# Documenting the Value of Urban Trees: UW Tacoma Tree Inventory, Map, and Ecosystem Services Analysis

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## Introduction

Trees are an important part of the urban landscape, mitigating air and water pollution, sequestering and storing carbon, providing shade and evaporative cooling, and providing aesthetic and psychological benefits (Roy et al. 2012). There is interest in quantifying the value of these services, and models have been created to do so. i-Tree Eco is one such modeling service, which relies on many different equations that can be found in its user manual (Nowak 2024). Tree inventories are useful tools for the management of an urban forest. The 46-acre UW Tacoma campus lacks such an inventory. Leaders of the campus are planning for growth of the student body and development of land, which places existing trees at risk (University of Washington Tacoma 2025). Creating an accessible tree inventory and assessing the value provided by existing trees helps facilitate well-informed decision making by those in power at our school.

## Data Collection

Data was collected between spring 2024 and winter 2025. Data collection was largely guided by the recommendations of i-Tree Eco.

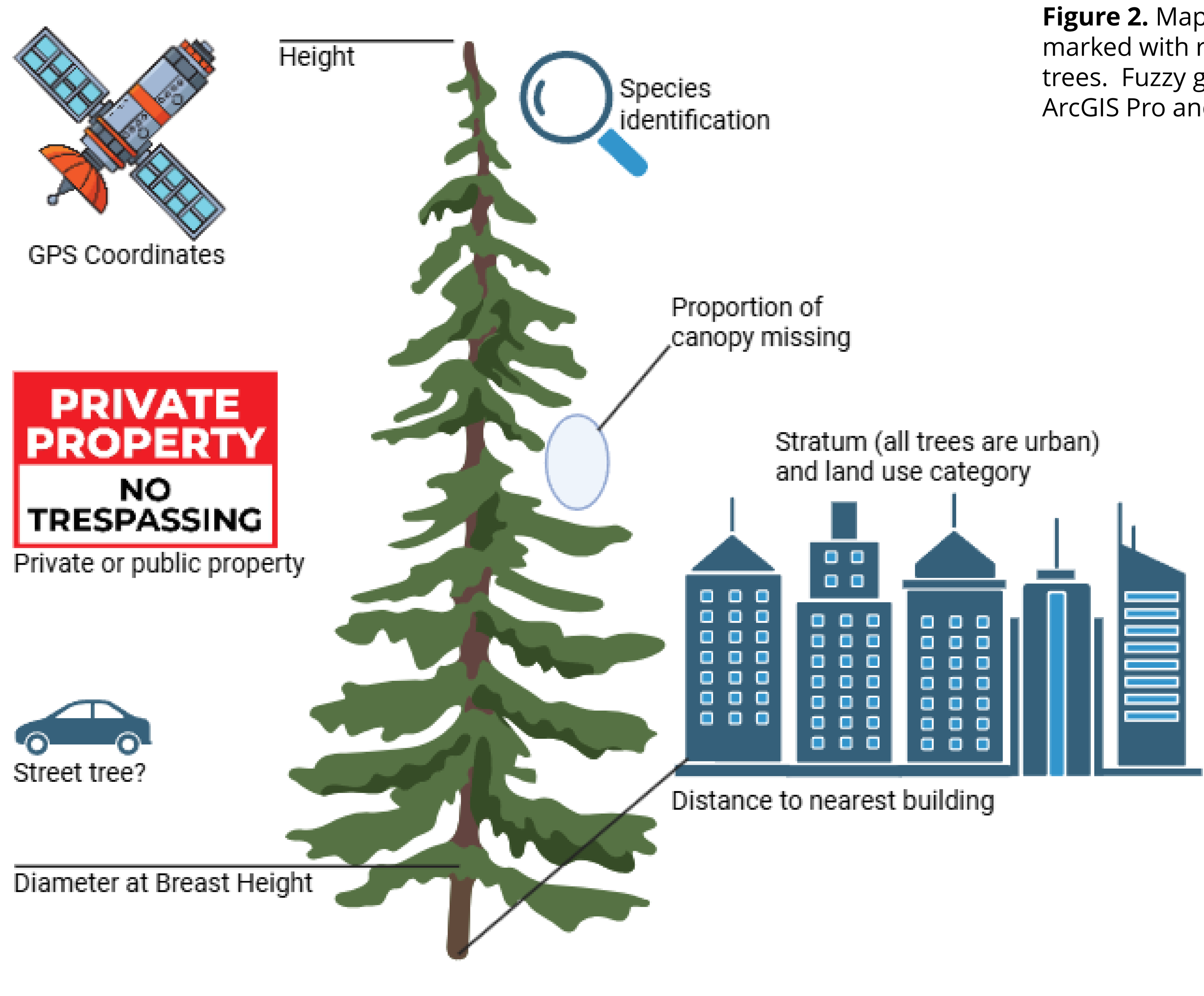


**Figure 1.** Illustration of data collected for every tree in inventory

## Data Processing

ArcGIS Pro

Software created by the company Esri, and used for the visualization, management, and analysis of geographic data. In this project, ArcGIS Pro was used to create a map of all trees on campus, with pop-up boxes displaying data collected for each individual tree.

i-Tree

Software developed in public-private partnership by the United States Forest Service, The Arbor Day Foundation, and others. It models and quantifies ecosystem services provided by sets of trees and the dollar values associated with those services. (itreetools.org)

i-Tree Eco used data from three different air quality monitoring stations in its estimation for air pollution removal. Nitrogen dioxide and PM2.5 data were taken from a monitoring station in Tacoma; carbon monoxide, sulfur dioxide, and PM10 data were taken from a monitoring station in Seattle, and ozone data was taken from a monitoring station in Lacey.

## Results


**Figure 2.** Map showing the distribution of trees on campus. Campus boundaries are marked with red lines. Green dots with black borders mark positions of measured trees. Fuzzy green tree canopy graphics come from World Topographic Map layer in ArcGIS Pro and are not entirely accurate.

Data was gathered for 400 trees, roughly 90% of trees on campus. According to i-Tree Eco, these trees:

- Store an estimated 146.45 metric tons of carbon, with an additional 3.5 tons sequestered annually
- Remove an estimated 45.5 kg of air pollutants per year, with an associated value of $763.
- Intercept an estimated 271 cubic meters of stormwater per year, with an associated value of $640.
- Raise energy costs by $326 for residential buildings
- Have a total replacement value of $678 thousand

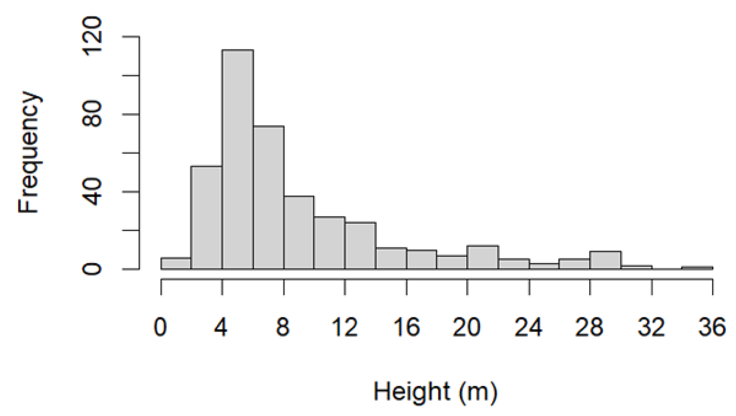


**Figure 3.** Frequency distribution of the heights of the 400 trees measured.

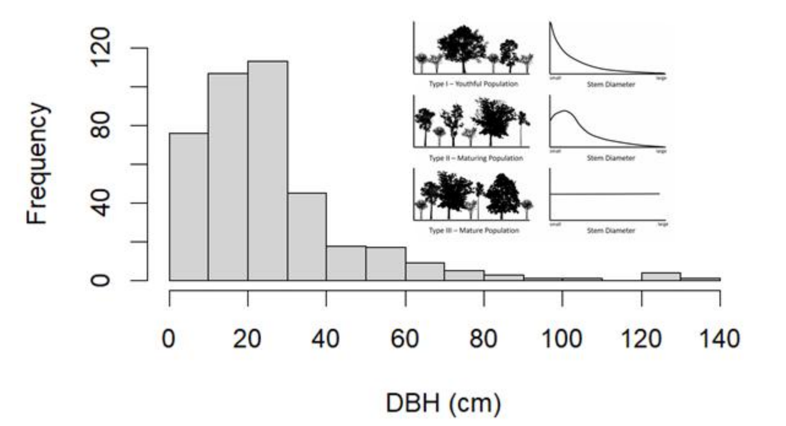


**Figure 4.** Frequency distribution of the diameter at breast height (DBH) of the 400 trees measured. Almost ¾ are under 30 cm in diameter. Inset: DBH distributions of urban forests of progressive maturity (Morgenroth et al. 2020)

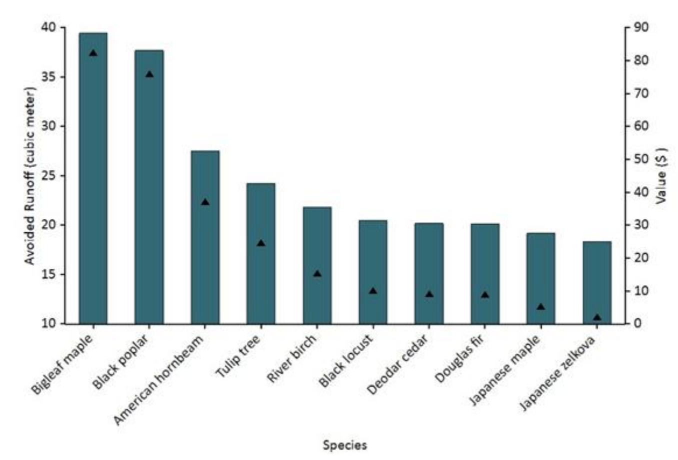


**Figure 5.** Annual avoided runoff (points) and value (bars) for species with greatest overall impact on runoff.

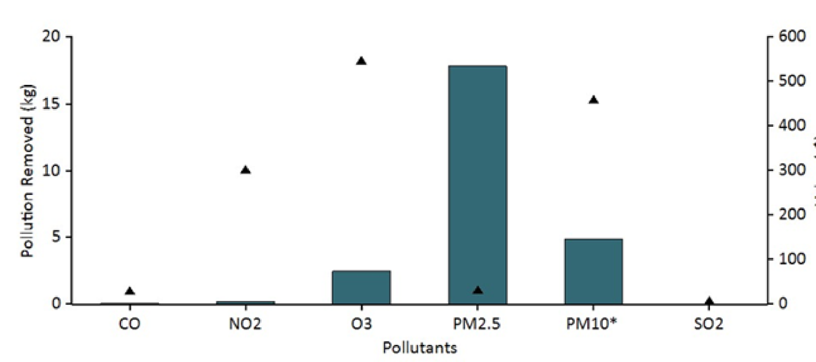


**Figure 6.** Annual air pollution removal (points) and value (bars) by trees included in inventory.

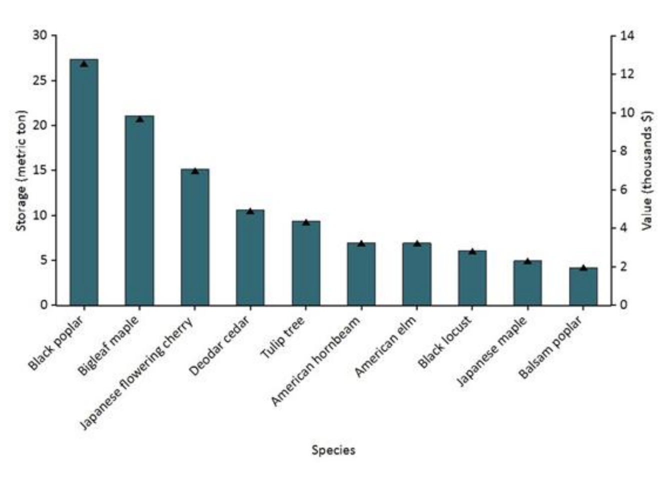


**Figure 7.** Estimated carbon storage (points) and values (bars) for tree species with the greatest storage.

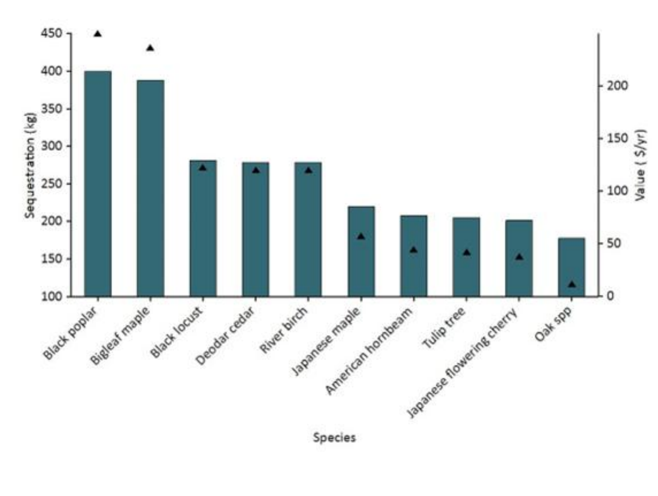


**Figure 8.** Estimated annual gross carbon sequestration (points) and values (bars) for tree species with the greatest sequestration

## Discussion

Replacement values from i-Tree Eco are based on a formula originally prescribed by the Council of Tree and Landscape Appraisers in 1992, found in a paper published in 2002 (Nowak et al. 2002). Based on my own judgement, this formula breaks down for mature trees. According to i-Tree Eco, the 21 m tall coast redwood we have on campus with a DBH of 98 cm has a replacement value of over $14,000. The true cost of transplanting mature trees is exorbitant and the process is carbon-intensive. The price must be assessed on a case-by-case basis by professionals and can run into 7 figures per tree.

The western half of campus is less developed than the eastern half. As seen on the map, the developed half seems to have more trees than the less developed half. It is possible that as the campus develops, with intentional planting, total tree cover will actually increase.

Analysis conducted in 2023 of a tree inventory for the UW Seattle campus showed that trees there store almost 25x as much carbon as trees at UW Tacoma and sequester over 30x as much annually (Hoss 2023). 8,646 trees were included in the Seattle inventory, about 22x the amount included in this inventory. The difference in benefits between the two campuses is greater than the difference in number of trees. This is possibly because the Seattle campus has a greater number of older trees. Hoss' analysis and my own found that more mature trees provide much more benefits than younger ones, outpacing the difference in age, so it is wise to prioritize preserving existing trees during development if at all possible.

Limitations of this project:

- i-Tree Eco does not account for psychological or aesthetic value of trees
- Did not collect data in all fields recommended by i-Tree Eco (canopy dimensions and health)
- Not a truly comprehensive inventory
- Replacement value of trees is not completely accurate

## References

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