

Introduction

- The American elm (Ulmus americana) is a riparian species known for its urban use as a street tree.
- Dutch Elm Disease (DED) is a fungal disease. introduced in the 1920s that is responsible for killing 50-100 million trees in the first 50 years of its introduction.
- The growth of the tree depends on the tree's photosynthetic rate.
- The elms used in this experiment were part of a common garden experiment at the National Arboretum in Beltsville, MD.

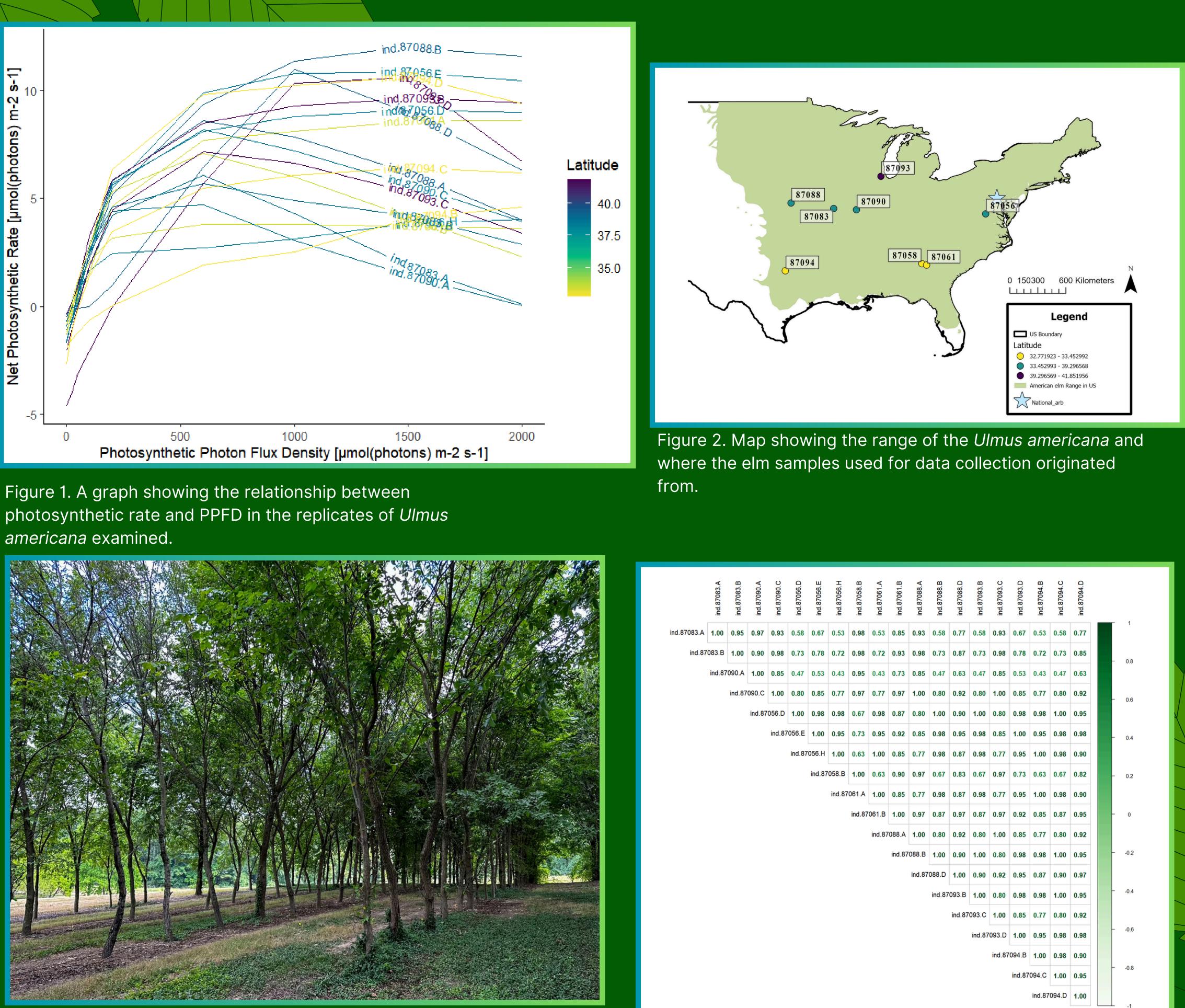
Objective/Hypotheses

- Determine if photosynthetic rate changes along a latitudinal gradient.
- Null Hypothesis: There is no direct correlation between the photosynthetic rate of the American elm and its latitudinal origin.
- Alternate Hypothesis: The photosynthetic rate of the American elm will be higher for trees that originated farther south.

Methodology

- The data collection occurred within the elm common garden experiment at the U.S. National Arboretum curated by Dr. Alan Whittemore with elms from across the range.
- A CIRAS-4 machine captured the chlorophyll fluorescence of branches from the canopy using a controlled photosynthetic photon flux density (PPFD).
- Using the Rstudio package ggplot with the geom_line() function we graphed the photosynthetic rates of each tree.
- To determine the correlation of each tree's photosynthetic rate we created a matrix of the Spearman Correlation Coefficients using the Rstudio package Corrplot with the function cor() and visualized it with the function corrplot().

Sources: KARNOSKY, DAVID F. "Dutch Elm Disease: A Review of the History, Environmental Implications, Control, and Research Needs." Environmental Conservation 6, no. 4 (1979): 311–22. http://www.jstor.org/stable/44517039. Martín, J. A., et al. "Correction to: Breeding and Scientific Advances in the Fight Against Dutch Elm Disease: Will They Allow the Use of Elms in Forest Restoration?" New Forests, vol. 50, 2019, p. 519. SpringerLink, https://doi.org/10.1007/s11056-018-9645-5.



collection.

Changes in Photosynthetic Rate across a Latitudinal Gradient in American elm Therie Moore, Marne Quigg, Jeremie Fant

Chicago Botanic Garden, National Science Foundation, University of Illinois Chicago, U.S. Forest Service mooretherie@gmail.com

Results

Figure 3. This is the plot used by Alan Whittemore at the National Arboretum for his common garden experiemnt and used for data

Discussion

ind.87090.C	ind.87056.D	ind.87056.E	ind.87056.H	ind.87058.B	ind.87061.A	ind.87061.B	ind.87088.A	ind.87088.B	ind.87088.D	ind.87093.B	ind.87093.C	ind.87093.D	ind.87094.B	ind.87094.C	ind.87094.D	
0.93	0.58	0.67	0.53	0.98	0.53	0.85	0.93	0.58	0.77	0.58	0.93	0.67	0.53	0.58	0.77	
0.98	0.73	0.78	0.72	0.98	0.72	0.93	0.98	0.73	0.87	0.73	0.98	0.78	0.72	0.73	0.85	- 0.8
0.85	0.47	0.53	0.43	0.95	0.43	0.73	0.85	0.47	0.63	0.47	0.85	0.53	0.43	0.47	0.63	
1.00	0.80	0.85	0.77	0.97	0.77	0.97	1.00	0.80	0.92	0.80	1.00	0.85	0.77	0.80	0.92	- 0.6
056.D	1.00	0.98	0.98	0.67	0.98	0.87	0.80	1.00	0.90	1.00	0.80	0.98	0.98	1.00	0.95	
ind.87	056.E	1.00	0.95	0.73	0.95	0.92	0.85	0.98	0.95	0.98	0.85	1.00	0.95	0.98	0.98	- 0.4
	ind.87	056.H	1.00	0.63	1.00	0.85	0.77	0.98	0.87	0.98	0.77	0.95	1.00	0.98	0.90	
ind.87058.B				1.00	0.63	0.90	0.97	0.67	0.83	0.67	0.97	0.73	0.63	0.67	0.82	- 0.2
			ind.87	061.A	1.00	0.85	0.77	0.98	0.87	0.98	0.77	0.95	1.00	0.98	0.90	
			ind.87	061.B	1.00	0.97	0.87	0.97	0.87	0.97	0.92	0.85	0.87	0.95	- o	
				ind.87088.A		1.00	0.80	0.92	0.80	1.00	0.85	0.77	0.80	0.92		
						ind.87	088.B	1.00	0.90	1.00	0.80	0.98	0.98	1.00	0.95	0.2
							ind.87	088.D	1.00	0.90	0.92	0.95	0.87	0.90	0.97	
ind.87093.B 1.00 0.80 0.98 0.98 1.00										0.95	0.4					
									ind.87	093.C	1.00	0.85	0.77	0.80	0.92	
										ind.87	093.D	1.00	0.95	0.98	0.98	0.6
ind.87094.B 1.00 0.98										0.98	0.90					
ind.87094.C 1.00													1.00	0.95	0.8	
													ind.87	094.D	1.00	

Figure 4. Matrix showing the relationship between the replicates and their photosynthetic rate. Values closer to 1.00 show more similarities and the opposite is true if farther from 1.00.

> REU Site: Plant Biology & Conservation Research Experiences for Undergraduates -From Genes to Ecosystems (Supported by NSF award DBI-2149888).

Acknowledgements

I would like to thank my mentor Marne Quigg and her advisor **Jeremie Fant** for the research opportunity. I would also like to thank contributors at the National Arboretum, including **Alan** Whittemore, for allowing study on their plot. Thank you to **Ahram Cho** and UIC Stable Isotope lab for helping to provide photosynthetic data used in the study. Thanks to all the friends along the way that supported my study. We'd like to thank NSF-REU grant DBI-2149888 for support.

• The samples examined showed no correlation in photosynthetic rate along a latitudinal gradient based on the statistical analysis.

- strong genetic control.
- origin.
- collect and examine.



2024 Research Experiences for Undergraduates Program

• There are some replicates showing a larger variation between each other, not indicative of

• Environmental factors may play a more

significant role in determining photosynthetic activity than genotypic or latitudinal factors. • The elms examined may have acclimate to their local weather conditions over time, which could overshadow the impact of the conditions at the

• This data could be used by the USFS to determine where to allocate resources for research and determine whether latitudinal factors can be used for restoration. • Potential limitations of this study would include the ability to obtain older elms due to DED and the amount of elms that was made possible to