Beetles offer hope for purple loosestrife control

DON HAMILTON, UNIVERSITY OF GUELPH

Galerucella sp. larvae (right) and an adult feeding on purple loosestrife foliage (above).

Hidden under a blanket of snow and having long since shed its showy magenta blossoms, purple loosestrife is far from the minds of most people. Although this invasive European plant is not noticeable during the winter months, millions of its tiny seeds are waiting in the soil to germinate. However, in the natural areas of Royal Botanical Gardens, these seeds are not alone in their dormancy. Thousands of adult beetles known only by their scientific names, *Galerucella pusilla* and *Galerucella calmariensis* are also buried in the soil, waiting for spring. Part of a biological control project initiated by the University of Guelph, these introduced beetles are RBG's latest and most effective defense against the purple loosestrife invasion.

Purple loosestrife chronology

1814	• First published mention of *Lythrum salicaria* in North America
1830s	• Loosestrife is well established along the eastern seaboard of North America
1880s	• Canal construction and increased use of waterways for commerce hasten loosestrife's spread westward
1940s	• Loosestrife spreading at a rate of 64,500 Ha per year
	• Beekeepers start planting loosestrife as a forage crop
1968	• Project researching ecology and control of *L. salicaria* at Cornell University
1985	• U.S. Fish and Wildlife report estimates *L. salicaria* invades 190,000 Ha of wet lands annually, at a cost of $45 million
mid-1980s	
	• Search for pathogens and insect pests in Europe
1988-1990	
	• Beetle species chosen for host-specificity tests on 50 plant species
1990	• Loosestrife is found across Canada and in all continental U.S. states except Florida
1991	• Experimental release of weevil *Hylobius transversovittatus* in New York and Pennsylvania
1992	• Three beetle species (*Galerucella pusilla, G. calmariensis* and *Hylobius transversovittatus* approved for release in Canada and the U.S.
	• RBG experiments with using herbicide Trichlopyr amine to control loosestrife
1993	• University of Guelph's Biological Control Laboratory begins *Galerucella* beetle release in Ontario, including sites at RBG
1996	• beetles released in 25 U.S. states and seven Canadian provinces, including 98,300 beetles at 168 sites in Ontario
1997	• 100,000 beetles released at six Ontario sites during a one-day blitz in August
	• Loosestrife in Mercer's Glen at RBG has been completely defoliated by beetles, and flowering almost completely suppressed
	• $180,000 annual budget for Ontario's loosestrife biocontrol program ends
1998 and beyond	
	• volunteers will continue to relocate and monitor beetles

Loosestrife in North America

Highly visible and much publicized in its spread across North American wetlands, ditches and meadows, purple loosestrife (*Lythrum salicaria* L.) arrived from Europe as early as 1814. A hardy herbaceous perennial, loosestrife can grow up to two metres in height, preferring sunny, wet locations. Its numerous upright spikes of purple-pink flowers appear from July to September. *L. salicaria* is a prolific seed producer, as each plant may release as many as 2.7 million tiny, floating seeds annually! These seeds are easily dispersed by flowing water or within mud carried by wildlife, people or machinery. Like many other exotic plant species, its seeds were probably first brought to North America in ships' ballast water and in livestock bedding. Prized by gardeners for their beautiful flowers, wild purple loosestrife and numerous cultivars were also planted extensively throughout North America. While it is still legal to sell loosestrife plants and seeds in Ontario, its use as a horticultural plant is strongly discouraged by environmental organizations. As a result, few nurseries now stock the controversial plant.

As is the case with many invasive introduced organisms (exotics), purple loosestrife was greeted by a continent that lacked the plant's natural insect pests and diseases. While this may be a blessing if you're trying to grow prize-winning loosestrife flowers, this simple fact causes many ecological problems. Free of the agents that control the plant's population in Europe, *L. salicaria* out-competes many native North American plant species. As a result, it is now found across Canada and the United States. Aided by its impenetrable woody roots, purple loosestrife tends to form dense single-species stands that crowd out existing wetland vegetation. These displaced native plants, including arrowhead, pondweed, sedges and bulrushes, would normally provide critical food, shelter and nesting habitat to birds, mammals, insects and fish. While its flowers are attractive to bees and other pollinating insects, loosestrife seems to be of little nutritional value to most wildlife. The domination of a wetland by *L. salicaria* is usually associated with a loss in diversity of native plant and animal species. In addition, the accumulation of decaying loosestrife roots and vegetation tends to hasten the natural conversion of wetland areas to dry land.

Human disturbance of natural plant communities also greatly enhances the spread of purple loosestrife and other exotic weeds. *L. salicaria* thrives in disturbed low-lying areas that have been cleared of existing vegetation - conditions that often follow the construction of roads and buildings, and the dredging of ditches and canals. While healthy, undisturbed ecosystems are more resistant to invasion by new species, one must realize that

Mercer's Glen before beetle introduction in 1993 (above) and in 1997 (below) following bettle defoliation.

natural disturbances such as wind damage and forest fires are an intrinsic part of the environment. However, with human-induced changes, it is important to consider the scale of disturbance. For example, human development in southern Ontario has led to the loss of over 75% of the wetlands that existed prior to European settlement. As human encroachment continues to threaten wetland ecosystems and their associated flora and fauna, any additional stresses imposed by introduced species are increasingly problematic. With this in mind, it is imperative that the abundance of purple loosestrife is restricted to ecologically acceptable levels.

Scientists at Royal Botanical Gardens are particularly concerned about the rampant invasion of purple loosestrife. *L. salicaria* is currently found in all of RBG's ponds and wetlands, including Mercer's Glen, Hendrie Valley, and many parts of Cootes Paradise. Left unchecked, its spread is expected to continue, especially as wetland restoration efforts such as Project Paradise favour the growth of emergent plants. Since purple loosestrife is a highly successful colonizer of "empty" ecological niches, it may end up dominating these

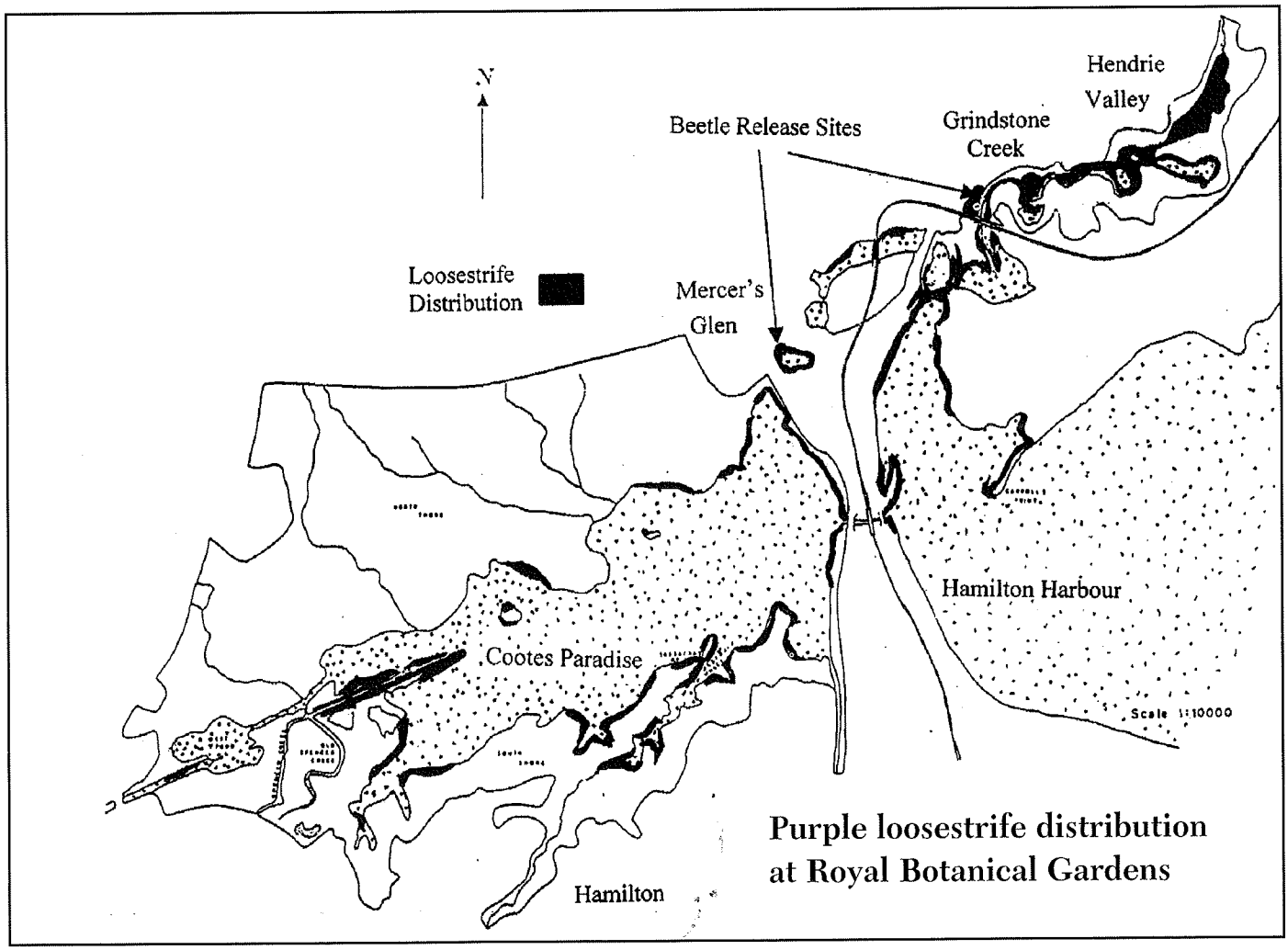
newly-restored wetland habitats.

Effective control of purple loosestrife, using traditional mechanical or chemical methods, has proven to be difficult. Small infestations can be dug out and burned, but any roots or stems left behind may re-sprout. In fact, mechanical removal can exaggerate the problem, as cutting the plant after flowering can inadvertently spread millions of seeds. Conventional herbicides such as Trichlopyr amine, 2,4-D and Glyphosate effectively kill above-ground vegetation, but the root systems may remain alive. More importantly, no herbicides are currently registered for general use in Canadian wetlands. Spraying around water could be harmful to other aquatic organisms and contaminate water supplies. In addition, large-scale herbicide application would be very costly to landowners, and would have to be carried out on a continuous basis.

Biological control of purple loosestrife

As these conventional control methods were proving to be largely ineffective against loosestrife, biological control agents were sought as an alternative. Biological control is desirable because it is self-sustaining, environmentally friendly and cost effective. In a classical biological control program, the introduced pest is reunited with natural predators (usually insects) from its place of origin. However, to avoid introducing new problem species, the release of biocontrol agents is strictly controlled by federal regulations. Before an insect is released to combat an invasive plant, extensive laboratory and field research must show that it is host-specific. This means that it will feed only on the problem plant, and it will not harm any other plants or insects. For a release program to be effective, the biocontrol agent must also be easy to raise in captivity, have a strong negative impact on the host, disperse readily, and be able to tolerate local climatic conditions.

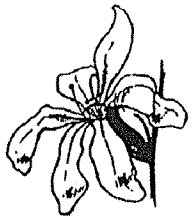
In the mid-1980s, purple loosestrife populations in Europe were surveyed to identify possible biocontrol candidates. After years of rigorous laboratory studies in Europe and at Cornell University in Ithaca, New York, three beetle species were approved for release in 1992. These are *Galerucella pusilla* and *Galerucella calmariensis* in the family Chrysomelidae, which eat leaves and tender shoots, and the root-eating weevil *Hylobius transversovittatus*. It is important to note, however, that these small brown beetles are not expected to eliminate

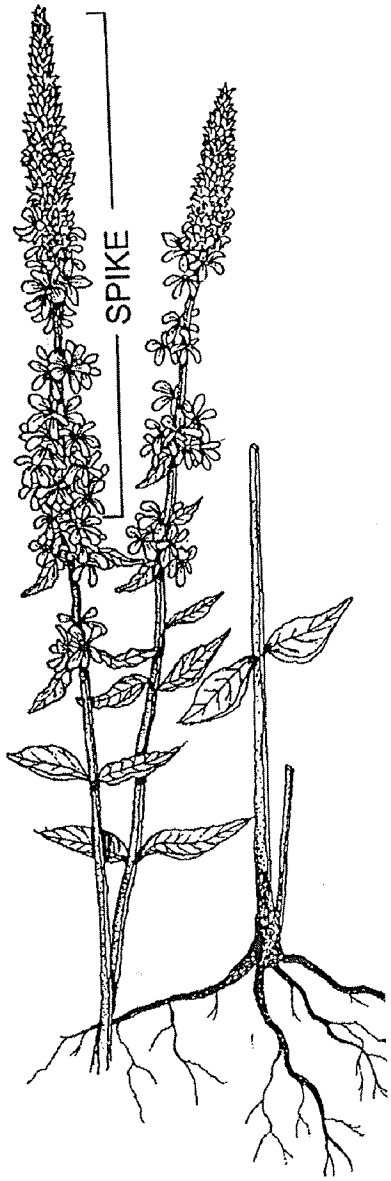


Purple loosestrife distribution at Royal Botanical Gardens

Identification of Purple Loosestrife

(*Lythrum salicaria* L.)
Lythraceae (Loosestrife Family)





Overview

- herbaceous wetland perennial reaching heights of 2 m
- invasive exotic plant originating from Europe in the early 1800s, now found throughout North America in a variety of habitats

Flowers

- attractive terminal spikes of numerous reddish purple flowers appear in July and August
- each flower has 5-6 petals and green hairy sepals

Leaves

- lance-shaped, downy, with smooth edges
- leaf arrangement is opposite or whorled

Stem

- upright woody stems are 4 to 6 sided
- up to 50 smooth to hairy stalks per mature plant

Seeds

- seed capsules on the stem produce millions of tiny floating seeds

Roots

- on mature plants, thick mats of woody roots can displace native vegetation

Similar Plants

- swamp loosestrife, winged loosestrife (both native species), fireweed, blue vervain

Public Programs Calendar

purple loosestrife entirely, but merely to control its abundance by up to 80%.

The Ontario Biological Control Program Against Purple Loosestrife was established at the University of Guelph in 1992. By the end of 1997, Biological Control Laboratory researchers Jim Corrigan and Donna MacKenzie had released over 320,000 *Galerucella* beetles at 200 sites across Ontario. While the beetles did not become established at some sites, the biocontrol program has been very successful at others. For example, in 1997, there were 15 to 20 sites across Ontario where beetle densities were high enough to devastate whole purple loosestrife populations. Given time, Corrigan expects this number will increase. To date, *Galerucella* beetles have colonized approximately 100 km of shoreline in the Hamilton-Wentworth region and in the Grand River watershed, including Guelph, Kitchener and Cambridge. Despite these resounding successes, however, the future of the Ontario loosestrife biological control program looks bleak. Funding for the team's $180,000 a year budget ended in September 1997, and unless additional money is found, the program will not continue in 1998.

Nonetheless, RBG is optimistic about the future of its loosestrife control program. Beetles were successfully released in 1993 at RBG's Mercer's Glen and on Grindstone Creek under the Plains Road bridge. This release follows several unsuccessful attempts to control *L. salicaria* in Mercer's Glen (see *Pappus* 12:2). These efforts included mowing, hand pulling by summer students, herbicide trials, and even cooking the plants with an experimental mobile boiler system. In contrast, the effect of *Galerucella* has been impressive. In 1993, this pond was completely ringed by thriving stands of *L. salicaria*. By August, 1997, the beetles were so abundant that loosestrife foliage was virtually eliminated, and hardly any plants produced seed. Despite this attack, the hardy root systems of many plants remain alive, and will probably sprout again in the spring. It may take a number of years before a balance is reached between populations of beetles and loosestrife plants. However, the beetles place purple loosestrife at a competitive disadvantage, and other plants such as cattails and sedges are gradually reclaiming lost territory.

Meanwhile, a research team led by botanist Jeremy Lundholm is monitoring the beetles' progress and impacts throughout RBG's wetlands. RBG ecologist Len Simser is optimistic that within a few years, *L. salicaria* in Cootes Paradise will show the same damage as in Mercer's Glen. By August, 1997, low densities of *Galerucella* were found all along the Cootes Paradise shoreline and into the western end of Hamilton Harbour. After these beetles consumed their food supply in Mercer's Glen, the hungry adults were forced to find new loosestrife stands in the surrounding area. In the future, Hamilton area scientists may hasten this dispersal process by relocating some of these beetles to other areas in the watershed. In addition, RBG is hoping to speed the recovery of native vegetation by experimentally seeding wetland plants in beetle-impacted areas. In 1998, this research will be conducted in partnership with a McGill University graduate student.

In light of these promising results, purple loosestrife invasion may not be the ecological disaster that was anticipated. To a great extent, it may be a symptom of a larger problem - specifically wetland loss and degradation. With the help of a small brown beetle, and proper management of our own actions on wetland ecosystems, the loosestrife problem may solve itself. However, it is essential that we continue to monitor the spread and impact of *Galerucella* beetles long after they have fallen from media attention. By further understanding the complex interactions between an invasive plant species and the insects released to control it, we will be better prepared to tackle the next invasive exotic that comes our way.

Further Sources of Information:

Benckhuysen, J.A. and W.L. Simser. 1993. Efficacy of Trichlopyr amine in controlling *Lythrum salicaria* L. (purple loosestrife). The Garden's Bulletin, from *Pappus* 12:2.

Thompson, D.Q., R.L. Stuckey, and E.B. Thompson. 1986. Spread, impact and control of Purple loosestrife (*Lythrum salicaria* L.) in North American wetlands. U.S. Fish and Wildl. Serv.

http://www.dnr.cornell.edu./bcontrol/weeds.htm

http://ducks.ca/purple/

http://www.ceris.purdue.edu/napis/pests/pls/index.html

http://bluegoose.arw.r9.fws.gov/NWRSFiles/HabitatMgmt/PestMgmt/LoosestrifeMgmt.html

Biological Control Laboratory
Department of Environmental Biology
University of Guelph,
Guelph, Ontario, Canada. N1G 2W1
(519) 824-4120, Ext. 8591

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