Supporting Information. Wilfahrt, P.A., A.L. Asmus, E.W. Seabloom, J.A. Henning, P. Adler, C.A. Arnillas, J.D. Bakker, L. Biederman, L.A. Brudvig, M. Cadotte, P. Daleo, A. Eskelinen, J. Firn, W.S. Harpole, Y. Hautier, K.P. Kirkman, K.J. Komatsu, R. Laungani, A. MacDougall, R.L. McCulley, J.L. Moore, J.W. Morgan, B. Mortensen, R. Ochoa Hueso, T. Ohlert, S.A. Power, J. Price, A.C. Risch, M. Schuetz, L. Shoemaker, C. Stevens, A.T. Strauss, P.M. Tognetti, R. Virtanen, and E.T. Borer. 2021. Temporal rarity is a better predictor of local extinction risk than spatial rarity. Ecology.

Appendix S1

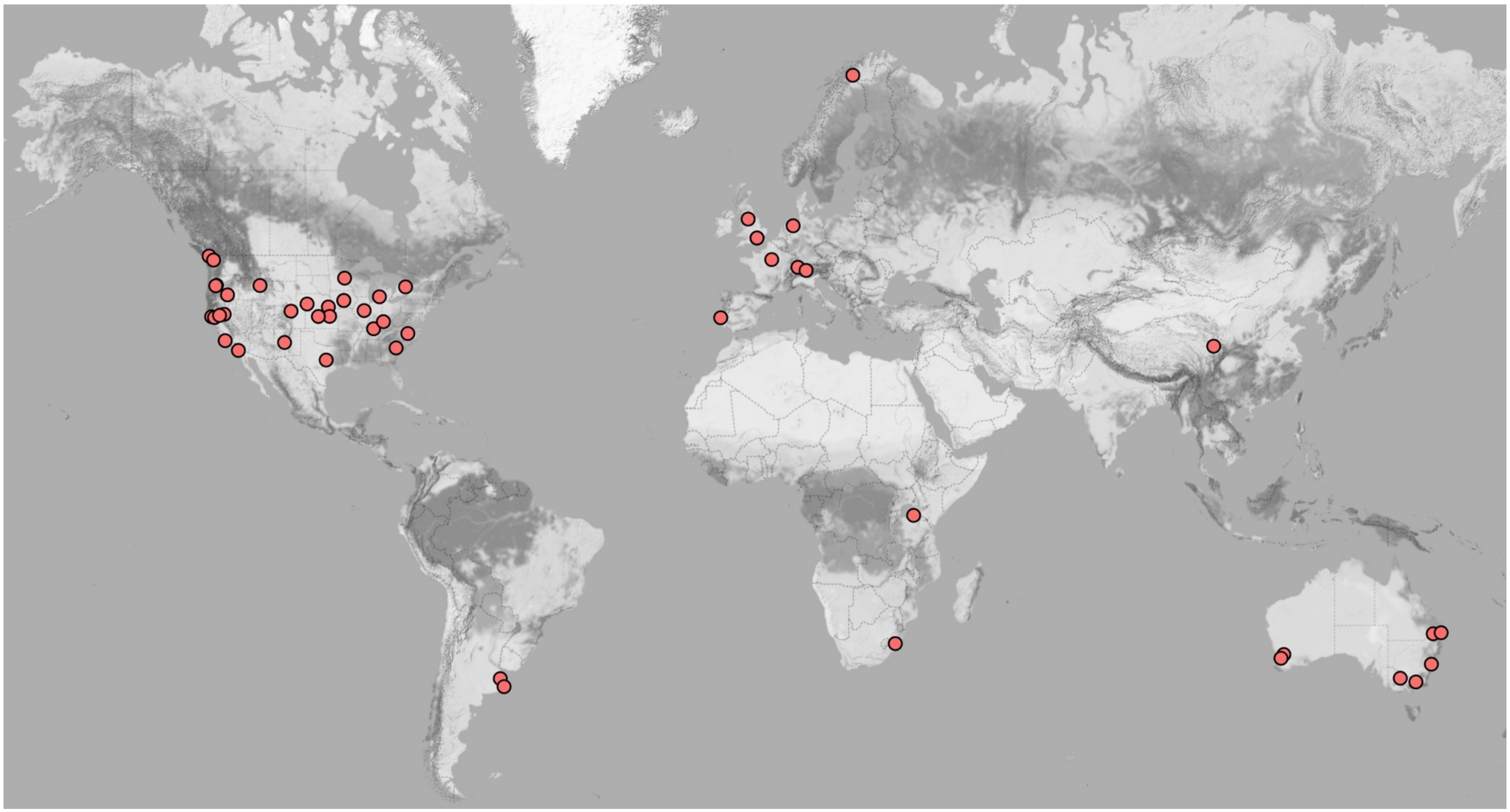
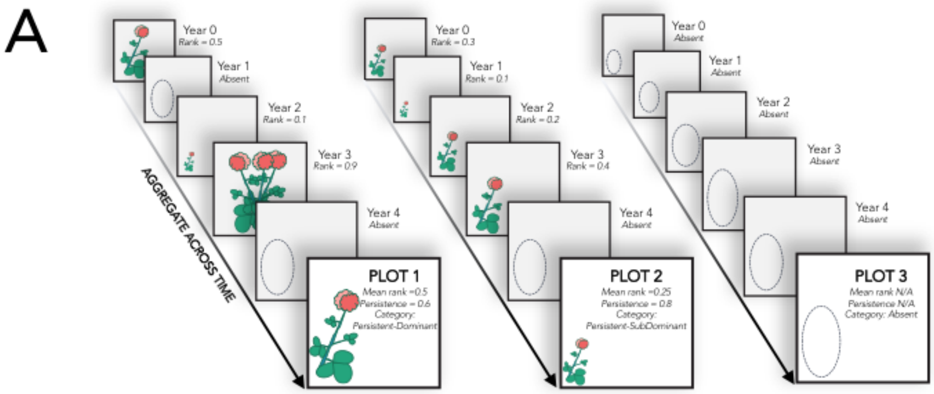
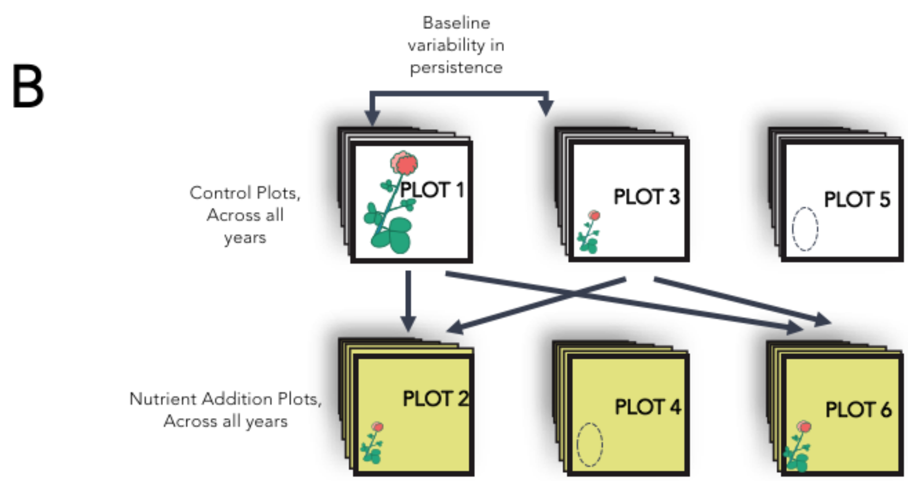


Figure S1. Location of the Nutrient Network sites included in this study. Some points overlap; see SI Table S1 for a full list.

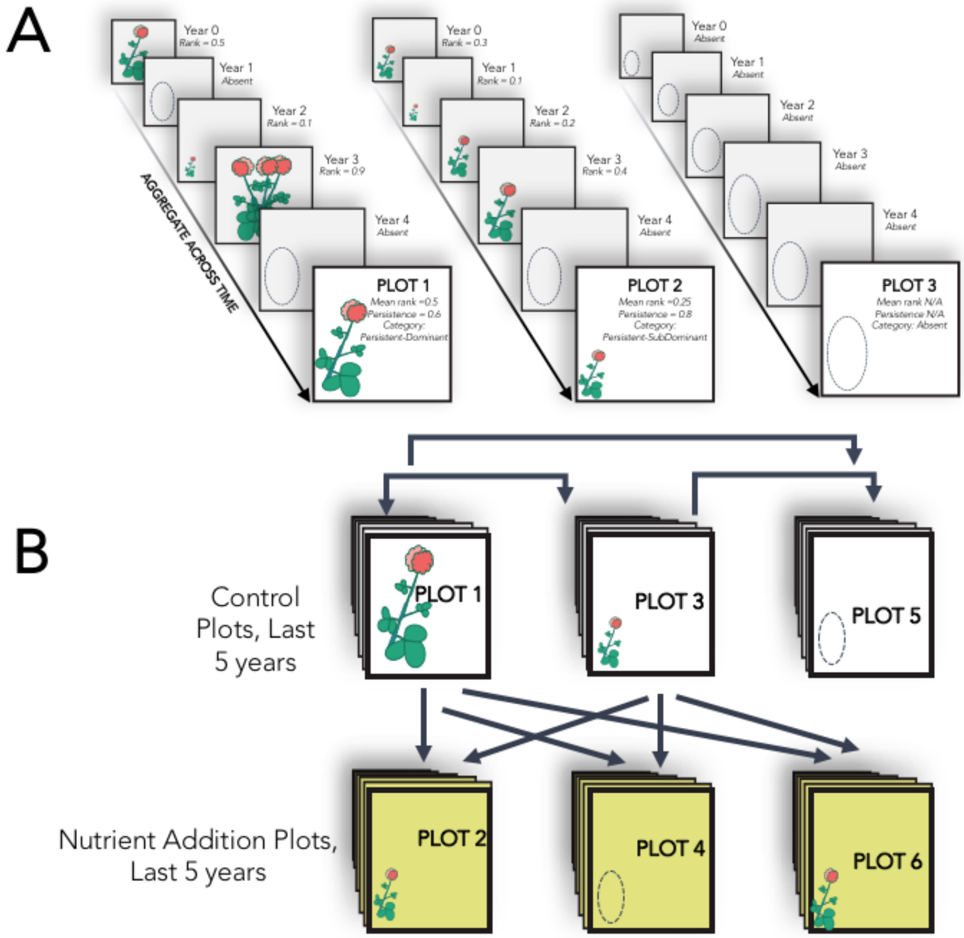




C

	Reference Plot				Comparison Plot			
Species	Plot#	Trt	Rank	Persistence	Plot#	Trt	Rank	Persist.
	1	Control	0.5	0.6	3	Control	0.25	0.8
	1	Control	0.5	0.6	2	+NPK	0.25	0.2
	1	Control	0.5	0.6	6	+NPK	0.40	0.4
	3	Control	0.25	0.8	2	+NPK	0.25	0.2
	3	Control	0.25	0.8	6	+NPK	0.40	0.4

Figure S2. Visual explanation of the methods used to evaluate treatment effects on species' persistence and abundance for one hypothetical species (a pink clover) at one site with three control and three nutrient addition (+NPK) plots monitored for the length of study (Years 0-4 in this example). This analysis did not use data from plots where the species never established (e.g. Plot 3 Control; Plot 2 NPK); for contrast, see Figure S3. **A:** Annual cover observations were aggregated across time to produce measures of average rank abundance and persistence in each plot. **B:** We compared persistence and abundance of each species in each control plot, to that of the same species in other control plots (to quantify baseline variability) and nutrient addition plots at the same site. **C:** The resulting dataset contained all unique plot-to-plot comparisons. Mixed-effects models were used to estimate how variability in ambient persistence and abundance changed with treatments. A separate analysis was conducted to estimate how persistence and abundance led to absences (i.e. species exclusion) in control and treatment plots in the last five years of study at a site (not visualized).



C

	Reference Plot				Comparison Plot			
Species	Plot#	Trt	Rank	Persistence	Plot#	Trt	Rank	Persist.
	1	Control	0.5	0.6	3	Control	0.25	0.8
	1	Control	0.5	0.6	2	+NPK	0.25	0.2
	1	Control	0.5	0.6	6	+NPK	0.40	0.4
	3	Control	0.25	0.8	2	+NPK	0.25	0.2
	3	Control	0.25	0.8	6	+NPK	0.40	0.4

Figure S3. Visual explanation of the methods used to evaluate treatment effects on species' categorical assignment for one hypothetical species (a pink clover) at one site with three control and three nutrient addition (+NPK) plots monitored for the last five years of study. **A:** Annual cover observations were aggregated across time to produce measures of average rank abundance and persistence in each plot. **B:** We compared persistence of each species in each control plot, to that of the same species in other control plots (to quantify baseline variability) and nutrient addition plots at the same site. Additionally, we evaluated the rates of loss among control plots (to quantify baseline rates of species exclusion) and between control and treatment plots (to evaluate treatment effects on species exclusion). **C:** The resulting dataset contained all unique plot-to-plot comparisons. A multinomial model was used to analyze the data.

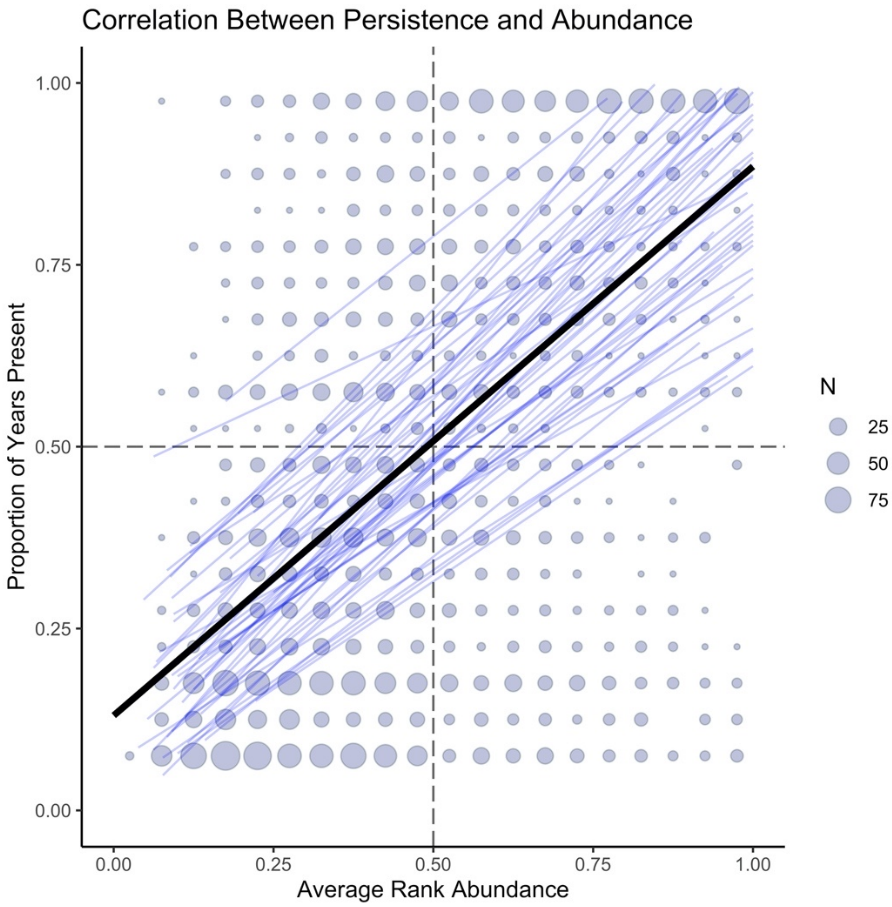


Figure S4. Relationships between species' average percentile rank abundance and the proportion of years it was present in a plot. Linear mixed-effects model fits for each site, which were allowed to vary in both slope and intercept, are shown in blue; the global fit for all sites is shown as a black line. Points represent the raw data, aggregated to the nearest 0.05 value for clarity.

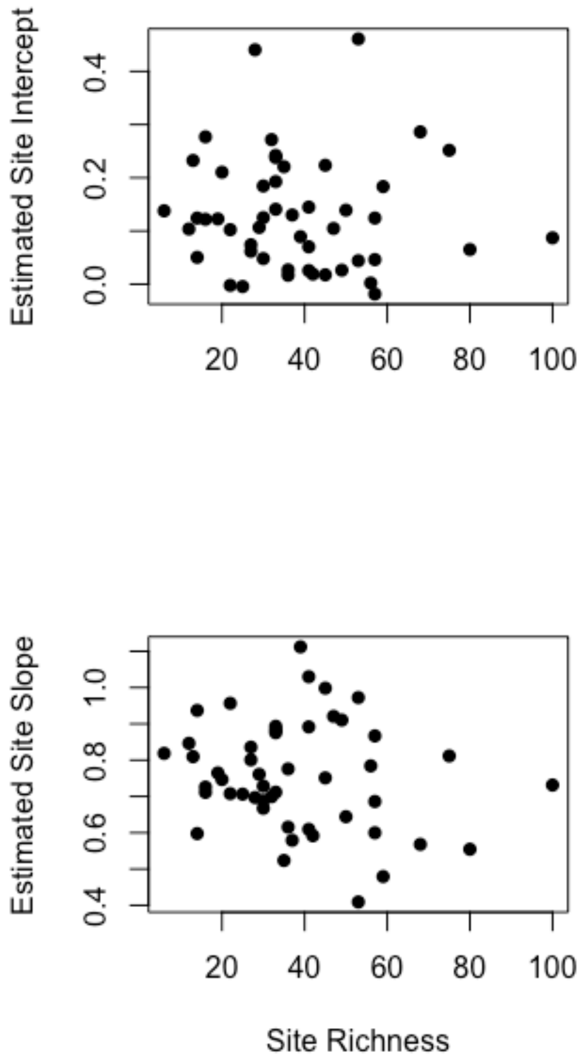


Figure S5. Relationships between the total richness of a site and the estimated site random slopes and intercepts from a mixed effects model with mean rank abundance as a predictor and persistence as a response for all species in control plots (i.e. the blue lines in Fig. S4). No significant relationship was found suggesting that site richness was not driving observed relationships.

Table S1. Site characteristics.

Site Name	Site Code	Continent	Country	Experiment Type	Latitude	Longitude	Mean Annual Temp (degrees C)	Mean Annual Precip (mm)	Years Active	Total Species Rich.	Average Richness Per Control Plot	Average Number of Core-dom. Spp. Per Control Plot	Average Number of Core-Sub. Spp. Per Control Plot	Average Number of Trans.-Dom. Spp. Per Control Plot	Average Number of Trans.-Sub. Spp. Per Control Plot
Azi	azi.cn	Asia	CN	Experimental (Full Factorial)	33.67	101.87	1.4	711	5	88	57	16	13	8	20
Boulder South Campus	bldr.us	North America	US	Experimental (Full Factorial)	39.972022	-105.23354	9.9	487	9	49	14	5	2	2	6
Bunchgrass (Andrews LTER)	bnch.us	North America	US	Experimental (Full Factorial)	44.27668543	-121.96802	6.8	1618	12	54	20	5	2	3	10
Bogong	bogong.au	Australia	AU	Experimental (Full Factorial)	-36.874	147.254	6.0	1678	11	43	23	9	9	1	4
Burrawan	burrawan.au	Australia	AU	Experimental (Full Factorial)	-27.734896	151.139517	18.2	643	12	43	22	4	3	4	11
Chichaqua Bottoms	cbgb.us	North America	US	Experimental (Full Factorial)	41.78506667	-93.385383	9.3	871	10	94	21	5	4	3	10
Cedar Creek LTER	cdcr.us	North America	US	Experimental (Full Factorial)	45.425	-93.2115	6.3	740	12	115	21	5	3	2	11
Cedar Point Biological Station	cdpt.us	North America	US	Experimental (Full Factorial)	41.2	-101.63	9.6	456	12	84	24	6	5	2	12
CEREEP - Ecotron IDF	cereep.fr	Europe	FR	Experimental (Full Factorial)	48.28	2.66	10.8	632	7	117	34	8	3	7	16
Las Chilcas	chilcas.ar	South America	AR	Experimental (Full Factorial)	-36.275556	-58.265556	15.1	955	7	99	22	4	2	5	11
Companhia das Lezirias	comp.pt	Europe	PT	Experimental (Full Factorial)	38.82928	-8.791406	16.6	564	8	97	47	11	6	9	21
Cowichan	cowi.ca	North America	CA	Experimental (Full Factorial)	48.8088	-123.6301	10.4	762	12	26	8	3	2	2	2
Doane College Spring Creek Prairie	doane.us	North America	US	Experimental (Nutrients Only)	40.6954	-96.8541	10.6	739	7	40	12	3	1	4	4
Elliott Chaparral	elliot.us	North America	US	Experimental (Full Factorial)	32.875	-117.05224	17.7	344	11	51	24	6	2	3	13
Fruebuel	frue.ch	Europe	CH	Experimental (Full Factorial)	47.113187	8.541821	7.0	1546	8	40	26	8	6	4	9
Hall's Prairie	hall.us	North America	US	Experimental (Full Factorial)	36.871944	-xf86.70167	13.8	1289	8	53	17	3	1	4	9
Hart Mountain	hart.us	North America	US	Experimental (Full Factorial)	42.723745	-119.49767	7.7	259	6	48	19	5	4	2	9
Heronsbrook (Silwood Park)	hero.uk	Europe	UK	Experimental (Full Factorial)	51.411	-0.639	10.2	668	7	57	25	7	9	4	6
Hopland REC	hopl.us	North America	US	Experimental (Full Factorial)	39.01275343	-123.06031	13.2	1065	12	124	57	9	2	14	32
Kellogg Biological Station LTER This is KBS Contribution #2288	kbs.us	North America	US	Experimental (Full Factorial)	42.408986	-85.3909	8.8	903	5	75	16	6	4	2	5
Kilpisjärvi	kilp.fi	Europe	FI	Experimental (Full Factorial)	69.0567	20.8747	-3.3	569	5	96	34	12	11	4	7
Kinypanial	kiny.au	Australia	AU	Experimental (Full Factorial)	-36.2	143.75	15.6	408	11	114	28	4	4	6	16
Koffler Scientific Reserve at Joker's Hill	koffler.ca	North America	CA	Experimental (Full Factorial)	44.024047	-79.535881	6.3	853	9	46	18	5	4	2	8
Konza LTER	konz.us	North America	US	Experimental (Full Factorial)	39.070856	-96.582821	12.1	889	11	88	27	8	6	1	13
Lancaster	lancaster.uk	Europe	UK	Experimental (Full Factorial)	53.98562471	-2.6284176	8.0	1522	10	34	16	5	4	3	3

Site Name	Site Code	Continent	Country	Experiment Type	Latitude	Longitude	Mean Annual Temp (degrees C)	Mean Annual Precip (mm)	Years Active	Total Species Rich.	Average Richness Per Control Plot	Average Number of Core-dom. Spp. Per Control Plot	Average Number of Core-Sub. Spp. Per Control Plot	Average Number of Trans.-Dom. Spp. Per Control Plot	Average Number of Trans.-Sub. Spp. Per Control Plot
Lookout (Andrews LTER)	look.us	North America	US	Experimental (Full Factorial)	44.20517707	-122.12845	6.9	1877	12	61	16	5	3	1	8
Mar Chiquita	marc.ar	South America	AR	Experimental (Full Factorial)	-37.71516	-57.42451	14.3	907	8	65	27	7	4	4	12
Mclaughlin UCNRS	mcla.us	North America	US	Experimental (Full Factorial)	38.86427212	-122.40641	14.0	936	12	76	24	5	2	6	12
Mt. Caroline	mtca.au	Australia	AU	Experimental (Full Factorial)	-31.782138	117.610853	17.7	324	11	70	26	8	7	2	10
Papenburg	pape.de	Europe	DE	Experimental (Full Factorial)	53.086	7.4728	9.1	788	7	14	6	3	1	0	2
Pingelly Paddock	ping.au	Australia	AU	Experimental (Full Factorial)	-32.496169	116.972947	16.3	456	6	23	11	6	2	1	2
Pinjarra Hills	pinj.au	Australia	AU	Experimental (Full Factorial)	-27.530556	152.923222	20.0	1085	5	34	8	3	1	2	4
Rookery (Silwood Park)	rook.uk	Europe	UK	Experimental (Full Factorial)	51.406	-0.644	10.1	685	7	39	14	5	4	2	4
Sagehen Creek UCNRS	sage.us	North America	US	Experimental (Full Factorial)	39.43	-120.24	5.8	831	7	45	18	7	5	1	6
Saline Experimental Range	saline.us	North America	US	Experimental (Full Factorial)	39.05	-99.1	12.1	608	10	122	30	5	3	5	16
Savannah River	sava.us	North America	US	Experimental (Full Factorial)	33.343894	-81.650936	17.4	1184	6	71	18	5	6	4	4
Sedgwick Reserve UCNRS	sedg.us	North America	US	Experimental (Nutrients Only)	34.7	-120.01667	15.6	478	11	34	13	4	2	2	6
Serengeti	sereng.tz	Africa	TZ	Experimental (Full Factorial)	-2.254503	34.512613	21.9	827	5	75	24	6	4	3	11
Sevilleta LTER	sevi.us	North America	US	Experimental (Nutrients Only)	34.3592	-106.6905	13.1	252	10	71	23	4	2	7	11
Sheep Experimental Station	shps.us	North America	US	Experimental (Full Factorial)	44.242989	-112.19839	5.3	246	10	97	30	5	10	1	13
Sierra Foothills REC	sier.us	North America	US	Experimental (Full Factorial)	39.23550963	-121.2837	16.3	936	12	120	22	5	2	4	12
Smith Prairie	smith.us	North America	US	Experimental (Full Factorial)	48.20658068	-122.62475	10.2	605	10	57	36	12	10	3	11
Spindletop	spin.us	North America	US	Experimental (Full Factorial)	38.135833	-84.500556	12.5	1152	12	51	21	6	4	2	9
Temple	temple.us	North America	US	Experimental (Nutrients Only)	31.044	-97.349	19.4	877	10	99	37	7	4	6	20
Trelease	trel.us	North America	US	Experimental (Full Factorial)	40.075	-88.829	11.1	992	10	25	9	3	1	2	4
Ukulinga	ukul.za	Africa	ZA	Experimental (Nutrients Only)	-29.67	30.4	17.7	832	10	176	44	9	5	7	23
Duke Forest	unc.us	North America	US	Experimental (Full Factorial)	36.00828	-79.020423	14.9	1157	5	67	24	5	5	5	9
Val Mustair	valm.ch	Europe	CH	Experimental (Full Factorial)	46.631345	10.372252	0.1	681	10	114	46	14	14	2	15
Yarramundi	yarra.au	Australia	AU	Experimental (Full Factorial)	-33.61	150.73	17.3	844	6	31	13	3	2	3	5

Table S2. Results from a mixed-effects model of species' persistence (the proportion of years a species is present) in control plots as predicted by species' functional group, lifespan and their combination.

Term	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
Lifespan	3.2	3.2	1	3552.5	34.7	<0.001
Functional Group	12.4	4.1	3	3955.0	46.3	<0.001
Lifespan * Functional Group	1.1	0.5	2	3954.3	5.7	0.003

Table S3. Results from a mixed-effects model of species' abundance (averaged across all years the species was present) in control plots as predicted by the species' functional group, lifespan and their combination.

Term	Sum Sq	Mean Sq	NumDF	DenDF	F value	Pr(>F)
Lifespan	1.5	1.5	1	1171.5	32.8	<0.001
Functional Group	13.4	4.5	3	3880.4	99.2	<0.001
Lifespan * Functional Group	0.6	0.3	2	3882.5	6.82	0.001

Table S4. Analysis of deviance from a multinomial model of species' persistence-abundance categorization predicted by species' functional group, lifespan, and their interaction.

Term	LR	X^2	Pr(>X^2)
Lifespan	57.78	3	<0.001
Functional Group	100.64	9	<0.001
Site	546.22	144	<0.001
Lifespan * Functional Group	24.54	9	0.004

Table S5. Results from the mixed-effects model of species persistence (proportion of years present) in response to treatments, species' persistence under ambient conditions, species' abundance under ambient conditions, and their interactions. The model had a conditional $R^2 = 0.60$ (fixed and random effects) and marginal $R^2 = 0.35$ (only fixed effects). Random effects were a unique taxon-plot ID term nested within site.

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	0.183	0.013	188	13.55	<0.001
+Nutrients	-0.071	0.01	27278	-7.42	<0.001
-Herbivores	-0.025	0.01	27470	-2.49	0.013
Ambient persistence	0.533	0.015	13910	35.67	<0.001
Ambient abundance	0.153	0.021	14445	7.29	<0.001
+Nutrients* -Herbivores	0.021	0.013	26721	1.62	0.105
+Nutrients* Ambient persistence	-0.064	0.014	27041	-4.6	<0.001
-Herbivores* Ambient persistence	-0.012	0.015	27355	-0.83	0.406
+Nutrients* Ambient abundance	0.057	0.02	26958	2.87	0.004
-Herbivores* Ambient abundance	0.006	0.021	27279	0.27	0.79
+Nutrients* -Herbivores* Ambient persistence	-0.05	0.018	26563	-2.7	0.007
+Nutrients* -Herbivores* Ambient abundance	0.009	0.026	26468	0.35	0.726

Table S6. Results from the mixed-effects model of species' abundance (average mean rank across years) in response to treatments, species' persistence under ambient conditions, species' abundance under ambient conditions, and their interactions. The model had a conditional $R^2 = 0.57$ (fixed and random effects) and marginal $R^2 = 0.32$ (only fixed effects). Random effects were a unique taxon-plot ID term nested within site.

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	0.176	0.008	1652	23.43	<0.001
+Nutrients	0.041	0.007	27154	5.81	<0.001
-Herbivores	0.012	0.007	27168	1.66	0.096
Ambient persistence	0.099	0.011	9912	9.12	<0.001
Ambient abundance	0.536	0.015	13747	34.74	<0.001
+Nutrients* -Herbivores	0.003	0.009	26568	0.31	0.756
+Nutrients* Ambient persistence	-0.043	0.01	26901	-4.17	<0.001
-Herbivores* Ambient persistence	-0.009	0.011	27200	-0.81	0.417
+Nutrients* Ambient abundance	-0.044	0.015	26809	-2.99	0.003
-Herbivores* Ambient abundance	-0.028	0.015	27154	-1.78	0.075
+Nutrients* -Herbivores* Ambient persistence	0.009	0.013	26399	0.68	0.497
+Nutrients* -Herbivores* Ambient abundance	-0.017	0.019	26295	-0.86	0.392

Table S7. Model comparisons predicting persistence and abundance in treatment plots. All models are nested within the full model, but not necessarily within each other. These models are a subset of the data used in the models reported in Table S5,6, as not all species had lifespan and functional group data available.

Response variable	Model terms	AIC	BIC	marginal R^2_{GLMM}	complete R^2_{GLMM}
Persistence	***Full model:*** Three-way interaction of treatments with ambient persistence, ambient abundance, lifespan, and lifeform	-3814.94	-3559.92	0.349	0.594
	No lifeform/lifespan: Three-way interaction of treatments with ambient persistence, ambient abundance	-3701.97	-3578.58	0.336	0.592
	No lifeform, lifespan, persistence: Three-way interaction of treatments with ambient abundance	-2142.69	-2052.2	0.17	0.61
	No lifeform, lifespan, abundance: Three-way interaction of treatments with ambient persistence	-3488.54	-3398.05	0.328	0.591
	No abundance, persistence: Three-way interaction of treatments with lifeform and lifespan	-1317.5	-1128.3	0.077	0.609
Abundance	***Full model:*** Three-way interaction of treatments with ambient persistence, ambient abundance , lifespan, and lifeform	-22027.66	-21772.64	0.36	0.575
	No lifeform/lifespan: Three-way interaction of treatments with ambient persistence, ambient abundance	-21661.4	-21538	0.327	0.57
	No lifeform, lifespan, persistence: Three-way interaction of treatments with ambient abundance	-21555.04	-21464.55	0.321	0.569
	No lifeform, lifespan, abundance : Three-way interaction of treatments with ambient persistence	-20021.79	-19931.3	0.153	0.584
	No abundance , persistence: Three-way interaction of treatments with lifeform and lifespan	-19845.73	-19656.52	0.135	0.578

Table S8. Results from the mixed-effects logistic regression model of species absence in response to treatments, species' persistence under ambient conditions, species' abundance under ambient conditions, and their interactions. The model had a conditional $R^2 = 0.57$ (fixed and random effects) and marginal $R^2 = 0.18$ (only fixed effects). Random effects were a unique taxon-plot ID term nested within site.

	Estimate	Std. Error	Z value	Pr(>|t|)
(Intercept)	-1.727	0.139	-12.43	<0.001
+Nutrients	-0.617	0.076	-8.09	<0.001
-Herbivores	-0.345	0.085	-4.08	<0.001
Ambient persistence	4.288	0.14	30.65	<0.001
Ambient abundance	1.085	0.19	5.7	<0.001
+Nutrients* -Herbivores	-0.024	0.115	-0.21	0.831
+Nutrients* Ambient persistence	-0.248	0.119	-2.09	0.037
-Herbivores* Ambient persistence	-0.021	0.131	-0.16	0.875
+Nutrients* Ambient abundance	0.046	0.17	0.27	0.788
-Herbivores* Ambient abundance	0.083	0.189	0.44	0.659
+Nutrients* -Herbivores* Ambient persistence	-0.28	0.175	-1.6	0.109
+Nutrients* -Herbivores* Ambient abundance	0.196	0.252	0.78	0.437

Table S9. Results from a multinomial logistic model of transition probabilities among plant species' persistence-abundance categories.

Term	**LR X^2**	**DF**	**Pr(>X^2)**
Control category	4041	16	<0.001
-Herbivores	192	4	<0.001
NPK	93	4	<0.001
Site	4819	196	<0.001
Control category:-Herbivores	204	16	<0.001
Control category:+Nutrients	264	16	<0.001
-Herbivores:+Nutrients	197	4	<0.001
Control category:-Herbivores:+Nutrients	212	16	<0.001

Table S10. Results from multinomial logistic models of the probability of correspondence among persistence-abundance categories. Shown are the estimated proportion (%) of species being in a given category in a treatment plot based on its category in control plots. Treatment effect shows the treatment difference between the ambient category switching among control plots. We further looked at whether sites with longer treatment maximum durations (late) had stronger effects compared to sites with shorter treatment maximum durations (early).

<table>
<tr><th></th><th></th><th></th><th colspan="4">Average Across All Years</th><th colspan="3">Early (5-8 max yr)</th><th colspan="3">Late (9-12 max yr)</th></tr>
<tr><th>Treatment</th><th>Category 1 (Control)</th><th>Category 2 (Treatment)</th><th>Pr(Cat2|Cat1) (%)</th><th>Treat. Effect (%)</th><th>P(>|t|)</th><th></th><th>Treat. Effect (%)</th><th>P(>|t|)</th><th></th><th>Treat. Effect (%)</th><th>P(>|t|)</th><th></th></tr>
<tr><td>-Herbivores</td><td>Core-Abundant</td><td>Absent</td><td>18</td><td>2</td><td>0.241</td><td></td><td>-1</td><td>0.775</td><td></td><td>3</td><td>0.027</td><td>*</td></tr>
<tr><td></td><td></td><td>Core-Abundant</td><td>55</td><td>-5</td><td>0.004</td><td>*</td><td>-4</td><td>0.214</td><td></td><td>-5</td><td>0.007</td><td>*</td></tr>
<tr><td></td><td></td><td>Core-Scarce</td><td>13</td><td>0</td><td>0.997</td><td></td><td>1</td><td>0.621</td><td></td><td>-1</td><td>0.836</td><td></td></tr>
<tr><td></td><td></td><td>Transient-Abundant</td><td>7</td><td>3</td><td>0.001</td><td>*</td><td>2</td><td>0.051</td><td></td><td>3</td><td>0.001</td><td>*</td></tr>
<tr><td></td><td></td><td>Transient-Scarce</td><td>7</td><td>0</td><td>0.963</td><td></td><td>1</td><td>0.607</td><td></td><td>0</td><td>0.987</td><td></td></tr>
<tr><td></td><td>Core-Scarce</td><td>Absent</td><td>32</td><td>5</td><td>0.007</td><td>*</td><td>4</td><td>0.111</td><td></td><td>5</td><td>0.024</td><td>*</td></tr>
<tr><td></td><td></td><td>Core-Abundant</td><td>20</td><td>-1</td><td>0.69</td><td></td><td>-1</td><td>0.853</td><td></td><td>-1</td><td>0.785</td><td></td></tr>
<tr><td></td><td></td><td>Core-Scarce</td><td>25</td><td>-4</td><td>0.013</td><td>*</td><td>-5</td><td>0.063</td><td></td><td>-4</td><td>0.096</td><td></td></tr>
<tr><td></td><td></td><td>Transient-Abundant</td><td>6</td><td>0</td><td>0.933</td><td></td><td>1</td><td>0.651</td><td></td><td>-2</td><td>0.342</td><td></td></tr>
<tr><td></td><td></td><td>Transient-Scarce</td><td>17</td><td>1</td><td>0.71</td><td></td><td>1</td><td>0.929</td><td></td><td>2</td><td>0.636</td><td></td></tr>
<tr><td></td><td>Transient-Abundant</td><td>Absent</td><td>46</td><td>8</td><td>0.003</td><td>*</td><td>4</td><td>0.537</td><td></td><td>11</td><td><0.001</td><td>*</td></tr>
<tr><td></td><td></td><td>Core-Abundant</td><td>15</td><td>1</td><td>0.958</td><td></td><td>-1</td><td>0.984</td><td></td><td>2</td><td>0.788</td><td></td></tr>
<tr><td></td><td></td><td>Core-Scarce</td><td>10</td><td>-2</td><td>0.435</td><td></td><td>-3</td><td>0.657</td><td></td><td>-2</td><td>0.611</td><td></td></tr>
<tr><td></td><td></td><td>Transient-Abundant</td><td>13</td><td>-3</td><td>0.338</td><td></td><td>2</td><td>0.662</td><td></td><td>-6</td><td>0.013</td><td>*</td></tr>
<tr><td></td><td></td><td>Transient-Scarce</td><td>16</td><td>-4</td><td>0.13</td><td></td><td>-3</td><td>0.595</td><td></td><td>-5</td><td>0.155</td><td></td></tr>
<tr><td></td><td>Transient-Scarce</td><td>Absent</td><td>55</td><td>7</td><td><0.001</td><td>*</td><td>5</td><td>0.096</td><td></td><td>7</td><td><0.001</td><td>*</td></tr>
<tr><td></td><td></td><td>Core-Abundant</td><td>6</td><td>-1</td><td>0.335</td><td></td><td>0</td><td>0.964</td><td></td><td>-2</td><td>0.122</td><td></td></tr>
<tr><td></td><td></td><td>Core-Scarce</td><td>11</td><td>-2</td><td>0.049</td><td>*</td><td>-2</td><td>0.375</td><td></td><td>-2</td><td>0.159</td><td></td></tr>
<tr><td></td><td></td><td>Transient-Abundant</td><td>6</td><td>-1</td><td>0.726</td><td></td><td>0</td><td>0.997</td><td></td><td>-1</td><td>0.5</td><td></td></tr>
<tr><td></td><td></td><td>Transient-Scarce</td><td>22</td><td>-2</td><td>0.139</td><td></td><td>-2</td><td>0.405</td><td></td><td>-2</td><td>0.33</td><td></td></tr>
</table>

			Average Across All Years				Early (5-8 max yr)			Late (9-12 max yr)		
Treatment	Category 1 (Control)	Category 2 (Treatment)	Pr(Cat2|Cat1) (%)	Treat. Effect (%)	P(>|t|)		Treat. Effect (%)	P(>|t|)		Treat. Effect (%)	P(>|t|)	
+NPK	Core-Abundant	Absent	23	6	<0.001	*	2	0.23		8	<0.001	*
		Core-Abundant	48	-12	<0.001	*	-6	0.008	*	-15	<0.001	*
		Core-Scarce	13	0	0.977		0	0.998		1	0.896	
		Transient-Abundant	7	3	<0.001	*	3	0.009	*	3	<0.001	*
		Transient-Scarce	9	2	0.006	*	1	0.539		3	0.002	*
	Core-Scarce	Absent	38	11	<0.001	*	2	0.537		16	<0.001	*
		Core-Abundant	16	-5	0.001	*	-2	0.608		-7	<0.001	*
		Core-Scarce	19	-10	<0.001	*	-7	0.004	*	-13	<0.001	*
		Transient-Abundant	6	0	0.992		0	0.97		0	0.956	
		Transient-Scarce	21	5	0.002	*	6	0.001	*	4	0.059	
	Transient-Abundant	Absent	55	17	<0.001	*	15	<0.001	*	19	<0.001	*
		Core-Abundant	12	-2	0.637		0	1		-3	0.392	
		Core-Scarce	3	-9	<0.001	*	-11	<0.001	*	-8	<0.001	*
		Transient-Abundant	16	0	0.976		1	0.842		0	0.991	
		Transient-Scarce	14	-7	0.001	*	-5	0.097		-8	0.001	*
	Transient-Scarce	Absent	60	12	<0.001	*	7	0.003	*	14	<0.001	*
		Core-Abundant	7	-1	0.785		-2	0.288		0	0.991	
		Core-Scarce	7	-6	<0.001	*	-3	0.046	*	-7	<0.001	*
		Transient-Abundant	8	1	0.405		1	0.349		1	0.679	
		Transient-Scarce	18	-6	<0.001	*	-3	0.119		-8	<0.001	*

			Average Across All Years				Early (5-8 max yr)			Late (9-12 max yr)		
Treatment	Category 1 (Control)	Category 2 (Treatment)	Pr(Cat2|Cat1) (%)	Treat. Effect (%)	P(>|t|)		Treat. Effect (%)	P(>|t|)		Treat. Effect (%)	P(>|t|)	
+NPK & Fence	Core-Abundant	Absent	27	11	<0.001	*	7	0.001	*	14	<0.001	*
		Core-Abundant	40	-20	<0.001	*	-15	<0.001	*	-23	<0.001	*
		Core-Scarce	12	0	0.92		2	0.498		-2	0.261	
		Transient-Abundant	9	5	<0.001	*	3	0.098		6	<0.001	*
		Transient-Scarce	11	5	<0.001	*	4	0.003	*	5	<0.001	*
	Core-Scarce	Absent	46	18	<0.001	*	12	<0.001	*	22	<0.001	*
		Core-Abundant	14	-7	<0.001	*	-5	0.04	*	-8	<0.001	*
		Core-Scarce	15	-14	<0.001	*	-11	<0.001	*	-16	<0.001	*
		Transient-Abundant	6	0	0.926		1	0.603		0	0.982	
		Transient-Scarce	18	2	0.296		3	0.449		2	0.579	
	Transient-Abundant	Absent	61	24	<0.001	*	21	<0.001	*	26	<0.001	*
		Core-Abundant	12	-2	0.595		-2	0.76		-2	0.816	
		Core-Scarce	3	-9	<0.001	*	-10	<0.001	*	-8	<0.001	*
		Transient-Abundant	11	-5	0.011	*	-2	0.779		-7	0.007	*
		Transient-Scarce	12	-8	<0.001	*	-6	0.107		-9	0.002	*
	Transient-Scarce	Absent	66	18	<0.001	*	15	<0.001	*	18	<0.001	*
		Core-Abundant	6	-1	0.551		-2	0.461		0	0.959	
		Core-Scarce	6	-7	<0.001	*	-4	0.01	*	-8	<0.001	*
		Transient-Abundant	7	1	0.706		0	0.953		1	0.604	
		Transient-Scarce	14	-10	<0.001	*	-9	<0.001	*	-11	<0.001	*

Table S11. Threshold analysis of multinomial logistic models of the probability of correspondence among persistence-dominance categories. Thresholds for separating core-transient and dominant-Scarce were set at 0.333 and 0.666 as opposed to 0.5. We tested a third sensitivity model that excluded species with a value in the middle range (i.e. greater than 0.333 but less than 0.666) in either category in the controls. For this latter model we used the 0.5 cutoff in treatment plots to avoid subsetting out species that had modest increases or decreases in persistence or dominance in the treatment plots. In other words, we tested category switching for only the extreme species' designations in the controls and allowed laxer designations in the treatments to increase the power of the results and decrease the artificiality of the results.

			0.333 Threshold				0.666 Threshold					<0.333 & >0.666 Thresholds		
Treatment	**Category 1 (Control)**	**Category 2 (Treatment)**	**Pr (Cat2|Cat1) (%)**	**Treat. Effect (%)**	**P(>|t|)**		**Treatment estimate**	**Treat. Effect (%)**	**P(>|t|)**		**Treatment estimate**	**Treat. Effect (%)**	**P(>|t|)**	
-Herbivores	Core-Abundant	Absent	23	3	0.001	*	14	2	0.127		19	3	0.137	
		Core-Abundant	60	-2	0.1		53	-8	0.001	*	74	-3	0.198	
		Core-Scarce	7	-1	0.092		18	5	0.002	*	1	0	0.982	
		Transient-Abundant	6	1	0.431		5	-1	0.655		3	1	0.874	
		Transient-Scarce	4	0	0.775		11	1	0.636		2	0	0.977	
	Core-Scarce	Absent	41	5	0.02	*	25	1	0.716		58	0	0.999	
		Core-Abundant	26	-1	0.806		12	1	0.758		7	6	0.02	*
		Core-Scarce	18	-3	0.253		32	-2	0.298		17	3	0.667	
		Transient-Abundant	5	1	0.815		4	0	0.898		1	-1	0.91	
		Transient-Scarce	10	-2	0.26		26	1	0.919		17	-7	0.264	
	Transient-Abundant	Absent	57	8	0.001	*	41	5	0.197		71	3	0.824	
		Core-Abundant	18	-5	0.022	*	8	-4	0.205		8	-2	0.783	
		Core-Scarce	7	0	0.955		12	4	0.142		1	0	0.96	
		Transient-Abundant	12	-2	0.534		14	-2	0.72		10	2	0.826	
		Transient-Scarce	7	-2	0.421		25	-4	0.412		9	-2	0.826	
	Transient-Scarce	Absent	59	6	0.007	*	50	7	<0.001	*	77	4	0.202	
		Core-Abundant	13	-1	0.881		3	0	0.96		2	0	0.993	
		Core-Scarce	9	-3	0.04	*	10	-2	0.032	*	3	-1	0.653	
		Transient-Abundant	8	-1	0.838		4	-1	0.071		2	0	0.999	
		Transient-Scarce	10	-1	0.554		33	-4	0.002	*	16	-3	0.328	

			0.333 Threshold				0.666 Threshold					<0.333 & >0.666 Thresholds		
Treatment	Category 1 (Control)	Category 2 (Treatment)	Pr (Cat2|Cat1) (%)	Treat. Effect (%)	P(>|t|)		Pr (Cat2|Cat1) (%)	Treat. Effect (%)	P(>|t|)		Pr (Cat2|Cat1) (%)	Treat. Effect (%)	P(>|t|)	
+NPK	Core-Abundant	Absent	29	9	<0.001	*	17	6	<0.001	*	28	12	<0.001	*
		Core-Abundant	53	-10	<0.001	*	40	-20	<0.001	*	64	-14	<0.001	*
		Core-Scarce	7	-1	0.114		20	6	<0.001	*	2	1	0.076	
		Transient-Abundant	7	2	0.003	*	6	0	0.923		3	0	0.925	
		Transient-Scarce	5	0	0.875		17	8	<0.001	*	3	0	1	
	Core-Scarce	Absent	48	12	<0.001	*	32	8	<0.001	*	61	3	0.879	
		Core-Abundant	22	-5	0.025	*	12	0	1		5	3	0.16	
		Core-Scarce	12	-8	<0.001	*	20	-14	0	*	10	-4	0.231	
		Transient-Abundant	7	3	0.054		4	0	0.997		1	0	0.981	
		Transient-Scarce	10	-2	0.412		32	7	<0.001	*	23	-1	0.975	
	Transient-Abundant	Absent	62	14	<0.001	*	46	11	0.001	*	75	7	0.281	
		Core-Abundant	15	-9	<0.001	*	7	-4	0.082		6	-4	0.379	
		Core-Scarce	4	-2	0.093		6	-2	0.443		0	-2	0.33	
		Transient-Abundant	13	-1	0.87		17	2	0.745		10	2	0.79	
		Transient-Scarce	7	-2	0.242		23	-6	0.077		8	-3	0.683	
	Transient-Scarce	Absent	63	10	<0.001	*	56	13	<0.001	*	79	5	0.021	*
		Core-Abundant	12	-2	0.308		3	-1	0.384		3	1	0.63	
		Core-Scarce	6	-6	<0.001	*	7	-5	<0.001	*	2	-2	0.108	
		Transient-Abundant	9	0	0.971		6	1	0.581		3	1	0.503	
		Transient-Scarce	9	-2	0.091		29	-8	<0.001	*	13	-5	0.006	*

			0.333 Threshold				0.666 Threshold					<0.333 & >0.666 Thresholds		
Treatment	**Category 1 (Control)**	**Category 2 (Treatment)**	**Pr (Cat2|Cat1) (%)**	**Treat. Effect (%)**	**P(>|t|)**		**Pr (Cat2|Cat1) (%)**	**Treat. Effect (%)**	**P(>|t|)**		**Pr (Cat2|Cat1) (%)**	**Treat. Effect (%)**	**P(>|t|)**	
+NPK -Herbivores	Core-Abundant	Absent	34	14	<0.001	*	21	10	<0.001	*	34	18	<0.001	*
		Core-Abundant	47	-16	<0.001	*	35	-25	<0.001	*	55	-22	<0.001	*
		Core-Scarce	6	-1	0.046	*	17	4	0.012	*	3	2	0.01	*
		Transient-Abundant	8	3	<0.001	*	6	0	0.914		3	0	0.903	
		Transient-Scarce	5	0	0.629		20	11	<0.001	*	5	2	0.029	*
	Core-Scarce	Absent	57	22	<0.001	*	37	13	<0.001	*	68	10	0.115	
		Core-Abundant	20	-7	0.001	*	8	-3	0.008	*	7	5	0.02	*
		Core-Scarce	8	-12	<0.001	*	18	-16	<0.001	*	7	-8	0.008	*
		Transient-Abundant	7	2	0.113		5	1	0.641		3	1	0.823	
		Transient-Scarce	7	-5	<0.001	*	31	6	0.001	*	16	-8	0.149	
	Transient-Abundant	Absent	68	20	<0.001	*	52	17	<0.001	*	78	10	0.089	
		Core-Abundant	14	-9	<0.001	*	8	-3	0.25		7	-3	0.608	
		Core-Scarce	2	-4	0.001	*	6	-2	0.48		0	-1	0.551	
		Transient-Abundant	9	-4	0.014	*	12	-4	0.237		5	-3	0.493	
		Transient-Scarce	6	-3	0.044	*	22	-7	0.027	*	9	-2	0.826	
	Transient-Scarce	Absent	70	17	<0.001	*	62	20	<0.001	*	84	10	<0.001	*
		Core-Abundant	11	-3	0.066		3	0	0.892		3	1	0.476	
		Core-Scarce	5	-7	<0.001	*	6	-6	<0.001	*	1	-2	0.012	*
		Transient-Abundant	7	-2	0.106		4	-1	0.433		1	-1	0.423	
		Transient-Scarce	7	-4	0.001	*	24	-13	<0.001	*	10	-8	<0.001	*

Table S12. Contributions of each author to the paper.

Name	Affiliation(s)	Developed and framed research question(s)	Analyzed data	Contributed to data analyses	Wrote the paper	Contributed to paper writing	Site coordinator	Nutrient Network coordinator
Wilfahrt, Peter A.	University of Minnesota, USA	X	X		X			X
Asmus, Ashley L.	University of Minnesota, USA	X	X		X			X
Adler, Peter	Utah State University					X	X	
Arnillas, Carlos	University of Toronto Scarborough, Canada					X	X	
Bakker, Jonathan D.	University of Washington					X	X	
Biederman, Lori	Iowa State University, USA					X	X	
Borer, Elizabeth	University of Minnesota, USA	X		X		X	X	X
Brudvig, Lars	Michigan State University					X	X	
Cadotte, Marc	University of Toronto Scarborough, Canada					X	X	
Daleo, Pedro	Universidad Nacional de Mar del Plata, Argentina					X	X	
Eskelinen, Anu	German Centre for Integrative Biodiversity Research (iDiv), Germany					X	X	
Firn, Jennifer	Queensland University of Technology, Australia					X	X	
Harpole, W. Stanley	German Centre for Integrative Biodiversity Research (iDiv), Germany					X	X	X
Hautier, Yann	University of Zurich, Switzerland					X	X	
Henning, Jeremiah A.	University of Minnesota, USA	X		X		X		
Kirkman, Kevin P	University of KwaZulu-Natal, South Africa					X	X	
La Pierre, Kimberly J.	University of California, Berkeley					X	X	
Laungani, Ramesh	Doane University					X	X	
MacDougall, Andrew	University of Guelph, Canada					X	X	
McCulley, Rebecca L.	University of Kentucky					X	X	
Moore, Joslin L.	University of Melbourne, Australia					X	X	
Morgan, John	La Trobe University, Australia					X	X	

Mortensen, Brent	Benedictine College, USA					X	X	
Ochoa Hueso, Raul	University of Cadiz, Spain					X	X	
Ohlert, Timothy	University of New Mexico, USA					X	X	
Power, Sally A.	University of Western Sydney, Australia					X	X	
Price, Jodi	Charles Sturt University, Albury, Australia					X	X	
Risch, Anita C.	Swiss Federal Institute for Forest, Snow and Landscape Research, Switzerland					X	X	
Schuetz, Martin	Swiss Federal Institute for Forest, Snow and Landscape Research, Switzerland					X	X	
Seabloom, Eric	University of Minnesota, USA	X		X		X	X	X
Shoemaker, Lauren	University of Wyoming, USA					X	X	
Stevens, Carly	Lancaster University, UK					X	X	
Strauss, Alexander T	University of Minnesota, USA	x		x		x		
Tognetti, Pedro Maximiliano	Universidad de Buenos Aires, Argentina					X	X	
Virtanen, Risto	University of Oulu, Finland					X	X	