

Title: Data associated with “Resilience and regime shifts: do novel communities impede ecological recovery in a historically metal-contaminated stream?”

Abstract: Novel communities that result from exposure to contaminants and other anthropogenic stressors often persist in ecosystems that have experienced regime shifts. Because these systems may not return to pre-disturbance conditions after removal of the stressor, understanding the ecological consequences of regime shifts has important implications for how restoration success is defined. Long-term observational studies can potentially identify regime shifts in disturbed ecosystems; however, experimental approaches may be necessary to demonstrate their ecological consequences. We report results of a long-term (28 year) observational study and a series of stream mesocosm experiments that investigated a regime shift in a mining-contaminated watershed. We tested the hypothesis that establishment of a novel, metal-tolerant macroinvertebrate community in a previously contaminated stream impeded recovery of sensitive species, despite significant improvements in water quality over the past two decades. Despite significant improvements in water quality, abundance and species richness, we observed persistent changes in community composition and trophic structure downstream from a former source of metal contamination. Downstream communities were dominated by large, metal-tolerant caddisflies that likely impeded colonization by metal-sensitive groups (e.g., grazing mayflies). Mesocosm experiments conducted with reference and downstream communities demonstrated that novel communities retained their tolerance to metals, but were significantly more sensitive to other stressors. We suggest that the failure of downstream communities to recover represented a contaminant-induced regime shift that resulted from the sustained dominance of metal-tolerant species. Restoration ecologists generally consider increased species diversity or abundance of recreationally/commercially important species as indicators of restoration success. However, few stream restoration projects have quantified ecological resilience, and none have included a significant experimental component. Our research is the first to experimentally demonstrate that novel communities in a stream recovering from historical metal pollution have lower resilience to other (e.g., non-metal) stressors. These results have important implications for how restoration success is defined. In systems where restoration to pre-disturbance conditions is unlikely, a better understanding of the ecological resilience of novel communities may be critical for assessing the restoration success. We suggest that resilience to novel stressors is an important indicator of restoration effectiveness that may be applicable in other aquatic ecosystems.

Recommended data citation:

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<https://hdl.handle.net/10217/196493>

Format of data file: .csv**Description:**

Data include macroinvertebrates and water quality collected from upstream and downstream locations at the Arkansas River (near Leadville, Colorado) and in experimental stream mesocosms. Field data were collected between 1989 and 2017. Mesocosm data were collected from 2009-2017. Below are specific details of the data included in this file.

1. Zn Concentration- measured Zn concentrations (ug/L) measured in the Arkansas River at upstream and downstream locations, 1989-2017
2. Metrics Field- Total number of taxa and total individuals (per 0.1 m²) collected from the Arkansas River at upstream and downstream locations, 1989-2017
3. Trophic field- Relative abundance of major functional feeding groups collected from the Arkansas River at upstream and downstream locations, 1989-2017
4. Metrics mesocosms- Abundance of macroinvertebrate orders, total abundance and number of taxa in control and metal-treated stream mesocosms. Communities were collected from upstream and downstream locations in the Arkansas River.
5. Mesocosms multivariate- Results of canonical discriminant analysis showing values for canonical variables 1 and 2. Results were based on abundance of dominant taxa from upstream and downstream locations in control and metal-treated stream mesocosms.
6. Mesocosms trophic- Relative abundance of major functional feeding groups in control and metal-treated stream mesocosms. Communities were collected from upstream and downstream locations in the Arkansas River.
7. Mesocosms diesel- Abundance of macroinvertebrate orders, total abundance and number of taxa in control and diesel-treated stream mesocosms. Communities were collected from upstream and downstream locations in the Arkansas River.

