

Re-evaluation of Risk Thresholds for Sardine and Anchovy

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Background

The following definitions of risk used for OMP-08 have been maintained from OMP-04:

$risk_S$ - the probability that adult sardine biomass falls below the average adult sardine biomass over November 1991 and November 1994 at least once during the projection period of 20 years.

$risk_A$ - the probability that adult anchovy biomass falls below 10% of the average adult anchovy biomass between November 1984 and November 1999 at least once during the projection period of 20 years.

The development of a trade-off curve for OMP-08 thus far (from which the 2008 sardine TAC and initial 2008 anchovy TAC and sardine TAB were recommended) was obtained by limiting $risk_S < 0.18$ and $risk_A < 0.25$ (Cunningham and Butterworth 2007a).

Since these risk thresholds were agreed, the following changes and/or corrections have been made to the OMP, without re-assessing the risk thresholds:

- 1) Average catch and risk is now calculated from 2008-2027 rather than 2007-2026 (Cunningham and Butterworth 2007b)
- 2) The data input file was corrected such that sardine adult bycatch with red-eye is 3 500t instead of 350t per year (Cunningham and Butterworth 2007c).
- 3) The program was corrected such that when calculating risk statistics for the no-catch option, the sardine adult bycatch is set to zero along with all other sardine and anchovy directed catch and bycatch. (Note that the no-catch option still allows for the 2007 TACs to be caught, but then assumes no catch from 2008 to 2027.)

Methods

With these changes/corrections now effected, the risk thresholds for both sardine and anchovy have been re-evaluated. As before, objective methods to assess any necessary changes to the risk thresholds are desirable. Following previous risk evaluations, the first criterion used was a multiplicative adjustment of the probability threshold used to define the risk level, by comparing ratios of probabilities in the absence of fishing to the OMP-04 case. The second criterion used was to compare the extent to which the biomass distribution curve

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is moved to the left under OMP-regulated fishing compared to the no-catch situation. The percentiles of these distributions are now directly compared in an attempt to make this comparison more objective.

Results

The combined effect of the above mentioned changes results in the multiplicative adjustment of the probability threshold defining the risk level to increase from (in round figures) 22% to 27% for sardine (Table 2) and from 24% to 37% for anchovy (Table 4).

Figure 1 shows the sardine biomass distribution after 20 years of simulation under a no-catch scenario compared to OMP regulated fishing scenarios. As before, a sardine risk threshold that corresponded to a leftward shift in the distribution similar to that under OMP-04 is desired. Table 5 provides the ratios of the percentiles of these distributions for a more objective comparison. These percentiles indicate that retaining the current sardine risk threshold of 18% results in the biomass distribution under OMP-08 relative to that under a no-catch scenario after 20 years of simulation being very close to that under OMP-04, though the lower 10% of the distribution is somewhat lower. Increasing the sardine risk to 27% would result in a much more pessimistic outlook at the current trade-off point, compared to OMP-04.

Figure 2 shows the anchovy biomass distribution after 20 years of simulation under a no-catch scenario compared to OMP regulated fishing scenarios. Table 6 provides the ratios of the percentiles of these distributions together with those for some further alternative anchovy risk thresholds. There is little difference between these ratios of percentiles at the current trade-off point, as this is determined by the choice of the sardine risk threshold. If, instead, the corner point of the trade-off curve is used, a risk of 37% clearly results in a worse situation than for OMP-04, while the distribution is better than for OMP-04 for all percentiles for a risk threshold of 24%. A selection of 28% for this threshold seems a reasonable intermediate candidate, given the greater importance of near equivalence at the lower percentiles.

Recommendation

We therefore recommend that the sardine risk threshold remains at 18% as previously agreed, while the anchovy risk threshold be increased from 25 to 28%. The trade-off curve given these new risk thresholds is shown in Figure 3. The 20-year average TACs predicted for the current trade-off and corner points for directed sardine/anchovy are 207/171 and 190/263 thousand tons respectively. Table 7 shows these average values at the corner points corresponding to alternative choices for the anchovy risk threshold.

References

- Cunningham, C.L., and Butterworth, D.S. 2007a. Proposed Change of Risk Criteria for Sardine and Anchovy. MCM Document MCM/2007/NOV/SWG-PEL/04. 5pp.
- Cunningham, C.L., and Butterworth, D.S. 2007b. Development and Testing of OMP-08. MCM Document MCM/2007/26NOV/SWG-PEL/01. 40pp.

Cunningham, C.L., and Butterworth, D.S. 2007c. Initial Sardine and Anchovy TACs and Sardine TAB for 2008, Using OMP-08. MCM Document MCM/2007/DEC/SWG-PEL/04. 4pp.

Table 1. The probability that sardine biomass drops below B_{04}^* at least once during the projection period of 20 years, using the OMP-04 simulation framework with the associated 2004 assessment (this defines “Risk” for OMP-04). B_{04}^* is the average 1991 to 1994 sardine November biomass calculated using the 2004 sardine assessment.

	B_{04}^*	$1.25 \times B_{04}^*$
C=0	0.010	0.030
C=OMP-04	0.098	0.188

Table 2. The probability that sardine biomass drops below B_{07}^* at least once during the projection period of 20 years, using the OMP-08 simulation framework with the associated updated assessment. B_{07}^* is the average 1991 to 1994 sardine November biomass calculated using the 2007 sardine assessment.

	Previously Used		Updated	
	B_{07}^*	$1.25 \times B_{07}^*$	B_{07}^*	$1.25 \times B_{07}^*$
C=0	0.022	0.108	0.027	0.088
$(C=OMP-04)^{04}/(C=0)^{04} \times (C=0)^{08}$	0.216	0.677	0.265	0.551
$(C=OMP-04)^{04} - (C=0)^{04} + (C=0)^{08}$	0.110	0.266	0.115	0.246

Table 3. The probability that anchovy biomass drops below $0.1 \times B_{04}^*$ at least once during the projection period of 20 years, using the OMP-04 simulation framework with the associated 2004 assessment (this defines “Risk” for anchovy for OMP-04). B_{04}^* is the average 1984 to 1999 anchovy November biomass calculated using the 2004 anchovy assessment.

	$0.1 \times B_{04}^*$	$0.15 \times B_{04}^*$
C=0	0.028	0.042
C=OMP-04	0.280	0.376

Table 4. The probability that anchovy biomass drops below $0.1 \times B_{07}^*$ at least once during the projection period of 20 years, using the OMP-08 simulation framework with the associated updated assessment. B_{07}^* is the average 1984 to 1999 anchovy November biomass calculated using the 2007 anchovy assessment.

	Previously Used		Updated	
	$0.1 \times B_{07}^*$	$0.15 \times B_{07}^*$	$0.1 \times B_{07}^*$	$0.15 \times B_{07}^*$
C=0	0.024	0.060	0.037	0.065
$(C=OMP-04)^{04}/(C=0)^{04} \times (C=0)^{08}$	0.240	0.537	0.370	0.582
$(C=OMP-04)^{04} - (C=0)^{04} + (C=0)^{08}$	0.276	0.394	0.289	0.399

Table 5. The ratio of the percentiles of the distribution of sardine biomass in 2027 under OMP-08 for alternative sardine risk thresholds ($risk_S < 0.18$ and $risk_S < 0.27$) to a no-catch scenario. The anchovy risk threshold is the same for both cases ($risk_A < 0.28$). A comparison is made to the ratio of the percentiles of the distribution of sardine biomass in 2023 under OMP-04 to a no-catch scenario using the previous assessment. Shaded cells represent cases for which the predicted ratio (depletion) is more pessimistic than that used for OMP-04.

	OMP-04/No-catch	OMP-08/No-catch (Current Trade-off)	
		$risk_S < 0.18$	$risk_S < 0.27$
10%ile	0.59	0.50	0.29
20%ile	0.68	0.69	0.45
30%ile	0.69	0.73	0.57
40%ile	0.71	0.74	0.60
Median	0.72	0.72	0.61

Table 6. The ratio of the percentiles of the distribution of anchovy biomass in 2027 under OMP-08 for alternative anchovy risk thresholds ($risk_A < 0.24$, $risk_A < 0.26$, $risk_A < 0.28$, $risk_A < 0.30$ and $risk_A < 0.37$) to a no-catch scenario. The sardine risk threshold is the same for all cases ($risk_S < 0.18$). A comparison is made to the ratio of the percentiles of the distribution of anchovy biomass in 2023 under OMP-04 to a no-catch scenario using the previous assessment. Shaded cells represent cases for which the predicted ratio (depletion) is more pessimistic than that used for OMP-04.

	OMP-04/No-Catch	OMP-08/No-catch (Current Trade-off)					OMP-08/No-catch (Corner Point)				
		$risk_A < 0.24$	$risk_A < 0.26$	$risk_A < 0.28$	$risk_A < 0.30$	$risk_A < 0.37$	$risk_A < 0.24$	$risk_A < 0.26$	$risk_A < 0.28$	$risk_A < 0.30$	$risk_A < 0.37$
10%ile	0.25	0.32	0.31	0.31	0.31	0.31	0.30	0.26	0.27	0.22	
20%ile	0.37	0.38	0.37	0.37	0.37	0.37	0.34	0.31	0.28	0.23	
30%ile	0.45	0.55	0.56	0.56	0.56	0.56	0.43	0.39	0.35	0.28	
40%ile	0.56	0.66	0.66	0.66	0.66	0.66	0.50	0.44	0.40	0.33	
Median	0.58	0.70	0.70	0.70	0.70	0.70	0.53	0.48	0.44	0.37	

Table 7. The average 2008-2027 directed sardine and anchovy catches (in thousands of tons) for different anchovy risk thresholds (with $risk_S < 0.18$) at the corner point. A comparison is given to the average catches for the recommended anchovy risk threshold at the current trade-off point.

$risk_A <$	Current Trade-off		Corner point	
	Directed sardine	Anchovy	Directed sardine	Anchovy
0.24			206	203
0.26			193	250
0.28	207	171	190	263
0.30			189	271
0.37			184	281

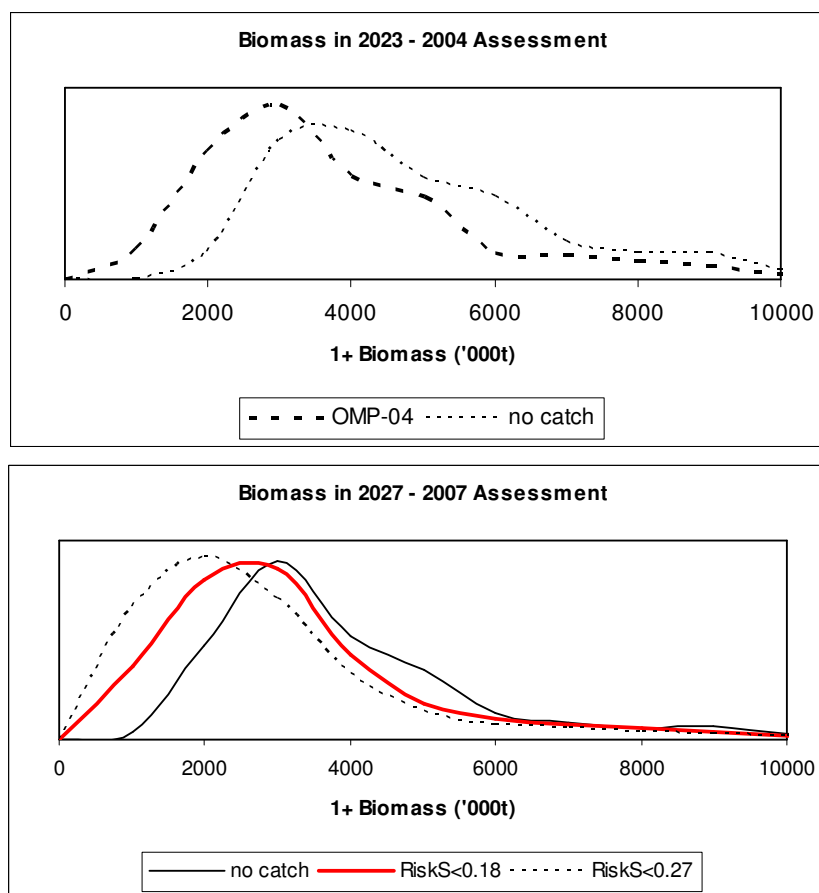


Figure 1. Comparison of sardine biomass distributions in the final projection year under a no catch scenario and the pertinent OMP for the 2004 assessment (upper panel) and the 2007 assessment (lower panel). In the lower panel two different risk thresholds for sardine are shown, using the same risk threshold for anchovy ($risk_A < 0.28$). The lower panel is based on OMPs corresponding to the current trade-off point.

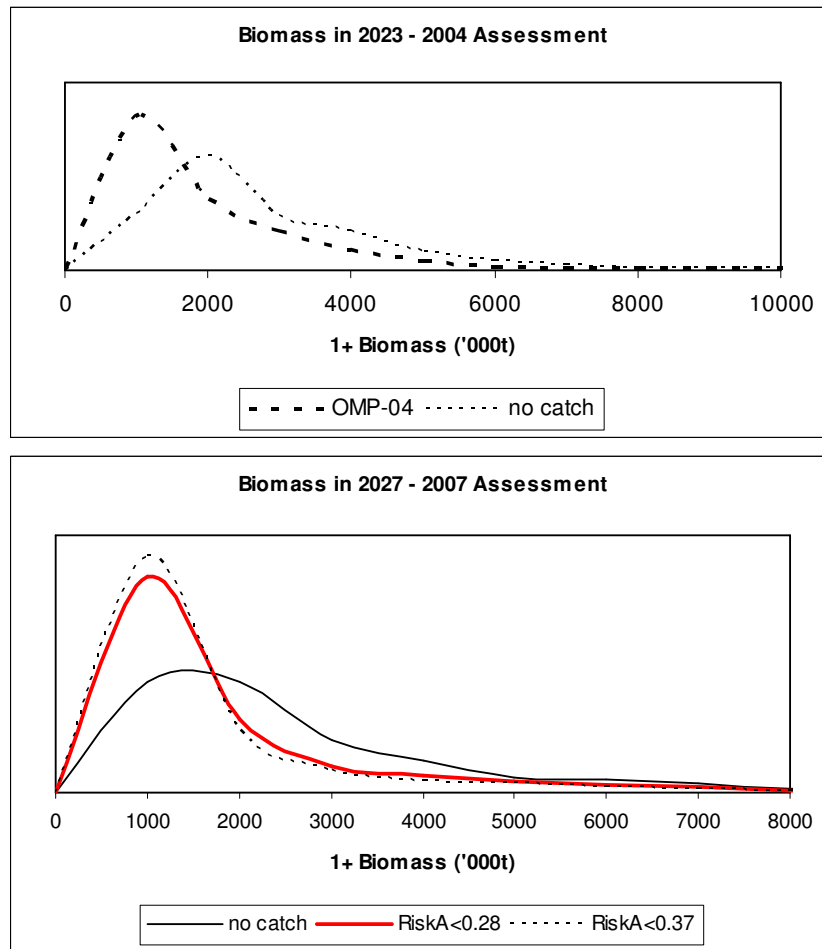


Figure 2. Comparison of anchovy biomass distributions in the final projection year under a no catch scenario and the pertinent OMP for the 2004 assessment (upper panel) and the 2007 assessment (lower panel). In the lower panel two different risk thresholds for anchovy are shown, and the associated OMPs correspond to the respective corner points of the trade-off curves; the same risk threshold for sardine ($risk_s < 0.18$) is used in both cases.

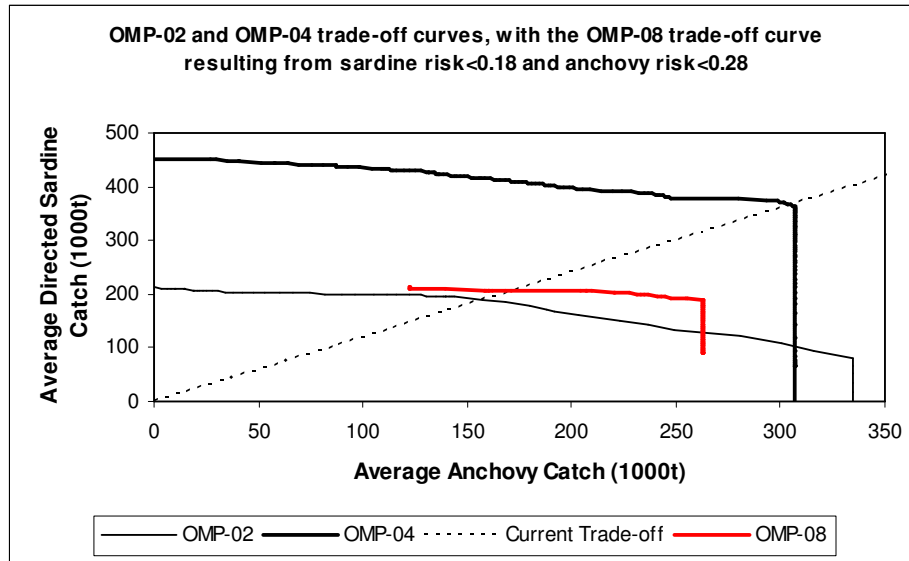


Figure 3. Trade-off curves for OMP-02, OMP-04 and OMP-08. The trade-off curve for OMP-08 is determined by points satisfying $risk_S < 0.18$ and $risk_A < 0.28$.