2011 LTER Cross-Site Synthesis Grant Final Report

Title: Temporal dynamics of plant community composition in relation to interannual variation in rainfall

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Background

Predictions regarding future climate change vary greatly among regions, and these predictions include directional changes such as more arid conditions in the US Southwest (Seager et al. 2007), as well as an expectation of greater interannual variability (Easterling et al. 2000). Ecologists are charged with identifying biotic communities and ecosystems most at risk for declines in diversity and functioning, which first requires an understanding of how diversity and ecosystem function respond to current temporal and spatial variation in climate, including interannual climate variation. In many systems there is great interannual variation in climate, making long-term observations of species composition and ecosystem functioning essential for documenting these climate-composition-function relationships.

Past research across the LTER network showed that above-ground net primary production (ANPP) was strongly correlated with mean annual precipitation (MAP) across sites, but this relationship did not hold within sites across years (Knapp and Smith 2001). The highest interannual variability in ANPP was found in mesic grasslands, and hypothesized to result in part from differences in species composition. Although observations from individual sites have documented remarkable interannual variation in species composition (Collins and Glenn, 1991), there has been little analysis of variation in species composition in relation to interannual climate variation. For instance one analysis of long-term species composition at three sites showed that species richness was positively correlated with MAP across space but not in time (interannually within sites), but this analysis was across sites that varied relatively little in both climate and species composition (Adler and Levine 2007).

The goal of our cross-site synthesis effort was to document the relationship between interannual variation in precipitation and plant species composition across

herbaceous dominated communities in U.S., using long-term (>10 years) datasets both from LTER and non-LTER sites.

Summary of activities

During 2011 our group was funded by an LNO Synthesis grant that included part-time salary support for a graduate student (Lauren Hallett) to assemble species composition datasets and a postdoc (Laura Turnbull) to assemble and analyze comparable long-term climate records for each site. We held two meetings involving mostly beginning investigators (3 graduate students, 4 postdocs, 1 assistant professor, 3 tenured professors). In total we identified 7 LTER sites and 3 non-LTER sites with paired data for climate and species composition.

The resulting manuscript shows that species richness and MAP were positively correlated across sites, but a temporal richness/MAP correlation was only evident in the driest sites, driven predominantly by the dynamics of annual species (Cleland et al. 2013). This suggests that among grasslands, xeric systems are likely to demonstrate the greatest community composition response to predicted increases in interannual precipitation variability.

Products:

Cleland*, E. E., S. L. Collins*, T. L. Dickson, E. C. Farrer, K. L. Gross, L. A. Gherardi, L. M. Hallett, R. J. Hobbs, J. S. Hsu, K. N. Suding, and L.Turnbull (2013). Sensitivity of grassland plant community composition to spatial versus temporal variation in precipitation. *Ecology (in press) http://dx.doi.org/10.1890/12-1006.1*

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Collins, S.L. and S.M. Glenn (1991). Spatial and temporal dynamics in species regional abundance and distribution. *Ecology* 72: 654-664.

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