

## **How are ecosystem properties affected by perturbations and global change?: Ecological memory and legacy controls on grasslands.**

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The focus of our working group was to explore how we can use climate induced temporal patterns of biomass production in long term experiments to get an understanding of mechanisms influencing stability of ecosystems. It began with a short presentation describing the ideas and existing research on legacy effects of precipitation on grassland ANPP, and the mechanisms thought to underlie these patterns. We then discussed how experimental manipulations such as nutrient addition, grazing and fire may change signals of precipitation legacies in grasslands. With a similar experiment performed across grasslands with varying climate, soil and plant communities, the 24 people present broke into 3 groups, and discussed how different mechanisms of legacies may operate in different ecosystems, and community/ecosystem properties that would be interesting to study in this framework. We came together as a large group to go over these, and ended with members from different LTER sites suggesting experimental datasets that can be used to work on this.

A list of ideas generated regarding ecological memory in grassland ecosystems.

- Plant traits that could influence legacies – Reproductive strategy (deterministic budders, non-deterministic budders, tillers), plant size (as a possible mechanism of legacies)
- Site characteristics that could influence legacies – Soil drainage, degree of nutrient limitation (for nutrient addition experiments), historical variability of precipitation (could select the plant community to have particular legacy responses), degree of nutrient limitation of ANPP in the grassland.
- An idea for a theoretical model - Different systems may have different frequencies of perturbations. If increased climate variability increases perturbation frequency in comparison to the return rate of the ecosystem to equilibrium, it could lead to a shift in the equilibrium state of the ecosystem.
- Ecosystem modelling – litter decomposition fluxes could result in legacies of precipitation, which would vary from site to site. Decomposition data from specific LTER sites could be used to construct litter feedback models and see if they match observed precipitation legacies.

A list of nutrient manipulation experiments within the LTER network, collected from the participants of the working group.

- KNZ - N fert expt started in 1987; P addn plots with 10 years of data
- Lauenroth (SGS) - adding N and water for 5 years - shift from grasses to forbs that is still around
- JRN - Precip x N treatment for 9 years
- NWT - N fert from 1997
- FCE - flume addition of P, run for about 5 years
- ARC - factorial N,P fertilizer experiments.
- PIE - whole creek fertilization
- Cape Cod - 40 year fertilization experiment - Ivan Valiela (MBL) has data

- Park Grass

The working group organisers will follow up on ideas generated here, and stay in touch with participants from different sites with regard to using their data.