

Mechanisms of convergence and divergence: understanding the variability of plant community responses to multiple resource manipulations

LTER synthesis working group meeting report

Meetings

First Full Meeting: February 26-28

Second Full Meeting: July 24-26

Both meetings took place at Colorado State University's School of Global Environmental Sustainability Conference Center.

Meeting between principal investigators: July 19-23 in Salt Lake City, UT

Organizers:

Meghan Avolio – University of Utah, KNZ

Kimberly La Pierre – Yale University, KNZ, SGS

Other Participants:

Sally Koerner – Colorado State University, KNZ

Melinda Smith – Colorado State University, KNZ, SGS

Kevin Wilcox* - Colorado State University, KNZ

Daniel Milchunas - Colorado State University, SGS

Eve Gasarch* - University of Colorado Boulder, NWT

Qiang Yu - Colorado State University

Greg Houseman – Wichita State University, KBS

Forest Isbell – University of Minnesota, CDR

Emily Grman – University of Michigan, KBS

Bill Bowman – University of Colorado Boulder, NWT

Dave Johnson – Marine Biological Station, PIE

* = Graduate Student

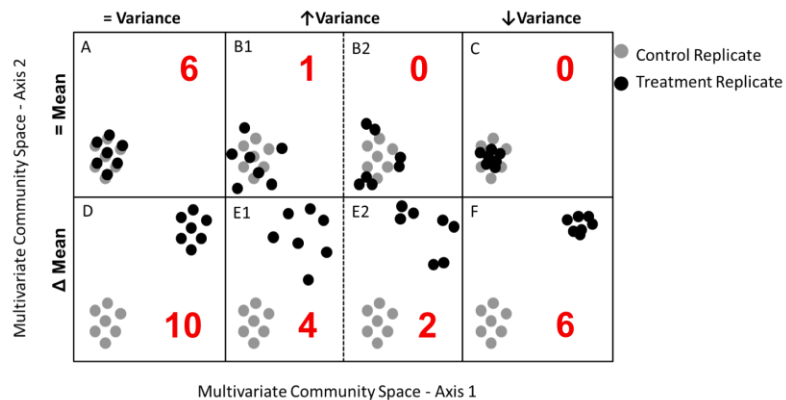
Summary

Ecologists have been tasked with predicting how communities will respond to altered environmental conditions in the face of global change. This task, however, is complicated by the inherent complexity of many ecological systems. Indeed, within a system the species composition of experimental replicates does not always respond to resource manipulations in similar ways; instead replicates can diverge to form distinct alternative community types. An understanding of the processes leading to such divergence is currently lacking.

Our working group focused on the ways in which plant communities could respond to resource manipulation experiments in multivariate community space (converge or diverge, or neither). We spent our first working group in February developing a conceptual framework of community change. Our first paper will be a conceptual paper that details a new approach to study community responses to global change.

This conceptual paper first introduces a new term, tertiary succession, which we believe will unite studies of global change drivers (GCD) and enable greater comparisons across systems. Additionally, by terming responses to global change a successional process we promote drawing upon a vast literature that goes into wonderful detail on how different mechanisms can result in community change. Second, our paper describes a new way to study patterns of community response to GCDs by focusing on the variability among replicates within a treatment. If all replicates respond the same way, then community responses may be more predictable than if all replicates responded differently. Next, we suggest in our paper that using multivariate techniques to study changes in community multivariate means and dispersion among replicates around a centroid is the best approach to study the variability in community responses. Using multivariate approaches we detail six ways in which communities could change. Finally, our paper shows how using rank abundance curves (RACs) to determine how the community changed, and present hypotheses of how changes in RACs can give rise to different multivariate patterns of community responses to GCDs. This paper is now in its fourth revision and we plan to have a manuscript submitted to Ecology Letters as an Ideas and Perspective piece by the end of 2013.

Between our first and second working group all members compiled datasets for analysis. Before the second working group in July, K. La Pierre and M. Avolio met to compile the datasets gathered and run preliminary analyses. At the second working group we



performed a literature search to identify more potential datasets to include in our meta-analysis, discussed ways to analyze all the data and outlined 6 more potential papers. At the start of the second meeting we had compiled 29 datasets. All had: 1) a minimum of three years of herbaceous community composition data, 2) at least four replicates and 3) manipulated at least one resource (water, light, nutrients, CO₂). These datasets included the desert, tundra, pasture, tallgrass prairie, forest understory, and salt marsh. Preliminarily, we found that six of the 29 studies had no community change, while the others showed all but one of our predicated community responses (Figure). Since so many of the studies were in tallgrass prairie (40%), we performed a literature search to expand the number studies in other ecosystems. K. La Pierre and M. Avolio have emailed another 80 scientists for potential studies. Once all datasets are cleaned up and compiled (goal of 50 studies) we will detail how each study fits into the six community responses detailed in our first study (Figure). We will also investigate whether there is a relationship between the number of manipulations and the degree of community shifts. In our

preliminary analysis, we generally found that there were fewer community shifts with a single manipulation compared with many. Our goal is for K. La Pierre to have a draft of the manuscript done by the beginning of 2014 and submitted to PNAS by the summer of 2014.

With 50 datasets compiled, all participants are excited about continuing to collaborate to work on other manuscripts as well as explore other avenues of research. In addition to our two main manuscripts from this working group, we are interested in securing more funding to explore 1) a paper on rank abundance curves integrating our hypotheses and what our compiled datasets show, again testing relationships proposed in our first conceptual paper; 2) a paper focusing on species investigating which species drive dissimilarity, whether we observe priority effects, and if possible include an analysis on functional traits (which we have for some datasets); and 3) a paper detailing community shifts in response to different factors and whether there are thresholds of responses.

Ultimately, this working group has resulted in the formation of promising new collaborations, two manuscripts, and the potential for more products in the future.