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The Effects of Ant Mounds of Acanthomyops Claviger on Floral Diversity in a Restored Tallgrass Prairie

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The Effects of Ant Mounds of *Acanthomyops Claviger* on Floral Diversity in a Restored Tallgrass Prairie

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ABSTRACT

Acanthomyops claviger (Roger) is a highly conspicuous mound-building ant native to North America. The effects of mound-building ant activity on floristic heterogeneity around the nest sites have been reported in various ecosystems. The objective of this study was to explore the effects of the nests of *A. claviger* on floral heterogeneity in a reconstructed tallgrass prairie in midwestern United Sates. The data collected included floral richness, soil moisture, soil temperature, and soil pH measurements for $1m^2$ sites having ant nests and control sites without nests. Differences in floral diversity approached significance between nest sites and control sites ($P<0.01$). Only soil moisture differed significantly ($P<0.05$) between nest sites and control sites. Based on these results and previous research it is expected that nests of *A. claviger* play an important role in the tallgrass prairie ecosystem, however further research is needed to better understand the role of insect communities in general and mount building ants in particular in prairie restoration projects.

INTRODUCTION

A variety of ant-plant symbioses have been studied in depth ranging from highly mutualistic to parasitic relationships. Some ant species including *Formica aquilonia*, *F. polycenta* and *F. rufa* are known to protect plants by collecting herbivorous insects (Holldober and Wilson 1990). The domatia developed by a number of ant plants and production of elaisosomes further illustrate the mutualistic relationship of ants and plants. There is evidence that various plant and ant species have evolved together and both benefit from the association. An interesting and complex example of such mutualism is the existence of ant gardens where ants plant the epiphytes in their nests, nourish them and feed on their fruit, food bodies and the secretions of extrafloral nectarines (Holldober and Wilson 1990). Harvesting ants play a major role in plant seed dispersal through myrmecochory especially for early-flowering herbs, select perennials and many tropical plants. Attracted by the arils on the seeds they collect, harvester ants detach the arils for food and disperse the seeds. These ants have been reported to improve soil conditions, compete with other garnivores and showed differential seed predation (MacMahon, et al. 2007). A few ant species also play a role as pollinators allowing plants to reproduce others disperse seeds or protect their host's territory by destroying plants that sprout within a certain distance from the nest (Dostal 2007, Holldober and Wilson 1990).

The presence of some species of ants in a given environment has been found to affect floristic heterogeneity. This is especially true in deserts, early stages of forests or grasslands where ant nests are often surrounded by a more species rich vegetation (Holldober and Wilson 1990). In some cases certain plant species have been more abundant in the close vicinity of the nest while others were much scarcer. The same effect has been found for the ants *F. podzolica*, *Myrmica fracticornis and M. incomplete* in an N-central Montana peatland (Lesica and Kannowski 1998). Ants are believed to permanently modify the peatland environment creating habitat for many shrubs and rare plant species. Some species are confined to hummocks or ant nests. It appears that better aeration, nutrient enrichment and a warmer temperature of the ant nests allow those species to survive on the peatland.

An elevation of the ant mounds provides a drier environment. Both ant nests and hummocks had significantly higher Mg, P, K and Na concentrations compared to the surrounding soil. Similar changes in soil properties and floristic composition have been reported in ant mounds in meadow systems (Lesica and Kannowski 1998).

Some effects of mound-building ants are propagated through time. Reconstructed tallgrass prairie sites show a greater difference in nitrogen dynamics of the mound than that found in natural prairie soils (Lane and BassiriRad 2005). Although the role of ants in the prairie restoration projects is not completely understood, they constitute a substantial part of an ecosystem. A study in Sweden showed that grasslands that have been managed over centuries have ecologically diverse and species-rich ant populations (Dauber, et al. 2006). Similar trends have been reported in restored and natural prairie sites in Missouri (Mlot 1990). Ant activity may impact both soil and vegetation heterogeneity in a number of ways, yet there is very little research on its role in prairie restoration projects.

Ecosystem reconstruction usually involves only returning components of the plant community and ignoring the other community members (Mlot 1990). Much of the grass prairie in North America has been eradicated over the years mainly as a result of agriculture (Thornton and Millenbah 2000, Mlot 1990). Today only 4% of the original prairie in the United States and 1% in Illinois remains. Efforts to preserve remaining prairie biodiversity include habitat restoration. A number of restoration efforts aimed at preserving remaining biodiversity have been attempted during the past decades. Although prairie creation techniques focused on restoring plant biodiversity have been researched in detail, very little in known about possible approaches to restoring animal species including insect communities native to the prairie (Thornton and Millenbah 2000). *Acanthomyops claviger* (Roger) is a conspicuous mound builder in the Russell Kirt Tallgrass Prairie and site of this study. This study focuses on the relationships of *A. claviger* mounds on floral diversity in the prairie site.

METHODS

The study site was Russell Kirt Tallgrass Prairie, a 1.5-ha reconstructed tallgrass prairie whose reconstruction began in 1984. The prairie is located at College of DuPage, Glen Ellyn, Illinois. The vegetation of Russell Kirt Tallgrass Prairie is characterized by tall grasses: big bluestem (*Andropogon gerardii* Vitman), and prairie dropseed (*Sporobolus heterolepsis* Gray). There are some 150 native tallgrass forbs in the prairie. The prairie plot is burned annually and was last burned during early spring 2007, prior to the beginning of this study.

10 ant nest sites and 10 control sites without ant nests were established for the study. Measurements of soil moisture, soil temperature, soil pH and floral diversity were taken from each site. A Keyway Soil Tester (Japan) was used to measure soil pH levels. An Aquater Temp-200 (Aquater Instruments, Costa Mesa, CA) was used to measure soil moisture and temperature.

Two-tailed t-tests were used to test for significant differences in floral richness and physical parameters between sites having nests of *A. claviger* and the control sites. Prior to t-testing measurements of floral richness, soil temperature, and soil pH were $\log_{10}$ transformed, and soil moisture $\arcsin\sqrt{x_i}$ transformed to meet assumptions of normality.

RESULTS

A summary of floral richness and physical measurements from sites having nests of *A. claviger* and the control sites is provided in Table 1. The difference in floral diversity was nearly significant between nest sites and control sites ($P<0.001$). Only soil moisture differed significantly ($P<0.05$) between nest sites and control sites.

DISCUSSION

Mound-building ants are known to affect soil temperature moisture and nutrient content in specific ecosystems. Based on many known examples of ant-plant symbiosis it was expected that the presence of *A. claviger* nests would affect floral diversity. The results show a nearly significant difference in floral diversity in the proximity of nest sites, an outcome not inconsistent with results of similar studies. It might be useful to further explore the issue and repeat the experiment using a larger sample. It would also be helpful to collect data on plant diversity (not only richness) and on the types of species found to see whether mounds provide better conditions for certain types of plants.

The soil temperature in this study did not significantly differ based on the presence of ant mounds; this however could be due to the season in which data were collected. The measurements were taken in early fall while ant mounds are known to have higher temperatures during the spring (Holldober and Willson 1994). These higher temperatures are caused by more exposure to the sun, a crust like layer that reduces heat loss from the mound, a decay of plant materials and a metabolism of ants. Measurements in early spring, particularly immediately after a burn, could probably show a temperature effect by nests.

The drier conditions of the soil associated with *A. claviger* mounds could be explained by a better aeration and more exposure to the sun of the ant nests. The difference in moisture may be significant for specific plant species that show a high sensitivity to changes in the moisture levels of the soil. The elevated mounds may also provide a more favorable habitat for new seedlings of some plants. Soil pH showed no sign of changing between ant mound and control sites in this study.

Findings in this study indicate mounds of *A. claviger* do affect soil moisture and are very likely to affect floral diversity around the ant mounds. This may have important implications for projects aimed at restoring natural ecosystems which presently focus on plant establishment and succession. Restoration of insect habitats including nests of *A. claviger* could serve as advancement in prairie restoration efforts especially for establishment of plants whose requirements match the unique environment typically created by ant mounds.

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Table 1. Summary (mean ± standard deviation) of floral diversity and selected physical measurements from sample sites having nests of *Acanthomyops claviger* and control sites. All n = 20. Student t and probability values from comparison of treatment sites are also provided with all df = 38.

Parameter	Sites Nests of *A. claviger* present	Control sites	t	P
Floral diversity	7.30 ± 2.89	8.60 ± 2.82	1.703	0.097
Soil temperature C	28.8 + 1.2	28.5 + 1.0	0.788	0.435
Soil pH	6.73 + 0.40	6.69 + 0.50	0.278	0.782
Soil moisture	0.68 ± 0.25	0.92 ± 0.10	4.215	<0.001