

Inter-Agency Work Plan For Management of Terrestrial Invasive Plant Species On State Land in the Adirondack Park

I. Background

The negative impacts of invasive species on natural forest communities have been well documented. Colonization and unrestrained growth of invasive plants cause the loss of biodiversity, interruption of normal hydrology, suppression of native vegetation, and significant aesthetic, human safety and economic impacts. Within the past 10 years in the Adirondack Park, terrestrial invasive species have been identified at increasing rates of colonization along roadsides. Some of these species have the potential to colonize backcountry areas and degrade natural resources protected by the State Land Master Plan (SLMP).

Although there are no explicit references to active invasive species management on Forest Preserve lands in the SLMP, one can infer that the SLMP contemplates and prescribes active management of invasive species to protect the “wild forest” character of the Forest Preserve. For instance, page 1 of the NYS Adirondack Park SLMP (2001 Update) states, “If there is a unifying theme to the master plan, it is that the *protection and preservation* of the natural resources of the state lands within the Park must be paramount.” (Emphasis added) Clearly, the framers of the document recognized that the natural forest resources of the Park should be held inviolate.

The Unit Management Plan (UMP) is a device that allows and guides land management with the specific goals of preserving, protecting and restoring natural resources in a wild forest context. The SLMP requires that UMPs be drafted and adopted for each Forest Preserve unit including Wilderness, Primitive, Wild Forest and Canoe Area designations as well as campgrounds. The guidelines for developing the UMP’s are quite clear and include the following considerations:

“Each unit management plan will also set forth a statement of the management objectives for the *protection and rehabilitation* (emphasis added) of the area’s resources and ecosystems... These management objectives will address... such issues as:

- 3.a. -- actions to minimize adverse impacts on the resources of the area;
- 3.b. -- the rehabilitation of such portions of the area as may suffer from overuse or resource degradation; ...
- 3.c. -- the preservation of aquatic and terrestrial habitats of the area;
- 3.d. -- the preservation and management of the fish and wildlife resources (including game and non-game species) of the area;
- 3.f. -- the preservation and management of special interest areas such as the habitats of rare, threatened or endangered species and areas with the potential for the reintroduction of extirpated species, unique geological areas and historic areas or structures...”

The language in the SLMP UMP guidelines gives the Department of Environmental Conservation (Department, DEC) broad powers to devise and implement management activities that achieve the preservation, protection and restoration of natural resources in a wild forest context.

Continued importation and expansion of invasive plants into and throughout the Adirondacks is of paramount concern. Terrestrial invasive plant species have the potential to be antithetical to all of the natural resource protection considerations noted in the SLMP. Models indicate that eradication of an invasive species gets progressively more difficult, more expensive, and less successful the longer the species is allowed to grow without intervention.

Developing an inventory protocol and implementing quick action under an Adopt A Natural Resource (AANR) Agreement that utilizes the full suite of tools described as Best Management Practices (BMP's) will provide the greatest level of protection for natural systems on State Lands as contemplated in the SLMP. Accepted BMP's for eradication or control of these species point to the necessity of applying a variety of techniques to successfully manage species, including the use of herbicides in certain situations. It may not be possible to meet the resource protection and rehabilitation goals expressed in the SLMP without using herbicides as a management tool.

In 2001, the Department and the Adirondack Park Agency (Agency, APA) entered into a Memorandum of Understanding (MOU) with other partners (NYS Department of Transportation, and Adirondack Nature Conservancy) to create the Adirondack Park Invasive Plant Program (APIPP) and actively evaluate and cooperate on the management of terrestrial invasive plant species. The MOU was re-signed in April 2004 adding the NYS Invasive Plant Council as a partner. One of the main responsibilities of the Department is to "cooperate on invasive plant species management activities on State land including inventory and control activities". As a principal partner in APIPP and co-chair of the NYS Invasive Species Task Force, the Department has taken a leadership role in addressing invasive species issues. This Inter-Agency Work Plan is a manifestation of the commitment embodied in the MOU.

II. Present Extent of Terrestrial Invasive Species on Forest Preserve Lands

Use of herbicides on Forest Preserve lands must be very carefully considered. An inventory of what invasive species are present and a measure of the extent of the invasive plant populations is essential to determining the correct course of action.

In 2004 and again in 2005 Adirondack Nature Conservancy / Adirondack Park Invasive Plant Program staff and Student Conservation Association / AmericCorps Environmental Steward staff in cooperation with the Department undertook a systematic effort to identify and quantify the extent of terrestrial invasive species on Forest Preserve units in the Adirondack Park. Documented priority invasive threats included garlic mustard (*Alliaria petiolata*), Japanese knotweed (*Fallopia japonica* ssp. *japonica*), common reed (*Phragmites australis* ssp. *australis*), purple loosestrife (*Lythrum salicaria*), and Japanese barberry (*Berberis thunbergii*). Other invasive species found included black locust (*Robinia pseudoacacia*), Japanese, Morrow's, tatarian, Amur and Bell's honeysuckles (*Lonicera japonica*, *L. morrowii*, *L. tatarica*, *L. maackii*, *L. x. bella*), Canada and/or bull

thistle (*Cirsium arvense*, *C. vulgare*) and wild parsnip (*Pastinaca sativa*). The following summary table documents the 2005 field work. Detailed location and population information has been provided to the Regional Land Manager.

State Land Unit	Terrestrial Invasive Species Present	Total Number of Populations	Total Area Affected in Square Feet (acres)
Moose River Wild Forest	garlic mustard, honeysuckle, wild parsnip	12	3620 (.08)
Sargent Ponds Wild Forest	garlic mustard, Canada thistle	6	1210 (.03)
Blue Mountain Wild Forest	Japanese knotweed, wild parsnip	4	3950 (.09)
Vanderwhacker Mountain Wild Forest	purple loosestrife, Japanese knotweed, honeysuckle, Canada thistle	27	14310 (.33)
Shaker Mountain Wild Forest	garlic mustard Japanese knotweed, purple loosestrife, black locust, honeysuckle, common reed	33	38870 (.89)
High Peaks Wilderness	Japanese knotweed	1	13500 (.31)
Ferris Lake Wild Forest	garlic mustard, Japanese knotweed, purple loosestrife, common reed, Japanese barberry, honeysuckle	48	33780 (.78)
West Canada Lake Wilderness	garlic mustard, Japanese knotweed	3	420 (.01)
Black River Wild Forest	garlic mustard, common reed, Japanese knotweed, honeysuckle	14	11950 (.27)
Saranac Lakes Wild Forest	Japanese knotweed, Japanese barberry, Canada thistle, honeysuckle	12	6130 (.14)
Total		160	127740 (2.93)

In addition to the formal survey of the above ten Wild Forest units, the survey team kept track of other invasive species occurrences on Forest Preserve lands noted during their ordinary course of work. Below is a summary table for several additional sites.

Location	Terrestrial Invasive Species Present	Total Number of Populations	Total Area Affected in Square Feet (acres)
Pepperbox Wilderness/Stillwater Dam	Japanese knotweed	2	700 (.02)
Cascade/Porter Mountain Trailhead	garlic mustard	1	50 (.001)

& trail			
Barnum Pond Boat Launch	purple loosestrife	1	1500 (.034)
Second Pond Boat Launch	Japanese knotweed	1	550 (.013)
Camp Santanoni	Japanese knotweed	2	1200 (.03)
Mt. Arab Trailhead Parking Area	Japanese knotweed	4	2000 (.05)
Grass River/Special Trout Area Parking Area	Japanese knotweed	2	1050 (.024)
Schroon Lake Boat Launch	purple loosestrife	1	100 (.002)
Region 6 Boonville Field HQ	giant knotweed	1	300 (.007)
Lake Colby Boat Launch & Public Beach	purple loosestrife	2	400 (.01)
Total		17	7850 (.18)

There are approximately 47 Wilderness, Wild Forest, Canoe and Primitive State land units in the Park. A straight extrapolation of the above data to all State land units would indicate 752 terrestrial invasive species populations occupying 600378 square feet (13.8 acres). Of course, a straight extrapolation will not yield numbers as accurate as a comprehensive survey. Also it should be noted that the ten units were all Wild Forest areas and therefore have a higher level and more varied type of use and than would be expected in Wilderness areas and potentially higher levels of terrestrial invasive species infestations. Further, the numbers should be placed in context. There is approximately 2.4 million acres in Wilderness, Wild Forest, Canoe and Primitive classification. If there were 13.8 acres of terrestrial invasive species infestation it represents a very minute portion of the whole. This level of invasion is an indication that invasives are at very low population levels and the chance of eradication is high. It's also a sobering wake-up reminding us that early detection and rapid response are key ingredients to protecting the natural systems on our State lands. Past experience in other parts of New York State and other states proves that if the infestation is allowed to consolidate it will be impossible to eradicate and will create an expensive, never-ending management effort merely to keep population levels low enough to limit environmental degradation.

The survey team also visited 28 of the 47 DEC campgrounds in the Adirondack Park during summer 2005. Of the 28, 16 had minor to severe infestations of terrestrial invasive plants. The most common problem species was garlic mustard, followed by Japanese knotweed, purple loosestrife and honeysuckle. The following table summarizes the extent of invasives knowledge on Forest Preserve campgrounds.

Campground	Terrestrial Invasive Species Present	Number of Populations
Paradox Lake Campground	garlic mustard, wild chervil	2
Lewey Lake Campground	garlic mustard	3
Limekiln Lake Campground	garlic mustard, honeysuckle	13
Carry Falls Camp Sites & Boat Launch	garlic mustard	several/many
Cranberry Lake Campground	garlic mustard	21+
Nick's Lake Campground	garlic mustard	49
Eighth Lake Campground	garlic mustard	33
Golden Beach Campground	garlic mustard	101+
Brown Tract Pond Campground	garlic mustard, honeysuckle	4
Lake Durant Campground	garlic mustard	6
Lake Eaton Campground	garlic mustard	6
Fish Creek-Rollins Pond Campground	garlic mustard	2
Meadowbrook Campground	garlic mustard	1
Moffitt Beach Campground	garlic mustard	14
Sacandaga River Campground	Japanese knotweed	5
Taylor Pond Campground	purple loosestrife	1

The inventory provides a preliminary indication that the following NYS DEC Public Campgrounds appear to be free of target terrestrial invasive plant species: Wilmington Notch, Jones Pond, Buck Pond, Meacham Lake, Sharp Bridge, Au Sable Point, Putnam Pond, Little Sand Point, Point Comfort, Poplar Point, Forked Lake and Fourth Lake Picnic Area.

The following campgrounds and day-use areas have not been inventoried: Alger Island, Caroga Lake, Crown Point Reservation, Eagle Point, Hearthstone Point, Hinckley Reservoir Picnic Area, Lake George Battlefield Picnic Area, Lake George Battlefield, Lake George Beach, Lake George Islands, Lake Harris, Lincoln Pond, Luzerne, Moffitt Beach, Northampton Beach, Poke-O-Moonshine, Roger Rock and Tioga Point.

It is noted that not all terrestrial invasive species infestations require the use of herbicides. The protocols in section VI. and the best management practices attached in Appendix A. below provide clear guidance as to which actions are best and allowed. In addition, all herbicide use will be approved by the Regional Land Manager under an AANR.

Effect of This Action

This Work Plan seeks to lay the ground rules for managing terrestrial invasive species on Forest Preserve lands. It identifies certain species that, if left untreated, have the potential for colonizing backcountry areas and causing severe disruption and degradation of natural systems. The Work Plan sets out a protocol for action and recommends a set of comprehensive Best Management Practices (BMP's) for dealing with the invasive species of concern. The BMP's provide detailed guidance on the use of several techniques for managing terrestrial invasives including hand pulling, cutting, digging, matting and herbicides. Finally, it identifies a host of additional terrestrial invasive plant species that require surveillance, early detection and rapid response to protect Forest Preserve lands.

Adoption and implementation of the Work Plan gives the Department the basic tools needed to preserve, protect and restore the natural systems of the Forest Preserve.

II. Definitions

- a. Agency – The New York State Adirondack Park Agency, its officers and employees.
- b. Adirondack Park Invasive Plant Program – A partnership including NYS DEC, NYS APA, NYS DOT, Adirondack Nature Conservancy and the NYS Invasive Plant Council whose goals are:
 1. to coordinate a regional early detection and monitoring program in cooperation with staff, volunteers and the public;
 2. to facilitate invasive plant management and control with public and private landowners; and,
 3. to increase public awareness and involvement to prevent the spread of invasive plants through education and outreach.
- c. Agreement – The Adopt-A-Natural-Resource Agreement is a binding contract between the Department and an individual or group to undertake certain management activities on State Lands. The Agreement allows the implementation of this Work Plan and specifies the responsibilities and limitations associated with the management activity. It extends for a designated period of time and can be terminated by either party upon notification.
- d. Area – Lands under the jurisdiction of the Department.
- e. Best Management Practice – Field tested recommendation for the most effective control of invasive species. The best management practices for control of terrestrial invasive plants are attached in Appendix A.
- f. Certified Applicator - An individual who has successfully completed the course of training and licensing and who holds a valid, appropriate pesticide applicators certificate in New York State.

- g. Department – The New York State Department of Environmental Conservation, its officers and employees.
1. h. Herbicide – A pesticide that is registered in New York State that kills plants. Due to the sensitive nature of Forest Preserve lands it is intended that only selected herbicides be included for use under this work plan. Glyphosate in the Roundup®, Rodeo®, Aquamaster®, and Glypro® formulations are the herbicides of choice. In wetlands with standing water only the RODEO® formulation may be used. In wetlands with no standing water either the RODEO®, ROUNDUP® or the AQUAMASTER® formulation may be used. In uplands either ROUNDUP®, AQUAMASTER® or GLYPRO® may be used. In all cases herbicides will be used in strict compliance with label precautions and the best management practices found in Appendix A.
- i. Herbicide Application Method – The method of herbicide application will be by wick applicator, handheld spray or dropper bottle applicator, stem injection, or cloth glove applicator. No application will be allowed by broadcast sprays or by equipment permanently mounted on a vehicle.
- j. Regional Land Manager – The individual in the Department charged with the administrative responsibility for the State lands on which herbicide application for terrestrial invasive species management is planned.
- k. Terrestrial Invasive Plant Species – A plant that is typically found in upland, wetland, or riparian settings that is capable of rapid reproduction and displacement of native species. Although these may be native species (species that were here at the time of European colonization) typically they are non-native species that were accidentally or purposefully introduced outside of their historic range.
- l. Work Plan – The document between the Adirondack Park Agency and the Department of Environmental Conservation that outlines regulated management of terrestrial invasive plant species on State land.

III. Goal of the Work Plan

The goal of the Work Plan is to implement early detection and rapid response efforts to eradicate terrestrial invasive plant species on State lands in the Adirondack Park.

IV. Objectives of the Work Plan

This Work Plan will provide a template for the process through which comprehensive active terrestrial invasive plant management will take place on State lands in the Adirondack Park. The Work Plan will provide protocols for implementing BMP's on State land. The protocols will describe what management practices are acceptable and when they can be implemented, who can be authorized to implement the management practices, and which terrestrial invasive plant species are targeted. The Work Plan is a

living document and should be revisited and revised periodically to reflect the dynamic nature of invasive species and the state of knowledge of best management practices. Unit Planners will include or reference these protocols in Unit Plans and also include available inventory information of the distribution of invasive terrestrial plant species on or in proximity to the Unit. The Work Plan and the UMP (with up-to-date inventory information) will guide and authorize invasive terrestrial plant species management activities on State land units.

The Work Plan also describes a process by which the Department may enter into AANR Agreements with and facilitate individuals or groups seeking to manage terrestrial invasive plant species on State lands using the listed best management practices, including herbicide use, in the appropriate circumstances.

V. Responsibilities

The responsibility for interpretation and update of this Work Plan and overall management shall reside with the cooperating agencies. The Department shall be responsible for management of terrestrial invasive plant species on State lands while the Agency will be responsible for providing review of and advice on the management activities contained in the Work Plan.

VI. Protocols

- a. All Department staff whose duties involve outdoor field work on State land (e.g. UMP planners, Forest Rangers, ECO's, Operations, etc.) shall receive terrestrial invasive plant species identification and management training. They will be expected to report the location of suspected terrestrial invasive plant species encountered during the course of their ordinary work and to implement BMP's when conducting or supervising work on State land .
- b. An AANR is required for all non-DEC personnel to implement BMP's on State land.
- c. Those entering into an AANR agreement will receive a date by which the work must be undertaken and completed.
- d. Any individual or group demonstrating an interest and appropriate expertise in implementing the BMP's may apply for and receive an AANR agreement to manage terrestrial invasive plant species. Appropriate certification (NYS pesticide applicator certification) is required for herbicide applications.
- f. All AANR agreements shall have a requirement for monitoring and reporting that shall include but not be limited to date and type of management actions, species managed, type and amount of herbicide used, effectiveness of control, additional actions necessary, and schedule of future work.
- e. All work on State land will be conducted using the Best Management Practices listed in Appendix A.

- f. Any deviation from the BMP's must be approved by the Department after consultation with the Agency.
- g. All other applicable State, Federal and local regulations regarding herbicide use, plant removal and disposal, and etc. shall be complied with.
- h. As of the date of the issuance of this Work Plan the following species are considered as terrestrial invasive plant species eligible for management actions under this Work Plan. Other species may be added over time recognizing the constant threat of new invasive species.

- Purple loosestrife (*Lythrum salicaria*)
- Japanese, giant and bohemian knotweed (*Fallopia japonica* ssp. *japonica*, *F. sachalinensis*, *F. x bohemica*)
- Common reed (*Phragmites australis* ssp. *australis*)
- Garlic mustard (*Alliaria petiolata*)
- Japanese, Morrow's, tatarian, Amur and Bell's honeysuckles (*Lonicera japonica*, *L. morrowii*, *L. tatarica*, *L. maackii*, *L. x. bella*)
- Yellow iris (*Iris pseudacorus*)
- Autumn and Russian olive (*Eleagnus umbellata*, *E. angustifolia*)
- Cherry oleagnus (*Eleagnus multiflora*)
- Common and smooth buckthorn (*Rhamnus cathartica*, *R. frangula*)
- Black locust (*Robinia pseudoacacia*)
- Norway maple (*Acer platanoides*)
- Tree-of-Heaven (*Ailanthus altissima*)
- Cypress spurge (*Euphorbia cyparissias*)
- Oriental bittersweet (*Celastrus orbiculata*)
- Porcelain-berry (*Ampelopsis brevipedunculata*)
- Giant Hogweed (*Heracleum mantegazzianum*)
- White and yellow sweet-clover (*Melilotus alba*, *M. officinalis*)
- Wild parsnip (*Pastinaca sativa*)
- Wild chervil (*Anthriscus sylvestris*)
- Multiflora and rugosa rose (*Rosa multiflora*, *R. rugosa*)
- False Spiraea (*Sorbaria sorbifolia*)
- Reed canary-grass (*Phalaris arundinacea*)
- Black and Pale Swallowwort (*Cynanchum louiseae*, *C. rossicum*)
- Cup Plant (*Silphium perfoliatum*)
- Japanese stiltgrass (*Microstegium vimineum*)
- Flowering rush (*Butomus umbellatus*)
- Spotted knapweed (*Centaurea maculosa*)
- Japanese and European barberry (*Berberis thunbergii*, *B. vulgare*)
- Canada and bull thistle (*Cirsium arvense*, *C. vulgare*)

- i. Those individuals or groups applying for an AANR to manage any wetland species except purple loosestrife, Japanese knotweed, common reed, garlic mustard, Japanese honeysuckle, Morrow's honeysuckle, tatarian honeysuckle, Amur honeysuckle, Bell's honeysuckle or yellow iris, must develop and submit BMP's for the species of concern. The submitted BMP's will be reviewed and approved by the DEC and the APA before issuance of the AANR agreement.

Appendix A. BEST MANAGEMENT PRACTICES

Applicability

- These Best Management Practices (BMP's) are intended for use by those applying for and implementing terrestrial invasive plant species management activities on State Lands under an Adopt-A-Natural-Resource Agreement (AANR). The following document contains acceptable practices for control of the following four terrestrial invasive species: purple loosestrife (*Lythrum salicaria*), Japanese, giant and bohemian knotweed (*Fallopia japonica* ssp. *japonica*, *F. sachalinensis*, and *F. x. bohemica*), common reed (*Phragmites australis* ssp. *australis*), garlic mustard (*Alliaria petiolata*), Japanese, Morrow's, tatarian, Amur and Bell's honeysuckles (*Lonicera japonica*, *L. morrowii*, *L. tatarica*, *L. maackii*, *L. x. bella*), and yellow iris (*Iris pseudacorus*).

The following management options, should be selected with consideration for the location and size of the infestations, the age of the plants, past control methods used at the site, time of year, weather conditions and adjoining and nearby land uses.

Other management approaches not identified here may be appropriate but must be approved by the Regional Land Manager of the NYS Department of Environmental Conservation in the region where the proposed invasive plant control activity will take place.

Within the Park there are several geographic and geophysical settings (at the location of the target plant(s)) that need to be considered when determining appropriate BMP's and the regulatory instruments needed prior to their implementation. These settings and relevant action are:

2. In or within 100' of a wetland on private or public lands -- requires a general permit from the Adirondack Park Agency.
3. In wetlands with standing water -- only the RODEO® glyphosate formulation may be used.
4. In wetlands with no standing water -- either the RODEO®, ROUNDUP® or the AQUAMASTER® formulation may be used.
5. In uplands either ROUNDUP®, AQUAMASTER® or GLYPRO® may be used.
6. Forest Preserve lands -- requires an AANR from the Department of Environmental Conservation and, if wetlands are involved, an Adirondack Park Agency permit.

GENERAL PRACTICES

1. **Erosion Control** - Some of the methods described below require actual digging or pulling of plants from the soil. In all cases they require removal of vegetation whether or not there is actual soil disturbance. Each situation must be studied to determine if the proposed control method and extent of the action will destabilize soils to the point where erosion is threatened. Generally if more than 25 square feet of soil surface is cleared or plant removal occurs on steep slopes staked silt fencing should be installed and maintained.

2. **Revegetation** - Although not a specific condition, replanting or reseedling with native species is highly desired. All of the control methods below are aimed at reducing or eliminating invasive species so that natives are encouraged to grow and re-establish stable conditions that are not conducive to invasive colonization. In most cases removal or reduction of invasive populations will be enough to release native species and re-establish their dominance on a site.

3. **Herbiciding** - The only herbicide application allowed is spot treatment to individual plants using a back pack or hand sprayer, wick applicator, cloth glove applicator, stem injection or herbicide clippers. **No broadcast herbicide applications using, for example, a truck-mounted sprayer, are allowed.** The only herbicides contemplated and approved for use are glyphosate which is marketed under the trade names ROUNDUP®, RODEO®, GLYPRO® or AQUAMASTER®. ROUNDUP® may be used only in situations where there is no standing water including wetlands, whereas RODEO® may be used where standing water is present. **In all cases all herbicide directions for use and restrictions found on the label must and shall be followed by a New York State Certified Applicator or Technician in an appropriate category.** Glyphosate and is a non-selective herbicides that are is applied to plant foliage, or cut stems or stem injected and are then translocated to the roots. The application methods described and allowed are designed to reduce or eliminate the possibility that non-target species will be impacted by the herbicide use. All herbicide spot treatments require follow-up inspection later in the growing season or the following year to re-treat any individuals that were missed.

4. **Equipment Sanitation** - All equipment used for invasive species control, whether it be hand or power driven, must be cleaned prior to entering onto a control site and prior to leaving the site. This is an effort to reduce transport of invasive plant seeds or plant propagules and reduce the potential for new invasive introductions. Use steam or hot water to clean equipment.

5. **Material Collection and Transportation** – While on the control site place all cut plant material in heavy duty, 3 mil or thicker, black contractor quality plastic clean-up bags. Securely tie the bags and transport from the site in a truck with a topper or cap in order to prevent spread or loss of the plant material during transport from the control work site to the appropriate staging or disposal location. The main root structure, root fragments and/or horizontal rhizomes from harvested controlled Japanese, giant or bohemian knotweed infestation should be bagged only to facilitate transport to an appropriate staging area. All knotweed root structure, root fragments and rhizome propagules should be separately bagged from any cut, aerial canes and crowns. Over an open bag, remove as much adherent soil as possible from the root/rhizome structure prior to spreading the root/rhizome parts out onto a secure, impervious surface. Once completely dried out the root/rhizome structure may be burned or disposed of in an approved landfill.

The mature, upright stems and canes of common reed and the knotweeds can be cut, formed into bundles and securely bound with rope or twine. The bundles may then be transported to an appropriate staging or disposal location that has an impervious or near-impervious surfaced area. After the bundles have completely dried out they may be burned at an approved incinerator or burn pit with appropriate permit.

6. **Composting** - Because of the extremely robust nature of invasive species, composting in a typical backyard compost pile or composting bin is not appropriate. However, methods can be used whereby sun-generated heat can be used to destroy the harvested plant materials. For instance, storage in a sealed 3 mil thickness (minimum) black plastic garbage bags on blacktop in the sun until the plant materials liquefy is effective. If a larger section of blacktop is available, make a black plastic (4 mil thickness minimum) envelope sealed on the edges with sand bags. The plant material left exposed to the sun will liquefy in the sealed envelope without danger of dispersal by wind. The bags or envelopes must be monitored to make sure the plants do not escape through rips, tears or seams in the plastic. **When composting is suggested later in the text it is understood that liquefying the plant material in or under plastic is the desired action; not disposal in backyard composters or open landfill composting piles.**

CONTROL METHODS FOR PURPLE LOOSESTRIFE (Lythrum salicaria)

PLANT DESCRIPTION

Purple loosestrife is a wetland perennial native to Eurasia that forms large, monotypic stands throughout the temperate regions of the U.S. and Canada. It has a vigorous rootstock that serves as a storage organ, providing resources for growth in spring and re-growth if the plant has been damaged from cuttings. New stems emerge from the perennial roots enabling the plant to establish dense stands within a few years. Seedling densities can approach 10,000-20,000 plants/m² with growth rates exceeding 1 cm/day. A single, mature plant can produce more than 2.5 million seeds annually which can remain viable after 20 months of submergence in water. In addition, plant fragments produced by animals and mechanical clipping can contribute to the spread of purple loosestrife through rivers and lakes.

MANAGEMENT OPTIONS

1. Digging/pulling

Effectiveness:

Can be effective in small stands i.e., <100 plants, low-med density(1-75%area), & <3 acres, especially on younger plants.

Methods:

Hand-pull plants <2 years old. Use mini-tiller for plants >2 years - gets most of roots w/minimum soil disturbance, has 3 heavy duty prongs on 1 side that are pushed under base of plant, then pry back on handle to leverage plant out of ground. Tamp down all disturbed soil surfaces. Use weed wrench for plants > 2 years old - good w/minimal soil disturbance. In mucky conditions, put base of wrench on small piece of wood (e.g.: piece of 2x4) to keep wrench from sinking into mud. Use shovel for plants > 2 years old - dig up plant, then replace soil and any existing cover.

Cautions:

May increase habitat disturbance & increase spread of loosestrife. Requires follow-up treatments of sites for 3 years to eliminate re-sprouting from rhizome fragments left behind. Must pull/dig ENTIRE rootstock or re-rooting will occur. Must pull/dig before the plants begin setting seed or must remove flower/seed heads first (cut & place into bags) to prevent spread of seeds. Also remove previous year's dry seed heads. Erosion control may be necessary if greater than 25 square feet of soil surface is disturbed.

Disposal:

Bag all plant parts & remove from site. Compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits.

Sanitation:

Clean all clothing, boots, tools, equipment and transport vehicle to prevent spread of seed.

2. Cutting

Effectiveness:

Can be effective in small stands i.e. <100 plants, low-med density (1-75%area), & <3 acres, especially on younger plants.

Methods:

Remove flower heads before they go to seed so seed isn't spread during the cutting or mowing activity. Must do repeated cutting & mulching to permit growth of grasses.

Cautions:

Need to repeat for several years to reduce spread of plants. Doesn't affect rootstalk & thus, cut pieces can be spread that will re-sprout. Once severed, stems are buoyant and may disperse to other areas and re-sprout. Removal of seed heads should be done as late in the growing season as possible yet before seed set. Early cutting without additional seed head harvest could allow re-sprouting with greater subsequent seed production.

Disposal:

Bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits).

Sanitation:

Clean all clothing, boots, & equipment to prevent spread of seed.

3. Herbicide

Effectiveness:

Use when >100 plants & <3-4 acres in size.

Methods:

Use glyphosate formulations only. If possible spray seedlings before they reach 12" in height. Cut and bag flower heads before applying herbicide. Apply prior to or when in flower (late July/Aug) so plants are actively growing.

For spot application use:

- sponge tip applicator w/wick.
- injection into stem(w/large gauge needle).
- 32 oz. commercial-grade spray bottle with adjustable nozzle.

Cautions:

This herbicide is not selective (kills both monocots & dicots), thus should be applied carefully to prevent killing of non-target species. All treatment mixes should be mixed with clean (ideally distilled) water because glyphosate binds tightly to sediments, which reduces toxicity to plants.

Do not apply in windy conditions because spray will drift and kill other plants. Do not apply if rain is forecast within 12 hours because herbicide will be washed away before it can act. Choose Rodeo® formulation for applications in standing water or along a shoreline.

4. Biocontrol

Two species of leaf-feeding beetle, *Galerucella californiensis* and *G. pusilla*, have been shown to be effective in controlling purple loosestrife. Over 5 million of these beetles have been released in 30 states including New York, the northeastern and midwestern states as well as all of the Canadian Provinces. The beetles have shown dramatic decreases in purple loosestrife populations with subsequent increases in populations of native species. The scientific literature indicates that the beetles are very specific to purple loosestrife with only minor “spillover” effects that do not compromise non-target plant populations.

Effectiveness:

Use if site has at least a half acre of purple loosestrife of medium to thick density. Best type of control for large patches of loosestrife >3-4 acres.

Methods:

The number of beetles released per site should be based on the size of the site, the density of loosestrife and the economics of purchase. More beetles are generally better than fewer.

Cautions:

Use only if mowing, pesticide and herbicide use are not active practices on the site.

The site must not be permanently flooded and should be sunny. Use only if winged loosestrife, (*Lythrum alatum*) and waterwillow (*Decodon verticillatus*) are not major components of the plant community on the release site.

CONTROL METHODS FOR COMMON REED (*Phragmites australis* ssp. *australis*)

PLANT DESCRIPTION

Phragmites is a perennial grass that can grow to 14 feet in height. Flowering and seed set occur between July and September, resulting in a large feathery inflorescence, purple-

hued turning to tan. Phragmites is capable of vigorous vegetative reproduction and often forms dense, virtually monospecific stands. It is unclear what proportion of the many seeds that Phragmites produces are viable. **Please note that identification of phragmites should be done by a professional botanist prior to treatment to distinguish the invasive non-native race from the non-invasive native.**

MANAGEMENT OPTIONS

1. Cutting / Mulching

Effectiveness:

Need to repeat annually for several years to reduce spread of plants. Hand-pulling, though labor intensive, is an effective technique for controlling common reed in small areas with sandy soils.

Can be effective in small stands i.e. <100 plants, low-med density (1-75% area) & <3 acres. The cutting of larger stands having high stem densities is not an effective control method unless coupled with an immediate application of glyphosate to the freshly-cut, stem cross sections or with a cut-stem injection of glyphosate.

Methods:

The best time to cut common reed is when most of food reserves are in aerial portion of plant when close to tassel stage, e.g.: at end of July/early August to decrease plant's vigor. Some patches may be too large to cut by hand, but repeated cutting of the perimeter of a stand can prevent vegetative expansion. Common reed stems should be cut below the lowest leaf, leaving a 6" or shorter stump.

Hand-held cutters and gas-powered hedge trimmers work well. Weed whackers with a circular blade were found to be particularly efficient, though dangerous.

Cut and mulch dead stems in winter to remove them and promote germination of other species. Repeat in second year and then every 3-5 years.

Cautions:

Since common reed is a grass, cutting several times during a season, at the wrong times, may increase stand density. However, if cut in late July/early August, most of the food reserves produced that season are removed with the aerial portion of the plant, reducing the plant's vigor. This cutting regime may eliminate smaller colonies if carried out annually for several years. Manual or mechanical cuttings of larger, high density, monospecific common reed stands without the application of glyphosate, is not recommended.

Disposal:

Cut material should be removed from the site and composted or allowed to decay on the upland to prevent sprouting and formation of rhizomes. Do not attempt to compost rhizomes.

Sanitation:

Clean all clothing, boots, & equipment to prevent spread of seed.

2. Herbicide

Effectiveness:

Herbicide use is a 2 year, 2 step process because the plants may need a “touch-up” application, especially in dense stands since subdominant plants are protected by thick canopy & may not receive adequate herbicide in the first application.

Methods:

Use glyphosate formulations only. Apply after tasseling stage when nutrients going back to rhizome and will translocate herbicide into roots. After 2 to 3 weeks following application of glyphosate, cut or mow down the stalks to stimulate the emergence and growth of other plants previously suppressed. If the plants are too tall to spray, cut back in mid summer and apply glyphosate using a spray bottle for individual foliar spot treatments or swab, syringe w/large gauge needle or Nalgene wide-mouth, Unitary wash bottle to apply 1-2 drops of 50% glyphosate solution directly into each cut stem.

Cautions:

This herbicide is not selective (kills both monocots & dicots), thus should be applied carefully to prevent killing of non-target species. All tank mixes should be mixed with clean (ideally distilled) water because glyphosate binds tightly to sediments, which reduces toxicity to plants.

Do not apply in windy conditions because spray will drift and kill other plants. Do not apply if rain is forecast w/in 12 hours because herbicide will be washed away before it can act. Choose Rodeo® formulation for applications in standing water or along a shoreline.

3. Black Plastic

Effectiveness:

Can be effective in small stands i.e.:<100 plants, low-med density(1-75%area). Plants die off w/in 3-10 days, depending on sun exposure.

Methods:

Cut plants first to 6-8" (hand-pushed bush hog or week whacker w/blade). After cutting a stand of common reed, anchor a sheet of black plastic or dark tarp over the cut area using sand bags or rocks. High temperatures under the plastic will eventually kill off the plants. This technique works best when the treated area is in direct sunlight. Plastic should be at least 6 millimeters thick. Hold plastic in place with sandbags, rocks, biodegradable stakes, etc. Can treat runners along the plastic edges with a spot application of Rodeo® or Roundup®. The plastic can be removed the following year when the covered plants have been killed. A few common reed shoots may return. These can be cut, hand-pulled or re-treated with appropriate herbicide.d.

Cautions:

Must monitor to determine if shoots are extending out from under the plastic.

Disposal:

Can leave cut material under plastic or bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits.

Sanitation:

Clean all clothing, boots, & equipment to prevent spread of seed.

4. Pulling

Effectiveness:

Can be effective in small stands i.e. <100 plants. Very labor intensive control method, best results when infestation occurs in sandy soils.

Methods:

Hand-pull plants <2 years old. Use shovel for plants >2 years old-dig up plant, then replace soil and any existing cover.

Disposal:

Bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits).

Sanitation:

Clean all clothing, boots, & equipment to prevent spread of seed.

6. Excavation

Effectiveness:

Can be effective for patches up to ½ acre. Cost is the limiting factor.

Methods:

When working in wetlands only tracked equipment shall be used. Rubber-tired excavators can operate from adjacent pavement or upland areas.

Cautions:

The patch should be excavated to below the depth of rhizome development. Follow-ups later in the season or the following year must be conducted to verify that all the plants have been removed

Disposal:

Bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits).

Sanitation:

Clean all clothing, boots, & equipment to prevent spread of seed.

CONTROL METHODS FOR GARLIC MUSTARD (Alliaria petiolata)

PLANT DESCRIPTION

Garlic mustard is a naturalized European biennial herb that typically invades partially shaded forested and roadside areas. It is capable of dominating the ground layer and excluding other herbaceous species. Its seeds germinate in early spring and develops a

basal rosette of leaves during the first year. Garlic mustard produces white, cross-shaped flowers between late April and June of the following spring. Plants die after producing seeds, which typically mature and disperse in August. Normally its seeds are dormant for 20 months and germinate the second spring after being formed. Seeds remain viable for up to 7 years.

MANAGEMENT OPTIONS

1. Pulling.

Effectiveness:

Hand pulling is an effective method for removing small populations of garlic mustard, since plants pull up easily in most forested habitats. It is best to pull plants when seed pods are not yet mature, but they can be pulled during most of the year.

Methods:

Soil should be tamped down firmly after removing the plant. Soil disturbance can bring existing garlic mustard seed bank to the surface, thus creating a favorable environment for additional germination within the control site.

Cautions:

Care should be taken to minimize soil disturbance but to remove all root tissues. Re-sprouting may occur from mature plants root systems if not entirely removed. Cutting is preferred to pulling when garlic mustard infestations are interspersed amongst native grasses/forbs or other sensitive or rare flora.

Disposal:

If plants have capsules present, they should be bagged and disposed of to prevent seed dispersal. Bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits).

Sanitation:

Clean all clothing, boots, & equipment to prevent spread of seed.

2. Cutting

Effectiveness:

Cutting is effective for medium-to large-sized populations depending on available time and labor resources. Dormant seeds in the soil seed bank are unaffected by this technique due to minimal disturbance of the soil.

Methods:

Cut stems when in flower (late spring/early summer) at ground level either manually (with clippers or a scythe) or with a motorized string trimmer. This technique will result in almost total mortality of existing plants and will minimize re-sprouting.

Cautions:

Cuttings should be conducted annually for 5 to 7 years or until the seed bank is depleted.

Disposal:

Cut stems should be removed from the site when possible since they may produce viable seed even when cut. Bag all plant parts & remove from site (compost at DOT Residency, dispose in approved landfill or incinerate with appropriate permits).

Sanitation:

Clean all clothing, boots, & equipment to prevent spread of seed.

3. Herbicide

Effectiveness:

Roundup will not affect subsequent seedling emergence of garlic mustard or other plants.

Methods:

Use glyphosate formulations only. Should be applied after seedlings have emerged, but prior to flowering of second-year plants. Application should be by spray bottle or wick applicator for individual spot treatments.

Cautions:

This herbicide is not selective (kills both monocots & dicots), thus should be applied carefully to prevent killing of non-target species. All tank mixes should be mixed with clean (ideally distilled) water because glyphosate binds tightly to sediments, which reduces toxicity to plants.

Do not apply in windy conditions because spray will drift and kill other plants. Do not apply if rain is forecast w/in 12 hours because herbicide will be washed away before it can act. Choose Rodeo® formulation for applications in standing water or along a shoreline.

CONTROL METHODS FOR JAPANESE, GIANT AND BOHEMIAN KNOTWEED (*Fallopia japonica* ssp. *japonica*, *F. sachalinensis*, and *F. x. bohemica*)

PLANT DESCRIPTION

The knotweeds are herbaceous perennials which forms dense clumps 1-3 meters (3-10 feet) high. Its broad leaves are somewhat triangular and pointed at the tip. Clusters of tiny greenish-white flowers are borne in upper leaf axils during August and September. The fruit is a small, brown triangular achene. Knotweed reproduces via seed and by vegetative growth through stout, aggressive rhizomes. It spreads rapidly to form dense thickets that can alter natural ecosystems. Japanese knotweed can tolerate a variety of adverse conditions including full shade, high temperatures, high salinity, and drought. It is found near water sources, in low-lying areas, waste places, and utility rights of way. It poses a significant threat to riparian areas, where it can survive severe floods.

MANAGEMENT OPTIONS

1. Digging

Effectiveness:

This method is appropriate for very small populations.

Methods:

Remove the entire plant including all roots and runners using a digging tool. Juvenile plants can be hand-pulled depending on soil conditions and root development.

Cautions:

Care must be taken not to spread rhizome or stem fragments. Any portions of the root system or the plant stem not removed will potentially re-sprout.

Disposal:

All plant parts, including mature fruit, should be bagged and disposed of in the trash to prevent re-establishment (stockpile at DOT Residency, dispose of in an approved landfill or incinerate with appropriate permits).

Sanitation:

Clean all clothing, boots, & equipment to prevent spread of seed.

2. Cutting

Effectiveness:

Repeated cutting may be effective in eliminating Japanese knotweed. Manual control is labor intensive, but is a good option where populations are small and isolated or in environmentally sensitive areas.

Methods:

Cut the knotweed close to the ground at least 3 times a year. Plant native species as competitors as an alternative to continued treatment.

Cautions:

This strategy must be carried out for several years to obtain success. Both mechanical and herbicidal control methods require continued treatment to prevent reestablishment of knotweed.

Disposal:

Bag all plant parts & remove from site (stockpile at DOT Residency, dispose of in an approved landfill or incinerate with appropriate permits).

Sanitation:

Clean all clothing, boots, & equipment to prevent spread of seed.

3. Herbicide

Effectiveness:

Glyphosate treatments in late summer or early fall are much more effective in preventing re-growth of Japanese knotweed the following year.

Methods:

Use glyphosate formulations only. In late June/early July cleanly cut or mow down existing stalks/canes. Allow the knotweed to re-grow. After August 1, spray knotweed all re-growth with ROUNDUP®, RODEO®.

A cut-stem treatment utilizing glyphosate formulations can be an effective control for smaller colonies of knotweed. In early to mid-July cut the existing stems just below the 2nd or 3rd node above the soil surface. Immediately after cutting apply by swab or small spray bottle a 50% solution of glyphosate to the freshly-cut cross section and into the internodal cavity of each stalk/cane. Monitor treatment area by early to mid-August and repeat cut-stem treatment to any residual stems.

Stem injection is another promising control method for smaller colonies of knotweeds. Currently, a supplemental label for AQUAMASTER® (glyphosate) herbicide exists for this stem injection method. In late June/early July inject 5 mLs of AQUAMASTER® below the 2nd node above the ground of each stem in the clump. Use suitable equipment that must penetrate into the internodal region. JKInternational manufactures a stem injection tool that is suitable and recommended for this control method.

Cautions:

Established stands of Japanese knotweed are difficult to eradicate even with repeated herbicide treatments. However, herbicide treatments will greatly weaken the plant and prevent it from dominating a site. Adequate control is usually not possible unless the entire stand of knotweed is treated (otherwise, it will re-invade via creeping rootstocks from untreated areas).

These herbicides are not selective (kills both monocots & dicots), thus should be applied carefully to prevent killing of non-target species. All tank mixes should be mixed with clean (ideally distilled) water because glyphosate binds tightly to sediments, which reduces toxicity to plants.

Do not apply in windy conditions because spray will drift and kill other plants. Do not apply if rain is forecast w/in 12 hours because herbicide will be washed away before it can act. Choose Rodeo® formulation for applications in standing water or along a shoreline.

CONTROL METHODS FOR JAPANESE, MORROW'S, TATARIAN, AMUR AND BELL'S HONEYSUCKLES (*Lonicera morrowii*, *L. tatarica*, *L. japonica*, *L. maackii*, *L. x. bella*)

PLANT DESCRIPTION – JAPANESE HONEYSUCKLE

Japanese honeysuckle (*Lonicera japonica*) is a perennial trailing or climbing woody vine of the honeysuckle family (Caprifoliaceae) that spreads by seeds, underground rhizomes, and aboveground runners. It has opposite leaves that are ovate, entire (young leaves often lobed), 4-8 cm long, with a short petiole, and variable pubescence. In the southern part of the range the leaves are evergreen, while in more northern locales the leaves are semi-evergreen and fall off in midwinter. Young stems are reddish brown to light brown, usually pubescent, and about 3 mm in diameter. Older stems are glabrous, hollow, with brownish bark that peels in long strips. The woody stems are usually 2-3 m long, (less often to 10 m).

Lonicera japonica creates dense tangled thickets by a combination of stem branching, nodal rooting, and vegetative spread from rhizomes.

Lonicera japonica (including the varieties) is easily distinguished from native honeysuckle vines by its upper leaves and by its berries. The uppermost pairs of leaves of *Lonicera japonica* are distinctly separate, while those of native honeysuckle vines are connate, or fused to form a single leaf through which the stem grows. *Lonicera japonica* has black berries, in contrast to the red to orange berries of native honeysuckle vines. The fruits are produced September through November. Each contains 2-3 ovate to oblong seeds that are 2-3 mm long, dark-brown to black, ridged on one side and flat to concave on the other.

The fragrant white (fading to yellow) flowers of *Lonicera japonica* are borne in pairs on solitary, axillary peduncles 5-10 mm long, supported by leaflike bracts. The species has white flowers tinged with pink and purple. Individual flowers are tubular, with a fused two-lipped corolla 3-4(-5) cm long, pubescent on the outside. Flowers are produced late April through July, and sometimes through October.

MANAGEMENT OPTIONS

1. Mowing and Pulling

Effectiveness

Removing the above-ground portion of *Lonicera japonica* reduces current-year growth but does not kill the plant, and generally stimulates dense regrowth. Cut material can take root and should therefore be removed from the site (not practical with most infestations).

Methods

Hand pulling is highly effective. Pull out Japanese honeysuckle by the roots in winter wherever it climbs, aim the roots upward and tie them in place. The absence of light energy causes the trailing vines to decline precipitously next year. This method greatly reduces spraying requirements.

Cautions

Mowing is an ineffective control method, stimulating growth and encouraging formation of dense, albeit shorter, mats. Bush-hogging is an ineffective control, as *Lonicera japonica* re-invades within one growing season.

2. Herbicide

Effectiveness

In northern states, *Lonicera japonica* retains some leaves through all or most of the winter (semi-evergreen or evergreen), when most native plants have dropped their leaves. This provides a window of opportunity from mid-autumn through early spring when it is easier to spot and treat with herbicides, fire or other methods without damaging native species.

Controls

A foliar application of 1.5% glyphosate shortly after the first frost appears to be the most effective treatment, applied after native vegetation is dormant and when temperatures are near and preferably above freezing. Applications within 2 days of the first killing frost are

more effective than applications later in the winter. *Lonicera japonica* is less susceptible to herbicides after the first hard frost (-4°C).

Cautions

Soil disturbance should be avoided in infested areas to minimize germination of seed in the seedbank. Treated plants should be re-examined at the end of the second growing season, as plants can recover from herbicide application.

These herbicides are not selective (kills both monocots & dicots), thus should be applied carefully to prevent killing of non-target species. All tank mixes should be mixed with clean (ideally distilled) water because glyphosate binds tightly to sediments, which reduces toxicity to plants.

Do not apply in windy conditions because spray will drift and kill other plants. Do not apply if rain is forecast w/in 12 hours because herbicide will be washed away before it can act.

PLANT DESCRIPTIONS – BUSH HONEYSUCKLES

Exotic bush honeysuckles (Morrow's, Bell's, Amur and tatarian) are upright, multi-stemmed, oppositely branched, deciduous shrubs that range in height from 2 m to 6 m. The opposite leaves are simple and entire, and paired, axillary flowers are showy with white, pink, or yellow corollas. The fruits of *Lonicera* spp. are red, or rarely yellow, fleshy berries (Gleason and Cronquist 1991).

In flower, exotic bush honeysuckles can be distinguished from all native bush honeysuckles except swamp fly-honeysuckle (*L. oblongifolia*) by their hirsute (hairy) styles. In fruit, the red or rarely yellow berries of the exotics separate them from the blue- or black-berried natives waterberry (*L. caerulea*) and bearberry honeysuckle (*L. involucrata*). The exotic bush honeysuckles also generally leaf-out earlier and retain their leaves longer than the native shrub honeysuckles.

Within the exotic bush honeysuckles, *L. maackii* alone has acuminate, lightly pubescent leaves that range in size from 3.5 to 8.5 cm long and peduncles generally shorter than 6 mm. Its flowers are white to pink, fading to yellow, 15-20 mm long. Its berries are red or with an orange cast. Height ranges to 6 m.

In North America, there has been considerable confusion regarding the correct identification of *L. morrowii*, *L. tatarica*, and *L. x bella*, their hybrid. The literature contains a number of references to plants called by the name of one of the parents, but described as having characters more like those of the hybrid. *L. x bella*. The hybrid therefore, may be more common than the literature would indicate, and accurate field identification may be similarly problematic.

The two parent species of *L. x bella*, however, are dissimilar. *L. morrowii* has leaves that are elliptic to oblong gray-green, soft-pubescent beneath, and are 3-6 cm long. Its flowers are pubescent, white fading to yellow, 1.5-2 cm long, on densely hairy peduncles 5-15 mm long. The fruits are red. The height ranges to 2 m. *L. tatarica* has leaves that are ovate to oblong, glabrous, and are 3-6 cm long. Its flowers are glabrous, white to pink, 1.5-2 cm long, on peduncles 15-25 mm long. The fruits are red or rarely yellow. Height ranges to 3 m.

L. x bella has intermediate characteristics. The leaves are slightly hairy beneath. Flowers are pink fading to yellow, on sparsely hairy peduncles 5-15 mm. long. Fruits are red or rarely yellow. Height ranges to 6 m.

MANAGEMENT OPTIONS

1. Grubbing, Pulling, Cutting

Effectiveness

Mechanical controls include grubbing or pulling seedlings and mature shrubs, and repeated clipping of shrubs. Effective mechanical management requires a commitment to cut or pull plants at least once a year for a period of three to five years.

Methods

Grubbing or pulling by hand (using a Weed Wrench or a similar tool) is appropriate for small populations or where herbicides cannot be used. Mature *L. maackii* shrubs growing in shaded forest settings can be eradicated by clipping once a year, during the growing season, until control is achieved. Other bush honeysuckles growing in more open settings can be managed by clipping twice yearly, once in early spring and again in late summer or early autumn.

Cautions

Any portions of the root system not removed can resprout. Because open soil can support rapid re-invasion, managers must monitor their efforts at least once per year and repeat control measures as needed. Winter clipping should be avoided as it encourages vigorous re-sprouting.

2. Herbicides

Effectiveness

Most managers report that treatment with herbicides is necessary for the control of *L. maackii* populations growing in full sun and may be necessary for all large bush honeysuckle populations.

Controls

Use formulations of glyphosate (brand names Roundup, and for use near water bodies, Rodeo) as foliar sprays or cut stump sprays and paints with varying degrees of success. Glyphosate is a non-selective herbicide which kills both grasses and broad-leaved plants. For cut stump treatments, 20-25% solutions of glyphosate can be applied to the outer ring (phloem) of the cut stem. 2% solutions of glyphosate can be used for foliar treatments. Glyphosate should be applied to the foliage late in the growing season, and to the cut stumps from late summer through the dormant season.

Cautions

The subsequent flush of seedlings following all herbicide treatments must also be controlled.

These herbicides are not selective (kills both monocots & dicots), thus should be applied carefully to prevent killing of non-target species. All tank mixes should be mixed with

clean (ideally distilled) water because glyphosate binds tightly to sediments, which reduces toxicity to plants.

Do not apply in windy conditions because spray will drift and kill other plants. Do not apply if rain is forecast w/in 12 hours because herbicide will be washed away before it can act.

CONTROL METHODS FOR YELLOW IRIS (*Iris pseudacorus*)

Plant Description

Yellow iris (*Iris pseudacorus*) is a robust, clumping perennial herb in the Iridaceae (Iris family). *Iris pseudacorus* is easy to identify in flower, since it is the only totally yellow-flowered *Iris* in wild lands in the United States (Ramey 2001). At maturity, *I. pseudacorus* grows to a height of 0.40-1.5 meters (1.3-4.9 ft) tall. Its thick fleshy rhizomes often form dense horizontal mats, with each rhizome measuring 1 to 4 cm in diameter with roots that may extend vertically 10-20 (30) cm deep. The stiff, sword-like leaves are glaucous, number approximately 10 per ramet, are about 50-100 cm long by 10-30 mm wide, have raised midribs, and are arranged with sheathing and overlapping leaf bases (Crawford 2000; Jepson 1993; Sutherland 1990; Hitchcock & Cronquist 1973; Bailey 1949).

Flowers of *I. pseudacorus* are borne on tall erect peduncles. Each inflorescence may have one to several large, showy flowers (Hitchcock & Cronquist 1973). The flowers measure 8-10 cm in diameter and vary from pale yellow to almost orange in color (Sutherland 1990; Bailey 1949). The flowers are bisexual. The perianth segments (3 sepals and 3 petals) are fused at the base, and form a flaring tube with the sepals spreading and reflexed. The 3 stamens are each individually fused by their filaments to the sepals, and the showy tongue-shaped sepals are often adorned with brown spots or purple veins, and are generally less than 6 cm long. The petals are erect and less conspicuous, and are narrower than the sepals. The 3 style branches are petal-like with two-lobed lips, are mostly < 25 mm long, and are opposite and curved over the sepals (Jepson 1993; Hitchcock & Cronquist 1973). *I. pseudacorus* has an inferior, 3-chambered ovary. Fruits are elongated capsules.

Seeds of *I. pseudacorus* are pitted, pale brown, disc-shaped (roughly circular and flattened), and measure approximately 2.0-5.0 mm in diameter and 0.5-3.0 mm tall (Crawford 2000; Jepson 1993; Bailey 1949). Seeds are arranged in three densely packed vertical rows within the seed pod or capsule (Sutherland 1990). These erect capsules at maturity are a glossy green color and measure 4-8 cm in length, 5.0-8.0 mm in width, and are 3-angled and cylindrical (Jepson 1993; Hitchcock & Cronquist 1973).

1. Digging, Pulling, Cutting

Effectiveness

Manual or mechanical methods that remove the entire *I. pseudacorus* rhizome mass can successfully control small, isolated patches.

Methods

Pulling or cutting *I. pseudacorus* plants may provide adequate control, but only if it is repeated every year for several years to weaken and eventually kill the plant. Dead-heading (removing the flowers and/or fruits) from plants every year can prevent seed development and seed dispersal, but will not kill those plants.

Cutting the foliage, followed by a herbicide application (see below for details), can provide good control with minimal off-target effects.

Cautions

These methods, however, are very time and labor-intensive, since even small rhizome fragments can resprout. Additionally, digging disturbs the soil, may fragment rhizomes, and promote germination of *I. pseudacorus* and other undesirable species from the soil seed bank.

Care should be taken when pulling, cutting, or digging *I. pseudacorus*, since resinous substances in the leaves and rhizomes can cause skin irritation.

2. Herbicide

Effectiveness

Iris pseudacorus can be effectively controlled by herbicides. Since it usually grows in or adjacent to water, an aquatic-labeled herbicide and adjuvant must be used. Glyphosate (for example, trade names Rodeo[®], Aquamaster[®] or Glypro[®]) applied in a 25% solution (13% a.i.) using a dripless wick/wiper applicator, or applied in a 5 to 8% solution if sprayed, when used with the appropriate non-ionic surfactant adjuvant, can effectively kill *I. pseudacorus*. *I. pseudacorus* can be effectively controlled by stem injection utilizing Aquamaster[®] applied at .5 to .7 mL. of product per flowering stem.

Controls

The timing and choice of application technique will determine control efficacy and should work to minimize off-target effects. *Iris pseudacorus* can be controlled by either directly applying the herbicide to foliage, or by immediately applying herbicide to freshly cut leaf and stem surfaces. Herbicides can be directly applied to *I. pseudacorus* foliage or cut stems by a dripless wick system or using a backpack sprayer.

Cautions

These herbicides are not selective (kills both monocots & dicots), thus should be applied carefully to prevent killing of non-target species. All tank mixes should be mixed with clean (ideally distilled) water because glyphosate binds tightly to sediments, which reduces toxicity to plants.

Do not apply in windy conditions because spray will drift and kill other plants. Do not apply if rain is forecast w/in 12 hours because herbicide will be washed away before it can act.

Be sure to always take appropriate precautions and wear suitable clothing and equipment, and follow all instructions on the herbicide label. Use a biodegradable tracer dye in the herbicide mix so you can watch for accidental contact or spill of the herbicide.