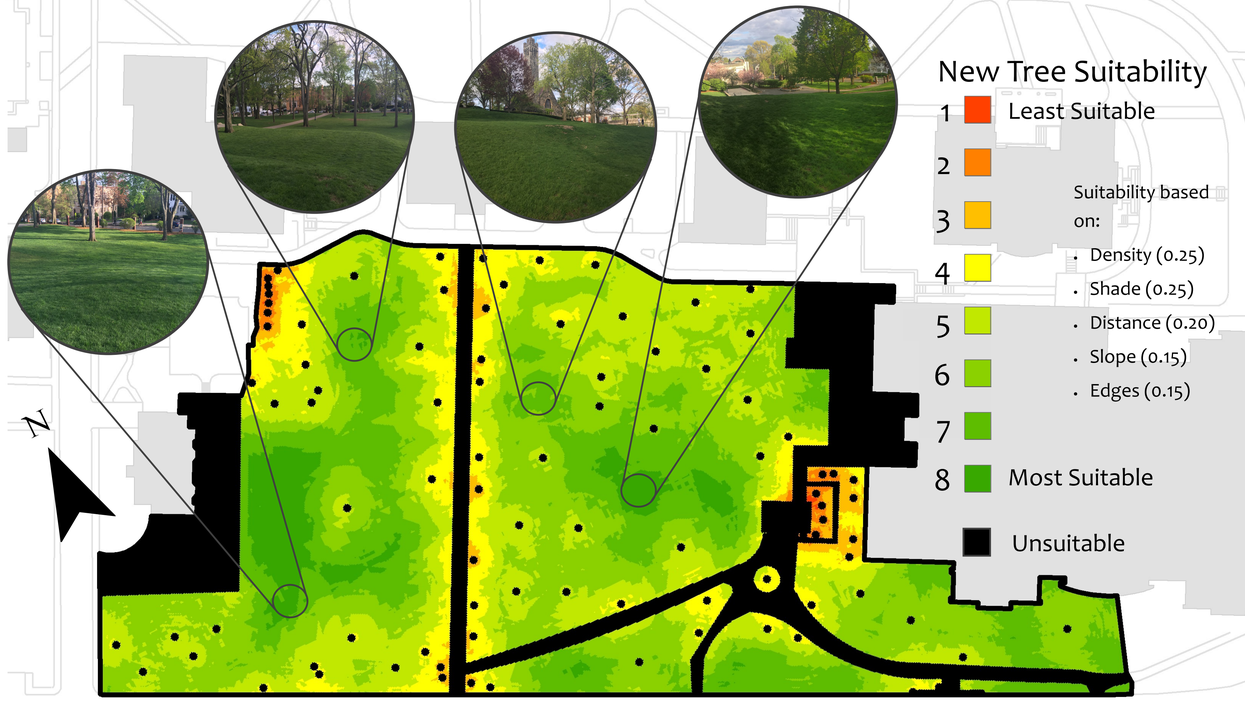
A Tree for Jumbo: Reforesting the Tufts University President's Lawn to Historic Levels



Cartographer: Michael LaScaleia | GIS 101, Intro to GIS | May 9th 2017

Projection: NAD 1983 State Plane Massachusetts Mainland FIPS 2001 (Meters)

Data Sources: Shurcliff, Shurcliff, Merill (1957). *Tree Survey; Tufts University, Medford Massachusetts*, Mass LIDAR, Tufts GIS Server, President's Lawn Tree Survey 2017 - LaScaleia

Images: https://upload.wikimedia.org/wikipedia/commons/4/4c/Ro%C3%9Fkopf_Panorama.jpg

Tufts UNIVERSITY

Introduction

Over the past 60 years, the trees on the President's Lawn on the Tufts University Campus in Medford and Somerville, Massachusetts have undergone significant change. Through the shifting of walkways and the construction of buildings such as the Tisch Library, only 6 of the trees present on the President's Lawn in 1957 remain standing in 2017. Trees, inarguably, play a significant role in the charm of the President's Lawn. They provide shade for students to do work, beautify campus in the fall and spring with vivid colors, and provide a refuge for some of the less common species in New England such as the flowering dogwood (*Cornus florida*) and the catalpa (*Catalpa sp.*).

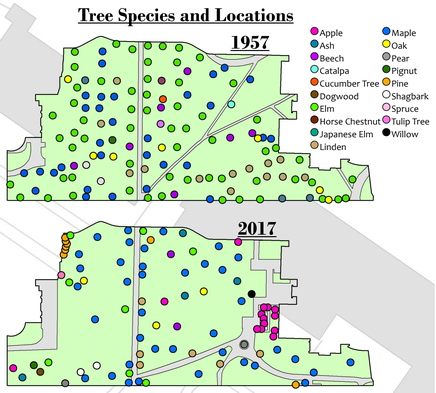
Despite the importance of trees on the Presidents Lawn, the number of trees growing there has declined significantly over the last 60 years. Where in 1957 there were a total of 129 trees within the extent of this study , there are now only 91 (See: *Tree Locations and Species*, 1957 & 2017). Additionally, many of the trees now are confined to spaces inaccessible for resting underneath, such as the pine stand in the North (top left corner) and the apple stand outside of Tisch (center far right). If these trees are excluded, the net number of trees lost ***on*** the President's Lawn since 1957 rises to 55. Furthermore, the density of trees on the Presidents lawn has also dropped dramatically over the last 60 years. In 1957 the President's lawn had a density of 58 trees per hectare, while now it has only 39. Additionally, the densest areas of trees have moved away from the center of the President's Lawn and towards the edges, creating less shade and more bare patches of land (See: *Tree Density*, 1957 & 2017).

Finally, a total of 5 species have been lost from the President's Lawn since 1957, while another 7 have been added (See: *Tree Species Change*). The Shannon Diversity of trees, a metric measuring diversity of tree species, has risen from 2.28 to 2.82. While this small rise in diversity is nice, it comes from the loss of the majority of the President's Lawn's elms, which dominated the areas in 1957. A diverse set of trees is one of Tufts Campus's proud boasting points, and the President's Lawn should be a reflection of this sentiment.

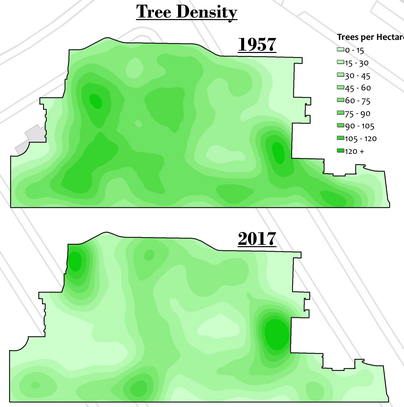
Tree Species Change

Species	1957	2017
Apple	0	14
Ash	3	0
Beech	7	2
Catalpa	1	0
Cucumber Tree	1	0
Dogwood	0	1
Elm	61	8
Horse Chestnut	1	0
Japanese Elm	0	4
Linden	13	6
Maple	31	38
Oak	7	3
Pear	0	2
Pignut	1	1
Pine	0	8
Shagbark	2	2
Spruce	0	1
Tulip Tree	1	0
Willow	0	1
Total	129	91

Tree Species and Locations



Tree Density



Methods

Data Collection: I employed two methods to collect the tree data for this project. The 1957 data comes from a map by Shurcliff, Shurcliff, and Merill entitled "Tree Survey; Tufts University, Medford Massachusetts." I scanned this map, then georeferenced the points based on the current Tufts building footprints. I added data for tree species, which was present on the map, to the point layer. For the 2017 trees, I conducted a field study using the Survey123 app, and recorded location, species, and diameter at chest height (DCH) in inches for all current trees within the study extent.

Rasters: I created six rasters to make the larger map shown above. All data is from 2017 unless otherwise noted. "Density" is the unweighted kernel density of the tree point data. "Slope" was created from the Mass LIDAR elevation data by applying the slope tool in ArcMap. Additionally, I used the aggregate tool to merge every 4 cells to eliminate strange lattices that appeared in the slope data. "Distance" is a raster of the Euclidian distance from any tree. To create "Shade," I created 3D buffers around each tree based on 1/2 their DCH in meters, getting their rough canopy size. I then used the sun shadow volume tool to project shadows for the trees on June 21st, 2017 every 1/2 hour from 11:00 AM to 1:00 PM. Next, I took the footprints of these shadows and dissolved them based on the tree they came from. I then used union, then dissolve by shape area and perimeter to get the total number of unique tree shadows that cover a given area between the hours of 11:00AM and 1:00PM. "Extent" is the Euclidian distance from walkways, buildings, and the edge of the President's Lawn. I reclassified all rasters to a 1 - 9 grouped scale. I also created a raster called "Eligibility," which had a value of "0" if zero meters from a walkway or <1 meter from a tree, and "1" if anywhere else. Finally, to create the map above, I used the equation (Eligibility) * ((Density * 0.25) + (Shade * 0.25) + (Distance * 0.20) + (Slope * 0.15) + (Edges * 0.15)). Any value <1 was deemed ineligible, and the rest were reclassified rounding down. This process produced the map above.

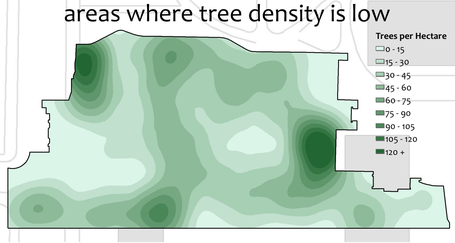
Conclusion

Using this method, I managed to identify 841 square meters of area in the presidents lawn that has optimal characteristics of all of the applied metrics for new tree growth. From President Monaco's backyard to the steps up to Tisch, these patches appear all over the President's Lawn. As expected, the areas that are already planted densely with trees, such as the stand of pines in the top left and the apples on the right, are very poor areas for planting new trees.

After ground-truthing the results of this study, I have pulled out the four areas that believe are best suited for new trees. Pictures are described from in order left to right. The first area is on the edge of the flat area behind the President's House. This area is flat and open, and the area in the highlight would not interfere with the regular events held there. The second area is on a terrace high on the Lawn with little cover, and would be well suited for a tree that could tower over lower campus. The third area is near the location of the massive copper beech which was removed in 2015; it is sorely in need of a new tree. The final location is on another terrace that gets more sun than anywhere on the president's Lawn and looks over Tisch Library. In addition to these locations, I believe it is possible to use this map to replant the 55 trees lost over the last 60 years, and reforest the Tufts President's Lawn.

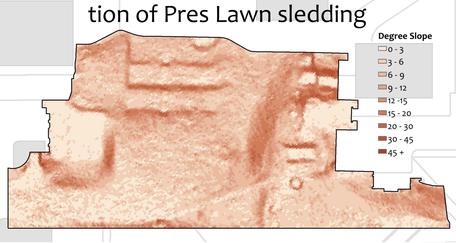
Density

In order to fill in the gaps in the President's Lawn, trees should be planted in areas where tree density is low



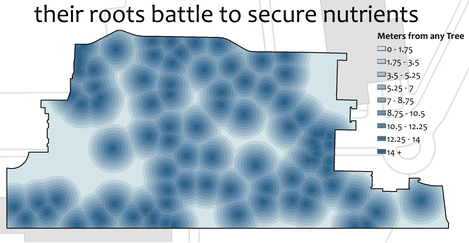
Slope

Trees grow poorly on steep slopes, and, if planted there, inhibit the student tradition of Pres Lawn sledding



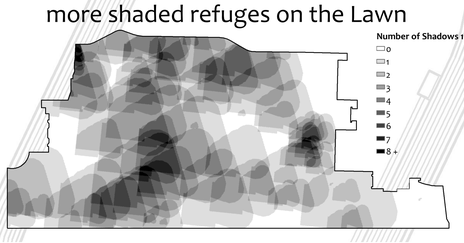
Distance

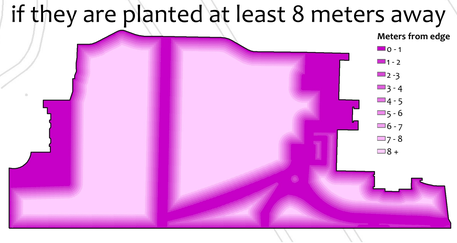
When planted too close together, trees' canopies can compete for sunlight, while their roots battle to secure nutrients



Shade

Planting trees in areas of high sunlight both helps their growth and provides more shaded refuges on the Lawn



Edges

Over time, tree roots can dramatically damage walkways and buildings; it is best if they are planted at least 8 meters away