On the cost-effective design of agglomeration bonus schemes for the conservation of multiple competing species

Supplementary Material

Appendix A: Output variables as functions of the model parameters for scenario 1: $N^2 = 121$ land parcels and $S = 2$ species.

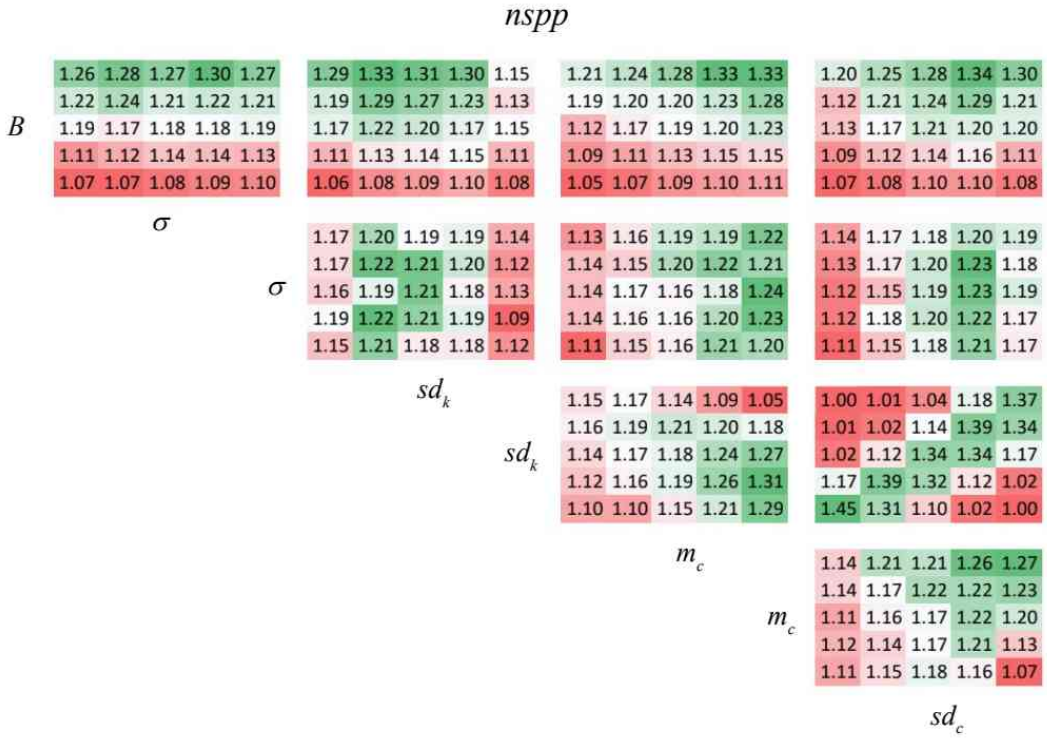

Figure A1: Expected number of persistence species *nspp* as a function of the model parameters (cf. Table 1). In each panel, *nspp* is a function of two model parameters, varied in five levels as described in the main text. Vertical axes: conservation budget B (first row), cost variation σ (second row), variation of competition strengths sd_k (third row), mean of colonisation probabilities m_c (fourth row). Horizontal axes: cost variation σ (first column), variation of competition strengths sd_k (second column), mean of colonisation probabilities m_c (third column), variation of colonisation probabilities sd_c (fourth column). To provide an example, the panel in the upper right shows *nspp* as a function of B and sd_c.

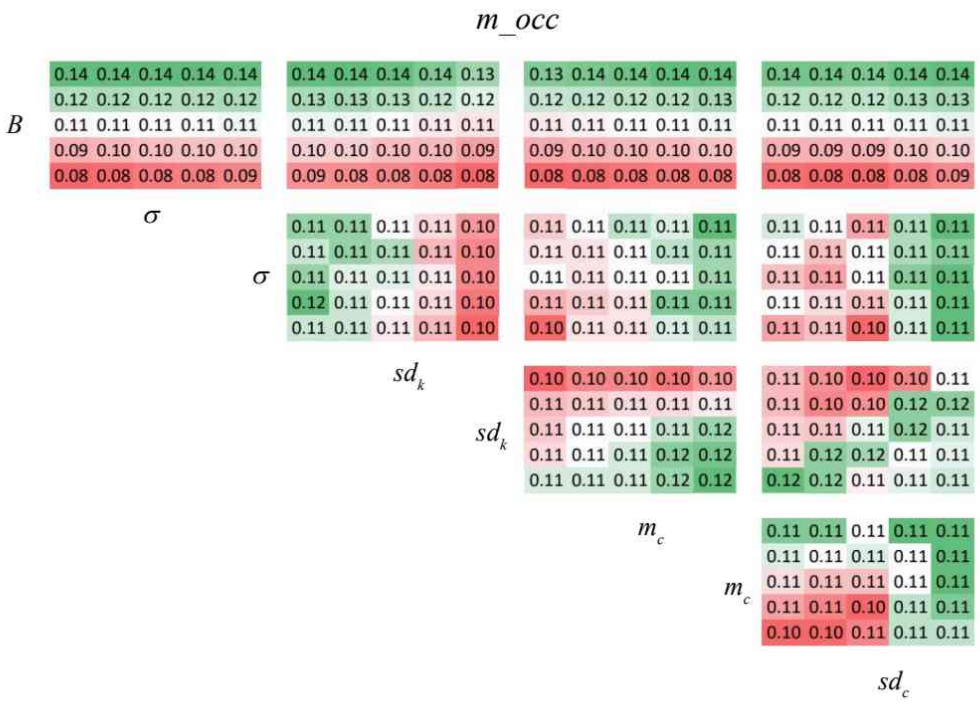

Figure A2: Mean proportion of occupied land parcels *m_occ* as a function of the model parameters (cf Fig A1).

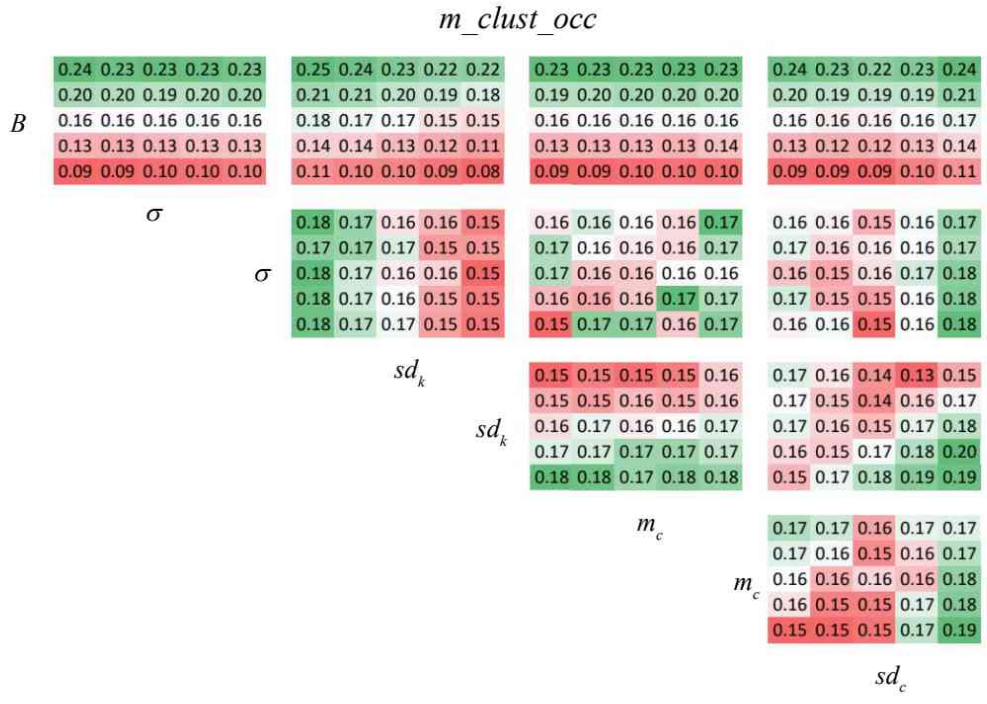

Figure A3: Mean clustering of occupied land parcels *m_clust_occ* as a function of the model parameters (cf Fig A1)

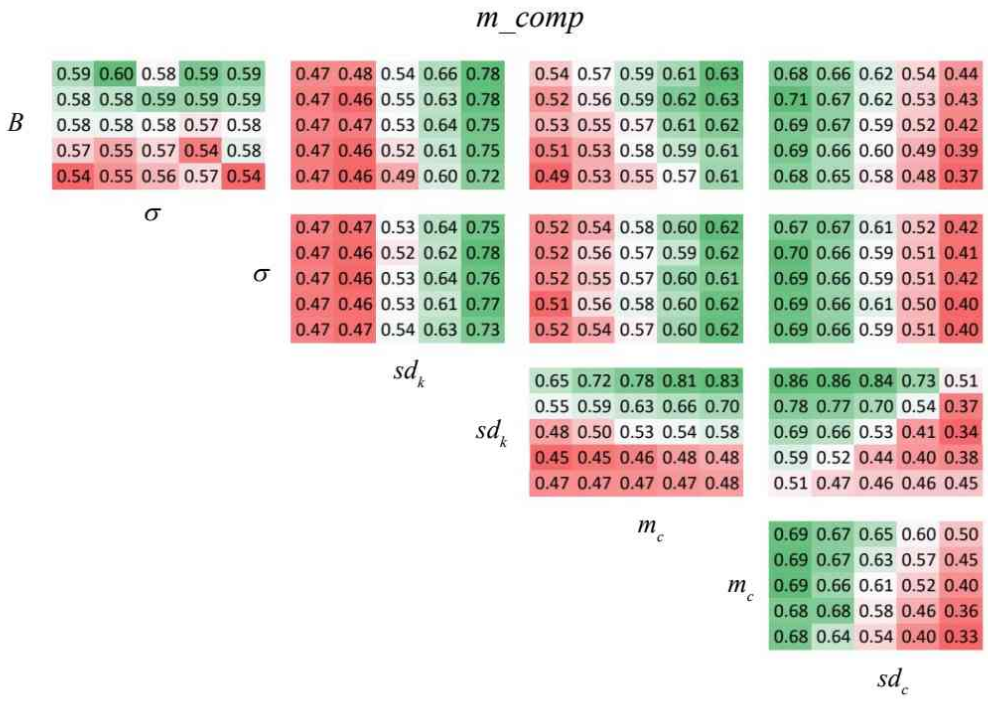

Figure A4: Mean competition strength *m_comp* as a function of the model parameters (cf Fig A1).

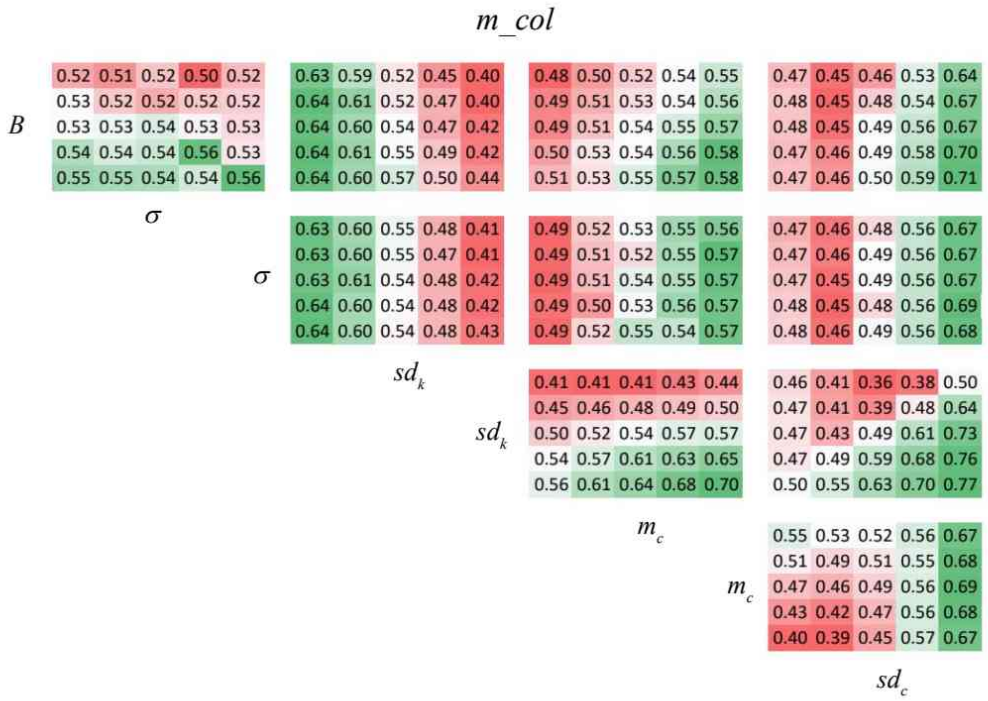

Figure A5: Mean colonisation probability *m_col* as a function of the model parameters (cf Fig A1).

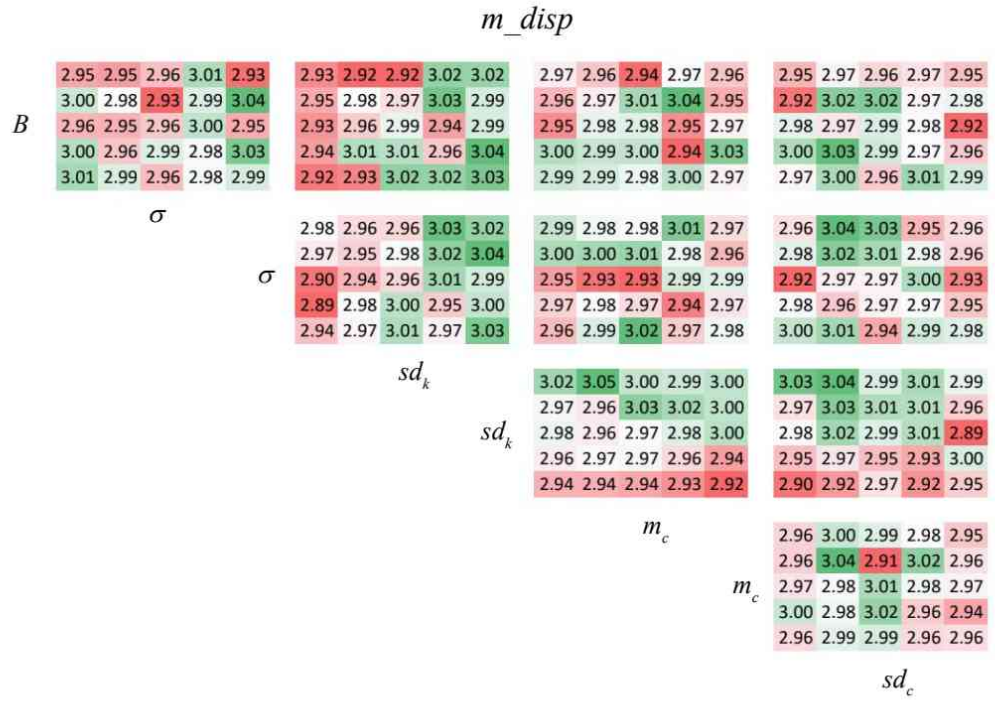

Figure A6: Mean dispersal range *m_disp* as a function of the model parameters (cf Fig A1).

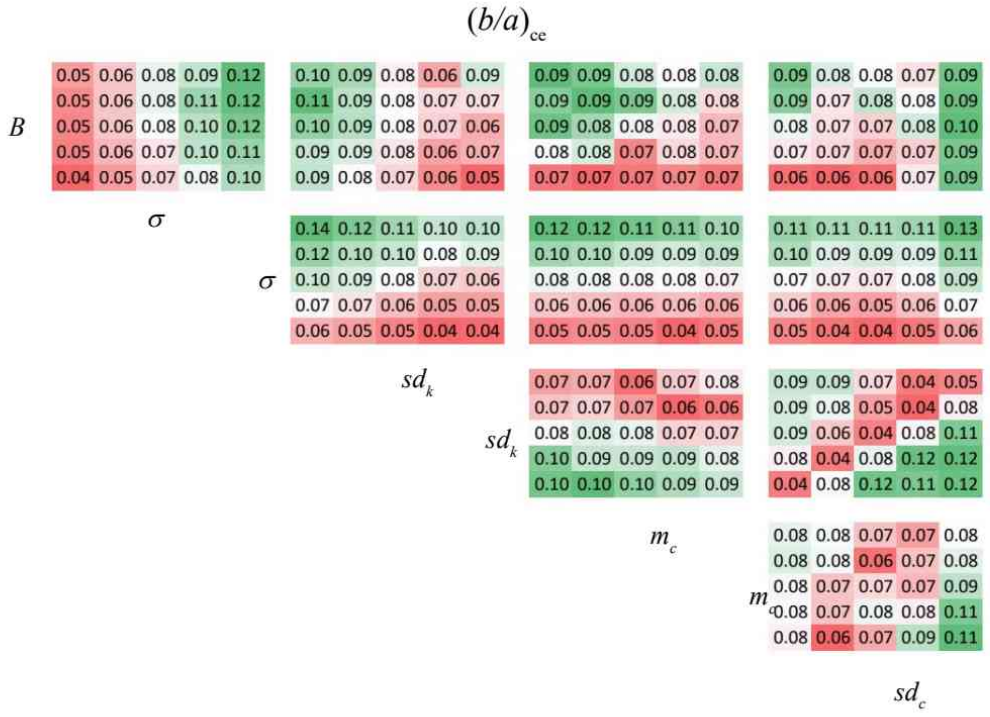

Figure A7: Cost-effective agglomeration bonus $(b/a)_{eff}$ as a function of the model parameters (cf Fig A1).

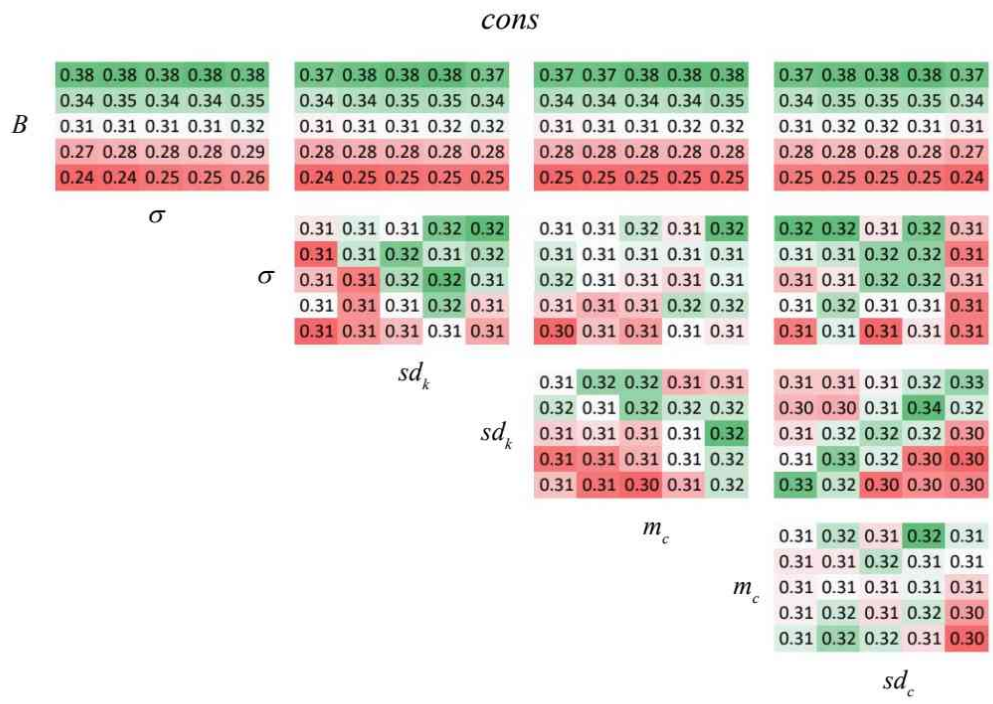

Figure A8: Proportion of conserved land parcels *cons* as a function of the model parameters (cf Fig A1).

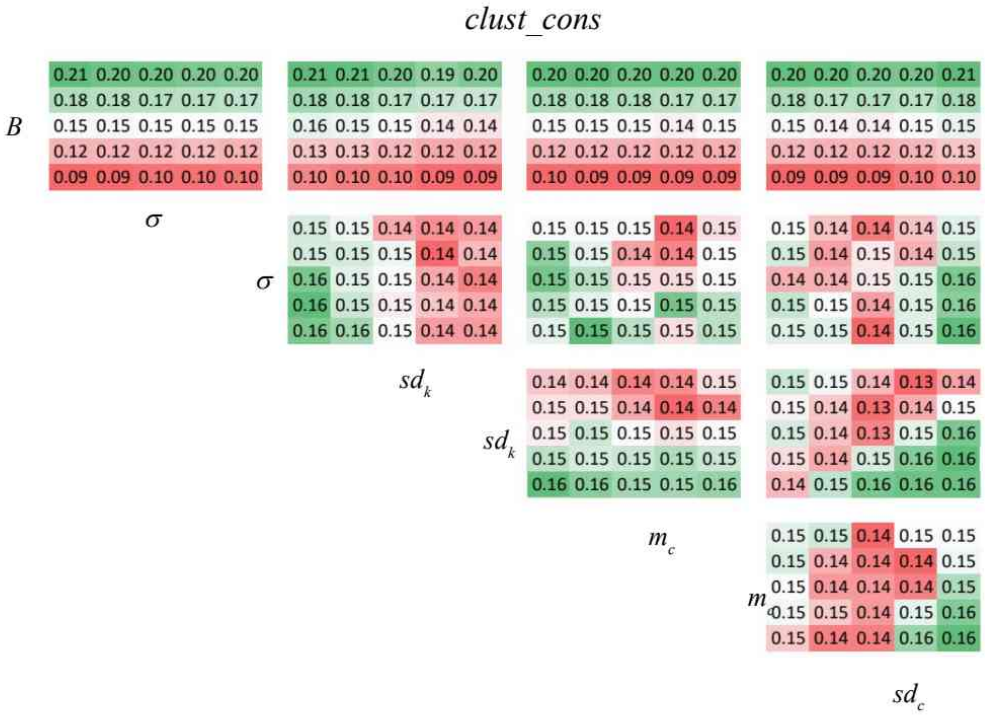

Figure A9: Clustering of conserved land parcels *clust_cons* as a function of the model parameters (cf Fig A1).

Appendix B: Performance variables as functions of the model parameters for scenario 2: N^2 = 225 land parcels and S = 5 species, with perfect negative correlation, ρ = -1, between competition strength and colonisation probability

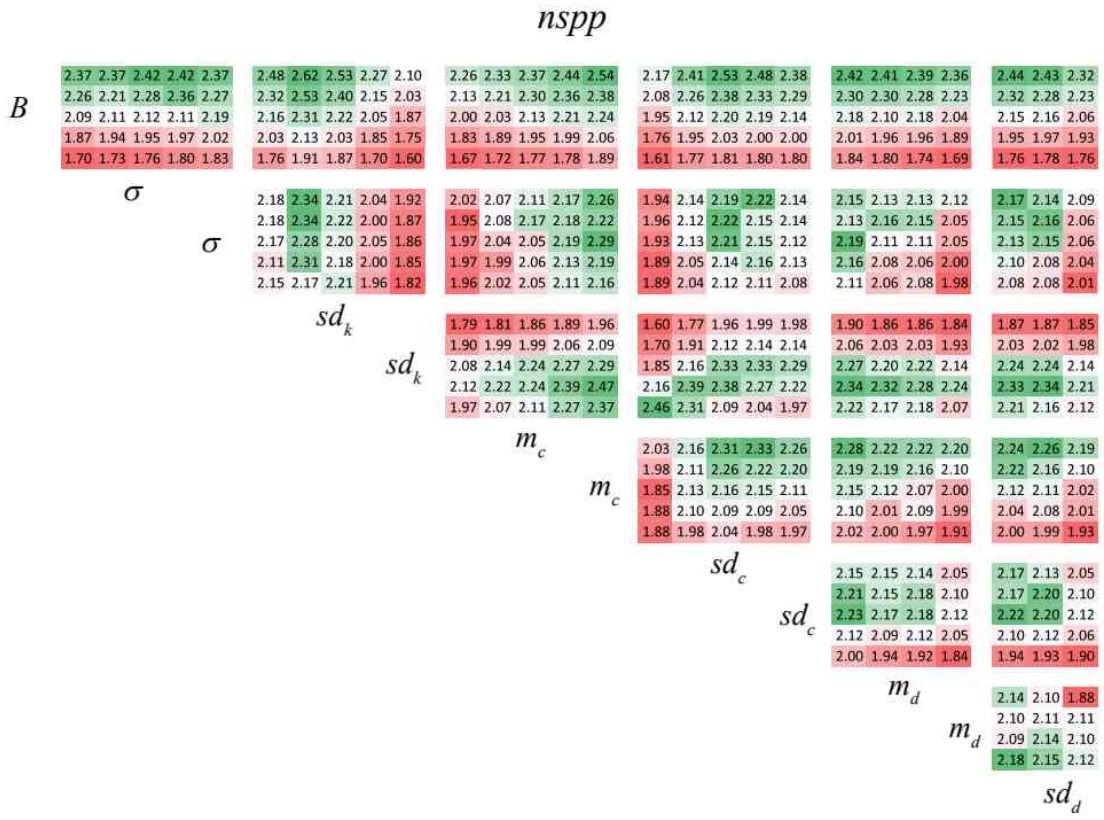

Figure B1: Expected number of persistence species *nspp* as a function of the model parameters (cf. Table 1). In each panel, *nspp* is a function of two model parameters, varied in five levels as described in the main text. Vertical axes: conservation budget B (first row), cost variation σ (second row), variation of competition strengths sd_k (third row), mean of colonisation probabilities m_c (fourth row), variation of colonisation probabilities sd_c (fifth row), mean of dispersal ranges m_d (sixth row). Horizontal axes: cost variation σ (first column), variation of competition strengths sd_k (second column), mean of colonisation probabilities m_c (third column), variation of colonisation probabilities sd_c (fourth column), mean of dispersal ranges m_d (fifth column), variation of dispersal ranges sd_d (sixth column).

Figure B2: Mean proportion of occupied land parcels *m_occ* as a function of the model parameters (cf Fig A1).

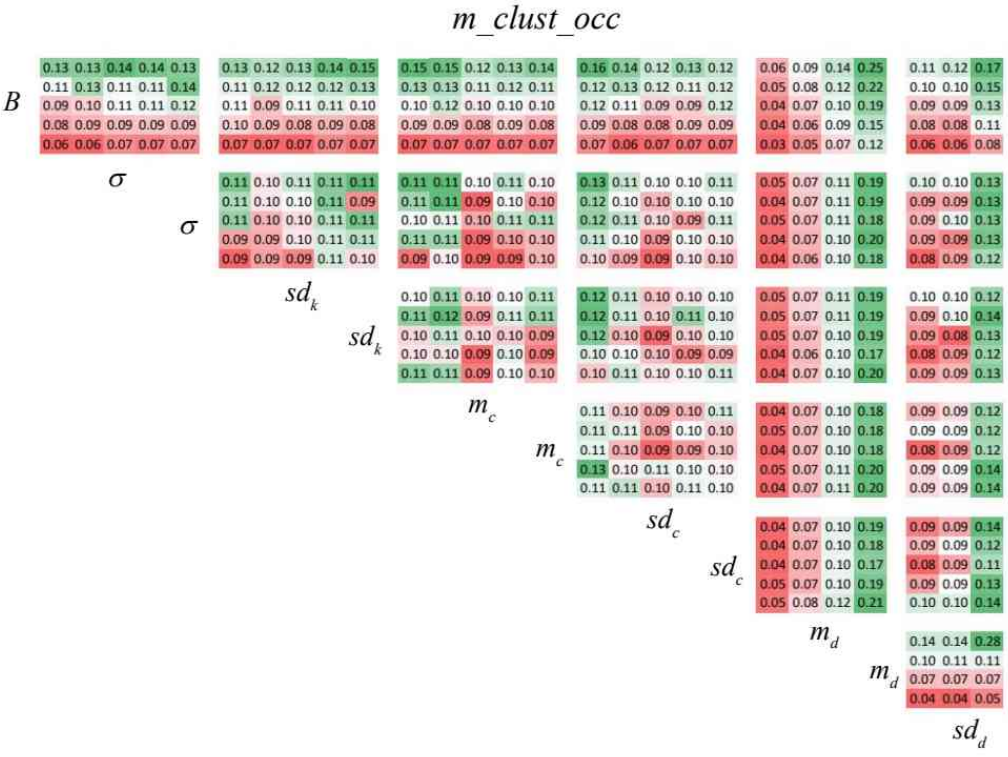

Figure B3: Mean clustering of occupied land parcels *m_clust_occ* as a function of the model parameters (cf Fig A1)

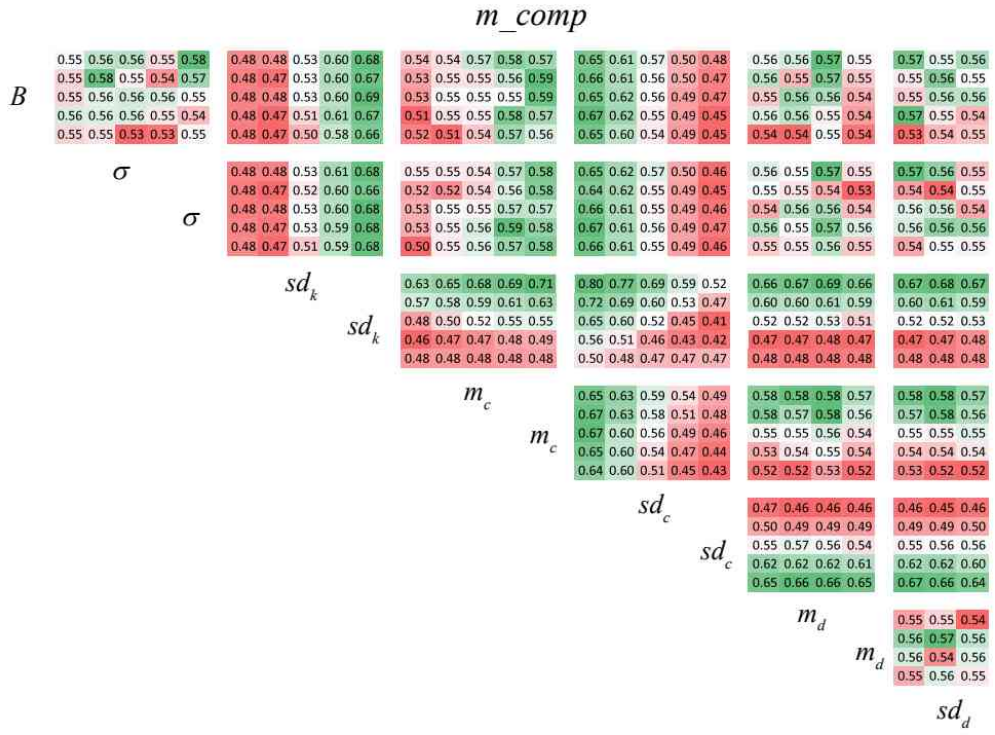

Figure B4: Mean competition strength *m_comp* as a function of the model parameters (cf Fig A1).

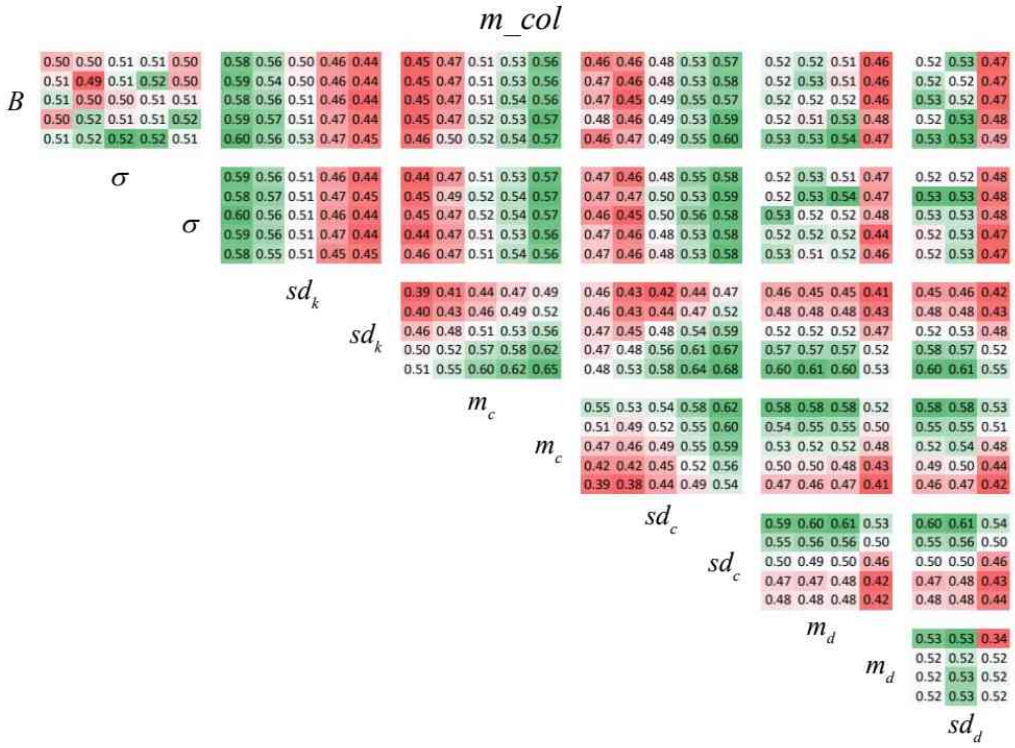

Figure B5: Mean colonisation probability *m_col* as a function of the model parameters (cf Fig A1).

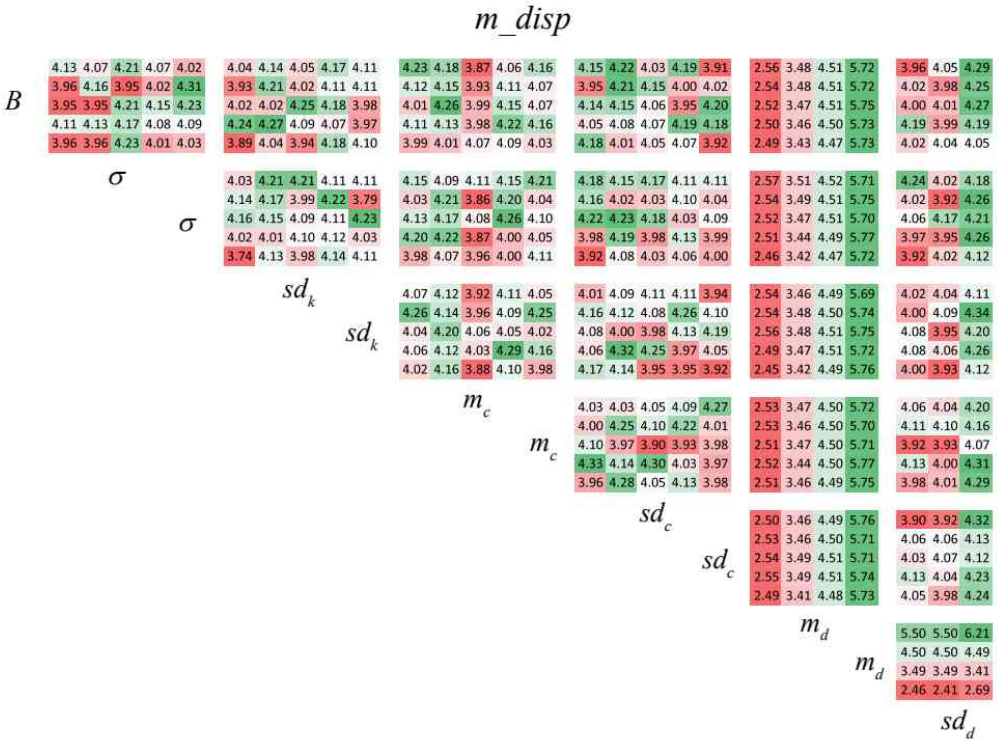

Figure B6: Mean dispersal range *m_disp* as a function of the model parameters (cf Fig A1).

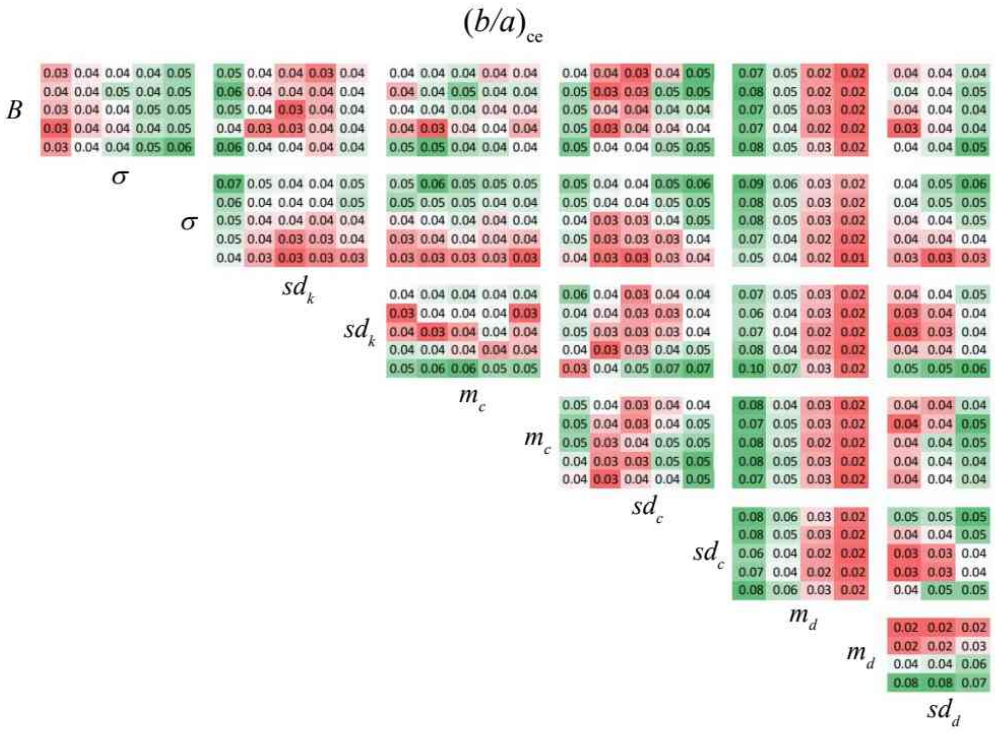

Figure B7: Cost-effective agglomeration bonus $(b/a)_{\text{eff}}$ as a function of the model parameters (cf Fig A1).

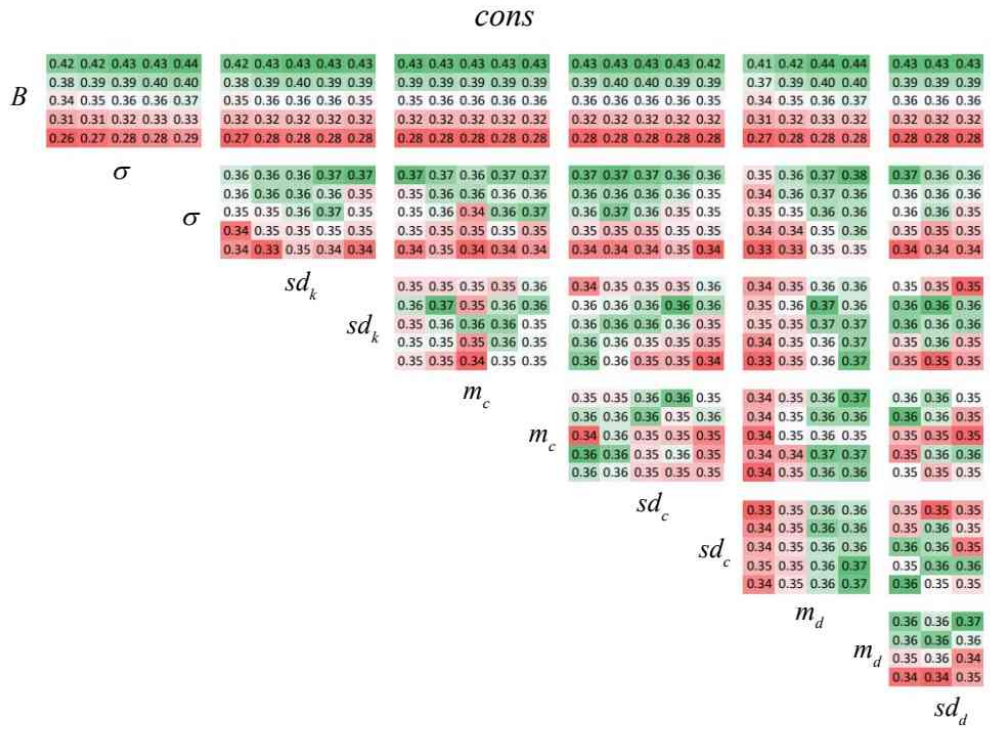

Figure B8: Proportion of conserved land parcels *cons* as a function of the model parameters (cf Fig A1).

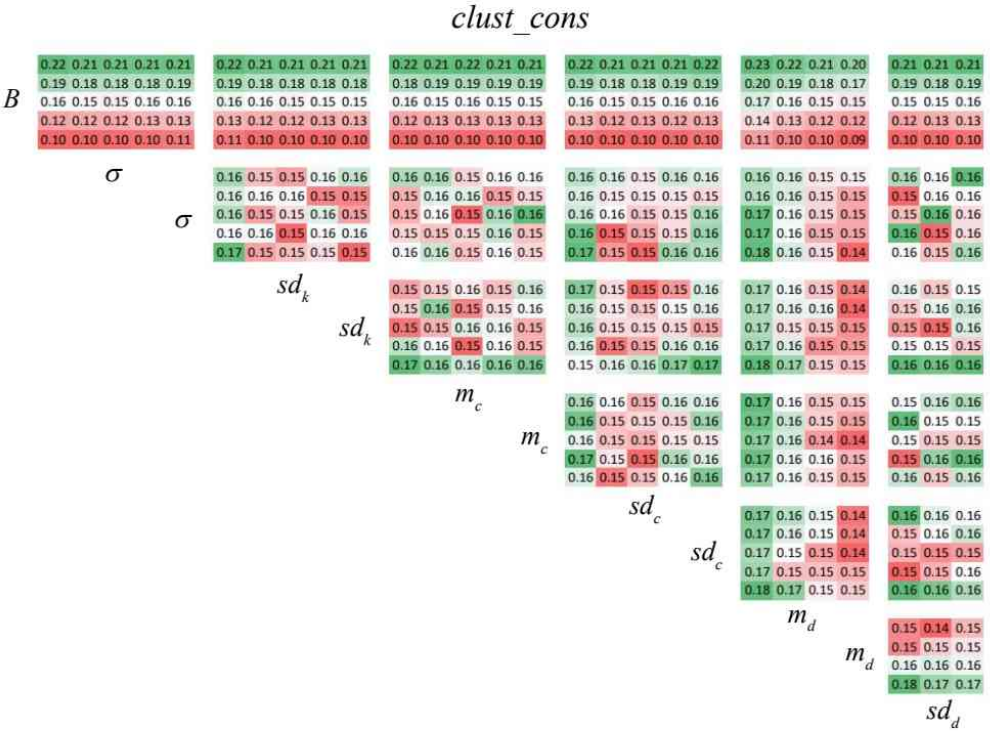

Figure B9: Clustering of conserved land parcels *clust_cons* as a function of the model parameters (cf Fig A1).

Appendix C: Performance variables as functions of the model parameters for scenario 3: N^2 = 225 land parcels and S = 5 species, with imperfect negative correlation, ρ = –0.5, between competition strength and colonisation probability

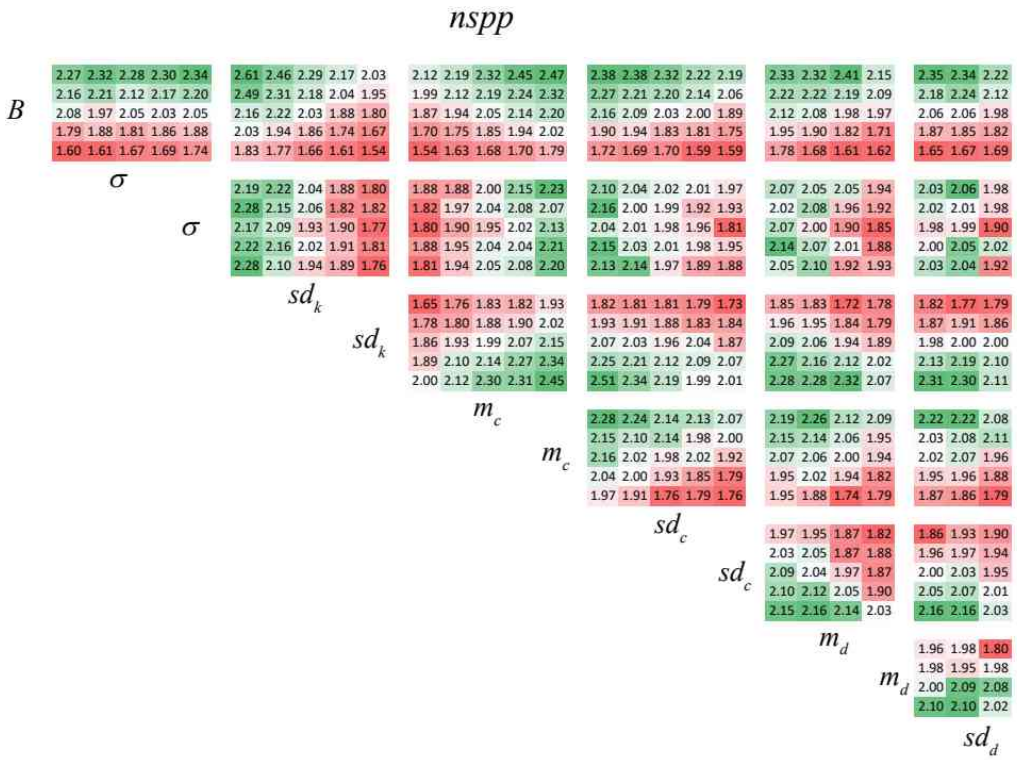

Figure C1: Expected number of persistence species *nspp* as a function of the model parameters (cf. Table 1). In each panel, *nspp* is a function of two model parameters, varied in five levels as described in the main text. Vertical axes: conservation budget B (first row), cost variation σ (second row), variation of competition strengths sd_k (third row), mean of colonisation probabilities m_c (fourth row), variation of colonisation probabilities sd_c (fifth row), mean of dispersal ranges m_d (sixth row). Horizontal axes: cost variation σ (first column), variation of competition strengths sd_k (second column), mean of colonisation probabilities m_c (third column), variation of colonisation probabilities sd_c (fourth column), mean of dispersal ranges m_d (fifth column), variation of dispersal ranges sd_d (sixth column).

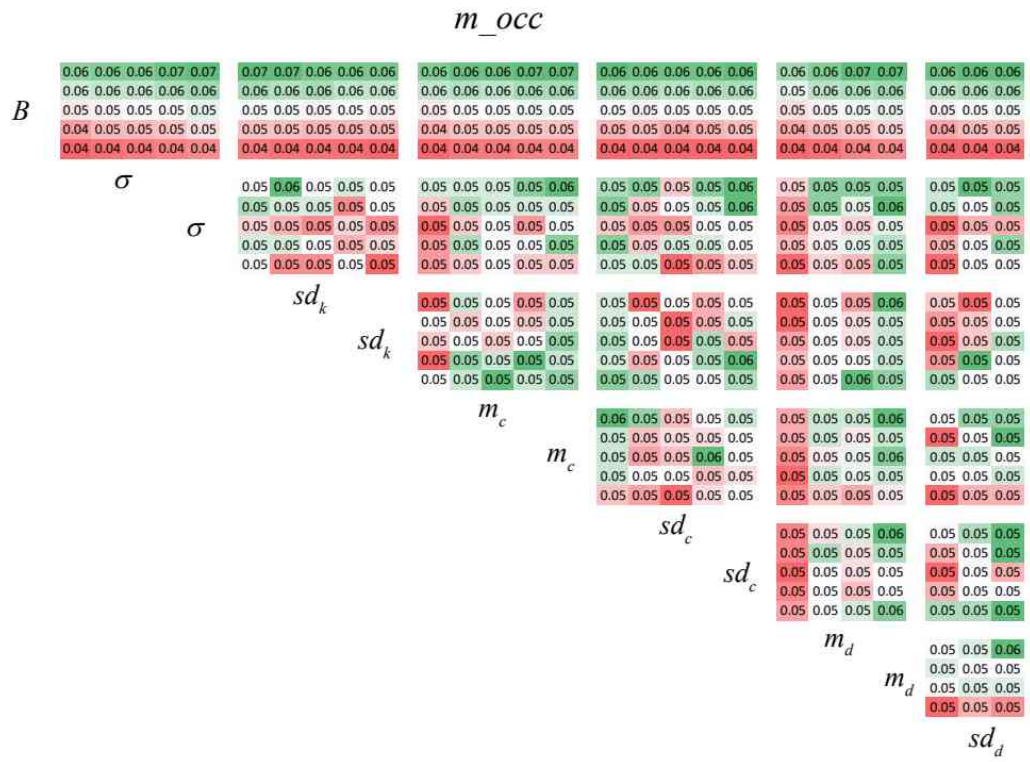

Figure C2: Mean proportion of occupied land parcels *m_occ* as a function of the model parameters (cf Fig A1).

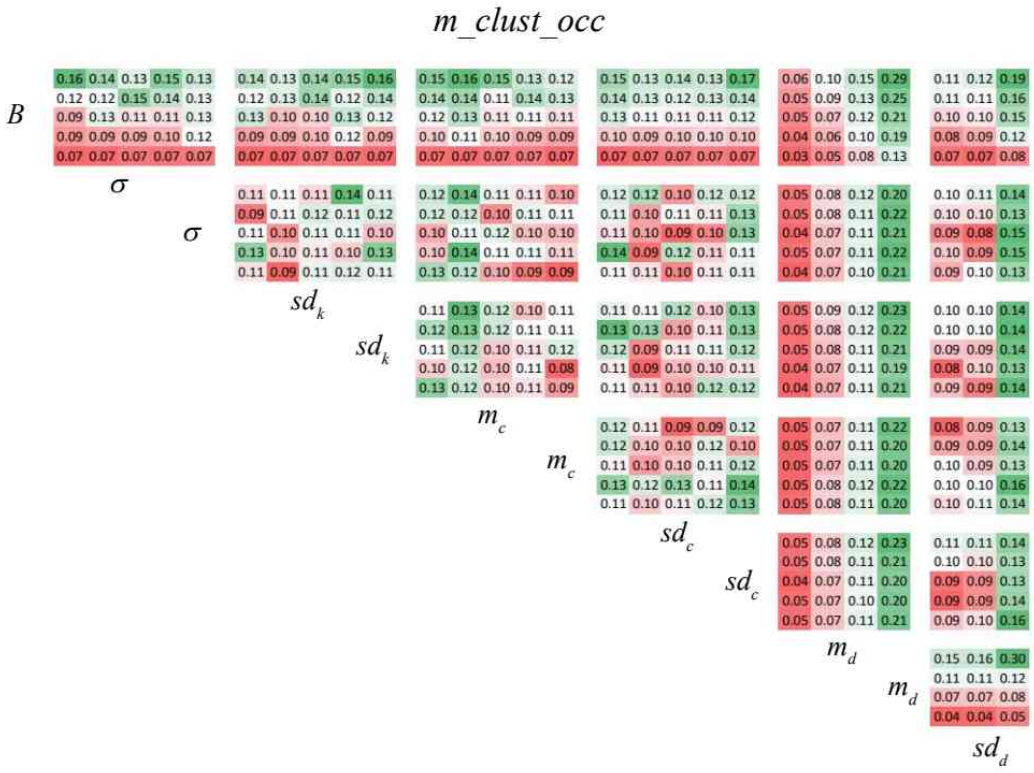

Figure C3: Mean clustering of occupied land parcels *m_clust_occ* as a function of the model parameters (cf Fig A1)

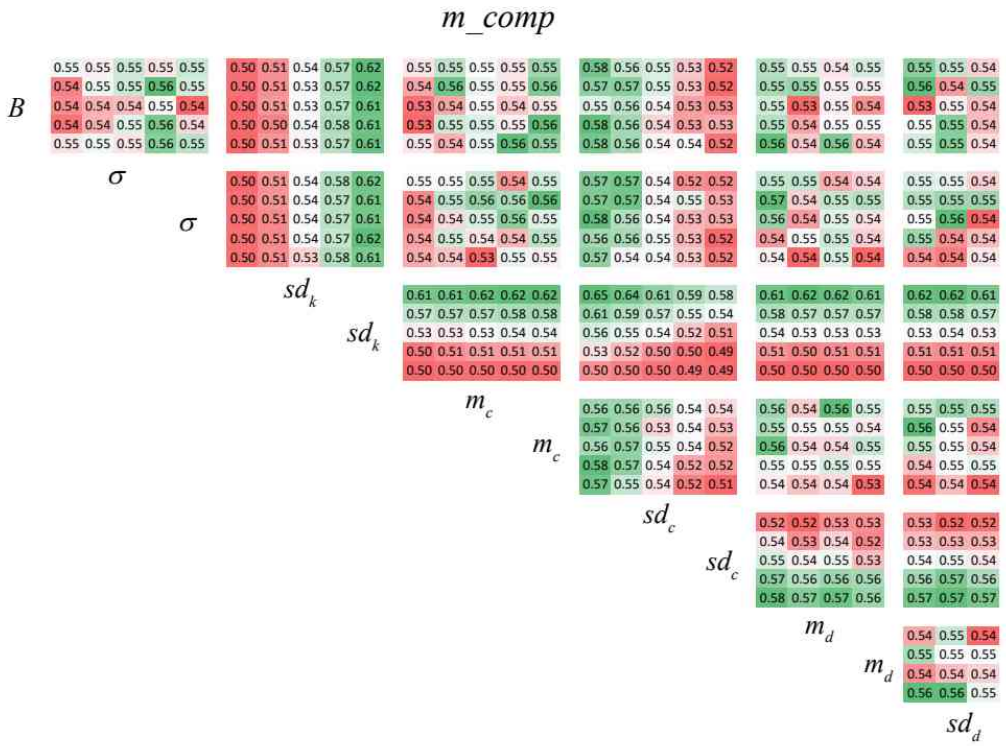

Figure C4: Mean competition strength *m_comp* as a function of the model parameters (cf Fig A1).

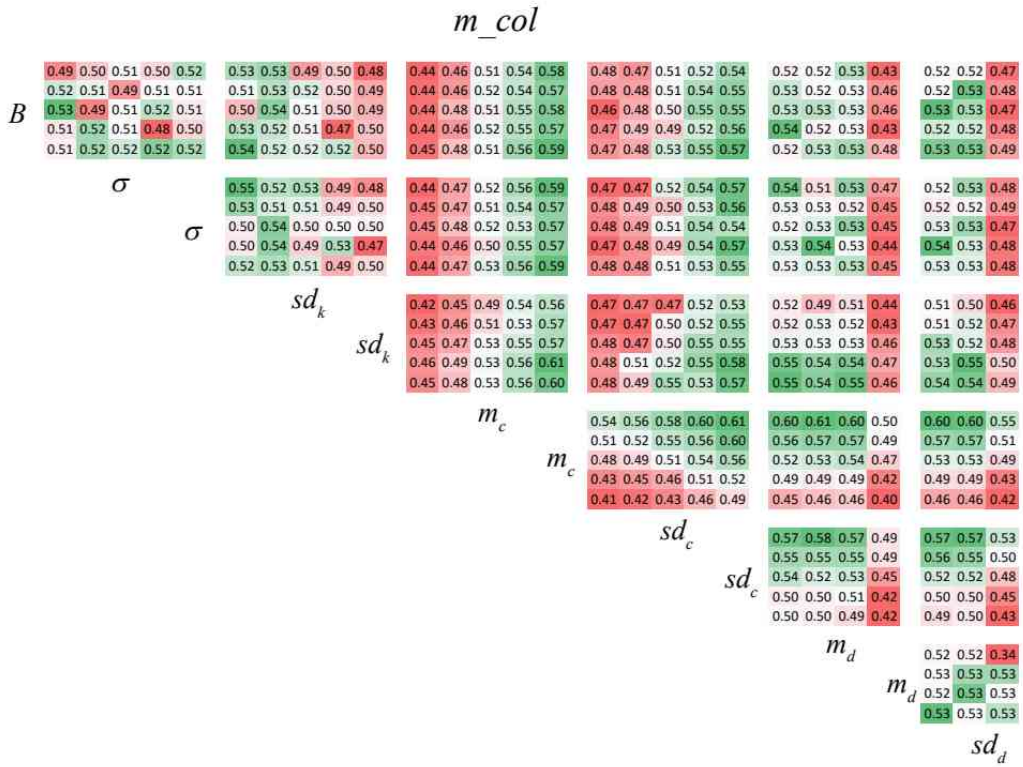

Figure C5: Mean colonisation probability *m_col* as a function of the model parameters (cf Fig A1).

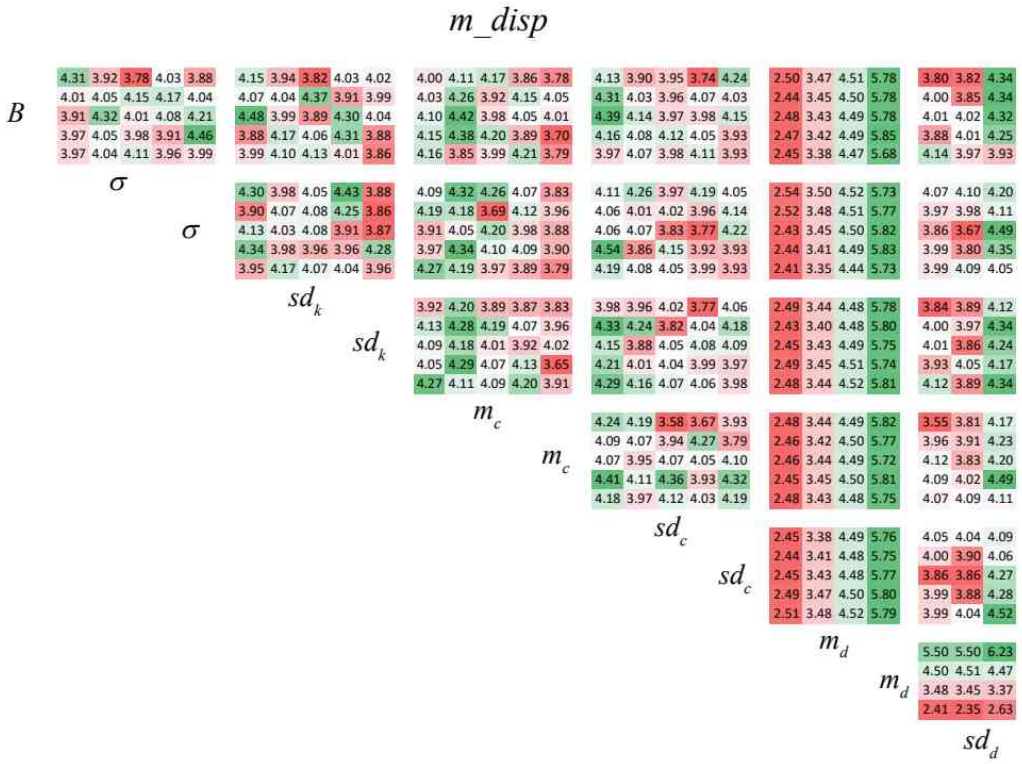

Figure C6: Mean dispersal range *m_disp* as a function of the model parameters (cf Fig A1).

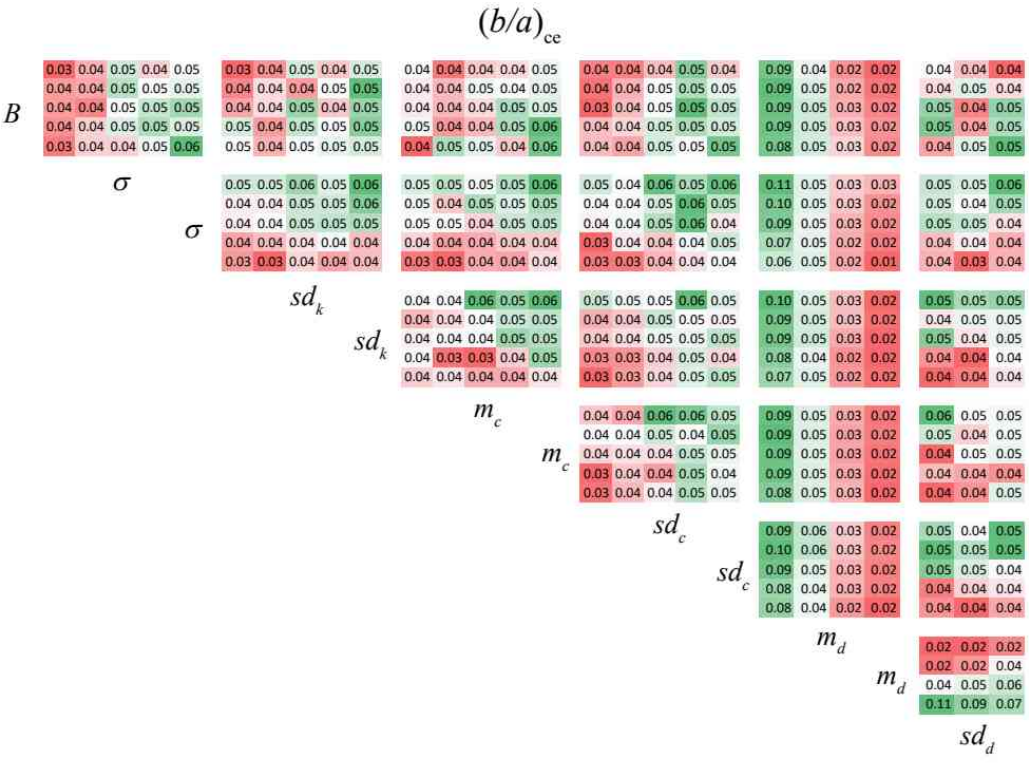

Figure C7: Cost-effective agglomeration bonus $(b/a)_{\text{eff}}$ as a function of the model parameters (cf. Fig A1).

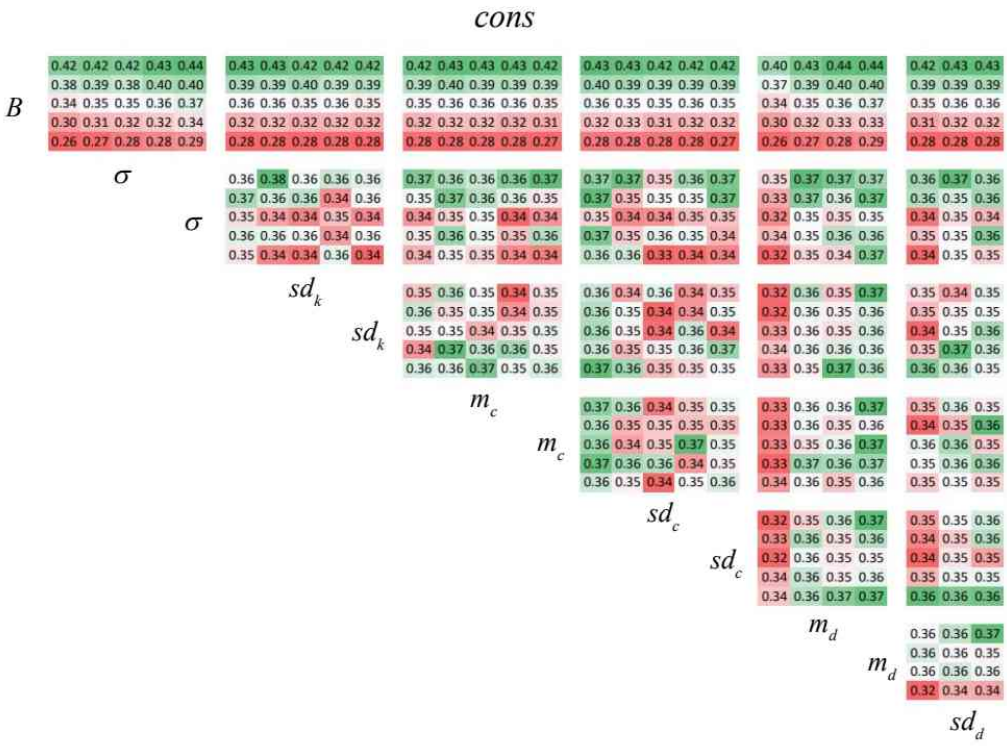

Figure C8: Proportion of conserved land parcels *cons* as a function of the model parameters (cf Fig A1).

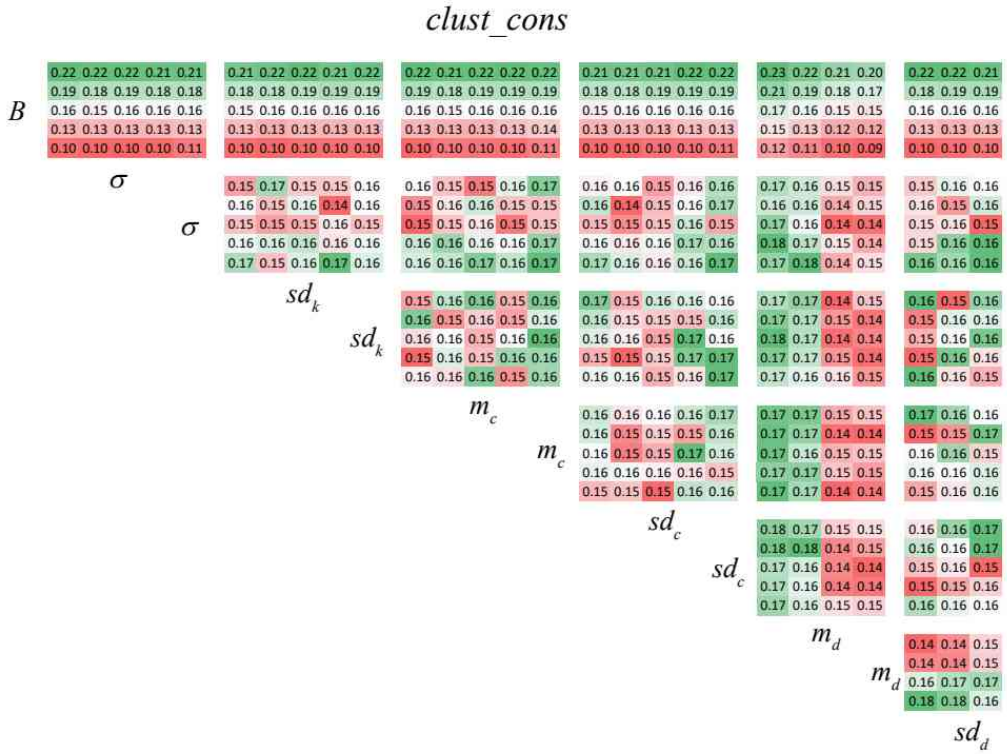

Figure C9: Clustering of conserved land parcels *clust_cons* as a function of the model parameters (cf Fig A1).

Appendix D: Influence of the agglomeration bonus (*a*/*b*) on selected model output variables

Table D1: Model output variables *nspp* (number of extant species), *m_comp* (mean competition strength of the extant species), *m_col* (mean competition strength of the extant species) and *m_disp* (mean dispersal range of the extant species) as functions of the base payment *a* (varied in steps of 0.03) and the associated bonus *b* (which is determined so that the conservation budget is exactly exhausted; for larger and smaller *a* than those given, no suitable *b* exists). Eight combinations of the model parameters sd_k (variation of competition strengths), sd_c (variation of colonisation rates) and m_d (mean dispersal range) are considered. The number of grid cells is $N^2 = 15^2$, $S = 5$ species are considered, and the correlation between competition strengths and colonisation rates is $\rho = -1$ (scenario 2). All other model parameters are at the means of their ranges provided in Table 1.

sd_k	sd_c	m_d	*a*	*b*	*nspp*	*m_comp*	*m_col*	*m_disp*
0.1	0.1	2.5	0.69	0.09	2.39	0.49	0.51	1.98
			0.72	0.07	2.57	0.49	0.51	2.19
			0.76	0.05	2.64	0.48	0.52	2.40
			0.79	0.04	2.66	0.48	0.52	2.52
			0.83	0.03	2.60	0.48	0.52	2.63
			0.86	0.02	2.52	0.48	0.52	2.76
			0.90	0.01	2.46	0.48	0.52	2.82
			0.93	0.00	2.39	0.48	0.52	2.83
0.1	0.1	5.5	0.69	0.09	2.10	0.48	0.52	5.07
			0.72	0.07	2.31	0.48	0.52	5.30
			0.76	0.06	2.43	0.48	0.52	5.40
			0.79	0.04	2.52	0.48	0.52	5.45
			0.83	0.03	2.55	0.48	0.52	5.48
			0.86	0.02	2.56	0.48	0.52	5.50
			0.90	0.01	2.56	0.48	0.52	5.51
			0.93	0.00	2.51	0.48	0.53	5.51
0.1	0.3	2.5	0.69	0.09	2.19	0.43	0.70	2.30
			0.72	0.07	2.16	0.43	0.71	2.40
			0.76	0.05	2.12	0.43	0.71	2.45
			0.79	0.04	2.11	0.43	0.71	2.50
			0.83	0.03	2.10	0.43	0.71	2.53
			0.86	0.02	2.07	0.43	0.71	2.57
			0.90	0.01	2.05	0.43	0.72	2.59
			0.93	0.00	2.01	0.43	0.72	2.61
0.1	0.3	5.5	0.69	0.09	1.95	0.43	0.72	5.39
			0.72	0.07	2.01	0.43	0.72	5.46
			0.76	0.05	2.04	0.43	0.72	5.48
			0.79	0.04	2.05	0.43	0.72	5.49
			0.83	0.03	2.06	0.43	0.72	5.49
			0.86	0.02	2.06	0.43	0.72	5.50
			0.90	0.01	2.06	0.43	0.72	5.50
			0.93	0.00	2.04	0.43	0.72	5.50
			0.97	0.00	2.03	0.43	0.72	5.51
0.4	0.1	2.5	0.69	0.09	1.71	0.81	0.42	2.21
			0.72	0.07	1.74	0.82	0.42	2.32
			0.76	0.06	1.76	0.82	0.42	2.42
			0.79	0.04	1.77	0.82	0.42	2.52
			0.83	0.03	1.75	0.82	0.42	2.60

			0.86	0.02	1.73	0.82	0.42	2.65
			0.90	0.01	1.70	0.82	0.42	2.71
			0.93	0.00	1.68	0.81	0.42	2.73
0.4	0.1	5.5	0.69	0.09	1.56	0.82	0.42	5.22
			0.72	0.07	1.66	0.82	0.42	5.39
			0.76	0.05	1.71	0.82	0.42	5.43
			0.79	0.04	1.74	0.82	0.42	5.46
			0.83	0.03	1.75	0.82	0.42	5.50
			0.86	0.02	1.76	0.82	0.42	5.50
			0.90	0.01	1.76	0.82	0.42	5.51
			0.93	0.00	1.74	0.82	0.42	5.50
0.4	0.3	2.5	0.69	0.09	1.86	0.55	0.46	2.16
			0.72	0.07	1.95	0.54	0.47	2.31
			0.76	0.05	1.97	0.53	0.47	2.43
			0.79	0.04	1.97	0.53	0.48	2.53
			0.83	0.03	1.95	0.53	0.48	2.60
			0.86	0.02	1.91	0.52	0.48	2.68
			0.90	0.01	1.88	0.52	0.49	2.72
			0.93	0.00	1.82	0.51	0.49	2.76
			0.97	0.00	1.66	0.50	0.50	2.83
0.4	0.3	5.5	0.69	0.09	1.67	0.51	0.50	5.24
			0.72	0.07	1.79	0.51	0.49	5.36
			0.76	0.06	1.86	0.51	0.49	5.43
			0.79	0.04	1.92	0.52	0.49	5.47
			0.83	0.03	1.93	0.52	0.49	5.49
			0.86	0.02	1.96	0.52	0.49	5.50
			0.90	0.01	1.95	0.52	0.49	5.51
			0.93	0.00	1.90	0.51	0.49	5.51