

GOOD GREEN

Land Manager's Guide to
Managing Invasive Plants



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The Invasive Species Problem

What is an Invasive Species?

An invasive species is a non-native species whose introduction does or is likely to cause ecological or economic harm, or is a threat to human health.

Generally, invasive species are introduced by human activities. This can be through purposeful introduction; for example, kudzu was introduced as an erosion control method. Other times it can be through accidental introduction, which is the predominant cause of insect and pathogen invaders. In some instances, invaders have spread from their native range into new areas through range expansion.

Most invasive species have attributes that allow them to outcompete native species. For example, many invasive plants grow rapidly, produce large seed crops, or are able to reproduce from fragments. After establishing, the introduced species does not face the natural controls on population like predation and disease. This can lead to rapid population expansion, with little opportunity for native species to compete.

Impacts and Costs of Invasive Plants

Invasive plants cause ecological and economic damage in our ecosystems. Most invasives inhibit native plant regeneration, leaving many Maryland forests completely empty of young native trees while native ecosystems struggle to persist over time. Many insects will not feed on invasives, making invaded systems “food deserts” for the birds and other wildlife that feed on insects for survival. Other herbivores, such as deer, will also avoid feeding on invasives, leading to increased browse pressure on our already struggling natives. Some species, such as Japanese barberry, have been found to host large numbers of black-legged ticks, the vectors of Lyme disease. There are even links to water quality; for example, non-native *Phragmites* replaces the complex root systems of native shoreline vegetation that stabilizes banks. Vines, such as oriental bittersweet, often grow into canopies along roadways, adding weight and weakening trees. The vines act as a sail during high wind or precipitation events, causing trees to fall on utility lines or into roadways, creating safety hazards, and requiring mitigation or cleanup costs.



Tree of heaven, Ansel Oommen, Bugwood.org

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How to Use this Guide

This document is meant to be used as a “cookbook” for developing an invasive management plan. It is designed to break down each step of developing and implementing a management project, including important considerations and real-world examples in each section.

For strategies on private land, see the partner document: “Good Green: Homeowner’s Guide to Managing Invasive Plants.”

Section 1: Setting Goals, Objectives, and Scope

The first step for management is to define the goals and objectives of your invasive management project. Goals are the overarching guidelines for what you want to achieve. The objectives are specific, shorter term, and measurable; they demonstrate how goals will be achieved. These goals and objectives will help you to define the scope of your work, from every park in a city to a focused effort on an important stream corridor.

When setting goals, think about what really matters to you and your community. Examples include protecting important areas for wildlife, protecting native ecosystems, improving recreation, or reducing hazards from trees with vines. When invasives are already present, the goal is not often eradication; it is limitation to protect an important resource. For example, if your goal is to improve wildlife habitat, you do not need to eliminate invasives. The plants they use for food and shelter just need enough pushback for regeneration and survival. Eradication is generally only a goal in areas that are still primarily invasive-free.



ERADICATION DOES NOT NEED TO BE YOUR GOAL. CURBING INVASIVES AND ALLOWING NATIVE SPECIES TO COMPETE WILL USUALLY ACHIEVE YOUR DESIRED OUTCOMES.

Objectives are the major steps needed to achieve your goals. For example, if your goal is to protect wildlife, you may need to control invasives in an important oak forest and pollinator meadows. If your goals are to improve recreation, you may want to control invasives along trails. Later in the document, we will break these down into prioritized action items. Here are some examples of important questions to ask when setting objectives:

1. What is the desired outcome of the treatment? For example, eradication of invasive species or protection of important native trees?
2. What species are the primary targets for management? All invasives, vines, a newly detected species?
3. What steps are within reason with your staff and funding levels?
4. What are your control options? Will you have volunteers available, or are there sensitive areas where herbicide cannot be sprayed?

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As you can see, these goals and objectives will also define your scope of work. You may choose to tackle invasives in part of a park, or certain parks within a town that are the highest priority for achieving your goals. You may leave other areas untouched until your resources change or it becomes a higher priority. Consider what will be necessary for you to attain your goal. **Sometimes, it is ok to do nothing.** Your goals and objectives should be free to change over time. The objectives and strategies should be adaptable for when situations and understanding of the invasion change. For example, if you realize that the invaded areas are significantly larger than first anticipated, an objective might change from eradication to control.

Section 2: Invasive Plant Survey

A good survey of the invasive species in the area of concern is necessary in order to plan priority areas and actions. While you, as a land manager, may have good knowledge of where problem areas are, a recorded survey is often more useful because it can allow for long-term planning and can show quality evidence of whether actions have been successful. Surveys also reveal new problem areas and early-stage invasions.

The first step to conducting a survey is to learn the invaders in your area. The end of the document lists excellent resources for identifying common invaders in the Mid-Atlantic.

Surveys are an ideal project for volunteer groups or citizen scientists. Since many may be learning species identification for the first time, it can be helpful to focus only on several of the most common invaders.

Surveys can either be set up electronically or using pen and paper. Electronic surveys may be done using spreadsheets on your cell phone or tablet. There are also free applications such as iNaturalist, that allow users to set up a survey for group members, and receive a copy of data as it is submitted. Electronic spreadsheets save the hassle of entering data into a computer later, but dead phone batteries or poor service can be a barrier. App-collected data generally needs to be downloaded



Real World Example

Broad Creek Memorial Scout Reservation, a Boy Scout camp in Harford County, MD, identified the following invasive plant goals that enabled them to further their mission as a camp:

- Enhance recreation
- Protect important habitats (a large eastern hemlock stand)
- Educate Scouts

From there, a series of objectives were formed including:

- Reduce invasives along trails and in important recreation areas in the center of camp.
- Control Japanese stiltgrass which is beginning to creep into the uninvaded hemlock stand.
- Control invasives around the Nature Pond in the center of camp, to act as a teaching ground for troops.

The camp chose not to tackle the entire property at once, but instead chose their hemlock stand and the central area of camp with the heaviest recreation.

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and manipulated in spreadsheet form to map and assess. Paper data sheets require someone dedicated to collect and compile data.

Tools

- Map of your property, either using a printed map or GIS. Maps can be printed from any online mapping source, such as Google Maps, or from your town or county's land records, which often have parcel maps available online.
- Clipboard/pencil OR a smartphone
- Datasheets, either printed paper or loaded onto your smartphone using a spreadsheet application. You may also design a survey using an app such as iNaturalist. A sample data sheet is at the end of this document.
- Handheld GPS unit (optional)

Survey Layouts

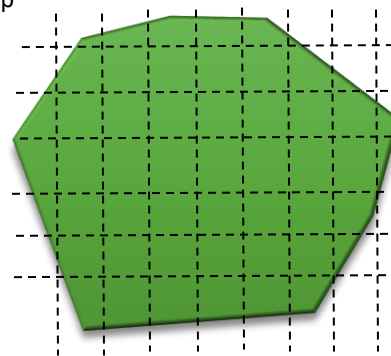
Grid survey

A grid survey will give you the most detailed information but is also the most time intensive.

When to use: smaller areas under 10 acres, easily accessible areas, or mostly uninvaded areas.

How to use:

1. Lay out a grid pattern over the area of concern, either using a paper map or ArcGIS. The lines do not need to be closer than about 20 feet apart, but the further apart they are, the less detailed information you will collect.
2. Walk transects of the grid.
3. Note and record coordinates where the invasive species can be found.
4. Determine the species and severity of infestation.
5. Compile notes either by drawing in points on your map or entering coordinates into GIS. By connecting points, you can approximate boundaries of infestations.



Transect survey

A transect survey provides a detailed survey with less intensive work than a grid but does not give an area estimate for larger invasions.

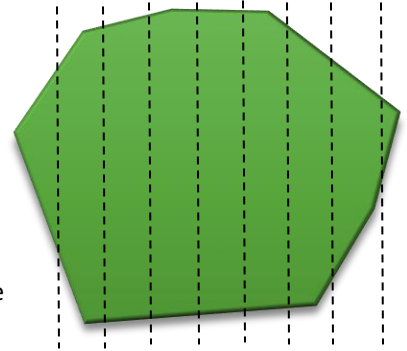
When to use: small to medium sized areas, with low to moderate levels of invasion.

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How to use:

1. Lay out the linear transects across your property.
2. Walk transects and note and record coordinates where invasive species are found.
3. Determine the species and the severity of the infestation.
4. It is helpful to assess size or extent of large infestations. You may walk the boundary of the patch, recording GPS points, or visually estimate the size of the patch. You can also describe the boundary, for example, “west of the trail to the creek.”
5. Compile notes on your paper map or in GIS. You will need to estimate and draw in the extent of some patches.



Biased survey

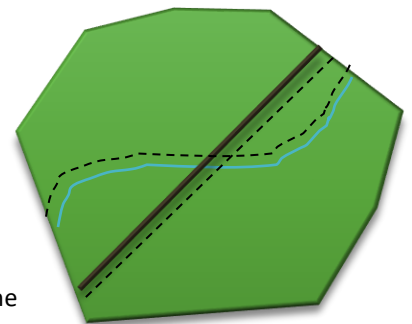
A biased survey targets your search where you are most likely to have invaders. Invasives tend to spread along trails, roads, streams, and around open areas or old fields. Your search would focus on these areas. You may know that other areas are particularly invaded, so you can focus more search effort in those areas. Many citizen-science surveys fall under the category of a “biased survey” because citizens report finds along trails or roads.

Biased surveys are faster than other survey types, so they work well with limited manpower. They also allow you to avoid inaccessible areas. However, you may miss new or isolated invasions because you have limited your search.

When to use: large areas when there is already a basic understanding of the invaded areas, highly invaded areas, and areas where some parts may be inaccessible.

How to use:

1. Determine areas of likely infestation (roads, forest perimeter, trails, streams).
2. Walk along the identified areas.
3. Note and record coordinates where invasive species are found.
4. Determine the species and the severity of the infestation.
5. It is helpful to assess size or extent of large infestations. You may walk the boundary of the patch, recording GPS points, or visually estimate the size of the patch. You can also describe the boundary, for example, “west of the trail to the creek.”



Combination

If time allows, a combination of approaches often works best. For example, run a biased survey, then run some transects in interior areas to catch things you may have missed.

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Data Collection

Assessing the impact of invasive plants

As part of the survey, it is a good idea to assess impact. This allows for planning to target the most effective areas for treatment. Impact assessment can be fine-tuned to fit the goals of the municipality or organization. Generally, you can rank the level of invasion as mild, moderate, or severe. If invasive vines are present, it can also be helpful to record the condition of the canopy. After all, vines can destroy the canopy and lead to more invasive plants in the understory. One example of a ranking system for both understory and overstory infestations can be found below.

Infestation	Understory	Overstory
1	No or light infestation. Few scattered plants or clumps. Mostly native or no vegetation.	No invasive plants are in the canopy.
2	Moderate infestation. Numerous scattered or connected clumps. Mostly native or no vegetation	Some invasive plants are starting to climb into the canopy. OR the canopy includes invasive trees OR <u>Severe</u> amounts of grape are in the canopy.
3	Infestation. Large areas are infested with some clumps of natives.	There are numerous invasive plants in the canopy, are likely causing damage to trees. OR the canopy is invasive trees
4	Severe infestation. Large swaths of invasive plants with little to no native vegetation	The invasive plants have severely taken over the canopy. Vines are causing severe damage to the trees.

In this example a mildly invaded area with no vines would be ranked as a 1, 1; if an area had severe vine damage but no understory invasives it would be ranked 1, 4. All invasive plants, or targeted invasive plants should be noted, and comments can be used to describe which plants are most prevalent.

Other methods of assessing impact can also be used. Taking ground cover plots in invaded areas would give a more exact idea of the severity of the infestation. A ground cover plot will have a set radius where surveyors will record the percentage of ground cover that is taken by which invasive species. A similar method could be used for the canopy. This is more intensive than supplying a simple ranking for each invasive area, but can be more informative.

Mapping the survey

Mapping is a useful tool that is important for long-term planning and management. A map can provide a holistic view of invasive species in the area of concern. Infested areas with similar species or severity can be consolidated into treatment areas. They are also necessary if contractors are hired for removal work. Maps are easiest to create if you used GPS to record the survey areas; this section will help you use it for planning purposes. This section will introduce two ways to map your inventory via Google Earth and ArcGIS.

Google Earth

The information in a GPS device is stored in a GPX format. This format is directly openable by Google Earth. Below is the method to enter field data into Google Earth.

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1. Use a USB cord to attach GPS to computer.
2. Navigate to the storage (varies by device).
3. Find the GPX file for the date you surveyed. It will be in a folder titled Points or Tracts.
4. Add file to computer.
5. Open Google Earth, navigate to File -> Open.
6. Change file type to GPX and navigate to the folder where you saved the data.
7. Add it to Google Earth.
8. Use the sketch tool to connect the GPS points and make a polygon for each invaded area.
9. Repeat for each day of the survey.

ArcGIS

GPX format can be directly input into ArcGIS using the GPX feature tool. GPX can also be open and edited in Excel if you wish to clean up the data before entering it into Arc.

1. Use the USB cord to attach the GPS to the computer.
2. Navigate to the storage (varies by device).
3. Find the GPX file for the date you surveyed. It will be in a folder titled Points or Tracts.
4. Add file to computer (use a folder that is connected to ArcGIS).
5. Open ArcGIS.
6. Navigate Tools-> conversion tools -> GPX to features.
7. GPS points will appear on the map, they can be utilized like this or converted to polygons.
8. A. Use point to polygon tool if available B. Create a polygon via Editor.
9. For Editor: open Arc catalog within the GIS session. In the desired location right click and select "create feature," in the next window select polygon as the type and name as desired.
10. The new feature will appear in the table of contents, open Editor and create feature.
11. Follow the points to create polygons matching the survey.

Planning management strategies

After completing an inventory and mapping the results, the management planning can begin. The questions that were asked during the goal setting phase of the project can be revisited to see if adjustments need to be made.

When setting priorities, your capabilities of treatment are an important factor to consider. Generally, the highest priority areas should be in the less invaded areas, or the leading edge of the invasion. Here are a few categories for general priority setting:

- Category 1 – area with vine infestations, light or outlying infestations, areas of ecological or historical priority
- Category 2 – moderate infestations, the main front, invasive shrubs and other shade tolerant species
- Category 3 – heavily infested and core areas

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Areas with vines should be targeted first because they can easily become more seriously invaded. They can also damage the canopy which will make restoration work more difficult. The small outlying infestations can also be targeted because they can be eliminated before causing more widespread invasions. These areas usually have intact canopy and will be easier to manage because restoration work will be less intensive and costly. Most vine and small infestations can also be targeted by volunteers. Volunteers are generally limited to mechanical control, for safety and liability reasons. This means that most volunteer control will be limited to mechanical techniques, which are impractical in heavily invaded areas.

Invasive species can cause irreparable harm to historic and ecologically sensitive sites. While these areas should be considered high priority, extra care should be taken when treating invasives here. Herbicides can kill rare plants, while mechanical treatments can injure historic sites. These situations should be a priority because they offer the most cost-effective way to limit invasive species spread.

Category 1 areas will be the first priority. These areas are relatively uninvaded, with only a few scattered plants, and lightly invaded areas with vines. Areas with vines should be targeted first because they can easily become more seriously invaded. They can also damage the canopy which will make restoration work more difficult. The small outlying infestations can also be targeted because they can be eliminated before causing more widespread invasions.

Category 2 invaded areas like the moderately invaded leading edge can lead to new areas being invaded or can become heavily infested. Invasive shrubs and other shade tolerant species can survive in the understory without disturbance, and thus require more effort to control. Moderately invaded areas can be targeted with mechanical treatments and volunteers; however it may be necessary to couple these with herbicide.

Heavily invaded areas make up category 3 and are the most difficult and the most costly to manage. Usually, these areas require a dedicated staff or contractors in order to complete work. These treatment areas will likely also require restoration work, like planting and seeding. Volunteers are usually not an option in heavily invaded areas, since they shouldn't use chemicals. However, they can be helpful in restoration activities like planting. In some situations, a heavily infested area can become a priority area if it is isolated from uninfested areas, small or is something your municipality is able to manage.

Many invasive species will take years of management to limit populations enough for native flora to be restored. If a project is started, there should be resources, and the will to be followed up for several years. For example, Japanese stiltgrass can take seven years of management before the seed bank is worn out and it is really under control. Good restoration activities can help limit the time and amount of management that is required in follow-up years.

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Section 3: Managing Invasive Plants

Cultural controls

The easiest way to manage against invasive species is to limit their possible exposure to a site. Cultural controls are preventive methods to try and prevent the introduction of an invasive species to a new area by changing human behavior. One of the best examples of this is the 'Don't move firewood' campaign, which was put in place to try and prevent the spread of invasive insects. By keeping firewood in the area where it was harvested, it will prevent the potential introduction and spread of an invasive insect to a new, uninvaded area.

In your municipality, there are a number of cultural controls that can be implemented. Construction, landscaping and other traveling crews should clean their equipment off before leaving an invaded site. Landscaping on public property can be limited to native species only, so new invaders are not introduced. Recreation access for horses, fishermen and boats can require the cleaning of equipment before and after use on the site. Simple actions like these can limit the spread and the introduction of invasive species, but they can't control an already present invasive.



A BOOT BRUSH STATION TO CONTROL SEED SPREAD.
CHRIS EVANS, UNIVERSITY OF ILLINOIS, BUGWOOD.ORG

Integrated Pest Management

There are three main categories for invasive plant control: mechanical, chemical, and biological. Each method has benefits and negatives but are very effective when combined in the process called integrated pest management. In the long term, integrated pest management is more cost-effective and better for the environment.

Mechanical

Mechanical treatments include hand and machine removal with methods like mowing, chipping and hand pulling. It is a popular method of control because it often does not add significant cost for management. For example, mowing can be used to control Japanese stiltgrass in a park. If park staff is already mowing the park, adding in the invaded area will not increase overall costs as much as a herbicide application would. Other methods, like vine cutting, can rely on volunteer work to keep costs low. Mechanical treatments do not eradicate the seed bank, and can leave root stocks that can resprout, so retreatment and monitoring is necessary. Over time, as the seed bank and other sources of reintroduction are depleted, the invasives can be controlled.

Mowing

Mowing is an especially good method for annual grasses, but will work well on perennial grasses, forbs and even vines. Mowing must be continued over several years before it will control the invasive plant. It is also best to mow a couple of times a year, to help control annual growth. Timing is important for mowing. Mowing after flowering will spread seed and worsen the infestation. Make sure mowing takes

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place before seed set, which is shown on the plant fact sheets at the links listed in Section 5: Resources for ID and Management.

Cutting

Cutting is similar to mowing but applied to larger woody stems that mowing cannot handle. Cutting is particularly useful for invasive vines. When vines are already climbing into trees, cutting them can prevent irreparable harm. The common method for cutting vines is a window cut; cut the vine as high as you can reach, and near where it comes out of the ground. This type of work is well suited to volunteer groups and is one of the most effective ways volunteers can be utilized.

Cutting can also be used for woody shrubs by cutting as close to the ground as possible. In both vines and shrubs, this will cause them to grow back but repeated cutting will cause the plant to use up its stored energy. To speed up the efficacy of cutting, herbicides can be used. More on this under the chemical section below.

In the case of some species, such as Japanese knotweed or English ivy, fragments of the plant can vegetatively reproduce, and extra care should be taken that all parts of the plant are removed from the site. Bagging and allowing the plant material to decompose before disposal is recommended.

Hand pulling and digging

Hand pulling is useful for forbs and smaller woody plants, where the root system can be more easily removed. It is also easier with sandy, loose, or wet soils. The benefit of pulling over cutting is that the removed root system is unable to resprout. However, it requires significantly more time and effort than cutting.

When a plant is too large for hand pulling, digging is an alternative. When using a shovel or other digging tool, be careful to remove all parts of the plant. Often, if you cut the roots and do not remove a section, it can resprout and become an issue again. Digging is still not practical for very large plants.

As with cutting and mowing, be sure to remove the plant before it seeds or remove seeds with the rest of the plant material. Material should be bagged and allowed to decompose before disposal. Be sure to stabilize soils after disturbing them or replant with desired species.

Girdling

Girdling is a method to control invasive trees by cutting off the flow of nutrients between the roots and the leaves. The most efficient method is to use a chainsaw, making a cut encircling the tree, deep enough to sever the cambium. Make a second cut several inches above the first in order to ensure cut off of nutrients. This method should only be used when you are able revisit the site to remove sprouts and suckers. Girdling should also be avoided where the falling tree could pose a safety hazard.

Livestock

In recent years, many municipalities have started trying livestock, such as goats, as a tool to combat invasives. Goats are useful for small trees, shrubs, and vines. They can be beneficial as a preventative, or a controlling measure for invasive plants, but will not eradicate them. Usually, goats are better perceived by the public than herbicides or other control practices. They also can be used to raise awareness of

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invasive species with the public. Their use generally requires temporary fencing, and assessment for plants that could harm the goats.

Goats can be a good way to initially clear an area that is too densely invaded to enter otherwise. Goats will eat higher up on the plant, leaving portions of the stem close to the ground. For best control, it is advisable to follow up with additional controls.

Chemical Methods

In many cases the scale of invasion is too much to handle with mechanical controls; in these cases chemical controls may be necessary. Herbicides can be used in a few ways to provide a quick and cost-effective way to manage an array of species. Herbicides can be post-emergents where they will kill a growing plant, or pre-emergents where they will prevent plants from being able to sprout. In some cases, herbicide will need to be applied more than once to prevent resprouting and new growth from seed. The appropriate treatments at the right time of year will help to eliminate regrowth.

It is important to choose the correct chemical to treat invasive plants safely and effectively. The categories below and the referenced plant fact sheets will have recommendations for which chemical to use. Be sure to always read the product label, and not to use it for purposes not on the label. There are many companies that will perform herbicide work. These companies employ certified pesticide applicators who can apply herbicide safely and effectively. Some chemicals will require a pesticide applicator's license and application should not be attempted without a license.

Method	Plants	When to use	Time of year
Foliar Spray	All	Mild to severe infestations. When plants are below head height.	Leaf out (spring) to early fall.
Hack and Squirt	Woody species	Mild to severe infestations. When plants are larger and away from areas where they present a hazard after dying.	Late summer to early fall.
Cut and Paint	Woody species	Mild to moderate infestations. Useful with large shrubs, vines, and trees, especially when above head height. Areas where standing dead plants could be a hazard.	Year-round, unless ground is frozen.
Basal Bark	Woody species	Mild to severe infestations. When plants are larger, and when plants away from areas they can present a hazard after dying.	Year-round, unless ground is frozen.

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Foliar spray

A foliar spray is the most versatile chemical treatment, as it can be used on any plant while there are leaves or other soft surfaces. A variety of sprayers, from backpack sprayers to truck rigs, can be utilized to adapt foliar application to your needs. Using sprayers, especially high-powered ones, can lead to drift and non-target application, and care should be taken to minimize these. In many cases the addition of a surfactant to the chemical will help the chemical stick to the leaves and improve efficacy.

The chart below shows timing of treatment, and type of chemical for different types of invasive species. A more in-depth guide can be found in 'A Management Guide for Invasive Plants in Southern Forests.'

Species	Chemical	Time of year
Lesser Celandine (Forb)	Glyphosate- 1.5% in surfactant and water	Early spring, before flowering
Oriental Bittersweet (Vine)	Glyphosate- 3% in surfactant and water	July to October
Japanese Stiltgrass(Grass)	Glyphosate- 1% in surfactant and water	July to October

Cut and Paint

Cut and paint is a combination of chemical and mechanical methods. It involves cutting the plant off near the ground, and then painting the stump with herbicide. This method works well to combat root suckering and resprouting in trees, vines and shrubs.

When using cut and paint, herbicide is usually applied with a backpack sprayer. The chemical is mixed with either an oil or a water-based carrier. Water based carriers should be applied to the stump immediately after the cut is made; otherwise the chemical may not be drawn down into the root system. An oil-based carrier can be applied within a few hours after the cut and still be effective.

Basal bark

A basal bark application is herbicide mixed with oil applied to the bark of a tree or shrub. Basal bark herbicides can be mixed with oil on your own or bought as a premix. A mixture of basal bark will require a slightly different pesticide than a foliar application; make sure that the product you purchase is labeled for basal bark.

To apply basal bark, start about two feet above the root collar, and spray the entirety of the bark surface down to the root collar. The bark should be wetted, but without chemical running off. This treatment can be applied at any time throughout the year, though it is most effective in the fall.

Basal bark treatment should be applied in areas where standing dead trees will not present a hazard. Trees will die while standing and can become falling hazards.

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Hack and squirt

Hack and squirt has a similar effect to basal bark, as it will kill the tree while standing. This method has the advantage of not needing a special herbicide or oil carrier. It is also extremely selective and uses less herbicide mixture (as the dose is more concentrated).

The hack and squirt treatment requires the use of a hatchet or other sharp tool to cut into the bark at a 45-degree angle; the cut should pass the cambium. A dose of the herbicide is then squirted directly into the cut using a spray or squirt bottle. Additional cuts are made around the tree, with one cut for every inch of diameter.

Like basal bark treatments, hack and squirt is well suited for areas with high density of invasive trees, that are away from easily accessible areas.



USING A HATCHET AND SPRAY BOTTLE FOR HACK-AND-SQUIRT. PHOTO BY J. MILLER.

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Biocontrols

Biocontrols use natural predators, pathogens, or parasites to combat invasives, and are usually introduced from the invasive species' native range. The introduction of biocontrols takes away a large advantage that invasive species have over natives, the lack of predators. These controls are the most effective method to treat invasive species for the long term and on a large scale. However, biocontrols will not eradicate the invasive populations; merely take it to a manageable level, usually to the point that it is not a threat to the ecosystem anymore.

Before a new biocontrol agent is introduced, it must undergo rigorous testing in order to ensure that it will not become a threat to native species. After approval, the biocontrol is reared in federal, state or university labs and released as available. Use of biocontrols in your municipality will require coordination with state or federal agencies.



KNAPWEED ROOT WEEVIL ON SPOTTED KNAPWEED. LAURA PARSONS, UNIVERSITY OF IDAHO, PSES, BUGWOOD.ORG

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Follow-up Practices

Invasive species management is never a one and done kind of project. Following up on the initial treatments will help to ensure that goals and objectives are met. Practices include additional treatments, monitoring, and restoration plantings.

Additional treatments can be completed in the same year as the initial ones, and in subsequent years. Many species can be treated in the spring, allowed to grow over the summer, then treated again in the fall. This practice will target resprouting and plants that were missed the first time. Treatments in subsequent years are necessary to deplete the root reserves, and the seed source. Many invasive plants have seeds that can survive in the soil for years before germinating. By treating for multiple years, it helps to give native plants a chance to outcompete the invasive seed source. Once native plants are re-established, the need for annual treatments should diminish.

In some cases, allowing for the native vegetation to come back on its own may not be enough. Areas that have been disturbed for many years may not have adequate seed source for native vegetation to restore naturally. Similarly, areas that were heavily invaded or invaded by virulent species may have too much competition for native seed source to establish. In these cases, it is best to do restoration work like planting.

Planting

Follow-up planting can have different approaches based on your needs. The most important thing that planting does is provide competition. Invasive plants will have a harder time re-establishing if there is shade or good ground cover.

Ground cover can be established by seeding in new grass or herbaceous plants or planting plugs. Ground cover is important in areas that were totally invaded and treated, which now have exposed, bare soil. These areas will erode and can be taken over quickly. Seeding in a native grass or fast-growing herbaceous plant can establish new ground cover quickly. Look for native meadow mixes that are rated for areas similar to the treated areas (mesic mixes for sites that are reasonably moist). You may desire to have some species in the site that do not grow well from seed. In this case, purchasing plugs of the plant can be an effective way to mix it in with a seed mixture.

Planting woody species is essential to restore damaged forested areas. By planting, you can help control the species that will grow into the area and give them a leg up on any re-establishing by invasive species. The goal with planting woody species is to eventually have canopy closure, which will make it more difficult for invasive species to be re-introduced. Your local county forester can help with making a planting plan for areas you need to restore. Below are some guidelines to follow for having a successful planting:

1. Right tree right place- make sure the planted species is suitable for the planting area
2. Diversity- having a variety of species can help protect against disease and increase resiliency of the planting. It also looks nice!

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3. Right time- planting in mid-spring and late fall are ideal for tree survival. Late spring and summer can be too hot, and the new environment can shock and kill the tree.
4. Spacing- 10 x 10 ft is common for spacing planted trees. It allows for the canopy to close quickly, but allows for mowers and equipment to fit between trees
5. Use tree protection- tree tubes and stakes will protect trees from being eaten by deer, voles and other animals. Weed mats can provide additional support against competition.
6. Maintenance- inspecting the planting, resetting tubes, and pulling weeds can all help ensure survival of planted trees.

Monitoring

As you move forward with managing the invasive species, it is important to continue monitoring to see how treatments are working, and if any new invasions are occurring. Monitoring can be significantly easier than the initial inventory, as you can focus on areas that you know are invaded or likely to become invaded. This allows for spending less time in areas like forest interiors that are less likely to have invasive species. Monitoring can also be less formal than the initial inventory, with quick notes of what has changed instead of a whole ranking system used before.

Areas that were treated for invasive species should be checked at least annually for re-establishment. Early detection of re-growing species will let you treat them before it becomes a time consuming and costly process. Areas that were not infested but were near severe infestations can also be checked annually.

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Section 4: Common Invasive Plants in Maryland Natural Areas

This appendix provides an overview and introduction to some of the common invasive plant species.

Tree of heaven

Growth form: tree

Habitat type: disturbed areas, open forest, rights-of-way

Reproduction and spread: produces windblown seeds, stressed trees will produce large number of root suckers

Asiatic dayflower

Growth form: emergent

Habitat type: wet soils, can be submerged

Reproduction and spread: seed, sometimes fragmentation

Autumn olive

Growth form: shrub

Habitat type: disturbed areas, open forest, rights-of-way

Reproduction and spread: animals spread seeds

Callery pear

Growth form: tree

Habitat type: disturbed areas, rights-of-way

Reproduction and spread: animals spread seed, roots suckering

Garlic mustard

Growth form: herbaceous biennial

Habitat type: prefers forest understory with partial shade, disturbed or riparian areas. Will grow full shade to sun

Reproduction and spread: cross or self-pollinated seed production

Japanese barberry

Growth form: shrub

Habitat type: disturbed areas, partially shaded forests

Reproduction and spread: animals spread seed



*Callery pear blooming in Anne Arundel County
Photo by Will Parson/Chesapeake Bay Program*

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Japanese honeysuckle

Growth form: vine

Habitat type: forest edge, riparian areas, disturbed areas

Reproduction and spread: animals spread seed



*Japanese honeysuckle by Mokkie
Wikimedia Commons*

Japanese knotweed

Growth form: herbaceous shrub

Habitat type: riparian, disturbed areas, rights-of-way

Reproduction and spread: seeds and fragmentation

Japanese stiltgrass

Growth form: grass

Habitat type: disturbed areas, rights-of-way, forests, riparian areas, especially areas that are partially shaded and moist

Reproduction and spread: seed and vegetative by root nodes



*Japanese stiltgrass by Michael Ellis
Wikimedia Commons*

Japanese/Chinese wisteria

Growth form: vine

Habitat type: forest edges, rights-of-way, disturbed areas

Reproduction and spread: seed or vegetative from rootstocks

Mile-a-minute

Growth form: vine

Habitat type: open fields, disturbed areas, forest edges, rights-of-way

Reproduction and spread: animals spread seed, water dispersal

Mimosa tree

Growth form: tree

Habitat type: disturbed areas, riparian, forest edges, other open areas

Reproduction and spread: seed and vegetative



*Multiflora rose by Famartin,
Wikimedia Commons*

Multiflora rose

Growth form: shrub, can act like a vine and climb

Habitat type: disturbed areas, fields, forests, common along agricultural/pastoral fields

Reproduction and spread: animals spread seed

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Oriental bittersweet

Growth form: vine

Habitat type: disturbed areas, forest edges, riparian area, can invade into forests

Reproduction and spread: animals spread seed, vegetative via stolons and rhizomes

Paulownia

Growth form: tree

Habitat type: forest edges, disturbed areas, adjacent to currently or previously landscaped areas

Reproduction and spread: wind and water spread seed, suckering

Wavyleaf basketgrass

Growth form: grass

Habitat type: forest shade tolerant, can be found from edges to interior

Reproduction and spread: sticky seeds that can be transported by animals and humans

Wineberry

Growth form: subshrub

Habitat type: disturbed areas, forest edges, riparian areas, prefers moist

Reproduction and spread: animals spread seed, vegetative when the edge of branches touch ground



Pulling wavyleaf basketgrass at Patapsco Valley State Park

Noxious weeds

There are several noxious weeds in the state including shattercane, johnsongrass, Canada thistle and other invasive thistles. These species are mainly a problem in agricultural lands and rights-of-way.

Intense management has led to the decrease of these species, and they are not often found in natural settings.

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Section 5: Resources for ID and Management

ID Guides

[Plant Invaders of Mid-Atlantic Natural Areas](#)

Swearingen, J., B. Slattery, K. Reshetiloff, and S. Zwicker. 2010. Plant Invaders of Mid-Atlantic Natural Areas, 4th ed. National Park Service and U.S. Fish and Wildlife Service. Washington, DC. 168pp.

Management Guides

[A management guide for invasive plants in southern forests](#)

Gen. Tech. Rep. SRS-131. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 120pp.

[Penn State Invasive and Competing Plants](#)

Species specific and general guides for tackling invasive species.

