Nitrogen Deposition Effects on Microbial Communities in Desert Soils

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Introduction:

- This project explores how nitrogen deposition caused by rising populations emitting more nitrogen into our atmosphere affects the microbial communities in soil in the Sonoran Desert, the home of CAP LTER.
- Ecologists have studied the impact of nitrogen deposition in other environments both through field and lab experiments.
- People have also studied the microbial communities in deserts, but no studies have yet explored the effects nitrogen deposition has in microbial communities in a desert.
- There has yet to be a study on how the addition of nitrogen in the field plays a role in the carbon utilization of microbial communities in desert soils.

Research Questions:

1. Does nitrogen deposition affect the rate and diversity of carbon utilization of microbial communities in Sonoran Desert soils?

2. How does other physical and chemical properties of the soil (texture, pH, conductivity, etc.) affect the microbial communities?

We hypothesize that the nitrogen deposition will cause greater diversity and a faster rate of utilization in the microbial communities. We expect there to be communities inside the city with greater C consumption capabilities, as they might not be as N-limited and they might have more nutrients, so they have fewer limitations on the types of carbon they can consume. Additionally, we predict that the chemical and physical properties of the soil significantly affects the microbial communities.

Methods:

Sampling

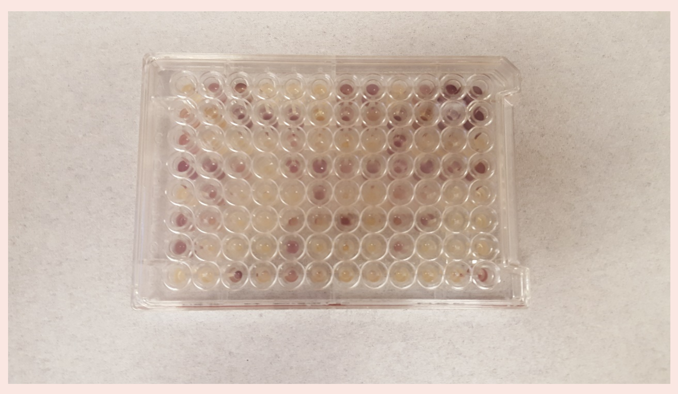
Field sampling took place over May and June of 2016.

Sites: The sites chosen for this project were the CAP LTER CN Dep sites, where there were control plots and plots with N added to the soils. At each site, 5 soil cores were taken from two plots, a control plot and a nitrogen-enriched plot. The areas included:

Core:
- Piestewa Peak
- South Mountain – East
- South Mountain - West

West:
- Estrella Mountains – North
- Estrella Mountains - South
- White Tanks

East:
- Lost Dutchman
- Salt River Recreation
- Usery Mountain



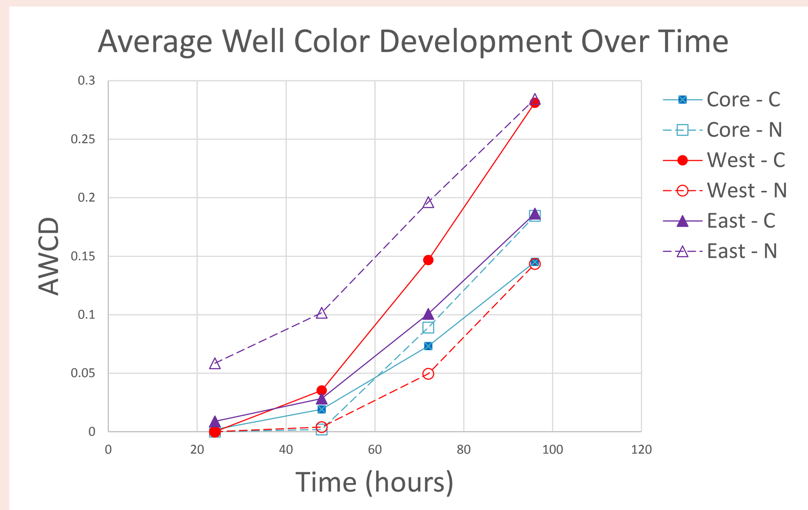
Microbial Communities

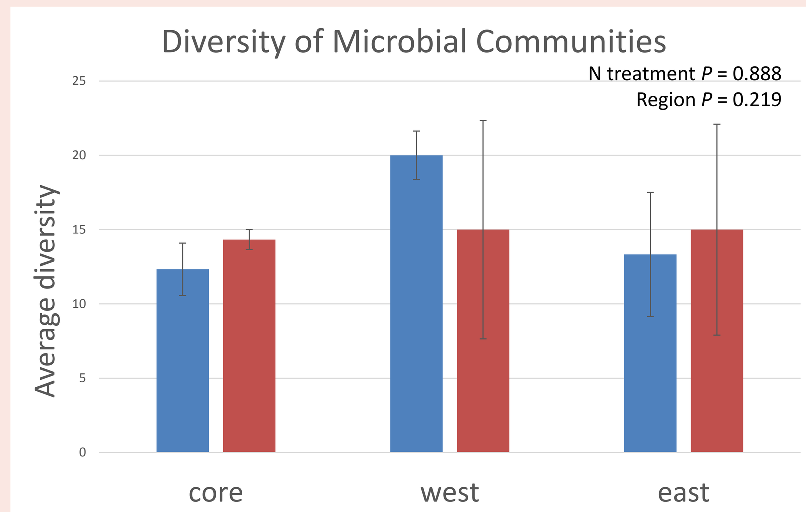
- Soil samples mixed with 1X PBS
- Diluted 1:10 with DI Water
- Pipetted into Biolog Carbon Utilization plates
- A microbe eating a carbon source and respiring causes the well to turn purple.
- The average well color development (AWCD) is found using microplate spectrophotometry over the course of a week.

Soil Chemistry

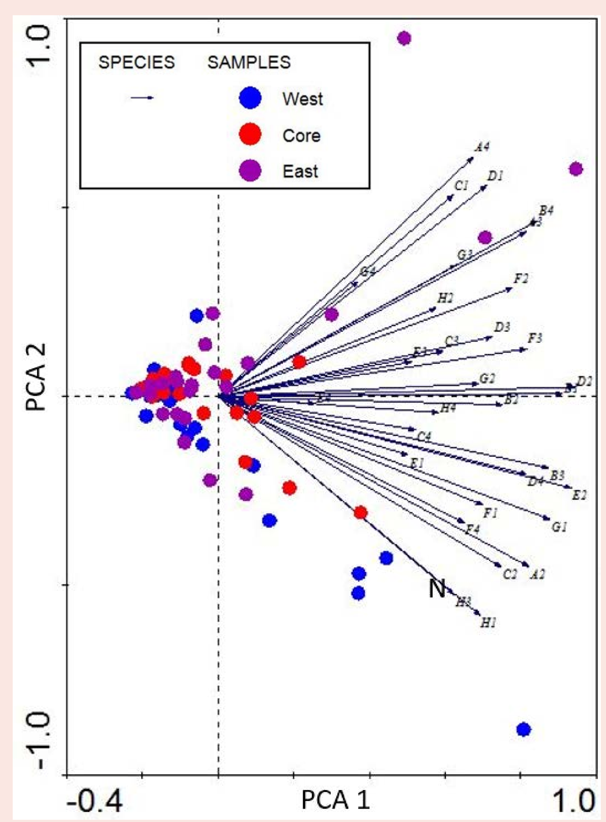
- Nitrate/Nitrite
- Ammonia
- Phosphate
- Moisture Factor
- Texture
- Carbon and Nitrogen
- pH
- Conductivity

Initial Results & Discussion:



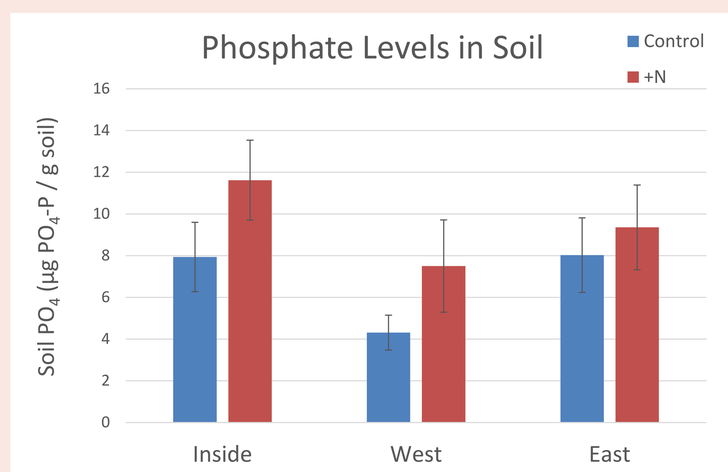


There is very little variance in the AWCD and Diversity of microbial communities among the inner-city samples and outer-city samples as well as the nitrogen-enriched samples.

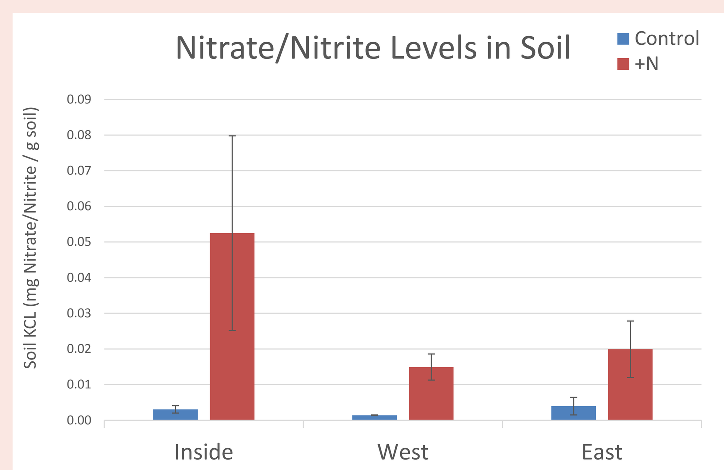


Principal Components Analysis

- East sites associated with: L-argenine, Tween 40, Tween 80, L-asparagine, D-Galactonic Acid γ-Lactone (N)
- West sites associated with: α-D-Lactose, D-malic acid, i-Erythritol, β-Methyl-D-Glucoside
- Core doesn't get as much well-color development, but perhaps tends to be more similar to western sites.
- No big differences between control and +N



There are little differences in phosphate levels from plot to plot.



There is higher levels of nitrate/nitrite in the N+ plots, and there is a larger amount of nitrate/nitrite levels in the city.

Conclusions:

Our results suggest there is very little difference between the microbial communities with varying amounts of nitrogen deposition. There are differences in amounts of nitrogen in the city and out of the city, which was expected, but these differences did not change the diversity and rate of carbon utilization of the microbial communities. Future directions will include examining how the other chemical and physical properties of the soil affect these microbes, as well as using other metrics to assess the microbial communities such as molecular sequencing and biomass.

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