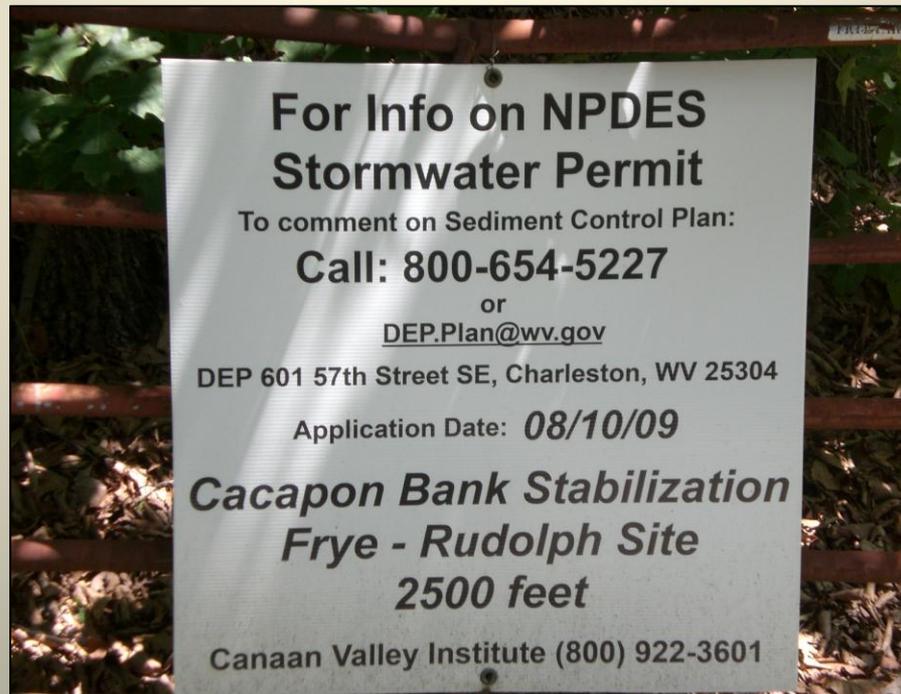


A Case Study of the Effectiveness of Stream Restoration in the Cacapon River, West Virginia

Jonathan Pitchford, Stephen Selego, Dr. Lance Lin, &
Dr. James T. Anderson



Restoration in the Chesapeake Bay Watershed

(Hassett et al. 2005)

- \$426 million dollars has been spent on restoration in the Chesapeake Bay Watershed as of 2005
- Only 5.4% of projects have been monitored
- Monitoring is important before and after restoration
- Restoration projects are still “experiments”



Objectives

Evaluate the effects of restoration on:

1. Bank stabilization
2. Riparian vegetation
3. Water quality
4. Benthic community health

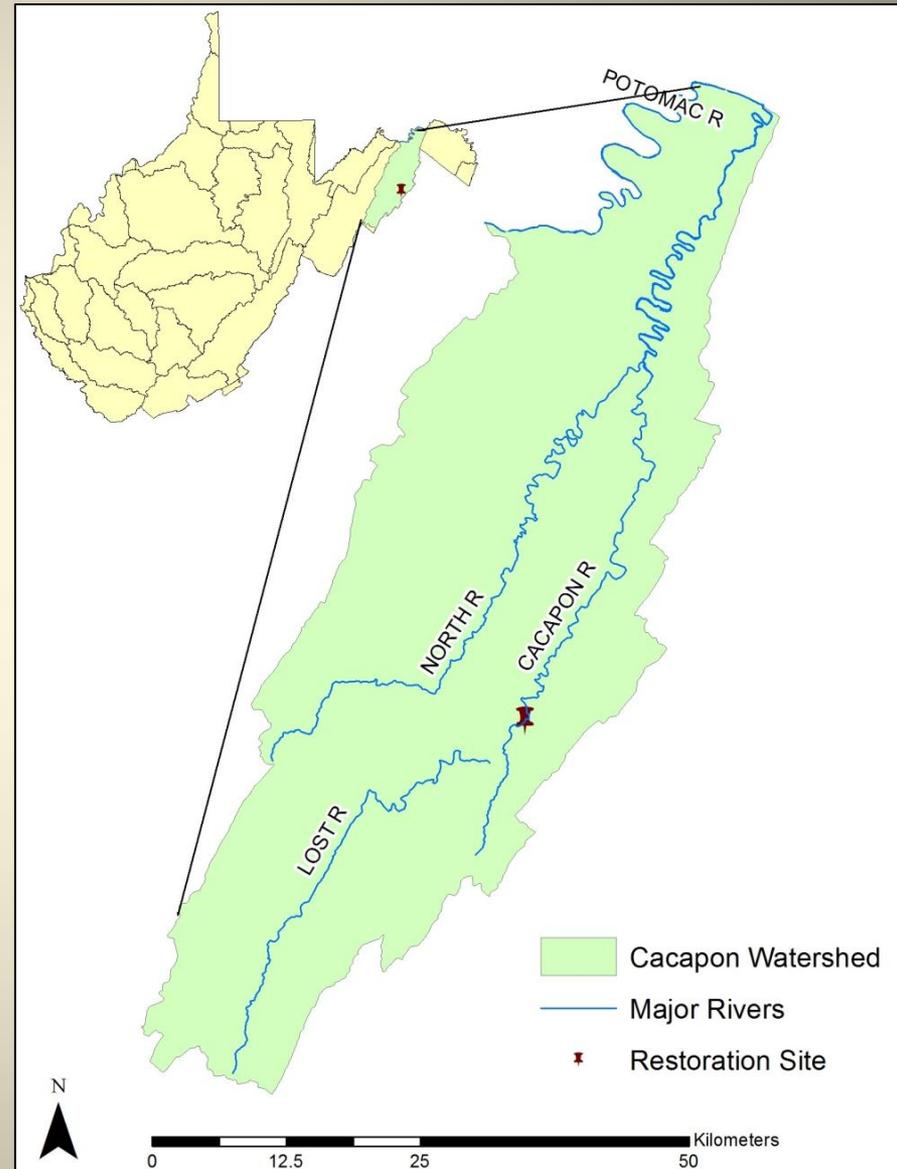
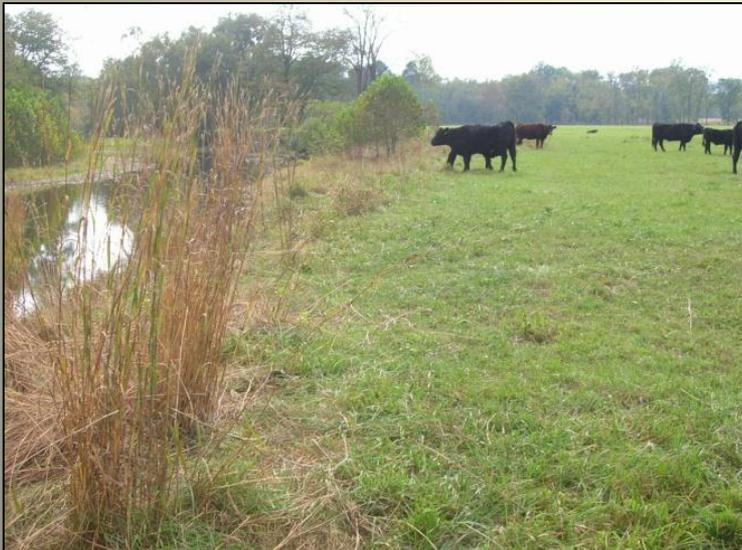
Hypothesis:

Restoration will improve bank stability and benthic community health.



Cacapon River

- 3rd order tributary of the Potomac River
- Rosgen C stream type
- ≈ 800m reach selected for restoration
- Grazing/hay production is the primary land use



Restoration Approach

1- Morphological reconstruction of banks

- 6 streambanks sections re-contoured to include a bankfull bench
- 9 log vanes constructed
- 1500 trees and shrubs planted throughout the reach & both sides were fenced to create 50 ft buffer

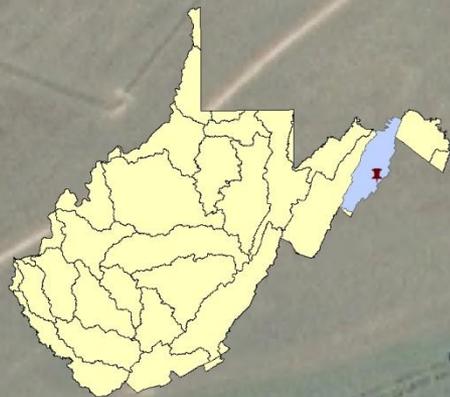


2- Construction of log vanes



3- Riparian planting & fencing





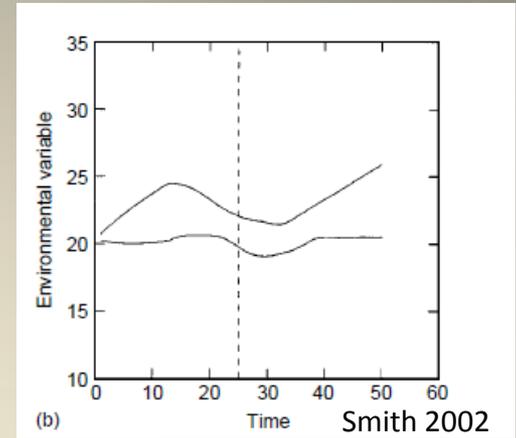
-  Cacapon Watershed
-  Restoration Site
-  Engineered Streambanks
-  Log Vanes
-  Survey Locations

- Rest-1
- Rest-2
- Rest-3
- Rest-4
- Rest-5
- Rest-6
- Rest-7
- Rest-8
- Rest-9
- Rest-10
- Rest-11
- Rest-12
- Rest-13



Monitoring Approach

- Before After Control Impact design (BACI)
 - During active phase of restoration
- Streambank Stability - Streambank migration (m/yr)
- Benthic sampling – Indices of Biotic Integrity (IBIs)



Restoration

Control

Reference

Before Restoration

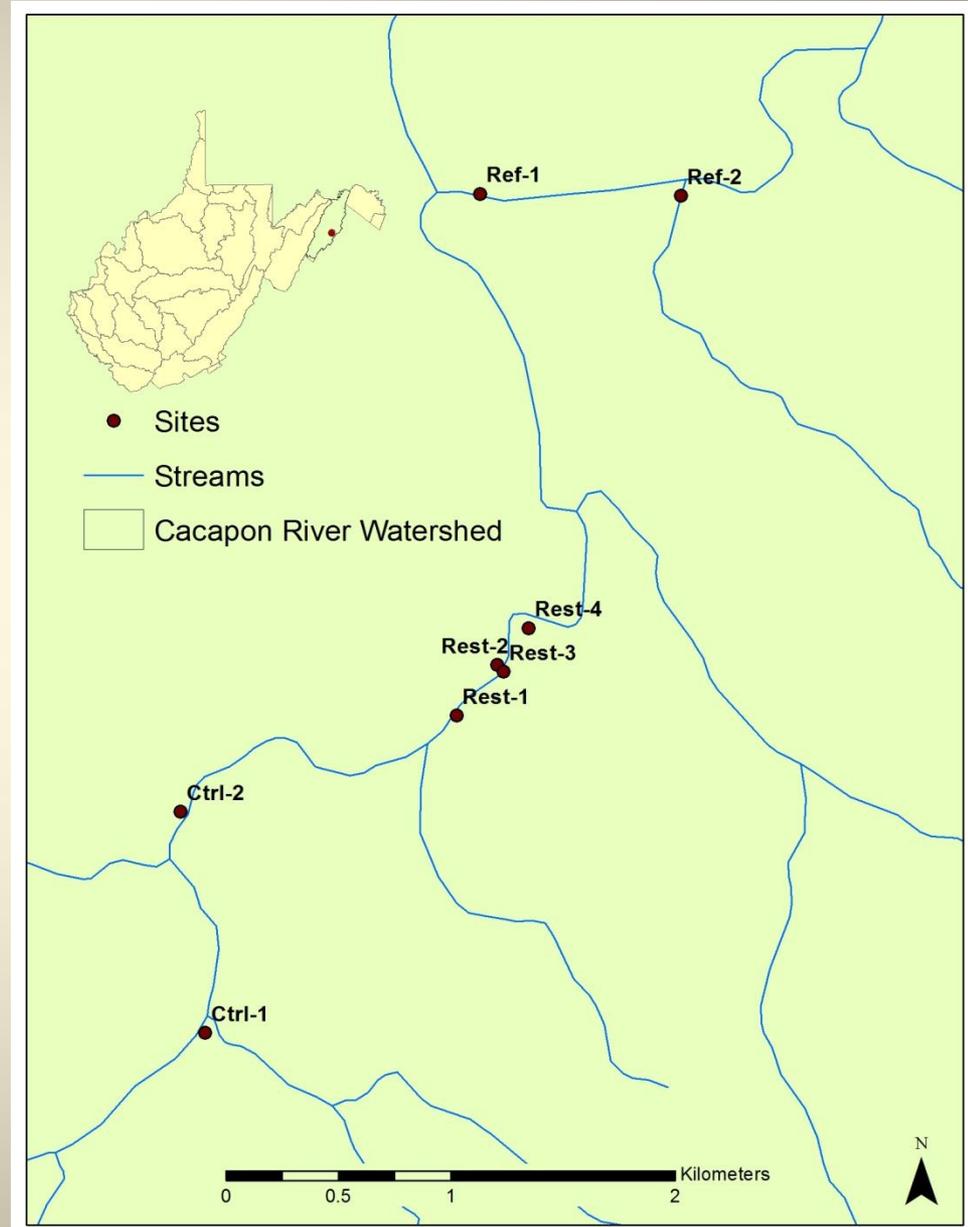


After Restoration

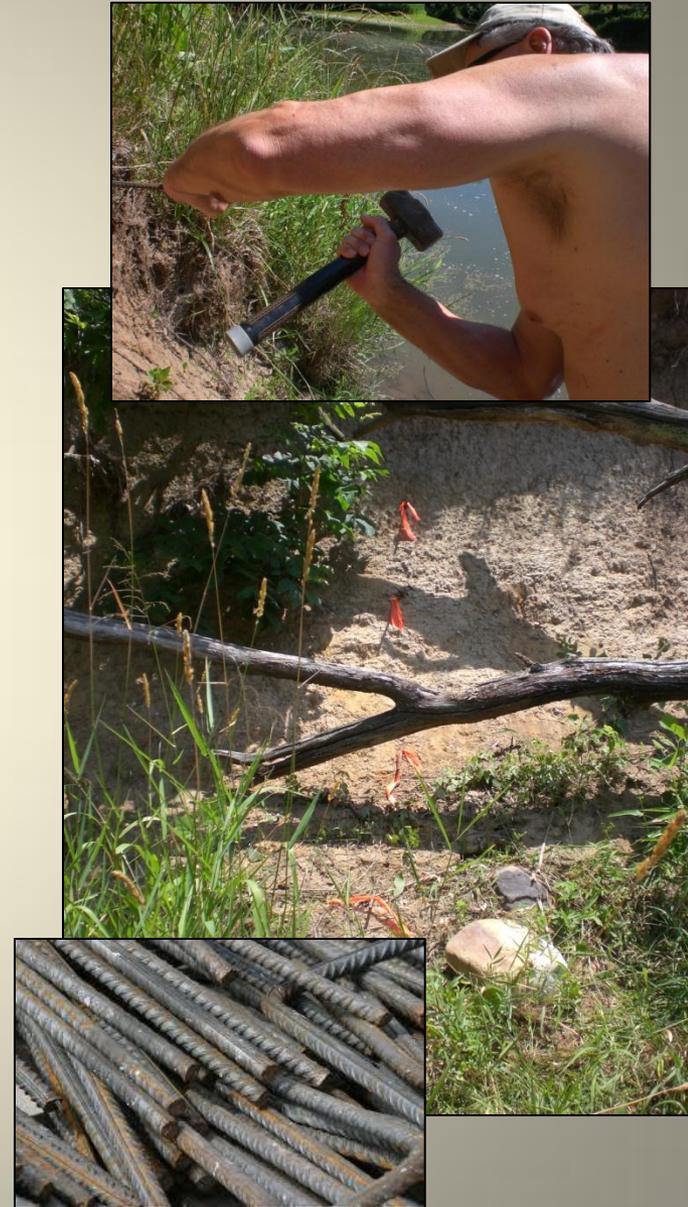
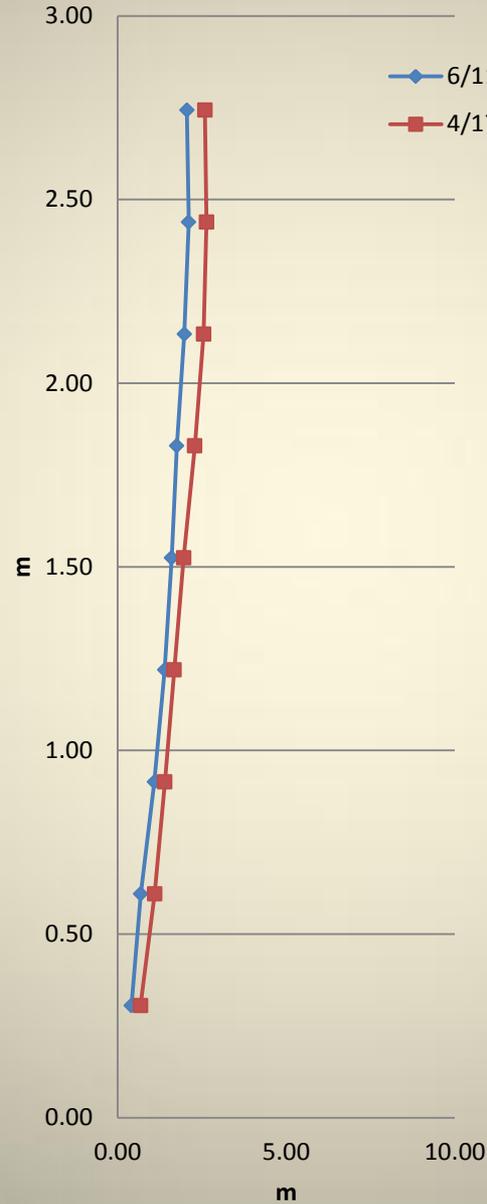


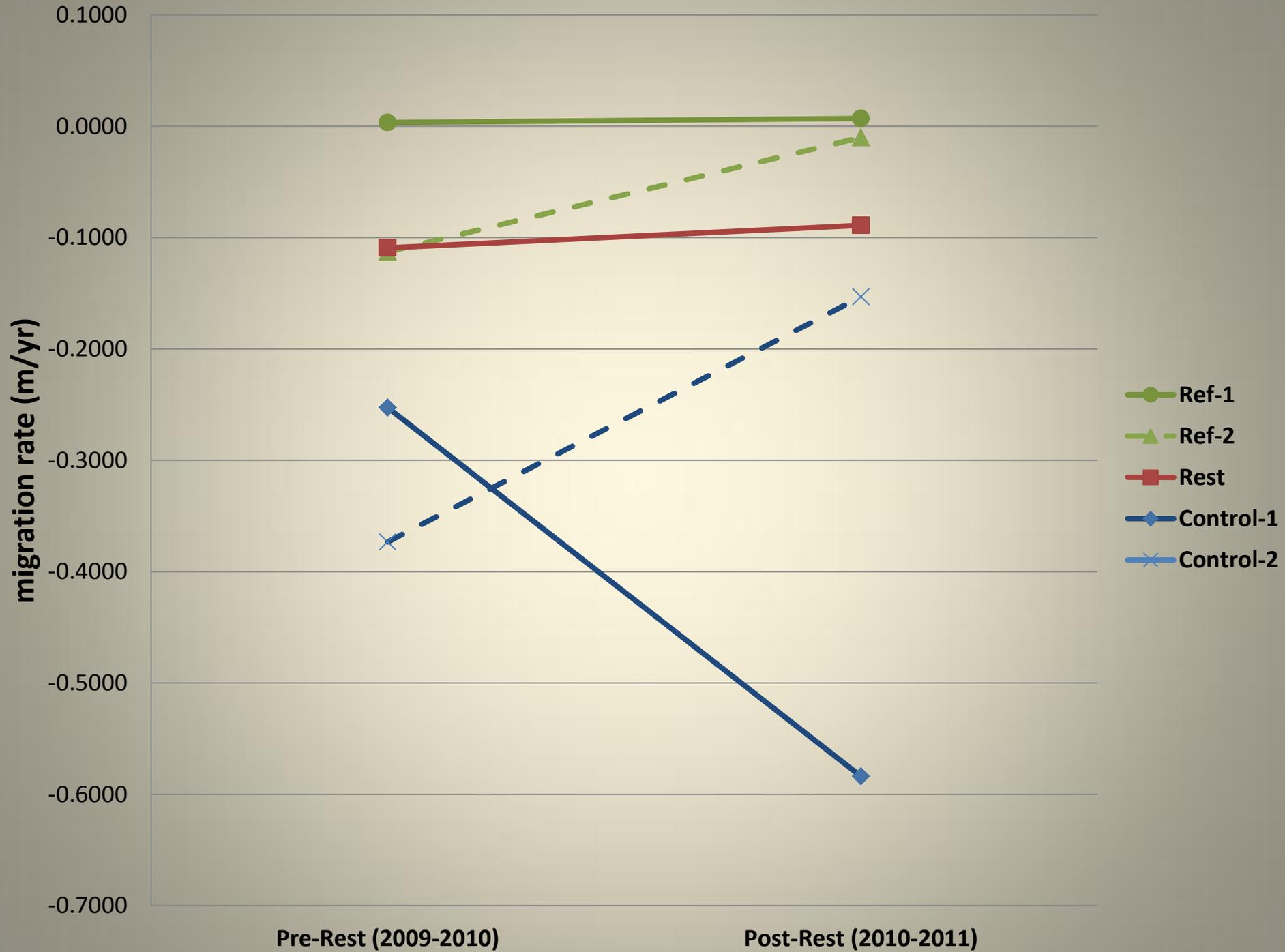
Streambank Stability

- Streambank migration rate (m/yr)
 - Pre-restoration (2009-2010)
 - Post-restoration (2010-2011)
- 3-5 survey locations within each site



Streambank Migration

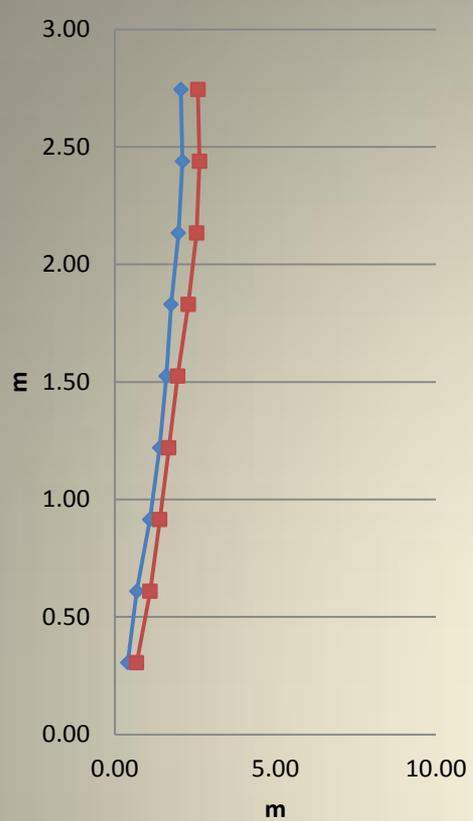




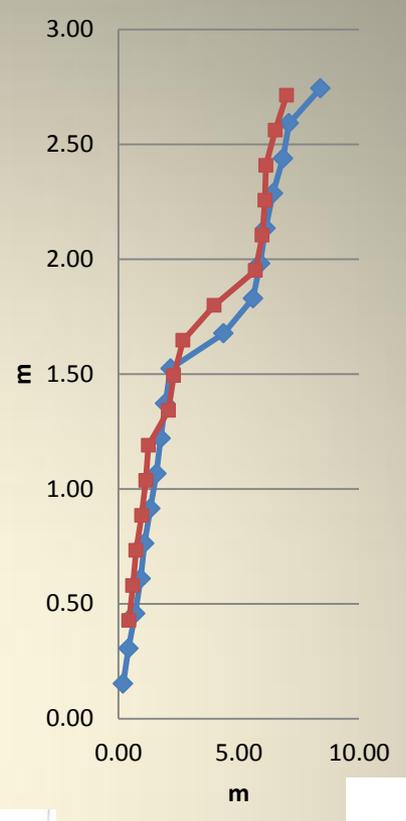








6/11/2009
4/17/2010



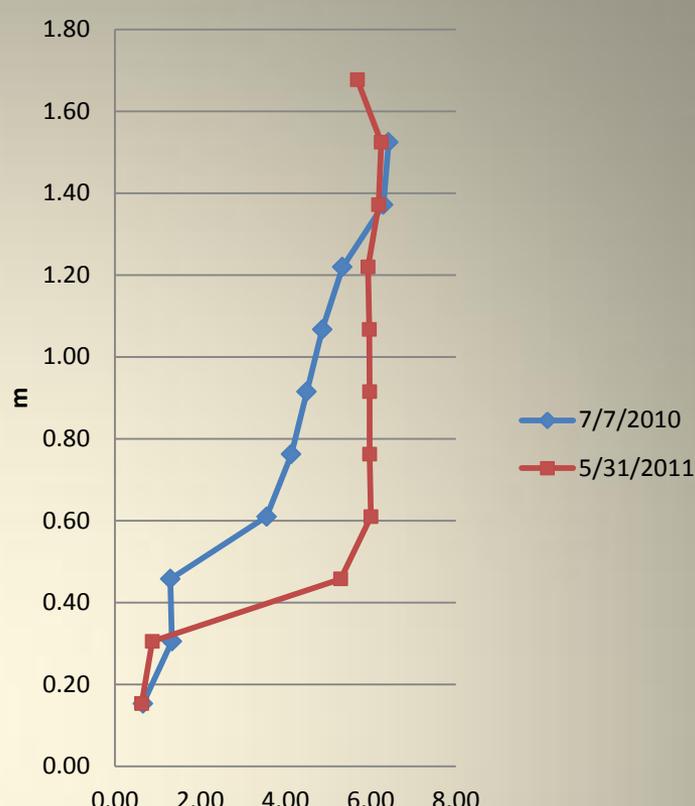
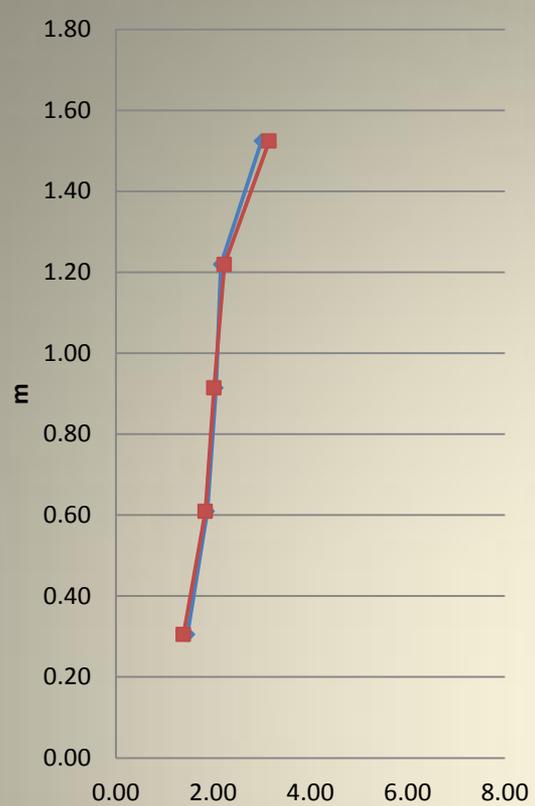
7/13/2010
5/31/2011









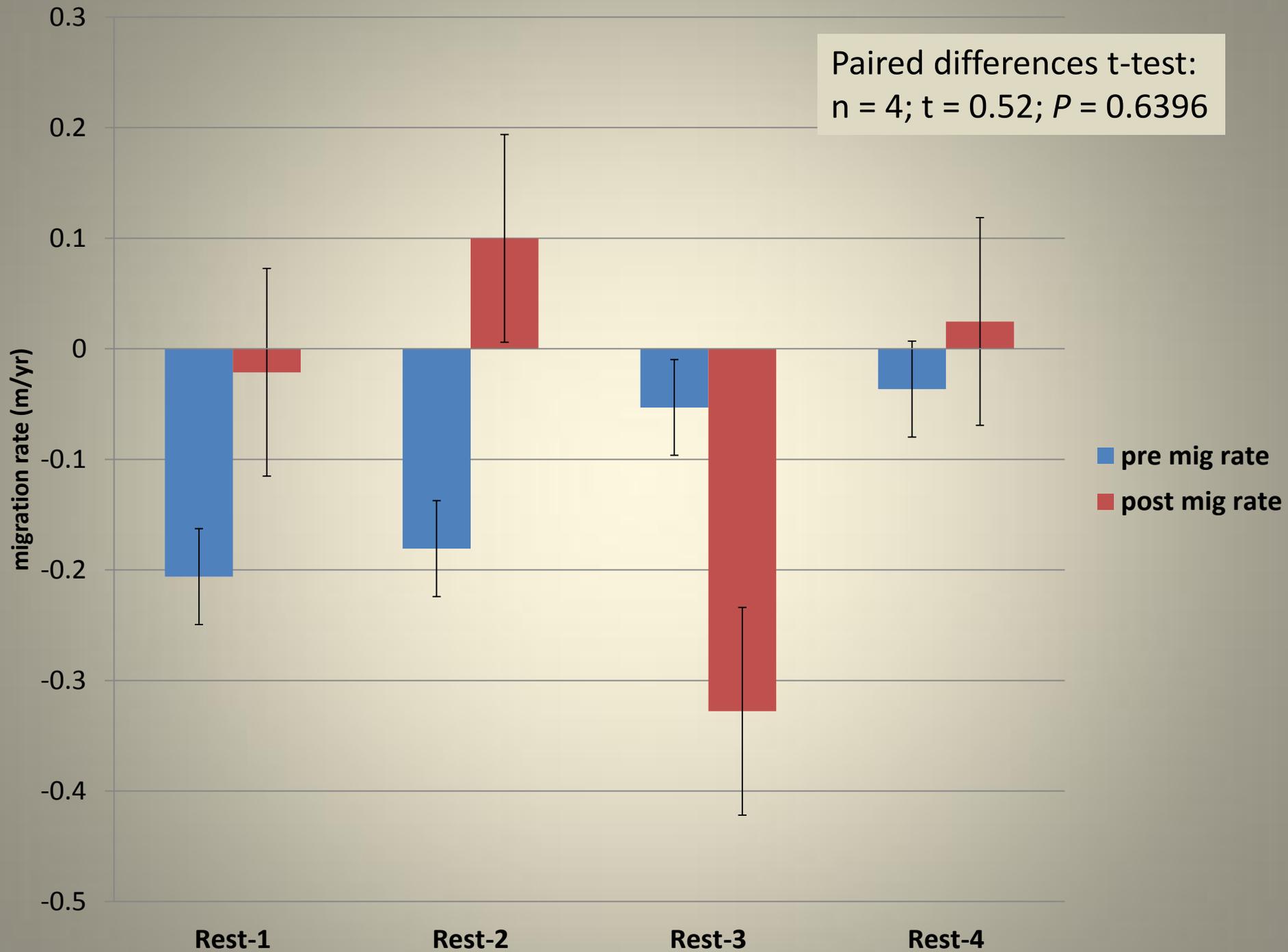


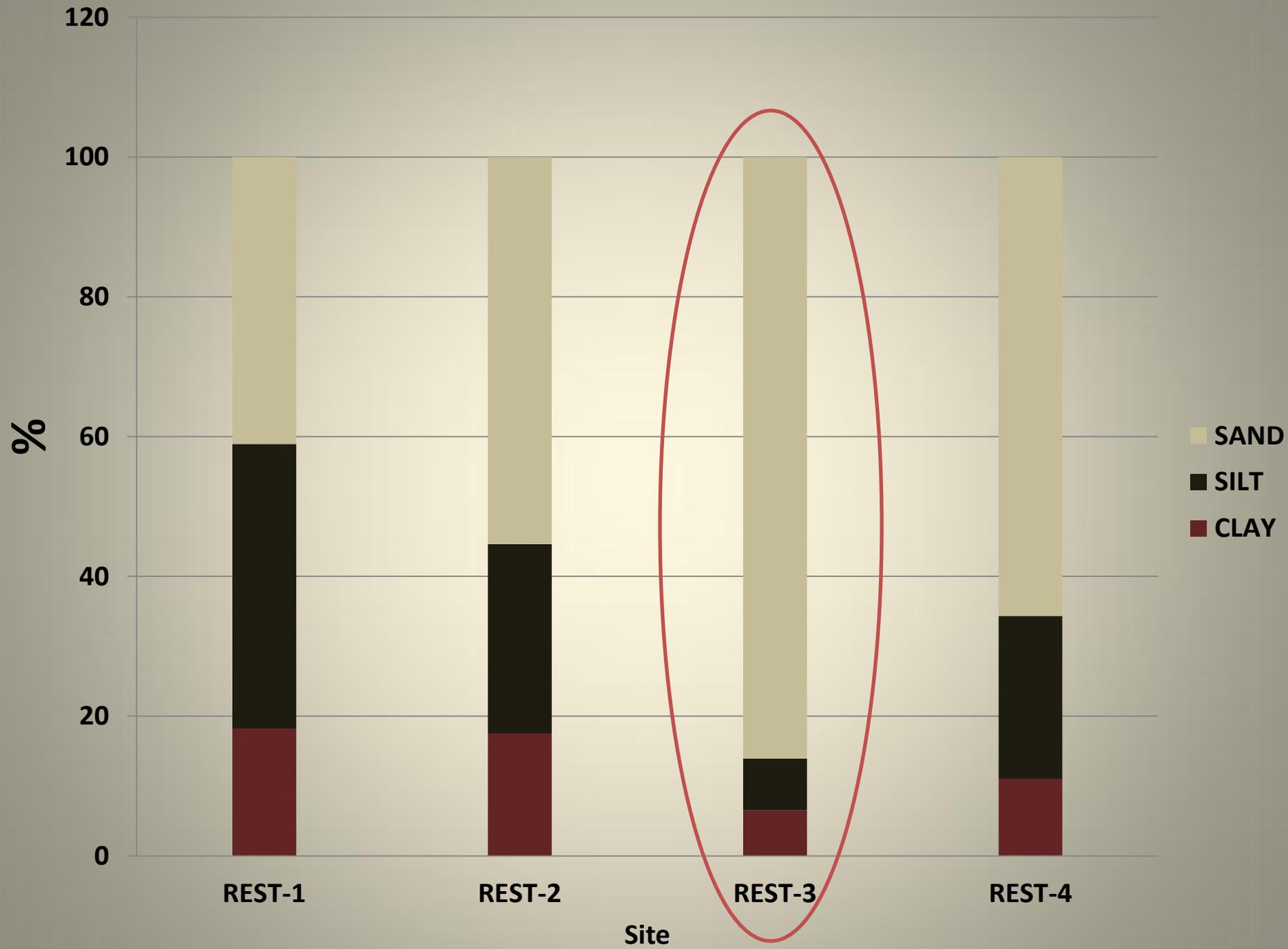
m



m

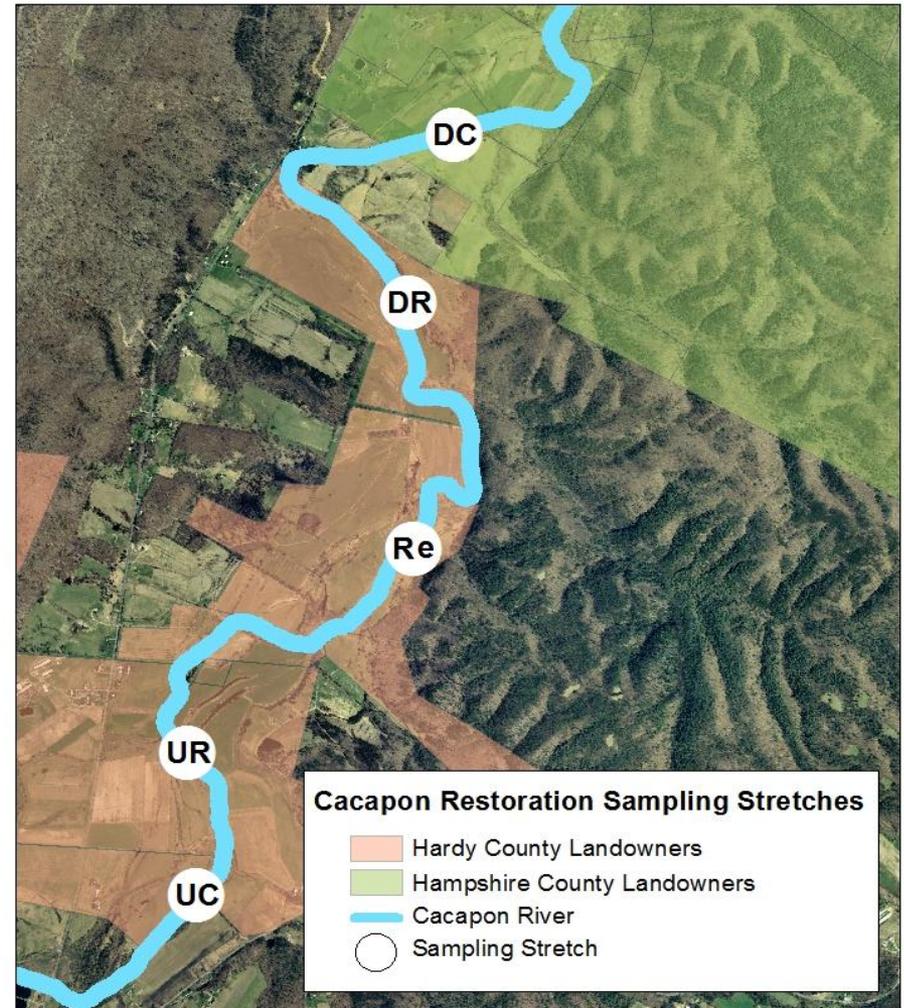






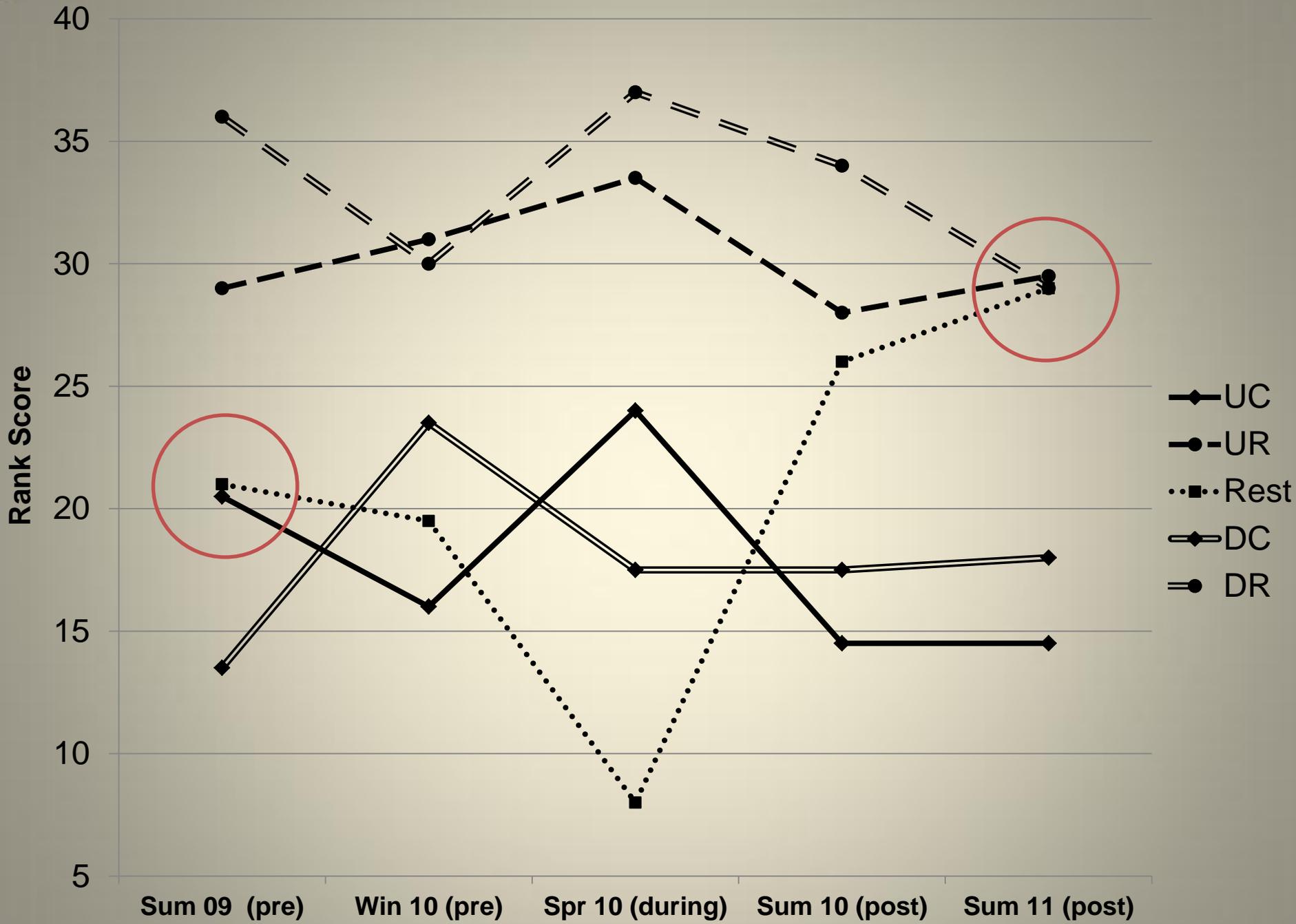
Macroinvertebrate Sampling

- 6 sampling locations within each site
- Id to genus
- 8 indices of benthic health (e.g., % EPT, HBI, etc.)
- Rank sums

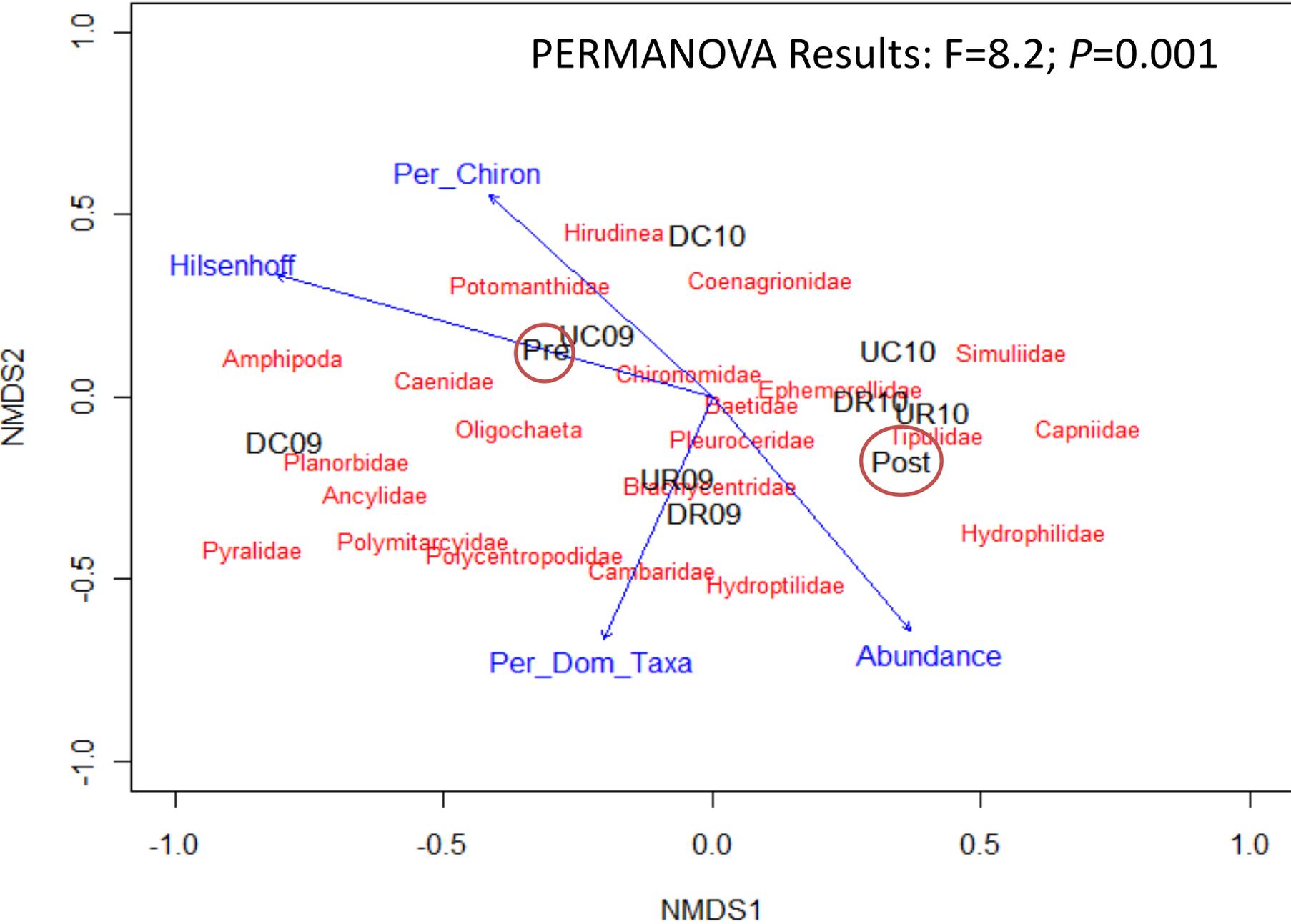


0 0.25 0.5 1 Kilometers





PERMANOVA Results: $F=8.2$; $P=0.001$



Summary & Conclusions



- Improved streambank stability
 - Success at 3 of 4 sites
 - Net gain in material (i.e., sediment storage in 2 of 4 sites
 - Two factors to consider:
 - Pre-restoration stability
 - Soil type



- Improved benthic community health
 - Increased habitat complexity
 - Decreased deposition

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- Graduate Students: Gabriel Strain, John Burkhardt, Katy McCoard
- Consultants and field help: Andy Coleman, Walter Veselka, Ed Watson, Cameron Eddy, Larry Pitchford

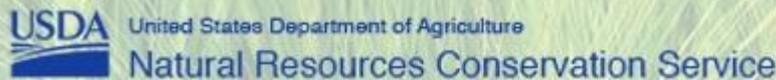


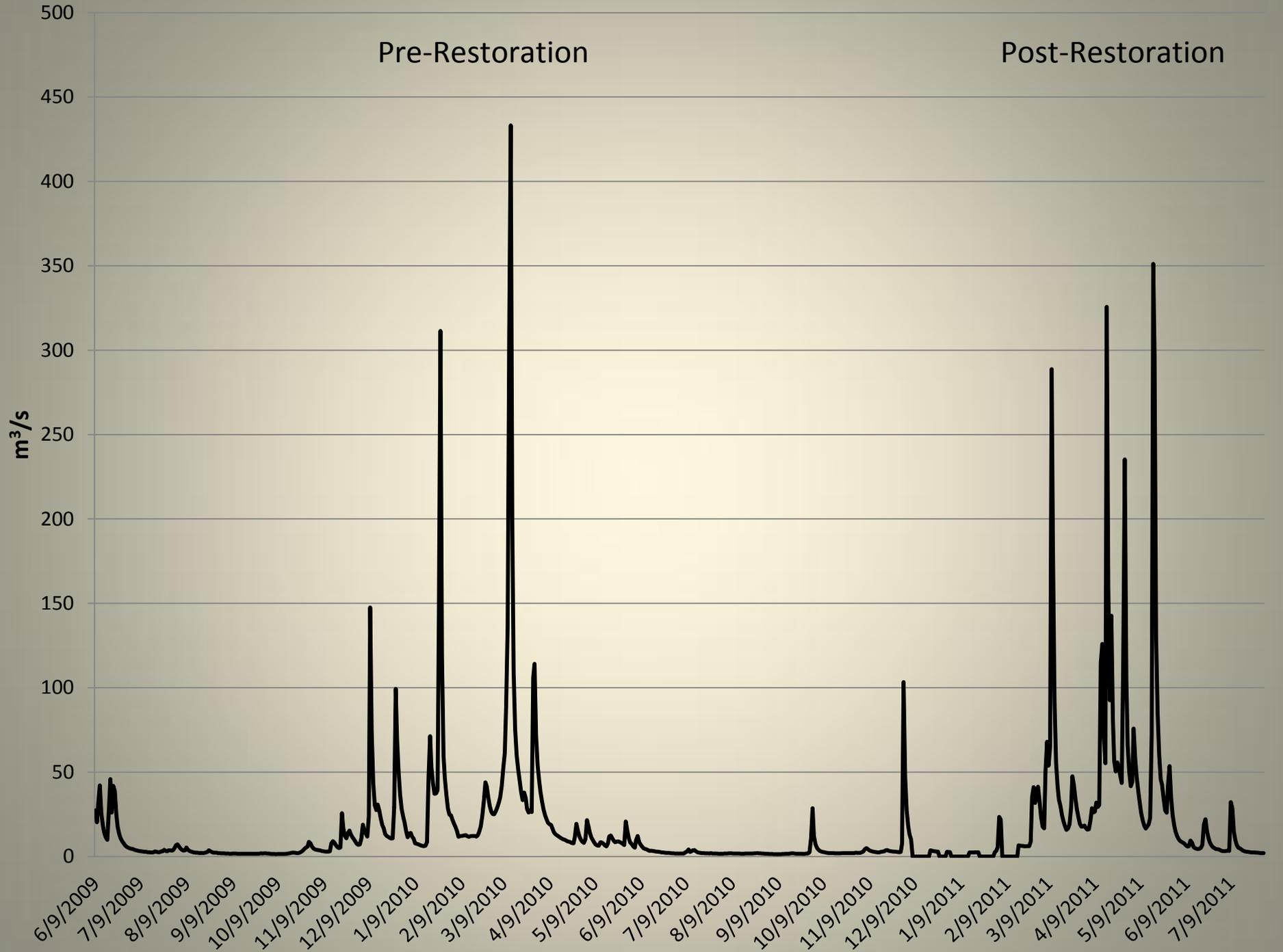


Acknowledgments

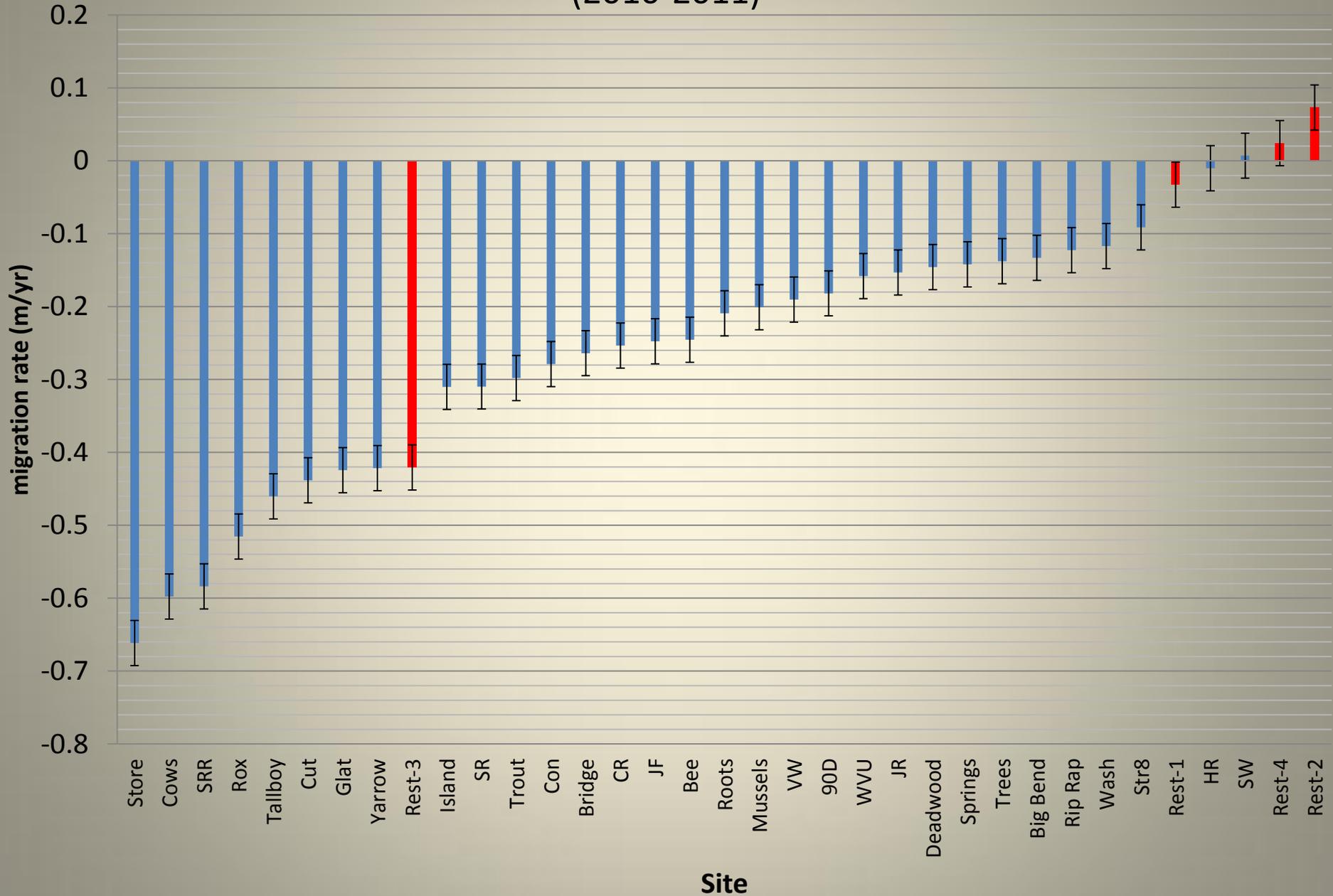


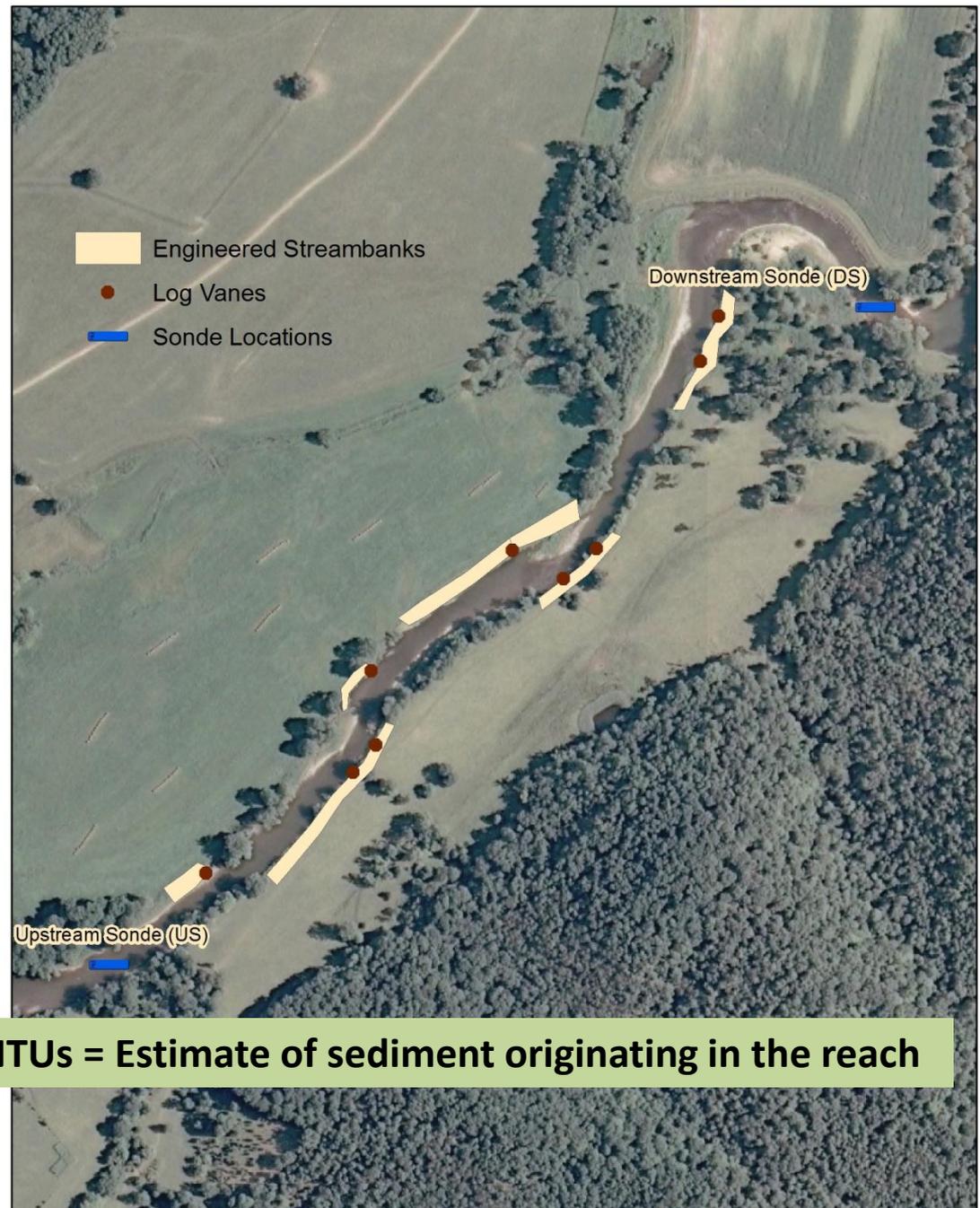
Joe and Josh Frye
Jack Rudolph
Arnette Landscapes, Inc
Red Creek Enterprises
Bland Fencing LLC





Streambank Migration in the Cacapon River Watershed (2010-2011)





- Hourly readings:

- Temp, pH, conductivity, **turbidity**
- Calibration before each deployment
- Used to determine change in parameters associated with the restored reach

Average DS NTUs – Average US NTUs = Estimate of sediment originating in the reach

