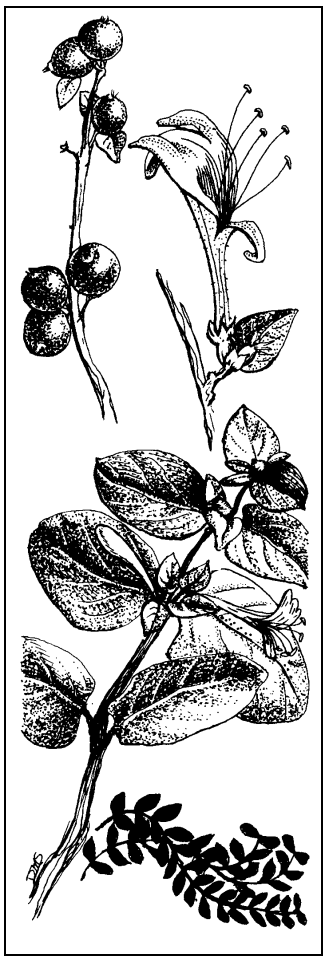
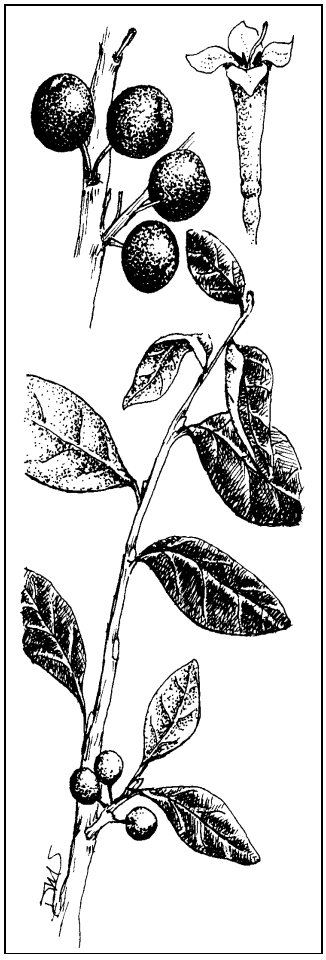
COMMONWEALTH OF VIRGINIA

Managing Invasive Alien Plants in Natural Areas, Parks, and Small Woodlands





DCR
Department of Conservation & Recreation
CONSERVING VIRGINIA'S NATURAL AND RECREATIONAL RESOURCES

MANAGING INVASIVE ALIEN PLANTS IN NATURAL AREAS, PARKS, AND SMALL WOODLANDS

Natural Heritage Technical Report 98-25

by

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I. What are Invasive Alien Plants?

Alien plants, also known as exotic, non-native, or nonindigenous plants, are species that have been intentionally or unintentionally introduced by human activity into a region in which they did not evolve. Many alien species are well known and economically important in agriculture and horticulture, such as wheat, soybeans, and tulips. Alien species, whether plant or animal, often do not become established outside of cultivation and, if they do, they usually have few impacts on natural communities.

Invasive alien plants, however, escape cultivation and become agricultural pests, infest lawns as weeds, displace native plant species, reduce wildlife habitat, and alter ecosystem processes. Across the country and around the world, invasive alien plants and animals have become one of the most serious threats to native species, natural communities, and ecosystem processes (Luken and Thieret 1997). They also exact a costly toll from human economies that depend on resources and services provided by healthy ecosystems. Examples include destruction of vast areas of western rangelands, clogging of important waterways, and increased costs in maintaining open powerline rights-of-way (Office of Technology Assessment 1993).

Of the 4,000 alien plant species introduced to the United States that have escaped cultivation, approximately 400 are serious invaders (Federal Native Plant Conservation Initiative - Alien Plants Working Group 1998). Half this total was introduced for horticultural uses (Randall and Marinelli 1996). Others arrived accidentally in seed mixes, packaging materials, ships ballast, and by other means. Invasive plants now infest more than 100 million acres. One study estimated that from 1901 to 1991, economic losses in the U.S. caused by 15 invasive plant species (not including agricultural weeds) were $603 million (Office of Technology Assessment 1993). The Virginia Department of Conservation s Natural Heritage Program (DCR-NHP) and the Virginia Native Plant Society (VNPS) have identified 115 invasive alien plant species that threaten natural areas, parks, and other protected lands in Virginia (DCR-NHP 1995).

Once thought to be a problem only on farms or in lawns, invasive plants are now recognized as a threat to natural areas, parks, forests, and other sites in a more or less natural state. Land managers, weed scientists, foresters, ecologists, and other conservationists are joining together to face this challenge in ways that help conserve native species and natural communities and protect environmental quality.

An invasive plant infestation is like a slow motion explosion, which, if left unchecked, may severely alter a site s natural, economic, aesthetic, and other cultural values. Managing invasive species while maintaining these values can appear to be a complicated and unending task. For this reason, planning and prioritizing are crucial. By articulating clear goals, gathering the best available information, and prioritizing actions based on the significance of an infestation s impacts and feasibility of control, land managers can identify how their time, effort, and money can most effectively be applied. Invasive species present a difficult challenge with no quick and easy solutions. Many unknowns exist regarding control methods and their efficacy, in addition to

limited budgets. Sometimes, the best course of action may be to do nothing.

In addition to the invasive plants list, DCR-NHP and VNPS have worked together to produce 30 invasive plants fact sheets and five brochures on using native plants for restoration and landscaping. Much of this work was helped with funding from the Department of Environmental Quality s Virginia Coastal Program. These publications can be obtained by contacting either VNPS or DCR-NHP at the addresses listed on the back cover. They are also available on the DCR-DNH web site, <http://www.state.va.us/~dcr/vaher.html>.

This publication is an introduction and guide to invasive plant management. For more detailed information on characteristics of a specific plant, a particular herbicide, or an invasives effects on ecosystem processes, see the Resources and Bibliography section at the end of this booklet.

II. Managing Invasive Plants

Before making decisions and taking action, land managers must first evaluate the extent of the problem. What is the conservation value of the site and the species it supports? Are rare species and/or natural communities threatened by an invasive alien plant infestation? Are important ecosystem processes or cultural resources threatened? These and other considerations should be addressed to clearly define site goals and help determine appropriate management actions. Presence of invasive plants alone normally does not justify action. Control of invasive plants is time and labor intensive and often requires commitment to apply treatments over a period of several years. Land managers will have to learn to live with many alien plant species and target control actions just to those that interfere with goals. Even when the most serious problems have been identified, management may not be feasible for a variety of reasons, such as a lack of resources, the distribution pattern of the invasive plant within the site, or an absence of effective and/or acceptable control measures.

Land managers seeking to control invasive plants should consider developing an invasive species management plan. Such a plan includes: site goals or management objectives, a list of the invasive plant species identified as interfering with goals or objectives, species life history information, the observed or potential impacts on the site, an assessment of control options, a monitoring plan to measure the effects of management actions, and a detailed budget of projected costs. A written plan is a record of the information used to make management decisions and will guide actions throughout the implementation of the control program. Additional factors to consider while planning management actions are: disruption of natural processes, hazards to human health, effects on non-target organisms, and overall damage to the environment.

A key aspect of a control program is to follow up management actions by monitoring results. Monitoring is collecting information for directing and evaluating management activities. It may include measuring changes in plant populations, community structure, or environmental factors such as light levels. Monitoring allows managers to assess the need for action and/or the results of actions taken, and provides critical information for planning future action. Again, the priority

assigned a site will help determine how rigorously to monitor.

Frequently review management goals and the lessons learned from actions taken to control invasive plants. Adjusting management strategies may be necessary according to this and any other new information that has become available since the plan was developed.

III. Assessing Threats from Invasive Alien Plants

Threats posed by an invasive plant can change from site to site and through time. To assess the current level of threat, land managers must gather information from scientific and management experts and literature sources regarding the species in question. This information should include the plant s life history, distribution and abundance, and influences on the natural communities and ecosystem processes. Site goals will determine the level of monitoring necessary; high priority sites usually justify intensive and quantitative measurements. Low priority sites may only need qualitative monitoring.

Life history characteristics

Information useful for understanding an invasive plant includes taxonomic description of the species, its life history, and habitat requirements. The taxonomic description will help positively identify the species. A species life history includes how it reproduces, when it germinates, flowers, and produces seed. Such information can yield clues about whether or not a species competes with natives having similar life histories. Other biological characteristics may suggest what kinds of community or ecosystem changes it may cause. Life history information may also reveal the most effective season to apply a control treatment. An understanding of the habitat requirements of the species can help determine the potential extent of an infestation.

Distribution and abundance

Two primary questions should be answered to assess the invasiveness of an alien plant species: First, how widespread is the invasive plant in the region and how abundant is it? Second, what is the historical trend of the plant species in the region? Natural areas, parks, and woodlands are not isolated from the surrounding landscape. The presence of a species in a region and its known propensity to become invasive will indicate the likelihood that a species will infest a given site. Such information can also suggest the potential for reinfestation after control efforts have been made. The best predictor of a species invasiveness is whether or not it is invasive elsewhere (Randall 1996).

Influences on natural communities and ecosystem processes

Knowledge of community ecology is important in predicting influences of an invasion on any given natural community. Information on community composition and structure, hydrology and soil water regimes, and disturbance history all play a role in understanding the changes an

invasive species may cause. Much of this information is difficult to obtain. The higher a site s priority, the greater the importance of collecting as much information as possible. When results from scientific studies are unavailable, land managers may have to make decisions based on inferences from experiences at other sites.

The specific ways that invasive plants influence natural communities often overlap and may interact. For clarifying the scope of influence exerted by an invasive, consider the following:

Community composition

Composition refers to the species present and their relative abundance at a site. Questions land managers should answer about an invasive s influences on composition include: How does the invasive plant alter the composition of the community? Does it increase or decrease diversity? Does the invasive plant outcompete native species? Does its presence increase the likelihood of invasion by additional alien species?

Community structure

The physical arrangement of plants at a site is called community structure and it most often refers to vertical strata of vegetation, such as the height of tree canopy, understory, shrub, and groundcover layers in a forest. Questions land managers should answer about an invasive s influences on structure include: Does the invasive species change the presence or density of existing vegetation layers? Does it create a new layer? Does it overtop the canopy and eradicate all layers below?

Ecosystem processes

The inputs, outputs, and cycling of nonliving elements such as water, nutrients, and energy, and the interactions of living organisms comprise ecosystem processes. Regarding an invasive s influences on ecosystem processes, land managers should determine: Does the species alter the hydrologic regime, sedimentation rates, soil nutrient levels, or the fire regime?

IV. Prioritizing Management Activities

Resources for the control of invasive plants are usually limited. Also, not all invasions warrant control. Therefore, individual invasions must be ranked. The method presented here is adapted from the National Park Service s *Handbook for Ranking Exotic Plants for Management and Control* (Hiebert and Stubbendieck 1993).

The following factors should be considered before carrying out any management action to control invasive plant infestations:

1) *Significance of impact* on the site, both current and potential. An assessment of the significance of impact includes distribution and abundance of the invasive plant, the level of impact (i.e., on native species, natural communities, and ecosystem processes), and the ability of the species to become invasive.

2) *Feasibility of control* for the species in question: extent of the infestation, what methods are effective, how effective they are, effects of control methods on non-target species, and likelihood of reinfestation.

The significance of impact is plotted on a graph over the feasibility of control (see Figure 1). The area of the graph is then divided into four quadrants. Each quadrant represents a priority level for action. Priority 1 infestations are easy to control and have a high level of impact on a site. Priority 2 are those with a high impact and are hard to control. Priority 3 exhibit a low impact and are easy to control. Priority 4 are low impact and hard to control.

V. Management Strategies

Management strategies are designed to achieve the site goals or management objectives. Strategies for managing invasive species fall into three broad categories: prevention, restoration, and control. These categories may overlap to varying degrees and are most effective if applied in combination.

Prevention

Preventing invasive species from establishing at a site should be a major component of any invasive species management plan. Early detection and control of an invasive species is a much more efficient and effective management strategy than is waiting until an infestation becomes a crisis. It may be the only real opportunity for control of an invasive. Preventive efforts will save a great deal of time, trouble, and money. It is also wise to start a routine biological monitoring program and include monitoring for invasive species as part of the program.

Two key strategies for reducing risk of infestation are 1) avoid planting known invasives and 2) reduce soil disturbance. Many known invasives are currently marketed for a variety of uses: gardening and landscaping, wildlife habitat enhancement, and erosion control. Planting of invasive alien species is becoming acknowledged by a growing number of agencies and organizations as poor management. New introductions should be screened for invasive characteristics. Another approach gaining popularity is to use native species with desired characteristics. For more information, see the DCR publications *Invasive Alien Plant Species of Virginia* and *Native Plants for Conservation, Restoration, and Landscaping*.

Preventing infestation by invasive species can be pursued on several fronts. To the extent possible, avoid or reduce soil disturbances. Soil and canopy disturbances associated with trail and road construction often create opportunities for establishment of invasive species. These species

frequently first appear in natural areas and parks around parking lots and trail heads. When undertaking such activities, follow best management practices for protecting soil and water quality. For information on best management practices for protecting soil and water resources, contact DCR s Division of Soil and Water Conservation. Whenever possible, use native plant species for revegetation. Following natural disturbances such as flooding or windthrow, watch for the appearance of invasive species and control them as swiftly as possible. Nutrient pollution can also create conditions favorable to invasive species, particularly wetland species (Howard 1977, Ulrich and Burton 1985).

Educate neighbors, local policy makers, and others who make land use decisions about the problem of invasive species. DCR-NHP and VNPS, in cooperation with many other partners, have developed extensive educational materials on invasive plant species. Remember that the number of problem species is constantly increasing. Keep in touch with other land managers throughout the region, agricultural extension offices, state and regional pest plant councils, and other groups and agencies that disseminate invasive plant information. See the Resources and Bibliography section at the end of this booklet.

Restoration

Human-induced disturbance of natural systems, including disturbance to vegetation, soil, hydrologic regime, or nutrient levels is a major cause of plant invasion. The term restoration here refers to a broad range of management activities, with the common approach of manipulating or mimicking one or more natural ecological processes. Restoration of ecological processes, such as succession, fire, hydrology, or grazing, is an important part of an ecosystem approach to prevent or control invasive plant infestations (Hiebert 1990).

Following a disturbance, planting and/or seeding of native species can establish a desirable natural community and preempt infestation by invasives. Whenever possible, native plant material should be from locally collected seeds or cuttings. See DCR s *Native Plants for Conservation, Restoration, and Landscaping* brochures for information on use of native species.

In some settings, such as impoundments, water levels can be manipulated to control invasive non-native plants with less tolerance to flooding than native species. Other species can be controlled by lowering water levels and conducting a prescribed burn (Smith 1998).

The introduction of grazing animals has also been used to control invasives. The appropriate animal species must be matched to the target invasive plant to effect control and avoid damage to desirable native species (Popay and Field 1996).

Ecological burning is prescribed burning for restoring or maintaining fire-adapted or fire-dependent species and natural communities. Many invasive plants are not adapted to fire; thus, ecological burning may be an effective tool for controlling these species. However, land

managers must first determine if fire is a natural component in the plant community in question and if prescribed fire can be expected to help meet site goals.

Conducting an ecological burn to achieve specific conservation goals requires extensive training and experience. The intensity of the fire and the time of year fire is applied are variables that will greatly affect the response of the natural community community. A well-trained burn crew and the equipment necessary for a safe and effective burn may not be available to many land managers. Furthermore, growth of some invasive plants, such as Chinese lespedeza (*Lespedeza cuneata*) and garlic mustard (*Alliaria petiolata*) are stimulated by fire.

Given these ecological and logistical challenges, prescribed burning may not be an appropriate method if considered for invasive species control only. It is best suited to a site where restoration and maintenance of fire-dependent or fire-tolerant communities are primary conservation goals.

Control methods

A variety of methods are used to control invasive alien plants. Effectiveness varies with the skill of application, the type of infestation, and many other factors. Selecting a control method depends on site goals and the resources available to achieve those goals. The majority of these methods described are most effective when used in combination as part of an integrated pest management approach. For example, practical experience suggests that control of common reed (*Phragmites australis*) is enhanced when herbicide treatments are followed up with prescribed fire (Clark 1997).

Mechanical control methods

Mechanical control methods include: 1) hand-pulling, 2) use of hand- and power-tools to cut, remove or girdle, 3) mowing, and 4) rototilling. Many species cannot be controlled by mechanical means alone, such as species with extensive root systems or those that regenerate from fragments of roots or stems. Whatever method is used, mechanical methods are best applied before the plants set seed. Root reserves are lowest during and after flowering; therefore, removal at this time reduces the plant s ability to resprout from portions of the root system left in the ground. Mechanical methods usually have less negative impact on the environment and are relatively safe for workers. However, care should be taken to avoid damage to rare native species and to minimize impacts to other desirable native species.

Hand-pulling can control small annual and biennial species, as well as seedlings of woody species. Remove as much of the root as possible. Workers should always wear gloves.

For larger infestations of herbaceous species, use hand tools such as machete, cane knife, and weed whip. Vines and species with many shallow roots can be raked out using a three-pronged claw gardening tool.

For shrub and tree saplings, use weed-pulling tools that are designed to pull up the entire plant, root and all. These devices clamp onto the base of the plant, while their long handles provide great leverage, allowing the worker to pry the plant out of the ground.

Mowing or bush-hogging is more effective for large or severe infestations. Several treatments during the growing season may be necessary in grasslands or meadows. When revegetating a severely infested site, rototilling can reduce germination of the existing seed bank.

Large shrubs and trees can be girdled, which may kill the plant by cutting off the flow of photosynthate (sugars) from the crown to the roots. Remove the bark down to the wood from a two-inch wide band around the trunk about four feet above the ground. While many species, such as tree-of-heaven (*Ailanthus altissima*), will resprout, reproduction by seed can be prevented if control is timed properly. Persistently and repeatedly cutting the sprouts will eventually kill the plant. Combining girdling or cutting with a herbicide application to the girdle or stump will greatly increase control of woody invasive species.

Remember three important steps when using mechanical methods. First, any cut plant material must be disposed of in a way that prevents it from regenerating and reinfesting the same or another site. Second, soil at the site should be disturbed as little as possible. Disturbed soil should be put back in place or covered with mulch. Third, plan to apply most treatments at least once per season over three to six years.

Chemical control methods

To be safe and effective, herbicide use demands careful planning and execution. For restricted-use pesticides and for applications on public lands, pesticide applicator certification is required. The Virginia Cooperative Extension Service offers pesticide applicator training and certification. Many different herbicides are on the market and application methods vary according to the herbicide, target species, and other factors. Research these carefully to find the appropriate product and method for your situation.

Workers should always wear protective clothing and gear when applying herbicides. Protective clothing should include coveralls, rubber gloves, and rubber boots. Gear includes eye protection and respirator or gas mask. After use, protective clothing must be washed separately from other clothes. Gear should be carefully cleaned after each use.

DCR-NHP and VNPS recommend the use of glyphosate-based herbicides. Glyphosate, or N-(phosphonomethyl) glycine, is a phosphanoglycine found to be relatively nontoxic to animal life and humans (Extension Toxicology Network 1998). It is quickly adsorbed in most soils and broken down by microorganisms. Half-life in the soil can range from one to 174 days.

Glyphosate is a general use, broad-spectrum, non-selective herbicide that acts on any plant it contacts. It is translocated throughout the plant from the point of contact. Best results are

obtained when the plant translocates the herbicide to the root system.

Foliar spraying applies herbicide to the leaves of the target plant. Apply just enough spray to coat the leaf, but not so much as to create runoff. Avoid allowing excess spray to drift onto non-target plants. Do not spray herbicide in windy conditions. Walking backwards through the treatment area will help reduce exposure to the applicator. Use of a vegetable dye mixed into the herbicide will make the application more visible to the applicator, aid precise treatment, and avoid worker exposure. Foliar application is effective on large infestations. Drawbacks of this method include risk to non-target species.

Small infestations can be treated using a backpack sprayer. Large or remote sites can be treated by using a helicopter fitted with an aerial spray device.

A more accurate, less wasteful method is wick application. Herbicide is applied to leaves or cut stumps using a cloth wick or sponge. Although slower and suitable only for small infestations, this method offers more control to the applicator and less risk to non-target species.

Small or young woody species with smooth and relatively thin bark may be controlled with application to the basal bark. Herbicide is applied to a 6 to 12 inch wide band of bark around the base of the trunk.

The cut-stump or cut-surface method, also for woody species, starts with cutting down the tree or large shrub. Herbicide is then applied immediately to the living tissue, or sapwood, around the edge of the stump just inside the bark.

Frilling, also known as the hack-and-squirt method, is the application of herbicide to cut areas in a woody stem. Cuts can be made with a chainsaw, axe, or machete. As with the cut-stump method, the herbicide should be applied immediately to the fresh cut.

Biological control

Biological control, or biocontrol, attempts control of a specified pest species by intentionally introducing an undomesticated enemy organism of the target species, usually an insect herbivore or a microbial pathogen. Biocontrol advocates have made promising claims as to the successes of biocontrol projects carried out around the world over the last 150 years (see DeLoach 1997). However, serious criticisms of those claims have emerged raising important questions about the effects of biocontrol agents on non-target species, and concomitant community and ecosystem effects that may result. Evidence of an array of serious, undesirable, and unintended effects of biocontrol measures calls for new thinking and research into this area of invasive species management (Simberloff and Stiling 1996).

Other issues germane to the debate about biocontrol center on insufficient pre- and post-treatment monitoring of non-target species and subsequent changes in community and ecosystem

processes. Also, large information gaps in typical cost-benefit analyses have unfairly weighted the balance in favor of biocontrol (Simberloff and Stiling 1996). Until these issues are addressed with more rigorous study and protocol, other means to achieve invasive plant control should be sought.

VI. Summary

Once established, invasive plants are difficult and costly to control. Effective management of alien plant invasions depends upon careful planning, research, and prioritization. Managers can make the most of their time, money, and staff by directing actions at those infestations that have the greatest impact on a site and for which control is feasible. To do otherwise is not only wasting resources, but may also lead to a sense of futility regarding the challenge posed by invasive plants. In summary, the following three guidelines for invasive plants management should be followed:

1) Be informed about invasives on your property and in your region, the threats they pose, and current invasive plants management practices.

2) Rank the natural resources and invasive plant infestations at your site.

3) Carry out action where management priorities and feasibility of control meet.

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