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STREAM RESTORATION – LONG TERM PERFORMANCE: A REASSESSMENT

Karl Williard[1], Blair Borries[1], Timothy Straub[2], Donald Roseboom[2], Clayton Nielson[1], Veronica Kelly[1], and Jack Nawrot[1]
[1]Southern Illinois University Carbondale and [2]United States Geological Survey, Urbana, IL

Project Description and Objectives:

In the 1980s, three of the largest stream relocations in the United States occurred as a result of surface mining in southern Illinois. Bonnie, Galum, and Pipestone Creeks in Perry County, Illinois were restored to the same location with many of the same physical attributes that were present prior to surface mining. The overall objective of the project was to determine the long-term (20 to 30 years post restoration) success of stream and wetland restoration efforts associated with these relocations. Success was evaluated by whether form and function had been restored in these ecosystems.

Applicability to Mining and Reclamation:

The Clean Water Act and the Surface Mining Reclamation & Control Act have established compensatory based systems to restore ecosystem functions lost due to surface mining. There is a need to establish whether or not the restored systems have achieved the same level of function, and if not, to establish a trajectory that will determine when or if the level of function will be achieved. The efficacy of specific practices such as connecting incline pit lakes to restored streams should be evaluated.

Methodology:

This project conducted post-restoration water quality and fish and macroinvertebrate sampling, and also evaluated stream stability, hydraulics, riparian wildlife habitat, and wetland soil quality along restored reaches of Bonnie, Galum, and Pipestone Creeks. Little Galum Creek, draining an adjacent unmined watershed, was used as a reference stream to help evaluate restoration success. Stream water quality was assessed seasonally by grab sampling and analyzing for metals, nutrients, and total suspended solids. YSI probes were used to measure in-situ specific conductivity, temperature, pH, and dissolved oxygen. Macoinvertebrates were sampled with pipestove cores in spring and fall 2012. Fish were sampled with minnow seines in summer 2013. Stream stability was qualitatively assessed with aerial and on-ground photography and quantitatively assessed with cross section surveys. Hydraulics and sediment transport were modeled with HEC-RAS. Riparian wildlife microhabitat was sampled in 200 plots. Macrohabitat for wildlife was assessed via patch and edge metrics in ArcMap 10.0. Wetland soil quality was evaluated in 12 wetlands by measuring total soil carbon and nitrogen in the 0-15 cm and 15-30 cm depth increments. Groundwater wells and IRIS tubes were installed in each wetland to verify that hydric conditions were present. Large incline pits were left to fill with water inline of restored stream segments on Bonnie and Galum Creeks.

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ABOVE PHOTO: Stream channel surveying of Galum Creek.

Methodology (continued):

This connection to a lacustrine habitat was not naturally found in streams within the region. The project investigated how these incline pits affected hydraulic and sediment relationships and the biotic communities.

Highlights:

Based on most of the stream water quality, wetland soil quality, hydraulic and stream stability, and wildlife habitat parameters measured, the streams and riparian systems have been restored to a level comparable to that of an unmined area. However, there were a few parameters that will take longer to recover such as canopy cover and soil quality in deeper horizons. In addition, several sections of Bonnie and Galum Creek still show signs of instability. A groundwater seep found along Bonnie Creek also shows the influence of groundwater inputs of sulfate on surface water quality. The incline pits provided some sediment retention benefits, but also affected the fish population. The fish communities were more similar to those found in lake habitats rather than stream habitats.

Results/Findings:

Overall, the stream and riparian restoration appears to have been successful. Current water quality was similar to 5 years post restoration. Riparian wetland soil quality in the top 15 cm was essentially fully recovered to natural reference wetland conditions. Hydric soil indicators as well as wetland vegetation were found in the wetlands restored on mined ground. An assessment of riparian wildlife habitat indicated that the restored riparian corridors were of similar value to wildlife as a natural riparian corridor.

Channel instability was found in several reaches in all three streams. Pipestone Creek and Galum Creek contained some low gradient sections, resulting in riffle substrate buried in fine sediment. Bonnie Creek showed the most instability and contained multiple sections with steep stream banks. The incline pit on Galum Creek served as an effective sediment trap. However, the current fish communities were not restored to ones that approximate natural communities, but rather ones that support more lake instead of stream species. The macroinvertebrate communities appeared to be less affected by the incline pits and more closely represented the community in Little Galum Creek, the natural reference stream that was sampled.

In summary, the relocation of Bonnie, Galum, and Pipestone Creeks were the largest of their kind associated with mine reclamation. The restoration of wide accessible floodplains with wooded riparian corridors and sinuous streams were a large improvement from the straight-line diversion channels that were common historically. While riparian processes were relatively quickly restored and water quality was maintained at near pre-mining conditions, in-stream processes and form will take longer to recover.

Above Photo: A view of the relocated Galum Creek, looking south, taken in July 2011. Several riparian wetlands, in the middle of the photo, were constructed adjacent to the stream. An incline pit is located inline of Galum Creek at the lower right corner of the photo.

Website Information:

The final project report can be found at **www.techtransfer.osmre.gov/NTTMainSite/appliedscience.shtm**

Principal Investigator:

Dr. Karl Williard
Southern Illinois University Carbondale
618-453-7478
williard@siu.edu

OSM Project Technical Representative:

Nick Grant
618-463-6463 x5148
ngrant@osmre.gov

For Further Information About OSM's Applied Science Programs:

Debbie Dale; ddale@osmre.gov; (618) 463-6463, Ext. 5149