Fungi Biodiversity in New York City

Sofia Aita, Angel Ariza, Erica Chhing

Frank McCourt High School, Manhattan Center for Science and Mathematics, New York University

URBAN BARCODE RESEARCH PROGRAM

CSH Cold Spring Harbor Laboratory DNA Learning Center

Abstract

Fungi, a diverse and enigmatic group of organisms, play crucial roles in ecosystem development, yet their biodiversity is often underrepresented. Beyond their roles as decomposers, fungi are integral to nutrient cycling, pathogenesis, and mutualistic relationships. DNA barcoding aids in identifying fungal species across geographical locations, offering insight into their biodiversity and ecological functions. Samples are collected from three different public parks and then labeled with location and time of extraction. DNA is then isolated from samples to aid in specimen identification via PCR and gel electrophoresis. To ensure a diverse dataset, three distinct samples were collected from different locations, providing a wide array of fungal specimens for analysis. Sequences obtained from DNA extraction and PCR were compared with pre-existing genome data for further analysis. Identified fungi were categorized yielding unexpected results with the categorization of Ganoderma oregonense an out of state fungi, with more common presence of Peniophora albobadia and Trametopsis cervina.

Introduction

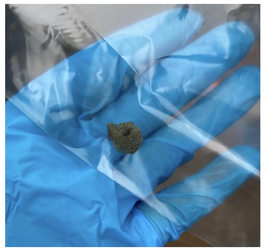
Fungi are a large and mysterious group of organisms, and many find it difficult to see where fungi fit into the diversity of an ecosystem. Fungi hold a major role in the ecosystem, not just as decomposers; they also mediate other essential processes within ecosystems. Fungi also function as nutrient cyclers, pathogens, and mutualists that live in tandem with other organisms (Olson 2022).. By discerning the nuances of fungal diversity in different boroughs, we can enhance our understanding of their ecological significance and promote more effective conservation strategies. Considering the prevalent role that fungal species play in our ecosystems, researchers need to broaden data on fungi. This project was meant to research why certain fungi are found in different areas along with analysis to see if the environment has an impact on where a fungi species may grow. This research can further help scientists examine fungal diversity in urban cities as well as contribute to ongoing data on the impacts of climate change on microbial communities. This can then help in advancing DNA barcoding methodologies, allowing researchers to explore and refine the silica DNA barcoding technique for fungal identification.

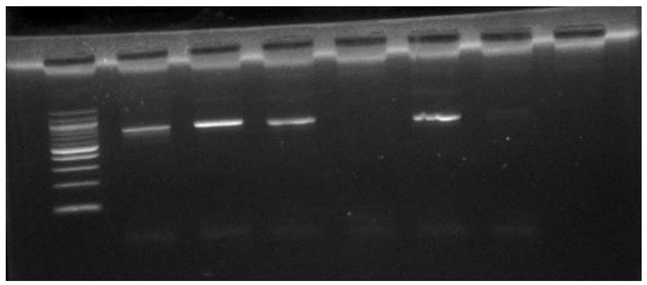
Materials & Methods

To begin the experiment we traveled to three separate boroughs and collected fungi from parks in those areas. When collecting the fungi gloves were used to gather the sample. Most of the samples were found on rotting logs, a common place for fungi to grow. The samples were collected at 3 different public parks in 3 different New York City boroughs; Bronx, Manhattan, and Brooklyn.

We isolated the DNA from the fungi by first adding 10mg of the fungi into a tube and 300 µL of lysis solution. We grinded the fungi sample in solution which assists the lysis by breaking up tougher material. After a water bath incubation for 10 minutes at 65 degrees Celsius, the tubes were subsequently placed into a centrifuge for one minute at maximum speed. This separates the organelles from the DNA, the pellet at the bottom being the organelles, while the supernatant (the liquid on top) contains the proteins and nucleic acids. Afterwards, 150 µL of the supernatant and 3µL of silica resin was mixed together in a fresh tube, that was then incubated for 5 minutes in a water bath at 57 degrees Celsius. The tube was then centrifuged for 30 seconds at maximum speed to pellet the resin. After removing the supernatant 500 µL of cold wash buffer was added to the pellet tube and centrifuged at maximum speed. After a second wash, 100 µL of distilled water was added to the silica resin, and incubated at 57 degrees Celsius for 5 minutes, and centrifuged for 30 seconds at maximum speed. After, 50 µL of the supernatant was transferred to a new tube. The sample was stored at -20 degrees Celsius until the PCR reaction is completed

We use gel electrophoresis technique to run PCR, which was then interpreted with an imaging system. For further interpretation, the band results were used as a reference to identify species. After using the UBRP-provided genome library, the sequences were compared with pre-existing genome data.





Results

Brooklyn

The first fungi we found and identified was Ganoderma Oregon, a large polypore with a lacquered cap that is mostly found on wood in the Pacific Northwest, but can also be found commonly in NYC on hardwood trees.

The second fungi found was Trametopsis Cervina, a pale yellowish brown fungi with brackets and large irregular pores that can split. It is commonly known as white rot, and is found on dead hardwoods of many genera.

The Bronx

Out of the fungi found in The Bronx, only one sample yielded results. The species found was Stereum Hirsutum, another hard-wood loving fungus with cap-like structures that fuse with each other. It was smaller than the other samples found, yet shared many close relations on the phylogenetic tree.

Manhattan

For Manhattan only one fungi species was identified, Peniophora Albobadia. This species forms a spreading crust on the bark of decaying twigs or logs of many hardwood species. It commonly resembles giraffe spots, with a reddish-brown center and a white lining.

Discussion

- Our four species identified were Peniophora albobadia, Ganoderma oregonense, Trametopsis cervina, and Stereum hirsutum.
- Ganoderma oregonense hasn't been said to have been identified in New York City as it is mostly found along the West Coast and more northern territories in North America. Finding this fungi in New York provides an expansion of survivable habitability for this fungi species as they were not previously classified as Eastern Coast fungi.
- Another species found was the Peniophora albobadia. This species is reviewed by other fungi biodiversity papers and is quite common in the NYC urban environment showing its prominence in boroughs such as the Bronx.
- The other fungi species that was found in the Bronx was the Stereum hirsutum. Stereum hirsutum is a common fungi species that can be found in many different areas in the Bronx. However, this fungi isn't only found in New York City and can be identified in many different parts of the world such as Ireland. It is safe to infer that this species is dominant in the other boroughs of New York.
- The final specimen belonged to the trametopsis cervina family. This fungi species is abundant in Northeast America and is often seen in other studies revolving around fungi biodiversity in New York City. A significant location for this mushroom is in Van Cortlandt Park where specimens have been collected previously. It is as such safe to assume that this fungi species is prevalent around all 5 boroughs considering our specimen was collected in Brooklyn.
- We had a 100% success rate with PCR since 4 out of 4 samples came back with corresponding fungi gene sequences. For further studies, a stricter collection routine with more samples would be more appropriate to get a true measure of the abundance and species of fungi that are prevalent in the NYC boroughs. Limitations included time constraints and lack of specimens found, a more ideal specimen collection season would have been ideal for more samples.

References

ARC - Plant Protection Research Institute.

Micheal Kuo

DNA Barcoding 101

Acknowledgements

Thank you to our mentor Dianny Almanzar and to the mentors in the program assisting us throughout this project.