

# IMPACTS OF SOIL LICHENS ON SOIL COMMUNITIES IN THE NEW JERSEY PINELANDS

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## WHY A LICHEN STUDY IN THE PINE LANDS?

### Introduction:

Among the many unusual features of the NJ Pinelands is the diversity and abundance of the lichens there (Figure 1). In some areas, lichens form dense mats that cover the ground, and may represent as much biomass as leaves on the forest floor (Wright et al., 2005). Earlier studies have found that lichen cover influences soil nutrient cycling and soil decomposition processes (Sedia and Ehrenfeld 2006). I wanted to understand why lichens influence decomposition, and have initiated a study to see whether lichens harbor distinctive microbial or microarthropod communities.

Because lichens leach many different organic acids, I thought that the soil conditions they create would provide unique habitats for soil organisms. This did not seem to have occurred in the first stage of this study.



## STUDY DESIGN

### Site Selection:

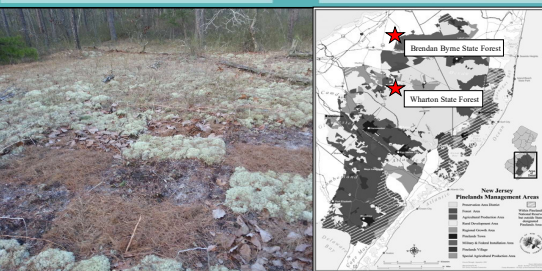
I chose 2 sites in the Pinelands (Figure 3), Wharton State Forest and Brendan Byrne State Forest. Both of which had well-developed lichen mats (accounting for over 60% cover in the study area) and landowners who approved that the study take place.

### Methods:

I set up a transplant study (Figure 2) in which I cleared the ground cover of a 2 x 3 m area and homogenized the topsoil by raking and removing the surface roots. I divided each site into twelve 1m x 0.5m subplots and placed one of 4 treatments on each plot. These treatments were the addition of 1000g/m<sup>2</sup> of: pine litter, lichens or mixed leaf litter (huckleberry:pine:oak 3:11:11). The fourth treatment was no litter added (bare ground). This transplant area was established in January of 2013, and soil animal samples were collected in April 2013. They will be collected each season (spring, summer, fall, winter) but I only present here the first round of sampling. Samples were taken with a .5cm diameter soil core, and animals were extracted into ethanol using a Tullgren extractor. Animals were identified to morphogroups by visual inspection.

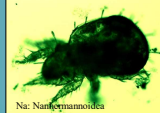
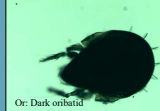
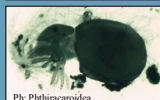
Figure 2. Transplant grid at Wharton State Forest

Figure 3. Study Sites in Pinelands



## ARTHROPODS ASSOCIATED WITH SOILS

### ORIBATID MITES



The arthropods I have included here are some of the ones I frequently found in my plots. I classified them as morphogroups; each picture represents a group (I lumped all collembolans and all "other" organisms together). I used 11 groups for the community analysis, and 4 major groups for the abundance analyses.

### Data Analysis : Arthropod community composition

I conducted a principal components analysis in R to graphically display differences among samples as distances along axes. The program chooses the axes that explain most of the variation in the data (Fig 4). In this study, the PC1 explained 72.9% of the variance in the data, and the PC2 explained 20.6%, but neither component was closely associated with lichens as ground cover. The first component appears to be associated with the presence of collembolans. Most sites associated with positive values of PC1 are from the Wharton site, and most sites associated with negative values of PC1 are associated with the sites at Brendan Byrne. Dindal (1990) suggests that many collembolans are r-strategists; their populations fluctuate dramatically as they take advantage of available resources. Perhaps there is more organic matter in the soil at Wharton for these saprophages to use? I will assess the organic matter content of the soils as part of the next phase of this project. As I continue sampling in the upcoming seasons, these data lead me to expect that collembolans will experience more population fluctuations than the mites.

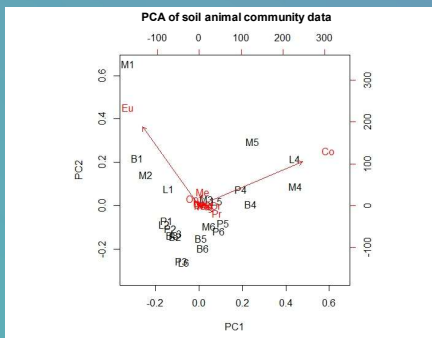
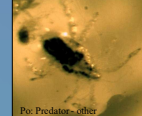
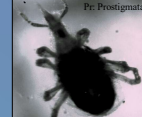


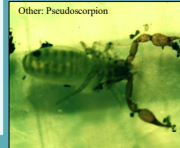
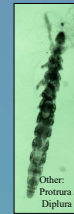
Figure 4. Principal Components Analysis of arthropod community data.

Samples are designated as follows: M = mixed litter, P = pine litter, L = lichen litter, B = bare ground. Numbers indicate plot; numbers 1-3 were in Brendan Byrne State Forest, and numbers 4-6 were at Wharton. Arthropods in each sample were grouped into 11 different groups as morphospecies as described in the pictures to the left and right. Co = Collembolan, Eu = Eulohmannoidea. Other arthropod groups were non-explanatory.

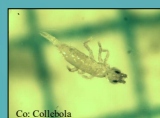
### PREDATORY MITES



### OTHER ORGANISMS



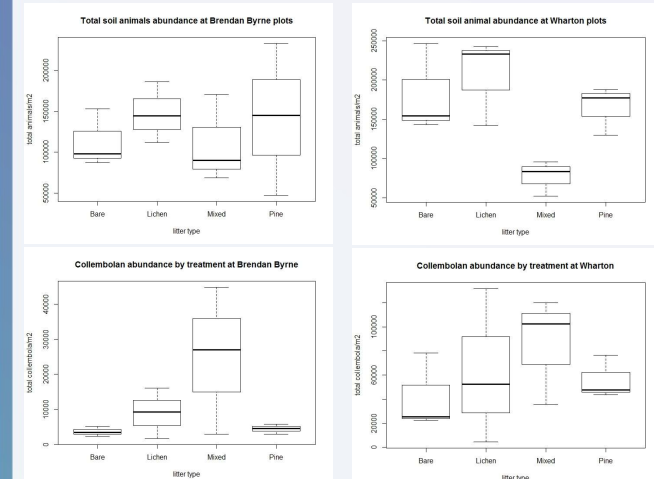
### COLLEMBOLANS



## ARTHROPOD ABUNDANCE NOT INFLUENCED BY GROUND COVER

### Data Analysis: Effect of Litter on Mite Abundance

Analysis of variance between the treatments showed that lichen litter did not have a significant influence on soil animal abundance. The mixed oak litter at Wharton had fewer total soil animals than the other treatments, and this was the only significant difference between the treatments ( $P = .037$ )



A non-significant but interesting pattern was that collembolan abundance was often higher under mixed oak litter. Additionally, there was much higher collembolan populations at Wharton, a pattern that is also reflected in the PCA results. When the plots were first established, the plots were all similarly disturbed, but as time elapses since the disturbance, I expect that community differences between treatments may become more pronounced.

## FUTURE RESEARCH

My data from this study suggests that the arthropod community is not responsible for any differences in decomposition rates between lichen covered areas and non-lichen covered areas, but I look forward to seeing whether differences between treatments do emerge as the plots mature. For future work, I will collect data on the microbial communities (including enzyme activities and respiration rates) in each treatment plot along with data on the abiotic conditions of the plots (soil moisture content, soil organic matter, and soil nitrogen). Also, I will investigate the fire history of my two sites, as fire may be important in soil arthropod community structure.

## REFERENCES

- Dindal, D.D., ed., Soil Biology Guide. 1990. Wiley Interscience, New York.
- Sedia, E. G., and Ehrenfeld J.G., 2006. Differential effects of lichens and mosses on soil enzyme activity and litter decomposition. *Biological Fertility of Soils*, 43: 177-189.
- Wright, C.S., Ottomar, R.D., Vihnanek, R.E., 2005. Stereo photo series for quantifying natural fuels. Volume VIII: Hardwood, pitch pine, red spruce/balsam fir types in the Northwestern United States. National Wildfire Coordinating Group, Interagency Fire Center, Boise, Idaho. 89 p