FLUVIAL RESTORATION IN THE CHATTAHOOCHEE HEADWATERS

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Abstract. The Soque River Restoration Project is part of the Upper Chattahoochee Riverkeeper's Chattahoochee River Headwaters Riparian Restoration and Education Project, focusing on demonstrating the value of functioning riparian zones in protecing stream health. In close cooperation with U.S. EPA scientists and a private landowner, Riverkeeper implemented a restoration project following the methods of hydrologist David Rosgen, based upon principles of fluvial geomorphology. The project objectives include demonstrating the value of reclaiming previously cattle-grazed stream banks to properly functioning riparian zones that protect and enhance fish habitat, improve overall stream health, and reduce loss of property through excessive erosion. Further work following construction has involved community groups in reestablishing the riparian zone.

INTRODUCTION

The Upper Chattahoochee Riverkeeper (Riverkeeper) initiated the Chattahoochee River Headwaters Riparian Restoration and Education Project ("Headwaters Project") in 1996 to address nonpoint source pollution prevention in the Chattahoochee Headwaters (see Baer and Derby 1997), defined as the 1036 mi^2 Lake Lanier watershed. Lake Lanier is the first of 14 mainstem reservoirs on the Chattahoochee River, providing drinking water and recreational opportunities that together drive the economic engine for the region, including greater metropolitan Atlanta.

Two recent studies have shown that the quality of Lake Lanier is declining due to high levels of nutrients, fecal coliform bacteria, and sediment entering the lake from tributaries, including the Chattahoochee and Chestatee Rivers (Kundell et al. 1998, Limno-Tech 1998). Because riparian zones are recognized as critical components for mitigating nonpoint source pollution, stabilizing streambanks, decreasing water temperature, and providing instream habitat structure (see Wenger 1998), Riverkeeper has focused the Headwaters Project on the concept of riparian zone protection and restoration. The cornerstone of Riverkeeper's Headwaters Project is the Soque River Restoration Project (Soque Project) on the Left Fork of the Soque River in Habersham County.

RESTORATION PROJECT

The restoration portion of the Headwaters Project has been a joint effort between Riverkeeper and the U.S. Environmental Protection Agency's (U.S. EPA) Water Management and Science and Ecosystem Support Divisions.

Currently there are many types of restoration techniques in use (i.e. Seehorn 1985, Poff et al. 1997, Federal Interagency Working Group 1998, Riley 1998) and many interpretations of the term "restoration" (see National Research Council 1992). The choice of a technique, however, depends largely on the specific goals of the project. The goals of the Soque Project were to:

- Prevent the further contribution of sediment and loss of property (through erosion) from the site into the Soque River.
- Use a restoration technique that is new to Georgia.
- Demonstrate that it is easier and more cost-effective to prevent problems than it is to fix them to emphasize riparian zone protection.
- Improve fish habitat and stream health.

With these goals, the group chose to use fluvial techniques based on the work of David Rosgen (Rosgen 1996). This approach is based on the concept of "natural stability" whereby "natural stream channel stability is achieved by allowing the river to develop a stable dimension, pattern and profile such that, over time, channel features are maintained and the stream system neither aggrades or degrades" (Rosgen 1996).

Site Selection

The Soque River, a major tributary to the Chattahoochee above Lake Lanier, drains most of Habersham County and provides the drinking water supply for the City of Clarkesville. In a 1997 U.S. EPA study of sediment yield delivery to the Chattahoochee River, the Soque River had t' highest sediment loading of any tributary between headwaters and Highway 384 (above Lake Lanier)(U.S 1997). Further, the Soque River is also a state de' trout stream, which provides an important tourist and economic input for Habersham County (Seab' Because of this, site selection focused within th' watershed. Other important criteria included i' the site for future educational programs, ii) an "unstable" channel, and iii) a landowner who was cooperative and owned both sides of the river. Working with personnel from the Clarkesville office of the Natural Resources Conservation Service (NRCS), a landowner, Justin Savage, living on the Left Fork of the Soque River (LFS) was contacted and agreed to implementation of a restoration project on his property. A reference site, on Dukes Creek in the Smithgall Woods Conservation Area in White County, was used to establish a range of baseline geomorphic benchmarks for use during the design phase of the project.

METHODS

This paper provides a broad overview of the processes used for the restoration project. The authors have a second publication in preparation that will focus on the detailed methods and the technical data used for design specifications. In general, however, the methods followed are outlined in Rosgen's text on river restoration (Rosgen 1996).

Site Description

The LFS drains a 7.55 mi^2 watershed the headwaters of which flow from Tray Mountain Wilderness, managed by the U.S. Forest Service (USFS). The river continues through non-Wilderness USFS land and onto private land, for approximately 8,400 feet, before reaching the Savage property. On private land, the river flows through a broad alluvial valley that has been used for forestry, agriculture and cattle grazing. The riparian zones are dominated by pasture and eroding banks. LFS is a third order stream with a pre-construction bankfull width of 41 feet. The restoration reach was 1250 feet long.

Channel Instability

Mr. Savage had initially contacted the NRCS office because of a severe erosion problem that was causing a loss of land from the pasture throughout the reach and especially in one tight meander where six-foot vertical banks were regularly sloughing into the water. Using bankpins, it was estimated that an average of 60 – 110 tons of sediment eroded into the water during the first two months of 1998 (Morris Flexner, U.S. EPA, personal communication). Additionally, the landowner reported a loss of one-half an acre of pastureland over several years (Justin Savage, Savage-Roberts Farms, personal communication). Channel instability was further quantified using the Pfankuch (1975) technique, the bank erodibility hazard index (Rosgen 1996) and near bank stress evaluation technique (Rosgen 1996), all confirming that the LFS was highly unstable. Past land use practices including dredging, channelization, cattle grazing and the clearing of vegetation from streambanks are widely recognized to cause streambank erosion (Waters 1995). These factors likely caused the stream to evolve to the unstable condition, scouring in some places and aggrading to form center bars in other portions of the reach.

Field Methods

In addition to the instability measures, one of the key components was the establishment of the current and design "bankfull" width (bankfull discharge is that flow that is responsible for the majority of channel formation (Dunne and Leopold 1978)). To accomplish this, nine permanent cross sections were surveyed using a Topcon® laser and 44 additional cross sections were completed using a Topcon® total station. This information facilitated the generation of a pre-construction site map and allowed the group to pinpoint bankfull widths and other important geomorphological features including the floodplain (where present) and the terrace. Confirmation of bankfull features was made by comparison to a regional curve (Dunne and Leopold 1978) indicating a bankfull width of 32 feet for the Soque watershed site. This width was modified to 27 feet based on more local research (Henson 1999).

Other surveying included a longitudinal survey to establish channel slope and to quantify the number and spacing of bed features (i.e. riffle, run, pool) throughout the reach and the spacing between features. Meander geometry, such as sinuosity and meander width ratios, was established using the Topcon® total station. Pebble counts were taken at every cross section to determine bed surface material and for stream classification purposes (Rosgen 1996). These channel materials were classified according to the size of their intermediate axis (Wolman 1954) to establish median particle size. Aquatic invertebrates were also sampled by U.S. EPA and Riverkeeper staff at the LFS and at the Dukes Creek reference site using the Rapid Bioassessment Protocol (Plafkin 1989).

Design

A design for the Soque River Restoration project was developed by U.S. EPA scientists. Based on the data collected, the design goals were to increase stream sinuosity, decrease bankfull width, and save any existing trees within the riparian zone. Additionally, the design included reconstruction of the most impacted section of the eroding channel, providing a more appropriate radius of curvature. Instream structures, such as rock cross veins and rock veins (Rosgen 1996), were included to create habitat and divert erosive flows away from vulnerable banks.

IMPLEMENTATION

Implementation took place during a two-week period in October 1998, although much of the implementation depended upon materials gathered during the previous month. This time period was chosen to coincide with the low precipitation period in this region, so as to minimize downstream disturbance from construction-generated sediment. Average discharge during construction was 9.9 cubic feet per second (cfs) (Bruce Pruitt, U.S. EPA, personal communication). The construction portion of the work was contracted to Waterways Restoration, Inc. of Colorado.

Riverkeeper and U.S. EPA personnel were at the site at all times during construction to facilitate implementation and answer questions from interested onlookers. U.S. EPA scientists were also monitoring water quality upstream and downstream of the site using a Hydrolab®. Immediately following construction, the Southeast Waters Americorps team worked to stabilize the banks of the new channel with BioD-Mat®(a coconut fiber mat), black willow fascines and grass seed. Several components crucial to this type of restoration project are detailed below.

Permits

Restoration projects involving instream construction require a number of different permits, three in this case. The first was the U.S. Corps of Engineers (U.S. COE) Nationwide Permit number 27 (NWP 27). NWP 27 covers wetland and riparian restoration and creation activities and grants the temporary use of heavy equipment in the channel (U.S. COE 1997). The second permit required was a county issued land disturbing activity (LDA) permit required under Georgia's Erosion and Sedimentation Control Act (O.C.G.A. 12-7-1 et seq.). Finally, a state buffer variance was required because the project clearly entailed working within the 100-foot trout stream buffer.

Materials

Rosgen restoration projects demand a number of materials, or supplies, for implementation. For this project they included 16 rootwads (lower trunk of trees with the root mass attached), 400 tons of rocks, 200 hay bales, 700 feet of silt fence, heavy machinery (front end loader and an excavator), 2000 feet of coconut mat and two dumptrucks of willow cuttings. Although many development sites in North Georgia are being cleared, trees are generally cut and the stump subsequently ground into the earth. Arrangements for rootwad extraction and transportation were a challenge given the number required. Cross veins and rock veins (Rosgen 1996) are constructed using boulders ranging in size. In this case the largest rocks were approximately 4.5 feet in diameter and weighed as much as nine tons. Rock this size is difficult to find, and finding a company to transport rock this size is also difficult. Rocks were donated to Riverkeeper by the Demorest quarry of Benchmark Materials®, and transportation costs were close to four thousand dollars.

Another challenge was locating an excavator weighing a minimum of 60,000 pounds (necessary to handle heavy rocks) with a live (or hydraulic) thumb that was available for a short-term rental. An excavator was eventually found out-of-state from a company in Charlotte, N.C.. Willows were harvested from the U.S. COE Lula Bridge Park on Lake Lanier. All of the requisite materials were eventually acquired within budget, but some items were not easily obtainable.

Sediment Control

According to Riverkeeper's Land Disturbing Activity (LDA) plan approved by Habersham County, rock filter dams and silt fences were the primary methods of sediment control. Three rock filter dams were installed in the stream prior to instream construction. Typically, however, rock filter dams are intended for sediment filtering in drainageways or small streams that drain watersheds of 50 acres (~ 0.08 mi^2) or less (Georgia Soil and Water Conservation Commission 1996). Not surprisingly, working in a stream with a 7.55 mi^2 watershed, the rock filter dams were only partially effective. While the rock filter dams trapped heavier particles, fine clay particles caused increased turbidity as far as 15 river miles downstream from the site. To alleviate this, extra measures were taken to control sediment. The Batesville Fire Department worked on site and provided hoses and a pump to pump standing muddy water from the newly excavated channel onto Mr. Savage's field. Additionally, a centripital pump was rented and used to "vacuum" heavy sediments from behind rock filter dams to prevent them from moving downstream once construction was completed and rock filter dams removed. Although the turbid water was of great concern to downstream landowners, the total loading during construction was approximately 400 tons (assuming a relationship between TSS (mg/l) and NTU from the Chattooga River Watershed of $TSS = 1.16 * (NTU)^{1.4}$ – Bruce Pruitt, U.S. EPA, personal communication). This compares to the loss of 60 –110 tons during just one major storm in 1998.

Ongoing Work

Work at the site is currently focused on revegetating the riparian zone with native plants and shrubs, educational site-tours and post-project monitoring. Several community groups have been to the site to work on replanting the riparian zone, including the locally based Soque River Watershed Association. Educational efforts include site tours for community groups, management agency staff and local government officials. Ninety people have already toured the site. Additionally, a video about the project and the river is being produced by Burst/Video Film. Finally, to evaluate the project's original objectives, post-project monitoring has been established. Bank pins to measure bank erosion have been reinstalled and a post-construction survey of the site has been made. Continued monitoring will include pebble counts and aquatic invertebrate surveys.

CONCLUSIONS

Altogether, the restoration project has been a success. After several high flows, the new channel features are intact and functioning effectively. While project costs were somewhat high (the construction budget for the project was $55,000), the project is serving well as a demonstration of a new and important technique. With further evaluation, certain principles may be replicated at lesser expense on other sites. One example of this could be the possible use of logs instead of rocks for certain instream structures (i.e. Seehorn 1985). Although the project was widely publicized, a better attempt to notify all landowners along the river should have been made to alleviate concerns associated with temporarily elevated levels of turbidity. Another added bonus to the project is the possibility that Mr. Savage and his family may now use the site as a fee fishing area, adding to the sustainable economic base provided by trout fishing.

Most importantly, this project has shown that the many assaults facing Georgia's streams and rivers are much easier to prevent than to fix. Knowing that this project represents only a tiny percentage of all the river miles in the Chattahoochee River Basin, the value of prevention is all the more clear.

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