



Precious Parks: Measuring Biodiversity in Central Park

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Abstract

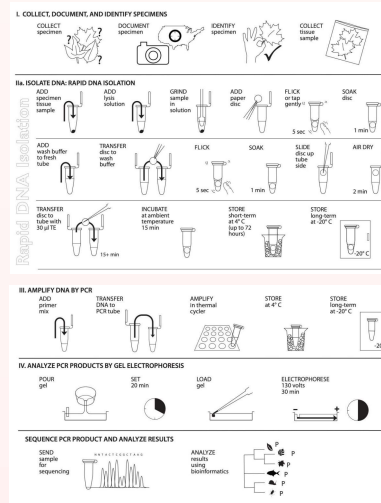
We are currently undergoing one of the biggest threats our earth has yet to face, air pollution. Over time, urbanization has significantly increased pollution in New York City, becoming one of this country's biggest offenders of nitrogen dioxide pollution. Our goal for this research project was to study pollution's effects on Central Park's biodiversity. We hypothesize that an increase in pollution will lead to a major decrease in the biodiversity of Central Park. We went to 4 randomly selected spots in Central Park and collected samples of multiple plant species to measure the biodiversity using Simpson's biodiversity index and the Nitrous pollution using the air quality index. We analyzed and represented this data by using tables to compare the biodiversity in relation to the average Nitrogen Dioxide level in the parking area. Our results comprised of three different factors, the air quality that day was at 54 AQI, the NO₂ had a value of 40 AQI, and our biodiversity was 0.57 using Simpson's index. That day's diminished air quality was primarily attributed to a large amount of nitrogen dioxide in the air, however, it cannot be claimed that this was the reason for mid-range biodiversity, because air quality and NO₂ pollution fluctuate every day.

Introduction

- New York City has diverse ecosystems including wetlands, forests, and meadows.
- Wetlands support invertebrates that serve as food for birds, fish, and other mammals.
- Freshwater land exhibits varied flora and fauna based on water depth.
- Urbanization has led to a decline in the city's biodiversity.
- Central Park is the most famous park in New York City and plays a crucial role in the city's life.
- Urbanization has negatively impacted the New York ecosystem and landscape.
- Nitrogen dioxide (NO₂) is a major pollutant emitted by vehicles, power plants, etc.
- NO₂ harms biodiversity and affects both humans and the environment.
- NO₂ can cause asthma and other chronic lung diseases in humans.
- NO₂ damages foliage, reduces plant growth, and decreases crop yields.
- NO₂ contributes to acid rain formation, which harms the environment.
- NO₂ pollution affects Central Park's biodiversity, leading to animal deaths.
- Factors like transportation and emissions from power plants contribute to biodiversity decline in Central Park.
- It is predicted that as pollution increases, Central Park's biodiversity will further decrease, especially in areas with higher NO₂ pollution.

Methodology

- Research conducted in the southeast region of Central Park.
- Created a 20cm x 20cm quadrant for data collection.
- Quadrant was thrown into different areas of Central Park four times, creating four regions.
- Plant samples were brought back to The Browning School lab for DNA barcoding analysis.
- Sample data was frozen in the freezer in the Bio lab for preservation.
- Samples were crushed with a pestle, and DNA-attracting beads were used to separate DNA from the rest of the sample.
- Purified DNA underwent PCR using rbcL primer to obtain the gene sequence
- DNA subway's BLAST tool was used to identify the species.
- Species names and populations were recorded in a spreadsheet.
- Simpson's Diversity index was used to measure biodiversity in each area
- Concentration of NO₂ pollution and air quality were measured using an air quality index.



Result and Discussion

- Original hypothesis: Expected decline in Central Park's plant biodiversity due to increased pollution, specifically higher NO₂ levels.
- Air quality on the day of the visit: Poor, measured around 54 AQI.
- Observed low biodiversity with a Simpson's index of approximately 0.57.
- Poor air quality primarily attributed to pollutants: PM_{2.5}, PM₁₀, NO₂, and O₃. NO₂ identified as the second most significant contributor with a value of 40 AQI.
- Nitrogen dioxide forms harmful air pollutants like ground-level ozone and particulate matter, negatively impacting air quality and ecosystems.
- High levels of NO₂ can hinder plant growth, photosynthesis, and disrupt ecological interactions. Random sampling used to collect accurate and unbiased data on biodiversity in the southeast region of the park.
- Inability to understand how nitrogen dioxide has changed over time due to daily fluctuations in air quality and NO₂ levels.
- Limited study scope to a section of the park due to issues in species DNA identification for other regions.
- 19 samples collected from the southwest region, but sequencing was not verified in time, rendering them unusable for research.
- Future research should involve measuring air quality, nitrogen dioxide, and their effects on biodiversity over a longer period to establish trends.
- Measure plant biodiversity in other regions of the park (southwest, northeast, and northwest) to create an overall biodiversity assessment.
- Collect more random samples from these regions and sequence the plant species to determine their identity and biodiversity.
- Identify the reasons behind the Poa species' large population and study its interactions and growth in the park's environment.

Data Figures



Figure 1. Gel electrophoresis results for our samples 1 to 10.

Sample ID	Species	Population
001	<i>Euonymus species</i>	60
002	<i>Tulipa species</i>	30
003	<i>Hedera species</i>	10
004	<i>Poa species</i>	625
005	<i>Liriope species</i>	113
006	<i>maianthemum japonicum</i>	28
007	<i>Euonymus species</i>	25
008	<i>Jasminum nudiflorum</i>	20
009	<i>Japonicum species</i>	11
010	<i>Tupila serbica</i>	60

Table 1: Species identified and its population in the southeast region of central park.

Location in central park	Biodiversity Index	Air quality index (AQI)
South East location	0.57	54

Table 2: Biodiversity index and air quality index

main pollutants	AQI
PM _{2.5}	54
PM ₁₀	17
NO ₂	40
O ₃	32

Table 3: Main contributing pollutants in Central Park



Figure 2. Photos of sample collection using quadrant.

Southeast region where we collected our data



Figure 3: map of central park

Selected Reference

Michael L. McKinney, Urbanization, Biodiversity, and Conservation: The impacts of urbanization on native species are poorly studied, but educating a highly urbanized human population about these impacts can greatly improve species conservation in all ecosystems, *BioScience*, Volume 52, Issue 10, October 2002, Pages 883–890
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