Soil Characteristics in Relation to Urban Tree Mortality

William McCuen, Jordan Leis, and Nancy Broshot
Linfield College Environmental Studies

Introduction

Research in 1993, 2003, and 2013 showed high rates of tree mortality and low rates of recruitment (new trees) in Portland, Oregon's Forest Park and the Ancient Forest Preserve (Figure 1). To determine if the lack of young trees was an urban phenomenon, we added three control sites in the Mount Hood National Forest above Portland's air pollution plume in 2013 (Figure 2). The lack of recruitment has been noted in many urban forests, and we believe it is potentially caused by changes in the soil. To examine this hypothesis, we collected soil at all our sites and measured the depth of the O horizon, soil moisture, electroconductivity (ECP), pH, and soil respiration. We also collected soil samples that will be sent to OSU's Crop and Soil Science Central Analytical Laboratory to be analyzed for nitrogen, carbon, aluminum, calcium, and other important elements.

Methods

- Re-ran the third transect at all sites
- Measured depth of the O horizon, soil moisture, ECP, and pH at four locations surrounding the transect
- Soil was collected at each site and measured for 24 hour soil respiration rates
- Collected soil is being processed in the lab; it will be sent to the OSU lab where it will be analyzed for elemental concentrations
- Analyze data to determine whether any variables correlate with degree of urbanization

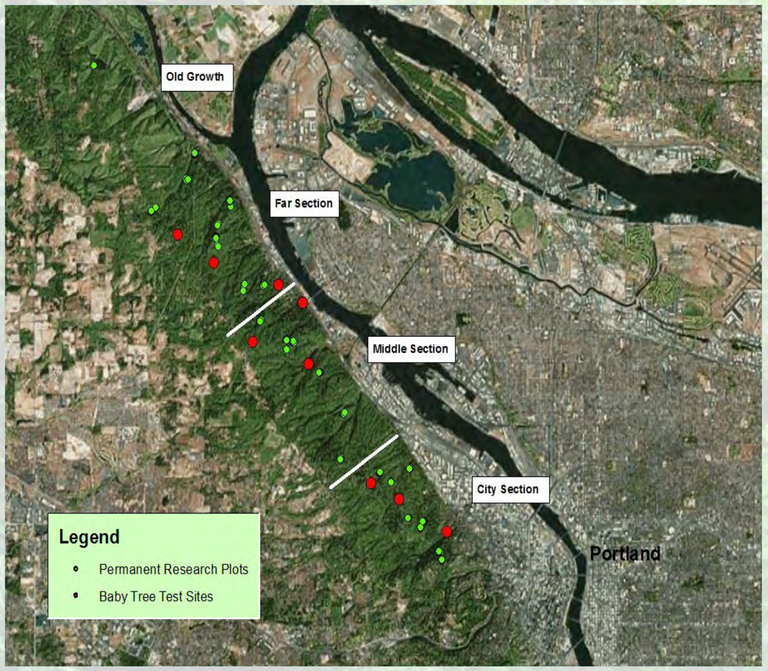

Figure 1. Map showing the locations of the permanent research plots in Forest Park and the Old Growth (Ancient Forest Preserve). Permanent research plots are green; baby tree test sites are red.

Figure 2. Map showing the location of the control sites above Estacada in the Mount Hood National Forest relative to Forest Park. Permanent research plots are green; baby tree test sites are red.

Results

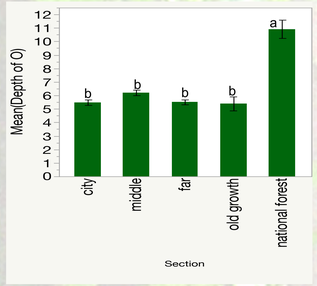

Figure 3. Mean depth of the O horizon in different locations ($p<0.0001$) as per ANOVA in different locations. Means with different letters are significantly different as per Tukey HSD Post hoc test.

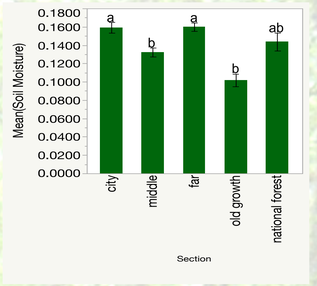

Figure 4. Mean soil moisture in different locations ($p<0.0001$) as per ANOVA in different years. Means with different letters are significantly different as per Tukey HSD Post hoc test.

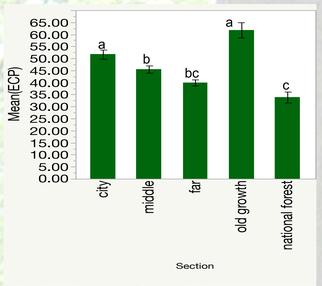

Figure 5. Mean electroconductivity in different locations ($p<0.0001$ as per ANOVA. Means with different letters are significantly different as per Tukey HSD Post hoc test.

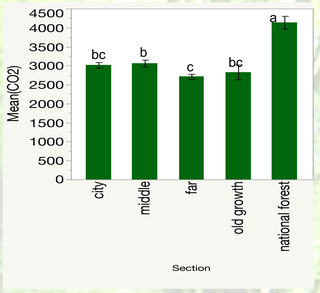

Figure 6. Mean soil respiration rate (CO_2) in different locations ($p<0.0001$) as per ANOVA. Means with different letters are significantly different as per Tukey HSD Post hoc test.

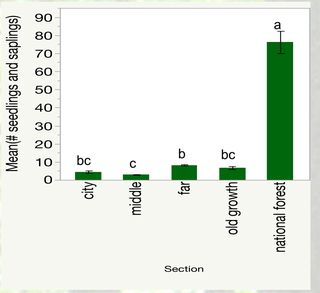

Figure 7. Mean number of seedlings and saplings in different locations ($p<0.0001$) as per ANOVA. Means with different letters are significantly different as per Tukey HSD Post hoc test.

Results Summary

- Depth of O horizon and the soil respiration rate were significantly greater at sites in the National Forest than at other locations
- Electroconductivity was significantly lower in the National Forest than at other sites; was significantly higher in the Old Growth and the City
- Soil moisture was significantly greater in the Far and City sections than in the Middle Section or the Old Growth
- pH was not significantly different among locations
- We are still processing our soil samples; hope to get those sent of for chemical analysis soon

Conclusions

Soils in the National Forest had deeper O horizons and greater levels of soil respiration; those sites had more seedlings and saplings. We hope the chemical analysis of the soil samples will reveal more important factors than may relate to recruitment.

Acknowledgements

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