# The influence of salamanders on the leaf litter decomposition rate in headwater streams.

Jones, Emily, Eastern Kentucky University
Faculty Mentors: Richter, Stephen and Braccia, Amy
NSF-Research Experiences for Undergraduates, Disturbance Ecology in Central Appalachia 2018

## Introduction

Woodland streams are the most studied lotic system due to their unique food webs and metabolic activities[1]. Unlike larger bodies of water, woodland streams get most of their energy from the surrounding vegetation or riparian area[2]. Due to their small size and ephemeral (drying) hydrology it is difficult for large, predatory fish to survive in them. The role of top predator is replaced by salamanders. Salamanders act as “sinks” for nutrients, meaning they prevent them from being used in other parts of the food web[3].

The study aimed to determine if salamanders play an important role in the leaf litter decomposition rate in woodland streams, impacting the flow of nutrients through the ecosystem. My hypothesis is that they will slow down the rate of decomposition, trapping nutrients in the leaves not to be cycled up the food web. I predict that salamanders will slow down decomposition rates by consuming macroinvertebrates that break down leaf litter and make it available to other organisms.

## Methods

Two headwater streams were chosen in Lilley Cornett Woods (LCW), Letcher County, Kentucky. Big Everidge Creek (BEC) flows through primarily old-growth forest, meaning the trees have never been cut down or harvested over the past 200 years (Martin, 1991). The second creek is Island Branch Creek (IBC). Island branch has been exposed to mining activities in its watershed.

To measure leaf litter loss, I started with 10 grams of Red Maple leaves (*Acer rubrum*) in 60 mesh bags with a mesh size of 0.3 cm. The leaves were air dried for two weeks before I began my experiment.

In both creeks I selected ten pools. Within each pool I placed three bags: one calibration, one treatment (salamander), and one control (no salamander) starting the first week of April. The three bags remained in the creek for 6 weeks. At 6 weeks, I removed the calibration bags to calculate how much leaf mass I lost up to this point and to get an idea of what the macroinvertebrate community was like at the start of the treatment. I placed the remaining bags into minnow traps. I added one salamander to the treatment trap and left the control trap empty. The bags, traps, and salamanders remained in the creek for 4 weeks. After 4 weeks I released the salamanders and began processing the leaf litter I had remaining.

Leaf litter processing has three main steps: washing, drying, and weighing. I washed all 60 bags using two metal sieves, 4 mm and 500 um. Anything remaining on the first sieve, 4 mm, I counted as original leaf matter. I collected everything caught on the smaller sieve to later be sorted and picked for macroinvertebrates.

I dried the leaves then incinerated them to calculate the ash free dry mass.

## Results

The leaf masses collected were compared using a Wilcoxon Ranked Sum test between control and treatment groups in both streams. Within each stream, treatment lost more mass than control bags (Fig. 1). This pattern is consistent when stream is not considered as a factor.

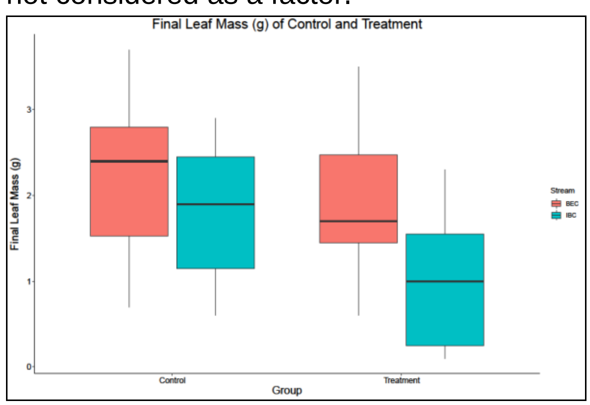


**Figure 1.** *Leaf Mass loss in control and treatment groups in both streams.*

The difference between control and treatment bags in Big Everidge Creek (BEC) is not significant (p = 0.4443) but the difference between control and treatment in Island Branch Creek (IBC) is (p = 0.02474). The overall difference between control and treatment bags is also significant (p= 0.03999).

The overall trend suggests bags with salamanders lose more leaf mass than those without salamanders.

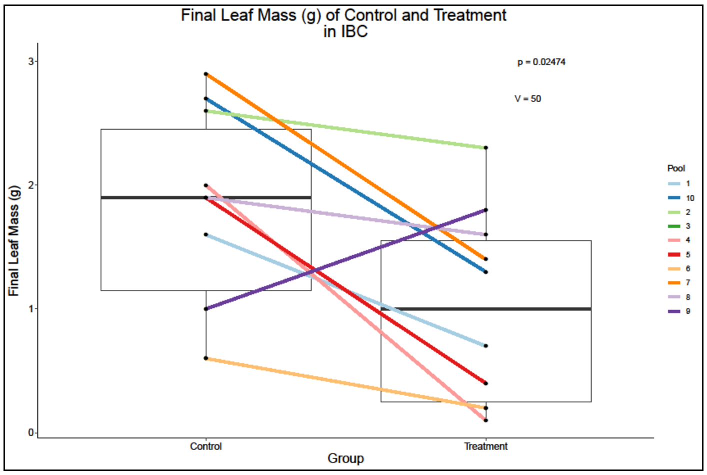


**Figure 2.** *The differences between control and treatment bags by pool in Island Branch Creek (IBC).*

## Conclusions

While the results suggest the opposite of the hypothesis, it sets the ground work for further research. The difference between control and treatment groups across both streams consistently suggest that salamanders have a positive effect on leaf litter decomposition (Fig. 2). In Big Everidge Creek (BEC), 7 out of 10 bags were consistent with this trend.

An explanation for this could be the impact the salamanders had on the macroinvertebrate community. It is possible that salamanders ate larger, predatory macroinvertebrates preferentially, leaving the smaller shredders in more abundance to break down the leaf litter. Further analysis of the macroinvertebrate communities within each bag need to be done before this can be said.  Another explanation could be excretion fed feedback loops. Some species of macroinvertebrate have been known to release excretions that break down leaf litter. It could be that salamanders are avoiding eating these specific species and therefore more are in treatment bags and the overall decomposition rates increase.

The difference between IBC and BEC could be explained by the macroinvertebrate community as well. It is possible that BEC has a higher abundance of macroinvertebrate so the difference between the control and treatment groups is not a pronounced. Further investigation into the macroinvertebrate community must be done before this can be said for certain.

## References

[1]Cummins, K. W. 2016. Structure and function of stream ecosystems. BioScience 24:11:631-641.

[2]Nery, T., and D. Schmera. 2016. The effects of top-down and bottom-up controls on macroinvertebrate assemblages in headwater streams. Hydrobiolgia 763:173-181.

[3]Burton, T. M., and G. Likens. 1975. Energy flow and nutrient cycling in salamander populations in the Hubbard Brook Experimental Forest, New Hampshire. Ecology 56:5:1068-1080.

Martin, M. H., 1991. Defining old-growth deciduous forests: seeing the forest and the trees.

EMILY JONES is a Senior at EKU studying Wildlife Management.

STEPHEN RICHTER is Professor of Biological Sciences at EKU. He is a co-director of the REU program.

AMY BRACCIA is a Professor of Biological Sciences at EKU.

The study was conducted as part of the NSF Research Experience for Undergraduates and Research Experience for Teachers program: Disturbance Ecology in Central Appalachia — a ten-week summer research program hosted by Eastern Kentucky University.

Funded by the National Science Foundation, DIB 1559980.