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Tracing nutrient inputs into a eutrophic lake using nitrogen isotopes, Wilgreen Lake,
Madison County, Kentucky

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Wilgreen Lake is a dammed lake that has been classified as nutrient-impaired (303d list) by the EPA and State of Kentucky. The lake is moderately-sized covering 169 acres (0.7 km²), and drains a watershed with residential developments, cattle pasture, modified woodlands, and some industrial/urban usage in the city of Richmond. The principal tributaries are Taylor Fork and Old Town Branch that meet to form the trunk of the lake approximately one mile in length. The upper reaches of Taylor Fork are adjacent to a densely-packed (quarter-acre lots) housing development with septic systems. Old Town Branch drains cattle pasture and residential areas. Residences within these developments, while also served by septic systems, are more sparsely distributed than residences within developments adjacent to those of Taylor Fork. An ancillary tributary flowing into Pond Cove is intermittent, and drains cattle pasture and one small housing development. Recognizing and quantifying potential nutrient sources is critical to any remediation efforts in decreasing nutrient input to the lake. We hypothesize that significant nutrient input occurs from the septic systems adjacent to the shallow lake waters of Taylor Fork. We use stable nitrogen isotopes (¹⁴N and ¹⁵N) as a tracer in characterizing organic sources of nitrogen entering lake waters, and in characterizing organic sinks of nitrogen residing in the lake system.

We measure the carbon-to-nitrogen ratio, carbon isotopic composition ($\delta^{13}\text{C}$), and nitrogen isotopic composition ($\delta^{15}\text{N}$) of organic matter held within potential nutrient sources and sinks within the Wilgreen Lake system. Potential sources include fertilizers, bovine fecal matter, human effluent from septic systems, and “natural” organic material. Sinks include plankton, macroalgae, macrophyta, and organic matter within sediments.

Our samples are being measured at press time. The fundamental assumption of the test of our hypothesis is that $\delta^{15}\text{N}$ values of nitrogen sinks should reflect that of their source. With knowledge of the nitrogen isotopic composition of nitrogen sources, we may be able to recognize gradients within the nitrogen sinks of the system. Consequently, our samples of plankton, macroalgae, macrophyta, and sedimentary organic matter are taken over the entire expanse of lake.