A Study of Road Salt Pollution in Prospect Park

Brooklyn College, The City University of New York

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National Science Foundation

INTRODUCTION

Snow and ice on streets and highways pose a major threat to safety and human life, and have the potential to significantly disrupt economic activity and cripple people's livelihood. For the past 50 years, the most effective and inexpensive method of controlling this threat has been through the liberal distribution of road salt — sodium chloride (NaCl). However, deicing with NaCl is not without risk: At certain levels, NaCl is toxic to plants and animals. Indeed, 50.8% of woody plant species are sensitive to NaCl, which at elevated levels creates osmotic imbalances, inhibiting water absorption and reducing root growth. NaCl can also inhibit certain soil bacteria, which will ultimately compromise the soil structure and inhibit erosion control. Therefore, the effects of road salt pollution on the surrounding environment should be taken into consideration. To study the impact of road salt pollution in Prospect Park in Brooklyn, New York, students at ITAVA high school collected soil samples after the last major snow and the last salting of the roads of the 2010 – 2011 season at two different time points approximately 6 weeks apart (Time 1 & Time 2). Soil samples were measured for conductivity, a proxy for salinity, and an indicator of how much salt is staying in the ground. Results from Time 1 indicated significantly higher concentrations of salt nearer the road than away from the road (approximately 20m). However, this difference disappeared in the results of Time 2, possibly indicating that salt concentrations nearer the road had dissipated considerably, reaching what are assumed to be normal levels. Results from this one study are inconclusive. An on-going long-term investigation into the effects of road salt pollution in Prospect Park has been suggested. Here's how do we did it.

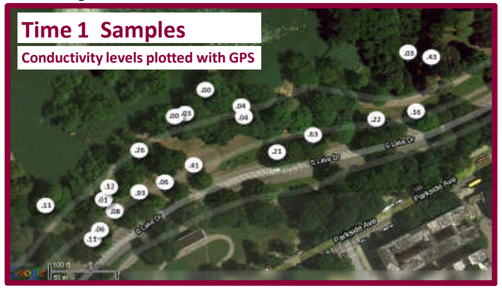
METHOD & MATERIALS

For soil sample collection: small trowels, small Ziploc baggies, sharpie pen, GPS unit, clipboard, large sturdy carrier bag to hold all the samples, pen & paper to record sample numbers and location.

For analysis: conductivity meters, small beakers, spatulas, graduated cylinders, balances, distilled water, and data recording sheets.

Time 1 Samples

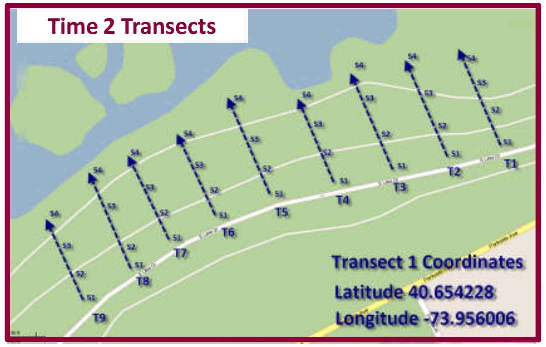
Conductivity levels plotted with GPS



PROCEDURE

Soil samples were collected at two different time periods in the same grassy section of South Park Drive in Prospect Park in two slightly different ways. At Time 1, 22 soil samples were collected at ~20 meter intervals: about 50% of the samples collected at the curbside next to the road and the remaining 50% of the samples were collected at varying distances away from the road (range from road ~20 – 30m). At Time 2, soil samples were collected at 4 points along 9 transects that started at the roadside and worked in a perpendicular fashion away from the road. For each transect, the first soil sample was taken at curbside, with each successive sample taken ~5 - 10m away from the previous sample. For each soil sample, topsoil was removed and soil from ~5cm below the surface was collected, placed in a baggie, and tagged with a sharpie. (Note: A previous batch of samples was lost when paper tags were placed inside the baggies. Condensation formed before the samples were analyzed causing the ink on the tags to run and the paper tags to deteriorate.) GPS coordinates were taken for each sample and recorded.

Time 2 Transects

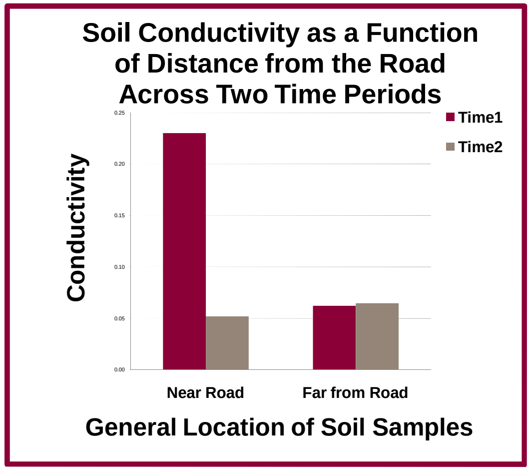


CONDUCTIVITY ANALYSIS

Soil was mixed with distilled water at a ratio of 2:1 (50 ml distilled water: 25 g of soil). The resulting solution was stirred by hand for ~2min and left to settle for ~2min. Conductivity meters were immersed into the solution carefully so as not to touch the bottom of the beaker or disturb the sediment. For each sample, conductivity measurements were made three times and the average of the three measurements was recorded and entered into a spreadsheet.

When NaCl is added to water, NaCl releases ions and increases conductivity. Conductivity refers to the ease with which electric current can pass through a substance or solution.

RESULTS



Conductivity was highest at Time 1 for the soil samples collected near the road. At Time 2, conductivity levels near the road had returned to levels observed away from the road. Where did all the salt go?

Results

At **Time 1**, conductivity levels from soil samples collected near the road (M = 0.23, SD = 0.27) were significantly higher than those collected away from the road (M = 0.06, SD = 0.07), as indicated by a (marginally) significant independent t test, $t(19) = 1.989$, $p = .06$.

At **Time 2**, conductivity levels from soil samples collected near the road (M = 0.05, SD = 0.03) were not significantly different from those collected away from the road (M = 0.06, SD = 0.07), as indicated by a non-significant independent t test, $t(36) = -0.715$, $p = .479$.

When all four points across both time periods are looked at together, we can see that the only the conductivity levels in the soil samples collected near the road at Time1 were significantly higher than the other three points, as indicated by a significant one-way ANOVA, $F(3, 55) = 5.679$, $p = .002$, and follow up Bonferroni post-hoc test, p 's < .01.

DISCUSSION

We're not finished!

In this study, we examined road salt pollution in Prospect Park, Brooklyn by determining the conductivity levels in the soil. Previous studies show that the salt concentrations ranging from 2000-16000 µS/cm are harmful to the crops and inhibit growth.[1] According to these figures, our results suggest that the salt concentrations in Prospect Park at Time 1 and Time 2 (February 16th and March 30th; about 6 weeks apart) are not at levels high enough to pose an immediate threat to the plant life or the water system in the park.

Where did all the salt go? One factor that may have contributed to the lower levels of salt concentrations is the methodology employed to collect the soil samples at Time 2. The samples were collected by digging only 5cm deep into the soil: Maybe the salt that had been on the ground for close to two months, had already penetrated deeper than 5cm into the soil. If this is true, then salt levels that we determined could, in fact, have been lower than the actual levels. That said, it should also be noted that low-level concentrations of salt were observed in the soil at distances of over 25 meters from the road. Future research should collect soil samples at varying deeper distances than 5cm and also explore how far the salt travels from the road. Checking conductivity levels in the summer might also be informative.

Selected References

G. A. Prior, P. M. Berthouex, A Study of Salt Pollution of Soil by Highway Salting, *Highway Research Board*, **1967**.

Acknowledgments

We'd like to thank our teachers Mr. Julius Buh-Mbi and Mr. Rony Charpentier, and the GK12 fellows Michael Magee and Reena Rahi for their guidance and support of this project.

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