Hydrological Changes in a Stream: Effects on Plant Ecology

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Overview

2 Geologists from the REU Keck Summer Program extensively examined the site of an incising channel at the Eastern State Property in Williamsburg.

→This project is a partial examination of the biological consequences of what is geologically observed at the stream. This presentation follows their explanation of the site and a discussion of their findings.

See “Stream Incision” by Evan Christensen and Nora Matel

Background: Plants and Channel Incision

An **incised channel** behaves differently than a normal one:

- Fewer overbank flows
- Lowered water table
- Greater variation in water levels and availability
- Water recedes more quickly

Both of these changes can dramatically affect **plant growth**:

- Increased sapling survivorship
- Reduced frequency of scouring
- Water supply less readily available

The Project Concept

QUESTIONS:

•Are there significant changes in herbaceous plant growth among different parts of the stream?

•If found, do any of these differences correlate to data from the Geology students?

•What vegetative clues are there for how long incision has been occuring?

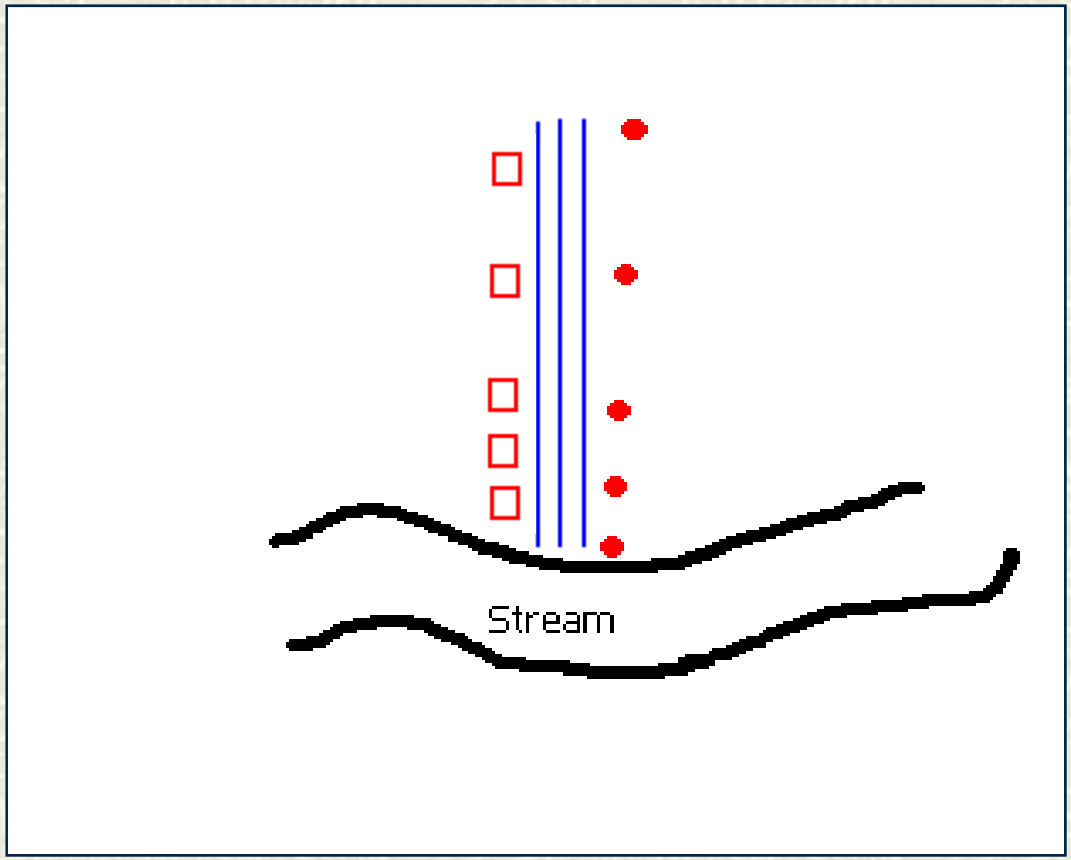
METHOD:

•Execute a systematic survey using quadrats to quantify visible changes

•Use information about specific species to find reasons for their growth patterns

Methodology

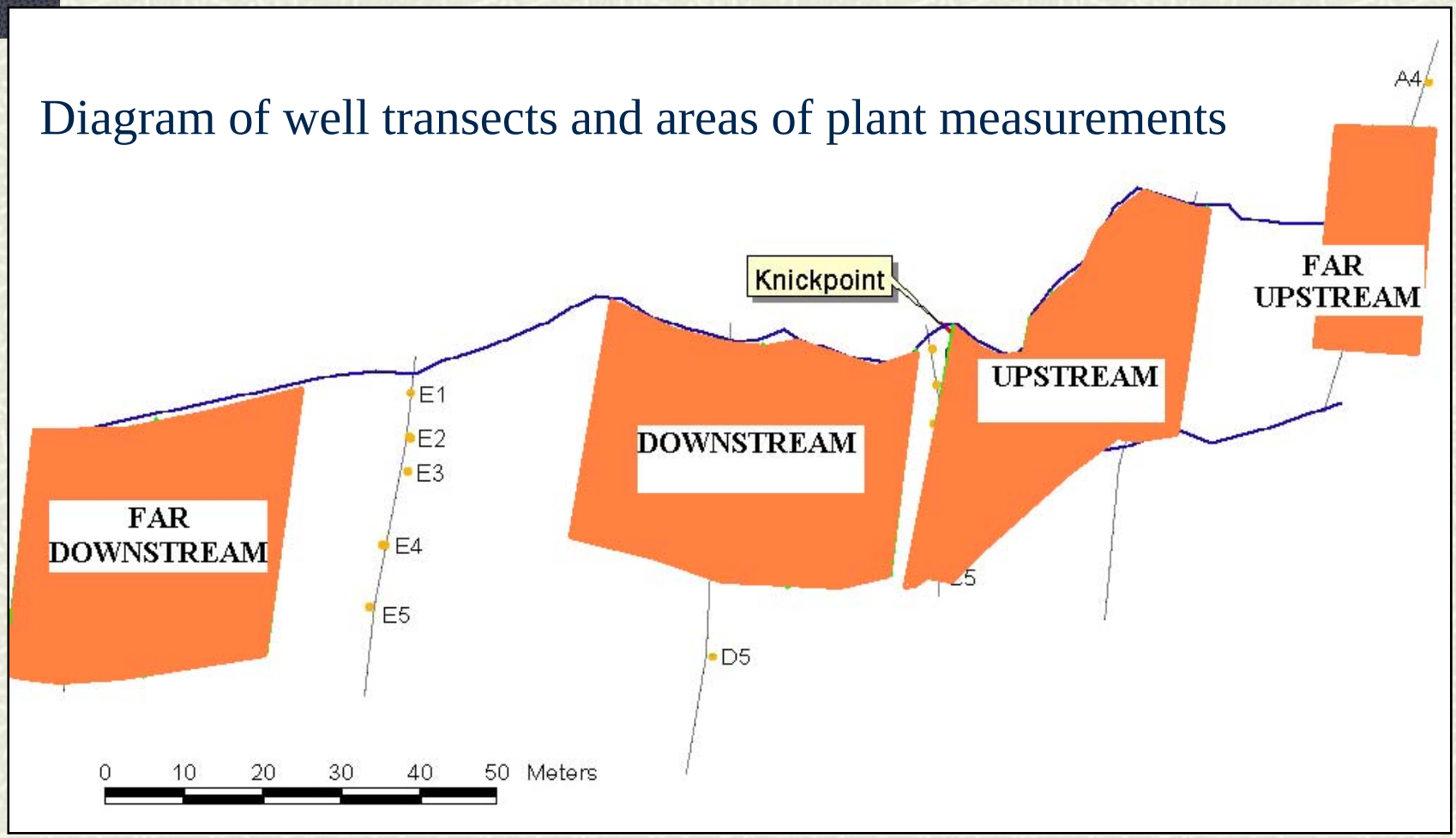
Along the stream, a compass was used to find a consistent line for the placement of quadrats



Each species gets a number which represents how much of the quadrat it covers.

Methodology, cont.

Examinations of plant diversity took place at 4 different parts of the stream



The Players: What is Being Counted

Japanese Stilt Grass

Golden Ragwort

Japanese Honeysuckle

Indian Strawberry

The Players: What is Being Counted

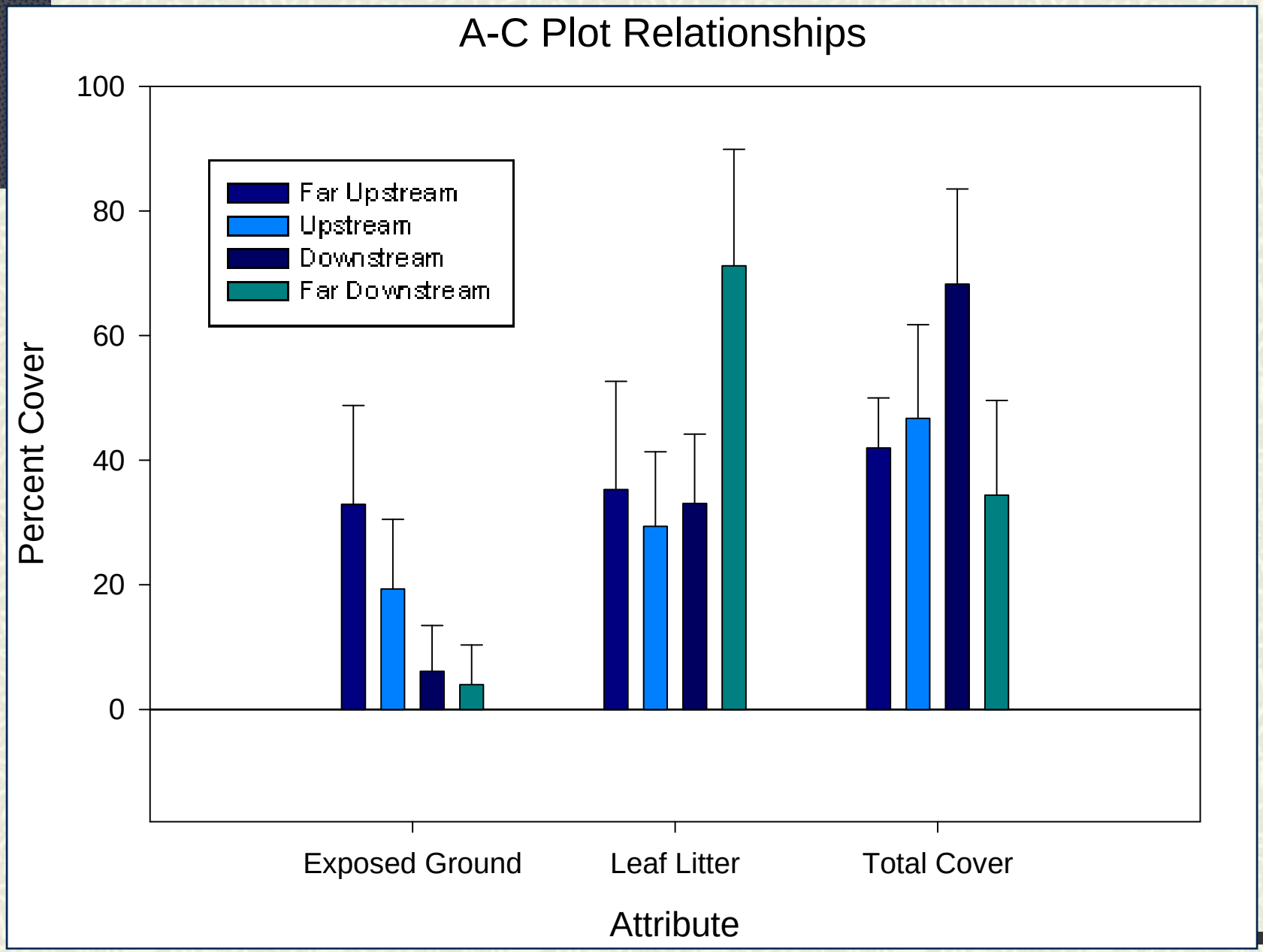
In addition to specific plant species, three other characters were measured:

- Total Herbaceous Cover
- Exposed Ground
- Leaf/Twig Litter

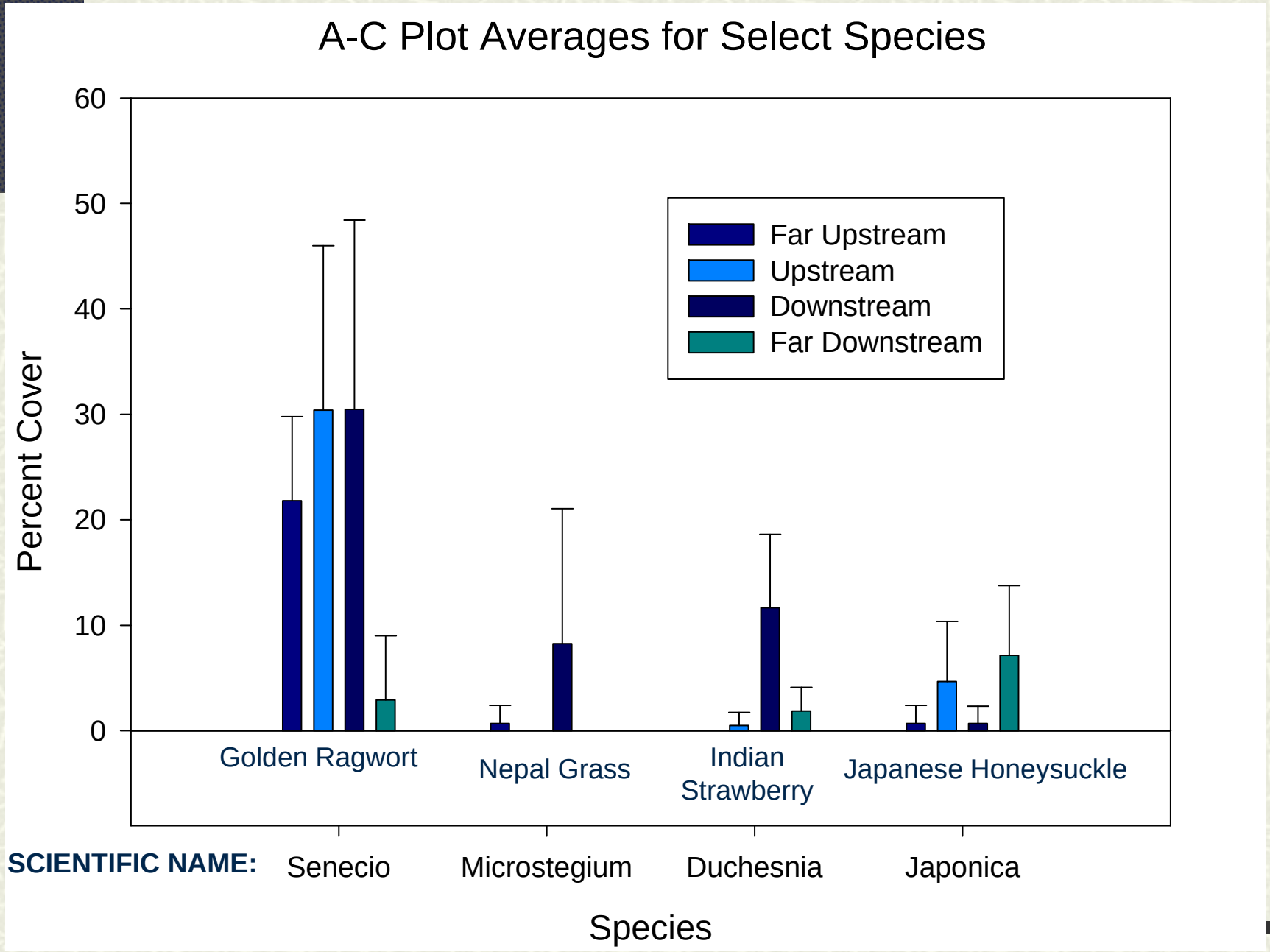
Each of these implicate the types of abiotic factors that plants in the area are encountering

Data Analysis of all this information was completed using Kruskal-Wallis and Mann-Whitney non-parametric tests to a 95% confidence limit

Data


A-C Plot Relationships
100
80
60
40
20
0
Percent Cover
Far Upstream
Upstream
Downstream
Far Downstream
Exposed Ground
Leaf Litter
Total Cover
Attribute

Data


A-C Plot Averages for Select Species
60
50
40
30
20
10
0
Percent Cover
Far Upstream
Upstream
Downstream
Far Downstream
Golden Ragwort
Nepal Grass
Indian Strawberry
Japanese Honeysuckle
SCIENTIFIC NAME:
Senecio
Microstegium
Duchesnia
Japonica
Species

The Picture Painted by the Results

UPSTREAM

GEOLOGY:

- Frequent flooding
- Slow recovery after storm
- Comparatively stable water table

VEGETATION:

- Hydrophytic and wetland indicator species dominate
- Large amounts of exposed ground

The Picture Painted by the Results

DOWNSTREAM

GEOLOGY:

- Less flooding
- Shorter hydroperiod
- Frequently changing, and frequently lower, water table

VEGETATION:

- Less overall herbaceous growth
- Dominant woody species (Paw paw)
- Little exposed ground, lots of litter

Conclusions

The results of this study demonstrate that there are **observable and significant changes in plant ecology** as a result of channel incision:

- Altered plant distribution
- Range of invasive species changed

This process of incision, and its consequences for plants, are a direct **result of increased storm water** runoff due to more impervious surface

Importance

- The environmental and naturalist community
- Developers/Planners- wetland services
- Citizens
- Animals: Salamanders

***Microstegium* patch**

Problems and Pitfalls

EXECUTION:

- Initially there were some problems with plant identification
- The area is now fairly high traffic and vegetation was frequently damaged. Sampling itself can harm the plants

ANALYSIS:

- Easy to find correlations, harder to draw causations
- Further study of non-herbaceous growth is advisable

Future Directions

Fall 2004:

←Survey of Paw paw growth downstream of knickpoint in order to determine average age

-Presentation of interdisciplinary project to Geological Society of America

Future:

-Examination of other biotic factors?

-Examination of woody plant ecology?

-How well is the stream recovering?

Thanks to Professors Stewart Ware, Randy Chambers, Greg Hancock, John Swaddle, researchers Evan Christensen, Nora Matel, Kristin Pederson, and Jen Toy, and Tim Russell, Tonya Insani, and the Keck Crew