Measuring Trailside Plant Diversity Along an Urban-Rural Gradient in West Virginia and Maryland

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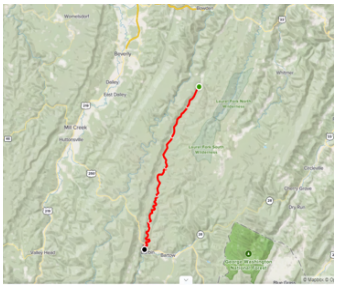
Abstract

The effect of urban development on plant diversity is a well-documented phenomenon, but these studies mainly focus on the effect of deforestation or ground disturbance, but the evaluation of proximity to urban development hasn’t been well covered. The presence of high plant diversity levels nearing a city are often seen due to the importation of ornamental species for personal landscaping, but we plan on documenting this effect in relation to proximity to these urban sites [4][5]. Given that the importation of non-native species is often dependent on the unknowing shoes, cars, and boat hulls of recreators, the trailside is a much more likely spot to identify these non-native species [11][12]. The combination of these findings resulted in the measure of trailside plant diversity in relation to the proximity from urban development centers. Species were found to be distributed relatively evenly throughout the 4 sites per trail, with the peaks at 2.0 miles for both trails. Along the West Fork Rail Trail and the Kendall River Trail we documented 7 and 8 non-native species, respectively, with the highest number documented (n=5) at 1.0 mile site and 2.0 mile site, respectively. No relationship was observed between total species number, and proximity to urban development.

Introduction

As increasing human populations prompt urban expansion, the impact of this dispersion is a popular source of study in the modern day. The impact of human interference in the growth of forests has been well documented, but the reaction of an environment to the presence of urban society is not well understood [3][5].. Urbanization is thought to be a major source of decrease in species diversity, but oftentimes the introduction of exotic/foreign species through nurseries and personal landscaping increases the botanical diversity within these cities [4][5]. Meanwhile, urban forests have shown increased susceptibility to pests and disease due to their lack of diversity; demonstrating that our understanding of the introduction of urban infrastructure and lifestyle into an ecosystem has an unpredictable effect on plant diversity, which in turn has an unpredictable effect on the overall health of that ecosystem.

The observable difference between plant diversity alongside a hiking trail, and undergrowth not subject to foot traffic is also an interesting impact of humanities expansion into the wilderness [11][12]. The studies conducted regarding trailside diversity have yet to evaluate the effects of proximity to urban development, and this is what we plan on investigating. Trails, such as those evaluated in Shenandoah, are usually far from urban development and even the trailheads are situated in the midst of protected wilderness. However, Rails-to-Trails offer us a unique opportunity to study the impact of urban proximity on trailside diversity. The nature of Rails-to-Trails allows for a relatively controlled observational experiment, given that the construction of these trails is relatively straight with very little elevation gain, even within topographically diverse areas. With these factors not only will we be able to maintain radial distance from urban structures as the trail progresses into wilderness, but elevation can also be ruled out as a factor in differing patterns of plant diversity along the trail.



Materials and Methods

Site Selection

Several characteristics were important in determining sites so as to control for as much as possible, even though this observational study had no intention of determining causation. Trails were selected upon their overall shape, duration, radial distance from urban development, and location. Trails that wind or maintain irregular shapes would negate our goal of maintaining radial distance from the urban starting point, so trails that were as straight as possible were selected. Given that 4 sites would be selected at 0,1,2, and 3 miles, the distance of the trail had to be at least 3 miles long. It would defeat the purpose of this study if, as the trail progressed from the urban starting point, it proceeded to
\decrease in proximity to other urban features such as major highways or other cities, therefore a trail that starts in an urban center and proceeds into wilderness

or undeveloped forest is an ideal candidate. With these characteristics in mind, the West Fork Rail Trail in Durbin, WV and the Kendall River Trail in Friendsville, MD were selected.

Species Collection and Monitoring

First a starting point is chosen, near the beginning of the trail, for the first measurement, labeled as milepost 0.0. The nature of this starting point is simple, appearing on either the left or right side of the trail based on environmental factors such as an extreme grade or obstacle such as a river, cliff, etc. that would make one side inaccessible. Once the side of the 0.0 site was chosen, all following sites for this trail would occur on the same side.

Once the site was chosen, A field tape was used to measure 5m perpendicular to the trail into the undergrowth, with the point of measurement starting directly past the section of vegetation subject to cutting/maintenance. Then measure the 20m running parallel to the trail that would make up the left-most side of the site. These steps were repeated to establish the 5m and 20m lines that would establish the front and right-most walls of the 5mx20m site. Using the “3-4-5” rule (pythagorean theorem), the field tape was used to check the site for square corners.

Once the 5mx20m site is established, data collection can begin. Each individual species was cut using small shears close to the ground, but larger plants only had a single branch and cluster of leaves harvested for proper identification. The species will be placed on the ground and documented with their corresponding number by photographing and recording known and unknown species in the corresponding document. The species chart will be according to trail rather than site, for example, if a red oak is found in sites 1,2 and 3, it will only be recorded in the species chart once. However, there will be one species richness sheet per site, so that red oak would be recorded in each of these species richness sheets once. Cover was not documented during this study, given that it is strictly a measure of species richness, and not density, therefore, if there are dozens of the same species within a site, it will only be recorded once in the species richness sheets.

After all species were documented, and all plants were labeled and photographed, the stakes will be pulled up, the plant matter discarded back within the site from which it came, and we moved on to the next site.A bicycle was the primary mode of travel between sites, and using either the mileposts, if our original site corresponds with the 0.0 milepost, or gps tracking system through the VeryFitPro running app, accurate to .01miles, we will document 4 total sites at 0.0 miles, 1.0 miles, 2.0 miles, 3.0 miles. After returning to school from the site, the photographs and field descriptions were cross referenced between multiple taxonomic guides, the PictureThis plant identification app, and Dr. Ed Lowry in order to properly identify each species.

#	Common Name	Genus	Species
1	Christmas Fern	Polystichum	acrostichoides
2	Blue ridge Carrion Flower	Smilax	lasioneura
3	Large-leaved aster	Aster	macrophyllus
4	Wood Nettle	Laportea	canadensis
5	Pignut Hickory	Carya	glabra
6	Blue Beech	Carpinus	caroliniana

Species Chart for the Kendall River Trail

0.0 Mile		1.0 Mile		2.0 Mile		3.0 Mile	
# of species	CSN*	# of species	CSN*	# of species	CSN*	# of species	CSN*
1	70	1	60	1	36	1	1
2	71	2	61	2	37	2	2
3	72	3	62	3	38	3	3
4	73	4	63	4	29	4	4

Species Richness Chart for the Kendall River Trail
**Corresponding Species Number*

Results

The Kendall River Trail had a total of 68 documented species, with 7 accidental repeats, in which I believed one specimen to be of a novel species when it had in fact already been recorded. There were also 3 unidentifiable grass species within this trail, and 2 species which were later nullified due to poor collection and documentation procedure. We identified 60 native species and 8 non-native species within this trail. The 2.0 mile site contained the most non-native plant species (n=5), and all other mile sites contained 2 non-native species. The 0.0, 1.0, 2.0, and 3.0 mile sites had 32, 29, 38, and 31 documented species, respectively

The West Fork Rail Trail had a total of 57 documented species, with 5 accidental repeats, in which I believed one specimen to be of a novel species when it had in fact already been recorded. There were also 2 unidentifiable grass species within this trail, which could be visually distinguished and recorded in the species richness charts, but could not later be distinguished from the hundreds of other grasses in the identification process. We identified 50 native species and 7 non-native species within this trail. The 1.0 mile site contained the most non-native plant species (n=5), and all other mile sites contained 3 non-native species. The 0.0, 1.0, 2.0, and 3.0 mile sites had 22, 26, 28, and 21 documented species, respectively.

Conclusion

Our initial hypothesis, in which species richness would be greater in closer proximity than it would be at farther sites was not supported. The West Fork Rail Trail (WFRT) demonstrated a normal distribution of species diversity, but the Kendall River Trail (KRT) had two peaks, with the highest at 2.0

miles, and the second, smaller peak, at the 0.0 mile site (Fig.1).

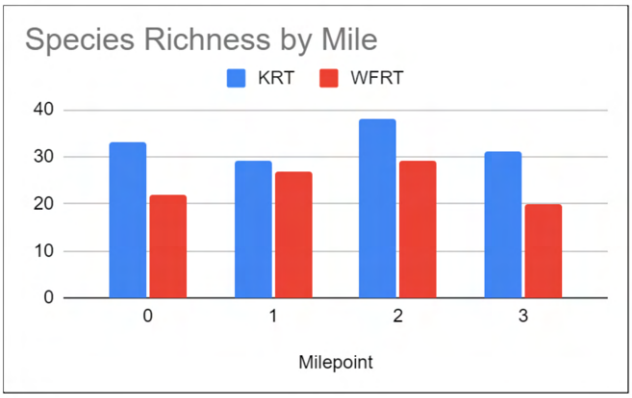


Figure 1

Both trails had their highest counts of species richness at the 2.0 mile site and, before determining the nativity status of the documented species, an initial thought was that the 2.0 mile mark was a distance in which native and non-native species could coexist in their greatest numbers. This thought was further supported in the finding that, on the KRT, the highest levels of non-native species were found at the 2.0 mile site (n=5). However, as we finished uncovering the nativity status of the WFRT species list, this thought did not have further support, as the highest levels of non-native species (n=5) were found at the 1.0 mile site (Fig.2). If this research proceeds into the fall, then more trails could be documented to evaluate the possibility of this hypothesis.

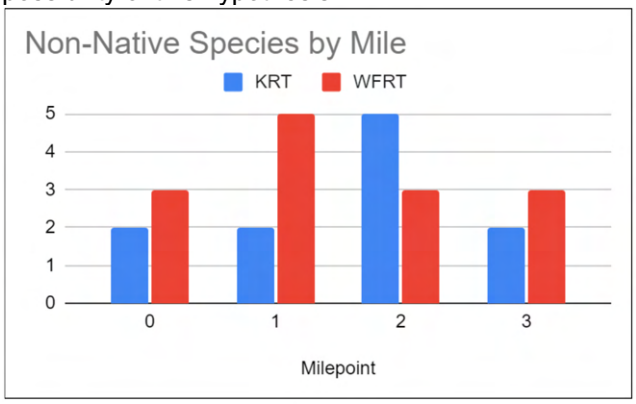


Figure 2

The 68 total species documented among the KRT didn't follow a particular pattern in their distribution and Figure 3 further supports the lack of relationship between species richness and urban proximity.

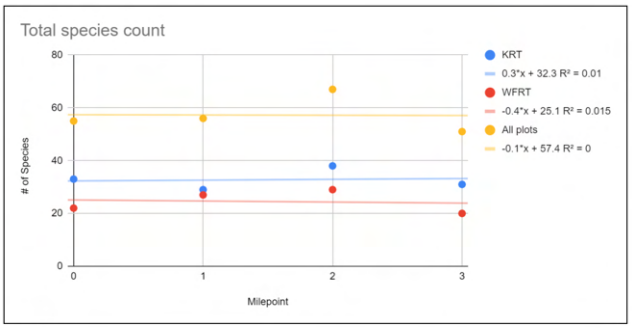


Figure 3

The KRT had an average of 32.75 species per milesite, and a standard deviation of 3.86. The 57 total species found on the WFRT had a normal distribution with a mean of 24.5 species per site, and a standard deviation of 4.20. The average species found per trail overall was 28.62, with a standard deviation of 5.78

Figure 4, Site 0.0 of the WFRT

Figure 5, site 2.0 of the WFRT

overall. The wide variation in the species distribution may also be attributed to the difference in micro-environments between sites. Within the same trail, sites varied from relatively flat grassy marshes, to rocky environments with a steep grade, to patches of conifer forest, which notably acidify the soil, impacting which species are able to grow there. Performing trailside measurements allowed for a more controlled environment compared to what would've been found had I been moving 10m-20m into the underbrush, but Figures 4 and 5 demonstrate the ecological and terrain differences that could be found within the WFRT. Meanwhile, the standard deviation of the KRT effectively communicates the ecological similarities between the sites.

Figure 6 helps to demonstrate the difference in environments present along these trails, for the number of species unique to their specific site is 8% higher in the West fork Rail Trail than what is seen in the Kendall River Trail.

	WFRT			KRT		
Milepoint	Species unique to site	total species	% unique to site	Species unique to site	total species	%unique to site
0	8	22	0.363	8	33	0.242
1	10	27	0.370	3	29	0.103
2	6	29	0.2067	12	38	0.315
3	4	20	0.2	5	31	0.161
Average	7	24.5	0.285	7	32.75	0.205

Figure 6

The differing environments along the West Fork Rail Trail would allow plants that found specializations in marshes, rocky soil, or conifer forests to thrive in their individual sites without appearing in any of the others. In order to combat this effect in the future, an area with less soil variation and elevational variation in the area could be chosen, so as to lessen the presence of extreme grade along the trailside.

Acknowledgments

I would like to acknowledge and thank Dr. Ed Lowry for helping with plant identification, field work advice, and continuous morale boosting, and Dr. Rachel Goodman for procedural and methods advice that made this project possible, and the Department of Undergraduate Research for providing the funding and opportunity to conduct this research.

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