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LCPS RSEF OFFICIAL ABSTRACT - 2023

Double Biological Filters to Reduce Pollutants in Fertilizer Runoff

Taranpreet Basati

High nitrogen levels present in fertilizer runoff cause water eutrophication, a global problem. Eutrophication leads to hypoxia, causing a decrease in aquatic life. The purpose of this project is to reduce fertilizer runoff pollutants, using a two-step filtration process (independent variable). Diluted fertilizer (mimicking runoff) is treated with chlorella algae (Chlorella vulgaris) and then through perennial ryegrass (Lolium perenne) to decrease ammonium, nitrate and nitrite levels (dependent variables). After initial treatment (exposure to algae), there is a noticeable reduction in nitrate (3.0 mg/l to 0.23 mg/l) and ammonium (5.5 mg/l to 0.62 mg/l). After the second treatment (filtered through grass), there was a significant increase in nitrate (0.23 mg/l to 87.68 mg/l) and ammonium (0.62 mg/l to 14.05 mg/l) levels. The null hypothesis is rejected since algae is effective in reducing pollutants in runoff. The hypothesis, If double biological filtration is used in the form of chlorella algae (Chlorella vulgaris) and perennial ryegrass (Lolium perenne), then there will be a significant decrease in the the nitrate, nitrite and ammonium concentrations, was supported for algae but rejected for grass. An ANOVA test showed that the results were statistically significant because the p value was 0.00341, which is less than 0.05 for nitrite and less than 0.00001 for nitrates and ammonium. Further experimentation needs to be conducted to identify the most effective methodology in implementing an algae filtration system.

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LCPS RSEF OFFICIAL ABSTRACT - 2023

A Comparison of eDNA Metabarcoding and Virginia Save Our Streams Kick-Seine Sampling Methods for Stream Health Analysis

Evalynn Bogusz, Keerthi Selvam

A traditional method of assessing stream health is kick-seine biological sampling, a time-consuming process requiring trained volunteer monitors to manually collect, identify, and count benthic macroinvertebrates. A novel method of biological aquatic monitoring involves the collection and genetic sequencing of environmental DNA (eDNA), nuclear or mitochondrial DNA shed by organisms. Because of its speed and cost-efficiency, eDNA offers a potential substitute for traditional methods of biological monitoring. The purpose of this research is to compare the efficacy of eDNA sequencing and Virginia Save Our Streams (VASOS) kick-seine net sampling in assessing stream biodiversity and species composition. This study could help to further gauge the benefits and limitations of eDNA, as there is still much to be learned regarding the extent to which it can be used to monitor ecological communities. Kick-seine sampling was performed at three locations on the Beaverdam Run tributary. Water and sediment samples were also collected at each of the locations. Using kick-seine sampling, eight distinct macroinvertebrate species were found in the tributary. Caddisflies and common net-spinning caddisflies were far more prevalent than other macroinvertebrate species, indicating low biodiversity and a VASOS classification of unacceptable ecological conditions. In subsequent steps, eDNA will be extracted from the water and sediment samples, and the 16S gene will be sequenced and then run through NCBI BLAST to determine which organisms were present at that site. Further data collection and analysis to yield a preliminary conclusion is ongoing.

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LCPS RSEF OFFICIAL ABSTRACT - 2023

How Surrounding Land Use Affects the Water Quality of the Broad Run River

Megan Davies, Alden Zerkle

Water makes up 71% of the world we live in, and is home to millions of organisms and ecosystems. The balance of a healthy water system is delicate, and disturbances from anthropogenic activity that impair the water quality can alter entire ecosystems. This study explores how surrounding land use affects water quality with focus on the Broad Run River. Water was collected at five different locations with four samples taken at each, for a total of 20 samples. Each sample was tested for nitrate, phosphate, iron, turbidity, pH, and dissolved oxygen levels. Using ArcGIS maps, data was collected and analyzed in relation to the surrounding land development near the river. After data collection, excess levels of nutrients were observed to occur near differing land development areas such as farms, dog parks, and recreational facilities, especially phosphate levels. The data and analysis gathered from the water samples and ArcGIS support the hypothesis that anthropogenic land areas (such as farms and construction sites) produce unnatural amounts of nitrates, phosphates, and irons, which will lead to increased levels of nutrients and decreased primary productivity rates in the Broad Run River. Based on the results, more effective and informative mitigation strategies can be implemented, but further research is necessary in this area. There is an existing gap within observation of the Broad Run River water quality in previous years, raising concerns of insufficient results regarding the health of local ecosystems and drinking water sources.

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LCPS RSEF OFFICIAL ABSTRACT - 2023

Analysis of Microplastic Content Along the Appalachian Trail in Loudoun County, Virginia

Prescott Noll

Several studies have explored microplastic content in various ecosystems such as the aquatic environments[1], however, an exploration of microplastic content in the deciduous forest environment of Loudoun had not been conducted. Through the chemical filtration of organic matter, wet sieving, density separation of inorganic matter, and microscopic analysis, microplastic content in sediment samples from the Appalachian Trail has been identified. Six various locations and five different morphological categorizations[2] of identified microplastics were employed to draw various conclusions from the dataset, most notably the relationship between microplastic aggregation tendencies and the nature of origin of said microplastics, the specific vectors of origin of microplastics identified, and the direct relationship between hiker concentration and microplastic abundance. Analyses of percent abundance per morphological classification as compared to other environments, such as oceanic, also shows a significant difference in distribution and deposit size[3]. These conclusions and data can be applied to a significant realm of human-environmental impact studies, and should be able to be used by other entities to conduct studies regarding the chemical composition and breakdown of microplastics to morphological identification[2][3], and origins or impacts of the abundance of microplastic and nanoplastic content in sediment samples and the local water cycle.

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