Posterior distributions for the South African sardine assessment

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Introduction

Results for the sardine assessment conditioned to data available from 1984 – 2015 have previously been presented at the joint posterior mode (e.g. de Moor 2016; de Moor and Butterworth 2016a,b). This document details the posterior distributions for some key sardine hypotheses.

Methods

Posterior distributions for key parameters from the sardine two component hypothesis have been simulated using Markov Chain Monte Carlo for i) the hypothesis assuming a Hockey Stick stock-recruitment relationship with no south component contribution to the west component recruitment (de Moor and Butterworth 2016a), and ii) the hypothesis with no assumed stock-recruitment relationship (de Moor 2016). In the former case, 100 million samples were drawn and thinned by 2000. 15 000 of the remaining chain was discarded and then 1000 samples were randomly drawn from the remaining 35 000. In the latter case, 70 million samples were drawn and thinned by 2000. A burn-in of 1000 was discarded and then 1000 samples were drawn from the remaining 34000. Hockey-stick stock recruitment relationships were then subsequently fitted to these 1000 sets of model outputs.

In addition, results are also presented here for a single sardine stock hypothesis (de Moor and Butterworth 2016b). In this case 71 million samples were drawn and thinned by 2000, afterwhich the first 5 000 and another 4 000 samples were discarded. 1000 samples were randomly drawn from the remaining 26 500.

In all cases the standard deviation in the residuals about the stock-recruitment curve during non-peak years is assumed to be $\sigma_{j,r}^{S} = 0.5$.

Results

Table 1 lists the medians and 90% probability intervals for the key parameters used in the Operating Models to simulation test Operational Management Procedures. Figures 1 to 4 show the medians and 90% probability intervals for some of the time-series parameters. These figures show that, except for south component spawner biomass, the biomass, recruitment and movement is estimated to be similar regardless of whether the stock recruitment curve is estimated during or after conditioning. In addition, while the contribution of south coast spawner biomass to west coast recruitment (the proportion *p* in Table 1) does show some difference, this difference is minimal and is expected to have little impact on future projections of the resource.

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References

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Table 1. Posterior medians [90% probability intervals] for key model parameters used during OMP-18 simulation testing (de Moor (2017)). Four different alternatives of the proportion, *p*, of south coast spawner biomass contributing to west coast recruitment were tested for the model where the stock recruitment relationship was estimated after conditioning.

Para-meter	Description	2 component with Hockey Stick estimated during conditioning	2 component with Hockey Stick estimated after conditioning				Single stock
			p=0	p=0.08	p=0.2	p=0.6	
$k^S_{1=2,I}$	Multiplicative bias associated with November survey for west/south component/single stock	0.69 [0.59,0.80]		0.71 [0.61,0.82]			0.68 [0.59,0.79]
$k^S_{1,r}$	Multiplicative bias associated with recruit survey for west component/single stock	0.67 [0.51,0.79]		0.70 [0.60,0.82]			0.65 [0.44,0.77]
$k^S_{2,r}$	Multiplicative bias associated with recruit survey for south component	0.60 [0.46,0.74]		0.40 [0.24,0.63]			-
$S_{1,1}$	Renormalised commercial selectivity at age 1 for west component/single stock	0.79 [0.60,0.93]		0.82 [0.61,0.95]			0.28 [0.00,0.84]
$S_{1,2}$	Renormalised commercial selectivity at age 2 for west component/single stock	0.95 [0.86,0.99]		0.96 [0.88,0.99]			0.72 [0.12,0.96]
$S_{1,3}$	Renormalised commercial selectivity at age 3 for west component/single stock	0.99 [0.95,1.00]		0.99 [0.96,1.00]			0.91 [0.58,0.99]
$S_{1,4}$	Renormalised commercial selectivity at age 4 for west component/single stock	1.00 [0.99,1.00]		1.00 [0.99,1.00]			0.98 [0.87,1.00]
$S_{1,5+}$	Recnormalised commercial selectivity at age 5+ for west component/single stock	1.00 [1.00,1.00]		1.00 [1.00,1.00]			1.00 [1.00,1.00]
$S_{2,1}$	Renormalised commercial selectivity at age 1 for south component	0.80 [0.60,0.93]		0.66 [0.42,0.86]			-
$S_{2,2}$	Renormalised commercial selectivity at age 2 for south component	0.96 [0.87,0.99]		0.89 [0.73,0.97]			-
$S_{2,3}$	Renormalised commercial selectivity at age 3 for south component	0.99 [0.96,1.00]		0.97 [0.90,0.99]			-
$S_{2,4}$	Renormalised commercial selectivity at age 4 for south component	1.00 [0.99,1.00]		0.99 [0.97,1.00]			-
$S_{2,5+}$	Renormalised commercial selectivity at age 5+ for south component	1.00 [1.00,1.00]		1.00 [1.00,1.00]			-
a^S_1	Stock-recruit parameter for west component/single stock (Hockey Stick: median maximum recruitment)	27 [18,60]	16 [13,21]	17 [13, 22]	17 [13,23]	17 [13,23]	26 [17,46]
a^S_2	Stock-recruit parameter for south component (Hockey Stick: median maximum recruitment)	2.4 [1.6,3.5]	0.30 [0.15,0.59]	0.30 [0.15,0.59]	0.30 [0.15,0.59]	0.30 [0.13,0.59]	-
c^S	Median recruitment during peak years for west component/single stock	211 [75,241]					245 [99,245]
b^S_1	Stock-recruit parameter for west component/single stock (Hockey Stick: inflection spawner biomass)	53 [8,245]	11 [0,51]	15 [2,68]	20 [2,87]	32 [5,122]	120 [0,367]
b^S_2	Stock-recruit parameter for west component/single stock (Hockey Stick: inflection spawner biomass)	0.9 [0.7,1.4]	0.03 [0.02,0.07]	0.0.3 [0.02,0.07]	0.03 [0.02,0.07]	0.03 [0.02,0.07]	-
$\sigma^S_{r,pea}$	Standard deviation in the residuals (lognormal deviation) about the stock-recruitment curve during peak years	1.6 [1.0,2.3]					1.7 [1.1,2.5]
$s^S_{1,cor}$	Recruitment serial correlation for west component/single stock	0.28 [0.00,0.57]	0.54 [0.31,0.73]	0.30 [0.10,0.47]	0.53 [0.28,0.72]	0.52 [0.29,0.71]	0.25 [-0.00,0.56]

Table 1 (continued)**.**

Para-meter	Description	2 component with Hockey Stick estimated during conditioning	2 component with Hockey Stick estimated after conditioning				Single stock
			p=0	p=0.08	p=0.2	p=0.6	
$s_{2,cor}^{S}$	Recruitment serial correlation for south component	0.04 [-0.24,0.32]	0.64 [0.44,0.75]	0.20 [-0.07,0.48]	0.64 [0.44,0.75]	0.64 [0.44,0.75]	-
$\varepsilon_{1,201}^{S}$	Standardised November 2014 recruitment residual for west component/single stock	0.17 [-0.89,1.20]	1.36 [0.08,2.84]	0.19 [-0.79,1.27]	1.33 [0.06,2.83]	1.35 [0.06,2.79]	-0.02 [-1.24,1.22]
$\varepsilon_{2,201}^{S}$	Standardised November 2014 recruitment residual for south component	0.96 [-0.55,2.63]	8.36 [6.66,9.77]	7.66 [5.47,9.30]	8.36 [6.66,9.77]	8.36 [6.65,9.77]	-
K_1^S	Carrying capacity for west component/single stock	563 [371,1255]	353 [265,485]	356 [265,490]	358 [267,502]	366 [271,502]	429 [276,746]
K_2^S	Carrying capacity for south component	30 [21,45]	3 [2,7]	3 [2,7]	3 [2,7]	3 [2,7]	-
ϕ	Proportion of the proportion of age 1 fish which move as 2+ fish from the west to the south component	0.65 [0.36,0.90]	0.99 [0.97,1.00]				-
$f_{1,1}^{S}$	Proportion mature at age 1 for west component/single stock	0.19 [0.12,0.25]	0.20 [0.15,0.26]				0.16 [0.04,0.33]
$f_{1,2}^{S}$	Proportion mature at age 2 for west component/single stock	0.61 [0.54,0.68]	0.62 [0.54,0.69]				0.41 [0.21,0.61]
$f_{1,3}^{S}$	Proportion mature at age 3 for west component/single stock	0.80 [0.72,0.86]	0.81 [0.71,0.88]				0.64 [0.49,0.78]
$f_{1,4}^{S}$	Proportion mature at age 4 for west component/single stock	0.84 [0.76,0.91]	0.85 [0.75,0.93]				0.75 [0.60,0.86]
$f_{1,5+}^{S}$	Proportion mature at age 5+ for west component/single stock	0.86 [0.77,0.93]	0.87 [0.76,0.95]				0.79 [0.63,0.90]
$f_{2,1}^{S}$	Proportion mature at age 1 for south component	0.19 [0.10,0.30]	0.16 [0.10,0.26]				-
$f_{2,2}^{S}$	Proportion mature at age 2 for south component	0.58 [0.49,0.67]	0.49 [0.40,0.60]				-
$f_{2,3}^{S}$	Proportion mature at age 3 for south component	0.72 [0.66,0.77]	0.68 [0.60,0.75]				-
$f_{2,4}^{S}$	Proportion mature at age 4 for south component	0.75 [0.68,0.81]	0.74 [0.66,0.80]				-
$f_{2,5+}^{S}$	Proportion mature at age 5+ for south component	0.76 [0.69,0.82]	0.76 [0.67,0.83]				-
$\bar{w}_{1,1}^{S}$	November weight at age 1 for west component/single stock	40 [35,43]	41 [37,44]				31 [17,44]
$\bar{w}_{1,2}^{S}$	November weight at age 2 for west component/single stock	75 [69,83]	75 [68,87]				67 [51,80]
$\bar{w}_{1,3}^{S}$	November weight at age 3 for west component/single stock	91 [81,107]	91 [80,113]				94 [72,124]
$\bar{w}_{1,4}^{S}$	November weight at age 4 for west component/single stock	96 [85,117]	97 [84,124]				108 [77,152]
$\bar{w}_{1,5+}^{S}$	November weight at age 5+ for west component/single stock	99 [86,121]	100 [85,129]				113 [78,169]
$\bar{w}_{2,1}^{S}$	November weight at age 1 for south component	28 [24,33]	28 [24,32]				-
$\bar{w}_{2,2}^{S}$	November weight at age 2 for south component	51 [47,57]	48 [44,54]				-
$\bar{w}_{2,3}^{S}$	November weight at age 3 for south component	58 [53,66]	58 [52,65]				-
$\bar{w}_{2,4}^{S}$	November weight at age 4 for south component	60 [54,68]	61 [55,70]				-
$\bar{w}_{2,5+}^{S}$	November weight at age 5+ for south component	60 [54,69]	63 [56,72]				-

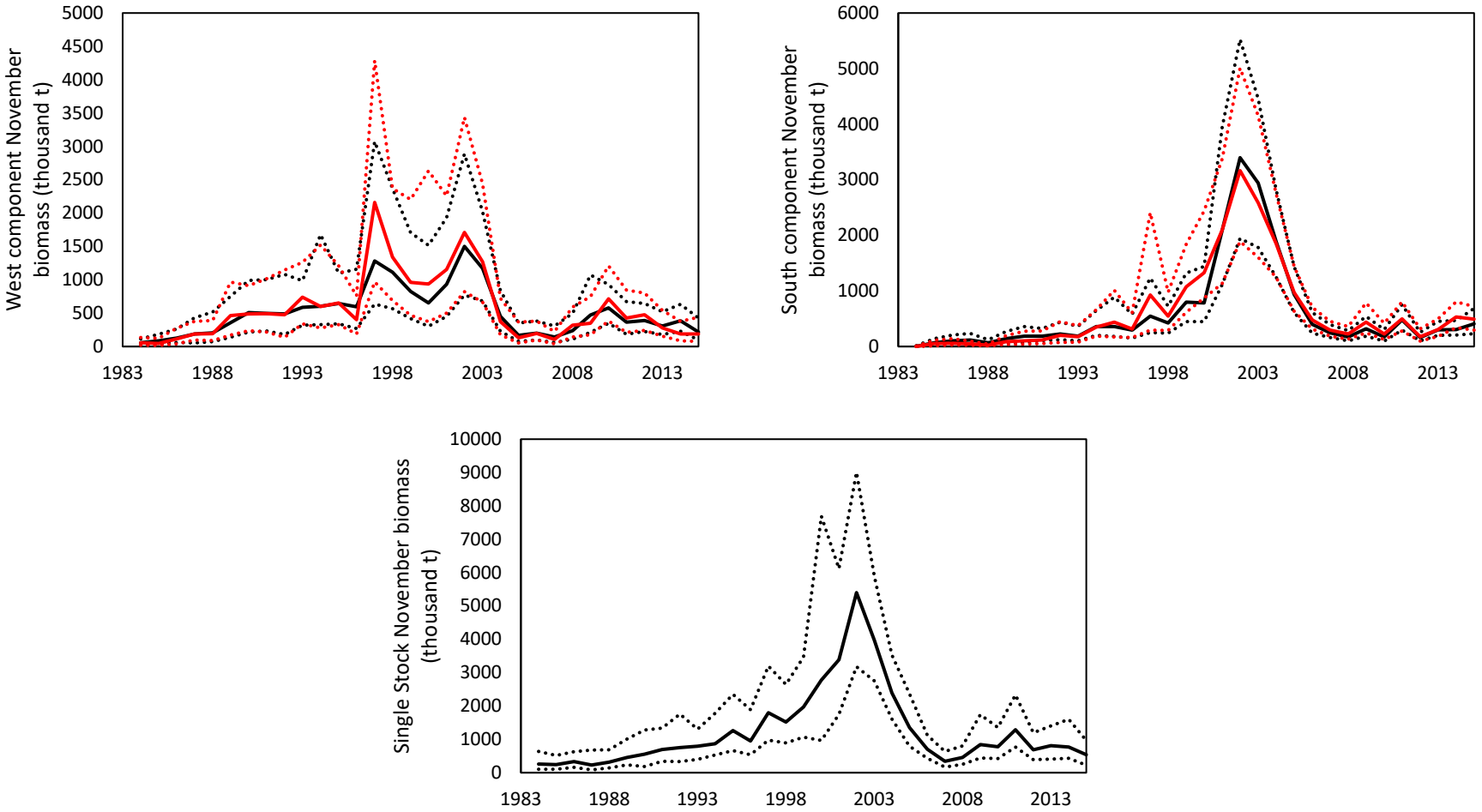

Figure 1. Posterior median (solid lines) and 90% probability interval (dotted lines) of a) west and b) south component November biomass for the model estimating the Hockey Stick stock recruitment relationship during conditioning (black), and the model where the stock recruitment relationship is estimated after conditioning (red). The results from the single stock hypothesis are shown in c).

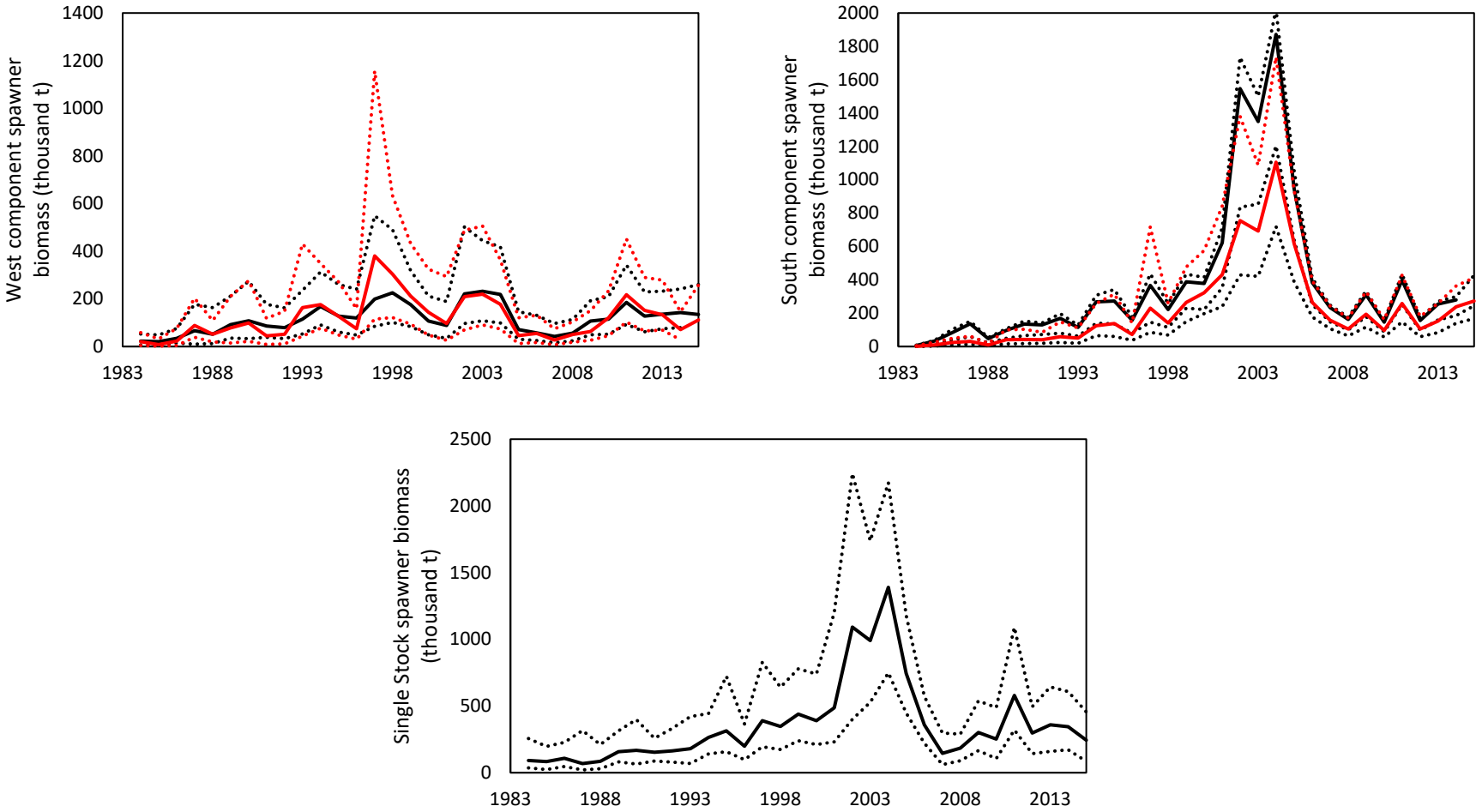

Figure 2. Posterior median (solid lines) and 90% probability interval (dotted lines) of a) west and b) south component spawner biomass for the model estimating the Hockey Stick stock recruitment relationship during conditioning (black), and the model where the stock recruitment relationship is estimated after conditioning (red). The results from the single stock hypothesis are shown in c).

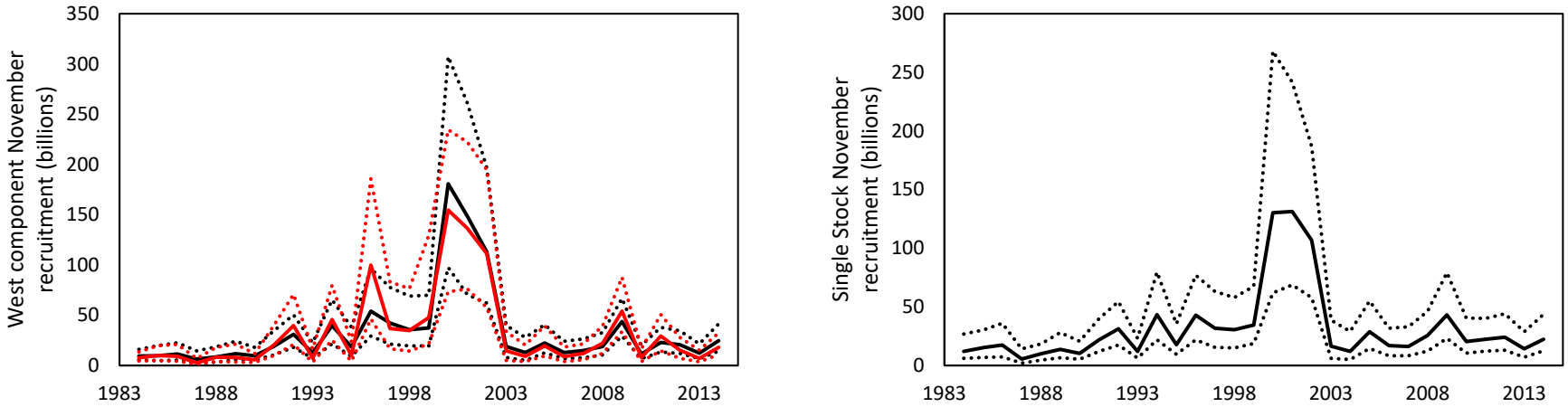

Figure 3. Posterior median (solid lines) and 90% probability interval (dotted lines) of a) west component November recruitment for the model estimating the Hockey Stick stock recruitment relationship during conditioning (black), and the model where the stock recruitment relationship is estimated after conditioning (red). The results from the single stock hypothesis are shown in b).

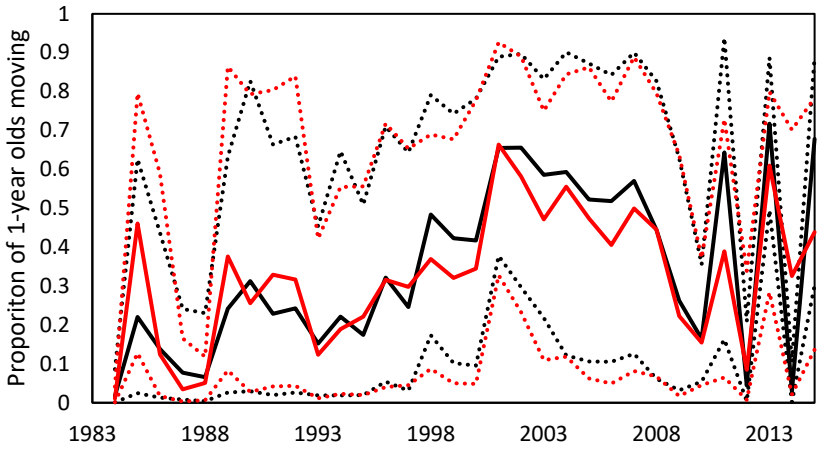

Figure 4. Posterior median (solid lines) and 90% probability interval (dotted lines) of the proportion of west component 1-year-olds which move to the south component each November, for the model estimating the Hockey Stick stock recruitment relationship during conditioning (black), and the model where the stock recruitment relationship is estimated after conditioning (red).