LITTLE TOPASHAW CREEK RESTORATION PROJECT: CONTEXT AND OVERVIEW

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ABSTRACT: Channel incision is a globally significant problem that is driven by base-level lowering due to channelization and impoundment, increases in runoff following urbanization or deforestation, and other factors. In the absence of geological controls, incision can result in increases in channel width and depth by several fold. Environmental impacts include export of large volumes of sediment, destruction of riparian buffers by erosion, and physical aquatic habitat degradation. Previous investigations of incised channels have documented the response of aquatic biota to incision and subsequent rehabilitation using stone structures. Herein we describe a project in northern Mississippi that is demonstrating the use of woody debris and plant materials to promote the recovery of an incised stream corridor ecosystem.

Studies focus on a 2 km reach of Little Topashaw Creek, a fourth-order stream in the Yalobusha River watershed in north central Mississippi. This site was selected by the USDA Agricultural Research Service National Sedimentation Laboratory, in cooperation with landowners, the USDA Natural Resources Conservation Service and the U.S. Corps of Engineers for a suite of experiments in stream corridor rehabilitation. Baseline studies described reach hydrology, water quality, resident flora and fauna, and dominant geomorphic processes. Using this information, experiments were conducted to assess the utility of large woody debris and planted willow cuttings, switch grass plantings, bank dewatering for erosion control and habitat rehabilitation. Findings of these efforts are described in other papers before this conference.

The 37-km^{2}study reach watershed has cultivated valley floors and forested hillslopes. Floodplain stratigraphy is characterized by dispersive silt and clay soils over sand that overlies consolidated cohesive material. Channels upstream and downstream from the study reach were straightened ca. 1913 and downstream reaches were again channelized in 1967. Systemic response of the 800-km^2 watershed encompassing our site has been described, and this includes incision of ~2 m in headwaters, aggradation of ~5 m downstream, and knickpoint migration rates of 0.6 to 16 m yr^{-1} have been reported. Incised channel evolution superimposed on meandering planform migration processes has ensued through the study reach, and headward-progressing knickpoints and knickzones are found downstream, within the study reach, and upstream. Study reach channel width increased by factors of 4 to 5 between 1955 and 1999 and thalweg elevation decreased by about 0.4 m between 1997 and 2002. Bed materials are comprised primarily of sand with median sizes between 0.2 and 0.3 mm. and bed slope is about 0.002. However, cohesive materials occur as massive outcrops and as gravel-sized particles. The channel is tortuous, with an average sinuosity of 2.1, and an average width, depth and slope of 33.3 m, 3.6 m, and 0.0025, respectively.

Although headcut migration, width adjustment and berm formation observed in the reach are characteristic of classical incised channel evolution, fluvial behavior is perturbed by meandering processes and sediment production from knickpoints that have progressed upstream from the study reach. In general, concave banks on the outside of meander bends are failing by mass wasting, and sand is accreting on large point bars opposite failing banks. Interestingly, several point bars have been dissected during high flows leaving large sand deposits along the toe of concave outer banks. The channel has therefore increased meander wavelength and reduced meander amplitude during the processes of degrading. At least two abandoned meanders in the study reach suggest recent natural neck cutoffs. Evolution appears to be more advanced in the downstream portion of the study reach, with greater widths, more pronounced sandy berms, and no headcuts or knickzones at present.

Along the outside of bends, eroding banks frequently invade adjacent cultivated fields, while inside bends and abandoned sloughs are vegetated with a diverse mixture of hardwood trees and associated species. Bar sedimentation rates appear to be quite rapid as few young trees are evident on the point bars.

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Preconstruction monitoring indicated stream habitat impairment and degradation associated with channel incision. Results of the floristic study have revealed 18 different vascular plant families with 51 different species. Little vegetation was found along the base flow channel, and most species were opportunistic. Further up the bank the herbaceous vegetation is compatible with herbaceous vegetation in the adjacent fields, suggesting seed dispersal from the fields. The sandbars were found to be slightly vegetated. The *Salix nigra* sampled on the sandbars are possible representatives of an attempt for early second succession.

Total PO4 and chlorophyll a concentrations in Little Topashaw Creek consistently exceeded currently proposed USEPA recommended concentrations of 0.03626 mg/L and 0.93 mg/L, respectively, during both low stream flow and storm events.

Little Topashaw Creek total nitrogen concentrations during low stream flow and storm events exceeded currently proposed USEPA recommended concentration of 0.69 mg/L by 57% and 88%, respectively.

Little Topashaw Creek ammonia, nitrate and nitrite concentrations exceeded 1986 USEPA water quality criteria guidelines only rarely during storm events.

Results indicate pesticide concentrations fluctuated seasonally and were associated with discharge, suspended solids concentrations and seasonal pesticide applications. Peaks in herbicide concentrations closely coincided with runoff following applications during April and May 2001. Peak insecticide concentrations were associated with runoff following applications in May and again in July 2001. Peak concentrations in historic use pesticide concentrations (pp' DDT, dieldrin) and metabolites (pp' DDD, pp' DDE) were associated with increases in discharge and suspended solids concentrations during May and June 2001. Most pesticide concentrations measured during high flow decreased during fall and showed only trace amounts during winter. A combination of factors, including magnitude of storm event (measured as discharge), seasonality and farming practices influence pesticide and associated metabolite concentrations observed within Little Topashaw Creek during storm events.

1Current-use pesticide types and concentrations were predictably greatest in storm events following agricultural applications with discharge and suspended sediment concentrations having a secondary role.

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2Historic-use pesticide and metabolite concentrations fluctuated with suspended sediment concentrations.

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3Pesticide contamination was transient within and among storm events.

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4Aquatic organisms in agricultural watersheds are exposed to transient pulses of pesticide mixtures that vary in frequency and magnitude depending upon agricultural practices, discharge and sedimentation.