Effects of Controlled Prairie Burning on Epigeal Arthropod Populations

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Introduction

Native Michigan prairies are host to a vast variety of plant and insect species. Commonly in nature, these prairies would be burned, usually as a result of lightning strikes. This cycling of vegetation is generally healthy for the prairie, because it reduces leaf and grass litter, and provides better grazing and foraging for herbivorous animals (Packard, 2005). These burns also reduce the number of invasive plants, clearing space for native plants to grow and promoting more biodiversity (Packard, 2005). However, what is not as well known is the effect that these prairie burns may have on the insect and arthropod populations residing in this habitat, particularly the species that are too small or flightless to escape the fire, or species that live in or raise offspring on the ground level of the prairie. These burns may also impact the ecosystem if they are done too frequently, which might hurt the recovery of prairie species if they cannot recover quickly enough (Packard, 2005). These questions are important to answer, as the arthropod populations and their environment affect each other in many ways; the environment providing habitat and foraging, and the arthropods providing soil enrichment by decomposing dead materials (Kral, 2017).

The purpose of this study is to determine what effect prairie burns have on the arthropod populations at ground level. These insects and arthropods were collected and counted to create a database of the biodiversity on the prairie. Statistical tests were run to understand how arthropod communities differ on the burned and unburned sites.

To test the significance of prairie burns on arthropod populations, a restored prairie donated to Calvin for research by Carol and Fritz Rottman was burned on one half during the spring prior to the start of the summer's research. The prediction is that there will be a general decrease in all arthropod species. Herbivorous arthropod species will have less foraging sources and cover, and predators will consequently have fewer insects to prey upon.

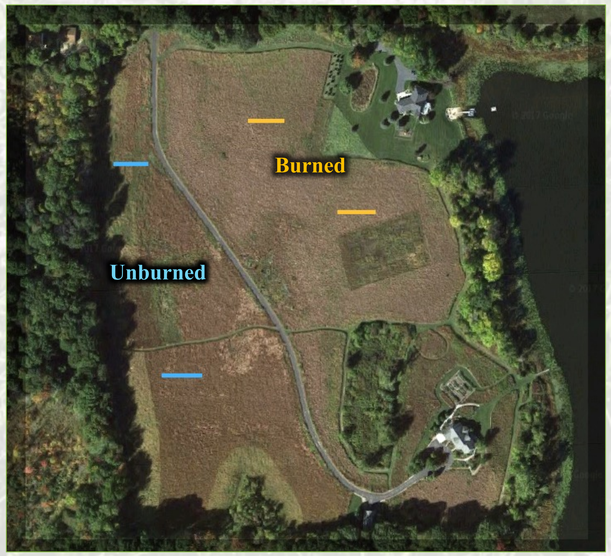
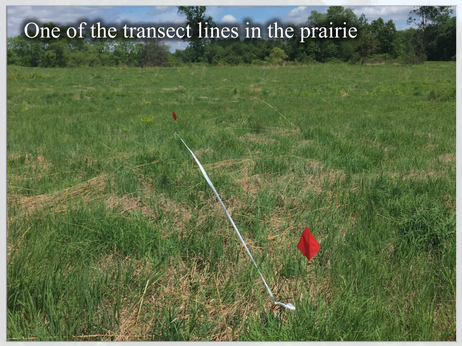


Fig. 1: Map of transect locations on the prairie. Orange sites indicate where the burn occurred, and blue sites indicate the unburned side.

Methods



To test if prairie burns have an impact on arthropod populations, four transects containing six pitfall traps were installed in the prairie; two on the burned side, and two on the unburned side. On each side of the prairie, one transect was set on a north facing slope, and the other on a south facing slope. Over the course of two weeks, June 26-July 10, these traps were set with antifreeze and collected, and each one processed and counted individually to record a representation of the species present on either side of the prairie.

- Each transect was set along previous years' coordinates using a GPS.
- 6 pitfall traps were dug, 2 meters apart, and set with a plastic cup and a transparent cover to block rain.
- Each cup was filled with 1" of antifreeze, and the contents were collected every 3-4 days to be identified and counted.
- At the end of each week, the plant, litter, and bare soil cover of were estimated for a 0.5 x 0.5 meter patch next to each trap, and soil temperature measurements were taken.

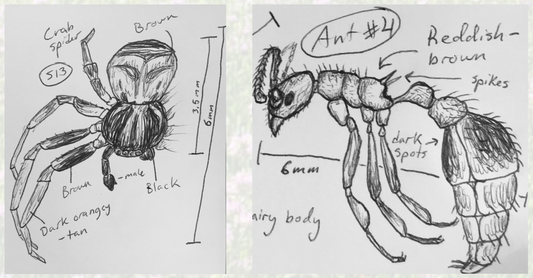


Fig. 2: Examples of specimen sketches I drew and used to help with species identification. Each species was designated with a code letter and number to associate it with its particular order.

Results

- There were no significant differences found between species diversity in the north and south sampling sites.
- Significant differences were found between the burned and unburned sides of the prairie of a few arthropod orders, particularly in the springtail (Collembola), ants, bees, and wasps (Hymenoptera), and leafhopper (Homoptera) populations.
- Another difference found were the total number of individual arthropods collected, which were significantly higher on the unburned side of the prairie than the burned side.

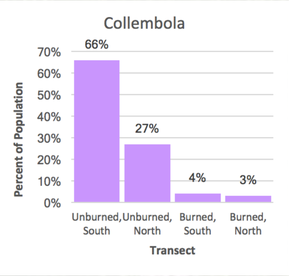


Fig. 3: Springtail densities among sampling sites.

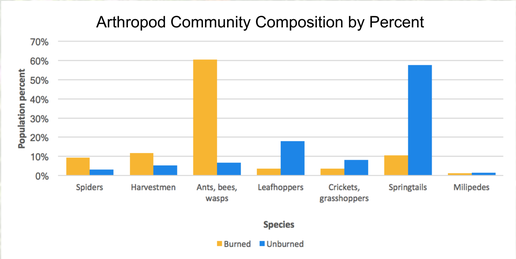


Fig. 4: Arthropod community composition frequencies by percent of species likely to be encountered in the prairie.

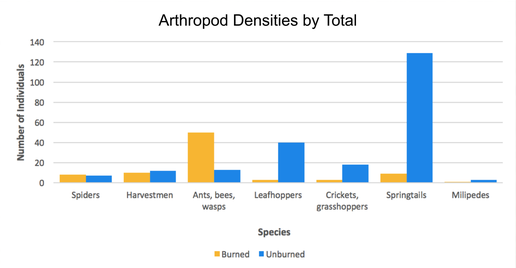


Fig. 5: Comparison of arthropod frequencies by total number of individuals captured.

Further Analysis

Table 1: Simpson's diversity index shows the amount of diversity across insect families per site, with 1 representing no diversity and 0 representing infinite diversity. The equitability index shows species evenness within the site.

	Simpson's Index	Equitability Index
Burned, North	0.441	0.5564
Burned, South	0.422	0.5699
Unburned, North	0.3173	0.5841
Unburned, South	0.5774	0.382

For additional analysis, we decided to run a species diversity test, and a species evenness test. The results of these tests show moderate equitability and diversity, but no statistically significant differences between the burned and unburned sites. This implies that controlled prairie burns do not impact the diversity of the arthropod community, but these burns do affect the population size and balance between the sites.

Conclusions

Based on the tests and observations from this year's research, the herbivore and detritivore arthropods were the most heavily impacted by the fire. Since the unburned side of the prairie was burned last year, we can also conclude that they recover fairly well in a year, likely aided by plant and detritus buildup.

For the last 5 years, this prairie has been alternately burned on either side, switching each year. Although the vegetation returns after just one year of growth, burning can result in disrupting the succession patterns of arthropods, which could cause a change in the arthropod community dynamics over time (Kral, 2017). Future comparisons between the first and fifth year datasets may provide a more long-term assessment of the impact of controlled burns on ground-level arthropod diversity.

Acknowledgements

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References

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