An abundance of invasive trees in Toronto and a lack of trees in the streets of Toronto's core.*

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Tree- lined streets are an exceptional way to add nature to urban envirnoments. Using the Street Tree data from OpenData Toronto, this paper examines the patterns and trends in Toronto's street trees. Tree species count, count of trees by ward, and distribution of tree-diameters were analysed. Uncovered was a abundance of a non-native tree species, and a lack of trees on the streets of Toronto's core

1 Introduction

Urban spaces can be void of vast expanses of nature, whether it be grass fields, blooming flowers, or teaming and diverse natural wildlife. One simple way to tackle this is to incorporate nature within the urban landscape, such as with trees. Trees are a vital plant in the world, they take in carbon dioxide and provide oxygen, a key component in the air we breath. Urban areas are known for the excess in carbon dioxide, which only makes it seem natural that trees can live and perhaps thrive in such environments. One way cities have incorporated trees into the city are roadside trees. Trees line many of the cities highways, arterials, collectors, and small roads. Lines of trees lined alongside highways can act as a natural sound barrier by reflecting, scattering and absorbing nearby noises (Dobson and Ryan (2000)). Tree-lined streets can also alter the way wind affects pedestrians below them, creating a more hospitable environment to promote active transportation such as walking or biking (Krayenhoff et al. (2020)). It should be no surprise then, that many cities around the world, including Toronto, have incorporated trees into their landscape, in busy downtown centres, to sleepy suburbs, and everywhere in between.

In this paper we look at street tree data from Toronto's roadside trees, and discern any patterns or observations to suggest further investigation. We first look at the most populous tree

*Code and data are available at: https://github.com/Veyasan1/STA3014-Paper1 species in Toronto, an the ward with the most trees. We will also look at tree diameter, which can indicate the approximate age of trees in the city, and look for anomalies and interesting summaries there. Finally we look at the least populous tree species and figure out where Toronto's native trees stack up.

Section 2 will outline the source of this data. Section 3 covers the graphs depicting interesting findings and trends. Section 4 is where discussion will be made about those findings and trends, as well as theories to explain them. Finally, section 4 discusses any weakness and limitations that can be considered for another report.

2 Data

All collection and analysis of data was done using R, a free programming language designed for data scientists (R Core Team (2023)). Additionally, tidycerse ((**citeTidyverse?**)), dplyr ((**dplyr?**)), and janitor (Firke (2023)) have been used as packages to read, clean, and present data. Finally OpenData Toronto is an online database containing thousands of datasets pertaining to the City of Toronto, which is where the data for this paper was initially accessed (Gelfand (2022)).

Rohan Alexander's book, *Telling Stories with Data* was referenced for troubleshooting and general ideas for data analysis (Alexander (2023))

The data comes from Urban Forestry, an organization dedicated to Toronto's urban forests. They work towards planting more trees, and protecting existing trees from damage due to individuals, private entities, and public entities ("Donate to Urban Forestry" (2024)). This particular dataset is called Street Tree Data, and focuses on city-owned trees located on roads. This information would be most likely used by city planners and road maintenance, ensuring snow plows and street dusters don't impede on any trees that line the roads. It is important to note that there may be some privately owned trees listed among the municipal trees, as they may be of interest with regards to road maintenance or other city services.

Street Tree Data contains around 32000 observations, each observation being an individual tree. Each observation has a general id for data analysis, as well as an structure id, telling us if the tree is part of an existing structure or building. Next is the location of the tree, using the nearest parcel delivery address, nearest cross-junction, and which ward it is located in. Street Tree contains both the botanical name and the common English name, however we have decided to use only the botanical name to avoid confusion between similar sounding trees. Common English names will be provided for species of key interest. Finally, there is a measurement called dbh_trunk. This is a standard method for measuring the diameter of a tree. The method asks record takers to read the circumference of the tree from 1.3m off the ground it is rooted in. This measurement has been known to be vague, especially when it comes to warped or tipping trees, making the exact measurements made on each tree inaccurate at best.

Using R and R Studio

3 Results

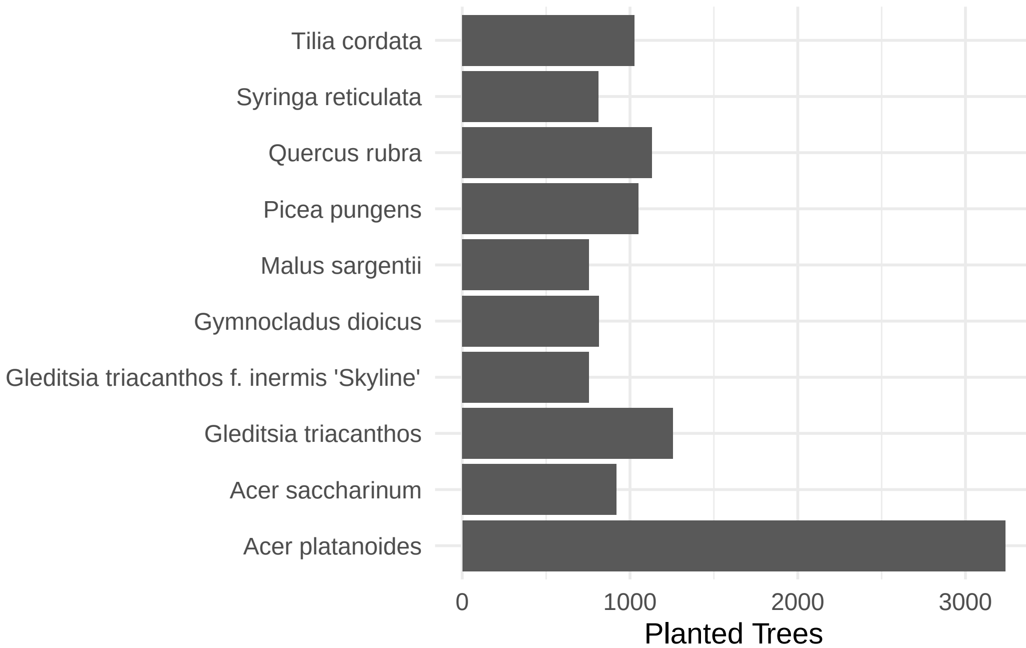

Figure 1: Street tree count of 10 most popoulus tree species in Toronto up to September 2024

Looking at (Figure 1), the most populous species by far is the Acer platanoides, commonly known as the Norwegian Maple. It is interesting how much more prevalent it is compared to any of the other top 10 tree species, at over 3000 recorded individuals. Also note the similarity of the names Gleditsia triacanthos and Gleditsia triacanthos f. inermis 'Skyline'. The latter is an example of a hybrid tree, which is why it's botanical name contains the botanical name of another tree.

((**fig?**) 2) shows the count of trees over each ward in Toronto. Toronto has 25 wards, each with varying land sizes and populations. Ward 2 takes the top spot for tree count, with Ward 3 trailing behind it. These wards are both in Toronto's west end, Etobicoke Centre, and Etobicoke- Lakeshore. Ward 13 and Ward 10 have the least amount of trees, being Spadina-Fort York and Toronto Centre.

(1) is a histogram of the frequency of certain tree-diameters across Toronto. The histogram has a very long tail to the left, indicating one or two trees having upwards of 815 cm of diameter.

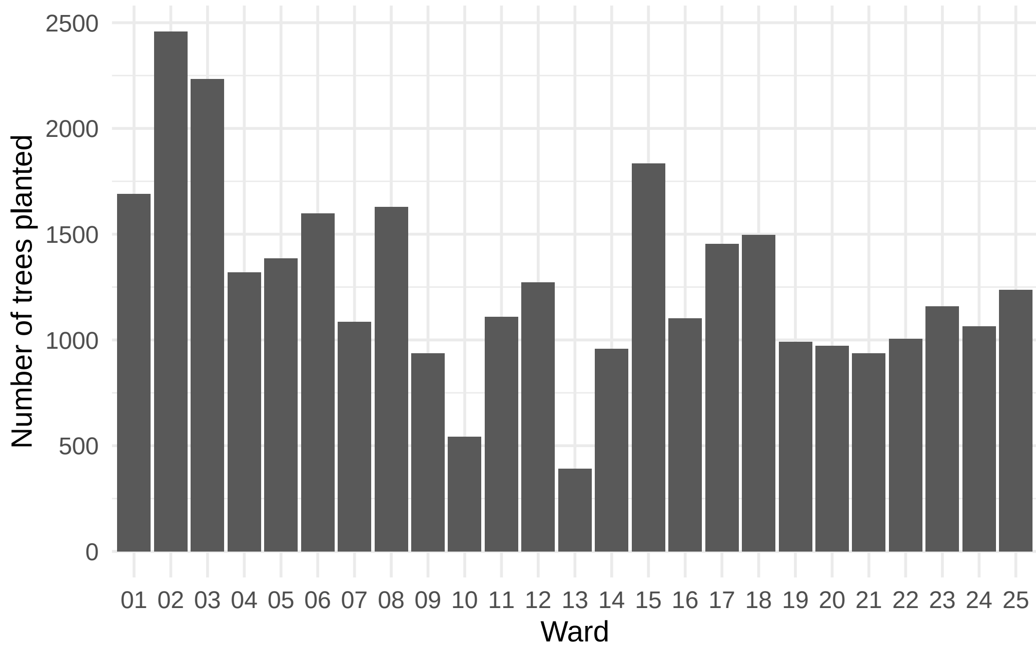

Figure 2: Street tree count by Toronto wards up to September 2024

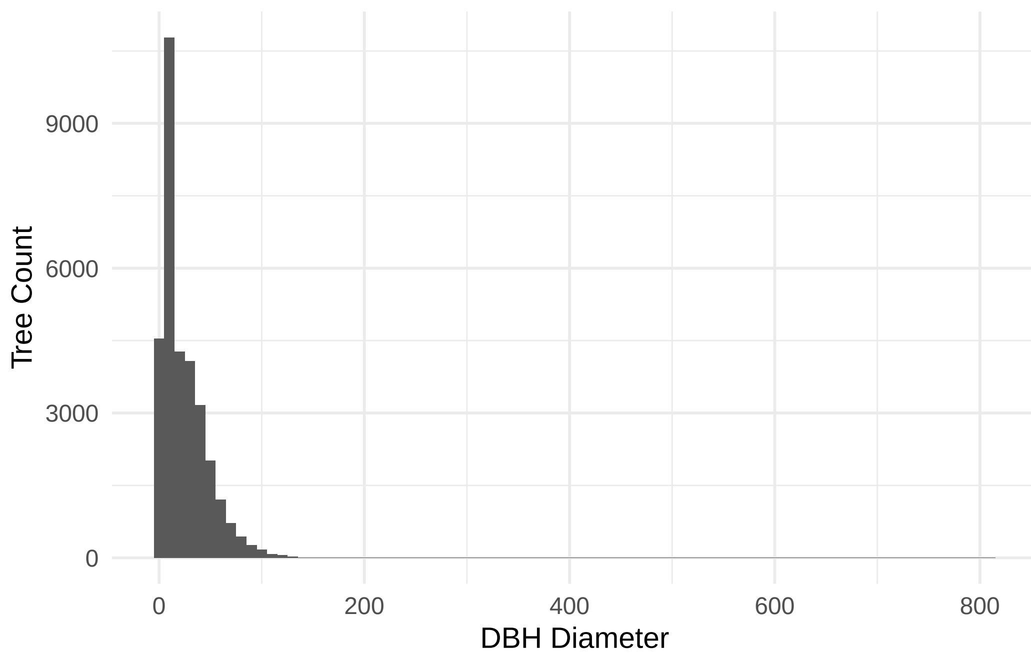

Figure 3: Distribution of Distance-at-Breast-Height diameter of all trees in Toronto up to September 2024

4 Discussion

4.1 The worrying prominence of Acer platanoides

Figure 1 shows that Acer platanoides, otherwise known as the Norway Maple, is clearly the most populous tree in the city of Toronto, beating out any of 9 other contenders by 200 individuals. Acer platanoides is a well known tree used in urban environments, especially after the demise of elm trees in the 1970s (Sandberg, Bardekjian, and Butt (2014)). These trees are know for ‘a vigorous early growth rate, desirable form and size, the capacity to withstand many urban impacts (e.g. pavement, moderate levels of pollution, dusts, and dry soils) and the abilities to transplant well, grow on a wide variety of soils, and withstand ice and snow damage better than other maples’ (Nowak and Rowntree (1990)). Being planted in cities, it’s seeds can travel by wind across to more wooded suburbs, where the seeds can tolerate shade for extended periods of time (Sandberg, Bardekjian, and Butt (2014)). However, as it’s common name suggests, it is not a native species to Canada, instead brought here by European explorers and settlers. While not a very invasive species, taking over just 9% of Southern Ontario’s forests, it does so by harming other native plants and trees ((**urbanforests?**)). More attention should be cast on the spread of this tree, as it has the potential to devastate Toronto’s and Southern Ontario’s forests in the years to come.

4.2 The supposed lack of trees in downtown Toronto

Figure 2 shows the distribution of trees across the 25 wards of Toronto. Wards 2 and 3 top the rankings, at over 2000 individuals. This isn’t a surprise as those wards are located in Etobicoke Centre and Etobicoke-Lakeshore, consisting mainly of suburbs and small pockets of woodland. On the other hand, Wards 10 and 13, Spadina-Fort York, and Toronto Centre, display a shocking lack of trees, at 500 or less. These wards make up a majority of Toronto’s downtown core, which would explain the lack of trees. However, this could be a call to invest in more roadside and path side greenery. Implementing more trees either along big avenues such as university, or small roads servicing townhouses and condos, can help liven up what is considered by many to be a dull, drab section of the city, with endless rows of concrete and glass interspersed with concrete and brick and little else.

4.3 DBH diameters

The spread of DBH diameters indicates that a small number of trees have extremely high DBH values. A DBH value of 800 for instance, means that the measured diameter of the tree is 8 meters! This is most likely an error on the part of the person in charge of inputting data at the time. There may have been a decimal missing from the entry, which would divide the offending dbh by 10. We can’t be certain when the data was taken and how accurate it is however, so we leave it as is for future examination. The largest bin is located somewhere between 10 cm and 20 cm, indicating that the median diameter of Toronto's street trees is around that value as well. This suggests that most street trees are actually very young, and have not had much time to develop their trunks. This can be explained by initiatives to plant saplings along new or existing roads, potentially replacing older trees that had been cut down to make way for urban development.

4.4 Weaknesses and next steps

Street Tree data is cumulative, meaning Urban Forestry has to manually update the status of each tree, which is an arduous task for over 30000 trees. As a result the data may be mismatched, with some trees having only been checked months or even years prior. Another limitation mentioned earlier is the inclusion of some privately-owned trees. There isn't a clear indicator mentioned of who owns the tree in each ovbservation.

Because of the scope of the data harvested, there may be some inacuraccies. For example, Figure 3 is skewed extremely far to the left due to some enourmous numbers. There isn't a clear way of double cheking whther a dbh of 815 was actually recorded and accurate, which makes any conclusions drawn from DBH potentially inaccurate.

5 Appendix

5.1 Data Cleaning

While cleaning that dataset, some inconsisten values were discovered. A particular species of tree, Salix x sepulcralis, had it's name misspelled in the dataset. This may have come from using special characters that could not be saved onto the dataset, resulting in a garbled name. An additional step was taken to restore the correct botanical name, using the common name as reference. Similarly, one observation did not have a ward location allocated. This was remedied by reading the globval coordinates from geometry, a varaible in the raw data file that shares the latitude and longtitude of the tree individual. Using these coordinates, and the address number, the general location for this tree was determined, along with its ward location. The ward entry for this observataion was updated accordingly.

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