# Studying the Effects of Norway Maple Populations on Biodiversity, Native Species presence, and Soil Quality in Fort Greene Park Zakiya Ahmed\*, Anna Kuflik\*, Michael A. Estrella<sup>±</sup>

# Abstract

The rapid growth of invasive species, such as the Norway Maple, is leading to decreases in biodiversity. We hypothesized that where Norway Maples were planted, the species that survived under them would be primarily non-native, with the percentage of non-native species increasing as proximity to a Norway Maple did. Plant species at three different distances under both Norway and non-Norway Maples were identified using DNA barcoding, phosphorus concentration in the soil was tested, and oxygen levels and height were measured. Our results showed that Norway Maples had a higher concentration of non-native species growing under them, there were fewer unique species, and the species under them were smaller, producing less oxygen. Phosphorus levels were unaffected by proximity to Norway Maples. This indicates that Norway Maples do have a negative impact on the species around them, decreasing important factors such as biodiversity and plant growth.

# Introduction

- Norway Maples are an invasive species that have been planted enthusiastically in many North American cities, grow and spread quickly, and can withstand more damage than native Maples (1).
- They have shallow root systems and dense canopies that prevent the growth of understory plants (2). They may have toxic allelopathic properties, releasing chemicals into the soil that harm other plants (3).
- Norway Maples are the 4th most common species in Fort Greene Park and inhabit several of areas suffering from erosion (4). This may be caused by a lack of understory plants.
- We hypothesized that where Norway Maples were planted, the species that survived under them would be primarily non-native, with the percentage of non-native species increasing as proximity to a Norway Maple did, and there would be low biodiversity overall
- We hoped to determine whether Norway Maples impacted phosphorus concentration, which impacts plant growth and fertility (5).
- This research helps us to understand Norway Maples' impacts on biodiversity, native species, and erosion in NYC parks.



2) Sample Collection Distribution 21 Trees A and C Trees B and D (Norway Maples) (Non-Norway Maples)

Figure 1. Map of collection sites in Fort Greene Park in Brooklyn, NY. Trees A and C are Norway Maples, while Trees B and D are non-Norway Maples. The insert shows Fort Greene Park's location in Brooklyn

**Figure 2: Labeling of the** Samples Map. The first number represents that number of the sample in the ring. The second number determines what ring the sample is in, which represents the distance the samples are away from the tree (1, 2 and 3 meters away). At the end of the sample labeling is what tree we collected the sample from (A, B, C, D). Placement within the rings is arbitrary.

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# Results

	Sample Collection						Barcoding Analysis			
Tree	Collection Date	Coordinates	Photo	O2 Concentration	Height (cm)	DNA Name	% ID	Species	Common N	
A	12/3/24	(40.6902452, -73.9771841)		17789 ppm	10.9	11A	99.65%	Oligoneuron album	Rigid G	
A	12/3/24	40.6902755, -73.9772256	Ø	6822 ppm	12	21A	99.65%	Lolium perenne	Perenni Ryegras	
A	12/3/24	(40.6902755, -73.9772256)	$(\cdot)$	16999 ppm	4.9	31A	98.79%	Oligoneuron album	Rigid G	
A	12/3/24	(40.6903057, -73.9772434)	Ó	11920 ppm	5.4	32A	99.82%	Chenopodium album	White G	
A	12/3/24	(40.6902211, -73.9772102)	$\bigcirc$	18648 ppm	4.3	13A	99.64%	Veronica hederifolia	lvy-leav Speedw	
с	3/21/25	(40.6932684, -73.9776427)	Q	3826 ppm	14	11C	86.36%	Allium ampeloprasum	Wild Lee	
с	3/21/25	(40.6932778, -73.9775113)	$\bigcirc$	3386 ppm	1.7	21C	100.00%	Veronica sublobata	False Iv Speedw	
с	3/21/25	(40.6930889, -73.9774748)		3638 ppm	2.4	22C	100.00%	Veronica sublobata	False Iv Speedw	
с	3/21/25	(40.6931975, -73.9775361)	Q	13911 ppm	9.5	32C	99.47%	Allium ampeloprasum	Wild Lee	
с	3/21/25	(40.6930431, -73.9775066)		33526 ppm	4.3	13C	99.65%	Juncus tenuis	Path Ru	
с	3/21/25	(40.6930843, -73.9774577)	$\bigcirc$	53069 ppm	3.1	23C	99.82%	Ornithogalum oligophyllum	(Dwarf) Bethleh	
с	3/21/25	(40.6930218, -73.9775455)		39976 ppm	3.1	33C	99.82%	Veronica sublobata	False Iv Speedw	
в	12/3/24	(40.6904758, -73.9767610)	Q	19876 ppm	12.5	12B	90.35%	Symphyotrichu m cordifolium	Blue Wo Aster	
D	3/21/25	(40.6930566, -73.9773846)	$\bigcirc$	5126 ppm	7.1	11D	98.95%	Ornithogalum oligophyllum	(Dwarf) Bethleh	
D	3/21/25	(40.6930897, -73.9773232)	$\bigcirc$	31856 ppm	8	21D	99.10%	Taraxacum officinale	Commo Dandeli	
D	3/21/25	(40.6929763, -73.9773242)	0	37112 ppm	2	12D	99.30%	Ranunculus rhomboideus	Prairie E	
D	3/21/25	(40.6930139, -73.9773380)	$\bigcirc$	22685 ppm	10.8	22D	99.30%	Allium ampeloprasum	Wild Lee	
D	3/21/25	(40.6931494, -73.9772612)	0	59401 ppm	1.8	13D	99.82%	Veronica sublobata	False Iv Speedw	

Figure 4: Sample collection and barcoding analysis of samples. For each sample, the date of collection, approximate coordinates, height, and mean oxygen concentration over a period of two minutes is recorded. The barcoding analysis contains the species, identified using Nucleotide BLAST with the sequencing data, percent identity, and whether the species is native the New York area. A photo of each specimen is also included.

## **DNA Barcoding Results**

#### Invasiveness

• The majority of species identified were not native to the NYC region. 5 of the 18 samples were native, with species including the Rigid Goldenrod, the Path Rush, the Blue Wood-Aster, and the Prairie Buttercup (Figure 4).

## **Phosphorus Test Results**

- Plants under Norway Maple trees showed a bell curve when comparing phosphorus levels to distance away from trees. Plants under non-Norway Maples showed a decreasing trend when comparing distance to phosphorus levels (Figure 5a). **Height Results**
- Plants under Norway Maples tend to be shorter than plants under non-Norway Maples (Figure 5b). **Oxygen Test Results**
- Plants under non-Norway Maples on average produced more oxygen than plants under Norway Maples (Figure 5b).



# Acknowledgements

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# Materials & Methods

## **DNA Barcoding Procedure**

Collected plant samples from 4 trees and 3 distances.

• Isolated DNA from leaf tissue using the DNALC universal DNA extraction protocol.

• Performed PCR to amplify DNA samples using Rbcl primers. Performed gel electrophoresis to confirm the presence of DNA amplicon.

• Sent PCR product to Genewiz/Azenta for sequencing.

• Used NBCI BLAST on the sequencing results to identify the plant species collected from the distances.

## Soil Analysis Procedure

Performed phosphorus tests using the LaMotte Soil Testing Kit on samples that had successful DNA amplification with their respected plants.

## **Oxygen Test Procedure**

• Samples were tightly wrapped around the plastic bags attached to Venier Oxygen Gas sensors. The concentration was measured in ppm for a 2-minute period.

## **Height Procedure**

• The tallest leaf of samples were measured with a ruler in centimeters

# Discussion

• The results support our prediction that non-native species are more likely to thrive under Norway Maples, that Norway Maples inhibit biodiversity, and that plants under them may have inhibited growth or oxygen production.

• Proximity to non-Norway Maples may lead increased growth and fertility due to higher phosphorus levels.

• Limitations: Small sample size overall, and particularly for non-Norway Maples (only 6 samples), as well as human bias in selecting samples.

• Future research: Repetition with greater number of samples and trees, further phosphorus testing and implications, soil testing for other nutrients.

## References

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