Ecosystem metabolism controls nitrogen uptake in streams in Grand Teton National Park, Wyoming

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ABSTRACT: Streams and rivers regulate nitrogen transport (N) to downstream ecosystems. Rates of N uptake can be high in streams, but controls on the variation in uptake rates of N among streams are not known. We measured ammonium (NH^+_4) and nitrate (NO^-_3) uptake velocities (V_f) and compared these with whole-reach estimates of gross primary production (GPP) and community respiration (CR) in 11 low-nitrogen streams in Grand Teton National Park, Wyoming. We predicted that increased metabolism would positively relate to higher N demand because of stoichiometric N requirements associated with carbon fixation. Rates of GPP and CR explained 82% of variation in NH^+_4 V_f. Nitrate V_f was controlled by GPP, not CR, with GPP explaining 75% of variation in NO^-_3 V_f. Nitrate concentrations did not increase downstream during NH^+_4 addition in all streams, including streams with zero NO^-_3 uptake, suggesting low nitrification rates relative to NH^+_4 uptake. Using a stoichiometric model, we show that areal N uptake estimated from microbial and algal production was similar to measured areal N uptake. High primary production could be a prerequisite for streams exhibiting high NO^-_3 uptake rates.