Arthropod Biodiversity of Urban Prairies and Turf Landscapes

Armando Mireles[1], Karel Jacobs[2], Susan Kirt Alterio[2]

[1]Undergraduate Student, [2] Faculty, Department of Biological Sciences, Chicago State University, Chicago, IL 60628

ABSTRACT

Soil arthropod communities were compared at the 1 ha Chicago State University (CSU) prairie, the adjacent turfgrass landscape, and a nearby 24 ha Gensburg-Markham (GM) prairie remnant. The GM prairie has been actively managed since 1971, and the CSU prairie was installed over turfgrass in 2002. Both prairies were sampled for soil dwelling arthropods using 25 pitfall traps per site in June and October of 2012. The CSU turfgrass was sampled only in October using 10 pitfall traps. A total of 1186 arthropods were collected, encompassing 16 orders, 7 genera and 69 species. The CSU prairie had the greatest species richness during summer (31 taxa), a value twice as high as the GM site. Richness was lowest in the turfgrass (8 taxa). The Shannon-Weiner Diversity Index (SWI) revealed a higher level of arthropod diversity in both prairies during summer versus fall (2.79 vs 0.67 and 2.43 vs. 1.52) for the CSU and GM prairies, respectively. The turfgrass SWI was 1.35, twice as high as the fall CSU prairie index, but lower than the GM prairie. Additional analyses are planned to determine the extent of taxa similarity among sites as well as native arthropod diversity. .

INTRODUCTION

Illinois is known as the "Prairie State", although less than 1/10th of 1% of the original prairie acreage remains (930 ha /9 million ha) (Sampson and Knopf, 1994). Prairies improve environmental health through building and reclaiming soil, capturing storm water runoff, sequestering carbon, and enhancing biodiversity (Whiles and Charlton, 2006). These benefits are especially important in urban areas, where prairies also contribute benefits associated with green space (Ackerman, 2006). Few studies have examined arthropod communities in prairies as potential bioindicators of ecosystem health and diversity, perhaps overlooking the essential role they play in decomposition, organic matter redistribution and nutrient cycling (Kirkwood, 2000).

Our **objectives** were to:

1). Compare soil arthropod communities within a relatively young, urban prairie restoration (CSU) and a decades old, high quality prairie remnant (GM);

2). Quantify potential changes in arthropod taxa and diversity that occurred over the last 10 years between the CSU prairie and adjacent turfgrass.

Hypothesis

Our hypothesis is that arthropod species diversity and similarity indices for the CSU prairie will be less than the established GM prairie and greater than the CSU turfgrass landscape.

METHODS

1. Sample locations were mapped using GPS (Fig.1) ;
2. Pitfall traps were constructed from PVC pipe and filled with 20 ml of a 50% solution of polyethylene glycol and placed flush with the soil at each site (Fig. 2);
3. Solutions were collected from the field after 3 days and arthropods were collected manually and preserved in 70% ethanol at room temperature;
4. Each specimen was examined microscopically and identified to genus and species when possible using several taxonomic keys (Fig. 3);
5. Images of representative genera were digitally captured;
6. Count data were analyzed using Excel® software and calculations of abundance, richness, diversity and similarity were made.

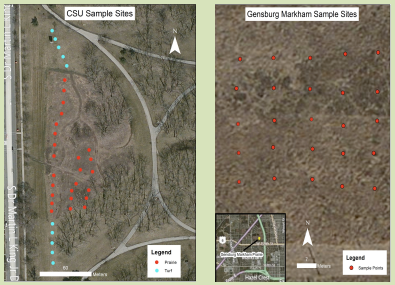

Figure 1. Satellite images of the CSU prairie and Turfgrass (left) and the Gensburg-Markham prairie (right). Dots represent pitfall traps.

Figure 2. Pitfall traps and Pitfall trap installation

Figure 3. Identifying & sorting arthropods

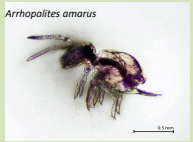

Table 2. Species collected from CSU and GM prairies and turf, arranged by Order. Average abundance per trap (x10-1) in parentheses.

Order	CSU Prairie		GM Prairie		Turf
	Summer	Fall	Summer	Fall	Fall
Aranea (Spiders)	3 (0.9)	0	5 (0.8)	1 (0.1)	3 (1.2)
Chordeumatida (Millipedes)	0	0	0	1 (0.1)	0
Coleoptera (Beetles)	4 (1)	2 (0.2)	6 (1)	1 (0.1)	0
Collembola (Springtails)	0	4 (46.3)	0	4 (13.2)	1 (1.8)
Dermaptera (Eearwigs)	1 (5.4)	0	0	0	0
Diptera (Flies)	1 (0.1)	1 (0.1)	1 (0.1)	2(0.2)	0
Ephemeroptera (Mayflies)	1 (0.1)	0	0	0	0
Hemiptera (Aphids, Hoppers)	2(0.2)	1 (0.1)	0	0	2 (0.3)
Hymenoptera (Ants)	13 (1.53)	0	6 (4.6)	2(0.2)	1 (0.2)
Isopoda (Isopods)	2(2.3)	1 (0.3)	1 (0.1)	1 (0.3)	0
Ixodida (Ticks)	0	0	1 (3.5)	0	0
Lithobiomorpha (Stone Centipedes)	1 (0.1)	0	0	0	0
Mesostigmata (Mites)	0	1 (0.2)	0	1 (0.1)	0
Opilliones (Harvestmen)	1 (1.0)	0	1 (2.2)	1 (0.1)	0
Orthoptera (Grasshoppers, Crickets)	1 (1.9)	1 (0.4)	4 (0.6)	0	0
Siphonaptera (Fleas)	1 (0.1)	0	0	0	0

Figure 4. Comparative abundance of most common species from each site. Bars represent total number per site.

Table 1. Qualitative Shannon-Weiner diversity index and Sorensen Similarity Index

Shannon-Weiner Diversity Index					
	CSU		GM		TURF
	SUMMER	FALL	SUMMER	FALL	FALL
Shannon-Weinner Diversity	2.80	0.67	2.43	1.53	1.36
Species Richness	31.00	11.00	26.00	15.00	8.00
Eveness	0.52	0.18	0.43	0.30	0.48

Soernsen's Similarity Index						
	CSU vs GM		CSU vs Turf	GM Vs Turf	CSU	GM
	Summer	Fall	Fall	Fall	S vs F	S vs F
Species Similarity	7.00	7.00	3.00	4.00	3.00	4.00
Sorensen Quotient	22.44	17.27	17.55	17.50	11.19	16.36

RESULTS AND DISCUSSION

Biodiversity indices (Table 1) were greatest at both prairie sites during June and several taxa were only detect1ed at that time (Table 2). An extremely high abundance of Collembola species (springtails) was found in the CSU prairie in October resulting in the lowest biodiversity index measured (even lower than turf.) These findings indicate pronounced seasonal differences occur in soil arthropod communities and underscores the need for multiple samplings each year.

Sorenson's similarity indices (Table 1) and the comparative abundance of individual taxa (Table 2, Figure 4). reveal important differences in arthropod composition between prairies. For example, the CSU prairie had a greater ant species richness (13 species) compared to GM prairie (8 species) and earwigs (*Forficula auricularia*) were present only at CSU. Likewise, the GM prairie had less seasonal variation in diversity and more Orthroptera (grasshoppers/ cricketsi) richness (4 species) compared to the CSU prairie (I species). These and other differences detected between sites may be useful to gauge prairie development and serve as indicators of prairie quality, although more sampling is needed to verify trends

CONCLUSIONS & FUTURE STUDIES

❖ Summer indices of arthropod biodiversity were 38-75% greater than fall, and several taxa were only detected in one season, underscoring the need for multiple sampling periods when studying arthropod communities. The high summer and low fall biodiversity of the CSU prairie leads us to reject our original hypothesis.

❖ High abundance of Collembola species skewed the fall CSU prairie diversity measurement.

❖ Only 4 orders of arthropods were detected in turfgrass (8 species) confirming suspicions that lawns offer little benefit in terms of biodiversity in urban ecosystems.

❖ Similarity of taxa collected from CSU and GM prairies was greater than that between prairie and turfgrass, suggesting that the isolated urban CSU prairie is developing a rich arthropod community similar to a high quality prairie.

❖ Continued assessment of unique taxa in prairies of differing quality is needed to identify useful bioindicator arthropod species.

❖Statistical analyses of indices are planned to validate these findings.

ACKNOWLEDGEMENTS: Research supported by a CSU CTRE grant and student stipend from the LSAMPS program. Summer 2012 research was supported by DOE Visiting Faculty Program at Argonne National Laboratory, and Prairie Biotic, Inc. Thank you to CSU Geography Prof. Jason Biller for creating GIS maps and Dr. Andrew Maselli for aiding microscopic procedures.