

2.16 Purple Loosestrife

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Lythrum salicaria L.; erect, emergent perennial herb in the Lythraceae (loosestrife) family
Derived from *lythrum* (Greek: blood) and *salicaria* (Latin: willow-like) “plant that stops blood and is willow-like”

Introduced from Europe to the east coast of North America in the early 1800s
Present in every state throughout the US, but not recorded in Florida, and found in all Canadian provinces

Introduction and spread

Lythrum salicaria L. (purple loosestrife) is often referred to as “the purple plague” in North America and is native to Europe and Asia. Purple loosestrife is an aggressive invasive plant deliberately introduced to the eastern coast of North America in the early 1800s. Settlers of the region valued the plant as an ornamental for perennial gardens and used the species as a medicinal herb to treat dysentery, diarrhea, bleeding and ulcers. The honey trade also increased regional seed propagation of the plant because it was a favored bee forage. In addition, European ships contributed to the spread of purple loosestrife by releasing ballast water and delivering shipments of wool that contained seeds of the species. By the 1830s, purple loosestrife had become established along the New England seaboard and the range of the species further expanded throughout New York State and the St. Lawrence River Valley through inland canals constructed in the late 1880s. As road systems expanded and commercial distribution of the plant by the nursery trade increased, purple loosestrife spread westward and southward invading every state and province of the US and Canada, while still not recorded in Florida. Purple loosestrife grows in most freshwater wetlands but also tolerates a wide range of environmental conditions and can spread to both tidal and non-tidal brackish waters.

Description of the species

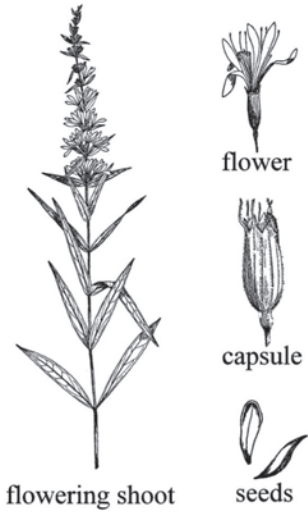
Purple loosestrife is an erect, emergent perennial dicot herb with a dense, bushy appearance. The species tolerates a wide range of wetland environments and grows in habitats ranging from pastures with moist soil to sites with shallow water such as marshes and lakeshores. Established plants can tolerate a variety of soil conditions, including soils that are dry or permanently flooded and soils that are low in pH and nutrients. In addition, plants can grow in rock crevasses, on gravel, sand, clay or organic soils. Purple loosestrife can grow from four to ten feet in height and has a dense canopy of stems that emerge from its wide-topped crown. Each plant produces as many as 50 square, hard, red to purple stems that arise from a single root mass. Leaves are 1-1/2 to 4 inches long and 2/10 to 6/10 inch wide and are lance-shaped, stalk-less, heart-shaped or rounded at the base and borne in an opposite or whorled arrangement. Purple loosestrife produces flowers with magenta, purple, pink or white petals that are 4/10 to 8/10 inch long. The species blooms throughout most of the summer, which adds to its appeal as an ornamental plant and as a favorite of beekeepers. The reddish-brown seeds are very small (1/25 inch long) and are often produced during the first growing season. Purple loosestrife is often confused with several plants with spikes of purple flowers, including prairie blazing star (*Liatris pycnostachya*), blue vervain (*Verbena hastata*) and fireweed (*Chamaenerion angustifolium*). However, the species most closely resembles the native winged



loosestrife (*Lythrum alatum*) and *Lythrum virgatum* L., a nonnative cultivated purple loosestrife. *L. virgatum* is very similar to purple loosestrife in appearance and formerly classified as a separate species, but considered by some to be a subspecies or variant form of purple loosestrife.

Reproduction

The extended flowering season of purple loosestrife typically lasts from June to September and allows each mature plant to produce more than 2 million seeds each year. Long-tongued insects, including bees and butterflies, serve as pollinators. Seed dispersal is often by water and seeds can hitchhike in mud that adheres to wildlife, livestock and people. Seed survival can be as high as 60 to 70%, which produces a sizeable seedbank in only a few years. Germination occurs in open, wet soils as temperatures increase in the spring, but seeds can remain dormant and viable for many years in the soil. In addition, submersed seeds can survive for up to 20 months in flooded conditions. Purple loosestrife readily colonizes newly disturbed areas because of its high production of viable seeds with multiple modes of dispersal. Disturbed areas with exposed soil are most vulnerable to invasion and rapid colonization by purple loosestrife because these sites provide ideal conditions for seed germination and usually lack native plants that compete with the weed for resources. Purple loosestrife spreads predominately via seed dispersal, but also by vegetative means through production of new shoots and roots from clipped, trampled or buried plants. Purple loosestrife's ability to reproduce via vegetative processes is an especially important consideration when contemplating adoption of management strategies. Mechanical or physical control efforts can inadvertently spread harvested plant fragments and create new infestation sites. In addition, disturbances in the form of changes in water levels from drought or a planned water drawdown provide ideal conditions for maximum seed germination and growth.



Problems associated with purple loosestrife

Purple loosestrife aggressively invades many types of wetlands, including freshwater wet meadows, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs and roadside ditches. The formation of dense, monotypic stands of purple loosestrife suppresses native plant species, decreases biodiversity and leads to a change in the wetland's community structure and hydrological functioning, while eliminating open water habitat in many locations. The United States historically has lost around 200,000 acres of wetlands every year due to invasions of purple loosestrife and has spent as much as \$45 to \$50 million per year on efforts to control the growth of this species. In addition to funds spent on control efforts, economic losses to agriculture can exceed millions of dollars annually when purple loosestrife invades irrigation systems. Also, the loss of entire crops of wild rice can occur when this species invades shallow lakes and bays dominated by wild rice, which results in great economic loss to local agricultural communities.

Purple loosestrife alters the physical makeup of a wetland but the species can change the chemical properties of the wetland as well. For example, the shedding of purple loosestrife leaves in the fall that rapidly decompose, allow a quick flushing of nutrients out of the wetland. In contrast, the vegetation of native species does not fully decompose until the following spring maintaining nutrients in the wetland throughout the fall and winter. This difference in the timing of nutrient release means that wetland decomposers have fewer nutrients available to subsidize peak population growth in the spring, which alters the structure of the food web. The effects of altered water chemistry extend to many of the fauna in aquatic ecosystems as well. For example, chemicals released during the decomposition of purple loosestrife leaves can slow the development of certain frog tadpoles, which decreases the frog's chance of surviving its first winter. Research at Cornell University suggests an underestimation of the threats to amphibians by nonnative plants. Their data indicate that organisms that breathe through gills (especially *Bufo americanus*, the American toad) are sensitive to the high concentration of tannins naturally produced during purple loosestrife decomposition.

Purple loosestrife further affects the wildlife communities of wetlands through a variety of other means. The species is a very poor food source for herbivores and crowds out species that are more beneficial to the wetland food web. As a result, stands of purple loosestrife can jeopardize threatened and endangered plants and wildlife, especially in the northern US. For example, the bog turtle has lost extensive basking and breeding habitat due to the introduction of this aggressive plant. Purple loosestrife also displaces native plants such as cattail (*Typha* sp.) and bulrush (*Scirpus* sp., *Schoenoplectus* sp.), which provide high quality habitat to numerous nesting birds and aquatic furbearers. Wetland

specialists such as the marsh wren, red-winged blackbird or least bittern (Section 1.4) prefer sturdy nesting sites such as cattail-dominated wetlands and are unable to utilize purple loosestrife for their nests. Also, muskrat, beaver and waterfowl prefer cattail marshes and are more able to utilize sites that native plants dominate compared to dense, monotypic populations of purple loosestrife.

A primary problem associated with purple loosestrife is its attractiveness. European immigrants to the US deliberately imported purple loosestrife as an ornamental plant in the 1800s and homeowners still actively plant the species today. Purple loosestrife may add a welcome burst of color to an otherwise dull private garden or pond, but the adaptability and aggressiveness of this plant can quickly wreak havoc on the unsuspecting homeowner's backyard. The sale or distribution of purple loosestrife is illegal in most states; however, nurseries, greenhouses and mail order sources sell the plant in many areas across the country and some seed mixes include the plant seeds. Consumers should always read seed package labels before purchasing in order to ensure that this aggressive nonnative plant is not in the mix.

Management options

The best way to stop an invasion of purple loosestrife is to be aware of pioneering plants and small isolated colonies. In these cases, hand removal of small, isolated stands is an effective preventative control method. The use of physical (Section 3.4) and mechanical (Section 3.5) control methods may provide annual control of low-density invasions and can include water level manipulation, hand removal, cutting and burning. These control methods should take place before seed production to avoid seed dispersal and contributions to the seed bank. It is also essential to remove roots from the soil since plants will regrow from broken roots or root fragments. Removal of flowering spikes will prevent seed formation and cutting or harvesting stems at the ground level will inhibit growth temporarily. While these methods temporarily halt growth, their use should be in conjunction with herbicides or biological control agents to provide longer-term management.

Annual applications of herbicides (Section 3.7.1) can be effective and can provide relatively successful season-long control of purple loosestrife stands but it is important to note that most states require application permits before using herbicides for management of purple loosestrife in wetlands or other aquatic locations. Control rates of greater than 90% can be realized with applications of the herbicides glyphosate and imazapyr; also, triclopyr (alone or mixed with 2,4-D) provides control for purple loosestrife. Single applications of registered herbicides generally do not provide satisfactory control of loosestrife for more than one season, but the use of imazapyr and glyphosate can result in multi-season control of purple loosestrife. Herbicides used to control purple loosestrife have very different selectivity spectrums for nontarget plants and application rate affects selectivity. When selecting an herbicide for management of purple loosestrife, it is important to consider potential negative impacts of the herbicide on the many important nontarget wetland species from overspray or exposure to high concentrations of herbicides needed to effectively control purple loosestrife.



The vast seedbank in the soil of established stands of purple loosestrife facilitates regrowth of the species after herbicides dissipate and are no longer effective. Therefore, the most effective long-term option for suppressing and controlling the growth of this invasive weed may be the use of biological control (Section 3.6). Research and evaluation of potential biological control agents for the North American purple loosestrife invasion identified European insects that showed promise as biocontrol agents. The USDA-APHIS approved four European insect species for introduction as classical biocontrol agents that have become well established (Section 3.6.1). These include two leaf-feeding beetles [*Galerucella calmariensis* L. and *G. pusilla* Duftschmidt (Coleoptera: Chrysomelidae)], a root-mining weevil [*Hylobius transversovittatus* Goeze (Coleoptera: Curculionidae)] and a flower-feeding weevil [*Nanophyes marmoratus* Goeze (Coleoptera: Curculionidae)]. Initial releases of the leaf-feeding beetles and the root-mining weevil into natural areas from New York to Oregon were experimental and early observations suggested that the leaf-feeding beetles occasionally feed on native plant species. However, this now appears to be of little consequence; both species have shown great success across the United States and Canada and are now becoming well-established.

The introduced European leaf-feeding beetles described above may be easily confused with native North American *Galerucella* species but the introduced beetles seriously affect purple loosestrife growth and seed production by feeding on the leaves and new shoot growth. The two introduced beetles are similar in appearance and share similar life history characteristics. Adults overwinter in leaf litter and emerge in the spring shortly after shoot growth begins.



Adults overwinter in leaf litter and emerge in the spring shortly after shoot growth begins. Peak dispersal of overwintered beetles occurs during the first few weeks of spring when new-generation beetles make dispersal flights shortly after emergence and can locate host patches greater than a half mile away within only a few days. Adults feed on shoot tips and females lay 2 to 10 eggs on the leaves and stems of purple loosestrife from May to July. Young larvae feed on developing leaf buds, while older larvae feed on all aboveground plant parts. Pupation by mature larvae takes place in the litter below the plant. Reports from

several locations describe complete defoliation of large multi-acre stands of purple loosestrife, with local biomass reductions of greater than 95%. These positive results after years of introductions are extensive while sometimes localized, but have occurred in states ranging from the East to West Coasts and into the provinces of Canada.

Larvae of the introduced root-boring weevil hatch and feed on root tissue for one to two years depending on environmental conditions. Pupation occurs in the upper part of the root, with adults emerging between June and October. Adults then feed on foliage and stem tissue and can live for several years. The root-boring weevil can survive in all potential purple loosestrife habitats except for permanently flooded sites. Adults and larvae can survive extended submergence, depending on the temperature, but excessive flooding prevents access to plants by adults and eventually kills developing larvae. Feeding by adults has little effect on the plants, but as is typical, feeding by larvae can be very destructive to the rootstock.

Several states introduced the flower-eating weevil which is widespread in Europe and Asia, where it tolerates a wide range of environmental conditions. The flower-eating weevil greatly reduces seed production of purple loosestrife as larvae consume the flower and mature larvae form a pupation chamber at the bottom of the bud. Damaged buds do not flower with buds aborting, thus reducing purple loosestrife seed output. New-generation beetles appear mainly in August and feed on the remaining green leaves of purple loosestrife. Adults overwinter in leaf litter; development from egg to adult takes about 1 month and there is one generation per year.

Summary

The introduction of purple loosestrife into North America occurred in the early 1800s with the importation of wool containing seeds, as a favorite herb in flower gardens and from released ship ballast water. Unfortunately, this attractive plant has become one of North America's most widely dispersed and dominant nonnatives in habitats ranging from dry soils to inundated marsh areas or lakes. Stems can grow as tall as 10 feet and can form densities of up to 50 stems per plant, creating a canopy that limits light and space to native plants. Purple loosestrife causes problems in wetland ecosystems by forming dense monocultures, outcompeting native plants, altering hydrology and changing water chemistry, which all in turn affect native plant and animal communities. Purple loosestrife is an easily identified emergent plant, which facilitates hand removal and selective herbicide applications. Although limited, these methods can provide temporary control of small populations. Multiple control methods used in combination can effectively control populations, but biocontrol seems to provide the best long-term suppression of large dense stands of purple loosestrife. Fortunately, classical biocontrol agents appear to be able to successfully reduce populations of purple loosestrife throughout North America.

Photo and illustration credits:

Page 93: Purple loosestrife; Bernd Blossey

Page 94: Line drawing; adapted from Muenscher (1967)

Page 95: Mating pair of the leaf-feeding beetle *Galerucella californiensis*; Bernd Blossey

Page 96: Adult root-boring weevil *Hylobius transversovittatus*; Bernd Blossey