Title: Directionality of community change with respect to nutrient identity

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Abstract:

Previous analyses of relationships between multiple nutrient enrichment and community diversity have suggested that the addition of multiple limiting nutrients has greater impacts than the addition of a single nutrient on plant biodiversity (Harpole et al. 2016). Within the assumption of niche collapse is the trade-off among resource use strategies – addition of phosphorous, for example, may not produce large declines in species diversity when all resource competition occurs on an axis of nitrogen limitation. Comparison of pairwise compositional dissimilarity plots suggests that fertilization drives greater divergence between communities of different nutrient identities relative to control.

­­To expand upon prior analyses on the role of nutrient identity, exploration of the species-specific responses to multiple added nutrients can shed light on the mechanisms that may be driving niche collapse.

For multiple nutrient limitation to drive niche differentiation across some three-dimensional trade-off surface, there must be:

1. A diversity of species with different growth strategies (the raw possibility to have niche differentiation), and;
2. A heterogenous environment that may support species with different resource use strategies

Thinking about harshness –

* 2 things get embedded with harshness:
  + There’s one major limiting resource
  + Either the resource supply rate is below the species isocline
  + High density independent mortality (e.g. salt in a desert)
  + Low growth rate? Low supply of one limiting resource, so you’re never near carrying capacity, so density dependent declines are never an issue

Emphasize nutrient tradeoff piece:

* Are more spatially heterogenous enrivonments more likely to yield higher diversity
* Spatial variability should ease coexistence at the 30-plot scale
* Check on Doro’s paper to think about some more concrete hypotheses that might arise
* Alexandra L.’s paper on lakes, marine, and NutNet data (Resource availability and resource imbalance)
  + Variation in soil chemistry

How to model nut change:

* Change from pre-treatment
  + Removing among-plot variability (detrended LRR)

Structuring through time (does the effect size differ through time?):

* Year 0
* 1 -3 Year (growth + extinction)
* 6 + years (colonization of new species)

Thinking about phylogenetic diversity:

* Raw phylogenetic diversity?
* Richness vs. PD? (MPD)
  + Marc Cadotte 2010 paper

Thinking of environmental variation:

* How skewed are resource relationships?
* How are biomass values responding to individual treatments?
* Stan’s 2017 Paper

1. Observational data
   1. Do we see differences in species occupancy within sites just based on observational data and variation in soil resources?
   2. Start with observations – here’s a bunch of sites with 30 plots, do you see some of the same kind of trade-offs among species in plots within a block?
   3. Start with this + when we perturb it, is there a greater response?
2. Global trade-off
   1. Are species responses to different nutrients negatively correlated?
      1. Are the trade-offs correlated with species characters?
         1. Are the trade-offs phylogenetically clustered, or are trade-offs related to functional or provenance groupings? (Eric Lind, check with him. Are responses to N, P, and K phylogenetically clustered? Get his view on this + where it is in his research queue? Would this be something we could push out first, if necessary?)
3. Site-level analyses
   1. What are site characters that create strong trade-offs? (Resource competition)
      1. NPP co-limitation (Fay et al.)
      2. Nutrient stoichiometry supply and imbalance (Lewandasta)
   2. What are community characters that create stronger trade-offs? (Phylogeny + community scale – Cavender-Bares)
      1. Phylogenetic diversity at the site
      2. Functional diversity at the site

Using this data, we can ask:

1. Are there consistent patterns in resource use trade-offs among species in Nutrient Network sites? For example, do species which show a proportional increase in response to nitrogen fertilization show a decrease in response to phosphorous addition?
2. What site-level variables are correlated with the presence of a resource use tradeoff?
   1. We hypothesize that trade-offs in response to nutrient enrichment will be strongest in sites with higher spatial heterogeneity in resource use (measured heterogeneity in soil resources, CV of biomass pre-treatment), larger species pool, and higher mean annual precipitation (or lower harshness? Higher productivity?)
3. What characteristics are associated with greater affinity for certain resources/tradeoffs?
   1. We hypothesize that relationships between nutrient identity and response will be correlated with functional group identity (and some subset of species traits)?

Explanatory Variables:

Timeline:

Data:

Status:

Supporting Information: