

Moss Variation in Urban and Rural Parks

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The Browning School

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Abstract

Moss is a non-vascular plant that is found all over the world. There are about 12,000 species spread throughout the world in many different environments. The research question trying to be answered is, does the environment around moss affect the diversity of the species. 20 total samples of moss were collected from Black Rock Forest and Central Park. Out of those samples 8 were acrocarp and 12 were pleurocarp. The Species Density of each site was different from each other. Black Rock Forest had a species density of 8.7 species per square kilometer, and Central Park had a species density of 4.11 species per square kilometer. This shows that there were more species in Black Rock Forest than in Central Park, which means it has more diversity.

Introduction

By observing the moss, it will be determined whether urban or rural areas have more moss diversity and determine whether certain growth forms are more strongly associated with an urban or rural forest. Therefore, this project will record different species of moss, the frequency of the species, and the location of those species. Recent trends have also shown that moss, especially peat moss, affects nitrogen fixation in forests⁶. These trends will allow us to deduce the environmental factors that allowed for the particular species of moss to grow in a specific area. The location of moss species can depend on altitude, air humidity, air contents, air quality, the climate of a particular area, the geographic features/landforms, and the type of land it is situated on. Moss species can be visually differentiated by their shade/color, leaf pattern, physical structure, but the main approach that will be employed in this study is DNA Barcoding. Hypothesis: Black Rock Forest will have more moss variation. Black Rock has nearby streams and less roads running through it to hinder moss growth. Black Rock Forest's age may have also allowed for the moss species there to evolve longer, in contrast to Central Park which was built relatively recently.

Materials & Methods

Before sampling in the Black Rock and Central Park a trail for each area will be drawn using satellite imaging or maps. Only sample moss that is within 3 meters of the trail. Samples will be identified before amplification using a moss field guide and a microscope. Each sample will be amplified using RBCL primers, Ready-to-go PCR beads, a lysis solution, and silica resin. The samples were then sent to be sequenced and were sent back as a fasta file. The fasta files were uploaded into DNA subway and ran through BLASTN to find species that had similar DNA sequences to the fasta files. The species that were collected from the BLASTN and the fasta files were used to create a Neighbor Joining tree, which shows the similarity between them.

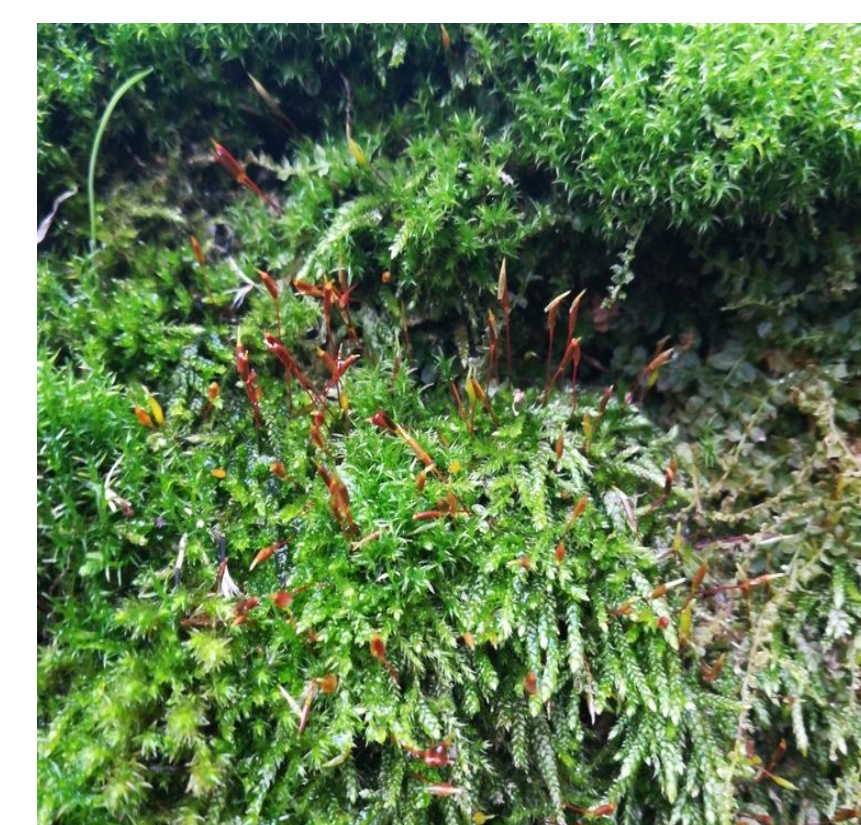


Figure 3: Pictures taken of moss samples on site and posted to iNaturalist

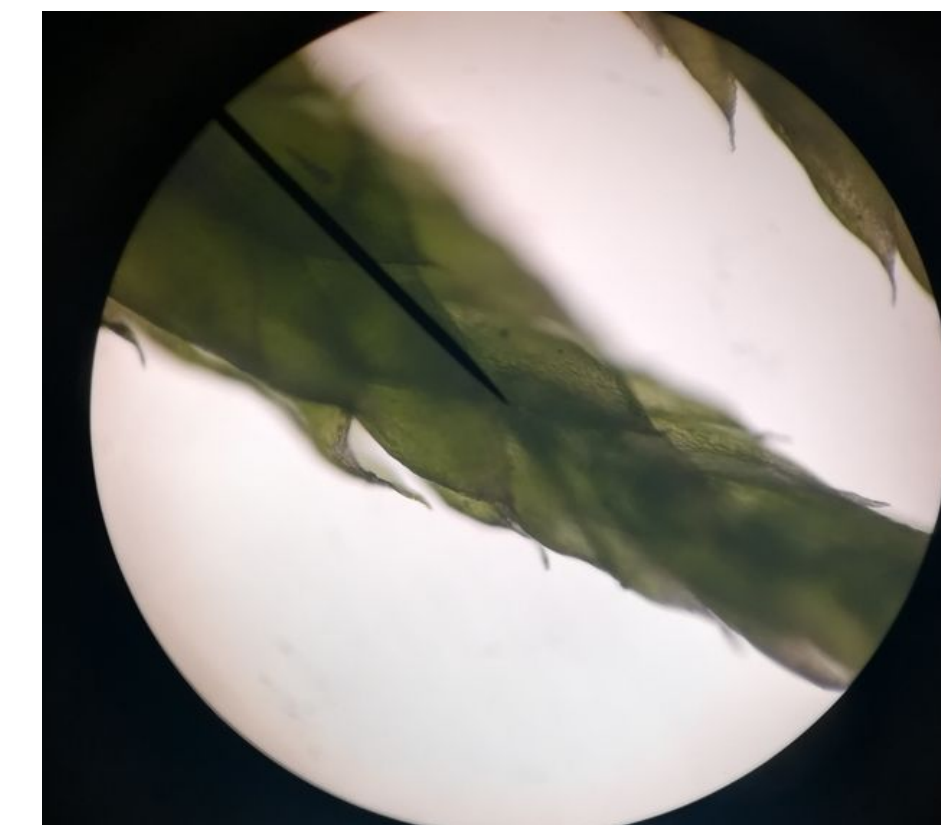


Figure 4: Microscopic picture of moss leaf. Posted to iNaturalist

Results:

Table 1: Species Richness and Species Density

Location	Black Rock Forest	Central Park
Species Present	13	7
Number of Species Found	13	7
Area of Sample Spot	1.5 km ²	1.7 km ²
Species Density	8.7 sp/km ²	4.11 sp/km ²

This data table shows the number of species found, the area of sample spot, and the species density of Black Rock Forest and Central Park. The area of each sample spot was measured using google My Maps and the unit is kilometers squared. The Species density was calculated by # of species Sample Spot Area (m²).

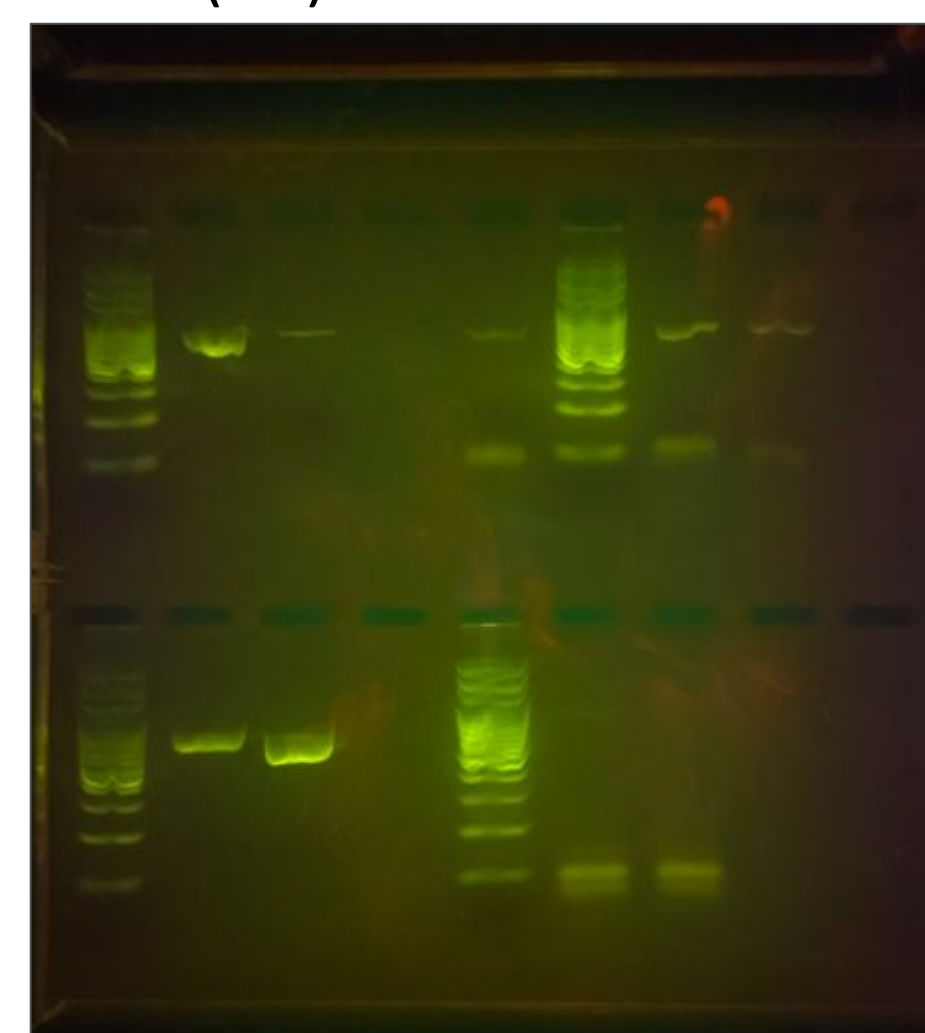
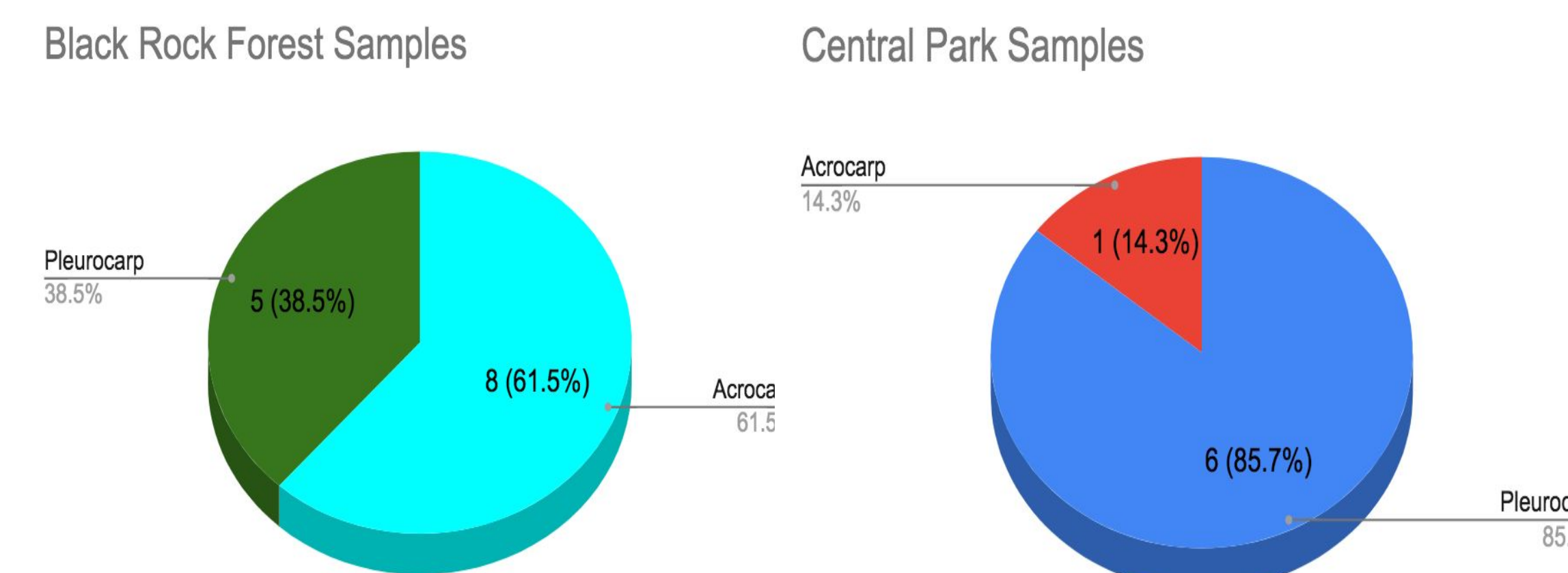


Figure 5: This picture shows the gel that was run on January 29, 2020. Samples BRF-1 and BRF-2 are in the second and third wells on the right of the top row.

Table 2: BLASTN Results

Species Identified (Guessed) in Field	Species Taken from BLASTN (Actual Species)	Percentage Similarity Between BLASTN and Species Identified in Field
Grimmia pilifera	Polytrichum commune	66%
Leskeella nervosa	Climacium dendroides	98%
Rhynchostegium serrulatum	Orthodicranum fulvum	72%
Heterophyllum affine	Heterophyllum affine	78%
Dicranum montanum	Thuidium pristocalyx	72%
Brachythecium rutabulum	Calli cladium haldanianum	99%
Leucobryum glaucum	Polytrichum pallidisetum	95%

This data table shows the relationship between the samples that were identified in the field and the ones that were taken from BLASTN in DNA Subway. BLASTN analyzes fasta files that contain DNA sequences, to find a species that is similar to the fasta file. The species name that was identified (guessed) in the field is in the first column followed by the species name according to the BLASTN, on the right. The percentage similarity of the two DNA sequences is shown in the third column.



This pie chart shows the percentage of Pleurocarp and Acrocarp in Black Rock Forest Of the 13 samples that were collected

This pie chart shows the percentage of Pleurocarp and Acrocarp in Central Park of the 7 samples that were collected

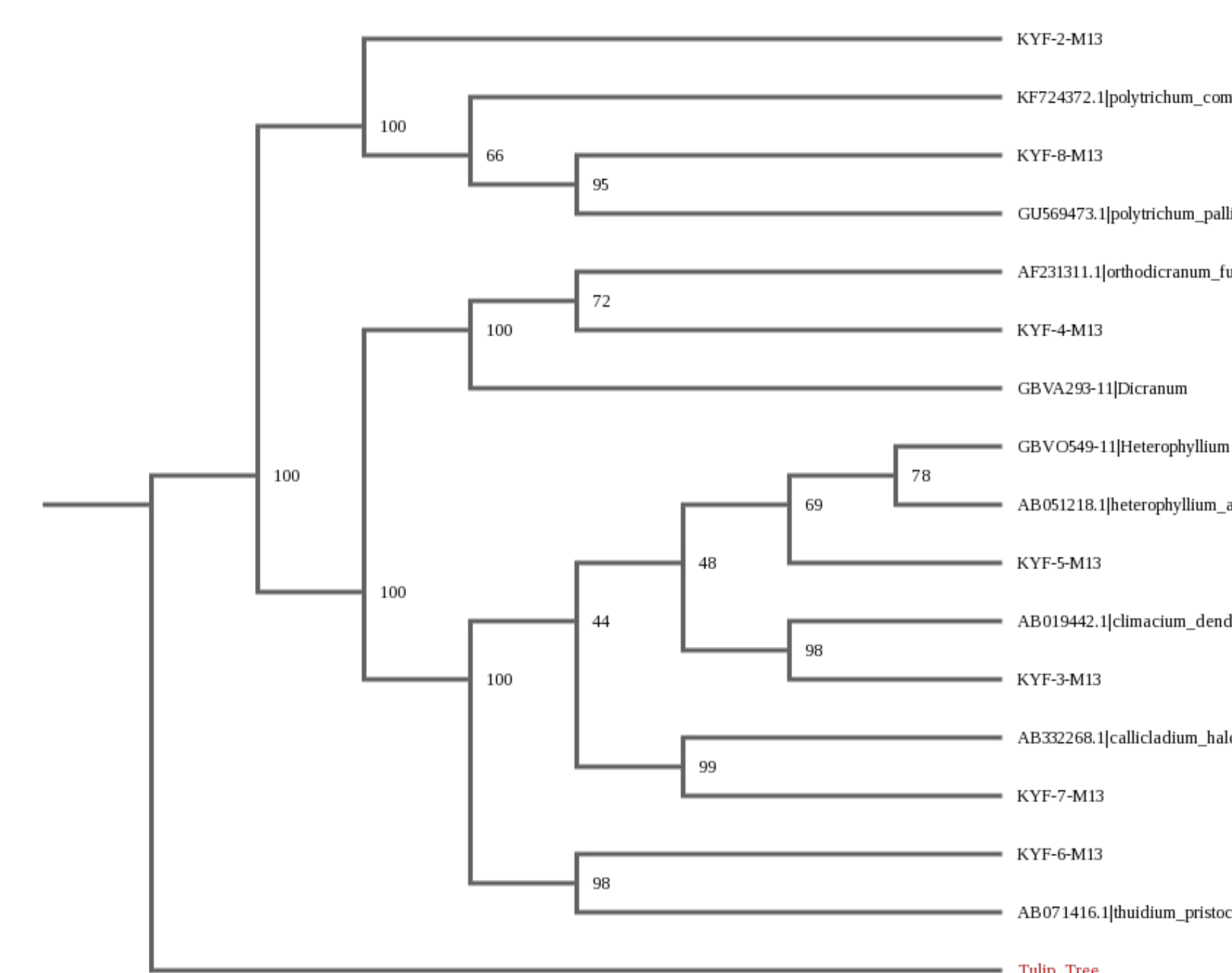


Figure 6: This is the NJ (Neighbor Joining) tree that was produced using DNA Subway. It shows the similarity between the fasta files and the sequences that were collected from the BLASTN

Discussion:

According to the results, Black Rock Forest did showcase a greater moss diversity than Central Park (Table 1). There were 13 moss samples found in 1.5 km² of Black Rock Forest, amounting to 8.7 species per km². In Central Park there were 7 moss samples found in 1.7 km², amounting to 4.11 species per km². Therefore our hypothesis was supported, Black Rock Forest has a greater moss density per square kilometer than Central Park.

The completion of this study was curbed due to COVID-19. All samples were run through PCR, however, not all samples were able to be prepared to be sequenced. Prior to COVID-19, the moss samples were observed and their species were determined through their macroscopic characteristics using a field guide, microscopy, and photographic evidence. The species' sequences were found on BOLD and inserted into DNA Subway which allowed us to compare the sequences of each species and helped us determine the species that fit our descriptions.

Throughout this study various trends have been identified. In figure 1 and 2, the samples from each sample site were identified as either acrocarp or pleurocarp. In figure 1, Black Rock Forest samples conveyed 11 (57.9%) pleurocarp samples and 8 (42.1%) acrocarp samples. In Chart 2, Central Park samples conveyed 6 (85.7%) pleurocarp samples and 1 (14.3%) acrocarp samples. In Black Rock Forest's rural environment, acrocarp and pleurocarp species were able to flourish almost evenly. However, in Central Park's urban environment, there were significantly more pleurocarp samples than acrocarp samples.

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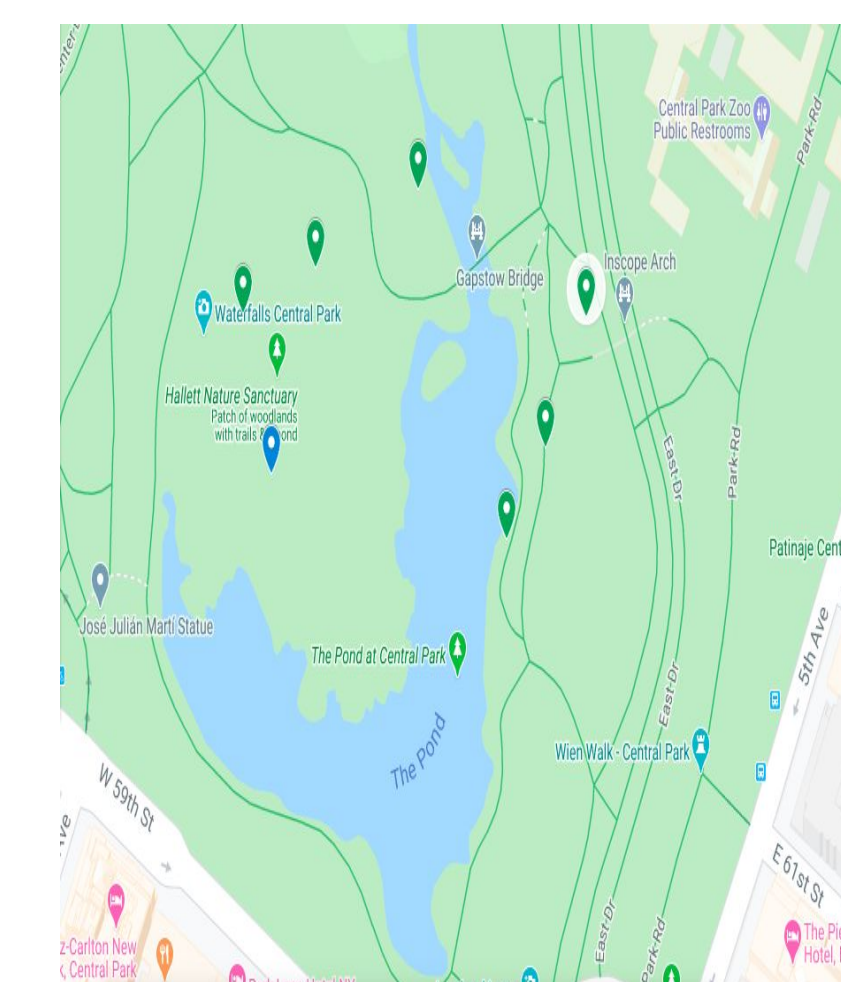


Figure 1: Map showing locations of moss samples found in Central Park

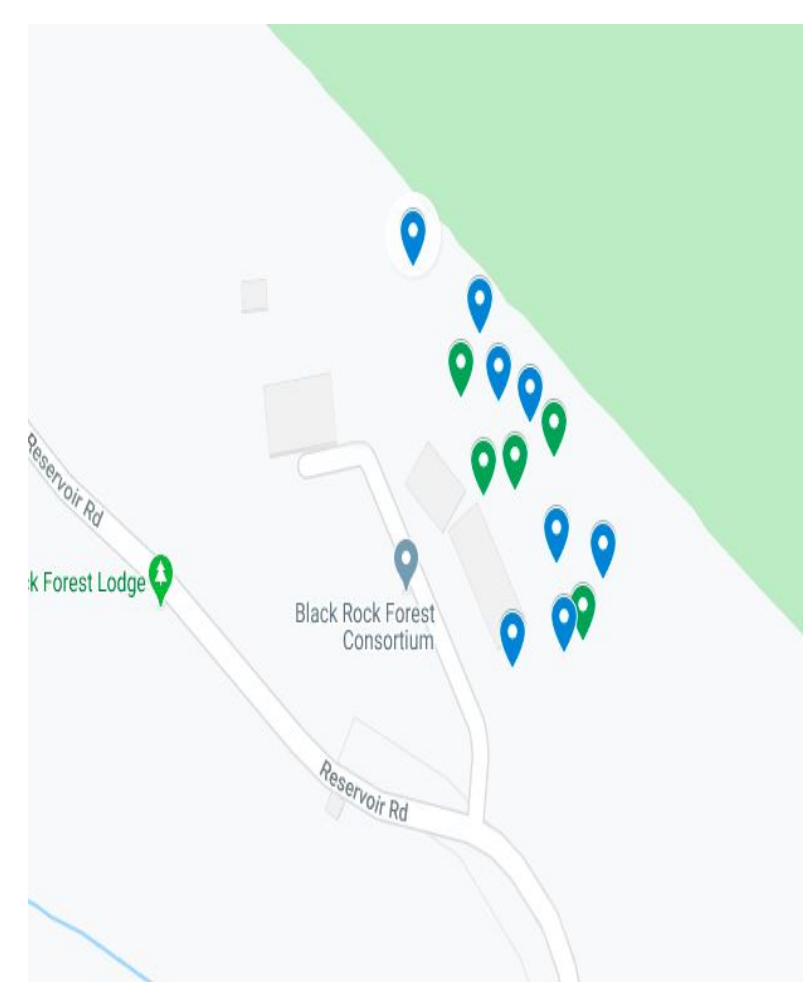


Figure 2: Map showing the locations of moss samples in Black Rock Forest