Exploring the Correlation between Vegetation and Arthropod Community Diversity on Urban Green Roofs

Amelia Tejada, Nana Adwoa Agyemang, Oscar Smith

Abstract

Arthropods play a crucial role in urban ecosystems' balance and diversity. Green roofs offer habitats for various flora and fauna, benefiting arthropod diversity and habitat connectivity. Our study on four green roofs in two boroughs (Bronx and Brooklyn) found that increased vegetation diversity correlates with higher arthropod diversity and abundance. Expanding green roofs in urban areas could positively impact the ecosystem by promoting plant biodiversity and arthropod presence. These findings provide valuable insights for enhancing biodiversity and ecological sustainability in urban environments, aiding in climate change mitigation and understanding green roofs' contribution to our cities.

Introduction

Despite the numerous benefits urban green roofs provide, there is currently limited knowledge regarding the diversity of vegetation and arthropod species on them. Arthropods, such as spiders, beetles, flies, and ants, have segmented bodies, an exoskeleton, and no internal spine. They are integral to the communities in which they live as they pollinate plants, control pests, and serve as crucial food sources for other species. The relationship between vegetation and arthropods is complex with both positive and negative interactions, and often the species of one type impact the survival of the others. Green roofs are highly valuable in densely populated cities like NYC, where climate change is evident, and green spaces are scarce. They promote diversity and offer advantages for humans by reducing Combined Sewer Overflow, filtering air pollutants, and lowering carbon emissions. Despite these advantages, green roofs only cover 0.1% of urban roof space.

While ground-level urban green spaces are well-acknowledged for their importance, green roofs have been largely overlooked despite their potential for significant ecological benefits. It is crucial to gain a deeper insight into how green roofs can aid urban species and enhance biodiversity, especially as the urgency of conservation grows.

This study aims to examine how vegetation diversity on green roofs affects the diversity and abundance of arthropods. This insight could prove beneficial in future green planning, and help bring species conservation to the forefront of these endeavors.

Hypothesis

If an urban green roof contains higher levels of vegetation diversity, it will promote higher diversity in present arthropod communities

Methods

This study involved placing traps on four New York City roofs, chosen based on accessibility and the presence of intensive green roof structures. In order to keep the data consistent, green and impervious surfaces on each roof were recorded via Google Earth, and the percent green area was used to determine the number of traps used. One arthropod trap and one herbaceous vegetation survey were completed for every 100 m2 of green space. The traps comprised of a pitfall trap and two sticky traps, while vegetation surveys were conducted using 1-meter squared quadrats to asses percent plant cover. Herbaceous and tree diversity were measured separately, as trees were measured as a count of individuals and not percent cover. Arthropods were collected from the traps after 24 hours, sorted, counted and identified. The Picture This app was used for species identification for both arthropod and vegetation species. The Shannon Diversity Index was used to quantify plant and arthropod diversity, with all data tracked on a Google Spreadsheet.

Results

- Urban green roofs with higher levels of vegetation diversity supported higher levels of diversity in arthropod communities
- Herbaceous vegetation had a greater impact on arthropod diversity than tree diversity on urban green roofs

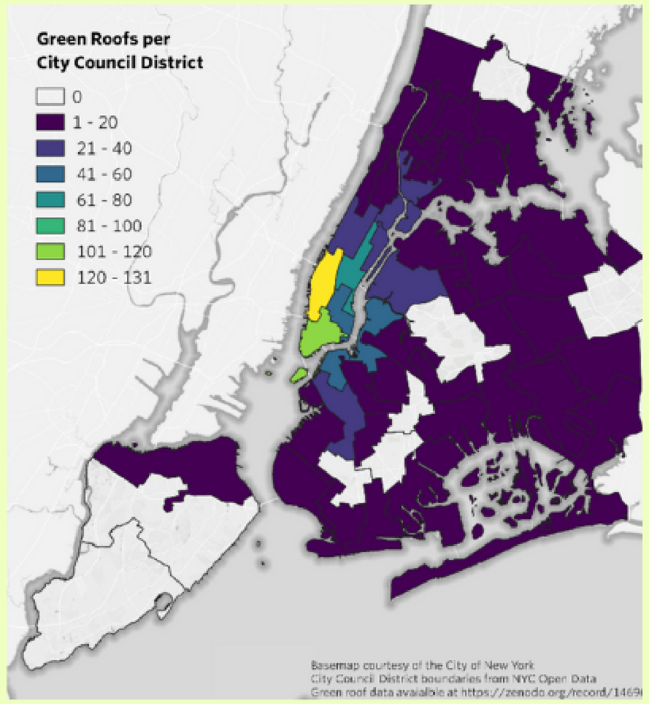

Fig. 1. Green Roofs per City Council District

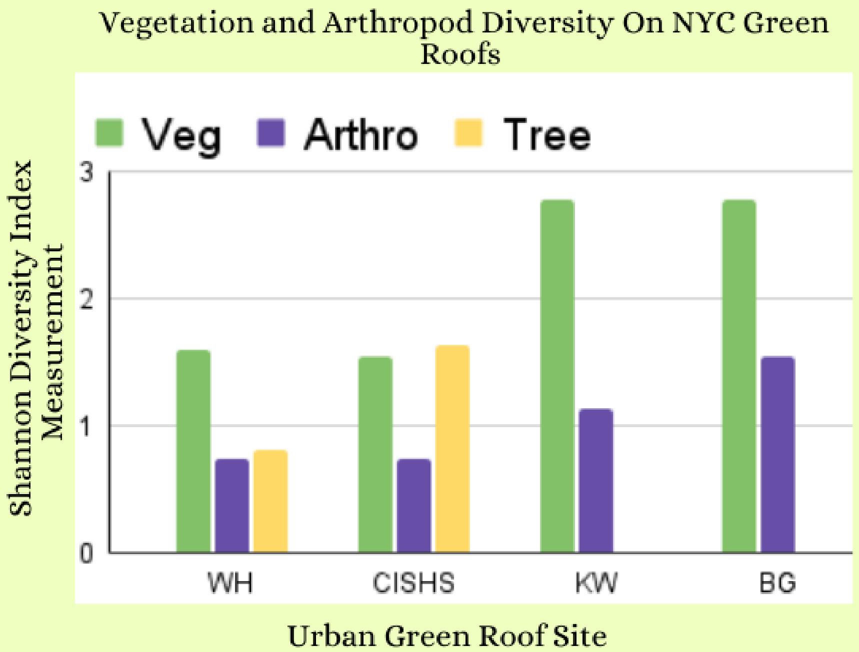

Fig. 2. Vegetation, arthropod and tree diversity across four NYC green roofs

Discussion

Our supported hypothesis reveals that heightened herbaceous vegetation diversity corresponds to increased arthropod diversity. Alongside this, our data suggests that tree diversity has a lesser impact compared to herbaceous diversity. A varied array of herbaceous plants attracts diverse arthropods due to their resource provisions like food, shelter, and shade, while tree diversity might not offer equivalently necessary resources. Our results align with previous studies, exemplified by Frédéric Madre's 2013 study indicating that mixed herbaceous vegetation enhances species richness and abundance across taxa.

Our study experienced constraints in time and resources that could potentially impact our data. Mainly we believe baiting the traps differently in future endeavors could provide a better idea of the species in each site. Increasing traps for data collection, especially on larger roofs, like Brooklyn Grange's vast expanse, may enhance accuracy. **For future urban green roof planning, enhancing vegetation diversity stands as a vital strategy to bolster arthropod communities.**

Conclusion

Our study uncovers the positive correlation between vegetation diversity and arthropod communities on New York City green roofs. Observing four green roofs in two boroughs, we found that herbaceous vegetation diversity is crucial for fostering diverse and abundant arthropods, surpassing the impact of tree diversity alone. This emphasizes the need to incorporate a variety of plant species in green roof design for maximum ecological benefits. Recognizing the importance of arthropods and their relationship with vegetation, we aim for a more harmonious coexistence between nature and urbanity. Our research encourages further exploration and implementation of green roofs to create a healthier environment for humans and wildlife.

Acknowledgements

Thank you to our mentor, Corinne, for making our research enjoyable and informative throughout the research process. We also express our appreciation toWave Hill and the other organizations that granted us access to their green roofs for data collection.

References

Cooper, R., & Whitmore, R. (1990). ARTHROPOD SAMPLING METHODS IN ORNITHOLOGY. Studies in Avian Biology No, 13, 29–37.

Madre, F., Vergnes, A., Machon, N., & Clergeau, P. (2013). A comparison of 3 types of green roof as habitats for arthropods. Ecological Engineering, 57, 109–117.

Franco, J., Vasconcelos, T., & Branco, M. (2010). Effect of ground cover vegetation on the abundance and diversity of beneficial arthropods in citrus orchards. Bulletin of Entomological Research, 100(4), 489-499.