INVASIVE EXOTIC PLANTS OF NORTH CAROLINA

Invasive Exotic Plants of North Carolina

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N.C. Department of Transportation • 2012

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Introduction

Land managers in North Carolina face considerable challenges in their efforts to control invasive exotic plants. Although most of our exotic plants have little or no impact on natural areas, and in many cases are highly beneficial (e.g. agricultural crops and most ornamentals), a small percentage are threats to native plants, biological diversity and habitat value.

Land management in North Carolina is diverse — from roadsides to agricultural fields to unique natural heritage sites. The primary purpose of this guide is to provide technical information regarding the identification of those plants that pose the most threat to wildlife habitat and natural areas, habitats most susceptible to invasion, and methods to control or eradicate these plants.

Information about this guide

The 74 species of exotic plants highlighted in this guide are included as a result of input from a variety of sources and agencies. In addition to the list of invasive plants compiled by the North Carolina Native Plant Society that was used as a starting point for the content of this guide, a number of state and federal agencies made suggestions based on their experience managing natural areas.

The plants are divided into 3 main categories depending on their reported impact to natural areas: 1) threat to habitat and natural areas, 2) moderate threat to habitat and natural areas, and 3) watch list. The 17 species in the threat section are known to be invasive and to degrade habitat. Those 17 species listed as a moderate threat do not, at present, appear to be as significant of a problem in natural areas. The watch list includes 40 species that have caused problems in neighboring states, are currently found in localized areas but should be watched for expansion in range, and/or are state-listed noxious weeds. Information pertaining to the identification of the species on the watch list and their current status in neighboring states or in North Carolina is presented in this section.

Scientific nomenclature throughout this manual generally follows that of Alan S. Weakly's *Flora of Carolinas, Virginia, and Georgia, and Surrounding Areas* (2007). Images from numerous photographers were

generously donated for this project, and credits appear with the individual photographs.

Persistence and often a long-term commitment are necessary to successfully control the multitude of invasive exotic plants found in our state. The rewards for this work are great and can mean the difference between a monotypic landscape and a landscape full of the biological diversity and natural heritage that distinguish North Carolina from other places on earth.

Appendices

Prevention of the further spread of plant species posing a threat to natural areas must be a common priority among all land managers in North Carolina. Appendix A contains a list of common native plants arranged by type and native seeds for soil stabilization as recommended alternatives to choosing invasive exotic species.

As the list of species to watch continues to grow, we must also improve our efforts at early detection and response. Appendix B contains information about a project that the Southeast Exotic Pest Plant Council (SE-EPPC) has initiated called the Early Detection and Distribution Mapping System (EDDMapS). This project will go a long way to help land managers prioritize management strategies, identify leading edges of actively spreading infestations, and rapidly respond to new invasions. Since the success of this online mapping project depends on the participation of all land managers in this state, information regarding how to report an infestation is included in this appendix.

A list of additional resources for exotic and native plants is provided in Appendix C. This list highlights some of the most widely used resources on these topics and is not intended to be comprehensive. Appendix D contains the Federal Noxious Weed List as of June 30, 2006.

Noxious weeds

Noxious weeds are those plants in any stage of development whose presence is detrimental to crops or other desirable plants, livestock, and

land or is injurious to the public health. In North Carolina, every weed that is listed on the Federal Noxious Weed List (Appendix D) is also a state noxious weed.

In addition to the federal noxious weeds, the N.C. Department of Agriculture and Consumer Services (NCDA&CS) lists weeds if they have been determined to cause harm and are not native to North Carolina. It is the role of the NCDA&CS Plant Industry Division to prevent the entry and movement of noxious weeds into North Carolina or out of regulated (quarantined) counties within the state to non-quarantined counties within the state and to assist with control and eradication when practical. The 20 state-listed noxious weeds are included in this manual and are highlighted by 

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Noxious weeds (or regulated articles such as soil) cannot be brought into North Carolina. For certain species of noxious weeds that are quarantined in particular counties, the movement of these weeds into other counties is prohibited except by permit. The sale of all noxious weeds is prohibited with the exception of *Celastrus orbiculatus* (Oriental bittersweet) which can only be sold in 18 quarantined counties in western North Carolina. Additional information about noxious weed regulations is available online at www.ncagr.com/plantindustry/plant/weed/weedprog.htm.

Information on chemical treatments

For most of the terrestrial species in this manual, glyphosate and triclopyr are recommended for chemical control. There are no restrictions on the use of these 2 chemicals in natural areas so many land managers use them almost exclusively. Important differences exist between the oil- and water-based forms of triclopyr. Triclopyr-TEA (water-based) can be used for cut stump and foliar treatments but not for basal bark treatments. Triclopyr-BEE (oil-based) can be used for basal bark, cut stump, and foliar treatments but is more volatile and much more likely to drift. Triclopyr-BEE should not be used near water.

Chemicals other than glyphosate and triclopyr have been used to control invasive exotic plants with higher rates of success. These additional

chemicals and application rates are specified where this information is available. Consult the North Carolina Agricultural Chemicals Manual for comprehensive information regarding pesticides. County Cooperative Extension Service agents can also provide assistance with chemicals and application rates. Always consult with the N.C. Department of Environment and Natural Resources Division of Water Resources, Aquatic Weed Control Program before initiating any control method using chemicals in aquatic areas. As with all pesticides, label directions must be followed to ensure efficacy of treatment and to minimize adverse impacts.

Acknowledgements

The comprehensive reviews of this field guide by a number of individuals are greatly appreciated and proved invaluable to the completion of this work. Many thanks go to the following individuals:

Karen M. Lynch, Bruce Ellis, Steve Mitchell, Dennis Herman and Gordon Cashin, N.C. Department of Transportation Natural Environment Unit

Derek Smith, Kevin Clemmer, Connie Morgan and Bob Kopetsky, N.C. Department of Transportation Roadside Environmental Unit

Marshall Ellis, N.C. Department of Environment and Natural Resources Division of Parks and Recreation

Rick Iverson, N.C. Department of Agriculture and Consumer Services

Johnny Randall, Ph.D., N.C. Botanical Garden

Robert J. Richardson, Ph.D., N.C. State University

Karen Hall, N.C. State University

Perry Sugg, N.C. Ecosystem Enhancement Program

Margaret Fields, The Nature Conservancy

Thanks also go to Emily Jones, N.C. Department of Transportation Communications Office for her artistic talents regarding the layout of this field guide and to Marcia Nye for her copy-editing assistance.

In addition, thanks to the following individuals who provided important input regarding the plant species included in this field guide:

Nancy Fraley, Southeast Exotic Plant Management Team

Carol Price, Mark Johns, Kelly Hughes, Travis Wilson and Marla Chambers, N.C. Wildlife Resources Commission

Lee Patrick, Invasive Plant Control, Inc.

Kristine Johnson, Great Smoky Mountains National Park

Misty Buchanan, Mike Schafale, Bruce Sorrie and Richard LeBlond, N.C. Natural Heritage Program

Gary Kauffman, United States Department of Agriculture Forest Service

Carolyn Wells, Ph.D., U.S. Fish and Wildlife Service

Stratford Kay, Ph.D., N.C. Division of Water Quality

Chris Militscher, United States Environmental Protection Agency

Mary Frazer, N.C. Department of Transportation Natural Environment Unit


trees
shrubs
herbaceous plants
vines
aquatic plants

Ailanthus altissima (Tree-of-Heaven)
Simaroubacea (Quassia Family)

Initial Introduction and Expansion in Range

Native to China, *Ailanthus altissima* was brought to the United States in 1784 by a Philadelphia gardener. Its rapid growth rate and ability to grow in harsh conditions with little care made this tree a popular horticultural plant relatively quickly in the east. It was spread to the west by Chinese miners during the California gold rush who cultivated the seeds for medicinal purposes. In North Carolina, *A. altissima* is most prevalent in the piedmont and mountain regions but can also be found on the coastal plain.

An individual *A. altissima* tree can produce several hundred thousand seeds per year, and the light winged seeds can be carried great distances from the parent plant. It grows vigorously and establishes dense, clonal thickets that can displace native vegetation. The ability of *A. altisimma* to tolerate poor soils and atmospheric pollution make it a common colonizer in urban areas. Roadways provide the perfect migration routes for this tree.

Description and Biology

- Small to medium sized deciduous tree up to more than 80 feet in height.
- Alternate, compound leaves composed of 10 to 40 leaflets arranged along the leaf stem with a terminal leaflet. Leaflets are lanceolate and not always directly opposite. Each leaflet has 1 to 3 teeth on each side close to the base. When crushed, leaves produce a distinctive unpleasant odor described as “burnt peanut butter.”
- Smooth gray bark that cracks with age.
- Young twigs are light brown and stout with fine hairs.
- Flowers in July and August with flowers occurring in panicles (much branched flower clusters) at the end of branches. Greenish-yellow flower has 5 sepals and 5 petals.
- Seeds encased in papery wing-like sheath called a samara. Samaras are slightly twisted or curled.
- Often confused with *Rhus* spp. (sumac) and *Juglans nigra* (black walnut).

Habitats Susceptible to Invasion

Although *A. altissima* is most common in urban areas, it poses an environmental threat because of its invasiveness in cultivated fields and natural areas. Seedlings can establish a deep taproot within 3 months from germination allowing the plant to grow quickly and out-compete native species for sunlight and space. It thrives in full sun but also exhibits shade tolerance. In addition, this plant produces an allelopathic chemical that prevents other plants from growing in its vicinity. Roadsides throughout the piedmont and mountains are infested with *A. altissima* providing the ideal habitat and conduit for spread of this plant.

Prevention and Control

Large female fruit bearing trees should be targeted for control to help reduce the spread of this plant by seeds. Hand-pulling young seedlings (no more than 0.5 inch in diameter) is possible when the soil is moist. Care must be taken to remove the entire plant since root fragments can re-grow.

Ailanthus altissima photography by James H. Miller, USDA Forest Service, Bugwood.org *(left) and Leslie J. Mehrhoff, University of Connecticut,* Bugwood.org (*right).*

For thickets of *A. altissima*, apply a foliar solution of 4 percent glyphosate plus a 0.5 percent non-ionic surfactant. The most successful chemical control can be achieved with a foliar solution of 1.0 oz metsulfuron/100 gallons water plus a 0.5 percent non-ionic surfactant. This solution will treat an area approximately the size of an acre.

For larger trees, cut them within 6 inches of the ground and immediately spray the freshly cut stump surface and sides with a solution of 50 percent triclopyr. It is best to apply the herbicide between summer and early fall while the plant is translocating nutrients to the roots.

The hack-and-squirt method is effective for controlling *A. altissima* particularly when conducted in the summer. Use an ax to make downward-angled cuts into sapwood around the tree trunk as close to the ground as possible. Immediately squirt a 50 percent solution of triclopyr into the cuts so that the bottom of the cut is covered, but liquid does not run out. Space the cuts so that about 1 to 2 inches of uncut living tissue remains between the cuts since a continuous line may cause an emergency response in the plant resulting in basal sprouts and root suckers.

Basal bark application of herbicide is one of the easiest methods of control for trees up to 6 inches in diameter. This method should be used judiciously since it takes a lot of chemical and can result in overspray. It has been used successfully in situations where no other technique is easy such as cliff faces or other exposed sites. Apply a solution of 25 percent triclopyr and 75 percent mineral oil to the basal parts of the tree to a height of 12 to 16 inches from the ground during the late winter/early spring or summer. All treatments should be followed up the next year to monitor and control basal sprouts and root suckers.

Paulownia tomentosa (Princess Tree)
Paulowniaceae (Paulownia Family)

Initial Introduction and Expansion in Range

Native to eastern Asia, *Paulownia tomentosa* has been widely planted for horticultural purposes in North America from Montreal to Florida and west to Missouri and Texas. This tree is moderately cold-hardy so it has spread principally in the Eastern and Southern portions of the United States. In North Carolina it poses a particular problem in the foothill and mountain regions.

Paulownia tomentosa is capable of flowering within 8 to 10 years and a mature tree can produce millions of seeds. The seeds are small and winged, dispersing easily in the wind. This aggressive tree grows rapidly (up to 15 feet per year) in all types of disturbed habitats.

Description and Biology

- Small to medium sized deciduous tree up to 50 feet in height.
- Large (5 to 10 inches long on mature trees) heart-shaped leaves arranged oppositely along the branches. Young plants and stump sprouts have leaves up to twice the size.
- Thin grayish brown bark with shallow fissures.
- Flowers in April and May before leaf emergence. Arranged in upright pyramidal clusters, the flowers are lavender and showy.
- Fruits are oval capsules initially sticky and green, later turning brown and dry persisting on the tree through the winter.
- Often confused with *Catalpa bignonioides* (southern catalpa). The long slender persistent beans and whorled leaves of *Catalpa* help distinguish it from *P. tomentosa*.

Habitats Susceptible to Invasion

Paulownia tomentosa is an extremely fast-growing competitor with native species in disturbed natural areas including forests, stream banks and steep rocky slopes. It tolerates high soil acidity, drought, and low soil fertility enabling it to survive, grow, and reproduce on harsh, exposed sites. Roadsides provide ideal habitat and migration routes for this plant.

Prevention and Control

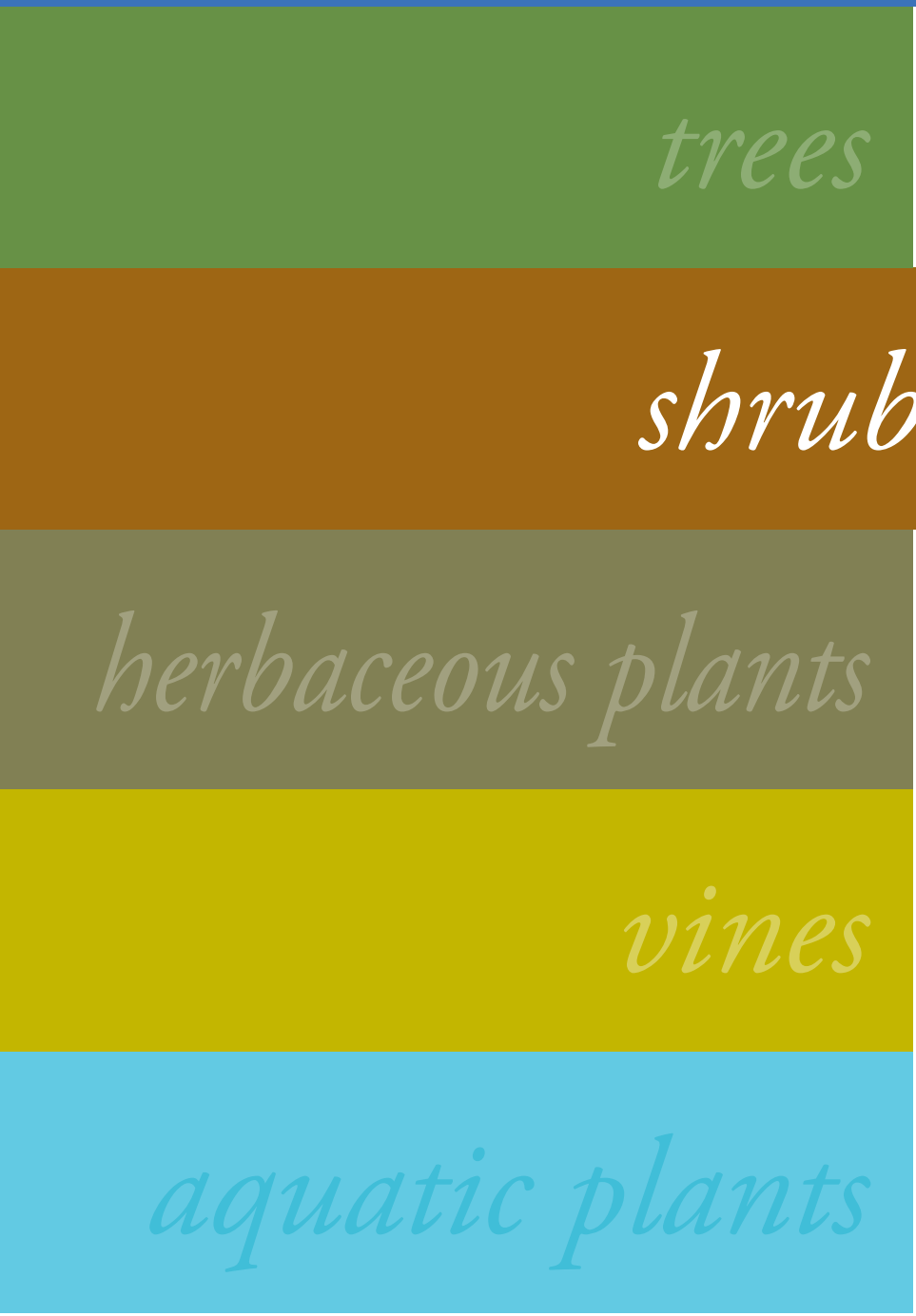
Paulownia tomentosa was originally introduced as an ornamental and is still planted for that purpose. The wood of this tree is highly prized in Asia leading to the establishment of commercial plantations in the United States. Successful control of this plant will first require prevention of propagation and planting.

Young seedlings (no more than 0.5 inch in diameter) can be pulled by hand when the soil is moist. Care must be taken to remove the entire root since broken fragments may re-sprout.

Seedlings and young trees can be controlled with a foliar solution of 3 percent glyphosate plus a 0.5 percent non-ionic surfactant to thoroughly wet all leaves. For larger trees, cut them down within 6 inches of the ground and immediately spray the freshly cut stump surface and sides with a solution of 50 percent triclopyr. It is best to apply the herbicide in the summer to early fall while the plant is translocating nutrients to the roots.

Trees up to 6 inches in diameter can be controlled with a basal bark application of herbicide. This method should be used judiciously since it takes a lot of chemical and can result in overspray. It has been used successfully in situations where no other technique is easy such as cliff faces or other exposed sites. Apply a solution of 25 percent triclopyr and 75 percent mineral oil to the basal parts of the tree to a height of 12 to 16 inches from the ground during the late winter/early spring or summer. All treatments should be followed up the next year to monitor and control basal sprouts and root suckers.

Paulownnia tomentosa photography by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org *(top left), Cherri Smith, NCDOT (top right) and Steve Mitchell, NCDOT (bottom).*


trees
shrubs
herbaceous plants
vines
aquatic plants

Ligustrum sinense (Chinese Privet)
Oleaceae (Olive Family)

Initial Introduction and Expansion in Range

Ligustrum sinense was introduced to the United States from China as a garden plant in 1952. It has been widely planted for hedges and has since escaped cultivation spreading throughout the Southeast and Midwest. *Ligustrum sinense* is now found in all 3 physiographic regions of North Carolina. This shrub prefers moist soil conditions but is also found on upland sites usually at elevations less than 3,000 feet.

A single mature *L. sinense* shrub can produce hundreds of fruits that are a favorite food for a number of bird species. Although *L. sinense* can spread by suckers, birds are by far the primary dispersal mechanism of this plant.

Description and Biology

- Large evergreen shrub up to 15 feet tall.
- Small (usually 1 to 1.5 inches long) elliptic, smooth-edged leaves arranged oppositely along the twigs. Leaves are thick with a glossy upper surface and a pale green lower surface. Midrib of each leaf is hairy.
- Smooth light tan to gray bark.
- Small white flowers arranged in branching clusters at the ends of branches bloom in June and July.
- Small black fruits ripen in August and September.
- Resembles *Ligustrum japonicum* (Japanese privet) which has larger, more glossy leaves and is further described in this document.

Habitats Susceptible to Invasion

Ligustrum sinense is usually found in bottomlands, low woods, stream sides and disturbed areas. Roadsides and fence-rows are avenues contributing to the expansion in range of this plant. *Ligustrum sinense* is an extremely aggressive shrub forming dense, impenetrable thickets that can shade out the herbaceous layer altering the natural species composition and community structure of natural areas.

Prevention and Control

If an infestation of *L. sinense* is caught early, the possibility of successful control and eradication is good. Well-established thickets of *L. sinense* can be controlled but complete eradication is difficult.

Young seedlings (no more than 0.5 inch in diameter) of *L. sinense* can be effectively controlled by hand-pulling. Stems up to 2 inches in diameter can be manually removed by tools designed for this purpose, such as a Weed Wrench. Larger plants can be killed by spraying the foliage with a 2 percent solution of glyphosate or triclopyr and a 0.5 percent nonionic surfactant. Ideally, the plants should be sprayed in the late fall or early spring when temperatures are above 65 degrees Fahrenheit and many native species are dormant. As long as the ground is not frozen, this shrub can also be killed by cutting it down within 6 inches of the ground and immediately spraying the freshly cut stump with a 50 percent solution of triclopyr. All treatments should be followed up the next year to monitor and control basal sprouts and root suckers.

Ligustrum sinense photography by Troy Evans, Bugwood.org *(top) and Chuck Bargeron, University of Georgia,* Bugwood.org *(bottom).*

Rosa multiflora (Multiflora Rose)
Rosaceae (Rose Family)

Initial Introduction and Expansion in Range

Native to Japan, Korea and China, *Rosa multiflora* was introduced to the United States in the 1860s as rootstock for ornamental roses. In the 1930s, the Soil Conservation Service (renamed the Natural Resource Conservation Service in 1994) promoted this plant for erosion control and living fences for containing livestock. Various conservation organizations have also promoted its use for wildlife cover and food. In some states, *R. multiflora* was planted within highway medians as a crash barrier and as a means to reduce headlight glare from oncoming vehicles. It is now found throughout North Carolina.

Rosa multiflora reproduces by rooting at the tips of its arching branches and by seed. In a good year, an average size *R. multiflora* shrub can produce 500,000 to 1,000,000 seeds. This plant has become a serious threat to natural areas not only because its seeds are widely dispersed by birds, but because of its ability to grow in diverse light, soil and moisture conditions.

Description and Biology

- Medium-sized, deciduous, thorny shrub up to 10 feet in height.
- Stems distinctly arching in form.
- Compound leaves composed of 5 to 11 leaflets alternately arranged along the stem with a terminal leaflet. Each leaflet broadly oval with a serrate (toothed) margin. A feathery stipule (green, leaf-like structure) is found at the base of each leaf.
- Clusters of fragrant, white to pinkish-white, 5-petaled flowers bloom in May or June.
- Small red fruits called “rose hips” develop during the summer and can persist on the plant through winter.
- Distinguished from other native species of roses by arching stems and feathery stipule.

Habitats Susceptible to Invasion

Rosa multiflora forms dense impenetrable thickets that can choke out native understory species. Roadsides, pastures, wetlands (i.e. mountain

bogs) and other non-forested areas are particularly susceptible to invasion. Disturbed right of ways provide the ideal conditions for the spread of this plant.

Prevention and Control

Cutting or mowing *R. multiflora* at least once during the growing season will control but not eradicate this plant. Small plants can be dug out by hand. Large plants can be pulled from the ground by tractors or trucks using strong ropes or chains.

Rosa multiflora can be effectively controlled from spring through fall with a foliar solution of 2 percent glyphosate or triclopyr plus a 0.5 percent non-ionic surfactant that thoroughly wets the leaves. The most successful chemical control can be achieved with a foliar solution of 1 ounce metsulfuron/100 gallons water plus a 0.5 percent non-ionic surfactant. This solution will treat an area approximately the size of an acre.

If foliar spraying is not an option because of proximity to sensitive areas, *R. multiflora* can be effectively controlled with the cut stump method any time of year as long as the ground is not frozen. Once the plant is cut to the ground, immediately apply a 25 percent solution of triclopyr to the stumps taking care to cover the entire surface. All treatments should be followed up the next year to monitor and control sprouts.

Rosa multiflora photography by Mike Kunz, NC Botanical Garden (left) and James H. Miller, USDA Forest Service, Bugwood.org *(right).*

Vitex rotundifolia (Beach Vitex)
Lamiaceae (Mint Family)

Initial Introduction and Expansion in Range

Vitex rotundifolia has a widespread distribution and is found on beaches from China, Taiwan, Japan south to Malaysia, India, Sri Lanka, Australia and Hawaii. It was introduced to the South Carolina coast in the 1980s to control erosion. It is a quickly growing landscape plant tolerant of salt and drought. By the mid-1990s, *V. rotundifolia* had escaped cultivation and was rapidly spreading along the beaches in South Carolina. It is now found in North Carolina.

Seed production of this plant can be as high as 10,000-20,000 seeds per square meter. In addition to reproduction from seeds, broken shoot fragments can also establish new populations of this plant. As storms wash the seeds and shoots to new beaches, *V. rotundifolia* has the ability to become established great distances from existing populations.

Description and Biology

- Deciduous, sprawling shrub reaching 1 to 2 feet in height and up to 12 feet in diameter. Runners from this shrub have been documented up to 60 feet in length.
- Smooth, round, dark gray-green leaves. Underside of leaves is lighter green to whitish gray. When crushed, the leaves have a spicy fragrance.
- In the summer, bluish-purple flowers bloom in clusters at the ends of branches.
- Spherical, black, dry fruits between 0.25 and 0.5 inch in diameter persist on the plant through the winter.

Habitats Susceptible to Invasion

Vitex rotundifolia thrives in full sun, sandy soils and moderate temperatures. This plant forms a thick monoculture on dunes creating deep shade that inhibits the establishment of native species. *Uniola paniculata* (sea oats) and the federally threatened *Amaranthus pumilus* (seabeach amaranth) cannot compete with the aggressive growth of *V. rotundifolia*. The thick vegetative cover formed by *V. rotundifolia* may also contribute to the decline in nesting of sea turtles.

Prevention and Control

Consult with the appropriate Division of Coastal Management field office before conducting any activity that involves disturbance to dunes. Native dune species should be re-established in areas targeted for control of *V. rotundifolia*.

Vitex rotundifolia seedlings should be pulled up as soon as they can be accurately identified. It can be effectively controlled from spring through fall with a foliar solution of 5 percent glyphosate plus a 0.5 percent non-ionic surfactant that thoroughly wets the leaves. Established *V. rotundifolia* has been successfully controlled by cutting the plant as close to the ground as possible and applying a 10 percent solution of glyphosate to the cut stems. The cut plant material should be taken to a compost facility for proper disposal or piled on a concrete surface until the leaves fall off and then composted. The cut stumps should be monitored monthly for re-sprouting. Sprouts should be cut to expose a fresh surface and be treated with herbicide solution.

Vitex rotundifolia photography by Forest & Kim Starr, U.S. Geological Survey, Bugwood.org.


trees
shrubs
herbaceous plants
vines
aquatic plants

Alliaria petiolata (Garlic Mustard)
Brassicaceae (Mustard Family)

Initial Introduction and Expansion in Range

During the 1800s, *Alliaria petiolata* was brought to the United States from Europe as a medicinal herb and for cooking purposes. It is now found throughout the Northeast, the Midwest, Georgia and Oregon.

Alliaria petiolata spreads exclusively by seed. Each plant can produce hundreds of seeds that are ballistically dispersed up to 10 feet when the fruits burst open. Since the seeds do not float well and are probably not carried far by wind, wildlife and human activities are probably responsible for long distance dispersal of the seeds.

Description and Biology

- During the first year of establishment, the plants form rosettes of kidney-shaped leaves approximately 4 inches high that stay green throughout the winter. These rosettes may be mistaken for *Viola* spp. (violets).
- In the second year, the plant flowers and can grow 2 to 4 feet in height. Leaves are heart-shaped and coarsely toothed.
- Blooms from April to May with flowers occurring in a cluster at the end of the stem. Flowers are white with 4 petals in the shape of a cross.
- Fruits are slender capsules that contain a row of shiny black seeds when mature.
- Slender white taproot is a distinguishing characteristic of this plant.
- Distinctive garlic odor when leaves and stems are crushed.

Habitats Susceptible to Invasion

Alliaria petiolata poses a significant threat to natural areas because of its ability to thrive in partial shade. It can also grow in full shade to full sun and a variety of moisture regimes and soil types. As a result, this plant readily invades roadsides, trail edges, floodplains, streambanks, and forest edges and interiors. *Alliaria petiolata* is less common on acidic soils including peat and muck.

In North Carolina, *A. petiolata* is posing the biggest threat to natural communities in the mountains where it displaces native wildflowers that occur in the same habitat. This invasion of *A. petiolata* also threatens certain native butterfly species since the chemicals in this plant appear to be toxic to their eggs.

Prevention and Control

Alliaria petiolata is difficult to eradicate once established so the best and most effective control method is to prevent its initial establishment. Monitor potential habitats in the late fall or early spring for immature rosettes, and in early to mid-spring for flowering adults in order to locate and remove plants before seeds are produced. In the case of small infestations, plants can be removed by hand but care must be taken to ensure that the entire root system is removed.

For larger infestations, flowering stems can be cut at ground level or within several inches of the ground to prevent seed production. If stems are cut too high it is possible for this plant to produce additional flowers at the leaf axils. This practice should continue until the seed bank is exhausted. In addition, *A. petiolata* is effectively killed with a 2 percent solution of glyphosate as long as the temperature is above 50 degrees Fahrenheit.

Alliaria petiolata photography by Cherri Smith, NCDOT (left) and Karen M. Lynch, NCDOT (right).

Lespedeza cuneata (Sericea, Korean or Chinese Lespedeza)
Fabaceae (Legume Family)

Initial Introduction and Expansion in Range

Native to Asia, *Lespedeza cuneata* was introduced to the United States in the 1940's for soil conservation, wildlife and livestock forage and hay. It is now found throughout the eastern portion of the United States from New York to Florida. It has spread west to Nebraska, Kansas, Oklahoma and Texas. *Lespedeza cuneata* is ubiquitous in North Carolina.

Although originally introduced for forage, as *L. cuneata* ages it develops tough stems and a high tannin content that makes it unpalatable to wildlife and livestock. Some herbivores will eat *L. cuneata* but only early in the season when the shoots are tender or when no other food is available. It is still planted for food (seeds) and cover for quail and for erosion control at construction sites, especially along highways. A prolific seed producer, *L. cuneata* readily escapes from cultivation. The extensive seed bank of this plant can remain viable for decades.

Description and Biology

- Aggressive, warm-season, perennial legume ranging in height from 2 to 5 feet.
- Herbaceous to somewhat woody stems with numerous straight branches.
- Wedge-shaped leaf bases distinguish this plant from other species within the genus *Lespedeza*. Leaves are compound in groups of 3 arranged alternately along the stem.
- Flowers are white with violet markings along the veins and emerge close to the stem in the leaf axils from the middle to upper portions of the plant. Blooms from mid-July to October.
- Small, tan, oval seeds borne in a legume that are flat and oval shaped.
- Dormant brown plants remain upright during most of the winter.
- Begins growth from root crown buds at the base of the stem from the previous year.

Habitats Susceptible to Invasion

Lespedeza cuneata is adapted to a wide range of climatic conditions enabling it to invade a variety of habitats including fields, meadows, marshes, pond borders, open woodlands and roadsides. It thrives in conditions difficult for other plants such as on eroded, infertile soils and steep slopes. It is drought resistant and is rarely affected by insects and disease. If left unchecked, *L. cuneata* can take over entire fields in 3 to 4 years. These stands become so dense that recruitment of native plants is drastically reduced.

Prevention and Control

The complete elimination of *L. cuneata* from natural areas is extremely difficult given that large numbers of viable seeds can remain in the seed bank for years. Any control effort requires years of commitment from land managers. The best way to slow the spread of this plant is the commitment of land managers to no longer recommend and specify the planting of *L. cuneata* for erosion control.

Although prescribed buring is not an effective control method since fire scarifies the seeds and promotes germination, it has been used by land managers to remove the biomass of this plant followed by chemical treatment. Others have used prescribed burning to stimulate germination and speed up getting rid of the seed bank. Mowing *L. cuneata* is also an effective means to remove the biomass prior to chemical treatment. If burning or mowing is desired, allow the plant to grow back and then follow up during the first growing season with chemical treatment. Apply a solution of 2 quarts triclopyr plus 6 ounces clopyralid per acre and a 0.5 percent nonionic surfactant before the plant sets seed.

Lespedeza cuneata photography by James H. Miller, USDA Forest Service, Bugwood.org *and Chris Evans, River to River CWMA,* Bugwood.org.

Microstegium vimineum (Japanese Stilt Grass, Japanese Grass, Nepalese Browntop) Poaceae (Grass Family)

Initial Introduction and Expansion in Range

Native to Asia, *Microstegium vimineum* was first identified in the United States in the first part of the 20th century. It was collected from the western portion of North Carolina in the 1930s. Since that time, *M. vimineum* has spread to states east of the Mississippi River and from New York, south to Florida. It is now ubiquitous in North Carolina.

There is no documentation that *M. vimineum* was ever intentionally planted as an ornamental or for erosion control or forage. It is suspected that the widespread use of *M. vimineum* for packing material for Chinese porcelain is responsible for the introduction of this plant into the United States.

An individual *M. vimineum* plant produces 100 to 1,000 seeds that can remain viable for up to 5 years. Seeds are readily dispersed by flooding, deposition with fill dirt, contaminated hay, footwear and animals. Deer avoid *M. vimineum* giving it a competitive advantage in areas that are overly grazed. On fertile moist sites, this grass can form dense monotypic stands within 3 to 5 years.

Description and Biology

- Bright green grass growing up to 2 to 3 feet by late summer.
- Long, thin, alternate, lance-shaped leaves. Blades are flat and sparsely hairy on both surfaces. Mid-vein whitish and off center.
- Stalk of this grass is distinctly divided by nodes.
- Delicate spikes of flowers emerge from slender tips from August to September. Spikes may be either terminal or arising from leaf axils.

Habitats Susceptible to Invasion

The spread of *M. vimineum* poses a particularly severe threat to natural areas because this plant is adapted to low light conditions and is able to grow and produce seeds underneath a closed forest canopy. It is most prevalent in disturbed shaded floodplains that are prone to scouring and

those areas subject to mowing, tilling, and other soil disturbing activities such as utility corridors, lawns, gardens and roadside ditches. It is most commonly associated with moist, acidic to neutral soils that are high in nitrogen content, but this grass can also tolerate drier sites with full sunlight.

Prevention and Control

Because of the seriousness of its threat to natural areas, preventing the introduction of *M. vimineum* and early control of new infestations should be the utmost priority for land managers. *Microstegium vimineum* can be hand pulled or mowed when the plant is flowering but before it sets seed. These methods are ineffective earlier in the growing season since new seeds will be able to germinate and may still set seed by the end of the growing season. In addition, mowing earlier may result in plants producing new seed heads in the axils of the lower leaves.

Similarly, herbicide treatments should be made late in the growing season but before the plants set seed. Apply a 0.25 to 0.5 percent solution of glyphosate plus a 0.5 percent non-ionic surfactant to thoroughly wet all foliage. Land managers have found that *M. vimineum* is sensitive to this relatively low concentration of glyphosate that often will not harm adjacent plant species. When working in wetland sites and sites in proximity to surface waters, use an aquatic formulation of glyphosate. All treatments will require follow up in successive years until the seed bank is exhausted.

Herbicides specific to grasses are effective and selective. A grass-specific chemical called fluazifop can be applied at a rate of 12 to 24 ounces per acre plus a 0.5 percent non-ionic surfactant. To achieve excellent control over a londer period of time, add pendimethalin (pre-emergent) at a rate of 2 to 4 quarts per acre to the chemical mix.

Microstegium vimineum photography by Johnny Randall, N.C. Botanical Garden.

Miscanthus sinensis (Chinese silvergrass)
Poaceae (Grass Family)

Initial Introduction and Expansion in Range

Miscanthus sinensis is native to eastern Asia throughout China, Japan, and Korea. It was introduced to the United States about a century ago as an ornamental and is still widely sold for this purpose. It has been introduced or has spread throughout the eastern United States from Florida to Texas, north to Massachusetts and New York, and Colorado and Texas. In North Carolina, *M. sinensis* is most prevalent in the western portion of the state.

Miscanthus sinensis reproduces through wind-dispersed seeds and rhizomes. This grass can form extensive infestations by escaping from established ornamental plantings into disturbed areas where it forms dense clumps that displace native vegetation. Since it is highly flammable, *M. sinensis* is notorious for being a fire hazard.

Description and Biology

- Tall, perennial, densely bunched grass 5 to 10 feet in height.
- Elongated, upright to arching leaves 3 feet long and 1 inch wide with whitish upper midrib. The leaves have sharp tips and rough margins. Blades are green to variegated (light green horizontal stripes).
- Showy, fan-shaped, silvery to pink, terminal inflorescence that emerges in late August to early September and matures in early fall.

Miscanthus sinensis photography by Karen M. Lynch, NCDOT (left) and Cherri Smith, NCDOT (right).

Habitats Susceptible to Invasion

Miscanthus sinensis will grow on a variety of habitats but prefers full sun and moist, well-drained soil. Although it is intolerant of shade, it can survive in sparsely forested areas. This grass has the ability to form extensive infestations within disturbed sites and forest margins and is particularly prevalent along roadsides in the western piedmont and mountains of North Carolina.

Prevention and Control

The widespread sale and use of *M. sinensis* as an ornamental grass ensures the continued spread of this plant. When it escapes to natural areas, infestations should be controlled as soon as possible since the ability of *M. sinensis* to sprout from pieces of rhizome makes it difficult to control. Unless the entire rhizome system is killed, re-growth will occur the next year.

Miscanthus sinensis has been effectively controlled with a 2 to 3 percent solution of glyphosate and 0.5 percent non-ionic surfactant in the late summer before the plant sets seed.

Murdannia keisak (Asian Dayflower, Asian Spiderwort)
Commelinaceae (Spiderwort Family)

Initial Introduction and Expansion in Range

Murdannia keisak, a native of eastern Asia, was first recorded in the United States in the 1920s and early 1930s. Since it is associated with rice production in Asia, it was probably accidentally brought to the southeast in rice imported for use in farming. This plant is found primarily in the coastal plain regions of the Southeastern United States from Delaware to Louisiana, and Kentucky, Tennessee, Washington and Oregon.

In addition to producing seeds that are dispersed by wildlife (particularly ducks and other waterfowl), *M. keisak* can reproduce vegetatively and has the ability to invade new locations when floodwaters transport root and stem fragments. As this plant forms dense monotypic mats, it is able to out compete native plants.

Description and Biology

- Succulent annual with stems that grow prostrate along the ground eventually ascending 12 to 18 inches. Stems root at the nodes.
- Leaves are alternately arranged along the stem, lance-shaped, and up to 3 inches long. Bases of the leaves clasp and surround the stem.
- Flowers occur from late August to late September at the ends of the stems or in the leaf axils. Small, pink to purple flowers consist of 3 petals and can occur singly or in small clusters.

Habitats Susceptible to Invasion

Murdannia keisak prefers moist soil and invades the edges of ponds, lakes, freshwater marshes, and slow moving streams. It was thought to be restricted to the coastal plain of the southeastern states but is expanding its range to the piedmont and foothills of neighboring Virginia and Tennessee.

Prevention and Control

There is little available information regarding the successful control of *M. keisak*. Pulling the plant by hand is not an effective method of control since the stems and roots break easily making it impossible to remove all of the fragments from the site to prevent vegetative reproduction. Since *M. keisak* often forms dense monocultures, it may be best to chemically treat this plant with an herbicide labeled for use in aquatic and wetland sites.

Murdannia keisak photography by Linda Lee, University of South Carolina, Bugwood.org *(top) and Nancy Loewenstein, Auburn University,* Bugwood.org *(bottom).*

Phragmites australis (Common Reed)
Poaceae (Grass Family)

Initial Introduction and Expansion in Range

Until recently, the status of *Phragmites australis* as a non-native or native species to North America has been in dispute. Current research confirms the existence of native North American haplotypes (family lines or lineages) and introduced European haplotypes. Peat core analyses in coastal areas indicate that the native *P. australis* has been a component of mixed tidal wetland plant communities in North America for at least 3,000 years. The non-native *P. australis* was probably an accidental introduction in ballast material from ships in the late 18th or early 19th centuries. Over the course of the 20th century, this plant has spread across the continent invading fresh and brackish marshes and displacing native mixed communities with near monocultures.

Phragmites australis can spread by seed dispersal and vegetatively by fragments of rhizomes that break off and are transported elsewhere. Non-native *P. australis* is capable of vigorous vegetative reproduction and can quickly take over a marsh community. This invasion is causing serious problems for many native North American wetland plants and has resulted in changed ecosystem processes and detrimental impacts to native wildlife. Generalist bird species such as red-winged blackbirds will roost in *P. australis*, but specialist bird species will not use marsh habitat that has been taken over by this plant.

In Europe, *P. australis* is grown commercially and is used for thatching, as fodder for livestock, and for cellulose production. The decline of this plant in parts of Europe is causing concern because of its economic importance and because ecological degradation is thought to be the cause of this decline. In North America, there is no known economic use for *P. australis*, and it thrives in degraded habitats.

Description and Biology

- Tall, perennial, wetland grass ranging in height from 3 to 13 feet.
- Strong leathery rhizomes growing on or beneath the ground surface.
- Cane-like stems are green during the growing season and turn tan by fall.

- Leaves are alternately arranged, flat and hairless, up to 24 inches long, 0.5 to 2 inches wide, tapering to a point at their ends.
- Large, dense, feather-like, 5 to 12 inches long, grayish purple plumes appear on top of the stem by late June.
- *Spartina cynosuroides* (giant cordgrass) is a native species that can be confused with *P. australis*. It is distinguished from *P. australis* by its sparse flowering structure and longer, more gracefully arching leaves.
- Non-native and native *P. australis* are difficult to distinguish without genetic analysis. Typically, non-native *P. australis* will occur in monocultures while native *P. australis* co-exists with other wetland species. Non-native *P. australis* tends to have leaves that persist in contrast to the native *P. australis* that typically loses most of its leaves by fall. The stems of native *P. australis* are reddish in the summer and fall. Non-native *P. australis* predominates in North Carolina.

Habitats Susceptible to Invasion

Phragmites australis is found in tidal and nontidal brackish and freshwater marshes, river edges, and shores of lakes and ponds within the coastal plain of North Carolina. It occurs in disturbed areas as well as pristine sites. This plant is particularly common in roadside ditches.

Prevention and Control

Control of *P. australis* is time-consuming and labor intensive. Management efforts have shown that *P. australis* can be controlled with the return of native vegetation, but monitoring is imperative since this plant tends to re-invade, necessitating control techniques for years or possibly in perpetuity. It is also important to realize that some areas have been so severely manipulated and degraded that it may be impossible to eliminate *P. australis*.

The use of glyphosate (labeled for use in aquatic sites) has proven to be an effective means of controlling *P. australis*. The herbicide should be applied in the late summer or early fall after the plant has flowered as a 2 percent foliar spray. Successive treatments for several years will definitely be necessary. The most successful chemical control can be achieved with a foliar solution of 1 to 2 percent imazapyr plus 1 percent metholated seed oil. Prescribed burning after herbicide treatment has the advantage of reducing standing dead stems and litter, giving the seeds of other native species area to germinate.

Phragmites australis photography by Johnny Randall, N.C. Botanical Garden.

Reynoutria japonica (Japanese Knotweed)
Polygonaceae (Smartweed Family)

Initial Introduction and Expansion in Range

Native to Japan, *Reynoutria japonica* (also known as *Polygonum cuspidatum*) was introduced to North American in the late 19th century probably as an ornamental. Since that time, this plant has also been used for erosion control and landscape screening. It is now found throughout the Eastern United States, in scattered locations in the Midwest and Western States, and the southern portions of Canada.

Reynoutria japonica spreads rapidly from long stout rhizomes and prolific seeds. It can invade new sites from both seeds and rhizome fragments that are transported by floodwaters and contaminated fill dirt. It appears to be able to tolerate a variety of adverse conditions including high salinity and drought, but is generally found in open sites with more exposure to light.

Description and Biology

- Upright, shrubby, herbaceous perennial that can grow up to 10 feet in height.
- Stems are smooth, hollow, stout and swollen where the leaf meets the stem.
- Leaves are normally about 6 inches long by 3 to 4 inches wide and are broadly oval, tapering to a fine point at the tip.
- Fleecy, white, branched sprays of flowers appear from August to September.
- Seeds are triangular, reddish, shiny and about 0.10 of an inch long.
- Distinguished from other native species of *Polygonum* by greater overall height and growth of stout rhizomes.

Habitats Susceptible to Invasion

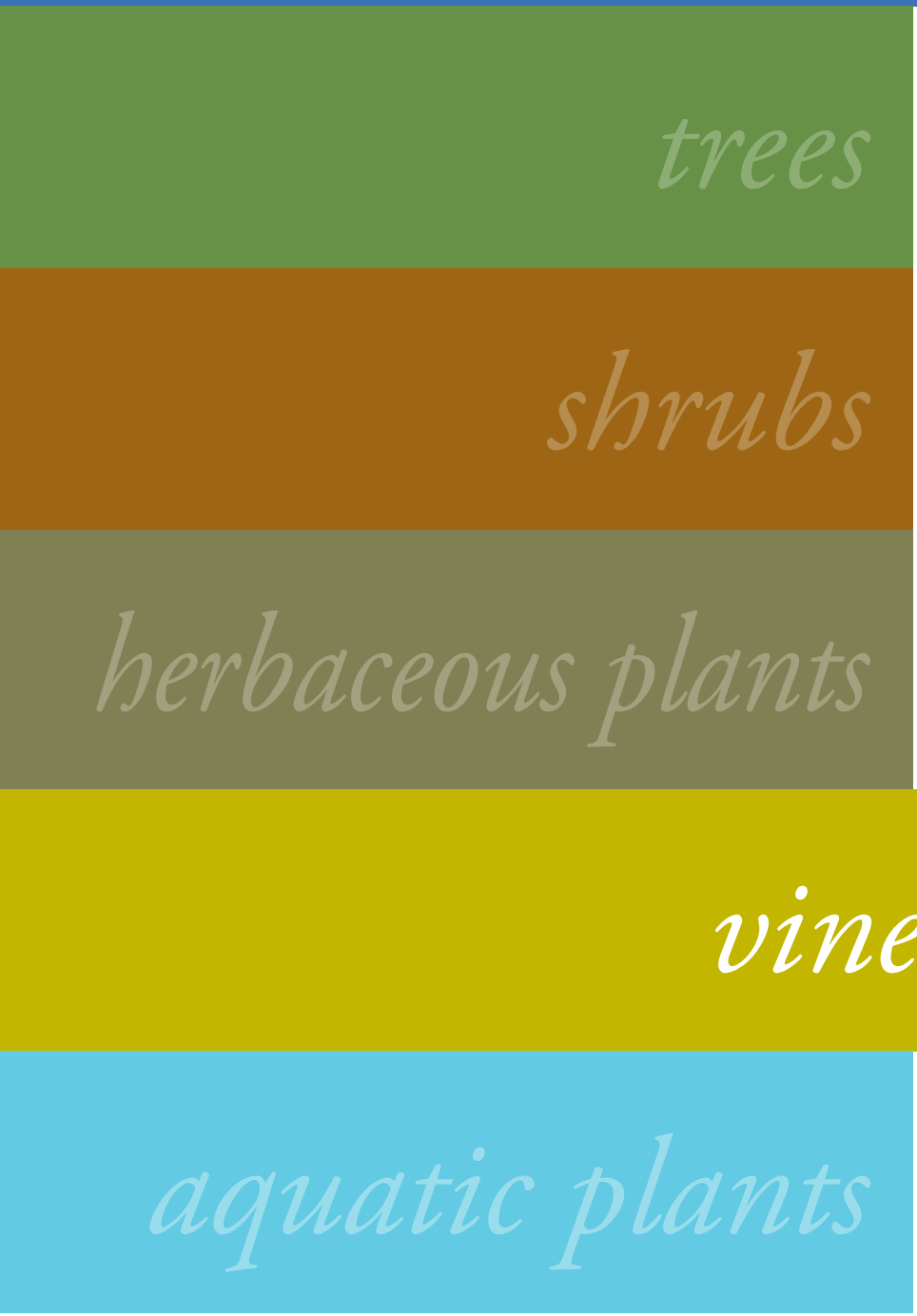
Reynoutria japonica is found along streams and rivers and other low-lying areas, waste places, utility rights-of-way, old home sites and roadsides. In North Carolina, this plant is wreaking ecological havoc along stream banks and floodplains in the mountains. It is also found in similar habitats in the piedmont but is currently not as common. Once established, this plant forms dense monospecific stands that displace virtually all other vegetation.

Prevention and Control

Established populations of *R. japonica* are extremely difficult to eradicate. Natural areas susceptible to invasion by *R. japonica* should be routinely monitored for this plant so that small infestations can be eliminated. Young plants can be successfully pulled or dug as long as the entire root system is removed.

Reynoutria japonica can be controlled with a foliar solution of 3 to 4 percent glyphosate plus a 0.5 percent non-ionic surfactant to thorougly wet all of the foliage in the late summer. Where *R. japonica* is found adjacent to aquatic areas, it will be necessary to use a formulation of glyphosate that is labeled for aquatic sites. As with any plant that can effectively reproduce by seeds, control activities should be conducted before the plant has produced seeds.

Reynoutria japonica photography by Karen M. Lynch, NCDOT (top) and Cherri Smith, NCDOT (bottom).


trees
shrubs
herbaceous plants
vines
aquatic plants

Celastrus orbiculatus (Oriental Bittersweet)
Celastraceae (Bittersweet Family)

Initial Introduction and Expansion in Range

Celastrus orbiculatus is native to Japan, Korea, and northern China and was introduced to the United States in the mid-1800s for ornamental purposes. The spectacular bright yellow and red-orange fruits of this vine continue to make it popular for cultivation. *Celastrus orbiculatus* is still widely sold for floral arrangements and wreaths providing additional avenues for spread and infestation. This plant is now found from Maine to North Carolina, and west to Illinois.

In North Carolina it is listed as a Class C state noxious weed. Anyone who suspects an infestation outside of the 18 regulated couties in western North Carolina should notify the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Celastrus orbiculatus has all of the attributes of a competitive and successful plant. It is a prolific seed producer and since the seeds are consumed by a wide variety of birds, it has the potential for long-range dispersal. It has a high rate of seed germination (up to 95 percent) with the highest rate of seed germination in lower light intensities. This ability to germinate in a closed forest canopy provides this plant with a "sit and wait" invasion strategy until it is released by a disturbance that creates optimal conditions for rapid growth. It also expands vegetatively by rhizomes and through the ability to send shoots up from the roots known as root suckering.

Description and Biology

- Deciduous, woody, perennial vine growing up to 60 feet in height. It can also grow in dense, low patches.
- There are separate female (fruiting) and male (non-fruiting) plants.
- Leaves are alternate, glossy and rounded with finely toothed margins. Yellow fall color.
- Clusters of small, white-green flowers emerge between May and June from leaf axils.
- From August through September fruits ripen turning from green to yellow. In the winter, fruits split to reveal red-orange interiors that

persist at most leaf axils (female plants).
- Stems have many raised whitish corky dots also known as lenticels.
- *Celastrus orbiculatus* can be confused with our native *C. scandens* (American bittersweet) which is becoming more and more rare. Generally, *C. orbiculatus* produces fruits that are a brighter shade of red and are found all along the stems in clusters of 3 to 7. *Celastrus scandens* produces larger clusters of fruit only at the tips of stems. These 2 species have been known to hybridize making identification even more difficult and resulting in the loss of the genetic identity of *C. scandens*.

Habitats Susceptible to Invasion

Most often associated with old home sites in the mountains of North Carolina, *C. orbiculatus* has escaped into surrounding natural areas. It is frequently found along forest edges, hedgerows, fields, disturbed woodlands and roadsides. It has started to appear sporadically in the piedmont. This aggressive invader has the ability to kill other vegetation by completely covering plants and preventing photosynthesis, and by making trees more susceptible to uprooting because of the excessive weight of the vine and also by girdling.

Prevention and Control

Identifying and eradicating populations of *C. orbiculatus* in forested areas before they are released by a disturbance is the best method of control. It is possible to dig and hand pull small initial populations taking care to remove all of the root system to prevent re-sprouting. All plant material should be bagged and disposed of in the trash.

A successful control technique for low dense patches of *C. orbiculatus* involves cutting the vegetation to the ground early in the growing season and allowing it to re-sprout. Approximately 1 month later, spray the foliage with a 2 percent solution of triclopyr.

Where vines have grown into the canopy, cut the stem 2 inches above the ground and immediately apply a 50 percent solution of triclopyr to the cut stem. This method is effective as long as the ground is not frozen. All treatments should be followed up the next year to monitor and control new seedlings and root sprouts.

Celastrus orbiculatus photography by Johnny Randall, N.C. Botanical Garden (top), Mike Kunz, N.C. Botanical Garden (bottom left) and Cherri Smith, NCDOT (bottom right).

Pueraria montana (Kudzu)
Fabaceae (Legume Family)

Initial Introduction and Expansion in Range

Native to Asia, it is widely believed that *Pueraria montana* was introduced into the United States in 1876 at the Philadelphia Centennial Exposition where it was exhibited as an ornamental vine. This plant quickly became valued by gardeners for its fragrant flowers and large leaves that provide shade for arbors and work well as a screen. Subsequent to its use as an ornamental plant, *P. montana* was sold mainly as an inexpensive livestock forage. From the mid-1930s to the early-1950s, farmers in the south were encouraged to plant *P. montana* to control agricultural erosion. By 1953, the United States Department of Agriculture removed this plant from its list of allowable cover plants and in 1970 it was listed as a common weed of the South.

Pueraria montana is a common sight throughout most of the Southeastern United States. It has spread as far west as Oklahoma and Texas and is now occasionally found in Northern states. The spread of *P. montana* is primarily vegetative by rhizomes and by vines that root at the nodes where the vines come in contact with soil and form new plants. To a much lesser extent this plant can spread by seed, but there are usually few viable seeds in each pod. Regardless of how many seeds are viable, *P. montana* poses a serious threat to natural areas because of its extremely rapid growth rate. Growing up to 1 foot a day, this plant has the ability to out-compete and kill everything from grasses to mature trees through crowding and shading.

Description and Biology

- Perennial, woody, trailing or climbing vine up to 100 feet in length.
- Young stems are hairy, while older stems become woody and are up to 4 inches in diameter.
- Leaves are compound with 3 broad leaflets up to 4 inches across. Leaflets may be entire or 2 to 3 lobed.
- Fragrant purple flowers 0.5 to 0.75 inch long are produced in the late summer on plants exposed to direct sunlight.
- Brown, hairy, flattened pods are present in October and November.

- Roots are fleshy with massive taproots that can become 7 inches or more in diameter and several feet in length.

Pueraria montana photography by James H. Miller, USDA Forest Service, Bugwood.org (top) and Johnny Randall, N.C. Botanical Garden (bottom).

Habitats Susceptible to Invasion

Pueraria montana grows well in a variety of habitats and soil types, although the greatest growth rate is achieved where winters are mild, summer temperatures are above 80 degrees Fahrenheit, and annual rainfall is greater than 40 inches. The large roots of this plant allow it to survive summer drought conditions. Populations of *P. montana* are generally established along roadsides, old fields, forest edges and other sunny disturbed areas throughout North Carolina.

Prevention and Control

The most effective method of control of *P. montana* depends on the size of the infestation and proximity to non-target desirable vegetation. Small patches of *P. montana* that are not well-established can usually be eliminated by persistent weeding, mowing, or grazing during the growing season. The spread of a well-established infestation of *P. montana* can be controlled the same way, but cutting will typically not kill the roots of larger plants.

For vines in tree canopies, cut the vines near the ground and apply a 50 percent solution of triclopyr to the stumps. This procedure remains effective at lower temperatures as long as the ground is not frozen. Large infestations can be effectively controlled with a foliar solution of 2 to 3 percent glyphosate or triclopyr plus a 0.5 percent non-ionic surfactant to thoroughly wet all leaves. The ambient air temperature should be above 65 degrees Fahrenheit. After the above ground vegetation is controlled and it is possible to dig and cut into the central root crown, apply a 50 percent solution of glyphosate or triclopyr to the wound. The most successful chemical control of *P. montana* can be achieved with a foliar solution of 0.75 percent clopyralid plus a 0.5 percent non-ionic surfactant. Monitor all treatments in subsequent years for re-sprouting.


trees
shrubs
herbaceous plants
vines
aquatic plants

Alternanthera philoxeroides (Alligatorweed)
Amaranthaceae (Amaranth Family)

Initial Introduction and Expansion in Range

Originally from South America, *Alternanthera philoxeroides* is an invasive species in a number of countries including China, Thailand, Australia, New Zealand and the United States. First introduced into the United States around 1900, this aquatic weed is now found on the coastal plain from Virginia to Florida, westward to Texas, and in coastal California.

The ability of this plant to root at stem nodes allows *A. philoxeroides* to rapidly spread as pieces of stem break and float away. Vegetative reproduction is the primary means for this plant to establish new populations since seeds rarely develop and those that do develop are typically not viable.

The ability of *A. philoxeroides* to invade aquatic and moist terrestrial habitats makes this weed particularly troublesome for land managers. It forms large interwoven mats over the water and along shorelines impairing access and use of waterways. The aquatic form can reduce water flow and degrade water quality by preventing light penetration and oxygenation. Both the aquatic and terrestrial forms can crowd out native species.

Description and Biology

- Perennial, vine-like plant with stems reaching lengths of 3 feet or more. Stems of the more common emergent aquatic form are hollow providing great buoyancy across large expanses of water. In the terrestrial form, the stems are barely hollow and the leaves tend to be smaller.
- Growing up to 4 inches long, the leaves are elliptic, have smooth margins, and are arranged oppositely along the stem.
- Small, white, clover-like flowers appear during warmer months.

Habitats Susceptible to Invasion

Alternanthera philoxeroides can grow in a variety of habitats, including uplands, but is usually found as an aquatic plant in water less than 6 feet deep. It roots in soil along the shore or in shallow water and then grows across the surface forming a dense interwoven floating mat.

Prevention and Control

Insects have been released in the United States for the biological control of *A. philoxeroides*. The most successful and widely used insect for this purpose is *Agasicles hygrophila* (alligatorweed flee beetle). *Amynothrips andersoni* (alligatorweed thrips) and *Vogtia malloi* (alligatorweed stem borer) have also been released in the United States. Given the inherent uncertainties and complexities with the introduction of biological control agents, these insects are mentioned only as information and not as a recommendation for control of *A. philoxeroides*.

Since *A. philoxeroides* can take years to control, early detection and prevention is the most cost-effective form of weed control. In addition, the maintenance and establishment of native vegetation on the banks of waterways will reduce soil erosion and prevent *A. philoxeroides* from gaining a terrestrial foothold.

Two herbicide treatments with a 2 percent solution of glyphosate plus a surfactant (formulations approved for aquatic sites), 1 in the spring and 1 in the fall, have shown to be most effective for the initial treatment of alligatorweed. Within 3 or 4 years when the weed is reduced to a maintenance level, only annual treatments should be required. It may take at least 4 or 5 years to reduce the terrestrial stage of *A. philoxeroides* to a maintenance level since the formation of a large taproot at this stage makes management more difficult.

The most effective chemical control of *A. philoxeroides* can be achieved with a foliar solution of 0.5 percent imazapyr plus 1 percent metholated seed oil. Imazapyr can virtually eradicate *A. philoxeroides* over a 2-year period. Always consult with the NCDENR-DWR Aquatic Weed Control Program before initiating any control method using chemicals in aquatic areas.

Alternanthera philoxeroides photography by Larry Allain, National Wetlands Research Center, USGS (left) and Steve Mitchell, NCDOT (right).

Hydrilla verticillata (Hydrilla)
Hydrocharitaceae (Frog's-bit Family)

Initial Introduction and Expansion in Range

Hydrilla verticillata is native to the warmer regions of Asia and is now found in Australia, New Zealand, the Pacific Islands, Africa, Europe, South America and North America. This federally-listed noxious weed was first discovered in Florida during the 1960s following release from aquariums into waterways. By the 1990s it was well established throughout the southern United States. *Hydrilla verticillata* has been documented in Maryland, Delaware and eastern Pennsylvania. It is also a problem in California and Washington. In North Carolina, *H. verticillata* is found most commonly in the piedmont. Anyone who suspects an infestation in North Carolina should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Hydrilla verticillata reproduces by seeds and vegetatively, although seed production is probably of minor importance compared to the highly successful vegetative reproduction of this plant. *Hydrilla verticillata* can sprout new plants from stem fragments containing as few as 2 whorls of leaves. As a result, small amounts of *H. verticillata* on boat trailers and motors, bait pails, and other items can spread the plant from place to place. *Hydrilla verticillata* also reproduces by axillary and subterranean turions (small, potato-like shoots produced from a bud on a root) that can each develop into a new plant. Subterranean turions are considered the more important of the 2 methods of turion reproduction since a single subterranean turion has been shown to produce over 6,000 new turions per square meter and can remain viable for up to 4 years. These propagules can withstand prolonged herbicides, prolonged drying, and ingestion and regurgitation by waterfowl.

Hydrilla verticillata can grow up to 1 inch per day as it approaches 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 native submersed plants. As these thick mats decay, oxygen levels are reduced and adversely affect aquatic life. *Hydrilla verticillata* causes major negative impacts on water use. It impedes flow in drainage canals, clogs the intakes of pumps used for conveying irrigation water, interferes with

the navigation of both recreational and commercial boats, and severely limits recreational uses such as fishing, swimming and water skiing.

Description and Biology

- Submersed aquatic plant that is generally rooted to the bottom, although in some cases fragments will break loose and survive in a free-floating state.
- Forms dense stands of long stems up to 25 feet. Branching is usually sparse in the water column and then becomes profuse near the water surface.
- Characterized by leaves in whorls of 3 to 6 that are coarsely serrated on the margins and has minute spines on underside of midvein.
- Axillary turions are compact dark green buds that fall from the plant when they mature. Subterranean turions are off-white to yellow and are formed terminally on rhizomes.
- *Hydrilla verticillata* is often confused with another invasive exotic species, *Egeria densa* (Brazilian elodea) and 2 species of *Elodea* spp. (American elodea).

Habitats Susceptible to Invasion

Hydrilla verticillata can grow in almost any freshwater habitat that is not swift-flowing including ponds, lakes, marshes, ditches, rivers and tidal areas. It can grow in only a few inches of water or in water more than 20 feet deep. This plant is adapted to use low light levels for photosynthesis allowing it to colonize in deeper waters than other aquatic plants. This adaptation also allows *H. verticillata* to begin to photosynthesize earlier in the morning so that it can successfully compete with other aquatic plants for a limited amount of dissolved carbon.

Hydrilla verticillata can grow under a wide range of water chemistry conditions and is found in oligotrophic (low nutrient) to eutrophic (high nutrient) conditions. It will tolerate salinity up to 9 to 10 parts per thousand, allowing it to encroach into estuaries.

Prevention and Control

A number of control methods have been used on *H. verticillata* including mechanical removal, desiccation through lake drawdown, herbicide application, and biological control with variable rates of success.

Mechanical removal is extremely expensive and risks spreading plant fragments to new locations. Water level drawdowns have been ineffective in this area since subterranean turions are able to survive prolonged periods of drought.

Fluridone has been one of the most effective chemicals for controlling *H. verticillata.* Formulated copper, diquat, endothal, or mixtures of these chemicals can be used for contact herbicidal control. Some of these chemicals may be harmful to aquatic life so always consult with NCDENR-DWR Aquatic Weed Control Program before initiating any control method using chemicals.

In North Carolina, the most effective and least expensive method of control has been the use of sterile (triploid) grass carp. The downside to using this method of biological control is that grass carp are non-specific herbivores that will consume desirable native species in addition to *H. verticillata* resulting in a reduction in food and habitat for invertebrates, other fish and waterfowl. Stocking rates for partial control have not been established. The stocking and monitoring of grass carp can be coordinated through the NCDENR-DWR Aquatic Weed Control Program. NCDENR-DWR will also evaluate infestations to recommend other appropriate control measures.

Hydrilla verticillata photography by Rob Emens, N.C. Division of Water Resources.

Ludwigia grandiflora spp. *hexapetala* (Creeping Water Primrose, Uruguay Water Primrose, Hairy Water Primrose) Onagraceae (Evening-primrose Family)

Initial Introduction and Expansion in Range

Native to Central and South America, *Ludwigia grandiflora* spp. *hexapetala* was introduced to the United States as an ornamental and water garden plant because of its abundant, showy, yellow flowers. It is now widely distributed from the middle Atlantic region to Florida, westward to Texas and along the west coast. It is currently found throughout North Carolina and is listed as a Class B state noxious weed. Anyone who suspects an infestation in North Carolina should report it to the North Carolina Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333. *Ludwigia grandiflora* spp. *hexapetala* reproduces by seeds and vegetatively from root and stem fragments that readily re-sprout.

Description and Biology

- Perennial herb that can be found creeping along the shoreline, floating on the water surface, or growing upright.
- Early in the growing season, *L. grandiflora* spp. *hexapetala* produces light, green, floating stems with rosettes of smooth, somewhat shiny, rounded leaves.
- Later in the season as the stems emerge from the water, they become hairy, woody, and reddish brown, and may begin to split lengthwise.
- Leaves become elongated and strap-shaped with pointed tips on erect stems.
- Flowers with 5 to 6 bright yellow petals appear during the early summer and are produced until the end of August or early September.

Habitats Susceptible to Invasion

Ludwigia grandiflora spp. *hexapetala* forms dense mats up to 3 feet tall in marshes, swamps, ditches, ponds, and around lake margins. The amphibious character of this *Ludwigia* species allows it to creep into moist terrestrial habitat surrounding open water.

Ludwigia grandiflora spp. *hexapetala* presents a direct threat to native plant and animal communities by growing over surrounding vegetation

and producing a thick mat of woody perennial stems and decaying plant material. This mat inhibits the recruitment of other plants and eliminates open water foraging grounds for birds and other wildlife.

Prevention and Control

Mechanical methods such as cutting, dredging, and hand-pulling have been attempted to control *L. grandiflora* spp. *hexapetala.* These methods are difficult and costly, and since *L. grandiflora* spp. *hexapetala* is a perennial that readily re-sprouts from root and stem fragments, mechanical removal that does not completely eliminate the root system or is not done in conjunction with a systemic herbicide treatment to kill the roots, will likely result in re-growth. Grass carp do not find *L. grandiflora* spp. *hexapetala* palatable so, to date, attempts at the biological control of this plant have been unsuccessful.

The 2 chemicals that have had the greatest success in controlling *L. grandiflora* spp. *hexapetala* are glyphosate and triclopyr. Treat *L. grandiflora* spp. *hexapetala* with a 2 percent solution of glyphosate or triclopyr plus a surfactant (formulations approved for aquatic sites) early in the growing season when the canopy of the plant is less dense, allowing for a more thorough penetration of the chemicals. Follow-up treatments in successive years will likely be necessary. Always consult with the NCDENR-DWR Aquatic Weed Control Program before initiating any control method using chemicals in aquatic areas.

Ludwigia grandiflora spp. hexapetala photography by Robert J. Richardson, N.C. State University.

trees

shrubs

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Albizia julibrissin (Mimosa)
Fabaceae (Legume Family)

Initial Introduction and Expansion in Range

Albizia julibrissin is native to southern and eastern Asia. It is found from Iran, east to China and Korea. The introduction of this plant to the United States has been traced back to 1745. The showy and fragrant pink flowers and attractive fern-like leaves of *A. julibrissin* continue to make this plant a popular choice for ornamental plantings. It is widely spread from New York, west to Missouri and Illinois, south to Florida and across to California.

Albizia julibrissin can form dense colonies from root sprouts, but the prolific seeds of this plant pose the greatest threat to natural areas. The seeds are readily dispersed by animals and water and have impermeable seed coats that allow them to remain viable for years.

Description and Biology

- Fast-growing deciduous tree with a low branching, open, spreading form that reaches heights of 20 to 40 feet.
- Trunks may be single or multiple stems.
- Thin, light bark is nearly smooth with lens shaped areas (lenticels) along the stem.
- Feathery, fern-like leaves are 5 to 8 inches long.
- Appearing from May to July, the fragrant flowers resemble pom-poms with numerous filaments and pink feathery tufts with white bases.
- The flat, straw-colored fruits, or pods, are about 6 inches long, ripen from August to September, and remain on trees into winter.

Albizia julibrissin photography by Cherri Smith, NCDOT.

Habitats Susceptible to Invasion

Preferring full sun, *A. julibrissin* often spreads along roadsides and escapes into vacant lots in suburban and urban areas. In natural areas this plant poses a particular threat along stream banks since the seeds are easily dispersed in water. *Albizia julibrissin* tolerates a variety of soil types and moisture regimes but is rarely seen in the mountains above 3,000 feet since it is not cold-hardy at these elevations.

Prevention and Control

Despite its weed potential and susceptibility to disease (mimosa wilt), *A. julibrissin* is still widely planted for ornamental purposes. As news of these problems becomes more widespread, some cities are passing ordinances outlawing the further planting of this species. Regardless of whether there are ordinances in place, responsible property owners and land managers should no longer plant this tree.

Small infestations of young seedlings can be effectively controlled by hand-pulling. Cut larger trees of *A. julibrissin* before they set seed at or within 6 inches of the ground and immediately apply a 50 percent solution of triclopyr to the cut stump. This method is effective as long as the ground is not frozen.

If cutting down the tree is not practical, girdle the trunk near the base using an ax, hatchet, saw, or chainsaw and immediately apply a 50 percent solution of triclopyr to the wound. Similarly, use an ax or hatchet to make closely spaced and angled downward cuts around the trunk as close to the ground as possible and immediately spray the cuts with the same chemical solution.

As long as the ground is not frozen, *A. julibrissin* can also be killed with a mixture of 25 percent triclopyr and 75 percent mineral oil applied to the basal parts of the trunk to a height of 12 to 15 inches from the ground. This method should be used judiciously since it takes a lot of chemical and can result in overspray. It has been used successfully in situations where no other technique is easy such as cliff faces or other exposed sites.

For large thickets of *A. julibrissin* seedlings, apply a foliar solution of 2 percent glyphosate or triclopyr plus a 0.5 percent non-ionic surfactant to thoroughly wet all of the leaves. The air temperature should be above 65 degrees Fahrenheit to ensure maximum performance of the chemicals.

trees

shrubs

herbaceous plants

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Elaeagnus pungens (Thorny Olive, Autumn Silverberry)
Elaeagnaceae (Oleaster Family)

Initial Introduction and Expansion in Range

Elaeagnus pungens is native to eastern Asia and was first introduced to the United States as an ornamental in the 1830s. It is now found throughout the Southeast from Virginia, south to Florida and west to Kentucky and Louisiana. Because *E. pungens* produces fruits that are irresistible to wildlife, this fast-growing, weedy ornamental is readily dispersed by animals. It is often planted along highways providing a major source of seeds for dispersal.

Description and Biology

- Evergreen, sprawling shrub up to 15 feet high and 20 feet in diameter. Shoots long, branchless, limber stems beyond the bushy crown during the growing season.
- Twigs develop short, sharp shoots that give it a thorny appearance and feel every bit as sharp as thorns.
- Thick, oval leaves are 2 to 4 inches long with distinct wavy margins. Waxy, dark green above with silver and scattered rusty-brown scales below.
- Blooms in fall producing fragrant, small, cream-colored, bell-shaped flowers that are held in small clusters where the leaf joins the stem.
- Small, reddish-brown fruits with a silvery textured surface mature in the spring.
- Can be easily confused with *E. umbellata* (autumn olive); however, *E. umbellata* blooms in the spring and produces fruits in the fall. In addition, the leaves of *E. umbellata* are not as waxy as those of *E. pungens* and are void of rusty-brown scales on the bottom surface. *Elaeagnus umbellata* also tends to be a more prolific berry producer than *E. pungens*.

Habitats Susceptible to Invasion

The shade tolerance of *E. pungens* enables this plant to survive in open areas as well as under forest canopies, posing a particular threat to forested natural areas. This adaptable plant is also tolerant of drought and salt spray resulting in its recommendation as a good choice for landscaping along coastal areas.

Prevention and Control

Elaeagnus pungens is still widely planted as an ornamental shrub by individual landowners and public agencies; ceasing this activity would go a long way toward slowing down its further spread. Seedlings and sprouts can be grubbed by hand when the soil is moist to ensure removal of the root system. Small patches of *E. pungens* can be treated from April to October with a foliar solution of 2 percent glyphosate or triclopyr plus a 0.5 percent nonionic surfactant.

The basal sections (ground to 12 inches) of larger plants can be treated with a solution of 25 percent triclopyr and 75 percent mineral oil. This method should be used judiciously since it takes a large amount of chemicals and can result in overspray. It has been used successfully in situations where no other technique is easy such as cliff faces or other exposed sites. Larger shrubs can also be cut as close to the ground as possible and the stumps immediately treated with a 50 percent solution of triclopyr.

Elaeagnus pungens photography by Mike Kunz, NC Botanical Garden (left) and Cherri Smith, NCDOT (right).

Elaeagnus umbellata (Autumn Olive, Spring Silverberry)
Elaeagnaceae (Oleaster Family)

Initial Introduction and Expansion in Range

Native to eastern Asia, *Elaeagnus umbellata* was introduced to the United States for cultivation in the 1830s. It is now found from Maine, south to Florida and west to Wisconsin. It has been widely planted as an ornamental shrub and for wildlife food and cover. The ability of this plant to fix nitrogen has also resulted in its widespread promotion and use for re-vegetation and stabilization of disturbed, infertile sites.

Elaeagnus umbellata grows rapidly and produces fruits within 3 to 5 years with a mature shrub producing tens of thousands of seeds. As with *E. pungens*, the fruits are highly desirable to wildlife providing an effective dispersal mechanism for this species. In addition to its prolific fruit production, widespread seed dispersal, rapid growth and ability to adapt to many sites, *E. umbellata* re-sprouts vigorously after cutting or burning. These traits enable this plant to out-compete native plants. By creating heavy shade, it can suppress natural plant succession.

Description and Biology

- Deciduous shrub up to 20 feet high.
- Slender twigs develop short shoots that may become sharp like thorns.
- Elliptic leaves are 2 to 4 inches long with a bright green upper surface and are densely covered beneath with silver-white scales.
- Blooms in the spring producing fragrant, tubular clusters of silvery white to yellow flowers.
- Fruits mature in the fall and are produced in great quantity. Fruits are small, round, reddish to pink and are dotted with scales.
- Can easily be confused with *E. pungens* (thorny olive); however, *E. pungens* blooms in the fall and produces fruits in the spring. In addition, the leaves of *E. pungens* are waxier than those of *E. umbellata* and have rusty-brown scales on the bottom surface. *Elaeagnus pungens* tends to not be as prolific a berry producer as *E. umbellata*.

Habitats Susceptible to Invasion

The ability of *E. umbellata* to tolerate drought and a variety of soil conditions makes this plant highly successful and competitive in natural areas. Although *E. umbellata* does not do well in densely forested areas, it can invade forest openings and open forests eventually forming dense stands. As with many exotic plants, *E. umbellata* also invades roadsides, pastures, grasslands and disturbed areas.

Prevention and Control

The use of *E. umbellata* as an ornamental shrub and wildlife habitat is still widely promoted. Until this shrub is no longer planted, it will continue to escape cultivation and invade natural areas. Seedlings and sprouts can be grubbed by hand when the soil is moist to ensure removal of the root system.

Elaeagnus umbellata can be treated from April to October with a foliar solution of 2 percent triclopyr plus a 0.5 percent nonionic surfactant. The most successful chemical control can be achieved with a foliar solution of 1.0 ounce metsulfuron/100 gallons water plus a 0.5 percent non-ionic surfactant. This solution will treat an area approximately the size of an acre.

The basal sections (ground to 12 inches) of larger plants can be treated with a solution of 25 percent triclopyr and 75 percent mineral oil. This method should be used judiciously since it takes a large amount of chemicals and can result in overspray. It has been used successfully in situations where no other technique is easy, such as cliff faces or exposed sites. Larger shrubs can also be cut as close to the ground as possible and the stumps immediately treated with a 50 percent solution of triclopyr.

Elaeagnus umbellata photography by James H. Miller, USDA Forest Service, Bugwood.org (left) and Chris Evans, River to River CWMA, Bugwood.org (right) .

Lespedeza bicolor (Shrub Lespedeza, Bicolor Lespedeza)
Fabaceae (Legume Family)

Initial Introduction and Expansion in Range

Introduced to the United States in the late 1800s from Japan, *Lespedeza bicolor* now occurs throughout most of the Southeast from Arkansas to Maryland, and south to Florida and Texas. It can be found statewide in North Carolina. It was introduced primarily to provide food and cover for bobwhite quail and other popular, upland, game birds. Additional uses include erosion control, stabilization along stream banks and steep slopes, and landscaping for borders and hedges. The ability of this plant to fix nitrogen has also resulted in its use for re-vegetation of disturbed, infertile sites, particularly areas that have been burned. As with other species of *Lespedeza*, it responds positively to burning, enabling this plant to out-compete native plants on sites that have been disturbed by fire.

The seeds of *L. bicolor* are readily dispersed by birds, allowing it to escape cultivation and invade open areas where it can form dense thickets that displace native vegetation. It is less common than *L. cuneata* (Sericea, Korean, or Chinese lespedeza) which is still widely planted for erosion control and its alleged benefits for wildlife forage.

Description and Biology

- Upright, loosely branched deciduous shrub, 4 to 10 feet in height with many slender branches.
- Leaves are compound in groups of 3 arranged alternately along the stem.
- Rosy-purple, pea-like flowers appear in the late summer.
- Small, black seeds singly produced in flat pods that open when mature. Seed maturity occurs from late September to early October.
- Widely branching, lateral root system.

Habitats Susceptible to Invasion

Found primarily in the piedmont and coastal plain of North Carolina, *L. bicolor* thrives in fields, open woodlands, clearings, fence and hedge rows, and along roadsides. It can invade open forest canopies after disturbance and, as a result, can be a threat to natural areas. It does well on droughty and dry to medium well-drained soils in full sun to partial shade but cannot tolerate poorly drained sites.

Prevention and Control

Lespedeza bicolor can be successfully controlled from July to September with a foliar solution of 2 quarts triclopyr plus 6 ounces clopyralid per acre and a 0.5 percent nonionic surfactant before the plant sets seed. For large stands of *L. bicolor*, it may be advantageous to mow 1 to 3 months prior to the herbicide application to reduce the amount of biomass that must be treated.

Lespedeza bicolor photography by James H. Miller, USDA Forest Service, Bugwood.org.

Ligustrum japonicum (Japanese Privet)
Oleaceae (Olive Family)

Initial Introduction and Expansion in Range

As the name indicates, *Ligustrum japonicum* is native to Japan and eastern Asia. It is believed that this plant was introduced to the United States in 1945 for its desirable characteristics as a specimen shrub and for hedges and screens. Its attractive, glossy leaves and abundant, showy, white flowers have resulted in the widespread cultivation of this plant so that it is now found throughout the Southeast and Midwest.

Although not nearly as invasive and abundant as the closely related *L. sinense*, *L. japonicum* occurs in similar habitats, preferring moist soil conditions but able to tolerate upland sites. It readily grows from root and stem sprouts and escapes cultivation by seeds that are dispersed by wildlife, particularly birds.

Description and Biology

- Large, evergreen shrub up to 20 feet in height.
- Elliptical leaves are 2 to 3 inches long, smooth-edged, glossy, thick and leathery, dark green on upper surface, light green underneath, and oppositely arranged along the stem.
- Smooth, gray-brown bark with many raised corky dots (lenticels).
- Clusters of small, creamy white, fragrant flowers are born on large terminal clusters in June and July.
- Small, blue-black, oval fruits ripen in early fall.
- Resembles *L. sinense* (Chinese privet) which has small, less glossy and less leathery leaves and is further described in this document.

Habitats Susceptible to Invasion

Ligustrum japonicum is found in the same habitats as *L. sinense* but generally is not as abundant. It invades both lowland and upland habitats but is usually more prevalent in lowlands. Forest gaps can also become invaded since birds often disperse the seeds. This plant can readily expand its range along fence-rows and roadsides.

Prevention and Control

Young seedlings of *L. japonicum* can be effectively controlled by hand pulling. Stems up to 2 inches in diameter can be manually removed by tools designed for this purpose (e.g. Weed Wrench). Larger plants can be killed by spraying the foliage with a 2 percent solution of glyphosate or triclopyr and a 0.5 percent nonionic surfactant. Ideally, the plants should be sprayed in the late fall or early spring when temperatures are above 65 degrees Fahrenheit and many native species are dormant.

As long as the ground is not frozen, this shrub can also be killed by cutting it down near the ground and spraying the freshly cut stump with a 50 percent solution of triclopyr. Larger plants can be killed with the application of a solution of 25 percent triclopyr and 75 percent mineral oil to the basal parts of the tree to a height of 12 to 16 inches from the ground during the late winter/early spring or summer. This method should be used judiciously since it takes a lot of chemical and can result in overspray. It has been used successfully in situations where no other technique is feasable, such as cliff faces or other exposed sites. All treatments should be followed up the next year to monitor and control basal sprouts and root suckers.

Ligustrum japonicum photography by James H. Miller, USDA Forest Service, Bugwood.org *(left) and Cherri Smith, NCDOT (right).*

Phyllostachys aurea (Golden Bamboo, Fishpole Bamboo)
Poaceae (Grass Family)

Initial Introduction and Expansion in Range

There have been hundreds of bamboo species introduced into the United States from various countries. In North Carolina, most of the cultivated bamboo species are in the genus *Phyllostachys*, and the most commonly cultivated species that is naturalizing is *Phyllostachys aurea*.

Introduced from China in the late 1800s, *P. aurea* is found throughout the southeastern United States from Maryland, south to Florida, west to Louisiana and Arkansas, and northwest to Oregon. This plant is still widely promoted and sold as an ornamental and to be used for privacy fences. Although *P. aurea* rarely flowers, infestations can rapidly spread through rhizomes, often forming dense, monotypic thickets.

Description and Biology

- Although a member of the Grass Family, *P. aurea* is a woody, perennial, reed-like plant that can reach heights up to 30 feet.
- Golden to green stems (canes) are hollow with solid joints and measure between 1 and 6 inches in diameter.
- Lance-shaped leaves are arranged alternately along the stem in fan-like clusters.
- Rarely produces flowers and fruit.
- Can be confused with *Arundinaria gigantea* (giant cane), a native throughout the United States, but this plant usually only reaches a height of 6 to 8 feet.

Habitats Susceptible to Invasion

Phyllostachys aurea thrives in full sun but is also able to grow and spread in sparsely wooded forests. It is commonly found in suburban woodlands, around old home sites and along roads. It seems to spread most rapidly in moist soils.

Prevention and Control

As tempting as it may be to plant *P. aurea* for its striking growth form and ability to form an almost impenetrable living privacy fence, this plant should be avoided at all costs since it rarely remains contained within desirable boundaries. An established stand of *P. aurea* can take several years of hard work to completely eradicate.

Small infestations can be controlled by repeatedly cutting or mowing the stems as close to the ground as possible several times during the growing season for successive years until the energy reserves in the rhizomes are exhausted. Large infestations of *P. aurea* can be killed by thoroughly wetting the foliage with a 2 percent solution of glyphosate and a 0.5 percent nonionic surfactant. Ideally, the plants should be sprayed in the late fall or early spring when temperatures are above 65 degrees Fahrenheit to ensure absorption of the chemical. Many native species are also dormant at this time. As long as the ground is not frozen, large plants can be killed by cutting them down near the ground and spraying the freshly cut stump with a 25 percent solution of glyphosate.

Phyllostachys aurea photography by James H. Miller, USDA Forest Service, Bugwood.org *(left) and Cherri Smith, NCDOT (right).*

Spiraea japonica var. *fortunei* (Japanese Spiraea, Japanese Meadowsweet)
Rosaceae (Rose Family)

Initial Introduction and Expansion in Range

Spiraea japonica var. fortunei, a native of Japan, Korea and China was originally introduced to the northeast United States in the late 1800's as an ornamental shrub. It has since spread from the Northeast and is naturalized in much of the Southeast and Midwest. Currently, *S. japonica* var. *fortunei* is spreading and posing a threat to natural areas in the mountains of North Carolina. The showy pink flowers of this shrub continue to make it a popular landscape plant that is commonly available commercially.

An aggressive invader in the wild, a single plant of *S. japonica* var. *fortunei* produces hundreds of seeds that can remain viable in the soil for many years. The seeds are typically dispersed by water and deposited along stream banks, providing an effective avenue for invasion into natural areas.

Description and Biology

- Multi-stemmed, deciduous shrub growing 3 to 6 feet tall.
- Slender, reddish brown stems may be hairy or smooth.
- Alternate, egg-shaped leaves are 1 to 3 inches long and have toothed margins.
- Flat-topped clusters of rosy-pink flowers are found at the tips of the branches in June and July.
- Small, shiny capsules form in the late summer and contain seeds measuring about 0.10 of an inch long.
- Naturally variable in form with many varieties in the horticultural trade.

Habitats Susceptible to Invasion

Spiraea japonica var. *fortunei* is most commonly found along streams and rivers since water provides an effective mechanism for dispersal, but also readily invades forest edges and openings, old fields, roadsides and utility rights-of-way. Once established, this plant grows rapidly forming dense stands displacing or reducing populations of native herbs and shrubs. The fact that it tolerates a wide range of soil conditions and grows in full sun and partial shade makes this plant particularly troublesome to managers of natural areas.

Prevention and Control

Repeated cutting or mowing of *S. japonica* var. *fortunei* will control the spread of this plant but will not eradicate it. Otherwise, it can be effectively controlled using readily available general use herbicides such as glyphosate or triclopyr.

Large infestations of *S. japonica* var. *fortunei* can be killed by thoroughly wetting the foliage with a 2 percent solution of glyphosate or triclopyr and a 0.5 percent nonionic surfactant. The plants should be sprayed in the spring or summer when temperatures are above 65 degrees Fahrenheit to ensure absorption of the chemical but before they have set seed. As long as the ground is not frozen, *S. japonica* var. *fortunei* plants can be killed by cutting them down near the ground and spraying the freshly cut stump with a 50 percent solution of triclopyr.

Given the persistence of the seed bank of this plant, all treatments should be conducted prior to seed production. In addition, all treatments should be followed up to monitor and control basal sprouts.

Spiraea japonica var. fortunei photography by Cherri Smith, NCDOT.


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Glechoma hederacea (Gill-Over-the-Ground, Ground Ivy)
Lamiaceae (Mint Family)

Initial Introduction and Expansion in Range

Although *Glechoma hederacea* is occasionally cultivated as a potted plant or ground cover, it was originally brought to the United States by early European settlers for its culinary and medicinal uses. It was used to make herbal tea, as well as a tonic for colds and coughs. This plant is now found in the northeastern, north-central and southern United States. In North Carolina, *G. hederacea* occurs statewide. It spreads vegetatively by creeping stems and less commonly by seeds.

Description and Biology

- Perennial herb with creeping stems that root at the nodes.
- Leaves are round to kidney-shaped (1 to 3 inches in diameter) with round-toothed margins. They are arranged oppositely along the stem and are attached with long petioles. A mint-like odor is emitted when the leaves are crushed.
- Slender, square stems are typically smooth but occasionally have short hairs.
- Appearing in early spring, the blue-violet flowers grow in whorls in the leaf axils.
- Fruits contain 4 smooth nutlets.

Glechoma hederacea photography by Richard Old, XID Services, Inc. (left) and Johnny Randall, N.C. Botanical Garden (right).

Habitats Susceptible to Invasion

Glechoma hederacea thrives in moist, shaded areas but is also quite successful in sunny locations. It typically favors disturbed areas such as forest edges, lawns, pastures, road and railroad right-of-ways but can also be found on stream banks, moist woods and floodplains. This plant is considered an ecological threat because it has the capability to form dense mats that can eliminate desirable native vegetation.

Prevention and Control

Small infestations of *G. hederacea* can be controlled through hand weeding; however, repeated weeding will likely be required because this plant is rhizomatous and will continue to spread from root fragments that are not removed. Larger infestations have been successfully controlled with glyphosate and triclopyr in the spring when the plant is in flower and in the fall. Start out by thoroughly wetting the foliage with a 2 percent solution of glyphosate or triclopyr and a 0.5 percent nonionic surfactant and monitor the success of the kill. Follow-up treatments with a stronger solution may be necessary. This plant has also been successfully controlled with herbicide treatments in the winter (when the temperature is above 50 degrees Fahrenheit), which lessens the potential to harm adjacent plant species.

Sorghum halepense (Johnson Grass)
Poaceae (Grass Family)

Initial Introduction and Expansion in Range

One of the most cosmopolitan of weeds, *Sorghum halepense* is thought to be native to the Mediterranean region but is now found in essentially all temperate regions of the world. It was introduced to the United States in the early 1800s as a forage grass, and by the end of the 19th century *S. halepense* was growing throughout most of the United States. In North Carolina, it occurs statewide.

Each plant can produce hundreds of seeds with potential for far ranging dispersal by water, wind, livestock, commercial seed contamination, and contaminated machinery, grain or hay. The immense, rapidly growing rhizome system of *S. halepense* gives this plant a competitive edge allowing it to form dense colonies, displacing desirable vegetation and restricting tree seedling establishment. In addition, the rhizomes regenerate easily from small pieces and are capable of growing or remaining dormant in a wide range of environmental conditions.

Description and Biology

- Tall (up to 8 feet), perennial, rhizomatous grass that grows in clumps or nearly solid stands.
- Stout stem that is pink to rusty-red near base.
- Long (2 feet), smooth leaves with a characteristic white mid-vein.
- Appearing during the summer, flowers are large, loosely branched and purplish.
- Seeds are reddish-brown and nearly 0.08 of an inch long.

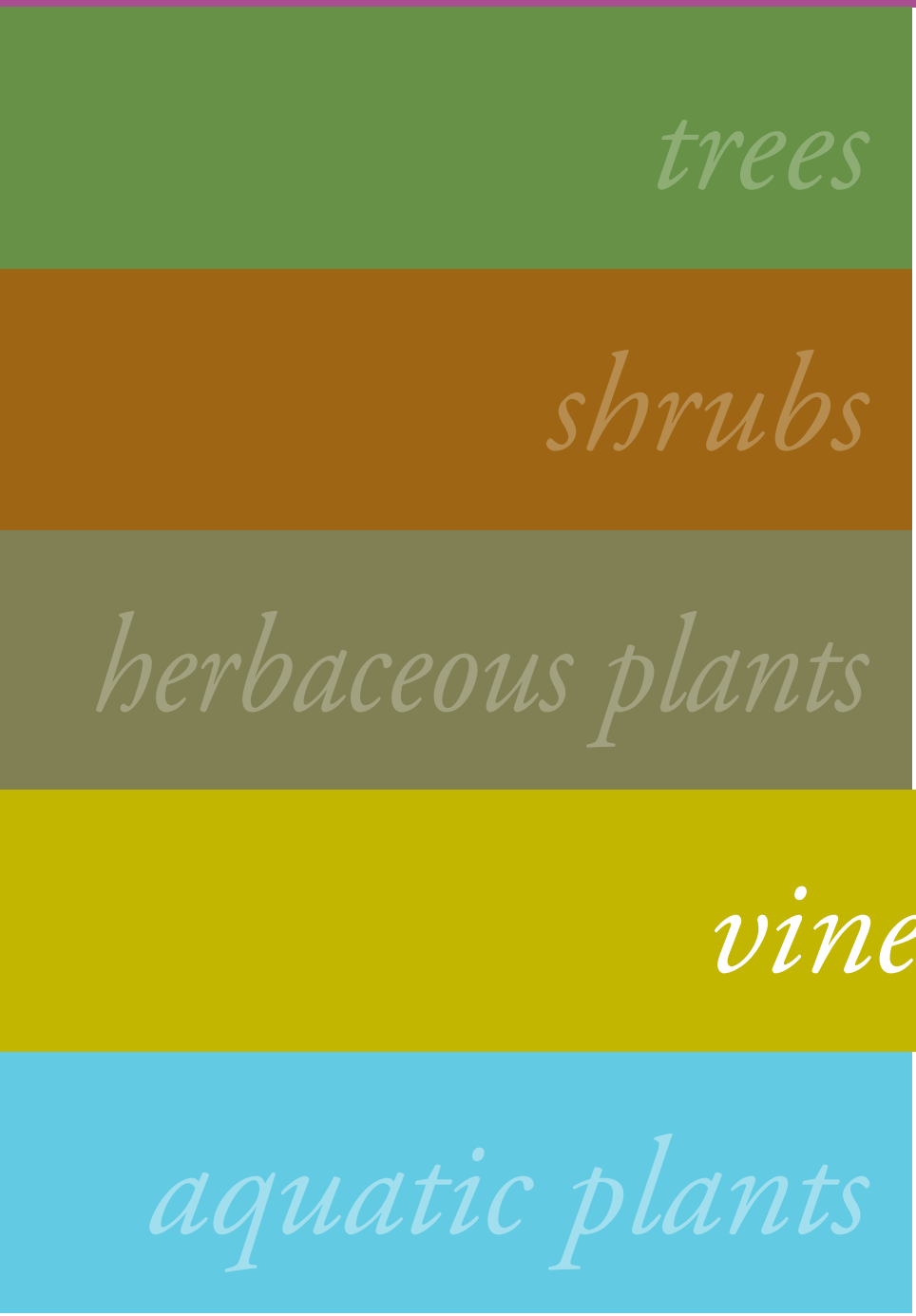
Habitats Susceptible to Invasion

A major agricultural weed throughout the world including the United States, *S. halepense* is especially troublesome in corn fields where it forms tall, dense stands. It is also adapted to a wide variety of habitats including open forests, old fields, ditches and stream banks. Management of *S. halepense* is a constant problem along roadsides where it creates safety hazards by obscuring visibility.

Prevention and Control

Sorghum halepense is a challenging plant to control because of its prolific seed production, extensive rhizome system, ability of rhizome fragments to re-sprout, and adaptation to a wide range of habitats. The application of a foliar solution of 2 percent glyphosate in the early summer (just prior to seed maturity) has resulted in a high rate of mortality. This herbicide treatment may need to be repeated for several years to ensure good control. The most successful chemical control can be achieved with a foliar solution of 1 ounce sulfosulfuron/100 gallons water plus a 0.5 percent non-ionic surfactant. This solution will treat an area approximately the size of an acre.

Sorghum halapense photography by Cherri Smith, NCDOT (left) and Karen M. Lynch, NCDOT (right).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Ampelopsis brevipedunculata (Porcelain Berry)
Vitaceae (Grape Family)

Initial Introduction and Expansion in Range

A native of northeast Asia, it is thought that *Ampelopsis brevipedunculata* was introduced to New England sometime in the 1870s as an ornamental plant. Since that time it has spread south to North Carolina and west to Michigan. Despite its aggressiveness, *A. brevipedunculata* is still widely used as a bedding plant, for screening, and as a trellis climber because of the remarkable beauty of its shiny multi-colored berries.

Seeds are the primary means of dispersal for this plant as the colorful berries attract birds and other small animals. Since *A. brevipedunculata* is often found growing in riparian areas, it is thought that the seeds may also be dispersed by water.

Description and Biology

- Deciduous, woody vine climbing to heights of 15 to 20 feet. It climbs with tendrils that occur opposite the leaves.
- Alternate leaves are dark green, heart-shaped with toothed edges and vary from slightly lobed to deeply dissected with 3 to 5 lobes per leaf.
- Inconspicuous, greenish-white flowers appear in clusters between June and August.
- Distinguishing, colorful berries range in color from white, pastel shades of green, lilac to dark purple, and turquoise to sky blue. All colors of the berry are often found simultaneously on the same plant.
- A member of the grape family, it is often confused with native grape species in the *Vitis* genus.

Habitats Susceptible to Invasion

Although *A. brevipedunculata* prefers moist, rich soils such as those found in riparian areas, it can adapt to a variety of environmental conditions and is resistant to disease and insects. Generally found in urban areas in the piedmont and foothills of North Carolina, it invades stream banks, pond and forest edges, thickets and other disturbed areas where there is full sunlight to partial shade and where conditions do not remain permanently wet. Urban parks with wooded borders neighboring residential and other

landscaped areas are especially vulnerable to invasions. This vine is capable of smothering native shrubs and small trees, and the extra weight can make mature trees more susceptible to wind and ice damage.

Prevention and Control

To the dismay of landscapers and gardeners, the most effective control of *A. brevipedunculata* is removal from commercial trade. Once established, this plant can be extremely difficult to control especially since the extensive root system cannot be effectively dug out by hand. One method of control is to gradually shade it out while allowing planted or existing trees to mature while keeping them free of vines.

The most effective chemical control of *A. brevipedunculata* has been achieved using triclopyr formulations toward the end of the growing season when plants are transporting nutrients to their roots. Apply a 2 percent solution of triclopyr plus a 0.5 percent non-ionic surfactant to the foliage or cut the plants first, allow time for re-growth, and then apply the herbicide mixture. *Ampelopsis brevipedunculata* can also be killed with a mixture of 25 percent triclopyr and 75 percent mineral oil applied to the basal parts of the stem to a height of 2 to 3 feet from the ground. This method should be used judiciously since it takes a lot of chemical and can result in overspray. It has been used successfully in situations where no other technique is feasable, such as cliff faces or other exposed sites.

Ampelopsis photography by Johnny Randall, N.C. Botanical Garden (left) and Mike Kunz, N.C. Botanical Garden (right).

Euonymus fortunei var. *radicans* (Climbing Euonymus, Winter Creeper)
Celastraceae (Bittersweet Family)

Initial Introduction and Expansion in Range

Euonymus fortunei var. *radicans* is native to China, Japan, and Korea and was introduced to the United States in the early 1900s as an ornamental plant. Since then it has either been cultivated or has spread throughout populated areas of the East and Midwest. It is still a popular horticultural plant and is used as a groundcover or a vine to climb walls and trees.

Euonymus fortunei var. *radicans* spreads vegetatively by long and lateral shoots and by new plants that originate from rootlets along the stem. Fruits are readily distributed by birds giving this plant the ability to escape landscaped areas and invade undisturbed natural areas.

Description and Biology

- Evergreen, woody vine that grows in mats up to 3 feet in height or climbs trees attaching itself with hairy rootlets.
- Leaves are 1 to 2 inches long, elliptical, thick, glossy, dark green with lighter veins (some cultivars are variegated).
- Stems are green and become corky with age. Rootlets are present when climbing.
- Clusters of inconspicuous green-white flowers bloom in June and July. Typically only the vertically climbing stems produce flowers.
- In the fall, pinkish to red fruit split open to expose vibrant orange seeds.
- Members of the same family, *E. fortunei* var. *radicans* can be confused with *Celastrus* spp. (bittersweet).

Habitats Susceptible to Invasion

The ability of *E. fortunei* var. *radicans* to tolerate a variety of environmental conditions, in particular full shade, makes this plant particularly threatening to natural areas and other areas with mature forests. The dense mats that it forms can displace native understory species and inhibit natural forest regeneration. Vines on trees can eventually overtop them and impede photosynthesis.

Prevention and Control

Light infestations of *E. fortunei* var. *radicans* can be hand pulled, but care must be taken to remove the entire plant, including roots and runners, since any portion of the remaining root system may re-sprout. Denser infestations can be eradicated by cutting the stems at ground level and applying a 50 percent solution of triclopyr to the freshly cut stem. In North Carolina, this treatment is generally effective in all seasons except winter. Subsequent herbicide applications will probably be necessary. Cut and treat all vertically climbing stems to prevent fruiting and therefore the spread of the seeds by birds.

Foliar spraying may be necessary to control large populations of *E. fortunei* var. *radicans*, and it may be necessary to precede foliar applications with stump treatments to minimize damage to desirable species. Thoroughly wet all leaves with a 2 percent solution of glyphosate plus a 0.5 percent non-ionic surfactant. This type of treatment is most effective when air temperatures are above 65 degrees Fahrenheit.

Euonymus fortunei var. radicans photography by Keith Langdon, National Park Service, Bugwood.org *(left) and James H. Miller, USDA Forest Service,* Bugwood.org *(right).*

Hedera helix (English Ivy)
Araliaceae (Ginseng Family)

Initial Introduction and Expansion in Range

Hedera helix is native to Europe and was probably brought to the United States by early settlers for use as an ornamental vine. The appealing, dark green, glossy leaves of this plant continue to make it a popular, low maintenance, evergreen groundcover. It is now found throughout eastern and southern states and is posing particularly damaging ecological impacts in Oregon and Washington.

Hedera helix is an interesting plant in that it has 2 distinct leaf shapes depending on its age and exposure to sun. As a groundcover, the leaves have 3 to 5 lobes (the most common). Mature plants in full sun that are ready to flower often have un-lobed, oval leaves.

Description and Biology

- Evergreen, climbing, woody vine that also forms dense groundcovers.
- Vines attach to the bark of trees, brickwork, and other surfaces with small rootlets that produce a glue-like substance that aids in climbing.
- As a groundcover, stems are woody and slender. Climbing vines can reach several inches in diameter.
- Leaves are dark green with white veins, waxy to somewhat leathery, and arranged alternately along the stem. The most common leaf shape has 3 to 5 lobes, but does not have any lobes on mature vines.
- Small greenish-yellow flowers are produced on mature vines during the summer.
- Clusters of blackish-purple fruits may persist through the winter if not eaten by birds.

Habitats Susceptible to Invasion

Hedera helix threatens both disturbed and undisturbed forests as a groundcover and climbing vine making this plant a particularly insidious enemy to natural areas. In addition to forming a thick mat along the forest floor, smothering native wildflowers and seedlings and preventing natural regeneration, vines that climb trees slowly kill them from base upwards. Vigorously growing vines envelop the branches, preventing photosynthesis

and causing upwardly migrating branch death. Eventually the entire tree will die. Trees heavily draped with vines are more susceptible to blowing over during storms, making them hazardous near homes, roads and public-use areas in parks.

Prevention and Control

Small infestations of *H. helix* can be pulled by hand. Monitor and remove any re-sprouts. Care should be taken to bag and remove the plants since pulled plants left on the ground can continue to grow.

Large infestations of *H. helix* will usually require a combination of cut stump and foliar herbicide treatments. Where vines have grown into the tree canopy, cut each stem as close to the ground as possible, then cut again a little higher up and remove the cut pieces. The top portion of the vine will eventually die, rot and fall off the tree. Treat the freshly cut surface of the rooted stem with a 50 percent solution of triclopyr. Groundcovers of *H. helix* can be treated with a foliar solution of 4 percent glyphosate plus a 0.5 percent to 1 percent non-ionic surfactant or a 2 percent solution of triclopyr plus a 0.5 percent non-ionic surfactant to thoroughly wet all of the leaves.

Since *H. helix* is evergreen, it can be treated year round as long as temperatures are above 55 to 60 degrees Fahrenheit for several days. Repeated treatments will likely be necessary for complete control. As a general rule, solutions of glyphosate work best on *H. helix* in the spring, and solutions of triclopyr work best in the summer and fall.

Hedera helix photography by Johnny Randall, N.C. Botanical Garden (left) and Mike Kunz, N.C. Botanical Garden (right).

Lonicera japonica (Japanese Honeysuckle) Caprifoliaceae (Honeysuckle Family)

Initial Introduction and Expansion in Range

Introduced to the United States in the early to mid-1800s as an ornamental plant, *Lonicera japonica* is native to east Asia, including Japan and Korea. It is still promoted by some landscapes architects for its rapid growth and fragrant flowers that linger on the vine throughout most of the summer. Wildlife managers have promoted the plant as winter forage, particularly for deer. Still others are nostalgic about this plant, remembering the sweet nectar they enjoyed as children. *Lonicera japonica* is now found across the southern United States from California to New England and the Great Lakes Region.

Lonicera japonica spreads locally by long aboveground runners and underground rhizomes. The runners develop roots at the nodes (stem and leaf junctions) so this plant often forms dense mats. Under high light conditions, the plants are able to flower and produce fruits that can be dispersed long distances primarily by birds.

Description and Biology

- Perennial trailing or twining vine. In North Carolina, it is considered semi-evergreen to evergreen.
- Young stems are slender, while older stems are hollow and up to 2 inches in diameter with brownish bark that peels in long strips.
- Oblong to oval shaped leaves are 1 to 2 and a half inches long arranged in opposite pairs along the stem. Mature leaves have smooth edges and young leaves are often lobed.
- White and pale yellow, trumpet-shaped flowers occur in pairs from between the leaves and bloom from late April to August.
- Small, nearly spherical, black fruits mature in autumn.
- Distinguished from North Carolina's 3 native species by the leaves near the tips of the vines. The leaves of *L. japonica* are distinctly separate. In our native species, the leaves are fused to form a single leaf through which the stem grows. In contrast to the red and orange fruits of native *Lonicera* spp., *L. japonica* has black fruits.

Habitats Susceptible to Invasion

Lonicera japonica thrives in a wide variety of habitats including all types of forests and fields. Dense infestations occur along forest margins, rights-of-way, and other disturbed lands. In forests, *L. japonica* vines spread both horizontally and vertically by climbing up the trunks of small trees (typically stems are less than 3 inches in diameter) and shrubs. These small trees and shrubs can be killed by girdling or by dense growths that overtop and eventually kill the plants by blocking sunlight from the leaves.

Prevention and Control

Small infestations of *L. japonica* can be pulled by hand. Monitor to remove any re-sprouts. Care should be taken to bag and remove the plants, including mature fruits to prevent re-establishment.

Large infestations of *L. japonica* will usually require a combination of cut stump and foliar herbicide treatments. Where vines have grown into the tree canopy, cut each stem as close to the ground as possible. Treat the freshly cut surface of the rooted stem with a 25 percent solution of glyphosate or triclopyr. Remove the twining vines to prevent them from girdling and killing desirable vegetation. Groundcovers of *L. japonica* can be treated with a foliar solution of 2 percent glyphosate or triclopyr plus a 0.5 percent non-ionic surfactant to thoroughly wet all of the leaves.

As long as healthy green leaves are present at application time and temperatures are above 55 to 60 degrees Fahrenheit for several days, *L. japonica* can be treated any time of year. Repeated treatments will likely be necessary for complete control.

Lonicera japonica photography by Mike Kunz, N.C. Botanical Garden.

Wisteria floribunda (Japanese Wisteria)
Wisteria sinensis (Chinese Wisteria)
Fabaceae (Legume Family)

Initial Introduction and Expansion in Range

These two exotic wisteria species were brought to the United States in the first half of the 19th century as ornamental vines. A stunning bloomer, it is not difficult to understand why these plants became a favorite choice for garden arbors, gazebos, porches and walls. The drooping clusters of fragrant bluish-purple or white flowers are absolute head-turners in the spring. These invasive vines are now found extensively throughout the eastern United States.

Appearing not to be widely spread by seed, exotic wisteria colonizes primarily by the spread of runners that develop roots and shoots at short intervals. It is believed that the large seed size of these plants is a deterrent to animal dispersal though seeds may be carried downstream in water for great distances.

Description and Biology

- Deciduous, woody vine capable of growing up to 70 feet long and 10 inches in diameter.
- *Wisteria floribunda* has whitish bark and the vines twine clockwise around the host plant (as viewed from the top). *Wisteria sinensis* twines counter-clockwise.
- Alternate, compound leaves comprised of 7 to 13 (Chinese) and 13 to 19 (Japanese) leaflets. Leaflets are tapered at the tip with wavy edges.
- Showy, fragrant, violet to blue-violet flowers festoon the vines in April and May.
- Fruits are velvety brown, bean-like pods, 4 to 6 inches long.
- Resembles our native *Wisteria frutescens* (American wisteria) except that this species produces smooth pods.

Habitats Susceptible to Invasion

Most infestations of exotic wisteria in natural areas have escaped from landscape plantings around old home sites. Once they escape, exotic wisteria can wreak havoc on surrounding native vegetation through

shading and girdling. Climbing wisteria vines have the ability to strangle and kill mature trees, opening the forest canopy and making conditions more favorable to their own aggressive growth. Exotic wisteria thrives in full sunlight but can persist and reproduce in partial shade. These vines are commonly seen growing along forest edges and roadsides.

Prevention and Control

As enticing as it is to plant exotic wisteria, it would be best for the environment if these plants were removed from commercial trade altogether. Our native *W. frutescens* is every bit as stunning in the spring with no detrimental environmental effects. Unfortunately, to date it has been much more difficult to find in commercial trade.

Once established, exotic wisteria is extremely difficult to control. Only small initial infestations can be controlled manually because of the extensive runner and root systems of these plants.

An infestation of any appreciable size will usually require a combination of cut stump and foliar herbicide treatments. Where vines have grown into the tree canopy, cut each stem as close to the ground as possible, cut again a little higher up, and remove the cut pieces. Treat the freshly cut surface of the rooted stem with a 50 percent solution of triclopyr. It will usually not be possible to remove all of the twining vines from desirable trees and shrubs, but at least these vines will die and not continue to spread. Groundcovers of exotic wisteria can be treated with a foliar solution of 2 percent glyphosate or triclopyr plus a 0.5 percent non-ionic surfactant to thoroughly wet all of the leaves.

Exotic wisteria is best treated from the spring to fall when air temperatures are above 65 degrees Fahrenheit. Repeated treatments will likely be necessary for complete control.

Wisteria photography by Mike Kunz, N.C. Botanical Garden (left) and Chris Evans, River to River CWMA, Bugwood.com *(right).*


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Egeria densa (Brazilian Waterweed, Elodea, Anacharis)
Hydrocharitaceae (Frog's-bit Family)

Initial Introduction and Expansion in Range

Egeria densa was introduced to the United States from South America and has been offered for commercial sale since the early 1900s, when it was recommended as a good "oxygenator" plant for aquariums. It is still one of the top-selling aquatic plants for aquariums and, as a result, is a common aquatic weed throughout North Carolina. It also has widespread distribution across the United States from Massachusetts to Florida and west to California and the Pacific Northwest.

Since only male plants have been found in the United States and no seeds have been documented, *E. densa* relies solely on vegetative reproduction. Hardly an impediment to its spread, this plant can readily establish in natural waters after escaping human settings. Stem fragments easily break off of the plant and float into suitable habitats.

Description and Biology

- Submersed, freshwater aquatic plant usually 1 to 2 feet long but can grow to 6 feet or longer and may be highly branched forming dense mats at the water surface.
- Leaves usually occur in whorls of 4 to 8 (double nodes) but may occur in whorls of 3 to 6. Leaf margins are minutely serrated and can only be seen under magnification.
- Short distances between leaf whorls give plant distinctively leafy appearance.
- Flowers are on short stalks about 1 inch from the water, have 3 white petals, and usually appear in the spring through early summer.
- *Egeria densa* is often confused with another invasive exotic species in the same family, *Hydrilla verticillata* (hydrilla) described earlier in this document. It also looks like a larger, more robust version of our native *Elodea canadensis* (common waterweed).

Habitats Susceptible to Invasion

Egeria densa easily spreads from lake to lake by boaters and by people who dispose of aquarium contents in our lakes. It has become a nuisance in small ponds to large impoundments throughout North Carolina. It grows either rooted or free-floating and forms dense surface mats that provide poor fish and waterfowl habitat, block light penetration, and reduce the diversity of native plants. Dense stands of this plant also interfere with fishing, boating, and swimming.

Prevention and Control

One of the best ways to prevent the continued spread of *E. densa* is to substitute our native *Elodea canadensis* as an aquarium plant. It looks similar to *E. densa* but is less aggressive and does not create the same kind of serious ecological and recreational problems as this plant.

A number of control methods have been used on *E. densa* including mechanical removal, herbicide application, and biological control with grass carp and tilapia with variable rates of success. Mechanical removal is costly and risks spreading the plant to new locations. The use of sterile (triploid) grass carp shows promise as a control technique since *E. densa* is highly palatable and older grass carp will eat it in preference to other plants. The stocking and monitoring of grass carp can be coordinated through the NCDENR-DWR Aquatic Weed Control Program.

Successful control of *E. densa* has been reported using the contact herbicides diquat and complexed copper, endothal dipotassium salt, and endothal and complexed copper. The plant growth regulator fluridone has also been used with good results. Some of these herbicides may be harmful to aquatic life so always consult with the NCDENR-DWR Aquatic Weed Control Program before initiating any control method using chemicals.

Egeria densa photography by Virginia Tech Weed Identification Guide Archive, Virginia Polytechnic Institute and State University, Bugwood.org *(left) and Ann Murray, University of Florida,* Bugwood.org *(right).*

Myriophyllum aquaticum (Parrot Feather)
Haloragaceae (Water-milfoil Family)

Initial Introduction and Expansion in Range

Introduced to the United States from South America in the late 1800s, *Myriophyllum aquaticum* is now found in non-tidal fresh waters throughout much of the southern United States and along the Atlantic coast north to New York, as well as the Pacific coast north to Washington. In North Carolina it is most common in the piedmont and coastal plain. As its name implies, the emergent leaves of *M. aquaticum* are feather-like, and unfortunately this attractive feature has given this plant universal appeal for water gardens and wetlands.

Only female plants are present in the United States so the spread of *M. aquaticum* has resulted solely from vegetative reproduction. The tough rhizomes of this plant can survive being transported long distances in addition to the fact that it is especially easy to cultivate.

Description and Biology

- Submersed and emergent, freshwater, aquatic plant usually growing up to 6 feet in length and forming dense mats of intertwined stems in the water.
- Leaves exhibit 2 distinct forms depending on whether they are submersed or emergent. Submersed leaves appear limp while the bright green emergent leaves are distinctly stiffer and darker and can extend 8 to 12 inches above the water surface. The plant is named for the emergent, feather-like leaves.
- Brownish stems are stiff and robust.
- Inconspicuous white flowers usually appear in the spring on the emergent stem.
- *Myriophyllum aquaticum* is easily mistaken for *M. spicatum* (Eurasian watermilfoil), a close relative and another exotic species. There are also several native species of *Myriophyllum* so consult a botanist to confirm identification before initiating control measures.

Habitats Susceptible to Invasion

Myriophyllum aquaticum is adapted to a wide variety of conditions from full sun to partial shade and saturated soil to water depths of 6 feet or

greater. Consequently, this plant can be found in a variety of aquatic habitats including lakes, ponds, edges of sluggish streams, drainage ditches, sloughs and lagoons. The dense monotypic mats formed by this plant can alter the aquatic food web by shading out algae in the water column. In addition to the ecological impacts, *M. aquaticum* can also degrade recreational opportunities and navigation in our waterways. The stems are brittle and fragment easily and are, therefore, readily spread by boats, trailers and waterfowl.

Prevention and Control

Despite all of the problems *M. aquaticum* can cause, it is still widely available in commercial trade and unsuspecting consumers continue to purchase it for water gardens. This situation is particularly troubling since *M. aquaticum* is one of the more difficult aquatic plants to control. Mechanical control tends to enhance its rate of spread and should only be conducted in small, contained waters. Since *M. aquaticum* has a high tannin content and tough woody stems, most grazers, including grass carp, find it unpalatable. Research into the biological control of this plant with insects and fungus is ongoing, but currently no agents are approved for sale.

The chemical control of *M. aquaticum* has additional challenges since the emergent stems and leaves have a waxy cuticle that requires the use of a surfactant to permeate. Reports indicate that often the weight of the spray causes the emergent stem to collapse into the water, washing the chemical off before it is translocated into the rest of the plant.

Some success controlling *M. aquaticum* has been reported using 2,4-D diquat, diquat and complexed copper, endothall and complexed copper, endothall dipotassium salt and fluridone. Some of these herbicides may be harmful to aquatic life so always consult with the NCDENR-DWR Aquatic Weed Control Program before initiating any control method using chemicals.

Myriophyllum aquaticum photography by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org *(left) and Nancy Loewenstein, Auburn University,* Bugwood.org *(right).*

Salvinia molesta (Giant Salvinia)
Salviniaceae (Floating Fern Family)

Initial Introduction and Expansion in Range

Although the native range of *Salvinia molesta* is limited to southeastern Brazil, this plant is now a serious problem in many parts of the world. In 1983, it was listed as a federal noxious weed making it illegal to sell or transport this plant. It is also a Class A state noxious weed in North Carolina.

Infestations currently exist in Texas, Louisiana, Mississippi, Alabama, Georgia, Florida, Arizona, California and North Carolina. Since *S. molesta* requires a temperate climate to survive over the winter, southern states are more susceptible to infestation. Despite the fact that *S. molesta* is prohibited, the plants are still found for sale at some nurseries. It is also often found as a contaminant in other aquatic nursery stock.

In North Carolina, the creation of the multi-agency Giant Salvinia Task Force has been instrumental in monitoring and controlling infestations of *S. molesta*. To date, all reported infestations of *S. molesta* have been on the coastal plain.

In the United States, *S. molesta* reproduces solely through vegetative means since the spores it produces are not known to be fertile. This fact is certainly not a hindrance to the spread of the plant. Under favorable natural conditions, it can double its biomass in about seven to 10 days. Small fragments are viable propagules that are easily spread by boats and animals and when used as a pond or water garden plant.

Description and Biology

- Floating, rootless, aquatic fern that forms overlapping and tightly packed mats.
- Leaves of young plants lie flat on the water surface, while leaves of mature plants grow up to 2 inches long and are forced upward as plants press into tight chains.
- The 2 floating and emergent leaves are green in color and oblong in shape. The third leaf is brown, highly divided, and hangs underwater. These submersed leaves are often mistaken for roots.

- The surface of emergent leaves has rows of arching hairs that join at the tips giving a velvety appearance that also resembles an egg beater. The hairs aid the plant in repelling water.

Habitats Susceptible to Invasion

Salvinia molesta is considered one of the world's most noxious aquatic weeds. Although this plant is intolerant of brackish and salt waters, it has the capability of dominating any slow moving or quiet freshwaters in tropical, subtropical and warm temperate regions.

The dense, thick, interwoven mats formed by this plant have serious ecologic, economic and recreational impacts. Light and oxygen are prevented from entering the water at the same time as decomposing material drops to the bottom consuming dissolved oxygen needed by fish and other aquatic life. It can clog irrigation and drinking water lines and interfere with electrical generation. Waters infested with *S. molesta* can no longer be used for boating, swimming or fishing.

Prevention and Control

Preventing the spread of *S. molesta* will only be achieved by educating the public since it is most commonly spread by people. When mechanical control is undertaken, any material physically removed from the water should be left to desiccate and then be disposed of some distance from the water. Chemical control is effective on small infestations, but water quality can be detrimentally affected if a large amount of *S. molesta* is killed and decomposes at once.

Salvinia molesta photography by Troy Evans, Bugwood.org *(left) and Kenneth Calcote, Mississippi Department of Agriculture Commerce,* Bugwood.org *(right).*

The good news is that the biological control of *S. molesta* looks promising. In Brazil, *S. molesta* is controlled by the indigenous weevil, *Cyrtobagous salvinia*. This weevil is host-specific and does not feed on other vegetation. The USDA Animal and Plant Health Inspection Service has experimented with the use of this weevil with encouraging results. Trial releases began in North Carolina in 2004, in addition to the creation of a multi-agency Giant Salvinia Task Force to monitor and control infestations in North Carolina. Immediately report infestations of *S. molesta* to the NCDENR-DWR Aquatic Weed Control Program. In addition, notify the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333 to report the location so that plans can be made in cooperation with the DENR-DWR to survey and control the infestation.

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Melia azedarach (Chinaberry)
Meliaceae (Mahogany Family)

Description and Biology

- Small to medium sized tree up to 50 feet in height with a spreading crown and often having multiple trunks.
- Alternate, double-compound (having leaflets on leaflets) leaves 1 to 2 feet long. Leaflets are glossy dark green above and pale green below with toothed margins. Leaves have long stems (petioles) and become golden yellow in the fall.
- Stems are stout, green to brown with light dots (lenticels).
- Bark is dark brown and cracks with age.
- Clusters of lilac-colored flowers with 5 petals surrounding a purple tube appear in April and May.
- Round berries change in color from yellow to green and then eventually become brownish leathery seed capsules. Fruits ripen in late summer and early fall and persist on the tree throughout the winter, hence the local common name, chainey-ball tree.

Current Status

Commonly cultivated and often escapes invading localized areas along woodland borders and roadsides throughout North Carolina, except rarely at higher elevations.

Melia azedarach photography by James H. Miller, USDA Forest Service, Bugwood.org.

Morus alba (White Mulberry)
Moraceae (Mulberry Family)

Description and Biology

- Small to medium sized tree up to 60 feet in height.
- Alternate leaves are variable in shape, sometimes un-lobed but often lobed or mitten-shaped, have sharply toothed margins, and are 3 to 6 inches long and 2 to 4 inches wide. The upper surface is shiny green and smooth in contrast to the pale green and more or less hairy lower surface.
- Young twigs are orange-brown with light dots (lenticels), becoming gray with long narrow irregular ridges with age.
- Small greenish white flowers appear in clusters in the early spring.
- Pale pink to red fruits resembling blackberries ripen in the late spring.
- Easily confused with our native *Morus rubra* (red mulberry) except that the leaves of *M. rubra* are rough and do not have glossy upper surfaces.

Current Status

Found in widely scattered locations throughout North Carolina in pastures, urban lots, roadsides and occasionally along streams.

Morus alba photography by David J. Moorhead, University of Georgia, Bugwood.org.

Pyrus calleryana (Bradford Pear, Callery Pear)
Rosaceae (Rose Family)

Description and Biology

- Small to medium sized tree up to 50 feet tall and 20 to 30 feet wide. Young trees exhibit upright pyramidal growth habit, becoming more lollipop shaped and spreading with maturity.
- Alternate, heart-shaped leaves with round-toothed margins are shiny green above and paler and dull below. Leaves turn burgundy-red in late fall.
- Bark is gray and fissures with age.
- Twigs are reddish-brown to gray with spur shoots present and relatively large, fuzzy terminal buds.
- Showy white flowers bloom in early spring before the leaves appear. They are often so dense the entire tree appears white.
- Small (0.5 inch diameter), brown fruits form during late spring and summer.
- There are a number of cultivars of *Pyrus calleryana* with various physical characteristics that cross-pollinate and produce viable seeds. The seedlings often differ from selected cultivars and have less regular shapes and are densely thorny.

Current Status

Non-sterile cultivars are beginning to invade natural areas in the piedmont and coastal plain of North Carolina.

Pyrus calleryana photography by Dan Tenaglia, Missouriplants.com, Bugwood.org.

Triadica sebifera (Chinese Tallow Tree)
Euphorbiaceae (Spurge Family)

Description and Biology

- Small to medium tree up to 60 feet but commonly closer to 30 feet in height.
- Alternate leaves are distinctly heart-shaped with long pointed tips and a wedge-shaped base, and are 2 to 3 inches long. The leaf surfaces are green above, slightly paler below and smooth on both sides.
- Slender green twigs becoming light brown have scattered brownish dots (lenticels). Bark is light reddish-brown to gray-brown with wide fissures and narrow ridges.
- Slender, yellow, drooping spikes of tiny flowers appear in the spring.
- Nearly round, 3-lobed fruits split in the fall and winter revealing 3 white seeds that resemble popcorn.

Current Status

Not reported as a serious problem in North Carolina, but has invaded natural areas in Texas, Florida and South Carolina. It invades wet areas such as stream banks and floodplains but can also invade drier upland sites. It poses a serious threat because of its ability to invade undisturbed forests.

Triadica sebifera photography by Karen M. Lynch, NCDOT.

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Berberis thunbergii (Japanese Barberry)
Berberidaceae (Barberry Family)

Description and Biology

- Compact, deciduous, thorny shrub 3 to 6 feet in height and 4 to 7 feet wide.
- Small oval to spatula shaped leaves range in color from green, bluish-green, to dark reddish purple.
- Thorny twigs are slender, brown, and zigzagged in form.
- Small, pale yellow flowers, usually in small clusters, bloom from March to April.
- Shiny red, egg-shaped fruits, approximately 1/3 of an inch long, often persist on the shrub through winter.

Current Status

Not yet reported as a threat in North Carolina since it has rarely escaped cultivation and is still uncommon in natural areas. It is currently a problem in New England, the Northeast, and west to Michigan and Missouri where it forms dense stands in a variety of habitats including closed canopy forests, open woodlands, pastures and meadows.

Berberis thunbergii photography by Jill M. Swearingen, USDI National Park Service, Bugwood.org.

Elaeagnus angustifolia (Russian Olive)
Elaeagnaceae (Oleaster Family)

Description and Biology

- Deciduous, usually thorny shrub or small tree up to 30 feet in height with a single trunk.
- Alternate, linear, dull green to almost gray leaves are 1 to 3 inches long and have silvery scales on both surfaces.
- Young twigs are slender, silvery and scaly and usually have thorns.
- Bark is smooth and gray when young, becoming brown and fissured later.
- Bell-shaped, fragrant, silvery white and yellowish flowers bloom in the late spring.
- Olive-like silver fruits, sometimes developing a reddish tinge, mature in the late summer.

Current Status

Still uncommon in North Carolina and found primarily in the central and western United States as well as the East from Virginia to Pennsylvania. It thrives in a variety of soil and moisture conditions, including bare mineral soil, but appears to be shade intolerant.

Elaegnus angustifolia photography by Paul Wray, Iowa State University, Bugwood.org.

Euonymus alatus (Burning Bush, Winged Euonymus)
Celastraceae (Bittersweet Family)

Description and Biology

- Deciduous shrub up to 10 feet in height with horizontal branches and a flat top.
- Opposite elliptical leaves are 1.5 to 3 inches long, have finely toothed margins, and are dark green above and slightly paler beneath. The brilliant red fall foliage gives this shrub its popular common name.
- Gray to gray-brown bark splits causing it to look faintly striped.
- Tan-colored corky wings contrast strongly with greenish stems.
- Inconspicuous yellow-green flowers occur in clusters of 3 and appear in late spring.
- Purplish red fruits split open to reveal bright orange-red seeds.

Current Status

Though not a problem yet in North Carolina, this plant has been observed escaping from cultivation in the Northeast and Midwest, most notably in Connecticut, Pennsylvania, Illinois and Virginia. It is adaptable, does well in sun to part shade, and is not particular about soil.

Euonymus alatus photography by James H. Miller, USDA Forest Service, Bugwood.org.

Lonicera spp. (Bush Honeysuckles)
Caprifoliaceae (Honeysuckle Family)

May include the following species: *Lonicera x bella* (Belle's) *L. fragrantissima* (Fragrant), *L. maackii* (Amur), *L. morrowii* (Morrow's), *L. standishii* (Standish's), *L. tartarica* (Tartarian), and *L. xylosteum* (European Fly).

Description and Biology

- Generally deciduous (in some species leaves may remain until winter), multi-stemmed shrubs growing to heights of 6 to 20 feet.
- Opposite, oval to egg-shaped leaves range in length from 1 to 2.5 inches.
- Bark is often light tan and flaky, and older branches are hollow.
- Fragrant, tubular flowers range in color from white to yellow in most species to pink or bright red, and are arranged in pairs along the stem.
- Fruits are orange to red berries with many seeds.

Current Status

Lonicera x bella, L. maacki, L. morrowii, and *L. tartaria* generally range from the central Great Plains, to southern New England and south to Tennessee and North Carolina. The remaining species are sporadically distributed. In North Carolina, they are typically associated with old home sites, disturbed forests, and urban/suburban woodlands.

Lonicera morrowii photography by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

Nandina domestica (Heavenly Bamboo, Nandina) Berberidaceae (Barberry Family)

Description and Biology

- Evergreen shrub up to 8 feet tall with an upright growth form.
- Large, alternate, double-compound leaves (having leaflets on leaflets) are lacy in appearance. Leaflets have dark green upper surfaces and taper to a long thin tip.
- Multiple, non-branching, cane-like stems resemble bamboo and explain the origin of its two common names.
- Huge terminal clusters of white flowers appear in the spring.
- Bright red berries festoon the plant into the fall and winter.

Current Status

Widely planted in the piedmont and coastal plain, this plant is increasingly escaping and spreading into woodlands. It has been more destructive to natural communities in states south of North Carolina and is listed as a Class I invasive species by the Florida Exotic Pest Plant Council meaning that it is "actively disrupting plant communities".

Nandina domestica photography by James H. Miller, USDA Forest Service, Bugwood.org.

Rubus phoenicolasius (Wineberry)
Rosaceae (Rose Family)

Description and Biology

- Multi-stemmed, spiny shrub with long arching stems reaching 4 to 6 feet high and often forming thickets.
- Alternate, compound leaves have 3 heart-shaped toothed leaflets. The undersides of the leaflets are silvery-white and hairy, and the petioles have small spines.
- The long stems of the mature plant are covered with red tipped hairs and small spines.
- Inconspicuous white flowers have reddish hairs and appear from late spring to early summer.
- The juicy bright red to orange-red fruits resemble raspberries, are edible, and ripen in the middle of the summer.

Current Status

Found from New England to North Carolina and west to Michigan and Tennessee, this plant prefers moist conditions and full sun to partial shade. It is invasive in fields, along roadsides, and various edge habitats.

Rubus phoenicolasius photography by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.


trees
shrubs
herbaceous plants
vines
aquatic plants

Arundo donax (Giant Reed)
Poaceae (Grass Family)

Description and Biology

- Tall, robust, perennial grass 10 to 30 feet tall.
- Grows in multi-stemmed, cane-like clumps and often forms large colonies.
- Spreads from horizontal rhizomes below the soil.
- Leaves are arranged alternately along the stem and are distinctly 2-ranked (2 rows along the stem).
- Produces tall, plume-like flowers 2 feet in length on the upper portion of the stem during August and September.
- Most often confused with *Phragmites australis*, a grass usually around 10 feet tall with flowers up to 1 foot long.

Current Status

Widely planted throughout warmer areas of the United States as an ornamental and in the Southwest where it is used along ditches for erosion control. In North Carolina, it is planted in the piedmont and coastal plain and may spread to adjacent disturbed areas.

Arundo donax photography by James H. Miller, USDA Forest Service, Bugwood.org.

Carduus acanthoides (Plumeless Thistle)
Asteraceae (Aster Family)

Description and Biology

- Annual or biennial (living for 2 years) herb 1 to more than 4 feet tall.
- Freely branched stems give the plant a candelabra-like appearance. Stems are covered with spiny wings that extend up to the flowers.
- Alternate leaves are deeply lobed and each lobe has 1 to 3 short pointed marginal spines.
- Flower heads are pink to purple in color and are up to 1 inch in diameter.
- Seeds are small, slightly curved, and grey to light brown in color.

Current Status

A widespread invasive exotic plant in the United States, it has been found in the mountain region of North Carolina and is listed as a Class B state noxious weed. Anyone who suspects an infestation outside of the regulated counties of Haywood, Jackson, Madison or Watauga should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Carduus acanthoides photography by Todd Pfeiffer, Klamath County Weed Control, Bugwood.org.

Carduus nutans (Musk Thistle, Nodding Thistle)

Asteraceae (Aster Family)

Description and Biology

- Biennial (living for 2 years) herb 1.5 to 6 feet tall with a spiny stem. It may germinate and flower in a single year in warmer climates.
- Dark green leaves are coarsely lobed with a waxy surface and a spine at the tip.
- Showy, red-purple, disk-shaped flower heads will droop to a 90-degree angle from the stem when large, hence the common name "nodding thistle."
- A prolific seed producer, each plant may produce thousands of straw-colored seeds with plume-like bristles.

Current Status

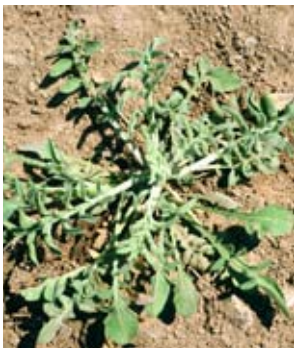
An invasive exotic in most of the United States, it has been found in several counties in North Carolina, primarily in the piedmont and mountains and is listed as a Class B state noxious weed. Anyone who suspects an infestation outside of the regulated counties of Buncombe, Chatham, Cleveland, Gaston, Henderson, Lincoln, Madison, Randolph, Rowan and Rutherford should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Carduus nutans photography by James R. Allison, Georgia Department of Natural Resources, Bugwood.org.

Centaurea stoebe ssp. *micranthos* (Spotted Knapweed)
Asteraceae (Sunflower Family)

Description and Biology

- Biennial (living for 2 years) or short-lived perennial commonly growing 3 to 4 feet in height.
- Typically forms a basal rosette of leaves in the first year and flowers in subsequent years.
- Slender, hairy stems grow in a straight and branched arrangement.
- Pale green leaves 2 to 3 inches in length are arranged alternately along the stem. Lower leaves may be slightly lobed; upper leaves are more linear in shape and more deeply lobed. Leaf size decreases toward the top of the stem.
- Thistle-like pinkish to purple flowers reach 0.75 of an inch in diameter and bloom throughout the summer. This plant gets its common name from the stiff bracts (modified leaves situated near the flower) that are marked with fine, vertical streaks and dark tips that give the flower head a spotted appearance.



Current Status

Invades open areas throughout most of the United States and is posing a serious problem in rangelands of the Northwest. In North Carolina, this plant is common along roadsides and disturbed areas in the piedmont and mountains.

Centaurea stoebe ssp. micranthos photography by Cherri Smith, NCDOT.

Circium arvense (Canada Thistle)
Asteraceae (Aster Family)

Description and Biology

- Upright, perennial herb 1.5 to 4 feet tall.
- Alternate leaves are lance-shaped with margins that vary from entire to deeply lobed and have spines.
- Stems are branched, ridged and often hairy.
- Purplish lavender or, less commonly, white flowers occur in rounded, umbrella-shaped clusters.
- Single-seeded fruits called achenes are 1 to 1.5 inches long with a feathery structure that allows them to float and be easily dispersed by wind.
- There are many native species of thistle that can easily be confused with this invasive exotic species.

Current Status

This plant is listed in North Carolina as a Class B state noxious weed and has been found primarily in the mountains. Anyone who suspects an infestation outside of the regulated counties of Ashe, Avery, Haywood, Mitchell, Northampton and Yancey should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Circium arvense photography by Mary Ellen (Mel) Harte, Bugwood.org.

Commelina benghalensis (Benghal Dayflower, Tropical Spiderwort)
Commelinaceae (Spiderwort Family)

Description and Biology

- Creeping annual (perennial in tropical climates) herb up to 3 feet long, commonly forming dense, monotypic stands.
- Alternate, broad, short leaves are 13 inches long and 0.5 to 1.5 inches wide. Leaves are succulent and often hairy.
- The presence of reddish hairs (or sometimes white) on the sheath apex (point at which leaf blade attaches to stem) helps distinguish this species from other *Commelina* spp.
- White underground rhizomes with modified flowers that produce subterranean seeds definitively identify this species from other *Commelina* spp.
- Aboveground flowers have 2 bluish-purple petals and 1 smaller typically white petal.

Current Status

This plant is listed as a federal noxious weed. Recent surveys have shown that it is being confined to quarantine areas at two NCDA&CS Research Stations on the coastal plain in North Carolina. Intensive survey, hand pulling, fumigation and herbicide treatments are being used to prevent spread and eradicate this weed from infested fields at these stations. Anyone who suspects an infestation in North Carolina should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Commelina benghalensis photography by Forest and Kim Star, U.S. Geological Survey, Bugwood.org.

Commelina communis var. *communis* (Asiatic Dayflower, Common Dayflower) Commelinaceae (Spiderwort Family)

Description and Biology

- Upright or more often creeping annual herb, reaching a height of 6 to 12 inches with reclining stems growing 1 to 3 feet long.
- Broadly lance-shaped to egg-shaped alternate leaves are 2 to 4 inches long and 1 to 1.5 inches wide.
- The base of each leaf is clasping, which means the lower edges of the blade are partly surrounding the stem. It also has a membranous sheath, which is a tubular envelope formed where the leaf attaches to the stem. The upper edge of the sheath is usually hairless.
- Flowers consist of 3 petals, 2 larger petals above and 1 smaller below. The larger petals have a "true blue" color found in few other plants. Flowering occurs during the summer and early fall and each flower blooms for a single day, hence the common name.

Current Status

Widely distributed in the United States. In North Carolina, it is found in low moist woods and disturbed areas.

Commelina communis var. communis photography by Wendy VanDyk Evans, Bugwood.org.

Heracleum mantegazzianum (Giant Hogweed) Apiaceae (Carrot Family)

Description and Biology

- Biennial (living for 2 years) or short-lived perennial herb growing 8 to 15 feet in height when flowering. Remains in the rosette stage until it develops sufficient root reserves to initiate flower formation.
- Large, alternate, compound leaves with 3 leaflets are deeply incised and can become 3 to 5 feet wide.
- Hollow stems 2 to 4 inches in diameter have prominent purple blotches and white hairs.
- Thousands of tiny, white flowers are on a large, flat, umbrella-shaped head (umbel) that can be up to 2 feet in diameter.
- Sap from the leaves, and especially the stem, photosensitizes the skin causing blisters and burns.

Current Status

This plant is listed as a federal noxious weed and is also listed as a Class A state noxious weed in North Carolina. It has been found in Caldwell County. Anyone who suspects a potential infestation in North Carolina should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Heracleum mantegazzianum photography by Donna R. Ellis, *University of Connecticut,* Bugwood.org.

Imperata cylindrica (Cogon Grass)
Poaceae (Grass Family)

Description and Biology

- Perennial, dense, colony-forming grass usually growing 2 to 4 feet in height.
- Upright leaf blades are approximately 0.5 to 1 inch wide, have a sharp tip and finely toothed margins, and are most often yellowish green in color. The most distinguishing feature of the leaf is the off-center, white central vein called the midrib.
- Rhizomes have sharply pointed tips and form a dense interwoven mat usually within the upper foot of the soil surface.
- Conspicuous, cylindrical, silky, white flower spikes are 2 to 8 inches long and bloom from March to June. Timing depends on local climate.

Current Status

This plant is considered to be one of the top 10 worst weeds in the world and is a federal noxious weed. It is extremely aggressive and is now well-established and rapidly invading fire-maintained communities such as pine savannahs on the Gulf Coastal Plain of Florida, Alabama and Mississippi. Small infestations have also been confirmed in South Carolina. It forms dense mats of leaves and thatch that out compete native plants. Anyone who suspects a potential infestation in North Carolina should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Imperata cylindrica photography by Chris Evans, River to River CWMA, Bugwood.org.

Lygodium japonicum (Japanese Climbing Fern)
Lygodiaceae (Climbing Fern Family)

Description and Biology

- Perennial, climbing fern with twining fronds reaching 90 feet long.
- Leaves (fronds) are opposite, compound and highly dissected, and triangular in overall shape. They are typically 3 to 6 inches long and 2 to 3 inches wide and have hairs on the lower surfaces.
- Where winter frosts occur, the leaflets die in the winter but stalks of leaves usually remain intact.
- May be confused with *L. microphyllum* (Old World climbing fern) but the leaflets are not dissected and have smooth lower surfaces, and the overall leaf is palm-shaped.

Current Status

Rare in North Carolina but common and weedy in Florida and Georgia. It forms dense tangled mats, covering the ground and shrubs and climbing into the canopy of trees.

Lygodium japonicum photography by Chris Evans, River to River CWMA, Bugwood.org.

Rorippa sylvestris (Yellow Fieldcress)
Brassicaceae (Mustard Family)

Description and Biology

- Upright, perennial herb up to 8 inches in height.
- Alternate and basal leaves are all deeply pinnately divided (divisions in a featherlike arrangement on each side of the leaf axis). The lowest leaves are up to 6 inches long becoming smaller toward the top of the plant.
- Flowers comprised of 4 distinct yellow petals.
- The wet habitat of this plant and its creeping stems with fibrous roots are other distinguishing characteristics.

Current Status

This plant has been found in numerous states throughout the United States. In North Carolina, it is listed as a Class B state noxious weed and has been found in Orange County. Anyone who suspects a potential infestation outside of the regulated county of Orange should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Rorippa sylvestris photography by Dan Tenaglia, Missouriplants.com, Bugwood.org.

Securigera varia (Crown Vetch)
Fabaceae (Bean Family)

Description and Biology

- Low growing, perennial herb that can form large thickets from creeping stems.
- Feathery, compound leaves have an odd number of leaflets (usually 15 to 25), a characteristic that distinguishes it from other members of the bean family.
- Long rhizomes (up to 10 feet) allow the plant to spread rapidly.
- White to pink to purple clover-like flower heads typically appear from late spring through the summer. The individual flowers are pea-like with 2 lips and occur in clusters at the end of long, extended stalks.

Current Status

This plant has been used throughout much of the United States for erosion control and soil stabilization. To date in North Carolina, it is more of a threat in pastures and abandoned fields since it is intolerant of shade.

Securigera varia photography by Cherri Smith, N.C. Department of Transportation.

Solanum viarum (Tropical Soda Apple)
Solanaceae (Nightshade Family)

Description and Biology

- Perennial, shrubby herb usually 3 to 6 feet in height.
- The entire plant, including stems and leaves, is armed with straight, thorn-like prickles.
- Leaves resemble fig or oak leaves, are alternate, and are 4 to 8 inches long and 2.5 to 6 inches wide.
- White flowers with 5 petals appear from May to August.
- Distinctive immature fruits, approximately 1 inch in diameter with a mottled mix of light and dark greens, resemble tiny watermelons. When fruits mature, they turn bright yellow.

Current Status

This plant has only recently appeared in North Carolina but has been described as extremely aggressive and rapidly spreading farther south. It is usually associated with pasture areas where cattle imported from infested fields of other states are fed and held prior to processing. It is listed as a federal noxious weed and is also listed as a Class A state noxious weed in North Carolina. Anyone who suspects a potential infestation should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Solanum viarum photography by Charles T. Bryson, USDA Agricultural Research Service, Bugwood.org.

Stachys floridana (Florida Betony, Rattlesnake Weed)

Lamiaceae (Mint Family)

Description and Biology

- Perennial, erect herb 8 to 20 inches in height with hairy square stems.
- Lance-shaped leaves have scalloped margins, are oppositely arranged, and are approximately 2 inches long and 1 inch wide. They are connected to the stem by a 1.5 inch petiole (stalk to a leaf).
- Occurring in clusters at the top of the stem, the trumpet-shaped flowers are white to pink and may have purple spots.
- The underground segmented and white tuber resembles the rattle of a rattlesnake, hence the common name "rattlesnake weed."

Current Status

A native of Florida, this plant has spread north since the 1940s and is now found throughout the southeastern United States. It has been found in several counties in North Carolina primarily in the coastal plain and is listed as a Class B state noxious weed. Anyone who suspects a potential infestation outside of the regulated county of Orange should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Stachys floridana photography by John D. Byrd, Mississippi State University, Bugwood.org.

Tribulus terrestris (Puncturevine)
Zygophyllaceae (Creosote-bush Family)

Description and Biology

- Prostrate annual herb that forms a dense mat up to 4 feet across from highly branching stems arising from the crown.
- Opposite leaves are compound with 4 to 8 pairs of oval, hairy, 0.5 inch long leaflets.
- Small, yellow, flowers have 5 petals and occur on short stalks at leaf nodes (where the leaf meets the stem).
- Fruit is a woody burr with sharp, rigid spines, hence the common name "puncturevine."

Current Status

Introduced from the Mediterranean region, this plant is found throughout the United States except those northernmost states along the border with Canada. It is listed in North Carolina as a Class B state noxious weed and has been found in Durham and New Hanover counties. Anyone who suspects an infestation outside of the regulated counties of Durham and New Hanover should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Tribulus terrestris photography by Forest & Kim Starr, U.S. Geological Survey, Bugwood.org.

Tussilago farfara (Coltsfoot)
Asteraceae (Aster Family)

Description and Biology

- Low growing perennial herb 3 to 12 inches in height.
- Heart-shaped leaves are slightly toothed, arise directly from the root with no main stem present and are 3 to 6 inches wide. The common name is derived from the leaf shape that also vaguely resembles a horseshoe. The upper leaf surface is smooth while the lower surface is covered with white wool-like hairs.
- Each plant has several scaly, white flower stalks.
- The unique flowering characteristic of this plant, whereby the solitary, bright yellow, dandelion-like flowers appear early in the spring before the leaves, distinguishes it from other members of the aster family.
- White, fluffy seeds resemble those of dandelions.

Current Status

Spreading rapidly southward from the Northeast, this plant is now relatively common in the mountains of North Carolina along roadsides, streamside gravel bars and disturbed ground. It is beginning to appear at scattered sites in the piedmont.

Tussilago farfara photography by Jan Samanek, State Phytosanitary Administration, Bugwood.org.

Youngia japonica (Oriental False Hawk's-Beard) Asteraceae (Aster Family)

Description and Biology

- Upright, annual herb 1 to 2 feet in height.
- Leaves have smooth surfaces with finely toothed edges, are mostly clustered at the base, and are 2 to 5 inches long and 0.5 to 2 inches wide. The shape resembles that of a guitar divided into segments that are sometimes irregular with a large terminal segment (dandelion-like leaves).
- Numerous, small, yellow flowers are arranged in a flat or convex-topped open cluster.

Current Status

Currently found along roadsides and disturbed areas primarily in the piedmont and coastal plain of North Carolina, this plant is spreading relatively rapidly. It has the potential to be a problem in natural areas given its prolific seed production.

Youngia japonica photography by Larry Allain, National Wetlands Research Center, USGS.

trees

shrubs

herbaceous plants

vines

aquatic plants

Cayratia japonica (Bushkiller)
Vitaceae (Grape Family)

Description and Biology

- Perennial, high-climbing, smothering vine.
- Compound leaves comprised of 5 smooth, coarsely-toothed, egg-shaped leaflets, 1to 3 inches long and 0.75 to 1.5 inches wide. Leaves resemble *Parthenocissus quinquefolia* (Virginia creeper), a native vine.
- Long tendrils arise opposite from the leaves along the stem.
- Small, salmon-colored flowers are arranged in a flat or convex-topped open cluster.
- Fruits are round 2 to 4-seeded berries.

Current Status

Reported as naturalized in Mississippi, Louisiana and Texas. To date, this plant has been found in the Charlotte, Lexington and Winston-Salem areas of North Carolina.

Cayratia japonica photography by Rick Iverson, N.C. Department of Agriculture and Consumer Services.

Dioscorea bulbifera (Air Potato)
Dioscorea oppositifolia (Chinese Yam, Cinnamon Vine)
Dioscoreaceae (Yam Family)

Description and Biology

- Perennial, deciduous, creeping and climbing vines that can grow 60 to 70 feet in length.
- Stems die back in the winter and new growth vigorously sprouts from underground tubers (thickened, short stems with buds called eyes, like a potato).
- Alternate, heart-shaped leaves of *D. bulbifera* are 8 inches or more in length with long petioles (leaf stems). Alternate and opposite leaves of *D. oppositifolia* are triangular with elongated tips and heart-shaped bases usually 1.5 to 3 inches long. Stems and leaf margins are reddish-purple.
- Inconspicuous greenish to whitish flowers bloom from May to August. Flowers of *D. oppositifolia* may have a spicy cinnamon fragrance.
- Bulbils (small aerial tubers) are produced in the leaf axils where the leaf attaches to the stem. As the common name implies, the numerous bulbils of *D. bulbifera* resemble potatoes and can grow up to 5 inches in length. Bulbils of *D. oppositifolia* are smaller, more warty in appearance, and grow up to 1 inch in length.

Current Status

The current distribution of *D. bulbifera* extends from Florida to adjacent states. *Dioscorea oppositifolia* has been reported from a number of counties in North Carolina and is usually found along roadsides, stream banks, drainage ways, old home sites and other disturbed areas.

Dioscorea bulbifera photography by Karen Brown, University of Florida, Bugwood. org *(left) and Dioscorea oppositifolia photography by Jack Ranney, University of Tennessee,* Bugwood.org *(right).*

Humulus japonicus (Japanese Hops)
Cannabaceae (Hemp Family)

Description and Biology

- Perennial climbing or trailing vine 3 to 20 feet long, branching occasionally.
- Opposite leaves 2 to 5 inches in length are divided into 5 distinct lobes. Leaves are rough to the touch and occur on long petioles (leaf stems) up to 8 inches in length.
- Stems are covered with downward pointed prickles.
- Inconspicuous green flowers occur in clusters approximately 2 inches long and appear from mid-summer to early fall.

Current Status

Though still relatively rare in the piedmont of North Carolina in disturbed areas and particularly alluvial soils, this plant has become a serious weed along major rivers in Virginia.

Humulus japonicus photography by Karen M. Lynch, NCDOT.

Persicaria perfoliatum (Mile-A-Minute Vine, Devil's Tear-Thumb)
Polygonaceae (Smartweed Family)

Description and Biology

- Annual, highly branched, trailing vine that forms dense, tangled mats.
- Leaves are alternate, light green and almost perfectly triangular in shape with barbs on the lower surface.
- Stems are green when young, become red with age, and are armed with downward pointing barbs.
- Distinctive circular, leafy structures called ocreae, surround the stem at intervals.
- Inconspicuous, small, white flowers emerge from within the ocreae.
- Attractive, deep blue fruits 1/4 inch in diameter are arranged in clusters.

Current Status

Currently found in the Northeast and south to Virginia, this plant invades utility rights of way, roadsides, fields, stream banks and wetlands. It is listed in North Carolina as a Class A state noxious weed. Anyone who suspects a potential infestation in North Carolina should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Persicaria perfoliatum photography by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

Vinca major (Bigleaf Periwinkle)
Apocynaceae (Dogbane Family)

Description and Biology

- Evergreen trailing vine reaching a length of up to 3 feet.
- Arching stems can reach about 12 inches in height, but at this point they fall over rooting at the nodes as they cover the ground.
- Opposite, shiny dark green, oval or heart-shaped leaves are 1.5 to 2.5 inches long. Some varieties have variegated leaf colors.
- Bluish-lavender or "periwinkle" flowers about 1 inch across with 5 petals radiating from a funnel appear from April to May and bloom intermittently throughout the summer.

Current Status

Found in widely scattered localities across North Carolina, this plant spreads from cultivation and is usually found associated with old home sites and in suburban woodlands.

Vinca major photography by Cherri Smith, NCDOT.

Vinca minor (Common Periwinkle)
Apocynaceae (Dogbane Family)

Description and Biology

- Evergreen trailing vine up to 18 inches in length forming a dense mat along the ground.
- Stems reach 3 to 6 inches in height and spread by rooting at the nodes as they creep along the ground.
- Opposite, shiny dark green, elliptical leaves are 0.5 to 1 inch long. Some varieties have variegated leaf colors.
- Bluish-lavender or "periwinkle" flowers about 1 inch across with 5 petals radiating from a funnel bloom profusely in early spring and then sporadically throughout the summer.

Current Status

Commonly found throughout North Carolina spreading from cultivation around old home sites and especially old cemeteries.

Vinca minor photography by Cherri Smith, NCDOT.

trees

shrubs

herbaceous plants

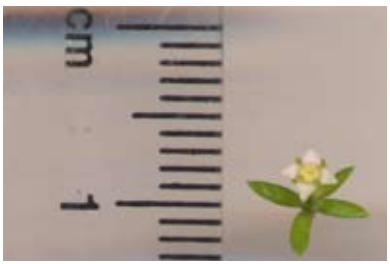
vines

aquatic plants

Crassula helmsii (Swamp Stonecrop)
Crassulaceae (Stonecrop Family)

Description and Biology

- Growing on the margins of aquatic habitats, this plant forms tight hummocks of fine, bright green foliage 2 to 4 inches in height.
- It has non-flowering, submersed shoots and emergent flowering shoots.
- The leaves are succulent, opposite, joined at the base and linear to narrowly oval in shape.
- The flowers are stalked, solitary and form at the base of the leaves. They have 4 white or occasionally pale pink petals.



Current Status

Although this plant is not currently a significant problem in the United States, it warrants close monitoring because of the ecological damage it has caused in Australia, New Zealand and the United Kingdom. It is listed in North Carolina as a Class A state noxious weed. Anyone who suspects a potential infestation in North Carolina should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Crassula helmsii photography by CEH, UK and Graham Day, www.habitas.org.uk/flora.

Eichornia crassipes (Water Hyacinth)
Pontederiaceae (Pickerelweed Family)

Description and Biology

- Floating aquatic plant to a height of 6 inches with a mass of long feathery roots that dangle in the water underneath the plant.
- Pale green, shiny, rounded leaves form a basal rosette. It gets its name "crassipes," meaning thick foot, from the balloon-like petioles (stalks of the leaves) that are swollen with spongy tissue.
- The leaf stalk is thick and spongy, which helps keep the plant buoyant.
- Large showy flower spikes are blue to pinkish-lavender in color. Each flower has 6 petals joined at the base forming a short tube, and 1 petal has a small yellow marking.

Current Status

Considered one of the world's worst aquatic plants, it is now a widespread weed throughout the tropics and subtropics. In North Carolina, this plant is rare in natural settings since it usually will not overwinter. A persistent small population exists near Burgaw in Pender County.

Eichornia crassipes photography by Karen M. Lynch, NCDOT.

Lagarosiphon major (African elodea, oxygen weed)
Hydrocharitaceae (Frog's-bit Family)

Description and Biology

- Submersed, rooted, aquatic plant growing up to 20 feet long and forming think mats at the surface.
- Greatly recurved (curved downward), stiff, linear leaves are up to 1 inch long and 1/16 to 1/8 of an inch wide and occur in alternate spirals along the stem.
- Tiny, transparent to white or pinkish flowers have 3 petals and are on a long filament-like stem. Flowers float on the surface of the water.

Current Status

A native of southern Africa, this plant is now found in New Zealand and many parts of Europe. If it is introduced to the United States, the consequences may be as dire as the problems caused by *H. verticillata*, another member of the Hydrocharitaceae family. It is listed as a federal noxious weed and is also listed as a Class A state noxious weed in North Carolina. Anyone who suspects a potential infestation should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Lagarosiphon major photography by Rohan Wells, National Institute of Water and Atmospheric Research, Bugwood.org,

Lythrum salicaria (Purple Loosestrife)
Lythraceae (Loosestrife Family)

Description and Biology

- Perennial wetland herb that grows 3 to 10 feet tall with an average height of 5 feet.
- Leaves are primarily opposite or in whorls of 3, lance-shaped, and heart-shaped or rounded at the base.
- Stems are distinctly 4-sided and covered with downy hairs. Mature plants may have numerous often branching stems giving the plant a bushy or woody appearance.
- Large magenta-colored flower spikes provide a dramatic display throughout the summer.

Current Status

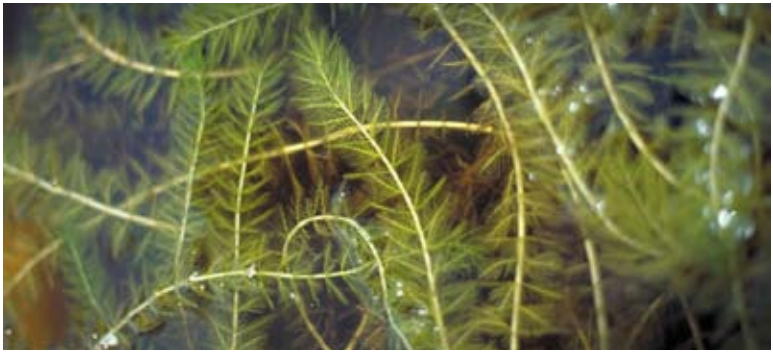
This plant is an extremely invasive weed in the Northeast, aggressively colonizing and dominating a wide range of freshwater wetlands. It has been reported in the northwestern mountains of North Carolina and is listed as a Class B state noxious weed. Anyone who suspects an infestation outside of the regulated counties of Forsyth and Watauga should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Lythrum salicaria photography by Linda Wilson, University of Idaho, Bugwood.org.

Myriophyllum spicatum (Eurasian Water-Milfoil)
Haloragaceae (Water-Milfoil Family)

Description and Biology

- Submersed, rooted, aquatic plant with stems usually extending 3 to 10 feet and forming dense intertwined mats at the water surface.
- The finely dissected, feather-like, grayish-green leaves are arranged in whorls of 3 or 4 along the stem. Each leaf has threadlike leaflets generally in pairs of 14 or more.
- Stems are slender, branching, and become leafless toward the base.
- Small yellow flowers are on a spike that projects 2 to 4 inches above the water surface.
- *M. spicatum* is easily mistaken for *M. aquaticum*, a close relative and another exotic species. There are also a number of native species of *Myriophyllum* so it is wise to consult a botanist to confirm identification.



Current Status

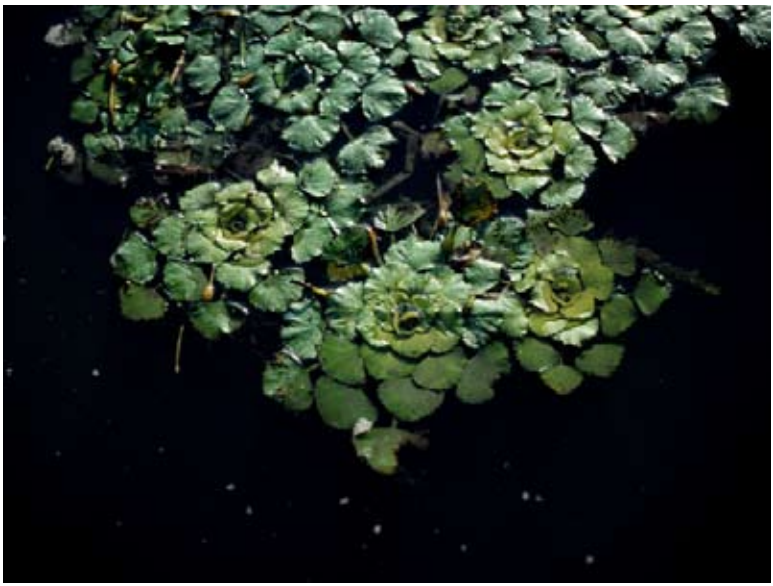
Found throughout the United States in almost every state, this plant is considered a major nuisance throughout the Northeast, northern Midwest, and Pacific Northwest. It is listed in North Carolina as a Class B state noxious weed. Anyone who suspects an infestation outside of the regulated counties of Halifax, Northampton, Perquimans, Tyrrell and Warren should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Myriophyllum spicatum photography by Alison Fox, University of Florida, Bugwood.org.

Trapa natans (Water Chestnut)
Trapaceae (Chestnut Family)

Description and Biology

- Submersed aquatic plant with stems reaching 12 to 15 feet in length and long fine roots anchoring the plant in soil.
- At the water surface, fan-shaped, toothed leaves are arranged in a rosette. Each leaf has a slightly inflated stem for added buoyancy.
- Small white flowers have 4 petals.
- Fruit is a nut with 4 sharp spines.



Current Status

Native to Eurasia, this plant is an aggressive invader in the Northeast and is now found as far south as Virginia. It is listed in North Carolina as a Class A state noxious weed. Anyone who suspects a potential infestation should report it to the N.C. Department of Agriculture and Consumer Services Weed Specialist at 1-800-206-9333.

Trapa natans photography by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

Appendices

SCIENTIFIC NAME	COMMON NAME	REGION			LIGHT			MOISTURE			
		M	P	C	S	P	F	L	M	H	A
MEDIUM TO LARGE TREES											
Acer barbatum	Southern sugar maple		●	●	●	●			●		
Acer saccharinum	silver maple	●	●		●	●	●		●		
Acer saccharum	sugar maple	●				●	●		●		
Aesculus flava	yellow buckeye	●			●	●			●		
Betula alleghaniensis	yellow birch	●			●	●			●		
Betula lenta	cherry birch, sweet birch	●			●	●			●		
Betula nigra	river birch	●	●	●		●	●		●	●	
Carya cordiformis	bitternut hickory	●	●	●	●	●			●		
Carya glabra	pignut hickory	●	●	●	●	●		●	●		
Carya ovata	shagbark hickory	●	●		●	●			●		
Carya tomentosa	mockernut hickory	●	●	●	●	●		●	●		
Celtis laevigata	sugarberry, hackberry		●	●	●	●			●		
Chamaecyparis thyoides	Atlantic white cedar			●		●	●		●	●	
Cladrastis kentuckea	yellowwood	●			●	●			●		
Diospyros virginiana	persimmon	●	●	●	●	●	●	●	●		
Fagus grandifolia	American beech	●	●	●	●	●			●		
Fraxinus americana	white ash	●	●	●	●	●			●		
Fraxinus pennsylvanica	green ash	●	●	●	●	●			●	●	
Juglans nigra	black walnut	●	●	●	●	●			●		
Liriodendron tulipifera	tulip poplar, yellow poplar	●	●	●	●	●	●		●		
Magnolia acuminata	cucumber magnolia	●	●		●	●			●		
Nyssa aquatica	water tupelo			●	●	●				●	
Nyssa sylvatica	black gum	●	●	●	●	●	●	●	●		
Nyssa sylvatica var. *biflora*	swamp black gum, swamp tupelo			●	●	●	●			●	
Oxydendrum arboreum	sourwood	●	●	●		●	●	●	●		
Pinus palustris	longleaf pine		●	●			●	●	●		
Pinus strobus	white pine	●	●			●	●		●		
Platanus occidentalis	sycamore	●	●	●		●	●		●		
Prunus serotina	black cherry	●	●	●	●	●	●	●	●		
Quercus alba	white oak	●	●	●	●	●	●	●	●		
Quercus bicolor	swamp white oak		●		●	●				●	

Native Regions: **M**ountains, **P**iedmont, **C**oastal Plain
Light Requirements: **S**hade, **P**artial Sun, **F**ull Sun
Moisure Requirements: **L**ow Moisture, **M**oderate Moisture, **H**igh Moisture, **A**quatic

SCIENTIFIC NAME	COMMON NAME	REGION			LIGHT			MOISTURE			
		M	P	C	S	P	F	L	M	H	A
MEDIUM TO LARGE TREES											
Quercus coccinea	scarlet oak	●	●		●	●		●			
Quercus falcata	Southern red oak	●	●	●	●	●		●	●		
Quercus falcata var. *pagodaefolia*	cherrybark oak		●	●	●	●			●	●	
Quercus laurifolia	laurel oak			●	●	●	●		●	●	
Quercus lyrata	overcup oak		●	●	●	●				●	
Quercus michauxii	swamp chestnut oak		●	●	●	●				●	
Quercus nigra	water oak		●	●	●	●		●	●		
Quercus phellos	willow oak		●	●	●	●			●	●	
Quercus prinus	chestnut oak	●	●		●	●		●			
Quercus rubra	Northern red oak	●	●		●	●		●	●		
Quercus shumardii	shumard oak		●	●	●	●			●	●	
Quercus virginiana	live oak			●		●	●	●			
Taxodium distichum	baldcypress			●		●	●				●
Tilia americana var. heterophylla	basswood	●	●		●	●			●		
Tsuga canadensis	Eastern hemlock, Canada hemlock	●	●		●	●	●		●		
Ulmus americana	American elm	●	●	●	●	●			●		
SMALL TREES											
Amelanchier spp.	serviceberry	●	●	●	●	●	●	●	●	●	
Asimina triloba	pawpaw	●	●	●	●	●			●		
Carpinus caroliniana	ironwood, American hornbeam	●	●	●	●	●			●	●	
Cercis canadensis	Eastern redbud	●	●	●	●	●			●		
Chionanthus virginicus	white fringetree, old man's beard	●	●	●		●	●		●		
Cornus alternifolia	alternate-leaf dogwood	●			●	●			●		
Cornus florida	flowering dogwood	●	●	●	●	●		●	●		
Cyrilla racemiflora	titi			●		●	●		●	●	
Halesia tetraptera	common silverbell	●	●		●	●			●		
Ilex opaca	American holly	●	●	●	●	●		●	●	●	

Native Regions: Mountains, **P**iedmont, **C**oastal Plain
Light Requirements: Shade, **P**artial Sun, **F**ull Sun
Moisure Requirements: Low Moisture, **M**oderate Moisture, **H**igh Moisture, **A**quatic

SCIENTIFIC NAME	COMMON NAME	REGION			LIGHT			MOISTURE			
		M	P	C	S	P	F	L	M	H	A
SMALL TREES											
Juniperus virginiana	Eastern red cedar	●	●	●		●	●	●	●		
Magnolia tripetala	umbrella tree	●	●		●				●		
Magnolia virginiana	sweetbay magnolia		●	●	●	●			●	●	
Morus rubra	red mulberry	●	●	●	●	●			●		
Persea borbonia	red bay			●	●	●			●	●	
Prunus caroliniana	Carolina laurel-cherry			●		●	●	●	●		
Rhus aromatica	fragrant sumac		●			●	●	●	●		
Rhus glabra	smooth sumac	●	●				●	●	●		
Rhus hirta (Rhus typhina)	staghorn sumac	●					●	●			
Sassafras albidum	sassafras	●	●	●		●	●	●	●		
Staphylea trifolia	bladdernut		●		●				●	●	
Symplocos tinctoria	horse-sugar, sweetleaf	●	●	●	●	●		●	●		
SHRUBS											
Aesculus pavia	red buckeye		●	●	●	●			●		
Aesculus sylvatica	painted buckeye	●	●		●	●			●		
Alnus serrulata	common alder	●	●	●	●	●	●				●
Aronia arbutifolia	red chokeberry	●	●	●	●	●			●	●	
Callicarpa americana	American beautyberry		●	●	●	●			●		
Calycanthus floridus	sweet-shrub	●	●		●	●			●		
Cephalanthus occidentalis	buttonbush	●	●	●		●	●				●
Clethra alnifolia	sweet pepperbush			●	●	●			●	●	
Cornus amomum	silky dogwood	●	●	●	●	●					●
Cornus stricta	swamp dogwood			●	●	●				●	
Corylus americana	American hazel, hazelnut	●	●		●	●			●		
Diervilla sessilifolia	Southern bush honeysuckle	●	●		●	●		●	●		
Euonymus americanus	hearts-a-bustin', strawberry bush	●	●	●	●	●		●	●		
Hamamelis virginiana	witch hazel	●	●	●	●	●		●	●		
Hydrangea arborescens	wild hydrangea	●	●		●	●			●		
Ilex coriacea	gallberry			●	●	●			●	●	
Ilex decidua	deciduous holly possumhaw		●	●	●	●			●		

Native Regions: **M**ountains, **P**iedmont, **C**oastal Plain
Light Requirements: **S**hade, **P**artial Sun, **F**ull Sun
Moisure Requirements: **L**ow Moisture, **M**oderate Moisture, **H**igh Moisture, **A**quatic

SCIENTIFIC NAME	COMMON NAME	REGION			LIGHT			MOISTURE			
		M	P	C	S	P	F	L	M	H	A
SHRUBS											
Ilex glabra	inkberry			●	●	●			●	●	
Ilex verticillata	winterberry	●	●	●	●	●			●	●	
Ilex vomitoria	yaupon holly			●	●	●	●	●			
Itea virginica	Virginia willow		●	●	●	●				●	
Kalmia latifolia	mountain laurel	●	●		●	●		●	●		
Leucothoe axillaris	coastal dog-hobble			●	●	●			●		
Leucothoe fontanesiana	dog-hobble	●	●		●				●		
Lindera benzoin	spicebush	●	●	●	●				●		
Lyonia ligustrina	Northern maleberry	●	●			●			●	●	
Lyonia lucida	shining fetterbush			●	●	●			●		
Myrica cerifera	Southern wax-myrtle		●	●	●	●	●	●	●	●	
Pieris floribunda	evergreen mountain fetterbush	●					●	●	●		
Rhododendron atlanticum	dwarf azalea			●		●			●		
Rhododendron calendulaceum	flame azalea	●			●	●			●		
Rhododendron catawbiense	Catawba rhododendron	●	●		●	●	●	●	●		
Rhododendron maximum	rosebay rhododendron, great laurel	●	●		●	●		●	●		
Rhododendron periclymenoides	pinxter flower, wild azalea	●	●	●	●	●			●		
Rhododendron viscosum	swamp azalea	●		●		●	●		●	●	
Rhus copallina	winged sumac	●	●	●		●	●	●	●		
Rosa carolina	pasture rose, Carolina rose	●	●	●		●	●	●	●		
Styrax grandifolia	bigleaf snowbell		●	●	●	●			●		
Vaccinium arboreum	sparkleberry		●	●	●	●		●	●		
Vaccinium corymbosum	highbush blueberry	●	●	●	●	●	●	●	●	●	
Viburnum acerifolium	maple-leaf viburnum	●	●		●	●		●	●		
Viburnum dentatum	Southern arrowwood viburnum	●	●	●	●	●			●		
Viburnum nudum	possumhaw viburnum	●	●	●	●	●				●	
Viburnum prunifolium	blackhaw viburnum	●	●	●	●	●			●		

Native Regions: Mountains, **P**iedmont, **C**oastal Plain
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Moisure Requirements: Low Moisture, **M**oderate Moisture, **H**igh Moisture, **A**quatic

SCIENTIFIC NAME	COMMON NAME	REGION			LIGHT			MOISTURE			
		M	P	C	S	P	F	L	M	H	A
SHRUBS											
Viburnum rafinesquianum	downy arrowwood		●		●	●			●		
Viburnum rufidulum	rusty blackhaw		●	●	●	●		●			
Xanthorhiza simplicissima	yellowroot	●	●	●	●			●	●		
VINES											
Berchemia scandens	rattan vine, supplejack			●	●	●			●		
Bignonia capreolata	crossvine		●	●	●	●			●	●	
Campsis radicans	trumpet creeper	●	●	●	●	●			●	●	
Clematis virginiana	virgin's bower	●	●			●	●		●		
Decumaria barbara	climbing hydrangea	●		●	●				●	●	
Gelsemium sempervirens	Carolina jessamine		●	●	●	●	●	●	●		
Lonicera sempervirens	coral honeysuckle		●	●		●			●		
Wisteria frutescens	American wisteria			●		●	●		●	●	
HERBACEOUS PLANTS											
Amsonia tabernaemontana	blue star		●	●	●	●			●		
Anemone quinquefolia	wood anemone	●			●				●		
Anemone virginiana	thimbleweed	●	●			●			●		
Anemonella thalictroides	rue anemone, windflower	●	●		●				●		
Antennaria neglecta	field pussytoes	●	●			●	●	●	●		
Aquilegia canadensis	wild columbine	●	●	●	●	●			●		
Arisaema triphyllum	Jack-in-the-pulpit	●	●	●	●				●		
Aruncus dioicus	goat's beard	●	●		●	●			●		
Asarum canadense	wild ginger	●	●		●				●		
Asclepias incarnata	swamp milkweed	●	●				●				●
Asclepias syriaca	common milkweed	●	●				●	●	●		
Asclepias tuberosa	butterfly weed	●	●	●			●	●			
Aster concolor	Eastern silvery aster		●	●			●	●			
Aster divaricatus	white wood aster	●	●		●	●	●	●	●		
Aster grandiflorus	large-flowered aster		●				●	●			
Aster novae-angliae	New England aster	●					●		●	●	
Baptisia alba	white wild indigo		●			●	●	●			
Baptisia cinerea	Carolina wild indigo			●		●	●	●			
Baptisia tinctoria	yellow wild-indigo	●	●	●		●	●	●			

Native Regions: Mountains, **P**iedmont, **C**oastal Plain
Light Requirements: Shade, **P**artial Sun, **F**ull Sun
Moisure Requirements: Low Moisture, **M**oderate Moisture, **H**igh Moisture, **A**quatic

SCIENTIFIC NAME	COMMON NAME	REGION			LIGHT			MOISTURE			
		M	P	C	S	P	F	L	M	H	A
HERBACEOUS PLANTS											
Chelone glabra	white turtlehead	●	●	●	●	●				●	
Chrysogonum virginianum	green-and-gold		●	●	●	●			●		
Cimicifuga racemosa	black cohosh	●	●		●	●			●		
Convallaria montana	American lily-of-the-valley	●			●	●			●		
Coreopsis auriculata	coreopsis		●		●	●			●		
Coreopsis lanceolata	lance-leaved coreopsis		●	●		●	●	●	●		
Coreopsis tripteris	tall coreopsis	●	●			●	●		●		
Delphinium tricorne	dwarf larkspur	●	●		●				●		
Dicentra cucullaria	Dutchman's breeches	●	●		●				●		
Eupatorium fistulosum	Joe-Pye-weed	●	●	●		●	●		●		
Eupatorium perfoliatum	boneset	●	●	●		●	●		●	●	
Geranium maculatum	wild geranium	●	●		●	●			●		
Gillenia trifoliata	bowman's root	●	●		●	●			●		
Helenium autumnale	sneezeweed	●	●	●		●	●		●	●	
Helianthus angustifolius	narrow-leaf sunflower			●		●	●		●	●	
Helianthus decapetalus	ten-petaled sunflower	●	●		●	●			●		
Helianthus divaricatus	woodland sunflower	●	●			●		●			
Heliopsis helianthoides	ox-eye sunflower	●	●			●	●		●		
Hepatica acutiloba	sharp-lobed hepatica	●			●			●	●		
Hepatica americana	round-lobed hepatica		●		●				●		
Heterotheca mariana	Maryland golden aster	●	●	●		●	●	●			
Heuchera americana	alumroot		●	●	●			●	●		
Hexastylis arifolia	wild ginger, hearleaf	●	●	●	●	●		●	●		
Hibiscus moscheutos	rose mallow	●	●	●			●				●
Iris cristata	dwarf crested iris	●	●		●	●			●		
Iris virginica	blue flag iris	●		●		●	●				●
Kosteletskya virginica	seashore mallow			●			●				●
Liatris graminifolia	grass-leaf blazing star	●	●	●		●	●	●	●		
Liatris spicata	spiked blazing star	●		●		●	●		●		
Liatris squarrosa	plains blazing star		●			●	●		●		
Lilium michauxii	Carolina lily	●	●	●	●	●		●	●		
Lilium superbum	Turk's-cap lily	●			●	●			●	●	

Native Regions: Mountains, **P**iedmont, **C**oastal Plain
Light Requirements: Shade, **P**artial Sun, **F**ull Sun
Moisure Requirements: Low Moisture, **M**oderate Moisture, **H**igh Moisture, **A**quatic

SCIENTIFIC NAME	COMMON NAME	REGION			LIGHT			MOISTURE			
		M	P	C	S	P	F	L	M	H	A
HERBACEOUS PLANTS											
Lobelia cardinalis	cardinal flower	●	●	●		●	●				●
Lobelia siphilitica	great blue lobelia	●				●					●
Mitchella repens	partridgeberry	●	●	●	●	●		●	●		
Monarda didyma	bee balm, Oswego tea	●			●	●			●	●	
Monarda fistulosa	wild bergamot	●	●			●	●		●		
Nymphaea odorata	American water lily	●	●	●			●				●
Oenothera fruticosa	sundrops	●	●	●		●	●	●	●		
Peltandra virginica	arrow arum		●	●		●	●				●
Penstemon laevigatus	smooth beardtongue		●	●		●	●		●		
Penstemon smallii	beardtongue	●				●	●	●	●		
Phlox carolina	thick-leaved phlox, Carolina phlox	●	●			●	●	●	●		
Phlox divaricata	blue phlox	●			●	●			●		
Phlox glaberrima var. *triflora*	smooth phlox	●				●	●		●		
Phlox paniculata	summer phlox	●	●			●	●		●		
Phlox stolonifera	creeping phlox	●			●	●			●		
Podophyllum peltatum	mayapple	●	●	●	●	●			●		
Polygonatum biflorum	Solomon's seal	●	●	●	●	●			●		
Pontederia cordata	pickerelweed		●	●			●				●
Pycnanthemum incanum	hoary mountain-mint	●	●	●		●		●	●		
Pycnanthemum tenuifolium	narrow-leaved mountain-mint	●	●	●		●	●	●	●		
Rudbeckia fulgida	Eastern coneflower		●			●	●	●	●		
Rudbeckia hirta	black-eyed Susan	●	●	●		●	●	●	●		
Rudbeckia laciniata	cut-leaved coneflower	●	●	●		●	●		●	●	
Rudbeckia triloba	three-lobed coneflower	●	●			●			●		
Sagittaria latifolia	duck-potato, arrowhead		●	●			●				●
Sanguinaria canadensis	bloodroot	●	●	●	●				●		
Saururus cernuus	lizard's-tail		●	●	●	●	●				●
Sedum ternatum	wild stonecrop	●	●		●	●			●		
Silene stellata	starry campion	●	●		●				●		

Native Regions: **M**ountains, **P**iedmont, **C**oastal Plain
Light Requirements: **S**hade, **P**artial Sun, **F**ull Sun
Moisure Requirements: **L**ow Moisture, **M**oderate Moisture, **H**igh Moisture, **A**quatic

SCIENTIFIC NAME	COMMON NAME	REGION			LIGHT			MOISTURE			
		M	P	C	S	P	F	L	M	H	A
HERBACEOUS PLANTS											
Silene virginica	fire pink	●	●			●		●	●		
Silphium compositum	rosin-weed	●	●	●		●	●	●			
Smilacina racemosa	false Solomon's-seal	●	●	●	●	●			●		
Solidago caesia	bluestem goldenrod		●		●	●			●		
Solidago odora	sweet goldenrod		●	●		●	●	●			
Solidago rugosa	rough-stemmed goldenrod	●	●	●		●	●		●		
Tiarella cordifolia	foamflower	●			●				●		
Trillium cuneatum	little sweet Betsy	●			●				●		
Trillium erectum	wake robin	●			●				●		
Trillium grandiflorum	large-flowered trillium	●			●				●		
Uvularia grandiflora	large-flowered bellwort	●			●				●		
Vernonia noveboracensis	New York ironweed	●	●	●		●	●			●	
Viola pedata	bird's-foot violet	●	●	●		●	●	●			
Zephranthes atamasco	Atamasco lily		●	●		●	●		●	●	
FERNS											
Adiantum pedatum	maidenhair fern	●			●				●		
Athyrium asplenioides	Southern lady fern	●	●	●	●				●	●	
Onoclea sensibilis	sensitive fern	●	●	●		●	●		●	●	
Osmunda cinnamomea	cinnamon fern	●	●	●	●	●			●	●	
Osmunda regalis	royal fern	●	●	●	●	●			●	●	
Polystichum acrostichoides	Christmas fern	●	●	●	●	●		●	●		
Pteridium aquilinum	bracken fern	●	●	●		●		●	●		
Woodwardia areolata	netted chain fern	●	●	●	●	●			●	●	
Woodwardia virginica	Virginia chain fern		●	●	●	●	●	●	●		
SEEDS FOR STABILIZATION											
Andropogon gerardii	big bluestem	●	●	●		●	●	●	●		
Carex stricta	tussock sedge	●	●	●		●	●			●	●
Chasmanthium latifolium	river oats	●	●	●	●	●	●		●	●	
Elymus hystrix	bottlebrush grass	●	●	●	●	●			●		
Elymus virginicus	Virginia wild rye	●	●	●	●	●			●		
Juncus effusus	soft rush	●	●	●		●	●			●	●
Panicum anceps	beaked panicum	●	●	●		●	●	●	●		

Native Regions: Mountains, **P**iedmont, **C**oastal Plain
Light Requirements: Shade, **P**artial Sun, **F**ull Sun
Moisure Requirements: Low Moisture, **M**oderate Moisture, **H**igh Moisture, **A**quatic

SCIENTIFIC NAME	COMMON NAME	REGION			LIGHT			MOISTURE			
		M	P	C	S	P	F	L	M	H	A
SEEDS FOR STABILIZATION											
Panicum clandestinum	deer tongue	●	●			●	●		●	●	
Panicum virgatum	switch grass	●	●	●		●	●	●	●	●	
Schizachyrium scoparium	little bluestem	●	●	●		●	●	●	●		
Sorghastrum nutans	Indian grass	●	●	●		●	●	●	●		
Tridens flavus	purple top	●	●	●		●	●	●	●		

Native Regions: Mountains, **P**iedmont, **C**oastal Plain
Light Requirements: Shade, **P**artial Sun, **F**ull Sun
Moisure Requirements: Low Moisture, **M**oderate Moisture, **H**igh Moisture, **A**quatic

*Species list is a modification of the list found in the North Carolina Division of Parks and Recreation's *Planting Guidelines: Choosing the Appropriate Trees, Shrubs, Herbs, and Seeds to Plant in Our Parks*.

Southeast Exotic Pest Plant Council Early Detection and Distribution Mapping System

The Southeast Exotic Pest Plant Council (SE-EPPC) has initiated a project to map the distribution of invasive exotic plants in the Southeast called the Early Detection and Distribution Mapping System. States included in this project are Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee. The White Paper describing this project has been reprinted from the SE-EPPC Web site and is included in this appendix.

In addition, the SE-EPPC Mapping Project Data Collection Form has been reprinted from the Web site and is included in this appendix. This form includes all of the information that should be collected in the field to report an infestation. Keep in mind that the latitude and longitude must be recorded in decimal degrees of at least five decimal places. A single point denotes an entire infestation so it is best to collect the point as close to the center of the infestation as possible.

All of the information for viewing distribution maps and reporting infestations can be found on the SE-EPPC Web site at www.se-eppc.org, then click on "EDDMapS."

White Paper: SE-EPPC Invasive Species Mapping Project

Accurate, comprehensive data on the distribution of invasive weed species can be a valuable asset to assist managers, researchers, and policy makers in prioritizing management strategies, identifying leading edges of actively spreading infestations, and to rapidly respond to detections of new invasive species. Unfortunately, much of the current distribution data for invasive plants in the Southeastern United States is incomplete, often available only to a county level and generally not available online. In response to this lack of information, the SE-EPPC has initiated an invasive species mapping project designed by the University of Georgia Bugwood Network. The SE-EPPC mapping project seeks to provide more complete data on the distribution of selected invasive plant species across the South by: 1) compiling current data from herbarium records, literature and current on-going projects; 2) creation of new data using volunteers from the state EPPCs; and 3) providing user-friendly access to the data online at the SE-EPPC's Web site, www.se-eppc.org. This data can be used to aid

early detection/rapid response programs and can increase the accuracy of predictive modeling projects.

The project will compile data from existing online projects and collected by the SE-EPPC project to produce species distribution maps. All data collected will be compliant with North American Weed Management Area mapping standards and can be shared with most major mapping projects. Descriptive features of the infestation, such as habitat, infested area and abundance are included within the data. To ensure data validity, herbarium vouchers for recorded infestations are encouraged for submission to a local herbarium. Additionally, identification-level images can be uploaded with the infestation distribution data. States in the Southeastern United States with an active EPPC or Invasive Plant Council can be involved. Each state is responsible for appointing a state representative who oversees recruiting and training volunteers and reviews the data entered for that state. Invasive species currently included in the project list are from a compilation of each state EPPC invasive species list, state noxious weed list, and relevant federal noxious weeds, likely to be introduced into the Southeast. This list continues to evolve and additions are easily added to the project list.

The data can be viewed on the online mapping program at www.se-eppc.org/mapping. Distribution data can be graphically displayed as point-data or county-level maps. This project uses Google Maps web service to allow users to overlay the point data with road maps, satellite images and topographic maps. With the cooperation of the state EPPCs, this project can help fill in the gaps in the distribution data and provide users with an easy to operate method of retrieving the data.

The Bugwood Network is a cooperative working group between the University of Georgia's College of Agricultural and Environmental Sciences and the Warnell School of Forestry and Natural Resources. The Bugwood Network aims to provide information sources for supporting forestry, natural resources and agriculture with funding from USDA Forest Service Forest Health Program, USDA Forest Service -Forest Health Technology Enterprise Team, USDA APHIS PPQ, USDA CSREES and NSF Center for Integrated Pest Management. The Network has developed and serves

15 Web sites that receive over 7 million hits and 2.5 million requests from 750,000 unique users each month.

SE-EPPC Mapping Project Data Collection Form (v.4/2/06)

Species _____ Observation Date _____

State _____ County _____

Latitude _____ Longitude _____

Datum* ☐NAD27 ☐NAD 83 ☐Other _____
*Most GPS systems are based off of NAD83 by default.

Infested Area _____ ☐ Acres ☐Hectares ☐Sq. Feet ☐Sq. Meters

Gross Area _____ ☐ Acres ☐Hectares ☐Sq. Feet ☐Sq. Meters

Canopy Closure

☐ Trace (Less than 1 percent) ☐ Low (Less than 1 percent) ☐ Moderate (5.1 – 25 percent) ☐High (Less than 1 percent)

Habitat

☐Edge: Upland/wetland
☐Edge: Field/forest
☐Edge: Lake edge
☐Edge: Roadside
☐Open Field
☐Old Field
☐Right-of-way
☐Other
☐Forests: Pine
☐Forests: Hardwood
☐Forests: Mixed
☐Dune
☐Beach
☐Park
☐Rocky outcrops
☐Wetlands: Marsh
☐Wetlands: Swamp
☐Wetlands: Bog
☐Streambank
☐Yard/Garden
☐Ag Field
☐Abandoned lot/homesite

Abundance

☐Single Plant ☐Dense Monoculture ☐Scattered Plants ☐Scattered Dense Patches

Ownership

☐U.S. Army Corps of Engineers
☐Environmental Protection Agency
☐Department of Defense
☐National Biological Survey
☐National Oceanic and Atmospheric Administration
☐National Park Service
☐Natural Resources Conservation Service
☐Tennessee Valley Authority
☐United States Forest Service
☐United States Fish and Wildlife Service
☐United States Geological Survey
☐U.S. Government (Other Federal Lands)
☐Native American Allotments
☐Bureau of Indian Affairs
☐Tribal Lands
☐Agricultural Research Station
☐USDA Forest Service Research Station
☐University Lands
☐State Lands
☐County Government
☐The Nature Conservancy
☐Private Landowner
☐Other/Unknown

Location Description/Comments:

_____

_____

_____

Voucher Specimen Made ☐Yes ☐No
Herbarium holding specimen _____

Resources for Additional Information

1. **The University of North Carolina at Chapel Hill North Carolina Botanical Garden: www.ncbg.unc.edu**
   Links to two publications: Recommended Sources for Native Plants and Controlling Invasive Plants. In addition, provides lists of Native Southeastern Plants for Your Garden.

2. **Southeast Exotic Pest Plant Council: www.se-eppc.org**
   Information regarding the Early Detection and Distribution Mapping System (EDDMaps) for invasive exotic plants.

3. **University of Georgia Bugwood Network: www.bugwood.org**
   A comprehensive Web site for links to invasive species publications and images.

4. **The Nature Conservancy Global Invasive Species Initiative: http://tncweeds.ucdavis.edu/**
   Provides resources for conservationists to deal effectively with invasive species.

5. **Invasive.org: www.invasive.org**
   Source for invasive and exotic species information and images.

6. **National Park Service: Alien Plant Invaders of Natural Areas: www.nps.gov/plants/alien**
   Provides list of invasive plants invading natural areas throughout the United States, illustrated fact sheets, and links to other people and organizations.

7. **North Carolina Department of Agriculture and Consumer Services, Plant Industry Division, Plant Protection Section: www.ncagr.com/plantindustry/plant/weed/weedprog.htm**
   Describes the Regulatory Weed Program and provides a listing of state noxious weeds.

8. **North Carolina Agricultural Chemicals Manual: http://ipm.ncsu.edu/agchem/agchem.html**
   Comprehensive information regarding pesticides and application rates.

*Federal Noxious Weed List**

Aquatic/Wetland

Azolla pinnata R. Brown (mosquito fern, water velvet)
Caulerpa taxifolia (Vahl) C. Agardh, Mediterranean strain (killer algae)
Eichornia azurea (Swartz) Kunth (anchored waterhyacinth, rooted waterhyacinth)
Hydrilla verticillata (Linnaeus f.) Royle (hydrilla)
Hygrophila polysperma T. Anderson (Miramar weed)
Ipomoea aquatica Forsskal (water-spinach, swamp morning-glory)
Lagarosiphon major (Ridley) Moss
Limnophila sessiliflora (Vahl) Blume (ambulia)
Melaleuca quinquenervia (Cav.) Blake (broadleaf paper bark tree).
Monochoria hastata (Linnaeus) Solms-Laubach
Monochoria vaginalis (Burman f.) C. Presl
Ottelia alismoides (L.) Pers.
Sagittaria sagittifolia Linnaeus (arrowhead)
Salvinia auriculata Aublet (giant salvinia)
Salvinia biloba Raddi (giant salvinia)
Salvinia herzogii de la Sota (giant salvinia)
Salvinia molesta D.S. Mitchell (giant salvinia)
Solanum tampicense Dunal (wetland nightshade)
Sparganium erectum Linnaeus (exotic bur-reed)

Parasitic

Aeginetia spp.
Alectra spp.
Cuscuta spp. (dodders), other than following species:
Cuscuta americana Linnaeus
Cuscuta applanata Engelmann
Cuscuta approximata Babington
Cuscuta attenuata Waterfall
Cuscuta boldinghii Urban
Cuscuta brachycalyx (Yuncker) Yuncker
Cuscuta californica Hooker & Arnott
Cuscuta campestris Yuncker
Cuscuta cassytoides Nees ex Engelmann
Cuscuta ceanothii Behr

Cuscuta cephalanthii Engelmann
Cuscuta compacta Jussieu
Cuscuta corylii Engelmann
Cuscuta cuspidata Engelmann
Cuscuta decipiens Yuncker
Cuscuta dentatasquamata Yuncker
Cuscuta denticulata Engelmann
Cuscuta epilinum Weihe
Cuscuta epithymum (Linnaeus) Linnaeus
Cuscuta erosa Yuncker
Cuscuta europaea Linnaeus
Cuscuta exalta Engelmann
Cuscuta fasciculata Yuncker
Cuscuta glabrior (Engelmann) Yuncker
Cuscuta globulosa Bentham
Cuscuta glomerata Choisy
Cuscuta gronovii Willdenow
Cuscuta harperi Small
Cuscuta howelliana Rubtzoff
Cuscuta indecora Choisy
Cuscuta jepsonii Yuncker
Cuscuta leptantha Engelmann
Cuscuta mitriformis Engelmann
Cuscuta nevadensis I. M. Johnston
Cuscuta obtusiflora Humboldt, Bonpland, & Kunth
Cuscuta occidentalis Millspaugh ex Mill & Nuttall
Cuscuta odontolepis Engelmann
Cuscuta pentagona Engelmann
Cuscuta planiflora Tenore
Cuscuta plattensis A. Nelson
Cuscuta polygonorum Engelmann
Cuscuta rostrata Shuttleworth ex Engelmann
Cuscuta runyonii Yuncker
Cuscuta salina Engelmann
Cuscuta sandwichiana Choisy
Cuscuta squamata Engelmann

Cuscuta suaveolens Seringe
Cuscuta suksdorfii Yuncker
Cuscuta tuberculata Brandegee
Cuscuta umbellata Humboldt, Bonpland, & Kunth
Cuscuta umbrosa Beyrich ex Hooker
Cuscuta vetchii Brandegee
Cuscuta warneri Yuncker
Orobanche spp. (broomrapes), other than the following species:
Orobanche bulbosa (Gray) G. Beck
Orobanche californica Schlechtendal & Chamisso
Orobanche cooperi (Gray) Heller
Orobanche corymbosa (Rydberg) Ferris
Orobanche dugesii (S. Watson) Munz
Orobanche fasciculata Nuttall
Orobanche ludoviciana Nuttall
Orobanche multicaulis Brandegee
Orobanche parishii (Jepson) Heckard
Orobanche pinorum Geyer ex Hooker
Orobanche uniflora Linnaeus
Orobanche valida Jepson
Orobanche vallicola (Jepson) Heckard
Striga spp. (witchweeds)

Terrestrial

Ageratina adenophora (Sprengel) King & Robinson (crofton weed)
Alternanthera sessilis (Linnaeus) R. Brown ex de Candolle (sessile joyweed)
Asphodelus fistulosus Linnaeus (onionweed)
Avena sterilis Linnaeus (including Avena ludoviciana Durieu) (animated oat, wild oat)
Carthamus oxyacantha M. Bieberstein (wild safflower)
Chrysopogon aciculatus (Retzius) Trinius (pilipiliula)
Commelina benghalensis Linnaeus (Benghal dayflower)
Crupina vulgaris Cassini (common crupina)
Digitaria scalarum (Schweinfurth) Chiovenda (African couchgrass, fingergrass)

Digitaria velutina (Forsskal) Palisot de Beauvois (velvet fingergrass, annual conchgrass)
Drymaria arenarioides Humboldt & Bonpland ex Roemer & Schultes (lightning weed)
Emex australis Steinheil (three-cornered jack)
Emex spinosa (Linnaeus) Campdera (devil's thorn)
Galega officinalis Linnaeus (goatsrue)
Heracleum mantegazzianum Sommier & Levier (giant hogweed)
Homeria spp.
Imperata brasiliensis Trinius (Brazilian satintail)
Imperata cylindrica (Linnaeus) Raeuschel (cogongrass)
Ischaemum rugosum Salisbury (murainograss)
Leptochloa chinensis (Linnaeus) Nees (Asian sprangletop)
Lycium ferocissimum Miers (African boxthorn)
Melastoma malabathricum Linnaeus
Mikania cordata (Burman f.) B. L. Robinson (mile-a-minute)
Mikania micrantha Humboldt, Bonpland, & Kunth
Mimosa invisa Martius (giant sensitive plant)
Mimosa pigra Linneaus var. *pigra* (catclaw mimosa)
Nassella trichotoma (Nees) Hackel ex Arechavaleta (serrated tussock)
Opuntia aurantiaca Lindley (jointed prickly pear)
Oryza longistaminata A. Chevalier & Roehrich (red rice)
Oryza punctata Kotschy ex Steudel (red rice)
Oryza rufipogon Griffith (red rice)
Paspalum scrobiculatum Linnaeus (Kodo-millet)
Pennisetum clandestinum Hochstetter ex Chiovenda (kikuyugrass)
Pennisetum macrourum Trinius (African feathergrass)
Pennisetum pedicellatum Trinius (kyasumagrass)
Pennisetum polystachion (Linnaeus) Schultes (missiongrass, thin napiergrass)
Prosopis alpataco R. A. Philippi
Prosopis argentina Burkart
Prosopis articulata S. Watson
Prosopis burkartii Munoz
Prosopis caldenia Burkart
Prosopis calingastana Burkart

Prosopis campestris Griseback
Prosopis castellanosii Burkart
Prosopis denudans Bentham
Prosopis elata (Burkart) Burkart
Prosopis farcta (Solander ex Russell) Macbride
Prosopis ferox Grisebach
Prosopis fiebrigii Harms
Prosopis hassleri Harms
Prosopis humilis Gillies ex Hooker & Arnott
Prosopis kuntzei Harms
Prosopis pallida (Humboldt & Bonpland ex Willdenow) Humboldt, Bonpland, & Kunth
Prosopis palmeri S. Watson
Prosopis reptans Bentham var. reptans
Prosopis rojasiana Burkart
Prosopis ruizlealii Burkart
Prosopis ruscifolia Grisebach
Prosopis sericantha Gillies ex Hooker & Arnott
Prosopis strombulifera (Lamarck) Bentham
Prosopis torquata (Cavanilles ex Lagasca y Segura) de Candolle
Rottboellia cochinchinensis (Lour.) W. Clayton
Rubus fruticosus Linnaeus (complex) (wild blackberry)
Rubus moluccanus Linnaeus (wild raspberry)
Saccharum spontaneum Linnaeus (wild sugarcane)
Salsola vermiculata Linnaeus (wormleaf salsola)
Senecio inaequidens DC (South African ragwort)
Senecio madagascariensis Poir (Madagascar ragwort)
Setaria pallide-fusca (Schumacher) Stapf & Hubbard (cattail grass)
Solanum torvum Swartz (turkeyberry)
Solanum viarum Dunal (tropical soda apple)
Spermacoce alata (Aublet) de Candolle
Tridax procumbens Linnaeus (coat buttons)
Urochloa panicoides Beauvois (liverseed grass)

***As of June 30, 2006**

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Moderate Threat to Habitat and Natural Areas

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