Land use and experimental sedimentation: mixed impact on macroinvertebrate assemblages in low-order streams

Samouel Beguin
Middlebury College

Declan McCabe
St. Michael's College

Introduction

■ Fine sediment deposition (sedimentation) is a stressor in aquatic ecosystems
(Larsen et al. 2011)

■ Sediment loading can depend on land use and surrounding terrestrial habitat type
(Longing et al. 2010)

■ We were interested in the effects of two factors, **land use** and **sedimentation,** on benthic macroinvertebrate assemblages

■ Will macroinvertebrate communities respond differently to sedimentation depending on dominant land use?

Methods - Sites & Setup

- Six low-order streams from three Vermont watersheds were selected based on dominant catchment area land use data (Streams Database 2011)

- These included three largely forested sites and three largely urban sites

- Sixteen plastic salad containers (1L) were installed in the streambed at each site and natural substrate was used to half-fill each container

- Fine sediment (0.5 kg of playground sand) was added to half of the containers, with another 0.5 kg added to the same containers one week later (press)

Methods - Sampling & Analysis

▪ After 15 days, samples were collected from containers, processed and identified to genus (Barbour et al. 1999)

▪ Response variables: community composition metrics and rarefaction (expected species richness)

▪ Data Analysis: One-way & Two-way (Factorial) ANOVA, generation of rarefaction curves with their confidence intervals (Gotelli and Entsminger 2012)
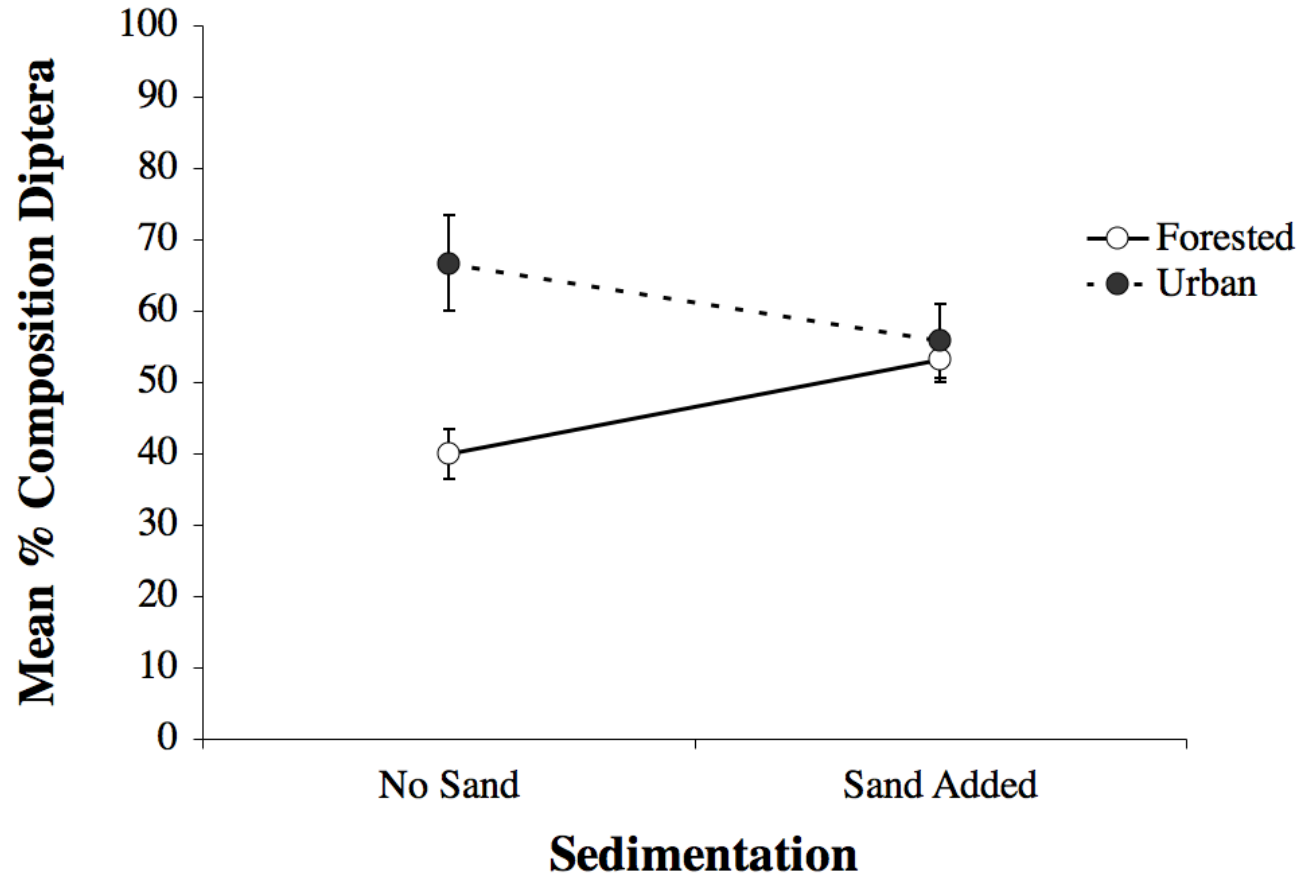
Results - Land Use
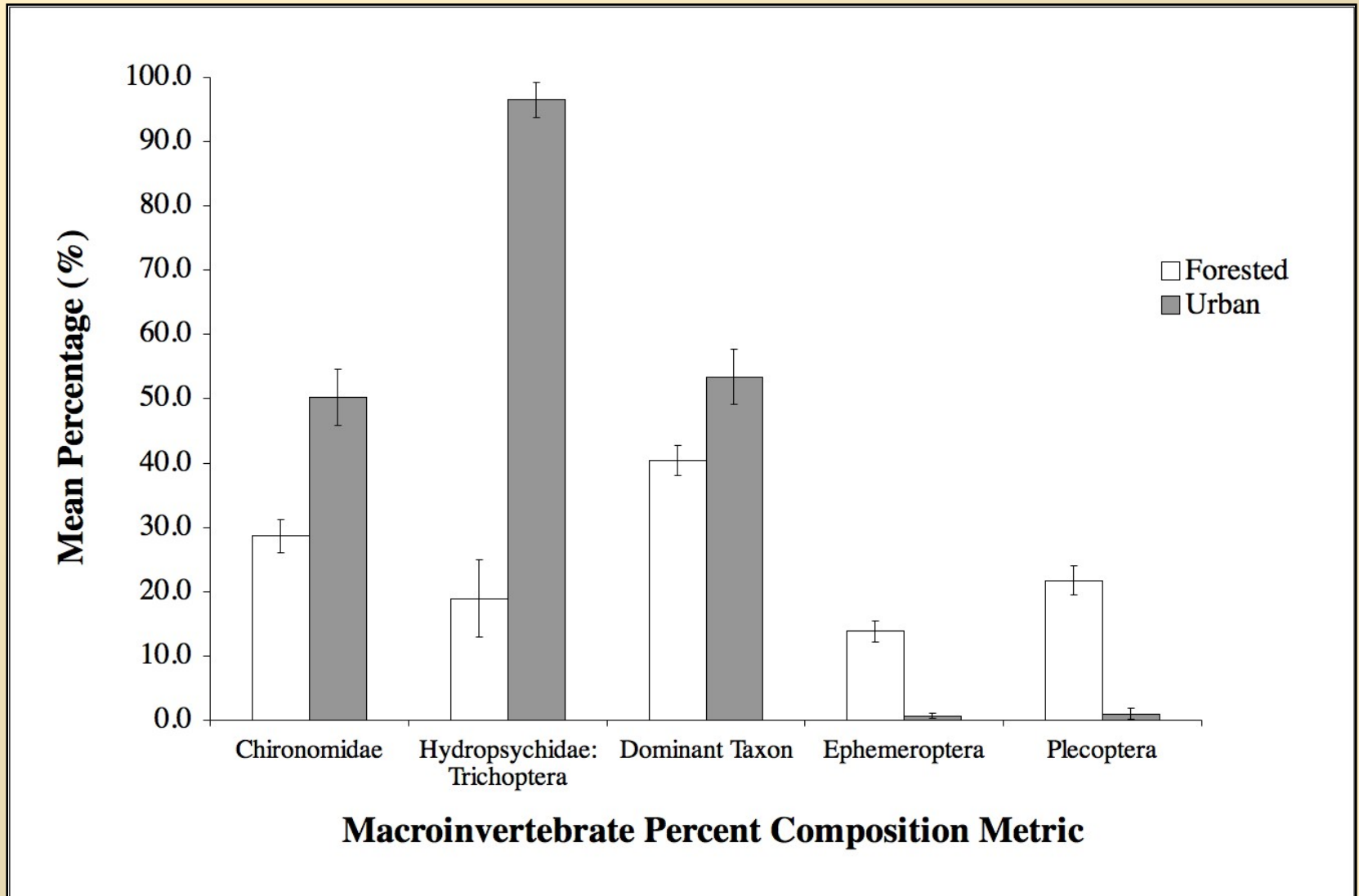
For all metrics: One-way ANOVA, $p < 0.003$, n = 74
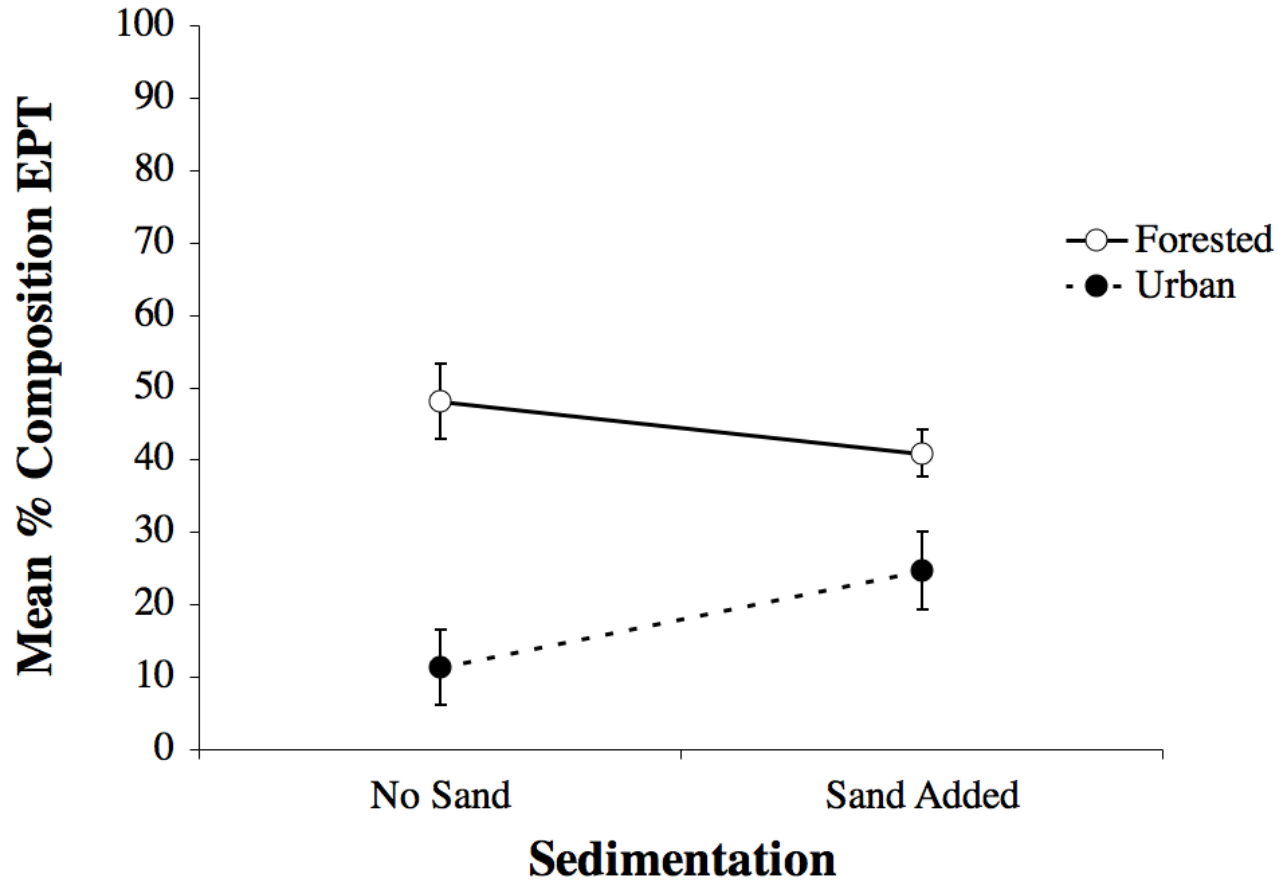
Error bars represent ± one SEM

Results - Diptera

Example Taxa

- Two-way ANOVA: p = 0.038 (indicating an interaction)
- Error bars represent ± one SEM, n = 74
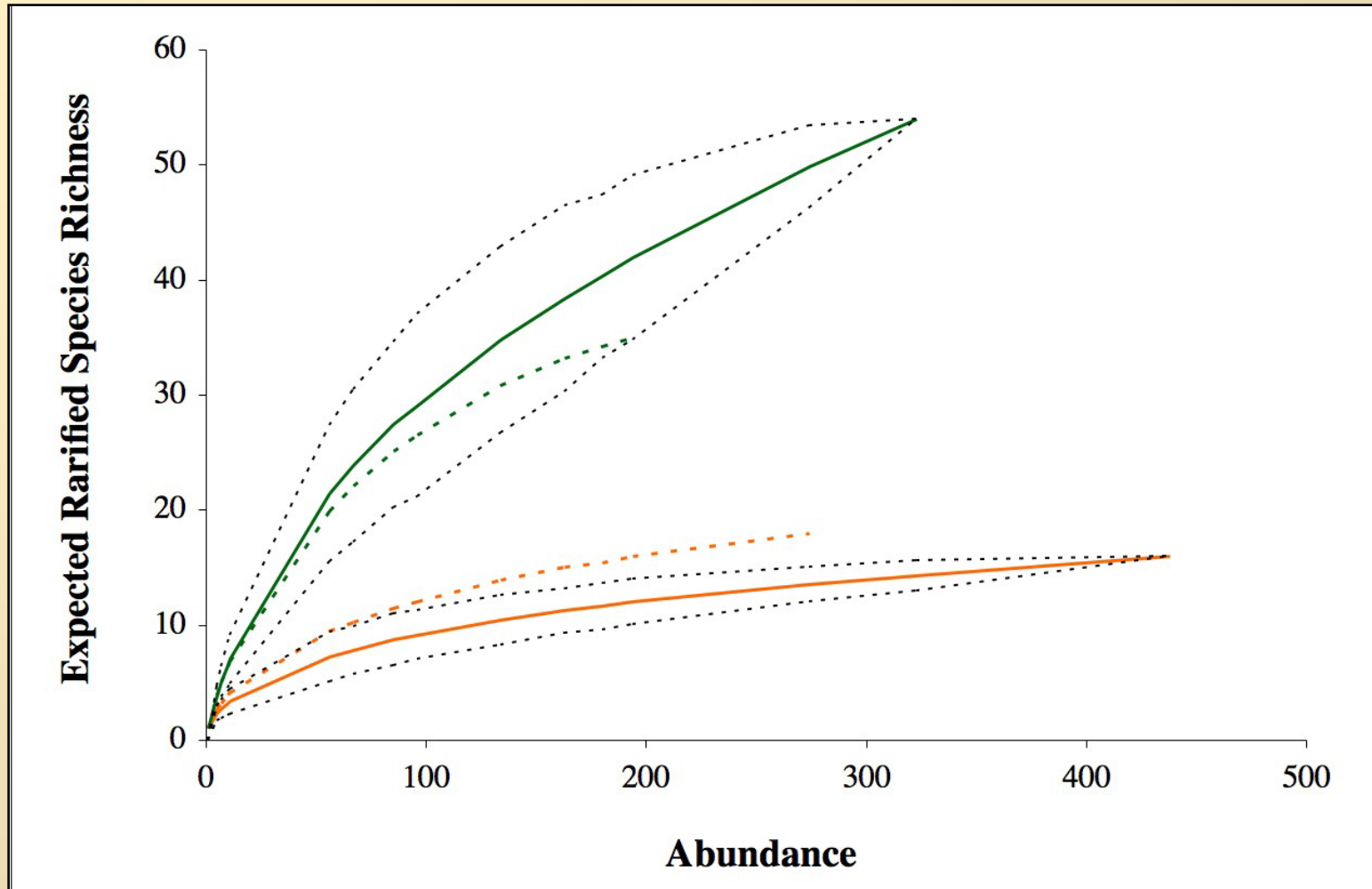- One-way ANOVA: p = 0.026 (land use factor only)

Results - EPT

Example Taxa

Two-way ANOVA: p = 0.014 (indicating an interaction)

Error bars represent ± one SEM, n = 74

One-way ANOVA: p < 0.001 (land use factor only)

Results - Rarefaction

- Forested site: French Hill Brook (green), n = 16
- Urban site: Englesby Brook (orange), n = 16
- Dashed black lines = 95% confidence intervals

Results - Summary

- Many significant differences in community metrics between forested and urban streams

- Urban streams had larger % composition of Diptera than forested streams whereas forested streams had larger % composition of EPT taxa

- Interactions were observed for % composition of Diptera and % composition of EPT, which indicated different responses to sedimentation for the two dominant land uses

- Sedimentation led to an increased rarified expected species richness in Englesby Brook (urban). For French Hill Brook (forested), no significant difference, though sedimentation curve nears boundary of lower confidence interval at higher abundances

Discussion & Conclusions

- For land use, predictions for differences between forested and urban sites were supported, suggesting that urban sites are generally more 'impacted'

- Results for % composition of EPT and rarefaction were unexpected and suggest that our sedimentation regime may have actually improved microhabitats in urban sites like Englesby Brook

- This may reflect the possibility that the coarse playground sand used had less impact than some of the fine sediments already found in these urban stream sites

- Riparian habitat characteristics at a small-scale may better predict the effects of sedimentation than broad-scale land use

  (Moore and Palmer 2005)
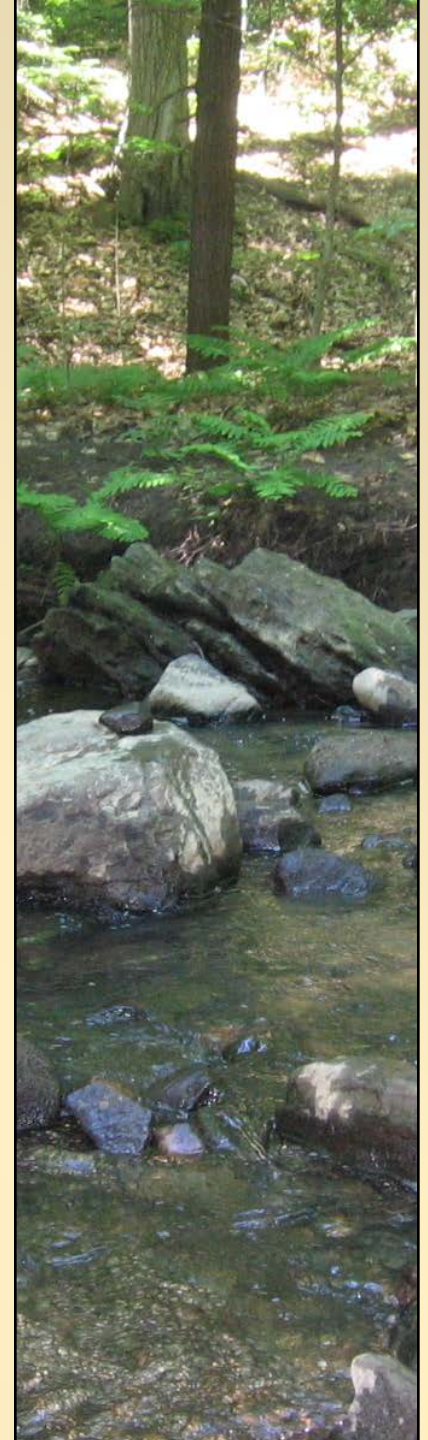
Acknowledgements

Many thanks to:

- the Vermont EPSCoR Streams Project and the National Science Foundation for funding this research

- St. Michael's College for facilities and equipment

- Sodexo at St. Michael's College for donating plastic sampling containers

- Gary Entsminger for developing the EcoSim rarefaction program

- our wonderful lab colleagues:

  Evelyn Boardman, Anne Burnham, Valerie Calderon, Erin Hayes-Pontius, Dayanara Lebron, Ismael Orengo, Jennifer Pattriti, Janel Roberge, and Ian Sullivan.

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Questions?

Feel free to send questions to:

Sam Beguin
sbeguin@middlebury.edu