

## Supplementary Online Appendices

2 **Table S1:** Study sites included in analyses. Pretreatment observational data were collected at all sites. Subsequent fertilization and  
 4 fencing were only conducted at experimental sites. Study type indicates if sites had observation data only (Obs.) or observational and  
 experimental fencing and fertilization data (Exp.).

Site	Name	Continent	Region	Country	Ecosystem	Lat.	Lon.	Elev. (m)	Precip. (mm)	Study Type	Number of Plots	First Sample Year
1	Serengeti	Africa	Africa	Tanzania	Savanna	-2.25	34.51	1536	854	Exp.	30	2008
2	Mt Gilboa	Africa	Africa	South Africa	Montane Grassland	-29.28	30.29	1748	926	Exp.	30	2010
3	Summerveld	Africa	Africa	South Africa	Mesic Grassland	-29.81	30.72	679	939	Obs.	30	2010
4	Ukulunga	Africa	Africa	South Africa	Mesic Grassland	-29.67	30.40	842	880	Obs.	30	2009
5	Azi	Asia	Asia	China	Alpine Grassland	33.67	101.87	3500	667	Exp.	30	2007
6	Kibber (Spiti)	Asia	Asia	India	Alpine Grassland	32.32	78.01	4241	504	Obs.	30	2011
7	Bogong	Australia	Australia	Australia	Alpine Grassland	-36.87	147.25	1760	1592	Exp.	30	2009
8	Burrawan	Australia	Australia	Australia	Semiarid Grassland	-27.73	151.14	425	683	Exp.	30	2008
9	Derrimut	Australia	Australia	Australia	Semiarid Grassland	-37.81	144.79	38	574	Obs.	30	2007
10	Ethabuka (South Site)	Australia	Australia	Australia	Grazed Pasture	-23.64	138.40	104	211	Obs.	28	2013
11	Kinypanial	Australia	Australia	Australia	Semiarid Grassland	-36.20	143.75	90	426	Exp.	30	2007
12	Mt. Caroline	Australia	Australia	Australia	Savanna	-31.78	117.61	285	330	Exp.	40	2008
13	Pinjarra Hills	Australia	Australia	Australia	Grazed Pasture	-27.53	152.92	38	1133	Obs.	30	2013
14	Fruebuel	Europe	Europe	Switzerland	Grazed Pasture	47.11	8.54	995	1355	Exp.	30	2008
15	Val Mustair	Europe	Europe	Switzerland	Alpine Grassland	46.63	10.37	2320	1098	Exp.	30	2008
16	Papenburg	Europe	Europe	Germany	Old Field	53.09	7.47	0	783	Exp.	10	2007
17	Elva	Europe	Europe	Estonia	Semiarid Grassland	58.26	26.35	64	616	Obs.	10	2012
18	Kirikukyla	Europe	Europe	Estonia	Mesic Grassland	58.71	23.80	8	601	Obs.	30	2012
19	Companhia das Lezirias	Europe	Europe	Portugal	Grazed Pasture	38.00	-8.00	200	554	Obs.	31	2012
20	Heronbrook (Silwood Park)	Europe	Europe	United Kingdom	Mesic Grassland	51.41	-0.64	60	692	Exp.	30	2007
21	Lancaster	Europe	Europe	United Kingdom	Grazed Pasture	53.99	-2.63	180	1322	Exp.	26	2008
22	Rookery (Silwood Park)	Europe	Europe	United Kingdom	Mesic Grassland	51.41	-0.64	60	706	Exp.	30	2007
23	Koffler Scientific Reserve	North America	Central	Canada	Grazed Pasture	44.02	-79.54	301	815	Obs.	36	2010
24	Cowichan	North America	Pacific Coast	Canada	Old Field	48.46	-123.38	50	764	Exp.	30	2007
25	Hanover	North America	Atlantic Coast	USA	Old Field	43.42	-72.14	271	1033	Exp.	30	2007
26	Savannah River	North America	Atlantic Coast	USA	Savanna	33.34	-81.65	71	1194	Exp.	20	2007
27	Duke Forest	North America	Atlantic Coast	USA	Old Field	36.01	-79.02	141	1163	Exp.	30	2007
28	Barta Brothers	North America	Central	USA	Semiarid Grassland	42.24	-99.65	767	597	Exp.	30	2007
29	Boulder South Campus	North America	Central	USA	Semiarid Grassland	39.97	-105.23	1633	425	Exp.	20	2008
30	Chichaqua Bottoms	North America	Central	USA	Mesic Grassland	41.79	-93.39	275	855	Exp.	54	2009
31	Cedar Creek LTER	North America	Central	USA	Mesic Grassland	45.40	-93.20	270	750	Exp.	50	2007
32	Cedar Point Biological Station	North America	Central	USA	Semiarid Grassland	41.20	-101.63	965	445	Exp.	60	2007
33	Hall's Prairie	North America	Central	USA	Mesic Grassland	36.87	-86.70	194	1282	Exp.	30	2007
34	Konza LTER	North America	Central	USA	Mesic Grassland	39.07	-96.58	440	877	Exp.	30	2007
35	KonzaN1B	North America	Central	USA	Mesic Grassland	39.08	-96.56	440	878	Obs.	12	2007

36	Saline Experimental Range	North America	Central	USA	Semiarid Grassland	39.05	-99.10	440	607	Exp.	30	2008
37	Sevilleta LTER	North America	Central	USA	Desert Grassland	34.36	-106.69	1600	252	Obs.	40	2007
38	Shortgrass Steppe LTER	North America	Central	USA	Semiarid Grassland	40.82	-104.77	1650	365	Exp.	30	2007
39	Spindletop	North America	Central	USA	Grazed Pasture	38.14	-84.50	271	1140	Exp.	30	2007
40	Temple	North America	Central	USA	Mesic Grassland	31.04	-97.35	184	871	Obs.	26	2007
41	Trelease	North America	Central	USA	Mesic Grassland	40.08	-88.83	200	982	Exp.	30	2008
42	Tyson	North America	Central	USA	Old Field	38.52	-90.56	169	997	Exp.	40	2007
43	Bunchgrass (Andrews LTER)	North America	Intermountain West	USA	Montane Grassland	44.28	-121.97	1318	1647	Exp.	30	2007
44	Buttercup (Andrews LTER)	North America	Intermountain West	USA	Montane Grassland	44.28	-121.96	1500	1718	Obs.	30	2007
45	Hart Mountain	North America	Intermountain West	USA	Shrub steppe	42.72	-119.50	1508	272	Exp.	30	2007
46	Lookout (Andrews LTER)	North America	Intermountain West	USA	Montane Grassland	44.21	-122.13	1500	1898	Exp.	30	2007
47	Niwot Ridge LTER	North America	Intermountain West	USA	Alpine Grassland	39.99	-105.38	3050	439	Obs.	40	2007
48	Sagehen Creek UCNR	North America	Intermountain West	USA	Montane Grassland	39.43	-120.24	1920	882	Exp.	30	2007
49	Sheep Experimental Station	North America	Intermountain West	USA	Grazed Pasture	44.24	-112.20	910	262	Exp.	40	2007
50	American Camp	North America	Pacific Coast	USA	Mesic Grassland	48.47	-123.01	41	557	Obs.	30	2007
51	Elliott Chaparral	North America	Pacific Coast	USA	Annual Grassland	32.88	-117.05	200	331	Exp.	30	2008
52	Finley NWR	North America	Pacific Coast	USA	Mesic Grassland	44.41	-123.28	68	1104	Obs.	19	2007
53	Glacial Heritage	North America	Pacific Coast	USA	Mesic Grassland	46.87	-123.03	33	1311	Obs.	30	2007
54	Hastings UCNR	North America	Pacific Coast	USA	Annual Grassland	36.20	-121.55	750	702	Obs.	30	2007
55	Hopland REC	North America	Pacific Coast	USA	Annual Grassland	39.01	-123.06	598	1127	Exp.	27	2007
56	Jasper Ridge Biological Preserve	North America	Pacific Coast	USA	Annual Grassland	37.41	-122.24	120	592	Obs.	30	2007
57	Leadbetter Point	North America	Pacific Coast	USA	Salt Marsh	46.61	-124.05	2	2072	Obs.	30	2007
58	Mclaughlin UCNR	North America	Pacific Coast	USA	Annual Grassland	38.86	-122.41	642	867	Exp.	30	2007
59	Sedgwick Reserve UCNR	North America	Pacific Coast	USA	Annual Grassland	34.70	-120.02	550	521	Obs.	30	2007
60	Sierra Foothills REC	North America	Pacific Coast	USA	Annual Grassland	39.24	-121.28	197	935	Exp.	30	2007
61	Smith Prairie	North America	Pacific Coast	USA	Mesic Grassland	48.21	-122.62	62	597	Exp.	30	2007
62	Mar Chiquita	South America	South America	Argentina	Mesic Grassland	-37.72	-57.42	6	838	Obs.	30	2011

6 **Table S2.** Final regression model of exotic cover and exotic richness at the site scale (N=62) explained by environmental covariates.  
 8 Tests of significance are based on quasi-likelihood due to significant over- or under-dispersion in the data. Only the reduced model is  
 10 shown. The full model included elevation (m); precipitation (mm yr<sup>-1</sup>); seasonal precipitation and temperature variation; mean,  
 maximum, and minimum annual temperature (C); aboveground live biomass (log g m<sup>-2</sup> yr<sup>-1</sup>); aboveground dead biomass (log g m<sup>-2</sup>).  
 Estimated dispersion parameter for quasi-likelihood was 0.56 for exotic cover, 4.24 for exotic richness, and 3.10 for native grass  
 richness.

<b>Response</b>	<b>Source</b>	<b>Estimate</b>	<b>Type II S.S.</b>	<b>D.F.</b>	<b>F</b>	<b>p</b>
Exotic Cover	Mean Annual Temp.	0.227	8.03	1	14.3	0.000
	Temp. Wettest Quarter	-0.133	7.08	1	12.6	0.001
	Residuals		33.17	59		
Exotic Richness	Temp. Driest Quarter	0.065	51.78	1	12.2	0.001
	Residuals		254.36	60		
Native Grass Richness	Elevation	0.447	33.89	1	10.9	0.002
	Temp. Wettest Quarter	0.040	34.95	1	11.3	0.001
	Residuals		179.78	58		

14 **Table S3.** Author contributions to manuscript.

<b>Full Name</b>	<b>Wrote the paper, e.g. contributed substantially to at least one section of the paper</b>	<b>Analyzed data, e.g. generated models (statistical and/or mathematical), figures, tables, maps, diagrams etc.</b>	<b>Developed and framed research questions for specific study using Nutrient Network data</b>	<b>Nutrient Network coordinators, e.g. designed experiments, coordinates network data collection and compilation, and garners funding.</b>	<b>Contributed substantially to data analyses, e.g. provided comments and suggestions</b>	<b>Contributed to paper writing, e.g. provided comments and suggestions</b>	<b>Collected Data</b>
Eric Seabloom	X	X	X	X	X	X	X
Elizabeth Borer			X	X	X	X	X
Yvonne Buckley					X	X	X
Elsa Cleland			X		X	X	X
Kendi Davies					X	X	X
Jennifer Firn			X		X	X	X
W. Stanley Harpole			X	X	X	X	X
Yann Hautier					X	X	X
Eric M. Lind				X	X	X	X
Andrew MacDougall			X		X	X	X
John L. Orrock					X	X	X
Suzanne M Prober					X	X	X
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Martin Schuetz						X	X
Anna Simonsen							X
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Lauren Sullivan						X	X
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