THE OHIO STATE UNIVERSITY DEPARTMENT OF ENTOMOLOGY

Does pocket prairie creation improve vacant land conservation for ants?

Alex Tyrpak, Kayla I. Perry, Christopher B. Riley, Joseph M. Raczkowski, P. Larry Phelan, and Mary M. Gardiner

INTRODUCTION

Many cities around the world are growing, but many are also encountering economic decline, leading to population loss (1). This has led to an overabundance of infrastructure which is eventually torn down forming vacant land (Fig. 1). Vacant lots are perceived as a blight but could also act to conserve arthropods (2, 3).

Vacant lots in Cleveland, OH are mown monthly which may limit their conservation value (4). Lead concentrations in the soil of vacant land from previous industrial emissions, gasoline, and paint, may also adversely affect their conservation value (5). We wanted to determine how converting vacant lots into pocket prairies improved their conservation value. We also want to determine how soil lead concentrations might be influencing ant assemblages on urban vacant land.

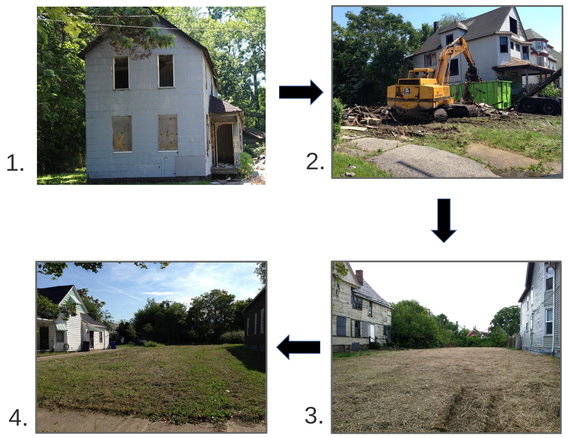

Figure 1: Vacant lot formation: 1: A building falls into disrepair due to negligence or abandonment, 2: Building is torn down by the city, 3: Turf grass is planted over the site, 4: The site is mowed on a monthly basis

AIM

Objective 1: Determine if establishing pocket prairies on vacant land increases ant species richness and alters community composition

***Hypothesis*: Creating pocket prairies in the city will increase ant species richness and alter species composition relative to vacant lots**

Objective 2: Examine how soil lead concentrations influence the conservation value of vacant lots and pocket prairies

***Hypothesis*: Ant species richness will decline with increasing soil lead concentrations**

METHODS

Site selection and trapping: Within eight neighborhoods in Cleveland, OH, we established two treatments: vacant lots and pocket prairies, and we also selected eight Metropark forest sites surrounding downtown Cleveland.

- Vacant lot (mown monthly) (Fig. 2: 1)
- Pocket prairie (mown annually) (Fig 2: 2)
- Metropark forest (unmanaged) (Fig 2: 3)

Pitfall traps were set in June, July, and August of 2018, and trap contents were collected after seven days. Samples were brought back to the laboratory where adult worker ants were identified to species (Fig. 3).

Figure 2: 1: A mown vacant lot. 2: A pocket prairie established on a vacant lot. 3: A Metropark forest

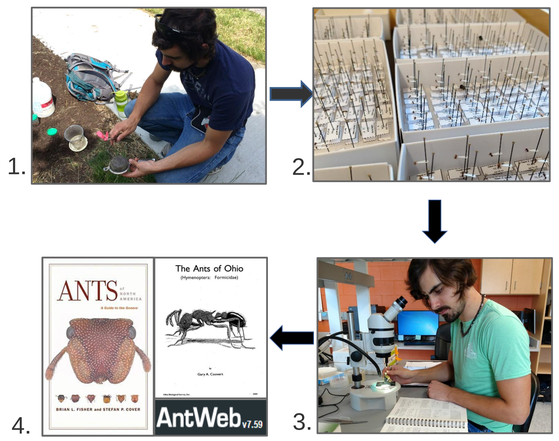

Figure 3: 1. Collection of pitfall trap contents at each site. 2: Ants separated into 20 mL scintillation vials. 3. Identification of ants to species. 4: Ant identification resources: A: Ants of Eastern North America: A Guide to the Genera, (6), B: The Ants of Ohio (7), and C: Antweb.org

Figure 4: Soil collection from each site

Soil data: The Phelan laboratory collected soil samples at all sites. Soils were analyzed by the Ohio State University STAR Lab for total available (elemental) levels of lead (Fig. 4).

Statistical analysis:

- Generalized Linear Mixed Models (glmmTMB package version 1.0.0 in R version 3.6.1) with a negative binomial distribution to compare species richness across months and treatments, and total soil lead levels
- Trap days were incorporated into the model as an offset to account for missing pitfall traps
- Multiple comparisons of means with Tukey Contrasts test to compare ant species richness among treatments
- Nonmetric Multidimensional Scaling to visualize differences in species composition across habitat types
- ADONIS test to compare ant species composition

RESULTS

Ant species richness was lower in Metropark forests in July ($P < 0.001$; $\chi 2 = 20.3$)

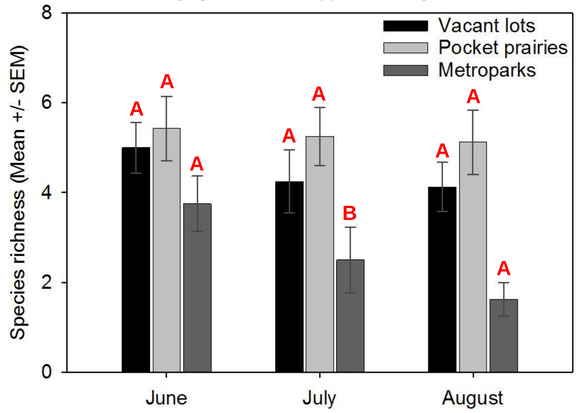

Figure 5: Ant species richness over June, July, and August of 2018

Ant species composition is different in Metropark forests compared to vacant lots and pocket prairies which are similar ($P < 0.001$)

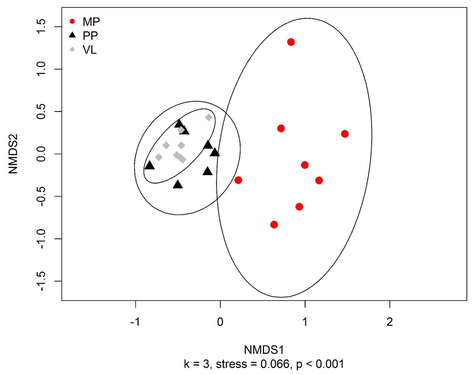

Figure 6: Ant species composition between vacant lots and pocket prairies treatments and Metropark forests

Ant species richness is not significantly affected by soil lead concentrations ($P = 0.122$; $\chi 2 = 2.39$)

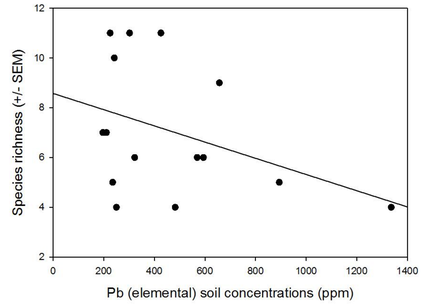

Figure 7: Total soil lead concentrations and ant species richness

CONCLUSIONS

Metropark forests had a significantly lower ant species richness in July, possibly due to differences in habitat type. Pocket prairies had similar ant communities as vacant lots. Nonetheless, planting native wildflowers could still provide many benefits, such as providing a pollinator habitat (8). However, soil lead concentrations could potentially be affecting ant fitness and survivorship (9). Inner-city habitats provide unique habitats for ants, but do not replace the importance of maintaining forest habitats.

BIBLIOGRAPHY

1. Oswalt, P., T. Rieniets, H. Schirmel, 1Kilo, and K. des Bundes. 2006. Atlas of shrinking cities. Atlas der schrumpfenden Städte. Hatje Cantz Publishing, Berlin, DE
2. Sivakoff, F. S., S. P. Prajzner, and M. M. Gardiner. 2018. Unique bee communities within vacant lots and urban farms result from variation in surrounding urbanization intensity. Sustain. 10(6): 1926.
3. Delgado de la Flor, Y. A., C. E. Burkman, T. K. Eldredge, and M. M. Gardiner. 2017. Patch and landscape-scale variables influence the taxonomic and functional composition of beetles in urban greenspaces. Ecosphere. 8(11):e02007
4. Hemmann, K., I. Hopp, and H. F. Paulus. 1987. Zum Einfluss der Mahd durch Messerbalken, Mulcher un Saugmäher auf Insekten am Strassenrand. Natur und Landschaft. 62: 103–106.
5. Rabitsch, W. B. 1995. Metal accumulation in arthropods near a lead/zinc smelter in Arnoldstein, Austria. II. Formicidae. Environ. Pollut. 90(2,): 221-237
6. Fisher, B., and S. P. Cover. 2007. Ants of North America: A Guide to the Genera. University of California Press, Berkeley, CA
7. Coovert, G. A. 2005. The ants of Ohio (Hymenoptera: Formicidae). Ohio Biological Survey, Columbus, OH
8. Turo, K. J., and M. M. Gardiner. 2019. From potential to practical: conserving bees in urban public green spaces. Front. Ecol. Environ. 17(3): 167–175
9. De La Riva, D. G., and J. T. Trumble. 2016. Selenium exposure results in reduced reproduction in an invasive ant species and altered competitive behavior for a native ant species. Environ. Pollut. 213 888e894

ACKNOWLEDGEMENTS

Ellen Dunkle, Michael Rogers, Emily Goodwin, Molly Frabotta, and Anthony Ursetti

Alex Wild (ant photographs)
Cleveland Metroparks – Patrick Lorch

Funding support provided by NSF CAREER (1253197) and USDA AFRI (20166701925146 and 20176701326595)

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Urban Landscape Ecology
The Gardiner Lab – Department of Entomology
216 Kottman Hall
Columbus, OH 43210-1065
Email: Tyrpak.3@buckeyemail.osu.edu