

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 LC₅₀ 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 $\mu\text{mhos/cm}$). It was also determined that any toxic contribution of sulfate in solution with high concentrations of sodium ($\sim 1,000$ mg/L) and/or TDS ($\sim 4,200 - 6,400$ mg/L) was secondary to that of the toxic effect of sodium or TDS in that solution.

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Table of Contents

Abstract	ii
Acknowledgements	iv
Table of Contents	v
List of Tables.....	vi
List of Figures	viii
Introduction:	1
Literature Cited	67
Chapter One:	4
Introduction	5
Methods	7
Results	11
Discussion	20
Conclusions	26
Literature Cited	68
Chapter Two:	27
Introduction	28
Methods	30
Results	33
Discussion	49
Conclusions	55
Literature Cited	74
Chapter Three:.....	56
Introduction	57
Methods	59
Results	61
Discussion	64
Conclusions	66
Literature Cited	78
Curriculum Vitae.....	80

List of Tables

Chapter One:

Table 1. Mean benthic macroinvertebrate total abundance and taxon richness values measured in each stream	11
Table 2. Mean benthic macroinvertebrate EPT abundance, EPT abundance as % of total abundance and EPT richness values measured in each stream	11
Table 3. Mean mayfly abundance and % of total abundance as mayflies measured in each stream	12
Table 4. Mean abundance of chironomids and chironomids as % of total abundance measured in each stream	12
Table 5. Mean biomass of periphyton as chlorophyll <i>a</i>	13
Table 6. Summary of non-metallic water chemistry data	14
Table 7. Summary of water column metals data	15
Table 8. Summary of mean <i>Ceriodaphnia dubia</i> 48-hr survival .	18
Table 9. Summary of mean <i>Daphnia magna</i> survival and reproduction in 10-day chronic sediment tests	19
Table 10. Summary of mean <i>Chironomus tentans</i> survival and growth in 10-day chronic sediment tests	19
Table 11. Summary of mean survival and growth of <i>Corbicula fluminea</i> from 35-day <i>in situ</i> toxicity tests	19

Chapter Two:

Table 1. Summary of non-metallic water chemistry data	38
Table 2. Summary of water column metals data	39
Table 3. Mean survival and reproduction of <i>Daphnia magna</i> and mean survival and growth of <i>Chironomus tentans</i> from April 1997, 10-day chronic sediment tests	41
Table 4. Mean survival and reproduction of <i>Daphnia magna</i> and mean survival and growth of <i>Chironomus tentans</i> from August 1997, 10-day chronic sediment tests	41
Table 5. Mean survival and reproduction of <i>Daphnia magna</i> and mean survival and growth of <i>Chironomus tentans</i> from January 1998, 10-day chronic sediment tests	42
Table 6. Mean survival and reproduction of <i>Daphnia magna</i> and mean survival and growth of <i>Chironomus tentans</i> from June 1998, 10-day chronic sediment tests	43
Table 7. Mean survival and reproduction of <i>Daphnia magna</i> and mean survival and growth of <i>Chironomus tentans</i> from June 1998, 10-day chronic sediment tests using site specific overlying water	43
Table 8. Summary of 48-hr water column toxicity to <i>Ceriodaphnia dubia</i>	44
Table 9. Summary of simple linear regression analysis performed on data collected summer 1998.....	48

Chapter Three:

Table 1. Summary of concentration of each salt used to create synthetic coal mine effluents	59
Table 2. Summary of <i>Ceriodaphnia dubia</i> 48-hr LC ₅₀ values for conductivity, TDS, sodium and sulfate for each of the four synthetic effluents tested.....	61

List of Figures

Chapter One:

- Figure 1A-D. Mean levels of conductivity and mean concentrations of sodium, sulfate and chloride measured in each stream 16
- Figure 2A-D. Mean pH and concentrations of manganese, aluminum, and iron 17
- Figure 3. Sediment depths measured in each stream 18

Chapter Two:

- Figure 1. Mean values of benthic macroinvertebrate community total abundance, EPT abundance, taxon richness and EPT richness values measured in April 1997, immediately following coal slurry spill 34
- Figure 2. Mean values of benthic macroinvertebrate community total abundance, EPT abundance, taxon richness and EPT richness values measured in July 1997..... 34
- Figure 3. Mean values of benthic macroinvertebrate community total abundance, EPT abundance, taxon richness and EPT richness values measured in January 1998 35
- Figure 4. Mean values of benthic macroinvertebrate community total abundance, EPT abundance, taxon richness and EPT richness values measured in July 1998..... 35
- Figure 5A-D. Mean levels of conductivity and mean concentrations of TDS, sulfate and sodium measured in Parker Run..... 40
- Figure 6A-D. Mean survival and growth of *Corbicula fluminea* in 35-day *in situ* toxicity tests conducted in July 1997, July and August 1998 45
- Figure 7. Mean *Corbicula fluminea* survival and growth from all 35-day *in situ* testing conducted in Parker Run..... 46
- Figure 8. Mean *Corbicula fluminea* survival and growth from 35-day *in situ* toxicity tests conducted above and below mine effluent..... 47

Chapter Three:

- Figure 1A-D. Mean *Ceriodaphnia dubia* 48-hr LC₅₀ values to conductivity, TDS, sodium and sulfate in each of the four synthetic mine effluents tested..... 63