Smith College:
The Campus Role in Invasive Species Management

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Abstract

Invasive species cause both economic and environmental problems, and their management is an important but controversial subject. It is important to correctly identify and classify such species so that the surrounding communities are aware of the potential problem. Most invasive species originated as ornamental plants, and, hence, are common and popular species in landscaping. This is particularly important for botanic gardens like the one at Smith College, which keep as well as import many exotic species. I observed the invasive species in and around the Smith College campus, recording the species I saw. I also searched the Botanic Garden’s plant database for invasive species. A large number of invasive species exist in both areas. The path along the Mill River exhibits many patches dominated entirely by a single invasive species, or by several invasive species occupying different niches. There are eight species listed as invasive planted intentionally on campus, and two that persist unaided. Removal of every specimen is impractical and probably unhelpful; the process would energy and money intensive with possible environmental side effects, and the high numbers of invasive species in the surrounding area would keep providing new infestations. Instead, the college should focus on regulating the spread of currently known invasives, and should invest in a system to predict whether a new species has invasive potential. Most importantly, Smith College should educate both its students and the surrounding communities about invasive species, so a more thorough plan can be formulated.
Introduction

Invasive species management and control is an important but controversial subject. Environmentalists, farmers, botanical gardens, and nurseries all have interests and opinions, which often conflict with one another. Invasive species have both environmental and economic consequences; according to the National Park Service’s Invasive Species Management Plan (2004), invasive plants and animals cost the US Economy $137 billion annually. The Ecological Society of America noted that invasive species contribute to the listing of 35 to 46 percent of all threatened and endangered species. Today, the exotic plants infest some 2.6 million acres in the national parks. Two hundred and thirty-four parks have invasive animals in need of management.

For plants, the environmental consequence most often cited is loss of biodiversity. Through mechanisms not fully understood, invasive species can quickly colonize an area and crowd out native species. A study conducted in Australia showed that where para grass, an invasive grass, was present, it usually dominated between 75-95% of a sample plot, and the mean number of taxa over such areas was reduced by 50%. Its presence also correlated with scarcity of bird species (Ferdinands, Beggs, and Whitehead 2005). Invasive species through their very definition crowd out native species and tend to create monocultures, lowering biodiversity in an invaded area and possibly impeding ecosystem function.

Some native species exhibit invasive tendencies, but few are “considered troublesome in the long-run within their own range. Natural succession…is enough to prevent one species from dominating a habitat” (NEWFS 1998a). Released from natural predators and pathogens, introduced plants can grow unchecked. What is considered “invasive” has been debated, and it is important to have a set criteria under which species can be listed as invasive. Most non-native species are not invasive, and it is important to recognize the difference so that economic benefit
can be gained and environmental harm can be avoided. The Massachusetts Invasive Plant Advisory Group (2005) adopted a series of criteria to do just that. They list plants as “invasive,” “likely invasive,” “potentially invasive,” or “do not list at this time” based on a series of fifteen questions. A species must meet between five and nine of the main criteria to be considered invasive, likely invasive, or potentially invasive. The criteria require that the plant be non-indigenous, have the biologic potential for rapid and widespread dispersion and for existing in high numbers away from managed artificial habitat, persist without cultivation, out-compete other species, and already be widespread in Massachusetts or certain Massachusetts habitat types.

Many of the common invasive species in Massachusetts originated as ornamental or horticultural species (National Park Service 2005, NEWFS 1998a). Now, they are familiar inhabitants of landscapes, gardens (including botanic gardens), and roadsides. A walk down a neighborhood in many towns and cities would probably yield at least one Norway maple, and probably several other species as well. My area of concern is Western Massachusetts, particularly Northampton, MA and the Smith College campus. The species of interest in this area almost all popular aesthetic species—Norway maple, winged euonymus, multiflora rose, fig buttercup, Japanese Barberry, Japanese knotweed, garlic mustard, and oriental bittersweet. I approached the problem asking how Smith College contributes to or helps the problem of invasive species. Considering the status of the college as an arboretum and its prominent botanic garden, it imports a large number of non-native species, some of which are bound to be invasive. Through prudence and careful management, Smith College needs to be able to minimize its impact on the surrounding environments, whether from existing, new, or future plantings.
Methods

In order to examine this topic, I gathered both primary and secondary articles on invasive species, their characteristics, spread, and prediction methods. I also gathered information from federal and state government and non-governmental organizations that deal with invasive species management and control. Then, with the help of Denise Lello and using the New England Wild Flower Society’s “Field Manual of Invasive Plants” (1998b) and the Massachusetts Invasive Plant Advisory Group’s “Evaluation of Non-Native Plant Species for Invasiveness in Massachusetts,” I walked along the Mill River upstream from Smith Campus in order to identify and observe invasive species growing in a relatively unmanaged area. I identified the species primarily by leaf shape and description, and sometimes via the use of photograph comparison. For the Norway maples, however, I identified the tree by leaf shape first, and then broke a leaf from the stem to observe the sap; all similar native species have clear sap, while the Norway maples have white sap (Massachusetts Invasive Plant Advisory Group 2005). Using the Smith Botanic Garden Plant Database, I checked for the intentional placement of known invasive species on campus. I also observed specimens around campus and in the surrounding neighborhoods. Most of my information about Smith College came from the Smith College Botanic Garden web page.

Results

Along the Mill River, in three hours, I observed eight different invasive species. They were distributed along the length of the river; nowhere on the path could I not see an invasive species. Multiflora rose (*Rosa multiflora*) lined the path next to the river for some ways, and continued in lesser densities the entire length I walked. Japanese barberry (*Berberis thunbergii*)
and knotweed (*Fallopia japonica*) often occurred together along the river bank—not surprising, since both species do well in disturbed areas, and Japanese knotweed in particular grows well along water sources (National Park Service 2005). Winged Euonymus (*Euonymus Alatus*), garlic mustard (*Alliaria petiolata*), and Norway maple (*Acer plantanoides*) occurred along the path, but their densities varied. I found oriental bittersweet (*Celastrus orbiculatus*) only in one location, but that was densely infested. Since it was early in the season, the bittersweet did not yet have its leaves, and was only identified positively later. The worst invader of the area appeared to be the fig buttercup (*Ranunculus ficaria*), also known as lesser celandine. It carpeted the ground in many areas, allowing no other plant growth. Native wildflowers did not occur in areas dominated by the buttercup.

A search of the Smith Botanic Garden plant database (http://rbg-web2.rbge.org.uk/Smith/searchform.html) for known invasive species yielded enlightening results. Six of the species I observed along the Mill River (everything except for garlic mustard and multiflora rose) are intentionally planted on campus. Two other known invasive species, the yellow flag iris (*Iris pseudacorus*) and purple loosestrife (*Lythrum salicaria*), are also intentionally planted on campus grounds. Even though they are not listed as intentional plantings, both garlic mustard and multiflora rose exist on campus grounds; the garlic mustard, in particular, exists along roadsides and in at least one garden (which appears to be unintentional). Upon closer examination, several major plantings on campus are invasive species. A large winged euonymus sits outside Neilson library, and a very large stand of winged euonymus (it is unclear how many specimens it represents) surrounds the northwest corner of Gillett House. Norway maples dominate the slopes along the Mill River downstream from the dam; the largest trees are a mix of
species, but almost every observed sapling was a maple, and every maple I tested (by breaking off a small leaf) had white sap, and was identified as a Norway maple.

Most of the intentionally planted invasive species on campus are well established. They were probably placed before the current college staff began working, and before they were considered problematic. Considering the popularity of these species elsewhere, their presence on campus is not unexpected. The college’s stance on invasive species is not well publicized. A Norway maple removed in mid-April, a—‘‘volunteer’ left for decades to grow just off the northwest corner of Sabin Reid” (Brenda Bolduc [email] 2006)—was removed largely because of its intrusion on the building and systematics beds. Its status as an invasive species was a secondary concern, and it probably would have remained had it not caused other problems. The Botanic Garden has control over which species are planted and removed. According to Madelaine Zedak (2001), interim Assistant Director of the Smith College Botanic Garden, a

“serious problem is the proliferation of exotic invasives that are damaging ecosystems in all parts of the world. It has become the responsibility of botanic gardens to educate the public about this issue as well as to restrict distribution of known invasive materials and to monitor introduced plants for their potential to escape cultivation and become invasive.”

The Botanic Garden understands the seriousness of the issue and its role in preventing the spread of invasive species. However, prevention and control is difficult at best, and the level of infestation in this area already appears to be high.

Discussion

There are two main parts to this issue as it pertains to Smith College: control of existing species, and prevention of future invasions. Control of invasive species is complicated and difficult; removal can be expensive, time consuming, and controversial, and control is often
ineffective. There are several options for dealing with the invasive specimens on campus—remove all of them, leave the parent plants and limit spread by preventing reproduction or removing seedlings, or do nothing and remove plants as they become problematic for other reasons. A number of removal methods exist, but each species has attributes that may make it difficult to remove using some methods, meaning each species must be dealt with individually. Manual removal is effective for most species, but can be very time-consuming, and some species, such as the oriental bittersweet, can re-grow from roots left underground. Other mechanical methods include systematic defoliation, controlled fire, and mulching may be effective in some areas. Herbicides may be effective, but also may cause more damage to the area—to other valuable plants in cultivated settings, and to native species and watersheds in less managed areas. Cultural practices (such as water level management) may be used to limit spread, but may be difficult outside of an agricultural setting. Physical barriers can be placed in some areas, but are easily breached by many species. Finally, release of biological control species is possible, but may cause unpredicted damage (Weatherbee, Somers, and Simmons 2005, NEWFS 1998a, National Agricultural Library 2001). There is no simple answer as to how to remove invasive species, and, the larger the invasion, the more complicated the problem becomes.

At Smith, budget and personnel restraints, aesthetic concerns, and the need to protect the surrounding landscape limit the options for removal. In some cases, such as the winged euonymus in front of Neilson Library and Gillett House, complete removal would be unpopular as well as difficult. Many of the Norway maples on campus are large, and would require extra precautions (and expenses) if they were to be removed—and, the case of the hill near the Mill River, removal would have other severe ecological consequences—the trees would need to be
replaced. Species, such as the garlic mustard and multiflora rose, which exist on campus unintentionally could be removed systematically, but it would require constant vigilance from the College staff in order to keep these species in check. Beyond that, Smith College itself is not the only problem—Norway maples dot the streets of Northampton, with their saplings sprouting nearby through hedges and other vegetation, winged euonymus is displayed proudly in front yards, and Japanese barberry is used as a hedge bush. Considering the invasions of these species in to the Mill River area beyond Smith campus and the existence of intentional plantings in the local neighborhoods, it hardly seems like it would be worth eradicating all invasive species from campus. Smith College alone is incapable of reversing the trend of invasions in the area. Yet, it does not seem ethical to merely leave the species as they are. On the federal level, the National Agricultural Library’s National Invasive Species Management Plan (2001) states that, “When invasive species appear to be permanently established, the most effective action may be to prevent their spread or lessen their impacts through control measures.” Hence, Smith’s approach should be the second proposed approach—limit spread through reproduction, remove unintentional specimens, and monitor the status of the species. As individuals age, they should not be replaced—of course, by that time, it may be redundant to plant species so common in the area.

All of the invasive species I found in and around Smith College are on the Massachusetts Department of Agricultural Resources Bureau of Farm Products and Plant Industries’ prohibited plant list. They are either now prohibited entirely, or are scheduled to be prohibited by 2009—this bans sale, distribution, trade, purchase and related activities, although existing specimens are excluded from the ban (2005). Considering the College’s awareness and Massachusetts law, it is unlikely that new specimens of currently known invasives will be planted. However,
considering that most invasive species have horticultural origins, it is possible that Smith College could introduce a new invasive species to the area through the Botanic Garden. In the past, no one knew a species was invasive until it began causing problems—by that time, the species were already widespread and difficult to control. In order to rectify this, scientists have tried to identify criteria that could indicate a potential invasive species before it is introduced.

While many invasive species share similar traits, biological properties have proven poor predictors of invasiveness; the same can be said for geographic range (Goodwin, McAllister, and Fahrig 1999). Most of the successful prediction models used to date for invasive species have been location-specific. Daehler and Carino (2000) evaluated systems developed for use in Australia, North America, and Russia to test their effectiveness in predicting invasives. These systems sorted the plants into three categories based on their invasive potential: accept, reject, or further study. The two successful methods, the Australian (developed by Dr. Pheloung) and North American (developed by Reichard and Hamilton), both rejected more than 90% of the known invasive species, and did not accept any of them. The Australian method, which the authors determined to be the most accurate, put the species through a series of tiers consisting of 49 questions that examined their taxonomic status and relation to other invasive species, biological composition, geographic range, and behavior. This method allows for knowledge gaps and protects against bias, since a minimum number of questions—but not all—must be answered to rank a species (Australian Government Department of Agriculture 2004). The Daehler and Carino test shows that this system can be adopted successfully for use in other areas, but it requires careful review of the questions to reflect the new habitats.

The proposed theories about how invasive species can invade new territory more vigorously than the species’ native territory involve the removal of a species from its predators
and pathogens and the introduction of the species into an area that cannot compete with its natural defenses—called allelochemicals. Coevolution with native species will eventually achieve some sort of balance, although the damage to the natural ecosystem may be severely impaired (Hallet 2006). However, these mechanisms are not fully understood, and prudence would demand that botanic gardens take preventative measures before non-native plant species become invasive. William Brumback, of the New England Wildflower Society, writes, “Though more research is clearly needed, the pace of change and the potential for damage is too great to justify extended delay in beginning to take preventive measures” (2001). The Smith College Botanical Garden, as well as other botanical gardens, should keep this in mind when selecting new species for their collections. The formulation and adoption of a predictive system, like the Australian system, is time-consuming, and requires extensive research on each species, but may prevent an ecological disaster.

The Botanic Garden has an obligation—which it acknowledges—to keep campus landscaping from harming the surrounding environment. Keeping this in mind, I recommend that the college take measures to control the spread of invasive species on its own grounds, and prevent them from spreading outside the grounds. I also recommend that the college adopt a strict method for evaluating new species additions to the college grounds. Collaboration with other botanic gardens and scientists will hopefully yield a prediction method that can detect potential invasive species before they enter the biosphere. Since an invasive species may still be interested and important academically, any admitted species with invasive potential must be isolated and prevented from escaping into the environment.

Most invasive species were introduced by well-meaning individuals and groups concerned mainly with aesthetics. Early records indicate that “many plants, introduced
intentionally or by accident, were considered part of the local flora” (NEWFS 1998a). We simply did not know any better. Even in the last quarter of a century, people have planted invasive specimens, believing they are doing something good. A plaque hanging on the large winged euonymus in front of Neilson Library attests to this fact. It reads:

EUONYMUS ALATA
WINGED EUONYMUS
PLANTED BY THE CLASS OF ‘83
ENVIRONMENTAL WEEK 1981

This ironic example shows the need for an understanding of a species’ behavior before it is introduced, and for monitoring afterward. One institution may not be able to solve the problem of invasive species, even in its surrounding community, but it can at least refrain from adding to it. Smith College’s most valuable actions, however, may not be through biological control at all. According to the Greater Worcester Land Trust, the first things citizens and organizations can do to help is be aware of the native habitat and species, understand the dangers of invasive species, and learn to identify those invasive species (2005). As an educational institution, Smith College should use its landscape to educate both the students and community about invasive species. While the institution itself may not be capable of controlling the spread of invasive species, community involvement and awareness are the greatest weapons against such a daunting problem.
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