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SUPPLEMENTARY INFORMATION
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Local loss and spatial homogenization of plant diversity reduce ecosystem multifunctionality

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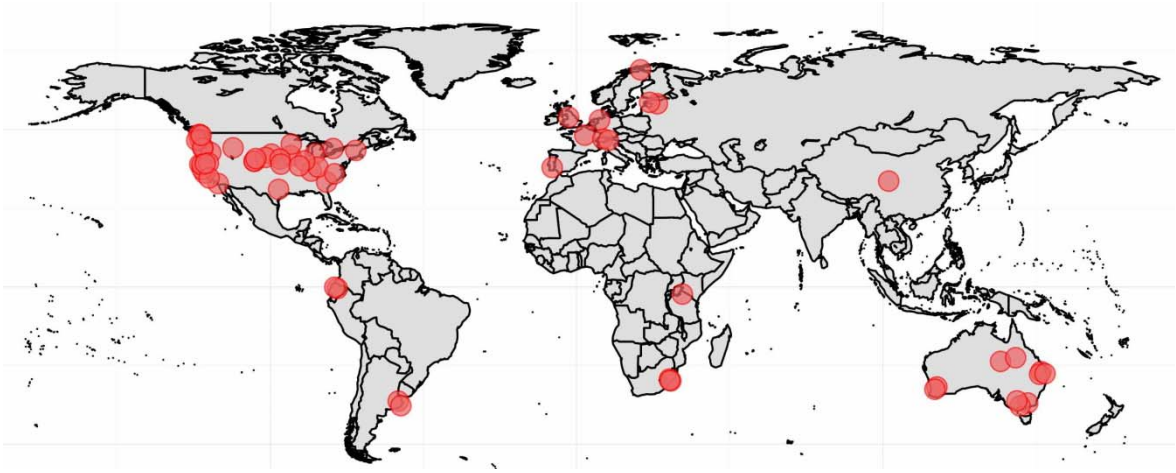
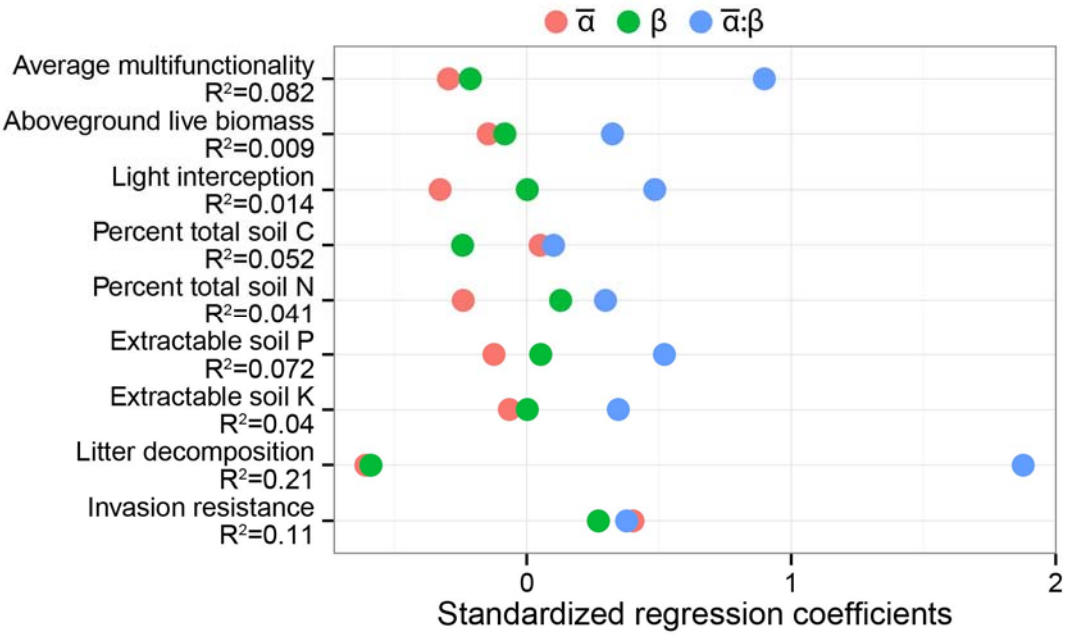
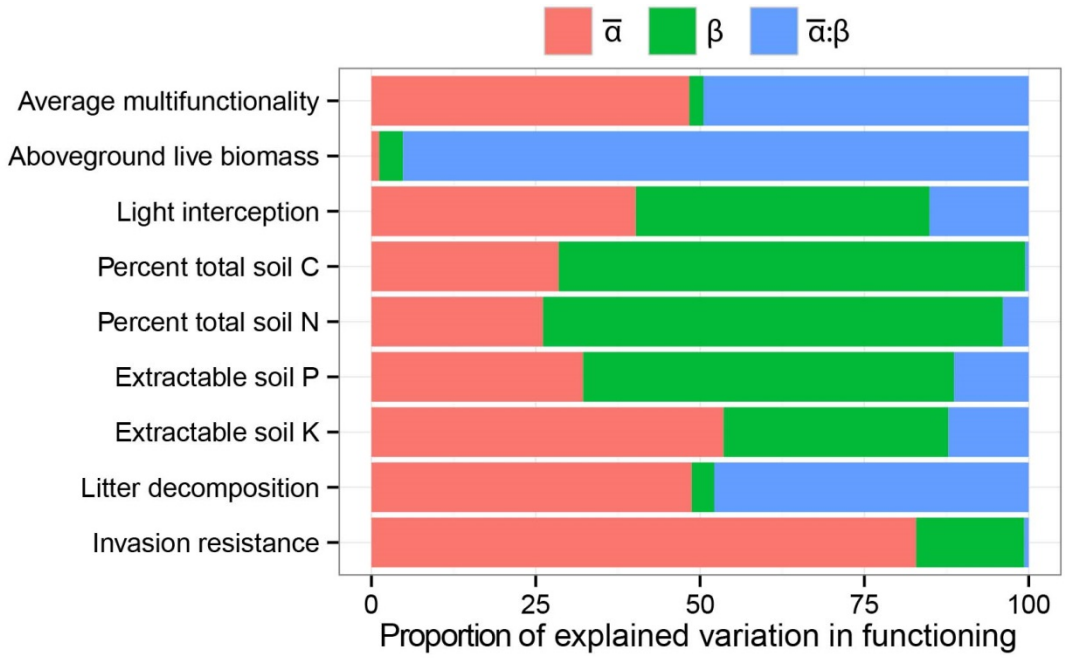


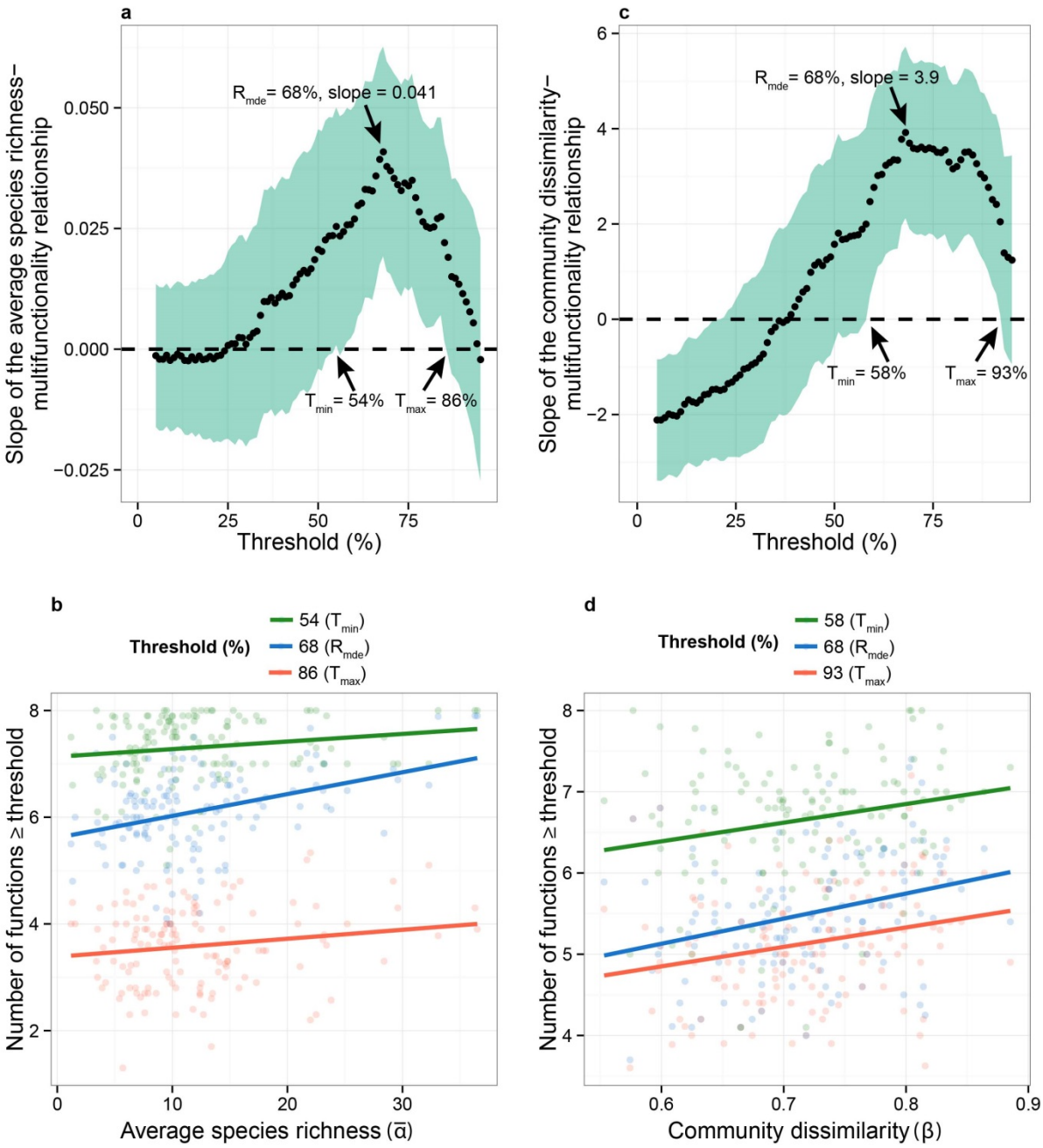
Supplementary Figure 1. Locations of the 65 Nutrient Network sites included in this study.



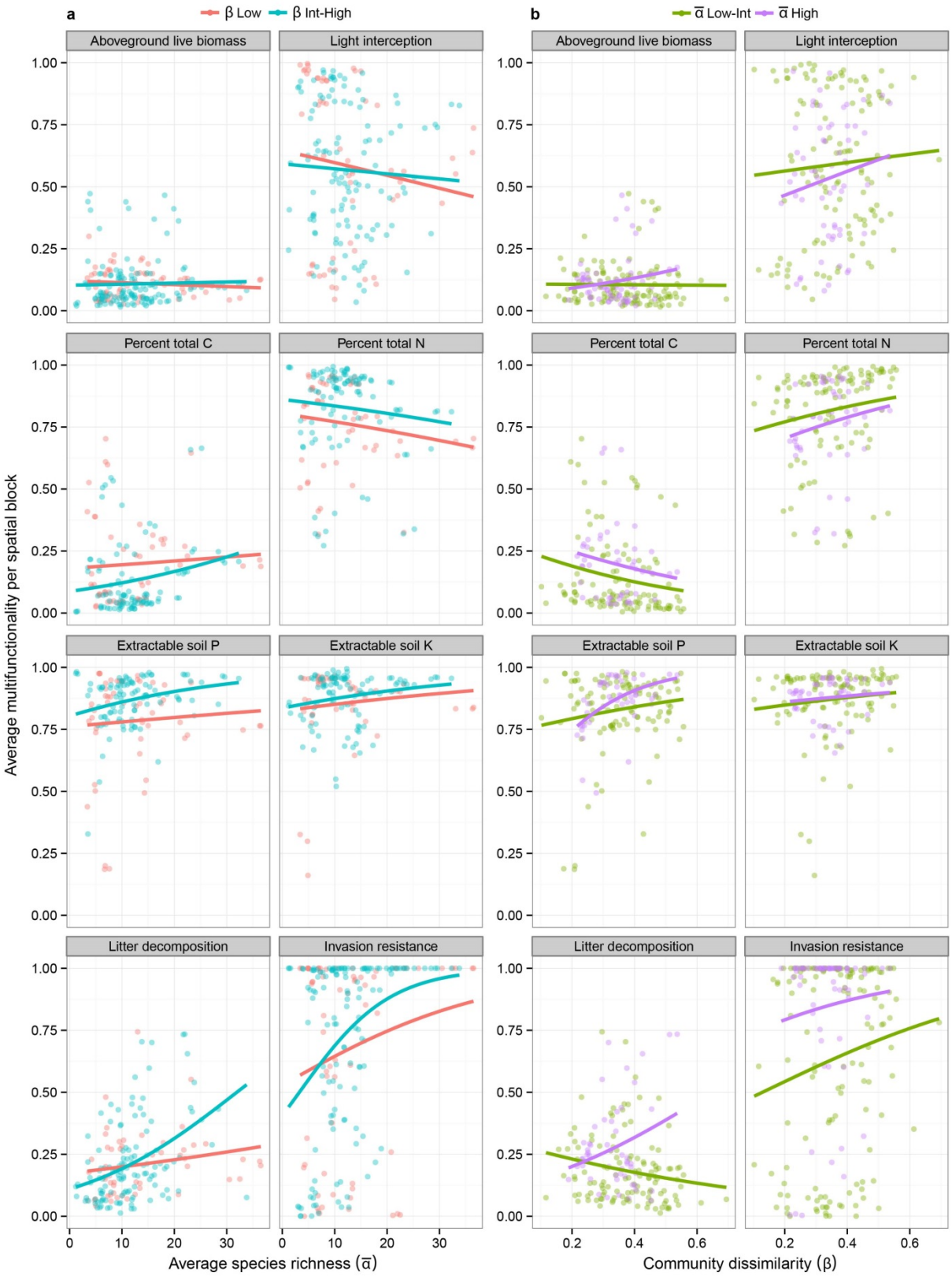
Supplementary Figure 2. Effect sizes of plant diversity on individual function and on the average multifunctionality. Standardized regression coefficients of local species richness ($\bar{\alpha}$), community dissimilarity (β) and their interaction ($\bar{\alpha}$: β) with each individual function and with the average multifunctionality. R^2 values are the proportion of variation explained by each regression.



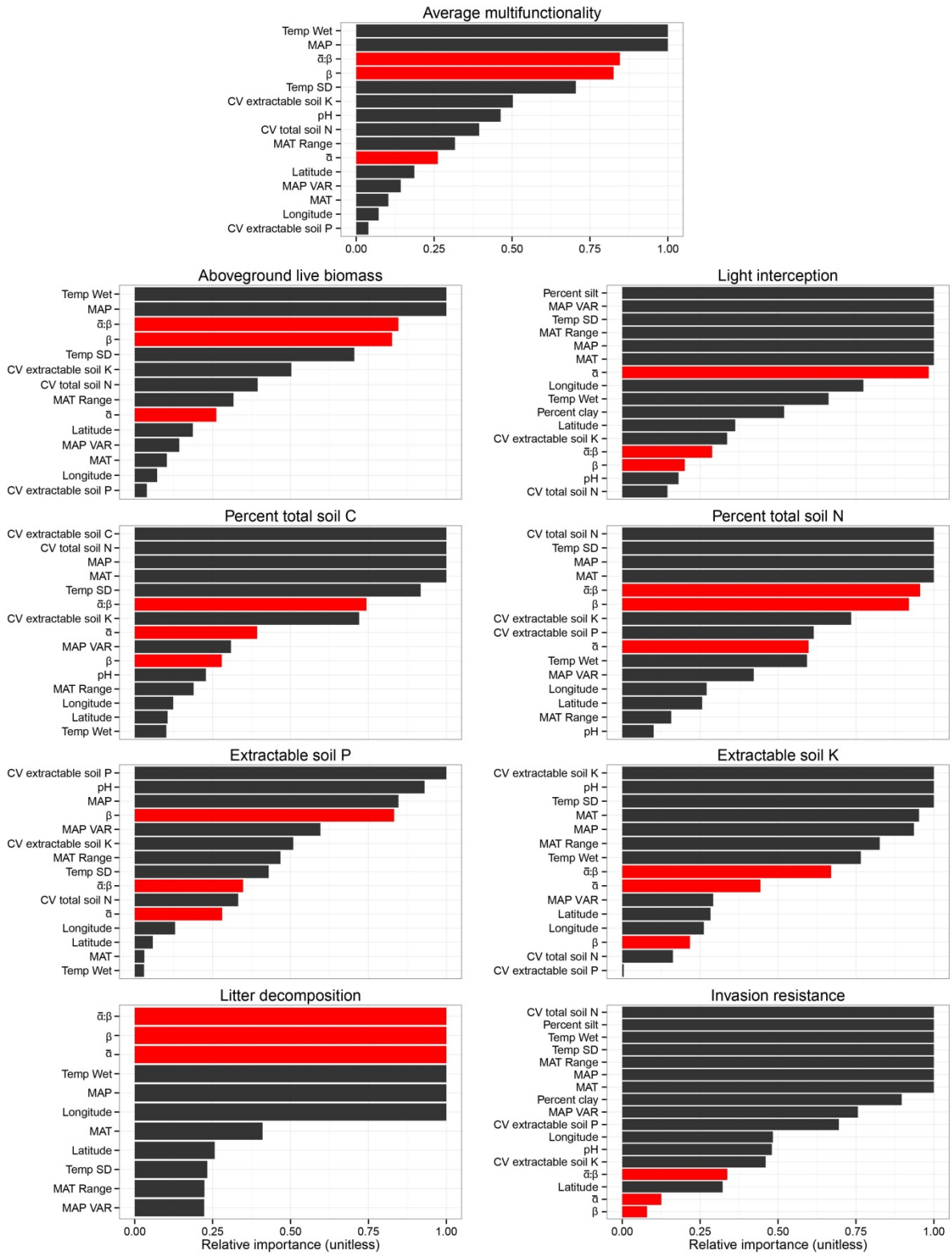
Supplementary Figure 3. Relative contribution of plant diversity to individual function and to the average multifunctionality. Percentage of variance explained by local species richness ($\bar{\alpha}$), community dissimilarity (β) and their interaction ($\bar{\alpha}$: β) on each individual function and on the average multifunctionality. The proportion of variance explained is based on R^2 values for each regression shown in Extended Data Figure 2.



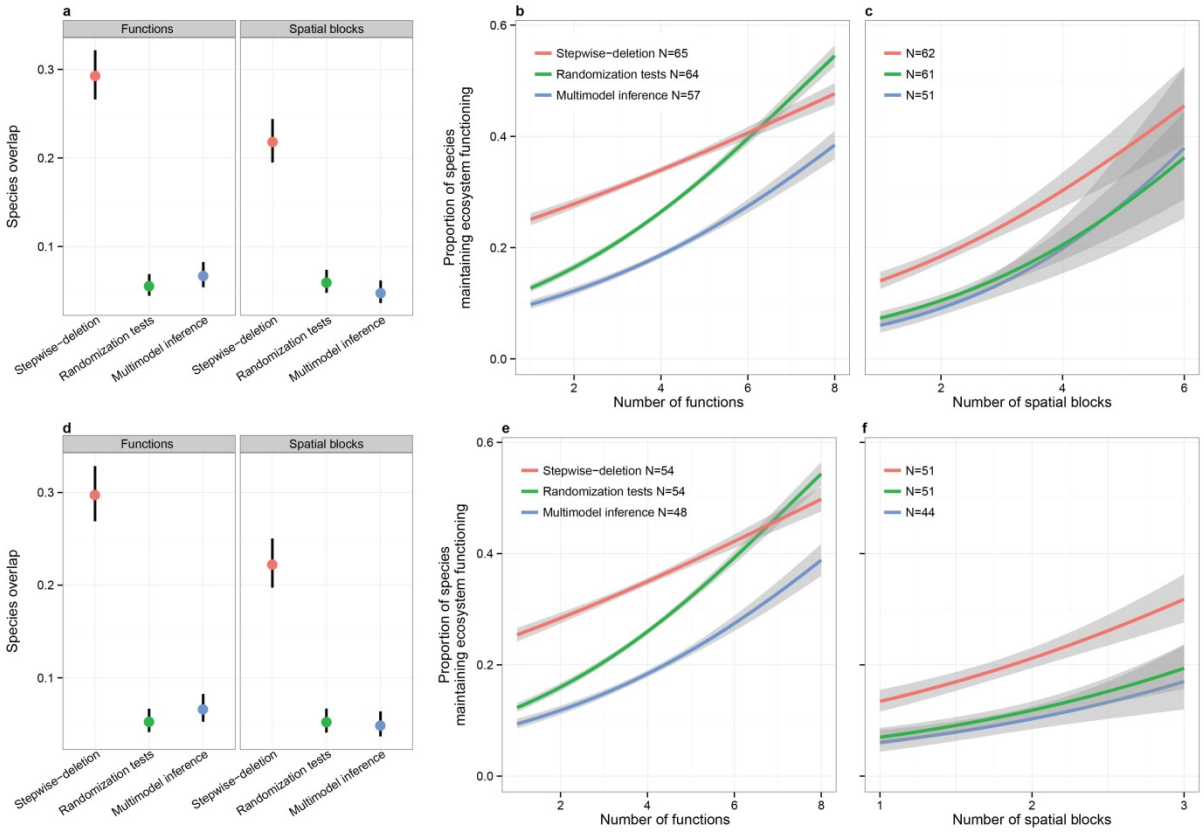
Supplementary Figure 4. Relationships between plant diversity and multiple-threshold multifunctionality after accounting for environmental variables. a and b, $\bar{\alpha}$ diversity; **c and d**, β diversity. Points in A and C are the slopes of the diversity-multifunctionality relationships for a range of threshold values ranging from 5 to 95% of maximum for each function. The shaded green area in **a** and **c** represents the 95% confidence intervals around the slopes such that diversity effect on multifunctionality is significant when the intervals do not overlap the zero line. Lines in B and D are the slopes shown in **a** and **c** for the minimum threshold above which (T_{min}) and maximum threshold below which (T_{max}) multifunctionality is associated with diversity, and for the realized maximum diversity effect (R_{mde}) where the slope of the diversity-multifunctionality relationship is steepest.



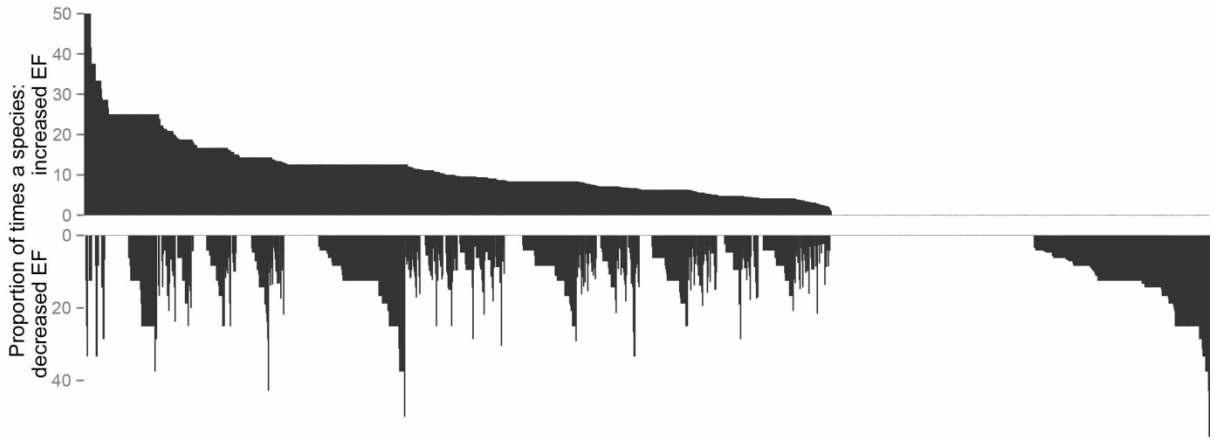
Supplementary Figure 5. Relationships of plant diversity with each individual function. a, average number of species per plot within spatial blocks ($\bar{\alpha}$ diversity); **b**, dissimilarity in species composition among plots within spatial blocks (β diversity). Red lines indicate the fits at low (Low) diversity and blue lines at intermediate to high diversity (Int-High).



Supplementary Figure 6. Relative importance of ᾱ, β diversity, their interaction (ᾱ:β) (red bars) and other key environmental predictors (black bars) on individual function and on the average multifunctionality. The size of the bars represents the importance of a variable relative to the other variables in the same model. Temp Wet: Mean temperature during the wettest four months (^{0}C), MAP VAR: Coefficient of variation of precipitation, MAT Range: Mean annual range in temperature (^{0}C), MAT: Mean annual temperature (^{0}C), Temp SD: Standard deviation in temperature, MAP: Mean annual precipitation (mm), CV: coefficient of variation.



Supplementary Figure 7. Analyses using presence-absence instead of species abundances (a-c) or only sites with three or fewer spatial blocks (d-f). Mean overlap values ± 95% CI between sets of species maintaining ecosystem functioning **a & d**. Higher proportion of species maintained ecosystem functioning when more functions **b & e**, or when a wider range of spatial blocks **c & f**, were independently considered. N denotes the number of sites included in each approach.



Supplementary Figure 8. Proportion of times a species significantly increased or decreased ecosystem functioning (EF). Study species (1633) are ordered from those that promoted EF most frequently (left) to those that promoted EF least frequently (right). About two third of the species studied (1082) increased EF at least once and about one fifth of the species (295) never influenced EF.

Supplementary Table 1. Additional information on the 65 Nutrient Network study sites.

Site	Continent	Country	Habitat	Elevation	Latitude	Longitude	Year	Number of block	Number of functions	Functions measured	Land use history	Number of plot per block 1,2,3,4,5,6	PIs
amcamp.us	North America	USA	mesic grassland	41	48.5	-123.0	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Jonathan D. Bakker, Janneke Hille Ris Lambers
anti.ec	South America	Ecuador	alpine grassland	4400	-0.5	-78.2	2013	5	4	AGB PAR LD IR		10,10,10,10,10,0	Selene Baez
azi.cn	Asia	China	alpine grassland	3500	33.7	101.9	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Chengjin Chu
barta.us	North America	USA	mixedgrass prairie	767	42.2	-99.7	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	David Wedin
bldr.us	North America	USA	shortgrass prairie	1633	40.0	-105.2	2008	2	8	AGB PAR C N P K LD IR	Managed	10,10,0,0,0,0	Brett Melbourne, Kendi Davies
bnch.us	North America	USA	montane grassland	1318	44.3	-122.0	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Eric Seabloom, Elizabeth Borer
bogong.au	Australia	Australia	alpine grassland	1760	-36.9	147.3	2009	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	John Morgan, Joslin L. Moore
bttr.us	North America	USA	montane grassland	1500	44.3	-122.0	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Eric Seabloom, Elizabeth Borer
bunya.au	Australia	Australia	grassland	0	-26.9	151.6	2013	3	7	AGB C N P K LD IR		10,10,10,0,0,0	Jennifer Firn
burrawan.au	Australia	Australia	semiarid grassland	425	-27.7	151.1	2008	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Jennifer Firn, Yvonne M. Buckley
cbgb.us	North America	USA	tallgrass prairie	275	41.8	-93.4	2009	6	8	AGB PAR C N P K LD IR	Burned Anthropogenic	10,10,10,8,8,8	W. Stanley Harpole, Lori A. Biederman
cdcr.us	North America	USA	tallgrass prairie	270	45.4	-93.2	2007	5	8	AGB PAR C N P K LD IR		10,10,10,10,10,0	Elizabeth Borer, W. Stanley Harpole, Adam Kay, Eric Seabloom
cdpt.us	North America	USA	shortgrass prairie	965	41.2	-101.6	2007	6	8	AGB PAR C N P K LD IR		10,10,10,10,10,10	Johannes M. H. Knops
cereep.fr	Europe	France	old field	83	48.3	2.7	2012	3	5	AGB C N P K	Managed Grazed Anthropogenic	10,10,10,0,0,0	Amandine Hansart, Beatriz Decencière
chilcas.ar	South America	Argentina	mesic grassland	15	-36.3	-58.3	2013	3	4	AGB PAR LD IR		10,10,10,0,0,0	Enrique Chaneton, Laura Yahdjian
comp.pt	Europe	Portugal	annual grassland	200	38.0	-8.0	2012	3	7	AGB PAR C N P K IR	Managed Grazed Anthropogenic	10,11,10,0,0,0	Maria Caldeira, Miguel Bugalho
cowi.ca	North America	Canada	old field	50	48.5	-123.4	2007	3	7	AGB C N P K LD IR		10,10,10,0,0,0	Andrew MacDougall
derr.au	Australia	Australia	semiarid grassland	38	-37.8	144.8	2007	3	3	AGB PAR IR	Managed Burned	10,10,10,0,0,0	John Morgan
doane.us	North America	USA	tallgrass prairie	418	40.7	-96.9	2012	6	4	AGB PAR LD IR	Managed Burned Anthropogenic	10,10,10,10,10,10	Ramesh Laungani
elliot.us	North America	USA	annual grassland	200	32.9	-117.1	2008	3	6	PAR C N P K IR		10,10,10,0,0,0	Elsa Cleland
elva.ee	Europe	Estonia	semiarid grassland	64	58.3	26.4	2012	1	4	AGB PAR LD IR		10,0,0,0,0,0	Meelis Pärtel, Aveliina Helm
ethass.au	Australia	Australia	desert grassland	104	-23.6	138.4	2013	3	8	AGB PAR C N P K LD IR	Managed Grazed	10,9,9,0,0,0	Glenda Wardle
frue.ch	Europe	Switzerland	pasture	995	47.1	8.5	2008	3	7	AGB PAR C N P K IR	Managed Grazed Anthropogenic	10,10,10,0,0,0	Andy Hector, Yann Hautier
gilb.za	Africa	South Africa	montane grassland	1748	-29.3	30.3	2010	3	7	AGB PAR C N P K IR	Managed Burned	10,10,10,0,0,0	Peter D. Wragg

glac.us	North America	USA	mesic grassland	33	46.9	-123.0	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Janneke Hille Ris Lambers, Jonathan D. Bakker
hall.us	North America	USA	tallgrass prairie	194	36.9	-86.7	2007	3	8	AGB PAR C N P K LD IR	Managed	10,10,10,0,0,0	Rebecca L. McCulley
hart.us	North America	USA	shrub steppe	1508	42.7	-119.5	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Nicole M. DeCrappeo, David Pyke
hast.us	North America	USA	annual grassland	750	36.2	-121.6	2007	3	4	AGB PAR LD IR		10,10,10,0,0,0	Elizabeth Borer, Eric Seabloom
hnvr.us	North America	USA	old field	271	43.4	-72.1	2007	3	8	AGB PAR C N P K LD IR	Anthropogenic	10,10,10,0,0,0	Elizabeth M. Wolkovich, Kathryn L. Cottingham
hopl.us	North America	USA	annual grassland	598	39.0	-123.1	2007	3	4	AGB PAR LD IR		9,9,9,0,0,0	Elizabeth Borer, Eric Seabloom
jasp.us	North America	USA	annual grassland	120	37.4	-122.2	2007	3	4	AGB PAR LD IR		10,10,10,0,0,0	Elsa Cleland
kbs.us	North America	USA	old field	288	42.4	-85.4	2013	5	8	AGB PAR C N P K LD IR		10,10,10,10,10,0	Lars Brudvig
kilp.fi	Europe	Finland	tundra grassland	700	69.1	20.8	2013	4	2	AGB LD	Grazed	10,10,10,10,0,0	Anu Eskelinen, Risto Virtanen
kiny.au	Australia	Australia	semiarid grassland	90	-36.2	143.8	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	John Morgan
kirik.ee	Europe	Estonia	calcareous grassland	8	58.7	23.8	2012	3	4	AGB PAR LD IR		10,10,10,0,0,0	Aveliina Helm, Meelis Pärtel
koffler.ca	North America	Canada	pasture	301	44.0	-79.5	2010	3	4	AGB PAR LD IR	Managed	12,12,12,0,0,0	Marc Cadotte, Robin Marushia, Arthur Weiss
konz.us	North America	USA	tallgrass prairie	440	39.1	-96.6	2007	3	3	AGB PAR IR	Managed Burned	10,10,10,0,0,0	Melinda Smith, Kimberly J. La Pierre
lancaster.uk	Europe	UK	mesic grassland	180	54.0	-2.6	2008	3	7	AGB C N P K LD IR	Managed Grazed	10,8,8,0,0,0	Carly Stevens
lead.us	North America	USA	salt marsh	2	46.6	-124.0	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	John G. Lambrinos
look.us	North America	USA	montane grassland	1500	44.2	-122.1	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Eric Seabloom, Elizabeth Borer
marc.ar	South America	Argentina	grassland	6	-37.7	-57.4	2011	3	4	AGB PAR LD IR		10,10,10,0,0,0	Juan Alberti, Pedro Daleo
mcla.us	North America	USA	annual grassland	642	38.9	-122.4	2007	3	4	AGB PAR LD IR		10,10,10,0,0,0	Eric Seabloom, W. Stanley Harpole, Elizabeth Borer
mitch.au	Australia	Australia	semiarid grassland	242	-22.5	143.3	2013	1	8	AGB PAR C N P K LD IR		10,0,0,0,0,0	Jennifer Firn
mtca.au	Australia	Australia	savanna	285	-31.8	117.6	2008	4	4	AGB PAR LD IR		10,10,10,10,0,0	Suzanne M Prober
niwo.us	North America	USA	alpine grassland	3050	40.0	-105.4	2007	4	3	AGB LD IR		10,10,10,0,0,0	William Bowman, Timothy Seastedt
pape.de	Europe	Germany	old field	1	53.1	7.5	2007	1	8	AGB PAR C N P K LD IR	Anthropogenic	10,0,0,0,0,0	Helmut Hillebrand
pich.ec	South America	Ecuador	alpine grassland	4200	-0.1	-79.0	2013	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Selene Baez
ping.au	Australia	Australia	old field	338	-32.5	117.0	2013	3	4	AGB PAR LD IR	Managed Grazed Anthropogenic	10,10,10,0,0,0	Jodi Price, Rachel Standish
pinj.au	Australia	Australia	pasture	38	-27.5	152.9	2013	3	8	AGB PAR C N P K LD IR	Grazed Anthropogenic	10,10,10,0,0,0	John Dwyer, Yvonne M. Buckley

sage.us	North America	USA	montane grassland	1920	39.4	-120.2	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Daniel S. Gruner, Louie Yang
sava.us	North America	USA	savanna	71	33.3	-81.7	2007	2	8	AGB PAR C N P K LD IR		10,10,0,0,0,0	Ellen I. Damschen, Lars Brudvig, John L. Orrock
sedg.us	North America	USA	annual grassland	550	34.7	-120.0	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Elizabeth Borer, Eric Seabloom, Carla M D'Antonio, W. Stanley Harpole
sereng.tz	Africa	Tanzania	savanna	1536	-2.3	34.5	2008	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	T. Michael Anderson
sgs.us	North America	USA	shortgrass prairie	1650	40.8	-104.8	2007	3	7	AGB PAR C N P K IR		10,10,10,0,0,0	Cynthia S. Brown, Dana M. Blumenthal, Julia A. Klein
shps.us	North America	USA	shrub steppe	910	44.2	-112.2	2007	4	8	AGB PAR C N P K LD IR	Managed Grazed	10,10,10,10,0,0	Peter Adler
sier.us	North America	USA	annual grassland	197	39.2	-121.3	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Elizabeth Borer, W. Stanley Harpole, Eric Seabloom
smith.us	North America	USA	mesic grassland	62	48.2	-122.6	2007	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Jonathan D. Bakker
spin.us	North America	USA	pasture	271	38.1	-84.5	2007	3	8	AGB PAR C N P K LD IR	Managed Grazed Anthropogenic	10,10,10,0,0,0	Rebecca L. McCulley
summ.za	Africa	South Africa	mesic grassland	679	-29.8	30.7	2010	3	7	AGB PAR C N P K IR	Managed Burned	10,10,10,0,0,0	Peter D. Wragg
temple.us	North America	USA	tallgrass prairie	184	31.0	-97.3	2007	3	7	AGB PAR C N P K IR		8,10,8,0,0,0	Philip A Fay
trel.us	North America	USA	tallgrass prairie	200	40.1	-88.8	2008	3	6	PAR C N P K IR		10,10,10,0,0,0	Andrew Leakey, Xiaohui Feng
tyso.us	North America	USA	old field	169	38.5	-90.6	2007	4	8	AGB PAR C N P K LD IR	Anthropogenic	10,10,10,10,0,0	John L. Orrock, Tiffany Knight, Ellen I. Damschen
ukul.za	Africa	South Africa	mesic grassland	843	-29.7	30.4	2009	3	8	AGB PAR C N P K LD IR	Managed Burned	10,10,10,0,0,0	Kevin P Kirkman, Nicole Hagenah, Michelle Tedder
unc.us	North America	USA	old field	141	36.0	-79.0	2007	3	8	AGB PAR C N P K LD IR	Anthropogenic	10,10,10,0,0,0	Justin Wright, Charles Mitchell
valm.ch	Europe	Switzerland	alpine grassland	2320	46.6	10.4	2008	3	8	AGB PAR C N P K LD IR		10,10,10,0,0,0	Martin Schuetz, Anita C. Risch

AGB: Aboveground live biomass , PAR: Percentage of photosynthetically active radiation intercepted at ground level, C: Percent of soil carbon, N: Percent total nitrogen (nitrate ammonium), P: Soil extractable phosphorus, K: Soil extractable potassium, LD: Litter decomposition, IR: Invasion resistance

Supplementary Table 2. Correlation matrix between each pair of eight standardized functions.

	Aboveground live biomass	Light interce-ption	Percent total C	Percent total N	Extractable soil P	Extractable soil K	Litter decompo-sition
Light interception	**0.29*** **	---	---	---	---	---	---
Percent total C	0.05	**0.10*** **					
Percent total N	**0.07** **	**0.11*** **	**-0.96*** **	---	---	---	---
Extractable soil P	**0.20*** **	**0.30*** **	0.01	0.04	---	---	---
Extractable soil K	**0.08** **	-0.02	-0.01	0.02	**0.25*** **	---	---
Litter decomposition	**0.06* **	**-0.26*** **	0.02	-0.01	**-0.14*** **	0.02	---
Invasion resistance	0.01	**-0.11*** **	**0.10*** **	0.05	**-0.25*** **	**0.14*** **	0.05

Significance levels of Pearson's correlation coefficients: ***P < 0.001, **P < 0.01, *P < 0.05. Significant Pearson's correlation coefficients are shown in bold.

Supplementary Table 3. Relationships of plant diversity with each individual function. Coefficients of the relationships of the average number of species per plot within spatial blocks ($\bar{\alpha}$ diversity) and dissimilarity in species composition among plots within spatial blocks (β diversity) with each individual functions. The effects report the value of the intercept and slope of the fits at low (Low) diversity for $\bar{\alpha}$ diversity and at low to intermediate (Low-Int) diversity for (β diversity) as well as the differences (in italics) between the intermediate to high diversity (Int-High) and low diversity for $\bar{\alpha}$ diversity and between the high (High) diversity and low to intermediate diversity for β diversity.

Alpha				**Beta**			
	Effect	2.5%	97.5%		Effect	2.5%	97.5%
Aboveground live biomass				**Aboveground live biomass**			
Intercept Low	-1.98	-3.59	-0.53	Intercept Low-Int	-2.11	-4.19	-0.26
Intercept Int-High	-0.19	-2.07	1.77	*Intercept High*	-0.60	-4.74	3.36
Slope Low	-0.01	-0.12	0.08	Slope Low-Int	-0.09	-5.20	5.00
Slope Int-High	0.01	-0.11	0.15	*Slope High*	2.16	-9.29	13.38
Light interception				**Light interception**			
Intercept Low	0.60	-0.35	1.60	Intercept Low-Int	0.11	-1.11	1.34
Intercept Int-High	-0.23	-1.48	1.01	*Intercept High*	-0.64	-3.43	2.09
Slope Low	-0.02	-0.09	0.04	Slope Low-Int	0.71	-2.52	3.97
Slope Int-High	0.01	-0.07	0.10	*Slope High*	1.23	-6.50	9.18
Percent total soil C				**Percent total soil C**			
Intercept Low	-1.51	-2.82	-0.30	Intercept Low-Int	-0.97	-2.83	0.76
Intercept Int-High	-0.83	-2.63	0.95	*Intercept High*	0.28	-3.45	4.02
Slope Low	0.01	-0.09	0.09	Slope Low-Int	-2.42	-7.60	2.59
Slope Int-High	0.03	-0.09	0.15	*Slope High*	0.32	-10.92	10.93
Percent total soil N				**Percent total soil N**			
Intercept Low	1.41	0.27	2.64	Intercept Low-Int	0.82	-0.76	2.51
Intercept Int-High	0.41	-1.23	2.05	*Intercept High*	-0.41	-3.91	3.08
Slope Low	-0.02	-0.10	0.06	Slope Low-Int	1.94	-2.58	6.57
Slope Int-High	0.00	-0.11	0.11	*Slope High*	0.31	-9.57	10.78
Extractable soil P				**Extractable soil P**			
Intercept Low	1.16	-0.05	2.41	Intercept Low-Int	1.02	-0.60	2.77
Intercept Int-High	0.25	-1.51	2.01	*Intercept High*	-1.16	-5.47	3.02
Slope Low	0.01	-0.07	0.11	Slope Low-Int	1.59	-3.05	6.32
Slope Int-High	0.03	-0.11	0.17	*Slope High*	4.43	-7.69	18.34
Extractable soil K				**Extractable soil K**			
Intercept Low	1.54	0.12	3.03	Intercept Low-Int	1.46	-0.34	3.45
Intercept Int-High	0.08	-1.87	2.03	*Intercept High*	0.14	-4.22	4.63
Slope Low	0.02	-0.07	0.15	Slope Low-Int	1.29	-3.94	6.58
Slope Int-High	0.01	-0.15	0.16	*Slope High*	-0.21	-12.57	13.10
Litter decomposition				**Litter decomposition**			
Intercept Low	-1.56	-2.90	-0.36	Intercept Low-Int	-0.87	-2.55	0.72
Intercept Int-High	-0.53	-2.12	1.10	*Intercept High*	-1.13	-4.48	2.06
Slope Low	0.02	-0.06	0.09	Slope Low-Int	-1.67	-6.00	2.57
Slope Int-High	0.05	-0.05	0.15	*Slope High*	4.76	-4.25	14.00
Invasion resistance				**Invasion resistance**			
Intercept Low	0.11	-0.89	1.09	Intercept Low-Int	-0.31	-1.50	0.86
Intercept Int-High	-0.49	-1.82	0.83	*Intercept High*	1.09	-2.33	4.54
Slope Low	0.05	-0.02	0.13	Slope Low-Int	2.42	-0.69	5.64
Slope Int-High	0.07	-0.04	0.17	*Slope High*	0.40	-9.44	10.95

Supplementary Table 4. Coefficients of the best and most parsimonious model following multi-model inference evaluating the influence of $\bar{\alpha}$, β diversity, their interaction ($\bar{\alpha}$:β) and other key environmental predictors on each individual function and on the average multifunctionality. Details as for Extended Data Figure 6.

	Estimate	Std.Error	z values	Pr(>|z|)
Average multifunctionality				
MAP	0.00005	0.00001	4.937	<0.001
Temp SD	0.00065	0.00021	3.046	0.003
Temp Wet	0.00356	0.00071	5.027	<0.001
CV extractable soil K	-0.00010	0.00008	-1.209	0.229
β	-0.14940	0.06165	-2.423	**0.017**
$\bar{\alpha}$:β	0.01200	0.00228	5.272	**<0.001**
Aboveground live biomass				
MAT	-0.00805	0.00149	-5.406	<0.001
MAP	0.00005	0.00001	5.076	<0.001
Temp SD	-0.00217	0.00025	-8.642	<0.001
MAP VAR	-0.00082	0.00023	-3.624	<0.001
Temp Wet	0.00591	0.00101	5.835	<0.001
$\bar{\alpha}$	-0.00184	0.00074	-2.484	**0.014**
Light interception				
Longitude	-0.00105	0.00025	-4.190	<0.001
MAT	0.02001	0.00637	3.139	0.002
MAP	0.00030	0.00005	6.268	<0.001
MAT Range	-0.04705	0.00937	-5.022	<0.001
Temp SD	0.01901	0.00357	5.323	<0.001
MAP VAR	0.00380	0.00107	3.567	0.001
Temp Wet	0.00772	0.00398	1.942	0.055
Percent silt	0.00698	0.00126	5.535	<0.001
$\bar{\alpha}$	0.01014	0.00324	3.127	**0.002**
Percent total soil C				
MAT	-0.01383	0.00216	-6.397	<0.001
MAP	0.00009	0.00002	4.571	<0.001
Temp SD	-0.00304	0.00045	-6.739	<0.001
CV total soil N	-0.00031	0.00011	-2.972	0.003
CV extractable soil C	0.00037	0.00011	3.435	0.001
CV extractable soil K	0.00029	0.00015	1.940	0.054
$\bar{\alpha}$:β	-0.00956	0.00378	-2.529	**0.013**
Percent total soil N				
MAT	0.02022	0.00236	8.555	<0.001
MAP	-0.00012	0.00002	-5.604	<0.001
Temp SD	0.00410	0.00051	8.057	<0.001
CV total soil N	0.00035	0.00011	3.255	0.001
CV extractable soil P	-0.00037	0.00011	-3.337	0.001
CV extractable soil K	-0.00029	0.00015	-1.889	0.061
$\bar{\alpha}$	-0.00998	0.00507	-1.968	**0.051**
β	-0.58260	0.19040	-3.060	**0.003**
$\bar{\alpha}$:β	0.04576	0.01497	3.057	**0.003**
Extractable soil P				
MAP	-0.00005	0.00002	-2.210	0.029
MAP VAR	0.00091	0.00045	2.019	0.045
pH	-0.03255	0.01620	-2.009	0.046
CV total soil N	-0.00017	0.00011	-1.569	0.119
CV extractable soil P	0.00070	0.00011	6.238	<0.001
β	0.35150	0.10390	3.383	**0.001**
Extractable soil K				
MAT	0.00810	0.00297	2.727	0.007
MAP	-0.00005	0.00002	-2.544	0.012
MAT Range	-0.00804	0.00361	-2.230	0.027
Temp SD	0.00466	0.00135	3.444	0.001
Temp Wet	-0.00377	0.00174	-2.172	0.031
pH	-0.06885	0.01394	-4.939	<0.001
CV extractable soil K	0.00055	0.00014	4.101	<0.001
$\bar{\alpha}$:β	0.01299	0.00354	3.669	**<0.001**
Litter decomposition				
Longitude	0.00079	0.00011	7.336	<0.001
MAP	-0.00010	0.00002	-4.999	<0.001
Temp Wet	-0.00393	0.00136	-2.892	0.004
$\bar{\alpha}$	-0.03017	0.00466	-6.469	**<0.001**
β	-0.98680	0.17060	-5.785	**<0.001**
$\bar{\alpha}$:β	0.10910	0.01380	7.908	**<0.001**
Invasion resistance				
MAT	-0.07650	0.00852	-8.975	<0.001
MAP	0.00049	0.00006	7.685	<0.001
MAT Range	0.07299	0.01103	6.615	<0.001
Temp SD	-0.02972	0.00408	-7.288	<0.001
MAP VAR	-0.00299	0.00130	-2.296	0.024
Temp Wet	0.03533	0.00500	7.066	<0.001
Percent silt	-0.00548	0.00179	-3.067	0.003
Percent clay	0.00711	0.00289	2.459	0.015
CV total soil N	0.00082	0.00029	2.873	0.005
CV extractable soil P	0.00062	0.00027	2.311	0.023

Supplementary Table 5. Relationship between plant diversity and average multifunctionality across environmental gradients. Coefficients of the relationships between the slopes of relationships of $\overline{\alpha}$ and β diversity with average multifunctionality as response variable and each environmental variable as explanatory variables**.**

	$\overline{\alpha}$ diversity				**β diversity**			
Variable	Slope	Std.Error	t values	Pr(>|t|)	Slope	Std.Error	t values	Pr(>|t|)
Latitude	609.80	4653.32	0.13	0.90	-129.63	109.90	-1.18	0.24
Longitude	17251.98	13366.51	1.29	0.20	99.73	323.06	0.31	0.76
MAT	356.45	831.38	0.43	0.67	6.34	19.86	0.32	0.75
MAP	-63.01	1074.25	-0.06	0.95	-8.19	25.63	-0.32	0.75
MAT RANGE	96.35	403.28	0.24	0.81	-5.05	9.61	-0.53	0.60
Temp SD	4540.13	3708.58	1.22	0.23	-249.05	83.91	-2.97	**<0.01**
MAP VAR	863.74	3508.30	0.25	0.81	74.33	83.27	0.89	0.38
Temp Wet	1565.12	1122.72	1.39	0.17	-44.82	26.62	-1.68	0.10
pH	-77.46	73.19	-1.06	0.29	0.40	1.97	0.21	0.84
Percent silt	1344.43	1530.71	0.88	0.38	92.60	41.25	2.24	**0.03**
Percent clay	1441.03	1088.88	1.32	0.19	84.23	29.08	2.90	**<0.01**
Bulk density	33.77	35.39	0.95	0.34	0.06	1.17	0.05	0.96
CV total soil N	-178.75	123.38	-1.45	0.15	-6.81	3.28	-2.07	**0.04**
CV extractable soil P	49.61	110.34	0.45	0.65	1.36	2.96	0.46	0.65
CV extractable soil K	-85.68	94.68	-0.90	0.37	-3.94	2.53	-1.56	0.12

Supplementary Table 6. Author contribution matrix.

Co-author	Developed and framed research question(s)	Analyzed data	Contributed to data analyses	Wrote the paper	Contributed to paper writing	Site level coordinator	Nutrient Network coordinators	Acknowledgements
Yann Hautier	x	x		x		x		
Forest Isbell	x	x		x				
Elizabeth Borer			x		x	x	x	
Eric W Seabloom			x		x	x	x	
W Stanley Harpole					x	x	x	
Eric M. Lind					x		x	
Andrew S MacDougall					x	x		
Carly J. Stevens					x	x		
Peter B. Adler					x	x		
Juan Alberti					x	x		
Jonathan D. Bakker			x		x	x		
Lars Brudvig					x	x		This is KBS contribution # 2004
Yvonne M. Buckley					x	x		
Marc W. Cadotte					x	x		
Maria C Caldeira					x	x		
Enrique J. Chaneton					x	x		
Chengjin Chu					x	x		
Pedro Daleo					x	x		
Christopher R Dickman					x	x		The Ethabuka site is supported by the Long Term Ecological Research Network, part of Australia's Terrestrial Ecosystem Research Network
John M. Dwyer					x	x		
Anu Eskelinen					x	x		
Philip A. Fay					x	x		
Jennifer Firn					x	x		
Nicole Hagenah					x	x		
Helmut Hillebrand					x	x		
Oscar Iribarne					x	x		
Kevin P. Kirkman					x	x		
Johannes M H Knops					x	x		
Kimberly La Pierre			x		x	x		The Konza Prairie site was supported by the Konza Prairie LTER and the Yale Institute for Biospheric Studies. The Saline Experimental Range site was supported by the Yale Institute for Biospheric Studies.
Rebecca L. McCulley					x	x		

John W. Morgan					x	x		
Meelis Pärtel					x	x		Meelis Pärtel was supported by the Estonian Ministry of Education and Research (IUT20-29) and the European Regional Development Fund (Centre of Excellence EcolChange)
Jesus Pascual					x	x		
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Risto Virtanen					x	x		
Glenda M. Wardle					x	x		The Ethabuka site is supported by the Long Term Ecological Research Network, part of Australia's Terrestrial Ecosystem Research Network
Laura Yahdjian					x	x		The Las Chilcas site is supported by Agencia Nacional de Investigaciones Cientificas y Tecnologicas and Universidad de Buenos Aires, Argentina
Andy Hector	x	x		x		x		