Lakeshore
NATURE PRESERVE
UNIVERSITY OF WISCONSIN

Invasive Plant Control Handbook

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The control handbook documents the processes and procedures utilized by those individuals engaged in pest plant control in the Lakeshore Nature Preserve and will be shared with contractors, volunteers and staff. It is a fluid document impacted by continuing research, education and applied field experience.

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INVASIVE PLANT CONTROL HANDBOOK

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SECTION I – INVASIVE PLANT CONTROL STRATEGY AND TECHNIQUES

Introduction

This document aims to guide proper herbicide use in the Lakeshore Nature Preserve. Years of human use have modified the Preserve landscape and its biological interactions, introduced numerous aggressive non-native species, and shifted plant communities away from their native form. As management activities seek to cultivate native plant diversity, a variety of tools and techniques will be used to control vegetation inconsistent with our management objectives.

A number of resources have been consulted in the development of this document. UW-Madison Arboretum land care staff created a thorough Invasive Plant Control Strategy Handbook, which outlines best management practices for a variety of the most troublesome invasive plants common to this region, as well as proper herbicide use. They have graciously allowed the Preserve to adapt portions of their document for use here. Preserve staff also consulted with Tom and Kathy Brock, long-time supporters of the Lakeshore Nature Preserve (previously the Campus Natural Areas), and managers of Pleasant Valley Conservancy State Natural Area near Black Earth, WI. Their numerous years of experience successfully employing herbicides in ecological restoration efforts have provided a wealth of observations and tips for effective herbicide use. Additional input on herbicide best management practices was provided by Mark Renz, UW-Extension Weed Specialist.

Prior to initiating control efforts, the site in question is assessed to determine the scope of the infestation, as well as the status of the plant community that is being invaded. Understanding the life cycle and modes of dispersal for target species is critical to choosing the appropriate control methods. Other site conditions are also noted, such as topography, soil, hydrology, worker access, and likelihood of Preserve user access across the site. All of these factors play a part in determining the appropriate control methods and timing.

Manual and mechanical control methods (hand-pulling, digging, root-wrenching, cutting, and mowing) are generally the first tools employed to control a variety of invasive plant species. Such approaches often need to be repeated several times during the growing season for many years in order to maintain control over target populations.

For perennial invasive plants, control methods may seek to prevent seed production in the short-term, but eventually the root system must be destroyed to achieve control. When infestations are extensive and resources limited, proper herbicide application is the most practical means to achieve control of difficult invasive plants in an efficient manner. There are pros and cons to each control method, and the decision to use herbicide is never made lightly. Inappropriate use can result in significant damage to non-target organisms and the environment.

If needed, herbicides are utilized selectively in the Preserve, and are integrated with other techniques to achieve management goals. The use of hazardous persistent chemicals (i.e., those labeled as restricted use) or chemicals with the ability to leach and migrate from the application site are avoided.

INVASIVE PLANTS IN WISCONSIN'S NATURAL AREAS

Adapted from Wisconsin Department of Natural Resources:

Why are some plants so invasive?

As plants have evolved and moved around over the millennia, they have adapted to the community of other plants and animals that also existed in their habitat. Most plants have numerous insects or other animals that feed on them and various disease organisms that keep them from overpopulating their native homeland. Yet when these plants are moved to a new continent or region without these predators and diseases, they are given the opportunity to spread unchecked. In addition, some plants are pioneers, capitalizing on disturbed sites by rapidly reproducing and seeding in to bare soil. Fortunately not all non-native plants are weedy in natural areas, gardens, agricultural fields, wetlands and prairies. Some, such as honeysuckle and common buckthorn, have been a problem for a number of years and are now so abundant that most urban parks in the Madison area have few other plants beneath their branches. These European shrubs leaf out early and cast a dense shade, virtually eliminating spring wildflowers, native shrubs, and even tree seedlings. Other species, such as garlic mustard, are fairly recent invaders, very rapidly colonizing the forest floor in the last 10 years. Some plants have shown to be very weedy further east, south or west, yet have not yet become a problem here. Our cold winter temperatures or other environmental conditions limit the spread of some species not adapted to our area. But there are others that are very likely to become a problem here in the future.

Can these plants be eliminated?

Plants like common buckthorn and garlic mustard are already so abundant in the landscape that it is unlikely they ever will be eliminated. Yet with early and effective control measures we may be able to reduce their abundance and allow native plants to thrive once more. Other weeds, such as Japanese hedge parsley have only become established in a few sites and may still be able to be contained. Careful regular monitoring for new weed infestations can detect new outbreaks.

What measures are used to control these weeds?

Many of the herbaceous weeds and shallow-rooted shrubs can be hand-pulled. Take care to wear gloves as some of the plants contain toxic compounds. Prescribed burning controls many invaders in prairies and other grasslands. Carefully timed mowing can work for some weeds. For many trees, shrubs, vines and larger perennials, the most effective way to kill the plant is by cutting it and applying the proper herbicide to the cut stump. Leaves must be sprayed on some herbs and grasses. Specific control methods are gradually being developed for each species as landowners and managers experiment with different techniques. For most weeds, it is important to identify and control new infestations right away, and to prevent seed from being distributed.

What can you do about invasive plants?

Unlike many environmental problems, this one is close to home, often as close as your own yard or neighborhood park. There are many things that anyone can do to help contain these weeds:

- Learn to identify the most troublesome weeds in your area and start controlling them **before** they take over.

- Learn the most effective control methods for the plant. Experiment and find what works best for you.
- Join in a neighborhood -wide weed control effort such as Friends of the Lakeshore Nature Preserve annual “Garlic Mustard Pull”.
- Recruit friends and neighbors to help in a local weeding effort.
- Find out what landscape plants, herbs or other plants have the potential to be invasive and either remove them from your yard or remove and carefully dispose of the older flowers and seed heads (don't compost them - most weed seeds remain viable in the compost).
- Talk to friends and neighbors about weeds and help them identify and remove them from their yards.
- When planting, try using native trees, shrubs, vines, flowers and grasses to better harmonize with the natural landscape and to provide habitat for a diversity of butterflies, birds and other wildlife.

VOCABULARY

Exotic – Species from other places brought here after European settlement.

Flora – The species of plants in an area.

Forbs – Herbaceous plants, excluding grasses and sedges; especially used to describe broad-leaved, flowering plants. An herb that is not a grass, sedge, or rush.

Herb – An herbaceous (non-woody) plant.

Indigenous – A native species.

Introduced-escaped – Normally cultivated, but established (i.e., growing and reproducing) where not planted.

Introduced-naturalized – Well established, often widespread.

Invasive species – Non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to health.

Native – An indigenous species. A native plant historically occurs naturally somewhere within the boundaries of a given region.

Non-Native – A non-native species, or exotic, is a species introduced to a location outside its natural geographic range. Exotics enter an area as intentional horticulture, agricultural or arrive accidentally.

Pest Plant – Plants that “interfere” with the growth of desired species. Pest plants may be native or exotic.

Pioneer – A plant species that characteristically first colonizes exposed soils.

Weed – A plant, native or non-native, that grows where it is not wanted by humans.

PRIORITY INVASIVE PLANTS SPECIES OF THE NATURE PRESERVE

Target species are ranked on a variety of criteria (listed below). In specific project areas, priority species may be categorized differently than they are listed below based on site-specific conditions and management objectives. The list is not intended as a comprehensive list of all non-native species managed in the Lakeshore Nature Preserve, and will be continually updated as conditions change on the ground.

RANKING CRITERIA:

Adapted from the Invasive Plants Ranking System – Northern Prairie Wildlife Research Station:

1) Degree of ecological threat and impact
2) Means of reproduction
3) Stage of invasion
4) Competitive ability
5) Prevalence in surrounding region
6) Difficulty of control
7) Likelihood for successful control

Scientific Name	Common Name	Criteria	NR 40 Status
	HIGH PRIORITY SPECIES*		
Ampelopsis brevipedunculata	Porcelain-berry	1, 2, 3, 4, 5, 7	Prohibited
Torilis japonica	Japanese hedge parsley	1, 2, 3, 4, 5, 7	Prohibited/Restricted
	MEDIUM PRIORITY SPECIES*		
Alliaria petiolata	Garlic mustard	1, 2, 4,	Restricted
Celastrus orbiculatus	Oriental bittersweet	1, 2, 3, 7	Restricted
Chelidonium majus	Greater celandine	3, 5, 7	Prohibited/Restricted
Cirsium arvense	Canada thistle	1, 2, 4, 6	Restricted
Coronilla varia	Crown vetch	1, 2, 4, 6	Restricted
Dipsacus fullonum/D. laciniatus	Common and Cut-leaf teasel	1, 2, 3, 4, 5, 7	Restricted
Euphorbia esula	Leafy spurge	1, 2, 3, 6	Restricted
Hesperis matronalis	Dame's rocket	1, 2, 3	Restricted
Lonicera spp.	Bush honeysuckle	1, 3, 4, 7	Restricted
Lysimachia vulgaris	Garden loosestrife	1, 2, 3, 4, 5, 6	Restricted
Lythrum salicaria	Purple loosestrife	1, 2, 3, 4, 5, 6, 7	Restricted
Melilotus alba/M. officinalis	Sweet clovers	1, 2, 4, 6	
Pastinaca sativa	Wild parsnip	1, 2, 3, 7	Restricted
Phalaris arundinacea	Reed canary grass	1, 2, 4, 6	
Polygonum cuspidatum	Japanese knotweed	3, 4, 6	Restricted
Ranunculus ficaria	Fig buttercup	2, 3, 5, 7	Prohibited
Rhamnus cathartica	Common buckthorn	1, 4	Restricted

Scientific Name	Common Name	Criteria	NR 40 Status
LOW PRIORITY/WATCH LIST			
Acer tataricum subsp. ginala	Amur maple	3, 5, 7	Restricted
Aegopodium podagraria	Goutweed	3, 6	Restricted
Arctium minus	Burdock	2, 7	
Artemisia absinthium	Wormwood	3, 5, 7	Restricted
Berberis thunbergii	Japanese barberry	3, 5, 7	Restricted
Campanula rapunculoides	Creeping bellflower	2, 3, 5, 6	Restricted
Carduus acanthoides	Plumeless thistle	2, 3, 7	Restricted
Euonymus alatus	Winged burning bush	3, 7	Restricted
Iris pseudacorus	Yellow flag iris	3, 5, 7	Restricted
Leonurus cardiaca	Motherwort	3, 5	
Ligustrum spp.	Privet	2, 3	
Morus alba	White mulberry	3, 5	Restricted
Populus alba	White poplar	3, 7	Restricted
Robinia pseudoacacia	Black locust	5, 7	Restricted
Silene latifolia	Bladder campion	3, 5	
Valeriana officinalis	Garden heliotrope (Valerian)	3	Restricted

**See Section II for detailed species descriptions and control strategies.*

NR40 – INVASIVE SPECIES RULE

http://dnr.wi.gov/topic/Invasives/classification.html

The Invasive Species Identification, Classification, and Control Rule (Wis. Adm. Code Chapter NR 40) went into effect on September 1, 2009. The rule establishes a comprehensive, science-based way to classify and regulate invasive species in Wisconsin. The rule divides species into 2 categories, "Prohibited" and "Restricted," with different regulations and control requirements. The rule also establishes "Preventive Measures" to show what actions we can take to slow the spread of invasive species. Chapter NR 40 covers over 128 species, including plants, animals, and microorganisms. The rule affects everyone in Wisconsin.

Prohibited Invasive Species*

- Not yet in the state or only in a few places
- Likely to cause environmental and/or economic harm
- Eradication and prevention is feasible

Regulations: Cannot transport, possess, transfer, or introduce without a permit.**

Control Requirements: Control is required. DNR may order or conduct a control effort.

Restricted Invasive Species*

- Already widely established in the state
- High environmental and/or economic impacts are evident with these species
- Complete eradication is unlikely

***Regulations*:** Cannot transport, transfer, or introduce without a permit.**
Possession is allowed except for fish or crayfish.
Control Requirements: Control is encouraged but not required.

Preventive Measures

- Certain preventive measures are required under NR 40. These include actions such as removing plants and draining water from boats, complying with pest quarantines, and others.
- Best Management Practices are other preventive measures that will aid in rule compliance.
- These "BMP's" exist or are in development for many sectors. See the website for more info.

** Any viable part of the species is covered by these regulations.*

***Certain exemptions do exist with these regulations. Please consult with the website or DNR staff for clarification.*

INVASIVE PLANT CONTROL TECHNIQUES

(Originally written by Steve Glass, former UW Arboretum Land Care Manager; edited by Michael Hansen, UW Arboretum Land Care Manager and Marian Farrior, Earth Partnership Field Manager; further edited by UW Lakeshore Nature Preserve staff)

INTRODUCTION

This handbook describes the protocols followed by the Lakeshore Nature Preserve's program of woody and herbaceous invasive plant control. The handbook is written primarily for Preserve staff, contractors and volunteers responsible for planning and/or implementing invasive plant control efforts. It may also be useful to others attempting to restore biological diversity and integrity to prairies, woodlands, and wetlands. The handbook has three objectives:

1. Provide a how-to guide for staff, volunteers, and others interested in methods of invasive plant control;
2. Summarize knowledge of invasive plant control methods; and
3. Identify areas where research and field implementation is needed on invasive plant control methods.

The handbook draws on a combination of "on-site" work experience of Lakeshore Nature Preserve staff, studies conducted by UW Arboretum staff over the years, and invasive plant control methods borrowed from the many others working in this field.

The handbook includes advice on seasonal timing, worker safety and herbicide application issues. It also offers specific control methods for the priority invasive plant species that require management attention at the Lakeshore Nature Preserve. A plant's status as invasive may be site-specific and determined by the restoration and management goals for the ecological unit in question.

Included are mechanical, cultural, and chemical methods of invasive plant control and eradication. This list of control methods contains only those that have proven effective and are routinely used at the Lakeshore Nature Preserve. If a control technique is not mentioned, it does not mean that it is not effective under some circumstances. It just means that we do not employ it either because we have not had time to try it, or that we do not know about it. If you develop an effective invasive plant control technique, please let us know so we can try it.

The philosophy of invasive plant control at the Lakeshore Nature Preserve is effectiveness through persistence, thoroughness, and responsible use of herbicides. Chemical controls are used only if cultural or mechanical methods are ineffective.

We believe that a invasive plant control program is more than just attacking the species in question. Managers must do three other things to keep invasive plants in check: 1) eliminate the on-site disturbance that gives the species a foothold; 2) sow seeds or establish plants of desirable, appropriate native species in the invasive plant's place; and 3) find allies to help control the invasive plant species outside the Preserve's borders. Constant vigilance is required, and these measures must often be repeated again and again.

Research is needed to refine our understanding of such things as: lowest effective herbicide concentrations on a species-by-species basis; timing of treatments; best height for cut-stump treatment; and how long after a stump is cut can herbicide application be delayed and still be effective. See also: WI DNR website – Control Methods for Invasive Species.

WOODY INVASIVE PLANTS

BRUSH CUTTING AND HERBICIDING PROTOCOLS

SEASON: Fall is an ideal time of year to target many woody invasive plants. Introduced species such as buckthorn (*Rhamnus cathartica* and *Rhamnus frangula*) and honeysuckle (*Lonicera x bella*) are highly visible during October and November because these plants retain green leaves while native species are going dormant.

Invasive plant control work is performed year-round in the Preserve. Volunteers and interns work throughout the seasons to remove invasive brush. Fall is often the most effective time to remove brush and treat stumps with herbicide. Some winter herbicide treatments are effective and may be used to our advantage since there is usually more management time available than in the busy spring and summer.

CUTTING: The target species is cut by loppers or saws as close to the ground as possible. The cut needs to be made parallel to the ground to avoid leaving a sharp point, so herbicide applied to the stem remains in place, and so puncture wounds are less likely if one were to fall on the stem. The use of cutting alone will require repeated follow-up for many years to achieve control of target species. There are occasional circumstances when cuts are made 6 to 8 inches above ground line.

GIRDLING (from WI DNR): Remove the bark and cambium in a ring, 1-2" wide on smaller diameter trees and 6-8", extending entirely around a trunk or stem and cutting in only enough to interrupt the flow of sap. Herbicide can be applied to the wound, but if herbicide is not being used, girdling should be done in early spring. Thick barked trees may be girdled using a chainsaw; cut two rings 2-6” apart, making sure to cut beyond the cambium, and apply herbicide to the cuts.

BRUSH DISPOSAL: Currently, brush generated by land management in the Preserve is chipped and removed from the site, though there are situations where brush piles may be left for wildlife habitat. Wood chips are used to line trails or as mulch in plantings at Eagle Heights Community Gardens. Disposal methods depend upon the size of the brush, its density on the site, whether it’s fruiting or not, and the presence of desirable understory or herbaceous layer vegetation.

When working in a site with a dense stand of invasive species (hard to walk through), brush is hauled to the nearest trail or utility vehicle access point. Whenever possible, brush piles should be kept to a manageable size so they are easy for staff to pick up and run through the wood chipper or throw on the back of a truck. All branches should face the same way, with cut edges facing towards the firelane or road edge. The piles should not have a lot of cross branches, nor vines. If possible, avoid stacking brush on top of untreated cut stumps or on top of desirable vegetation.

HERBICIDE APPLICATION: Herbicide use should be planned to minimize exposure of applicators and the rest of the environment. The lowest effective concentration of herbicide is directed at the target plant by using cut stump or basal bark treatments. Foliar applications are used as a last resort. All herbicides must be applied according to the manufacturer's label recommendations and in a manner consistent with the label. The herbicide label is a legally-binding document. It is the applicator's responsibility to adhere to the label's requirements.

Cut-stump treatment is the application of a small amount of herbicide to the cut surface of a plant's trunk. Small, foam paint brushes, squirt bottles, or laboratory wash bottles make handy applicators. Staff and contractors also use Solo brand backpack low-pressure tanks with controlled spray to drip herbicide on the cut stump.

Cutting and treating is most efficient when workers are paired into teams with one person cutting and the other immediately applying herbicide. Cutters should not move too far ahead of herbicide applicators and should make sure that their applicator-partner treats all cut stumps. For this control technique to be most effective, treat the stump within 30 minutes after making the cut.

Basal bark treatment is the application of herbicide to the base of the trunk(s) of a standing, live plant, or to previously cut stumps that were not treated immediately. Only triclopyr ester formulations (Garlon® 4, Element™ 4, Pathfinder®) are used in this way. The herbicide is applied in a band around the trunk from 8" to 10" above the ground down, or the top of a cut stem, to the ground level. Care is taken not to drip chemical on the soil surface. A variety of homemade and professional application equipment is available as mentioned above. Basal bark is the most efficient and effective technique we have. A single applicator can easily treat up to 150 trees or shrubs per hour, working for two to three hours at a stretch.

HERBICIDE CHOICE: Garlon® 4/Element™ 4 (18% solution) is the first choice for woody invasive plant control at the Preserve. It is the one herbicide that will kill all woody species that are controlled through herbicide application. It may be applied 1) immediately to the cut surface when workers are paired into teams; 2) it may be applied on a delayed basis when brush cutting

and herbicide applications are widely separated in time; or 3) it may be applied to the base of standing, live trees up to 6" in diameter. Garlon® 4/Element™ 4 may be applied year-round but its use must be avoided under two circumstances: 1) when snow is on the ground, and 2) when temperatures exceed 75^0 F. Snow cover prevents treatment of the plant's root collar in basal bark and cut-stem applications, and applications made while snow cover is present is prohibited by the herbicide label.

Garlon® 4/Element™ 4 is extremely volatile. At air temperatures above 85^0 F to 90^0 F, chemical vapors pose an extra hazard to applicators and to desirable plants nearby that may be damaged by fumes wafting through the air. To be safe, the Preserve has set a safe temperature maximum of 75^0 F when using Garlon® 4/Element™ 4. Garlon®/ Element™ 3A is not as volatile as Garlon® 4/Element™ 4, but the same temperature maximum is Preserve policy.

Glyphosate and Garlon®/Element™ 3A are effective as cut-stump treatments if applied to the cut surface right away. They are also effective as foliar applications.

SAFETY: All invasive plant control workers must wear a long-sleeved shirt, long pants, gloves, eye protection and shoes plus socks. Having a change of clothes on site is a good idea. An herbicide spill kit should also be brought to the site. Herbicides should be applied by backing away from the treated area.

PUBLIC NOTIFICATION: The public must be notified of an herbicide application. The perimeter of a treated area is marked with 7"x11" herbicide application signs (see below) in metal sign holders. Signs are marked with the application date, safe entry date and the herbicide used.

FEDERAL AND STATE REGULATIONS: All federal and state regulations must be complied with. These regulations are covered in the University of Wisconsin Pesticide Use Policy.

HERBACEOUS INVASIVE PLANTS

STRATEGY: Many of the herbaceous invasive plants in our restored and remnant areas are annuals, biennials, or short-lived perennials. Species such as the sweet clovers and garlic mustard, for example, can be discouraged by hand pulling, mowing, or properly-timed burning. The strategy in these cases is to control or eradicate the species by eliminating seed production on site. For this reason, the timing of our control efforts is usually determined by the flowering period of the invasive plant in question. Furthermore, searching for the invasive plant when it is in flower is easier that at other times of the year.

EARLY DETECTION: Preserve lands are searched thoroughly and systematically each year to detect new invasive plant outbreaks. Small invasive plant populations can quickly become large patches if left uncontrolled.

Rapid growth rates, abundant seed production, effective dispersal and high germination rates can produce sudden population explosions that make early detection critical. The sooner we know about an invasive plant outbreak, the sooner we can begin the control effort and the more effective we are likely to be.

SANITATION: Many plant species world-wide are known to have the ability to "after-ripen," that is to nourish and ripen their immature seeds after the plant has been cut or pulled out of the ground. We know that sweet clover, garlic mustard, thistles, motherwort, burdock, and Dame's rocket, for example, after-ripen their seeds, so we make it a practice to bag and remove pulled and cut plants from the site.

MECHANICAL/CULTURAL CONTROL: In general, mechanical and cultural control methods – pulling, mowing, and burning – are used more frequently on herbaceous invasive plants than they are on woody species. The physical fragility of herbaceous plants, compared with woody ones, makes them more susceptible to physical damage than trees and shrubs.

There are exceptions, or course. Leafy spurge (*Euphorbia esula*) and Canada thistle (*Cirsium arvense*) are long lived, deep-rooted perennial species. They have proven immune to mowing, pulling, and burning. Therefore, herbicide application is the method of choice for control of these species.

Implementation of mechanical control methods should take into consideration impact on wildlife, and avoid or mitigate any land-disturbing activity which could result in erosion or promote weed seed germination.

HERBICIDE APPLICATION: Invasive grasses and forbs can present special problems for the herbicide applicator when they are embedded in a matrix of desirable native plants. The

herbicide applicator must pay attention to detail and take pains to avoid overspray to non-target plants.

Cut-stump application is just as effective on forb stems as it is on woody plant stems but it may be more tedious and take longer than a foliar application because of the large number of herbaceous stems typically found in a given area.

Wick applications use a sponge or wick on a long handle or cotton glove to wipe herbicide onto foliage and stems. Use of a wick reduces the possibility of spray drift or droplets falling on non-target plants and increases precision of applications. However, herbicide can drip or dribble from some wicks.

Foliar applications can avoid or minimize damage to native species by timing the treatment to coincide with native plant dormancy. Garlic mustard and Dame's rocket, for example, retain green, living basal rosettes throughout the year and may be targeted for herbicide application in early spring or late fall. At these times they are actively growing, but desirable plants nearby may be dormant.

SCALE OF INFESTATION: The mix of control methods used is determined by the size, density, and distribution pattern of the population, and the amount of time and labor available. For example, small, discrete, scattered patches of garlic mustard, sweet clover, or Dame's rocket covering a few square feet each, can be pulled or dug by a small group of workers in a few hours. By contrast, infestations covering hundreds of square feet may require a different approach. If time is short and labor resources scarce, mowing, burning, or herbicide application may be more appropriate.

SECTION II – PRIORITY INVASIVE PLANTS

This section provides descriptions of the highest priority species in the Preserve and outlines typical management approaches used for each species. The species descriptions are in alphabetical order and are taken from factsheets available online, with the source noted at the beginning of each description.

Alliaria petiolata Garlic mustard

From Wisconsin Department of Natural Resources website: http://dnr.wi.gov/topic/invasives/fact/garlicmustard.html

DESCRIPTION: Garlic mustard is a cool-season biennial herb that ranges from 12-48 inches in height as an adult flowering plant. Leaves and stems emit the distinctive odor of onion or garlic when crushed (particularly in spring and early summer), and help distinguish the plant from all other woodland mustard plants. First year plants consist of a cluster of 3-4 round, scallop-edged leaves rising 2-4 inches in a rosette. Second-year plants generally produce one or two flowering stems with numerous white flowers that have four separate petals. Garlic mustard is the only plant of this height in our woods with white flowers in May. Fruits are slender capsules 1-2.5 inches long that produce a single row of oblong black seeds with ridged seed coats. Stem leaves are alternate and triangular in shape, have large teeth, and can be 2-3 inches across in fruiting plants. Petioles are longer on the leaves towards the base. Garlic mustard can also be distinguished by its taproot, which is slender, white, and "s"-shaped at the top of the root.

Garlic mustard

DISTRIBUTION AND HABITAT: Garlic mustard is an exotic species introduced from Europe presumably by early settlers for its supposed medicinal properties and for use in cooking. It is widely distributed throughout the northeastern and Midwestern U.S. from Canada to South Carolina and west to Kansas, North Dakota, and as far as Colorado and Utah. In Wisconsin, the plant is currently concentrated in the southeastern and northeastern counties, although distribution records indicate its presence is nearly statewide.

Garlic mustard grows in upland and floodplain forests, savannas, yards, and along roadsides, occasionally in full sun. It is shade-tolerant, and generally requires some shade; it is not commonly found in sunny habitats. It cannot tolerate acidic soils. The invasion of forests usually begins along the wood's edge, and progresses via streams, campgrounds, and trails.

LIFE HISTORY AND EFFECTS OF INVASION: This species is a biennial that produces hundreds of seeds per plant. The seeds are believed to be dispersed on the fur of large animals such as deer, horses, and squirrels, by flowing water and by human activities. In our areas, seeds lie dormant for 20 months prior to germination, and may remain viable for five years. Seeds germinate in early April. First-year plants appear as basal rosettes in the summer season. First-year plants remain

green through the following winter, making it possible to check for the presence of this plant in your woods throughout the year. Garlic mustard begins vegetative growth early in the spring, and blooms in southern Wisconsin from May through early June. Fruits begin to ripen in mid-July, and are disseminated through August. Viable seeds are produced within days of initial flowering.

Garlic Mustard is a rapidly spreading woodland weed that is displacing native woodland wildflowers in Wisconsin. It dominates the forest floor and can displace most native herbaceous species within ten years. This plant is a major threat to the survival of Wisconsin's woodland herbaceous flora and the wildlife that depend on it. There are two modes of spread: an advancing front, and satellite population expansion possibly facilitated by small animals. Unlike other plants that invade disturbed habitats, garlic mustard readily spreads into high quality forests.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	**Preferred Timing**	**Comments**
Hand-pull second year plants by field staff or volunteers.	Through bloom time (usually May) but before seeds fully mature which is a few weeks after flowering. Place all plants in trash bags and remove from site.	For smaller, highly-patrolled areas, four to five years of sustained effort may be needed for near-eradication. Monitoring will be continuously needed.~~May take four to five years of sustained effort to be sure population is eradicated~~. Basal rosettes are evergreen.
Prescribed fire. Have to burn annually for 3-5 years. May be a two-edged sword. Unburned leaf litter will protect 2nd year root crowns; bare mineral soil, however, will promote survival of seedlings. Prescribed burns performed by contractor or staff.	A small ground fire can destroy light infestations of first or second year plants.	Prescribed fires are often patchy and may not burn infested areas. Thick growths of garlic mustard may retard the fire. Plants with deep taproots can resprout following top-kill from fire, and fire may stimulate germination of new seedlings. Do not rely on this method without a post-burn, walk-thru inspection.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon® 3A (1.5-3% a.i.) by contractor or staff.	As early in the season as discovered, but before seed set. Fall applications to first-year rosettes after desirable vegetation goes dormant.	Use only when and where desirable plants will not be harmed.
Vigilance and monitoring by field staff and volunteers.	Early detection is the key. Regular, systematic mointoring is necessary.	Commonly found at storm water entry points; animal and human trails; and the base of large trees.

Some tips for controlling garlic mustard by pulling
(Written by Steve Glass, former UW Arboretum Land Care Manager)

1. To be effective, the entire root must be pulled from the ground. Root fragments that are left behind will resprout. This is best done by:
    a. working when the soil is moist
    b. grasping the plant at the base, just above the soil line and pulling with steady force straight up - don't try to yank it out of the ground
    c. use a trowel or other tool to leverage the root out of the ground
2. Work a small area; be systematic and thorough. It's best to do a good job in a small area rather than a so-so job in a larger area.
3. Concentrate on flowering plants only as the goal is to prevent seed set; ignore the seedlings as many of them will die over the season anyway.
4. Garlic mustard must be treated as a biological hazard. All plants must be placed in trash bags and removed from the site. Garlic mustard will not wilt and die when left lying with exposed roots on the ground - it will continue to flower and set seed.
5. Use sturdy plastic trash bags.
6. Fill the bags only one half to three quarters full so as not to over stuff and puncture the bag. If the bags are ripped and the garlic mustard seeds are mature, the seeds can spill out and contaminate other areas.
7. Tie a knot in the top of the bag.
8. Transport all bags of garlic mustard to the Preserve's ~~Arboretum's~~ garbage dumpster near the seed shed. If the dumpster is more than half full, place bags on the ground against the side of the seed shed.
9. Congratulate yourself on a job well-done.

Ampelopsis brevipedunculata Porcelain-berry

From Wisconsin Department of Natural Resources website: http://dnr.wi.gov/topic/invasives/fact/garlicmustard.html
From National Park Service website: http://www.nps.gov/plants/alien/fact/ambr1.htm

DESCRIPTION: Porcelain-berry is a deciduous, woody, perennial vine. It twines with the help of non-adhesive tendrils that occur opposite the leaves and closely resembles native grapes in the genus *Vitis*. The stem pith of porcelain-berry is white (grape is brown) and continuous across the nodes (grape is not), the bark has lenticels (grape does not), and the bark does not peel (grape bark peels or shreds). The leaves are alternate, broadly ovate with a heart-shaped base, palmately 3-5 lobed or more deeply dissected, and have coarsely toothed margins. The inconspicuous, greenish-white flowers with "free" petals occur in cymes opposite the leaves from June through August (in contrast to grape species that have flowers with petals that touch at tips and occur in panicles. The fruits appear in September-October and are colorful, changing from pale lilac, to green, to a bright blue. Porcelain-berry is often confused with species of grape (*Vitis*) and may be confused with several native species -- *Ampelopsis arborea* and *A. cordata*.

Adam Gundlach, Lakeshore Nature Preserve

ECOLOGICAL THREAT: Porcelain-berry is a vigorous invader of open and wooded habitats. It grows and spreads quickly in areas with high to moderate light. As it spreads, it climbs over shrubs and other vegetation, shading out native plants and consuming habitat.

Porcelain-berry was originally cultivated around the 1870s as a bedding and landscape plant. In spite of its aggressiveness in some areas, it is still used in the horticultural trade (for example, the ornamental *A. brevipedunculata 'Elegans'* is often recommended as a landscape plant with a cautionary note that "care must be taken to keep it from overtaking and shading out small plants"). The same characteristics that make porcelain-berry a desirable plant for the garden -- its colorful berries, good ground coverage, trellis-climbing vines, pest-resistance, and tolerance of adverse conditions -- are responsible for its presence in the United States as an undesirable invader.

BIOLOGY & SPREAD: Porcelain-berry spreads by seed and through vegetative means. The colorful fruits, each with two to four seeds, attract birds and other small animals that eat the berries and disperse the seeds in their droppings. The seeds of porcelain-berry germinate readily to start new infestations. Porcelain-berry is often found growing in riparian areas downstream from established patches, suggesting they may also be dispersed by water. The taproot of porcelain-berry is large and vigorous.

Bryn Scriver, Lakeshore Nature Preserve

Resprouting will occur in response to cutting of above-ground portions.

Porcelain-berry grows well in most soils, especially forest edges, pond margins, stream banks, thickets, and waste places, where there is full sunlight to partial shade, and where it is not permanently wet. Porcelain-berry appears to be less tolerant of heavily shaded areas, such as that found in mature forest interiors.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	**Preferred Timing**	**Comments**
Hand pulling of seedlings and roots of young vines by staff and volunteers.	Young plants on loose, soils.	Bits of roots may resprout. Pulling the long roots, which run just under the soil surface for 10 feet or more, may damage other vegetation.
Cut-stump treatment with Garlon® 4/Element™ 4 (14-18% a.i.) by field staff.	Effective anytime on both fresh and old cut surfaces.	May not be effective for vines rooted in multiple locations along the stem, unless each rooting node is cut and treated. Do not perform treatment with snow cover.
Basal bark treatment treatment with Garlon® 4/Element™ 4 (14-18% a.i.) to large root crowns and rooted vines by field staff.	Fall is best, but any time of year except when snow is on the ground, or when temperature is above 75^0 F, or during sap flow.	Likely more effective than cut-stem application for mature vines rooted in multiple locations along the stem. Do not perform treatment with snow cover.
Foliar spray with Garlon® 3A (1.5-3% a.i.) or glyphosate (1.5-3% a.i.) by field staff.	Whenever plant is in leaf, but fall is best when native plants are going dormant.	Foliar spray is impractical on specimens twining towards the canopy of host plants. Use only on porcelain-berry clumps rambling over the ground.

Celastrus orbiculatus Oriental bittersweet

From National Park Service website: http://www.nps.gov/plants/alien/fact/ceor1.htm

DESCRIPTION: Oriental bittersweet is a deciduous, woody, perennial vine in the staff-tree family (Celastraceae), which sometimes occurs as a trailing shrub. Also known as round-leaved and Asiatic bittersweet, stems of older plants sometimes grow to four inches in diameter. Leaves of oriental bittersweet are glossy, rounded, finely toothed and arranged alternately along the stem. Clusters of small greenish flowers emerge from leaf axils, allowing each plant to produce large numbers of seeds. At maturity, globular, green to yellow fruits split open to reveal three red-orange, fleshy arils that contain the seeds. These showy fruits have made oriental bittersweet very popular for use in floral arrangements. Since this plant is easily confused with our native climbing bittersweet vine (*Celastrus scandens*), which flowers at the tips rather than along the stems, it is imperative that correct identification be made before controls are attempted. The native range of Oriental bittersweet is Eastern Asia, Korea, China, and Japan.

Oriental bittersweet

ECOLOGICAL THREAT: Oriental bittersweet is an aggressive invader that threatens all vegetation levels of forested and open areas. It grows over other vegetation, completely covering it, and kills other plants by preventing photosynthesis, girdling, and uprooting by force of its massive weight. In the northeastern U.S., exotic Oriental bittersweet appears to be displacing the native climbing bittersweet, *Celastrus scandens*, which occurs in similar habitats, through competition and hybridization.

METHODS OF REPRODUCTION & DISPERSAL: Oriental bittersweet reproduces prolifically by seed, which is readily dispersed to new areas by many species of birds. Its seeds germinate in late spring in partial to dense shade. It also expands vegetatively by stolons (above-ground stems), and rhizomes (underground stems), and through root suckering, the ability to send shoots up from the roots.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Hand pulling of roots by staff and volunteers.	Young plants on loose, sandier soils.	Bits of roots may resprout. Pulling the long roots, which run just under the soil surface, may damage other vegetation and cause soil disturbance.
Cut-stump treatment with Garlon® 4/Element™ 4 (14-18% a.i.) by field staff.	Effective anytime on both fresh and old cut surfaces.	Do not perform treatment with snow cover.

Control Methods	Preferred Timing	Comments
Foliar spray with Garlon®/ Element™ 3A (1.5-3% a.i.) or glyphosate (1.5-3% a.i.) by field staff.	Whenever plant is in leaf, but fall is best when native plants are going dormant.	Foliar spray is impractical on specimens twining towards the canopy of host plants. Use only on bittersweet clumps rambling over the ground.

Chelidonium majus Greater Celandine

From Wisconsin Department of Natural Resources website: http://dnr.wi.gov/topic/invasives/fact/celandine.html

DESCRIPTION: Greater celandine is an herbaceous biennial, sometimes perennial, that grows up to 2 feet tall with a semi-woody tap-root. It has sprawling branches and ribbed stems covered with soft hairs. When broken, it reveals an orange-yellow sap. Leaves are alternate, compound and deeply lobed, with rounded teeth. The leaves are up to 6 inches long and 3 inches wide, with 5 leaflets or lobes that are ovate. Leaves are slightly hairy, green above and pale green below, and have fine hairs along the leaf veins. When stems are broken, toxic orange-yellow sap exudes. The yellow flowers have 4 petals in axillary umbels of 3-8 flowers. Flowers bloom from April-September.

Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

Fruits are cylindrical seed pods ¾- to 2-inch long that taper toward the apex. The pods are hairless and constrict at interval as they ripen. The seeds are shiny black, oval, flat, and readily dispersed by ants. Seeds also have pitting on the surface.

Robert Vidéki, Doronicum Kft., Bugwood.org

Similar species: Celandine poppy (*Stylophorum diphyllum*; native) and horned poppy (*Glaucium flavum*; non-native) have similar yellow-orange sap and yellow, 4-petaled flowers. Celandine poppy is hairless and the flower petals are larger (¾- to 1-inch long). Horned poppy is hairy like greater celandine but its flowers are larger (2-3.5”) and more poppy-like. Narrowleaf bittercress (*Cardamine impatiens*; invasive) rosettes are similar to greater celandine but are hairless.

DISTRIBUTION AND HABITAT: Often found in roadsides, gardens, forest edges and woodlands. Celandine prefers disturbed areas with moist soil.

LIFE HISTORY AND EFFECTS OF INVASION: Greater celandine can outcompete native plants in minimally managed land and is very difficult to remove once established. Sap is irritating to the skin and eyes, making the plant unpalatable to most foragers. It is highly toxic to humans if ingested; however, it is commonly used in medicines.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Mowing/cutting by field staff.	Cut before seeds set.	Avoid skin contact with plant sap.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff or contractors.	Anytime plant is in leaf prior to seed set.	
Cut and bag seedheads and remove from site by field staff or volunteers.	Spring/summer months before mature seeds disperse.	Plants are easy to identify. Must wear gloves when removing. May need to monitor following cutting to see if re-flowering occurs.

Cirsium arvense Canada thistle

From Wisconsin Department of Natural Resources website: http://dnr.wi.gov/topic/invasives/fact/garlicmustard.html

DESCRIPTION: Canada thistle is a 2- to 5-foot tall dioecious perennial forb with slender, grooved stems that branch only at the top. Stems are slightly hairy when young and progressively more hairy as the plant matures. The leaves are smooth, oblong, tapering, somewhat lobed, and characterized by crinkled edges with numerous spines along the margins. Numerous and fragrant purple flowers grow to 3/4 inch in size from July to September. The small, light-brown seeds are slightly tapered, and have a tuft of tan hair loosely attached to the tip to enable wind dispersal.

DISTRIBUTION AND HABITAT: Canada thistle is native to Europe, not Canada, as its name suggests. Its current range encompasses the northern portion of the United States east of the Rocky Mountains. Canada thistle is considered a noxious weed under Wisconsin law and should not be allowed to go to seed.

Canada thistle
(c) John M. Randall/The Nature Conservancy

Canada thistle thrives in disturbed areas and in a wide variety of soils. In undisturbed prairies or shady woodlands, the plant becomes tall and lanky with few flowers. Although a high water table limits root development, it sometimes occurs in wetlands where water levels fluctuate (such as stream banks and ditches), and in wet prairies or sedge meadows adjacent to disturbed areas. It is abundant along roadsides and its seeds are spread by mowing after flowering has begun.

LIFE HISTORY AND EFFECTS OF INVASION: Canada thistle is an exotic, herbaceous, clone-forming perennial. The species is found in agricultural areas throughout Wisconsin. This thistle does not pose a serious threat to high quality natural areas, however, it can greatly reduce species diversity in old fields, disturbed natural areas, or areas under restoration. It is important to control this species prior to restoration work.

The plant grows in clonal patches of all female or male plants. As a result, some patches produce seeds and others do not. Seeds mature quickly and are capable of germinating within 8 to 10 days after the flowers open, even if the plants are cut when flowering. Most seeds germinate within one year, but may remain viable in the soil for up to 20 years. Seeds are mostly dispersed by wind.

The root system is usually within a foot of the surface, but may extend 6 feet deep or more in loose, well-tilled soil. The horizontal roots stemming from the fibrous taproot of a single plant can spread 10 to 12 feet in one season, resulting in a circular infestation 20 feet across. Aerial shoots are sent up in 2 to 6 inch intervals, and generally produce basal leaves the first year and flowering stems the next year.

Introduction to new areas occurs mostly by windborne seed, or sometimes by water runoff. Small sections of broken roots are capable of producing new plants.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	**Preferred Timing**	**Comments**
Mowing/cutting by field staff.	Cut in summer months during bud formation but before flowers open and seeds set.	Cuttings performed multiple times per season over the course of several years will weaken the root system. Can provide uniform regrowth for herbicide application.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff or contractors.	Anytime plant is in leaf prior to seed set.	
Cut and bag seedheads and remove from site by field staff or volunteers.	Summer months before mature seeds disperse.	Plants are easy to identify. Must wear gloves when removing. May need to monitor following cutting to see if re-flowering occurs.

Coronilla varia Crown Vetch

From Wisconsin Department of Natural Resources website: http://dnr.wi.gov/topic/invasives/fact/crownvetch.html
UW-Extension factsheet: http://learningstore.uwex.edu/Assets/pdfs/A3924-21.pdf

DESCRIPTION: Crown vetch is an herbaceous perennial in the legume family. This species has creeping stems that form dense colonies, growing 2-6 feet long. In winter and early spring, crown vetch can be easily recognized as large, brown patches. Leaves are pinnately compound, alternate and 2-6 inches long, with 11-25 elliptical leaflets occurring in an odd number. Leaves are hairless. The flowers are pea-like, ranging in color from pink or lavender to white. Flowers are clustered in flat-topped umbels of 14-20 flowers that grow on long stalks extending from the leaf axils. Blooms form from mid-spring through August. Long, slender, pointed seed pods contain 3-7 narrow seeds each develop in late summer. Seeds remain viable in the soil for up to 15 years. Crown vetch also reproduces vegetatively by fleshy rhizomes that grow up to 10 inches long. Roots are not fibrous, limiting the utility of crown vetch for erosion control.

Chris Evans, Illinois Wildlife Action Plan, Bugwood.org

Similar Species: Crown vetch can be distinguished from other plants in the legume family by its compound leaves that have an odd number of leaflets. Also, its leaves and flower stalks arise from the main stem and the species has flat-topped umbels.

DISTRIBUTION AND HABITAT: Crown vetch prefers sunny, open areas, but also has a broad environmental tolerance. It can grow in full to partial sun, is drought tolerant but also withstands heavy precipitation, and colonizes a wide range of soil types.

LIFE HISTORY AND EFFECTS OF INVASION: Crown vetch is difficult to control and rapidly reproduces vegetatively via rhizomes that can grow up to 10 feet per year. One plant may grow to completely cover 70-100 square feet within 4 years. Its seeds can remain viable in the soil for more than 15 years. It invades a variety of ecosystems, including prairies, grasslands, dunes, floodplains, forest edges, gravel bars in waterways, agricultural lands, and roadsides. Crown vetch alters native ecosystems through nitrogen fixation, enhancing soil fertility. It can climb over and smother shrubs and small trees as well as shade-out native herbaceous vegetation. Invasion of crown vetch can also change fire behavior by increasing fuel loads. Crown vetch has historically been planted for erosion control and is widely distributed throughout the state.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Repeated hand pulling	Prior to flower and seed set.	Effective for small patches. Remove entire plant and as much of the root system as possible. Root fragments will resprouts.
Mowing/cutting by field staff.	Prior to flowering. Mow in late spring (June), late July, and again in late August, correlated with leaf-out.	Will suppress but not completely control populations. Can provide uniform regrowth for herbicide application.
Prescribed burning	Late spring.	Will need to be repeated several years. Can kill germinating seedlings. May stimulate seed germination. Integrate other control methods.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff or contractors.	Early spring prior to flowering.	Glyphosate is non-selective and will kill any plant contacted.

Dipsacus fullonum **Common teasel**
D. laciniatus **Cut-leaved teasel**

From Wisconsin Department of Natural Resources website:
http://dnr.wi.gov/topic/Invasives/fact/CommonTeasel.html
http://dnr.wi.gov/topic/Invasives/fact/CutLeavedTeasel.html
UW-Extension factsheet: http://learningstore.uwex.edu/Assets/pdfs/A3924-14.pdf

DESCRIPTION: The teasels are herbaceous, monocarpic perennial species native to Europe. They grow as a basal rosette for at least one year, and then form a prickly, angled flowering stalk, 2-6 feet tall, typically in second or third year. Leaves of both species are opposite, large (up to 1.5 feet long), oblong, and prickly. Leaves of flowering plants are perfoliate, joining into cup around the stem. Leaves of cut-leaved teasel are broader and have deep, feathering lobes. Common teasel's leaves are not lobed. Both species have hundreds of small flowers, clustered in dense, egg-shaped heads. Stiff, spiny, leaf-like bracts curve up from base of flower head. Common teasel has purple flowers, bracts longer than the flower heads, and blooms from June-October. Cut-leaved teasel has bracts shorter than the flower heads, white flowers and blooms from July-September. Each plant can produce as many as 2,000 seeds, which remain viable in the soil for at least 2 years. Plants have deep taproots, up to 2 feet long and 1" in diameter.

Steve Dewey, Utah State University, Bugwood.org

Chris Evans, Illinois Wildlife Action Plan, Bugwood.org

DISTRIBUTION AND HABITAT: (From invasive.org) *Dipsacus* species. prefer open, sunny habitats and are commonly found growing in disturbed sites such as roadsides, ditches, waste places, riparian sites, fields and pastures, although it can sometimes be found in high quality areas such as prairies, savannas, seeps, and sedge meadows. It can be found in the northern states from Massachusetts to Colorado. This is an Early Detection Rapid Response plant for the Southeastern United States. It has been reported in Virginia, West Virginia and Kentucky.

LIFE HISTORY AND EFFECTS OF INVASION: (From WI DNR) Invades open areas, including prairies, savannas, and sedge meadows, as well as roadsides and disturbed areas. Rapid range expansion of teasel has been observed in several Midwestern states.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred timing	Comments
Cut below ground level with a sharp hoe or shovel by field staff or volunteers.	Spring or summer months prior to flowering.	Remove as much of the root as possible. Must wear gloves when removing.
Hand pull second year plants.	Spring or summer months prior to flowering.	Plants are easy to identify. Must wear gloves when removing.
Cut and bag seedheads and remove from site by field staff or volunteers.	Summer months before mature seeds disperse.	Plants are easy to identify. Must wear gloves when removing.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff.	As early in the season as discovered, but before seed set.	Use only when and where desirable plants will not be harmed.

Euphorbia esula Leafy spurge

From Wisconsin Department of Natural Resources website: http://dnr.wi.gov/topic/invasives/fact/leafyspurge.html
UW-Extension factsheet: http://learningstore.uwex.edu/Assets/pdfs/A3924-30.pdf

DESCRIPTION: Leafy spurge is an herbaceous perennial with deep root systems and milky sap (latex) in its stems, flowers, and leaves. Sap is distasteful to some animals and can cause blistering on their mouths or throats. Above-ground shoots grow 2-3 feet tall, with simple bluish-green leaves that are alternate, smooth, and hairless with pointed tips. Flowers are small, yellowish-green, and surrounded by cup-shaped bracts. The flowers are paired, arising in clusters of 7-10 pairs in umbels at the tops of stems. Flowers develop from late spring through mid-summer, forming capsules that contain three seeds each, which burst when dry, dispersing seeds explosively. Each plant can produce more than 250 seeds that remain viable in the soil for up to 8 years. Seeds are dispersed by wildlife, humans, and water. Leafy spurge has an extensive root system, with taproots extending up to 15 feet deep and lateral roots spreading up to 35 feet. New sprouts from root buds facilitate spread into undisturbed areas.

William M. Ciesla, Forest Health Management International, Bugwood.org

DISTRIBUTION AND HABITAT: Found across much of Wisconsin. Large infestations of leafy spurge give the landscape a yellowish tinge when in bloom, due to the yellow flower bracts. The plant is native to Europe and was introduced accidentally into North America in the early 1800s as a seed contaminate.

David Cappaert, Michigan State University, Bugwood.org

LIFE HISTORY AND EFFECTS OF INVASION:
Leafy spurge invades open areas, including prairies, savannas, and roadsides. It can quickly create monocultures, excluding native vegetation and reducing wildlife habitat value. It is tolerant of a wide range of habitats, from dry to moist and sunny to semi-shade. It is often most aggressive in areas where soil moisture is limited, as its deep root system allows it to draw on soil moisture other plants cannot reach.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Hand pulling of plants by field staff or volunteers.	Prior to seed production.	Only appropriate for small, young populations. If entire root is not removed, resprouting will occur. Must repeat until root system no longer resprouts.
Mowing/cutting	Repeated 2-4 week intervals during growing season. Be cautious of wildlife.	Will not eradicate but will suppress populations and prevent seed production. Also can provide uniform regrowth for herbicide application.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff or contractors.	As early in the season as discovered, but before seed set. Applications may be needed spring and fall.	Use only when and where desirable plants will not be harmed. Other herbicides are more effective, but pose potential off-target damage and the ability to migrate from the site of application.

Hesperis matronalis Dame's rocket

From Wisconsin Department of Natural Resources website: http://dnr.wi.gov/topic/invasives/fact/damesrocket.html

DESCRIPTION: Dame's rocket is a showy, short-lived perennial with large, loose clusters of fragrant white, pink or purple flowers that bloom from May to August on flowering stalks 2-3 feet in height. This member of the mustard family has flowers with four petals. Many seeds are produced in long, narrow fruits. The leaves are oblong, sharply toothed, and alternately arranged. Leaves decrease in size as they ascend the stem. The overwintering rosette is easily identified from fall through spring. This species is often confused with garden phlox (*Phlox paniculata*)l. Unlike dame's rocket, the phlox species have opposite leaves that are not toothed, and flowers with five petals, not four.

Dame's rocket

DISTRIBUTION AND HABITAT: Dame's rocket is native to Eurasia but was introduced to North America in the 1600's. This plant usually grows in moist and mesic woodlands, on woodland edges, along roadsides, and also in open areas.

LIFE HISTORY AND EFFECTS OF INVASION: Dame's rocket is planted as an ornamental, but quickly escapes cultivation because of its prolific seed set. Unfortunately, part of its success can be attributed to its wide distribution in "wildflower" seed mixes. It generally produces a basal rosette the first year, flowering the following year. The plants are prolific bloomers and produce large quantities of seed from May into July. Each plant may have several clusters of flowers at various stages of development, enabling the plant to produce both flowers and seeds at the same time. The effects of dame's rocket invasion are not known, but it may compete with native species.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Hand pulling of second year plants by field staff or volunteers.	Up to bloom time (usually May) but before seeds fully mature which is a few weeks after flowering. Place all plants in trash bags and remove from site.	May take four to five years of sustained effort to be sure population is eradicated. Basal rosettes are evergreen.

Control Methods	Preferred Timing	Comments
Prescribed fire. Have to burn annually for 3-5 years. May be a two-edged sword. Unburned leaf litter will protect 2nd year root crowns; bare mineral soil, however, will promote survival of seedlings. Prescribed burns are done by field staff.	A small ground fire can destroy light infestations of first or second year plants.	Prescribed fires are often patchy and may not burn infested areas. Thick growths may retard the fire. Do not rely on this method without a post-burn, walk-thru inspection.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff or contractors.	As early in the season as discovered, but before seed set.	Use only when and where desirable plants will not be harmed.
Vigilance and monitoring by field staff and volunteers.	Early detection is the key. Regular, systematic and thorough inspections of your property are necessary.	Commonly found at storm water entry points; animal and human trails; and the base of large trees.

Lonicera maackii	**Amur honeysuckle**
Lonicera morrowii	**Asian fly or Morrow's honeysuckle**
Lonicera tatarica	**Tartarian honeysuckle**
Lonicera X bella	**Bush honeysuckle**

From Wisconsin Department of Natural Resources website:
http://dnr.wi.gov/topic/Invasives/fact/AmurHoneysuckle.html
http://dnr.wi.gov/topic/Invasives/fact/MorrowsHoneysuckle.html
http://dnr.wi.gov/topic/Invasives/fact/TatarianHoneysuckle.html
http://dnr.wi.gov/topic/Invasives/fact/BellsHoneysuckle.html

DESCRIPTION: Exotic bush honeysuckles are dense, upright deciduous shrubs (3 to 10 feet in height) with shallow roots; opposite, simple, and oval or oblong leaves; and yellow, orange, or red berries. Tartarian honeysuckle has smooth, hairless, bluish-green leaves. Morrow's honeysuckle has downy leaves, while bella honeysuckle is a hybrid between the Tartarian and Morrow's varieties. The shaggy-barked older stems and branches of the shrubs are often hollow. Flowering occurs during May and June, and produces fragrant, tubular flowers arranges in pairs. Flowers of the Tartarian honeysuckle are generally pink to crimson in color. Flowers of the other bush honeysuckle species are white and become yellow as they age.

Morrow's Honeysuckle

SIMILAR SPECIES: *Lonicera maakii* is another invasive species that is troublesome in states to the south, and may become a problem in Wisconsin. The exotic bush honeysuckles are easily separated from native *Lonicera* species. All native honeysuckles of the *Lonicera* genera--grape honeysuckle (*Lonicera reticulata*), yellow honeysuckle (*Lonicera flava*), and red honeysuckle (*Lonicera dioica*)--are woody vine-like twining species. The exotics are stout, erect shrubs. *Diervilla* species are native bush honeysuckles with yellow flowers found in dry or rocky sites.

Tartarian honeysuckle

Bush honeysuckles are easy to find in early spring when they begin leaf development one to two weeks before native shrubs. Similarly, they hold their leaves later into the fall than native species. These species can be discerned from a distance during their flower and fruit periods in late spring and midsummer.

DISTRIBUTION AND HABITAT: Bush honeysuckles can live in a broad range of plant communities with varying moisture and shade levels. Most natural communities are susceptible to invasion by one or more of the species, with or without previous invasions. Woodlands are most affected, and are particularly vulnerable is the habitat is already disturbed. Bush honeysuckles thrive in sunny, upland habitats, including forest edges, roadsides, pastures, and abandoned fields. They can also be found in fens, bogs, and lakeshores.

Bush honeysuckles are native to Asia and western Europe. Tartarian honeysuckle was introduced to North America as an ornamental in 1752. The others were introduced in the late 1800's. Distribution is typically near large urban areas, but rural infestations have occurred where the species were introduced to provide wildlife with cover and a food source. Bush honeysuckles have naturalized from New England south to North Carolina and west to Iowa. Exotic honeysuckles have become widespread in Wisconsin. Their proliferation is due largely to horticultural plantings, especially in more urban southern and eastern Wisconsin. However, there are pockets of infestation in rural areas where honeysuckles were planted to improve wildlife habitat.

LIFE HISTORY AND EFFECTS OF INVASION: The widespread distribution of bush honeysuckle is aided by birds, which consume the ripened fruit in summer and disperse the seeds over long distances. The seeds appear to require a cold stratification period to break dormancy. Seedlings establish in sparse vegetation, and are usually found growing under tall shrubs or trees. Their vigorous growth inhibits development of native shrub and ground layer species; eventually they may entirely replace native species by shading and depleting soil moisture and nutrients. The early leafing of these species is particularly injurious to spring ephemerals, which have evolved to bloom before trees and shrubs have leafed out.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	**Preferred Timing**	**Comments**
Dig or pull shrubs by volunteers.	Spring or fall, when soil is moist.	Plants easy to find and pull at these times of year.
Fresh cut-stump treatment with glyphosate (20% a.i.), or Garlon®/ Element™ 3A (20% a.i.) by field staff.	Spring – except when sap is flowing – or fall. Winter application has also proven effective. Avoid temperatures that freeze solution.	Plants easy to find in early spring or late fall.
Basal bark spray with Garlon® 4/Element™ 4 (14-18% a.i.) by field staff.	Fall is best, but anytime of year except when snow is on the ground, or when temperature is above 80^0 F, or during sap flow.	Do not perform treatment with snow cover. Volatile at temperatures above 75^0 F – poses hazard to applicators and desirable plants.
Cut-stump treatment with Garlon® 4/Element™ 4 (18% a.i.) by field staff.	Fall is best. Spring – except during sap flow – is second best for reasons listed above.	Do not perform treatment with snow cover. Effective on both new and old cut surfaces.

Control Methods	Preferred Timing	Comments
Foliar spray glyphosate (1.5-3% a.i.) or Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff.	Anytime plant is in leaf. Least desirable method because more herbicide is used than with cut-stump or basal bark treatment and because chemical always drips onto ground and desirable plants.	Fall and spring are best because fewer desirable plants may be growing.

Lysimachia vulgaris Garden loosestrife

From Wisconsin Department of Natural Resources website:
http://dnr.wi.gov/topic/invasives/fact/gardenyellowloosestrife.html

DESCRIPTION: Garden loosestrife is an herbaceous perennial wetland invader with yellow flowers. Leaves are lanceolate-shaped leaves are arranged whorled or opposite along erect stems. Undersides of leaves have dot markings and are softly hairy. Flowers develop from June through early September on the stalks in a leafy, terminal inflorescence. The small yellow flowers have 5 petals. Egg-shaped capsules develop that contain a few seeds each. The plant spreads locally through long rhizomes that creep along the soil surface.

Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

Similar species: There are a number of native wetland plants in the same family as garden yellow loosestrife that also have yellow flowers (*L. quadrifolia*, *terrestris*, *ciliata* and *lanceolata*). Many of these do not have dots on the underside of the leaves. Garden yellow loosestrife is similar to the closely related purple loosestrife (*Lythrum salicaria*).

DISTRIBUTION AND HABITAT: Invades wet areas including wetlands, marshes, stream edges, lakes, and fens.

LIFE HISTORY AND EFFECTS OF INVASION:
Garden loosestrife is invasive throughout much of the United States and is banned from sale in Connecticut and Washington State. Plants reproduce both vegetatively and by seed. Seeds can remain viable in the soil for up to 20 years.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Hand pulling or digging of plants by field staff or volunteers.	Prior to seed production.	Only appropriate for small, young populations. If entire root is not removed, resprouting will occur.
Cut-stem herbicide application	Prior to seed set.	Effective for small populations.

Control Methods	Preferred Timing	Comments
Mowing/cutting	NOT RECOMMENDED, as stem fragments can be transported to new sites and may root to form new plants.	DO NOT MOW
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff or contractors.	Anytime plant is in leaf prior to seed set.	Use only when and where desirable plants will not be harmed. Ensure herbicide is approved for use in aquatic environs.

Lythrum salicaria Purple loosestrife

From Wisconsin Department of Natural Resources' website:
http://dnr.wi.gov/topic/invasives/fact/purpleloosestrife.html

DESCRIPTION: Purple loosestrife is a wetland perennial that grows 3-7 feet tall, with up to 50 stems topped with purple flower spikes. Plants typically have one main leader stem, but many side branches often make the plant look bushy. Many areas of the state use safe biocontrol beetles that feed on the loosestrife to keep it in check and allow other plants to grow.

David Cappaert, Michigan State University, Bugwood.org

Stems of purple loosestrife are green, sometimes tinged purple, stiff, erect, and generally 4-sided (older stems, 5 or 6 sided). Leaves are simple, lance-shaped and do not have petioles. The leaves are usually opposite and rotated 90 degrees from those below, but are sometimes whorled. Flowers are closely attached to the stem with 5-6 pink-rose colored petals. Blooms form from the bottom of the flower spike to the top starting in early July and continuing through September. Plants can bloom the first year after seeds germinate. The seed capsules burst open when mature in late July-September. A single stem can produce 100,000-300,000 seeds per year. Mature plants with many stems can produce 2 million seeds, which remain viable for at least 7 years. The root system is composed of a large woody taproot and many side roots. Plants intertwine to form dense clumps.

Similar species: Garden loosestrife (*Lysimachia vulgaris*) is a non-native, wetland garden escapee with yellow flowers. Smaller, native winged loosestrife (*L. alatum*) is found in moist prairies and wet meadows, has winged, square stems, solitary flowers in separated leaf axils, paired lower leaves and alternate upper leaves. Swamp loosestrife (*Decodon verticillatus*) arches out from shorelines, has mostly whorled leaves, and flowers in well-separated leaf axils.

John D. Byrd, Mississippi State University, Bugwood.org

DISTRIBUTION AND HABITAT: Found throughout Wisconsin. Prefers moist soils and shallow waters where it competes with native wetland plants. It will adjust to varying light conditions and water levels. *Lythrum salicaria* is native to Europe and Asia. It was first introduced into North America in the early 1800s for ornamental and medicinal purposes.

LIFE HISTORY AND EFFECTS OF INVASION: Has been widely planted as an ornamental where it escapes to nearby water ways. It is still sold in nurseries as a sterile variety; however, it can still produce viable seeds with wild varieties.

(From invasive.org) Purple is a serious invader of many types of wetlands, including wet meadows, prairie potholes, river and stream banks, lake shores, tidal and nontidal marshes, and ditches. It can quickly form dense stands that completely dominate the area excluding native vegetation. This plant can spread very rapidly due to its prolific seed production; each plant can produce up to 2.5 million seeds per year. It can also hybridize with native loosestrife species, potentially depleting the native species gene pool.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	**Preferred Timing**	**Comments**
Hand pulling or digging of plants by field staff or volunteers.	Prior to seed production.	Only appropriate for small, young populations. If entire root is not removed, resprouting will occur.
Mowing/cutting	NOT RECOMMENDED, as stem fragments may be transported to new sites and may root to form new plants.	DO NOT MOW
Cut-stem herbicide application	Prior to seed set.	Effective for small populations.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff or contractors.	Mid-summer prior to flowering and seed set.	Use only when and where desirable plants will not be harmed. Ensure herbicide is approved for use in aquatic environs.

Melilotus alba White sweet clover
Melilotus officinalis Yellow sweet clover

From Wisconsin's Department of Natural Resources website:
http://dnr.wi.gov/topic/invasives/fact/whitesweetclover.html
http://dnr.wi.gov/topic/invasives/fact/yellowsweetclover.html

DESCRIPTION: Yellow and white sweet clover appear very similar except for the distinguishing yellow or white flowers. Yellow sweet clover is usually smaller than white sweet clover and blooms earlier. Sweet clovers are members of the legume family. They are biennial. Plants are strictly vegetative in the first year and have a small, branched stem with clover-like leaves. Leaves are divided into three finely toothed leaflets, with the middle leaflet occurring on a distinct stalk. In the second year, plants may appear bushy, and grow from three to five feet in height. The flowers are packed densely on the top four inches of an elongated stem. Each small flower is attached to the stem by a minute stalk.

White sweet clover
Photo by Paul E. Berry
Wisconsin State Herbarium

DISTRIBUTION AND HABITAT: Sweet clovers are native to Europe and Asia. They were brought to North America in the late 1600's as an agricultural crop for forage and honey production. These clovers also fix nitrogen, and thus became popular as soil enhancers. The chemical used in the production of the blood thinner Warfarin was first discovered in sweet clover. Due to the economic values of white and yellow sweet clover, these species will continue to be planted despite the problems they pose for land managers.
Both species are found in all fifty states, although they are most frequently found in the states of the Upper Midwest and Great Plains. Sweet clovers grow well in direct sunlight or in partial shade. Neither species can tolerate complete shade. Sweet clovers seem to prefer calcareous or loamy soils, and are most frequently found in open, disturbed, upland habitats such as prairies, savannas, and dunes.

Yellow sweet clover
Photo by Kitty Kohout
Wisconsin State Herbarium

LIFE HISTORY AND EFFECTS OF INVASION: Sweet clovers are fire-influenced, aggressive, weedy plants that produce populations with high rates of fluctuation. Both species degrade native grasslands by overtopping and shading native sun-loving species.

Both white and yellow sweet clovers are biennials. After germination in late spring or summer, the plants put their energy into developing a healthy root system. First-year plants can be found in late summer. In the second year, plants may be seen in late April or early May. By that

time, individuals have a strong taproot and a root crown from which new shoots appear. Plant height is dependent on root development and growing conditions; healthier plants are taller. Sweet clovers flower from late May through September, set seed, and die. Both plants produce small, hardy seeds that remain viable in the soil for as many as thirty years.

Burning produces excellent growing conditions for clover by scarifying seeds and stimulating germination. During the next year following a burn, many flowering plants generally emerge.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	**Preferred Timing**	**Comments**
Pull by hand or dig with spade or other tool by field staff or volunteers.	Becomes possible only when plants start to bloom in mid-June to early July.	Once seed pods begin to form, plants should be bagged, removed from site and discarded.
Hand cutting or mowing by field staff.	When stem becomes woody you may cut at ground level and plant will not resprout. Cut/mow when first in flower but before seeds fully mature.	Pulling and cutting are feasible where plants are scattered. Dense stands should be mowed. Mow as close to ground as possible. Mowed areas should be checked for missed plants that will have to be hand cut or pulled.
Prescribed fire by field staff.	Research at the Arboretum (Kline) has shown that an April burn followed the next year by a May fire is an effective control.	Timing of the burn is critical. May burn should be conducted when second-year plants are 6” to 8” high. Method effective only to degree that April burn stimulates synchronous germination, as a few plants always fail to cooperate.

Pastinaca sativa Wild parsnip

From Wisconsin's Department of Natural Resources website: http://dnr.wi.gov/topic/invasives/fact/wildparsnip.html

DESCRIPTION: Wild parsnip is a member of the Umbelliferae (parsnip) family. Rosettes grow close to the ground and bear leaves averaging six inches in height. The plant has a long, thick taproot, which is edible. Flowering plants produce a single, thick stem that contains hundreds of yellow umbellate flowers. The lateral flowers often overtop the terminal flowers. Depending on the habitat and growing conditions, individual flowering plants range to over four feet in height. Leaves are alternate, pinnately compound, branched, and have saw-toothed edges. Each leaf has 5-15 ovate to oblong leaflets with variable toothed edges and deep lobes.

Wild parsnip Photo by Paul E. Berry
Wisconsin State Herbarium

Wild parsnip can be confused with prairie parsley (*Polytaenia nuttallii*), a native prairie species listed as threatened in Wisconsin. Its flowers and leaves resemble those of wild parsnip. Comparatively, flowers of the prairie parsley plant are light-yellow, sparse, and typically found at the end of the stem. The leaves are pinnately compound like those of the wild parsnip, but are oblong with few teeth.

DISTRIBUTION AND HABITAT: Wild parsnip is tolerant of a wide range of conditions, including dry, mesic, and wet-mesic prairies; oak openings; and calcareous fens. It is shade-intolerant and prefers sunny conditions.

LIFE HISTORY AND EFFECTS OF INVASION: Wild parsnip can cause phytophotodermatitis to the skin. If the plant juices come in contact with skin in the presence of sunlight, a rash and/or blistering can occur, as well as skin discoloration that may last several months.

This species reproduces readily from seed. Seeds are fairly large and many are produced on one plant. As a monocarpic perennial, wild parsnip spends one or more years as a basal rosette. When conditions are favorable, it flowers, produces seed, and dies. Look for the large, coarse, flower spikes and yellow flowers from the first of June to the middle of July (although some plants may continue flowering through late summer). Optimal growing conditions apparently stimulate an increase in flowering. Apparently seeds take at least three weeks from flowering to become viable.

Wild parsnip slowly invades an area in waves following initial infestation. Once the population builds, it spreads rapidly. This species is an aggressive, Eurasian weed that frequently invades and modifies a variety of open habitats.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Cut below ground level with a sharp hoe or shovel by field staff or volunteers.	Mid-June or when in flower but before seeds mature. Best to remove plants from site. Wild parsnip is a monocarpic perennial. It blooms only once but its habit is to come up year after year until it has produced seed. Digging the plant after it has flowered fools it into thinking it has produced seed.	Priority should be given to edges of paths. Plant is phytophototoxic. When plant juice touches the skin and is subsequently exposed to sunlight, painful and persistent blisters and scars develop. **Wear long sleeve shirts, long pants and gloves when working with this plant.**
Hand pulling of flowering plants by field staff or volunteers.	Mid-June or when plant is in flower.	See above.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/Element™ 3A (1.5-3% a.i.) by field staff or contractors.	Apply to rosettes in fall or spring	

Phalaris arundinaceae Reed canary grass

From Wisconsin's Department of Natural Resources website:
http://dnr.wi.gov/topic/invasives/fact/reedcanarygrass.html

DESCRIPTION: Reed canary grass is a large, coarse grass that reaches 2 to 9 feet in height. It has an erect, hairless stem with gradually tapering leaf blades 3 1/2 to 10 inches long and 1/4 to 3/4 inch in width. Blades are flat and have a rough texture on both surfaces. The lead ligule is membranous and long. The compact panicles are erect or slightly spreading (depending on the plant's reproductive stage), and range from 3 to 16 inches long with branches 2 to 12 inches in length. Single flowers occur in dense clusters in May to mid-June. They are green to purple at first and change to beige over time. This grass is one of the first to sprout in spring, and forms a thick rhizome system that dominates the subsurface soil. Seeds are shiny brown in color.

Reed Canary Grass
(c) Barry A. Rice/The Nature Conservancy

Both Eurasian and native ecotypes of reed canary grass are thought to exist in the U.S. The Eurasian variety is considered more aggressive, but no reliable method exists to tell the ecotypes apart. It is believed that the vast majority of our reed canary grass is derived from the Eurasian ecotype. Agricultural cultivars of the grass are widely planted.

Reed canary grass also resembles non-native orchard grass (*Dactylis glomerata*), but can be distinguished by its wider blades, narrower, more pointed inflorescence, and the lack of hairs on glumes and lemmas (the spikelet scales). Additionally, bluejoint grass (*Calamagrostis canadensis*) may be mistaken for reed canary in areas where orchard grass is rare, especially in the spring. The highly transparent ligule on reed canary grass is helpful in distinguishing it from the others. Ensure positive identification before attempting control.

DISTRIBUTION AND HABITAT: Reed canary grass is a cool-season, sod-forming, perennial wetland grass native to temperate regions of Europe, Asia, and North America. The Eurasian ecotype has been selected for its vigor and has been planted throughout the U.S. since the 1800's for forage and erosion control. It has become naturalized in much of the northern half of the U.S., and is still being planted on steep slopes and banks of ponds and created wetlands. Reed canary grass can grow on dry soils in upland habitats and in the partial shade of oak woodlands, but does best on fertile, moist organic soils in full sun. This species can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream banks, and seasonally wet areas; it also grows in disturbed areas such as bergs and spoil piles.

LIFE HISTORY AND EFFECTS OF INVASION: Reed canary grass reproduces by seed or creeping rhizomes. It spreads aggressively. The plant produces leaves and flower stalks for 5 to 7 weeks after germination in early spring, then spreads laterally. Growth peaks in mid-June and declines in mid-August. A second growth spurt occurs in the fall. The shoots collapse in mid to late summer, forming a dense, impenetrable mat of stems and leaves. The seeds ripen in late June

and shatter when ripe. Seeds may be dispersed from one wetland to another by waterways, animals, humans, or machines.

This species prefers disturbed areas, but can easily move into native wetlands. Reed canary grass can invade a disturbed wetland in less than twelve years. Invasion is associated with disturbances including ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, and intentional planting. The difficulty of selective control makes reed canary grass invasion of particular concern. Over time, it forms large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Foliar application of glyphosate (1.5-3% a.i.) or monocot-specific herbicide (sethoxydim/clethodim) in upland situations.	Results are best in fall (less likely to harm non-target plants then, too) but can be done whenever plants are found. Plants very noticeable in flush of growth after a burn.	May use cut-stem treatment on scattered clumps; foliar treatment on larger patches. Avoid overspray to desirable species. Use aquatic-approved formulation in wetlands.
Repeated cutting/mowing	At least 3 times during growing season – late-spring/early-summer, mid-summer, late-summer.	Suppresses growth and prevents seed production, but will not eradicate. Can be followed by foliar herbicide application in fall.
Cut seedheads by field staff or volunteers.	Prior to seed dispersal, cut off flowering heads or seed heads, bag and remove from site.	Slows spread of plant. May need to monitor following cutting to see if re-flowering occurs.

Polygonum cuspidatum Japanese knotweed

From Wisconsin Department of Natural Resources website:
http://dnr.wi.gov/topic/invasives/fact/japaneseknotweed.html
UW-Extension factsheet: http://learningstore.uwex.edu/Assets/pdfs/A3924-11.pdf

DESCRIPTION: Japanese knotweed is an herbaceous perennial that forms large colonies of erect, arching stems (resembling bamboo). Stems are round, smooth, and hollow with reddish-brown blotches. Plants reach up to 10 feet tall and the dead stalks remain standing through the winter. The leaves are simple, alternate, 3-4 inches wide and 4-6 inches long. Leaves are spade-shaped and more heart-shaped on young shoots. They have long petioles that are broad at the base, narrowing to a fine point at the tip. The upper surface is dark green while the lower surface is pale green. The small flowers are creamy white or greenish; borne in plume-like clusters in upper leaf axils near the end of stems. Flowers develop from August through September. Black seeds are small, triangular, and shiny. Viable seeds are only produced by female plants, and are rare since colonies seldom have both male and female plants. The seed is enclosed in a winged calyx that contributes to its buoyancy. The seeds have no dormancy requirement and germinate readily. White roots extend deeply into the soil creating a dense impenetrable mat. Roots form along rhizomes that can spread up to 65 feet. Plants can also produce adventitious roots on lower stems.

Tom Heutte, USDA Forest Service, Bugwood.org

Similar species: It has hollow stems with distinct raised nodes that give it the appearance of bamboo, though it is not related. Japanese knotweed is similar in appearance to Giant knotweed (*Polygonum sachalinense*; invasive); they are known to hybridize. The best way to tell them apart is by their leaf bases, Japanese knotweed is squared off while Giant knotweed is heart shaped.

DISTRIBUTION AND HABITAT: Common in areas of disturbance with high light levels, such as roadsides and stream banks, but can tolerate shade. New infestations of Japanese knotweed often occur when soil contaminated with rhizomes is transported or when rhizomes are washed downstream during flooding.

LIFE HISTORY AND EFFECTS OF INVASION: Poses a significant threat to riparian areas where it prevents streamside tree regeneration, and increases soil erosion. Root fragments as small as a couple inches can resprout, producing new infestations. Infestations disrupt nutrient

cycling in forested riparian areas. The plants contain allelopathic compounds (chemicals toxic to surrounding vegetation)

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Mowing/cutting	Repeated multiple times during growing season when plants reach 2-3 feet height.	Cuttings performed multiple times per season over the course of several years will weaken the root system of young patches. Established colonies will only be suppressed. Can provide uniform regrowth for herbicide application.
Hand pulling/digging	Repeated multiple times during growing season.	Remove as much of the root system as possible. Root fragments will resprout.
Cut-stem herbicide application with glyphosate (20-25% a.i.) or Garlon®/Element™3A (20-25% a.i.)	Anytime plant actively growing.	Allow 3 feet of growth prior to application.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/Element™ 3A (1.5-3% a.i.) by field staff or contractors.	Anytime plant actively growing.	Mow/cut and allow 3 feet of growth prior to application. Use aquatic approved herbicide in wetlands.

Ranunculus ficaria Lesser celandine

From Wisconsin Department of Natural Resources website:
http://dnr.wi.gov/topic/invasives/fact/lessercelandine.html

DESCRIPTION: Lesser celandine, also known as fig buttercup, is an herbaceous groundcover with kidney to heart-shaped leaves and showy, daisy-like yellow flowers. It rapidly reproduces vegetatively by abundant tubers and above-ground bulblets. The leaves are dark-green, shiny, and kidney to heart-shaped on short stalks. Leaves emerge from a basal rosette in early spring before canopy trees leaf out. Flowers are bright butter-yellow, glossy, and usually have 8 petals (although sometimes up to 12), arranged around a central disk. Numerous 1-inch flowers are borne singly on stalks. Flowers open in early spring, from March to April. This species does produce viable seed, up to 70 seeds per plant. After flowering, aerial vegetation dies back and entire plants can be dead by June.

Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

Above-ground whitish bulblets are produced on the stem axils, usually forming after flowering. Below-ground rhizomes are thick, finger-like tubers. These storage organs keep the plant alive through summer and fall when above-ground portions of the plant have senesced.

Similar species: Lesser celandine resembles marsh marigold (*Caltha palustris*) a native wetland plant found throughout eastern United States. Marsh marigold contains 5-9 yellow "petals" (actually sepals), while lesser celandine often contain 8 petals. Marsh marigold also does not produce tubers or bulblets. Lesser celandine varieties include 'Pencarn' and 'Buttered Popcorn'. Notable traits of these varieties are leaves variegated with silver markings and double flower heads. These varieties are considered equally as invasive. This species is unrelated to greater celandine (Cheidonium majus).

DISTRIBUTION AND HABITAT: Thrives in partial sun and moist soils, but also tolerant of drier, sunny sites. It invades forests, wetlands and riparian areas, as well as upland areas and disturbed areas such as lawns.

LIFE HISTORY AND EFFECTS OF INVASION: Infestations of this plant eliminate spring ephemeral communities in woodlands, which includes sensitive native plants. The species has been noted as invasive in neighboring states with similar habitats. It is extremely invasive in northern Ohio. In one Cleveland park, approximately 400 acres are dominated by this plant. Easily reproduces and spreads into new areas through bulbils and tubers, or seed.
Plants are poisonous to livestock and humans.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Hand dig/Pull	Early spring.	Effective for small populations. Remove all roots and bulblets.
Foliar spray with glyphosate (1.5-3% a.i.) or Garlon®/Element™ 3A (1.5-3% a.i.) by field staff or contractors.	Late-winter to early spring. Treat up until approximately 50% of population is flowering. Later treatments decline in efficacy.	Applications should be made early, prior to native spring ephemeral flower and amphibian emergence.

Rhamnus cathartica Common buckthorn
Rhamnus frangula Glossy buckthorn

From Wisconsin's Department of Natural Resources website:
http://dnr.wi.gov/topic/invasives/fact/commonbuckthorn.html

DESCRIPTIONS: Both common and glossy buckthorns are tall shrubs or small trees reaching 20-25 feet in height and 10 inches in diameter. Most often they grow in a large shrub growth form, having a few to several stems from the base. The shrubs have spreading, loosely-branched crowns. Their bark is gray to brown with prominent, often elongate, lighter-colored lenticels. The buckthorns share a very distinctive winter appearance having naked, hairy terminal buds and gracefully curving, or arched, twigs with closely-spaced, prominent leaf scars that give the twigs a warty or bumpy silhouette. Cutting a branch of either species exposes yellow sapwood and a pinkish to orange heartwood. Both species of buckthorn are distinctive enough from other native species to be identified at all times of the year once their characteristics have been learned.

Common Buckthorn

Glossy Buckthorn

The dioecious common buckthorn may be somewhat easier to spot when the female plants are in fruit. The columnar variety of glossy buckthorn has a very narrow upright form and is commonly used for wind or visual screening. Common buckthorn has dull green, ovate-elliptic leaves which are smooth on both surfaces and have minute teeth on the margins. They vary from rounded to pointed on the tip. Twigs of common buckthorn often end in thorns. Glossy buckthorn has thin, glossy, ovate or elliptic leaves. The upper leaf surface is shiny; the lower surface can be hairy or smooth and their margins are entire (not toothed). There are several ornamental cultivars of *Rhamnus frangula* including "columnaris" and "asplenifolia." It is believe that the seeds from these plants can disperse and produce weedy plants.

SIMILAR SPECIES: Alder buckthorn (*Rhamnus alnifolia*) is a small native shrub of less than 3 feet in height with twigs that are hairless and dark scales on the buds in winter. Lance-leafed buckthorn (*Rhamnus lanceolata*), found in bogs and swamps, is a small native shrub of less than 6 feet in height. Its leaves are 2-6 inches which gradually taper to a point at the tip that are alternate and has bud scales in the winter. Its leaves are 2-6 inches in length, alternately arranged, and gradually taper to a point at the tip. Branches bears bud scales in the winter.

DISTRIBUTION AND HABITAT: Common buckthorn and glossy buckthorn are two closely related species originating in Eurasia and were introduced to North America as ornamentals. They were planted in hedgerows in Wisconsin as early as 1849. They have become naturalized from Nova Scotia to Saskatchewan, south to Missouri, and east to New England. They are well established and rapidly spreading in Wisconsin. Although their aggressively invasive growth patterns have created problems in many areas, exotic buckthorns are still legally sold and planted as ornamentals.

Common buckthorn is a problem species mainly in the understory of southern oak, oak-beech, maple, and riparian woods, prairies, and savannas. It also occurs in thickets, hedgerows, pastures, abandoned fields, roadsides, and on rocky sites. It aggressively competes with local flora, mainly on well-drained soils.

Glossy buckthorn is an aggressive invader of wet soils. It has become a problem in wetlands as varied as acidic bogs, calcareous fens, and sedge meadows. It is capable of growing both in full sun and in heavily shaded habitats. The species is not confined to wetlands, however, and grows well in a wide variety of upland habitats, including old fields and roadsides. Neither species is adversely affected by nutrient-poor soils.

LIFE HISTORY AND EFFECTS OF INVASION: Both buckthorns are characterized by long distance dispersal ability, prolific reproduction by seed, wide habitat tolerance, and high levels of phenotypic plasticity (adjusting physical appearance to maximize environmental conditions). Under full sun conditions, they can begin to produce seed a few years after establishment. Fruit production may be delayed for 10 to 20 years in shaded habitats. Common buckthorn flowers from May through June and fruit ripens August through September; glossy buckthorn blooms from late May until the first frost and produces fruit from early July through September. The abundant fruits are eaten birds, thus encouraging the long-distance dispersal of horticultural plantings. Seedlings establish best in high light conditions, but can also germinate and grow in the shade. The exotic buckthorns have very rapid growth rates and resprout vigorously after they have been cut. Typical of several non-native understory shrub species, buckthorns leaf out very early and retain their leaves late in the growing season, thereby shading out native wildflowers.

The first few individuals established in a natural area are usually from seeds transported by birds. Once these individuals begin to produce seed, the buckthorns can rapidly form dense thickets. The vigor of buckthorns is positively correlated to light availability.

Once established, both buckthorn species have the potential to spread very aggressively in large numbers because they thrive in habitats ranging from full sun to shaded understory. Both species cast a dense shade as they mature into tall shrubs. This shading has a particularly destructive effect on herbaceous and low shrub communities, and may prevent the establishments of tree seedling.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Dig or pull by volunteers with shovels or weed wrench.	Spring or fall, when soil is moist.	Works best on those plants up to about 2" in diameter.
Fresh cut-stump treatment with glyphosate (20% a.i.) or Garlon® 4/Element™ 4 (14-18% a.i.) by field staff.	Effective most times of the year, but fall is best application time.	Do not perform treatment with snow cover.
Basal bark spray with Garlon® 4/Element™ 4 (14-18% a.i.) by field staff. (Note: a 6% Garlon® 4/Element™ 4 solution has been found to be > 95% effective on stems up to 2.75" in diameter at 18" above ground.)	Any time of year except when snow is on the ground. Fall is best because plants easily spotted and sap is running downward carrying herbicide to the root system.	Effective only on plants up to 4" to 5" in diameter at this concentration. Do not perform treatment with snow cover. Due to its volatility avoid using at temperatures above 75^0 F.
Foliar spray with Garlon®/ Element™ 3A (1.5-3% a.i.) by field staff.	Anytime plants in leaf. Least preferred method. More herbicide is used than with cut-stump treatment. Drips onto ground and can harm nearby desirable plants.	Spring and fall best. Not as volatile as Garlon® 4/Element™ 4, but best to avoid temperatures above 75^0 F.

Torilis japonica Japanese hedge parsley

From Wisconsin's Department of Natural Resources website:
http://dnr.wi.gov/topic/invasives/fact/japanesehedgeparsley.html
Invasive Plants of Minnesota:
http://www.friendsofeloisebutler.org/pages/plants/japhedgeparsley.html

DESCRIPTION: Japanese hedge parsley is an herbaceous biennial that grows up to 2-6 feet in height and has a spreading form. The first year plants have leaves that are low, parsley-like rosettes that stay green until late fall. The second year plants have leaves that are alternate, compound, fern-like, 2-5 inches long and slightly hairy. Flowers are tiny and white and grow in small, open, flat-topped umbels, with 2 or more pointed bracts at the base of each umbel. Blooms form in July and August. The small fruit ripens quickly, and is covered in hooked hairs that attach to clothing and fur.

Japanese hedge parsley

SIMILAR SPECIES: Queen Anne's lace or wild carrot (*Daucus carota*)—a widespread weed in Wisconsin—has similar finely-divided leaves, but leaves and stems are quite hairy and when crushed smell like carrots. Other look-alikes include wild chervil (*Anthriscus sylvestris*), caraway (*Carum carvi*), poison hemlock (*Conium maculatum),* Chinese hemlock parsley (*Conioselinum chinense*), sweet cicely (*Osmorhiza* spp.) and spreading hedge parsley. Spreading hedge-parsley (*Torilis arvensis*) is not currently known in Wisconsin, but nationally is more common than *T. japonica*. It looks very similar to Japanese hedge parsley but lacks the pointed bracts at the base of each umbel.

DISTRIBUTION AND HABITAT: Japanese hedge parsley's native range is Eurasia. It is currently observed throughout Iowa, Wisconsin, Illinois, Indiana, Ohio and Michigan. It is also seen in northern Missouri and into southern Ontario. Japanese Hedge Parsley grows from a thick taproot that develops during the first year of growth. It takes root in exposed disturbed sites, waste sites, path edges, in various soils, sandy preferred, in moist to dry conditions.

LIFE HISTORY AND EFFECTS OF INVASION: Japanese hedge parsley has been observed acting as a biennial similar to that of garlic mustard with seed possibly germinating in the fall as well as the spring. It is commonly found in disturbed, upland areas such as urban areas, railroad rights-of-way, roadsides, trails, or forest edges. It then proliferates into the adjacent grasslands, prairies, savannas, and forests. It tends to spread very quickly in areas high in human or animal traffic due to the fact that the fruits grab hold of nearly any fabric and any hairy appendage which happens to be exposed. Pets, such as dogs, and other animals appear to be spreading Japanese hedge parsley quickly throughout the state.

PRESERVE CONTROL RECOMMENDATIONS

Control Methods	Preferred Timing	Comments
Hand pull second year plants by field staff or volunteers.	Through bloom time but before seeds fully mature, which is a few weeks after flowering.	Place all plants in trash bags and remove from site.
Cut/mow	After bolted , but prior to flower/seed development.	May need to repeat to prevent flowering/seed production, though resprouting plants rarely produce viable seed.
Foliar spray with glyphosate or Garlon®/Element™ 3A (1.5-3% a.i.)	First year plants, or second year plants prior to flower production.	Only necessary for large infestations.

Section III – HERBICIDE USE GUIDANCE

(Originally written by Steve Glass, former UW Arboretum Land Care Manager; edited by Michael Hansen, UW Arboretum Land Care Manager and Marian Farrior, Earth Partnership Field Manager; further edited by UW Lakeshore Nature Preserve staff)

Volunteer Work Parties

Herbicide applications are generally not made during volunteer work parties at the Lakeshore Nature Preserve. If herbicides are to be used, work party volunteers should be informed during the introduction that herbicides may be used at the work party. Preserve staff or contractors will apply the herbicide, keeping well away from the work group and wearing appropriate safety equipment (boots, gloves, goggles, mask, etc.). Herbicide can always be applied soon after the work party. Once the herbicide application is completed, the area should be marked with a sign and/or flags indicating that pesticide has been applied.

Volunteers who do not wish to participate in work parties where herbicides are to be applied can be referred to the volunteer coordinator to see if there are other projects on which they would like to work.

Youth Activities

If brush is cut during a work party that involves youth (under the age of 18) and it is deemed necessary to apply the herbicide, the application should be done after the work party is over by Preserve staff or contractors. (In most cases, the herbicide used would be Garlon 4® to control woody plants.) However, the participants should learn during the session that herbicides would be applied later, as part of the Preserve's overall strategy of controlling invasive plants.

Archaeological Sites

When using herbicides in archaeological sites, considerations must be made to avoid damage to the site.

From ***UW-Madison Archaeological Sites: Land Management Guidelines November 2013 (pg. 12)***:

The use of herbicides to manage vegetation within habitation sites is generally acceptable, when pulling and cutting are not practical or desirable control strategies.

Use of herbicide may be necessary to control stump regrowth or certain persistent invasive species, but herbicide should only have a limited role in overall vegetation management. Spot application to individual plants/stems/stumps is the preferred application method. Broadcast applications should be avoided to limit alteration of soil chemistry, and to prevent the habitation site from being denuded of vegetation. If a broadcast application is deemed necessary to reclaim a site from an invasive species and prepare the site for establishment of desired vegetation, proper erosion control considerations must be made in the interim, until adequate ground cover vegetation is re-established.

Herbicide formulations that include phosphorous (e.g., the compound glyphosate) may leave a chemical signature in the soil that could compromise archaeological research activities. Glyphosate may occur in many herbicide formulations. Round-up (brand name) is one example of a glyphosate herbicide. Consult with Department of Campus Planning & Landscape Architecture (CPLA) staff to determine areas on campus that have been designated as high priority

archaeological research areas. Refrain from using herbicides containing phosphorus in these research areas.

GUIDELINES FOR HERBICIDE USE

PROTECTIVE GEAR FOR APPLICATORS/MIXERS

Mixing of herbicides is the most dangerous phase of herbicide use because the worker is exposed to raw, undiluted herbicide. Transporting herbicides by vehicle to the work site is the second riskiest part of herbicide use because of the potential for spills en-route and the increased difficulty of obtaining timely help in the field. The application of herbicides is the least risky if the worker is well-prepared and follows common-sense safety precautions. In all instances, however, worker safety is the primary concern. Applicators and mixers must wear the protective equipment required by the herbicide label. In addition, Preserve staff and volunteers must wear the following when mixing or applying herbicides:

1. Long-sleeved shirt
2. Long pants
3. Close-toed shoes plus socks
4. Rubber (nitrile) gloves
5. Safety glasses or goggles

Respirators are not recommended but will be provided for those who wish to use them. Respirators are hard to fit properly; they must be cleaned regularly to prevent bacteria buildup; and they may cause overheating, sweating and irritation which may increase the wearer's vulnerability to herbicide vapors. A hat is also recommended.

In general, herbicides are prepared by Preserve field staff or contractors. All safety equipment is provided by the Preserve to its staff.

STORING AND MIXING OF HERBICIDES

All herbicide mixing is done in the Preserve's Dairy Barn storage room. When weather conditions allow, both doors (front/exterior, and loading dock/interior) should be left open for cross-ventilation. For emergencies, a portable spill containment kit is kept in the cabinet to the left of the mixing table. This spill containment kit, or another one like it, must always be taken to the field when herbicides are being applied.

For personal safety, mixers and applicators have access to emergency eye wash above the sink next to the mixing table. When in the field, a portable safety kit must be taken along by the herbicide applicator.

TRANSPORTING HERBICIDES AND APPLICATION EQUIPMENT

Herbicides are transported to the field in the labeled container from which they will be applied. To prevent spills and contamination, herbicides should not be mixed in the field nor poured from one container to another in the field. Herbicides are taken to the work site in an open truck cargo bed, never in the cab, and never in an automobile trunk or passenger area.

Backpack herbicide sprayers are secured in the truck cargo bed with bungee cords strung between the shoulder straps and the tank body and secured to cargo tie-down rings. Handheld herbicide applicators are placed in a bucket with an absorbent material in the bottom, which is then similarly secured in the truck bed.

Buckets, bungee cords, etc. have designated storage places in the shop.

POSTING TREATED AREAS

State of Wisconsin regulations govern how, where and for how long treated areas are posted with informative signs. Staff, volunteers and the public should be kept out of treated areas at least until the herbicide dries. Drying time varies with temperature and humidity. After that, people are free to re-enter but Preserve policy is to post warning signs for 48 hours. Posting and removal of warning signs is the responsibility of the applicator.

The Preserve uses 7”x11” herbicide warning signs in metal sign holders to post treated areas. Herbicide warning signs are marked with a dry erase marker to indicate the name of the herbicide used, the date of application, and the date when re-entry is judged safe (48 hours later). Official herbicide warning signs are posted at regular intervals (spacing is site-dependent) around the perimeter of the treated area.

The herbicide warning signs are kept in the Dairy Barn storage room. Dry erase markers should be kept in each vehicle, and extras kept at the Dairy Barn and Herrick Drive storage rooms. Warning signs and dry erase markers will be provided by the Preserve.

EMERGENCY PRECAUTIONS AND EQUIPMENT

Accidents happen. To minimize these check your equipment before you head to the field and during the application. Make sure the applicator top or lid is tight. Check that hose connections are secure. Do not bend over when you are wearing a backpack to prevent the chemical from leaking out the top and down your back. Do not point the spray tip at yourself or others. Watch where you place your feet and look for tripping hazards.

In case something happens, a spill containment kit and a personal safety kit are carried to the field with the applicator. The spill containment kit is a bright yellow duffle bag in the lab. The kits have all the equipment and instructions to minimize environmental damage and personal harm if a spill occurs. If you or anyone else gets herbicide on their skin stop immediately to wash it off. If herbicide gets in your eyes or the eyes of someone else, use the eyewash bottles to rinse them out. If your clothes become saturated with herbicide, stop and remove them to prevent the herbicide soaking through to your skin. In all cases, clean up the mess, seek help if needed and call it a day. An accident report must be filled out and turned in to risk management within 48 hours.

EQUIPMENT MAINTENANCE

Preserve field staff cleans and maintains herbicide application equipment. On a regular maintenance schedule, the equipment are checked and faulty valves, gaskets and hoses are replaced. Nevertheless, spray tanks or bottles can develop leaks and break down between maintenance intervals. So, check the sprayer in the shop before you take it to the field. If the sprayer needs maintenance, put a repair tag on it, set it back on the shelf and choose another. Do the same thing if this happens in the field.

FIRST AID FOR PESTICIDE POISONING

In cases of emergency, call 9-1-1, and then follow the first aid guidelines below.

GENERAL FIRST AID

- Refer to the label for statement of practical treatment.
- Promptly seek medical help.
- Bring along the pesticide label or labeled container to give to the doctor, however, do not take the container with you in the passenger seat of a vehicle.
- If oral or dermal exposure has occurred, your first objective is to dilute the pesticide as quickly and as effectively as possible. You should always have a supply of water readily available when you are working with pesticides. You can use any source of fairly clean water, including water from lakes, ponds, watering troughs, etc.
- If inhalation exposure has occurred, get to fresh air immediately.
- If you are with someone who has been exposed to a pesticide and if his or her breathing has stopped or is labored, give mouth-to-mouth artificial respiration.
- Never try to give anything by mouth to an unconscious person.

SPECIFIC FIRST AID INSTRUCTIONS

Dermal Exposure

- Remove clothing if it has been contaminated.
- Drench skin with water.
- Wash skin, hair, and fingernails with soap and water.
- Rinse thoroughly and wash again.
- Dry and wrap in blanket.
- Where chemical burns of skin have occurred, cover area loosely with a clean, soft cloth. Avoid the use of ointments, greases, powders, and other medications.

Inhalation Exposure

- Get to fresh air immediately.
- If you are with someone who has been poisoned, carry (don't walk) the victim to fresh air immediately.
- Do not attempt to rescue someone who has been poisoned in an enclosed area if you don't have the proper respiratory equipment.
- Loosen all tight clothing.
- If breathing has stopped or is irregular, give artificial respiration.
- Victim should remain as quiet as possible.
- Prevent chilling (wrap in blankets, but don't overheat).
- If victim is convulsing, watch for breathing irregularities and protect the victim's heads form striking the floor or wall. Keep the victim's chin up so that the air passage will remain free for breathing.

Eye Exposure

- Hold eyelids open and wash eyes with a gentle stream of clean running water. Use large amounts of water. Do so immediately; delay of even a few seconds greatly increases the possibility of injury. Continue washing for 15 minutes or more.
- Use only pure water.

Oral exposure

- Do not spend a lot of time attempting to induce vomiting; get to a hospital as soon as possible.
- If a pesticide has gotten into your mouth, but has not been swallowed, rinse your mouth with large amounts of water.
- If the pesticide has been swallowed, the most important consideration is whether or not to induce vomiting; the decision must be made quickly and correctly. Where specific instructions are given, always follow label directions. Beyond that, never induce vomiting if:
    - The victim is unconscious or is having convulsions.
    - The pesticide is corrosive. A corrosive substance is any material, such as a strong acid or alkali (base), which causes chemical destruction of living tissue. The victim will complain of severe pain and have signs of severe mouth and throat burns.
- In attempting to induce vomiting, it is important to use safe and effective procedure. Vomiting should be induced with two tablespoons of Syrup of Ipecac and two glasses or water for an adult, or one tablespoon of Syrup of Ipecac and one glass of water for a child. If Syrup of Ipecac is not available, induce vomiting by drinking 1 or 2 glasses of water and then touching the back of your throat with your finger. Salt water should not be used to induce vomiting.
- Victim should be lying face down or kneeling forward while retching or vomiting, thus preventing vomitus from entering the lungs and causing further damage.
- Collect some of the vomitus for the doctor; it may be needed for chemical tests.
- Do not spend a lot of time attempting to induce vomiting; get to a hospital as soon as possible.
- Where the label identifies a specific antidote, this information is intended for use by a doctor. Antidotes should not be administered except under the direction of a physician or other medical personnel. Taken improperly, antidotes can be more harmful than the pesticide itself.

Shock

- Sometimes poison victims go into shock. If untreated or ignored the victim can die from shock even if the poisoning injuries might not be fatal.
- The skin will be pale, moist, cold, and clammy. The eyes are vacant and lackluster with dilated pupils. The breathing will be shallow and irregular. The pulse is very weak, rapid and irregular. The victim may be unconscious or go into a faint.
- Unless vomiting, keep the victim flat on his or her back and elevate legs 1 to 1½ feet above the head.
- Keep the victim warm enough to prevent shivering. Do not overheat.
- Keep the victim quiet and give reassurance often.
- Never try to give anything by mouth to an unconscious person.

Poison Control Center

- For any emergency, call: 9-1-1
- While hospitals and medical facilities may have some information, Poison Control Centers have the most complete and current files and their personnel are specifically trained to deal with poison cases. The services of Poison Control Centers are available to the general public; however, in an emergency, it is best to get to a doctor or to a hospital immediately and let them contact a Poison Control Center if necessary. National Poison Control hotline: 1-800-222-1222