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Nutrient Network – synthesis through modularized experiments and data analysis

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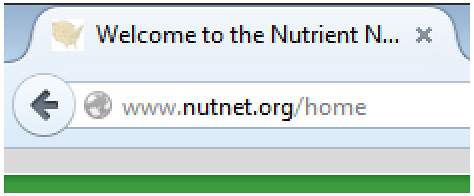
The network


Welcome to the Nutrient N...
www.nutnet.org/home


Nutrient Network: A Global Research Cooperative
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Welcome to the Nutrient Network!
Two of the most pervasive human impacts on ecosystems are alteration of global nutrient budgets and changes in the abundance and identity of consumers. Fossil fuel combustion and agricultural fertilization have doubled and quintupled, respectively, global pools of nitrogen and phosphorus relative to pre-industrial levels. Concurrently, habitat loss and degradation and selective hunting and fishing disproportionately remove consumers from food webs. At the same time, humans are adding consumers to food webs for endpoints such as conservation, recreation, and agriculture, as well as accidental introductions of invasive consumer species. In spite of the global impacts of these human
Tweets
Follow
Nutrient Network
23 Jan
@NutNetGlobal
Friday #NutNet site: Sierra Foothill @ucsfrec, CA USA. Has it all: oak savanna, invasive grasses, cows, and cowboys.
pic.twitter.com/Q4X1A39hpv
Nutrient Network
16 Jan
@NutNetGlobal
significant update from the prior version: P cycles have joined N cycles in being off the scale.
sciencemag.org/content/earl
Expand
Science Magazine
16 Jan
Tweet to @NutNetGlobal

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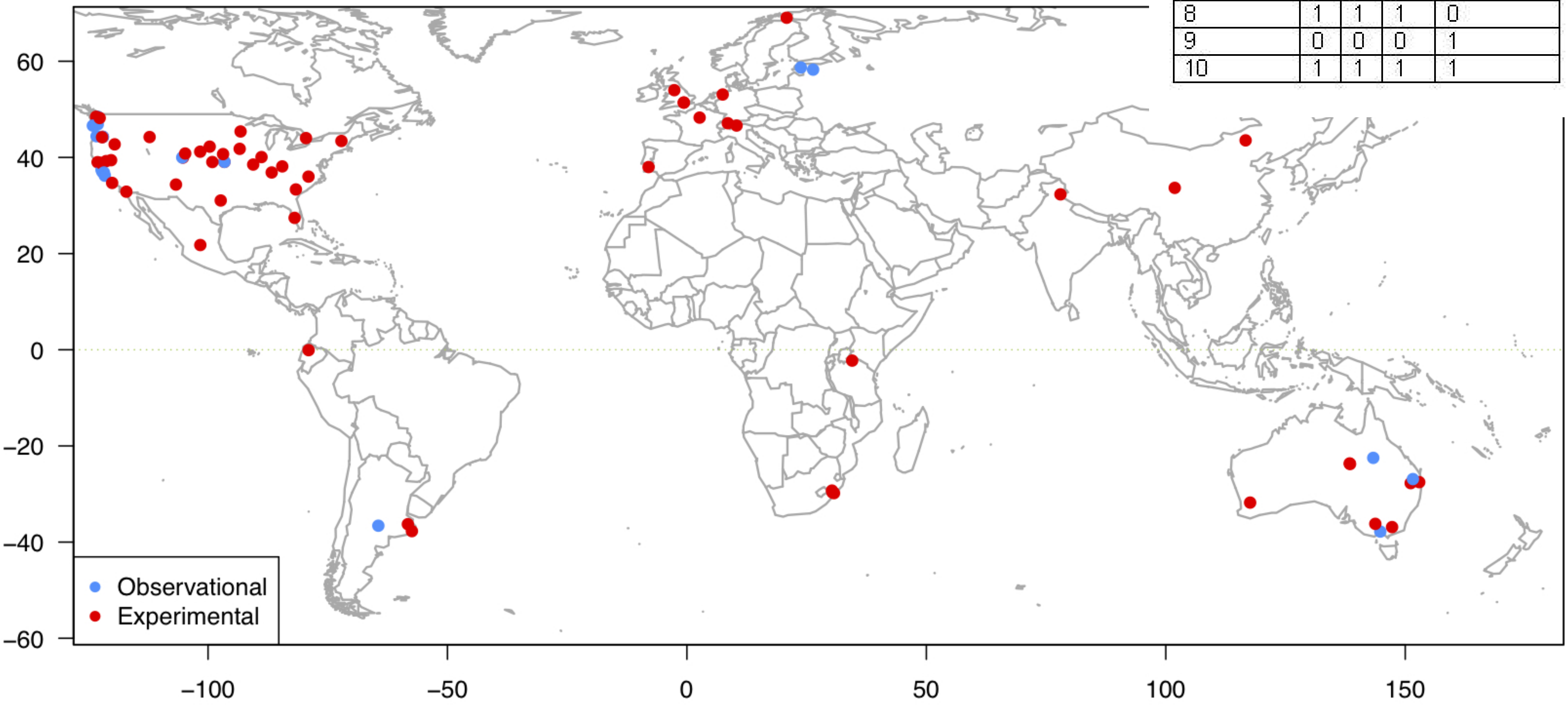
The network

Table 1. NutNet experimental treatments (0 = control, 1 = nutrient-added).

Treatment	N	P	K+	Exclosure
1 (control)	0	0	0	0
2	0	0	1	0
3	0	1	0	0
4	1	0	0	0
5	0	1	1	0
6	1	0	1	0
7	1	1	0	0
8	1	1	1	0
9	0	0	0	1
10	1	1	1	1



The network

Standardized. Researchers worldwide add nutrients and measure plots the same way.

NETWORK SCIENCE

Open-Source Ecology Takes Root Across the World

A new collaboration of volunteer research sites is running simple yet powerful experiments to shed light on global change in grasslands

to global change—without disproportionate effort by any one individual. "It's not a brand-new idea, but it's novel that they've pulled it off," says Alan Townsend of the University of Colorado, Boulder, who is not involved. The network also provides an easy way for young faculty members, postdocs, and grad students to get involved in a large collaboration and contribute to high-profile papers.

So far, the effort has been funded with just a single $322,000 grant from the U.S. National Science Foundation (NSF) for coordinating data and analysis, yet already the first few papers have been published over the past year. The most recent, which appeared in *Science* last month (23 September, p. 1750), challenged a long-standing idea in ecology about plant diversity and productivity. Doz-

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The network

Nutrient Network: A Global Research Cooperative

Home

Search this site:

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Log in

- Request new password

Navigation

- NutNet Home
- NutNet Guidelines for Participation
- Authorship Guidelines
- Protocols & Templates
- Publications
- PI directory
- Data
  - Metadata
- Participating Sites

Data

Latest available dataset
(login required)

NutNet Metadata

Data Submission:

Please follow the directions for submitting data:

1. Be sure your data are collected using the standardized protocol

2. All data should be entered into the provided (*xls) data sheet

3. Save data sheet with naming format:

NutNet_"yoursite"_ year.xls e.g. NutNet_burrawan_2008.xls

4. Email data to: Eric Lind. In your email please specify the UNITS of your biomass data (i.e. whether you have already multiplied x5 to get grams per meter squared)

Data Use:

If you have specific questions about data availability and use, please contact:
Eric Lind

The network

Steering Committee

Nutrient Network Steering Committee (2011-2012)

PI	Institution
Peter Adler	Utah State University
Elizabeth Borer	University of Minnesota
Jennifer Firn	Queensland University of Technology
Daniel Gruner	University of Maryland
W. Stanley Harpole	Iowa State University
Eric Lind	University of Minnesota
John Orrock	University of Wisconsin-Madison
Eric Seabloom	University of Minnesota
Melinda Smith	Yale University

Science

Productivity – biodiversity relationships

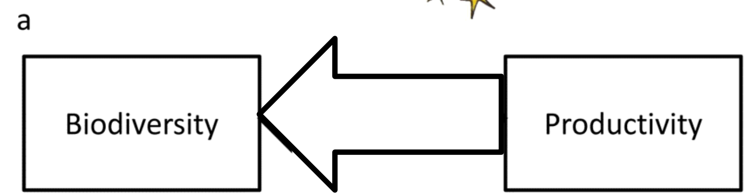
Top-down versus bottom up control

Diversity - stability hypothesis

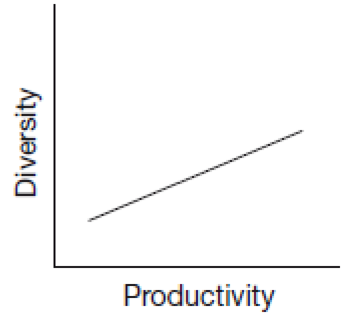
Invasive species

The debate

Productivity drives biodiversity

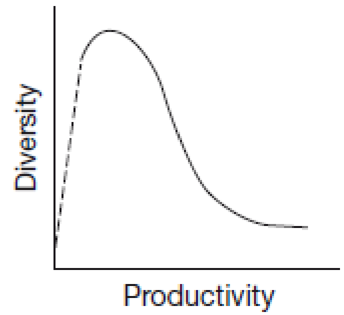


Search for a general pattern: unimodal or monotonic increasing



Major conceptual and empirical pitfalls

- Unclear definition of productivity (production rate, biomass, very derived measures)
- Unclear mechanisms (species energy theory? competition? evolution?)
- Inconsistent patterns observed (also negative, U-shaped and none)



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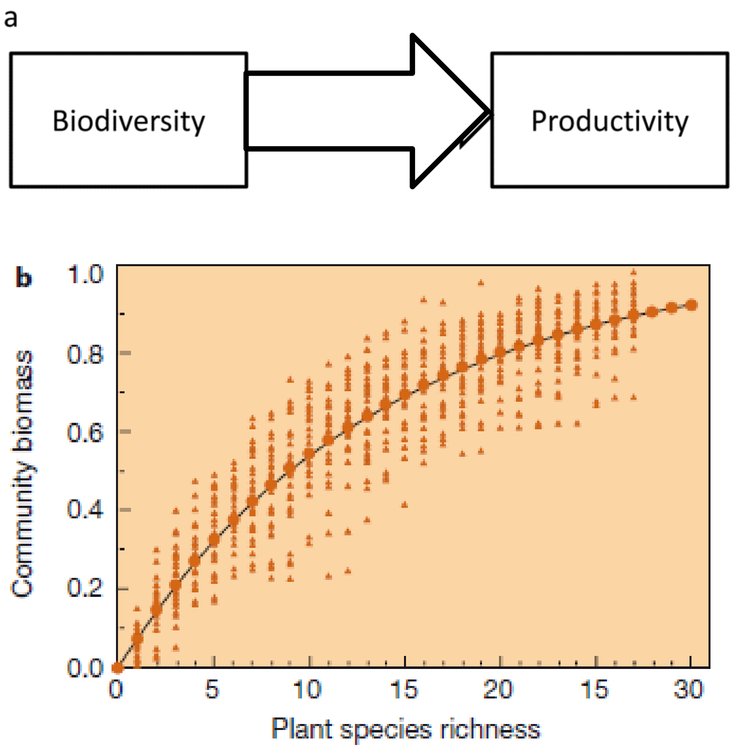
The debate

Biodiversity drives productivity

Mainly derived from biodiversity - ecosystem functioning (BEF) literature

Raises concern about cause and consequence in biodiversity productivity relationships



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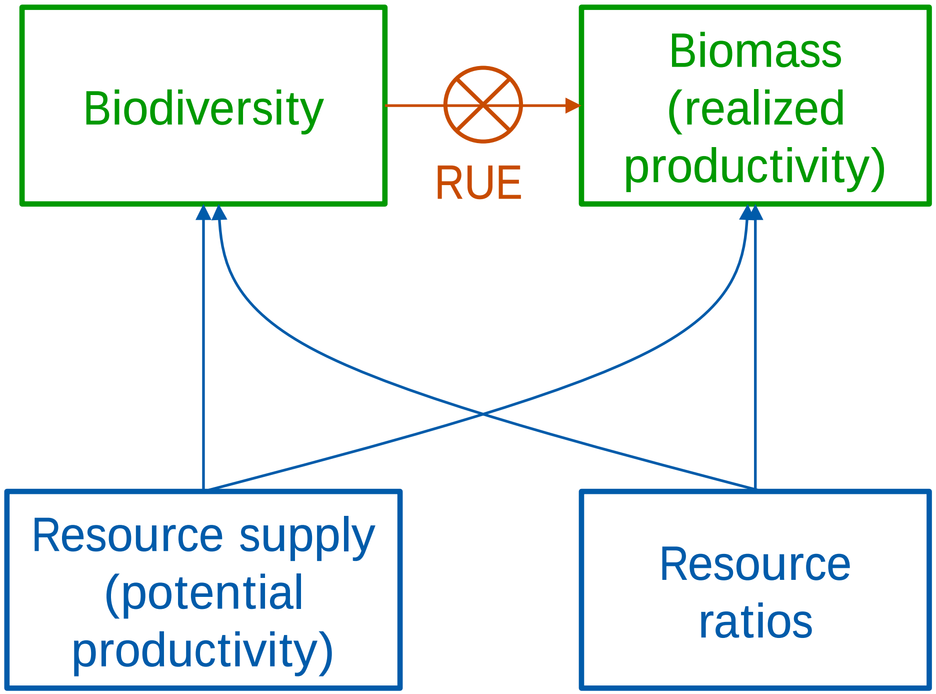
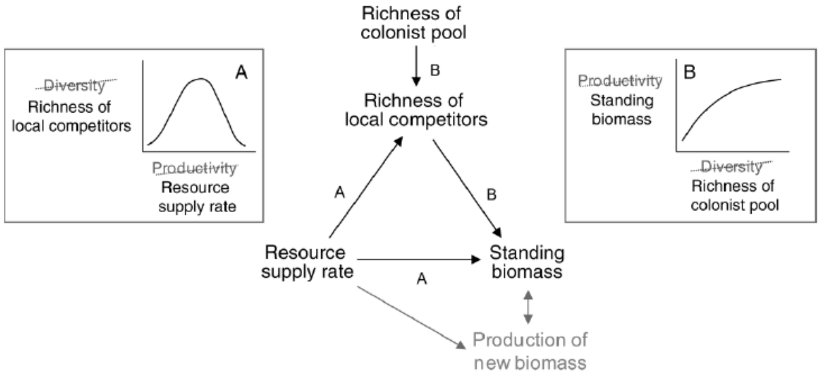
Merging perspectives

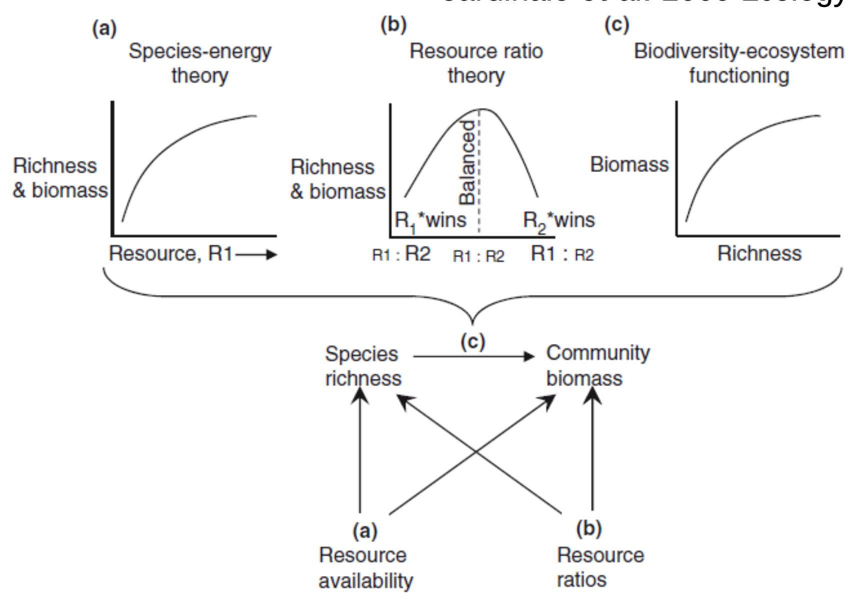
Recent models and concepts promote a more mechanistic view disentangling potential and realized productivity



Hillebrand & Lehmpfuhl 2011 Am Nat



Cardinale et al. 2009 Ecology



Cardinale et al. 2009 Ecology Letters

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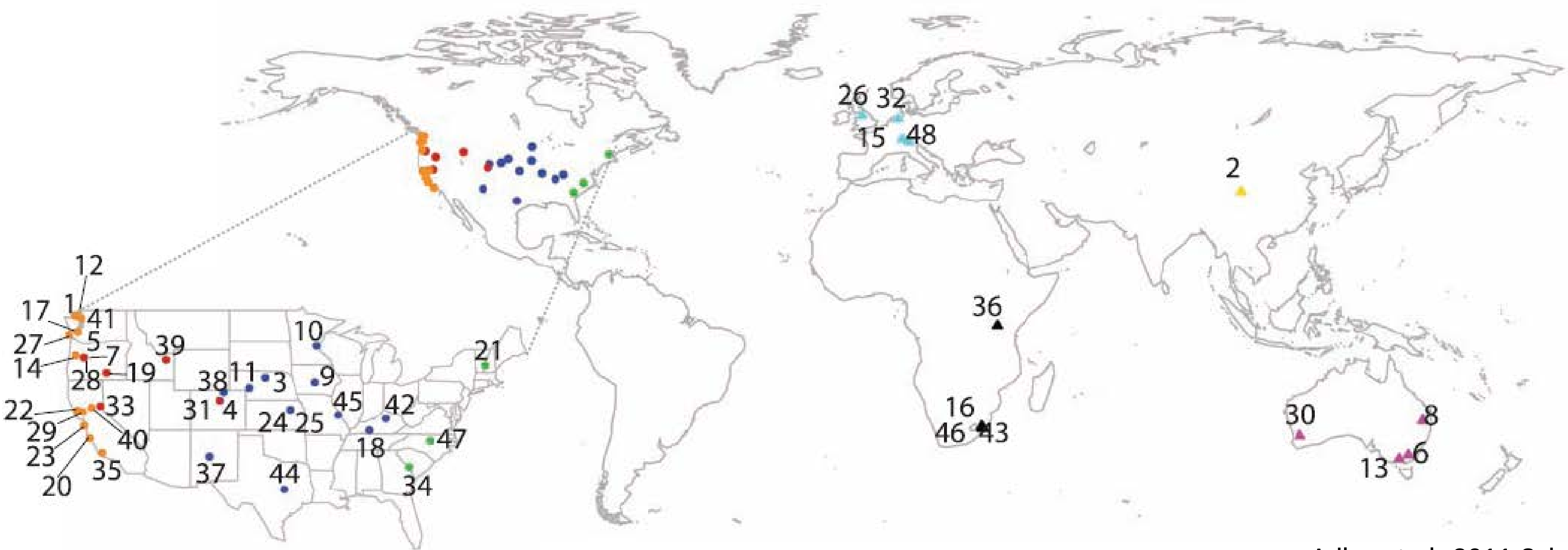
A global test of PDR

nutrient network

NutNet: the Nutrient Network



Adler et al. 2011 Science

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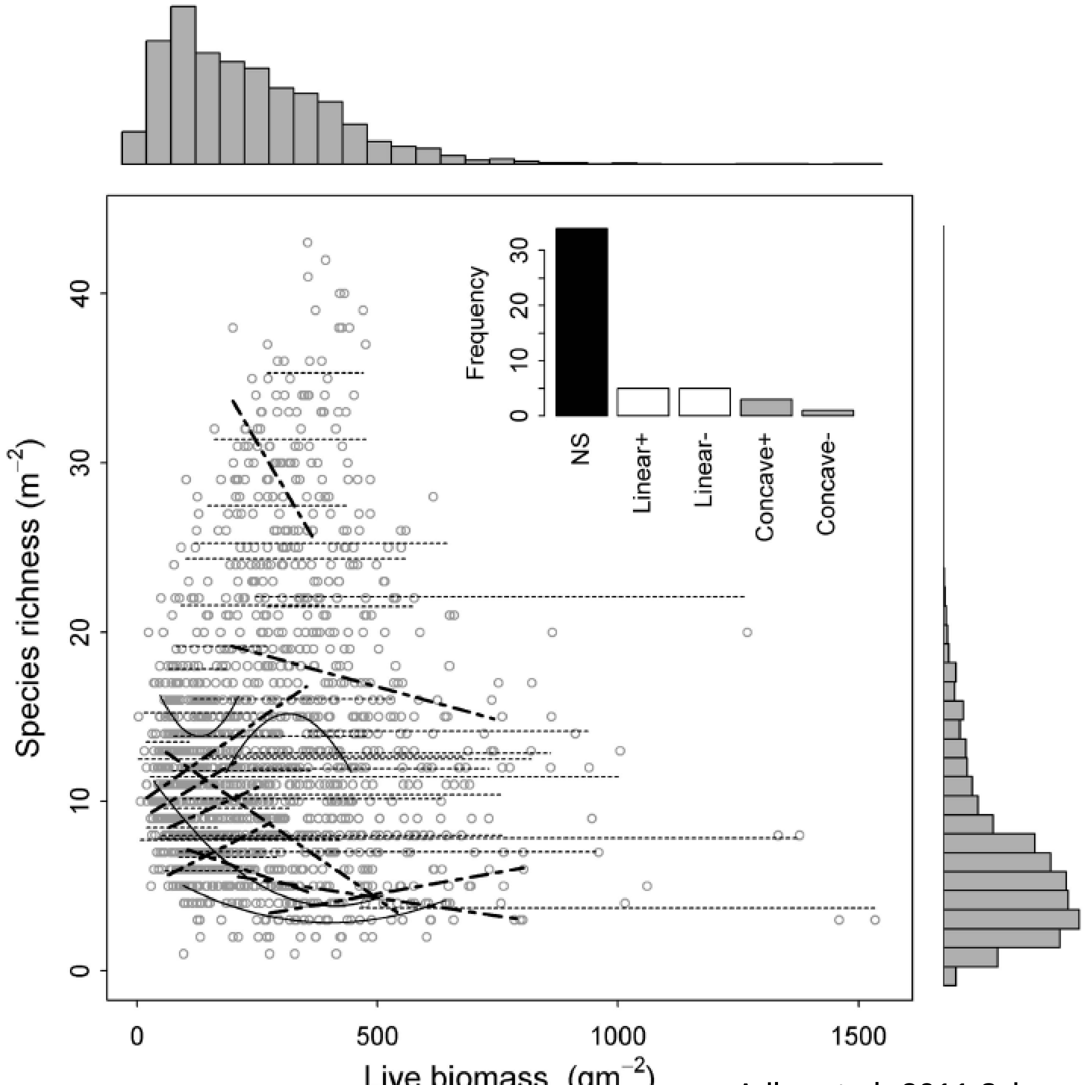
A global test of PDR

NutNet: the Nutrient Network

Within sites: 34 out of 48 local regressions were non-significant, from the remaining 14 no single pattern emerged



Adler et al. 2011 Science

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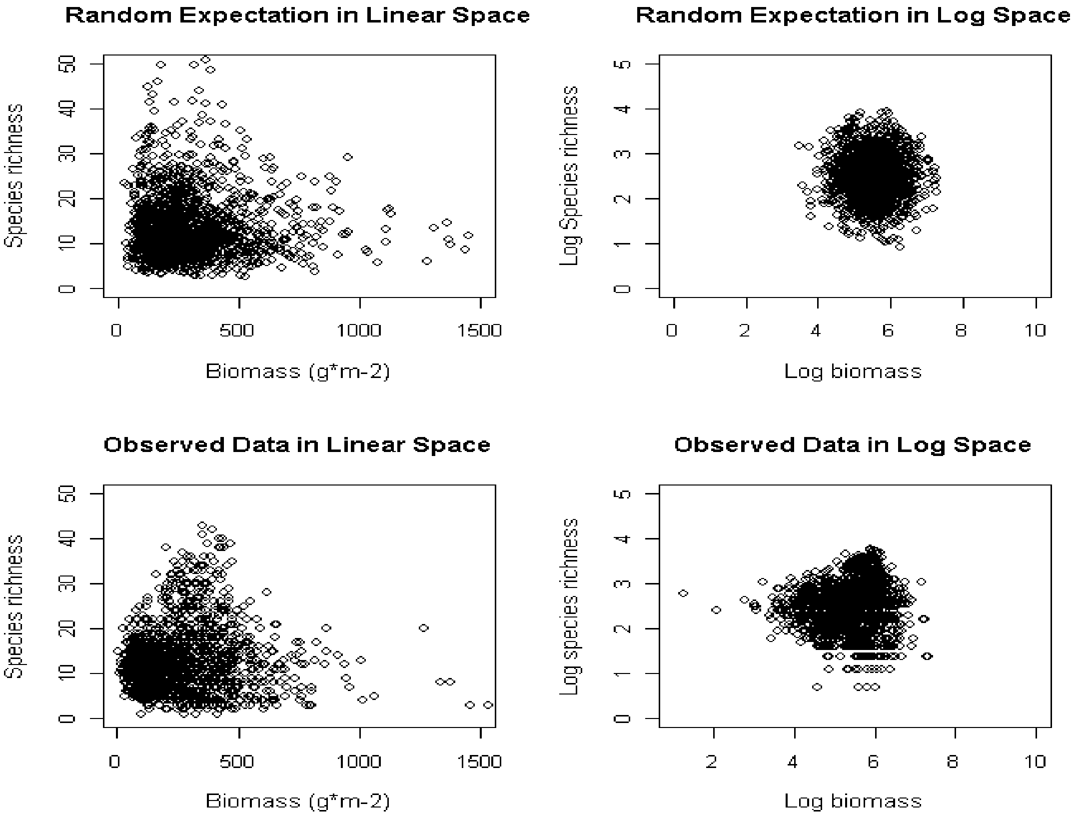
A global test of PDR

nutrient network

NutNet: the Nutrient Network

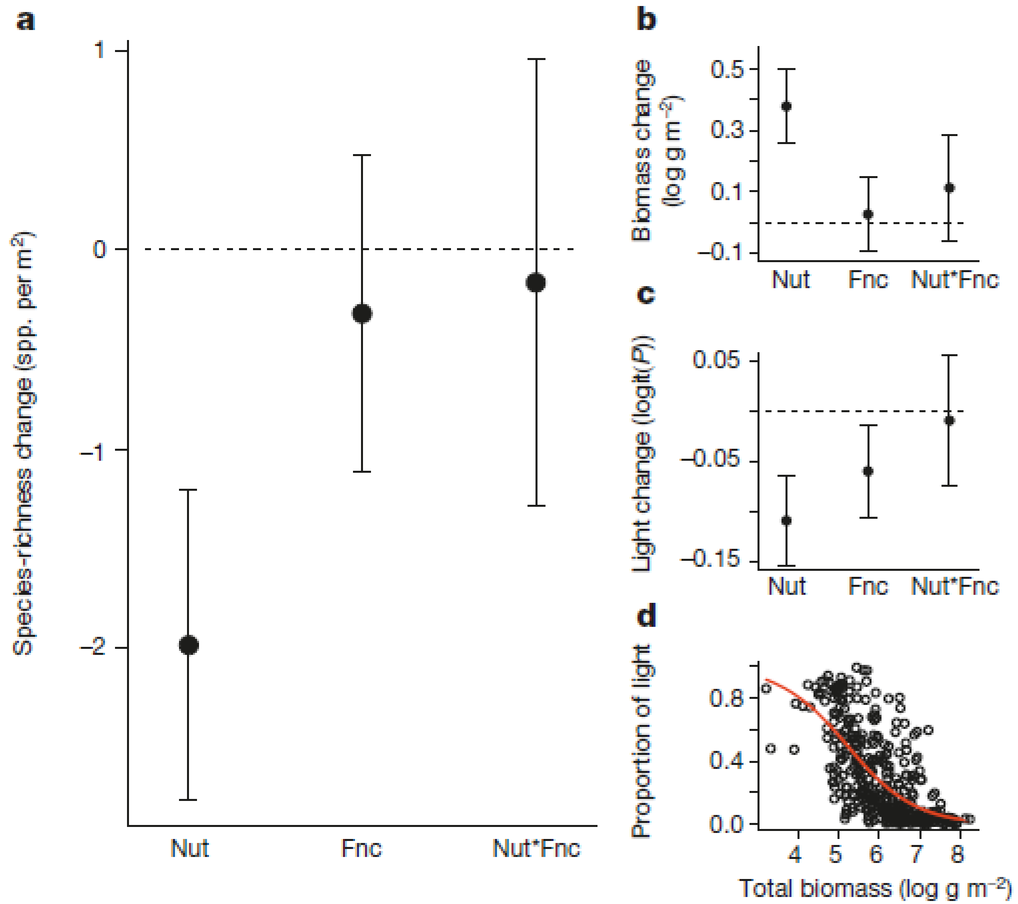
For the skeptics: The faint appearance of unimodality in the data reflects only the fact that both richness and biomass are log-normal distributed variables.



Grace et al. 2012 Science

Nutrients vs Grazing

Nutrients significantly decreased richness across sites, whereas fencing did not have a significant main effect.



Borer et al. 2014 Nature

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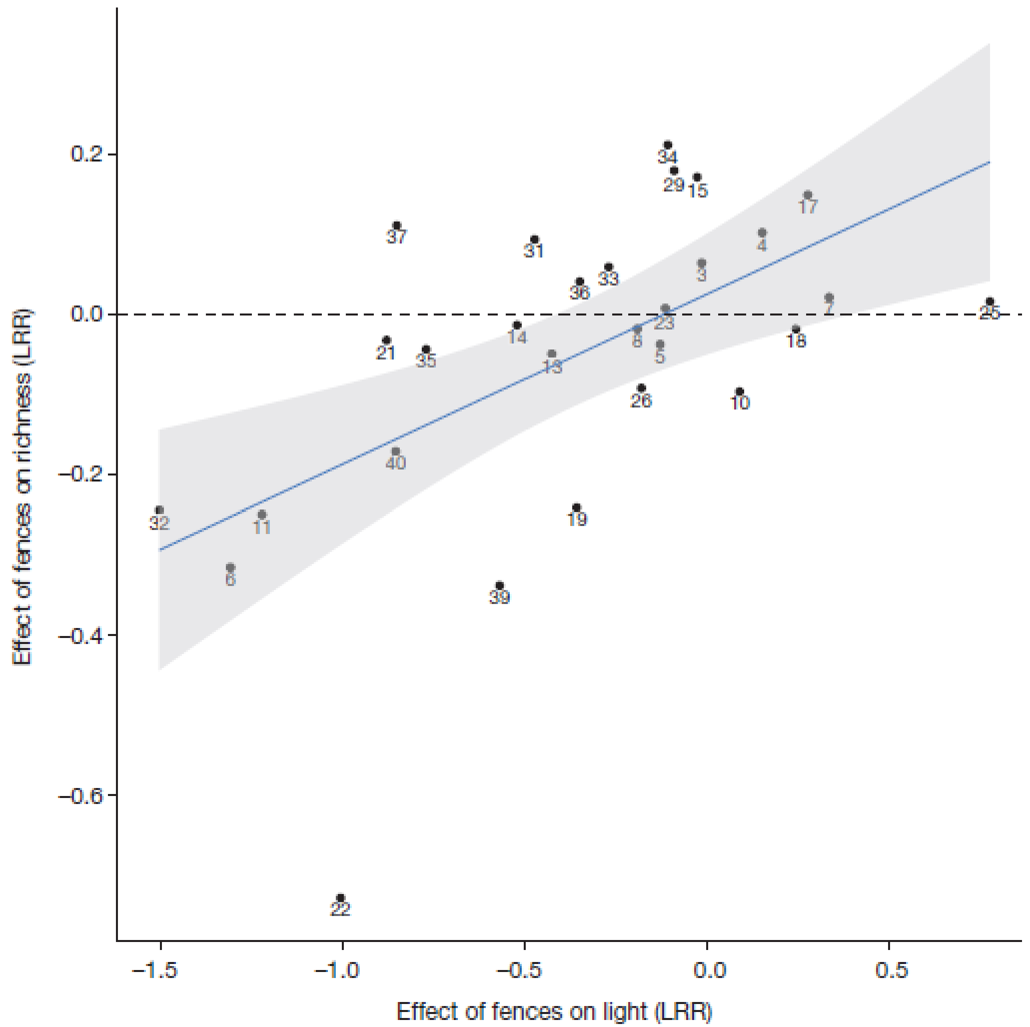
nutrient network

Nutrients vs Grazing

Nutrients significantly decreased richness across sites, whereas fencing did not have a significant main effect.

Only if fencing increased light availability, it increased plant species richness



Borer et al. 2014 Nature

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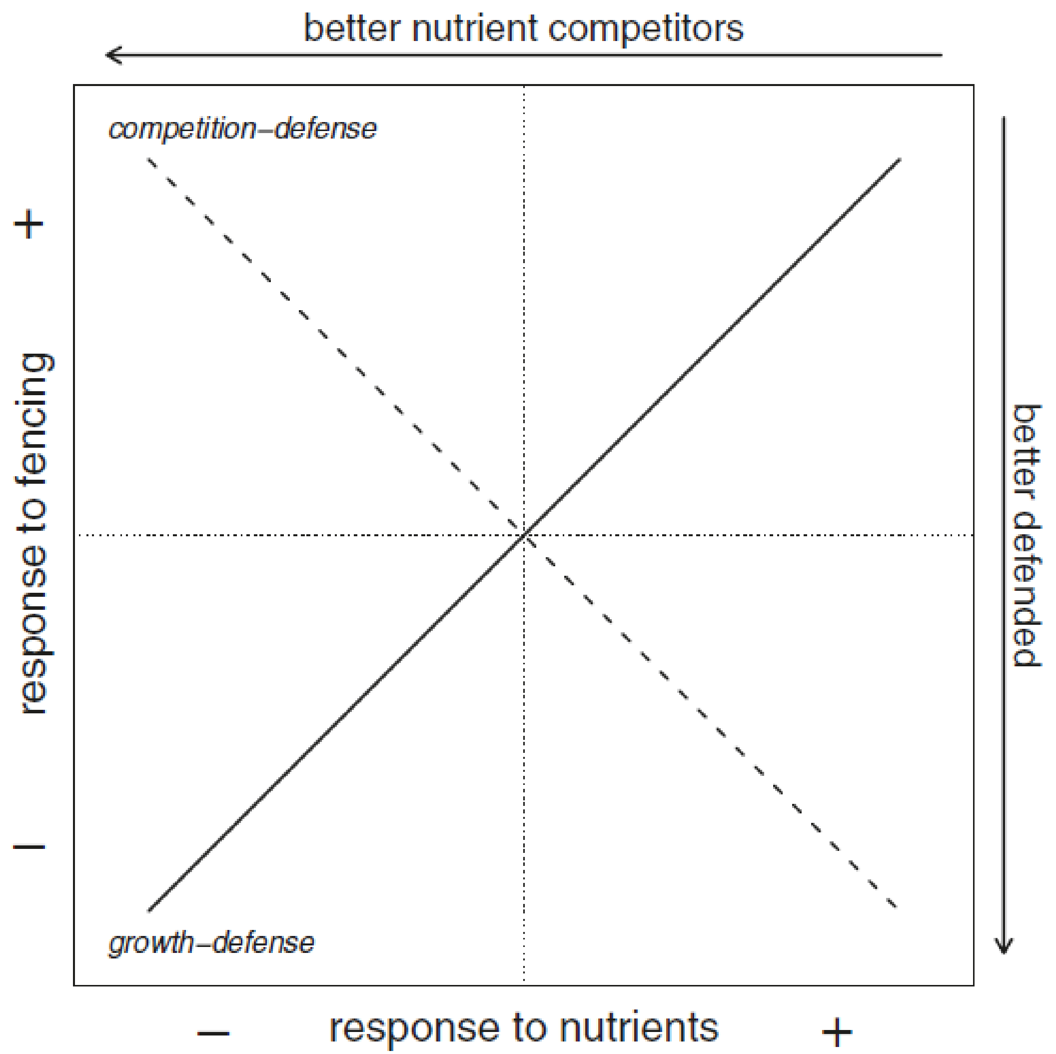
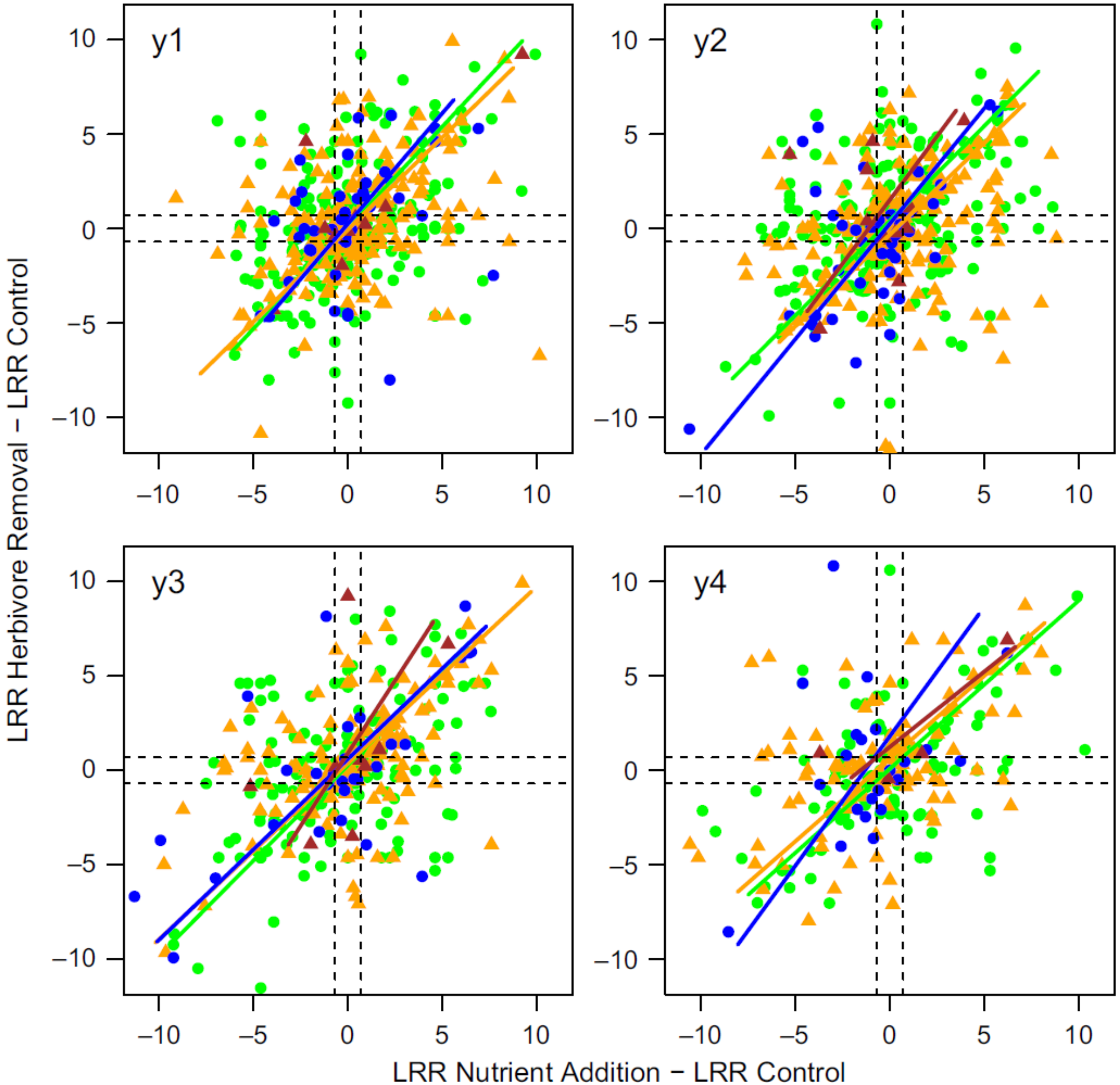
Species trade-offs



Lind et al. 2013 Ecol Lett

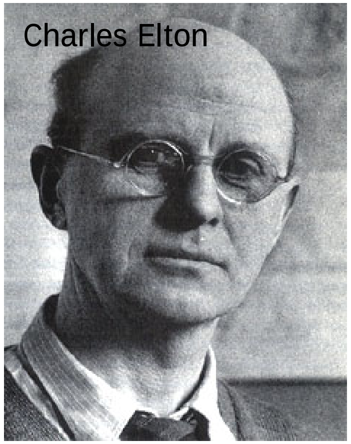
Species trade-offs

Plant species response by life form and years of treatment to the removal of two key limitations (nutrient availability and mammalian herbivory). Points are site species means of the log response ratio of abundance (%cover) of plant species naturally present after 1–4 years of treatment compared with baseline (pretreatment) abundance in the same plot, corrected by subtracting the ratio from control plots.

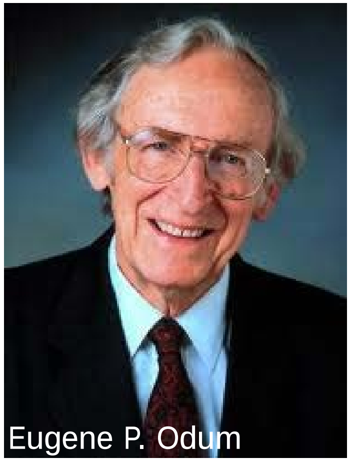


Lind et al. 2013 Ecol Lett

A short history of the diversity-stability hypothesis



"simple communities were more easily upset than that of richer ones; that is, more subject to destructive oscillations in populations, and more vulnerable to invasions"

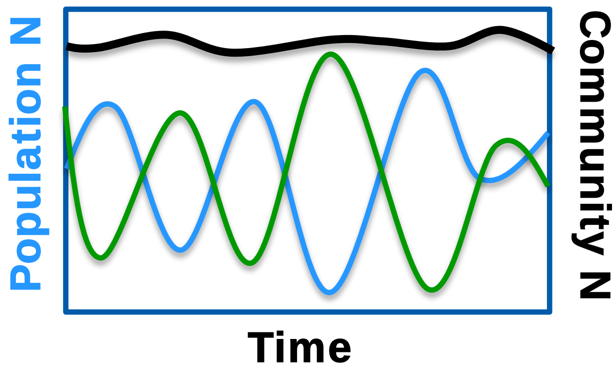


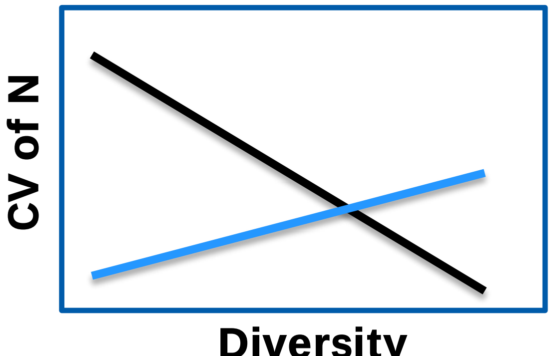
"our results show that weak to intermediate strength links are important in promoting community persistence and stability"

A short history of the diversity-stability hypothesis

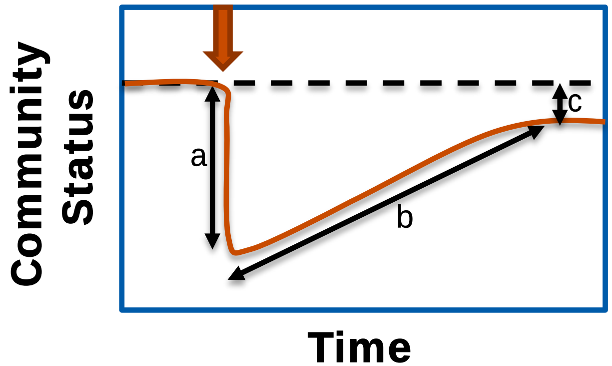
What is stability in the DSH context?

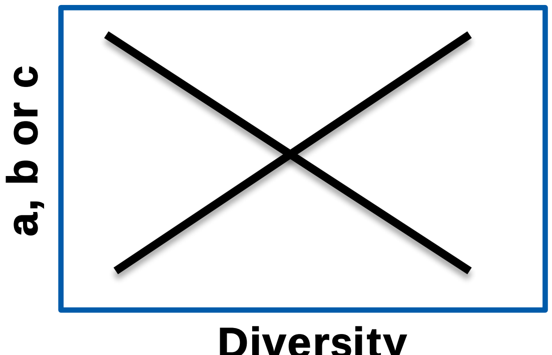
Dynamic equilibrium





Response to pulse disturbance





$$a = \frac{Dis_{t0}}{Con_{t0}}$$ Resistance

$$b = ln\left(\frac{Dis_{tx}}{Con_{tx}} - \frac{Dis_{t0}}{Con_{t0}}\right)$$ Resilience

$$c = \frac{Dis_{tx}}{Con_{tx}}$$ Recovery Ratio

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Here we analyze diversity-stability relationships from 41 grasslands on five continents and ask how these relationships are affected by chronic fertilization, one of the strongest drivers of species loss globally.

Hautier et al. 2014 Nature

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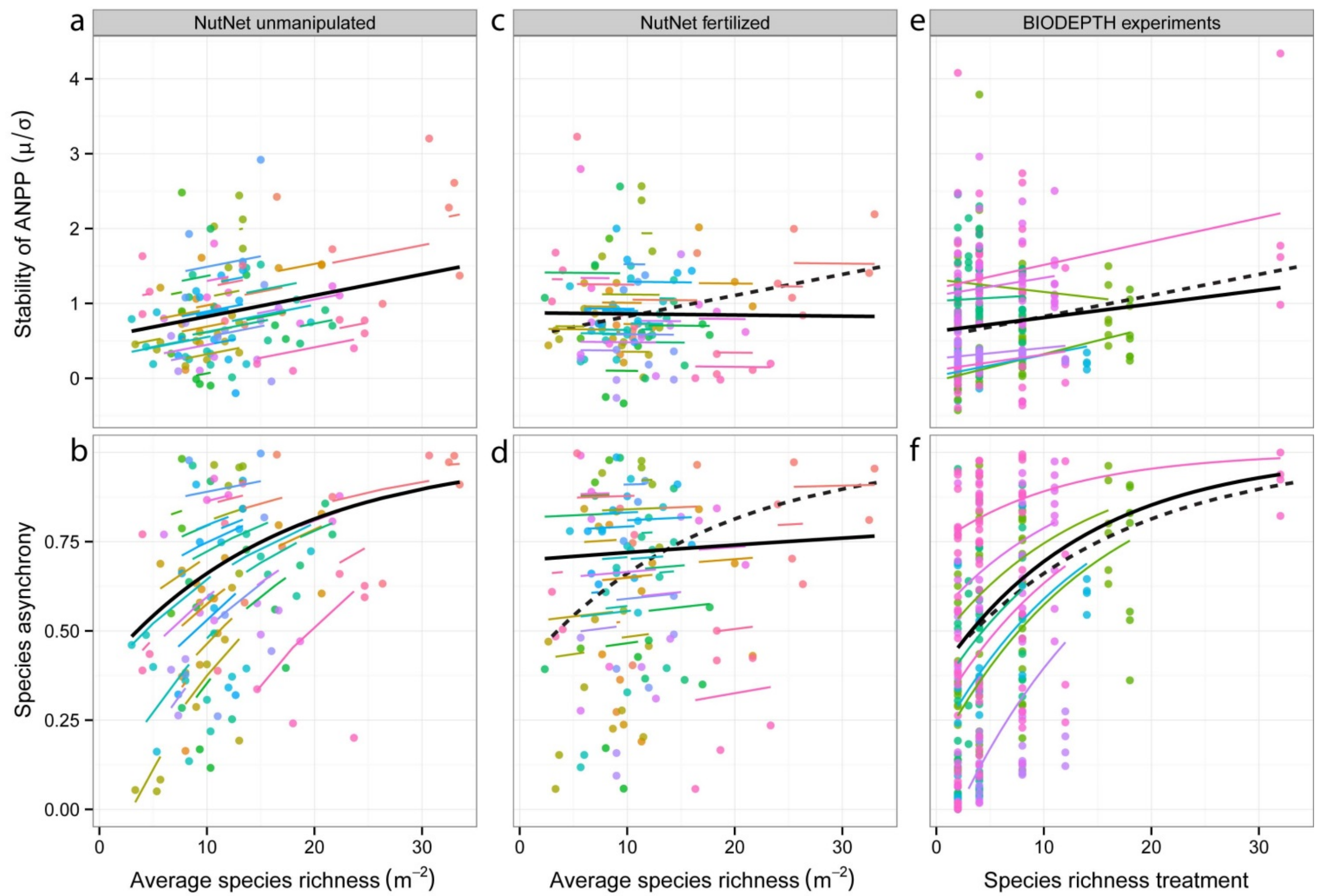
nutrient network

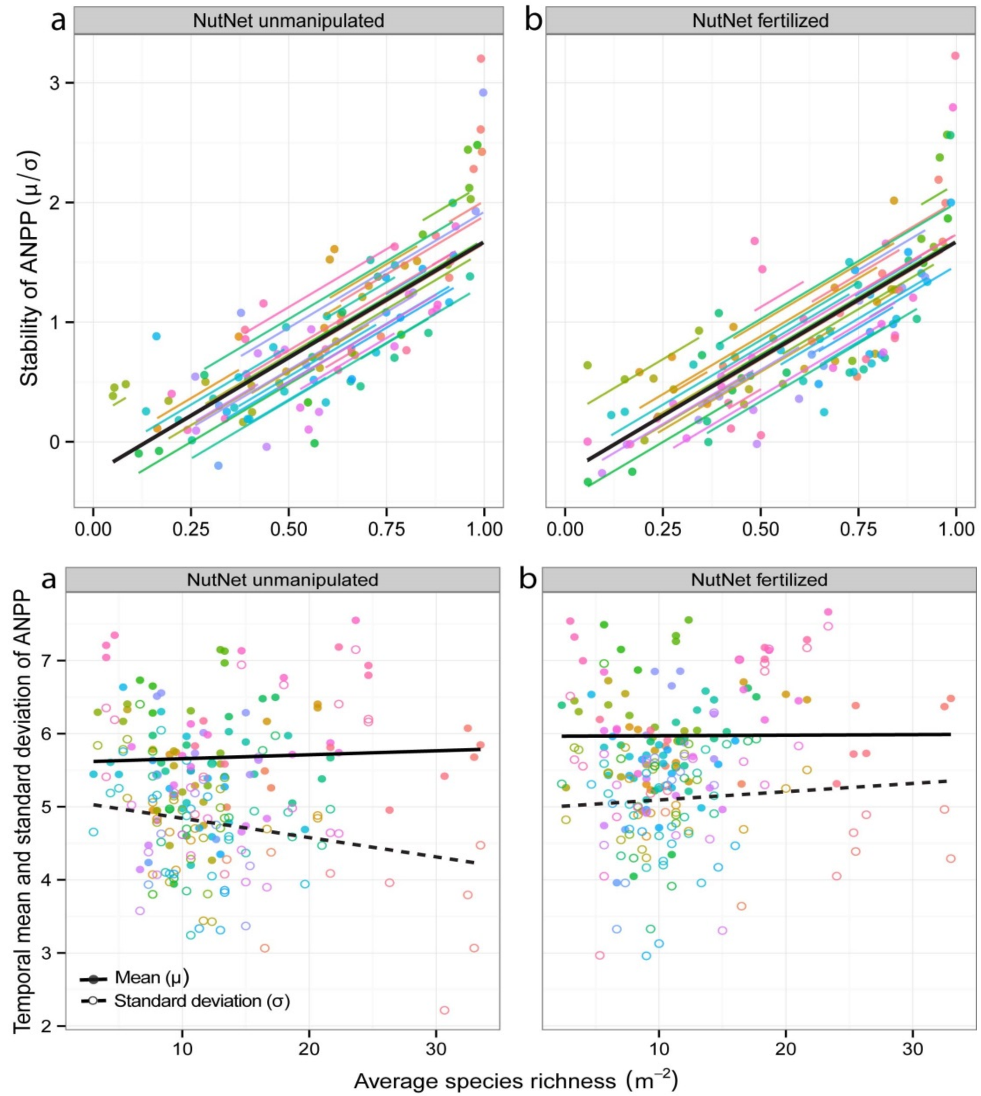
Unmanipulated communities with more species had greater species asynchrony resulting in more stable productivity, generalizing a result from biodiversity experiments to real-world grasslands. Fertilization weakened the positive effect of diversity on stability.



Hautier et al. 2014 Nature

Nutrient network

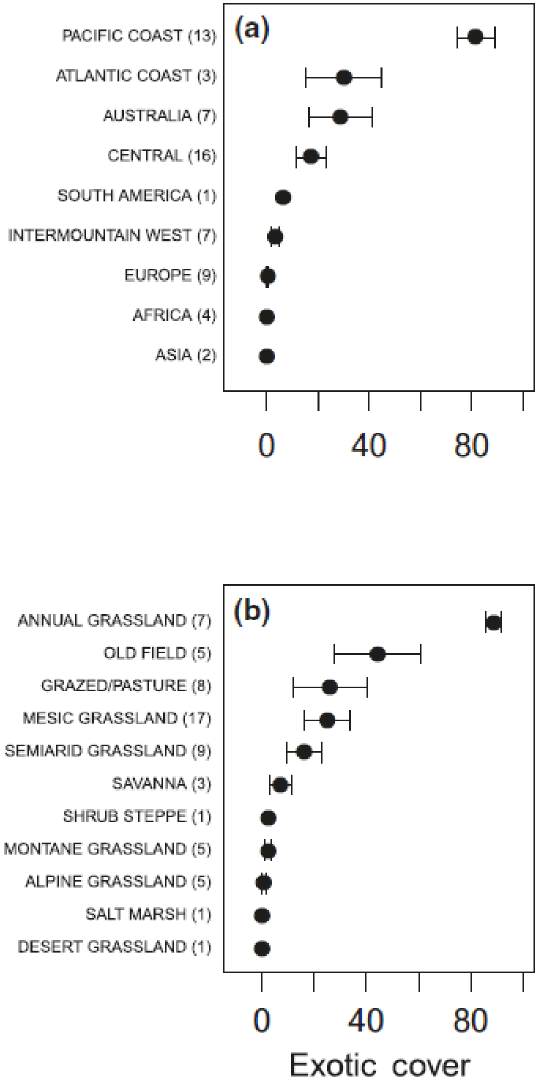
Counter to expectations, this was not due to species loss following eutrophication but to an increase in temporal variation of productivity in combination with a decrease in species asynchrony in diverse communities.



Hautier et al. 2014 Nature

Invasions

Exotic cover in the Nutrient Network sites by region and ecosystem type.



Seabloom et al. 2013 Global Change Biology

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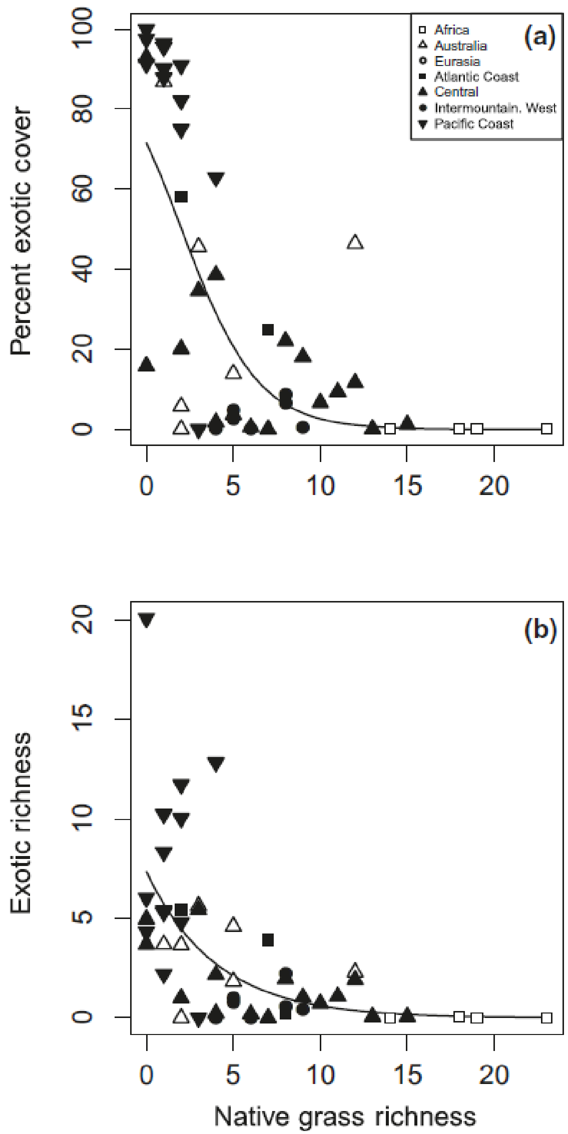
Invasions

Both exotic cover and richness were predicted by native plant diversity (native grass richness) and land use (distance to cultivation).

Response	Source	Estimate	*P*
Exotic cover	Native grass richness	−0.362	0.000
	Precipitation variation	0.050	0.003
	Distance to cultivation	−1.022	0.032
	Residuals		
Exotic richness	Native grass richness	−0.163	0.000
	Distance to coast	−0.511	0.002
	Maximum temperature	0.117	0.003
	Temp. wettest quarter	−0.048	0.041
	Distance to cultivation	−0.338	0.041
	Residuals		



Seabloom et al. 2013 Global Change Biology

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Summary

Productivity – biodiversity relationships

Top-down versus bottom up control

Diversity - stability hypothesis

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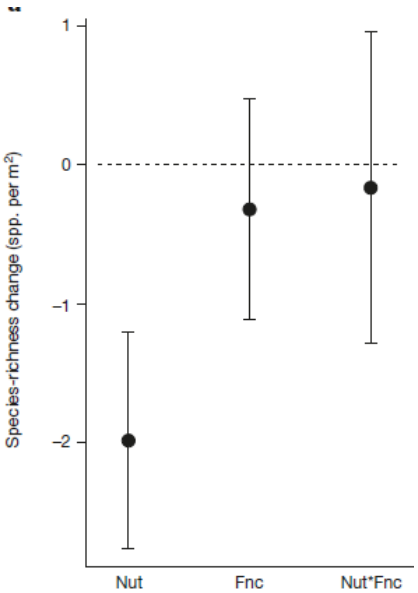

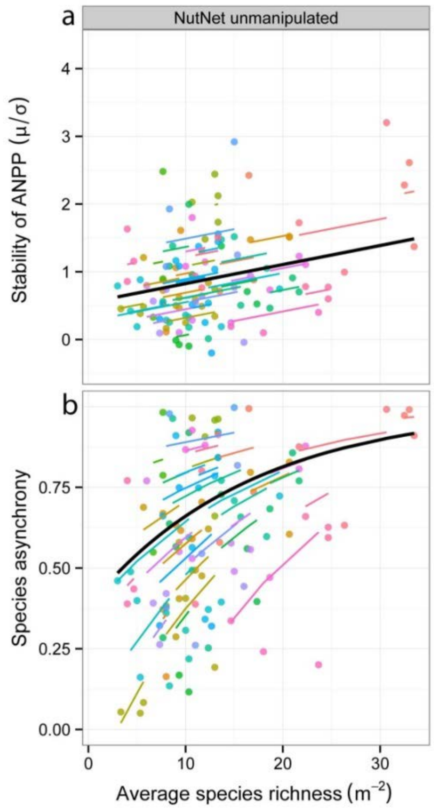

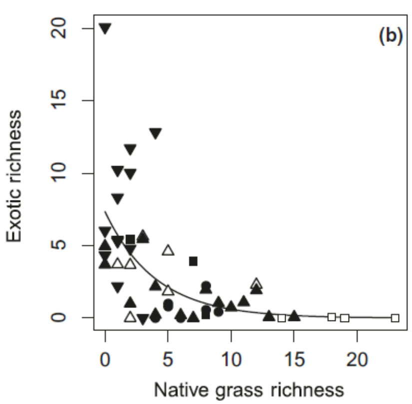

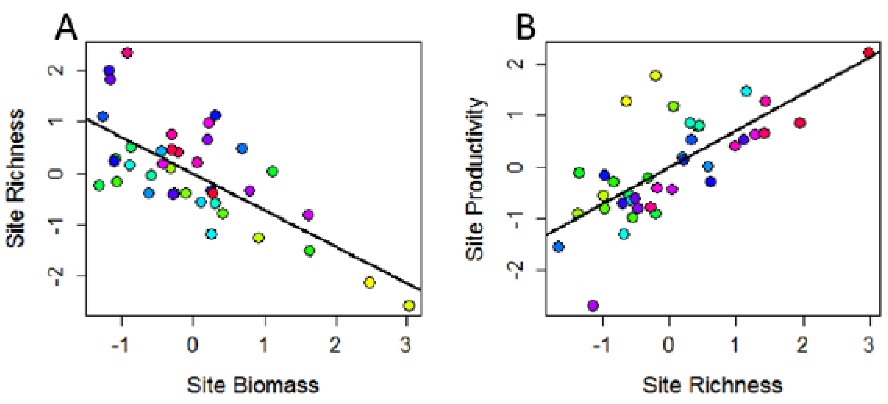

Summary

Networks rock!

NETWORK SCIENCE

Open-Source Ecology Takes Root Across the World

A new collaboration of volunteer research sites is running simple yet powerful experiments to shed light on global change in grasslands