Supplementary Information
Analysis outputs, assumption checks, and sensitivity analysis

Fire facilitates ground layer plant diversity in a Miombo ecosystem

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List S1. List of ground layer species with family, functional group assignment and information on presence/absence (1/0) in each treatment. 72.1% of species were identified to species level or lower, 17.1% to genus, 7.9% to family, and 2.9% were unidentified. 60% of species were vouchered with 45% of species confirmed to species level or lower, 14.3% to genus, and 0.7% to family.

	Species	Family	Functional group	Late	Early	No
1	*Acalypha allenii*	Euphorbiaceae	Geoxyle	1	0	0
2	*Acalypha ambigua*	Euphorbiaceae	Geoxyle	1	0	0
3	Acanthaceae 1	Acanthaceae	Dicot	0	1	0
4	Acanthaceae 2	Acanthaceae	Dicot	1	0	1
5	*Achyropsis laniceps*	Amaranthaceae	Dicot	0	1	0
6	*Acmella radicans*	Asteraceae	Dicot	0	1	0
7	*Adenia* sp.	Passifloraceae	Dicot	0	0	1
8	*Adiantum patens* subsp. *oatesii*	Pteridaceae	Fern	0	1	0
9	*Adiantum philippense* subsp. *philippense*	Pteridaceae	Fern	0	1	1
10	*Aframomum alboviolaceum*	Zingiberaceae	Non-graminoid monocot	0	1	1
11	*Agathisanthemum globosum*	Rubiaceae	Dicot	0	1	1
12	*Amorphophallus abyssinicus* subsp. *unyikae*	Araceae	Non-graminoid monocot	1	1	0
13	*Andropogon schirensis*	Poaceae	C4 grass	1	1	0
14	*Anthephora elongata*	Poaceae	C4 grass	1	0	0
15	*Aristida recta*	Poaceae	C4 grass	1	0	0
16	*Aspilia natalensis*	Asteraceae	Geoxyle	1	1	0
17	Asteraceae 1	Asteraceae	Dicot	1	1	0
18	Asteraceae 2	Asteraceae	Dicot	1	0	0
19	*Begonia princeae*	Begoniaceae	Dicot	0	1	0
20	*Bidens steppia*	Asteraceae	Dicot	1	0	1
21	*Bulbostylis macra*	Cyperaceae	Sedge	1	0	0
22	*Carex echinochloe*	Cyperaceae	Sedge	0	1	0
23	*Cephalaria katangensis*	Caprifoliaceae	Geoxyle	1	0	0
24	*Chamaecrista meelii*	Fabaceae	Dicot	1	0	0

25	*Chlorophytum* sp.	Asparagaceae	Non-graminoid monocot	0	1	0
26	*Cissampelos owariensis*	Menispermaceae	Dicot	0	1	1
27	*Cissus* sp. 1	Vitaceae	Dicot	0	0	1
28	*Cissus* sp. 2	Vitaceae	Dicot	0	0	1
29	*Clematis villosa* subsp. *villosa*	Ranunculaceae	Geoxyle	1	1	0
30	*Clerodendrum buchneri*	Lamiaceae	Geoxyle	1	1	1
31	*Clerodendrum* sp.	Lamiaceae	Dicot	0	1	1
32	*Commelina africana*	Commelinaceae	Non-graminoid monocot	1	1	1
33	*Commelina pycnospatha*	Commelinaceae	Non-graminoid monocot	1	1	1
34	*Commelina schweinfurthii* subsp. *ceciliae*	Commelinaceae	Non-graminoid monocot	1	1	0
35	*Commelina* sp.	Commelinaceae	Non-graminoid monocot	0	1	0
36	*Costus spectabilis*	Costaceae	Non-graminoid monocot	0	1	0
37	*Crotalaria calycina*	Fabaceae	Dicot	1	0	0
38	*Cryptolepis oblongifolia*	Apocynaceae	Geoxyle	1	0	0
39	*Cryptolepis* sp.	Apocynaceae	Dicot	0	1	0
40	*Crystallopollen jelfiae*	Asteraceae	Dicot	0	1	0
41	Cucurbitaceae 1	Cucurbitaceae	Dicot	0	1	0
42	*Cussonia corbisieri*	Araliaceae	Geoxyle	1	1	0
43	*Cussonia* sp.	Araliaceae	Dicot	1	0	0
44	*Cynorkis debilis*	Orchidaceae	Non-graminoid monocot	0	1	1
45	*Cyperus angolensis*	Cyperaceae	Sedge	1	0	0
46	*Cyperus cyperoides*	Cyperaceae	Sedge	0	1	0
47	*Cyperus mapanioides*	Cyperaceae	Sedge	0	1	0
48	*Cyperus* sp. 1	Cyperaceae	Sedge	1	0	0
49	*Cyperus* sp. 2	Cyperaceae	Sedge	0	1	0
50	*Cyperus* sp. 3	Cyperaceae	Sedge	0	1	1
51	*Cyperus sylvestris*	Cyperaceae	Sedge	0	1	0
52	*Cyperus tenuiculmis*	Cyperaceae	Sedge	1	0	0
53	*Cyphostemma* sp. 1	Vitaceae	Dicot	0	1	0

54	*Cyphostemma* **sp. 2**	**Vitaceae**	**Dicot**	**0**	**1**	**0**
55	*Cyphostemma vanmeelii*	**Vitaceae**	**Dicot**	**0**	**1**	**1**
56	*Desmodium* **sp.**	**Fabaceae**	**Dicot**	**0**	**1**	**0**
57	*Digitaria gazensis*	**Poaceae**	**C4 grass**	**1**	**0**	**0**
58	*Diheteropogon amplectens*	**Poaceae**	**C4 grass**	**1**	**0**	**0**
59	*Dioscorea buchananii*	**Dioscoreaceae**	**Non-graminoid monocot**	**0**	**1**	**0**
60	*Dioscorea cochleariapiculata*	**Dioscoreaceae**	**Non-graminoid monocot**	**0**	**1**	**0**
61	*Dioscorea hirtiflora*	**Dioscoreaceae**	**Non-graminoid monocot**	**0**	**1**	**1**
62	*Dioscorea praehensilis*	**Dioscoreaceae**	**Non-graminoid monocot**	**0**	**1**	**1**
63	*Dolichos* **sp.**	**Fabaceae**	**Dicot**	**1**	**1**	**1**
64	*Dracaena* **sp.**	**Asparagaceae**	**Non-graminoid monocot**	**0**	**0**	**1**
65	*Elephantopus scaber*	**Asteraceae**	**Dicot**	**1**	**1**	**1**
66	*Eragrostis racemosa*	**Poaceae**	**C4 grass**	**1**	**0**	**0**
67	*Eulophia* **sp.**	**Orchidaceae**	**Non-graminoid monocot**	**0**	**0**	**1**
68	**Fabaceae 1**	**Fabaceae**	**Dicot**	**0**	**1**	**0**
69	*Fadogia cienkowskii* **var.** *cienkowskii*	**Rubiaceae**	**Geoxyle**	**1**	**0**	**0**
70	*Fadogia triphylla*	**Rubiaceae**	**Geoxyle**	**1**	**0**	**0**
71	*Geophila obvallata* **subsp.** *ioides*	**Rubiaceae**	**Dicot**	**1**	**1**	**1**
72	*Gladiolus gregarius*	**Iridaceae**	**Non-graminoid monocot**	**1**	**0**	**0**
73	*Gloriosa lindenii*	**Colchicaceae**	**Non-graminoid monocot**	**0**	**1**	**1**
74	*Grona adscendens*	**Fabaceae**	**Dicot**	**1**	**1**	**1**
75	*Grona barbata*	**Fabaceae**	**Dicot**	**1**	**1**	**1**
76	*Haumaniastrum villosum*	**Lamiaceae**	**Dicot**	**1**	**0**	**0**
77	*Helichrysum kirkii* **var.** *petersii*	**Asteraceae**	**Dicot**	**1**	**0**	**0**
78	*Heteropholis* **sp.**	**Poaceae**	**C4 grass**	**0**	**1**	**0**
79	*Heteropholis sulcata*	**Poaceae**	**C4 grass**	**1**	**0**	**0**
80	*Hyparrhenia bracteata*	**Poaceae**	**C4 grass**	**1**	**0**	**0**
81	*Hyparrhenia filipendula*	**Poaceae**	**C4 grass**	**1**	**1**	**0**
82	*Hyparrhenia newtonii* **var.** *newtonii*	**Poaceae**	**C4 grass**	**1**	**0**	**0**

83	*Hyparrhenia welwitschii*	**Poaceae**	**C4 grass**	**1**	**1**	**0**
84	*Hypericophyllum angolense*	**Asteraceae**	**Dicot**	**1**	**0**	**0**
85	*Hypoestes forskaolii*	**Acanthaceae**	**Geoxyle**	**1**	**1**	**0**
86	*Indigofera livingstoniana*	**Fabaceae**	**Dicot**	**1**	**1**	**1**
87	*Indigofera sutherlandioides*	**Fabaceae**	**Geoxyle**	**0**	**1**	**0**
88	*Justicia elegantula*	**Acanthaceae**	**Geoxyle**	**0**	**1**	**0**
89	*Lactuca setosa*	**Asteraceae**	**Dicot**	**0**	**1**	**0**
90	*Lilium* **sp. 1**	**Liliaceae**	**Non-graminoid monocot**	**0**	**1**	**0**
91	*Lilium* **sp. 2**	**Liliaceae**	**Non-graminoid monocot**	**0**	**1**	**0**
92	*Lilium* **sp. 3**	**Liliaceae**	**Non-graminoid monocot**	**0**	**1**	**0**
93	*Malaxis katangensis*	**Orchidaceae**	**Non-graminoid monocot**	**0**	**1**	**1**
94	*Microchloa caffra*	**Poaceae**	**C4 grass**	**1**	**0**	**0**
95	*Murdannia simplex*	**Commelinaceae**	**Non-graminoid monocot**	**1**	**0**	**0**
96	*Nephrolepis undulata*	**Polypodiaceae**	**Fern**	**1**	**1**	**1**
97	*Nervilia kotschyi* **var.** *kotschyi*	**Orchidaceae**	**Non-graminoid monocot**	**0**	**1**	**1**
98	*Ochna pygmaea*	**Ochnaceae**	**Geoxyle**	**0**	**1**	**0**
99	*Ocimum fimbriatum* **var.** *fimbriatum*	**Lamiaceae**	**Dicot**	**1**	**1**	**1**
100	*Oplismenus hirtellus*	**Poaceae**	**C3 grass**	**0**	**1**	**1**
101	*Orthosiphon allenii*	**Lamiaceae**	**Geoxyle**	**0**	**1**	**0**
102	*Oxytenanthera abyssinica*	**Poaceae**	**C3 grass**	**0**	**1**	**1**
103	*Plectranthus* **sp.**	**Lamiaceae**	**Dicot**	**0**	**1**	**1**
104	*Poaceae* **1**	**Poaceae**	**NA**	**0**	**1**	**0**
105	*Poaceae* **2**	**Poaceae**	**NA**	**0**	**1**	**1**
106	*Poaceae* **3**	**Poaceae**	**NA**	**0**	**1**	**0**
107	*Poaceae* **4**	**Poaceae**	**NA**	**0**	**0**	**1**
108	*Polygala erioptera*	**Polygalaceae**	**Dicot**	**1**	**1**	**1**
109	*Rhynchosia* **sp.**	**Fabaceae**	**Dicot**	**1**	**0**	**0**
110	*Rottboellia cochinchinensis*	**Poaceae**	**C4 grass**	**0**	**1**	**1**
111	**Rubiaceae 1**	**Rubiaceae**	**Dicot**	**0**	**1**	**0**

112	*Scadoxus multiflorus*	**Amaryllidaceae**	**Non-graminoid monocot**	0	1	0
113	*Schizachyrium brevifolium*	**Poaceae**	**C4 grass**	1	0	0
114	*Scleria bulbifera*	**Cyperaceae**	**Sedge**	1	0	0
115	*Scleria* **sp.**	**Cyperaceae**	**Sedge**	0	1	1
116	*Scutellaria schweinfurthii subsp. paucifolia*	**Lamiaceae**	**Geoxyle**	1	0	0
117	*Sida urens*	**Malvaceae**	**Dicot**	0	1	1
118	*Spermacoce chaetocephala*	**Rubiaceae**	**Dicot**	1	1	0
119	*Spermacoce dibrachiata*	**Rubiaceae**	**Dicot**	1	0	0
120	*Spermacoce ocymoides*	**Rubiaceae**	**Dicot**	1	0	0
121	*Sphenostylis stenocarpa*	**Fabaceae**	**Dicot**	1	1	1
122	*Stephania abyssinica*	**Menispermaceae**	**Dicot**	0	1	1
123	*Stylochaeton puberulum*	**Araceae**	**Non-graminoid monocot**	0	0	1
124	*Tacca leontopetaloides*	**Dioscoreaceae**	**Non-graminoid monocot**	0	1	1
125	*Thunbergia kirkiana*	**Acanthaceae**	**Geoxyle**	1	1	1
126	*Thunbergia lancifolia*	**Acanthaceae**	**Geoxyle**	1	0	0
127	*Thyrsia huillensis*	**Poaceae**	**C4 grass**	1	0	0
128	*Trichanthecium nervatum*	**Poaceae**	**C3 grass**	1	1	0
129	*Tristachya superba*	**Poaceae**	**C4 grass**	1	0	0
130	*Triumfetta angolensis*	**Malvaceae**	**Dicot**	0	1	1
131	*Triumfetta glechomoides*	**Malvaceae**	**Geoxyle**	1	1	1
132	*Triumfetta setulosa*	**Malvaceae**	**Dicot**	0	0	1
133	*Unknown* 1	**Unknown**	**Unknown**	0	1	0
134	*Unknown* 2	**Unknown**	**Unknown**	1	0	0
135	*Unknown* 3	**Unknown**	**Unknown**	0	1	1
136	*Unknown* 4	**Unknown**	**Unknown**	0	0	1
137	*Urochloa brizantha*	**Poaceae**	**C4 grass**	1	1	1
138	*Urochloa platynota*	**Poaceae**	**C4 grass**	1	1	0
139	*Vernoniastrum latifolium*	**Asteraceae**	**Dicot**	1	0	0
140	*Zornia glochidiata*	**Fabaceae**	**Dicot**	1	0	0

List S2. List of tree species with family and information on presence/absence (1/0) in each treatment.

	Species	Family	Late	Early	No
1	*Afzelia quanzensis*	**Fabaceae**	1	0	1
2	*Albizia adianthifolia*	**Fabaceae**	1	1	1
3	*Albizia amara*	**Fabaceae**	0	1	0
4	*Albizia antunesiana*	**Fabaceae**	1	1	1
5	*Albizia versicolor*	**Fabaceae**	0	1	1
6	*Anisophyllea boehmii*	**Anisophylleaceae**	1	1	1
7	*Annona senegalensis*	**Annonaceae**	0	1	1
8	*Baphia bequaertii*	**Fabaceae**	1	1	1
9	*Bobgunnia madagascariensis*	**Fabaceae**	0	0	1
10	*Brachystegia boehmii*	**Fabaceae**	1	1	1
11	*Brachystegia floribunda*	**Fabaceae**	1	1	1
12	*Brachystegia longifolia*	**Fabaceae**	0	1	1
13	*Brachystegia manga*	**Fabaceae**	0	1	0
14	*Brachystegia* **sp.**	**Fabaceae**	0	1	0
15	*Brachystegia spiciformis*	**Fabaceae**	1	1	1
16	*Brachystegia utilis*	**Fabaceae**	0	1	1
17	*Bridelia micrantha*	**Phyllanthaceae**	0	1	0
18	*Canthium* **sp.**	**Rubiaceae**	0	1	0
19	*Combretum pisoniiflorum*	**Combretaceae**	0	1	0
20	*Combretum* **sp.**	**Combretaceae**	1	1	1
21	*Combretum zeyheri*	**Combretaceae**	0	1	0
22	*Dalbergia lanceolaria* **subsp.** *paniculata*	**Fabaceae**	0	1	0
23	*Dalbergiella nyasae*	**Fabaceae**	0	1	0
24	*Diospyros batocana*	**Ebenaceae**	0	1	0
25	*Erythrina abyssinica*	**Fabaceae**	0	1	0
26	*Erythrophleum africanum*	**Fabaceae**	1	1	1

27	*Flacourtia indica*	**Salicaceae**	**0**	**1**	**1**
28	*Gardenia imperialis*	**Rubiaceae**	**0**	**1**	**0**
29	*Hexalobus monopetalus*	**Annonaceae**	**0**	**1**	**1**
30	*Hymenocardia acida*	**Phyllanthaceae**	**1**	**0**	**0**
31	*Isoberlinia angolensis*	**Fabaceae**	**0**	**0**	**1**
32	*Julbernardia paniculata*	**Fabaceae**	**1**	**1**	**1**
33	*Landolphia kirkii*	**Apocynaceae**	**1**	**0**	**0**
34	*Lannea discolor*	**Anacardiaceae**	**0**	**0**	**1**
35	*Lannea schweinfurthii* **var.** *stuhlmannii*	**Anacardiaceae**	**0**	**1**	**1**
36	*Magnistipula butayei*	**Chrysobalanaceae**	**0**	**1**	**1**
37	*Markhamia obtusifolia*	**Bignoniaceae**	**1**	**0**	**0**
38	*Marquesia macroura*	**Dipterocarpaceae**	**0**	**1**	**1**
39	*Monotes africanus*	**Dipterocarpaceae**	**1**	**1**	**1**
40	*Monotes* **sp.**	**Dipterocarpaceae**	**1**	**0**	**0**
41	*Ochna pulchra*	**Ochnaceae**	**1**	**1**	**1**
42	*Parinari curatellifolia*	**Chrysobalanaceae**	**1**	**1**	**1**
43	*Pericopsis angolensis*	**Fabaceae**	**1**	**1**	**1**
44	*Phyllanthus muellerianus*	**Phyllanthaceae**	**0**	**1**	**1**
45	*Piliostigma thonningii*	**Fabaceae**	**0**	**1**	**0**
46	*Pseudolachnostylis maprouneifolia*	**Phyllanthaceae**	**1**	**1**	**1**
47	*Pterocarpus angolensis*	**Fabaceae**	**1**	**1**	**1**
48	*Rothmannia engleriana*	**Rubiaceae**	**1**	**1**	**0**
49	*Searsia longipes*	**Anacardiaceae**	**0**	**0**	**1**
50	*Strychnos cocculoides*	**Loganiaceae**	**1**	**0**	**0**
51	*Strychnos innocua*	**Loganiaceae**	**0**	**1**	**1**
52	*Syzygium coarctatum*	**Myrtaceae**	**1**	**1**	**1**
53	*Syzygium guineense*	**Myrtaceae**	**0**	**1**	**1**
54	*Uapaca kirkiana*	**Phyllanthaceae**	**1**	**1**	**1**
55	*Uapaca nitida*	**Phyllanthaceae**	**0**	**1**	**1**

56	*Uapaca sansibarica*	**Phyllanthaceae**	**0**	**1**	**1**
57	*Vachellia sieberiana*	**Fabaceae**	**1**	**0**	**1**
58	*Vitex doniana*	**Lamiaceae**	**1**	**0**	**0**
59	*Vitex payos*	**Lamiaceae**	**0**	**1**	**0**

Table S1. Results of the overdispersion test in GLM analyses. Slight overdispersion has been detected for (a) total and (g) dicot.

	Group	Overdispersion test result
a	Total	1.34
b	Total (sensitivity test)	0.72
c	C_4 grass	0.72
d	C_3 grass	0.64
e	Sedge	0.96
f	Non-graminoid monocot	0.73
g	Dicot	1.13
h	Geoxyle	0.96
i	Fern	0.84

Table S2. Output summaries of GLM analyses of ground layer richness. The table contains Incidence Rate Ratios (IRRs) which should be interpreted as the proportion of the value for the intercept; 95% Confidence Intervals (CI) and the associated p-values (p). Marginal and conditional r-squared values for mixed models are reported which are calculated based on Nakagawa et al. (2017), where Conditional R^2 takes into account both the variance of fixed and random effects and Marginal R^2 takes into account only the fixed effects.

	(a) Total		
Predictors	*IRR*	*CI*	*p*
(Intercept)	7.25	5.43 – 9.68	<0.001
site [Early]	0.77	0.69 – 0.86	<0.001
site [No]	0.46	0.40 – 0.52	<0.001
Random Effects			
σ^2	0.17		
$\tau_{00\ month}$	0.10		
ICC	0.37		
N_{month}	5		
Observations	315		
Marginal R^2 / Conditional R^2	0.280 / 0.550		

	(b) Total (sensitivity test)		
Predictors	*IRR*	*CI*	*p*
(Intercept)	7.13	5.18 – 9.81	<0.001
site [Early]	0.73	0.58 – 0.90	0.004
site [No]	0.45	0.36 – 0.56	<0.001
Random Effects			
σ^2	0.19		
$\tau_{00\ plotID}$	0.10		
$\tau_{00\ month}$	0.10		
ICC	0.52		
N_{month}	5		
N_{plotID}	63		
Observations	315		
Marginal R^2 / Conditional R^2	0.223 / 0.625		

Table S2 (continued)

Predictors	(c) C$_4$ grass IRR	CI	p	(d) C$_3$ grass IRR	CI	p	(e) Sedge IRR	CI	p	(f) Non-graminoid monocot IRR	CI	p	(g) Dicot IRR	CI	p	(h) Geoxyle IRR	CI	p	(i) Fern IRR	CI	p
(Intercept)	2.75	2.13-3.57	<0.001	0.67	0.47-0.97	0.031	0.11	0.06-0.20	<0.001	0.12	0.03-0.44	0.001	1.55	1.19-2.02	0.001	2.01	1.62-2.50	<0.001	0.03	0.01-0.12	<0.001
site [Early]	0.14	0.10-0.20	<0.001	0.23	0.14-0.39	<0.001	2.5	1.28-4.87	0.007	7.74	5.02-11.93	<0.001	1.14	0.92-1.40	0.224	0.47	0.37-0.60	<0.001	5.2	2.04-13.22	0.001
site [No]	0.01	0.00-0.03	<0.001	0.14	0.07-0.26	<0.001	0.33	0.11-1.03	0.056	7.04	4.56-10.89	<0.001	0.9	0.72-1.12	0.341	0.06	0.03-0.10	<0.001	0.6	0.15-2.42	0.473

Random Effects							
σ^2	0.66	1.45	2.1	0.95	0.49	0.68	2.8
$\tau_{00\ month}$	0.07	0.1	0.08	1.94	0.06	0.04	1.48
ICC	0.09	0.06	0.04	0.67	0.11	0.05	0.34
N$_{month}$	5	5	5	5	5	5	5
Observations	315	315	315	315	315	315	315
Marginal R^2 / Conditional R^2	0.829 / 0.846	0.317 / 0.360	0.238 / 0.267	0.235 / 0.748	0.016 / 0.124	0.677 / 0.693	0.166 / 0.454

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**Figure S1**. Histograms of GLM residuals.
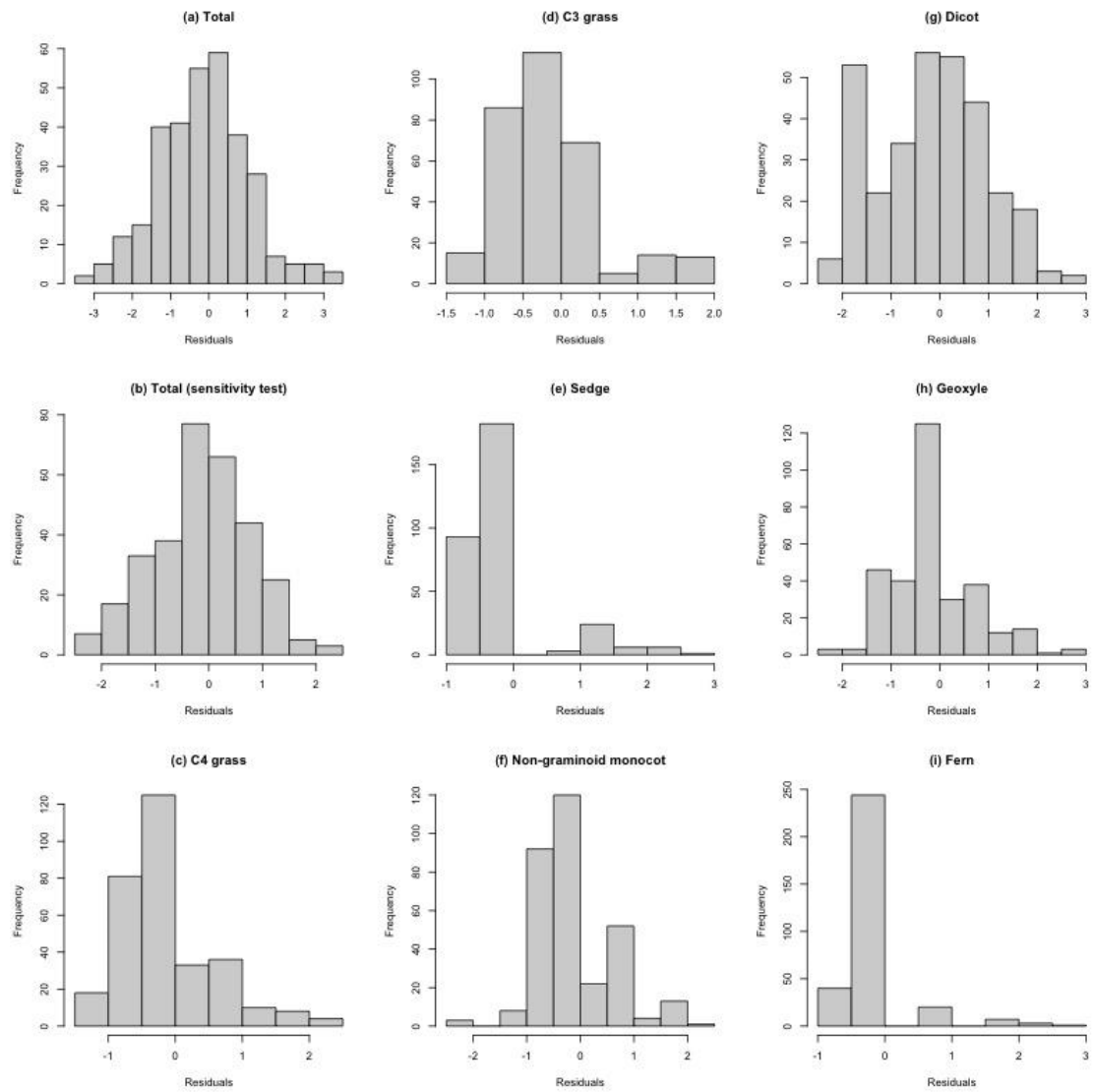
Figure S2. Visualisation of the fixed effect of fire treatment in the sensitivity test for the model of total richness which incorporates a random effect of plot. Letters are used to indicate whether 95% Confidence Intervals overlap. The species richness in Late (7.13, 95%CI: 5.18, 9.81) and No fire treatment (3.18, 95%CI: 2.29, 4.41) do not overlap. Species richness in the Early fire treatment (5.18, 95%CI: 3.75, 7.15) overlaps with other treatments.
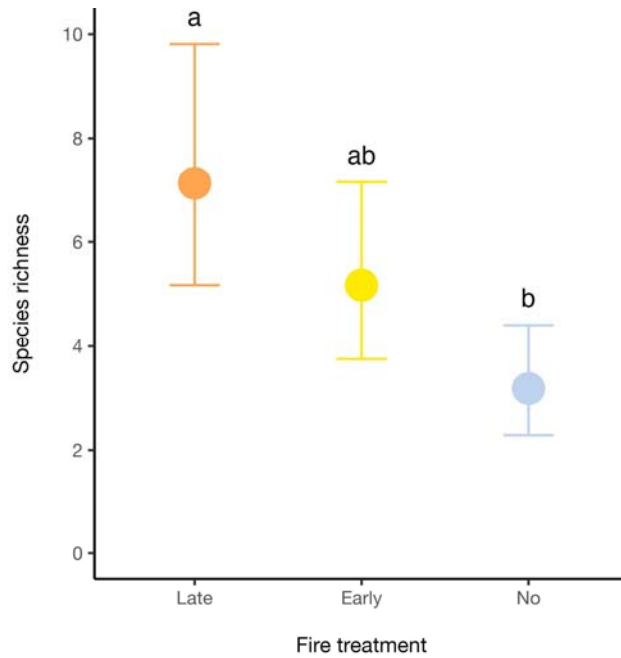
Figure S3. Sample-size-based rarefaction and extrapolation of species richness at each treatment in each month of sampling. Species richness has been divided into (a) grasses, and (b) all ground layer species except for grasses. The extrapolation was carried out to a sample size of 51 plots (~40 m^2), using iNEXT (Hsieh et *al.,* 2016) function with an 'incidence_raw' data type (species by sampling-units incidence matrix). Grass species richness saturated quicker than non-grasses, however, some species could still have been missed, especially in April and in Late fire treatment. Non-grass plot richness did not saturate in Early and Late fire treatments in any month which means that some species present at the two sites have likely been missed.

Globally, the Brazilian Cerrado is lauded for its plant diversity. Comparing local richness recorded at Mwekera to that of Abreu et al. (2017) across a similarly fire-determined tree cover gradient, mean ground layer species richness was comparable. Extrapolation of Mwekera ground layer richness to an equivalent area as sampled by Abreu et al. (2017) from our April sampling alone would be 34 (No fire), 58 (Early fire), and 60 (Late fire) species compared with their three categories of encroachment of 23, 78 and 81 species (over 40 m^2, excluding trees and palms).
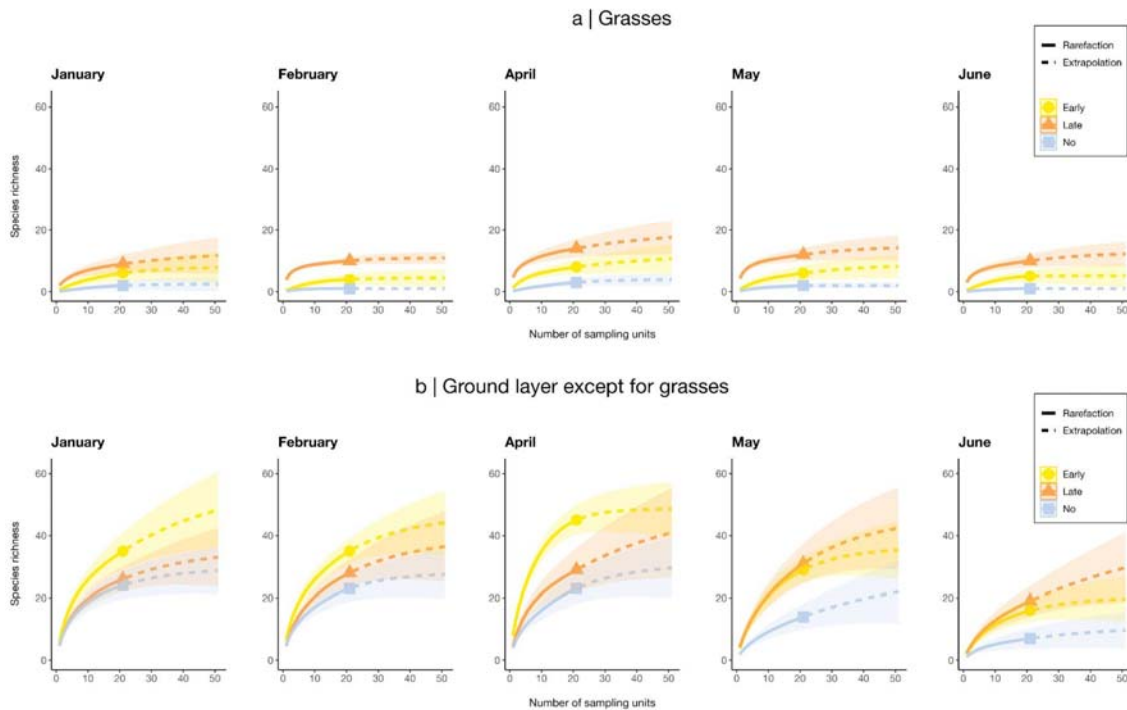
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