COMMUNITY-LEVEL EFFECTS OF THE AMUR HONEYSUCKLE IN SOUTHWESTERN OHIO

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ABSTRACT

The Amur honeysuckle (*Lonicera maackii* (Rupr.) Maxim) (Caprifoliaceae) is one of several bush honeysuckles invading hardwood forests throughout the central and eastern United States. Other problematic species include Morrow's honeysuckle (*L. morrowii* A. Gray), Tatarian honeysuckle (*L. tatarica* L.), and Bell's honeysuckle (*Lonicera* × *bella*). All share a common set of morphological and ecological characteristics that make them invasive in certain habitats including high rates of seed dispersal, high seed viability, seed banking, extended morphology, disease resistance, and relatively high levels of phenotypic plasticity.

Observations in southern Ohio suggest that Amur honeysuckle is often dominant in the midstory of forests along edges and appears to be affiliated with minor disturbance. It is able to proliferate through the midstory of certain hardwood forests, displacing the native shrub flora and largely decimating the understory layer of native woody seedlings and herbs.

Several experiments were designed to evaluate the impact of Amur honeysuckle on the understory vegetation, overstory vegetation, and the impact of restoration on severely damaged forested ecosystems.

The first experiment was designed to evaluate the effects of Amur honeysuckle on vegetation, composition, structure, and diversity. We used 16 sites in southwestern Ohio: 8 from Dayton Metroparks and 8 from Cincinnati Metroparks. Most of the stands were of similar vegetation, stand history, soils, and climate. Six of the eight sites around each city contained moderate to heavy infestations of Amur honeysuckle and two served as honeysuckle-free control areas. Thus, there were 12 stands with Amur honeysuckle and 4 without.

Within each stand, we ran two parallel transects, each containing seven sample units, consisting of a modified point-center-quarter sampling unit. Thus, each stand contained 14 sample units. Each sample unit recorded the four nearest overstory trees and four nearest understory trees. Four nested quadrats were used to record the abundance of understory saplings, shrubs, woody seedlings, and herbs. Four soil samples were also obtained from each point to be used for seed-bank analysis. Finally, the four nearest Amur honeysuckles were identified and cut at ground level; dry weight biomass was determined, along with shrub age, using standard dendrochronological techniques.

From dendrochronological analysis, it was straightforward to determine when a stand had been invaded by Amur honeysuckle. In comparing the mean percent species richness for long-invaded stands vs. non-invaded stands, there was a significant decrease in virtually every structural level. The most dramatic declines occurred in the sapling (-58.2%), seed bank (-41.4%), and woody seedling (-34.9%) layers. Herb richness did not decline dramatically (-4.4%). Observations suggest that this might be due to a possible facilitation effect of Amur honeysuckle allowing other non-native species into the habitat (e.g., garlic mustard, *Alliaria petiolata*). The overstory layer, as expected, did not change in species composition (+1.4%).

Likewise, we used density as a measure of abundance and found the results quite similar to the species richness response. Regression analyses examining time since invasion (independent variable) modeled against density by layer showed a significant decline over time in the seedling, sapling, and herb layers but not in the overstory and seed bank ($\beta = 0$).

We used a multi-stratum congruence analysis to evaluate the change in species community composition. Growing literature suggests a linkage between one vegetative layer and the next. This type of analysis uses the Bray-Curtis similarity coefficient of each plot and compares the B-C similarity for the adjacent layer. This analysis revealed that there was a disintegration of the strength of linkage between layers the longer that Amur honeysuckle was found in the stand. This suggests that Amur honeysuckle will have a marked impact on the trajectory of stand succession and likely alter community dynamics for years to come.

Our second experiment was designed to determine if Amur honeysuckle was in any way impacting the overstory. Our studies to date suggested that it had no impact on the numbers of species, species composition, or density (the trees were all there before Amur honeysuckle invaded), but might there be other effects? Extensive forestry literature supports the reasoning for thinning from below. Lower strata often influence overstory productivity. Using dendrochronological techniques applied to both honeysuckle and the overstory, we were able to precisely date the time of invasion of each stand and the subsequent response of the overstory trees as measured by annual increment and basal area increment.

Using intervention analysis, we discovered that the overstory responded to invasion within 5-10 years after arrival of honeysuckle in the understory via a reduction in growth. We observed anywhere from a 5 to 30% (range; mean = 18%) decline in overstory productivity, whether adjusted by honeysuckle density or biomass. The implications of this are profound and provide a clear example of the direct negative impacts of an understory invasive species on timber economics.

Lastly, we examined different methods for Amur honeysuckle control, evaluated their efficacy and economic cost, and assessed the ability to recover a stand following invasion. This work was conducted at the Fernald Environmental Management Project outside of Cincinnati, OH. We compared two methods of honeysuckle control. One method involved traditional stem cutting and subsequent painting of the stump with herbicide (Round-up™); the other involved the use of herbicide capsule injection using the EZ-Ject Lance, which injects a capsule of herbicide (Round-up™) into the phloem and ultimately kills the tree. Both methods resulted in 99% mortality. The latter method was somewhat more costly in startup and ongoing supplies, but was able to treat a much larger area per unit time and was safer for the operator. We concluded that the EZ-Ject Lance was perhaps the best method to treat honeysuckle invasions.

Following control methods, we then in-planted a number of hardwood seedling species including black walnut, green ash, chinkapin oak, black cherry, flowering dogwood, and redbud. While survival of these species was significantly greater in treatment plots (herbicide) compared to untreated controls, we found that the ultimate survival of each species was very closely tied to the microenvironment of that site, indicating that any restoration effort involving planting of native species must very carefully match up environment and species to get a good long-term response.

In sum, Amur honeysuckle represents a significant threat to hardwood forests of the central and eastern United States. Site invasion occurs relatively quickly once the species arrives and the midstory can be subsumed within a decade. Honeysuckle will displace most native shrub, sapling, and hardwood seedlings and leads to significant declines in herb species abundance. Honeysuckle also has a marked impact on the overstory, but in a fashion quite different from lower vegetative layers. It results in the loss of overstory productivity, and this loss can be substantial. Overall, honeysuckle affects virtually every vegetative layer present. The species can be controlled, but in order for the effects to be useful, and before native vegetation declines past an irrevocable point, the species should not be left unattended in a stand for more than 10 years. Restoration in habitats that have been disturbed for longer periods of time are possible, but will require much more intensive efforts because species will need to be added manually back into the plant community.