Research Proposal:
A Study of Microbial Populations in NYBG

By Chi Chiu Lo, Saranya Radhakrishnan, Fabiha Saiyed, and Les Wong

macaulay honors college
BIOBLITZ
AT THE NEW YORK BOTANICAL GARDEN

Question

How do microbial population densities change throughout the different locations of the New York Botanical Gardens?

Introduction

There is an abundant amount of biodiversity of microbes in the natural environment but only recently have microorganisms been studied outside of the laboratory. Developments in technology have allowed the exploration of microorganisms inhabiting various environments such as freshwater, marine waters, and soil. Soil microbes, in particular, interact with the environment and have a strong influence on insect and plant populations as well as nonliving features such as soil composition. Soil microbes such as bacteria, fungi, protozoa, nematodes, and many more organisms have a small biomass and are able to sustain themselves underground with just a source of carbon to feed on (Hoorman, 2010). The great diversity and large population size creates a suitable system to understand microbial interactions and evolutionary processes which can give us an insight into human health (Buckley, 2004). By investigating how the densities of microbes change in the New York Botanical Gardens, we can observe the difference factors that impact the behavior of microbial communities.

Microbes play an essential role in recycling important nutrients that are required for plants and therefore provide an indication of quality soil. As a result, many studies have been conducted to determine the factors that influence the populations of microbes. In an agriculture experiment lead in China, field equipment was used to alter the physical properties of the soil to determine how different levels of soil bulk density affect the microbial populations underground (Li,2002). The number of bacteria and actinomycetes were measured during the plant-growing season periodically. It was observed that as the bulk density increased, the amount of microbes decreased. The graphs in the next panel show how the microorganisms decreased through the season as found in Li's study.

Methods

Undisturbed soil samples can accurately portray the microbial life in a specific location. Soil samples were collected in 24 hours at various locations in the NYBG:

- Rose Garden
- Old Growth Forest
- Native Plant Garden

Rose Garden: taken by Fabiha Saiyed

Native Growth Forest: taken by Fabiha Saiyed

Native Plant Garden: taken from NYBG website

Process of Collecting Data

- Soil cores were pushed 15 cm in the dirt, removing the soil for study
- Images of the hole and the sky directly above the hole were recorded
- Holes were refilled with surrounding soil to minimize the environmental disturbance
- Soil samples were sent to the lab for examination and identification using DNA sequencing

Left: A soil core from the old growth forest
Right: A core from the Native Plant Garden

Graphs

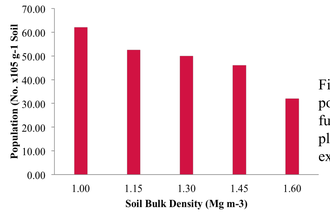


Figure 1. This graph shows the population of actinomycetes as a function of soil bulk density at the plant growth stage of the 6 fully expanded leaf (Li,2002).

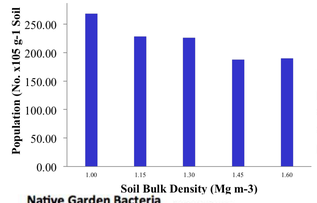
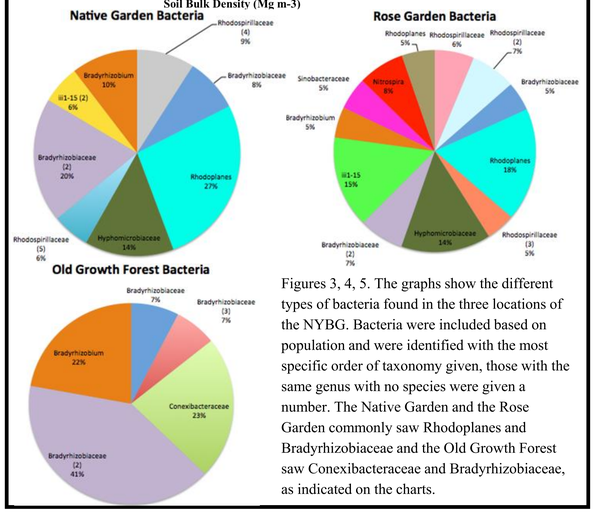


Figure 2. This graph shows the population of bacteria averaged as a function of soil bulk density at the four different stages of plant growth(Li,2002).



Figures 3, 4, 5. The graphs show the different types of bacteria found in the three locations of the NYBG. Bacteria were included based on population and were identified with the most specific order of taxonomy given, those with the same genus with no species were given a number. The Native Garden and the Rose Garden commonly saw Rhodoplanes and Bradyrhizobiaceae and the Old Growth Forest saw Conexibacteraceae and Bradyrhizobiaceae, as indicated on the charts.

Map

Left: Areas circled in blue are the collection sites from NYBG

Right: A chart of core location and the description of the soil and area where it was taken

Site	Core Depth	Core Description	Area Description
Rose Garden	15mL	Compact, moist	Flowers (Rosaceae all around)
Rose Garden	25mL	Fine, moist, compact	Bushes, shrubs, cinderella
Rose Garden	20mL	Relatively fine, moist, dense	Roses(Double knock out), grass
Rose Garden	30mL	Thick, compact, wet, fine grained	Rose bushes (Rosa Janice Kellogg)
Rose Garden	25mL	Compact	Roses, grassy
Rose Garden	25mL	Wet, compact, soft, spongy, rich, dark	Rose bushes
Old Growth Forest	15mL	Compact, moist	Plants all around
Old Growth Forest	20mL	Loose, fine	Trees
Old Growth Forest	20mL	Fine, sandy, dry, not dense	Trees
Old Growth Forest	25mL	Reddish-brown, fine	Oak trees, saplings
Old Growth Forest	20mL	Loose, moist	Grassy, sapplings, dead tree, leaves
Old Growth Forest	35mL	Dry, loose, fine	Trees
Native Garden	20mL	Dry, loose on top and compact underneath	Lavender weeds, plant all around
Native Garden	25mL	Compact, dry, coarse	Some bushes
Native Garden	20mL	Dry, Fine	Trees, Scrubs, Zizia aurea
Native Garden	15mL	Slightly moist, coarse, powdery	Bushes, flowers
Native Garden	25mL	Loose, fine	Grassy, lavander
Native Garden	25mL	Clay, warm, sandy dry	Grass, leafy plant, flower plants

Proposal

When collecting the soil core samples, we took note of the density (whether it was loose or compact) of the soil that we collected. We want to conduct a study similar to the study in China. We want to see how soil density affects the population densities of different microbes. We hope to have our soil cores sent to a lab in order for the microbes living in them to be identified by their DNA sequences. This will give us an understanding of what types of microbes can thrive in different types of soil. From there we can see how the microbial populations through the different areas in New York Botanical Garden differ.

Citations

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- Hoorman, James. J., Islam, Rafiq. *Understanding Soil Microbes and Nutrient Cycling. The Ohio State University. 2010. Print.*
- Li, C. H., B. L. Ma, T. Q. Zhang. *Soil Bulk Density Effects on Soil Microbial Populations and the Enzyme Activities During the Growth of Maize(L.) Planted in Large Pots Under Field Exposure. Canadian Journal of Soil Science 82.2(2002): 147-54. Web.*

Acknowledgements

We would like to say thank you to the following people and organizations:

- Macaulay Honors College
  For giving us the opportunity to participate in the BioBlitz
- New York Botanical Garden
  For hosting the BioBlitz
- Jessica Joyner; Ph.D.
  CUNY, Brooklyn College, Postdoctoral Fellow
  For sequencing the microbe data collected at the BioBlitz
- Kelly O'Donnell; Ph.D.
  CUNY, City College
  For being our professor and guiding us through this Project
- Macaulay Honors College class of 2017
  For collecting the soil samples during the BioBlitz

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