**“Negative effects of an allelopathic invader on native plant species’ carbon assimilation are driven by species-specific mechanisms”**

Evan A. Perkowski1,\*, Kelly Carroll1, Jessie Mutz2, Snehanjana Chatterjee1, Lalasia Bialic-Murphy2,3, Stephanie N. Kivlin2, Susan Kalisz2,Nicholas G. Smith1

1Department of Biological Sciences, Texas Tech University, Lubbock, TX, USA

2Department of Ecology and Evolutionary Biology, University of Tennessee Knoxville, Knoxville, TN, USA

3Institute of Integrative Biology, ETH Zurich, Zurich, Switzerland

**Abstract**

Invasive plants exploit strategies that maximize their competitive success for establishment in novel ecosystems. Allelopathy, a ‘novel weapon’ defined here as a secondary compound produced by a plant that negatively impacts neighboring plant species and soil microbial communities, has gained traction as a mechanism to explain the widespread success of invasive plant species. Previous work estimates that ~72% of invasive plant species demonstrate the ability to produce and secrete allelopathic compounds. Allelopathy-mediated plant invasion reorganizes belowground arbuscular mycorrhizal (AM) fungal communities, which may have major consequences for native plant species resource provisioning, uptake, and allocation to organs that support primary productivity and reproduction. Recent work indicates that altered AM fungal community composition due to the allelopathic plant invasion can modify plant water and nutrient economies. However, mechanisms that drive these responses have not been well characterized, limiting our ability to make inferences about the role of allelopathic plant invasion on native plant physiology, primary productivity, and survivorship.

Here, we show that Alliaria petiolata, an allelopathic invader that reorganizes AM fungal communities by secreting glucosinolates belowground, negatively affected leaf gas exchange in two native understory AM-associating plant species (Maianthemum racemosum and Trillium spp.) growing in a long-term A. petiolata field manipulation experiment. Alliaria petiolata presence decreased M. racemosum stomatal conductance more strongly than it decreased net photosynthesis, increasing the extent to which stomatal conductance limited M. racemosum net photosynthesis. In contrast, A. petiolata presence decreased maximum rates of Rubisco carboxylation and electron transport for RuBP regeneration in Trillium spp., but this pattern was only apparent after the tree canopy had closed and soil nitrogen availability decreased. Reduced photosynthetic capacity in Trillium spp. was observed despite no effect of A. petiolata presence on net photosynthesis or stomatal conductance. Overall, results indicate that mechanisms that drove the negative effects of A. petiolata presence on native plant species physiology are species-specific. Reduced net photosynthesis rates in M. racemosum may have been the result of changes in water use that increased stomatal limitation, while reduced photosynthetic capacity in Trillium spp. may have been the result of reduced nitrogen uptake that reduced allocation to photosynthetic leaf tissue. These findings suggest that allelopathy-mediated plant invasion can exert species-specific effects on native plant physiology, which may partly hinge on phenological shifts due to changes in soil nutrient supply or demand for building and maintaining photosynthetic enzymes.