The Effect of NO2 on the Biodiversity of Tree Saplings in Urban Areas Compared to Rural Areas

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Introduction

New York has copious levels of air pollution which affects the biodiversity of trees. Black Rock Forest and Central Park are entirely different areas of land. While Central Park is 842.6 acres, Black Rock Forest is 3,920-acres (Black Rock, n.d.; Park History, n.d.). Due to Central Park's location in the center of New York City, it interacts with air pollutants from cars and other sources of fossil fuels frequently. Contrastingly, Black Rock Forest is properly preserved and distant from many harmful air pollutants. However, both areas similarly have a large amount of both tolerant trees (trees that are more resistant to air pollutants) and sensitive trees (trees that are more susceptible to air pollutants) (Black Rock, n.d.; Park History, n.d.).

Nitrogen Dioxide (NO_2) is one of the major air pollutants in New York State that results from the burning of fossil fuels (Basic Information, 2023). NO_2 also has a large impact on forests due to its abil ity to form into acid rain, which can harm sensitive ecosystems (Basic Information, 2023). Therefore, NO_2 can have a large effect on the biodiversity of trees. This experiment specifically investigates the effect of NO_2 on the biodiversity of tree saplings in urban areas, which have higher levels of NO_2, and rural areas, which have lower levels of NO_2. This experiment is important because the biodiversity of trees helps all ecosystems, regulates disease, and aids social well-being (Buttke et al., 2018). If there is a positive correlation between NO_2 and the biodiversity of trees, more effort can be used to reduce NO_2 in areas with large populations of trees.

It can be hypothesized that if there is a smaller amount of NO_2 recorded in the air, then the biodiversity of that area will be larger than an area with more NO_2. In an area with more NO_2, the species will be more tolerant.

Our goal in the Urban Barcoding Project is to examine the impact of pollutant NO2 on tree biodiversity in urban settings compared to rural settings. We plan to achieve this by collecting 20 samples from Black Rock Forest, and comparing them to 20 samples collected from Central Park. We expect that in Black Rock Forest, there will be more biodiversity of tree samples because there are lower values of NO2. Additionally, a second goal is to discover how the NO2 levels affect what species of trees grow in Black Rock Forest compared to Central Park. We expect that more tolerant species will grow in Central Park because it has higher levels of pollution.

Results

Table 1: Air Quality Index in Black Rock Forest and Central Park

	Black Rock Forest	Central Park
NO_2 (µg/ m^3)	7	52

Quadrant 1 and Quadrant 2 in Black Rock Forest

Quadrant 3 and Quadrant 4 in Central Park

Abstract

This experiment aimed to explore how NO_2 affects leaf biodiversity in Black Rock Forest (BRF) and Central Park (CP). First, samples were collected from BRF and CP. Then, rapid DNA isolation was used to decode and determine the species of the leaves. Lastly, the biodiversity and NO_2 levels were compared to determine their correlation. Through this experiment, we hoped to prove that NO_2 had effects on the biodiversity of trees, and therefore, larger effects should be implemented to reduce NO_2 near areas with large amounts of trees. The collected data did not provide evidence to conclude that NO_2 has significant effects on the biodiversity of trees in Black Rock Forest and Central Park. Due to these findings, the implications for policies regarding NO_2 reduction near areas with large populations remain inconclusive as well.

Discussion

It was hypothesized that the smaller amount of NO_2 in the air would result in a higher biodiversity than in an area with a larger amount of NO_2. In other words, it was hypothesized that the biodiversity in Black Rock Forest would be larger than the biodiversity in Central Park because of the lower NO_2 levels. Unfortunately, the study yielded no conclusive results and the biodiversity was not calculated. However, from examining the photos of the leaf samples, it can be inferred that the biodiversity in Black Rock Forest is higher than the biodiversity in Central Park, supporting our hypothesis.

Throughout this experiment there are several aspects of this protocol that might have contributed to the lack of results presented by the gel electrophoresis. One reason for this may have been that the DNA from the leaf may have not been collected in the beginning. Additionally, another reason may have been the dye used for the gel electrophoresis after the procedure. The protocol had asked for a green dye, however a blue dye was used. While this may not seem like a significant change, it may have contributed to the absence of results. Lastly, the DNA from the leaves were collected 5 months after collecting the leaves from BRF and CP, which probably also contributed to the results of this experiment.

Unfortunately, this research was inconclusive. This means that there are no conclusions or implications of our research. However, if our inferences are correct, it would connect the pollutant NO_2 to a higher biodiversity, leading to the understanding that in order to obtain higher biodiversity there needs to be a reduction in NO_2.

In the future, this study should be altered to fix errors and reconducted in order to obtain conclusive results. Future studies can also examine the relationship between other pollutants in the air and biodiversity.

Materials & Methods

For this project, two locations were observed: Black Rock Forest and Central Park. The reason these locations were chosen was because of the varying air pollution levels in each area. Before going to Black Rock Forest, the air quality index and levels of NO_2 were recorded using an online website. This allowed us to compare its air quality to Central Park using the same database. Once arriving at Black Rock Forest, a 1m by 1m quadrant, 20 plastic bags to store the collected leaves, and a sharpie to label the samples were provided. When collecting leaf samples, a 1m by 1m area with different types of saplings was chosen. Then, the quadrant was placed onto the chosen area and 10 leaves from different saplings were collected and placed into separate labeled bags. A total of two quadrants were placed and used for collection at Black Rock forest. The same process was repeated at Central Park. After completing the collection, all 20 leaves from Black Rock Forest and 20 leaves from Central Park were stored in a refrigerator to preserve the leaves. Then, the Rapid DNA Isolation protocol was used to determine the species of each of the leaves and the biodiversity for both Black Rock Forest and Central Park will be calculated using the Simpson's Diversity Index. Finally, correlations between the levels of NO2 and biodiversity will be analyzed.

Acknowledgements & Results

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