Central Arizona-Phoenix
Long-Term Ecological Research
CAP LTER

Hydrological and geochemical correlations with potential denitrification rates in an arid, urban wash

SCHOOL OF Life Sciences
ARIZONA STATE UNIVERSITY

Danielle Shorts[1], RL Hale[1], S Earl[2], NB Grimm[1, 2]

Introduction

- ☐ Nitrogen (N) pollution is common in urban systems and may accumulate through the use of fertilizer, pet waste, and atmospheric deposition.
- ☐ N is primarily accumulated in urban washes when storms sweep N into these catchments; N is then transported through urban washes to downstream systems.
- ☐ Data on N cycling in urban, arid washes are limited; therefore, understanding of how these waterways affect distribution and reduction of N is also limited.
- ☐ Research was centered on better understanding how these washes remove N through denitrification.

Research Questions

(1) What is the capacity of urban, arid washes to remove N via denitrification?

(2) Is denitrification potential spatially heterogeneous, and what physical and chemical aspects of soil are associated with denitrification potential?

(3) Does soil sample incubation time affect DEA results?

Study Site and Methods

Soil samples were collected from a xeric wash in Scottsdale, AZ during summer 2012.

Denitrification Enzyme Assays were used to determine potential denitrification rates:

1. Incubated soil samples with NO_3^- , glucose, and water. N_20 conversion to N_2 was inhibited by the addition of Acetylene. N_2O samples were taken throughout the incubations to monitor denitrification potential.
2. Compared N_2O concentrations taken at 90 minute incubation period to samples taken at 4 hour incubation period.

Variables

- ☐ Soil characteristics measured: Soil moisture, soil organic matter, NH_4^+ , NO_3^-, Cl^-, soil texture
- ☐ Spatial variables: Location from road inlet (storm water delivery) was measured in ArcGIS.

Affiliations of authors
1. School of Life Sciences, Arizona State University, Tempe, AZ
2. Global Institute of Sustainability, Arizona State University, Tempe, AZ

Results: Denitrification and Soil Properties

The results suggest that there is limited potential for denitrification compared with other urban ecosystems (Table 1). This could be due to a fewer number of microbes surviving in the soil.

Table 1: Potential DEA in washes and other habitats

Ecosystem Type	Average	Standard Deviation	Min	Max	Reference
Xeric wash	12	37			This study
Grassy Retention Basin	673		407	1251	Larson 2010
Xeric Retention Basin	285		bdl	1090	Larson 2010
Xeriscape	1503	5569			Hall et al. 2009
Lawn	1511	2868			Hall et al. 2009

Figure 1: Spatial distribution of potential denitrification rates (m)

Despite microbial limitations on potential denitrification rates, there was a spatial pattern of denitrification potential within the wash. Denitrification rates were clustered in areas where inlets are located (Figure 1). Rates were plotted against their distance from the nearest inlet (Figure2) resulting in a clear negative relationship between distance of nearest inlet and denitrification rates.

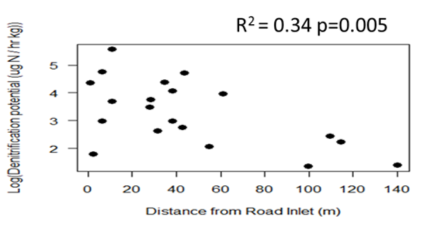

Figure 2: Graph of Distance from Road Inlet (m) and Log (Denitrification Potential (ug N/hr kg))

Table 2: Relationship between Soil Characteristics and DEA results

Variables	r-value	p-value
Sand	-0.05	0.65
Silt	-0.06	0.68
Clay	0.24	0.03
Chloride	0.23	0.1
Nitrate/Nitrite	-0.03	0.83
Ammonium	0.17	0.19
Soil Organic Matter	-0.02	0.91
Soil Moisture	0.06	0.67

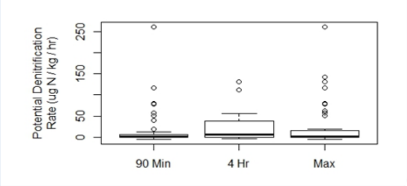

Figure 3: Comparison of 90 minute and 4 hour incubation

Conclusions /Discussion

- There was a weak but significant trend between clay and the DEA data (Table 2); no other soil characteristics were associated with DEA.
- There was a significant, negative relationship between the inlet data and the DEA data. This may be because the inlets receive the most water during a storm causing the microbes to naturally grow most abundantly in locations closest to them.
- Potential Denitrification rates calculated with 90 minute incubations were not significantly different from those calculated with 4 hour incubations (Figure 3). This suggests that the number of microbes could possibly be a limiting factor in addition to other unevaluated soil and hydrological properties.

Acknowledgements: A special thank you to the Hall Lab, the Central Arizona Project-LTER, and the National Science Foundation for their assistance and provision of materials. I would also like to thank Rebecca Hale for all of her help in the Arizona heat and in the lab, and Stevan Earl and Nancy Grimm for their encouraging support and advisement. I would also like to thank Monica Palta, Emma Holland, Lindsey Pollard, and Jennifer Learned for all of their help.