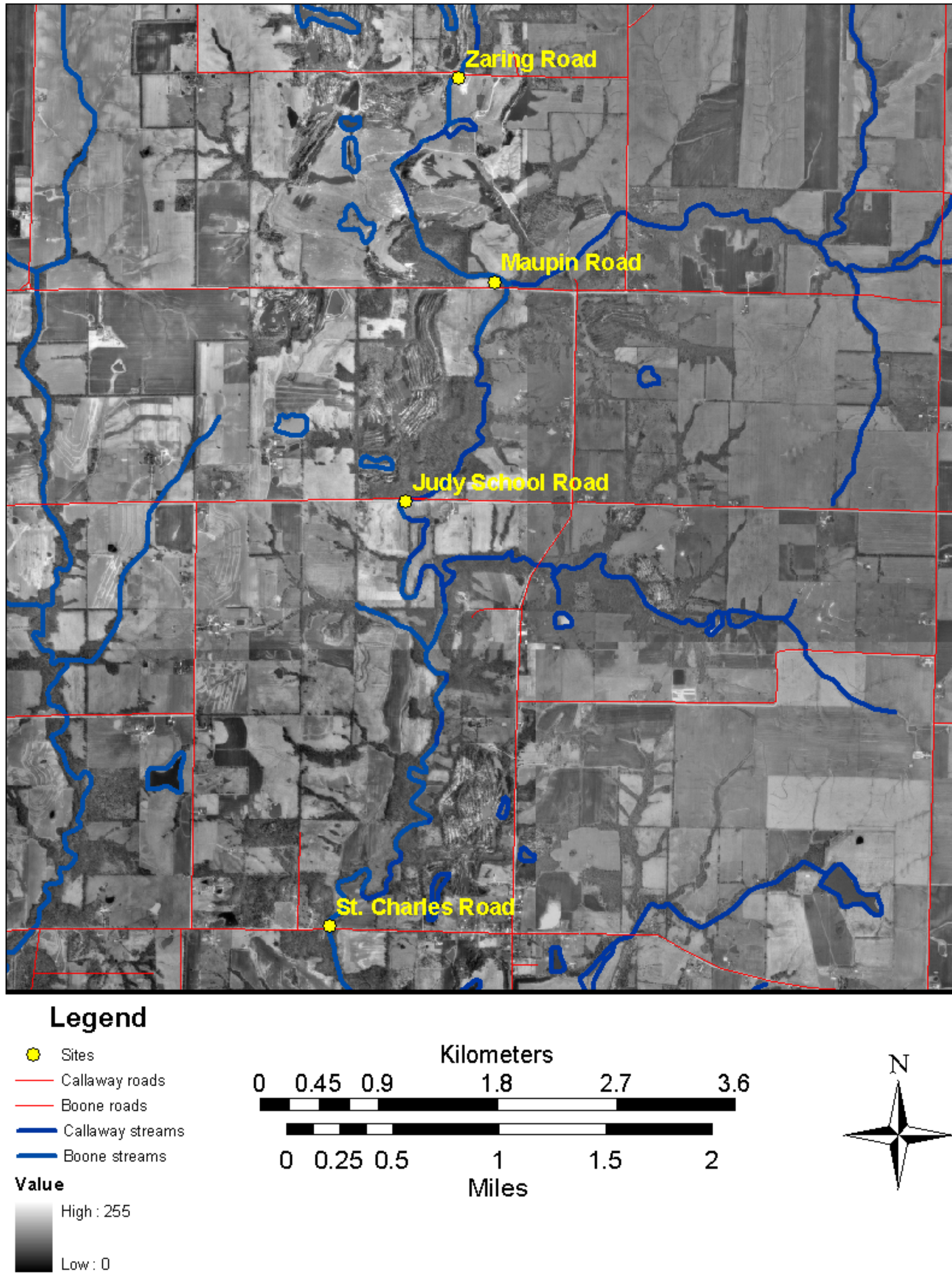


Figure 1. Site locations in the Upper Cedar Creek study area.

USGS
science for a changing world

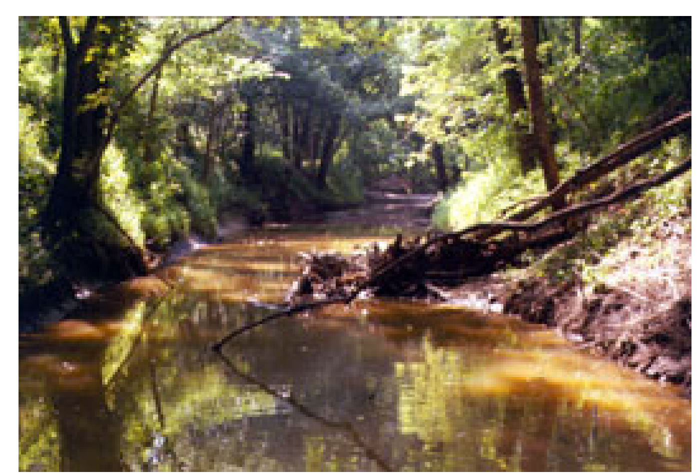
Columbia Environmental Research Center and the Missouri Department of Natural Resources

Assessment of the Biological Recovery of Upper Cedar Creek, Boone County, Missouri, Following an Abandoned Mine Land Reclamation

Introduction

In 1977, the Surface Mining Control and Reclamation Act (SMCRA) created the U.S. Office of Surface Mining Reclamation and Enforcement (OSM) and initiated the Abandoned Mine Lands Reclamation Fund. The Fund was established to facilitate reclamation and rehabilitation of abandoned coal mines in the United States. Acid drainage from abandoned coal mines represents a significant threat to aquatic resources due to the effects of low pH, low alkalinity, and increased concentrations of metals such as aluminum, manganese, iron and zinc.

Upper Cedar Creek, Boone County, Missouri, lies within the boundaries of the Mark Twain National Forest and is a significant aquatic resource in Central Missouri. It drains approximately 2,000 acres of abandoned coal mines, and in 1979, the U.S. Forest Service declared 14 miles of Cedar Creek "lifeless".



Cedar Creek, Maupin Road

Cedar Creek, Zaring Road

The Missouri Department of Natural Resources Land Reclamation Program (LRP) received approval from OSM in 1982 to operate an Abandoned Mine Land Program (AML) to receive grants and perform reclamation of mining impacted sites. The Land Reclamation Program completed several projects within the Cedar Creek watershed between 1985 and 1990, and rehabilitated over 700 acres of land. Flooding in 1990 and 1993 severely damaged streambanks at the Upper Cedar Creek project.

In 1997, the Land Reclamation Program initiated additional work in the Upper Cedar Creek watershed to construct passive treatment wetlands, repair streambanks, and seed barren soil with warm-season native grasses. Wetland construction and streambank improvements were started in 2000 and completed in 2002.

U.S. Geological Survey Project

The U.S. Geological Survey, Columbia Environmental Research Center entered into an agreement with the LRP to document the recovery of biological communities in Upper Cedar Creek following the recent reclamation activities. The objective of this project was to determine the success and rate of biological recovery of Cedar Creek by monitoring water quality, dissolved metal concentrations, and fish and benthic invertebrate (aquatic insect) community structures. Work was initiated in 1999 and completed in 2002.

Ten sites were selected for the assessment. Sites were selected upstream of the reclamation area (reference) and downstream of the area (impacted and recovery sites). Water quality was monitored bimonthly at all sites. Fish and benthic invertebrate communities were monitored annually at seven sites.

Leafpack, Benthic Invertebrate Sampler

Benthic invertebrates were sampled using a standardized sampler (leafpack). Leafpacks consisted of 10 g of cottonwood leaves packaged in a black polyethylene mesh. Leafpacks were placed on the stream bottom for a 28-d period and used to measure invertebrate community composition. Temperature was monitored throughout the leafpack deployment.

Fish were sampled using seines immediately after the retrieval of leafpacks. Fish were identified on-site and released. Crayfish collected in seines were also counted and released.

Preliminary Results and Discussion

This fact sheet focuses on water quality and fish communities at Zaring Road (immediately upstream of the reclamation area); Maupin Road (immediately downstream of the area), and two sites further downstream, Judy School Road and St. Charles Road (recovery sites) (Figure 1, page 4).

The impacts of past mining activity at Maupin Road were exhibited by low pH and alkalinity, which were below water quality criteria. Alkalinity (Figure 2) and pH (Figure 3) increased over time indicating a reduction in acidic discharge into Cedar Creek. There were no extremely low pH or alkalinity measurements after the passive wetlands were installed and streambanks were repaired in December 2000. Water quality continued to improve through 2002. Alkalinity in Cedar Creek at Maupin Road has increased to 150 mg/L, which is 75% of the production capability of the wetland cells (200 mg/L alkalinity).

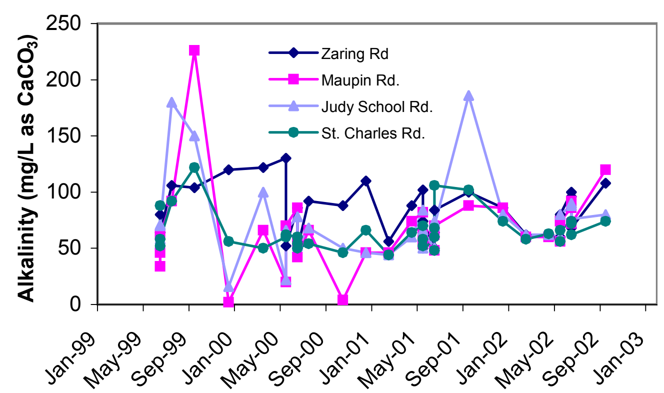


Figure 2. Changes in alkalinity over time.

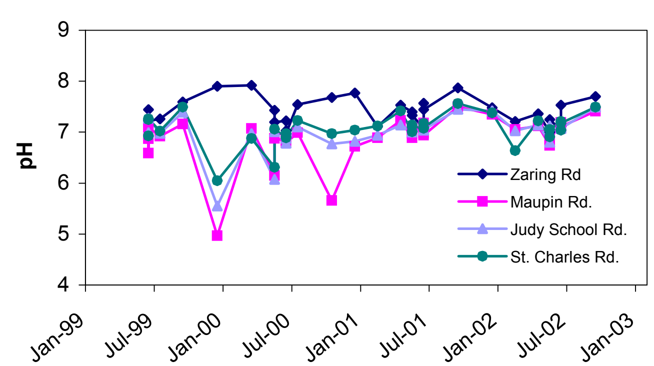


Figure 3. Changes in pH over time.

Dissolved metal concentrations did not change greatly over time. Concentrations of metals such as manganese (Figure 4) were slightly elevated during 2000, which was a period of high water flows and prior to completion of the treatment wetlands.

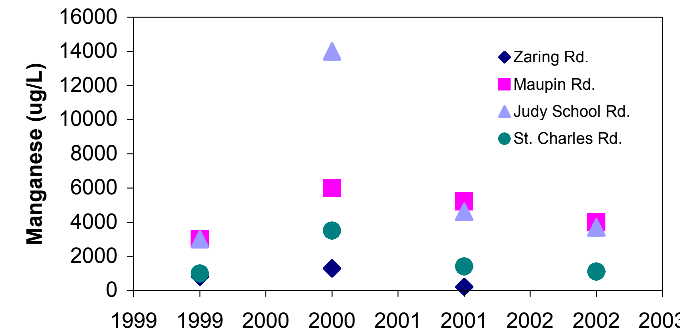


Figure 4. Changes in manganese over time.

The total numbers of fish generally increased at all sites, with the greatest increase occurring at Maupin Road, which was the most impacted site (Figure 5). Seasonal variation in water levels may have contributed to the lower number of fish at several of the sites in 2002.

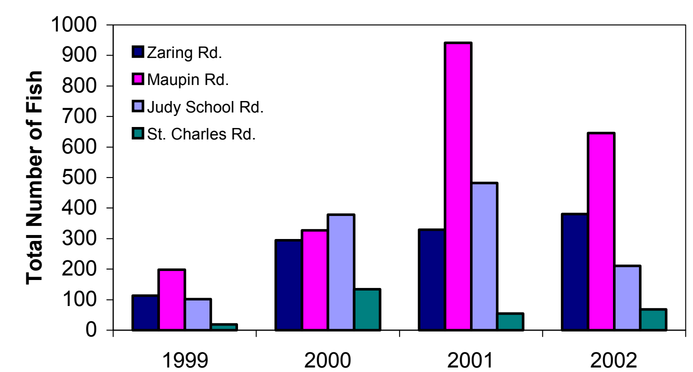


Figure 5. Changes in number of fish over time.

There was a significant positive correlation between the number of fish species and pH (Figure 6) which demonstrates the importance of pH and water quality to fish communities. There was a similar relationship with alkalinity.

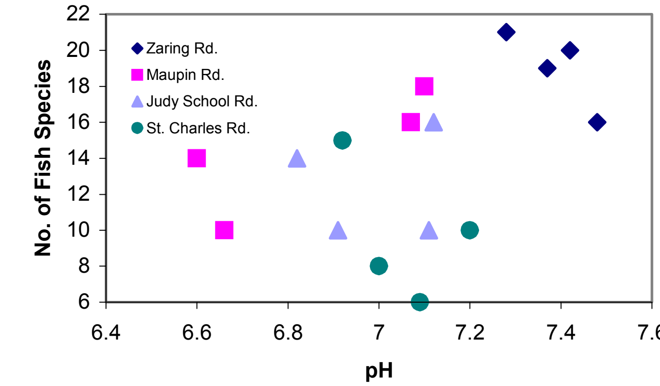


Figure 6. Correlation of number of fish species and pH.

Other factors that may contribute to the number of fish species include size of stream, water levels, temperature, dissolved oxygen and food availability. One of the project's goals is to further examine the interaction of these factors to determine which variables are most important to fish community structure.

Early analysis of the data documents improvements in water quality and fish community structure. We anticipate the benthic invertebrate analysis will also indicate overall ecological improvement in Cedar Creek.

A final report will be available from the USGS Columbia Environmental Research Center in October 2003.

Acknowledgements

This work could not have been completed without the support of the landowners, who allowed stream access across private land. This project was funded by the Missouri Department of Natural Resources, Land Reclamation Program.

For more information, please contact:
Ann Allert
U.S. Geological Survey
Columbia Environmental Research Center
4200 New Haven Road
Columbia, Missouri 65201
phone: 573-876-1903; fax: 573- 876-1896
email: Ann_Allert@usgs.gov
http://www.cerc.usgs.gov/