Short term biotic response before and during the treatment of an acid mine drainage with sodium carbonate

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Abstract

The lower portion of Upper Three Runs, a woodland stream in central Pennsylvania, receives acid drainage from a strip mine. In 1974, the effect of this input on pH and benthic invertebrates was studied by Tomkiewicz & Dunson (1977). We sampled the same stations in 1986 and then treated the mine drainage with sodium carbonate for seven days in an effort to evaluate the short term colonization response of brook trout (Salvelinus fontinalis) and invertebrates. No differences in the pattern of pH and invertebrate distribution was found between the 1974 and 1986 results, although pH values and invertebrate densities were higher in 1986. Total number of invertebrates and number of taxa colonizing bricks during three pre-treatment time periods (8, 10, 18 days) did not differ from the single treatment period (7 days). However, two species of Baetis (Ephemeroptera: Baetidae) did increase in the treatment section during sodium carbonate application. The number of brook trout also increased in the treatment section, as compared to one pre-treatment estimate. These results indicate that motile species are able to respond within seven days, whereas, longer treatment may be required to produce community wide responses.

Introduction

Like Upper Three Runs (UTR), thousands of streams in the U.S. receive acid mine drainage from abandoned deep and strip mines. Mine drainage is usually a point source pollutant and has greater potential for reclamation than non-point source pollutants. One form of mine drainage reclamation is the addition of a strong base to the acid source. This base will raise the pH and lower the solubility of toxic heavy metals. A pool of potential colonists should exist on each polluted stream, above the locations where mine drainage enters. The simplicity of identifying and mitigating the pollutant, combined with the ready source of colonizers, makes mine drainage an excellent candidate for reclamation and the study of recolonization patterns of the biota.

The pH and invertebrates at an acid drainage impacted site on UTR were studied during the summer of 1974 by Tomkiewicz & Dunson (1977). They found a substantial decrease in Shannon-Wiener diversity, density, biomass and number of taxa from above to below the acid input. The objectives of our study were first, to assess the similarity of the pH and invertebrate
variables measured in 1986 with those of Tomckiewicz & Dunson (1977) twelve years earlier, and second, to evaluate the short term colonization response by brook trout (*Salvelinus fontinalis*) and invertebrates within UTR to the application of base (sodium carbonate) to the acid tributary.

**Study area**

The study area consisted of four stations used by Tomckiewicz & Dunson (1977) and one additional: (1) the acid tributary, (2) upstream of the acid tributary on UTR, (3) immediately below acid tributary on UTR, (4) 0.85 km downstream of acid tributary, and (6) 75 m downstream of acid tributary on UTR (additional station). Station 5 of Tomkiewicz & Dunson (1977) was not included in order to exclude any influence of human development in the vicinity of Pottersdale. One major change in the vicinity of the acid tributary, since 1974, is a diversion of approximately one fourth of UTR flow, about 140 m upstream of the acid tributary, which was constructed by local residents. The diversion re-enters UTR approximately 330 m downstream, 190 m below the acid tributary.

**Methods**

Fish number per linear meter of stream was estimated with the aid of a backpack DC shocker on November 11 (pre-treatment), and November 22 (last day of seven day sodium carbonate application). Four sections were delineated: I, from approximately 60 m downstream of the rebraid of the diversion with the main channel, to the rebraid point (see Fig. 1), II, from the point of rebraid upstream 75 m, III, from 75 m upstream of the rebraid to the confluence of the acid tributary with UTR, and IV, from just above the acid tributary to 140 m upstream.

Three benthic invertebrate samples were taken at stations 1–4 on October 7, with a modified

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**Fig. 1.** Schematic of study site on Upper Three Runs. Arabic numerals correspond with water and invertebrate sampling sites, roman numerals correspond with trout sampling sections.