The Effects of Native Tree Species on Ambient Air and Surface Temperatures in Michigan

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Abstract

Gathering data is essential when developing strategies to improve our understanding of the impact urban trees potentially have in helping to mitigate the urban heat island effect. The GLOBE Observer App for trees was used to obtain tree height and circumference and a Pasco weather station was used to record weather data. All of the data was entered through the GLOBE data entry portal. Preliminary analysis showed that of the trees sampled, basswoods (*Tilia americana*) had the largest ability to reduce surface and air temperatures while the red maples (*Acer rubrum*) appeared to have a smaller effect. Concluding that planting a greater proportion of basswoods in urban plantings might help to mitigate the warming effect that many anthropogenic structures and surfaces have in cities. The urban heat island effect continuously increases as humanity evolves. By understanding which native tree species are the most suitable for reducing the urban heat effect, creating a comfortable environment for today's and future generations. Although most trees have the ability to reduce temperatures, this research sought to determine if some native tree species were a better choice than others. Further research must be conducted to evaluate other native tree species suitable for city plantings.

Research Question(s)

•How do different native tree species affect air and surface temperatures?
•Which native tree species planted in urban areas are most effective at reducing urban temperatures during the summer? Which tree is the least effective?
• Does overall tree form and leaf shape affect the ability of a tree to reduce temperatures?
These driving questions were used to focus and lead our investigation seeking to find optimal solutions for choosing trees to help mitigate urban heating.

Null Hypotheses

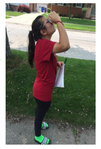
- Tree height and circumference have no effect on surface and air temperatures.
- Different tree species have no difference in their ability to modify air and surface temperatures.
- The shape of specific leaves on different native tree species does not affect cooling temperatures.

Methods

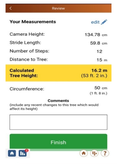
Set up a PASCO device, connect it to sparkvue application, and let it run for ten minutes.

Take 9 recording of surface data both under the canopy and in the sun

Collect the DBH of the trees from the breast of the tree 1.37 meters from the base



Measure height using a suunto clinometer three times per partner



Measure the height using the globe observer app and submit into the GLOBE database.

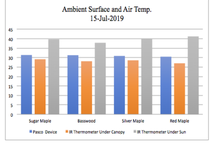


Figure out average temperatures from the infrared thermometer and PASCO weather device and graph the data.

Measurement Limitations

Due to the fact that the trees suitable to the research were clustered together, but there weren't too many trees other than those it was difficult to look through the trees in order to get the exact point. When choosing to use the GLOBE observer app, it seemed to be off to the averaged measurements as well as achieving measurement from both partners didn't prove to be feasible since when it was attempted only one member gained accurate results.

Discussion

All of the trees provided a significant difference, there were trees that performed better than others. The Tilia Americana had the largest effect on the temperatures with an average change of 10.3 degrees Celsius when using a PASCO weather device and a 12.1 degree Celsius difference when using an infrared thermometer. Although the data collected by the PASCO weather device was taken for a total of ten consecutive minutes per tree, and started at solar noon, the difference in the time from the first tree analyzed and the last tree analyzed. When taking tree heights, since it was approaching winter it became more difficult to measure tree heights easily. The clinometers were also not at the highest accuracy, and even though there were two partners measuring the trees, there could have been difficulties getting precise readings. A research study stated that the larger trees with a higher canopy volume tended to show an decrease in soil temperatures (Mohammad A. Rahman, Astrid Moser, Anna Gold, Thomas Rötzer, Stephan Pauleit). Compared to the data, although the largest tree didn't have the greatest effect, it was shown that the red maple, which was the smallest, performed worst. The results supported one of our hypotheses as the smaller trees would be the worst at providing cooling against the urban heat island effect.

Measurement Implications

By going through with this investigation it is possible to view which trees perform to the highest of their ability in reducing the urban heat island effect. With knowing this information, trees of these specific species could be planted to become more populated so that the urban heat effect can be reduced best as possible. In continuing this research, the required conditions for each tree can be greater to increase accuracy of the experiment in different types of climates as well as working with students from the Princess Chulabhorn Science High School in Thailand to also spread the research into a wider area of study.

Results

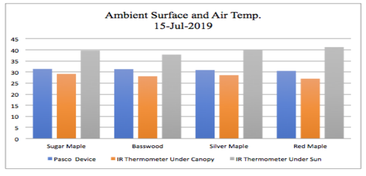


Figure 1: Figure one visualized the data taken on July 15, 2019. It showed that the Red Maple had the largest effect while.

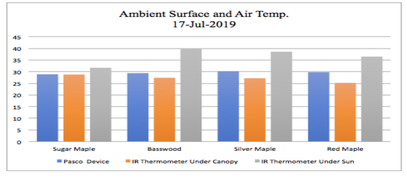


Figure 2: Figure two showed the Basswood had the greatest effect while only having a 2 day difference from Figure 1.

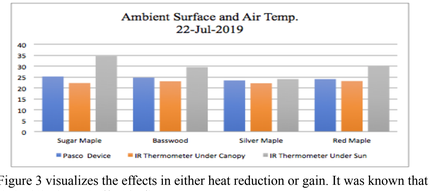


Figure 3: Figure 3 visualizes the effects in either heat reduction or gain. It was known that Sugar Maple had the largest affect in figure 3.

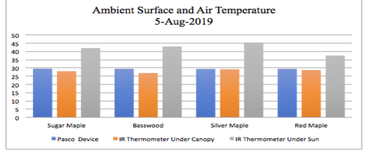
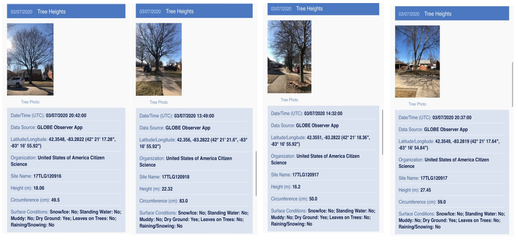


Figure 4: All data was consecutively collected through the PASCO device and Auto-Pro Raytek IR Thermometer. Basswood had the largest affect in figure 4.



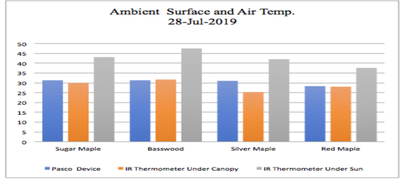


Figure 5: In figure 5, as it was one of the coolest it was shown that the tree having the most effect was Sugar Maple, creating the correlation that the taller in height the tree the larger the change in surface and air temperature when weather is cooler.

Conclusion

Through further analysis of the data, it was figured that the *Tilia Americana* tree species provided the largest effect on cooling with an average cooling of 11.214 degrees Celsius between surface temperatures and air temperatures taken by the PASCO wireless weather device. The *Acer rubrum* provided the least cooling with an average of 9.161 degrees Celsius. The *Acer saccharum* provided an average of a 9.74 degree Celsius cool down while the *Acer saccharinum* provided an average of 10.295 degrees Celsius. To follow up this research, a plan could be taken into effect to plant more of the *Tilia Americana* tree species in order to further reduce the effect of urban heating and increase cooling provided by the trees. In the future, it is planned to continue this research, but gathering more air and surface temperatures as well as using new methods with the current ones.

Bibliography

Loughner, Christopher P. "Roles of Urban Tree Canopy and Buildings in Urban Heat Island Effects: Parameterization and Preliminary Results." *Roles of Urban Tree Canopy and Buildings in Urban Heat Island Effects: Parameterization and Preliminary Results: Journal of Applied Meteorology and Climatology: Vol 51, No 10*, journals.ametsoc.org/doi/full/10.1175/JAMC-D-11-0228.1.

What Tree Is That? Online. (n.d.). Retrieved from http://www.arborday.org/trees/whattree/whatTree.cfm?ItemID=E6A

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