Supporting information to

Land-use intensity and biodiversity effects on infiltration capacity and hydraulic conductivity of grassland soils in southern Germany

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Table S1: Transformations of variables used to obtain approximate normal distribution for the Pearson correlations, linear model and structural equation model (SEM). For the SEM, some variables additionally had to be scaled as given in the column Scaling.

y	λ	**Transformation**	**Scaling**
Infiltration capacity (ν_B)	0.00	log_e(y)	-
Unsaturated hydraulic conductivity (K_u)	0.00	log_e(y)	-
Saturated hydraulic conductivity (K^*)	0.00	log_e(y)	-
Grazing intensity	0.00	log_e(y+1)	-
Mowing intensity	1.00	((y+1)$^\lambda$-1)/λ	-
Fertilizing intensity	-1.00	((y+1)$^\lambda$-1)/λ	-
Land-use intensity	0.00	log_e(y)	-
Plant species richness	0.00	log_e(y)	-
Evenness	1.00	(y$^\lambda$-1)/λ	-
Shannon index plants	1.00	(y$^\lambda$-1)/λ	-
Number of herb species	0.00	log_e(y)	-
Number of grass species	1.00	(y$^\lambda$-1)/λ	-
Number of legume species	1.00	(y$^\lambda$-1)/λ	-
Cover of herbs	0.00	log_e(y)	-
Cover of grasses	1.00	(y$^\lambda$-1)/λ	-
Cover of legumes	0.00	log_e(y)	-
Total plant cover	1.00	(y$^\lambda$-1)/λ	-
Cover bryophytes	0.00	log_e(y+1)	-
Aboveground plant biomass	1.00	(y$^\lambda$-1)/λ	-
Clay content	2.00	(y$^\lambda$-1)/λ	z/100
Sand content	0.00	log_e(y)	-
Earthworm abundance	1.00	(y$^\lambda$-1)/λ	-
Pauropoda abundance	0.18	((y+1)$^\lambda$-1)/λ	-
Symphyla abundance	0.33	((y+1)$^\lambda$-1)/λ	-
Centipede abundance	0.33	((y+1)$^\lambda$-1)/λ	-
Stone content	0.00	log_e(y+1)	-
Bulk density	1.00	(y$^\lambda$-1)/λ	-
Microbial C	1.00	(y$^\lambda$-1)/λ	-
Fungal biomass	1.00	(y$^\lambda$-1)/λ	z/10
Invertebrates	1.00	(y$^\lambda$-1)/λ	-
Slope	0.00	log_e(y)	-
Fine root biomass	0.00	log_e(y)	-
Root decomposition	0.00	log_e(y)	-
Shannon index Myriapoda	0.00	log_e(y+1)	-
Soil pH	1.00	(y$^\lambda$-1)/λ	-
Soil depth	0.00	log_e(y)	-
Total C concentration	1.00	(y$^\lambda$-1)/λ	-
Inorganic C concentration	-0.50	(y$^\lambda$-1)/λ	-
Organic C concentration	1.00	(y$^\lambda$-1)/λ	z/100

Table S2: Pearson correlations between transformed (Table S1) infiltration capacity (ν_B) and unsaturated hydraulic conductivity (K_u) at different matrix potentials and saturated hydraulic conductivity (K^*), respectively, and biotic and abiotic ecosystem properties.

	Pearson's r								p-value							
	ν_B				K^*	K_u			ν_B				K^*	K_u		
Ψ [cm]	-0.1	-2.0	-4.0	-6.0	0.0	-0.1	-2.0	-4.0	-0.1	-2.0	-4.0	-6.0	0.0	-0.1	-2.0	-4.0
Grazing intensity	*0.25*	**0.29**	**0.36**	0.35	0.12	0.12	*0.29*	0.19	0.078	0.042	0.036	0.196	0.398	0.397	0.093	0.504
Mowing intensity	**-0.37**	**-0.34**	**-0.44**	-0.35	**-0.37**	**-0.37**	**-0.40**	-0.39	0.008	0.016	0.010	0.195	0.008	0.008	0.018	0.169
Fertilizing intensity	**-0.34**	**-0.29**	**-0.44**	-0.21	**-0.41**	**-0.41**	**-0.50**	-0.41	0.017	0.040	0.009	0.450	0.003	0.003	0.003	0.147
Land use intensity	**-0.31**	*-0.27*	-0.28	-0.09	**-0.43**	**-0.43**	**-0.38**	-0.29	0.026	0.061	0.109	0.747	0.002	0.002	0.029	0.307
Plant species richness	**0.45**	**0.41**	**0.51**	0.29	**0.56**	**0.55**	**0.52**	0.38	0.001	0.004	0.002	0.286	0.000	0.000	0.002	0.176
Evenness	0.19	0.21	*0.33*	0.06	0.21	0.21	**0.37**	0.27	0.178	0.144	0.053	0.845	0.140	0.139	0.031	0.351
Shannon index plants	**0.40**	**0.38**	**0.48**	0.18	**0.47**	**0.47**	**0.51**	0.38	0.004	0.006	0.004	0.514	0.001	0.001	0.002	0.178
Number of herb species	**0.42**	**0.38**	**0.38**	0.22	**0.49**	**0.49**	**0.37**	0.32	0.003	0.007	0.026	0.423	0.000	0.000	0.029	0.264
Number of grass species	**0.33**	**0.30**	**0.52**	0.35	**0.42**	**0.42**	**0.56**	0.43	0.018	0.035	0.002	0.196	0.002	0.003	0.001	0.127
Number of legume species	**0.41**	**0.35**	**0.51**	0.33	**0.54**	**0.54**	**0.54**	0.37	0.003	0.015	0.002	0.237	0.000	0.000	0.001	0.194
Cover of herbs	0.02	0.00	0.07	-0.21	0.05	0.05	0.05	-0.04	0.908	0.977	0.709	0.453	0.714	0.722	0.789	0.893
Cover of grasses	*-0.25*	*-0.24*	-0.25	0.27	**-0.28**	**-0.28**	-0.29	0.08	0.084	0.096	0.146	0.335	0.048	0.048	0.101	0.788
Cover of legumes	-0.02	-0.04	0.18	-0.08	0.08	0.08	*0.31*	0.04	0.874	0.807	0.299	0.779	0.563	0.570	0.077	0.879
Total plant cover	*-0.27*	*-0.26*	-0.12	-0.04	*-0.25*	*-0.25*	-0.15	-0.07	0.062	0.067	0.508	0.897	0.078	0.077	0.383	0.813
Cover bryophytes	**0.35**	**0.31**	**0.37**	0.09	**0.47**	**0.47**	**0.42**	0.15	0.013	0.030	0.032	0.749	0.001	0.001	0.014	0.601
Aboveground plant biomass	**-0.33**	**-0.30**	-0.26	-0.05	**-0.39**	**-0.39**	-0.27	-0.18	0.018	0.036	0.145	0.868	0.005	0.005	0.121	0.538
Fine root biomass	0.16	0.13	0.07	0.22	0.18	0.18	-0.01	0.33	0.280	0.361	0.677	0.441	0.206	0.208	0.954	0.255
Root decomposition	*0.25*	*0.24*	-0.12	0.06	*0.25*	*0.25*	-0.10	0.08	0.078	0.091	0.512	0.834	0.086	0.083	0.570	0.790
Shannon index Myriapoda	0.20	0.15	0.07	-0.21	**0.33**	**0.33**	0.07	-0.01	0.154	0.301	0.714	0.443	0.018	0.019	0.690	0.983
Earthworm abundance	-0.20	-0.22	**-0.52**	-0.41	-0.16	-0.16	**-0.54**	-0.16	0.164	0.135	0.001	0.125	0.272	0.266	0.001	0.584
Pauropoda abundance	**0.28**	*0.25*	**0.42**	0.18	**0.34**	**0.34**	**0.54**	0.45	0.046	0.087	0.014	0.529	0.016	0.017	0.001	0.103
Symphyla abundance	0.11	0.07	0.12	0.05	0.20	0.20	0.11	0.21	0.448	0.628	0.487	0.854	0.162	0.165	0.522	0.475
Centipede abundance	0.19	0.15	0.03	*-0.47*	*0.27*	*0.27*	-0.08	-0.33	0.190	0.294	0.859	0.075	0.061	0.063	0.637	0.246
Invertebrates	-0.20	-0.17	-0.12	0.10	**-0.29**	**-0.29**	-0.14	-0.19	0.154	0.242	0.491	0.724	0.041	0.042	0.415	0.505
Microbial biomass C	-0.12	-0.09	*-0.29*	-0.09	-0.18	-0.18	*-0.31*	-0.17	0.403	0.518	0.096	0.763	0.204	0.205	0.076	0.566
Fungal biomass	0.07	0.05	0.21	-0.10	0.15	0.15	0.26	-0.10	0.637	0.755	0.242	0.722	0.289	0.293	0.138	0.741
Slope	0.11	0.12	0.17	0.11	0.12	0.12	0.10	0.14	0.444	0.424	0.345	0.702	0.400	0.401	0.580	0.624
Soil depth	*-0.27*	**-0.29**	-0.17	-0.37	-0.18	-0.18	-0.05	-0.15	0.055	0.041	0.323	0.170	0.219	0.216	0.771	0.612
Stone content	0.14	0.14	0.08	-0.35	0.23	0.22	0.11	-0.18	0.328	0.348	0.648	0.196	0.116	0.116	0.523	0.528
Bulk density	-0.13	-0.11	-0.07	-0.03	-0.16	-0.16	-0.06	0.06	0.363	0.459	0.679	0.922	0.267	0.270	0.744	0.846
Clay content	0.01	0.00	0.17	0.39	-0.02	-0.02	0.05	0.32	0.934	0.976	0.346	0.145	0.870	0.866	0.789	0.258
Sand content	-0.05	-0.03	-0.22	-0.39	-0.03	-0.03	-0.08	-0.25	0.722	0.843	0.208	0.151	0.814	0.821	0.668	0.382
Soil pH	0.10	0.09	-0.08	-0.25	0.19	0.19	0.02	0.01	0.499	0.528	0.651	0.373	0.192	0.192	0.913	0.967
Total C concentration	0.21	0.21	-0.11	0.01	0.17	0.17	-0.11	-0.03	0.153	0.140	0.553	0.968	0.247	0.245	0.544	0.910
Inorganic C concentration	0.06	0.06	-0.25	-0.38	0.12	0.12	-0.13	-0.21	0.703	0.696	0.146	0.164	0.390	0.388	0.453	0.481
Organic C concentration	0.13	0.13	-0.06	0.07	0.07	0.07	-0.13	-0.13	0.374	0.369	0.736	0.815	0.648	0.649	0.480	0.653

Table S3: Correlation table between the transformed (Table S1) response variables infiltration capacity (ν_B) and unsaturated hydraulic conductivity (K_u) at different matrix potentials and saturated hydraulic conductivity (K^*), respectively.

		K^*	K_u			ν_B			
	Ψ [cm]	0.0	-0.1	-2.0	-4.0	-0.1	-2.0	-4.0	-6.0
K^*	0.0	1.00	1.00	0.88	0.81	0.92	0.87	0.78	0.32
	-0.1	1.00	1.00	0.88	0.82	0.92	0.88	0.78	0.32
K_u	-2.0	0.88	0.88	1.00	0.97	0.92	0.90	0.94	0.68
	-4.0	0.81	0.82	0.97	1.00	0.92	0.90	0.87	0.80
	-0.1	0.92	0.92	0.92	0.92	1.00	0.99	0.98	0.94
ν_B	-2.0	0.87	0.88	0.90	0.90	0.99	1.00	1.00	0.97
	-4.0	0.78	0.78	0.94	0.87	0.98	1.00	1.00	0.99
	-6.0	0.32	0.32	0.68	0.80	0.94	0.97	0.99	1.00

Table S4: Unstandardized path coefficients of the structural equation model (SEM) of the land-use intensity (LUI) effect via selected variables on saturated hydraulic conductivity (K^*).

Path			**Coefficient**	**SE**	**z-value**	**p-value**
Plant species richness	←	LUI	-0.52	0.06	-8.76	<0.001
Plant species richness	←	Slope	0.03	0.04	0.75	0.456
Plant species richness	←	Soil depth	-0.06	0.05	-1.12	0.264
Plant species richness	←	Clay content	0.00	0.01	0.35	0.728
Plant species richness	←	Sand content	-0.09	0.06	-1.63	0.103
Plant species richness	←	Soil pH	0.21	0.10	2.16	0.031
Plant species richness	←	Inorganic C concentration	-0.10	0.07	-1.54	0.125
Plant species richness	←	Stone content	0.03	0.04	0.65	0.515
Fungal biomass	←	LUI	-0.36	0.16	-2.34	0.019
Fungal biomass	←	Slope	0.14	0.11	1.24	0.217
Fungal biomass	←	Soil depth	-0.11	0.12	-0.95	0.343
Fungal biomass	←	Clay content	0.01	0.01	1.07	0.284
Fungal biomass	←	Sand content	-0.17	0.09	-1.87	0.062
Fungal biomass	←	Soil pH	0.48	0.18	2.63	0.008
Fungal biomass	←	Inorganic C concentration	-0.09	0.11	-0.76	0.445
Fungal biomass	←	Stone content	-0.06	0.11	-0.50	0.618
Shannon index myriapoda	←	LUI	-0.11	0.13	-0.86	0.389
Shannon index myriapoda	←	Slope	0.03	0.08	0.31	0.760
Shannon index myriapoda	←	Soil depth	0.07	0.08	0.87	0.383
Shannon index myriapoda	←	Clay content	0.00	0.01	-0.46	0.649
Shannon index myriapoda	←	Sand content	-0.04	0.07	-0.57	0.571
Shannon index myriapoda	←	Soil pH	-0.08	0.17	-0.45	0.652
Shannon index myriapoda	←	Inorganic C concentration	-0.09	0.10	-0.86	0.390
Shannon index myriapoda	←	Stone content	0.17	0.07	2.43	0.015
Root decomposition	←	LUI	0.10	0.15	0.66	0.511
Root decomposition	←	Slope	0.05	0.09	0.52	0.604
Root decomposition	←	Soil depth	-0.17	0.11	-1.59	0.112
Root decomposition	←	Clay content	-0.02	0.01	-1.30	0.193
Root decomposition	←	Sand content	0.01	0.08	0.18	0.861
Root decomposition	←	Soil pH	0.35	0.23	1.53	0.127
Root decomposition	←	Inorganic C concentration	-0.14	0.14	-1.01	0.313
Root decomposition	←	Stone content	-0.12	0.07	-1.64	0.102
Plant species richness	↔	Fungal biomass	0.029	0.01	2.788	0.005
K^*	←	LUI	-0.51	0.48	-1.06	0.287
K^*	←	Plant species richness	2.74	0.72	3.80	<0.001
K^*	←	Fungal biomass	-0.71	0.47	-1.52	0.129
K^*	←	Shannon index myriapoda	1.00	0.47	2.12	0.034
K^*	←	Root decomposition	0.68	0.35	1.93	0.053

Table S5: Unstandardized path coefficients of the structural equation model (SEM) of the land-use intensity (LUI) effect via selected variables on infiltration capacity (ν_B) at matrix potential Ψ = -0.1 cm.

Path			**Coefficient**	**SE**	**z-value**	**p-value**
Plant species richness	←	LUI	-0.52	0.06	-8.76	<0.001
Plant species richness	←	Slope	0.03	0.04	0.75	0.456
Plant species richness	←	Soil depth	-0.06	0.05	-1.12	0.264
Plant species richness	←	Clay content	0.00	0.01	0.35	0.728
Plant species richness	←	Sand content	-0.09	0.06	-1.63	0.103
Plant species richness	←	Soil pH	0.21	0.10	2.16	0.031
Plant species richness	←	Inorganic C concentration	-0.10	0.07	-1.54	0.125
Plant species richness	←	Stone content	0.03	0.04	0.65	0.515
Fungal biomass	←	LUI	-0.36	0.16	-2.34	0.019
Fungal biomass	←	Slope	0.14	0.11	1.24	0.217
Fungal biomass	←	Soil depth	-0.11	0.12	-0.95	0.343
Fungal biomass	←	Clay content	0.01	0.01	1.07	0.284
Fungal biomass	←	Sand content	-0.17	0.09	-1.87	0.062
Fungal biomass	←	Soil pH	0.48	0.18	2.63	0.008
Fungal biomass	←	Inorganic C concentration	-0.09	0.11	-0.76	0.445
Fungal biomass	←	Stone content	-0.06	0.11	-0.50	0.618
Soil organic C concentration	←	LUI	0.40	0.60	0.66	0.510
Soil organic C concentration	←	Slope	-0.14	0.40	-0.36	0.716
Soil organic C concentration	←	Soil depth	-0.82	0.36	-2.26	0.024
Soil organic C concentration	←	Clay content	0.07	0.04	1.83	0.068
Soil organic C concentration	←	Sand content	-0.08	0.33	-0.23	0.820
Soil organic C concentration	←	Soil pH	0.52	0.72	0.72	0.473
Soil organic C concentration	←	Inorganic C concentration	0.31	0.44	0.69	0.488
Soil organic C concentration	←	Stone content	-0.16	0.29	-0.54	0.587
Root decomposition	←	LUI	0.10	0.15	0.66	0.511
Root decomposition	←	Slope	0.05	0.09	0.52	0.604
Root decomposition	←	Soil depth	-0.17	0.11	-1.59	0.112
Root decomposition	←	Clay content	-0.02	0.01	-1.30	0.193
Root decomposition	←	Sand content	0.01	0.08	0.18	0.861
Root decomposition	←	Soil pH	0.35	0.23	1.53	0.127
Root decomposition	←	Inorganic C concentration	-0.14	0.14	-1.01	0.313
Root decomposition	←	Stone content	-0.12	0.07	-1.64	0.102
Plant species richness	↔	Fungal biomass	0.03	0.01	2.79	0.005
ν_B (Ψ = -0.1 cm)	←	LUI	-0.23	0.56	-0.42	0.677
ν_B (Ψ = -0.1 cm)	←	Plant species richness	2.86	0.80	3.56	<0.001
ν_B (Ψ = -0.1 cm)	←	Fungal biomass	-0.96	0.45	-2.14	0.032
ν_B (Ψ = -0.1 cm)	←	Soil organic C concentration	0.23	0.10	2.23	0.026
ν_B (Ψ = -0.1 cm)	←	Root decomposition	0.82	0.42	1.94	0.052

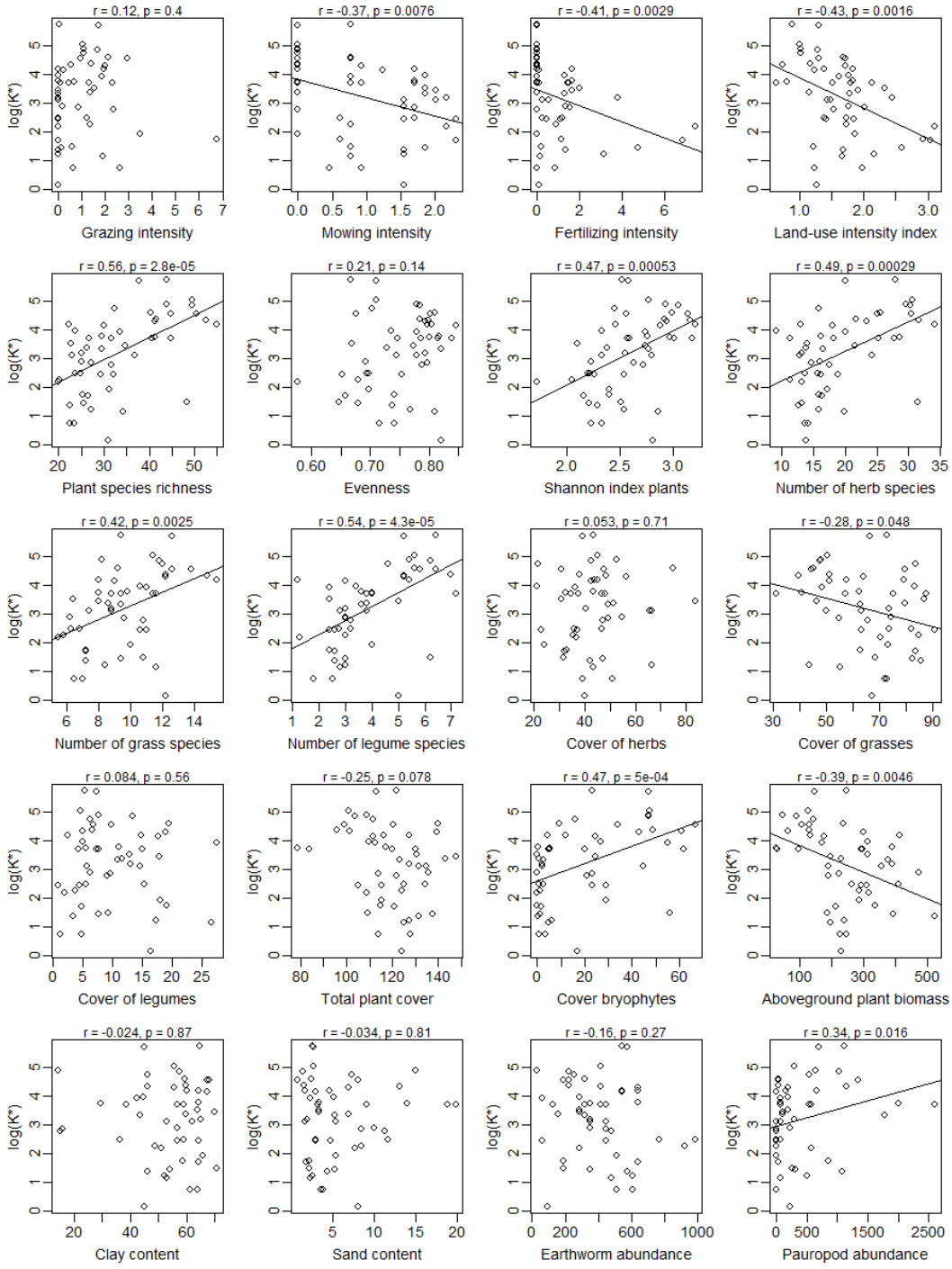

Figure S1: Part 1: Relationship between the saturated hydraulic conductivity (log_e-transformed K^* in 10^{-6} m s^{-1}) and all potential explanatory variables (see Table 1 in main manuscript). The values given for r and p represent the results of a Pearson correlation for continuous variables that were transformed according to Table S1 to obtain approximate normal distribution. Regression lines are shown for illustration purpose only.

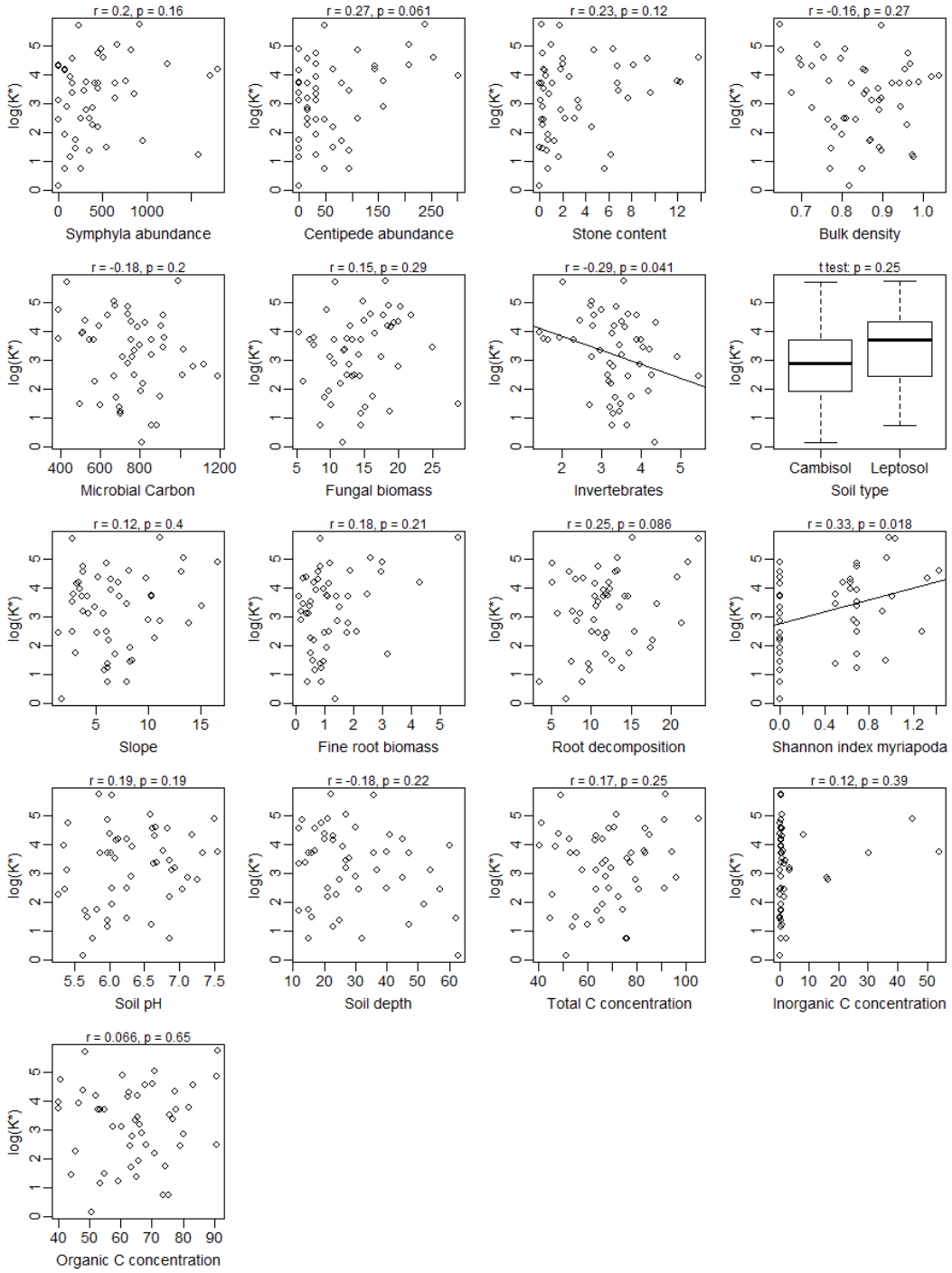

Figure S1: Part 2: Relationship between the saturated hydraulic conductivity (log_e-transformed K^* in 10^{-6} m s^{-1}) and all potential explanatory variables (see Table 1 in main manuscript). The values given for r and p represent the results of a Pearson correlation for continuous variables that were transformed according to Table S1 to obtain approximate normal distribution. Regression lines are shown for illustration purpose only.

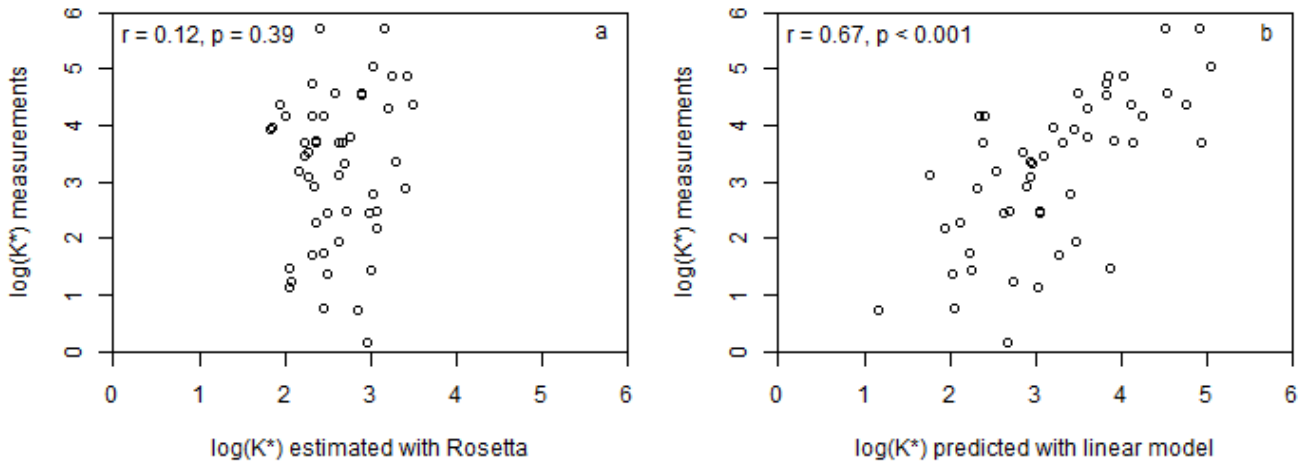

Figure S2: Comparison of the saturated hydraulic conductivity (log_e-transformed K^* in 10^{-6} m s^{-1}) calculated from infiltration measurements with (a) K^* estimated with Rosetta, using clay, silt, and sand content and bulk density as input data and with (b) K^* predicted from a linear model with the explanatory variables plant species richness, Shannon index Myriapoda, fungal biomass, and root decomposition ($log_e(K^*)$ = -8.58 + 3.16 x log_e(plant species richness) + 1.00 x log_e(Shannon index Myriapoda +1) - 0.08 x fungal biomass + 0.67 x log_e(root decomposition)). The values given for r and p represent the results of a Pearson correlation of the log-transformed data.