

Supplementary material for article:

Soil Bacterial Community Responds to Land-Use Change in Riparian Ecosystems

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Supplementary Table 1: Species composition of three strata at each site, listed alphabetically by family. Average relative density (RD, stems ha⁻¹) is shown for species in canopy and average percentage cover is shown for species in sub-canopy and ground cover. Ticks represent species that were present in the quadrat but outside sampled areas.

Strata/Family	Species	Site					
		Main Creek	Yarra River	Little Yarra River	Spring Creek	Myrniong Creek	Whitehorse Creek
Canopy (RD, stems ha ⁻¹)							
Myrtaceae	Eucalyptus cypellocarpa		✓				
	Eucalyptus goniocalyx				0.02	✓	
	Eucalyptus obliqua		✓	✓			
	Eucalyptus ovata		✓	0.04	0.15	0.10	0.02
	Eucalyptus radiata				0.02	0.19	
	Eucalyptus tricarpa				0.06		
	Eucalyptus viminalis		0.13	0.38	0.08	0.50	0.40
Proteaceae	Banksia marginata	0.31					
Sub-Canopy (% cover)							
Aizoaceae	Tetragonia implexicoma	6.22					
Asteraceae	Bedfordia arborescens		✓				
	Cassinia aculeata		8.56				2.34
	Cassinia spp.				11.11		3.49
	Cassinia trinerva		13.66				
	Chrysanthemoides monilifera *	3.89					
	Olearia lirata	0.11	0.11	5.22			
	Ozothamnus ferrugineus		✓				
Cyatheaceae	Alsophila australis		1.22				
Cyperaceae	Gahnia sieberiana			0.44			
Dennstaedtiaceae	Pteridium esculentum	0.67		0.67			
Dicksoniaceae	Dicksonia antarctica		2.78	1.67			
Fabaceae	Acacia dealbata		16.67	5.00	12.78		2.22
	Acacia mearnsii					2.22	
	Acacia melanoxylon		3.89	3.66	2.78	✓	
	Acacia obliquinervia		✓				
	Acacia spp.	✓					
	Acacia verticillata		✓				
Goodeniaceae	Goodenia ovata		0.33				

Strata/Family	Species	Site					
		Main Creek	Yarra River	Little Yarra River	Spring Creek	Myrniong Creek	Whitehorse Creek
	Goodenia spp.				0.56		
Lamiaceae	Prostanthera lasianthos		✓	✓			
Malvaceae	Gynatrix pulchella		✓				
Monimiaceae	Hedycarya angustifolia		1.11	3.33			
Myrtaceae	Kunzea leptospermoides		16.55	33.77			
	Leptospermum continentale			0.22			
	Leptospermum grandifolium		✓				
	Melaleuca squarrosa		0.56				
Pittosporaceae	Pittosporum undulatum	0.56					
Rhamnaceae	Pomaderris aspera		0.56	13.89			
Rubiaceae	Coprosma quadrifida	18.34		1.00			
Solanaceae	Solanum aviculare	0.89					
	Solanum laciniatum			0.11			
	Solanum nigrum*				1.67		
	Solanum spp.		2.78		2.78		
Ground Cover (% cover)							
Aizoaceae	Tetragonia implexicoma	6.22					
Apiaceae	Apium prostratum	0.11					
Araliaceae	Hydrocotyle geraniifolia		0.33				
Asparagaceae	Lomandra filiformis	0.33					
	Lomandra longifolia		✓				
	Lomandra spp.					0.67	
Asteraceae	Allittia cardiocarpa				0.56		
	Asperula conferta					0.44	
	Bedfordia arborescens		✓				
	Cirsium vulgare*					0.33	
	Erigeron spp.*	✓					
	Hypochaeris radicata*	0.67	4.44	0.78	0.11		2.00
	Leontodon saxatilis*					1.11	
	Olearia lirata	0.11	0.11	5.22			
	Rhaponticum repens*		✓				

Strata/Family	Species	Site					
		Main Creek	Yarra River	Little Yarra River	Spring Creek	Myrniong Creek	Whitehorse Creek
Caryophyllaceae	Stellaria flaccida		0.33				
	Stellaria media*	0.11	5.33	0.11			
Chenopodiaceae	Rhagodia candolleana	23.34					2.11
	Rhagodia crassifolia				11.11		
	Rhagodia parabolica				2.67		0.11
Convolvulaceae	Dichondra repens		0.27				
Cyatheaaceae	Cyathea australis		1.22				
Dennstaedtiaceae	Hypolepis rugosula		5.89	3.78			
	Pteridium esculentum	2.00		0.67	✓		
Dryopteridaceae	Polystichum proliferum		3.78				
Fabaceae	Bossiaea prostrata					2.56	
	Lotus corniculatus*		0.11				
	Trifolium repens*	0.11	0.22	7.67			
Goodeniaceae	Goodenia ovata seedling			0.33			
	Goodenia spp. seedling				0.56		
Iridaceae	Romulea rosea*					1.00	
Juncaceae	Juncus pallidus					2.56	
	Juncus spp.	0.33	0.22				0.22
Lamiaceae	Prostanthera lasianthos seedling		✓				
	Prunella spp.*		0.13				
	Prunella vulgaris*			0.44			
Oxalidaceae	Oxalis perennans		0.11			0.78	
	Oxalis pes-caprae*						0.11
	Oxalis spp.	0.33					0.89
Plantaginaceae	Plantago coronopus*						0.78
	Plantago lanceolata*		0.87			1.50	
	Plantago spp.	2.22					
Poaceae	Agrostis capillaris*	✓	14.51		0.22		0.56
	Anthoxanthum odoratum*	18.89	16.64	4.44	5.22	26.22	13.45
	Austrostipa spp.					0.89	
	Dactylis glomerata*		0.44			0.11	

Strata/Family	Species	Site					
		Main Creek	Yarra River	Little Yarra River	Spring Creek	Myrniong Creek	Whitehorse Creek
	Festuca spp.						1.56
	Holcus lanatus*	6.67	0.22	1.11		13.33	0.67
	Lagurus ovatus*	8.78					
	Paspalum dilatatum*		3.16				
	Paspalum distichum*			1.22			
	Phalaris aquatica*	1.22			✓		7.56
	Poa ensiformis		0.22				
	Poa labillardierei						27.56
	Poa pratensis*	5.89				12.44	
	Rytidosperma setaceum	✓		0.22	0.89		
	Rytidosperma spp.			1.78			
	Tetrarrhena juncea		2.33	2.89			
	Vulpia spp.*		✓				
Polygonaceae	Acetosella vulgaris*	0.89			0.22	3.33	0.78
	Polygonum aviculare *				0.11		
	Polygonum spp.						0.22
	Polystichum proliferum		3.78				
	Rumex crispus *			0.78	0.11		
Primulaceae	Lysimachia arvensis *	0.11					
Pteridaceae	Adiantum aethiopicum		0.56	0.44			
Ranunculaceae	Clematis spp.	✓		0.11			
	Ranunculus repens *		0.56				
Resedaceae	Reseda luteola *				1.33		
Rhamnaceae	Pomaderris aspera		0.56	13.89			
Rosaceae	Rosa rubiginosa *					0.11	
	Rubus parvifolius		0.33				
	Rubus spp.	0.22		0.11			
Rubiaceae	Opercularia varia					2.00	
Urticaceae	Australina pusilla		0.33				
Violaceae	Melicytus dentatus seedling		✓				
	Viola hederacea		✓				

* Exotic species (ground cover only), classification is defined based on Flora of Victoria classifications of naturalised and introduced.

✓ indicate species found but not quantified.

Supplementary Table 2: Carbon sources tested in EcoPlates and the corresponding guild group

Guild Group	Carbon Source	Status in soil
amines/amides	Phenylethylamine	Synthetic
	Putrescine	Natural
amino acids	L-Arginine	Synthetic
	L-Asparagine	Natural
	L- Phenylalanine	Synthetic
	L-Serine	Natural
	L-Threonine	Natural
	Glycyl-L-Glutamic Acid	Natural
carbohydrates	Pyruvic Acid Methyl Ester	Synthetic
	D-Cellobiose	Natural
	α -D-Lactose	Synthetic
	β -Methyl-D-Glucoside	Natural
	D-Xylose	Natural
	i-Erythritol	Natural
	D-Mannitol	Natural
	N-Acetyl-D-Glucosamine	Natural
	Glucose-1-Phosphate	Natural
	DL- α - Glycerol Phosphate	Synthetic
carboxylic and ketonic acids	D-Glucosaminic Acid	Synthetic
	D-Galactonic Acid γ -Lactone	Synthetic
	D-Galacturonic Acid	Natural
	2-Hydroxybenzoic Acid	Natural
	4-Hydroxybenzoic Acid	Natural
	γ -Hydroxybutyric Acid	Natural
	Itaconic Acid	Synthetic
	α -Ketobutyric Acid	Natural
	D-Malic Acid	Natural
polymers	Tween 40	Synthetic
	Tween 80	Synthetic
	α -Cyclodextrin	Natural
	Glycogen	Natural

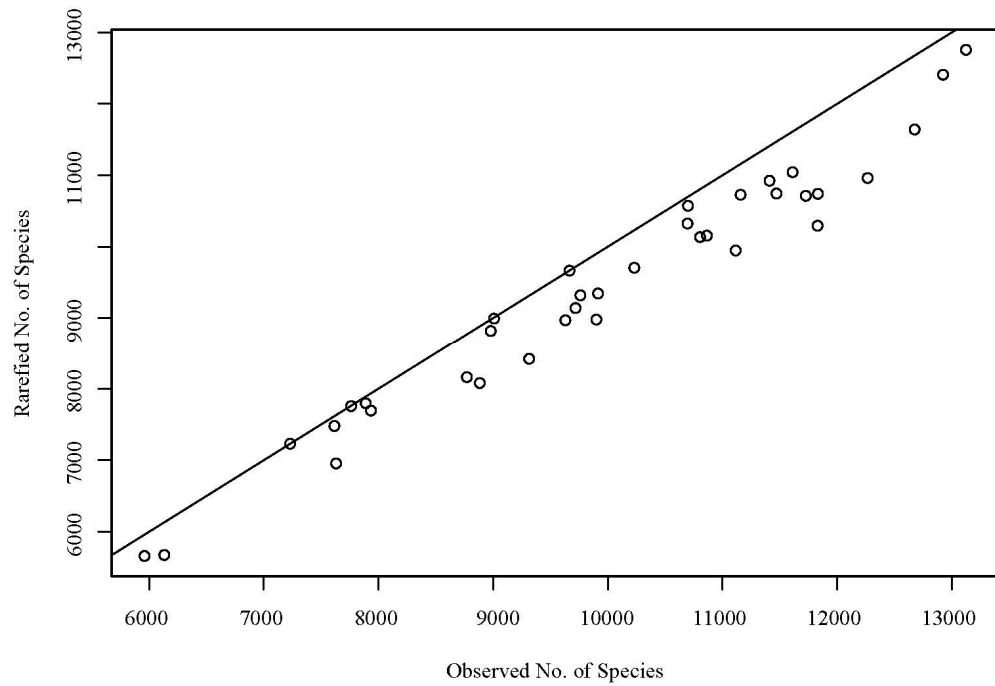
Supplementary Table 3: Eigenvalues and percent variance for principal component analysis for environmental factors.

Environmental factors	Dimension	Eigenvalue	Percent variance	Percent Cumulative variance
Vegetation factors				
	1	6.81	45.37	45.37
	2	2.38	15.86	61.23
	3	1.89	12.57	73.80
	4	1.59	10.61	84.41
	5	0.87	5.78	90.19
	6	0.49	3.29	93.48
	7	0.33	2.23	95.70
	8	0.27	1.80	97.51
	9	0.16	1.09	98.59
	10	0.08	0.51	99.10
	11	0.06	0.40	99.51
	12	0.05	0.31	99.82

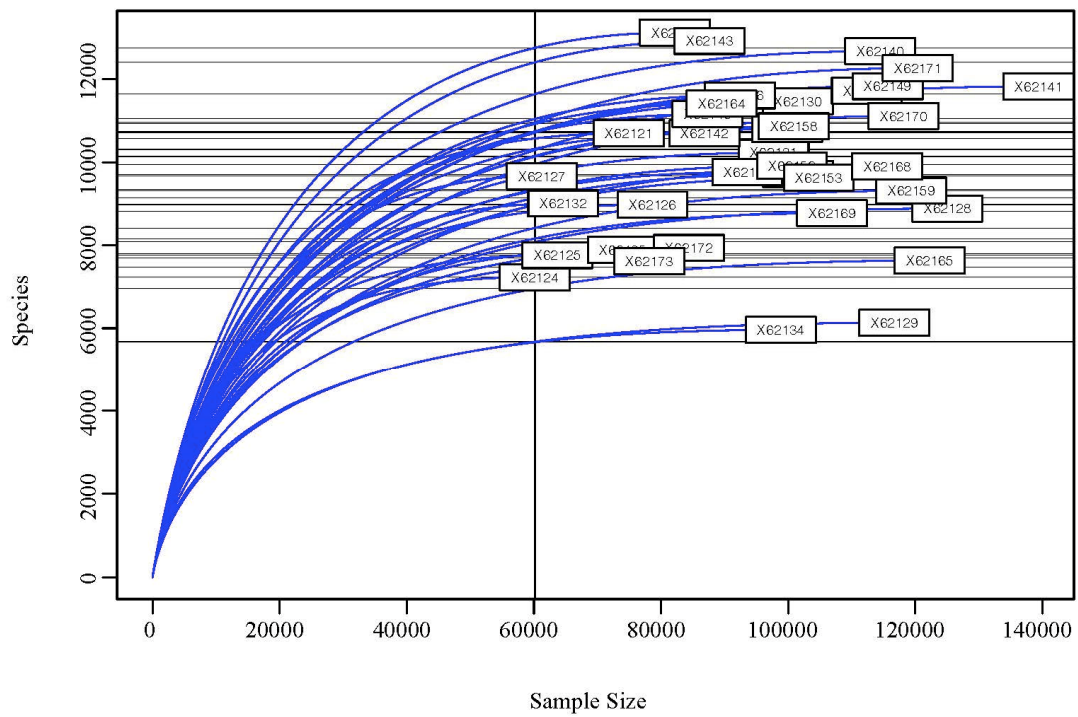
13	0.02	0.13	99.95
14	0.01	0.04	99.99
15	0.00	0.01	100.00
Soil physicochemical factors			
1	6.87	32.71	32.71
2	5.51	26.26	58.97
3	2.34	11.17	70.13
4	1.47	7.01	77.14
5	1.16	5.53	82.67
6	0.81	3.84	86.51
7	0.63	3.02	89.53
8	0.56	2.68	92.21
9	0.37	1.77	93.98
10	0.32	1.55	95.53
11	0.24	1.16	96.69
12	0.19	0.92	97.61
13	0.14	0.66	98.27
14	0.12	0.59	98.87
15	0.09	0.41	99.27
16	0.06	0.27	99.54
17	0.04	0.20	99.74
18	0.02	0.11	99.85
19	0.02	0.07	99.93
20	0.01	0.05	99.97
21	0.01	0.03	100.00

Variables in PCA for vegetation are listed in Table 2 and for soil physicochemical factors are listed in Table 3.
Supplementary Table 4: Redundancy analysis fit of environmental variables. P values <0.05 are in bold and have been included in Figure 5.

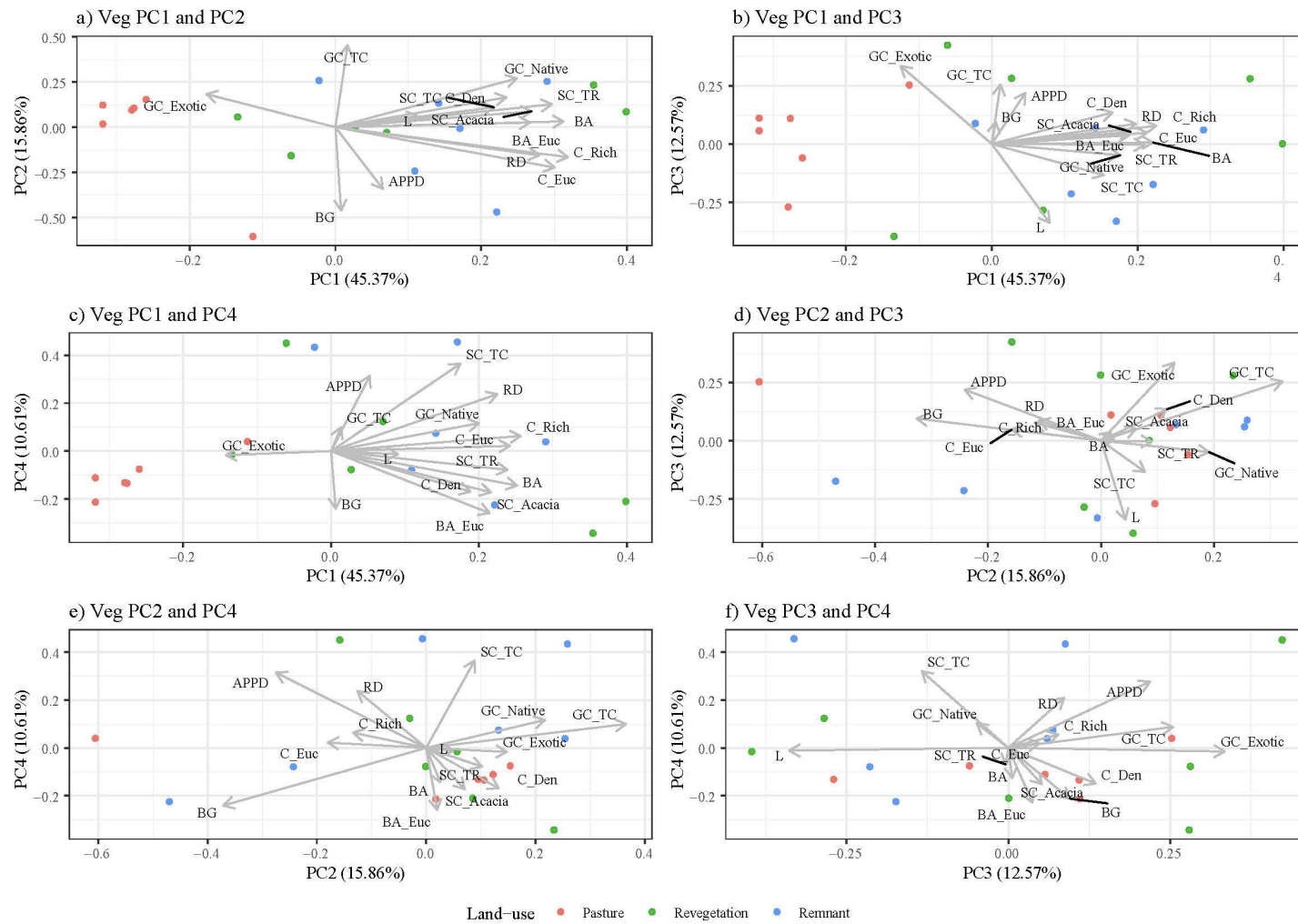
Environmental PCs	R ²	P value
Bacterial taxonomic composition		
Soil PC1	0.68	<0.00
Soil PC2	0.32	<0.00
Soil PC3	0.15	0.07
Soil PC4	0.08	0.27
Soil PC5	0.08	0.27
Veg PC1	0.11	0.15
Veg PC2	0.08	0.24
Veg PC3	0.04	0.51
Veg PC4	0.04	0.54
Bacterial functional composition		
Soil PC1	0.02	0.69
Soil PC2	0.31	<0.00
Soil PC3	0.02	0.689
Soil PC4	0.25	0.01
Soil PC5	0.04	0.51
Veg PC1	0.13	0.09
Veg PC2	0.06	0.40
Veg PC3	0.01	0.89
Veg PC4	0.03	0.66



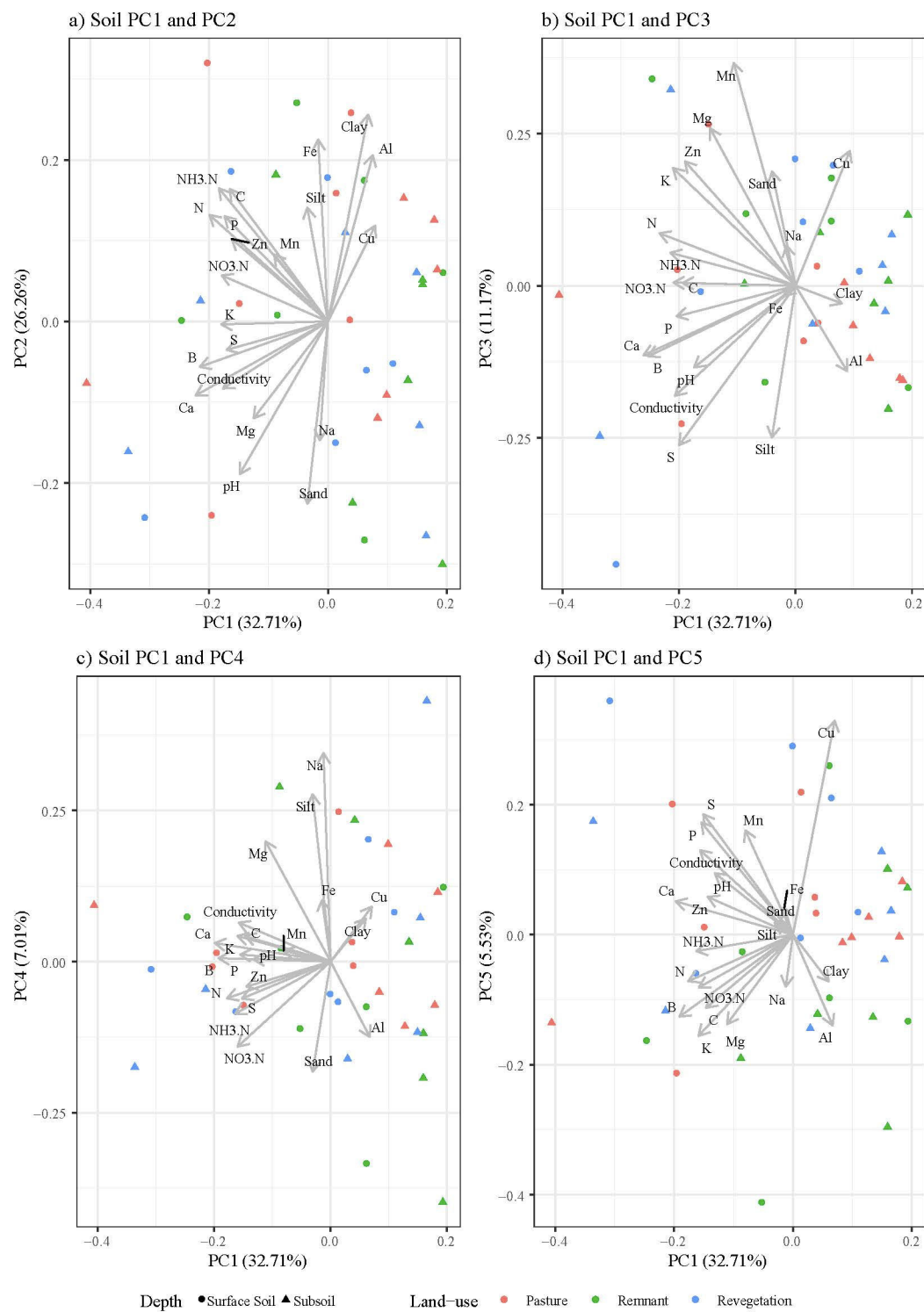
Supplementary Figure 1: Observed richness compared to rarefied richness



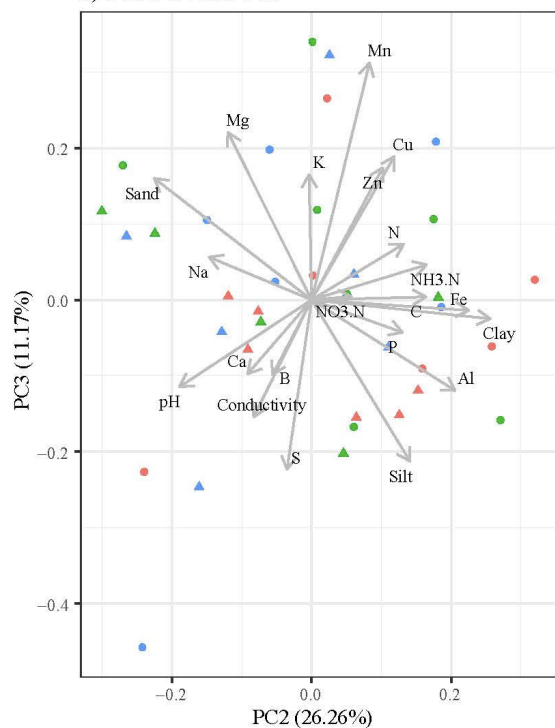
Supplementary Figure 2: Rarefaction curve showing richness of each sample.



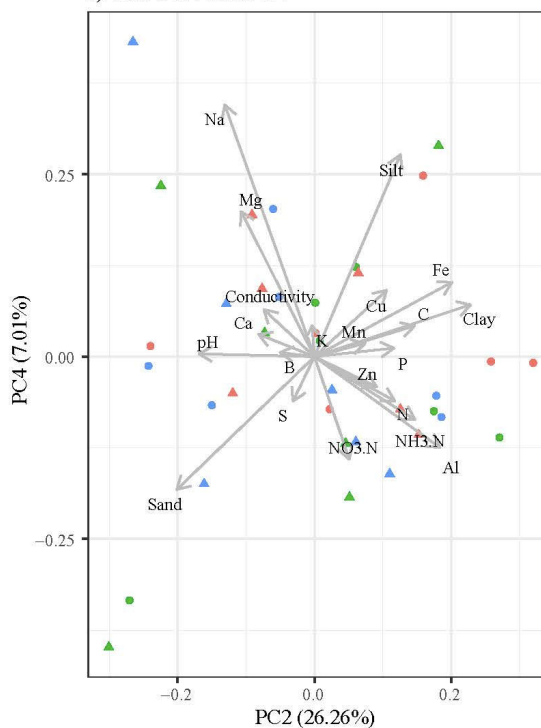
Supplementary Figure 3: Principal component analysis (PCA) of vegetation factors (a) PC1 and 2, (b) PC1 and 3, (c) PC1 and 4, (d) PC2 and 3, (e) PC2 and 4, (f) PC3 and 4. Points are colored based on land-use. Abbreviations of predictor variables are provided in Table 2.



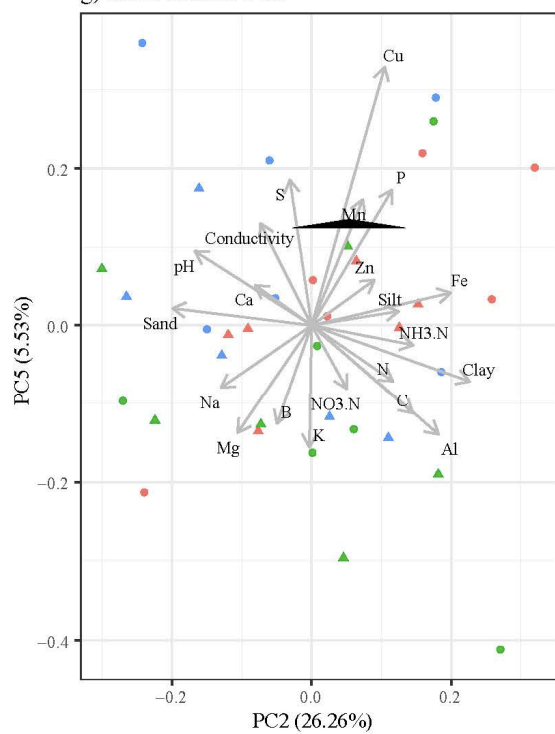
e) Soil PC2 and PC3



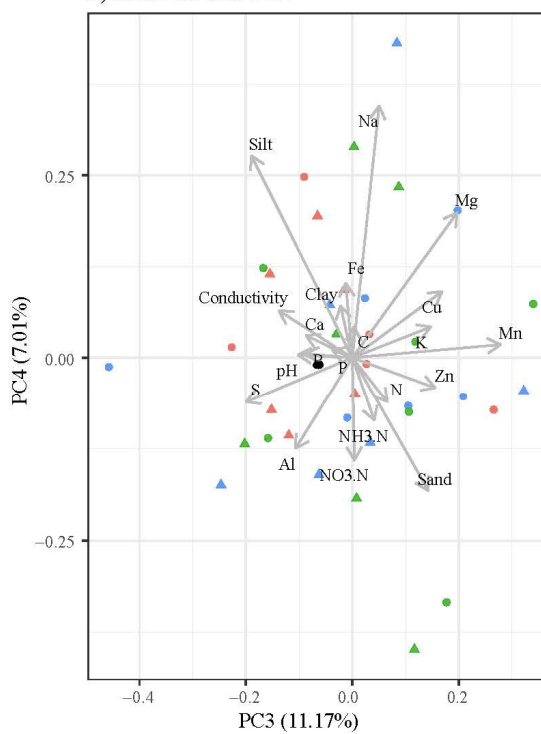
f) Soil PC2 and PC4



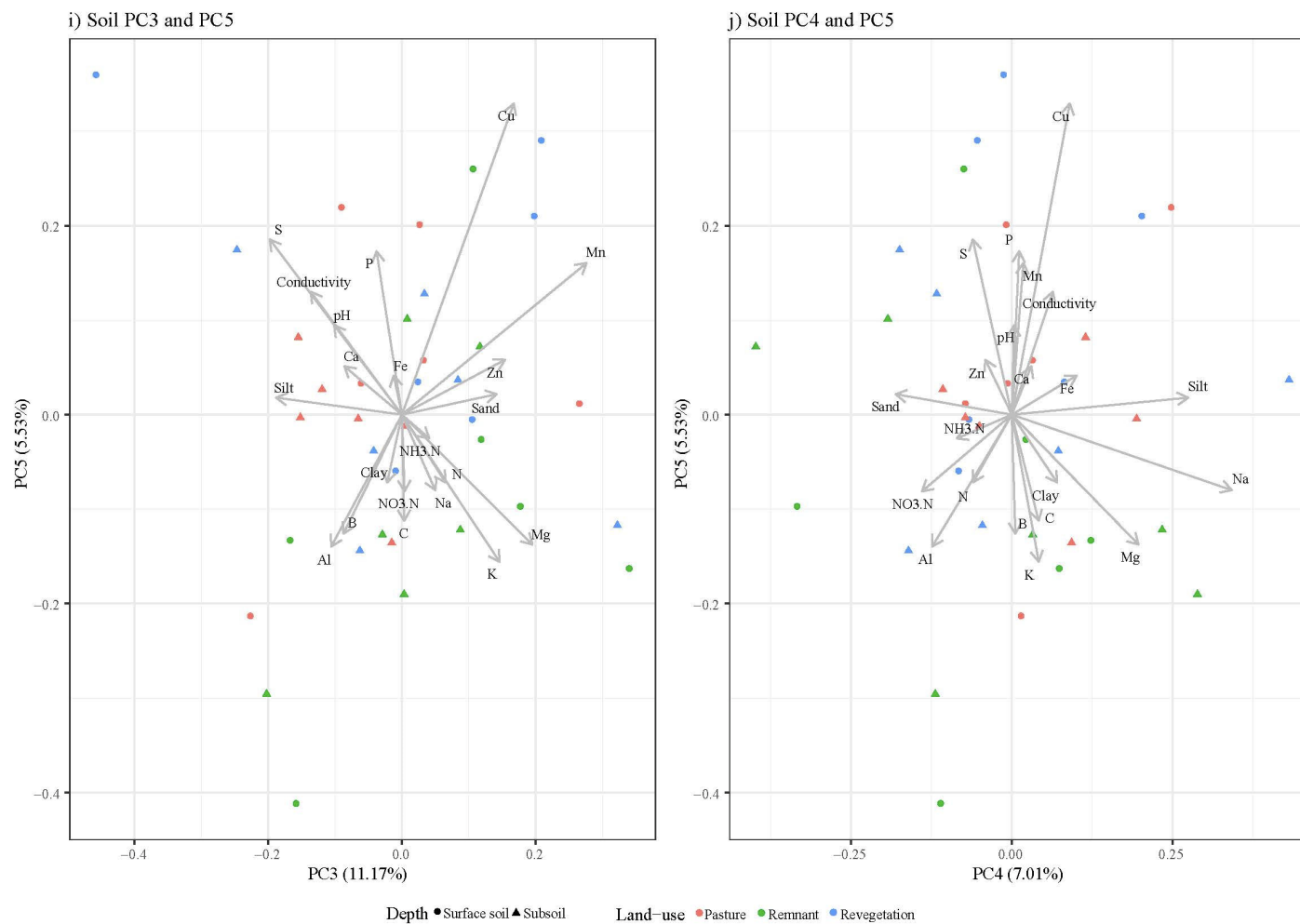
g) Soil PC2 and PC5



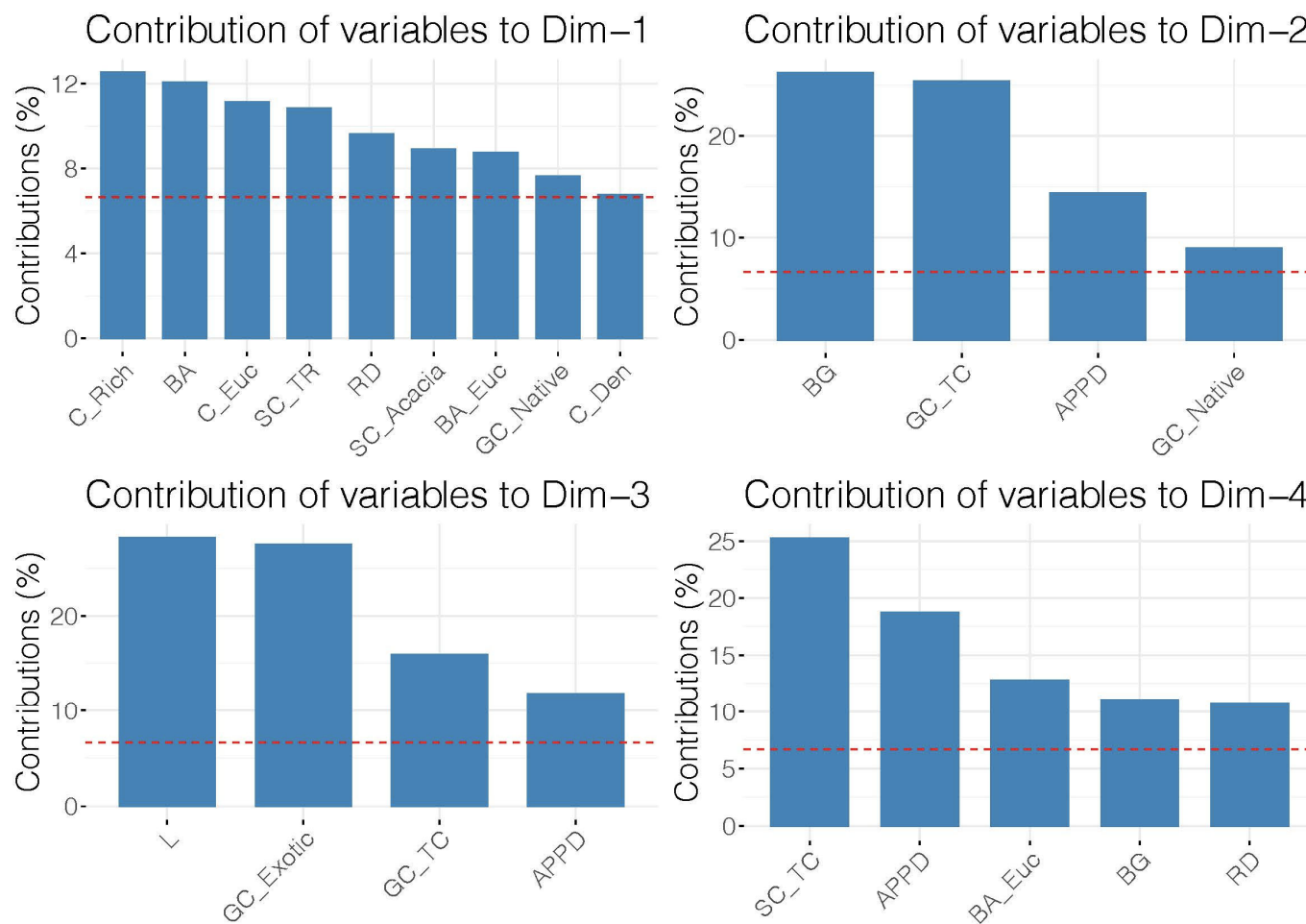
h) Soil PC3 and PC4



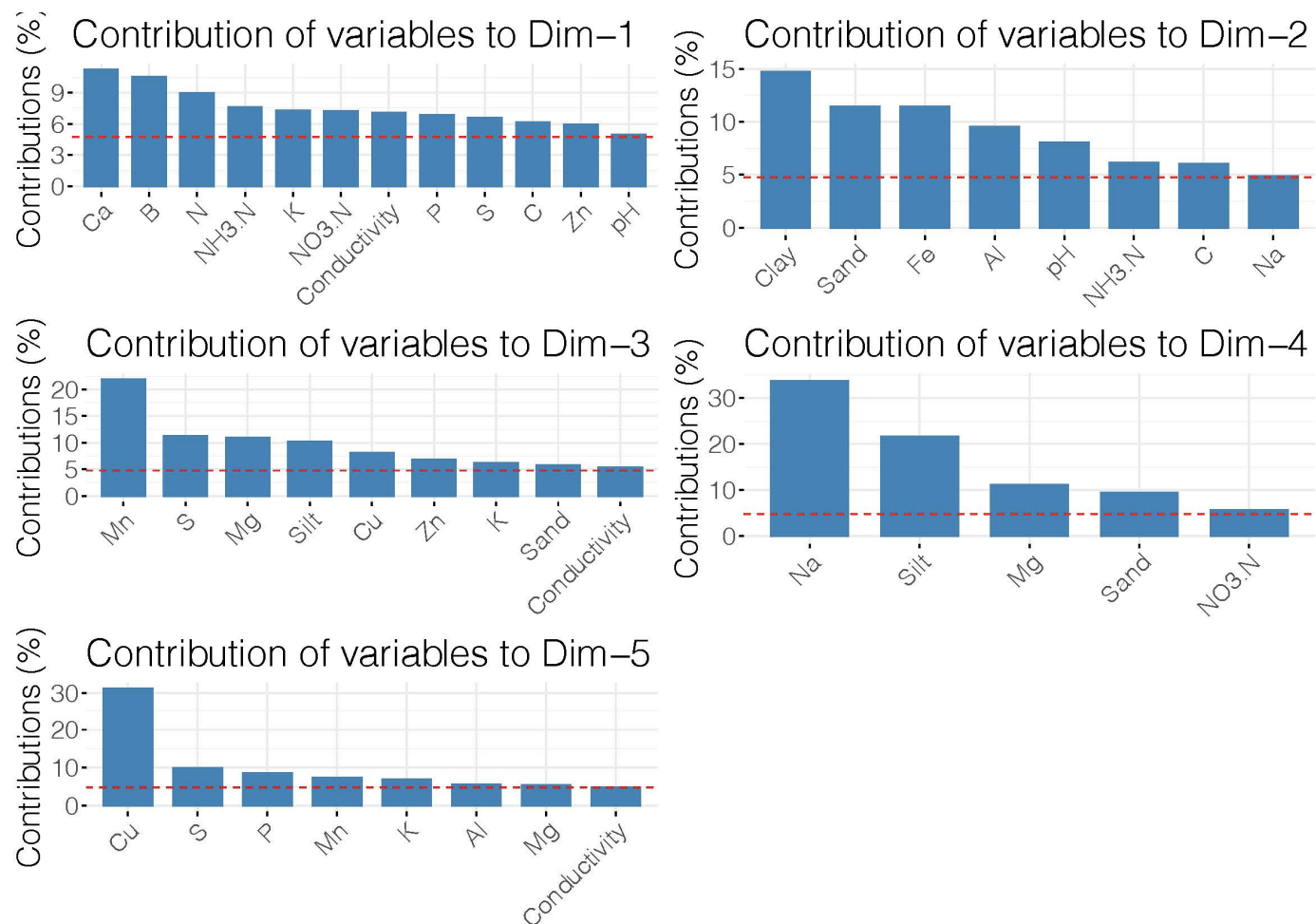
Depth ● Surface soil ▲ Subsoil Land-use ● Pasture ● Remnant ● Revegetation



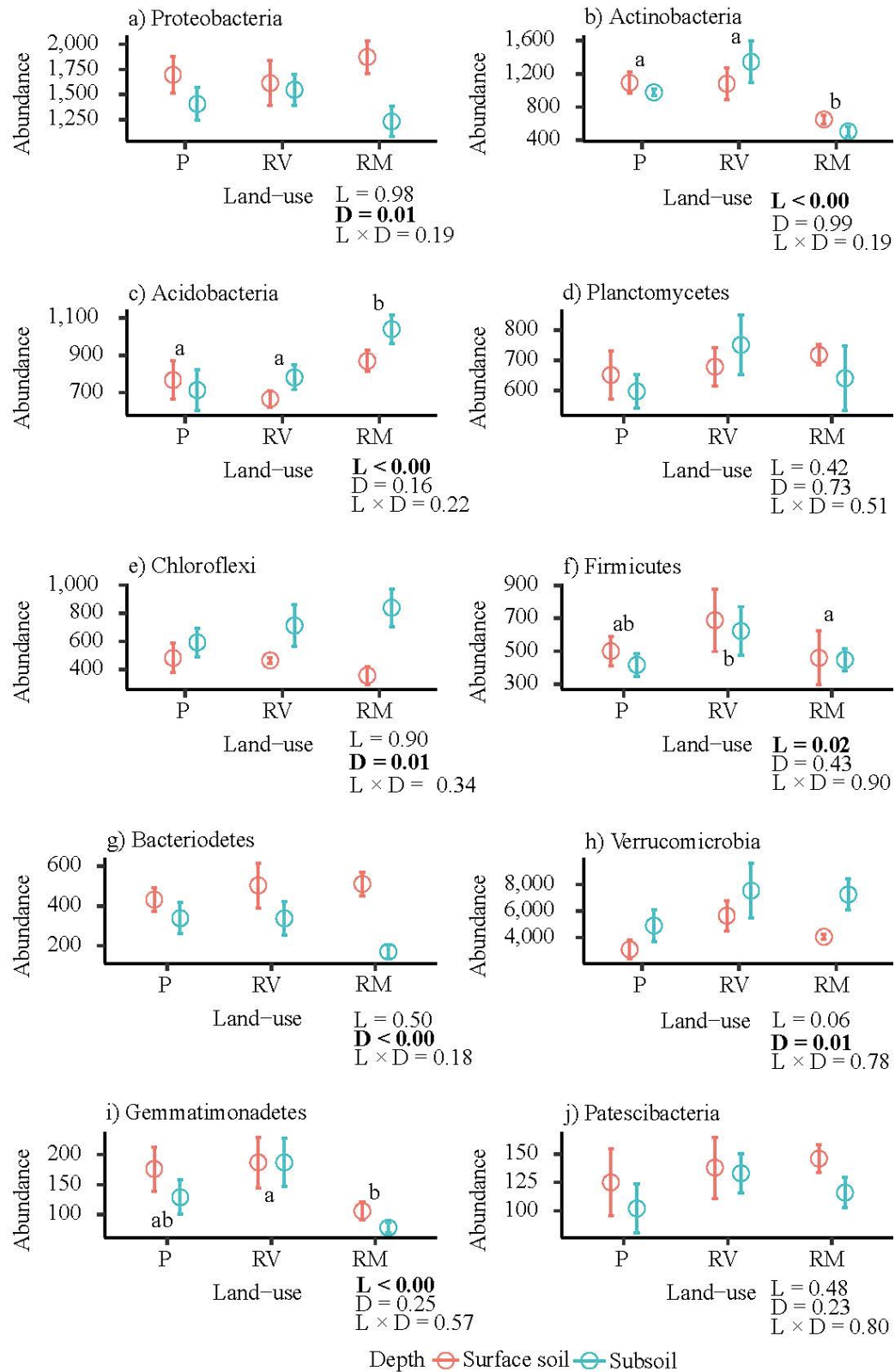
Supplementary Figure 4: Principal component analysis (PCA) of soil physicochemical factors (a) PC1 and 2, (b) PC1 and 3, (c) PC1 and 4, (d) PC2 and 3, (e) PC2 and 4, (f) PC3 and 4, (g) PC2 and PC5, (h) PC3 and PC4 (i) PC3 and 5, and (j) PC4 and 5. Points are colored based on land use and shape is based on depth. Abbreviations of predictor variables are provided in Table 3.



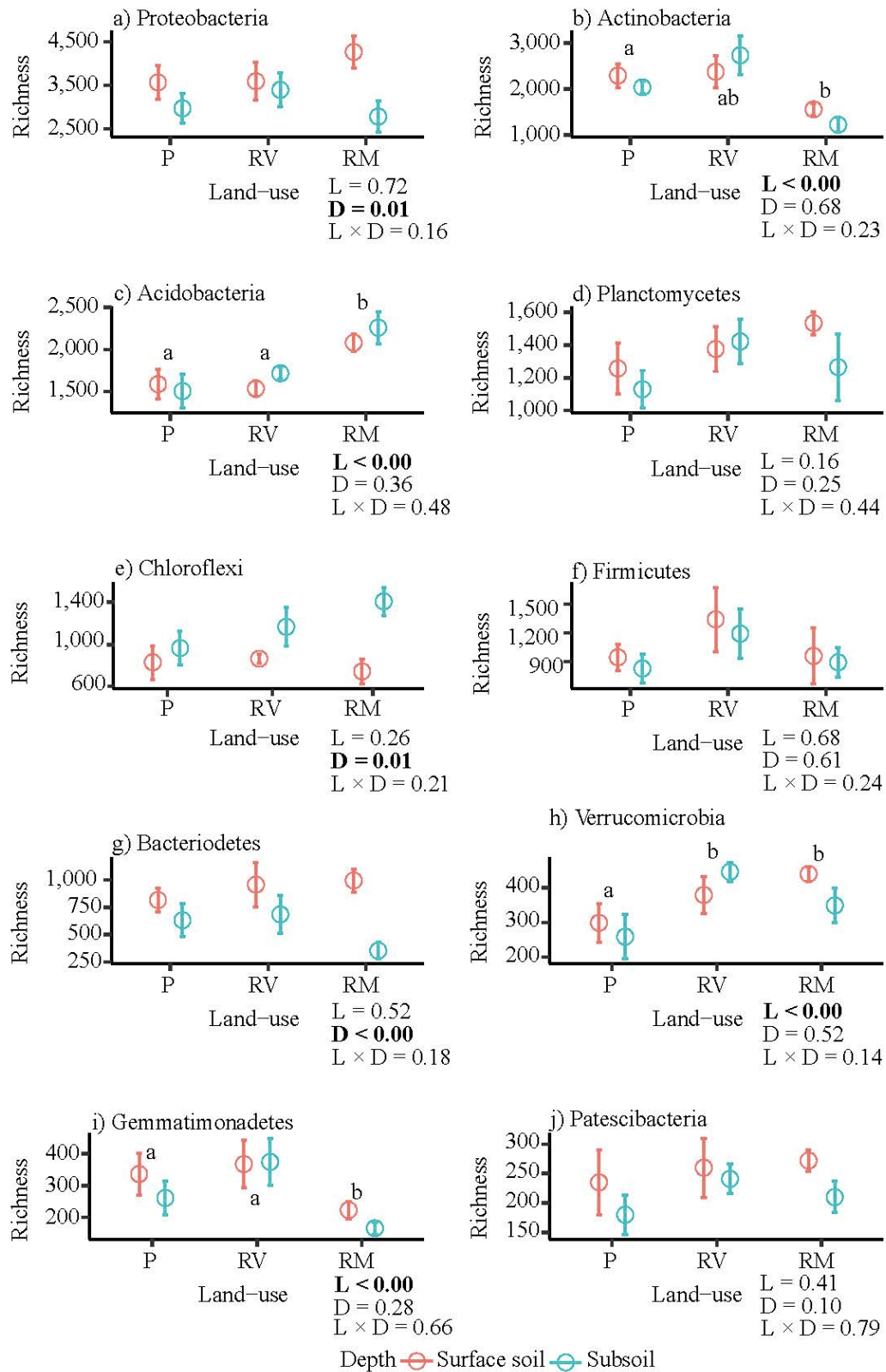
Supplementary Figure 5: Dimensions for principal components of vegetation characteristics showing the contribution of each variable to that component. Abbreviations of predictor variables are provided in Table 2.



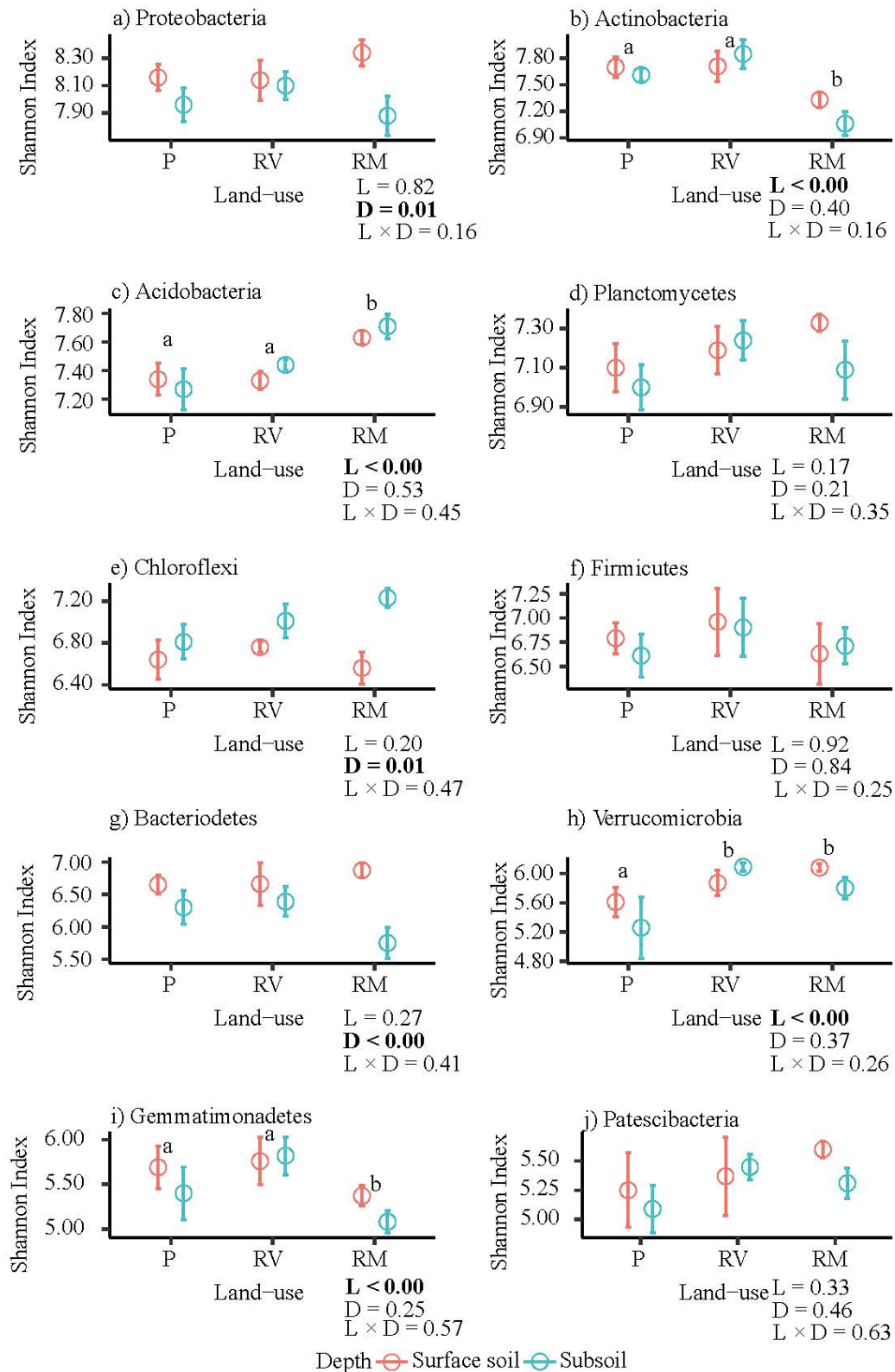
Supplementary Figure 6: Dimensions for soil physicochemical principal components showing the contribution of each variable to that component. Abbreviations for predictor variables are provided in Table 3.



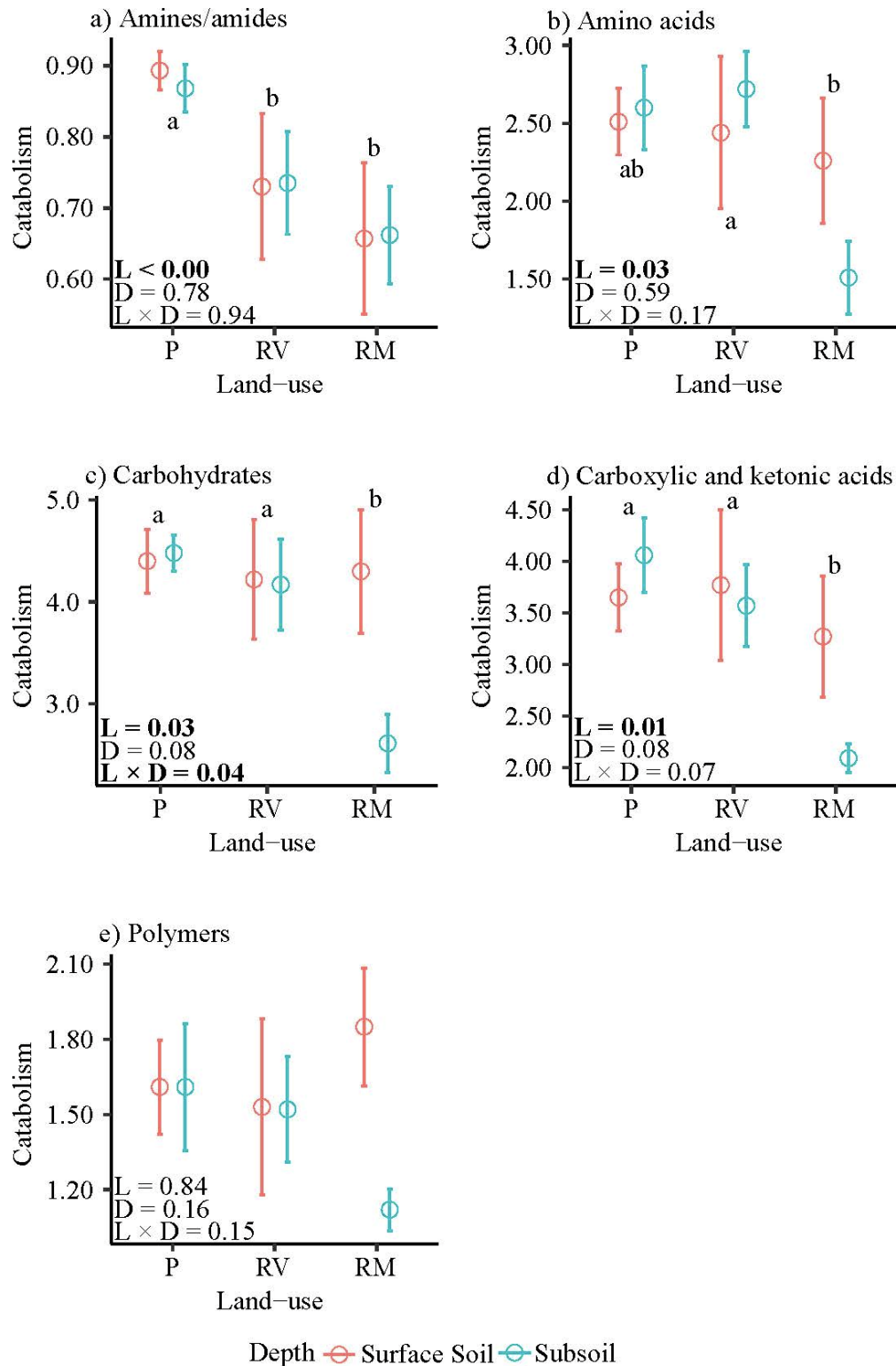
Supplementary Figure 7: Bacterial taxonomic abundance by phylum showing mean land use (P = pasture, RV = Revegetated and RM = Remnant) grouped by soil depth, error bars represent standard error of the mean, P values for GLM shown on graphs (L = Land-use, D = Depth and L x D = Interaction), bold indicates significant difference (<0.05).



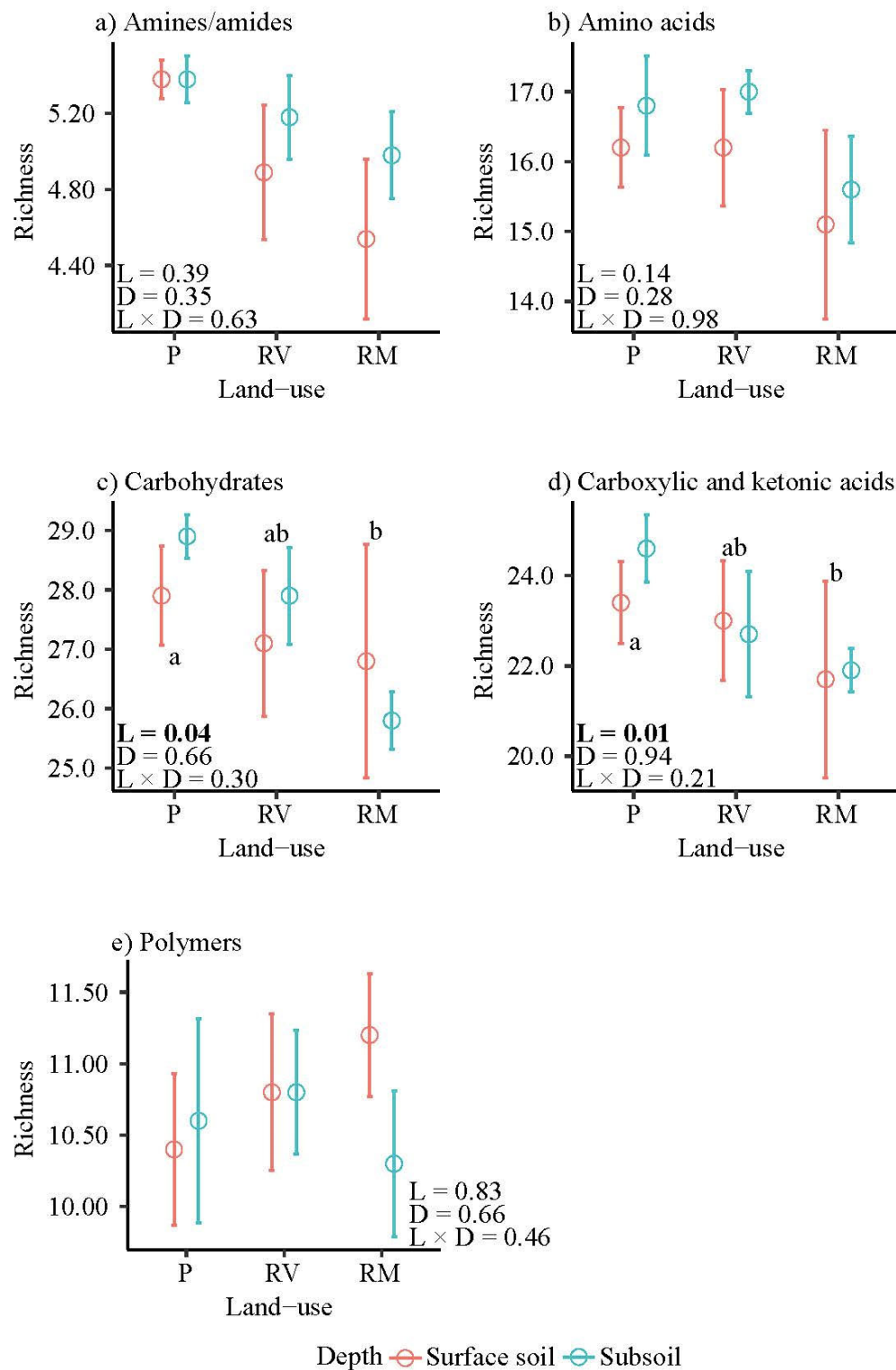
Supplementary Figure 8: Bacterial taxonomic richness by phylum showing mean land use (P = pasture, RV = Revegetated and RM = Remnant) grouped by soil depth, error bars represent standard error of the mean, P values for GLM shown on graphs (L = Land-use, D = Depth and L × D = Interaction), bold indicates significant difference (<0.05).



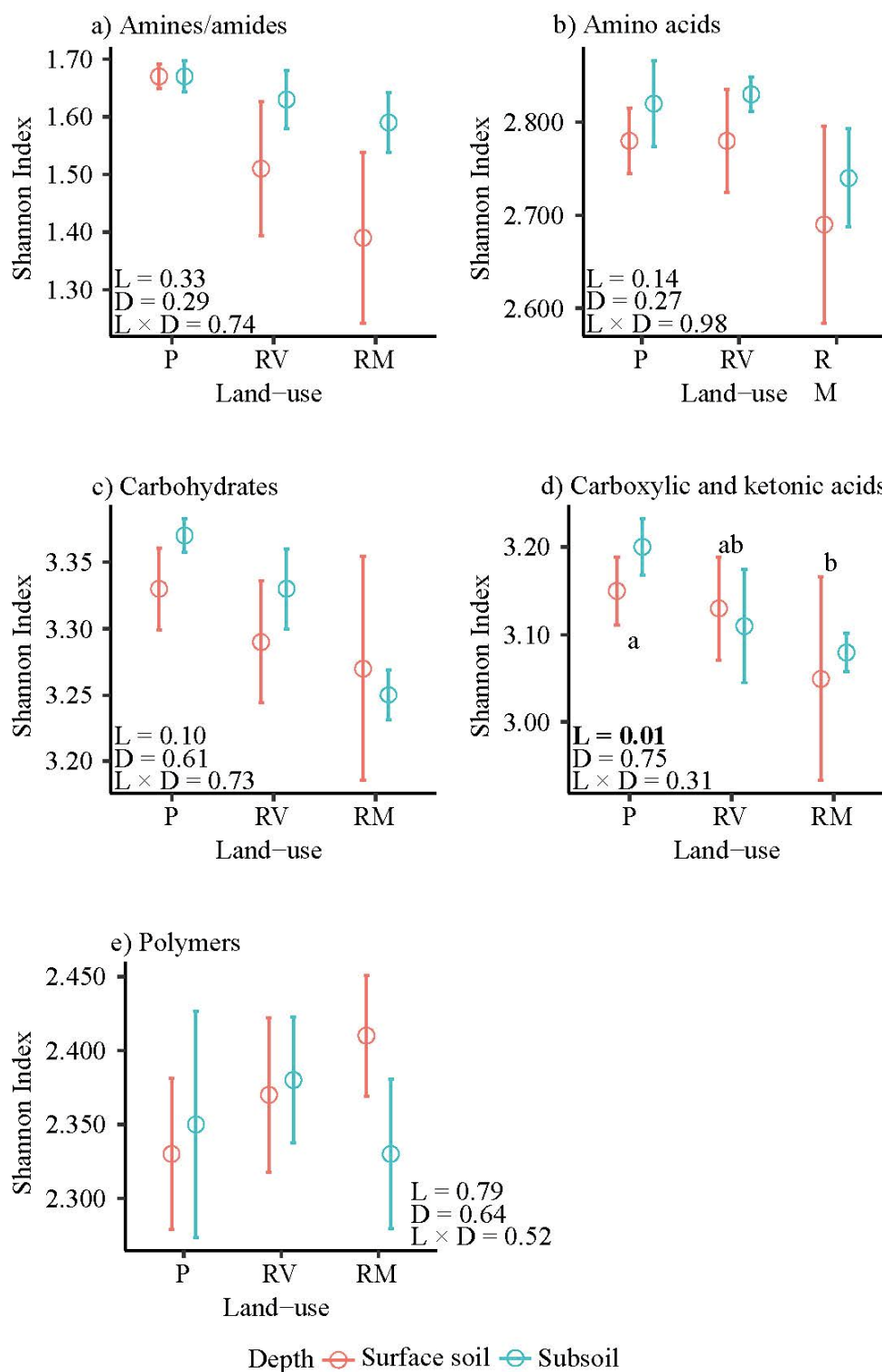
Supplementary Figure 9: Bacterial taxonomic Shannon Index by phylum showing mean land use (P = pasture, RV = Revegetated and RM = Remnant) grouped by soil depth, error bars represent standard error of the mean, P values for GLM shown on graphs (L = Land-use, D = Depth and $L \times D$ = Interaction), bold indicates significant difference (<0.05).



Supplementary Figure 10: Bacterial Functional catabolism (abundance) calculated using AWCD shown by carbon guild, points indicate mean land use (P = pasture, RV = Revegetated and RM = Remnant) grouped by soil depth, error bars represent standard error of the mean, P values for GLM shown on graphs (L = Land-use, D = Depth and L × D = Interaction), bold indicates significant difference (<0.05).



Supplementary Figure 11: Bacterial Functional richness calculated using AWCD shown by carbon guild, points indicate mean land use (P = pasture, RV = Revegetated and RM = Remnant) grouped by soil depth, error bars represent standard error of the mean, P values for GLM shown on graphs (L = Land-use, D = Depth and L × D = Interaction), bold indicates significant difference (<0.05).



Supplementary Figure 12: Bacterial Functional Shannon's Index of diversity calculated using AWCD shown by carbon guild, points indicate mean land use (P = pasture, RV = Revegetated and RM = Remnant) grouped by soil depth, error bars represent standard error of the mean, P values for GLM shown on graphs (L = Land-use, D = Depth and $L \times D$ = Interaction), bold indicates significant difference (<0.05).