Maximizing Urban Green Roof Potential Through the Understanding of Microbial Composition

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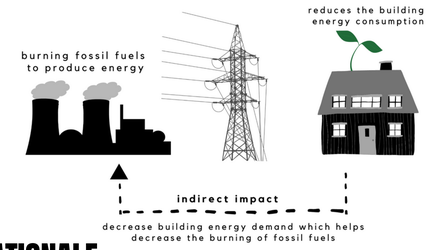
INTRODUCTION

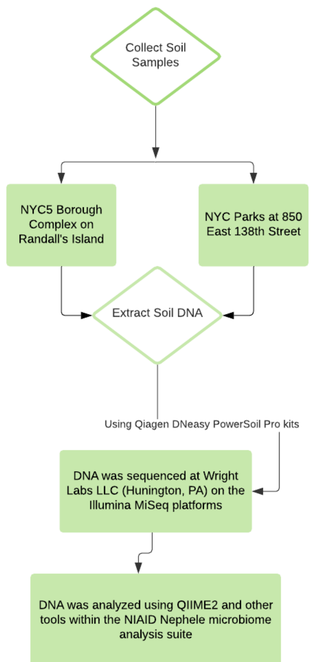
Plant and soil-associated microbes have been linked to building resilience in green roof plants against environmental stressors. However, factors impacting the microbial community composition and dynamics are not well understood. Seasonal and green roof plot architecture (set-up, design, and construction materials of the raised beds) changes might affect soil microbial communities based on past findings.



RATIONALE

The 5 Borough Complex was compared to the 138th Street location due to differences in the depth of green roof plots, agricultural differences, and 4x4 modular boxes vs. a continuous green roof covering. 138th Street plant composition is mostly sedum and moss, while the 5 Borough Complex is mainly wildflowers and grasses. Since these buildings are in close proximity to each other, the location was not a factor considered. We currently do not know how much these variables might contribute to differences in the microbiome.

METHODOLOGY



RESULTS

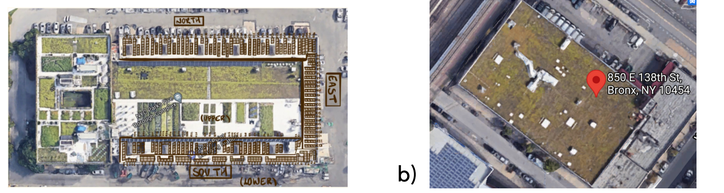


Figure 1. An aerial image of NYC 5 Borough Complex illustrating how samples were labeled and collected, and b) the NYC Parks at 850 East 138th Street

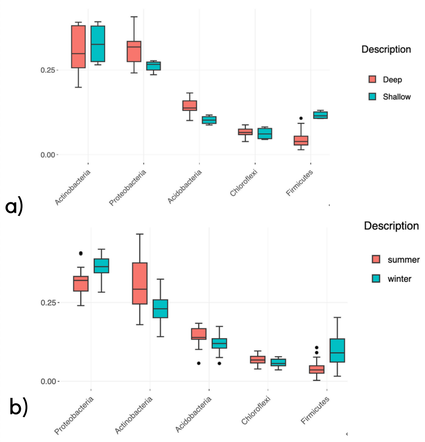


Figure 3. Most abundant phyla of a) the green roof plot architecture from the summer samples and b) the season samples from the 5boro complex

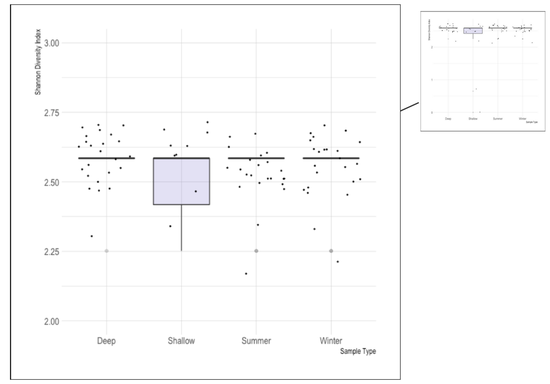


Figure 2. Shannon Diversity Index of the green roof plot architecture and the seasons

Table 1. Top Ten Taxa for Deep Samples

Genus
unclassified Subgroup_6
unclassified 67-14
Solirubrobacter
unclassified Xanthobacteraceae
Subgroup_10
unclassified Gaiellales
unclassified Bacteria
Gaiella
unclassified Micromonosporaceae
Nocardioides

Table 2. Top Ten Taxa for Shallow Samples

Genus
unclassified Subgroup_6
Nocardioides
unclassified 67-14
unclassified Solirubrobacteraceae
RB41
unclassified Burkholderiaceae
unclassified Acidimicrobiia
Blastococcus
unclassified KD4-96
Pseudonocardia

Table 3. Top Ten Taxa for Summer Samples

Genus
unclassified Subgroup_6
unclassified 67-14
Solirubrobacter
unclassified Xanthobacteraceae
Subgroup_10
unclassified Gaiellales
unclassified Bacteria
Nocardioides
Gaiella
unclassified Micromonosporaceae

Table 4. Top Ten Taxa for Winter Samples

Genus
unclassified Subgroup_6
unclassified 67-14
Solirubrobacter
unclassified Xanthobacteraceae
Subgroup_10
unclassified Gaiellales
unclassified Bacteria
Nocardioides
Gaiella
unclassified Micromonosporaceae

Tables 1-4. Relative abundance of the separate green roof plot architecture from the summer samples and the separate season samples from the 5boro complex

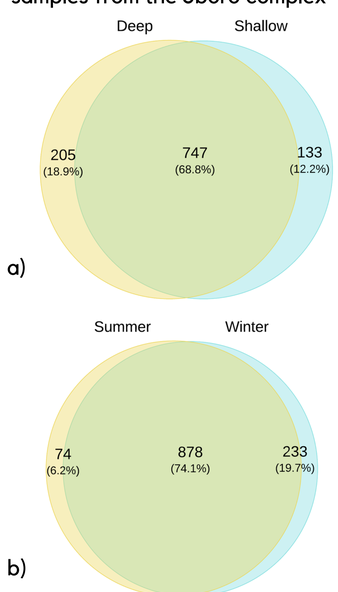


Figure 4. Venn Diagram comparing the genus taxonomic rank of both a) green roof architecture and b) seasons

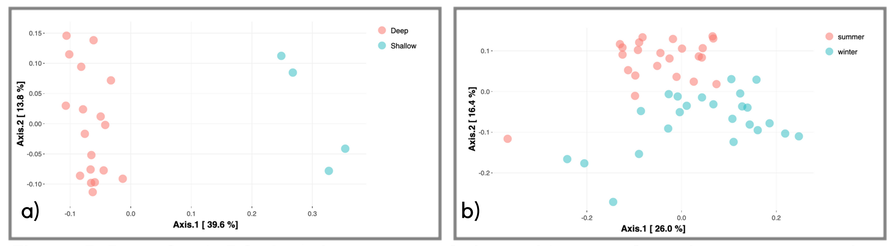


Figure 5. Bray-Curtis PCoA a) the green roof plot architecture from the summer samples and b) the season samples from the 5boro complex

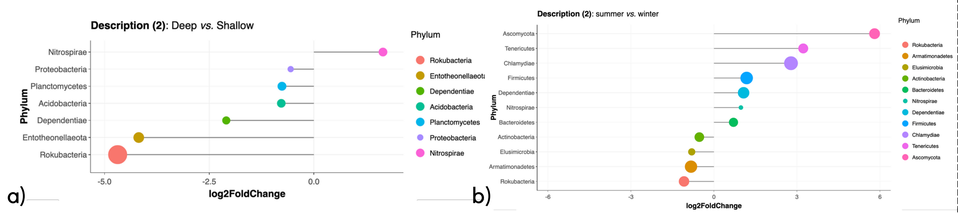


Figure 6. Differential Abundance figure displaying the phylum of a) the green roof plot architecture from the summer samples and b) the season samples from the 5boro complex

DISCUSSION & CONCLUSION

- The Shannon's α Diversity Index was higher in the shallow green roof plot architecture, as well as the seasonal winter samples.
- The three dominant phyla for both the seasons and the green roof plot architecture were Actinobacteria, Acidobacteria, and Proteobacteria, which are common of most soil types.
- There was a higher commonality with the genus of the soil between the summer and winter compared to the deep and shallow plots.
- A larger amount of dissimilarity exists between the deep and shallow plots compared to the summer and winter samples.
- Soil microbial communities are slightly influenced by seasonality, but more so by green roof plot architecture and other factors such as agriculture.

Overall, there is not a large difference in the microbial communities between the winter and summer samples, but what difference they had could be due to shifting physicochemical properties that might be underlying due to seasonal changes (Wu et al., 2016). There is a difference in the microbial communities between the deep and shallow plots due to differences in the depth of green roof plots, agricultural differences, and 4x4 modular boxes vs. a continuous green roof covering. We are continuing to analyze these data to gain additional insights into the factors that may influence green roof microbiome communities. Having a more thorough understanding of these green roof microbiomes will give the urban soils community and city planners improved strategies for maximizing the benefits of green roofs with hopes of mitigating urban heat island effects.

ACKNOWLEDGEMENTS

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- Venn Diagrams and Methodology Created in Lucidchart (www.lucidchart.com)