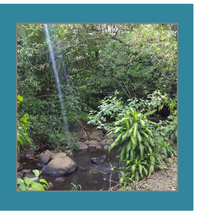
Analysis of a Stream Macroinvertebrate Community in a Disturbed Costa Rican Rainforest

Rachel Alenius and Spencer Weinstein
Dr. Amanda Hale, Dr. Mike Misamore, and Dr. Dean Williams
Department of Biology



Introduction

- Millions of hectares of tropical rainforest have been deforested for logging and agriculture over the past century [1].
- Land conversion alters abiotic inputs to watershed and has direct and indirect effects on both terrestrial and aquatic communities [2, 3].
- In aquatic communities, stream macroinvertebrates can serve as indicators of healthy ecosystems [3-5].
- Many stream macroinvertebrates are larval emergent insects, so negative impacts to macroinvertebrate communities may translate to impacts on nearby terrestrial systems [6].
- We seek to examine the effects of ecosystem modification on macroinvertebrate communities in a disturbed Costa Rican stream (**Fig.1**).

Figure 1: Image of stream used in this study

Objectives

- To evaluate abundance, species richness, diversity, and evenness of macroinvertebrates in ten sampling locations within a disturbed Costa Rican stream.
- To test whether water velocity, substrate size, water depth, and pH affect macroinvertebrate community composition.

Methods

- We divided the stream into four-5 m reaches. Within each reach, we selected one riffle and one pool based on visual attributes (N = 10) **(Fig. 2)**.
- We measured water velocity, depth, and pH at each sampling site, and used a Surber sampler to collect macroinvertebrates **(Fig. 3)**.
- We stored invertebrates from each sampling site in 70% ethanol and identified to family and/or order level using an aquatic ecology dichotomous key **(Fig. 4)**.
- For each sampling site, we calculated total number of organisms collected, as well as species richness, evenness, and diversity.
- We used a Two-sample t-test to determine if biotic and abiotic conditions were significantly different between riffles and runs.

Figure 2: Determining location of sampling sites

Figure 3: Emptying contents of Surber Sampler

Figure 4: Determining taxa of collected macroinvertebrates

Results

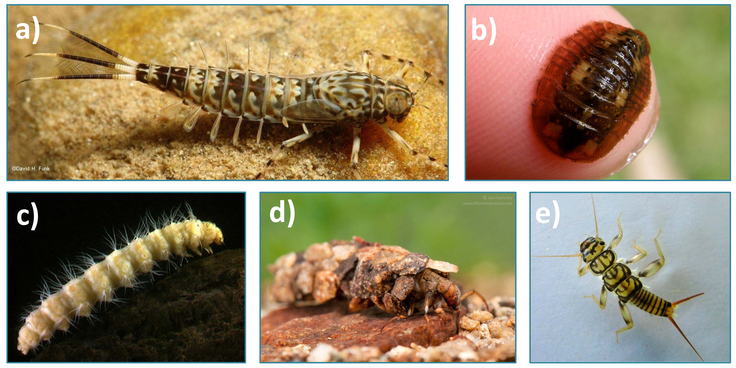


Figure 5: Examples of larval macroinvertebrates identified in this study, including a) mayflies (Ephemeroptera), b) water pennies (Coleoptera: Psephenidae), c) aquatic caterpillars (Lepidoptera: Pyralidae), d) caddisflies (Trichoptera), and e) stoneflies (Plecoptera)

Table 1: Results of Two-sample t-tests comparing average biotic and abiotic characteristics of riffles and pools. P values below 0.05 are significant. Average values are displayed with ±1 SEM

Average:	Riffle (N=5)	Pool (N=5)	T Statistic	DF	p-value
Velocity (m/s)	0.023 ± 0.003	0.009 ± 0.002	3.91	8	0.002*
Depth (cm)	8.9 ± 1.3	14.1 ± 2.1	-1.88	8	0.048*
Abundance	39 ± 8.8	9.4 ± 4.6	2.98	6	0.02*
Richness	6.4 ± 1.7	5 ± 1.5	0.63	8	0.55
Evenness	0.776 ± 0.03	0.943 ± 0.03	-4.00	7	0.005*
Diversity	0.31 ± 0.05	0.088 ± 0.03	3.92	6	0.008*

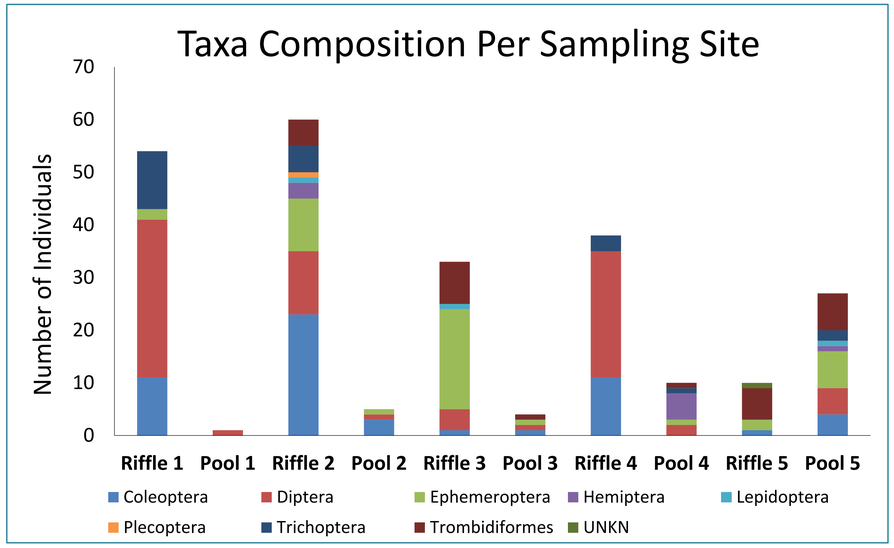


Figure 6: Number of individuals of each order found in each riffle (n = 5) and pool (n = 5) in the disturbed stream.

Figure 7. Examples of adult macroinvertebrates identified in this study, including a) Riffle Beetles (Coleoptera: Elmidae), b) water striders (Hemiptera: Gerridae), and c) Naucoridae (Hemiptera)

Figure 8: Fish, believed to be a species of sculpin, captured in the Surber sampler.

Discussion

- Significantly more organisms were identified in riffles than in pools. Evenness and diversity were also significantly different between the riffles and the pools **(Table 1)**.
- While water velocity had an effect on macroinvertebrate community composition **(Table 1)**, other abiotic factors, such as substrate size and pH, were similar between the riffles and the pools.
- In both riffles and pools, several taxa known to be bioindicators of stream health, such as Trichoptera **(Fig. 5d)**, Ephemeroptera **(Fig. 5a)**, and Plecoptera **(Fig. 5e)** [7], were identified. This suggests that, despite human activity in the surrounding ecosystem, the stream continues to support a healthy aquatic community.
- In addition to the macroinvertebrates, we captured one fish, believed to be a species of tropical freshwater sculpin, in the Surber sampler **(Fig. 8)**. Sculpin are also known to be bioindicator species [8], further indicating the high water quality of the stream.

References

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Acknowledgments

- Thank you to Dr. Amanda Hale, Dr. Mike Misamore, and Dr. Dean Williams for assistance with fieldwork and sample identification. Thank you as well to Gustavo of the TCU San Ramon Tropical Biology Field Station for allowing us access to the stream in which we sampled, and to Dr. Ray Drenner, for allowing us to use his Surber sampler.