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New tools applied to seepage and nitrate dynamics within a losing stream

The Pajaro River, central coastal California, consistently loses 0.2-0.4 m^3/s of discharge through streambed seepage along an 11-km reach during the second (dry) half of the water year. This loss could contribute ~20-40% of current sustainable basin yield. Differential gauging and tracer dilution experiments reveal significant storage exchange and dilution fluxes, and channel losses are best explained by streambed seepage. Time-series analysis of streambed thermal records reveal significant changes in seepage rates during the water year. Major ion chemistry shows a consistent pattern of increasing concentrations during the dry part of the water year, but nitrate concentrations decrease consistently along the reach by ~30%. Reductions in nitrate concentration and channel discharge along the experimental reach represents an absolute nitrate sink of ~50%, comprising a net removal rate of 200 - 400 kg/day $N\text{-}NO_3$. High-resolution sampling shows that most of the nitrate loss occurs along the lower part of the reach, which is also the stretch along which most seepage loss of water occurs. Streambed chemical profiles suggest that rapid biogeochemical processes within the streambed contribute significantly to nitrate removal. Stable isotopes of nitrate show streambed and downstream enrichment associated with removal that is most consistent with denitrification. When discharge is greater and storage exchange is most vigorous, denitrification is least efficient and isotopic fractionation is greatest. When discharge is lower and storage exchange is more sluggish, denitrification appears to be more efficient, resulting in lower isotopic fractionation.

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