Dr. Ishi Buffam, Assistant Professor in the Department of Biological Sciences and Dr. Dominic Boccelli, Assistant Professor in the College of Engineering and Applied Science at the University of Cincinnati are nearing completion of an Ohio Water Resources Center funded project via a joint USGS 104(b) and OWDA subaward. This project entitled "**Assessment of a Novel Application of Biochar to Improve Runoff Water Quality from Vegetated Roofs"** aims to improve nutrient retention of vegetated roofs using biochar (Figure 1). Vegetated roofs are becoming increasingly more important as a part of green-engineered solutions for stormwater management in urban areas.

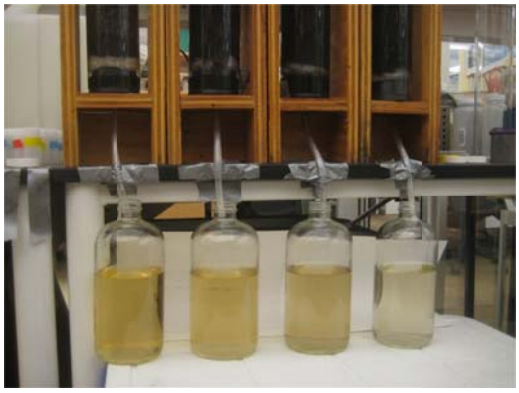

Figure 1 Leachate from laboratory columns of green roof growing media with varying amounts of biochar ranging from no biochar (left) to high biochar (right). Note the reduction in color in the water is due to biochar binding organic matter which minimizes its elution.

The integration of biochar is a potential breakthrough in reducing water quality degradation by green roof runoff, but very little is known about the sensitivity to variation in the proportion of the biochar amendment, or the dynamics of sorption kinetics or equilibria. Our project has demonstrated that a biochar amendment substantially decreases ammonium leaching from green roof substrate, by up to 75% for the high biochar (14% w/w) treatment (Figure 2). The high biochar treatment also doubled water holding capacity of the substrate, a finding with great significance for green roof design for stormwater runoff reduction. This is of particular note because on a per mass basis, biochar is no more expensive than typical commercially available green roof substrate mixes. The patterns of breakthrough curves also give insight into likely physicochemical mechanisms of nutrient binding. Follow-up work using different sorption breakthrough models and isotherms are underway to further explore the sorption/desorption dynamics. The research demonstrates the water quality improvements associated with a biochar-amended green roof, but will also result in a modeling component that can be used within an integrated assessment framework both within and beyond the Ohio River Valley.

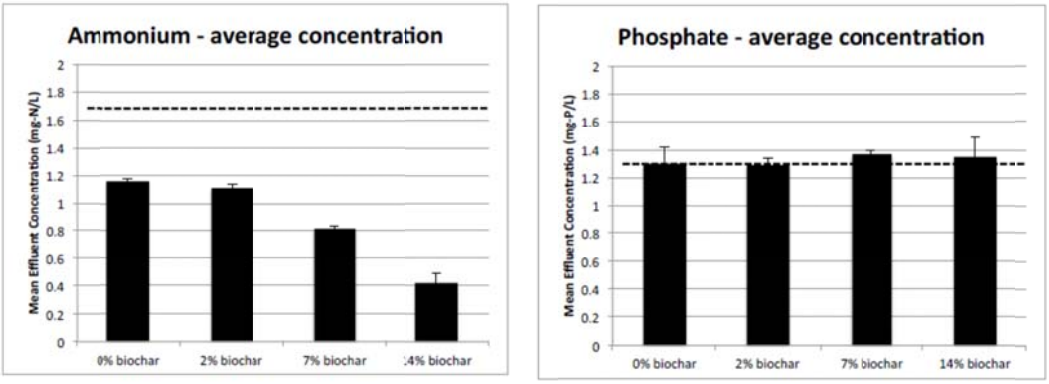

Figure 2 Volume-averaged mean effluent nutrient concentrations for the entire 5-day experiment for columns varying in biochar % integrated into green roof substrate. Error bars represent standard error of the mean for duplicate trials. The horizontal dotted lines represent the volume-averaged influent "precipitation" concentration in the experiment. Substrate alone resulted in a 34% reduction in NH_4^+, with higher biochar resulting in a reduction of up to 76% of NH_4^+. In contrast, PO_4^{3-} fluxes were not affected significantly by either substrate alone, or biochar amendments.

Principal Investigator: Dr. Ishi Buffam is an ecosystem ecologist and aquatic biochemist. He uses a combination of field vegetation and soil surveys, lab-based water and soil chemistry/biogeochemistry analysis, empirical modeling and GIS-based modeling to evaluate the relationship between landscape/watershed characteristics and surface water chemistry and biotic communities. Many of his current projects are centered on quantifying ecosystem services and potential disservices associated with green (vegetated) roofs, since little is known about the direct biogeochemical functions of green roofs.