

For Stormwater Design

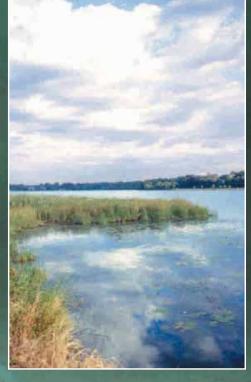
Species Selection for the Upper Midwest

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Second Edition

PLANTS FOR STORMWATER DESIGN

Species Selection for the Upper Midwest

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ABOUT THE AUTHORS

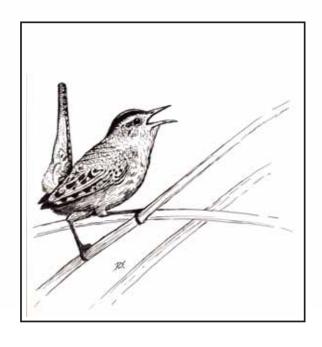
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Introduction

In recent years interest has increased in the use of innovative methods to retain and treat stormwater. These methods, often called stormwater management practices, rely on natural processes, such as microbial activity, filtration, infiltration, denitrification, nutrient reduction and evapotranspiration, to attain water-quality goals. Although technical information is available on the design of many types of stormwater practices, little information is currently available on plant species appropriate for these systems. This book has been developed to guide designers through the process of selecting plant

RAIN WATER GARDEN

species for a variety of stormwater practices.

Plant species included in this book have been chosen based on their availability, presence in the Upper Midwest before European settlement, aesthetic properties and functional abilities within stormwater practices.

Native plants are the focus of the book and are recommended exclusively due to their hardiness, and the wide variety of functions they provide. See page 61 for a complete list of species included in the book.

This guidebook focuses on the selection of plant species that will optimize landscape function. The beneficial functions plants perform in the landscape are varied and complex, and range from providing habitat for beneficial microbes to physically inhibiting the flow of stormwater. The ability of plants to intercept and hold rainwater and to decrease water flow with stalks, stems, branches and foliage is one of the better recognized functions of vegetation, but there are many others (MPCA 2000). In many stormwater systems, native vegetation provides habitat for amphibians, reptiles, birds and insects. Native plants also take

nutrients into their tissues and their roots provide a substrate for growth of bacteria and algae, which are responsible for nutrient cycling and organic degradation. In addition, decaying plant matter supplies fixed organic carbon and food for microbes (Fassman et al. 2001). Native plants also contribute to the water cycle by returning water to the atmosphere through evapotranspiration. In stormwater MPs such as vegetated filter strips, the roots of native species increase soil strength and stability. Another function of native plants, particularly in urban areas, is to add aesthetic value to stormwater systems. The vegetation softens the appearance of structures and shoreline edges, adds interest through line, texture and contrast, and provides color and harmony with the natural environment (Fassman et al. 2001, MPCA 2000).

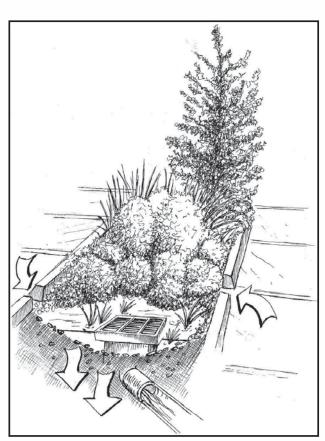
Selecting plants for stormwater practices is not a simple process. Stormwater systems are often affected by a number of environmental conditions that are not conducive to plant growth and survival. Some of these environmental conditions include prolonged flooding, fluctuating water levels, sedimentation and pollutants. To complicate matters, invasive species are sometimes better adapted to the above-mentioned conditions and ongoing plant management may be important for project success.

Tools included in this book to aid plant selection

- Information about environmental factors that influence wetland plants
- Description of retention, detention, infiltration, wetland and filtration BMPs and species lists for individual types of BMPs
- A plant matrix to select plants appropriate for various environmental conditions
- Information and photographs of 131 plant species
- Hydrology and species information for three stormwater projects in the Twin Cities area

USING THIS GUIDEBOOK

This book was developed to lead designers through a plant selection process. First, **environmental factors** that influence plants in stormwater systems are presented. The potential influence of these environmental factors should be investigated during the site-analysis



INFILTRATION SWALE
(ADAPTED FROM CITY OF PORTLAND)

process and will be useful information for the selection of stormwater management practices.

Next, information is presented for **common** types of practices and plant considerations are provided for each. The information about stormwater practices corresponds to design information in the Minnesota Urban Small Sites BMP Manual. Stormwater Best Management Practices for Cold Climates (Barr 2001) and the *Protecting* Water Quality in Urban Areas, Best Management

Practices for Dealing with Storm Water Runoff from Urban, Suburban and Developing Areas of Minnesota manual (MPCA 2000). Only stormwater MPs that incorporate vegetation are included in this guidebook.

In addition to a discussion of planting considerations for each system, **plant lists** are provided. These lists include a large number of species for each stormwater practice. Many species were included to ensure that plant options are available to cover as many potential site conditions as possible. The plant lists are arranged by scientific name and range from mesic prairie species to emergent wetland plants. To help designers

refine their plant lists for a project, detailed information is provided for all of the 131 species that are included in the plant lists. Page numbers are provided in the plant lists referring to the more detailed information for each plant species located in the Plant Species for Stormwater Management Practices section of this guidebook.

Information for each plant includes

- Habitat/plant community and type of system where the plant can be used
- Geographic range
- Plant description
- Normal water level for which the species is adapted
- Fluctuation tolerance
- Sensitivity of other tolerances
- Design considerations
- Wildlife use
- Nursery/plant information
- Planting techniques
- Indicator status

Flood tolerance charts that correlate water level and duration are presented to demonstrate how long each_species can remain inundated. These charts were developed from available research, site observations and professional judgement and review.

A **plant matrix** summarizing information for each plant starts on page 66. The plant matrix has been developed from information for each of the 131 species in the guidebook. The matrix will aid in plant selection for a number of different environmental conditions and stormwater management practices.

The authors gathered **plant composition and hydrology information for three stormwater projects** in the Twin Cities area. Plant community success and structure for each case study project is presented in appendix 2. This information should be useful to designers in making decisions about plant selection.

Environmental Influences on Plants

Many environmental factors affect plant growth and survival. These factors should be considered during project planning (particularly during plant selection). This guidebook is designed for the selection of plants after stormwater practices have been chosen for a site. However, many site characteristics that relate to plant growth should also be considered when stormwater practices are being selected. A thorough site analysis is necessary to compile information to aid in species selection.

General site conditions to investigate during site analysis

- Texture, organic content and pH of the soil
- Anticipated water levels or soil moisture
- Adjacent plant communities
- Slopes
- Surrounding weedy vegetation
- Amount of sun or shade
- Aspect (north-, south-, east- or west-facing slope)

Several additional environmental factors can significantly affect plant growth in stormwater projects. The following section provides detailed information about these factors. The potential influence that each of these may have on a project should be investigated thoroughly during site analysis to aid in the plant-selection process.

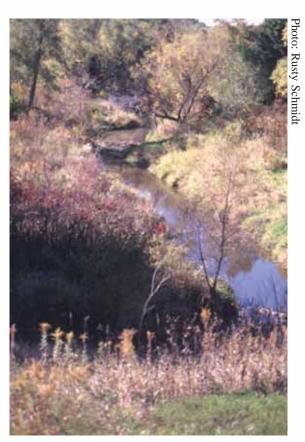
Environmental threats to investigate

- Flood depth and duration
- Low water levels
- Flood frequency
- Wave energy
- Sediment loads
- Pollutants and toxins

- Nutrients
- Salt
- Turbidity
- Erosion
- Invasive plants
- Herbivores

Flood Depth and Duration Flood depth and duration can significantly influence the growth and survival of vegetation. Flooding particularly influences plants in detention basins and wetland systems that receive a significant amount of water during storms.

The effect of flooding on plants includes the inhibition of seed germina- tion and vegetative reproduction, changes in plant anatomy and mortality. In plants that are not adapted to flooding, leaf and fruit formation and growth can be suppressed, premature leaf abscission and senescence can result, and shoot dieback and decreased cambial



URBAN STREAM

growth can occur in woody plants. Flooding can also inhibit root formation and branching as well as growth of existing roots and mycorrhizae. It may also lead to decay of the root system.

Flooding can often cause many physiological changes in plants: photosynthesis and transport of carbohydrates are inhibited, absorption of macronutrients (nitrogen, phosphorus and potassium, or N, P and K) is decreased due to root mortality, mycorrhizae may be lost, stomata may close and root metabolism may be suppressed. The hormonal balance in plants can also be altered by

increases in ethylene (Kozlowski 1997).

Despite the negative influences of flooding, many plant species have developed physiological and anatomical adaptations that allow them to survive in flooded conditions. These adaptations include metabolic adaptations, oxygen transport and rhizospheric oxidation, hypertrophied lenticels, aerenchyma tissue and adventitious roots.

Metabolic adaptations. Several metabolic adaptations to flooding are utilized by plants. They include control of energy metabolism, availability of abundant energy resources, provision of essential gene products and synthesis of macromolecules and protection against postanoxic injury (Kozlowski 1997).

Oxygen transport and rhizospheric oxidation. This is the capacity of plants to absorb and transport oxygen from above-ground tissues to roots growing in oxygen-scarce environments. Oxygen transport is aided by hypertrophied lenticels, aerenchyma tissues and adventitious roots (Kozlowski 1997).

Aerenchyma tissue. This root and stem tissue is permeated with large intercellular spaces. Species that do not respond to soil anaerobiosis by enlarging their internal air spaces typically undergo anoxia in their roots (Kozlowski 1997).

Adventitious roots. Adventitious roots are specialized roots growing at or just above the water or ground surface that increase the flood tolerance of plants. Adventitious roots increase water absorption, assist with oxygen absorption, transform some toxins to less harmful compounds and increase the supply of root-synthesized gibberellins and cytokinins to the leaves (Kozlowski 1997). Adventitious roots may allow species such as buttonbush and black willow to persist in early successional environments characterized by fluctuating water levels and sedi-ment levels (Donovan et al. 1988).

Seedlings and plants that are totally submerged are the most susceptible to flood-related mortality. Photosynthesis is limited or nonexistent in times of complete submergence except for plants that are adapted to submerged conditions. Seedlings are particularly susceptible to flood stress because they generally have fewer reserves to draw upon during stressful conditions. Seedlings are also susceptible to sediment deposition and scouring. Kennedy and Krinard (1974) found that tree seedlings were killed in a flood whereas trees at least one year old survived.

Other factors that can influence a plant's resistance to flooding and saturated soil include its age and condition and the timing and duration

of the flood (Yeager 1949, Kozlowski 1997). Generally plants are less affected by flooding in the spring than during summer months when they are actively growing. Soil conditions can also have a significant effect on plant survival. Flooding can affect soils by altering soil structure, depleting oxygen, accumulating CO², inducing anaerobic decomposition of organic matter and reducing iron and magnesium (Kozlowski 1997).

Harris and Marshall (1963) studied the drawdown and reflooding of wetlands in the Agassiz National Wildlife Refuge in northwestern Minnesota. After reflooding a wetland, they found that spike-rush (*Eleocharus palustris*) and soft-stem bulrush (*Scirpus validus*) were destroyed by flooding with over 15 inches of water. Common cattail (*Typha latifolia*) and sedges (*Carex* spp.) disappeared from continuously flooded areas in four to five years. Hybrid cattail (*Typha glauca*) survived in 24 inches of water through five years of flooding.

In another study investigating species' tolerance to flooding, Squires and Van der Valk (1992) found that awned sedge (*Carex atherodes*), white top-grass (*Scholochloa festucacea*), common reed grass (*Phragmites australis*), hybrid cattail (*Typha glauca*), hard-stem bulrush (*Scirpus acutus*), soft-stem bulrush (*Scirpus validus*) and alkali bulrush (*Scirpus maritimus*) survived for only one or two years in the flooded areas. They also found that some *Scirpus* species survived as tubers in the flooded areas.

Casanova and Brock (2000) investigated how depth, duration and frequency of flooding influence the establishment of wetland plant communities. The study was conducted by exposing seed bank samples to various water level treatments of depth, duration and frequency of inundation and comparing germination success. They found that depth was least important in influencing plant community composition while duration of individual flooding events was important in segregating plant communities. The highest biomass and species richness was found in pots that were never flooded and pots with short, frequent floods.

Prolonged flooding will most likely lead to plant mortality and a drawdown is generally necessary for revegetation. Most aquatic emergents need low water levels or complete removal of water from a basin for seeds to germinate. The physiological processes necessary for germination require oxygen. Since flooding restricts oxygen availability, it also prevents germination from occurring (Kozlowski 1997). Linde (University of Michigan 1974) found that cattail (*Typha* spp.), sweet flag (*Acorus calamus*), burreed (*Sparganium* spp.), bulrush (*Scirpus* spp.), Walter's millet (*Echinochloa walteri*), smartweed (*Polygonum* spp.), willow (*Salix* spp.) and flatsedge (*Cyperus* spp.) germinated most successfully when mud flats were exposed by drawdowns. Harris and Marshall (1963) determined that it is desirable to induce drawdowns in wetlands with continuous standing water every five or six years to maintain emergent cover.





CARDINAL FLOWER



BLUE LOBELIA

Low Water Levels Prolonged low water levels can also stress plants within wetlands and stormwater systems. Most wetland plants are not well adapted to retaining moisture during dry conditions. In areas of open water that become dry, submergent species are generally replaced by emergent species. Emergent species have root systems such as large rhizomes and tubers that make them resistant to erosion by waves and ice as well as changes in water level. Submergents, however, devote most of their biomass to above-ground structures and cannot survive prolonged periods of drying (Wetzel



DRY POND

1983). In a study of aquatic vegetation of the St. Photo: Dan Shaw Lawrence River, Hudon (1997) found that emergent vegetation was not affected by a one-year drop in water levels whereas submerged plants did not survive.

A variety of short-lived, early successional species are also well adapted to low water levels. Species that germinate quickly on exposed mud flats and are common in seasonally flooded basins include smartweed (*Polygonum* spp.), flatsedge (*Cyperus* spp.), spikerush (*Eleocharis* spp.) and beggartick (*Bidens cernua*). If water levels remain low, these species are generally replaced with perennial grasses and forbs.

Flood Frequency The effect of flood frequency and accompanying water fluctuations on plants has not been studied as thoroughly as that of flooding depth and duration, but it is believed to be a major plant stressor. Galatowitsch et al. (1997) found that hydrologic alterations by stormwater could reduce native perennial cover to the

same extent as cultivation in wet meadows. They discovered that less than 25 percent of the relative abundance of species in stormwater-impacted wetlands is comprised of species that are characteristic of unimpacted sites. Examples of species not found_in impacted wetlands included slender sedge (*Carex lasiocarpa*), Canada blue-joint grass (*Calamagrostis canadensis*) and prairie cord grass (*Spartina pectinata*). It is not known whether altered water chemistry, water fluctuations or both are responsible for the plant community changes observed. Reed canary grass (*Phalaris arundinacea*), an invasive species found in many impacted sites, may have an advantage because



WETLAND EDGE

it can grow in flooded conditions as well as in relatively dry soils. Husveth (1999) found that sedge meadow species were more prevalent in low-fluctuation wetlands than in high-fluctuation wetlands while mudflat annual

species were more common to high-fluctuation wetlands than low-fluctuation wetlands.

In Montgomery County, Maryland, Shenot (1993) conducted a study to investigate the persistence of wetland species planted along the aquatic bench (a plateau, 3-18 inches deep, designed to optimize area for emergent species) of three stormwater ponds two to three years after planting. The ponds were planted with six to eight species of plants in single-species clusters with an average density of four plants per square meter. Two ponds were extended detention ponds with periodic inundation of 3-6 feet. Eighty-two percent of the planted species persisted in the ponds after two to three years. Factors believed to contribute to plant death included frequency and depth of inundation, nutrient-poor inorganic soils, steep bench slopes and predation by ducks. Thirty-five to 80 wetland plant species established as volunteers in each of the ponds (Shenot 1993, Schueler 2000).

Relative Persistence of Eight Species of Wetland Plants on the Aquatic Bench (Shenot, 1993)		
	Persistence	Spread
Sweet flag (Acorus calamus)	Good	Limited
Arrow arum (Peltandria virginia)	Poor	None
Pickerelweed (Pontederia cordata)	Good	Moderate
Arrowhead (Saggitaria latifolia)	Excellent	Excellent
Lizard's tail (Saururus cernus)	Poor	None
Common three square (Scirpus americanus)	Good	Excellent
Soft-stem bulrush (Scirpus validus)	Excellent	Good
Wild Rice (Zizania aquatica)	Excellent	Limited

(Adapted from Schueler 2000)

Top 10 Volunteer Species Recorded at the Thro	ee Ponds (Shenot 1993)
Various exotic grasses (Graminea)	75%
Common rush (Juncus effusus)	55%
Fox sedge (Carex vulpinoidea)	33%
Other sedges (<i>Carex</i> spp.)	33%
Smartweeds (<i>Polygonum</i> spp.)	33%
Mostly many-flowered aster (Aster spp.)	30%
False nettle (Boehmeria cylindrica)	30%
Rice cutgrass (Leersia oryzoides)	30%
Bugleweed (Lycopus virginicus)	30%
Spike rush (<i>Eleocharis</i> sp.)	22%
Defined as percentage of stations where the spe	ecies was recorded as one

Defined as percentage of stations where the species was recorded as one of the five most numerically dominated species at the station. N=40

(Adapted from Schueler 2000)

As was discussed earlier, flooding tends to limit root growth, and in some cases specialized water roots are developed. It is likely that as plants dryquickly after flooding, their root systems may not be able to supply sufficient water. A study on the effects of water fluctuation on trees, including black gum (*Nyssa sylvatica*), common baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*), in a swamp in the southeastern United States showed that weekly changes in the growth of the three species were significantly affected by changes in water levels. It is believed that the reduced growth resulted from frequent restructuring of root systems in response to alternately flooded

and drained conditions. In sites that were permanently flooded or saturated, limits of tree growth was not observed (Keeland and Sharitz 1997).



SMARTWEED

Kozlowski (1997) states that "Because root growth typically is reduced more than stem growth, the root/shoot ratio is decreased. When the flood water drains away, the previously flooded plants may be less tolerant of drought because absorption of water by their small root systems cannot adequately replenish losses due to transpiration."

Although water fluctuations can have detrimental effects on plants, it is also important to recognize that the fluctuation of water levels is a natural phenomenon in many basins, particularly where there are steep slopes surrounding wetlands. In some cases, water fluctuations can help certain community types, such as floodplain forests, that are adapted to such conditions. The fluctuations may decrease weed competition and aid in seed dispersal.

Flooding frequency has been shown to influence plant diversity in some situations. Pollock et al. (1998) studied 16 wetland sites in Alaska and found that "species-rich sites had low to intermediate levels of productivity and intermediate flood frequencies, and species-poor sites had very low or high flood frequency and low productivity." This corresponds with Huston's (1979) dynamic-equilibrium model of species diversity, which predicts that the highest diversity will be found where there are intermediate levels of disturbance and low diversity will be found where there are high or low levels of disturbance.

A study in northern Minnesota (Wilcox and Meeker 1990) also demonstrated that high diversity can be found with intermediate levels of disturbance. Two regulated lakes and one unregulated lake were studied to determine the effects of water fluctuations on aquatic macrophytes. It was found that the unregulated lake, which fluctuated about 1.6 m annually, had structurally diverse plant communities at all depths. In Rainy Lake, which had reduced water fluctuations (1.1 m annually), few species were present along transects that were never dewatered. In Namakan Lake, which had increased water fluctuations (2.7 m annually), rosette and mat-forming species dominated transects where drawdown occurred in early winter and disturbance resulted from ice formation in the sediments.

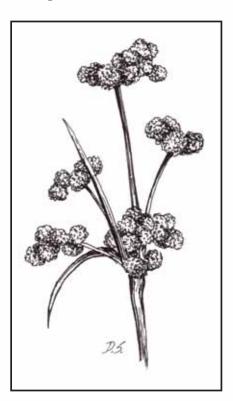
Stormwater practices, such as wet and dry swales, filter strips and rain water gardens, can be important for treating and slowing water flow before it reaches ponds and wetlands. Appropriate design is important to ensure that flooding and water fluctuation will not be severe. The outlets should be designed so as to endure natural fluctuations during storm events. Multiple wetland cells and gentle side slopes can add to species diversity by dispersing water, decreasing water fluctuations and providing a wide range of available habitat for wetland species. A Vermont study (Occoquan Watershed Monitoring Lab et al. 1990) demonstrated that multiple pond systems can promote diversity (18 species) in wetland BMPs. Common rush (*Juncus effusus*), spikerush (Eleocharis obtusa) and rice-cut grass (Leersia oryzoides) dominated the 0-to-6-inch zone; spikerush (Eleocharis spp.) and rice-cut grass dominated the 6-to-12-inch zone; water purslane (Ludwigia palustrus) and duckweed (Lemna spp.) dominated the 12-to-18-inch zone; and cattail (*Typha* spp.), spikerush (*Eleocharis* spp.), yellow water lily (Nuphar adventa) and white water lily (Nymphea odorata) dominated the 18-to-30-inch zone.

For more information on the effect of hydrology on vegetation, see appendix 2 for an investigation of three stormwater projects in the Twin Cities area. Wave Energy On large water bodies, waves can have a significant influence on plant growth. In a study of the effects of wave action at Axe Lake in Ontario, Keddy (1983) found that "waves may have direct effects on vegetation; for example, through removing biomass, uprooting seedlings, and transporting propagules." He observed that "waves may also have many indirect effects through the erosion, transport and deposition of sediment." At Axe Lake, Keddy found that "Large leafy species on sheltered shores tended to be replaced by small creeping or rosette species on exposed shores." Of the emersed species, bulrushes (Scirpus spp.) tend to do best in exposed situations. If emersed plants can become established, their presence may reduce wave and current action and permit a greater variety of plants to establish (University of Michigan 1974). Stormwater MPs, such as wet ponds, generally are not large enough to be significantly affected by wave action, but waves may contribute to plant stress. Wave break structures are often necessary on large water bodies to ensure planting success.

Sediment Loads Wetlands often receive sediment and nutrients from runoff (Brown 1985) and this is the case in stormwater detention basins and other types of stormwater systems. A study of beaked sedge (*Carex rostrata*) and common fox sedge (*Carex stipata*) in Washington State (Ewing 1995) investigated the effect of sedimentation and showed that sediment deposition can depress plant productivity. Other studies have shown similar results. Van der Valk et al. (1981) found that with 15 cm of sediment, root density decreased by 37 and 49 percent in subsequent years in freshwater lowland wetlands in Alaska.

It has also been demonstrated that the accumulation of sediment negatively affects seed germination. Jurik et al. (1994) found that sediment loads as low as 0.25 cm significantly decreased the number of species that germinated from seedbank samples. The addition of sediment had the least effect on species with large seeds.

Pollutants and Toxins Plants vary greatly in their ability to assimilate toxins and pollutants into their stems and roots. With recent interest in phytoremediation and wastewater cleansing, an increasing number of species are being investigated to determine their ability to assimilate pollutants and toxins. A study by the City of Seattle (1993) investigated the ability of five wetland species to take up zinc, lead and total petroleum hydrocarbons (TPH) into plant tissue. The species chosen for the study were common cattail (*Typha latifolia*), water flag (*Iris pseudacorus*), burreed (*Sparganium* spp.), blunt-spikerush



GREEN BULRUSH

(Eleocharis ovata) and hardstem bulrush (Scirpus acutus). Of the five species, cattail was the most efficient at taking up pollutants, but concentrations of lead, zinc and TPH were highest in burreed tissue. Cattail was more vigorous and therefore had a higher pollutant uptake per area of cover. Spike rush also had high pollution concentrations within plant tissue. There is concern that wetland species that assimilate pollutants may pose a risk to wildlife that use them as a food source. This study found that concentrations of TPH, zinc and lead were higher in the roots than in the shoots, which may help decrease the risk to most wildlife species.

Just as plant species vary in their ability to assimilate toxins and pollutants, they also vary in their tolerance to these materials (Stockdale 1991). Snowden and Wheeler (1993) examined 44 fen species in solution culture to determine their tolerance to iron. The plants varied greatly in their tolerance, with species such as common rush (*Juncus effusus*) and water-flag (*Iris pseudacorus*) being very tolerant, marsh marigold (*Caltha palustris*) and reed canary grass (*Phalaris arundinacea*) being semi-tolerant, and green sorrel (*Rumex acetosa*) and queen of the meadow (*Filipendula ulmaria*) being very sensitive.

Individual species can be affected by some chemicals and unaffected by others. Dushenko et al. (1995) investigated the effect of arsenic bioaccumulation and toxicity in aquatic macrophytes exposed to gold mine effluent and found that broad-leaved cattail (*Typha latifolia*)



MARSH MILKWEED

responded with decreased stand height, necrosis of leaf tips and reduced micronutrient concentrations of copper, manganese and zinc in root tissues. A study in China (Ye et al. 1998) investigating the tolerance of broadleaved cattail to zinc (1.0 μ g/ml), lead (10.0 μ g/ml) and cadmium (0.2 μ g/ml) accumulation found that this species was able to tolerate these metals for 48 to 72 days.

Nutrients As nutrient inputs to wetlands increase, nutrients can be stored in surface litter, plants or soils. However, the capacity of a wetland to retain a nutrient such as phosphorus can become saturated over time and release of the nutrient can result. Nutrient inputs can have a direct effect on vegetation. Species like reed canary grass (*Phalaris arundinacea*) that thrive in nutrient-rich conditions can displace species that are adapted to conditions of lower nutrient availability (Horner et al. 1988). A study of a wastewater-treatment wetland showed that plants near the discharge point had greater biomass, were taller and had higher concentrations of phosphorus in their tissues (Tilton et al. 1979). Athanas and Stevenson (1991) compared two stormwater wetlands in Maryland. They found that the system that received higher amounts of sediment and nutrients had higher diversity (cattails, rushes, sedges and boneset) than the other system (cattails and common reeds), which received less sediment and nutrients. A study in Vermont (Schwartz 1985) investigated the effect of sewage on wetland vegetation. Nitrate levels of 0.328 mg/L and phosphate levels of 2.53 mg/L from raw sewage resulted in unchanged growth of cattail (*Typha* spp.). Rushes (*Scirpus* spp.), giant burreed (Sparganium eurycarpum), lesser duckweed (Lemna minor)

and coontail (*Ceratophyllum demersum*) were positively affected by the nutrients, while elodea (*Elodea canadensis*) and pondweeds (*Potomogeton* spp.) were negatively affected.



FOX SEDGE

There is concern that wetland treatment systems in northern climates will not function effectively during the winter months due to inactivity of bacteria and plant material. Research being conducted at Montana State University by Stein and Hook is showing that systems containing plants can function effectively in cold climates. The researchers are finding that wetland systems with water temperatures of 36 degrees F can effectively remove nitrogen and organic carbon from water. Plant debris and snow cover helps keep water temperatures around 36 degrees. In addition, water treatment in cold temperatures improves significantly

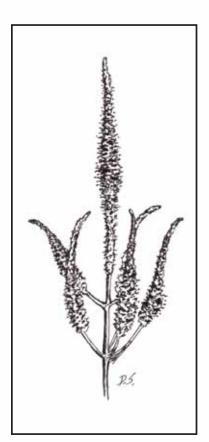
when plants are a part of the system. This differs from research conducted in southern climates that shows that bacteria play the largest role in cleaning water and plants play a less important role. Plants that the Montana State researchers are finding most effective are sedges and bulrushes. These species are much more effective at treating water during the winter than cattails, which are relatively inactive (Flaherty 2002).

Mowing and removing above-ground growth of cattails, grasses and other species used in stormwater MPs is one method of removing nutrients. The removed biomass can be composted or possibly incinerated.

Salt Roadways and parking lots in the Midwest are salted heavily during winter months. During melting and rainfall events, salt can be washed into a stormwater system. Biesboer and Jacobson (1994) studied the role of road salt in limiting germination of warm-season grasses. They found that salt concentrations were highest within the

first 3 feet from the road and then rapidly declined within 30 feet. They found that most warm- and cool-season grasses could germinate and grow beyond 10 feet from a road without experiencing stress. They state that warm-season grasses, such as blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*), can handle high salinities. Warm-season grasses also have advantages over cool-season grasses because they germinate later in the season, after spring rains reduce concentrations of sodium chloride in the soil (Ohrel 2000).

Another study (Isabelle et al. 1987) demonstrated that salt in roadside snowmelt can affect species composition and biomass of wetland vegetation. In the study, seed of five wetland species was planted in greenhouse plots and exposed to snowmelt/tapwater mixtures containing 0, 20 and 100 percent snowmelt each day. After



CULVER'S ROOT

a month the seedlings were harvested, and it was found that the number of germinating seeds was inversely proportional to snowmelt salt concentration. Two species, purple loosestrife (*Lythrum salicaria*) and common cattail (*Typha latifolia*), germinated when exposed to undiluted snowmelt while other species (*Aster umbellatus, Dulichium arundinaceum* and *Scirpus cyperinus*) did not. Both purple loosestrife and cattails dominate many urban wetland and stormwater systems and their ability to germinate under high-salt conditions may contribute to their dominance.

Wilcox (1986) observed that a bog in Indiana that was adjacent to an uncovered salt storage pile for 10 years was prone to invasion by non-bog species such as narrow-leaf cattail (*Typha angustifolia*). Many tamarack (*Larix*

laricina) and many species of sphagnum moss (*Sphagnum* spp.) were killed by the salt. The author noted that it is probable that red maple

(Acer rubrum), eastern white pine (Pinus strobus), leather-leaf (Chamaedaphne calyculata), holly (Ilex spp.) and highbush blueberry (Vaccinium corymbosum) were also affected by the salt. Other than cattails, species that did not appear to be affected by salt included duckweed (Lemna spp.), arrowhead (Sagittaria spp.) and bladderwort (Utricularia spp.).

Turbidity While flooding is a stress to many plant species, turbid water can compound the problem. Turbidity tends to reduce the amount of photosynthesis that can be conducted by a plant by limiting sunlight. Shaw (2002) observed that in nursery beds, Tussock sedge (*Carex stricta*) fully submerged in turbid water declined quickly while plants that still had some leaves above the surface of the water continued to increase their above-ground growth. It was believed to be the combination of flooding and turbid water that caused the plants to decline.

Loading of sediments can directly increase turbidity. Street cleaning and erosion control can effectively decrease the amount of sediment entering stormwater systems.

Erosion Erosive action around roots is another potential stress to plants in stormwater systems. Erosion naturally occurs in floodplains but may also occur in stormwater systems that are not adequately vegetated. Deep-rooted, native, prairie species and wetland shrubs do a good job of stabilizing buffer areas around ponds and wetlands. Aggressive grasses, such as prairie cord grass, big bluestem, Indian grass and switch grass, as well as many native shrub species are particularly well suited for this use. Cover crops such as oats, winter wheat and annual ryegrass are also useful in controlling erosion. Cover crops germinate quickly and hold the soil while the slower-developing native grasses become established. Since cover crops germinate quickly, they are good indicators of the overall success of plantings. If cover crops do not germinate in an area, there is a good chance that native species that were planted will need to be re-seeded.

Invasive species Flooding can influence plant competition by physically or physiologically damaging plants and by changing the physical and chemical environment of soils (Pollock et al. 1998). Some invasive

species seem to thrive under conditions of flooding and fluctuating water levels. Cooke et al. (1989) found that invasive species such as reed canary grass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*) can come to dominate wetlands that receive urban stormwater. Salt tolerance also gives an advantage to some invasive species, and the combination of these factors may explain why so many urban wetlands and stormwater systems are dominated by invasive plants.

While few native plants can compete with these invasive species,



PURPLE LOOSESTRIFE

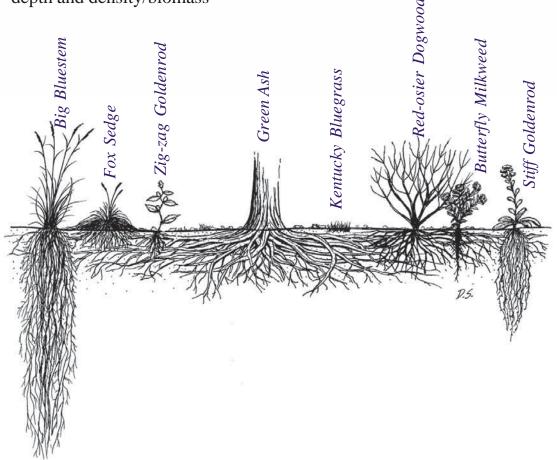
some aggressive native species can live amongst them. For example, cup plant (Silphium perfoliatum), blue vervain (Verbena hastata) and green bulrush (Schoenoplectus atrovirens) can be found in ditches among reed canary grass (Phalaris arundinacea). Seed of fast-establishing natives can be used also to stabilize and compete in areas where reed canary grass is a significant threat. Ultimately, management of native plantings is important to limit the growth of invasive plants.

Herbivores Wild geese and

other herbivores, such as deer, rabbits, muskrat, beavers, mice and carp, are a significant threat to new plantings. Geese are particularly attracted to seedling plants and have been know to completely destroy projects. Animal exclosures are often necessary to stop herbivores. Exclosures constructed to prevent geese from grazing newly planted areas should also help to prevent grazing by deer, rabbits, muskrat, beavers and carp. It is difficult to select plants that herbivores will not eat, so exclosures are generally the best option.

PLANT CONSIDERATIONS AND SPECIES FOR STORMWATER MANAGEMENT PRACTICES

Root systems of species covered in this guidebook vary greatly in their depth and density/biomass



Vegetation is often grouped into the categories of trees and shrubs, grasses/sedges/rushes and forbs/ferns. Each of these categories of vegetation has its own benefits and limitations for stormwater projects.

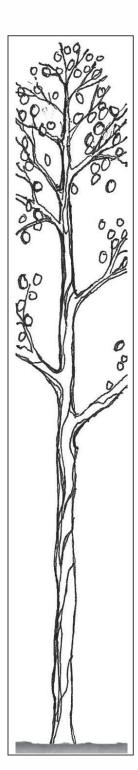


Benefits

- Trees and shrubs, particularly willow species, have a significant influence on evapotranspiration and a capacity for nutrient uptake.
- Roots aid infiltration by acting as pathways for water flow.
- Fibrous roots absorb large amounts of water.
- Trees and shrubs are useful for bank stabilization and can often be planted as cuttings. Deeprooted species are particularly useful for anchoring soil to steep slopes.
- Trees provide vertical structure in the landscape.
- Trees provide important habitat for many wildlife species.
- Trees provide important habitat for many wildlife species.

Limitations

- Debris from trees may block outlets.
- Trees cannot be used in stormwater MPs where sediment will be excavated.
- Trees can inhibit the growth of prairie species.







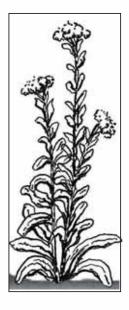
Grasses, Sedges and Rushes

Benefits

- Roots of prairie grasses can extend deep into the ground and aid in infiltration and evapotranspiration.
- Dense root networks stabilize soil and minimize erosion.
- Wetland species, particularly broad-leaved sedges and bulrushes, generally have shallow roots but aid in evapotranspiration.
- Grasses generally have many stems and produce thatch that slows water flow and facilitates filtration, making them well suited for filter strips.
- Many grasses, sedges and rushes are efficient at nutrient uptake.
- Native grasses, sedges and rushes add winter interest to the landscape and have high wildlife value.

Limitations

 In projects with high flow rates, grasses must be mowed often to most efficiently decrease stormwater velocity. Mown clump grasses will not produce seed.



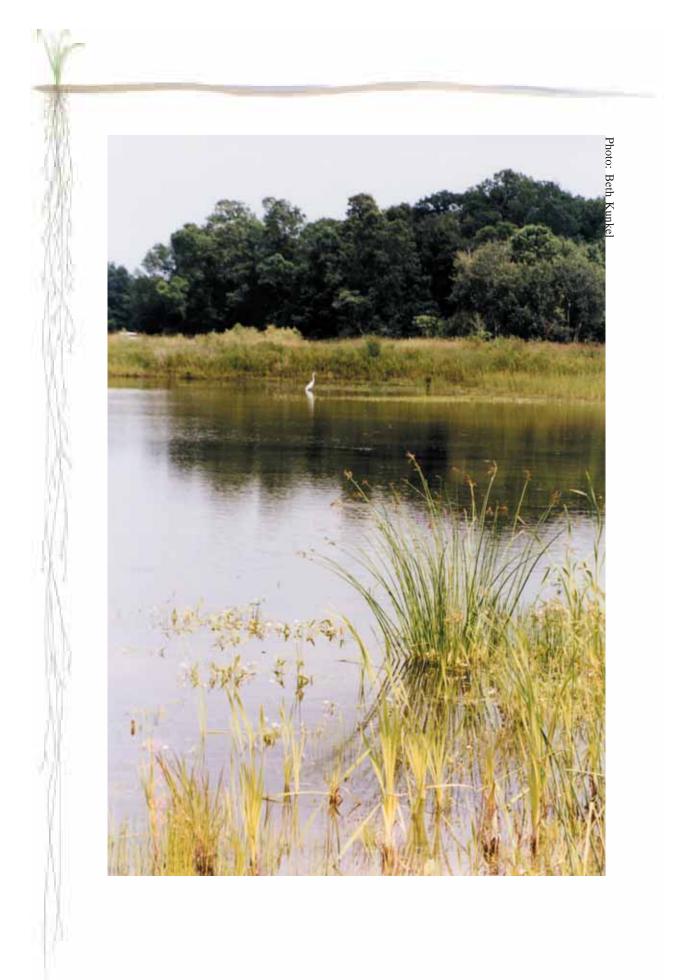
Forbs and Ferns

Benefits

- Roots of prairie forbs can extend deep into the ground and aid in infiltration and evapotranspiration.
- Wetland forbs, particularly broad-leaved species, generally have shallow roots but aid in evapo transpiration.
- Native forbs add aesthetic appeal to the land scape and have high wildlife value.

Limitations

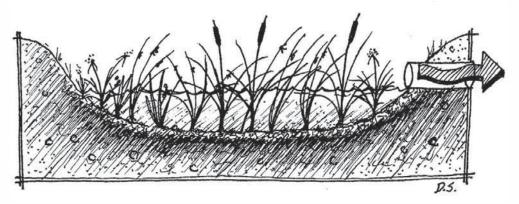
• Forbs generally have fewer basal stems than grasses and may not filter stormwater as efficiently.



STORMWATER MANAGEMENT PRACTICES

The types of stormwater management practices (MPs) are grouped into the categories of retention, detention, infiltration, wetlands and filtration. The following information provides a brief description of the types of stormwater MPs and planting considerations for each.

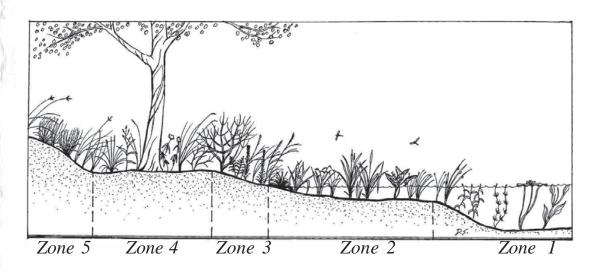
Retention



Retention (extended detention) systems are designed to utilize the retention of water to improve water quality. Retention systems covered in this guidebook include wet ponds and extended storage ponds.

Wet Ponds and Extended Storage Ponds. Wet ponds are designed to retain a permanent pool of water. The primary function of wet ponds is sedimentation, which removes metals, nutrients, sediment and organics from stormwater. Wet ponds are suitable for sites with high nutrient loads. Benches are often incorporated into wet ponds to add areas for plant growth which aid in sedimentation, evapotranspiration and providing wildlife habitat. Vegetation also acts as a barrier to keep children away from open water areas (MPCA 2000). Extended storage ponds are similar to wet ponds but are generally designed to provide temporary storage of stormwater. As a result, extended storage ponds are designed to fill quickly and then slowly decrease in water level (Barr 2001). Since both wet and extended storage ponds may experience significant water fluctuations after storms, plants must be chosen that can handle these conditions. Many urban wetlands and lakes that receive stormwater experience environmental conditions similar to wet ponds and many of the species in the following tables would be suitable for their planting.

Floodplain species may be well suited for extended storage ponds that flood and then become dry. Plant species suitable for ponds can be grouped according to zones that change with elevation. These zones are often referred to as "plant communities." It is useful to think about plantings in terms of plant communities because plant communities are composed of species adapted to growing together.



ZONE	PLANT COMMUNITY	HYDROLOGY
1	Submergent zone	1.5-6 feet of water
2	Emergent zone	0-18 inches of water
3	Wet meadow zone	Permanent moisture
4	Floodplain zone	Flooded during snowmelt and large storms
5	Upland zone	Seldom or never inundated (the upland zone includes prairie and forest plant communities)

Zone 1 (Submergent zone) – The submergent zone is found in areas of 3-6 feet of water in wet ponds. Submergent vegetation makes up this zone because emergent vegetation generally does not grow deeper than 3 feet. Submergent species may float free in the water column or may root in the pool bottom and have stems and leaves that generally stay under water. Submergent species are important for wildlife habitat and

pollutant removal, especially nitrates and phosphorus. Submergent species are not readily available from native plant nurseries and can be difficult to plant. Many submergent species establish on their own (Ogle and Hoag 2000).

Zone 2 (Emergent zone) – The emergent zone of a wet pond is generally 0 to 18 inches deep. It is often designed as benches within ponds to optimize the area for emergent plants. Emergent plants are important for wildlife and evapotranspiration. They also provide habitat for phytoplankton, which play an important role in nutrient removal (Ogle and Hoag 2000). A wide variety of wetland species are adapted to the emergent zone. However, large fluctuations in water level and pollutants within wet ponds may limit the number of species.

Zone 3 (Wet meadow zone) – The wet meadow zone is a constantly moist area that can become inundated. The transition area between open water and the shoreline is prone to erosion. Therefore, it is an important area for plant establishment. In addition to wet-meadow grasses, sedges, flowers and shrubs, such as dogwoods, willows, buttonbush and chokeberry, are well suited to this zone.

Zone 4 (Floodplain zone) – The floodplain zone is normally dry but may flood during snowmelt and after large storms. Floodplain zones are generally flat terraces and are common along rivers and streams. If a wet pond has a steep side slope, it may go directly from zone 3 (wet meadow zone) to zone 5 (upland zone) without having a floodplain zone. Floodplain species must be adapted to extremes in hydrology; they may be inundated for long periods in the spring and be dry during the summer. The ability of floodplain species to handle extremes in hydrology make them well suited to the edges of wet ponds and detention ponds.

Zone 5 (Upland zone) – The upland zone is seldom or never inundated. A wide variety of species are well adapted to the upland zone and their selection will depend on the site conditions.

Zone 1 Submergent zone	3-6 feet of water
Note: Submergent species are not covere	ed in depth in this guidebook, but desirable
species include the following:	
Scientific Name	Common Name
Forbs and Ferns	_
Brasenia schreberi	Water shield
Ceratophyllum demersum	Coontail
Elodea canadensis	Elodea
Lemna trisulca	Lesser duckweed
Myriophyllum exalbesieus	Water milfoil
Nelumbo lutea	Lotus
Nuphar lutea	Yellow water-lily
Nymphaea odorata	White water-lily
Potamogeton illinoensis	Illinois pondweed
Potamogeton natans	Floating-leaved pondweed
Potamogeton pectinatus	Sago pondweed
Ranunculus flabellaris	Yellow water crowfoot
Spirodela polyrrhiza	Giant duckweed
Urticularia vulgaris	Bladderwort
Vallisneria americana	Wild celery
Woffia columbiana	Watermeal

Zone 2 Emergent zone	0-18 inches of wat	er
Scientific Name	Common Name	See Page
Trees and Shrubs	•	•
Cephalanthus occidentalis	Buttonbush	148
Forbs and Ferns	·	•
Acorus calamus	Sweet flag	78
Alisma trivale	Water plantain	82
Caltha pahıstris	Marsh marigold	120
Polygonun amphibium	Water smartweed	248
Pontederia cordata	Pickerelweed	250
Sagittaria latifolia	Broadleaved arrowhead	266
Sparganium eurycarpum	Giant burreed	298
Typha latifolia	Broadleaved cattail	320
Grasses, Sedges and Rushes	•	•
Bolboschoemus fluviatilis	River bulrush	112
Carex aquatilis	Water sedge	122
Carex lacustris	Lake sedge	132
Carex stricta	Tussock sedge	142
Juneus areticus	Baltic rush	202
Juncus effusus	Soft rush	204
Schoenoplectus acutus	Hardstem bulrush	278

Schoenoplectus pungens	Three-square bulrush	280
Schoenoplectus tabernaemontani	Soft-stem bulrush	282

Zone 3 Wet meadow zone	permanent moisture	
Scientific Name	Common Name	See Page
Trees and Shrubs	•	•
Amorpha fruticosa	Indigo bush	88
Salix nigra	Black willow	272
Sambucus racemosa	Red-berried elder	274
Forbs and Ferns	•	
Agastache foeniculum	Giant hyssop	80
Anemone canadensis	Canada anemone	92
Angelica atropurpurea	Angelica	94
Asclepias incarnata	Marsh milkweed	102
Aster lucidulus	Swamp aster	110
Bidens cermia	Beggarsticks	110
Boltonia asteroides	Boltonia	114
Chelone glabra	Turtlehead	152
Comarum palustre	Marsh cinquefoil	154
Eryngium yuccifolium	Rattlesnake master	168
Eupatorium perfoliatum	Boneset	170
Euthamia graminifolia	Grass-leaved goldenrod	174
Eutrochium maculatum	Joe-pye-weed	176
Gentiana andrewsii	Bottle gentian	184
Helenium autumnale	Sneezeweed	190
Impatiens capensis	Jewelweed	198
Iris versicolor	Blueflag	200
Liatris ligulistylis	Meadow blazingstar	212
Liatris pycnostachya	Prairie blazingstar	214
Lilium superbum	Turk's-cap lily	216
Lobelia cardinalis	Cardinal flower	218
Lobelia siphilitica	Blue lobelia	220
Lysimachia thrysiflora	Tufted loosestrife	222
Monarda fistulosa	Wild bergamot	230
Onoclea sensibilis	Sensitive fern	236
Osmunda regalis	Royal fern	238
Physostegia virginiana	Obedient plant	246
Pycnanthemum virginiamum	Mountain mint	258
Scutellaria lateriflora	Mad-dog skullcap	288
Silphium perfoliatum	Cup plant	292
Spiraea alba	Meadowsweet	302
Symphyotrichum lanceolatus	Panicle aster	306

Zone 3 Wet meadow zone	Cont. permanent moisture	
Scientific Name	Common Name	See Page
Symphyotrichum novae-angliae	New England aster	308
Symphyotrichum puniceum	Red-stemmed aster	312
Thalictrum dasycarpum	Tall meadowrue	316
Verbena hastata	Blue vervain	324
Vernonia fasciculata	Ironweed	326
Veronicastrum virginicum	Culver's root	328
Grasses, Sedges and Rushes	•	•
Andropogon gerardii	Big bluestem	90
Bolboschoemus fluviatilis	River bulrush	112
Bromus ciliatus	Fringed brome	116
Calamagrostis canadensis	Canada blue-joint grass	118
Carex bebbii	Bebb's sedge	124
Carex comosa	Bottlebrush sedge	126
Carex crinita	Caterpillar sedge	128
Carex hystericina	Porcupine sedge	130
Carex lasiocarpa	Wooly needle sedge	134
Carex pellita	Wooly sedge	136
Carex retrorsa	Retrorse sedge	138
Carex stipata	Awl-fruited sedge	140
Carex vulpinoidea	Fox sedge	144
Eleocharis obtusa	Blunt spikerush	162
Equisetum fluviatile	Horsetail	166
Głyceria grandis	Giant manna grass	186
Głyceria striata	Fowl manna grass	188
Juneus arcticus	Baltic rush	202
Juncus effusus	Soft rush	204
Juncus torreyi	Torrey rush	206
Leersia oryzoides	Rice-cut grass	210
Panicum virgatum	Switchgrass	240
Schoenoplectus pungens	Three-square bulrush	280
Schoenoplectus tabernaemontani	Soft-stem bulrush	282
Scirpus atrovirens	Green bulrush	284
Scirpus cyperinus	Woolgrass	286
Spartina pectinata	Prairie cord grass	300

Scientific Name	Common Name	See Page
Trees and Shrubs	'	
Acer saccharimum	Silver maple	76
Almus incana	Speckled alder	86
Amorpha fruticosa	Indigo bush	88
Aronia melanocarpa	Black chokeberry	98
Betula nigra	River birch	108
Celtis occidentalis	Hackberry	146
Cephalanthus occidentalis	Buttonbush	148
Cornus amomum	Silky dogwood	156
Cormis sericea	Red-osier dogwood	160
Fraximus nigra	Black ash	178
Fraximus pennsylvanica	Green ash	180
Physocarpus opulifolius	Ninebark	244
Populus deltoides	Eastern cottonwood	252
Quercus bicolor	Swamp white oak	260
Salix discolor	Pussy willow	268
Salix exigua	Sandbar willow	270
Salix nigra	Black willow	272
Sambucus racemosa	Red-berried elder	274
Spiraea alba	Meadowsweet	302
Viburnum lentago	Nannyberry	330
Viburnum opulus var. americanum	High bush cranberry	332
Forbs and Ferns		
Anemone canadensis	Canada anemone	92
Boltonia asteroides	Boltonia	114
Comarum palustre	Marsh cinquefoil	154
Impatiens capensis	Jewelweed	198
Lobelia cardinalis	Cardinal flower	218
Lobelia siphilitica	Blue lobelia	220
Lysimachia thrysiflora	Tufted loosestrife	222
Physostegia virginiana	Obedient plant	246
Scutellaria lateriflora	Mad-dog skullcap	288
Silphium perfoliatum	Cup plant	292
Symphyotrichum puniceum	Red-stemmed aster	312
Symplocarpus foetidus	Skunk cabbage	314
Vernonia fasciculata	Ironweed	326
Grasses, Sedges and Rushes		
Carex comosa	Bottlebrush sedge	126
Elymus virginicus	Virginia wild rye	164
Leersia oryzoides	Rice-cut grass	210
Panicum virgatum	Switchgrass	240

Zone 4 Floodplain zone	Cont.	nt. Flooded during snowmelt and large storms	
Scientific Name		Common Name	See Page
Scirpus atrovirens		Green bulrush	284
Spartina pectinata		Prairie cord grass	300

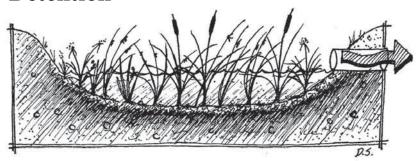
Zone 5 Upland zone	Seldom or never inundate	
Scientific Name	Common Name	See Page
Trees and Shrubs	•	
Cormus racemosa	Gray dogwood	158
Populus tremuloides	Quaking aspen	254
Quercus bicolor	Swamp white oak	260
Viburnum lentago	Nannyberry	330
Viburnum opulus var. americanum	High bush cranberry	332
Forbs and Ferns	•	•
Agastache foeniculum	Giant hyssop	80
Allium stellatum	Prairie wild onion	84
Arisaema triphyllum	Jack-in-the-pulpit	96
Artemisia ludoviciana	Prairie sage	100
Asclepias tuberosa	Butterfly milkweed	104
Athyrium filix-femina	Lady fern	106
Boltonia asteroides	Boltonia	114
Chamerion angustifolium	Fireweed	150
Comarum palustre	Marsh cinquefoil	154
Eurybia macrophylla	Bigleaf aster	172
Galium boreale	Northern bedstraw	182
Helianthus grosseserratus	Sawtooth sunflower	192
Heuchera richardsonii	Prairie alumroot	194
Maianthemum racemosum	False Solomon's seal	226
Monarda fistulosa	Wild bergamot	230
Oligoneuron riddellii	Riddell's goldenrod	232
Oligoneuron rigidum	Stiff goldenrod	234
Onoclea sensibilis	Sensitive fern	236
Pteridium aquilinum	Bracken fern	256
Pycnanthemum virginiamum	Mountain mint	258
Ratibida pinnata	Yellow coneflower	262
Rudbeckia subtomentosa	Brown-eyed Susan	264
Solidago flexicaulis	Zig-zag goldenrod	294
Symphyotrichum laeve	Smooth aster	304
Symphyotrichum lanceolatus	Panicled aster	306
Symphyotrichum pilosum	Frost aster	310
Tradescantia ohiensis	Ohio spiderwort	318
Veronicastrum virginicum	Culver's root	328

Zizia aurea	Golden alexanders	334
Grasses, Sedges and Rushes		
Andropogon gerardii	Big bluestem	90
Panicum virgatum	Switchgrass	240
Schizachyrium scoparium	Little bluestem	276
Sorghastrum nutans	Indian grass	296



MEADOW BLAZINGSTAR

Detention



Detention systems are designed to filter and slow stormwater. Detention systems covered in this guide included dry ponds and dry swales/ditches.

Dry Pond. Dry ponds are generally at the end of storm sewer systems and are designed to reduce stormwater velocity. Dry ponds typically empty completely between storms so they provide limited pollution removal (Barr 2001). Plants in dry ponds must be able to handle flooding and subsequent dry conditions. Only a few species are well suited to dry ponds. However, several floodplain-forest and wet-prairie species are adapted to these conditions.

Scientific Name	Common Name	See Page
Trees and Shrubs		
Amorpha fruticosa	Indigo bush	88
Aronia melanocarpa	Black chokeberry	98
Betula nigra	River birch	108
Cephalanthus occidentalis	Buttonbush	148
Cormis racemosa	Gray dogwood	158
Cormus sericea	Red-osier dogwood	160
Quercus bicolor	Swamp white oak	260
Salix discolor	Pussy willow	268
Salix exigua	Sandbar willow	270
Spiraea alba	Meadowsweet	302
Forbs and Ferns	·	•
Equisetum fluviatile	Horsetail	166
Euthamia graminifolia	Grass leaved goldenrod	174
Helenium autumnale	Sneezeweed	190
Liatris pyenostaehya	Prairie blazingstar	214
Lobelia siphilitica	Blue lobelia	220
Monarda fistulosa	Wild bergamot	230
Pycnanthemum virginiamum	Mountain mint	258

Symphyotrichum lanceolatus	Panicle aster	306
Symphyotrichum puniceum	Red-stemmed aster	312
Vernonia fasciculata	Ironweed	326
Veronicastrum virginicum	Culver's root	328
Grasses, Sedges and Rushes		
Andropogon gerardii	Big bluestem	90
Bromus ciliatus	Fringed brome	116
Carex bebbii	Bebb's sedge	124
Carex vulpinoidea	Fox sedge	144
Elymus virginicus	Virginia wild rye	164
Panicum virgatum	Switchgrass	240
Spartina pectinata	Prairie cord grass	300

Dry Swales/Ditches. Dry swales are open, vegetated channels that are designed to filter and slow stormwater. Check dams or berms are often used to hold water and settle pollutants. Dry swales are used along easements between properties or along roadways. Sandy soils may be added to the base of dry swales if existing soils are impermeable. Under-drain systems may also be installed to direct water to a storm sewer (Barr 2001).

Grasses are generally chosen for dry swales because they have many stems to slow water flow and can be repeatedly mown during the growing season. Dry swales may be maintained as lawn, but are most effective at slowing and treating water when they are planted with dry

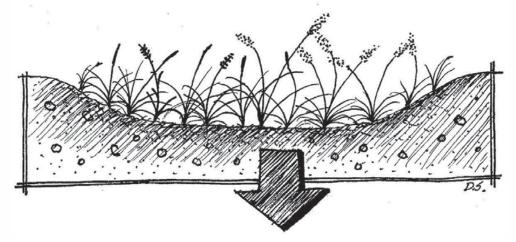


SPIDERWORT

or mesic prairie species. Grass swales should be mowed at least annually to prevent trees and shrubs from inhibiting grass growth (King County 1996). Mowing height for grass swales should be 4 to 9 inches. A common Minnesota Department of Transportation (MnDOT) seed mix used for swales is Mixture 28B.

Dury Sweles		
Dry Swales	lo v	2 2
Scientific Name	Common Name	See Page
Forbs and Ferns		
Anemone canadensis	Canada anemone	92
Artemisia ludoviciana	Prairie sage	100
Asclepias incarnata	Marsh milkweed	102
Euthamia graminifolia	Flat-top goldenrod	174
Lobelia siphilitica	Blue lobelia	220
Pycnanthemum virginianum	Mountain mint	258
Symphyotrichum puniceum	Red-stemmed aster	312
Verbena hastata	Blue vervain	324
Grasses, Sedges and Rushes	·	
Andropogon gerardii	Big bluestem	90
Bromus ciliatus	Fringed brome	116
Calamagrostis canadensis	Canada blue-joint grass	118
Carex bebbii	Bebb's sedge	124
Carex vulpinoidea	Fox sedge	144
Elymus virginicus	Virginia wild rye	164
Głyceria striata	Fowl manna grass	188
Juncus effusus	Soft rush	204
Panicum virgatum	Switchgrass	240
Scirpus atrovirens	Green bulrush	284
Spartina pectinata	Prairie cord grass	300
Useful sod-forming grasses not		
Agrostis palustris	Creeping bentgrass	
Elymus sp.	Wheat-grass	
Poa palustris	Fowl bluegrass	

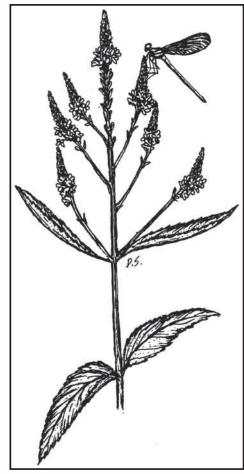
Infiltration



Infiltration systems are designed to infiltrate stormwater into the soil and often utilize plants to provide filtration and evapotranspiration. Infiltration systems covered in this guidebook include rain water gardens, infiltration basins, dry swales and infiltration trenches.

Rain Water Gardens (on-lot infiltration)

Rain water gardens are small depressions that are ideal for residential and small commercial sites. They are most effective in areas where soils have good infiltration capacity. Since these systems are designed to drain relatively quickly, a large variety of shrubs, perennial grasses and flowers can be planted. Dry- and mesic-prairie species are well suited to the side slopes of rain water gardens while wet meadow species are well suited to the lower portions.



BLUE VERVAIN

Scientific Name	Common Name	See Page
Trees and Shrubs	•	
Aronia melanocarpa	Black chokeberry	98
Cornus racemosa	Gray dogwood	158
Viburnum opulus var. americanum	High bush cranberry	332
Forbs and Ferns		•
Allium stellatum	Prairie wild onion	84
Anemone canadensis	Canada anemone	92
Arisaema triphyllum	Jack-in-the-pulpit	96
Artemisia ludoviciana	Prairie sage	100
Asclepias tuberosa	Butterfly milkweed	104
Chamerion angustifolium	Fireweed	150
Eryngium yuccifolium	Rattlesnake master	168
Eurybia macrophylla	Bigleaf aster	172
Galium boreale	Northern bedstraw	182
Heuchera richardsonii	Prairie alumroot	194
Liatris ligulistylis	Meadow blazingstar	212
Liatris pyenostaehya	Prairie blazingstar	214
Lilium superbum	Turk's-cap lily	216
Maianthemum racemosum	False Solomon's seal	226
Matteuccia struthiopteris	Ostrich fern	228
Monarda fistulosa	Wild bergamot	230
Oligoneuron riddellii	Riddell's goldenrod	232
Oligoneuron rigidum	Stiff goldenrod	234
Osmunda regalis	Royal fern	238
Pteridium aquilinum	Bracken fern	256
Pycnanthemum virginiamum	Mountain mint	258
Ratibida pinnata	Yellow coneflower	262
Rudbeckia subtomentosa	Brown-eyed Susan	264
Solidago flexicaulis	Zig-zag goldenrod	294
Symphyotrichum laeve	Smooth aster	304
Symphyotrichum pilosum	Frost aster	310
Tradescantia ohiensis	Ohio spiderwort	318
Zizia aurea	Golden alexanders	334
Grasses, Sedges and Rushes		
Andropogon gerardii	Big bluestem	90
Bromus ciliatus	Fringed brome	116
Panicum virgatum	Switchgrass	240
Schizachyrium scoparium	Little bluestem	276
Sorghastrum nutans	Indian grass	296

Scientific Name	Common Name	See Page
Trees and Shrubs	-	
Aronia melanocarpa	Black chokeberry	98
Cephalanthus occidentalis	Buttonbush	148
Cormis sericea	Red-osier dogwood	160
Ilex verticillata	Winterberry	196
Viburnum opulus var. americanum	High bush cranberry	332
Forbs and Ferns		<u>'</u>
Agastache foeniculum	Giant hyssop	80
Anemone canadensis	Canada anemone	92
Angelica atropurpurea	Angelica	94
Asclepias incarnata	Marsh milkweed	102
Boltonia asteroides	Boltonia	114
Chelone glabra	Turtlehead	152
Equisetum fluviatile	Horsetail	166
Eupatorium perfoliatum	Boneset	170
Eutrochium maculatum	Joe-pye weed	176
Gentiana andrewsii	Bottle gentian	184
Helenium autumnale	Sneezeweed	190
Iris versicolor	Blueflag	200
Liatris ligulistylis	Meadow blazingstar	212
Liatris pycnostachya	Prairie blazingstar	214
Lilium superbum	Turk's-cap lily	216
Lobelia cardinalis	Cardinal flower	218
Lobelia siphilitica	Blue lobelia	220
Lysimachia thrysiflora	Tufted loosestrife	222
Oligoneuron rigidum	Stiff goldenrod	234
Onoclea sensibilis	Sensitive fern	236
Osmunda regalis	Royal fern	238
Physostegia virginiana	Obedient plant	246
Pteridium aquilinum	Bracken fern	256
Pycnanthemum virginianum	Mountain mint	258
Rudbeckia subtomentosa	Brown-eyed Susan	264
Scutellaria lateriflora	Mad-dog skullcap	288
Silphium perfoliatum	Cup plant	292
Symphyotrichum novae-angliae	New England aster	308
Symphyotrichum puniceum	Red-stemmed aster	312
Thalictrum dasycarpum	Tall meadowrue	316
Vernonia fasciculata	Ironweed	326
Veronicastrum virginicum	Culver's root	328

Rainwater Garden Base		
Scientific Name	Common Name	See Page
Grasses, Sedges and Rushes		
Bromus ciliatus	Fringed brome	116
Carex comosa	Bottlebrush sedge	126
Carex crinita	Caterpillar sedge	128
Carex hystericina	Porcupine sedge	130
Carex vulpinoidea	Fox sedge	144
Głyceria striata	Fowl manna grass	188
Juncus effusus	Soft rush	204
Panicum virgatum	Switchgrass	240
Scirpus cyperinus	Woolgrass	286
Spartina pectinata	Prairie cord grass	300

Infiltration Basin. Infiltration basins, like rain water gardens, are designed to infiltrate stormwater relatively quickly, but they are larger in



BLUE VERVAIN

size and receive stormwater from wider areas via pipes or swales. Deep-rooted plants are most effective in these systems as they increase the rate of infiltration and prevent erosion. If sod is chosen to vegetate an infiltration basin, the sod should be grown in permeable soils; sod grown in clay may restrict infiltration. If sod is used for infiltration basins, mowing height should be 4 to 9 inches. Trees can be incorporated along the side slopes of infiltration basins but should be planted at least 15 feet away from perforated pipes and 25 feet from riser structures (Ogle and Hoag 2000).

Infiltration Basin Side Slo	opes	
Scientific Name	Common Name	See Page
Trees and Shrubs	•	•
Acer saccharinum	Silver maple	76
Amorpha fruticosa	Indigo bush	88
Aronia melanocarpa	Black chokeberry	98
Betula nigra	River birch	108
Celtis occidentalis	Hackberry	146
Cormis racemosa	Gray dogwood	158
Fraximus nigra	Black ash	178
Fraximus pennsylvanica	Green ash	180

Ilex verticillata	Winterberry	196
Larix laricina	Tamarack	208
Physocarpus opulifolius	Ninebark	244
Populus deltoides	Eastern cottonwood	252
Populus tremuloides	Quaking aspen	254
Quercus bicolor	Swamp white oak	260
Salix nigra	Black willow	272
Sambucus racemosa	Red-berried elder	274
Spiraea alba	Meadowsweet	302
Viburnum lentago	Nannyberry	330
Viburnum opulus var. americanum	High bush cranberry	332
Forbs and Ferns		'
Agastache foeniculum	Giant hyssop	80
Allium stellatum	Prairie wild onion	84
Anemone canadensis	Canada anemone	92
Angelica atropurpurea	Angelica	94
Artemisia ludoviciana	Prairie sage	100
Asclepias tuberosa	Butterfly milkweed	104
Athyrium filix-femina	Lady fern	106
Boltonia asteroides	Boltonia	114
Equisetum fluviatile	Horsetail	166
Eryngium yuccifolium	Rattlesnake master	168
Eurybia macrophylla	Bigleaf aster	172
Euthamia graminifolia	Grass-leaved goldenrod	174
Galium boreale	Northern bedstraw	182
Helianthus grosseserratus	Sawtooth sunflower	192
Heuchera richardsonii	Prairie alumroot	194
Liatris ligulistylis	Meadow blazingstar	212
Liatris pycnostachya	Prairie blazingstar	214
Lilium superbum	Turk's-cap lily	216
Matteuccia struthiopteris	Ostrich fern	228
Monarda fistulosa	Wild bergamot	230
Oligoneuron riddellii	Riddell's goldenrod	232
Oligoneuron rigidum	Stiff goldenrod	234
Osmunda regalis	Royal fern	238
Pteridium aquilinum	Bracken fern	256
Pycnanthemum virginiamum	Mountain mint	258
Smilacina racemosum	False Solomon's seal	300
Solidago flexicaulis	Zig-zag goldenrod	294
Symphyotrichum laeve	Smooth aster	304
Symphyotrichum lanceolatus	Panicle aster	306
Symphyotrichum novae-angliae	New England aster	308
Symphyotrichum pilosum	Frost aster	310
Tradescantia ohiensis	Ohio spiderwort	318

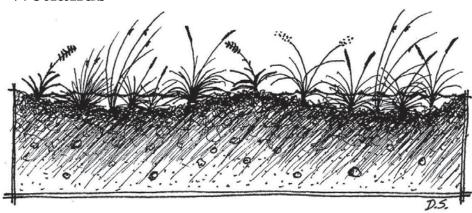
Infiltration Basin Side Slopes Cont.			
	Scientific Name	Common Name	See Page
	Zizia aurea	Golden alexanders	334
	Grasses, Sedges and Rushes		
	Andropogon gerardii	Big bluestem	90
	Bromus ciliatus	Fringed brome	116
	Carex vulpinoidea	Fox sedge	144
	Panicum virgatum	Switchgrass	240
	Schizachyrium scoparium	Little bluestem	276
	Sorghastrum mutans	Indian grass	296

Scientific Name	Common Name	See Page
Trees and Shrubs	•	
Aronia melanocarpa	Black chokeberry	98
Cephalanthus occidentalis	Buttonbush	148
Cormus sericea	Red-osier dogwood	160
Ilex verticillata	Winterberry	196
Viburnum opulus var. americanum	High bush cranberry	332
Forbs and Ferns	•	
Agastache foeniculum	Giant hyssop	80
Anemone canadensis	Canada anemone	92
Angelica atropurpurea	Angelica	94
Asclepias incarnata	Marsh milkweed	102
Boltonia asteroides	Boltonia	114
Chelone glabra	Turtlehead	152
Equisetum fluviatile	Horsetail	166
Eupatorium perfoliatum	Boneset	170
Eutrochium maculatum	Joe-pye-weed	176
Gentiana andrewsii	Bottle gentian	184
Helenium autumnale	Sneezeweed	190
Iris versicolor	Blueflag	200
Liatris ligulistylis	Meadow blazingstar	212
Liatris pyenostaehya	Prairie blazingstar	214
Lilium superbum	Turk's-cap lily	216
Lobelia cardinalis	Cardinal flower	218
Lobelia siphilitica	Blue lobelia	220
Lysimachia thrysiflora	Tufted loosestrife	222
Oligoneuron rigidum	Stiff goldenrod	234
Onoclea sensibilis	Sensitive fern	236
Osmunda regalis	Royal fern	238

Physostegia virginiana	Obedient plant	246
Pteridium aquilinum	Bracken fern	256
Pycnanthemum virginiamum	Mountain mint	258
Rudbeckia subtomentosa	Brown-eyed Susan	264
Scutellaria lateriflora	Mad-dog skullcap	288
Silphium perfoliatum	Cup plant	292
Symphyotrichum novae-angliae	New England aster	308
Symphyotrichum puniceum	Red-stemmed aster	312
Thalictrum dasycarpum	Tall meadowrue	316
Vernonia fasciculata	Ironweed	326
Veronicastrum virginicum	Culver's root	328
Grasses, Sedges and Rushes	•	•
Bromus ciliatus	Fringed brome	116
Carex comosa	Bottlebrush sedge	126
Carex crinita	Caterpillar sedge	128
Carex hystericina	Porcupine sedge	130
Carex vulpinoidea	Fox sedge	144
Głyceria striata	Fowl manna grass	188
Juncus effusus	Soft rush	204
Panicum virgatum	Switchgrass	240
Scirpus cyperinus	Woolgrass	286
Spartina pectinata	Prairie cord grass	300

Infiltration Trench. This infiltration technique involves digging a trench 3 to 8 feet deep, lining it with filter fabric and then filling it with stone. Infiltration trenches are designed to receive clean sheet flow from a small area, such as a few residences or rooftops (Barr 2001). Although infiltration trenches are not vegetated, it is important that suspended solids be removed before they enter the trench. Grassed filter strips are often an effective tool for pretreatment (Barr 2001). Grass filter strips are discussed under filtration.

Wetlands



Wetland systems are designed for flood control and the removal of pollutants from stormwater. Wetland systems covered in this guidebook include stormwater wetlands and wet swales.

Stormwater Wetland. Like natural wetlands, stormwater wetlands have the capacity to improve water quality through microbial breakdown of pollutants, plant uptake, retention of stormwater, settling and adsorption. Sediment forebays and micropools are often designed as part of stormwater wetlands to prevent sediment from filling the wetland. Stormwater from large areas can be diverted into these wetlands. If soils drain too quickly, liners can be used to hold water (Barr 2001). Stormwater wetlands will have zones and plants similar to wet ponds. They may have less fluctuation, though, and can maintain higher diversity. (For species list, see Wet Ponds and Extended Storage Ponds.)

Wet Swale. Wet swales consist of broad, open channels, used to temporarily store water. Wet swales are constructed on existing soils and are often at or slightly above the water table (Barr 2001). As a

result, they can incorporate a wide variety of wetland and wet-meadow shrub, grass and flower species. The primary purpose of wet swales is to improve water quality and to slow runoff velocity. Check dams and berms are often used to slow and retain water.



Photo: Dan Shaw

Wet Swale		
Scientific Name	Common Name	See Page
Trees and Shrubs		
Almus incana	Speckled alder	86
Amorpha fruticosa	Indigo bush	88
Aronia melanocarpa	Black chokeberry	98
Betula nigra	River birch	108
Cephalanthus occidentalis	Buttonbush	148
Cornus amomum	Silky dogwood	156
Cormis racemosa	Gray dogwood	158
Cormis sericea	Red-osier dogwood	160
Ilex verticillata	Winterberry	196
Larix laricina	Tamarack	208
Physocarpus opulifolius	Ninebark	244
Salix discolor	Pussy willow	268
Salix exigua	Sandbar willow	270
Sambucus racemosa	Red-berried elder	274
Spiraea alba	Meadowsweet	302
Viburnum lentago	Nannyberry	330
Viburnum opulus var. americanum	High bush cranberry	332
Forbs and Ferns		•
Agastache foeniculum	Giant hyssop	80
Alisma trivale	Water plantain	82
Anemone canadensis	Canada anemone	92
Angelica atropurpurea	Angelica	94
Artemisia ludoviciana	Prairie sage	100
Asclepias incarnata	Marsh milkweed	102
Boltonia asteroides	Boltonia	114
Caltha palustris	Marsh marigold	120
Chelone glabra	Turtlehead	152
Comarum palustre	Marsh cinquefoil	154
Equisetum fluviatile	Horsetail	166
Eryngium yuccifolium	Rattlesnake master	168
Eupatorium perfoliatum	Boneset	170
Euthamia graminifolia	Grass-leaved goldenrod	174
Eutrochium maculatum	Joe-pye-weed	176
Gentiana andrewsii	Bottle gentian	184
Helenium autumnale	Sneezeweed	190
Helianthus grosseserratus	Sawtooth sunflower	192
Impatiens capensis	Jewelweed	198
Iris versicolor	Blueflag	200
Liatris ligulistylis	Meadow blazingstar	212

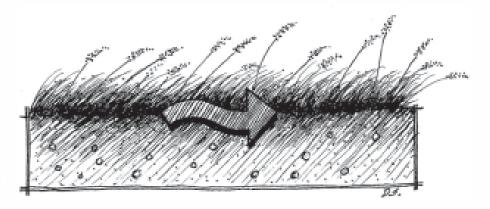
Scientific Name	Common Name	See Page
Liatris pycnostachya	Prairie blazingstar	214
Lilium superbum	Turk's-cap lily	216
Lobelia cardinalis	Cardinal flower	218
Lobelia siphilitica	Blue lobelia	220
Lysimachia thrysiflora	Tufted loosestrife	222
Monarda fistulosa	Wild bergamot	230
Oligoneuron rigidum	Stiff goldenrod	234
Onoclea sensibilis	Sensitive fern	236
Osmunda regalis	Royal fern	238
Physostegia virginiana	Obedient plant	246
Polygonum amphibium	Water smartweed	248
Pontederia cordata	Pickerelweed	250
Pycnanthemum virginianum	Mountain mint	258
Rudbeckia subtomentosa	Brown-eyed Susan	264
Sagittaria latifolia	Broadleaved arrowhead	266
Scutellaria lateriflora	Mad-dog skullcap	288
Silphium perfoliatum	Cup plant	292
Sparganium eurycarpum	Giant burreed	298
Symphyotrichum lanceolatus	Panicle aster	306
Symphyotrichum novae-angliae	New England aster	308
Symphyotrichum puniceum	Red-stemmed aster	312
Symplocarpus foetidus	Skunk cabbage	314
Thalictrum dasycarpum	Tall meadowrue	316
Tradescantia ohiensis	Ohio spiderwort	318
Verbena hastata	Blue vervain	324
Vernonia fasciculata	Ironweed	326
Veronicastrum virginicum	Culver's root	328
Zizia aurea	Golden alexanders	334
Grasses, Sedges and Rushes		
Andropogon gerardii	Big bluestem	90
Bolboschoenus fluviatilis	River bulrush	112
Bromus ciliatus	Fringed brome	116
Calamagrostis canadensis	Canada blue-joint grass	118
Carex aquatilis	Water sedge	122
Carex bebbii	Bebb's sedge	124
Carex comosa	Bottlebrush sedge	126
Carex crinita	Caterpillar sedge	128
Carex hystericina	Porcupine sedge	130
Carex lacustris	Lake sedge	132
Carex lasiocarpa	Wooly needle sedge	134
Carex pellita	Wooly sedge	136

Carex retrorsa	Retrorse sedge	138
Carex stipata	Awl-fruited sedge	140
Carex stricta	Tussock sedge	142
Carex vulpinoidea	Fox sedge	144
Eleocharis obtusa	Blunt spikerush	162
Elymus virginicus	Virginia wild rye	164
Głyceria grandis	Giant manna grass	186
Głyceria striata	Fowl manna grass	188
Juneus areticus	Baltic rush	202
Juncus effusus	Soft rush	204
Juncus torreyi	Torrey rush	206
Leersia oryzoides	Rice-cut grass	210
Panicum virgatum	Switchgrass	240
Schoenoplectus acutus	Hardstem bulrush	278
Schoenoplectus pungens	Three-square bulrush	280
Schoenoplectus tabernaemontani	Soft-stem bulrush	282
Scirpus atrovirens	Green bulrush	284
Scirpus cyperinus	Woolgrass	286
Spartina pectinata	Prairie cord grass	300
Typha latifolia	Broadleaved cattail	320



OBEDIENT PLANT

Filtration



Filtration systems remain dry between storm events and are designed to remove pollutants from stormwater. Filtration MPs covered in this guidebook include bioretention systems and filter strips.

Bioretention Basins. Like rainwater gardens and infiltration basins, bioretention basins rely on plants to function effectively. Bioretention basins can be designed for infiltration but often have longer detention times and are often built with soils that have less infiltration capacity (Barr 2001). Generally the same species used for rain water gardens and infiltration basins can be used for bioretention areas (for species list, see Rain Water Gardens and Infiltration Basins).

Filter Strips. Filter strips are densely graded and uniformly vegetated areas designed to treat sheet flow (Barr 2001). Filter strips differ from natural buffers in that they are generally designed specifically for pollutant removal (MPCA 2000). In filter strips, native vegetation slows runoff, collects sediment and allows some infiltration. Dry- and mesic-prairie species, especially deep-rooted grasses, are well suited for filter strips. They produce many stems that slow water flow and have deep roots that increase infiltration and absorption. Tree and shrub species can be planted among the prairie species also, but they will inhibit growth of the prairie species if the shade they produce is dense. Dense stands of vegetation are required for filter strips to function effectively. As a result, monitoring is important to ensure the establishment and persistence of desirable vegetation. Excessive accumulation of sediment can affect plant growth and should be removed (MPCA 2000).

Scientific Name	Common Name	See Page
Trees and Shrubs	'	, ,
Acer saccharinum	Silver maple	76
Aronia melanocarpa	Black Chokeberry	98
Betula nigra	River birch	108
Celtis occidentalis	Hackberry	146
Cornus racemosa	Gray dogwood	158
Fraxinus pennsylvanica	Green ash	180
Larix laricina	Tamarack	208
Physocarpus opulifolius	Ninebark	244
Populus deltoides	Eastern cottonwood	252
Populus tremuloides	Quaking aspen	254
Quercus bicolor	Swamp white oak	260
Salix nigra	Black willow	272
Spiraea alba	Meadowsweet	302
Viburnum lentago	Nannyberry	330
Viburnum opulus var. americanum	High bush cranberry	332
Forbs and Ferns	•	•
Agastache foeniculum	Giant hyssop	80
Allium stellatum	Prairie wild onion	84
Anemone canadensis	Canada anemone	92
Angelica atropurpurea	Angelica	94
Artemisia ludoviciana	Prairie sage	100
Asclepias tuberosa	Butterfly milkweed	104
Athyrium filix-femina	Lady fern	106
Boltonia asteroides	Boltonia	114
Equisetum fluviatile	Horsetail	166
Eryngium yuccifolium	Rattlesnake master	168
Eurybia macrophylla	Bigleaf aster	172
Euthamia graminifolia	Grass-leaved goldenrod	174
Galium boreale	Northern bedstraw	182
Helianthus grosseserratus	Sawtooth sunflower	192
Heuchera richardsonii	Prairie alumroot	194
Liatris ligulistylis	Meadow blazingstar	212
Liatris pyenostachya	Prairie blazingstar	214
Lilium superbum	Turk's-cap lily	216
Maianthemum racemosum	False Solomon's seal	226
Matteuccia struthiopteris	Ostrich fern	228
Monarda fistulosa	Wild bergamot	230
Oligoneuron riddellii	Riddell's goldenrod	232
Oligoneuron rigidum	Stiff goldenrod	234
Osmunda regalis	Royal fern	238

Filtration Strips Cont.		
Scientific Name	Common Name	See Page
Pteridium aquilinum	Bracken fern	256
Pycnanthemum virginiamum	Mountain mint	258
Solidago flexicaulis	Zig-zag goldenrod	294
Symphyotrichum laeve	Smooth aster	304
Symphyotrichum lanceolatus (simplex)	Panicle aster	306
Symphyotrichum novae-angliae	New England aster	308
Symphyotrichum pilosum	Frost aster	310
Tradescantia ohiensis	Ohio spiderwort	318
Zizia aurea	Golden alexanders	334
Grasses, Sedges and Rushes	•	•
Andropogon gerardii	Big bluestem	90
Bromus ciliatus	Fringed brome	116
Carex vulpinoidea	Fox sedge	144
Panicum virgatum	Switchgrass	240
Schizachyrium scoparium	Little bluestem	276
Sorghastrum mutans	Indian grass	296
Other appropriate grasses not covered	d in this guidebook	•
Bouteloua curtipendula	Side-oats grama	
Bouteloua hirsuta	Hairy grama	
Bromus kalmii	Prairie brome	
Elymus canadensis	Canada wild rye	
Koeleria cristata	June grass	
Sporobolis heterolepis	Prairie dropseed	
Stipa spartea	Porcupine grass	



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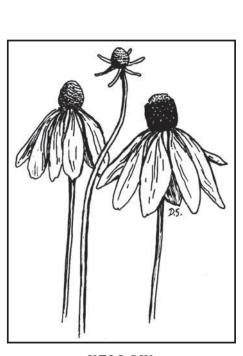
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YELLOW CONEFLOWER

PLANT SPECIES INFORMATION



The following table lists plant species included in this guidebook. The table presents generally recognized scientific and common names for each species as well as the current accepted scientific name references and common name references derived from the *Annotated Checklist of the Flora of Minnesota* from the University of Minnesota herbarium (available on the herbarium's Web site at http://biosci.cbs.umn.edu/herbarium/checklis2.htm) and from the Integrated Taxonomic Information System(ITIS). The ITIS is a collaborative effort between taxonomists in the United States, Canada and Mexico. The goal of the ITIS is to determine and support the most current taxonomic standing for flora and fauna in North America. Data records have been confirmed online at http://www.itis.usda.gov. Note that several names were current as of January 2003.

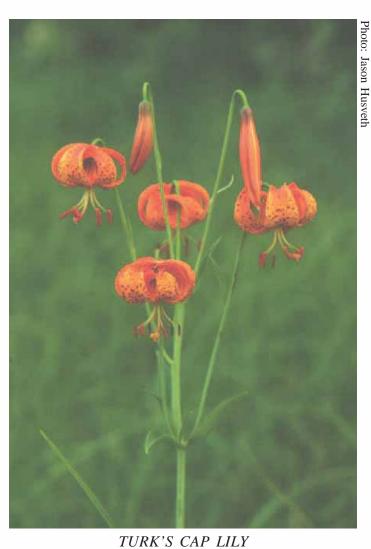
Also included in this section are two pages for each plant species.

Currently Accepted Scientific	Accepted Common	Scientific Name
Name	Name	Used in Previous Version
Acer saccharinum L.	Silver maple	
Acorus calamus L.	Sweet flag	
Agastache foeniculum (Pursh) Kuntze	Giant hyssop	
Alisma trivale Pursh	Water plantain	
Allium stellatum Fraser ex Ker Gawl.	Prairie wild onion	
Alnus incana ssp. rugosa (Du Roi) R.T. Clausen	Speckled alder	
Amorpha fruticosa L.	Indigo bush	
Andropogon gerardii Vitman	Big bluestem	
Anemone canadensis L.	Canada anemone	
Angelica atropurpurea L.	Angelica	
Arisaema triphyllum (L.) Schott	Jack-in-the-pulpit	
Aronia melanocarpa (Michx.) Elliott	Black chokeberry	
Artemisia ludoviciana Nutt.	Prairie sage	
Asclepias incarnata L.	Marsh milkweed	
	Butterfly milkweed	
Asclepias tuberosa L.	-	
Athyrium filix-femina ssp.	Lady fem	
angustum (Willd.) Clausen	River birch	
Betula nigra L. Bidens cernua L.		
Bolboschoemus fluviatilis (Torr.) Sojak	Beggarsticks River bulrush	Scirpus fluviatilis
		(Torrey) Gray
Boltonia asteroides (L.) L'Hér.	Boltonia	
Bromus ciliatus L.	Fringed brome	
Calamagrostis canadensis	Canada blue-joint	
(Michx.) Beauv.	grass	
Caltha palustris L.	Marsh marigold	
Carex aquatilis Wahlenb.	Water sedge	
Carex bebbii Olney ex Fern.	Bebb's sedge	
Carex comosa Boott	Bottlebrush sedge	
Carex crinita Lam.	Caterpillar sedge	
Carex hystericina Muhl. ex Willd.	Porcupine sedge	
Carex lacustris Willd.	Lake sedge	
Carex lasiocarpa Ehrh.	Wooly needle sedge	
Carex pellita Muhl. Ex Willd	Wooly sedge	Carex lanuginosa Michx.
Carex retrorsa Schwein.	Retrorse sedge	
Carex stipata Muhl. ex Willd.	Awl-fruited sedge	
Carex stricta Lam.	Tussock sedge	
Carex vulpinoidea Michx.	Fox sedge	

Currently Accepted Scientific Name	Accepted Common Name	Scientific Name Used in Previous Version
Celtis occidentalis L.	Hackberry	
Cephalanthus occidentalis L.	Buttonbush	
Chamerion angustifolium ssp.	Fireweed	Epilobium
angustifolium (L.) Holub		angustifolium L.
Chelone glabra L.	Turtlehead	
Comarum palustre L.	Marsh cinquefoil	Potentilla pahustris L. Scop.
Cormus amomum P. Mill	Silky dogwood	
Cornus racemosa Lam.	Gray dogwood	
Cornus sericea L.	Red-osier dogwood	
Eleocharis obtusa (Willd.) Schult.	Blunt spikerush	
Elymus virginicus L.	Virginia wild rye	
Equisetum fluviatile L.	Horsetail	
Eryngium yuccifolium Michx.	Rattlesnake master	
Eupatorium perfoliatum L.	Boneset	
Eurybia macrophylla L. Cass.	Bigleaf aster	Aster macrophyllus var. macrophyllus L.
Euthamia graminifolia vat.	Grass-leaved goldenrod	macrophymas 2.
graminifolia (L.) Nutt.		
Eutrochium maculatum (L.) E.E. Lamont	Joe-pye-weed	Eupatorium
P	D	maculatum L.
Fraximus nigra Marsh.	Black ash	
Fraxinus pennsylvanica Marsh.	Green ash	
Galium boreale L.	Northern bedstraw	
Gentiana andrewsii Griseb.	Bottle gentian	
Glyceria grandis S. Wats.	Giant manna grass	
Głyceria striata (Lam.) Hitchc.	Fowl manna grass	
Helenium autumnale L.	Sneezeweed	
Helianthus grosseserratus Martens	Sawtooth sunflower	
Heuchera richardsonii R. Br.	Prairie alumroot	
Ilex verticillata (L.) Gray	Winterberry	
Impatiens capensis Meerb.	Jewelweed	
Iris versicolor L.	Blueflag	
Juncus arcticus ssp. Littoralis Willd. (Engelm.) Hulten	Baltic rush	Juncus balticus Willd.
Juncus effusus L.	Soft rush	
Juncus torreyi Coville	Torrey rush	
Larix laricina (Du Roi) K. Koch	Tamarack	
Leersia oryzoides (L.) Sw.	Rice-cut grass	
Liatris ligulistylis (A. Nels.) K. Schum.	Meadow blazingstar	
Liatris pycnostachya Michx	Prairie blazingstar	

Currently Accepted Scientific Name	Accepted Common Name	Scientific Name Used in Previous Version
Lilium superbum L.	Turk's-cap lily	
Lobelia cardinalis L.	Cardinal flower	
Lobelia siphilitica L.	Blue lobelia	
Lysimachia thyrsiflora L.	Tufted loosestrife	
Lythrum salicaria L.	Purple loosestrife	
Maianthemum racemosum ssp. racemosum (L.) Link	False Solomon's seal	Smilacina racemosa L.
Matteuccia struthiopteris (L.) Todaro	Ostrich fern	
Monarda fistulosa L.	Wild bergamot	
Oligoneuron riddellii (Frank ex Riddell) Rydb.	Riddell's goldenrod	Solidago riddellii Frank
Oligoneuron rigidum var. rigidum (L.) Small	Stiff goldenrod	Solidago rigida L.
Onoclea sensibilis L.	Sensitive fern	
Osmunda regalis L.	Royal fern	
Panicum virgatum L.	Switchgrass	
Phalaris arundinacea L.	Reed canary grass	
Physocarpus opulifolius (L.) Maxim.	Ninebark	
Physostegia virginiana (L.) Benth.	Obedient plant	
Polygonum amphibium L.	Water smartweed	
Pontederia cordata L.	Pickerelweed	
Populus deltoides Bartr. ex Marsh.	Eastern cottonwood	
Populus tremuloides Michx.	Quaking aspen	
Pteridium aquilinum (L.) Kuhn	Bracken fern	
Pycnanthemum virginianum (L.) T. Dur. & B. D. Jackson ex B. L. Robins. & Fern.	Mountain mint	
Quercus bicolor Willd.	Swamp white oak	
Ratibida pinnata (Vent.) Barnh.	Yellow coneflower	
Rudbeckia subtomentosa Pursh	Brown-eyed Susan	
Sagittaria latifolia Willd.	Broadleaved arrowhead	
Salix discolor Muhl.	Pussy willow	
Salix exigua Nutt.	Sandbar willow	
Salix nigra Marsh.	Black willow	
Sambucus racemosa var. racemosa L.	Red-berried elder	Sambucus pubens L.
Schizachyrium scoparium (Michx.) Nash	Little bluestem	
Schoenoplectus acutus var. acutus (Muhl. ex Bigelow) A. & D. Löve	Hardstem bulrush	Scirpus acutus Muhi

Currently Accepted Scientific Name	Accepted Common Name	Scientific Name Used in Previous Version
Schoenoplectus pungens var.	Three-square bulrush	Scirpus pungens
pungens (Vahl) Palla		Vahl.
Schoenoplectus tabernaemontani	Soft-stem bulrush	Scirpus validus Vahl.
(C.C. Gmel.) Palla		
Scirpus atrovirens Willd.	Green bulrush	
Scirpus cyperinus (L.) Kunth	Woolgrass	
Scutellaria lateriflora L.	Mad-dog skullcap	
Silphium laciniatum	Compass Plant	
Silphium perfoliatum L.	Cup plant	
Solidago flexicaulis L.	Zig-zag goldenrod	
Sorghastrum mutans (L.) Nash	Indian grass	
Sparganium eurycarpum Engelm.	Giant burreed	
Spartina pectinata Bosc ex Link	Prairie cord grass	
Spiraea alba Du Roi	Meadowsweet	
Symphyotrichum laeve var. laeve (L.) A. & D. Löve	Smooth aster	Aster laevis L.
Symphyotrichum lanceolatus var.	Panicle aster	Aster lanceolatus
lanceolatum (Willd.) Nesom		(simplex) willd.
Symphyotrichum novae-angliae (L.) Nesom	New England aster	Aster novae-angliae L
Symphyotrichum pilosum var.	Frost aster	Aster pilosus var.
pilosum (Willd.) G.L.Nesom		pilosus Willd.
Symphyotrichum puniceum var.	Red-stemmed aster	Aster puniceus var.
puniceum (l.) A. & D. Love		puniceus L.
Symphyotrichum puniceum var.	Swamp aster	Aster lucidulus
puniceum (L.) A. & D. Löve		(Gray)(Wieg.)
Symplocarpus foetidus (L.) Salisb. ex Nutt.	Skunk cabbage	
Thalictrum dasycarpum Fisch. & Avé- Lall.	Tall meadowrue	
Tradescantia ohiensis Raf.	Ohio spiderwort	
Typha latifolia L.	Broadleaved cattail	
Typha xglauca Godr. (pro sp.)	Hybrid cattail	
Verbena hastata L.	Blue vervain	
Vernonia fasciculata Michx.	Ironweed	
Veronicastrum virginicum (L.) Farw.	Culver's root	
Viburnum lentago L.	Nannyberry	
Viburnum opulus var. americanum L. Ait.	High bush cranberry	Viburnum trilobum L
Zizia aurea (L.) W. D. J. Koch	Golden alexanders	



Plant Matrix

This plant matrix summarizes information for plant species covered in the guidebook. Pages for individual species should be referred to for more detailed information. Within the matrix **Water Level** indicates the ideal moisture condition for the species. **Frequency** refers to the frequency of water fluctuation (frequency of inundation) that the species can handle without significant stress.

Depth refers to the depth of inundation that the species can handle for the time period listed under **Duration**.

Design refers to the type of BMP or other type of plating the species is suited to. The **Nursery** category provides information about the general availability of the plant species.

- ¹ Water Level is the water level of each plant as described in the Normal Water Level section: D = Dry soils, I = Inundation, M = Moist/mesic soils and S = Saturated soils.
- ² **Frequency** is the tolerance to frequency for each plant as described in the Fluctuation Tolerance section: H = High tolerance, L = Low tolerance and M = Moderate tolerance.
- 3 **Depth** is the tolerance to depth in inches for each plant as described in the Fluctuation Tolerance section.
- ¹ **Duration** is the tolerance to duration for each plant as described in the Fluctuation Tolerance section followed by the number of days: H = High, ML = Medium Long, MS = Medium Short, S = Short.
- ⁵ **Design Potentials** is the possibilities for this plant in designed landscapes as described in the Design Consideration section: A = Aromatic, BF = Butterfly/Nectar Source, CF Cut/Dried Flowers, E = Erosion-control Plant, FC = Fall Color, GC = Ground Cover, GP = Garden Perennial, L = Landscape Design, NR =Use Not Recommended because this species is invasive, R = Restoration, RG = Rainwater Gardens, RO = Rock Garden, S = Shade, SW = Vegetated Swales, UB = Upland Buffer, W = Wave Buffer, WL = Wildlife.
 - ⁶ Nursery is the availability of the plant at nurseries with three categories
 - ⁷ of availability: L = Limited availability, NA = Not Available and
- 8 W = Widely available.

Scientific Name	Common Name	Water Level ¹ Frequency ² (in inches)		Depth ³ (in inches)	Duration ⁴	Design Potentials ⁵	Nursery ⁶
Acer saccharimm	Silver maple	S	PoM	09	L 20	L, R, S	M
Acorus calamus	Sweet flag	S-1 (6-20)	Low	12	MS3	E, R, RG. SW, W, WL	W
Agastache foeniculum	Giant hyssop	M-D	Mod	12	S2	A, CF, GP, RG, UB	W
Allium stellatum	Prairie wild onion	M-D	Mod	12	SI	A, GP, RG, UB	W
Alisma trivale	Water plantain	M-1(6)	High	18	L6	E, R, RP, SW, WL	W
Almus incana	Speckled alder	M-S (6)	High	24	T6	E, L, R, RP	Τ
Amorpha fruiticosa	Indigo bush	M-D	High	18	MS3	E, GP, L, R, RG	W
Andropogon gerardi i	Big bluestem	M	Mod	12	S2	E, FC, GP, L, R, UB	W
Anemone canadensis	Canada anemone	M-S	High	12	S2	R ,RG, RO ,SW	W
Angelica atropurpurea	Angelica	S-1(3)	Mod-Low	18	MS3	A, R	Τ
Arhyrium felix-femina	Lady fem	M-S	Low	12	S2	GC, GP, L, RG, S, UB	W
Arisaema triphyllum	Jack-in-the-pulpit	M-S	poM	12	SI	L, R, S	Т
Aronia melanocarpa	Black chokeberry	M-S	Mod	12	S2	FC. L, RG	W
Artemisia ludoviciana	Prairie sage	M-D	poM	18	MS3	A, GC, L, R, UB	W
Asclepias incarnata	Marsh milkweed	M-1(3)	роМ	18	MS3	A, BF, L, R, RG, RP, SW, UB	W
Asclepias tuberosa	Butterfly milkweed	M-D	Low	12	SI	BF, GP, L, R, RG, UB	W
Betula nigra	River birch	M-S	High	09	LS	E, L, RG, R, WL	W
Bidens cernua	Beggarsticks	M	High	24	ML4	E, R, SW	L
Bolboschoemus fluviatilis	River bulnush	S-I (30)	High	30	MS3	E, R, SW, WL	W
Boltonia asteroides	Boltonia	M-S	Mod	18	MS3	BF, CF,GP	L
Bromus ciliatus	Fringed brome	M-S	Mod	18	MS3	CF, L, S	W
Calamagrostis canadensis	Canada blue-joint grass	M-1(6)	High	9	ML4	E, L, R, SW, WL	W
Caltha palustris	Marsh marigold	S-I (6)	Mod	9	MS3	R	W
Carex aquatilis	Water sedge	S-1 (6)	HiQh	12	MS3	E, R, RG, S, SW	L
Carex bebbii	Bebb's sedge	M-S	High	12	MS3	L, R, RG, RP	W
Carex comosa	Bottlebrush sedge	S-1 (12)	High	36	MS3	E, L, R, RG	W
Carex crinita	Caterpillar sedge	S-1 (6)	High	12	MS3	E.L. R. RG. S	L

Scientific Name	Common Name	Water Level ¹ Frequency ² (in inches)		Depth ³ (in inches)	Duration ⁴	Design Potentials ⁵	Nursery ⁶
Carex hystericina	Porcupine sedge	(9) I-S	High	36	MS3	E, L, R, RG	1
Carex lacustris	Lake sedge	S-1 (24)	Mod	24	ST	R	W
Carex lasiocarpa	Wooly needle sedge	(9) I-S	Mod	12	MS3	R	T
Carex pellita	Wooly sedge	M-1 (3-6)	High	12	9T	E, R, SW	T
Carex retrorsa	Retrorse sedge	S-1 (6)	Mod	12	MS3	R	T
Carex stipata	Awl-fruited sedge	M-I (6)	High	9	ML4	E, R, S, SW	W
Carex stricta	Tussock sedge	(9) I-S	High	12	MS3	L, R,RG, SW	W
Carex vulpinoidea	Fox sedge	S-1 (6)	High	24	ML4	E, L, R, RG, SW	W
Celtis occidentalis	Hackberry	M-D	Mod	09	L5	E, L, R	W
Cephalanthus occidentalis	Buttonbush	S-I (36)	Mod	24	L45+	E,L,R	W
Chamerion angustifolium	Fireweed	M-S	Mod	12	S2	E,WL	T
Chelone glabra	Turtlehead	S-1(3)	Mod	6	S2	BF, CD, L, R, RG	W
Comarum palustre	Marsh cinquefoil	S-I (6)	Low	12	\$2	R	NA
Сотии атотит	Silky dogwood	M-S	Low	36	T30+	E, L, R, RG, WL	W
Cornus racemosa	Gray dogwood	D-S	Mod	9	S2	ER	W
Cornus sericea	Red-osier dogwood	M-S	Mod	36	L 30+	E, L, R, RG, WL	W
Eleocharis obtusa	Blunt spikerush	S-1 (6)	High	18	T 30	E.R. SW	W
Elymus virginicus	Virginia wild rye	M-S	Mod	36	L 15	E, L, R, SW, WL	W
Equisetum fluviatile	Horsetail	S-I (36)	High	24	L 10	R,WL	Τ
Eryngium yuccifolium	Rattlesnake master	M-D	Mod	12	S2	BF, CF, L, RG	W
Eupatorium perfoliatum	Boneset	M-S	High	24	ML3.5	E, GC, L, R, RG, SW	W
Eurybia macrolylla	Bigleaf aster	M-D	Low	12	IS	GC, R, S, UB	Г
Euthamia graminifolia	Grass-leaved goldenrod	M-S	Mod	12	\$2	E, R,RG, SW	Γ
Eutrochium maculatum	Joe-pye-weed	M-S	High	24	ML3.5	BF, CF, E, GP, R, RG, SW	W
Fraxinus pennsylvanica	Green ash	M-S	High	60/24	L 10/ML 4	E, R, S	W
Fraxinus nigra	Black ash	M-S	High	09	L5	R	W
Galium boreale	Northern bedstraw	M-S	Mod	12	IS	CF, GC, L, RO	Г
Gentiona andreweii	Bottle gentian	M.S	Mod	12	S	CE GP I R RG RO SW	m

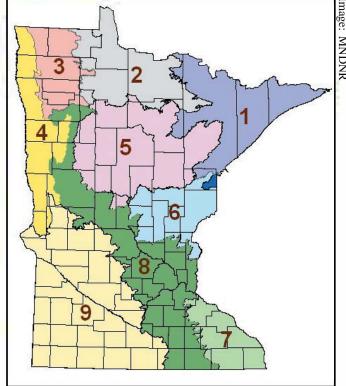
Scientific Name	Common Name	Water Level Frequency ²		Depth ³	Duration ⁴	Design Potentials ⁵	Nursery
Ghoeria orandis	Giant manna grass	S-1(12)	High	24	SI	R SW WI.	A
Glyceria striata	Fowl manna grass	M-1 (6)	High	24	TS	R. SW. WL	W
Helenium autumnale	Sneezeweed	W-S	Mod	18	MS3	CF, E, L, R, SW	W
Helianthus grosseserratus	Sawtooth sunflower	M-S	High	18	MS3	E, R, SW	W
Heuchera richardsonii	Prairie alumroot	M-D	High	9	S 1	RP, L, RG, RO	W
llex verticillata	Winterberry	M-S	Mod	18	MS3	L, R, RG	W
Impatiens capensis	Jewelweed	s	High	18	L 30	R, WL	W
Iris versicolor	Blueflag iris	S-1 (12)	Mod	12	ML4	CF, E, L, R, RG, SW	M
Juncus arcticus	Baltic rush	S-1 (6)	High	24	L 10	E, R, SW, WL	T
Juncus effusus	Soft rush	S-1 (12)	Mod	18	ML4	L, R, RG, SW	M
Juncus torreyi	Torrey rush	M-1 (3-6)	Mod	18	9T	CF, E, L, R, SW	M
Larix laricina	Tamarack	M-S	Low	12	L5	L, R, RG	M
Leersia oryzoides	Rice-cut grass	S-1 (6)	High	30	PT	E, R, SW, WL	M
Liatris ligulistylis	Meadow blazingstar	M-S	Low	12	S 1	BF, CF, GP, L, RG	M
Liatris pycnostachya	Prairie blazingstar	M-S	Low	18	MS3	BF, CF, GP, L, R, RG	W
Lilium superbum	Turk's-cap lily	M-S	Low	12	S2	BF, R	T
Lobelia cardinalis	Cardinal flower	M-S	High	18	L5	CF, E, L, RG	M
Lobelia siphilitica	Blue lobelia	M-S	High	18	L5	CF, GP, L, R, RG, WL	M
Lysimachia thyrsiflora	Tufted loosestrife	I(3)	Mod	12	ML4	R	T
Lythrum salicaria	Purple loosestrife	(9) I-S	High	36	L 10	NR	NA
Maianthemun racemosum	False Solomon's seal	M	Low	12	IS	CF, E, R, S, UB	W
Matteuccia struthiopteris	Ostrich fem	M-S	Mod	12	IS	L, R, S	W
Monarda fistulosa	Wild bergamot	M-D	Mod	12	S2	A, CF, E, L, R, UB, WL	W
Oligoneuron riddellii	Riddell's goldenrod	M-S	Mod	12	S2	BF, CF, L, R, WL	W
Oligoneuron rigidaum	Stiff goldenrod	M-D	Low-Mod	12	S2	BF, CF, E, R, RG, UB	W
Onoclea sensibilis	Sensitive fern	S-1(3)	High	12	ML4	CF, GC, L, R, RG, S	W
Osmunda regalis	Royal fem	S-I(3)	High	12	ML4	GC, L, RG, S	W
Pamicum virgatum	Switchgrass	M	High	18	MS3	CF F. I. WI.	W

Scientific Name	Common Name	Water Level ¹ Frequency ² (in inches)		Depth³ (in inches)	Duration ⁴	Design Potentials ⁵	Nursery ⁶
Phalaris arundinacea	Reed canary grass	S-I (12)	High	24	ST	NR	1
Physocarpus opulifolius	Ninebark	D-S	Mod	18	MS3	L, R	W
Physostegia virginiana	Obedient plant	S-I(3)	Mod	12	\$2	CF, GP, L, RG	W
Polygonum amphibium	Water smartweed	S-I (36)	High	12	\$2	E, R, W, WL	W
Pontederia cordata	Pickerelweed	I(12-18)	Mod	12	ML4	L, R, RG, WL	W
Populus deltoides	Eastern cottonwood	M-S	High	09	T30	L, R, S	W
Populus tremuloides	Quaking aspen	M-D	Low	18	MS3	R, WL	W
Pteridium aquilinum	Bracken fem	M-D	Mod	12	S 1	NR	NA
Pycnanthemun virginianun	Mountain mint	M-S	Mod	12	\$2	A, CF, E, GP, L, R, SW	W
Quercus bicolor	Swamp white oak	M-S	Mod	09	L 15	E, L, R, RG, UB	W
Ratibida pinnata	Yellow coneflower	M-D	Mod	12	S 1	CF, E, L, SW, UB	W
Rudbeckia subtomentosa	Brown-eyed-Susan	M	High	18	MS3	BF, CF, L, R, RG, SW	W
Sagittaria latifolia	Broadleaved arrowhead	S-I (24)	Mod	18	MS3	E, R, RP, W, WL	W
Salix discolor	Pussy willow	(9) I-S	Mod	24	Te	CF, L,R	T
Salix exigua	Sandbar willow	S-I (6)	High	36	L 30+	E, R	W
Salix nigra	Black willow	S	High	60/24	L 10/ML4	BF, E, R, SW	W
Sambucus racemosa	Red-berried elder	M	Mod	18	MS-3	E, R, S	W
Schizachyrium scoparium	Little bluestem	M-D	Low	12	S 1	E, FC, RG, UB, WL	W
Schoenoplectus acutus	Hardstem bulrush	1 (60)	High	24	ML4	E, L, R, SW, W, WL	W
Schoenoplectus pungens	Three-square bulrush	S-I (30)	High	18	ML4	E, R, SW, WL	W
Schoenoplectus tabernaemontani	Soft-stem bulrush	I(12-48)	High	24	L42+	E, R, SW, W, WL	W
Scirpus atrovirens	Green bulnush	S-I (30)	High	30	MS3	CF, E, R, SW	W
Scirpus cyperinus	Woolgrass	S-I(3)	High	18	L5	E, L, R	W
Scutellaria lateriflora	Mad-dog skullcap	S	Mod	24	MS 3.5	L, R, RG	Τ
Silphium laciniatum	Compass plant	M-S	Low	12	IS	BF, E, R, RG	Τ
Silphium perfoliatum	Cup plant	M-S	Mod	18	MS3	BF, E, R, RG, SW, UB, WL	W
Solidago flexicaulis	Zig-zag goldenrod	M-D	Low	12	IS	R, RG, S, UB	W
Conglection and	In diam came	MG	Mod	10	Z-	DE E I D DC CW	

Scientific Name	Common Name	Water Level Frequency Depth 3	Frequency ²	Depth ³	Duration ⁴	Design Potentials ⁵	Nursery ⁶
		(in inches)		(in inches)			
Sparganium eurycarpum	Giant burreed	(81) 1-S	High	12	S2	E, R, W, WL	M
Spartina pectinata	Prairie cord grass	(3)	High	24	ML4	E, R, SW	M
Spiraea alba	Meadowsweet	(3)	Mod	18	ST	BF, L, R	M
Symphyotrichum puniceum	Red-stemmed aster	S-IVI	High	18	T2	BF, CF, E, R, RP, SW	M
Symphyotrichum laeve	Smooth aster	Q-M	High	12	IS	BF, CF, R, RG, SW, UB	M
Symphyotrichum lanceolatus	Panicle aster	S-M	Mod	24	ML4	BF, CF, R, RG, SW, UB	M
Symphyotrichum novae-angliae	New England aster	S-M	Mod	24	ϵ SM	BF, CF, GP, R, SW, UB	M
Symphyotrichum pilosum	Frost aster	M-S	High	12	S2	BF, CF, R, SW, UB	T
Symplocarpus foetidus	Skunk cabbage	S	Mod	12	MS3	R, S, WL	T
Thalictrum dasycarpum	Tall meadowrne	S-M	Mod	18	MS3	L, R, S, UB	W
Tradescantia ohiensis	Ohio spiderwort	S-D	Low	12	S2	BF, CF, E, GP, L, R, RG, UB	W
Trypha x glauca	Hybrid cattail	S-1 (24)	High	12	9T	CF, E, WL	NA
Typha latifolia	Broad-leaved cattail	S-1 (18)	High	24	L42	CF, E, WL	T
Verbena hastata	Blue vervain	M-S	High	12	ML4	BF, CF, E, RG, SW	W
Vernonia fasciculata	Ironweed	S-M	Mod	18	ML4	BF, CF, E, L, RG, W	M
Veronicastrum virginicum	Culver's root	M-S	Mod	18	MS3	BF, CF, GP, L, R, RG, SW, UB	w
Viburnum lentago	Nannyberry	M-S	Mod	18	MS3	E, L, R, UB, WL	W
Viburnum opulus var. americanum High bush cranberry	High bush cranberry	M-S	High	18	MS3	E, FC, L, R, UB, WL	W
Zizia aurea	Golden alexanders	M-S	High	12	SI	BF. CF. E. L. R. SW	W

The following section provides detailed information for 131 plant species that are well suited to stormwater management practices (MPs). This information is intended to help designers narrow their species lists down to plants that are adapted to specific site conditions. Both wetland and upland species are included to cover a wide range of possible hydrologic conditions and to enhance the appearance and performance of upland areas adjacent to stormwater MPs. Information provided for each species includes:

- Habitat/Plant
- Community and Geographic Range
- Description
- Normal Water Level
- Flooding/Fluctuation Tolerance
- Sensitivities or Other Tolerances
- Design Considerations
- Wildlife Use
- Nursery/Plant
- Information
- Planting Techniques
- Additional Notes
- Indicator Status



ECOLOGICAL CLASSIFICATION MAP

The eco-region where each plant species is typically found in Minnesota is provided as part of the Geographic Range information. Eco-regions have been developed as part of the Minnesota Department of Natural Resources' Ecological Classification System, or ECS (see at http://www.dnr.state.mn.us), by integrating climate, geological, hydrologic, topographic, soil and vegetation data for the state.

Flood tolerance charts are provided for each species. The charts were developed through a combination of available research, observations by the authors and review by professionals throughout the region. These

charts are intended to help designers select species that will be well adapted to the hydrologic conditions of their projects. The charts show the number of days the species can tolerate submersion at a specific water level in the middle of the growing season before experiencing "significant stress," or the point where it begins to die. Water level is represented on the x-axis of the chart, and the y-axis represents the duration of inundation in one-half-day increments. The green line on the chart represents tolerances for adult plants, while the blue line represents the normal water level for the species. If the species is normally found in saturated-to-dry soils, no blue line is represented on the charts.

The native range of plants within the Twin Cities metropolitan area is 300 miles east and west and 200 miles north and south of the center of the Twin Cities metro area. This range also represents the area where the majority of plant information was collected for this guide.



Botanical Name

Common Name - a.k.a. - alternative names commonly recognized for this species

Habitat/Plant Community and Geographic Range

The habitat/plant community and geographic range for each species is given in this section. Eco-Region numbers represent the Minnesota Department of Natural Resource ecological regions in Minnesota where the species is commonly found. Abbreviations used for compass directions are: c.-central; e.-east, eastern; n.-north, northern; nc.-north-central; ne.-northeast, northeastern; s.-south, southern; se.-southeast, southeastern; sw.-southwest, southwestern; w-west, western.

Abbreviations used for geographic locations are: Ala.-Alabama, Alta.-Alberta, Amer.—America, Ariz.-Arizona, Ark.-Arkansas, B.C.-British Columbia, Calif.-California, Can.-Canada, Colo.-Colorado, Conn.-Connecticut, Del.-Delaware, Fla.-Florida, Ga.-Georgia, Ill.-Illinois, Ind.-Indiana, Kan.-Kansas, Ky.-Kentucky, La.-Louisiana, Labr.-Labrador, LP-Lower Peninsula, Man.-Manitoba, Mass.-Massachusetts, Md.-Maryland, Me.-Maine, Mex.-Mexico, Mich.-Michigan, Minn.-Minnesota, Miss.-Mississippi, Mo.-Missouri, Mont.-Montana, N.B.-New Brunswick, N.C.-North Carolina, N.D.-North Dakota, Neb.-Nebraska, New Engl.- New England, Nev.-Nevada, Nfld.-Newfoundland, N.H.-New Hampshire, N.J.-New Jersey, N.M.-New Mexico, N.S.-Nova Scotia, Nw. Terr.-Northwest Territories, N.Y.-New York, Okla.- Oklahoma, Ont.-Ontario, Ore.-Oregon, Pa.- Pennsylvania, P.E.I.-Prince Edward Island, Que.-Québec, R.I.-Rhode Island, Sask.-Saskatchewan, S.C.-South Carolina, S.D.-South Dakota, Tenn.-Tennessee, Tex.-Texas, UP-Upper Peninsula; USA-United States, Va.-Virginia, Vt.-Vermont, Wash.-Washington, Wis.-Wisconsin, W.Va.a-West Virginia, Wyo.-Wyoming.

[#] – This symbol represents citation numbers in the Plant Pages Bibliography.

Description

The species' physical features are broken down into eight categories for identification: general description, flower, leaf, stem or twig, bark, fruit, root and soil.

Normal Water Level

This section describes where the species typically grows relative to soil moisture or normal level of inundation.

Flooding/Fluctuation Tolerances

This section describes the tolerance to frequency, depth and duration of flooding. Special information about the species' sensitivity to water level fluctuation is given here also.

Sensitivities or Other Tolerances

Other stresses and tolerances are described here. Stressors include salt, nutrient, siltation, insect tolerances as well as the species' preferred exposure. Tolerances are represented as high, medium or low. A high level indicates a high tolerance to the stress. "Unknown" indicates that the authors did not find information for that stress.

Design Considerations

This section describes the optimal management practices appropriate for the species. Design concerns or considerations are presented here also.

Indicator Status: XXX



Full Shade

Indicator Status Categories:

FAC (Facultative) — Equally likely to occur in wetlands or nonwetlands (estimated probability, or est. prob., 67-99%).

FACU (Facultative Upland) — Usually occurs in nonwetlands (est. prob. 67-99%), but is occasionally found in wetlands (est. prob. 1-33%).

FACW (Facultative Wetland) — Usually occurs in wetlands (est. prob. 67-99%), but is occasionally found in nonwetlands.

OBL (Obligate Wetland) — Under natural conditions, occurs almost always (est. prob. >99%) in wetlands. UPL (Obligate Upland) — Occurs in wetlands in another region, but occurs almost always (est. prob. >99%) under natural conditions in nonwetlands in the region specified.

A positive (+) sign indicates that the species is more likely to be found in wetlands, and a negative (-) sign indicates that it less likely to be found in wetlands. [38]

Wildlife Use

This section describes fauna species for which this plant species provides habitat and how the plant is used.

Nursery/Plant Information

This section provides information on the species' availability from nurseries and the types of plant material that are available.

Planting Techniques

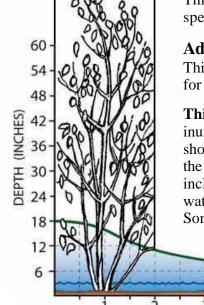
This section provides information on how to establish the species.

Additional Notes

This section provides information of interest or importance for this plant.

This graphic shows how long the species can remain inundated before decline. The left portion of the graphic shows the exposure level (depth in inches) and the form of the species (tree, shrub, grass or forb). The graphic includes a survival line that indicates the depth of standing water and how long the species can tolerate the inundation. Some graphs will indicate depth of normal water level.

DURATION (DAYS)



Acer saccharinum

Silver Maple - a.k.a. Soft Maple, White Maple

Habitat/Plant Community and Geographic Range

Habitat/Community: Silver maple is a dominant tree in floodplain forests. It is also found in swamps, on stream banks, shores, and low areas of wet to mesic soils. It does well in upland plantings and is common in Midwest windbreak and farmstead plantings. [7, 11, 22, 32, 36] **Range:** Minn. (Eco-Regions 1, 2, 4-9), especially se., uncommon in far nw. Wis., especially s. LP of Mich.; N.B. and Que. to Minn. and e. S.D., s. to Ga., w. Fla., La. and Okla. [7, 21]

Description

General: Large, deciduous tree with short, stout trunk, spreading open, irregular crown of curving branches that may grow to a height of 90'. This tree is the fastest growing native maple. Flower: February to March, usually ¼" long; clusters; male and female are separate. Leaf: Opposite 4-6" long, broadly ovate, deeply 5-lobed, green above and silvery white below. Twigs: light green to reddish, hairless with slightly unpleasant odor when crushed. Bark: Gray and smooth in young trees, becoming furrowed into long, scaly, shaggy ridges. Fruit: A winged samara. Roots: Shallow, very wide spreading, fibrous. Soils: Tolerates wide variety of soils, but reaches largest size in moist soils. [7, 11, 22, 36]

Normal Water Level

This species prefers wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth**: 5'. **Duration**: Long – 20 days (decreasing 6"/day for 8 days, leveling out at 18" for until the 20th day) during the growing season, although it tolerates weeks of inundation in the spring and is very resistant to drought/heat. [1, 22, 37]

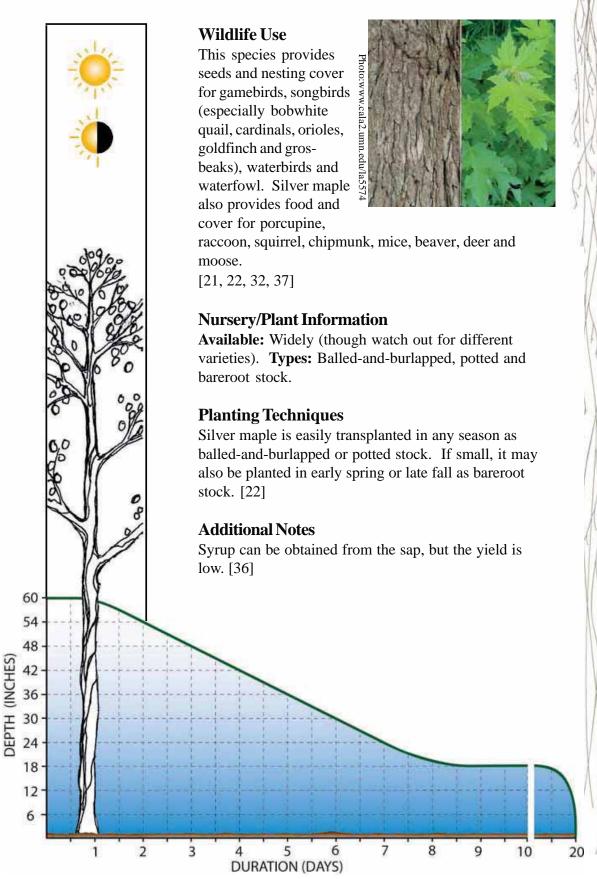
Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderately high for spray and moderately low for soil. **Nutrient:** Manganese chlorosis in calcareous or high-pH soils. **Siltation:** N/A. **Insect:** Frequent – ocellate leaf gall, cottony maple scale, borers, other scale. **Other:** Resistant to SO_2 , HCl, Cl, mine spoils and soil compaction. Sensitive to O_3 and alkaline soils, though intermediate to HFl. [1, 2, 10, 22, 24, 37]

Design Considerations

Silver maple is frequently used in landscaping as a shade tree because of its rapid growth and toleration of a wide variety of soil types. A good tree for wetland use, restorations, stream edges and floodplains. **Concerns:** The branches are very weak and damage easily. Other issues are that it does not tolerate dense shade, fruit produces litter, and roots may grow at the surface and become exposed, creating tripping hazards. [11, 36]

Indicator Status: FACW



Acorus calamus

Sweet Flag - a.k.a. Acorus americanus

Habitat/Plant Community and Geographic Range

Habitat/Community: Bogs, streambanks, marshes (often with cattails), swamps, shallow water, peatlands and sometimes in seasonally inundated wet meadows. Usually forming beautiful clumps. [4, 7, 16, 35] **Range:** Minn. (Eco-Regions: All), scattered throughout Wis., Mich. Native, though widely naturalized in N. Amer. from N.S. and Que. to Alta., s. to Fla., Tex., Colo., n. Idaho and Wash.; Asia. [7, 21]

Description

General: Perennial, aromatic, emergent herb, growing in clumps or dense beds with tall, sword-like leaves. Mature height is 2-6'. Flower: Small, in a dense cluster (spadix) near the top of the flattened, leaflike stem. Color is green/brown from May 25 to June 30. Leaf: Its erect, swordlike leaves are much like those of blue flag, except they are yellowish-green and give off a sweet odor when bruised. Stem: The spathe is the tapering upper part of the stem with a 2-edged stalk. Fruit: Brown and persistent into late fall. Root: Stout, aromatic rhizomes. Soil: pH range 5.9-8.8; tolerates most wet soils in inundated conditions. [4, 7, 16, 35, 44]

Normal Water Level

This species prefers shallow water of 20" of inundation or less to wet/saturated conditions, though it prefers depths of 6-20". [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Medium short – 3 days (decreasing 4"/day). Prefers stable water levels and will decrease in abundance with flood depth increases, although will tolerate dry periods. [1, 6, 29, 37, 44]

Sensitivities or Other Tolerances

Exposure: Partial to full sun. **Salt:** Low to moderate. **Nutrient:** Low. **Siltation:** Low. **Insect:** N/A. **Other:** Tolerates acidic conditions and moderately tolerates general disturbance and stress. [1, 6, 37, 44]

Design Considerations

Sweet flag is used in soil stabilization of lower shoreline zones and vegetated swales. Rhizomes and roots form a mat in upper 4-8" of soil, which prevents erosion, stabilizes sediment, and mitigates buffering wave action. Good for wetland restoration (wet meadow/wet woods) due to its aggressive behavior and rhizomatous growth – though it is moderate in spread rate. Good for rainwater and water gardens. Uses may also include wildlife cover and a food source. **Concerns:** This species is considered aggressive, although this may be beneficial to some sites. [16, 21, 44]

Wildlife Use

Sweet flag provides food (seed) and cover for waterfowl (especially wood ducks). Muskrats will eat the rhizomes. Sweet flag is also considered an excellent feeding cover

Indicator Status: OBL

for woodcock, snipe and rodents. This perennial grows in clumps that provide nesting spots for waterfowl and shorebirds. [4, 21, 37, 44]

Nursery/Plant Information

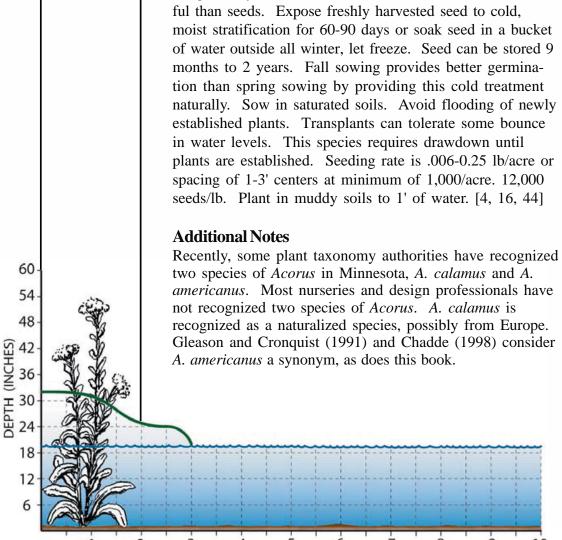
Available: Widely.

Types: Transplants, rhizomes

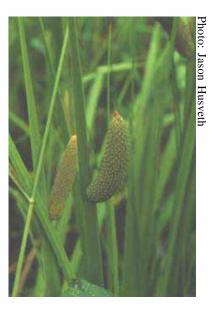
and seeds.

Planting Techniques

Rhizomes and transplants are generally more success-



DURATION (DAYS)



Agastache foeniculum

Giant Hyssop - a.k.a. Wonder Honey Plant; Fragrant, Fragrant Giant, Giant Blue or Anise Hyssop

Habitat/Plant Community and Geographic Range

Habitat/Community: Mesic to dry prairies and open or semishady woodlands (savanna), often along roads. [16, 17, 35, 41] **Range:** Minn. (Eco-Region: 1-6, 8, 9), Wis. Wis. to n. Iowa and Man., s. to Colo. and Alta., and occasionally e. to Que. **Endangered in Iowa.** [17, 21]

Description

General: One of the more ornamental and larger of our native mints. Giant hyssop is a perennial, commonly 2-4' tall. **Flower:** A thick spike with dense, often interrupted, whorls of bright blue flowers ¼" long, June to October. **Leaf:** Sharply pointed, lance-shaped, toothed, opposite, glossy, dark green with fine hairs underneath and 2-3" long. Leaves have an anise or licorice odor when crushed; can be used for tea. **Stem:** Square. **Fruit:** Light to dark brown. **Roots:** Fibrous, shallow. **Soil:** Medium (mesic) to dry loam soil. [17, 35, 41, 47]

Normal Water Level

This species prefers upland moist/mesic to dry conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short – 2 days (decreasing 6"/day).

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate; low to 2,4-D. **Nutrient:** Unknown. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** Giant hyssop has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

Giant hyssop is an ornamental perennial that grows well in gardens and produces excellent cutflowers. This plant has use as an aromatic and as a herb for teas. Will work well in shallow rain gardens and upland buffers. **Concerns:** Giant hyssop self-seeds readily and may spread in gardens. It survives poorly in northern Minnesota. [41]

Wildlife Use

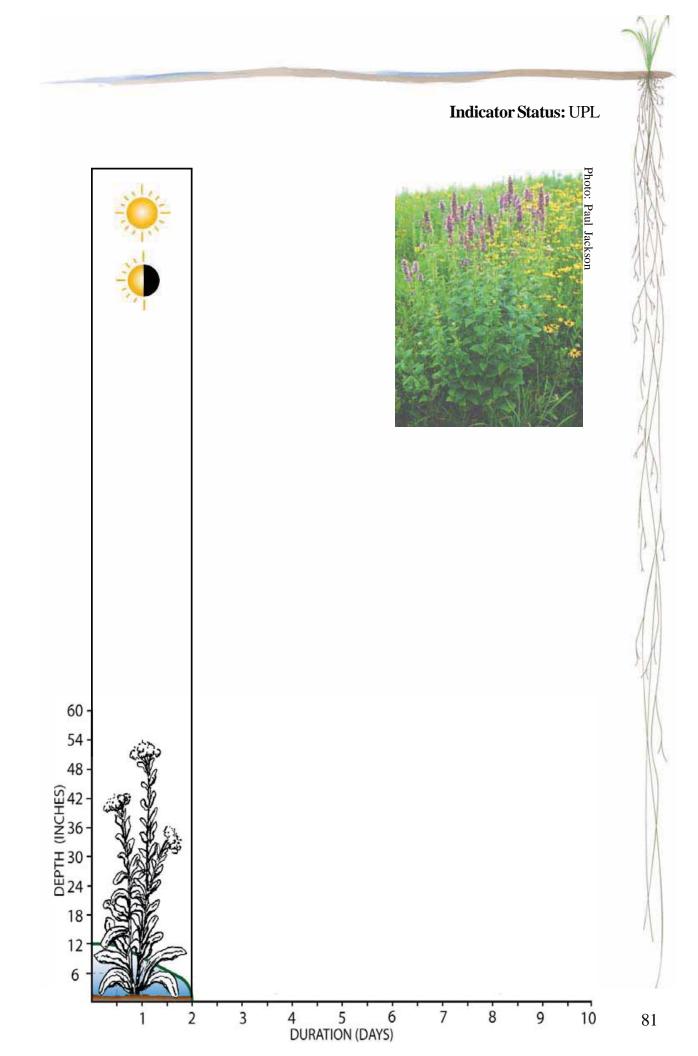
Flowers are very attractive to bees and butterflies throughout the summer. [21, 41]

Nursery/Plant Information

Available: Widely. Types: Plants and seed.

Planting Techniques

Spreads by producing hundreds of tiny, black seeds. Seeds need no treatment, but moist, cold stratification may help. 1,040,000 seeds/lb. [16, 21, 41]



Alisma trivale

Water Plantain - a.k.a. Common Water Plantain or Mud Plantain

Habitat/Plant Community and Geographic Range

Habitat/Community: Shallow water and in saturated soils, marshes, shrub swamps, wooded swamps, shores of lakes and streams, and ditches. It rapidly invades exposed mud flats and is common in farmed wetlands. [4, 7, 11, 16, 21] **Range:** Minn. (Eco-Region: All), n. Wis., Mich. N.S. to s. B.C., s. to Pa., Mo. and Calif. [4, 7, 21]

Description

General: A decorative, perennial herb, usually emergent with a mature height of 3-4'. **Flower:** Inflorescence is highly branched with perfect flowers of 3 sepals and 3 white or pinkish petals from May to September. Pistils are in a single whorl on a small, flat receptacle. **Leaf:** Broad, flat blades that may be rounded or tapered at the base; however, submerged forms with only ribbon-like leaves are also produced. The leaves are olive-green in color. **Fruit:** A group of minute, flat-sided achenes borne in a whorl. Achenes are not quite 1/8" long. **Root:** Submerged bulb. **Soil:** The pH range is 7.0-8.8. Tolerates saturated to inundated conditions on many soil types. [4, 7, 11, 16, 44, 47]

Normal Water Level

This species prefers shallow water, 6" or less, to wet/saturated conditions of 36" of inundation or less, though it prefers 0-6" of water depth. [11, 21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Long -6 days (decreasing 6"/day). This species tolerates periodic inundation of short durations during the early part of the growing season. It will increase in abundance with increases in flood depth. Tolerant of late-season drawdowns. [1, 21, 16, 37, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Moderate. **Siltation:** High. **Insect:** Infrequent. **Other:** It has a moderate-to-high tolerance of general disturbance and stress. [1, 44, 47]

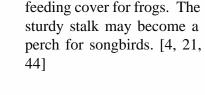
Design Considerations

Water plantain is well adapted for use in upper and lower shoreline zones, for streambank stabilization, and in vegetated swales. It is also well suited for restorations of wetlands, low spots in wet prairies and wet meadows. Seed is common in seedbanks of hydric soils. Well adapted for habitat as wildlife cover and food. **Concerns:** This long-lived species can be invasive. [16, 44]

Wildlife Use

Waterfowl (mallard, pintail, scaup, blue-winged and green-winged teal), songbirds, pheasants and rodents eat the achenes and tubers. Plants provide shade for fish. Rabbits and deer sometimes eat the leaves. The leaves also provide an excellent

Indicator Status: OBL



Nursery/Plant Information

Available: Widely.

Types: Achenes, transplants

and rootstocks.

Planting Techniques

Achene production is high, about 144,000/plant.

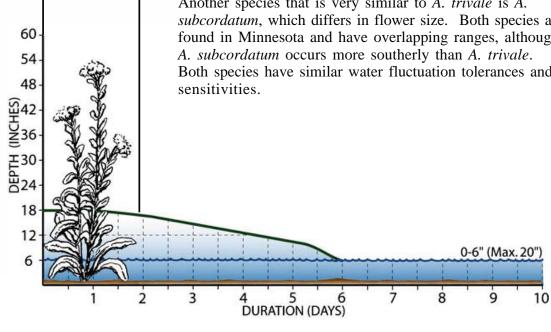
Achenes require scarification to break dormancy, which



can be done with sandpaper and moist, cold stratification for 30 days. Fall sowing provides better germination on wet mudflats. Alternating temperatures in moist (underwater) conditions and/or light for germination. Achenes retain viability when stored in water under cold temperatures for 6 months and are found in seedbanks in many hydric soils. Avoid flooding of newly established plants. Common water plantain germinates quickly and favors drawdown until plants are established. Seeding rate is .06-0.5 lb/acre or plant rootstock or plants 2-5" in damp soils to 12" of water. 1,122,800 seeds/lb. [4, 16, 37, 39, 42, 44]

Additional Notes

Another species that is very similar to A. trivale is A. subcordatum, which differs in flower size. Both species are found in Minnesota and have overlapping ranges, although A. subcordatum occurs more southerly than A. trivale. Both species have similar water fluctuation tolerances and sensitivities.



Allium stellatum

Prairie Wild Onion - a.k.a. Prairie Onion, Cliff Onion

Habitat/Plant Community and Geographic Range

Habitat/Community: Prairies, meadows and rocky soils. [16, 17, 35, 41]

Range: Most common in s. and w. Minn. (Eco-Region: All), Wis. (except for n. 1/4),

Mich. W. Ont. to Ill., w. to Sask., Wyo. and Okla. [17, 21]

Description

General: A native perennial herb that grows to 1-2'. The entire plant has a strong onion fragrance. **Flower:** A round cluster, 1-2" wide, that stands atop a single, erect umbel at the end of the stem; pink to rose with yellow centers, summer to fall. **Leaf:** Slender and solid in a basal clump of thin grass-like leaves. **Stem:** Slender, solid stem. **Root:** A small, papery-scaled bulb. **Soil:** Moist to dry, sometimes rocky soils. [16, 17, 35, 41, 47]

Normal Water Level

This species prefers upland moist/mesic to dry conditions, which sometimes are rocky. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short -1 day (decreasing 12" in 1 day). This plant does not tolerate long periods of saturation.

Sensitivities or Other Tolerances

Exposure: Full sun. Salt: Moderate. Nutrient: Low. Siltation: Low.

Insect: Infrequent. **Other:** N/A. It is tolerant to general disturbance and stressors. [47]

Design Considerations

Prairie onion can be used for the edges of rainwater gardens and upland buffers. Plant in groups for more visibility. **Concerns:** Prairie wild onion does not compete well with aggressive native grasses. Even though this plant can be used for food, please do not pick or dig up this plant from natural conditions. [16, 21]

Wildlife Use

This species attracts butterflies and bees and is edible to humans. [16, 21]

Nursery/Plant Information

Available: Widely. Types: Plants and seed.

Planting Techniques

Seeds need to be moist, cold stratified. Fall planting is ideal. 162,000 seeds/lb. Seeds self sow. [16]

Additional Notes

The flower always grows on erect stalks, which distinguishes it from the nodding onion (A. cernuum), whose flowers always hang downward. [41]



Alnus incana

Speckled Alder - a.k.a. Alnus rugosa - Hazel, Tag or Gray Alder

Habitat/Plant Community and Geographic Range

Habitat/Community: Speckled alder is found in swamps, thickets (especially alder thickets), bog margins, shores, moist meadows and is common on stream banks and floodplains. This species is also found in lowland wet areas such as openings in low, wet woods and low alluvial flats. It may also be present in bogs and coniferous swamps on neutral to acidic soils. [7, 11, 22, 36] **Range:** All but sw. Minn. (Eco-Region: 1-8), but local in sw. Wis., and se. Mich. Widespread across Can. from Nfld. to Alaska, s. to Md., Ohio, n. Ind., Minn., N.D., N.M., Ariz. and Calif.; Eurasia. This is the dominant species in alder thickets of Minn. and Wis. [7, 21] **Endangered in Illinois.**

Description

General: A deciduous, thicket-forming shrub or small tree sometimes growing to 16' tall. Flower: Tiny; in early spring before leaves. Male in drooping catkins 1½-3" long. Female in cones ¼" long. Cones: ½-5/8" long; elliptical, blackish, hard, short-stalked. Leaf: Leaves are dull, dark green with network of sunken veins and often hairy above; whitish-green with hairy veins beneath. Leaves are alternate, simple and elliptical or ovate. Bark: Gray, smooth. Stem: 4" maximum diameter. Twigs: Gray-brown, slender, slightly hairy when young. Fruit: Purple-black fruit persisting into winter. Root: Roots are very shallow and narrow spreading. Soil: Prefers deep loams to loamy sands that are wet to moist. [7, 11, 22, 36]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions and is able to tolerate inundation to 6" or less. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 2'. **Duration:** Long -6 days (decrease of 1' in first 2 days and a steady 6''/2 days thereafter). This species is very tolerant of flooding, somewhat tolerant to flood duration, and moderately tolerant to increases in flood depth. [1, 2, 22, 25]

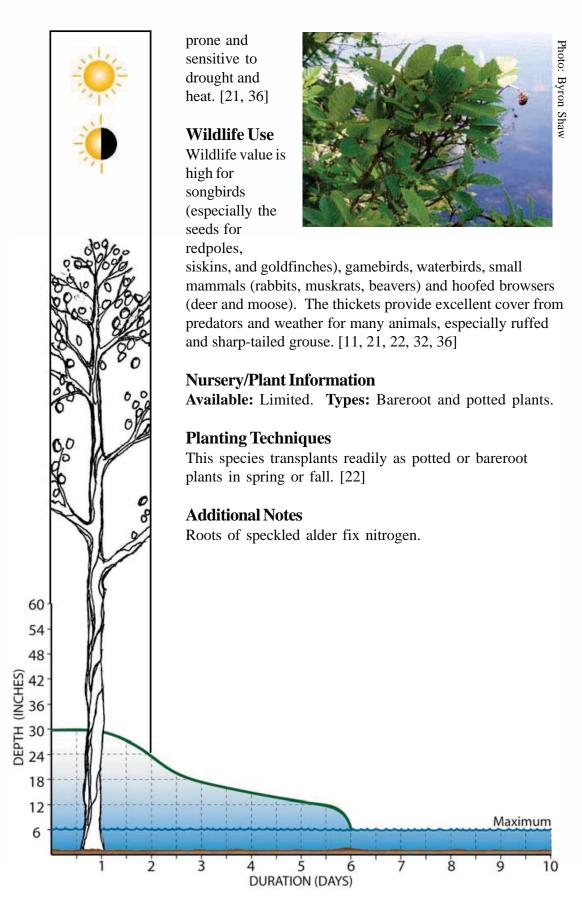
Sensitivities or Other Tolerances

Exposure: Full to partial sun. Very intolerant to shade. **Salt:** Moderate. **Nutrient:** Low to moderate. **Siltation:** Moderate. **Insect:** frequent – several borers, alder bark beetle, tent caterpillar. **Other:** Sensitive to drought/heat. Sensitive to mine spoils, though tolerant to soil compaction. Sensitive to O_3 . The root system gives little wind support, especially in wet, spongy soils; weak wooded. It has a moderate tolerance for general disturbance and stress. [1, 22]

Design Considerations

This species has been planted as an ornamental at water edges. Its root mass prevents erosion on stream banks and enriches soil by making nitrogen available to other plants. Use this plant in restorations (see community section above), pond edges and acidic soil conditions. **Concerns:** Weak-wooded, shade-intolerant, insect-damage-

Indicator Status: OBL



Amorpha fruiticosa

Indigo Bush - a.k.a. False Indigo, Indigo Bush Amorpha, Bastard Indigo

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadow, stream banks, shores and ditches. This species may also be found in bogs, swamps, dunes in lowland wet to wet-mesic conditions of flood plain depressions, hummocks, wet clearings and lakeshores. Grows well in river bottoms and floodplains. [7, 16, 22] **Range:** Nw., c. and s. Minn. (Eco-Region: 3-9); wc. and sw. and along St. Croix and Mississippi rivers of Wis., local in s. LP of Mich. Pa. to Sask., s. to Ala. and n. Mex. [7, 21]

Description

General: A multiple-branched shrub that can grow 12" tall. Flower: Attractive, purple flower spikes blooming from June to August, turning to a seedpod.

Leaf: Pinnately compound leaves. Stem: Many branches. Fruit: Interesting brown seed pods in autumn. Root: This species has fibrous, shallow lateral roots, somewhat suckering. Soil: Prefers sandy loams that are wet to dry. [7, 17, 22]

Normal Water Level

This species prefers upland moist/mesic to dry conditions, though the soil may be saturated in spring. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/day). Indigo bush is very tolerant to floods, especially in the spring, though can handle short periods of inundation during the growing season. [22, 37]

Sensitivities or Other Tolerances

Exposure: Full to partial sun; intolerant to shade. **Salt:** Salinity resistant. **Nutrient:** Unknown. **Siltation:** Unknown. **Insect:** Occasional – inflorescence galls; generally free of insect problems. **Other:** Sensitive to 2,4-D and resistant to mine spoils, drought and heat. It has a moderate tolerance to general disturbance. [1, 22, 37]

Design Considerations

Indigo bush is a good ornamental landscaping plant and is suited well for wetland or floodplain restorations. This plant works well in erosion control and rain gardens. **Concerns:** Weak-wooded plant that is easily broken. [16, 21]

Wildlife Use

This species provides food and cover for waterfowl, marshbirds, shorebirds and small mammals. Its fruits are poisonous to humans. [21, 22, 37]

Nursery/Plant Information

Available: Widely. Types: Plants only.

Indicator Status: FACW+



Planting Techniques

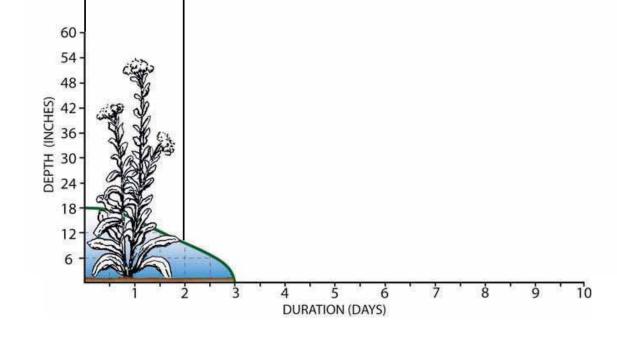
The seeds should be scarified or hot water treated and prefers fall planting (cold treatment gives poor results). Cuttings should be inoculated. Acid scarification (10-15 min.) can be used for large lots. 105,488 seeds/lb. This species transplants well. [16, 22]



89

Additional Notes

The roots of indigo bush fix nitrogen.



Andropogon gerardii

Big Bluestem - a.k.a. A. furcatus, Turkey Foot

Habitat/Plant Community and Geographic Range

Habitat/Community: Big bluestem is one of the more dominant of the tallgrass prairie grasses in mesic prairies, savannas and woodlands. It often occurs in wet to wet-mesic prairies and may occur in calcareous fens and the other extreme of dry sand plains and bluffs. This species seems to be limited only by shade and excessive soil moisture. [11, 16, 17] **Range:** Minn. (Eco-Region: All), Wis., Mich. Me., s. Can. to Sask., s. to N.M., Tex., n. Fla. [17, 21]

Description

General: A perennial, clump-forming, warm-season grass that grows 3-9'. Flower: Flowers are arranged in fingerlike spikes that resemble turkey feet. Flower color is bronze turning to steely gray-blue as autumn advances. Blooms in July. Leaf/Stem: The foliage is purplish on stout stems. The leaves and stems turn bright yellow, red, orange or purple in the fall. Fruit: The inflorescence contains 2-10 finger-like racemes with 2 types of spikelets: perfect, stalkless spikelets and staminate, stalked spikelets. Root: Fibrous; can extend over 10' deep. Soil: Wet-dry loam/clay soils with a wide pH range. This species will tolerate a variety of soil conditions. [8, 11, 16, 17, 44, 47]

Normal Water Level

This species prefers upland moist/mesic conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. Depth: 12". Duration: Short -2 days (decreasing by 6"/day). Big bluestem is not tolerant of flooding, but it is tolerant of saturated soils for short periods and is drought tolerant. [1, 8, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low. **Siltation:** Low. **Insect:** Unknown. **Other:** This species will tolerate a variety of soil conditions and is moderately tolerant to general disturbance and stress. [1, 44]

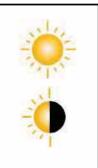
Design Considerations

This species is used to stabilize soil and slow surface runoff, especially in upland buffer zones. Big bluestem is a major grass component in any prairie restoration and a successional species. Provides wonderful fall color throughout the winter, making a nice touch for landscaping in areas where its height is not a problem, and is becoming more common as an ornamental grass in gardens. A good clump former. Will perform well in well drained rain garden situations. **Concerns:** Big bluestem can be moderately aggressive. [16, 21, 44]

Wildlife Use

Big bluestem provides food for Delaware skipper and forage for antelope, bison, deer and livestock. Also provides cover and some food for upland gamebirds and songbirds

Indicator Status: FAC-



(especially tree and field sparrows, finches and juncos). [16, 32, 37]

Nursery/Plant Information

Available: Widely. **Types:** Seeds and plants.

Photo: Paul Jackson

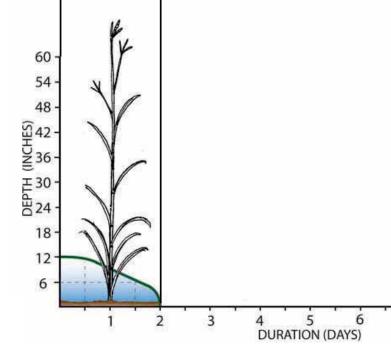


Planting Techniques

Propagation by seed with

no treatment is easy, although moist, cold stratification may help some seed lots. Fall-planted seed germinates when the soil temperature reaches 55 degrees F. Otherwise, plant in late April to June. This is a self-seeding, warm-season grass. In mixed grass plantings for tall grass, use up to 75% big bluestem along with Indian grass on dry to mesic sites. 131,200 seeds/lb. [16, 44]

7



10

Anemone canadensis

Canada Anemone - a.k.a. Canada Windflower, Round-leaved or Meadow Anemone

Habitat/Plant Community and Geographic Range

Habitat/Community: Moist-to-wet openings, stream banks, thickets, wet meadows, low prairies (mesic prairies and savannas), ditches, roadsides and railways; usually growing in patches. [7, 16, 21, 35, 41] **Range:** Minn. (Eco-Region: 1-8), Wis., Mich. E. from Que. to Alta., s. to Md., W.Va., Mo., Kan. and N.M. [7, 21]

Description

General: A native, perennial herb that grows 1-2' tall from slender rhizomes that usually form large patches. **Flower:** White, arising from a long stem, blooming May to August. The flowers are 1-1½" across, have 5 petal-like sepals and a yellow center. **Leaf:** This species has deeply lobed and basal leaves with a long stem with whorled leaves forming the flower cluster. Leaves appear hairy, especially on the lower surface. **Stem:** Flowers and leaves arise from a long, hairy stalk. **Fruit:** Light to dark brown late in fall. **Root:** Rhizomatous. **Soil:** Medium soil from mesic to wet (hydric). [7, 35, 41, 47]

Normal Water Level

This species does well in moist to wet (saturated) soils, spreading as a good groundcover. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Short -2 days (decreasing 6"/day). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Partial to full sun. **Salt:** Low. **Nutrient:** Low to moderate. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** It has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

A good plant for restorations (wet meadow, low prairies and woodland openings) and revegetation sites such as roadsides and vegetated swales. This species has a use in rock gardens and rainwater gardens in shallow inundation conditions. **Concerns:** This species is an aggressive underground spreader for gardens and other formal landscaping areas, though this may be desirable in restorations. [16]

Wildlife Use

This plant is sometimes used by waterfowl, muskrats and small rodents. [21]

Nursery/Plant Information

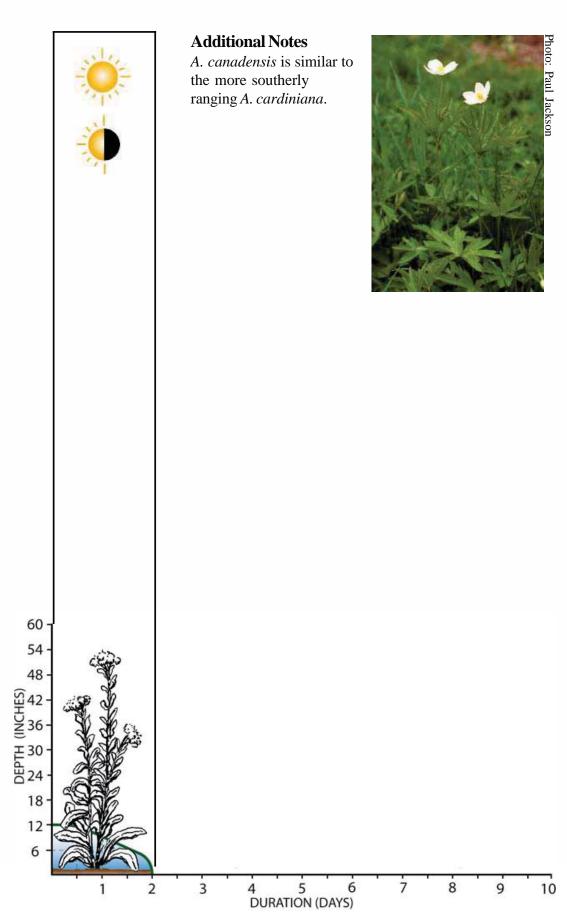
Available: Widely. Types: Seeds and plants.

Planting Techniques

The seed should be stored dry for about 180 days. Approximately 97,600 seeds/lb. [16]

Indicator Status: FACW

93



Angelica atropurpurea

Angelica - a.k.a. Alexanders; Purplestem, Great or Great High Angelica

Habitat/Plant Community and Geographic Range

Habitat/Community: Springs, seeps, calcareous fens, stream banks, shores, marshes, sedge meadows, wet depressions in forests in calcium-rich soils. [7, 11, 16] **Range:** E. though local in ne. Minn. (Eco-Region: 1,6-8), ec. and s. Wis., mostly s. LP of Mich. This species is generally in the n. from Lbdr. to Minn. and s. to Del., W.Va. and Ill. [7, 21] **Endangered in Iowa.**

Description

General: A native perennial herb that can grow to 8" tall, this species is a member of the carrot family. Flower: The inflorescence is a large 4" in diameter, compound umbel. Flowers are white or greenish-white and bloom around the first week in June. Leaf: Basal leaves are pinnately more than once divided, and upper leaves are progressively reduced, with broadly sheathing leaf stalks and serrate, pointed leaflets. Stem: The stout, round stems are purplish, aromatic and hollow. Fruit: Thin, flat lateral wings occur on the hairless fruit, which fall by midsummer. Root: Fibrous, shallow. Soil: This species prefers calcareous-rich soils. [7, 11, 16]

Normal Water Level

This species prefers shallow water of 3" of inundation or less to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate to low. **Depth:** 18". **Duration:** Medium short -3 days (decreasing in water depth 6"/day). Can survive early-summer flooding while dormant.

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Low to moderate. **Nutrient:** Unknown. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

This is a good species for wetland restorations (especially in calcareous situations, seeps and springs). It is underutilized for landscaping. **Concerns:** This species can be aggressive in some soils, though this may be desirable. [16]

Wildlife Use

Angelica provides good habitat for upland gamebirds and songbirds. It is also a bee and butterfly attractant. [16, 21]

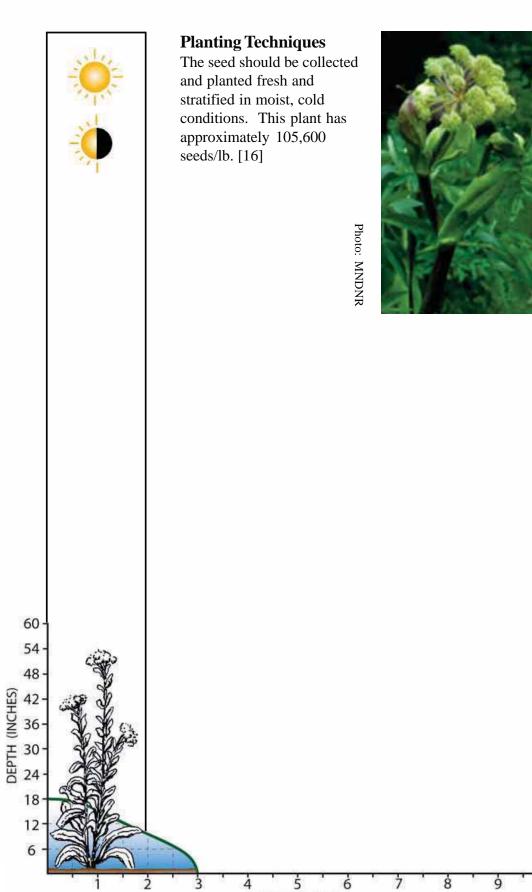
Nursery/Plant Information

Available: Limited. **Types:** Only seed is widely available.

Indicator Status: OBL

10

95



DURATION (DAYS)

Arisaema triphyllum

Jack-in-the-pulpit - a.k.a. A. atrorubens - Indian Turnip

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet, shady, moist deciduous forests and cedar swamps. [7, 16, 35, 41] **Range:** Minn. (Eco-Region: All), Wis., Mich.; N.S. to Ont., s. to Fla., La. and Kan. [7, 21]

Description

General: This native perennial herb of rich, moist woods is an attractive member of the arum family. It can grow 1-2' tall. **Flower:** Small flowers crowd near the base of a club-like spadix (Jack) 2-3" long, enclosed by a narrow, funnel-shaped structure (spathe) that has an overhanging flap at the top, the "pulpit." **Leaf:** Compound with 3 pointed leaflets. **Stem:** Upright, single stem. **Fruit:** In late summer, the withering of the spathe exposes in shiny, green berries that turn bright red. **Root:** Bitter-tasting corm. **Soil:** Rich, moist woodland soils. [7, 35, 41, 47]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short – 1 day (decreasing all 12" in 1 day). This species does tolerate seasonal inundation or short, irregularly timed periods of inundation. [1, 37]

Sensitivities or Other Tolerances

Exposure: Partial sun to full shade. **Salt:** Low. **Nutrient:** Low to moderate. **Siltation:** Low. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 37, 47]

Design Considerations

This plant has been used in landscaping in shady or deciduous woodland areas. It may also be used in woodland restorations as a successional species, especially in cedar swamps and wet deciduous forests. This species self seeds. **Concerns:** The fresh root is poisonous but edible after it has been cooked. If disturbed or affected by other stress, the female plant declines in vigor and may stop producing fruit. [16]

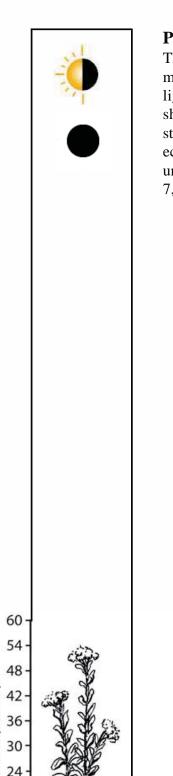
Wildlife Use:

Gamebirds (ring-necked pheasants and turkeys), wood thrushes, wood ducks and mammals, such as raccoons and chipmunks, eat the fruit and leaves. The fruit is toxic to humans. [21, 32, 37]

Nursery/Plant Information

Available: Limited. **Types:** Plants only.

Indicator Status: FACW-

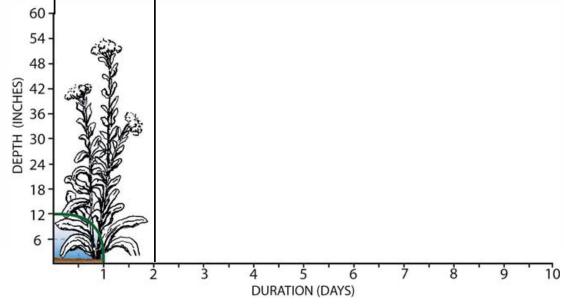


Planting Techniques

The seeds need to be macerated and fall planted in light conditions. They should be moist, cold stratified for 60 days. Some ecotypes may not germinate until second year. About 7,040 seeds/lb. [16]



97



Aronia melanocarpa

Black Chokeberry - a.k.a. Glossy Black Chokeberry or Indigo Bush

Habitat/Plant Community and Geographic Range

Habitat/Community: Tamarack swamps, open bogs, wet thickets, marshes, springs, prairies, dunes, old fields, creek banks, and shores. [7, 16, 22] **Range:** Nc., ne. and ec. Minn. (Eco-Regions: 1-3, 5, 6), Wis., Mich. Nfld. and Labr. to Minn., Iowa and se. Mo., s. to n. Ga. and Ala. [7, 21] **Endangered in Iowa.**

Description

General: Black chokeberry is a very attractive, spreading shrub of the rose family that grows 3-6' tall. **Flower:** Nice clusters of white flowers in May. **Leaf:** Excellent, deep red fall foliage. **Stem:** Suckering, upright habit. **Fruit:** Black to blue-black berries. **Root:** Shallow fibrous, fine textured, suckers profusely. **Soil:** Wet-to-dry soils, although it prefers sandy wet or boggy. [7, 22]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions and tolerates dry conditions and salty soil and water. [6, 21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. Depth: 12". Duration: Short -2 days (decreasing 6"/day). Black chokeberry is very tolerant to floods early in the season and somewhat tolerant to flood duration. [1, 22]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate (Tolerates salty soil and water). **Nutrient:** Low to moderate. **Siltation:** Moderate. **Insect:** Infrequent – round-headed apple borer; rarely serious. **Other:** Resistant to drought/heat, compacted soils, mine spoils and infrequently damaged by ice and wind. It has a moderate tolerance to general disturbance and stress. [1, 6, 22]

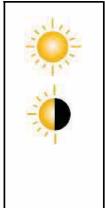
Design Considerations

This species is excellent for wet, lake edge plantings. Black chokeberry is also used as an ornamental for its showy white flowers, black fruit and fall color. Good in massing, borders and backgrounds in landscaping. This species does well in rain gardens with well drained conditions. **Concerns:** Black chokeberry Spreads aggressively under favorable conditions. [16]

Wildlife Use

The fruit are of some importance, as they persistent through the winter. The fruit is consumed by upland gamebirds (sharp-tailed and ruffed grouse), songbirds (cedar waxwings, chickadees, and meadowlarks), large and small mammals (bear and white-footed mice), hoofed browsers eat twigs, leaves, fruits edible to humans. [21, 22]

Indicator Status: FACW-



Nursery/Plant Information

Available: Widely. **Types:** Available as potted and bareroot plants.

Planting Techniques

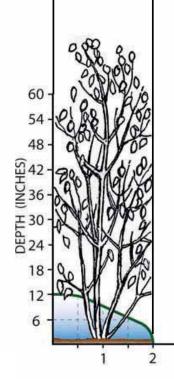
This species transplants well. The seeds need to be macerated and fall

> 4 5 6 DURATION (DAYS)

3

Photo: www.cala2.umn.edu/la5574/

planted in light conditions. Seeds should also be moist, cold stratified for 90 days. Cuttings also work. About 276,000 seeds/lb. [16, 22]



10

Artemisia ludoviciana

Prairie Sage - a.k.a. White Sage or Dark-leaved Mugwort

Habitat/Plant Community and Geographic Range

Habitat/Community: Prairie sage often grows in patches in sand and dry prairies, primarily near major rivers, pastures and savannas. [16, 17, 35] **Range:** Especially s. and w. Minn. (Eco-Region: All), Wis.; Man. to Ala., s. to Mont., N.M., n. Tex., Ark., n. to w. Ind., s. Wis. and Minn. [17, 21]

Description

General: Prairie sage is a native perennial that is grown for its silvery gray foliage. Flower: The inconspicuous flowers are arranged in an elongated, pyramidal influoresence. Leaf: Leaves of this plant are oblong and up to 3" in length. They appear white because they are covered with soft, white hairs on both sides. The leaves have an aromatic, sagebrush odor when crushed. Stem: Spreading. Fruit: Light brown achene at the end of fall. Root: Aggressive, rhizomatous roots. Soil: Medium (mesic) to dry (xeric) soils. [17, 35, 47]

Normal Water Level

This species prefers upland moist/mesic to dry conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/day).

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Unknown. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

Prairie sage is a good groundcover for sunny, dry slopes because of its aggressive habit. This species is also good for restorations, as a contrast plant in landscapes and for aromatic use. **Concerns:** Spreads quickly in gardens. [21]

Wildlife Use

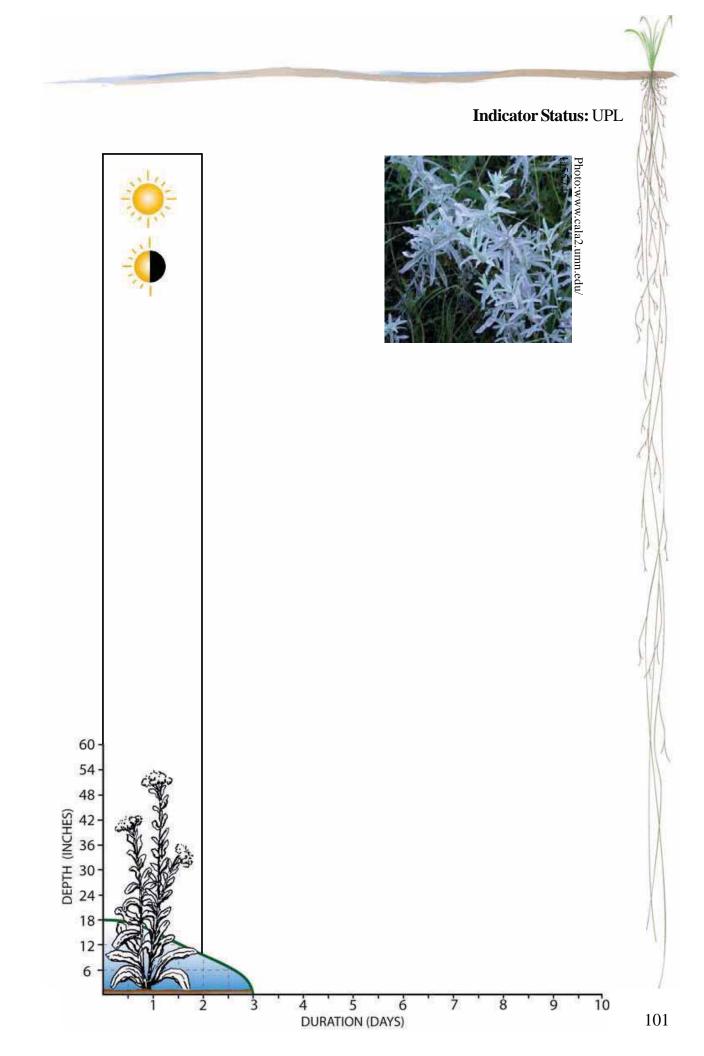
Provides habitat and cover in prairies for small birds and mammals. [21, 32]

Nursery/Plant Information

Available: Widely. **Types:** Plants only.

Planting Techniques

The seed needs no treatment other than light. [16]



Asclepias incarnata

Marsh Milkweed - a.k.a. Swamp or Red Milkweed

Habitat/Plant Community and Geographic Range

Habitat/Community: Marsh milkweed is a common wetland and lakeshore milkweed found in openings in conifer swamps, sedge meadows, shallow marshes, stream banks, ditches, open bogs, open fens, often in shallow water and will tolerate moist prairie conditions. [7, 11, 16, 35, 41] **Range:** Minn. (Eco-Region: All), Wis., Mich. N.S. to Sask., s. to Fla., Tex. and N.M. [7, 21]

Description

General: A common, native, erect, perennial herb usually 3-4' tall that has milky juice when the stem or leaf is cut. Often the entire plant is reddish. **Flower:** Clusters of pink to rose-purple flowers from June to August. The inflorescence is comprised of several flat umbels, the individual flowers have 5 downward-curving petals and 5 upward petals, resembling a crown. **Leaf:** Opposite, lance-shaped to linear to oblong on short leaf stalks. **Stem:** Usually 1 long stem that branches near the top, and is erect decorative deep red-brown. **Fruit:** Pointed 3" seedpods, which open up in late summer with downy, airborne seeds. **Root:** Thick rhizomes. **Soil:** Prefers wet to moist wetland or loamy soils. [7, 11, 35, 41]

Normal Water Level

This species prefers shallow water of 3" of inundation or less to wet/saturated to upland moist conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short – 3 days (decreasing 3"/day). Tolerant of spring flooding when dormant. This species prefers wet meadows and tolerates seasonal inundation or short periods of inundation during the growing season. [1, 37]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Low to moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species has a moderate to low tolerance to general disturbance and stress. [1, 37, 47]

Design Considerations

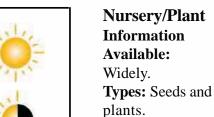
A good plant for butterfly gardens and landscaping due to its aromatic and decorative qualities. This species also is used well in restorations of wetlands, wet woods, marshes and wet prairies. Also recommended for rain gardens, pond edges and vegetated swales. **Concerns:** This species can be short lived. [16, 21, 41]

Wildlife Use

This species is a host and nectar plant for monarch butterflies. Many birds use the fibers from old stems to build nests. Many insects use this plant; it is particularly attractive to bees and butterflies. Flowers often conceal crab spiders lying in wait for pollinators. [11, 37, 41]

Indicator Status: OBL

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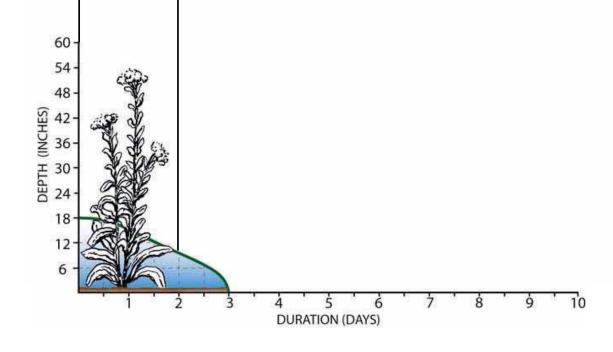


Planting Techniques

Store the seeds



dry. Seeds should be light GA3, moist, cold stratified for 10 days. Best when fall planted in saturated soils. Approximately 50,000-72,000 seeds/lb. [16, 37]



Asclepias tuberosa

Butterfly Milkweed - a.k.a. Butterflyweed, Pleurisy Root or Chigger-flower

Habitat/Plant Community and Geographic Range

Habitat/Community: Dry, sunny prairies and savannas, prefers sandy soils. Found along railroad beds and roadsides high on the outside berm, growing in clumps in open places, often on sand. [16, 17, 35, 41] **Range:** Mostly s. and e. Minn. (Eco-Region: 3-9), mostly s. and w. Wis.; Me. to Minn., s. to Ariz., Fla. [17, 21]

Description

General: One of the brightest and most conspicuous native perennials, growing usually 1-2' tall. This plant, unlike other milkweeds, has no milky juice, instead, its stem and leaves bleed clear sap. Flower: Spreading clusters of flowers ranging from bright yellow to blazing orange. Flowers are arranged in a large, flat-topped umbel 2-3" wide, blooming from late June to September. Leaf: Hairy, toothless, narrow, alternate leaves 2-6" long, widen at tip. Stem: Often clumped with a single stem that branches only near the top. Fruit: Erect small cluster of narrow pods, 6" long, covered in fine hairs; pods contain large, brown seeds with silken "parachutes." Root: A large taproot. Soil: Sand/loam soils, will tolerate dry, sandy soils. [17, 35, 41]

Normal Water Level

This species prefers upland moist/mesic to dry conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Short -1 day (Inundation is acceptable if in sandy soils that infiltrates quickly in less than 1 day). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to part sun, not tolerating a lot of shade. **Salt:** Low to 2,4-D; moderate to soil salt and high to spray. **Nutrient:** Low to moderate. **Siltation:** Low. **Insect:** Infrequent. This species has moderate tolerance to general disturbance and stress. [1, 47]

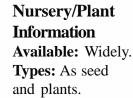
Design Considerations

Butterflyweed is a wonderful landscaping garden perennial though it can be short lived. As the name indicates, it is a good butterfly garden plant and is used in prairie and upland restorations. This plant can be used in rain gardens on the edge or areas that are not inundated frequently, dry quickly and do not exceed depths greater than 3". **Concerns:** Many cultivars exist, some of which do not have disease resistance. [16, 35]

Wildlife Use

A host plant for gray hairstreak and monarch butterfly caterpillars. This species is an excellent nectar source for all butterflies, often attracting hords of butterflies. [21, 41]

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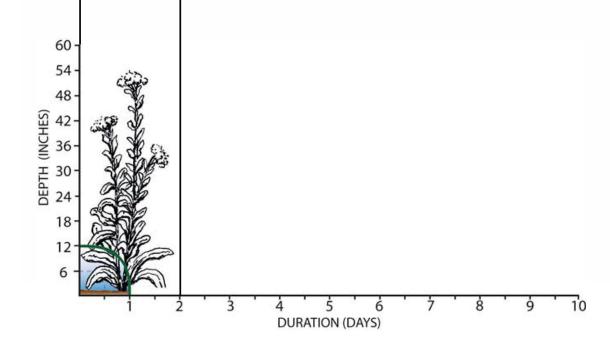


Planting Techniques

Butterflyweed can be raised from seed



or root cuttings but the species name, *tuberosa*, refers to its large taproot, which complicates transplanting. Seed has no treatment requirements, though moist, cold stratification, bottom heat and fall planting is recommended. Approximately 3,500 seeds/lb. [16, 35, 41]



Athyrium felix-femina

Lady Fern - a.k.a. Athyrium angustum

Habitat/Plant Community and Geographic Range

Habitat/Community: Moist, rich soils of forests, wooded swamps and a dominant fern in midwestern woodlands. [17] **Range:** Minn. (Eco-Region: All), Wis., Mich.; N.S. and N.B. to Ont., Minn.; s. to Ga., La. and Okla. [17, 21]

Description

General: A perennial, native fern that may grow to 36". **Leaf:** Lady fern is a vigorous, semi-spreading fern with lime-green, lacy, cut fronds. **Fruit:** Light brown spore in August. **Root:** Rhizome, short-creeping to suberect. **Soil:** Moist, rich soils of forests. [17, 21, 47]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Short -2 days (decreasing 6"/day). This species is moderately tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Part sun to full shade. **Salt:** Low. **Nutrient:** Low to moderate. **Siltation:** Low. **Insect:** Infrequent. **Other:** Sensitive to wind. This species has a moderate tolerance to general disturbance and stress. [1]

Design Considerations

Lady Fern makes a very useful groundcover for shady restorations, gardens, rain water gardens and replacement for hostas to deter deer. This species is also a good indicator for wetland boundaries in northern woodlands. **Concerns:** Ferns are susceptible to excess wind and sun exposure. [21]

Wildlife Use

Ferns are widespread, especially in moist woodlands. Yet as a wildlife food source, they are used only to a minor extent. Their leaves are eaten by deer, hares and grouse when other green plants are scarce. Ferns are a good cover plant for small mammals and songbirds. [21]

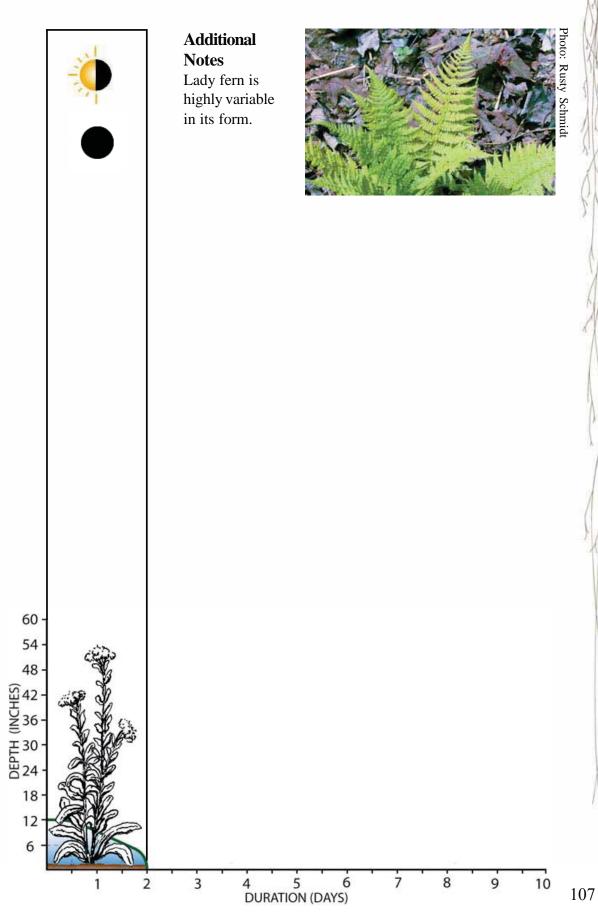
Nursery/Plant Information

Available: Widely. Types: Available as plants or rhizomes.

Planting Techniques

Plants or rhizomes should be planted in the spring or fall and adequately watered. Ripened spores can also be spread on top of exposed soil, but this technique is most successful under greenhouse conditions.

Indicator Status: FAC



Betula nigra

River Birch - a.k.a. Red Birch, Black Birch

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forest, river banks, swamps, lowland wet and wet mesic forests, ox-bows, lakes, swampy bottomlands and low, open sites of recent disturbance along streamsides. Its preferred germination sites are sandbars exposed after spring floods have receded or silty loam bottomlands. [7, 11, 22, 32, 36] **Range:** Se. along Mississippi River in Minn. (Eco-Region: 7), c. and s. Wis., Mich.; N.H. to Ohio and s. Minn., s. to Fla. and Tex. [7, 21]

Description

General: Medium-sized tree that may grow to a mature height of 50–75' and width of 35-40'. Can grow 20-30' in 10 years. Often slightly leaning and forked tree with irregular, rounded, spreading crown. Flower: Male yellowish, with 3 stamens, many in long, drooping catkins near tip of twigs. Female greenish, in short, upright catkins back of tip of same twig during April and May. Leaf: Alternate, simple, deltoid-towedge-shaped that is doubly serrated. Shiny, dark-green above, whitish and usually hairy beneath; turning dull yellow in autumn. **Bark:** Cinnamon-to-reddish, papery, horizontal exfoliation, blocky scales at base; adult trunks, red-brown to black, becoming thick, fissured and shaggy. Twigs: Cherry-like, with conspicuous, horizontal striped lenticels. **Bud:** Stalked, woolly through summer, small, just a bit over ½", light chestnut brown. Fruit: Oblong elliptic strobiles, erect, medium green becoming tanbrown at maturity. Cones are 1-1½" long; cylindrical, brownish, upright, short-stalked, with many hairy scales and hairy, 2-winged nutlets; maturing in late spring or early summer. Root: Shallow, fibrous, wide-spreading roots. Soil: Tolerates most soils, including fine, heavy clays that are poor to moderately well drained: prefers wet-toaverage moisture, acid soils, pH 6.5 or lower. [7, 8, 11, 22, 36]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [8, 21, 36, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 60". **Duration:** Long -5 days (prefers a rapid water decrease of 12"/day). This species can survive dry summer/fall seasons and can tolerate seasonal or irregularly inundated-to-saturated conditions. Seedlings somewhat tolerate flood duration and flood depth increases, while adults have a moderate tolerance. [1, 8, 22, 37]

Sensitivities or Other Tolerances

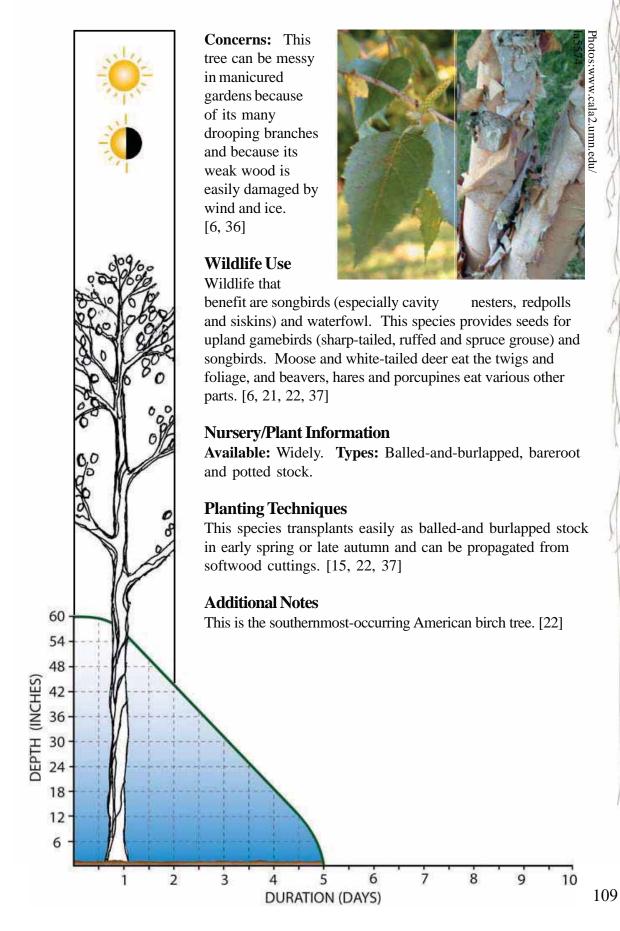
Exposure: Full sun to part shade. Salt: Low. Nutrient: Moderate.

Siltation: Moderate. **Insect**: Infrequent: unlike other birch species not susceptible to bronze birch borer. **Other:** Sensitive to 2,4-D and to lighting. Resistant to drought/heat. Resistant to mine spoils and soil compaction. This species has a moderate tolerance to oil/grease and metals. It has a moderate tolerance for general disturbance, from which seedlings decrease in abundance. [1, 8, 22, 37, 47]

Design Considerations

River birch is well suited for bank stabilization, shoreland and floodplain restorations on mesic-to-wet soils. Its ability to thrive on moist sites makes it useful for erosion control and rain gardens. This species is long lived and fairly disease resistant. It is used in yards and landscape designs.

Indicator Status: FACW



Bidens cernua

Beggarsticks – a.k.a. Nodding Beggarsticks, Bur Marigold, Stick-tight, Nodding Bur-Marigold

Habitat/Plant Community and Geographic Range

Habitat/Community: Exposed, sandy or muddy shores, streambanks, marshes, forest depressions, wet meadows, ditches, pond margins and other wet places. [7, 11, 32, 35] **Range:** Minn. (Eco-Range: all), Wis., Mich. N.B. to B.C., s. to N.C., Okla., N.M. and Calif.; Eurasia. [7].

General Description

General: Annual species. Mature height is 4" to 3.3'. **Flower:** Small, yellow, sunflowerlike heads from August to October. **Fruit:** The elongate achenes end in 2-4 barbed awns which stick tightly to clothing and fur. The flower heads nod as seeds ripen. **Leaf:** Bases of the opposite simple, sessile, leaves are often joined. **Soils:** Wet soils of a variety of textures. [7, 11, 35, 44]

Normal Water Level

This species prefers moist/mesic conditions. [44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Medium-long – 4 days (decreasing 6"/day). Species tolerates seasonally flooded conditions for short duration and decreases in abundance as flood depth increases or decreases. Do not submerge young plants for more than 2 or 3 days in 1-2" of water. Mature plants have a tolerance for water level fluctuation, flood duration, and this species thrives in conditions similar to *Symphyotrichum lanceolatus*.[1, 44]

Sensitivities or Other Tolerances

Exposure: Full sun. **Salt:** Low to moderate. **Nutrient:** Moderate, though *B. cernua* is intolerant to P levels decreasing. **Siltation:** Moderate to high. **Insect:** Infrequent. **Other:** This species has a moderate-to-high tolerance to general disturbance and stress. [1, 44, 47]

Design Considerations

Beggarsticks is used in upper shoreline zones and in vegetated swales. A good pioneer species. Well suited for restorations of all wet, disturbed areas and urban conditions. This species may be in the seed bank and respond well to drawdowns. **Concerns:** This genus is considered a nuisance for walkers when the seeds are ripe. It is short-lived. [26, 42, 44]

Wildlife Use

Provides wildlife cover. Waterfowl (especially wood duck), shorebirds, songbirds, and small mammals consume achenes. [32, 44]

Nursery/Plant Information

Available: Limited. Types: Plants and achenes.

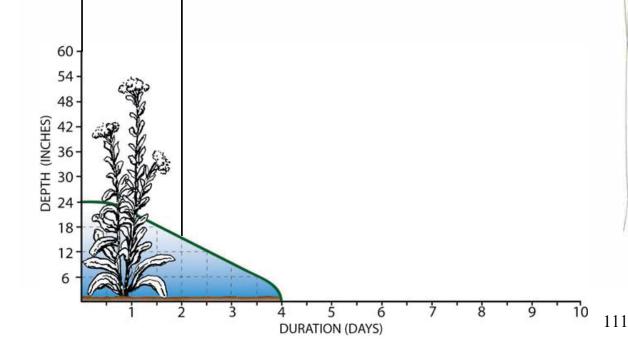
Indicator Status: OBL (*B.cernua*)



Achenes should be broadcast on wet mudflats or shorelines and raked into the soil. For best results, fall planting after drawdown on mudflats or shorelines to allow



winter exposure. Drawdown in early summer will cause explosive growth from fall-planted achenes. An early, shallow, summer flooding followed by a drawdown promotes best seed production from established plants. For optimum germination, cold (34-36 degrees F.), moist stratification for several months before exposure to warm temperatures. Seeding rate is 0. 25-0.5 lb/acre. [37,39,44]



Bolboschoemus fluviatilis

River Bulrush - a.k.a. River Rush, Three-square Rush

Habitat/Plant Community and Geographic Range

Habitat/Community: Streams, ditches, deep and shallow marshes, lakes, ponds and in fresh and mixosline waters (usually in shallow water, though sometimes brackish). [4, 7, 11, 16] **Range:** Occasional; Minn. (Eco-Region: All), all but nc. Wis., local in UP and mostly c. and s. LP of Mich. Que. to Wash., s. to Va., Mo., Kan. and Calif. It is a common dominant in Miss. River backwaters. [7, 21]

Description

General: Stout, native, perennial, emergent herb often 5-7' tall and forming large colonies. Flower: Spikelets are brown, 3/8-1" long, and sessile on 4"-long stalks from July to September. Leaf: Leaf blades are smooth, ½-½" wide and strongly M-shaped in cross section. Stem: Sharply, triangular stems with flat sides are mintgreen and leafy, growing to a height of 6'. Fruit: Distinctly, 3-angled achenes that are a dull, tan-to-gray green with a beak and 6 barbed bristles at the base. Root: Thick rhizome with tuber-like enlargements that are red to gray-black in color, covered with hair-like roots. Soil: Tolerates a wide variety of conditions although it prefers silty soils with a pH range of 7.0-9.1. [4, 7, 11, 44]

Normal Water Level

This species prefers shallow water of 30" of inundation or less to wet/saturated conditions. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 30". **Duration:** Medium short – 3 days (decreasing 12"/day for 2 days and then 6" the last day). River bulrush tolerates regular flooding and inundation; it is moderately tolerant to flood duration and will increase with flood depth increases and decrease with depth decreases. [1, 37, 44]

Sensitivities or Other Tolerances

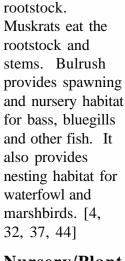
Exposure: Full to partial to sun. **Salt:** Moderate. **Nutrient:** Moderate to high. **Siltation:** High. **Insect:** Infrequent. **Other:** This species has a moderate rate of spread and a moderate tolerance to general disturbance and stress. [1, 37, 44]

Design Considerations

River bulrush has been used in soil stabilization and erosion control in shorelines, vegetated swales and riverbanks, especially in 6" or less of standing water. It is recommended for wetland restorations, mitigation sites and shoreline improvements of streams, ponds and lakes. It provides good wildlife habitat. **Concerns:** This species is very aggressive and can form monocultures, which may be desirable to compete with invasive species. It also may be uprooted by wave action. [16, 44]

Wildlife Use

Bulrush provides habitat for waterfowl and other species. Coots, black, canvasback, mallard, pintail, redhead, ring-necked, scaup and teal ducks eat the seeds. Young stems are utilized by Canada and snow geese. Sora and Virginia rails eat the seeds and





Nursery/Plant Information

Available: Becoming widely. **Types:** Rhizomes, rootstocks, tubers and

transplants.

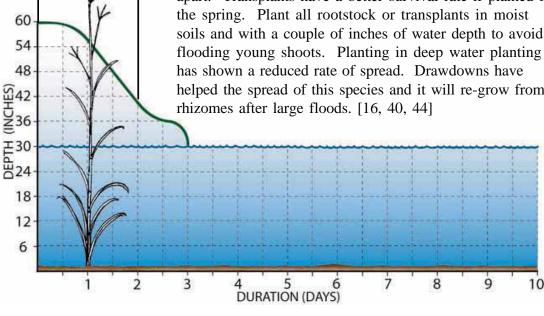
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Planting Techniques

River bulrush achenes

require moist, cold stratification for at least 90 days, then good light for germination. Seed production is erratic. Fresh seed planted in the fall has the highest germination rate. Recommended seeding rate is 0.06-0.125 lb/acre with about 54,000 seeds/lb. This species divides well, and rhizomes, tubers and transplants are the preferred propagation method. Plant rootstock 2-5" deep and 1-3' apart. Transplants have a better survival rate if planted in the spring. Plant all rootstock or transplants in moist soils and with a couple of inches of water depth to avoid flooding young shoots. Planting in deep water planting has shown a reduced rate of spread. Drawdowns have helped the spread of this species and it will re-grow from rhizomes after large floods. [16, 40, 44]



Boltonia asteroides

Boltonia - a.k.a. White or Star Boltonia, White False Aster, False Aster

Habitat/Plant Community and Geographic Range

Habitat/Community: Seasonally flooded, muddy shores, wet meadows, marshes, swamps, low or damp prairies, swales and edges of streams. [7, 35] **Range:** C. and s. Minn. (Eco-Range: 4, 7-9), s. Wis., extreme s. LP of Mich.; N.J. to s. Man., s. to Fla. and Tex.; introduced in nw. USA. [7, 21]

Description

General: A robust, asterlike, perennial herb, which has branched stems, often in clumps and grows 3-5' tall. **Flower:** The heads are about 1" across, have yellow, hemispherical centers and narrow, usually white rays in the fall (August to October). **Leaf:** Broadly linear-to-lanceolate leaves that reduce towards the top. **Fruit:** Achenes differ from those of the asters and fleabanes by having no tuft of hairs at the end. **Root:** Fibrous-rooted, sometimes with shallow rhizomes. **Soil:** Moist-to-wet soils. [7, 35]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/day).

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Unknown. **Siltation:** Unknown. **Insect:** Unknown. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

Boltonia makes a great cutflower and attracts butterflies, which makes it a good plant for perennial gardens. It may do well in semi-shaded areas. **Concerns:** This plant grows tall and should be planted with other robust species. [35]

Wildlife Use

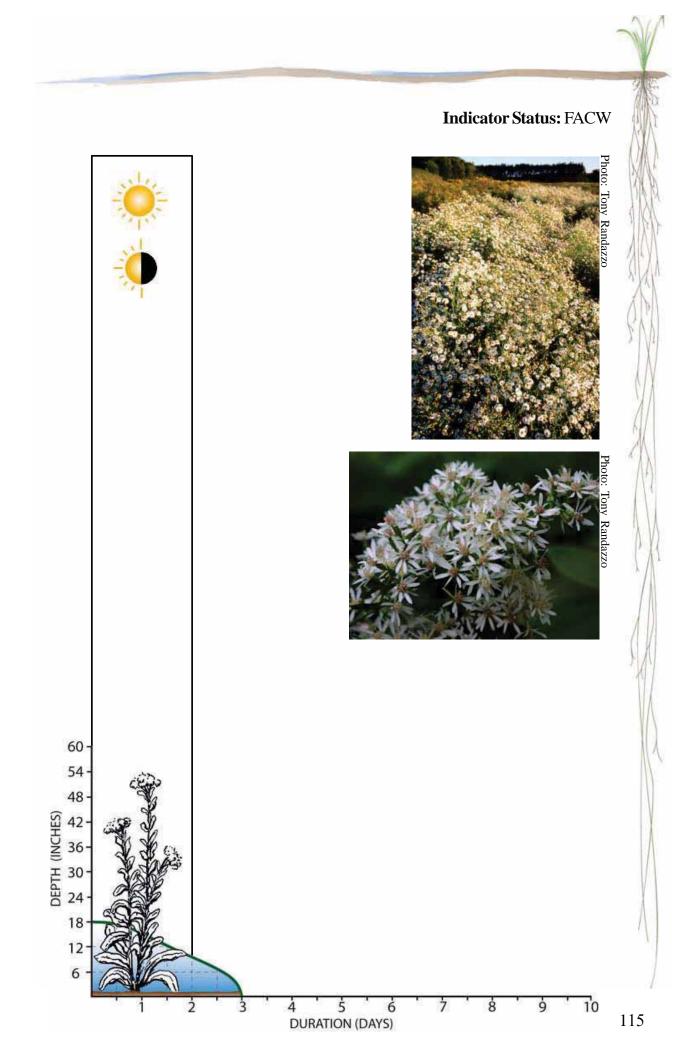
This species is a bee and butterfly magnet. [21]

Nursery/Plant Information

Available: Limited. Types: Plants primarily, although achenes are available.

Planting Techniques

The species establishes readily from achenes. [21]



Bromus ciliatus

Fringed Brome a.k.a. Bromus kalmii - Fringed Brome-grass, Prairie Brome, Kalm's Brome, Wood Chess, Cheat

Habitat/Plant Community and Geographic Range

Habitat/Community: Stream banks, shores, thickets, sedge meadows, fens, marshes, wet meadows and moist woods and thickets. This species is widely adapted to habitats from saturated wetland soils to mesic upland forests and roadsides. [7, 16, 21] **Range:** All but sw. Minn. (Eco-Range: 1-6, 8), Wis., Mich.; Nfld. to Wash., s. to N.J., Tenn., Iowa, Tex. and Calif. [7, 21]

Description

General: Cool-season, perennial grass that reaches 2-4' in height. It is a bunching, short-lived species. **Leaf:** Green, turning tan in autumn. **Flower:** Blooms June to July, often flowering first year. The influorescences resemble those of wheat. **Fruit:** Delicate, gracefully nodding caryopsis. **Root:** Fibrous. **Soil:** Saturated wetland soils to mesic upland forests and roadsides. [7, 16, 17, 47]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions, although it is drought tolerant. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/day). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full sun to shade. **Salt:** Unknown. **Nutrient:** Low to moderate. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** Drought tolerant and moderate-to-low tolerance to general disturbance and stress. [1, 47]

Design Considerations

A good restoration plant for shady sites as well as mesic-to-wet conditions. The seed head has dried flower uses. This species can be grown as a specimen or in small groups. **Concerns:** This species is not competitive with taller grasses.

Wildlife Use

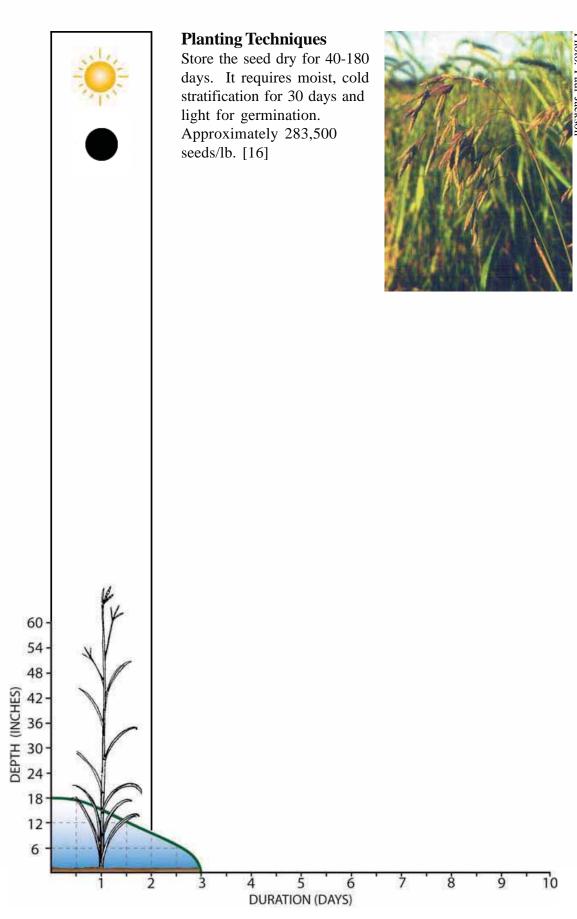
The good-sized seeds are eaten by a number of birds (grouse, partridges, lark sparrows, savannah sparrows and brown towhees) and rodents (chipmunks, gophers, ground squirrels, mice and prairie dogs). Hoofed browsers and geese consume the leaves or other parts of the plant, especially when young. [32]

Nursery/Plant Information

Available: Widely. Types: Seed.

Indicator Status: FACW

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Calamagrostis canadensis

Canada Blue-joint Grass a.k.a. Blue Joint Grass, Canada Blue-joint Grass, Bluejoint, Blue-joint Reedgrass, Reedgrass

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadow, wet-mesic prairies, shallow-water marshes, calcareous fens, stream banks, shrub-carrs and thickets. This species usually occurs as a subdominant in sedge meadows, and is the most frequent grass associate of the sedges. [7, 11, 16] **Range:** Common to abundant; Minn. (Eco-Range: All), Wis., Mich. Greenland to Alaska, s. to N.J., W.Va., N.C., Mo., Kan., N.M. and Calif. [7, 21]

Description

General: Cool-season, perennial grass with a mature height of 2-4' has many very slender stems that arise from small rhizomes. Flower: A pretty, open inflorescence of tiny flowering spikelets on bluish stems that is a brown color from May to August. Leaf: The sheaths are usually hairless. The slender leaves tend to be flat. A distinct, thin, dry, papery structure extends beyond the summit of the sheath (the ligule). Stem: Nodes often are blue to reddish purple. Fruit: A caryopsis. Root: Creeping rhizomes. Soil: The pH range is 5.0-8.0. [7, 11, 44]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions, though will tolerate 3 to 6" of inudation. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 6". **Duration:** Medium long – 4 days (decreasing 3" every 2 days). Canada blue-joint grass can tolerate regularly or seasonally inundated condition to 6", but not permanently flooded conditions, but will moderately tolerate flood duration. This species is more abundant in wetlands with minimal water level fluctuations and will increase in abundance with decreases in flood depth. [1, 23, 37, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species has a moderate-to-low tolerance to general disturbance and stress. [1, 44, 47]

Design Considerations

Canada blue-joint grass is used in upper shoreline zones and in vegetated swales. This species also does well in landscaping, restorations especially wetland, wet meadow and wet prairie, and mitigation sites. It provides good wildlife habitat for songbirds. **Concerns:** Can spread aggressively by rhizome under optimal conditions, though this is desirable in restorations threatened by invasive species. This species may decrease with heavy grazing. [14, 16, 21, 37, 44]



Wildlife Use

Songbirds and waterfowl eat the seeds. Geese, moose, deer, small mammals and muskrats graze on the entire plant, especially the young shoots. This grass stands up well in winter, making it a good source of food and cover for wildlife, especially songbirds. [11, 14, 37, 44]



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Nursery/Plant

Information

Available: Widely.

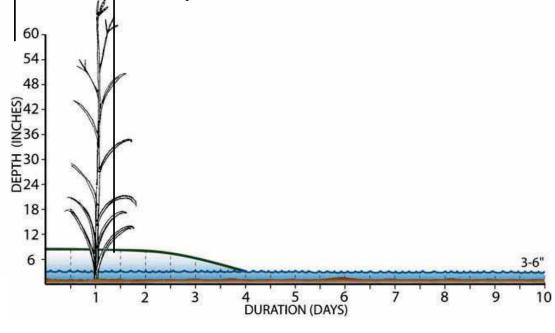
Types: Plants and seed, although not in large quantities due to low seed production and low viability.

Planting Techniques

Planting plugs has been most successful. Planting should be on ½ centers because the rhizomes spread slowly. Can be grown from seed, but is slow to establish. Soil should be moist to saturated, but not inundated during planting. Seed should be fresh, moist, cold stratified and divided. Light is important in germination. Seeding rate is 0.03-0.06 lb/acre, approximately 1,512,000 seeds/lb. Established stands may be mowed in alternate years for maintenance. [16, 44]

Additional Notes

This species is abundant in c. to n. Minn.



Caltha palustris

Marsh Marigold - a.k.a. Cowslip, Common Marsh-marigold, King-cup

Habitat/Plant Community and Geographic Range

Habitat/Community: Shallow water, swamp, hardwood swamps, wet woods, shrub swamps, thickets, especially stream banks, sedge meadows, fresh (wet) meadows, calcareous fens, marshes and springs. This species is usually associated with peaty ground and some flowing water. [7, 11, 16, 35, 41] **Range:** Common; Minn. (Eco-Range: All), throughout Wis., Mich. Circumboreal; s. to N.C., W.Va., Tenn., Ind., Ill., Iowa and Neb. [7, 21]

Description

General: With its early bloom, marsh marigold is a harbinger of spring. It is a native perennial herb, that reaches a height of 1-2'. **Flower:** Many round, green-and-yellow buds open to become a flower with 5-9 bright yellow petals sepals, 1-1½" wide and 4 or more pistils surrounded by many stamens; blooms during April and May. **Leaf:** The basal leaves are broadly heart-shaped or rounded, 2-7" wide, and usually coarsely toothed. **Stem:** Hollow, 8-24" long. **Fruit:** A follicle 3/8-5/8" long with a pronounced beak. **Root:** Fibrous, deep. **Soil:** Grows in saturated soil and prefers peat. [7, 11, 35, 41, 47]

Normal Water Level

This species prefers shallow water of 3" of inundation or less to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 6". **Duration:** Medium short – 3 days (decreasing 3" the first 2 days then 3" more the last day). Marsh marigold will tolerate seasonal to regular inundation with a moderate tolerance to duration. [1, 37]

Sensitivities or Other Tolerances

Exposure: Part sun to shade. **Salt:** Low. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species spreads slowly. It has a moderate tolerance to general disturbance and stress, and moderate tolerance to iron concentrations. [1, 37, 47]

Design Considerations

The main use for this plant is in wetland/stream restorations or rehabilitation, especially in wet meadows, marsh/bog areas or areas associated with peaty ground and some flowing water. This species can be successfully planted on any wet ground, although it prefers swamp and peatlands. **Concerns:** Marsh marigold may not do well in nutrient-poor soils. [16]

Wildlife Use

Upland game birds eat the seeds and moose eat it as food. It is used by frogs and insects as well. However, cattle and deer avoid eating this plant, which may be toxic to livestock. [21, 35, 37]

Indicator Status: OBL Nursery/Plant Information Available: Widely. **Types:** Available in plant form and limited availability as seed. **Planting Techniques** Fresh seed is preferred with moist, cold stratification to break dormancy. Fall is the preferred season for seeding. Marsh marigolds produce approximately 756,000 seeds/lb. [16] 60 54 48 DEPTH (INCHES) 36 30 30 24 18 12 4 5 6 DURATION (DAYS) 121

Carex aquatilis Water Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, marshes, shores, stream banks, kettle lakes, ditches and fens. [7] **Range:** N., c. and infrequently s. Minn. (Eco-Region: 1-6, 8, 9), e. and n. Wis., local in w. UP of Mich. Circumboreal, s. to N.J., Ind., Iowa, Kan., N.M. and Calif. [7, 21]

Description

General: This native perennial forms clumps or tufts. One of the lake sedges, *Carex aquatilis* is very similar to tussock sedge (*Carex stricta*). It may grow to a mature height of 2-3'. **Flower:** Pistillate scales reddish-brown or tawny to often purplish-black, usually with a paler midrib, which is generally narrower and often shorter than the perigynia. **Leaf:** Lowest leaves have blades; mature leaves tend to be blue-green. **Stem:** The flowering stems arise centrally; lack basal sheaths with 2 rows of fibers on each side of a central fiber. **Root:** Spreading by many slender rhizomes. **Soil:** Wet soils. [7, 11]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions, sometimes in salt marshes. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Medium short -3 days (decreasing in depth 6" in day 1 and 6" more in days 2 and 3). This species can tolerate seasonal-to-regular inundation, with a moderate tolerance to flood duration. It usually increases in abundance with flood depth increases. Found in sites with stable water levels. [1, 29, 37]

Sensitivities or Other Tolerances

Exposure: Partial shade. Salt: Unknown. Nutrient: Unknown.

Siltation: Unknown. **Insect:** Infrequent. **Other:** Water sedge has a moderate rate of spread and a moderate-to-low tolerance to general disturbance and stress. [1, 37]

Design Considerations

In addition to being a good stream bank stabilizer, this species works well in many restoration efforts. Restorations or reestablishment may include wet meadows, shores, stream banks, kettle lakes, fens and ditches. This is a good plant for partially sunny to shady conditions within rain garden designs. [37]

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed chicks), marsh birds, shorebirds, seed-eating songbirds (swamp, tree, song and Lincoln sparrows; snow buntings; cardinals; larkspurs and redpolls) and most waterfowl. Sedges also provide food for moose, beavers, deer and muskrats. Stands of *Carex* in shallow water can provide valuable spawning habitat. In addition to providing food, sedges also provide

valuable cover for ducks, and their tufted growths furnish concealment for other animals. [4, 32, 37, 44]

Nursery/Plant Information

Available: Limited.

Types: Limited plant and

seed availability.

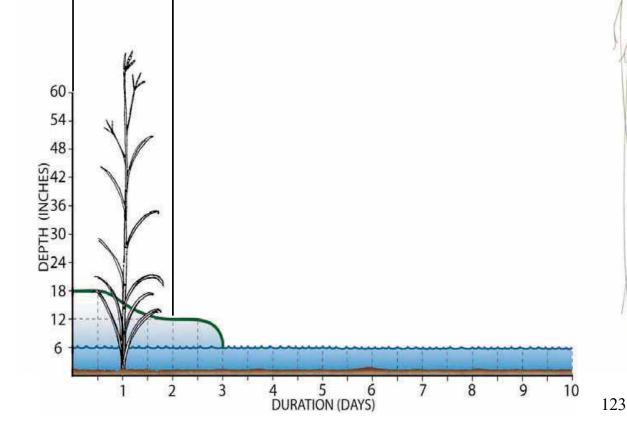


Planting Techniques

Many seeds should be planted as viability may be low. Seeds may need moist, cold stratification to maintain viability.

Additional Notes

C. aquatilis is similar to *C. stricta* but does not form as high a tussock clump (see *C. stricta*).



Carex bebbii

Bebb's Sedge - a.k.a. Bebb's Oval Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet-to-moist meadows, marshes, lake edges, stream banks, ditches and calcareous fens. It forms dense clumps on moist-to-saturated soil. [7, 16] **Range:** Common northward; all but s.w. Minn. (Eco-Range: All), Wis., Mich. Nfld. to B.C., s. to N.J., Ohio, Ill., Neb. and Colo. [7, 21] **Threatened in Indiana.**

Description

General: This native, cool-season, perennial, grass-like herb forms dense clumps with heights of 24-36". **Flower:** Green in May to June with 4-12 spikes, 3/16-3/8" long, sessile in a compact, crowded spike or head ½ to 1-3/16". Bracts inconspicuous, even the lowest one shorter than the inflorescence. Pistillate scales shorter and narrower than the perigynia. Perigynia crowded, stiffly ascending (the beaks often standing out from the body of the spike), ovate, 2-3 times as long as wide. **Leaf:** Elongate, mostly 1/16-3/16" wide; sheaths ventrally hyaline. **Fruit:** Achene lenticular. **Soil:** Moist-to-saturated soil, especially in calcareous situations. [7, 17]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: High. Depth: 12". Duration: Medium short -3 days (6" the first day then 6" the following 2 days).

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Unknown. **Nutrient:** Unknown.

Siltation: Unknown. Insect: Unknown. Other: This species has a moderate tolerance

to general disturbance and stress. [1]

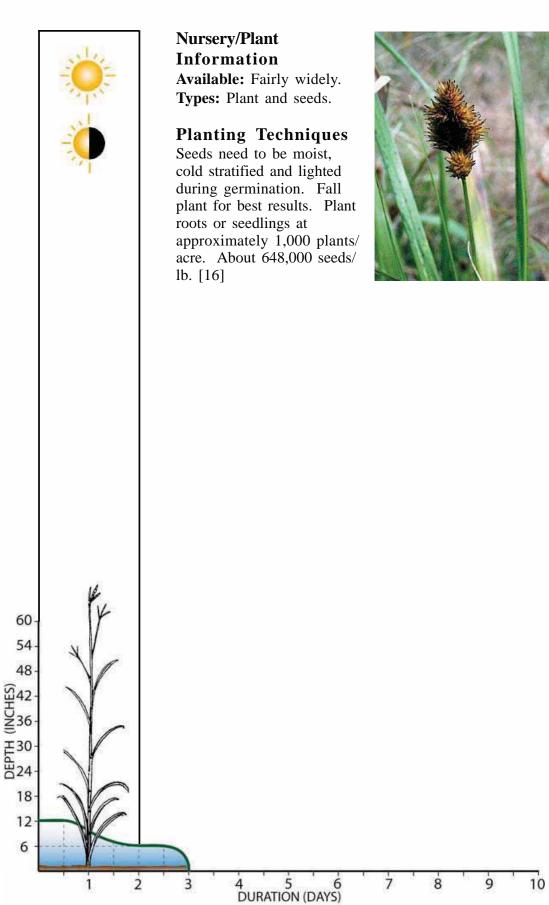
Design Considerations

A good species for wetland restorations and other saturated areas, such as stream banks and lake shores. It does exceptionally well in calcareous situations and wet meadows. This bunching herb will stay controlled for landscaping situations, rain gardens and moist pond areas. **Concerns:** *C. bebbii* may decline with competition from robust grasses and forbs. [16]

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed chicks), marsh birds, shorebirds, seed-eating songbirds (swamp, tree, song and Lincoln sparrows; snow buntings; cardinals; larkspurs and redpolls) and most waterfowl. Sedges also provide food for moose, beavers, deer and muskrats. Stands of Carex in shallow water can provide valuable spawning habitat. In addition to providing food, sedges provide valuable cover for ducks, and their tufted growths furnish concealment for other animals. [4, 32, 37, 44]

125



Carex comosa

Bottlebrush Sedge - a.k.a. Bristly Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Shallow marshes, wetland margins, floating mats, bogs, shores of ponds, lakes, streams and ditches. [4, 7, 11, 16] **Range:** Nc. and e. Minn (Eco-Regions: 1, 5-9), Wis., Mich. Que. to Minn. and S.D., s. to Fla. and Tex.; also Wash. and n. Idaho to Calif. [7, 21]

Description

General: One of the region's more common aquatic sedges. It is a large, native, perennial herb, often forming large clumps that may grow to a height of 1½-4′. Flower: Green from May to July. The more slender male spike is on a short stalk just above the female spikes. It is the female spikes that are nodding and have the bottle brush appearance. The sac-like structures around the ovaries called "perigynia" have a long beak with two slender teeth that curve away from each other. When these perigynia are all clustered together in a spike, the teeth create a "bristly" appearance. The perigynium are approximately ¼" long and strongly ribbed. Leaf: Leaves are ¼-½" wide, M-shaped, septate and rough-margined. Stem: Sharply triangular. Fruit: Tan achenes from July to August. Root: Rhizome in a dense cluster. Soil: Grows in very shallow water or moist soil. [4, 7, 11, 16, 44, 47]

Normal Water Level

This species prefers shallow inundation of 12" or less to wet/saturated soils. [4, 21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 36". **Duration:** Medium short -3 days (12"/day). This species tolerates regular and seasonal inundation. [37, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low. **Siltation:** Not tolerant. **Insect:** Infrequent. **Other:** Bottlebrush sedge spreads slowly and is moderately tolerant to general disturbance and stress. [1, 44, 47]

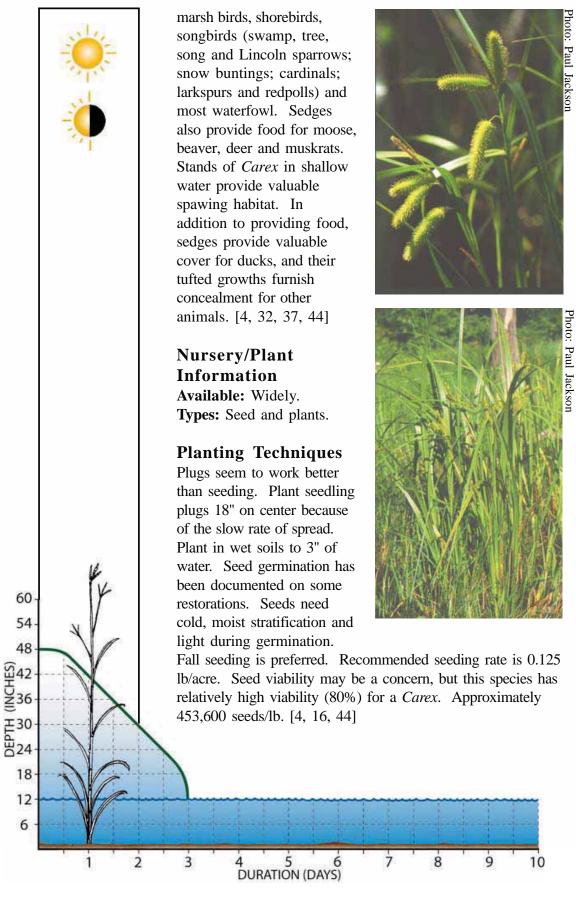
Design Considerations

Bottlebrush sedge, a good clump former, is used in upper shoreline zones. This species does well in restorations, especially in wetlands, shores of lakes, ponds and stream banks. A beautiful plant that is excellent in water gardens or other landscape situations. Spikes persist into the winter. The dense growth form makes this sedge a valuable shoreline stabilizer. It is a successional species that starts in very shallow water and moves to deeper areas that are normally arrowhead and pickerel weed habitat.

Concerns: While it is difficult to establish from seed, this species is important in many plant communities and can be established by plants or plugs. [4, 16, 44]

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed chicks,



Carex crinita

Caterpillar Sedge - a.k.a. Fringed Sedge, Sickle-grass

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamps, alder thickets, wet openings and mesic savannas, ditches, lake edges and potholes. [7, 16] **Range:** Ne. and ec. Minn. (Eco-Range: 1, 5, 6), n. and c. Wis., Mich. Nfld. and Que. to Minn., s. to Ga. and Tex. **Threatened in Iowa.** [7, 21]

Description

General: Large, densely clumped perennial that may grow 2-5' as a cool-season, native herb. **Flower:** Attractive, 4", nodding spikes that resemble a caterpillar from May to June. The flower heads are deep brown, with perigynia silk-green, 2-ribbed, otherwise nerveless, smooth, somewhat inflated, nearly circular in x-section, rounded to an abrupt, minute beak. **Leaf:** The leaves are flat, 1- to 3-ribbed, and brownish tinged. Main leaves are ½-½" wide, the sheaths glabrous, bracts leaf-like, sheathless or nearly so, the lowest one 8-22". **Stem:** 3- sided, surpassing the leaves.

Fruit: Achene lenticular, constricted on 1 side or edge, with a bent style.

Soil: Wet-to-moist soils. [7, 16]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Medium short -3 days (decreasing 6" the first day and a total of 6" the following 2 days). This species has a moderate tolerance to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Unknown. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderate-to-high tolerance to general disturbance and stress. [1]

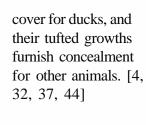
Design Considerations

This species is well suited for a wetland restoration especially in semi-shaded conditions, such as shrub-carrs or shrub wetlands. It will also do well in water gardens in many situations. Due to its bunching habit, this species will look good in all landscape scenarios and serves as a good plant for stabilization areas. [16]

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed chicks) marsh birds, shorebirds, seed-eating songbirds (swamp, tree, song and Lincoln sparrows; snow buntings; cardinals; larkspurs and redpolls) and most waterfowl. Sedges also provide food for moose, beaver, deer and muskrats. Stands of *Carex* in shallow water can provide valuable spawning habitat. In addition to providing food, sedges also provide valuable

Indicator Status: FACW+



Nursery/Plant Information

Available: Limited.

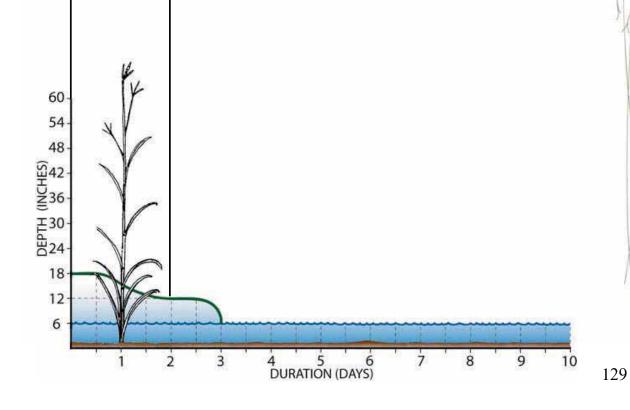
Types: Plants and

seed.



Planting Techniques

Fresh seed is needed, and it prefers moist, cold stratification. Germination requires light. Fall planting is preferred. [16]



Carex hystericina

Porcupine Sedge - a.k.a. Bottlebrush Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamps, marshes, alder thickets, wet meadows, lake edges, ditches (agricultural) and calcareous fens. [7, 11, 16] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. N.B. to Wash., s. to Va., Ky., Ark., Tex., N.M. and Calif. [7]

General Description

General: A slender, native perennial, which often forms large clumps about 2-3 1/2' tall. **Flower:** Bracts of the lowest pistillate spike are generally longer than the inflorescence, which blooms from May to June. The lower spikelets are usually drooping on slender stalks. The numerous perigynia are 15-20 nerved, and densely clustered. The slender beak of the perigynium is conspicuous and has short, straight teeth. **Leaf:** Leaves are 1/8- 3/8" wide, M-shaped and not septate. **Stem:** Triangular. **Fruit:** Achene is trigonous, with a bony style, which becomes flexuous or contorted as the achene matures. **Root:** Clustered on short, stout rhizomes. **Soil:** Wet-to-moist soils at water's edge and calcareous situations. [7, 11, 16]

Normal Water Level

This species prefers shallow water to wet/saturated conditions of 6" of inundation or less. [37]

Flooding/Fluctuation Tolerances

Frequency: High. Depth: 36". Duration: Medium short -3 days (12"/day). Porcupine sedge will tolerate seasonal to regular inundation to 6" of water with a moderate tolerance to duration. [1, 37]

Sensitivities or Other Tolerances

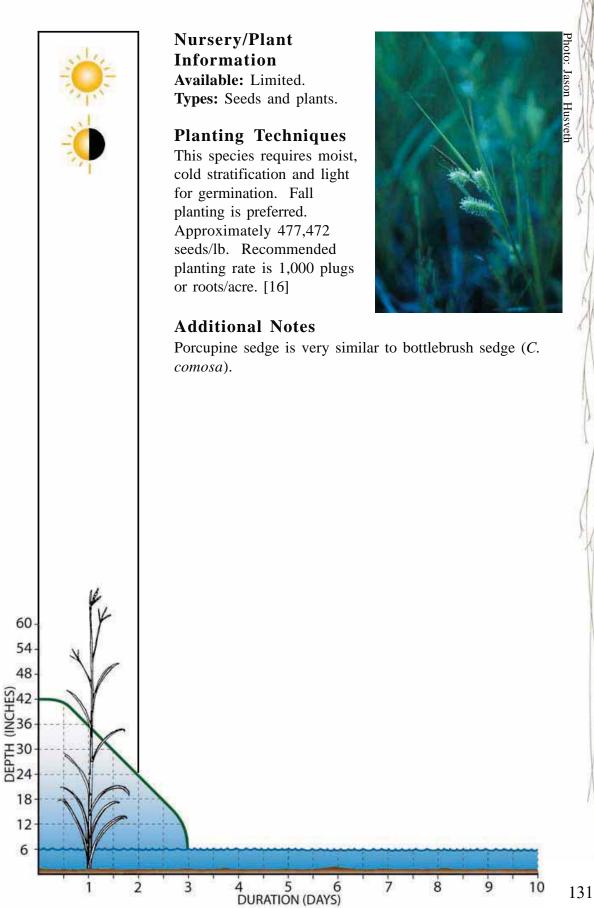
Shade: Full sun to part shade. **Salt:** Moderate. **Nutrient:** Moderate. **Siltation:** Unknown. **Insect:** Unknown. **Other:** Bottlebrush sedge has a moderate rate of spread and a moderate tolerance to general disturbance and stress. [1, 37, 47]

Design Considerations

This species is a very attractive plant for shoreland restoration and water gardens. It may be a good soil stabilizer because of its bunching characteristic. It prefers calcareous soils, although it tolerates many soil types and fluctuating water levels. [16]

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. Many birds, including rails (sora, yellow), grouse (especially ruffed chicks), marsh birds, shorebirds, seed-eating songbirds (swamp, tree, song and Lincoln sparrows; snow buntings; cardinals; larkspurs and redpolls) and most waterfowl, eat the achenes. Sedges also provide food for moose, beaver, deer and muskrat. Stands of *Carex* in shallow water can also provide valuable spawning habitat. In addition to providing food, sedges provide valuable cover for ducks, and their tufted growths furnish concealment for other animals. [4, 32, 37, 44]



Carex lacustris

Lake Sedge - a.k.a. Common Lakeshore or Lake-bank Sedge, Rip Gut

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamps, shallow marshes, shrub-carrs, alder thickets, wooded swamps, sedge meadows, borders of lakes and streams, kettle wetlands, wetland margins (usually in shallow water), low areas in tamarack swamps) and sometimes seasonally inundated wet meadows. [7, 11, 16] **Range:** Common; all but sw. and se. Minn. (Eco-Range: 1-8), Wis., Mich. Que. to Sask., s. to Fla. and Tex. [7, 21]

Description

General: Lake sedge produces large, persistent scattered beds of clones. A coolseason, native perennial that can reach a height of 2-3'. Flower: Pistillate spikelets numbering 2-4 that are ¾-4" long, and are sessile or on short stalks. Staminate spikelets number 2-4. The perigynium is ¼-5/16" long, without hairs, distinctly ribbed and gradually tapers into a beak, which blooms from May to June. Leaf: Coarse leaves that are M-shaped, bluish-green, 3' or more long, and 5/16-9/16" wide. It has reddened basal sheaths and open, feather-like (pinnate) fibers. Stem: Triangular stems. Fruit: The achene is 3-angled. Root: Scaly rhizomes. Soil: Saturated soils. [7, 11, 16]

Normal Water Level

This species prefers shallow water of 2' of inundation or less to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 24". **Duration:** Long – 8 days (decreasing 3"/day). Will tolerate seasonal-to-regular inundation to 2', though more abundant in wetlands with minimal water level fluctuations. It will tolerate a moderate flood duration. [1, 23, 37]

Sensitivities or Other Tolerances

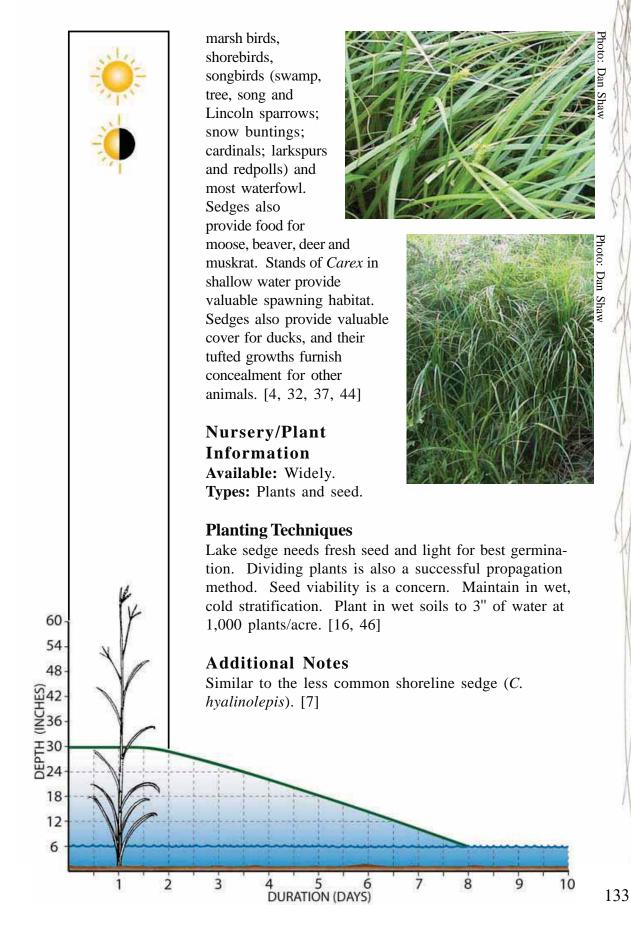
Exposure: Full to partial sun. **Salt:** Moderate. **Nutrient:** Moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** Lake sedge has a rapid rate of spread and a moderate tolerance to general disturbance and stress. [1, 37, 46]

Design Considerations

Lake sedge is another sedge well-adapted for restorations of shallow marshes, and any wooded swamps, thickets or shrub-carrs. It does well in borders of ponds, lakes and streams. **Concerns:** Lake sedge is aggressive, so it would probably not be ideal for landscape conditions or rain gardens, although the aggressiveness may be preferred for some restoration areas to outcompete invasive species.

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed chicks),



Carex lasiocarpa

Wooly Needle Sedge -a.k.a. Slender, Wiregrass or Hairy-fruited Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Peatlands, wet peat soils, open bogs, calcareous fens, shrub-carrs, sedge meadows, shallow marshes; frequently in shallow water and on pond margins. The well developed, air-filled root and rhizome system makes this sedge one of the floating, mat-forming species that create the first stage in bog succession. Persists in wetlands with relatively unaltered watersheds, land use and hydrology. [7, 11] **Range:** Common; especially along the hollows in Red Lake peatlands of Minn. (Eco-Range: 1-9), Wis., Mich. Circumboreal, Nfld. to Alaska, s. to N.J., Ohio, Iowa, N.D., Mont., Idaho and Wash. [7, 21]

Description

General: A colony-forming, native perennial reaching over 3' tall. **Flower:** The 1-3 pistillate spikelets are 3/8 to 1-1/8" long and sessile, while the 1-3 staminate spikelets are 3/4 to 2-3/8" long. The perigynia are densely fuzzy with an oblong-oval shape and sharp teeth. **Leaf:** Wiry leaves (not over 2 mm wide) are characteristically C-shaped in cross section or inrolled, tapering to very slender tips. **Stem:** Triangular. **Fruit:** Achene concavely trigonous. **Root:** Air-filled root and long, scaly rhizomes. **Soil:** Prefers peat soils. [7, 11]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Medium short -3 days (decreasing 6" the first day and a total of 6" the next 2). This species has a moderate tolerance to flood duration. [1, 23]

Sensitivities or Other Tolerances

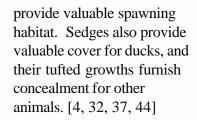
Exposure: Partial sun. **Salt:** Unknown. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Unknown. **Other:** This species has a moderately low tolerance to general disturbance and stress. [1, 46]

Design Considerations:

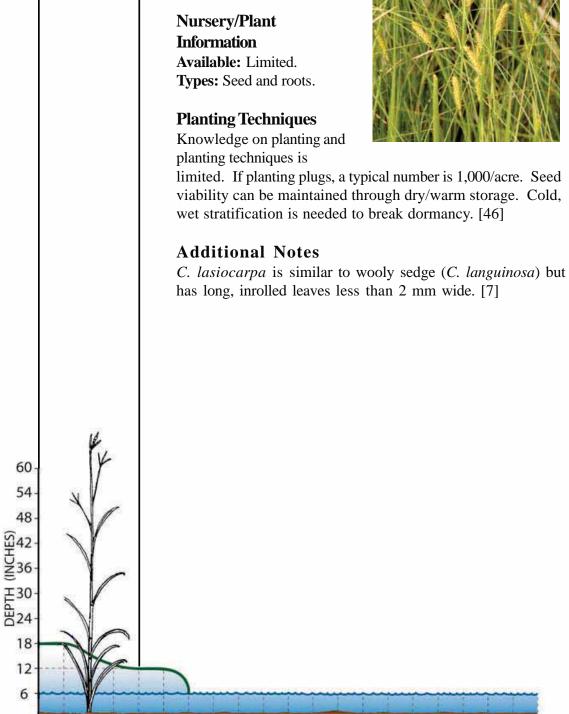
Wooly needle sedge will do well in some wetland restoration sites especially peatlands and peat soils or in bog conditions. This species create the first stage in bog succession. Persist in wetlands with relatively unaltered watersheds land use and hydrology. **Concerns:** This species decreases with moderate grazing. [14]

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed grouse chicks), marsh birds, shorebirds, songbirds (swamp, tree, song and Lincoln sparrows; snow buntings; cardinals; larkspurs and redpolls) and most waterfowl. Sedges also provide food for moose, beaver, deer and muskrat. Stands of *Carex* in shallow water



has long, inrolled leaves less than 2 mm wide. [7]



4 5 6 DURATION (DAYS)

2

Carex pellita

Wooly Sedge - a.k.a. Slender Sedge, Wiregrass Sedge, Hairy-fruited Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet-to-moist meadows and swales, marshes, sandy or marly shores and flats, stream banks (often wet places), and characteristic of floating bogmats and minerotrophic sedge-mats. [7, 11] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. N.B. and Que. to B.C., s. to Va., Tenn., Ark., Tex. and Calif. [7, 21]

Description

General: Colony-forming, native perennial that forms mats with stems 1-3' tall. **Flower:** Green from April to July. Perigynia have bidentate teeth up to 0.5 (0.7) mm long and less than half of the body length. Pistillate are usually narrower than the perigynia and acute or shortly awn-tipped, with scales party or wholly brownish or purplish. **Leaf:** Glabrous folded along the midrib, blades have revolute margins and are 1/16-3/16" wide. **Stem:** Triangular. **Fruit:** Concavely trigonous achene. **Root:** From scaly rhizomes. **Soil:** Bogs and minerotrophic sedge-mats. [7, 11, 44]

Normal Water Level

This species prefers moist soil although it will tolerate shallow water to 3-6" of inundation or less. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Long – 6 days (decreasing 4"). Woolly sedge will tolerate seasonal or irregular inundation to a depth of 6". [37, 44]

Sensitivities or Other Tolerances

Exposure: Full sun. **Salt:** Low. **Nutrient:** Moderate to high. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** Tolerates moderate disturbance

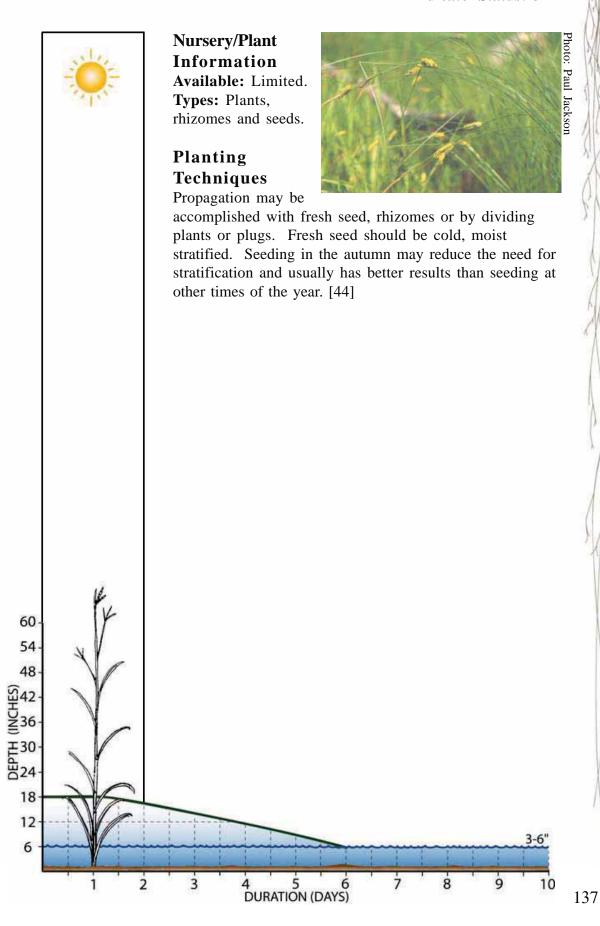
and stress. [1]

Design Considerations

This species is used in upper shoreline zones and in vegetated swales. It will do well in some wetland restoration sites and along streams. **Concerns:** The species decreases with moderate grazing. [14, 37, 44]

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed grouse chicks) marsh birds, shorebirds, songbirds (swamp, tree, song and Lincoln sparrows; snow buntings; cardinals; larkspurs and redpolls) and most waterfowl. Sedges also provide food for moose, beaver, deer and muskrat. Stands of *Carex* in shallow water provide valuable spawning habitat. Sedges also provide valuable cover for ducks, and their tufted growths furnish concealment for other animals. [4, 32, 37, 44]



Carex retrorsa

Retrorse Sedge - a.k.a. Deflexed Bottlebrush Sedge, Beaked Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forest, swamps, thickets and marshes. [7, 16] **Range:** Common in n., occassional in s. Minn. (Eco-Range: All), Wis., Mich. Que. to B.C., s. to Md., Ind., Iowa and Ore. **Endangered in Ind.** [7, 21]

Description

General: Densely clustered perennial reaching 2-4' tall. Flower: Spikes sheathless, at least the lowest one generally several times as long as the inflorescence. Several crowded spikes are sessile. Lower spikes are pistillate and upper spikes are staminate. Pistillate scales conspicuous, shorter and narrower than the perigynia. Perigynia numerous, densely crowded in 8 or more rows, widely spreading or the lowest ones retrorse, glabrous, shining, firm-walled but somewhat inflated, ellipsoid and often somewhat oblique, narrowed to a prominent, slender, smooth beak 1/16" long with short teeth. Leaf: Septate (especially the sheaths), mostly 1/8-3/8" wide with the leaves subtending the pistillate. Stem: Triangular. Fruit: Achenes dark brownish, narrowly trigonous, 1/16" long; the persistent, bony style becoming contorted with maturity. Root: Densely clustered on a very short rhizome. Soil: Wet to mesic soils of sandy to mucky conditions. [7, 17]

Normal Water Level

This species prefers shallow water to wet/saturated conditions of 6" of inundation or less, although it will tolerate mesic conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Medium short -3 days (decreasing 6" the first day and a total of 6" the following 2 days). Retrorse sedge will tolerate regular, seasonal or irregular inundated periods of 6" or less and is somewhat tolerant to flood duration. [1, 37]

Sensitivities or Other Tolerances

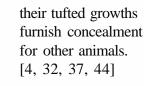
Exposure: Full sun. **Salt:** Unknown. **Nutrient:** Moderate. **Siltation:** Unknown. **Insect:** Unknown. **Other:** This species has a moderately low tolerance to general disturbance and stress. [1, 37]

Design Considerations

Retrorse sedge is used well in wetland restorations of flood plains, thickets and marsh conditions. **Concerns:** This species spreads slowly.

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed grouse chicks) marsh birds, shorebirds, songbirds (swamp, tree, song and Lincoln sparrows; snow buntings; cardinals; larkspurs and redpolls) and most waterfowl. Sedges also provide food for moose, beaver, deer and muskrat. Stands of *Carex* in shallow water provide valuable spawning habitat. Sedges also provide valuable cover for ducks, and



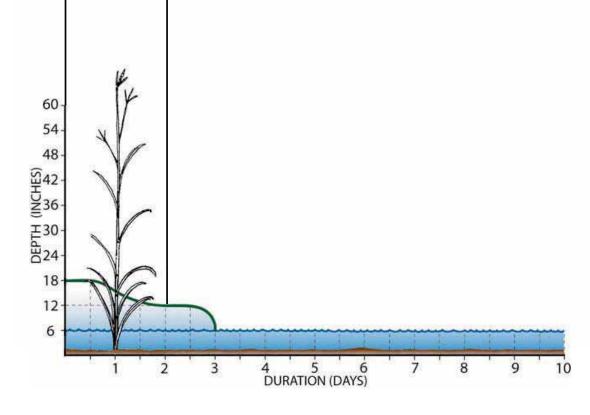
Nursery/Plant Information Available:

Limited.

Types: Plants and seed.

Planting Techniques

For best germination, the seed should be fresh and stratified in moist, cold conditions. Fall seeding is preferred with high light levels. If planting plugs, use 1,000 plants/acre. [16]



Carex stipata

Awl-fruited Sedge - a.k.a. Common Fox, Stalk-grain or Soft Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forest, swamps, thickets, wet meadow, wetland margins, wet basins, marshes and ditches (usually not in sphagnum bogs). [7, 11, 16] **Range:** Common; Minn. (Eco-Range: All), Wis., Mich. Nfld. to s. Alaska, s. to Fla., Tex. and Calif. [7, 21]

Description

General: Awl-fruited sedge is a somewhat stout, clump-forming sedge that may reach 3'. It is a cool-season, native, perennial herb that is similar to *C. vulpinoidea*, but slightly more robust with flaccid stems. **Flower:** Green flower color from May to July. Perigynia are 1/8-1/4" long, lance-triangular shaped, sessile and densely aggregated. The perigynia has a conspicuous beak that is less than twice as long as the body, but gives the large pyramid-shaped inflorescence a prickly appearance. **Leaf:** M-shaped, coarse, green leaves that are usually shorter than the stem. Thin sheaths extend beyond the leaf base and are conspicuously cross-wrinkled and whitish. **Stem:** Clustered, sharply triangular. **Fruit:** Achene lenticular. **Soil:** Prefers wet-to-moist soils of peat, muck, bogs (but not sphagnum) and loams. [7, 11, 44]

Normal Water Level

This species prefers moist soil although will tolerate shallow water to wet/saturated conditions of 12" of inundation or less. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 6". **Duration:** Medium long – 4 days (decreasing 3" every 2 days). This species will tolerate some seasonal and irregular water fluctuations and is somewhat tolerant to flood duration. It is tolerant, however, to flood depth and frequency increases. [1, 37, 44]

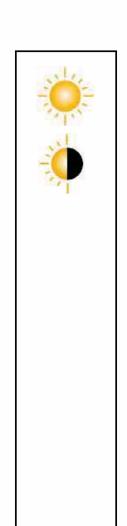
Sensitivities or Other Tolerances

Exposure: Full to part sun, although it usually occurs in shaded to partially shaded areas. **Salt:** Low to moderate. **Nutrient:** High. **Siltation:** Moderate – although it decreases in abundance with high water levels. **Insect:** Infrequent. **Other:** Has a slow rate of spread. Increased sediment has been shown to decrease biomass of *C. stipata*, and it has a moderately high tolerance to general disturbance and stress. [1, 12, 37, 44]

Design Considerations

Although awl-fruited sedge is well adapted for partially sunny to shaded wet basins and marshes, it is used in upper shoreline zones, other open, wet habitats and vegetated swales. This species is well suited to calcareous areas and its bunching character provides soil stabilization. It is a fast grower for shoreland habitats, restorations and revegetation zones in a variety of light conditions. [16, 44]

Indicator Status: OBL



Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed grouse chicks) marsh birds, shorebirds, songbirds (swamp, tree, song and Lincoln sparrows; snow buntings; cardinals; larkspurs, and redpolls) and most waterfowl. Sedges



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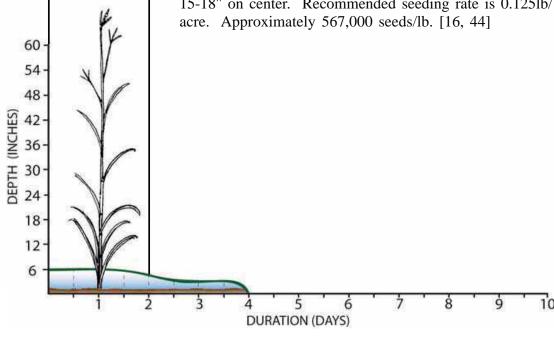
also provide food for moose, beaver, deer and muskrats. Stands of *Carex* in shallow water provide valuable spawning habitat. Sedges also provide valuable cover for ducks, and their tufted growths furnish concealment for other animals. [4, 32, 37, 44]

Nursery/Plant Information

Available: Widely. Types: Plants and seed.

Planting Techniques

Seeding works well, and the plants spread quickly. Store seeds in dry, cold conditions (14% moisture) and sow the following spring, or fall seed with fresh seed. Awlfruited sedge is a clump-forming species. Plugs should be planted 15-18" on center. Recommended seeding rate is 0.125lb/acre. Approximately 567,000 seeds/lb. [16, 44]



Carex stricta

Tussock Sedge - a.k.a. Common Tussock, Hummock, or Meadow Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Sedge meadow, marshes, shrub-carrs, calcareous fens, peatlands, shores, stream banks and ditches. This is the characteristic sedge of Minnesota and Wisconsin sedge meadows. The hummocks may persist for decades, even when pastured. [7, 11, 16] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich.; N.J. to Man., s. to Fla., Tex. and Colo. [7, 21]

Description

General: Densely clumped, colonial perennial forming large, raised hummocks to 30" tall. Flower: Flowering stems arise laterally. Perigynia are beakless, flat, widest below the middle section of the body, and taper to the tip. Blooms from April to June. Leaf: Slender and green mature leaves, like the stems, are extremely rough on the edges. The flower stem has been reduced to bladeless sheaths on the lowest leaves. The reddish-brown basal sheaths disintegrate into 2 rows of fibers on each side of a central fiber (pinnate). Pincushion-like young shoots erupt in late summer, persist through winter, and grow quickly in early spring into a tuft of bright blue-green leaves.

Stem: Mostly triangular stems about 15-40" tall which usually exceed the leaves.

Fruit: Lenticular achenes. Root: Long, scaly rhizomes. Soil: Prefers wet-to-saturated peat and calcareous soils. [7, 11, 17]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions. [16, 21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Medium short -3 days (decreasing 6" the first day and a total of 6" the following 2 days). It will tolerate regular or seasonal water fluctuations, is moderately tolerant to flood duration and will increase in abundance as flood depth increases. [1, 23, 37]

Sensitivities or Other Tolerances

Exposure: Full to part sun. Salt: Unknown. Nutrient: Moderate.

Siltation: Moderate, 0-8 cm/year. **Insect:** Infrequent. **Other:** This species is acid tolerant and has a moderate rate of spread. It has moderate tolerance to general disturbance and stress. [1, 37]

Design Considerations

Tussock sedge is used in wetland restorations, and should be used in calcareous, sedge meadow, shrub-carr and peat situations. It may be used in shoreland restorations of lakes, ponds and streams, and has survived ditches. Persists in wetlands with relatively unaltered watershed land use and hydrology and the hummocks may persist for decades, even when grazed. It is attractive in landscape and water garden plantings due to its bunching form. **Concerns:** At times, this species has been overspecified in restorations due to its availability. [16]

Indicator Status: OBL



Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed grouse chicks) marsh birds, shorebirds, songbirds (swamp, tree, song and Lincoln sparrows; snow buntings; cardinals; larkspurs and redpolls) and most waterfowl. Sedges also provide food for moose, beaver, deer and muskrats. Stands of *Carex* in shallow water provide valuable spawning habitat. Sedges also provide valuable cover for ducks, and their tufted growths furnish concealment for other animals. [4, 32, 37, 44]





Nursery/Plant Information

Available: Widely. Types: Plants, roots and seeds.

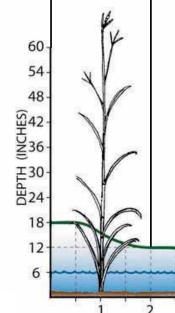
Planting Techniques

Tussock sedge germinates well when fresh seed is fall planted. If storing over winter, the seed should be moist, cold stratified and germinated with plenty of light. About 3,000,000 seeds/lb. Plant seedlings or plants in wet soils to 3" of water at a density of about 1,000 plants/acre. [16]

Additional Notes

DURATION (DAYS)

Water sedge (*C. aquatilis*) is very similar to tussock sedge. *C. aquatilis* lacks basal sheaths with 2 rows of fibers on each side of a central fiber; the flowering stems arise centrally; lowest leaves have blades; mature leaves tend to be blue-green; and stems do not form pincushion-like young shoots that persist through winter [11].



Carex vulpinoidea

Fox Sedge - a.k.a. Brown Fox Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet and moist meadows, marshes, lake shores, stream banks, roadsides and ditches (a pioneer species). [7, 11, 16] **Range:** Common; Minn. (Eco-Range: All), Wis., Mich. Nfld. to B.C., s. to Fla., Tex., Colo., Ariz. and Ore. [7, 21]

Description

General: Densely clumped, cool-season, perennial sedge that may reach 3' in height. **Flower:** Green, brown flower color resembling a fox's tail, blooms from May to July. Perigynia are lance-ovate and taper into a beak. **Leaf:** Generally longer than the stem, although the lowest stem leaves are reduced to scales (aphyllopodic). **Stem:** Slender, firm stems about 12-40" tall that have whitish, thin sheaths that are conspicuously cross-wrinkled. **Fruit:** Achene lenticular. **Root:** Short rootstocks. **Soil:** Wet soils of all types. [7, 8, 11, 44]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Medium long – 4 days (decreasing 6" the first day, 12" the second day, and a total of 6" the last 2 days). Fox sedge tolerates regular and seasonal inundation although it is not tolerant of extended periods of flooding. [1, 8, 37, 44]

Sensitivities or Other Tolerances

Exposure: Partial to full sun. **Salt:** Low to moderate. **Nutrient:** Moderate to high. **Siltation:** Moderate, 0-8 cm/year. **Insect:** Infrequent. **Other:** Fox sedge has a slow rate of spread and a moderate-to-high tolerance to general disturbance and stress. [1, 8, 37, 44]

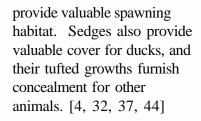
Design Considerations

Fox sedge is used in upper shoreline zones, streambank stabilization and vegetated swales. It is an excellent colonizer for wetland mitigation sites since it is a pioneer species that tends to revegetate wet, open sites soon after disturbance. It will do well in landscapes and rain gardens due to its clump form, tolerance to water fluctuation and slow rate of spread. The seedhead looks similar to a fox's tail. **Concerns:** Fox sedge may not be long lived if it is in areas of dense competition. [11, 16, 44]

Wildlife Use

Carex species are an essential food source for a wide variety of wildlife. The achenes are eaten by many birds, including rails (sora, yellow), grouse (especially ruffed grouse chicks) marsh birds, shorebirds, songbirds (swamp, tree, song and Lincoln sparrows; snow buntings, cardinals; larkspurs and redpolls) and most waterfowl. Sedges also provide food for moose, beaver, deer and muskrat. Stands of *Carex* in shallow water

Indicator Status: OBL



Nursery/Plant Information

Available: Widely.

Types: Seeds, rootstocks

and plants.

Planting Techniques:

Fox sedge establishes readily from seed, which can

be moist, cold stratified for later use or sown fresh in late fall. Seed needs high levels of light for germination. Seeding rate is 0.06-0.5 lb/acre with approximately 2,268,000 seeds/lb. Transplants should be planted from early spring to June 15 on 6-18" centers due to this species' slow rate of spread. Plant approximately 1,000 plants/acre. [16, 44]



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Celtis occidentalis

Hackberry - a.k.a. Sugarberry, Nettletree, Common Hackberry

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain and river valley (first terrace) forest species; lowland wet-to-mesic and upland mesic-dry drainage basins, wooded slopes and on high, rocky, limestone bluffs bordering streams and windbreaks. [17, 22, 36, 44] **Range:** Minn. (Eco-Region: 4-9), Wis., Mich. Extreme s. Ont., e. to N. England., s. to n. Ga., w. to nw. Okla., n. to N.D.; local in s. Que. and s. Man. [17, 21]

Description

General: A deciduous tree reaching heights of 50-75', widths of 50-75' and trunk diameters of 1½-3'. It usually has a rounded crown of spreading or slightly drooping branches, often deformed by bushy growths on the ends of the branches called "witches' brooms." Flower: Greenish yellow flowers from April to May, with both male and female flowers at base of young leaves in early spring. Leaf: Ovate, long, pointed leaves in 2 rows, usually sharply toothed, unequal-sided with a rounded base and 3 main veins. Shiny green and smooth above, often hairy on veins and paler beneath, turning yellow in autumn. Bark: Gray or light brown; smooth with conspicuous corky warts or ridges, becoming scaly. Twigs: Light brown, slender, mostly hairy, slightly zigzag. Fruit: Persistent small (¼-3/8"), orange-red to purplish berries that are 1-seeded drupes; dry and sweet; slender-stalked at leaf bases; maturing in autumn. Root: Deep, coarse, wide-spreading lateral roots. Soil: Sandy loam to silty clays with a pH range of 6.6-8.0. [17, 22, 36, 44]

Normal Water Level

Upland moist-to-dry soils and can tolerate limestone bluffs. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 60". **Duration:** Long – 5 days (decreasing 12"/day). Seedlings cannot tolerate submergence, yet mature trees can survive irregular or spring floods. A permanent high water table will stress the plant. Seedlings are somewhat tolerant, saplings are moderately tolerant and trees are tolerant to flood duration and flood depth increases. [1, 22, 37, 44]

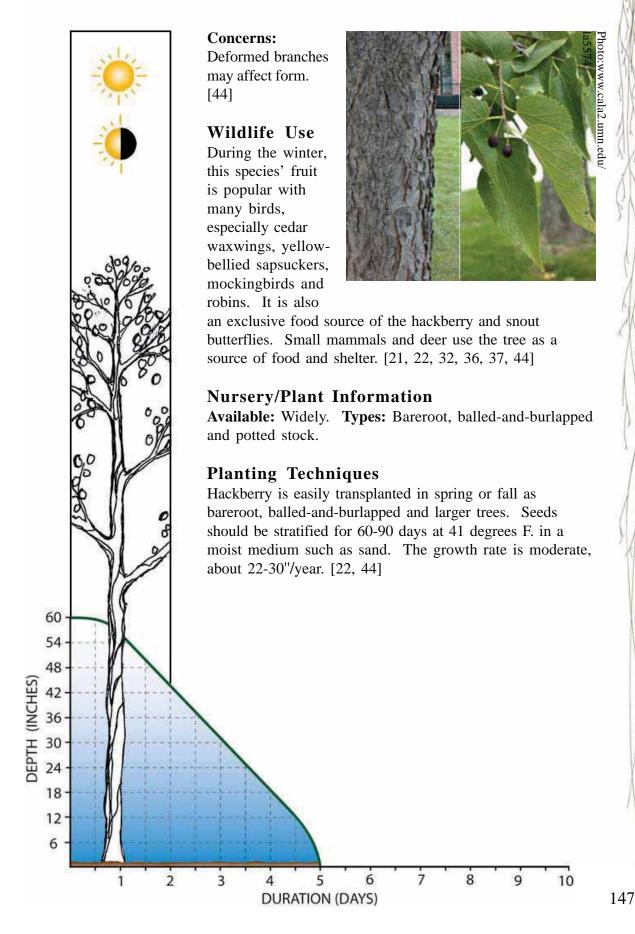
Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate to high. **Nutrient:** Low to moderate. **Siltation:** Low to moderate. **Insect:** Frequent – hackberry nipple gall, morning cloak butterfly, scales. **Other:** Hackberry is susceptible to witches' broom, powdery mildew and leaf spots. It is resistant to drought, heat, salt, akaline soils and mine spoils. It can be impacted occasionally by soil compaction and wind and ice damage. A good tree for dry, polluted conditions, it is moderately tolerant to general disturbance and stress. [1, 22, 25, 32, 37, 44]

Design Considerations

Hackberry is used in upper shoreline zones, stream bank stabilization, upland slope buffers and shelterbelts. It has been used well in polluted urban conditions and as a street tree. Hackberry is a hardy tree that can withstand many stresses.

Indicator Status: FAC-



Cephalanthus occidentalis

Buttonbush - a.k.a. Common Buttonbush, Honey-balls, Globe-flowers

Habitat/Plant Community and Geographic Range

Habitat/Community: Hardwood swamp, low alluvial woods, flood plain forest, thickets, stream banks, marshes, meadows, prairie sloughs and open bogs (often in standing water or muck). [7, 16, 22, 36] **Range:** Se. Minn. (Eco-Region: 6-8), wc. and s. Wis., LP of Mich. N.S., N.B. and Que. to s. Minn, s. to W. Indies and Mex. [7, 21]

Description

General: A spreading, aquatic shrub or sometimes small tree with many branches (often crooked and leaning) and an irregular crown. This shrub can form dense thickets 3-12' tall. Flower: White, tubular flowers collectively forming globose balls from June to August. Leaf: Opposite or 3 at a node (whorled), ovate, pointed at the tip, rounded at the base; without teeth. Paler and sometimes hairy beneath and shiny green above. Bark: Gray or brown; becoming deeply furrowed into rough, scaly ridges. Twigs: Mostly in 3s; reddish-brown, stout, sometimes hairy, with rings at nodes. Fruit: Button-like balls of fruit ¾-1" in diameter, each 2-seeded and maturing in autumn. Root: Fibrous, shallow, lateral roots. Soil: The pH range is 6.0-8.5. Tolerates most soils although it prefers lowland wet, wet-mesic, moist peat, and low alluvial woodland types. [7, 22, 36, 44]

Normal Water Level

Although it will grow in drier areas, this species prefers shallow water of 2-3' of inundation or less to wet/saturated conditions. [6, 21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 24". **Duration:** Long – 45+ days (12" in 3 days and 12" for possibly 45 more days). Seedlings that are 10" tall or less can survive complete submergence for up to 45 days in 18" or less of water. This species will tolerate regular, irregular and seasonal flooding of up to 3" and will tolerate increases in flood depth. [1, 13, 22, 37, 44]

Sensitivities or Other Tolerances

Exposure: Partial to full sun. Will tolerate full shade but may decline. **Salt:** Moderate to high (will tolerate salty soil and water). **Nutrient:** Moderate, although low for seedlings. **Siltation:** Moderate. **Insect:** Infrequent – San Jose scale can be troublesome. **Other:** Buttonbush is damaged infrequently by wind and ice. It is sensitive to drought and heat, though resistant to alkaline soils and soil compaction. It has a moderate-to-low tolerance to general disturbance and stress. [1, 6, 13, 22, 25, 37, 44]

Design Considerations

Buttonbush has been used in stream bank stabilization and in upper and lower shoreline zones. It is a nice landscape plant if allowed to be aggressive and soil moisture is maintained. A good plant for wetland restorations, especially in flood plain forests, meadows, thickets and stream banks. **Concerns:** This species can be very

Indicator Status: OBL

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aggressive and may form monocultures, this may be a desirable trait if invasive species are a threat. [16, 44]

Wildlife Use

Buttonbush provides a good nectar source and

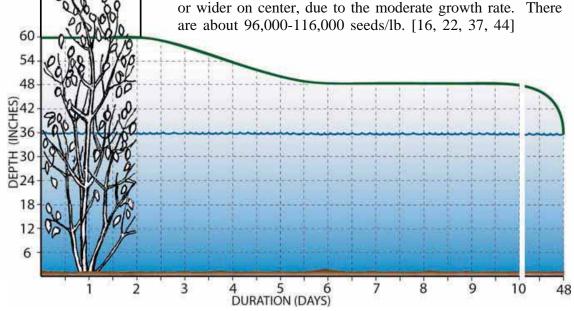
habitat for insects and hummingbirds. Waterfowl (mallard, widgeon, shoveller, wood duck, teals) are the principal users of its seeds, although they may be eaten also by insects, beaver and muskrats. Deer, muskrats and beaver browse it. It provides habitat for birds and reptiles. The leaves are poisonous to humans and unpalatable to livestock. [6, 22, 32, 36, 37, 44]

Nursery/Plant Information

Available: Widely. **Types:** Seed and bareroot and potted stock.

Planting Techniques

Seeds are best germinated in plenty of light on wet mudflats and shorelines. Seeds can be collected August to September and stored in fresh water at 34 degrees F. if they are not planted immediately. This species sprouts easily from cuttings and should be rooted prior to flooding. Plants transplant well in all forms and should be spaced 5' or wider on center, due to the moderate growth rate. There are about 96,000-116,000 seeds/lb. [16, 22, 37, 44]



Chamerion angustifolium

Fireweed - a.k.a. Great Willow Herb or Willow Herb

Habitat/Plant Community and Geographic Range

Habitat/Community: Open and brushy uplands, woodlands, forest edge and clear cuts, burned areas and common along roadsides. Fireweed grows individually in disturbed soils or in large masses after the wind disperses its seeds into burned areas. [17, 35, 41] **Range:** Mostly e. and n. Minn. (Eco-Region: 1-8), n. 2/3 of Wis. Circumboreal, s. to N.J., Ohio, n. Ill. (where it is rare), Neb. and N.M. [16, 17, 21]

Description

General: Stately, native, northwoods perennial that grows 2-4' tall. A couple of plants will spread to form a large stand. Flower: A 6-12"-long tapering spike of rose-purple flowers. Individual flowers, 1" wide with 4 oval petals, open individually from the bottom of the spike from June to August. Leaf: Narrow, elongate, alternate leaves, faintly toothed, willow-like, that grow up to 8" long. Stem: Erect, usually reddish. Fruit: Slender, pods up to 3" long that open from the top downward. The seeds are wind borne by their tufts of hairs. Root: Coarse, running, rhizome-like roots. Soil: Disturbed, wet-to-moist soils associated with woodlands and roadsides, although it prefers moist soils rich in humus. Often abundant after fires. [17, 35, 41]

Normal Water Level

This species prefers upland moist to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short -2 days (decreasing 6"/day). This species is somewhat tolerant to flood duration and will decrease in abundance as flood depth increases. [1]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Moderate with increases in abundance with N increases. **Siltation:** N/A. **Insect:** Infrequent. **Other:** This species has a moderately low tolerance to general disturbance. It increases with fire. [1, 47]

Design Considerations

Fireweed is used as an early successional species after a major disturbance, such as fire, restorations and heavy construction in the northern woodlands. It has wildlife use, especially for birds and insects. **Concerns:** Although it is preferable to other invasive, non-native species, fireweed can be very aggressive and may invade sites of forest fires, often becoming the most conspicuous plant. [16, 35]

Wildlife Use

Mice, deer and moose use this species. It is a good nectar source for many species of butterflies, bees and insects and an excellent source of nectar for hummingbirds. [21, 41]

Indicator Status: FAC



Nursery/Plant Information

Available: Fairly. **Types:** Plants commercially.

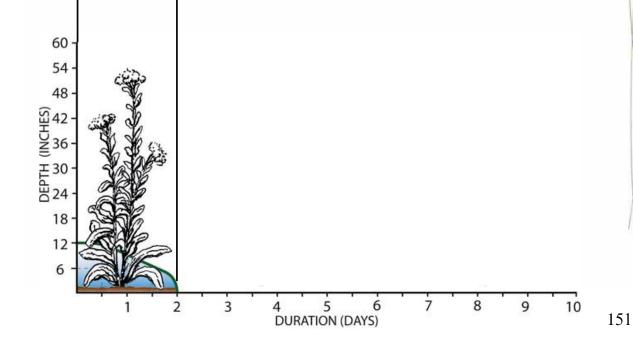
Planting Techniques

This species is easily germinated in fall planting with exposure to light. Plants may also be divided. If storing seed, moist, cold stratification is the preferred method. Approximately 10,400,000 seeds/lb. [16]



Additional Notes

Fireweed is often one of the first species to colonize newly exposed areas, especially after a fire, hence its common name. [35, 41]



Chelone glabra

Turtlehead - a.k.a. White Turtlehead, Snake-head

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamp openings, thickets, stream banks, shores, wet meadows, marshes, peatlands and calcareous fens. [7, 16, 35, 41] **Range:** Nc. and e. Minn. (Eco-Region: 1-3, 5-9), Wis., Mich. Nfld. to Minn., s. to Ga. and Ala. [7, 21]

Description

General: Robust perennial herb that is 1-3" tall, and often grows as a single stem topped with a cluster of large, white flowers. Flower: It has spikes of white (sometimes lavender) flowers that are 2-lipped and 1-1½" long. The shape of the flower suggests the head of a turtle. Blooms from July to October. Leaf: Narrow, opposite, elongate (½-1" wide and 3-6" long), glossy, dark green and coarsely toothed. Stem: Bluntly angled stems are often clumped. Fruit: Seeds flat, suborbicular, with a broad wing. Root: Fibrous, deep. Soil: Wet-to-moist soils of many types, although it prefers calcareous soils and peat. [7, 35, 41]

Normal Water Level

This species prefers shallow water of 3" of inundation or less to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 9". **Duration:** Short -2 days (decreasing 6" the first day and 3" the second). This species has a moderate tolerance to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Unknown. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderate-to-low tolerance to general disturbance and stress. [1,47]

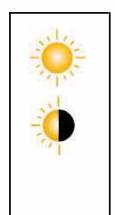
Design Considerations:

Turtlehead is widely known as a landscape plant for mesic to wet gardens. It is also well suited for wetland restorations, rain gardens, and lake-edge restorations, especially in calcareous and peaty conditions. It is suited for cutflowers and is a butterfly host. **Concerns:** Loss of habitat has made turtlehead less common. Many cultivars have been produced that may be mistakenly used in wetland restorations. [16, 41]

Wildlife Use

This species is a host plant for the very rare Baltimore butterfly as well as other butterfly larvae and insects. It attracts hummingbirds. With the decline of turtlehead habitat, the baltimore butterfly is losing its host. [21, 41]

Indicator Status: OBL



Nursery/Plant Information Available: Widely.

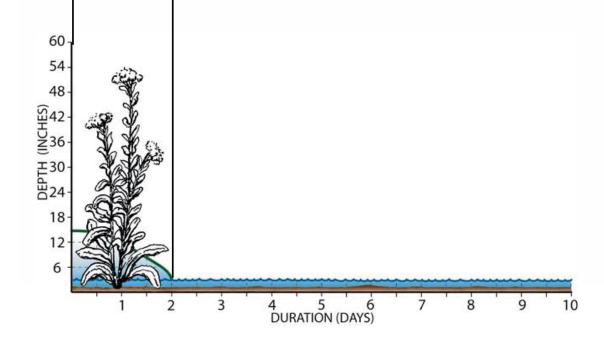
Types: Plants.

Planting Techniques

Seeding has been somewhat successful, but plugs and seedlings have been more so. Seeds need to be moist, cold stratified for 120 days if stored and require light for germination. Fresh seed can be planted and once a plant is established, self-sowing continues. Stem



cuttings and dividing plants work well. White turtlehead produces about 1,008,000 seeds/lb. [16]



Comarum palustre

Marsh Cinquefoil - a.k.a. Purple Marshlocks

Habitat/Plant Community and Geographic Range

Habitat/Community: Open bogs (especially in pools and wet margins), conifer swamps and shores, sometimes with the lower parts growing in water. [17, 35] **Range:** All but extreme w. and s. Minn. (Eco-Region: 1-3, 5-6, 8), all but sw. Wis., Mich. Circumpolar subarctic, Greenland and Labr. to Alaska, s. to N.J., Ohio, Iowa, N.D., Wyo. and Calif. [17]

Description

General: Erect, reddish, native, perennial herb. Flower: Ends in a loose cluster of single or paired flowers from leaf axils. The sepals are dark red or purple, ovate to lance-shaped, ¼-¾" long, with 5 petals (sometimes 10) with a short, slender tip and 25 dark-red stamens. Leaf: Pinnately divided compound leaves all from the stem, with 3-7 leaflets. The leaflets are oblong to oval, 1-4" wide, mostly rounded at the tip. The leaf has a waxy underside with sharp, forward-pointed margins. The lower leaves are long petioled, while the upper leaves are nearly stalkless, with stipules forming wings around the petioles of the lower leaves, becoming shorter upward. Stem: Woody base stem 12-30" long, ascending to sprawling or floating in shallow water, often rooting at the nodes. The lower stems are smooth, while the upper stems are sparsely hairy. Fruit: Smooth, red-to-brown achenes are attached to the enlarged, spongy receptacle, from June to August. Root: Long, stout rhizomes. [17, 35]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions. [35]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Short – 2 days (decreasing 6"/day). This species is moderately tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. Salt: Moderate. Nutrient: Moderate.

Siltation: Unknown. **Insect:** Infrequent. **Other:** This species has a moderately low tolerance to general disturbance and a moderate tolerance to iron concentrations. [1, 47]

Design Considerations

Marsh cinquefoil is recommended for bog, conifer swamps and shores in shallow water or saturated soils.

Wildlife Use

Grouse and woodcock eat the seeds and foliage. [32]

Nursery/Plant Information

Available: Not available.



Cornus amomum

Silky Dogwood - a.k.a. C. obliqua

Habitat/Plant Community and Geographic Range

Habitat/Community: Conifer swamps, floodplain depressions, ox-bows, low alluvial woods, wet thickets, marshes, springs, meadows, open bogs, calcareous fens, lake shores, stream banks and wet dunes. Silky dogwood is not as common as red-osier dogwood (*C. sericea*) in shrub-carrs. [7, 11, 22] **Range:** Common; se. Minn. (Eco-Region: 5-9), c. and s. Wis., LP of Mich. (occasional in s. UP). Me. and Que. to Minn., s. to Ga., Ala., Ark. and Okla. [7, 21]

Description

General: An erect, deciduous shrub that forms a dense cluster of stems usually 6-12' high and wide. Flower: Our latest-flowering dogwood. The inflorescence is an open cyme with white flowers that bloom from May to July. Leaf: Opposite, ovate-to-elliptic, and 2-3/8 to 4¾" long with 4 to 6 pairs of lateral veins. The leaves are dark green on top and silky underneath. Stem: Brownish stems and reddish-purple bark. Twigs: Magenta with fine hairs and brown pith. Fruit: Mature berry is dark blue; the immature fruit may be white to bluish white. Root: Fibrous, shallow lateral roots. Soil: Tolerates most soils. [7, 11, 22]

Normal Water Level

This species prefers moist-to-wet/saturated conditions although it is tolerant of more upland conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 36". **Duration:** Long -30+ days (decreasing 24" in 4 days and then 12" in the next 30 days). This species can tolerate seasonal and irregular flooding and is moderately to somewhat tolerant to flood duration. [1, 8, 22, 37]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Infrequent – borers, scales, dogwood club-gall and leaf miner can be minor problems. **Other:** Infrequent damage from ice and wind, though sensitive to 2,4-D, lighting, drought and heat. Silky dogwood is resistant to soil compaction. It has a moderate-to-high tolerance to general disturbance and stress. [1, 8, 22, 37]

Design Considerations

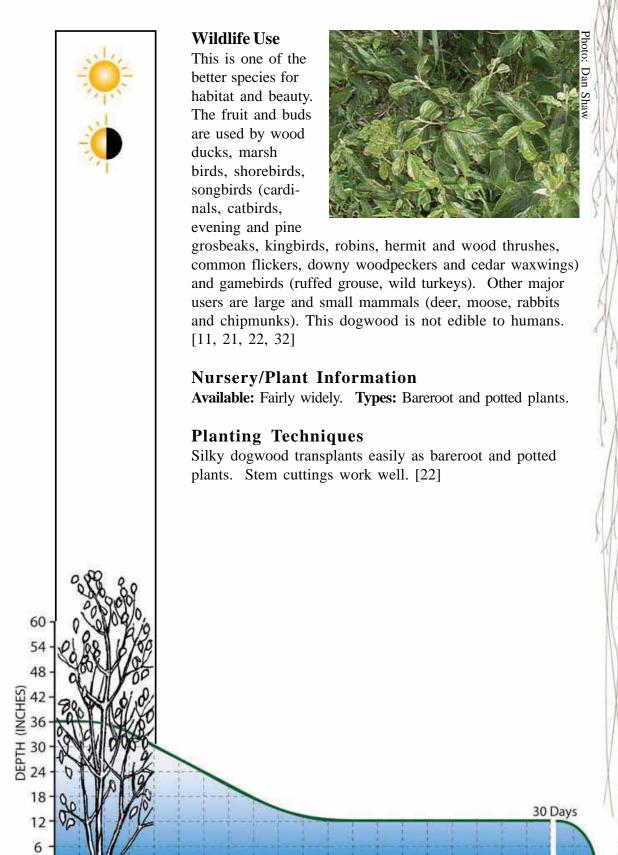
Silky dogwood has been used often for wildlife cover and in restorations. It is well suited for stream bank stabilization and for shrubby thickets adjacent to wooded swamps. Other restorations that it would be well suited for are calcareous fens, lake shores, marshes and wet dunes. This species should be considered In landscaping situations and for rain gardens with low-salt conditions. Concerns: Stressed by drought conditions. [11]

Indicator Status: FACW+

10

30

157



DURATION (DAYS)

Cornus racemosa

Gray Dogwood - a.k.a. C. foemina, C. paniculata, C. foemina racemosa

Habitat/Plant Community and Geographic Range

Habitat/Community: Lake shores, stream banks, swamps, thickets, marshes, low prairies, savannas and moist woods (open alluvial woods, rocky wooded hilltops, wood's edge, fence row, rocky ledges, limestone outcrops, glades, oak woods). [7, 16, 22] **Range:** Common; all but far ne. Minn (Eco-Range: 1, 3-9), local in nc. Wis., LP and occasional in c. and e. UP of Mich. Me. and s. Que. to s. Man., s. to Va., s. Ill. and Mo. [7, 21]

Description

General: Gray dogwood is a widely adapted, multistemmed shrub that forms large, upright, branching stands that may reach heights of 12'. Flower: Showy white flower clusters in May to July. Leaf: Lanceolate-to-elliptic leaves that are 1½ to 3-1/8", abruptly acuminate, often whitened beneath, with 3-4 lateral veins to a side. Good purple-red fall color. Bark: Old bark mostly smooth and gray, pith white or tan. Twigs: Glabrous, at first green, soon becoming tan and eventually gray-brown. Fruit: Excellent production of berries that are white, August to September. Root: Fibrous, shallow lateral roots; suckers profusely, forming large colonies. Soil: Wet-mesic, mesic-dry, dry soil gradient with a pH range of 5.5-8.5, will tolerate most soils. [7, 22, 44]

Normal Water Level

This species prefers moist/saturated-to-dry conditions, although it persists on unfavorable sites. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 6". **Duration:** Short – 2 days (decreasing 3"/day). This species will tolerate seasonal and irregular inundation of 2-4" of short duration and will decrease in abundance with flood depth decreases. [1, 22, 37, 44]

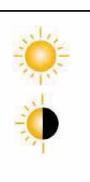
Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Moderate to high. **Siltation:** Moderate to high. **Insect:** Infrequent; none serious. **Other:** Gray dogwood is sensitive to 2,4-D, salt and lighting. It has some resistance to O₃, wind/ice damage and soil compaction. Gray dogwood is resistant to drought, heat, alkaline soils and mine spoils. It has a high tolerance to general disturbance and stress. [1, 2, 10, 16, 22, 25, 37, 44]

Design Considerations

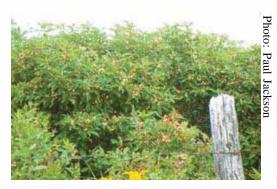
Gray dogwood is commonly used in restorations or revegetation sites and is often allowed to form thickets. It has been used in slopes, buffers, fence rows, stream bank stabilization, lake edges, and upper shoreline zones. It will increases and become denser with disturbance. **Concerns:** This species suckers and forms thickets that will invade surrounding area and become aggressive. This may be a strategy to inhibit other species that invade, such as buckthorn and honeysuckle. [16, 44]

Indicator Status: FACW-



Wildlife Use

This is one of the better species for habitat and beauty. The flowers attract the common blue butterfly. The fruit and buds are particularly used by wood ducks, marsh birds, shorebirds, songbirds (cardinals, catbirds, evening and pine grosbeaks, kingbirds, robins, hermit and wood thrushes, common flickers, downy





woodpeckers and cedar waxwings), and game birds (ruffed grouse, pheasants and wild turkeys). Other major users are large and small mammals (deer, moose, rabbits, beavers, woodchucks, raccoons, squirrels and chipmunks). This dogwood is not edible to humans. [21, 22, 32, 37, 44]

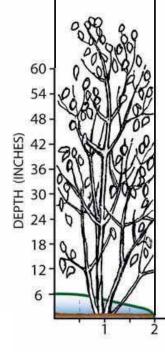
Nursery/Plant Information

DURATION (DAYS)

Available: Widely. Types: Bareroot and potted stock.

Planting Techniques

The seeds germinate readily if they are scarified. The roots sucker well and will spread quickly. Cuttings also root easily and grow rapidly. About 12,100 seeds/lb. [16, 22, 44]



Cornus sericea

Red-osier Dogwood - a.k.a. C. stolonifera - Red Osier, Redosier or Red-twigged Dogwood; Kinnikinnik

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamps, marshes, shores, stream banks, flood plain forests, sedge meadows, wet to wet-mesic prairies, calcareous fens, shrub thickets and sand dunes. It is a characteristic shrub of shrub-carrs. It may form dense thickets and may invade nonwooded areas in response to water level changes. [7, 11, 16, 22, 36] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. Nfld. to Alaska, s. to Pa., Ill., Neb. and n. Mex. [7, 21]

Description

General: Many-stemmed, erect, deciduous shrub, 6-12' tall, forming thickets. **Flower:** Flat-topped clusters of small, creamy white flowers from May to August. **Leaf:** Lanceolate to ovate, without teeth, 1½-3½" long with 5-7 pairs of lateral veins. The leaves are dull green above, whitish green and covered with fine hairs beneath, and turn reddish in autumn. **Bark:** Gray or brown, smooth or slightly furrowed into flat plates. **Twigs:** Reddish to bright red, hairy when young, then lack hairs with rings at nodes. **Fruit:** A cluster of white, juicy, berry-like drupes with 2 seeds; April to November. **Root:** Fibrous shallow lateral roots, stoloniferous. **Soil:** Lowland wet water gradient with a pH range of 5.5-8.5. Will tolerate many soil types, including calcareous and peat. [7, 8, 11, 22, 36, 44]

Normal Water Level

This species prefers mesic to wet/saturated conditions. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 36". **Duration:** Long -30+ days (12" every 2 days until the last 12", which may last up to 30 days). It tolerates constant inundation during early spring better than during the growing season, although it will tolerate seasonal and irregular fluctuations. [1, 8, 11, 22, 37, 44]

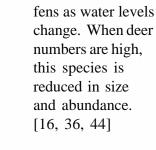
Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Moderate to high. **Siltation:** Moderate to high. **Insect:** Occasional – scale, bagworms, other insects. **Other:** Red-osier dogwood spreads slowly by stolons. It is tolerant to drought, heat, alkaline soils and soil compaction, although it is intolerant to 2,4-D, O₃ and lighting. It is also tolerant of oil/grease and metals. It may handle SO₂, wind and ice damage. It has a moderate tolerance to general disturbance and stress. [1, 2, 8, 10, 22, 25, 37, 44]

Design Considerations

Red-osier dogwood is specified in many plans for restorations, buffers, screens, erosion control, stream bank stabilization and landscaping. It will work well in rain gardens and other water-fluctuation situations. It provides habitat for wildlife and beauty to landscapes. Overall a good plant in many designs. **Concerns:** There are many cultivars and varieties. It may invade sedge meadows, prairies and calcareous

Indicator Status: FACW





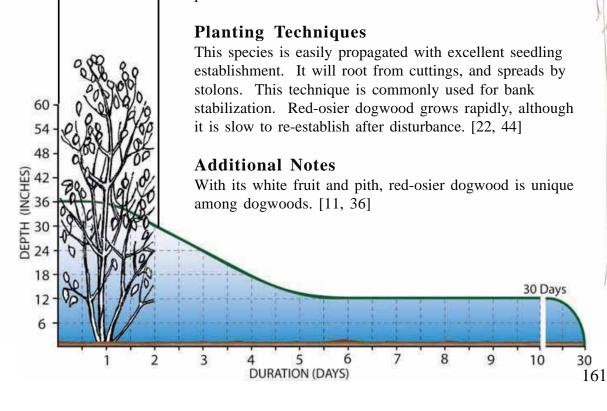
Wildlife Use

This is one of the better species for

habitat and beauty. The flowers attract common blue butterflies. The fruit and buds are used particularly by wood ducks, marsh birds, shorebirds, songbirds (cardinals, catbirds, evening and pine grosbeaks, kingbirds, robins, hermit and wood thrushes, common flickers, downy woodpeckers and cedar waxwings), and gamebirds (ruffed grouse, pheasants and wild turkeys). Other major users are large and small mammals (deer, moose, rabbits, beavers, woodchucks, raccoons, squirrels and chipmunks). It provides excellent warbler and American goldfinch habitat. Its fruit is not edible to humans. [7, 11, 21, 22, 32, 37, 44]

Nursery/Plant Information

Available: Widely. **Types:** Bareroot and balled-and-burlapped plants.



Eleocharis obtusa

Blunt Spikerush - a.k.a. Eleocharis ovata - Blunt Spike Rush

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet, sandy or muddy shores, marshes, ditches, mud flats, disturbed artificial wetlands and temporary ponds. Commonly found in disturbed, saturated soils, such as those of farmed wetlands and wetland creation or restoration sites. [7, 11, 16, 44] **Range:** Mostly ne. and ec. Minn (Eco-Region: 5-9), n. Wis., local in w. UP and far n. LP of Mich. Widespread over much of N. Amer. and Eurasia. [7, 21]

Description

General: A densely tufted, herbaceous annual that is hardy and reaches 12-20". **Flower:** Brown, from June to October in ovoid spikelets. **Stem:** The soft stems have sheaths that are oblique at the apex. **Fruit:** Lens-shaped achene with a triangular cap (the tubercle) that is a different color and texture than the body of the achene. Bristles subtending the achene usually number 6-7 and are as long or longer than the achene. **Root:** Fibrous. **Soil:** Wet sandy or muddy soils. [7, 11, 24, 44]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Long – 30 days (decreasing 6"/day for 2 days, then the last 6" over 28 days). Blunt spikerush will tolerate regular flooding to 6" of water. Continuous flooding of 15" or more or increases in flood depth can kill it. It has a moderate tolerance to flood duration. [1, 24, 26, 37, 44]

Sensitivities or Other Tolerances

Exposure: Prefers full sun. **Salt:** Low to moderate. **Nutrient:** Moderate to high and unaffected by P increases. **Siltation:** Low. **Insect:** Infrequent. **Other:** Spikerush has a high metal uptake and a moderate tolerance to general disturbance and stress. [1, 6, 24, 37, 44]

Design Considerations

Blunt spikerush is commonly found in disturbed, saturated soils, such as farmed or created wetlands and restoration sites. It is used in stream bank stabilization, mud flat revegetation, vegetated swales and in calcareous situations. A good plant to add to many restorations, and may come from the seedbank. **Concerns:** May decline with increased competition. [16, 26, 44]

Wildlife Use

Waterfowl (coots, black ducks, mallards, pintails, ring-necked ducks and teal; blue, snow and Canada geese; and swans) eat the rhizomes and achenes of this plant. The achenes are also eaten by sora and Virginia rails. Prairie voles, muskrats and rabbits eat the plant and achenes. [24, 32, 37, 44]

Indicator Status: OBL Nursery/Plant Information Available: Widely. **Types:** Mainly seeds. **Planting Techniques** Blunt spikerush is an annual that spreads by seed where there is little to no competition. It requires a drawdown to germinate or spread on mud flats. Seed at a rate of 0.02-0.4 lb/acre. This species also does well from the seedbank. [16, 26, 44] 60 54 48 OEPTH (INCHES) 18 30 Days 12 4 5 6 DURATION (DAYS) 2 10 30 163

Elymus virginicus

Virginia Wild Rye - a.k.a. Virginia Wildrye, Terrell-grass

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forests, wet savannas, mesic woodlands, thickets and stream banks. [7, 16] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. Nfld. to Alta., s. to Fla. and Ariz. [7, 21]

Description

General: A short-lived, cool-season perennial grass that clumps and reaches heights up to 3'. **Flower:** Tan color from June to October. The awn is less than 3 cm long. **Leaf:** Flat, 3/8-9/16" wide, rough to the touch on both sides, with smooth sheaths. **Stem:** 24-48" long. **Fruit:** A caryopsis. **Root:** Rhizomes. **Soil:** Moist soil in many types. [7, 17, 44]

Normal Water Level

This species prefers upland moist to wet/saturated conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 36". **Duration:** Long – 15 days (decreasing 12"/day for first 2 days, then 6" on day 3 and last 6" over 15 days). It will tolerate dry soils as well. [44]

Sensitivities or Other Tolerances

Exposure: Partial to full sun. **Salt:** Moderate. **Nutrient:** Moderate.

Siltation: Moderate. Insect: Infrequent. Other: This species has a moderate

tolerance to general disturbance and stress. [1, 44, 47]

Design Considerations

Virginia wild rye is used mostly as a forage and haying species. It is also used along stream banks for stabilization, slope buffers, vegetated swales and in floodplain forest or savanna areas. It is a good landscape plant and dries well for arrangements. Consider it for many types of wetland restorations. **Concerns:** This species can become aggressive if it is seeded too heavily. [16, 44]

Wildlife Use

Virginia wild rye is grazed and is palatable for many browsers as well as blackbirds and quail. [32, 44]

Nursery/Plant Information

Available: Widely. Types: Plants and seed.

Planting Techniques:

Seeding is best done in spring or fall. Recommended rates are 0.06-1.0 lb/acre. Over seeding can be a problem. Approximately 73,000 seeds/lb. [16, 44]



Equisetum fluviatile

Horsetail - a.k.a. Water-horsetail, Swamp Horsetail, Pewterwort, Joint Rush

Habitat/Plant Community and Geographic Range

Habitat/Community: In standing water of marshes, muddy shores, bogs, lake edges, ponds, peatlands, ditches and swales. [4, 7, 17] **Range:** All but sw. Minn. (Eco-Region: 1-8), common in Wis., Mich. Circumboreal, s. to Pa., W.V., Ohio, n. Ill., Iowa, Nebr., nw. Mont. and Ore. [7, 21]

Description

General: A rhizomatous perennial with annual stems which, like other horsetails, grows in large beds. A dark-green, leafless plant, growing to 3'. Sterile and fertile stems look alike, except fertile stems produce a terminal cone. Leaf: Leaves reduced to a toothed membrane that encircles the stem at each node. The 15-20 pointed teeth are dark brown to black with a pale margin. Stem: Hollow, jointed stems that may branch and are ridged and stiff, with a high silica content. A central cavity takes up about 80% of the stem's diameter. Each stem is jointed and can be pulled apart, making a snapping sound, like popping bubble wrap. Depending on growing conditions, branching may occur at the nodes. Fruit: Oval cone that produces spores which will germinate on moist soil. Root: Emerges from a buried rhizome. Soil: Muddy to peaty soils preferred in standing water. [4, 7, 17]

Normal Water Level

This species prefers deep water of 3' of inundation or less to wet/saturated conditions. [4, 7, 21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Long – 10 days (decreasing 2.5"/day). This species has a moderate tolerance to flood event duration, although it is very tolerant to depth increases. [1]

Sensitivities or Other Tolerances

Exposure: Full sun to part shade. **Salt:** Low to moderate. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderate-to-low tolerance to general disturbance and stress. [1, 47]

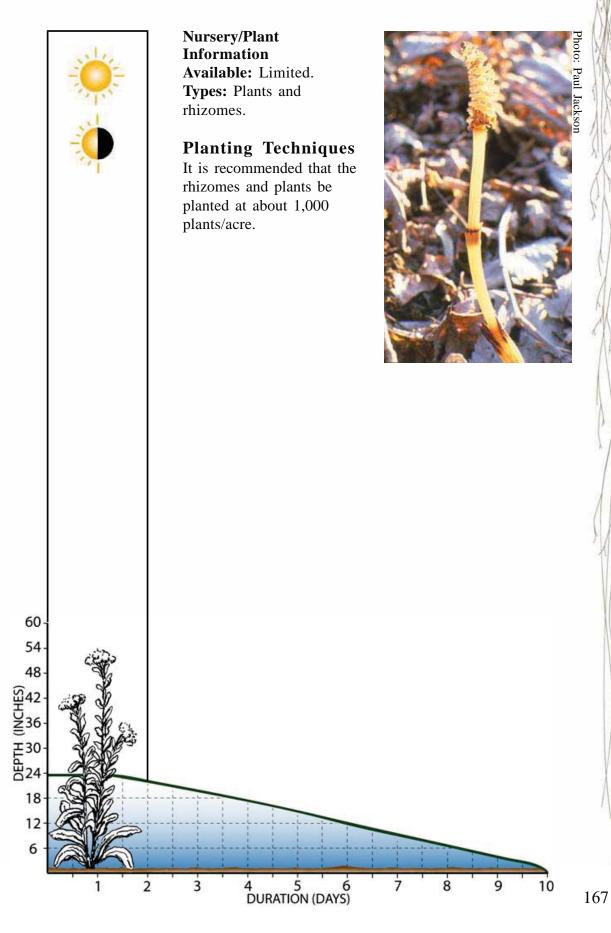
Design Considerations

Even though common horsetail regrows from the rhizomes each year, it will work well in restorations in peat soils, muddy shores, ponds and mud flats. It provides good habitat for fish and other animals. **Concerns:** May produce large, monotypic beds. [4]

Wildlife Use

Common horsetail provides good fish cover and habitat, food for geese and is grazed by ruffed grouse and moose. Research in Alaska has shown that it is a primary food source for trumpeter swans, dominating the diet of both adult and young swans. [4, 21, 32]

Indicator Status: OBL



Eryngium yuccifolium

Rattlesnake Master - a.k.a. Rattlesnake-master, Button Snakeroot

Habitat/Plant Community and Geographic Range

Habitat/Community: Mesic and dry, sandy soils of open woods, prairies and savannas. [16, 17] **Range:** Nw., c. and s. Minn. (Eco-Region: 3-5, 7-9), Wis. and Mich. S. USA, n. to Va., Ind., Minn. and Kan., and occasionally farther north. **Special concern species in Minn., endangered in Mich.** [17]

Description

General: Rattlesnake master's appearance is reminiscent of the Southwest's yucca. This coarse, spiny, erect perennial stands 28-42" tall. Flower: Composed of dense heads, each head subtended by a bract, each flower by a bractlet. Heads round-ovoid; white-to-lilac blooms from July to September. Leaf: Linear, very elongate, parallel-veined leaves that are whitish with bristly outer edges. The upper leaves gradually reduce. Stem: Usually simple to the inflorescence. Fruit: Round, scaly and about 1" in diameter. Root: Fascicled roots. Soil: Prefers wet-to-dry sandy soil in uplands. [17]

Normal Water Level

This species prefers mesic to dry upland conditions.

Flooding/Fluctuation Tolerances

Frequency: Moderate. Depth: 12". Duration: Short -2 days (decreasing 6"/day). It will tolerate drought and heat.

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Low. **Siltation:** Low. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

A beautiful, distinctive plant that is ideal for landscapes as a contrast or background plant. The flowers may be dried for arrangements. It is a butterfly magnet and is a tough fast grower for restorations, rain garden edges, and upland buffers. It is an early successional species. **Concerns:** Rattlesnake master is an endangered or special concern species in Minnesota and Michigan. Cultivars are starting to be produced. [16]

Wildlife Use

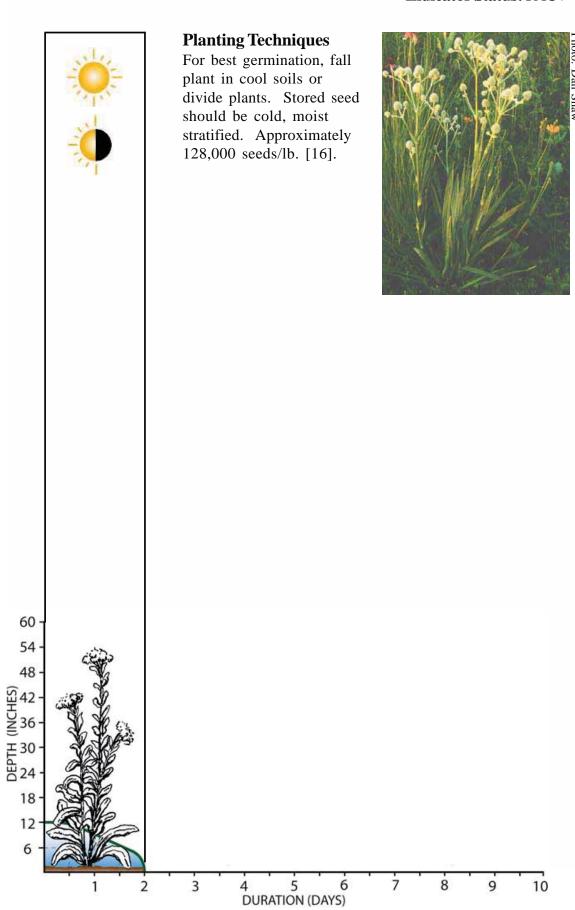
It is a butterfly host plant and a bee and butterfly magnet.

Nursery/Plant Information

Available: Widely. Types: Plants and seed.

Indicator Status: FAC+

169



Eupatorium perfoliatum

Boneset - a.k.a. Common Boneset, Indian Sage

Habitat/Plant Community and Geographic Range

Habitat/Community: Marshes, wet meadows, sedge meadows, low prairies, prairie swales, shores, stream banks, ditches, cedar swamps, thickets and calcareous fens. Often occurring with Joe-pye-weed (*Eutrochium maculatum*). It is often associated with groundwater seepages and tends to be a pioneer species. [7, 11, 16, 35, 41, 44] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. N.S. and Que. to se. Man., s. to Fla. and Tex. [7, 21]

Description

General: Coarse, hairy, native, perennial herb that may reach heights of 2-3'. **Flower:** Conspicuous, flattish cluster of small, flowerheads that lack ray flowers. 9-23 white disc flowers occur in each head; individual flowers are ¹/₄" in diameter and give a fuzzy appearance. **Leaf:** Opposite, elongate, wrinkly, leaves 4-8" long, join at the base (perfoliate) so that the stem appears to grow through the leaves. Leaves are covered in fine, whitish hair. **Stem:** Stems are coarsely hairy. **Fruit:** Achenes prismatic, mostly 5-angled and nerved. **Root:** Fibrous. **Soil:** Prefers moist or wet low grounds of rich loam or calcareous soils. [7, 11, 35, 41, 44]

Normal Water Level

This species prefers wet/saturated-to-moist conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Medium long – 3.5 days (decreasing 6" the first half day and then 6"/day after that). This species has a moderate tolerance to flood duration and is unaffected by increases in flood depth. [1, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low to moderate. **Siltation:** Low to moderate. **Insect:** Infrequent. **Other:** This species has a moderate-to-high tolerance to general disturbance and stress. [1, 44, 47]

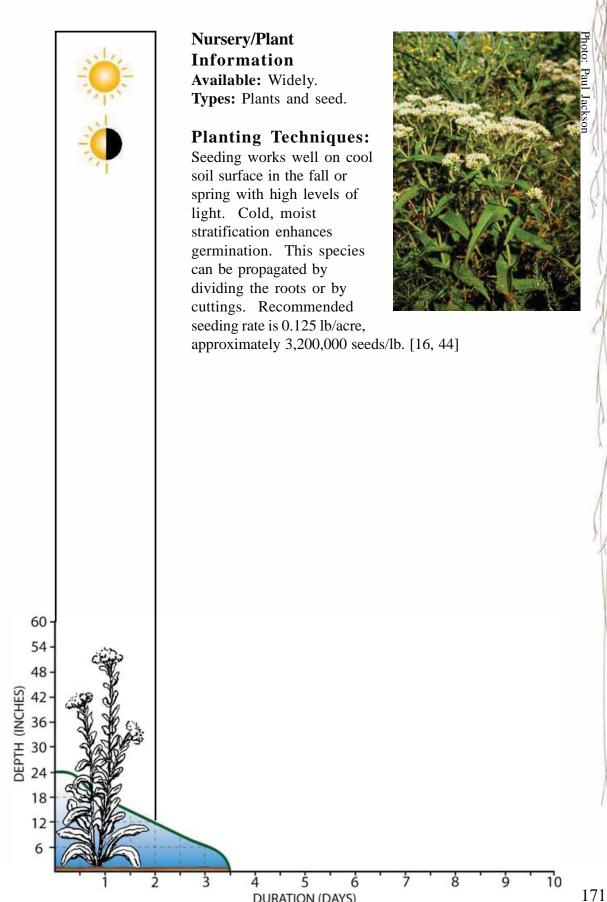
Design Considerations

Similar to Joe-pye-weed, boneset is used in restorations, vegetated swales, shorelines, and is used to bind soil with its fibrous root system to resist erosion. It is a good habitat provider and groundcover. Flower color is not brilliant in gardens but the 2-3' plant has an interesting texture. Consideration should be given for this plant in rain gardens, lake edges and other landscape designs. **Concerns:** Leaves are often eaten by insects. [16, 44]

Wildlife Use

Boneset is an excellent nectar provider for bronze copper, monarch, crescent and fritillary butterflies. Turkeys, swamp sparrows and some waterfowl eat the achenes. Mallards and ruffed grouse eat the leaves. It also provides cover for small mammals, reptiles and amphibians. [21, 32, 41, 44]

Indicator Status: FACW+



DURATION (DAYS)

Eurybia macrophylla

Bigleaf Aster - a.k.a Large Leaf Aster

Habitat/Plant Community and Geographic Range

Habitat/Community: One of the more common asters found in northern forests, a common groundcover in dry, shady savannas, woodlands and forests. May form a ground cover. [17, 35, 41] **Range:** Throughout northern upland forests of Minn. (Eco-Region: 1, 2, 5–8), Wis., Mich. N.S., N.B. and Que. to Wis., Minn. and se. Man., s. to Pa. and Ky., and in the mountains of Ga. [17, 21]

Description

General: Native perennial, with a height of 8-18". Only a few plants send up flower stalks each year. **Flower:** Influorescence is a loose cluster of lilac-to-purple flowers with yellow anthers that turn red with age. Blooms from Aug. to Oct. **Leaf:** Basal leaves are broad heart-shaped; coarsely toothed and rough to the touch, 4-8" long, that are deeply notched where they attach to the stalk. **Stem:** Long flowering stems, 1-2' tall, which are sticky to the touch because of miniature glands. **Fruit:** Light brown achene at the end of the growing season. **Root:** Rhizomes. **Soil:** All soil types. [17, 35, 41, 47]

Normal Water Level

This species prefers upland moist/mesic to dry conditions and is usually an indicator of the upland side of wetland boundaries. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. Depth: 12". Duration: Short -1 day (decreasing all 12" in 1 day). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full sun to shade. **Salt:** Low. **Nutrient:** Low to moderate.

Siltation: Low. **Insect:** Infrequent. [1, 47]

Design Considerations

Bigleaf aster is a great groundcover for shaded slopes or dry, shaded edges of rainwater gardens, forested wetlands or upland buffers. **Concerns:** This species can be aggressive and form monocultures within the groundcover of the forest floor. [21]

Wildlife Use

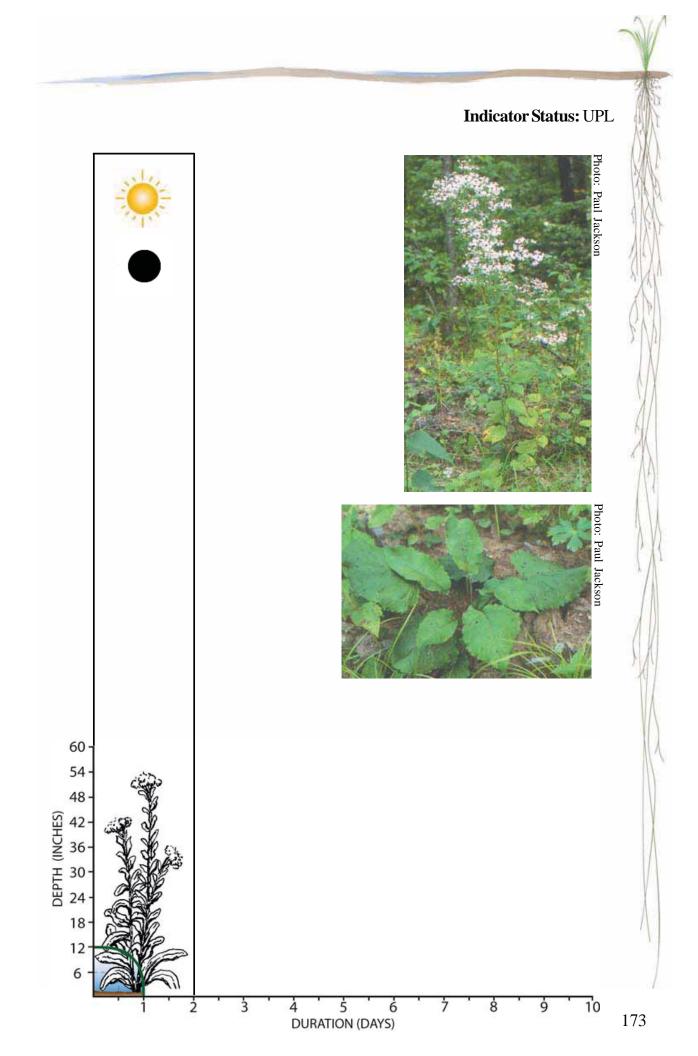
This aster provides cover and nesting habitat for songbirds of the forest floor. [21, 32]

Nursery/Plant Information

Available: Limited. **Types:** Only as plants.

Planting Techniques

Plant containerized plants in spring or fall.



Euthamia graminifolia

Grass-leaved Goldenrod - a.k.a. Solidago graminifolia - Bushy, Fragrant, Common Flat-topped, or Flat-topped Goldenrod

Habitat/Plant Community and Geographic Range

Habitat/Community: Shrub, wet meadows, low prairies, springs, fens, swamps, interdunal wetlands, and stream banks (often where sandy or gravelly; also weedy in abandoned fields). [7, 17] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. Nfld. and Que. to B.C., s. to Va., Ala., Tex. and N.M. [7, 21]

Description

General: An erect, native, perennial herb that grows 1-3' high. **Flower:** Yellow disk and ray flowers from July to October. It looks more like an aster than a typical goldenrod. **Leaf:** Alternate, linear-to-narrow, lance-shaped leaves usually 1-6" long with 3 veins. **Stem:** Erect stem that has many small, lance-like leaves, usually branched at head. **Fruit:** A finely haired achene. **Root:** Spreading by rhizomes. **Soil:** Prefers wet/ saturated to moist gravelly or sandy soils. [7, 17]

Normal Water Level

This species prefers wet/saturated to moist/upland conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Medium. **Depth:** 12". **Duration:** Short -2 days (decreasing 6"/day). This species has a moderate-to-low tolerance to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full sun. **Salt:** Moderate. **Nutrient:** Low. **Siltation:** Low, from 0-8 cm/year. **Insect:** Infrequent. **Other:** This species has a moderate-to-high tolerance to general disturbance and stress. [1, 46]

Design Considerations

A good restoration plant for old fields and meadows, wet prairies, fens and stream banks. Its root system helps resist erosion. A good plant for rain gardens due to its ability to withstand flooding and dry soils. **Concerns:** This species can spread quickly from rhizomes and become weedy.

Wildlife Use

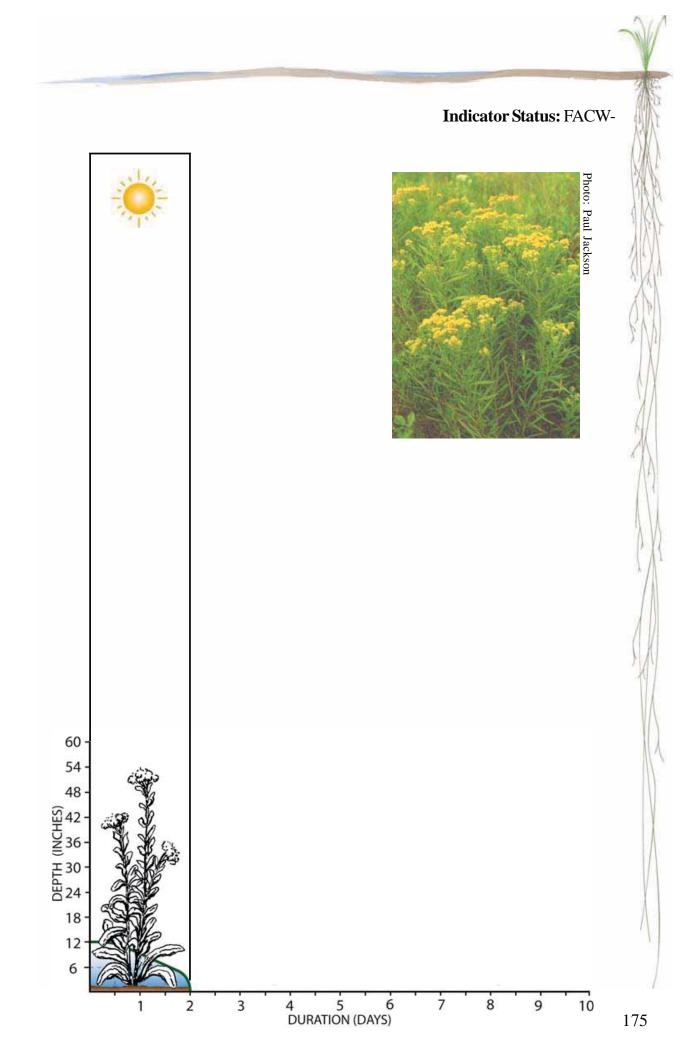
This species provides food and habitat for mice, rabbits, deer, grouse, bees and other insects. [21]

Nursery/Plant Information

Available: Limited. **Types:** Plants and seed.

Planting Techniques

This species should be planted with other aggressive species such as native gasses. There are 350,000 seeds/oz.



Eutrochium maculatum

Joe-pye-weed - a.k.a. *Eupatoriadelphus m.* - Joe-pye Weed, Spotted Joe Pye Weed, Purple Boneset

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, sedge meadows, shrub-carrs, marshes, low prairie, shores, stream banks, ditches, cedar swamps, calcareous fens and open bogs. [7, 11, 16, 35, 41, 44] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. Nfld. to B.C., s. to Md., Ohio, Ill., N.M. and Utah. [7, 21]

Description

General: Robust, native perennial herb, usually 3-5' tall with 1 to several stems. **Flower:** Deep-rose to light-pink, flat inflorescence that lacks ray flowers and appears fuzzy or shaggy, 9-22 disc flowers occur in each head from July through September. Hundreds of individual flowers, ¹/₄" wide, make up each influorescence.

Leaf: Toothed, lance-shaped leaves generally are in whorls of 4 or 5 and are 3-9" long. **Stem:** Often spotted with purple. **Fruit:** Achenes prismatic, mostly 5-angled and nerved. **Root:** Fibrous, shallow. **Soil:** Moist soils, especially calcareous wet or rich loam soils. [7, 11, 35, 41, 44, 47]

Normal Water Level

This species prefers moist soil to wet/saturated conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Medium long – 3.5 days (6" the first half day and then 6"/day). This species has a moderate tolerance to flood duration and will decrease in abundance as flood depth increases. [1, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low. **Siltation:** Low. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 44]

Design Considerations

Joe-pye-weed is used in restorations, vegetated swales, shorelines, lake edges, wet prairies and gardens. It is an attractive plant, well suited for the perennial garden, rainwater garden and landscape where height is allowed. It provides good cutflowers, bird habitat and butterfly food. Joe-pye-weed prefers calcareous and heavy soils and is usually a good addition to a prairie garden. **Concerns:** This species may become aggressive, which may be preferable in some situations. Also, many cultivars or varieties are available, which may work in a landscape design but are not well suited to restorations. [16, 44, 47]

Wildlife Use:

This species provides habitat for many species. It attracts butterflies, bees and many other insects. It provides cover for small mammals, amphibians and reptiles. Swamp sparrows and turkeys eat the seeds. [21, 32, 41, 44]

Indicator Status: OBL



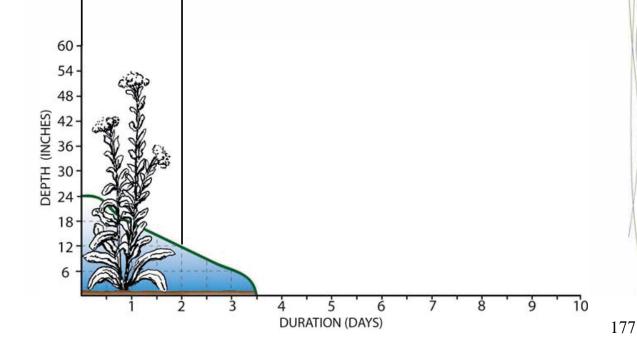
Nursery/Plant Information

Available: Widely. **Types:** Seed and plants.

Planting Techniques

The seeds germinate spottily, though quickly. Sow seed in the fall or early spring on cool ground and provide plenty of light. Plants may be divided, although not every year. Recommended seeding rate is 0.06-2.0 lb/acre, about 1,360,000 seeds/lb.





Fraxinus nigra

Black Ash - a.k.a. Basket Ash, Hoop Ash

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forest, wooded or cedar swamps, peat bogs, edge of bogs, along streams, low lake margins, alluvial flats and wet depressions in forests. [7, 11, 22, 36] **Range:** All but sw. Minn. (Eco-Range: 1, 2, 4-8), Wis., Mich. Nfld. and Que. to Man., s. to Del., W.Va., Ind. and Iowa. [7, 21]

Description

General: A stout-twigged, deciduous tree with narrow, rounded crown of upright branches 50-75' tall and 35-50' wide. Flower: 1/8" long, purplish flower during April and May before the leaves emerge. Male and female flowers are on separate trees. Leaf: Opposite and pinnately compound 12-16" long. Leaflets number 7-11 and are 1-2½" long, toothed, sessile and paired (except at end). Leaf scars are nearly circular. Dark green above, paler beneath, with tufts of rust-colored hairs along midvein, and a burgundy-purple fall color. One of the last species to leaf out in the spring. Bark: Gray, corky, furrowed into soft, scaly plates that rub off easily. Twigs: Branches are circular, gray, stout, becoming hairless. Fruit: Flat samaras, 1-1½" long wing to the base, and blunt on both ends that hang in clusters and matures in late summer. Root: Very shallow and wide-spreading roots. Soil: Prefers lowland wet soils, though will tolerate most soils and a pH of 4.6-6.5. [7, 11, 22, 36, 37]

Normal Water Level

This species prefers upland moist to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 60". **Duration:** Long – 5 days (decreasing 12"/day). This species is tolerant of both seasonal and irregular inundation and somewhat tolerant to flood duration. [1, 22, 37]

Sensitivities or Other Tolerances

Exposure: Full sun to part shade. **Salt:** High. **Nutrient:** Low. **Siltation:** Moderate. **Insect:** Frequent – oystershell scale, ash borer. **Other:** This species is resistant to 2,4-D, lighting, drought, heat, mine spoils and soil compaction. It is frequently damaged by wind and ice and is susceptible to leaf spot, anthracnose, rust and canker. It has a moderate to low tolerance to general disturbance and stress. [1, 22, 37]

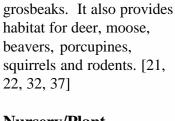
Design Considerations

A good species for lake edges, restorations of wooded swamps and other wooded wetlands. It is a tough species that can tolerate many adverse conditions. **Concerns:** A couple of cultivars exist.

Wildlife Use

Black ash provides seeds for a number of birds (especially wood ducks, turkeys, bobwhites, red-winged blackbirds, cardinals, purple finches, and pine grosbeaks), sap for yellow-bellied sapsuckers, and nesting habitat for mourning doves and evening

Indicator Status: FACW+



Nursery/Plant Information

Available: Becoming more widely available.

Types: Bareroot, balledand-burlapped and potted stock.

Planting Techniques

Black ash is readily transplanted in spring or autumn with care. [22]

Additional Notes

The circular leaf scars and flat samaras winged to the base of black ash distinguish it from the half circle leaf scars and flat, winged wedge-shaped samaras of green ash. Black ash takes its name from its dark brown





7

heartwood. [11, 36] 60 54 48 DEPTH (INCHES) 42 36 30 24 18 12 6

3

DURATION (DAYS)

2

179

10

Fraxinus pennsylvanica

Green Ash - a.k.a. F. pennsylvanica subintegerrima, F. pennsyl lanceolata - Swamp Ash, Water Ash

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forests, swamps, shores, lake edges, stream banks, Midwest windbreaks and farmstead plantings. [7, 11, 22, 36, 44] **Range:** Minn. (Eco-Region: All), Wis., Mich. N.S. and Que. to Alta., s. to Fla. and Tex. [7, 21]

Description

General: Early successional, deciduous tree with a height of 50-75' and width of 35-50'. Trees have dense, rounded or irregular crowns of shiny green foliage; fast growing on dry soils. Flower: Small clusters of many yellow flowers that bloom before leaves in early spring. Male and female flowers are on separate trees. Leaf: Opposite, pinnately compound, shiny green above, green or paler and slightly hairy beneath; turn yellow in autumn. The leaflets number 5-9 (usually 7) and are toothed, slightly petioled and 2-5" long. The leaf scars are in a half circle. Bark: Furrowed in a very tight, regular diamond pattern of crisscrossing ridges with reddish inner layer. Twigs: Smooth and round, becoming gray and hairless. Fruit: A wedge-shaped samara, with a round or somewhat round body and a flat 1¼-2¼" long wing that is yellowish and hangs in clusters that mature in late summer and autumn. Root: Shallow, fibrous roots. Soil: It tolerates most soil types, although it prefers moist alluvial soils of sand to sandy loam and a pH range of 6.1-7.5. This species may be found in rich, upland habitats. [7, 8, 11, 22, 36, 44]

Normal Water Level

This species prefers upland moist to wet/saturated conditions, although it will tolerate dry, rich, upland soils. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 60" in spring and 24" in summer. **Duration:** Long for spring, medium long for summer – 10 and 4 days, respectively (decreasing 6"/day in spring and 12" over 2 days in summer). This species has a high flood tolerance in spring, especially at the thaw and rainy season. It has a tolerance to irregular inundation throughout the rest of the year. Adults are very tolerant to flood depth increases; seedlings are moderately tolerant. [1, 8, 22, 44]

Sensitivities or Other Tolerances

Exposure: Not much shade; full to part sun. **Salt:** Moderate. **Nutrient:** High. **Siltation:** High. **Insect:** Frequent – ash borer, oystershell scale, brown headed ash sawfly, lilac leaf minor, lilac borer. **Other:** Green ash is resistant to 2,4-D, lighting, drought, heat, alkaline soils, mine spoils and soil compaction. It is the most tolerant of the ashes. It is damaged by wind and ice and is sensitive to SO₂ and O₃. It has a moderate tolerance to general disturbance and stress. [1, 2, 8, 10, 22, 25, 37, 44]

Design Considerations

Green ash is one of the more common shade trees being planted because of its toughness and ease of growth. It is used for restorations of wet depressions, flood plain forests, stream bank stabilization, slope buffers and shelterbelts. It thrives along roads, streets, and restrictive urban landscapes. **Concerns:** Green ash may be

Indicator Status: FACW

overplanted. It is often used in place of slower-growing species such as hard maples and oaks. [11, 36, 44]

Wildlife Use

The twigs and seeds provide forage for many mammals like deer, beavers and mice. This ash also provides habitat for many bird species



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(especially wood ducks, turkeys, bobwhites, red-winged blackbirds, cardinals, purple finches and pine grosbeaks), sap for yellow-bellied sapsuckers, and nesting habitat for mourning doves and evening grosbeaks. Fallen logs provide habitat for amphibians, reptiles and insects. [21, 22, 32, 37, 44]

Nursery/Plant Information

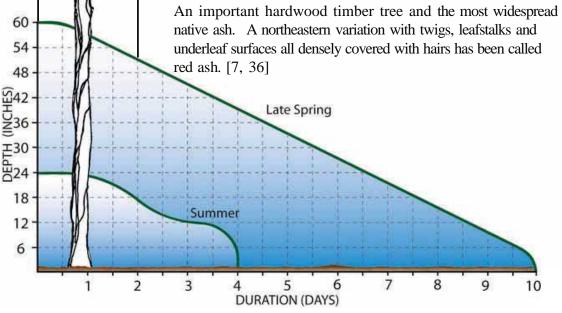
Available: Widely. **Types:** Balled-and-burlapped, potted and bareroot stock.

Planting Techniques

Green ash establishes readily, and it can be transplanted readily from bareroot or balled-and-burlapped stock in spring or autumn with care. It will tolerate drought and sterile soils, and has a fast growth rate. This species germinates from seed quickly. Store seed dry before sowing at 40 degrees F., followed by 70 degrees. [22, 44]

Additional Notes

native ash. A northeastern variation with twigs, leafstalks and underleaf surfaces all densely covered with hairs has been called red ash. [7, 36]



Galium boreale

Northern Bedstraw - a.k.a. Snow Bedstraw

Habitat/Plant Community and Geographic Range

Habitat/Community: Stream banks, shores, thickets, swamps, common along roads and wet-to-moist meadows (also in drier woods and fields). It usually grows in well-drained, open places. [7, 16, 35, 41] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. Circumboreal, s. to Del., Ky., Mo. and Calif. [7, 21]

Description

General: Northern bedstraw is a native, perennial herb standing 10-36". It often grows in large clumps and is an impressive sight when in bloom. **Flower:** Small, rather showy, 4-petaled, white flowers in a dense cluster (1-3" wide) at the top of the square stem. The flowers are sweet scented, and each flower is ½" wide and blooms from June to July. **Leaf:** Elongate, without teeth, and in whorls of 4. Each leaf is very narrow, ½" wide, linear, ¾-2" long, with a minutely rounded end and 3-nerved. **Stem:** A square-stemmed plant with many smooth stems that are commonly short-bearded just beneath the nodes. Sterile axillary branches with smaller leaves often develop. **Fruit:** Fruit with 2 carpels, 1-seeded, 2 mm, smooth or with short, straight or curled (not hooked) hairs. **Root:** Rhizomes. **Soil:** A variety of not-too-dry soils, though prefers old fields. [7, 35, 41]

Normal Water Level

This species prefers upland moist to wet/saturated conditions, although it will tolerate some drought. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short – 1 day (decreasing 12" in 1 day). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full sun to partial sun. Salt: Unknown. Nutrient: Low.

Siltation: Unknown. Insect: Infrequent. Other: This species is moderately low in

tolerance to general disturbance and stress. [1, 47]

Design Considerations

This species may be used in landscapes or rock gardens as a ground cover and provides good cutflower. **Concerns:** It may become overly aggressive due to its rhizomonous spread, though this may be preferred in some situations to compete with non-native species. [16]

Nursery/Plant Information

Available: Limited. Types: Plants and seed.

Planting Techniques

No seed treatment is needed, and this species divides well. Approximately 1,008,000 seeds/lb. [16]

Indicator Status: FAC **Additional Notes** This plant was once used to stuff mattresses, hence its common name. [41] 60 54 48 DEPTH (INCHES) 36 30 24 18 12 10 3 5 **DURATION (DAYS)** 183

Gentiana andrewsii

Bottle Gentian - a.k.a. Prairie, Closed Blue or Blind Gentian

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, swamps, wet woods, mesic savannas, thickets, low prairies, shores and ditches. It is found in moist, undisturbed open or somewhat shaded areas, especially along railroad beds and old fields. [7, 16, 35, 41] **Range:** Minn. (Eco-Region: All), Wis., Mich. Que. to Man., s. to N.J., N.C., Ohio, Mo. and Neb. [7, 21]

Description

General: A beautiful, slow-growing, native, perennial herb that is usually 1-2' tall. It has maroon-to-bronze fall color. Flower: Stems end in clusters of bottle-shaped, 1- to 1½"-long, blue flowers. The top of the flower is closed or nearly so by 5 fused petals, making the interior available only to large insects such as bumblebees, which can push the petals apart. Blooms August-October in second year if competition is minimized. Leaf: Toothless opposite, lance-shaped leaves with a pair of nerves in addition to the midrib. The leaf sides bend upward to form a trough. Stem: Upright simple stems. Fruit: Papery pod, roughly the size and shape of the flowers, contains hundreds of tiny, brown seeds. Root: Cluster of fleshy-fibrous to sometimes tuberous-thickened roots. Soil: Found in most soil types. [7, 35, 41]

Normal Water Level

This species prefers upland mesic moist-to-wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. Depth: 12". Duration: Short – 1 day (decreasing 12" in 1 day).

Sensitivities or Other Tolerances

Shade: Full to part sun. Salt: Low. Nutrient: Low. Siltation: Low.

Insect: Infrequent. Other: This species has a moderate tolerance to general distur-

bance and stress. [1, 47]

Design Considerations

A wonderful perennial for perennial gardens, rain gardens and rock gardens. It is used in restorations of prairies, wet meadows, lake edges, calcareous situations and ditches where it will be provided with enough sun the first growing season. It provides great cut and dried flowers. **Concerns:** It can be hard to establish in areas with significant competition. [16, 41]

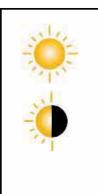
Wildlife Use

Bottle gentian is a good nectar source for bumblebees. [21, 35, 41]

Nursery/Plant Information

Available: Widely. Types: Plants. It does not start well from seed in competition.

Indicator Status: FACW



Planting Techniques

A successional species that may be divided. Seeds require moist, cold stratification and plenty of light for germination. Fall planting is best. About 12,800,000 seeds/lb. [16]

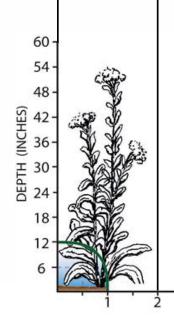
Additional Notes

One of at least seven species of gentian in the region. [41]

5

DURATION (DAYS)





Glyceria grandis

Giant Manna Grass - a.k.a. Panicularia (Glyceria) grandis American, Reed, or Tall Manna Grass

Habitat/Plant Community and Geographic Range

Habitat/Community: Shallow and deep marshes, fresh (wet) meadows, ditches, streams, lakes, ponds, open bogs, peatlands and fens (usually in shallow water and mud). [7, 11, 16] **Range:** Minn. (Eco-Region: All), Wis., Mich. Que. and N.S. to Alaska, s. to Va., Tenn., La., Neb., N.M., Ariz. and Wash. [7, 21]

Description

General: Loosely clumped, perennial grass with culms growing 4-6' tall. Light-green-to-tan, cool-season plant. **Flower:** A large panicle 3" long. Spikelets each have 5-9 flowers. The lemmas are distinctly 7-ribbed and usually purple, blooming from June to August. **Leaf:** Long and flat, usually smooth underneath and rough on top and 1/3-½" wide. **Stem:** Clustered stout culms. **Fruit:** The seeds are rounded at the base and sharp at the point. **Root:** Rhizomes usually rooting from the lower nodes. **Soil:** Shallow water or wet ground of muddy shores, peat or bogs. [7, 11]

Normal Water Level

This species prefers shallow water of 12" of inundation or less to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Long – 8 days (decreasing 3"/day). Giant manna grass will tolerate regular inundation to saturation of 12" and has a moderate tolerance to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Minor. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

Giant manna grass has been used for wetland restorations, especially in marshes, ditches and fens, where shallow water is constant or bounce is considerable. A good forage material for wildlife, and seems to increase with trampling and grazing. [14, 16]

Wildlife Use

Giant manna grass provides good cover and food for waterfowl (especially wood ducks) and muskrats. It is grazed heavily by deer. [14, 32, 37]

Nursery/Plant Information

Available: Widely. Types: Plants and especially seeds.

Planting Techniques

Requires cold, moist stratification. Fall planting has better results. [16]

Indicator Status: OBL Additional Notes Good identifying characteristics for the manna grasses (Glyceria spp.) include parallel ribs on the lemmas and frequently closed leaf sheaths. [11] 60 54 48 36 30 24 24 36-18 12 6 187 **DURATION (DAYS)**

Glyceria striata

Fowl Manna Grass - a.k.a. Fowl-Mannagrass

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamps, thickets, low areas in forests, wet savannas, wet meadows, springs, lakeshores and streambanks. [7, 16, 17] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. Nfld. and Labr. to B.C., s. to Fla., Tex. and Calif. [7, 21]

General Description

General: Loosely clumped, perennial, cool-season grass that is 1-4' tall and pale green. **Flower:** An open, loose panicle, 4-8" long and drooping. Ovate spikelets, often purplish, 3-7 flowered from June to August. **Leaf:** Greenish or purplish with slender, flat blades or folded, smooth, 1/16-1/4" wide with smooth sheaths. **Stem:** Erect, slender, 12-40" long. **Fruit:** Light brown achene from July to August.

Root: Erect or decumbent at base and often rooting from the lower nodes.

Soil: Moist, saturated, shallow water in most soil types. [7, 8, 44, 47]

Normal Water Level

This species prefers innudated conditions of 3 to 6". [21, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Long – 8 days (decreasing 3"/day). Giant manna grass will tolerate regular inundation to saturation of 12" and is somewhat tolerant to flood duration. [1, 8]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Low. **Nutrient:** Low to moderate.

Siltation: Moderate. Insect: Infrequent. Other: This species has a low tolerance to

general disturbance and stress. [1, 8, 44, 47]

Design Considerations

Fowl manna grass has been used for wetland restorations, especially in marshes, ditches and fens, where shallow water is constant or bounce is considerable. It is a good pioneer species for vegetated swales, stream banks and shorelines. A cool-season grass that bunches, fowl manna grass is a good forage material for wildlife, and seems to increase with trampling and grazing. **Concerns:** This species establishes well from seed, though it is not very competitive with non-natives, such as reed canary grass. [16, 44]

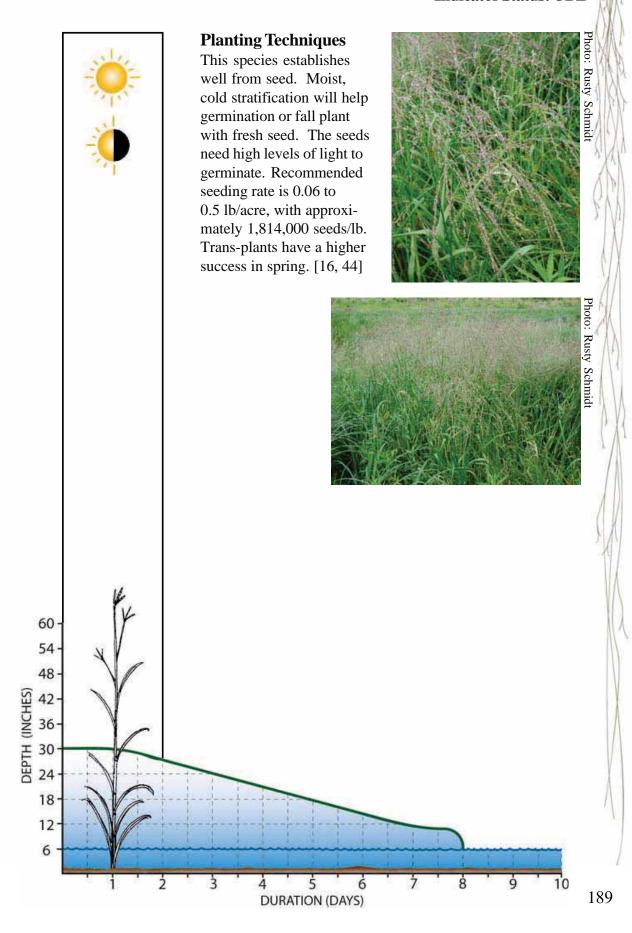
Wildlife Use

This species provides good cover and food for waterfowl (especially wood ducks) and muskrats. Grazed heavily by deer. [6, 32, 37, 44]

Nursery/Plant Information

Available: Widely. **Types:** Plants and seeds, although there may not be a local ecotype.

Indicator Status: OBL



Helenium autumnale

Sneezeweed - a.k.a. Common Sneeze Weed, False or Swamp Sunflower

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, sedge meadows, wet prairies, shores, stream banks, marshes, fens and tamarack swamps. It is often found along streams in large, dense clumps. [7, 11, 16, 35, 41, 44] **Range:** All but ne. Minn. (Eco-Region: 3-9), Wis., Mich. Que. to B.C., s. to Fla. and Ariz. [7, 21]

Description

General: Native, perennial herb that grows 3-5'. Flower: Reduced, yellow ray flowers with 3 teeth; blooms from August to November. The numerous flower heads have raised, nearly globular centers and wedge-shaped, yellow rays. Leaf: Well-developed, alternate, flat, elongate leaves, the bases of which extend down the stem as flanges or wings. The leaf is stalkless, ½-1" wide and 3-6" long, with widely spaced teeth. Stem: Often the stems are clumped and are usually winged. Fruit: Achenes 4-to-5-angled, with as many intermediate ribs; pubescent on the angles and ribs. Root: Fibrous root system. Soil: The pH range is 6.0-7.0. Moist, low ground of

Root: Fibrous root system. **Soil:** The pH range is 6.0-7.0. Moist, low ground of many soil types. [7, 11, 35, 41, 44]

Normal Water Level

This species prefers moist-to-wet/saturated conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short – 3 days (decreasing 6"/day). Sneezeweed will tolerate brief inundation like that found in wet prairies, fens and sedge meadows. [1, 44]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Moderate. **Nutrient:** Moderate to high. **Siltation:** Moderate to high. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 44, 47]

Design Considerations

Sneezeweed is a wonderful plant for wetlands and landscape designs. It has a fibrous root system that is beneficial in stabilizing stream banks, shores and vegetated swales. It can provide cut and dried flowers. **Concerns:** It tends to be aggressive and forms large clumps, although that characteristic may be desirable to deter other invasive or non-native species during establishment. Many cultivars are available. [16, 44]

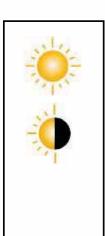
Wildlife Use

This species provides seeds for songbirds and upland gamebirds. It is a butterfly attractant and provides cover for many species. [16, 21, 44]

Nursery/Plant Information

Available: Widely. Types: Seeds and plants.

Indicator Status: FACW+



Planting Techniques

Propagated by division, cuttings and spring seeding. It germinates well in 4 weeks with no treatment. Recommended seeding rate is 0.12-0.5 lb/acre. [16, 44]

Additional Notes

Flowers release a volatile oil that has insecticidal properties. Native Americans used the dried flower heads to promote sneezing to loosen a head cold. [35, 41]



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60 - 54 - 48 - 42 - 36 - 30 - 24 - 18 - 12 - 6 - 7 8 DURATION (DAYS)

Helianthus grosseserratus Sawtooth Sunflower - a.k.a. Serrated Sunflower

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, sedge meadows, low prairies, stream banks, swamps, ditches and roadsides. It also occurs along disturbed streambanks and in old fencerows. [7, 11, 16, 44] Range: Common; Minn. (Eco-Region: All), Wis, mostly s. LP of Mich. N.Y. to Sask., s. to Ark. and Tex.

Description

General: A stately, perennial sunflower that produces an abundance of heads and stands up to 12' tall. Flower: Both yellow-to-cream ray and disc flowers are present from July to October. The conspicuous ray flowers are deciduous and sterile, whereas the disc flowers are perfect and fertile. **Leaf:** Lanceolate, sharply toothed leaves are densely hairy below and are often supported by winged leaf stalks and are alternate on the middle to upper stem. Basal leaves are absent or inconspicuous. Stem: Essentially without hairs below the inflorescence. Fruit: Achenes which are thick, moderately compressed at right angles to the involucellate bracts. Root: Coarse, fleshy, tuberous; spreading by elongate rhizomes and forming colonies. Soil: Prefers rich, moderately moist soil. [7, 11, 44]

Normal Water Level

This species prefers moist-to-wet/saturated conditions, though it has been found in dry soils. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: High. Depth: 18". Duration: Medium short – 3 days (decreasing 6"/day). This species will tolerate seasonal inundation to greater levels. [44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Moderate.

Siltation: Moderate. Insect: Infrequent. Other: This species has a moderate

tolerance to general disturbance and stress. [1, 44, 47]

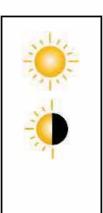
Design Considerations

Sawtooth sunflower is a good pioneer species that self sows and grows from rhizomes quickly. It has been used for soil stabilization of vegetated swales and shores. Concerns: Because this species self seeds and spreads by rhizomes, it can become weedy. This characteristic may be desirable if invasive plants are a concern. [16, 44]

Wildlife Use

This sunflower, like many others, has large, nutritious seeds that are eaten by gamebirds (mourning doves, sharp-tailed grouse, pheasants and bobwhites) and songbirds (red- winged and yellow-headed blackbirds; crossbills; crows; eastern goldfinches; and English, Lincoln, savannah, vesper and white-crowned sparrows). It also provides nectar and pollen for bees and other insects. It is a host plant for the Gorgone checkerspot butterfly. Mammals that use this plant are the 13-lined ground squirrel and pocket gopher. [21, 32, 44]

Indicator Status: FACW-



Nursery/Plant Information

Available: Widely. **Types:** Seeds and plants.

Planting Techniques

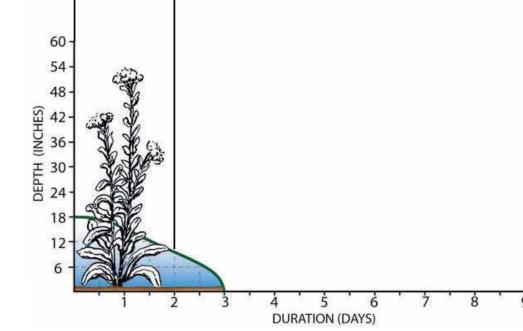
No treatment is required, though the seeds may benefit from cold stratification. Seeds do not need light, so drilling may work. Fall seeding with fresh seed provides the best results. The plants may be propagated by division or stem cuttings. Division



should be done in the fall, stem cuttings taken in the spring. [16, 44]

Additional Notes

H. grosseserratus is one of two native sunflowers with opposite leaves. [11]



Heuchera richardsonii

Prairie Alumroot - a.k.a. Alum Root, Richardson's Alumroot, Prairie Coralbells

Habitat/Plant Community and Geographic Range

Habitat/Community: Mesic and dry prairies, open woods, along roads, fields and rock outcroppings. [16, 17, 35, 41] **Range:** Minn. (Eco-Region: All), Wis., sc. Mich. Mich. and nw. Ind. to nw. Ark. and ne. Okla., w. and n. to Colo. and Alta. Upper Midwest and Great Plains. [17, 21]

Description

General: Native, perennial herb 2-3' tall. **Flower:** The irregularly shaped green or brownish flowers are perfect, ¹/₄" wide, on a tall, thin, leafless stalk; blooms from spring to summer. **Leaf:** A clump of basal leaves with rounded or heart-shaped blades, 3-4" wide, that are lobed and on a hairy stalk. Each leaf is coarsely toothed and made up of 3-5 lobes. An excellent foliage plant with burgundy- tinged leaves.

Stem: Usually 2-3' tall. Fruit: Capsule 2-beaked. Root: Short rhizome.

Soil: Mesic-dry sand/loam soils. [17, 35, 41]

Normal Water Level

This species prefers mesic-to-dry conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 6". **Duration:** Short – 1 day (6" in 1 day). This species needs well-drained soils if flooded further.

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low. **Siltation:** Low. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

Prairie alumroot has been used in rock gardens as an accent plant and in garden borders. It has beautiful foliage. It can be used in rain gardens with shallow inundation that dissipates quickly. **Concerns:** This plant grows low to the ground and is vulnerable to competition. [16]

Wildlife Use

Prairie alumroot provides habitat for birds and animals.

Nursery/Plant Information

Available: Widely. **Types:** Seeds and plants.

Planting Techniques

Fresh seed is needed for this species to be successfully germinated. It requires cool soils and significant light. It can can be divided easily. Approximately 12,800,000 seeds/lb. [16]



Ilex verticillata

Winterberry - a.k.a. Black Alder, Winterberry Holly or Michigan Holly

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamps, stream banks, swamp forests, thickets, seepage areas in woodlands, cypress swamps, moist woods at bases of bluffs, shores, peatlands and open bogs. [7, 22] **Range:** E. Minn. (Eco-Region: 1, 5-8), Wis., Mich. Nfld. and Que. to Ont. and Minn., s. to Md., Ind. and n. Ill. [7, 21]

Description

General: Multi-stemmed shrub or small, rounded tree to 25', though typically 6-8' tall. Flower: Greenish white flowers in June. This species is dioecious – plants of both sexes are needed to produce fruit. Leaf: deciduous, alternate, round-to-oval, tapered to the tip, dull green above, paler below with numerous incurved teeth margins. Bark/Stem: Twigs are smooth and finely ridged. Fruit: Female plants bear many red berries that persist into winter and are poisonous to humans. Root: Fine, fibrous, shallow lateral roots. Soil: Although winterberry tolerates most soils, it prefers acidic soils (pH 4.5-6). [7, 22]

Normal Water Level

This species prefers upland moist to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Medium. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/day). Winterberry is very tolerant to both seasonal and irregular flooding and moderately tolerant to flood duration. [1, 8, 22, 37]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Scale. **Other:** Winterberry can be damaged by wind and ice. It is somewhat tolerant to lighting, drought and heat, though it is very tolerant to O_3 and soil compaction. It is also moderately tolerant to oil/grease. It has a moderate-to-low tolerance to general disturbance and stress. [1, 2, 8, 22, 37]

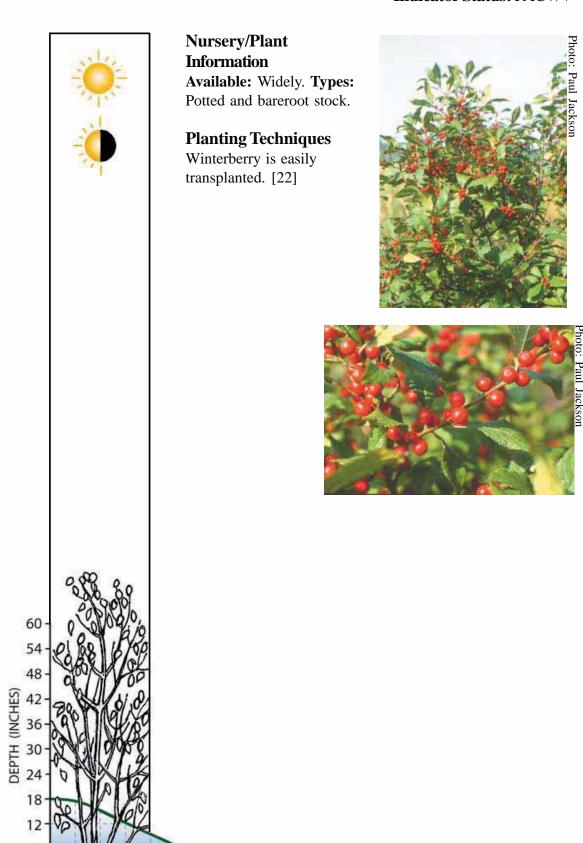
Design Considerations

This species is used along lake edges, though it will tolerate most upland soils. It is an ornamental plant (gorgeous in winter) in moist landscapes and restorations of bogs, thickets, stream banks and peatlands. It will do well in rain gardens and other landscape designs. **Concerns:** At least 3-4 plants should be planted together to ensure the proper sex ratio for berry production. Berries are poisonous to humans. [32]

Wildlife Use

Many songbirds, particularly hermit thrushes, mockingbirds, robins, catbirds, bluebirds and brown thrashers, use the fruit extensively. Ruffed grouse, turkeys, pheasants and yellow-bellied sapsuckers also use winterberry for food. Mammals, such as deer, bear, cottontail rabbits, raccoons, white-footed mice and squirrels, also use this species as a food source. [6, 21, 22, 32, 37]

Indicator Status: FACW+



5

DURATION (DAYS)

197

Impatiens capensis

Jewelweed - a.k.a. Touch-me-not, Spotted Touch-me-not, Orange Jewelweed

Habitat/Plant Community and Geographic Range

Habitat/Community: Found in a wide variety of wetland habitats, including swamps, low areas in moist soils, flood plain forests, thickets, shrub-carrs, fresh (wet) meadows, stream banks, shores, marshes, springs and fens (often where disturbed). [7, 11, 16, 41] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. Nfld. and Que. to Sask., s. to Fla., Ala. and Tex. [7, 21]

Description

General: Annual herb that grows 3-5' tall in wet areas. Flower: Pendent, conical, 3/4-1" long, with a sharp-curved tube (spur) that curves forward. Flowers from June to September. Flower is usually orange-yellow with brown or reddish spots and a mouth that is half as wide as the flower is long. Leaf: Alternate, finely toothed, oval leaves, 1-4" long on petioles about 1/8" long. Stem: A succulent, smooth stem that is nearly translucent and contains a slippery juice that can be used to soothe the sting from nettles or poison ivy. Fruit: A thin, banana-shaped capsule that, when mature, pops open at the slightest touch (which gives this plant another common name, touch-me-not), throwing seeds in all directions. Within the seed's dark brown covering is a sky-blue seed. Root: Fibrous, shallow. Soil: Wet-to-mesic soils, though it prefers alluvial woodlands. [7, 11, 32, 41]

Normal Water Level

This species prefers wet/saturated conditions, though will tolerate moist soils. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Long - 30 days (decreasing 6"/day for the first 2 days and then a total of 6" over the next 30 days). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full sun to shade. **Salt:** Low to moderate. **Nutrient:** Moderate. **Siltation:** High. **Insect:** Infrequent. **Other:** This species is tolerant to general disturbance and stress. [1, 45]

Design Considerations

Jewelweed is an annual that can be used to revegetate an area quickly. It is an important nectar source. **Concerns:** Plants only live 1 year. [16]

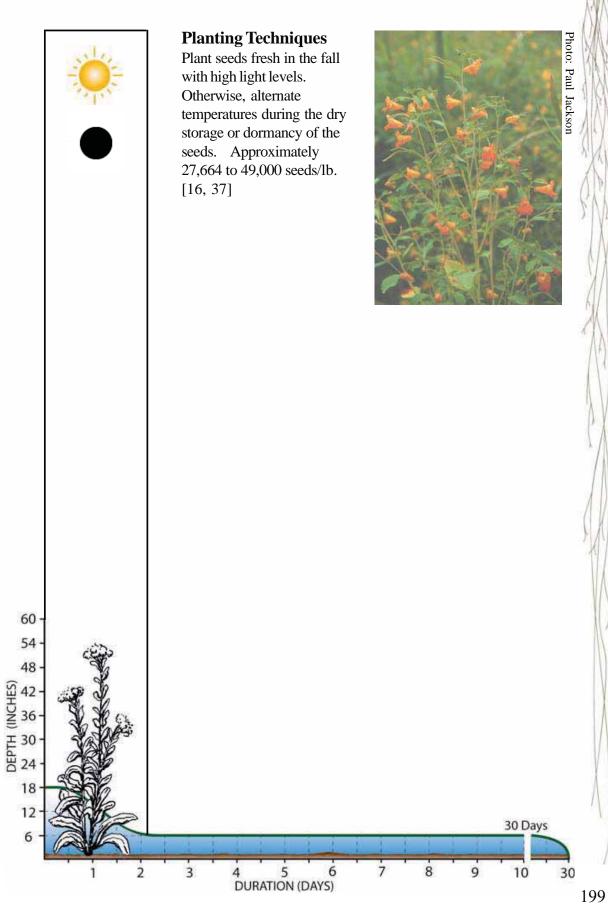
Wildlife Use

Jewelweed is an important nectar source for hummingbirds, orioles and bees. Gamebirds and mice eat the seeds. It provides cover for frogs and other reptiles. [21, 32, 41]

Nursery/Plant Information

Available: Limited. **Types:** Seeds.

Indicator Status: FACW



Iris versicolor

Blueflag Iris - a.k.a. Northern Blue Flag, Northern Iris, Blue Water Iris, Larger Blue Flag, Poison or Water-flag, Clajeux

Habitat/Plant Community and Geographic Range

Habitat/Community: Marshes, shores, wet meadows, sedge meadows, open bogs, swamps, thickets, stream banks, shores, pond edges and wet depressions in forests (often in shallow water). [4, 7, 11, 16, 35, 41] **Range:** All but se. Minn. (Eco-Region: All), n. and c. Wis., UP and n. LP of Mich. Nfld. and Labr. to Man., s. to Va., Wis. and Minn. [7, 21]

General Description

General: Native, perennial, emergent herb that forms colonies and reaches a height of 2½'. Flower: Usually light to deep blue, in bloom May to July. The flower has 3 spreading, downward-bent sepals and 3 shorter, ascending petals. The longer sepals are beardless (no bristles) with a white patch (throat) trimmed in yellow. The inferior ovary is bluntly angled. Leaf: Upright, sword-like, basal leaves that are more than 1" wide and 2-ranked. Leaves are folded on the midribs so that they form an overlapping, flat fan and are 8-30" long, similar to those of garden irises. Stem: Unwinged, erect, branched stems, up to 2' tall with conspicuous "cat-eye" cross section. Fruit: A large, green pod with rounded ends 1½-2½" long. The large seeds can be observed floating in the fall. Root: Thick, fleshy, creeping rhizomes. Soil: Wet-mesic sand/loam soils. [4, 7, 11, 35, 41, 44]

Normal Water Level

This species prefers shallow water to wet/saturated conditions of 12" of inundation or less. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Medium. **Depth:** 12". **Duration:** Medium long – 4 days (decreasing 6" every 2 days). Blueflag iris can tolerate regular inundation, but young shoots should not be inundated. This species is moderately tolerant to flood duration and will decrease in abundance with an increase in depth. [1, 37, 44]

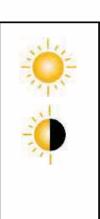
Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** Has a slow rate of spread and a moderately low tolerance to general disturbance and stress. [1, 37, 44]

Design Considerations

Blueflag iris is used in the shoreline zones of wet meadows and vegetated swales. It is recommended for restorations of meadows, swamps, shorelines, open bogs and pools. It is a beautiful, decorative plant that is well suited for rain gardens and other landscape design. It provides cut flowers. **Concerns:** Severe dermatitis may result from handling rhizomes. It will not flower unless it is in full to partial sun. Many cultivars exist. [16, 44]

Indicator Status: OBL



Wildlife Use

Blueflag iris provides nectar for hummingbirds and butterflies. Waterfowl and other birds eat the seeds. This species will persist under heavy grazing as cover for marsh birds. It provides food for muskrats and sometimes beaver. It provides cover for fish and amphibians, foraging habitat for snakes, and



habitat for many insect species. [4, 6, 21, 32, 37, 44]

Nursery/Plant Information

Available: Widely. Types: Seeds, rhizomes and plants.

Planting Techniques

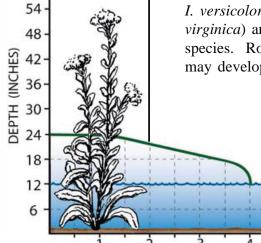
The seed requires moist, cold stratification for 120 days or less. Germination has been successful in greenhouse conditions that meet these requirements. Fall seeding with fresh seed will fulfill these requirements naturally, although birds and insects may eat the seeds. Recommended seeding rate is 0.06-0.25 lb/acre, with about 13,600-18,000 seeds/lb. Plants can be divided. Rhizomes and transplants give better results for permanent, on-site planting in spring. Plant rhizomes in 2-3" of saturated soil or plants in no more than 12" of inundation 0.5-1.5' apart or at a rate of 1,000/acre. Rhizomes can be toxic. [4, 16, 37, 41, 44]

60 -54 -

Additional Notes

DURATION (DAYS)

I. versicolor is similar to southern blueflag iris (I. virginica) and sometimes is considered a variety of that species. Rootstocks are poisonous to cattle and people may develop skin reactions from handling. [7, 11, 35, 41]



201

Juncus arcticus

Baltic Rush - a.k.a. Stiff, Wire, Shore or Salt rush

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet sandy or gravelly shores, interdunal wetlands near the Great Lakes, meadows, ditches, marshes and seeps. It prefers sandy shores and brackish-to-fresh water. [7, 16, 24] **Range:** Common (especially near Lake Michigan); all but se. Minn. (Eco-Region: 1-6, 8, 9), e. Wis., Mich. Circumboreal, s. to N.Y., Pa., Ohio, Ill., Mo., n. Tex., N.M. and Calif.; S. Amer. [7, 21]

Description

General: A grass-like, perennial herb that grows 1-2' tall. Flower: Clustered, greenish, tawny or brown flowers that bloom from May to August. Dense-to-spreading heads of single flowers on stalks. The heads appearing lateral, extending outward from the stem, 3/8-2¾" long. The tepals are lance-shaped, dark brown, with chaffy margins and 6 stamens. Leaf: Reduced, narrow leaves with red-brown sheaths at base of stem. The bracts are erect, round in section, 4-8" long, longer than the head and resemble a continuation of the stem. Stem: Dark green, simple stems that are in rows from the rhizomes and are pithy or hollow, slender and tough, 1-2' long. Fruit: Capsules ovate, somewhat 3-angled, red-brown 1/8-3/16" long, tapered to a sharp point. Root: Spreads by stout, brown-to-black rhizomes. Soil: Wet sandy and gravelly soils, which may be calcareous. [7, 24]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Long – 10 days (decreasing 2.4" every 2 days). Baltic rush will tolerate regular or seasonal flooding and a moderate tolerance for flood duration. [1, 37]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Unknown. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Generally not a problem. **Other:** This rush has a slow rate of spread and a high tolerance for general disturbance and stress. [1, 24, 37]

Design Considerations

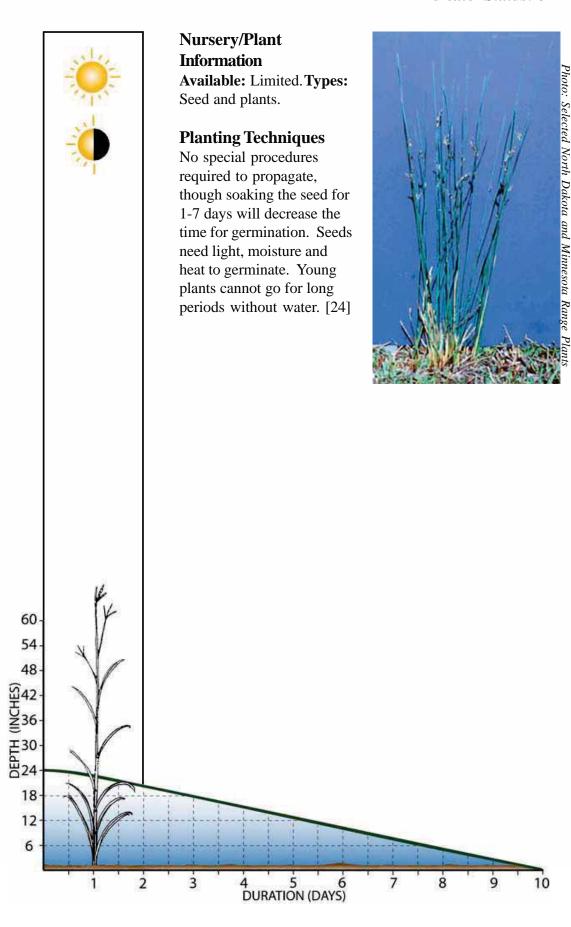
Baltic rush provides good wildlife habitat and is used in restorations, shores, dunes and meadows. It should be considered for sandy ditches and vegetated swales due to its use for erosion control and stabilization. [24, 37]

Wildlife Use

This species provides good spawning grounds for rock bass, bluegills and other panfish. The roots occasionally provide food for muskrats, rabbits and moose. Waterfowl, upland gamebirds, marsh birds and songbirds eat the seeds. [24, 32, 37]

Indicator Status: OBL

203



Juncus effusus

Soft Rush - a.k.a. Common Rush

Habitat/Plant Community and Geographic Range

Habitat/Community: Marshes, shores, thickets, stream banks, bog margins, swales, shallow pools, roadsides, inland fresh meadows and wet meadows. [4, 7, 11, 16] **Range:** Common; e. and c. Minn. (Eco-Range: 1, 2, 5-7), Wis., Mich. Throughout e. USA and se. Can. **Endangered in Iowa.** [7, 21]

Description

General: A densely clumped, emergent, perennial herb. Soft rush has deep-green stems in clumps 2-4' tall. Flower: Many-flowered inflorescence, which appears to erupt from the side of the stem. Flowers are green, tawny or brown, blooming from July to August. Each flower consists of 6 tepals (3 sepals and 3 petals that are similar in color and size) surrounding a capsule. Leaf: Lacks a leaf blade and auricles, only a sheath is present, which appears to be a continuation of the stem. Stem: Pithy or hollow simple, stout stems 1-4' high. Fruit: A many-seeded capsule that has minute seeds. Root: Stout rhizomes. Soil: Tolerant of many saturated soils. [4, 7, 11, 44]

Normal Water Level

This species prefers shallow water of 12" of inundation or less to wet/saturated conditions, although it will tolerate somewhat drier conditions. [6, 21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 2'. **Duration:** Medium long – 4 days (decreasing 6"/day and 6" over the next 2 days). This species will tolerate regular inundation and drought in summer. It is somewhat tolerant to flood duration and water depth increases. The population will increase with an increase in flood frequency. [1, 37, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** Soft rush has a slow rate of spread. It has a moderate-to-high tolerance to general disturbance and is very tolerant to iron concentrations. [1, 37, 44]

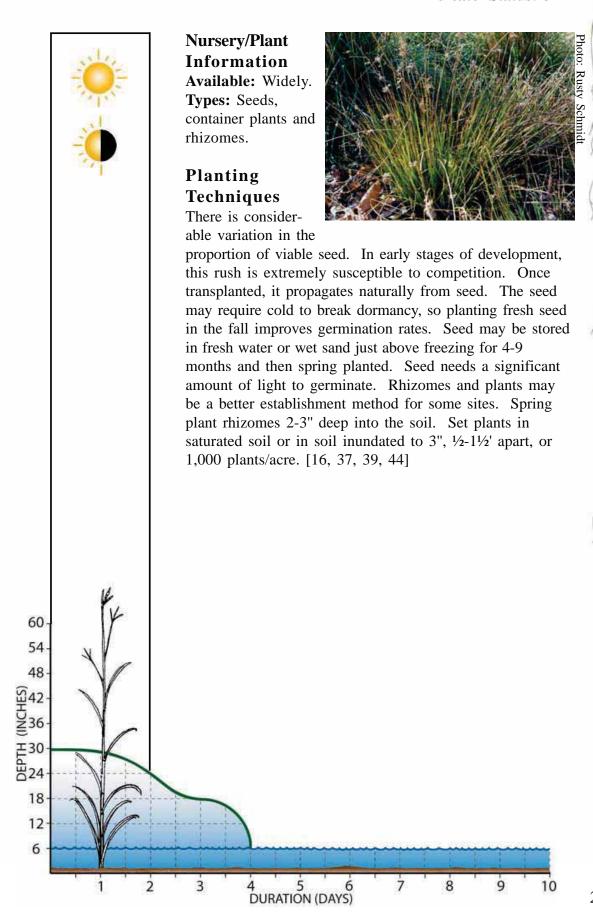
Design Considerations

This attractive, evergreen plant is a good contrast plant. It is used in vegetated swales, shorelines, restorations of wet meadows, marshes and thickets. It has been used successfully in rain water gardens. [16, 44]

Wildlife Use

This species provides good spawning grounds for rock bass, bluegills and other panfish. The roots occasionally provide food for muskrats, deer, rodents, rabbits and moose. Waterfowl, upland gamebirds, marsh birds and songbirds eat the seeds. Soft rush provides nesting habitat for rails, ducks and insects. [4, 21, 32, 37, 44]

Indicator Status: OBL



Juncus torreyi Torrey Rush

Habitat/Plant Community and Geographic Range

Habitat/Community: Sandy and gravelly shores, stream banks, shallow pools, wet meadows, marsh borders, springs and ditches. [7, 16, 17] **Range:** Mostly nw., c. and s. Minn. (Eco-Region 1, 3-6, 8, 9), Wis., LP and local in e. UP of Mich. Me. to B.C., s. to Ky., Ala., Tex., Colo. and Calif. [7, 21]

Description

General: Grass-like, perennial herb that stands to 3' tall, its succulent foliage topped with pompom-like flower heads and occurring in large clones of several hundred stems. **Flower:** Clustered greenish, tawny or brown flowers that bloom from July to October. **Leaf:** Narrow. **Stem:** Pithy or hollow simple stems. **Root:** Tuber-bearing rhizomes. **Soil:** Sandy and gravelly soils in shores and pools. Torrey's rush is alkali tolerant. [7, 17, 44]

Normal Water Level

This species prefers upland moist to wet/saturated conditions, although it will tolerate 3" of inundation. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Long – 6 days (decreasing 3"/day). Torrey's rush will tolerate seasonal or irregular inundation from flooding for relatively short durations. [37, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** Torrey rush spreads slowly and is alkali tolerant. It has a moderate tolerance to general disturbance and stress. [1, 37, 44]

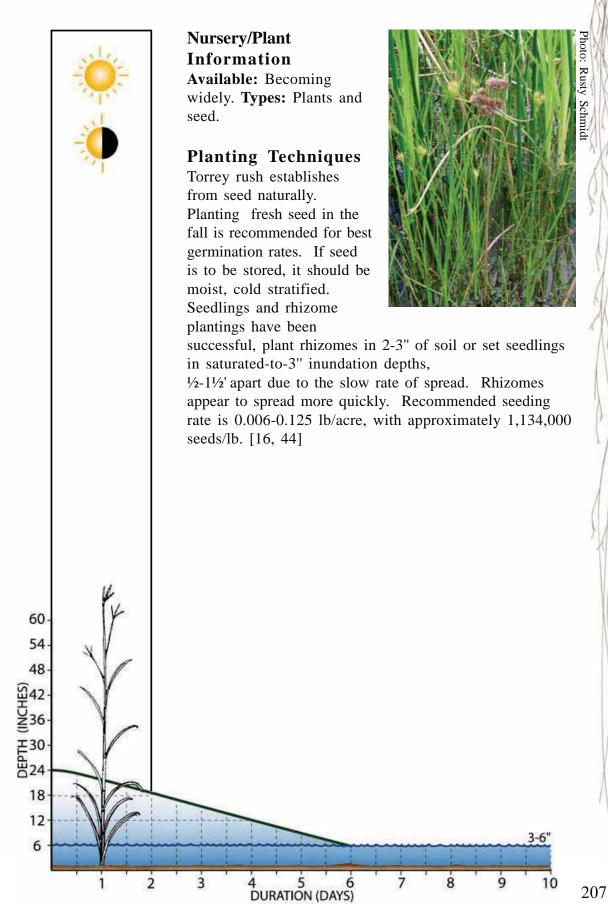
Design Considerations

Torrey rush has a rhizomatous root system that stabilizes soil well in vegetated swales, slopes and shorelines. It is used in wetland restorations, especially along stream banks, wet meadows, marsh borders and shores. It is an excellent choice for sandy or alkali conditions. It is a good contrast plant for shores, lake edges and other landscape designs. The stems and seed heads are good for cutting and dried arrangements. **Concerns:** This plant has an aggressive characteristic, though it spreads slowly. It may be considered as a competitor with invasive species. [16, 44]

Wildlife Use

This species provides good spawning grounds for rock bass, bluegills and other panfish. The roots occasionally provide food for ducks, muskrats and other rodents, deer, rabbits and moose. Waterfowl, upland gamebirds, marsh birds and songbirds eat the seeds. Torrey rush provides nesting habitat for rails, ducks and insects. [32, 37, 44]

Indicator Status: FACW



Larix laricina

Tamarack - a.k.a. Eastern Larch or Hackmatack

Habitat/Plant Community and Geographic Range

Habitat/Community: Cold, poorly drained swamps, coniferous swamps, muck, peatlands, bogs, black spruce bogs, stream borders, seep areas and wet lakeshores – confined to wet depressions. [7, 11, 22, 36] **Range:** N. and c. (but uncommon in se.) Minn. (Eco-Region: 1-3, 5-8), Wis., Mich. Nfld. and Labr. to Alaska, s. to n. N.J., W.Va., n. Ohio, ne. Ill. and Minn. [7, 21] **State Threatened:** Illinois.

Description

General: A deciduous conifer up to 60' high and 30-35' wide that is frequently stunted and scrubby. It has a narrow crown, with a straight, tapering trunk and horizontal branches. One of the last trees to lose its leaves. Leaf: Clusters of soft, slender, needle-like, deciduous leaves that are ³/₄-1" long and 3-angled. They are light blue-green, turning yellow in autumn before they are shed. Bark: Reddish brown, scaly and thin. Twigs: Orange-brown, stout, hairless twigs with many spurs. Fruit: Cones that are ¹/₂-³/₄" long, elliptical, rose-red turning brown, upright and stalkless. The cones fall in their second year and have several overlapping, rounded cone-scales and paired, brown, long-winged seeds. Young cones are purple. Root: Shallow, fibrous roots. Soil: Neutral-to-acidic soils (sphagnum moss may be lacking) when south of the vegetation tension zone and when growing on acidic, peat soils north. Tamarack is associated with black spruce (*Picea mariana*) and sphagnum mosses (*Sphagnum* spp.). It is also tolerant of drier, upland and mesic, loamy soils. [7, 11, 22, 36]

Normal Water Level

This species prefers upland moist to wet/saturated, often acidic, conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Long – 5 days (decreasing 6" every 2.5 days). It is very tolerant of flooding for short periods. [1, 22]

Sensitivities or Other Tolerances

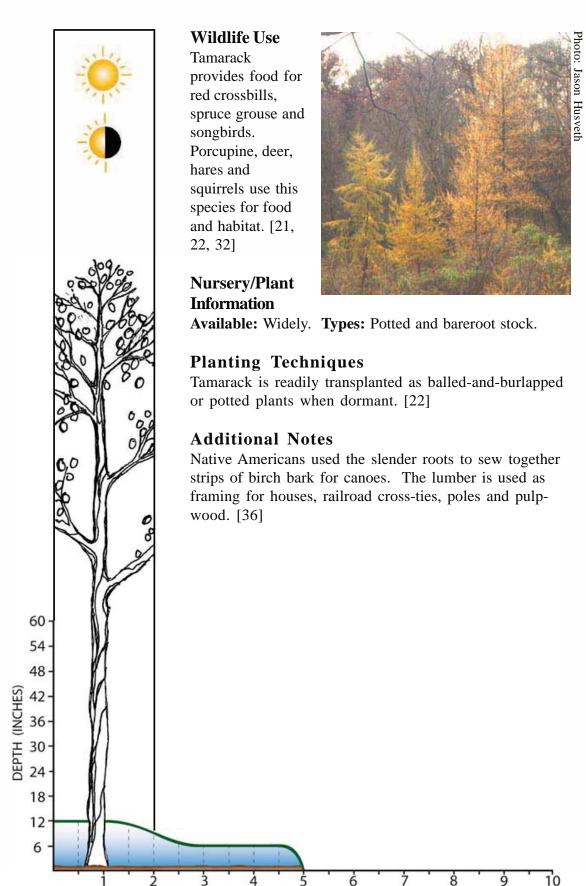
Exposure: Full to part sun. **Salt:** High. **Nutrient:** Low. **Siltation:** Moderate. **Insect:** Frequent – larch casebearer, larch sawfly (will defoliate stands infrequently, causing death or damage). **Other:** This species is frequently damaged by wind. It is sensitive to SO₂, O₃, HFl, HCl, Cl, drought, heat and mine spoils, though resistant to soil compaction. It has a moderately low tolerance to general disturbance and stress. [1, 2, 21, 22, 25, 36]

Design Considerations

An ornamental tree for very cold climates. It is used in restorations (especially in wetlands, peat and woodland depressions). It is a wonderful specimen or mass grouping tree for lake or bog edges. It is well suited for rain gardens and other ornamental situations. [36]

Indicator Status: FACW

209



DURATION (DAYS)

Leersia oryzoides Rice-cut Grass

Habitat/Plant Community and Geographic Range

Habitat/Community: Muddy or sandy streambanks, shores, swales, wet meadows and marshes (sometimes forming large patches). [4, 7, 16] **Range:** Common to occasional; Minn. (Eco-Region: All), all but ne. Wis., Mich. Que. and N.S. to B.C., s. to Fla., Tex. and Calif.; Europe and e. Asia. [7]

Description

General: A native, perennial, emergent grass that is loosely clumped and 2-5' tall. **Flower:** Open, greenish white panicle at end of stem and from leaf axils (these are often partly enclosed by leaf sheaths), with ascending, spreading branches. Spikelets are 1-flowered, oval, compressed, pale green, turning brown with age, without glumes and the lemmas are covered with bristly hair. It blooms from June to October. **Leaf:** Flat, 8-12" long and 3/16-3/8" wide, with finely saw-edged leaves with rough, hairy sheaths and a flat-topped ligule. **Stem:** Weak and sprawling, rooting at nodes, 2-5' long. **Root:** Creeping rhizomes. **Soil:** Rich, fine, muddy or sandy soils near, or partly within, the waters edge, with a pH of 6.0-7.0. [4, 7, 32, 44]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to moist or wet/saturated conditions. [37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 30". **Duration:** Long – 6 days (decreasing 1' every 2 days for 4 days then a total of 6" the last 2 days). Young plants do not tolerate seasonal or regular inundation to submergence for more than 2-3 days. Mature plants will tolerate regular, seasonal or irregular inundation and flood duration. This species will tolerate drought, and it has been observed to tolerate regular water fluctuations. It decreases in abundance as flood depth increases. [1, 37, 44]

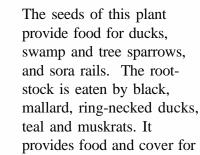
Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Moderate. **Nutrient:** Moderate to high. **Siltation:** Moderate to high; very tolerant for adult plants and it will decrease in abundance with seedlings. **Insect:** Infrequent. **Other:** Rice-cut grass has a moderate rate of spread and a moderate-to-high tolerance to general disturbance. [1, 37, 44, 45]

Design Considerations

Rice-cut grass is an excellent soil stabilizer, especially along fast-moving water, and has been used in stream bank stabilization, vegetated swales and shores. It is a good wetland cover crop and provides nesting and feeding cover for wildlife. Recommended restorations include wet meadows, marshes and stream banks. This species may be in the seed bank or be transported by wildlife. **Concerns:** Rate of spread is moderate to sometimes aggressive once plants are established, which may help keep out unwanted species. Keep away from high-use areas because the leaf edges cut skin. [6, 16, 26, 37, 44]

Indicator Status: OBL



Wildlife Use

invertebrates, reptiles, amphibians and fish. [4, 6,

32, 37, 44]



211

Nursery/Plant Information

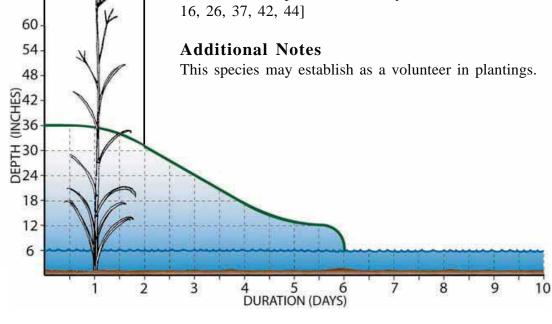
Available: Widely.

Types: Seeds, rhizomes,

rootstocks and container-grown plants.

Planting Techniques

Seeds require moist, cold stratification for 30 days, then they should be planted in saturated soils. Another option is to seed in the fall with fresh seed. Establishment from seeding restorations have been observed to be low. Recommended seeding rate is 0.1-0.25 lb/acre, with about 610,000-1,512,000 seeds/lb. Rhizomes should be planted 2-5" deep and seedlings should be planted in saturated or inundated soils to a depth of 3". Recommended spacing is 1-3' apart and drawdowns of water levels improve the success of this species, which may be in the seed bank. [4, 16, 26, 37, 42, 44]



Liatris ligulistylis

Meadow Blazingstar - a.k.a. Northern Plains Blazing Star or Meadow
tot/Plant Community and Coographic Bango
Blazingstar

Habitat/Plant Community and Geographic Range

Habitat/Community: Mostly in damp, low places, occasionally drier; open, grassy meadows, prairies, savannas, hillside and jackpine forests. [17] **Range:** Minn. (Eco-Region: 3-9), Wis., Mich. Wis. to Alta., Colo. and N.M. [17, 21]

Description

General: This tall (24-42"), native, perennial herb produces a brilliant, rosy-purple flower spike. Flower: Heads are arranged in a dense spike with small individual flowers. Each flower is tubular and perfect, rosy-purple, blooming from July to August with 30-100/head. Leaf: Green with a white mid-vein, 2-6" long, alternate, entire, narrow and sessile or with the blade tapering to the petiole. Stem: May grow to 42" tall and usually glabrous below the inflorescence. Fruit: Achenes 10-ribbed. Root: Thickened, usually corm-like rootstock. Soil: Moist to saturated, though will tolerate dry soils of many types. [17]

Normal Water Level

Although this species prefers upland moist to wet/saturated conditions, it will tolerate dry soils. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Short – 1 day (decreasing all 12" in 1 day).

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Low to moderate. **Siltation:** Low. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance. [1, 47]

Design Considerations

A great nectar source and butterfly garden plant. It also provides wonderful cut and dried flowers. This species does well in most landscape designs, including rain gardens as long as the water depth is 6" or less and dissipates within a day.

Concerns: Many cultivars are available that can be mistaken for the native variety. Seedlings and seeds take a couple of years to flower.

Wildlife Use

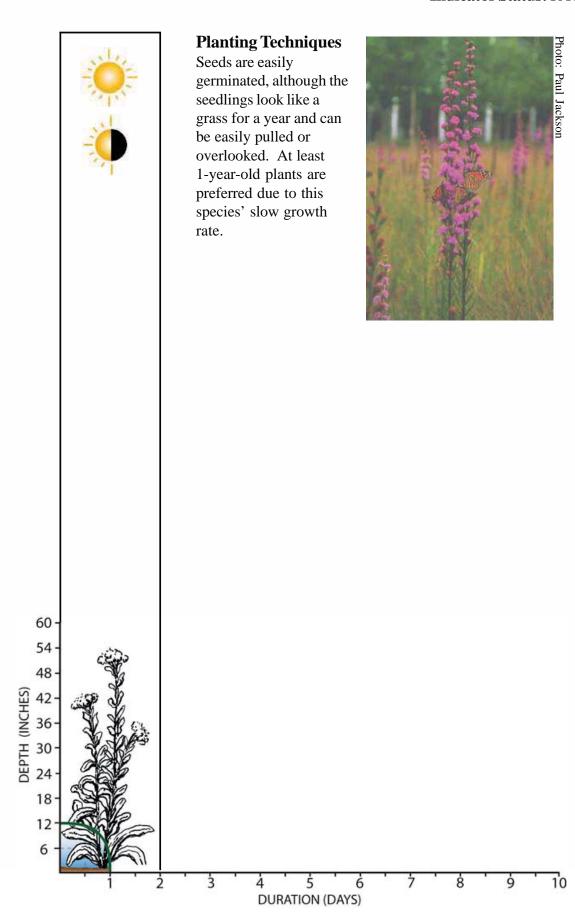
Meadow blazingstar is said to be the best butterfly attractant within the *Liatris* genus. Birds eat the seeds as well.

Nursery/Plant Information

Available: Widely. Types: Seeds and plants.

Indicator Status: FAC

213



Liatris pycnostachya

Prairie Blazingstar - a.k.a. Prairie Gayfeather, Tall or Thick Spike Blazing Star, Prairie or Hairy Button-Snakeroot

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, wet and mesic prairies, marshes, lake edges, seepage areas and some calcareous fens. [11, 16, 17, 35, 41] **Range:** Sw. Minn. (Eco-Region: 1, 4-9), s. 2/3 of Wis., Mich. Ind. and Ky. to Minn., N.D., Tex. and Miss., and introduced e. to N.J. and w. N.Y. [17, 21] **State Endangered:** Indiana.

Description

General: An erect, native, perennial herb with unbranched stems that are often 3-4' tall. Flower: The small, purple flowerheads are crowded and sessile (usually more than 20 heads) on a spike 6"-1½' long. Each head usually contains 5-7 perfect, tubular flowers. Blooms from July to mid-September. Leaf: Numerous, essentially linear (grass-like), alternate leaves that are gradually reduced upwards on the stem. Each leaf is up to 12" long and ½" wide, green with a white mid-vein. Stem: Hairy, sturdy stem. Fruit: Achenes 10-ribbed. Root: Thickened, usually corm-like rootstock. Soil: Wet, sandy soils, and in moist areas in prairies; will tolerate heavy soils. [11, 17, 35, 41]

Normal Water Level

This species prefers upland mesic to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 18". **Duration:** Medium short – 3 days (decreasing 6"/day).

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Moderate. **Nutrient:** Moderate to low. **Siltation:** Low. **Insect:** Infrequent. **Other:** It has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

Prairie blazingstar is a good plant for moist and wet restorations of prairies and meadows. It is a wonderful butterfly plant that provides good cut and dried flowers. It will be successful in rain gardens and other landscape designs where water fluctuation is minimal or dissipates in a day or less. **Concerns:** Wind can damage this plant, so plant with other tall, sturdy plants and grasses, such as big bluestem. Many cultivars of this plant exist. [35]

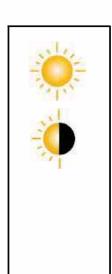
Wildlife Use

Prairie blazingstar is a great nectar source and butterfly attractant. It is relished by deer and cattle. [21, 41]

Nursery/Plant Information

Available: Widely. **Types:** Plants and seeds.

Indicator Status: FAC-



Planting Techniques

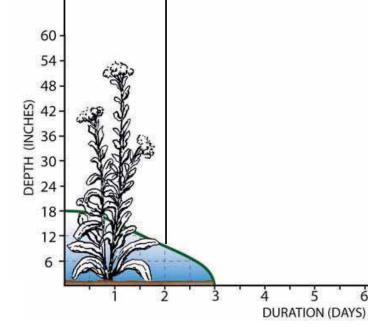
This species propagates easily from seed, although it takes a couple of years to mature. Mature plants are usually more satisfying in landscape designs due to this slow start. Approximately 192,000 seeds/lb. [16, 35, 41]



Similar to *L. aspera*, but more robust and showy, tolerates heavier soils. [41]

5





Lilium superbum

Turk's-cap Lily - a.k.a. Michigan Lily

Habitat/Plant Community and Geographic Range

Habitat/Community: Bogs, meadows, low woods, wet prairies, fens and moist savannas. [16, 17] **Range:** Minn. (Eco-Region: 1-3, 5-9), Wis., w. N.Y. and s. Ont. to Man., s. to Tenn. and Ark. [17, 21]

Description

General: Stout, erect perennial herb to 8' in height. **Flower:** 1 to many flowers, nodding from long, erect stalk. Blooms from June to August. The tepals are strongly recurved, lanceolate, orange, spotted with purple, with widely separated anthers. **Leaf:** Whorled, the upper alternate, the blades lanceolate, tapering to both ends and usually spiculate-scabrous along the margins and on the veins beneath. **Stem:** Stout, erect stem with many narrow leaves. **Fruit:** A capsule with many closely packed, flat seeds. **Root:** A scaly bulb. **Soil:** Wet, wet mesic, mesic soil with a pH of 5.0.-7.0. [17]

Normal Water Level

This species prefers upland moist to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Short – 2 days (decreasing 6"/day). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Low. **Nutrient:** Moderate. **Siltation:** Low to moderate. **Insect:** Infrequent. **Other:** It has a moderately low tolerance to general disturbance and stress. [1, 47]

Design Considerations

Turk's-cap lily is a nectar source for hummingbirds and other wildlife. It is well adapted for wet-to-mesic conditions of meadows, bogs, fens and wet prairies. Restoration sites with these conditions should be considered.

Wildlife Use

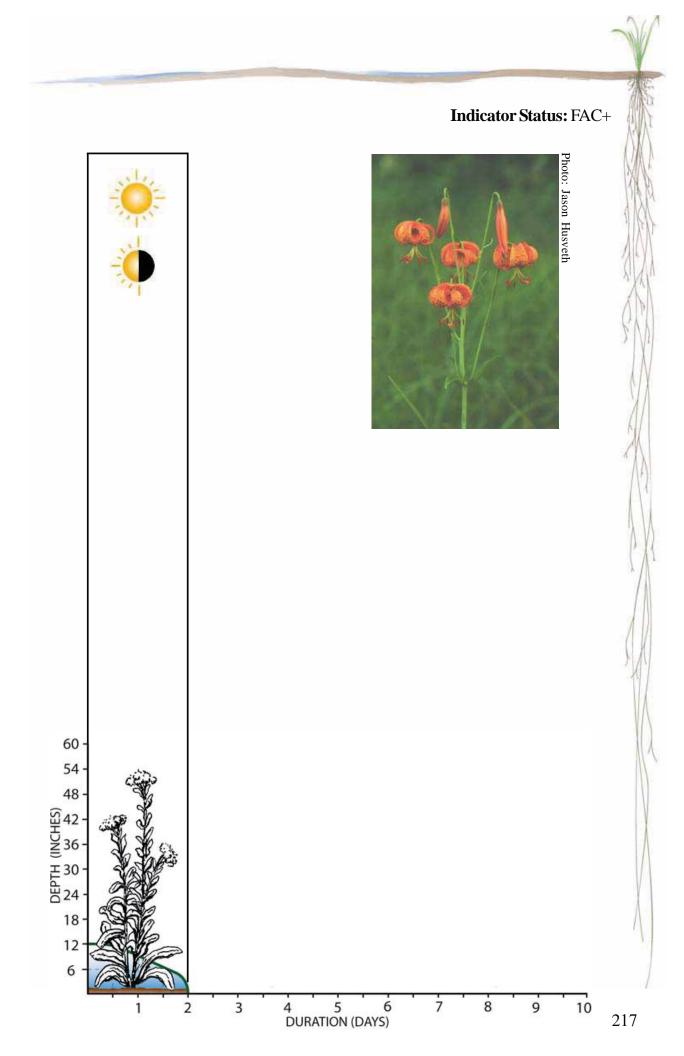
This species provides nectar for hummingbirds and orioles. Deer also eat this plant. [21]

Nursery/Plant Information

Available: Limited. Types: Plants only; difficult to start from seed.

Planting Techniques

Seed germination is difficult; cold, moist stratification is required and plants mature slowly. Mature plants divide well. Approximately 108,800 seeds/lb. [16]



Lobelia cardinalis

Cardinal Flower - a.k.a. Red Cardinal-flower

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forest, swamps, thickets, stream banks, shores, wet meadows and ditches (sometimes in shallow water). [7, 11,16, 35, 41] **Range:** Ec. and se. along Miss. River in Minn. (Eco-Region: 7-8), Wis., s. UP and LP of Mich. N.B. to Minn., s. to Fla. and Tex. [7, 21]

Description

General: Native, perennial herb 2-4' tall. Flower: Intense red flowers that alternate on a stem in an elongate cluster 1-2' long. Each flower is about 1" across and has 3 spreading lower petals and 2 upright petals united into a tube toward their base. Blooms from July to September. Leaf: Thin, smooth, dark green with some crimson, lanceolate-to-lance-ovate, and irregularly serrate up to 6" long and nearly clasp the stem. Stem: Usually a simple, reddish stem with milky, acrid juice. Root: Shallow, fibrous roots. Soil: Wet-to-mesic rich loams. [7, 11, 35, 41]

Normal Water Level

This species prefers moist-to-wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Long – 5 days (decreasing 6" the first day and then 6" every 2 days thereafter). Cardinal flower will tolerate seasonal and regular flooding and is somewhat tolerant to flood duration. [1, 37]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Moderate. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a slow rate of spread and a moderate-to-low tolerance to general disturbance and stress. [1, 37]

Design Considerations

Cardinal flower, a very attractive plant, is used in gardens, rainwater gardens, wetland restorations, stream bank stabilization and habitat restoration. It provides wonderful cutflowers. It is also a good nectar source. **Concerns:** Because this plant has shallow roots, the soil it grows in must be kept moist to wet at all times. Many gardens have failed because of this, some sun is necessary to flower. Only the hummingbird pollinates this species, so seeds are not always available. Plants may not be long lived. [16, 35, 41]

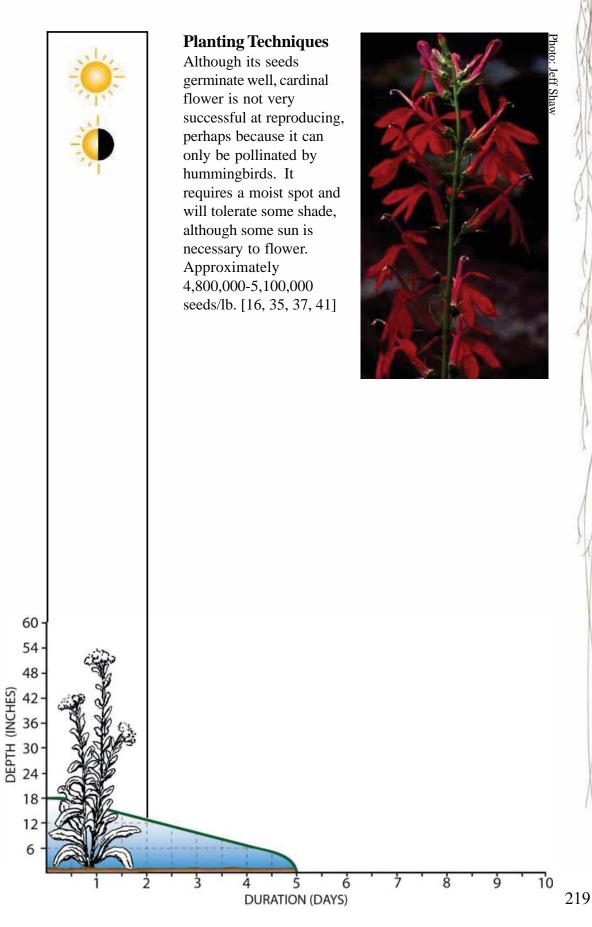
Wildlife Use

A great nectar source for hummingbirds, orioles and butterflies, though it can only be pollinated by hummingbirds. [6, 21, 32, 37, 41]

Nursery/Plant Information

Available: Widely. **Types:** Seeds and plants.

Indicator Status: OBL



Lobelia siphilitica

Blue Lobelia - a.k.a. Lobelia syphilitica - Blue Cardinal-flower, Great
Blue Lobelia or Hi-belia

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamps, flood plain forests, mesic savannas, thickets, stream banks, calcareous fens, peatlands and wet meadows.[7, 16, 35] **Range:** Common; Minn. (Eco-Region: 1, 4-9), Wis., local in e. UP of Mich. Me. to Man., s. to N.C., Tex. and Colo. [7, 21]

Description

General: Erect, native, perennial herb usually 20-30" tall. **Flower:** Resembles that of the cardinal flower but is blue or occasionally white; alternate on a stem in an elongate cluster to 1' long. Each flower is about 1" across and has 3 spreading lower petals and 2 upright petals united into a tube toward their base. Blooms from July to October. Flowers in the axils of leafy bracts of this plant, the lower bracts lanceolate, the upper reduced. Leaf: Thin, narrowly oblong to lanceolate, mostly 3-5", narrowed to a sessile base and irregularly serrate. **Stem:** Leafy stem. **Root:** Shallow, fibrous roots. **Soil:** It prefers rich, lowland wood, meadows and swamps. [7, 35]

Normal Water Level

This species is widely adapted to upland moist-to-wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Long -5 days (decreasing 6" the first day and 6" every 2 days thereafter). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Moderate. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

Blue lobelia is an attractive forb well suited to perennial gardens, rainwater gardens and other landscape designs. It provides wonderful cutflowers. Recommended restorations include calcareous fens, wet meadows, stream banks and rich woodlands or swamps. **Concerns:** Blue lobelia self seeds readily in gardens. [16]

Wildlife Use

Blue lobelia provides nectar and songbirds eat its seeds. Deer also like this plant. [21, 32]

Nursery/Plant Information

Available: Becoming widely. Types: Plants and seeds.

Planting Techniques

Approximately 7,520,000 seeds/lb. Plant near the soil surface. [16]



Lysimachia thyrsiflora

Tufted Loosestrife - a.k.a. Swamp Loosestrife

Habitat/Plant Community and Geographic Range

Habitat/Community: Thickets, shores, fens, bogs, marshes, low places in forested swamps, often in shallow water and found among cattails and sedges. [7, 35] **Range:** Minn. (Eco-Region: All), occassional in Wis., Mich. Circumboreal, s. to N.J., Ohio, Ill., Mo., Neb., Colo., Idaho and Calif. [7, 21]

Description

General: Perennial, upright herb which is conspicuously dotted with glands and usually 1-2' tall. **Flower:** "Tufts" of small, yellow flowers crowded in dense racemes in the leaf axils. Each flower is mostly 6-parted on which are dark markings. Blooms from June to August. **Leaf:** Opposite, narrow, linear leaves 1-5" long, smooth above and smooth or sparsely hairy below with no petioles. **Stem:** Erect stems are smooth or with patches of brown hairs, 12-28" long, unbranched or branched on lower stem. **Fruit:** A small capsule less than 3/16" wide. **Root:** Spreads by stoloniform rhizomes. [7, 35]

Normal Water Level

This species prefers shallow water of 3" of inundation or less. [21, 35, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Medium long – 4 days (decreasing 6" every 2 days). [1, 37]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. Salt: Unknown. Nutrient: Unknown.

Siltation: Unknown. **Insect:** Infrequent. [1]

Design Considerations

Tufted loosestrife is a good substitute for the invasive, non-native purple loosestrife. It prefers similar habitats of many types of wetlands and may be found among cattails and sedges in shallow water. Consider using this plant in wetland restorations and mitigation sites, if you can find a supplier.

Wildlife Use

No information available.

Nursery/Plant Information

Available: Very limited. Types: Seeds only.

Planting Techniques

Plant the small seeds near the soil surface.



Lythrum salicaria

Purple Loosestrife - a.k.a. Spiked Loosestrife, Spiked Lythrum, Salicaire, or Bouquet Violet

Habitat/Plant Community and Geographic Range

Habitat/Community: Introduced from Europe and sometimes planted as an ornamental, escaping to deep and shallow marshes, wet ditches, wet meadows, stream banks, cranberry bogs and shores. It is a serious threat to outcompete our native flora and has little value to wildlife. It is often associated with wetlands that have been disturbed by agricultural use, drainage, pasturing, siltation or water level fluctuations. [4, 7, 11, 35, 41] Range: Most common in c. and s. portions of our region. Ec. near Mississippi River, local elsewhere in Minn. (Eco-Region: All), Wis., LP of Mich. especially s., local in UP. Naturalized over much of e. and c. USA, s. Can.; local in w. USA. Within the Twin Cities, it is most abundant in the Lake Minnetonka area west of Minneapolis, and has become abundant in many marshes and along streams since about 1940. [7]

General Description

General: A stout, non-native, perennial herb often 3-6' tall. A very showy plant that often grows in large clones. Flower: Conspicuous, elongate clusters of purple flowers, 4-15" long composed of 6 crinkled petals. Each flower is ½-¾" wide, rising on short stalks near the leaf axils. Blooms from June to September. Leaf: Leaves are opposite or whorled, lance-shaped in 3s, entire, sessile, and sometimes clasping the stem and usually 1-4" long. One of the few plants that has both opposite and whorled leaves on the same plant. Stem: Woody, square or multiple-sided stems. Fruit: A capsule enclosed by the sepals. Root: Spreading and forming colonies by thick, fleshy rhizomes which send up new shoots. Soil: Tolerates many permanently saturated soil types. [4, 7, 11, 35, 41]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions, though it has been seen growing on floating mats. [37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 36". **Duration:** Long – 10 days (decreasing 12" every 2 days). Purple loosestrife tolerates water fluctuation at regular, irregular and seasonal periods. [1, 37]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** High. **Nutrient:** Unknown. **Siltation:** High. **Insect:** Insects are used as a biological control for this species. **Other:** Purple loosestrife spreads rapidly. It is highly invasive and considered a pest species in the Midwest. [1, 37, 47]

Design Considerations

No design considerations other than to eradicate this species.

Indicator Status: OBL



Wildlife Use

This species has little wildlife value. The large colonies that this species creates actually result in a loss of plant and animal diversity because it replaces higher-valued plant species. [4, 7, 11]

Nursery/Plant Information

This species does not seem to be available commercially anymore.

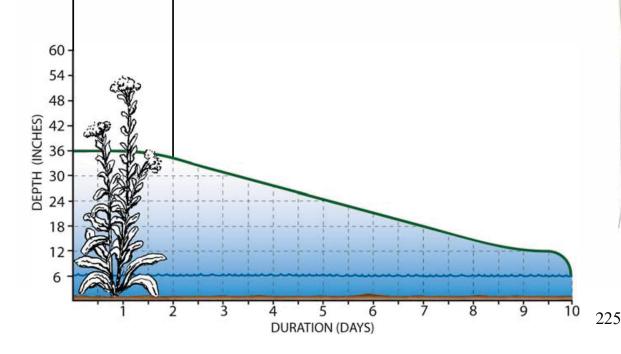


Planting Techniques

This species is a serious threat to our native flora and is of little value to wildlife. In addition to spreading vegetatively, a single plant may produce several hundred thousand seeds each year. **Do not plant this species.** [4, 7, 11, 35, 41]

Additional Notes

Purple loosestrife was once grown as a garden plant because of its striking, magenta flower spikes. Efforts are underway to reduce the loosestrife population by releasing beetles that feed on the plant's roots and leaves. [41]



Maianthemum racemosum

False Solomon's Seal - a.k.a. *Polygonatum Biflorum*, *Smilacina trifolia* - False Spikenard, Feathery False Solomon's Seal, Feathery Solomon's Plume, Solomon's Plume

Habitat/Plant Community and Geographic Range

Habitat/Community: Open bogs, conifer swamps, deciduous woods, mesic and dry savannas, and thickets. [7, 16, 35, 41] **Range:** N. and ec. Minn. (Eco-Range: 1, 2, 4-9), n. and c. Wis., Mich. Nfld. to Nw. Terr. and B.C., s. to N.J., Ohio, s. Wis. and Minn.; n. Asia. **Rare in se. Wis.** [7, 21]

Description

General: Native, perennial, woodland herb that grows 1-3' high. Flower: Stem ends in a dense cluster (3-5" long) of many small, star-shaped, white flowers 1/8" wide. Each flower has 3 petals and 3 sepals, giving the appearance of 6 petals, blooming in spring. Leaf: Alternate, elliptical-to-oval, stalkless leaves 3-6" long; hairy underneath with heavy, parallel veining. Stem: Unbranched stems, often arching, usually 1-2' long. Fruit: A cluster of waxy red berries, which may be conspicuous in the fall. Root: Elongate rhizome rootstalks that have scars on them, marking the attachment position of former aerial stems that are similar to the seal of King Solomon. Soil: Rich, mesic-to-dry forests. [7, 35, 41]

Normal Water Level

This species prefers upland moist conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Short -1 day (decreasing 12" in 1 day). This species has an intolerance to flood duration of 3 days or more. [1]

Sensitivities or Other Tolerances

Exposure: Partial sun to full shade. **Salt:** Low. **Nutrient:** Low to moderate. **Siltation:** Low. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1]

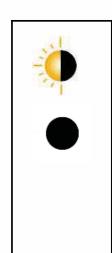
Design Considerations

False Solomon's seal has been used in woodland restoration as well as in some slope soil stabilization. It has beautiful dried seed heads, and is well suited to shady conditions. **Concerns:** It may become aggressive, though it does create a good woodland ground cover. [16]

Wildlife Use

This species is used to a limited extent by ruffed grouse, gray-cheeked thrush, olive-backed thrush, veery and white-footed mouse. Its waxy red berries are not edible to humans. [21, 32, 41]

Indicator Status: FACU



Nursery/Plant Information

Available: Widely. **Types:** Plants.

Planting Techniques

The seeds require moist, cold stratification for 180 days and dry storage. Fall planting with fresh or stored seed has a better success rate than spring planting. The plant is temperature sensitive during germination and requires a double dor-

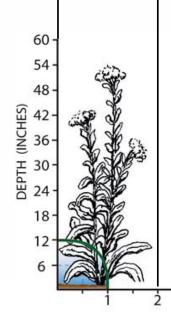
mancy. About 14,400 seeds/lb. [16]

5

DURATION (DAYS)



Photo: Paul Jackson



Matteuccia struthiopteris

Ostrich Fern - a.k.a. Pteridium nodulosa or Matteuccia struthiopteris var. persylvanica

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet woods, floodplain hardwoods, swampy woods, thickets, stream banks, seeps and ditches. Often found growing on alluvial deposits. [7, 11] **Range:** Minn (Eco-Region: All), Wis, Mich. Circumboreal; Nfld. to Alaska, s. to Va., Ohio, Mo., S.D. and B.C.; Europe. This species typically occurs north of the tension zone. [7, 21]

Description

General: Large, colony-forming perennial fern with erect, coarse, stout, leafy crowns growing to a height of 6'. Leaf: Two types of fronds. The sterile fronds are green and pinnate, which alternate and gradually reduce toward the base of the frond with a fine pubescence along the rachis. The fertile fronds are shorter, brown at maturity, and have inrolled pinnae, which enclose the sporangia. They are produced midsummer to early fall and persist through the winter. Fruit: Sori hidden by inrolled pinnule margins with green spores. Root: Black, scaly, stoloniferous, rhizomes deep and long-creeping, producing erect, leafy crowns. Soil: Often growing on alluvial deposits. [7, 11]

Normal Water Level

This species prefers upland moist to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short -1 day (decreasing the entire 12" in 1 day). This species has a moderate tolerance to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Part sun to full shade. **Salt:** Low. **Nutrient:** Low to moderate. **Siltation:** Low to moderate. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 47]

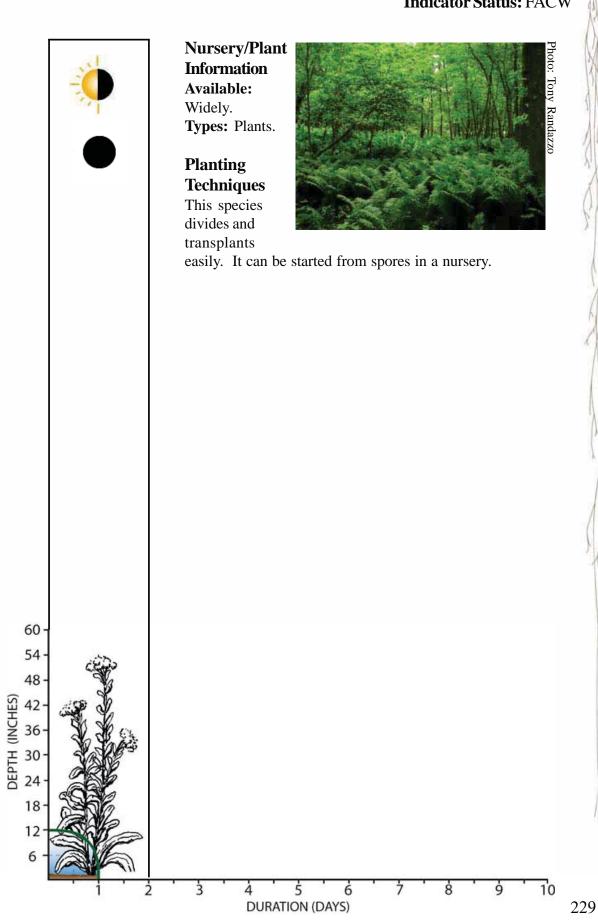
Design Considerations

A lovely, large fern that is used in wet woods, shaded landscapes that are moist, along wooded stream banks and seeps. It is ideal for alluvial deposits and other rich woodland soils. **Concerns:** Because this species spreads by rhizomes and forms large colonies, it may be aggressive in certain conditions. This may be desirable in some instances to compete with invasive species.

Wildlife Use

Ferns are widespread, especially in moist woodlands. Yet as a wildlife food source, they are used to a minor extent. Their leaves are eaten by deer, hares and grouse especially when other green plants are scarce. Ferns provide good cover for small mammals and songbirds. [21, 32]

Indicator Status: FACW



Monarda fistulosa

Wild Bergamot - a.k.a. Horsemint or Bee Balm

Habitat/Plant Community and Geographic Range

Habitat/Community: Mesic and dry prairies, savannas, open or brushy places, fields, often common on roadsides. [16, 17, 35, 41, 44] **Range:** Minn. (Eco-Region: All), Wis., Mich. Que. to Man. and B.C., s. to Ga., La. and Ariz. [17, 21]

Description

General: A native perennial herb that is usually 3-4' tall and clumped.

Flower: Lavender flowers that have 2 lips and are arranged in heads with lance-shaped, bracteal leaves. Heads are a round cluster, 1-2" wide; individual flowers are 1/4" long and tubular with a lower curved petal and a thin, straight petal. Blooms from July to August. Leaf: Hairy, opposite leaves with an odor of mint and citrus when crushed. The leaves are coarsely toothed, lance-shaped, 1-3" long and grow on short petioles. Stem: Erect, often branched, square stems that are usually hairy at least above, and produce a strong odor. Root: Spreads by rhizomes. Soil: Tolerates a wide variety of soil conditions. [17, 35, 41, 44]

Normal Water Level

This species prefers upland moist to dry conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short – 2 days (decreasing 6"/day). Wild bergamot has minimal inundation tolerance and is somewhat tolerant to flood duration. [1, 44]

Sensitivities or Other Tolerances

Exposure: Full sun to part shade. Salt: Moderate. Nutrient: Moderate.

Siltation: Moderate. Insect: Low to moderate. Other: This species often suffers from

mildew and is moderately tolerant to general disturbance. [1, 44, 47]

Design Considerations

Wild bergamot is a beautiful mint that is used in slope and buffer stabilization because of its ability to hold soil. This species provides wonderful cut and dried flowers. It is used in landscape design where it may be a little unruly due to its aggressive behavior. It is an early successional species that is used in restorations, especially moist-to-dry prairies. It provides wildlife habitat and makes a great mint tea. **Concerns:** This species, though short lived, can be very aggressive. [16, 44]

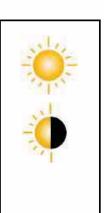
Wildlife Use

A nectar source for butterflies, bees and hummingbirds. It is also palatable in early growth by grazing species, such as deer, cattle and geese. [16, 21, 41, 44]

Nursery/Plant Information

Available: Widely. **Types:** Plants and seed.

Indicator Status: FACU



Planting Techniques

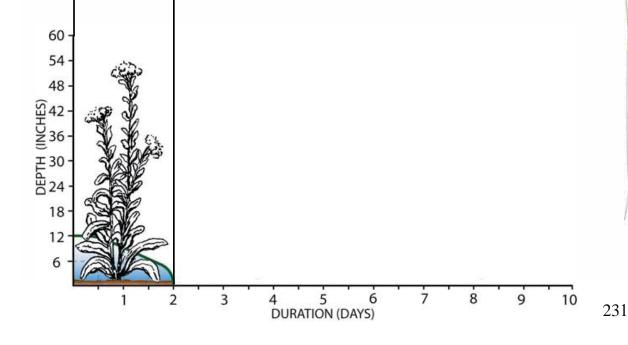
The seeds do not require treatment and establish easily. Seed will germinate better under high light levels and warm temperatures. Store the seed in a dry, cool area. Recommended seeding rate is 0.125-1.0 lb/acre, with approximately 1,248,000 seeds/lb. Mature clumps can be divided in March before stems emerge. Dig the entire plant before dividing and replant



immediately. It will also establish from cuttings. [16, 44]

Additional Notes

Native Americans used this species to treat digestive and respiratory ailments. "Bergamot", refers to a small citrus tree that produces a similar odor. This mint's oil is an essential flavoring ingredient in Earl Grey tea. [35, 41]



Oligoneuron riddellii Riddell's Goldenrod

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, calcareous fens, low prairies, lake shores and stream banks. It prefers to be supported by groundwater seepages. [7, 11, 16] **Range:** W. and s. Minn. (Eco-Range: 4, 7-9), c. and s. Wis., c. and s. LP of Mich. Ont. to e. N.D. and S.D., s. to Ohio and Mo. [7, 21]

Description

General: Perennial, native herb 2-3' in height. Flower: The inflorescence is a flattopped, hairy head with many and crowded – rarely less than 50 – often several hundred yellow ray flowers with 7-9 rays, each blooming from September to early November. Leaf: The lower basal leaves are better developed and usually persistent. The leaves are many along the stalk; sickle-shaped, folded, triple-nerved and not dotted with glands. They persist up to flowering time. Stem: Generally stout, smooth except for some hairs in the inflorescence. Fruit: Smooth achenes with 5-7 nerves. Root: A crown, sometimes with rhizomes. Soil: Many mesic-to-saturated soils, including calcareous. [7, 11]

Normal Water Level

This species prefers upland moist to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. Depth: 12". Duration: Short – 2 days (decreasing 6"/day).

Sensitivities or Other Tolerances

Exposure: Full sun. **Salt:** Moderate. **Nutrient:** Moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species is moderately tolerant to general disturbance and stress. [1]

Design Considerations

Riddell's goldenrod is well suited for wetland and calcareous restoration or mitigation sites. It provides a nice landscape plant and cutflowers. It also provides good bird and butterfly habitat. [16]

Wildlife Use

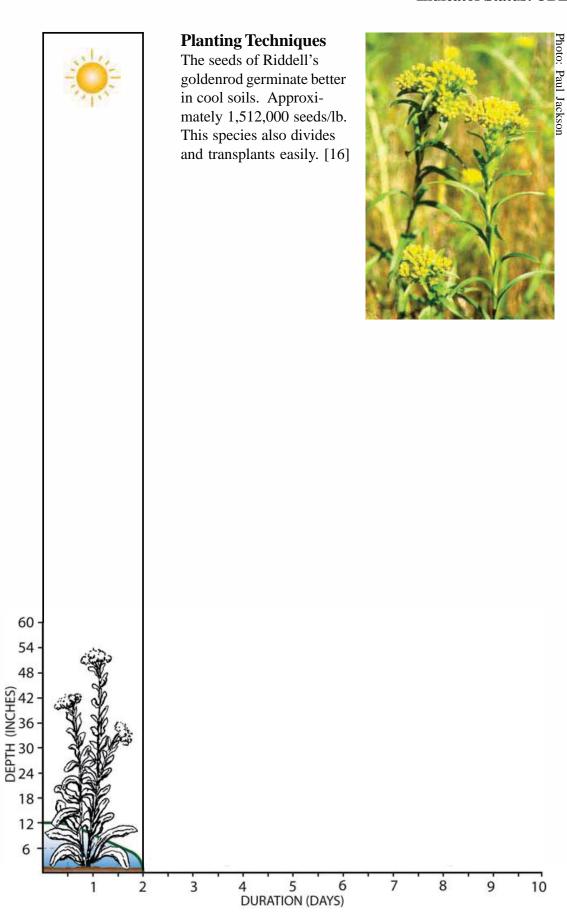
Goldenrod leaves are eaten to a limited extent by ruffed, sharp-tailed and spruce grouse. Goldfinches, juncos, and swamp and tree sparrows eat the seeds. Rabbits eat the foliage and plants. Mice eat the seed heads and foliage. This species is a butterfly favorite also. [21, 32]

Nursery/Plant Information

Available: Widely. **Types:** Plants and seeds.

Indicator Status: OBL

233



Oligoneuron rigidum

Stiff Goldenrod - a.k.a. Stiff or Hard-leaved Goldenrod

Habitat/Plant Community and Geographic Range

Habitat/Community: Mesic-to-dry open spaces, fields, prairies, savannas and along roadsides, especially in sandy soils. [16, 17, 35, 41] **Range:** Minn. (Eco-Region: All), Wis., Mich. R.I., Conn., w. Mass. and N.Y. to Ga., w. to Alta. and N.M., more common westward. [17, 21]

Description

General: Native, perennial herb that stands up to 5' tall and is worthy of growing for its very attractive foliage topped with a broad, flat cluster of yellow flower heads.

Flower: Yellow flower heads are in a wide, flat bloom from August. to September.

Each flower head has 7-10 ray flowers and 20-30 center disk flowers. Leaf: Alternate stem leaves that are oval to oblong. The stalked basal leaves stand erect (hence, the common name) and are rough with short, stiff hairs. The plant's round, fleshy leaves makes it easy to identify. Stem: Stiff, hairy, often clumped in 2s and 3s, that branch into flower heads near the top of the plant; 2-4' tall. Fruit: 10-20 nerved achenes that are angular. Root: Stout, branched caudex. Soil: Mesic-to-dry soils, especially sandy. [17, 35, 41, 44]

Normal Water Level

This species prefers upland moist/mesic to dry conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Low to moderate. **Depth:**12". **Duration:** Short -2 days (decreasing 6"/day). This species has a minimal flooding tolerance. [44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Low to moderate. **Siltation:** Low to moderate. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 44, 47]

Design Considerations

Stiff goldenrod is used in upland buffers and slope stabilization. It does well in well-drained rain water gardens. It provides cutflowers and nectar for butterflies. It self-sows easily. **Concerns:** Because this species self-sows, it can be aggressive. [16, 44]

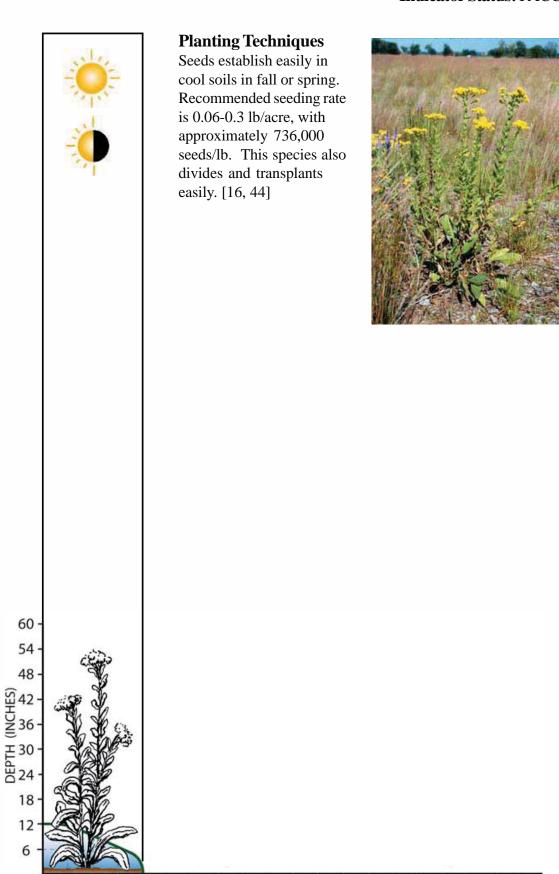
Wildlife Use

Goldenrod leaves are eaten to a limited extent by ruffed, sharp-tailed and spruce grouse. Goldfinches, juncos, and swamp and tree sparrows eat the seeds. Rabbits eat the foliage and plants. Mice eat the seed heads and foliage. This species also is an excellent source for nectar for butterflies, bees, flower flies and beetles. [21, 32, 41, 44]

Nursery/Plant Information

Available: Widely. Types: Seed.

Indicator Status: FACU-



4 5 6 DURATION (DAYS) 8

10

235

3

Onoclea sensibilis Sensitive Fern

Habitat/Plant Community and Geographic Range

Habitat/Community: Swampy woods, low areas in moist forests, alder thickets, shrub-carrs, wet meadows, calcareous fens, shaded ponds, roadsides and ditches (it can be found in wet or moist wheel ruts). [7, 11, 16] **Range:** All but sw. and extreme nw. Minn. (Eco-Region: 1-8), Wis., Mich.; Nfld. to Man., s. to Fla. and Tex. [7, 21]

Description

General: This distinctive fern has broad, green fronds and separate brown, fertile fronds that are attractive year-round. It grows 12-24" tall and forms large patches. A mass of pale red fiddle-heads forms in the spring. Leaf: Sterile fronds can reach 24" tall. It is deciduous, leathery, light green in color, and simple. The deeply pinnatifid leaflets occur as 8-12 paired segments that are 0.5-2" wide, with a characteristic net venation. The upper side of leaflet is smooth and the bottom side has scattered white hairs, usually on the veins. The rachis is broadly winged as are the upper leaflets. The fertile fronds are about 12" tall, turning dark brown at maturity and develop in midsummer to persist through winter. They are upright, with many short leaflets that form small, inrolled, bead-like divisions (pinnules). These divisions contain the spore cases. Root: Spreads by branching rhizomes.

Soil: Prefers saturated, fertile soils. [7, 11]

Normal Water Level

This species prefers shallow water of 3" of inundation or less to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Medium long – 4 days in summer (decreasing 6" every 2 days), 30 days in spring. Sensitive fern can tolerate regular, irregular and seasonal inundation with moderate tolerance to flood duration. [1, 37]

Sensitivities or Other Tolerances

Exposure: Partial sun to full shade. **Salt:** Low. **Nutrient:** Low. **Siltation:** Low. Insect: Infrequent. Other: Sensitive fern has a moderate rate of spread and is moderately tolerant to general disturbance and stress. [1, 37, 47]

Design Considerations

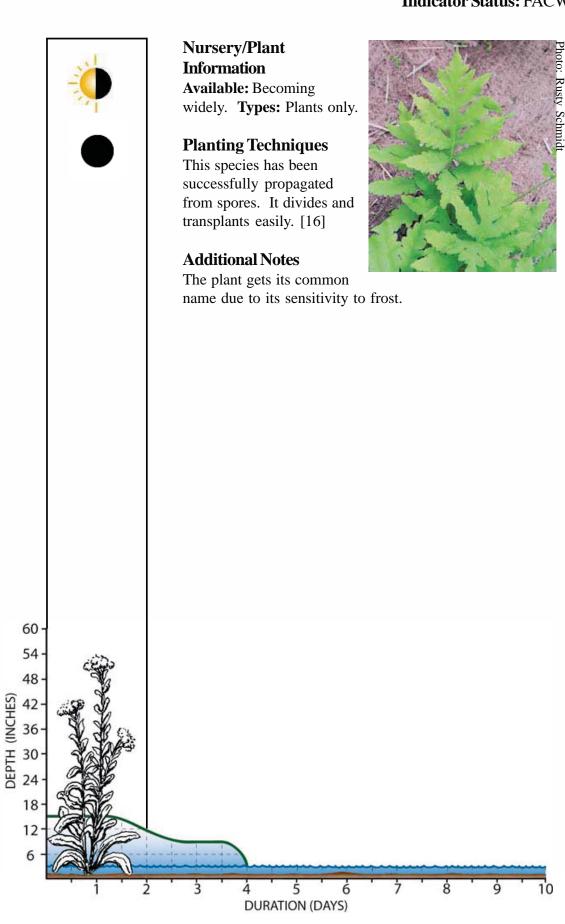
Sensitive fern is a good ground cover in wet to inundated areas of partial sun or less. It will work well in rain water gardens that do not dry out completely. A good wetland restoration plant for shrubby or wet meadow areas, especially in calcareous conditions. Good winter interest and useful in dried flower arrangements. [16]

Wildlife Use

Ferns are widespread, especially in moist woodlands. Yet as a wildlife food source they are used only to a minor extent. Their leaves are eaten by deer, hares and grouse especially in seasons when other green plants are scarce. Ferns are a good habitat cover plant for small mammals and songbirds. [21, 32, 37]

Indicator Status: FACW

237



Osmunda regalis

Royal Fern - a.k.a. Flowering Fern

Habitat/Plant Community and Geographic Range

Habitat/Community: Bogs, swamps, forests, alder thickets, and shallow pools (soil is usually acidic). [7, 17] **Range:** Ne. and ec. Minn. (Eco-Region: 1, 6, 8), Wis., Mich. Circumboreal, Nfld. to Sask., s. to Fla., Tex. and tropical Amer. [7, 21]

Description

General: Royal fern is a unique perennial fern 3' or more tall. **Leaf:** Highly attractive foliage of numerous erect fronds, reddish at first but becoming green. Blades are broadly ovate, 15-30" long and 12-20" wide with 2-pinnate opposite divisions (pinnules). The pinnules are well-spaced, oblong, rounded at tips, with entire or finely toothed margins. The fronds are rounded in back with broad, stipule-like basal wings. The fertile fronds have the uppermost several pinnae replaced by sporangia clusters. **Stem:** Smooth, green or red-green petioles to 3/4 length of blade.

Root: Stout rhizomes, with persistent leaf bases and fibrous roots but lacking scales. **Soil:** Prefers acidic soil. [7, 17]

Normal Water Level

This species prefers shallow water of 3" of inundation or less to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Medium long – 4 days in summer (decreasing 6"every 2 days). Royal fern is tolerant to regular, irregular and seasonal inundation with a moderate tolerance to flood duration. [1, 37]

Sensitivities or Other Tolerances

Exposure: Full sun to full shade, though prefers partial shade. **Salt:** Low. **Nutrient:** Low. **Siltation:** Low to moderate. **Insect:** Infrequent. **Other:** This species has a slow rate of spread and a moderately low tolerance to general disturbance and stress. [1, 37, 47]

Design Considerations

Royal fern is a beautiful specimen plant for landscape designs and rainwater gardens. It is also a good ground cover plant for buffers to wetlands, especially pools, swamps and thickets. **Concerns:** Slow rate of spread.

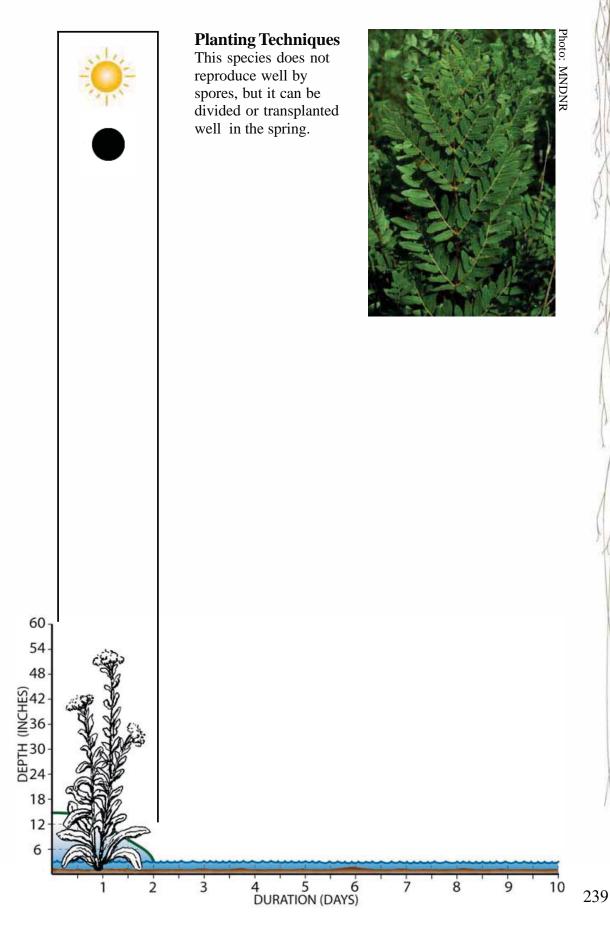
Wildlife Use

Ferns are widespread, especially in moist woodlands; yet, as a wildlife food source, they are used only to a minor extent. Their leaves are eaten by deer, hares and grouse, especially in seasons when other green plants are scarce. Ferns are a good habitat cover plant for small mammals and songbirds. [32, 37]

Nursery/Plant Information

Available: Becoming widely. Types: Plants only.

Indicator Status: OBL



Panicum virgatum

Switchgrass

Habitat/Plant Community and Geographic Range

Habitat/Community: Open woods, dunes, shores, brackish marshes, mesic prairies and buffer slopes. [16, 17, 44] **Range:** Minn. (Eco-Region: All), Wis., Mich. N.S. and Que. to Man. and Mont., s. to Ariz., Mex. and W.I. [17, 21]

Description

General: Coarse, native, perennial grass growing to 6½'. Stout and erect. It is a fast-growing clump. Flower: Attractive, open beige inflorescence from July to October. The inflorescence freely branches in a pyramidal shape 8-15" long. The spikelets are ovoid, soon widened distally by spreading of the glumes and sterile lemmae. The leaves are conspicuously veined. Leaf: Firm, elongated linear, smooth leaves, 8-20" long and ½" wide. The ligule is a dense zone of silky hairs. Stem: 6' tall stems bearing open panicles of spikelets. Root: Hard, scaly rhizomes, often forming large tufts. Soil: Suited to soils ranging from mesic to wet, though prefers dry-to-moist, sandy soils, especially along shores. [17, 44]

Normal Water Level

This species prefers mesic conditions, though it will tolerate dry to wet/saturated conditions. [6, 21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Medium short – 3 days (decreasing 6"/day). Switchgrass will tolerate irregular and seasonal inundation as well as drought and somewhat tolerant to flood duration. The seedlings decrease in abundance with a flood-depth increase. [1, 8, 37, 44]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Moderate to high. **Nutrient:** Low to moderate. **Siltation:** Moderate. **Insect:** High. **Other:** This species has a slow rate of spread and a moderate tolerance to general disturbance. [1, 8, 37, 44]

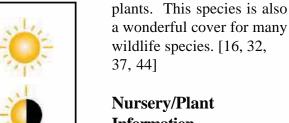
Design Considerations

Switchgrass has been used in stream bank, buffer, transitional and slope stabilization, especially where sandy. It is an excellent soil stabilizer. It is ideal winter cover for wildlife, pasture lands, waterways and other low, moist areas. It has an airy-looking head that makes a great space filler and is used in dried arrangements. **Concerns:** It is an aggressive species that may be appropriate for competing with invasive or non-native species. [6, 16, 37, 44]

Wildlife Use

This species is an important source of food for ground-feeding songbirds and gamebirds (snipe, turkey, pheasant, mourning dove, redwing blackbird, bobolink, cardinal, cowbird, junco and all sparrows for this area). Teal, widgeon and black duck eat the seeds and young foliage. Muskrats and rabbits eat the foliage and

Indicator Status: FAC+



Information

Available: Widely. **Types:** Seed and plants.

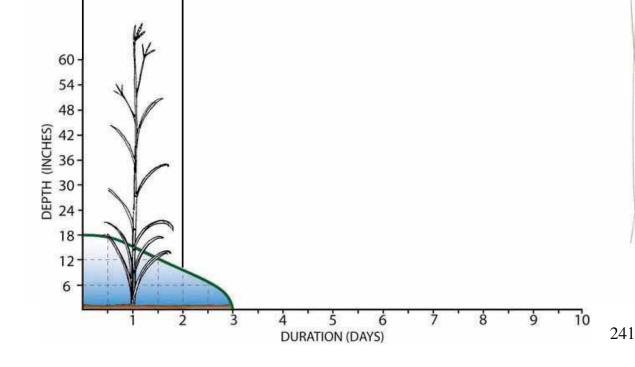
Planting Techniques

Switchgrass germinates best with alternating temperatures, high-light levels and warm temperatures of approximately 70 degrees F. Photo: Paul Jackson

No treatment is needed for stored seed. Planting in fall has a better success rate. Recommended seeding rate is 0.25-1.0 lb/ acre, with about 288,000-310,000 seeds/lb. Since this species has a slow rate of spread, plant seedlings or rhizomes 0.5-1.5' apart. [16, 37, 44]

Additional Notes

The 'Blackwell' cultivar has given this species a very bad reputation for being aggressive. The native switchgrass is not more aggressive than other native grasses. [16]



Phalaris arundinacea

Reed Canary Grass

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, shallow marshes, ditches, shores, shrub swamps, wooded swamps and streambanks. Reed canary grass is an extremely aggressive species that often forms persistent, monotypic stands on sites disturbed by agricultural use, drainage, filling, siltation and other factors. [4, 7, 11] **Range:** Common to abundant; Minn. (Eco-Range: All), Wis., Mich. Circumboreal, Nfld. to Alaska, s to N.C., Mo., Okla., N.M., Ariz. and Calf. [7, 21]

Description

General: Tall, probably a non-native strain, perennial grass that typically forms large, dense colonies. Flower: A narrow, densely flowered panicle, 2-10" long, often purpletinged. The branches are short and upright. Spikelets break above the glumes, with 1 fertile flower and 2 small, sterile lemmae below. Glumes are lance-shaped, tapered to tip, becoming straw-colored with age with 3 veins. The fertile lemma is ovate, shiny and blooms from June to July. Leaf: Flat and smooth, and usually 4-8" long and 1" wide, with smooth sheaths and a large, dry, papery ligule. Stem: Stout, smooth, branched stems 2-6' tall. Root: Spreading by rhizomes. Soil: Disturbed soils of any type, although it prefers it moist to wet. [4, 7, 11]

Normal Water Level

This species prefers shallow water of 12" of inundation or less to wet/saturated conditions, although it will tolerate drier soils. Waterlogged conditions in the spring can stop growth of the rhizomes. [9, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Long – 8 days (decreasing 6" every 2 days). This species will tolerate and even prefers regular and seasonal inundation with duration. Seedlings will decrease in abundance with flood depth increases, where mature plants are moderately tolerant. Mature plants are also tolerant with frequency increases and moderately so with flood depth decreases. [1, 37]

Sensitivities or Other Tolerances

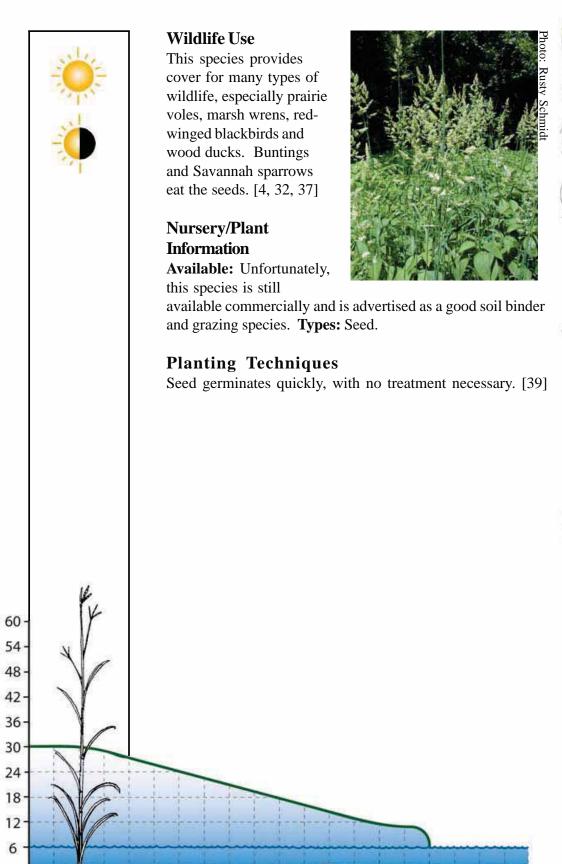
Exposure: Full to partial sun. **Salt:** High. **Nutrient:** High with increased abundance with an increase of N. **Siltation:** Moderate, 0-8 cm/year. **Insect:** Infrequent. **Other:** Reed canary grass has a rapid rate of spread. It has a high tolerance to general disturbance and stress. It has a moderate tolerance to iron concentrations. [1, 37]

Design Considerations

It has no design considerations other than to remove and manage this species. Reed canary grass has been planted for erosion control on upland and wetland sites, and for lowland pasture. The European strain of this grass has essentially assimilated the native strain. **Concerns:** Reed canary grass is an extremely aggressive, probably nonnative species that often forms persistent, monotypic stands on sites disturbed by agricultural use, drainage, filling, siltation and other factors, often to the detriment of other plants. [4, 7, 11, 37]

Indicator Status: FACW+

243



DURATION (DAYS)

DEPTH (INCHES)

Physocarpus opulifolius

Ninebark - a.k.a. Common Ninebark or Eastern Ninebark

Habitat/Plant Community and Geographic Range

Habitat/Community: Stream banks, lake shores, swamps, rocky or sandy creek banks, sluggish streams, pond shores, seepage areas, bogs, moist limestone cliffs and rocky shores of the west side of Lake Superior. [7, 16, 22] **Range:** E. Minn., especially near Lake Superior and the Mississippi River (Eco-Region: 1,5-8), Wis., Mich.; Que. to N.D. and Colo., s. to N.C., Tenn. and Ark. [7]

Description

General: Mound-forming shrub with closely spaced stems that grows 8-10' tall. **Flower:** White flowers that are 5-parted, no wider than 3/8" with many in stalked, rounded clusters at ends of branches and in bloom from May to June. **Leaf:** Ninebark's maple-like leaves are alternate; ovate in outline; mostly 3-lobed; dark green above, paler and often sparsely hairy below. The margins are irregularly toothed, with 3/8-3/4"-long petioles. Yellow-green foliage turns to maroon-purple in autumn. **Bark:** Loose bark, shredding in long, thin strips. **Twigs:** The long, greenish branches are covered with loose bark, slightly angled, smooth or finely hairy. **Fruit:** A red-brown pod to 3/8" long in round clusters. The 3 or 4 seeds in each pod are shiny and produced from June to July. **Root:** Fibrous, shallow, lateral roots. **Soil:** Loams to clay soils. [7, 8, 22]

Normal Water Level

This species prefers upland dry to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/day). This species is very flood tolerant, though seedlings are somewhat tolerant to flood duration and saplings are moderately tolerant. [1, 8, 22]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** High. **Other:** Ninebark is damaged occasionally by wind and ice. It is resistant to drought, heat and soil compaction. This species has a moderate tolerance to general disturbance and stress. [1, 8, 21, 22, 25]

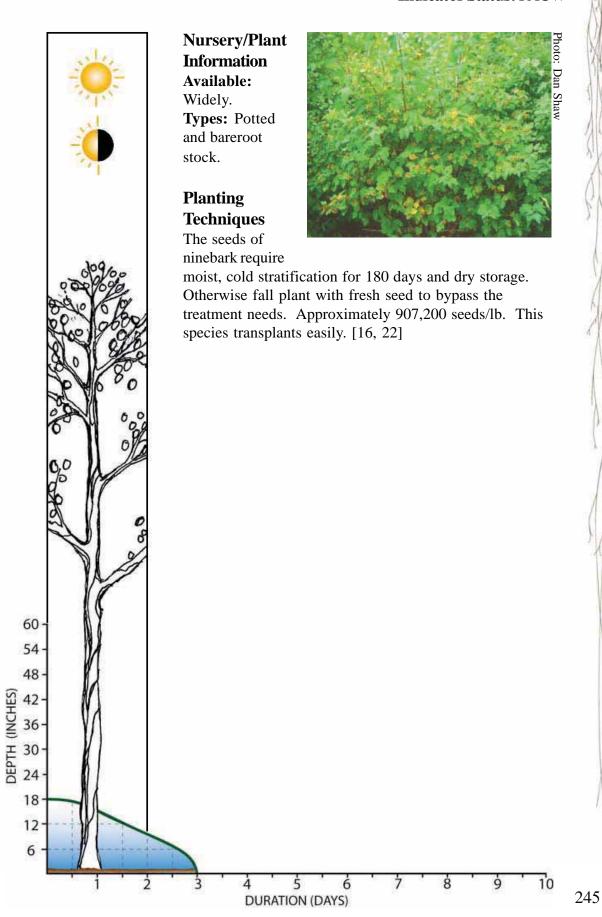
Design Considerations

Ninebark is a popular foundation shrub because it is tough and easy to maintain. It is also a good shrub for restorations along streams, lakes, swamps, calcareous conditions and areas along Lake Superior. [7,16]

Wildlife Use

This species provides food for waterfowl, marsh birds, shorebirds, upland gamebirds and small mammals. It is highly sought after by deer. The fruit is not edible to humans. [21, 22, 32]

Indicator Status: FACW-



Physostegia virginiana

Obedient Plant - a.k.a. *Physostegia virginiana speciosa* - Obedience, Lion's Heart, False or Showy False Dragonhead

Habitat/Plant Community and Geographic Range

Habitat/Community: Sedge meadows, low prairies, marshes, moist and open woods, stream banks, shores, swamps, flood plain forests, thickets and ditches. [7, 16, 35] **Range:** Minn. (Eco-Region: All), Wis., Mich. Que. to Man., s to Va., Tenn., Ill., Mo. and ne. Kan. [7, 21]

General Description

General: Erect, native, perennial herb, usually 2-3' tall. Flower: The showy, rosypink-purple flowers are about 1" long, borne in a spirelike, often branched, cluster that blooms from July to October. When the flower is pushed into a new position, it will remain there, giving the species its alternate name, obedient plant. Leaf: Elongate, oval, lance-shaped, opposite leaves that are smooth and without hairs, typically ¾-6" long, with sharp teeth margins and stalkless, not clasping. Stem: Erect stems 2-3' long that are often branched near top, 4-angled and smooth, without hairs. Fruit: a small achene forming from July to September. Root: Spreading by rhizomes. Soil: Tolerant of many types. [7, 35]

Normal Water Level

This species prefers shallow water of 3" of inundation or less to wet/saturated conditions and will tolerate moist, upland conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short -2 days (decreasing 6"/day). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Moderate. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 47]

Design Considerations

A wonderful landscape plant that is a popular perennial for gardens. Obedient plant has been used successfully in rain water gardens and should be considered in lakescaping, pond edges and other shoreland zones. It provides good cut flowers. **Concerns:** This species has rhizomes and can be aggressive, though that may be desirable when competing against invasive or non-native species. Many cultivars are available. [7, 16]

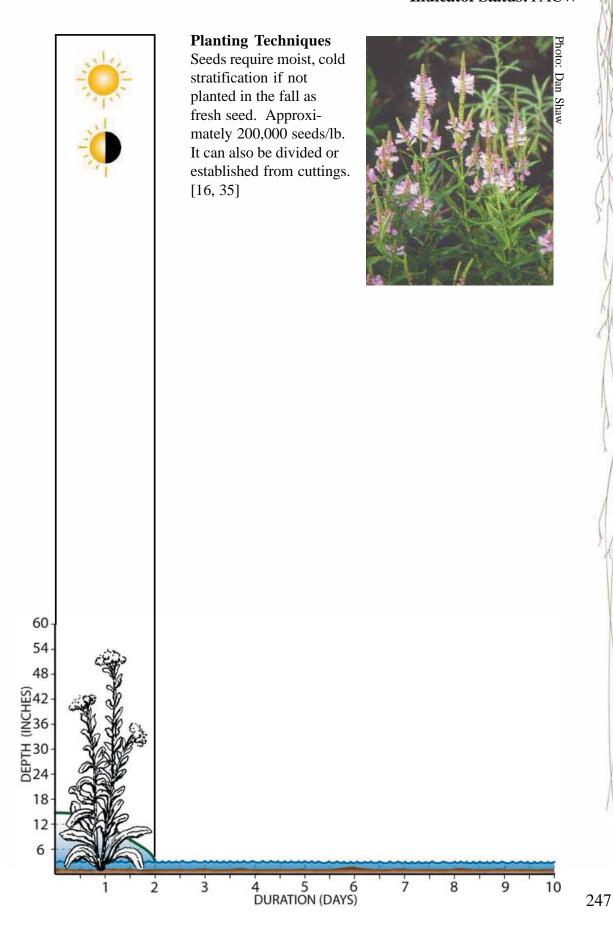
Wildlife Use

Obedient plant is a good nectar source for hummingbirds and butterflies. [16, 21]

Nursery/Plant Information

Available: Widely. Types: Plants and seed.

Indicator Status: FACW



Polygonum amphibium

Water Smartweed - a.k.a. P. amphibium stipulaceum, P. coccinum – Water Knot Weed; Marsh, Knotted or Nodding Smartweed

Habitat/Plant Community and Geographic Range

Habitat/Community: Ponds, lakes, marshes, bog pools, shores, backwater areas and quiet streams. [7, 11] **Range:** Minn. (Eco-Region: All), Wis., Mich. Widespread in N. Hemisphere. [7, 21]

Description

General: A highly variable perennial floating or emergent herb typically 3' tall. **Flower:** Usually a solitary terminal spike of densely crowded red-pink flowers. Blooms from June to August. **Leaf:** This species is divided into two forms -- an aquatic form and a "terrestial" form. Both forms have several lance-shaped leaves along the elongate stem. The aquatic form (formerly known as *P. natans*) has submergent and glabrous, floating leaves ³/₄-6" long and under ³/₄" wide. The terrestrial form (formerly known as *P. coccineum*) has erect, densely hairy leaves usually less than 2" wide. **Stem:** Prostrate or erect stems to a length of under 3' when terrestrial and under 6' when aquatic. The ocrea of at least the aquatic form exhibits a green flange at its summit. **Fruit:** Lensshaped achene, shiny, dark brown from June to September. **Root:** Spreading, long, forking rhizomes. **Soil:** Moist-to-wet soils with a pH range of 5.4-8.8. [7, 11, 44]

Normal Water Level

This species prefers areas with 36" of inundation or less. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Short - 2 days though will have extended duration at 18". This species will tolerate a wide range of inundation at a regular to seasonal conditions and moderate duration. It is very tolerant to flood depth increases and will increase in abundance with depth decreases. [1, 37, 44]

Sensitivities or Other Tolerances

Exposure: Partial to full sun. **Salt:** Low. **Nutrient:** Moderate to low. **Siltation:** Moderate to high. **Insect:** Infrequent. **Other:** It will tolerate waves and a wide range of inundation conditions. This species has a moderate-low tolerance to general disturbance and stress. [1, 44]

Design Considerations

Water smartweed has been used in shoreland, wave-reducing and erosion-control zones. It should be considered for ponds, lakes, marshes and backwater-area restoration sites. This species is a good food source for wildlife. It will establish from the seedbank and is favored by drawdowns. **Concerns:** This species grows in large, dense beds, which may choke out other vegetation. [26, 42, 44]

Wildlife Use

Water smartweed a good food source for wildlife. It is popular with waterfowl and valued by many of our most common and best-loved songbirds. The waterfowl include black, mallard, pintail, redhead, ring-necked, scaup, teal and wood ducks, Canada geese

and trumpeter swans. The songbirds include redwing blackbird; cardinal; rose-breasted grosbeak; junco; redpoll; and fox, savannah, song, swamp, vesper, white-crowned and white

crowned and white-throated sparrow. This species also serves as a major food source for the purplish copper butterfly and provides cover for fish. Chipmunks and mice also use this plant as food. [6, 21, 32, 44]



Photo: Jason Husveth



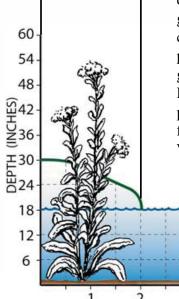
Available: Limited. **Types:** Plants and rhizomes.

4 5 6 DURATION (DAYS)



Planting Techniques

The achenes of water smartweed should be cold, wet stratified for 90+ days. Germination requires high light levels. Fresh seeding in the fall has better establishment rates. Smartweeds does well from seedbanks, and drawdowns may promote germination. This species can also be established by taking cuttings from the top part of the stems and burying the lower portion of the cuttings. Or, cuttings can be broadcast and gently raked into loose soil and then rolled to firm the surface. Rhizomes may also be planted in moist soils. Seedlings can be planted in muddy soil to a depth of 12". Spring drawdowns followed by shallow flooding has improved establishment. Water smartweed is a fast colonizer. [6, 26, 42, 43, 44]



Pontederia cordata

Pickerelweed - a.k.a. Pickerel Plant

Habitat/Plant Community and Geographic Range

Habitat/Community: Lakes, ponds, rivers, marshes, bogs, swamps and Mississippi River backwaters, often forms large colonies (shallow water to 1 m deep). [4, 7, 11, 41] **Range:** E. Minn. (Eco-Region: 1, 6, 7), w. ½ of Wis., but local in UP of Mich. N.S. to Ont. and Minn., s. to S. Amer. [7, 21]

Description

General: Pickerelweed is a nonpersistent, emergent, native, herbaceous perennial that is found in shallow water (rarely more than 3' deep) or saturated substrates to a height of 40". Flower: Violet-blue (rarely white) flowers are packed into a dense spike, 4-6" long that blooms from June to August. Individual flowers are ½" long and have 3 upper petals (the middle upper petal has 2 small, yellow spots) and 3 lower petals. Leaf: Heart-shaped to lanceolate leaves up to 7" long that has a potential of rosettes of submerged, ribbon-like leaves. The leaves are long-petioled and are dark green and glossy. Stem: Stout, upright, to 48" long, with 1 leaf. Fruit: A small, 1-seeded utricle produced from June to September. Root: Spreading, thick and creeping rhizomes, which form colonies. Soil: Shallow water or saturated substrates of muck or mud. [4, 7, 11, 41]

Normal Water Level

This species prefers shallow water 12-18" deep, though it will tolerate wet/saturated conditions or water depths of 36" or less. It also prefers fresh or slightly brackish water. [11, 37, 41]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Medium long – 4 days (decreasing 6" every 2 days). Pickerelweed will tolerate regular flooding of small levels and moderate duration. It is very tolerant to flood depth increases and will increase in abundance with depth decreases. [1, 37]

Sensitivities or Other Tolerances

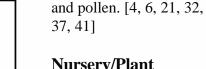
Exposure: Full sun to partial shade. **Salt:** Low. **Nutrient:** Unknown. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderately low tolerance to general disturbance and stress. [1, 6]

Design Considerations

Pickerelweed has been used in restorations of back waters, slow-moving streams and lake shores. It is a very decorative plant for water gardens and lake shores. It provides good habitat. **Concerns:** Pickerelweed does not always persist after planting, although once established it can produce very large beds.

Wildlife Use

Pickerelweed provides seeds for waterfowl, especially black and wood ducks. Muskrats eat the plants and roots. It also provides wonderful cover for frogs and fish. The small solitary bee, *Halictoides novae-angliae*, will visit this plant exclusively for nectar



Nursery/Plant Information

Available: Widely. **Types:** Roots, seeds and plants.

Planting Techniques

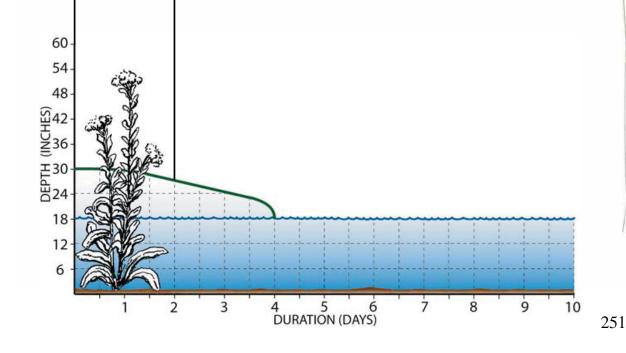
Pickerelweed seed requires moist, cold stratification if it is not broadcast fresh in the fall. Approximately 5,000 seeds/lb. Seedlings have proven successful in some situations if planted



in 6" to 2' of water, at a density of about 1,000/acre. Rhizome planting also has been successful at about 500 roots/acre. [4, 37]

Additional Notes

The common name refers to the pickerel, a fish that shares a similar habitat. [41]



Populus deltoides

Eastern Cottonwood - a.k.a. Carolina Poplar, Southern Cottonwood or Cottonwood

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forest, stream banks, wet ravines, sand bars, shores, wet meadows, windbreak, shelterbelt plantings and ditches. It is typically a pioneering species of disturbed sites, such as berms, ditches, sand bars and quarries. [7, 11, 22, 36] **Range:** All but ne. Minn. (Eco-Region: 2-9), c. and s. Wis., s. Mich. Que. to Sask., s. to Fla., Tex. and Ariz. [7, 21]

Description

General: Large, deciduous tree 75-100' or more tall, with a large trunk (often 3 to 4' or more in diameter) and a broad, rounded crown of spreading and slightly drooping branches. Flower: Brownish catkins 2-3½" long. The male and female catkins are on separate trees that flower April to May. Leaf: Triangular, long-pointed leaves 3-7" long and 3-5" wide that are usually straight at the base with curved, coarse teeth. The leaves are slightly thickened and shiny green in color, turning pale yellow in autumn. The leafstalks are long, slender and slightly flattened. Bark: Young bark is yellowish-green and smooth, turning light gray, then thick, rough and deeply furrowed. Twigs: Brownish, stout twigs with large resinous or sticky buds. Fruit: 3/8"-long, elliptical capsules that are light brown and mature in spring. The capsules split into 3 or 4 parts, with many on slender stalks in catkins 8" long and spreading thousands of tiny, cottony seeds that are carried by the wind long distances. Root: Shallow, fibrous roots. Soil: Tolerates most moist and wet/saturated soils, especially sandy or alluvial. [7, 8, 11, 22, 36]

Normal Water Level

This species prefers upland moist-wet/saturated conditions, though it will also tolerate drier conditions. The best growth for this species is when the water level is 2' below surface. [5, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 60". **Duration:** Long – 30 days (decreasing 12" every 2 days, then will level out at 18" until 30 days). Eastern cottonwood will tolerate seasonal flooding for long periods. For flood duration, tolerant as an adult, moderately so as a sapling and somewhat tolerant as a seedling. Seedlings are unaffected by flood depth increases in the spring, though fall flooding will decrease the population. [1, 8, 22, 37]

Sensitivities or Other Tolerances

Exposure: Full sun. Salt: High. Nutrient: Moderate. Siltation: High.

Insect: Frequent – bronze birch borer, poplar borer, poplar tent maker. **Other:** Cottonwood is frequently susceptible to poplar canker, Cytospora canker, Fusarium canker, leaf blister, branch gall and dieback. Wind and ice frequently damage it due to its very weak wood, and it is sensitive to lighting. It does have resistance to drought, heat, oil/grease, metals, mine spoils and soil compaction. This species has a moderate tolerance to general disturbance and stress. [1, 2, 8, 10, 22, 37]

Design Considerations

This species has been planted as a shade tree and for shelterbelts. Although it is short lived, it is one of the faster growing trees, which may help shade or reforest a restoration quickly.

Indicator Status: FAC+

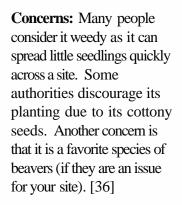




Photo:www.cala2.umn.edu/la5574

Wildlife Use

Eastern cottonwood provides habitat for many species, especially during winter. Ruffed and sharp-tailed grouse eat the buds and catkins in the winter and spring, as do the evening grosbeak and purple finch. The sap is utilized by the yellowbellied sapsucker. The tender bark, twigs and foliage are eaten freely by rabbits, deer, elk and moose. The wood and bark is a favorite of beaver and porcupine. Many songbirds use this species for nesting and habitat as do small mammals such as chipmunks, squirrels and mice. [21, 22, 32, 37]

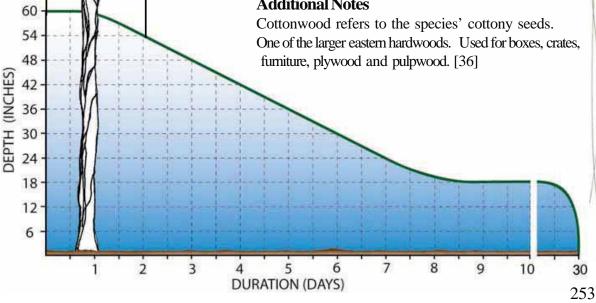
Nursery/Plant Information

Available: Widely. Types: Potted and bareroot plants.

Planting Techniques

This species is easily transplanted and moved as bareroot and balled-and-burlapped stock in spring and autumn with some care. It can also be propagated from cuttings. [15, 22]

Additional Notes



Populus tremuloides

Quaking Aspen - a.k.a. Trembling Aspen, Golden Aspen or Popple

Habitat/Plant Community and Geographic Range

Habitat/Community: Moist upland woods, seeps and streamsides, often on cut-over or burned land. Quaking aspen often invades abandoned agricultural lands and vacant urban lands. [17, 11, 22, 36] **Range:** Minn. (Eco-Region: All), Wis., Mich. Labr. to Alaska, s. to N.J., Va., Tenn., Mo. and Mex. [17, 21]

Description

General: The most widely distributed, native, deciduous tree in North America with a narrow, rounded crown of thin foliage, growing 40-50' tall and 20-35' wide. Trunk may have a diameter of 1-1½'. Flower: Sexes are on separate trees with pistillate catkins 1-2½" long, brownish, blooming in early spring before the leaves emerge. Leaf: Simple, alternate, nearly round 1¼-3" long leaves that have an abrupt, short point with a rounded base and finely saw-toothed margins. They are shiny green above, dull green beneath and turn golden-yellow in autumn, with slender, flattened leafstalks. Leaves tremble in the slightest breeze. Bark: Young bark is whitish, smooth and thin. As it matures, it turns dark gray, furrowed and thick. Twigs: Shiny brown, slender and hairless. Fruit: Narrowly conical, light-green capsules ¼" long in drooping catkins to 4" long that mature in late spring and split in 2 parts, with many, tiny, cottony seeds. Root: Shallow, fibrous, prolific sprouts form broad colonies. Soil: Tolerates most soil types, although it prefers sandy and gravelly slopes and wetmoist, limy soils where it can form large colonies from an extensive root system. [17, 11, 22, 36]

Normal Water Level

Although this species will tolerate saturated soils, it prefers upland moist to dry conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 18". **Duration:** Medium short – 3 days (decreasing 6"/day). This species is intolerant of flooding with somewhat of a tolerance to duration. [1]

Sensitivities or Other Tolerances

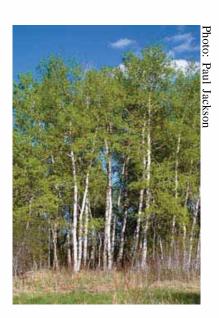
Exposure: Full sun. **Salt:** Moderate to high. **Nutrient:** Low. **Siltation:** Unknown. **Insect:** Frequent – poplar borer, poplar gall, scale, red humped caterpillar. **Other:** This species is frequently susceptible to leaf spot, shoot blight, Cytospora canker, Hypoxylon canker and other cankers. It is also frequently damaged by wind and ice and is sensitive to SO_2 , O_3 , lighting and soil compaction. It can be sensitive to HFl, drought, heat and mine spoils. It has a moderately high tolerance to general disturbance and stress. [1, 2, 22, 25]

Design Considerations

Quaking aspen has been used primarily for reforesting an area quickly, due to its pioneer qualities, especially in cut-over and burned areas. It is also a primary pulpwood species.

Indicator Status: FAC

Concerns: It has been very popular with the lumber industry lately, with cultivars being introduced for even faster growth. It can overtake native plant communities, especially prairies. Suckering can be a problem in gardens. Quaking aspen is a favorite food of beaver. [11, 22, 36]



Wildlife Use

Quaking aspen provides

habitat for many species, especially during the winter. Ruffed and sharp-tailed grouse eat the buds and catkins in winter and spring, as do the evening grosbeak and purple finch. The sap is utilized by the yellow-bellied sapsucker. The tender bark, twigs and foliage are eaten freely by rabbits, deer, elk and moose. The wood and bark is a favorite of beaver and porcupine. Many songbirds use this species for nesting and habitat as do small mammals, such as chipmunks, squirrels and mice. [11, 22, 32, 36]

Nursery/Plant Information

Available: Widely. Types: Bareroot, balled-and-burlapped and potted plants.

as bareroot or balled-and-burlapped stock. [22]

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Pteridium aquilinum

Bracken Fern

Habitat/Plant Community and Geographic Range

Habitat Community: Many habitats, often disturbed areas. **Range:** Minn. (Eco-Region: 1-3, 5-8), Wis., Mich. Widespread at least in the N. Hemisphere. [17, 21]

Description

General: Coarse fern with coriaceous, deciduous leaves mostly 18-60" tall overall. Leaf: Petiole coarse, erect and stem-like, with several vascular bundles that unite distally to form a gutter-shaped bundle. Blade is ternate-pinnately 2-3 times compound, the ultimate segments pinnatifid but otherwise entire. The pinnae are opposite and the pinnules alternate, their segments oblong to linear with revolute margins. Veins "free" but connected by a submarginal vascular strand on which the contiguous and confluent linear sori are borne; these are protected by the recurved, modified leaf margin and a minute hyaline inner indusial flap of tissue. Root: Widely creeping rhizomes with septate hair. [17]

Normal Water Level

This species prefers upland moist to upland dry conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. Depth: 12". Duration: Short -1 day (decreasing all 12" in 1 day). Bracken fern is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances:

Shade: Full to partial sun. Salt: Low. Nutrient: Low. Siltation: Low.

Insect: Infrequent. Other: This species has a moderate-to-high tolerance to general

disturbance and stress. [1]

Design Considerations

Design considerations are difficult to obtain. Concerns: Spreads aggressively.

Wildlife Use

Ferns are widespread, especially in moist woodlands. Yet, as a wildlife food source, they are used to a minor extent. Their leaves are eaten by several species, including deer, hares and grouse, especially in seasons when other green plants are scarce. Ferns are a good habitat cover plant for small mammals and songbirds. [32]

Nursery/Plant Information

Available: Not available.

Planting Techniques

Difficult to transplant.



Pycnanthemum virginianum

Mountain Mint - a.k.a. Common or Virginia Mountain Mint

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, sedge meadow, marshes, tamarack swamps, calcareous fens and low prairies. Mountain mint may persist when other prairie species are eliminated by grazing. [7, 11, 16, 44] **Range:** Nw., c. and s. Minn. (Eco-Region: 1,3-9), Wisc., c. and s. LP of Mich. Me. to N.D., s. to Ga. and Okla. [7, 21]

Description

General: Strongly scented (minty fragrance), native, perennial herb 20-36" tall with fine, attractive foliage. **Flower:** The small, triangular-shaped calyx lobes are shorter than the calyx tube. The inflorescence contains 4 or more flowers in dense, button-like cymes that terminate the stems and branches. Each white-with-purple-spot flower contains 4 stamens. Blooms from the end of June to the beginning of October. **Leaf:** Opposite, lance-linear-shaped leaves are entire, smooth above and usually average less than ¼" wide. The outermost modified leaves of the inflorescence are leafy and hairless above, without a prominent midvein. **Stem:** Square stems that are hairy along the angles. **Fruit:** 4-parted achene. **Root:** Stoloniferous rhizomes. **Soil:** The pH range is 5.0-7.0. [7, 11, 44]

Normal Water Level

Although it will tolerate drier conditions, mountain mint prefers upland moist to wet/saturated conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Low. Depth: 12". Duration: Short – 2 days (decreasing 6"/day). [44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Moderate. **Siltation:** Low to moderate. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 44, 47]

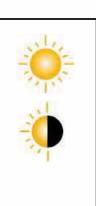
Design Considerations

Due to its stoloniferous growth habit, mountain mint has been used for stabilization of slopes, buffers, vegetated swales and shores. It is a good perennial for gardens and lake shore restorations. It has been used in a number of landscape designs where it is allowed to spread. It is a terrific plant for restorations of calcareous, wet meadows, marshes and low prairie conditions. It provides good cut and dried flowers that are very aromatic. **Concerns:** This species can be aggressive, although this may be a benefit in some situations where invasive species are a concern. [16, 44]

Wildlife Use

Mountain mint attracts butterflies. [21, 44]

Indicator Status: FACW+



Nursery/Plant Information

Available: Widely. **Types:** Plants and seeds.

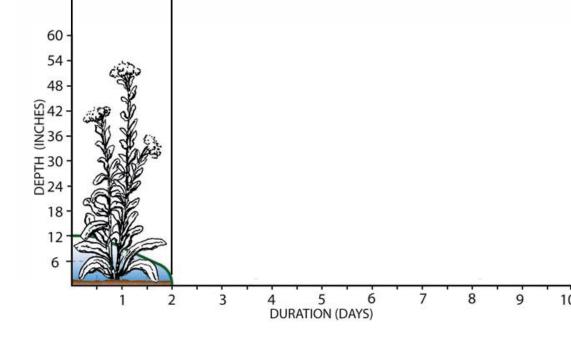
Planting Techniques

Mountain mint can establish quickly from seed with no treatment and invade new restorations, so limit seeding rate. Recommended seeding rate is 0.02-0.06 lb/acre with approximately 4,536,000 seeds/lb. Propagation is possible with cuttings and



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by dividing plants in the spring. Pinching the tops of young plants will provide a more sturdy growth habit. This species tolerates limited mowing. [16, 44]



Quercus bicolor

Swamp White Oak

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forest, terrace species, low areas in moist forests, alluvial flats, borders of small streams, lake margins and swamps. [7, 22, 36, 44] **Range:** Se. and sc. Minn. (Eco-Region: 7-8), c. and s. Wis., s. LP of Mich. Que. and Me. to c. Minn., s. to N.C., Tenn. and n. Ark. [7, 21]

Description

General: Deciduous tree 50-60' tall and 40-50' wide with a trunk up to 3' wide. Typically the crown is broad and rounded, often with drooping branches.

Flower: Separate, but on same tree, appearing with the leaves. The male flowers are slender, drooping catkins, while the female flowers are in groups of 2 to 4, opening in May. Leaf: Obovate, rounded or blunt at the tip that is broadest beyond the middle and gradually narrows to a pointed base 4-7" long and 2-4½" wide. The edges are wavy, with 5-10 shallow, rounded lobes on each side. Leaves are green and slightly shiny above, with soft, whitish hairs beneath that turn brown to red in the fall and persist through winter. Buds: Clustered at branch tips, yellow-brown and smooth.

Bark: Two-tone, light-gray bark with large, thin scales that become furrowed into plates and exfoliates. Twigs: Gray to yellow-brown. Fruit: ¾-1¼" long, egg-shaped acorns that are 1/3 or more enclosed by a deep cup of many distinct scales, which becomes light brown. Usually, there are 2 fruits on a long, slender stalk that mature the first year. Root: Shallow, fibrous roots. Soil: Tolerates most soils, though it prefers alluvial flats and requires acidic soil. [7, 8, 22, 36, 44]

Normal Water Level

This species prefers upland moist to wet/saturated conditions that dry out toward the end of the growing season. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 60". **Duration:** Long – 15 days (decreasing 12"/day for 4 days and gradually decreasing to 0" at 15 days). Seedlings cannot tolerate more than 9" of inundation over 12 hours. This species will tolerate seasonally and irregular inundation and flooding with a moderate tolerance to duration. It will tolerate depth increases. [1, 8, 22, 37, 44]

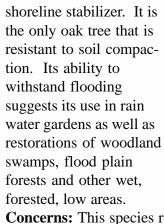
Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** High, especially for soil salt and lower for spray. **Nutrient:** Moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** Swamp white oak is often susceptible to severe iron chlorosis, and it requires acid soils. It is not damaged often by wind and ice, and it is resistant to drought, heat, soil compaction and mine spoils. It has a moderate-to-low tolerance to general disturbance and stress. [1, 8, 10, 22, 25, 37, 44]

Design Considerations

This species has recently been used in many urban conditions, including street trees, due to its ability to withstand many stresses. It is also used as a buffer slope and

Indicator Status: FACW+





10

15

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Concerns: This species requires acidic soils. [44]

Wildlife Use

Acorns from this species and most other oaks are an important food source for wildlife. Wood ducks, mallards, flickers, grackles, blue jays, white-breasted nuthatches, brown thrashers, red-headed woodpeckers, chipmunks and white-footed mice eat the acorns. Ruffed grouse, pheasants and turkeys eat the acorns and buds. Black bear, rabbits, raccoon, and flying, fox, gray and red squirrels eat the acorns, bark and wood. Deer eat the twigs, acorns and foliage. [21, 22, 32, 37, 44]

Nursery/Plant Information

Available: Widely. Types: Balled-and-burlapped or bareroot stock.

Planting Techniques

Swamp white oak, unlike most oaks, has a fibrous root system that makes it easier to transplant, especially in early spring or late autumn. [22, 44]

Additional Notes

DURATION (DAYS)

60

54

48

42

DEPTH (INCHES)

The Latin name, meaning "two-colored," refers to the leaves, which are green above and whitish beneath. [36]

Ratibida pinnata

Yellow Coneflower - a.k.a. Gray-headed Coneflower

Habitat/Plant Community and Geographic Range

Habitat Community: Mesic prairies, mesic savannas, open places, roads, railways and edges of woods, often on limestone. [16, 17, 35, 41, 44] **Range:** Minn. (Eco-Region: 1, 5, 7-9), Wis., Mich. S. Ont. to Minn. and S.D., s. to Tenn., Ga., w. Fla., La. and Okla., and adventive e. to Vt. and Mass. [17, 21]

Description

General: Yellow coneflower is a native, perennial herb with tall, thin, hairy stems up to 7' tall that support striking yellow flowers with droopy petals. After pollination, the cone dries to a light gray color and smells strongly of spice when crushed.

Flower: The showy flower heads have up to 15 drooping, yellow rays and raised, thimble-shaped, grayish cone disk flowers that are shorter than the rays. Approximately 10-25 very showy flower heads per plant, each on an individual stalk. Blooms from July to October. Leaf: Highly divided leaves with many thin, coarsely-toothed lobes are covered with short, gray hair and up to 7" long. Basal leaves have stalks up to 7" long in contrast to the stalkless, undivided, upper leaves, which become smaller near the top. Stem: Erect, covered with short, gray hair. Fruit: Smooth achenes. Root: Fibrous-rooted from a stout, woody rhizome or sometimes a short caudex. Soil: Tolerates most soils, especially adapted to difficult clay soils and on limestone with a pH range of 6.0 to 7.0. [17, 35, 41, 44]

Normal Water Level

This species prefers upland moist to dry conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short – 1 day (decreasing 12"/day). [44]

Sensitivities or Other Tolerances

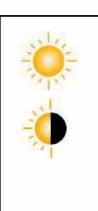
Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Low to moderate. **Siltation:** Low. **Insect:** Unknown. **Other:** [44]

Design Considerations

Yellow coneflower has an extensive fibrous root system from a stout, woody rhizome that provides good soil stabilization of slopes, ditches and other buffer areas. This species is a persistent plant with gray foliage, which makes it a good contrast plant for landscape design and provides cut flowers and dried seed heads. It is a successional plant that is adapted to most soils although it prefers limestone and clays. **Concerns:** This species can be aggressive, though this may be desirable in some situations. [16, 44]

Wildlife Use

Yellow coneflower provides seed for the American goldfinch and other songbirds and gamebirds. It attracts butterflies and other insects. It is palatable to grazing species when it is young. [16, 21, 44]



Nursery/Plant Information

Available: Widely. **Types:** Plants and seed.

Planting Techniques

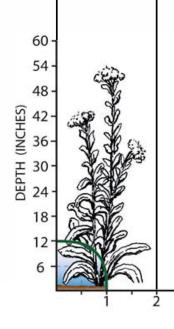
The seed requires no treatment, although it has better germination with moist, cold stratification. Approximately 432,000 seeds/lb. Seed establishes well in both spring and fall, although fresh fall seeding has shown more success. The extensive

5

DURATION (DAYS)



root system of older plants makes dividing difficult but not impossible plants. [16, 44]



Rudbeckia subtomentosa

Brown-eyed-Susan - a.k.a. Sweet Black Eyed Susan, Sweet Coneflower

Habitat/Plant Community and Geographic Range

Habitat/Community: Peat or wet sands, stream banks, drainage ditches, prairies, wet open woods and thickets. [16, 17] **Range:** Se. Minn. (Eco-Region: 6-8), sw. Wis., Mich. to Wis., s. to w. Tenn., La. and Okla. [17]

Description

General: Native, perennial herb with very attractive, yellow flower heads in profusion atop deep green, glossy leaves. Typically 24-36" tall and grows in bunches.

Flower: Disk flowers are dark purple or brown, 5/16-5/8" wide, with yellow ray flowers numbering 12-21, no more than ½" long. Blooms July to September.

Leaf: Alternate, entire leaves are firm, densely short-haired, especially beneath, ovate with petioles serrate, generally some of the larger ones deeply trilobed. **Stem:** 24-78" long, densely short-haired above. **Fruit:** Quadrangular achenes that are glabrous and partly enfolded in the bracts. **Root:** Stout rhizomes. **Soil:** Prefers peat or wet sands although it will tolerate heavy soils. [17]

Normal Water Level

This species prefers upland mesic conditions.

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Medium short – 3 days (decreasing 6"/day).

Sensitivities or Other Tolerances

Exposure: Full to part sun. Salt: Unknown. Nutrient: Unknown.

Siltation: Unknown. Insect: Infrequent.

Design Considerations

Brown-eyed-Susans are well suited for many restorations of stream banks, ditches, prairies and other sites with peat, heavy or sandy soil. It is a beautiful plant for landscape designs and rain water gardens. It provides cut and dried flowers. [16]

Wildlife Use

Birds and butterflies use this plant for food and habitat. Provides excellent ground cover.

Nursery/Plant Information

Available: Widely. Types: Seeds and plants.

Planting Techniques

The seeds benefit from moist, cold stratification. Approximately 736,000 seeds/lb. [16]



Sagittaria latifolia

Broadleaved Arrowhead - a.k.a. Arrowhead, Broad Arrowhead, Broadleaf Arrowhead or Common Arrowhead; Wapato, Rat Potato or Duck Potato

Habitat/Plant Community and Geographic Range

Habitat/Community: Shallow water, slow-moving streams, quiet lake shores, ponds, marshes, shrub swamps, wooded swamps and pools in bogs. [4, 7, 11, 16, 35, 41] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. N.S. and Que. to B.C., s. to S. Amer. [7, 21]

Description

General: Native, perennial, emergent herb usually erect, 1-4' tall, that is sometimes nonpersistent. **Flower:** Whorls of 2-15 flowers ½-1" wide, borne on the naked stem with 3 green sepals and 3 white petals, blooming from July to August. The male flowers have many stamens. **Leaf:** Mostly basal leaves with arrowhead-shaped blades vary greatly in width, which may be a response to varying water depths. **Stem:** Naked stems arise from base of plant. **Fruit:** Flattened achenes are packed into a dense head, where each achene is winged on the margins and has a horizontal beak. **Root:** Rhizomes and edible, starchy tubers 1" or more in diameter form in the fall. **Soil:** Shallow water and saturated soils of marshes with a pH range of 5.9-8.8. [4, 7, 11, 35, 41, 44]

Normal Water Level

This species prefers shallow water of 24" of inundation or less to wet/saturated conditions. [11, 21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/day). This species will tolerate regular inundation and withstand periods of drought. It persists in stabilized water levels at depths of less than 20" and few drawdowns. It has a moderate tolerance for flood duration and is unaffected by flood depth increases. [1, 23, 31, 37, 44]

Sensitivities or Other Tolerances

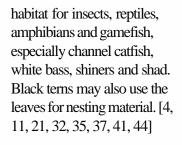
Exposure: Partial to full sun. **Salt:** Moderate. **Nutrient:** Moderate (high for P). **Siltation:** Moderate to low and decreases with sedimentation increases, though will tolerate turbid conditions. **Insect:** Unknown. **Other:** Broadleaved arrowhead spreads rapidly. It tolerates and assimilates high levels of nutrients and heavy metals. It has a moderately high tolerance to general disturbance and stress. [1, 6, 31, 37, 44]

Design Considerations

This species has been used in shoreline zones, especially within the bench of retention ponds. It is well suited for wetland restorations within quiet pools, shallow water of lakes and ponds and shrubby conditions. It species persists in the seed bank. **Concerns:** When newly planted, protect this species, especially from Canada geese. [4, 16, 26, 42, 44]

Wildlife Use

Broadleaved arrowhead provides wonderful waterfowl food and habitat. Ducks eat the seeds,but the tubers are the most valuable portions to wildlife. Black, canvasback, mallard, pintail, ringnecked and wood ducks as well as swans eat the seeds and tubers. The seeds are eaten by king rail and the starchy tubers are eaten by muskrat, beaver and porcupine. This species also provides



Nursery/Plant Information

Available: Widely. **Types:** Seed, tubers, rootstock and transplants.

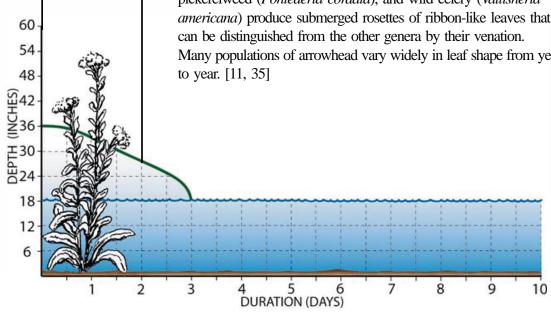


Planting Techniques

Broad arrowhead can be seeded with fresh seed in the fall. The seed floats and may dominate one side of the shallow water body if it is wind prone. Seed requires moist, cold stratification and can be fall planted the second year with bottom heat in saturated soil. Recommended seeding rate is 0.12-0.19 lb/acre, with about 940,000 seeds/lb. Tubers establish easily and are commonly used. Plant in saturated soils in the spring in 6" or less of water, approximately 2-6' apart and protect from predation. Drawdowns will help establish this species, then maintain a constant water level. The tubers require a 6- to 8-week cold treatment. Transplants may be planted in 6"-2' of water, although not submerged. [4, 16, 26, 31, 37, 42, 44]

Additional Notes

Arrowheads (Sagittaria spp.) like the burreeds (Sparganium spp.), pickerelweed (Pontederia cordata), and wild celery (Vallisneria americana) produce submerged rosettes of ribbon-like leaves that can be distinguished from the other genera by their venation. Many populations of arrowhead vary widely in leaf shape from year to year. [11, 35]



Salix discolor

Pussy Willow

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamps, fens, shrub-carrs, wet meadows, edges of wooded swamps, shores, stream banks, flood plain forests and marsh borders. [7, 11, 36] **Range:** Common; all but sw. Minn. (Eco-Region: All), Wis., Mich. Nfld. to B.C., s. to Del., n. Ga., Ky., Ill., n. Mo., S.D., Wyo. and Idaho. [7, 21]

Description

General: Erect, many-stemmed, deciduous shrub usually 20-25' high and 10-15' wide, with an open, rounded crown. It is usually the first willow to flower in spring. Flower: Plants are unisexual. The pistillate, silky, furry catkins are 1-2½" long. Usually bloooms during May and June. Leaf: Alternate leaves are generally elliptic, entire to slightly toothed, shiny green above, whitened beneath, and are without hair (may have sparse hair beneath); usually 1½-4¼" long, 3/8-1¼" wide. Large, roundish stipules are present. Bark: Gray, fissured and scaly. Twigs: Stout, reddish to dark brown, and lacking hair (although new twigs may be hairy). Fruit: A densely hairy narrow capsule that is 5/16-½" long, light brown, developing in early spring before the leaves. Soil: Wet to moist sands to loam soils. [7, 11, 36]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 24". **Duration:** Long – 6 days (decreasing 12" the first 2 days, then 6" every 2 days thereafter). Pussy willow is flood tolerant with moderate tolerance to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full sun. **Salt:** Moderate. **Nutrient:** Moderate to low. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** Pussy willow has a moderate-to-high tolerance to general disturbances and stress. [1, 10]

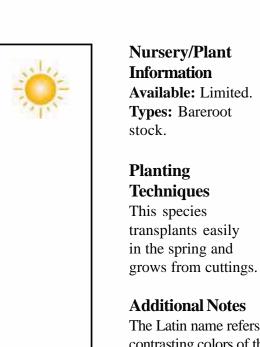
Design Considerations

Pussy willow is an attractive willow that is cut for its long-lasting branches. It has been planted in swamps, shores and stream banks to help stabilize the soils as well as for its beauty.

Wildlife Use

Willow buds and small, tender portions of the twigs are staples for ruffed and sharp-tailed grouse as well as songbirds, waterfowl and marsh birds. Rabbits, squirrels, porcupines, muskrats, beavers, elk, moose and deer eat the twigs, foliage and bark. [11, 21, 32, 37]

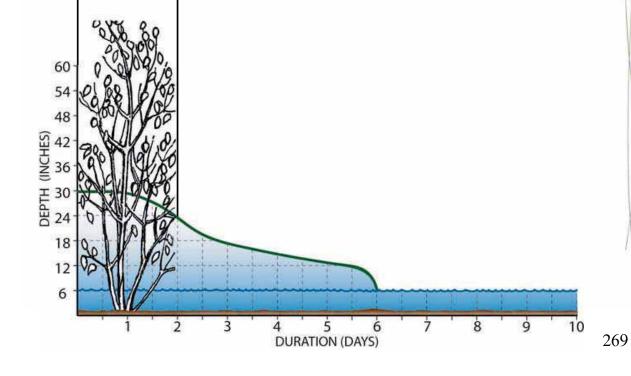




The Latin name refers to the contrasting colors of the leaf surfaces, which aid in recognition. [36]







Salix exigua

Sandbar Willow - a.k.a. Salix (exigua) interior - Coyote Willow, Narrowleaf Willow

Habitat/Plant Community and Geographic Range

Habitat/Community: Shores, stream banks, shrub-carrs, sand and mud bars, silt flats and ditches (as well as other wet places; often colonizing exposed banks). [7, 11, 36] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. N.B. and Que. to Alaska and B.C., s. to Va., Tenn., La., Tex., Colo. and Mont. [7, 21]

Description

General: Erect, deciduous shrub 6-20' tall that forms colonies which decrease in age and height from the colony center. **Flower:** 1-2½"-long catkins with hairy, yellow scales that emerge at end of leafy twigs in spring after the leaves.

Leaf: Distinctive, characteristic is its long, linear leaves (1½-4" long, ¼" wide) that are irregularly toothed. Yellow-green to gray-green on both surfaces without hairs when mature, lack stalk glands and stipules. In fall, the leaves turn a red-orange color. **Bark:** Gray; smooth, becoming fissured. **Twigs:** Often has many twigs that are slender, upright, reddish-brown, lack hair, and are leafy. **Fruit:** A ¼"-long capsule that is hairless to thinly silky, light brown that matures in early summer. **Root:** Spreading by rhizomes. **Soil:** Wet soils, preferring loamy sand to silt loams, sand and mud bars, although it tolerates other alluvial mineral soils. [7, 11, 36]

Normal Water Level

This species prefers shallow water of 6" of inundation or less to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 36". **Duration:** Long -30+ days (decreasing 12" every 2 days for 4 days, then 12" over 30 days). It responds positively to water level changes, especially seasonal or flood depth increases, and it is drought resistant. [1, 11, 36, 37]

Sensitivities or Other Tolerances

Exposure: Full sun. **Salt:** Moderate. **Nutrient:** High. **Siltation:** High. **Insect:** Infrequent. **Other:** This species spreads slowly by suckers. It has a moderately high tolerance to general disturbance and stress. [1, 10, 37]

Design Considerations

Sandbar willow is an aggressive shoreline stabilizer, especially along stream banks. It is suitable for planting on stream bottoms to prevent surface erosion. It often colonizes dredged and other disturbed sites. It also has a positive response to water level changes and has been shown to be successfully planted in rip-rap near the water level. **Concerns:** Sandbar willow is considered a weed species because it aggressively colonizes open sites. This may be a benefit in sites where invasive species are a threat.



Wildlife Use

Willows buds and small, tender portions of the twigs are staples for ruffed and sharp-tailed grouse as well as songbirds, waterfowl and marsh birds.



Rabbits, squirrels, porcupine, muskrats, beaver, elk, moose and deer eat the twigs, foliage and bark. [21, 32, 37]

Nursery/Plant Information

Available: Widely.

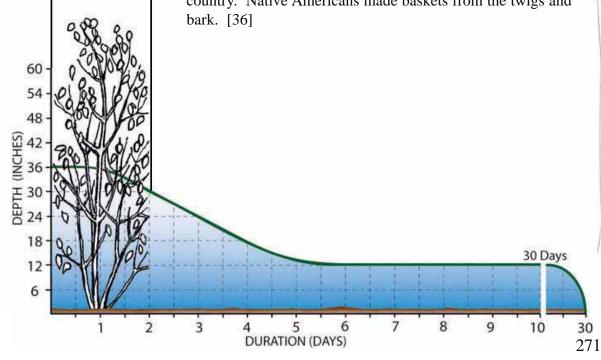
Types: Cuttings, potted and bareroot stock.

Planting Techniques

This species may be planted successfully as seed, potted plants and bareroot stock. The method that is easiest and becoming the most popular is burying bundles of cuttings in the soil 6-18" deep. This is used for quick establishment for eroded banks of streams and rivers. [37]

Additional Notes

A common shrub along streams throughout much of the country. Native Americans made baskets from the twigs and bark. [36]



Salix nigra

Black Willow - a.k.a. Swamp Willow, Goodding Willow

Habitat/Plant Community and Geographic Range

Habitat Community: Stream banks, lake shores, flood-plain forests, swamps, sloughs, swales, ditches and wet depressions in forests. [7, 11, 22, 36, 44] **Range:** Ec. and s. Minn. (Eco-Region: 2, 5-9), all but far n. Wisc., s L.P. of Mich.

N.B. to Minn., s to Fla., Tex., Calif. and into Mex. [7, 21]

Description

General: Deciduous tree 35-50' tall and 20-35' wide, with a single trunk or several trunks and a rounded, open crown. Trunks are often leaning or horizontal to the water or ground surface. Flower: Yellow-green catkins 1-3" long with hairy scales are borne among new leaves from April to May. Leaf: Alternate, narrow, lance-shaped leaves are 3-5" long and 3/8-¾" wide. Often they are slightly curved to one side with long, pointed and finely saw-toothed and hairless leaves. The upper side of the leaf is darker green than the lower. Bark: Dark brown or blackish, deeply furrowed or ridged into scaly, forking ridges. Twigs: Very slender, easily detached at the base, brownish. Fruit: Capsules 3/16" long that are reddish-brown, hairless and mature in late spring. Root: Shallow roots divide into a multitude of rootlets. Soil: Tolerates most soils with a pH range of 6.0-8.0. [7, 11, 22, 36, 44]

Normal Water Level

This species prefers wet/saturated conditions. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 60" in spring and 24" in summer. **Duration:** Long for spring, medium long for the summer - 10 and 4 days, respectively (decreasing 6"/day in the spring and 12" over 2 days in the summer). This species tolerates spring seasonal inundation better than irregular summer inundation. However, it is still very tolerant to flood duration and depth increases. It will decrease in abundance with flood depth decreases. [1, 22, 37, 44]

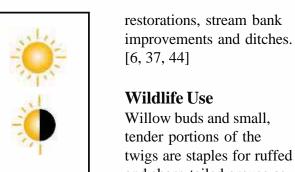
Sensitivities or Other Tolerances

Exposure: Full sun; not tolerant of shade. **Salt:** Moderate to high. **Nutrient:** Moderate to high. **Siltation:** Moderate. **Insect:** Infrequent – willow sawfly occasionally defoliates trees. **Other:** Black willow has a slow rate of spread even though it does spread by suckers and has a rapid rate of growth. It is frequently susceptible to fungus scab, and black canker causes leaf and shoot destruction. Wind and ice frequently damage it, especially breaking off large limbs. It is sensitive to SO₂ and O₃, though resistant to HFl, drought, heat, soil compaction and mine spoils. It is moderately tolerant to alkaline soils. It has a moderate-to-high tolerance to general disturbance. [1, 2, 22, 25, 37, 44]

Design Considerations

This species is a good stream bank stabilizer due to its rapid rate of growth and its ability to sucker if damaged. It has been used in both stream bank and shoreline stabilization. Due to its ability to withstand flooding, it is well suited for flood plain

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and sharp-tailed grouse as well as songbirds, waterfowl and marsh birds.



Rabbits, squirrels, porcupine, muskrats, beaver, elk, moose and deer eat the twigs, foliage and bark. It is also a food source for the mourning cloak butterfly. Cavities are used by racoons and woodducks. [6, 21, 22, 32, 37, 44]

Nursery/Plant Information

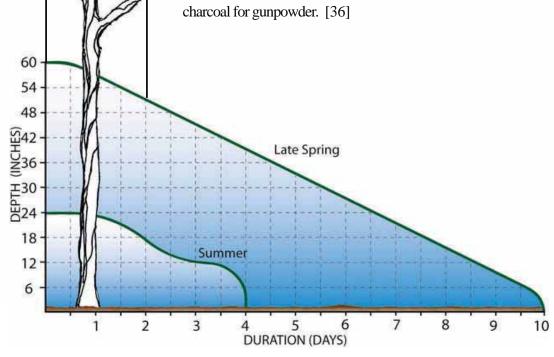
Available: Widely. Types: Potted and bareroot stock.

Planting Techniques

Seeding is not necessary for this species due to its ability to root from cuttings and spread from suckers. Its rapid rate of growth is about 3-6'/year. It transplants readily balled-andburlapped in any season. Seed does not remain viable in storage. [15, 22, 37, 44]

Additional Notes

Pioneers used the wood of this and other willows as a source of



Sambucus racemosa

Red-berried Elder - a.k.a. Sambucus racemosa - Scarlet Elder, Red Elderberry

Habitat/Plant Community and Geographic Range

Habitat/Community: Occasionally in swamps and thickets, but more common in moist, deciduous forests; deep, rich woods, lining quick-flowing creeks, moist rock crevices, sheltered coves, ravines, roadsides and fence rows in deep shade. [7, 22] **Range:** Minn. (Eco-Region: 1, 2, 5-9), Wis., Mich. Circumboreal, Nfld. to B.C., s. to Pa., N.C., Ind., Ill. and Minn. **This species is threatened in Ill.** [7, 21]

Description

General: Native, deciduous shrub 6-12' tall and 10-15' wide. Flower: Flowers opening with developing leaves in white, conical flower spikes. Individual flowers are small, 5-parted elongate, pyramidal clusters at the ends of the stem. Clusters are 2-5" long and usually longer than wide. Leaf: Large, opposite, pinnately divided, compound leaf with usually 5 leaflets. The leaflets are lance-shaped, tapered to a long, sharp tip and smooth or hairy on underside, with small margins of sharp, forward-pointing teeth. Bark: Matures to warty, gray-brown bark. Twigs: Yellow-brown and hairy with inner red-brown pith. Fruit: Round, red, berry-like drupe that ripens in June. Root: Fibrous, deep lateral roots. Soil: Prefers loam soils and moist, rich woods, although it will tolerate rocky and many other soil types. [7, 11, 22]

Normal Water Level

This species prefers upland moist conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short – 3 days (decreasing 6"/day). This species is actually flood intolerant and somewhat tolerant to flood duration. [1, 22]

Sensitivities or Other Tolerances

Exposure: Full sun to shade, and deep shade tolerant. **Salt:** Low. **Nutrient:** Moderate to low. **Siltation:** N/A. **Insect:** Infrequent--borers; rarely serious. **Other:** This species is frequently damaged by wind and ice and is easily broken. It is sensitive to 2,4-D, O_3 , drought and heat. It resists HFl and SO_2 and can be damaged by soil compaction occasionally. [1, 2, 22, 47]

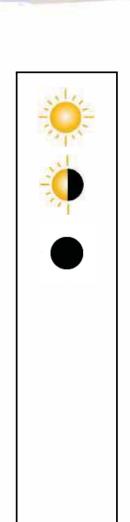
Design Considerations

Red-berried elder is a fast grower and even though it is intolerant to flooding, it is found near fast-moving streams, road sides and fence rows. This means it must be able to endure flooding for short periods. It will tolerate deep shade and is excellent in mass plantings.

Wildlife Use

Red-berried elder is an important food source for many kinds of songbirds and gamebirds in the summer, including robins, catbirds, pheasants, bluebirds, rose-breasted grosbeaks, ruffed grouse, starlings, brown thrashers, olive-backed thrushes and veery. Rabbits eat the fruit and the bark. The fruit is poisonous to humans. [11, 21, 22, 32]

Indicator Status: FACU+



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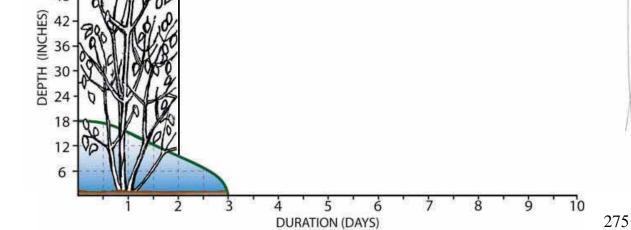
Nursery/Plant Information

Available: Widely. **Types:** Bareroot and potted stock.

Planting Techniques

This species transplants with difficulty. [22]





Schizachyrium scoparium

Little Bluestem - a.k.a. Andropogon scoparius

Habitat/Plant Community and Geographic Range

Habitat/Community: Dry to mesic prairies, savannas, old fields, open woodlands and other sandy to mesic habitats. [17, 44] **Range:** Minn. (Eco Region: 3-10), Wis., Mich. N.B. and Que. to Alta., s. to Fla. and Mex. [3, 17, 21]

Description

General: Little bluestem is a native, perennial, clump-forming grass that can be used as an ornamental grass. It grows 2-3' tall. **Flower:** Long, reddish-brown racemes bearing 5-20 sets of spikelets on a straight, white-ciliate rachis from July to September. **Leaf:** Blades 1/8-1/4" wide, amber foliage that maintains its color through the winter. **Stem:** 2-3' tall, amber. **Fruit:** Showy spikelets along the entire stem, each seed with a fluffy beard and a needle-like awn. **Root:** Numerous, branching, vertical roots that may extend to 6' in depth. **Soil:** Many types, although it prefers dry to mesic sandy habitats with a wide pH range. [3, 17, 44]

Normal Water Level

This species prefers dry to upland mesic conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Short -1 day (decreasing all 12" in 1 day). This species does not tolerate inundation and is somewhat tolerant to flood duration. [1, 44]

Sensitivities or Other Tolerances

Exposure: Full sun to part shade. **Salt:** Moderate. **Nutrient:** Moderate to low; it is unaffected by P decreases. **Siltation:** Low. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 44]

Design Considerations

Little bluestem is an excellent winter cover species in open places, with excellent fall and winter color. It has been used in slope stabilization areas and buffers and will hold soil against erosion once established. The roots are numerous and deep. It has been used successfully in the upper edge of rain water gardens where it is not being inundated, as a buffer or filter. **Concerns:** Many cultivars are being developed. Also, this plant is starting to be overused; you will find it in most ornamental landscape designs. [44]

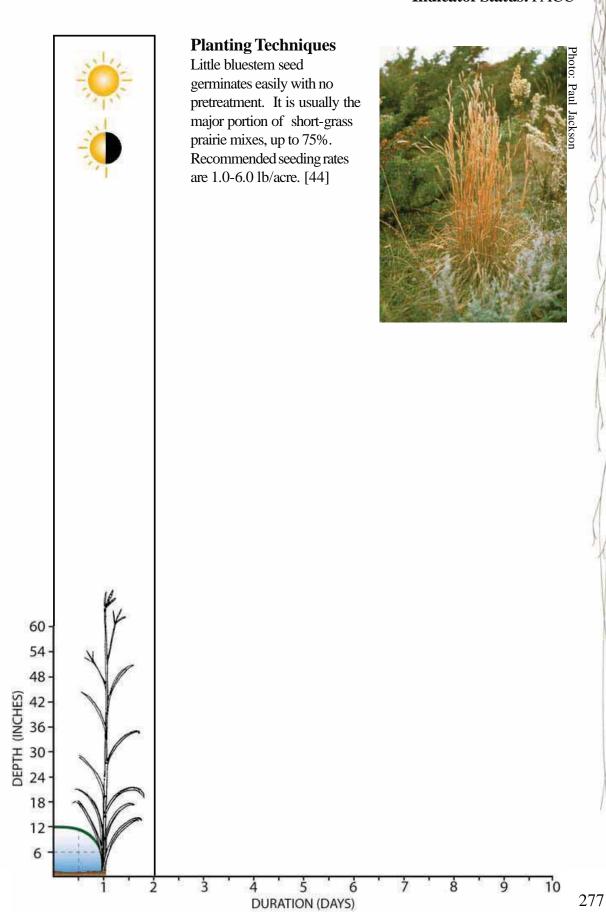
Wildlife Use

This species is a principal wildlife food for songbirds (field and tree sparrows) and deer in open and prairie areas. It is palatable and nutritious to many grazing species.[32, 44]

Nursery/Plant Information

Available: Widely. **Types:** Seeds and plants.

Indicator Status: FACU-



Schoenoplectus acutus

Hardstem Bulrush - a.k.a. Hard-stemmed Bulrush or Common Tule

Habitat/Plant Community and Geographic Range:

Habitat/Community: Marshes, calcareous fens, minerotrophic waters, ditches, ponds, streams, lakes and occasionally bog lakes (usually emergent in shallow-to-deep water, sometime where brackish). [4, 7, 11, 16, 24, 44] **Range:** Common; Minn. (Eco-Region: All), n. and e. Wis., Mich. N.S. to B.C., s. to N.C., Tex. and Calif. [7, 21]

Description

General: Persistent, native, perennial, emergent herb 3½-9' tall. Often forms large colonies. Hardstem bulrush can form colonial stands or by intermixing with other emergents. Hybrids between hardstem and softstem bulrush (*Schoenoplectus tabernaemontani*) can occur. Flower: A spikelet that is reddish brown; blooms from May to September. The spikelets are oval to cylindrical and are exceeded by a specialized leaf that appears to be a continuation of the stem. Leaf: A few sheathing vestigial leaves at the base. Stem: 3½-9' tall, cylindrical and dark olive green. The stems are small chambered, so that they are stiff and not easily crushed between the thumb and index finger. Fruit: Achenes are not quite 1/8" long, have 6 basal bristles and are covered by whitish-brown scales. The scales have marginal hairs and red dots on the back. Root: Stout rhizomes. Soil: It prefers sandy to marly substrates with good water circulation in the root zone and a pH range of 6.7-9.1. [4, 7, 11, 24, 44]

Normal Water Level

This species prefers deep-to-shallow water, generally in depths to 5', but it has been found in much deeper depths and can be found in wet/saturated conditions. [11, 21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Medium long – 4 days (decreasing 12" every 2 days). This species can tolerate regular inundation and high flood durations. It resists wave action and water level changes. [1, 37, 44]

Sensitivities or Other Tolerances

Exposure: Full sun. **Salt:** Moderate to high. **Nutrient:** Low to moderate. **Siltation:** Low to moderate. **Insect:** N/A. **Other:** It has a higher tolerance of mixosaline and minerotrophic conditions than softstem bulrush (*S. validus*). It has moderate tolerance to general disturbances and stress. [1, 6, 11, 24, 37, 44]

Design Considerations

Hardstem bulrush has been used in many conditions, from lake revegetation to shoreline and vegetated swales due to its ability to resist wave action and water level changes. It is an excellent buffer plant, protects dams, eroding shores, silt movement and creates excellent wildlife habitat. It is used in many wetland restorations and landscape designs. It should be planted to help limit the invasive qualities of cattail. **Concerns:** Protect new plantings from depredation by geese. [6, 16, 44]

Wildlife Use

Bulrush is a wonderful wildlife habitat for waterfowl and other species. Coots, black, canvasback, mallard, pintail, redhead, ring-necked, scaup and teal ducks eat the seeds. Stems

are utilized when young by Canada and snow geese. Sora and Virginia rails eat the seeds and rootstock. Muskrats eat the rootstock and stems. Especially in central Minn., bulrush provides the primary nesting sites for grebes, black terns and other waterfowl and marsh birds. It provides spawning and nursery habitat for northern pike, bluegills and other fish. [4, 6, 11, 16, 24, 32, 37, 44]



Available: Widely.

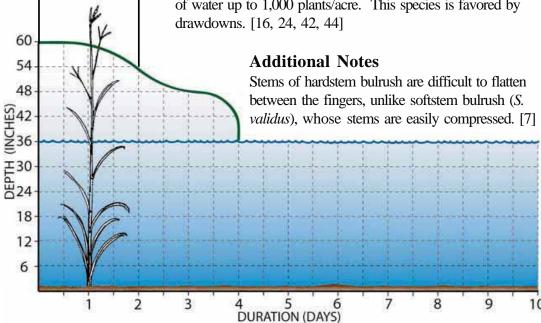
Types: Achenes, rootstocks, rhizomes and transplants.



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Planting Techniques

The achenes require moist, cold stratification for 90 days, then warm temperature and light. Fresh achenes may be planted in the fall with drawdowns in the spring. Plant in saturated soils. A recommended seeding rate of 0.06-0.25 lb/acre with approximately 292,800 seeds/lb. Rhizomes planting has had more success, so long as rhizomes are planted 2-5" deep in 4-6" of water and 3' apart. Clustered arrangements are proving more successful due to the slow rate of spread. Transplants can be planted in 6"-2' of water up to 1,000 plants/acre. This species is favored by drawdowns. [16, 24, 42, 44]



Schoenoplectus pungens

Three-square Bulrush - a.k.a. Scirpus americanus, Scirpus (americanus) pungens - Common Threesquare, True Three-square Bulrush, Chairmaker's Rush, Swordgrass

Habitat/Plant Community and Geographic Range

Habitat/Community: Shallow water, wet sandy, gravelly or mucky shores, streambanks, deep and shallow marshes, calcareous fens, wet meadows, ditches, seeps and other wet places. It is frequently found in mixosaline waters. [4, 7, 11, 16, 24] **Range:** Fairly common; Minn. (Eco-Region: All), nw. and e. Wis., LP and occasional in UP of Mich. S. Can., s. to S. Amer.; Europe, Australia and New Zealand. [7, 21]

Description

General: A persistent, perennial, emergent herb that grows 3-5' tall and forms colonies. **Flower:** 1 to 8 oblong spikelets ½-¾" long, sessile and crowded. Blooms from July to September. A specialized leaf appears to be a continuation of the stem beyond the spikelets. **Leaf:** One to three leaves that are narrowly linear and are less than half the height of the stems form basal sheaths. **Stem:** Sharply triangular stems with 2 or 3 concave sides, growing to a height of 5'. **Fruit:** Achenes with bristles. **Root:** Long, slender rhizomes. **Soil:** Likes shallow water in wet sandy, gravelly or mucky shorelines as well as calcareous conditions. [4, 7, 11, 24]

Normal Water Level:

This species prefers shallow water of 30" of inundation or less to wet/saturated conditions and will tolerate slightly salty water. [11, 21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Medium long – 4 days (decreasing 12" in 2 days, then 6" over the next 2 days). This species will tolerate regular or seasonal inundation and flood duration. It will increase and is tolerant to flood depth increases. [1, 37]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Low to high. **Nutrient:** Low to moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species has a rapid rate of spread. It will remove metals quickly. It has a moderate tolerance to general disturbance. [1, 6, 24, 37]

Design Considerations

Three-square bulrush is a good soil stabilizer for shores, stream banks and vegetated swales. It provides good wildlife habitat and has a rapid rate of spread for mitigation and restoration sites. **Concerns:** This species can become aggressive, although that may be desired in some instances. [16, 37]

Wildlife Use

Bulrush provides wildlife habitat not only for waterfowl, but for other species as well. Coots, black, canvasback, mallard, pintail, redhead, ring-necked, scaup and teal ducks eat the seeds. Stems are utilized when young by Canada and snow geese. Sora and

Virginia rails eat the seeds and rootstock. Muskrats eat the rootstock and stems. Bulrush provides spawning and nursery habitat for bass, bluegills and other fish. It also provides nesting cover for waterfowl and marsh birds. [4, 6, 11, 24, 32, 37]

Nursery/Plant Information

Available: Becoming widely. **Types:** Root, plants and seeds.

Planting Techniques

Three-square bulrush requires moist, cold stratification for at least 90 days and then light for germination. Fresh seed planted in the fall can bypass the stratification process. Approximately 220,000 seeds/lb. Transplants can be planted in saturated soil to a depth of 12" of inundation. This species grows best in water that is less than 24" deep. Plant survival is signifi-

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cantly increased with large rhizomes rather than small ones at greater water depths. Depths of 22-30" of water are the maximum depths for this species. This species is favored by drawdowns. [16, 24, 34, 37, 42]





DURATION (DAYS)

Schoenoplectus tabernaemontani

Soft-stem Bulrush - a.k.a. Scirpus validus - Great Bulrush, American Great Bulrush

Habitat/Plant Community and Geographic Range

Habitat/Community: Lakes, ponds, deep and shallow marshes, streams, ditches and occasionally bogs (shallow water and shores). [4, 7, 11, 16] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. Nfld. to s. Alaska, s. to S. Amer. [7, 21]

Description

General: A persistent, emergent, perennial herb that is 3-9' tall, sometimes forming large colonies that may be intermixed with other emergent species. Flower: Several to many brown, oval spikelets on a specialized leaf that appears to be a continuation of the stem and exceeds the spikelets; blooms from June to September. Leaf: A few sheathing vestigial leaves at the base. Stem: Cylindrical, light-green stems 3-9' tall may be a little over ½" thick and are large-chambered so they can be crushed easily between the thumb and index finger. Fruit: Achenes with 6 basal bristles about equal in length to the achenes and shiny, orange-to-brown scales are often with a conspicuous green midrib. The scales are slightly longer than the achene.

Root: Spreads by slender rhizomes. Soil: Soft-stem bulrush usually prefers mucky substrates with more stagnant conditions than those preferred by hardstem bulrush and a pH range of 6.5-8.5. [4, 7, 11, 44]

Normal Water Level

This species prefers shallow water of 12-48" of inundation although it will tolerate wet/saturated conditions. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Long -42+ days (decreasing 12" every 21 days). This species will tolerate flooding for long periods regularly to seasonally. It is unaffected by flood depth increases, and it increases with depth decreases. [1, 37, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low to moderate. **Nutrient:** Low to moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species is sensitive to oxygen depletion, though it will remove pollution quickly. It has a rapid rate of spread and a moderate-to-low tolerance to general disturbance and stress. [1, 6, 37, 44]

Design Considerations

Because it dissipates wave energy, soft-stem bulrush is an excellent soil stabilizer for shores, stream banks and vegetated swales. It is preferred to cattails and provides good habitat reconstruction. It is recommended for lake, pond, stream and wetland restorations and mitigation sites. Seed can be found in the seed bank. **Concerns:** This species is sensitive to oxygen depletion. It is also susceptible to depredation when young or if Canada geese populations are too high. It is an aggressive plant, which may be desirable in certain situations. [16, 19, 26, 44]

Wildlife Use

Bulrush provides wonderful wildlife habitat not only for waterfowl, but for other species as well. Coots, black, canvasback, mallard, pintail, redhead, ring-necked, scaup and teal ducks eat the seeds. Stems are utilized when young by Canada and snow geese. Sora and Virginia rails eat



the seeds and rootstock. Muskrats eat the rootstock and stems. Especially in central Minnesota, bulrushes provide the primary nesting sites for grebes, black terns and other waterfowl and marsh birds. Bulrush provides spawning and nursery habitat for northern pike, bluegills and other fish. [4, 6, 11, 32, 37, 44]

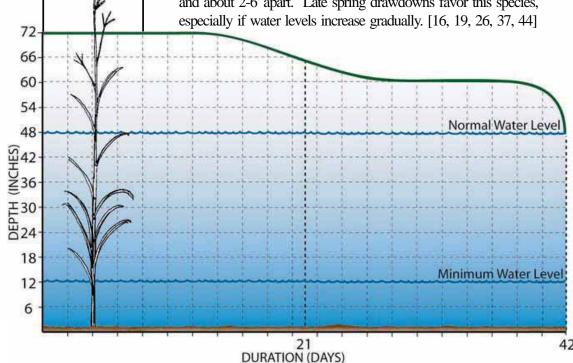
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Nursery/Plant Information

Available: Widely. **Types:** Achenes, rhizomes, rootstocks and container plants.

Planting Techniques

Soft-stem bulrush seeds require moist, cold stratification and high light levels to germinate. The achenes should be stored under water in darkness at 30-38 degrees F. Seed in the fall with fresh seed. Sow on wet mudflats and cover with 1-2" of water during the winter, then follow with a drawdown. Submerged young seedlings do not establish. Recommended seeding rate is 0.06-0.25 lb/acre with about 604,800 seeds/lb. Rootstock and transplants are more successful than seeding. Rootstocks and seedlings should be planted to a depth of 5-6" deep, and adult transplants to 24" deep and about 2-6' apart. Late spring drawdowns favor this species, especially if water levels increase gradually. [16, 19, 26, 37, 44]



Scirpus atrovirens

Green Bulrush - a.k.a. Black Bulrush, Dark Green Rush Habitat/Plant Community and Geographic Range

Habitat/Community: Moist woods, shores, ditches, stream banks, swamps, shrubcarrs, alder thickets, sedge meadows, springs and other wet places. It seems to increase with disturbance to peat/muck soils and often invades dredged material sites. [7, 11, 16] **Range:** Common; Minn. (Eco-Range: All), Wis., Mich. Ont. to Alta. and Wash., s. to Mo., Tex., N.M. and Ariz. [7, 21]

Description

General: Green bulrush is a common, short-lived, pioneer, emergent, native perennial with course clump form and nice clusters of small, brown heads that may reach a height of 5'. **Flower:** 2 or more conspicuous, spreading, modified leaves subtend the terminal inflorescence with flat blades. Numerous spikelets on the inflorescence are crowded into a dense, nearly spherical head on rays that angle out in different directions and bloom from June to July. **Leaf:** M-shaped, mint-green leaves are broad (up to ³/₄" wide), with sheaths that are brownish or green and not tinged with red. **Stem:** Sturdy, roundly triangular stems, with up to 10 stem leaves growing to 4.5' tall. **Fruit:** Achenes that are tan to nearly white, compressed 3-angled, with a short beak. **Root:** Short rhizomes with strong, fibrous roots. **Soil:** Prefers peat to muck soils and often invades dredged material sites or other poor, saturated soils and seems to increase with disturbance. [7, 11]

Normal Water Level

This species prefers shallow water of 30" of inundation or less to wet/saturated conditions, although it will tolerate periods of drought. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 30". **Duration:** Medium short—3 days (decreasing 12"/day for 2 days then 6" the last day). This plant has moderately low tolerance to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Low to moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species has a moderately high tolerance to general disturbance and stress. [1]

Design Considerations

Green bulrush is well suited to controlling erosion along shorelines, ditches, stream banks, meadows and thickets. It is a good pioneer species that will vegetate a site quickly with a decorative bunching form. It is a frequent pioneering colonizer of wetland mitigation sites and disturbed areas. **Concerns:** This species can be aggressive and is short lived. This may be desirable to compete with non-native or invasive species. [16]

Wildlife Use

Bulrush provides wildlife habitat for waterfowl and other species. Coots, black, canvasback, mallard, pintail, redhead, ring-necked, scaup, and teal ducks eat the seeds. Stems are utilized when young by Canada and snow geese. Sora and Virginia rails eat the seeds

Indicator Status: OBL

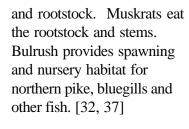


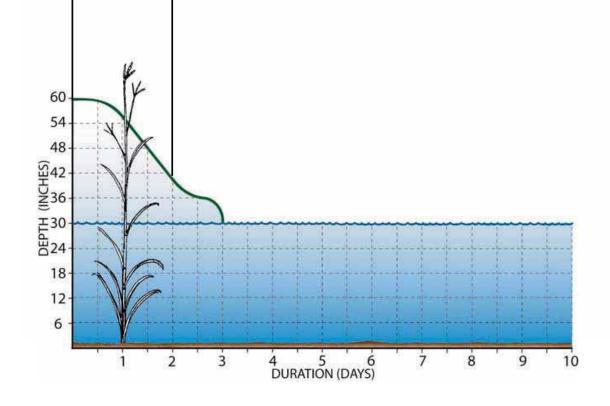
Photo: Jason Husveth

Nursery/Plant Information

Available: Becoming widely. **Types:** Roots, plants and seeds.

Planting Techniques

The achenes require moist, cold stratification and warm temperatures and light to germinate. Fall planting with fresh achenes can bypass these steps. It is a frequent pioneering colonizer of wetland mitigation sites and disturbed areas with one reference suggesting that its seeds can remain viable for at least 40 years. Approximately 4,536,000 seeds/lb. [11, 16]



Scirpus cyperinus

Woolgrass - a.k.a. Wool Grass Sedge

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, marshes, swamps, ditches, bog margins, lake

edges and alder thickets (where wet or in very shallow water). [7, 11, 16]

Range: Common to abundant; Minn. (Eco-Region: All), Wis., Mich. Nfld. to s.

B.C., s. to Fla., e. Tex. and S.D. [7, 21]

Description

General: Woolgrass is not a true grass; it is actually a member of the sedge family. A coarse, densely clumped, native, perennial herb that stands 36-48" tall. Flower: Two or more unequally spreading, modified leaves subtending the terminal inflorescence. Many tiny spikelets in small, compact clusters at the apex of the stem ascend from a fountain-like base of several to many rays on the inflorescence from June to July. Leaf: Woolgrass has a fountain of large, slender, basal leaves and about 10 stem leaves with brownish or green and not-tinged-with-red sheaths. Stem: Smooth and more or less round, sturdy stems with about 10 stem leaves that extend above the basal leaves. Fruit: Nutlets covered with many brown, woolly bristles that give the cluster of spikelets a fuzzy appearance. Root: Short rhizomes. Soil: Saturated or boggy soils of many types, though prefers peat. [7, 11]

Normal Water Level:

This species prefers shallow water of 3" of inundation or less to wet/saturated conditions, although it will tolerate a drought. [6, 21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Long -5 days (decreasing 6" in the first day then 6" every 2 days thereafter). Woolgrass can tolerate seasonal and irregular inundation periods and is moderately tolerant to flood duration. It will increase with a decrease of flood depth. [1, 37]

Sensitivities or Other Tolerances

Exposure: Full to part sun. Salt: Moderate. Nutrient: Moderate.

Siltation: Moderate. **Insect:** Infrequent. **Other:** This species has a moderate rate of spread and will tolerate acidic soils. It has a moderate-to-high tolerance of general

disturbance and stress. [1, 6, 37]

Design Considerations

Woolgrass has been used in restorations of wet meadows, sedge meadows, wet woodland reconstruction and peaty fens. It is an attractive plant for landscape design, mitigation and restoration sites. The short rhizomes help stabilize the soil. This is an early successional species. **Concerns:** Protect this species from depredation while it is becoming established. This species can be short lived. [16, 27, 42]

Wildlife Use

Bulrush provides habitat for not only waterfowl, but for other species as well. Coots, black, canvasback, mallard, pintail, redhead, ring-necked, scaup and teal ducks eat the

Indicator Status: OBL



Nursery/Plant Information

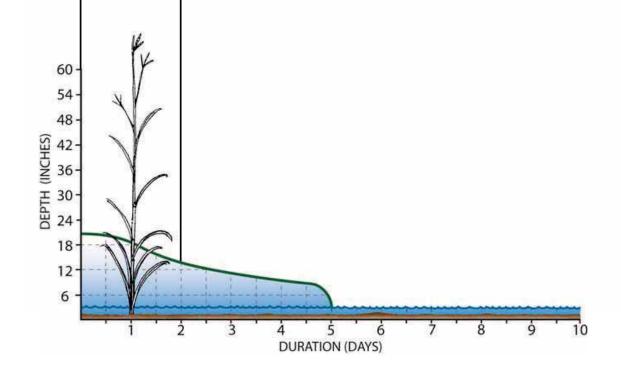
Available: Widely. **Types:** Roots, plants

and seeds.

Planting Techniques

Woolgrass achenes require moist, cold stratification and light for germination. Fall planting, especially with fresh seed, has shown a higher success rate. About 4,536,000 seeds/lb. Rootstock and transplants have had success in establishment, though seed establishes well. Woolgrass is favored by drawdowns, especially during the spring. [16, 37, 42]





Scutterlaria lateriflora

Mad-dog Skullcap - a.k.a. Blue Skullcap

Habitat/Plant Community and Geographic Range

Habitat/Community: Shores, stream banks, sedge and wet meadows, marshes, swamps and shaded wet areas, usually found among sedges. [7, 21, 35] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. Nfld. to B.C., s. to Ga., Tex. and Calif. [7, 21]

Description

General: Slender, native, perennial herb, usually 1-2' tall. **Flower:** Two-lipped, smaller blue petals and sepals in loose clusters from elongate racemes in the axil leaves. **Leaf:** Opposite, ovate to lance-shaped, smooth leaves are 1-3" long and ½-2" wide. The margins are coarsely toothed with petioles no longer than ¾" long.

Stem: Solitary, square stems 8-24" long and smooth. **Fruit:** An achene.

Root: Slender rhizomes. [7, 35]

Normal Water Level

This species prefers wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 24". **Duration:** Medium short – 3.5 days (decreasing 6" the first half day, then 6"/day thereafter). This species has a moderately low tolerance to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full sun to shade. **Salt:** Moderate. **Nutrient:** Moderate. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderate-to-high tolerance to general disturbance and stress. [1]

Design Considerations

Mad-dog skullcap is used in many mitigation and restoration sites of shores, stream banks and wet meadows within the seed mix for diversity. It self-sows well. It is a beautiful, small landscape plant that could do well in rain water gardens.

Wildlife Use

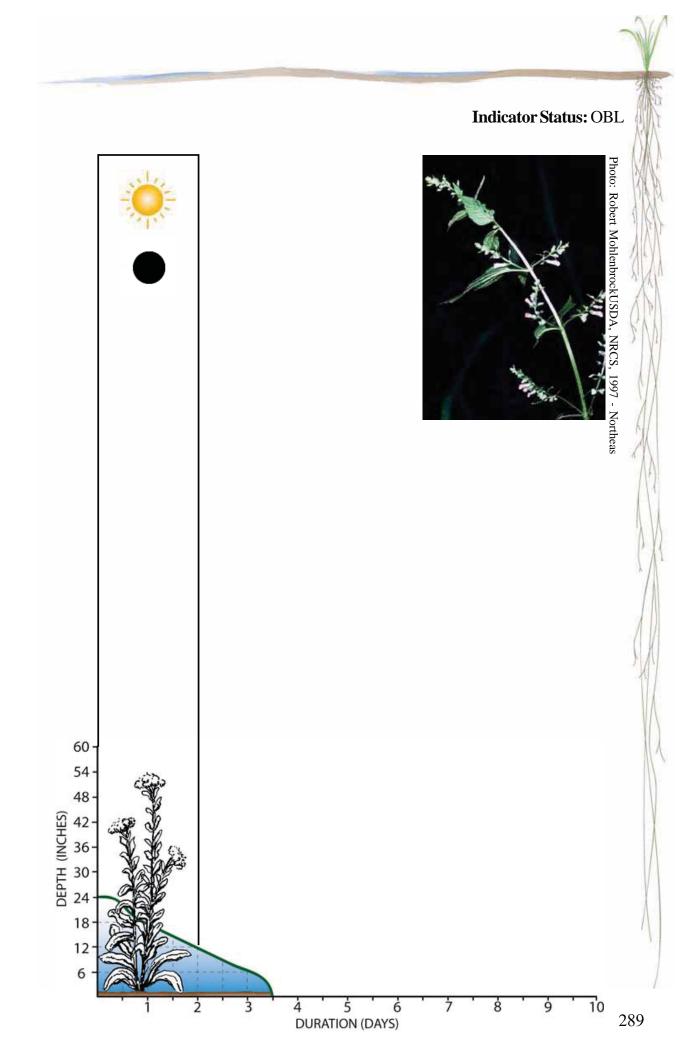
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Nursery/Plant Information

Available: Limited. Types: Seed only.

Planting Techniques

This species self sows easily. [21]



Silphium laciniatum

Compass Plant

Habitat/Plant Community and Geographic Range

Habitat/Community: Mesic prairies and railroads, though sometimes seen in natural sedge meadows and wet prairies. [17, 44] **Range:** Minn. (Eco-Region: All), Wis., Mich. Oregon to Minn. and S.D., s. to Ala. and Tex. Locally introduced along railroads e. to N.Y. [17]

Description

General: Coarse, perennial, native herb to a mature height of up to 10'.

Flower: Large, yellow, disk-type heads in a narrow line up the stalk similar to a raceme, blooming from July to September. The flower's ovate bracts exceeding the disk of rays, 17-25 per head and ¾-2" long. **Leaf:** Alternate, deeply cut-to-lobed lower leaves, which are up to 20" long and then progressively reduced upwards, with the uppermost entire and well under 4" long. The basal leaves tend to align themselves in a north-south direction. **Stem:** Small hairs along the stem. **Fruit:** A winged achene. **Root:** Coarse, taprooted, rough-hairy to 3-6'. **Soil:** Most rich prairie soils with a pH range of 4.5-7.5. [17, 44]

Normal Water Level

This species prefers upland mesic conditions, though it will tolerate some wet/saturated conditions. [44]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Short – 1 day (decreasing entire 12" in 1 day). This species will not tolerate artificial inundation situations, though has been found in sedge meadows and wet prairies occasionally. [44]

Sensitivities or Other Tolerances

Exposure: Full sun. **Salt:** Low. **Nutrient:** Low. **Siltation:** Low. **Insect:** Infrequent. [44, 47]

Design Considerations

This species has been used in buffer and slope stabilization. It has also had success in the restorations of mesic-to-wet prairies and the edges of rainwater gardens. [44]

Wildlife Use

Compass plant provides seed for songbirds, meadow mice and sharp-tailed grouse. It attracts butterflies and is a food source for the silphium weevil. Deer have been known to graze on the plant. [44]

Nursery/Plant Information

Available: Limited. Types: Plants and seeds.

Indicator Status: UPL

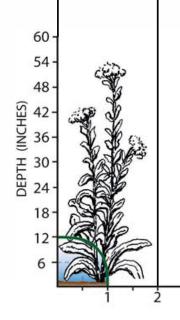


Planting Techniques

Seed can be germinated with moist, cold stratification for 60 days. Fresh seed planted in the fall does not need treatment. The recommended seeding rate is 0.03-0.19 lb/acre. It only grows one leaf the first year, so it may require protection the first year. Compass plant is difficult to transplant because of its taproot. [44]

DURATION (DAYS)





Silphium_perfoliatum

Cup Plant - a.k.a. Indian-cup

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forests, stream banks, wet prairies and savannas, wet meadows, along wetlands and springs. [7, 16, 35, 41] **Range:** S. and ec. Minn. (Eco-Region: 6-9), s. Wis., s. LP of Mich. S. Ont. to N.D., s. to Ga. and La. [7, 21] **This is a threatened species in the s. LP of Mich.**

Description

General: A robust, native, perennial herb, usually 4-6' tall, with sunflower-like heads up to 4" across and unique united leaves that form a "cup" that holds rainwater, hence its common name. Flower: A multibranched flower stalk with 10-30 heads arranged in a spreading cluster. Each head has 20-30 yellow rays that are 3-4" wide, with a light green-to-yellow, sterile disk flower center that blooms from July to September. Leaf: Bristly, lance-shaped, opposite leaves that are 6-10" long and united at the base to form a "cup." Stem: Often reddish in color, wide, square and smooth to the touch. Fruit: Only the ray flowers produce seeds. Root: Spreads by rhizomes. Soil: Moist, fertile soils, especially in river valleys. [7, 35, 41]

Normal Water Level

This species prefers upland moist to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/day).

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species is sensitive to herbicide drift. It has a moderate tolerance to general disturbance and stress. [1, 16, 47]

Design Considerations

Cup plant has wonderful wildlife use and is used in wetland and prairie restorations. It has also been used for shoreline, buffer and vegetated swale soil stabilization. It is also an ideal plant for the background of rain water gardens. **Concerns:** This species is sensitive to herbicide drift. It can be aggressive, which may be desirable in some situations. [16]

Wildlife Use

The seeds of cup plant are eaten by meadow mice, goldfinches and sharp-tailed grouse. Cup plant is also a good butterfly and hummingbird plant. Yet, it is used mostly as a source of water after rain events. Birds use the "cups" as baths, and tree frogs will sit in them. [21, 32, 41]

Nursery/Plant Information

Available: Widely. Types: Seeds and plants.

Indicator Status: FACW-**Planting Techniques** Cup plant propagates from seed well and produces about 22,400 seeds/lb. [16] 60 54 48 OEPTH (INCHES) 36 30 24 18 12 **DURATION (DAYS)** 293

Solidago flexicaulis

Zig-zag Goldenrod - a.k.a. Broad-leaved Goldenrod, Woodland Goldenrod

Habitat/Plant Community and Geographic Range

Habitat/Community: Clearings, woods and woodland edges, especially in hardwood forest areas. The only goldenrod to grow in the forest. [16, 17, 35, 44] **Range:** Minn. (Eco-Region: 1, 4-9), Wis., Mich. N.S. and N.B. to N.D., s. to Va., Ky. and Ark., and in the mountains to Ga. [17, 21]

Description

General: Native, woodland, perennial herb that reaches a height of 1-3'. Flower: Several round clusters, 1-2" wide, often stalked at the axis of the upper leaf joints. Individual flowers are ¼" wide and have only 3-4 petals. Blooms from August to September. One of the few goldenrods with flower clusters located at each leaf joint rather than spikes near the top of the plant. Leaf: Pointed, oval leaves that are coarsely toothed and 1-3" long. The dark green leaves alternate along the stem with short leafstalks. Stem: 1 to 3 erect stems that bend back and forth between each leaf attachment, hence the common name, "zig-zag," which is most obvious between the upper leaves. Fruit: Short-haired achenes. Root: Long rhizomes. Soil: Moist, rich woodlands, though it will tolerate dry conditions and calcareous situations. [17, 35, 41]

Normal Water Level

This species prefers upland moist to dry conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Low. Depth: 12". Duration: Short -1 day (decreasing 12" in 1 day). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Part sun to full shade. **Salt:** Low. **Nutrient:** Moderate. **Siltation:** Low to moderate. **Insect:** Infrequent. **Other:** This species is moderately tolerant to general disturbance and stress. [1]

Design Considerations

Zig-zag goldenrod is a good woodland plant for restorations, shady flower gardens, calcareous soils, shady slopes and buffers. It has been used successfully in well-drained, shady rain water gardens. **Concerns:** This plant can be aggressive, and it prefers woodland situations. [16, 41]

Wildlife Use

Goldenrod leaves are eaten to a limited extent by ruffed, sharp-tailed and spruce grouse. Goldfinches, juncos, and swamp and tree sparrows eat the seeds. Rabbits eat the foliage and plants. Mice eat the seed heads and foliage. [21, 32]

Nursery/Plant Information

Available: Widely. **Types:** Plants and seeds.



Sorghastrum nutans

Indian Grass

Habitat/Plant Community and Geographic Range

Habitat/Community: Mesic or dry prairies, open woods, fields, and an important constituent of tall-grass prairies. [16, 17, 44] **Range:** Minn. (Eco-Region: All), Wis., Mich. S. to the Gulf of Mex., w. to Utah and Ariz. [17, 21]

Description

General: Warm-season, native, perennial grass that forms loose clumps and reaches 4-8'. **Flower:** Plume-like, golden brown panicles from August to September. Panicles are 4-12" long, narrow, freely branched, with the nodes and smaller branches having long, soft, bent hairs. Spikelets are lance-shaped and the awn is twisted below, bent at about a third of its length. **Leaf:** Leaves are 1/8-3/8" long with smooth sheaths and well-developed ligules that are firm and continuous with the auricles. **Root:** Short rhizomes, smooth except for the sericeous nodes. Fibrous roots reach 4' deep. **Soil:** Mesic-to-dry loam or sandy soils with a wide pH range and in most moist, grassy habitats. [17, 44]

Normal Water Level

This species prefers upland moist to wet/saturated conditions, although it will tolerate drier conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Short -1 day (decreasing 12" in 1 day). This species is somewhat tolerant to flood duration. [1, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** High and will increase with nutrients. **Siltation:** Low to moderate. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1, 44]

Design Considerations

An excellent plant for stabilizing soils of slopes, buffers and vegetated swales. A wonderful contrast or border plant for landscapes for a wide range of habitats. It is also wonderfully suited for many restorations of meadows, prairies and buffers. It has been used in shallow, well-drained rainwater gardens. The plumes may be cut and dried. **Concerns:** Be cautious of non-local seed and hybrids. [16, 44]

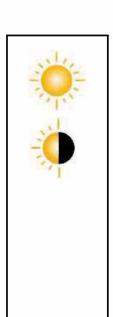
Wildlife Use

Indian grass is a robust perennial that provides good winter cover as well as seeds for game and songbirds. It is a butterfly attractant. But most importantly, it is a palatable and nutritious forage for grazing species. [16, 44]

Nursery/Plant Information

Available: Widely. Types: Seeds and plants.

Indicator Status: FACU+



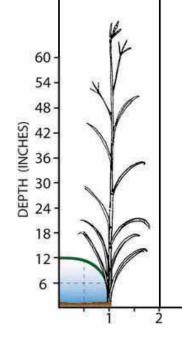
Planting Techniques

The seed germinates well with no treatment if fall planted. Otherwise, moist, cold stratification will help with some lots. Indian grass is a successional species and one of the first to establish the prairie habitat. Recommended seeding rate is 2.5-6.0 lb/acre with about 132,800 seeds/lb. [16, 44]

5

DURATION (DAYS)





Sparganium eurycarpum

Giant Burreed - a.k.a. Common Burreed, Broad-fruited Common Bur-reed

Habitat/Plant Community and Geographic Range

Habitat/Community: Marshes, streams, ditches, bogs, ponds and lakes (usually in shallow water; often with cattails). [4, 7, 11, 16, 44] **Range:** Minn. (Eco-Region: All), Wis., Mich. Nfld. to B.C., s. to N.J., Ohio, Ind., Mo., Okla., Ariz. and Calif. [7, 21]

Description

General: A stout, persistent, perennial emergent herb that is up to 4.5' tall.

Flower: Unisexual inflorescence that has zigzag branches and are white from June to August. The lower heads consist of the flowers with pistils and are bur-like at maturity, whereas the upper heads consist of flowers with 2 stamens. It can be distinguished from all other burreeds because it has 2 stigmas while other burreeds have just 1.

Leaf: Long sword-like, usually erect leaves are ½-½" wide, and strongly keeled so that they appear to be a flattened-triangular cross section. However, ribbon-like floating and submerged leaves can also be produced. **Stem:** Stout, branched and 15-40" long.

Fruit: The mature fruit is about ¹/₄" long and square-topped with a sharp break, where other burreeds are tapered to the base and apex. **Root:** Rhizomes. **Soil:** Shallow water and on wet substrates with a pH range of 6.7-8.8. [4, 7, 11, 44]

Normal Water Level

This species prefers shallow water of 18" of inundation or less to wet/saturated conditions. Giant burreed is characteristic of silty, fertile waters, especially south of the vegetation tension zone. [21, 11, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Short – 2 days (decreasing 6"/ day). This species tolerates regular inundation, is moderately tolerant to flood duration, and will decrease with flood depth increases. [1, 37]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Low to moderate. **Nutrient:** Moderate to high and will increase with both N and P level increases. **Siltation:** Moderate to high. **Insect:** Unknown. **Other:** This species has a rapid rate of spread. It will remove metal quickly. It has a moderate tolerance to general disturbance and stress. [1, 6, 37, 44]

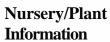
Design Considerations

Giant burreed has been used in shorelines of streams, lakes and ponds to provide erosion control. It also provides a wonderful wave buffer. It is used in wetland restorations where cattails would be, hopefully outcompeting the *Typha* spp. It provides good wildlife habitat. **Concerns:** At first glance, giant burreed may resemble cattail (*Typha* spp.) when not in flower; however, the strongly keeled leaves (flattened-triangular in cross section) of giant burreed will distinguish it from the flattened leaves (D-shaped in cross section) of cattail. This species is a competitor of cattail and aggressive enough to plant instead. [11, 16, 44]

Indicator Status: OBL



Waterfowl, especially black, mallard, ring-necked, scaup and wood ducks eat the achenes of this species. Muskrats eat the stems and foliage. The plant also provides cover for nesting ducks and marsh birds. [4, 11, 21, 32, 37, 44]



Available: Widely. **Types:** Corms, rhizomes, rootstock, seedlings and transplants.

Planting Techniques

Soak the seeds in a bucket of water outside all winter to allow them to freeze, then sow in saturated soils. The seeds will float, so the wind may spread the plants to other locations. Recommended seeding rate is 0.2-0.375 lb/acre with about 9,488 seeds/lb. Corms and rhizomes are more successful than seeding and should be planted in saturated soil





60 54 to 2" of water depth at 2-6' apart. Potted plants, transplants and seedlings transplant well and can be planted in 48 saturated soils to a depth of 12" of water with similar (NCHES) 36 spacing. One giant burreed corm can produce up to 43 plants the following growing season. [16, 28, 44] H30 18 12 **DURATION (DAYS)**

Spartina pectinata

Prairie Cord Grass - a.k.a. Cord Grass

Habitat/Plant Community and Geographic Range

Habitat/Community: Shallow-water marshes, wet meadows, sandy and gravely shores, ditches and low prairies. [7, 11, 16, 44] **Range:** Minn. (Eco-Range: All), especially s. and w. Wis., LP and c. UP of Mich. Nfld. and Que. to Alta., Wash. and Ore., s. to N.C., Ark., Tex. and N.M. [7, 21]

Description

General: Hardy, coarse, densely colonial, native, perennial grass 5-7' tall. **Flower:** Greenish yellow panicle with many, distinct one-sided spikes from July to August. The spikelets are longer than broad, overlay, and may be ascending or lie flat, resembling a comb. Unequal-size glumes are articulated below the glumes. **Leaf:** Main blades are shiny, long and flat, 1/8-3/8" wide and up to 3' long with strongly roughened margins. When dry, the leaves may be inrolled. Gracefully arching leaves turn red to light straw yellow in fall. **Stem:** Stout, smooth, erect stems with short ligules that may be monotypic clones up to 30' away. **Root:** A dense mass of stout, scaly rhizomes. **Soil:** Tolerates most moist-to-saturated soils, although it prefers poor, sandy and gravelly soils with a pH range of 4.7-7.8. [7, 11, 44]

Normal Water Level

This species prefers shallow water of 3" of inundation or less and wet/saturated to moist upland conditions. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Medium long – 4 days (decreasing 6"/day). This species will tolerate seasonal and regular inundation periods, is moderately tolerant to flood duration, and population decreases with flood depth increases. [1, 37, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low to moderate. **Nutrient:** Moderate to high. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species has a moderate rate of spread. It is moderately tolerant to general disturbance and stress. [1, 37, 44]

Design Considerations

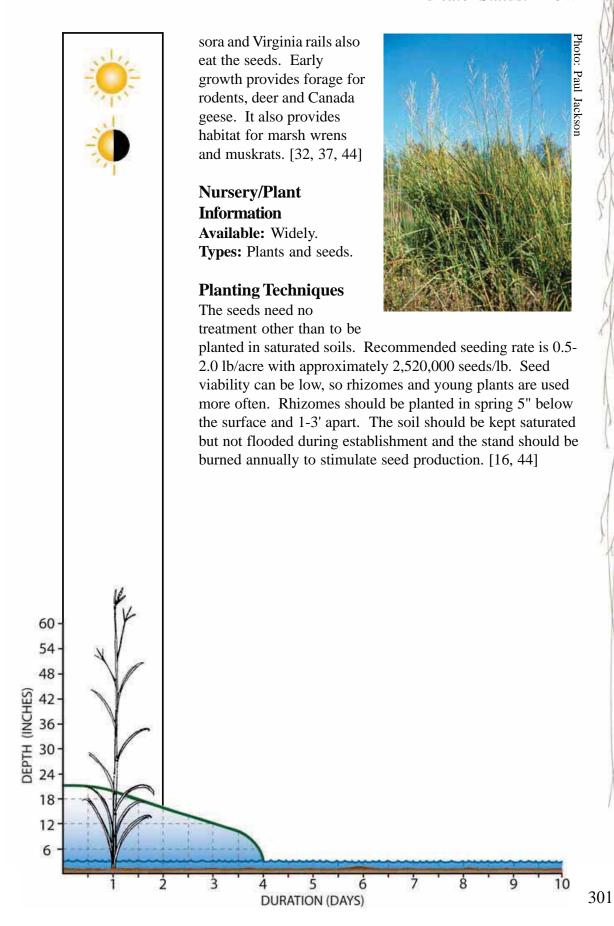
Prairie cord grass is an excellent soil stabilizer of shores, stream banks, slopes, buffers and vegetated swales due to the large rhizomatous mass it creates. It is well suited to restore wetlands, marshes, wet meadows and wet prairies as well as shorelines.

Concerns: It is an aggressive plant that can create clones up to 30' away. This may be desirable to compete with non-native and invasive species or to revegetate a site quickly to prevent erosion. [16, 44]

Wildlife Use

Although prairie cord grass seeds are eaten by several kinds of ducks, they are an important food source for only the black duck. Marsh birds such as the clapper, and

Indicator Status: FACW+



Spiraea alba

Meadowsweet - a.k.a White or Narrowleaf Meadowsweet, or Meadowsweet Spirea

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadows, stream banks, wet thickets, shrub-carrs, bogs, pond and lake shores, savannas, springs, dunes, old fields, meadows and conifer swamps (soils often sandy). It may form relatively tall, dense thickets on disturbed sites, and it tends to increase with declining water levels. [7, 11, 16, 22] **Range:** Minn. (Eco-Region: All), Wis., Mich. Nfld. and n. Que. to Alta., s. to Va., N.C., Ind., n. Mo. and S.D. [7, 21]

Description

General: Low, deciduous, woody shrub with many branches, often forming colonies. 3-6' in height. Flower: A terminal, finely hairy, elongate panicle that has small, white,5-petaled flowers in bloom from June to August. Leaf: Alternate, simple, unlobed, finely serrate leaves without hairs and 1-2½" long that turns yellow-red in the fall. Bark: Red-brown and smooth. Twigs: Slender, ascending, and generally dull brown and smooth. Fruit: A follicle. Root: Dense, fibrous, shallow lateral spreading, freely suckering roots. Soil: Soils ranging from sand, silt loams, peat and mucks that are saturated to moderately dry. [7, 11, 21]

Normal Water Level

This species prefers shallow water of 3" of inundation or less to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Long - 80 days in spring, 5 days in summer (decreasing 6" the first day then 6"/2 days for the next 4 days). It is very tolerant of flooding. [22]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Unknown. **Siltation:** Low to medium. **Insect:** Occasional – spirea sphid, oblique-banded leaf roller, scales. **Other:** Ice and wind infrequently damage meadowsweet, which is resistant to drought, heat and soil compaction. This species is not tolerant to general disturbance and stress. [1, 22]

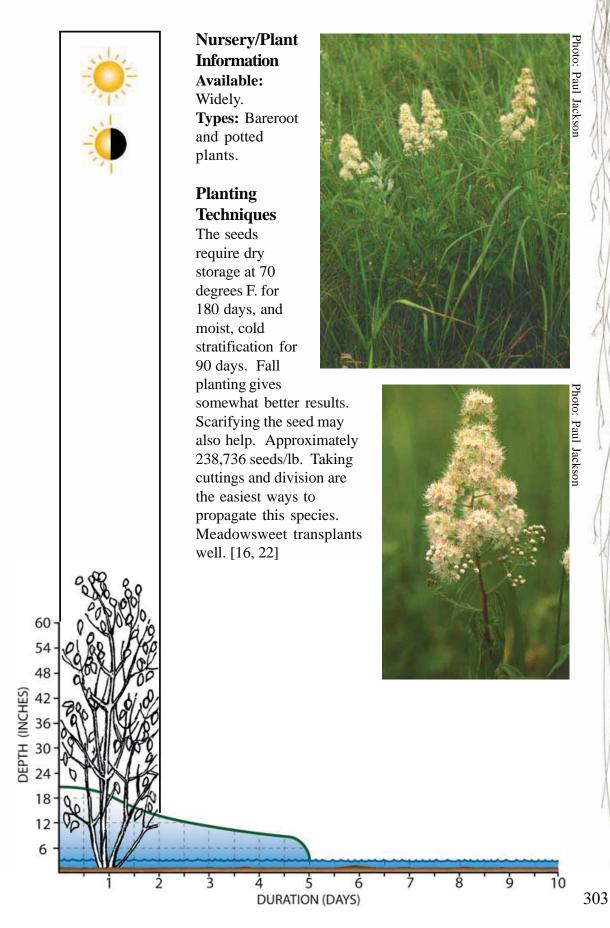
Design Considerations

Meadowsweet is a nice landscape shrub, although it can be aggressive. It is a fast grower for habitat restorations and suitable for naturalistic landscapes. It will create large, dense thickets and it tends to increase with declining water levels or with disturbed sites. **Concerns:** This species can be aggressive, though that may be desirable in some situations. [16]

Wildlife Use

Meadowsweet is valuable to deer, songbirds and gamebirds. The fruit is not edible for humans. It attracts butterflies, moths and other insects. [21, 22, 32]

Indicator Status: FACW+



Symphyotrichum laeve

Smooth Aster - a.k.a Smooth Blue Aster

Habitat/Plant Community and Geographic Range

Habitat/Community: A beautiful aster of mesic open or brushy places such as prairies, savannas, woodlands, swales and roadsides. [16, 17, 35] **Range:** All but ne. Minn. (Eco-Region: All), Wis., Mich. Mass., N.Y., s. Ont., s. Man. to Alaska, s. to N.D., S.D., Iowa, Mo., Tenn.; n. to Ohio, Pa., R.I. [7, 21]

Description

General: A showy, vibrant blue-flowered perennial herb that has a mature height of 2-4'. **Flower:** Color is lavender-blue, blooms from August to October. The flowers are 1" across with 15 to 25 rays. **Leaf:** Blue-green, thick leaves that clasp the stem throughout the plant. **Stem:** Upright, single stem. **Fruit:** Light brown achene at the end of autumn. **Root:** Fibrous, shallow. **Soil:** The pH range is 5.0 to 6.5, dry to mesic soil. [17, 35, 44, 47]

Normal Water Level

This species prefers upland moist/mesic to dry conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Short – 1 day (decreases 6" every 12 hours). Smooth aster can tolerate wet conditions for short durations and seasonal inundation. [1, 44]

Sensitivities or Other Tolerances:

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Low to moderate.

Siltation: Low to moderate. **Insect:** Infrequent. [1, 44, 47]

Design Considerations

Smooth blue aster is well suited for upland slope buffer stabilization, vegetated swales, rainwater gardens and stormwater runoff situations that drain well. It is also good in landscaping situations for butterflies, cut flowers and birds. **Concerns:** The plant is aggressive, which is favorable for some restorations. Several cultivated varieties exist. [16, 35, 44]

Wildlife Use

This aster attracts the orange sulphur butterfly. [21, 32, 44]

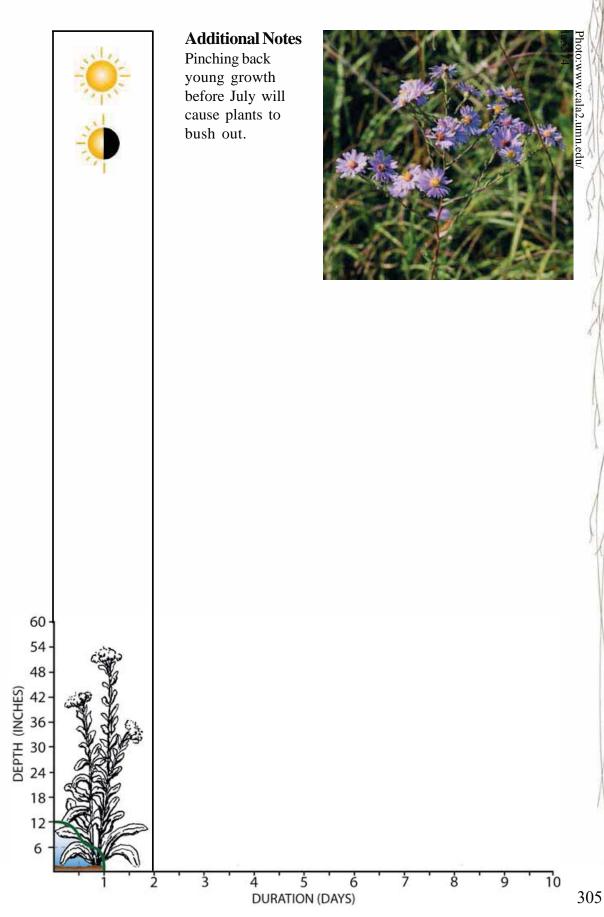
Nursery/Plant Information

Available: Widely. **Types:** Seeds and plants. Several cultivars exist.

Planting Techniques

Smooth aster is easily propagated from seed. No germination treatments are needed. Seed should be stored dry and cool. Cuttings can be rooted, and this species self sows well. Seeding rate is 0.02-0.125 lb/acre and approximately 768,000 seeds/lb. [16, 44]

Indicator Status: UPL



Symphyotrichum lanceolatus (simplex)

Panicle Aster - a.k.a. Aster simplex - White Panicle, Marsh or Eastern Lined Aster

Habitat/Plant Community and Geographic Range

Habitat/Community: Panicled aster is one of our more common asters found in drier, open marshes, wet meadows, sedge meadows, fens, swamp openings, low prairies, old fields, stream banks and shores. [7, 11, 16, 35] **Range:** Minn. (Eco-Region: All), Wis., Mich. N.S. to N.D., s. to Va. and Tex. [7, 21]

Description

General: This large, stout, perennial herb has a mature height of 2-4" and may form dense colonies. Flower: Flowers are about ¾" wide with 20 or more white rays, usually blooming from August to October. The inflorescence is leafy and forms a panicle. Although similar to the redstem and swamp asters (A. puniceus and A. lucidulus) the ray flowers of white panicle aster are always white and smaller. Leaf: Stem leaves are sessile or slightly clasping. Leaf undersides are smooth with the exception of occasional small hairs along the margins. Leaves are mostly serrate, longer than wide. Stem: Large, stout plant producing multiple branches toward the top. Fruit: Light brown achene maturing at the end of fall. Root: Forming colonies from long rhizomes. Soil: Prefers moist to saturated soils. [7, 11, 35, 44, 47]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 24". **Duration:** Medium long – 4 days (decreasing 6" daily). Panicled aster seedlings are killed by 2 days of inundation, though mature plants tolerate shallow flooding for short periods. This aster has a better tolerance to inundation than New England aster and is moderately to somewhat tolerant to flood duration. [1, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low to moderate. **Nutrient:** Low to moderate. **Siltation:** High. **Insect:** Infrequent. **Other:** This species is moderately tolerant to general disturbance and stress. [1, 44, 47]

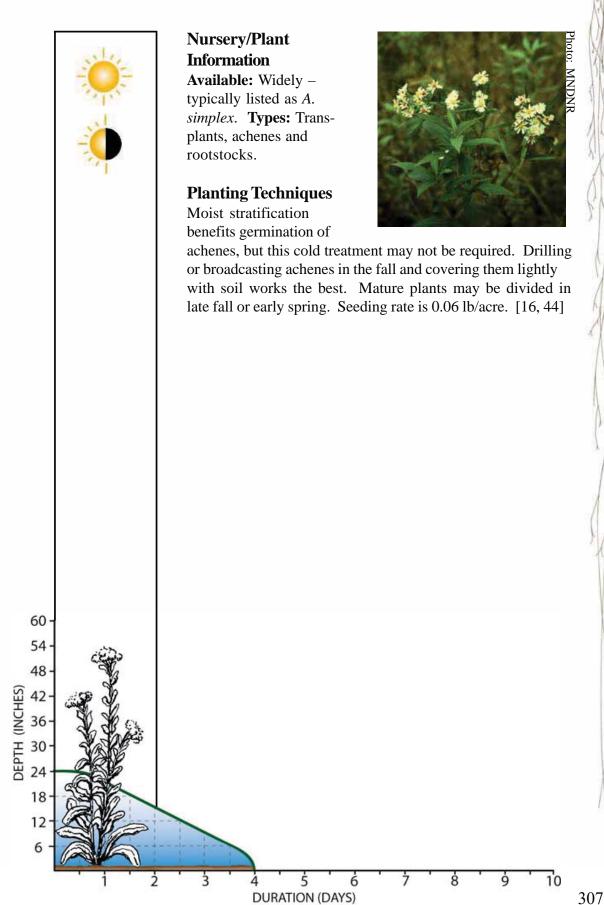
Design Considerations

Panicled aster is used well in the upper shoreline zone and for slope buffer stabilization. It also does well in vegetated swales and restorations. It is used for cutflowers and attracts butterflies. This species will work well in infiltration basins and rain gardens. **Concerns:** Can be very weedy and aggressive, though this may be a benefit against other invaders in restorations. [16, 44]

Wildlife Use

This aster provides waterfowl cover and will attract butterflies and bees. [21, 32, 44]

Indicator Status: FACW



Symphyotrichum novae-angliae

New England Aster - a.k.a. False Indigo

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet meadow, low prairie, shores, thickets, calcareous fens, and roadsides, usually in moist or wet, open areas. This species is a common aster of wet to wet-mesic prairies. [7, 11, 16, 35, 41] **Range:** Mostly w. and s. Minn. (Eco-Region: 3-9); Wis., especially s. LP of Mich.; Mass. to N.D. and Wyo., s. to Ala., Okla. and N.M. [7, 21]

Description

General: A native, perennial herb with clustered stems reaching 1-6½, which is easily grown and makes a robust, colorful garden plant. **Flower:** Individual flowers, flower stalks and modified leaves subtending the flowers have hairy glands. The ray flower is very variable in color, from amethyst to rosy, rarely blue or white. The distinctive disc flower is yellow. The flower heads are 1-2" wide and bloom from late summer until frost. **Leaf:** Bases of the oblong (lance-shaped) stem leaves are clasping and entire, while the lower leaves tend to be deciduous. **Stem:** Usually clumped and much branched and often covered with glandular hairs (use a 10-15X lens). **Fruit:** The achenes are densely covered with stiff hairs. **Root:** A short rhizome or crown. **Soil:** Moist to wet habitats with a pH range of 5.5-7.0. [7, 11, 35, 41, 44]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 24". **Duration:** Moderate short -3 days (decreasing 1' in the first day and 6" the following 2 days). Germinating seedlings are killed within 2 days of inundation. Mature plants appear to be more tolerant of short periods of shallow flooding in natural areas but not in reconstructed wet areas. [1, 37, 44]

Sensitivities or Other Tolerances

Exposure: Full to partial sun. **Salt:** Low. **Nutrient:** Low to moderate. **Siltation:** High. **Insect:** Infrequent. **Other:** This species has a moderate-to-high tolerance to general disturbance and stress. [1, 37, 44, 45, 47]

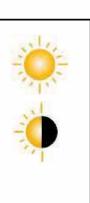
Design Considerations

New England aster is a good soil stabilizer for prairies, shorelines and upland buffer areas. It is often a garden perennial of cultivated varieties. It provides good cut flowers and is very good for lakeside plantings. It is also a good butterfly plant. Slight disturbances often benefit this aster. **Concerns:** This species can be aggressive and form monocultures. It spreads by seed. Many cultivars exist. [16, 21, 35, 41, 44]

Wildlife Use

This aster provides waterfowl cover. A great nectar source because of its long bloom time in autumn, during which it is heavily visited by migrating monarch butterflies. [21, 32, 41, 44]

Indicator Status: FACW



Nursery/Plant Information

Available: Widely; often a garden perennial with a white variety.

Types: Transplants, seed

and rootstocks.



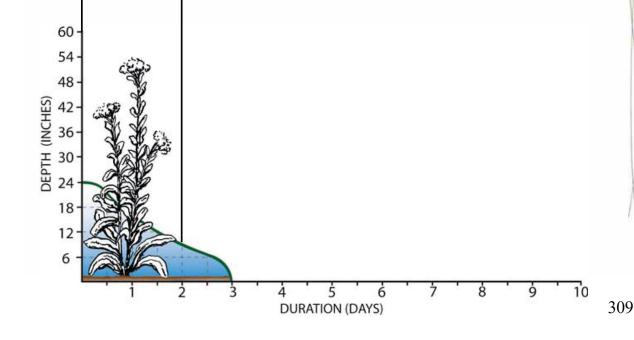
Fresh or dry achenes produce 95-100% germination in 3-8 days. Moist stratification of fresh achenes benefits germination. Drill or broadcast achenes in the fall and cover



them lightly with soil for natural stratification. Achenes are light and temperature sensitive. Mature plant may be divided in late fall or early spring. Spring cuttings of 1.5-2" may be rooted in sand. An April-May drawdown stimulates seed germination and plant growth. Seeding rate is 0.03-0.2 lb/acre. 1,120,000-4,600,000 seeds/lb. [16, 37, 44]

Additional Notes

Pinching back young growth before July will cause plants to branch.



Symphyotrichum pilosum

Frost Aster - a.k.a. Hairy Aster, White Oldfield Aster

Habitat/Plant Community & Geographic Range

Habitat/Community: Sandy and gravely shores, interdunal swales, wet meadows, widely adapted to prairie habitats and moist-to-wet marshes. This species is often in calcium-rich soil, and may become weedy in disturbed fields and roadsides. [7, 16] **Range:** Se. Minn. (Eco-Region: 7-8), Wis., Mich.; N.S. to s. Minn. and Neb., s. to n. Fla., La. and Kan. [7]

General Description

General: Frost aster is a spreading perennial herb, from a large crown that grows between 16-24". **Flower:** This species has green-tipped, white ray flowers and yellow disc flowers that bloom from August to November. **Leaf:** Alternate, basal and lower leaves oblong lance-shaped, with stalks that soon are deciduous. The upper leaves are smaller, linear, stalkless. Leaf margins are entire or slightly toothed and the petioles are fringed with hairs. **Stem:** Sometimes smooth or stems and leaves with spreading hairs. **Fruit:** An achene; pappus white. **Root:** Fibrous, shallow. **Soil:** Widely adapted to moist-to-wet soils. [7, 16, 17, 47]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions.

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Short -2 days (decreasing 6"/day). This species is somewhat tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Unknown. **Nutrient:** Low to moderate. **Siltation:** Unknown. **Insect:** Infreauent. **Other:** This species has a moderate-to-high tolerance to general disturbance and stress. [1, 47]

Design Considerations

Frost aster makes wonderful cutflowers and is a good nectar source with strong tolerance to sandy and gravel soil types. **Concerns:** Aggressively self-seeds. May become weedy in disturbed sites though it may be used beneficially in restorations to defend against invasive plants. [16]

Wildlife Use

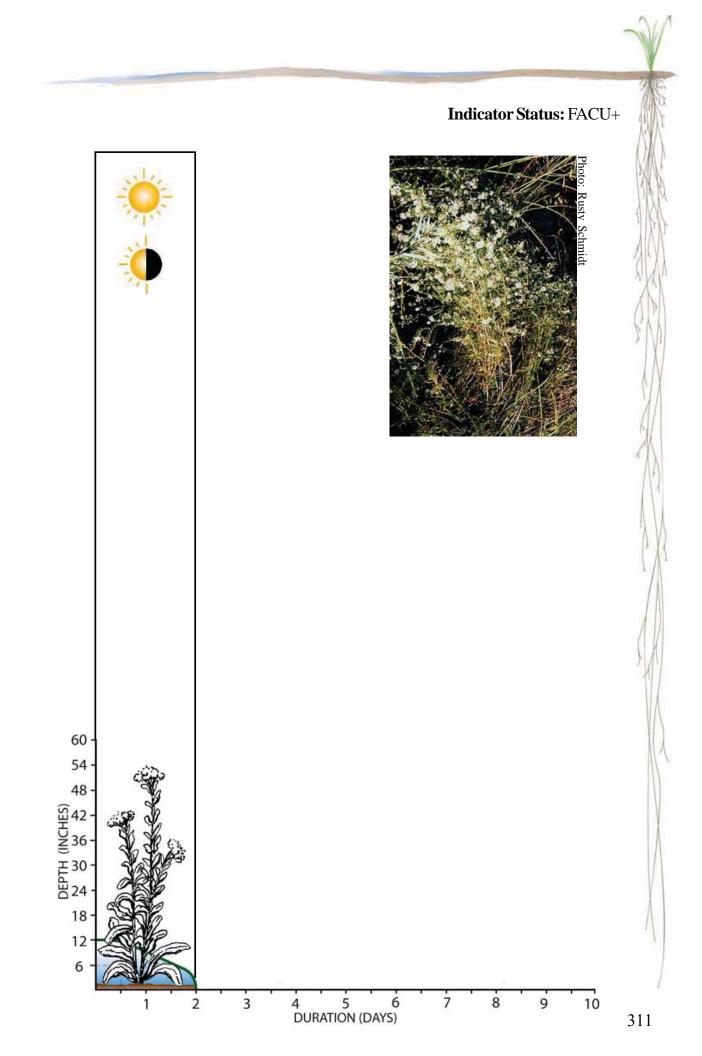
This aster provides waterfowl cover and will attract butterflies and bees. [7, 32]

Nursery/Plant Information

Available: Limited. Types: Plants only.

Planting Techniques

Achenes should be kept in dry storage before planting. [16]



Symphyotrichum puniceum

Red-stemmed Aster - a.k.a. Purplestem, Red-stalked, Bristly or Swamp Aster

Habitat/Plant Community and Geographic Range

Habitat/Community: A common wetland aster found in open and brushy swamps, shores, sedge meadows, shrub-carrs, marshes, thickets, alder thickets, calcareous fens, stream banks, shores, springs, roadsides and ditches. This aster sometimes forms large colonies and seems to respond to disturbances such as grazing and drainage by increasing or spreading. [7, 11, 35] **Range:** Minn. (Eco-Region: All), Wis., Mich.; Nfld. to N.D., s. to Ga., Ala., Ill. and Neb. [7, 21]

Description

General: Large, perennial herb commonly 1-5' tall. **Flower:** The flower heads have pale blue to deep lavender or violet ray flowers and yellow disc flowers. This species blooms from August to October. The inflorescence is hairy or smooth, but does not have glands. **Leaf:** Stem leaves are lobed, clasping the stem, and usually toothed. The leaves are not conspicuously crowded. **Stem:** The stem is often reddish, with scattered coarse, stiff, white hairs. **Fruit:** Achenes are smooth. **Root:** Short rhizomes or crowns and sometimes has short stolons. **Soil:** Hardy and tolerant of wet soils. [7, 11, 35]

Normal Water Level

This species prefers moist/mesic to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Long – 5 days (decrease of 6" in the first day and then 12" in the next 4 days). This species has a moderate tolerance to flood duration. [1, 46]

Sensitivities or Other Tolerances

Exposure: Full to part shade Salt: Low. Nutrient: Low to moderate.

Siltation: Unknown. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stress. [1]

Design Considerations

Red-stemmed aster is used in wetland restorations as well as in restorations of shores and streams. Also consider this plant for stormwater detention areas, slope buffer stabilization, and vegetated swales. This species is a wonderful source of nectar. **Concerns:** Can be very weedy and aggressive, though this may be a benefit against other invaders for restorations or areas of grazing. [16, 21]

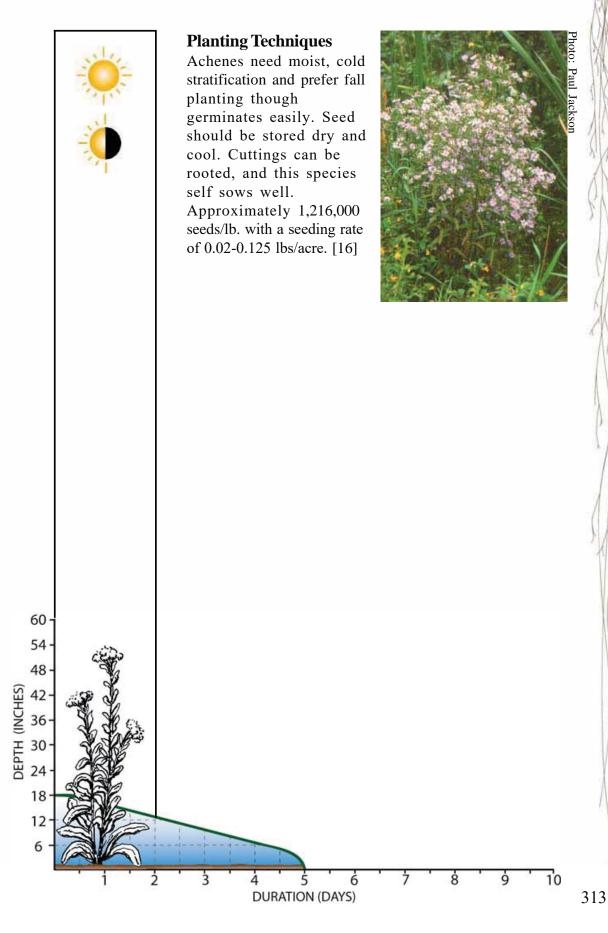
Wildlife Use

This aster provides waterfowl cover and will attract butterflies and bees. [21, 32]

Nursery/Plant Information

Available: Widely. Types: Seed and plants.





Symplocarpus foetidus Skunk Cabbage

Habitat/Plant Community and Geographic Range

Habitat/Community: Flood plain forests, swamps, stream banks, calcareous fens, shrub swamps, seepages, and moist, wooded slopes. [7, 11, 35, 41] **Range:** E. especially ec. and se. Minn. (Eco-Region: 1, 6-8), Wis., common in LP, local in UP (but common on Isle Royale) of Mich. N.S. to Minn., s. to N.C. and Iowa. [7, 21]

General Description

General: A native, coarse, perennial herb, which has a skunky odor and grows to 2' tall. **Flower:** This, our earliest-flowering native plant, has a pointed, brown or purplish spathe, 4-6" high. The spathe encloses a spherical or football-shaped stem, the spadix, on which tiny flowers bloom from March to May. **Leaf:** Exceptionally large basal leaves are 12-24", ovate and heart-shaped at the base, emerging after the flowers. The leaves are bright green and deeply veined, on very short stalks that are often unseen, rising from the base of the flower that also smells of dead flesh when crushed. **Fruit:** Much like a small-stalked and roughened potato. The fruit develops beneath large basal leaves and contains large, acrid seeds in a bland pulp.

Root: Thick rhizome. **Soil:** [7, 11, 35, 41]

Normal Water Level

This species prefers wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 12". **Duration:** Medium short -3 days (decreasing 6" the first day and 3"/day thereafter). It can tolerate seasonal and regular inundation and is moderately tolerant to flood duration. [1, 37]

Sensitivities or Other Tolerances

Exposure: Full shade. **Salt:** Low. **Nutrient:** Low to moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species has a slow rate of spread. It is moderately tolerant to general disturbance and stress. [1, 37]

Design Considerations

This species is well suited for restorations in shaded areas that are wooded, calcareous and ground-water-fed, or where springs and seeps occur. It is a unique plant that plays an important role for insects early in the growing season.

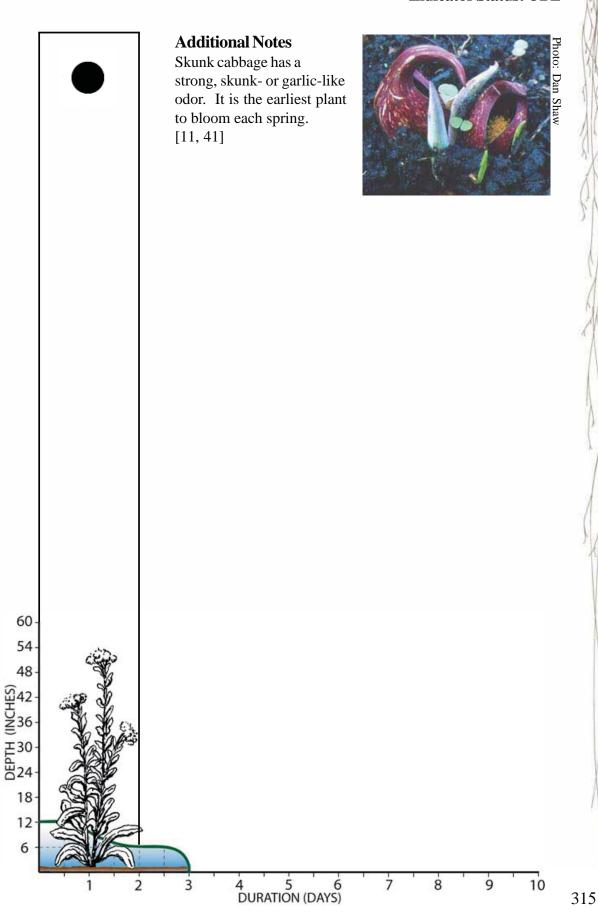
Wildlife Use

Skunk cabbage provides seeds for pheasants, wood ducks, ruffed grouse and bobwhite quail. Beaver, muskrats and frogs have also been known to use this plant as habitat or food. The strong odor attracts early flying insects that pollinate the flower. [21, 32, 37, 41]

Nursery/Plant Information

Available: Limited. Types: Seeds and plants.

Indicator Status: OBL



Thalictrum dasycarpum

Tall Meadowrue - a.k.a. Purple Meadow Rue

Habitat/Plant Community and Geographic Range

Habitat/Community: Wet-to-moist meadows, low prairies, swamps, thickets and stream banks. [7, 16, 35, 41] **Range:** Minn. (Eco-Region: All), Wis., Mich. S. Ont. to Alta. and Wash., s. to Ohio, Ill., Mo., Okla. and Ariz. [7, 21]

Description

General: A wind-pollinated, native, perennial herb often 2-8' tall. Flower: Round plumes of small, whitish green flowers that dangle. Lacks petals and instead has many showy yellow stamens (on male plants) or purplish clusters of pistils (on female plants) that bloom June to July. Leaf: Up to 25 bluish green leaflets on compound leaves that are longer than wide and end in 3 pointed lobes and are highly divided. Stem: Purple-tinted, 3-6'-long, branched stems. Fruit: 1/8- to ½"-long achene with ribs and in a round cluster. Root: Short rootstock. Soil: Wet-to-moist soils of many types, usually rich-to-heavy or peaty. [7, 35, 41]

Normal Water Level

This species prefers very moist/mesic to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. Depth: 18". Duration: Medium long - 30 days in spring; medium short - 3 days (decreasing 6"/day) in summer.

Sensitivities or Other Tolerances

Exposure: All but fully shaded areas. **Salt:** Low. **Nutrient:** Unknown. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species is moderately tolerant to general disturbances and stresses. [1, 47]

Design Considerations

Tall meadowrue is a beautiful, dark-green plant with highly divided leaves and clusters of white-to-pale-purple flowers, that enhances any garden or landscape design. It is well suited for partially shaded or brighter areas of restoration, mitigation, calcareous or buffer sites. [16]

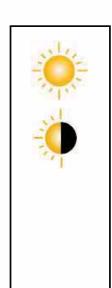
Wildlife Use

This species is wind pollinated, although it is visited by bees, butterflies and other insects. [21, 41]

Nursery/Plant Information

Available: Widely. **Types:** Seeds and plants.

Indicator Status: FACW-



Planting Techniques

Tall meadowrue seeds require moist, cold stratification of 60 days, then they should be planted in cool soils. It has more success when planted in the fall. Approximately 222,400 seeds/lb. When full grown, this species divides well and transplants easily. [16]



Photo: Paul Jackson

Tradescantia ohiensis

Ohio Spiderwort - a.k.a. Smooth or Common Spiderwort

Habitat/Plant Community and Geographic Range

Habitat/Community: Dry-to-mesic prairies, savannas, meadows, thickets and woodlands, also common along roadsides. [16, 17, 44] **Range:** Minn. (Eco-Region: All), Wis., Mich. Mass. to Minn., s. to Fla. and Tex., most common in the Midwest. [17]

Description

General: Grows and expands to form an attractive, native, perennial clump herb that is 1-3' tall. **Flower:** Nice display of solitary 1" flowers in heads that terminate the stem and branches along 2 long leaf bracts. Flowers open only in the morning. Sepals often red-margined, smooth throughout, whereas the petioles are blue. **Leaf:** Narrowly linear, flat, firm, smooth usually less than 3/8" wide. Leaves are in an angular arrangement, which conspicuously dilate into a sheath. **Stem:** Slender, straight, often branched, 15-40" long and smooth. **Fruit:** The ovary seed-cavity opens at maturity along the midrib. [17, 44]

Normal Water Level

This species prefers upland dry to moist/mesic-to-wet/saturated conditions. [16, 44]

Flooding/Fluctuation Tolerances

Frequency: Low. **Depth:** 12". **Duration:** Short -2 days (decreasing 6"/day). This species has more flooding tolerance in the spring and is drought tolerant. [44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate. **Nutrient:** Moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance and stresses. [1, 44, 47]

Design Considerations

Ohio spiderwort is a wonderful plant for many soil conditions and moisture tolerances. It is used mainly as a buffer and slope soil stabilizer. It is also well suited for landscape and garden design, including rain water gardens. Woodland, prairie and savanna restorations are sites that have this plant within the palette. It provides cutflowers and food for butterflies. [44]

Wildlife Use

This species attracts butterflies, bees and other insects. [16]

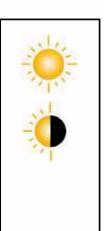
Nursery/Plant Information

Available: Widely. **Types:** Seeds or plants.

Planting Techniques

Ohio spiderwort establishes well from seed if planted fresh in the fall. If the seed is stored, it requires moist, cold stratification for 120 days. It prefers to be planted in

Indicator Status: FACU



cool soils. Kelp-based fertilizers simulate germination. Recommended seeding rate is 0.06-1.0 lb/acre with approximately 128,000 seeds/lb. This species may also be propagated with cuttings and by dividing adult plants. [16, 44]

Additional Notes

Spiderwort is a monocot, so it is not damaged by broadleaf herbicides. [16]



319

60 - 54 - 48 - (SH2) 36 - H30 - H30

Typha latifolia

Broad-leaved Cattail - a.k.a. Common Cattail

Habitat/Plant Community and Geographic Range

Habitat/Community: Marshes, open bogs, lake shores, stream banks, ditches and pond margins (usually in shallow water and less tolerant of brackish conditions than narrow-leaved cattail (*T. angustifolia*) and can form floating mats. [4, 7, 11, 35] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. S. Can. to c. Alaska, throughout USA and into Mex.; Eurasia and n. Africa. [7, 21]

Description

General: An erect, persistent, perennial, emergent herb found in almost all our wetland plant communities standing 3-9' high. **Flower:** Dense, cylindrical spike packed with flowers with no gap between the staminate (upper portion) and pistillate (lower portion) parts of the spike. Blooms May to June. **Leaf:** Pale green, 3/8- to \(\frac{1}{4}\)"-wide leaves that are D-shaped in cross section and typically do not extend above the spike and sheaths the base. **Stem:** Long, erect, smooth stem, 3-7\(\frac{1}{2}\)' long. **Fruit:** Tiny, tufted nutlet. **Root:** Spreads extensively by rhizomes; only a few plants can spread over an acre. **Soil:** Wet substrates of many types and often in 1-2' or more of standing water. [4, 7, 11, 35]

Normal Water Level

This species prefers deep to shallow water of 18" of inundation or less to wet/saturated conditions, although it can be deeper, and they can form floating mats. Broad-leaved cattail disappears from continuously flooded areas in 4-5 years. Hybrid cattail survived in 24" of water through 5 years of flooding. Generally, *T. angustifolia* will grow in water up to 3' deep; *T. latifolia*, up to 1' deep; and *T. glauca*, up to 2' deep. [11, 19, 21, 33, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 24". **Duration:** Long – 42 days (decreasing 12"/21 days). This species can tolerate regular, irregular or seasonal inundation. With constant inundation, this species can tolerate increased flood depth with high frequency and moderate-to-long durations. Light is essential for young plants and germination. [1, 37]

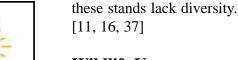
Sensitivities or Other Tolerances

Exposure: No shade. **Salt:** Low to moderate. **Nutrient:** Moderate, with a population increase of N and P and a decrease with a decrease in nutrients. **Siltation:** Moderate to high. **Insect:** Infrequent. **Other:** This species spreads rapidly. It is moderately tolerant to general disturbance and stress. [1, 6, 37, 47]

Design Considerations

Broad-leaved cattail is a cool-season soil stabilizer that has been used in many erosion-control situations. It colonizes an open wet area quickly if it is in the area naturally, to revegetate a mitigation site or another wet site. It provides wildlife habitat and has a decorative use. **Concerns:** In some cases, cattails can form extensive dense, monotypic colonies. They are considered pest species in many states because

Indicator Status: OBL



Wildlife Use

Broad-leaved cattail rootstock is more valuable as food than are the seeds. The starchy underground stems are eaten by geese and muskrats. Cattail stands also provide nesting for marsh wrens, and redwing and yellow-headed blackbirds. [4, 11, 32, 37]



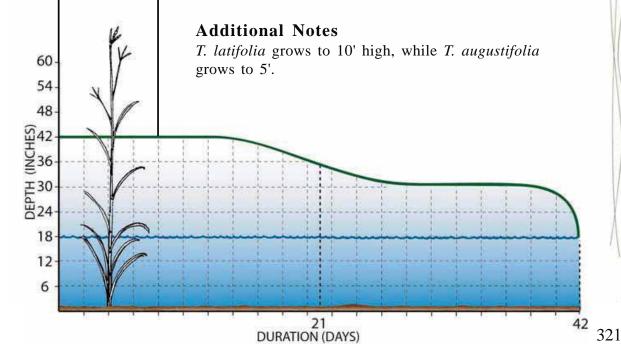
Nursery/Plant Information

Available: Limited.

Types: Seeds, plants and roots.

Planting Techniques

The seeds require moist, cold stratification, high light levels, hot soil temperature and saturated soils for germination. Approximately 14,000,000 seeds/lb. Rootstock and plants can be planted in muddy soils, shallow for rootstock and up to 12" for transplants. This species is favored by drawdowns and will do well from the seed bank. [16, 26, 37, 42]



Typha x glauca

Hybrid Cattail - a.k.a. White Cattail

Habitat/Plant Community and Geographic Range

Habitat/Community: Marshes, shores and shallow water, wherever broad-leaved cattail (*T. latifolia*) and narrow-leaved cattail (*T. angustifolia*) both occur because this is a hybrid of those two species. [7, 35] **Range:** Throughout but not common in ne. Minn. (Eco-Region: All), s. Wis., LP of Mich. (especially common in Lake Erie marshes of se. Mich.), and may be found wherever populations of *T. angustifolia* and *T. latifolia* overlap. N. and e. USA and adjacent Can. [7, 21]

Description

General: A hybrid, emergent, perennial herb often 6' or more tall. **Flower:** Minute flowers are in a dense spike, usually larger than those of either parent species, and separated by a stretch of smooth stem 1½' long. The male portion of the spike is light brown, 2-8" long, while the female portion is dark brown, 4-8" long. The staminate (upper portion) male flowers fall soon after they shed pollen, leaving only a rough stem. **Leaf:** Leaves are elongate, about ½" wide and D-shaped in cross section. **Stem:** Long, erect, smooth stem, 3-7½' long. **Fruit:** Seeds, although sterile, are wind-borne on a tuft of down. **Root:** Rhizomes. **Soil:** Wet substrates of many types and often in 1-2' or more of standing water. [7, 35]

Normal Water Level

This species prefers deep or shallow water at 12-24" of inundation or less (although it can be deeper) to wet/saturated conditions. Plants can form floating mats. Broadleaved cattail disappeared from continuously flooded areas in 4-5 years, whereas hybrid cattail survived in 24" of water through 5 years of flooding. Generally *T. angustifolia* will grow in water up to 3' deep; *T. latifolia*, up to 1' deep; and *T. glauca*, up to 2' deep. [19, 21, 33]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Long - 6 days (decreasing 2"/day). This species can tolerate regular, irregular or seasonal inundation. With constant inundation, this species can tolerate increased flood depth with high frequency and moderate-to-long durations. Light is essential for young plants and germination. [1]

Sensitivities or Other Tolerances

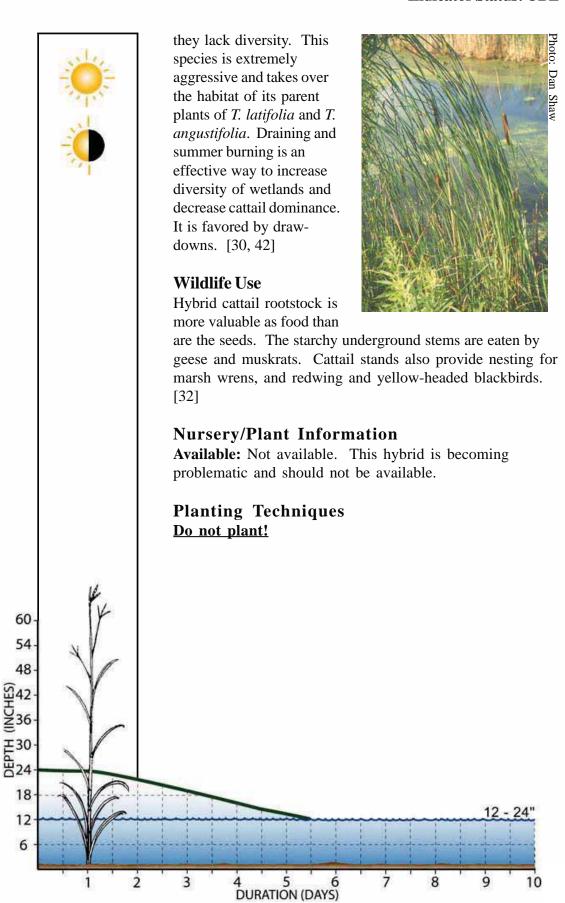
Exposure: No shade. **Salt:** High. **Nutrient:** Moderate to high, with a population increase of N and P and a decrease with a decrease in nutrients. **Siltation:** High. **Insect:** Infrequent. **Other:** This species has a rapid rate of spread. It is moderately tolerant to general disturbance and stress. [1]

Design Considerations

Hybrid cattail is a cool-season soil stabilizer that can be used in many erosion-control situations. It also colonizes an open wet area quickly if it naturally is in the area, and can be used to revegetate a mitigation or other wet site. It provides wildlife habitat and has a decorative use. **Concerns:** In some cases, cattails can form extensive, dense, monotypic colonies. They are considered pest species in many states because

Indicator Status: OBL

323



Verbena hastata

Blue Vervain - a.k.a. Common Vervain, False Vervain, or Wild Hyssop

Habitat/Plant Community and Geographic Range

Habitat/Community: Marshes, sedge meadows, wet meadows, wet prairies, shores, stream banks, openings in swamps, wet fields, roadsides and ditches. [7, 11, 16, 35, 41, 44] **Range:** Common; Minn. (Eco-Region: All), Wis., Mich. N.S. to B.C., s. to Fla. and Ariz. [7, 21]

Description

General: Robust, usually clumped, native, perennial herb that is 2-4' tall. **Flower:** Blue vervain has multiple, pencil-thin, purple/blue flower spikes that bloom from the bottom up. Flowers are 5 petals fused at the base to form a short tube and overlap, packing a panicle 2-5" long that blooms from July to August. **Leaf:** Opposite, lance-shaped or tapering leaves are coarsely toothed and often 3-lobed, 4-6" long and 2" wide. **Stem:** Usually 2-4' tall with square, erect stems. **Fruit:** Achenes are linear with faint striations and smooth. **Root:** Short, spreading, rough hairs. **Soil:** Tolerates a variety of soil conditions with a pH range of 6.0-7.0. [7, 11, 35, 41, 44]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Long -5 days (decreasing 6" the first 2 days, then 6" the next 3 days). This species tolerates moderate flood duration. [1, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Moderate to high. **Nutrient:** Moderate to high. **Siltation:** Moderate to high. **Insect:** Infrequent. **Other:** It has a moderate-to-high tolerance to general disturbance and stress. [1, 44]

Design Considerations

Blue vervain has been used in vegetated swales, stream bank stabilization, and shore line zones. It has been seen colonizing exposed, moist soils in wetland mitigation sites. Its flood tolerance suggests a good plant for rain water gardens. It is a butterfly plant, and provides wonderful cutflowers. **Concerns:** This species can be aggressive and short lived, though this may be desirable characteristics in some designs. [11, 16, 44]

Wildlife Use

Sandpipers, lark buntings, cardinals, juncos, and field, song, swamp, tree and white-crowned sparrows eat the seeds as do mice. Rabbits and other small mammals eat the shoots and plants. Due to its high nectar content; bees and butterflies visit blue vervain. [16, 21, 32, 41, 44]

Nursery/Plant Information

Available: Widely Types: Mainly seed, although plants can be found.

Indicator Status: FACW+

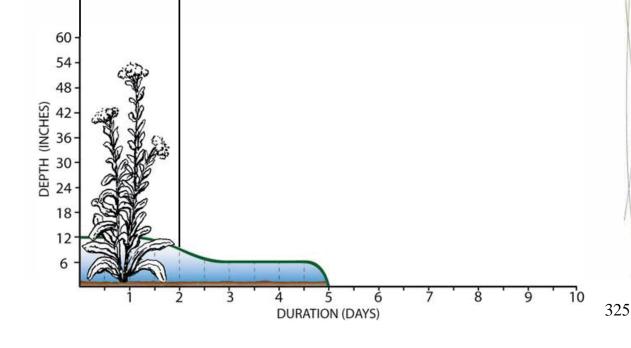


Planting Techniques

This species is easily and quickly propagated by seed although it needs moist, cold stratification for 90 days. The seed can be also stored dry at 40 degrees F., then shifted to 70 degrees F. with light for 180 days total. Recommended seeding rate is 0.06-1.0 lb/acre with approximately 690,000-1,600,000 seeds/lb. Seed should be planted with plenty of light, preferably



in the fall, although spring planting is successful as well. Plants can be divided and cuttings will establish in the summer. It is a good pioneer species. [16, 37, 39, 44]



Vernonia fasciculata

Ironweed - a.k.a. Common Iron Weed, Western Ironweed, Smooth Ironweed

Habitat/Plant Community and Geographic Range

Habitat/Community: Marshes, sedge meadows, low prairies and stream banks. Ironweed often thrives in wet pastures, where cattle graze around it. [7, 16, 35, 44] **Range:** All but ne. Minn. (Eco-Region: 4, 6-9), Wis., Mich. Ohio to Man. and Sask., s. to Mo. and n. Tex. [7, 21]

Description

General: Stout, native, perennial herb that clumps and is up to 5' tall. **Flower:** Deep purple, flat-topped disc flower heads only in a spreading cluster 5" across. Blooms from July to August. **Leaf:** Elongate hairless and sharply toothed leaves can be 6" long and over 1" wide with many tiny pits on the underside of each leaf. **Stem:** Stems are smooth, usually 2-4' tall, often reddish purple. **Fruit:** Ribbed achene with purple-to-brown, slender bristles. **Root:** A thick, stoloniferous root-stock. **Soil:** Moist-to-wet soils of many types with a pH range of 5.6-7.0. [7, 35, 44]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate **Depth:** 18" **Duration:** Medium long – 4 days (decreasing 6"/day for 2 days, then 6" over the last 2 days). This species is more tolerant early in the season and somewhat to moderately tolerant to flood duration. [1, 44]

Sensitivities or Other Tolerances

Exposure: Full to part sun. Salt: Low. Nutrient: Moderate. Siltation: Moderate.

Insect: Infrequent. [1, 44, 47]

Design Considerations

Ironweed has good rootstock that stabilizes soils in buffers, slopes and shorelines. It is a beautiful and underutilized plant for landscapes, cutflowers, lake edges and rain water gardens. It provides good wildlife habitat. **Concerns:** This species is considered aggressive. It forms clumps and will compete with non-native or invasive species. [16, 44]

Wildlife Use

Ironweed serves as a nectar source for butterflies, bees and other insects. It increases in density under grazing. [16, 21, 44]

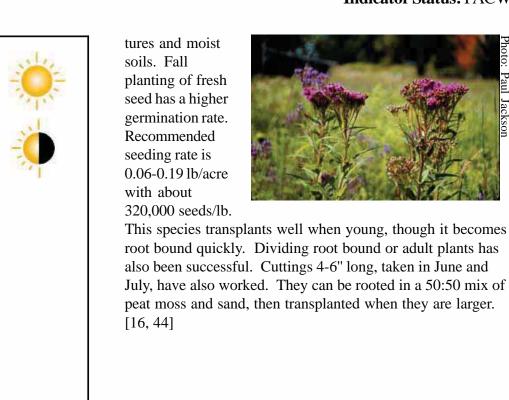
Nursery/Plant Information

Available: Widely. **Types:** Seeds and some plants.

Planting Techniques

Ironweed seeds require moist, cold stratification and have a low germination rate, though rates increase in controlled environments of consistently warm soil tempera-

Indicator Status: FACW





DEPTH (INCHES) **DURATION (DAYS)**

Veronicastrum virginicum

Culver's Root - a.k.a. Leptandra virginica

Habitat/Plant Community and Geographic Range

Habitat/Community: Fens, meadows, stream banks, moist-to-wet prairies (also found in drier deciduous forests and sandy grasslands), fields, and along railroad tracks. [7, 11, 16, 35, 41] **Range:** Minn. (Eco-Region: All), Wis., especially LP of Mich. New England to Ont. and Man., s. to Ga. and La. [7, 21]

Description

General: Erect, native, perennial herb usually 3-6½' tall. **Flower:** Showy, small, white flowers 1/4" long, in tapering spikes, 10-12" long. Each flower has 2 conspicuous stamens that are longer than the 4 fused petals. **Leaf:** Elongate leaves in whorls of 3-7 that are narrow, finely divided with both stem and basal leaves present. **Stem:** Usually with several upright branches. **Fruit:** Narrowly oval, 1/8"-long capsule, opening with 4 terminal slits. **Soil:** Good in most soils except extremely dry ones, although it prefers moist-to-mesic loam soils. [7, 11, 35, 41]

Normal Water Level

This species prefers upland moist-to-wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6''/day).

Sensitivities or Other Tolerances

Exposure: Full to part sun. **Salt:** Low. **Nutrient:** Moderate. **Siltation:** Unknown. **Insect:** Infrequent. **Other:** This species has a moderate tolerance to general disturbance or stress. [1, 47]

Design Considerations

This species has been used in buffer, shoreline and vegetated swales. It is a wonderful landscape design plant for gardens, rain water gardens and shores. Restorations, such as fens; wet meadows; wet, open woodlands; and stream banks, are good opportunities for this plant. Butterflies and bees love this plant and it provides cut and dried flowers. [16]

Wildlife Use

The flowers of culver's root attract butterflies and especially bees. [16, 21, 41]

Nursery/Plant Information

Available: Widely. **Types:** Plants and seed (although it is expensive).

Planting Techniques

The seed requires a cold-warm-cold stratification to break dormancy. Approximately 12,000,000 seeds/lb. Culver's root can be propagated by cuttings and division also, and it transplants easily. [16]



Viburnum lentago

Nannyberry - a.k.a. Blackhaw, Sheepberry

Habitat/Plant Community and Geographic Range:

Habitat/Community: Mesic woods, swamps, along banks of streams, lake edges, roadsides and fencerows. [17, 22, 36, 44] **Range:** Minn. (Eco-Region: All), Wis., Mich. Que. to se. Sask. and sc. Mont., s. to N.J., Va., Ill., Neb., Wyo. and Colo. [17, 21]

Description

General: Deciduous shrub 16-20' tall and 10-20' wide with a short trunk and compact, rounded crown of drooping branches. Flower: Small 1/4"-wide, white flowers with 5 rounded corolla lobes in clusters 3-5" wide that are slightly fragrant. Blooms from May to June. Leaf: Opposite 2½-4" long by 1½-2½" wide, elliptical, long, pointed leaves that are finely saw-toothed and have a prominent network of veins on broad, hairy leafstalks. The leaves are shiny green above, yellow-green with tiny black dots below and turn maroon-red in fall. Bark: Irregularly furrowed into scaly plates, reddish-brown or gray bark with an unpleasant, skunk-like odor. Twigs: Slender, slightly hairy twigs that are light green when young. Bud: Long, pointed, hairy, reddish bud. Fruit: ½" long, elliptical bluish-black fruit with sweet, juicy pulp. The seed is a somewhat flat stone in a droop on a slender, reddish stalk that matures in autumn and persists in winter. The berries are very tasty fresh or in jams. Root: Suckering, shallow, fibrous roots. Soil: Although it tolerates most soils, nannyberry prefers loam soils with a pH range of 6.0-7.5. [8, 17, 22, 36, 44]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21, 37, 44]

Flooding/Fluctuation Tolerances

Frequency: Moderate. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/ day). Nannyberry tolerates seasonal inundation and is moderately tolerant to flood duration. It is also drought resistant. [1, 8, 22, 37, 44]

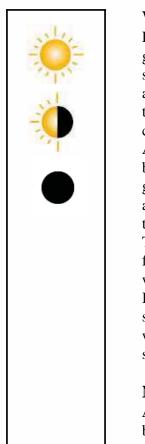
Sensitivities or Other Tolerances

Exposure: Partial to full sun and is shade tolerant. **Salt:** Moderate to low. **Nutrient:** Moderate. **Siltation:** Low. **Insect:** Infrequent. **Other:** Wind and ice damage nannyberry infrequently. It is sensitive to soil compaction, though resistant to drought, heat, alkaline soils, oil/grease, metals and mine spoils. It is moderately tolerant to general disturbance. [1, 8, 22, 25, 37, 44]

Design Considerations

Nannyberry is used to stabilize soils in shorelines, buffers, slopes and stream banks. It is recommended for use in restorations and mitigation sites of mesic woodlands and stream banks. This species is a beautiful landscape plant, a contributor to wildlife habitat and is highly recommended for natural settings. [44]

Indicator Status: FAC+



Wildlife Use

Ruffed and sharp-tailed grouse, pheasants, starlings, gray-cheeked and olive-backed thrushes, gray catbirds, common flickers, American robins, eastern bluebirds, rose-breasted grosbeaks, purple finches and cedar waxwings eat the fruit of this plant. The fruits also provide food for chipmunks and white-footed mice. Beaver, rabbits, and skunks eat the fruit and



wood. Deer eat the twigs and foliage. The fruit is edible and sweet. [21, 22, 32, 36, 37, 44]

Nursery/Plant Information

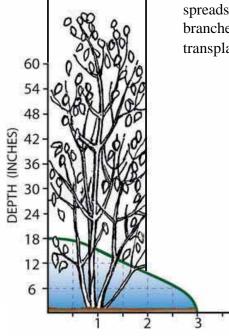
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DURATION (DAYS)

Available: Widely. **Types:** Bareroot, container-grown or balled-and-burlapped plants.

Planting Techniques

Nannyberry seed should be moist, warm stratified, followed by moist, cold stratification. The berry pulp should be washed off the seed to improve germination. This species spreads by suckers. Sprouts form roots when cut, and old branches will take root if in contact with the ground. It transplants easily in the early spring. [22, 36, 44]



Viburnum opulus var. americanum

High Bush Cranberry - a.k.a. American Cranberrybush Viburnum

Habitat/Plant Community and Geographic Range

Habitat/Community: Swamps, fens, streambanks, peat bogs, swampy woods, alder thickets, shores, wet pastures, lake banks and ditches. [7, 22] **Range:** All but sw. Minn. (Eco-Region: 1-8), Wis., Mich. Nfld. to B.C., s. to Pa., n. Ohio, Ind., Ill., Iowa and Wash. This species in part has been introduced. **Endangered in Ind.** [7, 21]

Description

General: Upright. arching, deciduous shrub, 6-12' tall that forms dense clusters. **Flower:** Large, flat-topped, broad clusters of white flowers 2-6" wide at the ends of the stems in June. The outer flowers have large petals and are sterile and surround the inner, smaller, fertile flowers. **Leaf:** Opposite, maple-like, sharply 3-lobed, dark-green leaves that turn red-maroon in autumn. The leaves are palmately veined, 2-4" long and about as wide, smooth or hairy beneath, especially on the veins. The lobes are tapered to sharp tips with entire or coarsely toothed margins and grooved petioles with several club-shaped glands present near the base or blade. **Twigs:** Smooth young stems. **Fruit:** Produces clumps of pretty scarlet berries that persist through winter. **Root:** Shallow, fibrous roots. **Soil:** It will grow in almost any type of soil, although it prefers loams to organic peats and moist, rich woods. [7, 22]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21, 37]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 18". **Duration:** Medium short -3 days (decreasing 6"/day). This species tolerates flooding with a moderate tolerance to duration, especially seasonally. [1, 22, 37]

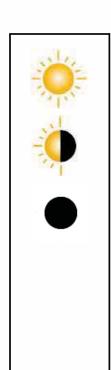
Sensitivities or Other Tolerances

Shade: Full to part sun and very tolerant of shade. **Salt:** Moderate to low. **Nutrient:** Moderate. **Siltation:** Moderate. **Insect:** Infrequent. **Other:** Wind and ice infrequently damage this species. It is sensitive to SO₂ and HFl. It is somewhat sensitive to Cl, although it is resistant to drought, heat and soil compaction. This species is moderately tolerant to general disturbance and stress. [1, 10, 22, 37]

Design Considerations

High bush cranberry has wonderful fall color and is beautiful throughout the year. It is recommended in landscape designs, wildlife habitat improvement areas, mitigation designs, and slope and soil-stabilization areas.

Indicator Status: FACW



Wildlife Use

High bush cranberry provides fruit for ruffed and sharp-tailed grouse, pheasants, starlings, graycheeked and olive-backed thrushes, gray catbirds, common flickers, American robins, eastern bluebirds, rose-breasted grosbeaks, purple finches,



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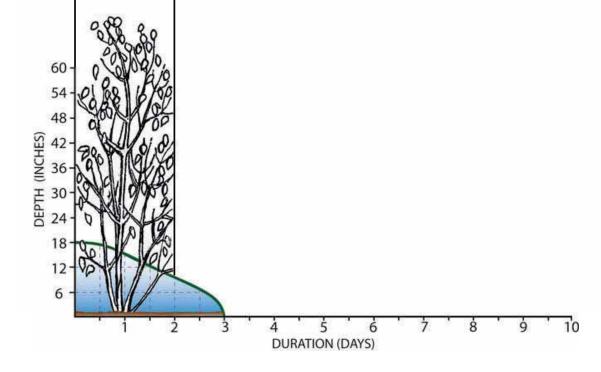
and cedar waxwings. The fruit also provide food for chipmunks and white-footed mice. Beavers, rabbits and skunks eat the fruit and wood. Deer eat the twigs and foliage. The fruit is edible and sharply acrid. [21, 22, 32, 37]

Nursery/Plant Information

Available: Widely. **Types:** Bareroot, potted and balled-and-burlapped stock.

Planting Techniques

This species is easily transplanted in spring or fall. [22]



Zizia aurea

Golden Alexanders - a.k.a. Early or Golden Meadow-Parsnip

Habitat/Plant Community and Geographic Range

Habitat/Community: Moist meadows, prairies, wet savannas, stream banks, ditches, roadsides, moist fields and brushy places. [16, 17, 35, 41] **Range:** Minn. (Eco-Region: All), Wis., Mich. Que. and Me. to Sask., s. to Fla. and Tex. [17, 21]

Description

General: This late-spring wildflower is a native, perennial herb usually 1-3' tall. Flower: The small, ¼"-wide, yellow flowers are in a 3"-wide, flat-topped cluster (compound umbel) that blooms from May to July. The outer 10-18 rays of the terminal umbel are stiffly ascending. Leaf: A single (compound) leaf that divides into 3 stalks. Each stalk has 3-7 narrow, coarsely toothed, pointed elongate leaflets. Stem: Smooth, branched, often tinged with red. Fruit: The seed heads, which are attractive throughout the year, contain ovate-to-oblong, laterally flattened seeds. Root: Cluster of thickened roots. Soil: Wet-to-mesic soils of many types. [17, 35, 41]

Normal Water Level

This species prefers upland moist/mesic to wet/saturated conditions. [21]

Flooding/Fluctuation Tolerances

Frequency: High. **Depth:** 12". **Duration:** Short – 1 day (decreasing 12" in 1 day). This species is moderately tolerant to flood duration. [1]

Sensitivities or Other Tolerances

Shade: Full to partial sun. Salt: Moderate. Nutrient: Moderate.

Siltation: Unknown. **Insect:** Infrequent. **Other:** This species is moderately tolerant

to general disturbance and stress. [1]

Design Considerations

Golden alexanders are used in soil stabilization of shores, vegetated swales, buffers and slopes. It is recommended this species be used for restorations of low prairies, calcareous fens, stream banks and other wet, open places. Butterfly gardens and cut flowers are some of the landscape design uses. **Concerns:** This species can be aggressive, which is desirable in many situations. [16]

Wildlife Use

This species, a wonderful butterfly plant, is a host for the swallowtail butterfly. [21]

Nursery/Plant Information

Available: Widely. **Types:** Plants and seed.

Planting Techniques

Seeds propagate easily and seedlings transplant without difficulty. Approximately 192,000 seeds/lb.[16]



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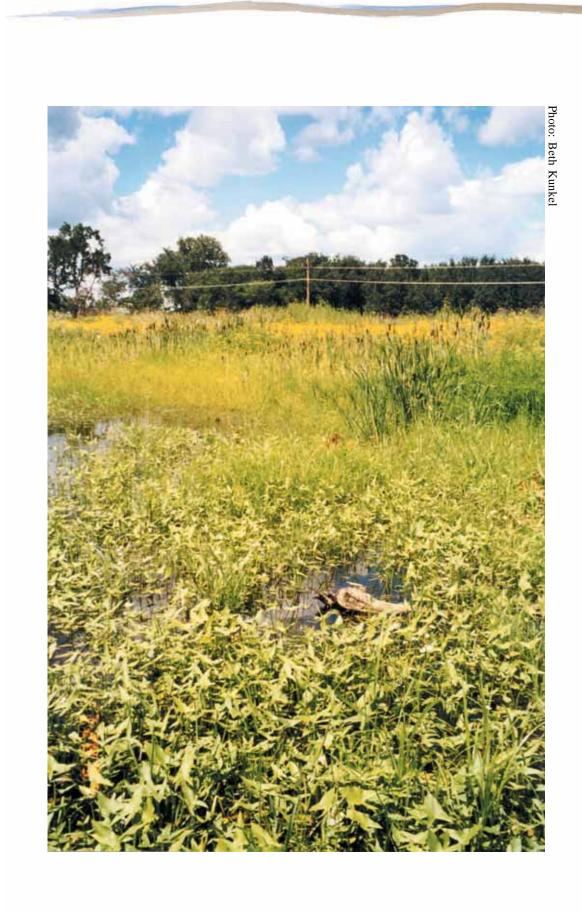
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APPENDIX 1

PLANTING AND MAINTENANCE RECOMMENDATIONS

This appendix includes a summary of planting and maintenance concerns for stormwater-management techniques. For a more detailed discussion of planting wetlands and buffers, see *Native Vegetation in Restored and Created Wetlands, Its Establishment and Management in Minnesota and the Upper Midwest* (Shaw 2000)*.

Planting

Thorough site analysis is very important for a successful planting design. Information that should be collected during site analysis includes data on soil characteristics, site hydrology, steepness and aspect of slopes, areas of sun and shade, existing vegetation, plant communities in the area, and potential influences from surrounding land. Understanding the geographic location of a project is also important as characteristics of plant species may vary throughout the region.

Site analysis will aid in deciding where different types of vegetation (plant communities) will be best suited at the site. Many management practices may require the planting of several zones of vegetation, depending on soil types and hydrologic conditions.

Selection of plant species will depend on site conditions, such as soils, hydrology, water fluctuations, road salt, salt spray and inputs of pollutants, including nutrients and sediment. Other potential plant stressors are discussed earlier in this guidebook. Choosing species from plant communities that will provide the most ecological value to the management practice should also be a consideration. The species lists provided for each type of management practice and the plant selection matrix on page 66 will help with species selection. It is recommended that experienced specialty contractors install native species in accordance with a contractural agreement. Such contractors are usually more

^{*} Citations in this appendix can be found in the Literature Cited section beginning on page 53 of this guide.

qualified to identify undesirable vegetation and be aquainted with native seeding and management techniques.

Proper site preparation cannot be stressed enough as an integral part of the planting process. Undesirable existing vegetation must be removed before a site is planted. It takes a full growing season or longer to eliminate many non-native species, so allow at least one full growing season to manage aggressive, non-native species before planting the site. A couple of the more popular techniques for removing aggressive, non-native species are:

- 1. Herbicide Applications Herbicide application may be required for one or possibly two growing seasons, depending on the tenacity of existing vegetation and the amount of weed seed in the soil. Herbicide application is often combined with burning to remove vegetation. In some cases, disking is also conducted to cut rhizomes and stimulate growth to increase the effectiveness of herbicide applications. Many repeated applications of herbicide may be necessary. Nonselective herbicides, such as glyphosate (e.g., Round-up® for land treatment and Rodeo® for aquatic treatment), are most often used to eliminate unwanted vegetation from a project site.
- 2. Topsoil Scraping Topsoil scraping generally involves removing the top 12 inches of soil from the project site. Advantages of this technique are that the roots of invasive species as well as

invasive plant seed are removed from the site and it is a rapid way to prepare a site for seeding. Topsoil scraping is particularly effective when matforming species such as red canary grass dominate a site. The limitation of this method is that it is expensive and may remove desirable topsoil.

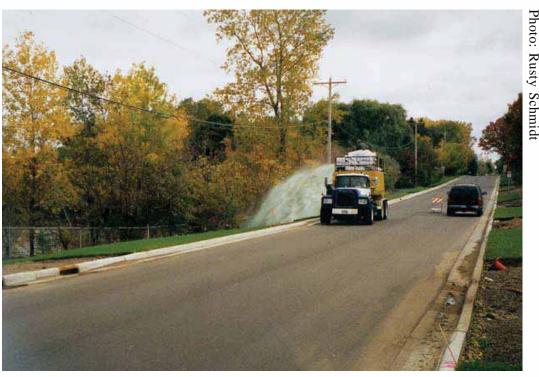


DRILL SEEDING

Photo: Rusty Schmidt

Seed can be used to vegetate some projects, but only if water levels can be controlled. Most wetland species germinate only under saturated soil conditions or in up to 1-2 inches of standing water. Excess water can inhibit growth, kill seedlings and wash away seed. The seeds of many wetland species float and can be moved to other sides of an open water system. Utilize the seedbank when possible as this will introduce local sources of propagules and decrease project costs. Also, be wary of aggressive cultivars of native grasses; they may be not a good choice for a project.

Fluctuating water levels, equipment limitations, and an understanding of the water requirements of various wetland species complicate seeding within wet areas. Basins are usually too wet for heavy equipment, so it may be necessary to use hand-held broadcast seeders. Hydroseeding is also an option in saturated areas. This involves spraying seed mixed with a slurry that will bind to the soil surface (use the hose instead of the turret from the top of the truck, though, for good soil-to-seed contact and complete coverage). Care needs to be taken so that seed is not buried too deeply because many species require light to germinate.



HYDROSEEDING

Cover crops, such as oats and annual rye grass, are useful to hold soil and compete with weed species. Since cover crops germinate quickly, areas that have low coverage after the cover crop germinates indicate where seeding was not successful because of washout, a malfunction with seeding equipment or because they were missed in seeding. These low-coverage areas should be reseeded as soon as possible.

An advantage of broadcast seeding and hydroseeding is that rows are not created. If interseeding or drill seeding, seed over the site in multiple directions to reduce the visibility of rows.

Fertilizers are generally not used in native plantings unless the soils are extremely low in available nutrients. Fertilizers usually promote weed growth. If a fertilizer is to be used, use an organic fertilizer or a slow-release, inorganic fertilizer.

Nearly all terrestrial plants have symbiotic associations with bacteria and fungi. Most legumes have associated rhizobial bacteria that fix atmospheric nitrogen for the plants in exchange for carbohydrates. Unfortunately, most inocula available commercially for native legumes are either the wrong type or not viable. And, the commerical mycorrihizal inocula currently available are typically the wrong kind for grassland species. University of Minnesota Professor Peter Graham has developed rhizobia specific for most of the native legumes currently planted in Minnesota. His source of inoculum is prairies in Minnesota. One should check with the vendor who is providing seed mixes to ensure that good bacterial inoculum is included with legumes. Dr. Graham can produce inocula for several legumes for a fee. Fungal inoculum for native plantings probably won't be available commercially for a number of years.

After seeding is complete, mulch is recommended to stablilize the soil and protect young plants from moisture loss. A "weed-free" straw or native prairie mulch is ideal and should be disked into the soil. If a site is very steep, an erosion-control blanket may be needed. Hydroseeding is often conducted on steep slopes where other equipment cannot be used. Hydroseeding with a heavy tackafier can eliminate the need for additional mulch.

Transplants are susceptible to excess water while they are becoming established. Generally it is best to slowly increase water levels as plants grow. Plants with well-developed root systems have the greatest chance of survival. Plugs and bareroot stock have become a cheap method to plant some species. As a rule of thumb, about 1,000 seedlings should be planted per acre. Clump plugs throughout the site in groups of 100 to 300 plants of mixed species and spacings. Protect from geese and other herbivores as needed. Do not install seedlings too late in the fall, as they need to establish roots to prevent frost-heave over the winter.

Many aquatic and emergent species do not establish easily from seed. So, establishing these species usually requires planting tubers/bulbs, floating plants or seedlings. Saturated and moist soil zones and uplands can usually be seeded. Plants can be used to augment seed mixes in these zones, especially for species that are difficult to establish from seed.

Remember that geese, deer, rabbits, muskrat, beaver and mice may significantly damage or destroy new plantings. If herbivores pose a potential threat, exclosures or other methods should be planned into the project. County offices of university extension services are good sources of information on methods to deter pests. In wetland areas, geese are the biggest concern and a snow fence posted on the interior and exterior sides of a planting is recommended. The fence may need to stay in place for at least a year while the seedlings are becoming established. If the fences are more than 50 feet apart or have long corridors where geese can land between them, interior fences may be necessary to discourage geese from flying into the planting. Taller vegetation will inhibit geese, eliminating the need for fencing as vegetation becomes established.

As part of the planting plan, a design contractor should specify site-preparation activities, soil amendments and step-by-step procedures for plant installation. Specify contractor responsibilities such as watering, weeding, care of plant material, timelines for plant replacement and for monitoring and performing management activities. Specify the species to be installed by botanical name, the size and

form of materials, time of year for installation, and the schedule for inspections, watering and maintenance (Claytor and Schueler 1996)*. We recommend that maintenance continue for two to five years after instillation is completed to successfully establish native plantings. Although native plantings are usually more expensive to install than most manicured landscapes, they will cost less to maintain over the long term.

Specify the warranty period, the required survival rate and expected condition of plant species at the end of the warranty period (Claytor and Schueler 1996)*. In the last five to six years, there have been many advances in restoration, mitigation and stormwater-management techniques. Many of these advances are the result of federal and state regulations related to wetland mitigation and banking credits. Plant specifications should be tailored to the plant zone or community that is to be established, and specifications should be written for each zone within a project site.

Plant all emergent species at the upper margins of their tolerance range zones and allow them to migrate into deeper zones. The only exception is when the site has a stable bounce zone and the planting technique is live plants. Plants should be planted in water that is no higher than the top 2 inches of the plants. When possible, plant mature plants as they will be better able to tolerate deeper water and poor water quality.



Photo: Rusty Schmidt

BROADCAST SEEDING

Management

The management of native plantings is very important for project success.

Stormwater-management practices are prone to invasion by invasive species, such as reed canary grass, purple loosestrife and hybrid cattail, and ongoing control of these species should be anticipated. Repeated visits during the growing season is the best way to keep invasive species from becoming a significant problem. Vegetation management can occur during these site visits as well as checking for other problems, such as erosion and excessive sedimentation.

Maintenance should include site evaluations for weed species and erosion concerns. To prevent weeds from producing seed in upland areas, mow as needed through the first two years to a height of 6-10 inches. Mow and spot spray over years 3 to 5 as needed. Make sure that contractors do not create ruts in wet areas. Prescribe burn upland areas on a three- to six-year rotation, and release biocontrol agents for purple loosestrife and/or leafy spurge if needed.

Locations of problematic species should be mapped during site visits so their status can be tracked.

Mowing may be necessary for some management practices, such as dry swales and infiltration basins. See recommendations in this guide for individual species.

Mulch degrades over time and mulch beds should be supplemented about once a year. If a thick (6-inch) layer of mulch is maintained on tree and shrub plantings, the mulch may need to be supplemented less frequently. Rain water gardens should not be mulched in most cases because the mulch may float and plug outlets. Instead, discourage weeds in rain gardens by using erosion-control blankets.

APPENDIX 2

VEGETATION AND HYDROLOGY DATA FOR THREE TWIN CITIES STORMWATER PROJECTS

During the autumn of 2002, the authors of this guidebook studied vegetation at three stormwater projects in the Twin Cities area. A retention basin was studied in Eagan and stormwater wetland/retention ponds were studied in Little Canada and Maplewood.

The authors used survey equipment at these sites to record the elevation of plant species in relation to outlets at each of the projects. The highest and lowest elevations were recorded for each plant species found at the sites and this information is summarized in the tables that follow.

Hydrographs for the Little Canada and Maplewood sites were provided by the Ramsey-Washington Metro Watershed District. The watershed district also provided background information for these sites. The City of Eagan provided hydrographs for the Cedar Pond site, while the engineering firm URS provided plant lists and background information.

The combination of project background information, hydrographs and species distribution information is provided in this guidebook as additional reference material for designers.

Cedar Pond



Cedar Pond is located at Cedar Pond Park in the City of Eagan, Minnesota. The pond is about 3 acres in size. It is a wet retention pond that was re-engineered in 2001 to have decreased water fluctuations and higher biological function and plant diversity. The site was planted in 2002 with a combination of seed and plugs. Site management involves the removal of invasive species, including cattails.

The authors field surveyed Cedar Pond along one side of the site. The survey was intended to locate the elevation and document occurrence or relative success of all plant species found at Cedar Pond that are included in this guide. The survey was not intended to be a comprehensive floristic study or survey of the site, and there was bias toward plants listed in this book.

While comparing the plant list of what was seeded or planted in the pond and the species observed, a couple of significant observations were made. Of the 45 species observed at Cedar Pond that are included in this guide, 11 were considered volunteer species and as such had not been planted or seeded. One of the volunteer species was reed canary grass (*Phalaris arundinacea*), which was in low abundance and will be

managed aggressively in the future. Four of the volunteer species (silver maple, cottonwood, sandbar willow and American elm) were woody plants, although only one (cottonwood) was a seedling and a true volunteer; the other three species had existed on site before the stormwater-management project was started.

More than 3,000 plugs were added to the seed mix, and just a few species were not observed during the field survey. We were surprised to find pickerelweed and hardstem bulrush absent at the site even though they had been seeded and planted as plugs. The city has indicated that pickerelweed and two other large-leaved, emergent plants will be added to the site in the summer of 2003. Three species of sedges (porcupine, fox and pointed broom sedge) that were planted as plugs were absent. These species may have been overlooked, were in other areas or were truly absent from the site. Four upland species (*Liatris* spp., culver's root, butterflyweed and Riddell's goldenrod) were absent from the plug list during field tests for similar reasons.

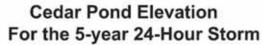
Only three grasses contained in the mesic tall-grass prairie seed mix (MnDOT 15B with F3 forb mix) were not encountered during the field survey. However, switchgrass is the only species of the three that is included in this guidebook. The other two were sideoats grama and slender wheatgrass. Only four forbs from the seed mix were found in the field survey. They were wild bergamot, yellow coneflower, spiderwort and blue vervain. Of the remaining species contained in the seeding mix, only five are discussed in this guide and all of these would be found at elevations higher than the pond edge. These species may have been overlooked, may have occurred in other areas along the shore or were truly absent from the site.

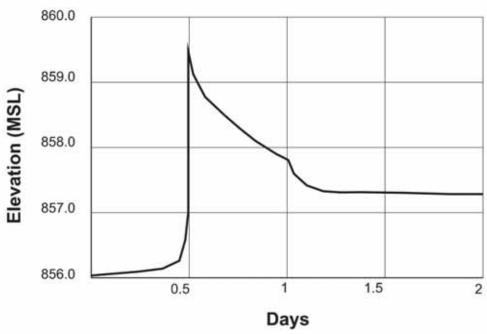
An emergent zone seed mix was developed with all five species present at the survey. Only reed manna grass was not part of the plug list. The other species encountered were broad-leaf arrowhead, green bulrush, softstem bulrush and water plantain.

From the prairie sedge meadow seed mix (MnDOT 25B) 20 of the 38 species were observed at the field survey. Of the 18 absent, the standout absentees were fringed brome, Canada blue-joint grass,

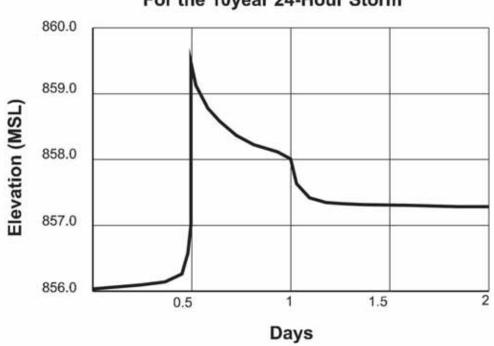
bottlebrush sedge, tussock sedge, fox sedge, fowl manna grass, blazingstar, culver's root, and golden alexanders. The sedges and Canada blue-joint grass were the main disappointments; the others may have occurred elsewhere on site, been overlooked or were absent.

The city and the designer are satisfied with the now-diverse wetland edge and with the success of the overall project. An important point is that several species in the mix were not successfully established on site. These species include pickerel weed, hardstem bulrush and several sedges. They may need to be introduced to the site in a couple of years as plants.





Cedar Pond Elevation For the 10year 24-Hour Storm



Scientific Name	Common Name	Lowest Elevation in Relation to Outlet*	Highest Elevation in Relation to Outlet*
Acer saccharimum	Silver maple	+1.08 (single record)	
Acorus calamus	Sweet flag	+.58 (single record)	
Alisma trivale	Water plantain	+.63 (single record)	
Amorpha fruticosa	Indigo bush	+1.93 (single record)	
Andropogon	Big bluestem	+1.85	Unlimited
Aronia	Black chokeberry	+0.83	Unlimited
Asclepias incarnata	Marsh milkweed	+1.19	+2.03
Bidens cermua	Beggarsticks	+2.25 (single record)	
Bolboschoemus	River bulrush	-1.05	+1.20
Carex bebbii	Bebb's sedge	+0.83	+1.13
Carex lacustris	Lake sedge	+0.82	+1.56
Carex stipata	Awl-fruited sedge	+0.67	+2.31
Eleocharis sp.	Spikerush	+1.03 (single record)	
Elymus virginicus	Virginia wild rye	+1.19	Unlimited
Eupatorium	Boneset	+1.11	+2.29
Eutrochium	Joe-pye weed	+1.38	+2.88
Glyceria grandis	Giant manna	+0.38	+0.75
Helenium	Sneezeweed	+0.95	+1.91
Iris versicolor	Blueflag	+0.84	+2.17
Juncus effusus	Soft rush	+0.31	+0.87
Lobelia cardinalis	Cardinal flower	+0.78	+2.21
Lobelia siphilitica	Blue lobelia	+2.07 (single record)	
Lolium multiflorum	Annual rye grass	+1.71	Unlimited
Monarda fistulosa	Bergamot	+1.32	Unlimited
Phalaris	Reed canary grass	+0.53	+3.96
Polygomim sp.	Smartweed	+0.79	+2.92
Populus deltoides	Eastern cottonwood	+1.12	Unlimited
Ratibida pinnata	Yellow	+2.33	Unlimited
Sagittaria latifolia	Broadleaved	-0.01	+0.87
Salix exigua	Sandbar willow	+.77 (single record)	
Schizachyrium	Little bluestem	+1.71	Unlimited
Schoenoplectus	Three-square	-0.70	
Schoenoplectus tabernaemontani	Soft-stem bulrush	-0.67	+0.01
Scirpus atrovirens	Green bulrush	+0.55	+0.97
Scirpus cyperinus	Woolgrass	+0.38	+1.36
Sorghastrum	Indian grass	+2.33	Unlimited
Sparganium	Giant burreed	-0.22	+0.83
Spartina pectinata	Prairie cord grass	+0.61	+1.49
Symphyotrichum	Smooth aster	+1.11	1.40

Scientific Name	Common Name	Lowest Elevation in Relation to Outlet*	Highest Elevation in Relation to Outlet*
Symphyotrichum novae-angliae	New England aster	+1.48	Unlimited
Symphyotrichum	Red-stemmed	+.83 (single record)	
Tradescantia	Ohio spiderwort	+2.09	Unlimited
Ulmus americana	American elm	1.49	Unlimited
Verbena hastata	Blue vervain	+1.19	2.09
Vernonia	Ironweed	1.56 (single record)	

"Single record" refers to instances where only one plant of a species was found during the site visit. "Unlimited" refers to upland species that had a range that was generally not limited by moisture conditions at the site.



GIANT BURREED

^{*}Elevations refer to height in inches above or below the pond or wetlands outlet.

Gervais Beach



Photo: Dan Shaw

The Gervais Beach stormwater project is located in the City of Little Canada, Minnesota. The project was designed to address a drainage problem on the southwest side of Gervais Lake. The pond/wetland was constructed to treat diverted stormwater. The project is about 0.5 acre in size and consists of prairie, emergent and shrub species. Prairie and emergent species were planted as seed and plugs and shrubs were planted as container stock. Site management included the spot treatment of cattails and invasive species, such as purple loosestrife and reed canary grass.

The authors field surveyed the near-shore area along the entire perimeter. The field survey was intended to locate the elevation and to document occurrence or relative success of all plant species found at Gervais Beach which are included in this guidebook. There was no intent to complete a comprehensive floristic survey of the site. There was an admitted bias toward plants included in this guide, and the survey was conducted only once, in late September 2002.

While comparing the list of plant species seeded or planted within the site and the species observed during the field survey, a couple of significant observations were made. This former beach area was planted with seed over three distinct time periods and with plugs during three other, desynchronous time periods. Only 11 of the 23 species planted as plugs were observed during the field survey. None of the five upland prairie species were observed, although this may be understandable given the survey's nearshore wetland edge focus. One of the wet-meadow species present is not discussed in this book. Hardstem bulrush is the most significant absent species. It was planted two times in two years but with no success. The other unsuccessful species were bottlebrush sedge, turtlehead, fowl manna grass and culver's root.

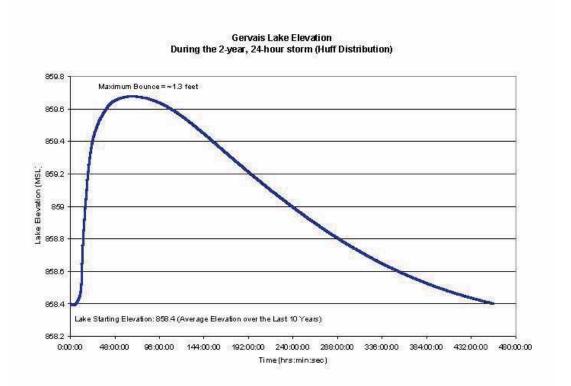
Of the 37 plants observed during the site visit, 11 were considered volunteer species and as such were not planted. Three of the volunteer species are reed canary grass, narrow-leaved cattail and purple loose-strife, all of which are invasive and should be discouraged and controlled in all planting projects. Five of the volunteer species (silver maple, green ash, cottonwood, sandbar willow and black willow) were woody species that may have been present prior to the planting. The final three volunteer species were fringed sedge, brown-eyed Susan, and broadleaf arrowhead.

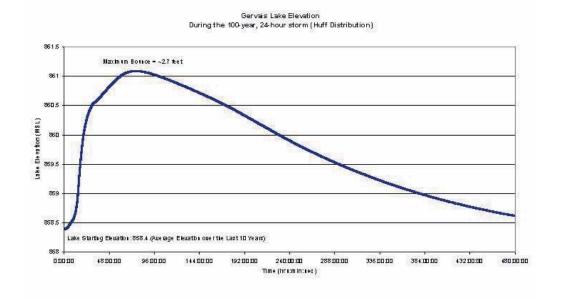
Only three of the 29 species in the short/dry grass seed mix were observed on site. This may be due to the location of seeding to the edge of the beach and also included several species not discussed in this guide. Of the 23 absent short-grass species, only five are included in this bood: butterflyweed, azure aster, silky aster, alum root and golden alexander.

The tall/wet grass and wildflower mix had very different results. Of the 36 species seeded, 17 were observed during the field survey. Fourteen of the remaining 19 are discussed in this book. Plant species absent from the fresh meadow wetland area were Canada bluejoint grass, wild rye, switchgrass, fragrant giant hyssop, smooth aster, panicled aster, grass-leaved goldenrod, blazingstar, wild bergamot, mountain mint, tall meadow rue, ironweed, culver's root and golden alexanders. It is important to note that Canada bluejoint grass, switchgrass, culver's root and golden

alexanders did not establish well from seed as they were not encountered during the survey.

Finally, a seed mix of emergent and wet meadow species was collected from other watershed district wetlands and planted early in the project's history. Of 19 plant species collected and seeded by hand, only five were not observed during the field survey. Of those five, one species is not included in this book. The important absentees were pickerelweed, arrowhead, ironweed and culver's root. All but the arrowhead have been mentioned in this project and in the Cedar Pond project as not having been successfully established.





Scientific Name	Common Name	Lowest Elevation in Relation to Outlet*	Highest Elevation in Relation to Outlet*
Acer saccharimum	Silver maple	+.93 (single record)	
Acorus calamus	Sweet flag	+.67 (single record)	
Alisma trivale	Water plantain	+.01 (single record)	+0.23
Andropogon gerardii	Big bluestem	+1.21	Unlimited
Asclepias incarnata	Marsh milkweed	+.67 (single record)	
Bolboschoemus fluviatilis	River bulrush	+0.33	+2.83
Carex crinita	Caterpillar sedge	+.68 (single record)	
Cormis sericea	Red-osier dogwood	+1.23	Unlimited
Eupatorium perfoliatum	Boneset	+0.95	+1.93
Eutrochium maculatum	Joe-pye weed	+0.72	+85
Fraximus pennsylvanica	Green ash	+1.34	Unlimited
Helenium autumnale	Sneezeweed	+0.90	Unlimited
Iris versicolor	Blueflag	+.88 (single record)	
Juncus effusus	Common rush	-0.3	+1.74
Larix laricina	Tamarack	+1.60	+1.63
Lobelia siphilitica	Blue lobelia	+1.69 (single record)	
Lythrum salicaria	Purple loosestrife	-0.18	+7.01
Oligoneuron rigidum	Stiff goldenrod	+1.39	+1.55
Phalaris arundinacea	Reed canary grass	+.95 (single record)	
Populus deltoides	Eastern cottonwood	+1.63	Unlimited
Rudbeckia subtomentosa	Brown-eyed Susan	+1.57	Unlimited
Salix exigua	Sandbar willow	+1.29 (single record)	
Salix nigra	Black willow	+1.03 (single record)	
Schizachyrium scoparium	Little bluestem	+1.74	Unlimited
Schoenoplectus pungens	Three-square bulrush	+0.72	+1.36
Schoenoplectus tabernaemontani	Soft-stem bulrush	+.01 (single record)	
Scirpus atrovirens	Green bulrush	+.91 (single record)	
Scirpus cyperinus	Woolgrass	+1.17 (single record)	
Sorghastrum nutans	Indian grass	+1.23	Unlimited
Sparganium eurycarpum	Giant burreed	-0.37	+1.28
Spartina pectinata	Prairie cord grass	+0.3	+1.08
Symphyotrichum novae- angliae	New England aster	+1.06	Unlimited
Symphyotrichum	Red-stemmed aster	+.9 (single record)	
puniceum Tombo analysis line	Names to seed out of	22 (sinds accent)	±1.20
Typha angustifolia	Narrow-leaved cattail	22 (single record)	+1.28
Typha latifolia	Broadleaved cattail	+0.71	+0.93
Verbena hastata	Blue vervain	+1.62	+1.91
Viburnum opulus	High bush cranberry	+1.43	+2.07

*Elevations refer to height in inches above or below the pond or wetlands outlet.

"Single record" refers to instances where only one plant of a species was found during the site visit. "Unlimited" refers to upland species that had a range that was generally not limited by moisture conditions at the site.



IRONWEED

Alum Pond



The alum treatment facility was planted in the fall of 1997 and spring of 1998. The pond was constructed to implement phosphorus reduction in the watershed in which it is located, and it utilizes alum injection. The site, about 1.5 acres in size, is located in the City of Maplewood, Minnesota. Prairie and emergent species at the site were planted with seed and plugs. In addition, shrubs were planted in many locations throughout the site. Site management involves the removal of cattails and invasive species, such as purple loosestrife and reed canary grass. Spot treatment has been the primary method of controlling invasive species.

The authors field surveyed the Alum Pond, which was constructed as part of Ramsey-Washington Metro Watershed District's phosphorus-reduction efforts for Tanners Lake in Oakdale. The field survey was completed along one-half of the pond near the shore-edge area. The field survey was intended to locate the elevation and to document the occurrence or relative success of all plant species found at Gervais Beach that are included in this guide. This field survey was not intended to be a

complete floristic study of the Alum Pond. Admittedly there was a bias toward plants discussed in this book and the survey was conducted only during late September 2002.

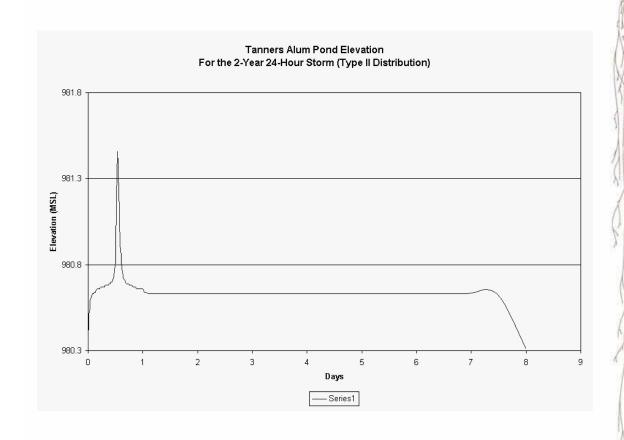
While comparing the planting and seeding list of Alum Pond with what was observed during the field survey, a couple of significant findings were noted. Other than the shrubs, this species was not planted with plugs but just seeded. Thirteen of the 37 species observed were volunteer species, or species that were not intentionally planted. Three of the 13 — narrow-leaved cattail, reed canary grass and purple loosestrife — are invasive plants and should be discouraged and controlled in all planting projects. Two of the volunteer species, spike rush and mad dog skullcap, are annuals. The most notable volunteer species were Torry's rush, common rush, white meadowsweet, woolgrass, river bulrush and mad dog skullcap. The other three species were cottonwood, black willow and elderberry.

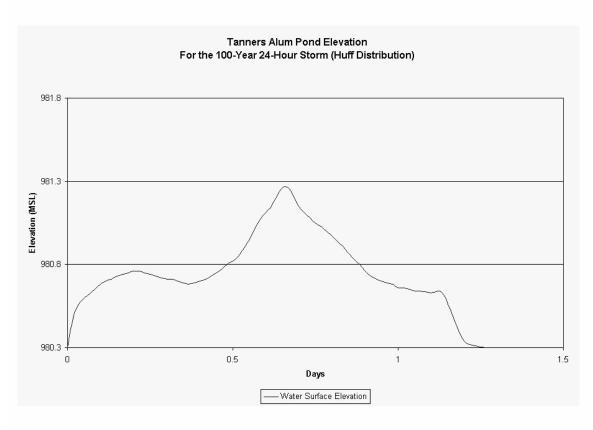
Seed was planted in distinct wetland zones as three mixes; mesic grass/ forb mix (lowland prairie), wet grass/forb mix (wet meadow) and marsh mix (emergent and lower zones). In the upper zone, 32 plant species were encountered during the survey, eight of which were documented. The remaining 24 plant species included only nine species discussed in this book. These are Virginia wild rye, little bluestem, giant hyssop, prairie wild onion, lead plant, Canada anemone, butterflyweed, rattlesnake master, blazingstar and brown-eyed susan. All of the planted or seeded plants which were not encountered in the field survey may have occurred elsewhere on the site, may have been overlooked or were truly absent from the site.

Twenty-nine species were seeded in the lower zone planting. Twelve of these species were present in the field survey. Of the 17 species planted which were not encountered in the survey, notable absences included culver's root, ironweed, meadow rue, blazingstar, red-stem aster and Virginia wild rye.

The emergent and lower zone seed mix included 35 plant species. Of these 35 species, 13 were observed at the field survey. The 22 species

planted but not observed in the survey included ironweed, burreed, hardstem bulrush, rice cut grass, the manna grasses, fox sedge, awlfruited sedge, retrorsa sedge, hop sedge, lake sedge, Canada blue-joint grass, panicled aster, water plantain and sweet flag. A few of the planted plants which were not observed during the field survey and had also not been observed in the other surveyed case study sites were hardstem bulrush, ironweed, manna grass, fox and other sedges, panicled aster and Canada blue-joint grass.





Scientific Name	Common Name	Lowest Elevation Relation to Outlet*	Highest Elevation in Relation to Outlet*
Andropogon gerardii	Big bluestem	+1.27	Unlimited
Asclepias incarnata	Marsh milkweed	+0.52	+0.62
Bidens spp.	Beggersticks	+.46 (single record)	
Bolboschoemus fluviatilis	River bulrush	+0.25	+1.9
Carex comosa	Bottlebrush sedge	+0.07	+0.61
Cormus sericea	Red-osier dogwood	+1.16	Unlimited
Eleocharis sp.	Spikerush	29 (single record)	
Eupatorium perfoliatum	Boneset	+.46 (single record)	
Eutrochium maculatum	Joe-pye weed	+0.51	+1.13
Helenium autumnale	Sneezeweed	+0.88	Unlimited
Helianthus grosseserratus	Sawtooth sunflower	+1.34	+2.26
Impatiens capensis	Jewelweed	+0.38	+1.09
Iris versicolor	Blueflag	+.28 (single record)	
Juncus effusus	Soft rush	17 (single record	
Juncus torreyi	Torrey rush	+.21 (single record)	
Lythrum salicaria	Purple loosestrife	-0.30	+0.14
Monarda fistulosa	Wild bergamot	+1.61	Unlimited
Oligoneuron rigidum	Stiff goldenrod	+0.58	Unlimited
Panicum virgatum	Switchgrass	+0.48	Unlimited
Populus deltoides	Eastern cottonwood (seedling)	+0.51	Unlimited
Ratibida pinnata	Yellow coneflower	+1.24	Unlimited
Sagittaria latifolia	Broadleaved arrowhead	48 (single record)	
Salix nigra	Black willow	+2.36	Unlimited
Sambucus racemosa	Red-berried elder	+1.64	Unlimited
Schoenoplectus	Soft-stem bulrush	-0.28	+0.52
tabernaemontani			
Scirpus atrovirens	Green bulrush	+0.24	+0.51
Scirpus cyperinus	Woolgrass	+.33 (single record)	
Scutterlaria lateriflora	Mad dog skullcap	+.45 (single record)	
Silphium perfoliatum	Cup plant	+1.4 (single record)	
Sorghastrum nutans	Indian grass	+1.46	Unlimited
Spartina pectinata	Prairie cord grass	+.22 (single record)	
Spiraea alba	Meadowsweet	+.91 (single record)	
Symphyotrichum novae- angliae	New England aster	+0.56	Unlimited
Typha angustifolia	Narrow-leaved cattail	-0.76	0.00
Verbena hastata	Blue vervain	+0.5	+0.63
Viburnum opulus	High bush cranberry	+1.48 (single record)	1
Zizia aurea	Golden alexanders	+0.77	Unlimited

*Elevations refer to height in inches above or below the pond or wetlands outlet.

"Single record" refers to instances where only one plant of a species was found during the site visit. "Unlimited" refers to upland species that had a range that was generally not limited by moisture conditions at the site.



BOTTLEBRUSH SEDGE

Appendix 3

Strategies for the Success of Stormwater Management Plantings

Lessons From the Last 20 Years



Stormwater plantings provide a wide range of benefits including water filtering, nutrient and pollutant uptake, evapotranspiration, pollinator habitat, decreasing heat islands, and aesthetics. Projects need to be successfully established and maintained to maximize environmental benefits and ensure that project goals will be met into the future. Since the publication of "Plants for Stormwater Design" in 2003 the approach for successful plant selection, project design, installation, and project management have continued to evolve. This chapter summarizes information learned from projects over the last twenty years and

includes information about new methods of assessing stormwater projects and assessing the resiliency of plant species.

The chapter emphasizes keys for successful projects with an emphasis on methods to increase the resiliency of plantings. Resiliency is defined as the capacity of plants to persist and maintain their health and function in stormwater plantings after stress or disturbance. Resiliency is important for adaptation to the impacts of climate changes such as increased extreme precipitation and drought. Projects with higher resiliency are considered better equipped to continue meeting project goals. Fortunately, our knowledge about how to increase resiliency has been increasing over time.

This chapter is also focused on a wholistic approach to projects to maximize resiliency and overall success. This wholistic approach involves considerations for project planning, plant selection, site preparation, installation, and management. These topics all needs to be considered together to result in successful projects.



Emergent plants in stormwater systems play important roles for water quality and habitat

The chapter has the following four sections:

- 1)Lessons Learned for Ensuring the Success of Stormwater Plantings Key lessons are discussed for aspects of projects from planning to project management. These lessons reflect input from a wide range of professionals and result from project experience and case studies. New approaches are discussed as well as methods to overcome common challenges.
- **2)Case Study Assessment Results** Three case study projects were studied in 2002 and included in "Plants for Stormwater Design" when it was published in 2003. These same case studies were revisited in the summer of 2024 to assess the vegetation within the projects and increase our understanding about how projects change, and what can be done to maximize the resiliency of plantings.
- **3)Method for Ranking the Resiliency of Plants in Stormwater Projects** To help determine the resiliency of plants within stormwater projects and aid project planning the authors developed a method for ranking individual plant species based on their ability to handle stressors and thrive in stormwater projects.
- **4)Research Needs Related to Stormwater Plantings** Topics needing additional research related to stormwater plantings are summarized. The list was developed by the authors with input from additional professionals.

Part 1) Lessons Learned for Ensuring the Success of Stormwater Projects



The following information summarizes lessons learned for ensuring the success of stormwater plantings. Key lessons are discussed for project planning; plant selection and layout; site preparation; planting; and monitoring and management. These lessons reflect input from a wide range of professionals.

Project Planning

Complete Plans Are Needed for Effective Projects - As part of project planning, complete plans provide a valuable guide for all aspects of a project. A good plan ensures that a wholistic approach is used for a project and provides a roadmap for short-term and long-term success. Plans should include a summary of current and planned site conditions such as soils; planned water depth, duration and frequency of inundation; available sunlight; and stressors such as herbivores, pollutants, and flooding. Plans should also include detailed information about site preparation methods, planned vegetation, planting methods, inspection timing, and maintenance methods such as weeding, watering, erosion control, and sediment removal. Contingency planning should also be included to respond to unexpected changes during construction, or as vegetation establishes.

Project Plans Should Include Detailed Schedules - Effective plans should also include schedules showing how different aspects of a project will be sequenced. It is particularly important to provide a schedule for the transition of earth moving and other construction activities to plant installation, as this transition usually involves different contractors and can be problematic if soils are left compacted or eroded after construction, and if debris is left on the site. It is important to have good communication between construction and restoration contractors.

Project Plans Should Summarize How Inspections Will Be Conducted - Inspections play an important role for projects to catch problems before they become more serious. Inspections may be needed weekly as a site establishes to catch any erosion or plant establishment issues but can become less frequent over time. Separate inspections may be needed after larger storm events to identify erosion problems and ensure that outlets are working correctly. Plans should define when inspections will be conducted, information to be collected, staff to conduct the inspections, and how the information will be documented and used to adjust management practices.

Ensure that Qualified Contractors Are Leading the Project - Having the right contractors involved with vegetation establishment can be essential for project success, It is recommended to have specifications for projects that require experienced contractors for vegetation establishment. It is often necessary to have a bidding process for the vegetation component of stormwater projects that is separate from site construction and grading.

Project Plans Should Consider Long-Term Management - Projects need management through the first few years as vegetation establishes, but they also require long-term management to continue meeting goals. Additional project planning is encouraged as projects extend past their establishment phase as they will have different needs for the control of invasive species, herbivory, and the encroachment of woody plants that may not be part of the initial plan for the project. It is common to combine management methods for sites using activities such as burning, mowing, hand weeding, herbicides, and conservation grazing.



Project monitoring plays an important role in guiding management activities

Consider Management During Project Design - The design of projects should consider future management needs. For example, if prescribed fire or mowing with large equipment is planned trees and shrubs in prairie planting should be avoided as they can make management more complicated. Inlet protection is also important to decrease sedimentation in biofiltration areas and other stormwater practices. Sediment can be a significant problem for seed establishment but can also bury or stress vegetation. Large masses of herbaceous plants should also be avoided in areas with high weed pressure where it will be difficult to maintain an organized appearance to the planting.

Project Plans Should Include Contingency Planning - With stormwater plantings it is best to expect the unexpected. Plans should include contingency information for impacts from extreme weather, vandalism, weed invasion, herbivores, or other impacts to vegetation. It is common that some additional planting is needed during the first few years of establishment. Plans should discuss potential impacts and corrective steps that can be taken.

Complete Project Teams Are Important - It is important that staff with expertise related to engineering, stormwater management, plant selection, installation, and management are part of project planning and project management teams. Project managers with expertise in construction methods benefit from involvement from team members with expertise in vegetation establishment.

Plant Selection and Layout

Select Plants Adapted to Site Conditions - The Web Soil Survey (WSS) that is maintained by the National Cooperative Soils Survey is often a good starting point for assessing soils at a site but taking soil samples, to understand organic content, soil nutrient levels, and pH are highly recommended prior to plant selection to determine any conditions that will influence the plant species that can thrive at a site, or soil amendments that may be needed. Native plants are adapted to a wide range of soil conditions but can also struggle if soil nutrients or organic content is extremely high or low, or if pH is extremely high or low.

Moisture levels, slope, and aspect are also important site conditions to investigate to help with plant selection, as well as observing plants that are thriving within the site or at nearby stormwater projects or natural plant communities. Potential site stressors should also be considered as part of plant selection. There are many potential impacts for projects including flood depth and duration, compaction, low water levels, flood frequency, wave energy, sediment loads, pollutants and toxins, climate change, heat islands, high nutrients, salt, turbidity, erosion, invasive plants, and herbivores. The <u>Blue Thumb Plant Finder</u> has incorporated information from the Plants for Stormwater Design book and has been developed to aid plant selection based on site conditions and potential stressors.

Focus on High Plant Diversity - In most cases high plant diversity should be planned for projects. There are some exceptions such as plantings in small areas or high manicured properties that need an orderly aesthetic or simplicity to help maintenance staff identify native plants from non-native plants. High plant diversity help make plantings more resilient to impacts from drought or extreme precipitation. If some plants do not establish or persist due to site characteristics or climatic conditions higher diversity will help ensure that other plants are present that can thrive. It is important that seed mixes include early, mid, and late successional species to allow for weed competition during all stages of the project. Plantings should also have species from a wide range of functional groups including warm-season grasses, cool-season grasses, sedges, forbs, rushes, ferns, shrubs and trees as appropriate for the site.



Diverse stormwater plantings can support a wide range of wildlife species.

Select Resilient Plant Species - Some plant species are more resilient to stressors than others, and it may be beneficial to use more resilient species for a project, particularly if it will have a low amount of maintenance. Part 3 of this chapter lists resiliency scores for plant species. High diversity should still be planned for projects in addition to the use of resilient plants.

Maximize Benefits for Wildlife - Many projects provide opportunities to benefit specific wildlife species and our understanding about how to benefit wildlife such as bird species and pollinators has been increasing. Some plant species are considered "Keystone" plants as they support large numbers of caterpillars that provide important food sources for birds. Over 90 percent of terrestrial bird species use insects as a food source. Other plants are keystone species as they provide important food sources for pollinators. The National Wildlife Federation provides information summarizing keystone species by ecoregion (NWF 2023). Examples of keystone trees and shrubs include white oak, *Quercus alba*; American plum, *Prunus americana*; black cherry, *Prunus serotina*; chokecherry, *Prunus virginiana*; river birch, *Betula nigra*; eastern cottonwood, *Populus deltoides*; box elder, *Acer negundo*; silver maple, *Acer saccharinum*; northern highbush blueberry, *Vaccinium corymbosum*; prairie willow, *Salix humilis*; and black willow, *Salix nigra* (NWF 2023). The following list includes butterfliy species and host plants that they rely on to complete their life cycles.

American Lady (Vanessa virginiensis)
Black Swallowtail (Papilio polyxenes)
Eastern Tailed Blue (Cupido comyntas)
Baltimore Checkerspot (Euphydryas phaeton)
Eastern Tiger Swallowtail (Papilio glaucus)
Monarch Butterfly (Danaus plexippus)
Painted Lady (Vanessa cardui)
Red Admiral (Vanessa atalanta)
Silver Spotted Skipper (Epargyreus clarus)
Spring Azure (Celastrina ladon)
Meadow Fritillary (Boloria bellona)
Viceroy (Limenitis Archippus)

pussytoes, pearly everlasting, fragrant cudweed golden alexanders and other species in the carrot family purple prairie clover white turtlehead tuliptree, black cherry, ash milkweeds native thistles, mallows, hollyhocks, asters, legumes nettles, false nettle black locust, honeylocust, other legumes flowering dogwood, black cherry, viburnums, violets

Maximize Environmental Health Benefits - Plants along the edge of open water help capture pollutants and increase the rate of denitrification. Many species can also play a role in managing environmental contaminants and our understanding of this topic has been increasing. Contaminants that plants can degrade or remove include total petroleum hydrocarbons (TPHs), polycyclic aromatic hydrocarbons (PAHs), metals, and pesticides (US EPA 2000).

willows, aspen

Don't Only Rely on Seeding - Relying on seed can be problematic for some projects that need a more formal appearance and for sites where seed can be washed away during rain event. In most cases, smaller raingardens, bioretention areas and stormwater swales should be planted with containerized plants. It can be helpful to keep some projects "off-line" as seeds germinate, or small containerized plants get

established as they typically can't survive inundation. Seed is commonly used for buffers around stormwater ponds and larger plantings such as dry ponds when water can be diverted until the vegetation establishes.

Consider New Approaches to Planting Design - A more recent approach to planting design for stormwater projects is to establish a grass or sedge matrix that can compete with weeds and provide structural support for tall forb species. Low-growing grasses such as little bluestem, *Schizachyrium scoparium*: switch grass, *Panicum virgatum*; and prairie dropseed, *Sporobolus heterolepis* can be used for a matrix in biofiltration areas with dry soils. In areas of higher moisture *Juncus* species such as soft rush, *Juncus effusus* can also be used, as well as sedges including plains oval sedge, *Carex brevior*; fox sedge, *Carex vulpinoidea*;, or Tussock sedge, *Carex stricta*. Grass and sedge matrix plantings have become common in raingarden and biofiltration projects as well as stormwater swales.

Shrub masses have also become more common for stormwater plantings as a way to minimize maintenance needs. Shade and root competition from shrubs often leave little opportunity for weed establishment.



Raingarden with prairie dropseed and little bluestem on side slopes and masses of individual forbs

Expect Plantings to Change Over Time - There is often an expectation that plantings will remain relatively the same over time. This may be true in a few cases with shrub and tree dominated areas, but more naturalized herbaceous plantings will change over time due to changing climatic conditions, colonization of other species, and management strategies. This change is often positive as sites will shift based on plants finding a suitable niche, adding to overall resiliency. These changes can sometimes be at the expense of aesthetics as plant groupings change and flower diversity can decrease over time requiring adjustments in management strategies.

Incorporate Cues For Care - Clean lines created by edging, sidewalks, fencing, or walls within landscapes, as well as plant masses help create a sense of order and care within plantings. For smaller raingardens and biofiltration areas consider swaths and large blocks of plants that will remain in masses over time (with site maintenance to maintain the design) instead of individual plants mixed together. This layout can also benefit maintenance efforts by helping assisting inexperienced gardeners with identifying the native plants compared with weeds.

Site Preparation

Ensure Soils Are Not Compacted Before Planting - Soils are often compacted as part of construction activities. Heavy equipment should not drive on soils within an infiltration areas, but if soils are compacted it is essential that they are loosened prior to planting (12-18" minimum depth) to allow for infiltration and the development of healthy root systems.

Take Measures to Protect Existing Desirable Vegetation - Trees on any construction site are at risk to damage due to root disturbance or soil compaction. It is essential that fencing be installed to protect existing trees, as well as any other vegetation that should remain on a project site. This may include shrub masses or intact areas of herbaceous vegetation.



It is important that stormwater project soils are not compacted by equipment

Ensure a Good Seedbed or Garden Bed is Prepared – Prior to seeding or planting a well-prepared soil bed is needed. This means that all problematic weeds are controlled, and the soil bed is prepared in a way that will be compatible with seeding/planting equipment to be used and will promote the growth of seedlings. If a native seed drill or hydroseeding method will be used a firm but not compacted seedbed is needed. If broadcast seeding will be conducted the soil surface can be rougher but should be allowed to settle prior to seeding so erosion does not bury tiny forb seeds too deep. For garden beds to be planted by hand a firm bed of loosened soil is best, and it is common to spread mulch over the garden prior to planting to minimize compaction during planting.

Don't Introduce Weeds – It isn't common that construction equipment is cleaned before entering a project site. It is essential that problematic weed seeds are not introduced to a site, or it can lead to long-term management problems. Equipment should be power washed prior to entering a site. It is also important that soils being brought to a project site are free of invasive species seeds. Similarly, when planting containerized plants, make sure that plants do not have weeds in the pots during the planting process.

Planting

Ensure That Plants are Installed Correctly – A reason to have qualified contractors involved with plant installation is to ensure that plants are installed correctly. Trees are commonly planted incorrectly including too deep, in small holes that don't allow roots to expand, or planted in compacted soil. It is also important that the outer edge of the hole is loosened to allow for root expansion, and that wire baskets are removed. Containerized plants often need their root systems loosened due to being rootbound from growing in containers for long periods of time. For containerized trees and shrub installation a motorized auger usually doesn't make a big enough hole or loosen the sides of the hole sufficiently and should only be used to start a hole.

Make Sure That Seed is Planted at the Correct Depth - Key reasons for native seedings to fail include seeding on compacted soils that don't allow seedlings to grow, or installing seed too deep, particularly for forbs, sedges, and rushes that have tiny seeds and need to be installed near the soil surface.

Water Plants When Needed – Another key reason for plantings to fail is a lack of watering during drought conditions or establishment. Herbaceous plants typically require around an inch of water a week and potentially more in sandy soils or hot conditions. Trees and shrubs usually require about 5 gallons of water per week.



Prairie grass seed

Site Inspections and Monitoring

Inspections Play and Important Role for Guiding Management – A key role of frequent site inspections and yearly management plans is to guide adaptive management efforts. Conditions within a site can change significantly from year to year, particularly related to weed invasion, making it important to collect frequent information to guide management.

Experienced Inspectors are Needed – Staff conducting inspections should trained in plant identification to understand what weed species are present, as well as how successfully native vegetation is establishing. This information will inform what management methods will be most effective.

Inspection Timing is Important – Inspections should be timed when the most useful information can be collected. Inpections in early May are useful to identify any weeds that need management before they start flowering and setting viable seeds in June and July. Visit sites after any large rain event to observe washouts, erosion, and sedimentation.

Site Management

Site Management Should be Guided by Project Goals – Management planning should reflect goals for project sites. For goals such as providing pollinator habitat, sustaining high plant diversity, or aesthetics specific management methods may be needed to sustain these benefits into the future. Techniques, such as prescribed burning, spot herbicide application, hand weeding, and supplemental planting may be needed over time.

Adequate Maintenance Frequency – Frequent management is important to effectively control weeds. Different weed species are active and flower during different times of the year, as a result, site visits are typically needed monthly the first year after installation, bi-monthly in year two and year three and beyond around three times a year to ensure that weeds are sufficiently maintained.

Adequate Site Management – It is also important that site management is thorough. It isn't uncommon that management crews are in a rush and can miss weed problems at a site, prioritize some species over others, or misidentify planted species.

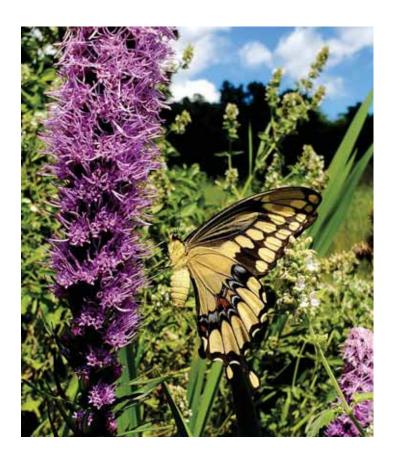


It is important to control small populations of weeds before they spread and require more intensive management.

Targeting the Right problem Species – Some weed species are a lower priority than others, particularly annual and biennial weeds that will go away on their own. Other species may be easily controlled through mowing, while some species spread aggressively and require additional effort or specialized timing, equipment or herbicides.

Maintenance to Sustain Forb Diversity – Grasses and sedges start to dominate many stormwater plantings over time at the expense of forbs. Disturbances such as prescribed fire or thinning of some dominant grass and sedge species may be needed to favor forbs. It is also common that sites receiving minimal maintenance will become dominated with trees and shrubs over time and lower forb diversity may result.

Documenting Results – It is important that records of management methods are maintained so it can be understood what techniques have been conducted in previous years as this information can be valuable to guide future management of similar sites.



Part 2) Case Study Assessment Results



During September of 2002, the authors of the Plants for Stormwater Design book studied vegetation at three stormwater projects in the Twin Cities area. A retention basin was studied in Eagan, Minnesota and stormwater wetland/retention ponds were studied in Little Canada and Maplewood, Minnesota. During August of 2024 the authors revisited the sites to repeat the study methods to understand how the sites have changed over time and gain an understanding about the resiliency of vegetation within the projects.

Consistent with the original site assessments the authors used survey equipment at these sites to record the elevation of plant species in relation to outlets at each of the projects to gain an understanding of how plants were responding to hydrology conditions in these stormwater projects. The highest and lowest elevations were recorded for each plant species found at the sites and this information is summarized in tables for each site. Information is also summarized about the management history of the sites. A new assessment that was conducted on these projects was an Urban Pollinator and Ecological Health Assessment adapted from an assessment developed by the Minnesota Board of Water and Soil Resources (BWSR 2024). This rapid assessment is intended to provide an overall understanding of the value of a site to pollinators and overall ecological health. The following information includes the adapted assessment form and notes for its use.

ASSESSING & PRIORITIZING PROJECT SITES Urban Pollinator & Ecological Health Assessment

This calculator is intended to provide a rough estimation of habitat value and ecological health

1)	SIZE OF PLANTED AREA PROVIDING HAI	BITAT	
	.1129 acres	5 points	
	35 acres	10 points	
	□ > .5 acres	15 points	
	Total Po	oints	
2)	HABITAT TYPE (check all that apply that are	.5 acres in size)	
	☐ Prairie/Savanna/Grassland/Filter Stri	p 5 points	
	■ Wetland/Swales/Biofiltration	5 points	
	■ Lakeshore/River/Emergent Vegetation		
	□ Forest/Woodland	5 points	
	Total Po		

3)	NAT	TIVE COVER DIVERSITY (# of 10-29 species 20-39 species >40 species	plant species) Total Points	5 points 10 points 15 points	
		SONS WITH 3 BLOOMING 2 seasons 3 seasons	Total Points	ESENT (select one) 10 points 15 points	
		r to BWSR's <u>pollinator toolbox</u> abou BITAT CONNECTIONS	it bloom season		
3)		Isolated project but habitat v Connected to other habitat Part of a habitat complex/con		5 points 15 points 20 points	
6)	AVA	AILABL HABITAT COMPON Trees and shrubs for nesting Installed habitat structures At least .5% milkweed species	·	all that apply) 5 points 5 points 5 points	
7)		TICIDE RISK (% of project per ther environmental stressors)	imeter adjacent	to pesticide use	
		1-25% 26-25% 51-75% 76-100%	Total Points	-5 points -10 points -15 points -20 points	
8)		CENT COVER OF NATIVE	VEGETATIO	N IN	
		60-69% 70-79% 80-100%	Total Points	5 points 10 points 15 points	
9)	FRE MA	EQUENCY OF VEGETATION INTAIN PLANT DIVERSITY 1 time per year 2 times per year 3 or more times per year	N MANAGEM Total Points	ENT TO 5 points 10 points 15 points	
		Grand Total	20002 2 011108		
		Project NameEvaluation Date			
	Hi M	cceptional Quality Habitat gh Quality Habitat edium Quality Habitat ow Quality Habitat	86-100 71-85 50-70 0-49		

Notes for use of the Urban Pollinator and Ecological Health Assessment:

Question 1 – The size of habitat plays and important role in supporting a wide range of wildlife species in both urban and rural landscapes. For question one the assessment should be based on the areas of the site dominated by native vegetation.

Question 2- Having different types of habitat at a site can support a wider range of insects and other wildlife species. When assessing urban pollinator habitat individual types of habitat can be relatively small and still provide unique benefits. Reviewers will need to decide when a portion of a site should be counted as a unique habitat and an area should be at least .5 acres in size to be counted.

Question 3- Native plant diversity adds to wildlife benefits as well as the resiliency of projects. For this question native species that establish at the site can be included for the total.

Question 4- For assessing seasons with three blooming species see BWSR's <u>Pollinator Toolbox</u> for a listing of bloom seasons for species. Non-native species that provide pollinator benefits can be included in the total. Non-native clovers can be counted as either spring or summer species but not both.

Question 5- For question five a project is considered "isolated but habitat within .5 miles" when it does not have a direct connection to another project or naturalized area but there are areas of habitat such as native plant communities, lakeshores, diverse stormwater plantings or pollinator plantings within .5 miles. A project would be considered "connected to other habitat" when it is planted directly adjacent to another habitat planting or to a naturalized area. A site would be considered part of a habitat complex or corridor when it is part of an existing area of habitat or added onto a complex or corridor. A habitat complex is defined as an area with native plant communities at least 20 acres in size. The following website provides information about the value of habitat corridors: https://conservationcorridor.org/the-science-of-corridors/

Question 6- The planting of native bunch forming prairie grasses, as well as native flowering shrubs is promoted as part of projects to increase nesting opportunities for native bees. Some native bees nest in bare soil between plants or in the stems of native plants. It is important that planted bunch grasses are not mowed lower than six inches as part of maintenance activities to prevent damaging the plants and nesting pollinators. Estimates of milkweed percent cover should be based on milkweed present across the entire site.

Question 7- It is important that seeds treated with insecticides are not used at project sites, or that sites are not sprayed with insecticides. For question seven the area surrounding the site where pesticides which include herbicides (such as for lawn maintenance or insecticides are used should be estimated. These areas could be lawns that are treated with chemicals or agricultural production areas. Any area where there are significant environmental stressors should also be included such as busy roadways, industrial areas, railroads, or areas dominated with invasive plants.

Question 8- For question eight the percent cover of native vegetation in planted areas should be estimated. Estimates of percent "cover" should be based on "absolute cover" (the percent of the ground surface that is covered by a vertical projection of foliage as viewed from above). When the cover of individual species are totaled they can cover more than 100 percent.

Question 9 Yearly monitoring of projects is important to identify any weed management needs and steps that can be taken to promote plant diversity. A variety of management methods can be used at sites to promote diversity including spot mowing, spot herbicide application, conservation grazing and hand weeding. It is important that flowering native plants are not mowed and that mowing is only done as

needed when it will not have an impact on native plant diversity. In most cases, management activities should occur at least twice a year.



Findings for the three cases study sites are summarized below. For each of the three case studies information includes a project overview, establishment and management history, urban pollinator and ecological health assessment score, 2022 observations, 2024 observations, and a plant species table.





2024 Site survey at the Cedar Pond site

Case Study 1) Cedar Pond

Project Overview

Cedar Pond is located at Cedar Pond Park in the City of Eagan, Minnesota. The pond is about 3 acres in size. It is a wet retention pond that was re-engineered in 2001 to have decreased water fluctuations, increased protection of nearby infrastructure from large storm events, and higher biological function and plant diversity.

Establishment and Management History

The site was planted in 2002 with a combination of seed and plugs. Site management involves the removal of invasive species, including cattails using mechanical and herbicide methods. Management is currently occurring around twice per growing season by an outside contractor hired by the City. Future management will be three times per growing season with a prioritized goal toward invasive plant management to reduce seed production and vegetative spread. The pond has been allowed to transition from an open wet meadow to trees and shrubs being dominant in many areas. A large number visitors come to the park and pond daily.

Invasive species and a few aggressive species that are present and continue to require maintenance include amur maple, burdock, sweet clove, stinging nettle, bittersweet nightshade, Canada thistle, birdsfoot trefoil, and curly dock.

Urban Pollinator and Ecological Health Assessment Score

The urban pollinator and ecological health assessment score for the project is 90 indicating that the site has exceptional quality habitat. This site had a high score due to the size of the project, having a variety of habitat types, regular site management to control invasive species, a high percentage of native species, and few adjacent environmental stressors.

2002 Observations

The following are finding from the original 2022 site survey:
-Of the forty-five species observed at Cedar Pond that are included in the Plants for Stormwater Design book eleven were considered volunteer species not being planted or seeded. One of the volunteer species was the invasive species



Wet meadow and emergent vegetation at Cedar Pond

reed canary grass which was in low abundance. Four of the volunteer species (silver maple, cottonwood, sandbar willow and American elm) were woody plants, although only one (cottonwood) was a seedling and a true volunteer; the other three species had existed at the site before the stormwater-management project was started.

-More than three-thousand plugs were added to the seed mix, and just a few species were not observed during the field survey. Pickerelweed and hardstem bulrush were absent at the site even though they had

been seeded and planted as plugs. Three species of sedges (porcupine, fox and pointed broom sedge) that were planted as plugs were absent. Four upland species (*Liatris spp.*, culver's root, butterflyweed and Riddell's goldenrod) were also absent.

- -Only three grasses contained in the mesic tall-grass prairie seed mix (MnDOT 15B with F3 forb mix) were not encountered during the field survey, these include switchgrass, sideoats grama and slender wheatgrass.
- -Only four forbs from the seed mix were found in the field survey. They were wild bergamot, yellow coneflower, spiderwort and blue vervain. Of the remaining species contained in the seeding mix, only five are discussed in the Plants for Stormwater Design book, and all of these would be found at elevations higher than the pond edge. These species may have been overlooked, may have occurred in other areas along the shore or were truly absent from the site.
- -An emergent zone seed mix was developed with all five species present at the survey. Only reed manna grass was not part of the plug list. The other species encountered were broad-leaf arrowhead, green bulrush, softstem bulrush and water plantain. From the prairie sedge meadow seed mix (MnDOT 25B) twenty of the thirty-eight species were observed at the field survey. Of the species absent the standout absentees were fringed brome, Canada blue-joint grass, bottlebrush sedge, tussock sedge, fox sedge, fowl manna grass, blazingstar, culver's root, and golden alexanders.

2024 Observations

The following are findings from the 2024 survey:

- -Ten species were not recorded in the 2024 survey that were observed in 2002. These species not being present is likely due to the site becoming shaded with trees and shrubs, or experiencing increased competition in the wet meadow area, such as Indian grass being outcompeted by prairie cord grass.
- -After twenty-two years, the project site has transitioned from an open wet meadow to a dominance of trees and shrubs.
- In addition to the site losing some plant species, the site has also gained twenty-two species, increasing the plant diversity of the site.
- -Thirteen plant species have not changed much in water fluctuation zones. However, twenty species did have significant movement; all but two species have migrated lower in elevation into deeper water levels. Species that moved deeper into the water column included sweet flag, water plantain, indigo bush, marsh milkweed, New England aster, red-stemmed aster, beggarsticks, Bebb's sedge, lake sedge, spikerush, joepye weed, sneezeweed, cardinal flower, blue lobelia, reed canary grass, giant burred, prairie cord grass, Ohio spiderwort, blue vervain and ironweed. The two species that moved higher in elevation were Virginia wild rye and broadleaved arrowhead. The broadleaved arrowhead was surprising that it moved to a higher elevation. Species moving to a deeper elevation be due to natural spread by rhizomes or a result from recent drought during three summer months where water levels may have been lower and requiring plants to expand into lower elevations.

2024 Plant Species Table

Cedar Pond				
Scientific Name	Common Name	2002 Data	2024 Data	
Acer saccharinum	Silver maple	+1.08, (single record)	+0.30, Unlimited	
Acorus calamus	Sweet flag	+.58, (single record)	-0.58, +.62	
Ageratina altissima	White Snakeroot	No Rec	+1.60, Unlimited	
Alisma trivale	Water plantain	+.63, (single record)	+0.00 (single record)	
Alnus incana	Speckled alder	No Rec	+3.40 (single record)	
Amorpha fruticose	Indigo bush	+1.93, (single record)	+1.15, +4.5	
Andropogon gerardii	Big bluestem	+1.85, Unlimited	No Rec	
Aronia melanocarpa	Black chokeberry	+0.83, Unlimited	No Rec	

Asclepias incarnata	Marsh milkweed	+1.19, +2.03	+0.30, +1.5
Aster laevis	Smooth aster	+1.11	No Rec
Aster novae-angliae	New England aster	+1.48, Unlimited	+0.50, Unlimited
Aster puniceus	Red-stemmed aster	+.83 (single record)	+0.12, +.74
Betula nigra	River birch	No Rec	+0.70, Unlimited
Bidens cernua	Beggarsticks	+2.25, (single record)	+0.70, Unlimited
Carex bebbii	Bebb's sedge	+0.83, +1.13	+0.00, +1.30
Carex lacustris	Lake sedge	+0.82, +1.56	-0.33, +1.20
Carex muskingumensis	Palm sedge	No Rec	+0.31, +1.54
Carex stipata	Awl-fruited sedge	+0.67, +2.31	No Rec
Carex vulpinoidea	Fox sedge	No Rec	+0.41, +4.0
Cephalanthus occidentalis	Buttonbush	No Rec	-0.41, +1.61
Echinacea purpurea	Purple coneflower	No Rec	+3.70, Unlimited
Eleocharis sp.	Spikerush	+1.03, (single record)	-0.58, +.58
Elymus canadensis	Canada wild rye	No Rec	+0.96, Unlimited
Elymus virginicus	Virginia wild rye	+1.19, Unlimited	+2.10, Unlimited
Eupatorium maculatum	Joe-pye weed	+1.38, +2.88	+0.15, +1.99
Eupatorium perfoliatum	Boneset	+1.11, +2.29	No Rec
Fraxinus pennsylvanica	Green ash	No Rec	+0.33, Unlimited
Glyceria grandis	Giant manna grass	+0.38, +.75	No Rec
Helenium autumnale	Sneezeweed	+0.95, +1.91	+0.30, Unlimited
Heliopsis helianthoides	Ox-eye Daisy	No Rec	+4.54, Unlimited
Iris versicolor	Blueflag	+0.84, +2.17	+0.11, +.55
Juncus effusus	Soft rush	+0.31, +.87	+0.31,88
Liatris pycnostachya	Prairie blazingstar	No Rec	1.85, (Single Rec.)
Lilium michiganese	Michigan lily	No Rec	+3.20, +4.04
Lobelia cardinalis	Cardinal flower	+0.78, +2.21	+0.00, +1.23
Lobelia siphilitica	Blue lobelia	+2.07, (single record)	+1.99, Unlimited
Lolium multiflorum	Annual rye grass	+1.71, Unlimited	No Rec
Mimulus ringens	Monkey flower	No Rec	0.09, (Single rec.)
Monarda fistulosa	Bergamot	+1.32, Unlimited	+1.17, Unlimited
Oligoneuron rigidum	Stiff goldenrod	No Rec	+0.70 (single record)
Phalaris arundinacea	Reed canary grass	+0.53, +3.96	-0.66, +1.94
Polygonum sp.	Smartweed	+0.79, +2.92	No Rec
Populus deltoides	Eastern cottonwood	+1.12, Unlimited	+3.20, Unlimited
Populus tremuloides	Quaking aspen	No Rec	+2.40, Unlimited
Pycanthemum virginianum	Mountain mint	No Rec	+1.67, Unlimited
Quercus bicolor	Swamp white oak	No Rec	+2.94 (single record)
Quercus macrocarpa	Burr oak	No Rec	+3.20, Unlimited
Ratibida pinnata	Yellow coneflower	+2.33, Unlimited	No Rec
Rudbeckia subtomentosa	Sweet black-eyed Susan	No Rec	+1.11, Unlimited
Sagittaria latifolia	Broadleaved arrowhead	-0.01, +.87	+0.57, +0.87
Salix exigua	Sandbar willow	+.77, (single record)	+0.20, +1.40
Schizachyrium scoparium	Little bluestem	+1.71, Unlimited	+1.50, Unlimited
Scirpus atrovirens	Green bulrush	+0.55, +.97	+0.55, +1.02
Scirpus cyperinus	Woolgrass	+0.38, +1.36	+0.70, Single Rec
Scirpus fluviatilis	River bulrush	-1.05, +1.20	-0.33, +.63
Scirpus pungens	Three-square bulrush	-0.70	-0.75,_1.12
Scirpus Validus	Soft-stem bulrush	-0.67, +.01	-0.58, +.70
Silphium perfoliatum	Cup plant	No Rec	+1.40, Unlimited
Sorghastrum nutans	Indian grass	+2.33, Unlimited	No Rec

Sparganium eurycarpum	Giant burred	-0.22, +.83	-0.66,30
Spartina pectinate	Prairie cord grass	+0.61, +1.49	+0.00, +2.10
Tradescantia ohiensis	Ohio spiderwort	+2.09, Unlimited	+0.63, Unlimited
Typha x glauca	Hybrid cattail	No Rec	-1.70 (single record)
Ulmus americana	American elm	+1.49, Unlimited	No Rec.
Vernonia fasciculata	Ironweed	+1.56 (single record)	+1.64, Unlimited
Verbena hastata	Blue vervain	+1.19 +2.09	+0.50, +2.09
Vernonia fasciculata	Ironweed	1.56 (single record)	+0.30, Unlimited
Veronicastrum virginicum	Culver's root	No Rec	+1.87 (single record)
Zizia aurea	Golden alexanders	No Rec	+0.69, Unlimited

Case Study 2) Gervais Beach

Project Overview

The Gervais Beach stormwater project is located in the City of Little Canada, Minnesota. The project was designed to address a drainage problem on the southwest side of Gervais Lake. The pond/wetland was constructed to treat diverted stormwater. The project is about 0.5 acre in size and consists of prairie, emergent and shrub species.

Establishment and Management History

Prairie and emergent species were planted as seed and plugs and shrubs were planted as container stock. The project site is being inspected and managed an average of three to five times a year through a combination of contractors and Watershed District staff. Primary methods of management have included weed whipping, foliar herbicide application, stump herbicide application, hand pulling, and inter-seeding. Prescribed burning has been an important management method as has been conducted in the spring of 2019, 2016, 2013, 2010, 2007, 2006, and the fall of 2004. Primary invasive species that have been managed include buckthorn, Tartarian honeysuckle, sweet clover, birds-foot trefoil, garlic mustard, purple loosestrife, thistles, reed canary grass, and crown vetch.

Urban Pollinator and Ecological Health Assessment Score

The urban pollinator and ecological health assessment score for the project is 100 indicating that the site has exceptional quality habitat. This site had a high score due to the size of the project, being adjacent to a lake and an urban habitat complex, site management occurring more than three times a



The Gervais Lake site has a higher dominance of trees and shrubs compared to the 2002 survey



Area of standing water at the Gervais Lake site.

year to control invasive species, a high percentage of native species, and few adjacent environmental stressors.

2002 Observations

The following are finding from the original 2002 site survey:

- -This former beach area was planted with seed over three distinct time periods and with plugs during three other time periods.
- -Only eleven of the twenty-three species planted as plugs were observed during the field survey. None of the five upland prairie species were observed, although this may be understandable given the survey's nearshore wetland edge focus.
- Hardstem bulrush is the most significant absent species. It was planted two times in two years but with no success. The other unsuccessful species were bottlebrush sedge, turtlehead, fowl manna grass and culver's root.
- -Of the thirty-seven plants observed during the site visit, eleven were considered volunteer species that were not planted. Three of the volunteer species are reed canary grass, narrow-leaved cattail and purple loosestrife are invasive and should be discouraged and controlled in all planting projects.
- -Five of the volunteer species (silver maple, green ash, cottonwood, sandbar willow and black willow) were woody species that may have been present prior to the planting. The final three volunteer species were fringed sedge, brown-eyed Susan, and broadleaf arrowhead.

2024 Observations

The following are findings from the 2024 survey:

- -Fifteen species were not recorded in the 2024 visit that were present in the 2002 site visit, this may be due to increased shade from tree and shrub establishment and a decrease in prairie vegetation.
- -After twenty-two years, the project site has transitioned from an open wet meadow to a tree and shrub dominated wetland shading out a number of the original species.
- -In addition to losing some plant species the project site also gained fourteen species. Periodic seeding efforts over the last twenty-two years likely was the primary reason for increased plant diversity. New species include many species tolerance of increased shade including golden alexanders, ironweed, jewelweed, and beggarsticks, as well as species tolerance of disturbance such as wild bergamot, spikerushes, ricecut grass, prairie wild onion, mountain mint, broadleaf arrowhead, yellow coneflower, and hybrid cattail.
- -Fifteen plant species have not changed much in water fluctuation zones between 2002 and 2024. -Eight species did have significant movement, all but one species recorded a lower elevation, growing in deeper water levels, including sweet flat, water plantain, red-osier dogwood, blueflag iris, purple loosestrife, reed canary grass, and three-square bulrush. The one species that moved to a higher elevation was Joe-pye weed.

2024 Plant Species Table

Gervais Beach				
Scientific Name	Common Name	2002 Data	2024 Data	
Acer saccharinum	Silver maple	+.93, (single record)	No Rec	
Acorus calamus	Sweet flag	+.67, (single record)	-0.66, 0.0	
Alisma trivale	Water plantain	+.01, (single record) +.23	-0.83, -0.08	
Allium stellatum	Prairie wild onion	No Rec	+1.8, (Single Record)	
Andropogon gerardii	Big bluestem	+1.21, Unlimited	+1.21, Unlimited	
Anemone canadensis	Canada anemone	No Rec	+1.2, +1.8	
Asclepias incarnata	Marsh milkweed	+.67, (single record)	No Rec	
Bidens cernua	Beggarsticks	No Rec	+0.95, Unlimited	
Bolboschoemus fluviatilis	River bulrush	+.33, +2.83	No Rec	
Carex crinita	Caterpillar sedge	+.68, (single record)	No Rec	
Cornus sericea	Red-osier dogwood	1.23, Unlimited	-0.33, +1.4 Unlimited	
Eleocharis sp.	Spikerush sp.	No Rec	-0.58, +0.5	

Eupatorium perfoliatum	Boneset	+.95, +1.93	+1.4 (single record)
Eutrochium maculatum	Joe-pye weed	+.72, +85	+1.47 +1.9
Equisetum fluviatile	Horsetail	No Rec	-0.4, +3.0
Fraxinus pennsylvanica	Green ash	+1.34, Unlimited	+0.22, Unlimited
Helenium autumnale	Sneezeweed	+.90, Unlimited	No Rec
Impatiens capensis	Jewelweed	No Rec	0.00, +1.15
Iris versicolor	Blueflag	+.88, (single record)	-0.5, 0.0
Juncus effusus	Common rush	3, +1.74	0.00 (single record)
Larix laricina	Tamarack	1.60, +1.63	No Rec
Leersia oryzoides	Rice cutgrass	No Rec	-0.58, 0.42
Lobelia siphilitica	Blue lobelia	+1.69, (single record)	No Rec
Lythrum salicaria	Purple loosestrife	18, +7.01	-0.41, +0.5
Monarda fistulosa	Wild bergamot	No Rec	+1.6, Unlimited
Oligoneuron rigidum	Stiff goldenrod	+1.39, +1.55	No Rec
Phalaris arundinacea	Reed canary grass	+.95, (single record)	-0.41, Unlimited
Physostegia viginiana	Obedient plant	No Rec	-0.1 (single record)
Populus deltoides	Eastern cottonwood	+1.63, Unlimited	+0.62, Unlimited
Pycnanthemum virginianum	Mountain mint	No Rec	+2.54, Unlimited
Ratibida pinnata	Yellow coneflower	No Rec	+3.19, Unlimited
Rudbeckia subtomentosa	Brown-eyed Susan	+1.57, Unlimited	+1.47, Unlimited
Sagittaria latifolia	Broadleaf arrowhead	No Rec	-0.75, -0.66
Salix exigua	Sandbar willow	+1.29, (single record)	-0.58, +0.5
Salix nigra	Black willow	+1.03, (single record)	+1.0, Unlimited
Schizachyrium scoparium	Little bluestem	+1.74, Unlimited	+2.12, Unlimited
Schoenoplectus pungens	Three-square bulrush	+.72, +1.36	-0.35, +0.63
Schoenoplectus tabernaemontani	Soft-stem bulrush	+.01, (single record)	-0.44 (single record)
Scirpus atrovirens	Green bulrush	+.91, (single record)	No Rec
Scirpus cyperinus	Woolgrass	+1.17, (single record)	No Rec
Sorghastrum nutans	Indian grass	+1.23, Unlimited	No Rec
Sparganium eurycarpum	Giant burreed	37, +1.28	-0.58, 0.00
Spartina pectinata	Prairie cord grass	+.3, +1.08	-0.08, +0.89
Symphyotrichum novae-angliae	New England aster	+1.06, Unlimited	No Rec
Symphyotrichum puniceum	Red-stemmed aster	+.9, (single record)	+0.1, +1.49
Typha angustifolia	Narrow-leaved cattail	22, +1.2	No Rec
Typha xglauca	Hybrid cattail	No Rec	-0.66, -0.16
Typha latifolia	Broadleaved cattail	+.71, +.93	No Rec
Verbena hastata	Blue vervain	+1.62, +1.91	+1.59, +1.99
Veronicastrum virginicum	Culver's root	No Rec	+1.3, +2.1
Viburnum opulus var. Americanum	High bush cranberry	+1.43, +2.07	No Rec
Zizea aurea	Golden alexanders	No Rec	+1.17, Unlimited

^{*}Elevations refer to height in inches above or below the pond or wetlands outlet.

[&]quot;Single record" refers to instances where only one plant of a species was found during the site visit. "Unlimited" refers to upland species that had a range that was generally not limited by moisture conditions at the site. "No Rec" indicates that the plant species was not found during the site survey for that year.

Case Study 3) Alum Pond

Project Overview

The Alum Pond was constructed to implement phosphorus reduction in the watershed in which it is located, and it utilizes alum injection. The site, about 1.5 acres in size, is located in the City of Maplewood, Minnesota. Prairie and emergent species at the site were planted with seed and plugs. In addition, shrubs were planted in many locations throughout the site.

Open water at the Alum Pond site

Establishment and Management History

The alum treatment facility was planted in the fall of 1997 and spring of 1998. The project site is being inspected and managed an average of 3-6 times a year through a

combination of contractors and Watershed District staff. Primary methods of management have included weed whipping, foliar herbicide application, stump herbicide application, hand pulling, prescribed burning, inter-seeding, and supplemental planting of bulrush and burred. Prescribed burns have been an important management method and have occurred in the spring of 2022, 2017, 2014, 2010, 2006, and fall of 2004.

Primary invasive species that have been managed include buckthorn, Tartarian honeysuckle, sweet clover, birds-foot trefoil, garlic mustard, purple loosestrife, thistles, reed canary grass, crown vetch, spotted knapweed, black locust, hybrid cattail, and smooth brome.

Urban Pollinator and Ecological Health Assessment Score

The urban pollinator and ecological health assessment score for the project is 85 indicating that the site has high quality habitat. This site had a slightly lower score than the other two case studies due to adjacency to a busy roadway. The site still scored high due to having a variety of habitat types, site management at least three times of year, a high percentage of native species, and high plant diversity.

2002 Observations

The following are findings from the original 2022 site survey:

- -Thirteen of the thirty-seven species observed during the survey were volunteer species, or species that were not intentionally planted. Three of the thirteen species, narrow-leaved cattail, reed canary grass and purple loosestrife are invasive plants.
- -The most notable volunteer species were Torry's rush, common rush, white meadowsweet, woolgrass, river bulrush and mad dog skullcap. The other three species were cottonwood, black willow and elderberry.
- -Seed was planted in distinct wetland zones as three mixes; mesic grass/forb mix (lowland prairie), wet grass/forb mix (wet meadow) and a marsh mix (emergent and lower zones). In the upper zone, thirty-two plant species were encountered during the survey, eight of which were documented. The remaining twenty-four plant species included only nine species included in the Plants for Stormwater Design book.
- -Twenty-nine species were seeded in the lower planting zone. Twelve of these species were present in the field survey. Of the seventeen species planted which were not encountered in the survey, notable absences included culver's root, ironweed, meadow rue, blazingstar, red-stem aster and Virginia wild rye.
- -The emergent and lower zone seed mix included thirty-five plant species. Of these species thirteen were observed at the field survey. Species planted but not observed in the survey included ironweed, burreed, hardstem bulrush, rice cut grass, manna grasses, fox sedge, awlfruited sedge, retrorsa sedge, hop sedge, lake sedge, Canada blue-joint grass, panicled aster, water plantain and sweet flag.

-A few of the planted plants which were not observed during the field survey and had also not been observed in the other surveyed case study sites were hardstem bulrush, ironweed, manna grass, fox and other sedges, panicled aster and Canada blue-joint grass.

2024 Observations

The following are finding from the 2024 survey:

- -Twelve species that were found in 2002 were not recorded in the 2024 visit. These species have been likely eliminated due to the site becoming shaded with tree and shrub establishment.
- -After 20 years many portions of the project site have transitioned from an open wet meadow to a shrub or forested wetland, except along Century Road. Prairie cord grass has spread significantly in a large patch between the road and pond and may be displacing some forb species.
- -In addition to losing some plant species the project site has also gained twenty-one species. A number of the new species are able to grow in some shade tolerance such as culver's root, tall meadowrue, flat topped aster, Canada wild rye, and beggarsticks, or are shrubs and trees such as silky dogwood, pussy willow, tamarack and American elm. Some more aggressive plants have moved in including rattlesnake master, sweetflag, maximilian sunflower, common ox-eye, reed canary grass, mountain mint, and hybrid cattail. Some of these species may have established from planting efforts over the last twenty-two years. -Thirteen plant species that have not changed much in water fluctuation zones. However, twelve species did have significant movement, all but two species are growing in a lower elevation in deeper water levels. The species that were observed lower in the water column included joe-pye weed, jewelweed, blueflag iris, soft rush, purple loosestrife, wild bergamot, broadleaved arrowhead, black willow, redberried elder, and blue vervain. One of the species that moved to a higher elevation was green bulrush which was not expected, while the other was golden alexanders which is not surprising due to its tolerance of a wide range of hydrology conditions.

2024 Plant Species Table

Alum Pond			
Scientific Name	Common Name	2002 Data	2024 Data
Acorus calamus	Sweetflag	No Rec	-0.83, +0.26
Andropogon gerardii	Big bluestem	+1.27, Unlimited	No Record
Asclepias incarnata	Marsh milkweed	+.52, +.62	0.00, +1.1
Bidens spp.	Beggarsticks	+.46, (single record)	No Record
Bolboschoemus fluviatilis	River bulrush	+.25, +1.9	+0.29, +1.05
Carex comosa	Bottlebrush sedge	+.07, +.61	No Record
Cornus amomum	Silky dogwood	No Rec	+2.3 (single record)
Cornus sericea	Red-osier dogwood	+1.16, Unlimited	+1.06, Unlimited
Doellingeria umbellate	Flat topped aster	No Rec	+0.38, +1.85
Eleocharis sp.	Eleocharis	29, (single record)	-0.41, +0.3
Elymus virginicus	Virginia wild rye	No Rec	+0.89, +3.7
Eryngium yuccifolium	Rattlesnake master	No Rec	+0.98
Eupatorium perfoliatum	Boneset	+.46, (single record)	+0.21, +0.66
Eutrochium maculatum	Joe-pye weed	+.51, +1.13	+0.23, +1.74
Helenium autumnale	Sneezeweed	+.88, Unlimited	No Record
Helianthus grosseserratus	Sawtooth sunflower	+1.34, +2.26	No Record
Helianthus maximiliani	Maximilian sunflower	No Rec	+4.84, Unlimited
Heliopsis helianthoides	Ox-eye daisy	No Rec	+3.59, Unlimited
Impatiens capensis	Jewelweed	+.38, +1.09	0.0, +3.71
Iris versicolor	Blueflag	+.28, (single record)	-0.83, +0.93
Juncus effusus	Soft rush	17, (single record	-0.44, +0.19
Juncus torreyi	Torry's rush	+.21, (single record)	0.0 (single record)
Larix laricinia	Tamarack	No Rec	+0.89, +2.84
Liatris ligulistylis	Meadow blazingstar	No Rec	+1.79, (single record)

Lythrum salicaria	Purple loosestrife	30, +.14	+0.56, (single record)
Mimulus ringens	Monkeyflower	No Rec	+1.31 (single record)
Monarda fistulosa	Wild bergamot	+1.61, Unlimited	+0.7, Unlimited
Oligoneuron rigidum	Stiff goldenrod	+.58, Unlimited	No Record
Panicum virgatum	Switchgrass	+.48, Unlimited	+0.77, Unlimited
Populus deltoides	Eastern cottonwood	+.51, Unlimited	+0.92, Unlimited
Phalaris arundinacea	Reed canary Grass	No Rec	-0.44, +2.82
Pycanthemum virginianum	Mountain mint	No Rec	+0.45, Uunlimited
Ratibida pinnata	Yellow coneflower	+1.24, Unlimited	+0.89, Unlimited
Rudbeckia subtomentosa	Brown-eyed Susan	No Rec	+0.55, Unlimited
Sagittaria latifolia	Broadleaved arrowhead	48, (single record)	-0.66, +0.39
Salix discolor	Pussy willow	No Rec	0.0 (single record)
Salix nigra	Black willow	+2.36, Unlimited	0.0, Unlimited
Sambucus racemosa	Red-berried elder	+1.64, Unlimited	+0.5 Unlimited
Schoenoplectus tabernaemontani	Soft-stem bulrush	28, +.52	0.0, (single record)
Scirpus atrovirens	Green bulrush	+.24, +.51	+0.69, +0.73
Scirpus cyperinus	Woolgrass	+.33, (single record)	-0.53, +0.22
Scutterlaria lateriflora	Mad dog skullcap	+.45, (single record)	No Record
Silphium perfoliatum	Cup plant	+1.4, (single record)	+0.56, Unlimited
Sorghastrum nutans	Indian grass	+1.46, Unlimited	No Record
Spartina pectinata	Prairie cord grass	+.22, (single record)	0.0, Unlimited
Spiraea alba	Meadowsweet	+.91, (single record)	No Record
Symphyotrichum novae-angliae	New England aster	+.56, Unlimited	No Record
Symphyotrichum puniceum	Red-stemmed aster	No Rec	+0.53, +1.0
Thalictrum dasycarpum	Tall meadow rue	No Rec	+0.51, +3.48
Tradescantia ohiensis	Ohio spiderwort	No Rec	+1.71, +1.98
Typha angustifolia	Narrow-leaved cattail	76, .00	No Record
Typha xglauca	Hybrid cattail	No Rec	-0.66, +1.89
Ulmus americana	American elm	No Rec	+1.96 Unlimited
Verbena hastata	Blue vervain	+.5, +.63	+0.16, +1.53
Vernonia fasciculata	Ironweed	No Rec	+4.34, Unlimited
Veronicastrum virginicum	Culvers root	No Rec	+0.72, +2.02
Viburnum opulus var. americanum	High bush cranberry	+1.48, (single record)	No Record
Zizia aurea	Golden alexanders	+.77, Unlimited	+2.03, Unlimited

^{*}Elevations refer to height in inches above or below the pond or wetlands outlet.

[&]quot;Single record" refers to instances where only one plant of a species was found during the site visit. "Unlimited" refers to upland species that had a range that was generally not limited by moisture conditions at the site. "No Rec" indicates that the plant species was not found during the site survey for that year.

Part 3) Method for Ranking the Resiliency of Plants in Stormwater Projects



To assess the resiliency of plants within stormwater projects the authors developed a method for ranking individual species based on the monitoring of case studies and other projects over the last twenty years. The method of ranking is described and a table is included with resiliency scores for plants included in the Plants for Stormwater Design book. The same method can be used for assessing additional species not included in the table. For this method resiliency is defined as a plant's capacity to persist and maintain health and function in stormwater plantings after stress or disturbance. Understanding the resiliency of plant species in stormwater projects can help with site design and plant selection. Resiliency scores are included for both native and invasive species, as it is useful to understand the competitive advantage of some invasive species to guide management needs, but also for selecting native plant species that are competitive. It is important to note that resiliency scores are one tool for plant selection. A high diversity of plant species should be used for projects to promote the overall resiliency of a planting. Resiliency scores can help determine species that have a high likelihood of persisting in a project and should typically be used in a higher percentage of seed mixes or as containerized plants.

The following are three steps used for assessing resiliency.

Step 1) As part of the ranking method, each plant is assessed based on eight criteria focused on their tolerance to stressors and ability to persist in projects. If a species has a low tolerance and persistance it receives a low number, while a high tolerance or persistence will receive a high number.

Criteria Based on Environmental Tolerances to Stressors and Persistence in Projects

Note: scoring a 1 represents very low, 3 represents low, 5 represents medium, 8 represents high and 10 represents very high.

Tolerance to High or Frequent Precipitation Typical to Stormwater Projects	1-10
Tolerance to Low Water Levels/Drought Typical to Stormwater Projects	1-10
Persistence in Stormwater Projects Due to Lifespan, or Ability to Spread	1-20
Tolerance of Plant Competition	1-10
Tolerance of Herbivores or Disease	1-10
Tolerance of Erosion or Sedimentation Typical of Stormwater Projects	1-10
Tolerance of High Nutrients, Salt, or Contaminants	1-10
Tolerance of an Urbanized/Constructed Setting Typical for Stormwater Projects	1-10
Tolerance of Low Site Vegetation and Sediment Management	1-10

Step 2) The individual scores for a plant should be totaled and averaged to determine a final resiliency score.

Step 3) Determine if the species has a low, medium, high, or very high resiliency based on the following scale.

0-6.4 Low Resiliency

6.5-7.4 Medium Resiliency

7.5-8.4 High Resiliency

8.5-10 Very High Resiliency

The following are additional considerations and observations related to the resiliency scores that influence the ranking of individual species:

- -Plants in the Plants for Stormwater Design book have been selected for their relatively high resiliency in stormwater projects, as a result many plants in the table have a high resiliency score.
- -All plants have limitations related to their growth and survival in stormwater projects, particularly related to surviving flooding or drought. As a result, the highest score for any species in the table below is a 9.0 out our 10.
- -Ash trees in the resiliency table have a relatively low resiliency score which is a result of current impacts from emerald ash borer. Otherwise the species would have a high resiliency score.
- -With the exception of ash trees woody plants often have higher resiliency scores than grasses, sedges, rushes.
- -In many cases grasses, sedges, and rushes have a higher resiliency score than forbs and ferns due to their ability to withstand herbivores, relatively high disease resistance, and ability to spread within stormwater projects.
- -Some species in stormwater projects such as Bidens sp., Impatiens species, or Lobelia species are short lived and susceptible to some environmental stressors but persist in projects due to reseeding. Many woody plants persist due to their long lifespan. Either ability to spread or lifespan can provide a significant advantage for species and is the reason for persistence in stormwater projects receiving a higher score than other categories.

This following table lists resiliency scores for plants included in the Plants for Stormwater Design Book

*indicates invasive species

Table of Resiliency Scores for Plant Species			
Scientific Name	Common Name		
Acer saccharinum	Silver maple	9.0	
Acorus calamus	Sweet flag	8.0	
Agastache foeniculum	Giant hyssop	7.0	
Alisma trivale	Water plantain	6.5	
Allium stellatum	Prairie wild onion	7.4	
Alnus incana	Speckled alder	7.7	
Amorpha fruticosa	Indigo bush	8.1	
Andropogon gerardii	Big bluestem	8.4	
Anemone canadensis	Canada anemone	7.9	
Angelica atropurpurea	Angelica	7.0	

Arisaema triphyllum	Jack-in-the-pulpit	6.2
Aronia melanocarpa	Black chokeberry	7.9
Artemisia ludoviciana	Prairie sage	7.8
Asclepias incarnata	Marsh milkweed	7.1
Asclepias tuberosa	Butterfly milkweed	6.7
Athyrium filix-femina	Lady fern	5.8
Betula nigra	River birch	8.6
Bidens cernua	Beggarsticks	7.2
Bolboschoenus fluviatilis	River bulrush	7.7
Boltonia asteroids	Boltonia	5.9
Bromus ciliatus	Fringed brome	7.3
Calamagrostis canadensis	Canada blue-joint grass	7.8
Caltha palustris	Marsh marigold	5.2
Carex aquatilis	Water sedge	7.6
Carex bebbii	Bebb's sedge	7.1
Carex comosa	Bottlebrush sedge	7.2
Carex crinita	Caterpillar sedge	7.2
Carex hystericina	Porcupine sedge	7.2
Carex lacustris	Lake sedge	8.3
Carex lasiocarpa	Wooly needle sedge	7.0
Carex pellita	Wooly sedge	7.1
Carex retrorsa	Retrorse sedge	7.2
Carex stipata	Awl-fruited sedge	7.1
Carex stricta	Tussock sedge	7.6
Carex vulpinoidea	Fox sedge	7.4
Celtis occidentalis	Hackberry	8.6
Cephalanthus occidentalis	Buttonbush	8.0
Chamerion angustifolium	Fireweed	6.1
Chelone glabra	Turtlehead	6.3
Comarum palustre	Marsh cinquefoil	5.9
Cornus amomum	Silky dogwood	7.8
Cornus racemosa	Gray dogwood	7.8
Cornus sericea	Red-osier dogwood	8.5
Eleocharis obtuse	Blunt spikerush	7.0
Elymus virginicus	Virginia wild rye	6.4
Equisetum fluviatile	Horsetail	7.4
Eryngium yuccifolium	Rattlesnake master	6.7
Eupatorium perfoliatum	Boneset	5.9
Eurybia macrohylla	Bigleaf aster	6.8
Euthamia graminifolia	Grass-leaved goldenrod	7.0
Eutrochium maculatum	Joe-pye-weed	7.0
Fraxinus nigra	Black ash	4.7
Fraxinus pennsylvanica	Green ash	4.9
Galium boreale	Northern bedstraw	6.0
Gentiana andrewsii	Bottle gentian	5.7
Glyceria grandis	Giant manna grass	6.6
Glyceria striata	Fowl manna grass	8.9

Helenium autumnale	Sneezeweed	6.8
Helianthus grosseserratus	Sawtooth sunflower	6.7
Heuchera richardsonii	Prairie alumroot	5.3
Ilex verticillata	Winterberry	7.4
Impatiens capensis	Jewelweed	6.2
Iris versicolor	Blueflag	7.2
Juncus arcticus	Baltic rush	6.7
Juncus effusus	Soft rush	7.1
Juncus torreyi	Torrey rush	7.1
Larix laricina	Tamarack	5.9
Leersia oryzoides	Rice-cut grass	7.0
Liatris ligulistylis	Meadow blazingstar	5.9
Liatris pycnostachya	Prairie blazingstar	5.9
Lilium superbum	Turk's-cap lily	4.8
Lobelia cardinalis	Cardinal flower	5.5
Lobelia siphilitica	Blue lobelia	7.1
Lysimachia thyrsiflora	Tufted loosestrife	6.6
Lythrum salicaria*	Purple loosestrife	8.6
Maianthemum racemosum	False Solomon's seal	5.4
Matteuccia struthiopteris	Ostrich fern	6.6
Monarda fistulosa	Wild bergamot	7.7
Oligoneuron riddellii	Riddell's goldenrod	6.2
Oligoneuron rigidum	Stiff goldenrod	7.3
Onoclea sensibilis	Sensitive fern	6.4
Osmunda regalis	Royal fern	6.4
Panicum virgatum	Switchgrass	7.5
Phalaris arundinacea*	Reed canary grass	8.8
Physocarpus opulifolius	Ninebark	7.7
Physostegia virginiana	Obedient plant	7.1
Polygonum amphibium	Water smartweed	6.6
Pontederia cordata	Pickerelweed	5.7
Populus deltoides	Eastern cottonwood	9.0
Populus tremuloides	Quaking aspen	8.0
Pteridium aquilinum	Bracken fern	5.7
Pycnanthemum virginianum	Mountain mint	6.7
Quercus bicolor	Swamp white oak	8.7
Ratibida pinnata	Yellow coneflower	6.4
Rudbeckia subtomentosa	Brown-eyed Susan	6.0
Sagittaria latifolia	Broadleaved arrowhead	6.8
Salix discolor	Pussy willow	7.8
Salix exigua	Sandbar willow	8.4
Salix nigra	Black willow	8.4
Sambucus racemosa	Red-berried elder	7.0
Schizachyrium scoparium	Little bluestem	6.3
Schoenoplectus acutus	Hardstem bulrush	6.0
Schoenoplectus pungens	Three-square bulrush	6.9
Schoenoplectus tabernaemontani	Soft-stem bulrush	6.3

Scirpus atrovirens	Green bulrush	6.3
Scirpus cyperinus	Woolgrass	6.1
Scutellaria lateriflora	Mad-dog skullcap	5.8
Silphium laciniatum	Compass plant	7.2
Silphium perfoliatum	Cup plant	7.7
Solidago flexicaulis	Zig-zag goldenrod	5.6
Sorghastrum nutans	Indian grass	7.6
Sparganium eurycarpum	Giant burreed	8.1
Spartina pectinata	Prairie cord grass	7.6
Spiraea alba	Meadowsweet	6.9
Symphyotrichum laeve	Smooth aster	5.8
Symphyotrichum lanceolatus	Panicle aster	5.9
Symphyotrichum novae-angliae	New England aster	5.9
Symphyotrichum pilosum	Frost aster	6.3
Symphyotrichum puniceum	Purple-stemmed aster	6.2
Symplocarpus foetidus	Skunk cabbage	5.3
Thalictrum dasycarpum	Tall meadowrue	5.6
Tradescantia ohiensis	Ohio spiderwort	5.9
Typha latifolia	Broadleaved cattail	7.4
Typha xglauca*	Hybrid cattail	9.0
Verbena hastata	Blue vervain	6.2
Vernonia fasciculata	Ironweed	7.3
Veronicastrum virginicum	Culver's root	6.9
Viburnum lentago	Nannyberry	7.0
Viburnum opulus var. Americanum	High bush cranberry	7.0
Zizia aurea	Golden alexanders	7.0

Part 4) Research Needs Related to Stormwater Plantings



The following list summarizes research needs related to the planning, installation and management of stormwater plantings. This list was developed by the authors with input from practitioners.

- 1)**Testing the resiliency and flood tolerance of individual plant species** Research is needed to further understand the resiliency and flood tolerance of native plant species that are common in stormwater projects and other types of ecological plantings.
- 2)Studying plants that are best suited to future climate conditions Future climate conditions are expected to involve increased extreme precipitation events, as well as heat and drought. Additional information is needed about what plant species can handle these expected climate conditions, as well as transitions from periods of high precipitation to drought.
- 3)Studying methods of sustaining forb diversity in plantings where grasses and sedges dominate over time Grasses and sedges tend to increase in cover within stormwater projects over time while forbs which are important for pollinators and other wildlife decrease over time. Information is needed about how to manage projects to decrease the dominance of grasses, and sedges and promote the persistence of forbs. Management methods such as prescribed burning, selective herbicide treatment, mowing, grazing, and mechanical vegetation removal need further investigation.
- 4)**Studying plants that are best suited for engineered soil** Engineered soils used in biofiltration areas typically have soils with around seventy to eighty percent sand with the rest of the soil composed of compost. The high percentage of sand creates conditions where plants need to withstand dry conditions for extended periods, but also handle periotic periods of high moisture. A wide range of plant species need to be tested for their adaptation to these conditions. Many dry prairie species can handle the dry conditions but may not be able to handle periotic flooding.
- 5) Developing and studying new weed suppression technologies the management of weed species, particularly invasive species is a significant challenge in stormwater projects and additional technologies are needed to suppress weeds as part of plant installation and site management over time. Technologies are particularly needed for suppressing rhizomatous invasive grasses such as reed canary grass and non-native phragmites, but also for woody invasive species such as buckthorn.

- 6) Plants that can manage or break-down pollutants such as hydrocarbons, PFA's, and heavy metals The majority of information about the role of plants in phytoremediation is focused on non-native species and has focused on a small percent of native species. Research is needed on the benefits of a much wider range of native plant species.
- 7) **Plants that thrive in low or high nutrient conditions** Research is needed to better understand which plants are best adapted to low or high nutrient conditions to aid plant selection efforts. New information would be valuable as part of plant selection tools such as the <u>Blue Thumb Plant Finder</u> which was recently updated to incorporate information from the Plant for Stormwater Design book.
- 8) **Plants that can survive saline conditions** We currently lack information about plants that can handle saline conditions that result from salt accumulation in soils or from salt spray. Many dry prairie species are relatively salt tolerant but we have limited information about wet meadow species, trees and shrubs. This information would also be valuable for plant selection tools.
- 9) The difference of native species and cultivars of native species for supporting host wildlife species, providing nectar and resiliency Additional information is needed about the differences in environmental functions such as pollinator habitat, root structure and tolerance to water fluctuations between native species, and cultivars of native species. Information is also needed about the environmental benefits of some non-native species commonly used in bioretention plantings.

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How do you achieve beauty, functionality and clean water through landscape design? "Plants for Stormwater Design" offers specific, detailed suggestions on selecting appropriate species for all design environments while protecting water quality and mitigating stormwater runoff.

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