



# WINNING THE WAR ON WEEDS

*A Guide to Adaptive Invasive Plant Management*

## A Publication of the Casco Bay Invasive Species Network

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### DISCLAIMER

This document represent the cumulative experience of a handful of practitioners working on terrestrial invasive plant management in southern coastal Maine. While its authors are professionals, and while the methodology outlined below has proven effective for us, we are by no means the definitive resource on invasive plant management, and this is not the only management framework. We encourage you to do further research and speak with other professionals before diving into any serious invasive control project.

**A FINAL NOTE OF CAUTION:** while it is reiterated in several places throughout this guide, we can't stress enough the need to **READ ALL HERBICIDE LABELS THOROUGHLY AND KNOW THE REGULATIONS BEFORE YOU BEGIN ANY KIND OF CHEMICAL CONTROL!** Herbicides are an extremely important tool in the toolbox of invasive plant management, but they do require extra attention to detail.

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***I**nvasive plant management can be intimidating for land stewards, foresters, and landowners. Taking the time to sit back, assess the situation, and set priorities and achievable goals can make a big difference. This isn't a "once and done" kind of effort—we have to be strategic and consider what we can commit to managing over the long term. Prioritize prevention; get rid of newcomers and monitor your treatment sites; and pick your battles with established invasive plants where they are doing the most harm. This Guide to Adaptive Management will help you to get started or check your progress!*

*Nancy Olmstead  
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## **INTRODUCTION**

It is not the intent of this document to provide the reader with exhaustive, species-by-species accounts of non-native invasive plants and the threats they pose. Persuasion, likewise, is also not the goal: the authors assume that if you're taking the time to read this guide, you no longer need to be disabused of the erroneous notions that invasives are merely a nuisance, or newcomers that simply have an anthropogenic leg-up on native species, or provide suitable food and shelter for wildlife. The authors assume you already know who the offenders are and just how destructive they can become.

This guide, then, is for the practitioner who is ready to take action, but who—perhaps with a chagrined glance at a dull pair of loppers—is intimidated by that unruly wall of unwanted vegetation and doesn't know where to begin. It is far too easy to squander time, sweat, money, tools, chemicals, and good will in a losing battle. Restoration of many invaded sites is possible—but it takes planning, the willingness to constantly re-evaluate, and in most cases, a multi-year commitment. We hope the pages that follow help you determine where to begin, what to do—and when to walk away.

## WHAT IS ADAPTIVE MANAGEMENT?

Adaptive management is an iterative, and, ideally, self-correcting approach to natural resources management. Simply put, the resource manager seeks to improve the management methodology over time by monitoring the system or resource, learning more about it in so doing. Adaptive management is particularly well-suited to situations where there are uncertainties in the outcomes of management activities. While there is a significant body of knowledge about the threats posed by invasive plants, and the best control methods for many species, invasives management in natural areas is a somewhat new field, and species respond differently to control methods in different settings and at different times of year. In a human-dominated landscape, there may also be uncertainty as to how the public will react, and this is also part of the adaptive management equation. Funding and manpower—resources, in other words—may also introduce additional uncertainty.

To bring this home, let's look at a hypothetical stand of Japanese barberry in an otherwise intact, forested natural area. The desired outcome is to eradicate barberry, and the land manager decides pulling it out of the ground is the best way to proceed. They recruit volunteers, spend all their money on Weed Wrenches™, and march into the woods. After an exhaustive effort—because there is always more barberry than you thought, those spines are sharp, and Weed Wrenches™ get heavy—the crew limps into the sunset. The following year, the ground is covered with seedling barberry plants, and all the volunteers have changed their phone numbers and email addresses. Where does our beleaguered manager go from here?

If our manager had been following the principles of adaptive management and planned the control strategy a little more thoroughly before getting started, he or she might be less likely to tear their hair out in frustration. They would have known barberry generates a phenomenal number of seeds which readily sprout in

full shade and disturbed soils, and they would have realized Weed Wrenches™ only work on large plants, making them useless for seedlings and young plants. For the smart weed warrior, adaptive management simply means thinking through each aspect of a control program, from biology to budget, and being prepared for all possible outcomes.

## BASIC PRINCIPLES OF INVASIVE MANAGEMENT

### On Disturbance

*Primum non nocere*: first, do no harm. A basic tenet of the medical world, all invasive plant managers should operate under this principle as well. Whether invasive terrestrial plant species came here as hitchhikers or our invited guests, they all spread for one primary reason: disturbance. Invasive plant management causes still more disturbance, but the wise practitioner will seek to minimize and remediate that disturbance. Before you hitch that mature Morrow's honeysuckle to the back of your truck and put it into gear, think about the vast seed bank likely present, and what the effects of that amount of soil disturbance might be. In some instances, such as in overwhelmingly invaded areas with little native vegetation left, there might be no other alternative than bringing in a flail mower or hydro-ax, but at low to moderate levels of invasion, seek control methods that disturb as little soil as possible.

### There's More Than One Way To...

Leaving any proverbial domestic felines out of it for the time being, there is certainly more than one way to kill a plant. Without delving into the details—which are summarized in **Appendix A** at the end of this document—the three general methods of killing plants are:

### Carbohydrate Starvation

Put another way, this is a war of attrition wherein the land manager wears the plant down to the point of death by exhausting its root reserves. A perennial plant (one which grows back year after year, such as a maple tree) grows leaves, undergoes photosynthesis,



then shuttles the sugars the leaves produce back down into the root system for long-term storage. Winter comes; the leaves die, but the plant will produce new growth the following spring using what it created and stored last summer. Through carbohydrate starvation, practitioners remove the above-ground portion of the plant again and again until there's nothing left in the root system. Repeated cutting, mowing, burning, grazing, and use of contact herbicides are all forms of carbohydrate starvation. This can take several cuttings a summer for many years, depending on the species and size of the plant. Note that this is not particularly useful for control of annual and biennial species!

### Physical Removal

As straightforward as it sounds, in this method, the practitioner simply pulls or digs the offending plant from the earth. Depending on the species, some root fragments may remain in the soil and re-sprout, which requires either more digging, or repeat cutting as described above. If you read On Disturbance above, you may be wondering about the possible ill effects of this method, in which case: good for you! Only pull small individuals, species whose control via pulling is actually recommended, and do so when soil is moist if at all possible. (**Note:** under no circumstances is digging out Japanese knotweed recommended, despite many who suggest otherwise. The exception to this is if you have access to a backhoe... and an incinerator.)

### Systemic poisoning (or, causing biological death *in situ*)

Herbicide is plant poison, and this will be covered in more detail below. Rather than wearing the plant down or physically removing it, a systemic herbicide applied to the plant will cause it to wither and die right where it's growing. Particularly tenacious species may require more than one herbicide application, or some other follow-up or precursor control method.

### Better living through chemistry

Herbicides are often a critical component of invasive plant management. Many are the practitioners who go into a stand of weeds armed with hand tools and good intentions, only to return with a backpack sprayer once the problem is out of control! There are two basic kinds of herbicide: systemic and contact. A systemic herbicide is applied to a certain part of the plant, usually the leaves, whereupon it moves through the plant, ultimately causing its death through a variety of biological pathways. One of the best-known systemic herbicides, glyphosate (the active ingredient in Round-up®), inhibits the production of an enzyme critical to the synthesis of certain amino acids. By contrast, a contact herbicide only kills plant tissue it comes in contact with.

The two most common methods of applying herbicide to invasive plants are foliar application (spraying the leaves) of a dilute solution, or by putting a more concentrated solution in direct contact with the plant's vascular system. An example of the latter is the cut stump application, where the plant is cut down, then a concentrated solution of herbicide is applied via hand-held sprayer to the freshly cut stump. This is most effective in late summer, when woody plants are reallocating sugars into the root systems, and virtually ineffective in the spring, when sap flows up from the roots into the shoots.



Herbicides are not silver bullets and are often best employed in conjunction with other methods: for instance, an early summer cutting of above-ground portions of perennial plants, followed by a late summer foliar application of a systemic herbicide, is often a highly effective two-pronged approach for woody species like honeysuckle. In many cases, properly-used herbicide may be the control method that poses the least disturbance to the management area.

Not all herbicides are created equal. Some pose greater ecological or human health risks than others; all should be handled with great care and only after reading the label. It is a violation of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to use any herbicide in a way not specified on the label, and it is also a violation of that law to use any substance that doesn't have an EPA pesticide registration number as an herbicide. And while there are certified organic options out there (highly concentrated acetic acid, often erroneously referred to as "vinegar," is one of those), they are not necessarily safe or harmless. Finally, herbicide application in many circumstances requires licensing. Be sure you know the rules before you spray, and are applying appropriate concentrations. The adage "if a little is good, a lot is better" does not hold true for herbicide use!

### **A Long Term Relationship**

Effective invasive plant control can take multiple growing seasons. In most cases, an ample seedbank will almost guarantee re-colonization for many years, and many species are quite tenacious and can fight their way back to vigor after cutting, spraying, digging, or all of the above. Be prepared to return to a control site several times a growing season and for up to ten years after you've achieved effective control of adult plants. In a highly disturbed landscape with invasives on nearby properties, this may require twice yearly monitoring with periodic control efforts in perpetuity.



## **GETTING STARTED**

### **Assess the Problem**

#### *What species are present?*

Be sure you've identified all problem species on a site. Because invasive plant species tend to colonize disturbed habitat, where there is one, there are often more. If you aren't an identification expert, bring someone with you who is, or consult web-based resources. Be sure to know the difference between those species capable of wreaking ecological havoc, like Oriental bittersweet, and those that are pesky roadside distractions, like sheep sorrel. Both are non-native invasives, but sheep sorrel rarely requires management outside of agricultural settings (or flower beds).

#### *Where are they?*

You don't need to be cartographer to create a map. A property tax map, photocopied at a large scale, and a pencil can be enough to develop a spatial understanding of the problem. Google Earth and either a GPS unit or GPS-enabled smartphone are also increasingly user-friendly and accessible options. At the time of writing, the State of Maine has also invested in an online mapping platform called iMapInvasives—check out [www.imapinvasives.org/](http://www.imapinvasives.org/) to learn more.

Be sure to “zoom out” and look at the spatial context for the problem as well: are you dealing with a small, isolated problem, or is the species at hand ubiquitous in the area? If it’s the former, this should be your number one priority for control efforts (see more on prioritization below)—while if it’s the latter, you’ll probably want to think carefully before tackling the plant in question.

But, why map at all? Invasive plants can pose different threats based on their location. A stand of Japanese knotweed growing in a parking area is a nuisance; a stand growing in a floodplain is a catastrophe waiting to happen. Mapping will help you identify any areas that are weed-free, and those are boundaries you want to delineate and fiercely protect: remember, the best control method is avoiding invasion in the first place. We’ll revisit the importance of knowing where your invasives are below.

#### *What threat do they pose?*

Oriental bittersweet climbs and strangles trees, eventually toppling them and forming a monoculture thicket. Common and glossy buckthorn stay in the understory, but grow thickly and eventually crowd out native trees and shrubs that would otherwise be regenerating. Garlic mustard forms a dense ground cover and outcompetes woodland wildflowers, and has also been shown to release chemicals from its root system, making the soil inhospitable for other species. Japanese knotweed chokes out floodplains and river systems. Many invasive species—buckthorn being the prime example—are also detrimental to wildlife and particularly bird life, as the nutrient balance in the fruits isn’t quite right for our native species. A particularly troubling threat is that posed by Japanese barberry, which is known to harbor much higher tick densities due to the favorable microclimate it creates. All of these species displace native plants, alter habitats, and can disrupt recreational opportunities. Knowing this helps you make the case for control when you need to raise money, rally volunteers, and convince skeptics.

#### *What are the risks of no action?*

A small problem rarely stays small, but rates of spread are different from place to place and from species to species. A patch of Morrow’s honeysuckle in a closed canopy forest will spread, but in all likelihood it will do so slowly. That same patch in a working forest can quickly take over. Are you going to harvest a woodlot? Or create a parking lot? Or disturb the soil in some other way? The no-action alternative here may be disastrous. On the other hand, are you dealing with a heavily invaded property in a matrix of highly disturbed and invaded land? Control may simply not be practical at this advanced stage, and the no-action alternative may free your resources up to fight a winnable battle.

### **Prioritize and plan**

#### *Learn about each species’ biology and control options*

Know your enemy! Once you’ve identified the species present, take the time to learn about their biology and ecology. While all invasive species tend to share the traits of being highly adaptable and fast-growing, not all invasives are created reproductively equal. Some—like purple loosestrife—produce millions of seeds and have the capacity to spread very quickly and disperse widely. Others, like Japanese knotweed, don’t reproduce by seed very well at all, and instead creep outwards from a central patch. Light and moisture requirements are other areas to learn about. Common buckthorn and honeysuckle will quite happily grow in almost full shade, but purple loosestrife needs full sun. Understanding how each species grows and the threat it poses will help you prioritize, since you can’t tackle everything at once. In general, it pays to tackle the most “threatening” species first, as well as those that are just getting a toehold on a property.

Finally, learn what the best control methods are for each species. Often they are highly individualized, and you don’t want to waste your valuable time and resources employing a tactic that is known by seasoned practitioners to be ineffective. (For example, digging out Canada thistle or Japanese knotweed is ill-advised, as both species

have extensive root systems that are virtually indestructible by manual efforts alone.) Timing is also critical: cut stem applications of glyphosate to woody species are highly effective during late summer, and almost completely ineffective in late spring. (Recall that perennial plants translocate stored resources from their roots to their growing shoots in the spring, then “slurp” sugars produced through photosynthesis back down to storage tissue in the fall.) Know when species flower and fruit so you know when your efforts will help curtail seed production, and know that some species are more susceptible to different herbicides at certain times during the growing season. Do your homework! There are numerous and excellent web resources out there, some of which are listed at the end of this document.

#### *Know your resources*

What tools do you have? How much labor can you drum up? Do you have the ability or willingness to use herbicides? Make sure you fully understand the resources (including money) you have to sink into any given property or problem before you get started. Time is the most valuable resource of all, so a final question to ask yourself is, “am I willing to dedicate multiple growing seasons to this problem?” Successful invasives control can take years, and in some situations (such as where there is a local seed source that’s out of your control) may turn into a chronic management condition. If you’re not willing to come back year after year until the rootstock and seedbank are exhausted, OR accept the ongoing burden of constant maintenance, is it worth beginning at all?

#### *Know the rules!*

Not everyone can spray herbicides wherever they please, and this is for many good reasons. If you are the owner of private property, you can go to the hardware store, buy some herbicide, follow the label, and apply it to the target pest. If the property is open to the public (such as a park or preserve), it isn’t that simple. Be sure to check with the Maine Board of Pesticides Control before you spray—and follow their motto: think first, spray last!

Also take note of where you are: application of any herbicide within 25’ of a water body or wetland requires special licensing, permits, and variances from state regulations. Even without herbicide, there may be limitations on what you can cut—is your honeysuckle patch within Resource Protection or Shoreland Zoning?

Even though it isn’t a rule, it always pays to check in with property neighbors. They may want to learn more, and chances are, they’ll have invasive species on their property as well—which could translate into more effective, trans-boundary control! At the very least, a neighbor check-in will hopefully ward off an unhappy phone call when full-sized Norway maples start coming down. If you’re working on public land, consider engaging users through a public meeting or, more simply, some laminated signs letting people know what you’re up to, why, and how they can help.

#### *You can’t do it all at once, so...*

Remember that map you created when first assessing your problem? Now is a good time to study it carefully. A small patch of a new species that’s just getting established should be your number one priority for control. This is often referred to as “early detection, rapid response,” (EDRR) since you’ll have caught a new invader early enough that its control can be easily and quickly tackled. Just down from those EDRR situations on the priority scale are the small patches or scattered single plants that may exist where there are otherwise few invasives. While control of these situations takes a little more planning and effort, success is usually realistic. Third on the list are denser, larger patches that are threatening an important resource such as a floodplain or campsite. Finally, we are left with the overwhelming messes: these are the infestations where invasive species form most or all of the ground cover, and where there is little—if any—native vegetation left. Save these places for after you have put out the smaller fires on the property you’re managing, and only when you have the ability and resources to tackle a serious restoration project.



### Set goals

What is the ten-year view for the property? Is it to be 100% invasives free? To keep trails or views or other recreational areas functional but accept the presence of invasives? To be rid of one particularly troublesome species, like bittersweet, but accept the slow encroachment of something like barberry or honeysuckle? Have a vision for the property before you get started, recognizing that that vision may be subject to refining.

### Implement

It's time to start killing. Sharpen your loppers, re-string the weed-whacker, calibrate the sprayer, and rally your labor force. Develop a seasonal work plan for each species or management area. Begin at the outside of a core infestation, and work towards the center—this helps contain the spread, and is an efficient use of resources (rather than starting in the worst of it and working outward). As you begin cutting, mowing, pulling, and spraying, come up with a simple way to record what you are doing and where you are doing it, since you can rarely count on being able to remember from season to season what you did! Pin flags are a great way of reminding yourself what you've done and where—stick them in the ground and note on the flag with a marker the date of control and what you did. This makes it easier to...



*Prescribed fire is another method of invasive plant control, and is increasingly used in the western United States for rangeland management. Though there are some applications for controlled burns in the northeastern US, a thorough treatment of this method is well beyond the scope of this guide. Know that many invasive species respond vigorously after burning. For information on species-specific fire response, visit: [www.feis-crs.org/feis/](http://www.feis-crs.org/feis/)*

### Evaluate!

#### Measures of success

Percent cover, number of plants, repeat photographs—how are you going to know if you were successful? Come up with a very simple way of evaluating the progress you're making throughout the growing season, and throughout the years. One easily-implemented method is a repeat photo of the site you've been managing: drive a wooden stake into the ground (pro-tip: wrap neon flagging around it so you can find it year after year), then take a photograph and note the compass bearing. This will make it easy to go to the same spot and do a side-by-side comparison of what you've been treating. Just make sure you record the date, as most plants look very different from one growth stage to the next.

#### And now, back to square one...

Were you effective? Did you meet your goals? Are your control methods working? After a year's worth of management, take stock of the situation. It may be that you're on the right path, or you may need to re-adjust your goals or strategies. Writing a plan that calls for continued mowing of Japanese knotweed is one thing; actually implementing it is another. Adapting your management strategies to your resources and reality is critical, and why we call it...adaptive management.





## RESTORATION: NATURE ABHORS A VACUUM

Assuming you have been successful, what you will be left with in an invasive species control area—whether it's the site of a single plant or two solid acres—is bare ground. There is virtually no where that plants will not colonize bare, exposed ground, and now that you've created real estate, you have the opportunity to determine who moves in next.

Removal of isolated plants or small patches in an otherwise native forest is unlikely to require re-vegetation, as there is probably enough of a native seedbank to do the work for you. If, on the other hand, you've denuded half an acre, a replanting plan is in order. Otherwise, you may have just temporarily turned the clock back on an invasion.

If you do find yourself in the position of having to do some replanting, there are a few things to think of. First and foremost, what sort of invasive seedbank is left? If you've cleared hundreds of square feet of bittersweet, you can count on thousands of tiny seedlings the following year. If you plant a bevy of native trees and shrubs on the site, how will you control the seedlings to keep them

from swallowing up your natives? In a situation like this, you may find the best strategy is to spend another growing season (or two, or three) continuing control. If you have access to herbicide, spraying all new shoots once they're large enough to form a target is an efficient way to wipe out the next generation. But whatever you do, be prepared to keep doing it for a while!

Now for the fun part—what to plant? The best way to determine what *should* be growing someplace is to look to an intact area nearby. If it's a mixed hardwood forest, red maple and white pine are usually safe bets. If there is no nearby relatively undisturbed analog, it might be wise to call in professional help from whatever nursery you're purchasing your material from. Another good resource is Cooperative Extension (see "Selected Resources" below for a native planting guide for Maine). Be sure also to think through all the possibilities for re-vegetation before assuming your job is to mimic what's "natural"—if it's a small patch of scrub next to a community garden, for example, why not plant fruit-bearing trees and shrubs? Obviously, these will require long-term maintenance, but it is a creative approach to restoration.

Whatever you plant, make sure you've thought through the best time of year (generally, late spring and early fall), if you need to water (probably) and how you'll do that, and where your labor and tools will come from if it's a big project. And finally, though you think you've controlled the invasive seed bank, plan on the occasional walk around your restoration area just to make sure...

## SELECTED RESOURCES

### National/Global

- **The Nature Conservancy's Element Stewardship Abstracts:**  
[www.invasive.org/gist/esadocs.html](http://www.invasive.org/gist/esadocs.html)
- **National Park Service/Plant Conservation Alliance:**  
[www.nps.gov/plants/alien/factmain.htm](http://www.nps.gov/plants/alien/factmain.htm)
- **Invasive.org:** [www.invasive.org](http://www.invasive.org)
- **The University of Georgia Center for Invasive Species and Ecosystem Health:** [www.bugwood.org/](http://www.bugwood.org/)
- **Invasipedia:** <http://invasipedia.org/>

### Regional

- **Invasive Plant Atlas of New England:**  
[www.eddmaps.org/ipane/](http://www.eddmaps.org/ipane/)
- **New England Wildflower Society:**  
[www.newenglandwild.org/conserv/controlling-invasives](http://www.newenglandwild.org/conserv/controlling-invasives)
- **Cornell University:** [www.invasiveplants.net/](http://www.invasiveplants.net/)
- **Connecticut Invasive Plant Working Group:** [cipwg.uconn.edu/](http://cipwg.uconn.edu/)

### Maine

- **iMapInvasives:** [www.imapinvasives.org/meimi/map](http://www.imapinvasives.org/meimi/map)
- **Maine Natural Areas Program:**  
[www.maine.gov/dacf/mnap/features/invasive\\_plants/invasives.htm](http://www.maine.gov/dacf/mnap/features/invasive_plants/invasives.htm)
- **Maine Invasive Species Network:**  
[www.extension.umaine.edu/invasivespecies/](http://www.extension.umaine.edu/invasivespecies/)
- **University of Maine Cooperative Extension planting guide:**  
[umaine.edu/publications/2500e/](http://umaine.edu/publications/2500e/)
- **Maine Board of Pesticides Control:**  
[www.maine.gov/dacf/php/pesticides](http://www.maine.gov/dacf/php/pesticides)

## APPENDIX A. THE “CALENDAR OF DEATH”

Another disclaimer: The “Calendar of Death” was developed for internal use by stewardship staff at Maine Coast Heritage Trust to help streamline the decision-making process for their invasive plant control program. The control methods outlined below have proven effective for the suite of invasive plant species common in Maine at the time of writing, but they are not the only methods for each plant, and they may not always be equally effective across all climates and growing conditions. We urge you to carefully assess your results to be sure you’re spending your resources effectively before completely committing to a management strategy based on the options outlined below.

The table below, organized alphabetically by Latin name, includes chemical and non-chemical control options for different life stages and infestation sizes for the most destructive non-native invasive plants currently in Maine. To use, find your target plant, assess which life stage your infestation most closely matches, and then choose the control strategy for which your resources are the best match. For all species below, an initial treatment method is paired with a follow-up treatment method (which is rarely “more of the same”). For almost all cases you will encounter, some form of follow-up is required.

Please pay close attention to the herbicide concentrations suggested, and also to the timing of all treatment types. What works in early summer may not work in late fall, and remember that with herbicide use, more is not always better. Note also that some herbicides may require the addition of a surfactant (often true for foliar applications), and some (such as most triclopyr-based products) can only be purchased and applied by licensed applicators. As always, we urge you to read the label and know the regulations before undertaking any herbicide use!

The key to the abbreviations in the table can be found on page 26.

~ INITIAL TREATMENT ~				~ FOLLOW-UP TREATMENT ~			
	METHODS	TIMING	NOTES		METHODS	TIMING	NOTES
<b>NORWAY MAPLE</b> ( <i>Acer platanoides</i> )							
Tree	<b>PGD</b>	Anytime soil is wet	Only for seedlings/very small saplings		Monitor, <b>PGD</b>	Growing season	
	<b>CS</b> or <b>FG</b> : 25-50% triclopyr	Anytime but late spring-early summer	Best for trees >6" DBH		<b>F</b> : 2%-5% triclopyr or glyphosate	Growing season	
	<b>BB</b> : 20% triclopyr	Late winter/early spring is best	Best for trees <6" DBH		<b>F</b> : 2%-5% triclopyr or glyphosate	Growing season	
<b>GARLIC MUSTARD</b> ( <i>Alliaria petiolata</i> )							
Biennial Herb	Hand-pull entire plant, then tamp soil down	Before seeds have formed, and when soil is wet	Small populations only (or big populations with many volunteers)		Same as initial	Until seed bank is exhausted	
	Mow/weed-whack to ground level	When plants are in flower (early summer)			Same as initial or hand-pull	Until seed bank is exhausted	
	<b>F</b> : 1%-2% glyphosate	After seedlings emerge, but before flowering (late spring)	Often grows in floodplains - take care to follow regs and not apply near within 25' of water/wetlands!		Same as initial or hand-pull	Until seed bank is exhausted	
<b>JAPANESE BARBERRY</b> ( <i>Berberis thunbergii</i> )							
Shrub	<b>PGD</b>	Anytime soil is wet	Very small plants only		Monitor, <b>PGD</b>		<b>Caution:</b> barberry is known to harbor high densities of deer ticks.
	Cut/mow to ground level	Right after leaf-out (late spring)	Small/med plants. Re-sprouting guaranteed.		Cut 3X/year for 2-4 years	After re-sprouting	
	<b>CS</b> : 25-50% glyphosate or triclopyr	Late summer/early fall	Re-sprouting likely. Note seed dispersal potential.		<b>F</b> : 2%-5% triclopyr or glyphosate	After re-sprouting or following spring	
	<b>F</b> : 2%-5% glyphosate	After leaf-out and before seed set	This species leafs out early		<b>F</b> : 2%-5% triclopyr or glyphosate	After re-sprouting or following spring	



~ INITIAL TREATMENT ~

~ FOLLOW-UP TREATMENT ~

	METHODS	TIMING	NOTES		METHODS	TIMING	NOTES
<b>ORIENTAL BITTERSWEET</b> ( <i>Celastrus orbiculatus</i> )							
Mature Vine	<b>CS:</b> 25-50% glyphosate or triclopyr	Late summer/early fall	Note seed dispersal potential		<b>F:</b> 5% triclopyr	After re-sprouting or following spring	
Low Growth	Cut/mow to ground level	Late spring after leaf-out	Practical in open areas/edges		Mow 2x/month, or <b>F:</b> 5% triclopyr	Until no re-sprouting occurs	May take 2-10 years
	<b>F:</b> 5% triclopyr	Anytime during growing season	Foliar spray tends to be more effective after an initial cut.		Spray, mow, or combo	Until no re-sprouting occurs	
<b>BLACK SWALLOWWORT</b> ( <i>Cynanchum louiseae</i> )							
Herbaceous Vine	Digging out root crowns	When small, immature seed pods are present	Only practical for small infestations. Note that the seedbank is persistent.		Repeated digging and monitoring	Throughout growing season and until seedbank is exhausted.	
	<b>F:</b> 5% glyphosate or triclopyr	When flowering begins	If pods are already present, mow/cut plants and wait for resprouts before spraying		Multiple follow-up foliar applications may be necessary	Throughout growing season and until seedbank is exhausted.	Regrowth will be rapid during summer
<b>RUSSIAN/AUTUMN OLIVE</b> ( <i>Elaeagnus angustifolia</i> , <i>E. umbellata</i> )							
Shrub	<b>PGD</b>	Anytime soil is wet	Only for very small plants		Monitor		
	<b>CS:</b> 25-50% glyphosate	Mid-late summer			Repeat cut or foliar application of 2%-5% glyphosate	If re-sprouting occurs; anytime during growing season	
	<b>BB:</b> 20% triclopyr	Late winter/early spring			Repeat cut or foliar application of 2%-5% glyphosate	If re-sprouting occurs; anytime during growing season	

~ INITIAL TREATMENT ~

METHODS

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**JAPANESE KNOTWEED** (*Fallopia japonica*)

Perennial	Cut/mow plant to ground level	Mid-late June	Fragments of this plant can take root		Repeat cutting/ mowing, or <b>F</b> : 2% glyphosate or triclopyr	After resprouting, throughout growing season	Follow-up for 5-6 years
	Stem injection with 5 ccs 50% glyphosate	Early June	Requires specialized injector tool; effective but time consuming		Return to inject missed individuals	1-2 weeks after initial treatment	Follow-up for 2-3 years

**BUCKTHORN** (*Frangula alnus*, *Rhamnus cathartica*)

Small Tree	Treat as Russian/autumn olive						
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**HIMALAYAN BALSAM** (*Impatiens glandulifera*)

Annual herb	Hand pull or cut/mow to below lowest node	Before flowering (early summer)	Shallow-rooted species – easily pulled. Plants cut above lowest node may flower.		Repeat pulling or cutting/ mowing	Throughout growing season and until seedbank is exhausted	Seed bank lasts approx. 18 months
	<b>F</b> : 5% glyphosate or triclopyr	Before flowering (early summer)			<b>F</b> : 5% glyphosate or triclopyr	Yearly until seedbank is exhausted	Seed bank lasts approx. 18 months

**BUSH HEYSUCKLE** (*Lonicera morrowii*, *L. tatarica*)

Shrub	<b>PGD</b>	When soil is wet	Only for small plants		Monitor		
	Cut/mow to ground level	Right after leaf-out			<b>F</b> : 2% glyphosate	After re-sprouting	
	<b>CS</b> : 25% glyphosate or triclopyr	Late summer/early fall	Best for larger plants, but they will likely re-sprout.		<b>F</b> : 2% glyphosate	Following spring	

~ INITIAL TREATMENT ~

~ FOLLOW-UP TREATMENT ~

METHODS		TIMING	NOTES		METHODS		TIMING	NOTES
PURPLE LOOSESTRIFE ( <i>Lythrum salicaria</i> )								
Perennial herb	PGD, making sure to get the rootstock.	Early spring after ground has thawed	Only practical for small infestations		Repeat cut/dig or F: 2% glyphosate	Throughout growing season	3+ years	
	Cut flowering heads and bag, or cut entire plant	Beginning of flowering season	Only practical for small infestations		Repeat cut/dig or F: 2% glyphosate	Throughout growing season	3+ years	
	Cut just below flower; drip 5% glyphosate into stem	Late summer during flowering	Only practical for small infestations		Repeat cut/dig or F: 2% glyphosate	Throughout growing season	3+ years	
	F: 2% glyphosate	Late summer during flowering			Repeat cut/dig or F: 2% glyphosate	Throughout growing season	3+ years	
	BIOCONTROL Check out Spruce Creek Association's guide to raising Galerucella beetles at <a href="http://www.sprucecreekassociation.org/Beetle_rearing_protocol.pdf">http://www.sprucecreekassociation.org/Beetle_rearing_protocol.pdf</a>							
COMMON REED ( <i>Phragmites australis</i> )								
Perennial grass	Cut or mow to 6" above ground-level	Mid-late July	Compost cut material in uplands. Best for smaller populations.		Control of individual plants via cut stem or foliar spray	2-3 weeks after initial treatment	3+ years	
	Tie/tape 5-10 stems together at waist height, cut, and spray 25% glyphosate into stems	After seed head forms	Best for small/medium patches.		Control of individual plants via cut stem or foliar spray	2-3 weeks after initial treatment	3+ years	
	F: 5% glyphosate	After seed head forms	Best for large monocultures.		Control of individual plants via cut stem or foliar spray	2-3 weeks after initial treatment to get stragglers	2-3 years of follow up may be required	
MULTIFLORA ROSE ( <i>Rosa multiflora</i> )								
Shrub	Cut/mow to ground level	Early summer during flowering			Repeat cut/mow 3-6x/season for 2-4 years, or F: 1-2% glyphosate	As soon as re-sprouting occurs		
	F: 1-2% glyphosate	Late summer (after fruit formation)			F: 1-2% glyphosate	Following year		

## KEY TO ABBREVIATIONS:

**BB:** Basal bark treatment. Spray around the base of the tree/shrub, aiming for the entire area from ground level to 12-18" above. Use ester formulation of triclopyr (Garlon 4A; Pathfinder II)

**CS:** Cut stem treatment. Use 25-50% herbicide; no surfactant is needed.

**F:** Foliar treatment. Use low concentrations (1-5%) of herbicide mixed with surfactant; apply via hand or backpack sprayer to foliage during growing season. 80% coverage is usually sufficient to kill plant. Spray early after leaf-out to avoid damage to native plants, or cover valuable native trees/shrubs with plastic bag.

**FG:** Frill girdle. Using ax or hatchet, make a series of overlapping, downward cuts through the bark, then apply 25-50% herbicide to the exposed sapwood.

**PGD:** Pull, grub, or dig. This is generally advised only for small plants and when soils are wet.

**DBH:** Diameter at breast height. A useful term for measuring the size of trees.

## NOTES:

For cut stem treatments, a 32 oz. hand sprayer works well. These can be purchased at any hardware store.

Basal bark and cut stem treatments can generally performed any time of year aside from late spring/early summer, as long as the bark is dry. For basal bark treatments, there should not be snow on the ground.

If removing seed-bearing plant material, be extremely careful not to disperse seeds. For herbaceous species like loosestrife, bag and dispose of as trash. For larger shrubs like barberry, do not remove from site.

Use an herbicide-specific tracer dye for all cut-stem and basal bark applications so you can see where you have treated. These can be purchased through most forestry equipment suppliers or from herbicide dealers.

Either glyphosate or triclopyr can be used for cut stem treatments. If glyphosate is used, the application must be made immediately after cutting. If triclopyr is used, the application can take place hours or even a day later.

Glyphosate is generally more cost-effective than triclopyr, but triclopyr will not harm grasses, sedges, orchids, lilies, and other monocots.

If applying herbicide in/near wetlands or waterbodies be sure to purchase wetland-approved formulations of herbicide and follow all permitting and licensing requirements.





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