Elemental composition of soils in an urban park: strategy for conservation and management

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Objective:

Urban parks represent complex ecological framework often altered from its natural state by urbanization and land cover change (Byrne 2007). Development of viable management strategies requires analysis of existing state of soils, including their chemical composition that can demonstrate changes in levels of various elements that might affect (negatively or positively) ecological conditions in the park (Heneghan et al 2008). Samples were taken in Van Cortlandt Park, a 1146 acre municipal park in Bronx, NY.

Research Questions:

1. What are the concentrations of various elements within the soil of Van Cortlandt Park?
2. Do elemental concentrations differ in each area?
3. Do elements correlate with each other? Context dependent?

Methods:

Site description: Van Cortlandt Park, Bronx, NY

1. Northwest Forest (NWF)
2. Croton Woods (CW)
3. Vault Hill (VH)
4. Tibbetts Brook Floodplain (TBF)

Sampling method:

- 80m linear transects (n=15)
- 5 sampling plots 8x8m each transect
- Soil at 5inch depth within plot

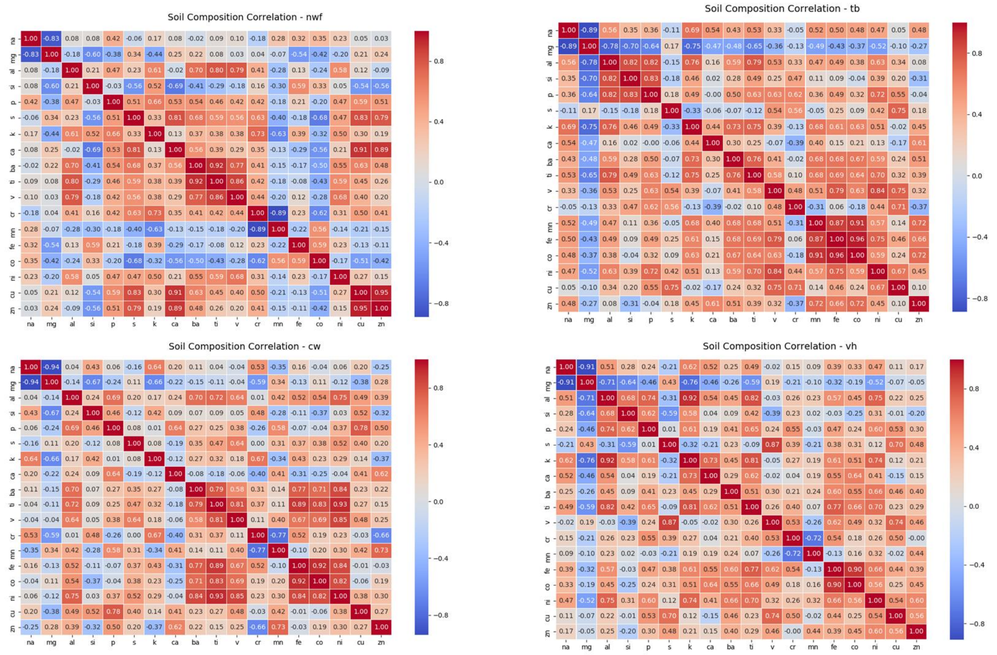
Laboratory preparation of samples:

- Soil dried at 70*C for 72hrs.
- Sieved through .25 mesh
- Samples analyzed by XRF

Statistical Analysis:

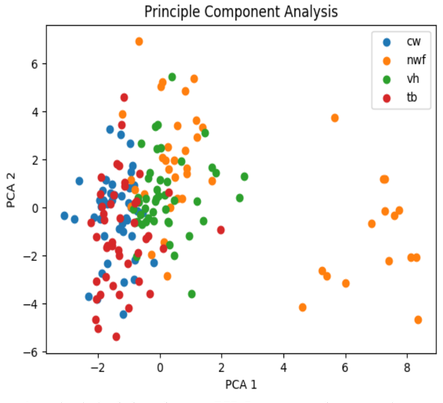
- Use a variety of modeling techniques including general linear modeling (GLM), multivariate statistics (PCA & NMDS) and parsimony analysis.

Correlation Matrix:



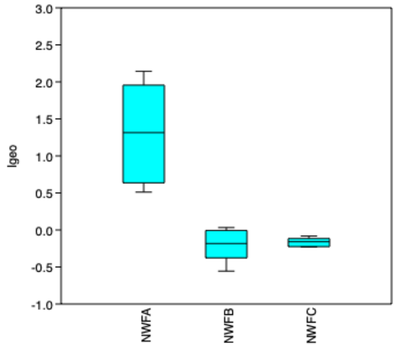
Inversely related elements are represented as values which are close to a value of -1.0 in the matrix, or dark blue on the heat map. Positive relationships are shown with positive numbers in red. Correlation patterns seem to be dependent upon site and therefore ecological community type.

Principal Components Analysis:



An initial look at KMeans clustering among these 4 different regions initially show that clustering is possible.

Index of Geological Accumulation Analysis (Zn):



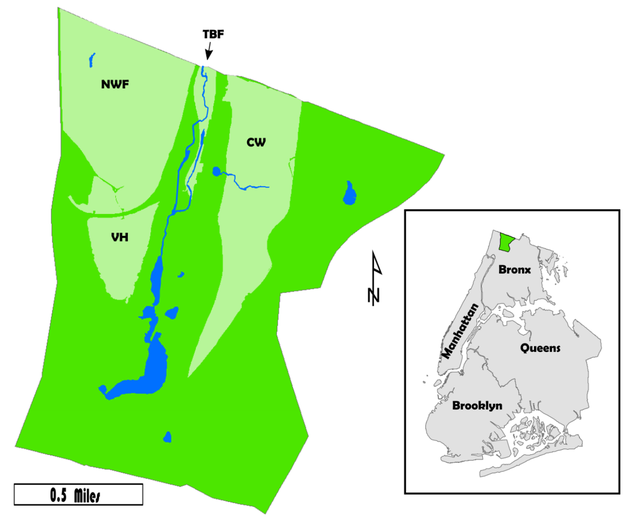
Index of geological accumulation for three transects within the NWF sites. NWF(A) has a history of uncapped dumping

Elemental Concentration:

Table 1. Average ppm of select elements from the four study locations.

Mean Element/Site	NWF	CW	TB	VH
Zn (ppm)	388.9473222	268.0248056	296.4613047	242.587154
Cu (ppm)	286.9578343	115.2036442	153.6675409	165.1910836
Ni (ppm)	48.04821206	48.01198095	53.89137033	48.026387
Co (ppm)	22.89573809	26.43739801	26.71467977	25.8847688
Mn (ppm)	1765.441567	1607.121765	938.2090505	996.8533581
V (ppm)	199.8819085	124.7487663	129.4911828	195.4270314

Study Site:
Van Cortlandt Park, Bronx, NY



Findings and Strategy for Conservation:

- Elemental concentrations suggest that VCP has been effected by anthropogenic pollution. For example according to the IGA index transect NWFA for Zn is Moderately to Heavily Polluted. Plantings in urban parks need to consider this.
- Relatively high readings are seen in Zn, Cu, Va and Mn.
- Correlations of elements are dependent on site and ecological community.
- Compositional overlap was observed as well as discrete clustering suggesting that urban park plantings consider the heterogeneity and homology of sites.
- Sites with Historical Fill must capped.

Works Cited:

Byrne, L. B. (2007). Habitat structure: a fundamental concept and framework for urban soil ecology. *Urban Ecosystems*, *10*(3), 255-274.

Heneghan, L., Miller, S. P., Baer, S., Callaham Jr, M. A., Montgomery, J., Pavao-Zuckerman, M., ... & Richardson, S. (2008). Integrating soil ecological knowledge into restoration management. *Restoration Ecology*, *16*(4), 608-617.

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