Where Have All the Young Trees Gone?
A Big Picture Look at the Lack of Seedlings and Saplings in Urban Forests

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Background

• Nancy Broshot, with the help of students from Linfield College, has been doing research in Forest Park (Figure 1) since 1993.
• In 1993, vegetation at 25 sites in Forest Park was measured.
• The same measurements were repeated in 2003.
• In 2005, 27 western red cedar seedlings were planted at 9 sites throughout the park; those have been measured annually.
• We outline our past work and preliminary results from preliminary 2012 lichen surveys
• Our hypothesis is that nitrogenous air pollution may be the cause of the mortality of young trees.

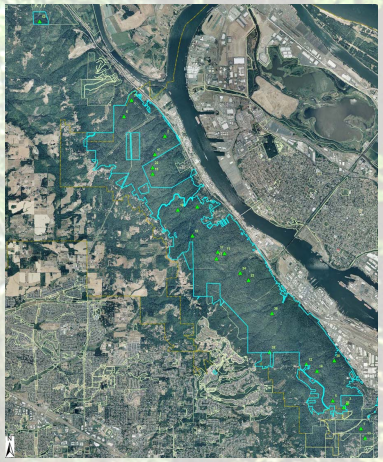
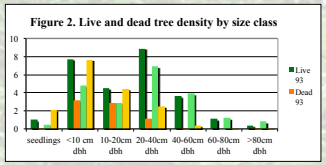


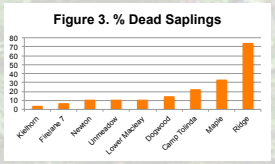
Figure 1. Forest Park (sites noted in green)

What Do We Know?

• There were significantly fewer live seedlings, saplings and young trees and significantly more dead seedlings, saplings and young trees in 2003 than in 1993 (Figure 2) (Broshot 2011)



• The percent mortality of western red cedar seedlings planted at 9 sites in Forest Park in 2005 ranged from 4 to over 70% (figure 3)



Acknowledgements
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Possible Causes

• Evidence suggests it is NOT due to soil moisture (Figure 4), mammalian grazing (Figure 5), slope aspect, light intensity, or disease.

Figure 3. Percent tree mortality in western red cedar saplings (2005-2012). No significant difference.

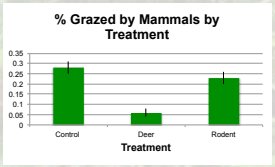


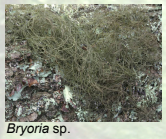
Figure 4. % grazing by mammals by treatment. Trees in deer enclosures had significantly less grazing ($p<0.0001$) than other trees.

What Do We Think is Going on?

• The problem may be nitrogenous air pollution.
• The highest tree mortality (>75%) is directly above the St. John's Bridge.
• Lichens are sensitive to nitrogen, making them excellent bioindicators of air pollution levels (Jovan 2008).
• For additional information, see Hannah Prather's poster.
• Preliminary examination of lichens at some of my sites (Table 1) suggests relatively high levels of nitrogenous pollution.
• Jovan (2008) found an average air quality score of 0.36 for the Willamette Valley; our values are within that range.
• We found the old growth site to have the best air quality score (lower scores mean better air quality); the Pittock Mansion site had the worst air quality.

Good Air Quality Lichens
(not present at any site)

Lobaria oregana



Bryoria sp.

Table 1. Mean Lichen Score by Study Site.

Site	Mean Lichen Score
Old Growth	0.20
Red house	0.31
Newton #22	0.34
Birch #12	0.35
Firelane12 #6	0.37
Newton #41	0.38
Newton #15	0.39
Firelane 7 gas	0.43
Firelane12 #39	0.46
Leif far	0.47
Pittock Mansion	0.53

Bad Air Quality Lichens
(common at all sites)

Candelaria concolor

Physia tenella

Conclusions

These are preliminary results. There is much more work to do. This summer is the 20th anniversary of my original study; we will measuring trees and lichens. In addition, a study of nitrogen deposition rates is currently being conducted in Portland. We hope to be able to correlate our findings with those from that study, as well as with Hannah Prather's results.

References

•Broshot, NE. 2011. Mortality and recruitment in an urban forest (Forest Park in Portland, Oregon) between 1993 and 2003. Urban Ecosystems 14 (4): 553-567
•Jovan, S. 2008. Lichen Bioindication of Biodiversity, Air Quality, and Climate: Baseline Results From Monitoring in Washington, Oregon, and California. USDA. Forest Service. Pacific Northwest Research Station. General Technical Report PNW-GTR-737