Kansas State University Agricultural Experiment Station
and Cooperative Extension Service
Kansas State University, Division of Biology
Kansas Cooperative Fish and Wildlife Research Unit
U.S. Environmental Protection Agency
Kansas Department of Wildlife & Parks

STREAMBANK REVETMENT

Introduction

Streambank erosion is a naturally occurring process in streams and rivers throughout the United States. Accelerated streambank erosion occurs when natural events or human activities cause a higher than expected amount of erosion, and is typically a result of reduced or eliminated riparian (streamside) vegetation. The removal of riparian vegetation is the primary factor influencing streambank stability. Historically, channel straightening (channelization) was the primary method used to control streambank erosion. However, since the 1970s, riparian and in-stream habitat restoration by natural or artificial methods has grown in popularity because channelization typically caused problems, such as erosion and flooding dowstream. Natural resource agencies throughout the Midwest have been using tree revetments as one type of streambank stabilization structure.

What are tree revetments?

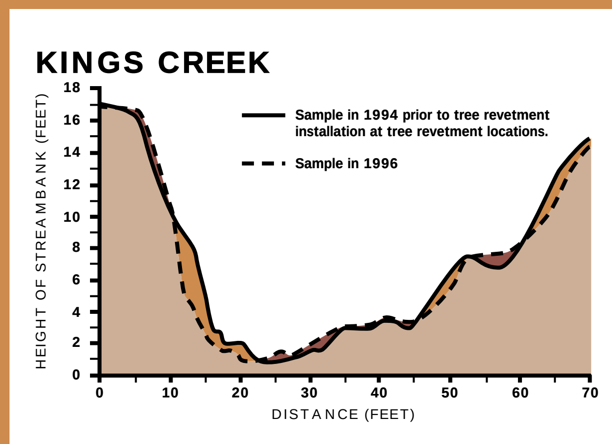
Tree revetments are a series of trees laid in the stream along the eroding bank. They are designed to reduce water velocity, increase siltation within the trees, and reduce slumping of the streambank. Tree revetments are not designed to permanently stabilize eroding streambanks. They should stabilize the streambank until other stabilization techniques, such as tree plantings in the riparian area become established. Tree revetments are not designed to fix problems at a watershed level. Tree revetments should only be used if good land management practices are applied in the watershed, for example fencing riparian areas from cattle use, maintaining buffer strips between streams and row crops, or terracing highly erodible row-crop fields.

How are tree revetments constructed?

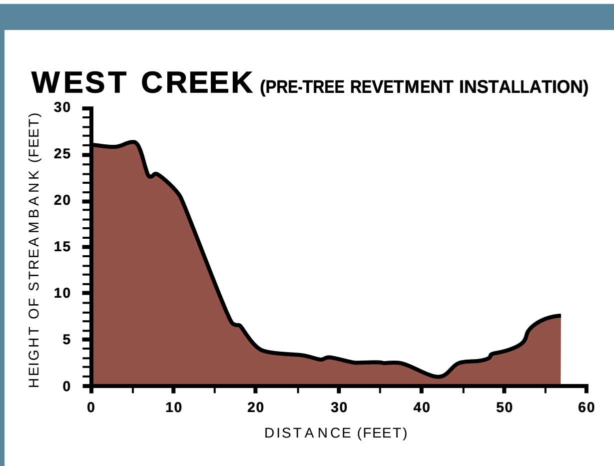
Tree revetments are constructed by anchoring finely branched trees, like eastern red cedar at the bottom of an unstable streambank. Installation starts at the downstream end of the eroded bank—at a point where the bank is stable. Each tree is placed into the stream with the cut end pointing upstream. Trees are overlapped approximately one-third and are anchored twice using a Duck- bill Anchor. Construction continues until the entire eroded surface is covered and the tree revetment is secured at a stable point upstream.

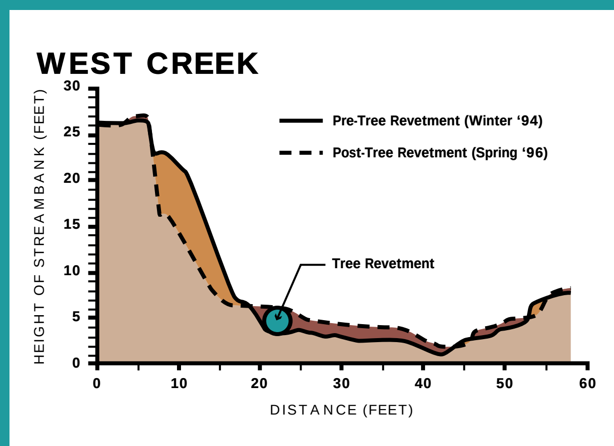
What did this research document?

The purpose of this research was to determine what effects tree revetments had on erosion and deposition within a stream, and how these processes influenced stream fishes and aquatic insects. The study was conducted on Kings Creek (Riley County) and West Creek (Greenwood County), Kansas from 1994 through 1996. Revetment sites were chosen in conjunction with the Kansas Forest Service, Kansas State University Agricultural Experiment Station and Cooperative Extension Service and Kansas Department of Wildlife and Parks. Each revetment site was compared to two control sites, one upstream and one downstream from the tree revetment location. While the controls had similar cross-sections to the tree revetment sites, they were different because they had well-developed riparian corridors. Therefore, if similar results were found among the controls and tree revetment sites, it was concluded that the tree revetments were functioning similar to a stable streambank with a well-developed riparian corridor.



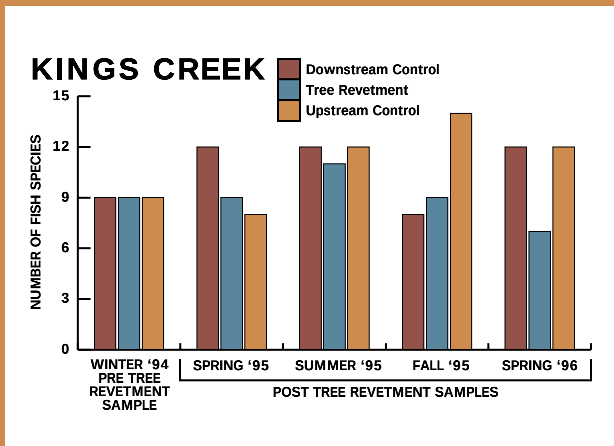
The control sites all had well-developed riparian corridors, as shown in the photo above. There was little change in the channel cross-section at the controls sites from 1994 to 1996, as shown by the representative cross-section in the graph.

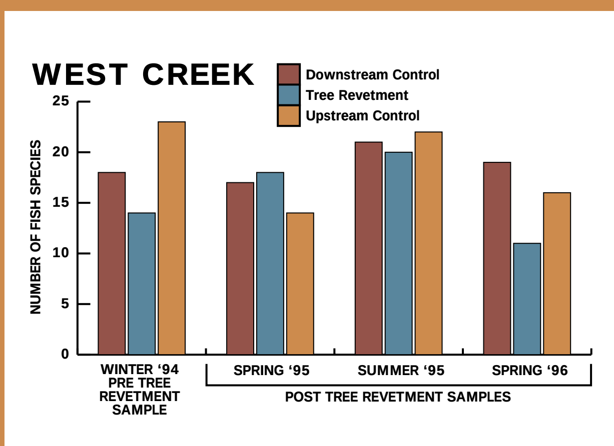




The tree revetment sites lacked a riparian corridor and had accelerated erosion problems, as shown in the photo above. The corresponding graph shows the eroding outside bend at 26 feet in height.

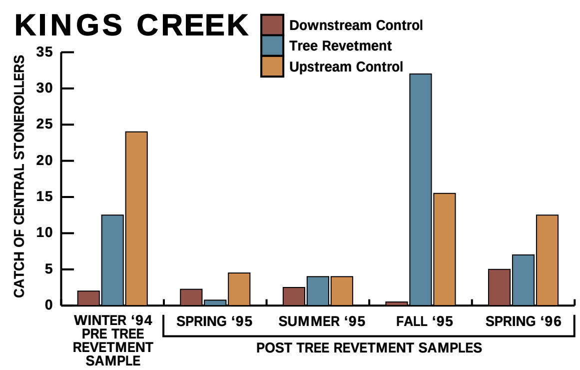
After tree revetment installation, banks became more gradual and the main channel of the stream was moved away from the eroding bank, protecting the streambank from excessive erosion. The corresponding graph illustrates how the slope of the eroding streambank decreased, and how silt increased within the tree revetment.

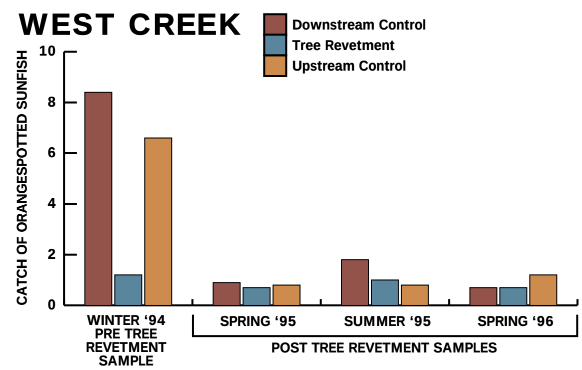


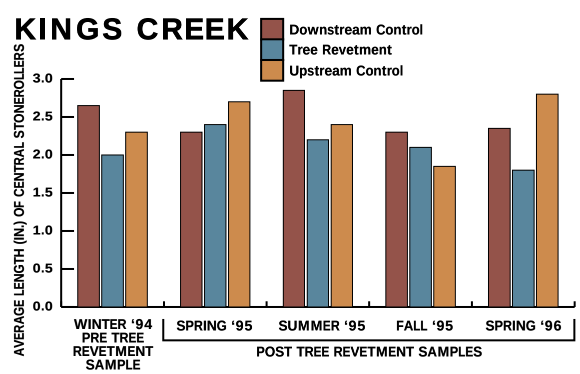


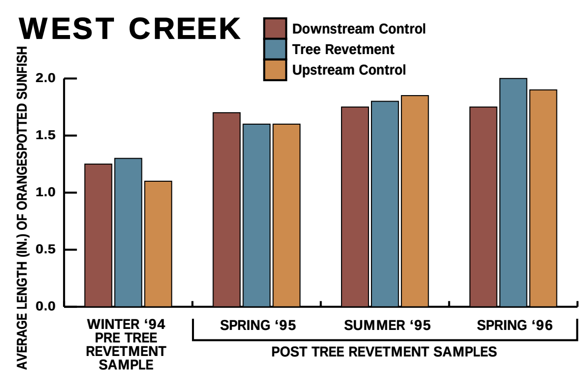
The number of fish species present at Kings Creek and West Creek was not related to the establishment of the tree revetments. This is evident by the lack of a distinct pattern in number of fish species present among the controls and tree revetment location.

- Central stoneroller (top photo) were the most abundant fish present in Kings Creek. Central stonerollers are common in streams through eastern Kansas. Central stonerollers feed primarily on algae and micro-organisms associated with the streambottom. Central stonerollers only get 6 to 8 inches long.
- Orangespotted sunfish were the most abundant fish present in West Creek. Orangespotted sunfish are in the same family of fish as bluegill and crappie, and usually feed on small aquatic insects and other fish. Orangespotted sunfish do not grow much larger than 6 inches.



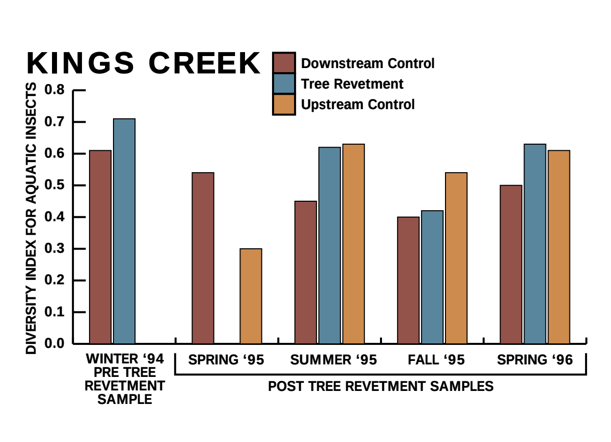


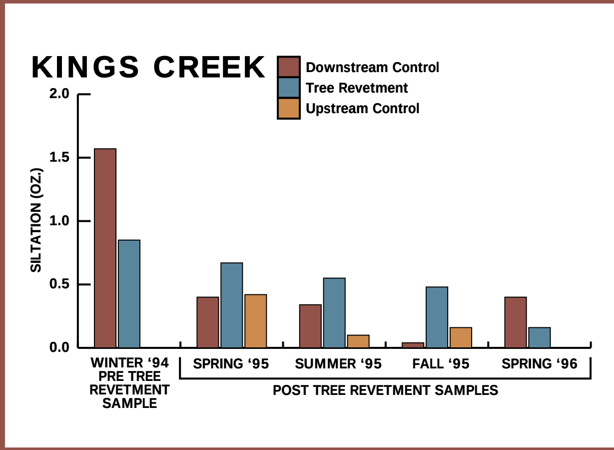


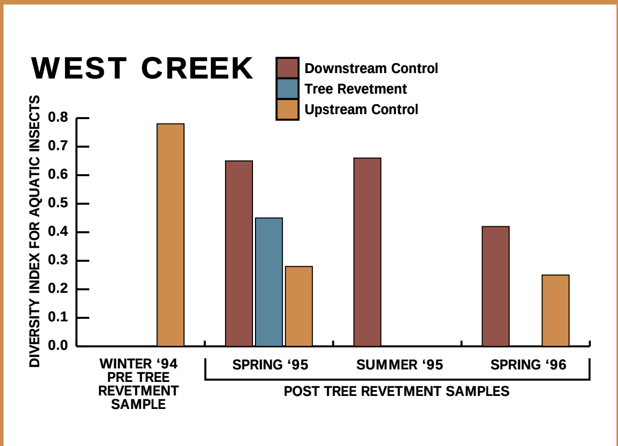


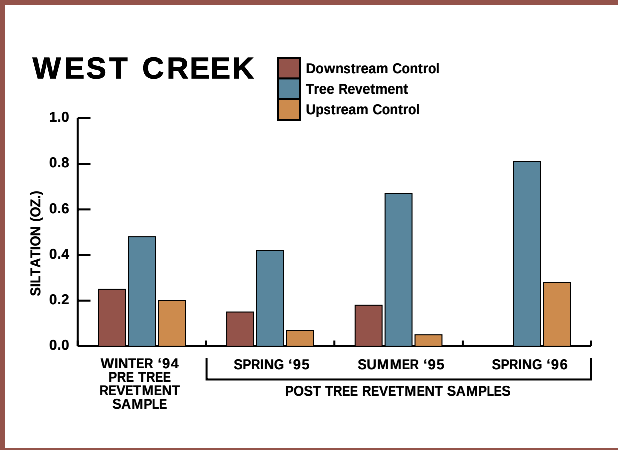
Catch of central stoneroller declined slightly after installation of the tree revetment at the tree revetment and upstream control locations. Thus, it is likely that catch of central stonerollers was influenced by a factor other than the tree revetment. Average length of central stonerollers remained similar at all locations before and after installation of the tree revetment.

Catch of orangespotted sunfish declined at all locations after installation of the tree revetment. Similar to catch of central stonerollers in Kings Creek, catch of orangespotted sunfish was not influenced by the tree revetment. Average length of orangespotted sunfish remained similar at all locations before and after installation of the tree revetment.









- **Diversity of aquatic insects was variable in Kings Creek and West Creek, but was not related to the tree revetment. Overall, the tree revetments had no effect on the diversity of aquatic insects present.**

- **The amount of siltation within Kings Creek (left) was generally lower at all locations after installation of the tree revetment. Conversely, siltation increased in West Creek at the tree revetment location after installation. This is likely caused by the tree revetments trapping sediment. Sediment trapping did not occur on Kings Creek because the tree revetment was slightly above the water level during normal flow.**

Summary

Control locations had well-established riparian corridors and represented areas with little streambank erosion. Therefore, if tree revetment locations were similar to control locations, we would conclude that tree revetments stabilized banks comparable to areas with well-established riparian corridors. In general, tree revetments did not differ from control locations, thus, tree revetments appear to stabilize streambank erosion. Similarly, this research suggests that tree revetments do not enhance or reduce stream fish and aquatic insect communities. It is likely that tree revetments can reduce localized sedimentation by trapping bank sluff behind the revetment.

This study was conducted for two years and applied on two streams. In addition, tree revetments were placed above the water-level at normal flow. It is likely that results may vary given different conditions. Nevertheless, the highest flood recorded at Kings Creek occurred during 1995 and the tree revetment reduced the erosion potential of the flood. Tree revetments can provide short-term relief from streambank erosion until good land management practices are made in the watershed.

Frequently Asked Questions

As tree revetments increase in popularity many landowners and managers are asking a number of questions, such as:

How long will the tree revetment last?
It is unknown exactly how long a tree revetment will last. It has been estimated to be about 10 to 15 years. However, this will depend on how often the trees are in and out of the water.

What type of tree should be used in tree revetments?
Trees with many fine branches are the best at slowing nearbank currents, catching sediment carried in the stream, and catching slump material from the bank. For this reason, Eastern red cedar is usually the best choice. Eastern red cedar is also more resistant to decay than hardwood trees.

How much maintenance is required?
The amount of maintenance required for tree revetments is going to depend on several factors. For example, the frequency they are submerged in water, number and frequency of large floods, and how well the ends are secured to the streambanks.

Will tree revetments affect the fish community?
The results from this study show that fish communities are not adversely affected by tree revetments.

Are permits required to install tree revetments?
Whether special permits are required or not will depend upon what county and state you are in. It is best to contact the U.S. Army Corps of Engineers, and your state Division of Water Resources.

Will tree revetments stop erosion?
Yes, results from this study have shown that localized streambank erosion can be reduced by tree revetments. However, to stop erosion for a long period of time (i.e., greater than 10 years), other methods must also be used, like large-scale watershed restoration, revegetation of the riparian corridor, maintaining buffer strips between row crops and the stream, and fencing cattle out of the stream.

Do tree revetments clean the water?
Water quality is generally related to problems in the watershed and typically tree revetments will not improve the overall water quality of a stream. The most appropriate way to improve water quality is to practice wise land use at the watershed level.

Where can I get technical and financial assistance?
Contact your local conservation district office, Kansas Department of Wildlife and Parks District Biologist, Kansas Forest Service, or K-State Research and Extension for additional information on tree-revetments, cost-share opportunities, or technical assistance.

Where can I get additional information about tree revetments and other streambank stabilization techniques?

- Tree Revetments for Streambank Stabilization. Missouri Department of Conservation, Streams for the Future, Fisheries Division.
- Wetland & Riparian Best Management Practices For Kansas No. 2—Tree Revetments. Wetland & Riparian Areas Program. K-State Research and Extension, Kansas Forest Service and Kansas Department of Wildlife and Parks.
- Wetland & Riparian Best Management Practices For Kansas No. 4—Willow Cutting. Wetland & Riparian Areas Program. K-State Research and Extension, Kansas Forest Service and Kansas Department of Wildlife and Parks.
- Wetland & Riparian Best Management Practices For Kansas No. 7—Tree and Shrub Planting. Wetland & Riparian Areas Program. K-State Research and Extension, Kansas Forest Service and Kansas Department of Wildlife and Parks.
- Wetland & Riparian Best Management Practices For Kansas No. 9—Streambank & Shoreline Protection. Wetland & Riparian Areas Program. K-State Research and Extension, Kansas Forest Service and Kansas Department of Wildlife and Parks.
- Wiens, J.R. 1996. Effects of Tree Revetments on the Abiotic and Biotic Components in Two Kansas Streams. M.S. Thesis, Kansas State University, Manhattan. 90 pp.

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