ELEMENT STEWARDSHIP ABSTRACT
for

Ligustrum spp.

Privet

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SCIENTIFIC AND COMMON NAMES

Ligustrum amurense (Carr.): Amur privet
Ligustrum japonicum (Thun.): Japanese privet
Ligustrum lucidum (Ait.f.): Tree privet; glossy privet
Ligustrum obtusifolium (Sieb. and Zucc.): Blunt-leafed privet; border privet
Ligustrum ovalifolium (Hassk.): California privet; waxy-leaved privet
Ligustrum quihoui (Carr.): Wax-leaf privet
Ligustrum sinense (Lour.): Chinese privet
Ligustrum vulgare (L.): European privet, common privet

DESCRIPTION AND DIAGNOSTIC CHARACTERISTICS

Ligustrum spp. are deciduous, semi-evergreen, or evergreen shrubs and small trees in the Oleaceae (olive family). There are approximately 50 *Ligustrum* species that are native to Europe, North Africa, and Asia. *Ligustrum* spp. have been cultivated and developed into several horticultural varieties, and were introduced to North America as a common hedge in landscaping. *Ligustrum* spp. can easily escape cultivation to invade adjacent areas and can form dense monospecific thickets.

Some *Ligustrum* spp**.** can grow to 5 m tall and have a stem diameter of 2.5-25 cm. *Ligustrum* spp. bark is whitish-tan to gray in color and smooth in texture. Slender twigs are straight, rounded or four-angled below the nodes, and gray-green in color. Winter buds are ovoid with two outer scales. Terminal buds are present. Leaves are elliptic to ovate in shape, oppositely arranged on slender twigs, often leathery and thick. Flowers have both male and female parts, and the corollas are white. The calyx is small, obconic or campanulate, and 4-toothed. Each flower has petals that are fused into a tube below with four separate lobes above. Flowers are borne on small panicles terminating the main axis and on short lateral branches. Bloom time is usually June-July. The fruit is a subglobose or ovoid drupe containing 1-4 seeds. Fruit clusters generally ripen during September and October and persist through the winter. Mature specimens can produce hundreds of fruit (Rehder 1977).

L. amurense grows to 5 m. Leaves are elliptic to oblong or oblong-ovate, 2.5-6 cm long, acute or obtuse, rounded or broad-cuneate at base; ciliolate, sometimes lustrous above, and smooth except on the midrib below. Petioles are 2-4 mm long, pubescent. Panicles are 3-5 cm long and pubescent. The calyx is glabrous or slightly pubescent. The corollas (from base of tube to tip of lobe) are 7-9 mm long, with the tube far longer than the lobes.

L. japonicum generally grows to 3 m, rarely to 6 m. Leaves are broad-ovate to ovate-oblong, 4-10 cm long, obtusely short-acuminate or acute to obtuse, rounded at the base with reddish margins and midrib and with 4-5 pairs of indistinct veins. Petioles are 6-12 mm long. Panicles are 6-15 cm long. Flowers are short-stalked with the corolla tube longer than the calyx. Stamens are slightly longer than the corolla lobes.

L. lucidum grows as a large shrub or medium-sized tree, to 10 m high, with spreading branches. Leaves are ovate to ovate-lanceolate, 8-12 cm long, acuminate or acute, usually broad-cuneate with 6-8 veins, usually distinct above and beneath. Petioles are 1-2 cm long. Panicles are 12-20 cm long and nearly as wide. Flowers are subsessile. The corolla tube is as long as the calyx. Stamens are as long as the corolla lobes. Fruits are oblong, 1 cm long, bluish or purplish-black.

L. obtusifolium grows to 3 m with spreading or arching branches. Leaves are elliptic to oblong or oblong-obovate, 2-6 cm long. Leaves are acute or obtuse, cuneate or broad-cuneate, glabrous above, pubescent below (or occasionally only on midrib). Petioles are 1-4 mm long, pubescent. Panicles are 2-3.5 cm long, nodding. Corollas are 8-10 mm long with anthers nearly as long as the corolla lobes. Fruits are subglobose, black and slightly bloomy (glaucous).

L. ovalifolium grows to 5 m. Leaves are elliptic-ovate to elliptic-oblong, 3-6 cm long, acute, broad-cuneate, dark lustrous green above, yellowish green below. Petioles are 3-4 mm long. Flowers are creamy-white with

an unpleasant scent, subsessile in panicles 5-10 cm long. Corollas are 8 mm long with anthers as long as lobes. Fruits are 5-7 mm across, black.

L. quihoui grows to 2 m with spreading, rigid branches. Leaves are elliptic to elliptic-oblong or obovate to obovate-oblong, 2-5 cm long, obtuse, sometimes emarginate, glabrous, subcoreaceous. Petioles are 1-3 mm long, puberulous. Flowers are sessile, in small clusters on long spikes collected into 10-20 cm long panicles. Corolla tubes are as long as the lobes with anthers exceeding the lobes. Flowers appear in late summer.

L. sinense is a shrub or small tree to 7 m. Leaves are elliptic to elliptic-oblong, 3-7 cm long, acuminate, acute to obtuse, dull green above, pubescent on the midrib below. Petioles are 6-15 mm long. Flowers are small, distinctly stalked, on panicles 10-16 cm long. Fruits are dull black.

L. vulgare grows to 5 m with spreading branches. Leaves are oblong-ovate to lanceoloate, 3-6 cm long, obtuse to acute, glabrous. Petioles are 3-10 mm long. Flowers are pediceled in dense puberulous panicles, 3-6 cm long. Anthers exceed the corolla tube. Fruits are subglobose or ovoid, 6-8 mm long, black and lustrous.

STEWARDSHIP SUMMARY

Several *Ligustrum* species have become common invaders of cultivated landscapes, disturbed areas and wildlands throughout the U.S. *L. amurense* is found in many eastern and some south-central states. *L. japonicum* is found in the Southeast and in Puerto Rico. *L. lucidum* is present from Maryland south and west to Texas. *L. sinense* and *L. obtusifolium* are found throughout the eastern and central U.S. *L. ovalifolium* is common in California and in parts of the central and eastern U.S. *L. quihoui* is seen in the southeast. *L. vulgare* is widely naturalized throughout much of the U.S. and southern Canada.

Ligustrum spp. may invade natural areas such as floodplain forests and woodlands. They may displace shrubs in regenerating communities and remain persistent in these areas. *Ligustrum* spp. can form dense thickets that outcompete many kinds of native vegetation.

In North America, *Ligustrum* spp. are seen along roadsides, in old fields and in other disturbed habitats and in a variety of undisturbed natural areas, including bogs, wetlands, floodplains, old fields, calcareous glades and barrens, and mesic hardwood forests.

Ligustrum spp. control methods include mowing and cutting, seedling removal, herbicide application, and burning. Mowing and cutting are appropriate for small initial populations or environmentally sensitive areas where herbicides cannot be used. Stems should be cut at least once per growing season as close to ground level as possible. Repeated mowing or cutting will control the spread of *Ligustrum* spp., but may not eradicate it. *Ligustrum* spp. can also be effectively controlled by manual removal of young seedlings. Herbicide control measures include foliar spraying in late autumn or early spring with glyphosate, triclopyr, or metsulfuron; cut stump applications using glyphosate or triclopyr; and basal bark applications of triclopyr. Some reports indicate that burning top-kills *L. vulgare* and *L. sinense* and, if repeated, can eliminate them over time.

RANGE

Ligustrum spp. are native to east Asia, Europe and North Africa: *Ligustrum amurense* is native to north China; *L. japonicum* to Korea and Japan; *L. lucidum* to China, Korea and Japan; *L. obtusifolium* to Japan; *L. ovalifolium* to Japan; *L. sinense* to China; and *L. vulgare* to the Mediterranean region.
Reported occurrences of the different *Ligustrum* spp. in North America include:

L. amurense: Arkansas, Kentucky, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Texas, and Virginia.

L. japonicum: Alabama, Florida, Georgia, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia, and Puerto Rico.

L. lucidum: Alabama, Florida, Georgia, Louisiana, Maryland, Mississippi, North Carolina, and Texas.

L. obtusifolium: Connecticut, District of Columbia, Illinois, Indiana, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Tennessee, Utah, Vermont, and Virginia.

L. ovalifolium: California, Connecticut, Delaware, District of Columbia, Florida, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Missouri, New Jersey, North Carolina, Ontario, Pennsylvania, Texas, Vermont, Virginia, and Puerto Rico.

L. quihoui: Louisiana, North Carolina, Texas, and Virginia.

L. sinense: Alabama, Arkansas, Connecticut, Florida, Georgia, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, Missouri, New Jersey, North Carolina, Oklahoma, Rhode Island, South Carolina, Tennessee, Texas, and Virginia.

L. vulgare has the broadest range of the invasive *Ligustrum* species established in North America. It has been documented in: Alabama, Arkansas, British Columbia, Connecticut, Delaware, District of Columbia, Florida, Georgia, Great Smoky Mountain National Park, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Newfoundland Island (Newfoundland), North Carolina, Nova Scotia, Ohio, Ontario, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, West Virginia, and Wisconsin.

IMPACTS AND THREATS POSED BY EXOTIC PRIVETS

Ligustrum spp. can form dense thickets that outcompete native vegetation. The privets can invade natural areas such as floodplain forests, woodlands, and disturbed agricultural fields. They generally expand along fence-rows, windbreaks and roadsides (Haragan 1996). In New Zealand, *L. sinense* may displace the shrub layer and marginal shrubs of alluvial forests, and remain persistent in these areas. *L. lucidum* replaces mid-canopy trees in forests and may completely dominate an area of forest or forest fragments if not controlled (New Zealand Weeds Web Site 1999). *L. japonicum* and *L. sinense* invade woodlands in the eastern and southeastern U.S. (Faulkner et al. 1989; Stone 1997). Forest gaps can also become invaded since birds often disperse *Ligustrum* seeds.

HABITAT

In North America, *Ligustrum* spp. often grow along roadsides, in old fields and in other disturbed habitats and in a variety of undisturbed natural areas. Examples of *Ligustrum* invasions include:

1) *L. obtusifolium* was found invading an old field succession site in Illinois. The field had an average of more than 6,082 plants per ha (2.5 acres) (Tennessee Exotic Pest Plants Council 1996).

2) *L. sinense* has been reported in bogs, an oak-hickory-pine forest, a longleaf pine-turkey oak forest, and mesic hardwood forests in Alabama. In Arkansas, *L. sinense* has been reported in virtually all non-xeric habitats. In Georgia, *L. sinense* has been reported in floodplain/wetland habitats, and in North Carolina, in woodland edges (Randall and Meyers-Rice. unpublished.).

3) *L. vulgare* has been recorded in bottomlands and mesic and riparian forests in Arkansas. In Ohio, *L. vulgare* is found in old fields, primary woodlands, and closed canopy forests. In Tennessee, the species has been recorded in calcareous glades and barrens and in deciduous cove forests (Randall and Meyers-Rice. unpublished.).

4) In New Zealand, *L. sinense* is found in alluvial forest remnants, waste places, shrublands, and open stream systems, particularly in coastal areas. *L sinense* is widespread and common, especially near towns. It is a common farm hedging plant. *L. lucidum* is found in forests (lowland and coastal), forest fragments, shrublands, along roadsides, in farm hedges, wastelands, and domestic gardens (New Zealand Weeds Web Site).

ECOLOGY AND BIOLOGY

Ligustrum spp. are perennial shrubs that grow readily from seed or from root and stump sprouts. They can escape from cultivation when the fruits are consumed by wildlife, particularly birds, which often excrete the seeds unharmed at distant locations where they may germinate and become established. Germination rates have been variously reported as low as 5%-27% (Tennessee Exotic Plants Council 1996) and as high as 77% (Schopmeyer 1974). Unlike most woody species, experimental defoliation did not result in reduced percentages of flowers producing fruits, decreased seed number, or decreased seed quality (Obeso and Grubb 1993).

Ligustrum spp. leaves are high in phenolic compounds that defend against herbivores, especially insects. These work by inhibiting digestive enzymes and proteins (Konno et al. 1998). Despite this, *L. sinense* has been identified as an important forage plant for deer in the southeastern U.S. (Stromayer et al. 1998).

L. vulgare grows well in high light, low nutrient soils, but will tolerate lower light levels if nutrients are increased (Grubb et al. 1996).

MANAGEMENT

Potential for Restoration of Invaded Sites

In North America, *Ligustrum* spp. have no important pests or predators. The various species are widespread and occasionally locally abundant. Manual and mechanical, environmental/cultural, and chemical methods are all useful in varying degrees in controlling *Ligustrum spp*. Fire management may be useful in some cases where the density of *Ligustrum spp.* is low and sufficient fuels available. Restoration potential is likely to be lowest where *Ligustrum spp.* occur in high densities and there is a high likelihood of continued dispersal of seeds into the restoration area. *Ligustrum* spp*.* have a high degree of reproductive vigor, a wide range of adaptability, and, in its present settings, few pests and predators. *Ligustrum spp.* produce large numbers of viable seed that are readily dispersed by birds and germinate at high rates in a wide range of conditions.

The potential for large-scale restoration of unmanaged natural areas or wildlands infested with *Ligustrum* spp. is probably low. Restoration potential for managed natural areas or wildlands infested *Ligustrum spp*. is probably moderate. If attacked during the early stages of colonization, the potential for successful management is high.

Mechanical Controls

Mowing and cutting are appropriate for small populations or environmentally sensitive areas where herbicides cannot be used. Stems should be cut at least once per growing season as close to ground level as possible. Repeated mowing or cutting will control the spread of *Ligustrum* spp., but may not eradicate it (Tennessee Exotic Pest Plants Council 1996). Managers of The Nature Conservancy preserves in Ohio reported eradication of *L. vulgare* after two cutting treatments (Randall and Meyers-Rice, unpublished).

Ligustrum spp. can be effectively controlled by the manual removal of young seedlings. Plants should be pulled as soon as they are large enough to grasp but before they produce seeds. Seedlings are best pulled after a rain when the soil is loose. Larger stems (up to 6 cm in diameter) can be removed using a weed

wrench or similar uprooting tools. The entire root must be removed since broken fragments may resprout (Tennessee Exotic Pest Plants Council 1996).

Biological Controls

Ligustrum spp. have no known biological controls, although a few pathogens are known to attack them in North America. *Cercospora adusta, C. lilacis*, and *Pseudocercospora lugustri* are fungal leaf spots that affect *L. vulgare* and *L. amurense*. *Nectriella pironi* creates galls on *L. sinense, L. lucidum* and *L. quihoui*. *Pseudomas syringae* impacts members of the olive family including *L. amurense. Agrobacterium tumefaciens*, *Ganoderma lucidum* and *Glomerella cingulata* affect *L. vulgare* (Sinclair et al. 1987).

Herbicides

Foliar Spray Method: This method may be effective for large thickets of *Ligustrum* spp. where risk to non-target species is minimal. Air temperatures should be above 17°C to ensure that herbicides are absorbed. The ideal time to treat is while plants are in leaf in late autumn or early spring but when many native species are dormant.

Glyphosate (brand name Roundup and others): A number of concentrations have been used successfully. The Tennessee Exotic Pest Plants Council (1996) suggests a 2% solution of glyphosate and water plus a 0.5% non-ionic surfactant to thoroughly wet all leaves. The New Zealand Weeds Web Site (1999) recommends, for a handgun sprayer, 1 liter Roundup and 100 mls of a surfactant per 100 liters of water (1% solution); for a backpack sprayer, the recommendation is 100 ml Roundup and 20 mls of a surfactant per 10 liters of water. (Roundup is a non-selective herbicide.)

Triclopyr (brand name Garlon, Pathfinder II and others): The Tennessee Exotic Pest Plants Council (1996) suggests a 2% solution of triclopyr and water plus a 0.5% non-ionic surfactant, sprayed to thoroughly wet all leaves. Use a low pressure and coarse spray pattern to reduce spray-drift damage to non-target species. (Triclopyr is a selective herbicide for broadleaf species only.)

Metsulfuron (brand name Escort and others): The New Zealand Weeds Web Site (1999) recommends, for a handgun sprayer, 35 g metsulfuron and 100 mls of a surfactant per 100 liters of water; for a backpack sprayer, the recommendation is 5 g metsulfuron and 10 mls of a surfactant per 10 liters of water. Metsulfuron methyl was identified as the most cost-effective herbicide in an experimental treatment comparing metsulfuron methyl, triclopyr ester and 2,4-D (Madden and Swarbrick 1990). (Metsulfuron is a selective herbicide active upon broadleaf and some annual grass species.)

Cut Stump Method: This control method should be considered when treating individual shrubs or where the presence of desirable species precludes foliar application. The Tennessee Exotic Pest Plants Council (1996) recommends this treatment only as long as the ground is not frozen, but other researchers have found it effective on *Rhamnus* spp. in frozen ground (Reinartz 1997). Immediately after cutting stems at or near ground level, apply a 25% solution of glyphosate and water or triclopyr and water to the cut stump, being careful to cover the entire surface (Tennessee Exotic Pest Plants Council 1996). Effectiveness of the herbicide is increased if holes are cut in the top of the freshly felled stump, to hold the herbicide in for better absorption by plant (New Zealand Weeds Web Site 1999).

Basal Bark Method: Apply a mixture of 25% triclopyr and 75% horticultural oil to the basal parts of the shrub to a height of 30-38 cm (12-15 in) from the ground. Thorough wetting is necessary for good control; spray until run-off is noticeable at the ground line. Like the cut stump application, this method may be effective throughout the year, if *Ligustrum* spp. responds similarly to *Rhamnus* spp. (Reinartz 1997). In New Zealand, researchers have killed standing *Ligustrum* trees by drilling downward-sloping 20 mm wide holes 5 cm into the trunk at no greater than 5 cm spacing around the trunk, and filling the holes with a stump paint-herbicide mix (New Zealand Weeds Web Site 1999).

Prescribed Burning

Faulkner et al. (1989) reported that in experimental trials of prescribed burning, there was no significant difference in the abundance of *L. sinense* in burned vs. unburned plots*. Ligustrum* litter has a low flammability and fires did not carry well in these treatments.

The Nature Conservancy land managers in Alabama reported that burning top-kills *L. vulgare* and *L. sinense* and eliminates them over time, and that burning is effective at controlling *L. sinense* if done annually with low fuel moisture and high Keetch-Byram Drought Index (Randall and Meyers-Rice. unpublished).

EXAMPLES OF *LIGUSTRUM* SPP. CONTROL ON TNC PRESERVES

Ligustrum spp. have been reported as problems weeds on TNC preserves in Alabama, Arkansas, Louisiana, Georgia, Florida, Mississippi, Tennessee, North Carolina, and in Ohio.

In Alabama and in Florida, Carlen Emanuel and Greg Seamon, respectively, reported that annual burning was effective in controlling *L. sinense*. Furthermore, cutting is also effective if done when conditions are dry. George Ramseur Jr. in Mississippi found that a combination of pulling and burning provided good control of *L. sinense*.

Richard Martin reports that *L. sinense* is one of the worst weeds on Louisiana preserves, and has found that the application of Garlon 4 (triclopyr) has produced excellent control results, but RoundUp (glyphosate) did not provide good results. In North Carolina, however, Robert Merriam found that RoundUp was useful in controlling large infested areas of *L. sinense*. Additionally, cutting was very effective if coupled with the use of Arsenal (imazapyr) on cut stumps. Rates of herbicide application should follow those recommended by the manufacturer. Rates that have been applied successfully for control of *Ligustrum* are described above.

In Arkansas, Scott Simon reports that burning only top-kills *L. vulgare* and *L. sinense*, but will eventually eliminate the plants over time if burns are repeated. Burning is not effective however, in moist bottomland areas.

L. vulgare was successfully controlled in central Ohio preserves. Ross Lebold reported that the cut-stump method, using RoundUp (glyphosate) was effective, and that repeated cutting also seemed effective. In Tennessee, *L. vulgare* was partially controlled by cutting, and Gabby Call reports that the use of goats to control privet works well. The goats however, must able to reach and destroy adult privet plants.

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MONITORING

In natural areas management, monitoring programs will likely follow changes in abundance of *Ligustrum* spp. AND changes in abundance of desirable native species or changes in community attributes that are the targets of management. Such programs should have explicit objectives that can be measured and that are meaningful from both a biological and management standpoint. These objectives may vary depending on the abundance of *Ligustrum* spp. and other invasive plants. For instance, the objective of managing a forest with 40% cover of *Ligustrum* spp. may be to reduce *Ligustrum* cover to 20%. On the other hand, on a site with 10% an appropriate management objective might be to prevent an increase of more than 10% of total cover (20% total). In addition, increasing regeneration of native species may be an important objective. Monitoring the status of other conservation targets such as invertebrates dependent on specific nectar sources or plant species that are conservation targets may be more important than tracking invasive plant species abundance. In general, the objectives of monitoring should track those of management.

In terms of effort (number of plots established and monitored), transects or long linear plots are more effective in providing the statistical power to necessary to detect changes than square, broadly rectangular, circular or other regularly shaped quadrats. Analyses of plant species composition and abundance can be simplified by (1) collecting data on abundance of dominant species; (2) collecting data on all species and pooling data on less abundant species; and (3) pooling data on species by placing them in guilds (e.g. invasive grasses, invasive legumes, native grasses, etc.).

While generally a research technique, measuring change, or lack thereof, in control (unmanaged) areas can be an effective way of assuring that changes observed in treated areas actually result from the treatmentand not from other factors such as fire, rainfall, etc. In forest communities that are in early successional stages or recently disturbed, declines in abundance of the *Ligustrum* spp. may occur with time without management.

RESEARCH

Additional research is needed on more efficient control methods, especially where cutting is used. Standard tools such as weed whackers, brush hogs, and other equipment are not designed for cutting this species or for use in the kinds of habitat which *Ligustrum* species often invade.

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