

4-1-2011

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### Recommended Citation

Sanchez, Annette (2011) "Effects of the Mound-building Ant, *Acanthomylops claviger*," *ESSAI*: Vol. 9, Article 34.  
Available at: <http://dc.cod.edu/essai/vol9/iss1/34>

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Effects of the Mound-building Ant, *Acanthomyrops claviger*, on Plant Productivity in Reconstructed Prairie

by Annette Sanchez

(Biology 1151)

ABSTRACT

The Russell R. Kirt Prairie is a 7.1 ha reconstructed prairie located on the campus of the College of DuPage, Illinois. In this prairie, it has been found that *Acanthomyrops claviger* (Formicidae) ants build mounds, and are believed to tend root aphids. In an attempt to examine the effects of colony location on plant productivity, measurements of above-ground biomass and organic content were taken from sites with ant mounds as well as adjacent sites. Above ground plant biomass and soil organic content were significantly higher where ant mounds were present as opposed to the adjacent control sites. *A. claviger* colonies appear to promote plant production and soil and organic content in the reconstructed prairie.

INTRODUCTION

Ants have profound abiotic and biotic effects in the ecosystems to which they belong, and their activities can influence plant growth (Zettler 2010). They are important soil engineers and have a large ecological influence on their soil ecosystem due to burrowing activities, functioning to accumulate nutrients and organic materials in the soil (Cammaraat and Risch 2008). Ants change the soil textural properties by mixing soil material from different soil depths and bringing soil material from deeper horizons to the top of the surface (Cammaraat and Risch 2008).

Kittelton et al (2008) found ants to be important members of prairie communities with plant species richness being greatest in prairie remnants where ant species richness was higher as compared to reconstructed prairies which tend to lack many ant species. Many important ecosystem functions such as water infiltration and soil modification are performed by ants. These services provide clean water and conserving soil. However, there is still a limited scientific understanding of how land management and ant communities are related (Sanford et al 2009). Likewise, little is known about how the development of soil heterogeneity in restoration sites (Lane and BassiriRad 2005). In view of the importance of mound-building ants to the structure of the plant community and soil characteristics, reestablishing consumers such as ants must be an important component of ecological restoration.

*A. claviger* is known to build conspicuous mounds at the bases of tall grasses in the Russell R. Kirt Prairie, IL. Within these mounds the ants are thought to tend root aphids. The objective of this study is to examine the effects of colony location on plant productivity as quantified by above-ground plant biomass. A prior prediction was that *A. claviger* mound presence should be associated with decreased plant biomass and organic content due to the herbivorous action of root aphids.

METHODS

The study site was the 7.1 ha Russell R. Kirt Tallgrass Prairie located on the campus of College of DuPage, IL. Reconstruction of the prairie was begun in 1986. The prairie is dominated by big bluestem (*Andropogon gerardii* Vitman), prairie dropseed (*Sporobolus heterolepis* Gray), and Indian grass (*Sorghastrum nutans* Nash). The prairie is maintained by burning every one to three years.

Above ground biomasses of flora on ant mounds and on control sites were measured by

harvesting the senescing vegetation at 5 cm height during September. A control site was within 3-m distance of an ants mound and shared the same grass type. Cuttings were oven-dried to a constant weight at 60°C. Fraction organic content of the soil was measured by taking soil cores during June from each ant hill and a control site sharing the same grass type within 3-m distance. The soil cores were measured at a 10 cm depth during September. A sample was taken at 10 cm depth where ant activity was heavy based on the number of workers, larvae, and pupae. Soil samples were oven-dried at 60°C to a constant weight, and then burned at 600°C for 6 hours within a muffle furnace.

Measurements of above-ground biomass were log<sub>10</sub> transformed and organic fraction arcsin√x<sub>i</sub> transformed prior to conducting of t-tests for dependent samples comparing ant and control treatments.

## RESULTS

Plant biomass and organic content where ant mounds were present and adjacent sites having vegetation of the same type where ant mounds were absent are summarized in Table 1. Ant mounds supported a significantly higher plant biomass ( $t=3.319$ ;  $P=0.003$ ;  $df=24$ ) and consisted of a higher organic content ( $t=2.285$ ;  $P=0.031$ ;  $df=24$ ) than adjacent control sites.

## DISCUSSION

The mound-building *A. claviger* have a positive effect on plant productivity and soil organic content. C and N concentrations are generally higher in ant mounds as ants bring organic materials into their nests such as prey, honeydew collected from aphids, and plant components, and these can mix with the mineral soil (Jurgensen et al 2008). Ant activity thereby can concentrate soil nutrients (Cerdeira and Jurgensen 2008). Biondini (2009) found that in restoration efforts, increasing minimum biomass levels over time reduces plant failure. Soil texture affects micro-distribution patterns indirectly by influencing plant species composition and seeds available to ants, which in turn affects the ant species that are present, as the ants tend to occur in soil with higher clay and/or moisture content (Johnson 2000).

Like many restored prairies, the study prairie is maintained by burning every one to three years, which can increase biomass and sometimes C concentration, but not all organic content such as N (Kitchen et al 2009). Biomass removal through burning increases diversity in restored prairies (Tix and Charvat 2005). However, Lenoir and Pihlgren found ants to be more abundant in areas with higher vegetation and taller grasses (2006). As biomass and organic content increase due to the presence of ants, the reestablishment of other life forms functions to increase plant productivity.

This experiment provided insight into the relationship between colony location and plant productivity in restored tallgrass prairies. Future studies could research whether the organic mound-building ants, the burning/mowing of restored prairies, or the type of vegetation has a greater effect on plant productivity to provide a greater insight of contribution to soil properties.

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Table 1. Summary (sample mean  $\pm$  standard error, all n=25) of above ground floral biomass and soil organic content based upon presence of ant nests. AGFB = above ground floral biomass

Variable	Sample mean $\pm$ standard error
Nest diameter (cm)	29.3 $\pm$ 2.66
AGFB over ant mounds (g)	90.7 $\pm$ 17.3
AGFB over control sites (g)	65.4 $\pm$ 12.3
Soil organic content of ant mounds (%)	13.6 $\pm$ 0.027
Soil organic content of control sites (%)	8.4 $\pm$ 0.006