

## Final Anchovy and Sardine TACs and TABs for 2017, Using OMP-14

Carryn L de Moor\*

Correspondence email: [carryn.demoor@uct.ac.za](mailto:carryn.demoor@uct.ac.za)

Following the recent 2017 recruit survey, the revised 2017 South African anchovy and sardine TACs and TABs are to be recommended. The following data have been used:

- 1) November 2016 survey estimate of sardine biomass: 258 575 tonnes.
- 2) November 2016 survey estimate of anchovy biomass: 1 733 040 tonnes.
- 3) June 2017 survey estimate of anchovy recruitment: 830.201 billion.
- 4) June 2017 survey estimate of sardine recruitment: 7.156 billion.
- 5) Time after 1 May that the survey commenced: 1.367 months (survey commenced on 12<sup>th</sup> June)
- 6) Anchovy recruit catch from 1<sup>st</sup> November to 11<sup>th</sup> June, using monthly cut-off lengths from de Moor *et al.* 2012 and assuming recruit cut-off lengths of 9cm for April to June: 17.496 billion
- 7) Anchovy adult catch from 1<sup>st</sup> November to 11<sup>th</sup> June, using monthly cut-off lengths from de Moor *et al.* 2012 and assuming cut-off lengths of 9cm for April to June: 3.490 billion
- 8) Juvenile sardine : anchovy ratio (by mass) observed in the June recruitment survey: 0.00903
- 9) Juvenile sardine : anchovy ratio (by mass) observed in the May commercial catches: 0.0394
- 10) Directed >14cm sardine TAC for 2016: 64 928 tonnes.
- 11) Directed anchovy TAC for 2016: 354 326 tonnes.

Using the above data, the final 2017 TAC and TAB recommendations are calculated by OMP-14 (de Moor and Butterworth 2014) to be:

Final directed >14cm sardine TAC:	45 560 tonnes
Final $\leq$ 14cm sardine TAB with directed >14cm sardine fishing:	3 189 tonnes
Final anchovy TAC:	450 000 tonnes
Final $\leq$ 14cm sardine TAB with directed anchovy fishing:	29 969 tonnes
>14cm sardine TAB with directed round herring and anchovy fishing:	7 000 tonnes
$\leq$ 14cm sardine TAB with directed round herring fishing:	1 000 tonnes
Anchovy TAB for sardine only right holders:	500 tonnes

The equations used to calculate these TAC/Bs are given in the Appendix.

### Comments on the TACs

As the November survey estimate of sardine abundance was less than 300 000t, the Exceptional Circumstances rule was used resulting in an initial directed >14cm sardine TAC being recommended at the beginning of the year. The final directed >14cm sardine TAC is dependent on the May survey estimate of

---

\* MARAM (Marine Resource Assessment and Management Group), Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch, 7701, South Africa.

7.156 billion sardine recruits, which was below the historical average of 13.74 billion. This historical average is the threshold at which the final directed >14cm sardine TAC would equal the “original TAC” of 59 910t. The final directed >14cm sardine TAC is thus calculated as 45 560t.

The final desirable maximum directed >14cm sardine TAC to be caught west of Cape Agulhas during 2017 is calculated as the average of two methods (de Moor 2017) and is 24 140t. The first method, being the upper bound of the “Gentleman’s Agreement”, gives a maximum catch of  $(0.49+0.10) \times 45\,560\text{t} = 26\,880\text{t}$ , while the second method, based on a short-term projection of the resource to November 2017, remains at a maximum catch of 21 400t as the observed recruitment was below the recent average.

The  $\leq 14\text{cm}$  sardine TAB associated with this directed sardine TAC is also revised, given its dependence on the directed >14cm sardine TAC.

The final anchovy TAC was subject to the maximum TAC constraint of 450 000t. Exceptional Circumstances do not apply.

### **Acknowledgements**

Janet Coetzee and Jan van der Westhuizen are thanked for providing the input data for these computations.

### **References**

- de Moor CL. The Agreed Method to Determine the Maximum Sardine Catch West of Cape Agulhas During 2017. Department of Agriculture, Forestry and Fisheries: Branch Fisheries Report No FISHERIES/2017/JUN/SWG-PEL/19.
- de Moor CL, Coetzee J, Durholtz D, Merkle D, van der Westhuizen JJ and Butterworth DS. 2012. A record of the generation of data used in the 2012 sardine and anchovy assessments. Department of Agriculture, Forestry and Fisheries: Branch Fisheries Report No FISHERIES/2012/AUG/SWG-PEL/41.
- de Moor CL and Butterworth DS. 2014. OMP-14. Department of Agriculture, Forestry and Fisheries: Branch Fisheries Report No FISHERIES/2014/DEC/SWG-PEL/60.

**Appendix: Summary of final anchovy and sardine TAC and TAB equations of OMP-14 (from de Moor and Butterworth 2014).**

The revised sardine TAC is initially calculated as:

$$TAC_{2017}^S = \begin{cases} TAC_{2017,init}^S + \frac{N_{2017,r}^{obs,S}}{R_{avg}} TAC_{2017,init}^S & \text{if } N_{2017,r}^{obs,S} \leq 1.2 \times R_{avg} \\ TAC_{2017,init}^S + 1.2 \times TAC_{2017,init}^S & \text{if } N_{2017,r}^{obs,S} > 1.2 \times R_{avg} \end{cases}$$

This results in  $TAC_{final,2017}^S = 45\,560\text{t}$ .

does not alter the revised sardine TAC. In the above equations we have:

$N_{y,r}^{obs,S}$  - the estimate of recruitment of sardine from the hydroacoustic recruit survey in May of year  $y$ .

$R_{avg} = 13.74$  - the level of sardine recruitment required in order to achieve the original HCR calculated sardine TAC.

$B_{y,Nov}^{obs,S}$  - the estimate of sardine 1+ abundance (in thousands of tonnes) from the hydroacoustic survey in November of year  $y$ .

$B_{ec}^S = 300$  - the biomass threshold (in thousands of tonnes) below which Exceptional Circumstances apply for sardine.

The revised  $\leq 14\text{cm}$  sardine bycatch with directed sardine fishing, is calculated as follows:

$$TAB_{2017,small}^S = \omega TAC_{2017}^S$$

where

$\omega = 0.07$  - an estimate of the maximum percentage of  $\leq 14\text{cm}$  sardine bycatch in the  $> 14\text{cm}$  sardine catch

The revised anchovy TAC is initially calculated as:

$$TAC_{2017}^{2,A} = \alpha_{ns} q \left( p \frac{N_{2016,rec0}^A}{N_{rec0}^A} + (1-p) \frac{B_{2016,N}^{obs,A}}{B_{Nov}^A} \right)$$

This results in  $TAC_{2017}^{2,A} = 1\,617\,878\text{t}$ . As the anchovy TAC in 2016 was above the 2-tier threshold of 330 000t, this TAC is subject to the following constraints:

$$\max \left\{ TAC_{2017}^{1,A}; \left( 1 - c_{msdn}^A \right) c_{tier}^A \right\} \leq TAC_{2017}^{2,A} \leq c_{mxtac}^A$$

which results in  $TAC_{2017}^{2,A} = 450\,000\text{t}$ . The anchovy biomass projected for November 2017 is above the Exceptional Circumstances threshold and thus no Exceptional Circumstances provisions were invoked. In addition the projected November 2017 biomass is above 700 000t, and thus no smoothing is applied. In the above equations we have:

$B_{2016,Nov}^A$  - the estimate of anchovy abundance (in thousands of tons) from the hydroacoustic spawner biomass survey in November 2016.

$\bar{B}_{Nov}^A$  - the historical average index of anchovy abundance from the spawner biomass surveys from November 1984 to November 1999, of 1 380.28 thousand tons.

$$N_{2016,rec0}^A = (N_{2017,r}^{obs,A} e^{r_{2017}^A \times 1.2/12} + C_{2017,obs}^A) e^{6 \times 1.2/12} = 1766.195$$

- the simulated estimate of anchovy recruitment from the recruitment survey in 2017,  $N_{2017,r}^{obs,A}$ , back-calculated to 1 November 2016 by taking natural and fishing mortality into account.

$\bar{N}_{rec0}^A = 217.3$  - the average 1985 to 1999 observed anchovy recruitment (in billions) in May, back-calculated to November of the previous year.

$\alpha_{ns} = 0.889$  - a control parameter which scales the anchovy TAC to meet target risk levels for sardine and anchovy.

$p = 0.7$  - the weight given to the recruit survey component compared to the spawner biomass survey component in setting the anchovy TAC.

$q = 300$  - reflects the average annual TAC expected under OMP99 under average conditions if  $\alpha_{ns} = 1$ .

$c_{mxdn}^A = 0.25$  - the maximum proportional amount by which the normal season directed anchovy TAC can be reduced from one year to the next.

$c_{mxtac}^A = 450$  - the maximum directed TAC that may be set for anchovy (in thousands tons).

$c_{tier}^A = 330$  - 2-tier threshold for directed anchovy TAC

$C_{2017,obs}^A = 17.496$  - the observed juvenile anchovy landed by number (in billions) from the 1<sup>st</sup> of November 2016 to the day before the recruit survey commenced in 2017.

$t_{2017}^A = 1.367$  - the timing of the anchovy recruit survey in 2017 (number of months) relative to the 1<sup>st</sup> of May.

The revised <14cm sardine TAB with anchovy is calculated using:

$$TAB_{2017,anch}^{2,S} = \lambda_{2017} TAC_{2017}^{1,A} + r_{2017} (TAC_{2017}^{2,A} - TAC_{2017}^{1,A})$$

This gives  $TAB_{2017}^{2,S} = 29969t$ , where  $\lambda_{2017} = \max\{\gamma_{2017}, r_{2017}\} = 0.102$ .

In the above equations we have:

$\gamma_{2017} = 0.101$  - a conservative allowance for the ratio of juvenile sardine to juvenile anchovy in subsequent catches.

$$r_{2017} = \frac{1}{2}(r_{2017,sur} + r_{2017,com}) = 0.024$$

- the ratio of juvenile sardine to anchovy “in the sea” during May 2017, calculated from the recruit survey and the sardine bycatch to anchovy ratio in the commercial catches<sup>1</sup> during May.

---

<sup>1</sup> Only commercial catches comprising at least 50% anchovy with sardine bycatch are considered.