

Levels of Dissolved Solids Associated with Aquatic Life Effects in Headwater Streams of Virginia's Central Appalachian Coalfield Region

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ABSTRACT

Benthic macroinvertebrate communities in headwater streams influenced by Appalachian coal mining often differ from communities in minimally disturbed streams. Elevated levels of total dissolved solids (TDS) associated with mining have been suggested as stressors to these communities. In studies of such streams conducted to date, both non-TDS stressors and elevated TDS have been present as potential influences on biota. In the study reported here the association between dissolved salts and benthic macroinvertebrate community structure was examined using a family-level multimetric index and genus-level taxa sensitivity distributions. Test sites were selected along a gradient of elevated TDS, with non-TDS factors of reference quality. Virginia Stream Condition Index (VASCI) scores were regressed against log-transformed measures of TDS, specific conductance, and sulfate (SO_4^{2-}) using ordinary least squares and quantile regression techniques. Biological effects, as defined by VASCI scores <60 indicating stressed or severely stressed conditions, were observed with increasing probability from 0% at ≤ 190 mg/L TDS to 100% at $\geq 1,108$ mg/L TDS, with 50% probability of effects observed at 422 mg/L TDS. Associations between water quality measures and biological condition were variable, with approximately 48% of the variance explained by TDS. Genus-level analysis using a field sensitivity distribution approach indicated 95% of reference genera were observed at sites with $\text{TDS} \leq 281$ mg/L, and 80% of genera were observed at sites with $\text{TDS} \leq 411$ mg/L. This is evidence that TDS, specific conductance, or SO_4^{2-} can be used to establish dissolved solids levels for streams influenced by Appalachian coal mining above which aquatic life effects are increasingly probable.

A preliminary report of results was published as Timpano et al. (2010), and a final report as Timpano et al. (2011). The final report was derived directly from Timpano (2011).

This research was supported by Virginia Department of Environmental Quality, Virginia Department of Mines, Minerals, and Energy, and Powell River Project. The authors thank property owners and mine permittees for providing access to study sites, as well as the industry and consultant personnel that provided site orientation. Finding and accessing high-quality study sites was made possible with assistance from numerous mine operators and their consultants, as well as private landowners. They are: Eddie Clapp and Roger Jones, Red River Coal Company; Mark Sproles, Dickenson-Russell Coal Company; Tad Nunley, United Coal Company; Phil Mullins, Skelly & Loy, Inc.; Keith Mohn, Arch Coal, Inc.; Chris Stanley and Dean Childress, Clintwood-Elkhorn Mining Company; Craig Kaderavek, The Forestland Group, LLC; Marty Large, Marty Corp. We thank also the Virginia Tech students that assisted with site selection, data collection, sample processing, and sample analysis: Autumn Timpano, Jackie Carl, Robert Northington, Trip Krenz, Mindy Forsyth, and Caleb Parks.

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