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Supplementary material

Spinifex–mallee revegetation: implications for restoration after mineral-sands mining in the Murray–Darling Basin

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Statistical Appendix S1: Statistical analysis

The model was:

$$r_{ij} \sim Binomial(p_{ij}, n_{ij}); logit(p_{ij}) = a + b_{litter(j)} + c_{location(j)} + \rho_i. \qquad (1)$$

The terms are: r_{ij} is the number of individuals of species *i* alive on transect *j* after 10 yr and is assumed to have a binomial distribution ('~'); n_{ij} is the number of individuals of species *i* alive on transect *j* in June 2001; p_{ij} is the survival proportion of species *i* on transect *j* after 10 years and is assumed to be a function of an overall survival rate (*a*), a possible effect of mulch application (*b*), location (*c*, crest, slope or swale) and plant taxon (ρ_i). Location and species were regarded as random effects and had these sampling distributions:

$$c_j \sim \text{Normal}(0, \sigma_c^2); \rho \sim \text{Normal}(0, \sigma_\rho^2); \sigma_c, \sigma_\rho \sim \text{Uniform}(0.01, 0.2).$$

Thus, the location random effects have a zero mean and common standard deviation, as do the species' random effects. The *a* and *b* parameters were given normal priors, mean 0 and standard deviations of 0.25; $b_{\text{no mulch}}$ was defined as the reference condition, so b_{mulch} is the effect of mulch application.

Changes in the Importance (IVI index) of Plant Taxa

Changes in the importance of plant taxa were modelled using a Gaussian-errors models based on the difference in the IVI values in 2011 and 2001. This involves recasting Model 1 slightly as:

$$d_{ij} \sim Normal(\mu_{ij}, \sigma);\ \mu_{ij} = a + b_{litter(j)} + c_{location(j)} + \rho_i. \qquad (2)$$

Most of the parameters have the same meanings as for Model 1. The differences are: (1) d_{ij} is the difference in IVI for species *i* in transect *j* between 2011 and 2001; and (2) σ is the common error for all observations, and has a prior of $\sigma \sim Uniform(0.01, 0.2)$. There were more plant taxa (n = 38) owing to natural regeneration or self-establishment within the revegetation transects; *d*-values for such taxa necessarily are positive.

Software

WinBUGS Bayesian modelling software was used (Spiegelhalter *et al.* 2003). We used three chains for each model estimation, which we checked for convergence using the Brooks-Gelman-Rubin statistics; chain convergence means that the model has mixed adequately and that the parameter estimates have stabilized (Brooks & Gelman, 1998). Further checks were done with assessments of Rhat values for each parameter, which should be 1.0-1.1 if the model has mixed adequately (Kery, 2010). Model runs had 'burns-in' of 80 000 and parameter samples of 50 000 for each chain.

The 'importance' of parameters (i.e., do these differ substantially from zero?) was assessed using posterior probability distributions and odds ratios (OR). ORs are ratios of posterior to prior odds, and are measure of how much the data change our initial expectations. The posterior probability that each parameter is above or below 0 was calculated. For a non-informative prior, for which there was no expectation that a parameter ≠ 0, the prior odds are 1:1 (i.e., the parameter is equally likely to be negative or positive). Thus, the OR is equivalent to the posterior odds. ORs > 10 are strong evidence supporting one hypothesis over another (Jeffreys, 1961). For negative parameters, inverse ORs hold (i.e. ORs < 1/10 are strong evidence). Inferences in the Results use OR ≥ 10 (or ≤ 1/10) as being 'important' effects.

Table S1: Summary of plant taxon plant-out rates and their proportions of the original total for that transect, as well as survival numbers and proportions ascertained from monitoring in October 2011.

	Transect 1 - Dune Crest				Transect 2 - Dune Crest				Transect 7 - Dune Slope				Transect 8 - Dune Slope				Transect 13 - Swale				Transect 14 - Swale			
Plant Taxon	**Number Planted Out**	**% of Total**	**Number Alive 2011**	**% Survival**	**Number Planted Out**	**% of Total**	**Number Alive 2011**	**% Survival**	**Number Planted Out**	**% of Total**	**Number Alive 2011**	**% Survival**	**Number Planted Out**	**% of Total**	**Number Alive 2011**	**% Survival**	**Number Planted Out**	**% of Total**	**Number Alive 2011**	**% Survival**	**Number Planted Out**	**% of Total**	**Number Alive 2011**	**% Survival**
Taxa from Hand Planting																								
Acacia acanthoclada subsp. *acanthoclada*	2	1.9	0	0	1	0.9	0	0	5	4.3	0	0	1	0.9	0	0								
Acacia brachybotrya																	12	9.2	5	42	8	5.8	0	0
Acacia colletioides																	11	8.5	6	55	9	6.5	4	44
Acacia ligulata	7	6.6	7	100	9	7.7	3	33	7	6.0	6	86	7	6.4	5	71								
Acacia microcapa	3	2.8	0	0	5	4.3	2	40	2	1.7	1	50	1	0.9	0	0								
Acacia oswaldii																	9	6.9	3	33	11	8.0	2	18
Acacia rigens	6	5.7	1	17	8	6.8	5	63	6	5.2	1	17	8	7.3	1	13								
Acacia sclerophylla var. *sclerophylla*																	11	8.5	4	36	9	6.5	3	33
Acacia wilhelmiana	2	1.9	1	50	7	5.9	4	57	6	5.2	0	0	5	4.5	4	80								
Callitris gracilis subsp. *murrayensis*	3	2.8	1	33	3	2.6	2	67	4	3.4	4	100	1	0.9	1	100	8	6.2	3	38	11	8.0	4	36
Callitris verrucosa	6	5.7	6	100	7	5.9	5	71	14	12.1	4	29	2	1.8	1	50								
Casuarina pauper																	12	9.2	8	67	15	10.9	6	40
Eucalyptus costata subsp. *murrayana*	14	13.2	14	100	9	7.7	4	44	8	6.9	5	63	11	10.0	8	73								
Eucalyptus dumosa	8	7.5	4	50	9	7.7	5	56	11	9.5	4	36	13	11.8	6	46								
Eucalyptus leptophylla	5	4.7	2	40	2	1.7	1	50	5	4.7	2	40	2	1.8	0	0								
Euclayptus oleosa subsp. *oleosa*	8	7.5	8	100	8	6.8	8	100	4	3.7	1	25	6	5.5	6	100	18	13.8	16	89	22	16.0	16	73
Eucalyptus socialis	8	7.5	6	75	11	9.4	11	100	11	9.5	11	100	10	9.1	8	80								
Grevillea pterosperma	1	0.9	0	0	1	0.9	0	0	1	0.9	0	0	1	0.9	0	0								
Hakea leucoptera subsp. *leucoptera*																	6	4.6	6	100	9	6.5	9	100
Hakea tephrosperma																	10	7.7	10	100	6	4.3	6	100
Melaleuca acuminata subsp. *acuminata*	2	1.9	0	0	2	1.7	1	50	4	3.4	0	0	2	1.8	0	0								
Melaleuca lanceolata					10	8.5	7	70					11	10.0	3	27								
Melaleuca uncinata	10	9.4	10	100	10	8.5	8	80	5	4.3	4	80	14	12.8	6	43								
Olearia passerinoides	5	4.7	3	60	6	5.1	4	67	5	4.3	3	60	5	4.5	3	60								
Olearia pimeleoides																	10	7.7	0	0	12	8.7	10	83
Rhagodia spinescens																	10	7.7	5	50	10	7.2	8	80
Senna artemisioides subsp. *filifolia*																	8	6.2	6	75	7	5.1	6	86
Senna artemisioides subsp. x *coriacea*																	6	4.6	4	67	9	6.5	6	67
Triodia scariosa	16	15.1	14	88	9	7.7	9	100	9	7.8	9	100	10	9.1	9	90								
Total % Re-Planting Success				**73**				**68**				**51**				**55**				**58**				**58**

Table S2: Summary of plant taxon plant-out rates and proportions in June 2001, compared with their importance as IVI in October 2011.

	Transect 1 - Dune Crest			Transect 2 - Dune Crest			Transect 7 - Dune Slope			Transect 8 - Dune Slope			Transect 13 - Swale			Transect 14 - Swale		
Plant Taxon	**Number Planted Out**	**% of Total**	**Importance % as 'IVI'**	**Number Planted Out**	**% of Total**	**Importance % as 'IVI'**	**Number Planted Out**	**% of Total**	**Importance % as 'IVI'**	**Number Planted Out**	**% of Total**	**Importance % as 'IVI'**	**Number Planted Out**	**% of Total**	**Importance % as 'IVI'**	**Number Planted Out**	**% of Total**	**Importance % as 'IVI'**
Taxa from Hand Planting																		
Acacia acanthoclada subsp. *acanthoclada*	2	1.9		1	0.9		5	4.3		1	0.9							
Acacia brachybotrya													12	9.2	7.6	8	5.8	
Acacia colletioides													11	8.5	8.7	9	6.5	4.5
Acacia ligulata	7	6.6	7.4	9	7.7	3.6	7	6.0	10.6	7	6.4	7.5						
Acacia microcapa	3	2.8		5	4.3	1.6	2	1.7	0.8	1	0.9							
Acacia oswaldii													9	6.9	3.8	11	8.0	2.3
Acacia rigens	6	5.7	0.7	8	6.8	3.7	6	5.2	1.0	8	7.3	0.9						
Acacia sclerophylla var. *sclerophylla*									1.5				11	8.5	12.5	9	6.5	2.7
Acacia wilhelmiana	2	1.9	0.9	7	5.9	5.8	6	5.2		5	4.5	9.2						
Callitris gracilis subsp. *murrayensis*	3	2.8	1.0	3	2.6	2.0	4	3.4	4.4	1	0.9	1.1	8	6.2	3.4	11	8.0	5.0
Callitris verrucosa	6	5.7	5.9	7	5.9	5.3	14	12.1	4.1	2	1.8	1.1						
Casuarina pauper													12	9.2	8.0	15	10.9	5.6
Eucalyptus costata subsp. *murrayana*	14	13.2	23.6	9	7.7	4.0	8	6.9	6.6	11	10.0	10.0						
Eucalyptus dumosa	8	7.5	4.4	9	7.7	6.1	11	9.5	6.2	13	11.8	8.0						
Eucalyptus leptophylla	5	4.7	1.5	2	1.7	0.7	5	4.7	1.9	2	1.8							
Euclayptus oleosa subsp. *oleosa*	8	7.5	9.3	8	6.8	9.5	4	3.7	1.2	6	5.5	9.0	18	13.8	25.0	22	16.0	22.3
Eucalyptus socialis	8	7.5	5.9	11	9.4	9.5	11	9.5	13.2	10	9.1	8.6						
Grevillea pterosperma	1	0.9		1	0.9		1	0.9		1	0.9							
Hakea leucoptera subsp. *leucoptera*													6	4.6	5.9	9	6.5	9.4
Hakea tephrosperma													10	7.7	9.7	6	4.3	6.3
Melaleuca acuminata subsp. *acuminata*	2	1.9		2	1.7	1.4	4	3.4		2	1.8							
Melaleuca lanceolata				10	8.5	6.6				11	10.0	4.1						
Melaleuca uncinata	10	9.4	7.8	10	8.5	6.2	5	4.3	4.3	14	12.8	6.4						
Olearia passerinoides	5	4.7	2.3	6	5.1	3.2	5	4.3	2.9	5	4.5	4.5						
Olearia pimeleoides													10	7.7	0.0	12	8.7	7.0
Rhagodia spinescens			0.7			0.1							10	7.7	7.5	10	7.2	13.7
Senna artemisioides subsp. *filifolia*													8	6.2	6.2	7	5.1	5.2
Senna artemisioides subsp. x *coriacea*													6	4.6	5.0	9	6.5	5.3
Triodia scariosa	16	15.1	27.1	9	7.7	11.6	9	7.8	16.7	10	9.1	14.2						
Taxa from Natural Regeneration																		
Aristida contorta																		
Aristida holathera var. holathera			0.7			3.1			0.8			3.1						
Calotis erinacea			0.1			0.6			3.7			0.9			0.1			
Dodonaea viscosa subsp. *angustissima*			11.9			3.2			2.1			0.3			1.6			0.9
Enchylaena tomentosa			1.7			2.6			4.9			6.6			2.3			1.9
Enneapogon avenaceus									0.8			1.3						
Eremophila longifolia									0.1									0.1
Triraphis mollis									0.8			0.0						0.8
Vittadinia dissecta			2.0			6.8			5.3			0.1			0.1			0.1
Vittadinia gracilis																		
Vittadinia cervicularis			0.1						0.1						0.1			

Table S3: Compilation of importance (IVI), density (DEN), cover (COV) and height (HT) for all plant taxa recorded in the six transects assessed in the October 2011 monitoring.

	T1 Crest				T2Crest				T7 Slope				T8 Slope				T13 Swale				T14 Swale			
	IVI	DEN	COV	HT	IVI	DEN	COV	HT	IVI	DEN	COV	HT	IVI	DEN	COV	HT	IVI	DEN	COV	HT	IVI	DEN	COV	HT
Acacia brachybotrya																	22.44	0.17	6.97	142.50				
Acacia colletioides																	25.55	0.21	7.41	130.00	13.52	0.14	2.76	112.00
Acacia ligulata	22.12	0.22	6.75	209.23	10.44	0.09	3.31	180.00	31.64	0.22	12.85	190.63	21.49	0.19	6.56	217.08								
Acacia microcarpa					4.56	0.06	0.66	145.00	2.40	0.04	0.02	5.00												
Acacia oswaldii																	11.14	0.10	2.59	130.00	6.98	0.07	1.52	168.75
Acacia rigens	2.09	0.03	0.13	100.00	10.65	0.16	1.16	136.43	2.97	0.04	0.44	127.50	2.61	0.04	0.07	80.00								
Acacia sclerophylla var. *sclerophylla*									4.38	0.04	1.48	87.50					12.49	0.14	1.83	86.25	8.18	0.10	0.86	100.00
Acacia wilhelmiana	2.81	0.03	0.69	146.67	16.89	0.13	6.34	221.67					26.63	0.15	12.15	134.55								
Aristida holathera var. *holathera*	1.95	0.03	0.02	35.00	9.06	0.19	0.17	40.00	2.40	0.04	0.02	10.00	8.87	0.15	0.11	56.67								
Asphodelus fistulosus													2.55	0.04	0.04	60.00								
Atriplex vesicaria																	0.40	0.00	0.28	38.33	7.24	0.14	0.38	58.75
Austrostipa drummondii					1.80	0.03	0.02	35.00																
Austrostipa scabra subsp. *falcata*	3.91	0.06	0.05	12.00	2.66	0.06	0.02	5.00	4.82	0.07	0.06	25.00	2.55	0.04	0.04	50.00								
Billardiera cymosa					1.80	0.03	0.02	3.00																
Brachyscome ciliaris	1.95	0.03	0.02	20.00																				
Brassica tournefortii	0.60	0.00	0.47	25.00	0.17	0.00	0.11	20.71	1.78	0.00	1.31	30.00	0.71	0.00	0.52	30.00	0.10	0.00	0.07	18.33	0.06	0.00	0.03	25.00
Bromus diandrus	0.08	0.00	0.06	20.00	0.05	0.00	0.03	20.00	0.05	0.00	0.04	10.00	0.03	0.00	0.02	20.00								
Bromus rubens																					0.03	0.00	0.01	15.00
Calandrinia eremaea									0.05	0.00	0.04	7.50												
Callitris gracilis	2.85	0.03	0.72	270.00	5.96	0.06	1.56	235.00	13.20	0.15	2.74	183.00	3.06	0.04	0.41	137.50	10.08	0.10	1.86	248.75	14.81	0.00	3.55	229.17
Callitris verrucosa	17.52	0.19	4.66	163.75	15.28	0.16	4.16	192.86	12.34	0.15	2.11	143.75	3.26	0.04	0.56	150.00								
Calotis erinacea	0.04	0.00	0.03	45.00	1.82	0.03	0.03	40.00	10.92	0.19	0.22	46.67	2.66	0.04	0.11	50.00	0.05	0.00	0.03	30.00				
Calotis hispidula									0.03	0.00	0.02	3.00												
Casuarina pauper																	23.66	0.28	2.76	234.55	16.63	0.21	1.89	182.27
Chamaesyce drummondii													0.03	0.00	0.02	1.00								
Chondrilla juncea	0.04	0.00	0.03	10.00	0.10	0.00	0.06	10.00	0.08	0.00	0.06	8.33	0.30	0.00	0.22	30.00					0.06	0.00	0.03	30.00
Crassula colorata var. *colorata*	0.08	0.00	0.06	3.00	0.02	0.00	0.02	3.00	0.13	0.00	0.09	3.00	0.07	0.00	0.06	2.67	0.03	0.00	0.03	3.00				
Crassula sieberiana	0.02	0.00	0.02	3.00					0.10	0.00	0.07	2.50					0.03	0.00	0.02	5.00				
Dodonea viscosa subsp. *angustissima*	35.34	0.56	2.86	111.88	9.32	0.16	0.30	53.00	6.15	0.07	1.04	180.00	0.76	0.00	0.56	200.00	4.72	0.03	1.55	210.00	2.59	0.03	0.21	125.00
Einadia nutans subsp. *nutans*									2.57	0.04	0.15	20.00												
Enchylaena tomentosa	4.94	0.09	0.13	18.33	7.62	0.13	0.34	30.75	14.50	0.26	1.19	29.00	18.94	0.26	1.98	28.80	6.67	0.10	0.38	31.67	5.77	0.00	0.86	50.00
Enneapogon avenaceus									2.42	0.04	0.04	20.00	3.81	0.07	0.07	40.00								
Enteropogon acicularis													3.76	0.07	0.04	25.00								
Eremophila longifolia									2.40	0.04	0.02	5.00									11.19	0.14	2.07	263.75
Eucalyptus costata	46.61	0.44	15.34	395.83	11.58	0.13	2.91	377.14	19.73	0.19	5.81	384.44	28.81	0.30	7.37	322.86								
Eucalyptus dumosa	13.03	0.13	4.16	362.22	17.89	0.16	5.84	350.50	18.52	0.15	6.67	380.00	23.03	0.22	5.85	322.69								
Eucalyptus leptophylla	4.45	0.06	0.47	118.75					5.70	0.07	0.70	158.33												
Eucalyptus oleosa subsp. *oleosa*	27.82	0.25	10.47	426.67	27.65	0.25	8.72	431.88	3.63	0.04	0.93	390.00	25.97	0.22	8.00	418.33	73.76	0.55	23.62	466.07	66.42	0.55	20.10	425.58
Eucalyptus socialis	17.72	0.19	4.81	335.00	29.79	0.34	7.25	407.06	39.23	0.41	9.70	425.50	24.81	0.30	4.44	394.00								
Hakea leucoptera subsp. *leucoptera*																	17.55	0.21	1.93	100.00	27.92	0.31	5.41	127.50
Hakea tephrosperma																	28.49	0.34	4.41	143.85	18.65	0.21	3.14	156.43
Homopholis proluta									2.42	0.04	0.04	20.00	2.55	0.04	0.04	30.00								
Hypochoeris glabra	0.02	0.00	0.02	10.00					0.15	0.00	0.11	9.00	0.05	0.00	0.04	10.00								
Lolium rigidum									0.03	0.00	0.02	5.00	0.20	0.00	0.15	21.43								
Medicago polymorpha	0.02	0.00	0.02	10.00					0.10	0.00	0.07	5.75												
Melaleuca acuminata					3.99	0.03	1.44	190.00																
Melaleuca lanceolata					19.17	0.22	4.38	221.15					11.82	0.11		252.00								
Melaleuca uncinata	23.37	0.31	3.22	136.54	18.14	0.25	2.56	145.45	12.80	0.15	2.44	148.33	18.42	0.22	2.48	144.44								
Olearia passerinoides	6.86	0.09	0.84	112.50	9.26	0.13	1.41	140.00	8.62	0.11	0.11	140.00	13.08	0.11	4.07	157.78								
Olearia pimeleoides																					20.73	0.34	1.83	93.13
Pentaschistis airoides subsp. *airoides*	0.10	0.00	0.08	13.75	0.05	0.00	0.03	15.00	0.40	0.00	0.30	7.22												
Rhagodia spinescens	1.97	0.03	0.03	20.00	1.80	0.03	0.02	20.00					2.55	0.04	0.04	25.00	22.24	0.17	6.83	81.00	40.89	0.00	14.03	106.07
Salsola tragus													2.58	0.04	0.06	14.00								
Schismus barbatus													0.03	0.00	0.02	5.00								

	T1 Crest				T2Crest				T7 Slope				T8 Slope				T13 Swale				T14 Swale			
	IVI	**DEN**	**COV**	**HT**	**IVI**	**DEN**	**COV**	**HT**	**IVI**	**DEN**	**COV**	**HT**	**IVI**	**DEN**	**COV**	**HT**	**IVI**	**DEN**	**COV**	**HT**	**IVI**	**DEN**	**COV**	**HT**
Senecio quadridentatus																					2.31	0.00	0.03	30.00
Senna artemisiodes subsp. *coriacea*																	14.75	0.14	3.38	112.50	15.79	0.21	1.38	68.64
Senna artemisiodes subsp. *filifolia*																	18.15	0.21	2.34	98.00	15.45	0.21	1.17	95.00
Silene apetala	0.18	0.00	0.14	8.57					0.28	0.00	0.20	11.11	0.23	0.00	0.17	6.11	0.05	0.00	0.03	5.00	0.03	0.00	0.02	10.00
Triodia scariosa	53.75	0.44	21.69	47.29	33.62	0.28	11.43	40.88	49.79	0.33	21.00	57.50	40.77	0.33	13.33	47.94								
Triraphis mollis									2.40	0.37	0.02	30.00									2.31	0.03	0.03	20.00
Vittadinia cervicularis	0.02	0.00	0.02	10.00					2.67	0.04	0.22	11.64					0.08	0.00	0.05	3.50				
Vittadinia dissecta	5.83	0.09	0.05	12.67	19.75	0.41	0.25	15.56	15.87	0.30	0.44	23.33	0.33	0.00	0.24	23.50	0.13	0.00	0.09	8.50	0.17	0.00	0.10	27.50
Vulpia myuros	0.02	0.00	0.02	15.00					0.03	0.00	0.02	20.00	0.03	0.00	0.02	10.00								
Wahlenbergia communis													0.05	0.00	0.04	60.00								
Xerochrysum bracteatum																	2.51	0.03	0.03	30.00				