



VEGETATION MANAGEMENT GUIDELINE

Exotic Buckthorns: Common, Glossy, Dahurian, Japanese, and Chinese Buckthorn (*Rhamnus cathartica* L., *Frangula alnus* Mill. syn. *R. frangula* L., *R. davurica* Pall., *R. japonica* Maxim., and *R. utilis* Decne.)

SPECIES CHARACTER

DESCRIPTION

For the purposes of this guideline the five species in the *Rhamnus* and *Frangula* genera covered in this guideline will be referred to as buckthorns. All of these species are deciduous shrubs or small trees that grow 3 to 8 meters (10-26 feet) tall, have simple leaves, greenish-white or yellowish flowers that bloom between May and July, and fleshy drupes that are black at maturity with 2 to 4 seeds.

Common Buckthorn (*Rhamnus cathartica*) twigs are terminated with a sharp spine. Leaves are nearly opposite to opposite, broadly elliptic, 3-7 cm long (1-3 inches), rounded to pointed at the tip, and minutely toothed with 2 or 4 pairs of lateral veins. The upper leaf surface is glabrous and lower surface slightly hairy. Leaves stay green late into fall. Seeds are grooved.

Dahurian Buckthorn (*Rhamnus davurica*) twigs are terminated with a sharp spine. Leaves, on average, are longer than 7.5 cm (3 inches), are more ovate and tapering at the base than common buckthorn, and less abruptly short-acuminate at the tip, with 4 or 5 pairs of lateral veins. The upper surface of the leaves is shinier than that of common buckthorn, and leaves are a little yellower and glabrous. Leaves turn brown in fall.

Glossy Buckthorn (*Frangula alnus*) has no spine on the end of its hairy twigs. Leaves are alternately arranged, oblong, 5-8 cm long (2-3 inches) and not toothed. The upper leaf surface is shiny, whereas, the bottom leaf surface is slightly hairy. Flower stalks are hairless or nearly so. Fruit is red when young and turns black as it matures, and seeds are ungrooved. The buds are long, with no bud scales. Leaves stay green late into fall.

Chinese buckthorn (*Rhamnus utilis*) leaves are broadest above the middle and routinely have 5 to 8 pairs of lateral veins.

Japanese buckthorn (*Rhamnus japonica*) leaves are subopposite and broadest at or below the middle. All shrubs should be accurately identified before attempting any control measures. If identification of the species is in doubt, the plant's identity should be confirmed by a knowledgeable individual and/or by consulting appropriate manuals or keys.

SIMILAR SPECIES

Three native buckthorns are found in Illinois. Carolina buckthorn (*Frangula caroliniana* syn. *Rhamnus caroliniana*) is an uncommon native to the southern one-third of Illinois and looks similar to glossy buckthorn. However, Carolina buckthorn grows to a larger size and its leaves are finely toothed and smooth on both sides. Alder buckthorn (*Rhamnus alnifolia*) is a rare native in northern Illinois and Richland County in bogs, calcareous fens and wooded swamps. It is a small shrub less than 0.9 meter (3 feet) in height with hairless twigs, dark scales on the buds in winter, and no petals on the



flowers. Lance-leaved buckthorn (*Rhamnus lanceolata*) is a shrub up to 1.8 meters (6 feet) high that occurs rarely in calcareous fens and on river bluffs in the northern two-thirds of Illinois. It has 0.75-2.5 cm (2-6 inch) long, lance-shaped leaves that are alternately arranged on the twig, and its buds have scales in the winter.

DISTRIBUTION

All exotic buckthorns mentioned are endemics of Eurasia that were introduced to North America, initially in Canada, as ornamental shrubs, hedges, and wildlife habitat. While the most serious buckthorn infestations occur in northeastern Illinois in several biotic communities, common buckthorn is present in small infestations as far south as Jackson County and could potentially show up in any urban area. Japanese and Chinese buckthorn have only recently been found in natural areas around the Morton Arboretum in DuPage County, and Dahurian buckthorn has spread from DuPage into Kendall, Kane, and Lake counties.

HABITAT

Common buckthorn and Dahurian buckthorn inhabit woodlands and savannas. Common buckthorn apparently is more sun-tolerant than Dahurian buckthorn, as it is found in prairies and abandoned fields. Glossy buckthorn is found most frequently in wetland communities. However, glossy buckthorn invades mesic upland sites, including roadsides and old fields.

LIFE HISTORY

Buckthorns have a long growing season unaffected by shorter thermo- or photoperiods in their introduced range, leafing out earlier than native deciduous trees and shrubs and not dropping leaves until late fall. Shoots rapidly develop and grow in the early part of the season. Common buckthorn blooms May through June during leaf expansion and glossy buckthorn blooms afterward from May through July. First year shoots of glossy buckthorn can bear flowers and fruit.

Buckthorn shrubs have high rates of fecundity, producing 2-4 seeds in each of their thousands of fleshy drupes. The mildly toxic fruits are eaten and dispersed by European starlings, blackbirds, cedar waxwings, robins, blue jays, and mice, especially when other food sources are limited. Immature fruits contain anthraquinones, preventing early frugivory. The chemicals persist to a lesser degree in mature fruits and have a severe laxative effect on the digestive system of the animal, resulting in quick seed dispersal. The fruits of common buckthorn persist on the plant through the winter availing them to an extended window of bird dispersal opportunity. While the fruits of glossy buckthorn fall to the ground more quickly after ripening, they may be more prone to water dispersal because their fruits and seeds can float longer than those of common buckthorn.

Reproduction in buckthorn is completely sexual, though shrubs vigorously resprout when top-killed. Seed viability varies among and even within species. Sometimes scarification and cold stratification aid germination and seeds can persist in the seed bank for an average of 6 years. Seedlings can establish in undisturbed soils, but are most successful where the soil is disturbed or the canopy is removed. Densities can be very great near fruiting shrubs. One study of glossy buckthorn showed an average of 540 seedlings in one square meter. Seedlings of

common buckthorn germinate and grow under partial light but do so more vigorously as light increases, while glossy buckthorn establishes in full light. Common buckthorn continues to show greater shade tolerance as it matures, retaining its lower leaves under its own dense shade while those of glossy buckthorn are lost. Buckthorn tends to develop dense, even-aged thickets where its own seedling establishment is repressed by dense shade. Glossy buckthorn decreases under increasing canopy shade, but can quickly respond to light gaps by vigorously sprouting.

EFFECTS UPON AGRICULTURAL AREAS

Common buckthorn is a primary host of the soybean aphid *Aphis glycines*, a pest that uses buckthorn as a winter host and in the spring invades soybean crops. It is also an alternate host for *Puccinia coronata*, the fungus that causes oat crown rust.

EFFECTS UPON NATURAL AREAS

Due to its high fecundity and human and animal-aided dispersal, buckthorn continues to expand its introduced range in North America. Due to its rapid growth rate and propensity for forming densely shaded colonies, its invasion has become a problem in natural areas. Common buckthorn invades woodlands, savannas, and prairies. Glossy buckthorn invades fen, bog and sedge meadow communities, as well as mesic upland sites, such as prairies. Dahurian buckthorn invades woodlands and savannas, but is not as widespread as the other exotic buckthorns. Invasion impacts native plant community structure and composition directly by shading out native species and indirectly through alterations in soil nutrient cycling.

The dense shade cast by buckthorn reduces the growth and survival of herbaceous seedlings as well as the seedlings of native shrubs and trees. In forests it slows the growth of saplings, delaying the filling of canopy gaps. Due to the early leaf-out of buckthorn, even spring ephemerals are impacted. Only the most shade tolerant species are capable of surviving under buckthorn shade. This results in a shift toward greater abundances of shade tolerant species in the native plant community that extends from the immediately-impacted ground layer all the way up eventually to the canopy where composition may shift from oak to maple dominance.

In addition to its direct aboveground shading effects, buckthorn may alter belowground soil nutrient cycling. Buckthorn is associated with soils with higher nitrogen and it is not known whether this is because it initially establishes better in such soils or if it engineers them through litter deposition. Buckthorn litter has a low carbon to nitrogen ratio relative to native leaf litter. This makes it highly palatable to exotic earthworms, which have also been found in great abundances in association with buckthorn. Exotic earthworms are known to change soil characteristics by increasing the carbon, nitrogen, pH, and moisture. Their activity modifies the soil microbial community and also greatly reduces soil mycorrhizae. In doing so, they produce soil conditions that are more like those found in Europe and could conceivably give European invaders an advantage over native species. This should be taken into consideration when buckthorn is removed. While it may be successfully killed, it could leave behind a soil legacy that is suitable for reinvasion or invasion by other exotic species.

Buckthorn can also impact animal populations. The mildly toxic fruits of buckthorn are eaten by several native animal species as well as by the European starling. The shrubs also provide branch structure suitable for nest construction and since they leaf out early, may be

preferentially chosen as nesting sites. In a study at the Morton Arboretum, it was found that nests constructed in buckthorn were more susceptible to predation than those built in native thorny shrubs that would offer greater protection.

CURRENT STATUS

Exotic buckthorns have been sold as ornamentals by several nurseries, and are used as hedges in many urban areas. The Illinois Exotic Weed Act (525 ILCS 10) prohibits the purchase, sale, and distribution of all of the above listed exotic buckthorn species.

CONTROL RECOMMENDATIONS

RECOMMENDED PRACTICES IN NATURAL COMMUNITIES OF HIGH QUALITY

Due to the avian mode of seed dispersal, persistence of viable seeds in the seed bank, and incredible ability to re-sprout after a top kill, buckthorn is difficult to control and will require repeated treatments regardless of what management practices or combinations of practices are selected. When resources are limited, management efforts should first focus on removal of the fruit-bearing shrubs. Control efforts must balance improvement of the biotic community with damage caused by the management. It is always best to take the least damaging approach that will affect the desired control of an exotic. The following are effective control measures for exotic buckthorns.

Prescribed burning

In fire-adapted communities, prescribed burning will kill seeds and seedlings and top kill mature plants. In order to reduce the vigor of re-sprouts, the best time to conduct burns is in the spring just after buckthorns' early leaf-out but while the carbohydrate resources are still low. Care should be taken not to burn later in the season when carbohydrate resources are greater because it may result in increased stem densities. An additional challenge for effective burn control is that buckthorn tends to shade out understory vegetation, reducing the fuel load necessary for moving the fire. This can be especially problematic when burning repeatedly for many years as would be necessary to control re-sprouts. Re-sprouts can be spot treated with foliar applications of herbicide. Fire should not be used to control these species if the community will be affected adversely (e.g. some bog communities).

Alterations to hydrology

In wetlands, where the water table has been artificially lowered, restoration of water levels often will kill glossy buckthorn. Care should be taken not to flood sensitive communities by raising water levels higher than occurred historically.

Mechanical control

Seedlings can be pulled by hand and mature shrubs with a base diameter up to 7 cm (3 inches) can be removed with weed wrenches. Larger individuals must be cut and the remaining stump and roots removed from the soil. This process creates significant soil disturbance which may exacerbate weed problems. If the stump is left intact and untreated with herbicide, it will

vigorously re-sprout.

Mechanical/Chemical control

In upland areas, girdled stems and cut stumps can be treated with glyphosate (trade name Roundup, Rodeo, Touchdown, Accord) to inhibit resprouting. Glyphosate is a non-specific post-emergent systemic herbicide that kills all photosynthetically active vegetation, has no soil residual activity, but may not be used over standing water (with the exception of Rodeo). The label indicates that glyphosate application is most effective during periods of active growth and leaf expansion and least effective following a frost. The Roundup label recommends a rate of 25.0-50.0% active ingredient solution for cut-stump treatments, a 25.0% active ingredient solution has proven effective. A Wisconsin study found that winter cutting and stump application of a 25.0% concentration of Roundup effectively killed glossy buckthorn. Autumn has also been cited as a good time to treat buckthorn, because 1) buckthorns retain green leaves late into the fall, making it easy to find all plants and 2) most native vegetation is dormant, minimizing the potential spray drift to non-target plants. Caution must still be taken where the target plant's roots may be grafted to the roots of desirable woody plants because the systemic herbicide can damage non-target individuals.

To be effective, glyphosate must be applied immediately after cutting. Consult appropriate herbicide label(s) for specific application directions. These chemicals can be applied either by spraying individual cut stumps with a low pressure hand sprayer or else by wiping the herbicide on each cut stump, ensuring coverage over the exposed cambium with a sponge applicator (sponge-type paint applicators can be used), but not overapplying to the point that herbicide drips off. In wetland areas, a 25.0% active ingredient solution of Rodeo can be used for treatment of girdled or cut stems.

Stem injection with an EZ-Ject lance or similar device is effective and less labor intensive than cut surface treatments. These devices work by pushing a 22-caliber capsule filled with a dry formulation of glyphosate into the vascular system of woody plants using a round. It is most effective on stems larger than 1.5 cm (5/8 inch) in diameter. For best results, every stem larger than 1.5 cm should be treated on each plant. Although initial startup cost (purchase of lance and capsules) is about 50% more than for cut stump treatments, there are advantages. Use of the injector lance is far less strenuous for the operator, exposure of the operator and nontarget species to herbicide is reduced, it can be used under a broad range of field conditions, it is approved for use in wetland situations, and it is 43% faster than cut surface treatments.

With all herbicides, care should be taken to avoid herbicide contact with nontarget plants. Native nontarget plants will be important in recolonizing the site after buckthorn is eliminated. By law, herbicides only may be applied according to label directions and by licensed herbicide applicators or operators when working on public properties.

RECOMMENDED PRACTICES ON BUFFER AND SEVERELY DISTURBED SITES

Same as given above for high-quality areas, with the following additions.

In addition to the girdled or cut stem glyphosate treatments recommended above, isopropylamine salt of imazapyr (trade name Stalker, Arsenal, Habitat) may be used. Stalker and Habitat should be applied as a 2.0% active ingredient solution; Arsenal as a 2.5% active

ingredient solution. Formulations of picloram plus 2,4-D trade name (Tordon RTU, Tordon 101, Pathway) can be applied as 25.0% active ingredient solutions to inhibit resprouting. A 2004 study in Illinois found that isopropylamine salt of imazapyr and picloram plus 2,4-D were no more effective than a 50.0% active ingredient solution of Roundup Pro. Since these herbicides are more persistent, they are not recommended for use in high quality natural areas. Unlike glyphosate, picloram remains phytotoxic for a year or more and is known to leach through soil into groundwater and should not be applied where soils are permeable, the water table is shallow, where in-field ditches, canals, or underground drainage tiles occur, or to frozen or snow-covered ground. Stalker can be used in much the same way and is not as much of a groundwater hazard as Tordon, but has been known to cause severe damage to non-target species. Stalker can be applied anytime during the year except during heavy spring sapflow. If desired, it can be diluted with water rather than oil if applied when temperatures are above freezing.

Buckthorn can be cut or girdled and treated with glyphosate as described above. Any resprouts should be cut and stump-treated again, or else hand sprayed with a 0.6% active ingredient solution of glyphosate herbicide. Care should be taken to use the appropriate formulation in wetland situations and to avoid herbicide contact with non-target plants. All of the herbicides listed are systemic and capable of translocating to non-target woody plants through grafted roots. As with most exotic plant control projects, follow-up treatments may be needed.

FAILED OR INEFFECTIVE PRACTICES

No effective biological controls that are feasible in natural areas are known. Late-season or one-time burning without follow-up treatments will result in increased buckthorn cover. Cutting or girdling stems without application of herbicide results in resprouting. Wedge direct injection was found to be an ineffective herbicide delivery when the stems are not sufficiently large. Additionally, the thin bark allows leakage from the injection site. Basal bark application was found to allow significantly more resprouting than application to a cut or girdled stem. Brushmaster (formulation of isooctyl ester of 2,4-dichlorophenoxyacetic acid, 2-ethylhexyl ester of (+)-R-2-propionic acid, and dicamba) and Garlon 4 (triclopyr) were less effective at reducing re-sprout after girdling or cutting than the other available herbicides described above.

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Glossy buckthorn



Common buckthorn