An Ecotoxicological Evaluation of Active Coal Mining, Sedimentation and Acid Mine Drainage in Three Tributaries of the Leading Creek Watershed, Meigs County, Ohio

By

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Abstract

Three streams (Parker Run, Little Leading Creek and Thomas Fork) in the Leading Creek watershed, Meigs County, Ohio were impacted by active coal mining, agricultural and abandoned mined land sedimentation and acid mine drainage (AMD), respectively. An ecotoxicological evaluation was performed using physical (water chemistry and sediment depth analyses), toxicological (acute water column, chronic sediment and 35-day *in situ* toxicity tests) and ecological (benthic macroinvertebrate community sampling) parameters. Persistent acute toxicity (mean 48-hr LC_{50} of 30.3% to *C. dubia*) due to low pH (mean of 5.4) and high concentrations of dissolved metals (ex: Al ~ 10 mg/L) were responsible for the significantly depressed benthic macroinvertebrate community sampled in Thomas Fork. Heavy sedimentation (>30 inches), with no associated toxins, significantly decreased both abundance and diversity of benthic macroinvertebrates in Little Leading Creek. High concentrations of sodium (mean of 910 mg/L), TDS (mean of 3,470 mg/L), and periodic acute water column toxicity (mean *C. dubia* survival of 62% in 100% sample) were most likely responsible for the depressed benthic macroinvertebrate community observed in Parker Run. In ranking the severity of impacts, AMD was first followed by non-toxic sedimentation, and active coal mining ranked last.

A catastrophic coal slurry spill significantly impacted the benthic macroinvertebrate community in Parker Run in April 1997. Six sampling stations were established to monitor the recovery of the stream's benthic community and evaluate any impact the active coal mine effluent had on the recovery time of the community. The effluent, characterized by high concentrations of TDS (~4,200 mg/L), significantly hindered benthic macroinvertebrate community recovery in Parker Run. The benthic community at the initial spill site, which was above the active mine effluent, recovered to levels measured at an upstream reference within 4-9 months. Benthic communities impacted by both the slurry spill and the effluent still had not recovered 16 months after the spill. Concentrations of TDS measured in the stream were significantly correlated (r = -0.765 and -0.649 respectively) with both EPT richness and percent *C. dubia* survival in water column toxicity tests.

Laboratory analysis of synthetic coal mine effluent, similar in composition to that of the Parker Run effluent, was performed to determine toxicity thresholds for sodium, sulfate, TDS and conductivity. Acute toxicity thresholds were found for sodium (between 900 and 1,000 mg/L), TDS (4,200 and 6,400 mg/L), and conductivity (5,000

and 6,200 μmhos/cm). It was also determined that any toxic contribution of sulfate in solution with high concentrations of sodium (~1,000 mg/L) and/or TDS (~4,200 – 6,400 mg/L) was secondary to that of the toxic effect of sodium or TDS in that solution.

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