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Beautiful Species to Hate:

Non-native Bush Honeysuckles: Invasive *Lonicera* species in the Midwest

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Introduction

Bush Honeysuckles, *Lonicera maackii, L. morrowii, L.tatarica,* and *L. ×.bella,* are invasive exotic shrubs naturalized throughout the midwestern United States, eastern United States and eastern Canada. Although most *Lonicera* populations can be traced to introductions starting in the late 1800's (Luken 1991). *Loniceras'* radiation into native habitat has been known since the late 1700's. In a 1791 letter, Thomas Jefferson mentions "the honeysuckle (probably *L. sempirvirens or L. japonica*) of the gardens growing wild on the banks' of the Little George." In the following pages, I will review our current state of knowledge on bush honeysuckles, including their effects on forest and open field ecosystems, their ecology and physiology, and management strategies for their control or eradication. Although, each of these species have differences in range and aggressiveness, I will treat the bush honeysuckles as a group since they are similar in terms of both their ecology and management. Moreover, several of these species hybridize.

Range and Species Description

Bush honeysuckles are upright, deciduous, multi-stemmed shrubs that can have a variety of forms depending on the species. They have intense, elliptical green leaves that contrast with a large crop of yellow to crimson berries. Invasive honeysuckles can easily be distinguished from native honeysuckles by their hollow pith stems. The largest specimen of the non-native group is *L. maackii* or Amur honeysuckle; it can grow to be 6 meters tall in open areas with full sun. Its present range in the U.S. is North Dakota to Texas east to Massachusetts and Georgia (Ed Hedborn, personal communication 11-30-00; Luken 1996). *L. maackii* is originally native to China, Korea and Japan and was first brought to North America in 1896 to the Dominion Arboretum in Ottawa, Canada (Luken 1996). Other reports indicate that *L. maackii* has been in the eastern U.S since 1855 or 1860 (Dirr 1983 in Mehrhoff 2000).

Lonicera tatarica, Tatarian honeysuckle, was introduced in 1752 and numerous times since. It is widely distributed as a horticultural species with flower or corolla colors ranging from deep red to white. It has a compact form growing up to 3 meters tall. Originally from Central Asia and Russia, its present range is the northern half of the U.S. from Montana to California east to Maine and Virginia (Ed Hedborn, personal communication 11-30-00; Luken 1997; Mehrhoff 2000).

Lonicera morrowii , A. Gray Morrow's Honeysuckle, has a short compact structure up to 2 meters tall. Its leaf shape is oval with pointed tips. Corolla color is usually white and occasionally pink (Luken 1997). Originally from Japan, it was brought to North America in the late 1800's (Luken 1996). It is naturalized in a broad band from Minnesota to Arkansas east to Maine and South Carolina; disjunct populations are present in Wyoming and Colorado (Ed Hedborn, personal communication 11-30-00; Luken 1996).

Lonicera ×bella is a fertile hybrid of *L. morrowii and L. tatarica* and can back cross with *L. morrowii*. It is present locally in the same range as *L. Morrowii*. This hybrid is the most aggressive of all the bush honeysuckles (Mehrhoff 2000). I can personally attest to this after watching them invade my family's land in southwestern Wisconsin over the past ten years (Figure 1). *L. × bella* is difficult to distinguish between *L. morrowii*. Both can have yellow or orange berries instead of red. This hybrid and *L.morrowii* have "wide ecological amplitude;" they can occupy dry uplands to wetlands in both open and forested ecosystems (Mehrhoff 2000). The breadth of habitat that *Lonicera ×bella* exhibits suggests that hybrid vigor or introgression may be an important aspect of this group's invasiveness. The propagation of these plants in the United States has allowed species with different native ranges to interbreed and hybridize. It is not known to what extent hybridization and backcrossing has contributed to the vigor and fecundity naturalized honeysuckles.

Figure 1. Invasion front of *Lonicera x. bella* in Southwestern Wisconsin (Photo credit: R. Rich).

As is the case with other invasive shrubs, bush honeysuckles were grown, promoted and distributed as a horticultural and hedge species. It was available from eight commercial nurseries throughout the United States in 1931. The USDA Soil Conservation Service (Natural Resource Conservation Service) promoted bush honeysuckles from the 1960s until 1984 for habitat improvement. Ease of its cultivation, seed harvesting and seedling survivorship made it a favorable species for distribution. Some cultivars of *L. maackii* were still commercially available as of 1996. (Luken 1996)

Ecosystem Description

Bush honeysuckles occupy a wide range of North American open and wood lands. Typically they can be found in along the transition between mesic hardwood deciduous remnants and disturbed open lands such as old farm fields or pastures (Curtis 1959). *Lonicera spp.* may be present with a variety of other weed species and invasive species such as *Rhamnus cathartica* (Schmidt and Whelan 1999). Centers of invasion are often near cities or towns where the plants were used as hedges of ornamental shrubs and spread into the surrounding landscape. One manager states "it has been my observation that Amur honeysuckle is most common in disturbed, degraded woods. It is less common, and has a harder time getting established in less disturbed woodlands (Ed Hedborn 11-30-00)."

What makes Bush Honeysuckles a successful invasive?

Non-native invasive species share several characteristics that distinguish them from their native competitors. These include high seed and biomass productivity, effective seed dispersal, extended growth period and absence of natural controls (MnDNR website). I will address each of these characteristics with respect to available information on *Lonicera spp.*

High seed and biomass productivity

Lonicera spp. have similar or greater biomass productivity than their native counterparts. At least two studies have compared morphological and physiological traits of *Lonicera spp*. to native flora. One such study examined trends in photosynthesis in open and understory habitats in southern Ohio. In open light environments, *Lonicera maackii* had maximum stem elongation at 100% PPFD (photosynthetic photon flux density) while *Lindera benzoin* (Spicebush) maximizes stem elongation with only 25% PPFD (Luken et al. 1997). Thus, in open light environments, *Lonicera maackii* has the ability to use more light and produce more photosynthate than native plants. Stem relative growth rate (RGR) was significantly greater for *Lonicera maackii* in 25% of full sun, too. In general, *Lonicera maackii* showed more characteristics of a shade intolerant plant while *Lindera benzoin* showed characteristics of a shade tolerant plant. However, *Lonicera maackii* was also able to equal or exceed *Lindera benzoin* growth in low light environments. (Luken et al. 1997) *Lonicera ×bella* also has similar growth characteristics but was more light limited in forest understory. (Harrington et. al. 1989) This study is of limited use since it s *L. maackii* of dry to mesic open woods to *L. benzoin* a native of shaded floodplain forest. Thus, moisture availability may also have an influence on habitat and competitiveness (Ed Hedborn, personal communication 11-30-00). I have found no studies that empirically quantify or compare seed productivity between *Lonicera spp* and native species. However, published accounts often refer to large seed productivity as outstanding characteristic of *Lonicera spp*. (Luken et al. 1997; Schopmeyer 1974; Ingold and Craycraft 1983; and Field and Mitchell 1988 in Williams 1992). Moreover, seed production of non-native *Lonicera* in the United States is equivalent or greater than in their native ranges in Asia due to horticultural breeding or hybridization. In Europe, seed production has always been lower due to climatic differences (Luken 1996).

Effective seed dispersal

Several studies have looked at the seed dispersal and germination rates in *Lonicera spp. Lonicera spp.* are not known to spread by root sprouts, so new areas must be colonized by seedlings. In *Lonicera maackii*, there is only a short time between dispersal and germination; this results in a lack of a persistent seed bank. In a laboratory experiments, seed germination began as soon as eighteen days after exposure to light in warm, moist conditions; seeds in the dark were delayed but not inhibited (Luken 1995). Germination rates were significantly higher ($p < .01$) (from 53.7% to 81.3%) in light than in dark (31.3% to 55.0%). These high germination rates indicate this species likely has a small seed bank, which gives hope that it can be successfully eradicated with minimal long-term maintenance assuming no further influx of seed (Luken 1995). Natural seedling germination also demonstrated these patterns. Seedling distribution increased from 5-328 seedling/ m2 along transects from interior forests to forest edges. This was highly correlated with PPFD (photosynthetic photon flux density) ($r = .88$) (Luken and Goessling 1995).

Over 20 species of birds are known to eat and disperse *Lonicera* seeds (Williams 1992). There is evidence that *L. maackii* distribution is linked to this dispersal mechanism (Williams 1992; Hutchison and Vankat 1998). One study found that *Lonicera maackii* seed dispersal depends on landscape structure where invasion potential is correlated with forest connectivity and edge availability. Two, 3.2 km, belt transects located north and west of Oxford, Ohio were compared for their % forest cover and honeysuckle distribution. *L. maackii* was absent from areas where forest cover dropped below 5%. It was not clear if it was the landscape connectivity or simply forest cover that facilitated invasion since *L. maackii* was also found in outlying patches. In either case, the lack of open field colonization makes sense since seeds are dispersed from birds that tend to remain under forest cover. This study implies that invasibility of an area by *Lonicera spp*. will increase with more landscape connectivity for wildlife and other ecological purposes. *Lonicera spp.* are an extremely effective edge colonizer (Hutchison and Vankat 1998).

Honeysuckle seed availability is not limited by seed predation or herbivore digestion as native species' seed might be. For example, small mammal seed consumption was found not to have a significant effect on *Lonicera maackii* seed number or germination (Williams et al. 1992). Although, small mammals were not deterred from eating seeds by the bitter pericarp, digestion did not influence the seed survival. In laboratory tests, 84-88% of seeds survived the digestive systems of *Peromysus leucopus*, white-footed mouse (Williams et al. 1992). I was unable to ascertain whether seed predation and digestion by birds was similar to the latter study for small mammals. This seed consumption information is important to allay concerns that removal of *Lonicera spp.* will negatively impact wildlife. *Lonicera spp.* seeds have not supplanted native food sources (Williams et. al 1992; Luken 1996).

Extended growing season

Non-native *Lonicera spp.* have an extended growing season compared to native species (Harrington 1989). Leaf emergence was one week earlier in *Lonicera bella* than other exotic and native shrubs. Leaf senescence was 3 weeks later than native *Prunus serotina* (wild black cherry) and 2 weeks later than *Cornus racemosa* (grey dogwood) (Harrington 1989). The consequences of these phenologic differences are substantial in understory or edge environments; Thirty-five percent of the annual carbon gained occurred prior to overstory or *C. racemosa* leaf emergence and approximately 10% of the annual carbon gain occurred after leaf senescence (Harrington 1989). Moreover, early leaf emergence puts *Lonicera spp.* in direct competition with native spring ephemeral herbs (Hoffman et. al 1997).

Absence of natural controls

I have found few references to natural controls for *Lonicera spp.* There is an introduced European honeysuckle aphid *Hyadaphis tataricae* that limits flower and fruit production of *Lonicera spp*. However, native ladybird beetles control this aphid (Nyboer 1992). Another natural control for some areas might be *Juglans nigra* (black walnut) or other members of the Juglandaceae family. They produce juglone, an allelopathic compound, which inhibits stem elongation and lower germination rates of *L. maackii* (Rietvald 1983). The usefulness of juglone in the field is doubtful; amur honeysuckle is often seen growing in the directly under *Juglans nigra* at the Morton Arboretum (Ed Hedborn, personal communication 11-30-00).

Effects of bush honeysuckles on native plants and animals

Bush honeysuckles have direct effects on the surrounding plant community. *Lonicera maackii* was negatively correlated with herb cover, tree seedling density and species richness in southwestern Ohio (Hutchison and Vankat 1997). One recent study hypothesized that *L. maackii* had a negative effect on the demography of native plant populations. Three experimental units were created where *L. maackii* was either absent, removed or left in place. The survival and fecundity of three native plants, *Galium aparine*, *Impatiens pallida* and *Pilea pumila*, were measured in each of these experimental units. *L. maackii* significantly reduced fecundity of all three species in both treated sites where *L. maackii* had colonized. The site with *L. maackii* present had the lowest fecundity in most cases. Fitness (as expressed by seeds per surviving seedling) was greater for all three native species where *L. maackii* was removed. The effects of *L. maackii* on native plant survival were less clear; there was no significant treatment effect on *P. pumilla* survival. *G. aparine* had significantly greater survival in one site where *L. maackii* was removed (87%) compared to *L. maackii* present (79%) but not on another site with the same experimental units (Gould and Gorchov 2000) It was not determined why *L. maackii* has such a profound effect on native vegetation. The shrub form of *L. maackii* may reduce light availability to the herbaceous layer (Gould and Gorchov 2000). Allelopathy may be another factor. Extract from leaves and tissues of *L. maackii* has been known to reduce germination in *Fraxinus americana*, (white ash) and *Acer saccharum* (sugar maple) (Gorchov 1995 in Gould and Gorchov 2000).

Bush honeysuckles also affect wildlife populations. *Turdus migratorius* (American Robin) nests in non-native *Lonicera maackii* and *Rhamnus cathartica* (common buckthorn) had higher predation rates than in native vegetation. Increased predation is attributed to the lower nesting height as compared to native tree species (Schmidt and Whelan 1999). Lack of structural defenses such as thorns and a branching structure that increases predator accessibility may also affect predation rates. Furthermore, robin nesting on *Lonicera spp*. increased throughout the study despite increased predation. This increase could be attributed to the early leaf emergence of *Lonicera spp.* coinciding with robin early-migration patterns (Schmidt and Whelan 1999).

Non-native species are also changing competition dynamics between robins and wood thrushes. Although the nature of this interaction is not yet understood, it is clear that these two species share in their use of *Lonicera spp.* Wood thrushes experienced more predation on their nests than robins did when these species were nesting in *Lonicera spp.* concurrently. Clearly, invasive species are impacting both the location and success of songbird breeding (Schmidt and Whelan 1999).

Management Strategies

No single control mechanism can eradicate bush honeysuckles. Successful control includes use of several control techniques and knowledge of *Lonicera spp*. phenology.

Site level control and eradication

Lonicera species will be most effectively removed when they are young and small. At this stage, seedlings can be hand pulled when soils are moist. Seedlings are easily seen in the early spring because of this species' early leaf emergence (Figure 2). Larger plants may also be pulled because their root systems are shallow and not interconnected. In erosion prone or sensitive habitats, this technique should not be used (Nyboer 1992). Invasions can be prevented if seedlings are killed or removed before fruit production begins at 3-5 years old (Luken 1996).

Figure 2. Early spring foliage of *Lonicera* (Photo credit: R. Rich).

A combination of cutting and herbicide is most effective. Large stems can be cut with brushcutters, chainsaws or hand tools. Cutting will encourage intense resprouting if not followed by herbicide treatment. The management standard is 20% glyphosate (Roundup ™ or Rodeo ™*) either sprayed or applied to cut stems (Nyboer 1992; Hoffman et al. 1997). My favorite personal application technique is a "spongy" toilet bowl cleaner because it gets a thorough amount to stumps effectively and efficiently. The 20% glyphosate concentration is lower than the recommended manufacturer concentration but works effectively for Round up™. Application timing is important. Application should occur in late summer, early fall or dormant season (Nyboer 1992). Spring applications are less effective on stumps because resources are flowing to new buds instead of the roots (Hoffman et al. 1997). Glyphosate is a non-selective herbicide should be applied carefully otherwise native vegetation will be killed. The Wisconsin DNR recommends using triclopyr formulated for dilution in oil for applications on stumps. They find winter treatment is more effective than spring treatment (Hoffman et al. 1997).

Leaves and flowers may also be sprayed in from late June to early fall. On leaves, a 1% to 1.5 % foliar spray has been used on dry upland and wetter site respectively (Nyboer 1992). Spring applications to foliage do not work from my own personal experience. Other herbicides such as Krenite are effective when applied following label instructions. Garlon is not effective against honeysuckles (Nyboer 1992). Reapplication of herbicide and recutting will probably be necessary to stop resprouting, although this may depend on whether the honeysuckle is in interior forest versus edge or open community. One recent study measured resilience of *Lonicera maackii* to repeated clipping in forest versus open grown plants. Forest-grown plants were less resilient than open grown plants; suggesting that forest is a secondary habitat for this non-native species. Repeated clipping in forest locations indicates that root reserves can be exhausted leading to death. This finding is consistent with the *Lonicera's* shade intolerant physiology. This study contends that forested sites may be controlled by mechanical means if reliable labor is available over a 5-year period (Luken 1991). After initial control the site should be repeatedly checked for new seedling germination. Evidence suggests that the *Lonicera spp.* seed bank can be exhausted since the seeds are short-lived (Luken and Goessling 1995). Moreover, new native plants or seeds need to be introduced to fill the niche from the non-native loss (Luken 1996).

Repeated burning may have a similar effect to cutting in open areas. On the heritage trail in northern Illinois, ten years of burning in open areas along with seedling weeding has exhausted the resprouting ability of *Lonicera maackii* (Ed Hedborn personal communication, 11-30-2000).

More evaluations and experiments are needed to verify their effectiveness of various techniques on *Lonicera spp.* This is especially true in the case of herbicide applications where over-spraying can have deleterious impacts on the surrounding and downstream environment.

Long-term and landscape level control

There are several approached to reducing landscape level invasion by bush honeysuckles. The best approach would be to catch newly colonized areas before they start producing seeds. This method would effectively stop the spread of honeysuckle into new areas but may be impossible to accomplish. Since individuals in open ground or edges are more productive than interior forest populations, these species should be targeted for eradication or at least prevented from seeding. Eradication of forest plants would be easier to achieve since *Lonicera spp.* are less resilient (Luken 1996; Luken et al. 1997). Native species such as *Viburnum, Cornus* or *Corylus* should be planted to replace removed honesuckle after restoration (Whelan 1995). Honeysuckle control will be impossible with out official coordination from natural resource officials because any site eradication will only be temporary if proximate seed sources are still available. Natural resource managers should also be aware that increased connectivity influences the spread of honeysuckle throughout an area. A long-term approach to limiting honeysuckle habitat would be to reduce the amount of forest edge in an area.

Any new breeds of this plant should be bread for lower seed germination, and production (Luken 1996). Ideally, these species would no longer be sold in North America.

Conclusions

Bush honeysuckles are an aggressive and stubborn invasive shrub naturalized throughout the midwestern and eastern United States. They can out-compete native shrubs through high growth rates, high seed production, and effective seed dispersal. Moreover, they seem ideally suited to colonize forest edges that abound in the rural and suburban United States. Successful control of *Lonicera spp*. through repeated cutting and herbicide applications is possible. Site eradication can work since honeysuckle seeds do not remain viable for long. Vigilance is required to maintain these areas honeysuckle-free by weeding and killing new individuals before they begin seed production. Widespread honeysuckle removal is worthwhile because of its adverse effects on both songbirds and native vegetation.

Literature Cited

Curtis, J. T. 1959.The Vegetation of Wisconsin. University of Wisconsin Press: Madison, WI. 417 p.

Gould, A.M.A; Gorchov, D.L. 2000. Effects of the exotic invasive shrub *Lonicera maackii* on the survival and fecundity of three species of native annuals. Amer. Midl. Nat. 144: 36-50.

Harrington, R.A; Brown, B.J; Reich, P.B. 1989. Ecophysiology of exotic and native shrubs in Southern, Wisconsin. Oecologia 80: 356-367.

Hedborn, Ed. Plant Resources Manager, Morton Arboretum, Lisle, Illinois. November 30, 2000.

Hoffman, R; Kearns, K. 1997. Wisconsin manual of control recommendations for ecologically invasive plants. Bureau of Endangered Resources. Madison, WI. 19-20.

Letters of Thomas Jefferson 1760-1826 <<www.history1700s.about.com>> (Accessed September 24, 2000.)

Luken, J.O. 1997. Bush Honeysuckles in ed. Randall, J.M; Martinelli, J. Invasive Plants: weeds of the global garden: 21st Gardening Series no.149. Brooklyn Botanic Garden: 112.

Luken, J.O; Goessling, N. 1995. Seedling distribution and potential persistence of the exotic shrub *Lonicera maackii* in fragmented forests. Amer. Midl. Nat. 133:124-130.

Luken, J.O; Kuddes, L.M; Tholemeir, T.G. and Haller, D.M. 1997. Comparative responses of *Lonicera maackii* and *Lindera benzoin* to increased light. Amer. Midl. Nat. 138: 331-343.

Luken, J.O; Mattimiro, D.T. 1991. Habitat-specific resilience of the shrub Amur honeysuckle (*Lonicera maackii*) during repeated clipping. Ecological Applications 1: 104-109.

Luken, J.O; Thieret, J.W. 1996. Amur honeysuckle, its fall from grace. Bioscience 46:18-24.

Mehrhoff, L .J. "The non-native honeysuckles occurring without cultivation in Connecticut. Notes from the G. Safford Torrey Herbarium, N.S.1" <<www.eeb.uconn.edu/collections/herbarium/herbariumother/lonicera.html>> (Accessed 10/26/00)

Nyboer, Randy 1992. Vegetation Management Guideline: Bush Honeysuckles- Tatarian Morrow's , Belle and Amur Honeysuckle. Natural Areas Journal 12(4): 218-219.

Rietvald, W.J. 1983. Allelopathic effects of Juglone on germination and growth of several herbaceous and woody species. Journal of Chemical Ecology 9(2): 295-308.

Schmidt, K. A; Whelan, CJ. 1999. Effect of exotic *Lonicera* species and *Rhamnus* on songbird nest predation. Conservation Biology 13(6): 1502-1506.

Whelan, C.J; Dilger, M.L. 1995. Exotic, invasive shrubs: a paradox revisited. Natural Areas Journal 15(4): 296.

Williams, C.E; Ralley, J.J; Taylor, D. H. 1992. Consumption of the invasive Amur honeysuckle, *Lonicera* maackii (Rupr.) Maxim., by small mammals. Natural Areas Journal 12(2): 86-89.

Wisconsin Department of Natural Resources "Exotic Bush Honeysuckles" <<www.dnr.state.wis.us/org/land/er/invasive/factsheets/honeysuckles.html>> May 5, 1999 (Accessed 9-24-00)