

ASSESSMENT OF STREAM RESTORATION IN KENTUCKY

Jeffrey Jack¹, Arthur Parola², William Vesely³ and Stacy Pritchard⁴

AUTHORS: ¹Asst. Professor of Biology, University of Louisville, Louisville, Kentucky 40292, ²Professor of Civil and Environmental Engineering, University of Louisville, Louisville, Kentucky 40292, ³Civil and Environmental Engineering, University of Louisville, Louisville, Kentucky 40292, and ⁴Department of Biology, University of Louisville, Louisville, Kentucky 40292.

REFERENCE: *Proceedings of the 2003 Georgia Water Resources Conference*, held April 23-24, 2003, at the University of Georgia. Kathryn J. Hatcher, editor, Institute of Ecology, The University of Georgia, Athens, Georgia.

Abstract. Stream restoration has become a priority for many resource management groups in Kentucky but there is little information available to assess the “success” of many commonly used restoration techniques in the state. We are beginning a project to evaluate a number of stream restoration projects statewide using a rapid restoration assessment protocol that is now under development. Preliminary data suggests that long-term monitoring will be needed for many sites in order to accurately assess restoration “success”.

INTRODUCTION

Proper management of water resources poses a significant challenge for regulatory agencies and for society at large in the Commonwealth of Kentucky. While the state has abundant water resources, the quality of surface and groundwaters has been impaired in many watersheds by agricultural activities and urbanization. One of the most common and serious problems affecting water quality in Kentucky involves impacts associated with direct and indirect physical alteration of streams. Direct physical alterations have occurred during activities such as road and bridge construction, land development, flood mitigation projects and mining. Indirect physical alteration occurs as a consequence of land-use modification that alters basin hydrology, causing complex physical responses in a stream system. A number of impacts from land development may contribute to a diminished ecological integrity including a reduction in the stream pool riffle sequences, increased embeddedness of channel substrate, loss of riparian vegetation, loss of hydrologic storage and a reduction in high-flow refugia for stream organisms.

The impact of such activities has long been recognized and various agencies at the state and federal level have developed guidelines for stream protection and for the restoration of streams damaged as a result of

development. Manuals of “Best Management Practices” and regulations designed to require restoration of altered streams have been used to mitigate the impact of development on the integrity of stream systems and on the quality of water carried by these streams. While these approaches have helped raise the level of awareness of the importance of stream protection and have also significantly improved stream stability and water quality in some instances, there is growing recognition that current approaches to restoration science have serious shortcomings.

Problems in Restoration Practice

Ebersole et al. (1997), Kauffmann et al. (1997), and Borhardt (1993) identified several problems currently plaguing the field of stream restoration including:

- a) Vague conceptual foundations and assumptions, which may lead to unintended problems in the future.
- b) Inadequate assessment of the physical requirements of stream biota
- c) Restoration goals which are not well defined
- d) Inadequate attention given to interactions with the watershed
- e) Restoration efforts that focus on manipulations within the channel even though most impacts occur from watershed-wide or riparian activities
- f) Inadequate or non-existent post-project monitoring. In the few instances where some post-project monitoring is attempted, many of the examined projects were not successful in meeting their restoration goals.

In order to address some of these issues in Kentucky, the USEPA, Commonwealth of Kentucky and faculty from the University of Louisville have developed a cooperative project to assess stream restoration in the state.

This effort has the following goals:

- a) Assess current and past mitigation projects in Kentucky and compile an electronic database for these projects with both universal and site-specific parameters designed to allow Kentucky Division of Water of Water (KDOW) personnel access to pertinent information on these projects
- b) Select a subset of these sites for intensive geomorphological survey and biological assessment. This will include an evaluation of the site's effectiveness in mitigation and a "lessons learned" analysis of each site.

METHODS

The KDOW has maintained a database of 401 Section Water Quality Certifications for projects where stream mitigation was required. The project team reviewed the Section 401 files and submitted a report to KDOW on the current restoration "state of practice" for Kentucky. This analysis included categorization of restoration "type" and an assessment of how well the contractors met their reporting obligations for design and monitoring. The project team and KDOW chose 21 mitigation projects statewide based on available pre-disturbance data and disturbance type. Physiographic region and land use patterns also factored in the selection of sites for visits. All of these sites will be visited to acquaint the project team with the range of mitigation activities in Kentucky, provide basic compliance information to the KDOW and to help the contractors pick sites for more intensive study (see below).

RESULTS

The first phase of the project, the review of Section 401 documents, has been completed and the initial field visits to the 21 selected streams has begun. After the site visits are completed, the project team will perform an intensive geomorphic surveys and biological assessments at 5 of the sites. These surveys and assessments will provide an evaluation of individual projects in light of current available technologies, with a focus on individual components that are deemed critical to project success in the various project watersheds. We will use data from these biological and geomorphologic assessments and surveys to determine which elements are critical to accurately evaluating Section 401 projects in Kentucky. Such post-project evaluations are rare in many states (Kondolf 1995) but

are essential learning opportunities to help ensure the success of future projects. These evaluations will serve to support a future project that will expand the intensive site surveys to encompass more sites and a broader range of stream mitigation activities.

As a result of these surveys and assessments, the team will develop a rapid restoration assessment protocol, similar in philosophy to the rapid biological assessment protocols of USEPA. This protocol will include both geomorphic and biological metrics to evaluate stream morphological stability, biodiversity, ecosystem attributes and other stream characteristics that may be positively or negatively affected by restoration.

While we are in the early stages of data collection in most streams, we do have some preliminary data from one stream. Winding Falls is an urban stream in Louisville, Kentucky, that had a reach moved and restored as part of a construction project. The restored reach was relocated using natural channel techniques and bioengineering. The site has been monitored annually since 1999. Until 2002, there was little evidence of channel cross-sectional change or riffle development. Recent surveys (Figure 1) however, have shown that cross-sectional areas in some reaches of the stream are beginning to change and riffles are beginning to form downstream of grade control structures. The dynamic role of woody debris transport and blockage and its impact on sediment transport, streambank erosion and damage to bioengineering has also become apparent through this study.

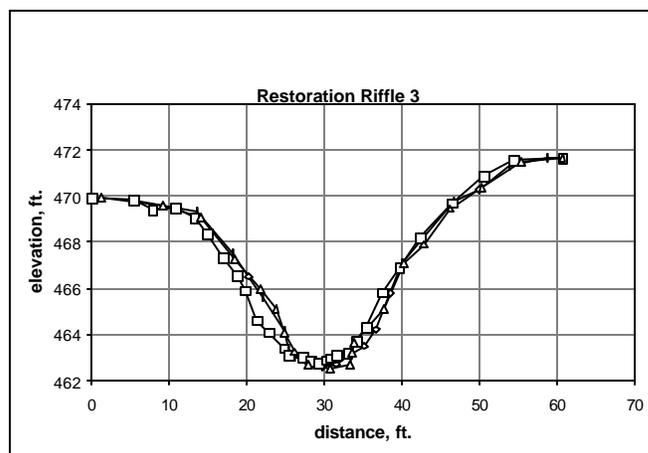


Figure 1. Changes in riffle cross-section over three years at Winding Falls, Louisville, KY. Open squares=March 2000, diamonds=December 2001, triangles=March 2002.

SUMMARY

While the assessment of restoration sites is just beginning, it is obvious that stream relocations, mitigations and other impacts are common statewide. The need for an assessment instrument that addresses both the geomorphic and the biological properties of streams is obvious. Many suitable models for "rapid assessment" protocols exist (USEPA Bioassessment and EMAP Habitat evaluation protocols) and a similar approach needs to be developed to help KDOW and other resource managers in Kentucky assess restoration plans and monitor restoration effectiveness.

The recent changes at the Winding Falls site emphasize the importance of long-term monitoring at restoration sites. The team working at the site would have come to very different conclusions about channel stability and habitat diversity if the monitoring had not continued for more than two years. This kind of monitoring requires a substantial commitment from management and funding agencies but it is necessary in order to fully incorporate "lessons learned" into future restoration projects.

REFERENCES

- Borchardt, D. 1993. Effects of flow and refugia on drift loss of benthic macroinvertebrates: implications for habitat restoration in lowland streams. *Freshwater Biology* 29:221-227.
- Ebersole, J. L., W. J. Liss and C. A. Frissell. 1997. Restoration of stream habitats in the western United States: restoration as a reexpression of habitat capacity. *Environmental Management* 21:1-14.
- Kauffmann, J. B., R. L. Case, D. Lytjen, N. Otting and D. L. Cummings. 1995. Ecological Approaches to riparian restoration in Northeast Oregon. *Restoration and Management Notes* 13:12-15.
- Kondolf, G. M. and E. R. Micheli. 1995. Evaluating stream restoration projects. *Environmental Management* 19:1-15.