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Supplementary Materials for

Latitude dictates plant diversity effects on instream decomposition

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The PDF file includes:

Figs. S1 to S3
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Appendix
Legend for dataset

Other Supplementary Material for this manuscript includes the following:

(available at advances.sciencemag.org/cgi/content/full/7/13/eabe7860/DC1)

Dataset

Fig. S1. Latitudinal variation in temperature seasonality, water stream temperature, and riparian plant phylogenetic distance and species richness. Temperature seasonality (standard deviation of monthly mean values x 100) was extracted from the WorldClim database (www.worldclim.org) for each of our study regions. Water temperature was measured every 1 h during the experiment in each stream. Plant phylogenetic distance (*34*), expressed as number of tree units, was extracted from Boyero et al. (*35*). Riparian species richness was qualitatively recorded in each region using three categories (<10, 10-40, >40 species). *P*-values result from linear models.

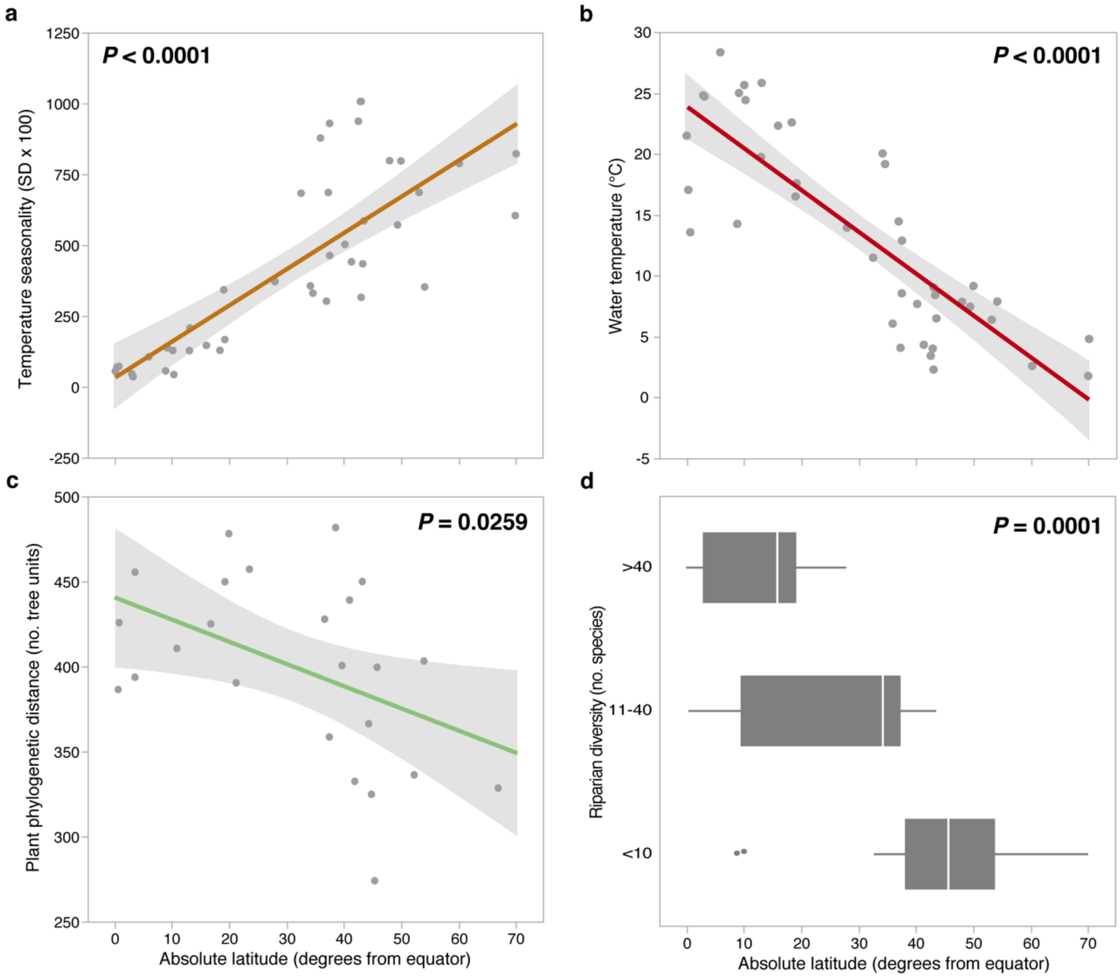

Fig. S2. **Decomposition (proportional litter mass loss, LML) of each plant species (a) and litter mixture (b) in coarse-mesh and fine-mesh litterbags (dark and light brown, respectively) at the end of the experiment.** Boxplots represent medians, interquartile ranges, minimum and maximum values and outliers.

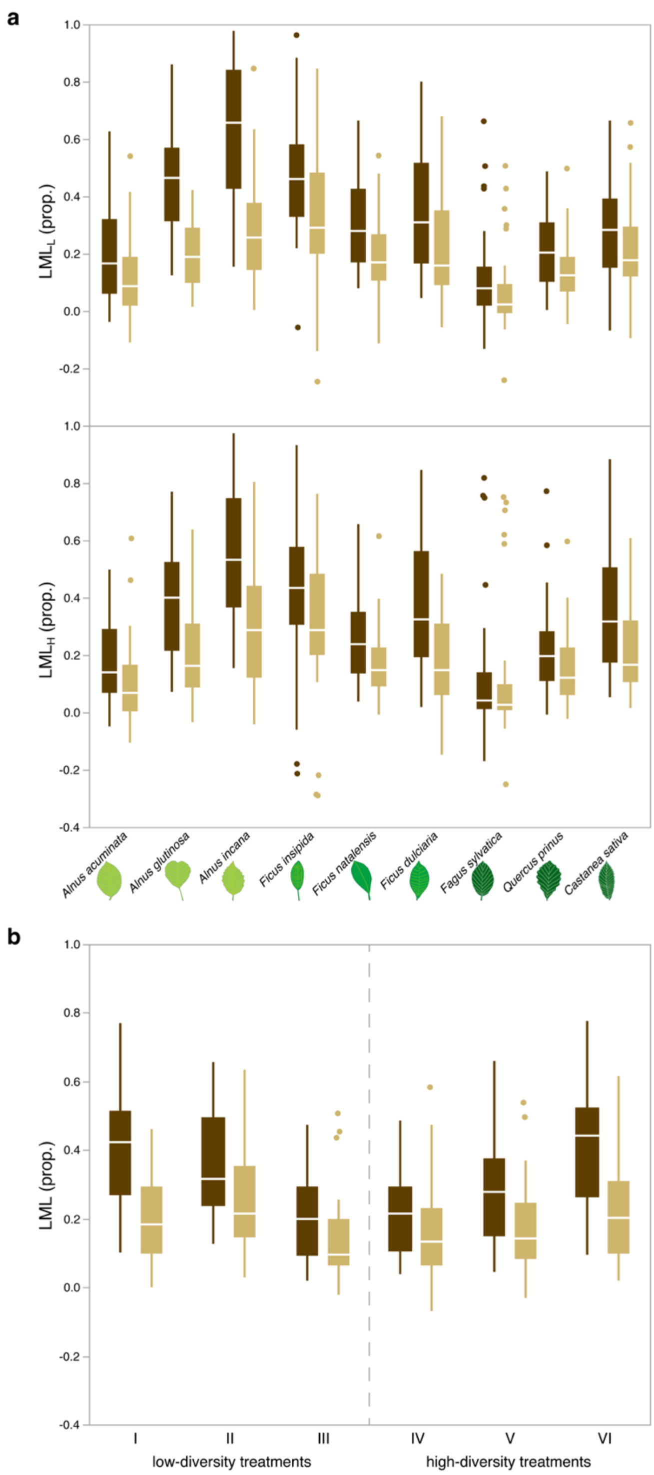

Fig. S3. Distribution of plant families (shown in yellow) and regions where species were collected. The distribution of each species is not shown. *Alnus acuminata* is distributed from Central America to northern Argentina; *A. glutinosa*, most Europe; *A. incana*, northern Europe, part of Asia and northern North America; *Ficus insipida,* Mexico to South America*; F. natalensis*, southeastern Africa; *F. dulciaria*, northwestern South America; *Fagus sylvatica,* central Europe; *Quercus prinus,* eastern United States*;* and *Castanea sativa*, southern Europe and northern Turkey.

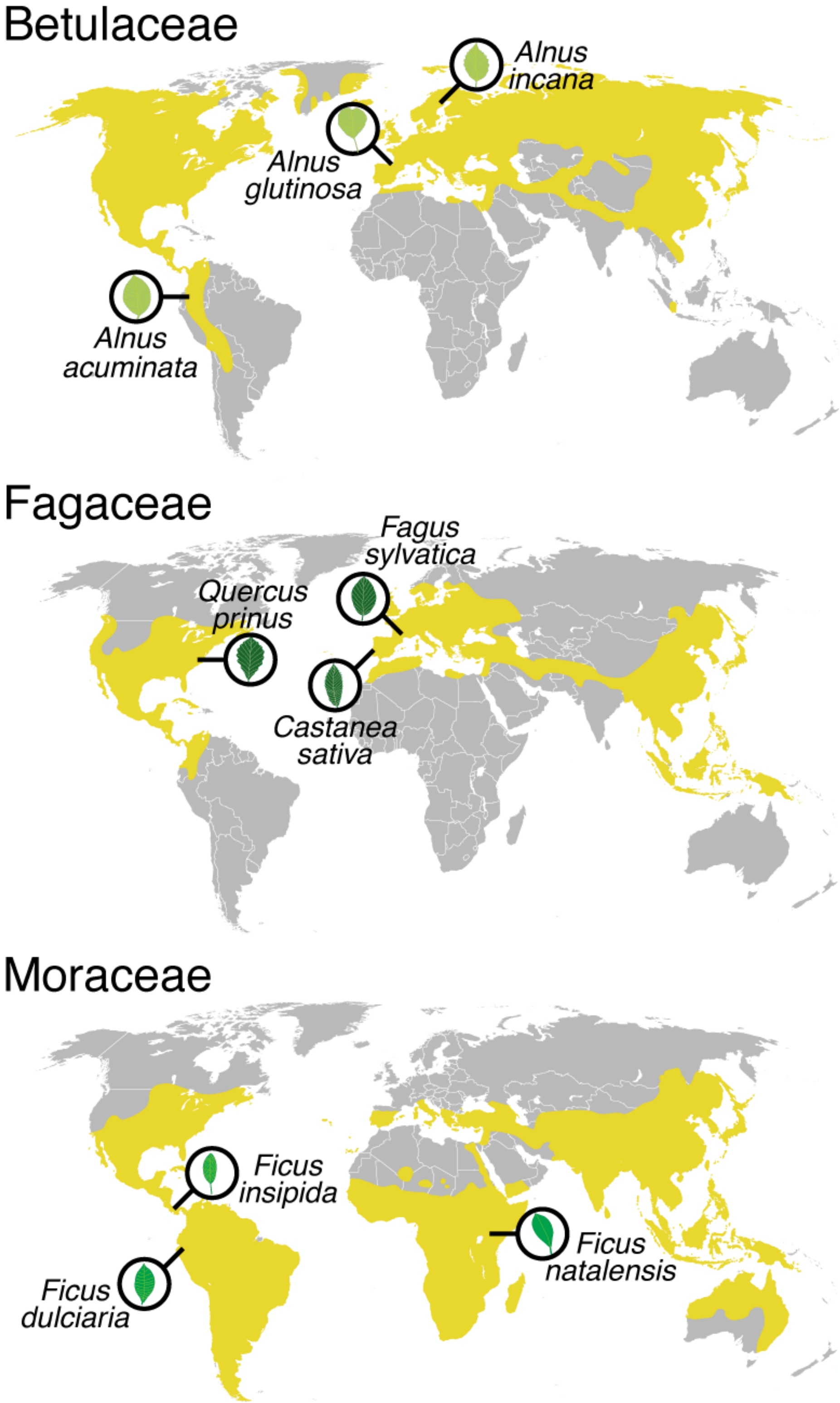

Table S1. Location of study streams. Country, region, ecoregion, stream name, biome, decimal latitude and longitude (Lat and Long; degrees), and altitude (Alt; m a.s.l.). Sites are ordered by increasing absolute latitude. NP, National Park; NT, Northern Territory; QLD, Queensland; GA, Georgia; WA, Western Australia; IL, Illiniois; MD, Maryland; NY, New York; MI, Michigan; MO, Montana BC, British Columbia. Biomes: TrS; tropical wet forest, TrWF; xeric shrubland, XeS (also termed desert, although aridity was low in riparian forests in our study regions); Mediterranean forest, MeF; temperate broadleaf forest, TeBF; temperate coniferous forest, TeCF; and tundra, Tu.

Country	Region	Ecoregion	Stream name	Biome	Lat	Long	Alt
Ecuador	Esmeraldas	NW Andean montane forests	Manuco	TrWF	-0.09	-78.99	691
Kenya	Nakuru	N Acacia-Commiphora bushlands and thickets	Njoro	TrS	-0.37	35.93	2263
Kenya	Narok	E African montane forests	Ngetunyek	TrWF	-0.71	35.46	2096
Brazil	Amazonas	Uatuma-Trombetas moist forests	Acará 23	TrWF	-2.95	-59.96	58
Malaysia	Kuala Lumpur	Peninsular Malaysian rain forests	Ampang	TrWF	3.17	101.78	176
Brazil	Rio Grande do Norte	Atlantic Coast restingas	Pitimbú	TrWF	-5.92	-35.18	50
Panama	Chiriquí	Talamancan montane forests	Caldera	TrWF	8.85	-82.50	1825
Guinea	Faranah	Guinean montane forests	Djigbè	TrWF	9.16	-10.56	549
India	Tamil Nadu	SW Ghats montane rain forests	Thadaganachiamman	TrWF	10.09	77.25	740
Venezuela	Yaracuy	La Costa xeric shrublands	Herrera 1	XeS	10.29	-68.65	123
Brazil	Bahia	Caatinga	Morro Fervido	XeS	-12.99	-41.34	950
Australia	Litchfield NP (NT)	Arnhem Land tropical savanna	Shady	TrS	-13.10	130.78	111
Guatemala	Laguna Lauchá NP	Petén-Veracruz moist forests	Machacas	TrWF	15.95	-90.68	194
Puerto Rico	El Yunque NP	Puerto Rican moist forests	Prieta	TrWF	18.31	-65.75	350
Australia	Paluma Range NP (QLD)	Queensland tropical rain forests	Birthday	TrWF	-18.98	146.16	820
Brazil	Minas Gerais	Cerrado	RCA52	TrS	-19.16	-47.01	891
Brazil	Paraná	Araucaria moist forests	Refúgio	TrWF	-26.52	-51.64	1230
Australia	Tamborine NP (QLD)	E Australian temperate forests	Cedar	TeBF	-27.90	153.18	240
United States	Toombs (GA)	SE coniferous forests	15 Mile	TeCF	32.45	-82.06	58
South Africa	Western Cape	Lowland fynbos and renosterveld	Lourens	Me	-34.08	18.89	85
Australia	South West (WA)	Jarrah-Karri forest and shrublands	Warren	Me	-34.51	116.10	93
Japan	Honshu	Taiheiyo montane deciduous forests	Komori	TeBF	35.83	138.53	1080
Chile	Biobío	Valdivian temperate forests	Nonguén	TeBF	-36.88	-72.99	95
Spain	Sierra Nevada	Iberian coniferous forests	Alhama	Me	37.20	-3.25	1374
United States	Balcom (IL)	Central U.S. hardwood forests	Big	TeBF	37.42	-89.17	123
Australia	Victoria	SE Australia temperate forests	Keppel	TeBF	-37.45	145.76	415
United States	Arbutus (MD)	SE mixed forests	Patapsco tributary	TeBF	39.22	-76.70	28
Portugal	Lousã (Coímbra)	SW Iberian Med. sclerophy. and mixed forests	Cerdeira	Me	40.09	-8.20	531
Argentina	Patagonia Andina	Valdivian temperate forests	Rojizo	TeBF	-41.23	-71.30	1120
United States	Ithaca (NY)	Allegheny Highlands forests	Cascadilla	TeBF	42.43	-76.45	275
United States	Macomb (MI)	S Great Lakes forests	Stoney	TeBF	42.79	-83.09	258
Australia	Tasmania	Tasmanian Central Highland forests	Browns	TeBF	-42.92	147.25	430

Country	Region	Ecoregion	Stream name	Biome	Lat	Long	Alt
Japan	Hokkaido	Hokkaido montane coniferous forests	Toyohira	TeCF	42.93	141.16	450
Spain	Cordillera Cantábrica	Cantabrian mixed forests	Agüera	TeBF	43.21	-3.27	305
France	Occitanie	W European broadleaf forests	Peyreblanque	TeBF	43.42	2.22	752
United States	Flathead lake NP (MT)	N Central Rockies forests	Roy's	TeCF	47.88	-114.03	897
Canada	Vancouver Coast (BC)	Puget lowland forests	East	TeCF	49.27	-122.57	165
Poland	Malopolska	Carpathian montane forests	Krzyworzeka	TeCF	49.86	20.12	266
Germany	NS Ruppiner Land	Baltic mixed forests	Kunster	TeBF	53.02	12.75	62
Ireland	Mayo	N Atlantic moist mixed forests	Burrishoole	TeBF	53.99	-9.52	241
Sweden	Uppsala	Sarmatic mixed forests	Lafssjon	TeBF	60.03	17.81	61
Norway	Tromsø	Scand. Montane Birch forest and grasslands	Kalvedalselva	Tu	69.77	18.82	59
Finland	Finnish Lapland	Scand. Montane Birch forest and grasslands	Garnjargajohka	Tu	69.93	27.14	75

Table S2. Climatic variables of study regions and environmental characteristics of streams. Mean annual temperature (MT, °C); annual precipitation (AP, mm); temperature seasonality (TS, standard deviation of monthly mean values x 100); precipitation seasonality (PS, coefficient of variation of monthly mean values); stream average width (Wi; m); pH; NO_3–N (NO3; µg L^{-1}); and PO_4–P (PO4; µg L^{-1}).

Country	Region	MT	AP	TS	PS	Wi	pH	NO3	PO4
Ecuador	Esmeraldas	22.2	3004	57	72	3.9	7.1	412.0	14.6
Kenya	Nakuru	15.8	954	72	43	4.4	8.1	2485.0	6.9
Kenya	Narok	16.5	1043	74	48	2.3	7.4	319.0	11.5
Brazil	Centro Amazonense	27.2	2188	48	439	2.6	4.6	15.7	26.3
Malaysia	Kuala Lumpur	26.5	2502	37	27	1.6	7.4	600.0	5.0
Brazil	Rio Grande do Norte	25.8	1402	108	71	4.2	6.5	1050.0	1.4
Panama	Chiriquí	15.9	2266	58	55	3.7	6.9	666.0	16.0
Guinea	Faranah	24.2	2131	139	76	3.8	7.5	140.0	0.7
India	Tamil Nadu	19.3	2150	130	76	3.2	6.9	980.0	32.0
Venezuela	Yaracuy	24.2	1253	45	55	4.3	8.3	1439.5	1.1
Brazil	Bahia	20.3	940	130	63	0.8	3.9	9.1	54.8
Australia	Litchfield NP (NT)	26.9	1422	210	109	2.2	8.0	7.0	0.7
Guatemala	Laguna Lauchá NP	25.7	3147	148	62	3.6	6.5	53.8	2.7
Puerto Rico	El Yunque NP	22.1	2961	131	27	2.1	7.2	55.2	3.1
Australia	Paluma Range NP (QLD)	20.2	2584	344	67	8.6	6.3	19.0	2.5
Brazil	Minas Gerais	21.1	1545	169	84	4.9	6.6	12.1	0.7
Brazil	Paraná	15.0	1854	312	16	2.3	6.5	1112.1	137.7
Australia	Tamborine NP (QLD)	18.6	1325	373	41	5.7	6.9	706.0	3.0
United States	Toombs (GA)	18.6	1198	685	23	7.9	7.2	96.8	140.8
South Africa	Western Cape	16.1	852	358	63	6.3	7.1	585.0	5.0
Australia	South West (WA)	14.9	1131	332	69	8.7	7.8	6.3	0.7
Japan	Honshu	7.6	1653	880	53	6.0	7.5	585.0	7.2
Chile	Biobío	11.2	1502	304	84	5.0	7.4	32.8	20.0
Spain	Sierra Nevada	9.3	758	688	44	2.5	7.5	89.5	3.5
United States	Balcom (IL)	13.6	1196	932	16	8.8	7.7	820.0	76.0
Australia	Victoria	10.8	1592	465	39	1.9	7.5	52.5	5.0
United States	Arbutus (MD)	13.1	1079	906	11	1.5	6.6	15.8	39.2
Portugal	Lousã (Coímbra)	12.5	1288	504	58	2.1	7.2	60.5	7.5
Argentina	Patagonia Andina	5.9	810	443	62	1.2	7.9	236.2	11.5
United States	Ithaca (NY)	7.7	930	939	20	4.3	8.0	250.8	6.8
United States	Macomb (MI)	8.7	792	1009	23	4.6	6.6	207.1	71.7
Australia	Tasmania	10.5	969	318	18	3.1	7.4	3.3	6.0
Japan	Hokkaido	5.4	1359	1009	23	3.7	7.1	919.4	0.7
Spain	Cordillera Cantábrica	12.5	1081	436	28	2.3	7.2	675.0	1.7
France	Occitanie	10.1	908	588	14	2.3	6.6	630.1	1.3
United States	Flathead lake NP (MT)	6.0	610	800	22	3.6	7.9	550.9	9.0
Canada	Vancouver Coast (BC)	8.8	1717	573	52	2.0	6.6	675.5	2.2
Poland	Malopolska	7.9	728	799	47	7.9	8.3	1516.5	15.1
Germany	NS Ruppiner Land	8.4	575	688	24	2.7	7.5	240.1	17.5
Ireland	Mayo	8.1	1345	354	25	0.9	6.1	62.5	3.0
Sweden	Uppsala	5.6	564	790	32	4.4	6.9	427.0	1.0
Norway	Tromsø	1.6	927	606	28	3.2	5.5	3.3	0.7
Finland	Finnish Lapland	-0.8	425	824	43	2.8	7.1	3.3	0.7

Table S3. **Latitudinal variation of the litter diversity effect on decomposition (LDED).** Models were run for coarse-mesh litterbags (which quantified total decomposition), fine-mesh litterbags (microbial decomposition) and the difference between paired coarse-mesh and fine-mesh litterbags (detritivore-mediated decomposition). Model parameters: LDED, response variable; latitude, fixed factor; species, random factor in the overall model. We report estimates, standard errors, degrees of freedom, *t*-values and *P*-values. Given that Fig. 3b indicated a potential strong influence of one region (Finland, 60º) on the latitudinal pattern, we repeated the analyses excluding this region; results remained the same (*P*-values given in column P_B).

	Estimate	**SE**	**df**	***t***	***P***	P_B
Overall						
Coarse mesh	-1.98×10^{-6}	6.12×10^{-7}	3305	-3.24	0.001	0.001
Fine mesh	-2.45×10^{-7}	5.48×10^{-7}	3305	-0.45	0.654	0.658
Detritivores	-1.83×10^{-6}	5.59×10^{-7}	4965	-3.27	0.001	0.001
Alnus acuminata						
Coarse mesh	-1.99×10^{-6}	1.59×10^{-6}	363	-1.25	0.214	0.214
Fine mesh	-1.05×10^{-6}	1.24×10^{-6}	363	-0.85	0.397	0.397
Detritivores	-8.04×10^{-7}	1.55×10^{-6}	542	-0.51	0.604	0.590
Alnus glutinosa						
Coarse mesh	-1.12×10^{-5}	2.32×10^{-6}	370	-4.86	<0.001	<0.001
Fine mesh	-1.38×10^{-6}	1.57×10^{-6}	370	-0.88	0.379	0.379
Detritivores	-1.20×10^{-5}	2.53×10^{-6}	555	-4.72	<0.001	<0.001
Alnus incana						
Coarse mesh	-4.80×10^{-6}	2.94×10^{-6}	366	-1.63	0.104	0.104
Fine mesh	7.02×10^{-6}	2.74×10^{-6}	366	2.56	0.011	0.012
Detritivores	-8.54×10^{-6}	3.07×10^{-6}	547	-2.78	0.006	0.009
Ficus insipida						
Coarse mesh	-2.43×10^{-7}	2.00×10^{-6}	359	-0.12	0.903	0.904
Fine mesh	3.12×10^{-7}	1.97×10^{-6}	359	0.16	0.874	0.874
Detritivores	5.78×10^{-7}	2.09×10^{-6}	534	0.28	0.782	0.994
Ficus natalensis						
Coarse mesh	-2.85×10^{-6}	1.80×10^{-6}	363	-1.59	0.113	0.113
Fine mesh	-1.89×10^{-6}	$1\text{-}61 \times 10^{-6}$	363	-1.17	0.242	0.242
Detritivores	-1.84×10^{-6}	1.70×10^{-6}	541	-1.08	0.280	0.051
Ficus dulciaria						
Coarse mesh	5.38×10^{-6}	2.94×10^{-6}	362	1.81	0.070	0.070
Fine mesh	-4.85×10^{-6}	2.92×10^{-6}	362	-1.66	0.098	0.098
Detritivores	1.02×10^{-5}	2.75×10^{-6}	539	3.69	<0.001	<0.001
Fagus sylvatica						
Coarse mesh	-7.10×10^{-7}	1.23×10^{-6}	368	-0.58	0.553	0.563
Fine mesh	1.57×10^{-6}	$1.28 \times 10^{-}$	368	1.23	0.219	0.219
Detritivores	-1.37×10^{-6}	9.10×10^{-7}	548	-1.50	0.134	0.078
Quercus prinus						
Coarse mesh	-2.66×10^{-6}	1.68×10^{-6}	369	-1.59	0.113	0.113
Fine mesh	1.39×10^{-6}	1.64×10^{-6}	369	0.85	0.397	0.397
Detritivores	-3.72×10^{-6}	1.69×10^{-6}	551	-2.20	0.028	0.034
Castanea sativa						
Coarse mesh	-6.99×10^{-7}	1.99×10^{-6}	369	-0.35	0.725	0.725
Fine mesh	-1.95×10^{-6}	1.56×10^{-6}	369	-1.25	0.213	0.213
Detritivores	-5.51×10^{-7}	2.05×10^{-6}	548	-0.27	0.788	0.740

Table S4. Influence of each plant species on the overall models shown in Table S3. The influence of each species on each model (coarse-mesh and fine-mesh litterbags) was quantified with Cook's distance. Values <1 in all cases indicate that model results were not driven by any particular species. Higher values indicate greater influence.

Species	Coarse mesh	Fine mesh	Detritivores
Alnus acuminata	0.0022	0.0321	0.0377
Alnus glutinosa	0.3877	0.0413	0.2785
Alnus incana	0.1065	0.1697	0.1936
Ficus insipida	0.0419	0.1939	0.0268
Ficus natalensis	0.2253	0.1494	0.0099
Ficus dulciaria	0.0761	0.0116	0.3576
Fagus sylvatica	0.3994	0.2496	0.1829
Quercus prinus	0.1049	0.1448	0.0965
Castanea sativa	0.1087	0.0165	0.0663

Table S5. Litter traits for each plant species and weighted mean values of traits for each litter mixture. Mean values of the concentrations (% dry mass) of carbon (C), calcium (Ca), nitrogen (N) and phosphorus (P); specific leaf area (SLA; mm^2 mg^{-1}); concentrations (% dry mass) of hemicellulose (Hem), cellulose (Cel) and lignin (Lig); toughness (Tou; kPa); and concentrations (% dry mass) of tannins (Tan), non-structural carbohydrates (NSC) and ash (Ash). Species are *Alnus acuminata* (Aa), *A. glutinosa* (Ag), *A. incana* (Ai), *Ficus insipida* (Fi), *F. natalensis* (Fn), *F. dulciaria* (Fd), *Fagus sylvatica* (Fs), *Quercus prinus* (Qp) and *Castanea sativa* (Cs). Mixtures I-III have low diversity, and mixtures IV-VI have high diversity.

Trait	Aa	Ag	Ai	Fi	Fn	Fd	Fs	Qp	Cs	I	II	III	IV	V	VI
C	56.16	52.47	51.04	36.72	45.16	47.59	49.82	48.61	51.63	53.34	43.29	50.01	47.76	48.71	50.03
Ca	0.84	1.30	2.52	5.62	1.89	1.67	0.92	1.01	0.81	1.51	3.01	0.91	2.39	1.39	1.62
N	2.39	2.90	3.55	1.09	1.32	1.84	1.05	0.69	1.05	2.92	1.43	0.93	1.51	1.60	2.07
P	0.05	0.05	0.09	0.07	0.05	0.08	0.04	0.03	0.05	0.06	0.07	0.04	0.05	0.04	0.07
SLA	11.52	20.74	30.03	17.22	9.69	8.95	24.98	12.36	19.34	20.33	11.85	18.89	18.06	14.17	18.83
Hem	8.07	13.73	14.89	19.24	15.82	16.13	13.09	17.90	21.53	12.09	17.03	17.47	13.38	15.88	17.66
Cel	19.05	15.01	16.90	26.16	23.60	20.68	22.75	20.66	24.32	17.02	23.41	22.56	22.61	19.81	20.85
Lig	26.72	23.73	23.75	11.95	15.39	20.61	20.11	15.94	12.85	24.79	16.10	16.33	19.71	18.25	18.80
Tou	1829	1390	1112	1076	3511	3771	1865	2685	1747	1460	2818	2102	1602	2541	2274
Tan	0.00	0.45	0.00	0.00	0.65	0.00	0.43	1.57	2.26	0.15	0.21	1.41	0.15	0.91	0.80
NSC	28.69	24.56	15.29	10.10	22.99	23.75	33.80	35.45	31.50	23.17	19.10	33.62	24.56	27.91	23.97
Ash	2.50	4.87	6.98	25.71	13.93	7.31	3.70	5.75	3.24	4.68	15.42	4.24	10.3	8.15	5.78

Table S6. Effect of plant diversity (measured as phylogenetic distance; low vs. high) and latitude on total decomposition in litter mixtures. Model parameters: LML, response variable; diversity, latitude and their interaction, fixed factors; litter mixture and region, random factors. We report degrees of freedom of the numerator and denominator, *F*-values and *P*-values.

	num. df	den. df	*F*	*P*
Coarse mesh				
Diversity	1	4	0.06	0.812
Latitude	1	1120	108.53	<0.001
Diversity x latitude	1	1120	1.03	0.310
Fine mesh				
Diversity	1	4	0.01	0.913
Latitude	1	1119	81.35	<0.001
Diversity x latitude	1	1119	0.03	0.854

Table S7. Influence of climatic and stream environmental factors on the litter diversity effect on decomposition (LDED) for each species in coarse-mesh and fine-mesh litterbags. We show the best model in each case, selected based on the Akaike Information Criterion (AIC) following a forward stepwise approach. Model parameters: LDED, response variable; climatic and stream environmental factors (see Table S2), fixed factors. Non-significant models (which included some species and both overall models) are not shown. We show the AIC, adjusted r^2, *F*-values and *P*-values for each model; and the mean estimate, standard error, *F*-values and *P*-values for each factor.

Species	Selected model	Factor	Estimate	SE	*F*	*P*
Coarse mesh						
Alnus glutinosa	LDED ~ TS + PO4					
	AIC = -626	Intercept	5.6×10^{-5}	1.0×10^{-4}		
	Adj. $r^2 = 0.35$	TS	-9.5×10^{-5}	1.0×10^{-5}	19.58	<0.001
	$F_{2,37} = 11.5$	PO4	4.3×10^{-6}	1.3×10^{-6}	3.42	0.073
	$P < 0.001$					
Alnus incana	LDED ~ TS + AP					
	AIC = -619	Intercept	4.1×10^{-4}	1.5×10^{-4}		
	Adj. $r^2 = 0.18$	TS	-8.5×10^{-5}	2.6×10^{-5}	7.78	0.002
	$F_{2,37} = 5.37$	AP	-2.0×10^{-7}	1.2×10^{-7}	2.95	0.094
	$P = 0.009$					
Ficus dulciaria	LDED ~ Wi + TS					
	AIC = -588	Intercept	3.1×10^{-4}	2.2×10^{-4}		
	Adj. $r^2 = 0.09$	Wi	-9.9×10^{-5}	4.7×10^{-5}	2.94	0.095
	$F_{2,37} = 2.96$	TS	5.5×10^{-5}	3.2×10^{-5}	2.98	0.093
	$P = 0.064$					
Quercus prinus	LDED ~ TS					
	AIC = -662	Intercept	5.5×10^{-5}	6.7×10^{-5}		
	Adj. $r^2 = 0.05$	TS	-2.3×10^{-5}	1.3×10^{-5}	3.18	0.083
	$F_{1,38} = 3.18$					
	$P = 0.083$					
Fine mesh						
Alnus acuminata	LDED ~ PS + Wi					
	AIC = -694	Intercept	-8.1×10^{-5}	7.4×10^{-5}		
	Adj. $r^2 = 0.08$	PS	2.2×10^{-6}	1.1×10^{-6}	3.35	0.075
	$F_{2,37} = 2.80$	Wi	-1.8×10^{-5}	1.2×10^{-5}	2.24	0.143
	$P = 0.074$					
Alnus incana	LDED ~ TS + PO4 + NO3					
	AIC = -635	Intercept	-2.0×10^{-4}	1.0×10^{-4}		
	Adj. $r^2 = 0.25$	TS	6.5×10^{-6}	1.8×10^{-5}	10.78	0.002
	$F_{3,36} = 5.34$	PO4	-3.5×10^{-7}	2.1×10^{-6}	3.20	0.081

Species	Selected model	Factor	Estimate	SE	*F*	*P*
	$P = 0.004$	NO3	1.5 x 10^{-7}	1.1 x 10^{-7}	2.04	0.162
Ficus natalensis	LDED ~ TS + pH					
	AIC = -675	Intercept	-5.3 x 10^{-4}	2.8 x 10^{-4}		
	Adj. $r^2 = 0.09$	TS	-2.1 x 10^{-5}	1.1 x 10^{-5}	2.42	0.128
	$F_{2,37} = 3.01$	pH	7.5 x 10^{-5}	4.0 x 10^{-5}	3.60	0.066
	$P = 0.061$					
Ficus dulciaria	LDED ~ TS					
	AIC = -620	Intercept	7.0 x 10^{-5}	1.1 x 10^{-4}		
	Adj. $r^2 = 0.12$	TS	-5.4 x 10^{-5}	2.2 x 10^{-5}	6.26	0.017
	$F_{1,38} = 6.26$					
	$P = 0.017$					
Quercus prinus	LDED ~ AT + NO3					
	AIC = -673	Intercept	1.4 x 10^{-4}	8.2 x 10^{-5}		
	Adj. $r^2 = 0.08$	AT	-8.0 x 10^{-6}	4.7 x 10^{-6}	2.97	0.093
	$F_{2,37} = 2.62$	NO3	9.9 x 10^{-8}	6.6 x 10^{-8}	2.27	0.141
	$P = 0.086$					
Castanea sativa	LDED ~ PO4 + pH					
	AIC = -678	Intercept	4.5 x 10^{-4}	2.7 x 10^{-4}		
	Adj. $r^2 = 0.12$	PO4	-3.0 x 10^{-6}	1.2 x 10^{-6}	4.97	0.032
	$F_{2,37} = 3.63$	pH	-5.7 x 10^{-5}	3.8 x 10^{-5}	2.28	0.139
	$P = 0.036$					

Table S8. Influence of litter traits on the litter diversity effect on decomposition (LDED) in coarse-mesh and fine-mesh litterbags. The best model was selected based on the Akaike Information Criterion (AIC), following a forward stepwise approach. Litter traits: see Table S5. We show the AIC, adjusted r^2, *F*-values and *P*-values for each model; and the mean estimate, standard error, *F*-values and *P*-values for each factor.

Selected model	Factor	Estimate	SE	*F*	*P*
Coarse mesh					
DE ~ N + P + Tou					
AIC = -5591	Intercept	-1.3 x 10^{-4}	9.8 x 10^{-5}		
Adj. $r^2 = 0.05$	N	-1.1 x 10^{-4}	3.1 x 10^{-5}	14.21	<0.001
$F_{3,356} = 7.14$	P	3.3 x 10^{-3}	1.6 x 10^{-3}	5.16	0.024
$P < 0.001$	Tou	3.7 x 10^{-8}	2.6 x 10^{-8}	2.06	0.152
Fine mesh					
DE ~ SLA + P					
AIC = -5837	Intercept	-5.0 x 10^{-5}	6.2 x 10^{-5}		
Adj. $r^2 = 0.05$	SLA	1.0 x 10^{-5}	2.4 x 10^{-6}	16.09	<0.001
$F_{2,357} = 11.33$	P	-2.4 x 10^{-3}	9.3 x 10^{-4}	6.56	0.011
$P < 0.001$					

Table S9. Phylogenetic distance of experimental litter mixtures (in bold) and of all potential combinations of high-diversity mixtures containing one species from each family. Phylogenetic distance was calculated using the 'leafbud.py' tool in Python 2.7., based on a phylogenetic tree of angiosperms that was constructed for a previous study (*35*).

Betulaceae	Moraceae	Fagaceae	Phylogenetic distance	Mixture
Aa Ag Ai			**215.814781**	I
	Fi Fn Fd		**263.016249**	II
		Fs Qp Cs	**233.230811**	III
Aa	*Fi*	*Fs*	**356.524811**	IV
		Qp	356.524761	
		Cs	356.524761	
	Fn	*Fs*	356.524829	
		Qp	356.524779	
		Cs	356.524779	
	Fd	*Fs*	356.52477	
		Qp	356.52472	
		Cs	356.52472	
Ag	*Fi*	*Fs*	356.524811	
		Qp	356.524761	
		Cs	356.524761	
	Fn	*Fs*	356.524829	
		Qp	**356.524779**	V
		Cs	356.524779	
	Fd	*Fs*	356.52477	
		Qp	356.52472	
		Cs	356.52472	
Ai	*Fi*	*Fs*	356.524811	
		Qp	356.524761	
		Cs	356.524761	
	Fn	*Fs*	356.52483	
		Qp	356.52478	
		Cs	356.52478	
	Fd	*Fs*	356.52477	
		Qp	356.52472	
		Cs	**356.52472**	VI

Appendix: Funding sources used to conduct research in different regions

Argentina: ANCYPT (PICT.2016-959). **Australia, Tasmania**: Australian Research Council Discovery Program (ARC- DP) DP190102837). **Brazil, Bahia**: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES ref. 88882.347849/2019-01); Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq ref. 424661/2016-0). **Brazil, Manaus**: Programa de Apoio à Fixação de Doutores no Amazonas FIXAM/AM (Amazonas State Research Foundation, FAPEAM); Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq; ref. 308970/2019-5); INCT ADAPTA II – CNPq (ref. 465540/2014-7); FAPEAM (ref. 062.1187/2017); CAPES–Coordination for the Improvement of Higher Education Personnel. **Brazil, Minas Gerais**: Programa Peixe-Vivo of Companhia Energética de Minas Gerais (CEMIG) and P&D Aneel-Cemig GT-599 and GT-611; Conselho Nacional de Desenvolvimento Científico e Tecnológico (303380/2015-2); Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) Finance Code 001. **Brazil, Rio Grande do Sul**: CNPq grant 305203/2017-7 and 421288/2017-5. **Chile**: ANID/FONDAP/15130015. **Canada**: Natural Sciences and Engineering Research Council of Canada. **Costa Rica** (litter collection and export): US National Science Foundation, grant DEB-1938843. **Finland**: Academy of Finland (grant no. 318230). **Guatemala**: Education for Nature Program from the World Wild Fund and LASPAU-Fulbright Program. **India**: Science and Engineering Research Board, New Delhi (ref. ECR/2016/000191/LS). **Japan, Sapporo**: Ministry of Land, Infrastructure, Transport, and Tourism of Japan; JSPS Grant-in-Aid for Scientific Research (B) (18H03407). **Kenya, Eldoret**: International Foundation for Science (Research Grant No. A/5810-1). **Panama**: National Secretariat for Science, Technology and Innovation (SENACYT; ref. APY-GC-2018B-052 contract no. 259-2018 and Scholarship contract no. 001-2015-AC); National Research System of Panama (SNI; contract no. 186-2018-AC); Scholarship IFARHU-SENACYT (contract no. 270-2018-1011-GG). **Portugal**: IATV and Portuguese Foundation for Science and Technology (FCT; strategic project UIDP/04292/2020 granted to MARE). **Spain, Almería**: 2014-2020 Operational Programme FEDER Andalusia, Spain (ref. UAL18-RNM-B006-B). **Spain, Basque Country**: Basque Government funds (ref. IT951-16); Spanish Ministry for Science, Innovation and Universities (ref. RTI2018-095023- B-I00). **Other regions:** funding was obtained from host institutions.

Dataset: Litter diversity effect on decomposition (LDED) values for each plant species within each replicate coarse-mesh or fine-mesh litterbag incubated in each study region. LDED units are given as a proportion per degree day (dd). File name: Dataset.xlsx