Analyzing Relationships Between Tree Coverage and Surface Temperature at Five School Canopies in Dearborn Heights, Michigan.

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Abstract

Urban tree canopies play a critical role in moderating temperatures and enhancing environmental sustainability. This GLOBE research study investigates the relationship between tree characteristics—species diversity, size (DBH and height), crown width, and Photosynthetically Active Radiation (PAR)—and temperature regulation across five school sites in the Crestwood School District. The study aimed to determine whether these factors significantly impact air and surface temperatures, with the null hypothesis stating that tree characteristics have no measurable effect on temperature reduction. Data collection followed GLOBE protocols, utilizing forestry DBH tapes, the GLOBE Observer app, infrared thermometers, and Vernier probes to measure tree dimensions, temperature variations, and light availability. Multiple readings were recorded at each site to ensure data accuracy. Statistical analyses, including correlation studies and regression models, were used to assess the relationships between tree characteristics and temperature differences.

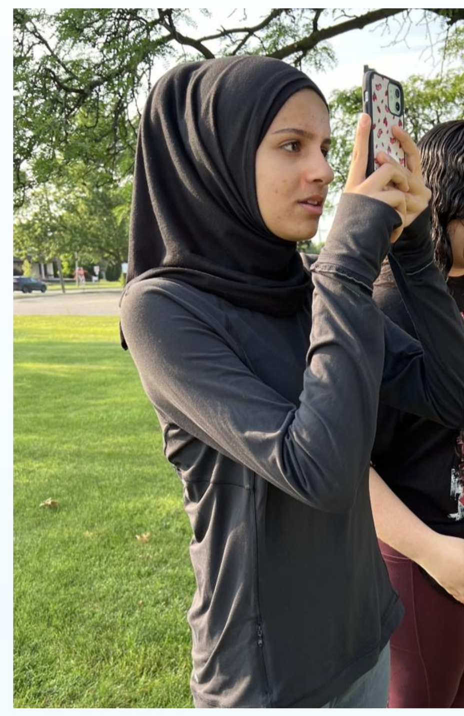
Results indicated that areas with greater tree coverage exhibited lower surface temperatures, and trees with larger crowns contributed more significantly to cooling effects. However, correlations between tree height, DBH, and temperature reduction were weak, suggesting additional environmental factors influence temperature moderation. Similarly, weak correlations between PAR and crown width suggest that species composition and canopy density may play a larger role in light absorption. These findings led to the rejection of the null hypothesis, confirming that tree diversity, size, and canopy coverage contribute to urban heat mitigation.

This research supports the importance of urban forests in reducing the urban heat island effect and improving climate resilience. By integrating tree planting strategies into urban planning, communities can create cooler, more sustainable environments. Future studies should consider additional factors such as seasonal variations, soil composition, and long-term climate impacts to refine strategies for maximizing the benefits of urban canopies.

Discussion

This study confirms that urban tree canopies significantly mitigate the urban heat island effect, as demonstrated through data collection on tree species diversity, size (DBH and height), crown width, and coverage, alongside air and surface temperature measurements. The results showed a clear correlation between greater tree coverage and lower temperatures, disproving the null hypothesis that tree characteristics would have no significant impact on temperature regulation. If repeated, improvements such as integrating LiDAR and drone technology for precise canopy mapping would enhance measurement accuracy and minimize human error. Expanding data collection across seasons would provide a more comprehensive understanding of long-term cooling effects, while increasing the sample size across diverse urban environments would improve the generalizability of results. Comparisons with prior research reinforce these findings. Nowak et al. (2017) demonstrated that urban trees play a critical role in temperature regulation and air quality improvement, aligning with this study's conclusions. Similarly, research conducted by Crestwood High School students Itidal Bazzi and Zeina Jebara found that native tree species in Southeastern Michigan effectively reduce surface and ambient air temperatures, further supporting the observed cooling effects. These findings extend beyond the classroom, emphasizing the necessity of strategic green infrastructure in urban planning to combat rising temperatures and improve public health. Future studies could explore the interactions between tree density, soil composition, and water availability to optimize urban canopy effectiveness. By refining data collection methods and expanding research parameters, this study contributes to the advancement of

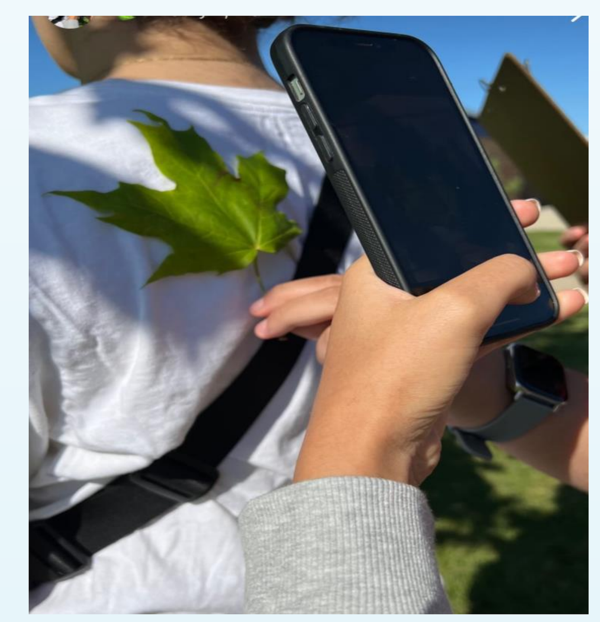
Methodology



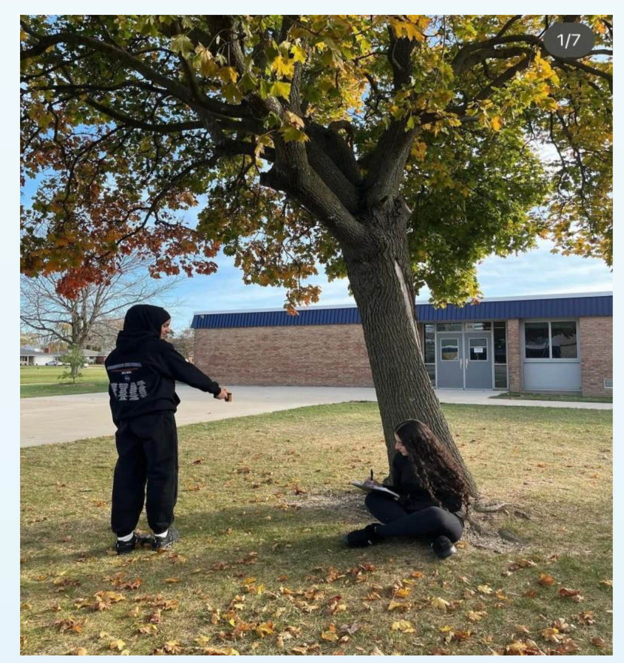
Student researcher gathering Tree height data using the GLOBE APP

Student Researches making use of their equipment, collaborating to gather DBH, tree characteristics data.

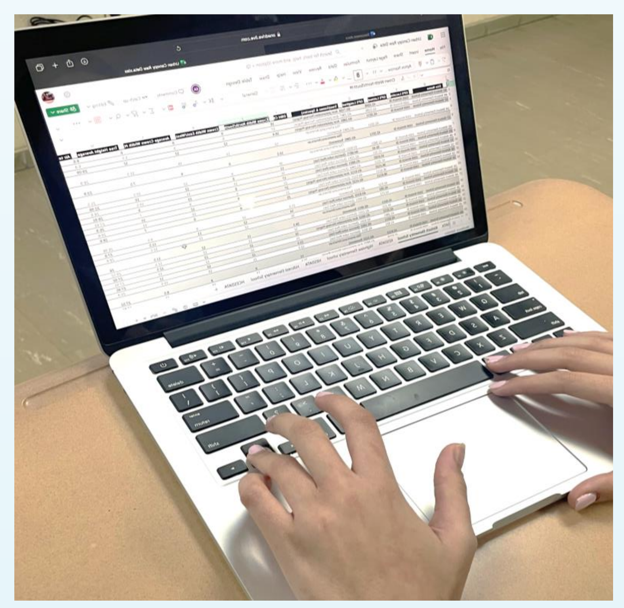
Student Researchers working together and evaluating PAR value.



Student researcher taking images of leafs on leaf snap, working to identify tree species.

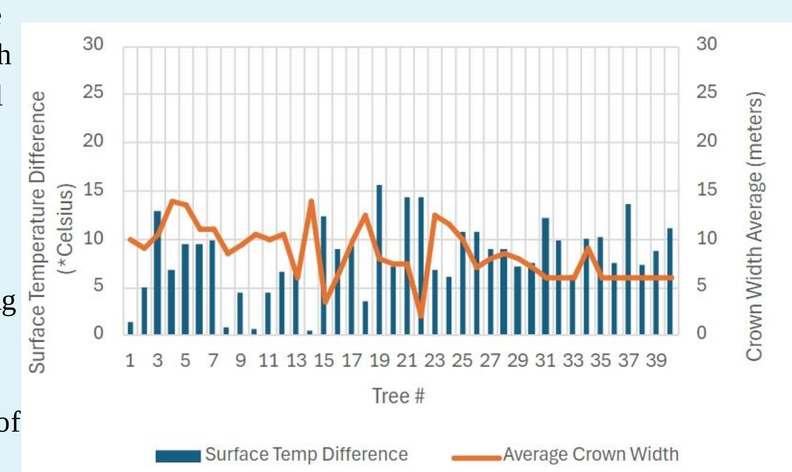


Student researchers analyzing their data at a research cite.

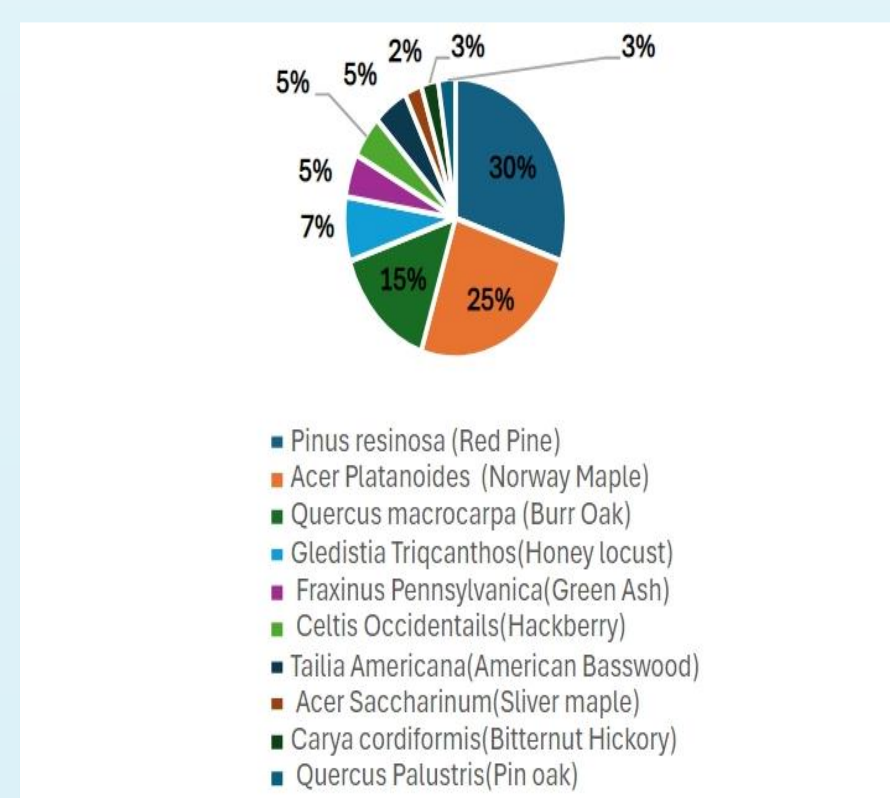


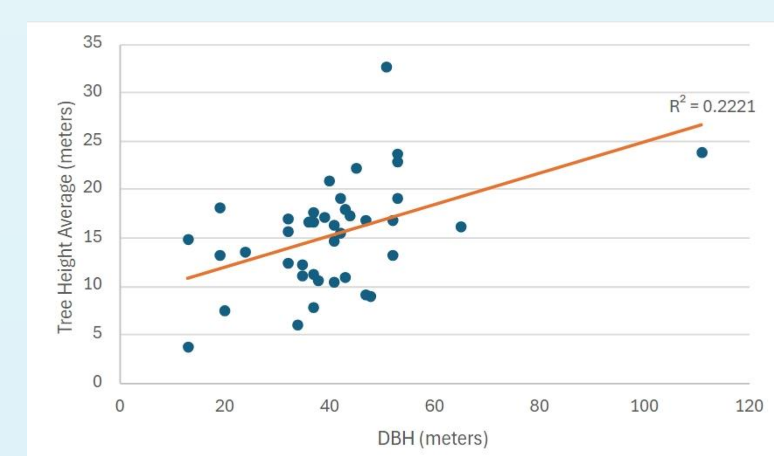
Student researcher inputting data into an Excel sheet

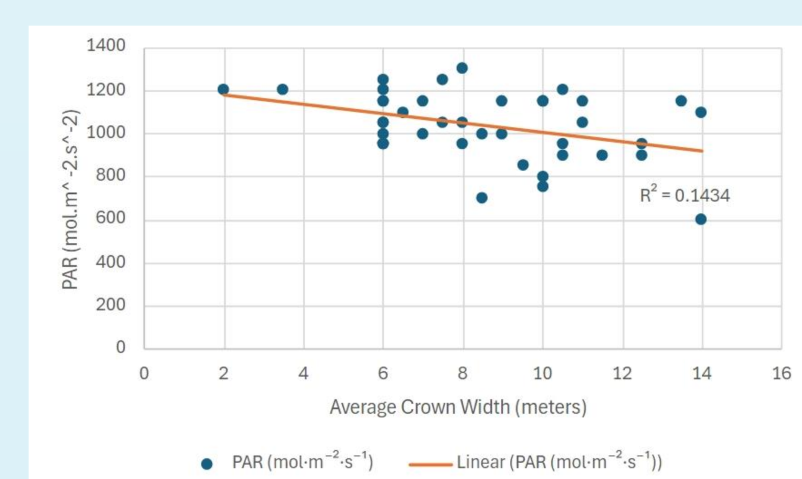
Results



Row Labels	Count of Tree(Genus & Species)
Pinus resinosa (Red Pine)	12
Acer Platanoides (Norway Maple)	10
Quercus macrocarpa (Burr Oak)	6
Gledistia Triqcanthos(Honey locust)	3
Fraxinus Pennsylvanica(Green Ash)	2
Celtis Occidentails(Hackberry)	2
Tailia Americana(American Basswood)	2
Acer Saccharinum(Sliver maple)	1
Carya cordiformis(Bitternut Hickory)	1
Quercus Palustris(Pin oak)	1
(blank)	
Grand Total	**40**







Conclusion

Understanding the vital role of urban trees in environmental sustainability, our research examined their impact within the Crestwood School District, revealing how species diversity, tree size, and canopy coverage influence temperature regulation and air quality. Our findings show that maintaining diverse urban forests significantly mitigates the urban heat island effect, reinforcing the need for strategic urban planning. Crestwood's predominant species—*Pinus resinosa* (Red Pine), *Acer platanoides* (Norway Maple), and *Quercus macrocarpa* (Bur Oak)—exhibited a moderate correlation between tree height and Diameter at Breast Height (DBH), suggesting that taller trees tend to have larger diameters and thus offer greater environmental benefits. In contrast, weaker correlations at Riverside and Kinloch suggest that external factors influence tree growth. Our crown width analysis confirmed that trees with expansive canopies substantially reduced surface temperatures at Crestwood, Riverside, and Kinloch, emphasizing the critical role of urban greenery in mitigating heat stress. Temperature data supported this conclusion, demonstrating significantly lower air and surface temperatures in densely forested areas, while our Photosynthetically Active Radiation (PAR) analysis indicated that species composition and canopy density influence light availability more than crown width alone. These findings disprove our null hypothesis, providing concrete evidence that tree diversity, size, and canopy coverage directly affect urban temperature regulation. Our conclusions align with foundational studies in urban forestry, including Oke's (1982) research on the urban heat island effect and Akbari et al.'s (2001) findings on heat island mitigation, both of which affirm that urban vegetation plays a crucial role in reducing heat retention. Santamour's (1990) principles on tree diversity, Nowak's (2002) insights on the economic and ecological benefits of preserving large trees, and Niinemets' (2010) research on photosynthesis further validate our results, demonstrating that diverse urban forests provide unparalleled environmental advantages. By proving that trees not only enhance air quality but also serve as natural climate regulators, our study underscores the urgent need for policies promoting urban canopy expansion. These results offer a compelling case for data-driven urban planning, ensuring sustainable and resilient cityscapes. Future research should explore additional variables such as soil quality, long-term temperature trends, and species-specific growth patterns to deepen our understanding of urban forestry's role in climate adaptation and environmental resilience.

Acknowledgements

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Citations

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