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Physicochemical Characterization of Sediment in Northwest Arkansas Streams

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ABSTRACT

Eutrophication of surface waters is a critical concern in regions around the world facing nutrient surpluses as a result of confined animal feeding operations (CAFOs) and subsequent land application of manures. While large amounts of research exist on the transport of nutrient enriched runoff from fields to surface waters less information is available on in-stream processes controlling the transport of P in-stream. Thus, information is needed on the role of stream sediments in regulating transient phosphorus (P) to better understand the relationship between nutrient inputs and water quality. Fine-sized sediments (<2-mm) regulate P via sorption and burial, while algae attached to larger-sediments (> 2-mm) consume and store P. From fine-sized sediment a modified P saturation ratio (PSR_{mod}), related to the sediment ' s ability to bind P and determined from Mehlich-3 extracted nutrients, has been correlated to in-stream dissolved reactive P (DRP) concentrations. The objectives of this study were to determine the relative size distribution of total- and fine-sized sediment (sand, silt clay) fractions among streams, determine the optimum sample number needed to characterize Mehlich-3 P (M3P) and PSR_{mod}, and finally determine the applicability of PSR_{mod}, as an indicator of stream water column DRP concentrations. Stream sediments were sampled from the 0- to 3-cm depth from stream reaches ranging from (25 – 75 m) in August, 2008 for characterization along with water samples collected from the thalweg for DRP concentration determination. Additional water column samples were collected along with fine-sized sedi- ment chemical properties in February, May, and June 2009. The distribution of sediment size classes was statistically similar, with 2- to 20- and 20- to 75-mm sized sediment dominating. Fine-sized sediment (<2 mm) contributed 9 to 18% of total-sediment and was comprised primarily of sand. Sampled stream M3P and PSR_{mod}, were determined to typically be sufficiently characterized by a sample scheme utilizing three samples points. Modified P saturation ratio of < 2-mm sediment was highly correlated to DRP levels across sampling dates (r = 0.86), suggesting PSR_{mod}, has the potential to be used as an indicator of the ability of stream sediments to enrich stream water with P. Thus, fine-sized sediment nutrient concentrations appear to be key regulators of water column P concentrations.

KEYWORDS

Stream, Phosphorus, Nutrient Enrichment, Sediment

Cite this paper

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