Modeling water use to achieve 25% canopy cover in Phoenix, Arizona

Central Arizona-Phoenix Long-Term Ecological Research
CAP LTER

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Introduction

- Extreme heat and water scarcity are of serious concern in Phoenix.
- In 2017 alone, 155 people died from heat related ailments in Maricopa County (Fig. 1), but vegetation has been cited as a protective factor against human heat stress in Phoenix and many other cities.

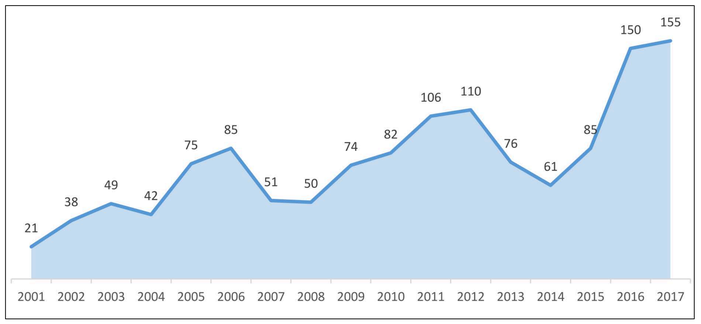

Fig. 1: Heat-associated deaths by year in Maricopa County (Maricopa County Public Health 2018).

- In 2010, the city of Phoenix published their Tree and Shade Master Plan in which they outlined a plan to achieve 25% canopy cover by 2030.
- This many trees would assuredly provide many ecosystem services including heat mitigation, but an immense amount of water would be needed to support the canopy.
- Balancing these tradeoffs is essential as the city moves forward in pursuing this ambitious 25% target.

Question

- How will water use change based on the prioritization of certain trees over others?

Methods and data

- Used the 2010 Survey 200 dataset for genus specific canopy data. Only mature trees (> 6.5m) were used.
- Water: Use It Wisely has a watering guide with seasonal watering estimates for trees based on their canopy size.
- A linear optimization model was used to select the optimal combination of genera to achieve 25% canopy while using the least total water.

Scenarios

- Business as usual: 2010 numbers scaled up to reach 25% canopy.
- Sonoran: Achieve 25% canopy using only trees native to the Sonoran Desert.
- Fewest trees: Achieving 25% canopy with the fewest total number of individual trees.
- Water minimization: Achieving 25% using the least amount of water possible.

Results

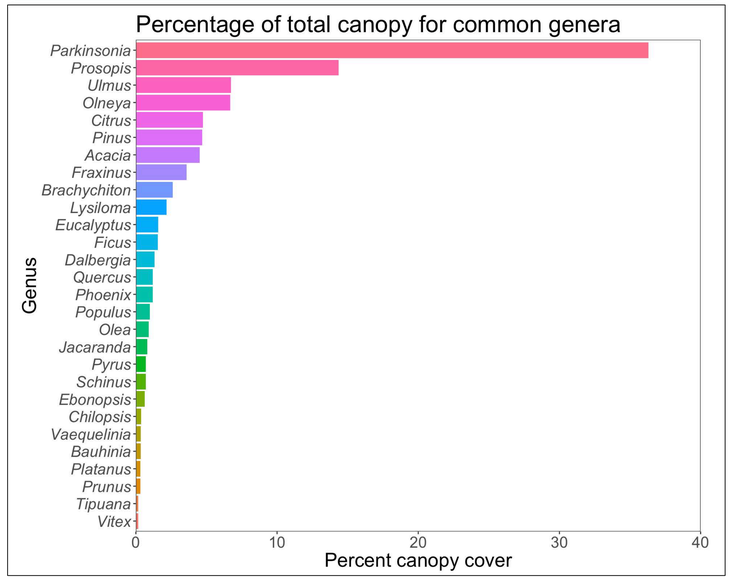

Fig. 2: The state of the tree canopy in 2010. *Parkinsonia* was, by far, the most dominant genus. With all genera taken together, only about 3% of total sampled area was taken up by canopy.

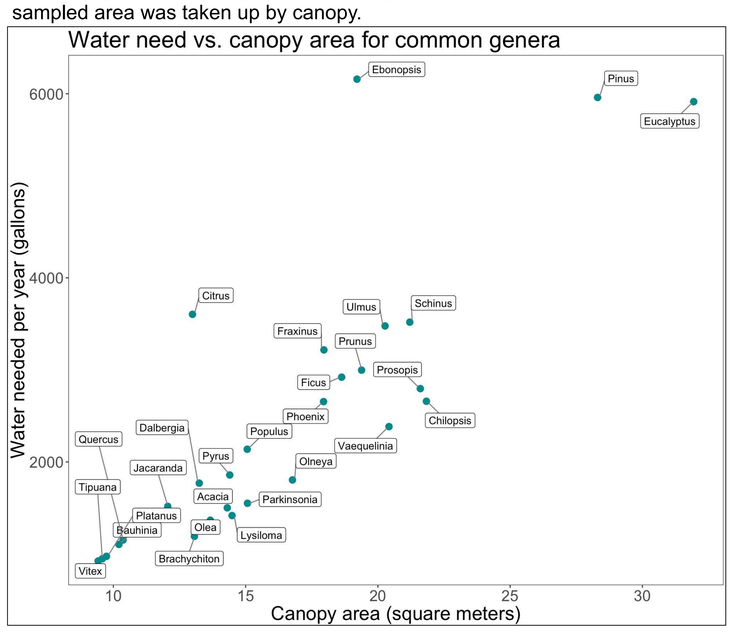

Fig. 3: Trade offs among common genera in the 2010 Phoenix tree canopy. The genus with the highest ratio of canopy area to water need was *Brachychiton*.

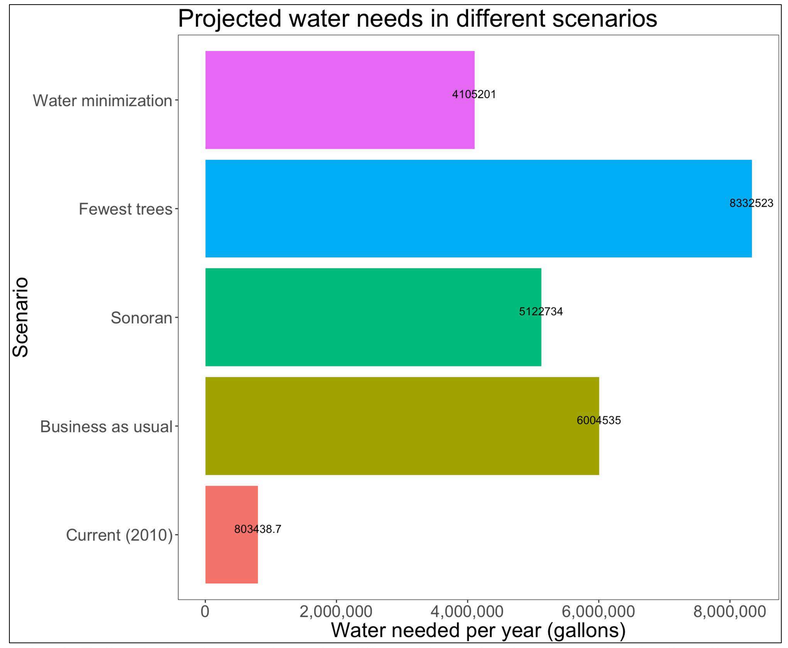

Fig. 4: Estimated water needs under different tree planting scenarios for the city of Phoenix in 2030. The "Fewest trees" scenario required the most water because *Eucalyptus*, the genus with the highest average canopy, is very water intensive.

Conclusions and next steps

- Prioritizing certain trees over others could have massive ramifications in terms of water use. Continuing on a similar trajectory as our past would require considerably more water than if we prioritized trees that are better suited for the environmental conditions here in Phoenix, whether they are native to the Sonoran desert or simply just adapted to arid environments.
- Gather higher quality water use data as well as other physical data, including microclimate regulation and leaf area index to better understand the actual services that the tree canopy provides.
- Other disservices like litter production and necessary maintenance should be taken into consideration.
- Use co-developed scenarios from the Urban Resilience to Extremes Sustainability Research Network.
- This is very much a work in progress – any suggestions are more than welcome!

Acknowledgments

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