



Investigating the Biodiversity of Lichens to Research the Impact of Air Pollutions in New York City Neighborhoods

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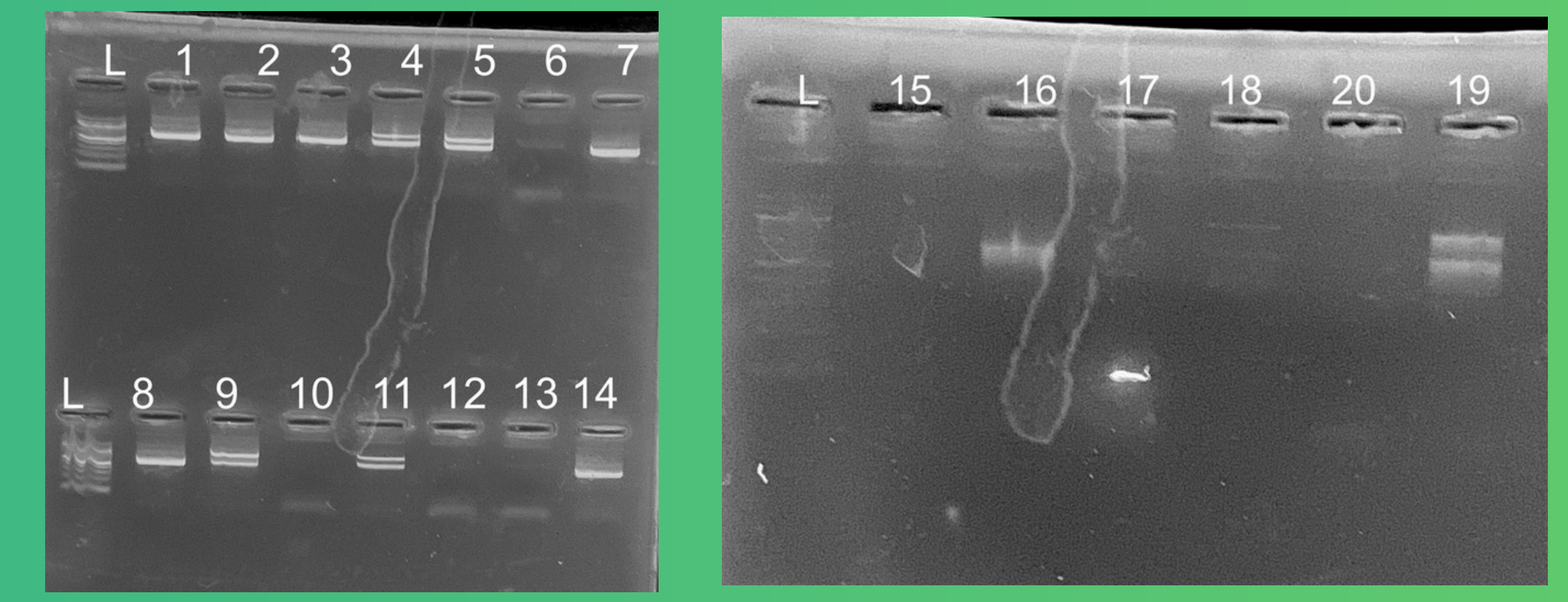
Abstract

Lichens are a fungus-algae that grows on trees globally, serving as a bioindicator. Similarly to lichens, each borough in New York City has its own unique environment which attributes to the species diversity. In our research, we test the correlation between lichen biodiversity and different environmental conditions in New York. Collection will occur on trees in Manhattan and Brooklyn. We will use DNA Barcoding for species identification using the procedure by DNA Barcoding 101, utilizing the DNA Subway site to match our results. We predict that a majority of the collected Lichen samples will be different than the species collected in Manhattan, to have greater success through the barcoding process given that the neighborhood has factors greater aiding the growth of lichens. Our results, being that the lichen biodiversity in Greenpoint is greater than East Village, suggests that environmental conditions play a role in shaping lichen biodiversity.

Hypothesis

The investigation aims to compare the lichen biodiversity differences between Mccarren Park in Northern Brooklyn and the Manhattan neighborhood Chelsea. While also looking at the effect that pollution has in lichen population. We predict that if we test the biodiversity of lichens from Greenpoint and Chelsea, then the species will differ in DNA because of the pollution and population differences in the neighborhoods.

Tables



Analysis

Initially, we predicted that the species of lichen DNA would differ between Greenpoint and East Village due to pollution and population differences in both neighborhoods. Of the 20 lichen samples that we amplified, only 7 total fragments sequenced correctly. High successive rates of amplification proved to be from East Village, with a 50% success rate. The low success rate of sequencing our Greenpoint fragments, with only a 20% success rate, can likely be credited to insufficient number of prime pairs selected or contamination in the sample collecting process. In constructing a phylogenetic tree to examine the relationship between the lichen biodiversity in the differing neighborhoods, we found that our original hypothesis was mostly correct. Our results mostly proved to support our original hypothesis because of the seven samples which were attained, the five from East Village were very close on the phylogenetic tree though sample 14 from Greenpoint was closely related to sample 1 in East Village which can be seen in figure 1. Sample 1 and 14 most likely represent Candelaria Asiatica, seen in figure 8, suggesting that the two fragments had a similar ancestor. Sample 16, though is the farthest relative of any lichen fragment on the tree, has a somewhat close evolutionary history to Sample 2. The species of Sample 16 is likely Candelaria Concolor.

Introduction

NYC is the most populous city in the United States, it's home to many demographics and environments within 5 unique boroughs. The mass spread of industrialization, pollution and poverty have created significant risks to big city ecosystems. A perfect model organism to research the effects of the aforementioned risks is lichens. Similar to New York, Lichens are a very populated organism with many different species. They are a two-part organism consisting of fungi and algae and are often located on trees, rocks, or substrates. However, the most interesting aspect of this organism, and the part most helpful in the research process is how lichens are bioindicators. Meaning they can indicate the health of an environment through unobservable symptoms. Using DNA Barcoding, we plan to identify the species of lichens collected from Brooklyn and Manhattan areas bordering the East River. Given the vastly different factors in both areas we hypothesize that the lichens will be of different species with Manhattan lichens likely appearing more often due to the lichen's ability to adapt to environments with greater pollutants and higher temperatures (Lichens Are in Danger of Losing the Evolutionary Race With Climate Change, 2022). Whereas Brooklyn lichens we predict will be of greater scarcity due to the lower standards of living. Knowing this information can aid in understanding the effect that surroundings, urban or not, have an impact on lichen diversity.

Procedure

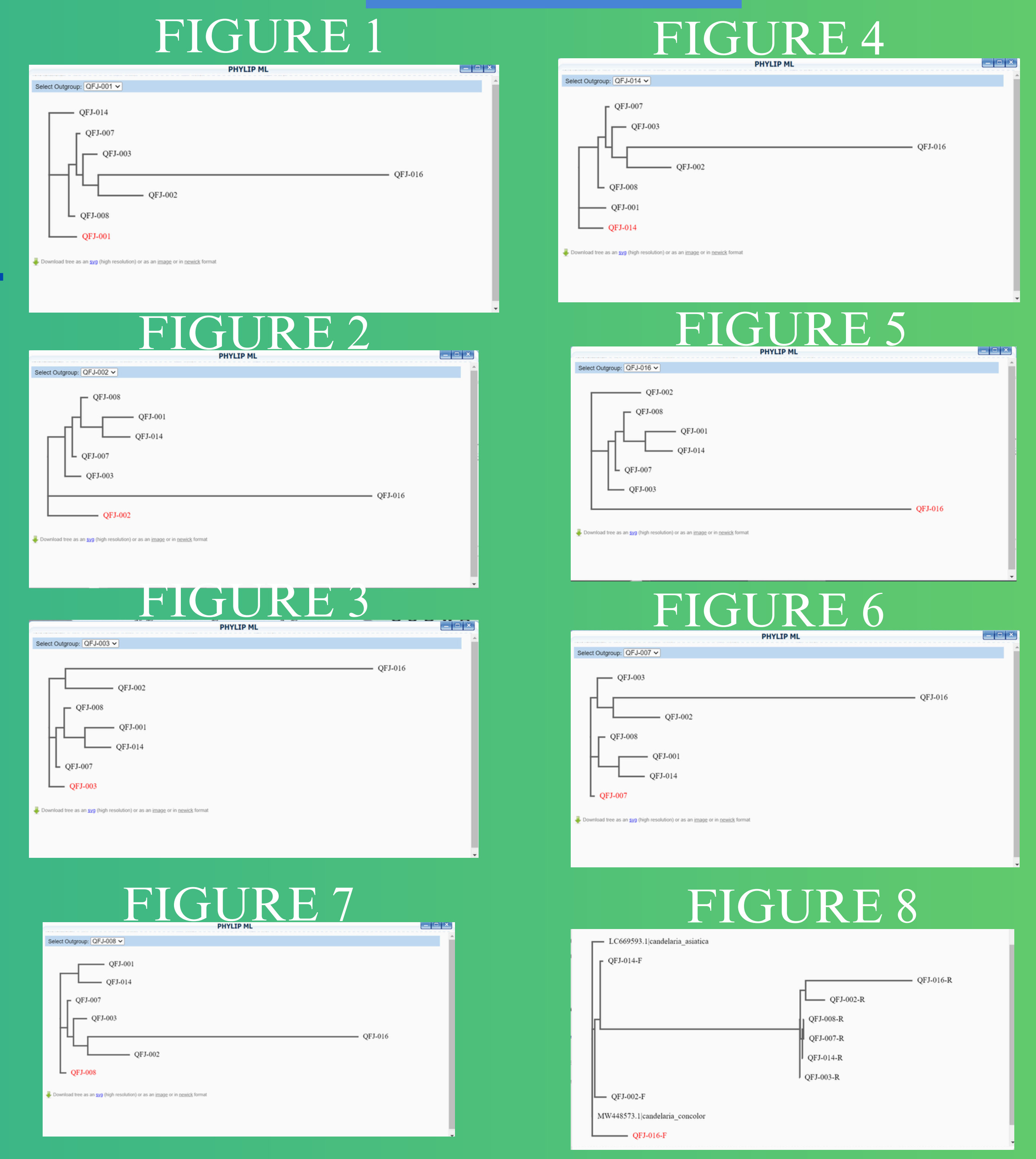
Part 1: Collecting Specimens

Part 2: Isolating DNA (Rapid DNA Isolation)

Part 3: Amplifying DNA

Part 4: Analyzing PCR Products

Graphs



Conclusion

In essence, our results highlight the impact of urban environmental conditions on lichen biodiversity. The genetic similarity observed among lichen samples from Chelsea suggests less stressful environmental conditions and greater stability compared to those from Greenpoint. This genetic similarity may indicate a lower presence of pollutants in Chelsea, fostering a more conducive environment for lichen growth and diversity. Our phylogenetic analysis supports these observations with samples 7, 3 and 4 being closely related which all came from Chelsea. Sample 16 was the farthest related to any sample, and originated in Green Point. The only exception was samples 1 and 14 which were closely related. Our results suggest that environmental conditions likely play a role in shaping lichen biodiversity.

References & Acknowledgements

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(n.d.). DNA Subway: Fast Track to Gene Annotation and Genome Analysis. Retrieved May 19, 2024, from https://dnasubway.cyverse.org/ , (2024, March 5). , - YouTube. Retrieved May 19, 2024, from https://www.pnas.org/doi/full/10.1073/pnas.0709936105 Average Rent in East Village, New York, NY | East Village, New York, NY Rent Costs. (n.d.). RentHop. Retrieved May 19, 2024, from https://www.renthop.com/average-rent-in/east-village-new-york-ny DNA Learning Center Barcoding 101. (n.d.). DNA Learning Center Barcoding 101. Retrieved May 19, 2024, from https://dnabarcoding101.org/lab/protocol-4.html Greenpoint/Williamsburg Neighborhood Profile - NYU Furman Center. (n.d.). NYU Furman Center. Retrieved May 19, 2024, from https://furmancenter.org/neighborhoods/view/greenpoint-williamsburg Lichens are in danger of losing the evolutionary race with climate change. (2022, February 15). Field Museum. Retrieved May 19, 2024, from https://www.fieldmuseum.org/about/press/lichens-are-danger-losing-evolutionary-race-climate-change Lichens | Herbarium | USU. (n.d.). Utah State University. Retrieved May 19, 2024, from https://www.usu.edu/herbarium/education/fun-facts-about-fungi/lichens The role of substrate type, moisture and temperature on the vertical growth of terricolous lichens. (2018, November 8). bioRxiv. Retrieved May 19, 2024, from https://www.biorxiv.org/content/10.1101/466227v1.full.pdf