Effect of Disturbance Events on the Abundance of Soil Bacterial Communities

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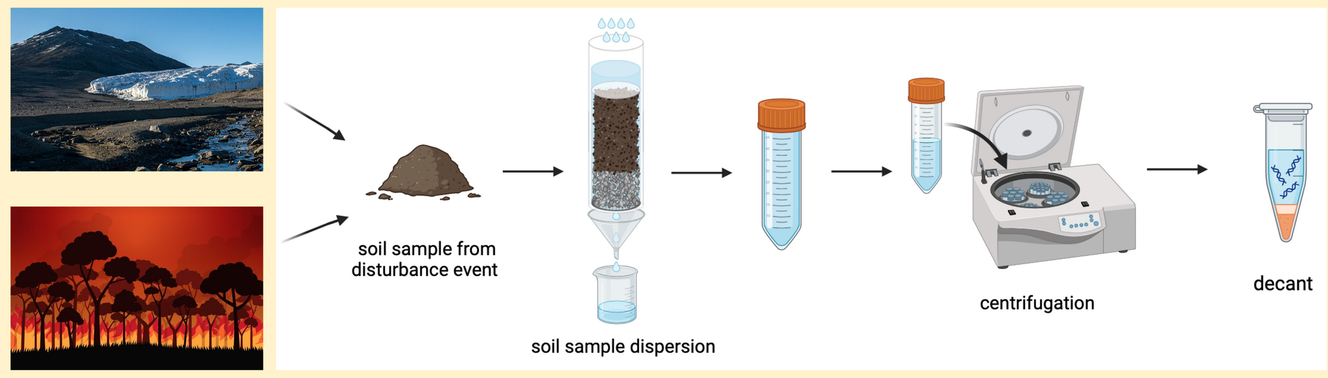
Introduction

- **Disturbance event:** a pronounced temporary change in environmental conditions that is caused either naturally or by humans.
- Can cause habitat destruction and fragmentation which can alter the spatial arrangement of ecosystems and isolate populations.
- Influences abundance and distribution of species within a population which can cause a rise or decline of certain bacterial communities as response to the change in resource availability and conditions after a disturbance event.
- Our main **objectives** are to
  - analyze the effect of two disturbance events (wildfires and deglaciation) on soil bacterial communities; and
  - evaluate the differences and causes behind differences in abundance and phyla that arise in these communities post-disturbance
- Understanding which bacterial species arise after a disturbance event can provide insights into the processes of soil formation and nutrient cycling. Also, knowledge of ecological succession can help researchers in predicting the impact of climate change on ecosystems.

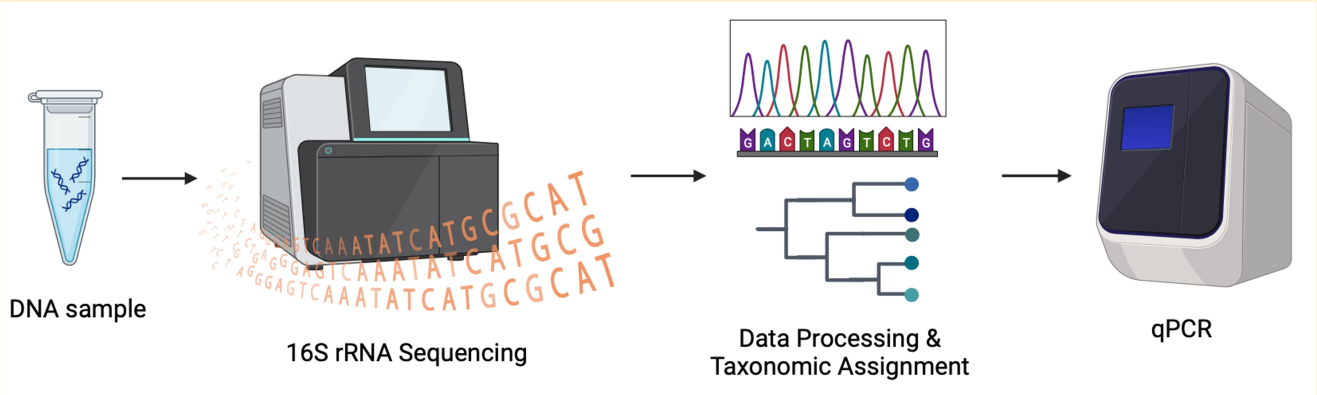
Materials and Methods

1. ***Analyzing Research Papers:*** Two focusing on species abundance changes before and after wildfires and two on species abundance after deglaciation.

1. ***Soil Sample Preparation:***



1. ***Bioinformatics Analysis:***



1. ***Statistical Analysis:*** ASV Identification, Shannon-Diversity, Bray-Curtis, and MSD Plots were constructed. To assess significant differences between the two disturbance events, a two-sample T-test was conducted.

Figures

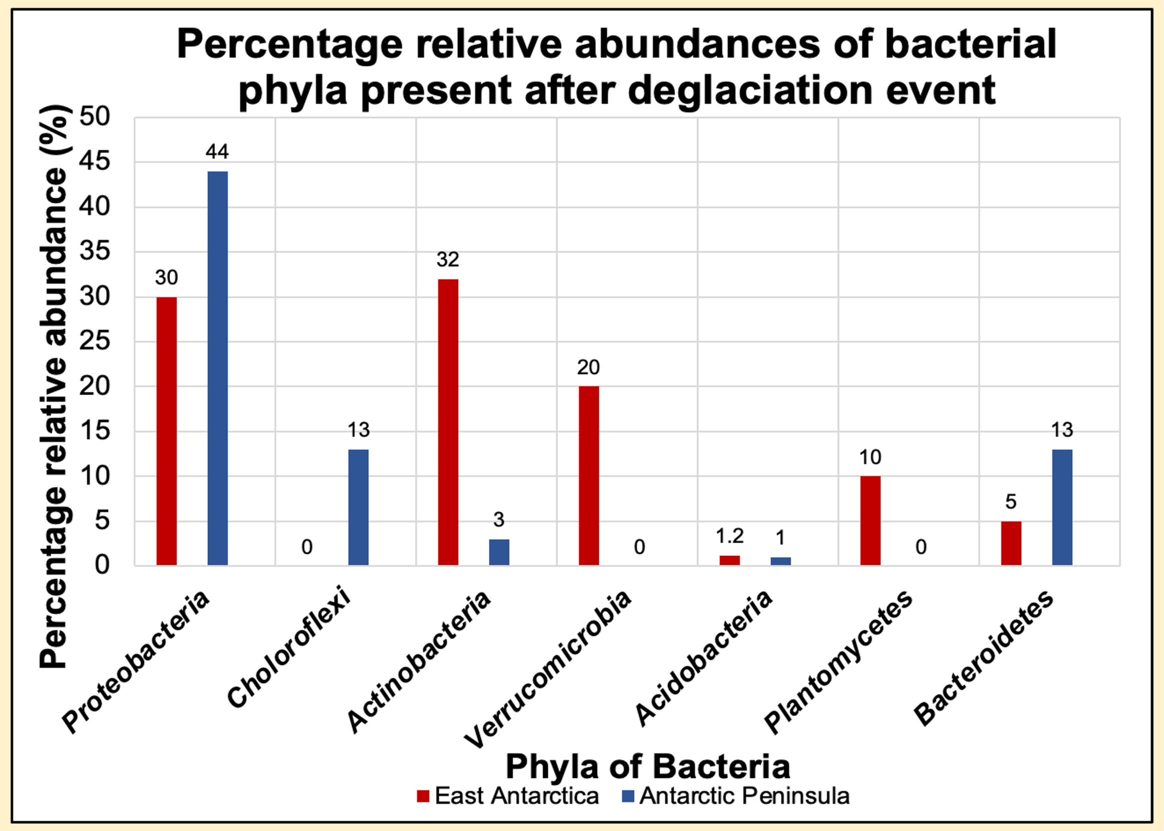


Figure 1. Bar graph depicting the percentage relative abundance of each bacterial phyla present after a deglaction event in East Antarctica and the Antarctic Peninsula.

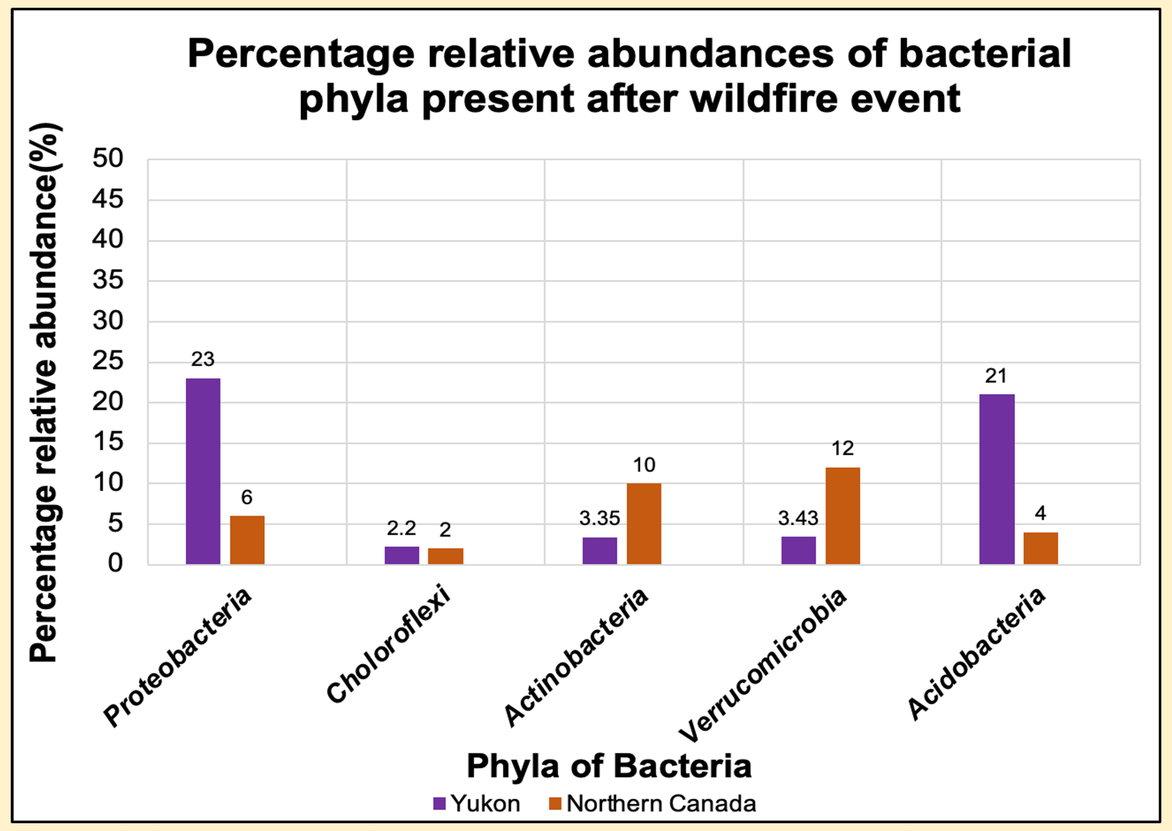


Figure 2. Bar graph depicting the percentage relative abundance of each bacterial phyla present after a wildfire event in Yukon and Northern Canada.

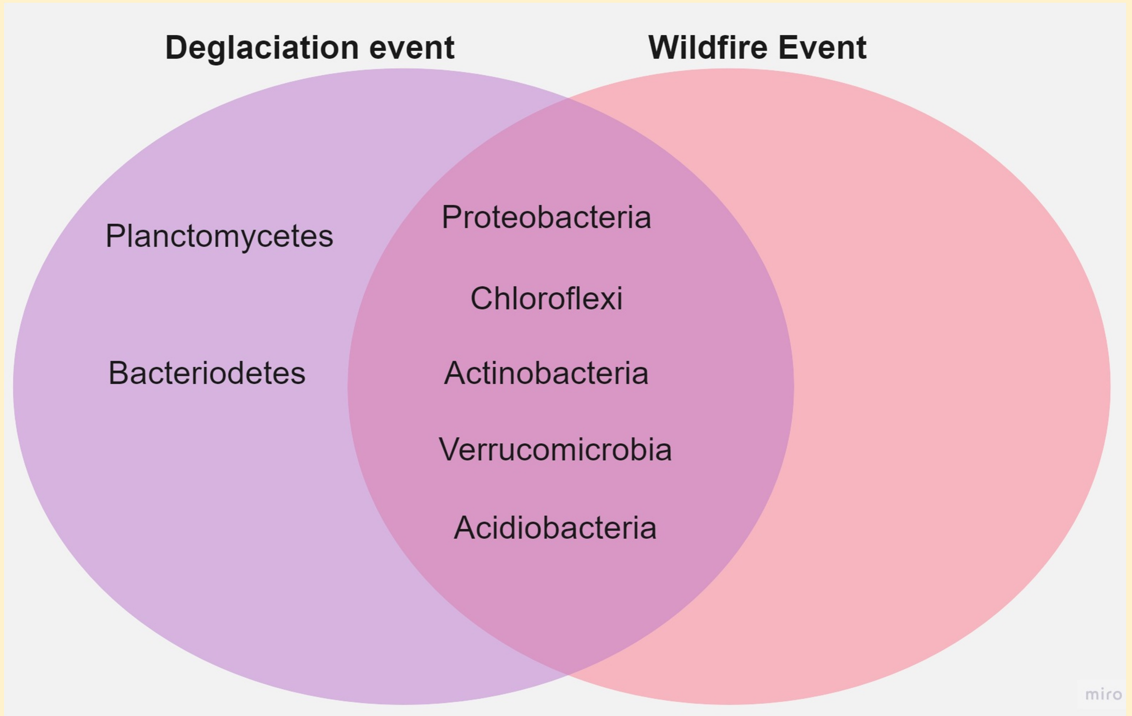


Figure 3. Venn diagram depicting the bacterial phyla that were present post each disturbance event while specifically comparing which phyla were seen in both events and which were restricted to a specific event.

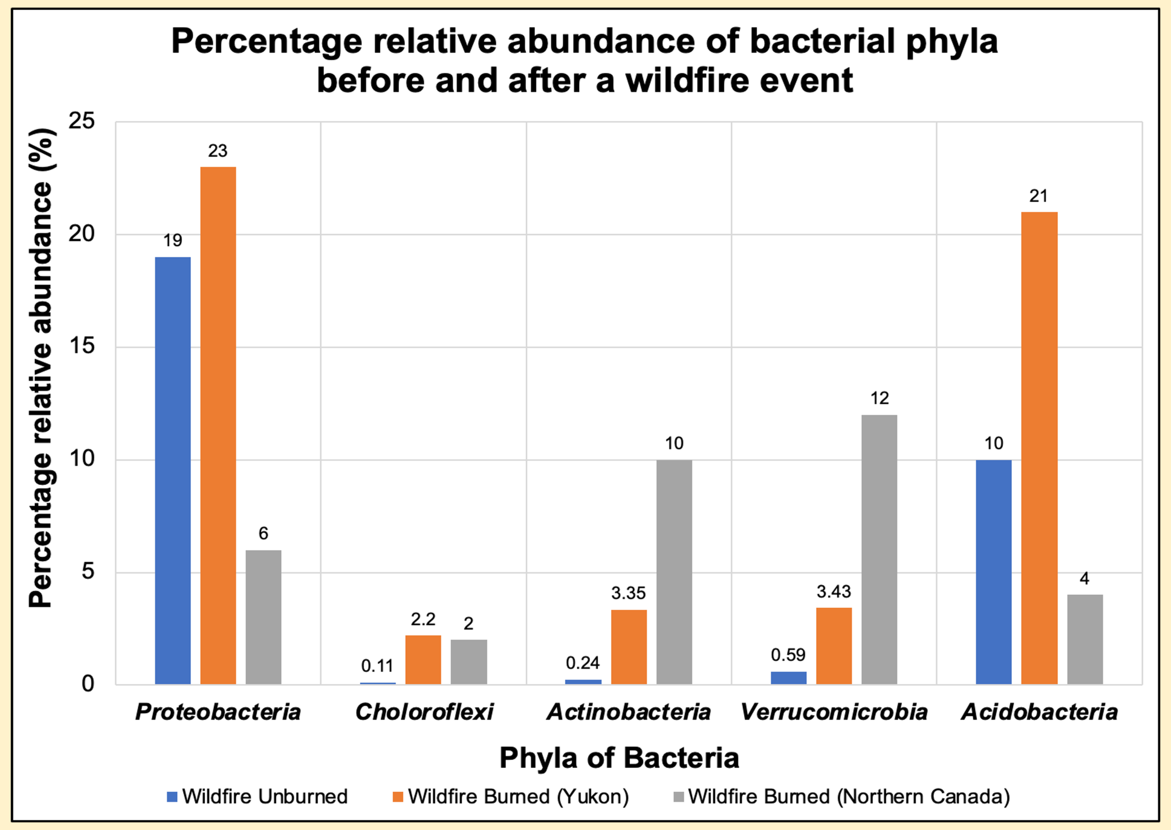


Figure 4. Bar graph depicting the percentage relative abundance of each bacterial phyla present before and after a wildfire event in Yukon and Northern Canada.

Results

Figure 1 - What are the bacterial phyla that arise after a deglaciation event?

- Knowing that prior to a deglaciation event there is minimal microbial species in the soil communities of a glacier, this figure shows the new bacterial phyla that arose post-deglaciation.
- In the East Antarctica sampling site, the highest relative abundance (%) was seen in *Actinobacteria, Proteobacteria,* and *Verrucomicrobia*. In the Antarctic Peninsula sampling site, the highest relative abundance (%) was seen in *Proteobacteria, Bacteroidetes,* and *Chloroflexi*.

Figure 2 - What are the bacterial phyla that arise after a wildfire event?

- Knowing that a wildfire event can hugely alter the abundance of bacterial communities that inhabit the soil, this figure shows which bacterial phyla were present post-wildfire.
- In the Yukon sampling site, the highest relative abundance (%) was seen in *Proteobacteria* and *Acidobacteria.* In the Northern Canada sampling site, the highest relative abundance (%) was seen in *Verrucomicrobia* and *Actinobacteria*.

Figure 3 - Which bacterial phyla are seen post-wildfire and post-deglaciation (restricted and common)?

- The Venn diagram provides a comparison between the bacterial phyla present and absent at both sampling sites post each disturbance event.
- Five bacterial phyla are present in soil communities post-deglaciation and post-wildfire. Two bacterial phyla are only seen in the post-deglaciation soil communities. No bacterial phyla were unique to the post-wildfire soil community.

Figure 4 - Did the abundance of bacterial phyla increase or decrease after a wildfire event?

- When compared to the abundance of bacterial phyla in the unburned sites, there was an overall increase in abundance in *Chloroflexi, Actinobacteria*, and *Verrucomicrobia*.
- For *Proteobacteria* and *Acidobacteria,* there was increase in abundance in the Yukon sample but a decrease in the Northern Canada sample.

Conclusion Statement

- *Actinobacteria* could be observed after each event because it plays a major role in soil development by carbon and nitrogen cycling thereby producing organic matter available for plants and other organisms in the soil.
- *Verrucomicrobia* was present after each disturbance event as it largely contributes to the soil formation by nitrogen cycling.
- *Chloroflexi* was observed in both disturbance events because some members of the phyla are aerobic thermophiles which could be observed in a post wildfire event and some are anaerobic phototrophs that could be present in a deglaciation event.
- *Acidobacteria* was expected to be in high abundance after a deglaciation event because of the high nutrient content present which helps for an increase in efficient carbon cycling, but they are usually adapted to sites where there is a low-nutrient availability. Therefore, we see an increase in *Acidobacteria* abundance after a wildfire compared to deglaciation.
- *Proteobacteria* was observed in highest abundances across both events because some classes of *Proteobacteria* perform nitrogen fixation in soil, acting as major contributors of nitrates which are essential plant growth.
- *Planctomycetes* are able to perform anaerobic respiration as a decreased oxygen concentration is observed after a deglaciation event.
- *Bacteroidetes* are only observed in deglaciation events. They thrive in anaerobic niches where oxygen availability is limited.

Future Works

- The study conducted by Zhou, *et al* could benefit by investigating the trend of abundance of the sampling site over many years.
- The study conducted by Yan, *et al* could be improved by studying the rare bacteria on long soil chronosequence events and investigate how the rare bacteria contribute to the stability of the bacterial community and the soil development over the years.

References

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