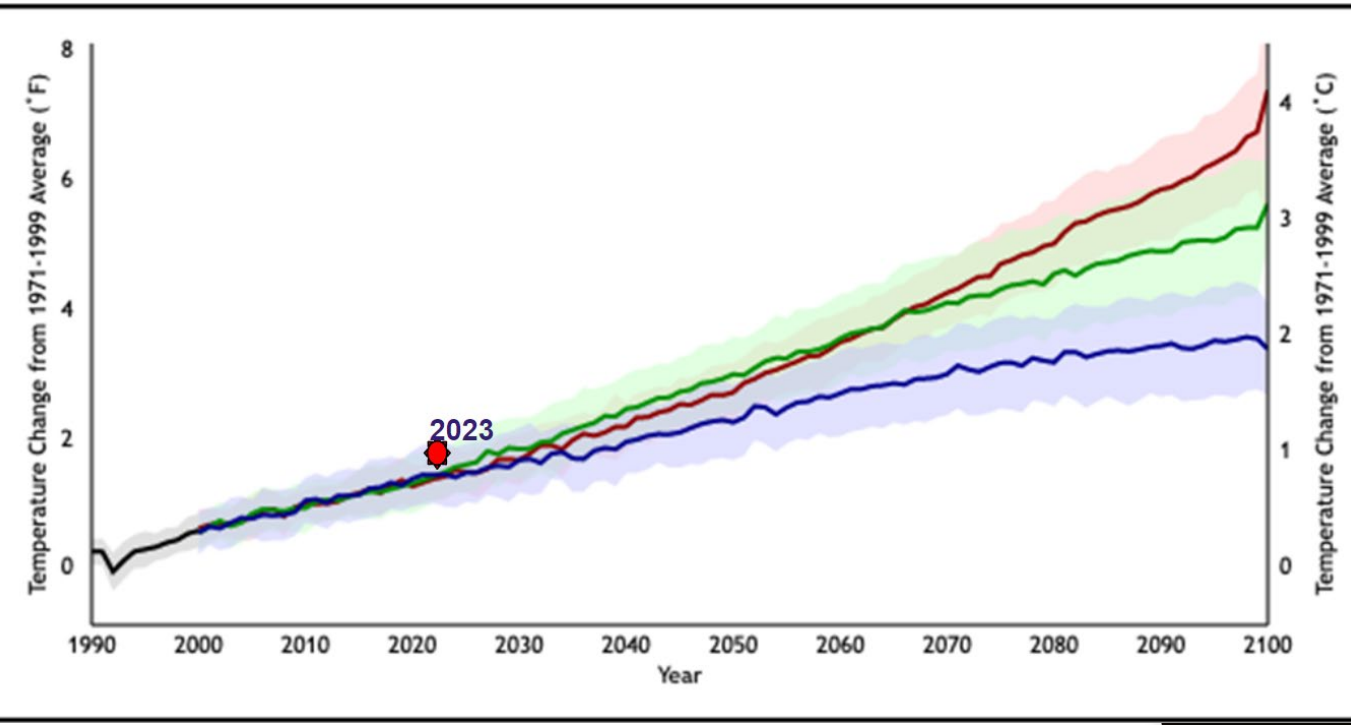
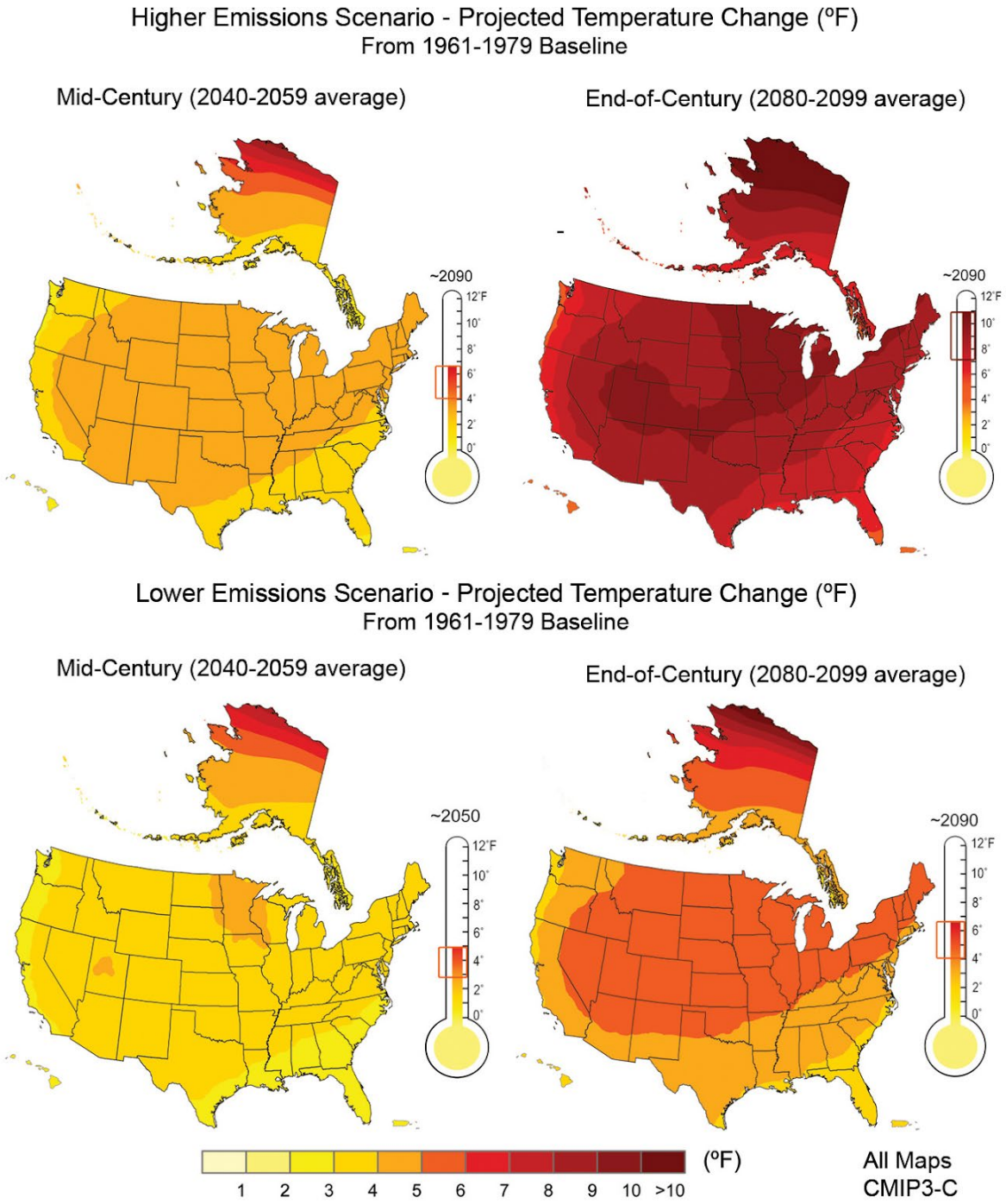
Exploring the Impact of Global Warming and Land Use on Seed Germination and Occurrence: A Case Study of *Rosa multiflora*

Aruni Kadawatha, Case Western Reserve University, Cleveland, Ohio

Global Warming



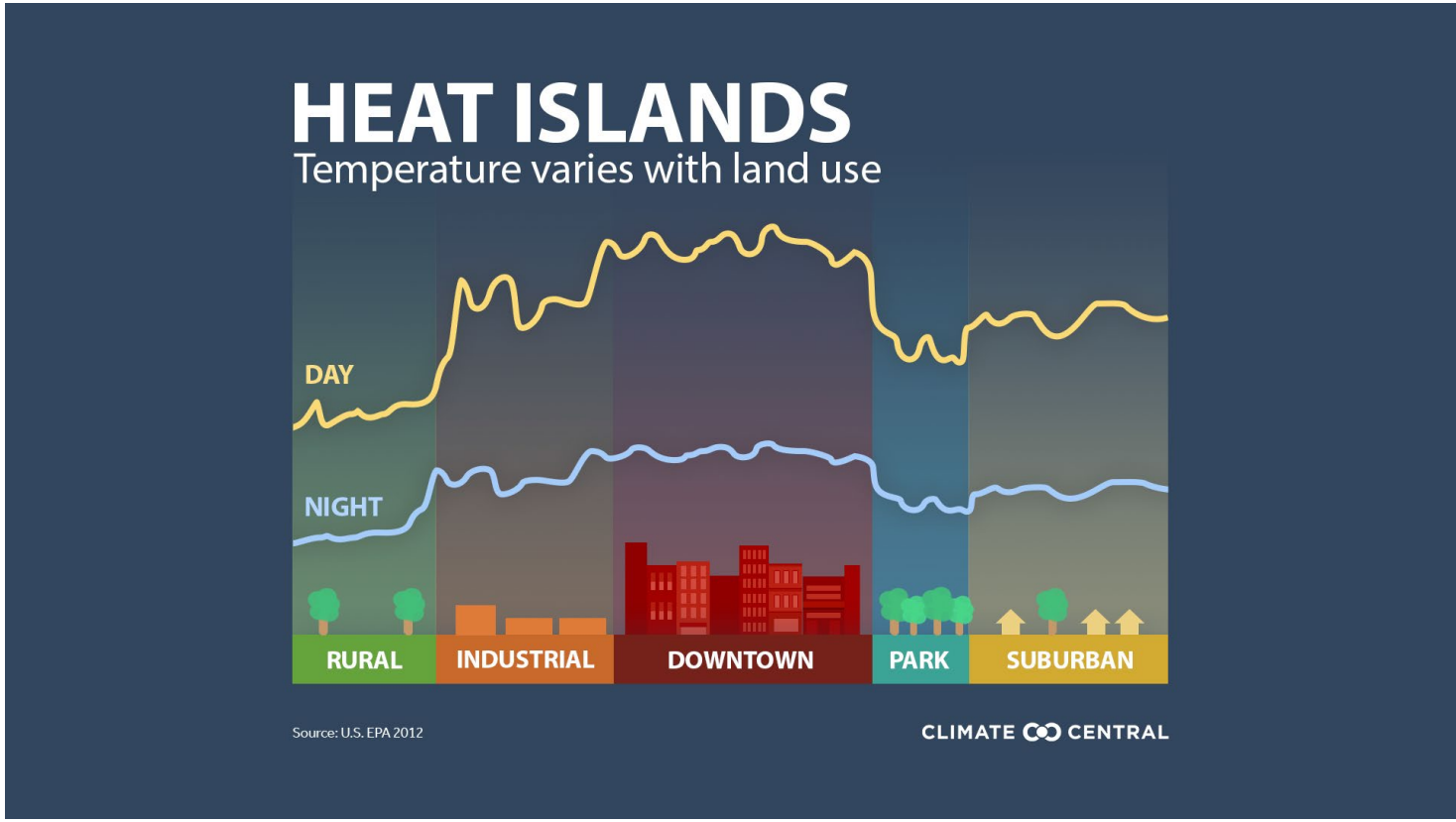


Land Use Changes

- Human activities transforming landscapes at a high rate
- Reasons: Urbanization

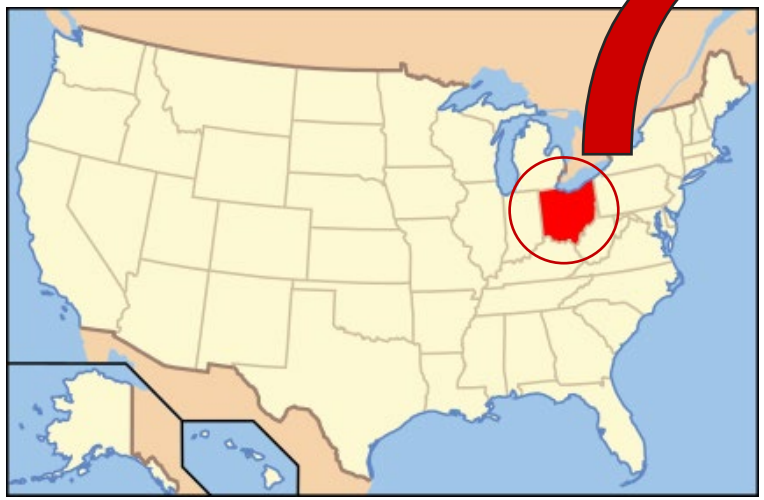
  Deforestation

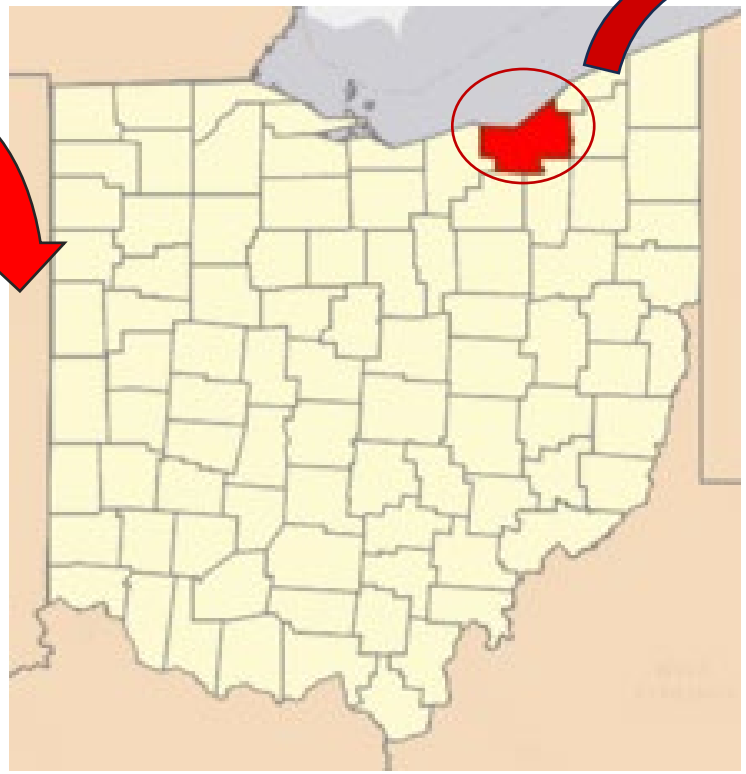
  Agricultural Expansion
- **Consequences?**
  - Advanced/delayed phenology
  - Isolated populations
  - Range shifts

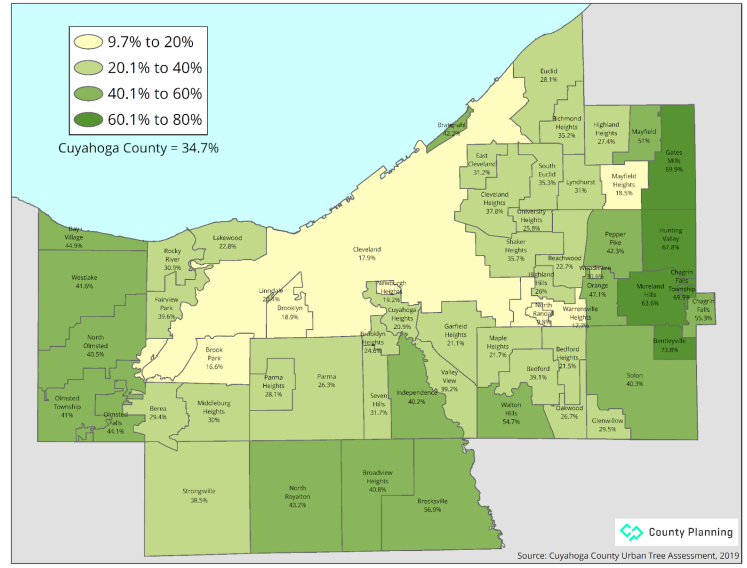


Case Study: Cuyahoga County, Ohio

- Dynamic Landscape: From forests and natural areas to farms and urban development
- Helps to analyze how diverse land uses affect ecological processes such as invasions
- Extensive data collection in the county



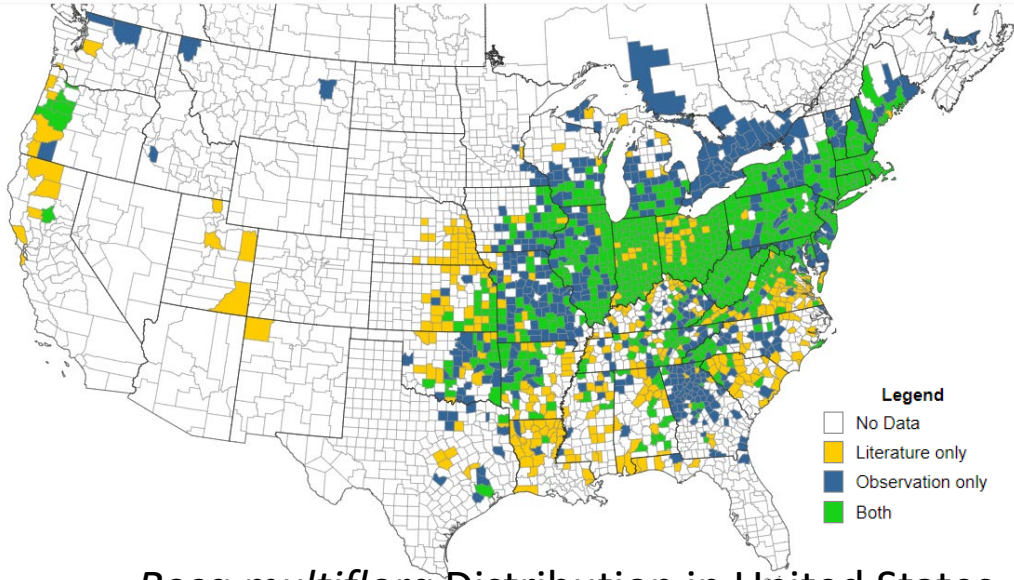




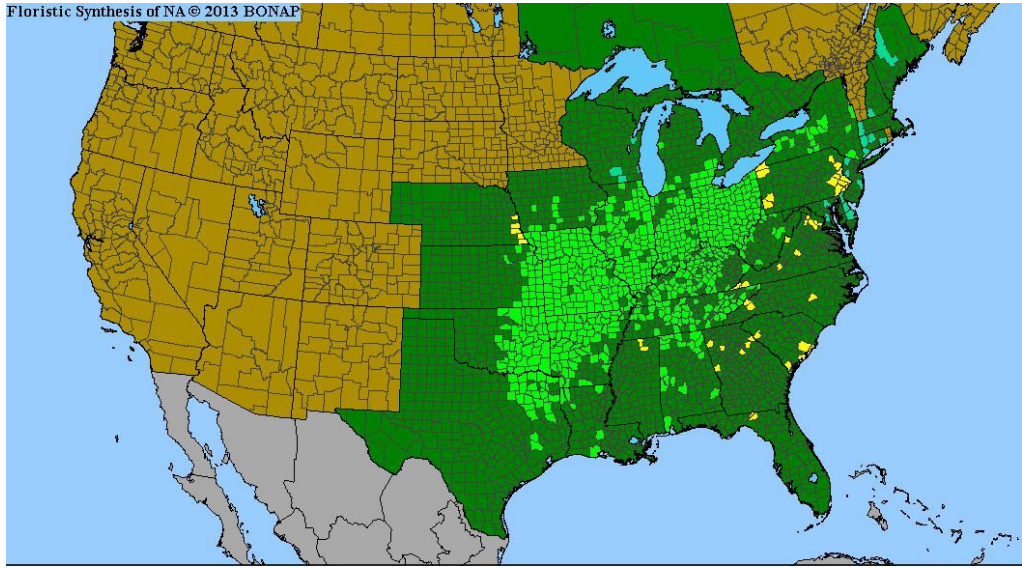
Source: Data-Cuyahoga County 2017 Tree Canopy Assessment

Study Species

- Two species for comparison
  - *Rosa multiflora* -Invader
  - *Rosa setigera*- Native



Rosa multiflora Distribution in United States
© EDDMaps



Present in state
Present and rare, native in county
Present in county and native
Previously present, now locally extinct

Rosa setigera Distribution in United States
© Prairie moon nursery

Problem Statement

Given the projected rise in global temperatures and dynamic land-use aspects, this study investigates whether the invasive *Rosa multiflora* exhibits an advantage in seed germination and occurrence success compared to the native *Rosa setigera*.

Methodology

PART 1: Seed Germination at Growth Chamber Experiment

- Seeds from two species
  - *Rosa multiflora*
  - *Rosa setigera*
- Cold Stratification
- Two experimental late-spring temperatures

  Control (Current)- 16.67^{0}C

  Treatment /2100 – 19.67 ^{0}C
- 10 seeds per pot
- Count germinated seeds in each treatment over two months
- Analysis of Data using R (4.2.2)

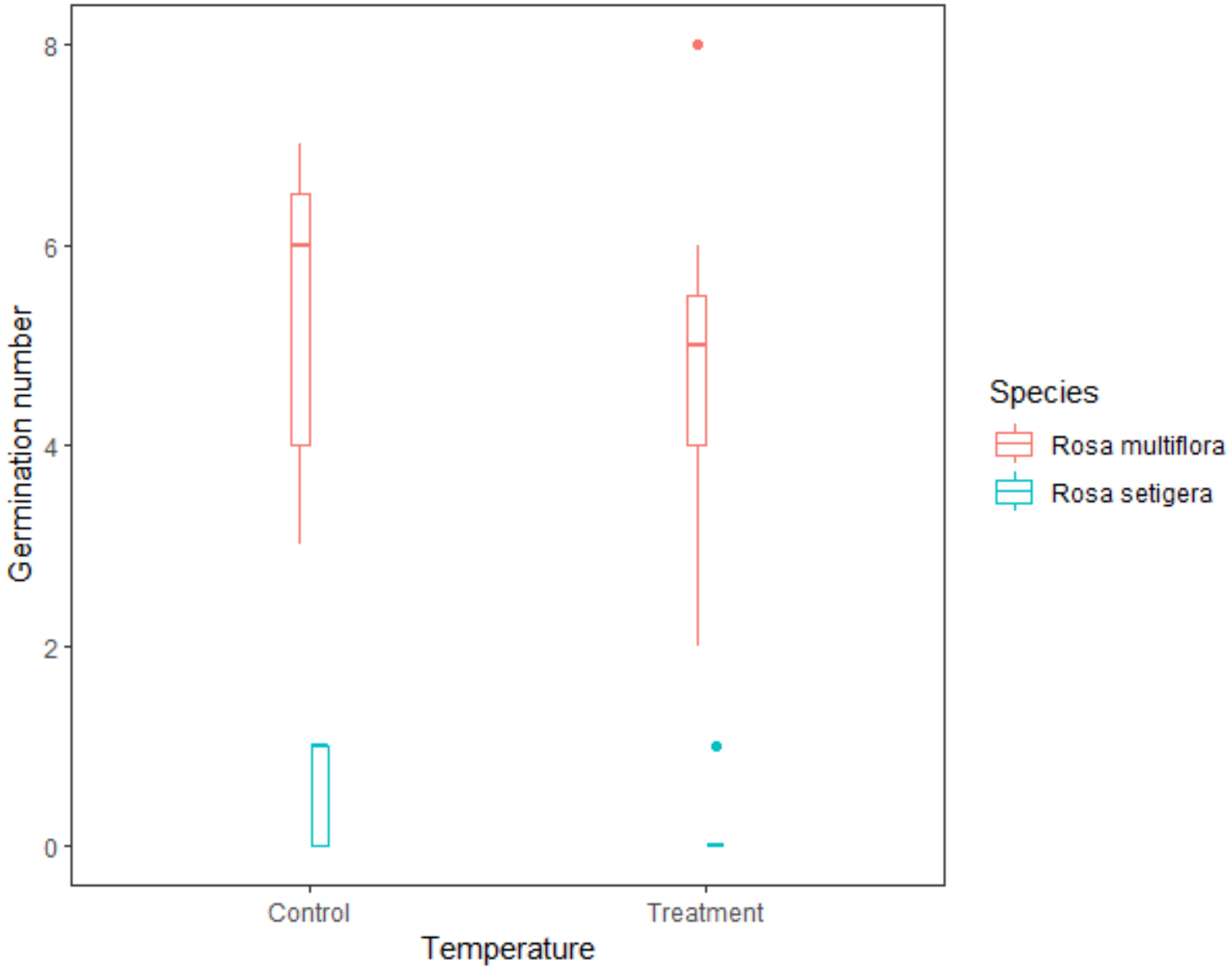
Part 2: Occurrence data analysis in Cuyahoga County

- GBIF presents data for both species
- Land Use Data-Cuyahoga County 2017 Tree Canopy Assessment (modified in March 2023)

Results: Germination Study

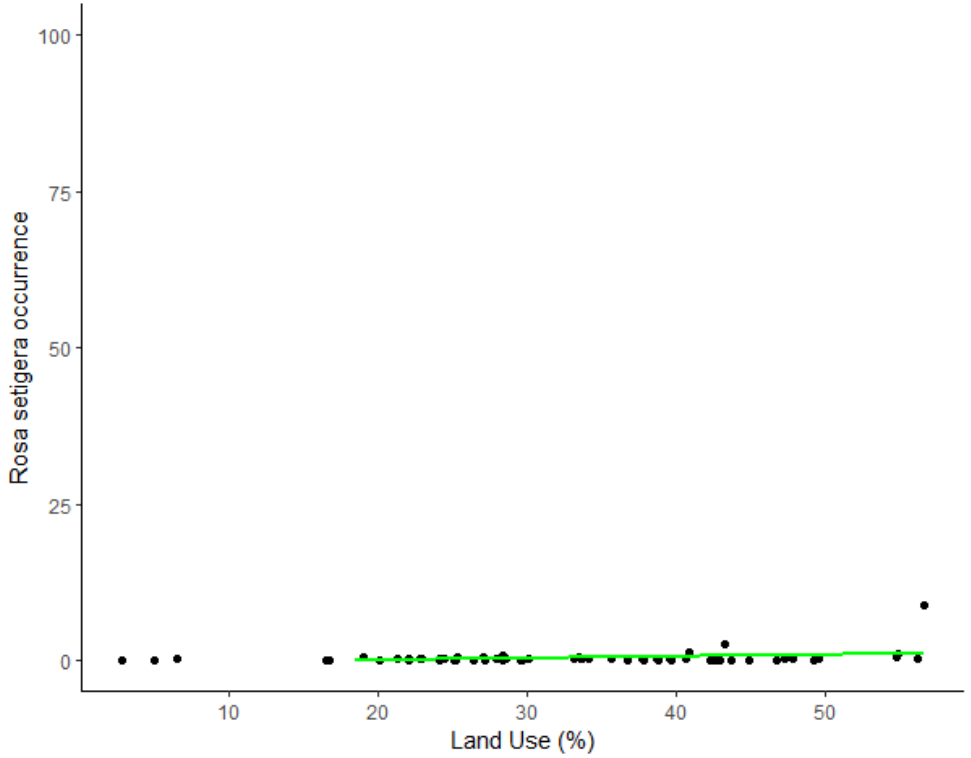
- *R.multiflora* showed greater germination in current and predicted elevated temperatures in 2100.

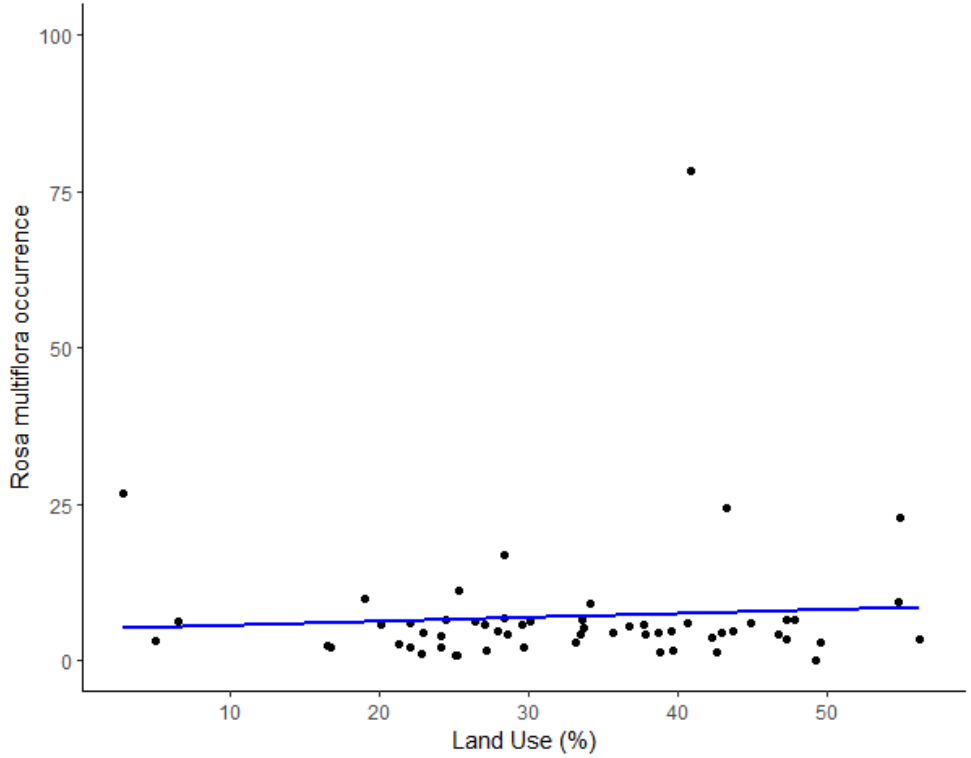
- This suggests a greater tolerance for high temperatures in *R. multiflora*, potentially leading to a **broader germination niche**.



Results: Land Use and Occurrence

- **Both *Rosa* species:** More likely increase with land use (%) (p-value < 0.05)
- **Key Difference:** *Rosa multiflora* (0.9523) benefited more than *Rosa setigera* (0.0289)
- **Higher Land Use favors *Rosa multiflora* establishment.**





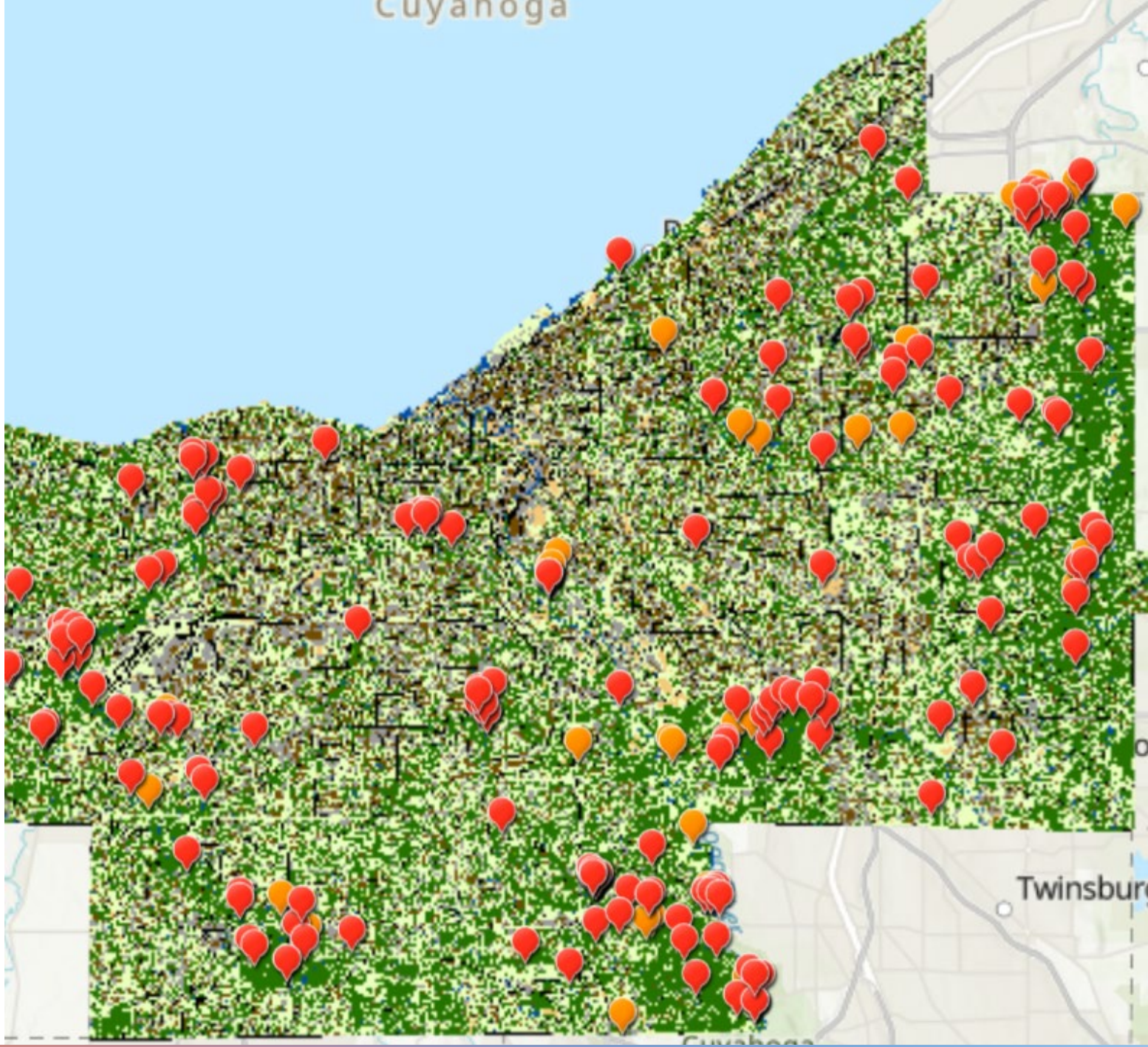
Species Occurrence

- *Rosa multiflora is* abundant in disturbed areas, particularly those subject to human intervention, like most cities

- I assume, that most recorded *R. setigera* is rather human cultivation than natural populations

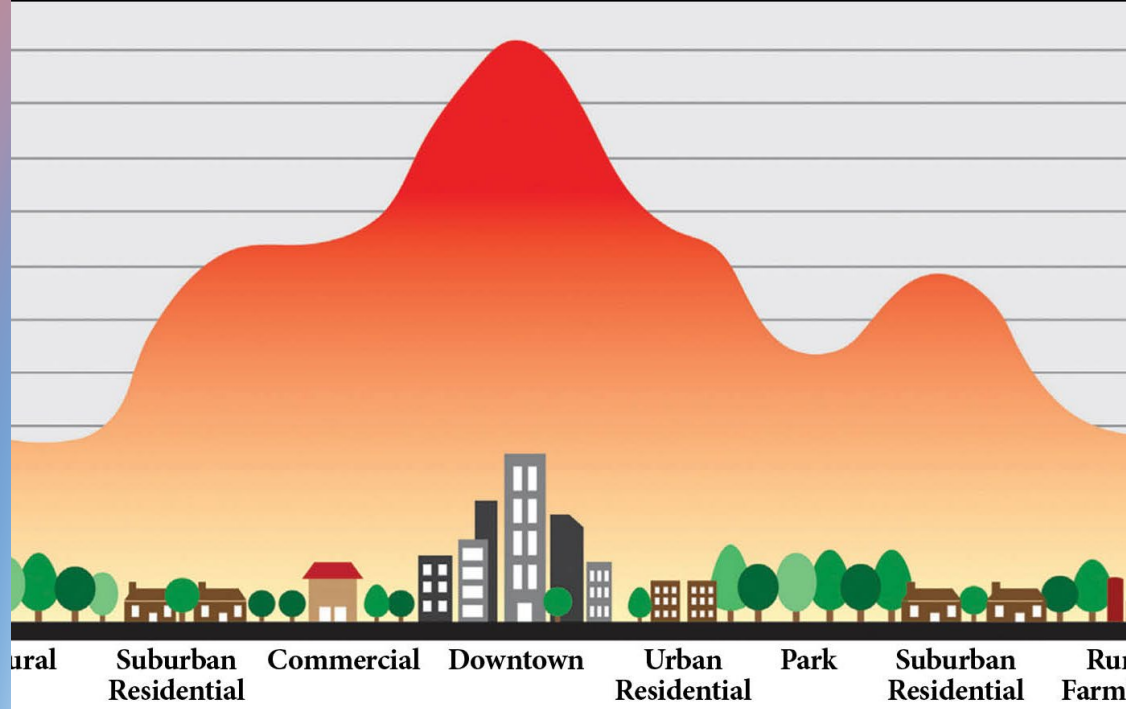
Rosa multiflora

Rosa setigera



Conclusion

- The invasive *Rosa multiflora* germinated earlier under simulated future temperatures, potentially gaining a competitive edge. Additionally, increased land use significantly increased its occurrence compared to the native *Rosa setigera*. These findings highlight the urgent need for proactive management strategies



Future Research Directions

- Climate warming along with other climatic parameters and land use change could be used to model the habitat suitability of *R. multiflora*

- Thus, develop science-based management strategies for *R. multiflora* in fragmented landscapes, particularly urban areas

References

Cuyahoga County Planning Commission, Cuyahoga County 2017 Tree Canopy Assessment (modified in March 2024), Data Resource for land use in Cuyahoga County, Ohio

EDDMapS. 2024. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. Available online at http://www.eddmaps.org/; last accessed May 4, 2024.

GBIF.org (03 May 2024) GBIF Occurrence Download https://doi.org/10.15468/dl.8m3dz7

Guo, F., Lenoir, J. and Bonebrake, T.C. (2018) 'Land-use change interacts with climate to determine elevational species redistribution', Nature Communications, 9(1). doi:10.1038/s41467-018-03786-9.

Reinhardt, J.R. et al. (2020) 'Assessing the current and potential future distribution of four invasive forest plants in Minnesota, U.S.A., using mixed sources of data', Scientific Reports, 10(1). doi:10.1038/s41598-020-69539-1.

Acknowledgment

- Research Facility: Case Western Reserve University Farm, Hunting Valley, Ohio
- Funding Support:

  Research Materials: Oglebay Small Grant, Case Western Reserve University Farm, Hunting Valley, Ohio

  Travel Fund: School of Graduate Studies, Case Western Reserve University

  Oglebay Travel Award, Case Western Reserve University Farm
- Data Resource: Cuyahoga County Planning Commission, Cuyahoga County 2017 Tree Canopy Assessment

- Burns Lab, Case Western Reserve University
- Biology Department, Case Western Reserve University

CASE WESTERN RESERVE UNIVERSITY