Sardine projections based on constant catch scenarios separated by recruitment scenarios

C.L. de Moor*

Correspondence email: *carryn.demoor@uct.ac.za*

Short-term projections of the South African sardine resource under alternative small sardine bycatch options have been run, now assuming five alternative west component recruitment scenarios, each corresponding to one of the five most recent years. The previous baseline projections randomly sampled west component recruitment from all of these years.

Introduction

de Moor (2020a) undertook short- and medium-term projections of the South African sardine resource to assist the Small Pelagic Scientific Working Group (SWG-PEL) in assessing whether increases in the 2020 directed sardine TAC and/or sardine TABs could be scientifically justified. Those projections assumed that future recruitment to the west component from November 2019 onwards was randomly drawn from the recruitments estimated from 2014 to 2018 by de Moor (2020b). This document reports on some of the short-term statistics separated for the five different recruitment levels.

Methods

The short-term projections were re-run, but now replacing the single baseline west component recruitment option of randomly drawing recruitment from the most recent 5 years with five alternative options, each assuming west component recruitment to correspond to one of the years 2014 to 2018 only. There is no change to the modelling of recruitment to the south component.

Five alternative small sardine bycatch options were tested, from 7 000t (bycatch with anchovy) + 400t (bycatch with round herring and directed sardine) to 12 000t + 400t, in steps of 1000t of bycatch with anchovy. The "large" sardine catch west of Cape Agulhas remains fixed at 2 625t (bycatch) + 9 000t (directed) and the "large" sardine catch east of Cape Agulhas remains fixed at 13 000t.

Results and Discussion

Table 1 shows the summary statistics reflecting the impact of alternative bycatch levels on the population after a single year assuming 2019 west component corresponds to one of the years 2014 to 2018. The "Baseline" results correspond to the random sampling of recruitment from 2014 to 2018 (de Moor 2020a).

A couple of points should be noted when interpreting and using these results:

i) The statistics reported in Table 1, reflecting a change in the population after just one year, will not give an accurate reflection of the impact of small sardine bycatch on the population. Small sardine bycatch is assumed to consist of only recruits in the model. The 2019 recruits will contribute relatively less to the November 2020 biomass due to the lower weight of 1-year olds than 2+ year olds, and few 1-year-olds will form part of the November 2020 spawner biomass. The impact of small sardine bycatch during 2019 will be better reflected in changes in the population after a few years.

* MARAM (Marine Resource Assessment and Management Group), Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch, 7701, South Africa.

ii) The directed sardine catch is assumed to consist of fish of all ages, including some recruits. Changes to the bycatch levels impacts changes to the directed catches-at-age (Appendix A, de Moor 2020a) as the directed fishing mortality is assumed to apply to the biomass available after bycatch. This subsequently impacts the contribution of 2+ year olds to the November 2020 biomass and spawner biomass.

iii) The impact of alternative bycatches on these "1-year-impact" statistics differ substantially between the five alternative recruitment scenarios. One should however also note that the same statistics differ substantially between the alternative recruitment scenarios even in the absence of catch.

References

de Moor CL. 2019. Sardine projections based on constant catch scenarios. DAFF: Branch Fisheries Document FISHERIES/2019/APR/SWG-PEL/07.

de Moor CL. 2020a. Sardine projections based on constant catch scenarios. DFFE: Branch Fisheries Document FISHERIES/2020/APR/SWG-PEL/33.

de Moor CL. 2020b. Baseline assessment of the South African sardine resource using data from 1984-2019. DEA: Branch Fisheries Document FISHERIES/2020/APR/SWG-PEL/30.

Table 1. 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 under alternative small sardine bycatch options and alternative November recruitment scenarios. The 5%ile, 20%ile and 50%ile of the multiplicative change under the catch options relative to the no catch option are also given. Grey cells indicate cases for which the selectivity function needed modification to enable the catch to be taken. The top two rows give the comparative statistics under the zero catch and 2019 TAB/B alternatives as estimated by de Moor (2019).

					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
2019	0	0	0	0	2.20	2.67	3.40	25	35	50						
	23	6.5	7	9.5	1.88	2.36	3.09	19	28	43				0.86	0.88	0.90
Baseline	0	0	0	0	1.25	1.55	2.14	9	15	21	-35	-8	17			
	32.05	11.65	13	7.4	1.16	1.44	1.95	6	12	18	-45	-19	7	0.89	0.91	0.92
	33.05	11.65	13	8.4	1.15	1.43	1.94	6	12	18	-46	-20	6	0.89	0.9	0.92
	34.05	11.65	13	9.4	1.15	1.43	1.94	6	12	17	-47	-20	6	0.88	0.9	0.92
	35.05	11.65	13	10.4	1.15	1.43	1.94	5	12	17	-47	-21	5	0.88	0.9	0.92
	36.05	11.65	13	11.4	1.15	1.43	1.93	5	12	17	-48	-21	4	0.88	0.9	0.91
	37.05	11.65	13	12.4	1.14	1.42	1.93	5	12	17	-49	-22	4	0.87	0.89	0.91
$N^S_{w,0,2017,0} = 3.47$	0	0	0	0	1.16	1.4	1.87	5	11	16	-63	-34	-14			
	32.05	11.65	13	7.4	1.06	1.27	1.68	2	7	13	-74	-44	-25	0.87	0.89	0.91
	33.05	11.65	13	8.4	1.06	1.27	1.67	2	7	12	-74	-45	-25	0.86	0.88	0.91
	34.05	11.65	13	9.4	1.05	1.26	1.67	1	7	12	-75	-46	-26	0.86	0.88	0.9
	35.05	11.65	13	10.4	1.05	1.26	1.66	1	7	12	-75	-46	-26	0.86	0.88	0.9
	36.05	11.65	13	11.4	1.05	1.26	1.66	1	7	12	-76	-47	-27	0.85	0.88	0.9
	37.05	11.65	13	12.4	1.05	1.26	1.65	1	7	12	-77	-47	-28	0.85	0.87	0.9
$N^S_{w,0,2015,0} = 6.99$	0	0	0	0	1.23	1.51	2.03	8	14	19	-40	-11	9			
	32.05	11.65	13	7.4	1.15	1.4	1.86	5	11	16	-51	-22	-2	0.88	0.9	0.92
	33.05	11.65	13	8.4	1.15	1.39	1.86	5	11	16	-51	-22	-2	0.88	0.9	0.91
	34.05	11.65	13	9.4	1.15	1.39	1.85	5	10	16	-52	-23	-3	0.88	0.9	0.91
	35.05	11.65	13	10.4	1.14	1.39	1.85	5	10	16	-53	-23	-4	0.88	0.89	0.91
	36.05	11.65	13	11.4	1.14	1.38	1.84	5	10	15	-53	-24	-4	0.87	0.89	0.91
	37.05	11.65	13	12.4	1.14	1.38	1.84	4	10	15	-54	-25	-5	0.87	0.89	0.91

Table 1 (continued).

					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
$N^S_{w,0,2016,0} = 8.11$	0	0	0	0	1.25	1.55	2.09	9	15	20	-33	-4	16			
	32.05	11.65	13	7.4	1.18	1.43	1.92	6	12	17	-43	-14	5	0.89	0.91	0.92
	33.05	11.65	13	9.4	1.18	1.43	1.91	6	12	17	-44	-15	5	0.89	0.9	0.92
	34.05	13.65	13	7.4	1.18	1.43	1.91	6	12	17	-45	-15	4	0.88	0.9	0.92
	35.05	11.65	13	10.4	1.17	1.42	1.9	6	11	17	-45	-16	4	0.88	0.9	0.91
	36.05	13.65	13	9.4	1.17	1.42	1.9	6	11	17	-46	-17	3	0.88	0.89	0.91
	37.05	16.65	16	7.4	1.17	1.42	1.89	5	11	16	-47	-17	2	0.87	0.89	0.91
$N^S_{w,0,2014,0} = 11.5$	0	0	0	0	1.32	1.67	2.26	12	18	23	-10	19	39			
	32.05	11.65	13	7.4	1.24	1.55	2.09	9	15	20	-21	8	28	0.9	0.91	0.93
	33.05	11.65	13	9.4	1.24	1.54	2.08	9	15	20	-21	8	27	0.9	0.91	0.92
	34.05	13.65	13	7.4	1.24	1.54	2.08	9	15	20	-22	7	27	0.9	0.91	0.92
	35.05	11.65	13	10.4	1.24	1.54	2.07	9	15	20	-23	6	26	0.9	0.91	0.92
	36.05	13.65	13	9.4	1.23	1.53	2.07	9	15	20	-23	6	26	0.89	0.91	0.92
	37.05	16.65	16	7.4	1.23	1.53	2.06	9	15	20	-24	5	25	0.89	0.9	0.92
$N^S_{w,0,2018,0} = 14.14$	0	0	0	0	1.37	1.76	2.38	15	21	26	6	35	55			
	32.05	11.65	13	7.4	1.3	1.64	2.2	11	17	22	-4	25	45	0.91	0.92	0.93
	33.05	11.65	13	9.4	1.3	1.63	2.2	11	17	22	-5	24	44	0.91	0.92	0.93
	34.05	13.65	13	7.4	1.3	1.63	2.19	11	17	22	-6	24	43	0.91	0.92	0.93
	35.05	11.65	13	10.4	1.3	1.63	2.19	11	17	22	-6	23	43	0.9	0.91	0.93
	36.05	13.65	13	9.4	1.3	1.62	2.19	11	17	22	-7	22	42	0.9	0.91	0.92
	37.05	16.65	16	7.4	1.29	1.62	2.18	11	17	22	-7	22	42	0.9	0.91	0.92