BEST MANAGEMENT PRACTICES

The following BMPs are for invasive species that are already present in the Adirondack region, or present in New York State and approaching, and have the highest likelihood of causing significant negative ecological, economic, or societal impacts. Additional BMPs will be developed and incorporated over time as new species arrive and/or additional information on impacts becomes available. For management advice on other species not referenced in this document please refer to other resources or contact APIPP.

Terrestrial Invasive Plants

The following general infestation size thresholds are provided to inform the specific management activities most appropriate for each individual plant species. For the purposes of the following terrestrial invasive plant BMPs, four size thresholds will be referenced:

- 1) **Early Detection Infestation** An early detection infestation is classified as being a discrete population under 0.1 acres (0.04ha).
- 2) **Small Infestation** A small infestation is classified as being a discrete population over 0.1 acres (0.04ha) but under 1 acre (0.4ha).
- 3) **Medium Infestation** A medium infestation is classified as being a discrete population over 1 acre (0.4ha) but under 2.47 acres (1ha).
- 4) Large Infestation A large infestation is classified as being a discrete population over 2.47 acres (1ha).

Note: When treating infestations larger than one acre, consider active restoration (seeding or planting) following management to facilitate the recovery of desirable, native vegetation.



Terrestrial Invasive Plant BMP's

| Common Name | Scientific Name | Page Number |
|--|---|-------------|
| Bush honeysuckles | Lonicera spp. | 13 |
| Common & glossy buckthorn | Rhamnus cathartica | 13 |
| Common reed grass | Phragmites australis | 10 |
| Garlic mustard | Alliaria petiolata | 5 |
| Giant hogweed | Heracleum mantegazzianum | 5 |
| Glossy buckthorn | Frangula alnus | 13 |
| Indian cup plant | Silphium perfoliatum | 5 |
| Japanese & common barberry | Berberis thunbergii & B. vulgaris | 13 |
| Japanese angelica tree | Aralia elata | 19 |
| Japanese honeysuckle | Lonicera japonica | 13 |
| Japanese stiltgrass | Microstegium vimineum | 3 |
| Japanese tree lilac | Syringa reticulata | 19 |
| Knapweed spp. (brown & spotted) | Centaurea stoebe & C. jacea | 5 |
| Knotweed spp. (Japanese, giant, & Bohemian) | Reynoutria japonica, R. sachalinensis, and R. x bohemica | 10 |
| Lesser celandine | Ficaria verna | 5 |
| Mile-a-minute | Persicaria perfoliata | 5 |
| Multiflora & rugosa rose | Rosa multiflora & R. rugosa | 13 |
| Norway maple | Acer platanoides | 19 |
| Oriental bittersweet | Celastrus orbiculatus | 13 |
| Porcelain berry | Ampelopsis brevipedunculata | 13 |
| Purple loosestrife | Lythrum salicaria | 5 |
| Reed canary grass | Phalaris arundinacea | 3 |
| Russian & autumn olive | Elaeagnus umbellata & E. angustifolia | 22 |
| Scotch broom | Cytisus scoparius | 13 |
| Slender false brome | Brachypodium sylvaticum | 9 |
| Swallowwort spp. (black & pale) | Cynanchum louiseae & C. rossicum | 5 |
| Sweetclover spp. (white and yellow) | Melilotus albus & M. officinalis | 5 |
| Tree-of-heaven | Ailanthus altissima | 19 |
| Wild parsnip | Pastinaca sativa | 5 |
| Wineberry | Rubus phoenicolasius | 13 |
| Winged euonymus | Euonymus alatus | 13 |
| Yellow iris | Iris pseudacorus | 10 |

GRASSES

Due to their similar biology and growth habits, most invasive grasses can be managed using comparable techniques. The following species can be managed using the general BMPs included in this section:

Grasses

Japanese stiltgrass Reed canary grass Slender false brome Microstegium vimineum Phalaris arundinacea Brachypodium sylvaticum



Japanese stiltgrass

Reed canary grass

Slender false brome

PLANT DESCRIPTIONS

JAPANESE STILTGRASS is an annual grass native to Asia. It prefers moist soil and can thrive in a variety of light conditions, including heavily shaded areas. Japanese stiltgrass readily invades forest understories, marshes, floodplains, wetlands, etc. where it forms dense carpets that displace native vegetation, interfere with forest regeneration, and alter soil chemistry. It grows one to three feet (0.3-1m) tall and has a small stem that resembles bamboo. The leaves are narrow and lance-shaped with a prominent silver strip that runs along the midrib on the upper surface. The inflorescence of Japanese stiltgrass is inconspicuous, appearing from late summer to early fall. It spreads primarily by human and wildlife dispersed seeds and infestations are often exacerbated in areas with high deer abundance.

REED CANARY GRASS is a tall, coarse, perennial grass native to parts of Europe, Asia, and North America. It commonly invades open canopy wetlands and riparian corridors but can also be found in drier sites. Reed canary grass can form dense infestations that displace native vegetation, degrade wildlife habitat, and alter wetland hydrology. Its leaves are tapered and grow up to 10 inches (25cm) long. The flowers are single and occur in dense clusters from May to August. New inflorescences range from green to purple and will transition to a light brown at maturity. The ligule of reed canary grass is transparent, distinguishing it from several native grass species. Spread occurs vegetatively via creeping rhizome and by seed; however, the establishment of seeds is assumed to be low.

SLENDER FALSE BROME is an annual bunch grass native to Eurasia. It is highly invasive in a wide range of habitats including wetlands, forests, and disturbed sites, where it often excludes native grasses and forbs. It is well adapted to a variety of light and soil conditions, allowing it to become the dominant species in the plant community. Mature plants reach 18+ inches (46cm) tall and have a distinctive drooping growth habit. The leaf blades are bright green and have fine hairs along the margins. The lower stem is also covered with fine white hairs. Roots have a prominent wintergreen aroma when crushed. It is primarily spread by human and wildlife dispersed seeds produced between June and September. Slender falsebrome infestations are often exacerbated in areas with high deer abundance.

MANAGEMENT OPTIONS

1. Digging/Pulling

Effectiveness:

Non-mechanized digging or hand pulling is an effective method for containing, suppressing, or locally eradicating early detection infestations of invasive grasses. Mechanical management should be performed prior to seed set, typically before mid-summer.

Methods:

Slowly dig or pull each plant up by the base to ensure the entire root system is removed. Root fragments that are left behind may re-sprout into new plants. Disturbed soil should be tamped down firmly after removing plants. Soil disturbance can bring seeds to the surface and create a favorable environment for germination within the control site. Plants should be removed before seed set. Refer to the plant descriptions above for phenological information.

Disposal:

Bag all plant parts and remove from site. Solarize by placing bagged plant material in the sun for at least two-weeks and then dispose of in an approved landfill.

2. Cutting/Mowing

Effectiveness:

Cutting or mowing can be effective in containing or suppressing early detection to medium sized infestations of invasive grasses. Persistent mowing/cutting will prevent seed production/dispersal but is unlikely to result in local eradication as dormant seeds in the soil are unaffected by this technique.

Methods:

Cut or mow the invasive grass at ground level manually or with motorized equipment just before its flowering period, typically by mid-summer. Follow-up mowing/cutting may be required within a growing season and must be repeated annually. Do not mow or cut plants during seed set as this will aid in seed dispersal.

Disposal:

If possible, bag all cut plant parts and remove from site. Solarize by placing bagged plant material in the sun for at least two-weeks and dispose of in an approved landfill. Mowed or mulched material can be left to decompose on site.

3. Herbicide

Effectiveness:

Herbicide treatments can be effective in containing or locally eradicating early detection to medium sized infestations and suppressing large infestations of invasive grasses. Invasive grasses can be effectively controlled by glyphosate-based herbicides.

Methods:

Apply glyphosate-based herbicide using one or more of the selective application techniques identified below. Treatments should be performed close to peak growth, but before seed production.

For herbicide treatments use any of the following application techniques:

- a) Wiper application sponge tip applicator with wick or cloth glove applicator.
- b) Foliar spray application commercial-grade spray bottle with adjustable nozzle, backpack sprayer with adjustable nozzle, boom/broadcast sprayer and/or spot sprayer.

Disposal:

Plants should remain undisturbed for at least two weeks following treatment. No disposal is required.

HERBACEOUS PLANTS AND VINES

Due to their similar biology and growth habits, many invasive herbaceous plants can be managed using comparable techniques. The following species can be managed using the general BMPs included in this section:

Herbaceous Plants and Vines

Garlic mustard Giant hogweed Indian cup plant Knapweed spp. Lesser celandine Mile-a-minute Purple loosestrife Swallow-wort spp. Sweetclover spp. Wild parsnip Alliaria petiolata Heracleum mantegazzianum Silphium perfoliatum Centaurea stoebe & C. jacea Ficaria verna Persicaria perfoliata Lythrum salicaria Cynanchum louiseae & C. rossicum Melilotus albus & M. officinalis Pastinaca sativa



Garlic mustard



Lesser celandine



Giant hogweed



Mile-a-minute



Indian cup plant



Purple loosestrife



Sweetclover spp.



Wildparsnip



Knapweed spp.



Swallow-wort spp.

PLANT DESCRIPTIONS

GARLIC MUSTARD is a European biennial herb that typically invades partially shaded forest understories and roadsides. It exudes an allelopathic compound from its root system that can suppress the growth of surrounding vegetation, negatively impact mycorrhizal fungi and reduce forest regeneration. Its seeds germinate in early spring and develop into a basal rosette of leaves during the first year. Leaves have a distinct onion/garlic aroma when crushed. Second-year flowering plants average three feet (1m) in height with white, cross-shaped flowers blooming between late April and June. Seeds mature and disperse in late July, are spread by both humans and wildlife, and may remain viable in the soil for up to seven years. Garlic mustard infestations are often exacerbated in areas with high deer abundance.

GIANT HOGWEED is a biennial or perennial herbaceous plant native to Eurasia that can exceed 15 feet (4.6m) in height. It can form dense stands and spreads quickly in disturbed areas such as abandoned fields and roadsides. The sap of giant hogweed is highly caustic – chemicals activated by sunlight may cause serious burns and blistering to exposed skin. In its first one to three years of growth, giant hogweed exists as an increasingly larger rosette. Its basal leaves are large and deeply divided, typically with three prominent lobes. Once mature, it produces a flowering stalk with several large, white umbels that can exceed two feet in diameter. Stems are characterized by coarse white hairs and purple/dark-red spots. Plants produce a large quantity of seeds that are easily dispersed by wind, water, and on equipment.

INDIAN CUP PLANT is a large perennial native to central North America that can reach eight feet (2.4m) in height. It can form dense stands that spread quickly in wetlands and along river corridors, excluding native species. Its stems are stout and uniquely square in cross section. The leaves are opposite and are joined to form a cup around the stem. The leaves are rough in texture and have finely serrated margins. Flowers are bright yellow, two to three inches (5-8cm) wide with 16-35 rays. Plants spread locally via rhizomes and can disperse longer distances via seeds carried by water and wind.

KNAPWEED SPP. are bushy, tap rooted biennials native to Europe. They can form large, monotypic stands in disturbed upland habitats and are most often associated with roadsides, railbeds, utility lines, forest edges, hiking trails, and open fields. In agricultural settings, knapweed can reduce grazing opportunities and increase soil erosion. Plants are allelopathic, producing chemicals that suppress the growth of surrounding vegetation. First year plants exist as a small basal rosette of deeply divided leaves. Second year plants grow up to three feet (1m) in height with leaves alternately arranged on the stem. Mature plants will bloom from late June to August, producing numerous flower heads at the tips of terminal or ancillary stems. Flowers are generally pinkish-purple, but in rarer instances, can be white. Each flower is surrounded by green scale-like structures called bracts. Knapweeds spread through prolific seed production. Each mature plant can release over 1000 seeds that can remain dormant in the soil for up to 10 years. New rosettes may also develop from lateral roots.

LESSER CELANDINE is a short lived herbaceous perennial native to Eurasia. It can form a dense carpet of vegetation that excludes native ephemeral plants in open woods, floodplains and wet meadows. Plants senesce early in the spring, often exposing large patches of bare soil that are prone to erosion. Plants are comprised of a basal rosette of dark green, kidney shaped leaves. It flowers early in the spring, between late March and May, producing bright yellow flowers, each with 8-12 petals. Plants spread vegetatively via small underground bulbils and tuberous roots.

MILE-A-MINUTE is an herbaceous, annual climbing vine native to Asia. Once established, vines can grow up to six inches (15cm) per day. Large mats can quickly smother native vegetation and alter the quantity of light filtering through the forest canopy. In additional to its ecological impacts, mile-a-minute can disrupt recreational opportunities with its spine-covered stems. The delicate, branched stems have alternately arranged triangular leaves. Ocreae, or circular shaped leaves, can be found surrounding the stem near its nodes. Flowers are small and inconspicuous, but give rise to attractive metallic blue berries, which begin growing in July. Mile-a-minute seeds can spread long distances via wildlife or water.

PURPLE LOOSESTRIFE is an herbaceous perennial native to Eurasia that can form large, monotypic stands that exclude native vegetation in open wetlands, drainage ditches, and along shorelines. Dense infestations can degrade waterfowl habitat, reduce furbearer populations, and negatively impact hay/forage fields. Plants average three feet (1m) in height and produce vigorous rootstock that serves as a storage organ for growth in spring and re-growth if the plant is damaged. Stems are square-shaped and produce leaves that are opposite, whorled, and lance-shaped with smooth edges. Plants produce several, vibrant magenta flower spikes between early July and September. A single mature plant can produce more than 2.5 million seeds per growing season, which are easily transported by water and human activities.

SWALLOW-WORT (BLACK & PALE) are herbaceous twining vines native to Europe that grow up to ten feet (3m). Vines typically twine and sprawl, shading out or smothering desirable vegetation. The foliage of swallow-wort is toxic to some wildlife and livestock. In forest understories, swallow-wort can impact forest regeneration. Both species have opposite, shiny leaves that are 2-4 inches (5-10cm) long. Black swallow-wort usually bears purple-black, star shaped flowers while pale swallow-wort usually bears light maroon, star shaped flowers. The flowers of black swallow-wort have petals that are about half as wide (at the base) as they are long, whereas the flowers of pale swallow-wort are much narrower at the base than their length. Both species produce long slender green seed pods around June, which bear numerous seeds that are dispersed by wind and wildlife. Seeds resemble common milkweed and are rounded and flattened with an attached tuft of silky hair.

SWEETCLOVER (WHITE AND YELLOW) are biennial invasive plants native to Europe that form large, monotypic stands in upland environments. Sweetclover prefers full sunlight and is most often associated with disturbed habitats such as roadsides, forest edges, and hiking trails. Dense infestations alter native seedling recruitment which can result in long term changes to plant communities and soil properties. First year plants do not bloom and exist as a small basal rosette of deeply divided leaves. Second year plants can reach six-feet (1.8m) in height with leaves alternately arranged on the stem. The small fragrant flowers appear in June through July and are located terminally on the branches. Flowers are creamy white or bright yellow depending on the species. Sweetclover spreads primarily by seed, which is persistent and can remain viable in the soil for up to 30 years. Plants can also sprout from root fragments.

WILD PARSNIP is a biennial or perennial herbaceous plant native to Eurasia that can grow over five feet (1.5m) tall. It can form dense stands and spread quickly in disturbed areas such as abandoned fields and roadsides. The sap of wild parsnip is highly caustic – chemicals activated by sunlight may cause serious burns and blistering to exposed skin. It exists as a low, spindly rosette of leaves in the first year while the root develops. In the second year, it flowers on a tall stalk and then dies. Its leaves are pinnately compound with saw-toothed edges. Branching stems bear umbels of small yellow flowers from mid-June to early August. It spreads primarily by seeds, which are dispersed by wind, water, and on equipment.

MANAGEMENT OPTIONS

1. Digging/Pulling

Effectiveness:

Non-mechanized digging or hand pulling is an effective method for containing, suppressing, or locally eradicating early detection infestations of invasive herbaceous plants. Mechanical control is most effective when performed before seed/fruit production.

Methods:

Dig or pull up each plant by the base to ensure the entire root system is removed. Disturbed soil should be tamped down firmly after removing plants. Soil disturbance can bring existing invasive plant seeds to the surface, creating a favorable environment for germination. Plants should be removed around peak flower, but before seed set. Refer to the plant descriptions above for phenological information.

Disposal:

Bag and remove all plant parts from site. Solarize by placing bagged plant material in the sun for at least two-weeks and then dispose of in an approved landfill. Do not compost invasive plant material.

2. Cutting/Mowing

Effectiveness:

Cutting or mowing can be effective in containing or suppressing early detection to large sized infestations of invasive herbaceous plants. Mowing or cutting must be repeated annually to reduce an infestation to desired levels as dormant seeds in the soil are unaffected by this technique.

Methods:

Cut or mow invasive herbaceous plants at ground level either manually or with motorized equipment just before their flowering period, typically by mid-summer. Follow-up mowing/cutting may be required within a growing season. Do not mow or cut plants when in seed set as this will aid in seed dispersal. In addition, do not use a weed-whacker or brush cutter to mow giant hogweed or wild parsnip. Mechanized cutting equipment can splatter the plants toxic sap leading to injury. Instead, use a sharp spade to cut the taproot or each plant approximately 6-10 inches (15-25cm) below the soil surface. If plants return, repeat the root cutting procedure.

Disposal:

If possible, bag all cut plant parts and remove from site. Solarize by placing bagged plant material in the sun for at least two-weeks and then dispose of in an approved landfill. Mowed or mulched plant material can be left to decompose on-site.

3. Herbicide

Effectiveness:

Herbicide treatments can be effective in containing or locally eradicating early detection to medium sized infestations and suppressing large infestations of invasive herbaceous plants. Invasive herbaceous plants can be effectively controlled by glyphosate, triclopyr, or imazapyr based herbicides. Glyphosate and triclopyr will not affect subsequent plant emergence; however; the use of imazapyr may inhibit regrowth for several months or years.

Methods:

Apply glyphosate, triclopyr, or imazapyr formulations using the selective application techniques identified below. Herbicide applications should be performed close to peak flower, but before seed set. The rosettes of biennial species may be treated later in the season following senescence of native species. Consult the herbicide product label for recommended dilution rates and to ensure the target species, desired application technique, and habitat type (upland vs. wetland) are listed and approved.

For herbicide treatments use any of the following application techniques:

- a) Wiper application sponge tip applicator with wick or cloth glove applicator. This technique is most often used with glyphosate-based herbicides.
- b) Foliar spray application commercial-grade spray bottle with adjustable nozzle, backpack sprayer with adjustable nozzle, boom/broadcast sprayer and/or spot sprayer. This technique can be used with most herbicide active ingredients.
- c) Stem injection application (hollow stemmed species) stem injection tool with a short, stout needle. This technique is most often used with glyphosate-based products.

Disposal:

Plants should remain undisturbed for at least two weeks following herbicide application. No disposal is required.

4. Biocontrol (NOTE: biocontrols are only used to control purple loosestrife at this time; biocontrols are available for mile-a-minute but infestations in the region are too small to warrant use in the region; biocontrols are under evaluation for swallow-wort)

Effectiveness:

Biocontrol releases of *Galerucella calmariensis* and *G. pusilla* can be effective in suppressing medium to large sized infestations of purple loosestrife. Release sites should have healthy, mature loosestrife plants and assurance from the landowner(s) that no insecticide spraying will occur. Biocontrol is most effective in areas that are not permanently flooded and have at least one acre of purple loosestrife of medium to high density.

Methods:

Beetles may be purchased from commercial suppliers or collected from historic release sites and moved to new areas. The number of beetles released per site depends on the infestation size, resources available, and seasonal timing. When releasing *Galerucella* in the spring, as few as 200 adults can be sufficient to establish a population. When collecting or releasing a summer generation, a minimum release of 2,000 insects is recommended.

Galerucella should be released as soon as they are collected or received. It is not necessary to wait for clear weather but avoid heavy rain events. Selecting periods of cool weather (morning or early evening) can increase the survival and establishment of the insects. If possible, avoid open water and release *Galerucella* near the shore or on dry land. It is not necessary to disperse the insects at multiple locations within an infestation, as insects will spread naturally on their own.

Disposal:

Plants should remain undisturbed following the release of biocontrol agents. No disposal is required.



CLONAL PLANTS

The following species are characterized by extensive rhizome systems and the ability to spread clonally via root and/or stem fragmentation, which presents unique management challenges. The following species can be managed using the general BMPs included in this section:

Clonal Plants

Common reed grassPhragmites australisKnotweed speciesReynoutria japonica,Yellow irisIris pseudacorus

Phragmites australis Reynoutria japonica, R. sachalinensis, and R. x bohemica Iris pseudacorus







Common reed grass

Knotweed spp.

Yellow iris

PLANT DESCRIPTIONS

COMMON REED is a perennial grass native to Europe that can grow over 14 feet (4.3m) in height. It is capable of vigorous vegetative reproduction and often forms dense, monospecific stands that exclude native plants. Established infestations can negatively impact the structure and hydrology of wetlands soils and degrade wildlife habitat. Purple-hued seed heads develop between July and September, turning light brown at maturity. It is believed that most seeds produced in the Adirondack region are non-viable and most spread occurs through the unintentional human-mediated movement of rhizome material. *NOTE: A native linage of Phragmites is present in New York State. Please consult a professional for identification guidance before beginning management.*

KNOTWEED SPECIES are herbaceous perennial shrubs native to Eastern Asia that can exceed ten feet (3m) in height. They spread rapidly to form large, dense thickets that exclude native vegetation near water sources, in low-lying areas, waste areas, and utility rights-of-way. Dense infestations along riparian corridors can increase erosion and impede recreational opportunities. Knotweeds can tolerate a variety of adverse conditions including full shade, high temperatures, high salinity, and drought. There are multiple species of invasive knotweed, including Japanese, giant and bohemian. All are closely related in biology and appearance and can be managed using comparable techniques. Knotweed species have broad, heart-shaped leaves that are pointed at the tip and alternately arranged on the stem. Their stems are green and hollow with prominent raised ridges/nodes, giving the plant a bamboo like appearance. Large clusters of small white flowers appear on the branches in August and September. Knotweed spreads via seed and by vegetative expansion through stout, aggressive rhizomes.

YELLOW IRIS is a robust, clumping perennial native to Europe, Asia and parts of Africa. It can form dense monotypic stands that replace and crowd out native plants. It's dense network of rhizomes can alter soil properties and damage or clog underground water/sewer pipes. At maturity, plants can reach five feet (1.5m) with stiff, sword-like leaves. Bright yellow, three petaled flowers are present from mid-June to early July. It can be distinguished from its native lookalike (blue flag iris) by its rhizomes. The interior of yellow iris rhizomes are orange to pink, while the interior of native iris rhizomes are white. Yellow iris spreads via water dispersed seed, and fragmentation and/or expansion of its extensive rhizome system.

MANAGEMENT OPTIONS

1. Digging/Pulling

Effectiveness:

Non-mechanized digging or pulling can be effective in containing, suppressing, or locally eradicating early detection infestations of clonal species.

Methods:

Dig or pull up the entire plant including all roots and runners using a digging tool. Extreme care must be taken to remove the entire root system, as new plants can sprout from residual fragments. Small plants may be hand-pulled depending on soil conditions and root development. Disturbed soil should be tamped down firmly after removing plants.

Disposal:

Bag and remove all plant parts from site. Solarize by placing bagged plant material in the sun for at least two-weeks and then dispose of in an approved landfill. Do not compost invasive plant material.

2. Herbicide

Effectiveness:

Herbicide treatments can be effective in containing, or locally eradicating early detection to medium sized infestations and suppressing large infestations of clonal species. Apply glyphosate, triclopyr, imazapyr, and/or imazamox based herbicides using the selective application techniques described below. Glyphosate will not affect subsequent plant emergence; however, the use of imazapyr or imazamox may inhibit regrowth for several months or years.

Methods:

Apply glyphosate, triclopyr, imazapyr, and/or imazamox formulations using the selective application techniques identified below. Herbicide applications should be performed near peak growth, typically in August or September. Consult the herbicide product label for recommended dilution rates and to ensure the target species, desired application technique, and habitat type (upland vs. wetland) are listed and approved.

For herbicide treatments use any of the following application techniques:

- a) Foliar spray application commercial-grade spray bottle with adjustable nozzle, backpack sprayer with adjustable nozzle, boom/broadcast sprayer and/or spot sprayer. This technique can be used with most herbicide active ingredients.
- b) Clip and drip or stem injection application:
 - For *common reed grass* cut the stem near the base and fill its hollow cavity with 2-5ml of glyphosate-based herbicide. Most herbicide product labels recommend a 50% v/v solution.
 - For knotweed spp. using a specialized stem injection system, deliver 2-5ml of undiluted glyphosate-based herbicide directly into the plants hollow stem. Injections are typically made between the 2nd and 3rd node from the soil surface.
 - For *yellow iris* cut a flowering stalk and inject the plants fleshy pith with 0.5-1ml of undiluted glyphosate-based herbicide.

Disposal:

Plants should remain undisturbed for at least two weeks following herbicide application. No disposal is required.

3. Excavation (mechanized)

Effectiveness:

Excavation can be effective in suppressing, containing, or locally eradicating early detection to small sized infestations of clonal species. Associated costs and disturbance can be limiting factors for this control method.

Methods:

Excavate plants below depth of rhizome - typically at least four feet (1.2 m) - including a buffer area of at least five feet (1.5m) around visible plants to account for underground roots and rhizomes.

Note: Excavation within 100 feet (30m) of a waterbody can cause erosion and/or bank destabilization and may be subject to regulation. Contact the Adirondack Park Agency or DEC (Appendix B) before proceeding.

Disposal:

Contaminated soil and plant material should be buried at least five feet (1.5m) deep in a disposal pit. The disposal site should be monitored annually for at least five years to ensure no new plants emerge.

Excavated material may also be spread on a contained, impervious surface to dry out for at least two years. Spread the material in an even, thin layer – approximately 1 foot (30cm) thick – to facilitate even heating. If necessary, treat emerging plants with herbicide.



WOODY VINES AND SHRUBS

Due to their similar biology and growth habit, many invasive woody vines and shrubs can be managed using comparable techniques. The following species can be managed using the general BMPs included in this section:

Woody Vines and Shrubs

Bush honeysuckles Common and glossy buckthorn Japanese and common barberry Japanese honeysuckle Multiflora and rugosa rose Oriental bittersweet Porcelain berry Russian and autumn olive Scotch broom Wineberry Winged euonymus

Lonicera spp. Rhamnus cathartica & Frangula alnus Berberis thunbergii & B. vulgaris Lonicera japonica Rosa multiflora & Rosa rugosa Celastrus orbiculatus Ampelopsis brevipedunculata Elaeagnus umbellate & E. angustifolia Cytisus scoparius Rubus phoenicolasius Euonymus alatus



Bush honeysuckle spp.



Japanese honeysuckle



Olive spp.



Common buckthorn



Rose spp.



Scotch broom



Oriental bittersweet



Winged euonymus



Barberry spp.



Porcelain berry



PLANT DESCRIPTIONS

BUSH HONEYSUCKLES (Morrow's, Bell's, Amur, and Tatarian) are multi-stemmed, deciduous shrubs native to Asia that grow up to 25 feet (7.6m) in height. They can form dense stands, even in shaded conditions, that exclude native plant species. Areas invaded by bush honeysuckles are known to have higher populations of ticks and greater incidences of tick related illness. Bush honeysuckles have simple leaves with smooth margins that are arranged alternately on the stem. Their flowers bloom in spring, typically around May, and are white, pink, or yellow. The fruits of bush honeysuckle are red, orange, or rarely yellow fleshy berries. Exotic honeysuckles can be distinguished from native varieties by their hollow stems. All species are spread by bird and animal dispersed seed.

COMMON BUCKTHORN is a deciduous shrub native to most of Europe and western Asia that can reach heights of 25 feet (7.6m). It can be found along forest edges, understories, and rights-of-way where it outcompetes native vegetation. Changes to the plant community composition result in altered litter decomposition and soil nutrient cycling. The main stem of common buckthorn can grow up to 10 inches (25cm) in diameter but is more commonly 1-3 inches (2.5-7cm). Leaves are dark-green and oval with toothed margins and 3-5 pairs of distinct arching veins. It can be distinguished from other buckthorns by its sharp, thorn tipped branches. Small, round, black berries ripen in the fall and are readily consumed by birds and other wildlife – serving as the primary spread mechanism.

GLOSSY BUCKTHORN is a deciduous shrub native to Eurasia that can reach 10-25 feet in height (3-7.6m). It grows in a wide variety of sites, including disturbed and nutrient poor habitats such as right-of-ways, forest edge, and wetlands. It is particularity invasive in wetlands where it outcompetes native vegetation and alters community composition through allelopathy. Bark is gray or brown with conspicuous white lenticels. Leaves are dark green with a shiny upper surface and 8-9 pairs of distinct arching veins. Pale yellow flowers grow from the leaf axils, turning to dark red or purple berries. Seeds are spread by birds and moving water, where they can remain buoyant for up to two weeks.

JAPANESE AND COMMON BARBERRY are spiny deciduous shrubs that can exceed ten feet (3m) in height. Japanese barberry is native to east Asia, while common barberry occupies central and southern Europe and west Asia. Their dense, thorny habit can exclude native species and impede recreational activities. Areas invaded by barberry are known to have higher populations of ticks and greater incidences of tick related illness. Leaves of Japanese barberry are small and oval with smooth margins, while common barberry has toothed margins. Japanese barberry has two common color morphs, a dark-green and deep-purple variety, while common barberry is typically only green. Japanese barberry has a single spine at each node where the leaves meet the stem, while common barberry has three spines. Flowers are very small, white to yellow in color, and bloom in April or May. Fruits are small, oval, bright-red berries less than 0.5 inches (1cm) long. The inner roots and stem of barberry are vibrant yellow in color. Both species are spread readily by bird dispersed seed. Barberry infestations are often exacerbated in areas with high deer abundance.

JAPANESE HONEYSUCKLE is a perennial trailing or climbing woody vine native to east Asia. It is most common at disturbed, open sites such as forest edges and rights-of-way. Its dense growth habit excludes native species, while its climbing stems can smother or topple host plants. The foliage and fruit of Japanese honeysuckle provide little value for native wildlife. Leaves are oval and approximately 2-4 inches (5-10cm) long. Fragrant white flowers are produced in late April through July. Fruits are small black berries that are produced September through November. Seeds are spread primarily by birds and other wildlife.

MULTIFLORA AND RUGOSA ROSE are thorny, perennial shrubs native to east Asia that can grow up to 15 feet (4.6m). Their dense, thorny habit can exclude native species and impede recreational activities. Stems are long, flexible, green or reddish in color, and covered with numerous stiff, recurved thorns. Leaves are alternate and compound. Multiflora rose often has 5-11 one-inch (2.5cm) leaflets, while rugosa rose has 7-9 (rarely 5). The leaf margins are toothed for both species. Invasive rose species bloom in late spring or early summer, producing numerous clusters of showy white or pink flowers. The flowers are small - 1 inch (2.5cm) wide - with five petals. In summer, flowers develop into small, hard red fruits approximately 1/4 inch (<1cm) in size. Both species spread through bird dispersed seed.

ORIENTAL BITTERSWEET is a rapidly spreading deciduous vine native to Asia. It twines around and drapes itself over other trees and shrubs in successional fields and along forest edges, often completely covering the supporting vegetation. Its characteristically bright orange roots can alter soil pH and nutrient levels, affecting plant community composition. Stems are round, light to dark brown, usually with noticeable lenticels. Leaves are round, glossy on the upper surface, and alternately arranged. Small greenish flowers occur in clusters in the leaf axils. Fruits are green to yellow berries that begin developing around July and transition to red-orange in late summer. This species may be distinguished from the native American bittersweet (*Celastrus scandens*) by the location of its fruit. Oriental bittersweet has small clusters in the leaf axils while *C. scandens* has clusters only at its branch tips. It can be spread long distances via bird dispersed seeds.

PORCELAIN BERRY is a woody, perennial climbing vine native to Asia. If occurs in open, edge habitats where mature vines can reach 20 feet (6m) into the canopy, blocking light and smothering native plants below. Heavy infestations can suppress the regeneration of native tree seedlings and degrade wildlife habitat. Leaves are alternate and dark green with 3-5 lobes. Flowers are small, greenish white, and appear from May through August. Vines begin to produce bright blue or purple, speckled berries in late-summer. Berries are readily spread long distances by birds.

RUSSIAN AND AUTUMN OLIVE are deciduous shrubs native to parts of Asia and Russia, that can reach 20 to 35 feet (6-10m) in height. They prefer disturbed sites such as forest edges or rights-of-way, where they form dense stands that exclude native plants. Both species have nitrogen fixing capabilities that provide a large advantage over native species. The leaves of autumn olive are oval and alternately arranged on the stem, with a green upper surface and silver underside. The leaves of Russian olive are more elongate, resembling a willow, and are silver on both sides. Twigs of both species are gray and often armed with sharp thorns. Flowers have four petals, are fragrant, white to yellow, and appear in late spring. The fruit of both species is a small, round berry. Autumn olive berries are typically red, while Russian olive berries are yellow-orange. Both species prefer disturbed sites, where they establish and spread via animal dispersed seed.

SCOTCH BROOM is a perennial shrub native to Europe that grows up to 10 feet (3m). It can fix nitrogen, allowing it to become established in poor sites where it may form dense thickets that decrease the richness and diversity of native plants. Established infestations can alter soil properties. Leaves are small, alternate, and compound with three leaflets. Stems are a prominent green and five-sided. Shrubs bloom early in the season from late May to June, producing small bright-yellow flowers along the length of the stem. Flowers give rise to fuzzy, flat seed pods that can be up to 1.5 inches (4cm) long. When seed pods are ripe, they split and eject seeds up to 20 feet (6m) where they may remain viable for up to 60 years in the soil.

WINEBERRY is a perennial shrub in the rose family native to parts of east Asia. It prefers moist soil and full to partial sunlight, and can readily invade forest edges, fields, forest understories, and wetland edges. Dense infestations exclude native vegetation and can impact recreational use. Leaves are light-green on top and white below, alternate, and compound with three heart-shaped leaflets. Branches are long, arching, and covered with reddish-purple spines. Small greenish-white flowers appear in late spring to early summer, giving rise to edible red raspberry-like fruits in mid-summer. Plants can spread long distances via animal and bird dispersed seed, but also locally through vegetative expansion.

WINGED EUONYMUS also known as burning bush is a deciduous shrub native to central and east Asia that can grow up to 20 feet (6m) tall and wide. Shrubs are adaptable to a variety of soil and light conditions, and can be found in forested wetlands, forest understories, riparian corridors, and rights-of-way. Dense stands exclude native species and can increase the populations of ticks, leading to greater incidences of tick related illness. Leaves are simple, opposite, and 1-3 inches (2.5-8cm) long with smooth edges. Green during the summer, foliage transitions to a vibrant red in the fall. Stems are green to brown in color with four prominent corky wings. Plants bloom in May or early June, producing small green flowers. Fruits mature in later summer as small, oval, bright red berries that are spread by birds.



MANAGEMENT OPTIONS

1. Digging/Pulling

Effectiveness:

Non-mechanized digging or pulling can be effective in containing, suppressing, or locally eradicating early detection infestations of invasive woody plants. Mechanical control is most effective when performed before seed/fruit production.

Methods:

Dig or pull up each stem by the base to ensure the entire root system is removed. Use a digging or leverage tool such as The Uprooter, Weed Wrench, or Honeysuckle Popper for larger individuals. Disturbed soil should be tamped down firmly after removing plants. Soil disturbance can bring existing invasive plant seeds to the surface, creating a favorable environment for germination. Plants should be removed around peak flower, but before seed set. Refer to the plant descriptions above for phenological information.

Disposal:

Woody debris can be mulched/chipped and left on-site or burned if allowed under local laws and regulations. Non-fruit bearing plants can be propped against or suspended from nearby tree trunks/branches with their roots exposed to decompose. They can also be arranged into brush piles for wildlife habitat.

2. Cutting/Mowing

Effectiveness:

Cutting or mowing/mulching can be effective in containing or suppressing early detection to large sized infestations of invasive woody plants. Mowing or cutting/mulching must be repeated annually to reduce an infestation to desired levels as dormant seeds in the soil are unaffected by this technique. Do not mow or cut plants when in seed set as this will aid in seed dispersal.

Methods:

Cut or mow/mulch invasive woody vines and shrubs at ground level either manually or with motorized equipment just before seed production, typically by mid-summer. Follow-up mowing/cutting may be required within a growing season and must be repeated annually.

Some shrubs respond positively to cutting and may release numerous root suckers; follow up treatment with herbicide may be necessary to minimize regrowth.

Disposal:

Woody debris can be mulched/chipped and left on-site or burned if allowed under local laws and regulations.

3. Herbicide

Effectiveness:

Herbicide treatments can be effective in containing or locally eradicating early detection to medium sized infestations and suppressing large infestations of invasive woody plants. Invasive woody plants can be effectively controlled by glyphosate, triclopyr, or imazapyr based herbicides. Glyphosate and triclopyr will not affect subsequent plant emergence; however; the use of imazapyr may inhibit regrowth for several months or years. Consult the herbicide product label for recommended dilution rates and to ensure the target species and desired application technique are listed and approved.

Methods:

Apply glyphosate, triclopyr, or imazapyr formulations using the selective application techniques identified below. Foliar applications should be performed close to peak flower, but before seed set. Cut stump and basal bark applications can be performed in the spring or fall for some species; consult the herbicide

product label for more information.

For herbicide treatments use any of the following application techniques:

- a) Foliar spray application commercial-grade spray bottle with adjustable nozzle, backpack sprayer with adjustable nozzle, boom/broadcast sprayer and/or spot sprayer. This technique can be used with most herbicide active ingredients.
- b) Cut stump application commercial-grade spray bottle with adjustable nozzle, backpack sprayer with adjustable nozzle, wash bottle, eye dropper, or paintbrush. This technique is primarily used with glyphosate or triclopyr based herbicides.
- c) Basal bark application commercial-grade spray bottle with adjustable nozzle, backpack sprayer with adjustable nozzle, or paintbrush. This technique is most often used with triclopyr based herbicides.
- d) Hack and squirt machete or ax with commercial grade spray bottle. This technique is most often used with glyphosate or imazapyr based herbicide.

Disposal:

Plants should remain undisturbed for at least two weeks following herbicide application. No disposal is required.



Photo Credit: The Nature Conservancy (Zachary Simek)

TREES

Due to their similar biology and growth habit, many invasive trees can be managed using comparable techniques. The following species can be managed using the general BMPs included in this section:

Trees

Japanese angelica tree Japanese tree lilac Norway maple Tree-of-heaven

ca tree Aralia elata .ac Syringa reticulata Acer platanoides Ailanthus altissima





Japanese tree lilac



Norway maple



Tree of heaven

PLANT DESCRIPTIONS

Japanese angelica tree

JAPANESE ANGELICA TREE is a fast-growing deciduous tree native to Asia and eastern Russia. It can be found in forests, edge habitats, fields, and rights-of-way where it may form large thickets that displace native plant species and wildlife. Its thorny stem makes it of little value as forage for wildlife. Mature individuals can reach 40 feet (12m) or more under optimal conditions. Leaves are very large – up to four feet long – and compound with up to 80 oval leaflets. Clusters of white flowers appear in late summer, ripening to purplish-black round berries. This species is readily spread by bird dispersed seed.

JAPANESE TREE LILAC is a large shrub or small tree native to Asia that can reach 30 ft (10m) in height. It can tolerate a range of site conditions, and as a popular ornamental, is frequently found in yards or urban areas. It can escape cultivation and invade natural areas such riparian corridors and floodplains where it excludes native trees and shades out native plants in the understory. Oppositely arranged leaves are ovate and dark green with a rounded base. The reddish-brown bark of young trees is smooth with many horizontal lenticles (slits). Large bunches of small, fragrant white flowers bloom in early summer. These flowers ripen to green seed pods that turn brown in later summer and persist into the winter months. Spread occurs through dispersal of wind dispersed seeds and may occur via dispersal by water.

NORWAY MAPLE is a large, deciduous tree native to Europe and Asia than can exceed 65 feet (20m) in height. It produces numerous seeds that can grow in dense shade, outcompeting native understory tree species and impacting native forest regeneration. It can be distinguished from native maples by its leaves and petioles that ooze white, milky sap when cut or damaged. Leaves are dark green, with five to seven lobes. The bark is smooth and gray-brown, becoming more furrowed as the tree matures. Fruit are double-winged samaras arranged nearly 180 degrees from each other. Spread occurs locally through wind dispersed seed.

TREE-OF-HEAVEN is a fast-growing deciduous tree native to Asia that can exceed 80 feet (24m) in height. Each tree can release over 100,000 seeds and sprouts prolifically, lending to rapid population expansion. Tree of heaven excludes native vegetation, can increase maintenance requirements along rights-of-way, and is a primary host for the invasive spotted lanternfly (*Lycorma delicatula*). Leaves are compound with 10-41 smooth edged leaflets. Leaves have a rancid aroma when crushed, reminiscent of cat urine or burnt peanut butter. The fruit is a single winged samara, which forms in late summer from clusters of small yellow flowers. Spread occurs by both seeds and aggressive vegetative root sprouts.



1.Digging/Pulling

Effectiveness:

Frequent non-mechanized digging or pulling can be effective in containing, suppressing, or locally eradicating early detection infestations of invasive trees < 3" DBH. Well rooted, mature individuals cannot be effectively removed by this technique.

Methods:

Dig or pull each individual sapling from the soil, taking care to remove the entire root system. Mechanical management should be performed prior to fruit production in late summer. Use a digging or leverage tool such as The Uprooter, Weed Wrench, or Honeysuckle Popper for larger stems. Some species of invasive trees (ex: tree-of-heaven) may produce numerous root suckers in response to mechanical control; use herbicide to minimize re-sprouting. Disturbed soil should be tamped down firmly after removing plants. Soil disturbance can bring seeds to the surface and create a favorable environment for germination within the control site.

Disposal:

Woody debris can be mulched/chipped and left on-site or burned if allowed under local laws and regulations. Non-fruit bearing plants can be propped against or suspended from nearby tree trunks/branches with their roots up to decompose. They can also be arranged into brush piles for wildlife habitat.

2. Cutting

Effectiveness:

Cutting can be effective in containing or suppressing early detection to large sized infestations of invasive woody trees. Cutting can be used to remove large stems to minimize or eliminate further seed production.

Methods:

Cut invasive woody trees either manually or with motorized equipment. Some invasive trees (ex: tree of heaven) respond positively to cutting and may release numerous root suckers; apply herbicide immediately to the stump after cutting to minimize re-sprouting.

Disposal:

Woody debris can be mulched/chipped and left on-site or burned if allowed under local laws and regulations.

2.Herbicide

Effectiveness:

Herbicide treatments can be effective in containing or locally eradicating early detection to medium sized infestations and suppressing large infestations of invasive trees. Invasive trees can be effectively controlled by glyphosate, triclopyr, or imazapyr based herbicides. Glyphosate and triclopyr will not affect subsequent plant emergence; however; the use of imazapyr may inhibit regrowth for several months or years. Consult the herbicide product label for recommended dilution rates and to ensure the target species, desired application technique, and habitat type (upland vs. wetland) are listed and approved.

Methods:

Apply glyphosate, triclopyr, or imazapyr formulations using the selective application techniques identified below. Foliar applications should only be used for low-growing stems. Cut stump and basal bark applications can be performed in the spring or fall for some species; consult the herbicide product label for more information. Avoid use of imazapyr in the root zone of desirable tree species.

For herbicide treatments use any of the following application techniques:

- a) Foliar spray application commercial-grade spray bottle with adjustable nozzle, backpack sprayer with adjustable nozzle, boom/broadcast sprayer and/or spot sprayer. This technique is primarily used on small, low-growing stems and can be used with most herbicide active ingredients.
- b) Cut stump application commercial-grade spray bottle with adjustable nozzle, backpack sprayer with adjustable nozzle, wash bottle, eye dropper, or paintbrush. This technique is primarily used on large, tall stems and with glyphosate or triclopyr based herbicides. Cut stump applications are not recommended for tree-of-heaven as it responds with prolific resprouting.
- c) Basal bark application commercial-grade spray bottle with adjustable nozzle, backpack sprayer with adjustable nozzle, or paintbrush. This technique is most often used on large, tall stems with triclopyr based herbicides.
- d) Hack and squirt machete or ax with commercial grade spray bottle. This technique is most often used on large, tall stems with glyphosate or imazapyr based herbicide.

Disposal:

Plants should remain undisturbed for at least two weeks following herbicide application. No disposal is required.

