30 Sept 2013 v2

Buried Streams and the Loss of Ecosystem Services in Urban Watersheds

Paul Mayer

Abstract

Nitrogen (N) retention in streams is an important ecosystem service that may be affected by the widespread burial of streams in stormwater pipes in urban watersheds. We predicted that stream burial suppresses the capacity of streams to retain nitrate (NO3-) by eliminating primary production, reducing respiration rates and organic matter availability, and increasing specific discharge. We tested these predictions by measuring whole-stream NO3- removal rates using 15NO3- isotope tracer releases in paired buried and open reaches in three streams in Cincinnati, Ohio (USA) during four seasons. Nitrate uptake lengths were 29 times greater in buried than open reaches, indicating that buried reaches were less effective at retaining NO3- than open reaches. Burial suppressed NO3- retention through a combination of hydrological and biological processes. The channel shape of two of the buried reaches increased specific discharge which rapidly transported NO3- from the channel, highlighting the relationship between urban infrastructure and ecosystem function. Uptake lengths in the buried reaches were further lengthened by low stream biological NO3- demand, as indicated by NO3- uptake velocities 17-fold lower than that of the open reaches. We also observed increases in the periphyton enzyme activity in the open reaches, indicating that the effects of burial cascade from the microbial to the ecosystem scale. Our results suggest that stream restoration practices involving "daylighting" buried streams have the potential to increase N retention, and further work is needed to elucidate the impacts of stream burial on ecosystem functions at the larger stream network scale.