A Field Identification Guide to

Invasive Plants

in Michigan's Natural Communities

A resource for public land managers, land stewards and volunteers engaged in conserving & restoring Michigan's native plant & animal communities

DEPARTMENT OF NATURAL RESOURCES · DNR · MICHIGAN

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan Natural Features Inventory

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Cover photos:
(From upper left, clockwise)

Garlic mustard
Chris Evans, The University of Georgia, www.forestryimages.org

Purple loosestrife
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Autumn olive
USDA NRCS Archives, www.forestryimages.org

Common buckthorn
Paul Wray, Iowa State University, www.forestryimages.org

Bell's honeysuckle
Leslie J. Mehrhoff, University of Connecticut, IPANE

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Michigan Natural Features Inventory

Inches

Please note that this field guide is a work in progress. In particular, knowledge of the distribution of these species is increasing rapidly.

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Preface

This booklet was developed to help land managers identify recognized invasive plant species that pose a threat to management goals on their lands. Detecting these plants during the early phase of their invasion is essential to achieving cost effective removal or control. The species in this field guide are included for at least one of the following reasons:

- numerous land managers in Michigan report them as a significant problem on their lands
- they are included in federal, state or regional listings of invasive plants
- there is research literature documenting their adverse impacts on native plant and animal communities

Inclusion in this guide does NOT imply legal status as a prohibited or restricted species as defined in Michigan's Natural Resources and Environmental Protection Act 451 of 1994, Section 324.41301. Only a few of the included species are prohibited or restricted by law and in these cases restrictions are noted. Also, this field guide does not rank individual species by their level of threat—determining the "invasiveness" of each species is a complex process still ongoing for Michigan at the time of publication. However, all of the included species have been noted as invasive somewhere in the Midwest.

Several of the plants in this guide are readily available in the horticultural trade and this guide makes no recommendations as to their sale, planting, or presence on lands where they may pose little threat to natural landscapes. Not all species are equally invasive and in some cases cultivars may not share the invasive traits of their parent species. However, some species, once thought to be benign, are now serious problems in Michigan.

We encourage you to thoughtfully consider the impact of your planting choices on Michigan's forests, grasslands, wetlands and dunes.

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We have benefited tremendously from feedback shared by numerous MDNR, MDEQ, and The Nature Conservancy (TNC) field staff, as well as Michigan Department of Transportation, USDA Forest Service, Midwest Invasive Plant Network, The Stewardship Network and Michigan Invasive Plant Council members who participated in workshops, shared their experiences with particular species and responded to our requests for information. In addition, we would also like to thank MNFI field staff for reporting the presence of invasive species in counties where their presence has not been documented formally.

Anton Reznicek and Edward Voss of the University of Michigan Herbarium generously shared expertise, insight and online access to the Herbarium's records. Doug Pearsall, of TNC, assisted in identifying regional distribution patterns for each of the species.

We're pleased that Doug Landis, Amos Ziegler, Steven Crisp, and Rob Ahern of MSU, have incorporated the information in this guide into the Michigan Invasive Species Information Network (MISIN), where users can readily view fact sheets, work through training modules for priority species and map new occurrences on-line.

We have been delighted to discover how willing people are to share photographs when the goal is combating the spread of invasive plants. Leslie J. Mehrhoff, of the University of Connecticut shared many of his photos, which are posted on the Invasive Plant Network of New England's website. Similarly, Steven J. Baskauf shared his photos from the Bioimages collection at Vanderbilt University. John M. Randall, Barry Rice and Mandy Tu of The

Nature Conservancy shared many of their photos from TNC's invasive photo gallery.

Two photo galleries maintained by The University of Georgia were incredible resources: Forestry Images, supported by the USDA Forest Service; and the Bugwood Image Database System, which is supported by the National Park Service and the USDA Forest Service. We truly appreciate the many people who have posted their images there and have made them available for educational use.

Since there is not room to list more than the photographer's name on the photos themselves, photographer affiliations and in some cases, the websites where they have so graciously made their work available are listed in the back of the booklet on page 114.

While it is not possible to individually thank the many people who have assisted us, there are a few without whose help this guide would not have been possible. Mark Sargent, Sue Tangora, Ray Rustem, Ray Fahlsing, Bob Clancy, Glenn Palmgren, Sherri Laier, Bob Grese, Vern Stephens, Larry Pedersen, Ellen Jaquert, David Mindell and Robert Schutzki all provided extensive, thoughtful assistance and reviews at various stages of the project. Their expertise has been invaluable and any errors that remain are solely our own.

Phyllis Higman
Suzan Campbell

Michigan Natural Features Inventory, Lansing, Michigan
September 3, 2009

What is an invasive plant?

The National Invasive Species Management Plan, developed in response to Executive Order 13112, defines an invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health." For the purposes of this field guide, non-native species are those that did not occur in Michigan's ecological communities prior to widespread European settlement.

Only a small fraction of the hundreds of non-native plants that have evolved elsewhere and been brought to Michigan are invasive. The few that are, however, can be very aggressive and spread rapidly once established. In our native forests, grasslands, wetlands and dunes, they pose a threat to management goals by displacing native species or altering ecosystem processes. It is these harmful non-native species that are the focus of this field guide.

Impacts of non-native invasive plants

Invasive species are a significant threat to Michigan's native biodiversity and their impacts are wide-ranging. They are aggressive competitors, often dominating an ecosystem and reducing native diversity dramatically. They have effective reproductive and dispersal mechanisms; many are capable of spreading by rhizomes and some can produce new plants from tiny root or stem fragments. Many store energy in extensive root systems and can sprout back repeatedly after cutting. Most invasive plants produce abundant fruit and seeds that are widely dispersed and remain viable in the soil for years.

Some invasive shrubs and trees create dense shade, preventing the growth of native herbs beneath them. They often leaf out early in spring and retain leaves late into the season, gaining as much as an extra month of productivity compared to some of their native associates. Some species secrete chemicals that inhibit the growth of neighboring plants or beneficial soil fungi. Invasive plants simplify ecosystem structure, and may alter site hydrology, nutrient cycles or patterns of natural disturbance, such as fire regimes.

Using this field guide

This field guide is intended to help readers identify recognized invasive species and facilitate a rapid response. It includes photos and a description of each plant, its habitat preferences, reproductive strategies and a brief overview of suggested methods for monitoring and treating small, newly detected, localized infestations.

Identification
Multiple photos, plant descriptions and habitat preferences will help in identifying each species. Similar "look-alike" plants are also noted to help minimize mistaken identities. Key features to look for include fruit and flower types, leaf shape and arrangement, how the plant is rooted and size of the plant and its parts. A glossary is included on page 109.

Invasive distribution and abundance
A map indicating the distribution and abundance of each invasive species is located in the upper right-hand corner of each description page. The map divides the state into 4 regions: Western Upper Peninsula, Eastern Upper Peninsula, Northern Lower Peninsula and Southern Lower Peninsula. Within each region, abundance is indicated by the following colors:

— not known from this region
— isolated occurrences known from this region
— local populations present in this region
— the species is widespread in this region

What the field guide WON'T tell you . . .
This field guide does NOT provide detailed information on using specific herbicides. Herbicides must be used in accordance with label instructions. Note potential damage to non-target plants and precautions for safe use. Land managers are responsible for obtaining any necessary licenses or permits, as well as determining that particular herbicides are registered in Michigan, and approved by their agency. Permits are required for any herbicide application in or adjacent to water bodies. For information, see MDEQ's Aquatic Nuisance Control website at:

www.michigan.gov/deqinlandlakes

Early detection—the focus of this field guide

Plant invasions typically begin with one or a few individuals. The initial infestation often persists at low levels until a threshold is reached, and then it expands rapidly. The window for potential eradication or effective long-term control is, with rare exception, during the early phases of infestation. As an invasive plant species' population expands, the feasibility of its eradication or control goes down, while costs escalate.

Invasive species are usually not detected and/or treated until they are well established. The goal of this field guide is to help readers identify and respond to invaders earlier, while success is still likely.

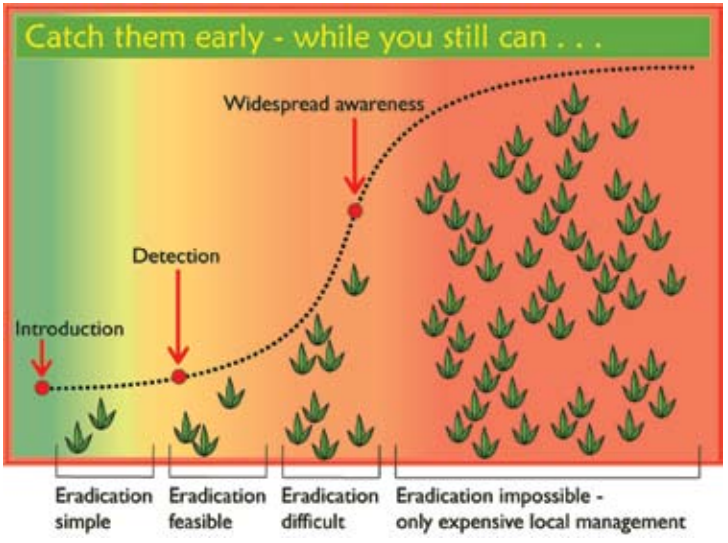


Figure 1: Adapted from a graph by Ellen Jacquart, The Nature Conservancy

Implementing an early detection and rapid response strategy begins with an assessment that a particular species poses a regional or local threat. Not all species in this field guide will necessarily interfere with management goals on all sites. They are included here for you to consider within the context of your own management goals and those of your neighbors.

A comprehensive approach—EDRR in context

Early detection and rapid response (EDRR) is one component of a broader framework for addressing invasive species. The elements of this framework are described briefly below to show how early detection fits into a comprehensive strategy to address this threat. A list of online resources for planning is included on page 107.

Prevention
Keeping invaders out of Michigan is the best way to prevent their dispersal. This entails learning which species pose serious threats, where they originate, and how they can be stopped. Globally, prevention involves knowledge of trade routes, transport methods and regulations. Locally, it involves becoming aware of potential invaders and preventing their dispersal. Cleaning vehicles, boats, equipment and boots and using certified weed free products can help prevent new invasions. Discouraging the planting of known invasive species is also important.

Early detection and rapid response
EDRR is the most cost-effective strategy to address plant invaders once they have entered the state. Its goal is to detect new infestations early enough that they can be eradicated or contained successfully. EDRR treatments will require follow-up also. It is useful to consider potential invaders before they invade—would you recognize a particular species in all stages of its life cycle? As a seedling? Or as a dried up plant at the end of the season? Can a particular invader be hand-pulled or removed mechanically? Or can it only be eradicated with herbicide? Are any special licenses or permits required to treat it successfully?

Assessment
It is important to assess any infestation thoroughly to determine if a rapid response is warranted. Is it a localized occurrence that can be treated successfully? Or is the species widely distributed throughout the region? Are there seed sources nearby that will continue to spread into your site and thwart any control efforts? Are there resources available to monitor and provide follow-up treatment for many years when necessary? Is this really an early detection site or a well established infestation that will require long-term control?

Long-term control
Once an infestation expands to a critical threshold, eradication becomes impossible or impractical. If the infestation can be contained, slowed down, or maintained within acceptable levels, long-term control may be warranted. Successful control of well-established infestations requires an integrated, multi-year approach using multiple techniques. Monitoring is essential and follow-up treatment is necessary to ensure depletion of the seed bank.

Restoration
Invasive species can disrupt complex ecological relationships involving soil fungi, pollinators, nutrient cycling and disturbance regimes. It may be possible to restore native species and natural processes, including disturbance, to facilitate ecosystem recovery. Before undertaking such an effort, it is important to ensure that the site is suitable for your management goals. Are the site conditions appropriate for the system to be restored? Is a native seedbank present? Can the restored ecological processes be maintained?

Prioritization
Resources are limited—systematic and informed prioritization is critically important for directing them wisely. Factors to consider when prioritizing include: a) the value of the site; b) the extent and abundance of the infestation; c) potential impacts of the invasive species; and d) feasibility of control or restoration. Does the site value and anticipated effectiveness of control merit the costs of treatment? Is the site important or strategic in the big picture?

Collaboration
Invasive species respect no jurisdictional boundaries—mitigating their impacts will require support from all landowners where a particular infestation occurs. Involving others with additional perspectives, skills, and resources will ultimately result in better and more lasting solutions.

Monitoring, adaptive management and education
Determining optimal treatments is an on-going task. Strategies must be adapted to incorporate knowledge gained by assessing the results of control efforts and from research. Learning from your own experiences and sharing your observations with others is a very important aspect of addressing invasive species impacts.

Mitigating impacts

Understanding the invader
It is critical to understand the biology and reproductive traits of a particular invasive species to effectively treat it. Not all treatments are equally effective for all species, in all settings or during all life cycle stages. For example, some woody species may be effectively controlled by cutting but others will simply sprout back from the roots unless the cut stumps are treated with herbicide. Fire may kill seedlings but not mature plants. For some species, small root or stem fragments can sprout and develop into new plants. Seed from many species remains viable in the seed bank for years.

Understanding control techniques and timing
Control techniques can have varying effects in different seasons and under different circumstances. For example, using herbicides early in spring may kill some invasive species while not harming dormant natives. Some herbicides are less effective on woody plants in spring, when the upward flowing sap inhibits movement of herbicide down into the roots. Humidity levels can increase or decrease the effectiveness of adjuvants used in some herbicides to aid absorption, as well as influence prescribed fire behavior. Be sure to consider treatment impacts on non-target species.

Control techniques
General descriptions of commonly used control techniques are included below but detailed discussions about how to use specific tools or herbicides, or certification and/or permitting requirements, are beyond the scope of this field guide. Users are responsible for ensuring personal safety, minimizing non-target impacts, and addressing all legal requirements when using any technique suggested. The Nature Conservancy's "Weed Control Methods Handbook" provides an excellent overview of this complex topic and is listed with other references in the Online Resources section at the back of this field guide.

Consider whether you have the skills, experience, required licenses and permits to use a particular method safely and effectively. In many cases, hiring a professional is appropriate and is sometimes the only legal option.

Hand pulling or digging
Some species can be controlled by hand pulling or digging. It is important to know if a given species can regenerate either from root or stem fragments so that all parts of the plant can be removed when necessary. Some species can still go to seed after they have been pulled—proper handling and disposal is important (See page xv). Wear gloves to avoid contact with any part of the plant that may cause a reaction. Plants with known toxins are noted in the descriptions. Specialized tools such as Root Talons® or Weed Wrenches® are useful where fragment or root resprouting is not a problem. Minimize soil disturbance, which can facilitate re-invasion of the site.

Cutting (clippers, mowers, chain saws)
In some cases, cutting can stop or delay the production of new seed or facilitate the implementation of other techniques. For example, it can be easier and more effective to apply herbicide to the new growth of many shrubs after they have been cut back. Appropriate handling and disposal of cut parts is important for many species.

Herbicide application
Herbicides can be extremely useful and in some circumstances are the only effective control method available. Generally, it is best to use the herbicide that poses the least risk, but is effective on the species being treated. Herbicide labels provide accurate information and should be consulted to ensure legal and effective use. Typical techniques for herbicide application are detailed below.

Always read the herbicide label and follow its directions for safe usage, including the use of personal protective equipment.

When using herbicides around water or wetlands, MDEQ permits may be required. See the Online Resources section at the back of this field guide for more information sources.

Foliar treatment
Apply herbicide to the green leaves of a plant with a sprayer, wick applicator, or glove. Consider non-target impacts—for some invasive plants, foliar treatments can be effective in the early spring or late fall, when many native plants are dormant. Do not spray on windy days. Refer to the herbicide label for specific details.

Cut stump treatment
Apply herbicide to the entire cambium ring of freshly cut stumps with a low-pressure sprayer, a sponge brush, or a weed wand. Some herbicides must be applied immediately after cutting while others can be used later—refer to the herbicide label for details.

Basal bark treatment
Apply herbicide around a 6-18 inch band at the base of a tree or shrub, with a penetrating oil or other adjuvant added to increase absorption.

Girdling
Remove a band of bark around tree trunks, severing the cambium layer to interrupt the flow of sap from root to crown. For large trees this band should be six to eight inches wide, while on smaller trees or shrubs, one or two inches is adequate. It is more effective if the ring is saturated with herbicide and is best done prior to spring sap flow. When herbicide is not used, girdling is most effective just after leaf-out is complete.

Frilling
Cut a ring of overlapping notches around a tree trunk with an ax or chain saw within 12 inches of the base. It is more effective if the ring is treated with herbicide and best done before spring sap flow.

Injection
Use a specialized tool to inject herbicide into trunks of trees, large shrubs or stems of herbaceous plants such as Japanese knotweed.

Fire (prescribed fire, spot burning)
Prescribed fire restores a natural disturbance that historically operated in many natural communities. Burning can reduce some invsive plant populations, stimulate the germination of native plants, and return nutrients to the soil. However, fire stimulates some invasive species and harms some desirable species. Spot burning with a torch is sometimes used to burn small patches of invasive plants or as a follow-up to other treatments.

Prescribed fire is a complex and potentially dangerous technique that requires specific training, insurance and permits. Contact your local Fire Marshall for information on its use in your area. The Michigan Prescribed Fire Council provides information and training.

Biological control
Biological control involves the use of animals, fungi, or microbial pathogens, to control invasive species. The organisms interfere with a plant's growth and reproduction by eating or otherwise damaging its parts and effectively reducing the size and density of infestations. Biological control does not usually eradicate an invasive species, rather it controls the population so that it doesn't dominate or out-compete desired species. Sometimes several control agents, targeting different parts of the plant's life cycle are used. Extensive testing is needed to minimize the chances of non-target damages before biological control agents can be released into the environment.

Grazing
Using animals to graze invasive species can be effective in some instances, particularly if grazing occurs when native species are dormant or when an invasive plant is flowering or producing seed. Grazers can pass viable seed through their digestive tract and carry seeds on their bodies, so care must be taken to avoid contaminating new sites. Used improperly, grazers can also decimate plant populations (including natives), disturb soils and create conditions that facilitate new invasions.

Disposal of invasive plant parts
Many land managers dispose of cut parts by burning plant material on site as part of an integrated treatment plan. In cases of early detection, this may be impractical. An understanding of species' reproductive strategies (i.e., can they reproduce from root or stem fragments, or produce seed after cutting) is critical to determining safe disposal practices for a particular species.

Since many municipal facilities distribute compost widely throughout a community, no seed producing parts or fragments that can regenerate should be composted. While landscape trimmings are not to be placed in landfills or incinerated, an exception has been made for invasive plants that are collected as part of an eradication or control program. For species that reproduce exclusively by seed, all fruit, seeds, developing seed heads, and in some cases, flowers, should be incinerated or disposed of in landfills. The remaining portions of the plant can be safely composted.

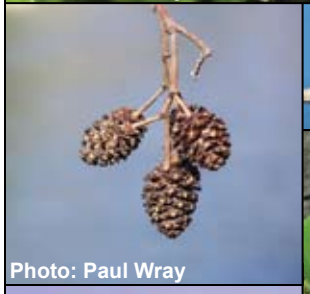
For species that can resprout from specialized reproductive propagules, root fragments, stolons or rhizomes, ideally, all plant materials should be incinerated or bagged and placed in a landfill. For species where information on reproductive capabilities is lacking, composting may be appropriate in circumstances where it can be monitored over several seasons. In some cases, wetland species can be dried thoroughly and composted on land if there is no chance that the resulting compost will be returned to a wetland or aquatic setting.

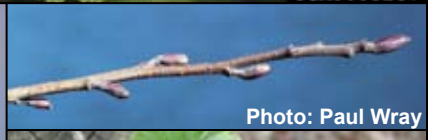
For most woody species, chipping or burning can provide a safe means of disposal. Chipping is not appropriate, however, when fruit and/or seed are present, as they can be distributed with the wood chips.

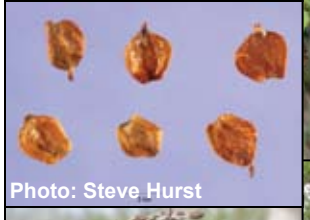
Tips for treating invasive plants:

- Keep the goal in mind—to stop reproduction and dispersal.
- It is most cost effective to treat the newest infestation in highest quality areas first.
- Consider treating small outlying colonies also.
- Eliminate large, seed producing plants before non-reproductive plants.
- Minimize soil disturbance.
- Plan for follow-up treatments for seedlings.
- Identify and monitor dispersal pathways.
- Species respond differently to different treatments.
- Not all herbicides are absorbed the same way.
- Site specific conditions should influence treatment choices.
- Beware of transporting seeds or fragments to new sites.
- Consider species biology when disposing of cut parts.
- Don’t use any technique you don’t thoroughly understand or are not qualified to use.

Trees







Black Alder

Alnus glutinosa

Habit: Deciduous, medium tree, ranging from 9-18 m (30-60 ft) in height and 25-38 cm (10-15 in) in diameter; narrow pyramidal shape when young, becoming more irregular with age.
Leaves: Simple, alternate, broadly rounded to truncate or notched at the apex; 5-13 cm (2-5 in) long and 5-10 cm (2-4 in) wide; toothed leaf margin; young leaves sticky to the touch; fall leaves green or brown.
Stems/bark: stems dark green-brown, smooth or rough; speckled with short lenticels; bark with prominent warty strips; buds stalked.
Flowers: Male and female flowers in separate structures; male flowers borne on long narrow catkins; female flowers borne in small woody structures resembling pinecones; bloom March-May.
Fruits/seeds: Small, woody, pinecone-like structures borne on long, narrow stalks; seeds are small and narrowly winged.
Habitat: Prefers full sun and wet soil but tolerant of drier soil and a range of pH conditions; found along rivers, in wetlands and moist forests.
Reproduction: By seed and spreading roots.
Similar species: Native speckled alder (*Alnus rugosa*) has leaves with a distinct (acute) tip; usually shrubbier than *A. glutinosa*.
Comments: Native to Eurasia and North Africa. Capable of displacing native vegetation; fixes nitrogen; has been planted on highly disturbed or infertile sites and for windbreaks; vulnerable to tent caterpillar.
Monitoring & rapid response: Monitor pond, river and wetland margins; distinguishable year-round by various combinations of its rounded leaves, catkins, cones and stalked vegetative buds. Begin control efforts in highest quality areas. Hand pull seedlings and remove mature trees that provide a source of seed. Cutting, girdling, and mowing are ineffective unless cut stumps are treated with herbicide to prevent resprouting.

Photo: James H. Miller, USDA FS

Photo: Chris Evans

Photo: Paul Wray

Photo: Steven J. Baskauf

Photo: Bill Cook

Photo: Gil Wojciech

Black Locust

Robinia pseudoacacia

Habit: Deciduous medium tree ranging in height from 12-25 m (40-82 ft) and 30-60 cm (12-24 in) in diameter; crown narrow, open, irregular with contorted branches.
Leaves: Alternate; pinnately compound with 7-21 leaflets per leaf; leaf 20-35 cm (8-14 in) long; ovate leaflets 2-5 cm (1-2 in) long and about half as wide, thin with smooth margins; hairless, dull bluish green above paler beneath, turning yellowish brown in fall.
Stems/bark: Twigs puberulent, becoming smooth, green to reddish brown, with zigzag shape and two spines at each node; bark is thick, tan to gray-brown, deeply furrowed; inner bark orange.
Flowers: White, irregular; very fragrant; dangling raceme of 10-25 flowers; bloom May-June.
Fruits/seeds: Seedpods form in the fall but persist over winter, pods are smooth, dark-brown, flat, and contain 4-8 small, flat, brown seeds.
Habitat: Very shade intolerant; can grow in many soil types except those with a high water table; formerly widely planted in Michigan and now found colonizing old fields, prairies, disturbed forests and woodlands.
Reproduction: By seed; also sprouts easily from roots and forms natural clones.
Similar species: Native honey locust (*Gleditsia triacanthos*) has smaller leaves; southern native bristly locust (*Robinia hispida*) is shrublike with brushlike hairs on stems and fruit; non-native false indigo (*Amorpha fruitcosa*) is shrublike with smaller leaves.
Comments: Native south of MI. Fixes nitrogen—may alter soil chemistry and subsequent nutrient cycling of forest systems.
Monitoring & rapid response: Monitor prairies and woodland edges and paths, particularly on well-drained soils; most visible in May and June while in flower but bark is distinctive year-round. Because this species is strongly clonal, all stems in a clone must be treated. Cutting and girdling stimulate sprouting unless cut stumps are treated with herbicide. Basal bark treatment is also effective. Fire stimulates resprouting; mowing stimulates germination of the (black locust) seed bank. This species is difficult to control—research control options thoroughly.

Photo: Steven J. Baskauf, Bioimages

Photo: Steven J. Baskauf

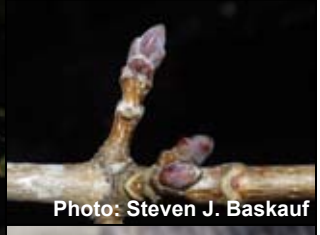


Photo: Steven J. Baskauf

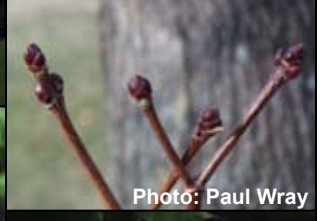


Photo: Paul Wray

Photo: Paul Wray

Photo: Paul Wray

Photo: Steven J. Baskauf, Bioimages

Photo: Steven J. Baskauf

Norway Maple

Acer platanoides

Habit: Medium tree reaching 12-18 m (40-60 ft) in height and 30-60 cm (12-24 in) in diameter; crown is dense, symmetrical, and rounded; spread is approximately two-thirds of the tree's height.
Leaves: Simple, opposite, green to bronze, smooth, 5-7 lobed with few teeth and broad bases up to 18 cm (8 in) wide; wider than long; petioles have milky juice; leaves retained late in autumn.
Stems/bark: Stout twigs, smooth, olive brown; leaf scars meet to form a sharp angle; buds are plump, rounded, fleshy, green to maroon; one large bud in center with two smaller lateral buds; bark is grayish black with small furrows.
Flowers: Yellow-green; stalked; in loose clusters; appearing before or with the leaves in spring.
Fruits/seeds: Two-winged samaras with the wings almost horizontally divergent (180 degree angle); seeds are wind dispersed; appear in late spring through summer.
Habitat: Shade tolerant; occurs in a variety of soil and moisture conditions but prefers fertile, moist, well-drained soils; found on roadsides, waste places, hedgerows, roadside thickets, disturbed and intact forest communities; somewhat resistant to drought.
Reproduction: By seed; with heavy seed crops every 1-3 years.
Similar species: Native sugar and black maples (*A. saccharum, A. nigrum*) do not have milky sap in leaves or stems; samara wings form a sharper angle.
Comments: Native to Europe. Creates dense shade; monopolizes soil moisture; regenerates prolifically under its own canopy, reduces overall plant diversity on a site; long lag time before early dispersers mature, then spread rapidly due to heavy seed production.
Monitoring & rapid response: Monitor road edges and paths; stays green until November, can be identified in spring, summer and early fall by the milky sap in its leaves and stems. Hand pull seedlings in spring while soil is moist. For large infestations, focus on highest quality areas and remove mature trees that provide a source of seed. Basal bark treatment is effective for trees less than 10 cm (4 in) in diameter. Cutting and girdling are effective for trees of any size; treat cut surfaces with herbicide to prevent resprouting.

Photo: Paul Wray

Photo: Patrick Breen

Photo: James H. Miller, USDA FS

Photo: John M. Randall, TNC

Photo: James H. Miller, USDA FS

Photo: J. Scott Peterson

Russian Olive

Elaeagnus angustifolia

Habit: Deciduous thorny shrub or small tree growing up to 9 m (30 feet) in height, rounded in shape with a loose arrangement of branches.

Leaves: Simple, alternate, oblong, 4-8 cm (1.5-3 in) long, untoothed margins; light green and covered with silvery star-shaped hairs above, silvery white and densely covered with scales below.

Stems/bark: Slightly thorny on ends; silvery scales present when young; bark is thin and comes off in elongate strips.

Flowers: Small, highly aromatic yellowish flowers, silver inside; umbel-shaped, single or clustered; usually flowers early in June-July, shortly after leaf emergence.

Fruits/seeds: Hard, yellow-red, olive-shaped fruits, 1 cm (0.4 in) long with silvery scales, clustered along stems in great quantities; eaten and dispersed by many bird species; begin fruiting at 3 to 5 years.

Habitat: Relatively shade tolerant; invades open and disturbed areas; can occur in a variety of soil and moisture conditions; not tolerant of acidic conditions (pH<6.0).

Reproduction: Primarily by seed, also vegetatively or by root sucker at the root crown.

Similar species: Non-native autumn olive (*Elaeagnus umbellata*) has shorter, broader, slightly greener/less silvery leaves; sage willow (*Salix candida*) usually less than 1 m (3 ft) tall and its leaves are narrower, with rolled edges.

Comments: Native to Eurasia. Forms a dense, monospecific shrub layer displacing native species and closing open areas; alters nutrient cycling and hydrology.

Monitoring & rapid response: Monitor edge habitats during growing season when distinctive foliage is present, early detection is critical as large stands are almost impossible to eradicate. Hand pull seedlings; small seedlings susceptible to fire. Burning, mowing, cutting and girdling all stimulate resprouting in larger plants without herbicide treatment; treat cut stumps with an herbicide; basal bark treatment effective on young trees; foliar herbicide treatment effective for small trees and resprouts.

Tree of Heaven

Ailanthus altissima

Habit: Deciduous small to large tree; 12-20 m (40-65 ft) tall and 60-100 cm (24-40 in) in diameter; crown wide-spread with multiple branches.

Leaves: Alternate; pinnately compound with 11-30 lance-shaped leaflets; leaves 30-90 cm (1-3 ft) long; 1-5 small gland tipped teeth near the base of each leaflet; dark green above, pale green below, turn yellow in fall; smell like rancid peanut butter when crushed.

Stems/bark: Twigs very stout, light to dark brown, smooth with large V-shaped leaf scars; bark thin, gray to brownish gray, smooth with shallow cracks appearing on older trunks.

Flowers: Small, yellow-green, five-petaled; borne in dense clusters near ends of upper branches; bloom in late spring; male and female flowers on different plants; pollen has an offensive odor.

Fruits/seeds: Two-winged, papery, flat samara; reddish when ripe; develop in clusters on female trees in fall; persist in winter; germinate readily; dispersed by wind, birds and water.

Habitat: Shade intolerant; thrives in poor soils; found in disturbed soils, fence rows, fields, roadsides, woodland edges, forest openings and rocky areas.

Reproduction: By seed and vegetatively via root suckering; up to 350,000 seeds produced annually by a single plant.

Similar species: Crushed leaves or broken stems of native sumacs (*Rhus* spp.), walnuts (*Juglans* spp.) and ash (*Fraxinus* spp.) lack rancid peanut butter aroma and gland-tipped teeth at base of leaves.

Comments: Native to Asia. Extensive cloning; allelopathic properties present; very fast growing.

Monitoring & rapid response: Monitor roadsides and woodland edges, paths; hand pull seedlings before taproot develops (< 3 months) as taproot fragments may resprout. Resprouts following cutting, girdling, mowing, and burning—follow-up treatment required; girdling followed by herbicide most effective; treat cut stumps with herbicide—all stems in a clone must be treated; basal bark treatment with herbicide provides good root kill, particularly in fall; foliar herbicide treatment is effective on small trees.

Shrubs

Photo: James H. Miller, USDA FS

Photo: James R. Allison

Photo: Barry A. Rice

Photo: Steven J. Baskauf, Bioimages

Photo: John M. Randall

Photo: Elizabeth J. Czarapata

Photo: USDA-NRCS Archives

Photo: James H. Miller

Autumn Olive

Elaeagnus umbellata

Habit: Deciduous shrub or small tree growing up to 6 m (20 ft) in height and 9 m (30 ft) wide.
Leaves: Simple, alternate, oval, 5-10 cm (2-4 in) long; margins entire, wavy; gray-green above, silvery scaly below; early leaf out (mid-March).
Stems/bark: Often thorny; silvery or golden brown, with brownish scales giving stems a speckled appearance.
Flowers: Fragrant; tubular; 4 petals and stamens; cream to light yellow; in clusters of 1-8; bloom from April to June.
Fruits/seeds: Drupe, 0.6 cm (0.25 in) in diameter; silvery with brown scales when immature, speckled red or yellow when mature; ripen September to October; begin to bear fruit at 3 to 5 years; each tree can produce 2-8 lbs. of seed per year; fruit eaten and seed dispersed by birds.
Habitat: Moderately shade tolerant; occurs in a variety of soil types (pH range of 4.8-6.5), thrives on infertile soils because of nitrogen-fixing root nodules; found in open woods, forest edges, roadsides, fence rows, meadows, sand dunes, and other disturbed areas.
Reproduction: By seed; also by root sprouting.
Similar species: Related invasive Russian olive (*E. angustifolia*) has longer, narrower, leaves, silver above and below.
Comments: Native to Asia. Invades disturbed areas, can out-compete native species; increases soil nitrogen levels which facilitates expansion of weedy and/or invasive species; had been widely recommended for conservation planting until invasive traits became apparent.
Monitoring & rapid response: Monitor sunny open sites; autumn olive leafs out early in spring, retains leaves in fall, can be recognized year-round. Hand pull seedlings; focus on newest infestations and highest quality areas first; cutting, girdling and burning are ineffective unless used in conjunction with herbicide as they stimulate sprouting; basal bark/stem sprays effective in late spring; basal stem injection of herbicide on dormant plants provides excellent control with low concentrations of herbicide. This species is difficult to control—research control options thoroughly.

Photo: Suzan Campbell, MNFI

Photo: John M. Randall, TNC

Photo: Suzan Campbell, MNFI

Photo: Suzan Campbell, MNFI

Photo: Suzan Campbell, MNFI

Black Jetbead

Rhodotypos scandens

Habit: Open, arching shrub ranging in height from 1-2 m (3-6 ft) in height and 1.2-2.7 m (4-9 ft) in width.
Leaves: Simple, opposite, bright green, 5-10 cm (2.25-4 in) long; doubly toothed margins, rough texture on the leaf surface; prominantly parallel-veined; resemble raspberry leaflets; emerge early in spring, retained until late fall.
Stems/bark: Young stems are green, smooth and shiny, turning brown; old stems are reddish brown, streaked with gray, with orange lenticels; stems arching, loosely branched.
Flowers: White, four-petaled, 3-6 cm (1-2 in) in diameter; occurring singly at branch tips; bloom in late April, early May, occasional flowers later in season.
Fruits/seeds: Fruits are shiny, black, hard, ovoid drupes; 1 cm (0.3 in) long; clustered in groups of three or four at branch tips, hanging below leaves; persist over winter.
Habitat: Prefers sunny, dry, well-drained sites but thrives in shade and also in harsh urban conditions; tolerates a wide range of soil pH values.
Reproduction: By seed; possibly bird-dispersed; develops roots where stem tips touch the ground.
Similar species: Resembles other opposite leaved shrubs slightly including Amur honeysuckle and dogwood but its leaves are toothed, its habit is more open and arching, and fruits are clustered at stem tips, rather than along branches; resembles other rose family members from a distance but it can be distinguished by its opposite leaves.
Comments: Native to China and Japan. Although jetbead is a member of Rosaceae, its leaves are opposite, rather than alternate.
Monitoring & rapid response: Monitor woodland edges and paths; jetbead is most visible while its white, four-petaled flowers are in bloom; it is also one of the earliest shrubs to leaf out in spring. Pull seedlings and hand dig small plants; for large infestations, cut shrubs to the ground in fall or winter; little information is available on this species but applying herbicide to cut stems is likely to enhance control efforts.

Photo: Chuck Bargeron

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Photo: James H. Miller, USDA FS

Photo: James H. Miller, USDA FS

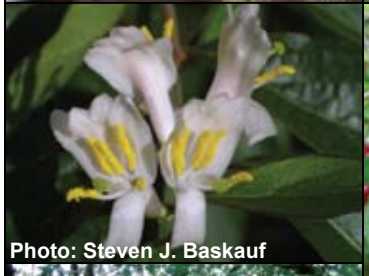
Photo: Steven J. Baskauf

Photo: Chuck Bargeron

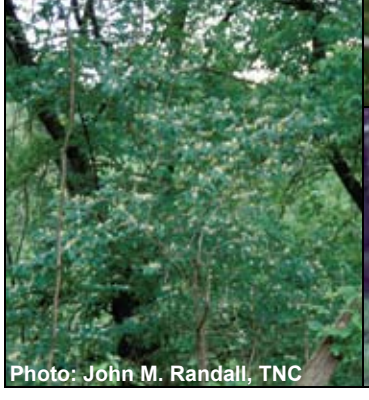
Photo: John M. Randall, TNC

Photo: Wisconsin DNR

Amur Honeysuckle

Lonicera maackii

Habit: Deciduous upright to spreading shrub growing up to 5 m (12-16 ft) tall.
Leaves: Simple, opposite, slightly hairy, elliptical leaves; 4-9 cm (1.5-3.5 in) long; smooth margins and a long distinctive apex or "drip tip"; early leaf out; long growing season.
Stems/bark: Multiple stems, numerous arching branches; thick non-exfoliating gray to tan bark with noticeable interlacing ridges; older branches often hollow.
Flowers: Small, white to pink, tubular, paired flowers on short (0.5 cm) stalks arising from the leaf axils; bloom May-June; fragrant.
Fruits/seeds: Berries are red and paired, borne on very short stalks; abundant and persistent.
Habitat: Relatively shade tolerant; occurs in a variety of soil and moisture conditions; invades open forests, savannas and prairies; disturbed areas are particularly vulnerable to invasion.
Reproduction: By seed; fruit dispersed by birds; root fragments may resprout.
Similar species: Native Canada honeysuckle (*L. canadensis*), American fly honeysuckle (*L. involucrata*), fly honeysuckle (*L. oblongifolia*) and swamp fly honeysuckle (*L. villosa*) are comparatively short and sparse and lack hollow stems on older branches. Dogwoods (*Cornus* spp.) have flowers and berries in clusters at the ends of their branches, not in the leaf axils.
Comments: Native of Asia. Common in urban areas and also occurs in rural areas where it was recommended for wildlife until its invasive traits became apparent; forms dense thickets; reduces tree and shrub regeneration, decreases overall plant diversity.
Monitoring & rapid response: Monitor sunny, upland sites and open forests in spring as non-native honeysuckle leafs out before natives. Begin control efforts in highest quality areas; hand pull or dig small plants, removing all roots; target large, fruit-bearing plants for control/removal; foliar spray may be effective for large populations where few natives are present; treat cut stumps with herbicide to prevent resprouting; basal bark treatment is also effective. Where fuel is present, multiple prescribed fires may provide effective control in fire adapted communities.

Photo: Leslie J. Mehrhoff, IPANE

Photo: Leslie J. Mehrhoff, IPANE

Photo: Wisconsin DNR

Photo: Leslie J. Mehrhoff, IPANE

Bell's Honeysuckle

Lonicera x*bella*

Habit: Deciduous upright to spreading shrub growing up to 3 m (10 ft) tall; hybrid between Tatarian and Morrow's honeysuckles; shallow roots.
Leaves: Simple, opposite, elliptic to oval or oblong; slightly hairy beneath; 3-6 cm long; early leaf out, long growing season.
Stems/bark: Multiple stems, arching branches; older branches hollow between nodes; pith brown; bark is gray or tan, shaggy.
Flowers: Small, pink, tubular, paired and fragrant; borne on stalks (0.5-1.5 cm long) arising from the leaf axils; bloom May to June.
Fruits/seeds: Berries are red and paired.
Habitat: Sun and shade tolerant; occurs in a variety of soil and moisture conditions; found along roadsides and on disturbed sites; invades forest, savannas and prairies.
Reproduction: By seed; fruit dispersed by birds; root fragments may resprout.
Similar species: Native Canada honeysuckle (*L. canadensis*), American fly honeysuckle (*L. involucrata*), fly honeysuckle (*L. oblongifolia*) and swamp fly honeysuckle (*L. villosa*) are relatively short and sparse in comparison with non-native honeysuckles and lack hollow stems on older branches. Dogwoods (*Cornus* spp.) have flowers and berries in clusters at the ends of their branches, not in the leaf axils.
Comments: Parent species native to Eurasia and Japan. Common in urban areas and also occurs in rural areas where it was recommended for wildlife until its invasive traits became apparent; forms dense thickets; reduces tree and shrub regeneration, decreases overall plant diversity.
Monitoring & rapid response: Monitor sunny, upland sites and open forests in spring as non-native honeysuckle leafs out before natives. Begin control efforts in highest quality areas; hand pull or dig small plants, removing all roots; target large, fruit-bearing plants for control/removal; foliar spray may be effective for large populations where few natives are present; treat cut stumps with herbicide to prevent resprouting; basal bark treatment is also effective. Where fuel is present, multiple prescribed fires may provide effective control in fire adapted communities.

Photo: John M. Randall, The Nature Conservancy

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Morrow's Honeysuckle

Lonicera morrowii

Habit: Deciduous upright to spreading shrub growing up to 1.8 m (6 ft) tall; shallow roots.
Leaves: Simple, opposite, elliptical to oblong, 3-6 cm (1-2.4 in) long; gray-green, softly hairy beneath; early leaf out, long growing season.
Stems/bark: Multiple stems; numerous arching branches; older branches often hollow; bark is gray or tan, shaggy.
Flowers: Small, white, tubular, paired, hairy and fragrant; borne on hairy stalks (0.5-1.5 cm long) arising from the leaf axils; bloom May-June.
Fruits/seeds: Berries are red and paired; dispersed by birds.
Habitat: Sun and shade tolerant; occurs in a variety of soil and moisture conditions; commonly found along roadsides and on disturbed sites; invades forest, savannas, and prairies.
Reproduction: By seed; fruit dispersed by birds; root fragments may resprout.
Similar species: Native Canada honeysuckle (*L. canadensis*), American fly honeysuckle (*L. involucrata*), fly honeysuckle (*L. oblongifolia*) and swamp fly honeysuckle (*L. villosa*) are relatively short and sparse in comparison with non-native honeysuckles and lack hollow stems on older branches. Dogwoods (*Cornus* spp.) have flowers and berries in clusters at the ends of their branches, not in the leaf axils.
Comments: Native to Japan. Common in urban areas and also occurs in rural areas where it was recommended for wildlife until its invasive traits became apparent; forms dense thickets; reduces tree and shrub regeneration, decreases overall plant diversity.
Monitoring & rapid response: Monitor sunny, upland sites and open forests in spring as non-native honeysuckle leafs out before natives. Begin control efforts in highest quality areas; hand pull or dig small plants, removing all roots; target large, fruit-bearing plants for control/removal; foliar spray may be effective for large populations where few natives are present; treat cut stumps with herbicide to prevent resprouting; basal bark treatment is also effective. Where fuel is present, multiple prescribed fires may provide effective control in fire adapted communities.

Photo: John M. Randall, TNC

Photo: Patrick Breen

Photo: Chris Evans

Tatarian Honeysuckle

Lonicera tatarica

Habit: Deciduous upright to spreading shrub growing to 4 m (12 ft) tall; shallow roots.

Leaves: Simple, opposite, oval to oblong, short, hairless, leaves with pointed tips; 3-6 cm (1-2.4 in) long and with smooth margins; dark green above and paler beneath; early leaf out, long growing season.

Stems/bark: Twigs are slender, brown to reddish with brown pith; multiple stems; numerous arching branches; older branches often hollow; bark is light gray, somewhat exfoliating.

Flowers: Small, pink to white, even red occasionally, tubular, fragrant, paired flowers on long (1.5-2.5 cm) stalks arising from the leaf axils; bloom May-June.

Fruits/seeds: Abundant, red or orange paired berries.

Habitat: Sun and shade tolerant; occurs in a variety of soil and moisture conditions; commonly found along roadsides and on disturbed sites; invades forest, savannas and prairies.

Reproduction: By seed; fruit dispersed by birds; root fragments may resprout.

Similar species: Native Canada honeysuckle (*L. canadensis*), American fly honeysuckle (*L. involucrata*), fly honeysuckle (*L. oblongifolia*) and swamp fly honeysuckle (*L. villosa*) are relatively short and sparse in comparison with non-native species and lack hollow stems on older branches. Dogwoods (*Cornus* spp.) have flowers and berries in clusters at branch tips, not in the leaf axils.

Comments: Native to Eurasia. Forms dense thickets; reduces tree and shrub regeneration, decreases overall plant diversity.

Monitoring & rapid response: Monitor sunny, upland sites and open forests in spring as non-native honeysuckle leafs out before natives. Begin control efforts in highest quality areas; hand pull or dig small plants, removing all roots; target large, fruit-bearing plants for control/removal; foliar spray may be effective for large populations where few natives are present; treat cut stumps with herbicide to prevent resprouting; basal bark treatment is also effective. Where fuel is present, multiple prescribed fires may provide effective control in fire adapted communities.

Photo: John M. Randall, TNC

Photo: Elizabeth Czarapata

Photo: Wisconsin DNR

Photo: Wisconsin DNR

Photo: John M. Randall

Photo: Chris Evans

Photo: Chris Evans

Common Buckthorn

Rhamnus cathartica

Habit: Deciduous, woody shrub to small tree ranging from 3-7.5 m (10-25 ft) in height and reaching 25 cm (10 in) in diameter.
Leaves: Simple, oval, dark green, smooth and shiny; small teeth along margins; veins that curve from base towards leaf tip; sub-opposite (not quite opposite) but may also appear opposite or alternate.
Stems/bark: One to several stems from the base; stems branch towards the crown; twigs often have thorns near the tips; bark is brown to gray, peeling with age, dotted with vertical light-colored lenticels; inner bark is orange.
Flowers: Small, green-yellow, four-petaled, clustered in leaf axils; dioecious; bloom May-June; fragrant.
Fruits/seeds: Round, pea-size, black berries (on female plants only); persistent through the winter.
Habitat: Found along roadsides, woodland edges, prairies, old fields; somewhat shade tolerant.
Reproduction: By prolific fruit and seed production, seeds widely dispersed by birds.
Similar species: Native alder-leaved buckthorn (*Rhamnus alnifolia*) is less than 1 m (3 ft) in height with dark scales on winter buds; non-native glossy buckthorn (*Rhamnus frangula*) has shiny entire leaves, always lacks terminal thorn.
Comments: Native to Eurasia. Produces a dense shade that suppresses growth of woody seedlings, and herbaceous groundcover, reduces overall plant diversity; changes nutrient cycling; had been widely recommended for conservation planting until invasive characteristics became apparent.
Monitoring & rapid response: Monitor woodland edges and paths. Buckthorn usually leafs out early and retains its leaves late into fall. Begin control efforts in highest quality areas; hand pull or dig seedlings or small plants; target large, fruit-bearing plants for control/removal; foliar spraying may be effective for large populations where there are few natives present; treat cut stumps with herbicide to prevent resprouting; basal bark treatment also effective. Where fuel is present, prescribed fire may provide effective control of seedlings in fire adapted communities.

Photo: John M. Randall, TNC

Photo: Leslie J. Mehrhoff, IPANE

Photo: John M. Randall, TNC

Photo: Suzan Campbell, MNFI

Photo: Leslie J. Mehrhoff

Glossy Buckthorn

Frangula alnus (Rhamnus frangula)

Habit: Deciduous shrub or small tree growing up to 6 m (20 ft) tall, multiple stems at the base, crown spreading, trunk up to 25 cm (10 in) in diameter.
Leaves: Simple, alternate, oblong, 2.5-6 cm (1-2.5 in) long, untoothed or crenulate margins, dark green, shiny; smooth or slightly hairy below; veins turn toward tip near leaf margins; leaves present from mid-May to November.
Stems/bark: Brown-green, hairy, prominent lenticels, chunky bark; terminal buds rust colored; bark gray or brown; sapwood yellow; heartwood pinkish to orange.
Flowers: Small, greenish yellow, five-petaled; perfect; clusters of 2-6; bloom late May through September.
Fruits/seeds: Round, pea-sized, drupes with 3-4 seeds, red, ripening to black/dark purple in July through September; abundant; remain viable in the soil for 2 to 3 years.
Habitat: Sun and shade tolerant; occurs in a variety of soil and moisture conditions, from wet to very dry; found in pastures, fence rows, roadsides, wetlands, and woodland edges.
Reproduction: Primarily sexual; plants mature quickly; at any given time there can be flowers, partially ripened fruit (red) and fully ripened fruit (black) on the same plant.
Similar species: Native alder-leaved buckthorn (*Rhamnus alnifolia*) is less than 1 m (3 ft) tall, hairless twigs. Dogwoods (*Cornus* spp.) have opposite leaves rather than alternate.
Comments: Native to Eurasia. Forms dense thickets; was recommended for wildlife planting until invasiveness became apparent.
Monitoring & rapid response: Monitor woodland and wetland edges, and paths; buckthorn usually leafs out early and retains its leaves late into fall. Begin control efforts in highest quality areas; hand pull seedlings or burn with propane torch where densities are high; target large, fruit-bearing plants for control/removal; treat cut stumps with herbicide to prevent resprouting; basal bark treatment is also effective. Where fuel is present, prescribed fire may provide some control of young seedlings in fire adapted communities. This species is difficult to control—research control options thoroughly.

Photo: John M. Randall, TNC

Photo: John M. Randall, TNC

Photo: Leslie J. Mehrhoff, IPANE

Photo: John M. Randall, TNC

Photo: James H. Miller

Photo: Wisconsin DNR

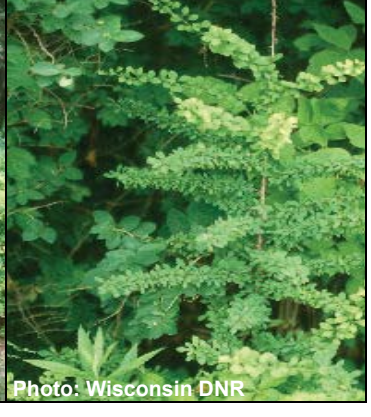
Photo: Wisconsin DNR

Japanese Barberry

Berberis thunbergii

Habit: Spiny, deciduous shrub, typically 0.5-1 m (2-3 ft) tall.
Leaves: Simple, alternate, oval to spoon shaped with smooth margins, 1.3-2 cm (0.5-0.75 in) long; bright green above, lighter below, in clusters at each node, red to purple in the fall depending on the cultivar.
Stems/bark: Numerous, spiny, slightly curving; older stems gray; twigs and young stems turning reddish brown in winter; inner bark yellow.
Flowers: Small, yellow, stalked; single or in small clusters of 2-4 blossoms; bloom April-May.
Fruits/seeds: Small, bright red, egg-shaped berries found singly or in clusters on slender stalks; mature in midsummer; remain on stems into winter; often dispersed by birds, deer, turkey and grouse. Some cultivars appear to produce little or no fruit.
Habitat: Found along woodland edges, open woods, roadsides, stream banks, old fields; tolerates a range of soil, moisture and light conditions; can establish under forest canopy.
Reproduction: By seed; creeping roots and cut stumps; branches root freely where they touch the ground.
Similar species: American barberry (*B. canadensis*), which is not native to Michigan, has toothed leaves and usually three pronged spines.
Comments: Native to Japan. Barberry is a common horticultural species and frequently escapes from cultivation; deer herbivory minimal. The non-native common barberry (*B. vulgaris*) is also invasive but was eradicated from large parts of its range, including Michigan, in the early twentieth century as it is a host to black stem grain rust.
Monitoring & rapid response: Monitor sunny open sites and edges in spring when barberry leafs out before native shrubs. Begin control efforts in highest quality areas; hand pull or dig young plants, removing all roots. Target mature shrubs that provide a source of seed; cutting effective when cut stumps are treated with herbicide; foliar herbicide treatment is effective in areas with few native plants. In fire-adapted communities, late spring burns with good fuel may kill seedlings.

Photo: Chris Evans

Photo: Ted Bodner

Photo: James H. Miller, USDA FS

Photo: James H. Miller

Photo: Wisconsin DNR

Photo: Steven J. Baskauf

Multiflora Rose

Rosa multiflora

Habit: Deciduous, dense, perennial shrub growing up to 5 m (16 ft) tall and 3-4 m (9-23 ft) wide, with long, slender, arching branches.
Leaves: Alternate, pinnately compound with 5-11 leaflets; leaflets 2.5 cm (1 in) long and finely toothed; base of leaf with a finely fringed stipule.
Stems/bark: Green-reddish, arching, with stout, recurved thorns.
Flowers: Numerous, white or slightly pink, five-petaled; up to 4 cm (1.5 in) wide; arranged in a panicle; bloom May-June.
Fruits/seeds: Fruits are small, clustered, hard, smooth, red rose hips that appear in September-October and last into winter; seeds yellowish and dispersed by birds and mammals, remain viable for 10 to 20 years.
Habitat: Found along roadsides, pastures, disturbed areas, forests and streambanks; tolerates a variety of soil conditions; prefers open, well-drained sites.
Reproduction: By seed; also by horizontal stems that root at the node and shoots that root at the tips.
Similar species: Native swamp rose (*Rosa palustris*) has broad-based recurved thorns but like all native roses, it has pink flowers and does not have fringed stipules.
Comments: Introduced from Japan and Korea in the 1800s; later promoted to control soil erosion, as a living fence and for wildlife food and cover until its invasive qualities became apparent; vulnerable to Japanese beetles and a number of other pests and diseases.
Monitoring & rapid response: Monitor paths, edges and open areas in late spring while flowering. Dig out small plants and remove all roots; cutting or mowing several times throughout the growing season for several years may reduce populations; treat cut stems with herbicide to prevent resprouting. Basal bark treatment effective—spray bottom 18 inches of all stems. Foliar herbicide treatment effective where few natives are present. In fire-adapted communities where good fuel is present, prescribed fire top kills well and facilitates follow-up with foliar herbicide treatment; repeated late spring fires reduce population if sufficient fuel is present.

Photo: Steven J. Baskauf, Bioimages

Photo: Steven J. Baskauf

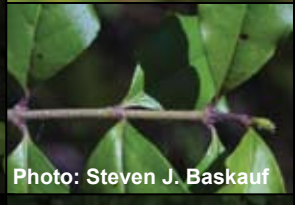
Photo: Steven J. Baskauf

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Photo: Steven J. Baskauf

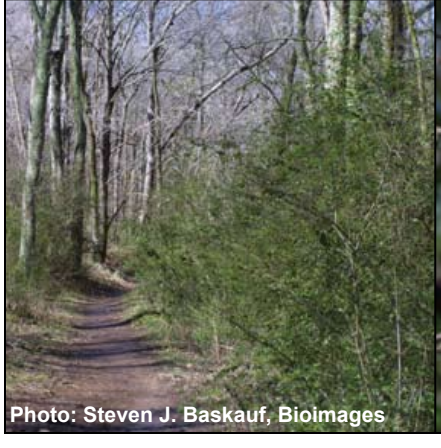


Photo: Steven J. Baskauf, Bioimages

Photo: Steven J. Baskauf

Privet

Ligustrum vulgare

Habit: Bushy, stout, shrub with unevenly spreading branches, ranging in height from 3.5-4.5 m (12-15 ft), with a comparable spread.
Leaves: Simple, opposite, elliptic to ovate, 3-7 cm (1.2-2.5 in) long, smooth margins, dark green above and paler beneath, turning purplish in fall; leaf out early, leaves retained until late fall/early winter.
Stems/bark: Young branches green, minutely puberulent, becoming smooth with age; thin, gray-brown bark with lenticels.
Flowers: Small, white; borne in terminal, branched cluster, 2.5-7.5 cm (1-3 in) long; strong odor; bloom mid-June.
Fruits/seeds: Fruits are small, lustrous, black, berry-like drupes that ripen in September and persist on the shrub through winter.
Habitat: Forests, and grasslands; can tolerate full sun to partial shade.
Reproduction: By seed; widely disseminated by birds; root fragments may resprout.
Similar species: Superficially resembles bush honeysuckles but leaves are smaller, flowers/fruit held at branch tip, not along its length.
Comments: Native to Europe, North Africa; planted widely as an ornamental historically but now less utilized; vulnerable to anthracnose twig blight.
Monitoring & rapid response: Monitor sunny, disturbed, upland grasslands and forest edges. Privet leafs out early in spring and retains its leaves late in fall. Hand pull or dig seedlings & small plants; remove all roots to prevent resprouting. Treat cut stumps with herbicide to prevent resprouting. Basal bark treatment is also effective. Foliar herbicide treatment may be effective for large populations where few natives are present.

Woody Vines

Photo: Suzan Campbell, MNFI

Photo: Chuck Bargeron

Photo: Steven J. Baskauf, Bioimages

Photo: Wendy VanDyk Evans

Photo: Suzan Campbell, MNFI

Photo: Suzan Campbell

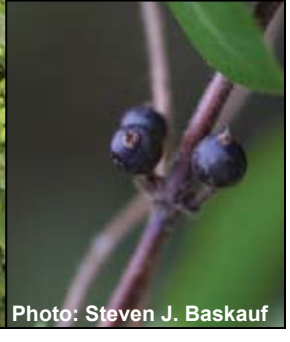


Photo: Steven J. Baskauf

Japanese Honeysuckle

Lonicera japonica

Habit: Perennial, woody vine that can reach up to 7 m (23 ft) in length and form a thick covering over trees, shrubs and ground-cover species.
Leaves: Simple, opposite, oval, young leaves often lobed, 4-8 cm (1.5-3 in) long; leaf base round/triangular; leaves are semi-evergreen to evergreen.
Stems/bark: Hairy, reddish/light brown, woody, hollow.
Flowers: White-cream-pink, paired, tubular flowers arising from leafs axils along stems, fade to yellow; bloom April-June; fragrant.
Fruits/seeds: Black to purple, glossy, paired fruit with 4-10 brown-black seeds.
Habitat: Found in open woods, old fields, disturbed areas, roadsides and fence rows; moderately shade tolerant but prefers full sun.
Reproduction: By seed and vegetatively by rhizomes.
Similar species: Native red honeysuckle (*L. dioica*), yellow honeysuckle (*L. flava*), hairy honeysuckle (*L. hirsuta*), and grape honeysuckle (*L. reticulata*) are similar but native honeysuckle vines have red-orange fruit and their terminal, opposite leaves unite at their bases.
Comments: Native to Japan. Competes aggressively below ground for nutrients and above ground for light; has been limited in past by cold winter temperatures but becoming more aggressive in southeastern Michigan; experiences much higher growth rates at higher CO_2 levels than native honeysuckles.
Monitoring & rapid response: Monitor open areas and woodland edges. Japanese honeysuckle retains some leaves over winter but is most visible in spring when it is in bloom. Cutting, pulling and burning Japanese honeysuckle may weaken it but will not eliminate it. Foliar herbicide treatment provides effective control. In fire adapted plant communities, late autumn or winter prescribed burns provide effective control when followed by foliar herbicide application about a month after resprouts emerge.

Kudzu

Pueraria lobata

Habit: Perennial, aggressive, semi-woody vine; forms dense mats covering trees and small buildings in southern states.
Leaves: Alternate, compound with 3 large leaflets; smooth leaf margins; may be hairy.
Stems/bark: Young stems hairy, becoming smooth, brown; older stems up to 7.5 cm (3 in) in diameter; upright vines develop bark and annual rings, and overwinter; more robust than prostrate vines on flat ground; may grow up to 18 m (60 ft) in one season.
Flowers: Reddish, purple, pea-like, grow on spikes in leaf axils up to 15 cm (6 in) long; bloom August-September, fragrant.
Fruits/seeds: Dark brown, dry, clustered, flat, legume seed pods, up to 8 cm (3 in) long, covered with stiff golden-brown, spreading hairs, each pod with up to 9 seeds.
Habitat: Grows in full sun on a variety of soils; prefers deep loam.
Reproduction: By seed; root expansion and fragmentation; roots develop from nodes, forming root crowns every 1-2 square feet.
Similar species: Hog-peanut (*Amphicarpaea bracteata*) has similar leaves, pale pink flowers in clusters, not spikes; poison ivy (*Toxicodendron radicans*) has lobed leaflets, lacks showy flowers, and has white berries, rather than flat seed pods.
Comments: Native to Asia. Fixes nitrogen; not aggressive in Michigan to date—may become a greater risk as climate warms.
Monitoring & rapid response: Monitor open disturbed areas and forest edges. Hand pull young plants, removing entire root crown; remove all plant material from site and place in landfill or incinerate. Mowing, grazing or tilling throughout growing season depletes root storage, weakens plant; most effective in conjunction with herbicide. Older infestations require higher herbicide concentrations; treat cut stems with herbicide; basal bark treatment effective; foliar herbicide treatment also effective. Kudzu is fire resistant.

Photo: Suzan Campbell, MNFI

Photo: James H. Miller

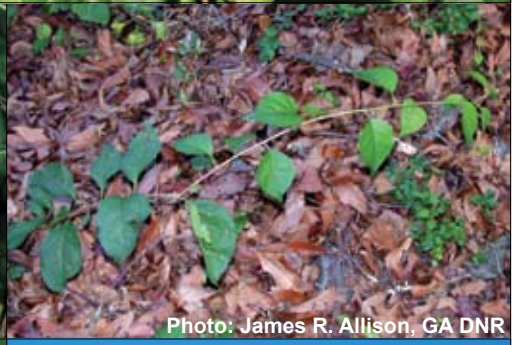


Photo: James R. Allison, GA DNR

Photo: James H. Miller

Photo: John M. Randall, TNC

Oriental Bittersweet

Celastrus orbiculatus

Habit: Deciduous, woody, twining vine.
Leaves: Simple, alternate, rounded, finely toothed, glossy; leaf tips acute or acuminate; 5-13 cm (2-5 in) long; turn yellow in fall.
Stems/bark: Light brown, often with noticeable lenticels; solid white pith; can climb 18 m (60 ft) high in trees and reach 10 cm (4 in) in diameter.
Flowers: Small; greenish yellow; five-petaled; clustered in leaf axils; bloom in May-June.
Fruits/seeds: Outer skin (green in summer and yellow orange in fall) covers a red, fleshy aril, which contains 3-6 seeds; fruits clustered in leaf axils; colorful fruit may persist through the winter.
Habitat: Found in grasslands, open woods, woodland edges, undisturbed forests, roadsides and fence rows; extremely shade-tolerant.
Reproduction: By prolific seed production and spreading underground roots that form new stems.
Similar species: Native American or climbing bittersweet (*Celastrus scandens*) has elliptical rather than rounded leaves; flowers and fruits terminal rather than axillary; greenbriar (*Smilax* spp.) leaves are entire, not toothed and have parallel leaf veins.
Comments: Native to Asia. Oriental bittersweet hybridizes with American bittersweet, making it a genetic threat to the native species; reduce photosynthesis of the plants that they cover and girdle trees; the native bittersweet cannot be cut or transported without a bill of sale or proof of ownership under Michigan law.
Monitoring & rapid response: Monitor open woods and edge habitats in late fall when most native plants have dropped their leaves. Oriental Bittersweet has bright yellow leaves and female plants have persistent showy fruit in leaf axils. Begin control efforts in highest quality areas; cut plants, allow them to resprout and then spray with herbicide. Initiate control efforts before burning or opening up forest canopy as both may stimulate seed bank. In fire adapted communities, prescribed fire may top-kill vines, facilitating foliar herbicide spraying on new growth. Monitor and re-treat as needed. This species is difficult to control—research control options thoroughly.

Herbaceous Plants

Photo: Steve Dewey

Photo: Joseph M. DiTomaso

Photo: Sue DeVries

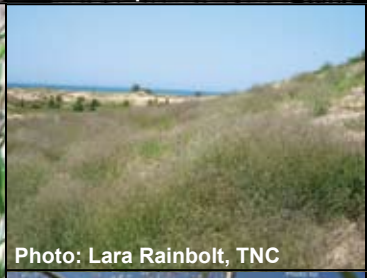


Photo: Lara Rainbolt, TNC

Photo: Richard Old

Photo: Steve Dewey UGA1459018

Baby's Breath

Gypsophila paniculata

Habit: Perennial, finely branched, bushy; 0.4-1 m (15-39 in) tall.
Leaves: Lance-like, with sharply pointed tips; opposite; 2-7 cm (1-4 in) long and 0.25-1 cm (0.2-0.4 in) wide; smaller at top of the stems.
Stems: Smooth and glaucous or somewhat rough near base.
Flowers: Tiny; white or pale reddish, five petals; 0.4-0.8 cm (0.15-0.3 in) across; located at branch tips; abundant; fragrant; bloom in July and August.
Fruits/seeds: Fruit a rounded capsule; up to 14,000 seeds per plant.
Habitat: Occurs on disturbed sites, particularly in dunes, prairies and barrens; prefers sunny, slightly alkaline sands.
Reproduction: Primarily by seed; plant breaks off and rolls in wind, dispersing seed widely.
Similar species: Similar to native flowering spurge (*Euphorbia corollata*) but lacks milky sap.
Comments: Native to Europe and commonly cultivated for cut and dried floral arrangements; often included in "wildflower" seed mixes.
Monitoring & rapid response: Monitor dunes and other sandy areas including roadsides and railroad tracks. Baby's breath can be controlled by cutting the taproot as far under ground as possible—below the point where the stem meets the root (10 cm deep). If severed above this point, the taproot may resprout. Dispose of cut plants by burning. Spot burning plants with a propane torch also provides effective control—torch until wilting occurs; mature plants will need re-treatment later in the season or in following year.

Photo: Steven J. Baskauf, Bioimages

Photo: Steven J. Baskauf

Photo: Tom Heutte, USDA FS

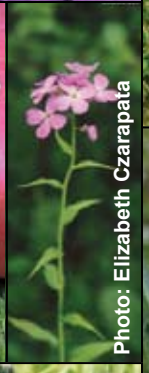


Photo: Elizabeth Czarapata

Photo: E. Czarapata

Photo: Steven J. Baskauf

Photo: Elizabeth Czarapata

Photo: Steven J. Baskauf

Dame's Rocket

Hesperis matronalis

Habit: Showy, biennial or short-lived perennial; ranging between 0.6-1.0 m (2-3 ft) in height; first year plants over-winter as an evergreen basal rosette.
Leaves: Simple, alternate, lanceolate or ovate-lanceolate, toothed margins; downy, with simple hairs above, branched hairs below; leaves become smaller as they ascend the stem.
Stems: Upright, branched, with rough spreading hairs.
Flowers: White, pink, or purple; four-petaled; borne in terminal clusters; bloom from mid-May through July; fragrant, clove-like aroma in evening.
Fruits/seeds: Seeds are rounded, dark reddish-brown; held in long, erect pods or siliques, up to 12 cm (4.75 in) in length; ripen from June through August.
Habitat: Prefers moist, well-drained loams; tolerates light shade but prefers full sun; tolerates high alkalinity; establishes along roadsides, woodlands, wetlands, old fields and open areas.
Reproduction: By abundant seed production; a single plant produces up to 20,000 seeds.
Similar species: Native phlox (*Phlox divaricata*) has five petals, rather than four.
Comments: Native to Europe. Introduced in wildflower mixes; in some areas, has been present at low levels for many years but is now spreading aggressively on many sites.
Monitoring & rapid response: Monitor roadsides and paths. Dame's rocket is easiest to identify while in bloom during June and July. Hand-pull plants while the soil is moist. Flower and seed heads must be burned or placed in a landfill to prevent seed development. Foliar herbicide treatment is effective in early spring or late fall while native species are dormant. Control efforts should continue for several years until the seed bank is exhausted.

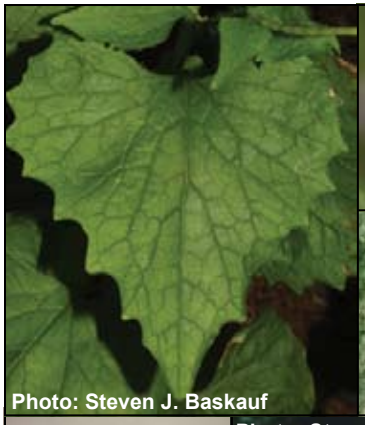


Photo: Steven J. Baskauf

Photo: Chris Evans

Photo: Wisconsin DNR

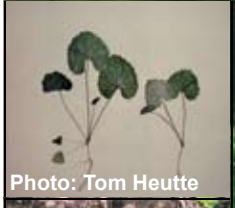


Photo: Tom Heutte

Photo: Steve Dewey

Photo: Chris Evans

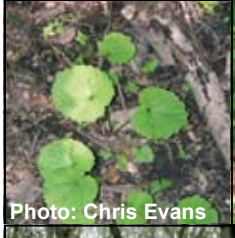


Photo: Chris Evans

Photo: Victoria Nuzzo

Photo: Chris Evans

Garlic Mustard

Alliaria petiolata

Habit: Upright, herbaceous biennial growing up to 1 m (3 ft) tall.
Leaves: Simple, alternate, triangular, toothed; lower leaves rounded with cordate bases and palmate venation, up to 12 cm (4.75 in) long, scalloped edges, arranged in a basal rosette; upper leaves stalked.
Stems: Up to about 1 m (3 ft); typically one flowering stem per rosette but may be more.
Flowers: Numerous, small, white, four-petaled; usually in clusters at tops of stalks or in leaf axils; bloom late April-early June.
Fruits/seeds: Small, dark brown/black; in long narrow capsules; one plant can produce up to 3,000 seeds; seeds viable within a few days of flowering and remain viable for many years.
Habitat: Found in upland and floodplain forests, savannas, along trails, roadsides and disturbed areas; shade tolerant but also found in full sun; spreads rapidly.
Reproduction: By seed; preferentially outcrosses but may self; produces basal rosette the first year, flowers the second year.
Similar species: Basal leaves resemble those of ragworts (*Senecio* spp.), violets (*Viola* spp.) and kidney-leaved buttercups (*Ranunculus* spp.); fruiting structures similar to other mustards; can be distinguished by garlic odor when crushed.
Comments: Native to Eurasia. Dominates the ground layer of forests to the exclusion of almost all other herbaceous species; destroys mycorrhizal fungi needed by woody plants for regeneration.
Monitoring & rapid response: Monitor forest edges, paths and floodplains. Begin control efforts in highest quality areas; pull seedlings when there only a few—otherwise, focus on second year plants. Pull plants before seed is produced. Remove upper half of root or it may resprout. Tamp soil thoroughly to minimize recolonization and germination. Flower and seed heads must be burned or placed in a landfill to prevent seed development. Herbicide can be used in early spring and fall, while native plants are dormant. Continue control efforts until the seed bank is depleted. This species is difficult to control—research control options thoroughly.

Photo: PA Dept. of Ag

Photo: Terry English, USDA APHIS PPQ

Photo: USDA APHIS PPQ

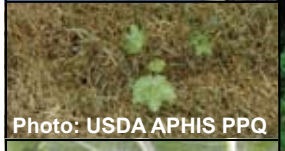


Photo: USDA APHIS PPQ

Photo: PA Dept. of Ag

Photo: Terry English, USDA APHIS PPQ

Photo: Steve Antunes-Kenyon

Photo: Steve Antunes-Kenyon

Giant Hogweed

Heracleum mantegazzianum

Habit: Extremely tall 2.5-6 m, (8-20 ft) biennial or short-lived perennial with a deep 40-65 cm, (16-26 in) taproot.
Leaves: Alternate; large, reaching up to 3 m (9 ft) in length; deeply divided and dissected leaves; hairy beneath, leaf stalk enlarged and surrounding the stem; upper leaves gradually becoming smaller.
Stems: Thick, 5-10 cm (2-4 in) in diameter; hollow, purple-mottled; with coarse white hairs.
Flowers: Small, white flowers clustered into large umbels at the top of each stem; bloom June-July; typically bloom once and then die (robust biennial or monocarpic perennial).
Fruits/seeds: Seeds in flat, dry, oval pods; one plant can produce up to 100,000 seeds.
Habitat: Prefers open, moderately moist, cool sites but can be found in a range of habitats.
Reproduction: By seed.
Similar species: Cow parsnip (*Heracleum lanatum*) is smaller reaching only 2.75 m (9 ft) in height. It has dense fine white hairs under leaves and lacks purple mottling on stem; angelicas (*Angelica* spp.) may have purplish stems but lack mottling.
Comments: Native to Asia. This species has been listed as a noxious weed under federal law and is also prohibited under Michigan law.
Monitoring & rapid response: Monitor riparian sites and disturbed edge habitat in partial shade. Sap causes increased photosensitivity; may cause severe burns, blistering, dermatitis, dark scars, and even blindness; protect skin; mowing stimulates budding from the rootstalk; plants may be dug out—remove entire root as it may resprout. Research herbicide options as not all are effective.

Photo: Wisconsin DNR

Photo: Tom Heutte, USDA FS

Photo: Leslie J. Mehrhoff

Photo: Wisconsin DNR

Photo: Tom Heutte, USDA FS

Photo: Barbara Tokarska-Guzik, University of Silesia

Giant Knotweed

Polygonum sachalinense

Habit: Perennial, herbaceous shrub up to 4 m (12 ft); larger than many woody shrubs but stems die back to the ground each year.
Leaves: Simple, alternate, large, from 15-30 cm (6-12 in) long and two thirds as wide with a shallow, heart-shaped base.
Stems: Upright, round, hollow with swollen nodes; resemble bamboo shoots.
Flowers: Sparse, white or greenish flowers on a slender stalk; arise from the leaf axils and stem tips; bloom August-September.
Fruits/seeds: Fruits are three winged, seeds are dark and glossy; wind and water dispersed.
Habitat: Native to Asia, now found along roadsides, stream and river banks, wetlands, wet depressions and woodland edges; shade intolerant; can tolerate a wide array of soil and moisture conditions.
Reproduction: Spreads extensively through rhizomes and root or stem fragments; can provide pollen to related species to produce viable hybrid seed.
Similar species: Non-native Japanese knotweed (*P. cuspidatum*) is shorter (up to 10 ft tall) and its leaves are smaller (< 6 in long) with a flat base, rather than rounded basal lobes.
Comments: Native to Asia. Hybridizes with Japanese knotweed and silver lace vine (*P. baldschuanicum*).
Monitoring & rapid response: Monitor sunny open sites along paths, ditches and canals in August and September while it is in bloom. This species is difficult to control—research control options thoroughly, particularly for mechanical control methods. On riparian sites, consider upstream and downstream populations and herbicide impacts. Multiple control strategies may be needed for a single population. Resprouts vigorously after cutting, mowing, tilling and digging. Tiny fragments of roots and stem nodes can sprout and form new colonies—remove all cut plant materials and incinerate or place in landfill. Repeated foliar herbicide application may provide effective control. Cutting early in the season and then spraying later preferable as plants will still be short enough to spray with minimal non-target impact. Wicking or injecting herbicide may be suitable for ecologically sensitive sites but it is labor intensive. Follow-up required for years.

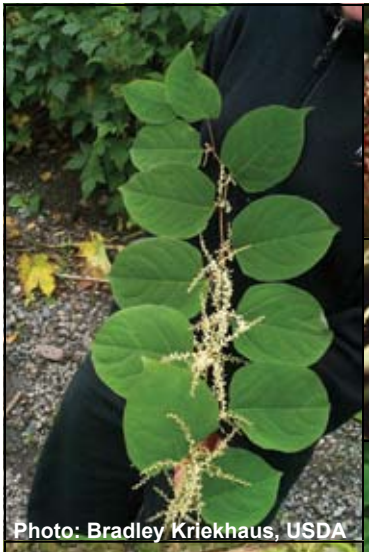


Photo: Bradley Kriekhaus, USDA

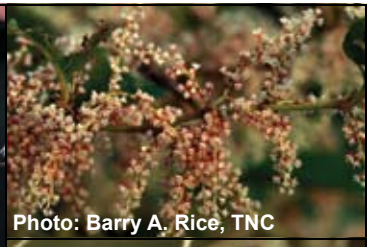


Photo: Barry A. Rice, TNC

Photo: Jil M. Swearingen, NPS

Photo: Britt Slattery, USFWS

Photo: JMandy Tu, TNC

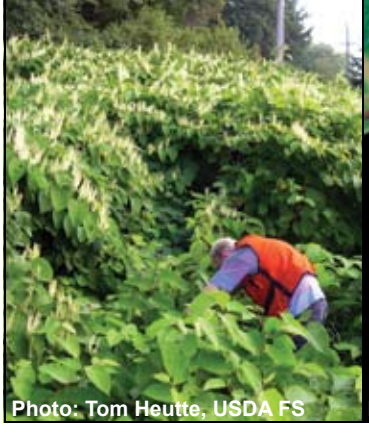


Photo: Tom Heutte, USDA FS

Photo: Barry A. Rice, TNC

Japanese Knotweed

Polygonum cuspidatum (Fallopia japonica)

Habit: Perennial, herbaceous shrub reaching 3 m (10 ft); larger than many woody shrubs, stems die but stalks persist through winter.
Leaves: Simple, alternate, broad, up to 15 cm (6 in) long and 12 cm (5 in) wide with an abruptly pointed tip and a flat base.
Stems: Upright, round, hollow, glaucous, often mottled; nodes with a papery membrane; persistent dead stalks resemble bamboo.
Flowers: Numerous, small, green-white flowers on a slender stalk in leaf axils and near the ends of stems; bloom August-September.
Fruits/seeds: Fruits are three-winged, seeds are dark and glossy; wind and water dispersed.
Habitat: Semi-shade tolerant; found along roadsides, stream and river banks, wetlands, wet depressions and woodland edges; can tolerate a wide array of soil and moisture conditions.
Reproduction: Primarily through rhizomes or fragments; some U.S. populations produce abundant fertile seed; forms fertile hybrids with giant knotweed (*P. sachalinense*).
Similar species: Non-native giant knotweed (*P. sachalinense*) has much larger leaves (> 6 in long) with rounded, heart-shaped bases.
Comments: Native to Japan. This species is prohibited under Michigan law. It forms dense thickets that shade out natives; rhizomes can damage pavement; spread by flood waters.
Monitoring & rapid response: Monitor riverbanks, stream and pond edges, particularly downstream from known occurrences; most conspicuous in late summer while in bloom. This species is difficult to control—research control options thoroughly. On riparian sites, consider upstream and downstream populations and herbicide impacts. Multiple control strategies may be needed for a single population; resprouts vigorously after cutting, mowing, tilling and digging; tiny fragments of roots and stem nodes can sprout and form new colonies—remove all cut plant materials and incinerate or place in landfill. Repeated foliar herbicide application may provide effective control. Cutting early in the season and then spraying later preferable as plants will still be short enough to spray with minimal non-target impact. Wicking or injecting herbicide may be suitable for ecologically sensitive sites but it is labor intensive. Follow-up required for years.

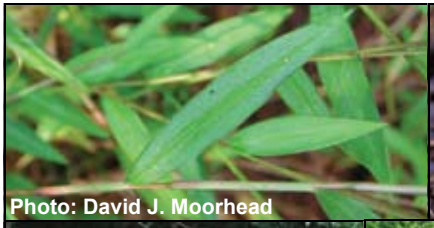


Photo: David J. Moorhead

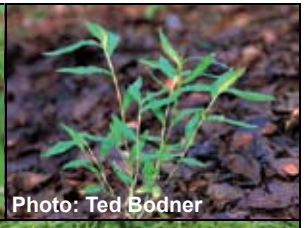


Photo: Ted Bodner

Photo: Chris Evans

Photo: Chris Evans

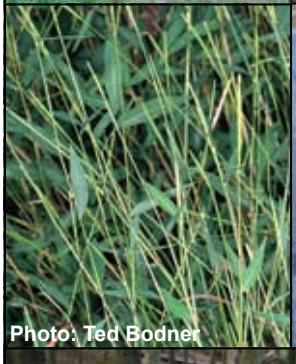


Photo: Ted Bodner

Photo: Nancy Loewenstein

Photo: Jil M. Swearingen, NPS

Photo: Nancy Loewenstein

UGA1378046

Japanese Stilt Grass

Microstegium vimineum

Habit: Annual grass growing up to 1 m (3 ft) tall; roots at the nodes, giving rise to reclining stems up to 1.6 m (5 ft) long, with upright branches at intervals; fibrous roots.

Leaves: Alternate, lance-shaped, thin, 5.0-7.5 cm (2-3 in) long and up to 1.5 cm (0.6 in) wide, slightly hairy on both surfaces with a line of silver hairs down the center on the upper surface; tapers at both ends, pale green turning slightly purplish in the fall.

Stems: Smooth nodes, stems more or less reclining, up to 1.6 m (5 ft) long.

Flowers: Inflorescences spikelike, terminal or arising from leaf axils; paired flowers with one sessile and one stalked flower; spikelets hairy; blooms mid-September.

Fruits/seeds: Seed is a yellowish-red, oval grain ripening in September-October; produces seed in deep shade; one plant can produce up to 1,000 seeds per plant, seeds viable for 3-5 years.

Habitat: Extremely shade tolerant; found in both moist areas including floodplain forest, wet meadow, streambanks and ditches as well as drier sites such as ridgetops, blowdowns, clearcuts, disturbed areas and roadsides.

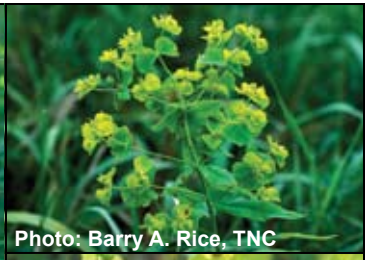
Reproduction: By seed and rooting nodes along the stem; seed frequently dispersed by deer, ATVs and hikers.

Similar species: Native white grass (*Leersia virginica*) has hairy stem nodes, while the nodes on stilt grass are not hairy; also, whitegrass has scaly, not fibrous roots. Deer-tongue grass (*Dichanthelium clandestinum*) leaves have short stiff hairs all over.

Comments: Native to southeast Asia. Unlike many exotic grasses, stiltgrass is a warm season grass and produces seed late in the season. This species is not yet recorded in Michigan.

Monitoring & rapid response: Monitor roadsides and trail edges, also along ditches and streams as seed may be dispersed by water. Hand pull new infestations but soil disturbance can increase germination where abundant seed is present. Mow in fall during flowering but before seed set. Timing is critical, as mowing too early can encourage regrowth and early flowering. Many herbicides do not kill this species—review options thoroughly before treatment. Follow-up required until seed bank is exhausted.

Photo: Barry A. Rice, TNC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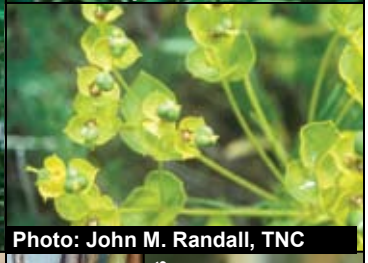


Photo: John M. Randall, TNC

Photo: Norman E. Rees, USDA

Photo: USDA ARS

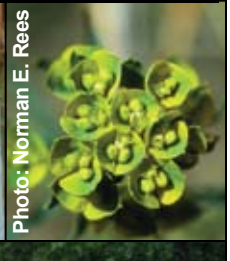


Photo: Norman E. Rees

Photo: John M. Randall, TNC

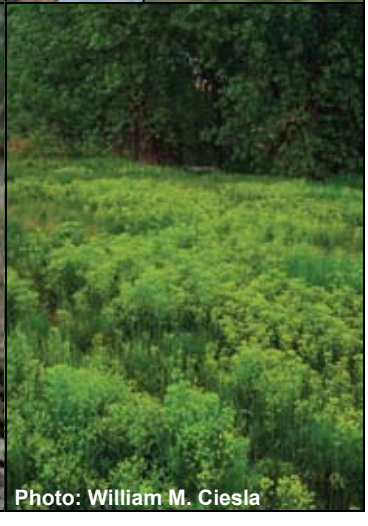


Photo: William M. Ciesla

Leafy Spurge

Euphorbia esula

Habit: Herbaceous perennial ranging in height from 15-92 cm (6-36 in); root system can extend up to 6 m (~20 ft), with lateral roots near the surface.
Leaves: Simple, alternate, long, narrow, bluish green; usually pointed and drooping with smooth margins; exude white milky sap when crushed.
Stems: Upright stems that branch towards the top of the plant; dry stems may persist into the winter and following summer; stems also release white, milky sap when broken.
Flowers: Small, yellowish-green flowers with fused petals forming a cuplike structure; bloom mid-June to late-July.
Fruits/seeds: Smooth, oblong, gray-brown seeds in explosive capsules; one plant can produce up to 200 seeds; high germination rate; viable up to 8 years with adequate moisture.
Habitat: Roadsides, prairies, savannas, gravel pits, open areas.
Reproduction: By seed; also spreads rapidly through its persistent root system from crown and root buds that over-winter under the soil surface.
Similar species: Flowering spurge (*Euphorbia corollata*) has white flowers and erect leaves; invasive non-native Cypress spurge (*Euphorbia cyparissias*) has stem leaf blades less than 2.5 mm wide.
Comments: Native to Eurasia. This species is listed as a prohibited noxious weed by the Michigan Department of Agriculture; deep taproot, up to 4.5 m (15 ft) deep; tough, woody extensive root system may extend up to 10 m (33 ft); large root reserves allow plant to recover from most disturbances.
Monitoring & rapid response: Monitor open sites and woodland edges—early detection is critical. Leafs out early in spring; bright yellow-green bracts appear in late May or early June. Seedlings develop buds w/in 7-10 days of emergence. Long shoots spread laterally—pulling, digging, burning and tilling may cause them to increase. Foliar herbicide treatment provides effective control of small infestations. Surveillance and control efforts needed for 5-10 years.

Photo: Jose Hernandez

Photo: Ken Hyde, NPS

Photo: Ken Hyde, NPS

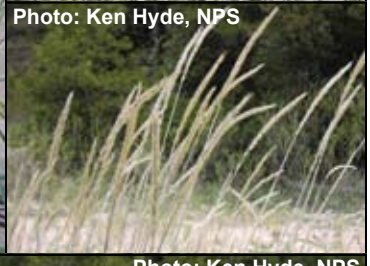


Photo: Ken Hyde, NPS

Photo: Ken Hyde, NPS

Lyme-grass

Leymus arenarius

Habit: Perennial grass; stout, erect; growing from creeping rhizomes or in tufts; 0.5-1.5 m (1.5-5 ft) tall.
Leaves: Blue-glaucous; 6-15 mm wide; sheaths crowded at base, ligule barely 1 mm long.
Stems: Blue-glaucous, hairless or nearly so at the summit.
Flowers: Arranged in a spike; 4-6 flowered spikelets usually paired at the nodes on spike.
Fruits/seeds: arranged in a spike; 1.5-2.5 cm (0.5-1 in) thick.
Habitat: Native to Europe; introduced locally around the Great Lakes; thrives on calcium-rich sands; shade-intolerant; drought-tolerant; invasive on beaches and dunes.
Reproduction: Primarily vegetative, spreading via its creeping rhizomes; may also reproduce by seed.
Similar species: Native thick-spike wheat grass (*Agropyron dasystachyum*) is also blue-green but its spikes are only 5-10 mm thick; beach grass (*Ammophila breviligulata*) is green rather than bluish; reed grass (*Calamovilfa longifolia*) has an open panicle rather than a spike; American dunegrass (*Leymus mollis*), a species of Special Concern, is greener and finely hairy under the spike, while Lyme-grass is bluer and its stems are hairless almost to the top. A dichotomous key or consultation with an expert should be used to distinguish between these species as several are rare.
Comments: Native to Europe. The species appears to be spreading as Lake Michigan water levels drop over time; it invades beaches, dunes and other sites with sandy soils; stabilizes dunes, eliminating the shifting sands that are home to rare species such as Pitcher's thistle (*Cirsium pitcheri*).
Monitoring & rapid response: Monitor beaches and dunes adjacent to sites where this species has been used for landscaping. Lyme-grass can sprout from rhizomes and root fragments—mechanical removal is not recommended; may be treated with herbicide in spring while native species are dormant; follow-up needed to ensure that all plants have been killed.

Photo: USDA APHIS Archives

Photo: John M. Randall, TNC

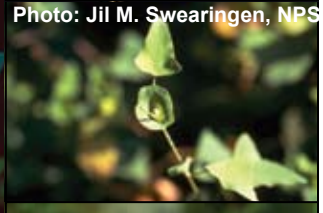


Photo: Jil M. Swearingen, NPS

Photo: Jil M. Swearingen, NPS

Photo: John M. Randall, TNC

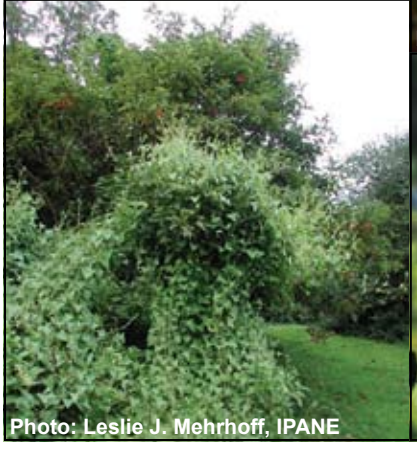


Photo: Leslie J. Mehrhoff, IPANE

Photo: Leslie J. Mehrhoff

Mile-a-minute Weed

Polygonum perfoliatum

Habit: Herbaceous annual, fast-growing, trailing vine; covers and eventually kills its host vegetation; variable height.
Leaves: Simple, alternate, triangular, light green-blue, barbs on the underside.
Stems: Reddish, narrow, covered with barbs that attach to other plants; stems with circular, cup-shaped, leafy appendages (ocreas) that surround the stem; stems up to 7 m (23 ft) long.
Flowers: Small, inconspicuous, white, closed, emerge from ocreas along the stem; bloom in June.
Fruits/seeds: Pea-sized, clumped berries; metallic, greenish-white, turning dark blue in fall.
Habitat: Relatively shade intolerant; found on moist sites in open disturbed areas, woodland edges, wetlands, stream banks.
Reproduction: Mainly through self-pollinated seed production.
Similar species: Mile-a-minute weed may resemble native tear-thumb (*Polygonum arifolium, P. sagittatum*) but its leafy, expanded ocreas and pea-sized blue fruits are distinctive.
Comments: Native to East Asia, introduced in the 1930s.
Monitoring & rapid response: Monitor roadsides, thickets, streambanks, meadows, woodland edges, clearcuts and utility right-of-ways—most easily recognized in late March and early April as it germinates early in the season. For small infestations, hand-pulling, mowing and cultivating may provide effective control by preventing flowering and seed production; remove and dry vines before disposal; wear heavy gloves; foliar herbicide application provides effective control. As the leaves have a waxy coating, a surfactant will help the herbicide adhere.

Photo: Leslie J. Mehrhoff

Photo: Leslie J. Mehrhoff, IPANE

Photo: Leslie J. Mehrhoff

Photo: Leslie J. Mehrhoff, IPANE

Photo: Leslie J. Mehrhoff

Photo: Dave Mindell

Narrow-leaved Bitter-cress

Cardamine impatiens

Habit: Herbaceous annual or biennial with spreading leaves; grows up to 60 cm (2 ft) tall.
Leaves: Pinnately divided with numerous (6-20), sharply toothed leaflets, with membrane-like, narrow, pointed auricles at the leaf base (see circled structure in photo); basal leaves are arranged in a rosette and pinnately divided; 3-11 leaflets with rounded lobes.
Stems: Erect, glabrous.
Flowers: Small, white, up to 2.5 mm (0.1 in.) long; petals lacking or shorter than the sepals, bloom May to August.
Fruits/seeds: Slender seedpods (siliques), 1.5-2 cm (0.6-0.8 in.) long; 10-24 seeds that are expelled from the pods as they ripen; they also stick to fur or clothing; ripen from May to September.
Habitat: Established in southern Michigan; found on banks, along thicket margins, shady woods and on moist limestone rocks and cliffs.
Reproduction: By seeds that are expelled from siliques.
Similar species: Native sand bitter-cress (*C. parviflora*), Pennsylvania bitter-cress (*C. pensylvanica*), tansy-mustard (*Descurainia pinnata*) and common yellow-cress (*Rorippa palustris*) lack narrow-leaved bittercress' characteristic narrow, pointed appendage at the leaf base.
Comments: Native to Europe. Easily dispersed due to its seed shooting ability; can form dense stands, outcompeting native species.
Monitoring & rapid response: Monitor moist forested sites in spring and summer—can be identified by the pointed auricle at the base of the leaf (see photo). Hand pull and remove all plants before seed dispersal.

Photo: Becky Schillo

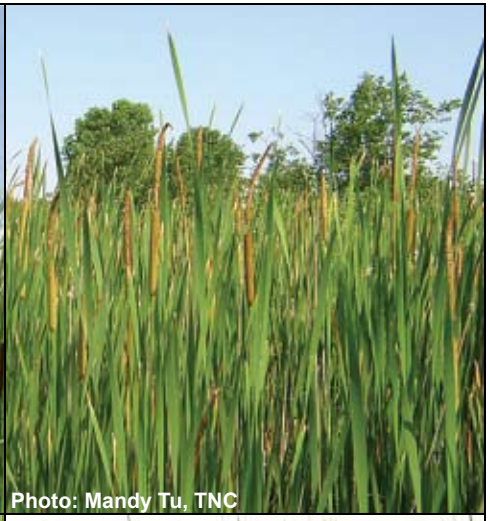


Photo: Mandy Tu, TNC

Photo: Mandy Tu, TNC

Photo: Mandy Tu, TNC

Narrow-leaved Cat-tail

Typha angustifolia

Habit: Aquatic, emergent perennial; 1.5-3 m (5-10 ft) tall.
Leaves: Upright, flat; up to 1 m (3 ft) long and 0.6-1.25 cm (0.25-0.5 in) wide with parallel veins; dark green.
Stems: Upright, 1-2 m (3-6 ft) long.
Flowers: Borne in terminal spikes; female flowers are dark brown, densely arranged, and located beneath the lighter male flowers; male and female sections separated by a 2-10 cm (1.75-4 in) gap (see circled gap in photo).
Fruits/seeds: Numerous, tiny, wind-dispersed seeds; up to 250,000 seeds/plant; viable in the seed bank for up to 100 years.
Habitat: Found in wetlands, ditches, stream and lake shores and wet depressions; tolerates high levels of silt, nutrients and salt.
Reproduction: By seed with establishment on bare soil and vegetatively by thick spreading rhizomes; also by fragmentation.
Similar species: Common cat-tail (*Typha latifolia*) does not have a gap between male and female sections of the spike, leaves are wider; narrow-leaved cat-tail hybridizes with the native cat-tail to produce *Typha* x*glauca*, which usually also has a gap between the male and female portions of the spike although gap size and leaf width are variable.
Comments: Native to Eurasia. The hybrid reproduces vegetatively and tolerates a greater range of conditions than either parent; cattail-dominated habitat in the Midwest has increased dramatically over the past few decades as *T. angustifolia* and *T.* x*glauca* have spread.
Monitoring & rapid response: Eliminating narrow-leaved cat-tail is impractical but all cat-tail species may become invasive and may be controlled. Aerial photos are useful in assessment. Where water level manipulation is possible, cut or burn stems just before flowering to cut off oxygen to roots and flood to at least 1 m (3 ft); higher water levels encourage muskrats; foliar herbicide also effective, particularly when followed by cutting and flooding; prescribed fire ineffective without herbicide or flooding.

Permits are usually required for herbicide use in water bodies and wetlands. For information see MDEQ's Aquatic Nuisance Control website at:

www.michigan.gov/deqinlandlakes

Photo: Linda Wilson

Photo: Steven J. Baskauf

Photo: Steven J. Baskauf

Photo: Elizabeth Czarapata

Photo: Linda Wilson

Photo: Linda Wilson

Photo: Barry A. Rice, TNC

Photo: Carol Bell Randall

Photo: John D. Byrd

Purple Loosestrife

Lythrum salicaria

Habit: Herbaceous, perennial, 0.5 to 2.0 m (1.5-6 ft) tall, densely pubescent, especially the upper part of the plant, pubescence variable; strongly developed taproot becomes woody with age.
Leaves: Lanceolate to almost linear, opposite or whorled; sessile to somewhat clasping; 3-10 cm (1-4 in); larger leaves at the base.
Stems: Four-angled; glabrous to pubescent.
Flowers: Numerous, purple (also white or light pink) with 5-7 petals; terminal spike-like inflorescences in axillary clusters of two to several; bloom July to October.
Fruits/seeds: Capsule with small seeds; prolific seed production.
Habitat: Shade intolerant but can tolerate up to 50% shade; found in disturbed wet areas; tolerates a wide range of soil types but prefers organic soils.
Reproduction: By seed; or vegetatively by resprouting from cut stems and regenerating from pieces of root stock.
Similar species: Native winged loosestrife (*Lythrum alatum*) has solitary flowers borne in axils of small bracts; fireweed (*Epilobium angustifolium*) has 4-petaled flowers and leaves taper at base.
Comments: Native to Eurasia. This species is restricted under Michigan law; attractive but persistent weed; spreads vigorously in moist soil conditions; crowds out native wetland plant species.
Monitoring & rapid response: Monitor wetlands, lakes, stream banks, and ditches in July and August when plants are in bloom. Hand pull seedlings; remove all flower and seed heads. Foliar herbicide treatment after peak bloom (late August) provides effective control but may damage non-target plants. *Galerucella* beetles (*G. calmariensis, G.. pusilla*) provide effective biocontrol although the beetle colonies may die out on smaller loosestrife populations. See Online Resources section in the back of this field guide for information on the beetles.

Permits are usually required for herbicide use in water bodies and wetlands. For information see MDEQ's Aquatic Nuisance Control website at:

www.michigan.gov/deqinlandlakes

Photo: Elizabeth Czarapata

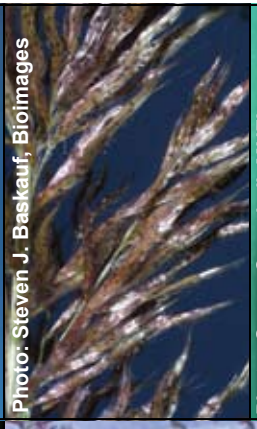


Photo: Steven J. Baskauf, Bioimages

Photo: Suzan Campbell, MNFI

Photo: Steven J. Baskauf, Bioimages

Photo: Leslie J. Mehrhoff, IPANE

Photo: John M. Randall, TNC

Eurasian Phragmites

Phragmites australis subsp. *australis*

Habit: Stout, warm-season perennial grass ranging in height from 1.8-3.9 m (6-13 ft); forms dense stands, in contrast with the native subspecies which occurs in a colony of scattered stems.
Leaves: Flat, smooth leaf blades; 25-50 cm (10-20 in) long, 1-3.5 cm (0.4-1.4 in) wide; hairy ligules; leaf sheaths stay attached after the stem senesces, in contrast with those of the native subspecies, which fall off easily.
Stems: Stems upright, rigid and hollow; dull yellowish; usually covered by the leaf sheath; the lower stems of the native subspecies are usually exposed, shiny and often reddish.
Flowers: Dense branched clusters on bearded axis at the end of each stem; becoming open and feathery at maturity.
Fruits/seeds: Seeds with white hairs below that are almost as long as the seed; prolific seeder.
Habitat: Found in wetlands, ditches, swales, stream and pond banks; tolerates road salt; responds rapidly to nutrient inputs.
Reproduction: Contrary to earlier beliefs, spreads easily and extensively by seed; also by an extensive, aggressive system of horizontal and vertical rhizomes that can live for 3-6 years.
Similar species: *Phragmites* is distinctive and much taller than most other grasses, particularly the non-native subspecies. Wild rice (*Zizania aquatica*), though quite tall, lacks the feathery appearance; large non-flowering plants of reed canarygrass (*Phalaris arundinacea*) appear similar but lack hairy ligules.
Comments: For references on distinguishing between native and exotic strains, check page 108 of the Online Resources section. This species has been listed as a restricted species under Michigan law; forms dense, impenetrable stands.
Monitoring & rapid response: Monitor wetlands, ditches and moist sites, particularly adjacent to areas which receive nutrient rich run-off or road salt. Burning, mowing, discing and digging may stimulate populations. Foliar herbicide treatment in late summer or fall provides effective control for large dense stands.

Permits may be required for herbicide use in water and wetlands. For information see MDEQ's Aquatic Nuisance Control website at: www.michigan.gov/deqinlandlakes

Photo: Barry A. Rice, TNC

Photo: Barry A. Rice, TNC

Photo: John M. Randall, TNC

Photo: John M. Randall

Photo: Michael Shepherd

Photo: Barry A. Rice, TNC

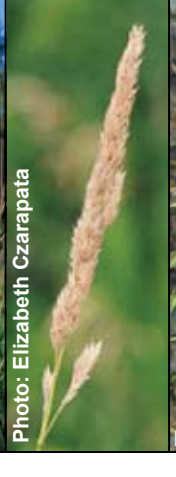


Photo: Elizabeth Czarapata

Photo: Elizabeth Czarapata

Reed Canarygrass

Phalaris arundinacea

Habit: Cool-season, colonial, perennial grass ranging from 0.7-2.4 m (2.5-8 ft) tall; forms dense monotypic stands; root system is a thick, fibrous mat of rhizomes.
Leaves: Flat, rough leaf blades; 1.9-2.6 cm (0.75-1 in) wide and up to 45 cm (1.5 ft) long; prominent transparent ligule.
Stems: Stems are upright; bluish-green in color.
Flowers: Found in crowded, branched clusters at the end of each stem; young clusters dense and spike-like, expanding at maturity.
Fruits/seeds: Small, shiny brown seeds; dispersed by water, humans, animals and machinery.
Habitat: Found in wetlands, ditches, stream and pond banks, and wet meadows.
Reproduction: Primarily through dense, mat-forming, spreading rhizomes; also by seed.
Similar species: Native blue joint grass (*Calamagrostis canadensis*) occurs in similar sites but is less robust and upright.
Comments: Native to North America and Europe; most Midwestern colonies thought to be escapes of cultivated and European forms. Reed canarygrass is a cool-season grass; the invasive character of some *Phalaris* populations may be the result of agronomic breeding for vigorous growth and drought tolerance.
Monitoring & rapid response: Monitor moist, fertile sites and wetlands; most visible in spring when inflorescences expand to facilitate pollination. Herbicide application in late summer or fall provides the most effective control, particularly for large populations; reseeding with desired plant species beneficial; burning, mowing, discing and plowing must be ongoing as root fragments resprout—one-time efforts may increase population; Monitoring and follow-up required for 5-10 years until seed bank is exhausted. This species is extremely difficult to eradicate—research control options thoroughly.

Permits are usually required for herbicide use in water bodies and wetlands. For information see MDEQ's Aquatic Nuisance Control website at:

www.michigan.gov/deqinlandlakes

Photo: Cindy Roche

Photo: John M. Randall, TNC

Photo: Great Smoky Mountains NP

Photo: Elizabeth Czarapata

Photo: Barry A. Rice, TNC

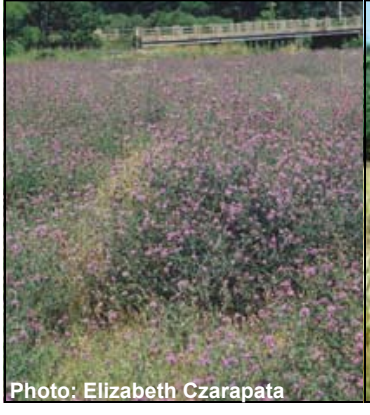


Photo: Elizabeth Czarapata

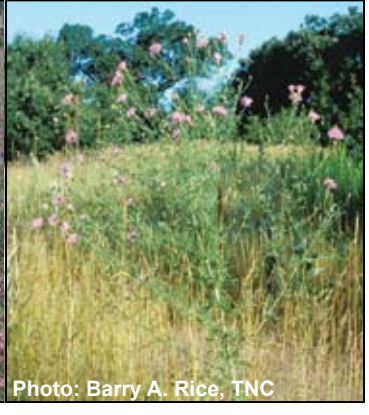


Photo: Barry A. Rice, TNC

Spotted Knapweed

Centaurea stoebe (Centaurea maculosa)

Habit: Short-lived herbaceous biennial or perennial reaching 0.6-1.2 m (2-4 ft).
Leaves: All leaves pale or grayish green with rough fine hairs; basal leaves form a rosette which may persist for up to four years; basal and lower stem leaves up to 15 cm (6 in) long; leaflets deeply divided to irregularly lobed, tapered at both ends; upper stem leaves smaller with few or no lobes.
Stems: Stems rough, upright and branching.
Flowers: Numerous, pink-purple, terminal solitary flowers at the end of each stem; phyllaries with dark tips and fringed margins; bloom from July-September.
Fruits/seeds: Small brown wind-dispersed seeds; germinate throughout the growing season; remain viable for up to nine years.
Habitat: Roadsides and right-of-ways, old fields, pastures, undisturbed dry prairies, oak and pine barrens, and dunes and beaches during low water conditions.
Reproduction: By prolific seed production and to a lesser extent by lateral roots.
Similar species: Russian knapweed (*Centaurea repens*), diffuse or white-flowered knapweed (*C. diffusa*), black knapweed (*C. nigra*), and yellow star thistle (*C. solstitialis*) are related non-native invasive species. The best way to distinguish spotted knapweed is by the dark tips and fringed margins of its phyllaries.
Comments: Native to Europe. This species is listed as a prohibited noxious weed by the Michigan Department of Agriculture. It is alleleopathic and poses a serious threat to western rangelands; may cause skin reactions in some individuals.
Monitoring & rapid response: Monitor well-drained, sunny sites—knapweed is recognizable throughout the growing season. Wear gloves, long pants and sleeves to prevent skin contact. Begin control efforts in highest quality areas; pull or dig plants in small infestations and remove entire root. Remove flower/seed heads from site. Foliar herbicide application of rosettes is most effective before the stem elongates. Late spring fire with adequate fuel provides effective control. Continue control efforts until the seed bank is exhausted. Biocontrols are being tested in Michigan.

Photo: Charlotte Pyle

Photo: Charlotte Pyle

Photo: Wisconsin DNR

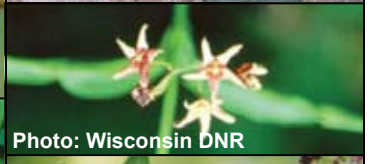


Photo: Wisconsin DNR

Photo: Elizabeth Czarapata

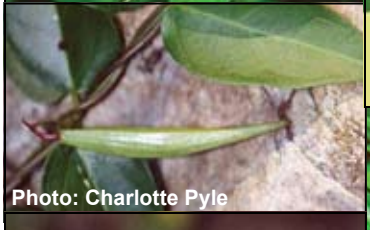


Photo: Charlotte Pyle

Photo: Charlotte Pyle

Photo: Wisconsin DNR

Black and Pale Swallow-worts

Cynanchum louiseae (Vincetoxicum nigrum)
Cynanchum rossicum (Vincetoxicum rossicum)

Habit: Herbaceous perennials; range from 0.6-1.8 m (2-6 ft) tall.
Leaves: Simple, opposite, narrow, oblong to ovate with a pointed tip; dark green leaves with a smooth, waxy coating; emits a pungent herbal smell when crushed.
Stems: Twining; may climb or creep around adjacent plants.
Flowers: Small, five-petaled, clustered in leaf axils; bloom June-August; slight rotting odor; petal width about the same as length; *V. nigrum*: purple-black with straight white hairs on dorsal surface; *V. rossicum*: pale to dark maroon, purple or pink, glabrous; petal width less than length.
Fruits/seeds: Narrow elongate seedpod, 4-7 cm (1.5-2.75 in) in length, similar to milkweed or dogbane pods; contain numerous flat brown seeds with tufts of white fibers; split open in mid-summer to release wind-borne seeds.
Habitat: Found in hardwood forests, shaded woods, open prairies, fields, savannas, roadsides; can tolerate a range of light and soil conditions.
Reproduction: By seed; vegetatively by rhizomes and shoots from root crown of parent plant.
Similar species: Native dogbanes (*Apocynum* spp.) have similar seedpods but are not vines.
Comments: Native to Eurasia. Grows rapidly over native vegetation; wind-dispersed seed travels long distances. Toxins may pose a threat to grazing farm animals when incorporated into hay bales.
Monitoring & rapid response: Monitor disturbed sites and also edges and paths in undisturbed sites; populations most visible in late summer when the leaves turn golden and seedpods appear. Hand-pulling ineffective—dig out entire root crown; burn or place in landfill. Foliar herbicide treatment provides effective control; two applications needed in a year for large, monotypic stands. Prescribed fire is not effective when used alone and may improve conditions for increased germination; fire may be useful following herbicide application to control seedlings with less developed root systems. Remove and burn seedpods; multi-year monitoring and follow-up required.

Photo: Steve Dewey

Photo: Michael Shepard

Photo: John M. Randall, TNC

Photo: John M. Randall, TNC

Photo: University of Alaska Extension

Photo: Mary Ellen Harte

Photo: University of Alaska Extension

Canada Thistle

Cirsium arvense

Habit: Perennial, rhizomatous thistle ranging in height from 0.6-1.5 m (2-5 ft); forms large monocultures.
Leaves: Simple, alternate, lance-shaped; crinkly, tapering, with irregular lobes and spiny toothed margins.
Stems: Upright, slender and branching towards the top, becoming increasingly hairy with age.
Flowers: Numerous, purple-lavender flowers, small flower heads less than 2.5 cm (1 in) high, clustered at the tops of stems, bloom June-September; fragrant.
Fruits/seeds: Seeds are small, light brown; tufts of hair attached to the tip for wind dispersal; one plant produces between 1500-5000 seeds, which can germinate 8-10 days after flowering begins and persist in the seed bank for up to 20 years.
Habitat: Found in disturbed open areas, roadsides, agricultural fields; invades prairie and riparian areas; salt-tolerant; shade intolerant.
Reproduction: Primarily by creeping, laterally spreading rhizomes, but also by prolific seed production; dioecious, with separate male and female clones; some hermaphroditic forms.
Similar species: Native swamp thistle (*Cirsium muticum*) has an involucre with cobweb-like pubescence and may be sticky; pasture thistle (*Cirsium discolor*) has leaves that are white below; other non-native thistles have spiny winged stems.
Comments: Native to Europe. This species is listed as a prohibited noxious weed by the Michigan Department of Agriculture.
Monitoring & rapid response: Monitor sunny, disturbed sites including degraded grasslands, open woodlands, edge habitats and restoration sites. Begin control efforts in highest quality areas; pull seedlings within 2.5 weeks after germination or they become perennial; Canada thistle is clonal; resprouts from root fragments. Fire NOT effective - it will stimulate this species. Herbicides are most effective with two applications per season: in spring, just before flowering, and in fall on new growth after mowing—treat all stems. Different strains of Canada thistle respond differently to the same herbicide; may require 5-10 years of ongoing efforts. This species is extremely difficult to eradicate—research control options thoroughly.

Photo: Steve Garske, GLIFWC

Photo: Steve Garske, GLIFWC

Photo: Dan Tenaglia

Photo: Steve Garske

Photo: Steve Garske, GLIFWC

European Swamp Thistle

Cirsium palustre

Habit: Herbaceous biennial ranging in height from 0.5-2 m (1.5-6.5 ft) tall.
Leaves: Thin, deeply lobed into pinnate segments, covered with loose matted hairs and spiny teeth along margins, up to 20 cm (8 in) long; basal leaves longer than those higher in the stem in flowering plants; leaves of basal rosettes (first year plants) are spiny, deeply lobed, long and hairy below.
Stems: Thick, with spiny lengthwise wings along stem; sometimes reddish; branching at the top.
Flowers: Small, purple flower heads ranging from 1-1.5 cm (0.4-0.8 in) across; held in dense clusters; bloom June-August.
Fruits/seeds: Fruit is a tiny achene, attached to a fluffy "parachute".
Habitat: Prefers moist, acidic soil conditions, shade intolerant; found in ditches, wetlands, swamps, fens.
Reproduction: By wind dispersed seed.
Similar species: The native swamp thistle (*Cirsium muticum*) has an involucre with cobweb-like pubescence and may be sticky; neither it nor the non-native weed Canada thistle (*Cirsium arvense*) has spiny stems or flowers. Although the non-native bull thistle (*Cirsium vulgare*) also has spiny winged stems, its flowers are much bigger.
Comments: Native to Europe. European swamp thistle is considered a high priority invasive species in the Hiawatha National Forest and has spread widely throughout northern Michigan.
Monitoring & rapid response: Monitor moist sites including wetlands, forest edges and fields—European swamp thistle blooms in June and July but can be identified by its thorny winged stems and small flower heads throughout the growing season. Mowing or cutting close to the ground throughout the growing season can reduce infestations; flower heads should be burned or placed in a landfill. Foliar herbicide treatment effective; can be used on fall rosettes, when plants are small—10-25 cm (6-10 in) and during the bud/flowering stage.

Photo: Elizabeth Czarapata

Photo: John M. Randall, TNC

Photo: Chris Evans

Photo: Elizabeth Czarapata

Photo: Wisconsin DNR

Photo: Elizabeth Czarapata

Wild Parsnip

Pastinaca sativa

Habit: Tall, herbaceous biennial; up to 1.5 m (5 ft) in height; long, thick taproot.
Leaves: Long, pinnately compound leaves form a basal rosette during first year; basal leaves reach 15 cm (6 in) in length; mature plants with pinnately compound, alternate leaves of 5-15 oval, smooth, toothed leaflets.
Stems: Upright, unbranched, thick, hairy, grooved.
Flowers: Numerous, small, yellow, five-petaled, found in flat, terminal umbels, up to 15 cm (6 in) wide; lateral flowers of umbel often taller than central flowers; bloom June - mid-July.
Fruits/seeds: Seeds are large, flat, round, yellowish; seeds can remain viable for up to four years.
Habitat: Found in open habitats such as prairies, savannas and fens. Tolerates a range of soil and moisture conditions; shade intolerant.
Reproduction: By seed.
Similar species: Cow-parsnip and giant hogweed (*Heracleum* spp.) have white flowers and leaves with only 3 leaflets that are hairy or pubescent below, rather than smooth; prairie parsnip (*Polytaenia nuttallii*) has finely divided pinnately compound leaflets rather than the coarse pinnately compound leaves of wild parsnip.
Comments: Native to Eurasia. Chemicals found in leaves, stems, and flowers of wild parsnip can cause skin rashes, burns, and blisters, especially in the presence of sunlight; roadside mowing disperses seed.
Monitoring & rapid response: Monitor grassland edges; easiest to identify in June and July when it begins to bloom. Sap causes increased photosensitivity; may cause severe burns, blistering, dermatitis and dark scars—protect skin by using protective clothing and a face shield. Wild parsnip may be cut 5 cm (2 in) below the soil surface if flowering has begun. Remove flower and seed heads from site. Foliar herbicide treatment is effective on basal rosettes. Fire does not control this species but does expose early rosettes in spring for herbicide application in fire adapted communities.

White Sweet Clover

Melilotus alba

Habit: Herbaceous annual or biennial that can grow up to 1.5 m (5 ft) tall; deep taproot, extensive lateral roots.
Leaves: Compound, alternate, clover leaves with three finely toothed leaflets.
Stems: Upright, many-branched; smooth; often hollow; leafy stems that may be spreading near the base give the plant a bushy appearance.
Flowers: Numerous, white, pea-like, fragrant; crowded onto elongated stems; bloom May-September.
Fruits/ Seeds: Fruit is a tiny, wrinkled seedpod containing 1-2 small, tough seeds; seeds may remain viable for up to thirty years; seed germination stimulated by burning.
Habitat: Found in open, dry, disturbed sites such as roadsides and old fields; also found in calcareous soils of sand dunes and prairies. Shade intolerant; will tolerate nutrient poor soils.
Reproduction: By prolific seed production; up to 350,000 seeds per plant.
Similar species: Resembles non-native yellow sweet clover (*Melilotus officinalis*) which has yellow rather than white flowers; seedlings may also resemble alfalfa (*Medicago* spp.), which has downy hairs on the leaf underside.
Comments: Native to Eurasia. Capable of nitrogen fixation. Has been planted for hay.
Monitoring & rapid response: Monitor open, sunny sites; sweet white clover is most easily identified in June and July, while in bloom. For small infestations, pull first year plants in fall, after the root-crown buds have developed; pull second year plants before flowering. Flowering plants should be removed and disposed of by burning or placing in a landfill. Fire increases germination—poorly planned prescribed fires will increase infestations. Ideally, an early spring burn one year, to stimulate germination, followed by a late spring burn the following year will provide effective control. A single burn may also be combined with herbicide application.

Photo: Steven J. Baskauf

Photo: Steve Dewey

Photo: Steven J. Baskauf, Bioimages

Photo: Steven J. Baskauf, Bioimages

Photo: Steven J. Baskauf,

Photo: Mary Ellen Harte

Photo: Steve Dewey

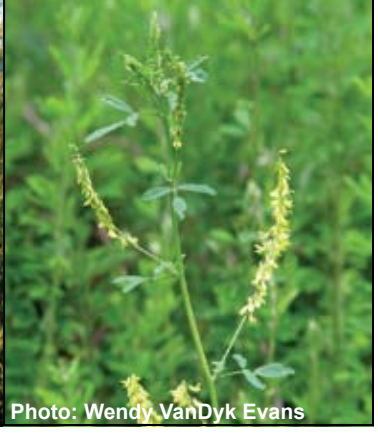


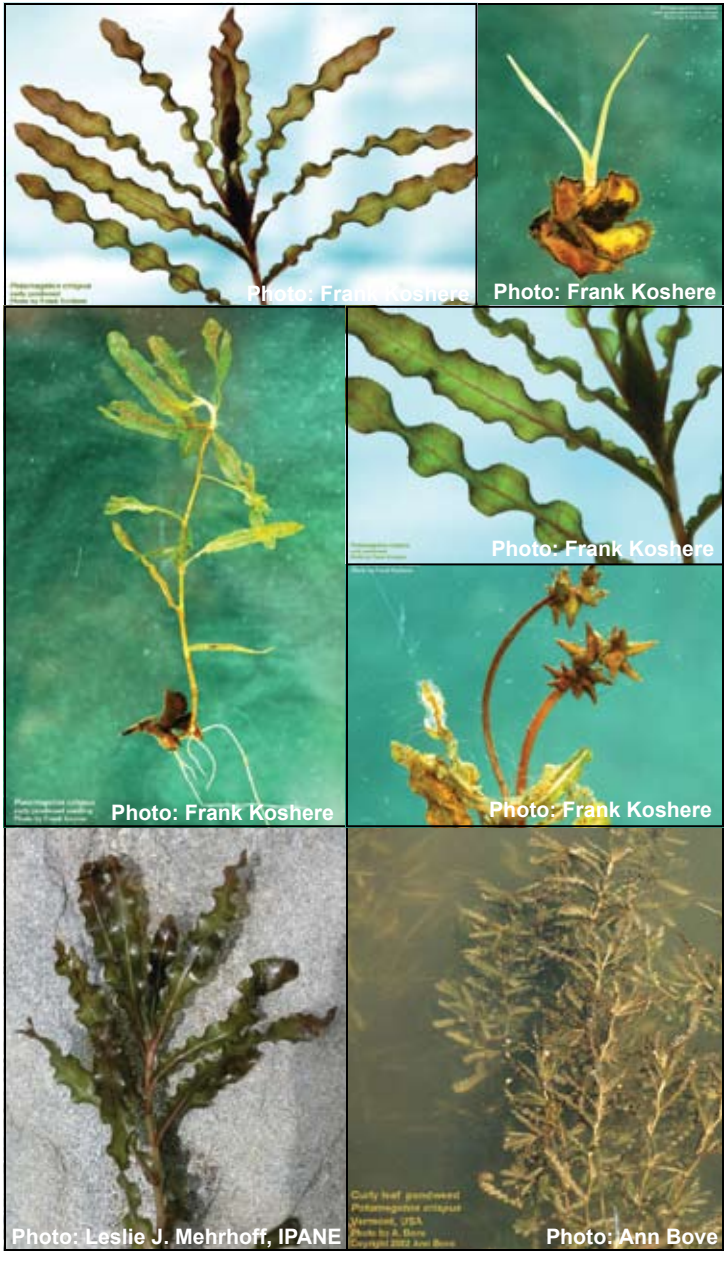
Photo: Wendy VanDyk Evans

Yellow Sweet Clover

Melilotus officinalis

Habit: Herbaceous annual or biennial that can grow up to 1 m (3 ft) tall; deep taproot, extensive lateral roots.
Leaves: Compound, alternate, clover leaves with three finely toothed leaflets.
Stems: Upright, many-branched; often hollow; leafy stems that may be somewhat spreading near the base give the plant a bushy appearance.
Flowers: Numerous, yellow, pea-like, fragrant; crowded onto elongated stems; bloom May-September.
Fruits/ Seeds: Fruit is a tiny, wrinkled seedpod containing 1-2 small seeds that may remain viable for up to thirty years; seed germination stimulated by burning.
Habitat: Occurs in open, disturbed sites such as roadsides and old fields; invades prairies, savannas and dunes; shade intolerant; tolerates nutrient poor soils
Reproduction: By prolific seed production; up to 350,000 seeds per plant.
Similar species: Resembles non-native white sweet clover (*Melilotus alba*), which has white rather than yellow flowers; seedlings may also resemble alfalfa (*Medicago* spp.), which has hairs (pubescent) on the leaf underside.
Comments: Native to Eurasia. Capable of nitrogen fixation. Has been planted for hay.
Monitoring & rapid response: Monitor open, sunny sites; sweet yellow clover is most easily identified in June and July, while in bloom. For small infestations, pull first year plants in fall, after the root-crown buds have developed; pull second year plants before flowering. Flowering plants should be removed and disposed of by burning or placing in a landfill. Fire increases germination—poorly planned prescribed fires will increase infestations. Ideally, an early spring burn one year, to stimulate germination, followed by a late spring burn the following year will provide effective control. A single burn may also be combined with herbicide application.

Aquatic Plants



Curly Pondweed

Potamogeton crispus

Habit: Submergent, aquatic perennial; ranges from 30-80 cm (1-2.5 ft) in length; forms dense mats.
Leaves: Submerged, alternate, oblong, up to 9 cm (3.5 in) long and 10 cm (0.4 in) wide; rounded at the tip; slightly clasping the stem at the base; wavy leaf margins with fine teeth.
Stems: Compressed, four-angled, with few branches, up to 80 cm (31 in) long.
Flowers: Found on dense cylindrical spikes that rise above the water for wind pollination; bloom in late spring/early summer.
Fruits/seeds: Small, brown, with a pointed beak.
Habitat: Found in shallow to deep water of lakes and rivers; pollution-tolerant; prefers alkaline, nutrient-rich waters.
Reproduction: Vegetatively by spindle-shaped turions (winter buds that form at leaf axils and stem tips); turions lie dormant during summer, germinate in fall; also spreads by fragmentation.
Similar species: Curly pondweed is similar to many other *Potamogeton* species but it is the only one with curly leaf edges.
Comments: Native to Eurasia. This species is listed as a restricted noxious weed by the Michigan Department of Agriculture; begins growing in early spring, dies back completely by mid summer after blooming; inhibits growth of native plants; midsummer die-back results in masses of dead vegetation, increase in phosphorus levels and potential algal blooms.
Monitoring & rapid response: Monitor water bodies for new colonies in spring, as it dies off by late June. Public education is critical. Raking/cutting at sediment surface in spring can prevent propagule formation—remove all fragments. Herbicide applications at low rates in early spring provide effective control; plants die back completely by late spring or early summer so later application ineffective; where water levels can be manipulated, fall drawdown may kill turions.

Permits are usually required for herbicide use in water bodies and wetlands. For information see MDEQ's Aquatic Nuisance Control website at:

www.michigan.gov/deqinlandlakes

Photo: Elizabeth Czarapata

Photo: Barry A. Rice, TNC

Photo: Robert H. Mohlenbrock

Photo: Alison Fox

UGA1624031

Photo: Robert L. Johnson

UGA0002002

Eurasian Water Milfoil

Myriophyllum spicatum

Habit: Submergent aquatic perennial; commonly ranges from 1-3 m (3-10 ft) in length but may reach 4 m (33 ft); forms dense mats.
Leaves: Submerged, feather-like, 4-5 leaves with 9-21 threadlike pairs of leaflets whorled around stem at each node; bright green; limp when out of water.
Stems: Thick near the base; becoming more slender and branching near the water surface; usually 1-3 m (3-10 ft) long.
Flowers: Inconspicuous yellow four-parted; flower spikes rise 5-10 cm (2-4 in) above water surface.
Fruits/seeds: Fruit is a hard capsule with 4 seeds.
Habitat: Found throughout Midwestern ponds and lakes in 1-3.5 m (3-12 ft) of water, prefers disturbed shorelines and nutrient rich waters.
Reproduction: Vegetatively by fragmentation and creeping runners; seeds viable but not an important dispersal mechanism; unlike many aquatic plants, it does not produce turions (winter buds).
Similar species: Although many aquatic plants look similar superficially, Eurasian water milfoil is unique in having whorled, pinnately compound leaves with 12-20 leaflets on each side. It most closely resembles northern water milfoil (*Myriophyllum exalbescens*), which has only 7-11 pairs of leaflets, remains rigid out of water and forms turions.
Comments: Native to Eurasia. This species is listed as a restricted noxious weed by the Michigan Department of Agriculture; Eurasian milfoil begins to photosynthesize and grow prolifically in early spring, allowing it to dominate an area and limit light available to other aquatic life.
Monitoring & rapid response: Monitor water bodies for new colonies. Public education and prevention is critical. Reduce nutrient enrichment where possible; hand pull or rake out colonies, removing all fragments; biological control with native herbivorous weevil (*Eurhychiopsis lecontei*) shows promise; herbicides show mixed results; check current research—treatment rapidly evolving.

Permits are usually required for herbicide use in water bodies and wetlands. For information see MDEQ's Aquatic Nuisance Control website at:

www.michigan.gov/deqinlandlakes

Photo: Leslie J. Mehrhoff, IPANE

Photo: Katie Bonjour

Photo: Todd Losee, MI DEQ

Photo: Suzan Campbell, MNFI

European Frog-bit

Hydrocharis morsus-ranae

Habit: Perennial, free-floating aquatic herb that forms large colonies, creating dense mats with tangled roots.
Leaves: Usually floating, kidney shaped with long stems, dark purple below, resemble tiny water lily leaves, 1-6 cm (0.5-2.25 in) across.
Stems: European frog-bit has strong, cord-like stolons.
Flowers: White, cup-shaped, three-petaled with yellow dots at the base; bloom mid-summer.
Fruits/seeds: Fruit a spherical berry; fruit/seedset uncommon.
Habitat: Occurs in shallow, slow-moving water on the edges of lakes, rivers, streams, swamps, marshes and ditches.
Reproduction: Primarily vegetative, through long stolons and turions (winter buds that are produced on the stolons); in fall, turions drop off and remain dormant until spring when they begin to grow; one plant can produce over 100 turions a year.
Similar species: Water lilies (*Nymphaea* spp., *Nuphar* spp.) are much larger. Water-shield (*Brasenia schreberi*) leaves are oval, not kidney-shaped and their stems arise in the middle of the leaf.
Comments: Native to Europe. This species is listed as a prohibited noxious weed by the Michigan Department of Agriculture; most plants are dioecious and many populations consist of only one sex; in mixed populations, most plants are male and little seed is produced.
Monitoring & rapid response: Monitor for new populations. No control measures have been reported for this species. Hand pulling or raking out colonies before fall, when turions drop off, seems advisable.

Permits are usually required for herbicide use in water bodies and wetlands. See MDEQ's Aquatic Nuisance Control website at:
www.michigan.gov/deqinlandlakes

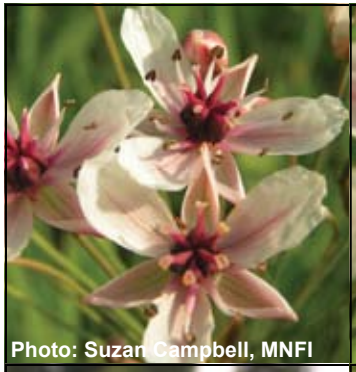


Photo: Suzan Campbell, MNFI

Photo: Suzan Campbell, MNFI

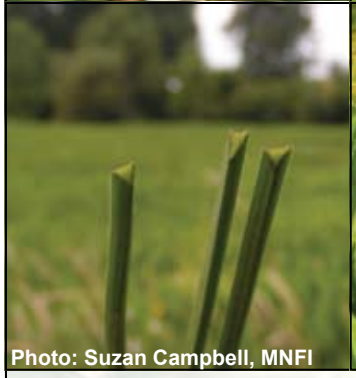


Photo: Suzan Campbell, MNFI

Photo: Suzan Campbell, MNFI

Photo: Suzan Campbell, MNFI

Flowering Rush

Butomus umbellatus

Habit: Perennial, erect, floating or submersed in water up to 2 m (6 ft) deep.
Leaves: Linear, up to 1 m (39 in) long and 0.5-1 cm (0.2-0.4 in) wide; growing from the base; triangular in cross-section.
Stems: Smooth, erect, round; 1-1.5 m (3-4.5 ft) tall.
Flowers: Pale pink, rose or white, with 3 petals and 3 petal-like sepals; held in a many-flowered, rounded cluster at the top of the stem; bloom midsummer; not all populations produce flowers although many in Michigan do.
Fruits/seeds: Fruit a beaked follicle, not all populations produce fertile seed but at least some Michigan populations do so.
Habitat: Occurs in rivers, lakes, emergent wetlands and ditches in waters up to 3 m (~10 ft) in depth.
Reproduction: By stout creeping rhizomes; vegetative bulbils form on the rhizome; some populations produce fertile seed also; seeds float, are water-dispersed, and are long-lived like those of many wetland species.
Similar species: Non-flowering specimens may resemble young bur-reeds (*Sparganium* spp.) or bulrushes (*Scirpus* spp.) as they may have similar leaves.
Comments: Native to Eurasia. This species is listed as a restricted noxious weed by the Michigan Department of Agriculture; flowering rush occurred in the Detroit River as early as 1918 but has become a much greater problem in recent years.
Monitoring & rapid response: Monitor lake shores, stream banks and ditches, particularly where water levels have dropped; plant is identifiable in summer when fruit or seed are present.
Cutting flowering rush under water may reduce population density—remove all plant parts; digging out isolated plants may prevent spread but bulbils on rhizomes must be removed also—do not compost near wetlands or water; control with herbicide difficult.

Permits are usually required for herbicide use in water bodies and wetlands. For information see MDEQ's Aquatic Nuisance Control website at:

www.michigan.gov/deqinlandlakes

Photo: Leslie J. Mehrhoff

Photo: Chris Evans

Photo: USDA ARS Archives

Photo: Raghavan Charudattan

Photo: Chris Evans

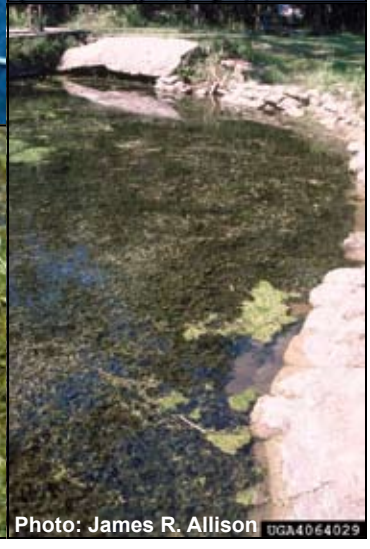


Photo: James R. Allison

Hydrilla

Hydrilla verticillata

Habit: Submerged, rooted, perennial; forms monocultures.
Leaves: Whorls of 3-10 thin (2-4 mm wide, 6-20 mm long), rough leaves at the node; small spines give the leaf margin a toothed appearance; midribs red and often spiny.
Stems: Usually rooted in water up to 6 m (20 ft) deep; little branching in deep water but dense at water's surface; forms horizontal stems in water (stolons) and underground (rhizomes).
Flowers: Female flowers are small, white, six-petaled, originate in leaf axils; male flowers are green and resemble an inverted bell.
Fruits/seeds: Cylindrical seedpods; 1-5 smooth, tiny, brown seeds.
Habitat: Found in lakes, ponds, reservoirs and ditches.
Reproduction: Vegetatively by tubers and vegetative winter buds (turions); stem fragments root at nodes; seed less important.
Similar species: Canadian waterweed (*Elodea canadensis*) lacks Hydrilla's toothed leaf margins, red veins, and spiny leaf midrib.
Comments: This species has been listed as a noxious weed under federal law and is also prohibited under Michigan law.
Monitoring & rapid response: Monitor aquatic habitats. Mechanical removal is problematic as fragments may produce new plants. Drawdown from fall through spring may reduce population levels. Herbicides with contact poisons have been used to control hydrilla but are non-selective and may be highly toxic to fish; systemic herbicides reduce the overall growth rate of this species, without eliminating it completely. Biocontrols are being tested.

Permits are usually required for herbicide use in water bodies and wetlands. For information see MDEQ's Aquatic Nuisance Control website at:

www.michigan.gov/deqinlandlakes

Photo: Barry A. Rice, TNC

Photo: John M. Randall, TNC

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Photo: Barry A. Rice, TNC

Photo: Leslie J. Mehrhoff

Photo: Mandy TU, TNC

Photo: Leslie J. Mehrhoff

Water-hyacinth

Eichhornia crassipes

Habit: Free floating aquatic plant; 0.5-1 m (1.5-3 ft) tall; distinctive air bladders that keep leaves afloat; forms dense, floating mats.
Leaves: Thick, waxy, round, broad, 10-20 cm (4-8 in) in diameter, cuplike, glossy, green leaves.
Stems: Spongy, erect, stems up to 50 cm (20 in) long, inflated with air bladders towards the base.
Flowers: Showy, lavender-blue, six-petaled flowers; upper petals with a central, yellow blotch; 8-15 flowers occur on a single spike that can be up to 30 cm (1 ft) long; bloom midsummer.
Fruits/seeds: Fruit is a three-celled capsule with many tiny seeds.
Habitat: Found in wetlands, marshes, ponds, lakes, and rivers.
Reproduction: By fragmentation of stolons, adventitious root system, and to a lesser extent by seed.
Similar species: Pickerelweed (*Pontederia cordata*) has purple flower spikes, lacks the conspicuous air bladder; not mat-forming.
Comments: Native to the Amazon Basin. In its southern range, it doubles in size in two weeks. Considered to the be one of the most troublesome aquatic weeds in the world; seems persistent in the lower Detroit River/western Lake Erie—unclear if it is dying off in mild winters.
Monitoring & rapid response: Monitor ditches, ponds, wetlands, lakes and rivers along the lower Detroit River for this species. Most recognizable in bloom (late summer, early fall). Hand pull small populations; several herbicides are effective.

Permits are usually required for herbicide use in water bodies and wetlands. For information see MDEQ's Aquatic Nuisance Control website at:

www.michigan.gov/deqinlandlakes

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Online resources

The Nature Conservancy's Global Invasive Species Initiative
Invasives and Control Methods - Provides abstracts that include plant descriptions, biology and relevant research for controlling specific invasive species:
www.invasive.org/gist/esadocs.html
Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas:
www.invasive.org/gist/handbook.html

USDA Forest Service's Fire Effects Information System (FEIS)
Provides comprehensive summaries of relevant research on invasive species biology, ecology, fire behavior and control methods:
www.fs.fed.us/database/feis/plants/weed/weedpage.html

USDA - National Invasive Species Information Center
Provides links to current federal, state and academic literature on selected invasive species:
www.invasivespeciesinfo.gov/plants/main.shtml

Invasive Plant Atlas of New England
Provides a "Catalog of Species" with photos, species descriptions, control techniques and bibliographies:
http://nbii-nin.ciesin.columbia.edu/ipane/icat/catalogOfSpecies.do

Midwest Invasive Plant Network
Provides information and a variety of resources on invasives in the Midwest:
http://mipn.org/

MSU's Invasive Species Initiative
Provides information and a variety of resources on invasives including current research at MSU:

www.invasivespecies.msu.edu/

The Stewardship Network
A grassroots cooperative organization working to protect, restore, and manage Michigan's natural lands and water:
www.stewardshipnetwork.org/

Herbicide Licensing and Permits

Michigan Department of Agriculture
Provides information on becoming a registered or certified pesticide applicator, including when this is required:
www.michigan.gov/mda/0,1607,7-125-1569_16988_35289-11990--,00.html

Michigan State University Pesticide Safety Education
Provides information on safe use of various categories of pesticide (including herbicides) and order forms for manuals:
www.pested.msu.edu/index.html

Michigan Department of Environmental Quality
Provides information on aquatic nuisance control including permits:
www.michigan.gov/deq/0,1607,7-135-3313_3681_3710---,00.html

Phragmites

Cornell: Ecology and Management of Invasive Plants Program
Phragmites Morphological Differences - native and introduced:
www.invasiveplants.net/phragmites/phrag/natint.htm

Michigan Department of Natural Resources
A Guide to the Control and Management of Invasive Phragmites:
www.michigan.gov/documents/dnr/PhragBook_Email_216473_7.pdf

Michigan Department of Environmental Quality
Information on *Phragmites* control and permits:
www.michigan.gov/deq/0,1607,7-135-3313_3677_8314-178183--,00.html

A Landowner's Guide to Phragmites Control:
www.michigan.gov/documents/deq/deq-ogl-Guide-Phragmites_204659_7.pdf

Purple Loosestrife

NCERA-125: Guidelines for biological control of purple loosestrife:
www.ncera125.ent.msu.edu/GuideGalerucella.htm

Glossary

acidic - having a pH of less than 7; increasing the concentration of H^+ ions when dissolved in water; the opposite of basic or alkaline.

acuminate - tapering gradually, even concavely, to a sharp point.

acute - sharply pointed, forming an angle of less than 90 degrees.

adjuvant - an ingredient that improves the effectiveness of an herbicide, such as a wetting agent or emulsifier.

adventitious root - a root arising from stem tissue.

alkaline - having a pH of greater than 7; increasing the concentration of OH^- ions when dissolved in water; the opposite of acidic.

allelopathic - suppressing growth of a potential plant competitor by the release of toxic or inhibiting substances.

annual - a plant that germinates, flowers, sets seed and dies in one year.

apex - the top or tip.

aquatic - growing in water.

auricle - a small lobe or projection, growing from the base of a a leaf blade or sheath.

axil - the position where a leaf or branch joins the stem.

axillary - located in the axil.

barrens - a type of grassland with scattered trees such as oaks and/or pines.

basal bark treatment - application of herbicide to the bark at the base of tree or shrub.

bearded - with a clump of hairs.

berry - a fleshy fruit with several seeds, derived from a single ovary such as a blueberry or elderberry.

biennial - a plant that lives only two years; flowering, producing seed and dying in the second year.

bog - a nutrient-poor wetland characterized by acidic, saturated peat, that derives its water primarily from ion-poor precipitation.

bract - a specialized leaf-like structure, from which a flower or flower stalk grows; some may be very small.

bulbil - a small new bulb that grows around a parent bulb or a bulb-like structure that grows in the leaf axil.

calcareous - containing, or characteristic of calcium carbonate, calcium, or limestone.

capsule - a dry, splitting fruit that grows from more than one carpel, usually with several or many seeds.

carpel - the basic female unit of a flower that bears the ovules; several may be united to form a compound pistil.

catkin - a dense spike of many flowers with no petals.

clone - a group of plants that arise vegetatively from a single plant.

colonial - forming colonies.

compound - in reference to leaves, with multiple subunits or leaflets.

connate - attached to or fused with other parts of the same type.

cool-season grass - a grass that grows best at lower temperatures in spring or fall, utilizing the C3 pathway to fix carbon dioxide.

corolla - all of the petals on a flower (collectively).

crenulate - with very small rounded teeth.

deciduous - in reference to leaves, falling at the end of the season.

dioecious - with male and female flowers on different individuals.

drupe - a fleshy fruit with a firm structure derived from the lining of the ovary wall that encloses the seed such as a peach or almond.

dune - a ridge or hill of wind-blown sand.

emergent - referring to an aquatic plant that extends above the water's surface.

exfoliating - referring to bark, peeling off in layers.

fibrous - containing fibers.

foliar spray - in reference to control measures, spraying leaves with herbicide.

follicle - a fruit derived from a single carpel that splits along one suture.

forest - a natural community that is dominated by trees.

girdle - in reference to control measures, to cut through the cambium around the trunk or stem of a woody plant.

glabrous - smooth, without hairs.

glaucous - covered with a whitish, fine, waxy powder that rubs off.

globose - spherical.

heartwood - the harder, non-living inner layers in the stem of a woody plant.

herbaceous - referring to a plant, with the stems dying back to the ground at the end of the season.

hermaphroditic - with both sexes together in the same flower.

inflorescence - cluster or arrangement of flowers of a plant.

involucre - a structure that surrounds the base of another structure, often applied to a set of bracts below the inflorescence, as in asters.

lanceolate - lance-shaped, much longer than wide and tapering to each end.

lateral bud - bud arising from the side of a stem.

leaflet - one of the subunits that make up a compound leaf.

leaf scar - the mark on a twig that is left when a leaf falls.

legume - a pod-like fruit that grows from a single carpel and splits along two sides as occurs in the bean family, for example.

lenticel - a small, dot-like area of corky tissue on bark.

ligule - an appendage at the top of a leaf sheaf.

linear - long, narrow and parallel-sided.

loam - a soil class with moderate amounts of sand, loam and clay.

lobe - a projection or extension, usually rounded.

marsh - a wetland dominated by herbaceous plants on mineral soils.

monocarpic - typically a perennial that blooms once and then dies after producing seed.

monotypic - with one representative; the single species in a genus.

node - place on the stem where a leaf or branch has attached.

mycorrhiza - a symbiotic relationship between a fungus and the root of a vascular plant.

noxious weed - legal designation for plants deemed troublesome.

ocrea - membranous sheath around the stem just above the base of a leaf; often found in members of Polygonaceae.

opposite - situated directly across from; as in leaves or branches at the same node.

palmate - with subunits or lobes arising from a single point.

panicle - a branching inflorescence or flower cluster that is broad at the base and tapers towards the top.

pappus - hairs, scales or bristles on top of the ovary and seed.

pedicel - the stalk of a single flower within an inflorescence.

penetrating oil - an additive that helps an herbicide pentrate leaves or bark.

perennial - a plant that lives more than two years.

petal - one of the inner set of floral leaves - often white or colored to attract pollinators.

phyllary - an involucral bract in flowers in the family Asteraceae.

pinnate - arranged in two rows along an axis, like barbs on a feather.

pistil - the female organ of the flower, composed of an ovary, style and stigma.

pith - the central tissue in a stem or root, surrounded by vascular tissue.

prairie - a natural community that is dominated by grasses.

pubescent - with hairs of any sort.

puberulent - finely pubescent, with soft, curled hairs.

raceme - a spike-like inflorescence, with stalked flowers arising from a central axis.

rhizome - a creeping stem that grows underground.

root crown - area where the major roots meet the trunk or stem of a plant.

root sucker - a shoot that arises from a root.

rosette - a cluster of leaves or other plant parts arranged in a circle, often at the base.

runner - a long, creeping stem, that roots at its tips and nodes.

samara - a dry, closed, winged fruit.

sapwood - the outer portion of a woody plant's trunk or branch, between the heartwood and the bark; the living part of the wood.

savanna - a natural community that is dominated by grasses and scattered trees.

sepal - one of the divisions of the corona, the ring of structures surrounding the petals.

sessile - without a stalk.

shade-tolerant - able to grow to maturity in shade.

sheath - plant part that wraps around another plant part.

silique - an elongate capsule that splits along the sides.

simple - in reference to a leaf, not compound.

spike - an elongate inflorescence with sessile or barely stalked flowers arising from a central stalk.

spikelet - a small spike, often in grasses and sedges.

stipule - one of a pair of appendages found on leaves of many species.

stolon - an elongate, creeping stem (above ground).

submergent - growing under water.

surfactant - a wetting agent that reduces the surface tension of a liquid, allowing it to spread easily.

taproot - the main or central root.

terminal - tip or end position.

terminal bud - bud arising from the tip of a stem.

toothed - with teeth, as in the margin of a leaf.

truncate - ending abruptly, as if chopped off.

tuber - a thickening of a rhizome, functioning as a form of food storage and/or for reproduction.

turion - a small bulb-like structure.

umbel - an umbrella-shaped inflorescence.

whorled - a group of three or more similar structures radiating from the same point or node.

woody - with lignified cell walls; wood-like.

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