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Urban Ground Covers Influence Soil Characteristics and Beetle Communities in Riparian Zone

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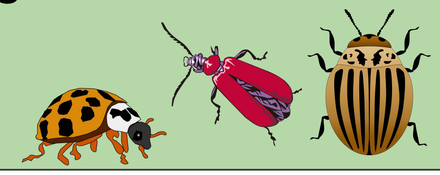


Introduction

- Riparian zones are terrestrial habitats adjacent to rivers or streams that frequently undergo environmental fluctuation and offer unique ecosystem services (1).
- These forests serve as soil buffers and offer unique habitats to support diverse arthropod communities (2). Previous research has shown that urbanization can have an adverse effect on these characteristics by inhibiting nutrient cycling in soil which can affect invertebrate communities and vegetation (3-5).
- Soil pH and conductivity may be an indication of nutrient availability and pollutants interfering within the soil. Monitoring these soil characteristics along with Coleoptera (beetle) communities can be indicative of the health of an urban riparian ecosystem.
- Conservation of these ecosystems in urban areas is important to society because they regulate floods, filter air and water pollutants, and reduce the heat island effect (2,6).

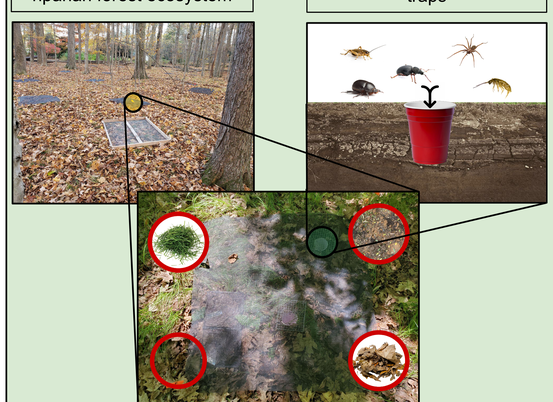
Questions

- Do urban ground covers affect soil characteristics, pH and conductivity?
- Are arthropod abundances and Coleoptera family richness impacted by urban ground covers?

Methods

Ten plots positioned in riparian forest ecosystem

Insects are collected in pitfall traps



Four treatments: Litter Addition, Control, Grass Addition, Litter Removal

Results

Soil Characteristics

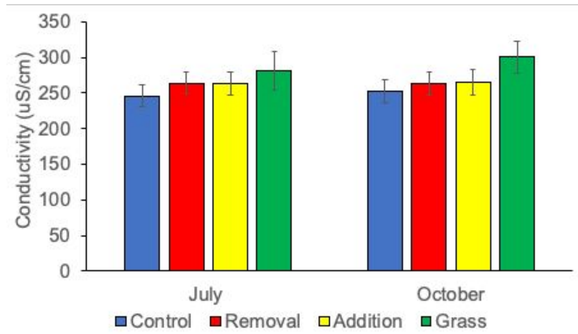


Figure 1. The mean conductivity ± SE (uS/cm) level of soil at each treatment during July and October 2021. In July, mean pH for control: 246.2 ±15.0, removal: 264.2 ± 16.2, addition: 263.6 ± 16.2, grass: 300.4 ± 27.5. In October, control: 252.9 ± 15.8, removal: 263.6 ± 16.5, addition: 264.9 ± 18.0, grass: 300.4 ± 22.5.

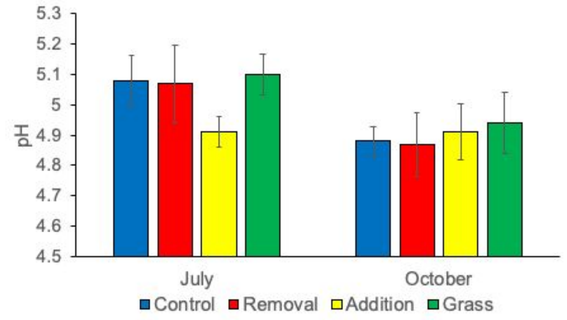


Figure 2. The mean pH of soil ± SE for each treatment during July and October 2021. In July, mean pH for control: 5.08 ± 0.08, removal: 5.07 ± 0.13, addition: 5.06 ± 0.05, grass: 5.10 ± 0.07. In October, control: 4.54 ± 0.05, removal: 4.53 ± 0.09, addition: 4.66 ± 0.08, grass: 4.63 ± 0.09.

Arthropod and Beetle Abundance

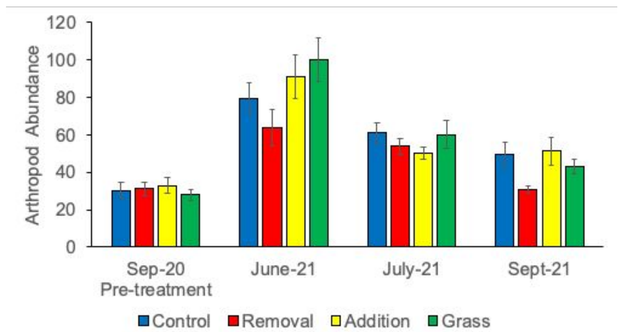


Figure 3. The mean abundance of arthropods ± SE throughout the experimental period. Preliminary data analysis suggests a significant difference over 1-year treatment. Before treatment in September 2020, the mean abundance for control: 30.4 ± 4.1, removal: 31.1 ± 3.6, addition: 32.9 ± 4.0, grass: 27.9 ± 3.0. After treatment, in September 2021, the control: 49.6 ± 6.8, removal: 30.9 ± 1.8, addition: 51.3 ± 7.5, grass: 43.0 ± 3.7.

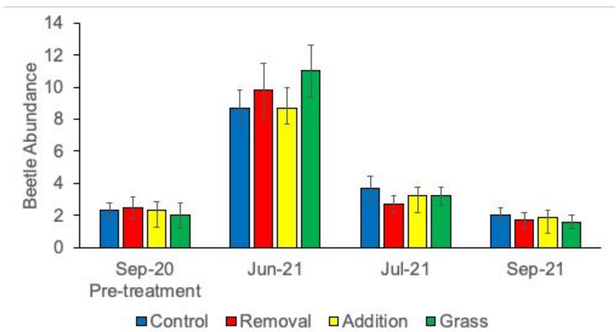


Figure 4. The mean abundance of beetles ± SE at each treatment. September 2020 data was collected before treatment set-up. In June, the mean count for control: 8.7 ± 1.1, removal: 9.8 ± 1.7, addition: 8.7 ± 1.3, grass: 11 ± 1.6. In July, control: 3.7 ± 0.73, removal: 2.7 ± 0.56, addition: 3.2 ±.57, Grass 3.2 ± 0.53. In September, control: 2.0 ± 0.52, removal: 1.7 ± 0.47, addition: 1.9 ± 0.46, grass 1.6 ± 0.43.

Beetle Families

Table 1. Beetle richness by family in each collection month among four treatment plots with overall season total. June and September 2021 had the lowest richness among treatments. July 2021 collection showed the highest number of families present. Although varying in number, there is no overall significant difference in total family richness of beetles collected.

Treatment	Pre-Treatment Sept	June	July	September	Total
Control	4	5	9	5	10
Removal	7	5	7	5	10
Addition	8	4	6	5	11
Grass	6	4	8	3	9

Table 2. Beetle abundance by family and treatment in June. Weevil beetles (Curculionidae) were the most abundant, particularly *Otiorhynchus ovatus* representing 75% of all beetles collected. Families with zero counts represent beetle families found in other collection months but not in June.

Family	Total	Percentage	Control	Removal	Addition	Grass
Curculionidae (Otiorhynchus ovatus)	291	75.6	67	74	67	83
Curculionidae (Otiorhynchus sulcatus)	36	9.4	6	9	13	8
Carabidae	21	5.5	7	4	1	9
Staphylinidae	17	4.4	3	5	5	4
Nitidulidae	10	2.6	4	1	2	3
Curculionidae (Anthonomus corvulus)	6	1.6	1	2	0	3
Scarabaediae	3	0.8	0	3	0	0
Tenebrionidae	1	0.25	1	0	0	0
Curculionidae (Scolytidae)	0	0	0	0	0	0
Tachyporinae	0	0	0	0	0	0
Histeridae	0	0	0	0	0	0
Mordillidae	0	0	0	0	0	0

Discussion

- Overall, there was a trend for higher soil conductivity in the grass treatments for each month. This could be attributed to the grass clippings' ability to retain moisture in the soil.
- In June, there was a greater abundance of arthropods, specifically beetles, in the grass treatments. This high abundance could be attributed to additional nutrient availability and suitable microclimates for these communities (Figure 3-4) (3).
- *Curculionidae ovatus* reside in moist environments such as riparian zones, feeding on roots and leaf litter. These beetles were the most abundant type collected over all treatments for June (75.6%) (Table 2) (7).
- Since ground arthropod communities can be indicative of ecosystem health, we will continue to investigate the influence of ground covers on soil characteristics and arthropod communities, to further both invertebrate and riparian zone conservation.

Future Research

- Investigate the relationship between ground covers and pollutants on arthropods and soil characteristics in urban areas.
- Determine whether beetle traits and niche requirements affect patterns of colonization in urban ground cover treatment areas.
- Implement repeated treatments for grass and litter additions to determine long term effects of urban ground cover.

Literature Cited

Due to the large amount of literature and sources used throughout creating our poster, we decided to format them all in a easy-to-use QR Code. Just scan with your phone!

Acknowledgements

Thank you to the Department of Biological Sciences and Binghamton University Research Day for this opportunity!