Supplementary Information to the manuscript ""**Homogenisation and loss of specialisation in terrestrial isopods along an urban gradient: the role of local and landscape factors**" by P. Gardini, P. De Smedt, S., P. Audisio and S. Sabatelli

Table S1 Details of the sampling plots and sites in Rome (Italy) considered in this study

Plot	Site	Urbanisation Category	Lat	Long	Altitude (m a.s.l.)	Distance from city center (km)
ADA_1	Villa Ada	UI1	41.92812	12.50097	49	3.088
ADA_2	Villa Ada	UI1	41.93102	12.49824	49	3.157
ADA_3	Villa Ada	UI1	41.93331	12.50131	51	3.124
ALB_1	Albano Laziale	Natural	41.734104	12.669968	465	24.130
ALB_2	Albano Laziale	Natural	41.734244	12.685163	465	24.927
ALB_3	Albano Laziale	Natural	41.74049	12.69069	516	24.716
ANAT_1	Anatomia Comparata	UI3	41.90693	12.51559	44	2.266
ANAT_2	Anatomia Comparata	UI3	41.90669	12.51525	44	2.237
ANAT_3	Anatomia Comparata	UI3	41.90606	12.51554	44	2.251
APP_1	Appia Antica	UI2	41.842014	12.533249	66	7.793
APP_2	Appia Antica	UI2	41.844058	12.533029	66	7.591
APP_3	Appia Antica	UI2	41.841999	12.53778	66	7.983
BORG_1	Villa Borghese	UI3	41.912849	12.492547	59	1.062
BORG_2	Villa Borghese	UI2	41.91476	12.4898	52	1.108
BORG_3	Villa Borghese	UI2	41.91248	12.48782	57	1.010
CEL_1	Villa Celimontana	UI2	41.88571	12.493274	44	2.040
CEL_2	Villa Celimontana	UI2	41.884529	12.494235	43	2.183
CEL_3	Villa Celimontana	UI2	41.88323	12.495712	40	2.352
CERV_1	Cervelletta	UI1	41.913082	12.584538	25	8.029
CERV_2	Cervelletta	UI2	41.912633	12.586501	26	8.185
CERV_3	Cervelletta	UI2	41.914685	12.585121	22	8.099
FIOR_1	Villa Fiorelli	UI3	41.88504	12.52307	43	3.535
FIOR_2	Villa Fiorelli	UI3	41.88441	12.52308	43	3.579
FIOR_3	Villa Fiorelli	UI3	41.88476	12.52371	43	3.597
INS_1	Insugherata	UI1	41.959279	12.433861	61	7.660
INS_2	Insugherata	UI1	41.959601	12.432508	60	7.755
INS_3	Insugherata	UI1	41.95989	12.431047	61	7.854
LAIS_1	Villa Lais	UI3	41.87577	12.53225	52	4.772
LAIS_2	Villa Lais	UI3	41.87622	12.53105	52	4.664
LAIS_3	Villa Lais	UI3	41.87692	12.53259	52	4.712
MARL_1	Marino Laziale	Natural	41.766687	12.657154	349	20.685
MARL_2	Marino Laziale	Natural	41.766256	12.655518	355	20.626
MARL_3	Marino Laziale	Natural	41.765046	12.651948	343	20.529
MMAR_1	Monte Mario	UI1	41.935012	12.448934	119	4.788
MMAR_2	Monte Mario	UI1	41.936388	12.449622	90	4.854
MMAR_3	Monte Mario	UI1	41.933759	12.449077	105	4.675
NEM_1	Nemi	Natural	41.699291	12.717635	504	29.630
NEM_2	Nemi	Natural	41.7069	12.722809	561	29.265
NEM_3	Nemi	Natural	41.709112	12.72031	595	28.955
PAM_1	Villa Pamphili	UI1	41.885956	12.445748	63	4.067
PAM_2	Villa Pamphili	UI1	41.888336	12.451752	79	3.502
PAM_3	Villa Pamphili	UI1	41.887943	12.454359	81	3.337
SNIA_1	Lago Bullicante - Ex SNIA	UI3	41.89541	12.54118	26	4.462
SNIA_2	Lago Bullicante - Ex SNIA	UI2	41.8957	12.54011	26	4.365
SNIA_3	Lago Bullicante - Ex SNIA	UI2	41.89453	12.53989	26	4.377

TORL_1	Villa Torlonia	UI3	41.911816	12.512038	40	2.143
TORL_2	Villa Torlonia	UI3	41.914475	12.510053	51	2.145
TORL_3	Villa Torlonia	UI2	41.913637	12.513676	50	2.355

Fig. S1 Photographs of a subset of the sampling sites. **A**) Albano Laziale, a natural site; **B**) Insugherata Nature Reserve, a large peri-urban seminatural area; **C**) Villa Ada and **D**) Villa Doria Pamphili, two large historical and forested urban parks, located in suburban areas; **E**) Villa Borghese, a large historical urban park located in a central area; **F**) Villa Celimontana, a medium-sized historical urban park located in a central area; **G**) Villa Lais and **H**) Villa Fiorelli, two small urban parks; **I**) Garden of the Institute of Comparative Anatomy, Sapienza University of Rome, a small green space. Further details on the sampling sites are provided in Table S1

Table S2 Functional trait values assigned to each species. Trait definitions are provided in Table 1 of the main text. Species are listed in alphabetical order, and references are reported below the table

	Size (mm^3)	Drought tolerance	Disturbance tolerance	Dispersal ability	Habitat affinity	Reference
Acaeroplastes melanurus	33.51	4	2	4	1	Vandel, 1962; Taiti & Ferrara, 1989; expert opinion.
Acaeroplastes delattini	11.78	4	1	3	1	Expert opinion.
Agabiformius lentus	14.14	4	3	3	1	Vandel, 1962; Taiti & Ferrara, 1989; Taiti & Argano, 2011.
Androniscus dentiger	25.66	1	3	3	2	Vandel, 1960; Taiti & Ferrara, 1989; Boeraeve et al., 2021.
Armadillidium arcangelii	28.86	4	3	4	1	Noël et al., 2022; De Smedt & Van Dijck, 2023; expert opinion.
Armadillidium cf. etruriae	301.59	4	2	5	3	Taiti & Ferrara, 1989; expert opinion.
Armadillidium depressum	402.91	4	3	5	2	Vandel, 1962; Taiti & Ferrara, 1989; expert opinion.
Armadillidium nasatum	424.12	4	3	5	1	Vandel, 1962; Taiti & Ferrara, 1989; Boeraeve et al., 2021.

Armadillidium vallombrosae	445.32	4	1	5	3	Taiti & Ferrara, 1989; expert opinion.
Armadillidium vulgare	335.10	4	3	5	2	Vandel, 1962; Taiti & Ferrara, 1989; Boeraeve et al., 2021.
Chaetophiloscia cellaria	20.03	2	2	4	3	Vandel, 1962; Taiti & Ferrara, 1989; Gregory & Marquis, 2019; expert opinion.
Chaetophiloscia elongata	32.07	2	3	4	1	Vandel, 1962; Taiti & Ferrara, 1989; Taiti & Argano, 2011; expert opinion.
Chaetophiloscia hastata	46.08	2	2	4	1	Shavadze et al., 2023; expert opinion.
Chaetophiloscia sicula	16.49	2	3	4	1	Vandel, 1962; Taiti & Ferrara, 1989; Szlavecz et al., 2025.
Cylisticus gracilipennis	68.92	3	1	5	3	Taiti & Ferrara, 1989; Expert opinion.
Haplophthalmus abbreviatus	2.53	1	1	1	3	Expert opinion.
Haplophthalmus danicus	2.16	1	3	1	2	Vandel, 1960; Taiti & Ferrara, 1989; Boeraeve et al., 2021.
Haplophthalmus mengii	2.05	1	2	1	3	Vandel, 1960; Taiti & Ferrara, 1989; Boeraeve et al., 2021.
Haplophthalmus monticellii	3.82	1	1	1	3	Vandel, 1960; expert opinion.
Leptotrichus panzerii	41.89	4	2	3	1	Vandel, 1962; expert opinion.
Lucasius pallidus	16.49	4	2	3	2	Vandel, 1962; expert opinion.
Orthometopon dalmatinum	131.95	3	3	6	2	Schmalfuss, 1993; expert opinion.
Philoscia affinis	71.99	2	2	6	3	Vandel, 1962; Boeraeve et al., 2021.
Philoscia muscorum	84.95	2	3	6	2	Vandel, 1962; Boeraeve et al., 2021.
Platyarthrus briani	1.77	2	1	2	1	Expert opinion.
Platyarthrus codinai	4.71	2	2	2	1	Vandel, 1962; expert opinion.
Platyarthrus costulatus	2.06	2	2	2	1	Vandel, 1962; Taiti & Ferrara, 1989; expert opinion.
Platyarthrus hoffmannseggii	8.18	2	3	2	1	Vandel, 1962; Taiti & Ferrara, 1989; Boeraeve et al., 2021.
Platyarthrus schoblii	3.39	2	2	2	1	Vandel, 1962; Taiti & Ferrara, 1989; expert opinion.
Porcellio dilatatus	634.99	4	3	6	2	Vandel, 1962; Taiti & Ferrara, 1989; Boeraeve et al., 2021.
Porcellio laevis	472.55	4	3	6	2	Vandel, 1962; Taiti & Ferrara, 1989; Boeraeve et al., 2021.
Porcellio obsoletus	538.01	4	2	6	1	Schmalfuss, 1992; expert opinion.
Porcellio pumicatus	321.56	4	1	6	3	Taiti & Ferrara, 1989; expert opinion.
Porcellionides myrmecophilus	79.19	4	2	6	1	Vandel, 1962; Taiti & Ferrara, 1989; expert opinion.
Porcellionides pruinosus	88.49	4	3	6	2	Vandel, 1962; Boeraeve et al., 2021.
Porcellionides sexfasciatus	60.97	4	2	6	1	Vandel, 1962; Taiti & Ferrara, 1989; expert opinion.
Sardoniscus verhoeffi	16.49	2	2	4	3	Taiti & Ferrara, 1989; Taiti & Argano, 2011; expert opinion.
Trachelipus arcuatus	381.70	3	2	6	3	Taiti & Ferrara, 1989; expert opinion.
Trichoniscus provisorius	3.39	1	2	2	3	Vandel, 1960; Taiti & Ferrara, 1989; Boeraeve et al., 2021.
Trichoniscus pygmaeus	1.47	1	3	1	2	Vandel, 1960; Taiti & Ferrara, 1989; Boeraeve et al., 2021.
Trichoniscus matulici	4.71	1	1	2	3	Expert opinion.

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Table S3 List of terrestrial isopod families collected in 48 plots within and outside the city of Rome (Italy). For each family, the total number of collected genera and species is reported, along with relative abundance and frequency across sampling plots

	N. of genera	N. of species	Relative abundance %	Frequency %
Agnaridae Schmidt, 2003	1	1	4.44	42.71
Armadillidiidae Brandt, 1833	1	6	13.76	83.33
Cylisticidae Verhoeff, 1949	1	1	1.93	27.08
Oniscidae Latreille, 1802	1	1	3.86	33.33
Philosciidae Kinahan, 1857	2	6	25.66	89.58
Platyarthridae Verhoeff, 1949	1	5	1.61	20.83
Porcellionidae Brandt, 1831	6	12	26.48	97.92
Trachelipodidae Strouhal, 1953	1	1	5.85	34.38
Trichoniscidae G. O. Sars, 1899	3	8	16.42	59.38

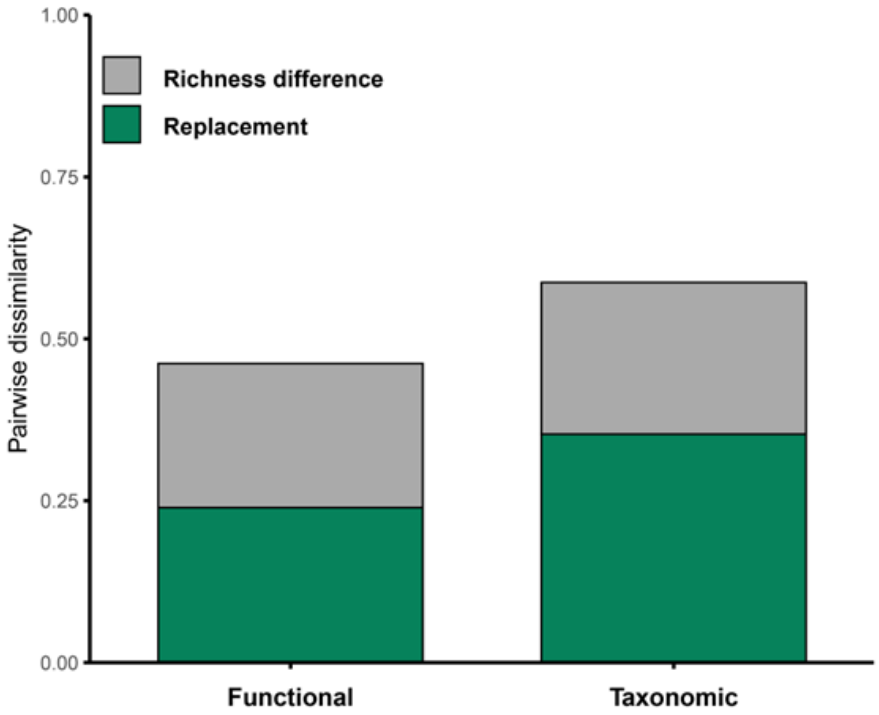

Fig. S2. Bar plot showing the contribution of *richness difference* (grey) and *replacement* (dark green) to total taxonomic and functional β-diversity

Table S4 Summary table reporting mean ± SD values of total global functional and taxonomic β-diversity

Global β-diversity			
Diversity	**Type**	**mean**	**SD**
Functional	Richness difference	0.223	0.153
Functional	Replacement	0.239	0.171
Functional	Total	0.462	0.186
Taxonomic	Richness difference	0.234	0.166
Taxonomic	Replacement	0.353	0.203
Taxonomic	Total	0.587	0.201

Table S5 Summary table reporting mean ± SD values of functional and taxonomic β-diversity across the three urbanisation categories

β-diversity by UI category				
Diversity	**Type**	**Group**	**mean**	**sd**
Functional	Richness difference	UI1	0.077	0.065
Functional	Richness difference	UI2	0.170	0.119
Functional	Richness difference	UI3	0.152	0.125
Functional	Replacement	UI1	0.350	0.167
Functional	Replacement	UI2	0.219	0.134
Functional	Replacement	UI3	0.127	0.151
Functional	Total	UI1	0.427	0.161
Functional	Total	UI2	0.390	0.125
Functional	Total	UI3	0.279	0.160
Taxonomic	Richness difference	UI1	0.095	0.081
Taxonomic	Richness difference	UI2	0.194	0.136
Taxonomic	Richness difference	UI3	0.188	0.146
Taxonomic	Replacement	UI1	0.438	0.190
Taxonomic	Replacement	UI2	0.343	0.178
Taxonomic	Replacement	UI3	0.191	0.185
Taxonomic	Total	UI1	0.533	0.181
Taxonomic	Total	UI2	0.536	0.163
Taxonomic	Total	UI3	0.380	0.189

Table S6 Results of linear mixed-effects models for taxonomic and functional β-diversity components across the three urbanisation categories. Significant p-values are shown in bold

Full model		**Pairwise comparison**			
		Contrast	**Estimate ± SE**	**t-ratio**	***P*-value**
Taxonomic – Total	$F_{2,75}$ = 6.35; *P*-value = **0.002**	UI1-UI2	-0.048 ± 0.045	-1.081	0.528
		UI1-UI3	0.108 ± 0.045	2.4	**0.047**
		UI2-UI3	0.156 ± 0.045	3.481	**0.002**
Taxonomic – Replacement	$F_{2,75}$ = 7.60; *P*-value = **<0.001**	UI1-UI2	0.038 ± 0.046	0.849	0.679
		UI1-UI3	0.169 ± 0.046	3.715	**<0.001**
		UI2-UI3	0.131 ± 0.046	2.876	**0.013**
Taxonomic – Richness difference	$F_{2,75}$ = 3.84; *P*-value = **0.024**	UI1-UI2	-0.086 ± 0.032	-2.703	**0.021**
		UI1-UI3	-0.059 ± 0.032	-1.872	0.151
		UI2-UI3	0.026 ± 0.032	0.831	0.684
Functional – Total	$F_{2,75}$ = 6.40; *P*-value = **0.002**	UI1-UI2	0.008 ± 0.036	0.231	0.971
		UI1-UI3	0.114 ± 0.036	3.204	**0.005**
		UI2-UI3	0.106 ± 0.036	2.973	**0.01**
Functional – Replacement	$F_{2,75}$ = 7.02; *P*-value = **0.001**	UI1-UI2	0.089 ± 0.038	2.337	**0.05**
		UI1-UI3	0.141 ± 0.038	3.702	**<0.001**
		UI2-UI3	0.052 ± 0.038	1.365	0.362
Functional – Richness difference	$F_{2,75}$ = 4.84; *P*-value = **0.009**	UI1-UI2	-0.083± 0.027	-3.038	**0.008**
		UI1-UI3	-0.025 ± 0.027	-0.942	0.615
		UI2-UI3	0.057 ± 0.027	2.096	0.095

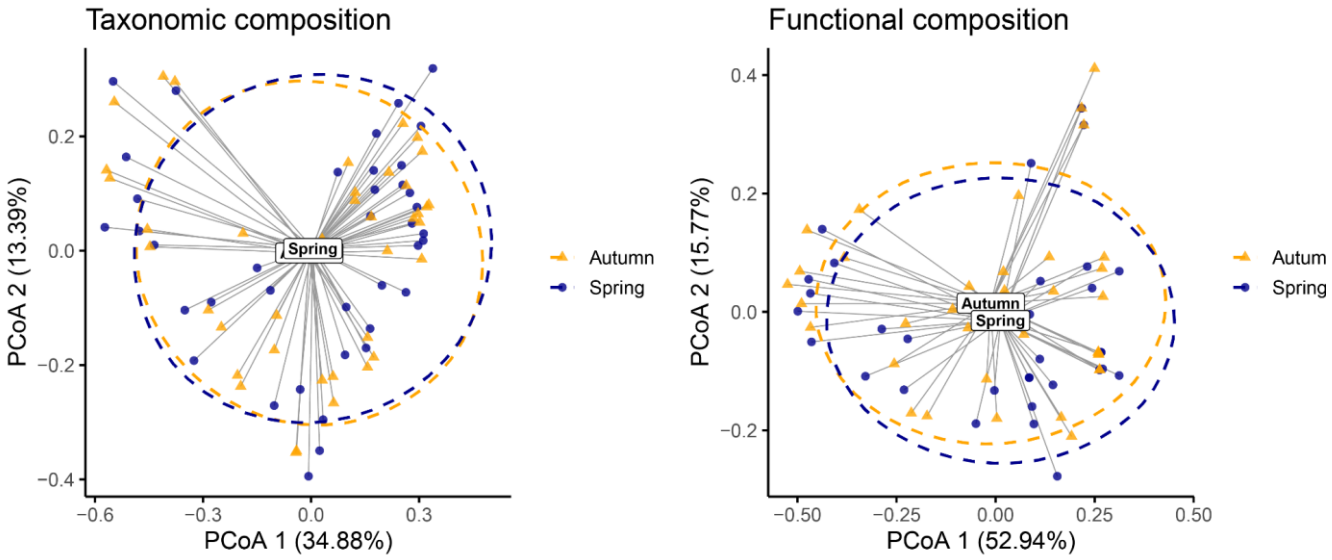

Fig. S3. Ordination of terrestrial isopod communities along the first two PCoA axes based on (A) taxonomic and (B) functional β-diversity for the two seasons. Different symbols and colors represent the seasons: blue circles = Spring, yellow triangles = Autumn.

Table S7 Results of the test for homogeneity of multivariate dispersion in terrestrial isopod taxonomic and functional β-diversity between seasons and urbanisation categories. Significant p-values are highlighted in bold

Variable	Composition		df	Sum of sq.	Mean of sq.	F	*p*-value
SEASON	Taxonomic	Groups	1	0.0002	0.0002	0.023	0.886
		Residuals	76	0.693	0.009		
	Functional	Groups	1	0.0002	0.008	0.015	0.902
		Residuals	76	1.063	0.014		
URBANISATION	Taxonomic	Groups	2	0.113	0.057	5.841	**0.005**
		Residuals	75	0.729	0.01		
	Functional	Groups	2	0.066	0.0332	2.490	0.089
		Residuals	75	1.001	0.013		

Table S8 Results of pairwise comparisons from the test for homogeneity of multivariate dispersion in terrestrial isopod taxonomic and functional β-diversity among the three urbanisation categories. Significant p-values are highlighted in bold

Composition	Group	n	Mean Distance	SD	Pairwise comparisons (permuted *p*-values)
Taxonomic	UI1	26	0.422	0.085	UI1– UI2: 0.663
	UI2	26	0.433	0.088	UI1– UI3: **0.011**
	UI3	26	0.347	0.119	UI2– UI3: **0.006**
Functional	UI1	26	0.336	0.095	UI1– UI2: 0.199
	UI2	26	0.303	0.090	UI1– UI3: **0.047**
	UI3	26	0.265	0.151	UI2– UI3: 0.281

Table S9 PERMANOVA results for terrestrial isopod taxonomic and functional β-diversity across seasons and urbanisation categories, accounting for spatial autocorrelation using Moran's eigenvector maps (MEMs). Significant p-values are highlighted in bold

Variable	Composition type		df	Sum of sq.	R^2	F	*p*-value
SEASON	Taxonomic	Season	1	0.125	0.007	0.72	0.639
		MEM1	1	3.497	0.193	20.02	**<0.001**
		MEM2	1	0.602	0.033	3.45	**0.006**
		MEM3	1	1.153	0.064	6.60	**<0.001**
		Residuals	73	12.754	0.703		
		Total	77	18.131	1.000		
	Functional	Season	1	0.055	0.005	0.52	0.768
		MEM1	1	2.318	0.203	21.92	**<0.001**
		MEM2	1	0.499	0.044	4.72	**0.002**
		MEM3	1	0.809	0.071	7.65	**<0.001**
		Residuals	73	7.716	0.677		
		Total	77	11.396	1.000		
URBANISATION	Taxonomic	UI_category	2	4.117	0.227	25.46	**<0.001**
		MEM1	1	0.728	0.040	4.50	**0.002**
		MEM2	1	0.285	0.016	1.76	0.104
		MEM3	1	1.197	0.066	7.40	**<0.001**
		Residuals	73	11.805	0.651		
		Total	77	18.132	1.000		
	Functional	UI_category	2	2.912	0.256	30.50	**<0.001**
		MEM1	1	0.455	0.040	4.76	**0.003**
		MEM2	1	0.200	0.018	2.10	0.071
		MEM3	1	0.861	0.076	9.02	**<0.001**
		Residuals	73	6.968	0.611		
		Total	77	11.396	1.000		

Table S10 Results of pairwise comparisons from the PERMANOVA analysis of terrestrial isopod taxonomic and functional β-diversity across the three urbanisation categories. Significant values are shown in bold.

Composition	Pairwise comparison	df	Sums of sq.	F	R^2	Adjusted *p*-value
Taxonomic	UI1 vs UI3	1	0.398	48.972	0.495	**<0.001**
	UI1 vs UI2	1	0.207	24.617	0.323	**<0.001**
	UI3 vs UI2	1	0.038	4.529	0.083	**0.005**
Functional	UI1 vs UI3	1	2.912	26.909	0.350	**<0.001**
	UI1 vs UI2	1	1.822	16.026	0.243	**<0.001**
	UI3 vs UI2	1	0.404	4.173	0.077	**0.016**

Table S11 Distance-based redundancy analysis (dbRDA) results for terrestrial isopod communities based on taxonomic and functional β-diversity in Rome (Italy). Significant p-values are highlighted in bold

Composition	**Variability explained (%)**			***p*-values**											**R^2**
	Total	Axes		Reduced model	Axes		UI	Dist. city centre	Habitat complexity	pH	Conductivity	CaO	TOC	C/N	Compaction	
		CAP1	CAP2		CAP1	CAP2										
Taxonomic	25.66	14.68	4.63	**<0.001**	**<0.001**	**0.001**	**<0.001**	**0.002**	**<0.001**	**0.019**	**<0.001**	**<0.001**	**0.002**	**0.028**	-	0.25
Functional	25.30	18.07	4.11	**<0.001**	**<0.001**	**0.013**	**<0.001**	-	**<0.001**	0.055	**<0.001**	0.059	**0.012**	-	0.078	0.23

Table S12 Results of variation partitioning showing the proportion of variation (adjusted R^2) in taxonomic and functional β-diversity explained by pure local effects, pure landscape effects, pure spatial structure (MEMs, included to control for spatial autocorrelation), their shared component, and residual unexplained variation

Composition	**Pure local**	**Pure landscape**	**Pure spatial (MEMs)**	**Shared local + landscape**	**Residual**
Taxonomic	0.071	0.016	0.049	0.277	0.536
Functional	0.069	0.055	0.044	0.214	0.594