Anthropogenic Effects on Macroinvertebrates in Wetlands

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Introduction

Wetlands are areas that are important both for the organisms that inhabit them and for humans. Wetlands provide habitats for plants and animals, serve as protection against flooding, control shoreline erosion, offer recreational opportunities, and are a source of research for educational purposes (Ehrenfeld, 2000). As compared to rural wetlands, urban environments are highly affected by human activity as a result of higher concentrations of humans around the wetlands themselves. Anthropogenic effects on urban wetlands include air and water pollution through poor waste disposal methods, as well as the release of harmful toxins into the air and into groundwater systems (Mensing, 1998). I hypothesized that the aquatic macroinvertebrates inhabiting restored urban wetlands are directly affected by the anthropogenic effects from upslope. My study included two recently restored wetlands at the Passionist Earth & Spirit Center in Louisville, KY. The wetlands are pictured here, in Figure 1.

Abstract

Wetlands are areas that are important both for the organisms that inhabit them and for humans. Wetlands provide habitat for plants and animals, serve as protection against flooding, offer recreational opportunities and are a source of research for educational purposes. As compared to rural wetlands, urban environments are highly affected by human activity. Anthropogenic effects on urban wetlands include air and water pollution through poor waste disposal methods and the release of harmful toxins into the air and water. I hypothesized that the aquatic macroinvertebrates inhabiting restored urban wetlands are affected by the anthropogenic effects from upslope. My study included two recently restored wetlands at the Passionist Earth & Spirit Center in Louisville, KY. To test for pollutants that might be present in the wetlands, I measured pH, turbidity (FNU), temperature (ºC), nitrate (mg/L), and specific conductance (uS/cm) using a YSI Pro-DSS. I used a Hach kit to test orthophosphate and alkalinity (mg/L CaCO3) and a Vernier instrument to test dissolved oxygen levels in each wetland. Macroinvertebrate sampling was performed in spring and fall by collecting organisms using a D-frame net and identifying them to family level in the field. Macroinvertebrates were more abundant in the spring in Wetland 1 and in the fall in Wetland 2. Water chemistry results indicated that the aquatic macroinvertebrates are affected by anthropogenic effects posed by humans. High nitrate levels found in each wetland in the fall likely are caused by fertilizers that are put on gardens and lawns above the wetland. The fertilizer infiltrates the groundwater that feeds into the wetlands and cause algal blooms and the subsequent removal of oxygen that macroinvertebrates need. These results are important for guiding restoration efforts and understanding the impacts that humans have on these important urban ecosystems.

Figure 1: Locations of Wetlands 1 & 2.

Figure 2: An image of Wetland 1 taken in the spring of 2020.

Figure 3: An image of Wetland 2 taken in the spring of 2020.

Methods

To test for pollutants that might be present in the wetlands, I measured pH, turbidity (FNU), temperature (ºC), nitrate (mg/L), and specific conductance (uS/cm) using a YSI Pro-DSS. To test orthophosphate and alkalinity (mg/L CaCO3) I used a Hach kit. I also used a Vernier instrument to test dissolved oxygen levels in each wetland. Macroinvertebrate sampling was performed in spring and fall by collecting organisms using a D-frame net and identifying them to family level in the field.

Results

The results of this study showed that macroinvertebrate abundance is higher in Wetland 2 in the spring than in the fall. Conversely, macroinvertebrate abundance was higher in the fall in Wetland 1 than it was in the spring. Nitrogen levels were found to be higher in the spring in Wetland 2 than they were in the fall. Nitrogen levels were higher in the fall in Wetland 1 than they were in the spring. There was also more of a fluctuation in oxygen when nitrate was abundant in each wetland, with higher oxygen during the day. For example, mean dissolved oxygen in September and October was 14.72 mg/L in Wetland 1 and 8.65 mg/L in Wetland 2.

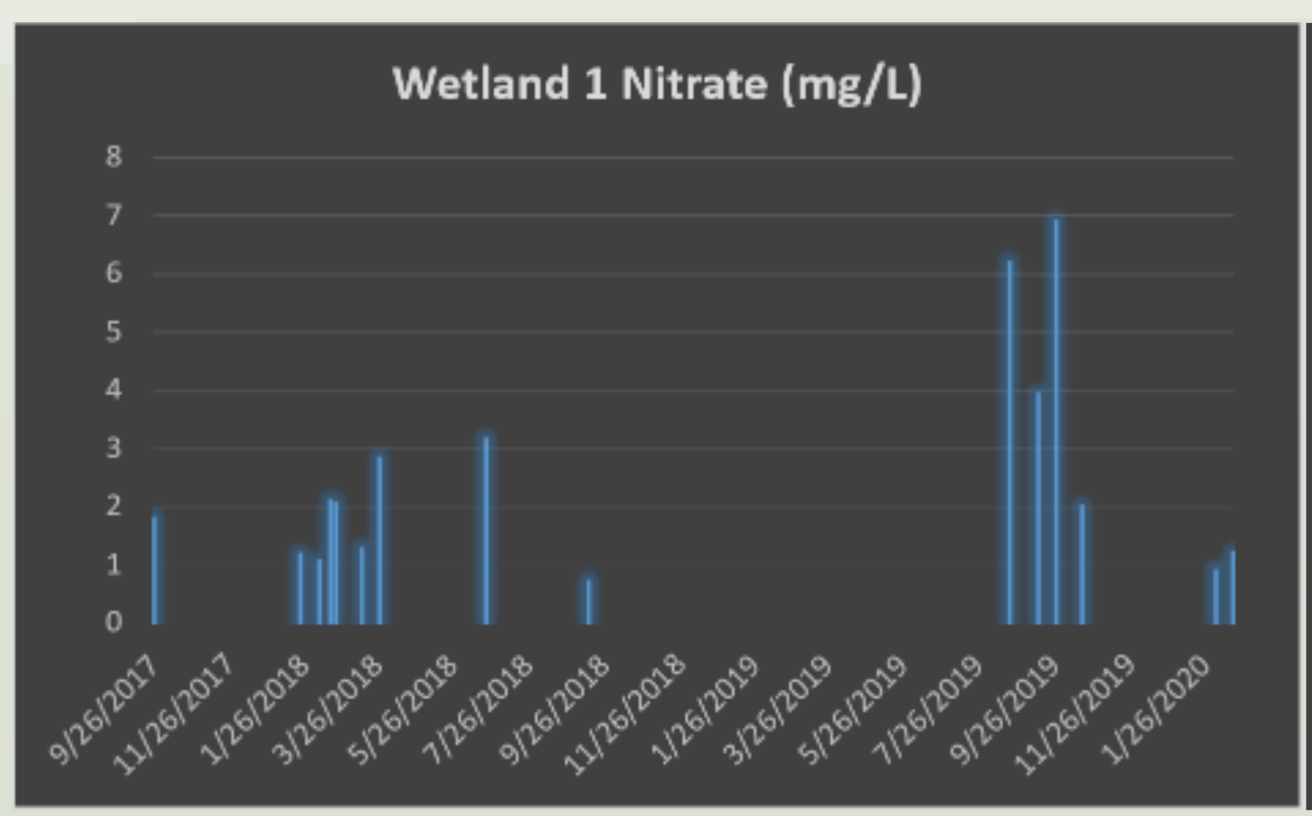

Figure 4: Wetland 1 Nitrate Sampling Results

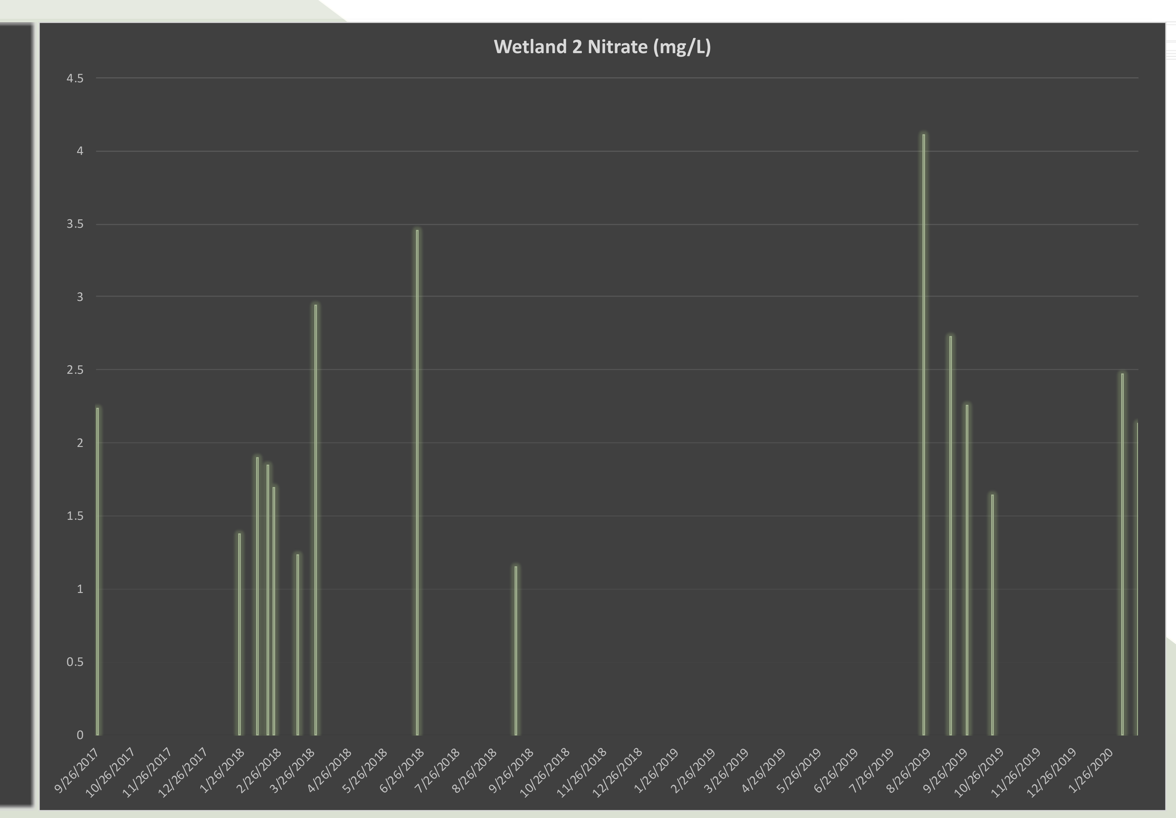

Figure 5: Wetland 2 Nitrate Sampling Results

Discussion

Wetland 2 differed from Wetland 1 in the sense that the wetland is fed year-round by a groundwater spring, which is located at the base of a hill. On the top of the hill are a lawn, trees and gardens that are regularly fertilized, which contained high levels of nitrogen. The high nitrogen levels found in Wetland 2 in the spring are likely a result of nitrogen permeating through the soil in groundwater and flowing into the wetland over time. Conversely, nitrogen levels were lower in Wetland 2 in the fall because the nitrate has not yet traveled through the groundwater system. Lower nitrogen levels in Wetland 1 in the spring were likely due to water supplied by rainfall. Higher nitrate levels in the fall in Wetland 1 were likely a result of nitrogen delivered by runoff. High nitrate levels lead to greater diurnal fluctuations in oxygen due to photosynthesis and respiration (USGS, 2020). As a result, these wetland environments are less hospitable to macroinvertebrates when nitrate levels are high.

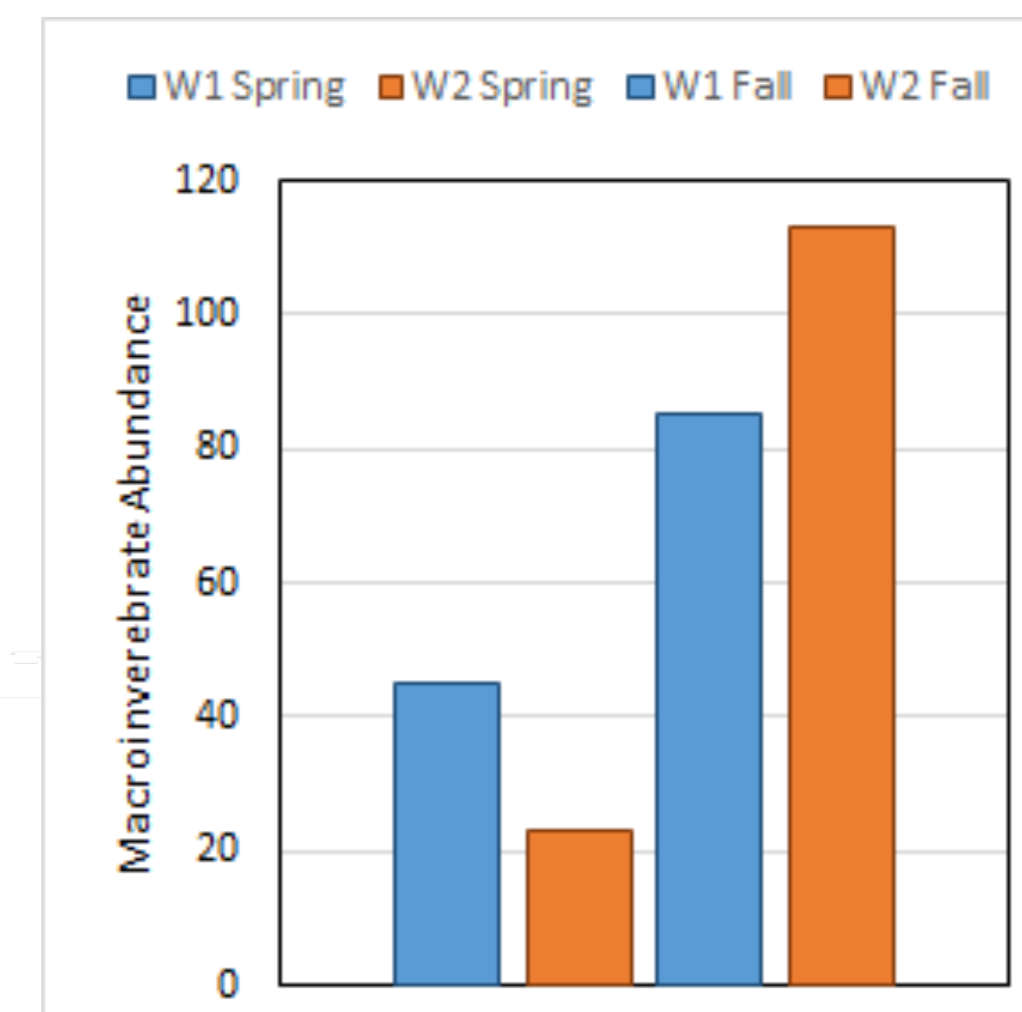

Figure 6: Macroinvertebrate Abundance

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