Landowners Guide to Controlling Invasive Plants

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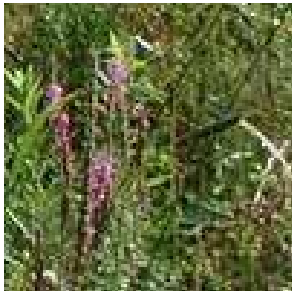


DEFINITIONS

Alien species (also known as exotic or introduced species) - Species of plants, animals, and microorganisms introduced by human action outside their natural past or present distribution.

Invasive species - Harmful alien organisms whose introduction or spread threatens the environment, the economy, or society.

Definitions taken from "An Invasive Alien Species Strategy for Canada"[1]

An invasive plant is one that has been moved from its native habitat to a new area (possibly for garden/ domestic use), and reproduces so aggressively that it displaces species within native plant communities, the result being economic, ecological or social disruption. In a forest ecosystem, an invasive plant can be a tree, shrub, or herbaceous plant.

Some particularly persistent invasive plants found in Ontario include garlic mustard *(Alliara petiolata)*, dog-strangling vine/black dog-strangling vine *(Vincetoxicum rossicum, Vincetoxicum nigrum)*, European and glossy buckthorn *(Rhamnus cathartica, R. frangula)*, Japanese knotweed *(Reynoutria japonica)*, wild parsnip *(Pastinaca sativa)*, Oriental bittersweet *(Celastrus orbiculatus)*, invasive honeysuckles *(Lonicera spp.)*, Himalayan balsam *(Impatiens glandulifera)*, black locust *(Robinia pseudoacacia)*, and Scots pine *(Pinus sylvestris L)*. This guide focuses on these established species of which landowners should be aware.

Since invasive plants pose a significant threat to Ontario's biodiversity, the province of Ontario has taken steps described in the Ontario Invasive Species Strategic Plan 2012 to address the issue, including the creation of the Invasive Species Act, 2015. Additionally, collaborative efforts to prevent introductions of invasive plants through education and awareness are organized by the Ontario Ministry of Natural Resources and Forestry, conservation authorities, stewardship councils, and organizations such as the Ontario Federation of Anglers and Hunters, and the Ontario Invasive Plant Council.

BACKGROUND

Most imported plants are unable to reproduce or survive away from the urban garden. However, some exotic plants are invasive (such as the plants listed in this guide) and can become established in natural habitats, outcompeting native species and overwhelming certain habitats. It has been reported that approximately 700 plant species (27% of the total flora) growing in Ontario are alien (Haber, 1998)[2].

Many exotic plants and shrubs have been transported into Canada from Europe and Asia. The largest factor contributing to the success of invasive plants is the fact that few natural "controls" exist here for that plant. In a plant's native habitat, natural controls such as climate, animals, insects, fungi, and other plants restrict them to a certain habitat niche within their range. Invasive plants have the potential to displace native vegetation such as trilliums, or interfere with the natural regeneration of forest tree species. If the habitat is very unique or rare, some flora and fauna may become locally endangered.

A critical first step in the control of invasive species is knowledge. Understanding the scope of the problem, how to identify invasive plants, and becoming familiar with options for control enables successful action. All gardeners should strive to utilize native plants and be aware of plants from unknown origins that "are suited to our climate zone and will grow on a wide variety of sites", as this is an indication of a potential invader.

The economic impacts of invasive species can be immense. The cost of the damage caused by invasive species affecting forestry and agriculture in Canada has been estimated to be $7.5 billion annually[3]. Their impact on native ecosystems and species is often severe and seemingly irreversible. It has been estimated that approximately 24% of the species at risk in Canada may be threatened with extinction by invasive alien species[4]. The costs can be reduced through the prevention of new introductions and the detection and control of invasions in the early stages. If landowners and communities can collaborate with control and eradication efforts for invasive species on their own properties, we can collectively help reduce their impact.

PATHWAYS OF INTRODUCTION AND SPREAD

Pathways are the route by which invasive species become introduced to Ontario, or spread to new areas once they have arrived. There are natural pathways and those created by humans:

- Natural pathways include wind, water and animal dispersal.
- Man-made pathways are routes by which the majority of invasive species are introduced. They include shipping, horticultural trade, recreation, agriculture, forestry, construction, travel, tourism, water garden and aquarium trade.

The best method of invasive species control is simple prevention. Think about the pathways discussed above and where they may apply to your property. As landowners you can prevent invasive species introduction and establishment on your property by following some simple practices:

GARDENING – Know what you're buying; research plants before planting them and request non-invasive or native plants at the nursery. Invasive plant seeds and insect larva can also be found in soil.

AQUARIUM AND WATER GARDENS – Never release aquarium or water garden plants or pets; these species can become invasive. Return them to the pet store or learn how to dispose of them properly.

MULCH | SOIL – Purchase mulch or soil from reputable suppliers. Be aware that invasive plant parts or seeds may be hitchhiking, and if possible find out where the mulch/soil originated. Be careful with municipal mulch; it often contains seeds or plant parts and can harbor invasive plant species.

LANDSCAPING – Minimize soil disturbance and retain shade trees on your property to prevent establishment of invasive plants.

Dispose of yard waste through your local municipality; yard waste dumped into natural areas can disturb the native vegetation leading to erosion and the spread of invasive species.

RECREATION – Inspect and clean mud and plant parts from recreational vehicles, pets, hiking boots and equipment before leaving any site and returning to your property. Stay on trails; going off trail can spread invasive species to new areas.

WOODLOT MANAGEMENT – Talk to the contractors to make sure they clean their equipment prior to entering your property.

FIREWOOD – Firewood can contain insect larvae such as emerald ash borer and Asian long-horned beetle. Therefore, don't move firewood. Buy it where you burn it, and be aware of CFIA's Ministerial Orders which prohibit movement of potentially infested materials from specific areas of Ontario and Quebec. Maps of these locations are available at the CFIA website:

www.inspection.gc.ca.

MANAGEMENT TECHNIQUES

Management techniques and control options outlined in this document have been updated during the winter of 2018 to reflect revisions in the series of Best Management Practices guides and Invasive Plant Technical Bulletin Series by the Ontario Invasive Plant Council (OIPC). These technical documents relay specific information relating to invasive plant control practices including the most up-to-date research and knowledge available. Management and control techniques recommended in this document are not a complete list of methods available for each species. For more information, we recommend reviewing the Best Management Practices guides and Invasive Plant Technical Bulletin Series by contacting the Invading Species Hotline (1-800-563-7711) or online at: http://www.ontarioinvasiveplants.ca/resources.

Applying the appropriate method of control is the key to success of any plan. The main objective is to provide the best method of control at the least cost to the landowner in terms of resources and time. Where chemicals (herbicides) are involved, reducing their use and impacts on the environment is also a key objective.

Control methods can be broken into three categories:

MECHANICAL – These methods involve strictly manual labour and include such things as cutting, pulling, mowing, solarisation (smothering vegetation with plastic), girdling (removing outer layer of bark from around a stem) or even a prescribed burn. These methods are listed in the table below with a description of the technique, advantages and disadvantages, typical population size targeted and the objective of each control method.

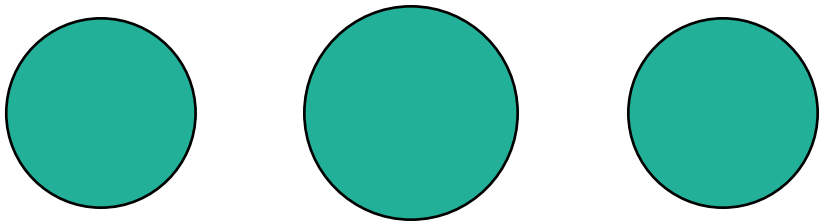
BIOLOGICAL – This involves using biological predators or agents to control invasive plants including: insects, fungal agents, bacteria or viruses. Most often insects are the agents referred to here such as the two European leaf-eating beetles, Galerucella calmariensis and G. pusilla used to control purple loosestrife. Agents for biological control must be approved by federal and provincial authorities before release.

CHEMICAL – This involves the use of herbicides (targets weeds and other plants). Herbicides can be applied using various techniques depending on the species, size of infestation and location. Herbicides must be applied in accordance with the federal Pest Control Products Act, the Ontario Pesticides Act, Ontario Regulation 63/09 and in accordance with all label directions. Ensure you have the most current label and are aware of any re-evaluation decisions.

Ontario's Cosmetic Pesticides Ban Act prohibits the non-essential use of prescribed pesticides (Class 9) on land. Exceptions exist to allow the use of these herbicides for control of plants that are detrimental to the environment, economy, agriculture and/or human health, for example. For more information on these exceptions and applicable procedures, please visit www.ontario.ca/pesticideban.

Proximity to aquatic habitats, presence or absence of native vegetation, and effectiveness of the herbicide product are examples of important factors to consider when selecting an herbicide.

Where use of pesticides is proposed in this guide it is advised that their use as a control method for managing invasive species be carefully considered using all measures of environmental impact as criteria. Even though chemical pesticides can be harmful their use is accepted as a final control method in situations where they are considered warranted. In circumstances where other more desirable control options are unsuccessful or not possible, chemical pesticides may need to be used to control invasive plants that are considered safety risks or environmentally damaging. Generally, the decision to use pesticides depends on the balance of what represents the greater risk or detriment. For example, if leaving an invasive species is worse than using pesticides to control them, then clearly pesticide use is warranted as a biodiversity issue; conversely, if spraying is more environmentally damaging than not controlling an invasive plant location, then not using chemical pesticides is the prudent decision. Because this manual's primary objective is protection of the natural environment, pesticide use remains a valid control option only if the net benefit to the environment is positive.



RESTORATION

Restoration can be a critical aspect of invasive plant management. Site restoration will result in a healthier ecosystem more resilient to future invasions. Monitor all restoration activities to ensure native species are becoming established, and continue removal of invasive plants that remain onsite. Restoration will be site-dependent, and could include mulching, seeding or after-control planting.

MULCHING

Mulching sites immediately after control (i.e. manual or chemical control) may aid in the recovery of native species and prevent immediate re-colonization by other invaders. Mulching reduces light availability, allowing more shade-tolerant native plant species to germinate and colonize the gaps left by invasive plant removal. This will also limit the amount of re-growth from established invasive plant seed banks.

SEEDING

Seeding an area with an annual cover crop or native plant species immediately after management activities may be useful to prevent the establishment of new invasive species. This can give desirable native species the chance to establish themselves.

PLANTING (AFTER-CONTROL)

If there are invasive plants nearby or in the seedbank which may colonize the control area, planting larger native species stock (potted etc.) can help to outcompete invasive seedlings. It may however be better to monitor and remove invasive species over several seasons before investing in restoration planting. Wait until all management is completed before doing a large stock re-planting if you find it difficult to distinguish between newly planted native species and invasive seedlings.

When completing planting at control sites, consider light availability (have any trees recently been removed which have opened up an area?). These and other environmental changes should be taken into account when choosing plant species for restoration, as they will affect the growing and soil conditions. Also, additional management activities may disturb the newly planted materials, so it is best to postpone planting until all invasive plant control is complete. For alternative non-invasive plant options, see the Grow Me Instead guide, available: http://www.ontarioinvasiveplants.ca/resources/grow-me-instead.

SPECIES PROFILES

GARLIC MUSTARD

(Allliara petiolata)

Garlic mustard is an invasive herb native to Europe. It was brought to North America in the early 1800s for use as an edible herb. Since its arrival in North America it has escaped into the wild and is now one of Ontario's most aggressive forest invaders. Garlic mustard is established in southern and eastern Ontario as far north as Sault Ste. Marie, in parts of Quebec, and south to North Carolina and Kentucky in the United States. Isolated populations have been found in British Columbia, Nova Scotia, Prince Edward Island and New Brunswick.

INVADED HABITATS

- Sunny and fully shaded habitats
- Undisturbed forest, forest edges, riverbanks and roadsides

IMPACTS OF GARLIC MUSTARD

- Invades undisturbed forests.
- Once established it can displace native wildflowers such as trilliums (Trillium spp.) and trout lily (Erythronium americanum). This species threatens several of Ontario's species at risk, including American ginseng (Panax quinquefolius), drooping trillium (Trillium flexipes), false rue-anemone (Enemion biternatum), hoary mountain mint (Pycnanthemum incanum), white wood aster (Eurybia

divaricata), wild hyacinth (Camassia scilloides) and wood poppy (Stylophorum diphyllum).

- It hinders other plants by interfering with the growth of fungi that bring nutrients to the roots of the plants.
- Does not provide a valuable food source for native wildlife.

IDENTIFICATION

- Young leaves release a strong garlic odour when crushed.
- First-year plants produce a rosette of dark green, kidney-shaped leaves with scalloped edges.
- Second-year plants grow a stem 0.3-1.2 m high with triangular, alternate, sharply toothed leaves.
- Lower leaves are broad, kidney-shaped and up to 10 cm across. Upper leaves are triangular and 5-10 cm across, narrowing towards the tip.
- Second-year plants produce white flowers with four small petals in May capable of producing 60 000 seeds per square metre; stands can double in size every four years.
- Narrow seed pods 2.5-6 cm long split open in mid-summer to reveal tiny black seeds.

CONTROL RECOMMENDATIONS

STRATEGY AND CAUTIONS

- Garlic mustard reproduces via seeds, making seed reduction and prevention an important factor in control. Focus on controlling the seed-producing, second year plants.
- Remove the outlying populations (isolated plants or satellite populations) first to prevent further spread.
- Pulling plants before or while they are in flower, but before they set seed, is the most effective control method for all populations sizes.
- If garlic mustard roots are damaged but not entirely removed, small buds (called axillary buds) on the roots will sprout additional stems.
- Even if the plants are damaged they can produce replacement flowers as late as September.

Caution: Make sure that all equipment, boots, clothing etc. are cleaned at the site to ensure seeds are not transported from the site. See the Ontario Invasive Plant Council's Clean Equipment Protocol for more details.

MANAGEMENT OF SMALL AND LARGE POPULATIONS

Pulling works best for infestations. The entire "s" shaped root must be removed to prevent re-sprouting. Pulling is easiest when the soil is soft and pliable (in early spring

Garlic mustard resembles several native Ontario plants. The leaves at the base of the plant look like those of several plants in the carrot family (Thaspium and Zizia), the daisy family (Senecio) and the violet family (Viola). The seed pods look like those of several other mustard (Brassicaceae) species. The easiest way to distinguish garlic mustard from these plant families is to crush the leaves. If they emit a strong garlic smell, then the plant is most likely garlic mustard.

(April/May) and after a rain) but must be done continuously throughout the growing season to ensure all stems are removed. Stop all control activities when garlic mustard starts to produce seed to prevent spreading seeds. If pulling is not an option (for example, in areas where erosion is an issue) cut the stem of the plants at soil level.

For a complete list of control methods for this species, please consult the Best Management Practices guides and Technical Document Series for Garlic Mustard.

DISPOSAL

Do not compost viable plant material (seeds and roots) at home or send to landfill. Pulled plants which have flowered are still able to produce seeds, so viable plant pieces should be removed and solarized. If your municipality has a high-heat compost program, plants can be sent there. Alternatively, solarize viable plant material by placing it in sealed black plastic bags and leaving them in direct sunlight for 1-3 weeks. Alternatively, place in yard waste bags, cover with a dark-coloured tarp and leave in the sun for 1-3 weeks. Allow stems and roots to dry out thoroughly before burning or disposing of them.






DOG-STRANGLING VINE

(Cynanchum louiseae and *C. rossicum)*

The name "dog-strangling vine" refers to two invasive plants native to Eurasia – black swallowwort and pale swallowwort. These look-alike members of the milkweed family were introduced to the northeastern United States in the mid-1800s for use in gardens. In recent years these perennial vines have spread rapidly throughout central and southern Ontario, southern Quebec and several American States.

INVADED HABITATS

- Prefers open sunny areas but will easily grow in filtered shade.
- Ravines, hillsides, waste areas, fence lines, and travel and utility corridors.

IMPACTS OF DOG-STRANGLING VINE

- Producing up to 30 000 seeds per square metre, dog-strangling vine forms dense stands which can overwhelm and crowd out native plants and young trees preventing forest regeneration.
- Populations are difficult to walk through and can interfere with forest management and recreational activities.
- Leaves and roots may be toxic to livestock. Deer and other browsing animals also avoid dog-strangling vine, which can increase grazing pressure on more palatable native plants.
- This species threatens the monarch butterfly, a species at risk in Ontario. The butterflies lay their eggs on the plant, but the larvae are unable to complete their life cycle and do not survive.

IDENTIFICATION

- Grows 1-2 m high by twining onto plants, trees or other structures.
- Leaves are oval with a pointed tip, 7-12 cm long, and grow on opposite sides of the stem.
- Pink to dark purple star-shaped flowers have five petals about 5-9 mm long.
- The plant produces bean-shaped seed pods 4-7 cm long that open to release feathery white seeds in late summer.

CONTROL RECOMMENDATIONS

STRATEGY AND CAUTIONS

- Dog-strangling vine is regulated under Ontario's Invasive Species Act as a restricted species.
- Remove the outlying populations (isolated plants or satellite populations) first to prevent further spread.
- Dog-strangling vine, once established, is extremely persistent and complete eradication may take several years.
- Follow-up is required to make sure seedlings do not germinate from the seed bank or re-sprout from missed rootstocks.
- The sap of this plant can cause an allergic reaction in some people. Wear gloves when handling it and wash exposed skin with liquid dishwashing detergent afterward.

Caution: Make sure that all equipment, boots, clothing etc. are cleaned at the site to ensure seeds are not transported from the site. See the Ontario Invasive Plant Council's Clean Equipment Protocol for more details.

MANAGEMENT OF SMALL POPULATIONS (<400)

Digging is the most effective means of eradication. Care must be taken to remove the entire root crown, as the plant will re-sprout from buds on the rootstock if not properly removed. Hand pulling is not recommended as the plant will send up multiple shoots from root fragments. If digging is not an option, then cut plants at ground level repeatedly to prevent seed production.

MANAGEMENT OF LARGE POPULATIONS (>400)

Chemical control with a glyphosate-based or imazapyr-based herbicide is the most effective method for managing large populations. Unless otherwise indicated on the product label, plants should be treated after leaves are fully developed but before onset of flowering. Single treatments are insufficient for complete control. Two treatments are recommended for best results in year one, with annual follow-up treatments for 3 or more years, as required. Pesticide drift may prohibit pesticide use near water.

For a complete list of control methods for this species, please consult the Best Management Practices guides and Technical Document for Landowners for Dog-Strangling Vine.

DISPOSAL

Do not compost viable plant material (seeds and roots) at home or send to landfill. If your municipality has a high-heat compost program, plants can be sent there. If flowers or seed pods have not formed, allow stems and roots to dry out completely before disposing of them. Alternatively, solarize viable plant material by placing it in sealed black plastic bags and leaving them in direct sunlight for 1-3 weeks. Alternatively, place in yard waste bags, cover with a dark-coloured tarp and leave in the sun for 1-3 weeks.

EUROPEAN *(Rhamnus cathartica)* AND GLOSSY BUCKTHORN *(R. frangula)*

European buckthorn (also known as common buckthorn) and glossy buckthorn were introduced to North America in the 1880s as an ornamental shrub and planted widely for fencerows and windbreaks in agricultural fields. They have spread aggressively throughout southern Ontario and in other provinces. Outside its native range of Eurasia, buckthorn is found in Canada as far west as Saskatchewan and as far east as Nova Scotia. It also grows throughout the northeastern and north central United States.

INVADED HABITATS

- European and glossy buckthorn can thrive in a wide range of soil and light conditions, enabling it to invade a variety of habitats however it is most often found in woodlands and open fields, where if forms dense stands under which few other plants can grow. In contrast, glossy buckthorn typically grows in wetter soils.
- Stands of buckthorn can invade roadsides, riverbanks, mature forests, farm fields and hydro corridors.

IMPACTS OF EUROPEAN AND GLOSSY BUCKTHORN

- Buckthorn thrives in a variety of habitats and forms dense thickets that crowd and shade out native plants. It can alter nitrogen levels in the soil, creating better conditions for its own growth and discouraging the growth of native species.
- The shrub can host oat rust, a fungus that causes leaf and crown rust and affects the yield and quality of oats.
- The soybean aphid, an insect that damages soybean crops, can use buckthorn as a host plant to survive the winter.
- High-productive rate prevents the natural growth of native trees and shrubs.
- Buckthorn can spread widely with the help of birds and animals that eat its fruit which carry the seeds long distances and deposit them in their droppings.

IDENTIFICATION

- Buckthorn is usually the first shrub to leaf out in the spring and the last to drop its leaves late in the fall.
- Both species often grow two to three metres tall. Occasionally it reaches six metres, with a trunk up to 25 cm in diameter.
- Flowers have two to six small yellowish-to-green petals.
- Fruits
  - **European buckthorn:** produce clusters of berry-like black fruit in late summer and fall.
  - **Glossy buckthorn:** berry-like fruits ripen throughout the summer with green, red and black fruits occurring at the same time.
- Leaves
  - **European Buckthorn:** Smooth, dark green leaves are finely toothed, 2.5-6 cm long, and arranged in opposing pairs along the stem.
  - **Glossy Buckthorn:** Alternate, shiny leaves with smooth, wavy edges.
- Twigs
  - **European buckthorn:** branches older than one year end in a short, sharp thorn.
  - **Glossy buckthorn:** whereas glossy buckthorn lack thorns on the end of the twig.

CONTROL RECOMMENDATIONS

STRATEGY AND CAUTIONS

- Remove the outlying populations (isolated plants or satellite populations) and the most prolific seed producers (female plants) first to prevent further spread.
- Because of the thorns, it is recommended that protective clothing, including gloves, is worn when applying manual control.

Caution: Re-sprouting can be dramatic after a failed control attempt. When applying manual control, the entire root must be removed to prevent re-sprouting.

Make sure that all equipment, boots, clothing etc. are cleaned at the site to ensure seeds are not transported from the site. See the Ontario Invasive Plant Council's Clean Equipment Protocol for more details.

MANAGEMENT OF SMALL POPULATIONS (<300M2) EXCLUDING LARGE TREES (>5CM DIAMETER)

Small populations of small plants (up to 1 m tall) can be hand-pulled any time of the year. Small populations of plants up to 5 cm in diameter can be removed using a weed pulling tool. The entire root crown must be removed in order to prevent re-sprouting. Disturbed soil will result from these techniques and should be tamped down or covered in a thick layer of mulch to minimize exposing new buckthorn seeds. Manual control is easiest after rain when the soil is soft and pliable. If possible, cut off berried branches in the summer, before the berries get too ripe and fall off, then come back in the fall and pull out the cut stems. Because European buckthorn leaves stay greener longer than most native plants, manual control in the fall or early winter, before the ground freezes, may be favorable as identification is easier and most of the ground vegetation will have gone dormant by this time, reducing disturbance to surrounding plants.

MANAGEMENT OF LARGE POPULATIONS (>300M2) AND LARGE TREES (>5CM DIAMETER)

Application of a glyphosate-based or triclopyr-based herbicide is most effective for managing large populations and large trees. A foliar application of a glyphosate-based herbicide is recommended for large populations of small trees. Large trees (>5 cm diameter) can be cut and the stumps treated with either glyphosate (must be applied immediately following cut) or trichlopyr mixed with bark oil. These plants can also be sprayed with triclopyr using a basal bark application. Since systemic herbicides need to be translocated to the roots to be effective, herbicide applications must be applied during the growing season. Glyphosate should be applied between 10 and 30°C and trichlopyr under 30°C. Neither should not be used in low humidity conditions. Pesticide drift may prohibit pesticide use near water.

For a complete list of control methods for this species, please consult the Best Management Practices guide and Technical Document Series for European Buckthorn.

DISPOSAL

Do not compost viable plant material (berries and roots) at home or send to landfill. If your municipality has a high-heat compost program, plants can be sent there. Alternatively, solarize viable plant material by placing it in sealed black plastic bags and leaving them in direct sunlight for 1-3 weeks. Alternatively, place in yard waste bags, cover with a dark-coloured tarp and leave in the sun for 1-3 weeks. When seedlings or young shrubs are pulled, they should be disposed of in a manner that will ensure that their roots will dry out completely. When feasible, it is advised to remove limbs containing dense clusters of berries. The remaining biomass can be sent to municipal composting facilities while the seed-containing berries are best disposed of at the landfill. European buckthorn wood (other than viable seeds and roots) that has been cut can be burnt as firewood, composted or sent to municipal composting facilities.

JAPANESE KNOTWEED

(Reynoutria japonica)

Japanese knotweed (Reynoutria japonica) is an invasive, perennial herbaceous plant native to eastern Asia (Japan, Korea, China and Taiwan), where it is relatively uncommon and one of the first species to grow after eruptions or disturbance on volcanic slopes. It was introduced to North America as a horticultural plant in the late 19th century and was widely planted as an ornamental, for the purposes of erosion control, and as forage for livestock. It has escaped cultivation to become an aggressive invader in North America as well as Europe, Australia, and New Zealand.

INVADED HABITATS

- Japanese knotweed grows most vigorously in full sunlight, preferring open exposed sites, but can grow in deep shade in riparian zones.

- Grows in a range of habitats including wetlands, roadsides, ditches, utility right of ways and fence lines.
- Spreads primarily along riparian areas or ditches where plant and rhizome fragments can be dispersed in moving water (i.e. along canals, beaches, streams and rivers).

IMPACTS OF JAPANESE KNOTWEED

- Can severely degrade the quality of wetland and riparian habitats where it becomes established.
- Dense thickets can reduce sunlight penetration by more than 90%, and prevent other plant species from growing ultimately reducing local plant and wildlife biodiversity.
- Japanese knotweed root systems, while strong, are not as dense as those of native plants, and do not hold soil as well. When Japanese knotweed establishes along stream banks, the bank can become unstable and more vulnerable to erosion and flooding.
- This plant can significantly damage infrastructure. It is able to grow through concrete/ asphalt up to 8 cm thick and building foundations.
- Japanese knotweed can block or interfere with access to water for activities such as canoeing, boating, angling and swimming.

IDENTIFICATION

- This plant typically grows 1-3 m in height.
- Hollow, smooth, purple to green coloured stems up to 2.5 cm in diameter. The hollow jointed stems have reddish-brown solid nodes surrounded by a papery sheath (stipule). The stems die back each fall and the dead brown to reddish stalks remain standing over the winter.
- Alternate leaves are oval to triangular with a pointed tip and a flat base with a long stalk (petiole) arising from the stem. The leaves are 10-17 cm long and 4-7 cm wide arranged alternately along the stem in a distinctive zigzag pattern.
- Small, green white flowers bloom in sprays near the end of the stem and in the leaf axils in late July or August. Flowers are produced in branching panicles (clusters).
- Japanese Knotweed quickly develops large underground root systems (rhizomes) which account for two thirds of its total mass. These rhizomes are dark brown, with a bright orange interior.

CONTROL RECOMMENDATIONS

STRATEGY AND CAUTIONS

- Japanese knotweed is regulated under Ontario's Invasive Species Act as a restricted species.
- Japanese knotweed reproduces mainly via rhizomes, which account for two thirds of the plants total mass and can extend more than 2 m deep and 18 m in length.
- Even a 1 cm root fragment can reproduce. It is therefore critical that manual control results in removal of 100% of the root mass and chemical control results in the death of the root mass.
- Remove the outlying populations (isolated plants or satellite populations) first to prevent further spread.

Caution: Other manual control methods including mowing or cutting, unless combined with chemical control, may increase densities by stimulating growth. These methods are not effective for long term control.

Make sure that all equipment, boots, clothing etc. are cleaned at the site to ensure seeds are not transported from the site. See the Ontario Invasive Plant Council's Clean Equipment Protocol for more details.

MANAGEMENT OF SMALL POPULATIONS (<15 PLANTS)

Using a shovel or similar digging tool may aid in the removal of smaller plants but it is essential to remove the entire plant, including all roots. This means digging out and sifting through the soil after the main stem is removed. Any portions of the root system not removed can re-sprout. Dig as much as you can at the site throughout the spring when the plant will be at the beginning of its growing season and after a rain when the soil is most pliable. Revisit the site 2-3 times in the growing season to remove or chemically treat re-sprouts.

MANAGEMENT OF LARGE POPULATIONS (>15 PLANTS)

Foliar spray or stem injections using a glyphosate-based or aminopyralid-based herbicide are the most effective means of control for large populations. Herbicide applications must be applied during the growing season. Single treatments are usually insufficient for complete control. At least 2 treatments per season are therefore recommended, one as soon as the leaves are fully extended (May-June) and another later in the summer (July-Aug). This must be repeated over multiple growing seasons. Older infestations will require more follow-up treatments than younger infestations. Pesticide drift may prohibit pesticide use near water.

For a complete list of control methods for this species, please consult the Best Management Practices guide and Technical Document Series for Japanese Knotweed.

DISPOSAL

Do not compost viable plant material at home or send to landfill. If your municipality has a high-heat compost program, plants can be sent there. Alternatively, solarize viable plant material by placing it in sealed black plastic bags and leaving them in direct sunlight for 1-3 weeks. Alternatively, place in yard waste bags, cover with a dark-coloured tarp and leave in the sun for 1-3 weeks.

WILD PARSNIP

(Pastinaca sativa)

Wild parsnip is an invasive plant native to Europe and Asia. It was likely brought to North America by European settlers, who grew it for its edible root. Since its introduction, wild parsnip has escaped from cultivated gardens and spread across the continent. In North America, scattered wild parsnip populations are found from British Columbia to California, and from Ontario to Florida. It has been reported in all provinces and territories of Canada except Nunavut. The plant is currently found throughout eastern and southern Ontario, and researchers believe it is spreading from east to west across the province.

INVADED HABITATS

- Often found in areas exposed to full sun, although it can grow in the semi-shade of forests and riverbanks.
- It is tolerant of a variety of soils, but cannot survive in flooded environments. Its deep taproot is thought to be of benefit during times of drought.
- Less common sites include cultivated fields, gardens, meadows, swampy lowlands and grassy areas.
- Ontario populations are commonly found growing along fence rows, the edge of agricultural fields, watercourses and drainage areas. It often grows along with perennial grasses.

IMPACTS OF WILD PARSNIP

- The plant can form dense stands that outcompete native plants, reducing biodiversity.
- Stem, leaves, and flowers contain chemicals that can increase skin sensitivity to sunlight and cause severe dermatitis.
- Wild parsnip reduces the quality and saleability of agricultural forage crops such as hay, oats, and alfalfa.
- Chemical compounds in the plant are known to reduce weight gain and fertility in livestock that eat it.

IDENTIFICATION

- **HEIGHT** - Grows up to 1.5 metres tall.
- **STEM** - The single green stem is two to five centimetres thick and smooth with few hairs.
- **LEAF** - Compound leaves are arranged in pairs, with sharply toothed leaflets that are shaped like a mitten.
- **FLOWER** - Yellowish green flowers form umbrella-shaped clusters 10 to 20 centimetres across.
- **SEED** - Seeds are flat and round.

STRATEGY AND CAUTIONS

- Wild parsnip reproduces only via seeds, making seed reduction and prevention an important factor in control.
- Remove the outlying populations (isolated plants or satellite populations) first to prevent further spread.
- Small populations (<400 plants) can be removed manually.
- Large populations (>400 plants) are most effectively controlled using a systemic herbicide.
- Motorized tools (whipper snipper, mowers, etc.) are not effective long term control and pose a danger of sap exposure to operator and to anyone/anything walking through the site.

SAFETY WARNING: Wild parsnip sap contains furanocoumarins, phototoxic (reacts with UV light to create a toxin) compounds which may cause phytophotodermatitis, 2nd degree burns, permanent scaring and/or eye damage. Extreme caution and protective clothing is essential when working with this species. Wear waterproof gloves, long sleeve shirts, pants and eye protection (or face shield when working with plants at or above chest height). See the Ontario Invasive Plant Council's Best Management Practices document for wild parsnip for details.

Make sure that all equipment, boots, clothing etc. are cleaned at the site to ensure seeds are not transported from the site. See the Ontario Invasive Plant Council's Clean Equipment Protocol for more details.

MANAGEMENT OF SMALL POPULATIONS (<400 PLANTS)

Digging or pulling is the most effective method for controlling small populations or in environmentally sensitive areas where herbicides cannot be used. The average plant can be pulled out like a carrot. For larger or more difficult plants, use a hoe or shovel to sever the taproot 3-5 cm below the soil line. Removal is easiest after a rain when soil is soft, or in times of drought when the taproot shrinks. Spring is best, when the taproot is at the beginning of its growing season.

MANAGEMENT OF LARGE POPULATIONS (>400 PLANTS)

Using a glyphosate-based herbicide is the most effective form of control for large populations. If a plant is flowering, herbicides are not effective and control methods should focus on carefully removing the flower heads. Herbicide treatments need to be repeated annually until the seedbank is depleted. Pesticide drift may prohibit pesticide use near water.

For a complete list of control methods for this species, please consult the Best Management Practices Guide for Wild Parsnip.

DISPOSAL

Do not compost viable plant material (seeds and roots) at home or send to landfill. Burning is not recommended, as it is unknown if smoke as an exposure route is a problem. If your municipality has a high-heat compost program, plants can be sent there. Alternatively, solarize viable plant material by placing it in 3.0 MIL gauge black plastic bags, seal the bags tightly and leave them in direct sunlight for about 1-3 weeks. Note: Using weaker, thinner bags will increase the chance of tearing and exposure to sap.

ORIENTAL BITTERSWEET

(Celastrus orbiculatus)

Oriental bittersweet is a deciduous, woody vine native to the regions of China, Korea, and Japan. Introduced to North America as an ornamental plant in the 1800s, and has since spread throughout Eastern US and Canada. Oriental bittersweet has been reported from northern Quebec south to Georgia, and as far west as Manitoba and Iowa stretching eastward to Prince Edward Island.

INVADED HABITATS

- Highly adaptable and can grow in a variety of light and soil conditions.
- Most productive in sunlight but shade tolerant. Found in woodlands, forest edges, grasslands, roadsides and hedgerows. Does not grow well in wet habitats.
- Birds consume the berries and can contribute to its long-distance dispersal.

IMPACTS OF ORIENTAL BITTERSWEET

- Oriental bittersweet grows by twining around shrubs and trees, that may reach lengths up to and exceeding 18 m and stems and 17 cm in diameter
- Can easily shade-out native vegetation, forming nearly pure stands
- It can strangle vegetation and weaken mature trees by girdling the trunk and smothering the crown causing mortality
- Oriental bittersweet reproduces through seed, vegetatively via rhizomes underground, and sprouts new stems from the root crown
- Oriental bittersweet can hybridize with the native species American bittersweet (C. scandens), which could threaten to genetically eliminate this native species. The American bittersweet is distinguished by flowers clustering at the tips of its branches, while Oriental bittersweet has flower clusters along the leaf axil

IDENTIFICATION

- Alternating highly variable glossy leaves (from round or egg-shaped to oblong or elliptical), smooth with wavy, slightly toothed margins and tips that taper to a point
- Light brown stems with lenticels and white piths
- Roots a distinctive orange
- From May to June, produces green-yellow five-petaled flowers at the leaf axils
- Female plants produce round leathery seed pods turning from green in spring, to bright yellow-orange in fall and persisting through winter
- Seed pods contain red fruit each with 3 – 6 seeds

STRATEGIES AND CAUTIONS

- Remove the outlying populations (isolated plants or satellite populations) and the most prolific seed producers (female plants) first to prevent further spread
- Oriental bittersweet is difficult to control once it becomes established, therefore a strategy which includes Integrated Pest Management principles (IPM), where more than one management technique are applied, increases overall effectiveness
- Take extra care with the movement of soil in areas where Oriental bittersweet is found as any root fragment can sprout and become a new plant
- Because of this species' capacity for long-distance dispersal, it is warranted to survey the surrounding landscape for additional or new infestations
- Cutting/mowing is not an effective control option as it stimulates re-sprouting via root suckering, however it will reduce the impacts on surrounding vegetation temporarily and if done regularly could eventually weaken the plants reserves

Make sure that all equipment, boots, clothing etc. are cleaned at the site to ensure seeds are not transported from the site. See the Ontario Invasive Plant Council's Clean Equipment Protocol for more details.

CONTROL RECOMMENDATIONS

MANAGEMENT SEEDLINGS AND SMALL POPULATION (<400 PLANTS)

Hand-pulling or digging is the most effective means of eradication, and although as a stand-alone method may not completely eradicate infestations, removing these plants will help prevent further damage to vegetation which Oriental bittersweet has twined around. Take care to remove the entire root as even a small root fragment may re-sprout and become new plants. It is important to determine whether young shoots are seedlings or sprouts as this knowledge will contribute to more effective management. Pulling and digging after a rain fall when the soil is moist may better facilitate this process. This can be especially difficult since the rhizomes can run long distances with many stems emerging along the way. Plants should be pulled steadily and slowly to minimize soil disturbance and soil should be tamped down following management. Continued hand-pulling and digging over several growing seasons. Sites should be monitored regularly for regrowth and seedlings, removing new seedling sprouts. In small infestations, it may be possible to remove larger plants can by digging carefully ensuring roots are removed.

MANAGEMENT OF LARGE POPULATIONS (>400 PLANTS)

Large vines can be cut and if performed regularly could eventually deplete the plants energy reserves. However, in most cases the use of herbicide is required to control large and established populations. Since the leaves of Oriental bittersweet persist much later than many native species, fall treatment may minimize damage to desirable broadleaf plant species.

DISPOSAL

Do not compost viable plant material (berries and roots) at home or send to landfill. If your municipality has a high-heat compost program, plants can be sent there. Alternatively, solarize viable plant material by placing it in sealed black plastic bags and leaving them in direct sunlight for 1-3 weeks. Alternatively, place in yard waste bags, cover with a dark-coloured tarp and leave in the sun for 1-3 weeks. When seedlings or young shrubs are pulled, they should be disposed of in a manner that will ensure that their roots will dry out completely. When feasible, it is advised to remove limbs containing dense clusters of berries. The remaining biomass can be sent to municipal composting facilities while the seed-containing berries are best disposed of at the landfill.

INVASIVE HONEYSUCKLES

(Lonicera spp.)

There are over 180 honeysuckle species in the genus Lonicera. These include honeysuckles native to North America, Asia, Europe, Russia and India. Sixteen honeysuckle species are found in Ontario, including ten introduced species. Invasive honeysuckles is the collective term for several shrub-form plants in the Lonicera genus including: Tatarian (Lonicera tatarica), Amur (L. maackii), Morrow (L. morrowii) and Bells (L.×bella) honeysuckles.

Honeysuckles were valued additions to gardens brought to North America from their native Korea, China, Japan, Europe and Russia. As far back as the 18th century, the honeysuckles were prized for their attractive flowers and were imported and promoted as a garden ornamental, as a shrub for wildlife and to prevent soil erosion. In Canada, invasive honeysuckles are found from as far west as Alberta and east to the Maritime Provinces, with infestations primarily in Ontario.

INVADED HABITATS

- Invasive honeysuckles adapt well to a variety of habitats and soil types, from disturbed to natural. They are established in habitats such as thickets and floodplains.
- These species are successful edge colonizers, often found in transition zones between woodlots and open areas such as old farm fields and pastures, as well as along shorelines and areas such as road sides, and railroad rights-of-way.
- They have been found growing in well drained, moist soils, and can tolerate low nutrient availability.
- These shade tolerant shrubs grow particularly well in calcareous soils, and in the case of Amur honeysuckle, may be found growing in fens, grasslands and barrens.

IMPACTS OF INVASIVE HONEYSUCKLES

- Invasive honeysuckles grow quickly, forming dense patches, outcompeting native plants species resulting in barren ground beneath a dense patch.
- Invasive honeysuckles have allelopathic qualities - they release a chemical that inhibits the growth of neighboring plants.
- Migratory songbirds feed on the abundant fruits of the invasive honeysuckles, but the berries are less nutritious than native shrub species.
- Songbirds nesting in invasive honeysuckles, experience higher rates of nest predation likely due to nesting closer to the ground than they would have in native trees and shrubs.
- In Ontario, invasive honeysuckles are identified as a threat to several plant species at risk including, American columbo *(Frasera caroliniensis)*, hoary mountain-mint *(Pycnanthemum incanum)*, drooping trillium *(Trillium flexipes)*, and spoon-leaved moss *(Bryoandersonia illecebra)*.

IDENTIFICATION

HEIGHT

Amur – up to 6 m
Tatarian – up to 5 m
Morrow – up to 2.5 m
Bells – up to 6 m

LEAVES

AMUR
· Dark green leaf appears much earlier in the spring than other vegetation
· Opposite and acuminate, tapering to a narrow, longer, more pronounced point compared to other species
· Leaf sparsely hairy above and below leaves end in a sharp point at the tip.
· Underside has hair along the veins.

TATARIAN
· Opposite and obtuse, more rounded and shorter leaf shape, like a spade
· Leaves and buds hairless, buds ovoid shaped

MORROW
· Opposite and oval-acute, tapering to a wide, sharp point
· Hairy underside, upper leaf surface usually hairless
· Leaf buds sparsely hairy or hairless, short cone shaped

BELLS
· Opposite and oval-acute-obtuse, tapering to a more blunt point intermediate shape between Tatarian and Morrow but roughly the same size as Morrow
· Leaves only slightly hairy or hairless, slightly hairy underside
· Leaf buds sparsely hairy or hairless, short cone shaped

FLOWER

AMUR
· White/yellow flowers
· Peduncles (flower stems) short (2-4 mm) and pubescent (downy)

TATARIAN
· White to dark pink flowers
· Peduncles long (10-15 mm), hairless, and longer than leaf stalks

MORROW
· White to pink
· Peduncles long (10-12 mm), pubescent, hairy and longer than leaf stalks

BELLS
· Pink fading to yellow with age
· Peduncles long (10 mm), sparsely hairy to hairless, and longer than leaf stalks

FRUIT

AMUR
· Red berries (can be slightly orange)

TATARIAN
· Red berries (rarely yellow)

MORROW
· Red Berries

BELLS
· Red berries (occasionally yellow)

BARK/BRANCHES

AMUR
· Often hollow between nodes or with brown pith

TATARIAN
· Branchlets hollow between nodes, twigs grey or yellow brown

MORROW
· Branchlets with brown pith, twigs hairy

BELLS
· Branchlets with brown pith, twigs hairy, twigs grey to dark grey brown and hairy

CONTROL RECOMMENDATIONS

STRATEGY AND CAUTIONS

- Remove the outlying populations (isolated plants or satellite populations), the young, small plants and the most prolific seed producers first.
- Remove honeysuckles before fruit develops, which is typically at 3-5 years old.

Caution: Manual control methods which do not result in total removal of the root will result in vigorous re-sprouting. These methods should only be used in combination with an herbicide application.

Make sure that all equipment, boots, clothing etc. are cleaned at the site to ensure seeds are not transported from the site. See the Ontario Invasive Plant Council's Clean Equipment Protocol for more details.

MANAGEMENT OF SMALL SHRUBS (<5CM DIAMETER)

Because the root systems of invasive honeysuckles are shallow, even some large plants can be manually pulled. Small plants can be hand pulled any time of the year. For larger shrubs, cut stems down first and then use a mechanical lever, such as a weed wrench, to pry up the root systems. Use a digging tool for larger plants or in harder, less pliable soil. Manual control is easiest after a rain when the soil is soft and pliable. If possible, cut off berried branches in the summer, before the berries get too ripe and fall off, then come back in the fall and pull out the cut stems. Any root that remains has the potential to re-sprout but fibrous root removal is unnecessary.

MANAGEMENT OF LARGE SHRUBS (>5CM DIAMETER)

Application of a glyphosate-based or triclopyr-based herbicide is most effective for managing large plants. The stump cut method is preferable but a basal bark application can also be effective. Large shrubs (>5 cm diameter) can be cut and the stumps treated with either glyphosate (must be applied immediately following cut) or triclopyr mixed with bark oil. This is most effective in spring or early summer but can be used into the fall. These plants can also be sprayed with triclopyr using a basal bark application. Pesticide drift may prohibit pesticide use near water.

For a complete list of control methods for this species, please consult the Best Management Practices guide and Technical Document Series for invasive honeysuckles.

DISPOSAL

Do not compost viable plant material (berries and roots) at home or send to landfill. If your municipality has a high-heat compost program, plants can be sent there. Alternatively, solarize viable plant material by placing it in sealed black plastic bags and leaving them in direct sunlight for 1-3 weeks. Alternatively, place in yard waste bags, cover with a dark-coloured tarp and leave in the sun for 1-3 weeks. When seedlings or young shrubs are pulled, they should be disposed of in a manner that will ensure that their roots will dry out completely. When feasible, it is advised to remove limbs containing dense clusters of berries. The remaining biomass can be sent to municipal composting facilities while the solarized seed-containing berries are best disposed of at the landfill. Branches and stems (other than viable seeds and roots) that has been cut can be burnt as firewood, composted, chipped or sent to municipal composting facilities.

HIMALAYAN BALSAM

(Impatiens glandulifera)

Himalayan balsam is an invasive herbaceous annual herb native to the western Himalayas introduced in the early 1800s to many parts of Europe, New Zealand and North America as a garden ornamental. Since then it has escaped cultivation and invading natural areas. In Canada, it has been reported in eight provinces including British Columbia, Manitoba, Ontario, Quebec, Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland. In Ontario it is found in southern parts of the province and reported from central Ontario in Sudbury and northern Ontario in Thunder Bay.

INVADED HABITATS

- Most often found in moist to wet soils, such as riparian areas, especially river edges. Seeds are buoyant and disperse downstream often germinating during along the way.
- Found along woodland edges, trails and roadsides

IMPACTS

- Himalayan balsam can completely cover an area and crowd out native vegetation
- Mature seed capsules explode when touched and can eject seeds as much as 5 metres from the parent plant, giving it the alternate common name of touch-me-not
- Creates dense stands that prevent native plants from establishing and reduce biodiversity and ecological value of land
- Prolific nectar producer, drawing pollinators away from surrounding native species
- Produces about 800 seeds per plant, which are released from capsules once they are disturbed or dry out
- An annual species that can aggressively replace native perennial plants along river banks, leading to soil erosion

IDENTIFICATION

- Stems are hollow and smooth with purple to reddish colour. Able to grow 1-3 m tall
- Leaves are 6-15 cm long and are widest in the middle with sharply toothed edges
- Flowers have 5 pink, white or purple petals, with 5-10 flowers on each stem
- Seeds are produced in capsules 1.5-3.5 cm long with up to 16 seeds inside. Mature seed capsules explode when touched, launching seeds in all directions up to 5 m away.
- Looks similar to Ontario's native Jewelweed *(Impatiens capensis)*, which is a related species with yellow-orange flowers

STRATEGIES AND CAUTIONS

- Pulling plants before or while they are in flower, but before they set seed, is the most effective control method for all populations sizes. Do not conduct management if seeds are present (mid- to late-August)
- Remove the outlying populations (isolated plants or satellite populations) and the most prolific seed producers first to prevent further spread

Make sure that all equipment, boots, clothing etc. are cleaned at the site to ensure seeds are not transported from the site. See the Ontario Invasive Plant Council's Clean Equipment Protocol for more details.

CONTROL RECOMMENDATIONS

MANAGEMENT SEEDLINGS AND SMALL POPULATIONS (<400 PLANTS)

Because the root systems of Himalayan balsam are shallow, even some large plants can be manually pulled. Small plants can be hand pulled any time of the year. For larger shrubs, cut stems down first and then use a mechanical lever, such as a weed wrench, to pry up the root systems. Use a digging tool for larger plants or in harder, less pliable soil. Manual control is easiest after a rain when the soil is soft and pliable. If possible, cut off berried branches in the summer, before the berries get too ripe and fall off, then come back in the fall and pull out the cut stems. Any root that remains has the potential to re-sprout but fibrous root removal is unnecessary.

MANAGEMENT OF LARGE POPULATIONS (>400 PLANTS)

Mechanical control by repeated cutting or mowing is effective for large stands. Plants will regrow if the lower parts are left intact therefore the plant must be cut below the lowest node to stop regeneration. Access to the sides of riverbanks can be difficult and inaccessible stands can re-colonise cleared areas, therefore this method should be repeated and used alongside other treatments for best results. For larger, established populations, herbicide has been effective. This method of control must be undertaken with careful consideration to due to this species' tendency to occupy riparian herbicides, as permit approval may be required for the use of herbicides near water.

DISPOSAL

Do not compost viable plant material (seeds) at home or send to landfill. If your municipality has a high-heat compost program, plants can be sent there. Alternatively, solarize viable plant material by placing it in sealed black plastic bags and leaving them in direct sunlight for 1-3 weeks. Alternatively, place in yard waste bags, cover with a dark-coloured tarp and leave in the sun for 1-3 weeks. When seedlings or young shrubs are pulled, they should be disposed of in a manner that will ensure that their roots will dry out completely. The remaining biomass can be sent to municipal composting facilities while the solarized seeds (if present) are best disposed of at the landfill. Branches and stems (other than viable seeds and roots) that has been cut can be burnt as firewood, composted, chipped or sent to municipal composting facilities.

BLACK LOCUST

(Robinia pseudoacacia L)

Black locust (Robinia pseudoacacia L.), also known as false acacia, post locust and yellow, white or green locust, is a tree belonging to the pea (Fabaceae) family. It is native to the Appalachian Mountains and Ozark Plateau, with its native range reaching from central Pennsylvania to Alabama and Georgia.

Because of its durability, adaptability to highly disturbed sites and because it burns well for firewood, it became a popular tree to plant in the early 1900s throughout North America. Its fast-growing nature makes it popular for mine reclamation, reforestation and erosion control, and it is still one of the most widely planted trees in North America. Black locust is commonly used for fence posts, mine timbers, poles, railroad ties, insulator pins, ship timber, nails for wooden ship construction, pulp, boxes, crates, etc. It is also a popular choice for woodworking projects, as the wood is naturally resistant to most rots.

INVADED HABITATS

- Black locust can survive in many ecosystem and soil types, including nutrient poor soils, readily colonizing disturbed or damaged ecosystems
- Poor, dry, sunny locations, savannas, prairie, fencerows, roadsides, forest edges, valley slopes, limestone etc.
- It is cold hardy and can withstand weather extremes, such as prolonged droughts, giving it an advantage over many native species.
- It aggressively invades ecosystems such as oak (Quercus spp.), beech-maple (Fagus sp. – Acer spp.) and aspen (Populus spp.) forests, and already fragmented native prairie and savanna ecosystems



IMPACTS OF BLACK LOCUST

- Forms dense colonies and shades out native plants
- The roots of the black locust have nitrogen fixing nodules that can increase the nitrogen content in the soil, altering ecosystem structure and dynamics and causing a decrease in species richness
- It is insect pollinated and may divert pollinators away from native plants.
- Many parts of the plant, including the leaves, inner bark, young shoots, pods and seeds, are toxic to humans and many animals, with horses being particularly susceptible.
- It reproduces through seeds but is extremely inclined to colonization through suckering (producing a number of new root sprouts)

IDENTIFICATION

- Up to 30 m in height
- Smooth bark; brown to green in young trees, tan to gray-brown, deeply furrowed ridges in older trees and orange inner bark
- Often form colonies with many suckers at margins
- Pinnately compound (single) leaves, each bearing 7-21 leaflets 30-50 mm long, bluish-green (yellowish-brown in autumn). A terminal leaflet is usually present. The leaves have paired stipular spines.
- Fragrant white clusters of 10-25 pea-like flowers; the upper petal bearing a yellow blotch
- Seeds are smooth, flat, dark red-brown pods 7-13 cm long containing 4-8 flat, brown, beanlike seeds 3-5 mm long.


CONTROL RECOMMENDATIONS

STRATEGY AND CAUTIONS

- Black locust is extremely difficult to eradicate once established and no single technique is entirely effective.
- Remove the outlying populations (isolated plants or satellite populations) first to prevent further spread.
- Younger trees with thin bark (15 cm in diameter) should be treated with a triclopyr-based herbicide using a cut stump method.

Make sure that all equipment, boots, clothing etc. are cleaned at the site to ensure seeds are not transported from the site. See the Ontario Invasive Plant Council's Clean Equipment Protocol for more details.

Caution: Once black locust is established, any attempt at physical control will encourage suckering/colonization, making it extremely difficult and costly to eradicate fully. For this reason, hand pulling, girdling, burning, mowing and cutting (without chemical control) is not recommended!

MANAGEMENT OF SMALL TREES (≤15 CM DIAMETER)

Small trees with thin bark (<15 cm in diameter) can be controlled using a basal bark application of a triclopyr-based herbicide. Basal bark application is best performed during the growing season (midsummer to early fall) after the heavy sap flow of spring has slowed

MANAGEMENT OF LARGE TREES (>15 CM IN DIAMETER)

Large trees should be controlled using a cut stump method combined with a triclopyr-based herbicide to prevent suckering. This method should be performed during the growing season. Cut the tree as close to the ground as possible and apply herbicide within 30 minutes of cutting. Apply herbicide to the cambium - the thin layer where active growth occurs, just inside the bark – using, for instance, a spray bottle or wicking applicator.

For a complete list of control methods for this species, please consult the Best Management Practices guide and Technical Document Series for Black Locust.

DISPOSAL

Do not compost viable plant material (seeds and roots) at home or send to landfill. If your municipality has a high-heat compost program, plants can be sent there. Alternatively, solarize viable plant material by placing it in sealed black plastic bags and leaving them in direct sunlight for 1-3 weeks. Alternatively, place in yard waste bags, cover with a dark-coloured tarp and leave in the sun for 1-3 weeks. Branches and stems that have been cut can be burnt as firewood, composted or sent to municipal composting facilities.

SCOTS PINE *(Pinus sylvestris)*

Scots pine (Pinus sylvestris L.), also known as Scotch pine, Scots fir, Irish Giuis, common pine or red fir, is a tree belonging to the pine (Pinaceae) family. It is among the most widely distributed conifer species with a natural range from Western Europe (Scotland) to Eastern Siberia, south to the Caucasus Mountains and as far north to the Scandinavian Peninsula in the Arctic Circle.

Scots pine was among the first European tree species introduced to North America used in an effort to control soil erosion by reforesting abandoned agricultural lands, and later in the 1950s and 1980s was one of the most sought after Christmas trees. However, within a relatively short time period other species proved better options and a lack of pruning led to plantations of Scots pine growing to the point of no longer being marketable.

INVADED HABITATS

- Scots pine is shade intolerant and tends to dominate niches such as old fields, roadsides, open bogs and open woods.
- In Ontario, Scots pine have invaded many sensitive ecosystems including oak savannas, tall grass prairies and sand dunes.

IMPACTS OF SCOTS PINE

- Scots pine is a vector or reservoir for some insect pests and diseases to valued tree species. There are more than 100 documented insect or disease issues associated with Scots pine in Ontario, several of which are introduced pests (ie. Pine wilt)
- Scots pine produce many seeds that spread and develop into aggressively growing seedlings which reach reproductive maturity quickly, outcompeting native wildflowers, grasses as well as native oak, maple and pine species

IDENTIFICATION

- A mature tree can reach up to 35 m in height and 1 m in diameter. They often have a crooked trunk with sparse branching and an irregularly-shaped crown.
- The bark is thick, scaly, dark grey-brown on the lower trunk and thin, flaky and orange-brown on the upper trunk and branches.
- On mature trees, leaves (needles) are dull, greyish blue-green and dark green to dark yellow-green in the winter. They are slightly twisted, 2.5-5 cm in length, 1-2 mm wide and bunched in groups of two with a grey 5-10 mm basal sheath. The needle-like leaves on young trees can grow up to twice as long and may occur in bunches of three or four.
- Scots pine is monoecious, which means it has both male and female flowers on one tree. Male flowers consist of yellow anthers at the base of shoots. Female flowers are smaller, globular, red-purple and grow on the tips of new shoots.
- The pollen (male) cones are yellow or sometimes pink, 8-12mm long and release pollen in the spring. Once pollinated, female flowers turn green and develop into seed cones. In their first year, seed cones are globular and 4-8mm in diameter. By the second or third year, seed cones are pointed, ovoid-conic and 3-7.5 cm long. It takes 2-3 years for cones to mature and release their seeds.
- Seeds are black, 3-5 mm long with a tan-coloured wing that is 12-20 mm long.
- Scots pine root system is shallow or it develops a deep taproot on dry soils.

CONTROL RECOMMENDATIONS

STRATEGY AND CAUTIONS

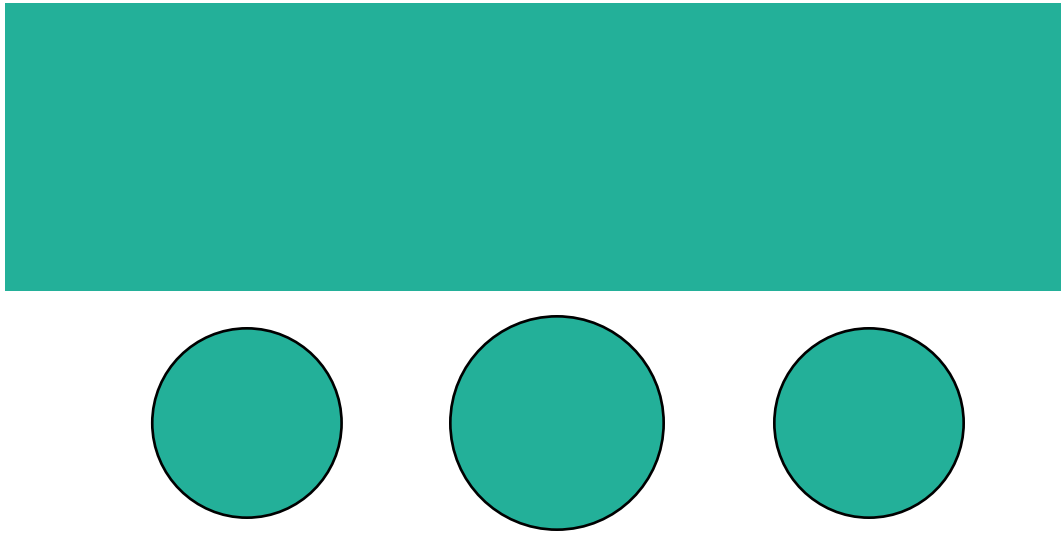
- Remove the outlying populations (isolated plants or satellite populations), the young, small plants and the most prolific seed producers first.
- For information on woodlot-level management, (ie. where invasive tree species dominate a woodlot and where large-scale management is considered) it is best to review the Best Management Practices Guide for Scots Pine as it contains specific information regarding stand-conversion, or consult with forestry professionals.

MANAGEMENT OF SMALL INFESTATIONS OF SMALL TREES (<0.5 HECTARE)

Pulling or cutting are the most effective means of controlling small and recent infestations. The trees can be up-rooted or cut either at the seedling or sapling stage, before they reach maturity and increase in height and diameter. Small plants can be hand pulled any time of the year.

Larger saplings may warrant it necessary to first cut stems down followed by the use of a mechanical lever, such as a weed wrench, to pry up the root systems. Use a digging tool for larger plants or in harder, less pliable soil. Manual control is easiest after a rain when the soil is soft and pliable. If root removal is not possible, seedlings, saplings and young trees can be cut below the lowest photosynthesizing branch. As Scots pine seed can remain viable for several years, periodic retreatment may be necessary.

Girdling is effective in controlling small infestations of mature trees as individual trees must be treated which may not be feasible at a large scale. Trees are most vulnerable early in the growing season just after rapid tissue growth has depleted carbohydrate resources. Bark is also "loose" in the spring and early summer when the cambium layer is active, making bark easier to peel. To girdle trees, remove the bark and phloem layer from a 10 cm band around trunk. Extra care must be taken to avoid damaging the xylem layer as this may encourage suckering. Check girdle for redevelopment of bark and remove if necessary. There are few tools specifically for girdling, but many can be used as girdling tools. With a chain saw, hand saw or rope saw, cut parallel, horizontal grooves through the bark several inches apart. Afterward, the bark and cambium layers between the cuts can be peeled away. The most effective method with an axe involves hacking a line around the tree with a series of down-ward blows, then hacking a second line three inches above the first. The material between the two lines must be pried out with the ax blade.



For a complete list of control methods for this species, please consult the Best Management Practices guide for Scots pine.

DISPOSAL

Do not compost viable plant material (seeds and roots) at home or send to landfill. If your municipality has a high-heat compost program, plants can be sent there. The branches and wood of Scots pine do not reproduce (unless still bound to the soil via roots i.e. a stump). Therefore, as long as you carefully remove the seeds and dispose of properly (see above) you can leave the branches on site to decompose on their own.

SUMMARY

LANDOWNER STRATEGIES AND USEFUL RESOURCES

Controlling invasive species is a daunting task; however, with a strategy in place, a landowner can control invasive species on their property over time. This guide identifies the invasive plant species most likely to occur in or surrounding forested areas, as well as management approaches based on population size (Table 1.0).

*Table 1.0 Summary of Common Invasive Plants and Management Techniques.**

Species	Management Based on Population/Specimen Size	Timing
Garlic Mustard	All population sizes: hand-pulled	April/May
Dog-Strangling Vine	Small populations (<400 plants): digging	April to August
	Large populations (>400 plants): herbicide	See product label
European and Glossy Buckthorn	Small population (<300m², excluding large trees >5cm Diameter): hand-pulled	Any
	Large populations (>300m² and large trees >5 cm diameter): herbicide	See product label
Japanese Knotweed	Small populations (<15 plants): digging	April/May and throughout growing season
	Large populations (>15 plants): herbicide	See product label
Wild Parsnip	Small Populations (<400 plants): digging	April/May
	Large Populations (>400 plants): herbicide/mowing	See product label
Oriental Bittersweet	Small plants and small infestations (seedlings and <400 plants)	Any time of year but if berries present (summer to winter) remove first if possible
	Large plants and large infestations (>400 plants)	
Invasive Honeysuckles	Small shrubs(<5cm diameter): digging	Any time of year but if berries present (summer) remove first if possible
	Large shrubs (>5cm diameter): herbicide	See product label
Himalayan Balsam	Small plants and small infestations (seedlings and <400 plants)	Any time of year prior to seed-pod development (August)
Black Locust	Herbicide	See product label
Scots Pine	Small plants and small infestations (seedlings, saplings and coverage <0.5 hectare): pulling/cutting/girdling	Any time of year. Girdling more effective in early growing season (spring) as bark is more loose
	Small infestation of large trees (<0.5 hectare): cutting/girdling/stand conversions	

** Refer to full sections for important timing and technical details*

Landowners must keep in mind that seed sources on neighboring properties, large infestations, or areas with large seed banks can be persistent and difficult to manage. Discussing the impacts of these species with neighbors and combining efforts can be beneficial in the overall success of the removal project. New control strategies are continually developed for these species. It is very helpful to include some personal research to determine what methods best suit your efforts and project. In addition, it is worth consulting other available resources on this topic including:

Ontario's Best Management Practices Guides

Best Management Practices for Invasive Plant Control: Technical Document Series

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

OTHER RESOURCES:

www.invasivespeciescentre.ca

www.ontario.ca/invasivespecies

www.ontarioinvasiveplants.ca

www.invadingspecies.com

For more information please contact the Invading Species Hotline at: 1-800-563-7711