European Buckthorn Best Management Practices

A manual for managers and stewards of natural areas

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European Buckthorn Best Management Practices – a manual for managers and stewards of natural areas

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Inception and Purpose

This manual was created for land managers, forest stewardship groups and anyone interested in control of European buckthorn in natural areas. Its aim is to: 1) assist with recognition of buckthorn and its associated environmental impacts, 2) enable adoption of appropriate control techniques at various states of buckthorn infestation and 3) maximize the effectiveness of buckthorn control throughout the growing season.

This manual has greatly benefitted from knowledge accumulated since control of European buckthorn began at the Naturalist Services Branch of the City of Winnipeg in 1998. Many of the practices presented in this manual have been implemented in natural areas in the City of Winnipeg with a major portion of work and research concentrated in Assiniboine Park, a high density buckthorn area. Novel control techniques that have been proven to be highly effective on buckthorn are included here as exciting new developments in integrated pest management.

European buckthorn leaf in the fall

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Background

Biological invasions of non-native species are one of the most serious threats to natural ecosystems. European buckthorn (*Rhamnus cathartica* L.) is an invasive-exotic species native to Eurasia that was first introduced by European settlers into North America in the 1800s for urban landscaping and for parks. European buckthorn is a member of the genus *Rhamnus* of which there are approximately 100 other species globally. Although buckthorn only grows in small isolated clusters within its native range, buckthorn has come to dominate the mid-level canopies amongst many disturbed urban forests in North America. The legacy of buckthorn continues to persist throughout many of these habitats owing to its high fecundity and prolific growth rate. Its success outside of cultivation is accelerated by the absence of natural controls and further modification of the environment by other invasive organisms. In eastern North America, buckthorn thrives in oak forests, upland prairie, canopy openings, fencerows, roadsides, ravines, riverbanks, early successional forests, forest edges and floodplain forests.

A buckthorn thicket at the center of Assiniboine Park, Winnipeg, Manitoba

Ecological Impacts

Although individual buckthorn plants are generally short-lived in Manitoba, with a maximum recorded age of 56 years, rapid reproduction and growth rates can quickly turn a few plants into an infestation. Buckthorn is able to displace native plant species through its tolerance of low-light conditions and its longer growing season. Closed-canopied buckthorn forests can reduce native plant recruitment by up to 90%. Consequently, the original native plant cover decreases as the environment shifts to favour more shade-tolerant species.

A small European buckthorn branch with thorns

The nutrient cycling dynamics of a forest is altered with the invasion of buckthorn. The high nitrogen content of buckthorn leaf litter accelerates decomposition which, in turn, creates bare ground that encourages buckthorn seedling establishment. Several sources have alluded to the alleged allelopathy of the plant though recent empirical studies suggest that this notion may have been overstated. Rather, a lack of plant diversity likely results from intense shading and deteriorated ecosystem functioning.

Impact in Manitoba

European buckthorn is included in the schedule of noxious weeds under the Manitoba Noxious Weeds Act. While the invasive-exotic poses problems in urban environments (natural areas, recreation and urban forestry), it also represents a significant risk to rural agricultural lands. Buckthorn is an alternate host to oat crown rust (*Puccinia coronata*), a pathogen affecting oat seed yield and quality, and a host for the soybean aphid (*Aphis glycines*).

Oat crown rust on European buckthorn

Identification of European Buckthorn

GROWING SEASON

The extended growing season, from early-spring until late-fall, distinguishes this exotic from the surrounding native vegetation as evidenced by green foliage which do not change colour in the fall. On the Canadian Prairies, buckthorn begins to leaf-out in mid-May and is able to retain its leaves until as late as early-November.

HEIGHT

It is essential to correctly identify European buckthorn since early detection and rapid response are critical in reducing costs of control. In Manitoba, European buckthorn is a large shrub – small tree that usually grows to 4-8 m in height at maturity, but can reach 10 m tall. Individual stem diameters may reach as large as 18 cm in girth. Single to multi-stemmed individuals are commonly observed throughout infested forests.

BARK

Distinctive horizontal, light coloured pores (known as lenticels) are prominent on young bark. The outer bark of buckthorn begins to peel away as plants mature. When the bark is cut or nicked, a bright, orange-coloured inner bark is revealed.

Unlike alder-leaved buckthorn (*Rhamnus alnifolia*) or glossy buckthorn (*Frangula alnus*), the lateral branches of European buckthorn often terminate in a thorn. Thorns are usually more prominent on young twigs of European buckthorn.

Orange inner bark of European buckthorn

Identification continued…

LEAVES

The leaves of European buckthorn are sub-opposite (neither alternate nor completely opposite); occurring in pairs slightly offset from one another. To complicate matters, variation in leaf morphology can hinder correct identification of the plant (see comparison chart). Leaves are elliptic to ovate, rounded to a point at the tip with small serrations along their margins. The leaves are generally 3-6 cm long, however, young or epicormic (stress) shoots often form larger leaves than those of mature trees. The upper leaf surface is smooth and the lower surface of the leaf slightly hairy. Two to four pairs of lateral veins on leaves originate at the mid rib (mid vein) and curve towards the apex or tip of the leaf.

Bark of mature European buckthorn showing lenticels

FLOWERS

Clusters of green to yellow, short-stalked flowers bloom from May into June and result in black fruit (drupes). Many of the berries persist on the plants into winter but remain relatively untouched by wildlife.

Buckthorn berries growing on branchlets

BERRIES

Buckthorn is dioecious with male and female reproductive organs on separate plants. Female plants allocate a large portion of their resources in late-summer towards berry production.

SEEDS

A vast seedbed is created in a relatively short timespan. The seeds are produced in late-summer on female trees of at least 5 years of age. Annually, one plant can produce thousands of berries, each containing 2-4 seeds. Openings in the canopy or soil disturbance stimulate the seeds to germinate.

It is not uncommon to find approximately 15 buckthorn seeds per m^2 under mature stands as many berries fall to the forest floor. Once in the ground, the seeds can remain viable for up to 6 years.

Leaves of European buckthorn in fall

Identifying features of buckthorn and other similar looking species in the Canadian Prairies

Features	European buckthorn * (*Rhamnus cathartica*)	Alder-leaved buckthorn (*Rhamnus alnifolia*)	Glossy/alder buckthorn * (*Frangula alnus*)	Choke cherry (*Prunus virginiana*)	Cotoneaster * (*Cotoneaster* spp.)	Red-osier dogwood (*Cornus stolonifera*)
Photo						
Leaf-grouping	Simple, sub-opposite	Simple, alternate	Simple, alternate	Simple, alternate	Simple, alternate	Simple, opposite
Leaf shape	Ovate to egg-shaped 3-6 cm long	Lance to egg-shaped 3-10 cm long, stipules present at leaf base	Oblong to elliptic 5-8 cm long with smooth margins	Elliptic to ovate 2-10 cm long, usually wider at top half of the leaf	Ovate to lanceolate usually 3-5 cm long with prominent tip	Ovate to lanceolate usually 2-8 cm long with smooth margins
Leaf veins	2-4 lateral veins curving towards leaf tip, dark and glossy above	6-8 prominent veins curving towards tip	6-9 veins, curving slightly	Veins almost parallel curving slightly at leaf margins	Veins variable. Leaves shiny above, woolly underneath	5-7 veins parallel curving towards leaf tip
Fruit	Purple-black berries seemingly clustered but borne singly from woody twig	Red/blue/black berries clustered in the axils of lower leaves, poisonous	Berries red becoming black	Shiny red/purple/black cherry clusters extending from a green stalk (raceme)	Pink, red, orange or black berry clusters	White berry clusters
Bark	Orange inner bark, smooth when young, bark peeling with age, horizontal pores	Stems have fine grey hairs becoming grey-brown with age	Orange inner bark, light-gray with yellowish pores	Reddish to grey brown with raised pores, does not peel	Often smooth brown	Young stems red but may turn greenish with age
Growth & Habitat	Usually 4-6 m tall, oak forest and riparian to upland areas	< 1 m tall, streams & shady woods across boreal forest (native to Canada)	Usually 4-6 m tall, wetlands and moist soils as well as upland habitat; commonly together with alders	1-6 m tall, woodlands and dry and exposed sites	Usually < 5 m tall, woodlands and open spaces, invasive ornamental	Usually 1-3 m tall, woodlands, clearings and riverbanks
Look-alikes	All other species in the table	Other buckthorns	Other buckthorns & choke cherry	Other buckthorns; esp. glossy buckthorn	European buckthorn	European buckthorn

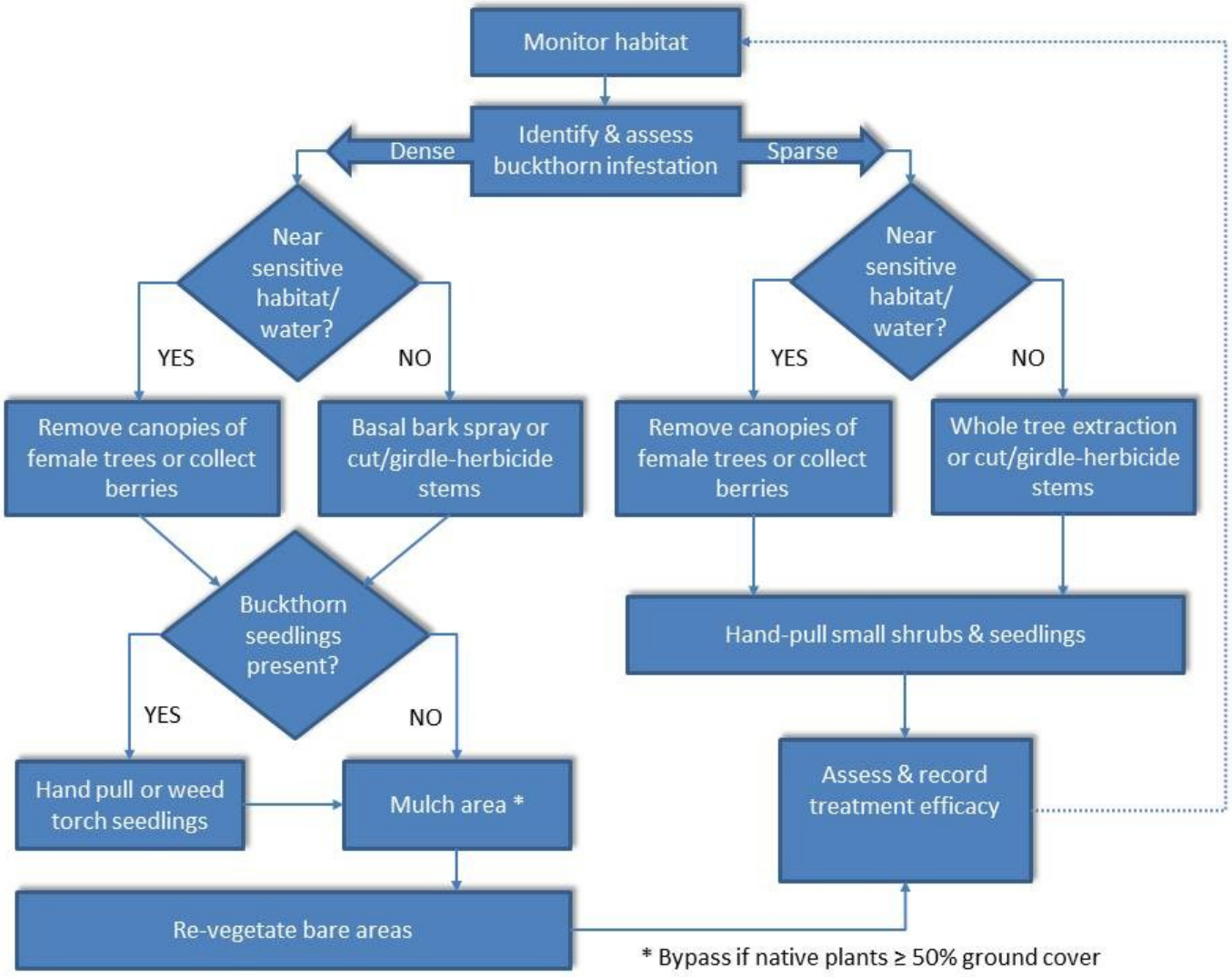
Photo credits (from left to right): P. Mutch, G. Fewless, RestoringTheLandscape.com, R. Au x2, K. Tuchscherer

* Plant species is invasive/non-native to North America

Integrated Pest Management

Controlling European buckthorn is a long-term iterative process. Monitoring and control of buckthorn has been conducted since 1998 at the Naturalist Services Branch of the City of Winnipeg. The techniques outlined in this manual combine conventional control procedures with some newer methods that have been researched at the branch.

Control measures described herein include mechanical removal: whole-tree extraction, hand-pulling, cutting and girdling (removal of bark around the circumference of trunk), chemical herbicides: glyphosate and triclopyr, a biological herbicide: *Chondrostereum purpureum*, a natural herbicide: acetic acid and supplementary cultural techniques: re-vegetation, mulching and torching. The number of available personnel and the season will also dictate which methods are best practiced. Below is a summary flowchart describing management recommendations for different levels of buckthorn infestation.



Flowchart of conditions required to reach each management recommendation for European buckthorn in this manual

Mechanical Methods

HAND PULLING

Buckthorn thickets often have very little vegetation in the understory as a result of intense shading. When a canopy gap is created, profuse buckthorn germination follows as a result of numerous dormant seeds beneath the parent plant. Buckthorn seedlings abound in open to low-density stands and out-compete much of the native vegetation.

COLLECTING BERRIES

Depending on the height of the tree, the berries are usually collected after the tree is felled. However, this does not have to be done if the berries have not yet ripened. Care should be taken when collecting berries which have ripened as they readily drop when disturbed.

Berry clusters of European buckthorn

Hand pulling is very time consuming and should only be attempted in small, manageable patches. For pure stands of seedlings growing in harder soils, a grub hoe may help break-up the soil to remove the plants. Seedlings are also easier to pull when the ground is wet, especially in clay soils. Hand pulling is limited to seedlings or smaller plants that are less than 1 cm in diameter since plants larger than this form more developed root systems.

Epicormic shoots or suckers emerging underground from an old stump remain connected and cannot be hand pulled; these must be dug-out with the stump. If there are too many seedlings for hand pulling to be practical, other options should be considered. Seedlings should be bagged or disposed of in a manner that does not facilitate colonization at new sites.

Devices for berry collecting, such as a berry scoop, can help prevent the accumulation of seeds under parent trees. This has allowed an un-experienced berry collector to collect approximately 3.6 kg of buckthorn berries within half an hour. The berry scoop is particularly useful for collecting berries growing on terminal branchlets, however, may not be feasible for berry clusters at the internodes of thicker branches as the prongs of the collector may bend. The berries should be double bagged and thrown in the trash.

MECHANICAL EXTRACTION

Removing only a portion of the plant will inevitably result in re-sprouting. Under this strategy, repeated cutting year-after-year is required to completely drain reserves from the root system. Alternatively, mechanical extraction or removal of the entire tree, although initially more time consuming, results in complete control.

Mechanical Methods continued…

A multi-stemmed buckthorn tree

Extraction of the entire plant can be accomplished using an Extractigator™ or Weed Wrench™. These tools are designed to clamp around the base of a stem that is less than 7 cm in diameter to leverage the plant out of the ground. Stems that are larger in girth should be dug-out 30 cm away from the stem. Several people can work at digging-out the root ball with shovels followed by cutting-off any horizontal roots. Smaller buckthorn roots of less than 2 cm left in the ground do not re-sprout or sucker.

The drawback to whole-tree removal is that the soil and any plants nearby will also be disturbed when the root ball is removed. This provides ideal conditions for buckthorn seedlings to germinate. Where possible, desirable plants uprooted or displaced from buckthorn extraction should be carefully placed back to reduce disturbance.

Depending on resources, whole-tree extraction may not be practical on a landscape scale due to the amount of labour involved. In these cases, solely focusing on female trees can be an initial stage to curtail further spread. Cutting down female trees just before their fruit ripen will temporarily reduce buckthorn dispersal. It is also important to leave the root systems of buckthorn intact adjacent to water to prevent erosion or bank collapse. When possible, female trees containing berries should not be felled into water as their berries are able to float and travel downstream.

Annual mowing may be suitable on pastures and unobstructed grasslands for buckthorn seedlings to deplete their reserves. In most other areas, it is difficult to maneuver the mower through the forest. Instead, use of a cord-trimmer or brush cutter is possible if the seedlings are small.

COMMUNITY VOLUNTEER GROUPS

Volunteers are a great way to educate the public about invasive species and bring together passionate people to remediate a natural area. Volunteers can include local stewardship groups, youth organizations and members of the community. Once trained in identification, a large group can decimate a buckthorn stand within hours.

Extraction of a buckthorn stump using a leverage-type tool

Chemical Methods

Chemical methods are required when removal of the entire tree is not feasible due to a large trunk size or time limitations. Applications applied in the early-growing season are more likely to trigger a stress response resulting in heavy suckering. Therefore, chemical herbicides are best applied when buckthorn is beginning to enter dormancy in the fall.

It is important to note that even systemic chemical herbicides sometimes require follow -up applications as the initial application may not kill off the plant completely. Cutting, girdling or even burning a stem without any treatment of the remaining portion of the plant will inevitably result in profuse epicormic growth or water sprouts.

Epicormic shoots arising from an un-treated stem

Please note that all herbicides should be applied according to the product label. Herbicides cannot be used in certain habitats such as near waterways. On public lands, personnel must hold a valid pesticide applicators license and wear protective equipment. Mentions of a specific product in this document does not imply endorsement.

APPLICATION TO CUT STUMPS

Cutting buckthorn followed by application of glyphosate to the fresh stump is one of the most common techniques to control the plant. Herbicide applications minimize the chances of re-sprouting that would inevitably occur without chemical treatment.

Glyphosate applications must be made to freshly cut stumps before they dry out; best within 5 minutes of the initial cut for transport of glyphosate into the root system. If no herbicide can be applied immediately onto the stems i.e. winter, then trees should be marked and herbicide applied after making a fresh cut in the spring.

Successful application of glyphosate

Chemical Methods continued…

Follow-up applications of the herbicide are usually required for at least some of the treated stems especially, if not initially applied in fall. Fall is the optimal period to paint or spray herbicide on buckthorn stems since this species enters dormancy later than most desirable native species. This downward transportation of nutrients is an ideal time for crown removal and the treatment of residual stumps with herbicide.

In a study that included nearly 400 buckthorn trees, glyphosate applied to cut stems in late-fall (October-November) resulted in 88% mortality. Application during other periods resulted in lower absorption of the herbicide. Efficacy also dropped considerably when glyphosate was applied to girdled stems. Although glyphosate has been identified as one of the best herbicides for buckthorn, caution is advised when applying this broad spectrum herbicide since it will kill non-target plants if contact is made. To be effective, a 10-12.5% concentration of glyphosate should be applied to the freshly cut surface. The herbicide should be applied with either a low-pressure hand sprayer or paintbrush for maximum effectiveness.

Glyphosate applied to a cut buckthorn in the fall

Frilling, or the injection of herbicide into a plant, was shown to be ineffective for buckthorn. Injectors such as the EZ-Ject lance, which injects stems with a dry formulation of glyphosate, was not shown to distribute herbicide effectively. Consequently, buckthorn plants would often re-sprout without follow-up applications over successive years.

Sprouts on buckthorn stumps after frilling

BASAL BARK APPLICATION

Basal bark applications are appropriate for dense stands of buckthorn growing on large tracts of land. However, applications typically require oil as a dilutant and are more effective for younger smooth-barked trees. A handheld sprayer or herbicide wand with a 12% concentration of triclopyr (or 4:1 oil to Garlon 4) should be applied around the base of stems (lower 15 cm swath). The advantage of the technique is that it can be applied almost year -round (between -15°C to 25°C) as long as the base of the tree is visible. Moreover, a triclopyr-based herbicide can treat upwards of two-times more stems compared to glyphosate.

Biological Control

Chontrol Peat Paste (CPP) is a biological herbicide containing a naturally occurring fungal plant pathogen *Chondrostereum purpureum* (strain PFC2139). This product is intended for the reduction of stem density of broad-leaved plants following brush cutting. This herbicide has been used to control hardwoods such as alders, birches, maples, poplars and willows and does not appear to translocate underground to other plants.

Once applied to a cut area, the fungus colonizes and begins to establish itself within the plant. The effects of the bio-herbicide are not immediate but if successful, the fungus will produce fruiting bodies on the stem over the next summer. This bio-herbicide is a viable alternative to chemical herbicides, especially in sensitive habitats where chemicals cannot be applied or during seasons where they are not as effective.

Despite the effectiveness of this herbicide, European buckthorn is not currently listed on the CPP product label and cannot be applied without first obtaining approval from the Pest Management Regulatory Agency, Health Canada. Nature Manitoba in partnership with the City of Winnipeg is currently working with the manufacturer of the bio-herbicide to obtain regulatory approval.

For up to date information on whether CPP has been approved for use on European buckthorn, please visit the Pest Management Regulatory Agency (www.pmra-arla.gc.ca) or the manufacturer website (www.mycologic.ca).

APPLICATION TO GIRDLED STEMS

The efficacy of CPP, like other herbicides, is heavily dependent upon environmental conditions. Research trials have indicated that the proper timing of herbicide application is crucial for success with weather being a limiting factor for fungal establishment. Inoculation of stems requires moist, high humidity conditions conducive for fungal growth. Chontrol Peat Paste applied in June to girdled stems showed no re-growth the following spring in 70-90% of treated stems. However, CPP applied to cut stumps showed high re-growth compared to girdled trees. This pronounced difference between these treatment methods (girdled to cut) could be related to the initial available colonisable area for the fungus.

Girdling a buckthorn stem

Freshly applied Chontrol Peat Paste to buckthorn

Biological Control continued…

Successful control using Chontrol Peat Paste

Fruiting bodies observed 1-year after application of Chontrol Peat Paste

Girdling should take place at 30 cm or lower along the stem but also needs to be below the lowest living branch. Girdling consists of removing all the bark and cambium in a 2-3 cm wide strip around the entire circumference. This severs the conductive tissue between the root system and canopy. A handheld girdling tool such as a Barkblaster™ is useful for medium to larger diameter stems, i.e. ≥ 10 cm, but is difficult to use on small-sized stems, i.e. ≤ 2 cm. Either a sharp knife or scraping tool may be used as alternatives.

Multi-stemmed trees containing 2 or more stems very close together cannot be girdled effectively since the other stem obstructs the process. In these cases, if girdling is desired, the other stems must first be cut. After girdling, a thin layer of CPP should be painted on stems within 30 minutes of cutting. The tree may be left standing to preserve forest structure, to support wildlife habitat, or to facilitate gradual changes.

"Natural" Based Control

There is no consensus as to whether concentrated vinegar (7% acetic acid), a "natural" herbicide, is an effective solution for treating buckthorn. Our trials using a spot application of concentrated vinegar showed a 75% regrowth rate the following summer. These unsatisfactory results can be explained by the inability of acidic acid to enter the root system of the plant. Concentrated vinegar could, however, be more effective on buckthorn seedlings with less developed root systems.

Cultural Methods

Implementation of cultural techniques often addresses the immediate problem of buckthorn while continuing to have a lasting effect within the habitat.

MULCHING

Spreading mulch over a buckthorn infested area can help prevent germination and should take place in the same year as treatment. In Winnipeg, profuse sprouting was observed several years after live buckthorn stumps were covered with plastic mulch. Therefore, buckthorn stumps should be killed or removed before being covered with either wood or plastic mulch. Installing plastic mulch over an area can, however, kill buckthorn seedlings.

It has been shown that a mulch of at least 10-12 cm thick is effective in reducing buckthorn germination. Moreover, other invasive plants were shown to decrease in a mulched plot compared to an adjacent un-mulched plot.

Mulched understory previously dominated by buckthorn

Mulched understory showing native plant regeneration

Profuse sprouting from a cut stump that was covered with plastic mulch

Cultural Methods continued…

WEED TORCHING

Weed torching is a secondary measure that is able to kill seedlings and re-sprouting buckthorn stumps. Spot treating with the weed torch should be conducted in spring shortly after leaf-out. This technique is only meant as a supplement to the other methods prescribed in this manual and usually cannot be used singly to control re-growth. Small seedlings and saplings are more susceptible to torching than mature trees as they have thinner bark and their root systems are closer to the surface. Re-sprouts from mature buckthorn trees may require torching for several years before their nutrient reserves are exhausted.

CONTROLLED BURNS

In upland areas such as oak forests that are dominated by buckthorn, burning a large swath of land through a controlled burn is effective. In addition to possessing proper authorization, controlled burning must be carried out under favourable weather conditions (with risk of spreading low) and ideally where the native ecosystem is adapted to fire. Controlled burning also requires specialized training and an adequate forest fuel load. The procedure has varying results depending on the structure/density of the stand and may pose a greater risk in urban landscapes.

ANIMAL BROWSE

White-tailed deer (*Odocoileus virginianus*) have been observed to feed almost exclusively on buckthorn in areas where deer numbers are high. Due to the almost ubiquitous browsing of young shoots, deer can naturally maintain buckthorn resulting in a low shrub layer (0.5-1.0 m). Unfortunately, these scenarios are uncommon and usually bring with them problems associated with repetitive browsing. There have also been reports of using sheep to browse European buckthorn in rural Manitoba with limited success.

Many sources presume that the berries are readily eaten by birds. However, they may only do so once preferred food sources have been depleted since many unconsumed berries are often left on trees into the early-winter.

A deer browsing on buckthorn

The results of herbivory on buckthorn

Cultural Methods continued…

RE-VEGETATING CONTROL SITES

Promoting the return of native plants to areas that have had buckthorn removed is essential to ensure that buckthorn does not regain its foothold in the area. Replacing invasive species such as buckthorn with native vegetation is vital in managing for long-term ecosystem health.

Several studies have shown that maple trees can help reduce buckthorn spread. In a germination study, Manitoba maple (*Acer negundo*) leaf extract resulted in >80% reduction in mean buckthorn seedling length. Thus, planting native maple may gradually lower buckthorn seedling recruitment once the buckthorn understory has been removed.

Habitat	Preferred native plants to replace buckthorn in Manitoba
Riparian	peachleaf willow (*Salix amygdaloides*), plains cottonwood (*Populus deltoides*), Manitoba maple (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), chokecherry (*Prunus virginiana*), red-osier dogwood (*Cornus stolonifera*), American hazelnut (*Corylus cornuta*), nannyberry (*Viburnum lentago*), high bush cranberry (*Viburnum trilobum*)
Upland	Bur oak (*Quercus macrocarpa*), American basswood (*Tilia americana*), Manitoba maple (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), American hazelnut (*Corylus cornuta*), hawthorn (*Crataegus* spp.), Saskatoon (*Amelanchier alnifolia*), prickly rose (*Rosa acicularis*), wild raspberry (*Rubus idaeus*)

Recently planted native vegetation at a restored site

Disposal of Buckthorn Debris

Ensure that buckthorn roots are dry prior to disposal to avoid the possibility of re-rooting. In a forest setting, uprooted buckthorn with soil still attached to their roots can continue growth for 2-months or more. Care must be taken when moving buckthorn as berries (especially those that have ripened) often become dislodged with the slightest disturbance.

Forestry companies regularly woodchip entire trees upon felling which can contribute to seed spread. This underscores the need to collect and double bag berries to be disposed. Trees should be cut to size and disposed of in a landfill or piled and burned following municipal by-laws.

Pendants made with European buckthorn wood

Uses for Buckthorn

Wood carvers enjoy working with buckthorn wood which possess a rich orange-to-reddish hue that is very attractive as a finished product. There has been growing interest from local carvers to exploit these unique features to produce utensils, jewellery and small sculptures out of reclaimed wood such as buckthorn.

The economic value of buckthorn has also been realized through its medicinal properties. The aged bark of glossy buckthorn is used as a laxative to treat constipation. Since both glossy and European buckthorn contain anthranoid derivatives known to cause the laxative effect, herbal usage could be expanded to include European buckthorn in the future. However, it is recommended that these products only be purchased from a local retailer. Caution should be exercised when consuming these natural health products as their effects may not be entirely understood.

Spoon carved from a single piece of European buckthorn

Monitoring

Long-term monitoring of both treatment efficacy and plant diversity is recommended for all major sites where buckthorn has been removed. In this way, remediation of problem sites can be tracked over time. Buckthorn regeneration and re-growth can be addressed with planned follow-up work. This process will also facilitate record-keeping of native plant species growing on the site and create awareness of invasive species as a threat to ecosystem functioning.

Although intense shading from both native and exotic shrubs can have detrimental effects on understory vegetation, changes to the forest ecology resulting from buckthorn infestations creates an alien environment that many native plants may not be adapted to. The cover of herbaceous species has been shown to be lower in areas that contain dense buckthorn thickets. Many studies show an increase in plant diversity after the first year of buckthorn removal as more light reaches the forest floor. Shade tolerant species become more important thereafter as canopy gaps recede and less sunlight penetrates the canopy. It is important to monitor and fill-in these openings with adapted native plants as soon as they are created to suppress buckthorn germination.

Buckthorn thicket showing little plant diversity

Understory with moonseed, Virginia creeper, trillium, ostrich fern and chokecherry 5-years after buckthorn removal

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