

## Supplementary material

**Supplementary Table S1.** List of all specimens used in the analyses from sampled litter macroinvertebrate communities at the German and Indonesian field sites (larval specimens were excluded from analyses). The majority of specimens collected in Germany were identified to taxonomic species, whereas all specimens from Indonesia were assigned to morphospecies.

Region	Class	Order	Species	Individuals		
Germany	Arachnida	Araneae	96	1799		
		Opiliones	12	136		
		Pseudoscorpionida	5	46		
	Chilopoda		14	689		
	Diplopoda		24	617		
	Gastropoda	Pulmonata	31	479		
	Insecta	Coleoptera		172	720	
			Dermaptera	2	67	
			Hemiptera	29	86	
			Hymenoptera	14	297	
			Malacostraca	Isopoda	9	386
			<b>Total</b>		<b>408</b>	<b>5322</b>
			Indonesia	Arachnida	Araneae	252
	Opiliones	14			63	
Pseudoscorpionida	5	46				
Schizomida	1	2				
Chilopoda		15		136		
Diplopoda		27		150		
Entognatha	Diplura	1		13		
Gastropoda	Pulmonata	12		29		
Insecta	Archaeognatha			3	20	
		Blattodea		25	326	
		Coleoptera		139	401	
		Dermaptera		5	34	
		Hemiptera		76	151	
		Hymenoptera		98	2963	
		Isoptera		14	778	
		Mantodea		4	15	
		Neuroptera		1	4	
		Orthoptera		25	128	
		Plecoptera		6	46	
		Psocoptera		17	507	
		Thysanoptera		9	41	
		Thysanura		1	1	
		Malacostraca		Isopoda	36	128
		Symphyla			2	35
		<b>Total</b>			<b>788</b>	<b>7096</b>
<b>Grand Total</b>		<b>1196</b>		<b>12,418</b>		

**Supplementary Table S2.** Variables used to construct environmental dissimilarity matrices for the ‘environmental distance’ variable in the path model.  $R^2$  and p values are from the permutational vector fitting on NMDS ordinations of litter macroinvertebrate communities. Both untransformed and logged variables are shown, giving a total of 30 variables. Variables that were selected to be included in the environmental dissimilarity matrices are indicated by bold-face parameter values for the Indonesian and German data sets. Where both logged and untransformed variables were significant, we selected the variable with the highest  $R^2$  value.

Factor	Indonesia		Germany	
	$R^2$	p-value	$R^2$	p-value
litter depth	<b>0.540</b>	<b>0.000</b>	0.017	0.673
soil pH	0.307	0.005	<b>0.456</b>	<b>0.000</b>
C (mg)	0.179	0.055	0.032	0.481
N (mg)	0.064	0.379	0.243	0.002
P (mg)	0.201	0.036	0.098	0.102
Al (mg)	0.151	0.093	0.424	0.000
Ca (mg)	0.161	0.077	<b>0.517</b>	<b>0.000</b>
Fe (mg)	0.135	0.115	0.270	0.001
K (mg)	0.245	0.016	0.286	0.001
Mg (mg)	0.001	0.992	0.158	0.020
Mn (mg)	0.169	0.065	0.465	0.000
Na (mg)	0.011	0.843	0.190	0.010
S (mg)	0.169	0.068	0.064	0.220
mean soil moisture	<b>0.207</b>	<b>0.033</b>	0.744	0.000
mean soil temperature	0.432	0.000	<b>0.385</b>	<b>0.000</b>
log litter depth	0.476	0.000	0.028	0.528
log soil pH	<b>0.323</b>	<b>0.003</b>	0.418	0.000
log C (mg)	0.061	0.410	0.008	0.840
log N (mg)	0.107	0.191	<b>0.262</b>	<b>0.001</b>
log P (mg)	<b>0.216</b>	<b>0.028</b>	0.108	0.079
log Al (mg)	0.157	0.088	<b>0.594</b>	<b>0.000</b>
log Ca (mg)	<b>0.230</b>	<b>0.024</b>	0.422	0.000
log Fe (mg)	0.174	0.061	<b>0.276</b>	<b>0.001</b>
log K (mg)	<b>0.361</b>	<b>0.001</b>	<b>0.328</b>	<b>0.000</b>
log Mg (mg)	0.007	0.906	<b>0.341</b>	<b>0.000</b>
log Mn (mg)	0.181	0.052	<b>0.466</b>	<b>0.000</b>
log Na (mg)	0.010	0.868	<b>0.191</b>	<b>0.009</b>
log S (mg)	0.177	0.059	0.114	0.061
log mean soil moisture	0.113	0.173	<b>0.766</b>	<b>0.000</b>
log mean soil temperature	<b>0.437</b>	<b>0.000</b>	0.286	0.000

**Supplementary Table S3.** List of variables used in the path models, along with details of how they are measured or calculated and the distance measure used for the MRMs.

<b>Variable in path model</b>	<b>Details</b>	<b>Distance measure</b>
geographic distance	Calculated from GPS coordinates.	Great Circle distance
environmental distance	Composite variable from 15 measured environmental parameters.	Euclidean distance
$\beta$ -diversity	Species composition.	Jaccard dissimilarity
$\alpha$ -diversity dissimilarity	Dissimilarity among plots in total species richness.	log response ratio
FDis dissimilarity	Dissimilarity among plots in functional dispersion.	log response ratio
biomass dissimilarity	Dissimilarity among plots in total biomass.	log response ratio
energy flux dissimilarity	Dissimilarity among plots in total calculated energy flux.	log response ratio

**Supplementary Table S4.** Parameters and their estimates from each of the two path models (from the Indonesian and German data sets). All response and predictor variables are dissimilarity matrices (e.g., ‘biomass’ denotes dissimilarity among plots in total biomass values).

<b>Response</b>		<b>Predictor</b>	<b>Unstandardised coefficients</b>	<b>Range-standardized coefficients</b>	<b>P</b>
<b>Indonesia</b>					
environmental dist.	< --	geographic dist.	0.003	0.096	0.008
$\beta$ -diversity	< --	geographic dist.	0.000	0.108	<0.001
$\beta$ -diversity	< --	environmental dist.	0.020	0.225	<0.001
$\alpha$ -diversity	< --	$\beta$ -diversity	3.709	0.592	<0.001
FDis	< --	geographic dist.	0.000	0.096	0.010
biomass	< --	$\alpha$ -diversity	0.797	0.409	<0.001
energy flux	< --	$\alpha$ -diversity	0.432	0.269	<0.001
energy flux	< --	biomass	0.603	0.733	<0.001
<b>Germany</b>					
environmental dist.	< --	geographic dist.	0.001	0.195	<0.001
$\beta$ -diversity	< --	geographic dist.	0.000	0.227	<0.001
$\beta$ -diversity	< --	environmental dist.	0.019	0.157	0.020
$\alpha$ -diversity	< --	geographic dist.	-0.000	-0.094	0.006
$\alpha$ -diversity	< --	$\beta$ -diversity	1.020	0.411	<0.001
biomass	< --	geographic dist.	0.000	0.057	0.020
biomass	< --	$\alpha$ -diversity	1.374	0.351	<0.001
biomass	< --	$\beta$ -diversity	3.364	0.347	<0.001
energy flux	< --	geographic dist.	-0.000	-0.054	0.001
energy flux	< --	$\alpha$ -diversity	0.579	0.208	<0.001
energy flux	< --	biomass	0.543	0.765	<0.001

**Supplementary Figure S1.** Study regions in a) Indonesia and b) Germany. The left-hand panels show the island of Sumatra within Indonesia and the country of Germany within Western Europe, with a magnification of the study regions in the right-hand panels. Green and yellow circles in a) denote the sampling plot locations for Bukit Duabelas and Harapan landscapes, respectively. Red, blue and orange circles in b) denote the sampling plot locations in the Swabian Alb Biosphere Reserve, Hainich National Park and the Schorfheide-Chorin Biosphere Reserve, respectively.

