Streambank Stabilization Monitoring Case Studies in Northeast Kansas

Charles J. Barden

Denisse Maria Benitez Nassar

KANSAS STATE UNIVERSITY
Horticulture and Natural Resources

INTRODUCTION

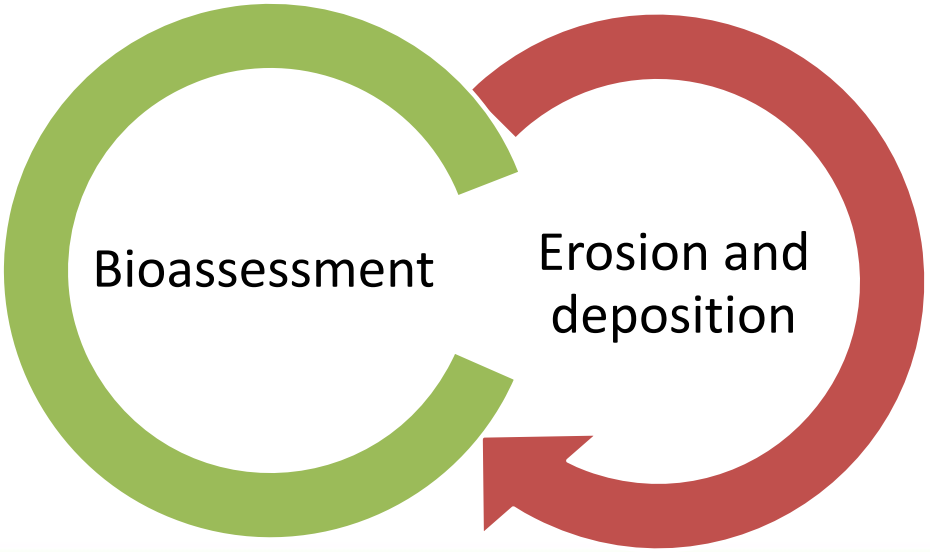
- In Kansas there are 24 federal reservoirs for drinking, domestic and recreation water use. On average 17% of original capacity is reduced, some reservoirs have lost much more, ie. Tuttle (Rahmani et al., 2018).

- We have installed over 20 streambank stabilization projects over the last 19 years.
- The effectiveness of bank stabilization projects needs monitoring and evaluation.
- New technique uses tree roots to estimate erosion rates (Stotts et al. 2014) dendro geomorphology

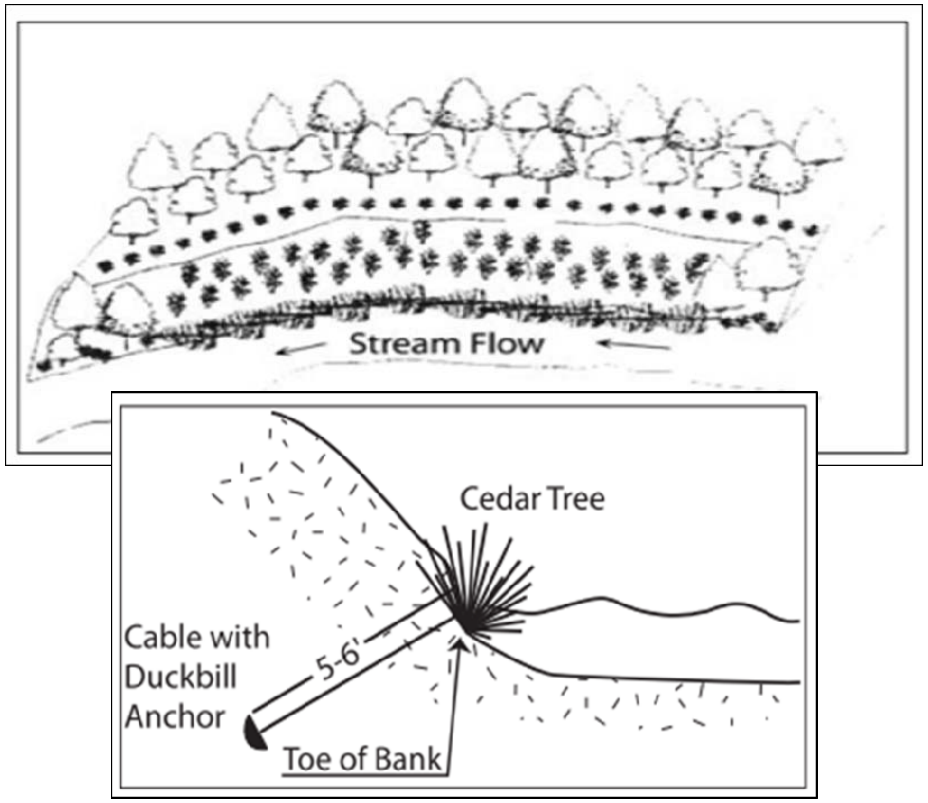
Location	Name	Revetment	Year installed	Method
Potawatomi Reservation	Little Soldier Creek	Cedar	2000	Rebar
Nemaha	Axtell-Schmidt	Cedar + Rock	2007	Rebar + Roots
Kickapoo Reservation	Delaware river	Rock	2010-2017	Bioassessment
	Plum Creek	Cedar	2010	Bioassessment
Atchison	Little Grasshopper Creek	Cedar	2017	Rebar
Nemaha	Wolfley Creek	Cedar	2017	Rebar + Roots

OBJECTIVES

The purpose of this study is to quantify the environmental benefits of streambank stabilization and restoration projects in northeast Kansas.



Cedar Revetment



- Cut-end of tree facing upstream.
- Attach anchored cable to the butt and top of the tree using a cable clamp.
- Anchor tree tightly against bank.
- Next tree top overlaps by 1/3 of the previous tree end.
- Fill gaps and plant willows.

Little Soldier Revetment Before March 2000

Little Soldier Mitchell Revetment After

Mitchell Revetment- 5 years later

Cedars trapped sediment, and vegetation got well-established

Nov. 2007

Aug. 2008

Before (2000) and After (2007)

Measured sediment deposited within the 200’ long cedar revetment

=86 cubic yards

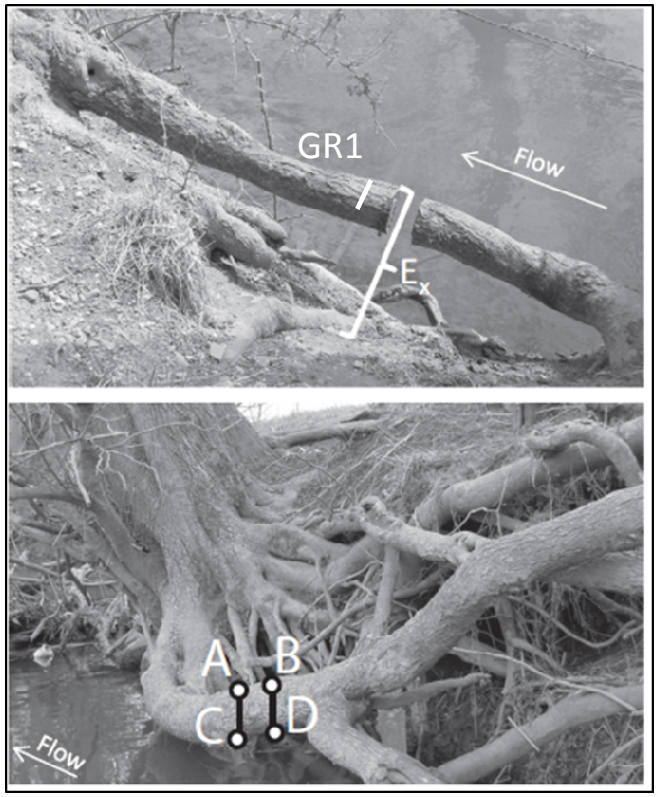
May 2017 Little Soldier Creek, 17 years old

Mid and upper bank erosion from March-April 2017 floods

Little Soldier May 2017

Note the color change of the recently exposed root

Erosion Rate Calculation



$$E_r = E_x - (Gr1) + \frac{(B1 + B2)}{2}$$

$$E_{ra} = \frac{E_r}{NR_{ex}}$$

- Er: Length of eroded bank
- Gr: Root growth after exposure
- Ex: Distance between the riverside edge of the root and the current bank position.
- (B1+B2)/2: Average root width.
- Era: The annual erosion
- NR ex: the number of years in which the root has been exposed.

Stotts et al. 2014, Geomorphology

Root sample collection

Axtell-Schmidt December 2006- before treatment

Revetment installed March 2007

The Cutest Tree Planting Crew

Trapped sediment from high flows

Sloughing soil held by cedars

Before and after 2007-2012

Axtell Schmidt revetment erosion rate root data

Tree Species	Years exposed NREX	ERA (cm/y)
Siberian Elm	8	6.03
Siberian Elm	7	0.37
Elm	7	7.15
Elm	5	0.08
Elm	8	5.60
Elm	7	0.31
Elm	7	4.34
Elm	6	0.38
Elm	10	5.18
Elm	8	4.53
Average	**7.3**	**3.39**

Little Grasshopper, March 2017

Little Grasshopper

3-23-2017

6/22/2017

6/22/2017

Little Grasshopper

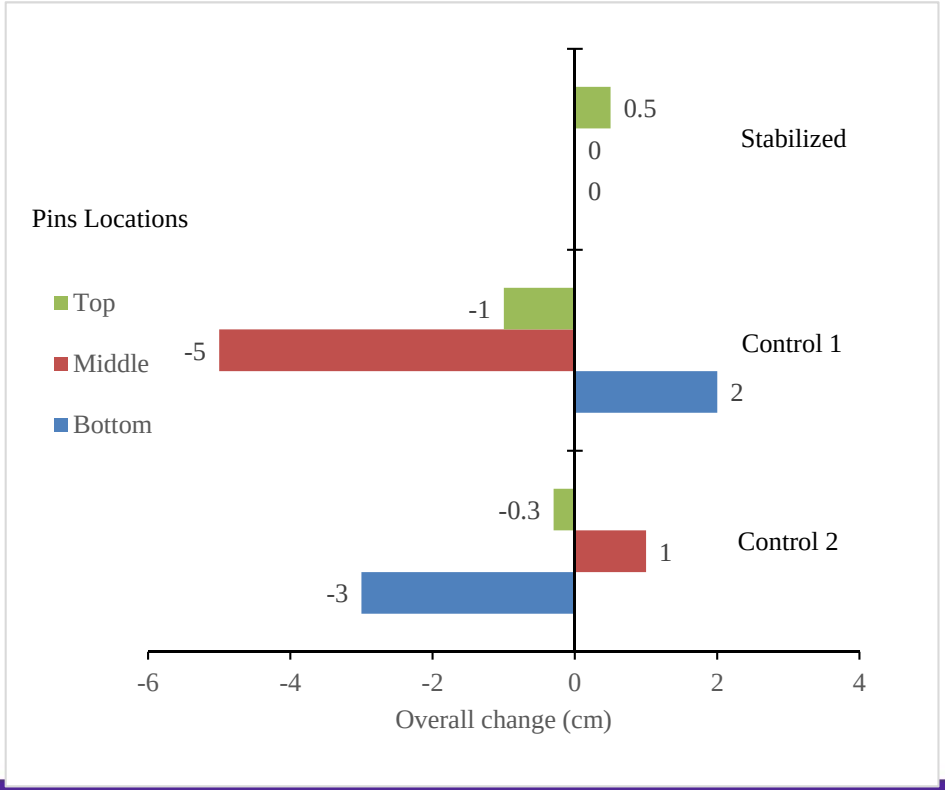
158 cubic yards

Little Grasshopper, 9-19-2018

MEASURING EROSION

- Place rebar on the cut bank.
- At the revetment, and on untreated control reaches.
- Place 3-4 in a vertical transect on cut bank.

Wolfley


Pins Locations
Top
Middle
Bottom
0.5
0
0
Stabilized
-1
-5
Control 1
2
-0.3
1
Control 2
-3
-6
-4
-2
0
2
4
Overall change (cm)

Wolfley Creek Control Reach

Species	Years	ERA (cm/y)
Ash	4	10.56
Hackberry	4	12.61
Elm	10	7.49
Elm	7	10.36
Average	6.25	10.26

Conclusions

- **Cedar revetments work on small streams, 1st and 2nd Order. They add soil at the toe of the bank, while upper slope continues to lay back.**
- **Stop the soil from moving, and vegetation will get established and reduce erosion rates.**
- **More quantification is needed!**

Acknowledgments

- USDA Tribal College Research grants Program
- Kansas Water Research Institute
- Haskell Indian Nations University
- Kansas Forest Service
- Westar Energy

Bio-assessment

Results

Cedar revetment

	Plum			Plum Control		
Channel Unit	Riffle	Cut Bank	Pool	Riffle	Cut Bank	Pool
Biotic Index	4.35	4.47	4.37	4.91	4.88	4.53
Shannon	2.40	2.14	1.52	1.98	1.37	1.74
Simpson	87%	85%	70%	81%	71%	76%

Rock Revetment

	Delaware Rock Revetment			Delaware Control		
Channel Unit	Riffle	Cut Bank	Pool	Riffle	Cut Bank	Pool
Biotic Index	2.00	4.53	4.58	3.99	4.91	5.5
Shannon	2.50	1.32	1.87	2.32	1.86	0.56
Simpson	89%	72%	81%	85%	78%	38%

Biotic Index	Water Quality Rating
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly poor
6.51-7.25	Poor
7.26-10.00	Very poor