USDA-CSREES 2006 National Water Quality Conference

In-Stream Losses of Nitrate in Midwestern Agricultural Watersheds

Agricultural regions of the midwestern US have large N fluxes. Nitrogen inputs (fertilizer, fixation, and deposition) and outputs (grain harvest) are not balanced, however, and denitrification (both terrestrial and aquatic) is likely an important loss mechanism that could affect the export of nitrate by rivers. We examined the role of in-stream and reservoir denitrification in affecting the export of nitrate in Illinois rivers from dominantly agricultural, tile drained regions of the state. Denitrification rates were measured at many headwater stream sites throughout the year, in both sediments and primary producer habitats, under different geomorphic conditions. We found high concentrations of nitrate in the tile drained regions (> 10 mg nitrate-N/L), suggesting that denitrification was not N limited throughout much of the year. Although in-stream denitrification rates were generally high, hydraulic retention time limited the importance of denitrification in terms of export on an annual basis. Geomorphology was important in explaining rates, but extensive channelization has eliminated most in-stream structures, which could have more effectively reduced stream export of N. Therefore, stream denitrification was only a minor sink for N and most nitrate in these headwater sites was exported downstream to the Mississippi River in rivers without large reservoirs. In a reservoir that we studied on the Kaskaskia River, nitrate concentrations were again high, with correspondingly high denitrification rates. Because retention times were much longer compared to streams, denitrification was effective at removing large amounts of N. During a twenty-three year period, denitrification was estimated to remove about 50% of the N entering the reservoir, and this river had much lower nitrate export than other Illinois rivers draining tile drained regions. In the overall mass balance of N and riverine transport of nitrate down the Mississippi River, reservoir and in-field denitrification are thought to be much more important than in-stream denitrification.

Author: Mark David