The Benthic Macroinvertebrate Assemblage Related to Stream Conditions in Smith Creek, Harrisonburg, Virginia, Prior to Restoration

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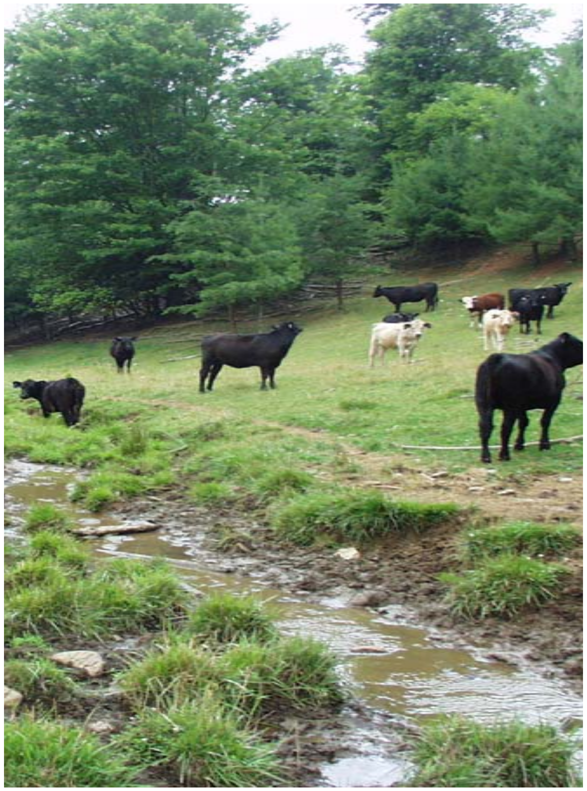
Stream Restoration

- Since 1990 government agencies have spent $7.5 billion
- Assumption that recovery of biological integrity will accompany stream restoration efforts
- When? How? If? Why or Why Not?
  - Poorly understood because comprehensive biological monitoring seldom accompanies restoration projects
- Estimated to be only 10% nationally and only 6% Chesapeake Bay projects

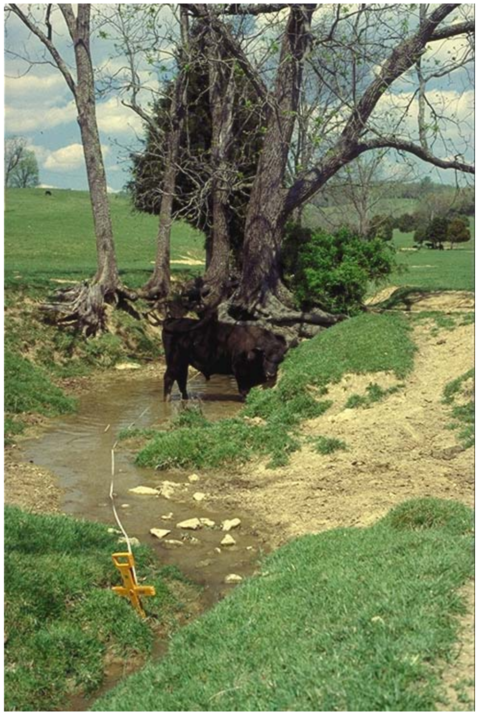
Agricultural Land Use - Cattle Grazing

- Primary Impacts on Streams
  - Erosion, sedimentation from loss of vegetation and trampling
  - Nutrients, organic loading from urine, feces



Erosion, Sedimentation

Nutrients, Organic Loading

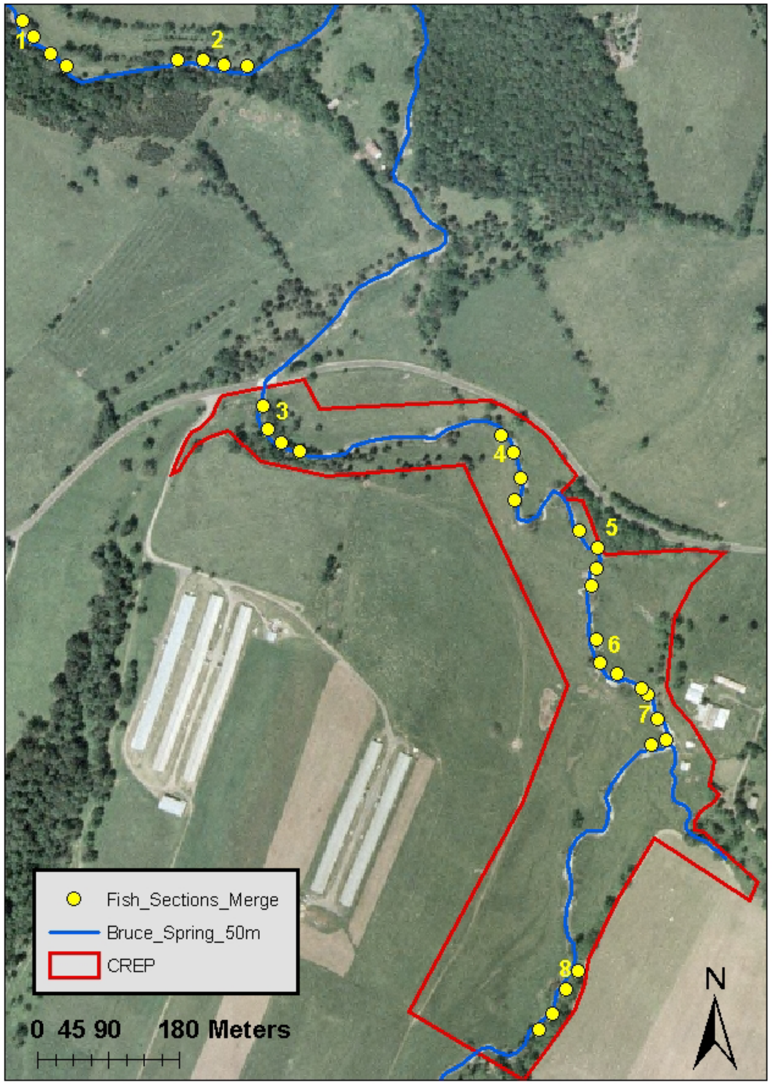


Smith Creek Restoration Project

- Team of scientists, primarily from James Madison University
  - Terrestrial botany
  - Terrestrial vertebrates
  - Fluvial geomorphology
  - Aquatic ecology
  - Fisheries
  - Microbiology
  - Water chemistry
  - Etc.
- Virginia Tech
  - Macroinvertebrates

Smith Creek Restoration Overview

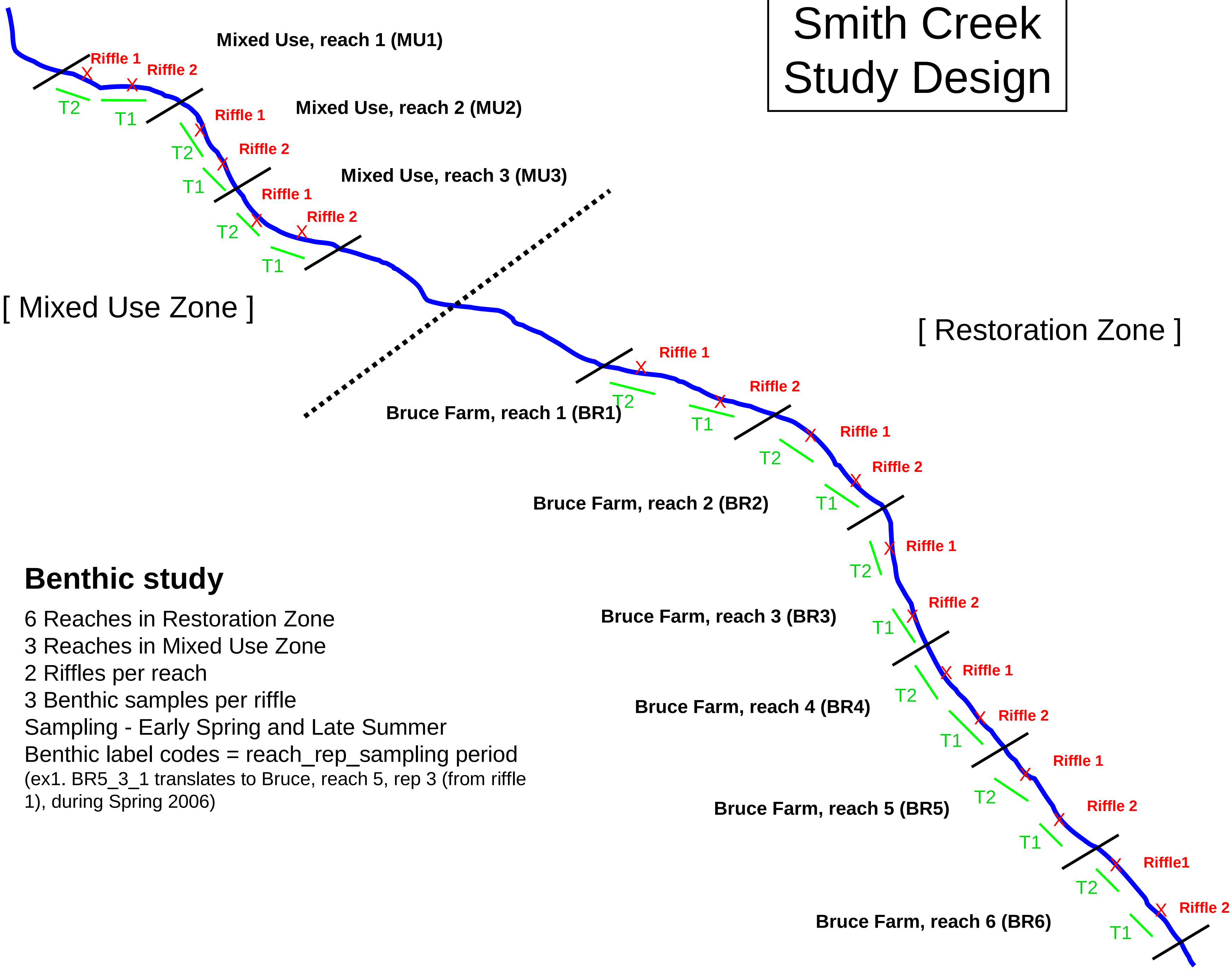
- Smith Creek - agricultural stream located in Harrisonburg, VA
- Restoration funded by CREP and other programs
- Bruce Farm
  - Cattle removed during winter 2006
  - Trees planted in spring 2006
  - Sampling began spring 2006



Purpose of Study

- Long-term: Follow recovery of biological integrity at all levels in relation to changing environmental conditions brought about by stream restoration
  - Answer questions: When? How? If? Why or Why Not?
- Short-term: Quantify biota and determinant environmental variables before restoration efforts (baseline)
  - Virginia Tech component: benthic macroinvertebrate assemblage (M.S. thesis)

Smith Creek Study Design



Benthic study

6 Reaches in Restoration Zone
3 Reaches in Mixed Use Zone
2 Riffles per reach
3 Benthic samples per riffle
Sampling - Early Spring and Late Summer
Benthic label codes = reach_rep_sampling period
(ex1. BR5_3_1 translates to Bruce, reach 5, rep 3 (from riffle 1), during Spring 2006)

Sampling Methods

- Modified Stovepipe Sampler
- Sampler inserted into stream substrate and contents removed
- Macroinvertebrates, organic matter, and substrate are collected and measured
- Facilitates quantitative measurements and associations of macroinvertebrates and their habitat and food

Lab Methods

- Macroinvertebrates identified (mostly genus) and counted

Independent variables

(environmental factors)

current, depth

% deciduous leaves, % wood

% pasture vegetation

Related to Sediment

D_{50}

Fredle index

Trask's sorting coefficient

%fines, %gravel

%pebble, %cobble

Related to Nutrients

epilithic biomass

epilithic chlorophyll *a*

FBOM

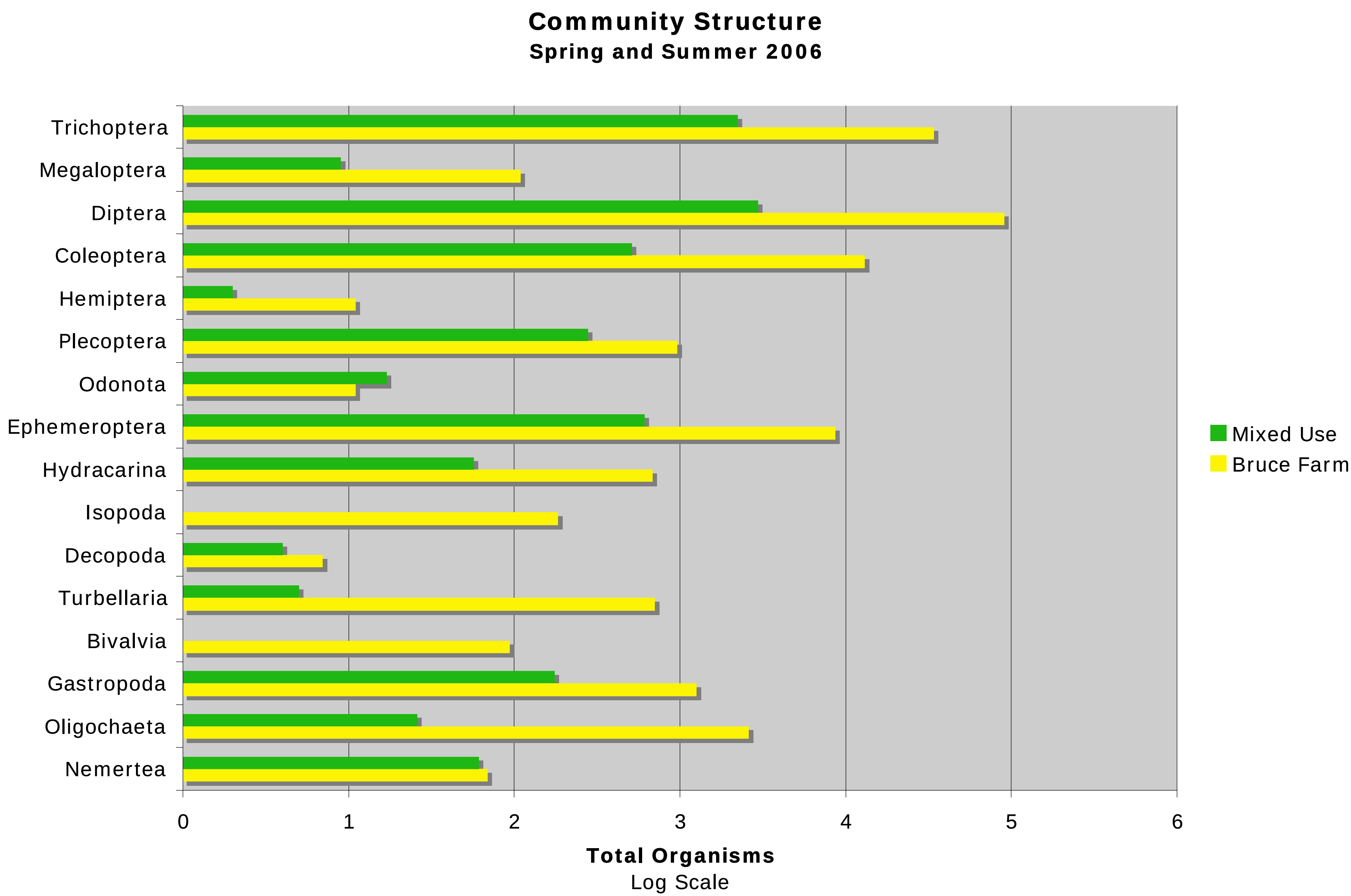
CBOM

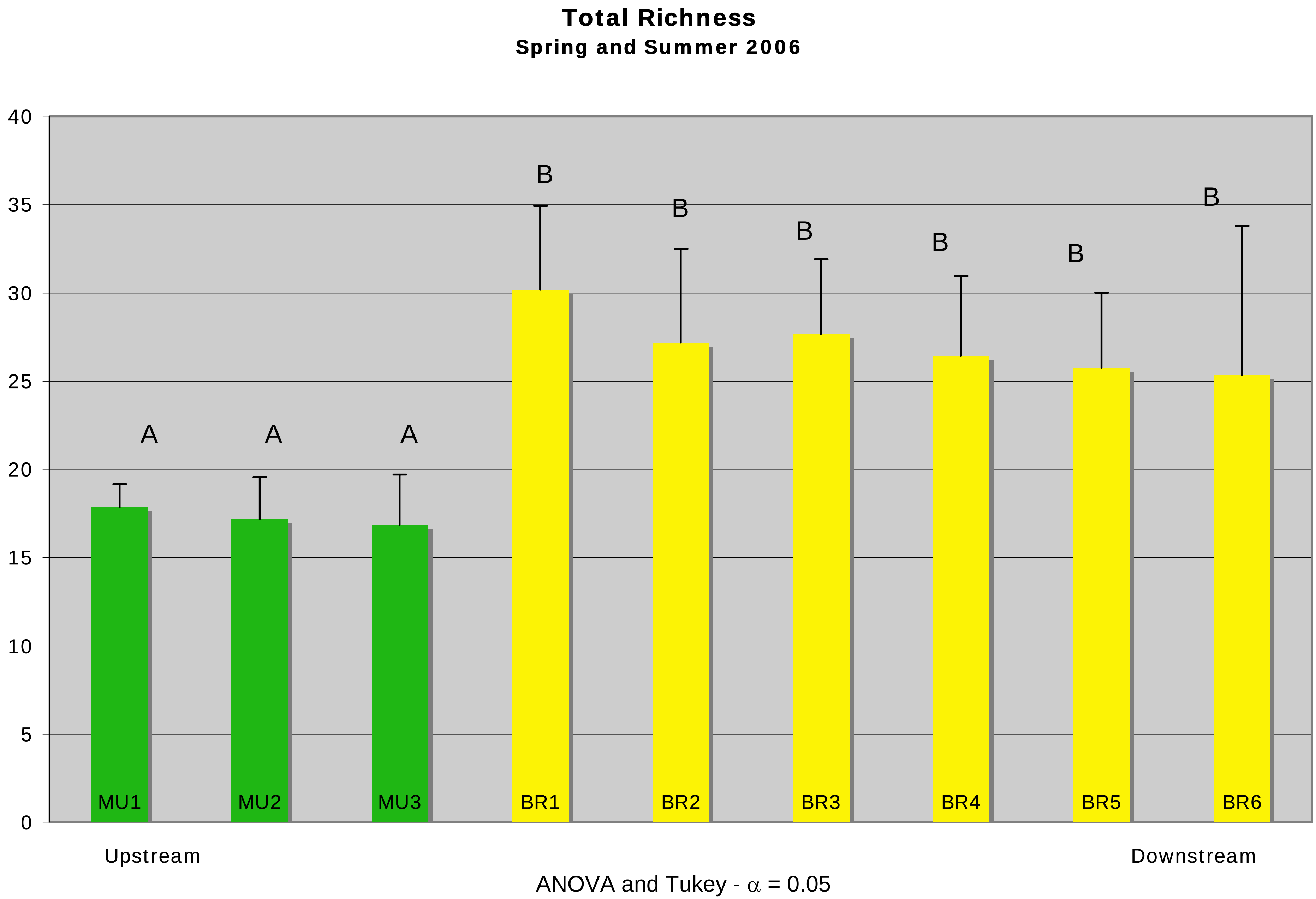
% moss

Dependent variables

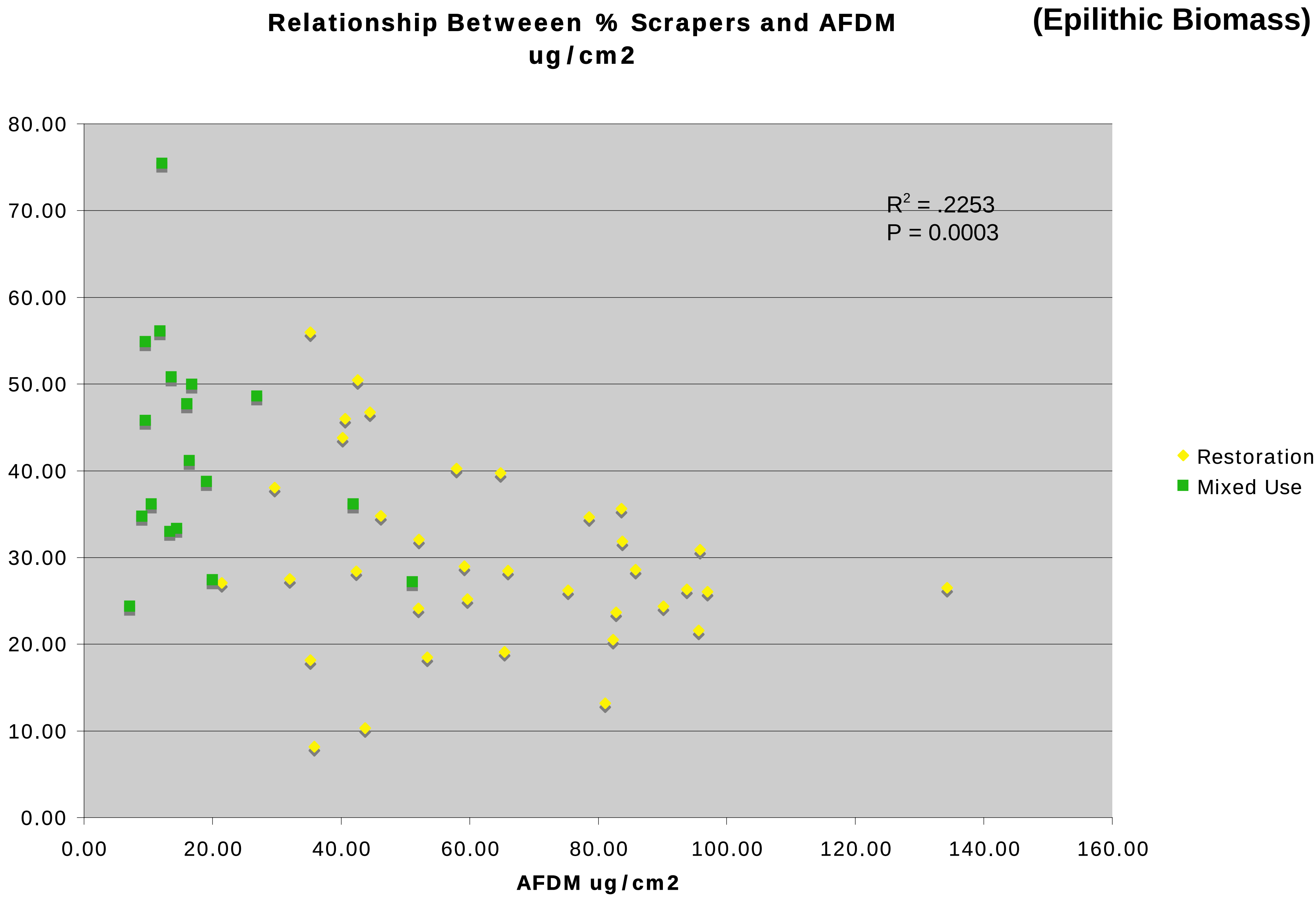
(macroinvertebrate assemblage)

10 assemblage metrics; 15 dominant taxa densities

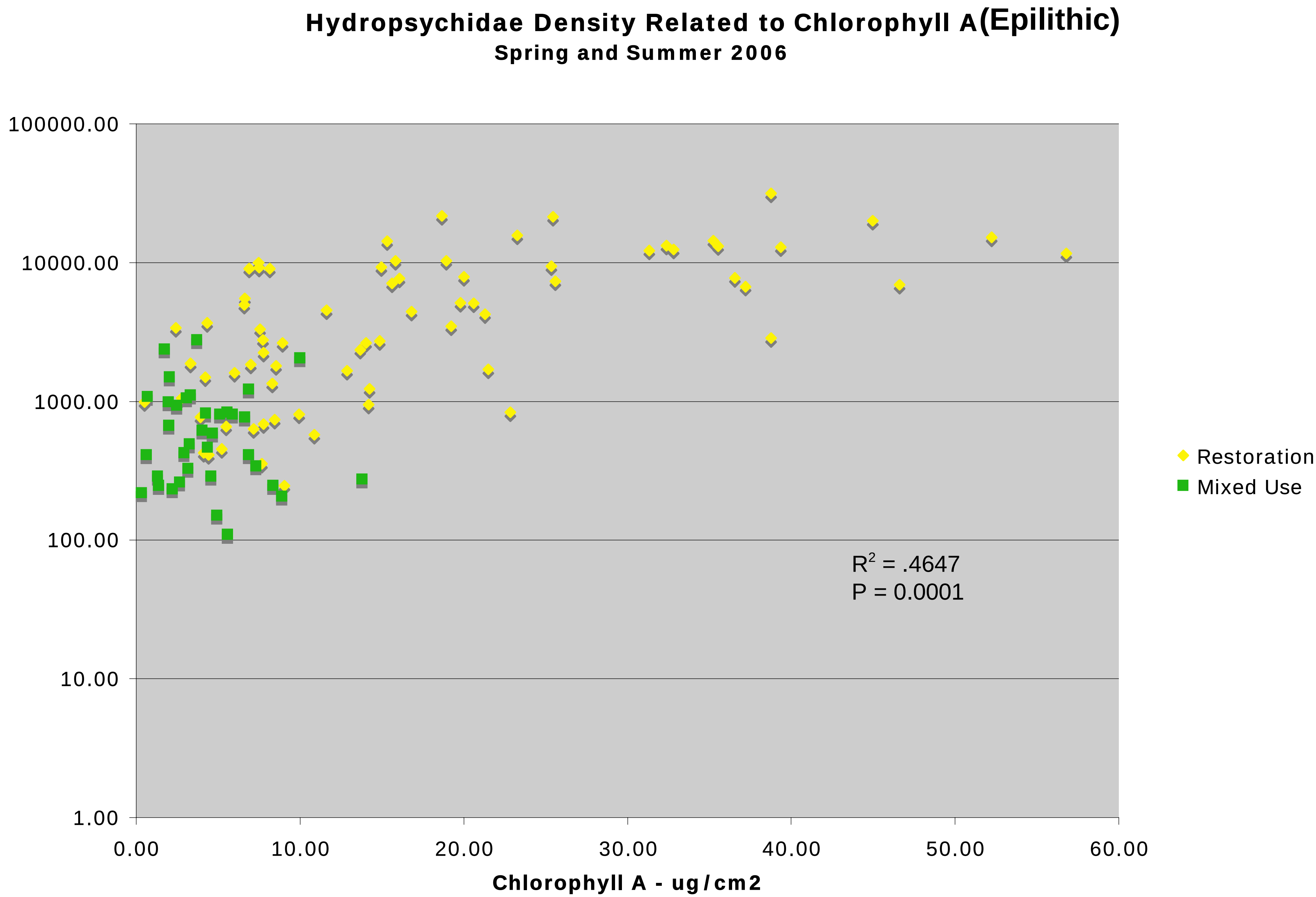

Community Structure
Spring and Summer 2006
Trichoptera
Megaloptera
Diptera
Coleoptera
Hemiptera
Plecoptera
Odonota
Ephemeroptera
Hydracarina
Isopoda
Decopoda
Turbellaria
Bivalvia
Gastropoda
Oligochaeta
Nemertea
0
1
2
3
4
5
6
Total Organisms
Log Scale
Mixed Use
Bruce Farm


Total Richness
Spring and Summer 2006
40
35
30
25
20
15
10
5
0
A
A
A
B
B
B
B
B
B
MU1
MU2
MU3
BR1
BR2
BR3
BR4
BR5
BR6
Upstream
Downstream
ANOVA and Tukey - α = 0.05

(Epilithic Biomass)



Relationship Between % Scrapers and Epilithic Biomass


Hydropsychidae Density Related to Chlorophyll A(Epilithic)
Spring and Summer 2006
100000.00
10000.00
1000.00
100.00
10.00
1.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
Chlorophyll A - ug/cm2
Restoration
Mixed Use
R^2 = .4647
P = 0.0001

Relationship between Hydropsychidae Density and Epilithic Chlorophyll a

Examples of Relationships Between Macroinvertebrates and Mineral Substrate

[Regression; $\alpha = 0.05$]

Macroinvertebrate Measure	Environmental Variable	P Value	R^2 Value
Density of *Psephenus herricki* (water pennies)	% Fines	0.9123	0.0002
Number of Clinger Taxa	% Cobble	0.1572	0.0381