

Purple Loosestrife

(*Lythrum salicaria*)

Best Management Practices in Ontario



Foreword

These Best Management Practices (BMPs) provide guidance for managing invasive purple loosestrife (*Lythrum salicaria*) in Ontario. Funding and leadership for the production of this document was provided by Environment and Climate Change Canada, Canadian Wildlife Service - Ontario (CWS - Ontario). The BMPs were developed by the Ontario Invasive Plant Council (OIPC) and its partners to facilitate the invasive plant control initiatives of individuals and organizations concerned with the protection of biodiversity, agricultural lands, infrastructure, crops and natural lands.

These BMPs are based on the most effective and environmentally safe control practices known from recent research and experience. They reflect current provincial and federal legislation regarding pesticide usage, habitat disturbance and species at risk protection. These BMPs are subject to change as legislation is updated or new research findings emerge. They are not intended to provide legal advice and interested parties are advised to refer to the applicable legislation to address specific circumstances. Check the website of the Ontario Invasive Plant Council (www.ontarioinvasiveplants.ca) for updates.

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

www.ontario.ca/invasivespecies, www.ontarioinvasiveplants.ca, www.invadingspecies.com or www.invasivespeciescentre.ca

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Purple loosestrife.

Photo courtesy of Owen Williams.



Purple loosestrife spreads rapidly, outcompeting native plants.

Photo courtesy of Owen Williams.

Introduction

Purple loosestrife (*Lythrum salicaria* L.) is an invasive, emergent, perennial plant, native to Europe and Asia. It was brought to North America in the early 1800s through a number of pathways including ship ballast, imported livestock, bedding and feed, sheep fleece, as seed for gardens and for use in beekeeping. Since its introduction to North America, purple loosestrife has made its way to nearly every Canadian province (territories excluded) and almost every U.S. state. However, it is most heavily concentrated in northeastern North America.

Purple loosestrife has spread rapidly across North American wetlands, shorelines and roadside ditches due to its tolerance of a variety of water regimes and soils, its ability to produce as many as two million seeds in a growing season and its ability to reproduce from plant fragments. Dense stands of purple loosestrife outcompete native plants for habitat. This results in changes to ecosystem function such as reductions in nesting sites, shelter and food for birds, fish and wildlife, as well as an overall decline in biodiversity.

North American purple loosestrife control programs were initiated in the 1980s with limited success until a biological control program using *Neogalerucella* spp. was developed in 1992. This saw a dramatic reduction in purple loosestrife populations. However, because purple loosestrife is capable of rapid adaption, it can quickly expand its range and spread into new environments. It has migrated northwards into Ontario from the eastern seaboard of the United States within just a few decades, evolving its growth and flowering patterns to adapt to, and thrive in, the shorter growing seasons and colder climate. This means that efforts in managing purple loosestrife populations must be continued. Although regulated in a number of U.S. states and Canadian provinces under weed legislation, purple loosestrife is not yet regulated in Ontario. Despite its invasive nature, it is still favoured by beekeepers and used as a medicinal and potheb.

This document was developed to help guide the effective and consistent management of purple loosestrife (*Lythrum salicaria* L.) across Ontario.



Purple loosestrife has spread rapidly across wetlands.

Photo courtesy of John D. Byrd, Mississippi State University, Bugwood.org.

Description

Purple loosestrife (*Lythrum salicaria* L.), which is sometimes referred to as loosestrife or spiked loosestrife, belongs to the family Lythraceae. There are six other non-invasive alien species in the genus in North America as well as several native species, all with varying degrees of similarity to purple loosestrife. The only other native loosestrife species growing wild in Ontario are winged loosestrife (*L. alatum*) and swamp loosestrife, also known as waterwillow (*Decodon verticillatus*). European wand loosestrife (*L. virgatum*), widely sold as an ornamental, is known to cross-pollinate with purple loosestrife. Studies have shown that additional varieties of loosestrife sold as ornamentals, such as Morden Pink, Morden Gleam or Dropmore Purple, are generally not sterile as advertised and that these garden varieties are also able to cross-pollinate with purple loosestrife and produce viable seed.

Purple loosestrife has evolved to adapt to the shorter growing seasons and the colder weather of the central and northern parts of the province. Plants in northern regions are smaller and flower earlier than those in southern regions. The size and life cycle differences should be taken into account when identifying the plant and choosing a management option specific to your region.

Morphology

Size and shape:

Plants average 1 to 15 flowering stems, although a single rootstock can produce 30 to 50 erect stems. The plant mass grows on average to be 60 to 120 cm tall, although some plants may grow over 2 m tall and form crowns of up to 1.5 m in diameter.



Plants average 1-15 flowering stems, but can produce up to 50.

Photo courtesy of Donna MacKenzie Ontario Beetles.

Stems:

Annual stems arise from a perennating rootstock (underground organ which stores energy and nutrients in order to help the plant survive overwinter and produce a new plant in spring). They are woody, stiff and square-shaped, with 4 to 6 sides. The form of the stems is somewhat branched, smooth or finely hairy, with evenly spaced nodes and short, slender branches. New, actively growing shoots are green while older stems are reddish to brown or purplish in colour.



The stems have 4 to 6 sides, giving them a square-shaped appearance. Opposite leaves are narrow and lance-shaped.

Photo courtesy of Rob Routledge, Sault College, Bugwood.org.

Leaves:

Leaves are simple, narrow and lance-shaped or triangular, with smooth edges and fine hairs. Leaf arrangement is opposite (two per node) or sometimes whorled (three or more per node) along an angular stem. Upper leaves and leaflets in the inflorescence are usually alternate (1 per node) and smaller than the lower ones. Leaves are stalkless (attached directly to the stem), broad near the base and tapering towards the tip. Leaf size, typically 3 to 12 cm long, will change to maximize light availability - leaf area increases and fine hairs decrease with lower light levels. Leaves are green in summer but can turn bright red in autumn.

Roots:

The strong, persistent taproot becomes woody with age and stores nutrients which provide the plant with reserves of energy for spring or stressful periods. During flood events it can survive by producing aerenchyma - a tissue that allows roots to exchange gases while submerged in water. The uppermost portion of the root crown produces white to purple buds, some of which sprout in the spring, while others remain dormant and can become activated upon damage.

Flowers:

Very showy, deep pink to purple (occasionally light pink, rarely white) flowers are arranged in a dense terminal spike-like flower cluster. Each flower is made up of 5 to 7 petals, each 7 to 10 mm long, surrounding a small, yellow centre. The petals appear wrinkly upon close inspection. Flowering time is climate-dependent, but in Ontario purple loosestrife typically flowers as early as June and sometimes continuing into October (mid-June to mid-September is typical). Populations contain three floral morphs that differ in style length and anther height, a condition known as tristily. Flowers are pollinated by insects, mostly bumblebees and honeybees, which promote cross-pollination between floral morphs.



Deep pink to purple flowers are arranged in a dense terminal spike-like cluster.

Photo courtesy of Owen Williams.

Seeds:

Larger plants produce upwards of 2.7 million seeds per growing season. Seeds are produced in a tiny, rounded seedpod/capsule, 3 to 6 mm in length and 2 mm broad with two valves enclosed in a calyx (a cuplike structure). Each pod can contain more than one hundred light, tiny, flat, thin-walled, light-brown to reddish seeds, which are shed beginning in the fall and continue throughout the winter.








Each seed pod can contain more than one hundred seeds.

Photo courtesy of Donna MacKenzie, Ontario Beetles.

Lookalikes

Table 1: The main identification features of purple loosestrife in comparison with four species that may appear similar (lookalikes).

| | Purple Loosestrife <i>(Lythrum salicaria L.)</i>  Photo courtesy of David J. McMurray. | Fireweed <i>(Chamerion [syn. Epilobium] angustifolium)</i>  Photo courtesy of Wasyl Bakowsky. | Blue Vervain <i>(Verbena hastata)</i>  Photo courtesy of Ken Allison. | Winged Loosestrife <i>(Lythrum alatum)</i>  Photo courtesy of Bob Peterson via Wikimedia Commons. | Swamp Loosestrife <i>(Decodon verticillatus)</i>  Photo courtesy of Bill McIlveen. |
|----------------|---|---|---|---|---|
| Habitat | <ul style="list-style-type: none"> • Introduced to Ontario • Marshes, ditches, swamps, pond/stream edges, ditches, uplands, meadows, etc. | <ul style="list-style-type: none"> • Native to Ontario • Burnt-over areas, forest edges, clearings, meadows, roadsides | <ul style="list-style-type: none"> • Native to Ontario • Moist, open sites including marshes, meadow marshes and swamps | <ul style="list-style-type: none"> • Native to Ontario • Moist marshes and prairies | <ul style="list-style-type: none"> • Native to Ontario • Marshes and lakeshores |
| Height | <ul style="list-style-type: none"> • 0.6 – 1.2 m | <ul style="list-style-type: none"> • Up to 2 m | <ul style="list-style-type: none"> • Up to 2 m | <ul style="list-style-type: none"> • Up to 1 m | <ul style="list-style-type: none"> • Up to 2.5 m |
| Stems | <ul style="list-style-type: none"> • 4-6 sides • Lower stem sometimes thick and spongy • Smooth or with fine hairs | <ul style="list-style-type: none"> • Rounded • Smooth | <ul style="list-style-type: none"> • Square • Rough-haired | <ul style="list-style-type: none"> • Square • Hairless • Winged | <ul style="list-style-type: none"> • 4-6 sides • Hairy, lower stem woody, sometimes thick and spongy • Branched |
| Leaves | <ul style="list-style-type: none"> • Opposite or whorls of 3 • Stalkless • 3-12 cm long • Lance-shaped • Fine hairs | <ul style="list-style-type: none"> • Alternate • Stalkless or short stalks • Linear to lance-shaped • 3-20 cm long • Hairless • Crowded | <ul style="list-style-type: none"> • Opposite • Stalked • Narrowly to broadly lance-shaped or lobed, with toothed margins • 4-18 cm long • Smooth to hairy | <ul style="list-style-type: none"> • Upper alternate, lower opposite • Stalked • Ovate or lance-shaped • Lower leaves up to 5 cm long and 1.2 cm wide, decreases as they move up the stem | <ul style="list-style-type: none"> • Opposite or whorls of 3-4 • Short-stalked • Lance-shaped • 1-4 cm long |

Purple Loosestrife
(*Lythrum salicaria* L.)



Photo courtesy of David J. McMurray.

Fireweed
(*Chamerion* [syn. *Epilobium*] *angustifolium*)



Photo courtesy of Wasyl Bakowsky.

Blue Vervain
(*Verbena hastata*)



Photo courtesy of Ken Allison.

Winged Loosestrife
(*Lythrum alatum*)



Photo courtesy of Bob Peterson via Wikimedia Commons.

Swamp Loosestrife
(*Decodon verticillatus*)



Photo courtesy of Bill McIlveen.

Flowers

- Spike-like clusters 10-40 cm wide
- Pink-purple
- 15-20 mm wide
- 4-8 sepals
- June-October

- Terminal raceme up to 60 cm long
- Pink/magenta
- 4 broad petals
- 15-30 mm wide
- June to September

- Blue-purple
- 2-5 mm wide
- Corolla weakly 2-lipped, funnel-shaped within 5 lobes
- June to October

- Solitary
- Pink-purple borne in the leaf axis
- 6 petals
- 4-13 mm
- June-September

- Dense axillary cymes
- Pink-purple
- 20-25 mm wide with 5-7 triangular sepals
- July to September

Seeds

- Capsule 6 mm long

- Capsule 2.5-7.5 cm long
- Seeds bear a plume of white silky hairs

- Cluster of 4 narrow mericaps
- 1-2 mm long

- Slender pod with tiny seeds

- Round capsule
- 4-6 mm across

Other Ontario look-a-like species include hardhack (*Spiraea tomentosa* L.), false dragonhead (*Physostegia virginiana* spp. *virginiana*), pickerel weed (*Pontederia cordata*), elephant's head lousewort, (*Pericularis groenlandica*) and blazing star species (*Liatris* sp.). The leaves and square-ish stem of purple loosestrife also resemble plants of the Mint Family but it is distinguished by having separate petals, a seedpod with many fine seeds, and it lacks the minty odour.

Biology and Life Cycle of Purple Loosestrife

Purple loosestrife is a perennial, herbaceous plant which grows from a persistent tap root and root stock. Both root and stem fragments can produce new root buds and shoots, however reproduction in natural populations occurs primarily through seeds.

Seeds are dormant over the winter months and can remain dormant for many years. Seeds float and can germinate in water but seedlings are most successful when the substrate is moist but not flooded. Germination takes place in open, sunny places in late spring and early summer when the soil temperature reaches approximately 15-20°C. Seedlings lodge into moist soil and can form dense carpets initially but, due to self-thinning, only a smaller proportion grow past the cotyledon stage.

With sufficient light the relative growth rate of purple loosestrife is one of the fastest of all wetland plants, resulting in superior competitive ability. Under favourable conditions the plant can quickly grow to over 1 metre tall in its first growing season and may even flower, although it is moderately susceptible to late-spring frosts. By the end of the first growing season the plant will have developed a large taproot with an extensive rootstock from which new plants will re-sprout each spring. The stems increase in number each year. The mature size of the plant will depend in part on growing conditions, soil type, water level, the genetic potential of the plant and plant density. Once established, monoculture loosestrife stands can sustain themselves for over 20 years although the maximum longevity of individual plants is not known with certainty.

The plant flowers in late June and is insect-pollinated with key pollinators including native bees, and bumblebees, honeybees, butterflies and wood nymphs. Once the petals start to drop from the bottom of the spike, usually starting in early August, the plant begins to produce seed. Purple loosestrife is a prolific seed producer and a single plant can produce upwards of 2.7 million seeds per season, depending on site conditions, plant age and size. A single stem can generate 900-1000 capsules, each with 83-130 seeds.

After the first extreme frost in fall, all above-ground plant parts will die back and the seeds shed throughout the winter. Purple loosestrife can outnumber native species in seedbanks with seed numbers in the top 5 cm of soil potentially amounting to more than the sum of seeds from all other surrounding species combined. There is a wide variability in seed germination rates from low to very high. Seed viability of greater than 90% is common. Seeds can remain viable in the soil for many years. However, seed germination is related to depth of burial with negligible germination from seeds buried more than 2 cm deep. This means that even small disturbances in the soil may lead to dormant seeds germinating.



Key pollinators for purple loosestrife include native bees, honeybees, bumblebees and butterflies.

Photo courtesy of Donna MacKenzie, Ontario Beetles.

Habitat

Purple loosestrife is a wetland plant native to Eurasia and most of central and northern Europe with extensions into the Mediterranean region stretching from the Iberian Peninsula to the Balkan Peninsula and North Africa. Because it thrives in moist habitats, it is now widely found in marshes, wet meadows, river flood-plains and damp roadsides throughout most of Ontario. It can colonize a wide variety of habitats and, for a wetland plant, it displays a surprisingly high tolerance of drought stress allowing it to grow in substrates such as gravel along roadsides and in rocky crevices. It prefers to grow in recently disturbed areas with exposed soil and abundant light, such as those created from a flood event, and does not tolerate deeper shade.

Established plants can tolerate and even thrive in a wide range of water levels, pH, soil types, climatic conditions and vegetation types. Infestations readily spread into old and unused pastures from adjoining low areas, posing a threat to agricultural lands. In Renfrew County, for example, purple loosestrife covers vast areas of abandoned lowland pastures, where shallow, poor soils have developed over limestone bedrock.



Infestations readily spread into old and unused pastures from adjoining low areas, posing a threat to agricultural lands.

Photo courtesy of Matt Smith, OFAH.

Pathways of Spread and Distribution in Ontario

Purple loosestrife was introduced to North America in the 1800s for bee-keeping, as an ornamental plant and in discarded soil used as ballast on ships. It can spread naturally via wind, water, birds and wildlife and through human activities, such as in seed mixtures, contaminated soil and equipment, clothing and footwear. Seeds may adhere to boots, vehicles, boats and even turtles. By the late 1800s it had spread throughout the northeastern United States and southeastern Canada reaching as far north and west as Manitoba. In the 1930s it became an aggressive invasive in the floodplain pastures of the St. Lawrence River and has steadily expanded its distribution since then, posing a serious threat to native emergent vegetation in shallow-water marshes throughout Ontario.

Purple loosestrife cultivars are still widely available. Consequently, it may be planted near or along shorelines and can escape into new areas when seeds and viable plant material are discarded into a nearby waterway or carried off by flooding during a rain event. Road maintenance and construction create disturbed sites which can contribute to the spread of purple loosestrife. Road equipment, when not properly cleaned, can transport seeds and plant fragments to further the spread. Boats, trailers, fishing equipment, hiking shoes and all other forms of transport vehicles can also carry the plant to new areas.

Because of purple loosestrife's ability to adapt to different climates within a short period, the chances are good that it will be very resilient to climate change, expanding its northern range as the climate warms.



Distribution map showing the locations of formally reported purple loosestrife. Single red dots represent one record. Red dots with numbers indicates the number of records reported in the area. Red dots with numbers: Indicates the number of records reported in the area.

Purple loosestrife distribution map courtesy of EDDMapS (www.eddmaps.org/ontario). The map point data is based on records contained in the Invasive Species Database, compiled as of November 2015 from various sources on a voluntary basis. This map is illustrative only. Please do not rely on this map as a definitive distribution as it is subject to change based on additional confirmed invasive species sites. This map may contain cartographic errors or omissions.

Impacts

Ecological Impacts: Ecosystem Function

Purple loosestrife alters decomposition rates and timing as well as nutrient cycling and pore water (water occupying the spaces between sediment particles) chemistry in wetlands. Purple loosestrife leaves decompose faster and earlier than native species (which tend to decompose over the winter and in particular in the spring). As a result, the nutrients from decomposition are flushed from wetlands faster and earlier. This change in the release timing of the chemicals produced through decomposition can slow frog tadpole development, decreasing their winter survival rate. It can also accelerate eutrophication downstream and affect detritivore consumer communities, which are adapted to spring decomposition of plant tissue. A change in nutrient cycling and a reduction in habitat and food leads ultimately to reductions in species diversity and species richness. This can lead to a reduction in pollination of native plants and as a result, decrease their seed outputs. The result is an altered food web structure and altered species composition of the area.



Purple loosestrife infestation in a marsh.

Photo courtesy of Wasyl Bakowsky.

Impacts to Species at Risk (SAR), Biodiversity and Wildlife

Because of its fast growth, abundant seed production and soil changing abilities, purple loosestrife is extremely competitive. It forms thick, monoculture stands, outcompeting important native plant species for habitat and resources and therefore poses a direct threat to many of Ontario's Species at Risk.

Purple loosestrife can also impact water levels, severely impacting the significant functions of wetlands such as providing breeding habitat for amphibians and other fauna. In some places purple loosestrife stands have replaced 50% of the native species. Not only does this decrease the amount of water stored and filtered in the wetland, but thick mats of roots can extend over vast distances resulting in a reduction in nesting sites, shelter and food for birds, fish and wildlife. The plant itself benefits few foraging animals although it can be a source of nectar for bees. Where purple loosestrife is the dominant species there is often a decline in some bird populations, such as marsh wrens. Water-loving mammals such as muskrat and beaver prefer cattail marshes over purple loosestrife.

The following is a list of Species at Risk for which purple loosestrife is named as a specific threat to the species in Ontario in either the federal Recovery Strategy (for species listed as Threatened or Endangered) or in the federal Management Plan (for species listed as Special Concern). More information can be found at the Species at Risk Act (SARA) Registry (www.sararegistry.gc.ca/default.asp?lang=en&n=24F7211B-1).

Table 2: Species at Risk for which purple loosestrife is named as a specific threat in Ontario.

| Species at Risk | SARA Status | Habitat / Details | Primary Threat(s) from Purple Loosestrife |
|---|---|--|--|
| Plants | | | |
| Dense Blazing Star (<i>Liatris spicata</i>) | <ul style="list-style-type: none"> Threatened | <ul style="list-style-type: none"> Found in disturbed areas, moist prairies, savannahs, dune swales and abandoned fields in coarse sand or sandy loam soils Does not tolerate shade | <ul style="list-style-type: none"> Habitat loss due to invasion/competition Shading |
| Eastern Prairie Fringed Orchid (<i>Platanthera leucophaea</i>) | <ul style="list-style-type: none"> Endangered | <ul style="list-style-type: none"> Found in wet prairies, fens, bogs, and occasionally old fields | <ul style="list-style-type: none"> Habitat loss due to invasion/competition |
| False Hop Sedge (<i>Carex lupuliformis</i>) | <ul style="list-style-type: none"> Endangered | <ul style="list-style-type: none"> Found in riverine swamps and marshes, and around temporary forest ponds | <ul style="list-style-type: none"> Habitat loss due to invasion/competition Shading Barrier to seed dispersal |
| Swamp Rose-mallow (<i>Hibiscus moscheutos</i>) | <ul style="list-style-type: none"> Special Concern | <ul style="list-style-type: none"> Open, coastal marshes, but it is also sometimes found in open wet woods, thickets and drainage ditches | <ul style="list-style-type: none"> Habitat loss due to invasion/competition |
| Birds | | | |
| King Rail (<i>Rallus elegans</i>) | <ul style="list-style-type: none"> Endangered | <ul style="list-style-type: none"> Found in freshwater marshes and marsh-shrub swamp habitats where wild rice, sedge and cattails grow Requires large marshes with open shallow water that merges with shrubby areas | <ul style="list-style-type: none"> Reduced availability of prey items and nesting sites |
| Least bittern (<i>Ixobrychus exilis</i>) | <ul style="list-style-type: none"> Threatened | <ul style="list-style-type: none"> Found in a variety of wetland habitats, but strongly prefers cattail marshes with a mix of open pools and channels | <ul style="list-style-type: none"> Habitat loss due to invasion |

| Species at Risk | SARA Status | Habitat / Details | Primary Threat(s) from Purple Loosestrife |
|--|---|---|--|
| Animals | | | |
| Northern Map Turtle (<i>Graptemys geographica</i>) | <ul style="list-style-type: none"> Special Concern | <ul style="list-style-type: none"> Inhabits rivers and lakeshores with emergent rocks | <ul style="list-style-type: none"> Habitat and food source loss due to invasion |
| Spotted Turtle (<i>Clemmys guttata</i>) | <ul style="list-style-type: none"> Endangered | <ul style="list-style-type: none"> Prefers ponds, marshes, bogs and even ditches with slow-moving, unpolluted water and an abundant supply of aquatic vegetation | <ul style="list-style-type: none"> Habitat loss due to invasion |
| Spiny softshell (<i>Apalone spinifera</i>) | <ul style="list-style-type: none"> Threatened | <ul style="list-style-type: none"> Found primarily in rivers and lakes but also in creeks and even ditches and ponds near rivers | <ul style="list-style-type: none"> Habitat loss due to invasion |

Economic Impacts: Agriculture, Recreation and Infrastructure

Dense purple loosestrife stands can clog irrigation canals, degrade farmland and reduce forage value of pastures. Dense stands also reduce water flow in ditches and the thick growth of purple loosestrife can impede boat travel. This results in the decrease of the recreational use of wetlands for hunting, trapping, fishing, bird watching and nature studies.

Costs of control, habitat restoration, and economic impact of the continuously expanding purple loosestrife acreage are difficult to quantify.

Applicable Legislation

Many plant species and control methods are regulated under federal and/or provincial legislation. Regulations regarding purple loosestrife and pesticide use at the time of writing are summarized in this document. Please note that this is for clarity only and is not legal advice. Please refer to the applicable legislation and government website(s) to determine the applicable legislative requirements.

Federal

Plant Protection Act and Plant Protection Regulations

Under the *Plant Protection Act* and Plant Protection Regulations, the Canadian Food Inspection Agency (CFIA) is responsible for protecting plant resources in Canada by preventing the importation of new plant pests and limiting the movement and spread of pests within Canada. Invasive plants that are regulated under the *Plant Protection Act* are included in the list of Pests Regulated by Canada.

Weed Seeds Order

The Weed Seeds Order (WSO), 2005 is a ministerial order made under the *Seeds Act* which lists invasive plants regulated under the *Seeds Act*. Under this order, the CFIA restricts the presence of weed species in commercially sold seeds in an effort to prevent the introduction and spread of new weeds.

Purple loosestrife is federally regulated under the WSO as a Class 2 Primary Noxious Weed. A Primary Noxious Weed is defined as:

“[A plant that is] present in Canada and has not reached its full ecological range. The species must be a weed whose presence in seed could affect the value and/or intended use of that seed lot; and/or could have a potential impact on the economy, human health or animal health.

This determination would be based on a Pest Risk Assessment type process. The species must have identifiable seeds that can be visually distinguished from those of other species, or in rare instances, from entire genera.”

A primary noxious listing aims to prevent the spread of purple loosestrife by restricting its presence in seed and seed mixtures imported into or sold in Canada.

Pest Control Products Act

The management of pesticides is the joint responsibility of the federal and provincial governments. Under the *Pest Control Products Act* (PCPA), Health Canada’s Pest Management Regulatory Agency (PMRA) registers pesticides for use in Canada with an approved label after conducting a stringent, science-based evaluation that ensures any risks are acceptable. The pesticide label is a legal document that prescribes how the pesticide can be used; pesticides must be applied in accordance with all label directions. Ensure you have the most current label and are aware of any re-evaluation decision: visit the Pest Management Regulatory Agency’s product label search site at <http://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php>.

Fisheries Act

The *Fisheries Act*, administered by Fisheries and Oceans Canada (DFO) and Environment and Climate Change Canada (ECCC), applies to both the plant and the pesticides used, as it specifies that it is an offence to (for example):

- harmfully alter, disrupt, or destroy fish habitat, including streamside vegetation;
- move or introduce aquatic organisms (including plants) to new habitats; and,
- damage fish habitat or put harmful substances such as pesticides into water frequented by fish, including pesticide drift.

Species at Risk Act

The ECCC also enforces the *Species at Risk Act* (SARA), whose purpose is “to prevent wildlife species in Canada from disappearing, to provide for the recovery of wildlife species that are extirpated (no longer exist in the wild in Canada), endangered, or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened.” Permits are required by those persons conducting activities that may affect Species at Risk, such as invasive plant management. To find out which species are at risk, for more information about critical habitat, or information on obtaining a permit, consult the SARA Public Registry (<http://www.sararegistry.gc.ca/default.asp?lang=en&n=24F7211B-1>).

Migratory Birds Convention Act

The *Migratory Birds Convention Act* (MBCA), administered by ECCC, provides for the protection of migratory birds through the Migratory Birds Regulations and the Migratory Birds Sanctuary Regulations. For birds protected under the MBCA (<http://www.ec.gc.ca/nature/default.asp?lang=En&n=496E2702-1>), it is not permitted to kill a bird and/or disturb or destroy its nest or eggs anywhere they are found in Canada except under the authority of a permit issued under the Migratory Birds Regulations. Information on general nesting periods is available to minimize the risk to breeding birds (<https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1>). However, operating outside nesting periods is not a guarantee that birds will not be killed or disturbed; therefore, it is the individual’s responsibility to ensure they do not contravene the Act. More information can be found at <https://www.ec.gc.ca/nature/default.asp?lang=En&n=2D16D723-1>.

Provincial

Weed Control Act

The *Weed Control Act*, administered by Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and enforced locally by municipalities. Is in place to reduce the infestation of prescribed plants (noxious weeds) that negatively impact agricultural or horticultural operations.

A noxious weed includes a plant that has been listed in the Schedule of Noxious Weeds found in Regulation 1096 made under the Act. This list is commonly referred to as the “Noxious Weed List”.

In general, a species designated as a noxious weed under the Weed Control Act is one that:

- Is difficult to manage on agricultural land once established and will reduce the yield and quality of the crop being grown;
- Negatively affects the health and well-being of livestock; or
- Poses a risk to the health and well-being of agricultural workers.

Purple loosestrife is not regulated under Ontario’s weed control legislation but is regulated in Alberta, BC, Manitoba, PEI, and Saskatchewan.

Pesticides Act

A federally registered pesticide must also be classified by MOECC under the *Pesticides Act* before it can be sold, stored or used in Ontario. The provincial classification of federally registered pesticides can be found at www.lrcsde.lrc.gov.on.ca/PCDWeb/home.action. Pesticides must only be used for purposes allowed under Ontario’s Cosmetic Pesticides Ban. The Ontario Cosmetic Pesticides Ban specifies exceptions for the use of certain pesticides (Class 9), including the use

of pesticides related to protecting public works including roads, buildings and structures, and provided certain conditions are met. For example, an exemption for a Class 9 active ingredient may apply if a plant interferes with the essential maintenance of a public works.

Endangered Species Act

The Ministry of Natural Resources and Forestry (MNRF) enforces the *Endangered Species Act*, whose purpose is to provide protection for species classified by the province as endangered or threatened, as well as to provide habitat protection for species classified by the province as endangered or threatened. Permits are required by those persons conducting activities that may affect Species at Risk, such as invasive plant management. To find out which species are at risk in Ontario or for information on obtaining a permit, consult www.ontario.ca/environment-and-energy/species-risk-ontario-list.

Municipal

Property standards and bylaws are the responsibility of individual municipalities. Municipalities are also responsible for enforcing the *Weed Control Act* and can produce bylaws to designate additional plants not listed on the Ontario Noxious Weed list as noxious within their own jurisdiction. Municipalities such as Toronto and Halton Hills have produced bylaws designating purple loosestrife as a noxious and nuisance weed, respectively.

Municipal bylaws regarding the use of animals for targeted grazing may also be in place.

Best Management Practices

Controlling purple loosestrife before it becomes locally established will reduce its impacts on biodiversity, the economy and society. Once it appears, however, it is important to create an integrated pest management (IPM) plan that is specific to your goals and resources, the infestation size and site conditions, as well as the sensitivity of local flora and fauna which may be impacted by the weed or the control measure(s) themselves. An IPM plan uses existing knowledge about the plant species (biology, life cycle, predators, etc.) and its surrounding environment to choose the most efficient control measures and timing to best prevent and fight infestations while minimizing negative impacts on ecosystem

or human health. This could mean treating a plant when it is in its most vulnerable stage, or perhaps before seed production, or it could mean choosing a treatment or time frame that least affects non-target species. An IPM plan usually relies on more than one type of control measure to be successful. A planned, well thought out management plan is the key to success.

A detailed inventory of each site is strongly recommended before starting control efforts. The infestation size and density information gathered in the inventory will aid in selecting control strategies and prioritizing areas. Keep in mind that some options may not be practical or legal for the habitat, budget or time of the year.

With large infestations and limited time and resources, control work can seem daunting. It is important to develop a feasible, long-term strategy with the following considerations:

1. After an infestation of purple loosestrife is confirmed, land managers should first focus their efforts on preventing spread by removing isolated plants and small populations (satellite infestations) outside of the main infested area. When action is taken early it can significantly reduce the cost of control.
2. Concentrate on high-priority areas such as the most productive or sensitive part of an ecosystem, a favourite natural area or the side of a trail where people may come into contact with the plants.
3. Consider dedicating a certain time each year to control efforts, and make it a joint effort with neighbouring landowners/land managers.
4. Consider replanting native plant species once the purple loosestrife population is eradicated or under control. This will help jump-start natural succession and increase biodiversity in the area.
5. Follow-up monitoring is crucial to remove seedlings that may sprout after initial control efforts. It is also important in understanding the impact of management efforts on native flora and fauna and adjusting management techniques as required.



To prevent the spread of purple loosestrife, remove isolated plants and small infestations first.

Photo courtesy of Dan Gregory.

Natural Resource Considerations

You are responsible for ensuring that your project follows all relevant laws, including the *Endangered Species Act*, *Migratory Birds Convention Act* and the *Species at Risk Act*. If protected species or habitats are present, an assessment of the potential effects of the control project could be required. Consult with your local MNRF district office (www.ontario.ca/page/ministry-natural-resources-and-forestry-regional-and-district-offices) early in your control plans for advice. Impacts to shoreline health must also be considered if controlling purple loosestrife in riparian areas. Factors to consider before removing or treating riparian areas include impacts to forage quality and quantity for wildlife, bank stability and erosion potential and the likelihood of downstream impacts such as the spread of the plant with water flows.

Setting Priorities

When creating management plans, it is important to make the most of resources by prioritizing invasive species control. The following will help you to prioritize sites and areas within sites for control of purple loosestrife.

Site Prioritization

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

1. Protect areas where purple loosestrife is absent or just appearing.
2. Protect rare species and communities. These include federally, provincially and regionally listed rare species. See www.ontario.ca/environment-and-energy/species-risk-ontario-list and www.plantsofcanada.info.gc.ca/ for species-specific information.
3. Protect important habitats and land values (i.e. agriculture, wildlife appreciation, forestry).
4. Pay special attention to disturbed sites, as these can be quickly colonized by purple loosestrife and other invasive species.
5. Cost and effort: Will the purple loosestrife invasion area need restoration or can it be left to regenerate naturally? (Note – it is usually recommended to restore control areas to make them more resistant to future invasions and prevent other invasive plants from invading.)

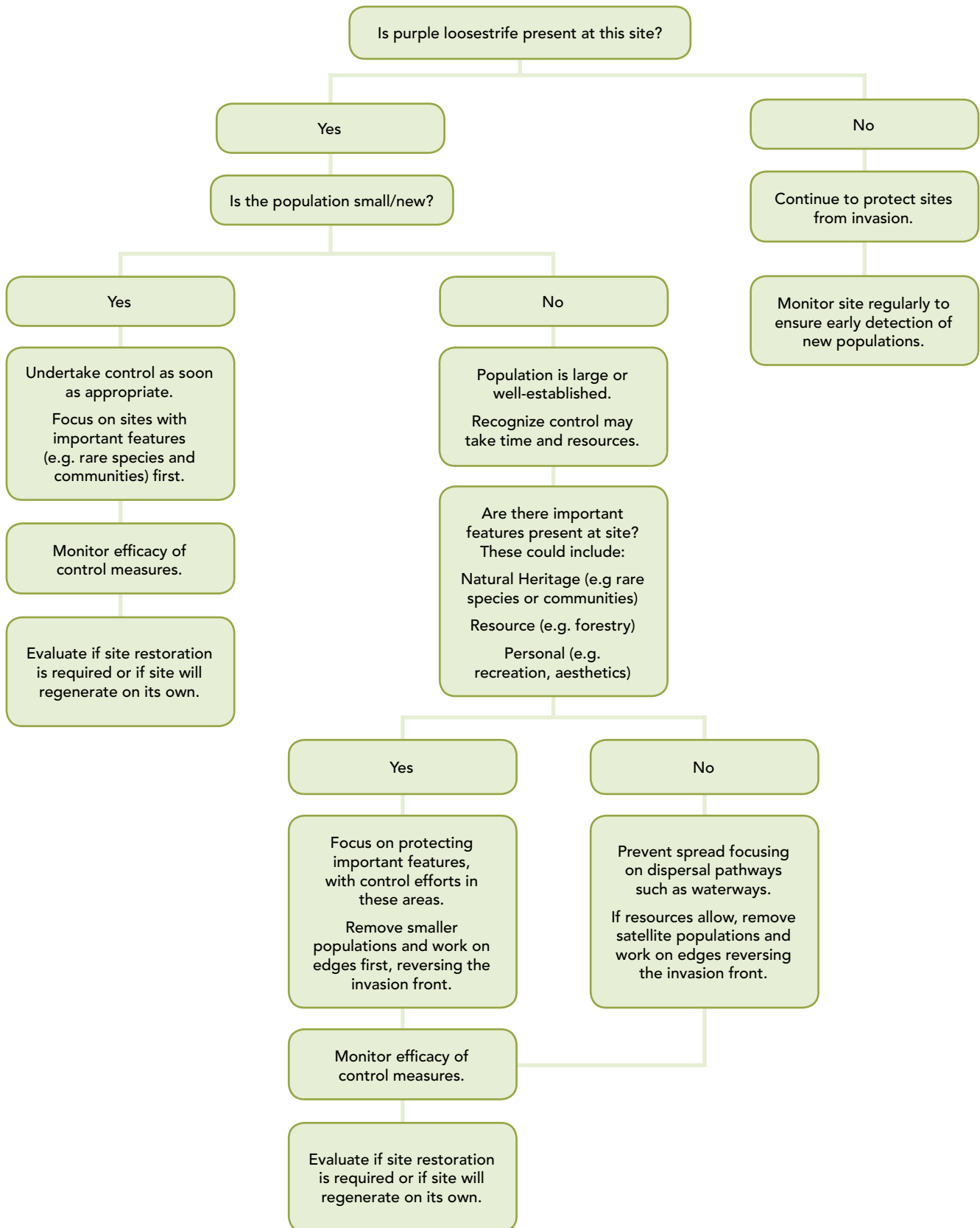
Prioritizing within a Control Area

1. Focus on large blocks of un-invaded areas and keep them free of invaders.
2. Control small, younger, outlier (satellite) populations first.
3. “Unfragment” the boundaries of invaded areas by removing outlying plants.
4. Reverse the invasion, expand the un-invaded area outward.

It is crucial to prioritize control by determining where the satellite populations are, and eradicating those before they connect with larger populations.

This flow chart can help land managers choose which site to first focus control efforts:

Figure 1: How to prioritize purple loosestrife sites for effective control.



Control Measures

Management of purple loosestrife began as long ago as sixty years and included techniques such as flooding, discing, fire and herbicides. These traditional control methods usually provide only short term positive results but are not successful for long term management. Biological control is considered the most effective control method for large invasions and long-term treatment. The size and location of the invasion will determine which control methods are most suitable, but budget and resources will also play a factor. Caution should be taken with every management option to avoid the spread of the plant and seeds, which can root and re-establish the invasion. This also means be careful of clothing worn and equipment used during the removal process.

For information on selecting control strategies based on infestation density and area, see Table 3.

Mechanical

Minimizing disturbance to the area is vital, since any soil disturbance by pulling or digging brings thousands of seeds to the soil surface. Any part of the root system left in the soil can start a new plant. Although disposal is discussed in a later section, it is important to mention here that all parts of the plant should be placed in a sealed, dark-coloured plastic bag and left in direct sun to “cook” for at least one week before disposal. **DO NOT** compost live or viable plant material. **DO NOT** discard in a natural area. Wherever permitted, plant material should be burned.

Pulling and Digging:

Pulling small, individual plants is feasible; pulling large plants is very difficult. Hand pulling is most effective when a stand is under two years old. Small infestations are most easily removed when the soil is moist. Removal can be performed throughout the summer and even when the plant is in flower but must be done **before it goes to seed**. It must be pulled up gently, so as not to break the taproot and encourage re-sprouting, and so as not to bring seeds to upper soil layers where they may germinate. Digging can also be done for small areas, but in a large-enough circumference so as not to break the roots for the same reason. In both cases, the entire root system must be removed from the soil to prevent re-sprouting.



Purple loosestrife can be pulled up or dug out but must be done in such a manner as not to break the taproot or bring seeds to upper soil layers where they may germinate.

Photo courtesy of Ontario Federation of Anglers and Hunters.

Mowing and Cutting:

Mowing and cutting are non-selective and require all cut plant parts to be removed, as purple loosestrife can, with sufficient moisture, regenerate from stem fragments. Cutting must be done before the flower stalks go to seed and repeated regularly until the plants energy stores are exhausted. Cutting of purple loosestrife within three weeks of flowering should destroy the seed crop and prevent additions to the seed bank. Mowing may be impractical due to the wet nature of the habitat in which most purple loosestrife is found. All equipment must be washed before it leaves the site to prevent spread to new areas.

Burning:

Prescribed burning is not effective because the plants rootstock is at least two centimeters below the soil surface and much of it in wet (and therefore protected) substrate. Plants recover within ten days.

Flooding:

Flooding can prevent germination of seeds or establishment of seedlings; however, this may also affect non-target vegetation. Flooding less than 30 cm does not kill seedlings and mature plants thrive in these conditions. Short term or temporary flooding of an area can actually cause a disturbance that will allow the loosestrife seeds in the seedbank to germinate, grow and proliferate once water levels have been returned to a previous level.

Chemical

The *Ontario Pesticides Act* and Ontario Regulation 63/09 provide natural resources, forestry and agricultural exceptions which may enable chemical control of invasive plants on your property. Other exceptions under the Act include golf courses, and for the promotion of public health and safety.

Natural Resource Exception:

The “natural resources” exception exists for the use of prohibited pesticides to manage, protect, establish or restore a natural resource. In order to qualify for this exception your project must meet the criteria specified in Section 33 of Ontario Regulation 63/09 including the use of pesticides in accordance with Integrated Pest Management (IPM) principles outlined in this BMP guide. You will need to contact the MNRF to obtain a written letter of opinion from the MNRF Regional or Branch Director. For a district office near you, enter “MNRF district offices” in your search engine.

Forestry Exception:

A forest is defined as a treed area of land that is one hectare in size or larger. Class 9 pesticides may be used in a forest for the purposes of harvesting, renewing, maintaining or establishing a forest, protecting forest resources derived from a forest, and accessing a forest for these purposes under the forestry exception. The control of purple loosestrife may fall under the forestry exception; a Forestry Class of land extermimator licence would be required to use commercial pesticides in a forest. Refer also to the Ministry of Environment and Climate Change’s factsheet titled “Pesticides Act and Ontario Regulation 63/09 Forestry”, found here: www.ontario.ca/document/technicalguidance-pesticides-act-and-ontario-regulation-6309-forestry.

Agriculture Exception:

The agriculture exception allows a farmer to use Class 9 pesticides for the purposes of the agricultural operation that he or she owns or operates. This exception may apply to the control of purple loosestrife if it impacts their agricultural or horticultural operation. Agricultural operations include agriculture, aquaculture and horticulture activities. Examples include:

- growing, producing or raising farm animals;
- production of crops, including greenhouse crops, maple syrup, mushrooms, nursery stock, tobacco, trees and turf grass, and any additional agricultural crops prescribed under the Nutrient Management Act, 2002;
- activities that are part of an agricultural operation such as maintenance of a shelterbelt for the purposes of the agricultural operation, and;
- the production of wood from a farm woodlot, if at least one of the activities described earlier is carried out on the property where the farm woodlot is located.

Some activities are not included in the definition of an “agricultural operation”. Please refer also to the Ministry of Environment and Climate Change’s factsheet titled “Pesticides Act and Ontario Regulation 63/09 Agriculture May 2011” found here: www.ontario.ca/document/technical-guidance-pesticides-act-and-ontario-regulation-6309-agriculture.

Herbicide Application:

Herbicides must be applied in accordance with all label directions. For an up-to-date list of herbicides labelled for purple loosestrife control, visit the Pest Management Regulatory Agency’s web site at <http://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php>.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)’s Publication 75, Guide to Weed Control is an excellent reference for all aspects of weed control, and includes a section on invasive plant management. To determine if a federally registered herbicide is also classified for use in Ontario, visit www.lrcsde.lrc.gov.on.ca/PCDWeb/home.action. Anyone using a pesticide is responsible for complying with all federal and provincial legislation. Most non-domestic (i.e. commercial, restricted etc.) herbicides can only be applied by licensed exterminators.

For more information, refer to the Ontario Pesticides Act and Ontario Regulation 63/09 (available at www.ontario.ca/laws), or contact the Ontario Ministry of the Environment and Climate Change (www.ontario.ca/ministry-environment-and-climate-change).

Herbicides and Purple Loosestrife:

Herbicides provide short-term control of small infestations or isolated plants, but may be impractical and uneconomical against large infestations and there are no pesticides registered for use over water in Ontario at this time. Herbicides are effective at killing seedlings and established plants but require repeated, often annual application, as purple loosestrife regenerates from seedbanks within a few years. In areas where the population is established and there is a large purple loosestrife seedbank, using non-selective herbicides will kill the loosestrife but will also kill the native species, causing purple loosestrife populations to increase if restoration is not undertaken.

Although there are many herbicides registered for control of purple loosestrife, they can only be applied when surface water is not present, which greatly limits their usefulness as a control measure. Carefully read and follow the label directions of the product you are using. For areas with 100 plants or more, spot applications to individual plants is the recommended treatment where hand pulling is not feasible. Care should be taken not to let the herbicide come in contact with non-target species. If there are such species, hand wicking individual stems (treating individual stems) is effective. Herbicides are most effective when plants have just begun flowering. If possible, seed heads should be cut off before application to prevent seed set, though cutting or chemical defoliation of purple loosestrife within three weeks of flowering should destroy the seed crop and prevent additions to the seed bank.

Hand wicking is the most effective and safe way to apply a herbicide. It applies the chemical directly to its intended target. This is recommended over broadcast spraying whenever possible.

For areas with large monocultures, generally greater than ~1.5 hectares in size, herbicides can be sprayed onto the foliage once when flowering has just started. The most effective control method is by treating large patches starting from the outside, and working towards the centre in following years. This allows native vegetation to establish in areas where loosestrife has been eliminated.

Biological

Targeted Grazing:

Using grazing animals as a part of an IPM plan for purple loosestrife is not ideal for all areas and habitats, but can be economical and highly effective. Intensive, rotational, targeted grazing by sheep has been shown to successfully reduce flowering in purple loosestrife populations, resulting in a reduction of purple loosestrife cover of up to 40 percent. The reduction of the invasive-dominated canopy by early-season grazing stimulates colonization by native and naturalized species and has resulted in a 20 percent increase in species richness.

An advantage of this method is that, often, several nuisance species can be controlled at once (for example, where reed canary grass is also present). In addition, the biological agent remains under control of the manager. Rare and desirable plants can be protected with fencing and, if necessary, the grazers can simply be removed from the landscape.

Biocontrol:

Biological control, the use of an herbivore, predator, disease or other natural enemy to reduce established populations of invasive species, is species-selective and can provide long-term control. As introduced species, most invasive species have few natural enemies in their new habitats. Classical biological control aims to re-establish an ecological balance between the introduced species and its natural enemies by selecting highly host-specific natural enemies from the country of origin, and moving them to the country where the invasive species is a problem. This is only done after extensive host-range testing in the country of origin or in quarantine, to ensure that the potential biocontrol agent is host-specific to the targeted invasive. This method has been used successfully for invasive plants in North America, including purple loosestrife (*Lythrum salicaria*), leafy spurge (*Euphorbia esula*), diffuse knapweed (*Centaurea diffusa*) and St John's-wort (*Hypericum perforatum*). Once established, the biocontrol agents will form self-perpetuating populations and can spread throughout and beyond the invaded region, thus minimizing recurring acquisition, rearing, and reintroduction costs.

Of over 120 potential biocontrol agents examined for purple loosestrife, four were found to be suitable and were released in North America in the 1990s, the black-margined loosestrife beetle (*Neogalerucella* californiensis* L.), the golden loosestrife beetle (*Neogalerucella* pusilla* Duftschmidt), the loosestrife root weevil (*Hylobius transversovittatus*) and the flower weevil (*Nanophyes marmoratus*).

*It should be noted that the beetles were formally known under the genus *Galerucella*.



Mating black-margined loosestrife beetles (*Neogalerucella calmariensis* L.).

Photo courtesy of Donna MacKenzie, Ontario Beetles.



Golden loosestrife beetle. (*Neogalerucella pusilla* Duftschmidt),

Photos courtesy of Photo courtesy of Central Lake Ontario Conservation.

The black-margined loosestrife beetle has been the most successful species, as it has become widely dispersed from the original release sites, and is the dominant species of the four in most regions of Ontario. In southern Ontario it completes two generations per year; the adults and larvae in the first generation (late spring) consume foliage and growing stems, while in the second generation (mid-summer) the larvae additionally feed on the inflorescences. Although the loosestrife flower weevil (*Nanophyes marmoratus*) was not released in Ontario, it has since become ubiquitous in southern and eastern Ontario, although its impacts have not been adequately assessed.

Overall the biological control program has been deemed successful and in some cases resulted in reductions in documented biomass of up to 90 percent in a single growing season, presumably limiting further spread and allowing native flora to re-establish.



The biological control program can reduce purple loosestrife biomass by up to 90% in a single growing season.

Photo courtesy of Central Lake Ontario Conservation Authority.

There are many factors to consider when using biocontrol agents in the management and control of purple loosestrife, such as whether to purchase agents or collect them yourself, timing and frequency of release and number of releases, optimal placement of the beetles, and number of insects to release. For detailed guidance and tips on developing, implementing and managing a purple loosestrife biological control program, including rearing, purchasing, handling and releasing biocontrol agents, references such as the *Biology and Biological Control of Purple Loosestrife* by Wilson et al. (2004) from the Forest Health Technology Enterprise Team—Morgantown, W.V., are available.

In Ontario, *Neogalerucella* beetles can be only be purchased from Ontario Beetles. This company has managed purple loosestrife biological control initiatives in Ontario for more than 25 years, conducting research, releasing biocontrol agents, developing management strategies and providing consultation on all aspects of purple loosestrife control. More resources and information can be found on the website found here: www.ontariobeetles.ca.

Choosing the Best Control Method

Table 3: Suggested purple loosestrife control measures according to infestation size and infested area density.

| Percent of Area Covered with Purple Loosestrife | Size of Area to be Managed | | | |
|---|--|--|--|--|
| | Isolated Plants | Small infestation <0.5 hectare / 1 acre | Medium <0.5 – 2 hectares / 1 - 4 acres | Large >2 hectares / > 4 acres |
| 1-10% | <ul style="list-style-type: none"> Mechanical Chemical | <ul style="list-style-type: none"> Mechanical Chemical | <ul style="list-style-type: none"> Biological | <ul style="list-style-type: none"> Biological |
| 10-25% | <ul style="list-style-type: none"> Mechanical Chemical | <ul style="list-style-type: none"> Mechanical Chemical | <ul style="list-style-type: none"> Biological | <ul style="list-style-type: none"> Biological |
| 25-50% | <ul style="list-style-type: none"> Mechanical Chemical Biological | <ul style="list-style-type: none"> Mechanical Chemical Biological | <ul style="list-style-type: none"> Biological | <ul style="list-style-type: none"> Biological |
| >50% | <ul style="list-style-type: none"> Biological | <ul style="list-style-type: none"> Biological | <ul style="list-style-type: none"> Biological | <ul style="list-style-type: none"> Biological |

Disposal

Parts of purple loosestrife capable of reproducing (seeds and roots) can only be composted if the material is taken to a large-scale municipal composting facility where temperatures in the compost pile reach high enough temperatures to kill the living material. Be sure to check with your local municipality before depositing the material, to ensure their composting programs reach the temperature required to kill plant material. Small-scale composters (backyard composters) do not reach the required temperatures to kill invasive plant material, therefore do not place the material in small-scale composters.

If your municipality does not have a sufficient composting program, carefully place reproductive material in a black plastic garbage bags. Seal the bags tightly and leave it in direct sunlight for one to three weeks to kill any living plant material. Check the bag to make sure all plant material has died and then deposit in your municipal landfill.



Plants can be sealed in a black plastic garbage bags and left in direct sunlight for one to three weeks to kill any living plant material. Check the bag to make sure all plant material has died and then deposit in your municipal landfill.

Photo courtesy of Ontario Federation of Anglers and Hunters.

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. Every effort should be made to minimize disturbances to the soil, since any soil disturbance by pulling or digging brings thousands of seeds to the soil surface.

Determining whether or not restoration efforts will be needed will depend upon multiple factors:

1. **Level of disturbance at the site:** What is the level of disturbance at the site? Was it a heavily invaded site (e.g. a lot of disturbance was caused during control measures)? Will it continue to be disturbed (e.g. through beach use or trail use/management)?
2. **Invasive species biology:** What is the biology of the invasive species removed and is there a seed bank to consider? (There will always be a seed bank to consider when dealing with purple loosestrife.)
3. **Re-invasion risk:** Are there invasive species nearby which could re-invade the site from nearby trails, watercourses or other pathways of introduction?
4. **Existing native vegetation:** What native vegetation is left? How long before it regenerates by itself? Does it need help?

Your answers to these questions will help you to determine if the site will be re-invaded before it has a chance to regenerate on its own.

Types of Restoration

During Control

Mulching:

Mulching sites immediately after invasive species control (i.e. manual or chemical control) may add 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 purple loosestrife removal.

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.

After Control

Planting:

If there are invasive plants nearby which may colonize the control area, planting native species stock (potted etc.) will help outcompete invasive seedlings. Wait until all management is completed before doing a small stock re-planting, as it may be 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 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.

The following are a list of alternative native plants suitable for restoration, or as an alternative for garden use:

- Blue vervain (*Verbena hastata*)
- Pickerel weed (*Pontederia cordata*)
- Hardhack (*Spiraea tomentosa* L.)
- Dense blazing star (*Liatris spicata*) - Note: This species is listed as Threatened in Canada under Schedule 1 of the Species at Risk Act, and as Threatened in Ontario under the Endangered Species Act.
- Cardinal flower (*Lobelia cardinalis* L.)
- False dragonhead/obedient plant (*Physostegia virginiana* spp. *virginiana*)
- Elephant's-head lousewort (*Pedicularis groenlandica*)
- Meadowsweet (*Spiraea alba*)
- Great blue lobelia (*Lobelia siphilitica*)
- Fireweed (*Chamerion* [syn. *Epilobium*] *angustifolium*)



Blue vervain (*Verbena hastata*).

Photo courtesy of Ken Allison.



Pickerel weed (*Pontederia cordata*).

Photo courtesy of Wasyl Bakowsky.



False dragonhead aka obedient plant (*Physostegia virginiana* spp. *virginiana*).

Photo courtesy of Bill McIlveen.

Purple Loosestrife (*Lythrum salicaria*)

Control Measures Summary

| Method | Population Characteristics | Purpose of Control | Notes |
|----------------------------|---|--|---|
| Pulling and Digging | <ul style="list-style-type: none"> • Small | <ul style="list-style-type: none"> • Removal of all plants | <ul style="list-style-type: none"> • Roots must be removed • Best in late June-early August (in flower, before going to seed) |
| Mowing/Cutting | <ul style="list-style-type: none"> • Small to medium | <ul style="list-style-type: none"> • Reduce seed production and plant density, depletion of root reserves | <ul style="list-style-type: none"> • Not ideal for wet habitats • Non-selective • Must be done before going to seed |
| Flooding | <ul style="list-style-type: none"> • Medium to large | <ul style="list-style-type: none"> • Reduce seed production and plant density | <ul style="list-style-type: none"> • Must flood deeper than 30 cm • Non-selective |
| Tillage | <ul style="list-style-type: none"> • Medium to large | <ul style="list-style-type: none"> • Reduce growth and seed production | <ul style="list-style-type: none"> • For use on agricultural land |
| Chemical | <ul style="list-style-type: none"> • Small to medium | <ul style="list-style-type: none"> • Eradication of plants | <ul style="list-style-type: none"> • Must be re-applied annually, as plants quickly grow from seed bank • Non-selective (unless hand wicking individual stems) • Dry ground only |
| Targeted Grazing | <ul style="list-style-type: none"> • Medium to large | <ul style="list-style-type: none"> • Removal of top growth, depletion of root reserves | <ul style="list-style-type: none"> • Grazing could stimulate colonization by native species • Not appropriate for all habitats |
| Biocontrol | <ul style="list-style-type: none"> • Medium to large | <ul style="list-style-type: none"> • Re-establish an ecological balance | <ul style="list-style-type: none"> • Selective • Provides long-term control but not eradication |

Preventing the Spread

Everyone can help prevent the spread of purple loosestrife by following these tips:

Report it.

If you think you see purple loosestrife take a picture, record the location and report it using the tools listed below.

Watch for it.

Learn what purple loosestrife looks like and then monitor hedges, property boundaries, riparian 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.

Avoid traveling off-trail and in areas known to have purple loosestrife or other invasive species.

Stop the spread.

Inspect, clean and remove mud, seeds and plant parts from clothing, pets (and 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. Don't plant purple loosestrife 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](#) guides list alternatives to plant instead of invasive species.

Tracking the Spread (Outreach, Monitoring, Mapping)

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

1) EDDMapS Ontario: an online reporting tool where users can view existing sightings of purple loosestrife and other invasive species in Ontario, and document their sightings. This tool, at www.eddmaps.org/ontario, is free to use.

2) Toll-free Invading Species Hotline: a telephone number (1-800-563-7711) which individuals can use to report sightings verbally.

3) Invading Species Website: an online reporting tool (www.invadingspecies.com).

If you think you have purple loosestrife on your property or if you see it in your community, please report it. You will be asked to send in photos of the leaf, stem, flowers and seeds for identification.

Best Management Practices Documents Series:

[Black Locust Best Management Practices for Ontario](#)

[Common Buckthorn \(European\) Best Management Practices for Ontario](#)

[Dog-strangling Vine Best Management Practices for Ontario](#)

[European Black Alder Best Management Practices for Ontario](#)

[Garlic Mustard Best Management Practices for Ontario](#)

[Giant Hogweed Best Management Practices for Ontario](#)

[Invasive Honeysuckles Best Management Practices for Ontario](#)

[Japanese Knotweed Best Management Practices for Ontario](#)

[Phragmites \(Common Reed\) Best Management Practices for Ontario](#)

[Phragmites \(Common Reed\) Best Management Practices for Ontario Roadways](#)

[Purple Loosestrife Best Management Practices for Ontario](#)

[Reed Canary Grass Best Management Practices for Ontario](#)

[White Sweet Clover Best Management Practices for Ontario](#)

[Wild Parsnip Best Management Practices for Ontario](#)

Additional Publications from the Ontario Invasive Plant Council:

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

A Quick Reference Guide to Invasive Plant Species

Clean Equipment Protocol for Industry

Compendium of Invasive Plant Management

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

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

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

Landowners Guide to Controlling Invasive Woodland Plants

Phragmites Site Prioritization Tool

Bibliography

Agriculture and Agri-Food Canada. 2016. Loosestrife, Purple, *Lythrum salicaria*. Pesticide Risk Reduction Program Pest Management Center. Available <http://www.weedinfo.ca/en/weed-index/view/id/LY TSA>. (Accessed: December 7, 2015).

Blossey, B., L. C. Skinner and J. Taylor. 2001. Impact and Management of Purple Loosestrife (*Lythrum salicaria*) in North America. *Biodiversity and Conservation* 10: 1787-1807.

Canadian Wildlife Service Wildlife Habitat Conservation. 1999. Invasive Plants of Natural Habitats in Canada: An Integrated Review of Wetland and Upland Species and Legislation Governing Their Control. Environment Canada.

Colautti, R. I. et al. 2006. Characterised and Projected Costs of Nonindigenous Species in Canada. *Biological Invasions* 8: 45-59.

Colautti, R. I. and S. C. H. Barrett. 2013. Rapid Adaptation to Climate Facilitates Range Expansion of an Invasive Plant. *Science* 342: 364-366.

Dickinson, T. et al. 2004. The ROM Field Guide to Wildflowers of Ontario. Toronto: The Royal Ontario Museum, McClelland and Stewart Ltd.

Environment Canada. 2014. Recovery Strategy for the Dense Blazing Star (*Liatris spicata*) in Canada - 2014. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vi + 28 pp.

Environment Canada. 2012. Recovery Strategy for the Eastern Prairie Fringed-Orchid (*Platanthera leucophaea*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. ii + 11 pp. + Appendices.

- Environment Canada. 2014. Recovery Strategy for the False Hop Sedge (*Carex lupuliformis*) in Canada, Species at Risk Act Recovery Strategy Series, Environment Canada, Ottawa, vi + 28 pages.
- Environment Canada. 2012. Recovery Strategy for the King Rail (*Rallus elegans*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vi + 21 pp.
- Environment Canada. 2014. Recovery Strategy for the Least Bittern (*Ixobrychus exilis*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vi + 41 pp.
- Environment Canada. 2013. Management Plan for the Swamp Rose-Mallow (*Hibiscus moscheutos*) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. iv + 18 pp.
- Government of Canada. 2015. Plants of Canada. Available <http://www.plantsofcanada.info.gc.ca>. (Accessed: December 16, 2015).
- Government of Ontario. 2012. Purple Loosestrife (*Lythrum Salicaria*) Factsheet. Toronto: Queen's Printer of Ontario.
- Haworth-Brockman, M.J., H.R. Murkin and R.T. Clay. 1993. The Effects of Shallow Flooding on Newly Established Purple Loosestrife Seedlings. *Wetlands* 13 (3): 224-227.
- Invasive Plant Council of British Columbia. 2011. Best Management Practices for Invasive Plants in Parks and Protected Areas of British Columbia: A Pocket Guide for B.C. Parks Staff, Volunteers and Contractors. British Columbia: IPCBC.
- Kaufman, S. R. and W. Kaufman. 2012. Invasive Plants: A Guide to Identification, Impacts, and Control of Common North American Species. 2nd edition. Pennsylvania: Stackpole Books.
- Kleppel, G.S. and E. LaBarge. 2011. Using Sheep to Control Purple Loosestrife. *Invasive Plant Science and Management* 4, 50-57.
- Lindgren, C.J. et al. 2000. Critical Steps Towards an Integrated Vegetation Management Strategy for the Control of Purple Loosestrife in Manitoba, Canada. Proceedings of the X International Symposium on Biological Control of Weeds. Edited by Neal R. Spencer. Bozeman, Montana, USA.
- Mai, T. K. et al. 1992. The Biology of Canadian Weeds. 100. *Lythrum salicaria*. *Canadian Journal of Plant Science* 72(4): 1305-1330.
- Manitoba Purple Loosestrife Project. 2010. Purple Loosestrife Manitoba. Available <http://purpleloosestrife.org>. (Accessed December 12, 2015).
- Mason, P. G. and D. R. Gillespie. 2013. Biological Control Programmes in Canada, 2001-2012. Wallingford, Oxfordshire, UK; Boston: CABI.
- McCaughey, T. L. and G. R. Stephenson. 2000. Time from Flowering to Seed Viability in Purple Loosestrife (*Lythrum salicaria*). *Aquatic Botany* 66: 57-68.

Michigan Department of Transportation. 2015. Invasive Species Guide. Michigan: Michigan Department of Transportation.

Minnesota Department of Agriculture. 2016. Prohibited Noxious Weeds: Purple Loosestrife -*Lythrum salicaria* (L.). Available <http://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/purpleloosestrife.aspx>. (Accessed Jan 26, 2016).

Nantel, P. et al. 2002. Alien Invaders in Canada's Waters, Wetlands, and Forests. Ottawa, Ontario: Canadian Forest Service, Science Branch.

Ontario Federation of Anglers and Hunters. 2003. Purple Loosestrife: What You Should Know, What You Can Do. Peterborough: OFAH.

Ontario Ministry of Agriculture, Food and Rural Affairs. 2013. Guide to Weed Control 2014-2015: Publication 75. Toronto: Queen's Printer for Ontario.

Stackpoole, S. 1997. Purple Loosestrife in Michigan: Biology, Ecology and Management. Bulletin E-2632. Michigan State University: Michigan Sea Grant.

Symonds, G. W. D. 1963. The Shrub Identification Book: The Visual Method for the Practical Identification of Shrubs, Including Woody Vines and Ground Covers. New York: M. Barrows.

Tavernia, B. G. and J. M. Reed. 2012. The Impact of Exotic Purple Loosestrife (*Lythrum salicaria*) on Wetland Bird Abundances. *The American Midland Naturalist* 168 (2): 352-363.

Templer, P., S. Findlay and C. Wigand. 1998. Sediment Chemistry Associated with Native and Non-Native Emergent Macrophytes of a Hudson River Marsh Ecosystem. *Wetlands* 18: 70-78.

Welling, C.H., and R.L. Becker. 1990. Seed Bank Dynamics of *Lythrum salicaria* L.: Implications for Control of This Species in North America. *Aquatic Botany* 38: 303-309.

Wilson, L. M. et al. 2004. Biology and Biological Control of Purple Loosestrife, Technology Transfer/Forest Health Technology Enterprise Team. Morgantown, West Virginia: Forest Health Technology Enterprise Team, U.S. Dept. of Agriculture, Forest Service.

Wisconsin Department of Natural Resources. 2004. Purple Loosestrife: A Major Threat to Wisconsin's Wetlands and Waterways. <http://www.conservemc.org/images/documents/WDNR-Purple-Loosestrife-Brochure.pdf>. (Accessed November 18, 2015).

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