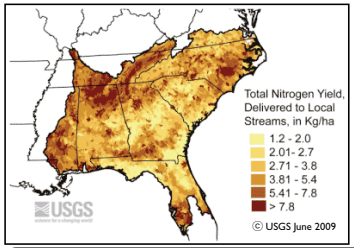
Evaluating Nutrient Retention in Restored and Unrestored Urban Streams

Angela Gardner
Sara McMillan, Alea Tuttle, François Birgand, Greg Jennings

Introduction

Fact 1: In North Carolina non-point source pollution delivers several Kg/ha of nitrogen to streams annually.
Fact 2: Approximately $1 billion/year is spent on stream restoration in the USA.
Fact 3: Biogeochemical processes in streams can transfer nitrogen species in water from nitrate to nitrogen gas, effectively removing it from the system.
Question: Can biogeochemical processes be optimized during stream restoration to enhance nutrient uptake and lower total N in streams?



Objectives

Nutrient Injections

- Quantify nutrient uptake in restored vs unrestored urban streams
- Compare effect of restoration methods on nutrient uptake
- Quantify effect of restoration age and seasonal variation on nutrient uptake

Artificial Stream

- Construct an artificial stream that recreates hyporheic flow patterns
- Create a "map" of hyporheic flow around specific geomorphic features and structures
- Evaluate potential of in-stream structures to create biogeochemical "hotspots"

Methods

Nutrient Injections: Data Collection Phase

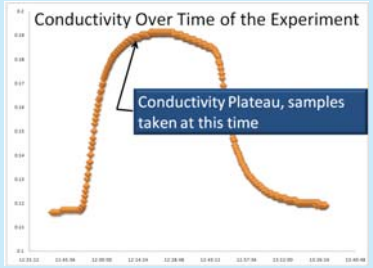

Mariotte Bottle Set-up

Steps:
1. Inject N and P into stream with NaCl at constant rate until well mixed along reach (conductivity plateau)

2. Collect water samples at 5 cross-sections along reach

3. Filter and analyze water samples for nutrient concentrations

4. Calculate uptake metrics from NaCl tracer data and water quality results



The above graph shows the conductivity readings at the downstream end of the reach. The change in conductivity is a result of the NaCl tracer injection

Artificial Stream: Construction Phase

The Artificial Stream is lined on the bottom with tubing, which regulates the artificial water table and simulates groundwater upwelling. Surface water is delivered to the system through the weir boxes at either end of the stream.

The Artificial Stream is located at Lake Wheeler Field Laboratories in Raleigh, NC. It is 40m long by 3m wide. There are three riffle pool sequences in the stream.

Watering tubes are also located on the stream edge to simulate lateral groundwater input

The Future

Nutrient Injections

- Complete pre- and post- leaf out nutrient injections in Spring 2011
- Analyze data for all six streams according to objectives
- Present data in final WRRI report

Artificial Stream

- Bring stream on-line in Spring 2011, Completing stream mapping and in-stream structure analysis in Summer/Fall 2011
- Utilize the Artificial Stream for nutrient analysis, including the utilization of stable isotope tracers.