

Final Report – Wildlife Preservation Fund Grant #02-002W
The effects of Amur honeysuckle (*Lonicera maackii*) on tree regeneration

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INTRODUCTION

The widespread invasion of exotic plant species is a major concern from both the perspectives of conservation and ecological research. Exotic plant invasions are often associated with 1) declines in local plant diversity (Wycoff and Webb 1996; Hutchinson and Vankat 1997), 2) inhibition of forest regeneration (Woods 1993; Wycoff and Webb 1996; Hutchinson and Vankat 1997) and 3) reductions in the productivity of agricultural land (Pimentel et al. 2000). In addition, exotic invasions often accrue the financial costs of biological or chemical control (Pimentel et al. 2000). Ecologists struggle to understand the impacts of these invasions on community structure and dynamics (Woods 1993; Hutchinson and Vankat 1997; Parker et al. 1999). I examined the impacts of the exotic shrub, *Lonicera maackii*, on tree regeneration in a deciduous forest of east-central Illinois with the goal of proposing management schemes that will promote forest regeneration within heavily invaded public lands.

Study species: *Lonicera maackii* is a native of western Asia that was originally introduced into North America largely for its value to wildlife and use in soil conservation (Luken and Thieret 1996). This species has become widespread in the Midwestern US, invading open fields and forests throughout the region (Luken and Goessling 1995; Luken and Thieret 1996; Hutchinson and Vankat 1997,1998). It is bird dispersed, which has allowed it to quickly invade isolated forest fragments (Hutchinson and Vankat 1998). *Lonicera maackii* grows best in disturbed forests and along forest edges (Luken and Goessling 1995; Hutchinson and Vankat 1997), from where it may then invade treefall gaps in forest interiors (Luken and Goessling 1995). In many areas, this species is the dominant understory shrub, forming a continuous thicket.

Areas invaded by *L. maackii* typically have fewer herbaceous species and show limited tree regeneration (Hutchinson and Vankat 1997). Experiments have shown that this species directly

interferes with the reproductive capacity of annual herbs (Gould and Gorchov 2000). *Lonicera maackii* leafs out earlier, and retains its leaves longer than co-occurring native species (Trisel and Gorchov 1994). This extended phenology may explain its influences on forest understories. For these reasons, the invasion of *L. maackii* is a management concern.

Seed predation vs. competition: Exotic shrubs may inhibit tree regeneration in two ways; through increases in seed predation and through competition with seedlings. Shrub cover is often associated with high levels of seed predation, as small mammals use these plants for cover (Hulme 1993; McCormick and Meiners 2000). This selective use of shrub cover may create 'hot spots' of intense seed predation under exotic shrub canopies. As shrub cover increases, the area in which seeds may escape predation becomes smaller, leading to reductions in tree regeneration. More commonly, exotic shrubs are thought to compete with tree seedlings, leading to reductions in tree regeneration. The roots, as well as the canopy of *L. maackii*, are very dense and may compete heavily with tree seedlings for both light and below-ground resources. This competition may result in the observed declines in tree regeneration under these shrubs.

MATERIALS AND METHODS

Study site: The study site is within the Douglas-Hart Nature Center, Mattoon, IL (DHNC). The site is an approximately 25-acre patch of mesic deciduous forest that has become heavily invaded by *L. maackii*. Native shrubs within the site are primarily *Sambucus canadensis* (Elderberry) and *Viburnum dentatum* (Arrowwood). In most places, the exotic shrub forms a continuous thicket in the understory. Roadside plantings in the vicinity of the nature center were the source of the original invasion.

Experimental design: Throughout the site, a series of ten 5 × 5 m plots were established in the fall of 2001. A 2 m buffer area surrounded each

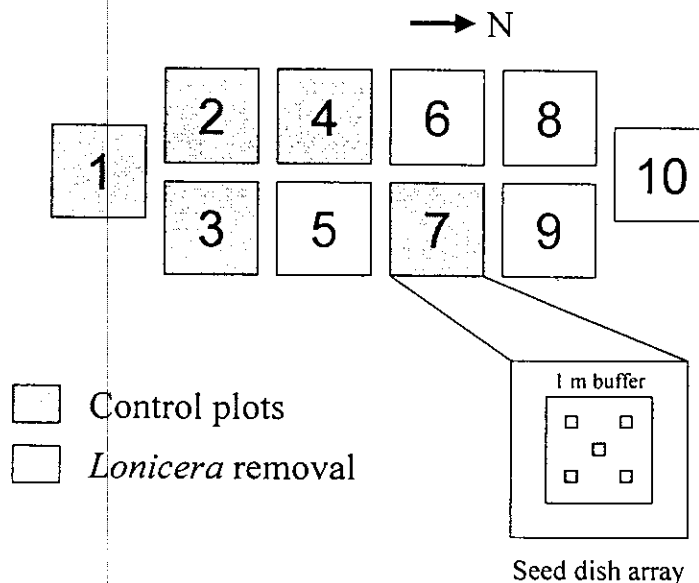


Fig. 1. Layout of honeysuckle removal plots within Douglas-Hart Nature Center. Inset shows the arrangement of the seed dishes within the individual plots. 2

experimental plot. Half of the plots were randomly assigned to have all *L. maackii* plants removed. The other five remained in *L. maackii* cover as control plots (Fig. 1.). Stems of *L. maackii* were cut and removed 14 September, 2001. Plots were monitored periodically to maintain removal treatments. At the time of stem removal, a 5-10 cm section was cut from the base of each stem and brought back to the lab for ageing. Fruit samples were also collected from 10 stems per plot to conduct estimates of fruit and seed production. All stems were removed from the plots and placed outside of the experimental area

The influence of *L. maackii* on seed predation intensity was assessed 2-30 October, 2001. Dishes made of aluminum screening were placed on the soil surface and anchored with a galvanized nail. Five of these dishes were placed into each plot within the central 3 x 3m of the plot (see Fig 1). Into each dish, 10 *Fraxinus pennsylvanica* seeds were placed and monitored on days 2, 7, 14, 21, and 28 for seed removal. The wing of each seed was clipped to reduce the likelihood of blowing out of the screen dish and to separate experimental seeds from naturally dispersing seed. Cox regression (using SPSS 11.0.1) was used to compare removal rates between the *Lonicera* removal and control treatments.

Continuing research: Seeds of three native tree species – redbud, (*Cercis canadensis*) pin oak (*Quercus palustris*) and green ash (*Fraxinus pennsylvanica*), were collected in the fall 2001 to be started in the greenhouse at Eastern Illinois University. Because of problems with an environmental chamber, seed dormancy was not broken in time to start seedlings in the greenhouse. In addition, *F. pennsylvanica* seeds were not viable. On 28 May 2002, 60 seeds of *C. canadensis* and 40 seeds of *Q. palustris* were planted into each plot. Half of the planted seeds were planted into an area trenched to a depth of 30 cm to separate out the influences of above-ground competition from below-ground competition from neighboring *L. maackii* roots. These experimental seedlings are individually tagged as they emerge and censused weekly for growth and survivorship. Because of the extremely high rainfall during spring, germination and survivorship is poor. A second planting is planned for next year to address the limited usefulness of this year's field experiment.

RESULTS

The population of *Lonicera maackii* at DHNC is very dense. From the removal plots, our density estimates indicate a stem density of 9360 stems/ha. These individuals are also incredibly fecund, producing an estimated 219 seeds m² (> 2 million seeds / ha). Most of the stems in the population are fairly young, with the largest number of stems in the 1-year age class (Fig. 2) and the oldest stems at 12 years of age.

Seed predation intensity at DHNC was very intense. Most seeds were removed within the first two weeks of the experiment. Final survival differed dramatically between the experimental treatment with 35% of seeds surviving in the removal treatment while only 10% survived in the control plots (Fig 3). The rates of removal differed significantly between the treatments with seeds in control plots having 1.59 × greater risk of predation than seeds within the honeysuckle removal plots (Cox regression: Wald Chi-square = 19.43, df = 1, $P < 0.001$).

DISCUSSION

The population structure at DHNC suggests a population that has only recently become established and is still increasing. Future increases in density will likely result in greater impacts on understory species composition and forest regeneration (Trisel and Gorchoff 1993; Hutchinson and Vankat 1997; Gould and Gorchoff 2000). The fecundity of this population is



Fig. 2. Age structure of *Lonicera maackii* stems within the removal plots at DHNC.

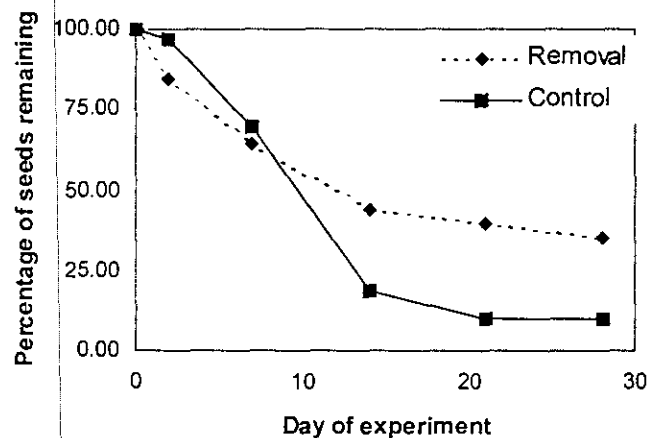


Fig. 3. Survival of *Fraxinus pennsylvanica* seeds placed in honeysuckle removal and control plots at DHNC.

also very high, resulting in a high density of seeds for the establishment of new individuals and as a potential food source for seed predators. These attributes indicate that the population is an extreme management concern.

This study found very strong localized seed predation under *L. maackii* canopies. Despite removal plots being small and immediately adjacent to control plots, they experienced much lower rates of seed removal. The seed predators in this system are mostly *Peromyscus leucopus* (determined from live trapping done in fall 2001). *Peromyscus leucopus* prefer to forage under woody cover that provides protection from avian predators (Hulme 1993; McCormick and Meiners 2000). They may also have been foraging under *L. maackii* canopies to forage on the high density of seeds produced by the plant. Because removals occurred before fruit ripening, seed densities would have differed between experimental treatments.

The implications of this differential seed predation on forest regeneration are clear. Seeds that fall under *L. maackii* cover have a much greater chance of becoming predated. As population density of *L. maackii* increases, the availability of safe sites with lower predation pressure will decline across the site. Fewer surviving seeds leave fewer individuals that can potentially germinate and become a part of the forest canopy. This, coupled with competitive impacts of the honeysuckle (Hutchinson and Vankat 1997; Gould and Gorchov 2000), represents a serious threat to the health of the forest at DHNC.

SUMMARY

The population of *Lonicera maackii* at Douglas-Hart Nature Center is increasing and is very productive. This exotic shrub is influencing the spatial pattern of seed predation in the site, with higher rates of predation and lower final survival under shrub canopies. The spatial pattern of seed predation likely explains at least some of the tree seedling regeneration under shrub canopies. An investigation into the role of above- and below-ground competition between *Lonicera maackii* and tree seedlings is ongoing. Separating the direct competitive and indirect seed predation effects of *L. maackii* on tree regeneration should lead to effective management strategies.

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