



Technical Note No. 190–72



March 2007

Noxious, Invasive, and Alien Plant Species:

A Challenge in Wetland Restoration and Enhancement

Issued March 2007

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Acknowledgements

Technical Note No. 190–72 was produced by the NRCS National Wetland Team (<http://www.wli.nrcs.usda.gov>), Fort Worth, Texas. For further information, contact **Norman C. Melvin**, Ph.D., Team Leader, 817–509–3572, E-mail: norman.melvin@ftw.usda.gov.

Photographic credits:

The Nature Conservancy: photos of *Melaleuca quinquinervia*, *Phalaris arundinacea* landscape image, and *Sesbania exaltata* flower

Gary Buckingham, Agricultural Research Service: *Alternanthera philoxeroides* landscape image

Alec McClay, McClay Ecoscience: *Circium arvense* landscape image

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Mark Anderson, NRCS, North Dakota: combination photo of *Typha latifolia*, *T. x glauca*, and *T. angustifolia*

USDA NRCS National Plants Data Center: all other photographs

Wildflowers home page: *Euphorbia escula* roots
http://www.wildflowers-and-weeds.com/weedsinfo/Euphorbia_escula.htm

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Noxious, Invasive, and Alien Plant Species

A Challenge in Wetland Restoration and Enhancement

Purpose

The purpose of this technical note is to provide information on noxious, invasive, alien, and other problem plant species that threaten the success of wetland restoration and enhancement projects. This report defines the different categories of problem species, identifies the threats to success caused by these species, and recommends methods of avoidance through planning and monitoring. This report also contains specific identification information and control information for 13 plant species that have a significant negative impact on the functions and values of wetland restoration and enhancement projects.

Noxious, invasive, alien, and other problem plant species and the threat to wetland restoration and enhancement

Noxious and invasive plant species threaten the success of many of our wetland restoration and enhancement activities. When these species become established on a developing wetland site, they can out-compete and displace native species, reduce wildlife habitat potential, alter natural ecosystem processes, and limit overall biodiversity. Although no site is immune from the chance dispersal of problem species, some sites are more predisposed than others to an invasion because of their position in the landscape, proximity to existing propagule sources, poor project design, or poor establishment of targeted vegetation. It is important to consider a site's risk to invasion in the planning process and perform regular follow-up monitoring to identify chance introductions. With early detection, a problem species is easier to contain or eradicate than when it is fully established. Once established, it may be difficult or impossible to control or eliminate problem vegetation, and control measures can often adversely impact remnant native vegetation.

What are native species and the different types of problem plant species and how are they defined?

This list is ordered from what can be considered from good, to bad, to worse:

- *Native species*—As defined in Presidential Executive Order (EO) 13112, a native species means, with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem. Accordingly, a species cannot be considered native to a geographic region or habitat merely because it is native somewhere within the continental United States. For example, pond pine (*Pinus serotina*) occurs as a native species in wetlands in the Southeast and Mid-Atlantic states from Alabama to New Jersey. Although habitats may be similar in the Lower Mississippi River Alluvial Valley (LMRAV), pond pine cannot be considered native to this geographical region because its native distribution does not extend into the LMRAV. Another example, coastal doghobble (*Leucothoe axillaris*), occurs in coastal plain wetlands throughout the Southeast. It is not be considered native to montane wetlands of the same southeastern states since these habitats are not part of Coastal Plain Province where the doghobble is native.
- *Alien species*—Synonyms for alien species include exotic, nonnative, nonindigenous, and introduced species. Of the thousands of plants introduced to the United States intentionally for cultivation or by accident, 4,094 of them presently occur outside of cultivation (NRCS PLANTS Database). This number does not include plants that are native to one ecosystem but now occur in other ecosystems. EO 13112 (Invasive Species) narrowly defines an alien species and ties the definition directly to an occurrence outside of its natural ecosystem: Alien species means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem. This definition in-

cludes introductions from other continents, bioregions, and importantly, those not native to the local geographic region. For example, saltmarsh cordgrass (*Spartina alterniflora*) is native to eastern North American estuaries. It has been introduced to western North American shoreline habitats where it is considered an alien species. In these western habitats, saltmarsh cordgrass adversely impacts native habitats and displaces native plant species.

- *Weed*—The U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS) defines a weed as any plant that poses a major threat to agriculture and/or natural ecosystems within the United States. Although this is more specific than a typical dictionary definition (a plant growing in an undesired location), it more accurately portrays the economic and ecological impact weeds can have on our landscapes and on the natural ecosystems we are restoring. It is important to realize that in restoration and enhancement work, species other than those listed on the USDA APHIS Noxious Weed List (http://plants.nrcs.usda.gov/cgi_bin/federal_noxious.cgi) or state lists (<http://plants.usda.gov/java/noxiousDriver>) can, and frequently do, limit restoration success. Therefore, the invasive potential of all proposed vegetative restoration materials, as well as those that may be expected to establish on the site independently, must be considered.
- *Invasive species*—Invasive species means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health (EO 13112). Of the 4,094 introduced species that have escaped cultivation in the United States, 17.3 percent (or 706 plant species) (NRCS PLANTS Database) are listed on Federal or state lists or in publications as being truly invasive. Invasives typically demonstrate rapid growth and spread, invade habitats, and displace other species. Characteristics such as prolific seed production, high seed germination rates, asexual propagation by root or stem fragments, and rapid growth and maturation can predispose a plant to being invasive. For example, the hybrid cattail (*Typha x glauca*), a cross between cattails, is extremely aggressive and out-competes its parental stock, as well as other native species, when established. Alien species that are predisposed to invasiveness have the added advantage of being relatively free from predators (herbivores, insects, parasites, and disease) and can, therefore, expend more en-

ergy for growth and reproduction. Another example, Japanese stiltgrass/Nepalese browntop (*Microstegium vimineum*), introduced from Asia, displaces native vegetation in flood plains and other moist environments by producing a dense, almost complete cover shading out existing vegetation and preventing their re-establishment. The result is a monoculture in the herbaceous layer. *Microstegium* now occurs in 22 states and Puerto Rico, ranging from Texas to Florida in the south, and north into New York and Illinois.

- *Noxious species*—Any living stage (including seeds and reproductive parts) of a parasitic or other plant of a kind which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants, livestock, poultry or other interests of agriculture, including irrigation, navigation, fish and wildlife resources, or the public health (Federal Noxious Weed Act (FNWA) of 1974, as amended). Although the FNWA defines a noxious species in this way, noxious species are formally designated as such by the Secretary of Agriculture, Secretary of the Interior, or by state law or regulation. Once listed, specific actions are required by law when one of these taxa occurs on a parcel of land. For example, purple loosestrife (*Lythrum salicaria*) is listed on the Federal Noxious Weed List. It was introduced into the Northeast in the early 1800s and now occurs in wetlands in 42 of the 48 conterminous United States. It aggressively develops dense monocultural stands, degrades native vegetation, reduces overall vegetative biodiversity, and directly impacts wildlife by the loss of habitat and food.

How do noxious, invasive, alien, and problem plant species interfere with wetland restoration and enhancement success?

These categories of nonnative species have been referred to as a form of biological pollution because they can upset the balance among native species within natural and agricultural ecosystems (USDA APHIS). It must be reiterated that *alien* does not necessarily mean bad; not all alien species are invasive or become noxious. In fact, many nonnative species peacefully coexist with native vegetative ecosystems and provide support for native wildlife habitat and the human population. It is important to note that the bulk of our agricultural food crops are alien species. However, there are numerous examples of alien plants that pose signif-

icant threats to the natural and agricultural landscapes and their biota. Although each alien, invasive, and noxious species exhibits its individual characteristics in the environment and in its interaction with other species, several patterns of disruptive behavior occur. Some of the more common ways these problem species negatively affect the native biota include:

- *Replacement of native vegetation systems*—Alien species commonly have few natural predators, parasites, or diseases and can simply out-compete native species. Other species, such as leafy spurge (*Euphorbia escula*), replace native species by being highly aggressive, tolerant of a wide range of habitat conditions, and producing allelopathic agents which kill existing vegetation and prevent re-establishment.
- *Reduction of biodiversity*—One invasive species can rapidly out-compete numerous native species and dominate an ecosystem with its accentuated reproductive potential. Often, these nonnative species are advantaged by different life-cycle and growth characteristics when compared to their native counterparts; some may germinate earlier, spread more rapidly, or establish quicker. By these and other various mechanisms, one invasive species can out-compete multiple species on a site. This creates a less diverse flora. The Nature Conservancy estimates that alien, invasive plant species are implicated as a causal agent in 42 percent of plant and animal species listed as endangered or threatened under the Endangered Species Act.
- *Reduction of wildlife habitat and food*—Native plants (providing food and habitat) and native animals have co-evolved over long time periods. Replacement of native vegetative systems with ones dominated by aliens generally alter these co-evolved relationships. For example, nonnative genetic strains of reed canarygrass (*Phalaris arundinacea*) establishes itself in dense monocultural stands in restored and enhanced wetlands throughout the northern half of the United States and offers little wildlife food value in the seed or foliage. An example of how altered vegetation can affect habitat structure can be demonstrated with purple loosestrife (*Lythrum salicaria*). It replaces annual emergent vegetation with its perennial sub-woody stems in wetlands throughout much of the United States and Canada. In contrast to these examples, there are situations where alien species are sometimes planted to provide specific benefit for specific species. In such cases, the net benefits provided to the targeted species may override the cost to the native vegetation and other wildlife species. For example, Japanese millet/barnyard grass (*Echinochloa crus-galli* var. *frumentacea*), an alien annual introduced from Asia, is commonly planted in waterfowl management areas for its prolific seed production and forage value. These and similar special use species frequently do become invasive on adjacent properties, causing economic and environmental harm.
- *Change of ecosystem processes*—Native ecosystems have developed under particular abiotic factors and ecosystem processes (rainfall patterns, fire regimes, rates of nutrient cycling) and have adapted to them. The presence of some alien species alters these processes which, in turn, alter the ecosystem to where it can no longer support the native vegetative or faunal community. Flack and Benton (1998) list several important examples. Paperbark/punktree (*Melaleuca quinquenervia*) is invading herbaceous marshes in southern Florida and converts these habitats to woody-dominated swamp forests. Another example is saltcedar (*Tamarix gallica*). It has been introduced into the South and Southwest and alters the natural hydrologic cycle by transpiring greater quantities of water than native vegetation in the same habitat, thus reducing water tables and some surface water habitats. Saltcedar also concentrates salt in its leaves and the decomposing leaf litter raises the site's salinity.
- *Hybridization*—Hybridization among species and populations affects native floras in many ways. Human activities often bring two similar species together, and they hybridize. When this occurs, the resulting offspring may not be as fit to survive as either parent (oak hybrids). On the contrary, there are incidences when two species are brought together hybridize, and the hybrid becomes more competitive than either parent. For example, the hybrid cattail (*Typha x glauca*) is a cross between the broadleaf (*T. latifolia*) and narrowleaf (*T. angustifolia*) cattails and also between broadleaf and southern (*T. dominicensis*) cattails. McGregor et al. (1986) cite the hybrid as, developing extensive pure stands by rhizomatous growth where it occurs in native prairie marshes with greatly varying water levels and disturbed habitats. In these habitats, the hybrid can out-compete its parents, as well as other native species. Galatowitsch (1994) reports that the hybrid cattail has replaced native white top (*Scolochloa festucacea*) and wildrice (*Zizania aquatica*) in prairie potholes in north-

ern Iowa. Another example of hybridization affecting native species and populations can be drawn from attempts to restore natural habitats through the use of native seed and plant materials where the originating source (genetic stock) is from nonlocal sources. It is well known by horticulturists and plant materials specialists that populations of plants adapt to their local environment over many generations. When these locally adapted populations are grown outside of those conditions, they are often less well adapted. When these introduced natives hybridize with the locals, the genetic makeup of the locals is altered and possibly produces populations less well adapted to their own local environment. This type of hybridization, which can result in lowered fitness of local populations, is of critical concern when rare, endangered, and threatened species are involved.

How can we mitigate the effects of noxious, invasive, and alien species in restoration and enhancement efforts?

The NRCS Invasive Species Policy (November 2004) (<http://policy.nrcs.usda.gov/viewerFS.aspx?id=219>) does the following:

- directs NRCS to prevent the introduction of invasive species to provide for their control and to do no harm
- encourages use of natives
- recognizes that NRCS staffs may be first to discover invasive species on working lands and may play a primary role in early detection
- encourages partnerships
- requires NRCS staffs to join with Federal, state, tribal, and local officials and the state technical committee in compiling state and regional invasive species lists
- requires NRCS to provide assistance to local weed management groups

Our restoration and enhancement activities can significantly contribute to the spread of noxious, invasive, and alien species and the detrimental effects caused by them. The colonization and establishment of these problem species on a site can affect the overall success of the project and can inadvertently create additional opportunities for the establishment and spread of these species throughout the watershed and onto other landscapes and land ownerships. Although it

may be impossible to eliminate all possibilities of invasion, the presence, impact, and spread of problem species can be limited through proper planning and monitoring. To diminish the negative effects of problem species in our wetland restoration activities and be compliant with the requirements of the NRCS Invasive Species Policy, we should do the following:

- Know the species that can cause problems in your area. State heritage programs, The Nature Conservancy, extension programs, USDA APHIS, and other state and private programs maintain lists of problem species. Request and maintain these lists. Be familiar with the species' identification, methods of dispersal, location and extent of existing populations, timing of reproduction and germination, and other growth characteristics. Check the USDA NRCS Plant Data Center's PLANT Web site for the invasive plants module: (<http://plants.usda.gov/java/noxiousDriver>).
- Be sensitive to the threats these species pose. Often, specific alien and rapidly proliferating plant species are used to enhance particular wetland functions. Understand the potential of these species for colonizing surrounding landscapes and the possible effects they may produce outside the project site. It may be necessary to alter the proposed vegetation if the threat to surrounding landscapes and properties is too great.
- Detect the presence of propagules in seed banks. If seed or other propagules of problem species are known (or suspected) to be in the seed bank in high concentrations, it may be advisable to delay the installation of the restoration for one growing season and concentrate on pest control.
- Plan accordingly—In the planning process, identify potential sources of accidental introduction onto a project site. Are particular problem species present on adjacent properties, upstream, or upwind? Are they capable of infesting the project site? Assess the potential rate of dispersal and infestation; alter your restoration accordingly. Be aware of potential sources of contamination during restoration, on equipment, in mulch, or weed seed contained in seed mixes (e.g., Canada thistle as a contaminant in uncertified, native warm-season grass seed).
- Understand the seed tag on purchased seed—The seed tag contains specific information on the types of seed, proportion of live seed, and weed seed contained in the mix. It is important to read the tags and evaluate the possible weed

contaminants. Purchased seed can legally contain seed that is classified as noxious in one state that may not be considered noxious in another. The NRCS Plant Materials Web site (<http://www.plant-materials.nrcs.usda.gov/pubs/IDPMSTN04265.pdf>) contains information on reading seed tags. It is recommended that certified seed be purchased and planted when a seed mix is specified. Certified seed contains a higher germination and purity rates. This will reduce the kinds and number of weeds that are planted with the desired grasses and forbs. If a weed species in the mix is not currently in the area, critically evaluate the potential ramifications of introducing that new species in the area.

- Re-establish vegetation on a disturbed site quickly. Many invasive and noxious species are rapid colonizers of bare soil. Restoration and enhancement sites that are allowed to revegetate naturally often do not have sufficient native sources of propagules in the soil and/or adjacent landscapes, especially after excavations have occurred to increase hydrology. These sites are exceptionally vulnerable to infestations of problem species. To repeat an old agricultural cliché, “For land’s sake, keep it covered.” Therefore, seeding and/or planting of locally acquired native plant materials may be required.
- Purchase and plant native species that were derived from local collections. When active regeneration (planting) is used as a technique in vegetative regeneration, specify that the plant materials are to be derived from local source material if available. Just because the vendor is local, does not mean that the provided plant material originated from locally native sources. Native, locally adapted vegetation (ecotypes) often performs better than the same species from a different geographic location. The result will be a quicker establishment of cover on the restoration site. Ecotypes generally perform satisfactorily if moved no farther than 250 to 300 miles to the north or 100 to 150 miles to the south (USDA SCS–TP–157, 1982); however, movement east or west is generally more variable and affected greatly by precipitation, altitude, and soils.
- Avoid establishing nonnative and cultivated (tame) species where possible. For example, fescues, bermudagrasses, bahiagrass, and bromegrasses are commonly planted because they are available, inexpensive, and easily established. These species do provide quick cover, but their benefits are not long term. They have limited wildlife benefit, and will restrict overall site biodiversity by developing dense, persistent monocultural stands. Native species may not give the visual satisfaction of quick success; however, for the long term they provide greater species diversity and wildlife habitat.
- Be knowledgeable in the approved methods of control (cultural, mechanical, chemical, biological) for the species. Often invading species can be controlled mechanically by hand removal or spot treatment if detected early and before they have a chance to reproduce. The chemical pesticides and biological agents available for use on invasive and noxious species vary by state. Contact county extension, state agriculture departments or state pest management departments for approved materials and techniques. For chemical control, identify the specific herbicides recommended, rates of application, mixing instructions, special application techniques, and the timing of application for most effective control, or review recommendations provided by a certified pest control advisor (or equivalent—depending on the state). When using chemical methods, be aware of the impact the herbicides may have on existing native species. If recommending approved biological controls, be knowledgeable about the specific biological agent to be used, the most effective time of release, duration of impact, intensity of activity of the biological agent, and comply with any special precautions or requirements.
- Develop monitoring protocols—Monitoring protocols should stress identification, early detection, and control/eradication. Knowing potential problem species in the area and their presence in the local landscape is useful to determine the rigor of monitoring necessary.

A listing of the most common invasive and noxious plant species colonizing wetland restoration and enhancement sites

The following list contains problem species known to invade and colonize restored and enhanced wetland sites and cause significant negative impacts. Although some of the taxa listed may not be considered wetland plants, they can and do become established in and around wetland sites and their adjacent buffer areas. This list is by no means exhaustive, and one should be familiar with other problem species in their area. Identification and methods of control of these and oth-

er species can be obtained from county extension, state, private organizations, and through Web sites. A listing of Web sites that contain this and other information is provided at the end of this report. Also included is specific identification and control information for each of these species.

Alligatorweed (*Alternanthera philoxeroides*)

Paperbark/punktree (*Melaleuca quinquenervia*)

Canada thistle (*Cirsium arvense*)

Phragmites (*Phragmites australis*)

Chinese tallow (*Triadica sebiferum*)

Purple loosestrife (*Lythrum salicaria*)

Cocklebur (*Xanthium strumarium*)

Reed canarygrass (*Phalaris arundinacea*)

Giant reed (*Arundo donax*)

Bigpod sesbania (*Sesbania herbacea*)

Cattail: Broadleaf (*Typha latifolia*), Narrowleaf
(*T. angustifolia*), Hybrid (*T. x glauca*)

Saltcedar (*Tamarix gallica*)

Leafy spurge (*Euphorbia escula*)

Useful Web sites for additional information on invasive species and noxious plants:

- Alien Plant Working Group: <http://www.nps.gov/plants/alien/>
- Biological control organism's photographs: <http://www.nysaes.cornell.edu/ent/biocontrol/weedfeeders/>
- Center for Invasive Plant Management: <http://www.weedcenter.org/>
- Control of Invasive Nonnative Plants in the Mid-Atlantic Region: <http://www.mdflora.org/publications/invasives.htm>
- Federal and State Noxious/Invasive species lists and Introduced species lists: <http://plants.usda.gov/java/noxiousDriver>
- Federal Noxious Weed Act (1974, as amended): <http://ipl.unm.edu/cwl/fedbook/fedweed.html>
- Federal Government Invasive Species Portal: <http://www.invasivespeciesinfo.gov/plants/main.shtml>
- Federal government/academic invasive species site: <http://www.invasive.org/weeds.cfm>
- Invasive Alien Plant Species of Virginia: <http://www.dcr.virginia.gov/dnh/pdflist.htm>
- Invasive Plant Atlas of New England: <http://invasives.eeb.uconn.edu/ipane/>
- Invasive Plants of the Eastern United States: <http://www.invasive.org/eastern/>
- Plant Invaders of Mid-Atlantic Natural Areas: <http://www.nps.gov/plants/alien/pubs/midatlantic/>
- Presidential Executive Order #13112, February 3, 1999: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=1999_register&docid=99-3184-filed.pdf
- USDA, APHIS Noxious weed home page: http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/index.shtml
- USDA, NRCS, National Wetland Team, Restoration, Enhancement, and Management: <http://www.wli.nrcs.usda.gov/restoration/>
- USDA, NRCS Invasive Species Policy: <http://policy.nrcs.usda.gov/viewerFS.aspx?id=219>
- USDA, NRCS, Plant Data Center invasive and noxious pages: <http://plants.usda.gov/java/noxiousDriver>
- Tennessee Exotic Pest Council's Weed Management Manual: http://www.tneppc.org/Manual/Management_Manual.htm
- The Nature Conservancy Wildland Weeds Management and Research Program: <http://tncweeds.ucdavis.edu/esadocs.html>
- U.S. Congress, Office of Technology Assessment, Harmful Nonindigenous Species in the United States, OTA-F-565 (Washington, DC: U.S. Government Printing Office, September 1993): <http://www.wws.princeton.edu/ota/disk1/1993/9325/9325.PDF>
- USGS, Southwest Exotic Plant Information Clearing House: <http://sbosc.wr.usgs.gov/research/projects/swepic/swepic.asp>
- Vegetation Management Guidelines: <http://www.inhs.uiuc.edu/chf/outreach/VMG/VMG.html>
- Wetland Restoration, Enhancement, Management and Monitoring: <ftp://ftp-fc.sc.egov.usda.gov/WLI/wre&m.pdf>
- Wisconsin invasive species control manual: http://www.dnr.state.wi.us/invasives/pubs/manual_TOC.htm

Alligatorweed / *Alternanthera philoxeroides*

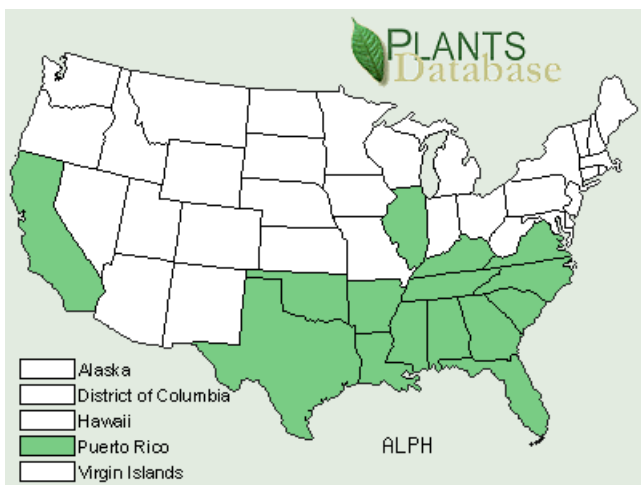
Symbol: ALPH

Dispersal methods: Asexual—primary mode of propagation; fragmentation of rapidly growing stems (stolons) with as little as one node; portions of vegetation mats break off; mechanical removal without removal of all plant materials will exacerbate spread. Sexual—limited; few fruits and seeds develop.

Control information:

<http://www.cdfa.ca.gov/phpps/ipc/weedinfo/alternanthera.htm>

Other: Rapid growth of stems that form large mats of vegetation block sunlight from entering the water column. Anoxic conditions result and mosquito breeding conditions are created.



Canada thistle / *Cirsium arvense*

Symbol: CIAR4

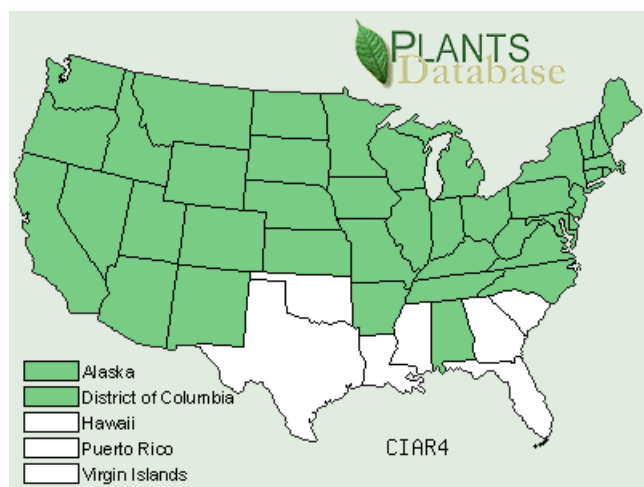
Dispersal methods: Formation of clonal colonies from horizontal roots is the primary means of spread. An individual plant will increase the colony by approximately 1 to 2 meters per year. Seed production and dispersal is a secondary means of dispersal with approximately >90 percent of seed falling within 10 meters from the parent plant and <0.2 percent falling at distances of 1 kilometer. Its primary method of long distance dispersal is by seed inclusion in hay, herbivore droppings, and farm equipment.

Control information:

<http://tncweeds.ucdavis.edu/esadocs/cirsarve.html>

Other: This species is distinguished from all other thistles by its small dioecious heads (separate male and female plants), creeping horizontal rhizomes, and dense clonal foliage.

There are four interfertile varieties and numerous geotypes of this species. The hybrids and genotypes respond differently to management; therefore, multiple management techniques are recommended.



Chinese tallow / *Triadica sebiferum*

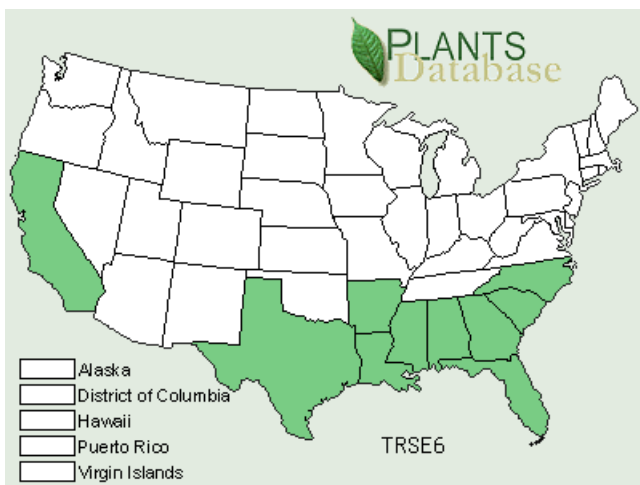
Symbol: TRSE6

Dispersal methods: Seed production and dispersal is its primary mode of reproduction. Plants can reproduce in 3 years and at full maturity can produce approximately 100,000 seeds per plant. Birds and water are the main dispersal agents. The seed is spread by humans since the white fruits are used to make wreaths for decorative purposes, and it is commonly included in floral arrangements. Asexually, this tree can reproduce from cuttings, and root fragments can sprout. Cut stems resprout readily, thus, making mechanical cutting and removal or burning as methods of control difficult.

Control information:

<http://tncweeds.ucdavis.edu/esadocs/sapisebi.html>

Other: Chinese tallow is a rapid invader of disturbed sites, herbaceous prairie, and established forest vegetation. Its early and prolific seed production allows it to quickly invade and establish dominance in a relatively short time. Since it is shade tolerant, it can invade established forest communities. It also invades established herbaceous habitats, shades out the existing vegetation, and shifts the ecology to that of a wooded system. The rapid decomposition of the leaves acidifies the soil by tannin input and leads to eutrophication by rapid inputs of nitrogen and phosphorous as the leaves decompose.



Cocklebur / *Xanthium strumarium*

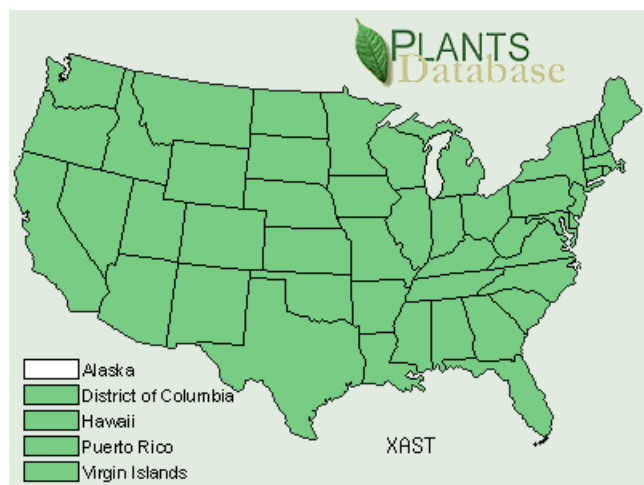
Symbol: XAST

Dispersal methods: Cocklebur is an annual that only reproduces by seed. The fruits can float and are water dispersed. The velcro-type hooks allow the fruit to hitch-hike on the fur of animals and human clothing. Human activity has greatly influenced its spread by the creation of disturbed habitat where it colonizes and by seed dispersed by improperly cleaned equipment.

Control information:

<http://tncweeds.ucdavis.edu/esadocs/xantstru.html>

Other: A rapid colonizer on open, moist, disturbed areas makes the receding edges of water in wetlands (moist-soil management) prime locations for colonization where it can create monotypic stands shading out native species. The cotyledons in developing seedlings are palatable but toxic. Cocklebur can withstand partial submersion for 6 to 8 weeks by growing adventitious roots in the water column. **This species is native to North America.**



Giant reed / *Arundo donax*

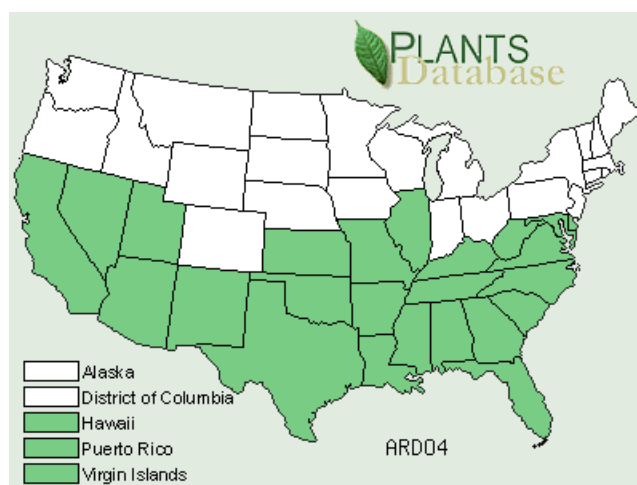
Symbol: ARD04

Dispersal methods: Asexual reproduction by the fragmentation and spread of rhizomes is the primary, if not sole, method of reproduction. Rhizome fragments can be spread by flooding, mechanically by water movement in streams and drainage ditches, and on mechanical equipment. Seed reproduction is limited to nonexistent.

Control information:

<http://tncweeds.ucdavis.edu/esadocs/arundona.html>

Other: Giant reed is a rapid invader along water courses and roadsides resulting from rhizome fragmentation and spread. The stems grow rapidly (stems can grow 0.7 m per week) and with heavy basal branching, is a strong competitor against native plant communities.



Cattails / Broadleaf cattail – *T. latifolia*; Narrowleaf cattail – *T. angustifolia*; Hybrid cattail – *Typha x glauca*

Symbols: Broadleaf – TYLA
Narrowleaf – TYAN
Hybrid – TYGL

Dispersal methods: Cattails produce copious wind-dispersed seeds that readily germinate on moist, warm, exposed soil. Horizontal rhizomes are responsible for increase in colony size and asexual reproduction via fragmentation.

Control information:

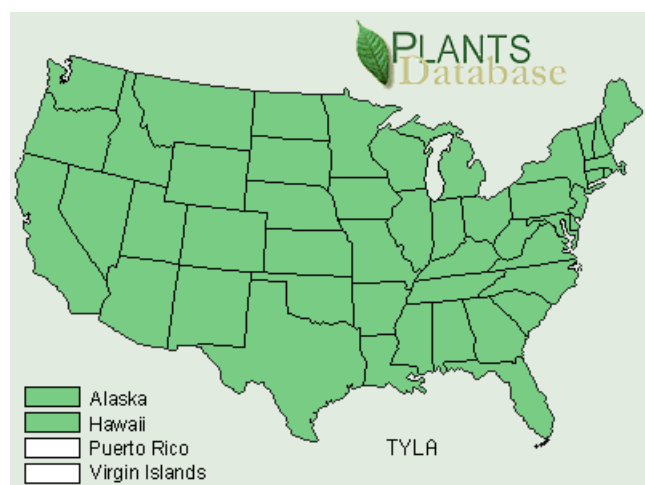
http://tncweeds.ucdavis.edu/esadocs/typh_spp.html

Other: The hybrid cattail is a cross between the broadleaf cattail with either the narrowleaf cattail or the southern cattail. The hybrid cattail is taller and more vigorous than either of the parents.

Identification: The separation between the male and female flowers can be used to distinguish the species. The male flowers of the **broadleaf cattail** begin immediately when the female flowers stop and the overall height of the plant is short in comparison to the others. In both the **narrowleaf** and southern cattails, a fairly wide separation of green stem separates the males from females. The **hybrid cattail** displays only short separation between the two flower types and exceeds the other cattail species in height.



With the broadleaf cattail, the male flowers are directly on top of the female flowers.

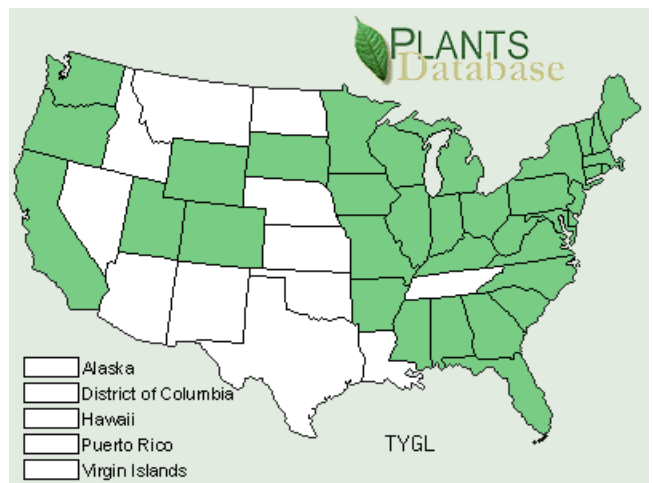
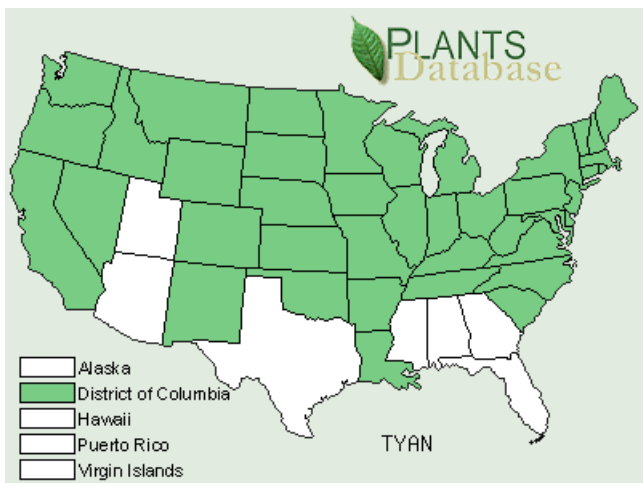




With the narrowleaf cattail, the male flowers are separated from the female flowers.



Three plants compared in this photo are *T. latifolia* (left), *T. x glauca* (center), and *T. angustifolia* (right).



Leafy spurge / *Euphorbia esula*

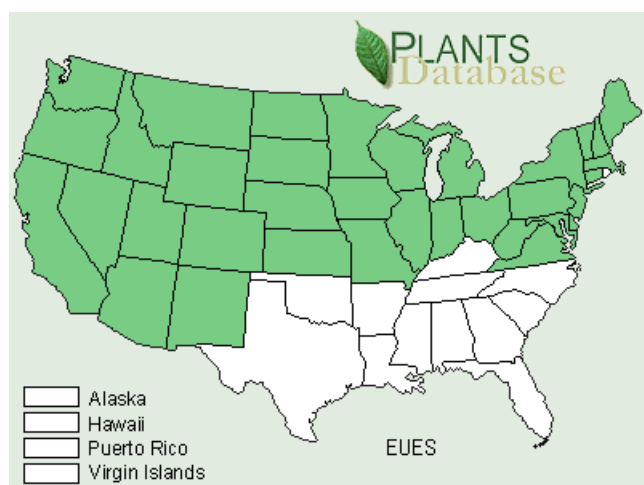
Symbol: EUES

Dispersal information: Sexual—Copious, highly viable seeds produced; capsule explosively ejects seed; seed floats; carried in the digestive tracts of birds and herbivores and on fur. Asexual—roots are elongate and produce numerous crown and root buds, roots fragment and propagate with disturbance or tillage.

Control information:

<http://tncweeds.ucdavis.edu/esadocs/euphesul.html>

Other: Highly aggressive and long lived; shades and displaces competing vegetation; shows alleleopatic tendencies.



Paperbark/punktree / *Melaleuca quinquenervia*

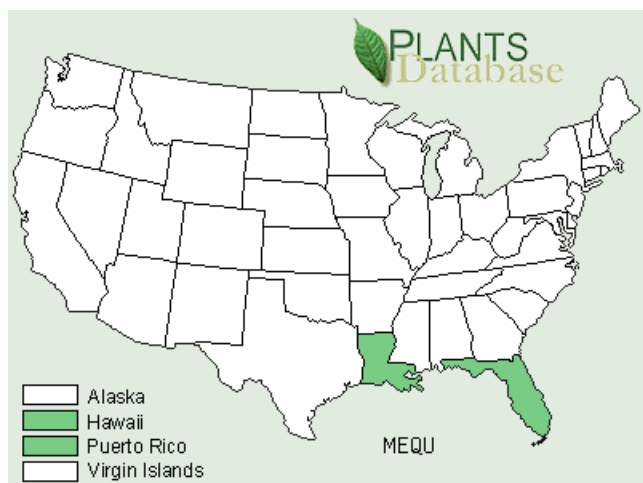
Symbol: [MEQU](#)

Dispersal method: Sexual reproduction by seed is the primary method. Establishing plants mature rapidly (often at 1 year), flowers multiple times per year, and produces copious seeds when fully mature.

Control information:

<http://www.invasive.org/eastern/biocontrol/8AutralianPaperbarkTree.html>

Other: Paperbark tree readily invades natural wetland sites creating monocultures, displaces native vegetation, degrades wildlife habitat, creates a fire hazard, reduces water table depths through transpiration, and its pollen causes allergic reactions to approximately 20 percent of the population. It is tolerant to brackish water, flooding, and fire.



Phragmites / *Phragmites australis*

Symbol: PHAU7

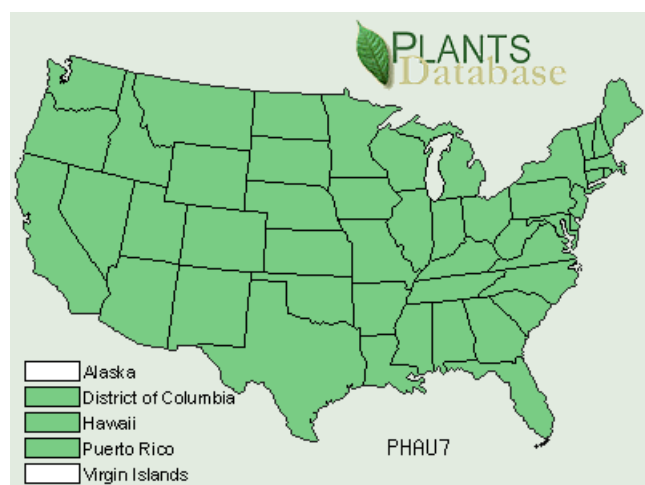
Dispersal method: Phragmites spreads readily by seed and fragmentation of rhizomes. Seed is produced in late summer to fall and dispersed in winter by wind and birds where it can settle on bare flats. Once established, vigorous vegetative reproduction via rhizomes produces nearly monotypic stands. Rhizomes are easily broken by mechanical breakage (wave, ditch cleanout) and propagate new colonies.

Control information:

<http://tncweeds.ucdavis.edu/esadocs/phraaust.html>

Other: Phragmites is found on every continent except Australia, and debate exists as to Phragmites' nativity in North America. Evidence suggests that both native and introduced strains exist and are taxonomically distinguishable. The nonnative, European strains appear to display invasive qualities while the native strains do not.

Phragmites occurs in multiple wetland habitats including those that are fresh, brackish, alkaline, and acidic.



Purple loosestrife / *Lythrum salicaria*

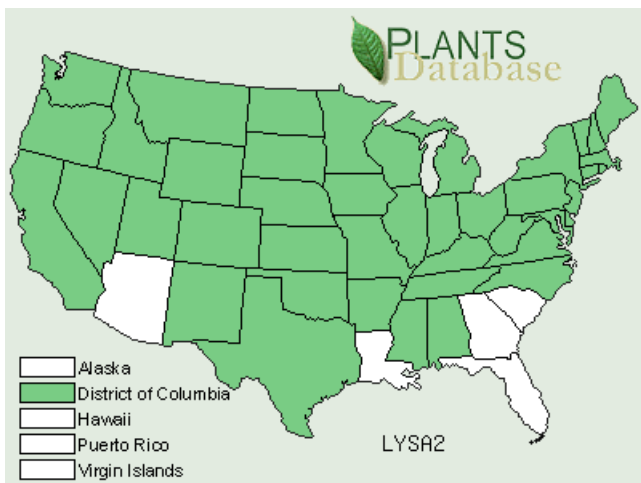
Symbol: LYSA2

Dispersal methods: Seed production and dispersal is the primary reproductive mechanism for this species. Seed production is prolific and may exceed 100,000 seeds per plant. The seed is minute and spread by wind and by mud on bird's feet, humans, and other animals. Seeds and seedlings in the cotyledon stage float and are water dispersed. Asexual reproduction from rootstocks are minimal, other than branching from the root apex. Rooting can occur from cut stems and roots in mechanically fragmented.

Control information:

<http://tncweeds.ucdavis.edu/esadocs/lythsali.html>

Other: Purple loosestrife is a very successful colonizer of bare, disturbed wetlands. This species demonstrates latent invasive behavior when establishing a population in a new area. Initially the population numbers remain low for several years until optimal conditions occur, and then the population explodes.



Reed canarygrass / *Phalaris arundinacea*

Symbol: PHAR3

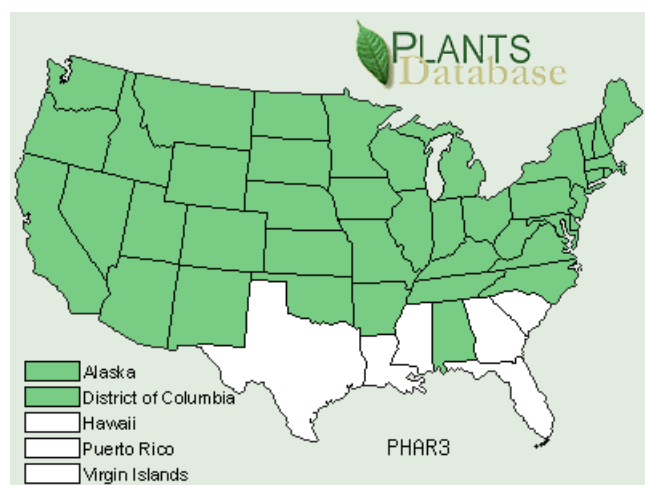
Dispersal methods: Reproduction is sexually by seed and asexually by rhizomes and fragmentation of vegetation mats. Seed is the main method of dispersal and establishment onto new sites where bare soil and disturbed soil conditions exist. Generally, seed viability is greatest immediately after maturity and decreases with time; however, variability exists in the seed's longevity of viability and germination ability. Rhizome spread is responsible for increasing the colony size and population density. Fragmentation of root wads or mats can float to new sites and establish.

Control information:

<http://tncweeds.ucdavis.edu/esadocs/phalarun.html>

Other: Reed canarygrass is circumboreal in distribution, including North America. It is suspected that the invasive quality of this species in our range results from nonnative biotypes and/or agronomic breeding for vigorous growth for hay and forage production and as a soil stabilizer. There are no known morphological characteristics to distinguish between these biotypes.

This species produces dense, vigorous, monocultural stands with little wildlife value. It successfully outcompetes native species, and in areas with long-term dominance, the seedbank of native species will be depleted.



Bigpod sesbania / *Sesbania herbacea*

Symbol: SEHE8

Dispersal method: Bigpod sesbania is an annual with seeds as its primary method of dispersal and propagation. The seeds have a long longevity, and they remain in the seed bank for many years. Germination is sporadic and stimulated by soil disturbance.

Control information:

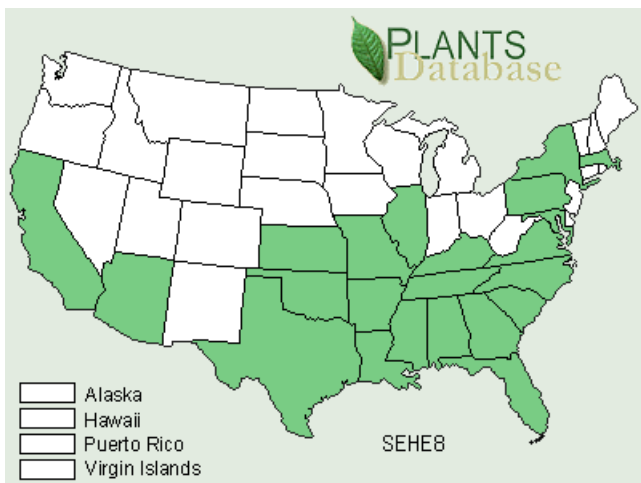
Chemical:

<http://mdc.mo.gov/nathis/exotic/vegman/twentyth.htm>

Biological:

<http://www.entomology.wisc.edu/mbcn/rev509.html>

Other: This species is toxic to livestock and humans, with seeds containing the highest concentration of toxic ingredients. Seed germination is delayed until later in the growing season when bare, moist sites are exposed. Dense stands occur, which shades other vegetation, slowing its establishment.



Saltcedar / *Tamarix gallica*

Symbol: TAGA

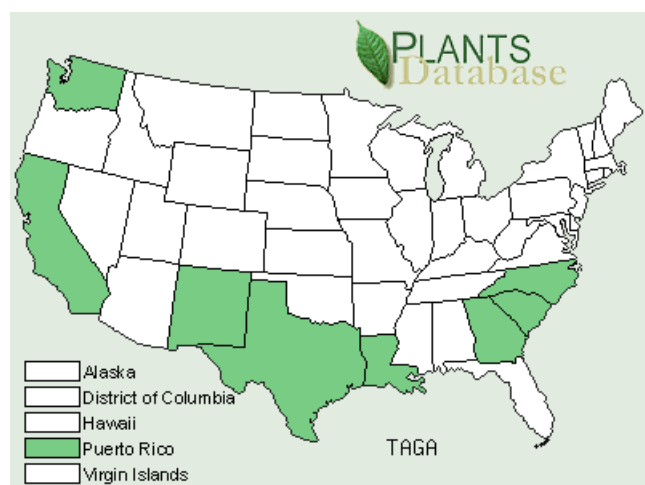
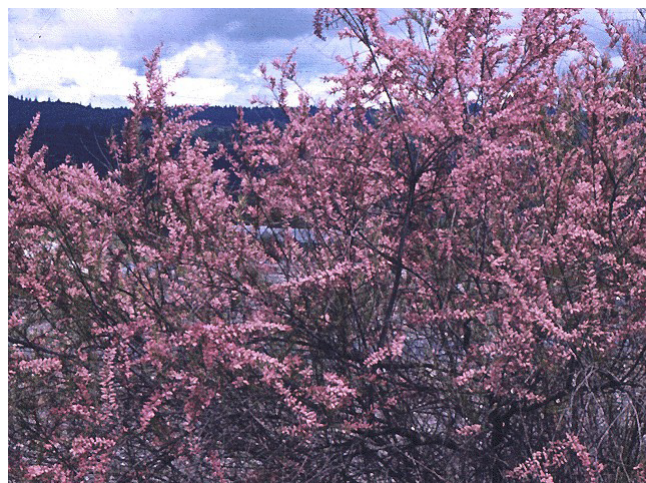
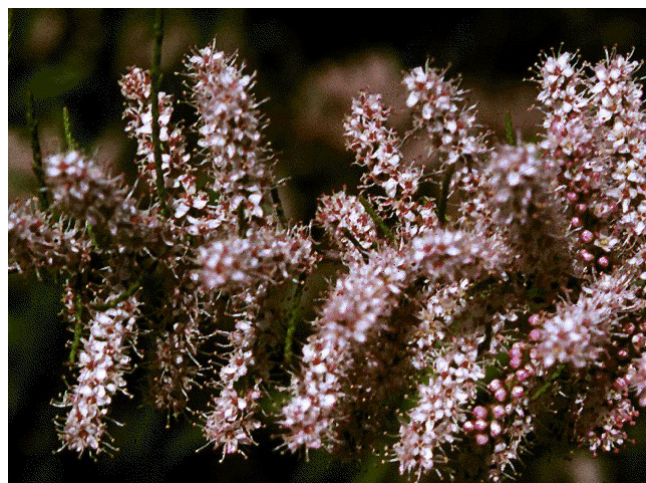
Dispersal methods: Produces massive quantities of minute (0.00001 gm) seeds that are dispersed by wind, water, and mud on bird feet and feathers, as well as in animal fur. Seeds are very short lived and remain viable for only a few to several weeks. Resprouting from underground and submerged stems occurs.

Control information:

<http://tncweeds.ucdavis.edu/esadocs/tamaramo.html>

Other: Saltcedar is an aggressive woody perennial that displaces native species in riparian areas. It has low wildlife value when compared to native species, except it may be valuable for bird nesting. It is a phreatophyte (can draw water from underground sources) which makes it capable of drying up springs and has a higher transpiration rate than native materials. Saltcedar is salt tolerant and salinates the soil surface by extracting salts from deep in the soil profile, concentrating salt in its leaves and depositing these salts on the soil surface through leaf decomposition. Increased salinity on the soil surface inhibits re-establishment of native species.

This species does not tolerate shade, and its seedling establishment is slow. Rapid revegetation of disturbed sites may slow its spread.



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