

Appendix 1. Scaling up of trait-based data to the community level to reveal trait-divergence assembly patterns related to ecological variables (Pillar *et al.* 2009). Input data matrices are: **W** with presences or abundances of species in communities, **B** with traits describing the species, and **E** with the ecological gradient of interest. The outcome is the partial matrix correlation $\rho(\mathbf{X}\mathbf{E}.\mathbf{T})$ measuring how strongly trait-divergence assembly patterns are related to the ecological gradient in **E**. See Pillar *et al.* (2009) for details.

Appendix 2. Plant traits used for description of species populations in a natural grassland experiment in south Brazil. All traits were taken as ordinal. See Pillar *et al.* (2009) for details.

Labels Traits and trait states

pi	Plant inclination (1:prostrated, 2:semi-erect, 3:erect)
he	Canopy height at estimated "center of gravity" of standing biomass (1: <7.5cm; 2: 7.5 - 14; 3: 14 - 22.5; 4: 22.5 - 30; 5: 30 - 40; 6: ≥40cm)
ll	Leaf length (1: <4.3cm; 2: 4.3 - 8.6; 3: 8.6 - 13; 4: 13 - 17.3; 5: 17.3 - 21; 6: ≥21cm),
sh	Leaf shape (width/length rescaled into classes: 1: <0.38; 2: 0.38 - 0.76; 3: 0.76 - 1.13; 4: 1.13 - 1.56; 5: 1.56 - 2.25; 6: ≥2.25)
la	Leaf area (leaf length x width rescaled into classes: 1: <11.2cm ² ; 2: 11.2 - 22.3; 3: 22.3 - 36.48; 4: 36.48 - 38.85; 5: 38.8 - 67.2; 6: ≥67.2cm ²)
tx	Leaf texture (1: membranous; 2: herbaceous; 3: coriaceous or fibrous)
ts	Leaf resistance to traction (4 classes, estimated by pulling by hand until breaking)

Appendix 3a. Categorical matrix of plant species by clades (matrix **F**) from higher monophyletic groups (e.g. Monocots, Eudicots) to families and genera. Phylogenetic relationships established according to APG (2003).

Nominal variables defined based on the phylogenetic tree APG (2003)

Species	d1	d2	d3	d4	d5	d6	d7
<i>Paspalum</i>				Commelini	Commelini	Monoco	Monoco
<i>notatum</i>	Paspalum	Poaceae	Poales	ds	ds	ts	ts
<i>Hypoxis</i>						Monoco	Monoco
<i>decumbens</i>	Hypoxis	Hypoxidaceae	Asparagales	Monocots	Monocots	ts	ts
							Core
<i>Eryngium</i>				Euasterids	Euasterids	Asterid	eudicot
<i>horridum</i>	Eryngium	Apiaceae	Apiales	ii	ii	s	s
							Core
<i>Desmodium</i>				Eurosids i			eudicot
<i>incanum</i>	Desmodium	Fabaceae	Fabales	b	Eurosids i	Rosids	s
							Core
<i>Vernonia</i>				Euasterids	Euasterids	Asterid	eudicot
<i>nudiflora</i>	Vernonia	Asteraceae	Asterales	ii	ii	s	s
<i>Piptochaetiu</i>							
<i>m</i>							
<i>montevidens</i>	Piptochaetiu			Commelini	Commelini	Monoco	Monoco
<i>e</i>	m	Poaceae	Poales	ds	ds	ts	ts
<i>Cyperus</i>				Commelini	Commelini	Monoco	Monoco
<i>sesquiflorus</i>	Cyperus	Cyperaceae	Poales	ds	ds	ts	ts
<i>Coelorhachis</i>	Coelorhachi			Commelini	Commelini	Monoco	Monoco
<i>selloana</i>	s	Poaceae	Poales	ds	ds	ts	ts
<i>Orthopappus</i>							Core
<i>s</i>	Orthopappu			Euasterids	Euasterids	Asterid	eudicot
<i>angustifolius</i>	s	Asteraceae	Asterales	ii	ii	s	s
<i>Lupinus</i>	Lupinus	Fabaceae	Fabales	Eurosids i	Eurosids i	Rosids	Core

<i>linearis</i>				b			eudicot s
<i>Setaria</i>				Commelini	Commelini	Monoco	Monoco
<i>geniculata</i>	Setaria	Poaceae	Poales	ds	ds	ts	ts Core
<i>Richardia</i>				Euasterids	Euasterids	Asterid	eudicot
<i>humistrata</i>	Richardia	Rubiaceae	Gentianales	i	i	s	s Core
<i>Dichondra</i>		Convolvulacea		Euasterids	Euasterids	Asterid	eudicot
<i>sericea</i>	Dichondra	e	Solanales	i	i	s	s Core
<i>Relbunium</i>				Euasterids	Euasterids	Asterid	eudicot
<i>richardianu</i>				Euasterids	Euasterids	Asterid	eudicot
<i>m</i>	Relbunium	Rubiaceae	Gentianales	i	i	s	s Core
<i>Soliva</i>				Euasterids	Euasterids	Asterid	eudicot
<i>pterosperma</i>	Soliva	Asteraceae	Asterales	ii	ii	s	s Commelini Commelini Monoco Monoco
<i>Juncus sp.</i>	Juncus	Juncaceae	Poales	ds	ds	ts	ts
<i>Cyperus</i>				Commelini	Commelini	Monoco	Monoco
<i>brevifolius</i>	Cyperus	Cyperaceae	Poales	ds	ds	ts	ts Core
<i>Ruellia sp.</i>	Ruellia	Acanthaceae	Lamiales	i	i	s	s Core Core
<i>Pfaffia</i>		Amaranthacea	Caryophylla	Core	Core	eudicot	eudicot
<i>tuberosa</i>	Pfaffia	e	les	eudicots	eudicots	s	s Core
<i>Facelis</i>				Euasterids	Euasterids	Asterid	eudicot
<i>retusa</i>	Facelis	Asteraceae	Asterales	ii	ii	s	s
<i>Hypochoeris</i>				Euasterids	Euasterids	Asterid	Core
<i>sp.</i>	Hypochoeris	Asteraceae	Asterales	ii	ii	s	eudicot

							s
							Core
				Euasterids	Euasterids	Asterid	eudicot
<i>Borreria laxa</i>	Borreria	Rubiaceae	Gentianales	i	i	s	s
							Core
<i>Scutellaria</i>				Euasterids	Euasterids	Asterid	eudicot
<i>racemosa</i>	Scutellaria	Lamiaceae	Lamiales	i	i	s	s
							Core
<i>Sida</i>							eudicot
<i>rhombofolia</i>	Sida	Malvaceae	Malvales	Eurosids ii	Eurosids ii	Rosids	s
<i>Briza</i>				Commelini	Commelini	Monoco	Monoco
<i>subaristata</i>	Briza	Poaceae	Poales	ds	ds	ts	ts
<i>Sisyrinchyu</i>	Sisyrinchyu					Monoco	Monoco
<i>m sp.</i>	m	Iridaceae	Asparagales	Monocots	Monocots	ts	ts
							Core
<i>Plantago</i>		Plantaginacea		Euasterids	Euasterids	Asterid	eudicot
<i>tomentosa</i>	Plantago	e	Lamiales	i	i	s	s
							Core
<i>Solidago</i>				Euasterids	Euasterids	Asterid	eudicot
<i>chilensis</i>	Solidago	Asteraceae	Asterales	ii	ii	s	s
							Core
<i>Centella</i>				Euasterids	Euasterids	Asterid	eudicot
<i>asiatica</i>	Centella	Apiaceae	Apiales	ii	ii	s	s
							Core
<i>Elephantopu</i>	Elephantop			Euasterids	Euasterids	Asterid	eudicot
<i>s mollis</i>	us	Asteraceae	Asterales	ii	ii	s	s
							Core
<i>Crotalaria</i>				Eurosids i			eudicot
<i>tweediana</i>	Crotalaria	Fabaceae	Fabales	b	Eurosids i	Rosids	s
<i>Anagallis</i>						Asterid	Core
<i>arvensis</i>	Anagallis	Primulaceae	Ericales	Asterids	Asterids	s	eudicot

s

<i>Axonopus</i>				Commelini	Commelini	Monoco	Monoco
<i>affinis</i>	Axonopus	Poaceae	Poales	ds	ds	ts	ts
							Core
				Euasterids	Euasterids	Asterid	eudicot
<i>Coniza sp.</i>	Coniza	Asteraceae	Asterales	ii	ii	s	s
<i>Aspilia</i>							Core
<i>montevidens</i>				Euasterids	Euasterids	Asterid	eudicot
<i>is</i>	Aspilia	Asteraceae	Asterales	ii	ii	s	s
							Core
<i>Macroptilium</i>	Macroptiliu			Eurosids i			eudicot
<i>prostratum</i>	m	Fabaceae	Fabales	b	Eurosids i	Rosids	s
<i>Setaria</i>				Commelini	Commelini	Monoco	Monoco
<i>vaginata</i>	Setaria	Poaceae	Poales	ds	ds	ts	ts
							Core
<i>Pterocaulon</i>				Euasterids	Euasterids	Asterid	eudicot
<i>sp.</i>	Pterocaulon	Asteraceae	Asterales	ii	ii	s	s
<i>Lolium</i>				Commelini	Commelini	Monoco	Monoco
<i>multiflorum</i>	Lolium	Poaceae	Poales	ds	ds	ts	ts
<i>Apium</i>							Core
<i>leptophyllu</i>				Euasterids	Euasterids	Asterid	eudicot
<i>m</i>	Apium	Apiaceae	Apiales	ii	ii	s	s
<i>Paspalum</i>				Commelini	Commelini	Monoco	Monoco
<i>plicatulum</i>	Paspalum	Poaceae	Poales	ds	ds	ts	ts
							Core
<i>Gnaphalium</i>				Euasterids	Euasterids	Asterid	eudicot
<i>spicatum</i>	Gnaphalium	Asteraceae	Asterales	ii	ii	s	s
							Core
<i>Cuphea cf.</i>							eudicot
<i>glutinosa</i>	Cuphea	Lythraceae	Myrtales	Rosids	Rosids	Rosids	s
<i>Herbertia</i>	Herbertia	Iridaceae	Asparagales	Monocots	Monocots	Monoco	Monoco

<i>pulchella</i>						ts	ts
<i>Cynodon</i>				Commelini	Commelini	Monoco	Monoco
<i>dactylon</i>	Cynodon	Poaceae	Poales	ds	ds	ts	ts
<i>Paspalum</i>				Commelini	Commelini	Monoco	Monoco
<i>urvillei</i>	Paspalum	Poaceae	Poales	ds	ds	ts	ts
							Core
<i>Borreria</i>				Euasterids	Euasterids	Asterid	eudicot
<i>verticillata</i>	Borreria	Rubiaceae	Gentianales	i	i	s	s
<i>Paspalum</i>				Commelini	Commelini	Monoco	Monoco
<i>paniculatum</i>	Paspalum	Poaceae	Poales	ds	ds	ts	ts
						Monoco	Monoco
<i>Cypella sp.</i>	Cypella	Iridaceae	Asparagales	Monocots	Monocots	ts	ts
						Core	Core
<i>Rumex</i>			Caryophylla	Core	Core	eudicot	eudicot
<i>obtusifolius</i>	Rumex	Polygonaceae	les	eudicots	eudicots	s	s
<i>Panicum</i>				Commelini	Commelini	Monoco	Monoco
<i>hians</i>	Panicum	Poaceae	Poales	ds	ds	ts	ts
							Core
<i>Eryngium</i>				Euasterids	Euasterids	Asterid	eudicot
<i>sanguisorba</i>	Eryngium	Apiaceae	Apiales	ii	ii	s	s
							Core
<i>Desmanthus</i>	Desmanthu			Eurosids i			eudicot
<i>depressus</i>	s	Fabaceae	Fabales	b	Eurosids i	Rosids	s
							Core
				Euasterids	Euasterids	Asterid	eudicot
<i>Verbena sp.</i>	Verbena	Verbenaceae	Lamiales	i	i	s	s
<i>Chloris</i>				Commelini	Commelini	Monoco	Monoco
<i>sesquiflora</i>	Chloris	Poaceae	Poales	ds	ds	ts	ts
							Core
<i>Tibouchina</i>		Melastomatac					eudicot
<i>gracilis</i>	Tibouchina	eae	Myrtales	Rosids	Rosids	Rosids	s

<i>Aristida</i>				Commelini	Commelini	Monoco	Monoco
<i>laevis</i>	Aristida	Poaceae	Poales	ds	ds	ts	ts
						Core	Core
<i>Drymaria</i>		Caryophyllace	Caryophylla	Core	Core	eudicot	eudicot
<i>cordata</i>	Drymaria	ae	les	eudicots	eudicots	s	s
							Core
<i>Gamochaeta</i>	Gamochaet			Euasterids	Euasterids	Asterid	eudicot
<i>sp.</i>	a	Asteraceae	Asterales	ii	ii	s	s
<i>Stylosanthes</i>							Core
<i>montevidens</i>	Stylosanthe			Eurosids i			eudicot
<i>is</i>	s	Fabaceae	Fabales	b	Eurosids i	Rosids	s
<i>Cyperus</i>				Commelini	Commelini	Monoco	Monoco
<i>cayennensis</i>	Cyperus	Cyperaceae	Poales	ds	ds	ts	ts
							Core
<i>Trifolium</i>				Eurosids i			eudicot
<i>dubium</i>	Trifolium	Fabaceae	Fabales	b	Eurosids i	Rosids	s
							Core
<i>Galianthe</i>				Euasterids	Euasterids	Asterid	eudicot
<i>fastigiata</i>	Galianthe	Rubiaceae	Gentianales	i	i	s	s
							Core
<i>Baccharis</i>				Euasterids	Euasterids	Asterid	eudicot
<i>trimera</i>	Baccharis	Asteraceae	Asterales	ii	ii	s	s
						Core	Core
<i>Spergula</i>		Caryophyllace	Caryophylla	Core	Core	eudicot	eudicot
<i>arvensis</i>	Spergula	ae	les	eudicots	eudicots	s	s
<i>Panicum</i>				Commelini	Commelini	Monoco	Monoco
<i>sabulorum</i>	Panicum	Poaceae	Poales	ds	ds	ts	ts
							Core
<i>Evolvulus</i>		Convolvulacea		Euasterids	Euasterids	Asterid	eudicot
<i>sericeus</i>	Evolvulus	e	Solanales	i	i	s	s
<i>Eleusine</i>	Eleusine	Poaceae	Poales	Commelini	Commelini	Monoco	Monoco

<i>thristhachya</i>				ds	ds	ts	ts
<i>Schizachyriu</i>							
<i>m</i>							
<i>microstachy</i>	Schizachyri			Commelini	Commelini	Monoco	Monoco
<i>um</i>	um	Poaceae	Poales	ds	ds	ts	ts
<i>Andropogon</i>				Commelini	Commelini	Monoco	Monoco
<i>lateralis</i>	Andropogon	Poaceae	Poales	ds	ds	ts	ts
							Core
					Eurosids i		eudicot
<i>Clitoria nana</i>	Clitoria	Fabaceae	Fabales	b	Eurosids i	Rosids	s
<i>Paspalum</i>				Commelini	Commelini	Monoco	Monoco
<i>saure</i>	Paspalum	Poaceae	Poales	ds	ds	ts	ts
<i>Paspalum</i>				Commelini	Commelini	Monoco	Monoco
<i>dilatatum</i>	Paspalum	Poaceae	Poales	ds	ds	ts	ts
<i>Paspalum</i>							
<i>pauciciliatu</i>				Commelini	Commelini	Monoco	Monoco
<i>m</i>	Paspalum	Poaceae	Poales	ds	ds	ts	ts
<i>Verbena cf.</i>							Core
<i>montevidens</i>				Euasterids	Euasterids	Asterid	eudicot
<i>is</i>	Verbena	Verbenaceae	Lamiales	i	i	s	s
							Core
		Scrophulariac		Euasterids	Euasterids	Asterid	eudicot
<i>Linaria sp.</i>	Linaria	eae	Lamiales	i	i	s	s
<i>Baccharis cf.</i>							Core
<i>dracunculifol</i>				Euasterids	Euasterids	Asterid	eudicot
<i>ia</i>	Baccharis	Asteraceae	Asterales	ii	ii	s	s
							Core
<i>Oxalis</i>				Eurosids i			eudicot
<i>eriocarpa</i>	Oxalis	Oxalidaceae	Oxalidales	a	Eurosids i	Rosids	s
<i>Borreria</i>				Euasterids	Euasterids	Asterid	Core
<i>eryngiodes</i>	Borreria	Rubiaceae	Gentianales	i	i	s	eudicot

s

Core

eudicot

*Waltheria**douradinha*

Waltheria

Malvaceae

Malvales

Eurosids ii

Eurosids ii

Rosids

s

Sporobolus

Commelini

Commelini

Monoco

Monoco

indicus

Sporobolus

Poaceae

Poales

ds

ds

ts

ts

Appendix 3b. Categorical matrix of plant species by clades (matrix **F**, see App. 3a) after numerical coding.

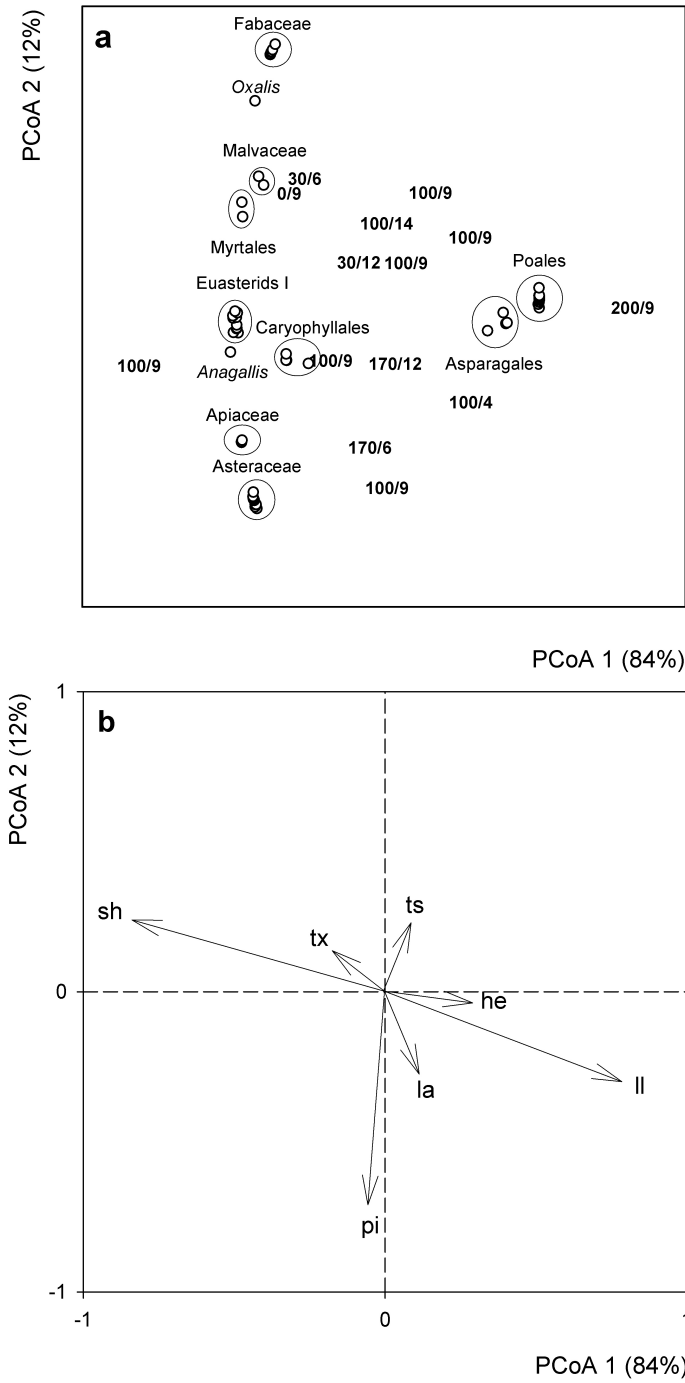
Nominal variables defined based on the phylogenetic tree (APG (2003) and coded numerically

Species	d1	d2	d3	d4	d5	d6	d7
<i>Paspalum notatum</i>	43	18	12	2	2	3	2
<i>Hypoxis decumbens</i>	34	9	2	9	8	3	2
<i>Eryngium horridum</i>	26	3	1	5	5	1	1
<i>Desmodium incanum</i>	21	8	6	7	6	4	1
<i>Vernonia nudiflora</i>	65	4	3	5	5	1	1
<i>Piptochaetium</i>							
<i>montevidense</i>	45	18	12	2	2	3	2
<i>Cyperus sesquiflorus</i>	19	7	12	2	2	3	2
<i>Coelorhachis seloana</i>	13	18	12	2	2	3	2
<i>Orthopappus</i>							
<i>angustifolius</i>	40	4	3	5	5	1	1
<i>Lupinus linearis</i>	38	8	6	7	6	4	1
<i>Setaria geniculata</i>	54	18	12	2	2	3	2
<i>Richardia humistrata</i>	49	21	7	4	4	1	1
<i>Dichondra sericea</i>	22	6	13	4	4	1	1
<i>Relbunium richardianum</i>	48	21	7	4	4	1	1
<i>Soliva pterosperma</i>	58	4	3	5	5	1	1
<i>Juncus sp.</i>	35	11	12	2	2	3	2
<i>Cyperus brevifolius</i>	19	7	12	2	2	3	2
<i>Ruellia sp.</i>	50	1	8	4	4	1	1
<i>Pfaffia tuberosa</i>	44	2	4	3	3	2	1
<i>Facelis retusa</i>	28	4	3	5	5	1	1
<i>Hypochoeris sp.</i>	33	4	3	5	5	1	1
<i>Borreria laxa</i>	8	21	7	4	4	1	1

<i>Scutellaria racemosa</i>	53	12	8	4	4	1	1
<i>Sida rhombifolia</i>	55	14	9	8	7	4	1
<i>Briza subaristata</i>	9	18	12	2	2	3	2
<i>Sisyrinchium sp.</i>	56	10	2	9	8	3	2
<i>Plantago tomentosa</i>	46	17	8	4	4	1	1
<i>Solidago chilensis</i>	57	4	3	5	5	1	1
<i>Centella asiatica</i>	10	3	1	5	5	1	1
<i>Elephantopus mollis</i>	24	4	3	5	5	1	1
<i>Crotalaria tweediana</i>	15	8	6	7	6	4	1
<i>Anagallis arvensis</i>	1	20	5	1	1	1	1
<i>Axonopus affinis</i>	6	18	12	2	2	3	2
<i>Coniza sp.</i>	14	4	3	5	5	1	1
<i>Aspilia montevidensis</i>	5	4	3	5	5	1	1
<i>Macroptilium prostratum</i>	39	8	6	7	6	4	1
<i>Setaria vaginata</i>	54	18	12	2	2	3	2
<i>Pterocaulon sp.</i>	47	4	3	5	5	1	1
<i>Lolium multiflorum</i>	37	18	12	2	2	3	2
<i>Apium leptophyllum</i>	3	3	1	5	5	1	1
<i>Paspalum plicatum</i>	43	18	12	2	2	3	2
<i>Gnaphalium spicatum</i>	31	4	3	5	5	1	1
<i>Cuphea cf. glutinosa</i>	16	13	10	10	9	4	1
<i>Herbertia pulchella</i>	32	10	2	9	8	3	2
<i>Cynodon dactylon</i>	17	18	12	2	2	3	2
<i>Paspalum urvillei</i>	43	18	12	2	2	3	2
<i>Borreria verticillata</i>	8	21	7	4	4	1	1
<i>Paspalum paniculatum</i>	43	18	12	2	2	3	2
<i>Cypella sp.</i>	18	10	2	9	8	3	2
<i>Rumex obtusifolius</i>	51	19	4	3	3	2	1
<i>Panicum hians</i>	42	18	12	2	2	3	2
<i>Eryngium sanguisorba</i>	26	3	1	5	5	1	1
<i>Desmanthus depressus</i>	20	8	6	7	6	4	1

<i>Verbena sp.</i>	64	23	8	4	4	1	1
<i>Chloris sesquiflora</i>	11	18	12	2	2	3	2
<i>Tibouchina gracilis</i>	62	15	10	10	9	4	1
<i>Aristida laevis</i>	4	18	12	2	2	3	2
<i>Drymaria cordata</i>	23	5	4	3	3	2	1
<i>Gamochaeta sp.</i>	30	4	3	5	5	1	1
<i>Stylosanthes</i>							
<i>montevidensis</i>	61	8	6	7	6	4	1
<i>Cyperus cayennensis</i>	19	7	12	2	2	3	2
<i>Trifolium dubium</i>	63	8	6	7	6	4	1
<i>Galianthe fastigiata</i>	29	21	7	4	4	1	1
<i>Baccharis trimera</i>	7	4	3	5	5	1	1
<i>Spergula arvensis</i>	59	5	4	3	3	2	1
<i>Panicum sabulorum</i>	42	18	12	2	2	3	2
<i>Evolvulus sericeus</i>	27	6	13	4	4	1	1
<i>Eleusine thristhachya</i>	25	18	12	2	2	3	2
<i>Schizachyrium</i>							
<i>microstachyum</i>	52	18	12	2	2	3	2
<i>Andropogon lateralis</i>	2	18	12	2	2	3	2
<i>Clitoria nana</i>	12	8	6	7	6	4	1
<i>Paspalum saure</i>	43	18	12	2	2	3	2
<i>Paspalum dilatatum</i>	43	18	12	2	2	3	2
<i>Paspalum pauciciliatum</i>	43	18	12	2	2	3	2
<i>Verbena cf.</i>							
<i>montevidensis</i>	64	23	8	4	4	1	1
<i>Linaria sp.</i>	36	22	8	4	4	1	1
<i>Baccharis cf.</i>							
<i>dracunculifolia</i>	7	4	3	5	5	1	1
<i>Oxalis eriocarpa</i>	41	16	11	6	6	4	1
<i>Borreria eryngiodes</i>	8	21	7	4	4	1	1
<i>Waltheria douradinha</i>	66	14	9	8	7	4	1

<i>Sporobolus indicus</i>	60	18	12	2	2	3	2
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Appendix 4. Principal Coordinates Analysis ordination based on the phylogenetic structure of grassland communities in south Brazil under experimental levels of nitrogen (0 to 200 kg-N.ha⁻¹.yr⁻¹) and grazing intensity (4 to 14 % of forage allowance). In (a) the experimental plots are identified by the nitrogen and grazing levels respectively, and the species are identified by their clades (APG 2003) and in (b) the species traits are projected on the same ordination diagram based on the correlation between each ordination axis and the trait averages at the community level.