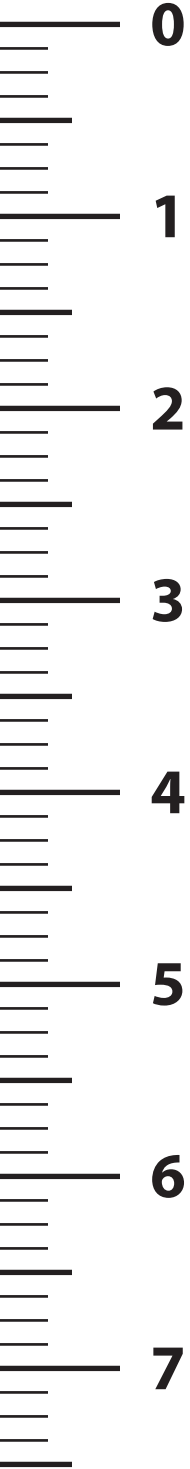


A close-up photograph of a dense cluster of green, oval-shaped leaves with prominent veins. Several bright purple, five-petaled flowers are scattered throughout the foliage, some in full bloom and others as buds. The background is dark, making the green leaves and purple flowers stand out.

# **Plant Invaders of Mid-Atlantic Natural Areas**

**Revised & Updated – with More Species  
and Expanded Control Guidance**

**National Park Service  
U.S. Fish and Wildlife Service**



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# **Plant Invaders of Mid-Atlantic Natural Areas, 4<sup>th</sup> ed.**

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Common periwinkle (*Vinca minor*) by Bill Johnson

## Preface

Contrary to the title, the focus of *Plant Invaders of Mid-Atlantic Natural Areas* is native biodiversity. Invasive species and habitat destruction, intensified by global climate change, are running neck-to-neck as the leading causes of environmental despoliation and loss of biological diversity worldwide. The ever-expanding human population and associated demand on limited natural resources are driving this worldwide problem. International trade provides a means to satisfy the great demand for exotic things but has resulted in the introduction of plants, insects and pathogens that are harmful to our environment and human health. Preserving remaining intact natural habitats, reestablishing native plants, managing overabundant white-tailed deer populations and restoring natural hydrologic and other conditions are some steps we can take to mend degraded lands.

This fourth edition has been updated, expanded and reorganized to provide more information in a more efficient manner. The book now includes information on 80 species (up from 60 previously) and expanded control guidance. A new section called “Plants to Watch” has been added which includes a number of species that may not be widespread but are increasingly catching the attention of ecologists, land managers and others as being invasive in natural habitats. Native plant alternatives have been consolidated in a separate section.

For the purposes of this manual, the mid-Atlantic region includes the District of Columbia and the states of Delaware, Maryland, New Jersey, Pennsylvania, Virginia and West Virginia. About 280 exotic plant species have been identified by experts as being invasive in natural areas in this region. A complete list is available from the *Invasive Plant Atlas of the United States* (see References). As of this printing, the *Invasive Plant Atlas* shows 1,173 plants having been reported to be invasive in natural areas in the U.S. This guide should be used as an introduction to invasive plants and the impacts they are having on natural habitats and ecosystems. Plants not included here should not be assumed to be non-harmful.

This book is dedicated to Gail Sharabi who inspired my first Weed Buster event at Brookside Gardens in Wheaton, Maryland on Columbus Day in 1993.

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# Plant Invaders of Mid-Atlantic Natural Areas

## Introduction

### **What is biodiversity and why is it important to us?**

All living things have evolved to live in various places on the Earth as a result of millions of years of responses to atmospheric, geologic, hydrologic, climatic and other conditions and biological interactions with other species. These forces have shaped the natural ecosystems and habitats present today and the plants, animals, fungi, bacteria and other organisms associated with them. The United States has an incredible array of wild natural areas including coniferous and deciduous forests, swamps, bogs, marshes, rivers, streams, lakes, prairies, barrens, deserts and montane habitats comprised of diverse groups of native species adapted to particular habitats and conditions. These species comprise our native biodiversity. Many of our parks, nature preserves and wildlife refuges provide some of the best examples of these living communities and species assemblages.

Healthy ecosystems are essential for maintaining native wildlife populations and the native plants that provide the food and shelter they require. As global travel and trade have expanded humans have been moving species to new areas, introducing them to places they would not likely have been able to reach by means of wind, water or wildlife. Some exotic species have escaped from plantings and are able to reproduce on their own in the wild and some of these naturalized species have become weedy or 'invasive.' As these species establish and spread they are replacing native plants and altering natural habitats, often with disastrous consequences for the plants and animals dependent on them. Habitats are being damaged, degraded and sometimes completely destroyed as a result of invasion by exotic species.

Maintaining healthy ecosystems is also vital for human survival and quality of life. Healthy ecosystems help provide clean air and water and reduce loss of vital soil resources to erosion. Wild areas are also great places for humans to enjoy, relax and recreate. For many, spending time in nature provides inspiration, spiritual enrichment, and opportunities for personal development. Restoration of invaded ecosystems offers some hope for the future but will require a large and long-term commitment of resources, labor and determination. Patches of disturbed land including small woodlots, landscaped areas and backyards can sustain native wildlife, if managed, designed and maintained properly. Management and reduction of white-tailed deer populations in areas where they are overabundant is critical to the success of restoration efforts and long term conservation of our natural areas and biodiversity.

## What are native species?

A native species is one that occurs in a particular place without human intervention. Species native to North America are generally recognized as those occurring on the continent prior to European settlement. Non-native (alien, exotic) species are ones that have been introduced by people, from other continents, ecosystems, or habitats to places where they don't occur and would not likely have been dispersed to by wind, water, wildlife or other natural means. Many non-native plants have great economic value for agriculture, forestry, horticulture and other industries and pose little environmental threat. However, others have become invasive and are having a serious and measurable ecological impact.

## What are invasive species?

Invasive species are alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. Invasives often benefit immensely from arriving in new places without the assortment of natural controls (e.g., herbivores and diseases) in their native ranges that serve as a check on their survival. Many also have one or more of the following: 1) adaptation to disturbance; 2) broad tolerance for environmental conditions and extremes of light, pH, and moisture; 3) production of large numbers of seeds; 4) high seed germination success; and 5) ability to spread by runners or rhizomes.

**An infestation of garlic mustard (*Allaria petiolata*) displaces spring wildflowers.**



Bill Johnson

**An infestation of purple loosestrife (*Lythrum salicaria*) appears pretty, but reduces local biodiversity, endangers rare species and provides little value to wildlife.**



*Bill Johnson*

### **Why are invasive plants a problem in natural areas?**

Like an invading army, invasive plants are taking over and degrading natural ecosystems and wreaking havoc on the intricate and complex web of life involving native plants, animals and other organisms. Invasive species compete for limited natural resources including soil, water, light, nutrients and space. They displace native plants, replace wildlife food sources with exotic plants that are inedible, toxic, or otherwise harmful, draw pollinators away from native plants, hybridize with native species, push rare species closer to extinction and cause an overall reduction in native biodiversity. Some invasive species spread rapidly and unabated, changing forests, meadows, wetlands and other natural plant communities into landscapes dominated by a single species. Such “monocultures” have little ecological value. Invasive plants also impede recreational activities such as boating, fishing, swimming, hiking and bike riding when they overgrow trails and riparian areas or form impenetrable tangles in shallow water areas. Once established over large areas, invasives require enormous amounts of time, labor and money to manage and most are difficult if not impossible to eliminate. One estimate of the economic impact of invasive species is \$142 billion annually.

**Kudzu (*Pueraria montana* var. *lobata*) grows vigorously over other plants and trees.**



*Bill Johnson*

### **How are invasive plants introduced?**

People introduce exotic plants intentionally and by accident, through a variety of means. Plants are introduced for food, medicine, landscaping, erosion control, forage, windbreaks and many other purposes. For example, kudzu was introduced to the U.S. from Japan in 1876 at the Philadelphia Centennial Exposition for forage and ornamental uses. From 1935 to the early 1950s, farmers in the South were encouraged to plant kudzu to reduce soil erosion, and Franklin D. Roosevelt's Civilian Conservation Corps planted it widely for many years. Kudzu was recognized as a pest weed by the U.S. Department of Agriculture and, in 1970, was removed from its list of permissible cover plants. By then its vigorous growth was widely recognized and it had earned the infamous moniker "the vine that ate the South."

Many ornamental species have escaped from plantings to become significant environmental weeds. About two-thirds of the almost 1,200 plants currently reported to be invasive in natural areas in the U.S. were imported for their horticultural value. Japanese barberry, bamboos, privets, Chinese and Japanese wisteria, porcelain-berry, Oriental bittersweet and Princess tree were introduced and planted for ornamental purposes and are now major weeds of natural habitats, requiring significant resources to attempt to control. Other species have come in unknowingly on various imported products or in soil, water and other materials used for ship ballast or packing materials. Japanese stiltgrass, one of our most insidious invasive

grasses, was used as packing material for porcelain and likely got a start when some material containing seed was deposited outdoors.

Invasive aquatic plants have been introduced by aquarium hobbyists who dump unwanted plants into waterways. Once established in a new environment and able to reproduce outside of cultivation, some exotic species are able to proliferate and expand over large areas, become invasive pests.

### **How do invasive plants spread?**

Invasive plants can spread by seed and by vegetative means including rhizomes, runners, shoots, tubers and bulbs. Seeds and plant fragments may be dispersed by wind, water, wildlife and people. Some animals spread invasive plants by consuming the fruits and depositing seeds later or by transporting seeds or fruits on their fur and feet. People can spread invasive plants by carrying seeds and other plant parts on their shoes, clothing and equipment, or by using contaminated fill dirt and mulch. A common pathway for dispersal of invasive aquatic plants is through attachment to anchors, propellers, and wheel wells.

### **How you can prevent the spread of invasive plants**

Become familiar with invasive plant species in your area and avoid using them. When selecting plants for landscaping, check the list before purchasing to avoid buying any that are known to be invasive or have a reputation for being weedy. Use native plants whenever possible that are native to the ecological region where you want to use them. Request nurseries to carry a wide variety of native species and offer some suggestions for plants you've been looking for. Consumer demand is a powerful tool that can be a major driver behind greater diversity and supply of natives – Use It! Lists of native plants are available from most state native plant societies and some state natural resources agencies. Some great sources of information on the importance and selection of native plants that provide food and shelter for native butterflies, birds, mammals and other wildlife are: 1) *Bringing Nature Home: How You Can Sustain Wildlife with Native Plants, Updated and Expanded* by Douglas Tallamy, 2) *Native Plants for Wildlife Habitat and Conservation Landscaping*, by the U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, 3) *Native Plants of the Northeast: A Guide for Gardening and Conservation*, by Donald J. Leonard, 4) *Designing Gardens with the Flora of the American Northeast*, by Carolyn Summers, and 5) the Lady Bird Johnson Wildflower Center's Native Plant Information Network (see References).

If you have invasive plants on your property, consider removing them and replacing them with native species, such as those suggested in

this guide. When visiting a natural area, be alert for invasive species. If you see some, notify the agency or organization responsible for managing the land. Before you leave, avoid carrying “hitchhiking” plant material by taking time to brush seeds from clothing and shoes and remove plant material from boats, trailers and other items.

## **Herbicide Use**

Taking action against invasive plants involves consideration of the various tools and techniques available for each plant and situation including site conditions, time of year, and resources available. Secondary and unintended consequences of control should also be considered, for example, if plants are pulled up, soil disturbance could bring more weed seed to the surface or facilitate invasion by additional invasive plants. The goal is to achieve effective long-term control and eventual restoration using approaches that pose the least risk of harm to people, especially those conducting the work, and to the environment including non-target plants and wildlife. And the bottom line is that the target species will be successfully controlled or at least reduced to a manageable level. This approach is referred to as integrated pest management (IPM) and sometimes integrated vegetation management (IVM). Often, the most effective method may be to do nothing at all until a suitable safe and well-thought-out tactic can be found.

Each method comes with its own set of risks. Cutting tools like pruning snips, hatchets, saws, weed whips, and mowers work great, but if not used with proper technique and care, can lead to serious injury. Use of herbicides poses additional risks and requirements associated with mixing, application, rinsing, disposal and storage. In order to avoid harm to yourself and others, to non-target plants and animals (including pets), and to the environment, especially in the case of an accidental spill, it is imperative that you are properly and sufficiently trained. No one should be applying herbicides without full knowledge about: 1) reading a pesticide label; 2) what the requirements for applying pesticides in your state are; 3) how to contact the company if there are questions about using the product; 4) how to measure the concentrate; 5) what type of personal protective equipment (PPE) is required during mixing and application; 6) what type of application equipment is recommended and most appropriate to your situation; 7) calibration of spray equipment, 8) rinsing and cleaning sprayers; and 9) disposal of unused mix, concentrate and containers.

Pesticide use by homeowners on their own property requires that the pesticide be allowed for residential use and that the product is not a Restricted Use pesticide, meaning it can only be applied by

a licensed applicator. Application of pesticides on public lands and other properties generally requires certification with the Department of Agriculture in your state, which involves training and testing. Contact the agency in your state responsible for pesticides for more information.

This book provides a few of the generally lower risk methods available for control of many invasive plants. It is not intended to be the ultimate reference for control practices. Additional methods and approaches are available and can be obtained by contacting organizations and specialists in the region. It is up to each individual to know and abide by the regulations applicable to the area where herbicide applications will be done.

**Note**

Use pesticides wisely: always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

**Notice**

Mention of a trade name does not constitute the endorsement of the product by authors, agencies or organizations involved in the production of this publication.

## Eurasian Water-Milfoil

*Myriophyllum spicatum* L.

Water milfoil family (Halogoraceae)

**Origin:** Eurasia and Africa

### Background

Introduced accidentally from Eurasia in the 1940s, Eurasian water-milfoil possibly escaped from an aquarium or was brought in on a commercial or private boat.

### Distribution and Habitat

Eurasian water-milfoil occurs in at least 33 states east of the Mississippi River and has recently been found in Colorado. It is abundant in the Chesapeake Bay, the tidal Potomac River and several Tennessee Valley reservoirs. Typical habitat includes fresh to brackish water of ponds, lakes, slow-moving streams, reservoirs, estuaries and canals. It is tolerant of many water pollutants.



*Graves Lovell, AL DCNR*

### Ecological Threat

Water-milfoil tends to invade disturbed areas and does not typically spread into undisturbed areas where native plants are well established. It can form large, floating mats of vegetation on the surface of lakes, rivers and other water bodies, that impede water traffic and reduce light for native aquatic species. It thrives in areas that have been subjected to natural and man-made disturbance.

### Description and Biology

- **Plant:** herbaceous aquatic plant; stems grow to the water surface, usually extending 3-10 ft. but as much as 33 ft. in length and frequently forming dense mats; stems are long, slender, branching, hairless and become leafless toward the base; new plants may emerge from each node (joint) on a stem and root upon contact with mud.
- **Leaves:** bright green, finely divided and occurring in whorls of three or four along the stem, with 12-16 pairs of fine, thin leaflets about ½ in. long that give it a feathery appearance.





Alison Fox, UFL



Mike Naylor, MD DNR



- Flowers, fruits and seeds: produces small, yellow, four-parted flowers on a spike that projects 2-4 in. above the water surface; flower spikes often remain above water until pollination is complete; fruit is a hard, segmented capsule containing four seeds.
- Spreads: vegetatively by rhizomes, fragmented stems and axillary buds that develop throughout the year. Although seeds are usually viable, they are not an important means of dispersal.
- Look-alikes: many species of submerged aquatic plants including non-native invasive parrot-feather (*Myriophyllum aquaticum*), and native species such as Northern water-milfoil (*M. sibiricum*), coontail (*Ceratophyllum demersum*) and water marigold (*Megalodonta beckii*).

### Prevention and Control

Large harvesting equipment can be used to mechanically remove Eurasian water-milfoil in larger areas; a sturdy hand-rake can be used for smaller areas. Other options include manipulation of water level, use of water colorants or floating aquatic plants to reduce light penetration, physical barriers and chemical control. Potential impacts to existing native aquatic plant species should be evaluated carefully before using any of these techniques.

### Native Alternatives

Aquatic plant species are difficult to tell apart to the untrained eye. Contact your state natural resource agency, native plant society or other resource (see References) for assistance.

## Giant Salvinia

*Salvinia molesta* D.S. Mitchell  
Floating fern family (Salviniaceae)

**Origin:** South America

### Background

Giant salvinia, also known as water fern or kariba-weed, was introduced as an ornamental aquatic plant and is spread to new water bodies on boats and fishing gear, by dumping of aquaria, and by other unintentional means. Sale, transport, release and other activities with this plant are prohibited in the United States by Federal law.

### Distribution and Habitat

Giant salvinia has populations scattered throughout the southeastern U.S. from eastern Texas through eastern North Carolina. There are two known occurrences in the tip of southern California. In the summer of 2000, a small population was discovered in ornamental ponds in Washington, D.C. but was quickly eradicated.

### Ecological Threat

Giant salvinia poses a serious threat to lakes, ponds, streams, rivers and other freshwater wetlands, and cultivated rice fields. It grows rapidly and spreads across water surfaces, forming dense floating mats that cut off light to other aquatic plants, reduce oxygen content and degrade water quality for fish and other aquatic organisms.

### Description and Biology

- Plant: floating aquatic fern with leaves that become compressed into chains in older plants.
- Leaves: about ½-1½ inches long; oval, folded, and covered with arching hairs that appear like “beaters” on upper leaf surfaces.
- Flowers, fruits and seeds: reproduces and spreads by tiny spores (rather than flowers).
- Spreads: by transport of plant fragments by water, humans and wildlife.
- Look-alikes: common salvinia (*Salvinia minima*), a native plant, looks very similar, but its leaf hairs do not join at the tip to form “beaters.”



Robert Vidéki, *Doronicum Kft.*

## Prevention and Control

Do not buy this plant or release it into the wild (these activities are prohibited by U.S. law). If you think you see this plant, call 1-877-STOP-ANS to report it. If you have this plant and no longer want it, pile plants onto a dry sunny surface (e.g., driveway) and let them dry out completely. Once completely dry, bag them in a sturdy plastic trash bag and dispose of in a landfill. Contact proper authorities about other methods of control and disposal.



Mic Julien, CSIRO



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## Hydrilla

*Hydrilla verticillata* (L. f.) Royle  
Frog-bit family (Hydrocharitaceae)

**Origin:** Central Africa

### Background

Hydrilla first appeared in the Crystal River system of Florida in 1960. Imported by the aquarium trade, its presence on the Delmarva Peninsula was confirmed in 1981. It attracted national attention when infestations were found in the Potomac River in Washington, D.C. in the early 1980s. It is a federal noxious weed.

### Distribution and Habitat

Hydrilla is documented throughout the southern United States from California to Delaware. In the mid-Atlantic, it occurs in much of the Potomac River, in Virginia and Maryland freshwater tributaries of the Chesapeake Bay, in the Delaware portion of the Nanticoke River,



Robert Vidéki, *Doronicum* Kft.

most southern Delaware ponds, and in sites in eastern Pennsylvania. It is not salt tolerant.

### Ecological Threat

Hydrilla outcompetes native submerged aquatic vegetation and can quickly fill a pond or lake, thus choking off the water body for boating, fishing, swimming and other recreational uses. Although non-native and invasive, it provides good quality habitat for fish and shellfish as well as water quality benefits.

### Description and Biology

- Plant: rooted aquatic plant.
- Leaves: in whorls of 4-5; about ½ in. long; fine-toothed margins, spine at tip.
- Flowers, fruits and seeds: tiny, translucent to white flowers produced on the upper branches in late summer and fall; tubers grow from the roots; winter buds (turions) are produced in the leaf axils.
- Spreads: vegetatively through fragments of stems, stolons, or rhizomes, turions, or tubers which are carried on boat livewells, motors and trailers, bait pails and other items, and by ingestion of tubers and turions by waterfowl.
- Look-alikes: native common waterweed (*Elodea canadensis*) with leaves in whorls of 3 and no teeth or spines.

### Prevention and Control

Physical, chemical and biological controls have been used for control of hydrilla, with varying levels of success. Water level drawdowns have generally been ineffective in our area. Mechanical aquatic weed harvesters provide temporary relief and open boating lanes, but resulting plant fragments can help spread the vegetation faster. Contact herbicides provide temporary control, but systemic herbicides provide more long-term control. Herbivorous fish such as sterile grass carp have been used for hydrilla control where allowed



David J. Moorhead, UGA

by law. Other biological controls are still being investigated. Each control method has its drawbacks and liabilities. On the Potomac River and other parts of the Chesapeake Bay watershed, resource managers struggle with hydrilla because submerged aquatic vegetation, including hydrilla, provides water quality benefits and habitat for fish and shellfish.

### Native Alternatives

Aquatic plant species are difficult to tell apart to the untrained eye. Contact your state natural resource agency, native plant society or other resource (see References) for assistance.

## Parrot-Feather

*Myriophyllum aquaticum* (Vell.) Verd.  
Water milfoil family (Haloragaceae)

**Origin:** South America

### Background

Parrot-feather was introduced to the United States in the Washington, DC area about 1890. Commonly sold for aquaria and aquatic gardens, it has escaped to become invasive in ponds and other calm water bodies in this region.



Graves Lovell, AL DCNR

### Distribution and Habitat

Parrot-feather occurs in at least 26 states throughout the United States. It is limited to non-tidal, freshwater, slow-moving water bodies including tributaries, ponds, lakes and canals. It prefers good light, slightly alkaline and high-nutrient environments.

### Ecological Threat

It can form dense mats and compete with native aquatic plants, especially in shallow ponds. It also provides habitat for mosquito larvae, impedes boats and clogs drainage ditches.

### Description and Biology

- Plant: aquatic plant with stout elongate stems suspended in the water column and/or floating; both stems and submerged leaves may be reddish tinted; gray-green tips of the stems with leaves may protrude above the water.



John M. Randall, TNC



Graves Lovell, AL DCNR

- Leaves: well-developed, finely pinnately divided, in whorls of mostly five with smooth leaf margins.
- Flowers, fruits and seeds: flowers and fruits, if present emerge from axils of leaves.
- Spreads: vegetatively from whole plants or fragments; it can be dispersed by people dumping aquaria into rivers and ponds and by animals carrying fruits and fragments on their bodies.
- Look-alikes: many species of submerged aquatic plants including non-native invasive Eurasian water-milfoil (*Myriophyllum spicatum*), and native species such as Northern water-milfoil (*M. sibiricum*), coontail (*Ceratophyllum demersum*) and water marigold (*Megalodonta beckii*).

### Prevention and Control

Attempting control by manual or mechanical means tends to spread the plants and should only be conducted in small, contained water bodies. Draining a pond in the summer achieved control in one instance, but draining may not achieve control in winter. Control with herbicides is difficult because the emergent stems and leaves have a waxy cuticle that repels herbicides. Research into biological control of parrot-feather is ongoing.

### Native Alternatives

Aquatic plant species are difficult to tell apart to the untrained eye. Contact your state natural resource agency, native plant society or other resource (see References) for assistance.

# Water Chestnut

*Trapa natans* L.

Water chestnut family (Trapaceae)

**Origin:** Europe, Asia and Africa

## Background

Water chestnut was first observed in North America near Concord, Massachusetts in 1859. The exact path for the introduction is unknown. It has been declared a noxious weed in Arizona, Massachusetts, North Carolina and South Carolina and its sale is prohibited in most southern states.



Mike Naylor, MD DNR

## Distribution and Habitat

Water chestnut can grow in any freshwater setting, from intertidal waters to 12 feet deep, although it prefers nutrient-rich lakes and rivers. Presently, the plant is found in Maryland, Massachusetts, New York and Pennsylvania, with most problematic populations occurring in the Connecticut River valley, Lake Champlain region, Hudson River, Potomac River and the upper Delaware River.

## Ecological Threat

Water chestnut can form dense floating mats, severely limiting light – a critical element of aquatic ecosystems. Once established, it can reduce oxygen levels, increasing the potential for fish kills. It competes with native vegetation and is of little value to waterfowl. Water chestnut infestations limit boating, fishing, swimming and other recreational activities. Further, its sharp fruits, if stepped on, can cause painful wounds.

## Description and Biology

- **Plant:** annual aquatic plant with a submerged stem; stems can reach 12-15 ft. in length; very fine roots anchor the plant into the mud.
- **Leaves:** rosette of floating leaves at the water's surface; saw-tooth margins; triangular in shape and connect to an inflated petiole which provides added buoyancy for the leafy portion; additional, feather-like leaves can be found along the submerged stem.



*Leslie J. Mehrhoff, University of Connecticut*

- Flowers, fruits and seeds: flowers are four-petaled and white; form in June; are insect-pollinated; fruit is a nut with four ½-inch, barbed spines; seeds can remain viable for up to 12 years, although most will germinate within the first two years.
- Spreads: by the rosette and by fruits detaching from the stem and floating to another area on currents or by clinging to birds and other floating objects.

### **Prevention and Control**

Specialized methods of control are required to handle water chestnut infestations. Because of the likelihood of unintentional spread offsite and injury to those attempting control, only trained and certified persons should undertake management. Manual, mechanical and chemical techniques are used in its control. Complete removal of plants is imperative, as floating, uplifted plants and plant parts can spread the plant to new locations. It is critical that any removal take place prior to the July seed set. Eradication is difficult because water chestnut seeds may lay dormant for up to 12 years. Biological controls are being investigated, but no species have been approved for release.

### **Native Alternatives**

Aquatic plant species are difficult to tell apart to the untrained eye. Contact your state natural resource agency, native plant society or other resource (see References) for assistance.



# Bamboos

Common bamboo - *Bambusa vulgaris*

Schrad. ex J.C. Wendl.

Golden bamboo - *Phyllostachys*

*aurea* Carr. ex A.& C. Rivière

Arrow bamboo - *Pseudosasa*

*japonica* (Sieb. & Zucc. ex Steud.)

Makino ex Nakai

Grass family (Poaceae)



Bill Johnson (*Bambusa vulgaris*)

**Origin:** Asia

## Background

Bamboos are woody reed-like grasses that have a shrubby growth habit.

The three species featured here are popular ornamentals that were introduced and planted widely but other species and cultivars are also available in the nursery trade. These

species have been reported by numerous sources as being invasive in natural areas (see below). Giant or switch cane (*Arundinaria gigantea*) is the only species of bamboo native to the U.S. It is found throughout the Southeast just into southern Maryland and is about the size of *Pseudosasa*.

## Distribution and Habitat

These species of bamboo have been reported to be invasive in the mid-Atlantic and Southeast as well as some sites in the western and southwestern U.S. Infestations are commonly associated with new and very old residences from which they've escaped.

## Ecological Threat

Bamboos can form very dense single-species thickets that displace native plant species and create dense shade that makes it difficult for seedlings of native species to survive. Once established, they can be very difficult to eradicate.

## Description and Biology

- Plant: woody stems varying from about ¼ in. (arrow) to 3-4 in. diameter (common and golden) with hollow centers and solid joints; grow to heights of 7-8 ft. (arrow) to 16-40 ft. (common and golden).
- Leaves: strap-shaped and tapering with pointed tips, tough, somewhat papery or leathery, up to 10 in. long and 1-2 in. across.
- Flowers, fruits and seeds: flowering is infrequent and unpredictable; flowers are grasslike and not especially showy.



Bill Johnson (*Phyllostachys aurea*)

- Spreads: by vegetative means through vigorous rhizomatous growth.
- Look-alikes: other bamboos, including native giant cane (*Arundinaria gigantea*) and some tall grasses.

### Prevention and Control

Do not plant exotic bamboos. While manual control of bamboo through cutting and digging out of rhizomes is possible, it is extremely labor intensive and will need to be continued over a long time to ensure eradication. Control with herbicides is more practical and can be very effective (see Control Options).

### Native Alternatives

Within its native range in the eastern U.S., giant reed (*Arundinaria gigantea*) is a good alternative to consider.

## Bog Bulrush

*Schoenoplectus mucronatus* (L.) Palla  
Cyperaceae (Sedge family)

**Origin:** Africa, Eurasia

### Background

Also called ricemarsch bulrush, ricefield bulrush and rough-seed bulrush, bog bulrush was collected before 1900 in New Brunswick and New Jersey. In recent times it has also been reported from New York, Pennsylvania, Illinois, Iowa, Kentucky, Missouri, Tennessee,



Ron Wilson

Maryland and Delaware. It is an important ricefield weed in California, where it was first observed in 1942. It was first observed in the Midwest in 1971. *Schoenoplectus mucronatus* is cultivated for wildlife food in Washington State.

### **Distribution and Habitat**

Bog bulrush occurs in wet soil and is emergent in fresh water, ponds, and ditches. It has colonized several wetland restoration areas in the mid-Atlantic.

### **Ecological Threat**

This species invades habitats that have been degraded in some way and is not currently known to invade high quality natural wetlands.

### **Description and Biology**

- Plant: annual or perennial sedge with fibrous roots.
- Leaves: triangular in cross-section, arising from the base of the plant.
- Flowers, fruit and seeds: flowers are near the top of the leaf and are brownish, scaly or spiky, carried near the end of a long stem with a distinctive angled bract.
- Spreads: seeds are eaten by waterfowl and probably carried between sites on their feet and feathers.
- Look-alikes: *Schoenoplectus fluviatilis* and *S. purshianus*, both native river bulrushes, and other native *Schoenoplectus* species (various bulrushes and three-square) lack the combination of hair-like projections from the base of the mature seed that are longer than the seed and the nearly right-angled upper bract.

### **Prevention and Control**

Mature seeds may be present anytime from June through October, depending on local conditions. If present, clip and bag the seed heads. Power wash any equipment when moving between sites to remove seeds. Manual and chemical methods are available and effective. For light infestations young plants can be hand-pulled, removing the roots as much as possible. For larger infestations of established plants with significant root masses, it is more effective to treat with a systemic herbicide such as glyphosate (see Control Options).

# Common Reed

*Phragmites australis* (Cav.) Trin. ex Steud.

Grass family (Poaceae)

**Origin:** Europe

## Background

European forms of *Phragmites* were probably introduced to North America by accident in ballast material in the late 1700s or early 1800s. Recent research using genetic markers has demonstrated that three separate lineages occur in North America – one endemic and widespread (native), one whose nativity is not certain that occurs across the southern U.S. from California to Florida and into Mexico and Central America ('Gulf Coast' type) and one from Europe (introduced invasive), which is the focus of this writing.



Joseph McCauley, USFWS

The European *Phragmites* first established along the Atlantic coast and then spread across the continent over the course of the 20th century. The native form was historically more widespread, occurring throughout Canada and most of the U.S. except for the Southeast (Texas to Florida and north to North Carolina). It remains fairly widespread in the western U.S.

Native Americans used common reed for arrow shafts, musical instruments, ceremonial objects, cigarettes, and leaves and stems for constructing mats. Preserved remains of native *Phragmites* 40,000 years old have been found in the Southwestern United States indicating that it is a part of the native flora of that region. In coastal areas, preserved rhizome fragments dating back 3,000-4,000 years before present have also been found in salt marsh sediments indicating that it is also native to these habitats. Both native and introduced forms have been used for duckblinds.

## Distribution and Habitat

Common reed occurs in disturbed to pristine wet areas including tidal and non-tidal wetlands, brackish and fresh-water marshes, river edges, shores of lakes and ponds, roadsides and ditches. It prefers full sun and can tolerate fresh to mesohaline salinities.

## Ecological Threat

Common reed is a vigorous growing plant that forms dense monotypic stands that consume available growing space and push out other plants including the native subspecies. It also alters wetland hydrology, increases the potential for fire and reduces and degrades wetland wildlife habitat due in part to its very dense growth habit. There is currently no evidence for of hybridization between native and introduced forms occurring in the field.

## Description and Biology

- Plant: perennial grass, stems to 15 ft., somewhat rough to the touch, lack fungal spots but some mildew may be present.
- Leaves: blue green and darker than the native form; elongate, typically 1-1½ in. wide at their widest point; leaf sheaths adhere tightly to stem and persist through the winter; ligule is less than 1 mm long.
- Flowers, fruits and seeds: flowers in bushy panicles, usually purple or golden in color; upper glumes 4.5-7.5 mm, lower glumes 2.5-5.0 mm (most <4.0).
- Spreads: by seed which is dispersed by wind and water; vegetatively through rhizomes and transport of rhizome fragments.
- Look-alikes: native form of *Phragmites*; other large grasses with plume-like inflorescences.

## Prevention and Control

Avoid spread of plants and plant parts to uninfested plant areas (see Control Options).



Bill Johnson

# Japanese Stiltgrass

*Microstegium vimineum* (Trin.) A. Camus

Grass family (Poaceae)

**Origin:** Japan, Korea, China, Malaysia and India

## Background

Japanese stiltgrass was introduced into the United States in Tennessee around 1919 and likely escaped as a result of its use as a packing material for porcelain.

## Distribution and Habitat

Stiltgrass is currently established in 16 eastern states, from New York to Florida. It occurs on stream banks, river bluffs, floodplains, emergent and forested wetlands, moist woodlands, early successional fields, uplands, thickets, roadside ditches, and gas and power-line corridors. It can be found in full sun to deep shaded forest conditions and is associated with moist, rich soils that are acidic, neutral or basic and high in nitrogen.



Bill Johnson

## Ecological Threat

Stiltgrass threatens native understory vegetation in full sun to deep shade. It readily invades disturbed shaded areas, like floodplains that are prone to natural scouring, and areas subject to mowing, tilling and other soil-disturbing activities including white-tailed deer traffic. It spreads opportunistically following disturbance to form dense patches, displacing native wetland and forest vegetation as the patch expands.

## Description and Biology

- Plant: annual grass resembling a small, delicate bamboo; mature plants grow to 2-3 ft. in height.
- Leaves: pale green, lance-shaped, asymmetrical, about 3 in. in length, with a shiny midrib.
- Flowers, fruits and seeds: hidden (cleistogamous), self-fertilizing flowers in axils and/or exposed (chasmogamous) flowers in terminal racemes of paired, hairy spikelets that open and are wind-pollinated; fruits awned and bristly; late summer to fall.
- Spreads: by seed and vegetative spread by rooting at joints along the stem—a new plant can emerge from each node; a single plant can produce 100-1,000 seeds that remain viable in the soil for at least three years, ensuring its persistence; seed germinates readily following soil disturbance. Although dispersal is not fully

understood, seeds can be transported by water (e.g., surface runoff, streams, and floodwaters), in soil and gravel, in nursery grown plants, and on the feet of animals including humans.

- Look-alikes: Virginia cutgrass (*Leersia virginica*), hairy jointgrass or small carpetgrass (*Arthraxon hispidus*), and possibly other delicate grasses and wildflowers like Pennsylvania knotweed (*Polygonum persicaria*).

### Prevention and Control

Because it is similar in appearance to several native grasses, it is important to know how to recognize and differentiate stiltgrass from look-alikes. Look for asymmetrical leaves with a shiny midrib and the stilt-like growth form. Attention to new infestations should be a priority. Because it is shallow-rooted, stiltgrass may be pulled by hand at any time. If flowering, cut plants back using a mower, weed whip or other device to prevent seed production. For extensive infestations, herbicides are the most practical and effective method currently (see Control Options).



James H. Miller, USDA FS

### Native Alternatives

Following disturbance to an area susceptible to stiltgrass, stabilize with native vegetation suitable to site conditions.

## Wavyleaf Basketgrass

*Opismenus hirtellus* ssp. *undulatifolius* (Ard.) U. Scholz  
Grass family (Poaceae)

**Origin:** southern Europe and southeast Asia

### Background

It was first discovered in Maryland in 1996 along the Patapsco River in Baltimore County and is spreading rapidly.

### Distribution and Habitat

Wavyleaf basketgrass has been found in six counties in Maryland (Anne Arundel, Baltimore, Carroll, Howard, Montgomery and Prince Georges) and in counties in Virginia



Kerrie L. Kyle, MD DNR

(Fairfax, Fauquier, Loudon, Madison, and Rockingham). It is highly shade-adapted and is found in forested areas from the margins to interior.

### Ecological Threat

Wavyleaf grows low to the ground and spreads across the forest floor displacing native plant species completely or nearly so. It often occurs with Japanese stiltgrass. An urgent effort is underway to eradicate this fast-spreading invasive that has the potential to become much more widespread.

### Description and Biology

- **Plant:** low-growing, shallow-rooted perennial grass; produces long stolons; branches and roots at the lower stem nodes.
- **Leaves:** flat, about ½ in. wide by 1½-4 in. long; deep green with undulating ripples across the leaf surface; leaf sheath and stem are noticeably hairy, with short hairs.
- **Flowers, fruits and seeds:** flowers are in spikelets that alternate along the flowering stalk; spikelets have glumes (lower bracts) with very long awns (extended pointed tips) that are sticky; late September into October.
- **Spreads:** by seed; sticky substance produced by the awns facilitates adherence to animal fur, human clothing and shoes, tires and other objects.
- **Look-alikes:** two native subspecies of basketgrass (*Oplismenus hirtellus* ssp. *fasciculatus* and *O. h.* ssp. *setarius*) occur in southern and southeastern U.S. but are not known to occur in the mid-Atlantic region. *O. h.* ssp. *setarius*, its closest relative, setarius, has only a few hairs, if any. Native deer-tongue panicgrass (*Dicanthelium clandestinum*) and small carpetgrass (*Arthraxon hispidus*) resemble wavyleaf but grow in upright clumps and their leaves are not rippled.

### Prevention and Control

Do not purchase or plant this or any basketgrass in the mid-Atlantic states. Stay out of infested areas from August through November to prevent seed dispersal. If you work in an infested area, be thorough in removing all seeds from shoes, clothing and equipment prior to leaving (see Control Options).

### Native Alternatives

Deer-tongue grass (*Dicanthelium clandestinum*), bottlebrush grass (*Elymus hystrix*) and many other native grasses are available.



# CONTROL OPTIONS

## GENERAL GUIDANCE FOR GRASSES AND GRASSLIKE PLANTS

A variety of methods are available for control of grasses, depending on the extent of the infestation, the type of habitat, and the availability of labor and other resources. Preventing the introduction of invasive grasses from infested to non-infested areas should always be a priority. Early control of new infestations will also reduce the likelihood of establishment and expansion. When deciding between physical and chemical methods, keep in mind that manual removal of plants can result in disturbance to the soil which can further encourage the invasive species and open the site up to new introductions. Using an herbicide leaves the plants and soil in place, thus minimizing that likelihood. The use of grass-specific herbicides will reduce impacts to non-target broadleaf plants.

Use pesticides wisely: always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations. Notice: mention of a trade name does not constitute the endorsement of the product by authors, agencies or organizations involved in the production of this publication.

## BAMBOOS

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### Biological

Biological control is not available for these species.

### Chemical

The following method is effective for control of most exotic invasive bamboos such as common bamboo (*Bambusa vulgaris*), golden bamboo (*Phyllostachys aurea*), arrow bamboo (*Pseudosasa japonica*) and others. It was developed by Dr. Francis Gouin, formerly the University of Maryland Agronomist and is presented here with slight modification.

Cut the bamboo down to the ground in spring (e.g., June). Depending on the type of bamboo you are working with, you will need a chain saw, weed whip or weed whacker, Swedish brush axe, pruning snips or other tool that will cut through the bamboo stems. Hand-held pruning snips work fine for the thinner stemmed running bamboos (*Pseudosasa*), but it is more labor intensive and time consuming. Cut down as low as is comfortable and leave alone for the summer, allowing it to regrow. In October or early November, on a sunny, non-breezy day, spray the leaves of regrown plants with a 2% rate

of glyphosate (e.g., Accord® or Roundup Pro®), mixed with water, according to the label directions. Apply thoroughly just to the point of drip. Wait 10-14 days and reapply the glyphosate at the same rate. After the second treatment, leave the bamboo alone. Do not cut, mow, or remove plant material. The following spring, the bamboo will be browned out and should not grow back. At this point, you can cut and remove the dead vegetation. If any bamboo remains or does reappear, repeat the procedure.

## **BOG BULRUSH**

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See General Guidance.

### **Manual**

Hand-pulling can be effective for young plants and light infestations.

### **Chemical**

For plants with established root mass, treat with a systemic herbicide such as glyphosate to kill the entire plant to the roots. Mature seeds may be present anytime from June through October, depending on local conditions. If present, clip and bag the seed heads. Power wash any equipment when moving between sites to remove seeds.

## **COMMON REED**

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### **Biological**

Biological control is not available at this time but is under active investigation. Finding an appropriate control agent for the U.S. is complicated by the co-occurrence of native and exotic genotypes.

### **Chemical**

**Foliar.** Systemic herbicides such as Accord®, Glypro® or Rodeo® and similar products containing 53-54% glyphosate, which moves through the plant to kill the roots, are most effective. Products must be labeled for wetland use. Low rates of herbicide (1.5-2%) mixed with water and a low toxicity surfactant approved for wetland use, can be applied to foliage using a backpack sprayer or power-driven hand sprayer. The most effective timing for treatments is after flowering into the fall, but applications can be made from June and early October as long as plants are actively growing and not under drought stress. Annual followup treatments should be made after July to allow for sufficient regrowth of plants affected by previous treatments and may be slower to emerge. For large infestations, truck-based applications or aerial treatments are the most practical and can be highly effective. The U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, uses 1.25% glyphosate mixed with water and 0.625% surfactant (e.g., LI-700® made by

UAP) from September through October applied to mature green plants. Treatments are followed with burning or mowing which helps the native vegetation recover. Another product to consider is Habitat® (imazapyr), which can be applied August-September in our region using 48-64 oz/acre (higher rate is best). To avoid damage to nontarget plants, maintain a 50-ft. buffer between the Phragmites and any desirable vegetation. Target vegetation in the buffer can be treated with glyphosate. Follow label precautions and avoid application to roots of desirable plants.

**Cut-stem.** Another method practical for small infestations is the following cut-stem treatment developed by The Nature Conservancy. Phragmites stems are cut at waist height for convenience for the applicator; cutting between the nodes to expose a hollow portion of the stem. Use a Nalgene® squirt bottle with a bent and pointed tip and fill with a 50:50 glyphosate and water mixture plus a blue marking dye to help track applications. Insert the tip into the stem and apply about ½ tsp. into the stem and around the cut edge. This can be done mid-summer through fall. Treated areas must be monitored and retreated as necessary for several years until the Phragmites has been eradicated.

### Hydrological

Altering water levels can be an effective, non-chemical option for certain sites and conditions. For more information on this method, refer to The Nature Conservancy's Element Stewardship report on Phragmites (see References).

### Manual-Mechanical

Hand-pulling of plants is not feasible due to the extensive tough rhizomes.

## JAPANESE STILTGRASS

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### Biological

Biological control is not available for this species, but pathogens have been observed infecting stiltgrass populations naturally.

### Chemical

For extensive stiltgrass infestations, use of a systemic herbicide such as glyphosate (e.g., Roundup Pro®) is a practical and effective method if used with some caution. Glyphosate is a non-specific herbicide that will kill or damage almost any herbaceous plant and possibly some woody plants it contacts. Roundup Pro® is surfactant-loaded (no additional surfactant needed) and the surfactant is not lethal to amphibians and aquatic invertebrates like the polyoxyethyleneamine surfactant in Roundup Classic® is. Roundup

Pro® carries the ‘Caution’ signal word while Roundup Classic® carries ‘Warning’. When treating stiltgrass in wetland sites, use Rodeo® or other formulation labeled for wetlands. Apply a 0.5 to 1% solution of Roundup® or Rodeo® mixed with water (8 oz. per 3 gals. mix) and a surfactant in late summer. Be careful to avoid application to non-target plants.

Grass-specific herbicides (graminicides) such as sethoxydim and clethodim fluzifop-p-butyl work very well on stiltgrass and if used correctly can reduce potential damage to woody or broadleaf plants. Grass-out®, and Grass-B-Gon® are homeowner versions of these products. Some success has also been reported using pre-emergent herbicide imazapic applied in March in the Mid-Atlantic region. For more details on these methods, refer to the fact sheet on the Plant Conservation Alliance’s ‘Weeds Gone Wild’ website (see References).

### Manual-Mechanical

Stiltgrass is a shallow-rooted annual that can be pulled by hand throughout the growing season, especially when the soil is moist and entire plants with roots can be removed. Pulling is easier and probably more effective in mid-to-late summer when the plants are much taller and more branched however if not done early enough, there’s a risk of plants flowering and producing seed. At this stage, entire plants can be easily removed by grabbing the basal portion of a plant and pulling firmly. In short time, a fair amount of stiltgrass can be pulled and piled up to dehydrate on site. If plants are already in the fruiting stage, they should be bagged and disposed of offsite to prevent dispersal of seed. Also, try to avoid pulling native grasses like Virginia cutgrass (*Leersia virginica*) that often grow intermingled with stiltgrass and may be difficult to distinguish from it. Because hand-pulling plants disturbs the soil and may expose stiltgrass seed from previous seasons, late season pulling will avoid the likelihood of survival of any seeds that germinate. Hand-pulling of plants needs to be repeated and continued for many seasons until the seed bank is exhausted. Stiltgrass can be mowed in late summer (i.e., August through September) when the plants are flowering but preferably before seed is produced. This can be done using a lawn mower or “weed whacker” type machine or a scythe. Because stiltgrass is an annual plant, cutting late in the season before the plants would die back naturally avoids the possibility of regrowth. Recent information suggests that stiltgrass plants that are cut early in the summer respond by regrowing and flowering soon after cutting, much earlier than they would normally flower. This is another reason to consider cutting in late summer to fall rather than during the early summer months.

### Biological

Biological control is not available for this species.

### Chemical

In herbicide trials in Maryland, clethodim and glyphosate were effective. Clethodim is grass-selective, so it leaves behind the woodland wildflowers and the sedges. More detailed information on its use can be obtained from the Maryland Department of Natural Resources. In areas where basketgrass has formed a monoculture, a 1-2% solution of glyphosate (53.8%) mixed with water and a non-ionic surfactant can be applied using a backpack sprayer. The spray should be applied to wet the plants but not to the point of run-off. Applications should be made in a slow and careful manner to avoid harming or killing native plants. Prior to herbicide treatments, applicators must be taught to recognize native plants on site. It is important to control basketgrass before seed is produced and check each following year for results in June.

### Manual-Mechanical

Where basketgrass is mixed with many native plants, manual removal of individual plants will help to retain the native flora. Plants can be pulled by hand fairly easily anytime. If not in flower, pulled material can be left on-site to desiccate and disintegrate. If plants are flowering and the possibility of seeds exists, it is best to bag and remove pulled material. However, once the awns become sticky it is probably best to stop pulling or working in basketgrass infestation because of the likelihood of spreading seeds.

# Beefsteak Plant

*Perilla frutescens* (L.) Britt.

Mint family (Lamiaceae)

**Origin:** Asia (China, India, Japan, Korea, Thailand, and other countries)

## Background

Also called perilla mint, beefsteak plant is a traditional Asian crop used in cooking and is often planted as an ornamental. It readily escapes cultivation and has become a problematic invasive plant in natural areas across the mid-Atlantic region and elsewhere.

## Distribution and Habitat

Beefsteak plant is reported to be invasive in Washington, D.C., Illinois, Maryland, Missouri, Pennsylvania, Tennessee, Virginia, and West Virginia. It is well established along riparian areas of streams and rivers, gravel bars, forest edges, roadsides, railroad right-of-ways, pastures, fields and other disturbed areas in soils that are rich, alluvial or dry.



Bill Johnson

## Ecological Threat

Beefsteak plant has spread to natural areas, especially those experiencing some form of disturbance. Once established, it disrupts native ecosystems by pushing out native plants. It has toxic characteristics which may explain why very few herbivores feed on it. It is ordinarily avoided by cattle and has been implicated in cattle poisoning. Beefsteak plants are most toxic if cut and dried for hay late in the summer, during seed production.

## Description and Biology

- **Plant:** small, freely-branching annual herb that grows to 18-30 in. high; stems four-sided and covered with short hairs.
- **Leaves:** opposite, ovate, green to purple with toothed margins; distinctive musky mint-like odor.
- **Flowers, fruits and seeds:** flowers are small, bell-shaped, white and purple with a distinctive ring of fine hairs along the bottom in terminal spikes or emerging from leaf axils; July and October.
- **Spreads:** by seed that either drops close to parent plant or may be transported by wind or water.
- **Look-alikes:** beefsteak plant superficially resembles basil and coleus and can be confused with other members of the mint family.



Chris Evans, River to River CWMA

### Prevention and Control

Do not purchase or plant beefsteak plant. Control is possible with long-term monitoring (see Control Options).

### Native Alternatives

Members of the mint family like bee balm (*Monarda didyma*) and mountain mint (*Pycnanthemum muticum*) are a few good alternatives to this invasive plant.

## Canada Thistle

*Cirsium arvense* (L.) Scop.  
Aster family (Asteraceae)

**Origin:** Europe and Asia

### Background

Canada thistle was accidentally introduced to North America in the 1600s and is designated as a noxious weed in 43 states.

### Distribution and Habitat

Canada thistle is an extremely widespread weed of agricultural and ecological areas in the U.S, occurring throughout the northern states and Southwest but is largely absent in the South from Texas to Georgia. Twenty large national parks across the country report it as a serious invasive plant affecting natural resources. It invades a variety of dry to moist open habitats including barrens, fields, glades, grasslands, pastures, stream banks, wet meadows, wet prairies, and open forests. It is not very tolerant of shade.



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## Ecological Threat

Once established, if conditions are suitable, Canada thistle can form dense stands that shade out and displace native plants, changing the plant community structure and species composition and reducing biodiversity. It spreads rapidly and is very difficult to remove.

## Description and Biology

- **Plant:** erect, perennial herbaceous plant, to 4 ft. tall with an extensive creeping rootstock and ridged and hairy stems.
- **Leaves:** lance-shaped, irregularly lobed, 2-6 in. long with weakly- to strongly-prickled margins.
- **Flowers, fruits and seeds:** flowering occurs in late June to August; flowers are purple to white and about 1 in. long by ½ in. across; seeds are called achenes, are 1-1½ in. long and have a feathery pappus.
- **Spreads:** by wind-dispersed seed; expands locally by vegetative means through lateral roots and root fragments.
- **Look-alikes:** a number of native and exotic thistle species, some which are very rare. Numerous species of thistle occur in North America. Some are invasive, some are native, and most are dependably difficult to distinguish without assistance.

## Prevention and Control

Management of Canada thistle is very difficult and requires repeated applications of systemic herbicides including products not covered in this guide. Glyphosate is not very effective against it. Other sources will likely need to be contacted for more effective herbicides (see Control Options).

## Native Alternatives

After eradicating, plant area with native vegetation appropriate to site conditions. Refer to References.

## Chinese Lespedeza

*Lespedeza cuneata* (Dum.-Cours.) G. Don.  
Pea family (Fabaceae)

**Origin:** Eastern Asia

### Background

Chinese or Sericea lespedeza was introduced in the late 1800s by federal and state agencies for use in bank stabilization, erosion control, soil improvement, mine reclamation, forage, hay and other purposes. It has been escaping from plantings for many years and is a well established invasive plant.



James H. Miller, USDA FS





Bill Johnson

### Distribution and Habitat

Chinese lespedeza occurs throughout much of the eastern U.S. from Minnesota to Texas east to New York and Florida. It is found in a variety of habitats including fields, prairies, floodplains, pond borders, stream banks, swamps, meadows, open woodlands, roadsides and other disturbed grounds, prefers full sun and is not tolerant of much shade.

### Ecological Threat

Chinese lespedeza poses the greatest threat to open areas such as meadows, prairies, open woodlands, wetland borders and fields. Once established, it out-competes and displaces native plants, forms extensive monocultures and develops an extensive seed bank in the soil, ensuring its long residence at a site. Its high tannin content makes it unpalatable to livestock and most native wildlife.

### Description and Biology

- **Plant:** warm season, perennial herbaceous plant with an erect growth form, 3-5½ feet in height; mature stems are somewhat woody and fibrous with sharp, stiff, flattened bristles.
- **Leaves:** each leaf is divided into three smaller leaflets which are narrowly oblong and pointed, with awl-shaped spines and wedge-shaped bases; leaflets are covered with densely flattened hairs, giving a grayish-green or silvery appearance.
- **Flowers, fruits and seeds:** flowers small (about ¼ in.) creamy white to pale yellow with central purple spots, single or in clusters of 2-4 in axils of upper and median leaves, summer; fruits form in fall; seeds tiny, bean-shaped, yellow to light brown.
- **Spreads:** by seed that is consumed by animals such as bobwhite quail and passed through digestive tract and deposited in new locations.
- **Look-alikes:** other species of *Lespedeza* including native and non-native species.

## Prevention and Control

Do not plant Chinese lespedeza. Hand pulling is impractical due to lespedeza's extensive perennial root system. Mowing plants in the flowering stage for two or three consecutive years may help control it. Plants should be cut as low as possible. Systemic herbicides can be effective when applied in early to mid summer (see Control Options).

## Native Alternatives

Blue indigo (*Baptisia australis*) or yellow wild indigo (*Baptisia tinctoria*), partridge pea (*Cassia fasciculata*), Virginia wild rye (*Elymus virginicus*), little bluestem (*Schizachyrium scoparium*), wild senna (*Senna hebecarpa* or *marilandica*).

## Common Daylily

*Hemerocallis fulva* (L.) L.  
Lily family (Liliaceae)

**Origin:** Asia

### Background

Common or orange daylily was introduced into the United States in the late 19th century as an ornamental. It is a very popular plant favored by homeowners and landscape designers for its showy flowers, hardiness and ability to spread.

There are now over 40,000 registered cultivars, many of which likely are or have the potential to become invasive and should be watched. For example, yellow daylily (*H. lilioasphodelus*), has also been identified as invasive in scattered locations in the eastern U.S. Daylily buds and flowers are edible and have a sweet-spicy or peppery flavor.



Olivia Kwong, PCA

### Distribution and Habitat

Common daylily occurs in every state in the eastern U.S. and in scattered locations west to Oregon. Infestations often occur near old homesites from which they've escaped from plantings.

### Ecological Threat

Daylilies established in natural areas pose a threat to native plants in field, meadows, floodplains, moist woods and forest edges. Once established, daylily multiplies and spreads to form dense patches that

displace native plants. The thick tubers make it a challenge to control.

### Description and Biology

- Plant: bulbous perennial, 2-4 ft. tall with round stems.
- Leaves: long, linear, strap-like, bright-green, 1-3 ft. (0.3-1 m) long and curve toward the ground.
- Flowers, fruits and seeds: flowers are large, showy, orange, usually with some striping; occur in clusters of 5-9 at the tip of the stalk; flowers in a cluster open one at a time, each for one day only; summer.
- Spreads: by growth from thick, tuberous roots from which new plants are produced; seed; people tossing away whole pulled plants and by farm equipment or other machinery in fields.
- Look-alikes: native lilies like Canada lily (*Lilium canadense*), wood lily (*Lilium philadelphicum*) and Turk's cap lily (*Lilium superbum*), and non-native lilyturf (*Liriope spicata*).

### Prevention and Control

Do not plant daylilies known to have weedy habits. Plants can be dug up using a shovel to loosen the soil so that the entire root system with tubers can be removed. Otherwise, re-sprouting will likely occur. Herbicides like glyphosate with systemic action are also effective (see Control Options).

### Native Alternatives

Canada lily (*Lilium canadense*), wood lily (*Lilium philadelphicum*), Turk's cap lily (*Lilium superbum*), three-lobed coneflower (*Rudbeckia triloba*), and Ox-eye sunflower (*Heliopsis helianthoides*).

## Dame's Rocket

*Hesperis matronalis* L.

Mustard family (Brassicaceae)

**Origin:** Europe

### Background

Dame's rocket, also known as dame's violet and mother-of-the-evening, was introduced as an ornamental around the time of European settlement. It continues to be widely used as an ornamental and can be found throughout North America.



Bill Johnson



Bill Johnson

### Distribution and Habitat

Habitats invaded include open woodlands, prairies, roadsides, ditches, and other disturbed areas.

### Ecological Threat

Dame's rocket displaces native plant species.

### Description and Biology

- Plant: herbaceous, biennial forb up to 4 ft. in height.
- Leaves: alternate, hairy, broadly lanceolate with toothed margins, sessile or nearly so, 2-6 in. long.
- Flowers, fruits and seeds: flowers showy, fragrant, white to purple or pink with 4 petals in a cross; late spring; fruits slender, cylindrical and arch upwards.
- Spreads: by seed.
- Look-alikes: might be confused with wild blue phlox (*Phlox divaricata*), fall phlox (*Phlox paniculata*) and non-native annual honesty (*Lunaria annua*).

### Prevention and Control

Do not purchase or plant this species. Individual plants can be pulled by hand if soil is moist or dug up using a spade or shovel to loosen the soil and remove the entire root system. Re-sprouting may occur if entire root system is not removed. Systemic herbicides can be used to kill the entire plant including the roots (see Control Options).

### Native Alternatives

Ox-eye sunflower (*Heliopsis helianthoides*), Canada lily (*Lilium canadense*), wood lily (*Lilium philadelphicum*), Turk's cap lily (*Lilium superbum*), and three-lobed coneflower (*Rudbeckia triloba*) are just a few showy native perennials that would make good substitutes for dame's rocket.

# European Stinging Nettle

*Urtica dioica* L.

Nettle Family (Urticaceae)

**Origin:** Europe

## Distribution and Habitat

Also called great nettle, European stinging nettle occurs in Coastal Plain, Piedmont and Mountain provinces in the mid-Atlantic and Southeast, from Delaware to Florida. It inhabits damp, rich, disturbed areas, primarily in calcareous soils, in floodplains and moist open forests, and can tolerate dry soils and some shade.

## Ecological Threat

This plant can become well established in floodplain areas and push out native plants, impacting spring ephemeral species as well as those that emerge later in spring and through the summer.



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## Description and Biology

- **Plant:** erect, rhizomatous, dioecious (male and female flowers occur on separate plants) perennial; unbranched; can grow to 6 ft. in height; covered with minute needle-like stinging hairs that can cause a painful burning sensation lasting many hours.
- **Leaves:** opposite, 2-6 in. long with leaf bases broadly ovate to cordate (heart-shaped) and leaf margins serrate; stipules (outgrowths on either side of leaf stalk) are 5-15 mm long.
- **Flowers, fruits and seeds:** flowers are branched, many-flowered, and emerge from below the petioles which they exceed in length; flowers occur May-July; fruits occur July-September.
- **Spreads:** by seed.
- **Look-alikes:** may be confused with other members of the nettle family including American stinging nettle (*U. gracilis*), which is usually monoecious, stouter and more sparsely hairy; wood nettle (*Laportea canadensis*) which is alternate leaved; false-nettle (*Boehmeria cylindrica*) and clearweed (*Pilea*) which lack stinging hairs.

## Prevention and Control

Due to its popularity in some circles as an edible plant, it may be purchased and cultivated. If grown, ensure that it does not spread beyond the planted site by removing flowers and fruits and killing back if it does begin to beyond the intended area. Manual, mechanical and chemical methods are available and effective (see Control Options).

## Fig Buttercup

*Ficaria verna* Huds.

Buttercup family (Ranunculaceae)

**Origin:** Europe

### Background

Fig buttercup, also known as lesser celandine, was introduced to the United States as an ornamental plant and many colorful varieties are currently available commercially.

### Distribution and Habitat

Fig buttercup is currently found in 20 northeastern states and in Oregon, Washington and several Canadian provinces. It occurs most commonly on moist, forested floodplains and other wet areas.



*Leslie J. Mehrhoff, University of Connecticut*

### Ecological Threat

Fig buttercup's greatest threat is to native spring-flowering or "ephemeral" plants. It emerges in the winter in advance of most native species, giving it a great competitive advantage. Once established, it spreads rapidly, forming a solid green blanket across the ground through which native plants are unable to penetrate.

### Description and Biology

- **Plant:** perennial herbaceous spring ephemeral plant with thick tuberous roots and bulblets.
- **Leaves:** shiny, dark green, kidney-shaped, and stalked.
- **Flowers, fruits and seeds:** glossy, butter-yellow flowers appear in March and April supported on delicate stalks above the leaves. Aboveground portions of lesser celandine die back by early June.
- **Spreads:** primarily by bulblets and underground tubers. The tiny cream-colored bulblets are attached to leafstalks and are easily dislodged from the plant. A mass of small, gray, fingerlike

tuberous roots underlies each plant. Bulblets and tubers are easily carried downstream during flood events and may be unearthed and scattered by the digging activities of some animals.

- Look-alikes: marsh marigold (*Caltha palustris*), a native relative in the buttercup family, wood or celandine poppy (*Stylophorum diphyllum*) and greater celandine (*Chelidonium majus*), native and non-native members of the poppy family, respectively.

### Prevention and Control

Care should be taken to correctly identify fig buttercup before undertaking any control efforts to avoid removing native look-alike plants. For small infestations, clumps can be pulled by hand or dug up using a shovel, removing entire plants and as many tubers as possible. Use of systemic herbicides is also an option but should be done as early as possible to avoid impact to native plant species (see Control Options).

### Native Alternatives

Wood poppy (*Stylophorum canadense*) and marsh marigold (*Caltha palustris*) are two good native alternatives available depending on the conditions of the planting site.

## Garlic Mustard

*Alliaria petiolata* (Bieb.) Cavara & Grande  
Mustard family (Brassicaceae)

**Origin:** Europe

### Background

Garlic mustard was first recorded in the United States around 1868, from Long Island, New York, and was likely introduced by settlers for food and medicinal purposes.

### Distribution and Habitat

Garlic mustard has been reported to be invasive in natural areas throughout the northeastern U.S. and in scattered localities in the Midwest, Southeast, western states, and Alaska. It occurs in moist to dry forest habitats, forest edges, floodplains, and along roadsides and disturbed lands and is not tolerant of highly acidic soils. White-tailed deer assist in its spread by eating native plant species that they prefer and are adapted to eat, leaving the garlic mustard behind.



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## Ecological Threat

Garlic mustard has displaced vast areas occupied by native spring wildflowers like spring beauty (*Claytonia virginica*), wild ginger (*Asarum canadense*), bloodroot (*Sanguinaria canadensis*), trilliums (*Trillium* species) and toothworts (*Cardamine*). Three native butterfly species, the West Virginia white (*Pieris virginienensis*), mustard white butterfly (*Pieris oleracea*), and the falcate orange-tip (*Anthocharis midea annicka*), are especially impacted when garlic mustard displaces toothworts, its host plants. Chemicals in garlic mustard are toxic to the larvae of the native butterflies. Other chemicals have been found to affect mycorrhizal fungi associated with native trees, resulting in suppression of native tree seedling growth.



Chris Evans, River to River CWMA



Robert Vidéki, *Doronicum Kft.*

## Description and Biology

- Plant: biennial herb in the mustard family (Brassicaceae); first-year plants are low rosettes of kidney shaped leaves; second-year plants produce single or multiple flowering stalks 1-4 ft. high and, then die back by late spring; dried fruiting stalks may persist for many months.
- Leaves: crushed leaves and stems smell like garlic; first-year leaves are kidney-shaped with scalloped margins; leaves of mature, second year plants are heart-shaped with toothed margins and pointed tips.
- Flowers, fruits and seeds: flowers occur in small button-shaped clusters, flowers have four petals in the shape of a cross; fruits are slender, erect capsules (siliques); seeds are 2½-3 mm long, slender and tan to dark.
- Spreads: a single plant can produce hundreds of seeds, most of which fall nearby but may be carried further by wind, water, wildlife and people.
- Look-alikes: toothworts (*Cardamine* or *Dentaria*), sweet cicely (*Osmorhiza claytonii*), wild anise (*Osmorhiza longistylis*) and early saxifrage (*Saxifraga virginienensis*).



## Prevention and Control

Garlic mustard seeds can survive for five or more years in the soil. Effective management requires a long-term effort. Hand removal of plants along with the roots, is effective for light, scattered infestations. Flowering plants can be cut low to the ground in spring to prevent seed production but cut plants can resprout. Careful hand removal and bagging of plants with mature fruits can be done as soon as fruits are present. Systemic herbicides containing glyphosate are effective but repeated treatments are usually needed because of the large seed stores in the soil (see Control Options). Researchers are investigating potential biological control agents but none are available at this time.

## Ground Ivy

*Glechoma hederacea* L.  
Mint family (Lamiaceae)

**Origin:** Eurasia

### Background

Also known as gill-over-the-ground and creeping Charlie, it was introduced into North America as an ornamental or medicinal plant, as early as the 1800s.

### Distribution and Habitat

Ground ivy occurs throughout the U.S. in all of the Lower 48 except for Nevada, Arizona and New Mexico and has been reported to be invasive in natural areas from Wisconsin to Connecticut, south to Tennessee and North Carolina. It is common in moist areas such as floodplains, low woods and disturbed sites and is a significant weed in lawns. It grows on damp, heavy, fertile and calcareous soils and does not tolerate highly acidic or saline soils.



*Bill Johnson*

### Ecological Threat

Ground ivy is a vigorous grower that spreads across the ground forming dense patches that push out native plants. It is toxic to many vertebrates, including horses, if eaten in large quantities either fresh or in hay.

### Description and Biology

- **Plant:** perennial scrambling herbaceous plant; stems square (4-sided) and fragile; flowering stems can reach a height of 1 ft.

- Leaves: opposite, heart-shaped with scalloped margins, about an inch across and have a musky mint odor when crushed.
- Flowers, fruits and seeds: flowers are about  $\frac{1}{2}$ - $\frac{3}{4}$  in. long, tubular, lavender, paired and emerge from leaf axils; flowering occurs March to July; each flower produces a pod containing four smooth tan seeds.
- Spreads: by vegetatively by creeping stems and to a lesser degree by seed; shallow fibrous roots form at the base of the plant and at leaf nodes on the stem.
- Look-alikes: henbit (*Lamium amplexicaule*), purple deadnettle (*Lamium purpureum*), first-year garlic mustard (*Alliaria petiolata*), and possibly other small herbaceous plants with opposite leaves and blue flowers.

### Prevention and Control

Once established, this plant is difficult to control because it is hard to remove all root and stolon fragments. Seed banks may also remain viable after control methods are used. Small patches can be pulled by hand or using a rake when the soil is damp. All roots must be removed. Large infestations can be effectively controlled using systemic herbicides like glyphosate (see Control Options). A rust fungus *Puccinia glechomatis* attacks ground ivy causing severe damage or death and may hold some potential for biological control.

## Japanese Knotweed

*Fallopia japonica* (Hout.) R. Decr.  
(previously *Polygonum cuspidatum*)  
Buckwheat family (Lythraceae)

**Origin:** Eastern Asia

### Background

Japanese knotweed was probably introduced into the United States in the late 1800s. First used as an ornamental plant, it has also been planted for erosion control and landscape screening. It is designated a noxious weed in the state of Washington.



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### Distribution and Habitat

Japanese knotweed occurs across the U.S. and has been reported to be invasive in natural areas throughout the northeast into Georgia and west to Missouri, with additional infestations in Oregon and Washington. It can tolerate a wide variety of challenging conditions,

including deep shade, high salinity, high heat, and drought. Knotweed is commonly found near water sources, such as along streams and rivers, and in a variety of low-lying areas like ditches, waste places, utility rights-of-way and around old home sites.

### **Ecological Threat**

It spreads quickly to form dense thickets and pushes out native plant species. Knotweed poses a significant threat to riparian areas where it can survive flooding events and rapidly colonize scoured shores and islands. Once established, populations are extremely persistent.

### **Description and Biology**

- **Plant:** upright, shrubby, herbaceous perennial 4-10 ft. tall with stems that are smooth, stout and hollow; stem leaf junctures are swollen and surrounded by a membranous sheath called an “ocrea” which is typical of the family.
- **Leaves:** variable; about 6 in. long by 3-4 in. wide, broadly oval to somewhat triangular with a truncated base and a tapered tip.
- **Flowers, fruits and seeds:** tiny greenish to white colored flowers occur in attractive sprays in summer; fruits are winged on three sides; seeds are triangular, dark brown, shiny and about 1/10 in. long.
- **Spreads:** by seed and by vegetative means through growth of long, stout rhizomes; can be transported long distances by water as a contaminant in fill-dirt, or on the soles of shoes; escapes from gardens and landscaped areas through discarded cuttings.
- **Look-alikes:** the lovely native Virginia knotweed (*Tovara virginiana*), and two exotic invasive relatives - prince’s feather (*Polygonum orientale*) and giant knotweed (*Polygonum sachalinense*).

### **Prevention and Control**

Japanese knotweed is an extremely difficult plant to control due to its ability to re-grow from vegetative pieces and from seeds. Mechanical and chemical methods are most commonly used to eliminate it. Single young plants can be pulled by hand when soil is moist and roots are small. Roots and runners must be removed to prevent re-sprouting. Glyphosate and triclopyr herbicides have been used effectively, applied to freshly cut stems or foliage (see Control Options). Although a biological control agent has been found and is being released in the United Kingdom in 2010, there are no agents available for release in the U.S. at this time.

# Nodding Star-of-Bethlehem

Nodding Star-of-Bethlehem - *Ornithogalum nutans* L.

Sleepydick - *Ornithogalum umbellatum* L.

Lily family (Liliaceae)

**Origin:** Europe (Ukraine, Bulgaria and Greece) and Asia (Turkey)

## Background

Also called drooping star-of-Bethlehem, this species was introduced for ornamental purposes and is widely cultivated. A diminutive close relative (*O. umbellatum*), known as sleepydick, nap-at-noon, and common star-of-Bethlehem, is native to northern Africa, western Asia and Europe, and was also introduced as an ornamental plant. It has been reported to be invasive in the mid-Atlantic, Northeast and elsewhere.



*Peter C. Gorman via Flickr (O. nutans)*

## Distribution and Habitat

Nodding star-of-Bethlehem occurs in scattered locations in the Midwest, Great Lakes, Northeast and mid-Atlantic and has been reported to be invasive in Maryland and Pennsylvania. It is adapted to floodplains, fields, waste places, abandoned gardens and grows in full sun to partial shade. Sleepydick is more widespread and has been reported to be invasive in at least 10 states from Wisconsin to Connecticut south to Tennessee and Virginia.

## Ecological Threat

Once established, it spreads across the forest floor and displaces many species of native spring ephemeral plants.

## Description and Biology

- Plant: bulbous herbaceous annual to 20 in. in height (nodding star-of-Bethlehem) or 12 in. (sleepydick).
- Leaves: basal, linear, narrow, and succulent with parallel veins, 0.3-0.6 in. wide (nodding); grasslike and less than ¼ in. wide (sleepydick).
- Flowers, fruits and seeds: flower is a “perianth” consisting of 6 petal-like structures called tepals that are white with a wide central green stripe on the outer or underside; flowers occur in racemes; fruits are 3-angled-capsules which are broadly ovoid.
- Spreads: by bulbils and seeds.
- Look-alikes: other spring-flowering herbaceous bulbous plants.

## Prevention and Control

Be on the lookout for it and dig it up as soon as it is noticed. Most of the time, the bulbs will be extremely deep (see Control Options).

## Native alternatives

Many native wild flower species are available including bloodroot (*Sanguinaria canadensis*), Virginia bluebells (*Mertensia virginica*), wild ginger (*Asarum canadense*), may apple (*Podophyllum peltatum*).

## Purple Loosestrife

*Lythrum salicaria* L.

Loosestrife family (Lythraceae)

**Origin:** Eurasia

### Background

Purple loosestrife was introduced to the northeastern United States and Canada in the 1800s for ornamental and medicinal uses. It is still widely sold as an ornamental, except in states such as Minnesota, Wisconsin and Illinois where regulations now prohibit its sale, purchase and distribution. Purple loosestrife adapts readily to natural and disturbed wetlands.

### Distribution and Habitat

According to the U.S. Fish and Wildlife Service, purple loosestrife now occurs in every state except Florida. It is found in many types of wetlands, including wet freshwater meadows, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs and ditches.

### Ecological Threat

Under favorable conditions, purple loosestrife is able to rapidly establish and replace native vegetation with a dense, homogeneous stand that reduces local biodiversity, endangers rare species and provides little value to wildlife.

### Description and Biology

- **Plant:** erect perennial herb with a square, woody stem usually covered by downy hair; 4-10 ft. high, depending upon conditions.
- **Leaves:** lance-shaped, stalk-less and rounded to heart-shaped at the base; arranged in pairs or whorls around the stem.



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- **Flowers, fruits and seeds:** produces a showy display of magenta-colored flower spikes throughout much of the summer. Individual flowers have five to seven petals. A single mature plant can have 30-50 stems arising from one rootstock, and can produce an estimated two to three million seeds per year. The flowering season extends from June to September; flowers require pollination by insects, for which they supply an abundant source of nectar.
- **Spreads:** through the vast quantity of seeds, dispersed by wind and water. It also readily reproduces vegetatively through underground stems at a rate of about one foot per year.
- **Look-alikes:** from a distance, purple loosestrife may be confused with blue vervain (*Verbena hastata*), blazing star (*Liatris aspera* and *L. spicata*), Canada germander (*Teucrium canadense*), swamp milkweed (*Asclepias incarnata*), and fireweed (*Chamaenerion angustifolium*), which is native to the northern U.S. and Canada.

### Prevention and Control

Small infestations of young purple loosestrife plants may be pulled by hand, preferably before seed set. For older plants, spot treatment with a glyphosate-based herbicide such as Rodeo® for wetlands or near water and Roundup® for uplands may be effective (see Control Options). Biological control, using several imported beetle species approved by the USDA for release, is the most effective method for long-term control of large infestations.

### Native alternatives

Blazing star (*Liatris aspera* and *L. spicata*), blue vervain (*Verbena hastata*), Canada germander (*Teucrium canadense*), cardinal flower (*Lobelia cardinalis*) and ironweed (*Vernonia noveboracensis*).



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# Spotted Knapweed

*Centaurea stoebe* ssp. *micranthos* (Gugler) Hayek

Aster family (Asteraceae)

**Origin:** Europe and western Asia

## Background

Spotted knapweed was accidentally introduced into North America in the late 1800s in contaminated alfalfa and clover seed and in soil used for ship ballast. In North America, plants generally live 3 to 7 years but can live up to nine years or longer and regrow from buds on the root crown. Reproduction is by seed. Individual plants are capable of producing an estimated 500-4,000 seeds per square foot per year. Most of the seed is



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viable at the time of dispersal and can remain viable in the soil for 5-8 years. Most seed is dispersed near the parent plant but can be moved great distances by people, livestock, wildlife, and vehicles and in soil, crop seed, and contaminated hay.

## Distribution and Habitat

Spotted knapweed is widely distributed in the U.S. and is reported to occur in every state in the Lower 48 except Texas, Oklahoma and Georgia. Over two dozen states and seventeen large national parks across the country recognize it as a significant invasive plant of natural areas. It invades open habitats, preferring full sun and can tolerate nutrient poor soils and harsh dry conditions.

## Ecological Threat

Spotted knapweed invades a wide variety of habitats including open forests, shale, serpentine and other barrens, meadows, prairies, old fields, and disturbed areas. It forms deep taproots allowing it to capture moisture and nutrients and spreads rapidly, displacing native vegetation and reducing the forage potential for wildlife and livestock.

## Description and Biology

- **Plant:** herbaceous biennial or perennial plant.
- **Leaves:** a basal rosette of deeply lobed leaves is produced the first year; rosette leaves are deeply lobed, stalked and about 8 in. long; stem leaves are alternate and may be slightly lobed or linear; leaves become smaller and less lobed toward the apex.



John Cardina, OH State Univ.



John M. Randall, TNC

- Flowers, fruits and seeds: flowering stems are 2/3- 4 ft. tall and branched; flowers are produced early summer after the first year and resemble tiny pineapples topped with a showy ring of pink to light purple, highly dissected petals; the bract tips of the base (“pineapple”) are dark, giving the spotted look for which the plant is named.
- Spreads: by wind-dispersed seed.
- Look-alikes: other knapweeds and thistles including Canada thistle (*Cirsium arvense*) which occurs in similar habitats in the mid-Atlantic region.

### Prevention and Control

The most cost effective management strategy for spotted knapweed is to prevent its spread to non-infested areas. Spread by seed can be minimized by avoiding travel through infested areas by: 1) cleaning footwear, clothing, backpacks, and other items after hiking through infested areas; 2) not grazing livestock when ripe seeds are present in the flower heads; and 3) using certified weed-free hay. Individual plants can be pulled by hand when the soil is moist as long as the entire crown and taproot are removed, using a shovel or weed-popper type tool if necessary. Control of spotted knapweed infestations is very difficult and may require large investment of time, labor and materials to remove using manual and mechanical means or repeated applications of herbicides often at higher rates (see Control Options).



# CONTROL OPTIONS

## GENERAL GUIDANCE FOR HERBACEOUS FORBS

Use pesticides wisely: always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations. Notice: mention of a trade name does not constitute the endorsement of the product by authors, agencies or organizations involved in the production of this publication.

### Chemical

**Foliar.** This method is effective on infestations where mechanical control is not practical or desired. Glyphosate (e.g., Accord®, Rodeo® and other products) is a non-selective systemic herbicide that is absorbed by the plant and carried to the roots, killing the entire plant. It is important to avoid contact of spray with desirable plants. Treatments should be done either in early spring when most other non-target vegetation is dormant or mid to late summer and fall when plant growth slows and resources are being sent to the roots. Refer to manufacturer's label for specific information and restrictions regarding use. In general, a 1-2% solution of glyphosate mixed with water and a non-ionic surfactant (seek manufacturer's recommendations) is used. Spray should be applied such that it thoroughly covers most of the leaves but not to the point that it is dripping off the leaves.

### Manual

Generally speaking, most herbaceous plants can be pulled by hand as long as the entire plant including the roots is removed to prevent regrowth. This is almost always recommended for individual plants

### Mechanical

While repeated mowing can be effective for control of some herbaceous forbs, it may not be practical for others. Mowing often needs to be conducted repeatedly and for many years to eradicate plants with significant root systems. It may be more practical and effective to use chemical methods or a combination of mowing and herbicides for difficult species.

## BEEFSTEAK PLANT

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See General Guidance.

**CANADA THISTLE** 

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See General Guidance.

Management of Canada thistle can be achieved through cutting, mowing, controlled burning, and chemical means, depending on the level of infestation and the type of area being managed. Due to its perennial nature, entire plants must be killed in order to prevent regrowth from rootstock. Hand-cutting of individual plants or mowing of larger infestations prior to seed set will help reduce spread, but will need to be done repeatedly to exhaust root reserves. Controlled burns have been used but require training and expertise not provided here. Other sources of information should be consulted. In natural areas where Canada thistle is interspersed with desirable native plants, targeted spot application of a systemic herbicide will be needed.

**CHINESE LESPEDEZA** 

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See General Guidance.

Mechanical and chemical methods are the most effective options currently available for Chinese lespedeza. Hand pulling is not recommended due to lespedeza's extensive perennial root system that will resprout from the root crown. Mowing plants in the flower bud stage for two or three consecutive years may reduce the vigor of lespedeza stands and control further spread. Plants should be cut as low to the ground as possible. Impacts to adjacent native plants should be minimized as much as possible during any treatments. Since root reserves increase up to the flower bud stage, all herbicide treatments should be completed in early to mid summer. The addition of a non-ionic surfactant at a concentration of 0.5% will improve the effectiveness of foliar treatments. A 2% solution of glyphosate (Accord® for upland and wet areas or Rodeo® for wet sites only) mixed with water is effective during the vegetative stage prior to branching or during flowering. Treatments should cover the leaves and stems of plants just to the point of runoff but should not be dripping off the leaves.

**COMMON DAYLILY** 

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See General Guidance.

**DAME'S ROCKET** 

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See General Guidance.

**EUROPEAN STINGING NETTLE** 

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See General Guidance.

## **FIG BUTTERCUP**

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See General Guidance.

In order to have the greatest negative impact to fig buttercup and the least impact to desirable native wildflower species, herbicide should be applied in late winter-early spring, generally February through March. Start applications prior to flowering and up until about 50 percent of the plants are in flower, around April 1, then stop. After that, control success declines and many more native wildflowers have emerged that could be killed by spray. Native amphibians would also be emerging and could be harmed. Apply a 1.5-2% rate of a 53.8% active ingredient glyphosate isopropylamine salt (e.g., Rodeo® which is labeled for use in wetland areas), mixed with water and a non-ionic surfactant to foliage, avoiding application to anything but the celandine. The full effect on the plant may take 1-2 weeks and retreatment will likely be needed for many years to fully eradicate it. Applications can be made during the winter season as long as the temperature is above about 65° F and no rain is anticipated for 12-24 hours. To minimize impacts to sensitive-skinned frogs and salamanders, some experts recommend applying herbicide in March and then switching to manual methods.

For small infestations, fig buttercup may be pulled up by hand or dug up using a hand trowel or shovel. It is very important to remove all bulblets and tubers. Due to the abundant tiny bulblets and tubers, all material must be bagged up, removed from the site and disposed properly in a landfill or incinerator. A major consideration when manually removing invasive plants like this is the disturbance to the soil which can encourage the target invasive as well provide openings for invasion by other exotic species. For these reasons, manual and mechanical removal is probably inappropriate for larger infestations in high quality natural areas.

## **GARLIC MUSTARD**

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Because the seeds of garlic mustard can remain viable in the soil for five years or more, effective management requires a long-term commitment. The goal is to prevent seed production until the stored seed is exhausted. Hand removal of plants is possible for light infestations and when desirable native species co-occur. Care must be taken to remove the plant with its entire root system because new plants can sprout from root fragments. This is best achieved when the soil is moist, by grasping low and firmly on the plant and tugging gently until the main root loosens from the soil and the entire plant pulls out. Pulled plants should be removed from site if at all possible, especially if flowers are present.

## Mechanical

For larger infestations of garlic mustard, or when hand-pulling is not practical, flowering stems can be cut at ground level or within several inches of the ground, to prevent seed production. If stems are cut too high, the plant may produce additional flowers at leaf axils. Once seedpods are present, but before the seeds have matured or scattered, the stalks can be clipped, bagged and removed from the site to help prevent continued buildup of seed stores. This can be done through much of the summer.

## Chemical

For very heavy infestations, where the risk to desirable plant species is minimal, application of the systemic herbicide glyphosate (e.g., Roundup®) is also effective. Herbicide may be applied at any time of year, including winter (to kill overwintering rosettes), as long as the temperature is above 65°F and rain is not expected for 8-12 hours, to allow for drying. Extreme care must be taken to avoid contact of glyphosate with desirable plants as the product is non-selective and will kill almost any plant it contacts. Spray shields may be used to better direct herbicide and limit non-intentional drift.

## Fire

Fire has been used to control garlic mustard in some large natural settings but, because burning opens the understory, it can encourage germination of stored seeds and promote growth of emerging garlic mustard seedlings. For this reason, burns must be conducted for three to five consecutive years. Regardless of the control method employed, annual monitoring is necessary for a period of at least five years to ensure that seed stores of garlic mustard have been exhausted.

## GROUND IVY

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See General Guidance.

## JAPANESE KNOTWEED

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See General Guidance.

## NODDING STAR-OF-BETHLEHEM

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See General Guidance.

## PURPLE LOOSESTRIFE

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See General Guidance.

Small infestations of young purple loosestrife plants may be pulled by hand, preferably before seed set. For older plants, spot treating with a glyphosate type herbicide (e.g., Rodeo® for wetlands, Accord® for uplands) is recommended. Herbicides are often most effective when applied late in the season when plants are preparing for dormancy

but an additional application in mid-summer would help to reduce the amount of seed produced. While herbicides and hand removal may be useful for controlling individual plants or small populations, biological control is seen as the most likely candidate for effective long term control of large infestations of purple loosestrife. As of 1997, three insect species from Europe have been approved by the U.S. Department of Agriculture for use as biological control agents. Two leaf-feeding beetles (*Galerucella californiensis* and *Galerucella pusilla*) offer the most promise and have been widely used with good control results throughout much of the northern U.S. Although occasional feeding on other plants has been observed it has been light and non-destructive and the beetles have not shown successful reproduction on any native plant species other than purple loosestrife.

## **SPOTTED KNAPWEED**

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See General Guidance.

### **Biological control**

Biological control is available and used primarily in the western and Southeastern U.S. for control for large infestations. However, because it has not been used in the mid-Atlantic to date and non-target effects are not well studied or understood, it is not recommended by the author at this time.

### **Manual**

Small infestations of spotted knapweed can be controlled by persistent hand-pulling done prior to seed set. Gloves should be worn because of the possibility of skin irritation and potential carcinogenicity of chemicals in knapweed. Because spotted knapweed can regrow from the base, care must be taken to remove the entire crown and taproot. Plants can also be dug out using a spade. In areas with more than about 10 plants per square meter, repeated spot-burning (see below) by trained individuals is more effective and efficient. For detailed information see McGowan-Stinski in the References section.

### **Burning**

Swath or spot-burning methods developed by The Nature Conservancy, Michigan Chapter, have been used very successfully. Generally, this method involves using a six-wheeled Polaris® ATV that has a rear bed retrofitted with a propane-based weed burner. The torches are set 1½-2 ft. above the ground and burn the knapweed at very high flame temperatures around 2,000°F. For detailed information see McGowan-Stinski in the References section.

**Mechanical**

Mechanical removal of spotted knapweed involves the use of a Weed Popper®. This tool consists of a row of spikes at the end of a spring-loaded pedal. The user inserts the spikes into the ground at the base of the plant, steps on the square foot pad on the top of the pedal and pushes down lightly (the same movement as when using a shovel). In one motion, the spikes move forward and up, thus uprooting the plant, and a plate moves forward that pushes the plant off of the spikes.

When removing knapweed mechanically, individuals generally spread out in a line and walk through an area to ensure complete coverage. For detailed information see McGowan-Stinski in the References section.

# Amur Honeysuckle

*Lonicera maackii* (Rupr.) Herder  
Honeysuckle family  
(Caprifoliaceae)

**Origin:** China, Japan, Korea, and Russian Far East

## Background

Amur honeysuckle was imported as ornamental into New York in 1898 through the New York Botanical Garden. It has been widely planted for wildlife cover and soil erosion control but long ago escaped from plantings and began reproducing on its own and spreading into natural

areas. Other invasive exotic shrub honeysuckles include fragrant (*L. fragrantissima*), Standish's (*L. standishii*), Morrow's (*L. morrowii*), Tartarian (*L. tatarica*), and Bell's (*L. x bella*), a hybrid between Tartarian and Morrow's. These are less common in our area.



Bill Johnson

## Distribution and Habitat

Amur honeysuckle is one of the most common and invasive bush honeysuckles found in the mid-Atlantic region. It occurs in most states in the eastern U.S. except for Minnesota, Maine and Florida and has been reported to be invasive in many. It is adaptable to a range of conditions from sun to deep shade and wet to dry. It occurs in disturbed habitats including forest edges, forest interiors, floodplains, old fields, pastures, and roadsides. Disturbance increases the likelihood of invasion. Amur honeysuckle grows especially well on calcareous soils.

## Ecological Threat

Amur honeysuckle impedes reforestation of cut or disturbed areas and prevents reestablishment of native plants. It leafs out earlier than most natives and form dense thickets too shady for most native species. Additionally, researchers in the Midwest found increased nest predation of robins using Amur honeysuckle as a result of plant structure which facilitates access to nests by predators such as snakes. While the carbohydrate-rich fruits of exotic honeysuckles provide some nutrition for birds and rodents in winter, they do not compare to the lipid-rich fruits of native species that provide greater energy to sustain migrating birds.

## Description and Biology

- Plant: upright, deciduous shrub up to 15-20 ft. high; pith of mature stems is hollow and white or tan (in contrast to solid white pith of native shrub honeysuckle species).
- Leaves: opposite, ovate with a tapered tip, lightly pubescent, and up to 3½ in. long.
- Flowers, fruits and seeds: flowers paired, tubular, white to pinkish, fading to yellow, less than 1 in. long, borne from leaf axils, five petals, upper 4 fused; fruits are red to orange-red berries produced in late summer and persist through the winter.
- Spreads: by fruits which are abundant and highly attractive to birds that consume them and defecate the seeds in new locations. Vegetative sprouting aids in the local spread and persistence.
- Look-alikes: other exotic bush honeysuckles including Tartarian (*L. tatarica*) and Standish's honeysuckle (*L. standishii*); native species of *Lonicera* like American fly honeysuckle (*L. canadensis*), swamp fly-honeysuckle (*L. oblongifolia*) and mountain fly honeysuckle (*L. villosa*); northern bush-honeysuckle (*Diervilla lonicera*) which has leaves with toothed margins.

## Prevention and Control

Young plants can be pulled by hand, larger plants either pulled using weed wrench-type tool or cut repeatedly. Systemic herbicides containing glyphosate or triclopyr can be applied to foliage, bark or cut stems (see Control Options).

## Autumn Olive

*Elaeagnus umbellata* Thunb.  
Oleaster Family (Elaeagnaceae)

**Origin:** East Asia

### Background

Autumn olive was introduced into the United States in 1830 and widely planted as an ornamental, for wildlife habitat, as windbreaks and to restore deforested and degraded lands.

### Distribution and Habitat

Autumn olive is found from Maine to Virginia and west to Wisconsin in grasslands, fields, open woodlands and other disturbed areas. It is drought tolerant and thrives in a variety of soil and moisture conditions. Because autumn olive is capable of fixing nitrogen in its roots, it can grow on bare mineral substrates.



James H. Miller, USDA FS





Bill Johnson



James R. Allison, GA DNR

## Ecological Threat

It threatens native ecosystems by out-competing and displacing native plant species, creating dense shade and interfering with natural plant succession and nutrient cycling.

## Description and Biology

- Plant: deciduous shrub that can grow to 20 ft. in height; stems, buds and leaves have a dense covering of silvery to rusty scales.
- Leaves: alternate; deciduous; egg or lance-shaped, smooth margined, dull green above and often with brown scales beneath.
- Flowers, fruits and seeds: flowers occur in June and July; aromatic, pale yellow, fused at the base with 4 petals pointed at the tips; fruits are produced August through October; small, red-brown to pink and dotted with brown or silvery scales; abundant.
- Spreads: by seed that is dispersed by birds and mammals; some vegetative propagation also occurs.
- Look-alikes: Russian olive (*Elaeagnus angustifolia*) leaves are narrow-elongate with silvery scales on both sides and fruit is mealy, yellow or silvery; thorny olive (*E. pungens*) has leaves that are persistent, egg-shaped with wavy margins, upper surfaces shiny green, lacking scales, and lower surfaces covered with dull white scales and dotted with light brown scales.

## Prevention and Control

Do not plant autumn olive. Individual young plants can be hand-pulled, ensuring that roots are removed. Cutting, in combination with herbicide application, is effective. Hedges can be cut down using a brush type mower, chain saw, or similar tool, and stumps treated with a systemic herbicide like glyphosate or triclopyr (see Control Options). Herbivorous animals are not known to feed on it and few insects seem to utilize or bother it. Canker disease is occasionally a problem.

## Native Alternatives

Many native shrubs are available as alternatives (see Native Alternatives).

# Japanese Barberry

*Berberis thunbergii* DC.

Barberry family (Berberidaceae)

**Origin:** Japan

## Background

Japanese barberry was introduced to the United States as an ornamental in 1875. Seeds were sent from Russia to the Arnold Arboretum in Boston, Massachusetts. In 1896, it was planted at the New York Botanic Garden. It was eventually promoted

as a substitute for *Berberis vulgaris*, an exotic plant introduced and used by early settlers from Europe for hedgerows, dyes and jams, and later found to be a host for the black stem rust of wheat.



James H. Miller, USDA FS

## Distribution and Habitat

Japanese barberry occurs and is reported to be invasive throughout the northeastern U.S. from Maine to North Carolina and west to Wisconsin and Missouri. It grows well in full sun to deep shade and forms dense stands in closed canopy forests, open woodlands, wetlands, fields and other areas.

## Ecological Threat

Where it is well established, barberry displaces many native herbaceous and woody plants. In large infestations, its leaf litter causes changes in the chemistry of the soil, making it more basic.

## Description and Biology

- **Plant:** spiny deciduous shrub typically to 3, but sometimes to 6 ft. in height; branches are deeply grooved, brown and usually have simple spines as opposed to 3-pronged spines in exotic invasive European barberry (*B. vulgaris*) and the native Allegheny barberry (*B. canadensis*).
- **Leaves:** small ½-1½ inches long and shaped like small spatulas or narrow ovals, with a color ranging from green to bluish-green to dark reddish purple.
- **Flowers, fruits and seeds:** flowering occurs in spring; abundant pale yellow flowers occur along the entire length of the stem in clusters of two to four; fruits are bright red berries about 1/3 in. long that mature July to October and persist through the winter.
- **Spreads:** seed produced in abundance and eaten by birds like turkey and grouse and other wildlife that spread it far and wide; local vegetative spread is through root creepers and tip rooting branches.



Jil M. Swearingen, NPS

### Prevention and Control

Do not plant Japanese or European barberry. No biological control is available for this plant. Wearing thick gloves to protect from spines, young plants can be pulled up by hand. A Weed Wrench® can be used to uproot older shrubs when soil is moist. Shrubs can also be mowed or cut repeatedly. Treatment with systemic herbicides like glyphosate and triclopyr has been very effective (see Control Options).

## Japanese Meadowsweet

*Spiraea japonica* L. f.  
Rose family (Rosaceae)

**Origin:** Japan, Korea and China

### Background

Also called Japanese spiraea, it was introduced into the United States around 1870 to 1880 for ornamental cultivation due to its showy rosy-pink to carmine flowers.

### Distribution and Habitat

Japanese meadowsweet is found throughout the mid-Atlantic and in the Southeast, most commonly in the Appalachian Mountains. Great Smoky Mountains National Park identifies it as a targeted invasive plant. It tolerates a wide range of soil and light conditions and inhabits forest edges and interiors, riparian areas, roadsides, power-line rights-of-way and other disturbed areas. It is often associated with old home sites.

### Ecological Threat

Japanese meadowsweet grows rapidly and can form dense stands, filling in open areas and creating dense shade. It displaces native plants and impedes native seedlings.



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## Description and Biology

- Plant: small, deciduous shrub, 4-6 ft. tall, brown to red-brown stems.
- Leaves: alternate, oval to lance-shaped, 3-6 in. long, dark green above, pubescent on veins beneath, coarsely toothed margins.
- Flowers, fruits and seeds: flowers small pink (rarely white) in dense branched umbel-like clusters at the tips of branches, July to August; fruits mature in the fall.
- Spreads: by seed which is produced in abundance.
- Look-alikes: native white meadowsweet (*Spiraea alba*) which has white flowers in narrow branched clusters; exotic invasive Thunberg's meadowsweet (*S. thunbergii*) and bridalwreath spiraea (*S. prunifolia*).

## Prevention

Do not plant this species. Cutting may be effective for small populations or environmentally sensitive areas. Repeated mowing or cutting will control the spread of spiraea but will not eradicate it. Systemic herbicides containing glyphosate or triclopyr are effective (see Control Options).

## Native Alternatives

White meadowsweet (*Spiraea alba*), ninebark (*Physocarpus opulifolius*), sweet pepperbush (*Clethra alnifolia*), silky dogwood (*Cornus amomum*), Virginia sweetspire (*Itea virginica*), and leatherleaf (*Dirca palustris*) are some great substitutes for this invasive plant.

## Linden Viburnum

*Viburnum dilatatum* Thunb.

Honeysuckle family (Caprifoliaceae)

**Origin:** Korea and eastern Asia

## Background

Linden viburnum was introduced in the early 1800s as an ornamental.

## Distribution and Habitat

It occurs in scattered locations throughout the mid-Atlantic region from New York to Virginia and has been reported to be invasive in natural areas in Virginia. It grows in disturbed forests and wetlands.

## Ecological Threat

Shrubs can grow over 15 ft. high in thickets that cast dense shade, suppressing native shrubs, small trees and herbaceous vegetation. A dense cover of young plants produced from seed and vegetative re-growth often blankets the ground in infested areas. Linden viburnum

leaves out earlier in the spring and keeps its leaves later into the fall than most native vegetation, giving it a competitive advantage.

### Description and Biology

- Plant: scruffy multi-stemmed deciduous shrub, upright to rounded, 8-10 ft. tall by 6-10 ft. across.
- Leaves: opposite, dark green, shiny, with shallowly toothed margins, nearly round to straplike, 2-5 in. long by 1-2½ in. wide; usually covered in soft hairs; leaves drop relatively late in the fall.
- Flowers, fruits and seeds: small creamy white flowers in numerous flattened clusters 3-5 in. wide; May to early June; fruits are bright red, flattened spheres, about 1/3 in. wide.
- Spreads: by seed that is consumed and spread by birds.
- Look-alikes: other viburnums and other opposite-leaved shrubs.



Mary Travaglini, TNC



Bill Johnson

### Prevention and Control

Do not plant linden viburnum. Cutting should be avoided in spring because cut branches can reproduce by layering (when a new plant forms from development of roots on a stem attached to the parent plant). Use of a systemic herbicide containing glyphosate or triclopyr will prevent resprouting (see Control Options). Seedlings can be pulled up by hand. Seed heads should be removed from mature plants to prevent seed dispersal and seedling establishment.

### Native Alternatives

Native shrubs including American cranberrybush (*Viburnum opulus* var. *americanum*), Southern arrowwood (*Viburnum dentatum*), mapleleaf viburnum (*Viburnum acerifolium*), red elderberry (*Sambucus racemosa*), and winterberry (*Ilex verticillata*) would make great substitutes for this invasive plant.

# Morrow's Honeysuckle

*Lonicera morrowii* A. Gray  
Honeysuckle family (Caprifoliaceae)

**Origin:** Japan and South Korea

## Background

Morrow's honeysuckle was imported in the 1800s for use as an ornamental, for wildlife food and cover as well as for soil erosion control. Widely planted through the 20th century it is recognized as highly invasive species impacting natural areas as well as managed parks, gardens and other lands.

## Distribution and Habitat

Morrow's honeysuckle is fairly common in the mid-Atlantic region, often co-occurring with Amur honeysuckle. It is found from Wisconsin to Maine and Missouri to North Carolina. It is shade tolerant but will flower and fruit more in full sun. Morrow's honeysuckle invades forest edges and interiors, floodplains, pastures, old fields, roadsides and other disturbed areas.

## Ecological Threat

Morrow's honeysuckle forms dense thickets and outcompetes and displaces native shrubs, trees and herbaceous plants. Its dense growth can impede reforestation efforts. It invades open woodlands, old fields and other disturbed sites and can spread rapidly with help from birds and mammals which disperse its seeds. Like Amur honeysuckle, Morrow's honeysuckle likely also encourages increased nest predation due to its branching structure. While the fruits of exotic honeysuckles 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.

## Description and Biology

- **Plant:** multi-stemmed, upright, deciduous shrub that grows to 7 ft. tall; pith of mature stems is hollow and white or tan in contrast to solid white pith of native shrub honeysuckle species.
- **Leaves:** opposite, 1-2 in. long, elliptic to oblong, on short stalks, sparsely hairy above, permanently hairy underneath.
- **Flowers, fruits and seeds:** flowers are paired, borne from leaf axils, white, tubular (lower half) with 5 separate (unfused) petal lobes, spring (late April-early May); fruits paired, red to orange,



Bill Johnson

many-seeded berries mature in July and persist through the winter.

- Spreads: by seed which is spread by birds that consume the fruits and defecate the seeds in new locations; vegetative sprouting aids in local spread.
- Look-alikes: native bush honeysuckles (*Diervilla* sp.), hairy honeysuckle (*L. hirsuta*), swamp fly-honeysuckle (*L. oblongifolia*) and water-berry (*L. villosa*).

### Prevention and Control

Young plants can be pulled by hand, larger plants either pulled using weed wrench-type tool or cut repeatedly. Systemic herbicides containing glyphosate or triclopyr can be applied to foliage, bark or cut stems (see Control Options).

### Native Alternatives

Other native honeysuckles including American fly honeysuckle (*L. canadensis*), swamp fly-honeysuckle (*L. oblongifolia*) and mountain fly honeysuckle (*L. villosa*) and the related northern bush-honeysuckle (*Diervilla lonicera*) can be alternatives for Morrow's honeysuckle.

## Multiflora Rose

*Rosa multiflora* Thunb. ex Murr.  
Rose family (Rosaceae)

**Origin:** Japan, Korea and Eastern China

### Background

Multiflora rose was introduced to the eastern United States in 1866 as rootstock for ornamental roses. Beginning in the 1930s, the U.S. Soil Conservation Service promoted it for use in erosion control and as “living fences” to confine livestock. State



Bill Johnson, James Miller (inset)

conservation departments recommended multiflora rose as cover for wildlife. More recently, it has been planted in highway median strips to serve as crash barriers and reduce automobile headlight glare.

Its tenacious growth habit was eventually recognized as a problem on pastures and unplowed lands, where it disrupted cattle grazing, and, more recently, as a pest of natural ecosystems. It is designated a noxious weed in several states, including Iowa, Ohio, New Jersey, Pennsylvania and West Virginia.

## Distribution and Habitat

Multiflora rose occurs throughout the eastern half of the United States and in Washington and Oregon. It tolerates a wide range of soil, moisture and light conditions and is able to invade fields, forests, prairies, some wetlands and many other habitats.

## Ecological Threat

Multiflora rose grows aggressively and produces large numbers of fruits (hips) that are eaten and dispersed by a variety of birds. Dense thickets of multiflora rose exclude most native shrubs and herbs from establishing and may be detrimental to nesting of native birds.

## Description and Biology

- Plant: multi-stemmed shrub, sometimes climbing vine, with arching stems and recurved thorns.
- Leaves: divided into five to eleven sharply toothed leaflets; leaf stalks with fringed stipules (paired wing-like structures).
- Flowers, fruits and seeds: clusters of showy, fragrant, white to pinkish, 1 in. wide flowers appear during May; small bright red fruits, or rose hips, develop during the summer and remain on the plant through the winter.
- Spreads: reproduces by seed and by forming new plants from the tips of arching canes that can root where they contact the ground. An average plant produces an estimated one million seeds per year, which remain viable in the soil for up to 20 years.
- Look-alikes: pasture rose (*Rosa carolina*); swamp rose (*Rosa palustris*); Allegheny blackberry (*Rubus allegheniensis*); flowering raspberry (*Rubus odoratus*). Only multiflora rose has the combination of upright arching stems and fringed stipules.

## Prevention and Control

Do not plant multiflora rose. Effective control of multiflora is possible using chemical, manual, or mechanical means or, preferably, a combination. Frequent, repeated cutting or mowing at the rate of three to six times per growing season, for two to four years, has been shown to be very effective. In high-quality natural communities, cutting of individual plants may be preferable to minimize habitat disturbance. Because of the long-lived stores of seed in the soil, follow-up treatments are necessary. Application of a systemic glyphosate-based herbicide to freshly cut stems, to regrowth, or to foliage is very effective, especially if done late in the growing season (see Control Options). Two naturally-occurring controls affect multiflora rose to some extent. A native virus (rose-rosette disease) spread by a tiny native mite impedes stem growth and a non-native seed-infesting wasp, the European rose chalcid, causes damage to the seeds.



# Privets

Border privet - *Ligustrum obtusifolium* Sieb. & Zucc.

California privet - *L. ovalifolium* Hassk.

Chinese privet - *L. sinense* Lour.

European privet - *L. vulgare* L.

Olive Family (Oleaceae)

**Origin:** Japan (Border); Japan and South Korea (California); China (Chinese); Europe, Morocco, Western Asia and Caucasus (European)

## Background

There are no species of *Ligustrum* native to the U.S. Privets have been introduced to the U.S. since the 1800s and some species even earlier. They are commonly used as hedges in yards, gardens and other landscapes from which they have escaped and are now well established in the wild.

## Distribution and Habitat

All four privet species featured here have been reported to be invasive in the mid-Atlantic region; some are recognized as invasive elsewhere in the eastern U.S. and nationwide. They thrive in floodplains, fields, disturbed forests and forest edges.

## Ecological Threat

Privets form dense thickets that shade out and take the place of native shrubs and herbaceous plants. The shady thickets make conditions unsuitable for native seedlings. Phenolic compounds in the leaves protect plants from leaf-feeding insects which include native herbivorous species.

## Description and Biology

- Plant: deciduous or semi-evergreen shrubs that grow from 8-20 ft. tall; trunks with multiple stems with long leafy branches; the presence or absence of hairs and type of hairs on stems is helpful in distinguishing species.
- Leaves: opposite, simple, entire, short-stalked, ranging in length from 1-3 in. and varying in shape from oval, elliptic to oblong.
- Flowers, fruits and seeds: flowers small, white and tubular with four petals and occur in clusters at branch tips; fragrant; late



Chris Evans, River to River CWMA (*L. sinense*)



Bill Johnson (*L. vulgare*)



James H. Miller, USDA FS (*L. sinense*)

spring to early summer (May to July); length of corolla tube length ranges from 1/10 in. (Chinese) to ¼ in. (border); anthers exceed the corolla lobes (Chinese and California); fruit is small black to blue-black oval to spherical drupe (i.e., a fleshy fruit with 1-several stony seeds inside), mature late summer to fall.

- Spreads: by birds that consume fruits and excrete seeds undamaged in new locations; can spread locally through root sprouting.

### Prevention and Control

Do not plant privets. Small plants can be dug out pulled out by hand or with the help of a mattock or heavy Weed Wrench® type tool. Larger plants can be cut repeatedly or treated with a systemic herbicide. Herbicide can be sprayed on foliage or applied to bark or cut stems and stumps (see Control Options). No biological controls are available for any of these species. Known pests that affect privets include a foliage-feeding insect native to Europe (*Macrophya punctumalbum*), a fungal leaf spot (*Pseudocercospora ligustri*) and a common root crown bacteria (*Agrobacterium tumefaciens*).

## Wineberry

*Rubus phoenicolasius* Maxim.  
Rose family (Rosaceae)

**Origin:** Japan, Korea and China

### Background

Wineberry, or wine raspberry, is a spiny shrub that was introduced into the United States in 1890 as breeding stock for new *Rubus* (raspberry genus) cultivars and still used today by berry breeders. It is prized for its delicious edible raspberry-like berries that are produced in abundance in summer.



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## Distribution and Habitat

Wineberry is found from New England and eastern Canada to North Carolina and west to Michigan and Tennessee. It occurs along forest, field, stream and wetland edges and in open woods, preferring moist habitats.

## Ecological Threat

Wineberry forms dense shady thickets that displace native plants and significantly alter habitat structure.

## Description and Biology

- **Plant:** multi-stemmed shrub with spiny stems densely covered with reddish, glandular hairs, also on flowering stems and buds.
- **Leaves:** alternate, divided into three leaflets with toothed margins, terminal leaflet largest; undersides conspicuously white.
- **Flowers, fruits and seeds:** flowers with five white petals occur in springtime; bright red edible berries produced in early summer.
- **Spreads:** by seed that is consumed and dispersed by birds and mammals (including humans) and by vegetative means when new plants grow from the tips of canes that touch the ground and new plants sprout from root buds.

## Prevention and Control

Do not plant wineberry. It can be controlled through mechanical means or by treating the canes with a systemic herbicide like glyphosate or triclopyr (see Control Options).

## Native Alternatives

Native blackberries and non-invading cultivated raspberry would be good alternatives.

## Winged Burning Bush

*Euonymus alatus* (Thunb.) Sieb.

Bittersweet Family (Celastraceae)

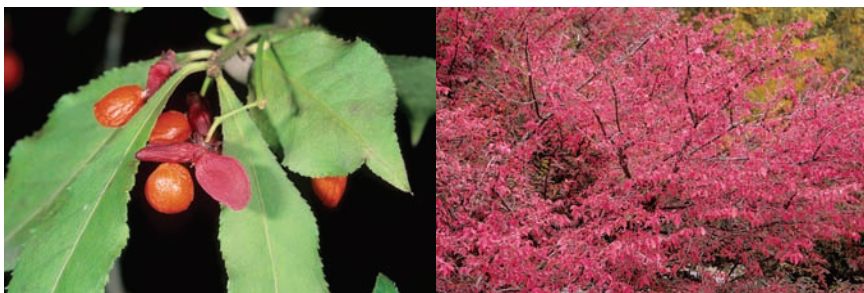
**Origin:** Northeastern Asia, Japan and Central China

## Background

Winged burning bush, also known as winged wahoo and winged euonymus, was introduced to the U.S. around 1860 as an ornamental plant for use in landscaping. Despite its invasive nature, it remains very popular and is widely sold for its hardiness, winged stems and intense red foliage



Bill Johnson



Bill Johnson

in the fall. It is ubiquitous and can be found planted along roadways, at commercial and industrial sites and in park and residential landscapes.

### Distribution and Habitat

In the United States, winged burning bush is found from New England to northern Florida and the Gulf Coast and also in Illinois.

### Ecological Threat

It threatens a variety of habitats including forests, coastal scrublands and prairies where it forms dense thickets, displacing many native woody and herbaceous plant species. Hundreds of seedlings are often found below the parent plant in what is termed a “seed shadow.”

### Description and Biology

- **Plant:** multiple stemmed, angular branching shrub with conspicuously winged stems, normally 5-10 ft. high but mature plants can grow to 20 ft.
- **Leaves:** deciduous, dark green, in pairs along stem, turn brilliant red-purple in autumn.
- **Flowers, fruits and seeds:** inconspicuous, greenish flowers occur in late spring and red-purple fruits mature during summer.
- **Spreads:** expands locally through vegetative reproduction and to new areas through bird dispersal of seeds.
- **Look-alikes:** may be confused with other species of euonymus including our native strawberry bush (*Euonymus americana*), also called ‘hearts-a-bustin,’ which has green non-winged stems. Saplings of native sweetgum (*Liquidambar styraciflua*) with winged stems may be mistaken for winged burning bush.

### Prevention and Control

Do not plant winged burning bush. Manual, mechanical and chemical means are available to control established plantings. Seedlings can be pulled by hand. Shrubs can be repeatedly cut to the ground to control re-sprouts, or cut and treated with systemic herbicides like glyphosate and triclopyr (see Control Options).

# CONTROL OPTIONS

## GENERAL GUIDANCE FOR MOST SHRUBS

Use pesticides wisely: always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations. Notice: mention of a trade name does not constitute the endorsement of the product by authors, agencies or organizations involved in the production of this publication.

### Chemical

Two of the more widely used systemic herbicides are glyphosate and triclopyr. Systemic herbicides are absorbed by plant tissues and carried to the roots causing the entire plant to die usually within about a week. Glyphosate is a non-selective herbicide that may kill or harm any plants that come in contact with the spray. It carries a Caution signal word and requires long-sleeved shirt, long pants, shoes and socks during application. Glyphosate products referred to in this publication are sold under a variety of brand names (Accord®, Rodeo®, Roundup Pro® Concentrate) and in three concentrations (41.0, 50.2 and 53.8% active ingredient). Other glyphosate products sold at home improvement stores may be too dilute to obtain effective control.

Triclopyr is a selective herbicide that affects only broadleaf plants (e.g., forbs, shrubs and trees) and can be used in grasslands or areas where desirable grasses are growing under or around targeted woody or broad-leaved invasives. Use of triclopyr in areas where soils are permeable, particularly where the water table is shallow, can result in groundwater contamination. Triclopyr comes in two forms – triclopyr amine (e.g., Garlon® 3A, Brush-B-Gone®, Brush Killer®) and triclopyr ester (e.g., Garlon® 4, Pathfinder®, and Vinex®). They are very different products with very different specific uses, hazards and precautions. Triclopyr amine mixes with water and can be used near water without posing a threat to aquatic organisms and can be used as a cut stem treatment at a 50% rate or a foliar treatment at 5% rate. It is not effective for basal bark treatments. However, the amine form of triclopyr carries a Danger signal word due to its corrosive properties which, in concentrated form, can cause irreversible eye damage. For this reason, it should only be used by trained and certified applicators who are familiar with this hazard and know the precautions that need to be taken when using it.

The ester form of triclopyr (e.g., Garlon® 4) carries a Warning signal word for the potential to cause skin and eye irritation but is not known to cause irreparable eye damage. Because it is toxic to aquatic invertebrates, it cannot be used near water or in wet soils. Garlon® 4 can be used for foliar, cut stem and basal bark applications. Due to the high potential for volatilization and offsite drift, *triclopyr should not be used when the temperature is above 85°F*. Drift can result in kill of non-target trees and other woody vegetation. It is imperative that protective eyewear and chemical resistant gloves be worn in addition to long-sleeve shirt, long pants, shoes and socks, during mixing and application. Always read the entire label before using any pesticide.

**Basal Bark Method:** This method is effective throughout the year as long as the ground is not frozen. While reducing the total amount of herbicide mixture applied to the environment, it requires a much more concentrated mix than that used for foliar applications. Prepare a mixture of 25% triclopyr plus 75% horticultural oil and apply to the basal parts of the shrub to a height of about a foot from the ground. Thorough wetting is necessary for good control; spray until run-off is noticeable at the ground line. A dye added to the mixture will help keep track of treated plants.

**Cut Stem Method:** This method and basal bark should be considered when treating individual plants or when target plants are mixed in with desirable species which would preclude foliar treatment. It is usually effective as long as the ground is not frozen. As with basal bark treatment, it reduces the total amount of herbicide mixture applied to the environment but requires use of a much more concentrated mix than that used for foliar applications. Cut stems at or near ground level and immediately apply a 25% solution of glyphosate or triclopyr mixed in water to the cut stump surface, making sure to cover the entire surface. As with basal bark, a dye added to the mix will help keep track of treated plants.

**Foliar:** Because this method involves applying herbicide mix to foliage (leaves), it should be considered mostly for large infestations where the risk to non-target species is minimal. The best time to treat is late fall or early spring when targeted plants are shifting resources toward the roots and many native species are dormant. Foliar application can be done almost anytime but air temperature should be above 65°F to ensure absorption of the herbicide mix. To allow ample drying time applications should be made when rain is unlikely for about 12 hours after application and leaves should be dry prior to treatment. Wind speed should be below 8-10 mph to avoid off-site drift. Apply a 2% solution of glyphosate or triclopyr and water plus a 0.5% non-ionic surfactant to thoroughly wet all leaves. Mix should not

be dripping off leaves. Use a low pressure and coarse spray pattern to reduce spray-drift damage to non-target species. To avoid drift, triclopyr and glyphosate should be applied when winds are below about 8 mph. If desirable trees are nearby, a no-spray buffer area should be established to protect non-target plants.

### **Manual**

Hand pulling is an effective method for many shrubs when in the young seedling stage, after which a tool or other method is often needed to remove strong roots. Plants should be pulled as soon as they are large enough to grasp but before they produce seeds. Seedlings are best pulled after a rain when the soil is loose. Larger stems, up to 6 cm (2½ in), can be removed using a Weed Wrench® or similar uprooting tool. For most species, the entire root should be removed to avoid resprouting.

### **Mechanical**

Cutting or mowing is appropriate for small infestations or environmentally sensitive areas where herbicides cannot be used. It is not generally recommended for plants that resprout heavily unless cutting can be repeated and plants monitored until the targeted invasive has been eliminated. Ideally, cutting is most effective when combined with an application of herbicide to cut surfaces. Stems should be cut at least once and preferably multiple times per growing season and as close to ground level as possible.

### **AMUR HONEYSUCKLE** ---

See General Guidance.

### **AUTUMN OLIVE** ---

See General Guidance.

**Basal bark.** Seedlings, saplings, and mature trees can be killed using triclopyr ester (e.g. Garlon® 4) as a basal bark treatment which is very effective. This method involves spraying herbicide directly onto the lower 2 feet of each stem with triclopyr (e.g. Garlon® 4 or Remedy™). It minimizes soil disturbance and maintains other desirable vegetation. Applications should completely wet the entire circumference of all stems or clumps of stems, but not to the point of run-off. For saplings, apply Garlon® 4 as a 20 percent solution (2.5 qts. per 3 gal. water) in horticultural oil with a penetrant (check with herbicide distributor) to young bark as a basal spray.

**Cut stump.** First cut the stem/trunk as close to the ground as possible, then immediately (within a few minutes) brush-on or squirt a 50% Garlon® 4 onto the cambium layer of the cut-stump. This can also be done as a hack and squirt type application.

**Foliar.** This method works well on seedlings and saplings and works best when applied July to October. These are directed spray treatments with limited soil activity. Thoroughly wet all leaves with a glyphosate-based herbicide (e.g., Accord®) or triclopyr-based herbicide (Garlon® 4) as a 2-percent solution (8 oz. herbicide per 3 gal. water) with a surfactant.

## **JAPANESE BARBERRY**

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### **Chemical**

See General Guidance.

Because Japanese barberry leafs out early, it is easy to identify and begin removal efforts in early spring. Small plants can be pulled by hand, using thick gloves to avoid injury from the spines. The root system is shallow making it easy to pull plants from the ground, and it is important to get the entire root system. The key is to pull when the soil is damp and loose. Young plants can be dug up individually using a hoe or shovel. Hand pulling and using a shovel to remove plants up to about 3 ft. high is effective if the root system is loosened up around the primary tap root first before digging out the whole plant. Mechanical removal using a hoe or Weed Wrench® can be very effective and may pose the least threat to non-target species and the general environment at the site. Tools like the Weed Wrench® are helpful for uprooting larger or older shrubs. Shrubs can also be mowed or cut repeatedly. If time does not allow for complete removal of barberry plants at a site, mowing or cutting in late summer prior to seed production is advisable.

## **JAPANESE MEADOWSWEET**

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See General Guidance.

Japanese meadowsweet resprouts after cutting, making repeated cutting necessary to exhaust the plants energy reserves. Stems should be cut at least once per growing season, prior to seed production, and cut as close to ground level as possible.

## **LINDEN VIBURNUM**

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See General Guidance.

Cutting should be avoided in spring because cut branches can reproduce by layering (when a new plant forms from development of roots on a stem attached to the parent plant). Use of systemic herbicides like glyphosate or triclopyr will prevent resprouting. Seedlings can be pulled up by hand. Seed heads should be removed from mature plants to prevent seed dispersal and seedling establishment.



## **MORROW'S HONEYSUCKLE**

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See General Guidance.

## **MULTIFLORA ROSE**

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See General Guidance.

### **Biological**

Biological control is not yet available for management of multiflora rose. However, researchers are investigating several options, including a native viral pathogen (rose-rosette disease), which is spread by a tiny native mite, and a seed-infesting wasp, the European rose chalcid. Rose-rosette disease, native to the western U.S., has been spreading easterwardly at a slow pace. It may hold some potential for eliminating multiflora rose in areas where it grows in dense patches.

## **PRIVETS**

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See General Guidance.

## **WINGED BURNING BUSH**

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See General Guidance.

# Callery Pear

*Pyrus calleryana* Dene.

Rose family (Rosaceae)

**Origin:** China and Vietnam

## Background

Callery pear was imported multiple times to the U.S., including the first introduction in 1909 to the Arnold Arboretum and an introduction in 1916 by the U.S. Department of Agriculture for development of fire blight resistance in the common pear (*Pyrus communis*), which was devastating the commercial pear industry. It was widely planted as a rootstock for common pear long before it gained interest as an ornamental. Around 1950,

the ornamental value and hardiness of Callery pear were recognized, leading to the development of a number of cultivars, including 'Bradford.' Cultivars in the U.S. originated from China and represent different genotypes. While some genotypes are self-incompatible, meaning they require cross pollination from another genotype in order to set seed, others can pollinate themselves. Different genotypes growing near each other (e.g., within about 300 ft.) can cross-pollinate and produce fruit with viable seed. Also, cultivars are often grafted onto seed-grown rootstocks with varying genotypes; if the plant produces shoots from the rootstock (which it often does), then these shoots and the graft can pollinate one another. Thus, the Bradford pear cultivar is one of several cultivars (varieties) of Callery pear capable of spreading and being invasive. *Pyrus calleryana* 'Bradford' is one genotype. It is propagated asexually (by grafting and cuttings) and does not change over time. Any plant resulting from a seed produced by *Pyrus calleryana* 'Bradford' is a different genotype of *Pyrus calleryana* and not a member of any cultivar (unless somebody propagates that seedling and names it as a new cultivar). The plants that spread in natural areas are not cultivars. They are sexually reproducing populations consisting of multiple genotypes that recombine every generation.



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## Distribution and Habitat

Callery pear occurs throughout the eastern U.S. from New Jersey to Illinois and south to Texas. It grows best in full sun but will tolerate some shading and drought.

## Ecological Threat

Once established Callery pear forms dense thickets that push out other plants including native species that can't tolerate the deep shade or compete with pear for water, soil and space. A single tree can spread rapidly by seed and vegetative means forming a sizeable patch within several years. Its success as an invader results from its capacity to produce copious amounts of seed that is dispersed by birds and possibly small mammals, seedlings that germinate and grow rapidly in disturbed areas and a general lack of natural controls like insects and diseases, with the exception of fire blight.

## Description and Biology

- Plant: 30-50 ft. tall, 20-30 ft. wide; young trees may be thorny.
- Leaves: deciduous, alternate, simple, broad-ovate to ovate, 1½-3 in. long; shiny dark green and leathery, small round-toothed margins; scarlet, mahogany, purple hues in fall.
- Flowers, fruits and seeds: flowers in early spring before the leaves, white with five petals, about 1 in. across; fruits mature in fall and are small, hard, brown, and almost woody.
- Spreads: by seeds that are dispersed to new locations by starlings and other birds that eat the fruits.
- Look-alikes: apple and crabapple (*Malus*); basswood (*Tilia*).

## Prevention and Control

Do not plant Callery pear or any cultivars including the well known Bradford pear. Seedlings and shallow-rooted plants can be pulled when soil is moist. Medium to large trees should be cut down and stumps treated with a systemic glyphosate or triclopyr-based herbicide (see Control Options).

## Native Alternatives

Several native trees would make excellent substitutes for Callery pear, including common serviceberry (*Amelanchier arborea*), Allegheny serviceberry (*Amelanchier laevis*), cockspur hawthorne (*Crataegus crus-galli*), green hawthorne (*C. viridis*) and the native sweet crabapple (*Malus coronaria*), although its availability may be limited currently.

# Norway Maple

*Acer platanoides* L.

Maple family (Aceraceae)

**Origin:** Europe and Western Asia

## Background

Norway maple was introduced for use as an ornamental landscape plant.

## Distribution and Habitat

John Bartram of Philadelphia first introduced Norway maple from England to the U.S. in 1756 and soon began offering it for sale. It was planted on farms and in towns for its shade, hardiness and adaptability to adverse conditions. Norway maple has been reported to be invasive throughout the northeastern U.S. from Maine to Wisconsin, south to Tennessee and Virginia and also in the Pacific Northwest. Over time, as reforestation occurred across the Northeast, Norway maple joined native tree species as a component of eastern forest ecosystems. It also escaped from town plantings.

## Ecological Threat

Norway maple forms monotypic populations by displacing native trees, shrubs, and herbaceous understory plants. Once established, it creates a canopy of dense shade that prevents regeneration of native seedlings. Although thought to have allelopathic properties (meaning that the plant releases toxins that inhibit or prevent the growth of other plants), research has not been able to confirm this.

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Jan Samanek, State Phytosanitary Administration



Paul Wray, IA State Univ.

## Description and Biology

- **Plant:** broad deciduous tree up to 90 ft. in height with broadly-rounded crown; bark is smooth at first but becomes black, ridged and furrowed with age; milky sap.
- **Leaves:** paired, deciduous, dark green, palmate (like a hand), broader across than from base to tip, marginal teeth with long hair-like tips.
- **Flowers, fruits and seeds:** flowers in spring, bright yellow-green;

fruits mature during summer into paired winged “samaras” joined broadly at nearly 180° angle; milky sap will ooze from cut veins or petiole.

- Spreads: to new areas by vegetative reproduction and seed.
- Look-alikes: other maples including sugar maple (*Acer saccharum*) and red maple (*Acer rubrum*). Distinguish Norway by milky white sap, broad leaves, hair-like leaf tips, samara wings straight out, yellow fall foliage.

### Prevention and Control

Don't plant Norway maple. Seedlings can be pulled by hand and small to large trees can be cut to the ground, repeating as necessary to control any re-growth from sprouts (see Control Options).

### Native Alternatives

Native maples like sugar maple (*Acer saccharum*) and red maple (*Acer rubrum*) would be good substitutes for this invasive tree.

## Paper Mulberry

*Broussonetia papyrifera* (L.) L'Her. ex Vent.

Mulberry family (Moraceae)

**Origin:** Japan and Taiwan

### Background

Paper mulberry was introduced for use as a fast-growing shade tree. Native Pacific cultures use it to make bark cloth.

### Distribution and Habitat

Found from Illinois to Massachusetts, south to Florida and west to Texas, paper mulberry invades open habitats such as forest and field edges. Internationally, it is identified as an invasive weed in over a dozen countries.



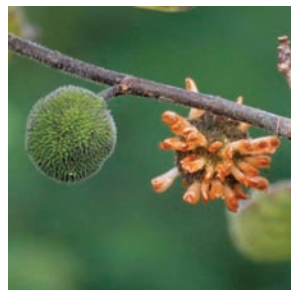
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### Ecological Threat

Once established it grows vigorously, displacing native plants through competition and shading. If left unmanaged, paper mulberry can dominate a site. Its shallow root system makes it susceptible to blowing over during high winds, posing a hazard to people and causing slope erosion and further degradation of an area.

## Description and Biology

- **Plant:** deciduous tree with milky sap that grows to a maximum height of about 45 ft. (15 m.); twigs of paper mulberry are hairy reddish brown, the bark is tan and smooth to moderately furrowed, the wood is soft and brittle, and it has conical buds; stems and leaves hirsute.
- **Leaves:** alternate, opposite, and whorled, densely gray-pubescent, often 3-15-lobed (the lobes sometimes deep), with leaf margins sharply toothed, and leaf base heart-shaped to rounded; upper leaf surface is somewhat rough feeling.
- **Flowers, fruits and seeds:** separate male and female flowers appear in the spring; male flower clusters are elongate, pendulous, 2½-3 in. long, and composed of many individual flowers; female flowers are globular and about 1 in. diameter; fruits are reddish purple to orange, ¾-1 in. across, mature in summer.
- **Spreads:** by seed and by vegetative growth through sprouting.
- **Look-alikes:** exotic invasive white mulberry (*Morus alba*) and native trees including red mulberry (*Morus rubra*), American basswood (*Tilia americana*) and sassafras (*Sassafras albidum*), due to a shared leaf form.



Amy Richard, UFL

## Native Alternatives

Basswood (*Tilia heterophylla*) and sassafras (*Sassafras albidum*) have similar foliage and form and grow in similar places as paper mulberry.

## Princess Tree

*Paulownia tomentosa* (Thunb.) Sieb. & Zucc. ex Steud.

Figwort family (Scrophulariaceae)

**Origin:** Central and Western China

### Background

Also known as empress tree or royal paulownia, it was imported to Europe by the Dutch East India Company in the 1830s and to North America soon after. Historical records describe important medicinal, ornamental and timber uses of Princess tree as early as the 3rd century B.C. Its ability to sprout prolifically from adventitious



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buds on stems and roots allows it to survive fire, cutting and even bulldozing in construction areas. It is highly prized for carving.

### **Distribution and Habitat**

Princess tree occurs throughout much of the eastern United States from Texas to New England where it can be found growing along roadsides, stream banks and forest edges. It tolerates infertile and acid soils and drought conditions and adapts to a wide variety of habitats.



*James H. Miller, USDA FS*

### **Ecological Threat**

Princess tree invades forests, stream banks and some rocky habitats, displacing native plant species.

### **Description and Biology**

- Plant: medium-sized deciduous tree that grows to 30-60 ft. in height; twigs are stout, green to brown, and have many lenticels; bark is thin, gray-brown with shallow features.
- Leaves: paired, large, hairy on upper surfaces, broadly oval to heart-shaped and sometimes shallowly three-lobed.
- Flowers, fruits and seeds: flowers are showy, pale violet and fragrant and produced in conspicuous upright clusters in spring before the leaves appear; fruit is a four-compartmented oval capsule containing thousands of small winged seeds; capsules green, becoming brown and dry as they mature and persist through the winter.
- Spreads: by seed which is abundant and easily transported long distances by wind and water; a single tree is estimated to produce twenty million seeds; seeds germinate easily in suitable soil; seedlings grow and mature quickly, producing flowers within 8-10 years.

### **Prevention and Control**

Do not plant princess tree. Young plants can be pulled by hand; cut larger trees at ground level with power or manual saw, preferably

prior to seed formation to prevent further spread. Systemic herbicides containing glyphosate or triclopyr are effective and can be applied to cut stumps or to bark (see Control Options).

## Silk Tree

*Albizia julibrissin* Durazz.  
Pea family (Fabaceae)

**Origin:** Asia

### Background

Silk tree, also called silky acacia or mimosa tree, was introduced to the United States in 1745 for use as an ornamental plant.

### Distribution and Habitat

Silk tree occurs from California across the southern United States to New York. It grows in disturbed areas such as roadsides, forest edges and various open habitats. It is a

hardy plant that tolerates a variety of soil and moisture conditions, enhanced by the ability of its roots to produce nitrogen.



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### Ecological Threat

Silk tree grows vigorously and displaces native trees and shrubs, spreading by seed and vegetative means. Once established, silk tree is difficult to remove due to its long-lived seeds and its ability to sprout vigorously.

### Description and Biology

- **Plant:** small deciduous tree that grows 10-50 ft. in height and often has multiple trunks; the bark is light brown, nearly smooth, thin and has lens-shaped spots along the stem.
- **Leaves:** alternate, twice-pinnately compound, fern-like.
- **Flowers, fruits and seeds:** flowers are pink, fragrant and look like pom-poms; flowering occurs in early summer; fruits are flat 6 in. long seedpods that develop in the late summer.
- **Spreads:** by seed and vegetative growth.
- **Look-alikes:** honey locust (*Gleditsia triacanthos*) and black locust (*Robinia pseudoacacia*) with leaves that are once-pinnately compound.



## Prevention and Control

Do not plant silk tree. Trees can be cut at ground level with power or manual saws. Cutting is an initial control measure, best done prior to seed set, and usually requires follow-up cuttings in combination with herbicide treatments due to re-sprouts. Systemic herbicides like glyphosate and triclopyr are effective (see Control Options).

## Native Alternatives

Serviceberry (*Amelanchier arborea*), river birch (*Betula nigra*), redbud (*Cercis canadensis*), fringetree (*Chionanthus virginicus*) and flowering dogwood (*Cornus florida*).

## Tree of Heaven

*Ailanthus altissima* (P. Mill) Swingle  
Simaroubaceae Family

**Origin:** Northeastern and Central China and Taiwan

## Background

Also called shumac, stinking sumac, Chinese sumac, and ailanthus, it was introduced by a Pennsylvania gardener in 1748 and was made available commercially by 1840. It gained some notoriety as the species featured in the book “*A Tree Grows in Brooklyn*,” by Betty Smith.

## Distribution and Habitat

Tree of heaven is reported to be invasive in natural areas in 30 states across continental U.S. and Hawaii. It is highly adaptable to disturbance and a huge range of soil types and conditions, grows best in full sun and is tolerant of drought.



Paul Wray, IA State Univ.



Bill Johnson

## Ecological Threat

A common tree in urban areas where it causes damage to sewers and structures, ailanthus poses a greater threat to agriculture and natural ecosystems. It is a vigorous growing tree and prolific seeder that establishes dense stands that push out natives. Tree of heaven contains chemicals, including ailanthone, that have been found to have strong allelopathic (herbicidal) effects on the growth of other plants

which help it establish and spread.

### Description and Biology

- Plant: deciduous tree that can reach 70 ft. in height; twigs with smooth, pale gray bark, and twigs that are light chestnut brown, especially in the dormant season; dioecious meaning plants are either male or female; wood soft, weak, coarse-grained and creamy white to light brown in color; leaves, stems and some flowers have a strong, unpleasant to offensive odor likened to cat urine or rotting peanuts or cashews.
- Leaves: alternate, large (1-4 ft. long), compound, with 11-25 smaller leaflets, each with one to several glandular teeth near the base.
- Flowers, fruits and seeds: large showy clusters of small yellowish-green flowers produced during June; in summer, flat, twisted, single-seeded winged fruits or samaras are produced on female trees and may remain on trees for long periods of time; individual trees may produce an estimated 325,000 seeds per year.
- Spreads: reproduces by seed and by vigorous re-sprouting, especially in response to injury such as breakage or cutting.
- Look-alikes: compound-leaved shrubs and trees like staghorn sumac (*Rhus typhina*), ash (*Fraxinus* sp.), black walnut (*Juglans nigra*), and hickory (*Carya* sp.). Sumac has fuzzy, reddish-brown stems and leaves; ash species have opposite leaves; ash, black walnut, hickory and sumac leaf margins are completely to mostly toothed; black walnuts have large green fruits.

### Prevention and Control

Do not plant tree of heaven or spread its seeds when moving soil from infested areas. Before attempting control, ensure that you are not mistaking a native species like staghorn sumac, ash or walnut for tree of heaven. Elimination of tree of heaven requires diligence. Targeting large female trees for control will help reduce spread by seed. Because vegetative spread by male and female trees will continue to be a threat, elimination of all trees must be the long term goal. Systemic herbicides with active ingredients like glyphosate and triclopyr are most effective and can be applied to bark, cut stems or foliage (see Control Options).

# White Mulberry

*Morus alba* L.

Mulberry family (Moraceae)

**Origin:** China

## Background

White mulberry was introduced to the U.S. during colonial times for the purpose of establishing a silkworm industry.

## Distribution and Habitat

White mulberry is widespread in the U.S., occurring in every state of the lower 48 except for Nevada. It invades old fields, urban lots, roadsides, forest edges, and other disturbed areas.



Chris Evans, River to River CWMA

## Ecological Threat

White mulberry invades forest edges and disturbed forests and open areas, displacing native species. It is slowly outcompeting and replacing native red mulberry (*Morus rubra*) through hybridization and possibly through transmission of a harmful root disease.

## Description and Biology

- Plant: deciduous tree, 30-50 ft. tall; young bark, inner bark and bark along the roots is bright orange; older bark is grey with narrow irregular fissures; bark splits easily; stems are glabrous to pubescent, not thorny.
- Leaves: alternate, simple, glossy above, toothed, unlobed or lobed with one or many, sometimes deep lobes; upper leaf surface glossy, glabrous or slightly scabrous; lower leaf surface glabrous, or slightly pubescent on the veins and in the vein axils only.
- Flowers, fruits and seeds: flowers are produced in Spring; male and female flowers are on separate plants; male flowers are small, green and occur in 1-2 in. long catkins; female flowers are inconspicuous and crowded in short spikes; fruits form from female flowers; fruits are multiple-seeded berries that range in color from black to pink to white when ripe; contain abundant seed--a single tree is estimated to produce twenty million seeds!
- Spreads: by seed which is consumed by wildlife and deposited in new locations.



John Cardina, The Ohio State Univ.



Bill Johnson

- Look-alikes: may be confused with native red mulberry (*Morus rubra*) which has larger leaves that are dull and rough; basswood (*Tilia* sp.) with unlobed leaves and flowers and fruits on leaf-like bracts; sassafras (*Sassafras albidum*) with smooth-margined lobed to unlobed leaves; and paper mulberry (*Broussonetia papyrifera*) with leaves densely gray-pubescent (see pg. 83).

### Prevention and Control

White mulberry seedlings can be pulled by hand. Otherwise, cut the tree and grind the stump or paint the cut surface with a systemic herbicide like glyphosate or girdle the tree (see Control Options).

### Native Alternatives

Red maple (*Acer rubrum*), hackberry (*Celtis occidentalis*), black gum (*Nyssa sylvatica*) and sassafras (*Sassafras albidum*).

# CONTROL OPTIONS

## GENERAL GUIDANCE FOR TREES

Use pesticides wisely: always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations. Notice: mention of a trade name does not constitute the endorsement of the product by authors, agencies or organizations involved in the production of this publication.

While removal of young plants or cutting of some trees may be effective for some species, the most effective method for control of invasive tree species involves the use of systemic herbicides. Herbicides which may be applied as a foliar (to the leaves), basal bark, cut stump, or hack-and-squirt treatment. Always be careful with herbicide applications in the vicinity of desirable native plants or valuable ornamental shrubs and trees.

### Chemical

Two of the more widely used systemic herbicides are glyphosate and triclopyr. Systemic herbicides are absorbed by plant tissues and carried to the roots causing the entire plant to die usually within about a week. Glyphosate is a non-selective herbicide that may kill or harm any plants that come in contact with the spray. It carries a Caution signal word and requires long-sleeved shirt, long pants, shoes and socks during application. Glyphosate products referred to in this publication are sold under a variety of brand names (Accord®, Rodeo®, Roundup Pro® Concentrate) and in three concentrations (41.0, 50.2 and 53.8% active ingredient). Other glyphosate products sold at home improvement stores may be too dilute to obtain effective control.

Triclopyr is a selective herbicide that affects only broadleaf plants (e.g., forbs, shrubs and trees) and can be used in grasslands or areas where desirable grasses are growing under or around targeted woody or broad-leaved invasives. Use of triclopyr in areas where soils are permeable, particularly where the water table is shallow, can result in groundwater contamination. Triclopyr comes in two forms – triclopyr amine (e.g., Garlon® 3A, Brush-B-Gone®, Brush Killer®) and triclopyr ester (e.g., Garlon® 4, Pathfinder®, and Vinex®). They are very different products with very different specific uses, hazards and precautions. Triclopyr amine mixes with water and can be used near water without posing a threat to aquatic organisms and can be used as a cut stem treatment at a 50% rate or a foliar treatment at 5%

rate. It is not effective for basal bark treatments. However, the amine form of triclopyr carries a Danger signal word due to its corrosive properties which, in concentrated form, can cause irreversible eye damage. For this reason, it should only be used by trained and certified applicators who are familiar with this hazard and know the precautions that need to be taken when using it.

The ester form of triclopyr (e.g., Garlon® 4) carries a Warning signal word for the potential to cause skin and eye irritation but is not known to cause irreparable eye damage. Because it is toxic to aquatic invertebrates, it cannot be used near water or in wet soils. Garlon® 4 can be used for foliar, cut stem and basal bark applications. Due to the high potential for volatilization and offsite drift, *triclopyr should not be used when the temperature is above 85°F*. Drift can result in kill of non-target trees and other woody vegetation. It is imperative that protective eyewear and chemical resistant gloves be worn in addition to long-sleeve shirt, long pants, shoes and socks, during mixing and application. Always read the entire label before using any pesticide.

**Basal Bark Method.** This is one of the easier methods available, does not require any cutting, uses a small amount of herbicide mix and is effective throughout the year as long as the ground is not frozen. It works best during late winter/early spring and in summer. The base of the tree must be free of snow, ice, or water on the bark from recent rainfall, though precipitation following application is inconsequential. Late winter/early spring (February 15 -April 15, Mid-Atlantic) is generally the most productive time, since vegetation near the base of the trees is usually absent or leafless. Late spring and early summer applications (April 15-June 1 in the mid-Atlantic), when plant fluids are moving upwards to support new growth, are usually not as effective. Application during the summer (June 1-September 15) works very well as long as vegetation is not a hindrance, and allows lower concentrations of herbicide to be used. Fall to mid-winter applications (October-January) may be less effective and temperatures below 45°F will restrict the use of triclopyr.

Mix up a solution of 20% (as low as 10% in summer depending on objectives) concentration of oil-soluble triclopyr product (e.g., Garlon® 4) in 80% oil (mineral oil, or special vegetable oils). A dye added to the mixture will help keep track of treated plants. Some applicators add a pine oil-based additive (e.g., Cide-Kick® II) at the rate of 10%, which helps penetrate the bark and eliminate unpleasant odor. Some companies market diluents based on mineral or vegetable oils specifically designed for basal bark application, which should be considered for use in sensitive areas. Another option is to use a pre-mixed, ready-to-use triclopyr product designed for basal bark (and

cut stump) application (e.g., Pathfinder® II). Using a handheld or backpack sprayer, apply the mixture in a 12-inch wide band around the entire circumference of the tree base with no “skips.” The basal bark method is generally used for trees that are less than 6 inches in diameter, though slightly larger stems may also be treated effectively by thoroughly treating bark up to 24 inches in height. Follow-up foliar application (see above) to basal sprouts and root suckers may be necessary, depending on the species.

**Cut Stem Method:** This method is useful in areas where the trees need to be removed from the site and will be cut as part of the process. While situations exist that dictate this method over the others given above, felling trees is usually less effective in killing the root system, slower, more labor intensive, and more hazardous to personnel than other methods. This method is likely to be most successful during the growing season, with diminishing success through the early fall. Dormant season applications may prevent resprouting from the stump itself, but will do little to inhibit root suckering. However, at any time of year, if the tree must be cut it is better to treat the stump than not.

Cut trees near ground level and immediately apply a 25% solution of glyphosate mixed with water or 20% Garlon® 4 plus 80% oil dilutant, to the whole cut stump surface and the sides to the ground line. As with basal bark, a dye added to the mix will help keep track of treated plants. The mixture may be painted on with a paint brush or sprayed on using a spray bottle or backpack sprayer. Application of herbicide to the cut stumps must be conducted immediately after cutting, within 5-15 minutes of the cut with water soluble formulations, longer with oil mixtures, to ensure uptake of the chemical before the plant seals the cut area off.

**Foliar:** Because this method involves applying herbicide mix to foliage (leaves), it should be considered for small dense infestations or for large infestations where the risk to non-target species is minimal. Foliar treatment can be very effective but requires use of larger volumes of herbicide mixture and increases the risk of non-target impacts. Limitations of the method are the seasonal time frame and the need to transport a larger, more dilute mixture. It is typically more effective in summer and late season when plants are shifting resources downward to roots.

For most plants, use a 2% rate of glyphosate mixed with water and a small amount (0.5%, or as per label) of a non-ionic surfactant (except for Roundup®, which contains a surfactant) to help the spray spread over and penetrate the leaves. A 1.5% rate (4 lb./gal.) triclopyr (Garlon® 4) can also be used in this way. The mixture

should be applied to leaves and green stems, including sprouts and suckers, until thoroughly wet but not to the point of runoff. Use a low pressure and coarse spray pattern to reduce spray-drift damage to non-target species. To avoid drift, applications should be made when winds are below about 8 mph. If desirable trees are nearby, a no-spray buffer area should be established to protect non-target plants.

Foliar application can be done almost anytime as long as air temperature is above about 65°F (and no higher than 85°F for triclopyr) to ensure absorption of the herbicide. To allow ample drying, applications should be made when rain is unlikely for about 12 hours after application and leaves should be dry prior to treatment. Wind speed should be below 8-10 mph to avoid off-site drift.

**Hack-and-squirt or injection.** This method can be very effective and is useful when target trees are mixed in with desirable trees. It requires using a hand axe to make downward-angled cuts into the sapwood around the tree trunk and squirting about a teaspoon of concentrated herbicide into the cut.

### **Manual**

Young seedlings may be pulled or dug up, preferably when soil is moist. Care should be taken to remove the entire plant including the roots whenever possible to avoid the possibility of regrowth through sprouting.

### **Mechanical**

Cutting can work for many trees unless they are likely to resprout. It will need to be done continuously until the plants are no longer found.

### **GALLERY PEAR** \_\_\_\_\_

See General Guidance.

### **NORWAY MAPLE** \_\_\_\_\_

See General Guidance.

### **PAPER MULBERRY** \_\_\_\_\_

See General Guidance.

### **PRINCESS TREE** \_\_\_\_\_

See General Guidance.

### **SILK TREE** \_\_\_\_\_

See General Guidance.



## TREE OF HEAVEN

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See General Guidance.

Elimination of tree of heaven requires diligence, due to its abundant seed production, high seed germination rate, and vegetative reproduction. Followup monitoring and treatment when needed should be an integral part of any serious ailanthus management program. Regardless of method selected, treated areas should be rechecked one or more times a year and any new suckers or seedlings treated (cut, sprayed or pulled) as soon as possible, especially before they are able to rebuild root reserves. Establishing a thick cover of trees (non-invasive and preferably native) or grass sod will help shade out and discourage establishment of ailanthus seedlings. Targeting large female trees for control will help reduce spread of ailanthus by seed.

### Biological

Several fungal pathogens are being investigated as potential agents for biological control for tree-of-heaven. Two of these, *Verticillium dahliae* and *Fusarium oxysporum*, have been isolated from dead and dying tree of heaven in New York and in southern and western Virginia. Another fungal pathogen, *Verticillium albo-atrum*, was recently confirmed using inoculations in the lab and on canopy field trees to be the cause of *Ailanthus* wilt disease that killed more than 8,000 trees in south-central Pennsylvania since 2002. Research and testing are on-going and none are available at this time.

### Chemical

The most effective method of ailanthus control is through the use of herbicides, which may be applied as a foliar (to the leaves), basal bark, cut stump, or hack and squirt treatment. While it is relatively easy to kill the above ground portion of tree of heaven, you need to kill or seriously damage the root system to prevent or limit stump sprouting and root suckering. Always be extremely careful with herbicide applications in the vicinity of valuable ornamental shrubs and trees.

**Foliar application.** See General Guidance. Foliar sprays applied when trees are in full leaf are very effective, and should be the method of choice where ailanthus size and distribution allow effective spray coverage of all foliage without unacceptable contact with nearby desirable vegetation or applicator. Where it growing in association with other exotic weed species, as is often the case, foliar spray allows treatment of the entire area at one time. Use either glyphosate or triclopyr mixed with water and a small amount (0.5%, or as per label) of a non-ionic surfactant (except for Roundup®, which already contains a surfactant) which will help spread the mix and

penetrate the leaves. Apply the mixture to leaves and green stems, including sprouts and suckers, until thoroughly wet but not to the point of runoff. For backpack sprayer applications, 2% glyphosate (e.g., Roundup, Accord) applied June 15 to Sep. 15 has worked well in the mid-Atlantic region. For higher volume applications using a truck-mounted sprayer, concentration can be reduced to 1 or 1.5%. Other herbicides which have shown to be effective as foliar treatment of *Ailanthus* include imazapyr (e.g., Arsenal®, Chopper®), and metsulfuron methyl (e.g., Escort®), but these products are not discussed further here.

**Basal bark method.** This method works best during late winter/early spring and in summer. The base of the tree stem must be free of snow, ice, or water on the bark from recent rainfall, though precipitation following application is inconsequential. Late winter/early spring (February 15 -April 15, Mid-Atlantic) is generally the most productive time, since vegetation near the base of the trees is usually absent or leafless. Late spring and early summer applications (April 15-June 1, Mid-Atlantic), when plant fluids are moving upwards to support new growth, are questionable. Application during the summer (June 1-September 15, Mid-Atlantic) works very well as long as vegetation is not a hindrance, and allows lower concentrations of herbicide to be used. Fall to mid-winter applications (October-January) have given poor results. Mix up a solution of 20% (as low as 10% in summer depending on objectives) concentration of oil-soluble triclopyr product (e.g., Garlon® 4) in 80% oil (mineral oil, or other recommended vegetable oils but not diesel or other fuels that can pollute groundwater). With these diluents some applicators add a pine oil based additive (e.g., Cide-Kick® II) at the rate of 10%, which helps penetrate the bark and eliminate any unpleasant odor. Some companies market diluents based on mineral or vegetable oils specifically designed for basal bark application, which should be considered for use in sensitive areas. Using a handheld or backpack type sprayer, apply the mixture in a 12 in. wide band around the entire circumference of the tree base with no “skips”. The basal bark method is generally used for trees that are less than 6 inches in diameter, though slightly larger stems may also be treated effectively by thoroughly treating bark up to 24 in. in height. Follow-up foliar herbicide application (see above) to basal sprouts and root suckers may be necessary. Another herbicide which has been shown to be effective for basal bark control of *ailanthus* is imazapyr (e.g., Chopper®, Stalker®). This is sometimes used in a combination with triclopyr at a concentration of 15% Garlon® 4 and 5% Stalker® in 80% oil dilutant.

**Hack-and-squirt or injection.** This method is very effective and minimizes sprouting and suckering when applied during the summer. Root suckering will be an increasing problem in the fall, winter and spring. The method requires first making downward-angled cuts into the sapwood around the tree trunk at a comfortable height, using a hand ax. With spray bottle or wand in the other hand, a straight (100%) concentration of a water-soluble triclopyr product (e.g., Garlon® 3A) is applied into the cuts within a minute or two of cutting, applying 1-2 milliliters into each cut (typically 1-2 squirts of a trigger squirt bottle) so that the bottom of the cut is covered, but liquid doesn't run out of it. Generally, you would make about 1 hack cut for each inch of diameter plus one (i.e., for a 10 in. diameter tree, make about 11 cuts). Space the cuts so that about 1-2 in. of uncut living tissue remains between them. A continuous line of cuts around the trunk would likely cause the tree to go into emergency response mode and react by producing basal sprouts and root suckers. For this reason, girdling or frilling (girdling followed by herbicide) is not recommended for *Ailanthus* unless long term follow-up treatment is possible. This method can be used with trees of any size, though it is most productive with stems over 2 in. in diameter. This method is relatively easy for one person to do, with hatchet in one hand and spray bottle in the other, but should be done with a buddy nearby in case of an accident. Monitor the treatment area and be prepared to follow-up with a foliar application the next year to control any basal sprouts or root suckers that might emerge. Glyphosate products have sometimes been recommended for control of ailanthus using this method, but field trials have shown consistently poor long-term control of basal sprouts and root suckers at any time of year.

**Cut stump.** See General Guidance. Use this method when trees need to be removed from the site and will be cut as part of the process. Effectiveness is likely to be better during the growing season, with diminishing success through the early fall. Dormant season applications may prevent resprouting from the stump itself, but will do little to inhibit root suckering. However, at any time of year, if the tree must be cut it is better to treat the stump than not. Application of herbicide to the cut stumps must be conducted immediately after cutting, within 5-15 minutes of the cut with water soluble formulations, longer with oil mixtures, to ensure uptake of the chemical before the plant seals the cut area off. The mixture may be painted on with a paint brush or sprayed on using a spray bottle or backpack sprayer. A mixture of 20% Garlon® 4 plus 80% oil dilutant, as for basal bark spraying (above), may be used. In this case the whole stump surface and sides to the ground line would be sprayed. Be prepared to follow-up with a foliar application the next year to

control any stump sprouts or root suckers which emerge. Other herbicides which have been shown to be effective in stump treatment of ailanthus are the same as those listed above for hack and squirt or injection but are not covered in this book.

### **Manual**

Young seedlings may be pulled or dug up, preferably when soil is moist. Care must be taken to remove the entire plant including all roots and fragments, as these will almost certainly regrow. Root suckers appear similar to seedlings, but would be connected to a pre-existing lateral root, and would be nearly impossible to remove effectively.

### **Mechanical**

Cutting alone is usually counter-productive because ailanthus responds by producing large numbers of stump sprouts and root suckers. However, for small infestations, repeated cutting of sprouts over time can exhaust the plants reserves and may be successful if continued for many years or where heavy shade exists. If possible, the initial cutting should be in early summer in order to impact the tree when its root reserves are lowest. Cutting large seed producing female trees would at least temporarily reduce spread by this method.

## **WHITE MULBERRY**

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See General Guidance.

# Black Swallow-Wort

*Cynanchum louiseae* Kartesz and Gandhi

Milkweed family (Asclepidaceae)

**Origin:** Endemic to southwestern Europe, primarily in the Iberian Peninsula, southern France and northern Italy

## Background

Also known as black dog-strangling vine, this species was introduced as an ornamental plant. Early North American collections include one from Essex County Massachusetts in 1864, stating “escaping from the botanic



Jennifer Forman Orth

garden where it is a weed and promising to become naturalized” and in 1867, Gray’s Manual of Botany, 5th edition, reported it as “a weed escaping from gardens in the Cambridge Massachusetts area.”

## Distribution and Habitat

This species occurs in southern and eastern Ontario and southern Quebec, around Montreal, and in the U.S., primarily in the Northeast and Midwest with an additional occurrence in California. Recent observations of infestations along the Appalachian Trail in Pennsylvania are a concern due to the potential for spread. It occurs primarily in upland areas in forest understory, pastures, old fields, shores, flood plains and disturbed areas. Most populations occur in areas dominated by limestone bedrock, although it is sometimes found on rock substrates or sandy areas of low pH. It is tolerant of a wide moisture regime and habitats subject to hydrologic extremes such as alvar communities, rocky outcrops and coastal areas are often colonized. Although tolerant of some shade, it flourishes in sunny open areas and shrubby habitats and once established moves into less disturbed habitats. Well-drained, stony soils are often densely colonized.

## Ecological Threat

Black swallow-wort is a threat to native flora because of its vigorous growth and the formation of dense patches that cover and shade out native plants and reduce invertebrate and vertebrate biodiversity. Establishment of *C. louiseae* is reportedly threatening the endemic Jessop’s milkvetch (*Astragalus robbinsi*) at Windsor, Vermont, on ice-scoured banks of the Connecticut River.

## Description and Biology

- Plant: herbaceous perennial twining vine; stems pubescent with the hairs often in longitudinal bands; sap is not milky.
- Leaves: opposite; oblong or ovate, rounded or subcordate at base, acute to acuminate at tip; smooth margins; 2-5 in. long by 1-2½ in. wide, largest leaves in the middle of the stem; petioles about ½ in. long; lightly pubescent on margins and major veins on underside of leaf.
- Flowers, fruits and seeds: flower buds globose with a rounded apex, unopened petals not twisted; flowers purple to almost black with fine hairs on inner surface, 5-parted, about ¼ in. across; corona is a fleshy lobed cup; fleshy petals ovate to broadly deltoid or triangular, about 1/10 in. long; flower stalks usually curved and hairy and less than 1 in. long; fruit is slender to plump, smooth hairless seedpod (follicle) about 1½ in. long; seeds are about ¼ in. long, dark brown, ovoid to obovoid, flattened with narrow membranous wing on margin and silky filament at tip.
- Spreads: by wind-dispersed seed.
- Look-alikes: honeyvine (*C. laeve*), native to the mid-Atlantic and Southeast, has heart-shaped leaves and white flowers; pale swallow-wort (*C. rossicum*) non-native and invasive, has flowers that are pink to maroon in color and strap-shaped petals.

## Prevention and Control

Do not plant this or other exotic swallow-worts. Plants can be pulled by hand or cut or mowed once or twice per season, or dug up, removing the roots. For large infestations, the most effective control is usually achieved with herbicides applied to foliage, because manual and mechanical control are difficult, labor-intensive and time-consuming. Systemic herbicides (e.g., glyphosate) are most effective because they kill the entire vine including the roots (see Control Options). No biological control agents are available for this species.

# Chinese Wisteria

*Wisteria sinensis* (Sims) A.P. de Cand.

Pea family (Fabaceae)

**Origin:** China

## Background

Chinese wisteria was introduced in 1916 as an ornamental plant. It has been widely planted and cultivated and is still very popular in the nursery trade despite its weedy and destructive habits.

## Distribution and Habitat

Found extensively throughout the eastern U.S., Chinese wisteria has been reported to be invasive in at least 19 states from Massachusetts to Illinois south to Texas. Wisteria prefers full sun, but established vines will persist and reproduce in partial shade. Vines climb trees, shrubs and manmade structures. It is tolerant of a variety of soil and moisture regimes but prefers deep, loamy, well drained soils. Infestations are commonly found along forest edges, roadsides, ditches, and rights-of-way.



James H. Miller, USDA FS

## Ecological Threat

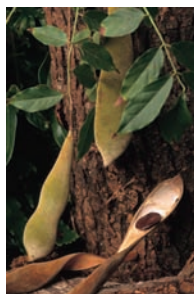
The hard woody vines twine tightly around host tree trunks and branches and cut through bark, causing death by girdling. On the ground, new vines germinating from seed or sprouting from rootstocks form dense thickets that smother and shade out native vegetation and impede natural plant community development. As girdled trees die, canopy gaps are created which increase the amount of sunlight reaching the forest floor. While this may temporarily favor some native species, it also stimulates vigorous growth and spread of wisteria.

## Description and Biology

- **Plant:** deciduous, woody twining vine that climbs up tree trunks in a clockwise direction; stems are stout, smooth gray-brown and covered with fine white hairs. Older plants can grow to 15 in. or more in diameter.
- **Leaves:** alternate, compound, 6-10 in. long with 9-11 (7-13) leaflets; leaflets egg-shaped with wavy-margins and strongly tapering tips.
- **Flowers, fruits and seeds:** flowering occurs in April before leaf expansion; flowers are lavender to purple, occur in pendulous racemes or clusters 6-8 (up to 12) in. long, and open mostly all



Bill Johnson



Ted Bodner, SWSS

at once; individual flowers are 0.8-0.9 in. long on 0.6-0.8 in. long stalks (pedicels); fruits are green to brown velvety seedpods 4-6 in. long, narrowed toward the base with constrictions between the 1-3 flat, round seeds; fruits begin to appear midsummer and persist for a long time on the vine.

- Spreads: by seed which, in riparian areas, can be transported by water; vegetatively by producing stolons (above-ground stems) that produce shoots and roots at short intervals.
- Look-alikes: Japanese wisteria (see pg. 110); American wisteria (*Wisteria frutescens*), with leaves 7-12 in. long, 9-15 leaflets of uniform size, margins plane, tips acute to slightly tapering, smooth bright green above, undersides slightly milky, flowers in May after leaf expansion, flower clusters 4-6 in. long and not especially pendulous, individual flowers about ¾ in. long, pale lilac-purple with a yellow spot, fruit green and glabrous (not hairy); seeds swollen, bean to kidney-shaped; and trumpet creeper (*Campsis radicans*) with opposite, compound leaves, leaflet margins toothed, flowers red-orange, tubular and bloom late spring through summer.

### Prevention and Control

For small infestations, cut vines to relieve trees of the weight and girdling. Treat lower cut stem portions with a systemic herbicide containing glyphosate or triclopyr. New plants may grow from seed. Long term management is needed (see Control Options).

## Chocolate Vine

*Akebia quinata* (Houtt.) Decne.

Lardizabala family (Lardizabalaceae)

**Origin:** Central China, Japan and Korea

### Background

Also known as five-leaf akebia, this is an unusual and attractive exotic vine that was imported around 1845 for ornamental purposes.



## Distribution and Habitat

It has been reported to be invasive throughout the mid-Atlantic to Kentucky with scattered occurrences elsewhere.

## Ecological Threat

Akebia can form an impenetrable groundcover and when climbing shrubs and trees forms a dense tangle that creates deep shade for the vegetation it covers.



Bill Johnson

## Description and Biology

- **Plant:** woody deciduous, perennial plant that grows either as a twining vine or a groundcover; slender stems are green when young becoming brown when mature.
- **Leaves:** alternate, dull blue-green, divided into five stalked leaflets that meet at a central juncture; leaflets are 1½-3 in. long, entire (non-toothed), oval shaped and notched at the tip.
- **Flowers, fruits and seeds:** flowers are reddish to purple-brown, about 1 in. across, and have a sweet fragrance likened to chocolate; female flowers are chocolate-purple, male flowers are lighter rosy purple; spring flowering; fruits, if produced at all, are large, soft, edible sausage-shaped pods 2¼-4 in. in length, that ripen in late summer to fall.
- **Spreads:** primarily by vegetative means; infrequently by seed.
- **Look-alikes:** Virginia creeper (*Parthenocissus quinquefolia*), native to the eastern U.S., has palmate leaves with five leaflets that are toothed.

## Prevention and Control

Young plants can be pulled by hand. Cutting can be done any time of year and vines should be cut to the ground. Vines may be dug up, removing as much of the roots as possible. For large infestations, a systemic herbicide containing glyphosate or triclopyr is effective (see Control Options).

## Native Alternatives

Pipevine (*Aristolochia macrophylla*), cross-vine (*Bignonia capreolata*), trumpet creeper (*Campsis radicans*) and trumpet honeysuckle (*Lonicera sempervirens*).

# Common Periwinkle

*Vinca minor* L.

Dogbane family (Apocynaceae)

**Origin:** Europe

## Background

Common periwinkle was first introduced into North America in the 1700s as an ornamental. It is still commonly sold as an ornamental ground cover.



Bill Johnson

## Distribution and Habitat

Periwinkle has escaped cultivation and is invading natural areas throughout the eastern U.S. It inhabits open to shady sites including forests and often escapes from old homesites.

## Ecological Threat

Periwinkle grows vigorously and forms dense and extensive mats along the forest floor, displacing native herbaceous and woody plant species.

## Description and Biology

- Plant: vine-like erect or trailing groundcover; mostly evergreen; stems slender.
- Leaves: opposite, dark green, glossy, oval to lance-shaped, thick-textured; may be variegated.
- Flowers, fruits and seeds: flower blue, lavender or white, about 1 in. across, five petals blunt at tip, arranged in spiral; springtime; no fruits or seeds typically.
- Spreads: vegetatively through rhizomes.
- Look-alikes: may be confused with several close relatives of this plant, including bigleaf periwinkle (*Vinca major*), imported from Europe, and Madagascar periwinkle (*Catharanthus roseus*), native only to Madagascar, both also invasive in natural areas in the mid-Atlantic and other parts of the United States; and winter creeper (*Euonymus fortunei*).

## Prevention and Control

Periwinkle can be pulled by hand, dug up or raked up, being sure to remove underground portions. Where appropriate, mowing can be used to cut plants back but will likely have to be repeated regularly. Mowing followed soon after by application of a systemic herbicide would improve control greatly (see Control Options).

# English Ivy

*Hedera helix* L.

Ginseng family (Araliaceae)

**Origin:** Europe, Western Asia and Northern Africa

## Background

European colonists introduced English ivy as early as 1727. It is widely planted for its evergreen foliage and dependability as a year-round “carefree” groundcover. Although recognized as a serious weed of natural ecosystems, parks, landscapes and other areas, it continues to be sold and marketed as an ornamental plant in the United States.

Vast resources, time and labor are expended attempting to manage infestations on public and private lands.



Bill Johnson

## Distribution and Habitat

English ivy is found throughout the eastern U.S. and in the West where it occurs from Arizona to Washington State. It flourishes under shady to full sun conditions in soils that are moderately fertile and moist but it is intolerant of drought and salinity. Habitats invaded include forest openings and edges, fields, cliffs, steep slopes, and disturbed areas.

## Ecological Threat

English ivy is an aggressive invader that threatens all vegetation levels of forested and open areas, growing along the ground as well as into the forest canopy. Vines climbing up tree trunks spread out and envelop branches and twigs, blocking sunlight from reaching the host tree’s foliage, thereby impeding photosynthesis. An infested tree will exhibit decline for several to many years before it dies. The added weight of vines also makes trees susceptible to blowing over during storms. English ivy has been confirmed as a reservoir for bacterial leaf scorch (*Xylella fastidiosa*), a harmful plant pathogen that affects a wide variety of native and ornamental trees such as elms, oaks and maples.

## Description and Biology

- Plant: evergreen perennial climbing vine that attaches to bark of trees, brickwork and other surfaces by root-like structures that exude a glue-like substance to aid in adherence.
- Leaves: alternate, dark green, waxy, somewhat leathery;



James H. Miller, USDA FS



Chris Evans, River to River CWMA

extremely variable leaf forms, from unlobed to 3-5 lobed; typically green with whitish veins.

- Flowers, fruits and seeds: flowering occurs in late summer to early fall, typically under full sun conditions; flowers are small, greenish-yellow and occur in globular starburst type inflorescences at tips of flowering stems; fruits are black with a fleshy outer layer and stone-like seeds.
- Spreads: vegetatively by vigorous growth at tip of stems; and by seed which is consumed by birds and dispersed to new areas; fruits contain glycosides that may be mildly toxic and cause some birds to regurgitate them; new plants grow easily from cuttings or stem fragments that make contact with the soil.
- Look-alikes: Irish ivy (*Hedera hibernica*), Persian ivy (*Hedera colchica*), Boston ivy (*Parthenocissus japonicus*) and Virginia creeper (*Parthenocissus quinquefolia*). Poison ivy (*Toxicodendron radicans*) may sometimes be confused with English ivy because of its hairy stems but because it is deciduous, it will lack leaves in the winter. In summer, poison ivy can be distinguished easily by its compound leaves of three leaflets and its clusters of creamy white fruits.

**NOTE:** The leaves and berries of English ivy contain the glycoside hederin which may cause toxicosis if ingested. Symptoms include gastrointestinal upset, diarrhea, hyperactivity, breathing difficulty, coma, fever, polydipsia, dilated pupils, muscular weakness, and lack of coordination. This feature also helps ensure effective seed dispersal by birds.

### Prevention and Control

Do not plant English ivy including invasive cultivars. Individual vines can be pulled by hand when soil is moist. Vines covering the ground can be uprooted and gathered using a heavy-duty rake, then close to the ground with pruning snips, Swedish brush axe or other cutting tool. Gathered vines can be piled up and allowed to desiccate and rot which will occur quickly, in a matter of days. If needed, material can be bagged and disposed of in normal trash. Vines climbing up trees can be cut a few feet from the ground, for convenience, to kill upper portions and then apply systemic herbicide to lower cut portions (see Control Options).

# Japanese Honeysuckle

*Lonicera japonica* Thunb.

Honeysuckle family (Caprifoliaceae)

**Origin:** Eastern Asia

## Background

Japanese honeysuckle was introduced to Long Island, New York, in 1806 for ornamental, erosion control and wildlife uses.

## Distribution and Habitat

Japanese honeysuckle is one of the most recognizable and well established ornamental vines in the U.S. It is documented to occur and reported to be invasive throughout the eastern U.S. from Maine to Florida and west to



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Wisconsin and Texas, with scattered occurrences in the Southwest. It is adapted to a wide variety of habitats from full sun to shade.

## Ecological Threat

It is a fast-growing vine that twines around stems of shrubs, herbaceous plants and other vertical supports. In full sun it forms large tangles that smother and kill vegetation. It can kill shrubs and saplings by girdling.

## Description and Biology

- **Plant:** perennial, deciduous to semi-evergreen twining vine; stems are pubescent and reddish brown to light brown.
- **Leaves:** paired (opposite), ovate to oblong-ovate, about 1-3 in. long by ½-1½ in. wide, entire-margined except for young leaves which are often deeply toothed.
- **Flowers, fruits and seeds:** flowers are bi-lobed, white turning yellow, highly fragrant and with nectar, produced in June; fruits are black, about ¼ in. diameter, paired, produced in the fall.
- **Spreads:** by seed that is dispersed by birds.
- **Look-alikes:** native trumpet honeysuckle which has red or yellow, long tubular flowers.

## Prevention and Control

Small infestations can be controlled by hand removal of vines. Large infestations require mowing twice or more per year or treatment with systemic herbicides like those containing glyphosate or triclopyr (see Control Options). No biological controls are available.

## Native Alternatives

Coral honeysuckle (*Lonicera sempervirens*), hairy honeysuckle (*L. hirsuta*), crossvine (*Bignonia capreolata*) and trumpet creeper (*Campsis radicans*).

## Japanese Hop

*Humulus japonicus* Siebold & Zucc.

Hemp family (Cannabaceae)

**Origin:** Temperate Asia (China, Japan, Korea, Taiwan and the Russian Federation) and tropical Asia (Vietnam)

### Background

Japanese hop was originally imported to the U.S. in the late 1800s for use as an Asian tonic and ornamental vine. It is still sold for these purposes today. Common hop (*Humulus lupulus*) contains bitter acids and essential oils used for flavoring and as preservative in beer. The chemistry of Japanese hop is less desirable for that purpose.

### Distribution and Habitat

Japanese hop occurs in scattered locations from Nebraska to Maine to Georgia and is most common in the Northeastern U.S. and eastern Canada. It has been reported to be invasive in natural areas in Connecticut, Delaware, Indiana, Maryland, Pennsylvania, Virginia, and the District of Columbia. Japanese hop prefers plentiful sunlight and moisture, rich exposed soil, and is most commonly found along stream banks and floodplains. Growth is less vigorous in shade and on drier soils, but it can grow in disturbed areas with fairly moist soils, including roadsides, old fields, and forest edges. In milder climates, it can survive the winter.

### Ecological Threat

Japanese hop can spread to cover large areas of open ground or low vegetation including understory shrubs and small trees. Many thousands of hop plants per acre may be produced, eventually blanketing the land and vegetation. The vines grow rapidly during the summer, climbing up and over everything in their path and can form dense mats several feet deep, blocking light to plants underneath. Hop vines also twine around shrubs and trees causing them to break or fall over. It is invasive in riparian and floodplain habitats where it displaces native vegetation, prevents the emergence of new plants, and kills newly planted trees installed for streamside habitat restoration. Hop can quickly cover small trees hiding them from view, preventing mowing and obstructing herbicide applications.



Chris Evans, River to River CWMA



Leslie J. Mehrhoff, Univ. of CT

## Description and Biology

- **Plant:** herbaceous annual, twining, shallow-rooted vine that can climb to heights of ten or more feet with the help of rough-textured stems covered with short, sharp, downward pointing prickles that can be very irritating to the skin.
- **Leaves:** leaves are rough-textured, paired, simple, palmate (like a hand) with typically 5-7 lobes; leaf margins are toothed.
- **Flowers, fruits and seeds:** flowering occurs in July and August; male and female flowers are borne on separate plants; male flowers are very small, greenish yellow and occur in branched panicles; female flowers are in pale green, plump, drooping, cone-like structures with overlapping scales that become ‘hops’; hop scales and the seeds are covered with yellow glands; seeds are about 1/8 in. in diameter, roundish with a blunt tip, and light brown with darker specks; seeds mature through September.
- **Spreads:** by seed which begins to germinate in early spring, but new plants may continue to emerge as the season progresses if sunlight and moisture are available; seeds are dispersed by animals (including people), machinery and floodwaters.
- **Look-alikes:** native common hop (*Humulus lupulus*) looks very much like Japanese hop but it is usually 3-lobed or unlobed; native bur cucumber (*Sicyos angulatus*) lacks prickles, has tendrils, and the leaves have much less pronounced lobes.

## Prevention and Control

Do not purchase, plant or transplant this species. Vines can be hand-pulled wearing gloves, long-sleeves and long pants and shoes to avoid injury from the prickles. Systemic herbicides are most effective (see Control Options).

## Native Alternatives

Native grapes (*Vitis*), Virginia creeper (*Parthenocissus quinquefolia*) and coral honeysuckle (*Lonicera sempervirens*).

# Japanese Wisteria

*Wisteria floribunda* (Willd.) DC.

Pea family (Fabaceae)

**Origin:** Japan

## Background

Japanese wisteria was introduced to the U.S. in 1830. It has been widely planted and cultivated and is still very popular in the nursery trade despite its weedy and destructive habits. It is probably frequently misidentified as Chinese wisteria.

## Distribution and Habitat

Japanese wisteria is found invasive in the mid-Atlantic and southeastern U.S., from New York to Florida and west to Texas. Wisteria prefers full sun, but established vines will persist and reproduce in partial shade.

Vines climb trees, shrubs and manmade structures. It is tolerant of a variety of soil and moisture regimes but prefers deep, loamy, well drained soils. Infestations are commonly found along forest edges, roadsides, ditches, and rights-of-way.

## Ecological Threat

The hard woody vines twine tightly around host tree trunks and branches and cut through bark, causing death by girdling. On the ground, new vines germinating from seed or sprouting from rootstocks form dense thickets that smother and shade out native vegetation and impede natural plant community development. As girdled trees die, canopy gaps are created which increase the amount of sunlight reaching the forest floor. While this may temporarily favor some native species, it also stimulates vigorous growth and further spread of wisteria.

## Description and Biology

- **Plant:** deciduous woody, twining vine that climbs upwards in a counter-clockwise direction; stems are slender, brown and densely hairy when young, becoming hairless with age; older plants can grow to 15 in. or more in diameter.
- **Leaves:** alternate, compound, 8-12 in. long, with 13-17 (11-19) leaflets; leaflets egg-shaped with wavy-margins and strongly tapering tips.
- **Flowers, fruits and seeds:** flowering occurs in April before



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the leaves expand; flowers are violet to violet blue, occur in pendulous racemes 1-3 ft. in length and open sequentially from the base to the tip; flowers are 0.6-0.7 in. long on 0.6-0.8 in. long stalks (pedicels); fruits are velvety pods 4½-7½ in. long, broader towards the tip, and contain 3-6 round, flattened seeds each about ½ in. in diameter; pods begin to appear soon after flowering, mature during the summer and may persist for quite a while on the vines.

- Spreads: by seed which, in riparian areas, is transported by water; vegetatively by producing stolons (above-ground stems) that produce shoots and roots at short intervals.
- Look-alikes: Chinese wisteria (see pg. 102); American wisteria (*Wisteria frutescens*) with leaves 7-12 in. long, 9-15 leaflets of uniform size, margins plane, tips acute to slightly tapering, smooth bright green above, undersides slightly milky; flowers in May after leaf expansion, flower clusters 4-6 in. long and not especially pendulous, individual flowers about ¾ in. long, pale lilac-purple with a yellow spot; fruit green and glabrous (not hairy); seeds swollen, bean to kidney-shaped; and trumpet creeper (*Campsis radicans*) with opposite, compound leaves, leaflet margins toothed, flowers red-orange, tubular and bloom late spring through summer.

### Prevention and Control

For small infestations, cut vines to relieve trees of the weight and girdling; treat cut stems with a systemic herbicide containing glyphosate or triclopyr; new plants will grow from seed; long term management is needed (see Control Options).

## Kudzu

*Pueraria montana* var. *lobata*  
(Willd.) Maes. & S. Almeida  
Pea family (Fabaceae)

**Origin:** Temperate and Tropical Asia, Australasia, and Pacific

### Background

Kudzu was introduced to the United States from Japan in 1876 at the Philadelphia Centennial Exposition, as an ornamental plant. In early 1900s, it was recognized and promoted as a forage crop and planted throughout the southeastern U.S. In the 1930s and 1940s, the Soil



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Conservation Service paid southern farmers to plant kudzu to reduce soil erosion on deforested lands, resulting in over 1 million acres being planted. Kudzu, nicknamed “the vine that ate the South,” was recognized as a pest weed in the 1950s and removed from the list of acceptable species in the Agricultural Conservation Program. In 1998, it was listed as a federal noxious weed by the U.S. Congress.

### **Distribution and Habitat**

Kudzu occurs primarily in the eastern U.S. and has been reported to be invasive in natural areas from Connecticut to Florida and west to Texas. Infestations have also been reported in North Dakota and Oregon. Kudzu grows well under a wide range of conditions and in many soil types. Preferred habitats are open, sunny areas like forest edges, abandoned fields, roadsides and disturbed areas. Kudzu grows best where winters are mild, summer temperatures are above 80°F and annual rainfall is 40 inches or more.

### **Ecological Threat**

Its vigorous growth and large leaves smother and shade out native plants. It can kill trees through girdling and the extra weight of vines can lead to toppling during storms. Once established, kudzu plants grow rapidly, extending as much as 60 feet per season, about 1 foot per day.

### **Description and Biology**

- **Plant:** climbing perennial vine in the pea family (Fabaceae); vines may extend 32-100 ft. in length, with stems up to 4 in. in diameter; roots are fleshy, with massive tap roots that can get to 7 in. or more in diameter, 6 ft. or more in length, and weigh as much as 400 lbs.; up to 30 vines may grow from a single plant.
- **Leaves:** alternate, deciduous, and compound, with three broad leaflets up to 4 in. across, leaflets may be entire or lobed with hairy margins.
- **Flowers, fruits and seeds:** individual flowers, about ½ in. long, are purple, fragrant and borne in upright clusters during late summer; fruits are brown, hairy, flattened seed pods, each of which may contain as many as ten hard seeds.

- Spreads: expands locally by vegetative means through runners & rhizomes and by vines that root at the nodes to form new plants; may spread by seed in areas where a pollinator, the giant resin bee, occurs.
- Look-alikes: Thick tangles of various vines including grape, porcelainberry and bittersweet may be mistaken for kudzu as well as some native three-leaved vines in the pea family.

### Prevention and Biological Control

Do not plant kudzu. The U.S. Department of Agriculture is investigating biological control agents for kudzu including the naturally occurring fungus *Myrothecium verrucaria*. For successful long-term control of kudzu, the extensive root system must be destroyed. Any remaining root crowns can lead to reinfestation of an area. Mechanical methods include repeated cutting of vines just above ground level, frequent mowing and cultivation. Use of systemic herbicides with the active ingredients triclopyr and glyphosate have been used effectively (see Control Options).

## Mile-A-Minute

*Persicaria perfoliata* (L.) H. Gross  
Buckwheat family (Polygonaceae)

**Origin:** India, Eastern Asia and the islands from Japan to the Philippines

### Background

Mile-a-minute, also called Devil’s-tail tearthumb, was experimentally introduced into Portland, Oregon in 1890, and in 1937 to Beltsville, Maryland, but did not become established at either site. An additional unintentional introduction in the 1930s to a nursery site in York County, Pennsylvania was successful, was allowed to reproduce, and is the likely source of this invasive plant in the mid-Atlantic and northeastern United States. Seeds of the plant may have been spread with rhododendron stock. In the past 70 years, the range for this plant in the United States has expanded more than 300 mi. from the York County site.

### Distribution and Habitat

Mile-a-minute is found in the northeast from Virginia to New York to Ohio and Oregon. It invades open and disturbed areas, such as fields, forest edges, stream banks, wetlands, roadsides and wetlands.

### Ecological Threat

Mile-a-minute grows rapidly, producing a thick tangle of vines over herbaceous and woody plants and even scrambling up into

trees. Thick tangles block sunlight and limit photosynthesis which eventually kills covered plants.



*Britt Slattery, USFWS*



*Bill Johnson*

### **Description and Biology**

- **Plant:** herbaceous, annual, trailing vine; stems are delicate and armed with recurved barbs which are also present on the underside of the leaf blades; distinctive circular, cup-shaped leafy structures called ocrea surround the stem at nodes.
- **Leaves:** alternate, pale green and shaped like an equilateral (equal-sided) triangle.
- **Flowers, fruits and seeds:** flower buds, and later flowers and fruits, emerge from within the ocrea; flowers are small, white and generally inconspicuous; fruits are berry-like, attractive, deep blue and arranged in clusters at terminals; each fruit contains a single glossy, black or reddish-black hard seed called an achene with a small elaiosome.
- **Spreads:** by seed that is transported long distances by birds; short-distance seed dispersal by ants attracted to the elaiosome has been observed but needs further investigation; water is an important mode of dispersal as fruits can remain buoyant for seven to nine days.

### **Prevention and Control**

Manual and chemical methods can be employed for control of mile-a-minute weed but biological control is the most promising and cost-effective methods currently available. Young vines can be removed by hand wearing gloves and long-sleeves to avoid injury from the numerous barbs. Pulling vines that have mature fruits should be done with care to avoid spreading seeds. Contact and systemic herbicides are effective in controlling it (see Control Options).

### **Native Alternatives**

After eradicating, if no native plants emerge, plant area with native species appropriate to site conditions. See References.

# Oriental Bittersweet

*Celastrus orbiculatus* Thunb.

Staff-tree family (Celastraceae)

**Origin:** Eastern Asia, Korea, China and Japan

## Background

Oriental bittersweet was introduced into the United States in the 1860s as an ornamental plant and it is still widely sold for landscaping despite its invasive qualities. It is often associated with old home sites, from which it has escaped into surrounding natural areas.

## Distribution and Habitat

Oriental bittersweet has been reported to be invasive from Maine to North Carolina west to Wisconsin and Missouri. It occurs in forest edges, open woodlands, fields, hedgerows, coastal areas, salt marshes and disturbed lands. While often found in more open, sunny sites, its tolerance of shade allows it to invade forested areas.



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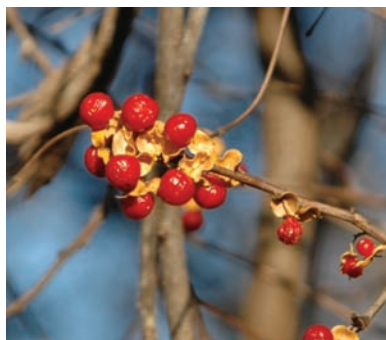
## Ecological Threat

Oriental bittersweet is a vigorous growing plant that threatens native vegetation from the ground to the canopy level. Thick masses of vines sprawl over shrubs, small trees and other plants, producing dense shade that weakens and kills them. Shrubs and trees can be killed by girdling and by uprooting as a result of excessive weight of the vines. In the Northeast, Oriental bittersweet appears to be displacing the native American bittersweet (*Celastrus scandens*) through competition and hybridization.

## Description and Biology

- **Plant:** deciduous, woody, twining vine, sometimes occurring as a trailing shrub; stems of older plants can reach 4 in. in diameter.
- **Leaves:** alternate, glossy and rounded with finely toothed margins.
- **Flowers, fruits and seeds:** abundant clusters of small greenish flowers emerge from most leaf axils; globular, green to yellow fruits split open at maturity to reveal fleshy red-orange arils that cover the seeds; seeds germinate in late spring.

- Spreads: by seed, which is dispersed to new areas by many species of birds and by people who are not responsible when disposing of faded bittersweet wreaths and other floral decorations; it expands locally by stolons and rhizomes and through root suckering (the ability to send shoots up from the roots).
- Look-alikes: is easily confused with the native American bittersweet (*Celastrus scandens*), which produces flowers just at the terminal ends (stem tips) rather than from multiple leaf axils as in the exotic invasive. For this reason, it is important to correctly identify the vine before controls are attempted.



Chris Evans, River to River CWMA

### Prevention and Control

Do not buy, plant, transplant Oriental bittersweet or dispose of live or dead seed-containing material. Manual, mechanical and chemical methods can be employed to control it. Vines can be pulled out by the roots, cut repeatedly or treated with systemic herbicides (see Control Options). No biological controls are currently available for this plant.

### Native Alternatives

Caution: Although our native bittersweet (*Celastrus scandens*) would be an excellent alternative plant to use as an alternative, many nurseries often confuse it with the exotic invasive bittersweet under the native label. Be certain of the species you are buying or choose another plant. Also, because of hybridization between the native and exotic species, many feel it is irresponsible to plant the native species when the invasive occurs in the area.

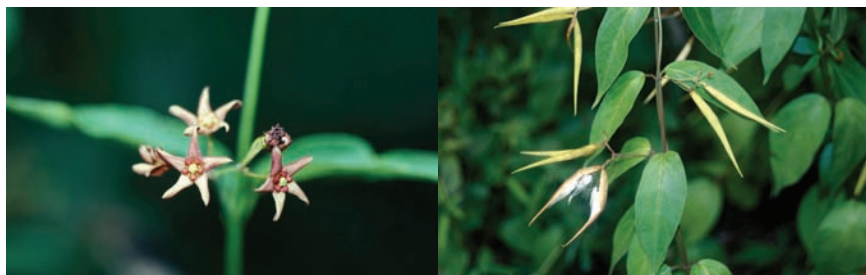
## Pale Swallow-Wort

*Cynanchum rossicum* (Kleopow) Borhidi  
Milkweed family (Asclepidaceae)

**Origin:** Endemic to southwestern European Russia in regions north of the Black Sea and the Caucasus

### Background

The first collections of pale swallow-wort in the northeastern United States were from Monroe and Nassau counties New York in 1897. Canadian records indicate that it was established and probably naturalized in southern Canada since the early 1900s.



John M. Randall, *The Nature Conservancy*

### Distribution and Habitat

Pale swallow-wort, also known as dog-strangling vine, occurs in southern Ontario, Montreal and west Quebec and the northeastern United States from southern Maine to northern Maryland with scattered occurrences in the Great Lakes and Midwest. It is widely distributed in central New York State. It is associated with calcareous soils in upland areas and is found in forest understory, pastures, old fields, shores, flood plains and disturbed areas. Ecosystems on well-drained, stony soils are often densely colonized but it can tolerate a wide moisture regime. Plants establish in full sun or under forest canopies and can form dense stands in all light conditions.

### Ecological Threat

Pale swallow-wort is a threat to native flora in forests, forest edges, fields, and open disturbed areas where it grows vigorously and forms dense patches that cover and shade out native plants. It smothers and kills vegetation and reduce invertebrate and vertebrate biodiversity.

### Description and Biology

- Plant: perennial herbaceous twining vine; sap is clear and watery, not milky.
- Leaves: paired, dark green, shiny, margins are non-toothed, oval to elliptic with a pointed tip; 2-5 in. long; are pubescent on the margins and major veins underneath; petioles are 2-8 in. long.
- Flowers, fruits and seeds: flower buds are ovoid to conoidal with a pointed apex, unopened petals are twisted; 5-20 flowers are produced in the axils of the leaves in small branched, clusters; flowers are 5-parted and about (5-7 mm) ¼ in. across; petals are strap-like, pink, red-brown to maroon and hairless above, flower stalks are ½-2 in. long and fuzzy; fruits are slender, smooth (hairless) seed pods, about 1½-3 in. long, usually one pair per flower; pods turn from green to light brown as they mature and split open at a ventral suture to release seeds; seeds are light to dark brown, wider towards tip, about 1/3 in. long, flattened or concave on one side and convex on the other, with a tiny membranous marginal wing a silky filament.
- Spreads: by wind-dispersed seed.

- Look-alikes: honeyvine (*C. laeve*), native to the mid-Atlantic and Southeast, has heart-shaped leaves and white flowers; black swallow-wort (*C. louisiae* - see pg. 99), also non-native and invasive, has clusters of small five-petaled, star-shaped flowers about ¼ in. across that are purple to nearly black and covered with white hairs.

### Prevention and Control

Do not purchase or plant this species. Plants can be pulled by hand or mowed, once or twice per season, or dug up, removing the roots. The most effective control is with herbicides, because mechanical control of this plant is difficult, labor-intensive and time-consuming. Systemic herbicides containing glyphosate or triclopyr are most effective because they kill the entire plant including the roots (see Control Options). No biological control agents are available for this plant.

### Native Alternatives

Honeyvine (*Cynanchum laeve*), if available, coral honeysuckle (*Lonicera sempervirens*) and pipevine (*Aristolochia macrophylla*) make suitable alternatives.

## Porcelainberry

*Ampelopsis brevipedunculata* (Maxim.) Trautv.

Grape family (Vitaceae)

**Origin:** China, Korea, Japan and Russian Far East

### Background

Porcelainberry, also called amur peppervine, was originally cultivated as a bedding and landscape plant. In spite of its acknowledged invasiveness, it is still widely used and promoted in the horticultural trade.

### Distribution and Habitat

Porcelainberry occurs from Wisconsin & Iowa to New Hampshire & south to Georgia and has been reported to be invasive in natural areas in at least ten states from Massachusetts to Virginia. It grows well in most soils, especially forest edges, pond margins, stream banks, thickets, and waste places, where there is full sunlight to partial shade, and where it is not permanently wet. It appears to be less tolerant of heavily shaded areas, such as that found in mature forest interiors. The seeds germinate readily in the soil after natural or human disturbance.



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## Ecological Threat

Porcelainberry is a vigorous invader of open and wooded habitats where it shades out native shrubs and young trees. As it spreads, it climbs over and blankets existing plants and weakens and kills them by blocking sunlight.

## Description and Biology

- Plant: deciduous, woody, perennial vine that resembles grape and climbs by non-adhesive tendrils at the base of each leaf; grows to 15-20 ft.; young twigs are usually pubescent; stem pith is white (grape is tan or brown) and is continuous across the nodes (except for *V. rotundifolia*, grape is interrupted by a diaphragm across the node); bark is dotted with lenticels and does not peel (grape bark lacks lenticels and peels or shreds).
- Leaves: alternate, simple, 3-5 lobed to highly dissected with heart-shaped base and coarsely toothed margins, shiny underneath with hairs on veins.
- Flowers, fruits and seeds: tiny, greenish-white flowers with petals separate at their tips occur in flat-topped clusters opposite the leaves; appear in summer (June through August); fruit is a speckled berry in colors ranging from aqua to pink to purple; each berry carries 2-4 seeds.
- Spreads: by seed that is eaten by birds and other small animals and dispersed in their droppings.
- Look-alikes: native species of grape (*Vitis*) and peppervine (*Ampelopsis*) including heartleaf peppervine (*Ampelopsis cordata*) which is native to the Southeast and has unlobed leaves and smooth (hairless) stems; other native *Ampelopsis* have compound leaves.



James H. Miller, USDA FS

## Prevention and Control

Do not plant porcelainberry. Birds are attracted to the fruits and will easily spread it far and wide. Once established it can be difficult to control due to the vigorous root system. Pull young vines up by hand anytime and try to remove the rootstock. Apply systemic herbicides like glyphosate and triclopyr to cut stems or leaves to kill entire plants including the roots (see Control Options).

# Sweet Autumn Virginsbower

*Clematis terniflora* DC

Buttercup family (Ranunculaceae)

**Origin:** Japan and China

## Background

Sweet autumn virginsbower was introduced into the United States as an ornamental vine and is still widely sold in the nursery trade.

## Distribution and Habitat

Sweet autumn virginsbower is documented to occur in much of the eastern U.S. from Minnesota to Vermont, south to Texas and Florida. It has been reported to be invasive in Alabama, Delaware, Florida, Georgia, Illinois, Maryland, New Jersey, North Carolina, South Carolina, Tennessee and Virginia, although it is probably invasive in additional states where it occurs. It prefers full sun but can tolerate partial shade.



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## Ecological Threat

This species is found invading forest edges, right-of-ways and urban areas along streams and roads. It grows vigorously over other vegetation, forming dense blankets that block sunlight to the plants underneath. In late summer infestations are conspicuous as a result of its abundant showy white flowers.

## Description and Biology

- Plant: climbing, deciduous to semi-evergreen, perennial vine.
- Leaves: opposite, compound 3 leaflets; leaflets are 2-3 in. long and have entire (non-toothed) margins.
- Flowers, fruits and seeds: flowers are produced late summer through fall; flowers are white with four petals; seeds are produced in profusion and are showy due to long, silvery-gray, feather-like hairs attached.
- Spreads: by wind-dispersed seed.
- Look-alikes: There are dozens of native species of *Clematis* in the U.S. including several that are quite rare. Devil's darning needles (*C. virginiana*), the species most likely to be confused with sweet autumn virginsbower due to its similar looking white flowers, has leaves that are compound and toothed. The much cultivated and highly popular ornamental *Clematis* vines with large, showy flowers in a wide variety of colors from white to rose to purple, typically with eight or more petals, have not been reported to be invasive.

# Winter Creeper

*Euonymus fortunei* (Turkz.) Hand.-Maz.

Bittersweet family (Celastraceae)

**Origin:** China, Japan, Korea

## Background

Winter creeper, or creeping euonymus, is an evergreen perennial vine that was introduced as an ornamental groundcover.

## Distribution and Habitat

Winter creeper has been reported to be invasive in natural areas in most of the states in the eastern half of the U.S. It can tolerate a broad range of environmental conditions ranging



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from full sun to deep shade, and acidic to basic and low nutrient soils, but it does not grow well in heavy wet soils.

## Ecological Threat

Winter creeper is a vigorous vine that invades forest openings and margins. It grows across the ground, displacing herbaceous plants and seedlings and climbs trees high into the tree canopy by clinging to the bark. Forest openings, caused by wind, insects or fire are especially vulnerable to invasion.

## Description and Biology

- **Plant:** evergreen woody vine or sprawling shrub with stems that are green when young, becoming light gray and corky with age.
- **Leaves:** opposite, glossy, dark green, oval, slightly toothed, with light-colored veins, about 1-2½ in. long.
- **Flowers, fruits and seeds:** flowers are small and greenish with five petals on long branched stalks; fruits are small round pink-red capsules that split open to expose seeds with red-orange arils.
- **Spreads:** by seed that is dispersed by birds and other wildlife and by water; local spread is by vigorous vegetative growth.
- **Look-alikes:** Japanese honeysuckle (*Lonicera japonica*) and common periwinkle (*Vinca minor*).

## Prevention and Control

Do not plant this plant. A variety of mechanical and chemical methods are available for its management, including hand pulling, cutting and application of systemic herbicides (see Control Options).

# CONTROL OPTIONS

Use pesticides wisely: always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations. Notice: mention of a trade name does not constitute the endorsement of the product by authors, agencies or organizations involved in the production of this publication.

## GENERAL GUIDANCE FOR VINES

Manual, mechanical and chemical control methods are all effective in removing and killing woody vines. Employing a combination of methods often yields the best results and may reduce potential impacts to native plants, animals and people. The method you select depends on the extent and type of infestation, the amount of native vegetation on the site, and the time, labor and other resources available to you. Whenever possible and especially for vines climbing up trees or buildings, a combination of cutting followed by application of concentrated systemic herbicide to rooted, living cut surfaces is likely to be the most effective approach. For large infestations spanning extensive areas of ground, a foliar herbicide may be the best choice rather than manual or mechanical means which could result in soil disturbance.

**HERBACEOUS VINES.** For most herbaceous vines, a systemic herbicide containing glyphosate (e.g., Accord®, Roundup®, Rodeo®) can be applied to the foliage at a rate of 1-3% mixed in water. If needed, the rate can be increased but not above the rate provided on the pesticide label.

**WOODY VINES.** For most woody vines, the most effective method of control is to cut the vine stem and apply a concentrated mix of systemic herbicide immediately to the cut surface. If foliar treatment is necessary, it is important to take measures to reduce off-site and non-target effects.

### Chemical

Two of the more widely used systemic herbicides are glyphosate and triclopyr. Systemic herbicides are absorbed by plant tissues and carried to the roots causing the entire plant to die usually within about a week. Glyphosate is a non-selective herbicide that may kill or harm any plants that come in contact with the spray. It carries a Caution signal word and requires long-sleeved shirt, long pants, shoes and socks during application. Glyphosate products referred to in this publication are sold under a variety of brand names (Accord®,

Rodeo®, Roundup Pro® Concentrate) and in three concentrations (41.0, 50.2 and 53.8% active ingredient). Other glyphosate products sold at home improvement stores may be too dilute to obtain effective control.

Triclopyr is a selective herbicide that affects only broadleaf plants (e.g., forbs, shrubs and trees) and can be used in grasslands or areas where desirable grasses are growing under or around targeted woody or broad-leaved invasives. Use of triclopyr in areas where soils are permeable, particularly where the water table is shallow, can result in groundwater contamination. Triclopyr comes in two forms – triclopyr amine (e.g., Garlon® 3A, Brush-B-Gone®, Brush Killer®) and triclopyr ester (e.g., Garlon® 4, Pathfinder®, and Vinex®). The amine and ester forms are very different products with specific uses, hazards and precautions.

Triclopyr amine (e.g., Garlon® 3A) mixes with water and can be used near water without posing a threat to aquatic organisms. It can be used as a cut stem treatment at a 50% rate or a foliar treatment at 5% rate. It is not effective for basal bark treatments. However, the amine form of triclopyr carries a Danger signal word due to its corrosive properties which, in concentrated form, can cause irreversible eye damage. For this reason, it should only be used by trained and certified applicators who are familiar with this hazard and know the precautions that need to be taken when using it.

The ester form of triclopyr (e.g., Garlon® 4) carries a Warning signal word for the potential to cause skin and eye irritation but is not known to cause irreparable eye damage. Because it is toxic to aquatic invertebrates, it cannot be used near water or in wet soils. Garlon® 4 can be used for foliar, cut stem and basal bark applications. Due to the high potential for volatilization and offsite drift, *triclopyr should not be used when the temperature is above 85°F*. Drift can result in kill of non-target trees and other woody vegetation. It is imperative that protective eyewear and chemical resistant gloves be worn in addition to long-sleeve shirt, long pants, shoes and socks, during mixing and application. Always read the entire label before using any pesticide.

**Basal bark.** Use a string trimmer or hand saw to remove some of the vine foliage in a band a few feet wide and a few feet above the ground at comfortable height. To the exposed vine stems, apply a 20% solution of triclopyr ester (Garlon® 4) (2.5 quarts per 3-gallon mix) in commercially available basal oil with a penetrant (check with herbicide distributor). As much as possible, avoid application of herbicide to the bark of the host tree. This method can be employed essentially year-round when daily temperatures remain around 50°F for several days. Efficacy will vary seasonally.

**Cut Stem Method.** Use this method in areas where vines are established within or around non-target plants or where vines are growing on host trees. Cut vine stems close to the ground (about a foot above ground or at a convenient height) and immediately apply a 25% solution of glyphosate (e.g., Accord®) or triclopyr (e.g., Garlon® 4) mixed with water to the cut surface of the stem. Glyphosate and triclopyr applications are effective at temperatures as low as 45°F as long as the ground is not frozen. Subsequent foliar applications may be necessary to control new seedlings or sprouts. Homeowners can apply products like Brush-B-Gone®, Brush Killer® and Roundup Pro® concentrate undiluted to cut stems. Use a paint brush or a plastic spray bottle to apply the herbicide to cut surfaces.

**Foliar.** Use this method to control extensive patches of woody vines where cut stem and basal bark treatments are not possible. If desirable native plants occur within the infestation, manual, mechanical or cut stem treatments could be used to reduce the risk to non-target species prior to spraying. Foliar spray herbicide applications are often used to control large infestations. Apply to the leaves a 2% solution (8 oz per 3 gal. mix) triclopyr ester (Garlon® 4) in water with a non-ionic surfactant. Concentrations as low as 1% in mid-summer and 0.05% in September have also been very effective. Thoroughly wet the foliage but not to the point of runoff. If large amounts of desirable native vegetation are present or small amounts of rare native plants occur, it may be best to delay spray until the fall when much of the native vegetation has become dormant. A 0.5% concentration of a non-ionic surfactant is recommended in order to penetrate leaf cuticle. If the 2% rate is not effective increase the rate to 3% or up to 5%. Ambient air temperature should be above 65°F.

For dense, low patches, another alternative is to cut the entire patch to the ground early in the growing season using a mower, weed-whip, machete or other tool. About one month later, apply 1-2% solution of triclopyr ester (Garlon® 4) in water to the cut patch using a backpack sprayer. This method has achieved complete kill of the targeted vines with little off-target damage or root uptake by adjacent plants. The herbicide clopyralid (e.g. Transline®) may be a better choice when managing plants in the aster (Asteraceae), buckwheat (Polygonaceae), and pea (Fabaceae) families. This herbicide is effective at a concentration of 0.5%.

### **Manual and Mechanical**

Always wear gloves and long sleeves to protect your skin from poison ivy and barbed or spined plants that often grow amongst the invasive vines. For small infestations, plants can be hand-pulled along with the root portions. If fruits are present, the vines should be bagged in

plastic trash bags and disposed of in a landfill or, alternatively, piled up and allowed to desiccate onsite. Dried piles of pulled material can either be left on-site and monitored the next year for new growth or hauled away. For climbing vines, first cut the vines near the ground at a comfortable height to kill upper portions and relieve host tree. Vines can be cut using pruning snips or a pruning saw for smaller stems and a hand axe or chain saw for larger stems. Try to minimize damage to the host tree's bark. Rooted portions will remain alive and should be pulled, repeatedly cut to the ground or treated with herbicide. Cutting without herbicide will require vigilance and repeated cutting because new plants will resprout from the stem base.

**Grubbing.** Grubbing is the removal of entire plants from the roots up and is appropriate for small initial populations or environmentally sensitive areas where herbicides cannot be used. Using a pulaski, weed wrench or similar digging tool, remove the entire plant, including all roots and runners. Juvenile plants can be hand pulled depending on soil conditions and root development. Any portions of the root system not removed may resprout.

### **BLACK SWALLOW-WORT** \_\_\_\_\_

See General Guidance.

### **CHINESE WISTERIA** \_\_\_\_\_

See General Guidance.

### **CHOCOLATE VINE** \_\_\_\_\_

See General Guidance.

### **COMMON PERIWINKLE** \_\_\_\_\_

See General Guidance.

### **ENGLISH IVY** \_\_\_\_\_

See General Guidance.

For vines growing on trees, cut vine stems in two places about a foot apart and remove cut segment. Treat cut surface of rooted stems immediately with 5% glyphosate (e.g., Accord®) mixed with water. This will kill the rooted portions and prevent regrowth.

For infestations of vines on the ground, use a sturdy double-sided rake with short tines to gather vines and, while pulling taut on the vines, have a second person cut the vine stems near the ground. Ball the mass up and start again. The cut vines can be piled and left to desiccate on site. This process also allows removal of the rooted portions of vines and is quite effective but labor intensive. It requires at least two people taking turns. This method can be done at any time

but may be more practical and effective in the dormant season when few other plants are around to interfere with the raking.

If treatment of foliage is needed, triclopyr and glyphosate can be used, with triclopyr typically giving greater control. Apply a 2-5% solution (8-20 oz. per 3 gal. mix) of triclopyr ester (e.g., Garlon® 4) mixed in water with a non-ionic surfactant to the leaves. Thoroughly wet the foliage but not to the point of run-off. Glyphosate can be applied as a 2-4% solution (8-16 oz. per 3 gal. mix) mixed in water with a 0.5 to 0.1% non-ionic surfactant. Repeat treatments may be needed.

## **JAPANESE HONEYSUCKLE**

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See General Guidance.

## **JAPANESE HOP**

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See General Guidance.

The information on control of this plant is from research conducted by Dr. Philip Pannill and is available in more complete detail on the Plant Conservation Alliance 'Weeds Gone Wild' website (see References).

While several herbicides are effective against Japanese hop, glyphosate (Accord Concentrate® at 1 qt./ac.) provides very effective control. Ideally, the first application would be made after most seeds have germinated (mid-April to mid-May) and before hop vines are covering the trees (early June to late July, depending on tree size) or before seed formation starts (August). Treatments in August or later can lessen the damage from hop vines and reduce seed production. Applications timed closer to the initiation of seed formation are more likely to prevent seed production before frost.

Two treatments are recommended in order to protect trees from damage by the hop vines and to prevent or reduce seed production. The herbicide options can also be combined with efforts to pull vines or regularly mowing. According to The Nature Conservancy, hop seeds in the soil are unlikely to last more than three years. Repeat treatments for two to three years should be expected especially in areas subject to flooding that may receive influx of seed from upstream infestations.

The use of pre-emergent herbicides, which typically kill weed seeds as they germinate, is potentially valuable in controlling hop. Because this method requires specialized skills and knowledge about calibration and timing of application, it will not be discussed in detail here. For further information, refer to the Weeds Gone Wild fact sheet on Japanese hop (see References).



## Cultural

Japanese hop prefers direct sunlight and does not tolerate heavy shade. As soon as the tree canopy closes, the hop will cease to be a problem. Practices that favor fast tree growth, early crown closure, and heavy shade will help the new stand survive and outgrow the hop. These include planting fast-growing tree species that are adapted to the site and that will create dense shade in spring and summer, spacing the plants close together, and using effective weed control measures. Hop will climb up and over shrubs and small trees, but it needs a ladder of tall weeds, shrubs, or low tree branches to cling to as it climbs. To minimize the availability of low-growing vegetation for hop to climb, it is important to reduce the proportion of shrubs and smaller trees in favor of tall-growing trees. As trees grow taller, prune the lower limbs and basal sprouts to reduce the ladder effect. Use of tree shelters can assist hop control by marking the location of the seedling, protecting it from herbicide spray, reducing low branching and making a less structured ladder. However, if the shelter surface is smooth, hop can still climb using the stake or adjacent vegetation. As much as possible, prevent hop vines from growing inside or overtop the shelters and depositing seed inside the shelter. Practices such as adequate site preparation, pre-emergent herbicide application or hand weeding inside the shelter, and herbicide application around the shelter can be used. If shelters are not used it is especially important to prevent and control hop from establishing or to detect and act on infestations early, before the vines can begin to climb onto the tree plantings.

## Manual

Manual control is the most targeted method, with the least likelihood of damage to other plants. However, it is slow and labor-intensive and best suited for fairly small, readily accessible infested areas. Japanese hop does not develop an extensive or deep root system and as a result is fairly easy to pull or dig early in the season, especially when the soil is moist. This is an effective method but care must be taken to remove the root and not just break the stem off at ground level. Hand weeding needs to be started early in the growing season (April-May) while the roots are small and before the vines become tangled with other vegetation. Monthly pulling and monitoring will be needed until the infestation is eradicated. Due to the irritating prickles on the stems and leaves, it is important to wear gloves, long pants and long sleeves to avoid skin contact with the plant. Started early enough, and using proper precautions, this is a good method for homeowners or for volunteers working in public areas.

## **Mechanical**

Cutting or mowing the hop vines as close to the ground as possible is an acceptable control method as long as the cutting is started early (late spring), the entire site is thoroughly cut, and the practice is repeated frequently until the plants die back in fall. There are problems with this method. Attempts to mow or drive a vehicle through tree planting sites with tangles of hop vines covering the trees can result in the vines pulling out trees and breaking tree shelters. Vines quickly re-grow from the cut stems and from uncut vines around the trees. If successful, mowing tends to retain and promote the development of perennial grasses.

### **JAPANESE WISTERIA**

See General Guidance.

### **KUDZU**

See General Guidance.

### **MILE-A-MINUTE**

See General Guidance.

### **ORIENTAL BITTERSWEET**

See General Guidance.

### **PALE SWALLOW-WORT**

See General Guidance.

### **PORCELAINBERRY**

See General Guidance.

### **SWEET AUTUMN VIRGINSBOWER**

See General Guidance.

### **WINTER CREEPER**

See General Guidance.

## Plants to Watch

The following plants include newly reported species and others that while known to be invasive elsewhere, have more recently been noticed to be expanding in our region. If you find these plants in the wild, outside of a planted landscape in an area that is supposed to be managed as natural habitat, it would be prudent to target them for removal.

### GRASSES

#### Japanese Silvergrass

*Miscanthus sinensis* Anderss.

Grass family (Poaceae)

Japanese silvergrass, also known as Chinese silvergrass, miscanthus, and susuki (in Japan), is native to Southeast Asia where it occurs along roadsides and disturbed sites throughout much of Japan, especially at higher elevations (3,000-4,000 ft.). It is popular and frequently planted in commercial and residential landscapes. Japanese silvergrass is found in scattered locations in most of the eastern U.S. and as far west as Missouri and Louisiana, and in California and Colorado. It is a clump-forming grass with short, inconspicuous rhizomes and is adaptable to a variety of soil types including light, well-drained, nutrient-poor soils not suitable for agriculture such as roadsides, powerline rights-of-way, railroads, and steep embankments. It prefers full sun. Mature plants have slender, upright or somewhat arching leaves up to 18 in. long, with silvery midribs, sharp tips and rough margins and feathery, fan-shaped, terminal flower panicles that are silvery to pink in color and up to 2 ft. long. Flowering occurs September through October. More than fifty ornamental forms of *Miscanthus sinensis* are sold in the U.S. nursery trade. Most forms set little or no seed due to self-incompatibility, meaning that pollen from other forms is needed in order to produce viable seed. The species or wild type of *Miscanthus* likely originated from ornamental plantings. Due to the large number of forms planted, the wild type now produces a significant amount of viable seed that is wind-dispersed. It resembles ravenna-grass and other tall showy exotic ornamental grasses. Good substitutes would include eastern gamagrass (*Tripsacum dactyloides*), little bluestem (*Schyzachirium scopyrium*) and other native grasses. Removing seedheads is one way to reduce the likelihood of spread to new areas.



Bill Johnson

## Ravenna-Grass

*Ripidium ravennae* (L.) Trinius  
Grass family (Poaceae)

Ravenna-grass, or plume-grass, is native to southern Europe and was introduced for ornamental purposes. It occurs in Delaware, District of Columbia, Florida, Georgia, Maryland, and Tennessee, as well as a number of other states across the U.S., from California to Michigan. It is a tall clumping grass with a basal tuft of leaves and flowering stalks that reach heights of 8-12 ft., towering over big bluestem and other plants and making them easily visible from a distance. The base of the clump can be several feet in diameter indicating a sizeable root mass. Control is difficult to date the most effective method has been achieved come from physically removing the plants by pulling or digging out. The leaves and stems are covered with fine hairs. Flower heads are pale, feathery plumes at the tips of the tall flower stalks. It has been observed spreading from plantings along roadsides and other disturbed edge habitats as well as in fields and other open sites. Spread is by wind-blown seed. While still fairly uncommon in our area, this species shows signs of being invasive under some conditions and should be watched and controlled whenever it spreads beyond a planting. It would be wise to find a non-weedy native substitute for this grass or at least one that is not likely to become invasive. It resembles Japanese silvergrass and other tall showy ornamental grass species. A good substitute would be eastern gamagrass (*Tripsacum dactyloides*). Previous names for ravenna-grass include *Saccharum ravennae* and *Erianthus ravennae*.



Bill Johnson

## Small Carpetgrass/Joint-Head Grass

*Arthraxon hispidus* (Thunb.) Makino  
Grass family (Poaceae)

Small carpetgrass, or joint-head grass, is an annual grass native to temperate and tropical Asia and Australia. It was first observed in Virginia in 1930s and may have been accidentally introduced. It is reported to be invasive throughout the mid-Atlantic from Connecticut to Tennessee. It favors sunny moist habitats like floodplains, stream banks and shorelines, as well as roads and trails and thrives in sunny areas. It is invasive in scattered locations but has not been reported to be highly invasive over large areas to date. It has up-



Leslie J. Mehrhoff

right, smooth hairless stems 1-2 ft. tall are branched with many nodes which can root when they come in contact with the ground. The leaves are 1-2 in. long by about ½ in. wide, egg- to lance-shaped with a cordate (heart-shaped) base that clasps around the stem. The leaf stem and leaf margins are visibly hairy and the leaf sheath is covered with wart-like nodules. Flowers and fruits are produced September through November in terminal finger-like clusters ½-1½ in. long. It spreads by seed that can be dispersed by moving water. It may be confused with deertongue panicgrass (*Dicanthelium clandestinum*), a native species, which is taller and has longer leaves that lack marginal hairs. It is a plant to keep an eye on and when possible, infestations should be eradicated to prevent potential spread.

## HERBACEOUS FORBS

### Broadleaf Helleborine

*Epipactis helleborine* (L.) Cr. Wats. & Coult.  
Orchid family (Orchidaceae)

This attractive non-native orchid superficially resembles several native lilies that occur in our region, including Virginia bunchflower (*Veratrum virginicum*), Appalachian bunchflower (*Veratrum parviflorum*) and green false hellebore (*Veratrum viride*). Broadleaf helleborine has irregular, bilaterally symmetrical flowers with 5 petals and all the *Veratrum* have regular flowers with 6 petals. This is an exotic plant that is becoming increasingly invasive throughout the region, especially in dryish, gravelly soils of forest and woodland edges. It's been documented in the eastern U.S. for a long time. It occurs throughout the Northeast in most counties from Pennsylvania to Maine, and in scattered locations in the mid-Atlantic and Great Lakes region as well as occasional locations in the central and western states. The state of Wisconsin included this plant in its control manual for ecologically invasive plants in 1997.



Paula Sullivan

### Giant Hogweed

*Heracleum mantegazzianum* Sommier & Leveux  
Parsley family (Apiaceae)

**DO NOT TOUCH THIS PLANT.** Giant hogweed is a dangerous plant and is designated as a federal noxious weed due to its toxic sap that causes skin sensitivity to UV radiation and leads to blistering and severe burns. It is native to Europe and Asia and was introduced around 1917 for use as an ornamental plant. It is also used as a spice in middle Eastern cooking.



USDA APHIS

Hogweed is a towering herbaceous biennial plant growing 15-20 ft. in height with interesting foliage and massive flower heads. The large stem is hollow, about 2 in. across and usually marked with purple blotches. The leaves are deeply lobed, sharply pointed, and up to 5 ft. across. Flowering occurs in late spring to early summer. The white flowers are arranged in large umbrella-shaped heads that can be up to 2½ ft. in diameter. Hogweed has been reported in scattered locations in the Northeast, Mid-Atlantic and Pacific Northwest regions. It grows well in a variety of habitats but prefers moist, rich soils in disturbed areas such as riverbanks, ditches and railroad right-of-ways. It spreads by seed. Do not cultivate, plant, purchase, or transplant this plant. If found, notify your state Department of Agriculture of the exact location and request assistance with control.

### Goutweed

*Aegopodium podagraria* L.  
Parsley family (Apiaceae)

Goutweed is a creeping perennial herbaceous plant native to Europe and temperate portions of Asia that was introduced to North America as an ornamental. It occurs throughout most of Canada and in the U.S. from Maine to Minnesota, south to Georgia, and in Montana, Idaho, Oregon and Washington. Goutweed flourishes in moist, shaded areas of forest edges and disturbed forests and other disturbed habitats. Goutweed grows to 3 ft. tall and has alternate, compound leaves divided twice into three leaflets that are 1-3 in. long and have toothed margins and are sometimes irregularly lobed. Leaf stalks have sheathing bases. Leaves at the top of the stem are smaller and have fewer leaflets. Most leaves are basal, with the leafstalk attached to an underground stem, or rhizome. There are “wild” forms with green foliage and cultivated forms with white-margined or variegated leaves (as shown). Flowering occurs in June. Flowers are tiny and arranged in flat-topped clusters 2-4 in. across.



Bill Johnson

### Italian Arum

*Arum italicum* P. Mill  
Arum family (Araceae)

Italian arum is an evergreen herbaceous ornamental plant native to African, Asia and Europe that is showing signs of being invasive in natural areas. It has showy arrow-shaped fleshy leaves with white veins and can be seen in the dead of winter in the mid-Atlantic states. It has been reported to be



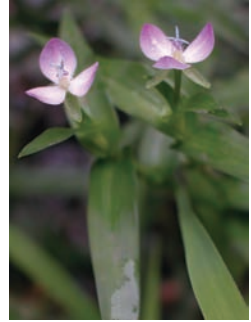
Bill Johnson

invasive in Rock Creek Park and the U.S. National Arboretum in Washington, D.C. and in the state of Oregon. Italian arum occurs as individual plants in low level infestations of scattered individuals over a particular area. It reproduces and spreads by seed.

### Marsh Dewflower

*Murdannia keisak* (Hassk.) Hand.-Mazz.  
Spiderwort family (Commelinaceae)

Marsh dewflower, Asian spiderwort, or wart-removing herb is native to eastern Asia and was first noted in 1935 in cultivated rice paddies in South Carolina. It escaped cultivation and has become established in the wild where it is invasive and spreading. It is a low growing, sprawling herbaceous plant with lance-shaped leaves and small solitary flowers with three equal sized petals that are pink to bluish in color. Flowers are borne in the upper leaf axils beginning in late summer (September). Fruits are capsules. It is known from 18 southern states north to Maryland and the District of Columbia. It prefers damp soil along the edges of freshwater tidal marshes, pond margins and slow-moving streams and can also be found inhabiting stream banks, canals, ditches, swamp forests, and other moist to wet disturbed places. Its vigorous growth enables it to out-compete native plants by forming dense mats. Seeds are dispersed by wildlife and it can spread by root fragments during flood events. Do not purchase or plant this invasive. Hand pulling may be effective if done before the plant sets seed. Chemical treatment with glyphosate (e.g. Rodeo®) labeled for wetland use may be effective if applied before seed set but it can be a challenge to control once established.



Linda Lee, Univ. of SC

### Spanish Bluebells

*Hyacinthoides hispanica* (Mill.) Rothm.  
Hyacinth family (Hyacinthaceae)

Spanish bluebells is a bulbous perennial native to Spain, Portugal and northwest Africa. It is a showy spring-flowering herbaceous plant with strap-shaped leaves and nodding, lavender, bell-shaped flowers on erect stalks that stand up to 18 in. high. Plants become dormant by early summer. Previously known as *Scilla campanulata* and *Scilla hispanica*. It is currently documented to occur in the wild in Delaware, Virginia and North Carolina and may be underreported. Spanish bluebells is known to naturalize and spread, a feature appreciated and used by the horticulture industry as a marketing



Dan Wihela via Flickr

tool. It poses a threat to native spring-blooming wildflower species already being heavily impacted by other non-native invasives like fig buttercup, garlic mustard, and nodding star-of-Bethlehem. For these reasons, it is a plant to keep an eye on and be prepared to remove if it is found invading natural habitats.

### Summer Snowflake

*Leucojum aestivum* L.

Lily family (Liliaceae)

Summer snowflake is an herbaceous perennial plant that flowers in spring. The flowers are white, nodding and easily identified by the small green spot on the outer tip of the petals and petal-like sepals that resembles nail polish on a fingernail. It is found throughout the eastern U.S. from Maine to Illinois, south to Texas and also in California and Oregon. It has been reported to be invasive in Fairfax County, Virginia, in habitats shared by fig buttercup (*Ficaria verna*) and garlic mustard (*Alliaria petiolata*) and is likely invasive elsewhere. Snowflake could be confused with other low-growing spring-flowering lilies with white flowers such as snowdrop (*Galanthus nivalis*), nodding star of Bethlehem (*Ornithogalum nutans*), fairy lily (*Zephyranthes candida*) and others.



Bill Johnson

### Yellow Archangel

*Lamiastrum galeobdolon* (L.) Her. & Pol.

Mint family (Lamiaceae)

Yellow archangel is a perennial herbaceous groundcover native to Europe. Grown as an ornamental in Europe, it has now escaped in several states in the mid-Atlantic as well as the mid-west and west coast. It has been found growing in gardens as far north as Newfoundland, Canada. It favors deeply shady, moist habitats like floodplains, stream banks and wet areas, but it can grow in rock gardens in full sun. It has not (yet) been reported to be highly invasive over large areas, rather localized in small monocultures in natural areas adjacent to gardens or where garden waste may have been deposited. Yellow archangel may have upright stems or long groundcovering vines. The opposite, variegated silver and green leaf is persistent, oval shaped, and pubescent with large teeth on the margin. Showy yellow flowers are present April through June in shade or sun on upright stems (1-2 ft.). It spreads by root fragments or numerous seed. Hand pulling control methods were not effective, as even small root fragments efficiently and vigorously



Bill Johnson



resprouted. A dense newspaper/mulch blanket can work in small areas. Effective control has been obtained with triclopyr although care must be used to avoid desirable species. Small populations should be eradicated when found as area of coverage can expand rapidly in fertile soil.

## SHRUBS AND SUBSHRUBS

### Castor Aralia

*Kalopanax septemlobus* (Thunb.) Koidz  
Ginseng family (Araliaceae)

Castor aralia is a showy ornamental shrub in the same family as ginseng and English ivy (pg. 105). Harvard University's Arnold Arboretum distributed the plant to schools across the country in 1972 to celebrate its centennial. Based on recent observations it is known from at least two sites in Maryland including Piscataway National Park in Accokeek, Maryland, and Rock Creek Park in Washington, D.C. Patches are currently limited in size but because it is able to spread vegetatively and by seed; it is a plant to watch and if possible should be removed to prevent its spread.



Bill Johnson

### Jethead

*Rhodotypos scandens* (Thunb.) Makino  
Rose family (Rosaceae)

Jethead is a multi-stemmed deciduous shrub that was introduced from Central China, Korea and Japan in 1866 for ornamental purposes. Found in at least 17 states east of the Mississippi, it has recently come to the attention of land managers who noticed it becoming invasive in natural habitats away from intentional plantings. It is very shade tolerant and can do well in forest edges and interiors. Once established, it shades out native plants in the ground layer and inhibits native tree generation. Jethead spreads by seed and by vegetative means. It can grow to 6 ft. in height and has opposite simple leaves 2½-4 in. long with doubly serrate toothed margins and conspicuous ribbed veins with long pointed tips. It flowers in the spring, producing white four-petaled flowers about 2 in. across. Small pale to red turning black, bead-like fruits are produced soon after flowering. Jethead invades forests, creating a thick shrub layer that displaces native shrubs, shades out understory species and restricts tree seedling establishment.



John M. Randall, TNC

**Leatherleaf Mahonia**

*Mahonia bealei* (Fortune) Carrière  
Barberry family (Berberidaceae)

Leatherleaf mahonia is native to China. It has been planted as an ornamental and is invading woodlands in the southeastern and mid-Atlantic states. It is an evergreen shrub that grows 5-10 ft. tall. The unusual leaves are pinnately compound, about 18 in. long with 9-13 paired, glossy holly-like leaflets. The leaflet margins have 2-7 teeth per side that are about ¼ in. or less in length. Leaflets are very thick and stiff. Flowering occurs in early spring. Fragrant yellow flowers emerge from the tips of the plant in attractive spike-like sprigs. The fruits are green berries that turn bluish black with a grayish bloom. Fruits hang in grapelike clusters.



Bill Johnson

**Orange-Eye Butterfly-Bush**

*Buddleja davidii* Franch.  
Snapdragon family (Scrophulariaceae)

Orange-eye butterfly-bush, or summer lilac, is native to southwestern China and was introduced into North America around 1900 for ornamental purposes. It escaped from plantings and occurs in scattered locations in the Northeast, Southeast and Mid-Atlantic and in the western U.S. from southern California to northern Washington. Butterfly-bush prefers disturbed sites and riparian areas. It is a deciduous shrub with arching stems and can grow 3-15 ft. in height. The leaves are 6-10 in. long, opposite, lance-shaped, pale gray-green, velvety and have toothed margins. It flowers summer to fall. The flowers are produced in thick, wand-like clusters from the tips of stems. Flowers are tubular, with four petals with wavy margins and can be lilac, pink or white with a deep yellow to orange center. The flowers produce lots of nectar which attracts butterflies. It spreads by seed which is dispersed mostly by wind. A related species, Lindley's butterfly-bush (*B. lindleyana*) has been reported to be invasive in natural areas in Florida.



Bill Johnson

## TREES

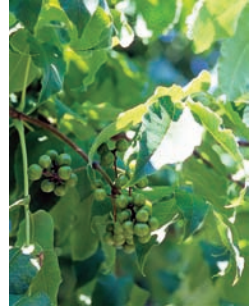
### Amur Corktree

*Phellodendron amurense* Rupr.

Rue family (Rutaceae)

Amur corktree is native to eastern Asia including Northern China (Manchuria, Ussuri, Amur), Korea, and Japan and was introduced into the United States in 1856 for ornamental purposes.

To date, it has been reported to be invasive in scattered locations in Illinois, Maryland, Massachusetts, New York, Pennsylvania and Virginia. It prefers full sun and rich soils. Once established, it can form patches that displace native plants. It spreads by seed which is produced in abundance. Amur corktree can reach 35-45 ft. at maturity. The distinctive bark is a light golden brown on younger trees and gray-brown, ridged, and furrowed on mature trees. Bark of both young and old trees is slightly spongy or corky to the touch and has a distinctive bright neon yellow layer of inner bark that can be revealed with a quick scrape of a pocket-knife. The leaves are 10-15 in. long, opposite, pinnately compound with 5-11 (up to 13) entire leaflets that are dark green, turning bright yellow in the fall. When crushed, the leaves have a distinctive citrusy smell sometimes likened to a disinfectant or skunk odor. Male and female plants are separate (dioecious) and each bears hanging panicles of yellowish-green flowers from May through June. From mid-June to mid-July, female trees produce abundant clusters of fruits (technically drupes) which are ¼-½ in. diameter. The fruits bright are green, turning black in late summer to fall, and may remain on the tree until winter. It is a plant to watch and should be controlled as necessary.



Bill Johnson

### Japanese Angelica-Tree

*Aralia elata* (Miq.) Seem

Ginseng family (Araliaceae)

Japanese angelica tree is a deciduous shrub or small tree native to China, Korea, Japan and the Russian Federation. It occurs in Ontario, Canada and throughout much of the northeastern U.S. from New Hampshire south to Maryland and west to Michigan and Illinois. It also occurs in Oregon and Washington. It can grow to 30 ft. in height. It has prickly stems and large compound leaves that are 2 or 3 times pinnate. The leaf stalks and flower stalks may have prickles. The main lateral veins of the leaflets continue all the way to the teeth at the leaflet margin. Flowering occurs late July



John M. Randall, TNC

through August and fruits mature in August and September. Flowers are small and white and emerge from tips of stems in broad umbels 1-2 ft. across that lack a central stalk. Fruits are black and about 1/10 in. across. Angelica-tree is becoming increasingly common in the mid-Atlantic and should be watched and controlled as needed.

### Sawtooth Oak

*Quercus acutissima* Carruthers  
Beech family (Fagaceae)

Sawtooth oak, a tree native to eastern Asia, is popular for use in street tree plantings due to its interesting foliage and fruits (acorns). It spreads by seed that is produced in large numbers and has been found in recent years to be escaping from plantings to become invasive in wild areas, displacing native plants. Because of this, land managers recommend against the use of sawtooth oak and suggest instead that landscapers use native oaks, of which there are many species to choose. One observer noted that it readily seeds into woodland edges, meadow habitats and open areas. Sawtooth oak successfully establishes in edge habitats that are not managed by mowing or other woody plant control. With regular, annual and semiannual mowing it does not seem to persist. If not mowed, however, it is fast growing, tolerant of a wide range of moisture and temperature conditions and can become a troublesome invasive. Do not plant sawtooth oaks. If small, pull seedlings or treat leaves with glyphosate. To control large trees: cut tree and grind stump; girdle, hack and squirt glyphosate; or cut and paint stump with glyphosate. Alternative plants include shagbark hickory (*Carya ovata*), American beech (*Fagus grandifolia*), red oak (*Quercus rubra*) and many other lovely native trees.



Chuck Barger, UGA

## VINES

### Chinese Yam

*Dioscorea polystachya* Turcz. (previously *D. oppositifolia*)

Yam family (Dioscoreaceae)

Chinese yam, or cinnamon vine, is an herbaceous, deciduous, perennial twining vine native to China. It is found throughout the eastern U.S. from Arkansas to Florida and as far north as Vermont with most current occurrences in the central portion of that range. It was introduced for ornamental, food, and medicinal purposes and probably escaped cultivation in the mid-1990s. It can form dense masses of vines that cover and kill native vegetation including trees within a variety of moist disturbed habitats. The leaves are halberd-shaped with a pointed tip, a concavity between leaf base and tip, long parallel veins, a long stalk, are 3-6 in. long by 3-4 in. wide and opposite to alternate (near the tips). The stems are rounded, thin and wiry. It rarely flowers. Reproduction is mainly by aerial potato-like tubers (bulbils) in leaf axils and by underground tubers. Several vines look like Chinese yam including two native species – whorled wild yam (*D. quaternata*) and common wild yam (*D. villosa*) which have heart-shaped leaves, small hairs on upper leaf surfaces, lack aerial tubers and twine right to left. Other vines that might be confused with it include native greenbrier (*Smilax* sp.) which lacks the aerial tubers, typically has thorns and blue to purple berries, non-native field bindweed (*Convolvulus arvensis*), which has alternate leaves and showy trumpet-like flowers, and morning-glory (*Ipomoea* sp.) which has heart-shaped, alternate leaves.



Jack Ranney, Univ. of TN



# Native Alternatives for Herbaceous Forbs

**blazing star or gayfeather**  
(*Liatris spicata*)



Bill Johnson

**blue vervain**  
(*Verbena hastata*)



R. Harrison Wiegand

**cardinal flower**  
(*Lobelia cardinalis*)



Bill Johnson

**creeping phlox**  
(*Phlox stolonifera*)



Connie Schmotzer, Penn State Coop. Ext.

**evergreen wood fern**  
(*Dryopteris marginalis* or *intermedia*)



Bill Johnson

**foam flower**  
(*Tiarella cordifolia*)



Bill Johnson

**green and gold**  
(*Chrysogonum virginianum*)



Bill Johnson

**Joe Pye weed**  
(*Eupatorium fistulosum*)



Bill Johnson

# Native Alternatives for Herbaceous Forbs

**lady fern**  
(*Athyrium filix-femina*)



Bill Johnson

**New York fern**  
(*Thelypteris noveboracensis*)



Bill Johnson

**New York ironweed**  
(*Vernonia noveboracensis*)



Bill Johnson

**obedient plant**  
(*Physostegia virginiana*)



Bill Johnson

**partridgeberry**  
(*Mitchella repens*)



Bill Johnson

**wild geranium**  
(*Geranium maculatum*)



Bill Johnson

**wild ginger**  
(*Asarum canadense*)



Britt Slattery, USFWS



# Native Alternatives for Shrubs and Subshrubs

**black haw**  
(*Viburnum prunifolium*)



Bill Johnson

**common blackberry**  
(*Rubus allegheniensis*)



©Steve Baskauf, 2002-2005 via Bioimages

**flowering raspberry**  
(*Rubus odoratus*)



Bill Johnson

**fragrant or shining sumac**  
(*Rhus aromatica* or *copallina*)



Bill Johnson

**gray dogwood**  
(*Cornus racemosa*)



Bill Johnson

**groundsel tree**  
(*Baccharis halimifolia*)



Bill Johnson

**highbush blueberry**  
(*Vaccinium corymbosum*)



Bill Johnson

**inkberry**  
(*Ilex glabra*)



Bill Johnson

# Native Alternatives for Shrubs and Subshrubs

**maleberry**  
*(Lyonia ligustrina)*



Alan Cressler via Flickr

**mapleleaf viburnum**  
*(Viburnum acerifolium)*



Ted Bodner, USDA PLANTS Database

**northern bayberry**  
*(Myrica pensylvanica)*



Bill Johnson

**pasture rose**  
*(Rosa carolina)*



Larry Allain, USDA PLANTS Database

**red or black chokeberry**  
*(Aronia arbutifolia or melanocarpa)*



Bill Johnson

**silky dogwood**  
*(Cornus amomum)*



Richard I. Bonser via Flickr

**smooth sumac**  
*(Rhus glabra)*



Bill Johnson

**southern arrowwood**  
*(Viburnum dentatum)*



Bill Johnson

# Native Alternatives for Shrubs and Subshrubs

**spicebush**  
*(Lindera benzoin)*



*Chris Miller, NRCS*

**staghorn sumac**  
*(Rhus typhina)*



*Bill Johnson*

**swamp rose**  
*(Rosa palustris)*



*Chris Miller, NRCS*

**sweet pepperbush**  
*(Clethra alnifolia)*



*Bill Johnson*

**Virginia sweetspire**  
*(Itea virginica)*



*Bill Johnson*

**winterberry**  
*(Ilex verticillata)*



*Bill Johnson*

# Native Alternatives for Trees

**American beech**  
(*Fagus grandifolia*)



Bill Johnson

**black gum**  
(*Nyssa sylvatica*)



Bill Johnson

**black haw**  
(*Viburnum prunifolium*)



Bill Johnson

**black walnut**  
(*Juglans nigra*)



Bill Johnson

**box elder**  
(*Acer negundo*)



Bill Johnson

**flowering dogwood**  
(*Cornus florida*)



Bill Johnson

**fringetree**  
(*Chionanthus virginicus*)



Bill Johnson

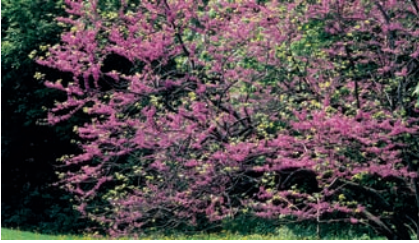
**red maple**  
(*Acer rubrum*)



Britt Slattery, USFWS

# Native Alternatives for Trees

**redbud**  
(*Cercis canadensis*)



Bill Johnson

**serviceberry**  
(*Amelanchier canadensis* or *arborea*)



Bill Johnson

**sourwood**  
(*Oxydendrum arboreum*)



Connie Schmotzer, Penn State Coop. Ext.

**sweet gum**  
(*Liquidambar styraciflua*)



Bill Johnson

**sweetbay magnolia**  
(*Magnolia virginiana*)



Bill Johnson

**willow oak**  
(*Quercus phellos*)



Bill Johnson

# Native Alternatives for Vines

**American wisteria**  
(*Wisteria frutescens*)



Fred Nation

**crossvine**  
(*Bignonia capreolata*)



Bill Johnson

**passionflower**  
(*Passiflora incarnata*)



Bill Johnson

**pipevine**  
(*Aristolochia macrophylla*)



Jim Gallion

**trumpet creeper**  
(*Campsis radicans*)



Olivia Kwong, Plant Conservation Alliance

**trumpet honeysuckle**  
(*Lonicera sempervirens*)



Bill Johnson

**virgin's bower**  
(*Clematis virginiana*)



Bill Johnson

**Virginia creeper**  
(*Parthenocissus quinquefolia*)



Marielle Anzelone via Flickr

# Glossary

**alien, exotic, foreign, introduced:** see non-native.

**axil:** the junction of leaf and stem.

**biodiversity:** the sum of all the plants, animals and other organisms living on Earth.

**biological control:** the use of living organisms — parasites, pathogens or predators — to control an invasive or other pest species.

**cultivar:** a race or variety of a plant that has been created or selected intentionally and maintained through cultivation.

**girdle:** to cut through the bark and growing layer (cambium) all around the trunk of a tree.

**glyphosate:** a type of systemic herbicide (e.g., Roundup® for non-wetland use, Rodeo® for wetlands or near water).

**indigenous:** see native.

**invasive:** a species that grows and spreads rapidly, establishes over large areas, and displaces native species.

**native:** a species that naturally occurs in a particular region, ecosystem and habitat. Species native to North America are generally recognized as those occurring on the continent prior to European settlement.

**natural area:** an area of land or water with predominantly native vegetation or natural geological features that is allowed to respond to the forces of nature with minimal human influence.

**non-native:** a species that, due to direct or indirect human activity, occurs in locations beyond its known historical or potential natural range. Refers to species from another continent, region, ecosystem, or habitat.

**noxious weed:** a legal designation used specifically for species that have been determined to be major pests of agricultural systems and are subject, by law, to certain restrictions.

**pedicel:** stalk that attaches individual flowers to the main stem of an inflorescence.

**peduncle:** stalk that supports an inflorescence.

**pest:** a plant, animal or other organism considered harmful.

**rhizomes:** underground stems.

**sepals:** bract-like or leaf-like structures below the petals of a flower.

**stipules:** a pair of leaf-like structures at the base of the leaf stalk on some plants.

**stolons:** above-ground stems.

**systemic herbicide:** an herbicide that is absorbed by a plant and carried throughout the tissues.

**turions:** vegetative buds formed in leaf axils or stem tips.

**triclopyr:** a type of systemic herbicide (e.g., Garlon®).

**weed:** a subjective word used to describe any plant growing wherever someone wishes it did not; can include native and non-native plants.

**wildland:** see natural area.

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### Eating your weeds

Alien Weeds: The Invasive Species Harvest:  
<http://alienweeds.com/>

Mid-Atlantic Invasive Plant Council:  
<http://www.maipc.org>

### Herbicide Information

Dow AgroSciences LLC Product Labels and Material Safety Data Sheets: <http://www.cdms.net/LabelsMsds/LMDefault.aspx>

Accord®:  
<http://www.dowagro.com/ivm/forestry/prod/accord.htm>  
<http://www.cdms.net/ldat/ld4TL015.pdf>

Garlon® 3A:  
<http://www.dowagro.com/ivm/utility/prod/garlon3a.htm>  
<http://www.cdms.net/ldat/ld0AU003.pdf>

Garlon® 4:  
<http://www.cdms.net/ldat/ld0B0013.pdf>  
<http://www.dowagro.com/ivm/utility/prod/garlon4.htm>

Habitat®:  
<http://www.cdms.net/ldat/ld6H2000.pdf>

Remedy™:  
<http://www.dowagro.com/ca/prod/remedy.htm>  
<http://www.cdms.net/ldat/ld0B4005.pdf>

Rodeo®:  
<http://www.dowagro.com/ivm/invasive/prod/rodeo.htm>  
<http://www.cdms.net/ldat/ld4TN001.pdf>

Roundup®:  
<http://www.scotts.com/smg/brand/roundup/brandLanding.jsp>

Backpack and Spot Treatment Calibration Guidelines in Techline Newsletter: <http://www.dowagro.com/range/resource/techline.htm>

### Plant Identification, Distribution and Management

California Invasive Plant Council – Invasive Plants of California's Wildlands: <http://www.cal-ipc.org/ip/management/ipcw/online.php>

Early Detection and Distribution Mapping System (EDDMapS):  
<http://www.eddmaps.org/>

Flora of the Southeast and Mid-Atlantic States (Weakley's):  
<http://herbarium.unc.edu/WeakleyFlora2010Mar.pdf>

Global Invasive Species Database:  
<http://www.issg.org/database/welcome>

Invasive Plant Atlas of the United States:  
<http://www.invasiveplantatlas.org>

Lady Bird Johnson Wildflower Center Native Plant Information Network: <http://www.wildflower.org>

NatureServe Explorer: An Online Encyclopedia of Life:  
<http://www.natureserve.org/explorer/index.htm>

Pennsylvania Flora Project:  
<http://www.paflora.org>

Plant Conservation Alliance:  
<http://www.nps.gov/plants>

U.S. Forest Service Weed of the Week:  
[http://www.na.fs.fed.us/fhp/invasive\\_plants/weeds](http://www.na.fs.fed.us/fhp/invasive_plants/weeds)

Weeds Gone Wild: Plant Invaders of Natural Areas in the United States: <http://www.nps.gov/plants/alien>

## **Organizations**

Central Jersey Invasive Species Task Force:  
<http://www.cjist.org>

Delaware Department of Natural Resources and Environmental Control: <http://www.dnrec.state.de.us>

Delaware Invasive Species Council:  
<http://www.delawareinvasives.net>

Delaware Native Plant Society:  
<http://www.delawarenativeplants.org>

Federal Aquatic Nuisance Species Task Force:  
<http://www.anstaskforce.gov>

Invasive and Exotic Species of North America:  
<http://www.invasive.org/>

Invasive Plant Atlas of the United States:  
<http://invasiveplantatlas.org>

Lady Bird Johnson Wildflower Center's Native Plant Information Network: <http://www.wildflower.org/explore>

Maryland Department of Natural Resources:  
<http://www.dnr.state.md.us>

Maryland Invasive Species Council:  
<http://www.mdinvasivesp.org>

Maryland Native Plant Society:  
<http://www.mdflora.org>

Mid-Atlantic Invasive Plant Council:  
<http://www.maipc.org>

Mid-Atlantic Panel on Aquatic Invasive Species:  
<http://www.midatlanticpanel.org/>

National Association of Exotic Pest Plant Councils:  
<http://www.naeppe.org>

National Invasive Species Council:  
<http://www.invasivespeciesinfo.gov>

New Jersey Invasive Species Council:  
<http://www.nj.gov/dep/njisc>

Pennsylvania Department of Conservation and Natural Resources  
Invasive Plant Tutorial: <http://www.dcnr.state.pa.us>

Pennsylvania Invasive Species Council:  
<http://www.invasivespeciescouncil.com>

U.S. Fish and Wildlife Service's Native Plants for Wildlife Habitat  
and Conservation Landscaping:  
<http://www.nps.gov/plants/pubs/chesapeake>

U.S. Fish and Wildlife Service, BayScapes.:  
<http://www.fws.gov/chesapeakebay/bayscapes.htm>

Virginia Department of Conservation and Recreation:  
<http://www.dcr.virginia.gov>

Virginia Department of Conservation and Recreation. Native Plants  
for Conservation, Restoration and Landscaping:  
[http://www.dcr.virginia.gov/natural\\_heritage/nativeplants.shtml](http://www.dcr.virginia.gov/natural_heritage/nativeplants.shtml)

Virginia Native Plant Society:  
<http://www.vnps.org>

West Virginia Division of Natural Resources:  
<http://www.dnr.wvdnr.gov>



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**National Park Service  
National Capital Region  
Center for Urban Ecology**  
4598 MacArthur Boulevard, N.W.  
Washington, DC 20007  
(202) 342-1443 ext 218  
[www.nps.gov/cue](http://www.nps.gov/cue)



**U.S. Fish & Wildlife Service  
Chesapeake Bay Field Office**  
177 Admiral Cochrane Drive  
Annapolis, MD 21401  
(410) 573-4500  
[www.fws.gov/chesapeakebay/](http://www.fws.gov/chesapeakebay/)

**National Fish and Wildlife Foundation**  
1120 Connecticut Avenue N.W., Suite 900  
Washington, DC 20036  
(202) 857-0166  
[www.nfwf.org](http://www.nfwf.org)

**Plant Conservation Alliance**  
1849 C Street N.W., LSB-204  
Washington, DC 20240  
(202) 912-7232  
[www.nps.gov/plants](http://www.nps.gov/plants)

**The Nature Conservancy  
Maryland/DC Chapter**  
5410 Grosvenor Lane, Suite 100  
Bethesda, MD 20814  
(301) 897-8570  
[www.nature.org](http://www.nature.org)

**Chesapeake Bay Foundation**  
Philip Merrill Environmental Center  
6 Herndon Avenue  
Annapolis, MD 21403  
(410) 268-8816  
[www.cbf.org](http://www.cbf.org)

**Chesapeake Bay Trust**  
60 West Street, Suite 200-A  
Annapolis, MD 21401  
(410) 974-2941  
[www.chesapeakebaytrust.org](http://www.chesapeakebaytrust.org)

**Maryland Department of Natural Resources**  
Wildlife and Heritage Service  
580 Taylor Avenue, Tawes State Office Building  
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(410) 260-8540  
[www.dnr.state.md.us](http://www.dnr.state.md.us)

**Mid-Atlantic Invasive Plant Council**  
5617 5th Street S.  
Arlington, VA 22204  
[www.maipc.org](http://www.maipc.org)

**National Capital Area Garden Clubs, Inc.**  
3501 New York Avenue, N.E.  
Washington, DC 20002-1958  
[www.ncagardenclubs.org](http://www.ncagardenclubs.org)

**City of Bowie, Maryland**  
Dept of Planning and Economic Development  
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Bowie, MD 20715  
(301) 809-3051  
[www.cityofbowie.org](http://www.cityofbowie.org)

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Snow Hill, MD 21863  
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