Background
Urban heat islands pose a major threat to human and environmental health, requiring city managers to develop strategies to mitigate the effects of excess heat. Urban vegetation is known for mitigating some of these threats by cooling the local surroundings through shade and evapotranspiration. However, choosing the appropriate tree species remains a challenge, as urban planners have little information on species’ cooling capacities (i.e., shade intensity and area, water use).

Objectives
We quantified the species-specific cooling effect of 14 tree species (native and exotic) commonly found in Phoenix, AZ, USA. Specifically:
1) How does plant water loss (stomatal conductance, gsw) and transpiration, Et vary across urban tree species (native vs. exotic)?
2) How did these parameters change from spring to summer, when temperatures regularly exceed 40 °C?

Methods
Research Site: Desert Botanical Garden, Phoenix, AZ, USA
Temporal extent: April–July, 2021. Measurements taken 4–5 days at the end of each month
Sample plants: 14 species chosen based on Maricopa County Urban Tree Selection Criteria list.
- 15-gallon potted plants from local nurseries irrigated daily (once in spring, twice in summer). Four plants per species
Measurements:
- Diurnal gas exchange: porometer (LI6000), and photosynthesis system (LI6400) for small leaves and needles → 4 leaves per plant
- Thermal: thermal IR sensor, FLIR One phone camera
- Weather: nearby HOBO weather station
- Plant traits: LMA, LDWC, thermal damage, canopy area and volume

Results
- Et rates increased 33% from spring to summer, and gsw increased 12%.
- Mean gsw was negatively affected by both VPDleaf and Tleaf. Mean Et kept constant (ns), with exception to negative response to VPDleaf during June/2021.
- Wide range of Et rates reflects different strategies that each species adopt to cope with heat (evaporative cooling vs. stomatal suppression).
- Mean Et and gsw (marginally) were both negatively correlated only to LMA. Relationship to LMA was strongest during the summer months.
- Tdiff became mostly positive in July/2021 after the heatwave, suggesting stomatal closure from hydraulic failure or leaf thermal damage. Highest Tdiff was in June/2021 indicating that stomatal regulation was focused on evaporatively cooling the canopy and surroundings.

Conclusions
- Pirus eldiana, Cupressus arizonica, Chilopsis linearis, Searis lancea, and Fraxinus velutina were the most "cooling efficient" trees for Phoenix landscaping → provide intermediate-full shade across seasons, relative to water use under and conditions.
- Highly drought-tolerant plants used the most water and partially dropped leaves during the summer (Quercus, Parkinsonia, and Prosopis).
- In progress: NDVI variation across seasons and species; leaf water use upscaled to whole-canopy.

Acknowledgements
This presentation contains partial findings from Kalika Naylor’s undergraduate thesis entitled ‘Water use of desert urban tree species across seasons’ (defended on 6 Dec 2021).
- Research funding: ASU SESE Education Postdoctoral Fellowship awarded to Dr. Aparecido.
- Student scholarships awarded through ASU NSF WISEO (Western Alliance to Extend Student Opportunities).
- Special thanks for the support given by the Desert Botanical Garden, Throop lab, Das lab and Hultine lab.

© Next steps: I will be starting my lab as an Assistant Professor at Univ of Utah in July 2023. Please reach out if you are interested in collaborating in future projects related to this work.