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## Nitrate removal in agriculturally impacted headwater streams

The objective of this study was to determine what factors control nitrate ($NO_3^-$) removal in agricultural headwater streams. We were particularly interested in assessing whether riparian land use had any impact on $NO_3^-$ removal. We identified paired, 50-meter reaches (one agricultural/urban and one forested reach) along 5 headwater streams (n = 10) in the Upper Sugar Creek Watershed in Northeast Ohio (40°51'42"N, 81°50'29"W). We hypothesized that forested reaches would have higher carbon supplies, longer residence times, and higher denitrification rates, and combined these factors would yield higher $NO_3^-$ removal. The streams were sampled 4 times from July 2005 to June 2006. Agricultural/urban and forested reaches have similar concentrations of dissolved organic carbon (4.4 ± 2.0 and 4.5 ± 2.3 mg C $L^{-1}$, respectively; mean ± 1 standard deviation; $p = 0.933$) sediment carbon content (3.3 ± 0.6 and 3.7 ± 1.0%, respectively; $p = 0.232$), and denitrification rates (4.4 ± 3.3 and 4.2 ± 3.6 mg N $m^{-2}$ $hr^{-1}$, respectively; $p = 0.342$) over the 4 sampling seasons. Using discharge as a covariate, we found that forested reaches have longer contaminant travel times than agricultural/urban reaches (23.7 ± 20.8 and 12.4 ± 8.2 min, respectively; $p = 0.008$, data was log transformed). A MANOVA on 3 common $NO_3^-$ removal metrics (uptake length, uptake velocity, and a first order loss rate) found no significant differences between agricultural/urban and forested reaches (Wilks' ë = 0.566, df = 3, 33). We concluded that in-stream $NO_3^-$ concentrations have a strong effect on $NO_3^-$ removal in agricultural headwater streams, regardless of riparian land use. Specifically, we determined that $NO_3^-$ removal exponentially declined as in-stream $NO_3^-$ concentrations increased ($p < 0.001$, $r^2 = 0.61$). This pattern suggests that our study streams have reached $NO_3^-$ saturation, causing these agricultural headwater streams to be ineffective at $NO_3^-$ removal.

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