

# Oriental Bittersweet

*(Celastrus orbiculatus)*

Best Management Practices in Ontario



# Foreword

These Best Management Practices (BMPs) provide guidance for managing invasive oriental bittersweet or célastre asiatique (*Celastrus orbiculatus*) in Ontario. Funding and leadership to produce this document was provided by the City of Toronto. These BMPs were developed by the Ontario Invasive Plant Council (OIPC) and its partners to facilitate invasive plant control initiatives by individuals and organizations concerned with the protection of biodiversity, agricultural lands, infrastructure, crops, and species at risk in Ontario. This document also supports and advances the management of invasive species identified as a priority by the City of Toronto's Ravine Strategy and Biodiversity Strategy.

The intent of this document is to relay specific information relating to invasive plant control practices that have been recommended by leading professionals across Ontario. This document contains the most up-to-date, effective, and environmentally safe control practices known from research, experience and literature available at this time. It complies with current provincial and federal legislation regarding pesticide usage, habitat disturbance, and species at risk protection. It is subject to change as legislation is updated or new research findings emerge. The information provided in this BMP is not to be considered legal advice. The timing windows suggested will differ throughout Ontario and should be tailored to your region. Interested parties are advised to refer to the applicable legislation to address specific circumstances.

Check the website of the OIPC ([www.ontarioinvasiveplants.ca](http://www.ontarioinvasiveplants.ca)) for updates.

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Simkovic, Vicki. 2024. Oriental Bittersweet (*Celastrus orbiculatus*): Best Management Practices in Ontario. Ontario Invasive Plant Council, ON.

## **Edition 1.0 - November 2024**

Support for the production and publication of this document was provided by: The City of Toronto.

Inquiries regarding this document can be directed to the **Ontario Invasive Plant Council (OIPC)**

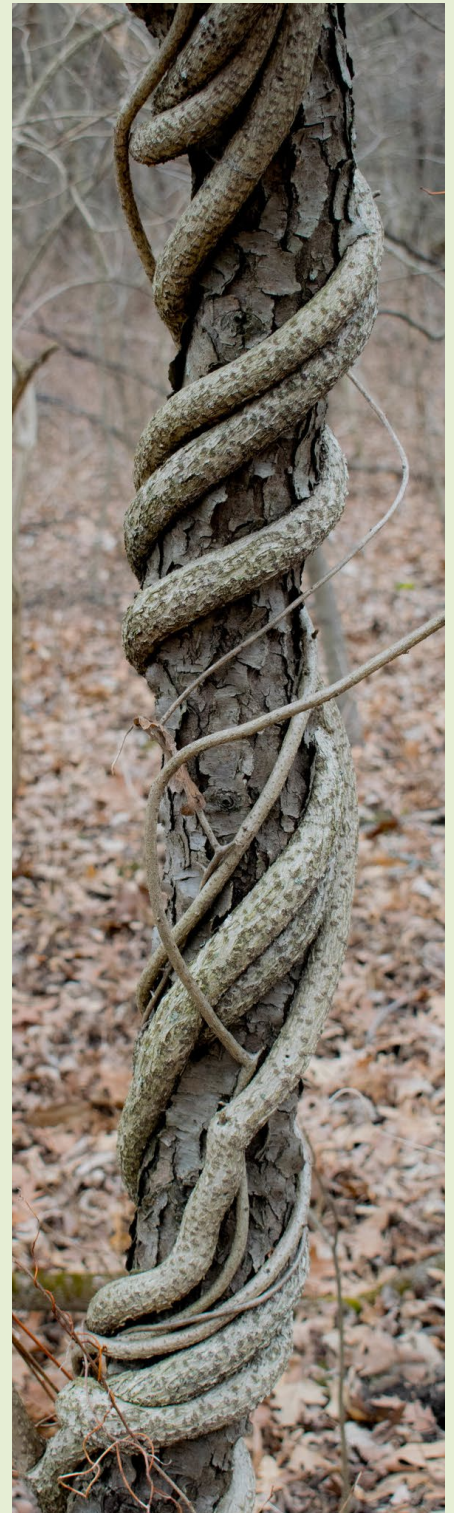
Email: [info@oninvasives.ca](mailto:info@oninvasives.ca)

**For more information on invasive plants in Ontario, please visit the following websites:**

[www.ontarioinvasiveplants.ca](http://www.ontarioinvasiveplants.ca), [www.ontario.ca/page/invasive-species-ontario](http://www.ontario.ca/page/invasive-species-ontario), [www.invadingspecies.com](http://www.invadingspecies.com),  
or [www.invasivespeciescentre.ca](http://www.invasivespeciescentre.ca)

# Table of Contents

Foreword.....	i
Introduction.....	1
Description.....	3
Cultivars of Oriental Bittersweet.....	6
Lookalikes.....	7
Biology and Life Cycle.....	10
Diseases and Natural Enemies of Oriental Bittersweet.....	13
Habitat.....	14
Pathways of Spread and Distribution.....	15
Impacts.....	16
Applicable Legislation.....	19
Municipal.....	21
Invasive Management Planning.....	22
Management Considerations.....	22
Mapping.....	22
Landscape Level Management.....	22
Setting Priorities.....	23
Long-term Management and Monitoring.....	26
Control Measures.....	27
Manual.....	28
Mechanical.....	29
Cultural.....	30
Chemical.....	31
Disposal.....	37
Restoration.....	38
Preventing the Spread.....	39
Tracking the Spread (Outreach, Monitoring, Mapping).....	40
Additional Resources.....	41
Best Management Practices Document Series.....	41
Technical Bulletin Series from the OIPC.....	41
Additional Publications from the Ontario Invasive Plant Council.....	42
References.....	43



**Oriental bittersweet.**

Photo courtesy of: Paul Beck.  
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Oriental bittersweet was introduced as an ornamental vine. It can escape cultivation and become invasive in natural areas.

Photo courtesy of: Colin Kennedy.

## Introduction

Oriental bittersweet (*Celastrus orbiculatus*), also known as Asiatic or Asian bittersweet, Japanese bittersweet, climbing spindleberry, round-leaved bittersweet, or célastre asiatique in French, is a woody vine in the staff-vine family (Celastraceae). Native to East Asia, it has been introduced to several parts of the world, including North America, Europe, and New Zealand. It was introduced to the United States of America as an ornamental plant sometime in the mid-1800s or possibly earlier. Its many attributes, such as attractive bicolored fruit, bright yellow fall leaf colour, rapid growth, hardiness to light and soil conditions, and being relatively pest and disease free, have made it a popular choice as an ornamental in gardens. Its many fruit branches are also used in flower arrangements and craft-making such as wreaths. Beyond deliberate planting, humans have further contributed to its spread by disposing plant parts in compost and brush piles. In the USA, it was historically planted for use in highway landscaping for wildlife food and cover, and erosion control. In addition, the showy fruit is eaten by birds and small mammals, which can disperse seeds long distances. These pathways for introduction and spread have allowed oriental bittersweet to quickly escape cultivation and become naturalized, such that it has since become a major invader and threat to native plant communities across the eastern and northern United States. In Canada, it has been planted in Ontario, Quebec and the Maritimes, where it is found in scattered, localized populations, particularly in urban areas. Although oriental bittersweet is currently not as problematic in Ontario as it is in parts of the USA, populations are expanding and it is expected to become a more serious problem in the future (i.e., with climate change).

Oriental bittersweet is a strong competitor, with many advantageous traits such as shade tolerance, high seed germination rates, high pollen and seed viability, high fruit production, and rapid growth. It can invade high quality closed canopy forests or sensitive open habitats such as sand dunes and outcompete other species, out shade the forest understory, decrease biodiversity and alter natural forest succession. The ability for oriental bittersweet to spread aggressively and dominate forest canopies, particularly in disturbed areas, has led to tree regeneration in forests being prevented or slowed. It grows rapidly each year, climbing over vegetation such as stumps, shrubs, saplings, and adult trees. As the vines climb up to the full height of canopy trees, they girdle or strangle the trunk and branches of the host tree, and their leaves block sunlight from reaching the tree, eventually killing it. The extra weight of the vines also makes trees vulnerable to breakage during wind or ice storms.

Oriental bittersweet closely resembles a native, non-invasive bittersweet species called American bittersweet (*Celastrus scandens*) but has many competitive advantages over this species. It grows faster, has higher seed production and viability, and can tolerate a greater range of light levels compared to its native relative. There is also potential for hybridization between these two species. This makes oriental bittersweet a direct threat to American bittersweet, which has been declining throughout its range. These species are hard to differentiate from one another and frequently oriental bittersweet is mislabeled as the native American bittersweet in nurseries.

Due to its potential for becoming a significant invader in Ontario, this document was developed to aid in the effective and consistent management of oriental bittersweet, as well as increase awareness of this less well-known but potentially significant invasive species in Ontario.



Oriental bittersweet has spread into a nearby natural area at Christie Lake Conservation Area, Dundas, Ontario. The abundant, bright red fruit makes this vine stand out in late fall.

Photo courtesy of: Graham Tebbit. Available: <https://www.inaturalist.org/observations/64809125>, licensed under CC-by-NC.

# Description

## Height:

Oriental bittersweet is a perennial, woody vine (also called a liana) that climbs by means of twining around a support. Stems may climb up into the canopy of trees, reaching a potential height of 18 metres. It can also be more of a trailing shrub in open areas where it has no support structure.



By twining around a support, oriental bittersweet can reach the upper canopy of trees.

Photo courtesy of: Lee Merrill, Credit Valley Conservation.

## Flowers:

The flowers are small (0.6 – 0.8 cm), yellow-green, with five petals and five sepals. Flowers are usually in clusters of two or three along the leaf axils (where the leaf attaches to the stem). Flowers are usually in clusters of two or three along the leaf axils (where the leaf attaches to the stem), although they are sometimes terminal for male plants. Male and female flowers occur on separate plants (dioecious), although occasionally male and female flowers have been found on the same vine (monoecious). Male flowers have five stamens, which are about as long as the petals and are inserted at the edge of a cup-shaped disk around a vestigial pistil. Female flowers have vestigial stamens, a three lobed stigma, and well-developed superior ovary, sometimes embedded in the disk. The flowers bloom in late spring (May and June); they are pollinated by insects, especially bees, and by wind.



Flowers are yellow-green with 5 sepals and 5 petals, borne in clusters of 2-3 along the leaf axils.

Photo courtesy of: Emily Summerbell. Available: <https://www.inaturalist.org/observations/42442016>, licensed under CC-by-NC.

## Fruit and Seeds:

The fruits are globose or spherical berries, three-valved, and small (0.6 - 0.8 cm in diameter). The fruit is covered by a yellow-orange capsule, which splits open at maturity to reveal three bright red-orange arils (a fleshy coating covering a seed) that contain three to six seeds. The fruits are borne in clusters of two or three in the leaf axils (where the leaf attaches to the stem) of female plants. The fruits are green when they first appear in summer (July – August) and the mature fruit persists on the vine throughout the fall and winter (September - March). Fruit only develops on female plants. Male cultivars do not produce fruit, although they can pollinate flowers of both oriental bittersweet and American bittersweet.



Immature fruit is covered by a yellow-orange capsule.

Photo courtesy of: Lee Merrill, Credit Valley Conservation.



Fruit splits open at maturity, revealing three bright-orange arils.

Photo courtesy of: Jeff Skrentny. Available: <https://www.inaturalist.org/observations/37430329>, licensed under CC-by-NC.

## Stem and Bark:

The stems are round, hairless, and range in colour from light grey to medium brown or red-brown with conspicuous light horizontal marks (lenticels). They have solid white piths. Older stems can reach up to 10 cm (5 cm most commonly) in diameter with slightly ridged dark to medium brown bark.



Note the conspicuous horizontal marks (lenticels). Older stems twine around one another, reaching 10 cm in diameter.

Photo courtesy of: rgraveolens. Available: <https://www.inaturalist.org/observations/55351547>, licensed under CC-by-NC.

## Leaves:

Leaves are variable in size (2 - 12 cm long and 1.5 – 8 cm wide) and shape, ranging from oval to oblong, to obovate or elliptical. The leaves are glossy, finely toothed along the margins with a pointed or rounded tip. The petioles (stem that attaches to the leaf) are 1 - 3 cm long. The leaves are arranged alternately on the stem. The leaves turn yellow in the fall, remain on the stems until late into the season (end October), and are lost annually.



Elliptical leaves, with finely toothed margins and a pointed tip.

Photo courtesy of: Lee Merrill, Credit Valley Conservation.



Leaves vary in shape. Note the circular leaves with rounded tip.

Photo courtesy of: Reuvin Martin. Available: <https://www.inaturalist.org/observations/28050813>, no rights reserved (CC0).

## Roots:

Oriental bittersweet has a large root system, which can spread both vertically and laterally and be up to 2 cm wide. The roots are distinctly bright orange in colour. New plants can sprout from roots, root fragments, and the root crown. Roots can vigorously sprout after damage to the plant.



Roots are distinctly bright orange in colour.

Photo courtesy of: City of Toronto.





There are a variety of oriental bittersweet cultivars available on the market..

Photo courtesy of: Joanne Muis Redwood. Available:<https://www.inaturalist.org/observations/8649652>, licensed under CC-by-NC.

## Cultivars of Oriental Bittersweet

There are self-pollinating cultivars of oriental bittersweet available, such as 'Hermaphoditus', although self-pollination is likely to be very limited given the dioecious nature of this species (Chandler 2011; Beringen et al. 2017). Two common cultivars 'Diane' (a female clone) and 'Hercules' (a male clone) produce abundantly fruiting offspring. There are no low-fruiting or sterile cultivar varieties available (WIGL 2024). Male cultivars do not produce fruit but can pollinate flowers of oriental bittersweet and American bittersweet (WIGL 2024).

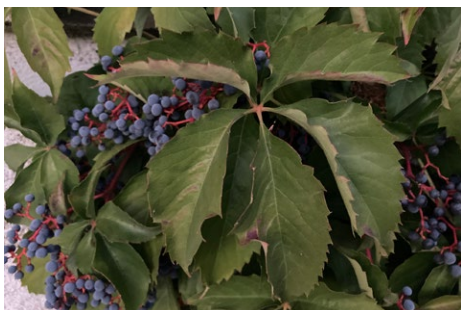
# Lookalikes

Prior to the introduction of oriental bittersweet, American bittersweet (*Celastrus scandens*) was the only North American member of the staff-vine genus. These two species closely resemble one another, and hybridization is known to occur in US populations, potentially complicating identification (Zaya *et al.* 2017). However, hybridization in the field is likely rare, as American bittersweet is uncommon in Ontario and typically found in high quality habitats that do not frequently overlap with oriental bittersweet. The current extent of hybridization in the field is not known, and further genetic studies are needed to determine the level of hybridization.

The most reliable way to distinguish oriental bittersweet from American bittersweet is by the size and location of the female flowers and fruit on the stem and the colour of the capsule (fruit covering). In oriental bittersweet, the flowers and fruits are borne in multiple clusters of two or three along the stem in the leaf axils. They are generally not arranged in terminal clusters (although they can sometimes be terminal in male plants). The fruit of oriental bittersweet is smaller, and the outer fruit cover is yellow. In American bittersweet, the flowers and fruit are borne at the end of the stem as a terminal cluster with numerous flowers or fruit often more than seven; the fruit is larger and more orange-yellow. The colour of the inner fleshy aril is red for both species.

The leaves are a less reliable identification feature due to variability in size and shape, as is identification of male flowers. In general, the leaves of oriental bittersweet are about twice as long as they are wide, are much rounder and more tear-shaped, while in American bittersweet the leaves are broader, and more elliptical in shape. When leafing out of the first buds in the spring, oriental bittersweet leaves are tightly packed in the bud, and the leaves uncurl like a book, whereas American bittersweet leaves are not as tightly packed and the leaves uncurl open like a scroll (Gleason and Cronquist 1991; Leicht-Young *et al.* 2007; Pavlovic *et al.* 2007; MDNR 2012; Minnesota Wildflowers 2022).

There are also other woody stem vine species found throughout Ontario including native and invasive honeysuckles (*Lonicera* spp.), riverbank grape (*Vitis riparia*), and Virginia creeper (*Parthenocissus quinquefolia*). However, none of these resemble the bittersweets. Winter creeper (*Euonymus fortunei*) is another ornamental species that can grow as a perennial climbing vine and has similar orange-red arils, although the capsule covering the aril is white instead of yellow, with opposite branching and more oval and darker leaves that are evergreen.



Virginia creeper.

Photo courtesy of: Josue Amoroso.  
Available: <https://www.inaturalist.org/observations/184736125>, licensed under CC-by-NC.



Riverbank grape.



Photo courtesy of: Nana Sandi.  
Available: <https://www.inaturalist.org/observations/59973328>



American bittersweet.

Photo courtesy of: Larry Noonan.

**Table 1:** The main identification features of oriental bittersweet (*Celastrus orbiculatus*) in comparison to American bittersweet (*Celastrus scandens*). Key identification features which differentiate the species are in **bold**.

	<p><b>Oriental bittersweet</b> <i>(Celastrus orbiculatus)</i></p>  <p>Photo courtesy of: Jeff Skrentny. Available: <a href="https://www.inaturalist.org/observations/37430329">https://www.inaturalist.org/observations/37430329</a>, licensed under CC-by-NC.</p>	<p><b>American bittersweet</b> <i>(Celastrus scandens)</i></p>  <p>Photo courtesy of: R.W. Smith, wildflower.org.</p>
<p><b>Native range and habitat</b></p>	<ul style="list-style-type: none"> <li>• East Asia (China, Japan, Korea).</li> <li>• Semi-natural habitats.</li> </ul>	<ul style="list-style-type: none"> <li>• Central and eastern North America.</li> <li>• Rich, well-drained soils in woodlands or dry sites, such as sandy or rocky woods. Also found in swampy thickets, roadsides, fencerows, edge habitat, and open fields.</li> </ul>
<p><b>Typical size and form</b></p>	<ul style="list-style-type: none"> <li>• Woody vine that will twine around trees and structures. In more open areas without support will sprawl across the ground and become more shrub-like. Reaches a height of 18 m.</li> </ul>	<ul style="list-style-type: none"> <li>• Woody vine that will twine around trees and structures. In more open areas without support will sprawl across the ground and become more shrub-like. Reaches a height of 6-9 m.</li> </ul>
<p><b>Flowers and Fruit</b></p>	<ul style="list-style-type: none"> <li>• Dioecious; flowers and fruit of female plants are borne on longer stalks in many clusters of <b>2-3 in the leaf axils along the stem, never terminal clusters</b>.</li> <li>• <b>Fruits are more numerous and smaller, emerging at many points along the stem.</b></li> <li>• Globose or spherical berry; inner fleshy aril is red.</li> <li>• <b>Outer fruit covering when mature is yellow.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Dioecious; flowers and fruit of female plants are borne on a very short stalk in the leaf axil. They are arranged in <b>terminal clusters with numerous flowers or fruit, often &gt; 7.</b></li> <li>• <b>Fruits are fewer and larger, emerging only at the end of the stem.</b></li> <li>• Globose or spherical berry; inner fleshy aril is red.</li> <li>• <b>Outer fruit covering when mature is orange-yellow.</b></li> <li>• Male flowers may occasionally occur along the stem but will not produce fruit.</li> </ul>
<p><b>Stems and Bark</b></p>	<ul style="list-style-type: none"> <li>• Stems are round, hairless, light grey to medium brown or reddish-brown. Younger stems have <b>prominent</b> white horizontal marks (lenticels).</li> </ul>	<ul style="list-style-type: none"> <li>• Stems are round, hairless, grey-brown to reddish brown. Younger stems have <b>less prominent</b> white horizontal marks (<i>lenticels</i>).</li> </ul>

## Oriental bittersweet

(*Celastrus orbiculatus*)



Photo courtesy of: Jeff Skrentny. Available: <https://www.inaturalist.org/observations/37430329>, licensed under CC-by-NC.

## American bittersweet

(*Celastrus scandens*)



Photo courtesy of: R.W. Smith, wildflower.org.

### Leaves

- Leaves typically nearly as wide as they are long; variable from oval to oblong to obovate or elliptical.
- Broadest near the tip of the leaf (obovate).
- Range from 2-12 cm long and 1.5-8 cm wide.
- Alternately arranged, simple, finely toothed margins, with a pointed or rounded tip.
- When beginning to emerge from bud, leaves are folded flat along the midvein, like a book opening.

- Leaves typically twice as long as they are wide, less rotund, more elliptical.
- Tapers evenly at the base and the tip (elliptical).
- Range from 5-10 cm long and up to 8 cm wide.
- Alternately arranged, simple, can have more finely serrated margins than oriental bittersweet; pointed tip.
- When beginning to emerge from bud, leaves curl along the edges towards the midvein, like a rolled-up scroll in cross-section.



Oriental bittersweet wrapping around a tree for structural support.

Photo courtesy of: MN Department of Agriculture.

## Biology and Life Cycle

Young vines grow vertically, wrapping around one another for support. In open areas without additional support, it takes on a more sprawling form and may form impenetrable thickets. The species will rely on any support the environment offers, such as grasses and native shrubs in open pastures. In closed canopy forests, vines will use woody shrubs or trees for structural support, wrapping their branches around trunks and branches until they reach the highest peak in the canopy.

Oriental bittersweet produces an abundant number of flowers, fruits, and seeds each year (Fryer 2011). Patterson (1974) found that the number of seeds per fruit ranged from 2.5 - 4.1 in North America. Assuming the average plant produces 375 fruits/year (Williams and Timmins 2003), this translates to roughly 938 - 1,538 seeds/vine per growing season. Any seeds or fruit not consumed by wildlife are dropped each season directly below or adjacent to the parent plant, a process known as seed rain. In a mixed hardwood forest in Massachusetts, mean seed rain from a single season was 168 m<sup>2</sup>, and ranged from 14 - 826 m<sup>2</sup> (Ellsworth *et al.* 2004).

Oriental bittersweet is capable of germinating under a wide range of light intensities. Seed germination is higher under lower light intensities, which allows this species to establish readily under closed canopy forests. Seedlings may persist in the understory under deep shade for many years; then rapid growth is initiated when disturbance allows for canopy gaps bringing more light to the forest understory. It may not take many seedlings to establish a new oriental bittersweet population on many sites, and it has a faster growth rate than native vines, such as riverbank grape (Tibbetts 2000). Fruit production is often sparse until the vines reach the overstory, and in these open conditions it produces abundant flowers and fruit. In this way, the vine can delay reproductive maturity until it reaches ideal light conditions in the upper canopy. On mesic sites in full sunlight, oriental bittersweet may grow 3 - 3.7 m per year and can overtop 1 - 2 m tall vegetation in one full growing season (Fryer 2011).

The seed bank tends to be short-lived, lasting for not much more than one growing season. A long-lasting seed bank is not a requirement to its success, as seed germination rates are very high (85 - 95% of

seeds germinate in the laboratory) and germinate within the same growing season. Since oriental bittersweet produces an abundant number of seeds at 370 fruits/year (Fryer 2011), the seed bank can quickly be replenished each year. Most seedlings that germinate are from seeds dropped in the spring of the same season.

Due to the high rate of seed germination, this leads to the establishment of seedling banks (rather than a seed bank) in closed canopy conditions, due to the high number of seedlings that blanket the forest floor around the parent plant. These seedlings remain in the understory, adopting a sit-and-wait until a disturbance creates a gap in the forest canopy. Despite the shade tolerance of seedlings, oriental bittersweet requires full sun to reproduce sexually (Silveri *et al.* 2001). For this reason, oriental bittersweet vines will forage for gaps of light, and then climb up various structures to the top canopy, where flower and fruit production can be maximized.

The colourful seeds are often eaten by birds and small mammals, who disperse the seeds to nearby areas. Although animal digestion (through gastrointestinal scarification of seeds) is not required for seed germination, ingested seeds have higher germination rates than seeds that remain intact in their fleshy arils. In general, any process which strips the fruit pulp or skin will increase germination, as the fruit covering serves as a barrier to seed germination (Greenburg 2001). Oriental bittersweet frequently establishes along fence lines and similar sites where birds perch and defecate the seeds.

Oriental bittersweet can reproduce vegetatively through underground roots (as well as sexually). New sprouts frequently arise from the roots, root crown, or small root fragments, and large clonal colonies can develop from one or a few seedlings. Damage to the root crown (e.g., in response to cutting or burning) can also encourage vigorous sprouting (Fryer 2011). Vegetative spread can

confer advantages for this species' survival, such as facilitating rapid local spread, and allowing it to persist following heavy disturbance (i.e., fire damage) (Dreyer *et al.* 1987; Pavlovic *et al.* 2016). Oriental bittersweet flowers are usually dioecious, although occasionally plants can have both unisexual and perfect flowers (called polygamodioecious), or rarely monoecious (e.g., a few plants will produce flowers with both male and female parts in one plant) (Freyer 2011). There are self-pollinating cultivars of oriental bittersweet available, such as 'Hermaphoditus', although self-pollination is likely to be very limited given the dioecious nature of this species (Chandler 2011; Beringen *et al.* 2017). Hymenoptera, particularly bees, pollinate oriental bittersweet flowers, and flowers can also be wind pollinated.

In Ontario, growth begins in late spring. Flowers bloom from late May to June, and pollen is released two weeks after the flowers open. Leaves emerge at the same time as flowers and are fully expanded by late May. Leaves begin to turn yellow towards the end of September and drop off by the end of October. The green, unripe fruits appear around mid to end of July, and the outer fruit covering begin to turn orange, but remain closed into the end of September and early October. By the end of October, the fruits mature, and the outer coverings open to reveal the attractive red arils that have made it so popular as an ornamental. Once the capsules split open to expose the fleshy arils, seeds can begin to disperse. The fruits remain on the vine throughout the winter (unless eaten by wildlife) when the plant is dormant, before dropping around mid-March. The early emergence and late dropping of leaves provides oriental bittersweet with a competitive advantage, as it is able to remain photosynthetically active longer than native plants in similar environments. Further, the ability for fruit to remain on the shrub through the winter provides opportunities for long-range dispersal by wildlife at a time when other species (including oriental bittersweet) are dormant.

# Diseases and Natural Enemies of Oriental Bittersweet

There are very few reported insect pests or diseases of oriental bittersweet in North America. This trait is what made it desirable as an ornamental plant (Williams and Timmins 2003). Records of possible natural enemies in its native range are scarce. Only a few fungal species are known to infect *Celastrus* species in the native range. Two species, *Microsphaera celastris* and *Uncinula sengokui* are host-specific to oriental bittersweet, and *Amazonia celastris* infects various *Celastrus* species (Zheng et al. 2004). In Korea, the fungus *Marssonina celastris* is associated with leaf spots on oriental bittersweet (Shin and Lee 1999, Fryer 2011). To our knowledge, there are no viruses, diseases or plant parasites that infect oriental bittersweet are reported in the literature.

There are six arthropod species known to cause damage to oriental bittersweet in its native range, and two are host-specific (Zheng et al. 2004). In its introduced range in Massachusetts, a leaf-mining chrysomelid beetle is known to feed on oriental bittersweet (Eiseman 2014), and Dreyer (1994) noted an ornamental planting of oriental bittersweet that was infested with *Euonymus* scale (*Unaspi euonymi*) in north Georgia.

Various wildlife species, such as white-tailed deer (*Odocoileus virginianus*), eastern grey squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*) are known to browse the foliage and berries, but it is not a preferred food source. Several studies in the United States have observed oriental bittersweet vines with evidence of extensive overwinter browsing by white-tailed deer. In restored grasslands in Minnesota, plants had damage to terminal buds and reduced growth rates, although most were still able to mature and produce fruit and seed (Mundahl and Borsari 2016). In the northeastern United States, Averill et al. (2016) found that white-tailed deer would preferentially browse on oriental bittersweet while avoiding other non-palatable invasive plants such as garlic mustard (*Alliaria petiolata*) and Japanese barberry (*Berberis thunbergii*). In mixed-deciduous forest in Amherst, Massachusetts, extensive herbivory by small mammals (such as rabbits and voles) was observed on oriental bittersweet in all field plots during the growing season and winter. All new growth in the plots had been removed, and it was concluded that small mammals may play a role in reducing the seedling bank population (Ellsworth et al. 2004). However, how herbivory impacts oriental bittersweet population dynamics is not known, and other research has suggested that oriental bittersweet is able to tolerate herbivory and overcompensate with higher growth rate following damage (Ashton and Lerdau 2008).

# Habitat

Oriental bittersweet frequently establishes and proliferates in open areas and disturbed sites, including along roadsides, hedgerows, thickets, open fields, logging roads, coastal wetlands, beaches, and wet prairies. Densities are typically higher in areas that have a prior history of disturbance, such as logging or farming. It is also found in old-growth forests and wind-throw disturbance patches in forests (Leicht-Young et al. 2007; Beringen et al. 2017; CABI 2020). For example, in Massachusetts, areas with moderate to heavy infestations of oriental bittersweet were strongly associated with former logging roads, and even 14 years after logging these roads provided ideal conditions for this vine to thrive including higher soil pH levels and mesic conditions (e.g., higher soil moisture) (Silveri et al. 2001). In a study by Kuhman et al. (2013), seed germination and first year seedling survival of oriental bittersweet was higher in tulip tree (*Liriodendron tulipifera*) stands compared to oak (*Quercus* spp.) stands in Ashville, North Carolina. This was attributed to a history of cultivation a century earlier and lower leaf litter mass, which facilitated mesic soil conditions. The oak stands never experienced prior cultivation, and the thicker leaf mass was thought to act as a growth and moisture barrier, which helped to suppress seed germination.

Oriental bittersweet will also establish in low light conditions under closed canopy forests. It is most common in early successional forests, mixed hardwood forests and along forest edges but can also invade late successional mature forests and coniferous forests. It prefers mesic sites with moist, well-drained soils that are mild to moderately acidic (pH 5.6 – 6.5), although it will grow in higher pH and drier soils. It is intolerant of flooding or waterlogged soils (poorly drained or permanently wet). In the forest interior, it will often adopt a 'sit-and-wait' strategy, persisting under low light conditions until a disturbance, such as storm

damage, logging, insect or disease infestation provides an opening for light in the canopy. When this occurs, it can initiate rapid vegetative growth.



In open areas, oriental bittersweet can take a more sprawling form without support. Pictured above climbing staghorn sumac.

Photo courtesy of: City of Toronto.



# Pathways of Spread and Distribution

Across its native range in eastern Asia, oriental bittersweet is not considered a forest species. It is typically found in lowland, grassy slopes or mountainous thickets at altitudes of 100 – 1,400 m. The vine is widely distributed in northern and central Japan and Korea, provinces north of the Yangtze River in China, far-eastern Russia and Sakhalin Island (Hou 1955; CABI 2020; Fryer 2011). The vine is the most widely distributed of the *Celastrus* species in China, although it is not known to be invasive in its native range (McKenzie-Gopsill and MacDonald 2021).

Oriental bittersweet is considered invasive in at least 21 states in the eastern and Midwestern USA (Patterson 1974; Fryer 2011). It is found from Minnesota, south to Texas, east to Maine, and west to Nebraska, Kansas, and Oklahoma. It is particularly common in the northeast and mid-Atlantic (Maryland, Washington DC, Connecticut, and Virginia), as well as North Carolina. Very dense populations are found in the northeastern United States, and localized dense populations are scattered throughout the eastern United States (CABI 2020; EDDMaps 2022). It is listed as a noxious weed in Connecticut, New Hampshire, Massachusetts, North Carolina, and Vermont. The sale of oriental bittersweet is prohibited in several US states including Connecticut, Minnesota, and New York. It is also found in the west, but populations are not considered invasive (i.e., California, Oregon, Washington State) (McKenzie-Gopsill and MacDonald 2021).

In Canada, the first record of introduction dates to 1937 (McKenzie-Gopsill and MacDonald 2021). It has since become naturalized in a number of locations in Ontario, Quebec, New Brunswick, Prince Edward Island, and Nova Scotia (CABI 2020). It is found scattered throughout Ontario where localized populations can be abundant, including areas within the Greater Toronto Area (GTA), Hamilton, Niagara, Middlesex, Haldimand-Norfolk and Ottawa. It can be common in urban areas where it is planted in backyards or along fences and is easily spread to neighboring properties and nearby natural areas (OIPC Working Group, personal communications; EDDMaps 2022). Although oriental bittersweet is currently not as problematic in Ontario as it is in portions of the USA, populations are expanding and are expected to become a more serious problem particularly in response to climate change impacts (Albright *et al.* 2009).

Oriental bittersweet spreads vegetatively by sprouting from underground roots, root fragments, and the root crown, as well as by seed. Root suckering can result in large clones which expand from one or a few original plants. The seeds are dispersed to new areas when the fruit is consumed by birds and other wildlife. Birds facilitate dispersal along fence lines and other roosting areas where they perch to rest. Humans can also facilitate spread when collecting and transporting fruiting branches to make decorations and when the branches are discarded in compost piles near natural areas. Oriental bittersweet was historically planted along highways for wildlife food and cover and for erosion control, which has further contributed to its spread. The vine is still occasionally sold in nurseries in Ontario or can be ordered online. It is occasionally mislabeled as the native American bittersweet.

**For up-to-date distribution information, visit EDDMapS: [www.eddmaps.org/ontario](http://www.eddmaps.org/ontario) or <http://inaturalist.ca>.**

# Impacts

## Ecological:

Oriental bittersweet is an aggressive species with the potential to displace many native plant species. It possesses a host of advantageous traits including rapid growth rate, ability to tolerate a range of light intensities, abundant fruit and seed production, high rates of germination and seedling establishment, adaptability, and multiple dispersal pathways.

Due to its rapid growth and ability to tolerate dense shade, oriental bittersweet is a substantial threat to mature closed-canopy forests. It adopts a 'sit-and-wait' strategy, germinating under low light levels in the forest understory. It can remain as a seedling for many years until a gap in the forest canopy opens, when the vine then initiates rapid growth. In response to increased light penetrating the forest floor, oriental bittersweet will climb over any supporting vegetation (herbaceous forbs, stumps, shrubs, and trees) to reach the top of the canopy (Greenburg *et al.* 2001). Annual growth may be more than three metres per year, allowing the vine to climb a canopy-sized tree in as little as three to four growing seasons (Silveri *et al.* 2001). As it climbs, it outcompetes other native species for light and space, and its leaves prevent the host plant and other understory plants from accessing sunlight. This can alter forest structure and reduce tree regeneration, as very few species are able to survive under the dense shade and weight of oriental bittersweet vines (Patterson 1974). For example, canopies of oriental bittersweet inhibited the establishment of understory spring ephemerals in Illinois (Hutchinson 1992). In Dingle Creek, North Carolina, areas with oriental bittersweet have been found to have lower species diversity and abundance in the herbaceous layer (Browder 2011). Furthermore, oriental bittersweet will also directly impact its host tree by tightly wrapping around the tree, strangling and girdling the tree

as it climbs. This restricts water and sap flow and makes the tree vulnerable to stem breakage and uprooting by heavy ice and high wind damage. The vine can delay reproductive maturity until reaching the top of the canopy where it can then begin to initiate rapid flower and fruit production in more ideal light conditions. In contrast to this 'sit-and-wait' strategy, the native American bittersweet is unable to adjust as easily to varying light intensities and does not photosynthesize as well as oriental bittersweet in low light conditions (Leicht and Silander 2006).

For this reason, American bittersweet is almost exclusively found in open habitats, such as alvars, prairies, and dune habitats.

Oriental bittersweet can also thrive in open areas, particularly if there has been a past history of disturbance. For example, it can invade old field sites, where it can slow or alter old field successional pathways. A study that tracked old field succession over four decades (between 1954 and 1992) found that an area of the field without oriental bittersweet naturally succeeded from a forb-grassland community into an early hardwood forest. However, in another section of the field where oriental bittersweet had spread from a nearby infestation it changed the forb-grassland into a thicket of oriental bittersweet, creating a vine-dominated community that excluded other woody species and altered the natural successional path from field to forest (Jean and Nierang 1999).

Oriental bittersweet may also impact native species by altering the soil pH and nutrient levels (Leicht-Young *et al.* 2015). A study found that field plots with oriental bittersweet had more alkaline soil, which could impact nutrient uptake of native plants, than plots without oriental bittersweet. Oriental bittersweet plots also had higher potassium,

calcium, magnesium, and nitrogen mineralization in a range of soil and forest community types (Leicht-Young et al. 2009).

Oriental bittersweet has many competitive advantages over native American bittersweet. It has a faster growth rate, higher rates of pollen and seed viability, and greater tolerance to a variety of environmental conditions. This has contributed to its expansion throughout the USA and Canada, while American bittersweet has declined throughout its range, due in large part to the expanding range of oriental bittersweet (Steward et al. 2003). Oriental bittersweet also has the potential to hybridize with American bittersweet, which can dilute the species gene pool (Zaya et al. 2015).

Oriental bittersweet has the potential to impact several Species at Risk if it encroaches and alters the habitat where the species are found. Oriental bittersweet is a potential threat to Virginia goat's-rue (*Tephrosia virginiana*), an endangered plant in Ontario (according to the Committee on the Status of Species at Risk in Ontario (COSSARO)). In Turkey Point Provincial Park, oriental bittersweet is in close proximity to a population of this endangered species (Mohr 2013). Another example is near Lake Michigan, where oriental bittersweet poses a threat to a population of Pitcher's thistle (*Cirsium pitcheri*) in a dune habitat (Leicht-Young and Pavlovic 2012). As Pitcher's thistle is also a threatened species in Ontario (COSSARO), oriental bittersweet could also further threaten this species if it escapes to where Pitcher's thistle is currently found. Lastly, oriental bittersweet has threatened sand dunes in Long Island Sound, Connecticut, which provide nesting sites for Piping Plover (*Charadrius melodus*) a state-threatened and Ontario (COSSARO) endangered species.

Oriental bittersweet berries have some benefits as a winter food source for a variety of bird species, including Black-capped Chickadee (*Parus atricapillus*), Northern Mockingbird (*Mimus polyglottos*), European Starling (*Sturnus vulgaris*),

Blue Jay (*Cyanocitta cristata*), Eastern Bluebird (*Sialia sialis*), American Robin (*Turdus migratorius*), and other thrush species (Turdidae). Overwintering flocks of birds have been observed targeting oriental bittersweet patches and contributing to seed dispersal where they perch along fence lines and other roosting areas (Greenburg et al. 2001). The oriental bittersweet berries are nutritious, with levels of protein and carbohydrates comparable to other shrub species. Other wildlife species, such as eastern cottontail (*Sylvilagus floridanus*), white tailed deer (*Odocoileus virginianus*), and eastern grey squirrel (*Sciurus carolinensis*) may browse the foliage and berries, but it is not a preferred food source.

### **Economic:**

Due to its impact on forest succession, oriental bittersweet could impact forestry production if it invades a forest following disturbance, such as timber harvesting. It is also a host for *Xylella fastidiosa*, a bacterial vector for several diseases of crops, including Pierce's grapevine disease, plum leaf scorch, phony peach disease, and variegated chlorosis (which affects several species including oak, elm, sycamore, citrus tree, and mulberry) (McElrone et al. 1999). However, oriental bittersweet is not considered a main or important host and the overall impacts are not known.

Oriental bittersweet is commercially available in Canada and several states, due to its popularity as an attractive ornamental and its fast growth, disease resistance and hardiness to the urban environment.

Oriental bittersweet may cause damage to infrastructure when the vine grows into fences or above ground low voltage power lines and telephone wires and makes these structures more vulnerable to wind-throw (Beringen et al. 2017).

### **Societal:**

Oriental bittersweet has been used in traditional medicine to treat rheumatoid arthritis and bacterial infections (Fryer 2011). One derivative has shown

the ability to reverse multidrug resistance of cancer cells to cancer treatment drugs (Kim *et al.* 1999). It is also used as a fine fiber in China, and leaf extracts can be an alternative to calf rennet enzymes used to make cheese. The fruit is known to be toxic to humans (Freyer 2011).

Oriental bittersweet has aesthetic value. It is still grown in gardens as an attractive ornamental due to its bright red fruit that remain on the vine in fall and winter, and its branches are used to make wreaths and decorative displays. In China it is also grown as a bonsai tree (Beringen *et al.* 2017).



Berries persist through the winter, providing a food source for wildlife, which disperse the seeds in their droppings.

Photo courtesy of: Max Lawrence. Available: <https://www.inaturalist.org/observations/36946210>, licensed under CC-by-NC.

# Applicable Legislation

(Last Updated – July 2024)

**Regulatory Tools – Oriental bittersweet:**  
 Oriental bittersweet is not a federally or provincially regulated species. **See Table 2 for details.**

Depending on the location, timing of work, and the type of management activities (e.g., mechanical/manual or chemical), permits, approvals or authorizations may be required from municipal, provincial or federal agencies before oriental bittersweet control can be initiated. Individuals undertaking control activities for oriental bittersweet are responsible for ensuring that these are obtained and complying with any applicable legislation. Please note that this is only for general guidance and is not intended as legal advice.

Additionally, if protected species or habitats are present, an assessment of the potential effects of the control project and authorization could be required. Depending on the species and its location, applications should be directed to the appropriate authorities.

While not an exhaustive list of permits or rules that may apply to oriental bittersweet management, the following examples are provided for consideration.

**Table 2:** Legislation pertaining to oriental bittersweet management.

Legislation & Regulating Body	Purpose	Application to Oriental Bittersweet Management
<b>PROVINCIAL</b>		
<p><b><i>Invasive Species Act, Ontario Regulation 354/16</i></b></p> <p>Ministry of Natural Resources (MNR)</p> <p>Applicable to Terrestrial and Aquatic Environments</p>	<p>Prevent the Introduction and Spread of Invasive Species</p>	<p>Oriental bittersweet is not regulated under the <i>Invasive Species Act</i>, 2015.</p> <p>For more information, visit: <a href="https://www.ontario.ca/page/managing-invasive-species-ontario">https://www.ontario.ca/page/managing-invasive-species-ontario</a></p>
<p><b><i>Weed Control Act</i></b></p> <p>Ontario Ministry of Agriculture, Food and Agribusiness (OMAFRA)</p>	<p>Regulation of Noxious Weeds in Ontario</p>	<p>Oriental bittersweet is not listed in the Schedule of Noxious Weeds under the <i>Weed Control Act</i> (WCA), 1990.</p> <p>The WCA is administered by the Ontario Ministry of Agriculture, Food and Agribusiness (OMAFRA). The objective of the WCA is to minimize the impact of noxious weeds and weed seeds on agriculture or horticultural land.</p> <p>Landowners whose property contains noxious weeds and weed seeds that negatively affect agriculture or horticultural lands are responsible for weed control and associated costs.</p> <p>For more information on noxious weeds and what to do if you find them on your property visit:</p> <p><a href="http://www.omafra.gov.on.ca/english/crops/facts/noxious_weeds.htm">http://www.omafra.gov.on.ca/english/crops/facts/noxious_weeds.htm</a></p>

Legislation & Regulating Body	Purpose	Application to Oriental Bittersweet Management
<p><b>Endangered Species Act</b></p> <p>Ministry of Environment Conservation and Parks (MECP)</p> <p>Applicable to Terrestrial and Aquatic Environments</p>	<p>Protection of Endangered and Threatened Species and their Habitat</p>	<p>The <i>Endangered Species Act</i> (ESA) prohibits the killing, harming, and harassing of species at risk (SAR) classified as extirpated, endangered or threatened, as well as damage and destruction of the habitat of endangered and threatened SAR. Management activities that may adversely impact protected SAR or habitat may proceed in accordance with an ESA authorization (permit or agreement) or regulatory exemption.</p> <p>For the full list of species at risk in Ontario and for information on permit requirements consult: <a href="http://ontario.ca/page/how-get-endangered-species-act-permit-or-authorization">http://ontario.ca/page/how-get-endangered-species-act-permit-or-authorization</a></p>
<p><b>Pesticides Act &amp; Regulation 63/09</b></p> <p>Ministry of Environment Conservation and Parks (MECP)</p> <p>Applicable to Terrestrial and Aquatic Environments</p>	<p>Regulation of Pesticide Use in Ontario</p>	<p>The <i>Pesticides Act</i> and Ontario Regulation 63/09 govern the sale, use, transportation, storage and disposal of pesticides in Ontario including license and permit requirements. Most invasive species control projects will require a licensed exterminator.</p> <p>Only pesticides registered under the federal <i>Pest Control Products Act</i> by the PMRA can be used in Ontario. <b>The pesticide label is a legal document that must be followed exactly.</b></p> <p>Exterminations on land are subject to the cosmetic pesticide ban. Other than certain biopesticides and low-risk pesticides on Ontario’s “Allowable List”, pesticides can only be used in accordance with an exception (e.g., agriculture, forestry, public health and safety, natural resources and other legislation) to the cosmetic pesticide ban. The licensed exterminator in charge can provide guidance regarding how the exceptions to the cosmetic pesticide ban apply to the specific extermination and any requirements that must be met to perform work under the exception.</p> <p><b>For more information on these exceptions and the rules with respect to pesticide use visit:</b> <a href="https://www.ontario.ca/laws/regulation/090063">https://www.ontario.ca/laws/regulation/090063</a></p>
<b>FEDERAL</b>		
<p><b>Species at Risk Act (SARA)</b></p> <p>Environment and Climate Change Canada (ECCC)</p> <p>Applicable to Terrestrial Environments</p>	<p>Protection and Recovery of Species at Risk and their Habitats</p>	<p>For most extirpated, endangered and threatened species, the <i>Species at Risk Act</i> (SARA) applies automatically only on federal lands. This includes national parks, national marine conservation areas, national historic sites and other protected heritage areas administered by Parks Canada.</p> <p>For control activities on federal lands that may affect non-aquatic species listed on Schedule 1 of SARA, or which contravene SARA’s general or critical habitat prohibitions, permits may be required.</p> <p>For more information, consult: <a href="https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/permits-agreements-exceptions/permits-agreements-information.html">https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/permits-agreements-exceptions/permits-agreements-information.html</a></p>

Legislation & Regulating Body	Purpose	Application to Oriental Bittersweet Management
<p><b>Migratory Birds Convention Act &amp; Regulations</b></p> <p>Environment and Climate Change Canada (ECCC) – Canadian Wildlife Service (CWS)</p> <p>Applicable to Terrestrial and Aquatic Environments</p>	<p>Protection of Migratory Birds, and their Nests and Eggs</p>	<p>When undertaking your project, you should take precautions to avoid harming migratory birds, nests and eggs.</p> <p>This includes:</p> <ul style="list-style-type: none"> <li>• Understanding how migratory birds and their nests are legally protected</li> <li>• Consider species activity timelines (i.e. active nesting season)</li> <li>• Planning your activity ahead of time, evaluate if the activity may cause harm to migratory birds, and determine what measures can be taken to avoid causing this harm</li> <li>• Develop and implement preventative and mitigation measures, such as beneficial management practices.</li> </ul> <p>For more information please visit: <a href="https://www.canada.ca/en/environment-climate-change/services/migratory-birds-legal-protection/convention-act.html">https://www.canada.ca/en/environment-climate-change/services/migratory-birds-legal-protection/convention-act.html</a></p>
<p><b>Pest Control Products Act</b></p> <p>Pest Management Regulatory Agency (PMRA), Health Canada</p> <p>Applicable to Terrestrial and Aquatic Environments</p>	<p>Regulation of Pest Control Products in Canada</p>	<p>Before a pesticide can be sold or used in Ontario, it must be registered under the federal <i>Pest Control Products Act</i> (PCPA) by the Pest Management Regulatory Agency (PMRA) of Canada. The pesticide label is a legal document. <b>Follow all label directions – and ensure you have the most current label and are aware of any re-evaluation decisions.</b></p> <p>Visit the PMRA's product label search site at: <a href="https://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php">https://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php</a></p>

## Municipal

Under the *Building Code Act* (1992), municipalities are able to pass bylaws to address the presence of invasive plants. Municipalities can enact bylaws to control plants when there is a risk of negative impact to human health and safety.

Municipalities are responsible for enforcing the *Weed Control Act of* (1990) to reduce the infestation of noxious weeds that negatively impact agricultural and horticultural land. Subject to the Ministry of Agriculture, Food and Rural Affairs approval, municipalities can designate additional plants not listed on the Ontario Noxious Weed list in their own jurisdiction.

# Invasive Management Planning

## Management Considerations

Avoiding planting oriental bittersweet and preventing its spread before it becomes locally established will reduce its impacts on biodiversity, the economy, and society.

It is important to use a control plan that incorporates Integrated Pest Management (IPM) principles. This means using existing knowledge about the invasive plant (i.e., its biology and life cycle), and its surrounding environment. This often requires more than one type of control measure to be successful.

Once oriental bittersweet has been confirmed at a location, a control plan should be developed based on infestation size, site accessibility, potential for spread and the risk of environmental, economic, or social impacts. Consider site-specific conditions such as native plant richness and diversity and wildlife usage including bird migration routes and species at risk. A detailed inventory of each site is strongly recommended before starting control efforts to help ensure proper methods and timing are used to minimize negative impacts on wildlife and native plant species.

## Mapping

If you are planning a restoration project on your property, conducting an ecological survey is a beneficial way to document current and future distributions of invasive plants that might be present, such as oriental bittersweet. Conservation authorities or municipalities which manage large land areas may use internal staff or contractors, or have qualified volunteers conduct ecological surveys. However, private landowners with smaller properties may be able to conduct their own surveys or hire a contractor. If you know you have oriental bittersweet in one area, survey the rest of the property to identify other infestations. Map the extent of the invasion, as well as any small satellite populations.

For detailed information on mapping techniques consult the [Landowners Guide for Managing and Controlling Invasive Plants in Ontario](#). To determine potential infestations in your areas, consult EDDMapS: <https://www.eddmaps.org/>

## Landscape Level Management

If oriental bittersweet has become widely established, a more detailed management strategy should be undertaken. A strategic, landscape-level approach to management should be undertaken that aids in bringing together partners, landowners, and land managers. This approach is designed to work towards common and shared goals that consider both site-level needs in conjunction with wider landscape considerations. It makes it easier to use resources efficiently, coordinate management activities and accomplish strategic goals. Failure to consider a broader landscape context, by only focusing on individual or local challenges, may increase management costs, be more labour intensive, and may not produce desired results across larger areas. Effective management of oriental bittersweet requires repeat treatments and the combination of control methods (i.e., hand pulling or digging, cutting and herbicide use). It is important to determine the land use objective and desired plant community because it is not always realistic, especially for larger populations, to eliminate the entire infestation at once. From here, develop an appropriate IPM strategy which takes into consideration the biology and life cycle of the plant in addition to using a combination of management techniques.



## Setting Priorities

Establishing your highest priority locations for control prior to management will help to determine the best course of action. Therefore, when developing a management strategy, it is important to consider the following considerations to help inform control decisions:

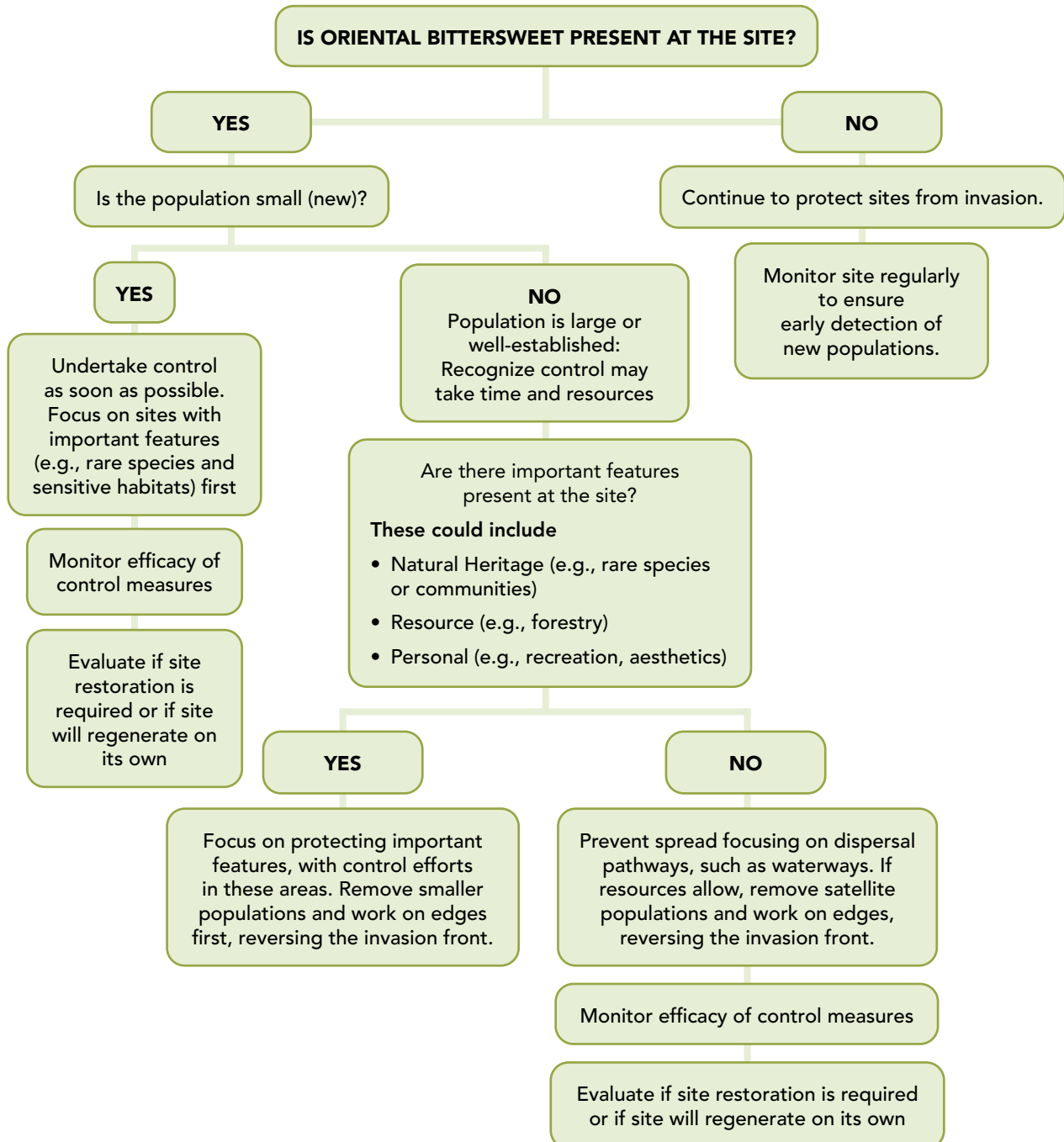
1. **Protect** federally, provincially, and regionally rare species and communities by removing invasive plants and ensuring rare species are not negatively impacted by control efforts. You are responsible for ensuring that your project follows provincial, federal, and municipal laws, including the provincial *Endangered Species Act*, and federal *Species at Risk Act*. For species-specific information consult: <https://www.ontario.ca/page/species-risk-ontario>
2. **Ensure** all landowners have been identified and consulted before control takes place.
3. **Contain:** If you have limited resources, try to remove the outlying populations of oriental bittersweet first (isolated plants or satellite populations), to prevent further spread. Protect areas where oriental bittersweet is absent or just appearing. When action is taken early it can significantly reduce the cost of control. Targeting new populations while they are still in seedlings can help to reduce seed source and spread. In these areas, the native habitat is likely also most intact, and will be fastest to recover from the infestation.
4. **Work inward:** If you have more resources, working from the outlying or satellite populations inward into larger, "core" populations of oriental bittersweet and reducing the quantity of seeds can prevent spread into uninfested areas. In many cases, resource limitations may prohibit the immediate removal of entire core populations. Under these circumstances, core areas should be prioritized and addressed strategically.
5. **Consider sensitive ecological areas:** Concentrate on preventive strategies in high-priority ecological areas or areas where the plant is going to cause the most problems in terms of spread, such as the most productive or sensitive part of an ecosystem, along a creek, near species at risk, or a favourite natural area. Pay special attention to disturbed sites which can be quickly colonized by oriental bittersweet and other invasive plants. Reduce the spread of oriental bittersweet by following the [Clean Equipment Protocol](#) and removing invasive plant material from boots, clothing, and animal fur.
6. **Logistics and costs:** Review the different control options and costs with consideration to surrounding water, habitat, time of year, and type of land use (i.e., high-traffic recreational areas, agriculture, etc.).
7. Consider dedicating a certain time each year to control efforts and make it a joint effort with neighbouring landowners and/or land managers.
8. Begin to assess whether regeneration or restoration is appropriate, and if seeding or planting of native plants is needed to help jump-start natural succession and increase biodiversity in the area.
9. Follow-up monitoring is crucial to remove new plants or address resprouts that may emerge after initial control efforts. Control for oriental bittersweet is most successful using a combination of techniques (mechanical removal, chemical control) applied more than once per year, as well as repeat monitoring and control over multiple years.

## Prioritizing within a Control Area

(This section is modified from *The Landowners Guide to Managing and Controlling Invasive Plants*, published by Credit Valley Conservation).

1. Focus on large blocks of un-invaded areas and keep them free of invaders.
2. Control small, younger, outlier (satellite) populations first.
3. Reverse the invasion, expand the cleared area outward and ensure that un-invaded areas are kept free of invasive plants (with regular monitoring).

This flow chart can help land managers choose where to first focus control efforts if controlling satellite populations due to limited resources:



**Figure 1:** How to prioritize oriental bittersweet sites for effective control.

## Long-term Management and Monitoring

Due to the potential impact of oriental bittersweet on deciduous forests in North America, a long-term management and monitoring plan should be created prior to the implementation of control efforts. Monitoring will enable assessment of the initial control measures, including their effectiveness, as well as the types of follow-up treatments that are necessary. Ongoing management is critical to the success of a project; after removal, a site remains at risk of re-invasion by nearby populations or another invasive species.

Monitoring could be as simple as taking photos or performing a visual inspection, or it could be more complex and include extensive vegetation surveys. In general, annual treatment is imperative and should focus on selectively removing isolated populations as they appear. Follow-up spot treatment will help to ensure the invasive population remains under control and allows for the regeneration of native plant species.

For detailed information on monitoring consult the [Landowners Guide for Managing and Controlling Invasive Plants in Ontario](#).

### After Management: Assessing Regeneration vs. Restoration

Consider the following factors:

#### 1. Level of disturbance at the site:

- Was this a heavily invaded site (e.g., was much disturbance caused during control measures)?
- Will it continue to be disturbed (e.g., through land-use activities such as logging)?

#### 2. Biology of the invasive species removed:

- Is there a seed bank to consider?
- Are there seed banks from other invasive plants in the area?

#### 3. Re-invasion risk:

- Are there any oriental bittersweet populations nearby which could re-invade the site through various pathways of spread (i.e. bird dispersal, nearby trails, or roads)?

#### 4. Existing native vegetation:

- Will any native vegetation that still exists on the site regenerate quickly?
- Does it need help? Species with specific habitat requirements or reproductive strategies resulting in low fecundity, including species at risk, may require re-introduction. The majority of plant species should be able to recover naturally, especially if healthy populations exist adjacent to the controlled area.

If you answered **Yes** to most of the questions under 1 to 3, it is most likely that (a) the site will be re-invaded before it has a chance to regenerate on its own or (b) that oriental bittersweet will continue to invade and be present among the native species so that annual control of oriental bittersweet may be required. Restoration will need to reduce the risk of re-invasion. If you answered **Yes** to the questions under 4, your site may have a lower risk of invasion but could still require some restoration measures to help re-establish native vegetation.



Focus on removing seed sources by eradicating large, fruit-bearing vines first.  
Photo courtesy of: Stephen Smith, Urban Forest Associates.

## Control Measures

The relative ease and success of control strategies will depend on the location, extent of infestation, amount of native vegetation at the site, as well as the time, labor and resources available. Oriental bittersweet is difficult to control once it becomes established, therefore a strategy which includes Integrated Pest Management (IPM) principles, where more than one management technique is applied increases overall effectiveness. Consider control strategies at different stages of the vine's growth (seedlings, small vines, large vines), as well as location (intact, closed canopy forest vs. open or disturbed areas).

In closed canopy, deciduous forests, the goals of treatment include eliminating the root system, stopping the destructive impacts of the vine on native trees and shrubs, and preventing infestations from spreading further (e.g., prevent further seed production and dispersal). Focus on removing seed sources by eradicating the large, fruit-bearing vines first, followed by the small vines. As a first step, desirable trees and shrubs can be freed of the weight of aerial stems by cutting them at ground level (do NOT pull the vines as this could result in damage to desirable vegetation or personal injury). This will kill the aerial strangling portions in the canopy, as cut vines lose their leaves and dry out, so that weight on desirable plants is no longer an issue. Large, mature vines often support many stems which may be wrapped around desirable trees high into the canopy, making treatment with basal bark or foliar herbicide impractical: basal barking vines risks off-target spray damage to the strangled plant, and most of the vine's leaf area is out of reach in the upper canopy for foliar spray. The most feasible approach to impact the root system is to employ one of two methods: either cut existing stems and apply herbicide to the cut-stump, or cut the stem and treat the re-sprouts later in the season. The vine is typically cut in two places, near the ground and again at chest height. Herbicide can also be applied without cutting the stems using the basal bark or hack-and-squirt methods, however these methods are often challenging and impractical, particularly if the vine is tightly wrapped around a desirable tree (Templeton *et al.* 2020).

Manual methods such as hand pulling or digging can be effective at removing small seedlings in the understory or isolated, low-density populations, as it is still possible to remove the entire root at this stage. Note that any leftover roots will respond by vigorous sprouting and regrowth, making full eradication and control a challenge for this species. The rhizomes can also run long distances, with many stems emerging along the way. Be sure to take precautions with the movement of soil in areas where oriental bittersweet is found as any root fragments can sprout and generate a new plant.

Restoration can be difficult in heavily infested areas, as the natural vegetation may have been greatly altered. Individual clone populations stemming from re-sprouts can be difficult to eradicate, and significant seedling regeneration may result following removal. Removal of seedlings through hand pulling or digging may need to be repeated over several seasons. It is also very important to take measures to reduce potential for disturbance during control, as this vine responds vigorously to disturbance. Fortunately, seeds are short-lived in the soil, allowing better opportunities for control than if the species had an extensive and long-lived seed bank. During control, consider potential off-site seed sources. Long-distance dispersal by birds or along roads provides opportunities for re-invasion, therefore ongoing removal of isolated plants or control of vines along roadsides are important control strategies.

In areas that are vulnerable to disturbances (i.e., areas of timber harvesting or construction activities), focus on eradicating any seedlings that may establish. Prioritize early control of isolated patches or small infestations before they become unmanageable. In open areas with dense infestations of low-lying vines, foliar spray may be an effective treatment.

Initial surveys for oriental bittersweet may be initiated any time of year but is most ideal when key ID characteristics are present, such as flowers (May – June) or fruit (August – mid-March). Also be sure to differentiate between oriental bittersweet and native American bittersweet, particularly in open habitats where the species have the potential to overlap. Continue to monitor sites on an ongoing basis for treatment effectiveness, and retouch as required.

## Manual

### Pulling and Digging:



Individual or young plants can be hand pulled.

Photos courtesy of: City of Toronto.

<b>Infestation Size:</b>	<ul style="list-style-type: none"> <li>• Small or early infestations (low stem densities).</li> </ul>
<b>Goal:</b>	<ul style="list-style-type: none"> <li>• Remove individual plants or young plants (seedlings) during early stages of invasion.</li> <li>• Remove leftover seedlings during post treatment monitoring.</li> </ul>
<b>Timing (season):</b>	<ul style="list-style-type: none"> <li>• Hand pulling is best when soil is moist.</li> <li>• Any time of year; best prior to fruiting to prevent seed spread (spring – summer).</li> </ul>
<b>Treatment Frequency:</b>	<ul style="list-style-type: none"> <li>• Repeat multiple times.</li> </ul>
<b>Best Practices:</b>	<ul style="list-style-type: none"> <li>• It is important to confirm whether young shoots are seedlings or sprouts from an established plant with an extensive root system. If it is a sprout, herbicide should be applied if the entire root system cannot be removed by pulling or digging. For digging, use a spade or weed wrench tool.</li> <li>• To hand pull seedlings, steadily and slowly remove the root to minimize soil disturbance, tamping soil down afterwards. Make sure to remove the entire root, as incomplete removal can stimulate re-growth. The uprooted vines should be removed from the site to prevent rooting, particularly if fruits are still present on the stems.</li> </ul>
<b>Advantages:</b>	<ul style="list-style-type: none"> <li>• Effective for scattered individuals or small seedlings.</li> </ul>
<b>Disadvantages:</b>	<ul style="list-style-type: none"> <li>• Removal of a large root system can be difficult or impossible, especially with larger vines or certain soils. The roots run long distances with stems emerging along the way, and re-sprouting can result if not entirely removed. Not recommended for large or established populations.</li> </ul>

## Mechanical

### Cutting or Mowing (alone):

**NOT RECOMMENDED.** While frequent cutting or mowing may prevent vines from climbing desirable vegetation, it is not possible to exhaust the plant's root system through repeated cutting. Cut vines will resprout vigorously from stumps and roots. Mowing has been found to encourage root sprouting, even if repeated periodically (Templeton *et al.* 2020). Cutting must be followed up with an herbicide application.

### Prescribed Fire:

#### NOT RECOMMENDED

<b>Goal:</b>	<ul style="list-style-type: none"> <li>• Reduce above ground vegetation on suitable sites.</li> </ul>
<b>Timing (season):</b>	<ul style="list-style-type: none"> <li>• Spring.</li> </ul>
<b>Treatment Frequency:</b>	<ul style="list-style-type: none"> <li>• Repeat annually.</li> </ul>

### Best Practices:

- Repeat annual prescribed fire in spring has shown success in controlling seedlings and small bittersweet stems when combined with herbicide treatment.
- Most practical in fire-adapted communities. Ideal for sites where a prescribed burn has already been planned (i.e., restoring savannah habitat), and bittersweet is treated as part of a broader restoration project.
- Apply in conjunction with cutting and herbicide application (either cut-stump or cutting and foliar spray of resprouts). Follow-up any resprouting from burn treatment with foliar application.

### Advantages:

- Can aid in controlling seedlings and small bittersweet stems in fire-adapted communities.

### Disadvantages:

- Difficult to control, presents risk of damage to other vegetation, adverse effects on air quality, does not kill the root system. Not recommended for established populations because it can trigger extensive growth and suckering in mature plants, worsening infestations. Oriental bittersweet is stimulated by open canopies and available nutrients, conditions that are promoted by fire. Cutting is more effective than burning in preparation for herbicide treatment. Be cautious with vines climbing trees as these vines could act as a ladder for the fire to reach the tree canopy (more suited to open sites). Note that fire can encourage seed germination, and any resprouts may need to be treated in a follow up treatment.

## Cultural

### Solarization:

If chemical control is not feasible, cutting the vines and tarping the invaded area may be an effective control option (McKenzie-Gopsill 2020). Seedlings or small vines are cut to the ground, and a large heavy black plastic sheet is placed over the area. The tarp will prevent light from reaching the stump, which will eventually kill the roots. This method will require frequent returns to monitor the site, to ensure the covered material has not been tampered with (by humans or wildlife) or damaged. Control any shoots that sprout from the tarp edges.



Dense thicket of oriental bittersweet.

Photo courtesy of: Lee Merrill, Credit Valley Conservation.

## Chemical



Oriental bittersweet loses its leaves later than most native species, making it easier to locate in autumn.

Photo courtesy of: Tom Norton. Available: <https://www.inaturalist.org/observations/34953792>, licensed under CC-by-NC.

The management of pesticides is a joint responsibility of the federal and provincial governments. The federal government, through the Pest Management Regulatory Agency (PMRA), is responsible for approving the registration of pesticides across Canada under the *Pest Control Products Act*. Ontario regulates the sale, use, storage, transportation and disposal of pesticides including issuing licenses and permits under the *Pesticides Act* and Ontario Regulation 63/09. Federally registered pesticide products are assigned one of four product class designations (e.g. Manufacturing, Restricted, Commercial or Domestic). The class of pesticides determines who can sell or use the pesticides products as well as what restrictions are placed on its use (e.g., requires a license and/or permit). Most invasive species control programs using a pesticide will require an appropriately licensed exterminator.

The use of pesticides on land is subject to the cosmetic pesticide ban. Other than certain biopesticides and low-risk pesticides on Ontario's "Allowable List", pesticides can only be used if the use is permitted under an exception to the ban. Depending on the specifics of the extermination, invasive plant control may be permitted in accordance with exceptions for forestry, agriculture, public health and safety (e.g., plants poisonous to humans by touch and plants that affect public works and other buildings and structures) and compliance with other legislation (e.g., control of noxious weeds where required by the *Weed Control Act*). There is also an exception for the management, protection, establishment or restoration of a natural resource that may be considered if other exceptions do not apply. The requirements that must be met for pesticide use under each exception are set out in Ontario Regulation 63/09 and may include conditions such as certification in integrated pest management, a letter from the relevant Ministry (MNR or MECP) and/or others.



The appropriately licensed exterminator in charge can provide guidance on requirements that apply to the specific extermination under consideration.

## Herbicide Selection and Application

Pesticide applications can be an effective method for oriental bittersweet management when used as part of an integrated pest management program and in consideration of the species biology and site-specific information. Pesticides must be applied in accordance with the federal *Pest Control Products Act*, the *Ontario Pesticides Act*, Ontario Regulation 63/09 and all label directions. Most invasive species control programs using a pesticide will require an appropriately licensed exterminator. The availability of pesticides to control oriental bittersweet may change over time, as may the label directions on how to use the pesticide so that it does not endanger human health or the environment.

Before using any pesticide, ensure you have the most current label. Pesticide labels can be accessed using the PMRA's label search tool, which can be found by searching "PMRA label search" in any major search engine. Always read and follow all directions on the label. The label is a legal document that must be followed exactly, including any applicable buffer zones. Using a pesticide to treat a species not listed on the label, or in a manner other than specified on the label violates the *Pest Control Products Act* and may incur penalties.

## Herbicides and Oriental Bittersweet

**Table 3:** Herbicides effective at controlling oriental bittersweet.

Herbicide	Application/Timing	Herbicide Class	Benefits	Cautions
<b>Glyphosate</b>	<ul style="list-style-type: none"> <li>Apply as a foliar spray to seedlings or dense infestations.</li> <li>Apply with a backpack or canister sprayer</li> </ul>	<ul style="list-style-type: none"> <li>Commercial</li> <li>Only licensed professionals may apply this herbicide.</li> </ul>	<ul style="list-style-type: none"> <li>Low rate of persistence in the environment, low toxicity.</li> </ul>	<ul style="list-style-type: none"> <li>Observe required buffer zones. Non-selective, avoid contact with non-target plants.</li> <li>Avoid application if heavy rain is forecasted.</li> </ul>
<b>Triclopyr</b>	<ul style="list-style-type: none"> <li>Apply to bark or cut stump from mid-summer onwards. Avoid using during heavy sap flow in spring.</li> <li>Apply with a backpack or canister sprayer.</li> </ul>	<ul style="list-style-type: none"> <li>Commercial</li> <li>Only licensed professionals may apply this herbicide.</li> </ul>	<ul style="list-style-type: none"> <li>Fast acting (3-5 days). Can be used for both basal bark and cut stump treatments.</li> </ul>	<ul style="list-style-type: none"> <li>Observe required buffer zones. Non-selective herbicide, avoid contact with non-target broadleaf weeds and woody plants.</li> <li>Avoid application if heavy rain is forecasted.</li> </ul>

## Foliar Spray:

Foliar application involves coating the leaves of target plants with herbicide. The leaves absorb the herbicide; it then translocates to other parts of the plant. A backpack sprayer is the most common equipment for targeted foliar application.

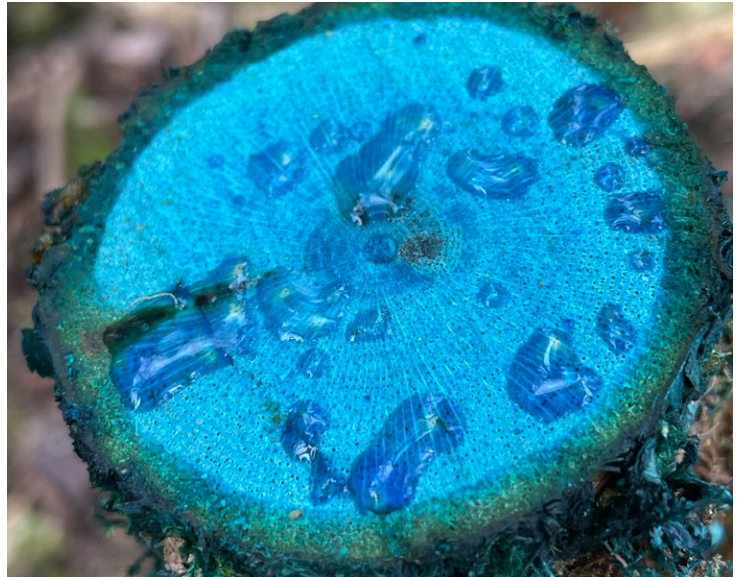
<b>Infestation Size:</b>	Large sized, well established or dense infestations. Dense populations of seedlings.
<b>Goal:</b>	Eradication.
<b>Timing (season):</b>	Summer to early fall; after leaves have fully leafed out and vine actively growing. Avoid when leaves are changing color in fall.
<b>Treatment Frequency:</b>	Once per year.
<b>Best Practices:</b>	<ul style="list-style-type: none"> <li>• Apply using a backpack sprayer under low pressure.</li> <li>• Spray until the leaves are just covered and the herbicide is not dripping off the leaves.</li> <li>• Foliar spray is most frequently applied using a glyphosate-based herbicide. Add a vegetable (or tracker) dye to the herbicide mix to increase spray precision and minimize spray drift.</li> <li>• Spraying in mid-season is ideal when leaves are green and fully leafed out.</li> <li>• Weather may impact treatment effectiveness therefore is an important consideration for foliar spray. Avoid spraying during drought, hot, dry weather, and shortly before rainfall. Higher wind speeds may also increase the risk for drift.</li> <li>• Monitor for effectiveness and treat any resprouts or seedlings in subsequent years (follow up with chemical or non-chemical method). Check the pesticide label for restrictions regarding treatment frequency.</li> <li>• Mature, multi-stemmed vines may take 1-2 years to completely die after one foliar application, due to the extensive root system.</li> <li>• Climbing vines with foliage close to the ground can be sprayed from the ground up to 2 m or more for effective control. If vines are too tall with no low-level foliage, and are climbing a desirable species, then cut-stump herbicide would be preferable.</li> </ul>
<b>Advantages:</b>	<ul style="list-style-type: none"> <li>• Effective after a single application for small/newer infestations. Less labour-intensive and costly than other methods.</li> </ul>
<b>Disadvantages:</b>	<ul style="list-style-type: none"> <li>• Potential for spray drift and harm to non-target plants.</li> <li>• On mature vines, leaves are high in the canopy and out of reach for foliar spray. Foliar spraying is used to treat resprouts later in the season following cutting.</li> </ul>
<b>Ideal for:</b>	<ul style="list-style-type: none"> <li>• Effective follow-up treatment on resprouts that emerge after mechanical cutting of vines (or resprouts following cut-stump herbicide treatment). Vines can be cut early in season (i.e., winter), and resprouts treated later in the season (i.e., late summer or fall). Allow at least 6 weeks between cutting and foliar spraying resprouts, in order to effectively control the roots.</li> <li>• In natural areas, targeted foliar spray is applied in areas of very dense infestations with little or no desirable vegetation, as it can negatively impact surrounding vegetation.</li> <li>• Foliar spray can also be applied to dense infestations in disturbed open areas such as along roadsides, trails, fields, where vines are not climbing on host vegetation.</li> </ul>

## Cut Stump:

Stump cutting involves cutting at the base of the stem near the soil surface to sever the connection between the photosynthesizing parts of the plant and the roots. Cutting will also remove aboveground growth and reduce seed production. Following stump cutting, a herbicide is applied to the entire cambium layer of the cut stump surface.

<b>To cut:</b>	<p>For large vines, use a handsaw or chainsaw to cut a 15 cm section out of the stem, starting from 30 – 90 cm off the ground (University of Minnesota Extension 2015). The stem can also be cut using the 'window-cut method', first close to the ground, approximately 5 cm above the root crown, and then again at chest height (Templeton <i>et al.</i> 2020). For small vines, use hand tools (i.e., hand pruners, bypass loppers, handsaw) to cut all stems close to the ground.</p> <p><i>Wear Personal Protective Equipment (PPE) for manual control:</i> protective clothing (long sleeves), hard hat, gloves, boots, and safety glasses (*Note: personal protective equipment will depend on the equipment being used).</p> <p><b>WARNING:</b> do <b>NOT</b> pull down the vine from the tree. Vines and tree branches are very heavy and falling material could result in serious injury. It can also cause tree damage by stripping smaller branches and snapping limbs. The remaining vine stems in the trees can be left in place, as they will decompose and fall within 2-3 years.</p>
<b>Infestation Size:</b>	<ul style="list-style-type: none"><li>• Any infestation size for vines with small to large stems.</li></ul>
<b>Goal:</b>	<ul style="list-style-type: none"><li>• Eradication.</li></ul>
<b>Timing (season):</b>	<ul style="list-style-type: none"><li>• Any season. Most effective later in growing season (August to October). Treatment in late fall or winter can help minimize effects on non-target plants, although cutting prior to seed production in July can help prevent seed spread. Herbicide application is not effective if applied to the cut stump in spring during heavy sap flow, or during periods of drought in the summer.</li></ul>
<b>Treatment Frequency:</b>	<ul style="list-style-type: none"><li>• Repeat annually or when regrowth is observed.</li></ul>
<b>Best Practices:</b>	<ul style="list-style-type: none"><li>• Start with large, berry-producing vines that reach high into the canopy, followed by smaller vines.</li><li>• Apply herbicide to the cut surface that remains rooted to the ground using a backpack sprayer. Thoroughly wet the area outer portion adjacent to the cambium and sides of the stump, but not to the point of runoff.</li><li>• A triclopyr-based herbicide is recommended. An advantage of triclopyr products is that the cut does not have to be fresh allowing for flexibility in herbicide application, and herbicide can be applied even in freezing conditions, as long as it is above <math>-10^{\circ}\text{C}</math>. It is however recommended to apply triclopyr to a cut stump as soon as possible, ideally within 48-72 hours after cutting.</li><li>• Continue to monitor cut stumps for re-sprouting for at least one year and treat any resprouts using herbicide application (either foliar spray, basal bark, or directly to cut stump, depending on the situation). Alternatively, the stump can be cut earlier in the season before seed production, then stumps allowed to resprout to deplete root reserves before herbicide is applied.</li><li>• It is good practice to flag vines as they are cut, so that they can be more easily located when addressing re-sprouts.</li><li>• If native American bittersweet is also found at the site, confirm that you are treating oriental bittersweet (particularly if the vine has already lost ID features like leaves and fruit).</li></ul>
<b>Advantages:</b>	<ul style="list-style-type: none"><li>• Selective and cost effective. Effective at killing whole shrub and resprouts.</li><li>• Prevents seed production the following year, so that only resprouts need to be treated.</li></ul>

<b>Disadvantages:</b>	<ul style="list-style-type: none"> <li>• Labour intensive. The root system of mature vines may support dozens of stems, making it impractical to cut-stump all cut surfaces. It may be easier to cut vines and wait to treat the resprouts.</li> </ul>
<b>Ideal for:</b>	<ul style="list-style-type: none"> <li>• Intended for large, berry-producing vines that reach high into the canopy as well as smaller vines. Cut stump herbicide application is ideal for thicker barked species like oriental bittersweet. Use where vines are established within or around non-target plants or vines that have grown into the canopy.</li> </ul>



Cut and stump treated vines during a restoration project in King County, Vashon Island, Vashon, Washington, US.

Photos courtesy of: Tom Erler. Available: <https://www.inaturalist.org/observations/188089154>, licensed under CC0.

## Basal bark:

<b>Infestation Size:</b>	<ul style="list-style-type: none"> <li>• Any infestation size for small to medium stems.</li> </ul>
<b>Goal:</b>	<ul style="list-style-type: none"> <li>• Eradication.</li> </ul>
<b>Timing (season):</b>	<ul style="list-style-type: none"> <li>• Any time of year except during heavy sap flow in spring. Less effective if snow or water prevents spraying at the desired height above ground level. Most effective in late summer and early fall when the sap of the tree flows towards the roots.</li> </ul>
<b>Treatment Frequency:</b>	<ul style="list-style-type: none"> <li>• Repeat if re-growth is observed.</li> </ul>
<b>Best Practices:</b>	<ul style="list-style-type: none"> <li>• A triclopyr-based herbicide is recommended as these products can penetrate bark.</li> <li>• Use a low-pressure, low-volume backpack sprayer.</li> <li>• Wet bark thoroughly but not to the point of run off.</li> <li>• Apply herbicide to the bark around the entire stem in a band 5-10 cm wide, in the lower parts of individual stems.</li> <li>• Do not apply if snow or other vegetation obscures the target area.</li> <li>• Avoid spraying the bark of desirable vegetation. This method can be challenging and impractical where vines are tightly wrapped around desirable trees.</li> </ul>
<b>Ideal for:</b>	<ul style="list-style-type: none"> <li>• Small to medium stems (less than 2.5 cm diameter) with thin bark.</li> </ul>

## Hack and Squirt:

Mature vines with stems 2.5 cm or greater that are not tightly twined around desirable trees can be treated using the hack and squirt method. Downward angled cuts are made around the stem at a convenient height, and cuts spaced 2.5 cm apart. The resulting cavity is immediately treated with a triclopyr-based herbicide using a backpack sprayer. In order to facilitate translocation of herbicide to the roots, do not girdle vines completely. As this method may result in re-sprouting below the cut, repeat applications may be needed. Re-sprouts may be foliar sprayed.



It is good practice to flag all cut stumps so that they can be easily relocated during follow-up applications. Restoration project in King County, Vashon Island, Vashon, Washington, US.

Photo courtesy of:

# Disposal

## **In natural areas**

In terms of cost effectiveness and time, it is generally better to leave biomass on site. The cut aerial portions will dry out and decompose on their own. Cut stems can be left to rot on site and become a refuge and food source for wildlife. Limbs or small branches without fruit/seeds can be piled and used as wildlife habitat, burned on site (check with your municipality for burn permits), or chipped and mulched. Following hand pulling or digging, the pulled plants should be removed from the site to prevent re-rooting, particularly if the fruit is still present. Place all viable material (roots, fruits/seeds) in thick, garbage bags and leave in the sun for 2-3 weeks. Following this, material can be disposed of in a landfill.

## **Do not backyard compost if fruit/seeds present:**

Backyard composters do not reach the temperatures necessary to kill seeds. Do not compost any viable plant material (i.e., rhizomes, fruits and seeds).

## **Municipal compost**

Large-scale municipal composting facilities where the compost pile reaches temperatures high enough to kill living plant material can be used to dispose of viable plant material. Ontario composting facilities are required to routinely monitor the compost process and meet strict, provincially regulated time-temperature parameters for pathogen kill. Consult your local municipality to determine if this is an appropriate course of action.

## **Solarize**

Place all plant material into thick plastic garbage bags. Seal the bags tightly and leave them in direct sunlight for 2 - 3 weeks. This will “cook” or kill viable plant material. The rotten material can then be composted or disposed of in a landfill.

# Restoration

Following control measures, consider restoring the site to encourage the re-establishment of native plant species. Consider the following restoration practices:

## Mulching:

Mulch can be created from the chipped material of oriental bittersweet vines. Avoid heavy mulching in natural areas. Covering a forest floor with a thick layer of mulch (> 5 cm) in a natural area can do more harm by changing nutrient composition of the soil and smothering desirable ground vegetation, such as spring ephemerals and native tree or shrub seedlings. Urban sites (i.e., urban parks or gardens) may be more appropriate. Mulch can be used to cover an area immediately after invasive species control (e.g., manual or chemical control), which may help to prevent re-colonization by other invaders and helps to reduce soil compaction by people and pets.

## Seeding:

Broadcasting seeds of native plant species immediately after management activities may be most suitable to less urbanized sites where wildlife species have more food sources available. Otherwise, seeds may be quickly eaten by wildlife. Seeding may be useful to prevent the establishment of new invasive plants. This can give desirable native species the chance to establish themselves. Seeding should only be done after management activities are completed to prevent new native plants from being damaged or killed. Collecting local seeds should be done ethically and sustainably.

## Planting:

Once oriental bittersweet has been successfully removed from a site, planting site-appropriate native species can help them out-compete invasive seedlings. This is especially important if there are nearby invasive plants that can colonize the sites. If management activities will be conducted in subsequent years, wait until all management is completed prior to planting to avoid damaging or killing newly planted stock. Consider site characteristics such as light availability and amount of space when choosing plant species for restoration as this will affect growth and soil conditions. A diverse mix of plants should be tailored to the region based on the site's growing conditions. Consider transplanting mature individuals from surrounding good quality habitat. Ensure that any plants brought into the habitat come from an appropriate ecoregional source.

# Preventing the Spread

Early detection is the most effective tool for controlling the spread of oriental bittersweet and everyone can help. Follow these tips:

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## Report it.

If you think you see oriental bittersweet, take a picture, record the location and report it using the following tools: contact the Invading Species Hotline at **1-800-563-7711** or report online at [www.eddmaps.org](http://www.eddmaps.org) or [www.inaturalist.org](http://www.inaturalist.org). For more information, call the Invading Species Hotline at 1-800-563-7711 or visit [www.invadingspecies.com](http://www.invadingspecies.com) or contact the Ontario Invasive Plant Council at: [info@oninvasives.ca](mailto:info@oninvasives.ca).

## Watch for it.

Learn to recognize what oriental bittersweet looks like and then monitor property boundaries, forested areas, fence lines and trails. Early detection of invasive plants can make it easier and less expensive to remove or control them.

## Stay on trails.

Inspect, clean, and remove mud, seeds and plant parts from clothing, pets (including horses), vehicles (including bicycles, trucks, ATVs, etc.) and equipment such as mowers and tools. Clean vehicles and equipment in an area away from natural areas where plant seeds or parts aren't likely to spread (e.g. wash vehicles in a driveway or at a car wash) before travelling to a new area.

## Stop the spread.

Inspect, clean, and remove mud, seeds and plant parts from clothing, pets (including horses), vehicles (including bicycles, trucks, ATVs, etc.) and equipment such as mowers and tools. Clean vehicles and equipment in an area away from natural areas where plant seeds or parts aren't likely to spread (e.g. wash vehicles in a driveway or at a car wash) before travelling to a new area.

## Keep it natural

Try to avoid disturbing soil and never remove native plants from natural areas. This leaves the soil bare and vulnerable to invasive species.

## Use native species.

Try to use local native species in your garden. Do not plant oriental bittersweet and if you have removed it, replant with native species. Encourage your local garden centre to sell non-invasive or native plants. The Grow Me Instead guide lists alternative species to plant instead of invasive species.

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# Tracking the Spread (Outreach, Monitoring, Mapping)

Several reporting tools have been developed to assist the public and resource professionals to report oriental bittersweet sightings, track the spread, detect it early and respond to it quickly. These include:

1. **EDDMapS Ontario:** an online reporting tool and **FREE** mobile application (iPhone and Android) where users can report sightings, review distribution maps and explore educational resources of invasive plants and other invasive species. This tool, at [www.eddmaps.org](http://www.eddmaps.org), is free to use.
2. **The Invading Species Hotline:** a toll-free telephone number (**1-800-563-7711**) where individuals can report sightings verbally.
3. **iNaturalist:** an online reporting tool ([www.iNaturalist.org](http://www.iNaturalist.org)). If you suspect you have encountered oriental bittersweet or another invasive species, please take a photograph, mark your location, and call the **Invading Species Hotline at 1-800-563-7711**.

# Additional Resources

## **Defeating a killer vine: Round leaf bittersweet management.**

<https://www.youtube.com/watch?v=7wmZ1Zuho1c>

## **Oriental Bittersweet: Control Strategies.**

<https://extension.psu.edu/oriental-bittersweet-video>

## **Woody Invasives of the Great Lakes Collaborative (WIGL).**

<https://woodyinvasives.org/woody-invasive-species/roundleaf-bittersweet/>

# Best Management Practices Document Series

Autumn Olive

Black Locust

Buckthorn

Burdock

Dog-strangling Vine

Erect Hedge-parsley

Eurasian Water-milfoil

European Black Alder

European Frog-bit

Flowering Rush

Garlic Mustard

Giant Hogweed

Goutweed

Invasive Honeysuckles

Invasive Phragmites

Japanese Barberry

Japanese Knotweed

Manitoba Maple

Multiflora Rose

Norway Maple

Purple Loosestrife

Reed Canary Grass

Scots Pine

Spotted Knapweed

White Mulberry

White Sweet Clover

Wild Parsnip

Yellow Iris

Winged Euonymus

# Technical Bulletin Series from the OIPC

Black Locust

Dog-strangling Vine

European Black Alder

European Buckthorn

Garlic Mustard

Giant Hogweed

Himalayan Balsam

Invasive Honeysuckles

Invasive Phragmites

Japanese Knotweed

Purple Loosestrife

Reed Canary Grass

White Mulberry

White Sweet Clover

Wild Parsnip

# Additional Publications from the Ontario Invasive Plant Council

A Landowner's Guide to Managing and Controlling Invasive Plants in Ontario

A Quick Reference Guide to Invasive Plant Species

Clean Equipment Protocol for Industry

Creating an Invasive Plant Management Strategy: A Framework for Ontario Municipalities

Grow Me Instead! Beautiful Non-Invasive Plants for Your Garden, a Guide for Southern Ontario, Edition 3, 2020 (EN)

Grow Me Instead! Beautiful Non-Invasive Plants for Your Garden, a Guide for Southern Ontario, Summer 2017 (EN, FR)

Grow Me Instead! Beautiful Non-Invasive Plants for Your Garden, a Guide for Northern Ontario

Invasive Aquatic Plant Species: A Quick Reference Guide

Invasive Terrestrial Plant Species: A Quick Reference Guide

The Landowners Guide to Controlling Invasive Woodland Plants

# References

- Albright TP, Anderson DP, Keuler NS, Pearson SM, Turner MG. 2009. The spatial legacy of introduction: *Celastrus orbiculatus* in the southern Appalachians, USA. *Journal of Applied Ecology*. 46: 1229-1238.
- Ashton IW and Lerda MT. 2008. Tolerance to herbivory, and not resistance, may explain differential success of invasive, naturalized, and native North American temperate vines. *Diversity and Distributions*. 14: 169-178.
- Averill KM, Mortensen DA, Smithwick EAH, Post E. 2016. Deer feeding selectivity for invasive plants. *Biological Invasions*. 18: 1247–1263.
- Beringen R, van Duinen GA, de Hoop L, de Hullu PC, Matthews J, Odé B, et al. 2017. Risk assessment of the alien staff-vine (*Celastrus orbiculatus*). *Reports Environmental Science*. 523: 1–70.
- Browder JB. 2011. The effect of *Celastrus orbiculatus*, oriental bittersweet, on the herbaceous layer along a western North Carolina creek. Western Carolina University. 70 pp. <https://libres.uncg.edu/ir/wcu/listing.aspx?id=8063> [Accessed 2020 October 15].
- CABI Invasive Species Compendium. 2020. *Celastrus orbiculatus* (Asiatic bittersweet). <https://www.cabi.org/isc/datasheet/12009> [Accessed 2020 October 24].
- Chandler M. 2011. MN NWAC risk assessment worksheet *Celastrus orbiculatus*. <https://www.mninvasives.org/risk-assessments>, accessed January 22, 2022.
- Chandler M and Calkins J. 2016. Minnesota Department of Agriculture; Minnesota Nursery and Landscape Association. MN NWAC Risk Assessment Worksheet for Oriental Bittersweet. [https://static1.squarespace.com/static/57539006044262fce01261c5/t/5a8ee5c1085229db68d4b1e9/1519314371071/OrientalBittersweet\\_MDARA00001OB\\_09\\_29\\_2016.pdf](https://static1.squarespace.com/static/57539006044262fce01261c5/t/5a8ee5c1085229db68d4b1e9/1519314371071/OrientalBittersweet_MDARA00001OB_09_29_2016.pdf) [Accessed 2020 October 20].
- Dreyer GD, Baird LM, Fickler C. 1987. *Celastrus scandens* and *Celastrus orbiculatus*: comparisons of reproductive potential between a native and an introduced wood vine. *Bulletin of the Torrey Botanical Club*. 114: 260-264.
- Dreyer GD. 1994. Element Stewardship Abstract for *Celastrus orbiculata*. The Nature Conservancy. Arlington, VA.
- EDDMapS. 2022. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. <http://www.eddmaps.org/>, accessed January 19, 2022.
- Eiseman CS. 2014. New host records and other notes on North American leaf mining Chrysomelidae (Coleoptera). *The Coleopterists Bulletin* 68: 351-359.
- Ellsworth JW, Harrington RA, Fownes JH. 2004. Seedling emergence, growth, and allocation of Oriental bittersweet: effects of seed input, seed bank, and forest floor litter. *Forest Ecology and Management*. 190: 255–264.

- Freyer JL. 2011. *Celastrus orbiculatus*. In: Fire Effects Information System (Online). US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. <https://www.fs.usda.gov/database/feis/plants/vine/celorb/all.html> [Accessed 2024 July 10].
- Gleason HA, Cronquist A. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. 2nd ed. New York Botanical Garden, Bronx, NY.
- Greenberg CH, Smith LM, and Levey DJ. 2001. Fruit fate, seed germination and growth of an invasive vine – an experimental test of ‘sit and wait’ strategy. *Biological Invasions*. 3: 363-372.
- Hawkeye Cooperative Weed Management Area (Iowa). Oriental Bittersweet. [https://bugwoodcloud.org/mura/mipn/assets/File/WIGL/OrientalBittersweet\\_HCWMA.pdf](https://bugwoodcloud.org/mura/mipn/assets/File/WIGL/OrientalBittersweet_HCWMA.pdf) [Accessed 2020 October 6].
- Hou D. 1955. A revision of the genus *Celastrus*. *Annals of the Missouri Botanical Garden*. 42: 215-302.
- Hutchison M. 1992. Vegetation management guideline: round-leaved bittersweet (*Celastrus orbiculatus* Thunb.). *Natural Areas Journal*. 12: 161.
- Jean F and Niering WA. 1999. Four decades of old field vegetation development and the role of *Celastrus orbiculatus* in the northeastern United States. *Journal of Vegetation Science*. 10: 483-492.
- Kershaw L. 2001. *Trees of Ontario*. Canada: Lone Pine Publishing. Pp 192-201.
- Kim SE, Kim S, Hong YS, Kim YC, Lee JJ. 1999. Sesquiterpene esters from *Celastrus orbiculatus* and their structure-activity relationship on the modulation of multidrug resistance. *Journal of Natural Products*. 62: 697-700.
- Kuhman TR, Pearson SM and Turner MG. 2013. Why does land-use history facilitate non-native plant invasion? A field experiment with *Celastrus orbiculatus* in the southern Appalachians. *Biological Invasions*. 15: 613-626.
- Leicht, SA and Silander JA. 2006. Differential responses of invasive *Celastrus orbiculatus* (*Celastraceae*) and native *C. scandens* to changes in light quality. *American Journal of Botany*. 93: 972-977.
- Leicht-Young, SA, Silander JA, and Latimer AM. 2007. Comparative performance of invasive and native *Celastrus* species across environmental gradients. *Oecologia*. 154: 273-282.
- Leicht-Young SA, O'Donnell, Latimer AM, and Silander JA. 2009. Effects of an invasive plant species, *Celastrus orbiculatus*, on soil composition and processes. *The American Midland Naturalist*. 161: 219-231.
- Leicht-Young SA and Pavlovic NB. 2012. Encroachment of Oriental Bittersweet into Pitcher's Thistle Habitat. *Natural Areas Association*. 32: 171-176.
- Leicht-Young SA, Bois ST, and Silander JA. 2015. Impacts of *Celastrus*-primed soil on common native and invasive woodland species. *Plant Ecology*. 216: 503-516.
- McElrone AJ, Sherald JL, Pooler MR. 1999. Identification of alternative hosts of *Xylella fastidiosa* in the Washington, DC, area using nested polymerase chain reaction (PCR). *Journal of Arboriculture*, 25:258-263.

- McKenzie-Gopsill A. 2020. Management of Destructive Invasive Vines, Oriental Bittersweet *Celastrus orbiculatus*. Agriculture and Agri-Food Canada Fact Sheet. Available from: <https://peiinvasives.com/wp-content/themes/peiisc/pdf/guidance/Oriental%20Bittersweet.pdf> [Accessed 10 July 2024].
- McKenzie-Gopsill A and MacDonald AN. 2021. The biology of invasive alien plants in Canada. 14. *Celastrus orbiculatus* Thunb. Canadian Journal of Plant Science. 101: 632-648.
- MDNR. Michigan Department of Natural Resources, Michigan Natural Features Inventory. 2012. Oriental Bittersweet (*Celastrus orbiculatus*). <https://mnfi.anr.msu.edu/invasive-species/OrientalBittersweetBCP.pdf> [Accessed 2021 October 12].
- Minnesota Department of Agriculture. Differentiating Oriental and American bittersweets. <https://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/orientalbittersweet/bittersweetdiffs> [Accessed 2020 October 15].
- Minnesota Wildflowers. *Celastrus orbiculatus* (Oriental Bittersweet). <https://www.minnesotawildflowers.info/shrub/oriental-bittersweet> [Accessed 2020 October 7].
- Mohr P. 2013. Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. <https://www.ontario.ca/page/virginia-goats-rue-recovery-strategy> [Accessed 2020 October 16].
- Mundahl N and Borsari B. 2016. Browsing by white-tailed deer on invasive oriental bittersweet spreading into restored grasslands. North American Prairie Conference Proceedings. 7: 128-136.
- Patterson DT 1974. The ecology of oriental bittersweet, *Celastrus orbiculatus*, a weedy introduced ornamental vine. PhD dissertation, Duke Durham, N.C.
- Pavlovic NB, Leicht Young S, Grundel R, Frohnapple KJ. 2007. American and Oriental Bittersweet Identification. GLSC Fact Sheet. [https://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/fsbdev3\\_017307.pdf](https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_017307.pdf) [Accessed 2020 November].
- Pavlovic NB, Leicht-Young SA, Grundel R. 2016. Oriental bittersweet (*Celastrus orbiculatus*): spreading by fire. Forest Ecology and Management. 364: 183–194.
- Shin H, Lee H. 1999. A new species of *Marssonina* on *Celastrus orbiculatus*. Mycotaxon, 72: 199-203.
- Silveri A, Dunnwiddie PW, Michael HJ. 2001. Logging and edaphic factors in the invasion of an Asian woody vine in a mesic North American forest. Biological Invasions. 3: 379-389.
- Soper JH and Heimbürger ML. 1982. *Celastrus* L. Bittersweet. Shrubs of Ontario. Toronto: Royal Ontario Museum. Pp 287-288.
- Steward AM, Clemants SE, and Moore G. 2003. The concurrent decline of the native *Celastrus scandens* and spread of the non-native *Celastrus orbiculatus* in the New York City Metropolitan Area. The Journal of the Torrey Botanical Society. 130: 143-146.
- Templeton S, Gover A, Jackson D, Wurzbacher S. 2020. Oriental Bittersweet. PennState Extension. Available from: <https://extension.psu.edu/oriental-bittersweet> [Accessed 15 July 2024].

Tibbetts TJ and Ewers FW. 2000. Root pressure and specific conductivity in temperate lianas: exotic *Celastrus orbiculatus* (Celastraceae) vs. native *Vitis riparia* (Vitaceae). *American Journal of Botany*. 87: 1272-1278.

University of Illinois Extension. Oriental vs American Bittersweet: winter identification using fruit characteristics. <https://uofi.app.box.com/v/clid=lwAR1FLvLPPWeHqGKSTyy2RIDSYMeoafgGTCOrqr51xkazAf6J5erhdLwtP4> [Accessed 2020 October 15].

University of Minnesota Extension. 2015. Defeating a killer vine: Oriental bittersweet management. Available from: <https://www.youtube.com/watch?v=7wmZ1Zuho1c> [Accessed November 2020].

Williams PA, Timmins, SM. 2003. Climbing spindle berry (*Celastrus orbiculatus* Thunb.) biology, ecology, and impacts in New Zealand. *Science for Conservation* 234. Department of Conservation, Wellington, New Zealand.

WIGL. Woody Invasives of the Great Lakes Collaborative (WIGL). Round leaf bittersweet. Round leaf bittersweet - WIGL ([woodyinvasives.org](http://woodyinvasives.org)) [Accessed 2024 July 15].

Zaya DN, Leicht-Young SA, Pavlovic NB, Hetrea CS, Ashley MV. 2017. Mislabeling of an invasive vine (*Celastrus orbiculatus*) as a native congener (*C. scandens*) in horticulture. *Invasive Plant Science and Management*, 10: 313-321.

Zheng H, Wu Y, Ding J, Binion D, Fu W, Reardon R. 2004. Invasive plants of Asian origin established in the United States and their natural enemies Vol. 1. USDA Forest Service, FHTET, Morgantown, WV.

# Acknowledgements

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