Model Projections from November 2003

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The simulation testing framework used during the development of recent Interim OMPs is based on assessments that have been conditioned on data up to and including November 2011 (de Moor and Butterworth 2013). Projections thus begin from November 2011. In this document, the initial starting conditions for projections are changed to match those of November 2003, and the model is run for eight years to compare with observations between November 2004 and 2011.

Methods

The following changes have been made to the data input to the simulation testing framework:

i)   Sardine numbers-at-ages 1 to 5+, model predicted 1+ biomass, spawning stock biomass (SSB) and survey estimated biomass in the initial starting year have all been changed to match those of November 2003 rather than November 2011.

ii)   The "most recent" proportion of "west" sardine stock recruits moving to the "south" stock have been changed from that estimated for November 2011 to that estimated for November 2003 – this affects projections in which the movement in a particular year is a function of the movement in the previous year.

iii)   Anchovy numbers-at-ages 1 to 4+, model predicted 1+ biomass which matches SSB and survey estimated biomass in the initial starting year have all been changed to match those of November 2003 rather than November 2011.

iv)   The recruitment in November 2003 is estimated from a combination of the May 2004 (not 2012) survey estimate of recruitment and the stock-recruitment curve, taking autocorrelation from the residual about the stock-recruitment in Nov 2002 (not 2010) into account.

The following changes have been made to the equations of the simulation testing framework:

i)   The anchovy and directed sardine TACs are fixed at the values in Table 1[1].

ii)   The anchovy catch-at-age 0 and 1 are fixed at the values in Table 1.

iii)   The "switch" years for the movement hypothesis *MoveE* are fixed at 2003 (then "decreasing") and 2009 (then "increasing").

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[1] The remaining TABs, are calculated according to Interim OMP-13v2 formulae.

All other parameters sampled from the posterior distributions of the assessments remain unchanged, as do the remaining model equations of de Moor and Butterworth (2013). In particular, the modelled catch in ii) above is still restricted by a maximum of 95% of exploitable biomass in order to prevent modelling negative numbers-at-age. In addition, the modelled undercatch of the sardine TAB is unchanged; though this will differ from the bycatch observed between 2004 and 2011.

As a further test, the annual residuals about the stock-recruitment relationship were fixed at those estimated for Novembers 2003 to 2010 at the joint posterior mode.

Results

Simply starting the projections from a different position results in median simulated November survey estimates of sardine biomass being relatively near to the actual observations between November 2004 and 2011 under *MoveE* (with fixed "switch" years) and *MoveAutoC* (Figures 1b,c). If no movement of "west" stock sardine recruits to the "south" stock is modelled (*NoMove*), then the actual observations from November 2006 to 2011 are close to or outside the 90% probability interval (Figure 1a). This provides an indication that the assumption of no movement of recruits between 2003 and 2011 is unrealistic.

These projections were done without any further information being provided, such as whether recruitment was good or poor. However, there is little change in simulated survey observations when fixing the recruitment residuals at those estimated at the joint posterior model between Novembers 2003 to 2010 (Figure 2).

The simulated annual proportion of "west" stock recruits that move to the "south" stock are plotted in Figure 3.

Discussion

These simulations have shown that the simulation testing framework currently used to project the sardine and anchovy resources forward under alternative catch scenarios can also realistically reproduce what has historically been observed.

The results could be further refined as follows:

- Fix the annual November 2003-2011 recruitment residuals at the full distribution of those estimated by the model, and not simply assuming the value at the joint posterior mode to apply to all simulations.
- Fix the proportion of sardine catch taken west:east of Cape Agulhas as that observed during 2004-2011, and not assume the model based on the relationship with the ratio of the directed sardine TAC : survey estimate of biomass west of Cape Agulhas.

- The sardine bycatch from 2004 to 2011
- The known survey CVs from May 2004 to November 2011 could be included to narrow the error range.

References

de Moor, C.L. and Butterworth, D.S. 2013. The simulation testing framework used during the development of OMP-13. Department of Agriculture, Forestry and Fisheries Document FISHERIES/2013/OCT/SWG-PEL/26. 27pp.

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Table 1. The TACs (in thousands of tons) and catches (in billions) fixed for the projections undertaken in this document.

|	Anchovy TAC	Directed sardine TAC	Anchovy 0-year old catch prior to the survey	Anchovy 0-year old catch	Anchovy 1-year old catch
2004	192.336	365.792	3.923	39.673	1.150
2005	282.217	240.294	3.821	31.523	10.085
2006	135.578	205.865	0.883	29.612	1.385
2007	251.305	134.616	5.824	47.756	1.765
2008	259.416	85.744	3.698	49.967	4.825
2009	181.197	89.202	7.398	34.726	4.592
2010	219.742	87.710	6.921	39.494	3.479
2011	119.670	88.595	5.781	23.570	1.666
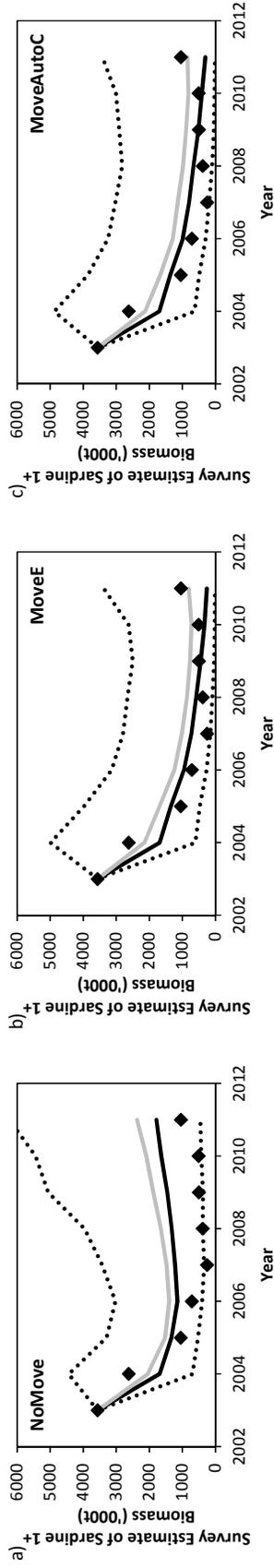
Figure 1. The median (average – grey line) and 90% probability interval of projected November survey estimates of 1+ sardine biomass, assuming a) *NoMove*, b) *MoveE* with fixed "switch" years, and c) *MoveAutoC*. The actual survey estimates are given as diamonds.
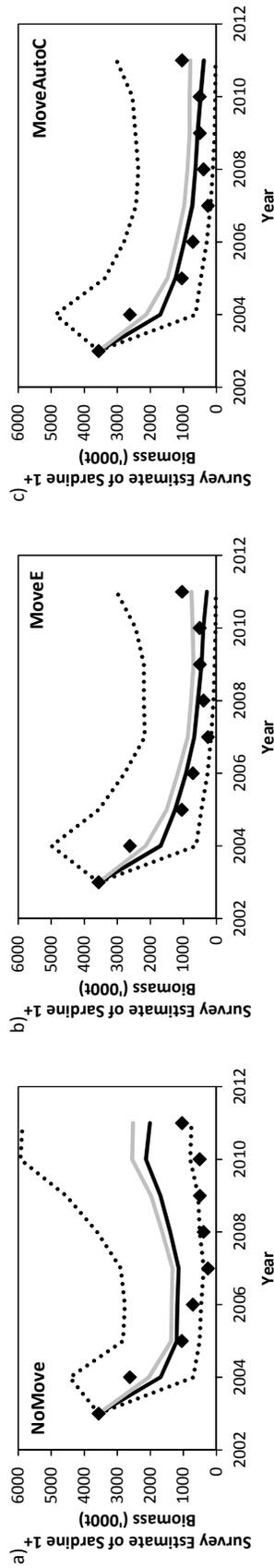

Figure 2. The median (average – grey line) and 90% probability interval of projected November survey estimates of 1+ sardine biomass, assuming a) *NoMove*, b) *MoveE* with fixed "switch" years, and c) *MoveAutoC*, and fixing the recruitment residuals at the values estimated at the joint posterior mode. The actual survey estimates are given as diamonds.
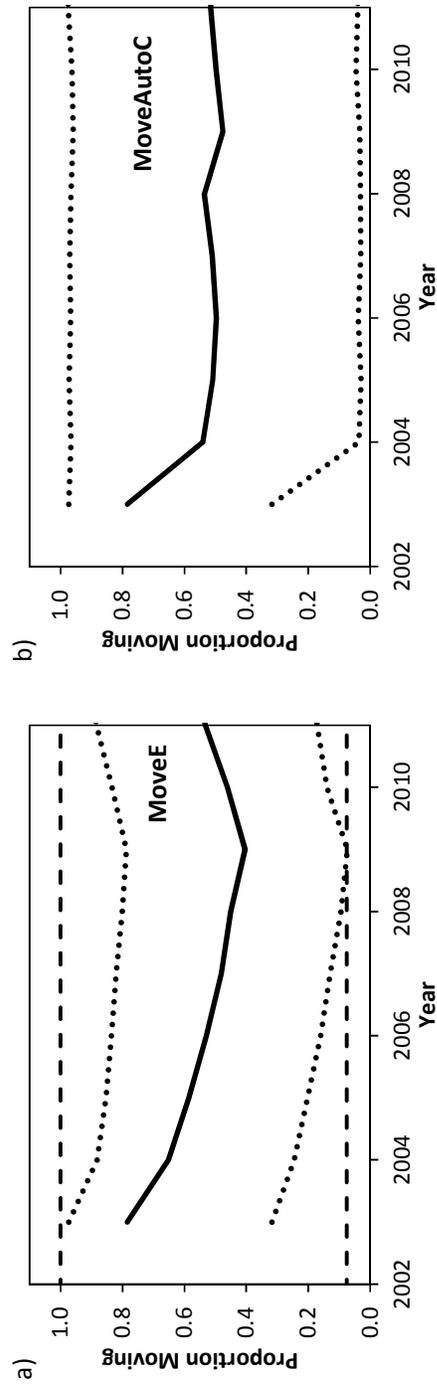
Figure 3. The median and 90% probability interval of the proportion of "west" stock sardine recruits that move to the "south" stock, assuming a) *MoveE* with fixed "switch" years and b) *MoveAutoC*.