Dr. David Costello, Assistant Professor in the Department of Biological Sciences at Kent State University continues an Ohio Water Resources Center funded project via USGS 104(b) subaward. This project titled "**Trace metal limitation of biofilm growth and metabolism: potential consequences for storage of nutrients in headwater streams"** attempts to address the unknown importance of limiting concentrations of trace metals on primary production in small streams draining into Lake Erie. This proposed research will provide important information about in-stream processing of nutrients in tributaries to Lake Erie.

Figure 1 Dr. Costello's students installing trace metal diffusing substrates in stream.

Small streams can be very efficient at slowing nutrient transport to downstream ecosystems by storing nutrients in biomass and potentially removing nitrogen and phosphorous through burial and nutrient transformations. The hypothesis of this research is that that low trace metal concentrations in eutrophic streams in Northwest Ohio limit biofilm growth, contribute to saturation of nutrient removal processes, and limit biofilm storage of nitrogen and phosphorous. After a water chemistry survey of twenty-six headwater streams in northeast Ohio, five streams with potential nutrient and/or trace metal limitation were chosen for biofilm growth limitation tests. Trace metal nutrient diffusing substrates increase nutrient and trace metal concentrations in a small area of the stream allowing for greater algal growth if nutrients or metals supplied by the cup cannot be found in the stream water (Figure 1). Algal biomass on the cups in these five streams was measured after 4 weeks of growth. Algal growth differed greatly among streams, but single element addition did not stimulate biomass growth as much as multi-element combinations (Figure 2). The multi-element additions show that trace metals (especially Zn) may be a pathway for promoting biomass growth in streams, which can increase nutrient removal rates and ultimately reduce or delay the export of macronutrients to Lake Erie. Given that controlling nutrient sources is a major technique for controlling HABs, management efforts that consider trace metals may be an important new tool for addressing nutrient load reduction goals.

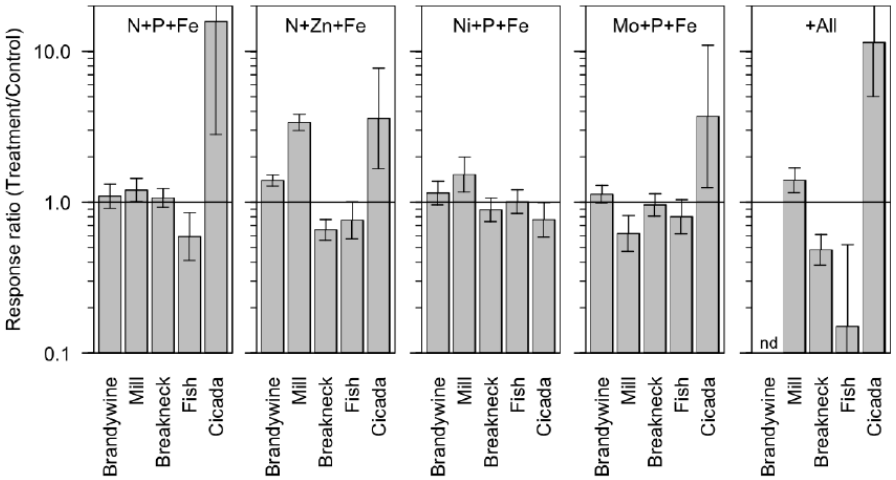

Figure 2 Response of algal biomass (as chlorophyll *a*) to multi-element additions. Response ratios >1 indicate greater biomass with nutrient amendment relative to controls and ratios <1 had lower biomass relative to controls. Error bars indicate standard errors. nd = no data.

<u>Researcher Profile:</u> David Costello received his BS from Hobart College in 2004 and his PhD in Biology from the University of Notre Dame in 2009. After finishing his PhD, Dave was a postdoc at the University of Michigan's School of Natural Resources & Environment. Broadly, Dave is interested in how human activities affect the functioning of freshwater ecosystems. Dave has interests in coupled biogeochemical cycles, ecotoxicology, and ecological stoichiometry.