Dynamic Soil/Litter Surfaces in Shrub Land Vegetation Patches: Implications of Wind and Water Erosion for Litter Decomposition.

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Problem Statement

1. It is important to understand the C cycle in the context of how our ecosystems are evolving and how much C is being held or lost from semiarid lands and other ecosystems.
2. Decomposition is a key part of understanding the C cycle, but most of what is known about decomposition, is based on studies from more mesic forest ecosystems rather than semiarid shrublands, which are globally extensive.
3. New developments suggest that decomposition in semiarid shrublands may be very different from that in forests and in particular may depend on soil and litter moving around and mixing together to provide nutrients. Yet there are few if any studies that have evaluated the degrees to which soil and litter are mobile on the soil surface.

Study Location: Semiarid grassland in southeastern Arizona at the University of Arizona Santa Rita Experimental Range

Objectives

We evaluated soil and litter movement in a semiarid shrubland using repeat photography to quantify, both at weekly and annual time scales, how much soil litter movement occurred, both with respect to (i) individual shrubs vs. shrub clusters and (ii) with respect to locations beneath shrub canopies and in the intercanopy spaces that separate the shrubs.

Methods

•An assortment of instruments were used for data collecting. For photographing we used a Nikon Coolpix 5400. All photographs were taken on the north side of the photo plots to reduce effects of shadowing. To create the plots in the canopies and intercanopies, 8" nails and kite string were used and were color coded with nail polish to depict cardinal directions.

•Photographs were taken twice this summer in July 2010. The first photo session was on July 15th, shot prior to a heavy rain from monsoon season. The last shots were taken on July 22nd, marking a year since 2009's photographs. Between July 15th and July 22nd a heavy rain fall occurred in the experimental range. From the data collected, there are enough photos to observe a change for a year and a change for a week.

•Microsoft PowerPoint and Excel programs were used to make grids over photographed plots and organize information into graphs to compare ground coverage and changes of this cover over time frames.

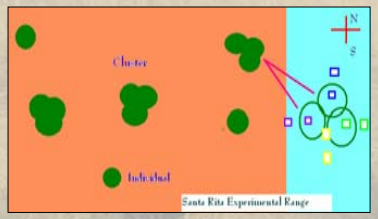
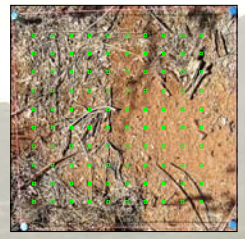


Fig 1. Colored squares depict cardinal direction. Blue = North Green= East Yellow= South Purple= West. Color coded plots are located under all randomly chosen shrubs.

Methods Continued…

Individual 1 Intercanopy North July 31 2009

Individual 1 Intercanopy North July 22 2010



Results

Figure 1 Individual Shrubs

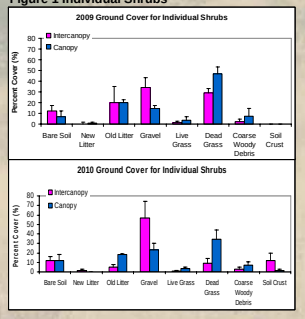


Figure 1
There were some interesting changes for the individual shrubs. From 2009-2010 gravel cover increased from 33.9% to 57.0% in the intercanopy area, and dead grass cover decreased from 47.0% to 34.3% beneath the canopy. Soil crust is another interesting factor, with an increase from 0% to 11.9% and 1.7% for intercanopy and canopy, respectively.

Figure 2 Shrub Clusters

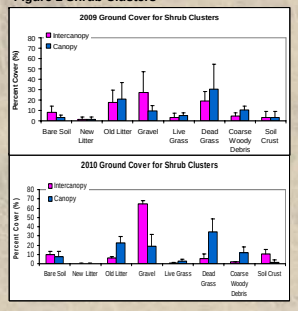


Figure 2
Gravel within the intercanopy area increased from 27.3% to 64.0% throughout the year. More soil crust was observed in 2010 then in 2009 in the intercanopy area, increasing from 3.3% to 10.6%. However beneath the canopy, soil crust decreased from 3.3% to 1.7%. Canopy changes stayed consistent aside from soil crust change.

Percent Changes within a year 2009-2010

Figure 3 Individual Shrubs

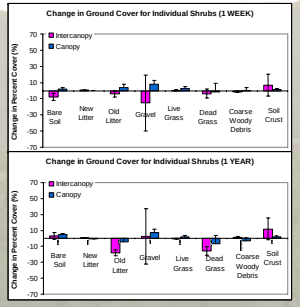


Figure 3
1 week table July 15th -22nd 2010
For the intercanopy areas, bare soil and gravel decreased by 7.9% and 15.3%, respectively. Soil crust increased by 6.8% within the week, which was the largest increase observed.

1 year table July 31st 2009- July 22nd 2010
Intercanopy areas actively seemed to experience more drastic changes then canopy areas. Old litter and dead grass decreased by 18.2% and 15.7%, respectively. Soil crust increased by 11.9%, covering substantially more ground then the year prior. The major changes that were observed beneath the canopies included gravel and bare soil increasing by 7.2% and 4.7%, respectively, and coarse woody debris decreasing by 3.3%.

Figure 4 Shrub Clusters

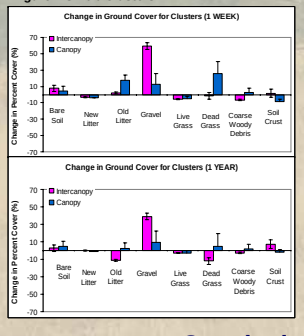


Figure 4
1 week table July 15th -22nd 2010
For the intercanopy areas gravel cover increased by 59.4% and bare soil increased by 7.8%. For the canopy areas soil crust decreased by 8.3% while dead grass and old litter cover increased by 25.6% and 17.2%, respectively.

1 year table July 31st 2009- July 22nd 2010
Intercanopy gravel cover increased by 39.1% and soil crust increased by 2.3%. Old litter decreased by 11.2% and dead grass decreased by 12%. Canopy's gravel increased by 9.4% and live grass decreased by 2.8% and soil crust decreased by 1.6%.

Conclusions

- Most decomposition occurred in the intercanopy areas where the largest percent changes occurred. It appears that temperature plays a large role in soil respiration which in turn affects C release.
- Soil litter movement is less active beneath canopy areas, thus leaving more litter to slowly decompose and more nutrients to be absorbed.
- There was a more dynamic percent change amongst individual shrubs then under shrub clusters. Shrub clusters appear to be larger communities that hinder soil litter movement and decomposition.

Acknowledgments

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