

$$I_y = w CPUE_y^{rel} + (1 - w) Survey_y^{rel}$$

where

$$w = 0.82, \quad CPUE_y^{rel} = \frac{\frac{1}{3} \sum_{y=3}^{y-1} CPUE_i}{\frac{1}{7} \sum_{2003}^{2009} CPUE_i} \quad \text{and} \quad Survey_y^{rel} = \frac{\frac{1}{3} \sum_{y=3}^{y-1} Survey_i}{\frac{1}{7} \sum_{2003}^{2009} Survey_i}.$$

Data from the 2012 Autumn demersal survey is required in order to calculate the 2014 TAC. Unfortunately, this survey was not conducted. Table 1 list available CPUE (see also Appendix 1) and survey data, and Figure 1 shows their trend.

Three approaches to dealing with the missing survey are considered.

- Rule 1:** Remove the year with missing data from calculations.
- Rule 2:** Assume that $Survey_{2012} = Survey_{2011}$
- Rule 3:** Assume proportionality: $\frac{Survey_{2012}}{Survey_{2011}} = \frac{CPUE_{2012}}{CPUE_{2011}}$, so that $Survey_{2012} = Survey_{2011} \times \frac{CPUE_{2012}}{CPUE_{2011}}$

Table 2 shows the results of these different rules. In summary, abundance indices from 2010 and onwards are high compared to their historical averages. Consequently, all three rules give $I_{2014} > I_{incr} = 1.26$ and hence a **midwater TAC for 2014 of 38115 tonnes**, which is the maximum allowed increase of 10% over last year's TAC.

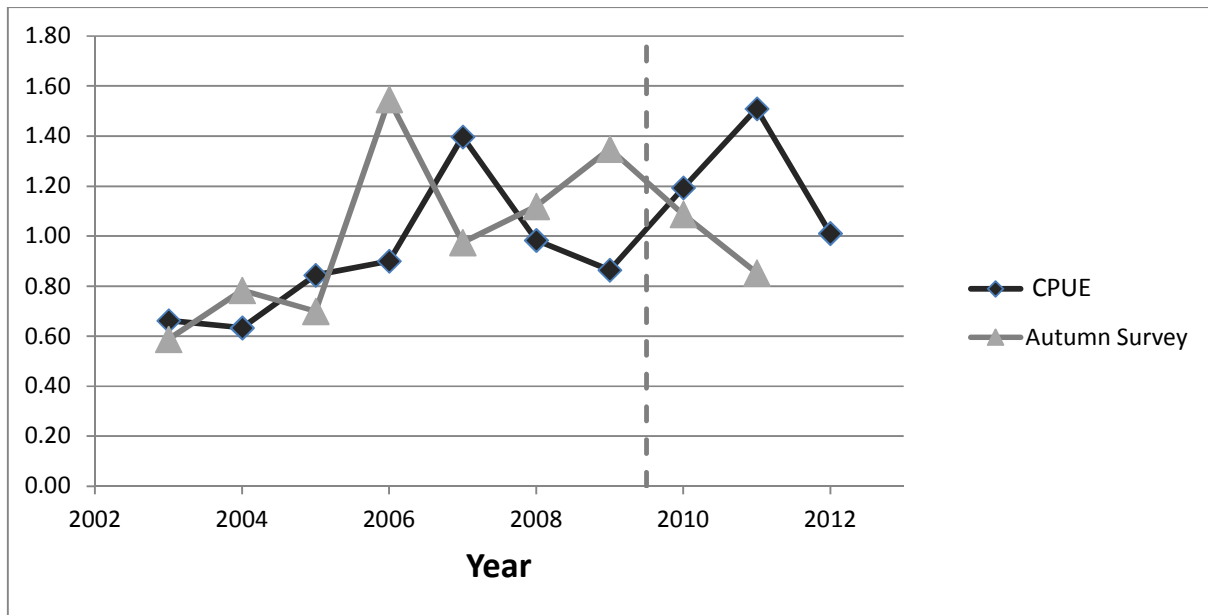
Table 1: *Desert Diamond* CPUE and Autumn demersal survey abundance indices. The shaded values are used to calculate "recent" abundance. Note there was no survey in 2012.

Year	CPUE	Survey
2003	0.66	0.59
2004	0.63	0.78
2005	0.84	0.70
2006	0.90	1.55
2007	1.40	0.97
2008	0.98	1.12
2009	0.86	1.35
2010	1.19	1.09
2011	1.51	0.85
2012	1.01	

Table 2: Results of three different approaches to dealing with the missing 2012 survey.

Rule	I_{2014}	TAC_{2014}
1	1.30	38115
2	1.30	38115
3	1.28	38115

Figure 1: *Desert Diamond* GLM standardized CPUE (see also Appendix 1) and Autumn demersal survey abundance indices. The dashed vertical line indicates the division between “recent” and “historical” indices for the purposes of calculating the 2014 TAC.



Appendix 1

Updated CPUE series

This appendix describes the process used to update the CPUE series from that in reported in FISHERIES/2012/OCT/SWG-DEM/23.

The CPUE series is standardized by a GLM of the form:

$$\ln(\text{CPUE} + \delta) = \beta_{\text{wind speed}} \times \text{wind speed} + \beta_{\text{lunar phase}} \times \text{lunar phase} + (\beta_{\text{depth}} + \beta_{\text{depth.longitude}}) \times \text{depth} + \alpha_{\text{wind direction}} + \alpha_{\text{year}} + \alpha_{\text{month}} + \alpha_{\text{time}} + \alpha_{\text{longitude}} + \alpha_{\text{wind direction}} + \mu$$

where

$\text{CPUE} = \text{catch} / (\text{trawl time} \times \text{trawl speed} \times \text{vertical opening})$ is the catch per unit effort for the trawl,

μ is the intercept,

α are contributions from categorical factors and

β are regression coefficients associated with continuous factors.

Cooper and van der Westhuizen (*pers. comm*) provided new data from the *Desert Diamond* for the 2011 and 2012 fishing seasons. Trawl records from 1/1/2011 to 18/5/2011 were not used in the GLM, because their format is different from the

rest of the data and the *vertical opening* of the nets is not recorded. More time will be required to incorporate these records into the GLM.

The resulting GLM standardised CPUE series is reported in Table 1 of the main paper.