How does urban residential landscape diversity impact soil microbial functional diversity?

Taylor Smith[1*], Lindsey C. Slaughter[1], Daniel Hirmas[1], Igor Bronz[2] , Dustin Herrmann[2]

[1]Department of Plant and Soil Science, Texas Tech University, Lubbock, TX; [2] TreePeople, Beverly Hills, CA

Contact:
Taylor Smith
smi72727@ttu.edu

Introduction

- Creating and maintaining functional landscapes is one of the biggest challenges homeowners face, especially in semi-arid areas.
- How does aboveground management affect the microbial communities, soil microbial diversity, and their functionality?
- Being able to maintain diversity within the landscape is an important factor because it can provide support and nutrition for the communities and increase functional biodiversity.
- The **hypothesis** of this study is that landscapes with higher aboveground diversity will in turn have higher microbial diversity, larger microbial communities, and increased functionality.

Materials

- Soil samples were collected from center and edge of residential landscapes across Los Angeles, California and were shipped to Texas Tech University. Subsamples were either air-dried or stored at -80 °C.
- 1) Natural Landscape (native plants, high diversity)
- 2) Traditional Landscape (high-maintenance lawns, low-medium diversity)
- 3) Modern Landscape (xeriscapes, low diversity)

Methods

- Functional diversity of microbial communities were measured by pH, electrical conductivity, POX-C, and Biolog plates.
- POX-C measured to assess active carbon levels in soil samples.
- Biolog plates used to determine functional diversity and capacity using 31 carbon sources.

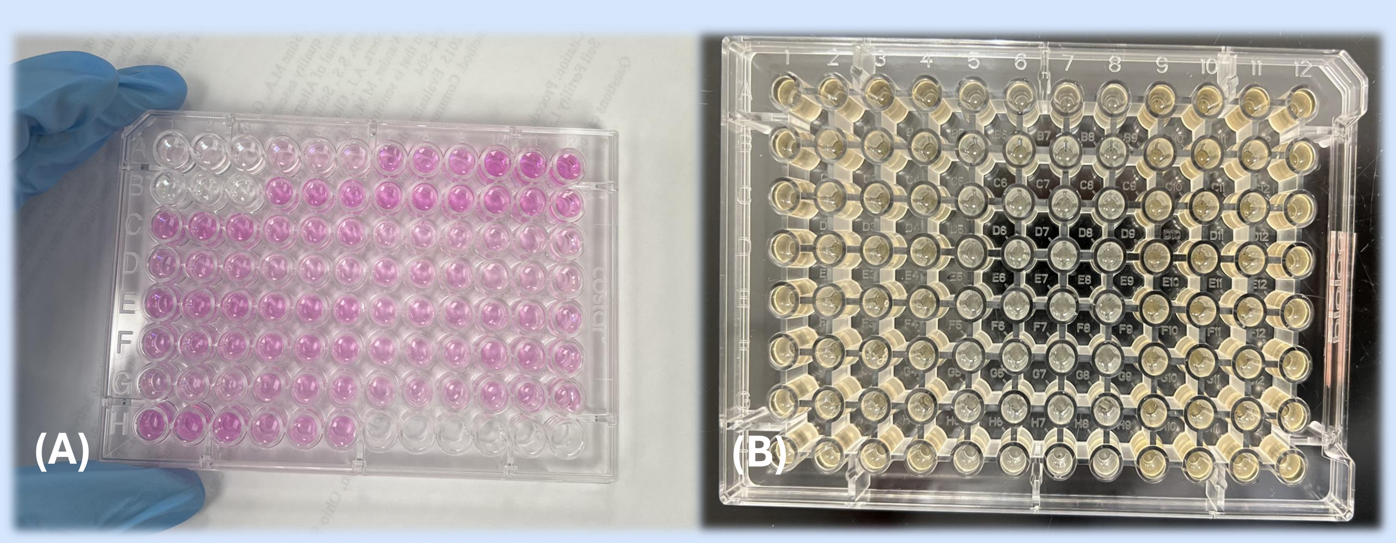

Figure 1: Microplate examples of A) POX-C and B) Biolog plate

Figure 2: Example residential land uses from which soil was collected across LA, California, including A) Manicured landscape, B) Xeriscape, C) Mixed Xeriscape and native plants, and D) Nature-based landscape.

Results

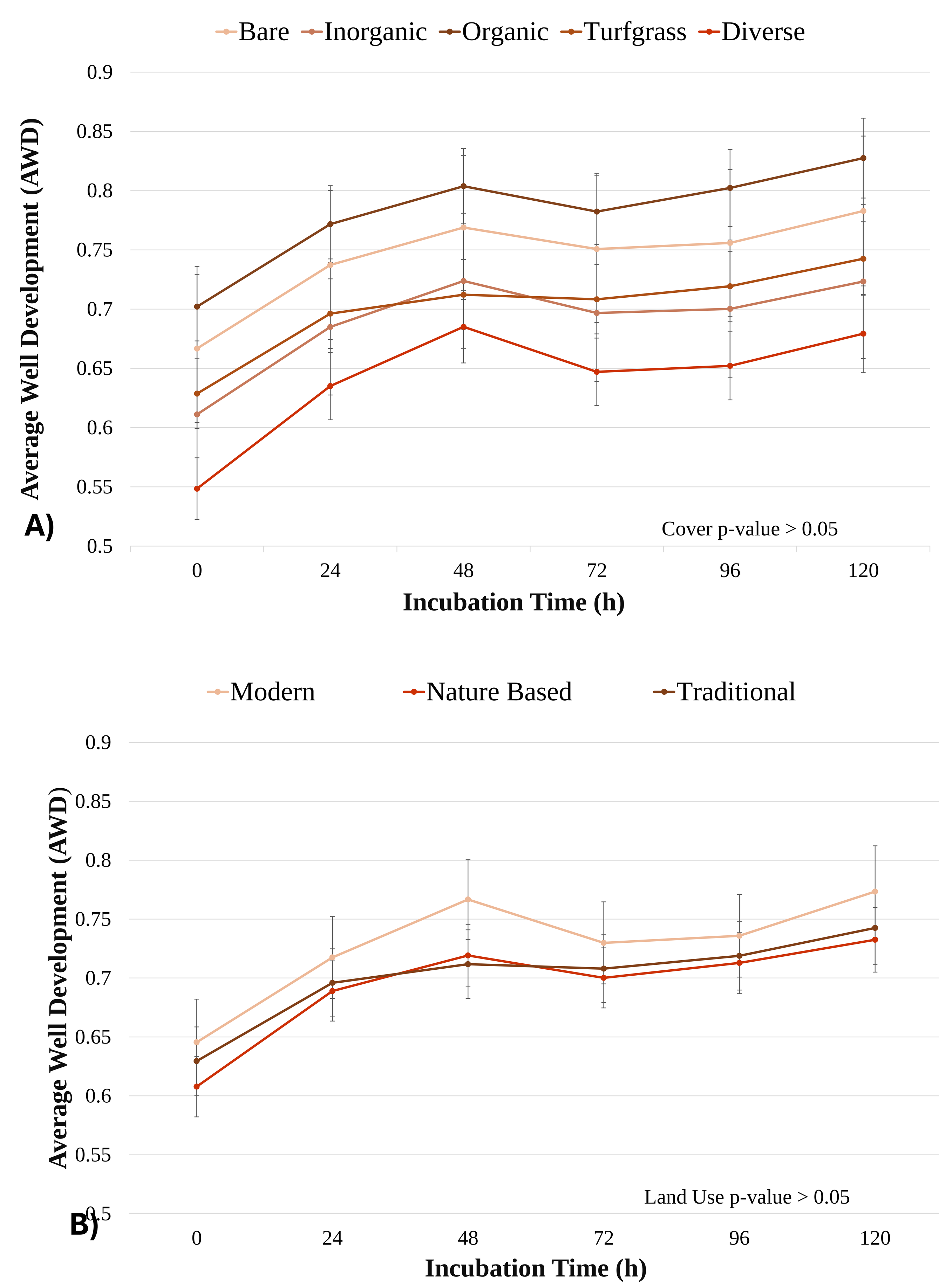

Figure 3: Average well color development in BIOLOG substrate utilization assays, averaged across the 31 carbon sources by **A)** Soil cover in the individual location sampled, and **B)** Land Use of the overall sampling area

Results

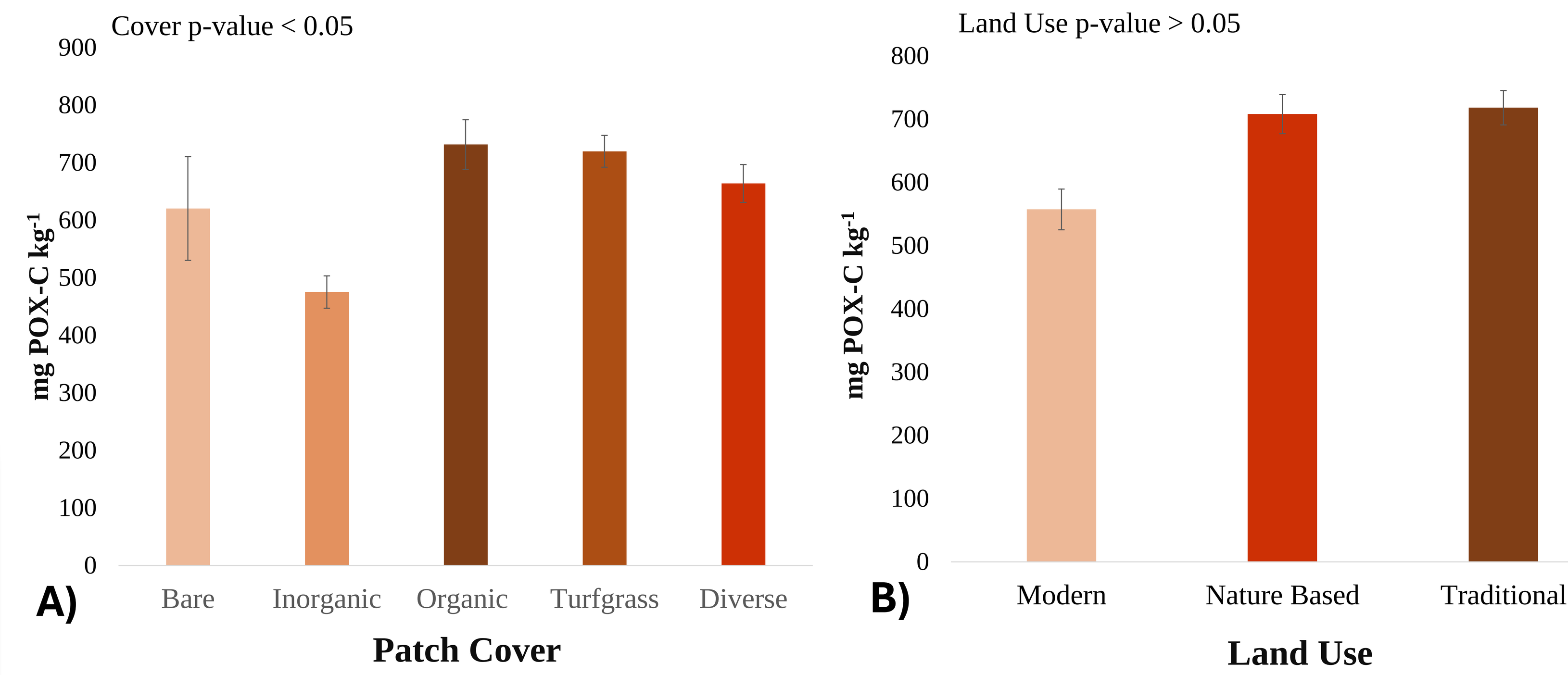

Figure 4: Average levels of permanganate-oxidizable carbon ("active carbon") by **A)** Soil cover in the individual location sampled, and **B)** Land Use of the overall sampling area

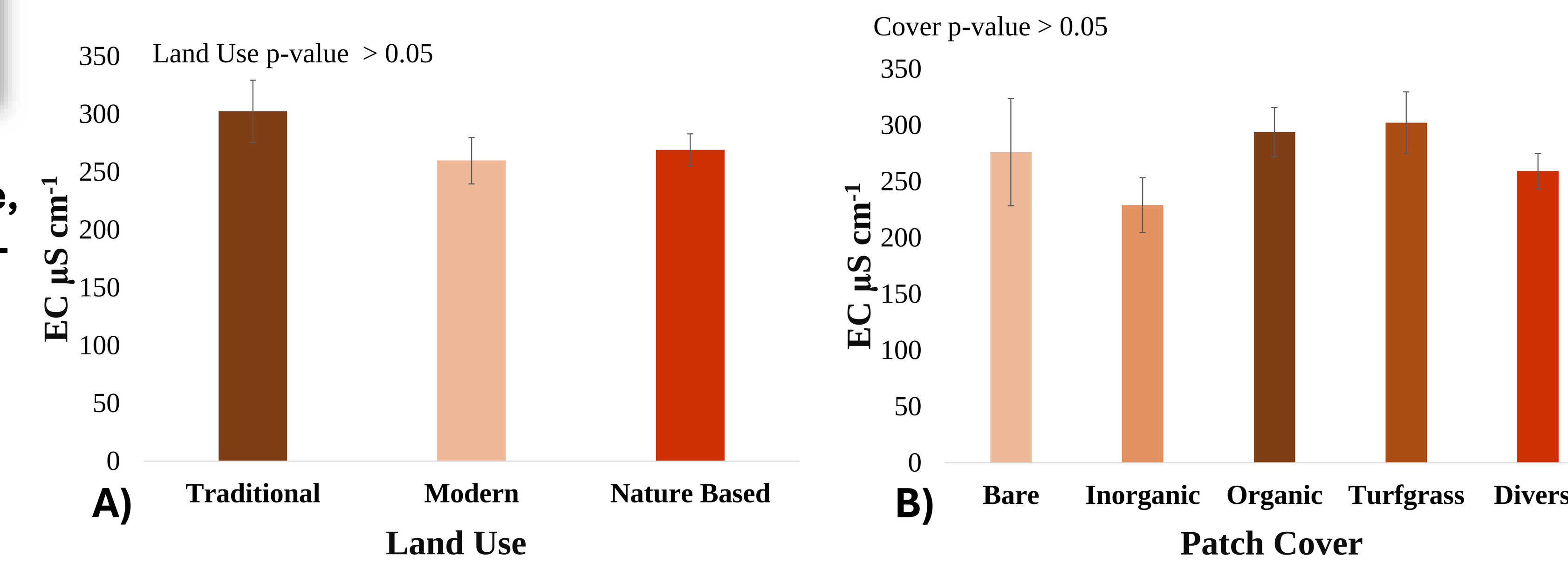

Figure 5: Average levels of EC ("electrical conductivity") by **A)** Land Use of the overall sampling area, and **B)** Soil patch cover in the individual location sampled

Discussion & Conclusions

- No statistically significant effects of sampling location (Center vs. Edge) within a given landscape on measured parameters
- No statistically significant effect of overall land use type on microbial substrate utilization capacity (Figure 3B).
- Cover located directly above the soil where sampled was the most important factor governing microbial substrate utilization and active carbon levels.
  - Organic covers (e.g., mulch) resulted in greater substrate utilization capacity than inorganic covers (e.g., crushed rock).
- Overall land use type further influenced active carbon levels
  - Any landscape dominated by vegetative cover (e.g., turf grass, nature-based lawns) resulted in higher active carbon than any landscape with little or no cover (e.g., bare soil or modern lawns).

Future work:

- Calculation of functional diversity indices (e.g., Shannon's H) using BIOLOG data.
- Chloroform Fumigation-Extraction to measure microbial biomass
- Nitrate and Ammonium concentrations
- Future studies for microbial taxonomic diversity using amplicon sequencing.

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TreePeople

Department of Plant & Soil Science, Texas Tech, Davis College