Testing robustness of the two mixing stock hypothesis for South African sardine to parasite prevalence data between 20 and 22degrees

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Introduction

The baseline two mixing stock assessment of South African sardine has been conditioned on parasite prevalence data on the south coast east of 22◦E only (Dunn et al. 2015, de Moor and Butterworth 2016). Data between 20 and 22◦E were excluded from the baseline assessment to ensure no age-1 sardine from the west stock that were not permanently moving to the south stock were included in south stock prevalence data. This document explores the sensitivity of the assessment results to including the parasite prevalence data between 20 and 22◦E.

Methods

The assessment model of de Moor and Butterworth (2016) is used, except that the south coast parasite prevalence-by-length data includes all samples east of 20◦E, not only east of 22◦E. While there were no south coast prevalence observations (east of 22◦E) in 2013 in the baseline model, observations (east of 20◦E) in 2013 are now included in this sensitivity test.

Results

While the fit to the May hydroacoustic estimates of recruitment is slightly improved under this sensitivity test (Table 1, Figure 1), the fits to the November hydroacoustic estimates of abundance and length frequency data are all slightly poorer (Figure 2, Table 1). Figure 3 shows the fit to the parasite prevalence-by-length data. While there is no noticeable difference in the fit to the prevalence data on the west coast, the alternative prevalence data on the south coast informs a different model predicted prevalence-by-length, particularly in 2010, 2011 and 2013 (Figure 4). Different proportions of 1-year-old sardine are also modelled to move from the west to the south stock under this alternative, with the Hessian-based 95%CIs for these proportions in 2013-2015 being mutually exclusive from those of the baseline model.

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The median maximum recruitment to the west and south stocks are estimated to be a little lower and higher, respectively, under the sensitivity test (Figures 5 and 6), but recruitment to the south stock is still an order of magnitude smaller than that of the west stock.

Summary

This document has explored the sensitivity of the two mixing stock hypothesis of de Moor and Butterworth (2016) to the inclusion of parasite prevalence-by-length data between 20 and 22◦E. The results indicate the model estimated proportions of sardine that move – particularly in recent years – are sensitive to the choice of prevalence-by-length data used.

References

de Moor, C.L., and Butterworth, D.S. 2016. Assessment of the South African sardine resource using data from 1984-2015: Results at the joint posterior mode for the two mixing-stock hypothesis. DAFF: Branch Fisheries Document FISHERIES/2016/JUL/SWG-PEL/22REV2.

Dunn, A., Haddon, M., Parma, A.M., and Punt, A.E. 2015. International Review Panel Report for the 2015 International Fisheries Stock Assessment Workshop. 30 November – 4 December 2015, Cape Town, South Africa.

Table 1. The individual contributions to the posterior distribution at the joint posterior mode for this model, compared to the results presented by de Moor and Butterworth (2016).

Contribution to Posterior	Include South Coast data (dM and B, 2016)	Include 20-22◦E Prevalence data (This document)	Difference
-lnposterior	689.22	852.21	*
$-\ln L^{Nov}$	60.51	63.17	2.7
$-\ln L^{rec}$	64.52	62.76	-1.8
$-\ln L^{compropl}$	-387.32	-387.18	0.1
$-\ln L^{surpropl}$	-356.39	-363.11	2.3
$-\ln L^{prev}$	1280.64	1432.21	*
$-\ln prior(k_{ac})$	-1.42	-1.24	0.2
-lnprior(recres)	25.51	33.03	7.5
-lnprior(movres)	-27.69	-27.76	0.1
-lnprior(t0res)	40.64	41.09	0.4
-lnprior(b/K)	-0.84	-0.82	0.0

* These are not directly comparable due to the use of an alternative time series of data in the results presented in this document.

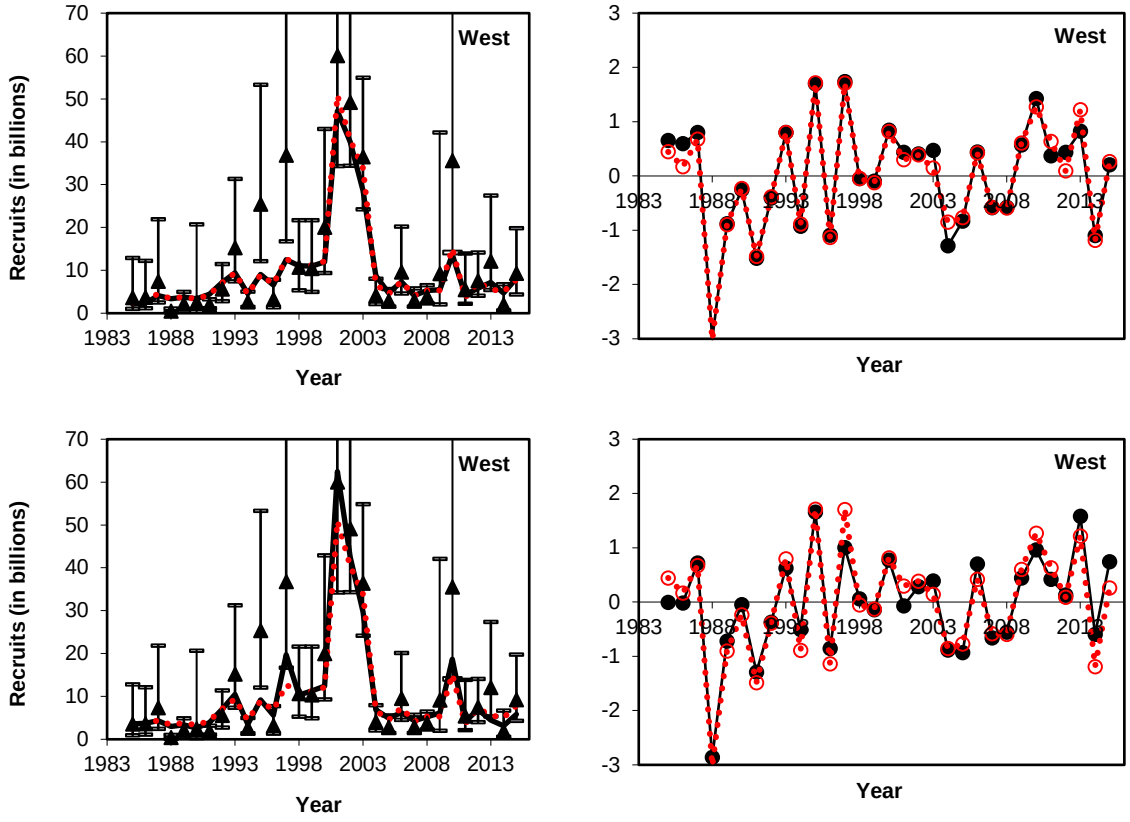

Figure 1. Acoustic survey estimated and model predicted sardine recruitment in May from 1985 to 2015 for the two mixing stock hypothesis fitted to parasite prevalence-by-length data east of 20◦E (red dotted lines) and east of 22◦E (black solid lines). The observed indices are shown with 95% confidence intervals. The standardised residuals (i.e. the residual divided by the corresponding standard deviation, including additional variance where appropriate) from the fits are given in the right hand plots.

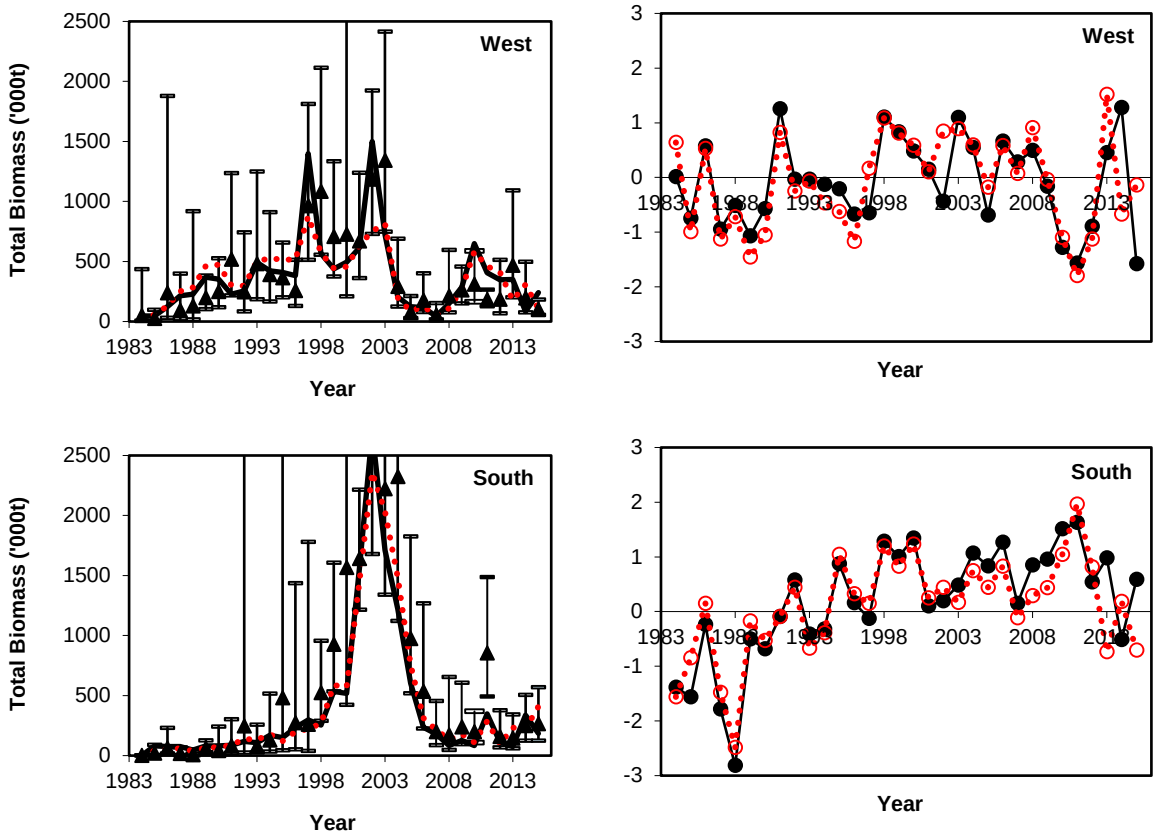

Figure 2. Acoustic survey estimated and model predicted November sardine 1+ biomass from 1984 to 2015 for the two mixing stock hypothesis fitted to parasite prevalence-by-length data east of 20◦E (red dotted lines) and east of 22◦E (black solid lines). The observed indices are shown with 95% confidence intervals. The standardised residuals from the fits are given in the right hand plots.

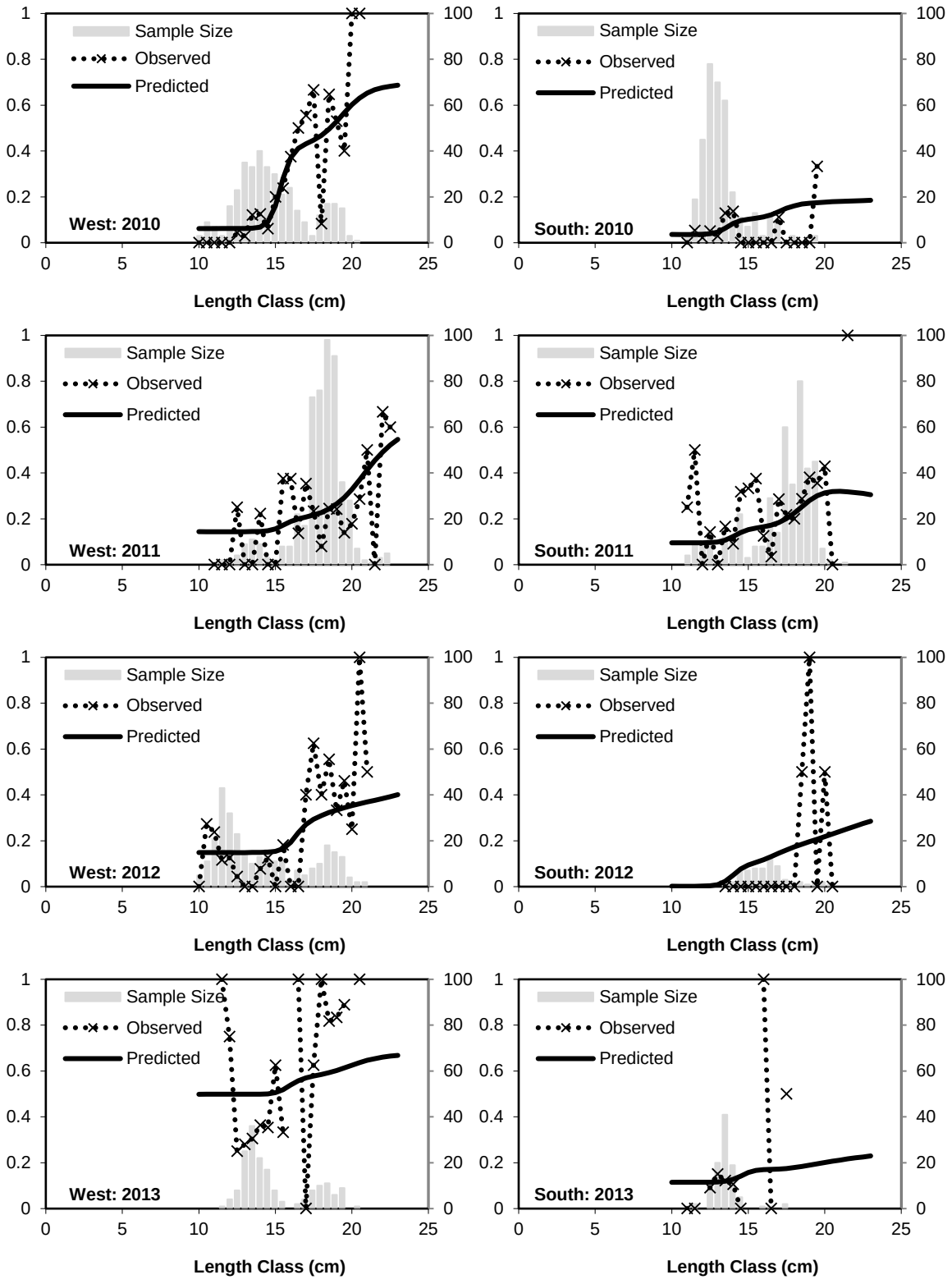

Figure 3a. The model estimated proportions-at-length of west and south stock sardine infected with the parasite (i.e. parasite prevalence-by-length) between 2010 and 2015 together with the observed proportions-at-length, using south coast data east of 20◦E. The sample size for each length class is given by the grey bars, plotted against the right vertical axis.

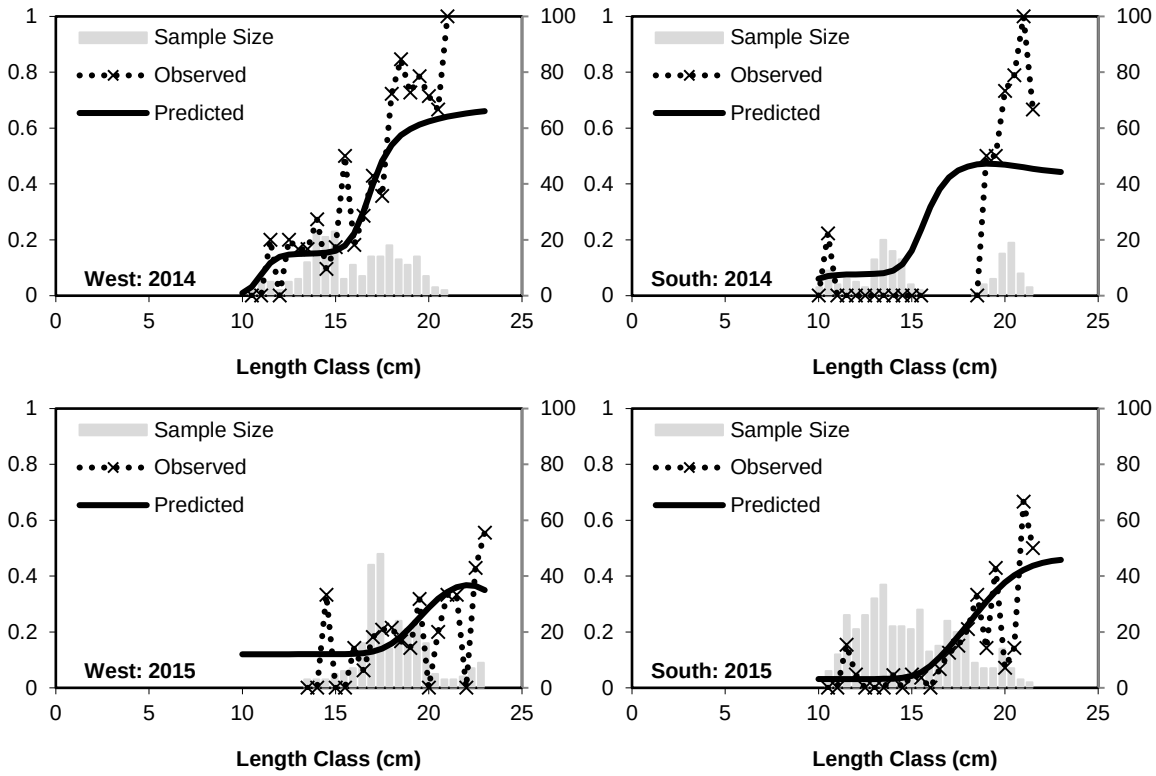

Figure 3a (continued).

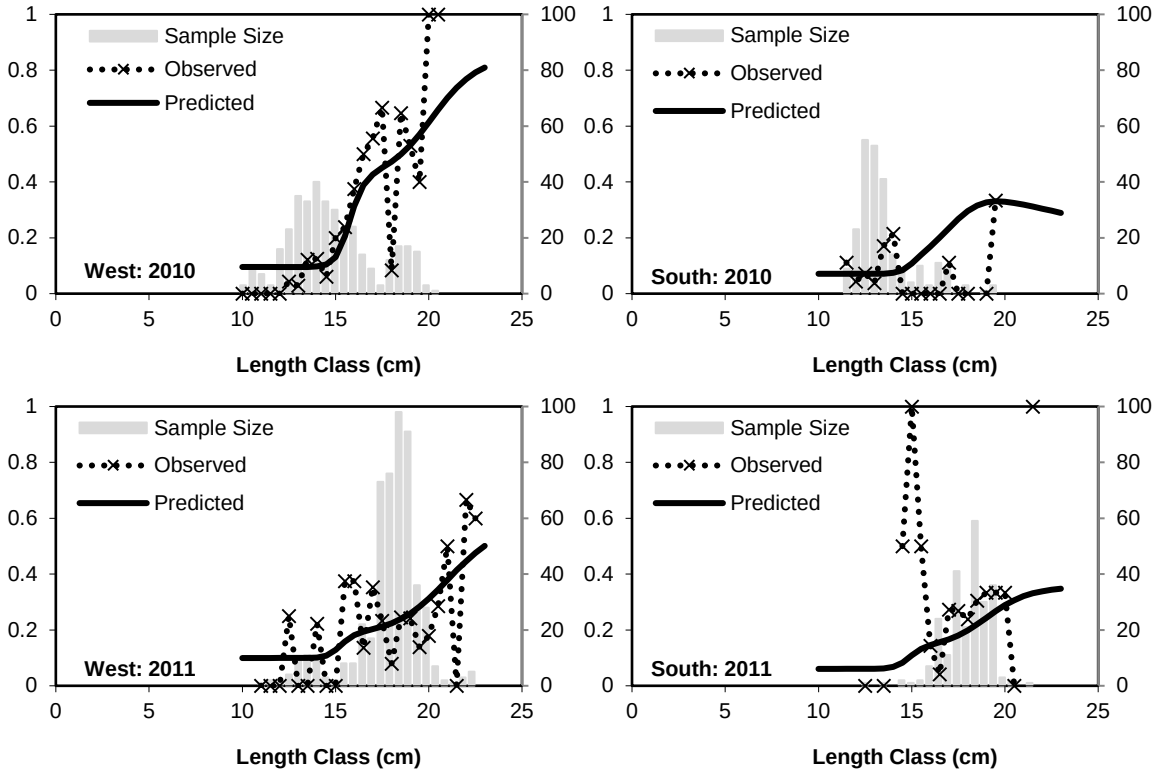

Figure 3b. The model estimated proportions-at-length of west and south stock sardine infected with the parasite (i.e. parasite prevalence-by-length) between 2010 and 2015 together with the observed proportions-at-length, using south coast data east of 22◦E. The sample size for each length class is given by the grey bars, plotted against the right vertical axis.

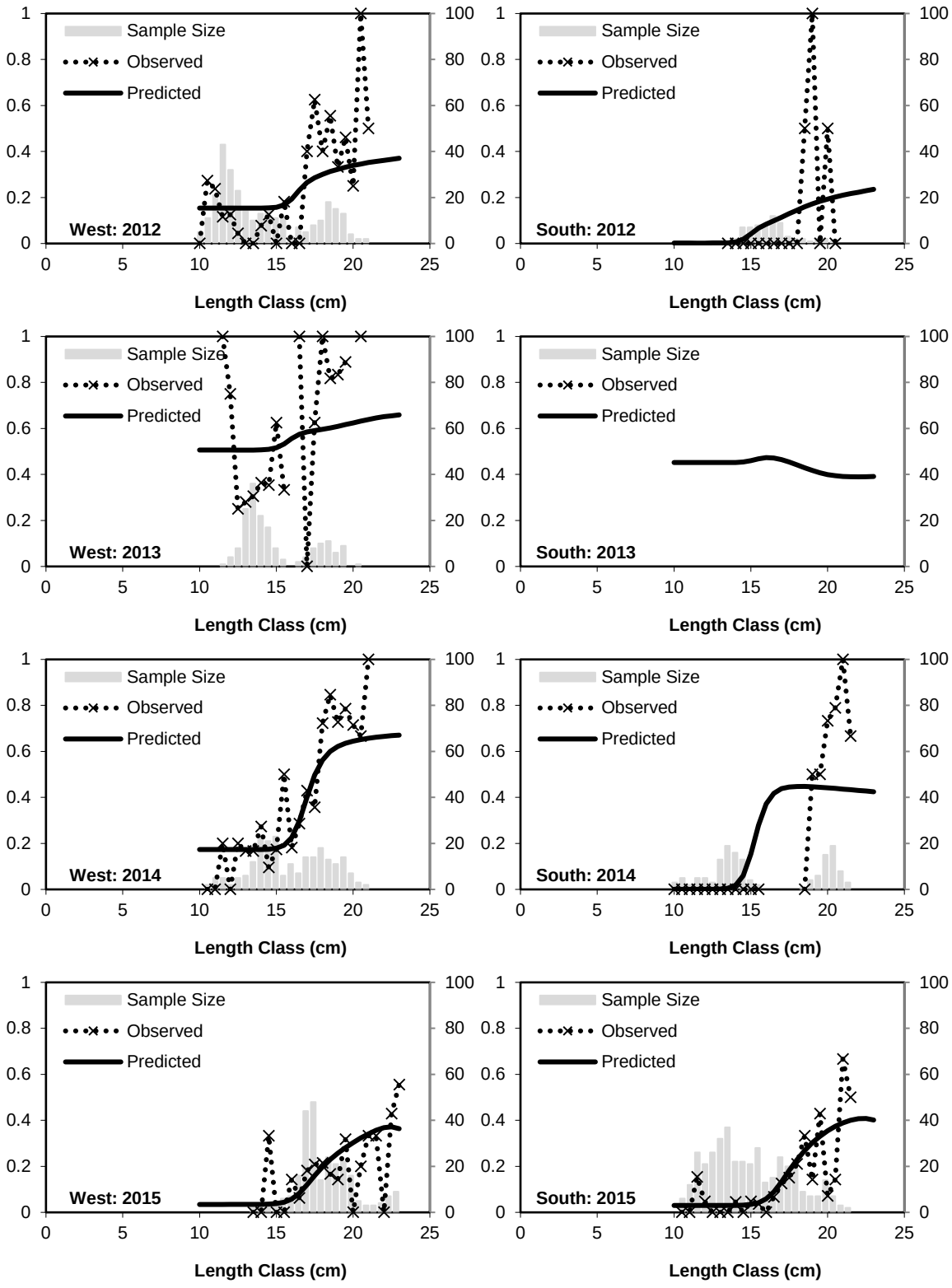

Figure 3b (continued).

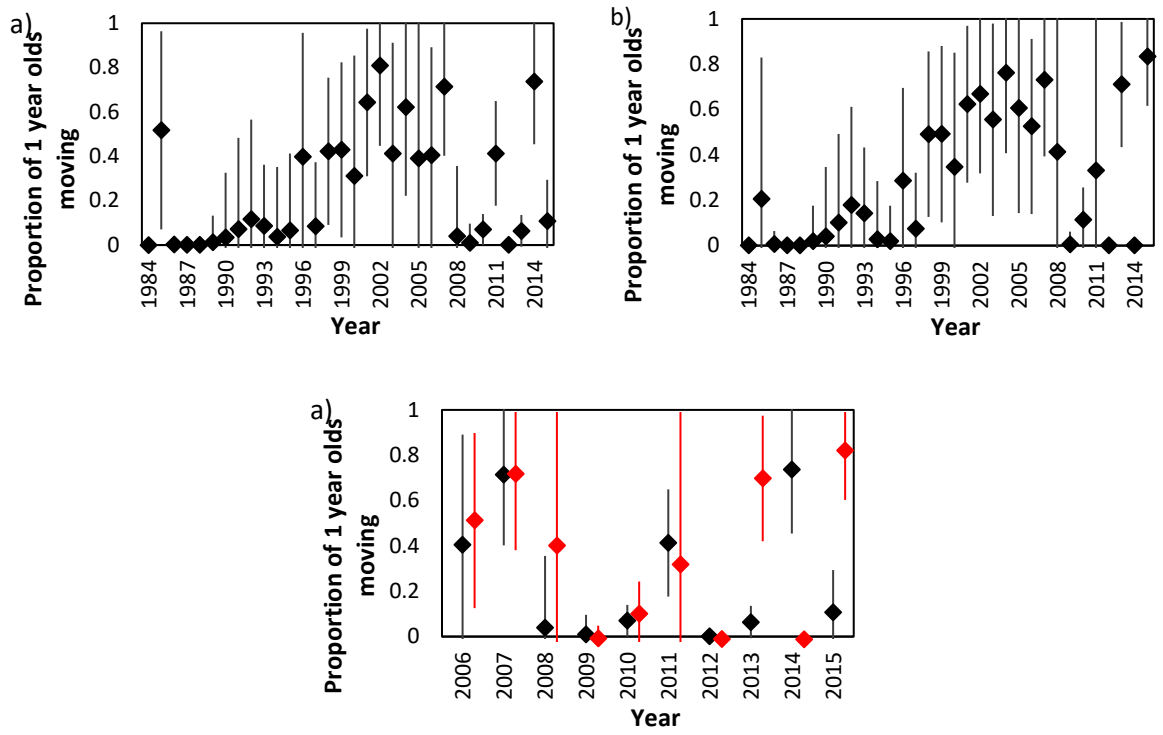

Figure 4. Model estimated annual proportions of 1-year-olds that move from the west to the south stocks, together with Hessian-based 95%CIs for a) the model fitted to parasite prevalence-by-length data east of 20◦E and b) the model fitted to parasite prevalence-by-length data east of 22◦E. The lower plot overlays the two alternatives for the most recent years, with the red corresponding to data east of 22◦E.

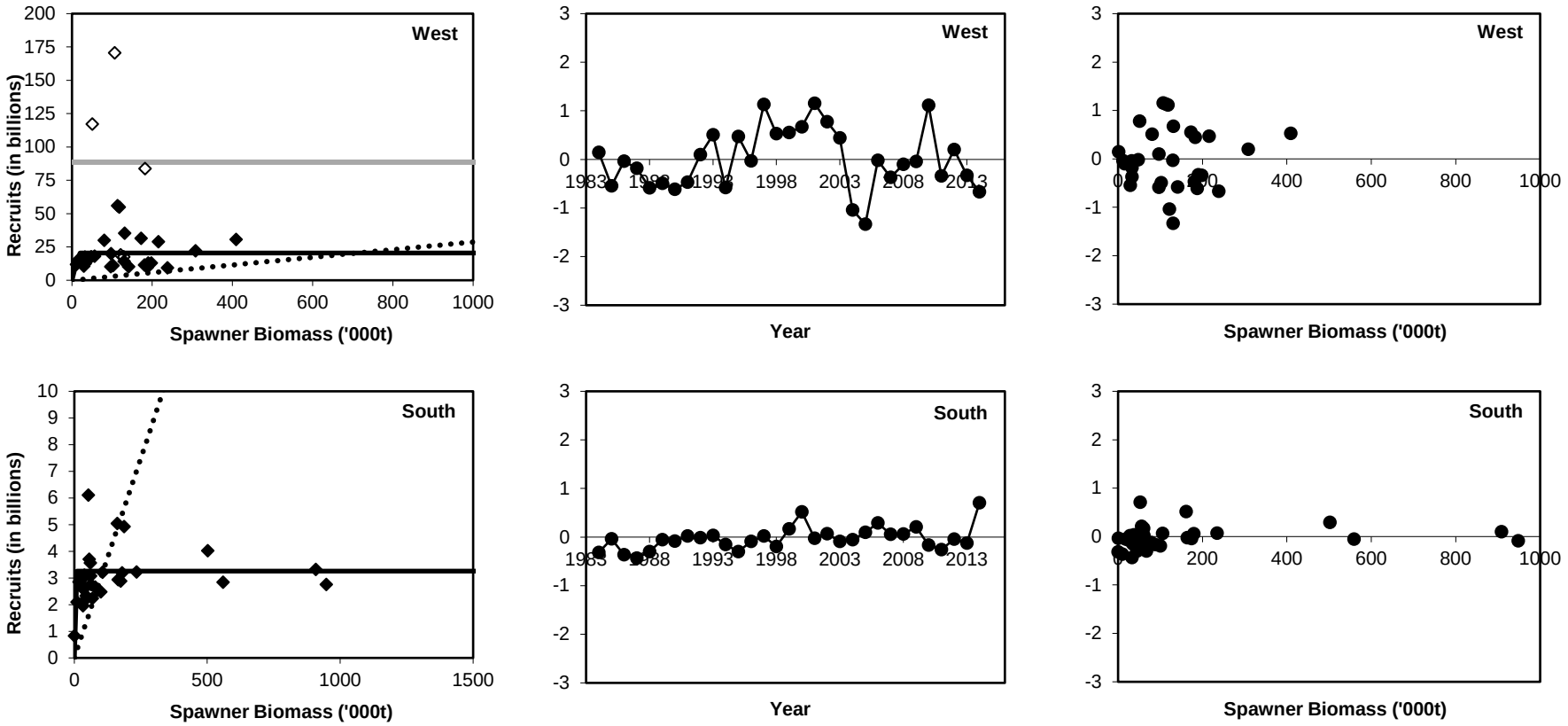

Figure 5. Model predicted sardine recruitment (in November) plotted against spawner biomass from November 1984 to November 2014 with the estimated Hockey stick stock recruitment relationships shown in the left side plots. The faded line shows the median 2000-2004 west coast recruitment and the open diamonds correspond to these same 'peak' years. The dotted line indicates the replacement line. The standardised residuals for the fits are given in the centre and right side plots, against year and against spawner biomass respectively.

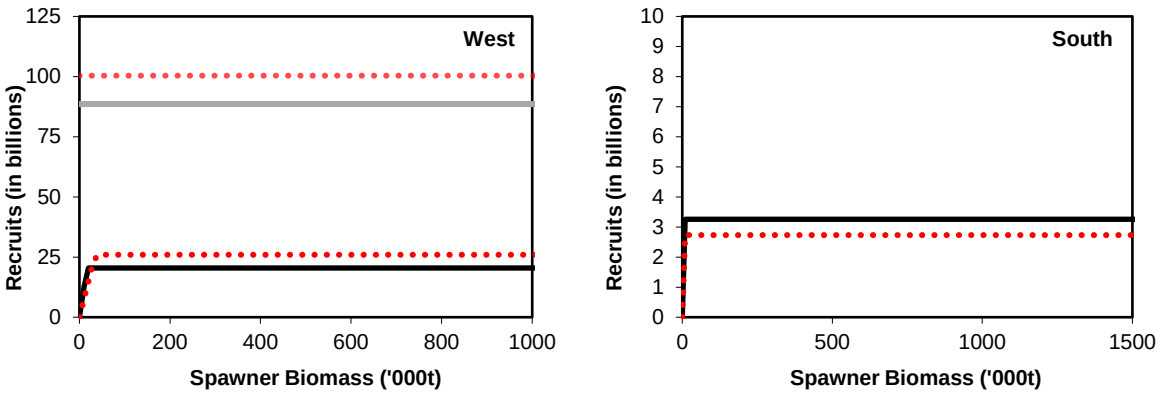

Figure 6. Model estimated Hockey stick stock recruitment relationships for the two mixing stock hypothesis fitted to parasite prevalence-by-length data east of 20◦E (red dotted lines) and east of 22◦E (black solid lines).