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Treated acid mine drainage and stream recovery: Downstream impacts on benthic macroinvertebrate communities in relation to multispecies toxicity bioassays

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Abstract

The success and long term effectiveness of extensive and expensive engineering solutions to restore streams impacted by Acid Mine Drainage (AMD) is rarely tested. Concentrations of pollutants were measured in water along a longitudinal gradient from a stretch of the Tweelopie stream, South Africa, that receives pH-treated acid mine drainage (AMD) from an abandoned gold mine. The biotoxic effects of treated AMD were determined through macroinvertebrate biotic indices (SASS5) and a battery of toxicity bioassays. These included the L. sativa, A. cepa, D. magna toxicity and Ames mutagenicity tests, as well as an in vitro human liver cancer cell line HepG2. Even though the Tweelopie stream was moderately to severely degraded by multiple anthropogenic stressors, the impact of the treated AMD was masked by the improvement in the system downstream after mixing with the domestic wastewater effluent receiving stream, and subsequent further dilution as a result of the karst springs downstream. The general improvement of the system downstream was clearly shown by the decrease in the ecotoxicity and mutagenicity in relation to the in-stream macroinvertebrates. PCA multivariate analysis successfully displayed associations between the different environmental variables and the decrease in toxicity and subsequent ecosystem improvement downstream. This study indicated that environmental management of AMD remediation should consider long term assessment strategies, including multiple factors, to promote biological ecosystem recovery.