# The Report Card

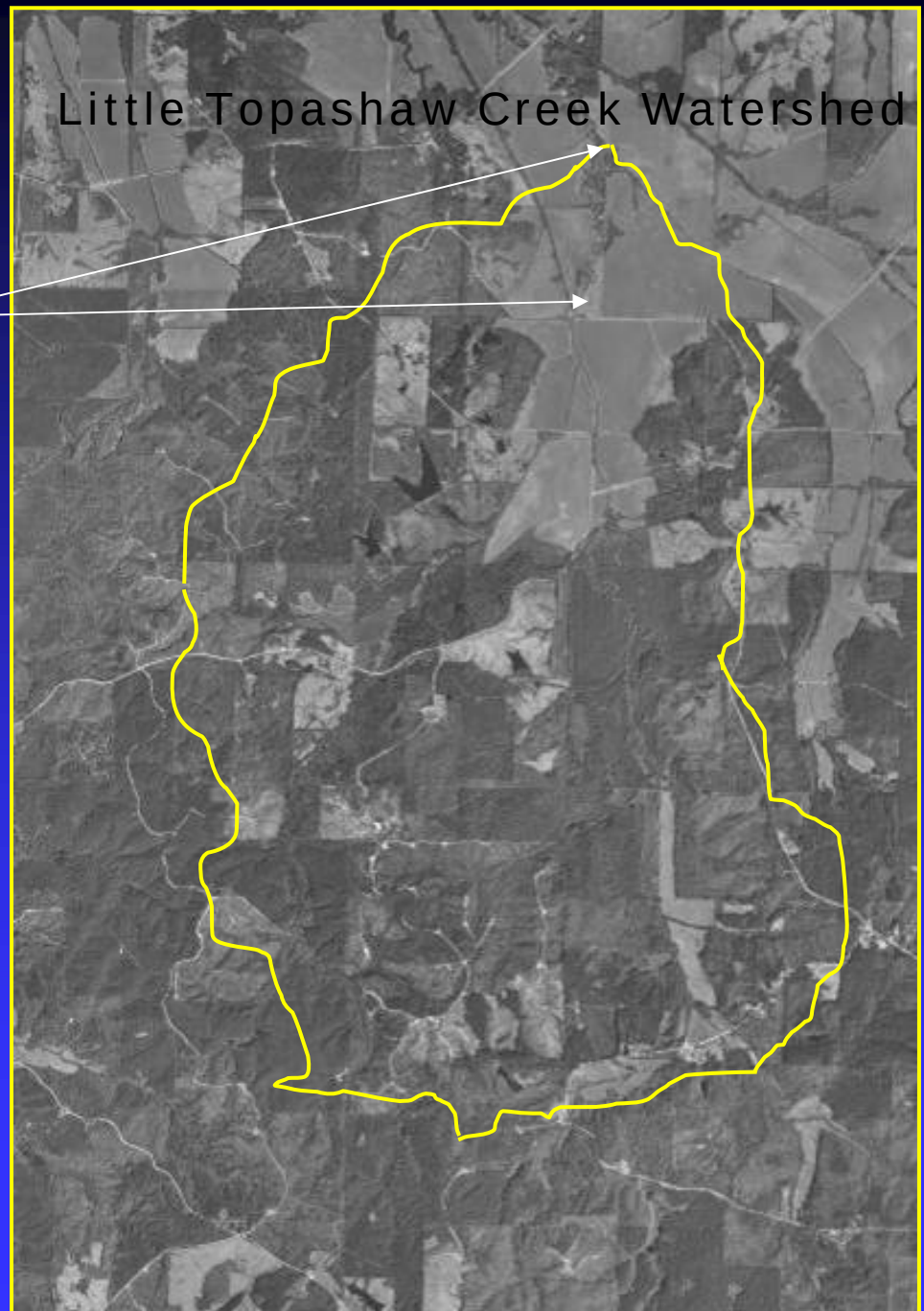
# The assignment

- Develop and test stream corridor ecosystem rehabilitation practices that
  - Are applicable at the landscape scale
  - Provide acceptable levels of stability and conveyance
  - Are low cost and low maintenance (feasible for landowner implementation)
  - Work with geomorphic processes to produce natural forms and functions

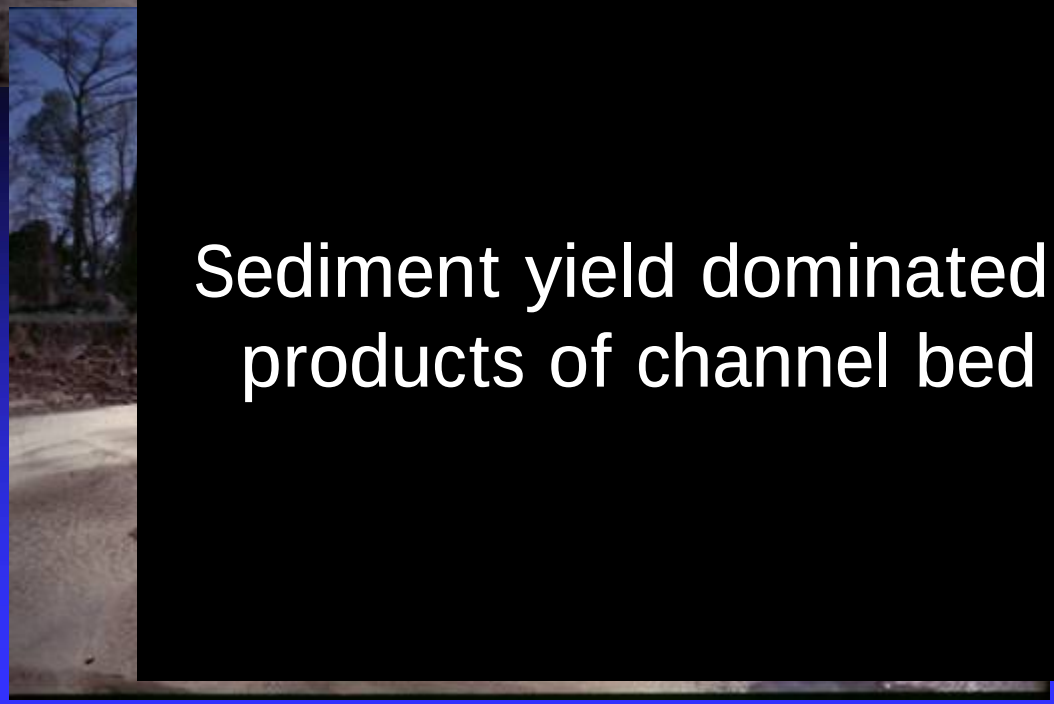
# The site

Modified reach

- 4th-order stream
- Watershed area = 37 km$^2$
- Maximum relief ~ 65 m
- Mixed cover land use
- Test bed for many types of research
- Cooperating action agencies provided construction funds, but ***no special research funding***.



# A very unstable environment



Sediment yield dominated (~85% of total) by products of channel bed and bank erosion.

# Categories of research

- Process studies--2

Grades are on effectiveness of measures—not on science or scientists!!

success--5

Process studies—no grade assigned

# Geomorphology

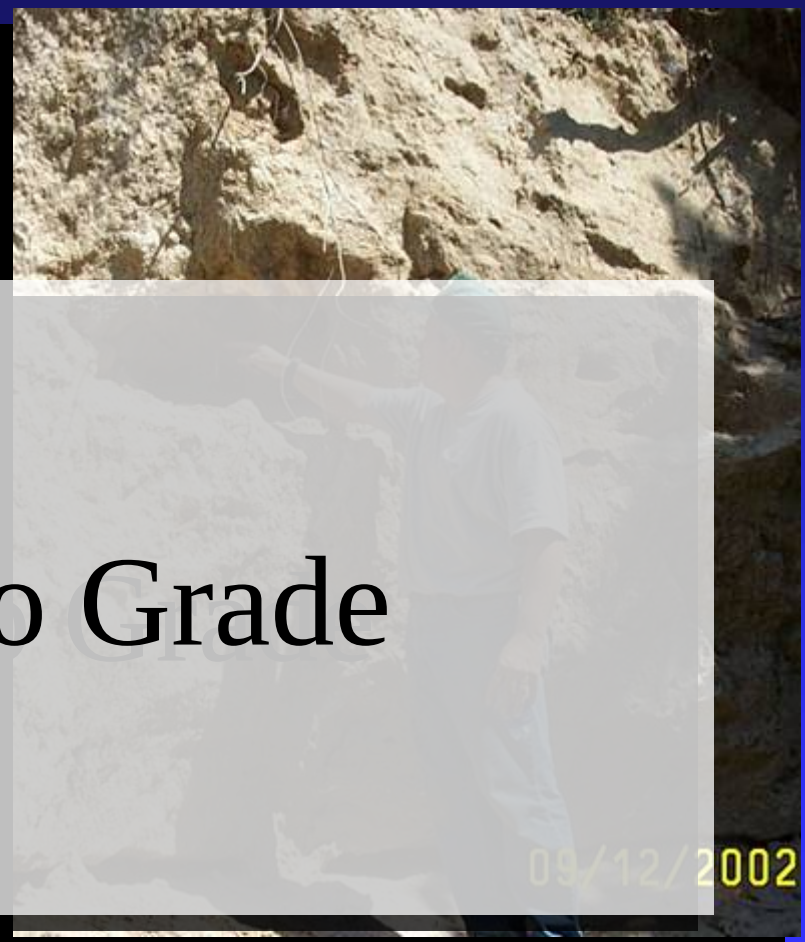
- Watershed characterization
- Knickpoint migration rates (up to 12 m/yr)
- Cohesive bed and bank erosion
- Reach scale response: downstream 3/4 aggrading, upstream ¼ degrading

## Process—No Grade

*Simon, Thomas, Hanson, Wallerstein*

# Subsurface erosion

- Seepage flow and sediment concentrations were measured *in situ* at eight locations
- Sediment concentrations as high as 660 g $L^{-1}$
- Foundation for laboratory lysimeter studies
- Results compared to ARS Bank Stability Model simulations



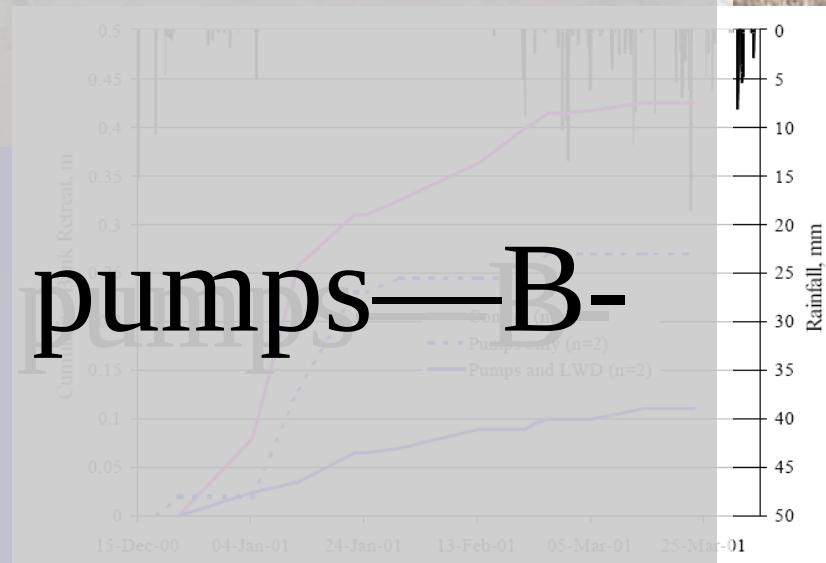

Process—No Grade

*Wilson*

# Management practices for channel erosion and habitat rehabilitation

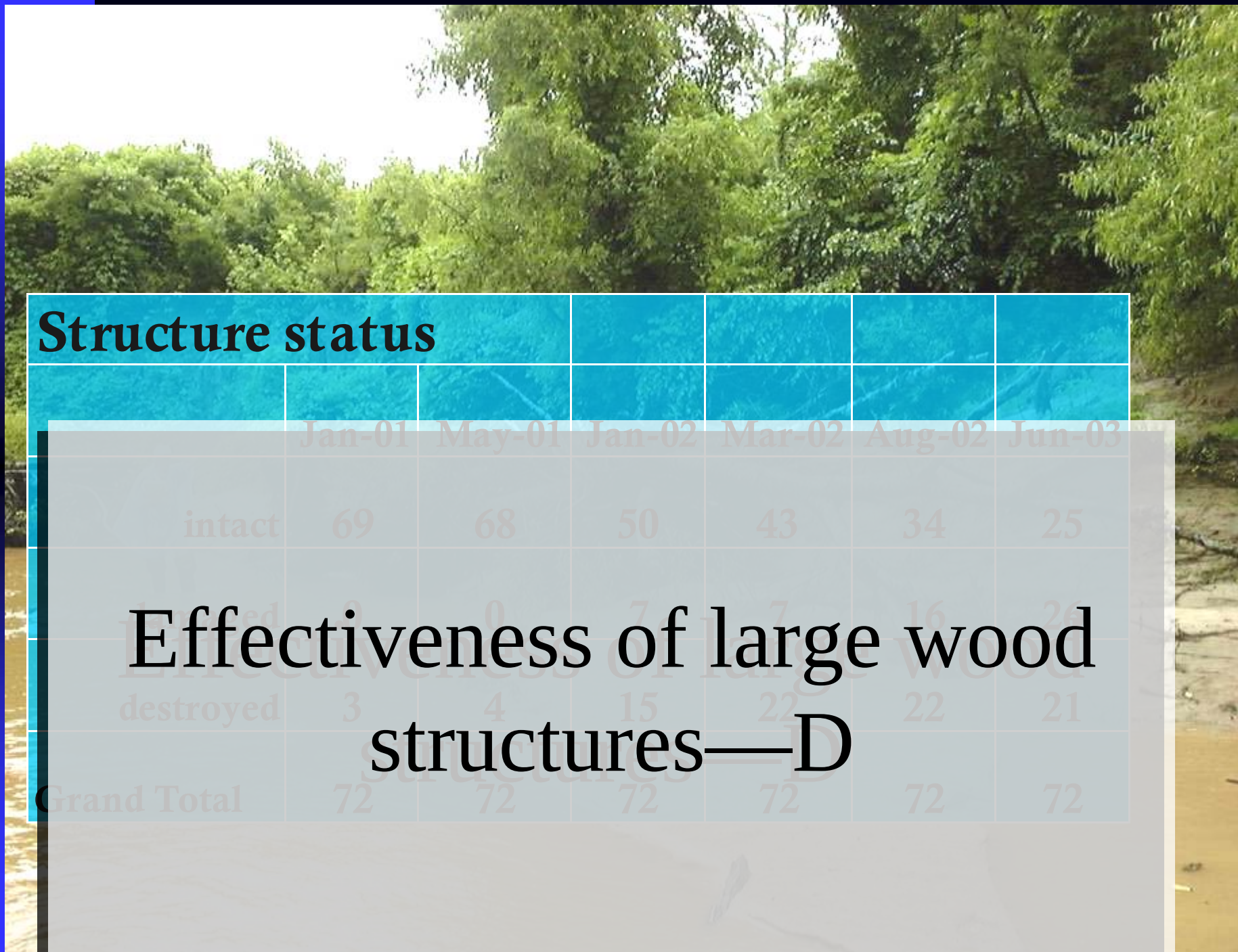
# Bank stabilization using pumps

- Reduced pore water pressure
- Retreat rate lowered by factor of 2 over two-year period
- No mass failures
- Safety factor increased
- Maintenance issues

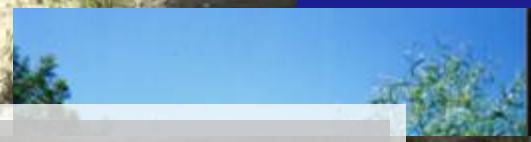

## Effectiveness of pumps—B-

*Simon, Collison, Dickerson*




# Effectiveness of large wood structures—D

# Willow cuttings for bank stabilization



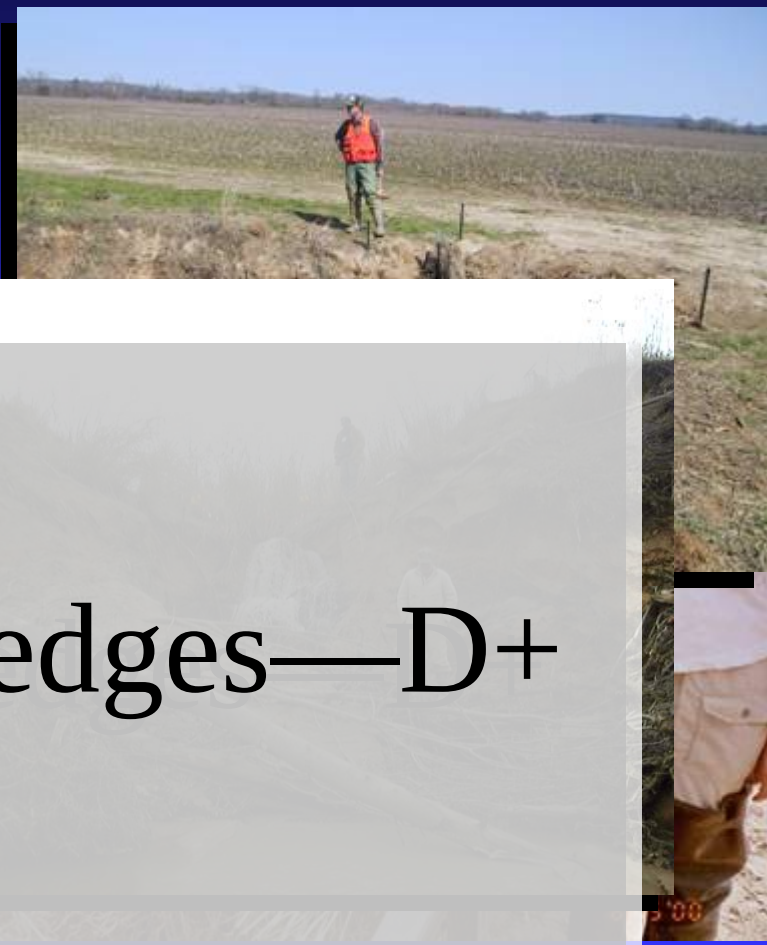
- 4000 willow cuttings planted on bars and banks
- Performance of presoaked and unsoaked cuttings showed positive effects of soaking on survival and growth
- Effectiveness of willows governed by soil texture and depth to water table
- Three-year survival < 10%!

## Effectiveness of willows—F

*Pezeshki, Martin, Li*

# Riparian gully stabilization using switchgrass hedges

- Hedges planted at 0.5-m vertical intervals
- Tested using pumped flows and natural runoff
- Main body of gully was stabilized
- Effectiveness of hedges progressing from streambed into gullies



## Effectiveness of hedges—D+

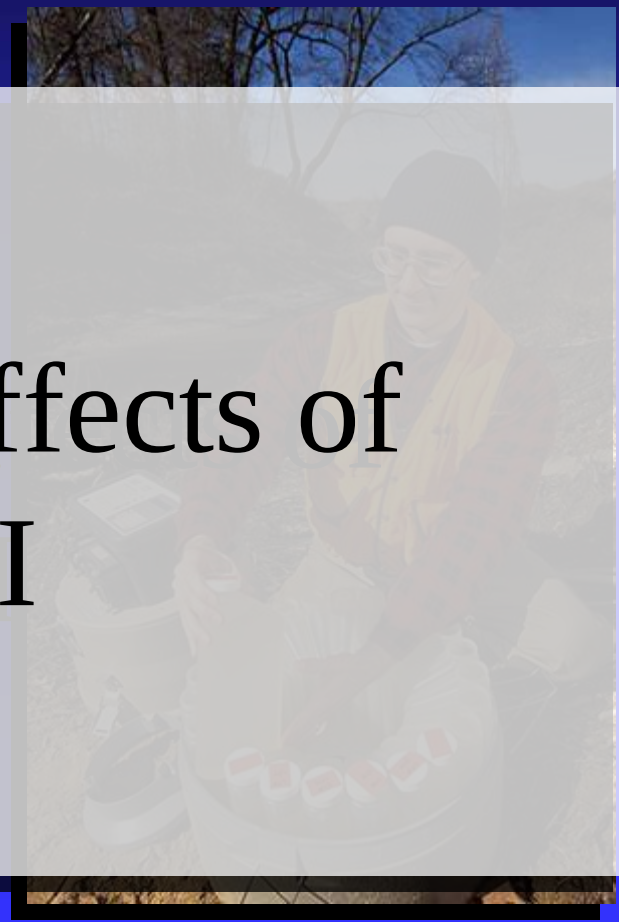
*Dabney, Langendoen*

# Indicators of overall project success

# Water quality

- Selected nutrients (Total N, $PO_4$) often exceeded proposed TMDL criteria, suggesting adjustment needed for regional characteristics
- Many pesticides were detected, but rarely at concentrations of concern
- Pesticide detections and concentrations coincided with runoff events following applications
- Analysis of effects of rehabilitation still pending

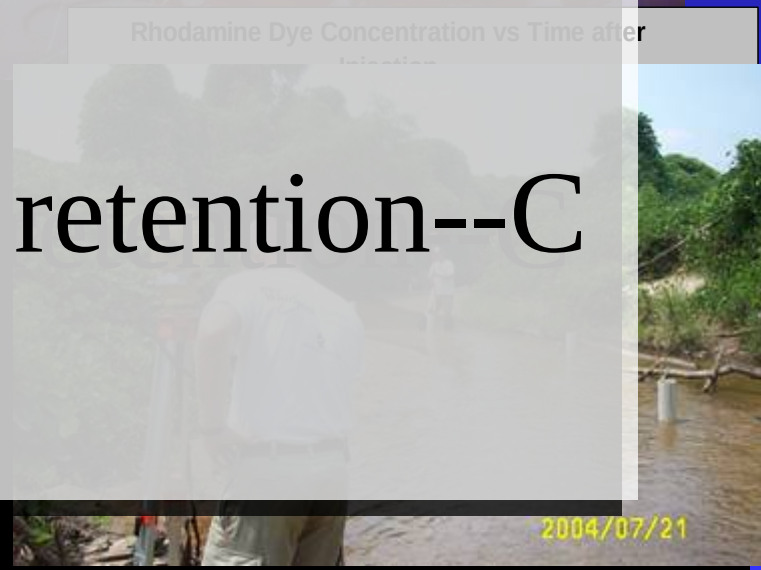
## Water quality effects of project--I



*Cooper, Smith, Lizotte*

# Hydraulic retention

- Mean velocity reduced 40 % relative to downstream untreated reach eight months after construction
- Overall retention 100% [illegible] large wood ($F_{med}$)
- Hyporheic storage less than 0.5% of total storage

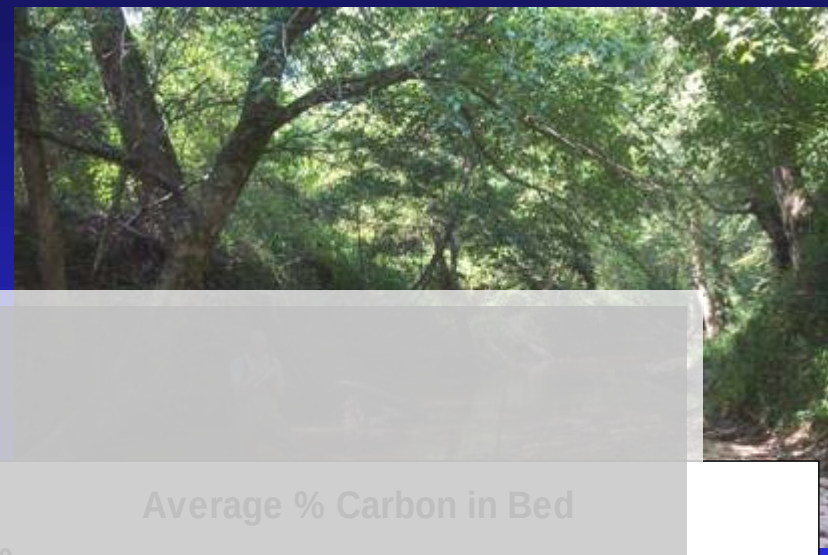


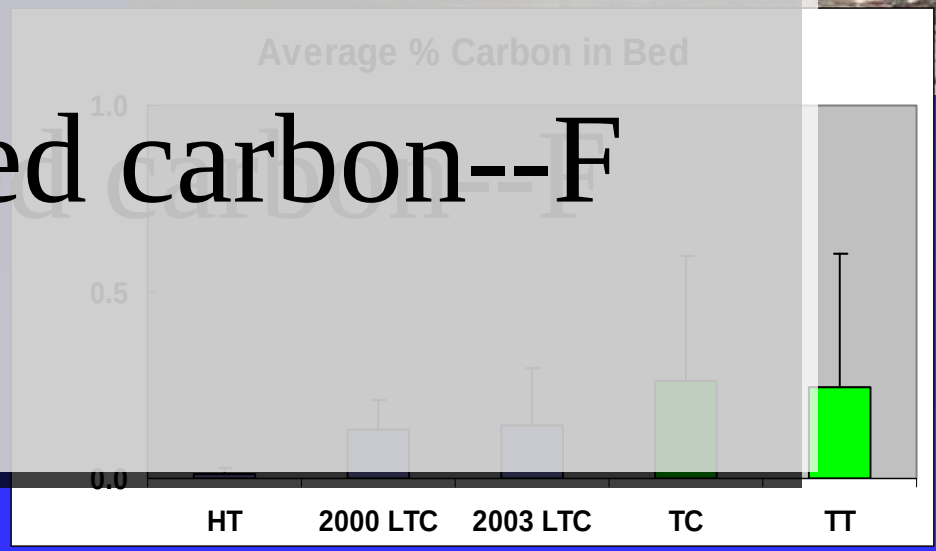

## Effects of project on retention--C

*Stofleth, Morin, Fox*

# Organic carbon in bed

- Surficial (top 10 cm) bed sediments sampled immediately before and 3 yr after rehabilitation
- OC levels were about half those of reference sites and were unchanged by rehabilitation



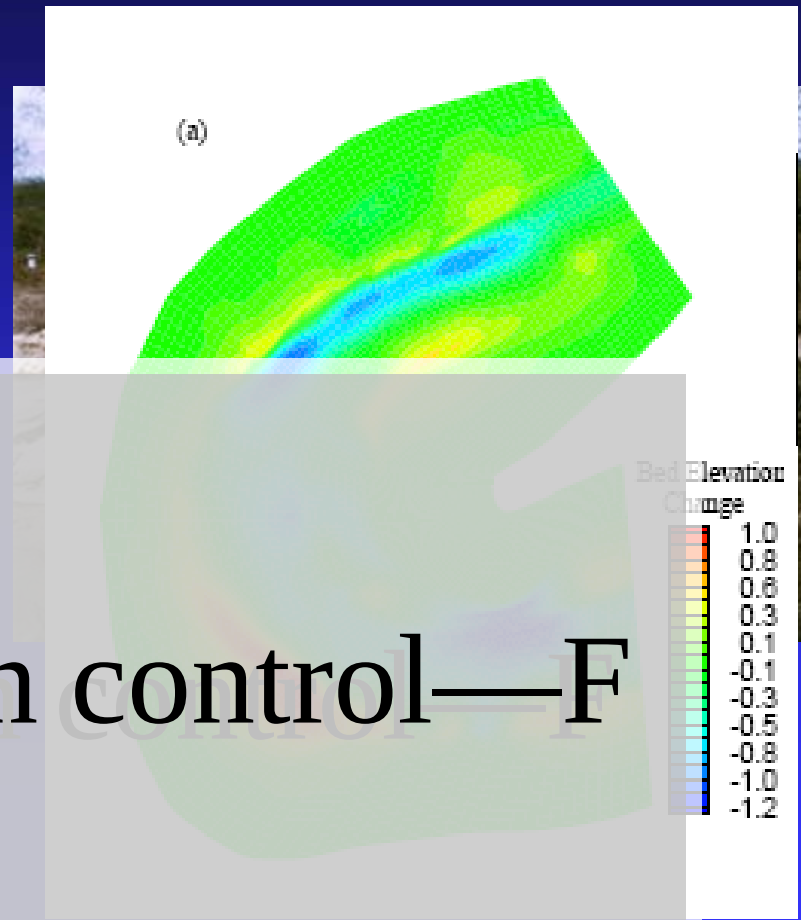



Effects on bed carbon--F

*Stofleth*

# Sediment retention and stabilization

- Repeated channel surveys, acoustic Doppler loggers, and a two-dimensional numerical model all showed that high flow velocities were retarded along concave bank toes by LW structures, promoting deposition of fine sediments.
- Eventual failure of LW structures allowed deposited sediments to be scoured away.

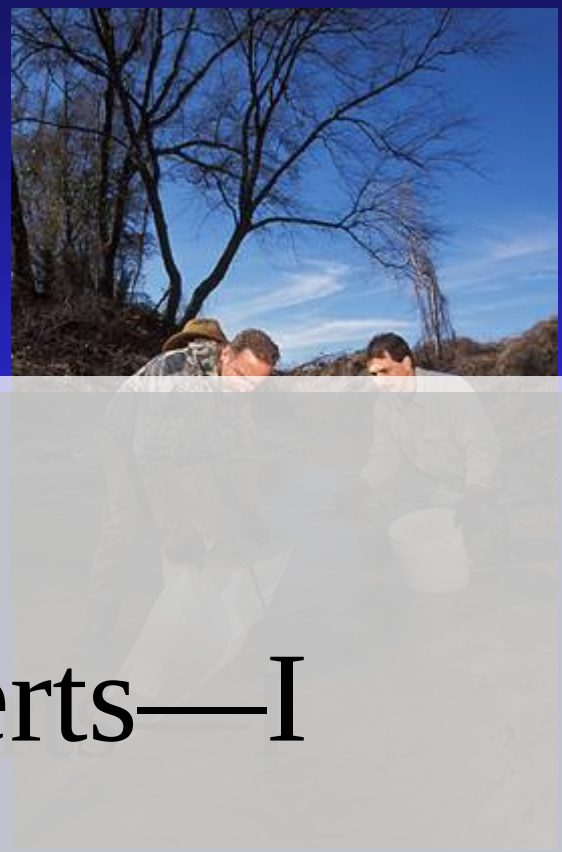



## Effects on erosion control—F

*Wu, Bennett*

# Aquatic macroinvertebrates

- Large increases in abundance of “desirable” types
- Increased biodiversity
- These increases occurred in treated and untreated reaches
- Major shifts in community composition in each reach
- Final analysis still pending



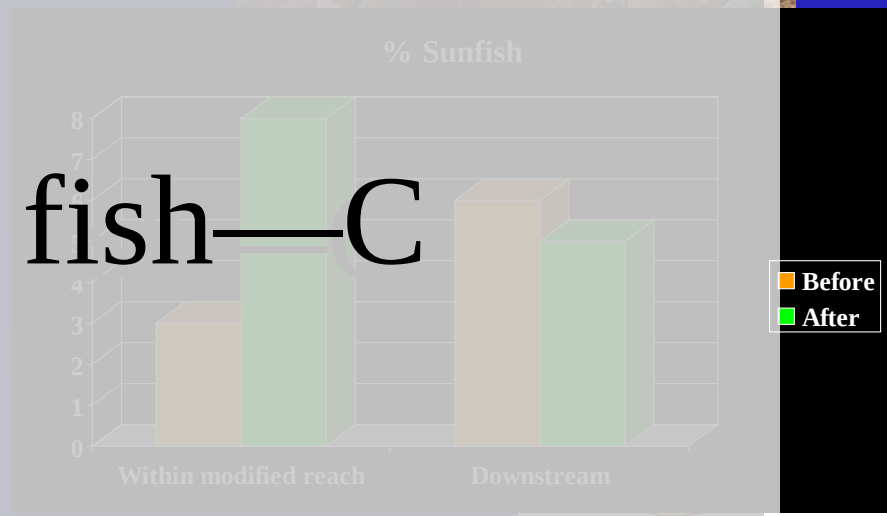
## Effects on inverts—I

*Cooper, Testa*

# Fish and their habitats

- Field data and numerical modeling indicated initial improvements in habitat quality due to LW addition
- Longer-term habitat effects were modest—mostly just an increase in LW density
- Number of fish species doubled
- Species composition became more like one typical of less-degraded reference site
- Some similar changes occurred in the untreated reach downstream

## Effects on fish—C




*Knight, Wu, He*

# Lessons learned


- Multidisciplinary watershed scale research is a worthy endeavor, providing (but not replacing) more basic, controlled laboratory and plot-scale studies
- Watershed research benefits from synergy of many types of investigation in the same locale
- We need to rethink control of concentrated flow erosion
- Ecological restoration, particularly in agricultural watersheds, is a daunting task