The Impacts of Deicing Salts on Chicagoland Roadside Soil Composition

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Introduction

- Every year deicing salts are applied to Chicagoland roads in preparation of winter. Due to melting snow and rainfall, runoff can occur and cause deicing salts to also be applied to roadside soils.
- Increasing salinity can become a major threat to microbial communities and decrease decomposition rates. This occurs because increasing salinity in soil also increases the pH of soil. This makes the soil more basic to the point where microbial communities can no longer thrive successfully.
- Increasing salinity in soil can directly affect nutrient uptake in plants. For instance an increase in salinity can reduce the amount of nitrate and potassium plants can uptake from soil.
- An increase in salinity in soil can also cause plants to go through complex interactions that affect plant metabolism.
- The soil samples collected this year are part of a study that started in 2006.

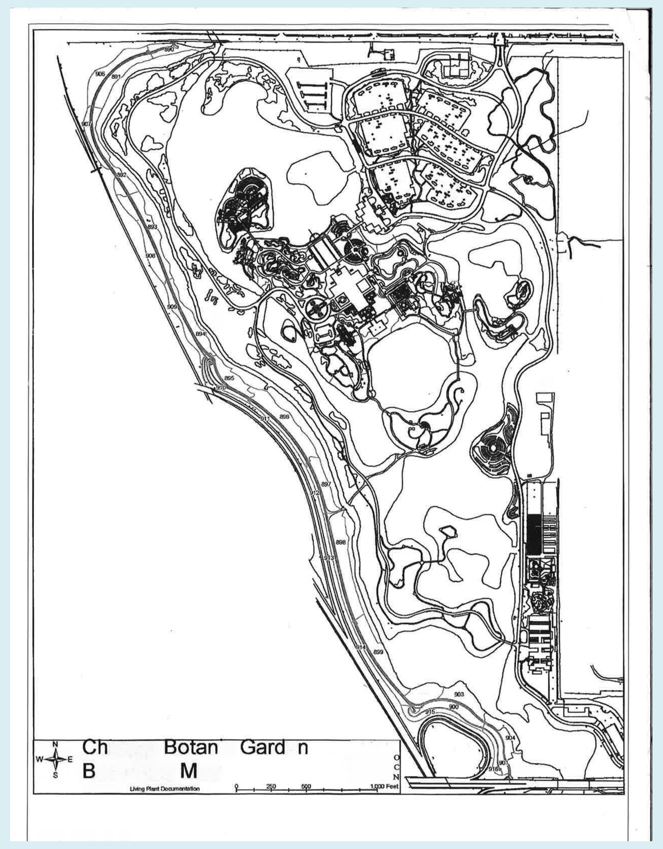
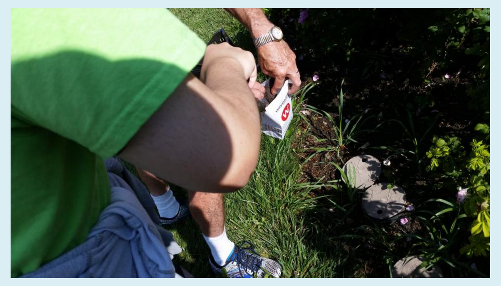


Figure 1. Map of Chicago Botanic Garden Berm.

Questions & Hypotheses

- Q1: How has soil salinity and pH changed in the past 10 years at the Chicago Botanic Garden berm?
  - We expect soil salinity to constantly increase over time showing an almost linear relationship depending on how much rainfall occurred during each year.
  - With an increase in salinity there should be an increase in pH overtime
  - The berm should also help mediated the amount of salt that is encroaching on the inside of the wall.
- Q2: How has soil composition change in the past 10 years at the Chicago Botanic Garden berm?
  - With an increase in salinity there should be a decrease in microbial communities such as mycorrhizal fungi.
  - With a decrease in microbial communities there should be a decrease in soil nutrients such as nitrate, phosphate, and ammonium.



Methods

- 72 soil samples were collected along both sides of the berm.
- Soil nutrient analysis for nitrate, phosphate, and ammonium were conducted using an epoch microplate spectrophotomer.
  - Using the absorbance values giving by the epoch, concentration values for nitrate, phosphate, and ammonium were calculated.
- Carbon and nitrogen percentage were analyzed using a leco combustion analyzer.
- Salinity and pH of soil samples were measured using a portable salinity meter and a portable pH meter.
- Two sample t-tested were used to compare the averages of both 2006 data and 2016 data

Results & Discussion

- Q1: How has soil salinity and pH changed in the past 10 years at the Chicago Botanic Garden berm?
  - There was a significant difference between the average salinity of year 1 and year 10 ($p < .001$).
  - However, the average pH between both Year 10 and Year 1 did not have a significant difference. ($p > .005$)
  - Year 10 average salinity was lower than year 1 average salinity
  - The Chicago Botanic Garden Berm did not mediate the salinity in a meaningful way. The average salinity of the soil inside the berm compared to outside the berm did not have a significant difference. ($p > .005$)

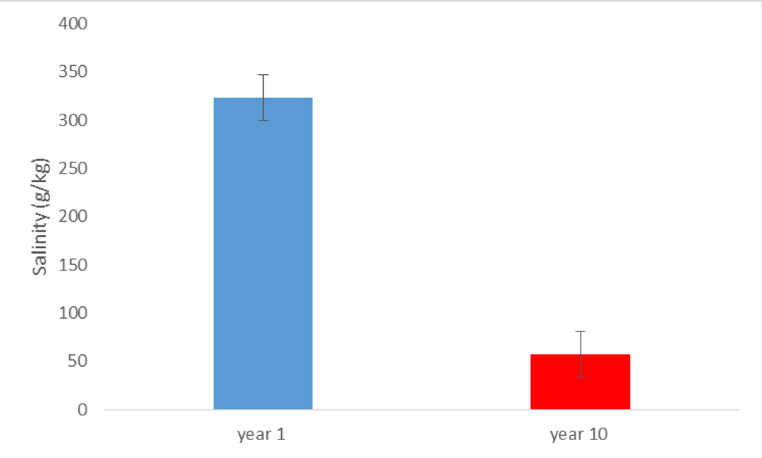


Figure 2. Average salinity for year 1 (2006, blue) and year 10 (2016, red)

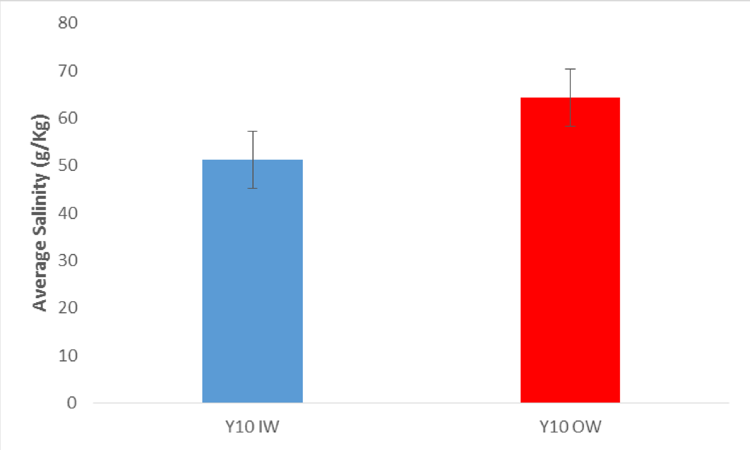
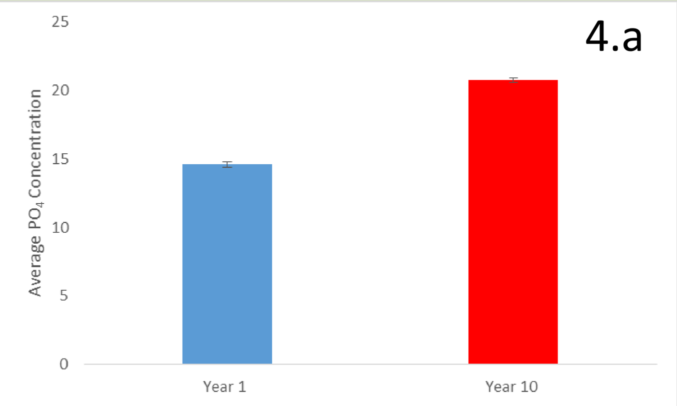
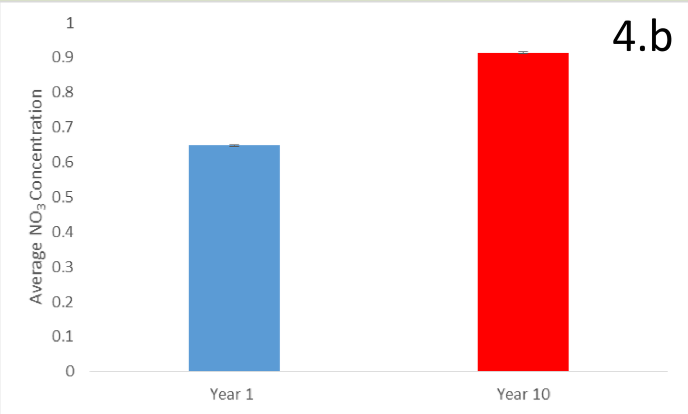


Figure 3. Average salinity for year 10 Inside wall (Blue) and year 10 outside wall (Red)

Results & Discussion (cont.)

- Q2: How has soil composition change in the past 10 years at the Chicago Botanic Garden berm?
  - There was a significant difference between the average concentration of nitrate, phosphate, and ammonium between Years 1 and 10. ($p < .001$)
  - Year 10 had the greatest amount of nitrate, phosphate, and ammonium





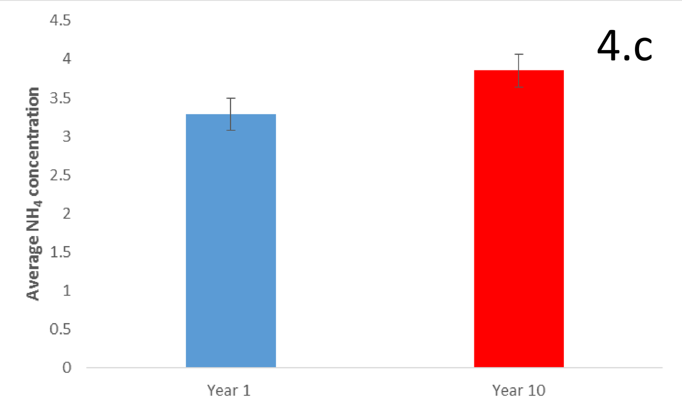


Figure 4.a, 4.b, and 4.c. Average concentrations for Nitrate, Phosphate, and Ammonium for years 1 (2006, Blue) and 10 (2016, Red)

Conclusion

- Comparing year 1 to Year 10 salinity has decreased significantly.
  - During year 1 the soil along the berm was new and did not have establish plants thriving there yet. If plants were establish this could help mediated the salinity in the soil.
  - This study only took in account year 1 and year 10. There are more years that need to be analyzed to see a trend in salinity.
- Comparing year 1 to Year 10 pH has not significantly changed
  - Method used in measuring pH could be flawed. The pH meter used was not accurate with readings.
  - The salinity in the soil for both years was not enough to significantly change the pH.
- There is no significant difference between the soil salinity inside and outside the berm.
  - Wind can also be a method of moving salt from outside the berm to inside the berm.
- Comparing year 1 and year 10 nitrate, phosphate, and ammonium are higher during year 10.
  - Year 10 has established plants and must have established mycorrhizae, this could increase the amount of nutrients in the soil.

Acknowledgements

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