Seasonal and spatial patterns in coupled nitrification-denitrification rates in a large Great Lakes coastal system: The St. Louis River Estuary

Brent Bellinger, Terri Jicha, LaRae Lehto, Colleen Elonen, Lindsey Monson, David Bolgrien, Matthew Starry, Brian Hill

Anthropogenic inputs of excess nitrogen (N) to aquatic systems are detrimental, but aquatic plants and sediments have the potential to mitigate N-loading. Sediment processes are driven by microbially mediated N-cycling. Coastal embayments purportedly play a significant role in N-cycling, but few studies have quantified potential removal. In a July 2011 study of vegetated areas of the St. Louis River Estuary (SLRE), net nitrification rates averaged 116 mgN m^{-2} d^{-1}. Spatially, rates were higher in the upper estuary, notably in wetlands of Spirit Lake. Conversely, unamended denitrification (DEN) rates increased downriver. Allouez Bay had highest rates (346 mgN m^{-2} d^{-1}) compared with the upper estuary (4 mgN m^{-2} d^{-1}). In a 2012 spatially and temporally comprehensive survey that largely excluded vegetated areas, system-wide rates of nitrification were more uniform across the estuary, but varied from May-September (82-211 mgN m^{-2} d^{-1}). Conversely, denitrification rates declined significantly from May (80 mgN m^{-2} d^{-1}) to September (18 mgN m^{-2} d^{-1}). Highest DEN rates were observed in the lower SLRE (74 mgN m^{-2} d^{-1}) relative to the upper estuary (<17 mgN m^{-2} d^{-1}), as was seen in 2011. Between 2011 and 2012, DEN rates were greater in the lower SLRE, but were lower in the upper SLRE. For both years, greatest nitrification and DEN rates were observed in waters >1m deep. The entirety of the SLRE is functioning in N-processing, but areas nearest Lake Superior have greatest potential. Specifically, vegetated areas below Spirit Lake were hotspots of N-cycling in 2011; however, effects of the 2012 June flood cannot be discounted as confounding results. *This abstract does not necessarily reflect EPA policy*.