

# Janey Lienau, MEd Student

## *Ground beetle nitrogen cycling in eastern temperate forests*

### Research Highlights

- Nitrogen cycling in eastern temperate forests is essential for forest growth and functioning.
- Large soil animals like ground beetles may be important for nitrogen cycling through top down predator controls on microfauna and microbes that directly control nitrogen decomposition.
- We used mesocosm cages in the forests with predatory ground beetles to test the importance of predators in the soil food web on nitrogen availability in the summer of 2022.
- Our results indicate that predatory ground beetles increase nitrogen availability in younger forests.

### Research Summary

Without nitrogen cycling through forests, trees would not be green, small flowers would not bloom, and the animals in the forest would disappear. Despite forests' dependence on nitrogen to maintain functioning, many questions remain about how nitrogen cycles through soil. The reigning paradigm is that nitrogen cycles from plants to leaf litter and is decomposed by microbes and then released in mineral form to the soil and taken up again by plants. Decomposition is thought to be the limiting step in this process and needs to be more fully understood.

In addition to plants, soil animals contribute to nitrogen cycling yet remain vastly understudied despite their abundance in the soil layer, especially larger species of beetles, millipedes, and pill bugs. These larger soil animals may be the link between plant litter and microbial decomposition which is essential for the nitrogen cycle. Ground beetles are the most abundant and diverse of these groups and are often top predators of the soil food web. As predators, they may control populations of mites and decomposing microbes that make nitrogen available to plants. Therefore, studying the effect of ground beetles as predators on soil nitrogen is essential to understanding nitrogen cycling and functioning of eastern temperate forests.



Janey Lienau stocking mesocosm cages with beetles.

**Research Summary cont.**

We tested the importance of predatory beetles on available forms of nitrogen using mesocosm cages in the forest stocked with species from the predatory genus of ground beetles *Pterosticus*. We set up 30 cages with live beetles for 68 days in both a young forest and an old forest stand at Yale Myers Forest to also examine differences between nitrogen cycling as forests ages. We set up control cages without added beetles, and cages stocked just with beetles that eat seeds and other plant litter.

Our results indicate that soil nitrogen was higher in younger forests than older ones, and that ground beetles were more important for available nitrogen in younger forests. Predator ground beetles increased nitrogen in the soil, while the seed eating beetles reduced the amount of nitrogen in the soil compared to the control. Although these results support our hypothesis that larger animals are important for nitrogen in forests, the mechanistic reasons for these results are unclear and leave remaining questions. I will be continuing my study of nitrogen cycling in forest soils through the animal food web for a second summer in 2023 to explicitly test the mechanisms driving these results.



Live *Pterosticus* species of ground beetles.



Conducting soil sampling at the end of the summer.