

# A Comparison of Urban Soil to Rural Soil

Nancy Broshot, Hayden Cooksy, Tatiana Taylor, and Wes Hanson  
Linfield College Environmental Studies

## Introduction

In 2003, Nancy Broshot found high levels of tree mortality in Forest Park, especially for seedlings and saplings. Seedlings that had been present in 1993 were mostly gone in the 2003 study. The loss of seedlings and saplings, concomitant with the lack of recruitment by new seedlings evidenced in 2013 was similar to findings in other urban forests, and raises concerns about the future of Forest Park. In 2015, three control sites were added that showed significantly more seedlings and saplings at sites above Estacada in the Mount Hood National Forest than in any area in Forest Park (Figure 1). We believe the lack of recruitment is related to nitrogenous air pollution (lichen studies show Forest Park to have a greater number of nitrogen loving species than rural forests). To try to elucidate soil parameters that may be affected by air pollution, we measured soil aspects including the soil moisture, temperature, pH, depth of the O horizon, and the carbon to nitrogen ratio (C/N). We also measured the amount of CO<sub>2</sub> produced in the soil over a 24 hour period to get an indication of soil respiration rates.

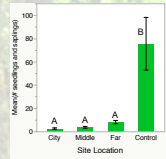


Figure 1. Number of seedlings and saplings in Forest Park and the National Forest ( $p < 0.0001$ ).

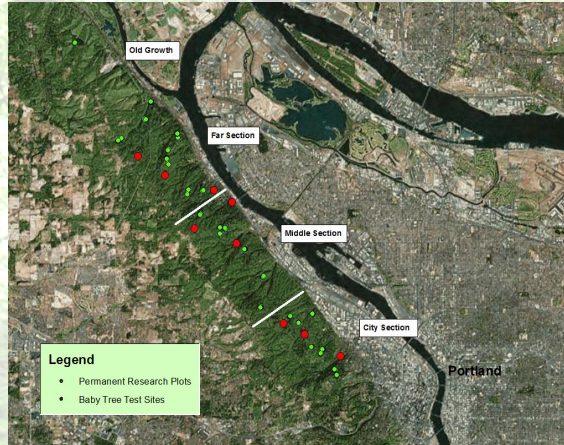


Figure 2. Map showing the locations of the permanent research plots in Forest Park and the Old Growth (Ancient Forest Preserve).

## Goals of Study

- Measure soil characteristics in urban forests (Forest Park) and rural forests (control sites above Estacada in Mount Hood National Forest)
- To find correlations between soil characteristics and tree community variables, especially those related to recruitment

## Methods

- Soil samples from the A Horizon were collected from 17 of the permanent research sites in Forest Park and at 3 control sites located above Estacada in the Mount Hood National Forest (Figures 2 and 3)
- Depth of the O horizon was measured at each site
- Soil temperature, moisture, and ECP were measured in the A horizon using a hand held decagon probe
- The pH in the A horizon was measured using a Hannah Instruments pH meter
- Collected soil samples were processed and sent to the OSU Analytical Laboratory, where they were analyzed for C, N, and the C/N ratio
- To measure soil respiration rates:
  - 12, liter Nalgene containers were seated in the soil along permanent transects at each site
  - Each container was covered with foil to minimize photosynthesis
  - After 24 hours, we measured the amount of CO<sub>2</sub> that had collected in each container using a Vernier handheld CO<sub>2</sub> probe (Figure 4)



Figure 4. CO<sub>2</sub> collection set up



Figure 3. Map showing the location of the control sites above Estacada in the Mount Hood National Forest relative to Forest Park.

## Results

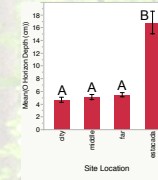


Figure 5. Depth of the O horizon in different locations ( $p < 0.0001$ )

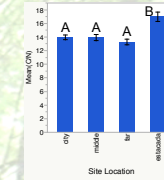


Figure 6. C/N ratio in different locations ( $p = 0.0003$ )

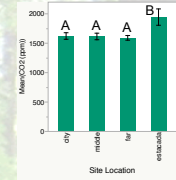


Figure 7. Soil respiration rate as measured by CO<sub>2</sub> production ( $p = 0.0043$ )

## Results Summary

- Rural control sites had significantly deeper O horizons, higher C/N ratios, and greater levels of soil respiration (Figures 5-7) than urban sites
- Rural control sites also had significantly more live trees (90 vs. 16-25) and seedlings and saplings (Figure 1), as well as a higher % conifers (93% vs. 28-53%) and greater total tree dbh (1008 vs. 583-743); all  $p < 0.0001$
- The number of seedlings and saplings was positively correlated with the C/N ratio ( $R^2 = 0.42$ ;  $p = 0.0026$ ) and the depth of the O horizon ( $R^2 = 0.48$ ;  $p < 0.0001$ ).
- The level of soil respiration was not found to be correlated with any other variable.

## Conclusions and Limitations

- The data suggest that the smaller O horizon, as well as the lower C/N ratio found in Forest Park may be related to seedling/sapling survival in urban forests, but more data is needed.
- The reason for the loss of O horizon and the lower C/N ratio need to be ascertained; one hypothesis is that nitrogenous air pollution affects the microbial flora (e.g., bacteria and fungi).
- Our CO<sub>2</sub> is inconclusive. Our collection containers did not always seal well in the soil, leading to errors. We are in the process of obtaining a better system of measuring soil respiration. We still believe that soil respiration rates will be an important factor in elucidating the causes for the lack of recruitment.
- We also plan to examine seedling and sapling roots for mycorrhizal fungi.

## Acknowledgements

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