

# **Trees, water quality, and stream ecosystem health: Lessons learned from the field and the literature**

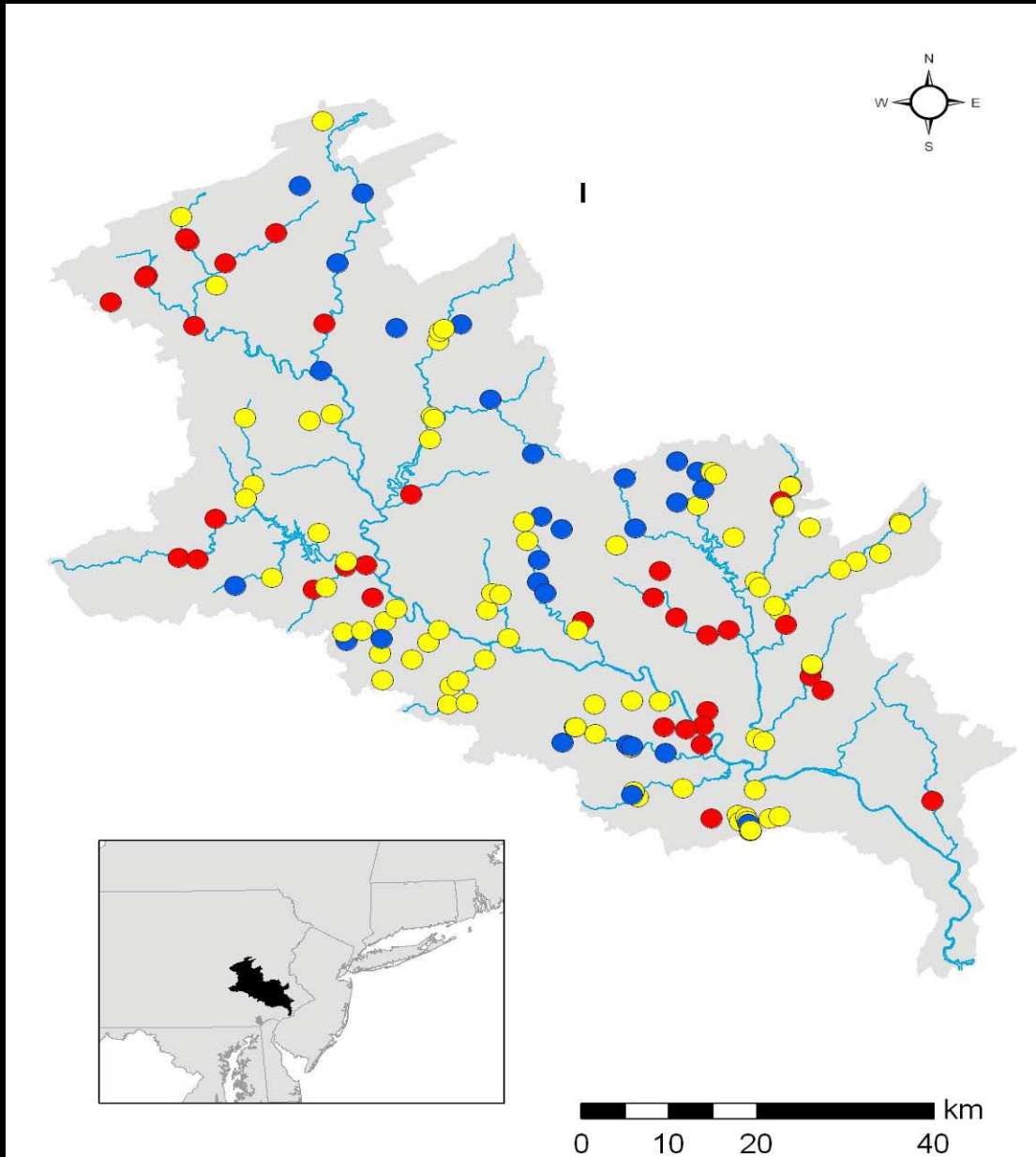
**Bern Sweeney**

**Our field data (& others)  
suggest:**

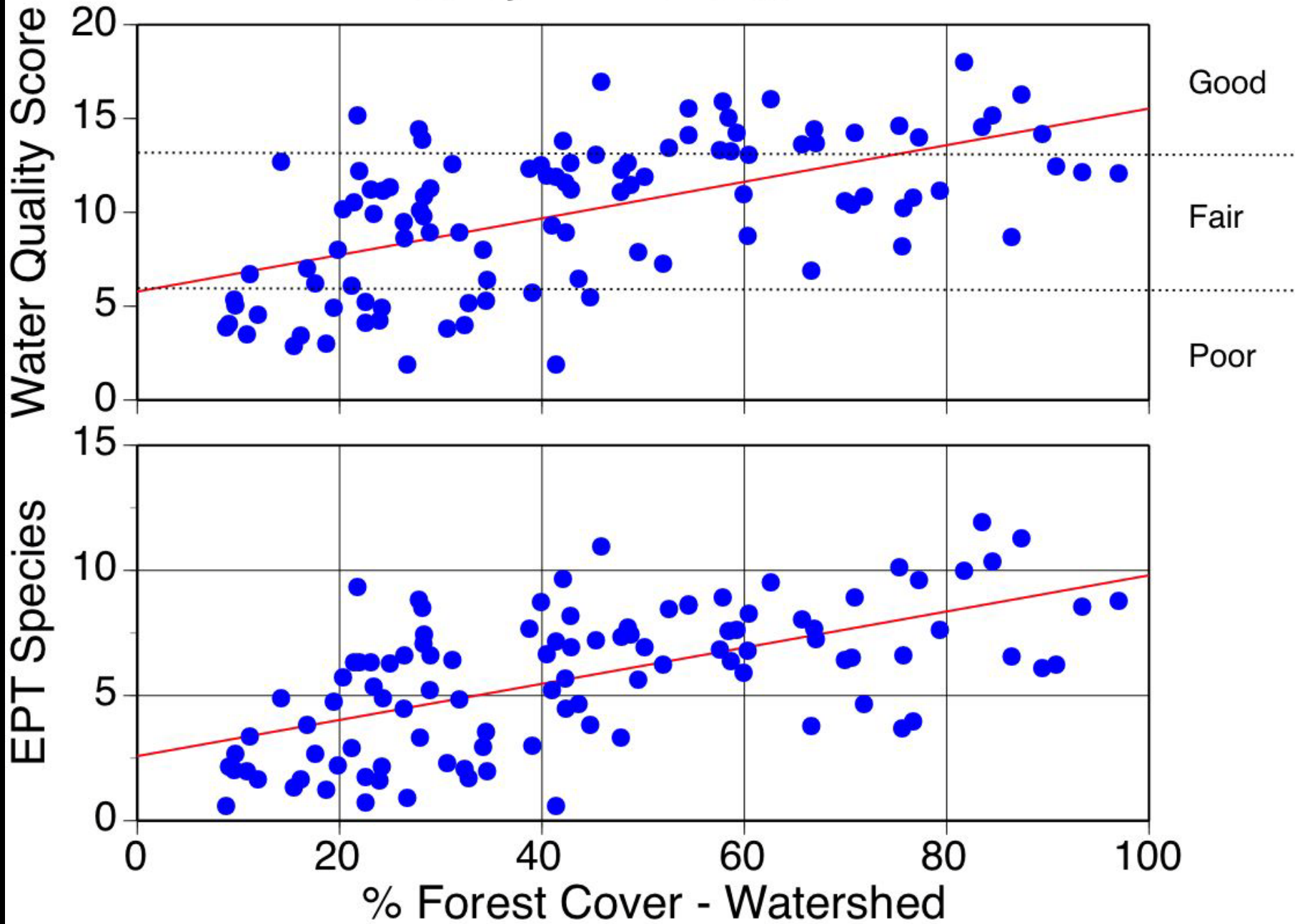
**the more trees in a  
watershed....**

**the better the water quality &  
the healthier the stream  
ecosystem**

# Schuylkill River Watershed PA



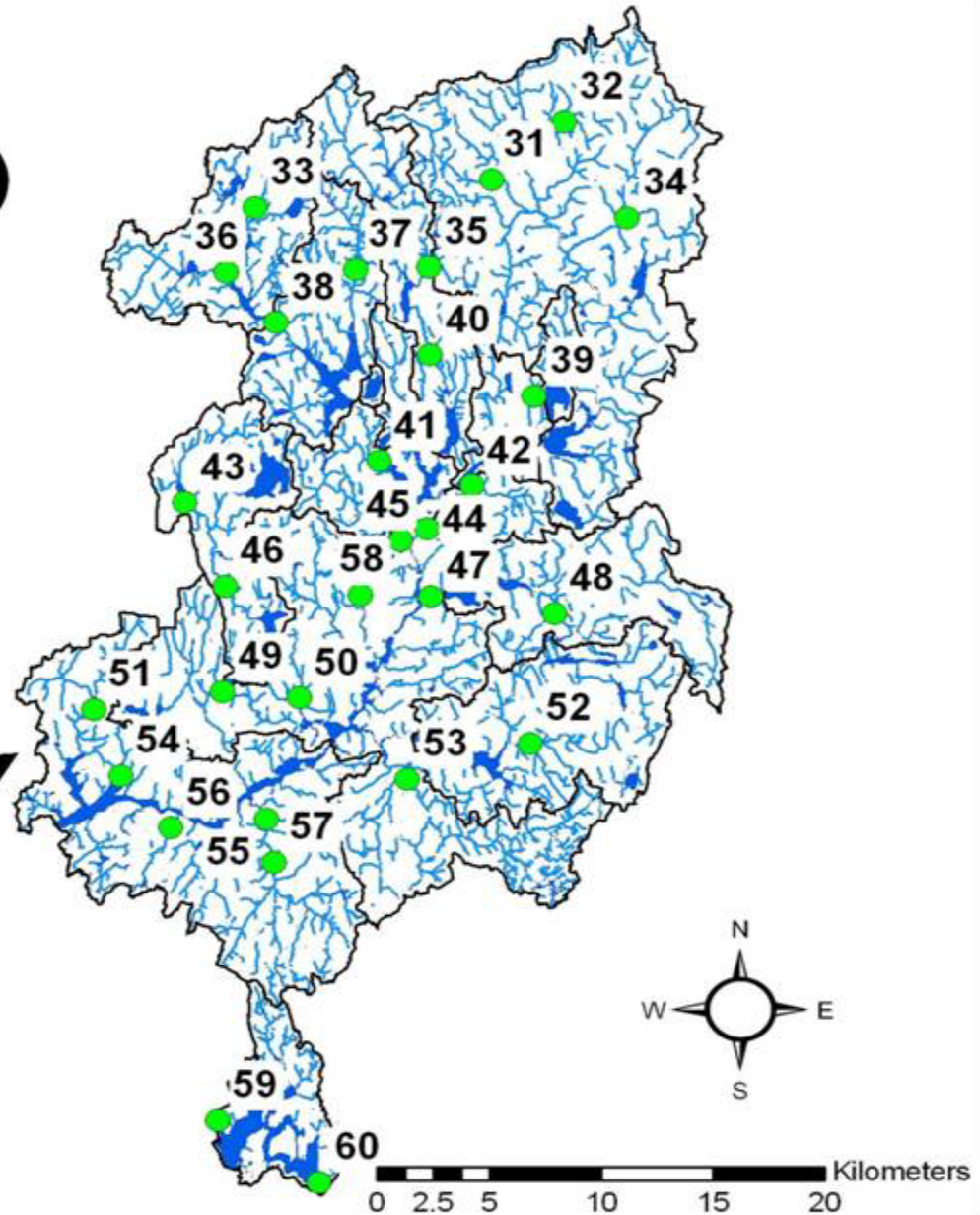
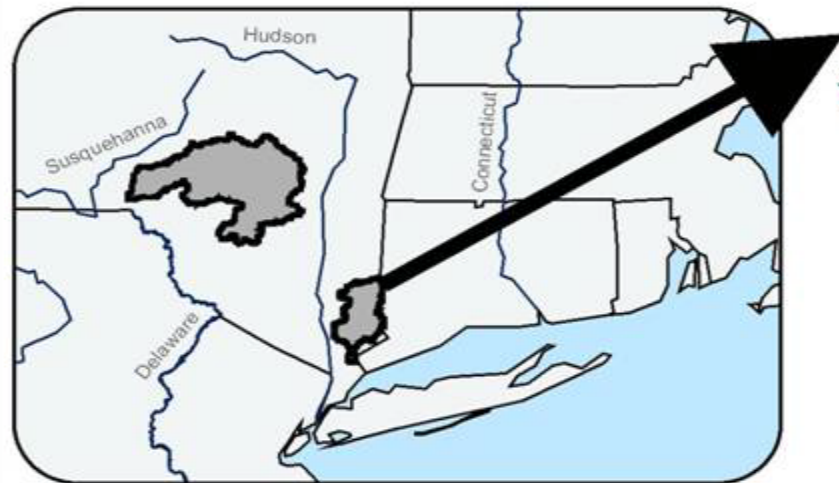
# Schuykill River Sites



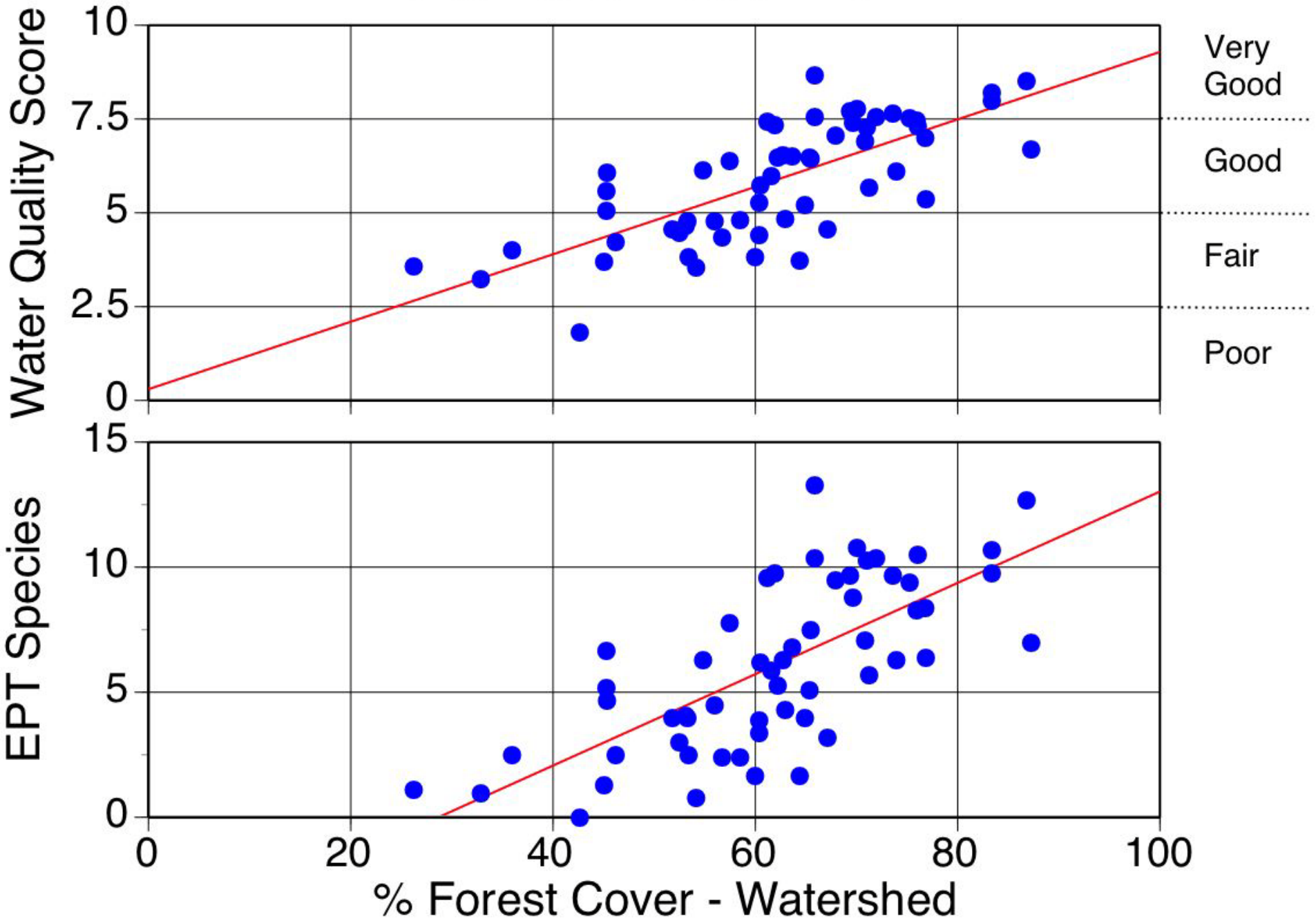
# Hudson River Watershed - NY

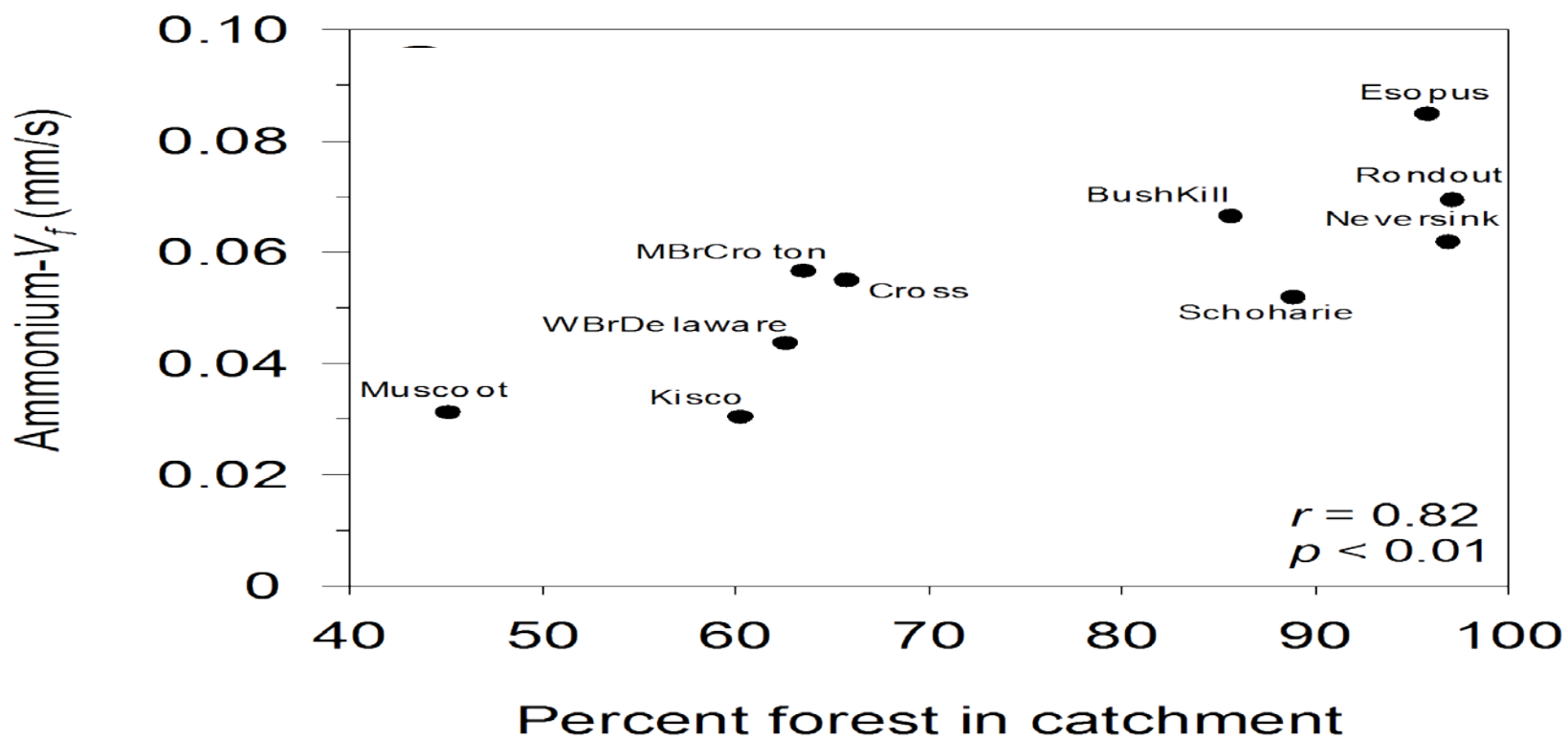
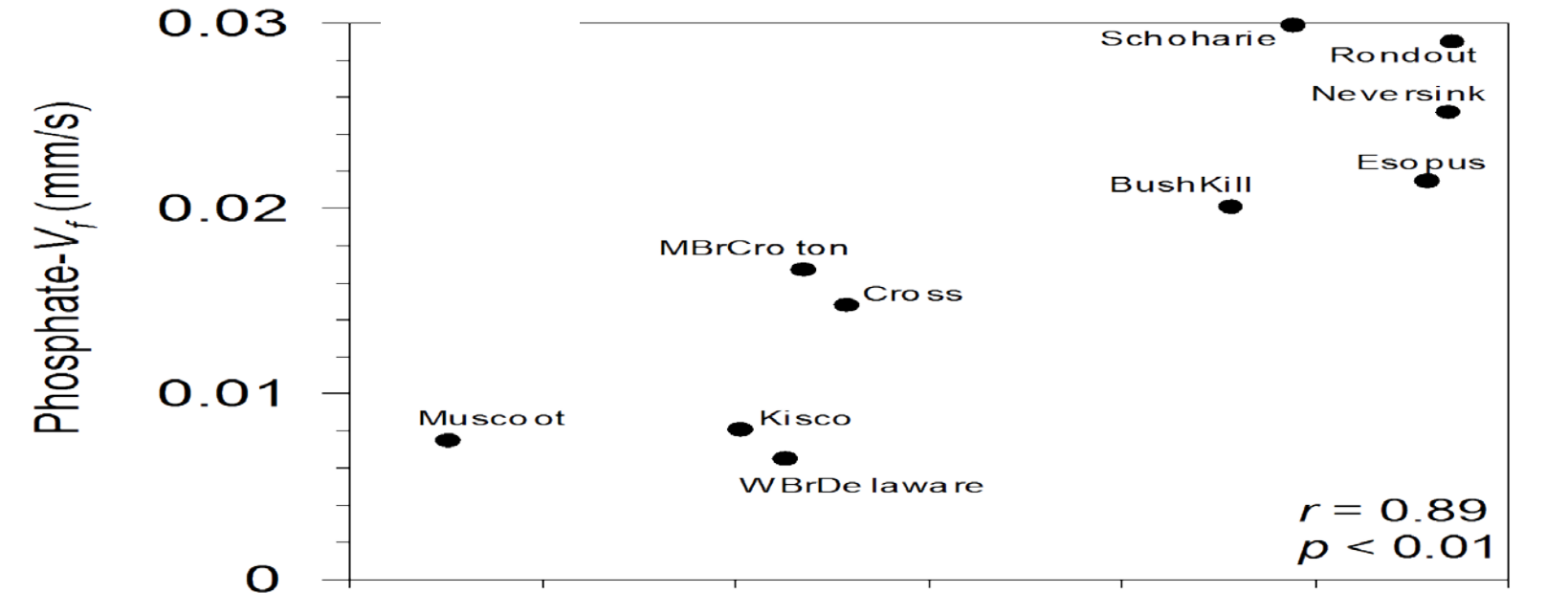
## East of Hudson Catchments (EOH)

Area = 1004 km<sup>2</sup>



# Sites East of HudsonRiver





**More forest....**

**Better water quality....**

**Healthier stream ecosystems ....**

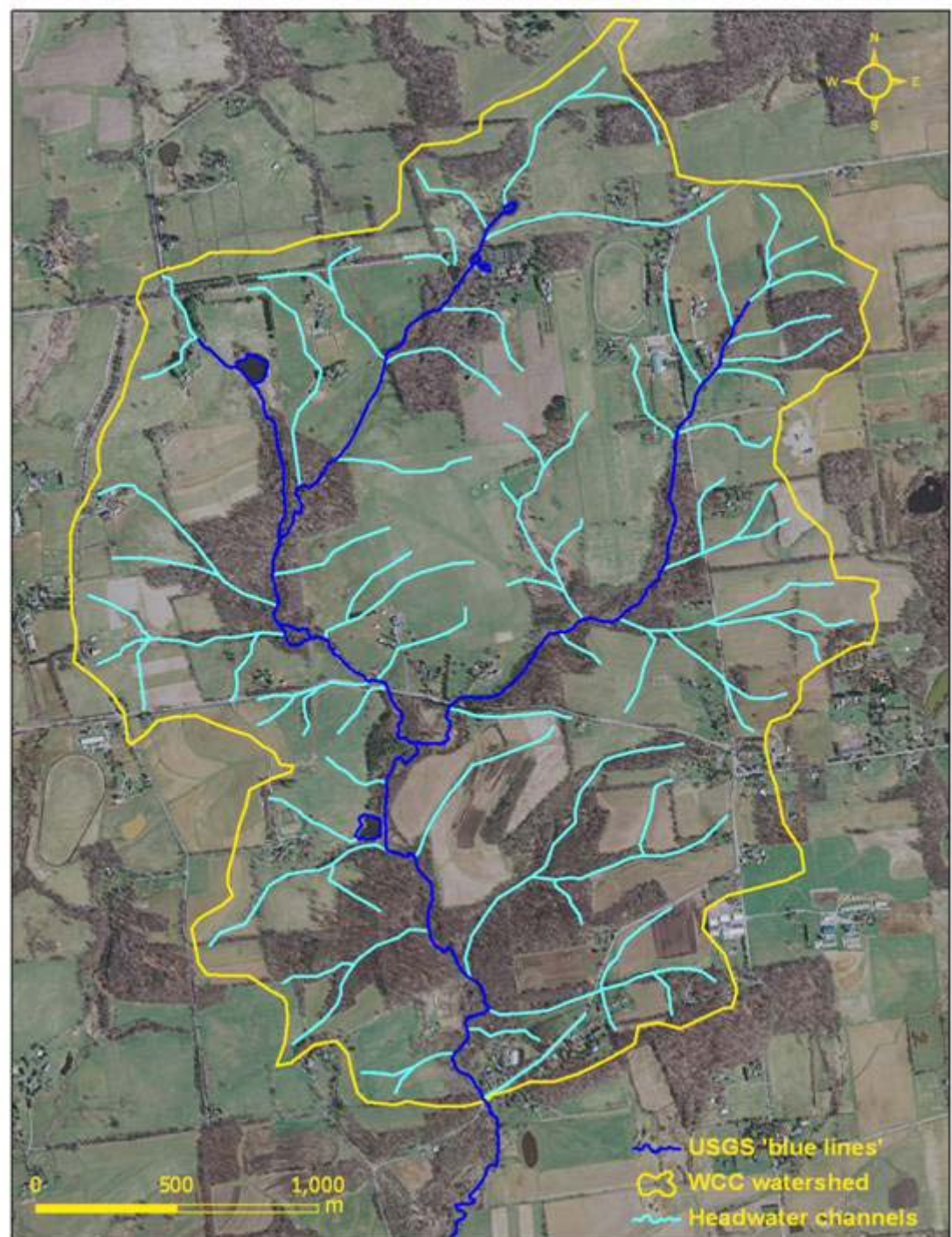
**More ecosystem services....**

**Even better water quality**

**% Forest in Watershed**

**has a stronger association with site differences than**

**% Forest in Riparian Areas**





**This suggests  
that .....**

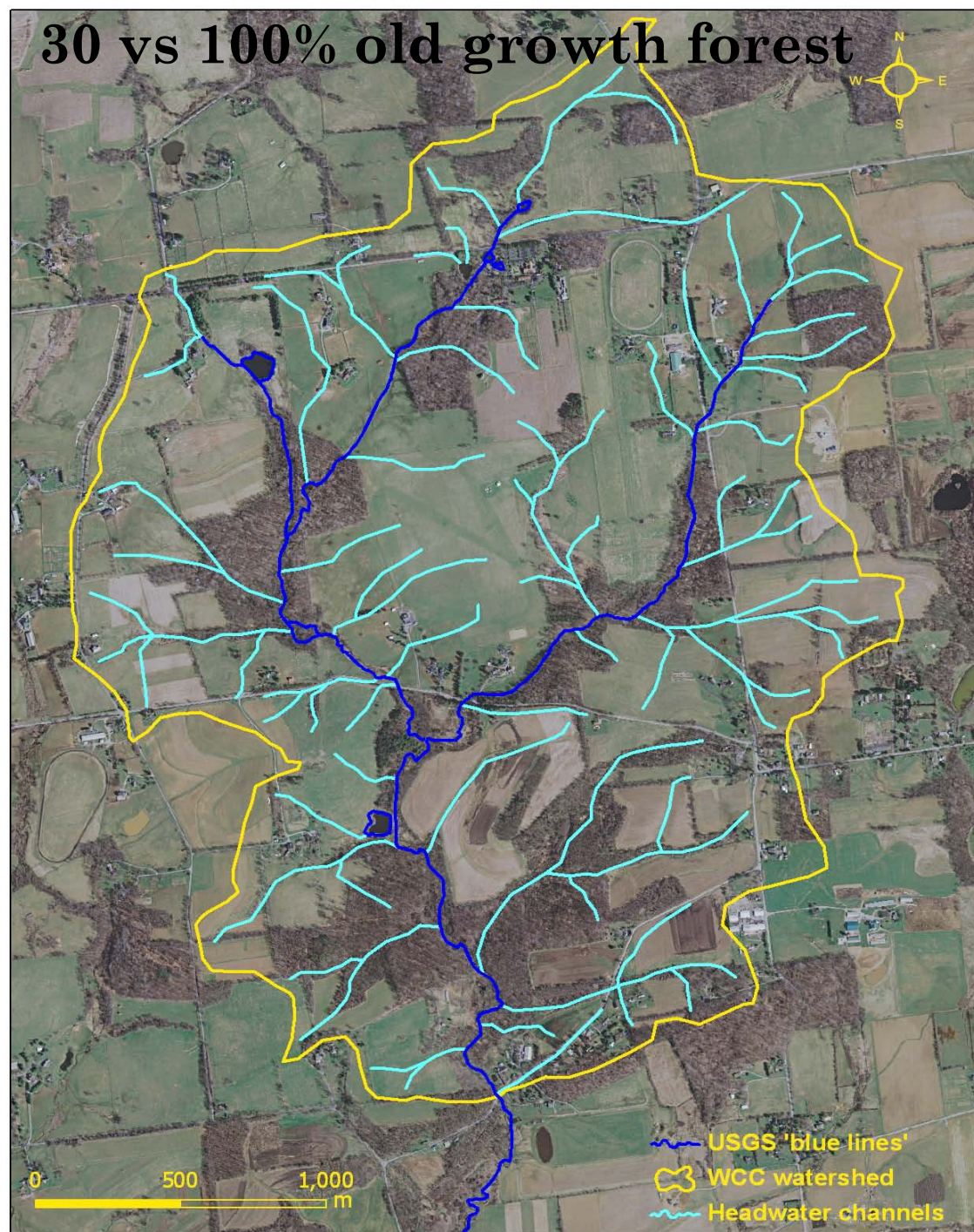
**every tree  
counts in a  
watershed!!**



**Why?**

**Trees help  
intercept and  
infiltrate  
rain.....**

**which promotes  
more natural,  
sustained,  
and clean  
stream flow**



**Old growth forest: 2240 kg/h (2000 lbs/acre)  
of leaves per year.....**



**soil beneath old growth forest  
(thick, organic, highly permeable)**



# Base Flow



# Post Thunderstorm Flow ---100% forested



# Post Thunderstorm Flow – 30% forested



**Little or no filtering/processing of this storm water  
before becoming stream flow**

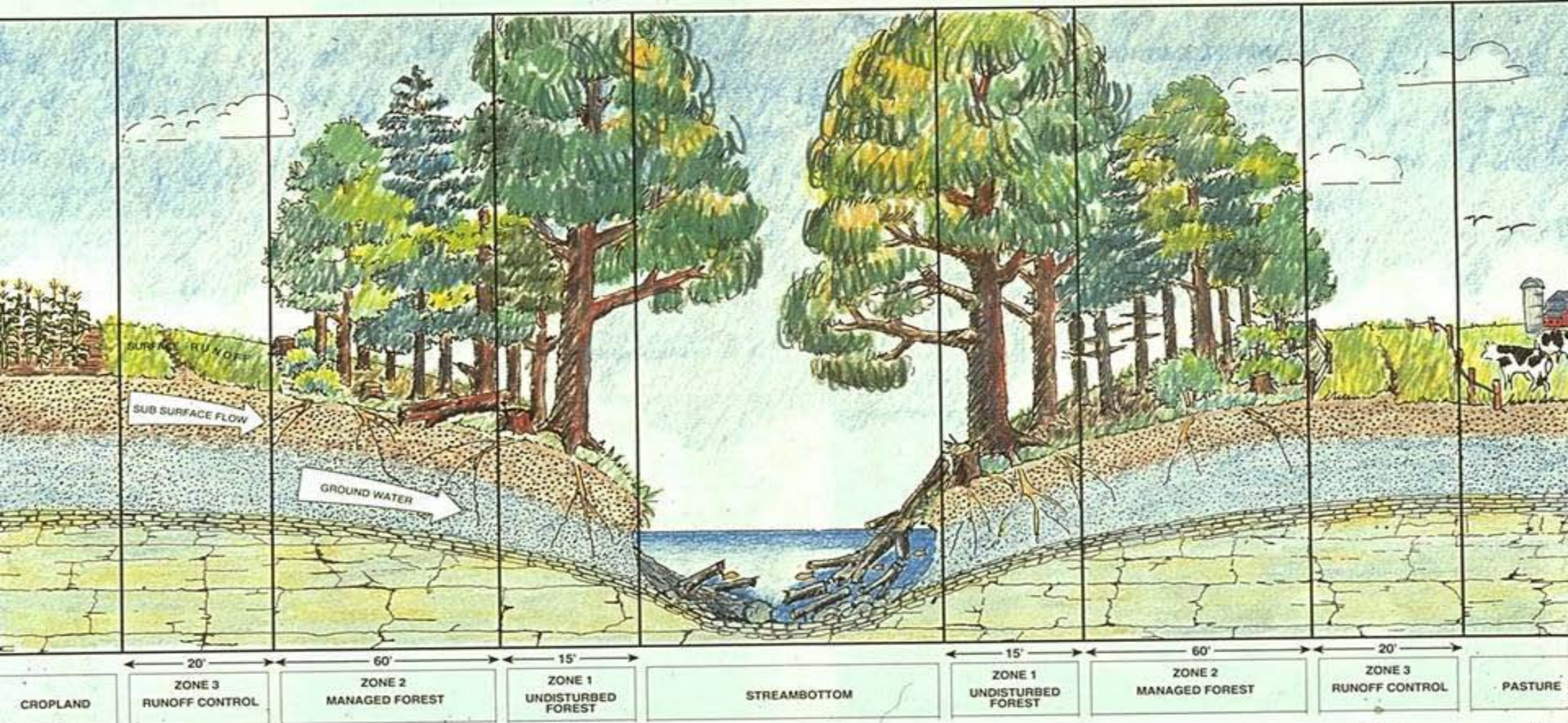


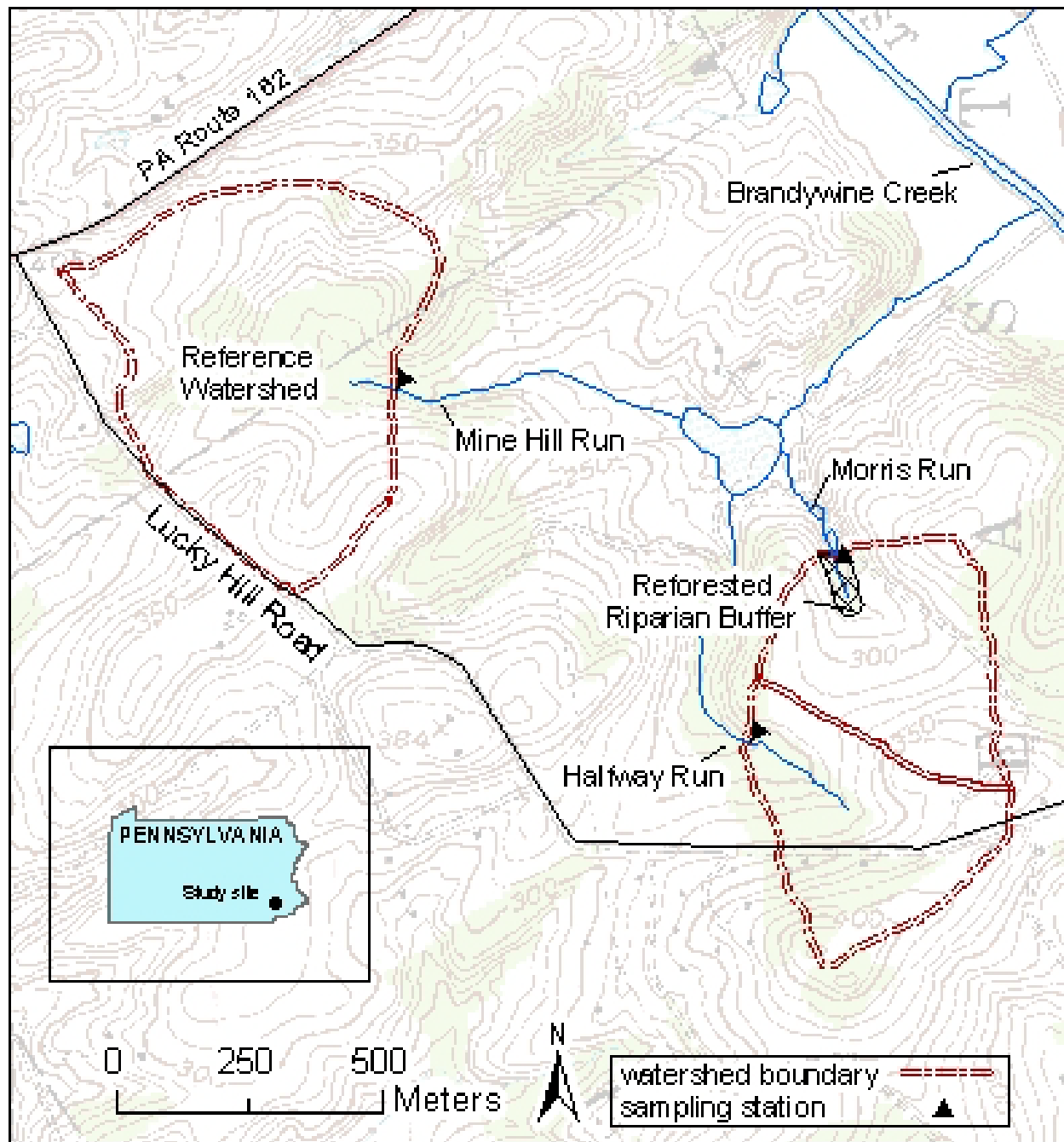
# Trees can also keep stuff out of the streams: “Buffers as Barriers”



# Lessons learned from a long-term buffer study in PA

THE STREAMSIDE FOREST BUFFER

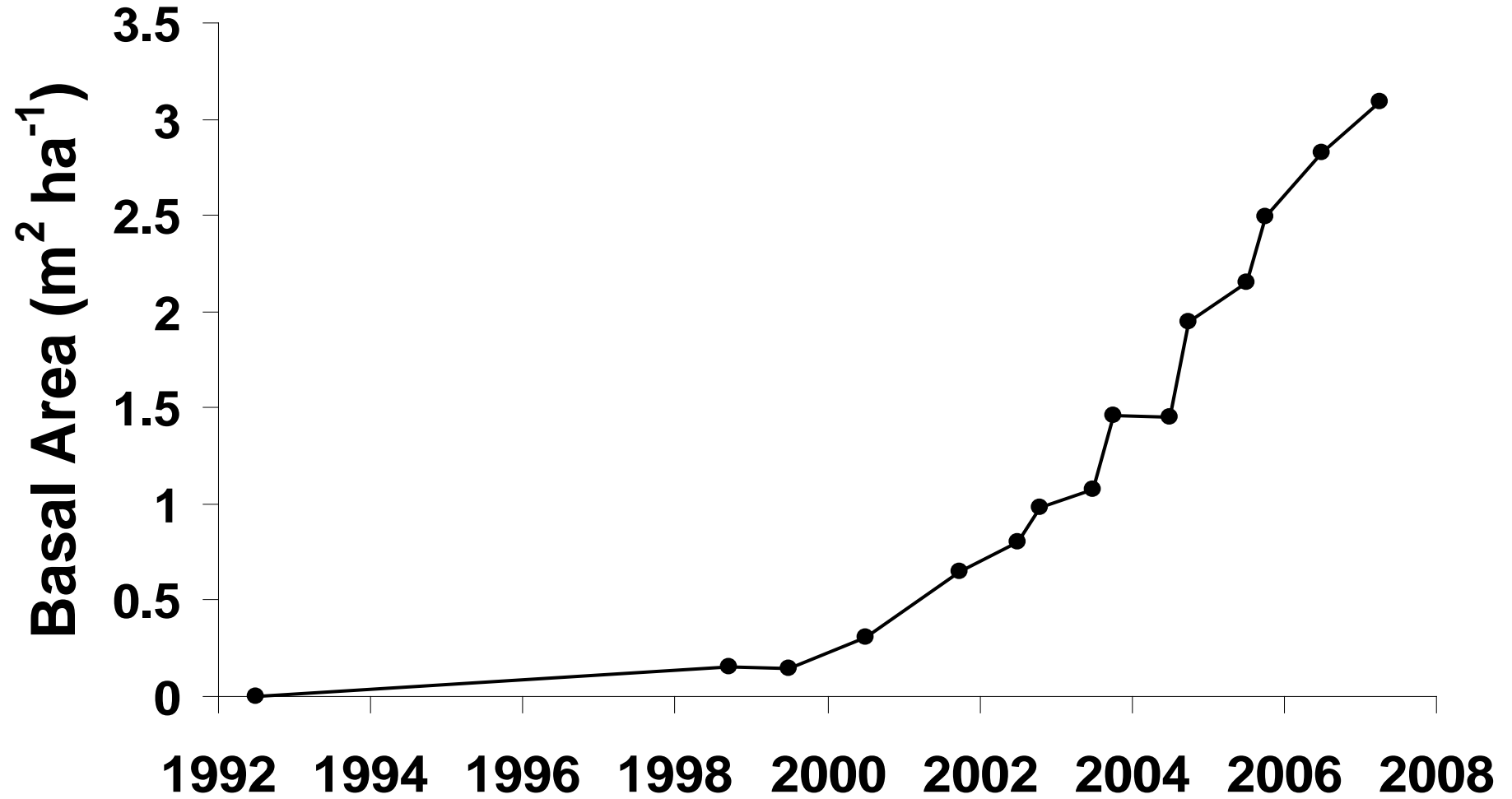


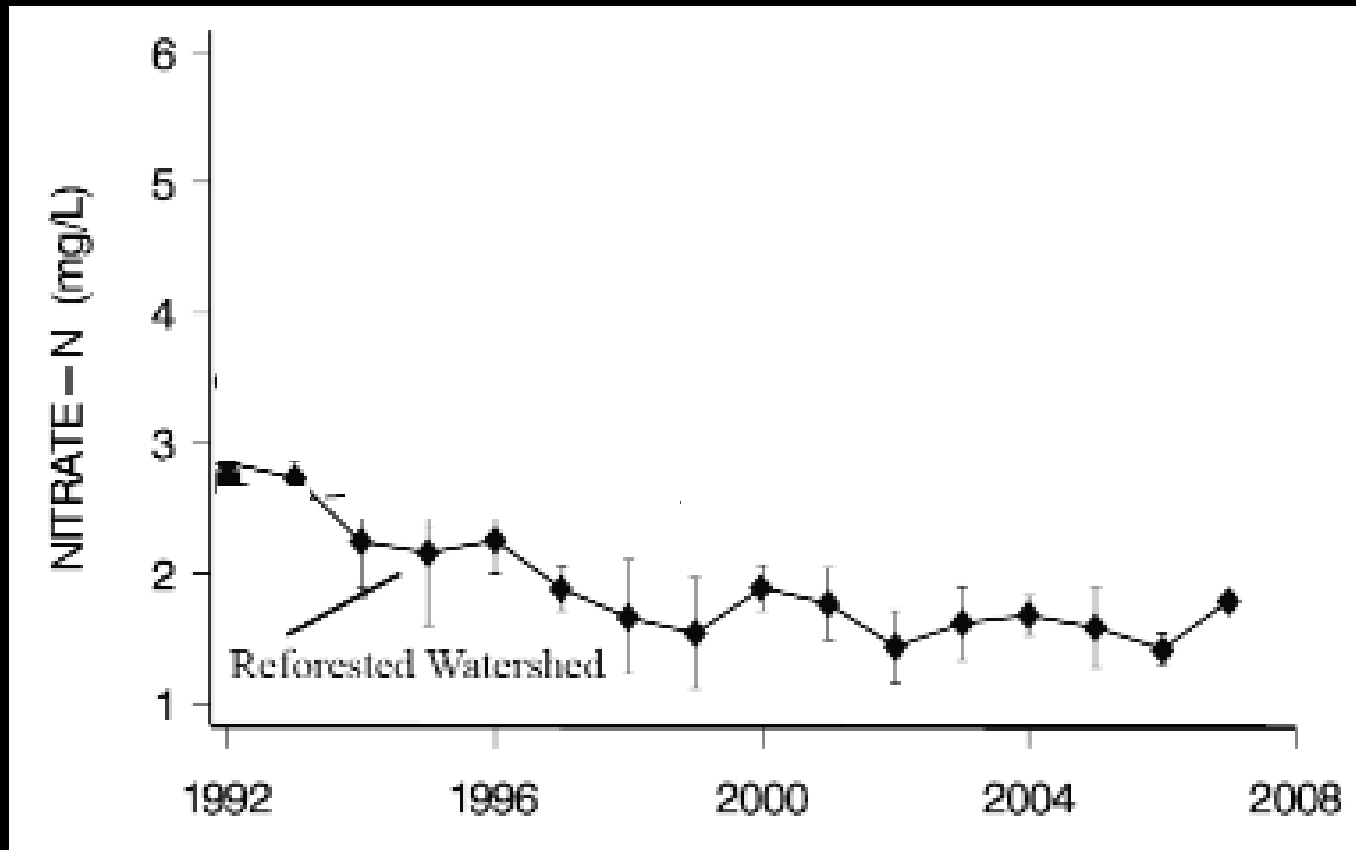


1992

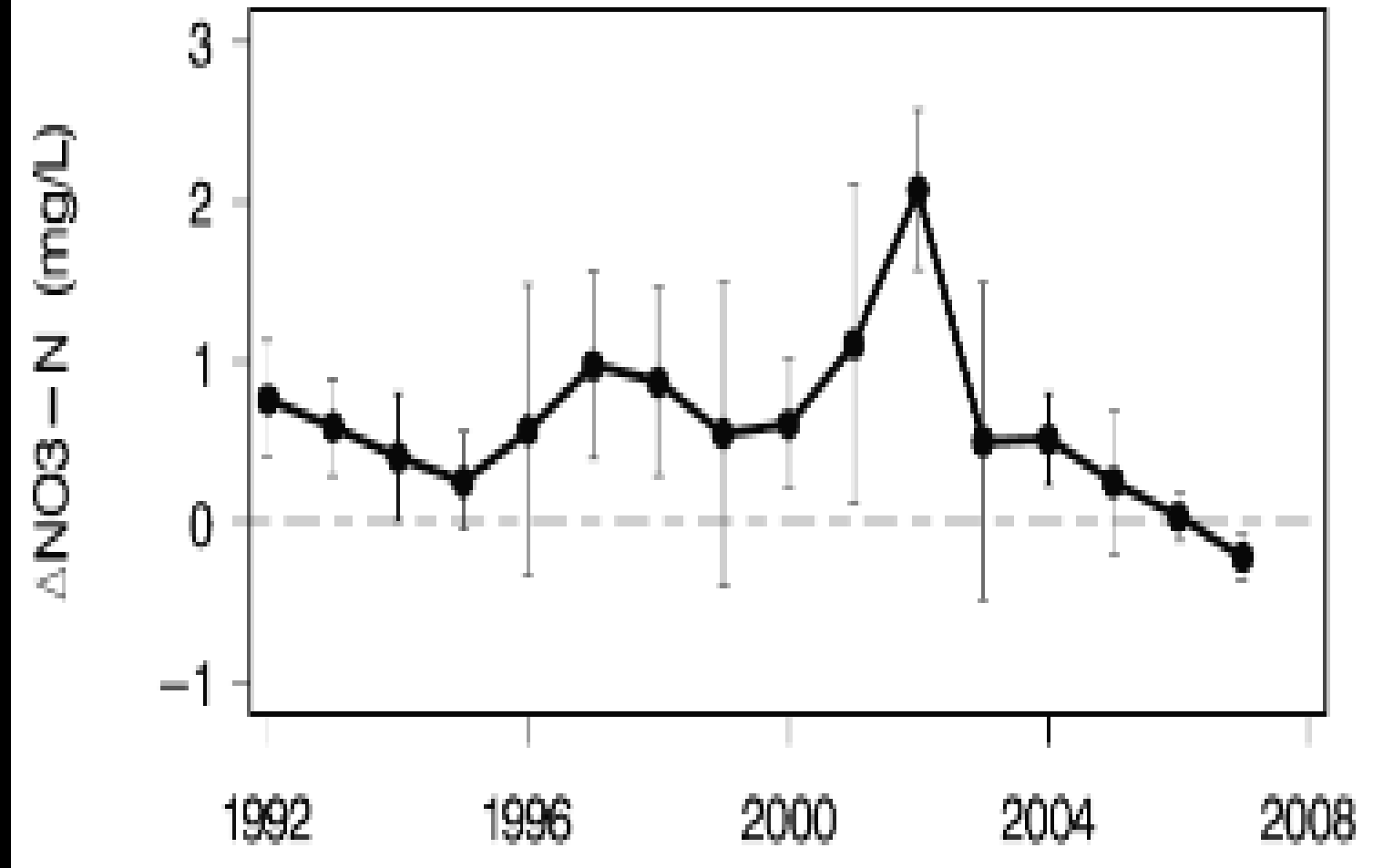


# Forest growth in buffer



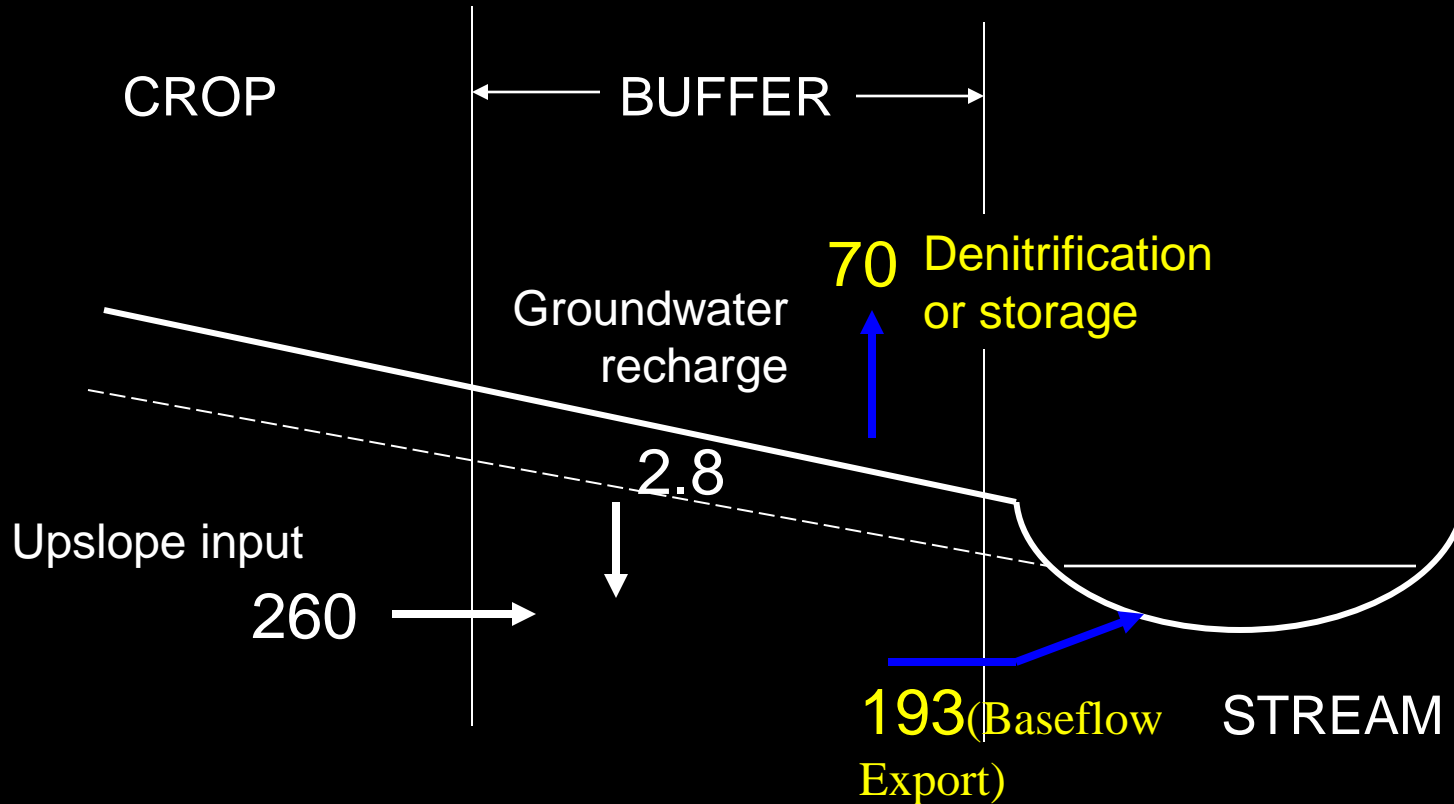


**Long slow decline in NO<sub>3</sub> levels with total reforestation**



**2-4 year lag in rainwater (& nitrate) exiting as storm flow**

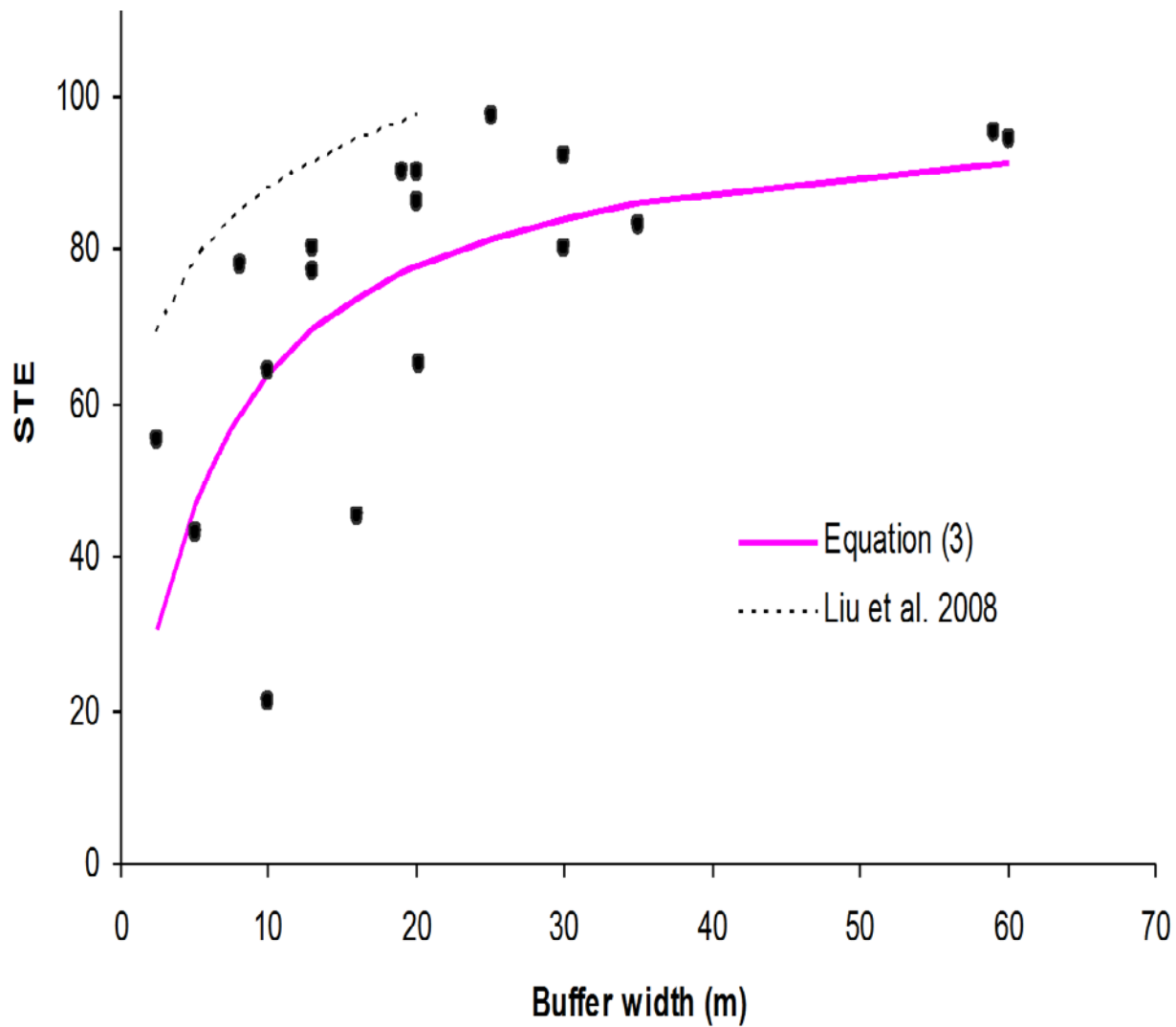
1998-2005



Average Removal Rate (kg/y):  $70/263 = 26\%$   $\text{NO}_3$   
= 43% Sediments

**What does the literature say  
about “Buffers as Barriers”?**

# Trapping efficiency 64% for 10m; 84% for 30m

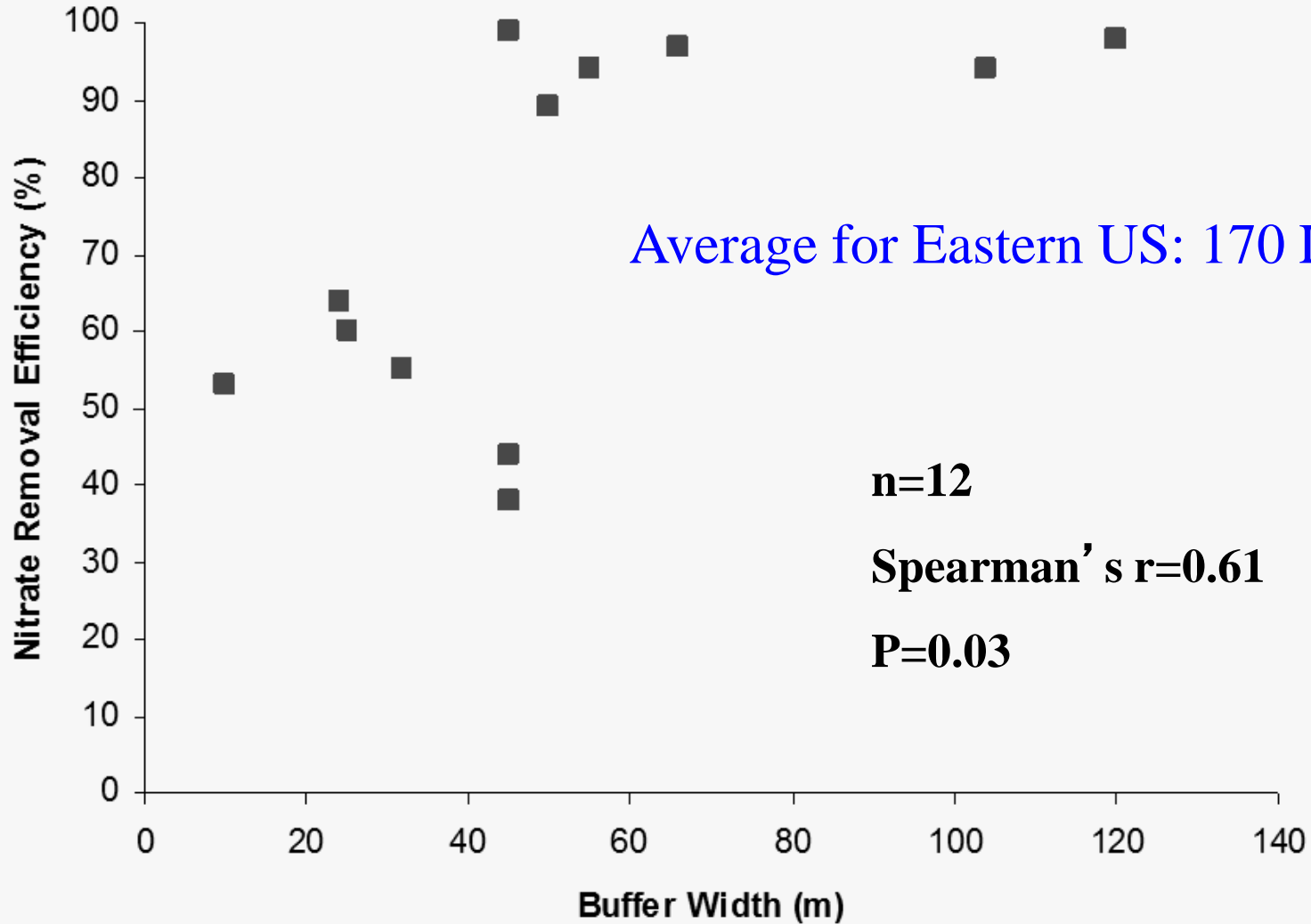


Buffer Width (m)

Sediment Trapping Efficiency

# Nitrate Removal efficiency

**>30 m to get >70% removal**



**Buffer Width (m)**

**What about the in-stream side of buffers?**



**Literature says:**

**Forest conditions  
along streams  
improve the health  
of the stream  
ecosystem....  
And it's ability to  
process stuff**



**Why?**

**More natural  
conditions.....**

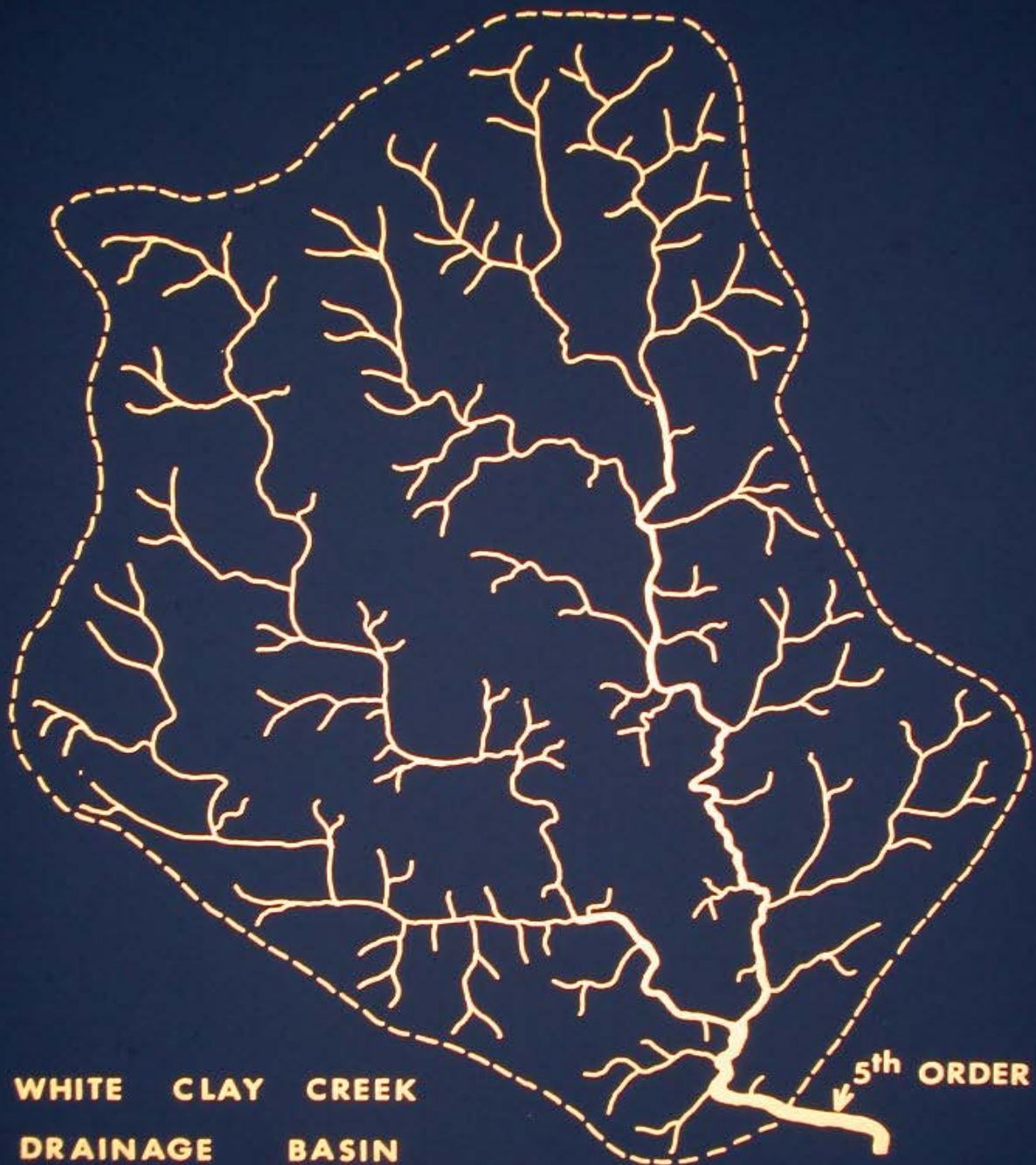
**Temperature  
Food  
Light**

**One important point..... forested streams are wider than deforested streams**



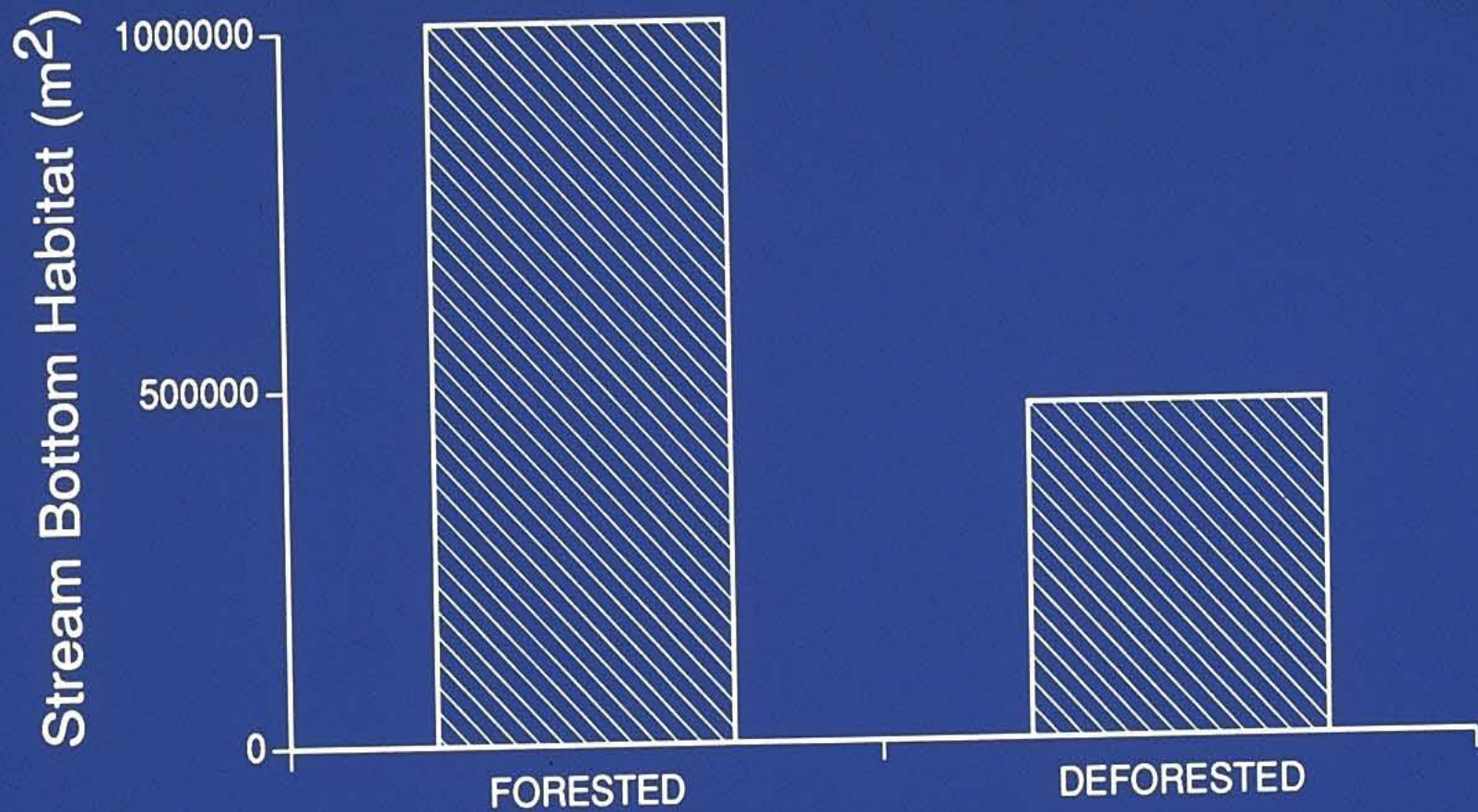
**Less bottom area per unit length of stream .....hence  
less ecosystem for processing stuff**





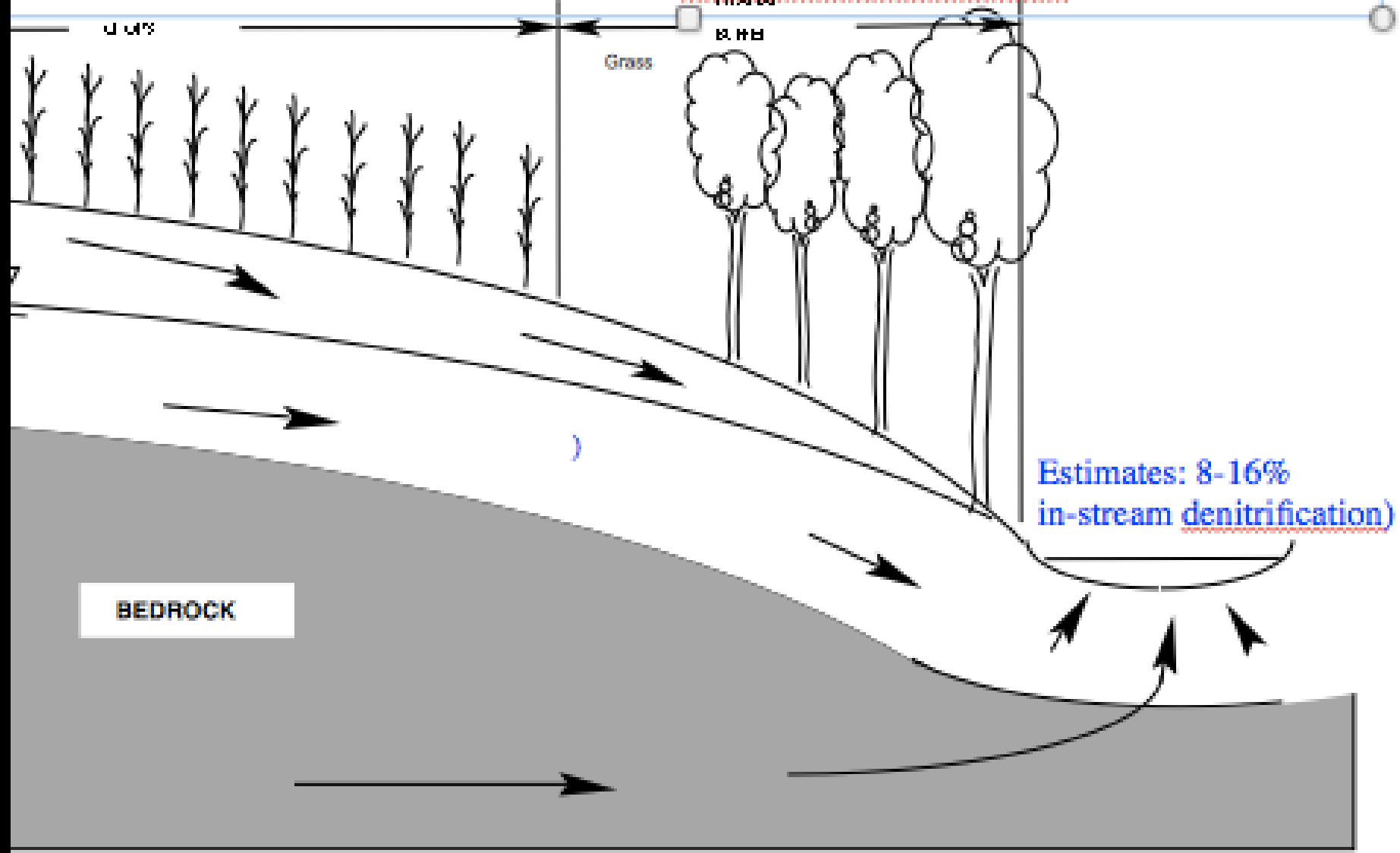
**WHITE CLAY CREEK  
DRAINAGE BASIN**

**5<sup>th</sup> ORDER**




WHITE CLAY CREEK (158 km<sup>2</sup> basin)

# We may be significantly underestimating in-stream removal of N via denitrification





**Every tree  
in the  
watershed  
counts and  
needs to be  
factored into  
the model**

A photograph of a house with a porch and a large tree trunk in the foreground. The text "...this person gets it!" is overlaid on the image.

...this person  
gets it!

# Our Mission

STROUD™ WATER  
RESEARCH CENTER



Photo: Marissa Morton

To advance knowledge and stewardship of fresh water through research and education