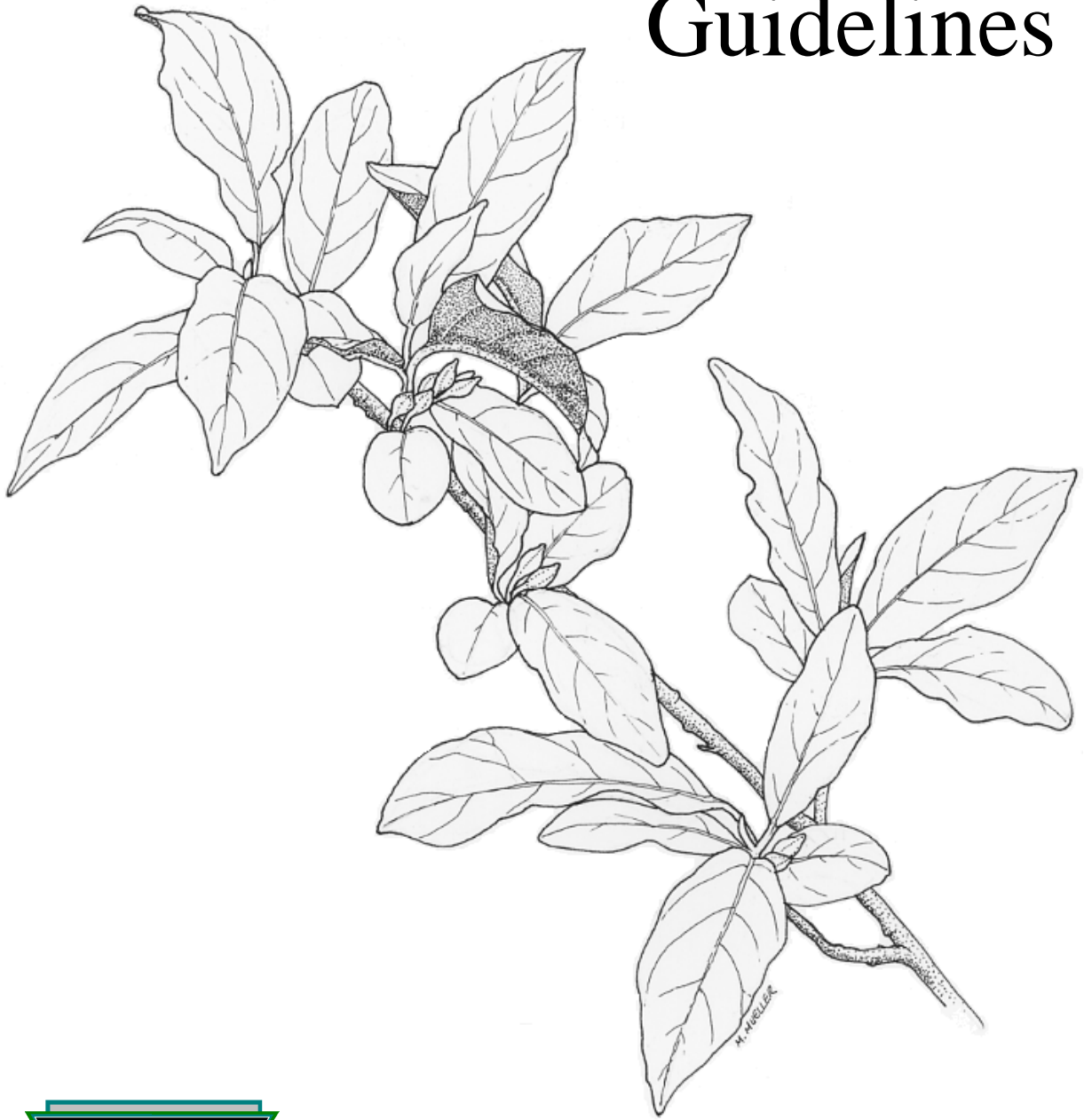


Exotic Plant Guidelines



North Carolina Division of Parks and Recreation
Department of Environment and Natural Resources

EXOTIC PLANT GUIDELINES

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1.0 **DIRECTOR'S STATEMENT**

As North Carolina continues to urbanize, our state parks become an even more important component of our landscape. Activities beyond park borders, however, are increasingly affecting natural resources and processes within our boundaries. In recent years, the introduction and spread of exotic plants has accelerated nationwide with North Carolina as no exception to the trend. Active control of exotic plants within the parks is becoming more and more critical to protect the integrity of the native biological communities of our parks.

Exotic plants have been introduced, either intentionally or by accident, into areas outside their native range. Although most of these exotic species have little or no impact, and in many cases are highly beneficial, a small percentage are potentially devastating to the natural resources of our state parks. As park resource managers, it is our mission to protect our native plants, animals, and biological communities by actively working to prevent the introduction and spread of invasive plant species within our borders.

The intent of the following Exotic Plant Guidelines is to provide technical information for the successful control of invasive exotic plant species. This document also outlines a systematic methodology for determining the priority of exotic plant problems and documenting control efforts. The initiation of actions to manage infestations of exotic plants will be in accordance with these guidelines.

Sincerely,

Philip K. McKnelly
Director

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2.0 INTRODUCTION AND POLICY STATEMENT

Of the thousands of species of exotic plants that are established in the United States, only a small percentage ultimately cause problems. This small percentage of plants, however, can wreak havoc as they spread into surrounding ecosystems and displace native vegetation. Exotic plant species often outcompete native species because they are aggressive in their growth habits, put out more seed that lasts longer in the soil, or have no natural predators and diseases in the ecosystem that they are invading.

The control of exotic plant species is an important component of natural resource management in the state parks system. At this point, it is necessary for us to intervene since exotic plants have disrupted natural processes in a number of our parks. In many cases, the continued existence and spread of exotic plant species pose a threat to our rare native plants, animals, and biological communities as well as to important archaeological sites.

It is, therefore, the policy of the North Carolina state parks system to control the spread of exotic plant species where feasible. Our first line of defense should always be to prevent the introduction of these undesirable species into our park boundaries. Where prevention is no longer an option, active control measures may be pursued. Implementation of control measures will be preceded by a control plan and followed by a monitoring program.

The following information outlines a strategy for the overall priority, management, and control of exotic plant species in North Carolina's state parks system. Appendix I presents the specific requirements for a management and control plan and Appendix II outlines an example management and control plan. Appendix III presents fact sheets covering how to identify and control the 14 most invasive exotic plant species found in our state parks. Appendices IV through VI cover North Carolina's Aquatic Weed Control Act of 1991, State Noxious Weed List, and Regulations for State Noxious Weeds.

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3.0 **DEFINITIONS**

Exotic species: A species occurring in a given place that is outside of its native range. Exotic, non-native, non-indigenous, introduced, and alien are synonymous terms. The vast majority of exotic species have little or no impact on our natural areas, and many are highly beneficial. Almost all of our important crops are exotic species that were deliberately introduced.

Invasive exotic species: A species outside of its native range that threatens the survival or reproduction of native plants or animals or threatens to reduce biological diversity. Invasive exotic species will be considered for active control in our state parks.

Historic cultivars: Varieties of domestic, ornamental, or crop plants that may be genetically or morphologically distinct from the common contemporary varieties, were present in historic districts during periods of significance, and have been used historically.

Native species: A species that occurs and evolves naturally without human intervention or manipulation.

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4.0 PREVENTION OF INVASION

The first line of defense in the management of exotic species is to **prevent** their introduction and establishment. **The importance of prevention cannot be overemphasized.** The following methods are useful to help prevent accidental introductions:

- 1) minimize the building of roads, trails, and structures that break up intact native communities. Also, locate facilities to minimize disturbance and fragmentation;
- 2) watch existing disturbed areas for invading species;
- 3) minimize changes in hydrology as well as erosion and sedimentation. These changes tend to degrade native plant communities, allowing more easy access for exotic plants;
- 4) ensure fill used in construction projects and other materials likely to transport exotics are as free as possible of exotic plant propagules; and
- 5) where feasible, control exotic plant species established on neighboring lands before they become established on the park.

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5.0 **ASSESSMENT OF EXOTIC PLANTS IN A PARK**

An assessment of exotic species problems will eventually be conducted for each park. The assessment will include an inventory of exotic species and an evaluation of the priority of each species for control efforts.

In order to do this inventory, park managers should eventually be able to recognize the exotic plant species within their parks. In some cases, park staff will be able to do this inventory on their own and, in other cases, it may be necessary for the division to hire a consultant or researcher to assist with this job. The inventory should thoroughly document the population size, extent, and effects on natural and cultural resources of each exotic plant species.

The following criteria that will be used to determine the priority of each species for control efforts include: the immediacy of the threat to an area of ecological or cultural significance, the likelihood of success of the control effort, and the invasiveness of the exotic species. The following categories are outlined by priority for control:

5.1 **Priority by Immediacy of Threat**

High priority where exotic species pose immediate threat to:

- rare or endangered native plants or biological communities;
- undisturbed examples of natural communities;
- biological communities representative of North Carolina's natural landscape that are not represented elsewhere in the state parks system;
- areas supporting species of animals known to depend upon native vegetation that is threatened by exotic species; and
- the integrity of a historic or culturally significant site.

Medium priority where exotic species will threaten an area as described above within 1-2 years.

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Low priority where it will be more than two years before an exotic species poses a threat to an area as described above.

5.2 **Priority by Likelihood of Success**

High priority where invading species is present in localized populations with good possibility for eradication.

Medium priority where invading species is controllable but only in selected areas or confinable to certain areas of the park. This category also includes species that are controllable parkwide, even though this effort may require removal from one area at a time.

Low priority where invading species is present with little possibility of control.

Localized exotic plants are the most amenable to control efforts. It may even be possible to completely eradicate these species if management is initiated quickly. Since exotic plant species often establish along predictable avenues such as roadsides and other areas where disturbance has taken place, efforts to assess the invasion of

exotic plants should be concentrated in these areas. Exotic plant species that have become established in the park may not be controllable throughout their entire range, but their impacts can be ameliorated. One method is to control these species in selected areas. These areas should include high priority natural areas and culturally significant sites. Another approach is to confine widespread exotic species to certain portions of a park. This approach works by controlling an infestation at the edges and then working toward the center. With this approach, surveys should be conducted beyond the controlled area to assure that long-distance establishment has not taken place.

Some widespread populations of exotic species cannot be controlled or can be controlled only partially. In these cases, their impacts must be accepted and every effort should be made to control further spreading.

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5.3 Priority by Invasiveness of Species

High priority for highly invasive species. These species may include but are not limited to:

tree-of-heaven (*Ailanthus altissima*)
autumn olive (*Elaeagnus umbellata*)
hydrilla (*Hydrilla verticillata*)
Korean lespedeza (*Lespedeza cuneata*)
Chinese privet (*Ligustrum sinense*)
Japanese honeysuckle (*Lonicera japonica*)
purple loosestrife (*Lythrum salicaria*)
Japanese grass (*Microstegium viminium*)
princess tree (*Paulownia tomentosa*)
common reed (*Phragmites australis*)
kudzu (*Pueraria lobata*)
multiflora rose (*Rosa multiflora*)
Johnson grass (*Sorghum halepense*)
alligatorweed (*Alternanthera philoxeroides*)

Low priority for moderately invasive species. These species may include but are not limited to:

mimosa (*Albizia julibrissin*)
gill-over-the-ground or ground ivy (*Glechoma hederacea*)
English ivy (*Hedera helix*)
common chickweed (*Stellaria media*)
bigleaf periwinkle (*Vinca major*)
common periwinkle (*Vinca minor*)
wisteria (*Wisteria sinensis*)

Each park's list of exotic species should be divided into these two categories of invasiveness to help prioritize where action should be taken. Those species with more potential to harm park resources should be given higher priority for control. Innocuous exotic species such as those restricted to areas subject to continuing human disturbance (i.e. continuously disturbed lawns and roadsides) are not

discussed in this section since management efforts should generally not be expended

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on these species. For the purposes of these guidelines, highly invasive exotic species are defined as those plants that have species, community-level, or ecosystem-level effects that can significantly alter natural processes such as fire regimes, nutrient cycling, hydrology, or successional patterns. These plants may also alter species composition by reducing populations of native species or by hybridizing with native species. Moderately invasive exotic species are those species that tend to spread slowly and stay in localized patches. They do not often pose a threat of becoming landscape-level problems. These species can, however, pose problems for small populations of rare plants.

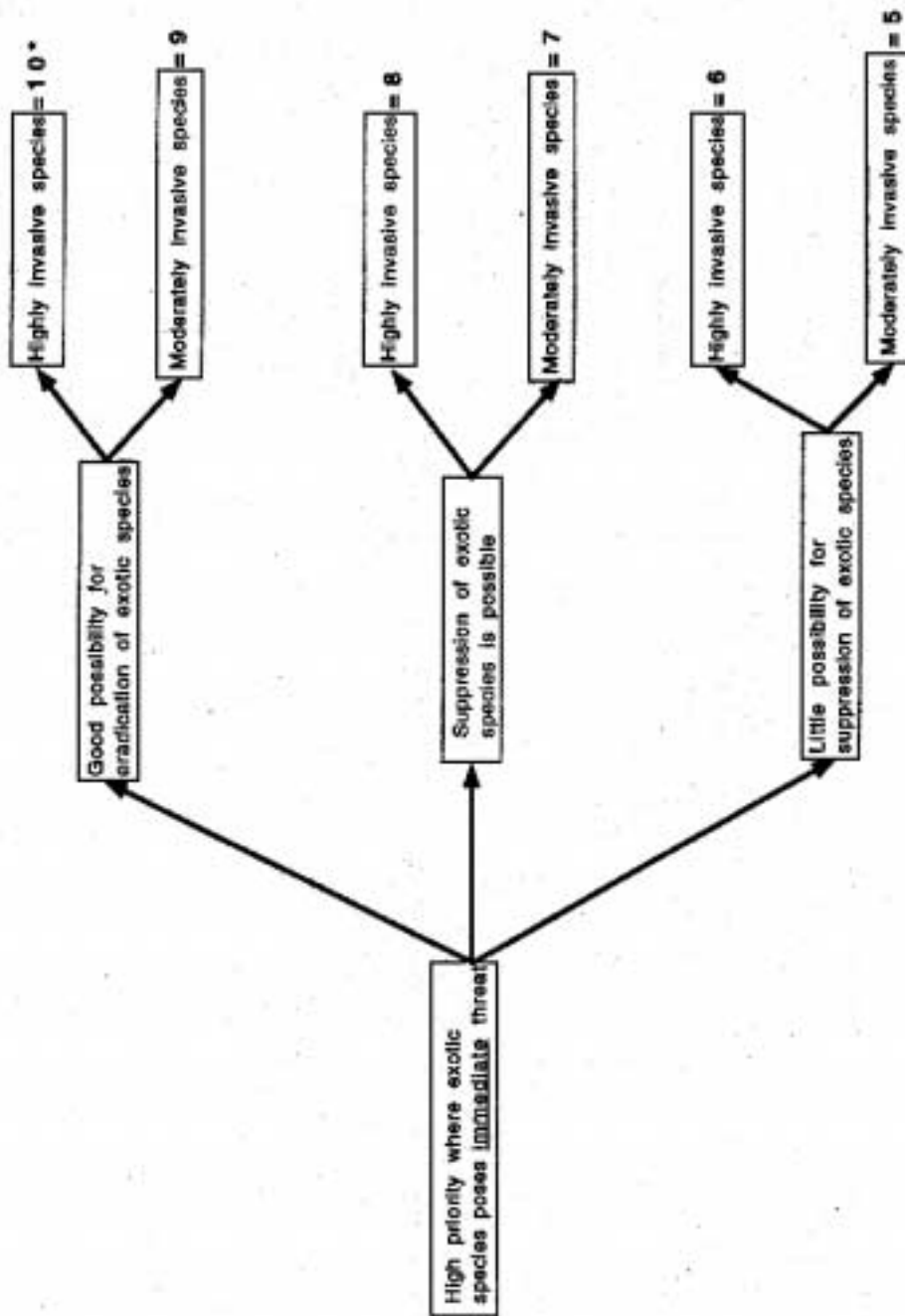
5.4 Flow Charts

These three criteria are combined into a series of flow charts in Figures 1a.-1c. These flow charts and corresponding scores of 1-10 are designed to provide park managers with guidance on when an exotic plant is an overall high, medium, or low priority for control. An overall score of 8-10, 4-7, and 1-3 indicates a high, medium, and low priority for control, respectively. Since these scores are meant as guidance, they should not in all cases replace best professional judgement. Each park's list of exotic plant species should eventually be prioritized based on the criteria set forth in these flow charts. Refer to Table 1 for an example of how to organize these data.

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FIGURE 1a. Method to Prioritize for Control of Exotic Plant Species

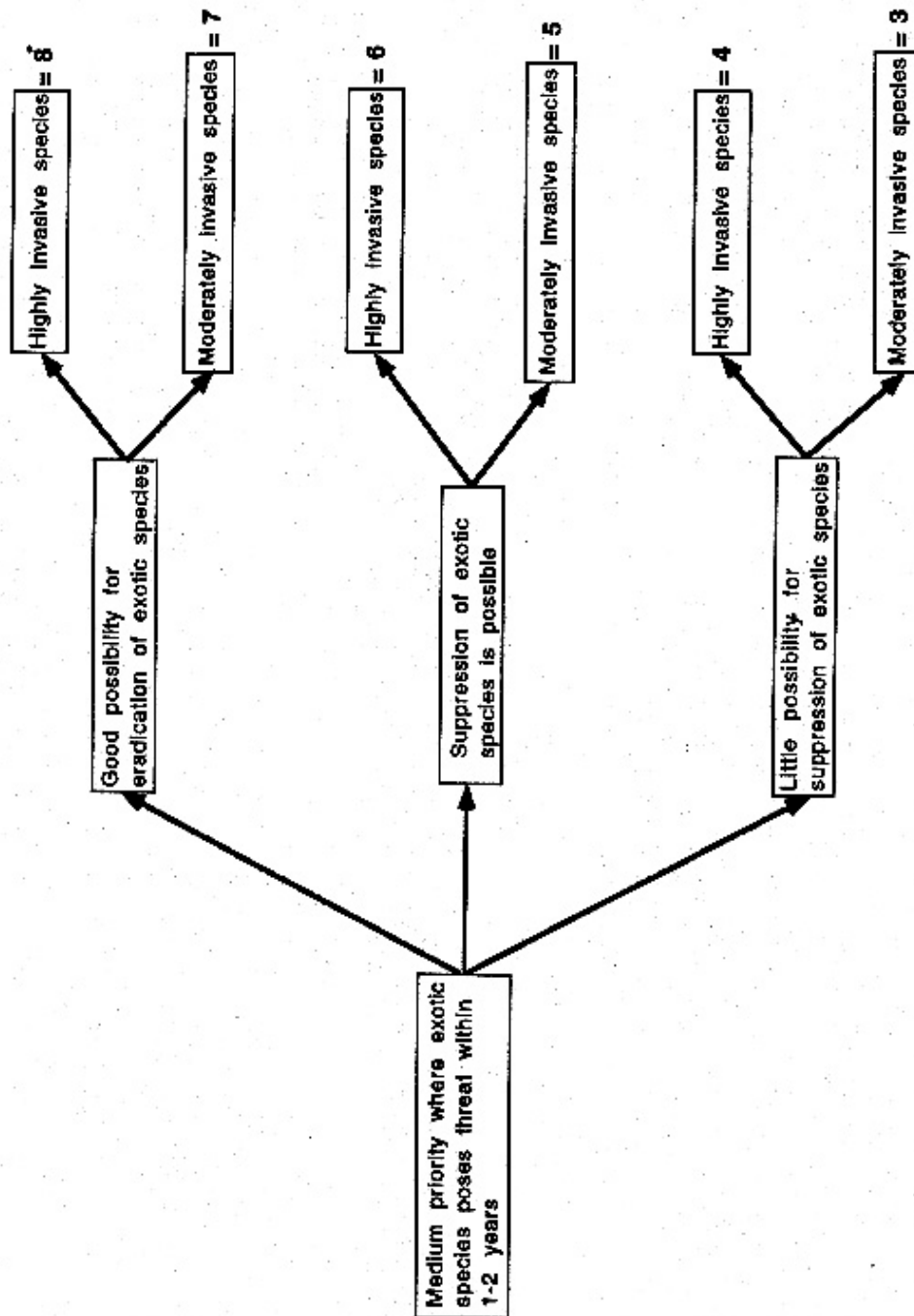


• 8-10=high priority for control; 4-7=medium priority for control; 1-3=low priority for control

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FIGURE 1b. Method to Prioritize for Control of Exotic Plant Species

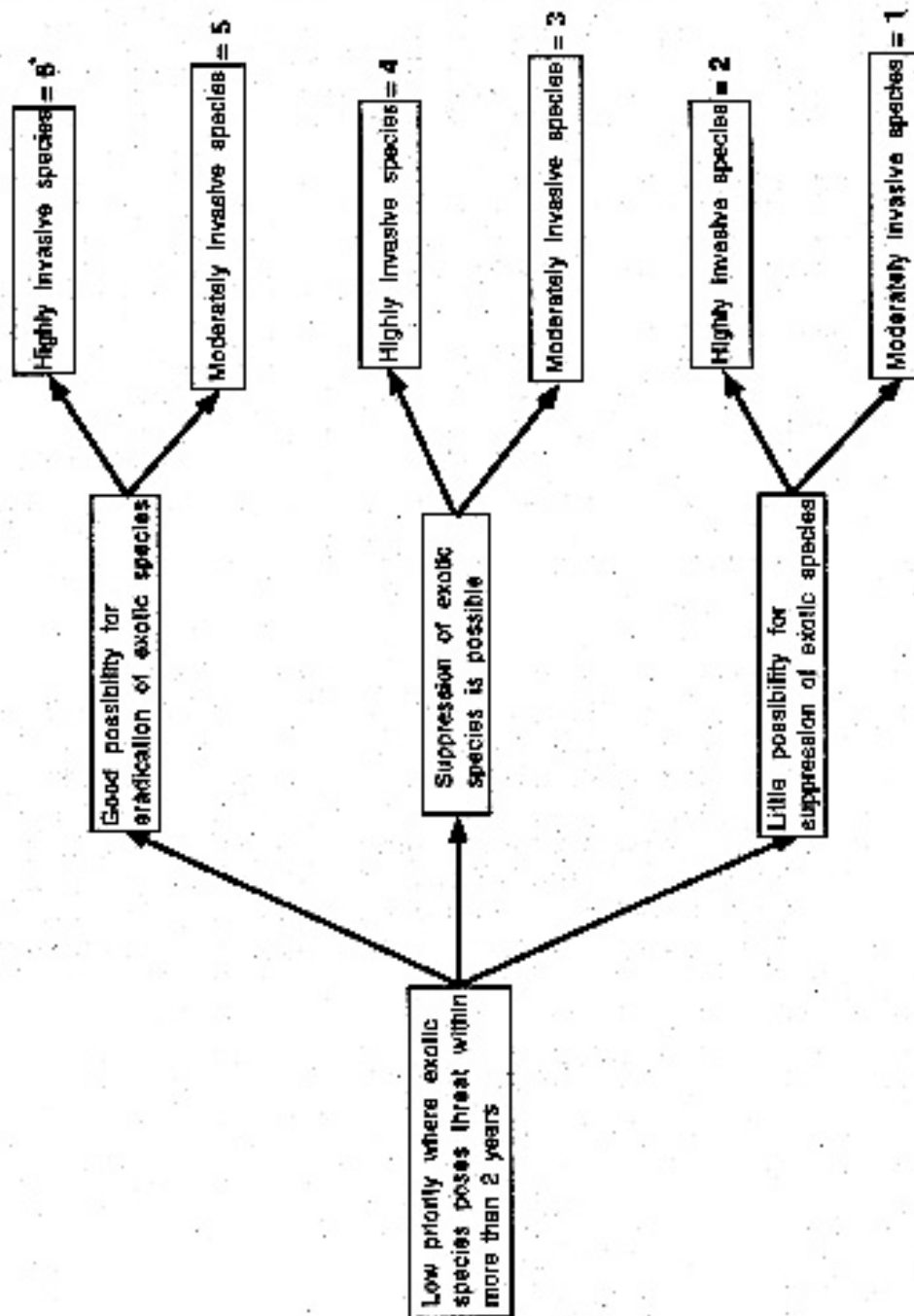


* 8-10=high priority for control; 4-7=medium priority for control; 1-3=low priority for control

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FIGURE 1c. Method to Prioritize for Control of Exotic Plant Species



• 8-10=high priority for control; 4-7=medium priority for control; 1-3=low priority for control

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Table 1. Prioritized List of Weed Species

Last Updated:

<u>Common Name</u>	<u>Scientific Name</u>	<u>Score/Category</u>	<u>Comments</u>

5.5

Staff Time

The initiation of an effort to control exotic species will obviously require staff time. Small infestations of exotic plants will likely be controllable by on-site park staff, whereas more widespread, established exotic plant problems may require a much greater commitment of time than is available within the individual park. High priority infestations for control, however, should not be neglected because of lack of staff. If additional staff time is needed for control of a high priority problem, the park superintendent may request assistance from elsewhere in the organization. Parks are encouraged to share expertise and to help each other with staff if possible. Parks may also use volunteer assistance for efforts to control exotic species if appropriate.

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6.0 PLANNING FOR CONTROL OF EXOTIC SPECIES

6.1 Preparation of a Control Plan

The importance of controlling exotic pests is recognized nationwide. Efforts are underway in North Carolina to control exotic plants at the federal, state, and local levels as well as by private organizations such as The Nature Conservancy. Any information that we gain in the state park system toward the goal of successful control of exotic plants will be valuable to other land managers with similar problems. Control plans are particularly important as a method of documenting the success or failure of various treatments for use by our own as well as other agencies.

An Exotic Species Control Plan will be prepared and approved before a major control effort is initiated. The plan will include a thorough inventory, the priority status for active control, locational maps, goals for control, description of selected control method(s), and a monitoring program for the problem species. Generally, control efforts will be initiated through park staff with resource management staff available for technical assistance.

In addition to eliminating a species that may be threatening a natural or cultural resource, a control plan must also focus on what should be in place of the exotic species. A program for the control of exotic species is best viewed as part of an overall restoration program. The control program also must consider what impact control operations will have on other indigenous species.

Long-term and sometimes even permanent management commitments and consistent follow-up are essential to successful programs for controlling exotic plants. Persistent seed banks and long-lived seeds often require control efforts over many years to eradicate exotic plants in a park even if the species are localized. For these reasons, plans should be developed for a specific period (e.g. 5 years) and be flexible enough to be modified if new circumstances arise. These plans should include schedules for achieving goals as well as estimates of required materials, money, and person-hours. Goals should consider the level of control desired and practically attainable. Eradication of the exotic species is ideal, but in many cases it may be impossible to achieve. Generally, the goal will be to reduce the population to some stable level. **Refer to Appendix I for an example of a control plan for exotic plant species.**

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6.2 When NOT to Write a Control Plan

Control plans are not necessary for the management of every exotic plant species in a park. Clear-cut situations where control plans are not necessary include the routine spraying of glyphosate around buildings to control weeds, removal of a few exotic shrubs at an old homesite, or pulling up English ivy at a ranger residence. As stated previously, at the other extreme are long-term or sometimes even permanent management commitments involving considerable money and staff time. Of course, there will always be a number of situations that fall somewhere in between the two extremes. When in doubt about whether an exotic species problem warrants a control plan, please call the division's resource management staff for advice.

6.3 Who Writes a Control Plan

Park staff may choose to write their own control plan or they may request that resource management staff write the control plan for them. In the latter case, park staff should schedule an on site field investigation with a representative from the Resource Management Program.

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7.0 **MANAGEMENT OF HISTORIC CULTIVARS**

In cultural landscapes, exotic plants should be evaluated according to their cultural and/or historical significance. Both cultivated and noncultivated species may be appropriate in a historical context. In fact, native plants and animals may require management if they are detrimental to the management of cultural landscapes.

If historic cultivars occur within a natural area and they are not invasive, they may be left in place. If removal is chosen, the park should provide propagules from the historic cultivars to botanical gardens, arboretums, and other interested public or nonprofit organizations. In historic areas, disruptive exotic plants may be replaced with cultivars, crop land, or pasture as well as by native plant communities which are historically appropriate. This activity requires an approved control plan.

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8.0 TREATMENT OF EXOTIC PLANTS

A number of factors need to be considered when choosing a method of eradication or control. These factors include: potential impact to non-target organisms; risks to workers, volunteers, and visitors; effectiveness; cost per unit of control; public relations; and impacts to public use areas. The various methods of control available may be classed under the headings: manual/mechanical, prescribed fire, competition/restoration, flooding, biological control, chemicals (herbicides), and integrated pest management. This list does not preclude other methods of control where appropriate.

8.1 Manual/Mechanical Control

Some weeds can be controlled by pulling them by hand or removing or killing them with a tool or mechanical device. A major advantage of manual/mechanical methods is that they can be safely used by staff and volunteers. On the other hand, these methods do not kill the wide variety of species (particularly shrubs) that resprout vigorously. Disturbance to the soil can also encourage reinvasion and incursions by other pests.

8.2 Prescribed Fire

The majority of park managers are familiar with the use of fire to manage vegetation communities that have evolved with fire. In this case, fire is used primarily to manage the growth of species that are native. Fire may also be used to control exotic species. Prescribed fires, however, should be used with caution since they may actually promote certain invasive, non-native species.

8.3 Competition/Restoration

The use of native plants to outcompete alien weeds is a frequently overlooked but potentially powerful technique. Often the natives must be planted into the habitat and given some care until they are well established. This technique may be appropriate where a native forest community is to be re-established in an old field that currently has an herb layer dominated by exotic grasses and forbs. Other weed control methods can be enhanced by encouraging competition from native species. Lightly infested patches or satellite populations of exotic plants can be cleared manually or with spot-treatments of herbicides, clearing the way for the

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re-establishment of native species. Once lightly infested patches or satellite populations have been cleared, the core infestation can be attacked by gradually clearing the perimeter and encouraging natives to move in.

8.4 Flooding

Prolonged flooding can kill plants that infest impoundments or other areas where water levels can be controlled. This method works best if the area is mowed or burned prior to flooding. For example, part of a *Phragmites australis* infestation at the Wertheim National Wildlife Refuge on Long Island, NY was eliminated by prescribed burning followed by flooding.

8.5 Biological Control

Biological control, or biocontrol, involves the use of animals, fungi, or other microbes that prey upon, consume, or parasitize a target species. “Classical” biological control carefully selects and introduces one or more of these enemies to the target species’ new habitat to reduce its population. Successful “classical” biological control programs result in permanent establishment of the control agent(s) and consequent permanent reduction in target species populations. Results cannot be expected immediately from this type control. “Inundative” or “augmentative” biological control involves mass releases of native or non-native organisms.

Biological control is not designed to eliminate the target completely, and it often takes years before the effects are obvious. Moreover, agents for biological control are available for only a few exotic plant species, and the research required to locate and test potential biological control agents is beyond the individual capabilities of the parks. For these reasons, biological control will at present have little utility for the majority of exotic plant problems.

8.6 Chemicals (Herbicides)

Herbicides are chemicals that kill or inhibit plant growth. Herbicides are frequently needed in exotic plant programs because they can be extremely effective tools in controlling or eliminating certain exotic plant species. They can also, however, be hazardous to human beings and the environment and should be used only after careful consideration of other options.

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8.7 **Integrated Pest Management**

In most cases, no single method of control is completely effective against an exotic species. Several considerations must be made when selecting pest management strategies. Consideration must be given to disruption of natural controls, hazards to human health, effects on nontarget organisms, overall damage to the environment, how effective treatments will be in reducing the pest population below the action level, how feasible it will be to effectively implement treatments, and how cost effective the treatment is over the short and long term. The integrated pest management concept is based on the fact that combined strategies for pest management are usually more effective in the long run than a single type of treatment.

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9.0 PROTOCOL FOR USING HERBICIDES

9.1 Choosing an Herbicide

When deciding which herbicide to use, consider the following factors:

- effectiveness on the target species;
- effects on non-target species;
- persistence in the soil;
- toxicity to animals; and
- likelihood that it will leach to groundwater.

Look for chemicals that:

- are selective;
- degrade rapidly;
- attach to soil particles and, therefore, are less likely to reach groundwater; and
- are non-toxic to animals.

In some cases the most effective herbicides are also more persistent and toxic. More effective herbicides, however, may not require repeated application and may result in the smallest total input of toxin to the environment. Trade-offs between effectiveness and toxicity will need to be evaluated on a case-by-case basis within an individual management plan.

Site conditions are also important to consider when choosing a control method. These conditions include: accessibility, proximity to open water, depth to groundwater, and the presence of rare species.

9.2 Choosing an Application Method

Herbicides can be applied:

- to living foliage;
- around the circumference of the trunk on the intact bark;

- to cuts in the stem;

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- by injection into the inner bark;
- to cut stems and stumps;
- in pellet form at the base of the plant; and
- to the soil before pest seeds germinate and emerge.

Application techniques that minimize the release of the herbicide to the environment are preferred, especially if other rare species are in the vicinity. This choice will depend greatly on the species being eradicated as well as the herbicide that is used. Use of a marker dye with foliar-applied herbicides will aid in avoiding non-target vegetation and will facilitate better coverage on the target weeds.

Park employees **must be licensed** by the North Carolina Department of Agriculture for any pesticide use on public lands. Training and exams are offered periodically in various locations throughout the state. Staff should contact Pesticide Education, 51 Kilgore Hall, N.C. State University, Raleigh, NC 27695, (919)-515-3113 for information regarding training.

9.3 **General Safety Considerations**

The health and safety of the applicator is always of utmost importance. Weed control management plans involving the use of herbicides should include protocols for safety that contain procedures for chemical storage, mixing, and cleanup. The following outlines some general guidelines that should be adhered to when using herbicides.

9.3.1 **Protective gear**

At a minimum, applicators must wear all protective gear required on the label of the herbicide they are using. Even if not required, the applicator should wear the following when mixing or applying herbicides:

- rubber boots
- long sleeved shirt and long pants (unless more protective clothing is required on the label such as a tyvek suit)
- rubber gloves (these should not be fleece lined)
- safety goggles

- respirator or dust mask if required on the label

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9.3.2 Emergency precautions and equipment

It is important for applicators to be supplied with decontamination and first aid kits whenever they do not have easy access to a shower or sink. Decontamination kits should include:

- two one gallon or more containers filled with potable water
- eyewash kits or eyewash bottles with buffered isotonic eyewash
- soap
- paper towels
- a map and directions to the nearest medical facilities and emergency phone numbers
- a full tyvek coverall with foot covers

9.3.3 Posting treated areas

The herbicide label will list any federal requirements for posting treated areas. Most of the more commonly used herbicides such as glyphosate and triclopyr have no federal posting requirements. Treated areas should always be kept off limits to the public at least until the herbicide dries and longer depending on the persistence of the herbicide.

When posting areas accessible to the public such as trails and visitor centers, place notices on the usual points of entry or the perimeter of the treated sites. The posting should include a notice that the area has or will be treated, the name of the herbicide used, the date of treatment, appropriate precautions to be taken, the date when re-entry is determined to be safe, and a phone number for additional information.

9.3.4 Storing herbicides

Always store herbicides in a well ventilated, cool, dry area where food and drinks are not stored or prepared. Always store herbicides in their original containers. The floor should be concrete or lined with plastic or other impermeable material to prevent leaks from reaching the soil. The storage area should also be inaccessible to the public and locked except when chemicals are being removed or returned. Containers should be labelled with the contents, date mixed, and approximate remaining volume. Containers must never be stacked.

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9.3.5 Mixing herbicides

Although it may seem obvious, **read the label** before mixing any herbicides. Water used for mixing in the field should be in separate containers labelled “Water and Rinsate for Herbicide Only, Nonpotable.” Always keep the water and rinsate containers separate. The rinsate should not go into the water container. Certain areas should be designated for the mixing of chemicals such as near the storage site or in areas near the treatment site. Field mixing sites should have relatively few native species that could be impacted, be in areas that are not susceptible to runoff or erosion, and be isolated from areas that are visited by the public. Rinse small spills to a safer dilution and always take a shovel, heavy plastic garbage bags, and a soil absorbent (eg. cat litter) to field mixing sites in case of a larger spill. Never mix herbicides near a well and never fill a tank with the hose placed in the mixing tank.

9.3.6 Transporting herbicides

Herbicides must always be transported in a well constructed and watertight box or bucket to prevent leaks from contaminating vehicles, applicators, and the environment. Containers should never be placed in the passenger compartment of a vehicle for transportation.

9.3.7 Herbicide disposal

Equipment cleanup

Application equipment and empty herbicide containers must be triple rinsed following use with 10% of the container volume for each rinse. This waste water must then be applied to a target weed for proper disposal. It is best to pressure rinse the container directly into the spray tank. Always read the label for specific procedures for equipment cleanup.

Container disposal

Containers should always be punctured before disposal to prevent re-use and should be crushed if possible. Properly rinsed containers can be disposed of at most municipal and county landfills throughout the state. Since some counties may also have specific collection centers for recycling pesticide contaminated containers, applicators should check on the availability of these centers. If the

herbicide label states that the container may not be disposed of in a regular sanitary landfill, call your county or municipal waste department for information on avenues for proper

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disposal. For example, many counties have periodic dates for collection of hazardous materials.

9.3.8 Applicator cleanup

After cleaning all pesticide containers and application equipment, thoroughly rinse personal protection gear with cold water from a hose or container that is hand-held (gloves off) and was not used during application work. All personal protection gear should then be washed in mild soap and water. Finally, applicators should wash their hands and any other areas that were exposed and could have potentially come in contact with the herbicide. Applicators should also shower and change clothing as soon as possible. Even if clothes worn during the application appear uncontaminated, they must be washed and dried separately from other clothing before being worn again.

9.3.9 Contaminated clothing

If concentrated herbicide spills on clothing, the clothing should be wrapped in newspaper and placed in the trash or a landfill, or burned where permitted. Items contaminated with certain commercial products, including “2, 4-D” or formulation in which “2, 4-D” is the sole active ingredient, are classified as hazardous wastes. In this case, you should contact your local hazardous waste materials center for instructions on how to dispose of this material.

9.3.10 Responding to spills

The proper response to a spill varies depending on the volume and concentration of herbicide released, the location of the spill, and the chemical involved. In general, it is not necessary to call for help unless an herbicide spill contaminates too much soil to dig up and place in plastic garbage bags.

When small volumes of dilute herbicide are spilled, they can be treated by digging up the affected soil and spreading this material at the legal rate or concentration. This material should be spread on areas within the designated treatment site. In situations where a spill is so large that it cannot be readily contained or disposed

of please call 911 and ask for assistance from the local fire department. The fire department will generally have access to their own hazardous materials team and, if not, they should know who to contact at the local or county level.

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10.0 MONITORING TREATMENT AREAS

The Exotic Species Control Plan will include a program for monitoring the results of control efforts. The importance of monitoring the impact of a control plan on an exotic plant species cannot be overemphasized. Monitoring data should be taken before the initiation of a control program as well as on an annual basis to determine if and when additional treatment is necessary. Monitoring is also important to determine whether the treatment adversely affected other organisms.

To monitor trends in population growth and possible expansions of range, baseline data on the exotic species must first be obtained. These data should include a range map of the exotic species and information on the density of the population. Information on the ecological role of the exotic species is also needed to determine the urgency of control measures.

The use of photographic monitoring to evaluate changes in cover, density, or population structure is one of the most efficient methods of long-term monitoring, both in terms of cost and time. These guidelines do not preclude the use of other types of monitoring such as vegetation transects; however, only the protocol for photographic monitoring will be covered given the parks limited resources. **It is the responsibility of the park superintendent to ensure that control programs are adequately monitored.**

The two types of photographic monitoring covered by these guidelines include photopoints (repeated photographs of a landscape area) and photoplots (repeated photographs of a plot located at or near ground level). The following outlines the protocol that should be followed when using photographic monitoring.

10.1 Equipment

- A quality 35 mm camera with either a 35 mm (for wide angle shots) or a 50 mm macro lens (for normal shots) is recommended.
- Either black and white prints (film: Kodak T-Max 100) or Kodachrome slides are the best for archival purposes.

- A tripod is useful for repeating shots at the same location and height above the ground as well as providing greater stability while

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focusing.

- A pole with clearly marked units to measure the height of vegetation and to provide a scale in the photographs is recommended.

10.2 **Permanently Marked Point**

For photopoints and photoplots, the location from which the photograph is taken needs to be permanently marked. This step requires a permanent stake or marker (i.e. PVC, conduit, rebar).

10.3 **Data and Data Sheets**

Locational as well as photographic data should be taken at each photopoint or photoplot. A sample data sheet is found in Appendix I.

10.4 **Archiving Photographic Monitoring Data**

Slides and photographs should be stored in a dark, cool (no higher than 70° F), and dry (between 25-50 percent relative humidity) environment. Storage locations can be metal file or storage cabinets or archival storage boxes made of acid-free paper. Wooden storage cabinets should not be used since wood maintains higher humidities than are recommended. Slides/photographs should be stored in tight plastic sleeves for protection from handling and dust.

The duplication of slides and photographs is recommended for long-term projects. Duplicates of slides are usually made on Ektachrome film and will, therefore, not last as long as the Kodachrome originals. It is best to use the Ektachrome duplicates for projection and for use in the field and to archive the Kodachrome originals.

10.5 **Important Considerations for Establishing Photopoints**

- recommend keeping the vertical angle of the camera at 90 degrees
- take photographs with the sun directly behind or directly above

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10.6 **Important Considerations for Establishing Photoplots**

Photoplots can be used for qualitative assessments of change; however, they are most useful to obtain quantitative data on cover or density. The prerequisites for quantitative photoplots include:

- short-statured vegetation (usually less than 1.5 feet)
- identifiable species of interest in the photograph or slide
- a small enough plot size (1.5 x 1.5 feet at most) to be photographed by people of different heights

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11.0 ROLES AND RESPONSIBILITIES

11.1 Superintendent of State Parks

The Superintendent of State Parks is responsible for the administration of the Exotic Plant Guidelines.

11.2 Park Superintendents

Park superintendents are responsible for preventing the invasion of exotic plant species into park boundaries to the greatest extent possible. They are also responsible for the assessment and the establishment of priorities of the exotic plant problems in their parks as well as ensuring that every major control effort has a completed control plan. Staff at an individual park may prepare their own plan or the park superintendent may request that resource management staff write a plan for them. Park superintendents share joint responsibility with the supervisor of the Resource Management Program for final approval of all control plans for exotic plants in their respective parks.

11.3 Resource Management Program

Staff of the Resource Management Program are available to provide technical assistance in the prevention and assessment of exotic species problems. They are also available to write control plans as requested. The supervisor of this program shares with the park superintendents the responsibility for final approval of all control plans for exotic plants.

11.4 Public Information Officer

In the case of large-scale programs, the public information officer, in coordination with the appropriate park superintendent, may prepare and implement an appropriate public information strategy to inform the public of the park's activities. Special attention should be paid to targeting residents of the surrounding areas.

11.5 District Superintendents

The district superintendents are available to assist with the allocation of personnel from other parks to work on various control efforts in their district.

Appendix I

Specific Control Plan for Exotic Plant Species

Common name:

Scientific name:

Name of State Park:

Date:

Background and Management Information

A. Priority

(Record priority number determined from flow charts in Figures 1a.-1c. Describe what criteria contribute to the priority status for this particular species.)

B. Description

(Briefly describe the habit, life history, native range, and any other pertinent characteristics of the exotic plant species. In most cases, this information can be found in Appendix III where each of the most invasive exotic plant species found in our parks is described.)

C. Current Distribution on the Site

(Describe the current range of the species in the park from baseline monitoring data. Include a range map and information on the density of the population. Also note whether the population is increasing, stable, or decreasing.)

D. Damage and Threats

(Describe how the species degrades a site on the park or could do so if allowed to proliferate.)

E. Goals

(Outline long-term goals for this species. For example, a management goal may be to reduce the numbers of this species so that it no longer threatens populations of a rare species.)

F. Measurable Objectives

(Establish measurable objectives for the control effort. These objectives should include:

- 1. the impact on numbers, density, cover, etc. that you would like to achieve;*
- 2. the size of the area in which you would like to achieve this objective; and*
- 3. the time frame that you would like to achieve this objective.)*

G. Management Options

(Briefly discuss the preferred alternative or alternatives and the conditions under which they may be used. Be sure to include the total anticipated cost of each of these alternatives.)

H. Actions Planned for Treatment and Monitoring

(Briefly describe the locations to be treated, materials and methods to be used, approximate dates and time of year, and an approximate schedule for control and monitoring activities. If several methods are to be tested, outline the design of the planned experiment or demonstration.)

I. Criteria for Success

(Outline the criteria that will be used to evaluate the success or failure of the program. These criteria should be based on the management goals and objectives.)

J. Resource Needs

(Estimate the amount of time for staff and the amount of money that will be required to carry out the planned control, monitoring, and evaluation for this species. Refer to the following worksheet for guidance on estimating resource needs.)

Annual Cost and Labor Worksheet

Common Plant Name:

Scientific Plant Name:

Year:

Date:	Item/Person:	Staff Hrs	Volunteer Hrs	Cost (\$)	Comments:

K. Results of Evaluation

(This section is reserved for when monitoring data on the control effort have been evaluated. Ideally, monitoring data should be taken within the first year after treatment and then each

successive year that the management plan is designed for. These data should then be used to determine whether any sections of the control plan will need to be modified.)

Emergency Information

Include directions and map to nearby hospitals or clinics.

Herbicide Use Protocols Where Herbicide Use is Planned

Note which herbicide(s) will be used and roughly how much will be used. Also outline any state and local requirements for posting of treated areas. Briefly describe how the herbicide(s) will be stored, mixed, and transported. Describe how excess herbicide and any equipment that has become contaminated will be disposed of. Describe emergency first aid procedures and plans for responding to spills or contamination. List the names of herbicide applicators and what protective gear will be available for them.

Herbicide Labels

If herbicide use is planned, attach copies of the herbicide label(s).

Monitoring Data

Photopoint or Photoplot Monitoring Record Form

Park:

Project:

Initial Take Information

Location:

Date:

Retake Frequency:

Describe access, location of permanent point, surrounding area, include sketch map.

Reference Point Descriptions:

Sketch Map below:

Reference Point 1

Description:

Reference Point 2

Description:

Reference Point 3

Description:

Photographic Information:

Photographer:

Camera:

Lens:

Filter:

Film:

ASA:

Time:

Weather:

Notes:

Retake Information

Date:

Photographer:

Camera:

Lens:

Filter:

Film:

ASA:

Appendix II

Example Control Plan for Exotic Plant Species

Common Name: Korean or Sericea Lespedeza Scientific Name: *Lespedeza cuneata*

Name of State Park: Raven Rock State Park

Date: August 20, 1997

Background and Management Information

A. Priority

The priority number for Korean lespedeza as determined from the flow charts in Figures 1a.-1c. is 8. This score indicates that the control of Korean lespedeza is a high priority at Raven Rock State Park. The main criterion contributing to this score is the fact that Korean lespedeza poses an immediate threat to areas that have been planted with long-leaf pines. Although once widespread in eastern North Carolina, long-leaf pine communities are now extremely rare.

At this point, the complete eradication of Korean lespedeza is probably impossible. It can still, however, be controlled and confined to certain areas of the park. Immediate action is necessary to combat Korean lespedeza since this plant is extremely invasive.

B. Description

A native of Japan, Korean lespedeza now occurs from southern New Jersey to central Florida and westward to eastern Texas, Oklahoma, and Kansas. It is also found as far north as the southern half of Illinois, Indiana, and Ohio. A prolific seed producer, this plant can readily colonize early to mid-successional grasslands and open forest communities. In a mixture of grass it usually becomes the dominant species after 3 or 4 years. It has a tendency to form dense stands that prevent or retard the natural invasion of other plants.

C. Current Distribution on the Site

The population of Korean lespedeza is increasing at Raven Rock because this plant is a prolific seed producer as well as the fact that a number of areas in the park are burned in the effort to re-establish long-leaf pine communities. Fire greatly enhances the ability of this species to seed and spread (refer to Figure 1).

D. Damage and Threats

Korean lespedeza is currently hindering the efforts of the park staff to re-establish long-leaf pine communities by shading out the pine seedlings as well as every other species in the herb layer.

E. Goals

The goal for this control effort is to manage Korean lespedeza at suppressed levels such that long-leaf pines and other species associated with this natural community can be re-established. It is also hoped that with the suppression of lespedeza, the natural recruitment of herbaceous species can occur.

F. Measurable Objectives

Approximately 25 acres at Raven Rock State Park need to be managed for the control of Korean lespedeza. The objectives of this control effort are a 95% reduction in cover of Korean lespedeza as well as the prevention of further spreading of this species. Such a significant reduction in cover is necessary to prevent Korean lespedeza from regaining a strong foothold in successive years. This objective will take approximately five years to achieve.

G. Management Options

An effective way to control Korean lespedeza is to mow it during the growing season and then spray it with Roundup. The park staff at Raven Rock would prefer to purchase a skid sprayer to treat the lespedeza with herbicide instead of hiring a tractor operator with a boom sprayer. In this way, the spray radius can be controlled more effectively in areas that are already planted with long-leaf pine seedlings. Although the less expensive alternative is to hire an herbicide applicator, this alternative is only viable in areas where long-leaf pines have not been planted. Because of this limitation, only the cost to treat the areas with a skid sprayer is calculated. Refer to Section J where resource needs are calculated.

H. Actions Planned for Treatment and Monitoring

Given limited staff time, it is impossible to mow and treat the entire 25 acres of Korean lespedeza with Roundup in one year. Realistically, approximately 5 acres can be mowed and treated with herbicide each year. This treatment should ideally occur in the early summer when the plants are still actively growing. After an area has been treated with herbicide, it will be monitored annually. Areas that are not being treated with herbicide in a particular year will be mowed in August while the Korean lespedeza is flowering but before it has set seed to prevent further spread of the plant. After the entire 25 acres has been initially treated with Roundup, spot treatments of Roundup will be required in successive years. At that point, monitoring for the entire area will be done annually.

I. Criteria for Success

The success of this program will be based on reducing the cover of Korean lespedeza by 95% of pretreatment levels and preventing the spread of this plant to new locations.

J. Resource Needs

Annual Cost and Labor Worksheet

Year: 1998

Date:	Item/Person:	Staff Hrs	Volunteer Hrs	Cost (\$)	Comments:
June	skid sprayer			1,000	
	mower operator	4		40	\$10/hour
	gas for mower			11.5	\$1.15/gallon
	herbicide applicator	40		400	\$10/hour
	Roundup			280	\$56/gallon
August	mower operator	16		160	\$10/hour
	gas for mower			46	\$1.15/gallon
total cost				1,937.50	

The total estimated cost for the first year of this control program is \$1,937.50. This cost includes the initial one time price for a skid sprayer of \$1,000 plus \$937.50 for mowing and herbicide application. This estimate assumes that it takes approximately 4 hours to mow 5 acres and that it takes approximately 8 hours to apply herbicide onto 1 acre. Note that in the first year 5 acres are mowed and sprayed with herbicide in the early summer when the Korean lespedeza is actively growing. The rest of the twenty acres will be mowed in August while the Korean lespedeza is flowering but before it sets seed. The annual cost for the successive 4 years of intensive treatment should remain at approximately \$937.50 given that the area to be mowed will decrease but that spot treatments of herbicide will be necessary in areas that have previously been treated. The costs for annual monitoring given that photographic monitoring is employed are negligible.

K. Results of Evaluation

(This section is reserved for when monitoring data on the control effort have been evaluated. Ideally, monitoring data should be taken within the first year after treatment and then each successive year that the management plan is designed for. These data should then be used to determine whether any sections of the control plan will need to be modified.)

Emergency Information

The closest hospital to Raven Rock State Park is Central Carolina Hospital in Sanford. From the park take 421 North. In Sanford, 421 will turn into Horner Boulevard. Take a left at the light at Field's Drive and the hospital will be on the right (refer to Figure 2).

Herbicide Use Protocols Where Herbicide Use is Planned

Roundup (glyphosate) will be used for this control effort at a rate of 1 gallon (concentrated) per acre. There are no requirements for posting areas that have been treated with glyphosate.

The herbicide will be stored in a cool, dry area of the maintenance building. If mixing is necessary, this activity will also be done at the maintenance building. The herbicide will be transported to the field site in watertight containers placed in the back of a pickup truck.

Excess herbicide will be applied to target weeds in the park. Application equipment and empty herbicide containers will be triple rinsed with 10% of the container volume for each rinse. This wastewater will also be applied to target weeds. Empty containers will be punctured and disposed of in the garbage.

On-site first aid kits should always contain at least two gallons of potable water, eyewash bottles with buffered isotonic eyewash, soap, and paper towels. In addition, a shovel, plastic garbage bags, and soil absorbant (eg. cat litter) should be taken to the field site in case of a spill.

Applicators at Raven Rock State Park may include: Paul Hart, David Brown, Jonathan Griffith, and Wayne Rouse. For mixing and applying herbicides, applicators must at a minimum wear rubber boots, a long sleeved shirt and long pants, rubber gloves (not fleeced lined), and safety goggles. This apparel should be washed in soap and water after use. Applicators should always wash their hands and any other areas that were exposed to the herbicide as soon as possible. It is also recommended that applicators shower and change clothing as soon as possible.

Herbicide Label

ROUNDUP

DIRECTIONS FOR USE

It is a violation to use this product in a manner inconsistent with its labeling.

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH LABEL PRECAUTIONARY STATEMENTS AND DIRECTIONS.

WHEN TO USE: Use anytime weeds and grasses are actively growing. Treated weeds usually show initial symptoms within hours and complete kill in 1 to 2 weeks. Larger more established weeds may take up to 4 weeks for a complete kill. Roundup works best in warm sunny weather with daytime temperature above 60°F. Reapply if it rains within 6 hours after application. If hard-to-control weeds are not killed within 4 weeks, reapply.

HOW TO USE: To treat individual weeds adjust the nozzle to a coarse spray. Spray when air is calm. Position sprayer tip approximately 1 to 2 feet from weeds and apply until completely covered. **IMPORTANT: Roundup is an all-purpose weed and grass killer which will kill**

almost all plants contacted. If necessary, use cardboard or plastic to shield desirable plants. If plants are accidentally sprayed, rinse off immediately with water. Do **NOT** use for spot weed control in lawns since Roundup kills all green plants, including lawn grass. Sprayed areas can be replanted with ornamentals or flowers the day after treatment.

STORAGE: Store this product in its original container, in a secure area. Protect container from freezing. **DISPOSAL:** To dispose of partially used or empty container, securely wrap it in several layers of newspaper and discard in trash. In case of SPILL or LEAK, soak up with paper towels and discard in trash. Do not reuse empty container except for refill in accordance with refill instructions.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS & DOMESTIC ANIMALS

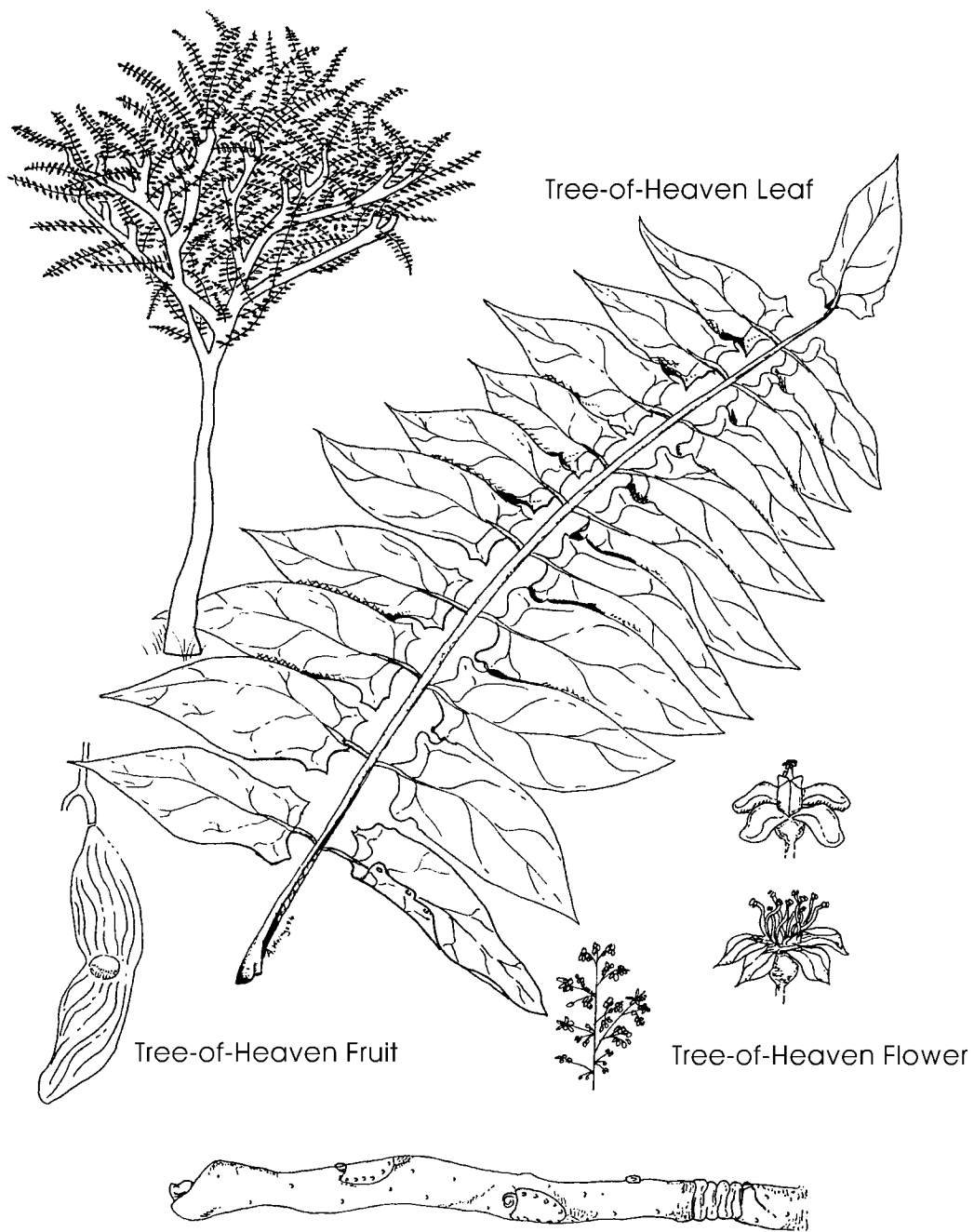
CAUTION: Causes eye irritation. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling. People and pets may re-enter treated areas after spray has dried.

FIRST AID: If in Eyes: Flush eyes with plenty of water. Call a physician if irritation persists. In case of emergency involving this product, call 1-800-454-2333.

ENVIRONMENTAL HAZARDS: Do not apply directly to water. Do not contaminate water when disposing of equipment washwaters. **NOTICE:** Buyer assumes all responsibility for safety and use not in accordance with directions.

Monitoring Data

To be completed after the first year of the control plan.



Appendix III

Invasive Exotic Plant Species in North Carolina's State Parks

Tree-of-Heaven (*Ailanthus altissima*)

Description

Tree-of-heaven is a small to medium sized tree with smooth, gray bark that can achieve a maximum height of up to 100 feet. Leaves are alternate along the stem and are compound, composed of 11-40 leaflets oppositely arranged along the leaf stem with a terminal leaflet. Each leaflet is two to five inches long, lance-shaped, with a pointed tip and blunt base. Most leaflets have one to three coarse teeth near their base. When crushed, the leaves produce a distinctive, offensive odor that has been described as "the smell of burnt peanut butter."

The tree flowers in July and August, with flowers occurring in panicles (much-branched flower cluster) at the ends of the branches. Each greenish-yellow flower has five sepals and petals. Seeds are encased in a papery sheath called a samara. The samaras are slightly twisted or curled and can be carried by the wind great distances from the parent plant.

Habitat

Tree-of-heaven readily establishes on disturbed sites such as vacant lots of the inner city, railroad embankments, highway medians, fence rows, and roadsides. In naturally forested areas, disturbance created by severe storms or insect infestations can open the way for the invasion of tree-of-heaven.

Distribution

Tree-of-heaven is native to a region extending from China south to Australia. It was imported to the United States in 1784 by a Philadelphia gardener. In the west, it was brought over by Chinese immigrants who use it for medicinal purposes.

Threats

Tree-of-heaven is an aggressive competitor that propagates by both seeds and underground runners. Once established, it can grow several feet every year. One tree can produce up to 350,000 seeds per year. Seedlings establish a taproot three months from germination allowing this plant to outcompete most native plants for sunlight and space. Furthermore, tree-of-heaven also produces a toxin in its bark and leaves that can accumulate in the soil and inhibit the growth of other plants.

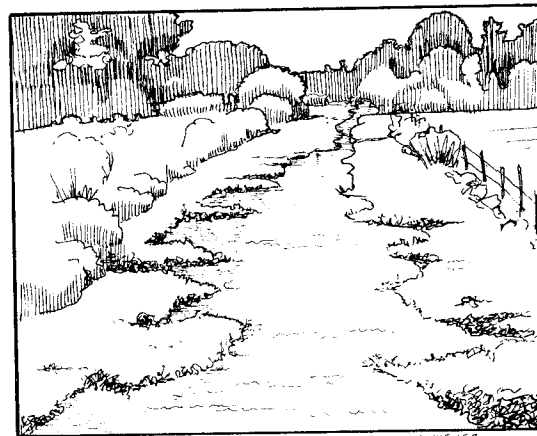
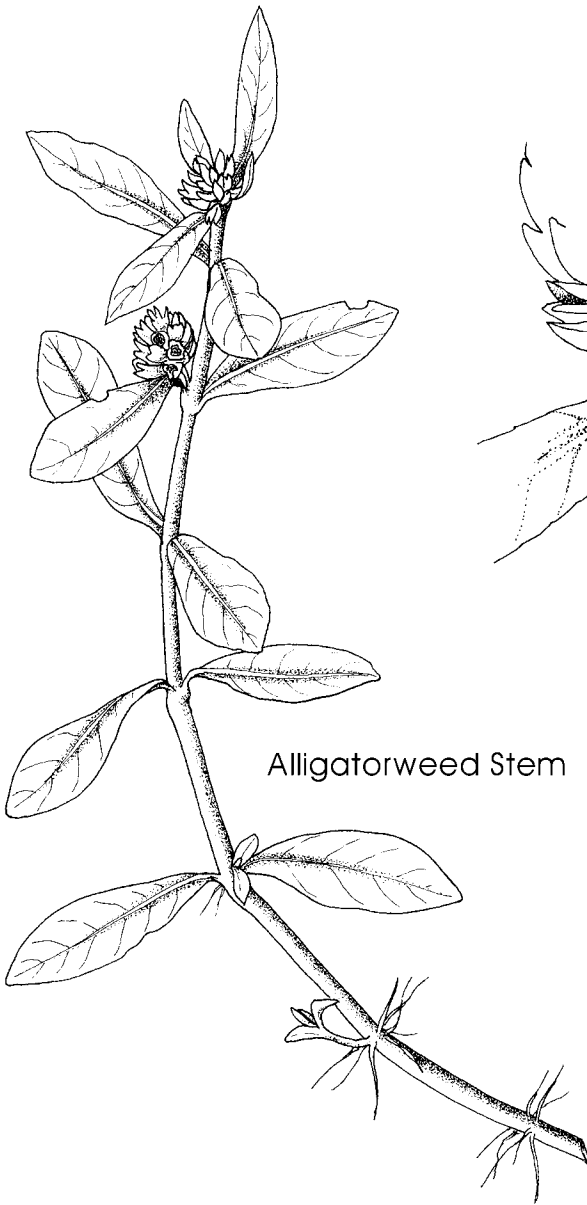
Control

This tree is best eliminated while still small since it is very difficult to remove once it has established a tap root. At first, the root system is shallow so that seedlings can simply be pulled out, roots and all, when the soil is moist and loose. When the tree becomes too large for mechanical removal, another option is to cut the tree down near to the ground and either paint or spray the freshly cut stumps with a 50% solution of glyphosate or triclopyr. Late spring to early fall is the best time to apply this herbicide since in the spring sap may flow to the surface of the cut and rinse the chemical off. Late fall to early spring, translocation is too poor to adequately distribute the chemical through the plant. In addition, the basal section of the tree (ground to 12 inches) can be treated with a solution of 25% triclopyr and 75% horticultural oil. After treatment, wet the area thoroughly.

Alligatorweed Flower



Alligatorweed Stem



M. MUELLER

Appendix III (continued)

Alligatorweed (*Alternanthera philoxeroides*)

Description

Alligatorweed is an aquatic and sometimes terrestrial plant that is characterized by opposite, non-succulent leaves and small white flowers that grow on a terminal spike. In its aquatic stage, the stems of this plant are hollow providing great bouyancy and enabling the plant to achieve lengths of up to 45 feet. The stems can also root at the closely spaced nodes giving the plant the ability to begin a new mat elsewhere. In the terrestrial stage, the stems of alligatorweed are usually not hollow and the leaves tend to be smaller.

Habitat

Alligatorweed roots in soil along the shore or in shallow water and then grows across the surface forming a dense interwoven floating mat. This plant grows primarily as an emersed aquatic plant but can also thrive in wet or dry soils.

Distribution

Alligatorweed, a South American immigrant, was first authentically recorded in 1897 near Mobile, Alabama, although it might have been found in Florida as early as 1894. It was present near New Orleans in 1898 and was recognized as a threat to waterways as early as 1901. Populations of alligatorweed, however, were mostly held in check by the more aggressive waterhyacinth, *Eichhornia crassipes*, until modern herbicides arrived in the late 1940's. Alligatorweed, which was more resistant than waterhyacinth to 2,4-D and other herbicides, often replaced waterhyacinth after both were sprayed. By 1963, an estimated 162,000 acres of water from North Carolina south to Florida and west to Mississippi were infested.

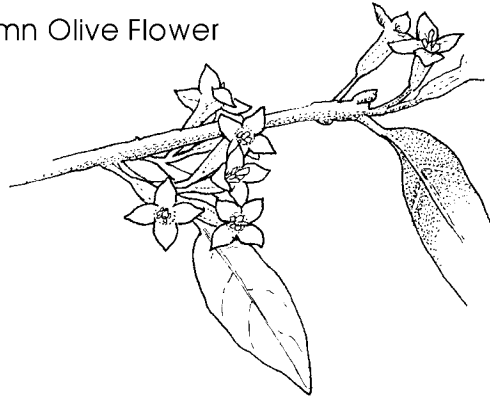
Threats

The hollow stems of this plant can grow to great lengths and allow plants to form dense floating mats that extend far into bodies of water. These mats reduce or eliminate native plants, are impenetrable to motor boats, and restrict water movement. Of particular concern is the ability of this plant to root at the stem nodes allowing alligatorweed to spread very rapidly as pieces of stem break and float away.

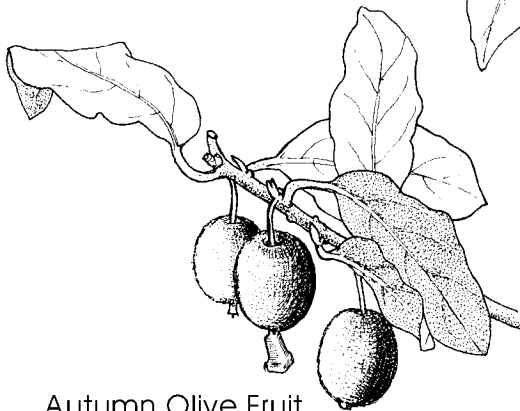
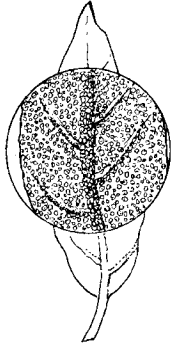
Control

At present, chemical control is the only viable means for alligatorweed control. Two herbicide treatments of Rodeo (a formulation of glyphosate that has been approved for use over water), one early in the growing season and one in late-summer or early fall, are most effective for the initial treatment of alligatorweed. After three or four years when the infestation of this weed is reduced to a maintenance level, only minor annual treatments should be required. The terrestrial stage of alligatorweed is more difficult to manage because of the formation of a large tap root. As with the aquatic stage, two herbicide treatments of glyphosate are needed each year during the growing season until the weed is reduced to a maintenance level where only one annual treatment is required. It may take at least four or five years, however, to reduce the terrestrial stage of alligatorweed to a maintenance level.

Autumn Olive Flower



Autumn Olive Stem



Autumn Olive Fruit



Appendix III (continued)

Autumn Olive (*Elaeagnus umbellata*)

Description

Autumn olive is a deciduous shrub or small tree with alternate, oval, untoothed leaves. The underside of the dark green leaf is characteristically covered with silver-white scales. After the leaves have appeared early in the growing season, small, light yellow, fragrant flowers are borne along the twigs. The small round fruits are reddish to pink, dotted with scales, and produced in great quantity.

Habitat

Typical habitats of autumn olive are disturbed areas, roadsides, pastures, and fields in a wide range of soil types. This plant has nitrogen-fixing root nodules that allow it to thrive in poor soils. It does not do well in wet or densely forested areas but has considerable tolerance to drought.

Distribution

A native to China, Korea, and Japan, autumn olive was introduced to the United States for cultivation in 1830. It has been planted in the eastern and central United States for revegetation of strip mines and other disturbed areas, as an ornamental shrub, and as wildlife cover.

Threats

Autumn olive has the potential of becoming one of the most troublesome invasive shrubs in the central and eastern United States. It exhibits prolific fruiting, rapid growth, wide dispersal by birds, and the ability to adapt to many sites. It also resprouts vigorously after cutting or burning. Populations of this shrub should be closely monitored and infestations eliminated while they are still small.

Control

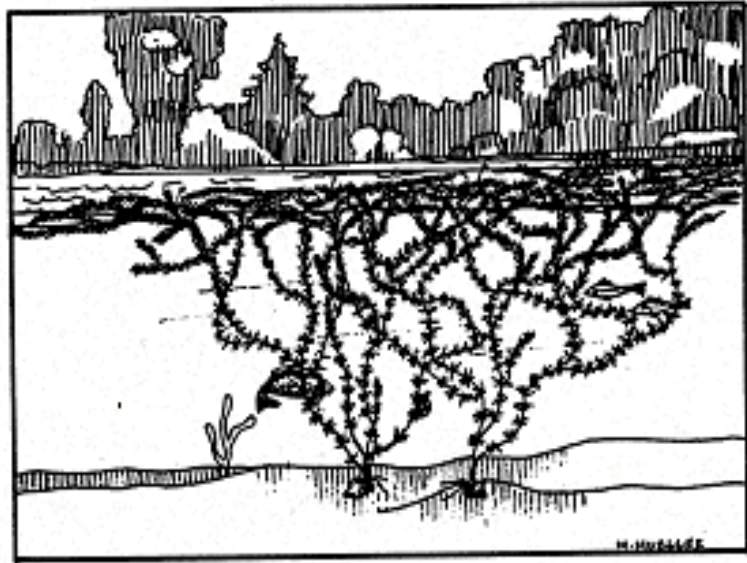
Seedlings and sprouts can be grubbed by hand when the soil is moist to insure removal of the root system. With larger plants, cutting alone results in thicker, more vigorous growth. Burning also results in vigorous resprouting.

Foliar application of a solution of 1 to 2% glyphosate or triclopyr with a 0.5% nonionic surfactant may be adequate for small patches of autumn olive. Application of herbicide should be done in late August or September when the plant is actively translocating materials to the

roots. The plant can also be cut off at the main stem and immediately painted with a 50% solution of glyphosate or triclopyr. Be sure to cover the outer 20% of all cut stumps. In addition, the basal section of the plant (ground to 12 inches) can be treated with a solution of 25% triclopyr and 75% horticultural oil. After treatment, wet the area thoroughly.



Hydrilla Stem



Hydrilla Leaves

Appendix III (continued)

Hydrilla (*Hydrilla verticillata*)

Description

Hydrilla grows submersed in water and is generally rooted to the bottom, although in some cases fragments will break loose and survive in a free-floating state. The coarsely serrated leaves of this plant occur in whorls of three to eight and have characteristic spines on the underside of the midrib. It closely resembles *Elodea canadensis* and *Egeria densa*, except that these two species do not have spines.

Hydrilla produces reproductive propagules called turions and tubers. Turions are compact dormant buds that are produced in leaf axils and fall from the plant when they are mature. Tubers are formed terminally on rhizomes and can be found up to a foot deep in the sediment.

Habitat

Hydrilla occurs primarily in lakes and ponds of tropical and temperate climates.

Distribution

Hydrilla is probably native to the warmer regions of Asia. It is a cosmopolitan species that occurs in Europe, Asia, Australia, New Zealand, the Pacific Islands, Africa, Europe, South America, and North America. Hydrilla was first discovered in the United States in 1960 and is now found in all Gulf Coast states, Atlantic Coast states as far north as Maryland and Delaware, and in the western states of California, Washington, and Arizona.

Threats

Hydrilla has many characteristics that enable it to compete so effectively and displace native aquatic vegetation. First, the growth habit of hydrilla enables it to compete effectively for sunlight. This plant can grow very rapidly, up to one inch per day, until it nears the water surface. Near the water surface it branches profusely and forms a thick mat, enabling this plant to intercept sunlight to the exclusion of other submersed plants.

Second, hydrilla is able to grow under a wide range of water chemistry conditions. It is commonly found in a range of lakes from oligotrophic to eutrophic. It can also grow in water up to nine to ten parts per thousand salinity (brackish) while also tolerating a wide range of pH.

Third, this plant is adapted to use low light levels for photosynthesis. Hydrilla can, therefore, begin to photosynthesize earlier in the morning allowing it to successfully compete with other aquatic plants for a limited amount of dissolved carbon. This requirement for low light also allows hydrilla to colonize in deeper water than other aquatic plants.

Fourth, although capable of reproducing by seed, hydrilla is particularly successful because of its varied modes of vegetative reproduction. Hydrilla can sprout new plants from stem fragments containing as few as two whorls of leaves. Fragments from rhizomes can also form new plants. This characteristic means that small amounts of hydrilla on boat trailers, bait buckets, etc. can spread the plant from place to place. The most troubling reproductive trait of hydrilla for aquatic plant managers is the production of tubers and turions. These propagules can withstand ice cover, prolonged drying, ingestion and regurgitation by waterfowl, and herbicides.

Control

A variety of control methods have been used on hydrilla including mechanical removal, dessication through lake drawdown, and herbicide application. In North Carolina, the least expensive and most effective method of control has been the use of sterile, triploid grass carp. The stocking and monitoring of grass carp in infested lakes can be coordinated through the Department of Environment and Natural Resources, Division of Water Resources, Aquatic Weed Control Program, P.O. Box 27687, Raleigh, NC 27611, (919)-733-4064. Keep in mind that grass carp are non-specific herbivores and will, therefore, consume desirable native species of aquatic plants in conjunction with hydrilla.

Please note that hydrilla is listed as a state noxious weed. All suspect infestations of hydrilla should be reported immediately to the North Carolina Department of Agriculture, Plant Industry, Plant Protection Section, P.O. Box 27647, Raleigh, NC 27611, (919) 733-6932, or toll free - 1-800-206-WEED (9333).

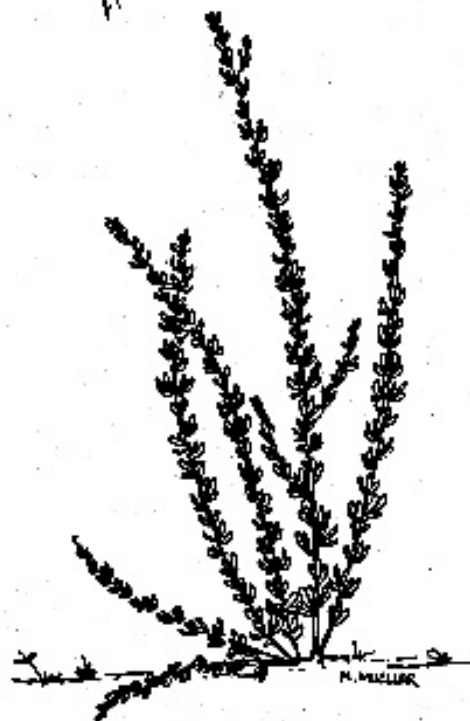
Lespedeza Stem



Lespedeza Flower



Lespedeza Leaf



Appendix III (continued)

Korean or Sericea Lespedeza (*Lespedeza cuneata*)

Description

Korean lespedeza is a perennial legume ranging in height from 1.5 to 5 feet. The blunt-tipped leaves of this plant are arranged alternately in groups of three along the entire length of the stem. The stems are herbaceous to somewhat woody with numerous straight branches.

The inconspicuous flowers of lespedeza are creamy-white with purple markings and grow in the axils of the leaves from the middle to the upper portions of the plant. They bloom in late summer or early fall.

Habitat

Korean lespedeza is found in open woodlands, clearings, borders, old fields, roadsides, and urban waste areas.

Distribution

Korean lespedeza is native to Japan and now occurs from southern New Jersey to central Florida and westward to eastern Texas, Oklahoma, and Kansas. It occurs as far north as the southern half of Illinois, Indiana, and Ohio.

Threats

A prolific seed producer, this plant can readily colonize early to mid-successional grasslands and open forest communities. In a mixture of grass it usually becomes the dominant species after 3 to 4 years. It has a tendency to form dense stands that prevent or retard the natural invasion of other plants.

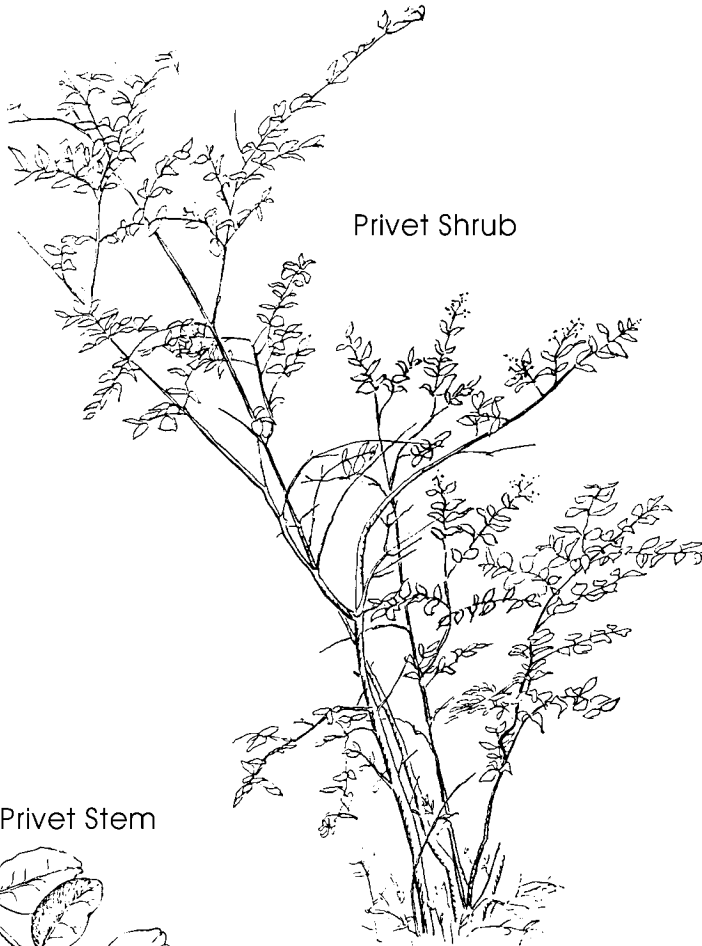
Control

At present, little is known about the control of this plant. Spraying the foliage of lespedeza with a solution of 2% glyphosate or triclopyr and 0.5% nonionic surfactant has some promise for control. The North Carolina Department of Transportation has found that the herbicide Transline is very effective for controlling lespedeza and should be applied in a 0.5% solution with 0.5% nonionic surfactant. This herbicide should not be used near water because of its toxicity to fish and insects. Either herbicide should be applied during the active growing season before the plant has had a chance to set seed. Mowing lespedeza in the flower bud stage for 2 to 3 consecutive years will also help to curtail the spread of this plant.

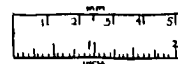
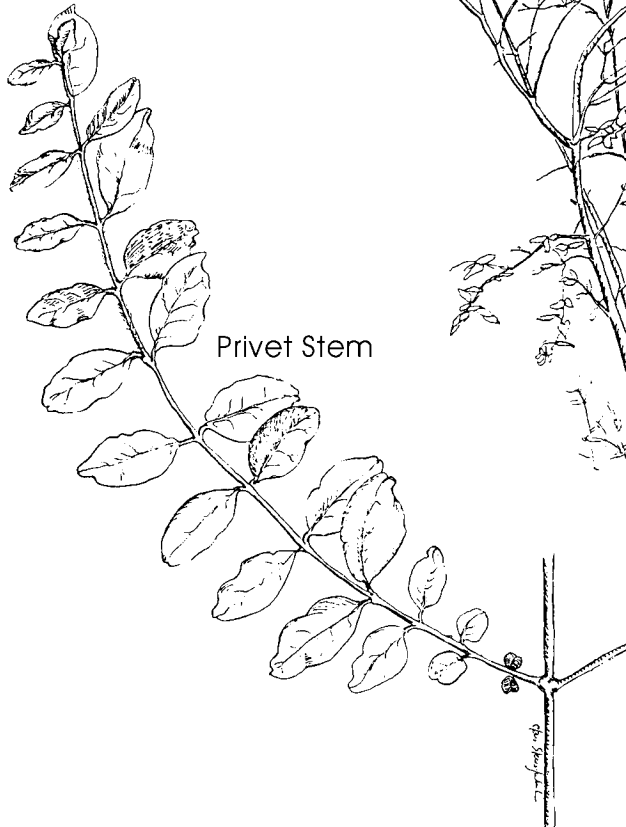
Privet Fruit



Privet Shrub



Privet Stem



Appendix III (continued)

Chinese Privet (*Ligustrum sinense*)

Description

Chinese privet is a multi-branched shrub that can grow up to 12 feet high. In North Carolina, it is evergreen in most of the state but may be semi-evergreen at higher elevations. The elliptical-shaped leaves are small (usually only one to one and a half inches long), smooth-edged, and oppositely arranged along the branches. The upper surface of each leaf is dark green, shiny, and leathery and the lower surface is pale green. A distinguishing feature of this plant is that the midrib of each leaf is hairy on the underside.

The flowers are tiny and white and grow in branching clusters at the ends of the twigs. The flowers are also quite fragrant with a smell that has been likened to cheap perfume. The black, pea-sized berries are a favorite food for a variety of birds.

Habitat

Chinese privet is usually found in lowlands and waste places often under a shady canopy. It frequently forms dense thickets.

Distribution

Chinese privet is a native of China and has been cultivated extensively in the southern United States.

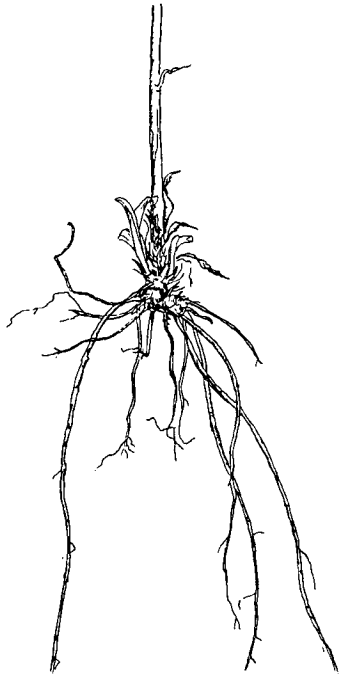
Threats

Propagated by seeds that are readily carried and spread by birds, this shrub has become an intrusive pest in natural areas, particularly in wooded floodplains.

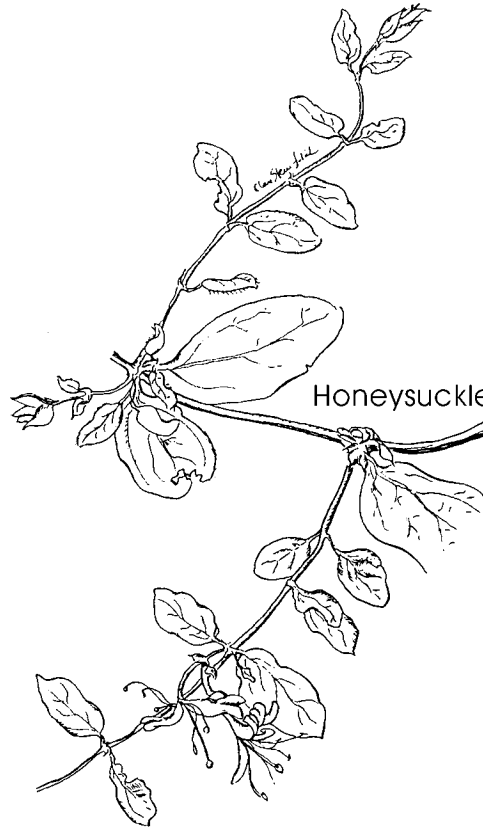
Control

Chinese privet bushes with stems one inch or smaller can be removed by hand pulling. Since the root system of these plants is extensive, pulling larger plants is seldom possible. Larger plants can be killed by spraying the foliage with a solution of 2% glyphosate or triclopyr and 0.5% nonionic surfactant. The leaves of the privet should be completely wetted, one bush at a time. Treatment is most effective on fully developed foliage, especially late in the summer. Another option is to cut the shrub down near to the ground and either paint or spray the freshly cut stumps with a 25% solution of glyphosate or triclopyr.

Honeysuckle Roots



Honeysuckle Stem



Honeysuckle Flower



Honeysuckle Fruit

Appendix III (continued)

Japanese Honeysuckle (*Lonicera japonica*)

Description

Japanese honeysuckle is a trailing or twining woody vine that can grow to more than 30 feet in length. Young stems are often hairy, while older stems are hollow with a reddish brown bark. The oblong to oval shaped leaves are one to two and a half inches long and grow along the stem in opposite pairs. In most of North Carolina, the leaves of Japanese honeysuckle are semi-evergreen and may persist on the vines year-round. The whitish, trumpet-shaped flowers occur in pairs from between leaves and bloom from late April into August. The fruit is a black, pulpy berry that matures in early autumn.

Japanese honeysuckle is distinguished from North Carolina's three native species by the leaves near the tips of the vines. These leaves are separate and not united. In our native species, these leaves are united at the base, forming a single leaf surrounding the stem.

Habitat

Japanese honeysuckle occurs primarily in disturbed habitats such as roadsides, trails, fence rows, abandoned fields, forest edges, and in many types of forests. It often invades native plant communities after natural or human induced disturbances such as logging, road building, floods, windstorms, or pest and disease outbreaks. It is especially prevalent and invasive in disturbed bottomlands.

Distribution

Imported to the United States in the 1800's as horticultural groundcover, Japanese honeysuckle is native to eastern Asia. In North Carolina, Japanese honeysuckle is naturalized statewide and is one of the most abundant plants in the state.

Threats

Since it propagates by both seeds that birds disseminate or by shallow, underground runners that can extend as much as 45 feet, this plant is very successful. In forests, Japanese honeysuckle vines spread both vertically and horizontally by climbing up tree trunks and/or by trailing over the forest floor.

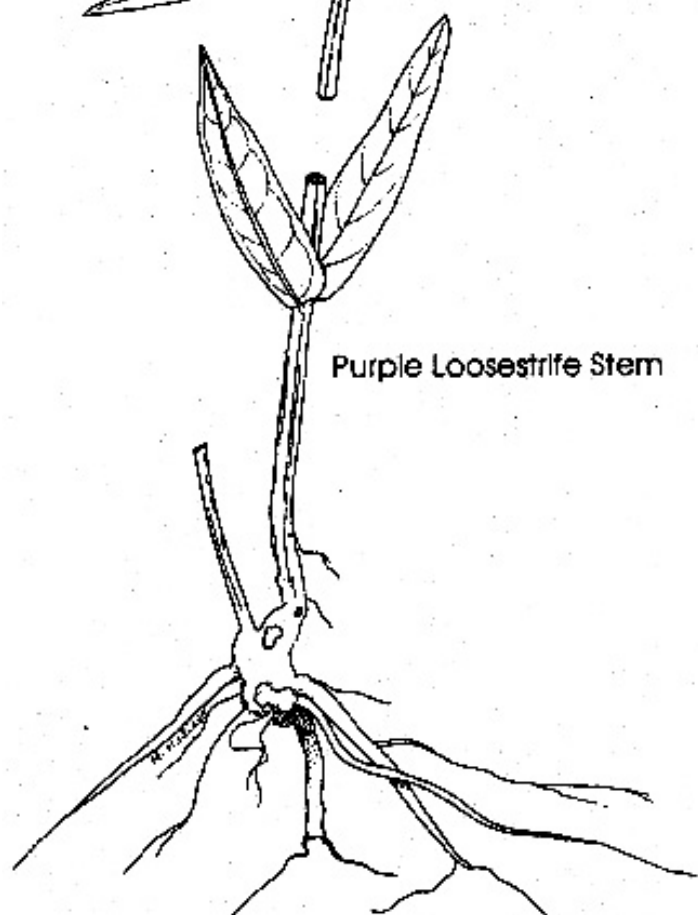
Dense, strangling growths of Japanese honeysuckle can impact natural vegetation by decreasing light availability, depleting soil moisture and nutrients, or by toppling upright stems by the sheer weight of accumulated vines. It is seen by many managers of preserves as the state's most formidable species of exotic plant.

Control

Small populations of Japanese honeysuckle can be controlled by careful hand-pulling, grubbing with a hoe or a shovel, and removal of trailing vines. In fire-dependent natural communities, Japanese honeysuckle can be controlled by prescribed burning. Burning can reduce the abundance of Japanese honeysuckle by up to 50%, but the area must be successively burned every year or every other year. The use of glyphosate or triclopyr is also an effective treatment either by itself or after a prescribed fire. The fact that the leaves of Japanese honeysuckle are evergreen in many parts of North Carolina provides an opportunity to treat this plant in the fall (October-November) after surrounding vegetation has become dormant. Apply a solution of 2% glyphosate or triclopyr and 0.5% nonionic surfactant to thoroughly wet all foliage. For vines climbing into surrounding trees use a 25% solution of glyphosate or triclopyr on cut vine surfaces. Ambient air temperature should be above 65°F.



Purple Loosestrife Flower



Appendix III (continued)

Purple Loosestrife (*Lythrum salicaria*)

Description

Characterized by long showy spikes of magenta flowers, purple loosestrife is an herbaceous, perennial, wetland plant. The plant ranges in height from two to six feet but may reach up to 10 feet in height in nutrient-rich habitats. The leaves are opposite or in whorls of three, lance-shaped, and without teeth. Purple loosestrife has flowers with five to seven petals occurring in dense clusters on terminal spikes. These flowers begin blooming in June and continue until September.

Habitat

Purple loosestrife is found in a variety of sunny wetland habitats including marshes, river banks, the edges of ponds and reservoirs, as well as ditches and other disturbed wetland areas. It grows best in high organic soils but tolerates a wide range of soil textures including clay, sand, and silt.

Distribution

A native of Eurasia, purple loosestrife was introduced into the northeastern United States and Canada in the early 1800's. Although this plant has subsequently spread through most of temperate North America, the heaviest concentrations are in the glaciated wetlands of the northeast. It is present but has not yet become a dominant invasive plant in North Carolina. **Please note that purple loosestrife and all other non-native *Lythrum* species are listed as state noxious weeds. All suspect infestations of purple loosestrife should be reported immediately to the North Carolina Department of Agriculture, Plant Industry, Plant Protection Section, P.O. Box 27647, Raleigh, NC 27611, (919) 733-6932, or toll free - 1-800-206-WEED (9333).**

Threats

Purple loosestrife thrives in disturbed wetlands but also invades natural wetlands, crowding out native wetland vegetation and forming extensive monospecific stands. As a result, the wildlife value of wetland habitats is greatly diminished.

A single stalk of purple loosestrife may produce as many as 300,000 seeds and densities of up to 80,000 stalks per acre. The species also readily reproduces from stem or root segments. Although not yet a significant invasive problem in North Carolina, wetland communities should

be closely monitored for the presence of purple loosestrife because of its potential devastating effects. It has dominated marshes and bogs in a number of states in the Northeast.

Control

Since small infestations of purple loosestrife can be removed by hand pulling, the early detection of this plant is critical to its control. Hand removal should always be done before the plants flower to prevent the scattering of seeds. The entire rootstock must be pulled out since the plant can rejuvenate from root fragments. In addition, plants that are pulled should be bagged on site to prevent dispersing the stem and root segments.

Where mechanical removal is not feasible, purple loosestrife may be removed by spot application of Rodeo (a formulation of glyphosate that has been approved for use over water) before or during the period of peak bloom, usually late August. The best way to apply this herbicide is to cut off all stems at about six inches (be sure to bag this refuse) and then paint or drip a 20-30% solution of Rodeo onto the cut surface. As with mechanical control methods, follow-up treatments may be needed in subsequent years to remove new plants that have sprouted from the seed bank.

For large areas a foliar spray may be necessary. Apply a solution of 2% Rodeo and 0.5% nonionic surfactant before flower head formation. If possible, cut the flower heads (bag these heads) before applying herbicide to ensure the prevention of seed production.

The most effective herbicide for controlling purple loosestrife is Garlon 3A. Since this product is still under experimental use for aquatic plants, it would have to be applied experimentally under supervision of the manufacturer, Dow Elanco.

Appendix III (continued)

Japanese Grass (*Microstegium vimineum*)

Description

This annual grass grows to be up to two to three feet by late summer. It has long, thin, alternate, lance-shaped leaves along a branched stalk. In spring and early summer the grass is shorter and more tender in appearance. The stalk of this grass is distinctly divided by nodes with flattened segments between the nodes that get wider toward the upper end.

Habitat

Japanese grass is often found in bright green patches along the margins of roads or paths and less frequently on forest floors. Preferring shaded or partially sunny areas, it tends to get a stronghold in moist areas which can be particularly troublesome when close to water courses since water aids in the dispersal of seeds. A number of bottomlands in the parks system have been heavily impacted by this weed.

Distribution

This grass was imported as an ornamental from Asia. It was not common as late as 1970 but has exploded in the past two decades and is now common throughout North Carolina.

Threats

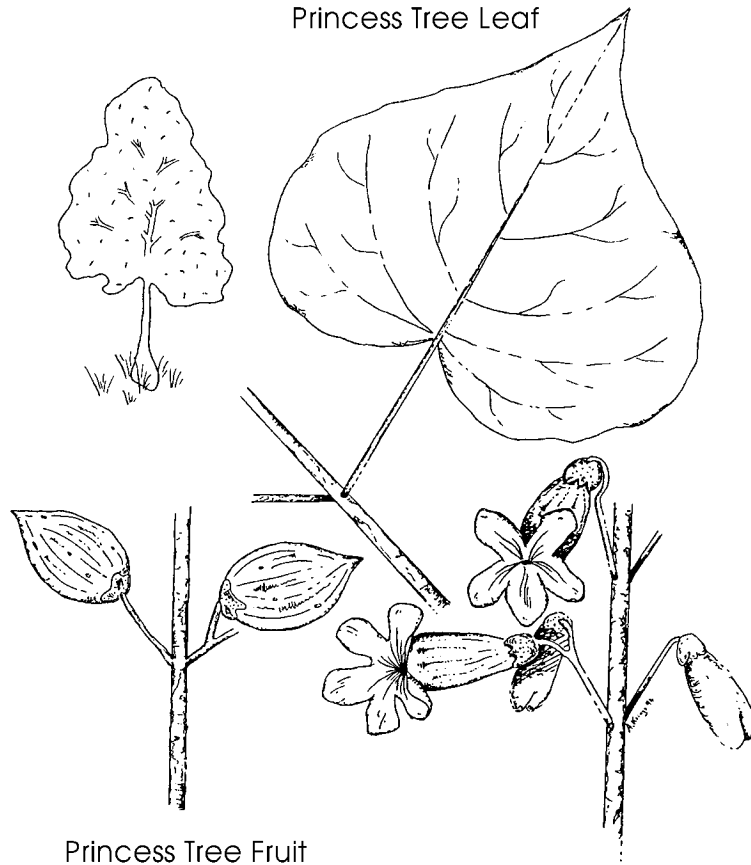
Japanese grass is a quickly spreading annual plant that produces seeds for the following year and then dies in the fall. It propagates both by shallow runners and seed and spreads in dense patches that eventually exclude most other plants. The plant spreads primarily in the spring and summer before flowering and the production of seed in late summer and early fall.

Control

The best time for removing Japanese grass is early in the growing season when it is small and before seed production. While young, the grass is shallow-rooted and easy to grub out by hand. Mowing while in flower and before seed production has also been effective in controlling the spread of this grass. Extensive areas of Japanese grass may be controlled by the herbicide Vantage (sethoxydim). This herbicide is particularly attractive because the active ingredient rapidly decomposes in soil and it acts mainly on grasses leaving most broad-leaved plants unaffected. This herbicide kills both perennial and annual grasses within about 14 days by

interfering with an enzyme involved in lipid synthesis. Herbicide treatments should be made late in the growing season but before the plants set seed. Apply a 1.5% solution of sethoxydium and 1% horticultural oil when the air temperature is above 65°F and rain is not expected within one hour following application. A solution of 2% glyphosate and 0.5% nonionic surfactant may also be used.

Princess Tree Leaf



Princess Tree Fruit

Princess Tree Flower

Appendix III (continued)

Princess Tree (*Paulownia tomentosa*)

Description

Princess tree may reach a height of up to 50 feet. The bark of this tree is characteristically gray with shallow, shiny ribs. The leaves are large (5-10 inches long on mature trees), heart-shaped, and oppositely arranged along the branches. The edges of the leaves often have blunt “horns” on each side. Stump sprouts and young plants have extremely large leaves that can be up to 32 inches long.

This tree flowers in April and May, usually before its leaves have fully emerged. The very, large, light purple flowers are distinctively sticky and hairy on the outside. These flowers are arranged in pyramidal clusters that are about 10 to 15 inches long. The fruits of this tree persist in large brown clusters through the winter and into early spring. The seeds from these fruits are small and winged and disperse easily.

Habitat

Princess tree favors sunny locations along roadsides, clearings, and borders of forests.

Distribution

The princess tree was imported from East Asia for horticultural purposes. It has since escaped cultivation and is scattered in a number of locations throughout the state, particularly in the mountains and foothills of western North Carolina.

Threats

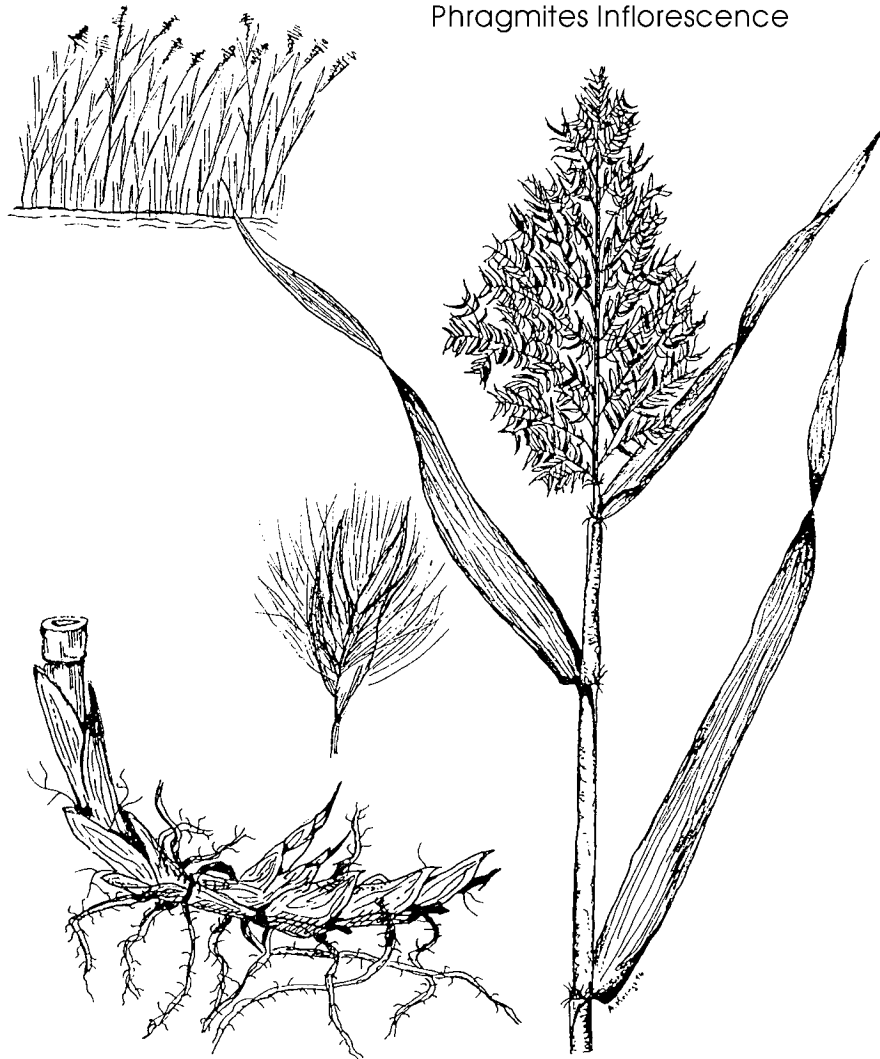
Once princess tree escapes into the wild, it is an extremely fast-growing competitor with native species. Propagating from seeds, this tree may be six to eight feet in its second year of growth.

Control

It is best to eliminate princess tree by hand when it is still a small sapling without a well-developed taproot. Of course this stage is short-lived since the tree is usually too big to manually remove by its second year.

Once hand pulling is no longer possible, another option is to cut the tree down near to the ground and either paint or spray the freshly cut stumps with a 25% solution of glyphosate or a 50% solution of triclopyr. Stump treatments can be used as long as the ground is not frozen.

Phragmites Inflorescence



Phragmites Roots

Appendix III (continued)

Common Reed (*Phragmites australis*)

Description

Common reed is a tall, perennial, wetland grass ranging in height from three to thirteen feet. Strong, leathery, horizontal shoots growing on or beneath the ground surface give rise to roots and tough vertical stalks. The leaves of these stalks are alternately arranged, flat and hairless, up to 24 inches long, one half to two and one half inches wide, and tapering to a sharp point. The foliage is gray-green during the growing season, with purple-brown, foot-long plumes appearing on the top of the stem by late June. By fall the entire plant turns tan. Giant cordgrass (*Spartina cynosuroides*), a non-invasive native species, can be confused with common reed. It is distinguished from common reed by its sparse flowering structure and longer, more gracefully arching leaves.

Habitat

Common reed thrives in sunny wetland habitats. It is found along elevated areas of brackish and freshwater marshes and along riverbanks and lakeshores. This plant is particularly abundant in the disturbed or polluted soils of roadsides, ditches, and dredged areas.

Distribution

Common reed may be the most widely distributed plant in the world. It is found throughout the temperate regions of North America. Many Atlantic coast wetlands have been invaded by common reed as a result of alterations to tidal movements by roads and impoundments. It is treated as an exotic species because it invades the habitats of other plants as a result of human alterations to the environment. Moreover, it is strongly suspected that a non-native, aggressive strain of this species was carried to North America in the early twentieth century.

Threats

Common reed has become a destructive weed in North Carolina, displacing desirable wetland plants such as wild rice and cattails. This plant propagates by seeds but once established, it spreads mostly through underground rhizomes. Invasive stands of common reed eliminate diverse wetland plant communities and provide little food or shelter for wildlife.

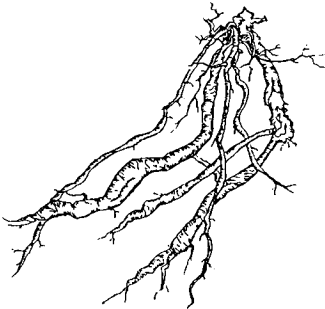
Control

Herbicide use in combination with burning has generally proven to be the most effective means of controlling common reed. Rodeo (a formulation of glyphosate approved for use over

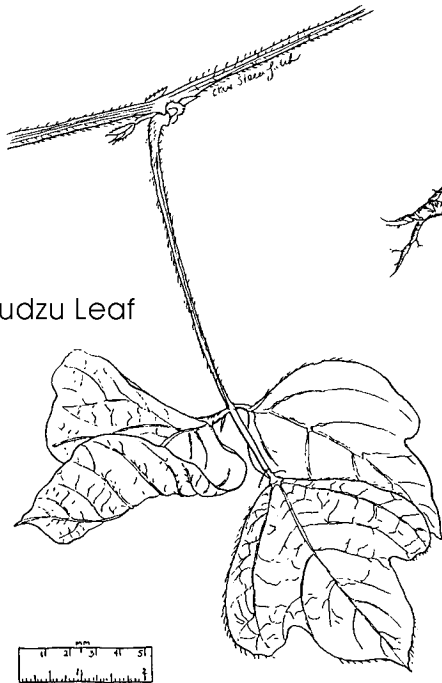
water) should be sprayed on common reed colonies after the tasseling stage (July-September) when the foliage is re-directing nutrients to the roots. Prescribed burning does not reduce the growing ability of phragmites unless root burn occurs. Root burn seldom occurs because the rhizomes are usually covered by a layer of soil, mud, or water. Burning does, however, have the advantage of removing accumulated phragmites leaf litter, giving the seeds of other species area to germinate.

Flooding can also be used to control phragmites when at least three feet of water cover the rhizomes for an extended period during the growing season (usually four months). Cutting the plant in July removes most of the food reserves produced in that season and, therefore, reduces the vigor of the plant. A cutting regime that is carried out on an annual basis may be enough to eliminate a colony.

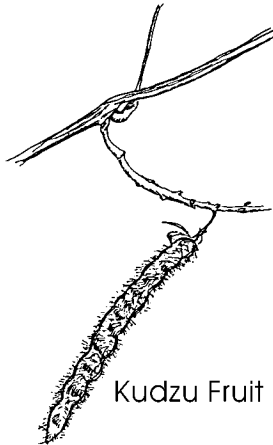
Kudzu Roots



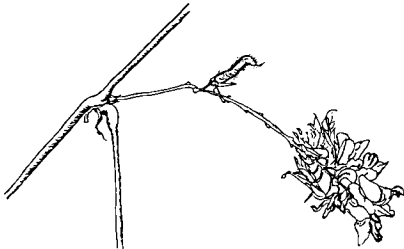
Kudzu Leaf



Kudzu Fruit



Kudzu Flower



Appendix III (continued)

Kudzu (*Pueraria lobata*)

Description

Kudzu is a perennial, trailing, or climbing vine of the legume (bean or pea) family. The compound leaves are broad, up to seven or eight inches long; have hairy undersides; and are arranged in threes at the ends of the stems. With a fragrance reminiscent of grapes, the one half to three quarter inch purple flowers are produced on plants exposed to direct sunlight. Kudzu fruits, present in October and November, are hairy bean-like pods with a few viable seeds in each pod. It is thought that some of these seeds can remain dormant for several years before they germinate.

Young stems of this plant are hairy, while older stems become woody and up to an inch in diameter. From roots that may extend down 12 feet in sandy soils, vines grow upward and runners extend outward. New plants begin at stem nodes every one to two feet. Roots become tuberous, storing as starch the carbohydrates produced by the leaves. These tuberous roots are capable of starting new vines when vines and leaves above ground have been destroyed.

Habitat

Kudzu grows in a variety of habitats and environmental conditions but does best on deep, well-drained, loamy soils. Almost any sunny disturbed area is suitable habitat for this vine.

Distribution

A native of Japan, kudzu was originally brought to the United States for use as animal food. About 50 years ago, it was planted extensively along highways and railroads to stabilize embankments. Now, kudzu has spread along the Atlantic coast, north to Illinois and Massachusetts, west to Texas and Oklahoma, and south to Alabama, Georgia, and Mississippi. In North Carolina, kudzu is a common sight along roadways and bordering agricultural fields.

Threats

Wherever it grows, kudzu has the ability to outcompete and eliminate native plant species. With vine growth of up to one foot a day, it completely overgrows and kills everything from grasses to mature trees in its expanding area.

Control

Eradication of kudzu is not easy and can take up to 10 years for well established stands. Burning kudzu patches in February or early March as well as discing the ground helps prepare an

area for the application of herbicide. Regular cutting may also be sufficient to control most kudzu populations.

The herbicide Transline has been shown to be effective against kudzu. It should be applied during the active growing season in a solution of 0.25% Transline and 0.5% surfactant. This herbicide should not be used near water because of its toxicity to fish and insects. For kudzu near bodies of water, the United States Forest Service recommends Banvel 720 at two gallons/acre for patches less than 10 years old and three gallons/acre for patches greater than 10 years old.

Kudzu can also be controlled by cutting the vines and runners just above ground level and then waiting one to two weeks for foliar resprouting. At this point, the plant can be treated with a solution of 2% glyphosate or triclopyr and 0.5% nonionic surfactant. This treatment may need to be repeated a couple of times during the growing season for several years before the plant is effectively controlled.

An alternative approach involves the application of glyphosate or triclopyr to cut stumps, foliage, and roots. For vines in tree canopies, cut the vines near the ground and apply a 25% solution of glyphosate or triclopyr to the stumps. Use a solution of 2% glyphosate or triclopyr and 0.5% nonionic surfactant to treat areas with extensive kudzu ground cover. If possible, locate the tap root and dig or cut into the root crown and apply a 50% solution of triclopyr to the exposed root.

Appendix III (continued)

Multiflora Rose (*Rosa multiflora*)

Description

Multiflora rose is a perennial thorny shrub of medium height. Its arching stems can root at the tip, forming dense thickets of thorny branches. Each compound leaf has five to 11 oval leaflets that are arranged alternately along the stem with a terminal leaflet. The tapering clusters of pungently fragrant, white or pinkish flowers of multiflora rose bloom in June to July. As with other rose species, the fruits are small, red hips containing many seeds in their fleshy interiors.

Habitat

Multiflora rose prefers clearings, roadsides, fence rows, borders of woods, and other open areas. It is adaptable to a wide range of environments but is usually not tolerant of extremely wet or dry habitats. It is, however, invading some bogs and other mountain wetlands in North Carolina.

Distribution

Native to North China, Korea, and Japan, multiflora rose was brought to the United States by horticulturalists in the second half of the nineteenth century. Later, wildlife managers planted it for wildlife food and cover. It was also used for control of soil erosion and on highway medians to reduce headlight glare. Multiflora rose is now found throughout most of the United States.

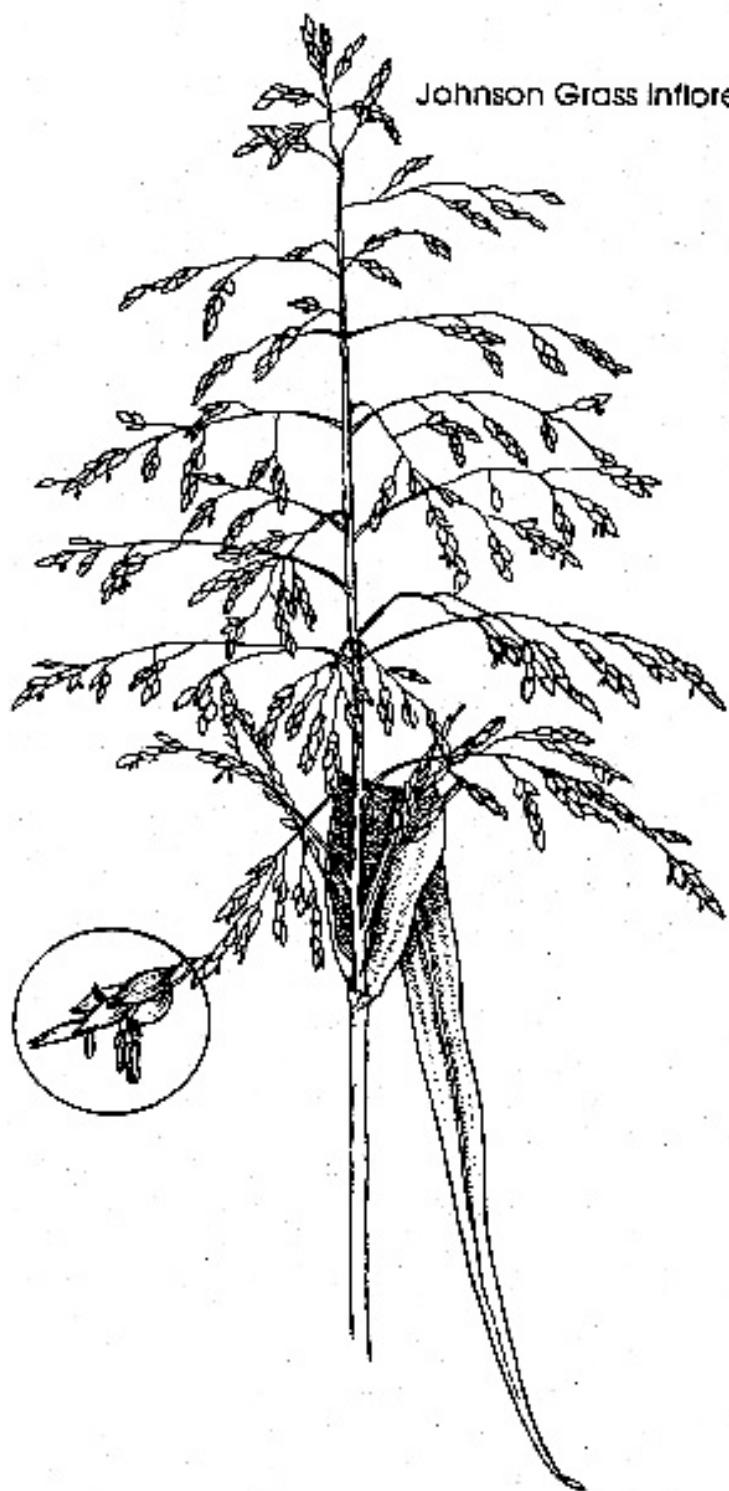
Threats

Reproducing by seeds, an average-sized multiflora rose shrub can produce 500,000 to 1,000,000 seeds in a good year. Birds disseminate the seed widely. Multiflora rose forms dense thickets that can choke out native plant species. These thickets form living fences that are impenetrable by large mammals.

Control

Lightly infested areas may be cleared with a shovel or hoe provided that the entire root is removed. In heavier infestations, three to six cuttings or mowings per year near the ground for two or more years will give high mortality. In some situations, a prescribed fire during the early growing season may be an appropriate method of control. As with mechanical methods of control, it may be necessary to annually burn for several years to completely kill this plant.

Glyphosate and triclopyr are probably the most effective herbicides for controlling multiflora rose. Apply a solution of 2% glyphosate or triclopyr and 0.5% nonionic surfactant to thoroughly wet all leaves. The air temperature should be above 65°F to ensure absorption of the herbicide. In addition, the stems of multiflora rose can be cut at or near ground level and then immediately be treated with a 25% solution of glyphosate or triclopyr. This treatment remains effective at low temperatures as long as the ground is not frozen. The basal section of the plant (ground to 12 inches) can also be treated with a solution of 25% triclopyr and 75% horticultural oil. After treatment, wet the area thoroughly.



Johnson Grass Inflorescence



Johnson Grass Roots

Appendix III (continued)

Johnson Grass (*Sorghum halapense*)

Description

Johnson grass forms dense clumps and can grow to a maximum height of eight feet. It has long, smooth leaves with a characteristic white mid-vein. The stems of this grass are often pink to rusty red near the base and the inflorescence is large and loosely branched.

Habitat

Johnson grass thrives in cultivated and abandoned fields, forest edges, stream banks, roadsides, vacant lots or any disturbed ground.

Distribution

Johnson grass was introduced to the United States from its native range around the Mediterranean Sea. It has spread to most temperate regions of the world and is found extensively in North Carolina.

Threats

A major agricultural weed, Johnson grass is especially troublesome in corns fields where it forms tall, dense stands. It also aggressively crowds out native species along riverbanks and along the edges of woodlands.

Control

Johnson grass can be a challenging plant to control since when this grass is cut it can resprout from underground rhizomes and it is resistant to many common herbicides. Moreover, spring burning encourages regrowth. Small stands of this grass can be controlled by hand-pulling when the soil is moist. Repeated winter tilling to expose and kill root material has been successful at controlling larger infestations.

The application of a 2% solution of glyphosate near the end of the growing season (just prior to seed maturity) when this grass is transporting nutrients to its roots results in a high rate of mortality. The herbicide may be applied to the leaves or freshly cut stems. Increase the concentration of glyphosate to 20% if it is applied to cut stems. These treatments must be repeated for several years to eradicate the seed bank.

Reference for Appendices IV, V and VI

North Carolina Department of Agriculture and Department of Environment, Health, and Natural Resources. Aquatic Weed Control Act of 1991 and Regulations. Raleigh, NC

North Carolina Department of Agriculture. State Noxious Weed List (Revised February 7, 1996). Raleigh, NC

North Carolina Department of Agriculture. 1994. Regulations for State Noxious Weeds. Raleigh, NC