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SUBURBAN PONDS REDUCE NITRATE LOSS FROM LAWNS TO STREAMS

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Introduction

- Loss of nutrients from terrestrial ecosystems into freshwater and marine environments is a threat to water quality, human health, and aquatic life.
- Loss of nitrogen and phosphorus from agricultural and suburban runoff from the Midwest is a major contributor to the dead zone in the Gulf of Mexico (Ribaudo et al. 2005).
- The dead zone is an area the size of New Jersey with oxygen levels that no longer support life near the bottom (NOAA 2017).
- Excess nutrients promote algal, bacterial, and plant growth which can result in elevated levels of toxins that could contaminate drinking water and affect human health. Once algae decompose, deeper areas are depleted of oxygen and aquatic life can no longer survive (Carpenter et al. 1998).
- Excess nitrates can interfere with the ability of red blood cells to transport oxygen, in infants this can lead to blue baby syndrome, brain damage, or death (Knobeloch et al. 2000).
- The EPA maximum contaminant level is 10 mg of NO_3-N per liter of drinking water and is commonly exceeded in surface drinking water supplies.
- Communities need a sustainable, cost effective, and aesthetically pleasing solution to prevent inputs to surface waters. Constructed ponds in suburban areas could effectively reduce nutrient loads before entering drinking water reservoirs.
- **The objective of this study is to test if pond complexes might successfully reduce nutrient loads downstream.**

Hypotheses:

H_0: No change in nutrient loads downstream

H_A: Reduction of nutrient loads downstream

Methods

- To examine the potential for suburban ponds to affect nutrient losses, we studied Tipton park, a 50 acre natural area designed to ecologically filter urban storm runoff in Bloomington, IL (Fig. 1).
- Runoff from a suburban neighborhood flows into a small pond complex and flows into Sugar Creek. (Fig. 1).
- To test water quality we collected 1 L samples bi-weekly from January-April 2018 at 4 sites within Tipton Park: inflow into the pond, outflow into the stream, upstream of the outflow and downstream of the outflow.
- We performed laboratory processes such as filtering, and nutrient analyses.
- To determine the effectiveness of this pond complex at reducing nutrient exports we compared outflow concentrations to inflow concentrations. To examine the affect on Sugar Creek water quality we compared downstream to upstream concentrations.
- Water samples were analyzed for ash free dry mass (AFDM), nitrates, total phosphorous, dissolved reactive phosphorous (DRP), and chlorides

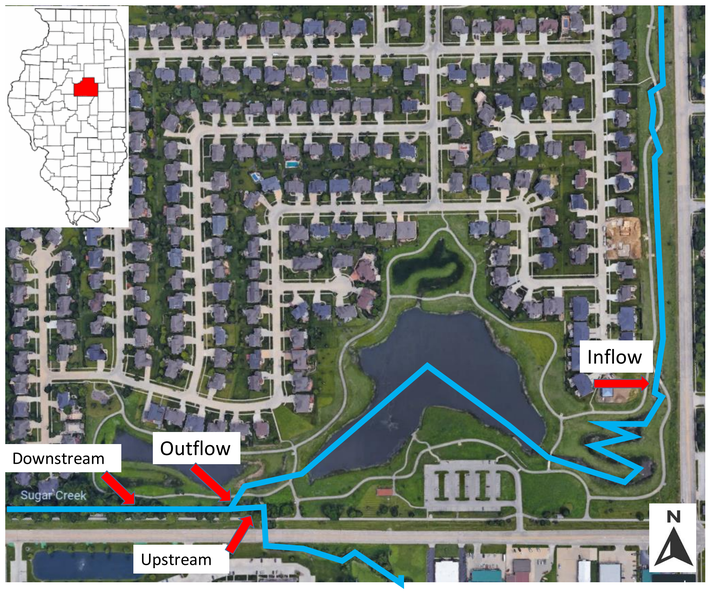
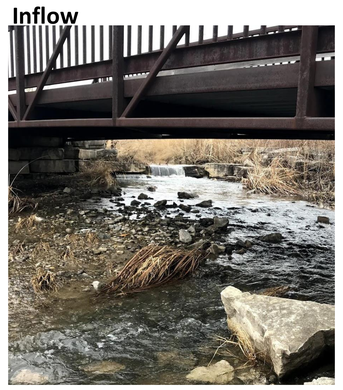
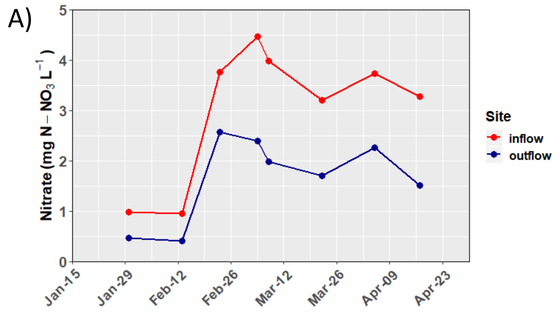
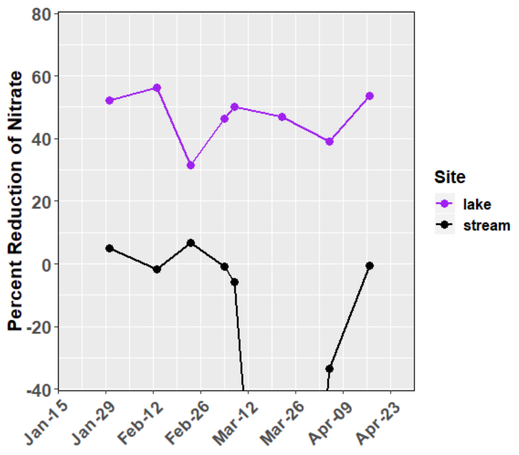


Figure 1. Tipton Park, a pond complex in Bloomington, IL within a suburban neighborhood. Suburban runoff enters the complex from the North, flows through the lake to the pond, and exits into Sugar Creek. I collected samples from the Inflow, Outflow, Upstream, and Downstream locations.







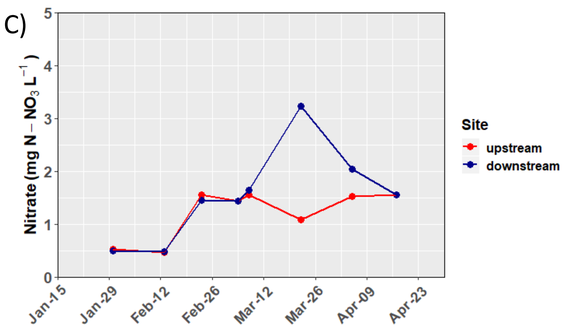
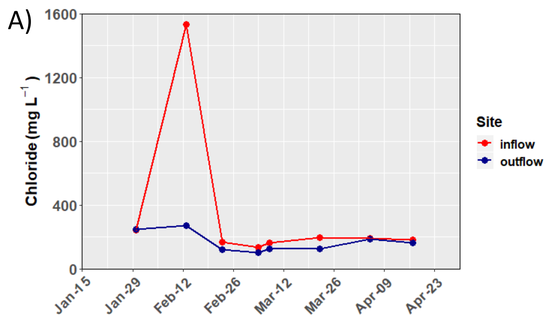


Figure 2. A)Nitrate concentrations in the inflow and outflow from January to April 2018 B)Percent reduction of nitrates from Inflow to Outflow, and Upstream to Downstream C) Nitrate concentrations upstream of the outflow, and downstream of the outflow from January to April 2018



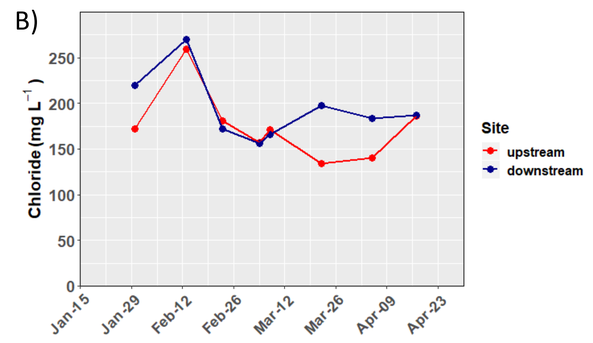


Figure 3. A)Chloride concentrations in the inflow and outflow from January to April 2018 B) Chloride concentrations upstream of outflow, and downstream of outflow from January to April 2018

Results

- Nitrate concentrations increased in the inflow and stream over the study with increased temperatures.
- The pond complex reduced nitrate concentrations in the outflow by 40-60% relative to the inflow.
- Nitrate concentrations in Sugar creek were not affected (Fig. 4).
- Chloride concentrations increased during a snow event and later declined.
- No change in chloride concentrations were observed from inflow to outflow (Fig. 3) and upstream to downstream (Fig. 5).

Discussion

- We found reduction of nitrate concentrations through small pond complexes.
- This pond complex added recreational value to the community and provided habitat for wildlife.
- Reducing excess nutrients at the source with sustainable urban planning techniques such as pond complexes, could be a cost effective solution for communities to mitigate nutrient pollution downstream.
- The lake outflow had little effect on stream water quality upstream to downstream because the volume of water leaving the lake was low relative to the stream water volume.
- Increases in urban and suburban areas are causing an increase in impervious surfaces and increased use of fertilizer to maintain green lawns. These changes can lead to increased nutrient inputs into streams (Kaye et al. 2006).
- In densely populated areas water quality tends to deteriorate and nutrient pollution is costly and challenging (Verhoeven et al. 2006).
- Adding pond complexes within suburban areas add aesthetic and recreational value, contribute to natural areas, and provide ecosystem free services to the surrounding community. They could also serve as a cost-effective solution to reduce nutrient losses from suburban development.

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