

INVASIVE SPECIES MANAGEMENT PLAN

Nobscot Scout Reservation Trail Project 1 Nobscot Road Sudbury & Framingham, Massachusetts



SUBMITTED TO:

Sudbury Conservation Commission
275 Old Lancaster Road
Sudbury, MA 01776

&

Framingham Conservation Commission
150 Concord Street, Room 213B
Framingham, MA 01702

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REPORT DATE: June 30, 2023





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June 30, 2023

Town of Sudbury Conservation Commission
Department of Public Works Building
275 Old Lancaster Road
Sudbury, MA 01776

City of Framingham Conservation Commission
150 Concord Street
Room 123B
Framingham, MA 01702

Re: Invasive Species Management Plan MassDEP File #301-1375 (Sudbury)
Nobscot Scout Reservation Trail Project MassDEP File #158-1621 (Framingham)
1 Nobscot Road
Sudbury & Framingham, Massachusetts

Members of the Sudbury and Framingham Conservation Commissions,

On behalf of the Mayflower Council (formerly known as the Knox Trail Council) with the Boy Scouts of America (Owner & Applicant), Lucas Environmental, LLC, has prepared this Invasive Species Management Plan (ISMP) as a requirement under General Project Condition II.d. of the Town of Sudbury Order of Conditions (OOC), MassDEP File #301-1375, issued for the above referenced project, and for Special Condition #33 of the City of Framingham OOC, MassDEP File #158-1621.

The ISMP includes plant species to be targeted, proposed treatment methods, potential herbicides for use in areas not within a resource area or buffer zone, seasonal timing of application, and monitoring and reporting over a five-year period, specifically for any invasive plants within 15 feet of disturbance associated with the Violation areas, in addition to the required mitigation area in the Town of Sudbury.

LE will conduct a site walk in May/early June of 2023 to identify the required area for invasive species mitigation, and confirm no other invasive species are present along the work areas. A Final ISMP will be submitted in June 2023.

If you have any questions, please do not hesitate to contact me at 617.405.4140 or cml@lucasenviro.com. Thank you for your consideration in this matter.

Sincerely,

LUCAS ENVIRONMENTAL, LLC

Christopher M. Lucas, PWS, CWS, RPSS
Environmental Consultant/Wetland & Soil Scientist

cc: Sudbury Valley Trustees; Howard Stein Hudson; Mayflower Council (electronic copies)

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SECTION I – ISMP



INVASIVE SPECIES MANAGEMENT PLAN

1.0 INTRODUCTION

Lucas Environmental, LLC, (LE) has prepared the following invasive plant species management protocol for the Nobscot Scout Reservation Trail Project located at 1 Nobscot Road in Sudbury and Framingham, Massachusetts.

Per General Project Condition II.d. of the Town of Sudbury Order of Conditions (OOC) issued for the project, which states: *“Prior to initiation of Phase I, the applicant shall submit a comprehensive Invasive Species Management Plan to the Commission and the Sudbury Valley Trustees for review and approval. Said plan shall identify any invasive plants within 15 feet of disturbance associated with this Violation and shall include monitoring and management of invasive species within this area for a minimum of 5 years. To mitigate for unauthorized work, the Plan shall also identify and include management of invasives within areas that at least match the same square footage as unauthorized disturbance. This should be concentrated in areas along the trails and near cabins, outside the work areas that are the subject of this Order. The Plan shall include protocols and timeframes for management and monitoring for a minimum of 5 years. Annual reports shall be submitted documenting mitigation efforts that have been employed. Mitigation shall commence the first growing season following issuance of this Order. Lack of adequate invasive species management and/or reporting may be cause to prevent commencement of future phases.*

In addition, as per the Sudbury OOC Perpetual Condition I.e., *“No pesticides or herbicides are allowed within a wetland resource area, including the 200-foot riverfront area, or within 100 feet of a wetland resource area (the adjacent upland resource area under the local bylaw)”*, and Perpetual Condition I.i. *“Invasive species must be manually removed from land adjacent to areas that are the subject of this Order, and may be manually removed along the adjacent trails and cabins. All invasive plants must be disposed of properly to prevent new infestations.”*

Peer Special Condition #33 of the City of Framingham OOC, MassDEP File #158-1621, *“the Applicant shall return to the Commission and provide an Invasive Species Management Plan should control of such species is necessary.”*

This document details measures to control invasive species and prevent their spread, and covers a wide range of potential invasive species control measures that could be implemented to effectively remove and control invasive species within the limit of work approved through the OOCs. Based upon field observations to date, a set of plant species has been identified which include target invasive species requiring varying degrees of management. The most effective methods will ultimately be selected from the options outlined herein, by the contractor performing the invasive species removal work. Invasive species removal work will be performed in accordance with all applicable state regulations and will be monitored for effectiveness.

This ISMP has been prepared for the invasive vegetation management in the areas required by the Conservation Commission and includes management of all invasive plant species identified within fifteen feet of disturbed areas and for the mitigation area required in the Town of Sudbury. The location for the mitigation area will be determined at a later date; however, the specifications are outlined herein.

INVASIVE SPECIES MANAGEMENT PLAN

A primary goal of the proposed ISMP is removal, or otherwise effective control, of invasive woody and herbaceous plant species in the target areas. To meet this goal, management activities focused on target invasive species performed over several years may be necessary.

Due to the presence of invasive species outside the limit of work areas, yearly management beyond this period will likely be required to avoid re-establishment of invasive species. Successful invasive species management will be for the benefit of impacted resource areas and adjacent terrestrial habitats supporting remaining native plant assemblages and associated faunal communities. Additional species will be added to the target species list after further site investigation for invasives species present.

The target species listed below include invasive tree, shrub, herbaceous, and woody vines species that have been observed on the site.

- Glossy/European Buckthorn (*Frangula alnus*)
- Multiflora Rose (*Rosa multiflora*)
- Tatarian & Morrow's Honeysuckle (*Lonicera tatarica* and *L. morrowii*)
- Burning Bush (*Euonymus alatus*)
- Oriental Bittersweet (*Celastrus orbiculatus*)
- Japanese Barberry (*Berberis thunbergii*)
- Black Locust (*Robinia pseudoacacia*)

LE has reviewed available literature on each of these target species and has modeled certain elements of the management protocol after control methods recommended by The Nature Conservancy (TNC), as well as other widely accepted guidelines and agency-recommendations for invasive species management. The management protocol presents alternatives for both mechanical and chemical (herbicide) control methods, depending on the particular species, species location in the landscape, and the most effective means of managing the species based upon current knowledge.

2.0 SIGNIFICANCE OF THE INVASIVE SPECIES THREAT

Invasive plants are non-native species that have been introduced to areas outside of their native range, where they often thrive and out-compete/overtake endemic plant communities. Non-native plants are characteristically aggressive, have few natural enemies and/or limiting biological factors within their introduced range, and tend to have very effective reproductive abilities. The spread of such plants is a major concern in the United States, as they reduce the functions and values of habitat for native flora and fauna within both wetlands and uplands and are a nuisance to manage once they have become established within an area. Adverse economic and environmental impacts are also often incurred by the establishment of invasive species.

In Massachusetts, the Massachusetts Invasive Plant Advisory Group (MIPAG), a voluntary collaborative representing organizations and professionals concerned with the conservation of the Massachusetts landscape, has been charged by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) to provide recommendations to the Commonwealth regarding which plants are invasive and what steps should be taken to manage these species.

INVASIVE SPECIES MANAGEMENT PLAN

Non-native invasive plants often displace native species over a relatively short period of time, often resulting in monotypic plant communities that lack species diversity. Species diversity is essential to maintaining an ecological balance. As is true with most exotic or non-native species, those found at the site are increasingly common throughout eastern North America, where their spread has led to a decline in species richness and cover of the local native plant communities.

Most exotic species are adapted to a wide variety of habitats and climactic conditions and are free of known diseases and/or insects or other predators native to the U.S. These plants reproduce either by producing large amounts of seeds that are readily dispersed by birds or small mammals (as with buckthorn or Oriental bittersweet), spread through underground stems or rhizomes (e.g., *Phragmites*), or both (as with Oriental bittersweet). As such, invasive plants quickly establish within a landscape, grow, and spread rapidly. Non-native species aggressively out-compete native plants and can dominate a plant community within a short period of time. In general, many of the introduced plants were widely cultivated in the past for their ornamental and perceived high wildlife values. Only in more recent years have conservationists and land managers come to realize the importance of preserving native plant communities.

MIPAG was instrumental in developing the Commonwealth's first list of invasive, likely invasive, and potentially invasive plants that have now been prohibited from importation, sale, or trade. As a result, future invasions by non-native species will be more likely due to the spread of naturalized populations, rather than new (accidental) introductions.

MIPAG has also developed a list of early detection species for the Commonwealth. MIPAG has also published its strategic recommendations to prevent, control, and where possible, eradicate invasive plant species in the Commonwealth of Massachusetts. These recommendations complement efforts at both the regional and national levels to establish an early detection and rapid response system for invasive plants. Their recommendations are published in the "Strategic Recommendations for Managing Invasive Plants in Massachusetts." More recently, MIPAG has published both the "Massachusetts Invasive Plant Species: Early Detection Priorities," (March 16, 2011) and the "Guidance for the Effective Management of Invasive Plants, Version 2" (December 2012).

3.0 INVASIVE SPECIES MANAGEMENT OPTIONS

LE has reviewed numerous resources from state and regional agencies and private organizations with land management expertise offering plant species-specific information and recommended invasive species removal and control techniques. These groups include MIPAG, the Nature Conservancy, the Massachusetts Trustees of Reservations, the SuAsCo Cisma (Cooperative Invasive Species Management Area), and other local land management experts and consultants. LE has presented much of this information in a summary format provided by Table 1 (Section II) providing information specific to the target invasive species.

The following sections of this management protocol provide species-specific information and control techniques. Because all pesticides, including herbicides, are toxic to some degree, and that even at low levels may cause serious adverse health and environmental effects, LE strongly recommends that qualified, Massachusetts-Licensed Pesticide Applicator contractors follow these or similar protocols during the project's implementation phase. Implementation should only begin once the Applicant has obtained all written approvals and all local and state review agencies have been notified as required per specific permits.

INVASIVE SPECIES MANAGEMENT PLAN

3.1 Management Techniques Overview

Selected management techniques are generally based upon the extent of a given invasive plant species within the plant community and employ a strategy that best controls the target species, while minimizing the potential for adverse impacts to other desirable (i.e., native) species. Invasive species are often difficult to completely eliminate from an area, and a practical management goal is to control, not necessarily eradicate, invasive species while simultaneously encouraging, or even introducing, a native plant community.

Methods for the management of invasive species fall into three basic categories:

- Mechanical (cutting, pulling, grubbing, covering, etc.);
- Chemical (use of herbicides); and
- Biological (using living organisms such as insects or domestic grazing animals).

In general, mechanical controls, such as cutting or pulling, have the least adverse impacts on the adjacent, native communities; however, mechanical methods are often not as effective in the control of certain plant species.

When warranted and appropriate, chemical controls (through the application of herbicides) are most effective by modest applications of specific herbicides applied to the surface freshly cut stems, which is the surface of exposed plants vascular tissue. Selective application of herbicides also functions to reduce adverse impacts on desirable native species from herbicide application. For this same reason, broad foliar spraying of herbicides is generally not recommended because of the potential for negative impacts to non-target plant and animal species, although foliar spraying may be effective in controlling larger, monotypic stands of invasive plants. Biological control, or use of living organisms as a control agent, has also been proven effective on certain species. Upon effective removal or control of invasive species, native plant species are then planted or seeded in order to restore a native plant community.

The initial invasive species removal should be conducted concurrently with the construction of the project.

4.0 PROPOSED SPECIFIC CONTROL METHODS

4.1 Glossy/European Buckthorn (*Frangula alnus*)

Glossy or European buckthorn is a deciduous shrub that inhabits typically wetter, less shaded areas with acidic soils. Fruit production of European buckthorn is abundant, and seeds are dispersed usually by birds and small mammals. This non-native shrub rapidly germinates in a variety of soil conditions, but germination is most successful in open areas where soils have been disturbed. Additionally, this species will re-sprout vigorously following top removal. In one study, researchers observed that mature shrubs cut near the base can send up sprouts nearly six feet in height in the same year (Wyman, 1971; Andreas, 1983; and Brue, 1980; as cited in Converse, 1984). This species is a huge threat to native wetland communities, where it can form dense stands that cause the growth of other species to be suppressed. European buckthorn is most successful under drier conditions in wetlands.

INVASIVE SPECIES MANAGEMENT PLAN

4.1.1 Management Protocol Options

Methods to control this species include manual and chemical management. Burning has been demonstrated as ineffective, particularly when burns are done on open land near a buckthorn population, as fire-exposed soils are more vulnerable to seed dispersal.

Manual and Mechanical Control

- Studies have shown that cutting back larger plants twice in a single growing season for two to three consecutive years results in fewer and shorter stems and reduced plant vigor. This is best done twice a season (in June and in August). Plants with stem bases less than two inches in diameter can be successfully girdled (a one inch-wide cut) during the winter months. Girdling does not disrupt soils and would not disrupt sensitive wetlands.
- Individual seedlings can be hand pulled or removed with a grubbing tool; however, this technique is only effective in areas of low buckthorn density.

Chemical Control

- Using glyphosate without a surfactant has been reported to have the greatest control with little or no harm to non-target vegetation. Herbicide application of glyphosate has been effective on cut stumps or along girdled stems.

4.1.2 Recommended Control Methods

The recommended method for control of this species is mechanical by cutting back larger plants and girdling of large-stemmed individuals. While the use of herbicide (Rodeo®) has proven effective elsewhere, it is not recommended where glossy buckthorn plants are located within or immediately adjacent to wetlands. **The Town of Sudbury has requested that this species be treated by pulling the plant and removing the roots in lieu of cutting and use of herbicide.**

4.2 Multiflora Rose (*Rosa multiflora*)

Multiflora rose is a large, thorny perennial shrub in the Family Rosaceae. This exotic species of rose can reach over 10 feet in height. Native to Asia, this species was introduced to the United States in the mid-1800s as rootstock for ornamental roses. As with many non-native species, multiflora rose tolerates a wide range of soil, moisture, and light conditions. It is found in fields, along roadsides, in waste areas, forest fragments, and on river banks. One plant can produce a million seeds and seed viability can be 20 years. The seed-containing fruits of this shrub are dispersed by birds. Low-lying branches that are in contact with the ground can develop roots and the shrub can spread vegetatively.

4.2.1 Management Protocol Options

Land managers have utilized both mechanical and chemical methods to effectively control this species.

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Manual and Mechanical Control

- Young multiflora rose plants may be removed by hand, but the entire root system must be removed for pulling to be an effective part of control.
- Mature plants may be managed by repeated cutting and mowing (three to six times a year) as a means of suppressing the plant's ability to photosynthesize. Cutting is best when populations are small and when the use of herbicides is not an option due to habitat sensitivity. Stems must be removed at least once per growing season as close to the ground level as possible. The reason for this is that the stems themselves are able to photosynthesize.

Chemical Control

- Treatment by repeated application of herbicides has proven to be an effective control method. Triclopyr may be applied in the early spring before or during flowering. Glyphosate is most effective when applied during the early summer and can be used through the early fall.

4.2.2 Recommended Control Methods

Mechanical removal methods may be most appropriate for this site for the initial treatment. Depending upon the results of seasonal monitoring and location of plants, a program involving herbicide application to plant seedlings may be appropriate. If herbicide is required, the Town of Sudbury is to be notified prior to any applications, and only if mechanical methods are proving unsuccessful.

4.3 Tatarian & Morrow's & Honeysuckle (*Lonicera tatarica* & *L. morrowii*)

Morrow's honeysuckle and the closely related Tatarian honeysuckle (i.e., "exotic bush honeysuckles") are deciduous, oppositely branched, hollow stemmed shrubs in the Family Caprifoliaceae. These honeysuckles are adapted to a wide variety of habitats, although disturbance of some kind usually precedes invasion. Fruit production of the bush honeysuckles is abundant, and reproduction is almost entirely by seeds that are typically dispersed by birds and possibly small mammals. These honeysuckles are typically among the earliest deciduous plant to leaf-out, with leaf break generally beginning two weeks earlier than for co-occurring trees. These honeysuckles contribute to reduced richness and cover of native herb communities and to reduced tree regeneration in early to mid-successional forests.

4.3.1 Management Protocol Options

Land managers have used both mechanical and chemical methods, as well as prescribed burning, to control exotic bush honeysuckles. There are no known biological controls of *Lonicera* spp.

Manual and Mechanical Control

- Mechanical controls include grubbing or pulling seedlings and mature shrubs, and repeated clipping of shrubs.
- Effective mechanical management requires a commitment to cut or pull plants at least once a year and may require more than one year of treatment. Winter clipping should be avoided as it encourages vigorous re-sprouting.

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- Repeated annual prescribed burns during the growing season will top-kill shrubs and inhibit new shoot production.

Chemical Control

- Most managers report that treatment with herbicides may be necessary for all large bush honeysuckle populations.
- Formulations of both glyphosate and Triclopyr have been used as foliar sprays or cut stump sprays and paints with varying degrees of success.
- A survey of The Nature Conservancy land managers undertaken in 1998 found that most used glyphosate, and used it as a cut stump treatment, to control *L. tatarica*.

4.3.2 Recommended Control Methods

Mechanical removal methods may be most appropriate for this site for the initial treatment. Depending upon the results of seasonal monitoring and location of plants, a program involving herbicide application to plants may be appropriate. **The Town of Sudbury has requested that this species be treated by pulling the plant and removing the roots in lieu of cutting and use of herbicide.** If herbicide is required, the Town of Sudbury is to be notified prior to any applications, and only if mechanical methods are proving unsuccessful.

4.4 Burning Bush (*Euonymus alatus*)

Burning bush, also called winged euonymus, is a perennial, fast growing, deciduous, multi-stemmed woody shrub in the Family Celastraceae that grows to 15 feet tall. It is native to northeastern Asia and is a popular and widely planted ornamental known for its bright red fall color and green stems with prominent raised, corky wings. In woodlands, burning bush forms dense thickets creating heavy shade that blocks light to native vegetation. This species thrives in forest interiors where many other invasive shrubs cannot compete in the dense shade. It reproduces abundantly by seed and the fruit is eaten and spread by birds but can also spread locally through vegetative reproduction. It is most successful in well drained soils but is also competitive in water logged soils. High white-tailed deer populations can promote establishment and spread of burning bush, as they preferentially feed on native vegetation.

4.4.1 Management Protocol Options

Land managers have used both mechanical and chemical methods to control burning bush. There is no known biological control. Control of this plant is difficult because it produces a tremendous amount of seed. Once an area has been cleared of burning bush, replant with native species to suppress resprouting and regrowth.

Manual and Mechanical Control

- Seedlings up to two feet tall can be hand-pulled by the base of the stem at any time of year, especially when the soil is moist, being sure to pull up as much of the root system as possible.
- If feasible and fruit is present, bag and dispose of fruits to prevent seed dispersal.

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- Larger plants and their root systems can be dug out with a spading fork or pulled with a weed wrench.
- Larger shrubs can be cut, and the stump ground out or the re-growth clipped.
- The shrub can be repeatedly cut to the ground, but re-sprouts must be controlled. Mowing with heavy-duty rotary blades (brush hog) or a flail cutter is an option to remove the shrub canopy, but can only be successful with follow up stem treatment (either continued cutting or chemical). Use a lopper, pruning shears, weed whacker/brush saw or mower to cut the stem as close to the ground as possible. Cut at least once during the growing season, repeating for three to five years.

Chemical Control

- The cut stumps of larger plants can be painted with glyphosate or Triclopyr immediately after cutting, following the label directions. Apply herbicide solution to the stump with a sponge or brush immediately after cutting. This is best done in late summer to early fall when plants are transporting resources to their root systems.
- Where populations are so large that cutting is impractical, herbicide (glyphosate or Triclopyr) may be applied as a foliar spray. This is most effective when burning bush plants are fully leafed out and can be done in the fall when native plants are losing their leaves, in order to minimize potential drift to native plants.

4.4.2 Recommended Control Methods

Mechanical removal methods may be most appropriate for this site for the initial treatment. Depending upon the results of seasonal monitoring and location of plants, a program involving herbicide application to plants may be appropriate. If herbicide is required, the Town of Sudbury is to be notified prior to any applications, and only if mechanical methods are proving unsuccessful.

4.5 Oriental Bittersweet (*Celastrus orbiculatus*)

Oriental or Asian bittersweet is a perennial vine in the Family Caryophyllaceae occurring in all regions of Massachusetts mainly in upland habitats including forests and forest edges, roadsides, clearings, and open rights-of-way. It was introduced to the United States in the mid-1800s. This vine often climbs to heights of 60 feet and stems may reach four to five inches in diameter. The leaves are opposite, round or elliptical, glossy, and finely toothed. Flowers appear in May. Mature fruit have bright yellow valves with one to three red seeds.

This exotic species is wide-spread and produces abundant seeds, which are spread by birds and possibly small mammals, and by humans (for instance, through the use of this plant in decorating). The stems of this woody vine wrap around and girdle trees, shrubs, and other woody vines, or may cause physical damage from the immense weight of its rapidly growing shoots. Oriental bittersweet may also spread laterally along the ground, forming an impenetrable tangled mass that smothers out all other vegetation.

It is widely recognized that management of Oriental bittersweet is difficult due to its high reproductive rate, long range dispersal, ability to root sucker, and rapid growth rates. Mechanical and chemical management techniques are described below. Management of this species requires extensive monitoring and often a multi-year commitment.

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While many mechanical and chemical methods are available, manual and mechanical methods are normally considered as temporary management strategies rather than a means for eradication. Due to the persistence of the seed bank and the ability to spread by root suckering, mechanical control of this species will require a long-term commitment. Chemical control methods are generally considered to be more effective than manual techniques and are the preferred strategy for management of bittersweet in certain locations. The preferred manual/chemical controls are as follows.

4.5.1 Management Protocol Options

Manual and Mechanical Control

- Cutting over several growing seasons may help to control a population to a certain extent. Small shoots may be mowed or cut weekly for at least a year, although less frequent mowing (two to three times a year) can stimulate re-sprouting from the roots. Larger shoots must be cut down to the ground every two weeks. It is important to cut vines as close to the root collar as possible. Cutting will eventually deplete the stored energy within the root stock, leaving only the seed bank to manage. Cutting can also result in vigorous re-sprouting from below-ground stems (rhizomes).
- Pulling or grubbing of larger plants including all roots and runners using a “Pulaski” or similar digging tool may also reduce a population, although re-sprouting is inevitable if not all the root material is removed. Even if all root material is removed, germination of seeds present in the seed bank will occur for several growing seasons. All plant parts (including fruits) should be sealed in bags and disposed of in a landfill to prevent re-establishment on a given site.

Mechanical control is most practical in small plots, or in areas where chemical control is not an option. Ultimately, manual and mechanical control is a means of restricting growth until the roots and seeds are no longer viable.

Chemical Control

Chemical control methods are preferred for management of Oriental bittersweet and are more effective than manual techniques. While both glyphosate and Triclopyr have been used to control bittersweet, most of the literature cites more effective control with Triclopyr. Triclopyr specifically targets broadleaf plants, reducing the chances of impacting nearby monocots. Triclopyr may be applied using several techniques.

- Cut-stump (or cut-stem) applications are effective and are preferred in environmentally sensitive areas. This method is also more appropriate for tall vines that have reached the tree canopy. The stems should be cut to approximately two inches above ground level, and then the cut surface should be immediately painted with concentrated herbicide (eight to twenty five percent active ingredient for Triclopyr). It is sometimes necessary to follow the cut-stump application with a foliar spray about two weeks after treatment.
- Basal bark application is another viable technique for controlling Oriental bittersweet. The foliage should be stripped from the stem in a band at a comfortable working height. A 20 percent Triclopyr solution in a commercial basal oil should be applied to the stripped area, while avoiding contact with any trees or plants the bittersweet is entwining. This technique may be conducted year round as long as the temperature remains above 50 degrees Fahrenheit (F) for several days.

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- Foliar spraying may be very effective in areas where it is permitted. Low, monocultures of bittersweet may be sprayed directly. Triclopyr has been effective at concentrations as low as two to five percent active ingredient. A one half-percent concentration of a state-approved non-ionic surfactant is recommended in addition to the Triclopyr so that the herbicide penetrates the leaf cuticle. While foliar spraying may be conducted at any point during growing season, it is preferable to spray in late fall while other non-target species are dormant. In addition, temperatures should be well above 40 degrees F, and rain should not be forecast within 24 hours of treatment. Both sides of the leaf should be sprayed liberally, but not to the point of dripping. A second application is often required after two weeks. For particularly large, dense stands, it may be more effective to cut the shoots before the foliar spraying. The stand may be cut to ground level in the spring then the new shoots may be spraying in the summer, prior to fruiting.

4.5.2 Recommended Control Methods

Mechanical Methods

Smaller plants and vines should be pulled or grubbed including all roots and runners using a “Pulaski” tool or similar digging tool. This should occur during the months of March and April. Some regrowth should be anticipated if not all of the root material is removed. Regrowth may also occur from germination of seeds present in the seed bank. Pulling or grubbing of larger plants including all roots and runners may also reduce a population, although re-sprouting is inevitable if not all parts are removed.

For larger plants, it is recommended that the stems be cut every two weeks down to the ground and as close to the root collar as possible. Stems should be cut frequently (weekly or bi-weekly) throughout the year (from April through October), as cutting less frequently can stimulate vigorous re-sprouting from below ground stems.

All plant parts, including fruits, should be bagged and disposed of in a landfill to prevent reestablishment on a given site.

Chemical Methods

Smaller populations have been successfully controlled by cutting and applying an herbicide (Triclopyr) to the regrowth about a month later. Research has also demonstrated effective control by applying Triclopyr to cut stems at the time of the first killing frost. Where warranted, and where mechanical methods have proven ineffective after several attempts, the use of herbicides is recommended. Large, dense populations (i.e., the most difficult to manage plants) will be cut down and then treated with Triclopyr one month following the cutting. This technique may occur during April and May as well as during September to October.

If herbicide is required, the Town of Sudbury is to be notified prior to any applications, and only if mechanical methods are proving unsuccessful.

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4.6 Japanese Barberry (*Berberis thunbergii*)

Japanese barberry is a small to medium, dense shrub in the Family Berberidaceae. This species was often planted as hedges for landscaping but has spread to native habitats. Japanese barberry is capable of changing soil characteristics in order to out compete native plants and also has early spring leaf emergence that allows it to shade out any nearby competitors.

European barberry (*Berberis vulgaris*), another invasive species, resembles Japanese barberry closely with the major exception being Japanese barberry has single spines whereas European barberry produces three-pronged spines. Japanese barberry twigs are ridged with spines. Plants are two to four feet high. Newer twigs and stems turn reddish in the winter and become gray as they age and the inner bark is bright yellow on the branches and roots.

This plant can colonize most sites, displacing a wide range of native species, especially herbaceous spring ephemerals. Highly adaptive, it can grow in sites from full sun to deep shade. Japanese barberry tolerates drought but has also been found growing in wet areas. Given enough individuals in an area, their leaf litter shifts the pH of the soil, making it more basic, thus further excluding many native plant species. It commonly grows in woodlands, trails, roadsides, fencerows, pastures, bottomlands, and highly disturbed areas. Japanese barberry spreads by both seed and vegetative means. In addition to spreading through seed dispersal, Japanese barberry is able to form rhizomes and spread via roots so it is necessary to remove all connecting roots when digging the plant up. Individual plants can spread horizontally by a process called layering, in which roots form when branches are in contact with the ground. New plants created in this way will survive being severed from the parent plant.

Once large plants are removed, regular mowing where possible can be effective in management. Spring prescribed fire can also be used for control. Even after plants have been removed, treatment may have to be continued for several years as seeds sprout.

4.6.1 Management Protocol Options

Manual and Mechanical Control

- Mechanical controls include grubbing or pulling seedlings and mature shrubs, and repeated clipping of shrubs. When pulling barberry by hand, extreme care should be taken because the tips of barberry spines are finer than the point of a hypodermic needle and their silicate composition decomposes very slowly under the skin.
- The plant has relatively shallow roots, but re-sprouting can occur if the entire root system is not removed. Manual removals are best suited to areas with only small barberry populations or areas of special ecological sensitivity.
- Mechanical mowing or top removal alone will not successfully control the plants since they vigorously re-sprout. However, mowing can serve as a step prior to herbicide applications to reduce plant size, allowing more efficient applications of herbicide in smaller quantities and with better coverage.

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- A relatively new method being explored for removing Japanese barberry is flame weeding. This is the application of a directed flame, usually using a propane torch, to the base of individual plants. This differs from a broadcast prescribed burn, where all surrounding vegetation would also be burned. While this method is very effective in reducing the size of the shrub, it has not exceeded 40 percent mortality, compared with 93 percent mortality for foliar-applied Triclopyr.

Chemical Control

- Foliar treatment with a backpack sprayer is the most effective means to treat sites with low to moderate target density. A useful treatment for barberry suppression is a mixture of glyphosate and Triclopyr at a 2:1 ratio. Other formulations containing glyphosate or Triclopyr can also be used according to the application specifications on the label.
- Stem treatments are effective against Japanese barberry and can be implemented throughout the year, which provides scheduling flexibility. Treatment options include basal bark and cut-stem treatments.
- Basal bark treatments use a concentrated mixture of the herbicide Triclopyr in oil applied to the entire circumference of the lower 12–18 inches of the intact stem, depending on its size.
- If top growth removal is preferred, cut the stems close to the soil line and treat the cut surfaces. Oil-based Triclopyr products can be applied any time after cutting, while water-based glyphosate treatments must be applied immediately after the stems are cut.

4.6.2 Recommended Control Methods

Mechanical removal methods may be most appropriate for this site for the initial treatment. Depending up the results of seasonal monitoring, a program involving herbicide application to plants may be appropriate. **If herbicide is required, the Town of Sudbury is to be notified prior to any applications, and only if mechanical methods are proving unsuccessful.**

4.7 Black Locust (*Robinia pseudoacacia*)

Black locust is a medium-sized tree in the Family Fabaceae not native to the northeast that can reach a height of 60 feet and form clonal colonies in upland areas of a landscape. This invasive species can grow in both full sun and full shade conditions. The species can readily sprout and grow rapidly from stumps and roots. The tree's root system can be extensive, spreading laterally a distance of one to one and one-half times the height of the tree. It can proliferate and disrupt native plant assemblages along roadsides, in forest fragments, along field edges, and in riparian forests. Black locust was not identified at the site.

4.7.1 Management Protocol Options

The most effective strategy for removal of black locust is one involving a combination of mechanical removal and chemical application, where the trees are killed and then mechanically removed. Using a “hack and squirt” technique, Triclopyr is applied directly to deep cuts in the bark, (“frill cuts”). Once the trees are dead, they can be felled.

INVASIVE SPECIES MANAGEMENT PLAN

If tree removal must occur initially, glyphosate must be applied immediately to the freshly cut stump surface. Treatment areas in the landscape should be monitored seasonally for the emergence of locust seedlings. **The Town of Sudbury has requested treatment by pulling the plant and removing the roots in lieu of cutting and use of herbicide is preferred and should be attempted initially. If herbicide is required, the Town of Sudbury is to be notified prior to any applications, and only if mechanical methods are proving unsuccessful.**

4.8 Notes on Herbicide Use

Various groups, including the Nature Conservancy, MIPAG, and the National Park Service (NPS) strongly recommend non-chemical methods of control wherever feasible. However, for large infestations, non-chemical methods are inadequate. Any herbicide use permitted at the site would be applied only by a Massachusetts-Licensed Pesticide Applicator and in accordance with all State regulations pertaining to herbicide application.

Note that per the Sudbury OOC, *“No pesticides or herbicides are allowed within a wetland resource area, including the 200-foot riverfront area, or within 100 feet of a wetland resource area (the adjacent upland resource area under the local bylaw.”*

The two main herbicide treatments considered in developing this management protocol include glyphosate and Triclopyr. Glyphosate (e.g., Round-up® or Rodeo®) is a non-selective, systemic herbicide that kills both grasses and broad-leaved plants. Triclopyr (e.g., Brush-B-Gone™, Garlon™, Pathfinder™) is a selective herbicide that kills broad-leaved plants but does little or no harm to grass species. Applied carefully to avoid non-target plants, glyphosate is the least environmentally damaging herbicide in most instances. Round-up® contains a petroleum-based sticker-spreader that allows the herbicide to cling to the target species to ensure its absorption into the plant’s tissues. Rodeo®, the glyphosate formulation for use in wetlands, does not contain any sticker-spreader, and thus is considered to be safer for the wetland environment.

Where appropriate and considered necessary for the successful management of the invasive species at this site, specifications for the type of herbicides will be provided. As with the timing for mechanical methods for management of invasive species, non-specific use of herbicides or use of a specific herbicide at incorrect times or in incorrect concentrations can actually lead to spreading of invasive species.

Other considerations for herbicide use include avoiding inclement weather conditions such as wind, which could result in herbicide application to non-target, possibly native species, or rainy conditions, which could dilute or wash away applied herbicides, rendering them ineffective.

If herbicide is required, the Town of Sudbury is to be notified prior to any applications, and only if mechanical methods are proving unsuccessful.

INVASIVE SPECIES MANAGEMENT PLAN

5.0 DISPOSAL

The construction of the Nobscot Scout Reservation Trail Project in conjunction with this invasive species management protocol will generate a substantial amount of plant debris and soil that often contains viable root fragments and seed banks. Invasive plant debris may contribute to the introduction or spread of the species at the project site or even at the disposal location if not properly disposed. Invasive plants managed using chemical control methods should be left in place to biodegrade, rather than disposing of the materials off-site. Disposal of invasive plants with flowers or seeds should be minimized to prevent the further spread of target species. Furthermore, plant material should not be composted to prevent regrowth or spread of seeds into the compost sediment. Invasive plant material is to be bagged and allowed to rot within the bags. The bags should be stored in a location with sun for a minimum of three weeks then disposed of in a landfill or incinerated. It is possible to air dry or incinerate herbaceous (non-grass) plants (i.e., purple loosestrife and garlic mustard); however, bagging plants and storing before removal off-site may be more successful.

6.0 REVEGETATION/RESTORATION

Following implementation of the initial invasive species management protocol for the target species, native vegetation will be allowed to re-colonize the areas via natural succession as part of an active restoration plan. The area within the limit of work will be supplemented with additional plantings/seeding of appropriate native species to allow rapid re-colonization and prevent re-establishment of non-native species, per the approved Plans.

As required under the Sudbury OOC, in order to mitigate unauthorized work a location(s) will be identified for management of invasives within an area that is at least the same square footage as the unauthorized disturbance. This mitigation area is to be concentrated along the trails and near cabins outside the work areas that are the subject of the OOC and will be identified on the Plans or other figure. This ISMP is appropriate for treatment in the selected mitigation area, the final location to be confirmed with the Town of Sudbury.

7.0 SITE MONITORING

LE will perform on-site observations during the implementation phase of the work and following completion of the initial land management work for a period of five years. LE will monitor the mechanical and chemical control efforts to manage existing populations of invasive species as identified. The primary purpose of these observations is to document and assess the effectiveness of the invasive species removal.

The assessment will help determine what additional measures will be required by the land management contractor(s) to attain effective control of the target invasive species. LE would recommend a set of additional measures to both the property owner and the land management contractor following the observations.

INVASIVE SPECIES MANAGEMENT PLAN

The intent of the assessment will also be to observe and document the response of the remaining native plant assemblage to the invasive species removal efforts. If a new invasive species is observed during monitoring that has not been previously documented at the site, a monitoring and control plan will be developed for that species. Action will likely be taken immediately if new invasive plants are encountered to prevent their spread, and the appropriate agencies notified. Delays may make the problem more difficult to address.

Post-implementation observations will occur at a minimum during the early and late portions of each growing season for a five-year monitoring period. Observations may be performed beyond the five-year monitoring period and possibly after a Certificate of Compliance is attained from the Conservation Commission. LE would provide the Sudbury and Framingham Conservation Commissions with written reporting on an annual basis, or more frequently if required.

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SECTION II – TABLE 1

TABLE 1 – TARGET INVASIVE SPECIES

SPECIES	MIPAG STATUS	DESCRIPTION	HABITAT and ECOLOGICAL THREATS	MANAGEMENT ACTIONS/OPTIONS
<p>Glossy/European Buckthorn <i>(Frangula alnus)</i></p>	<p>Non-native Invasive (FAC)</p>	<p>A deciduous, upright shrub in the Buckthorn Family (Rhamnaceae) with Eurasian and North African origin. Height may reach six meters. The shrub’s gray-brown bark is smooth with visibly speckled lenticels. Leaves are alternately arranged and vary in shape from obovate to oblong to elliptical. They are dark green (yellow in fall) and shiny with nearly parallel veins and <u>entire margins</u>.</p> <p>Yellowish-green flowers appear May to September in umbels each containing one to eight flowers. Small round juicy fruits with two to three stones change from red to black as they ripen from July to October.</p>	<p>Grows in full sun to full shade and is highly moisture tolerant, growing in a range of soil types. Habitats include fens, swamps, along bog edges, and in upland habitats such as woodlands, thickets, and old fields. Inhabits typically wetter, less shaded areas with acidic soils.</p> <p>A huge threat to native wetland plant communities where it can form dense shrub layers causing suppressed growth of other wetland plant assemblages. Interferes with natural processes of succession and regeneration of native species.</p> <p>Fruit production is abundant, and seeds are dispersed by birds and small mammals. Re-sprouts vigorously following top removal. Shrubs cut near the base can send up sprouts nearly 6 feet high in same year.</p>	<p>Cutting back larger plants twice in a single growing season for two to three consecutive years results in fewer and shorter stems and reduced plant vigor. This is best done twice a season (in June and in August). Plants with stem bases less than two inches in diameter can be successfully girdled (a one inch-wide cut) during the winter months. Girdling does not disrupt soils and would not disrupt sensitive wetlands.</p> <p>Individual seedlings can be hand pulled or removed with a grubbing tool; however, this technique is only effective in areas of low buckthorn density.</p> <p>Using glyphosate without a surfactant has been reported to have the greatest control with little or no harm to non-target vegetation. Herbicide application of glyphosate has been effective on cut stumps or along girdled stems.</p>

TABLE 1 – TARGET INVASIVE SPECIES

SPECIES	MIPAG STATUS	DESCRIPTION	HABITAT and ECOLOGICAL THREATS	MANAGEMENT ACTIONS/OPTIONS
<p>Multiflora or Rambler Rose <i>(Rosa multiflora)</i></p>	<p>Non-native Invasive (FACU)</p>	<p>A thorny, deciduous shrub from Japan, China, and Korea in the Rose Family (Rosaceae) with arching and scrambling stems that can grow to 3.0 to 4.5 meters. The stems are red to green with scattered, broad-based prickles. Leaves pinnately compound, each comprised of 5 to 11 elliptic leaflets with sharply serrated margins.</p> <p>Large pyramidal clusters of fragrant, mostly white but sometimes pink, five-petaled flowers appearing from May to June. Small, red, ovoid to elliptic rose hips containing achenes are borne in late summer. These hips become leathery as they age and remain on the plant throughout the winter.</p> <p>Considered a noxious weed in many states. There are many native and naturalized roses in Massachusetts, but the many flowers and exceptionally small hips of <i>R. multiflora</i> will usually identify it.</p>	<p>Occurring in upland, wetland, and coastal habitats. It commonly occurs along roadsides, streambanks, and in pastures and grows best in open, fertile, moist upland habitats. Grows in full sun to full shade and has broad tolerance to various soil and moisture conditions. A single plant may produce a million seeds per year (estimated), which may remain viable in the soil for up to 20 years. Seeds readily spread by birds.</p> <p>Forms impenetrable thickets that can overwhelm other vegetation and displaces/outcompetes native species. Dominates fallow or abandoned pasture land.</p> <p>Grows very prolifically in riparian areas, where its inedible leaf litter can change the composition of the aquatic macro-invertebrate community.</p>	<p>Mechanical and chemical methods can effectively control this species. Mature plants may be managed by repeated cutting and mowing (three to six times a year for several years) as a means of suppressing the plant's ability to photosynthesize. Cutting is best when populations are small and when the use of herbicides is not an option due to habitat sensitivity. Stems must be removed at least once per growing season as close to the ground level as possible.</p> <p>Young multiflora rose plants may be removed by hand. The entire root system must be removed for pulling to be an effective part of control.</p> <p>Treatment by repeated application of herbicides has proven to be an effective control method. Glyphosate should be selectively applied to kill the root and the stem if repeated cutting is not an option. It is most effective when applied during the early summer, and can be used through the early fall. Triclopyr may be applied in the early spring before or during flowering.</p>

TABLE 1 – TARGET INVASIVE SPECIES

SPECIES	MIPAG STATUS	DESCRIPTION	HABITAT and ECOLOGICAL THREATS	MANAGEMENT ACTIONS/OPTIONS
<p>Tatarian Honeysuckle <i>(Lonicera tatarica)</i></p> <p>&</p> <p>Morrow’s Honeysuckle <i>(L. morrowii)</i></p>	<p>Non-native, Likely Invasive</p> <p>(FACU)</p> <p>Non-native Invasive</p> <p>(FACU)</p>	<p>Morrow’s honeysuckle and the closely related Tatarian honeysuckle (i.e., “exotic bush honeysuckles”) are deciduous, oppositely branched, hollow stemmed shrubs in the Family Caprifoliaceae. The plants are multi-stemmed, upright, deciduous shrubs that grow to 7 ft. tall. The pith of mature stems is hollow and white or tan in contrast to solid white pith of native shrub honeysuckle species. They produce yellow, white, and sometimes pink flowers, as well as round, red and orange berries.</p>	<p>Adapted to a wide variety of habitats, although disturbance of some kind usually precedes invasion. They prefer areas with full to partial sun, like forest openings and edges, roadsides, abandoned agricultural fields, and other disturbed habitats where sunlight is penetrating the canopy, such as after a timber harvest. Found in thickets, woods, and edges of woods. Morrow's and Tatarian honeysuckle cross to produce the invasive hybrid Belle's honeysuckle (<i>L. x bella</i>)</p> <p>Fruit production is abundant, and reproduction is almost entirely by seeds, typically dispersed by birds. These honeysuckles are among the earliest deciduous plant to leaf-out, with leaf break generally beginning two weeks earlier than for co-occurring trees. They form dense thickets and outcompete and displace native shrubs, trees and herbaceous plants, reduced richness and cover of native herb communities and reduce tree regeneration in early to mid-successional forests.</p> <p>While the fruits provide some nutrition for birds and mice in winter, their carbohydrate-rich quality is no match for the lipid-rich fruits of many native species that sustain migrating birds.</p>	<p>Both mechanical and chemical methods, as well as prescribed burning, have been used to control exotic bush honeysuckles. There are no known biological controls of <i>Lonicera</i> spp. Mechanical controls include grubbing or pulling seedlings and mature shrubs, and repeated clipping of shrubs. Effective mechanical management requires a commitment to cut or pull plants at least once a year and may require multiple years. Winter clipping should be avoided as it encourages vigorous re-sprouting.</p> <p>To be effective, mowing must be followed with an herbicide application to either cut stumps or the regrowth.</p> <p>Most managers report that treatment with herbicides may be necessary for large bush honeysuckle populations. Formulations of both glyphosate and Triclopyr have been used as cut stump sprays and paints with varying degrees of success.</p>

TABLE 1 – TARGET INVASIVE SPECIES

SPECIES	MIPAG STATUS	DESCRIPTION	HABITAT and ECOLOGICAL THREATS	MANAGEMENT ACTIONS/OPTIONS
<p>Burning Bush (<i>Euonymus alatus</i>)</p>	<p>Non-native Invasive (UPL)</p>	<p>Burning bush, also called winged euonymus, is a perennial, fast growing, deciduous, multi-stemmed woody shrub in the Family Celastraceae that grows to 15 feet tall. It is native to northeastern Asia and is a popular and widely planted ornamental known for its bright red fall color and green stems with prominent raised, corky wings. In woodlands, burning bush forms dense thickets creating heavy shade that blocks light to native vegetation.</p>	<p>A shrub occurring in all regions of the state and capable of germinating prolifically in many different habitats. It grows in full sun to full shade. Escaping from cultivation and can form dense thickets and dominate the understory; seeds are dispersed by birds.</p> <p>It is most successful in well drained soils but is also competitive in water logged soils. High white-tailed deer populations can promote establishment and spread of burning bush, as they preferentially feed on native vegetation.</p> <p>In woodlands, burning bush forms dense thickets creating heavy shade that blocks light to native vegetation. This species thrives in forest interiors where many other invasive shrubs cannot compete in the dense shade. It reproduces abundantly by seed and the fruit is eaten and spread by birds but can also spread locally through vegetative reproduction.</p>	<p>Both mechanical and chemical methods have been used to control burning bush. There is no known biological control. Control of this plant is difficult because it produces a tremendous amount of seed.</p> <p>Seedlings up to two feet tall can be hand-pulled the base of the stem at any time of year, especially when the soil is moist, being sure to pull up as much of the root system as possible. If feasible and fruit is present, bag and dispose of fruits to prevent seed dispersal.</p> <p>Larger plants and their root systems can be dug out with a spading fork or pulled with a weed wrench, or can be cut, and the stump ground out or the re-growth clipped.</p> <p>The shrub can be repeatedly cut to the ground, but re-sprouts must be controlled. Mowing with heavy-duty rotary blades or a flail cutter is an option to remove the shrub canopy but can only be successful with follow up stem treatment (either continued cutting or chemical). Use a lopper, pruning shears, weed whacker/brush saw or mower to cut the stem as close to the ground as possible. Cut at least once during the growing season, repeating for three to five years.</p> <p>In locations outside resource areas or buffer zones, the cut stumps of larger plants can be painted with glyphosate or Triclopyr following the label directions. Apply herbicide solution to the stump with a sponge or brush immediately after cutting. This is best done in late summer to early fall when plants are transporting resources to their root systems.</p>

TABLE 1 – TARGET INVASIVE SPECIES

SPECIES	MIPAG STATUS	DESCRIPTION	HABITAT and ECOLOGICAL THREATS	MANAGEMENT ACTIONS/OPTIONS
<p>Oriental or Asiatic bittersweet (<i>Celastrus orbiculatus</i>)</p>	<p>Non-native Invasive (UPL)</p>	<p>A climbing, deciduous woody vine of the Staff-tree Family (Celastraceae) native to Asia that can sometimes be a low trailing shrub spreading by orange-colored roots.</p> <p>Stems are brown with warty lenticels when young, but gray-barked on older stems, which can reach diameter of six inches. Leaves are alternately arranged, short-petioled, roundish to obovate, with bluntly serrated margins and abruptly pointed tips.</p> <p>Axillary clusters of two to three greenish flowers bloom from May through June. Globular, yellow-orange capsules with three red fleshy arils inside are produced from July to October.</p>	<p>Occurring mainly in uplands, it invades forest edges, woodlands, hedgerows, early successional fields, coastal areas and salt marsh rims. Grows in full sun to partial shade. Thrives in disturbed areas.</p> <p>Has a high reproductive rate, long-range dispersal, ability to spread by root suckering, and rapid growth rates. Berries spread by birds and humans. Climbs over, smothers, shades, and girdles native vegetation, which may die from excessive shading and/or breakage (from weight of vines).</p> <p>This invasive threatens our rare, native American bittersweet (<i>C. scandens</i>) through competition/displacement and hybridization. Reduces native plant biodiversity and wildlife habitat value.</p>	<p>Mechanical and manual control by cutting and pulling is most practical in small plots, or in areas where chemical control is not an option. Ultimately, these methods are a means of restricting growth until the roots and seeds are no longer viable.</p> <p>Chemical control methods are preferred and are more effective than manual techniques. While both glyphosate and Triclopyr have been used to control the species, most of the literature cites more effective control with Triclopyr. Triclopyr specifically targets broadleaf plants, reducing the chances of impacting nearby monocots. Triclopyr may be applied using several techniques, including cut-stump, and basal bark.</p> <p>Treatment can be by hand-cutting stems in late summer/early fall and immediately wiping the cut stem with an ultra-low volume treatment of Triclopyr-based herbicide.</p>

TABLE 1 – TARGET INVASIVE SPECIES

SPECIES	MIPAG STATUS	DESCRIPTION	HABITAT and ECOLOGICAL THREATS	MANAGEMENT ACTIONS/OPTIONS
<p>Japanese Barberry <i>(Berberis thunbergii)</i></p>	<p>Non-native Invasive (FACU)</p>	<p>A small to medium, dense deciduous shrub in the Family Berberidaceae. The thin, grooved branches have thin, straight spines. Newer twigs and stems turn reddish in the winter and become gray as they age. The inner bark is bright yellow on the branches and roots.</p> <p>European barberry (<i>Berberis vulgaris</i>), another invasive species, resembles Japanese barberry closely with the major exception being Japanese barberry has single spines whereas European barberry produces three-pronged spines</p>	<p>Was often planted as hedges for landscaping but has spread to native habitats. It commonly grows in woodlands, trails, roadsides, fencerows, pastures, bottomlands, and highly disturbed areas.</p> <p>Japanese barberry spreads by both seed and vegetative means through rhizomes so it is necessary to remove all connecting roots when digging the plant. Individual plants can spread horizontally by layering, in which roots form when branches contact the ground.</p> <p>The plant is capable of changing soil characteristics to outcompete native plants. Given enough individuals in an area, their leaf litter shifts the pH of the soil, making it more basic, thus further excluding many native plant species.</p> <p>It has early spring leaf emergence that allows it to shade out any nearby competitors. Highly adaptive, it can grow in sites from full sun to deep shade. It is very shade-tolerant and can form dense stands which shade out and displace native species. It can colonize most sites, displacing a wide range of native species, especially herbaceous spring ephemerals.</p>	<p>Both mechanical and chemical methods, as well as targeted burning, have been used to control Japanese Barberry. Mechanical controls include grubbing or pulling seedlings and mature shrubs, and repeated clipping of shrubs.</p> <p>Re-sprouting can occur if the entire root system is not removed. Manual removals are best suited to areas with only small barberry populations or areas of special ecological sensitivity. Mechanical mowing or top removal alone will not successfully control the plants since they vigorously re-sprout. However, mowing can serve as a step prior to herbicide applications to reduce plant size, allowing more efficient applications of herbicide in smaller quantities and with better coverage.</p> <p>Stem treatments are effective and can be implemented throughout the year. Treatment options include basal bark and cut stem treatments. Basal bark treatments use a concentrated mixture of the herbicide Triclopyr in oil applied to the entire circumference of the lower 12–18 inches of the stem.</p> <p>If top growth removal is preferred, cut the stems close to the soil line and treat the cut surfaces. Oil-based Triclopyr products can be applied any time after cutting, while water-based glyphosate treatments must be applied immediately after the stems are cut.</p>

TABLE 1 – TARGET INVASIVE SPECIES

SPECIES	MIPAG STATUS	DESCRIPTION	HABITAT and ECOLOGICAL THREATS	MANAGEMENT ACTIONS/OPTIONS
<p>Black Locust/ False Acacia (<i>Robinia pseudoacacia</i>)</p>	<p>Non-native Invasive (UPL)</p>	<p>A fast growing deciduous tree in the Pea Family (Fabaceae) native to the southeastern United States north to central Pennsylvania. Can grow 0.6 meters per year and reach heights to 30 meters. Trunks have deeply furrowed gray to dark brown bark and may grow to one meter in diameter. Branches and twigs usually have sharp, paired spines at leaf bases. Compound leaves each bearing 7 to 19 blue-green paired and rounded leaflets. Fragrant, white pea-like flowers with yellow centers appear in May to June period in dense racemes. Fruits from September to October producing flat, brown pods with 4 to 8 reddish brown seeds. Reproduces vigorously by root suckering and stump sprouting to form groves (or clones) of trees interconnected by a common fibrous root system. Produces abundant seeds, which seldom germinate.</p>	<p>Grows in full sun to partial shade, but is intolerant of dense shade and poorly drained soils. It prefers sandy soil and can tolerate high soil acidity (i.e., low pH). In the eastern US, it occurs in immature forests, woodlands, roadsides, grasslands, and agricultural landscapes. Commonly found in disturbed upland areas. Poses a serious threat to native vegetation in dry, upland forest edge habitats. Once introduced to an area, it expands readily into areas where their shade reduces competition from other plants. Reduces or eliminates understory plant diversity, as dense clones of locust create dense islands with little ground vegetation. A great nectar producer, it can outcompete native plant species for pollinators.</p>	<p>The most effective strategy for management involves a combination of chemical application and mechanical removal, where the trees are killed and then removed. Using a “hack and squirt” technique, Triclopyr (e.g., Garlon-4) is applied directly to deep cuts in the bark (“frill cuts”) in period July to September (application also ok in dormant period). For basal bark and cut stem/stump applications, a 14 percent solution of Triclopyr or 20 percent solution of glyphosate is used. Once the trees are dead, they can be felled. Glyphosate (e.g., Round-up) can be applied to freshly cut stumps.</p> <p>If tree removal must occur initially, glyphosate must be applied immediately to the freshly cut stump surface. Treatment areas in the landscape should be monitored seasonally for the emergence of locust seedlings.</p>



SECTION III – FACT SHEETS



Shining Buckthorn

Photo by Frank Bramley,
courtesy New England Wildflower Society

Shining and Common Buckthorn

Rhamnus frangula and *R. cathartica*

Shining Buckthorn is the more abundant of these two shrubs in Massachusetts. Although sometimes found in uplands, it typically invades marshes, swamps, bogs, wet meadows and the edges of beaver ponds, crowding out a variety of native species. Common Buckthorn is typically found on drier sites. Both shrubs are tolerant of dense shade. They flower and fruit all season and spread rapidly because birds eat their berries and thus spread seeds. Removal is difficult because stems resprout after cutting. If stems are cut and herbicide applied to their stump tops in winter, mortality is high. Young plants can be pulled by hand and older ones pulled mechanically. Because of regeneration from remaining root and stem, as well as dormant seed, follow-up work will be necessary in subsequent years.

Shining Buckthorn



Common Buckthorn
(with fruit)



Artwork by Anne Rogelberg,
courtesy The New York Botanical Garden



Photo by Bill Byrne

Multiflora Rose

Rosa multiflora

Originally promoted as a “living fence,” this aggressive shrub now creates a “living hell” of thorny thickets. Thriving in any habitat from pasture to forest, it can displace many native trees, shrubs and herbs, effectively thwarting their regeneration. Clusters of many white flowers produce tiny red fruits (hips) spread by birds. Hand-pulling works for small plants, but large ones will require other techniques such as repeated cutting or mowing during the growing season for a couple of years. Once established, mechanical pulling or an herbicide applied to cut stems late in the growing season or during the dormant season can be effective.



Artwork by Regina O. Hughes,
courtesy Agricultural Research Service,
U.S. Department of Agriculture



Morrow's Honeysuckle

Photo by Bill Byrne

Morrow's Honeysuckle and other shrub honeysuckles

Lonicera morrowii, *L. tatarica*, *L. maackii*, *L. xbella*

The red berries of the shrubby honeysuckles are spread by birds, and the resulting shrubs quickly form impenetrable thickets, displacing other vegetation in young forests and on floodplains. Morrow's and Amur (*L. maackii*) have white flowers fading to yellow; Tatarian and its hybrid with Morrow's, *L. xbella*, are pink. Morrow's is the most pervasive in Massachusetts and can be distinguished from Tatarian honeysuckle by its hairy leaves and shreddy bark. It appears that Tatarian honeysuckle is not as invasive. Amur honeysuckle (*L. maackii*) is not yet common in Massachusetts, but is the predominant weedy honeysuckle in some midwestern states. Young shrubs can be pulled by hand, but mechanical means are necessary for extracting established older ones. Before initiating control measures, be certain that the plants in question have been identified correctly: there are two native species of honeysuckle that **belong** in the New England plant community.



Morrow's Honeysuckle

Artwork by Eduardo Salgado,
courtesy The New York Botanical Garden



Photo by Frank Bramley,
courtesy New England Wildflower Society

Shrubs and Vines

Oriental Bittersweet

Celastrus orbiculata



Artwork by Eduardo Salgado,
courtesy The New York Botanical Garden,
and Nancy Childs (lower illustration)

A fast growing vine, Oriental Bittersweet can wind around young trees, choking them, or spread over vegetation, smothering it. Similar to the now-scarce native bittersweet, it differs by having flower clusters all along the stem. The vine interferes with forest regeneration, kills trees, covers fields and hedgerows, and displaces native plants. Once established, it is extremely difficult to eliminate, but mowing, cutting or hand-pulling of vines may help. Due to extensive below-ground "runners" (rhizomes) that sprout prolifically, herbicide treatments applied to cut stems at the time of the first killing frost are often necessary to achieve control.



Photo by Bill Byrne

Japanese Barberry

Berberis thunbergii

Japanese Barberry has spread from plantings, taking over pastures, woodlands, ledges, and floodplains. It forms thorny thickets in young woodlands, preventing native herbaceous and shrub growth. Although it provides food for wildlife, the damage it does outweighs the good. Common Barberry, *Berberis vulgaris*, is also an invasive, non-native shrub in open, disturbed habitats across Massachusetts. Young plants can be pulled easily; cutting alone does not work.



Artwork by Walter Lincoln Graham, courtesy The New York Botanical Garden, and Nancy Childs (lower illustration)



Photo by Paul Somers

Trees

Black Locust

Robinia pseudoacacia

Not a native of the New England region, Black Locust has been extensively planted for wood, fence posts and landscaping in Massachusetts. It becomes a problem when large patches formed by root sprouts choke out other vegetation. It forms large colonies in grasslands and pine barrens in southeastern Massachusetts. Cutting, then herbiciding the freshly cut stumps, has proven to be an effective method of control.



Artwork by Walter Lincoln Graham,
courtesy The New York Botanical Garden

Invasive Alien Plant Species of Virginia

Multiflora Rose (*Rosa multiflora* Thunberg)

Description

Multiflora rose is a perennial, thorny shrub of medium height. Its arching or trailing stems can root at the tip, forming dense thickets. The compound leaves alternate along the stems; each leaf has 5-11 oval leaflets, the edges of which are toothed. In late spring, multiflora rose blooms in tapering clusters of white flowers. As in other rose species, the fruits are small, red hips. The seeds found in the hips of multiflora rose are sought after by many different bird species during winter.

Habitat

Usually found in fields, pastures and along roadsides, multiflora rose can also appear in dense forest where fallen trees have opened a gap in the forest canopy. It is adaptable to a wide range of environments but is not found in standing water or in extremely dry habitats.

Distribution

Multiflora rose is native to Asia and was brought to the United States from Japan in the 1880s by horticulturists. Later, wildlife managers planted it for wildlife food and cover. Once used for control of soil erosion and on highway medians to reduce headlight glare, multiflora rose is now found throughout most

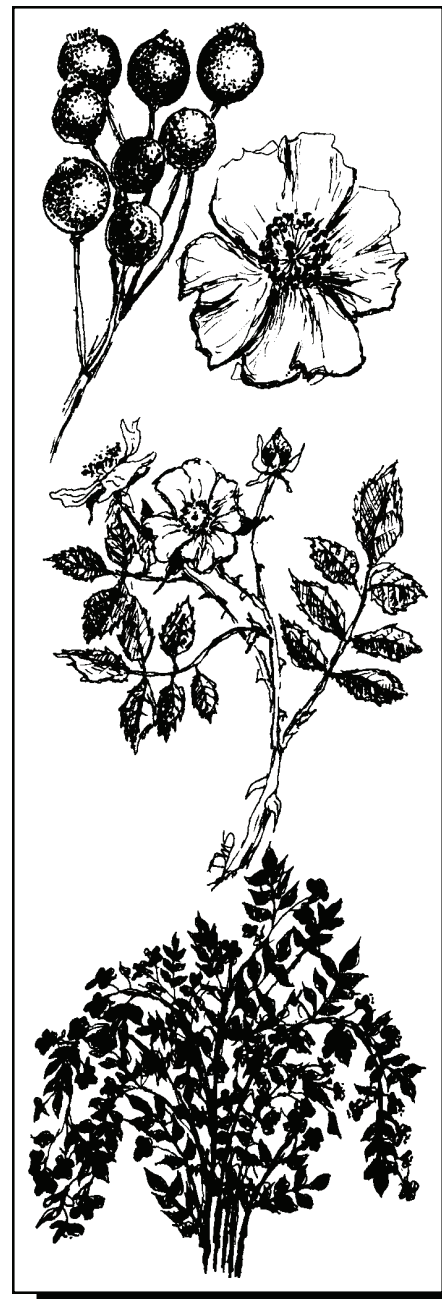
of the United States. It has established itself in all but a dozen counties of Virginia. The Virginia Department of Agriculture and Consumer Services has listed this plant as a noxious weed.

Threats

Multiflora rose forms dense thickets which can choke out native plant species. These thickets act as living fences, impenetrable by man or large animals. Results from studies done on multiflora rose suggest it is highly competitive for soil nutrients.

Control

Lightly infested areas may be cleared with a shovel or grubbing hoe provided the entire root is removed. Severe infestations of multiflora rose are effectively controlled by mowing or cutting. However, this treatment must be repeated 3-6 times a year for 2-4 years. Applying a glyphosate herbicide directly to freshly cut stumps helps insure kill of the root system. This method is most effective if done late in the growing season. Foliar application of a glyphosate herbicide will also kill multiflora rose. Glyphosate herbicides are recommended because they are biodegradable. However, glyphosate is a nonselective, systemic herbicide and will affect all



Multiflora Rose (Rosa multiflora Thunberg)

For more information, contact the Department of Conservation and Recreation or the Virginia Native Plant Society.



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Invasive Alien Plant Species of Virginia

Multiflora Rose (*Rosa multiflora* Thunberg)

green vegetation. To be safe and effective, herbicide use requires careful knowledge of the chemicals, appropriate concentrations, and the effective method and timing of application. Consult a natural resource specialist or agricultural extension agent for more information before attempting any herbicide control program.

In some situations, a prescribed burn during the early growing season may be an appropriate method for controlling severe infestations of multiflora rose. As with mechanical control methods, follow-up burn

treatments may be necessary for several years to remove plants sprouting from stems or seed. Seek the advice of an agricultural extension agent or natural resource specialist before implementing this control method.

Suggested Alternatives

Some native shrubs with attractive flowers and/or fruit production useful to wildlife include Carolina rose (*Rosa carolina*), high-bush blueberry (*Vaccinium corymbosum*), black haw (*Viburnum prunifolia*), winterberry (*Ilex verticillata*) and American holly (*Ilex opaca*) (dioe-

cious, female plant for fruit). These species should be available at most large nurseries and garden centers.

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Illustration by Donna Smith

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Invasive Alien Plant Species of Virginia

Bush Honeysuckles: Belle's honeysuckle (*Lonicera x bella* Zabel), Fragrant honeysuckle (*L. fragrantissima* Lindley & Pax), Amur honeysuckle (*L. mackii* (Rupr.) Maxim), Morrow's honeysuckle (*L. morrowi* A. Gray), Tatarian honeysuckle (*L. tatarica* L.), European fly honeysuckle (*L. xylosteum* L.)

Description

Bush honeysuckles are upright, generally deciduous shrubs that range from 6 to 16 feet in height. The opposite, simple leaves are usually oval to oblong in shape and range in length from 1 to 2.5 inches. Flowering occurs from May to June (February to April for fragrant honeysuckle) with the fragrant, tubular flowers borne in pairs. Flower color ranges from creamy-white in most species to pink or crimson in varieties of Tatarian honeysuckle. Whitish flowers become yellow with age. The fruit is a many-seeded, red to orange berry. Exotic bush honeysuckles can be confused with our Virginia native fly honeysuckle (*Lonicera canadensis*), but this seldom-seen species is restricted to high elevation mountainous terrain. Consult an appropriate guidebook or a natural resource expert for proper identification.

Habitat

In Virginia bush honeysuckles occur most often along roadsides and in forest edges, pastures and abandoned fields. Grazed and disturbed woodlots may also be invaded by some bush honeysuckle species. Although bush honeysuckles are most common in upland habitats, Morrow's honeysuckle is known to invade fens, bogs and lakeshores in portions of the northeastern United States.

Distribution

The invasive bush honeysuckles in Virginia are natives of Europe, eastern Asia or Japan. Most species have been cultivated as ornamentals in the eastern United States since the mid-1800s. Also, some varieties

were developed and planted widely for wildlife food source. At present, bush honeysuckles are distributed locally in Virginia, particularly in northern and central regions, although their ranges appear to be expanding.

Threats

Bush honeysuckles can rapidly invade and overtake a site, forming a dense shrub layer that interferes with the life cycles of many native woody and herbaceous plants. Exotic bush honeysuckles can alter habitats they invade by decreasing light availability and depleting soil moisture and nutrients. Some species may also release chemicals into the soil that inhibit the growth of other plant species. The fruit of bush honeysuckles is fed upon by many kinds of



Morrow's honeysuckle (*L. morrowi*)

For more information, contact the Department of Conservation and Recreation or the Virginia Native Plant Society.



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Invasive Alien Plant Species of Virginia

Bush Honeysuckles

birds. The birds then spread the seed throughout the landscape.

Control

Light infestations may be cleared by hand with a shovel or grubbing hoe provided the entire root is removed. Severe infestations may be controlled by repeated treatments of cutting, burning or applying herbicide.

Brush cutting plants should be done during the growing season. Generally two cuts per year are recommended, one in early spring followed by one in the late summer or early autumn. Cuts made in the winter while the plant is dormant will only encourage vigorous resprouting.

The application of an herbicide is also an effective control method. Glyphosate herbicides are recom-

mended because they are biodegradable. They will begin to break down into harmless components on contact with the soil. A glyphosate herbicide may be applied to the leaves or freshly cut stumps late in the growing season. Timing is important to insure effectiveness. Application near the end of the growing season when the plant is transporting nutrients to its roots will result in the highest rate of kill.

In some areas, prescribed burning may be used to control bush honeysuckles. Burns conducted during the growing season will top-kill shrubs and inhibit new shoot production. These burns will favor warm-season grasses and perennial forbs increasing species diversity and productivity.

Treatment of any severely infested areas usually requires man-

agement for a period of three to five years to inhibit growth of new shoots and eradicate target plants. Consult a natural resource specialist or an agricultural extension agent for more information on these control methods.

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Invasive Alien Plant Species of Virginia

Winged Burning Bush (*Euonymus alatus* (Thunb.) Siebold)

Description

Winged burning bush is a deciduous shrub that will grow to 15 to 20 feet tall and equally as wide. It is a member of the Staff-tree family (Celastraceae) with elliptic to obovate leaves, which are opposite or sub-opposite, 1 to 3 inches long and ½ to 1¼ inches wide. The leaves turn a bright red in the fall before dropping. Occurring in May to early June, the small green flowers are inconspicuous. The green to brown stems have two to four prominent corky wings.

Habitat

Native to northeastern Asia to central China, winged burning bush, also known as winged euonymus and burning bush euonymus, was introduced into this country about 1860 as an ornamental shrub. It is very adaptable to a variety of soils, including being pH adaptable, performing best in well drained soils and poorest in waterlogged soils. It grows well in full shade and full sun but shows stress in soils subject to drought.

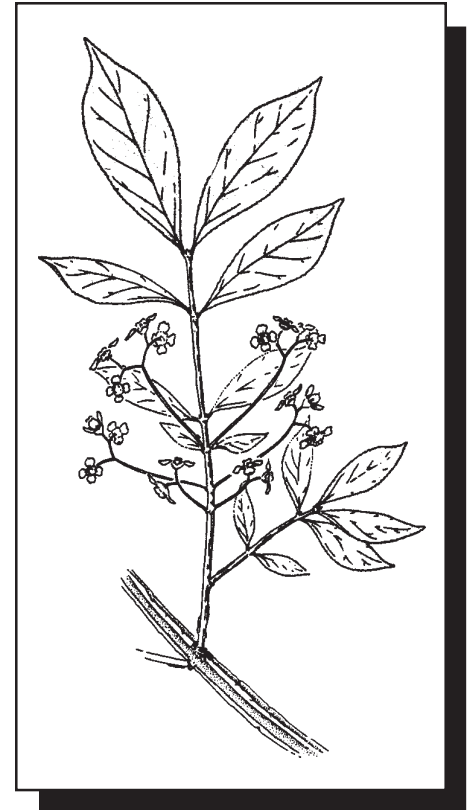
Distribution

Winged burning bush, because of its spectacularly red autumn foliage, is one of the most popular shrubs on the market. Consequently, its distribution is limited only by its

hardiness, extending from New England south to northern Florida and the Gulf Coast. It is commonly used in landscaping, especially for malls and highways. However, reports suggest winged burning bush may spread by seed from wherever it is used as an ornamental shrub.

Threat

The threat to natural areas from burning bush euonymus is that it shades out native herbs and crowds out native shrubs. Unfortunately, birds are very fond of the 1/4- to 1/3-inch long red fruit and consequently distribute the seeds across the countryside where plants readily sprout and establish themselves, enhancing the extent of the plant's distribution. According to the *Atlas of Virginia Flora*, 3rd edition (1992), it appears in only four counties of Virginia. That information is not up-to-date. The shrub may become one of our most troublesome plants because of the ease with which its seeds are spread, the readiness of germination, its adaptability to various soils, its tolerance of full shade and its spectacular fall foliage. Even Fernald recognized this in his 8th edition of *Gray's Manual of Botany* printed in 1950 as noted by his comment, "spreads from cult[ivation]." It appears entirely



Winged Burning Bush (*Euonymus alatus* (Thunb.) Siebold)

predictable that we will be unable to persuade either landscapers or nurserymen to voluntarily abandon either the use or sale of this plant.

Control

Control is therefore considered difficult once a parent plant has become established. It will probably not be much of a problem in cities, towns or thickly developed areas, but any nearby woodland where birds can roost may quickly become

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Invasive Alien Plant Species of Virginia

Winged Burning Bush (*Euonymus alatus* (Thunb.) Siebold)

infested. Therefore, abstaining from using the plant becomes the most important step toward control. Continued use of winged burning bush may result in it becoming a widespread invasive. No information on control of this species was found researching this fact sheet. Attempt control as for any shrub species.

Alternative Plants

A native shrub of rather limited availability that is not invasive to natural landscapes is red chokeberry (*Aronia arbutifolia*). It is spectacular in October when the foliage turns a brilliant red. The growth is more lax and less compact than the winged burning bush. The cultivar

“Brilliantissima” is recommended for more brilliant red foliage in the fall. Another choice would be the non-invasive exotic Koreanspice Viburnum (*Viburnum carlesii*), which may have reddish to wine-red fall color; however, fall selection is advised to be certain of the color one may expect.

For more information on native plant conservation, contact the Virginia Native Plant Society at the address below. For information on Virginia’s natural areas and natural heritage resources, contact the Virginia Department of Conservation and Recreation’s Natural Heritage Program (*see address below*).

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Invasive Alien Plant Species of Virginia

Oriental Bittersweet (*Celastrus orbiculatus* Thunb.)

Description

Oriental bittersweet is a deciduous, twining vine with alternate, nearly round, glossy leaves. Small, greenish flowers occur in clusters in the axils. The leathery capsule surrounding the seed ripens to a bright orange. The native species, American bittersweet (*Celastrus scandens*), differs from the invasive by its leaves, which are somewhat longer than wide, and the terminal panicle of flowers. Consult a natural resource specialist for an accurate identification.

Habitat

This species grows in alluvial woods, roadsides, thickets and old home sites. From there it may spread to undisturbed mesic or dry-mesic forests.

Distribution

Oriental bittersweet, a native of Asia, was brought to the United States for cultivation during the middle of the nineteenth century. It is now naturalized in 21 of the 33 states where it was introduced, a region extending from Maine south to Georgia, and west to Iowa. Oriental bittersweet is found in over half the counties of Virginia.

Threats

This plant can overrun natural vegetation in much the same way as kudzu (*Pueraria lobata*), over-topping all other vegetation and forming thick, nearly pure stands. It can strangle shrubs and tree limbs, and weaken a

tree by girdling the trunk and weighting the crown, making the tree more susceptible to wind and ice damage. There is some evidence that it can hybridize with American bittersweet, thus threatening genetic integrity of the native species.

Control

Light infestations of a few small plants can be controlled by cutting the vines and handpulling the roots. Dense infestations can be treated by cutting the vines followed immediately by application of a glyphosate herbicide to the stumps. Merely cutting vines without removing or killing the roots will only stimulate vigorous re-growth. To ensure rootkill, a late-season foliar application of herbicide may be necessary. Glyphosate herbicides are recommended because they are biodegradable. However, glyphosate is a nonselective, systemic herbicide that affects all green vegetation. To be safe and effective, herbicide use requires careful knowledge of the chemicals, appropriate concentrations, and the effective method and timing of their application. Contact a natural resource specialist for more information about controlling invasive plant species.

Alternative Plants for Cultivation

Many native species of vines are available through local nurseries or mail order. American bittersweet (*Celastrus scandens*) is our native bittersweet and does not exhibit the



Oriental Bittersweet (*Celastrus orbiculatus* Thunb.)

invasive tendencies of Oriental bittersweet. Crossvine (*Bignonia capreolata*), trumpet honeysuckle (*Lonicera sempervirens*), and trumpet creeper (*Campsis radicans*) are all climbing vines which produce bright red-orange flowers attractive to hummingbirds. Virgin's bower (*Clematis virginiana*) is a climbing vine which blooms in clusters of fragrant white flowers. Virginia creeper (*Parthenocissus quinquefolia*) grows well in the shade and its cluster of dark purple berries are an important food for birds. For more information on native plants for cultivation contact the Virginia Native Plant Society (see address below).

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