Organic Matter Processes of Constructed Streams and Associated Riparian Areas in the Coalfields of Southwest Virginia

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Abstract: Central Appalachian headwater streams in coalfield areas are prone to mining disturbances, and compensatory mitigation is required in cases of documented impacts. Stream construction on reclaimed mines is a common mitigation strategy. Streams constructed as compensatory mitigation are meant to restore structural and functional attributes of headwater streams and are often evaluated by measuring structural ecosystem characteristics. However, replacement of stream ecosystem functions is essential for mitigation of mining disturbances from an ecosystem perspective. This research compared selected structural and functional measures in eight constructed streams on mined areas to those of four forested reference streams across two years. Three organic matter functions were evaluated: riparian litterfall input, leaf breakdown, and periphyton accrual. Constructed streams were typically warmer than reference streams and also had elevated specific conductance, elevated oxidized nitrogen concentrations, depressed benthic macroinvertebrate richness, and lower levels of canopy cover. Functionally, litterfall input and total leaf breakdown means for constructed streams were approximately 25% and 60% of reference means, respectively. Leaf breakdown in constructed streams appeared to be inhibited as a result of reduced processing by benthic macroinvertebrates as well as inhibition of microbial and physicochemical pathways. Constructed streams with total breakdown rates most similar to reference-stream levels had the coldest stream temperatures. Areal periphyton biomass, benthic algal standing crop, and senescent autotrophic organic matter in constructed streams were roughly quadruple, double, and quintuple those of reference streams, respectively. Indicator ratios also suggested stream-type differences in periphyton structure. Mean algal accrual was greater in constructed streams than in reference streams during leaf-on seasons. My results suggest that light is likely the primary factor driving accrual rate differences during summer and fall, but that temperature may also be important during fall. Planting a diverse assemblage of native riparian trees and ensuring their successful development can inhibit benthic irradiance and thermal energy inputs while providing similar quantity and quality of OM to constructed streams, thereby fostering replacement of reference-like OM functions in some streams.

Reference: R.J. Krenz III. 2015. Organic Matter Processes of Constructed Streams and Associated Riparian Areas in the Coalfields of Southwest Virginia. Ph.D. Dissertation, Virginia Tech. (The above abstract is from that dissertation).

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