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Supplementary material

Effects of fire frequency and microhabitat on the ground layer in a grassy woodland

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Table S1. Sites used in a study of ground layer vegetation in Cumberland Plain Woodland microhabitats

Site name	Fire frequency category	Time since fire when sampled
Ropes Creek	High	9 months
Shanes Park	High	18–20 months
Lansdowne[A]	Moderate	18–19 months
Mount Annan 2[B]	Moderate	19 months
Orchard Hills	Low	18–19 months
Scheyville	Low	18–19 months

[A]Lansdowne: the current study was restricted to those parts of the site burnt ~18 months before sampling (the Watson *et al*. 2009 study covered a wider area).

[B]Mount Annan 2 (moderate fire frequency in the current study) was located adjacent to the low fire frequency area sampled by Watson *et al*. (2009) at Mount Annan. The two adjacent areas had different fire histories. Mount Annan 2 was burnt for experimental and ecological purposes in 1991, and again in 2001, 19 months before sampling (D. Benson and J. Howell, Royal Botanic Gardens, pers. comm., 2001).

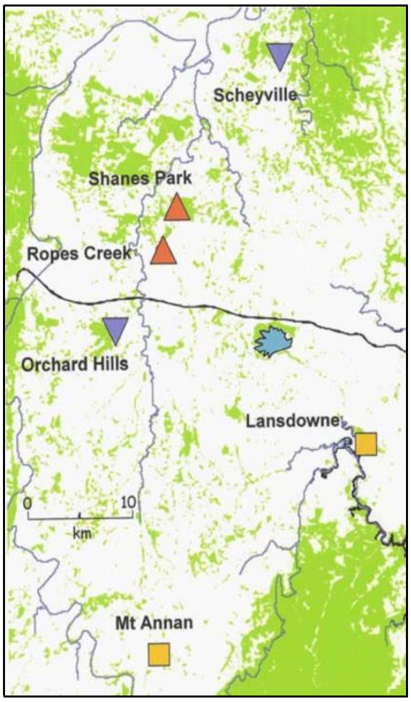


Fig. S1. Map of the Cumberland Plain showing remnant native vegetation (green) and study sites in three fire frequency categories. ▲, high fire frequency; ■, moderate fire frequency; ▼, low fire frequency.

Table S2. List of taxa with uncertain identification in the field, and how they were categorised for data analysis

Taxon	Categorised as
native *Glycine*	*Glycine tabacina*
native *Sporobolus*	*Sporobolus creber*
native *Oxalis*	*Oxalis perennans*
Lomandra filiformis subspecies	*Lomandra filiformis*
Einadia nutans subspecies *linifolia* and *nutans*	*Einadia nutans*
native *Arthropodium*	*Arthropodium milleflorum*
exotic *Solanum*	*Solanum nigrum*
native *Rytidosperma* species	grouped as *Rytidosperma*

(a)

(b)

(c)

Fig. S2. Examples of microhabitat types. (a) 'Tree' plots were located at the base of large Eucalyptus *moluccana* trees like this. (b) 'Bursaria' plots were located in thickets like this. (c) An area similar to those in which 'open' plots were located.

Fig. S3. Recording ground layer species in nested subplots within a 3.6 m diameter open microhabitat plot at Orchard Hills, a low fire frequency site.

Table S3. Characteristics of concentric nested subplots used in a study of ground layer vegetation in Cumberland Plain Woodland microhabitats

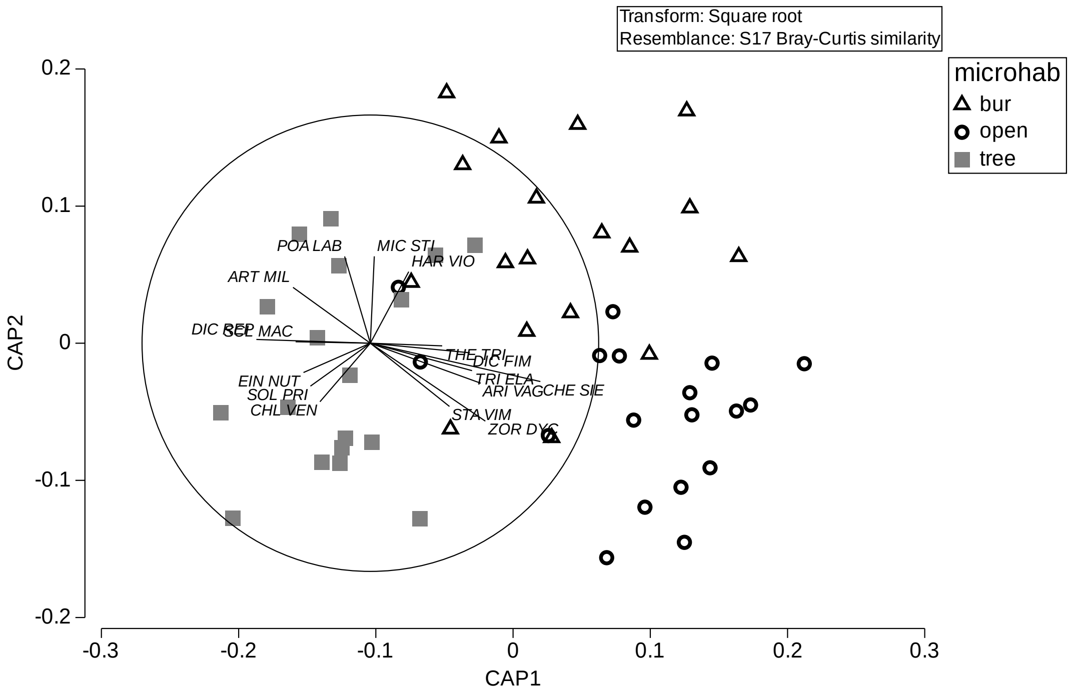
Subplot number	Distance from centre of plot (cm)	Subplot area (m^2)
1	30–40	0.22
2	40–60	0.63
3	60–90	1.41
4	90–130	2.77
5	130–180	4.87

Table S4. PERMDISP results for fire frequency, microhabitat, and fire frequency × microhabitat × site terms in the PERMANOVA analysis

$F_{x,y}$ = $F_{2,51}$ for fire frequency and microhabitat; $F_{17,36}$ for fire × micro × site

Factor	permutations	Numb groups	$F_{x,y}$	*P*
fire frequency	999	3	2.7307	0.091
microhabitat	999	3	0.1082	0.898
fire × mic × site	999	18	1.703	0.79
Fire frequency means and standard errors				
Group		Size	Average	s.e.
high		18	34.393	1.6507
mod		18	38.624	0.6563
low		18	36.323	1.3321
Microhabitat means and standard errors				
Group		Size	Average	s.e.
bur		18	39.722	1.3997
open		18	39.501	1.5243
tree		18	38.857	1.1505
Fire × microhabitat × site means and standard errors				
Group		Size	Average	s.e.
highShanesbur		3	32.433	3.2393
highShanesopen		3	25.831	2.5112
highShanestree		3	24.199	0.6701
modLansbur		3	22.817	2.2899
modLansopen		3	21.456	0.492
modLanstree		3	21.904	1.4528
modMtAnbur		3	25.953	1.0569
modMtAnopen		3	23.716	1.7386
medMtAntree		3	19.1	0.2594
lowOrcHbur		3	21.659	1.6683
lowOrcHopen		3	24.726	2.1285
lowOrcHtree		3	21.579	1.4786
highRopesbur		3	25.564	2.7247
highRopesopen		3	29.514	4.6002
highRopestree		3	25.801	1.8784
lowScheybur		3	31.245	7.5955
lowScheyopen		3	26.725	2.834
lowScheytree		3	21.221	0.7344

(a) Native species



(b) Exotic species

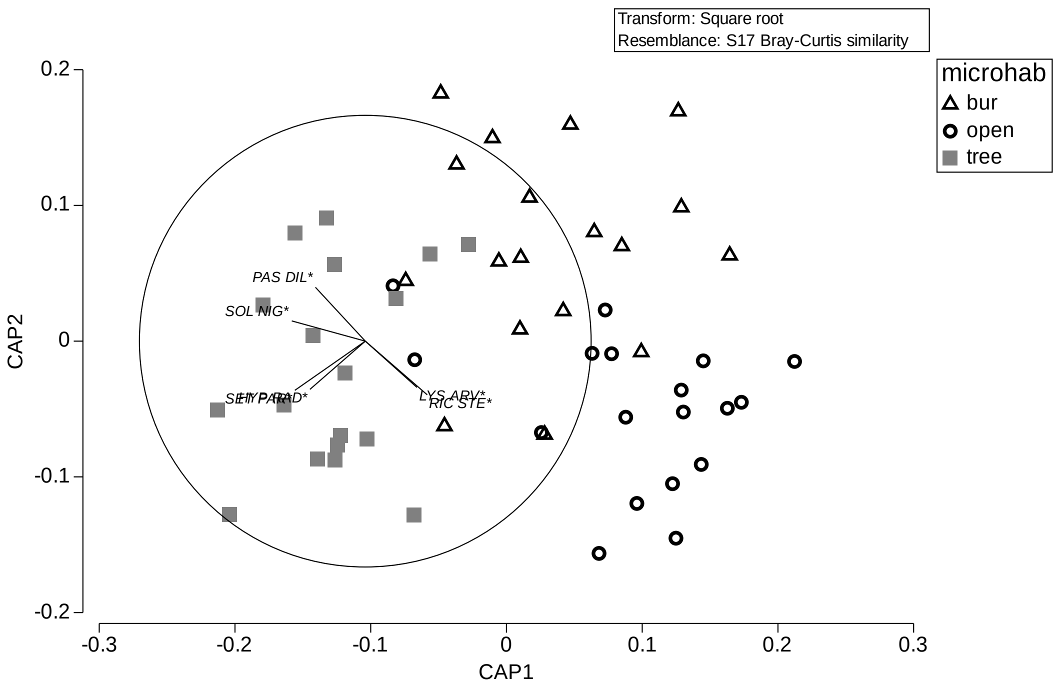


Fig. S4. CAP graphs of sites coded for microhabitat and showing vectors for (a) native species and (b) exotic species ($r \geq 0.3$). Data are (square root) frequency scores at block level (n = 54). Full names for species shown in Table S6.

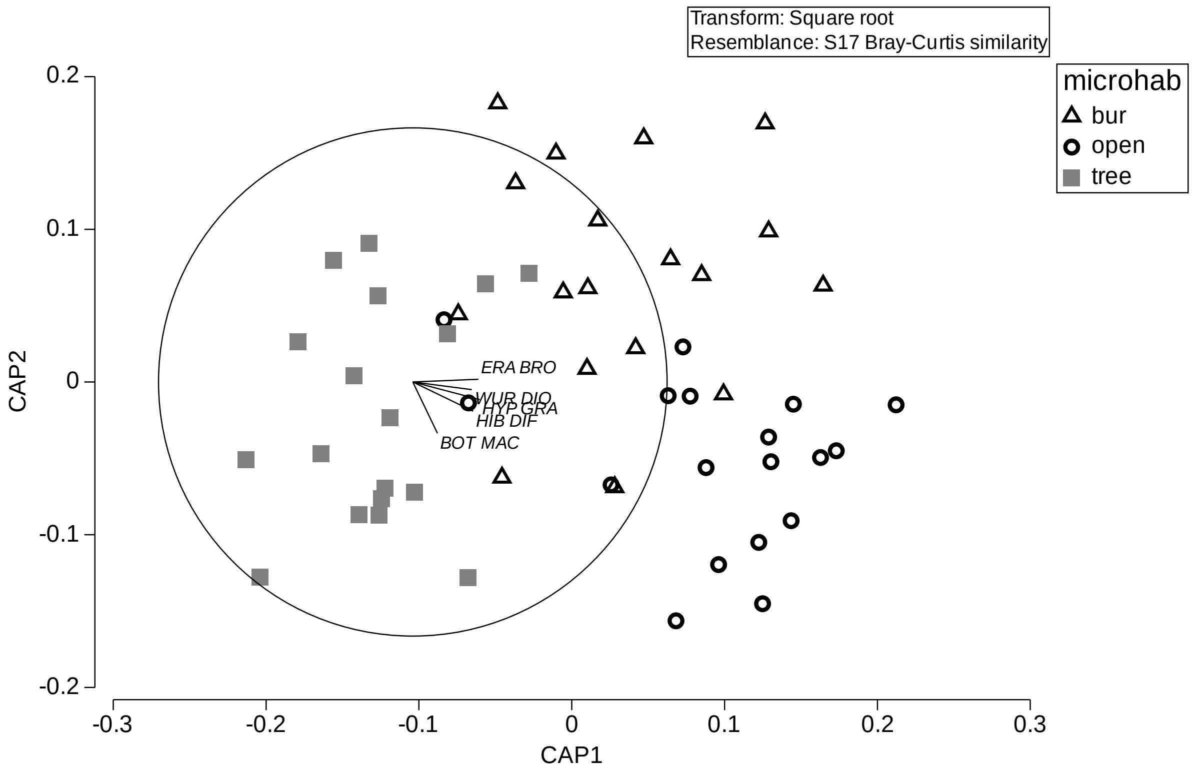


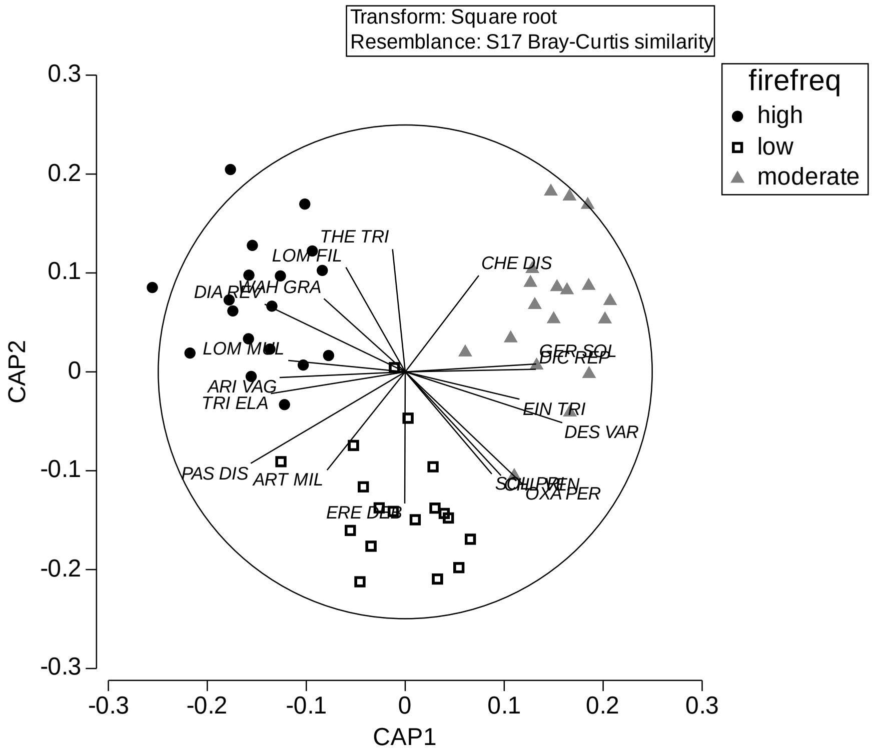
Fig. S5. CAP graph of sites coded for microhabitat showing vectors for native species that align with the open microhabitat but with $r < 0.3$. These species achieve maximum abundance in the open microhabitat and low abundance in one or both of the bursaria and tree microhabitats (Table S5). Full names for species shown in Table S6.

Table S5. Native species that achieve maximum abundance in the open microhabitat and low abundance in one or both of the bursaria and tree microhabitats, and whose vectors align with the open microhabitat (Fig. S4a, S5)

Data are mean square root frequency scores at block level (±s.e.)

	Open	Bur	Tree	Figure
Bothriocloa macra	0.41 (0.09)	0.11 (0.11)	0.10 (0.10)	S7
Dichopogon fimbriatus	0.82 (0.47)	0.65 (0.33)	0.12 (0.12)	S6a
Eragrostis brownii	0.30 (0.15)	0.25 (0.13)	0.08 (0.08)	S7
Hibbertia diffusa	0.38 (0.22)	0.11 (0.11)	0	S7
Hypericum gramineum	0.56 (0.12)	0.31 (0.05)	0.06 (0.06)	S7
Wurmbea dioica subsp. *dioica*	0.42 (0.29)	0.40 (0.24)	0.13 (0.13)	S7
Zornia dyctiocarpa var. *dyctiocarpa*	0.96 (0.26)	0.11 (0.11)	0.11 (0.11)	S6a

(a) Native species



(b) Exotic species

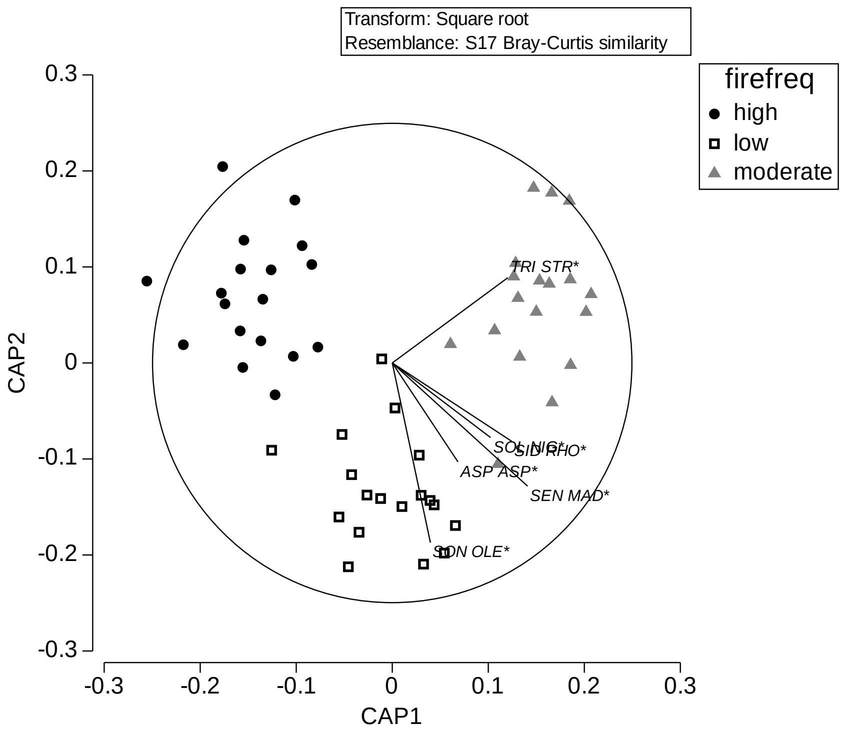


Fig. S6. CAP graphs of sites coded for fire frequency showing vectors for (a) native species and (b) exotic species ($r \geq 0.475$). Data are (square root) frequency scores at block level (n = 54). Full names for species shown in Table S5.

Table S6. Full species names and abbreviations for species names used in Fig. S4, S5 and S6

Native species	Abbreviation	Exotic species	Abbreviation
Aristida vagans	ARI VAG	*Asparagus asparagoides**	ASP ASP*
Arthropodium milleflorum	ART MIL	*Hypochaeris radicata**	HYP RAD*
Bothriochloa macra	BOT MAC	*Lysimachia arvensis**	LYS ARV*
Cheilanthes distans	CHE DIS	*Paspalum dilatatum**	PAS DIL*
Cheilanthes sieberi subsp. *sieberi*	CHE SIE SIE	*Richardia stellaris**	RIC STE*
Chloris ventricosa	CHL VEN	*Senecio madagascariensis**	SEN MAD*
Desmodium varians	DES VAR	*Setaria parviflora**	SET PAR*
Dianella revoluta var. *revoluta*	DIA REV	*Sida rhombifolia**	SID RHO*
Dichondra repens	DIC REP	*Solanum nigrum**	SOL NIG*
Dichopogon fimbriatus	DIC FIM	*Sonchus oleraceus**	SON OLE*
Einadia nutans	EIN NUT	*Trifolium striatum**	TRI STR*
Einadia trigonos subsp. *trigonos*	EIN TRI TRI		
Eragrostis brownii	ERA BRO		
Eremophila debilis	ERE DEB		
Geranium solanderi var. *solanderi*	GER SOL SOL		
Hardenbergia violacea	HAR VIO		
Hibbertia diffusa	HIB DIF		
Lomandra filiformis	LOM FIL		
Lomandra multiflora subsp. *multiflora*	LOM MUL MUL		
Microlaena stipoides var. *stipoides*	MIC STI		
Oxalis perennans	OXA sp.		
Paspalidium distans	PAS DIS		
Poa labillardierei var. *labillardierei*	POA LABORATORY		
Scleria mackaviensis	SCL MAC		
Solanum prinophyllum	SOL PRI		
Stackhousia viminea	STA VIM		
Themeda triandra	THE TRI		
Tricoryne elatior	TRI ELA		
Wahlenbergia gracilis	WAH GRA		
Wurmbea dioica subsp. *dioica*	WUR DIO		
Zornia dyctiocarpa var. *dyctiocarpa*	ZOR DYC		

Reference

Watson PJ, Bradstock RA, Morris EC (2009) Fire frequency influences composition and structure of the shrub layer in an Australian subcoastal temperate grassy woodland. *Austral Ecology* **34**, 218–232. doi:10.1111/j.1442-9993.2008.01924.x