"Influence of stem cutting and glyphosate treatment of *Lonicera maackii*, an exotic, invasive species, on stem regrowth and native species richness"

Ashlee M. Mounteer[1,2] and Henry R. Owen [1]

[1]Eastern Illinois University, Charleston, Illinois 61920, [2]Brigham Young University – Idaho, Rexburg, Idaho 93440

Abstract

Lonicera maackii (Rupr.) Herder (Amur honeysuckle) was introduced from Asia as an ornamental shrub. Since then, it has quickly overtaken disturbed areas and is now found in at least 23 states and in Ontario, Canada. *L. maackii* produces a dense canopy that reduces light for nearby native species because it has a longer growing season (April to November) than native species and because it produces a number of basal sprouts. Today, people continue to use *L. maackii* as a decorative shrub for landscaping; however, others are trying to eradicate it. Eradication (burning or spraying glyphosate) can be difficult, time consuming processes. In this study, *L. maackii* was mechanically removed and the cut stems were treated directly with 18% glyphosate [N-(phosphonomethyl)glycine] to determine whether an opened canopy would enable the once abundant wildflowers to reestablish themselves. The mean light intensity was significantly higher in transects where the *L. maackii* had been removed. By the end of the study, mean species richness and *Acer negundo* frequency were higher in the cut transects than in the control transect. Investigation at this site will continue to document whether these trends persist.

Introduction

Lonicera maackii (Rupr.) Herder (Amur honeysuckle) was introduced into the United States in 1897 from Asia as an ornamental shrub. It is an erect, deciduous shrub (2 m to 6 m) that has quickly overtaken disturbed areas, especially in the last few decades. It is now found in at least 23 states (mostly in the eastern and midwestern United States) and in Ontario, Canada (Hutchinson and Vankat, 1997; Luken et al., 1997). One reason for its rapid dispersal is that *L. maackii* produces large quantities of red berries that attract birds (Collier and Vankat, 2002). *Lonicera maackii*'s main invasive quality is that it produces leaves in early April (about two weeks before native species) that remain until November (Hoffman and Kearns, 1997). *L. maackii* also produces a number of basal sprouts that, along with the extended growing season, produces a dense canopy and thus reduces light for other competing, native species. There has been some thought that honeysuckle produces allelopathic chemicals, but it has not been documented (Minnesota Department of Natural Resources, 2003).

Lonicera maackii started invading forests and disturbed areas because it escaped cultivation. There are some people who continue to plant Amur Honeysuckle as a decorative bush for landscaping. *L. maackii*'s yellow flowers also emit an attractive fragrance. While some people still desire to plant *Lonicera maackii*, others are trying to eradicate it. Because of its invasive and antiherbivory qualities, eradication can be a difficult and time consuming process. The two most documented methods for successful eradication have been burning the honeysuckle and applying glyphosate (RoundUp) either to the whole bush or to cut stems (Batcher and Stiles, 2000; Minnesota Department of Natural Resources, 2003). Both of these methods take more than one year to prevent it completely from reestablishing itself (Batcher and Stiles, 2000). One reason is that the seed bank in the surrounding soil may be quite high due to *L. maackii*'s high seed production. In this study, a practical approach was taken where *L. maackii* was mechanically removed and the cut stems were directly treated with concentrated glyphosate to determine whether the opened canopy would enable the once abundant wildflowers to reestablish themselves.

Materials and Methods

The study was conducted on private property in Charleston, Illinois (39°28'N, 80°10'W) from mid May to mid July 2003. The plot was divided into three, 20 meter transects, running east to west (Figure 1). In transects A and B, the mature honeysuckle stems were mechanically removed 10 cm above soil level. Transect C was a control transect where no honeysuckle was removed. Once the honeysuckle was removed, an 18% solution of glyphosate (phosphonomethylglycine) was applied with a paintbrush to the stems contained within a two meter perimeter of transect A.

Prior to any honeysuckle removal, an initial inventory of the mature honeysuckle, including number and height of mature bushes, number of stems on each bush, and stem diameters, was recorded. Also, an initial inventory of the plants in alternating, 0.5 m^2 quadrats (40 quadrats per transect) was taken (Figure 2). After the honeysuckle stems were removed, six weekly inventories of each transect were conducted to monitor any regrowth of the honeysuckle stems and the growth of the understory plants. In addition, weekly measurements were taken of the light intensity (13 cm above soil surface) and soil temperature (5 to 8 cm below soil surface) of each transect, consisting of the average of three measurements spaced along each transect.

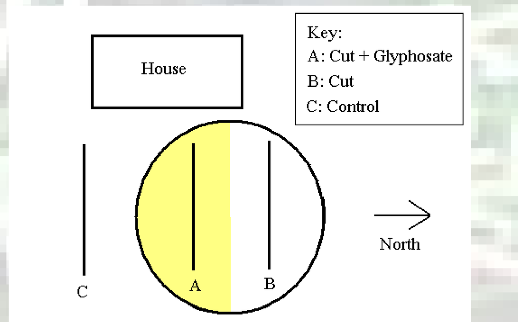

Figure 1. Layout of study site. The circle represents the area where the honeysuckle stems were cut. The shaded area indicates where glyphosate was applied to the stems.

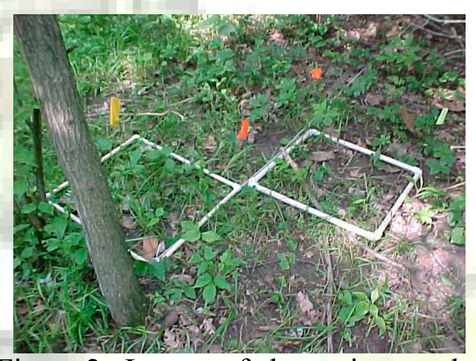

Figure 2. Layout of alternating quadrats along transect A.

Figure 3. Regrowth from cut *Lonicera* stems

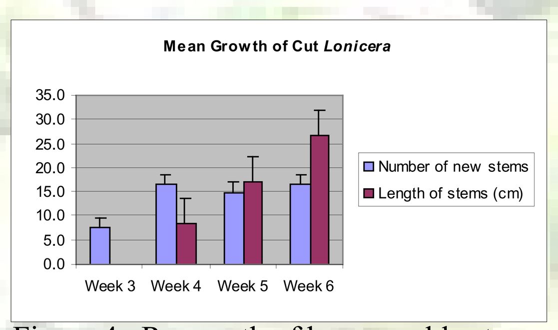

Figure 4. Regrowth of honeysuckle stems after mechanical stem removal only.

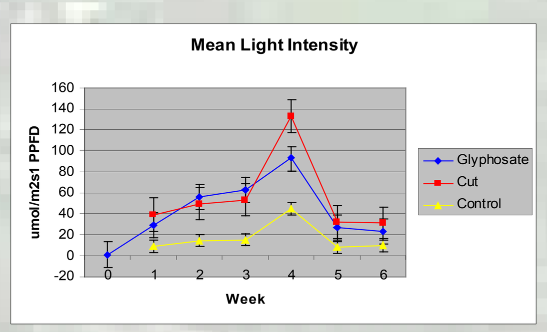

Figure 5. Mean light intensity in each of the three transects.

Results

The initial measurements of the mature honeysuckle and the understory plants are shown in Table 1 and Table 2, respectively. After three weeks, shoots started to emerge on the cut honeysuckle stems in transect B (no glyphosate). At this time, most of the shoots were just buds, so no measurements were made of shoot length. Starting at week four, stem lengths and combined values for stem length multiplied by stem number (to provide an indication of overall growth) were calculated (Figures 3 and 4). No shoots sprouted on the honeysuckle where glyphosate was applied. Weekly measurements of light intensity and soil temperature are shown in figures 5 and 6, respectively. Both the glyphosate and cut transects had higher mean light intensity and soil temperature; however, there was no significant difference between the transects for mean soil temperature.

Statistical analysis was done on *Lonicera maackii*, *Viola pratincola*, *Acer negundo*, and species richness using SPSS 11.0. Each of the species was tested using a univariate analysis of variance. The *Lonicera maackii* (Figure 6) did not show a significant difference ($p>.05$, df = 2) for any of the weeks. *Viola pratincola* showed a significant difference in all of the weeks ($p<.05$, df = 2) for all of the transects, including its initial inventory, suggesting that it is not a useful species to use to indicate the effect of honeysuckle removal. *Acer negundo* (Figure 8) was the last species tested. Its initial probability value was 0.289 with df = 2. The Tukey test showed that on the third week there was a significant difference between transects A and the control and B and the control ($p = 0.004$, df = 2) but not between the two transects where the *Lonicera* was removed (A and B). Species richness (Figure 9) was tested using a univariate analysis of variance. Before the honeysuckle stems were cut, there was no significant difference between treatments. At week 4, there was a significant difference ($p = 0.007$, df = 2) between the control and transect A. This was the only week where there was a significant difference between treatments.

Table 1. Initial inventory of mature *L. maackii* contained within the three treatment areas.

	Number of Honeysuckle Bushes	Honeysuckle Bushes per Square Meter	Mean Height (m)	Mean Number of Stems per Bush	Mean Stem Diameter
Glyphosate	34	3.4	2.6	4.4	22.9
Cut	23	2.3	3	5	38.1
Control	30	3	3	3.5	24

Table 2. Overall mean frequency (plants/m^2) of understory plant species by transect for all weeks.

	Glyphosate	Cut	Control
Acer negundo	6.2	6.2	4.7
*Ajuga reptans**	0	6.4	0
Brachythecium oxycladon	1.9	0.4	0.4
Carex jamesii	1.6	1.1	0.1
Geum canadense	1.8	0.2	1.3
Lonicera japonica	0.03	0.1	3.0
Lonicera maackii	17.5	18.4	15.4
Morus alba	0	0	0.1
Rosa multiflora	0.4	0.1	0.4
Sambucus sp.	0	0.4	0
Smilax hispida	0.07	0.03	0.17
Toxicodendron radicans	0.7	0	0.5
*Vinca minor**	0	0	7.3
Viola pratincola	10.9	31.7	0.7
Other	0.7	0.5	0.3

* Percent cover was determined since individual plants overlapped.

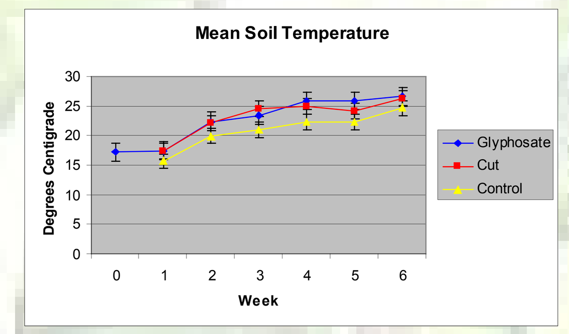

Figure 6. Mean soil temperature in each of the three transects.

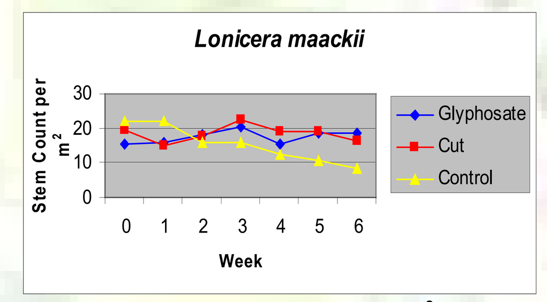

Figure 7. Mean stem count per m^2 of *Lonicera maackii* seedlings in the three transects.

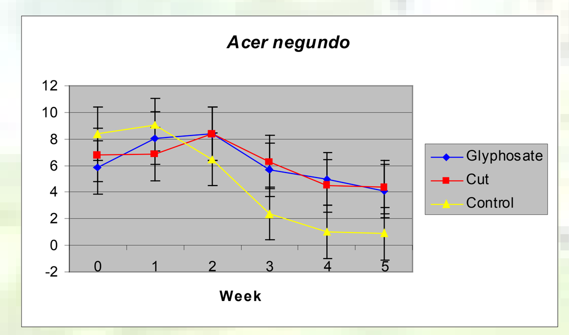

Figure 8. Mean stem count per m^2 of *Acer negundo* seedlings in the three transects.

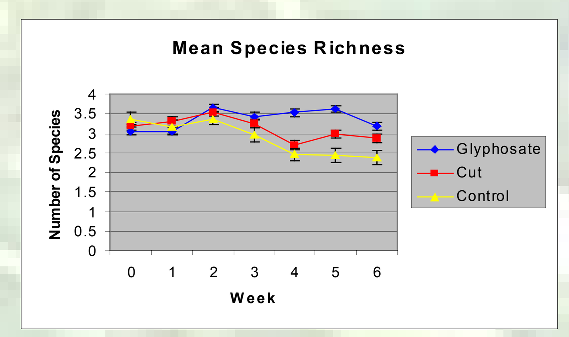

Figure 9. Species richness in the three transects.

Discussion

The initial inventory of the mature honeysuckle indicates similar plant densities and sizes of the bushes, enabling useful comparisons between the three transects. The data demonstrate that honeysuckle is a dominant species at this location. Cut stems without glyphosate application initiated new shoots within three weeks, illustrating the inefficiency of mechanical removal as a singular eradication method. By contrast, no stems were initiated on the stems where glyphosate was applied, suggesting that these individuals were killed by the herbicide. However, the plants would need to be observed for an additional year to be certain that regrowth was not simply delayed by the glyphosate treatment.

Our results are in accordance with Hutchinson and Vankat (1997) in that the light intensity was noticeably lower in the control compared to transects A and B (Figures 4), although no significant difference was demonstrated for soil temperature (Figure 5). This difference indicates that *L. maackii* produces a lot of shade and might be a reason why fewer herbaceous plants grow underneath the honeysuckle.

There were some differences in the understory species between the transects where the *Lonicera* were removed and the control transect; however, continued monitoring may be needed to observe the long term effect of the *Lonicera* removal. By week three, there were significantly fewer *Acer* seedlings in the control transect than in the two removal transects, suggesting that it is an opportunistic species. Again, it will be interesting to see whether their establishment into the transects where *Lonicera* was removed continues next year.

Our results agree with Collier's and Vankat's (2002) findings that species richness is lower under *Lonicera maackii*. This result makes sense given *L. maackii*'s invasive qualities, namely its ability to form dense canopies. It is interesting that, in the initial inventory, there were more *Lonicera* seedlings in the control transect than in either A or B. However, after the honeysuckle was removed from A and B and the canopy was opened, the *Lonicera* seedlings in transects A and B increased slightly, while at the same time decreased in the control transect over the length of the study. If the trends continue into next year's growing season, the transects where *Lonicera* was removed will start out with an increased species richness and this increase would likely persist, as long as the cut *Lonicera* stems did not resprout and new seedlings did not emerge from the seed bank.

Acknowledgements

The authors would like to thank Dr. Janice Coons for access to the site and Dr. Scott Meiners for statistical consultation. This research was supported, in part, by funds provided by the National Science Foundation-Research Experience for Undergraduates (NSF-REU) program.

REU
Research Experience for Undergraduates

References

Batcher, M. S. and Stiles, S. A. 2000. The Nature Conservancy, Element Stewardship Abstract for the bush honeysuckles. Retrieved from www.tncweeds.ucdavis.edu/esadocs/documnts/loni-sp.pdf.

Collier, M.H. and Vandat, J. L. 2002. Diminished plant richness and abundance below *Lonicera maackii*, an invasive shrub. American Midland Naturalist 147:60-71.

Hoffman, R. and Kearns, K. 1997. Wisconsin manual of control recommendations for ecologically invasive plants. Bureau of Endangered Resources. pp. 19-21.

Hutchinson, T. F. and Vankat, J. L. 1997. Invasibility and effects of Amur honeysuckle in southwestern Ohio forests. Conservation Biology 11(5):1117-1124.

Gould, A. M. A. and Gorchov, D. L. 1996. The competitive effects of the invasive shrub *Lonicera maackii* on native annual forest understory herbs. American Journal of Botany 83(6):66.

Gould, A. M. A. and Gorchov, D. L. 2002. Effects of the exotic invasive shrub *Lonicera maackii* on the survival and fecundity of three species of native annuals. American Midland Naturalist 144:36-50.

Luken, J. O., Kuddes, L. M., and Tholemeier, T. C. 1997. Response of understory species to gap formation and soil disturbance in *Lonicera maackii* thickets. Restoration Ecology 5(3):229-235.