

Sensitivity of the sardine assessment and projection models to final year survey length frequency information

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Historical assessments have been re-run excluding the survey length frequency data from the final year to test the sensitivity of the models to the inclusion of these data. The implications for short-term projections are also considered using past projections.

Keywords: assessment, length frequency, sardine, survey

Background

A proposal has been made to exclude the November 2021 survey length frequency data from the sardine assessment based on data from 1984 to 2021. This document (briefly) assesses the sensitivity of past assessments to the exclusion of the survey length frequency in the final year.

Methods

Three past assessments were run both including and excluding the survey length frequency data in the final year (2020 in two cases and 2019 in one case). These were:

- A) Model (i) from de Moor (2021a), which excluded all parasite prevalence-at-length data.
- B) Model (iv) from de Moor (2021a), which included all parasite prevalence-at-length from November survey samples.
- C) Model of de Moor (2020a).

Two past projections were also run based on the results of (A) and (C) to check the sensitivity of results previously presented by de Moor (2020b, 2021b) to the inclusion of survey length frequency information from the final assessment year.

Results

The assessment sensitivity is shown in Figures 1 to 4.

- The difference in final year biomass is greater for the south component than the west component, with inclusion of the final year's survey length frequency resulting in up to 29% and 12% change for the south and west components, respectively (Figure 1).
- The inclusion of the final year's length frequency results in up to 57% and 13% change for the west and south components' spawner biomass, respectively (Figure 2).
- There are larger differences in the final year's numbers-at-age (Figures 3 and 4).

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The individual contributions to the objective function for the three models both including and excluding the final year's survey length frequency are shown in Table 1. The sensitivity to short-term projection results is shown in Tables 2 and 3.

Conclusion

These results show that the sardine assessment model is sensitive to the inclusion of the final year's survey length frequency data and that the ad-hoc method used to recommend catch limits based on short-term projections would have resulted in different recommended catch limits had the final year's survey length frequencies been excluded. The differences are not uni-directional between the three models considered.

References

- de Moor CL. 2020a. South African sardine assessment posterior distributions and sensitivity tests. DEFF: Branch Fisheries Document FISHERIES/2020/DEC/SWG-PEL/138.
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- de Moor CL. 2021a. Updated assessment of the South African sardine resource using data from 1984-2020. DFFE: Branch Fisheries Document FISHERIES/2021/APR/SWG-PEL/23.
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Table 1. The contributions to the objective function from likelihood (equations A32 – A36 of de Moor 2020a) and prior components for the models considered in this document.

Model	Incl. final year survey LF	Obj fn	$-\ln L$	$-\ln L^{Nov}$	$-\ln L^{rec}$	$-\ln L^{com\ prop}$	$-\ln L^{sur\ prop}$	$-\ln L^{prev}$	$\ln(k_{ac}^S)$	$move_{y,1}$	η_y^t	$\bar{l}_{1,y}$
A)	Y	-705.30	-771.83	56.32	38.56	-458.39	-408.32	3533.94	-1.40	-32.74	-20.47	121.04
	N	-697.33	-762.81	57.18	38.98	-459.04	-399.92	3459.26	-1.42	-32.77	-21.47	121.03
B)	Y	1211.03	1136.88	63.08	40.62	-449.34	-394.47	1876.99	-1.25	-31.78	-13.87	120.76
	N	1217.17	1143.63	63.44	40.81	-448.90	-388.74	1877.01	-1.29	-31.76	-14.50	120.75
C)	Y	1147.39	1076.02	61.55	40.13	-442.90	-387.53	1804.76	-1.30	-30.84	-14.48	117.66
	N	1154.58	1084.08	61.50	40.53	-442.68	-381.61	1806.33	-1.36	-30.85	-15.22	117.66

Table 2. The 5%ile, 20%ile and 50%ile of the multiplicative and additive change in **west component effective spawning biomass** and additive change in **west component total biomass** from November 2019 to 2020 (top rows) and 2020 to 2021 (bottom rows) under a no future catch and one catch option for the baseline models of de Moor (2020b , 2021b) [in black] and the same models excluding the final year's November survey length frequency from the assessment [in red]. The 5%ile, 20%ile and 50%ile of the multiplicative change under the catch option relative to the no catch option are also given.

					Multiplicative Δ in effSSB			Additive Δ in effSSB			Additive Δ in B			Relative Multiplicative Δ		
	Total	West	South	ByC	5%ile	20%ile	50%ile	5%ile	20%ile	50%ile	5%ile	20%ile	50%ile	5%ile	20%ile	50%ile
2020 Baseline	0	0	0	0	1.25	1.55	2.14	9	15	21	-35	-8	17			
	0	0	0	0	1.05	1.22	1.48	3	8	14	-57	-22	10			
	45.05	16.65	18	10.4	1.12	1.39	1.87	4	11	16	-50	-23	2	0.84	0.87	0.89
	45.05	16.65	18	10.4	0.90	1.06	1.25	-4	2	8	-72	-37	-6	0.78	0.83	0.86
2021 Baseline	0	0	0	0	1.81	2.29	3.61	27	36	48	22	41	104			
	0	0	0	0	1.56	2.15	3.65	35	43	53	2	40	95			
	42.05	13.65	18.0	10.4	1.70	2.11	3.26	21	30	42	6	25	87	0.84	0.88	0.91
	42.05	13.65	18.0	10.4	1.48	1.98	3.32	28	36	46	-14	24	79	0.87	0.89	0.92

Table 3. The 5%ile, 20%ile and 50%ile of the multiplicative and additive change in **south component effective spawning biomass** and additive change in **south component total biomass** from November 2019 to 2020 (top rows) and 2020 to 2021 (bottom rows) under a no future catch and one catch option for the baseline models of de Moor (2020b, 2021b) [in black] and the same models excluding the final year's November survey length frequency from the assessment [in red]. The 5%ile, 20%ile and 50%ile of the multiplicative change under the catch option relative to the no catch option are also given.

					Multiplicative Δ in effSSB			Additive Δ in effSSB			Additive Δ in B			Relative Multiplicative Δ		
	Total	West	South	ByC	5%ile	20%ile	50%ile	5%ile	20%ile	50%ile	5%ile	20%ile	50%ile	5%ile	20%ile	50%ile
2020 Baseline	0	0	0	0	1.27	1.31	1.39	43	53	65	10	42	79			
	0	0	0	0	0.64	0.69	0.77	-118	-72	-36	-206	-104	-28			
	45.05	16.65	18	10.4	1.21	1.25	1.31	30	40	52	-17	15	53	0.91	0.93	0.94
	45.05	16.65	18	10.4	0.58	0.63	0.69	-131	-85	-49	-229	-127	-51	0.83	0.87	0.90
2021 Baseline	0	0	0	0	1.45	1.48	1.52	55	74	98	-280	-143	-52			
	0	0	0	0	1.54	1.57	1.61	90	112	136	-376	-255	-167			
	42.05	13.65	18.0	10.4	1.40	1.42	1.47	45	64	88	-303	-165	-75	0.93	0.95	0.96
	42.05	13.65	18.0	10.4	1.50	1.52	1.56	80	102	126	-398	-278	-190	0.96	0.96	0.97

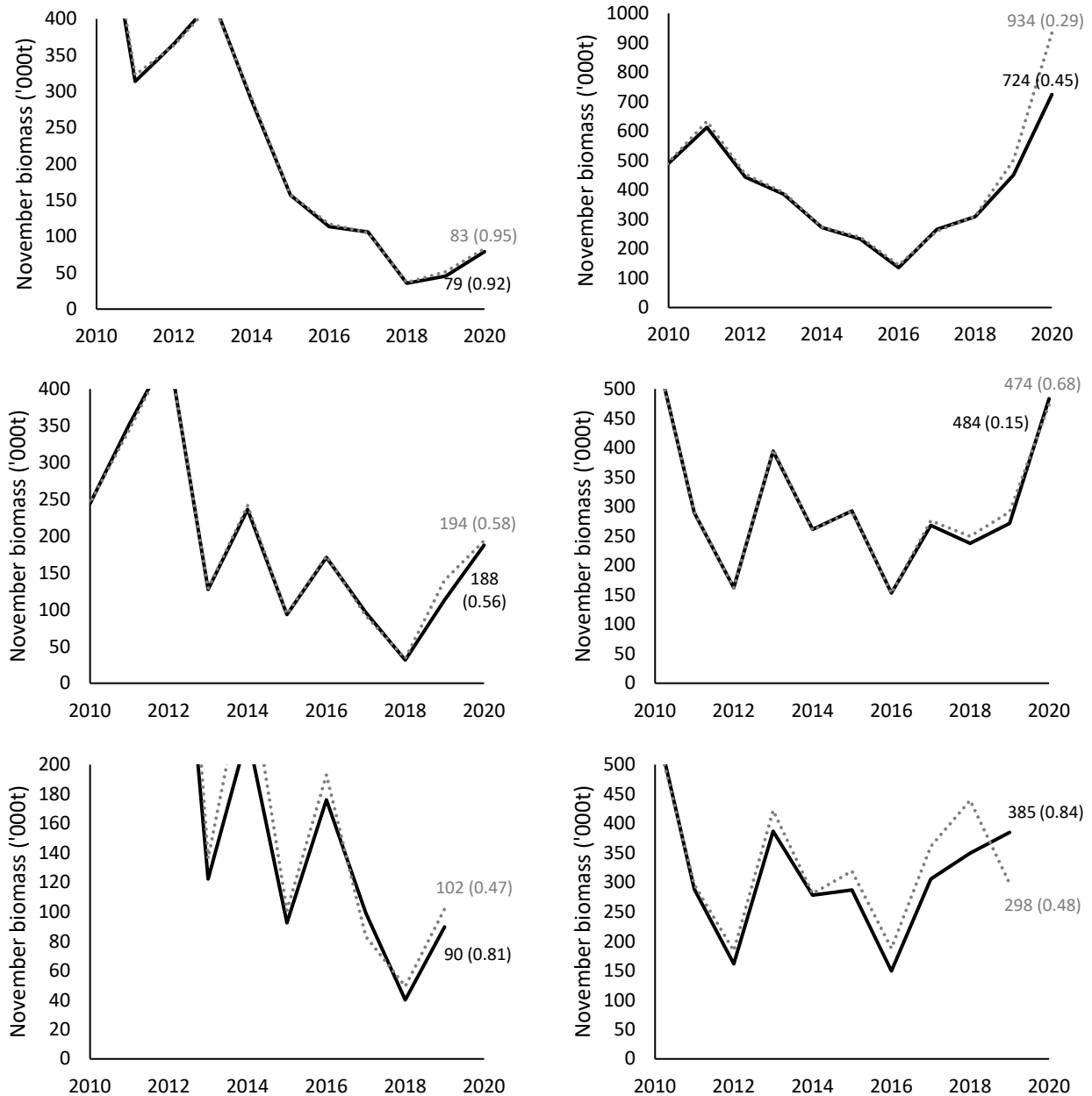


Figure 1. Model estimated total November biomass for west (right) and south (left) component sardine based on assessments including (solid line) and excluding (dotted line) the November survey length frequency data in the final year of the assessments. Results are given for the historical assessments A) (top panel), B) (middle panel) and C) (lower panel).

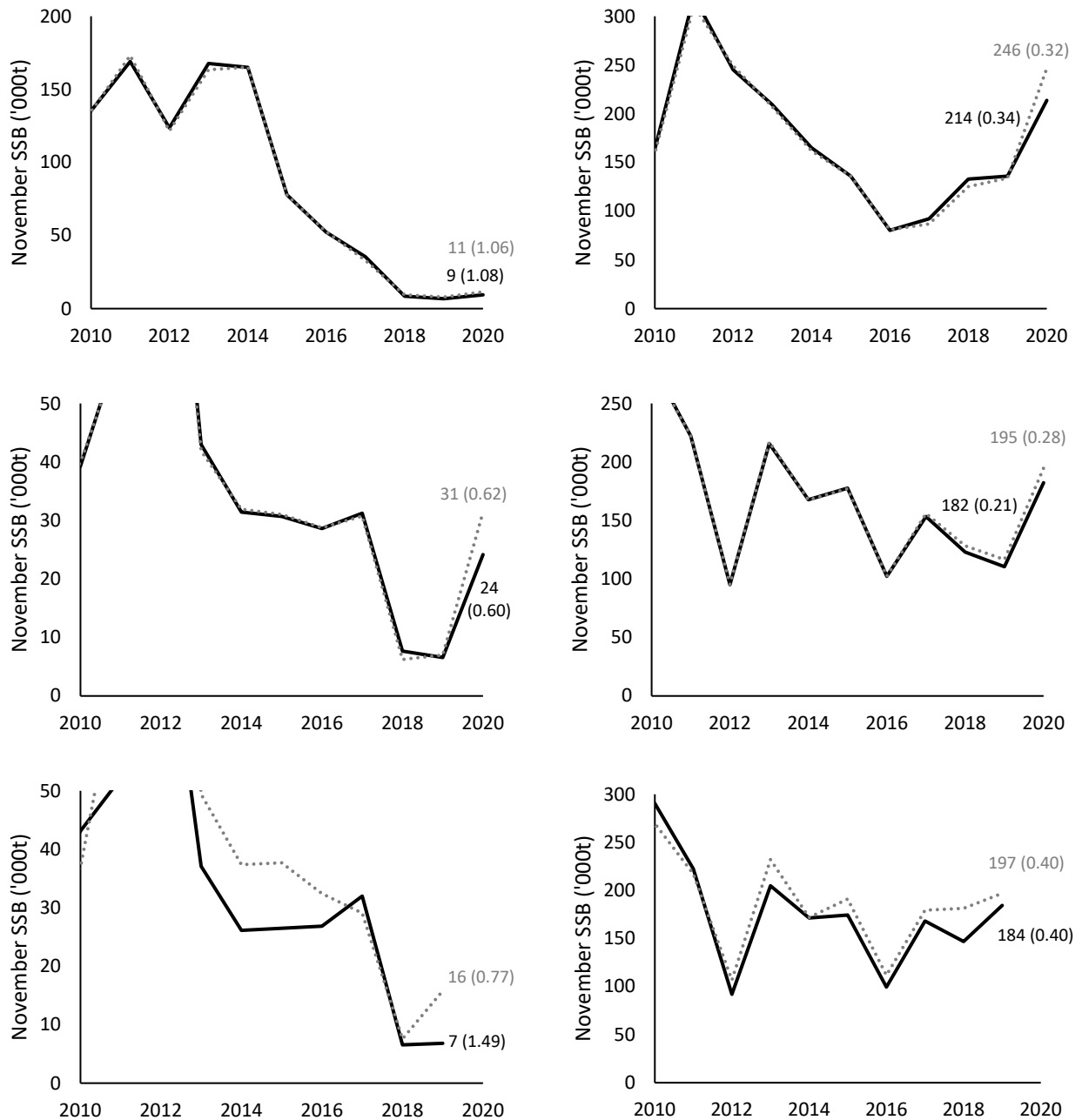


Figure 2. Model estimated November spawner biomass for west (right) and south (left) component sardine based on assessments including (solid line) and excluding (dotted line) the November survey length frequency data in the final year of the assessments. Results are given for the historical assessments A) (top panel), B) (middle panel) and C) (lower panel).

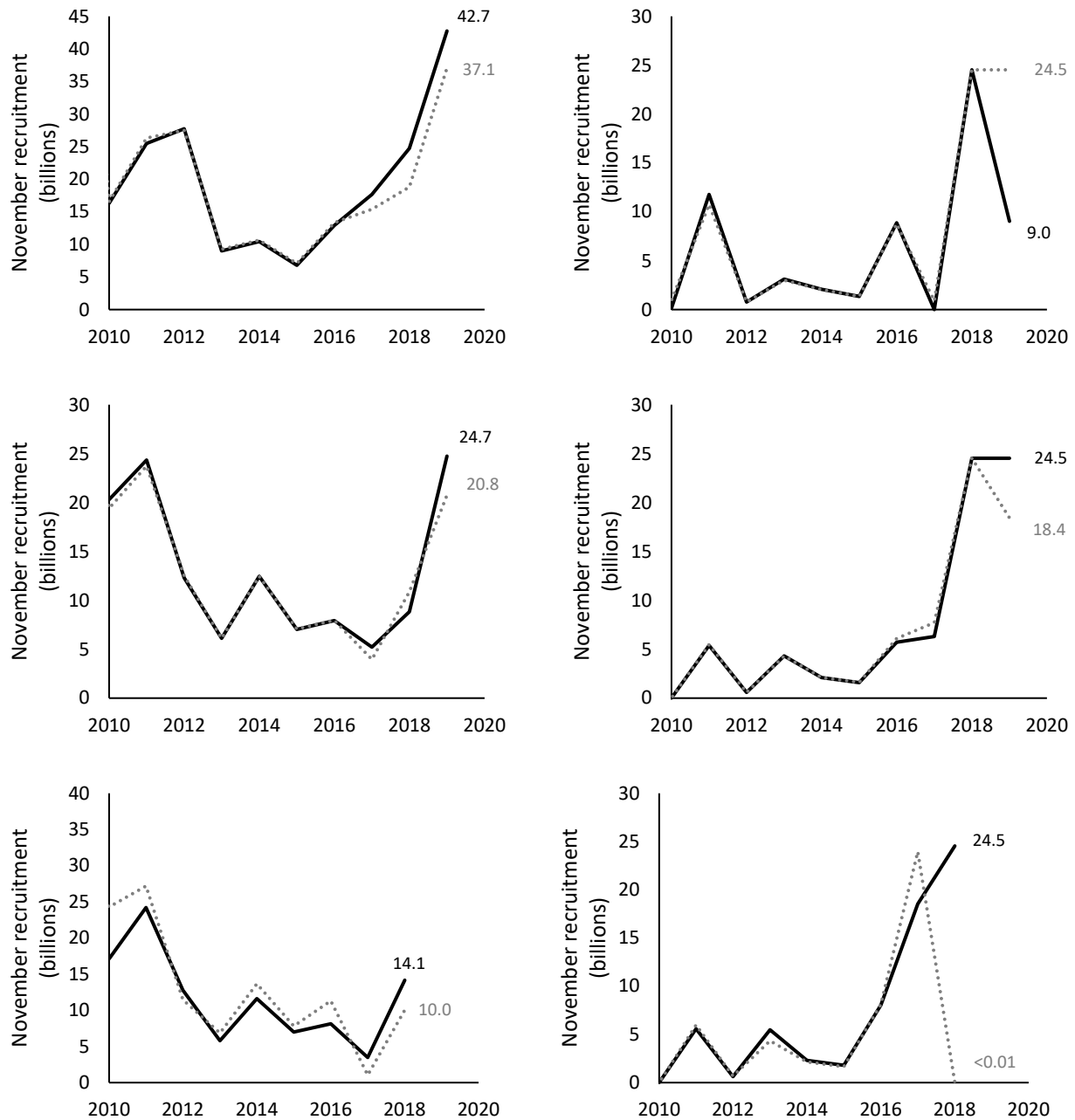


Figure 3. Model estimated November recruitment for west (right) and south (left) component sardine based on assessments including (solid line) and excluding (dotted line) the November survey length frequency data in the final year of the assessments. Results are given for the historical assessments A) (top panel), B) (middle panel) and C) (lower panel).

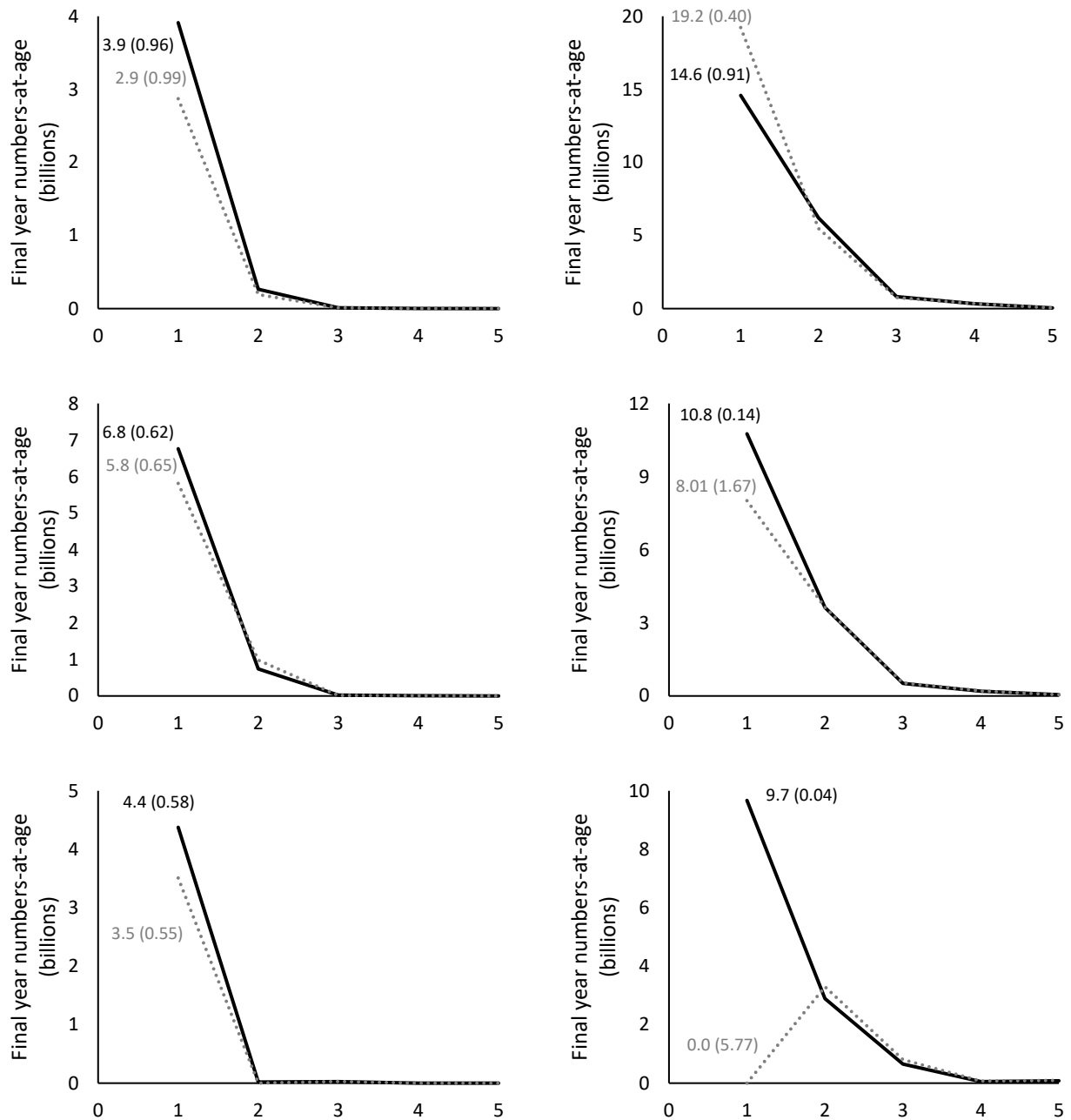


Figure 4. Model estimated final year numbers-at-age for west (right) and south (left) component sardine based on assessments including (solid line) and excluding (dotted line) the November survey length frequency data in the final year of the assessments. (Numbers-at-age 0 can be seen in Figure 3.) Results are given for the historical assessments A) (top panel), B) (middle panel) and C) (lower panel).