Variation in Arthropod Community on a Prairie-Style Green Roof

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Introduction

When engineering their Green Roof, the Botanical Research Institute of Texas (BRIT; Fort Worth, TX)) had three goals: aesthetic appeal, insulation efficiency, and creating a green roof that mimicked a local ecosystem in urban areas in order to achieve: high resilience to biotic disturbances, high biodiversity, and promote awareness of disappearing ecosystems. Finding green roof examples in Texas is difficult due to two biotic limitations: bimodal precipitation and extreme summer temperatures. In order to address these barriers, BRIT decided to model the green roof's ecosystem after the Goodland and Walnut Barrens *(Fig 1)*. Goodland and Walnut Barrens are characterized by extremely shallow limestone soils, drought conditions, and vegetation adapted to bimodal conditions. Building of the roof began in 2010. It is approximately 20,000 sq. ft., with a 9.5 degree slope. The polyculture vegetation of the roof is based upon transplanted Walnut and Goodland Barren soil. Bio-trays (n=5,700) were planted on the roof in July 2010 with three main vegetation tray types: cactus, grass, and yucca. Dr. Brooke Best (BRIT) was interested in investigating the plant-insect interactions and roles of arthropods in a green roof community.

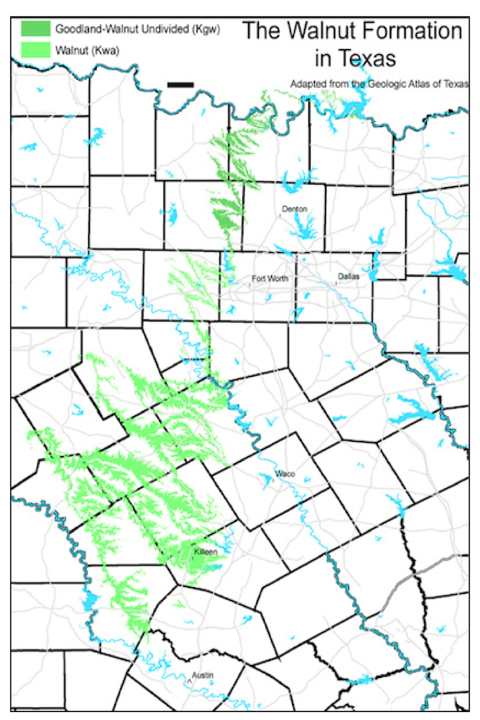

Figure 1. Map of Goodland Walnut Barrens (Swadek 2009)

Methods

We surveyed the BRIT green roof arthropod community using 18 pitfall traps *(Fig 2)* per plot that were at least three meters apart. We used a 3 x 2 factorial design with three replicates *(Fig 4)*. We had 3 vegetation types and 2 slope types: 9 high slope samples and 9 low slope samples overall and 6 grass plots + 6 yucca plots + 6 cactus plots overall. We sampled the roof bi-weekly for 22 weeks in 2012 when the roof was 2 years old. Pitfall contents from each plot were consolidated into a sampling bottle and contents were sorted, counted, and identified in the lab *(Fig 3)*. For analyses we used two diversity indices: Simpson's Diversity index and Shannon-Weiner's Diversity index. They both are a measure of diversity which take into account the number of species present, as well as the relative abundance of each species. Simpson's focuses more on dominance of species. Typical values for Simpson's diversity are between 0 (least diverse) and 1 (most diverse). Shannon-Weiner's Diversity Index focuses more on sample size of data of taxa collected and literature suggests that typical values are between 1.5 and 3.5.

Figure 2. Pitfall trap on BRIT green roof.

Figure 3. Sorting of pitfall samples in lab.

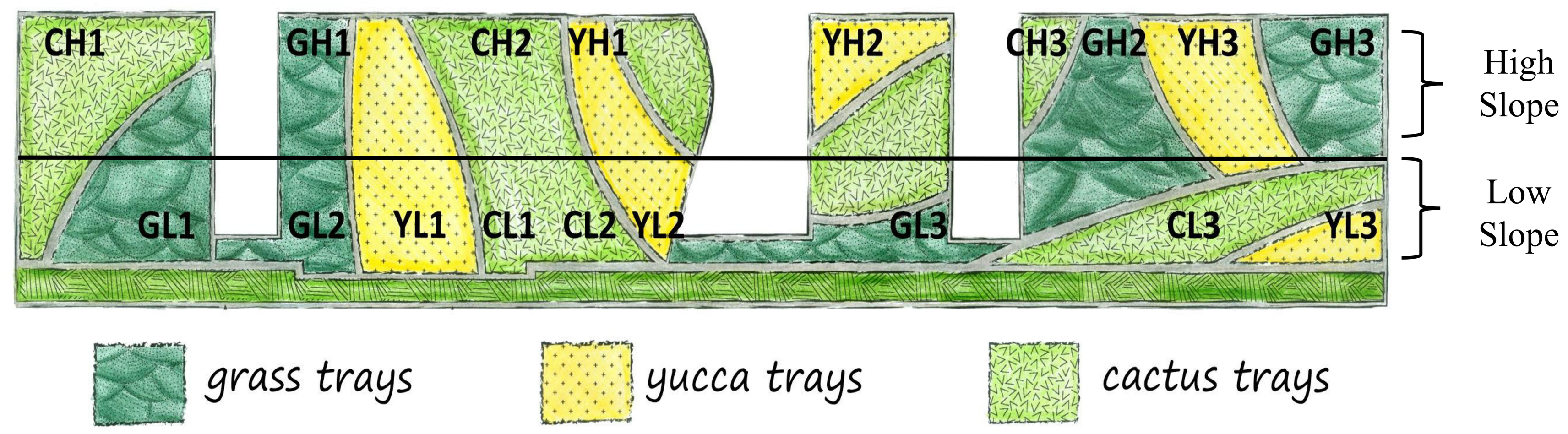

Figure 4. Map of BRIT Green Roof experimental design. Each plot is shown by the vegetation type, slope type, and plot number we abbreviations are as follows: vegetation type: C=Cactus, Y=Yucca, G=Grass; Slope type: H=High, L=Low. Numbers indicate plot number. For example, CH1 is Cactus, High, and the first pitfall trap replicate.

Questions

1. Do roof arthropod communities differ between vegetation tray types?
   - Cactus, Grass, and Yucca

2. Do arthropod communities differ relative to slope position?

3. What's the current status of roof arthropod community overall?

Results

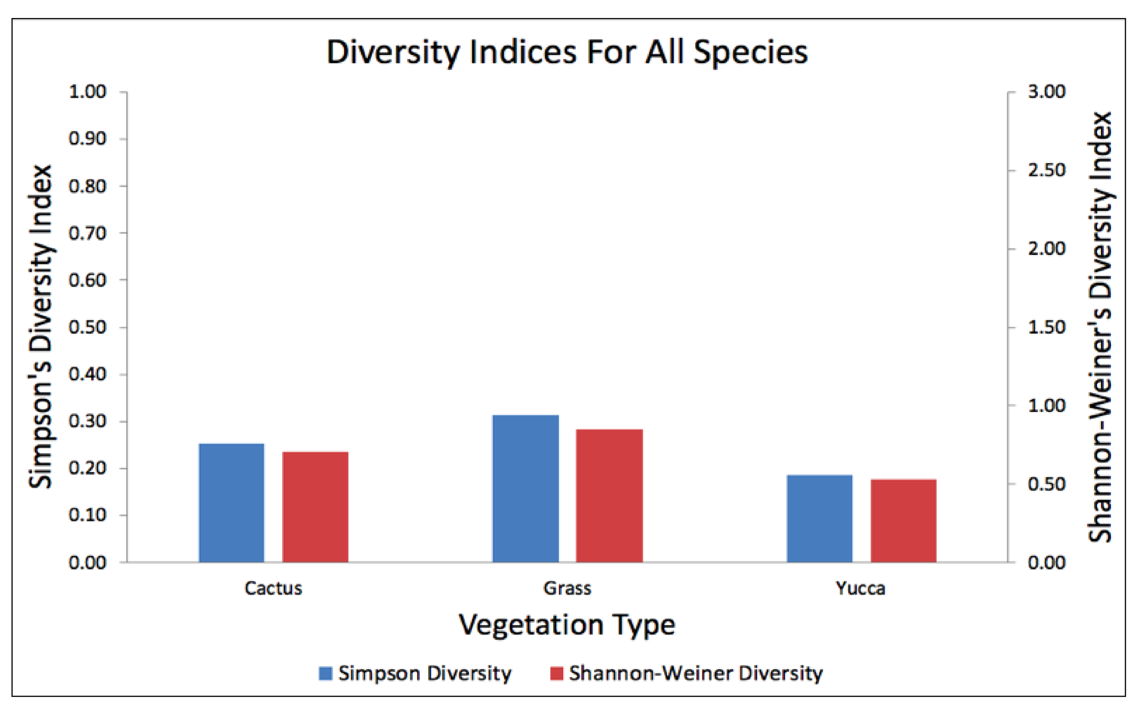

Figure 5. Low arthropod diversity for all vegetation types.

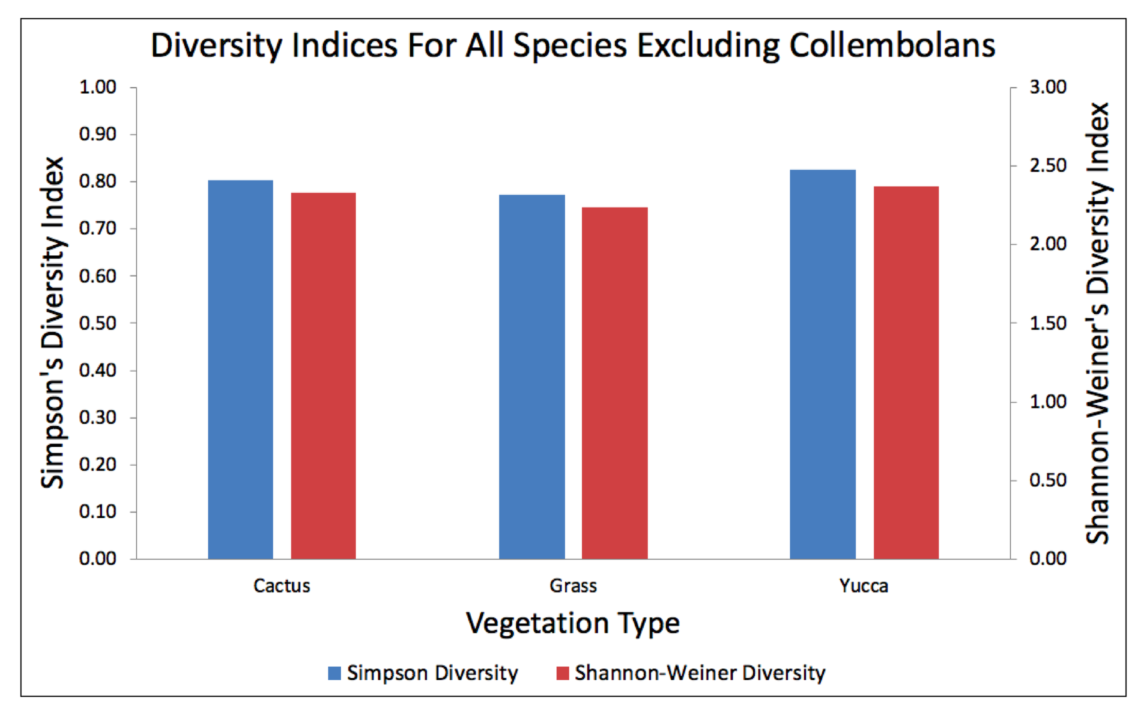

Figure 6. With removal of Collembolan abundance, there is high arthropod diversity for all vegetation types.

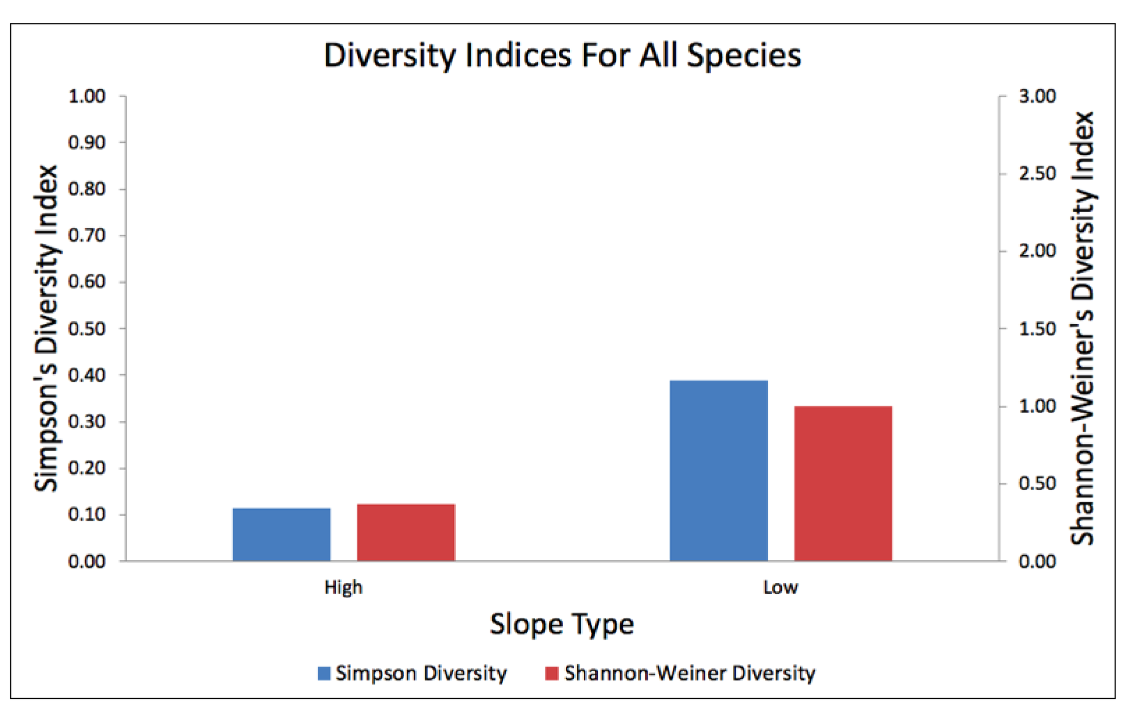

Figure 7. Low arthropod diversity for both slope types.

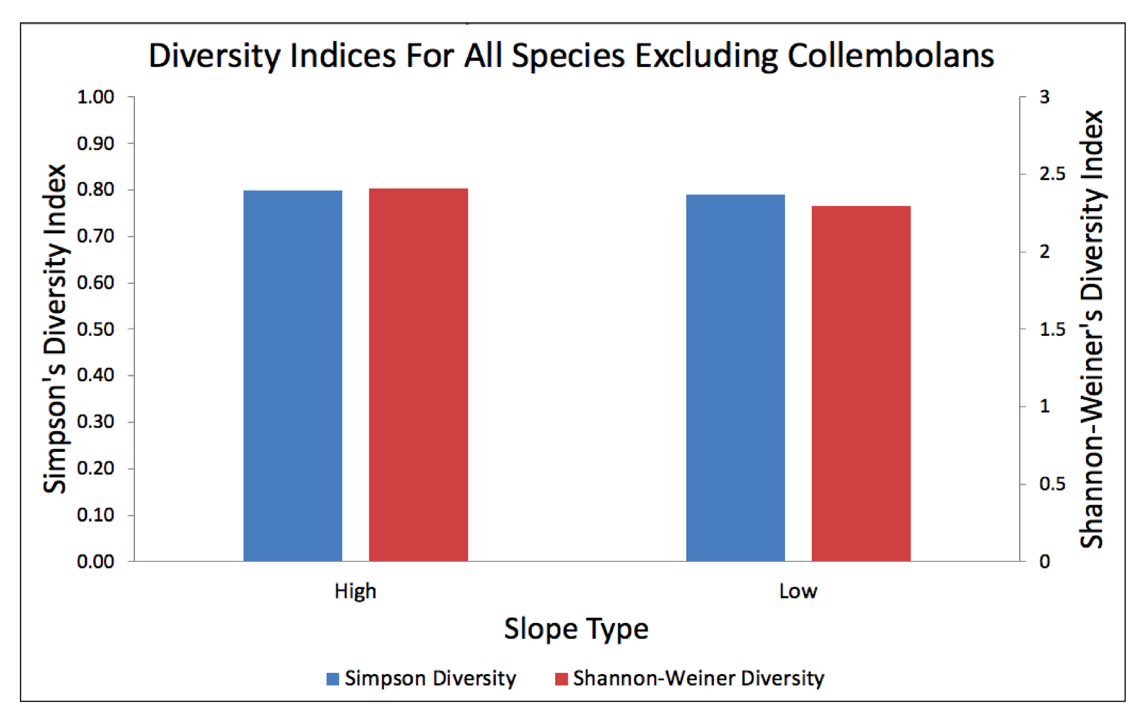

Figure 8. With removal of Collembolan abundance, there is high arthropod diversity for both slope types.

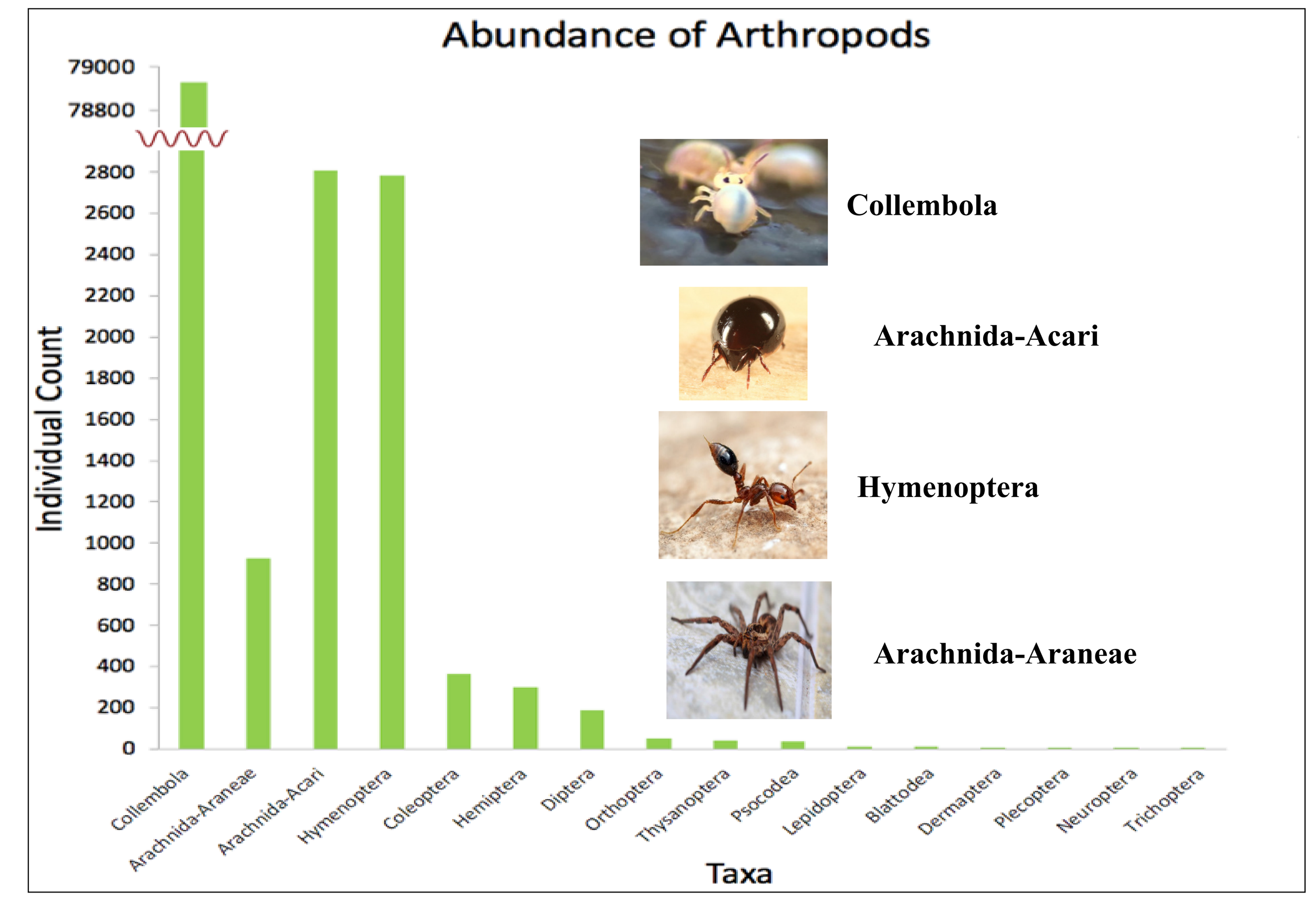

Figure 9. Springtails (collembolans) were the most abundant out of all of the roof insects sampled. This indicates early-successional insect populations.

Conclusions

1. Excluding collembolans, arthropod diversity appeared to slightly differ between vegetation types with yucca having the highest diversity *(Fig 6).*

2. Excluding collembolans, arthropod diversity appeared to not differ relative to slope position on the green roof *(Fig 8).*

3. High abundance of arthropods across trophic levels *(Fig 9).*

Future Goals

•Further analysis of data using Jaccard's Similarity Index

•At the same time of this study, we also sampled at ground level immediately around the building as well as a native prairie several miles away. Follow up questions:
- How does the roof compare to the ground below?
- How does the roof compare to the native prairie that it's modeled after? This might give us an idea of what we should expect to see over time on the green roof.

•Sample the roof again in 2022, ten years after original sampling, to see how these ecosystems evolve or change over time.

Acknowledgements

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