INVASIVE PLANTS AFFECTING THE MANAGEMENT OF OHIO'S FORESTS

Joanne Rebbeck, Todd F. Hutchinson and Robert P. Long
Northeastern Research Station, USDA Forest Service, 359 Main Road, Delaware, OH 43015

Abstract

Introduction

Mixed oak forests dominate much of southeastern Ohio. During the mid-1800s, vast areas of forests were completely cleared of timber to supply charcoal for more than 40 local iron furnaces. The industry declined by the late 1800s and areas reverted back to forest. These current 80- to 120 year-old second-growth forests are dominated by an oak overstory while the midstory and understory are composed of shade-tolerant and fire-sensitive species such as red maple (*Acer rubrum* L.), sugar maple (*Acer saccharum* Marsh.), blackgum (*Nyssa sylvatica* Marsh.) and beech (*Fagus sylvatica* Ehrh.) (Hutchinson et al. 2003). We began studying the impact of invasive plants primarily as a result of research related to the reintroduction of fire in these forests to promote oak regeneration. Fires have been effectively suppressed in Ohio for the last 70 years or more. In western regions of the U.S., where wildfires are more intense and often catastrophic, the introduction and establishment of invasive exotics is of major concern (Brooks et al. 2004). In eastern forests, fire effects on the ability of exotics to invade forests have not been characterized.

Of the 3,000 plant species known to occur in the forests and natural areas of Ohio, about 700 species are not native (Windus and Kromer 2001). The Ohio Department of Natural Resources (ODNR) in collaboration with The Nature Conservancy generated a list of 60 invasive species threatening Ohio's natural areas. These were separated into three categories based on their invasiveness within the state: targeted, watched, and well established species. Targeted invasive species have a statewide distribution and are the most invasive and the most difficult to control. Examples from this group that could impact forested areas include garlic mustard (*Alliaria petiolata* [Bieb.] Cavara & Grande), Japanese knotweed (*Polygonum cuspidatum* Sieb. & Zucc.), amur, Japanese, morrow, and tatarian honeysuckles (*Lonicera* spp.), and multiflora rose (*Rosa multiflora* Thunb.). Watch-list species are very invasive in neighboring states and pose a potential threat in Ohio. Generally their distribution is limited but needs to be monitored. Examples include mile-a-minute weed (*Polygonum perfoliatum* L.) and Japanese stiltgrass (*Microstegium vimineum* [Trin.] A. Camus). Well established invasives are distributed statewide or regionally within Ohio and pose a moderate to serious threat. Tree-of-heaven (*Ailanthus altissima* [Mill.] Swingle) is representative of this group.

Native to China, *Ailanthus*, was first introduced as an ornamental to Philadelphia, PA in 1784 (Hu 1979). It is a fast-growing tree that can reach 25 m in height. It is dioecious and is a prolific seed producer with up to 325,000 seeds per tree in a single growing season (Hoshovsky 1988). It is also capable of aggressive clonal spread often creating dense thickets that can out-compete native trees (Burns and Honkala 1990). While considered shade-intolerant, *Ailanthus* clonal sprouts attached to a parent tree can persist in a shaded forest understory up to 20 years (Kowarik 1995). This species is often associated with disturbed open sites such as roadsides but can also invade disturbed sites in forests, from harvested stands to canopy gaps in old-growth forests (Knapp and Canham 2000). Although the long-term effects on native tree regeneration are not known, *Ailanthus* likely has a negative effect on native vegetation, because of its highly competitive traits and production of the allelopathic compound ailanthone (Heisey 1996).

Current Research Projects

Since 1952, long-term forestry management research has been conducted at the Vinton Furnace Experimental Forest (VFEF) in Vinton County, Ohio. The 1200-acre mixed oak hardwood forest is managed by the USDA FS Northeastern Research Station and owned by MeadWestvaco. In 1958, Gustav Hall published the complete vascular flora of the VFEF (Hall 1958). At that time, non-native species were limited to open disturbed sites such as roadsides and open-fields and represented

9% of the 535 species observed. No non-natives were reported within forest stands. In 2001, a new floristic survey of the VFEF was initiated (Hutchinson and Ortt, personal communication). One objective was to document long-term changes in the non-native flora. Japanese honeysuckle (*Lonicera japonica* Thunb.) and multiflora rose appear to have naturalized within interior regions of the forest at low to medium abundance. Several new species could pose a formidable threat to forested areas including Japanese stiltgrass, tree-of-heaven, and garlic mustard. The monitoring of these exotics throughout VFEF is ongoing, and appropriate eradication measurements are implemented when necessary.

From 1995-1999, Hutchinson (2004) monitored the herbaceous layer of four study sites in southern Ohio as part of an ecosystem level assessment of the reintroduction of fire into mixed-oak forests. Exotic plans were infrequent on both burned and unburned experimental units throughout the study. Exotics made up only 3% of the 452 taxa observed and none of the 77 most commonly observed taxa were exotic.

Prescribed burning (B), thinning (T), and the combination of thinning and burning (T+B) treatments were applied to three study sites in southern Ohio in 2000-2001, as part of the national Fire and Fire Surrogates Study. At one of the sites, Tar Hollow State Forest, *Ailanthus* became established in high densities in some areas after thin and thin+burn treatments were completed. In 2003, we mapped the pre-treatment distribution of *Ailanthus* trees, quantified post-treatment *Ailanthus* seedling/sapling abundance in 5m-radius plots (N = 280), and assessed the relationship of *Ailanthus* establishment to its pre-treatment distribution, treatment type, and light availability. Prior to treatments, *Ailanthus* trees (≥8 cm dbh) were present but not abundant. In 2003, 32 trees or stumps were geolocated within the study area (Hutchinson et al. 2004). Of those 32 trees, 28 were in T+B; 3 in T and 1 in B units. Pre-treatment measurements also indicated *Ailanthus* seedlings were infrequent. By 2003, small *Ailanthus* stems (0.5 to ~3 m height) were widely distributed and abundant (96% of plots) in the T+B unit, 39% of plots in the T unit, and only 13 % of plots in the B unit. Visual inspections of stems indicated they originated as seedling germinants during the 2001 growing season. Open sky (%) and *Ailanthus* abundance were not significantly correlated. Our results show that the pre-treatment distribution of *Ailanthus* trees was indeed the most important factor affecting patterns of its post-treatment establishment. It is also possible that the T+B treatment enhanced germination and establishment by creating higher light levels and greater forest floor disturbance. This study shows that even when present at low densities, *Ailanthus* can disperse widely and establish in high densities after forest management activities, which may in turn inhibit the regeneration of native tree species.

Cooperative Research

A cooperative agreement entitled, "Ecological restoration of hardwood forest communities following the removal and control of tree-of-heaven (*Ailanthus altissima*)" was initiated with Dr. Brian McCarthy, Department of Environmental and Plant Biology, Ohio University in 2003. Kevin Lewis, a MS student, is working with McCarthy in the development of dose response models for three herbicides (triclopyr [Garlon], glyphosate [Roundup], and imazapyr [Arsensal]) for varying stem diameters (2.5-20 cm dbh) of *Ailanthus* trees grown under forest conditions. EZject Lance System was used to inject basal stems with encapsulated herbicides. During the summer of 2004, *Ailanthus* stems were injected with imazapyr within the T+B treatment unit of the FFS study at Tar Hollow State Forest (previously described). The objective is to assess if herbicide treatments applied a growing season prior to a prescribed fire are more effective than prescribed fire alone in the control of *Ailanthus*. An experiment is also under way at Tar Hollow State Forest to determine if neighboring trees are affected when Ailanthus is stem-injected with imazapyr. Also in progress is a study to determine how natural storage conditions affect *Ailanthus* seed viability.

Dr. Glenn Matlack and graduate student Lance Glasgow, Department of Environmental and Plant Biology, Ohio University, initiated a study of exotic plants at the VFEF in 2004. Seeds of multiflora rose and Japanese stiltgrass were planted in burned and unburned plots to determine

the effects of fire on germination and establishment. Also graduate student Doug Christen and Matlack are investigating the influence of different habitats (open or closed-canopy roadsides and forest gaps or closed-canopy forest interiors) on japanese stiltgrass at the VFEF.

Acknowledgments

We thank William Borovicka, David Hosack, Will Rohrig, Zach Traylor, Brad Tucker, and Kristy Tucker for field assistance in the Tar Hollow tree-of-heaven study. The Joint Fire Sciences Program provided funding for the Ohio Hills Fire and Fire Surrogate Study.

References

Brooks, M.T., D'Antonio, C.M., Richardson, D.M., Grace, J.B., Keeley, J.E., DiTomaso, J.M., Hobbs, R.J., Pellant, M., and D. Pyke. 2004. **Effects of invasive alien plants on fire regimes.** BioScience 54:677-688.

Burns, R.M., and B. H. Honkala. 1990. **Silvics of North America, Volume 2, Hardwoods.** Agriculture Handbook 654, USDA Forest Service, Washington, DC.

Hall, G. 1958. **The vascular flora of the Vinton Furnace Experimental Forest.** The Ohio Journal of Science. 58: 357-365.

Heisey, R.M. 1996. **Identification of an allelopathic compound from *Ailanthus altissima* (Simaroubaceae) and characterization of its herbicidal activity.** American Journal of Botany 83: 192-200.

Hoshovsky, M.C. 1988 E**lement Stewardship Abstract for *Ailanthus altissima*.** The Nature Conservancy, Arlington, Virginia, Edition Date: 88-11-30.

Hu, S. Y. 1979. ***Ailanthus***. Arnoldia 39:29-50.

Hutchinson, T. F. 2004. **Prescribed fire effects on understory vegetation across a topographic moisture gradient in oak forests.** Dissertation. Ohio State University, Columbus, OH.

Hutchinson, T. F., J. Rebbeck, and R. P. Long. 2004. A**bundant establishment of *Ailanthus altissima* (tree-of-heaven) after restoration treatments in an upland oak forest.** Page 515. in D. Yaussy, D.M. Hix, P.C. Goebel, and R.P. Long, editors. Proceedings of the 14th Central Hardwood Conference. USDA For. Serv. Gen. Tech. Report GTR-NE-316

Hutchinson, T.F., D.L. Rubino, E.K. Sutherland, and B.C. McCarthy. 2003. **History of forests and land-use.** Pages 17-27 in E. K. Sutherland and T. F. Hutchinson, editors. Characteristics of mixed-oak forest ecosystems in southern Ohio prior to the reintroduction of fire. USDA For. Serv. Gen. Tech. Rep. GTR-NE-299.

Knapp, L.B., and C.D. Canham. 2000. **Invasion of an old-growth forest in New York by *Ailanthus altissima*: sapling growth and recruitment in canopy gaps.** Journal of the Torrey Botanical Society 127:307-315.

Kowarik, I. 1995. **Clonal growth in *Ailanthus altissima* on a natural site in West Virginia.** Journal of Vegetation Science 6:853-856.

Windus, J. and M. Kromer. 2001. **Invasive Plants of Ohio. A series of fact sheets describing the most invasive plants in Ohio's natural areas.** Ohio Department of Natural Resources, Columbus OH.