

A Comparison Between Species Richness and Dominance of Macroinvertebrate Communities in Rural and Urban Streams in Northern, Vermont

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Introduction

- The Ephemeroptera, Plecoptera, and Trichoptera (EPT) orders of benthic macroinvertebrate communities are sensitive to pollution; therefore they are commonly used as a measure of stream health (Sponseller, 2001).
- Richness is a measure of the number of taxa within a given macroinvertebrate sample (Moore & Palmer, 2005).
- The dominance of a taxon is a measure of its contribution to the total number of individuals in a sample (Tolkkinen, 2013).
- It is widely accepted that urbanization of land leads to an increase in impervious surface, an increase in the amount of nutrients found in nearby streams, and therefore an increase in the number of pollution-tolerant macroinvertebrate species (Moore & Palmer, 2005).
- A note about urban streams: In Vermont, researchers will be hard-pressed to find true "urban" streams; other ecologists would categorize these streams as "suburban" (Johnson, *et al.*, 2013).
- Unlike their "urban" counterparts, truly forested streams are very common in Vermont. In fact, the GIS data for one of our forested sites suggests that it is within a 100% forested catchment.
- Some studies suggest that an increase in nutrient levels correlates to an increase in the dominance of the macroinvertebrate communities within a given stream (Tolkkinen, 2013).
- Similar studies have been previously undertaken, though the majority of these studies were focused on agricultural and authentically urban catchments (Moore & Palmer, 2005).
- We hypothesize that EPT richness will be greater in forested streams than in urban catchments. Also that sample dominance will be greater in urban streams than in forested catchments.

The Ephemeroptera, Plecoptera, and Trichoptera orders of benthic macroinvertebrate communities are sensitive to pollution; therefore they are commonly used as a measure of stream health. The dominance in a given sample is a good measure of the evenness of a community. Using Vermont Department of Environmental Conservation protocols for benthic macroinvertebrate sampling, specimens were collected from a gradient of both urban and forested land use catchments and identified to the lowest possible taxonomic level. This study found a strong correlation between the presence of pollution-sensitive species and forested land usage. Our hypothesis that the dominance of macroinvertebrate communities in urban sites would be higher (due to higher nutrient levels) than in their forested counterparts was supported.



Abstract



Figure 2.
The Response of EPT Richness to Percent Urban Land Use.
 $R^2 = 0.00003$

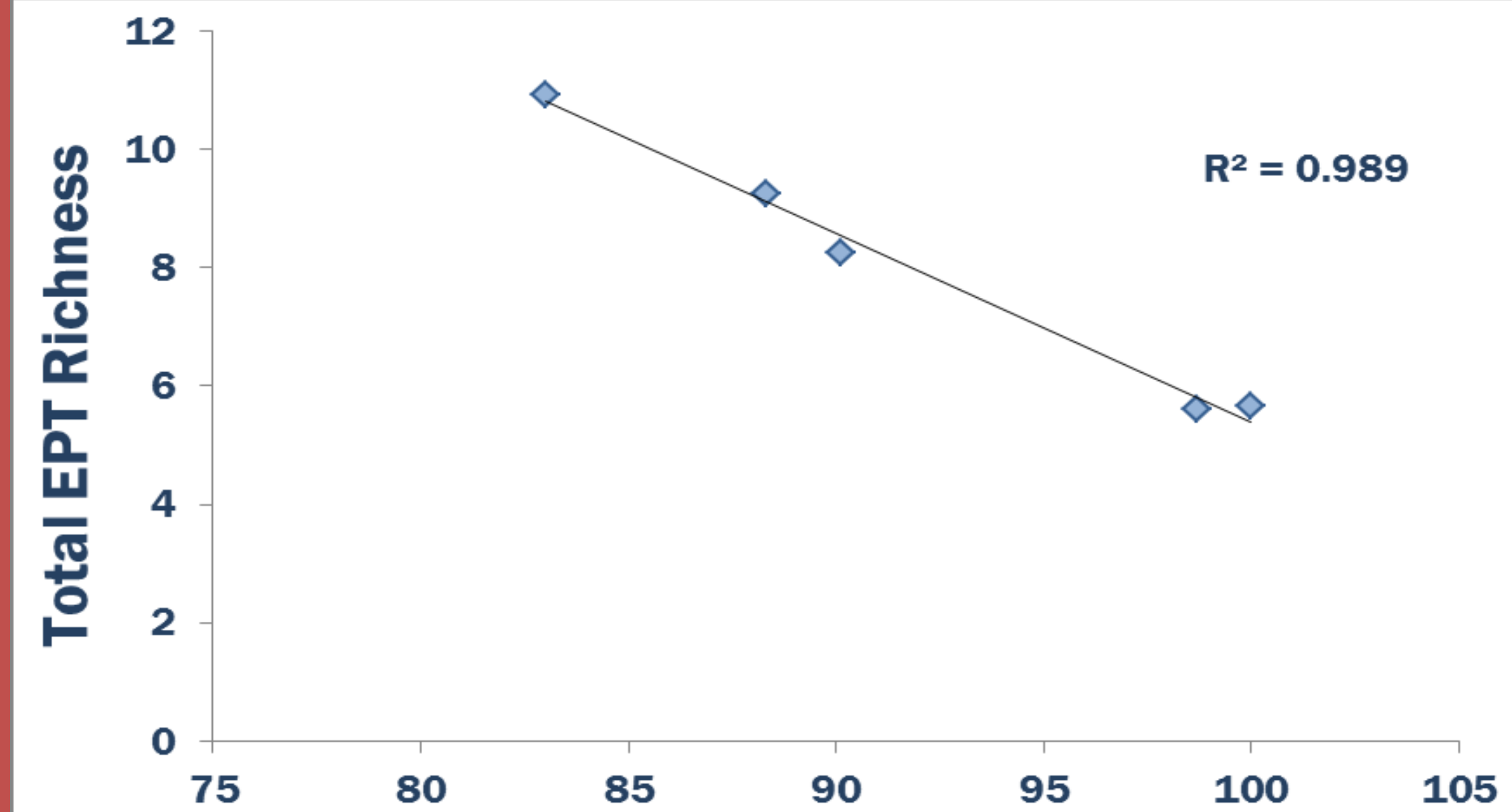


Figure 1.
The Response of EPT Richness to Percent Forested Land Use.

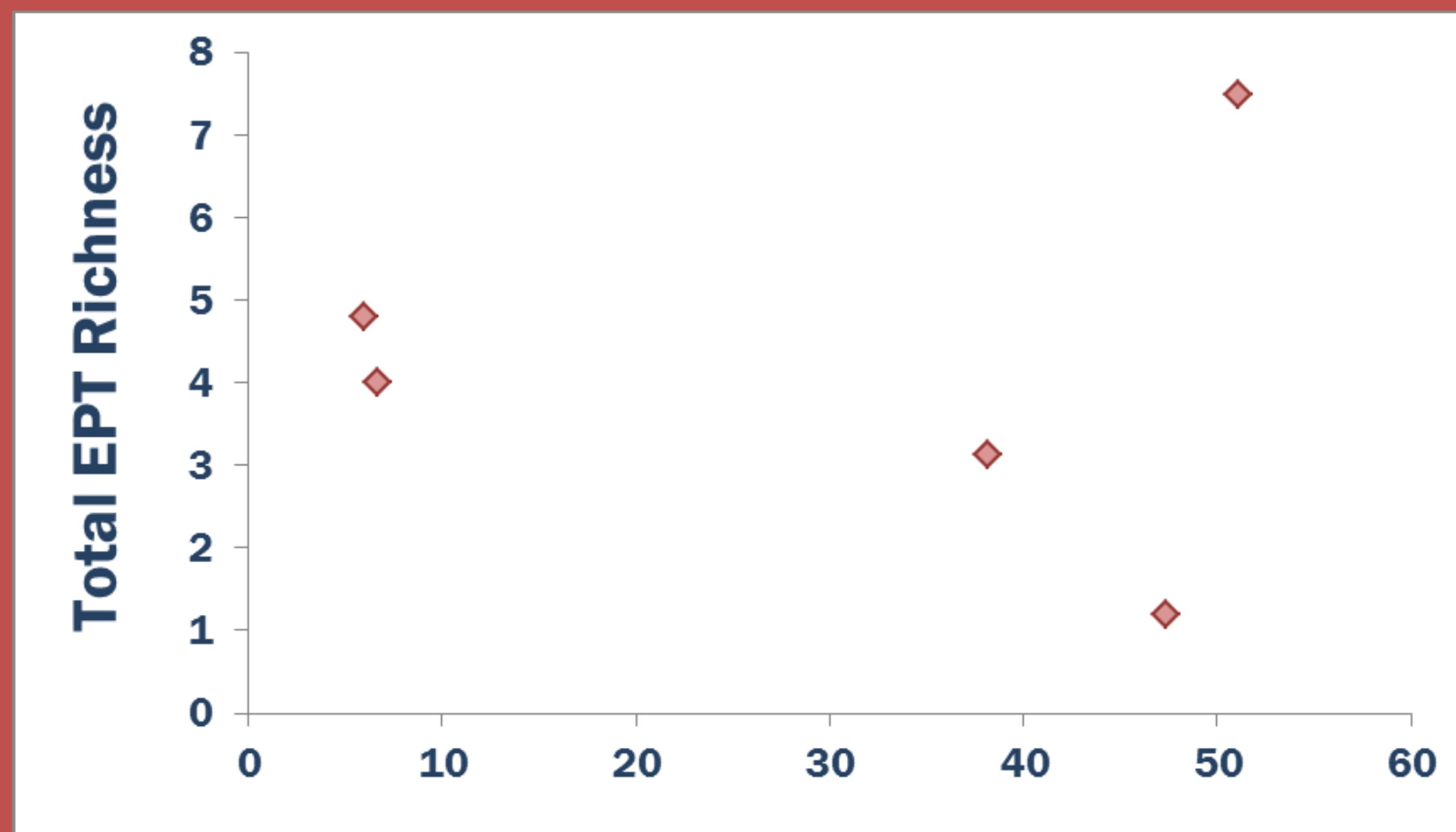
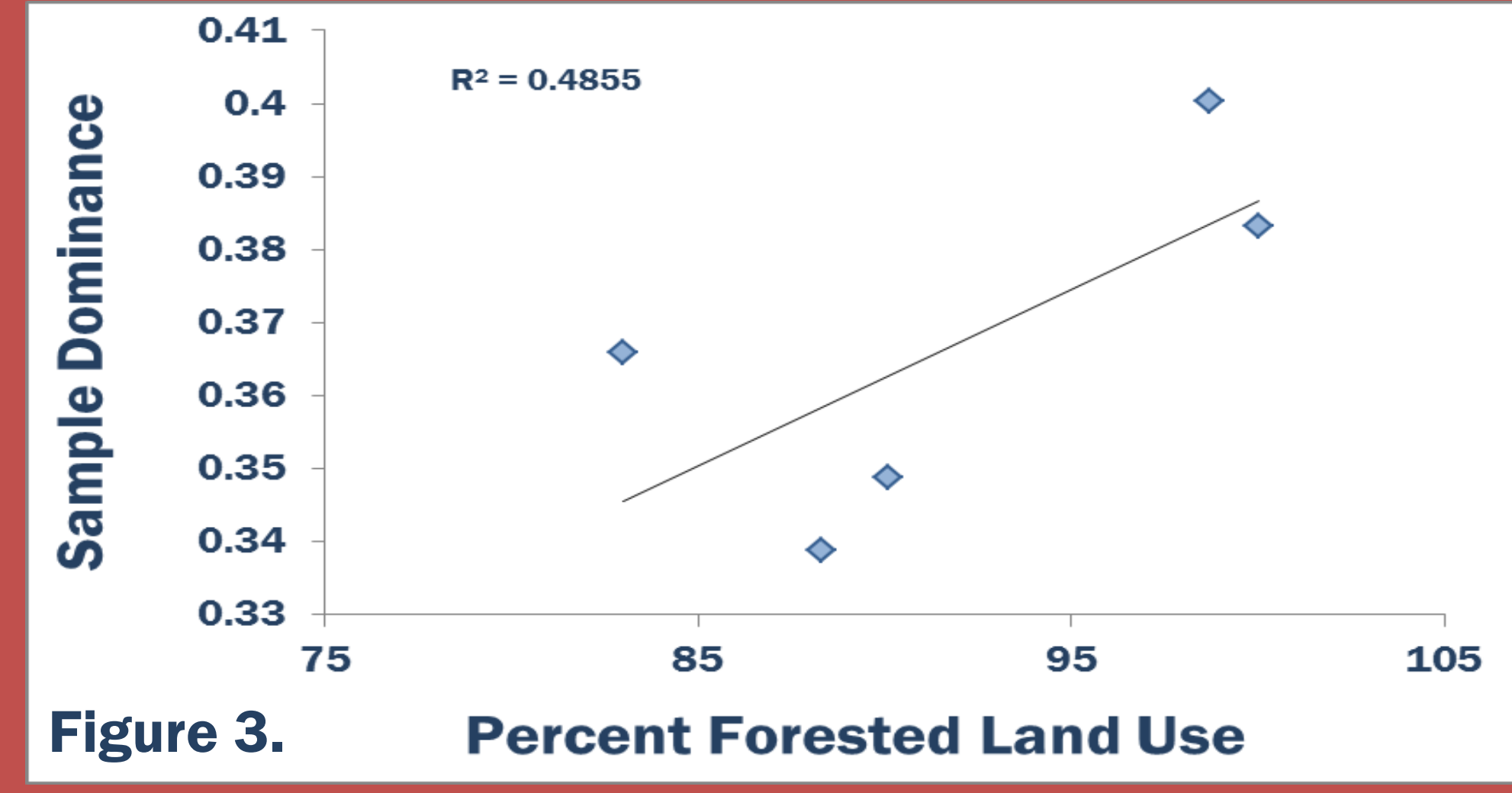


Figure 2.
The Response of EPT Richness to Percent Urban Land Use.

Results

Figure 3.
The Response of Dominance to Percent Forested Land Use.

Figure 4.
The Response of Dominance to Percent Urban Land Use.
 $R^2 = 0.0064$



Materials & Methods

- GIS data from the EPSCoR online database was used to determine dominant land use types of catchments to be sampled (see table below).
- Using 500µm rectangular kick sampling nets, macroinvertebrate samples were taken from streams via manual disturbance of the streambed and larger substrate within a square meter.
- Macroinvertebrates were preserved in 100% (nominal ~70%) ethanol.
- Preserved samples were rinsed through a US Standard #35 sieve to drain the ethanol.
- Samples were then picked in plastic trays under 2X magnification.
- Using dissecting microscopes, macroinvertebrates were identified down to lowest practical taxonomic level.
- EPT richness and dominance were then calculated (per site).
- These metrics were scatter-plotted in response to land use data over a gradient of forested and urban catchments.

2015 Sites Used in Analysis

'Urban' Sites	Forested Sites
Englesby Brook	Missisquoi River @ North Troy
Munroe Brook*	Mad River
Centennial Brook	Mill Brook (site 1)
Potash Brook	Mill Brook (site 2)
Allen Brook*	Snipe Island Brook

Conclusions & Future Studies

- As expected, there was a strong correlation between the percent of forested land use and the sensitive EPT richness metric (Figure 1).
- Forested land usages nearing the 100% mark appear to have lower total EPT richness than catchments with 80% forested land use. Evidence does show that mild to moderate disturbance to environments (Johnson, *et al.*, 2013) can actually have positive impacts on communities.
- There was a strong negative correlation between percent urban land use and EPT richness metric (Figure 2). This was expected as there is a negative linear relationship between richness and impervious surfaces in streams (Moore & Palmer, 2005).
- In addition we found that sample dominance was higher in urban vs rural stream, this supported our hypothesis and is supported by research done previously that established that higher nutrient levels will favor more competitive species as resource break down faster in higher nutrient streams (Tolkkinen, 2013).
- In other studies streams have been selected based on similarities between each other (Johnson, *et al.*, 2013). Our sites were not chosen this way and there was a great deal of variability between streams which may explain some variables in the data.

In Future Studies, we would consider running the same analysis with these metrics but incorporate agricultural sites into the analyses. We would also consider adding a broader range of land use percentages to the study. Additionally, we think sampling during different times of the year and incorporating historic land use data may yield interesting results.

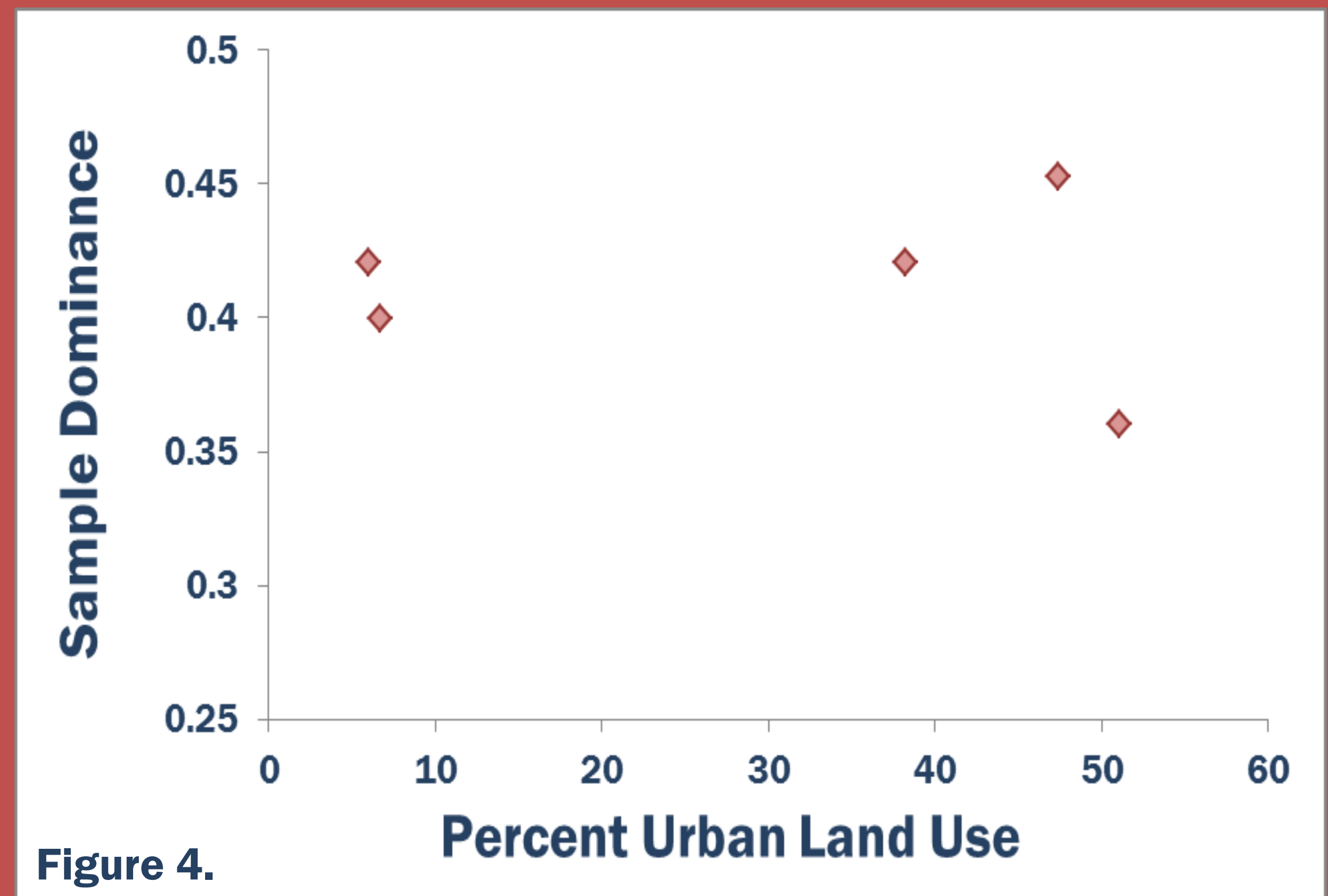


Figure 4.
The Response of Dominance to Percent Urban Land Use.



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