An Exploration of Soil Movement Effects on Leaf Litter Decomposition in a Chihuahuan Desert Grassland

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Introduction

- Encroachment by woody shrubs has been documented in many of the world's drylands.
- Shrub encroachment may be accompanied by a loss. This shift in vegetation alters patterns of soil erosion by wind and water.
- Models of decomposition are not particularly accurate in predicting decomposition in arid lands, because there are unique drivers of decomposition that have yet to be explored. At present, however, these generally models under-predict decay in arid systems.
- Recent studies suggest that additional drivers of decomposition may operate in drylands. These drivers include photodegradation from UV light and soil deposition. Soil deposition may enhance litter decay by causing physical damage to litter or by providing altering the microclimate for decomposers.
- The classical decomposition framework has not been tested explicitly, it may explain the inaccuracy of existing decomposition models.
- Our study aims to assess the relationship between soil flux, vegetation cover and decomposition. We expect that grass losses associated with shrub encroachment will allow for increased soil erosion, which will catalyze decomposition.

Methods

- Our study site is located at the Jornada Basin LTER (JRN), Las Cruces, NM, USA. The location of our study is in a mixed Chihuahuan desert grassland.
- Litter bags were deployed in wind manipulation plots (Fig. 3; Li et al. 2007). These plots consist of upwind treatment plots in which 100%, 75%, 50% or 0% of grass cover has been removed and downwind, unmanipulated response plots. Litter material: naturally senescent Prosopis glandulosa leaflets were collected at the JRN in the autumn of 2007.
- Mesh litter bags were filled with 2g of air-dried, naturally senescent Prosopis glandulosa. This mass provided a mono-layer of litter, thus limiting leaff return.
- Litter bags were deployed in late April 2008 at the start of the 'windy season' at our study site. Bag collections at 0, 1, 3 months have taken place, while 6, 12, 24, 36, and 48 month collections are planned.
- Litter has been analyzed for ash free dry mass loss, % ash (as an index of soil deposition), and C:N content, arthropod sampling and phospholipid fatty acid extraction (PLFA) to assess microbial communities in progress.

Results

- After three months, there is evidence of a relationship between vegetation removal, % ash and decomposition (Figs. 4 & 5). Although there is a correlation, this relationship is still not statistically significant. If this relationship becomes stronger it would suggest that soil deposition facilitates decomposition in arid systems.

Field Design

- The classical decomposition framework (Fig 1) has been expanded (Fig 2) to incorporate unique mechanisms that may be important mediating decomposition in drylands. Though this framework has not been tested explicitly it may explain the inaccuracy of existing decomposition models.
- Additional projects that explore influences of vegetation structure and soil-litter matrix interactions in these changing ecosystems.

Preliminary Data

- Table 1. Leaf litter decomposition in Wind manipulation plots (Fig. 6; Li et al. 2007).
- Fig. 6. The ash free dry mass remaining shows no among transect differences after three months (P>F= 0.7887, F= 0.4816).
- Fig 7. Mean % Ash among transects shows no statistically significant differences (P>F= 0.3085, F= 1.2233) or trend between transects after three months.

Discussion & Future Directions

- To explore the relationship between soil deposition and decomposition further, litter bag collections will continue for the remainder of the planned 48 month experiment at 6, 12, 24, 36 and 48 months.
- Because data presented here are from the 3 month collections it is not surprising to see a lack of statistical significance. It is, however, interesting to see a trend in decomposition and % ash with relation to the grass removal.
- We will also aim to conduct experiments in controlled environments manipulating UV, soil flux and microbial communities.
- The goal of this project is to help untangle a portion of the decomposition conundrum in arid lands and use the results along with results of other studies to aid in the parameterization of specialized drylands decomposition models.
- Understanding the drivers of decomposition in drylands will help us understand how nutrients and carbon are cycling in these changing ecosystems.

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Literature Cited