Determining the Origins of Plants at a Vancouver Park to Help Preserve Urban Biodiversity

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Abstract

Preserving natural biodiversity is a great way to increase ecological richness (Vila-Ruiz et al, 2014.) and to help do so, I made it my objective to determine how many plant species are native or non-native to North America in a Vancouver park. I hypothesized that if the majority of the plants in the park I had surveyed were non-native to North America, then it was likely that other parks in the city had a majority of plants non-native to North America as well. I counted trees and individual plants by sight and used a plotless distance-based plant survey technique, the closest individual method, to determine the number of higher-density plants in the area. It was determined that the majority of the plants were not native to North America (150/244 plants). The p-value was found to be 0.9185. There was no significant difference between the native and non-native plants in Vancouver. The reasons for this are most likely due to sources of error, such as the plotless technique I used or issues in plant identification. There were a few limitations during this study such as the fall weather and park restrictions. In the end, it was found that the majority of the plants in the park were non-native to North America and this has no effect on the other parks in the city.

Introduction

In Vancouver, we are lucky to have quite a few parks scattered around the city, but the city's focus lies with the people, building playgrounds and recreational areas, instead of conserving urban biodiversity. With the growing climate issue, it is now more important than ever to focus on sustainability and preserving natural biodiversity. One of the ways to do so is by observing the plants in our green spaces. Plants not native to the area are a major threat to biodiversity conservation. Non-native plants get unintentionally introduced to the parks from all sorts of places such as vehicles and other machinery, they can be introduced in materials such as soil, hay, mulch or passed on from clothing, fur, etc. (Barros and Pickering, 26). The plants native to the area then must compete for resources with the invading species. It can lead to a decline in native flora and fauna which can eventually lead to plant extinction and a loss of biodiversity. If left unattended, it can lead to a drastic change in the dominant vegetation type and changes in the composition of native habitats, affecting the animals and insects (Beninde et al, 592). That is why the focus of my project is observing a park in Vancouver and examining the plant species in that area. If the majority of the plants in the park are non-native, then it's most likely other parts of the city have a majority of non-native plants as well, because this demonstrates that there have not been any efforts made towards upholding the natural biodiversity. This would mean that the city of Vancouver needs to direct more attention to park maintenance and determining where non-native species are being introduced.

Methods

Figure 1: A bird-eye's view of Gladstone-Riverside Park. Dotted gray line marks the area selected to survey. Image taken from Google Maps.

Determining boundaries

It was decided to observe Gladstone-Riverside Park, located in Vancouver. The park is made up of a small grassy field and an established trail that continues onwards for many kilometers. As the park trail was so extensive, it was necessary for me to determine a specific area to survey. It was decided for my area to start from the park sign to the first edge of the first park bench on the trail. The areas directly beside the trail were dense with foliage. As such, my survey focussed on those areas. I used a tape measure to approximate the total area I was surveying, which came to be 2510.56m^2 excluding the parking lot.

Definition of a plant

From my initial survey, I discovered that there were many small plants that grew in patches and it was necessary for me to specify what plants to count. For the purpose of my research, a plant was counted as a single unit if it was taller than knee height (approximately 0.5m), had a primary stem into the ground that was roughly larger than a centimeter in diameter and within the boundaries I had predetermined. If it was more than 50% on the boundary line, it was also considered a plant.

Plant Survey

I started with an initial survey of the area, counting roughly how many distinctive plant species I saw. For larger trees and distinctively individual plants, I counted by sight. From that, I noticed that there were a few species that grew in dense bushes and clusters. I could not count these individually. I decided to count these species with a plotless distance-based technique to determine their density in the area. I chose to use the closest individual method. In the closest individual method, a set of points is positioned along a transect line. At each point, the closest plant is identified, and its distance from the point is measured and recorded. The sample mean of the distance between the plants is calculated and used to determine the density of plants within a certain area ("Closest Individual Method").

It was decided to use a 10 m transect line and set in the middle of the area I was surveying. I marked out 10 sampling points on the line with wooden skewers and spaced them approximately 1 m apart. I then used a tape measure to determine the distance to the closest individual plant cluster. This was repeated for each of the 10 sampling points, with each different plant species. Each distance was recorded on a table, to be used in density calculations later. To determine the plant species, I downloaded a plant identification app called PlantNet. This app involves uploading photos and allowing a community of users to validate the identification of the plant. I took photos of the leaves, stems and overall growth and let the app identify what plant it was. I verified with other photos and plant descriptions online to determine the species and origins. With the closest individual method, I determined the approximate number of high-density plants in the area through calculation. I performed an unpaired t-test to see if my test results were significant.

Results

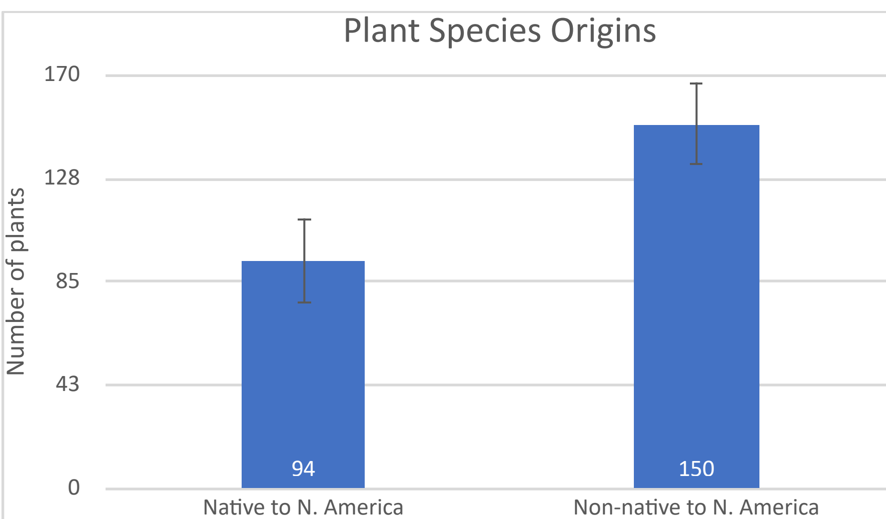

Figure 2: Bars represent the number of plants and their origins with SD. 94 plants were found to be native to North America (SD=17.50) and 150 plants were found to be non-native to North America (SD=18.61).

The total area I was surveying was 2510.56m^2. Within this area, I identified 15 different plant species, 6 of which were native to North America, and 9 that were not. Looking at Figure 2, there was a total of 244 plants, 94 native, 150 non-natives to North America. This means that 38.5% of plants are native, 57.4% non-native. The mean number of native plants was 15.67 with an SD of 17.5 and the mean number of non-native plants was 16.67 with an SD of 18.61. From the unpaired t-test, the p-value was 0.92 and the t-value was 0.10.

Discussion

From the total number of plants I examined, 57.4% of the plants were non-native to North America. The t-test found that between the native plants and non-native plants, there was no significant difference between them. The p-value was 0.92, meaning I failed to reject the null hypothesis. This means that in this particular park, the native plants had no effect on the non-native plants. While this park did have a majority of non-native plants, because the results are insignificant, I am unable to discern if the other parks in Vancouver have a majority of plants non-native to North America or otherwise.

There are a few reasons that could explain why I came to this result. A potential source of variation is from the plotless technique, closest individual method, that I used to determine the number of higher density plants in the area. This method, while effective, is also the most variable and least accurate of plotless techniques ("Closest Individual Method"). It best suited the area I was surveying because the closest individual method extends in only one direction, as the park was more of a simple trail than an expansive green space. However, this variation could have caused the statistics to be skewed.

A potential source of error would be from the plant identification app that I used primarily to identify the plant species. The app that I had used was PlantNet, which is a community-based app. This means that photos of plants are uploaded, and the community (users of the application) help validate whether the identification is correct or not. Identifications are based solely on photos of the plants, as a result, there is the potential for the identification to be incorrect. Another potential source of error and a source of uncertainty would be from myself. I used the closest individual method for the higher density plants but for the more identifiable plants, I simply counted by sight. I could have miscounted somewhere along the way and this would have affected my data and my results.

Numerous limitations were experienced on this project, with the main one being the weather. This project unfortunately started amid the fall season, which meant that most of the plants were in the process of dying. The leaves were different colours, many had already fallen from the tree, and there were no flowers or berries to help in the identification process. These things added to the difficulty of identifying the plant species. Another limitation was the size of the park. The park itself mainly consists of a small green space and a trail that extends for kilometers. Realistically, I could not survey the entire length of the trail, so I had to narrow my focus to a portion at the start. This means that the area observed, is only a snapshot of the plants on the trail, not the entire picture. Another limitation was the higher density plants and the park restrictions. Because of how they grow, in bushels, thick and dense with branches criss-crossing, it was very difficult to count other plants nearby. It was also difficult to ensure every plant was counted properly, because of being restricted to the trail. The combination of the sources of error and my limitations during the project, could have resulted in insignificant results.

Conclusion

Most of the plants were found to be non-native to North America, but the p-value was .92, which means results were insignificant. While the majority of the plants at this Gladstone-Riverside park are non-native to North America, it does not mean anything for the other parks in the city. For future studies, invasive species could be investigated in addition to plant origin, as well as testing other plant surveying techniques to count higher density plants.

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References

"Acer Pseudoplatanus." *Wikipedia*, Wikimedia Foundation, 24 Oct. 2020, en.wikipedia.org/wiki/Acer_pseudoplatanus.

Agustina Barros, and Catherine Marina Pickering. "Non-Native Plant Invasion in Relation to Tourism Use of Aconcagua Park, Argentina, the Highest Protected Area in the Southern Hemisphere." *Mountain Research and Development*, vol. 34, no. 1, 2014, pp. 13–26. *JSTOR*, www.jstor.org/stable/mounresedeve.34.1.13. Accessed 26 Nov. 2020.

"Alnus Rubra." *Wikipedia*, Wikimedia Foundation, 11 Oct. 2020, en.wikipedia.org/wiki/Alnus_rubra.

"Amelanchier." *Wikipedia*, Wikimedia Foundation, 7 Sept. 2020, en.wikipedia.org/wiki/Amelanchier.

Aronson, Myla F. J., et al. "Urbanization Promotes Non-Native Woody Species and Diverse Plant Assemblages in the New York Metropolitan Region." *Urban Ecosystems*, vol. 18, no. 1, 2014, pp. 31–45., doi:10.1007/s11252-014-0382-z.

Beninde, Joscha, et al. "Biodiversity in Cities Needs Space: A Meta-Analysis of Factors Determining Intra-Urban Biodiversity Variation." *Ecology Letters*, vol. 18, no. 6, 2015, pp. 581–592., doi:10.1111/ele.12427.

"Calystegia Sepium." *Wikipedia*, Wikimedia Foundation, 11 Sept. 2020, en.wikipedia.org/wiki/Calystegia_sepium.

"Closest Individual Method." *Closest Individual Method | Global Rangelands*, globalrangelands.org/inventorymonitoring/closestindividual.

“Cotoneaster.” *Wikipedia*, Wikimedia Foundation, 21 Oct. 2020, en.wikipedia.org/wiki/Cotoneaster.

“Hedera Helix.” *Wikipedia*, Wikimedia Foundation, 17 Nov. 2020, en.wikipedia.org/wiki/Hedera_helix.

“Ilex Aquifolium.” *Wikipedia*, Wikimedia Foundation, 9 Oct. 2020, en.wikipedia.org/wiki/Ilex_aquifolium.

“Phragmites Australis.” *Wikipedia*, Wikimedia Foundation, 13 Nov. 2020, en.wikipedia.org/wiki/Phragmites_australis.

“Populus Trichocarpa.” *Wikipedia*, Wikimedia Foundation, 4 Aug. 2020, en.wikipedia.org/wiki/Populus_trichocarpa.

“Quercus Laevis.” *Wikipedia*, Wikimedia Foundation, 4 May 2020, en.wikipedia.org/wiki/Quercus_laevis.

“Reynoutria Japonica.” *Wikipedia*, Wikimedia Foundation, 26 Oct. 2020, en.wikipedia.org/wiki/Reynoutria_japonica.

“Rosa Canina.” *Wikipedia*, Wikimedia Foundation, 12 Nov. 2020, en.wikipedia.org/wiki/Rosa_canina.

“Rubus Armeniacus.” *Wikipedia*, Wikimedia Foundation, 5 Nov. 2020, en.wikipedia.org/wiki/Rubus_armeniacus.

“Solidago Canadensis.” *Wikipedia*, Wikimedia Foundation, 28 Oct. 2020, en.wikipedia.org/wiki/Solidago_canadensis.

"Symphoricarpos." *Wikipedia*, Wikimedia Foundation, 28 May 2020, en.wikipedia.org/wiki/Symphoricarpos.

Threlfall, Caragh G., et al. "Increasing Biodiversity in Urban Green Spaces through Simple Vegetation Interventions." *Journal of Applied Ecology*, vol. 54, no. 6, 2017, pp. 1874–1883., doi:10.1111/1365-2664.12876.

Vila-Ruiz, Cristina P., et al. "Plant Species Richness and Abundance in Residential Yards across a Tropical Watershed: Implications for Urban Sustainability." *Ecology and Society*, vol. 19, no. 3, 2014. *JSTOR*, www.jstor.org/stable/26269607. Accessed 26 Nov. 2020.

Appendix A:

Table 1: Number of plant species and origins

Plant Species	Plant Name	# of plants	Plant Origin
Acer pseudoplantanus	Sycamore maple	6	Europe and Western Asia
Solidago canadensis	Canada goldenrod	9	Northeastern and north-central North America
Rosaceae	Cotoneaster tree	1	Temperate Asia, Europe, and North Africa
Calystegia sepium	Hedge false bindweed	2	Temperate Northern and Southern hemisphere
Ilex aquifolium	English holly	2	Western and southern Europe, northwest Africa, and southwest Asia
Quercus laevis	Turkey oak	5	Southeastern United States
Amelanchier canadensis	Canada serviceberry	2	Eastern North America
Reynoutria japonica	Japanese knotweed	30	East Asia
Populus balsamifera ssp. Trichocarpa	Black cottonwood	15	Western North America

Alnus rubra	Red alder	16	Western North America
Rubus armeniacus	Himalayan Blackberry	15	Armenia and Northern Iran
Hedera helix	English Ivy	15	Europe and western Asia
Symphoricarpos	Snowberry	49	North and Central America
Rosa canina	Dog rose	60	Europe, Northwest Africa, and western Asia
Phragmites australis subsp. americanus	Common reed grass	17	North America

Table 2: Distance measurements of higher-density plants and closest individual method calculation

	Distance from point (m)				
Point	**Himalayan blackberry**	**Reed grass**	**English Ivy**	**Snowberry**	**Dog rose**
1	5.85				
2	6.09	6.12			
3	6.77	5.75			
4		6.2	6.78		
5	6.37	5.73	6.75	3.47	3.25
6	6.67	6.4	6.04	3.54	3.22
7	6.6	6.0	6.65	3.64	3.31

8	7.09		6.07	3.67	3.13
9	6.57		6.34	3.38	
10	5.6		6.1	3.7	
Average distance (x)	6.4	6.0	6.4	3.56	3.22
MA (area/plant) = $2x^2$	163.9	145.6	163.33	50.88	41.66
Total number of plants in specified area (MA/area)	15.31	17.24	15.37	49.33	60.25