

RESTORATION & MANAGEMENT PLAN FOR THE ESCH PROPERTY

MADISON, WISCONSIN



MARCH 2004



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FOR THE ESCH PROPERTY**

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Submitted by

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To

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Introduction

Beginning in 2002, Applied Ecological Services has assisted Pat Esch in developing a management strategy for restoring the oak woodlands and naturalizing other areas of her property at 1311 Lake View Avenue in Madison, Wisconsin (Exhibit 1). Our recommendations presented in this document also encompass the portion of the property that has been deeded to Dane County, known as the Esch Addition to Lake View Conservancy (see area delineated in Exhibit 1). Additional supportive information can be found in the Lake View Conservancy Restoration & Management Plan (Lehnhardt & Apfelbaum 2003). Past and current management efforts on the Esch property have focused mainly on removal of exotic invasive woody growth, re-introduction of fire, and propagation and planting of desirable native herbaceous and woody species.

The following goals and objectives guide the recommendations presented in this document:

- Achieve a healthy woodland setting resembling the structure and composition of the oak woodland/savanna community that early records suggest were present in this location at the time of settlement.
- Develop a simple, low-budget, long-term management plan that can be implemented with little outside technical support (except for assistance with prescribed burns and large tree removal).
- Prepare a conceptual site plan delineating management zones and laying out a schedule for implementing the plan.
- Remove invasive exotic woody and herbaceous species, including Tartarian honeysuckle (*Lonicera tatarica*), common buckthorn (*Rhamnus cathartica*), black locust (*Robinia pseudoacacia*), and garlic mustard (*Alliaria petiolata*), and replace with suitable native species.
- Selectively reduce cover by invasive, weedy native woody species, such as boxelder (*Acer negundo*), wild black cherry (*Prunus serotina*), American elm (*Ulmus americana*), and gray dogwood (*Cornus racemosa*), to enhance establishment of native understory vegetation, stabilize soils, and improve habitat conditions for breeding and nesting birds and other local fauna.
- Provide lists of native woody and herbaceous species suitable for re-vegetation and enhancement plantings.
- Recommend creative landscaping solutions for lawn area, including plantings to mitigate light pollution from security light on west side of house.
- Recommend species for enhancement plantings in existing gardens, i.e. rock garden, prairie garden.
- Recommend strategies for discouraging ant colonization near house.

Setting & Site History

The Esch property (including the 2.3-acre Esch Addition to Lake View Conservancy) is a 3.3-acre parcel located on the southeast slope of a wooded, limestone bedrock prominence on the northeast side of Lake Mendota. Soils are comprised of deep, well-drained silt loams. The property consists of a residence, with adjacent surfaced parking area, mowed lawn, and gardens, situated under a dry-mesic oak woodland canopy that becomes highly degraded further south. Heavy concentrations of black locust and other invasive exotics have been the target of recent restoration activities in the southern sector. Three historic thoroughfares bisect or border the property, including two undeveloped platted streets Esch and Drewry Lanes, and an old haul road known as the Old Tote Road (see Exhibit 3). Drewry Lane is the most conspicuous feature, defined by the original graded surface and a well-worn public footpath. The Esch property shares boundaries with residences to the east and south, Lake View Avenue to the north, and Lake View Conservancy to the west, which includes the Dane County Human Services campus and grounds and Lake View Woods, a similar dry-mesic oak woodland community, at the top of the hill.

Based on interpretations of the early (circa 1830s) land survey records (Ellarson 1949), the local vegetation at the time of settlement consisted largely of regularly fired oak savanna and prairie, which characterized much of the pre- and early post-settlement Dane County landscape. Nearby on the shore of Lake Mendota was one of the few protected locations, today known as Maple Bluff, where mesic woodland developed in the absence of regular fires. Over the years, various agricultural land use practices maintained the open character of the savanna/prairie landscape on the Esch property and surrounding lands (see historic photo in Exhibit 2), however much of the native understory was quickly replaced by introduced agronomic grasses and weeds as a result. Plant communities in these locations continue to support minor remnant populations of the original native flora, providing evidence of the original floristic composition, however, these plant communities in general have become severely degraded due to direct disturbance and altered natural regimes, including cessation of fire, excessive shading, and intense competition from invasive exotic tree, shrub, and herbaceous plant species.

Management Areas & Recommendations

The Esch property is divided into three general management areas (MA1-3, see Exhibit 3), based on land use and level of disturbance: MA1, the house and yard, consisting of mowed lawn, formal and informal gardens, large trees, and various structures and walkways; MA2, existing dry-mesic oak woodland, containing a relatively diverse remnant native understory flora, and adequate fine fuels (largely oak leaf litter) for carrying fire; and MA3, an oak woodland/savanna restoration, recently cleared of black locust and exotic shrubs, and now requiring significant native re-vegetation.

Following is a description of existing conditions and management recommendations for each MA. Exhibit 4 provides a more complete, but not exhaustive, list of plant species found on the property, and identifies those species that are appropriate for propagation and enhancement seeding and planting on the site. Exhibits 5 and 6 present lists of additional native tree, shrub, and herbaceous species appropriate for introduction into the existing and restored oak woodland/savanna and naturalized landscapes of the property. Exhibit 7 presents a 5-year management schedule aimed at achieving a remedial level of restoration on the property. It is important that the management program be reviewed by a qualified restoration ecologist on an annual basis, to determine whether or not restoration goals are being achieved and to recommend any necessary changes.

House & Yard (MA1)

Description: The lawn flora was not closely examined, but consists largely of Kentucky or Canada bluegrass (*Poa* spp) and likely an assortment of weedy forbs, and perhaps many of the same species found in

the adjacent woodland understory. One species of interest that was observed in the central yard adjacent to the parking lot was robin's plantain (*Erigeron pulchellus*), a species of open woodlands and prairie/savanna edges. If left unmowed, many other species would become apparent. Young white oak seedlings are also common in the lawn. The lawn area has great potential for restoring the natural woodland understory vegetation or for establishing more formally designed native plantings and landscaping features. Possibilities include constructed trails leading to destinations or retreat locations under arbors, with outdoor seating and surfaces for dining or working on projects outside. A drain leading from the parking lot and from the roof of the house would provide an ideal opportunity for installation of rain gardens for managing stormwater.

An open area located south of the house consists of three general zones of volunteer and planted gardens. These zones are loosely distinguished by mowed trails. The "volunteer garden" is dominated by an extensive clone of woodland sunflower (*Helianthus strumosus*) and brambles (*Rubus occidentalis*), among other species of grasses and forbs. The "flower garden" is devoted to prairie flowers. The larger portion of the opening (included in Area 2, and labeled as "sedge area") consists of herbaceous vegetation dominated by sedges (*Carex pennsylvanica*, *C. rosea*, *C. cephalophora*, *C. blanda*), and many of the same native savanna forbs found in adjacent, higher-quality woodland understories, such as late horse gentian (*Triosteum perfoliatum*), woodland joe-pye weed (*Eupatorium purpureum*), elm-leaved goldenrod (*Solidago ulmifolia*), Short's aster (*Aster shortii*), wild geranium (*Geranium maculatum*), and tall bellflower (*Campanula americana*), with additional species more typical of open prairies and old fields, such as wild bergamot (*Monarda fistulosa*), Canada goldenrod (*Solidago canadensis*), daisy fleabane (*Erigeron strigosus*), and white vervain (*Verbena urticifolia*). Other native and non-native species found in this location include smooth bank cress (*Arabis laevigata*), white avens (*Geum canadense*), self heal (*Prunella vulgaris*), Canada bluegrass (*Poa compressa*), white snakeroot (*Eupatorium rugosum*), common woodland violet (*Viola sororia*), hog peanut (*Amphicarpaea bracteata*), creeping Charlie (*Glechoma hederacea*), and annual bedstraw (*Galium aparine*). The latter three species are a target of current species eradication or reduction, due to their tendency to smother other vegetation.

A more complete list of species found in this area is presented in Exhibit 4.

M1 Management Recommendations:

- Fire will be an important management tool in the "volunteer garden" and "sedge area", as many of the desirable species in this location will expand with regular burning. One species in particular, woodland sunflower, will respond favorably to the effects of fire, and it may require control to some extent to prevent dominance. Burning will need to be done carefully to avoid damaging desirable woody growth, such as the young red oak sapling growing in the "sedge area". Native plants may be re-introduced into other areas of the yard as desired, favoring those species that tolerate shade or partial shade.
- The ants nesting throughout the yard are an integral part of the savanna and prairie ecosystem. They are an important workforce in your efforts to restore native diversity to your property. They provide the following services:
 - Aeration of the soil and movement of nutrients and buried seed to the surface.
 - Seed dispersal, e.g. bloodroot (*Sanguinaria canadensis*) has a special appendage on the seed used by ants to transport the seed to their nests for food; many seeds are inadvertently planted in the process.
 - Provision of over-wintering nurseries for butterfly and other insect larvae.

Existing Dry-mesic Oak Woodland (MA2) & Savanna/Oak Woodland Restoration (MA3)

Description: The existing dry-mesic oak woodland consists of a closed, mature canopy of white oak (*Quercus alba*), with common canopy associates shagbark hickory (*Carya ovata*), red oak (*Q. rubra*), American elm (*Ulmus americana*), bitternut hickory (*Carya cordiformis*), and white ash (*Fraxinus americana*), with occasional hackberry (*Celtis occidentalis*), butternut (*Juglans cinerea*), wild black cherry (*Prunus serotina*), bigtooth aspen (*Populus grandidentata*), sugar maple (*Acer saccharum*), and boxelder (*Acer negundo*). Other trees in this area of the

property include planted or otherwise introduced black locust (*Robinia pseudoacacia*), northern white cedar or arbor vitae (*Thuja occidentalis*), eastern red cedar (*Juniperus virginiana crebra*), and red and white pine (*Pinus resinosa*, *P. strobus*).

The understory consists of a patchy to dense shrublayer of exotic buckthorn (*Rhamnus cathartica*) and honeysuckle (*Lonicera tatarica*), native gray dogwood (*Cornus racemosa*), black raspberry (*Rubus occidentalis*), chokecherry (*Prunus virginiana*), nannyberry (*Viburnum lentago*), and woody vines Virginia creeper (*Parthenocissus quinquefolia*) and riverbank grape (*Vitis riparia*). Occasional shrubs and low trees include Missouri gooseberry (*Ribes missouriense*) and Japanese barberry (*Berberis thunbergii*), both indicators of past grazing, as well as occasional staghorn sumac (*Rhus typhina*), prickly ash (*Xanthoxylum americanum*), and American plum (*Prunus americana*). Beneath dense shrub cover, the groundlayer vegetation is sparse and of low diversity. In other locations, however, where shrub cover is sparse, a more extensive cover by native flora persists (see in particular the *sedge area* mapped in Exhibit 3). Although the overall understory consists largely of shade and disturbance-tolerant species, such as enchanter's nightshade (*Circaea lutetiana canadensis*), white avens, false solomon's seal (*Smilacina racemosa*), carrion flower (*Smilax ecirrhata*, *S. lasioneura*), wild geranium (*Geranium maculatum*), and white snakeroot, a number of other less tolerant species of the historic savanna understory have persisted, including late horse gentian, pointed tick trefoil (*Desmodium glutinosum*), common oak sedge (*Carex pensylvanica*), woodland joy-pye weed, elm-leaved goldenrod, and Short's aster. This area of the property will respond relatively quickly to firing and other restoration treatments.

The southern portion of the property (MA3) is dominated largely by young black locust, with little else in the canopy. Black locust poses one of the most serious management problems on the property. It is known as a highly invasive introduced species (introduced from further south), which freely escapes from cultivation and commonly develops dense thickets containing a low-diversity vascular flora (Swink and Wilhelm, 1994). As a legume, nitrogen-fixing bacteria associated with nodules on the roots increase the nitrogen content of the soil in which the tree grows (Fowells 1965). In addition, soil mineral nutrients (calcium, magnesium, potassium), nitrates, and pH increase with decomposition of locust litter (Fowells 1965). Recent logging (winter 2004) has cleared this species from the site, along with boxelder and exotic shrubs. The understory is severely degraded and contains little but garlic mustard and a few other disturbance tolerant herbaceous species. The high nitrogen levels associated with the locust favor these weedy species, and control will depend on waging an aggressive management regime that will reduce nitrogen levels as well as remove reproductive plants. Introducing fire as soon as possible will help to reduce soil nitrogen levels.

A more complete list of species found in these areas is presented in Exhibit 4.

M2 Management Recommendations:

- Selected young saplings and smaller diameter stems (4-6 inches dbh) of non-oak species should be considered for reduction to improve light conditions for germination and establishment of oak seedlings in the understory. Species targeted for reduction can include boxelder, American elm, white ash, and wild black cherry. Oaks generally require 30% or more of full sunlight to germinate and grow successfully. Ornamental or occasional trees, such as the arbor vitae, white pine, and eastern red cedar may be removed or reduced as desired, with consideration given to shading effects or invasiveness (eastern red cedar). Desirable native tree and shrub species may be introduced on the site to replace exotic species. A list of appropriate species is included in Exhibits 5 and 6.
- Exotic shrub removal, which is underway, should continue, using cutting and chemical treatment methods. Cut stems can be scattered in place, chipped or removed from the site. The left-in-place method is the most cost effective way to deal with this material; however, dense brush residue on the ground will retard establishment of fine-rooted, soil-stabilizing groundcover vegetation, and may encourage shrub seedling establishment. Chipped wood should never be more than 1 inch in depth, if scattered over the site, to avoid smothering existing desirable vegetation and creating conditions for weed invasion. It is preferable, however, to stockpile chipped material in a small, already disturbed area and use for dressing trails. Subsequent re-vegetation of the chip pile area will be required. Firing the woods in the spring may speed reduction of the woody litter, where fire can be

carried by adequate fine fuels such as oak leaf litter. Consideration should be given to excessive brushy fuel loads, which once ignited may be difficult to manage safely near the residence. Fuel conditions should be assessed by a burn specialist prior to burning the site. Reduction of heavy accumulations of coarser stems is advisable, if possible, e.g. cut and stack for kindling for neighbor's fireplaces.

- Re-introduction of native understory species to sparsely vegetated and bare soil areas should occur as soon as possible following brushing treatments. This may include an annual cover crop, such as oats, to stabilize soils and provide early fine fuel for carrying fire. This cover will diminish as seed and plants of desirable native species are re-introduced or emerge from the soil seedbank. Many of the native species are already present on the site or nearby. Others may need to be purchased from local nurseries or collected with permission from local woodlands. This latter approach is the most desirable to maintain local genetics.

M3 Management Recommendations:

Year 1 Following Black Locust Removal

- In early spring, begin treating garlic mustard infestations using glyphosate (Roundup) at recommended rates on the label. Re-treat as necessary throughout the spring and again in the fall. Weed-whip flowering plants to prevent seed rains.
- Hand broadcast an annual grass cover, such as cereal oats, at a rate of 70 pounds per acre to bare-soil areas to stabilize soils and to begin building a fine fuel base. If volunteer labor is available, remove heavy litter and rake locust seedpods and other woody litter into burn piles to create larger seed beds.
- Monitor and treat re-sprouts of treated woody species. Monitor newly germinated seedlings of black locust, and if possible, torch treat.
- Monitor and treat weedy species responding to open light conditions, such as thistles (*Cirsium* spp, *Carduus nutans*), common burdock (*Arctium minus*), white mulberry (*Morus alba*), and giant mullen (*Thlaspi arvense*). If possible, weed whip or hand cut *heavy* weed growths to prevent seed production, of such species as motherwort (*Leonurus cardiaca*), catnip (*Nepeta cataria*), and stickseed (*Hackelia virginiana*).
- If first-year weed control is successful, fall dormant seed a woodland grass/forb mix (see Exhibit 5).

Year 2

- Repeat garlic mustard treatment in early spring.
- Conduct mid-spring burn, if fuels allow. If not seed Canada wild rye at a rate of 8 pounds PLS seed/acre (PLS=pure live seed).
- Monitor locust and buckthorn re-sprouts and weeds, as in Year 1.
- Begin enhancement seeding and planting of natives, if garlic mustard control is successful.

Year 3

- Repeat garlic mustard treatment in early spring, as necessary. Hand pull minor out-breaks.
- Conduct mid-spring burn, if fuels allow.
- Plant native trees and shrubs: 2-inch caliper white and red oaks at a rate of 20 trees per acre; other desirable native shrubs and fruiting trees, scattered and in small copses (no more than 40 stems per acre). Protect from herbivory with tree tubes and other recommended methods (chemical treatment, human hair, etc.). Protect planted trees and shrubs from fire.
- Continue enhancement seeding and planting.

Year 4-5

- Monitor garlic mustard and other invasives; spot-treat as necessary.

- Conduct spring burns.
- Continue enhancement seeding and planting; replace dead trees and shrubs.

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Exhibit 1. Property location map.

Exhibit 2. Historic air photo showing the area northeast of Lake Mendota in 1937. The Lake View Sanatorium and grounds appear upper center in the photo; the Esch property is situated immediately east of the Nurses Dormitory. Note the Esch property, as well as outlying areas in the lower photo, where grazing and other land management practices maintained a semblance of the historic open-canopied savanna landscape. (Photo courtesy of Patricia Esch).



Exhibit 3. Site Map & Management Zones.

Exhibit 4. Flora of the Esch Property. The following species are commonly found in woodland and naturalized open areas on the property. Species are identified by scientific and common name, habit (T=tree, S=shrub, V=woody/herbaceous vine, H=herb), status as being (N) native or (A) adventive (introduced), suitability for seed collections for propagation and reintroduction to other locations on the property or as seed for trade, and invasiveness, requiring management using control methods. Spaces are provided in the table to allow species to be added to the inventory as they are observed. (*Native species currently being controlled by the landowner due to vigorous growth, but which may be collected as seed for trade.)

WOODLAND (MA2 & MA3)					
Scientific name	Common name	Habit	N/A	Seed Collection	Control
<i>Acer negundo</i>	Boxelder	T	N		X
<i>Acer saccharum</i>	Sugar maple	T	N		
<i>Alliaria petiolata</i>	Garlic mustard	H	A		X
<i>Allium tricoccum</i>	Wild leek	H	N	X	
<i>Amphicarpaea bracteata</i>	Hog peanut	V	N	X*	
<i>Anemone quinquefolia</i>	Wood anemone	H	N	X	
<i>Anemone virginiana</i>	Thimbleweed	H	N	X	
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	H	N	X	
<i>Aster sagittifolius drummondii</i>	Drummond's aster	H	N	X	
<i>Aster shortii</i>	Short's aster	H	N	X	
<i>Berberis thunbergii</i>	Japanese barberry	S	A		X
<i>Carex cephalophora</i>	Short-headed bracted sedge	H	N	X	
<i>Carex pensylvanica</i>	Common oak sedge	H	N	X	
<i>Carya cordiformis</i>	Bitternut hickory	T	N		
<i>Carya ovata</i>	Shagbark hickory	T	N		
<i>Celtis occidentalis</i>	Hackberry	T	N		
<i>Circaea lutetiana</i>	Enchanter's nightshade	H	N		
<i>Cornus racemosa</i>	Gray dogwood	S	N		
<i>Desmodium glutinosum</i>	Pointed tick-trefoil	H	N	X	
<i>Eupatorium purpureum</i>	Woodland joe-pye weed	H	N	X	
<i>Eupatorium rugosum</i>	White snakeroot	H	N	X	
<i>Fraxinus Americana</i>	White ash	T	N		
<i>Galium aparine</i>	Annual bedstraw	H	N		
<i>Geranium maculatum</i>	Wild geranium	H	N	X	
<i>Geum canadense</i>	White avens	H	N		
<i>Hackelia virginiana</i>	Stickseed	H	N		
<i>Juglans cinerea</i>	Butternut	T	N		
<i>Juniperus virginiana</i>	Eastern red cedar	T	N		X
<i>Lonicera tatarica</i>	Tartarian honeysuckle	S	A		X
<i>Mertensia virginica</i>	Virginia bluebells	H	N		
<i>Parthenocissus quinquefolia</i>	Virginia creeper	V	N		
<i>Philadelphus sp.</i>	Mock orange	S	A		
<i>Pinus resinosa</i>	Red pine	T	N		
<i>Pinus strobus</i>	White pine	T	N		
<i>Podophyllum peltatum</i>	Mayapple	H	N	X	
<i>Polygonatum canaliculatum</i>	Solomon's seal	H	N	X	
<i>Populus grandidentata</i>	Big-toothed aspen	T	N		
<i>Prunus americana</i>	Wild plum	T	N	X	

Scientific name	Common name	Habit	N/A	Seed Collection	Control
<i>Prunus serotina</i>	Wild black cherry	T	N		
<i>Prunus virginiana</i>	Chokecherry	S	N	X	
<i>Quercus alba</i>	White oak	T	N		
<i>Quercus rubra</i>	Red oak	T	N		
<i>Rhamnus cathartica</i>	Common buckthorn	S	A		X
<i>Rhus radicans</i>	Poison ivy	V	N		
<i>Rhus typhina</i>	Staghorn sumac	S	N		
<i>Ribes missouriense</i>	Missouri gooseberry	S	A		X
<i>Robinia pseudoacacia</i>	Black locust	T	A		X
<i>Sambucus canadensis</i>	Elderberry	S	N		
<i>Sanguinaria canadensis</i>	Bloodroot	H	N	X	
<i>Smilacina racemosa</i>	False solomon's seal	H	N	X	
<i>Smilax ecirrhata</i>	Upright carrion flower	H	N	X*	
<i>Solanum americanum</i>	Black nightshade	H	N		
<i>Solidago ulmifolia</i>	Elm-leaved goldenrod	H	N	X	
<i>Sorbus sp.</i>	Mountain ash	T			
<i>Thuja occidentalis</i>	Northern white cedar	T	N		
<i>Trillium grandiflorum</i>	Large trillium	H	N	X	
<i>Triosteum perfoliatum</i>	Late horse gentian	H	N	X	
<i>Ulmus Americana</i>	American elm	T	N		
<i>Ulmus pumila</i>	Siberian elm	T	A		X
<i>Uvularia grandiflora</i>	Bellwort	H	N	X	
<i>Viburnum lentago</i>	Nannyberry	S	N	X	
<i>Viburnum opulus</i>	European highbush cranberry	S	A		X
<i>Viola pubescens</i>	Yellow violet	H	N	X	
<i>Viola sororia</i>	Common blue violet	H	N		
<i>Vitis riparia</i>	Riverbank grape	V	N		
<i>Xanthoxylum americanum</i>	Prickly ash	T	N		X

NATURALIZED OPENINGS (MA1)					
Scientific name	Common name	Habit	N/A	Seed Collection	Control
<i>Achillea millefolium</i>	Yarrow, milfoil	H	A		
<i>Amphicarpaea bracteata</i>	Hog peanut	H	N	X*	
<i>Arabis laevigata</i>	Sicklepod, smooth bank cress	H	N	X	
<i>Asclepias syriaca</i>	Common milkweed	H	N		
<i>Campanula americana</i>	Tall bellflower	H	N	X	
<i>Carex blanda</i>	Common wood sedge	H	N	X	
<i>Carex cephalophora</i>	Short-headed bracted sedge	H	N	X	
<i>Carex pennsylvanica</i>	Common oak sedge	H	N	X	
<i>Carex rosea</i>	Curly-styled wood sedge	H	N	X	
<i>Erigeron pulchellus</i>	Robin's plantain	H	N	X	
<i>Erigeron strigosus</i>	Daisy fleabane	H	N	X	
<i>Eupatorium purpureum</i>	Woodland joe-pye weed	H	N	X	
<i>Eupatorium rugosum</i>	White snakeroot	H	N	X	
<i>Gallium aparine</i>	Annual bedstraw	H	N		
<i>Geranium maculatum</i>	Wild geranium	H	N	X	
<i>Geum canadense</i>	White avens	H	N		
<i>Glechoma hederacea</i>	Creeping Charlie	H	A		X
<i>Helianthus strumosus</i>	Woodland sunflower	H	N	X	
<i>Monarda fistulosa</i>	Wild bergamot	H	N	X	
<i>Poa compressa</i>	Canada blue grass	H	A		
<i>Prunella vulgaris</i>	Self heal	H	N		
<i>Quercus rubra</i>	Red oak	T	N		
<i>Robinia pseudoacacia</i>	Black locust	T	A		X
<i>Rubus occidentalis</i>	Black raspberry	S	N		
<i>Smilax herbacea</i>	Common carrion flower	H	N	X	
<i>Solidago canadensis</i>	Canada goldenrod	H	N		
<i>Solidago ulmifolia</i>	Elm-leaved goldenrod	H	N	X	
<i>Triosteum perfoliatum</i>	Late horse gentian	H	N	X	
<i>Ulmus americana</i>	American elm	T	N		
<i>Verbena urticifolia</i>	White vervain	H	N	X	
<i>Viola sororia</i>	Common woodland violet	H	N		

Exhibit 5. Enhancement Species List recommended for the Esch Property. LR = Light requirements; S = Shade, PS = Partial shade, FS = Full sun.

Scientific name	Common name	LR	Seed Collection
TREES			
<i>Crataegus mollis</i>	Downy hawthorn	PS	Aug-Sep
<i>Crataegus punctata</i>	Dotted hawthorn	PS	Aug-Sep
<i>Malus ioensis</i>	Iowa crab	FS	Aug-Sep
<i>Prunus americana</i>	Wild plum	FS	Aug-Sep
<i>Quercus alba</i>	White oak	FS	Sep-Oct
<i>Quercus rubra</i>	Red oak	PS	Sep-Oct
SHRUBS			
<i>Cornus alternifolia</i>	Alternate-leaved dogwood	S	Jul-Aug
<i>Corylus americana</i>	American hazelnut	PS	Jul-Aug
<i>Rosa blanda</i>	Wild rose	FS	Jun-Oct
<i>Rosa carolina</i>	Pasture rose	PS	Jul-Oct
<i>Viburnum lentago</i>	Nannyberry	PS	Jul-Sep
<i>Viburnum prunifolium</i>	Blackhaw	PS	Jul-Sep
<i>Viburnum rafinesquianum</i>	Downy arrowwood	PS	Jul-Sep
GRASSESEDGES			
<i>Agrostis perennans</i>	Thin grass	PS	Jul
<i>Bromus pubescens</i>	Woodland brome	PS	Aug-Sep
<i>Carex cephalophora</i>	Short-headed bracted sedge	PS	Jun
<i>Carex gracillima</i>	Graceful sedge	PS	Jun
<i>Carex hirtifolia</i>	Hairy wood sedge	PS	Jun
<i>Carex pennsylvanica</i>	Oak sedge	PS	May-Jun
<i>Carex rosea</i>	Curly-styled wood sedge	PS	Jun-Jul
<i>Carex sparganioides</i>	Loose-headed bracted sedge	PS	Jul
<i>Elymus villosus</i>	Silky wild rye	PS	Aug-Sep
<i>Elymus virginicus</i>	Virginia wild rye	PS	Aug-Sep
<i>Festuca obtusa</i>	Nodding fescue	PS	Jul-Aug
<i>Hystrix patula</i>	Bottle-brush grass	PS	Jul-Aug
FORBS			
<i>Actaea pachypoda</i>	White baneberry	PS	Jul-Aug
<i>Agastache nepetoides</i>	Giant yellow hyssop	PS	Sep-Oct
<i>Agastache scrophulariaefolia</i>	Purple giant hyssop	PS	Sep-Oct
<i>Allium tricoccum</i>	Wild leek	S	Aug-Sep
<i>Anemone virginiana</i>	Tall anemone	PS	Aug-Oct
<i>Anemonella thalictroides</i>	Rue anemone	S	Jul-Aug

<i>Aquilegia canadensis</i>	Columbine	PS	Aug-Sep
<i>Asclepias exaltata</i>	Poke milkweed	PS	Jul-Aug
<i>Aster sagittifolius drummondii</i>	Drummond's aster	PS	Oct
<i>Aster shortii</i>	Short's aster	PS	Oct
<i>Campanula americana</i>	Tall bellflower	PS	Sep-Oct
<i>Caulophyllum thalictroides</i>	Blue cohosh	S	Jun-Jul
<i>Ceanothus americanus</i>	New Jersey tea	S	Sep-Oct
<i>Claytonia virginica</i>	Spring beauty	PS	May-Jun
<i>Dentaria laciniata</i>	Toothwort	PS	May-Jun
<i>Dicentra cucullaria</i>	Dutchman's breeches	PS	May
<i>Dodecatheon meadia</i>	Shooting star	PS	Jun-Jul
<i>Erythronium albidum</i>	Wild trout lily	PS	May-Jun
<i>Fragaria virginiana</i>	Wild strawberry	PS	Jul-Aug
<i>Galium circaezans</i>	Hairy wild licorice	PS	Jul
<i>Galium concinnum</i>	Shinning bedstraw	PS	Aug
<i>Geranium maculatum</i>	Wild geranium	PS	Jun-Jul
<i>Helianthus decapetalus</i>	Pale sunflower	FS	Oct
<i>Helianthus hirsutus</i>	Hispid sunflower	FS	Oct
<i>Helianthus strumosus</i>	Pale-leaved sunflower	FS	Oct
<i>Hepatica acutiloba</i>	Sharped-lobed hepatica	S	May-Jun
<i>Hydrophyllum virginianum</i>	Virginia waterleaf	PS	Jun-Jul
<i>Isopyrum biternatum</i>	False rue anemone	PS	May-Jun
<i>Lactuca floridana</i>	Blue lettuce	PS	Sep-Oct
<i>Monarda fistulosa</i>	Wild bergamot	FS	Aug-Sep
<i>Osmorhiza claytonii</i>	Hairy sweet cicely	PS	Jun-Jul
<i>Phlox divaricata</i>	Woodland phlox	PS	Jun-Jul
<i>Phryma leptostachya</i>	Lopseed	PS	Sep-Oct
<i>Podophyllum peltatum</i>	Mayapple	PS	Jul-Aug
<i>Polemonium reptans</i>	Jacob's ladder	PS	Jun-Jul
<i>Polygonatum canaliculatum</i>	Solomon's seal	PS	Sep
<i>Polygonum virginianum</i>	Woodland knotweed	PS	Sep-Oct
<i>Prenanthes alba</i>	White lettuce, lion's foot	PS	Oct
<i>Sanguinaria canadensis</i>	Bloodroot	PS	Jun
<i>Sanicula gregaria</i>	Black snakeroot	PS	Aug-Sep
<i>Scrophularia marilandica</i>	Late figwort	PS	Oct
<i>Smilacina stellata</i>	Starry false solomon's seal	PS	Jul-Sep
<i>Solidago flexicanlis</i>	Zig-zag goldenrod	PS	Oct
<i>Solidago umlifolia</i>	Elm-leaved goldenrod	PS	Oct
<i>Trillium recurvatum</i>	Red trillium	PS	Jun-July
<i>Uvularia grandiflora</i>	Bellwort	PS	Jun
<i>Veronicastrum virginianum</i>	Culver's root	PS	Aug-Sep
<i>Viola pubescens</i>	Yellow woodland violet	PS	Jun
FERNS			
<i>Athyrium filix-femina</i>	Lady fern	S	
<i>Botrychium virginianum</i>	Rattlesnake fern	S	Jul

Exhibit 6. Five-year remedial management schedule.

TASK	2004				2005				2006				2007				2008			
	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W
BRUSH																				
MA1																				
MA2	■	■	■	■																
MA3	■	■	■	■																
HERBICIDE																				
MA1																				
MA2	■		■		■		■													
MA3	■	■	■	■	■	■	■		■		■		■		■		■		■	
THIN CANOPY																				
MA1																				
MA2								■												
MA3																				
SEED AND PLANT																				
MA1	■	■			■	■			■	■			■	■			■	■		
MA2	■	■			■	■			■	■			■	■			■	■		
MA3	■	■			■	■			■	■			■	■			■	■		■
BURN	Apply for burn permit several weeks prior to burn.																			
MA1	■									■									■	
MA2	■					■									■					
MA3					■	■				■				■					■	
COLLECT PROPAGULES	■	■	■		■	■	■		■	■	■		■	■	■		■	■	■	

Exhibit 7. Black Locust Control Methods

BLACK LOCUST (*Robinia pseudoacacia*)

DESCRIPTION: Black locust is a leguminous deciduous tree that grows from 30 to 80 feet tall. It is often attacked by stem borers and other insects, causing deformed growth and dieback. It has a shallow, fibrous root system and spreads by underground rhizomes. Young saplings have smooth, green bark; older trees have deep, furrowed, shaggy, dark bark with flat-topped ridges. Leaves are alternate and pinnately compound with 7 to 21 leaflets. Leaflets are thin, elliptical, dark green above, and pale beneath. Smaller branches are armed with heavy, paired thorns. Flowers are pea-like, fragrant, white and yellow, and born in large drooping racemes. Seed pods are shiny, smooth, narrow, flat, 2 to 4 inches long, and contain 4 to 8 seeds. Black locust stands are easy to identify in spring because they typically form multiple-stemmed clones and are slow to leaf out. They produce showy flower clusters in May or June.

DISTRIBUTION AND HABITAT: Black locust is a translocated deciduous tree that is frequently found in upland prairies, savannas, roadsides, old fields, and woodlots in Wisconsin. Black locust prefers humid climates with sandy, loamy, well-drained soils in open, sunny locations.

The tree is native to the slopes and forest margins of Southern Appalachia and the Ozarks. It was introduced throughout Wisconsin in the early 1900's because its aggressive growth pattern and extensive root system discourage soil erosion. Black locust wood is also valued for its durability and high fuel value, and provides good forage for bees.

LIFE HISTORY AND EFFECTS OF INVASION: Black locust produces abundant seeds, but a thick seed coat hinders consistently successful seed germination. The plant typically reproduces vegetatively by root suckering and stump sprouting. Root suckers arise spontaneously from established root systems, sprouting new shoots and interconnecting fibrous roots to form extensive, dense groves of clones. Damage to roots or stems (e.g. from fire, wind, cutting, disease, etc.) stimulates vigorous sprouting, root suckering, and lateral spread. Black locust is susceptible to severe insect damage from locust borers, locust leaf miners, and locust twig borers.

Black locust commonly occurs in disturbed habitats like pastures, degraded woods, thickets, old fields, and roadsides. Successful reproduction via vegetative runners has contributed to the naturalization of black locust in upland forests, prairies, and savannas. Because dense clonal stands shade out most understory vegetation, such tree groves can be detrimental to native vegetation.

CONTROLLING BLACK LOCUST

Mechanical Control: Cutting black locust stimulates sprouting and clonal spread. For this reason, some suggest to avoid simply cutting the stems. Mowing and burning temporarily control spreading, but mowing seems to promote seed germination, and burning stimulates sprouting. Girdling is ineffective because it kills the stem but does not prevent sucker formation. Annual haying may be adequate to control first year seedlings and prevent spreading in prairie communities. Bulldozing may be an option on disturbed lands.

Chemical Control: The extensive root system of black locust spreads herbicides over large areas. Basal stem application is preferred for treatment because it is selective and easy to apply. The herbicide should be applied in a band at least 6 inches high all around the trunk approximately 12 inches from the ground. Triclopyr formulated for dilution in diesel fuel or mineral oil is currently the herbicide of choice for black locust. Both diesel fuel and mineral oil release volatile organic compounds into the immediate area. Although more expensive, mineral oil is potentially less toxic to neighboring organisms. The triclopyr/oil mixture may also be applied to a girdle cut at standing height or to cut stumps.

For small isolated plants or thick patches under 5 feet in height (such as those resulting from cutting or fire), florasulam can be applied as a foliar spray. Florasulam kills plants by inhibiting leaf bud growth and flower formation in the spring. Florasulam should be applied at the end of the growing season. In order to effectively curb regeneration, every branch or stem must be sprayed because missed stems will leaf out. Triclopyr mixed with water may also be used effectively as a foliar spray in the latter half of the growing season.

Glyphosate can be applied to foliage of actively growing trees using a hand sprayer (1-1.5% active ingredient solution). However, foliar glyphosate spray should not be applied in high quality natural areas because it is a nonselective herbicide. Black locust stems can be cut at the base with brush-cutters, chainsaws, or hand tools; stumps should be treated immediately with a 20% active ingredient solution of glyphosate. The treatment works best when applied in late summer, early fall, or during the dormant season.

Exhibit 8. UW Arboretum Species List for Oak Savanna and Oak Woodland Restoration (Bader 2001)

Developing A Species List for Oak Savanna/Oak Woodland Restoration at the University of Wisconsin-Madison Arboretum

by Brian J. Bader

Drawing on the work of regional ecologists and naturalists and historic records, staff at the UW-Madison Arboretum have compiled a list of groundlayer and shrub species for oak savanna/oak woodland restoration.

In 1995, Mark Leach and Laurel Ross (1995) outlined the need and importance of restoring and preserving functioning oak ecosystems. Six years later, interest in conserving and restoring oak savannas and oak woodlands continues to increase throughout the midwestern United States. While the level of interest is increasing, several problems confront restorers of midwestern oak ecosystems, including the lack of remnants with intact or partially intact groundlayers to serve as reference models. Work that has been underway at the University of Wisconsin-Madison Arboretum, the University of Wisconsin-Madison Botany Department, and by other researchers and restorationists has begun to answer some of the questions about the composition of these ecosystems.

In 1992, staff at the University of Wisconsin-Madison Arboretum identified oak savanna as having the highest priority for new restoration projects on Arboretum property (Kline 1992). The Arboretum currently has three oak savanna/oak woodland restorations underway. The Arboretum staff selected these sites because they met the following criteria: 1) open-grown oaks were present; 2) evidence from Government Land Office surveys indicated that the sites were

savannas at the time of European settlement; and 3) prescribed burning was a management option (Kline 1992). The sites were disturbed, overgrown with both exotic shrubs and shade-tolerant trees, and all had a depauperate groundlayer. Removing the unwanted shrubs and trees was relatively straightforward, but determining what the savanna groundlayer species might have been required considerable research.

In this paper I describe the process the Arboretum staff used to create a groundlayer species list to guide our restoration and research activities at the three oak savanna/oak woodland restoration projects. The list, which is derived from historical literature, recent research, and observations by ecologists in southern Wisconsin, includes species that may have occurred across all light and soil gradients of the historic oak savanna/oak woodlands.

Research and Observations of Oak Savanna Ecosystems

Several ecologists and restorationists (Curtis 1959, Nuzzo 1986, Packard 1988a, 1988b, 1993, Henderson 1995, Leach and Ross 1995) have documented the demise of the Midwest oak savanna ecosystem.

John T. Curtis made this point clear when he wrote in his classic treatise, *The Vegetation of Wisconsin*, "An oak savanna with an intact groundlayer is the rarest plant community in Wisconsin today." (1959, p. 327).

Curtis (1959) and his student, J. Roger Bray (1955, 1958, 1960) provided some of the first detailed descriptions of oak savanna vegetation, especially open savannas, in Wisconsin. Bray (1960) characterized open savannas as ranging from a few trees per acre to wooded areas with nearly 60 percent canopy cover. These plant communities had less grass cover and greater forb and woody plant cover than prairies, but more grasses, the same number of shrubs, and fewer forbs than forests. Curtis (1959) listed six modal species (those species present in a higher percentage of stands of that community than in any other) in oak openings and 19 modal species in oak barrens.

However, as several contemporary restorationists and ecologists have pointed out (Packard 1988a, Henderson 1995, Leach 1996), the savannas studied by Curtis and Bray had been in the process of degrading for 100 years by the time they were studied. The study sites were limited in size and number and had already been altered by domestic cattle grazing and the cessation of fire. Furthermore, many researchers and restorationists now recognize that oak ecosystems exist on a continuum from open savanna through oak woodlands (see models presented in Packard 1993, Pruka 1994, Leach and Ross 1995, Henderson 1995, Leach 1996). They also point out the heterogeneity of microsites that included a wide range of shaded, intermediate, and open habitats (Leach 1996, Leach and Givnish 1999).

Supported by his work with prairies and savannas in the Chicago area, Steve Packard (1988a, 1988b, 1993) suggested that there had been many species that were savanna specialists, but that they had become marginalized by the cessation of fire. Packard proposed a list of tallgrass savanna specialists that he derived from historical accounts and from the results of his own failed savanna plantings. We noted that many of the species on Pack-

ard's list were those found in areas of partial or full shade.

Rich Henderson (1995) describes the groundlayer flora as a shifting mosaic of plant associations with varying degrees of shade and sun tolerance. He postulates that this compositional blend contains the following: 1) true prairie species that require full sun, and will only survive in light shade; 2) prairie-associated species that do well in full sun or light shade; 3) true savanna species that do best in, or are restricted to, a mixture of shade and sun; 4) forest-associated species that thrive with fire and moderate amounts of sunlight; and 5) true forest species that can persist, but not thrive, with occasional fire and moderate sunlight.

Other studies have pointed out that oak savannas are unusually diverse. In a study of 22 savanna remnants, Mark Leach and Tom Givnish (1999) found 507 native plant species (about 27 percent of Wisconsin's indigenous vascular flora). They determined that the composition of the groundlayer was related to in-site differences in light availability and among-site differences in soil texture, and that that Midwest oak savannas are dominated by forbs, except on the sunniest and sandiest sites (Leach 1996, Leach and Givnish 1999). They suggest that the high diversity of the savanna groundlayer may be explained by the internal mosaic of shade, intermediate and sun conditions, the release of the forbs from C₄ grass competition, disturbance, and dispersal (Leach and Givnish 1999).

Developing a Species List for the Arboretum's Savanna Restorations

The staff at the UW-Madison Arboretum developed the savanna species list for the Arboretum's savanna restoration through a gradual process, making adjustments and modifications as new information became available. Molly Fifield Murray, Virginia Kline, and I compiled the initial mesic to xeric species lists after reviewing the data collected by Curtis (1959) and Bray (1955, 1958, and 1960)—data that are kept in the Plant Ecology Lab at the

University of Wisconsin-Madison Botany Department. We then fine-tuned the list using suggestions made by Arboretum staff and other area ecologists according to their observations of species' site preferences in Dane County and nearby areas (preliminary draft, Fifield-Murray and others, 1993). Later, we added to the list by

**"An oak savanna with an intact groundlayer is the rarest plant community in Wisconsin today."
Curtis (1959)**

consulting historical and regional lists, compiled by L.S. Cheney and R.H. True (1893), Robert Ellarson (1949), Steve Packard (1988a, 1988b, and 1993), Marlin Bowles and Jenny McBride (1994), Brian Pruka (1995), Karl Delong and Craig Hooper (1996), and Floyd Swink and Gerould Wilhelm (1994). We did not include species from these lists which, to the best of our knowledge, did not occur historically in southern Wisconsin (Cochrane and Iltis 2000).

We later modified the list to include species of the closed canopy oak woodland (partial shade to full shade). Referring to work by Peter Hujik (1995), we added species of wet-mesic, lowland savanna (sun to partial shade). Andrew Hipp (1998) added the genus *Carex* to the list. Prompted by a suggestion that shrubs (hazelnut, wild plum) and fire-stunted oak grubs were important components throughout the barrens, savanna, woodland continuum in Illinois (Bowles and McBride 1994, Bowles and others 1994), we added a few select shrub species.

Use of the Oak Savanna—Oak Woodland Species List

The Oak Savanna/Oak Woodland species list presented here is a working list, intended to serve as a guide for restorationists and ecologists working in oak

ecosystems in southern Wisconsin. The list is not a definitive list of species that occurred in historic oak savannas and oak woodlands. It represents our best estimate of the composition of these communities. The list is intentionally broad and covers the continuum described by Henderson (1995) from the open-sun, prairie associated species to the closed-canopied forest-associated species.

The list presented contains 484 species (95 grasses and sedges, 332 forbs, and 57 shrubs and vines). The nomenclature follows Gleason and Cronquist (1991), except for *Carex*, which follows Kartesz (1994). Asterisks identify species listed as threatened and endangered by the Wisconsin Department of Natural Resources (1999). We have also indicated species suitable for lowland and upland sites. The classification system (wet, wet-mesic, mesic, dry-mesic, and dry) represents the continuum from wet to dry as described by Curtis (1959). Information about light intensity follows the continuum from shade (SH), partial shade (PS), to sun (SU). Species that grow in calcareous conditions as reported by Swink and Wilhelm (1994) are indicated in the column (Ca). Species with a "lp" in the column are reported to grow in limestone prairies by Charles Umbanhower (1992).

The list contains species that are believed to have grown in the savanna—prairie ecoregions of southern Wisconsin. However, there are many species on this list that are not found throughout the range and, indeed, have restricted ranges in southern Wisconsin. For example, some species may be restricted to the southern tier of counties, others may be restricted to the Driftless area in the southwest corner of the state, and still others may be found in the southeastern corner. Species with restricted ranges, as reported by Cochrane and Iltis (2000) and the UW-Madison Herbarium web site, are footnoted. For more information regarding the species distribution throughout Wisconsin, please refer to the *Atlas of Wisconsin Prairie and Savanna Flora* (Cochrane and Iltis 2000) or visit the UW-Madison Herbarium web site (wiscinfo.doit.wisc.edu/herbarium/).

I suggest that everyone use care in interpreting this information because sev-

eral factors can influence the distribution of a species. For example, species growing in moist conditions in full sun are often found in drier conditions when growing in shadier environs (Bray 1958, Pruksa 1994).

There had been many species that were savanna specialists, but they had become marginalized by the cessation of fire.

Management regimes may also influence species distribution. For instance, DeLong and Hooper (1996) suggested that some shade-tolerant species currently found primarily in sand or on dry ridges, bluffs or hilltops might have occurred in clay-loam savannas in the fire-influenced, pre-European settlement condition. In addition, species distributions are likely to vary regionally. Some species that occur more frequently in savannas in Wisconsin are more likely to occur in forests in south-central Iowa (DeLong and Hooper 1996).

Leach and Givnish (1998) have suggested an alternative way to identify restorable savanna remnants—one that does not rely on existing canopy conditions but instead on the physiognomy (presence of open-grown oaks) and a diversity of native plants. This list should help restorationists identify restorable oak savannas and may suggest some management strategies. For example, sites with a large number of species that grow in a diversity of light conditions may be candidates for restoration using a fire-based management approach. Meanwhile, sites with primarily forest-associated species (as indicated by presence in shade only) may require a different restoration model (e.g., manage for oak woodland), or require extensive groundlayer introductions. Sites with low numbers of species that normally grow in sun to partial shade conditions may have only recently become closed.

These sites may benefit from an immediate opening of the canopy and a resumption of fire regimes. Sites with the open-grown canopy structure and a low diversity of native species may have been heavily grazed, especially if there is an abundance of armed shrubs, such as prickly ash (*Xanthoxylum americanum*) and brambles (*Rubus* spp.). They may require extensive groundlayer introductions.

I hope that restoration ecologists will find the oak savanna/oak woodland species list useful. As ecologists at the Arboretum and elsewhere conduct experimental plantings, monitor their restoration activities, and conduct ecological research (effects of fire, fire-altered regimes, competitive interactions, effects of exotic species), we will refine the list and a 'savanna flora' will emerge.

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This project is a distillation of the efforts of many people. Molly Fifield Murray (UW-Madison Arboretum Outreach supervisor) and Virginia Kline (emeritus ecologist at the UW-Madison Arboretum) drafted the preliminary species lists. Andrew Hipp contributed the genus *Carex*. Mark Leach (UW-Madison Arboretum ecologist) offered his insights on species to include in the list. An anonymous reviewer provided sound advice and made helpful suggestions regarding species ranges.

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Oak Savanna/Oak Woodland Species List *

Species	Light			Soil					Ca
	SH	PS	SU	Wet	W-M	Mesic	D-M	Dry	
Graminoids									
<i>Agrostis hyemalis</i> v. <i>scabra</i>	x	x	x			x	x	x	
<i>Agrostis perennans</i>	x	x	x				x	x	
<i>Andropogon gerardii</i>			x	x	x	x	x	x	lp
<i>Aristida basiramea</i>			x						x
<i>Aristida purpurascens</i>		x	x						x
<i>Aristida tuberculosa</i>			x						x
<i>Bouteloua curtipendula</i>		x	x			x	x	x	lp
<i>Bouteloua hirsuta</i> ¹		x	x				x	x	lp
<i>Brachyelytrum erectum</i>	x				x	x			
<i>Bromus altissimus</i>	x	x			x	x			
<i>Bromus ciliatus</i>	x	x		x	x				x
<i>Bromus kalmii</i>		x	x			x	x	x	lp
<i>Bromus pubescens</i>	x	x			x	x			
<i>Calamagrostis canadensis</i>			x	x	x	x			x
<i>Carex annectens</i>			x	x	x				
<i>Carex atherodes</i>		x	x	x	x				
<i>Carex bebbii</i>		x	x	x	x				
<i>Carex bicknellii</i>			x	x	x	x			
<i>Carex blanda</i>		x	x		x	x	x		
<i>Carex brevior</i>		x	x			x	x	x	
<i>Carex buxbaumii</i>			x	x	x				x
<i>Carex cephalophora</i>		x	x			x	x	x	
<i>Carex conoidea</i>			x	x	x				
<i>Carex eburnea</i> ¹		x	x			x	x	x	
<i>Carex gracillima</i>		x			x	x			
<i>Carex granularis</i>			x	x	x	x			x
<i>Carex haydenii</i>			x	x	x				
<i>Carex hystricina</i>			x	x	x				x
<i>Carex interior</i>			x	x	x				
<i>Carex laeviconica</i>			x	x	x				
<i>Carex lupulina</i>		x	x		x	x			
<i>Carex meadii</i>			x				x	x	x
<i>Carex molesta</i> ¹			x	x	x	x			
<i>Carex muehlenbergii</i>			x	x				x	x
<i>Carex normalis</i>		x	x	x	x	x			
<i>Carex pellita</i>			x	x	x				
<i>Carex pensylvanica</i>		x	x	x		x	x	x	lp
<i>Carex projecta</i>			x		x	x			
<i>Carex radiata</i>			x	x		x	x		
<i>Carex richardsonii</i> ¹			x				x	x	x
<i>Carex rosea</i>		x	x			x	x		
<i>Carex rugosperma</i> ¹			x	x			x	x	
<i>Carex sartwellii</i>			x	x	x				x
<i>Carex scoparia</i>			x	x	x				
<i>Carex siccata</i>			x	x	x	x		x	x
<i>Carex stipata</i>			x	x	x	x			
<i>Carex tenera</i>			x	x	x	x			
<i>Carex tetanica</i>			x	x	x				x

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Species	Light			Soil					Ca
	SH	PS	SU	Wet	W-M	Mesic	D-M	Dry	
<i>Carex tonsa</i>			x						x
<i>Carex tribuloides</i>			x	x	x	x			
<i>Carex trichocarpa</i>			x	x	x	x			
<i>Carex umbellata</i> ¹				x					x
<i>Carex vulpinoidea</i>			x	x	x	x			
<i>Cinna arundinacea</i>			x	x		x	x		
<i>Cinna latifolia</i> ¹			x	x		x	x		
<i>Danthonia spicata</i>			x	x					x
<i>Elymus canadensis</i>			x	x		x	x	x	lp
<i>Elymus hystrix</i>			x	x		x	x	x	x
<i>Elymus riparius</i>			x	x		x	x		x
<i>Elymus trachycaulus</i>			x	x			x	x	x
<i>Elymus villosus</i>			x	x		x	x	x	x
<i>Elymus virginicus</i>			x	x	x	x	x		
<i>Festuca subverticillata</i>			x	x			x	x	x
<i>Glyceria striata</i>			x	x	x	x			x
<i>Hierochloa odorata</i>			x	x	x	x			x
<i>Koeleria pyramidata</i>			x	x			x	x	lp
<i>Leersia oryzoides</i>			x	x	x	x			x
<i>Leersia virginica</i>			x	x		x	x		
<i>Luzula acuminata</i>			x			x	x		
<i>Luzula multiflora</i>			x	x			x	x	x
<i>Melica nitens</i>			x	x				x	x
<i>Muhlenbergia cuspidata</i> ¹				x				x	lp
<i>Muhlenbergia frondosa</i>			x	x	x	x	x		
<i>Muhlenbergia glomerata</i> ¹			x	x	x				x
<i>Muhlenbergia mexicana</i>			x	x		x	x		
<i>Muhlenbergia racemosa</i>			x	x			x	x	lp
<i>Muhlenbergia schreberi</i>			x	x		x	x	x	x
<i>Muhlenbergia sobolofera</i>			x	x			x	x	x
<i>Muhlenbergia sylvatica</i>			x	x		x			
<i>Oryzopsis racemosa</i>			x				x	x	x
<i>Panicum lanuginosum</i> v. <i>implicatum</i>			x					x	
<i>Panicum latifolium</i>			x	x				x	x
<i>Panicum leibergii</i>			x	x		x	x	x	lp
<i>Panicum oligosanthes</i>			x	x			x	x	lp
<i>Panicum villosissimum</i>			x	x				x	lp
<i>Panicum virgatum</i>			x	x	x	x	x	x	x
<i>Schizachyrium scoparium</i>			x			x	x	x	lp
<i>Scleria trigomerata</i>			x	x	x	x			x
<i>Sorghastrum nutans</i>			x	x	x	x	x	x	lp
<i>Spartina pectinata</i>			x	x	x	x			
<i>Sphenopholis obtusata</i>			x	x			x	x	x
<i>Sporobolus heterolepis</i>					x	x	x	x	lp
<i>Sporobolus cryptandrus</i>			x	x				x	lp
<i>Stipa spartea</i>			x	x			x	x	lp

Oak Savanna/Oak Woodland Species List (Continued)

Species	Light			Soil				Ca
	SH	PS	SU	Wet	W-M	Mesic	D-M	
Forbs and Ferns								
<i>Actaea alba</i>	x				x	x	x	
<i>Actaea rubra</i>	x				x	x	x	
<i>Agalinis aspera</i> ¹			x			x	x	x
<i>Agalinis auriculata</i> ¹		x	x			x	x	x
<i>Agalinis gattereri</i> * ¹		x				x		
<i>Agalinis purpurea</i>		x	x	x				x
<i>Agalinis skinneriana</i> * ¹		x	x				x	x
<i>Agalinis tenuifolia</i>			x	x	x	x		x
<i>Agastache nepetoides</i> * ¹		x				x	x	
<i>Agastache scrophulariaefolia</i>		x				x	x	
<i>Agrimonia gryposepala</i>	x	x			x	x	x	x
<i>Agrimonia pubescens</i>	x	x	x	x	x	x	x	x
<i>Allium canadense</i>		x	x	x	x	x	x	
<i>Allium cernuum</i> ¹			x		x	x		x
<i>Amphicarpaea bracteata</i>	x	x	x		x	x	x	
<i>Anaphalis margaritacea</i>	x	x				x	x	
<i>Anemone canadensis</i>			x	x	x	x		
<i>Anemone cylindrica</i>		x	x		x	x	x	lp
<i>Anemone patens</i>			x				x	x
<i>Anemone quinquefolia</i>	x	x			x	x	x	x
<i>Anemone virginiana</i>	x	x			x	x	x	x
<i>Anemonella thalictroides</i>		x				x	x	
<i>Angelica atropurpurea</i>		x	x	x	x			x
<i>Antennaria neglecta</i>		x	x				x	x
<i>Antennaria plantaginifolia</i> ¹		x	x				x	x
<i>Apios americana</i>	x	x	x	x	x			x
<i>Apocynum androsaemifolium</i>	x	x	x		x	x	x	x
<i>Apocynum cannabinum</i>		x	x		x	x	x	x
<i>Aquilegia canadensis</i>	x	x				x	x	x
<i>Arabis canadensis</i>		x	x				x	x
<i>Arabis drummondii</i>		x	x				x	x
<i>Arabis hirsuta</i>		x				x	x	x
<i>Arabis laevigata</i>	x	x	x		x	x	x	
<i>Arabis lyrata</i> ¹		x	x				x	x
<i>Aralia hispida</i>	x	x					x	x
<i>Aralia nudicaulis</i>	x	x				x		
<i>Arenaria lateriflora</i>	x	x				x	x	
<i>Arenaria stricta</i>		x	x				x	x
<i>Arisaema triphyllum</i>	x				x	x	x	
<i>Artemisia ludoviciana</i>			x			x	x	
<i>Artemisia campestris</i>		x	x				x	x
<i>Asclepias amplexicaulis</i> ¹		x	x				x	x
<i>Asclepias exaltata</i>	x	x				x	x	
<i>Asclepias hirtella</i> ¹			x	x	x	x		
<i>Asclepias incarnata</i>			x	x	x			x
<i>Asclepias lanuginosa</i> * ¹			x				x	x
<i>Asclepias ovalifolia</i> * ¹		x	x			x	x	x
<i>Asclepias purpurascens</i> * ¹		x	x		x	x		
<i>Asclepias sullivantii</i> * ¹			x		x	x		x

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Species	Light			Soil				Ca
	SH	PS	SU	Wet	W-M	Mesic	D-M	
<i>Asclepias syriaca</i>			x	x	x	x	x	x
<i>Asclepias tuberosa</i>		x	x			x	x	x
<i>Asclepias verticillata</i>			x		x	x	x	lp
<i>Asclepias viridiflora</i> ¹		x	x					x
<i>Aster ericoides</i>		x	x		x	x	x	x
<i>Aster laevis</i>		x	x		x	x	x	x
<i>Aster lateriflorus</i>		x			x	x	x	x
<i>Aster linariifolius</i> ¹		x	x				x	x
<i>Aster novae-angliae</i>		x	x	x	x	x		x
<i>Aster oblongifolius</i> ¹		x	x				x	x
<i>Aster oolentangiensis</i>		x	x		x	x	x	x
<i>Aster prenanthoides</i>	x	x	x	x	x			
<i>Aster sagittifolius</i>	x	x			x	x	x	x
<i>Aster sericeus</i>		x	x				x	x
<i>Aster shortii</i>	x	x					x	x
<i>Aster umbellatus</i>		x	x	x	x			
<i>Astragalus canadensis</i>		x	x		x	x	x	
<i>Athyrium filix-femina</i>	x	x			x	x	x	
<i>Aureolaria grandiflora</i>		x					x	x
<i>Aureolaria pedicularia</i> ¹		x					x	x
<i>Baptisia bracteata</i>		x	x		x	x	x	
<i>Baptisia lactea</i>			x		x	x	x	
<i>Bessya bullii</i> * ¹		x	x				x	x
<i>Blephilia ciliata</i>		x	x	x	x	x		x
<i>Boehmeria cylindrica</i>	x	x		x	x			
<i>Botrychium dissectum</i>	x	x			x	x		
<i>Botrychium virginianum</i>	x	x					x	
<i>Cacalia atriplicifolia</i> ¹		x	x		x	x	x	
<i>Cacalia muhlenbergii</i>		x					x	
<i>Cacalia plantaginea</i> * ¹			x	x	x	x	x	
<i>Cacalia suaveolens</i> ¹		x	x	x			x	
<i>Caltha palustris</i>	x	x	x	x				x
<i>Calystegia sepium</i>		x	x	x	x	x	x	x
<i>Calystegia spithamea</i>		x	x				x	x
<i>Camassia scilloides</i> * ¹	x	x	x	x	x	x		
<i>Campanula americana</i>	x	x			x	x	x	
<i>Campanula aparinoides</i>	x	x	x	x				x
<i>Campanula rotundifolia</i>	x	x					x	x
<i>Castilleja coccinea</i>		x	x	x	x	x		x
<i>Castilleja sessiliflora</i>			x				x	x
<i>Chamaecrista fasciculata</i> ¹		x	x				x	x
<i>Chelone glabra</i>	x	x	x	x	x			x
<i>Cicuta maculata</i>		x	x	x	x	x		
<i>Circaea lutetiana</i>	x	x			x	x	x	
<i>Cirsium altissimum</i>			x	x			x	x
<i>Cirsium discolor</i>			x	x	x	x	x	lp
<i>Cirsium hillii</i> * ¹			x				x	lp
<i>Cirsium muticum</i>	x	x	x	x	x			x
<i>Claytonia virginica</i>	x	x					x	x
<i>Comandra umbellata</i>		x	x	x	x	x	x	x

Oak Savanna/Oak Woodland Species List (Continued)

Species	Light			Soil				Ca
	SH	PS	SU	Wet	W-M	Mesic	D-M	
Coreopsis lanceolata			x				x	x
Coreopsis palmata		x	x		x	x	x	lp
Corydalis sempervirens	x	x	x				x	x
Cryptotaenia canadensis	x	x			x	x		
Cypripedium pubescens	x	x		x	x	x		x
Dalea candida		x	x			x	x	lp
Dalea purpurea		x	x		x	x	x	lp
Desmodium canadense		x	x	x	x	x	x	
Desmodium canescens ¹		x	x			x	x	x
Desmodium cuspidatum ¹		x				x	x	x
Desmodium glutinosum	x	x				x	x	x
Desmodium illinoense		x	x			x	x	lp
Desmodium nudiflorum	x	x				x	x	x
Dioscorea villosa	x	x		x	x	x		
Dodecatheon meadia		x	x		x	x	x	lp
Draba reptans			x				x	lp
Erigeron pulchellus		x	x					x
Erigeron strigosus		x	x		x	x	x	lp
Echinacea pallida* ¹			x			x	x	
Eryngium yuccifolium ¹			x		x	x	x	
Erythronium albidum	x	x				x	x	
Eupatorium altissimum		x	x			x		
Eupatorium maculatum			x	x	x			x
Eupatorium perfoliatum		x	x	x	x			x
Eupatorium purpureum	x	x			x	x	x	
Eupatorium sessilifolium ¹		x				x	x	
Euphorbia corollata	x	x	x	x	x	x	x	lp
Euthamia graminifolia		x	x	x	x	x		x
Fragaria vesca		x	x			x	x	x
Fragaria virginiana		x	x	x	x	x	x	lp
Galium boreale		x	x	x	x	x	x	
Galium circaeazans		x	x			x	x	x
Galium concinnum		x	x			x	x	x
Galium trifidum		x	x	x	x			x
Galium triflorum		x	x			x	x	
Gaura biennis ¹		x	x		x	x	x	
Gentiana andrewsii		x	x		x	x		x
Gentiana flavida*		x	x		x	x		
Gentiana puberulenta		x	x			x	x	lp
Gentianella quinquefolia		x	x			x	x	x
Gentianopsis crinita		x	x	x	x			x
Geranium maculatum		x	x			x	x	x
Geum canadense		x	x	x		x	x	x
Geum triflorum			x		x	x	x	lp
Gnaphalium obtusifolium		x	x				x	lp
Goodyera pubescens		x	x			x	x	x
Hedeoma hispida		x	x				x	lp
Helenium autumnale			x	x	x			x
Helianthemum bicknellii		x	x				x	x
Helianthemum canadense		x	x				x	x

Species	Light			Soil				Ca
	SH	PS	SU	Wet	W-M	Mesic	D-M	
Helianthus decapetalus	x	x				x	x	x
Helianthus divaricatus	x	x				x	x	x
Helianthus giganteus			x	x	x	x		x
Helianthus grosseserratus			x	x	x	x		
Helianthus hirsutus		x	x				x	x
Helianthus occidentalis		x	x			x	x	lp
Helianthus pauciflorus		x	x			x	x	lp
Helianthus strumosus	x	x			x	x	x	
Heliopsis helianthoides		x	x	x	x	x		lp
Hepatica acutiloba	x					x	x	
Hepatica americana	x					x	x	
Heracleum lanatum	x	x		x	x	x		
Heuchera richardsonii		x	x		x	x	x	lp
Hieracium kalmii ¹		x	x		x	x	x	
Hieracium longipilum ¹		x	x				x	lp
Hieracium scabrum		x	x			x	x	x
Hypericum punctatum			x			x	x	x
Hypericum pyramidalum		x	x	x	x			x
Hypoxis hirsuta		x	x	x	x	x	x	x
Iris virginica v. shrevei		x	x	x	x			x
Krigia biflora		x			x	x	x	lp
Krigia virginica			x				x	
Kuhnia eupatorioides		x	x			x	x	lp
Lactuca biennis	x	x			x	x	x	
Lactuca canadensis		x	x	x	x	x	x	lp
Lactuca floridana	x	x				x	x	x
Lactuca ludoviciana ¹			x			x	x	x
Lathyrus ochroleucus	x	x				x	x	x
Lathyrus palustris		x	x	x	x	x		x
Lathyrus venosus		x	x		x	x	x	
Lechea intermedia ¹		x	x				x	x
Lechea tenuifolia ¹		x	x			x	x	x
Lespedeza capitata		x	x		x	x	x	lp
Lespedeza leptostachya* ¹			x			x	x	x
Lespedeza violacea ¹			x				x	x
Lespedeza virginica* ¹		x	x				x	x
Liatis aspera		x	x			x	x	lp
Liatis cylindracea		x	x				x	lp
Liatis pchnostachya		x	x	x	x			x
Lilium michiganense		x	x	x	x	x	x	x
Lilium philadelphicum v. andinum		x	x			x	x	lp
Linum sulcatum			x				x	lp
Liparis liliifolia		x	x			x	x	x
Lithospermum canescens		x	x		x	x	x	lp
Lithospermum carolinense ¹		x	x				x	lp
Lithospermum incisum			x				x	lp
Lobelia cardinalis		x	x	x	x			
Lobelia inflata		x	x		x	x	x	x
Lobelia siphilitica		x	x	x	x			x

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Oak Savanna/Oak Woodland Species List (Continued)

Species	Light			Soil				Ca	
	SH	PS	SU	Wet	W-M	Mesic	D-M		Dry
Lobelia spicata		x	x		x	x	x	x	lp
Lupinus perennis		x	x				x	x	
Lycopus americanus		x	x	x	x				x
Lycopus uniflorus		x	x	x	x				x
Lysimachia ciliata	x	x			x	x	x		
Lysimachia lanceolata ¹		x	x		x	x	x		
Lysimachia quadriflora ¹			x	x	x				x
Lysimachia quadrifolia ¹	x	x				x	x	x	
Microseris cuspidata ¹			x				x	x	lp
Monarda fistulosa		x	x		x	x	x	x	lp
Monarda punctata		x	x				x	x	
Napaea dioica ¹		x	x	x	x				
Oenothera biennis		x	x		x	x	x	x	lp
Oenothera clelandii ¹		x	x				x	x	
Oenothera perennis		x	x	x	x				
Onoclea sensibilis	x	x	x	x	x				
Opuntia humifusa ¹		x	x				x	x	
Orobanche uniflora ¹		x	x				x	x	
Osmorhiza claytonii	x	x			x	x	x	x	
Osmorhiza longistylis		x	x		x	x	x		
Osmunda claytoniana	x	x			x	x			
Oxalis violacea		x	x			x	x	x	lp
Oxypolis rigidior			x	x	x				x
Parthenium integrifolium* ¹		x	x		x	x	x		
Pedicularis canadensis	x	x	x		x	x	x	x	lp
Pedicularis lanceolata		x	x	x	x				x
Penstemon digitalis		x	x			x	x		
Penstemon gracilis ¹		x	x				x	x	lp
Penstemon grandiflorus ¹		x	x				x	x	
Penstemon hirsutus ¹		x	x				x	x	
Penstemon pallidus		x	x				x	x	x
Phlox divaricata	x	x			x	x	x	x	
Phlox pilosa		x	x		x	x	x		x
Phyrma leptostachya	x				x	x	x		
Physalis heterophylla		x	x		x	x	x	x	lp
Physalis virginiana		x	x		x	x	x	x	lp
Physostegia virginiana		x	x	x	x	x			x
Platanthera leucophaea* ¹		x	x	x					x
Podophyllum peltatum	x	x				x	x		
Polemonium reptans		x	x		x	x	x		x
Polygala polygama		x	x				x	x	lp
Polygala sanguinea		x	x		x	x	x	x	lp
Polygala senega		x	x		x	x	x		
Polygala verticillata		x	x				x	x	
Polygonatum biflorum	x	x	x		x	x	x	x	lp
Polygonum virginianum		x	x	x	x	x			
Polymnia canadensis		x	x		x	x	x		
Polytaenia nuttallii* ¹		x	x		x	x			
Potentilla arguta			x		x	x	x	x	lp
Potentilla simplex		x	x		x	x	x		

Species	Light			Soil				Ca		
	SH	PS	SU	Wet	W-M	Mesic	D-M		Dry	
Prenanthes alba	x	x			x	x				
Prenanthes aspera* ¹			x			x	x	x	lp	
Prenanthes racemosa ¹			x			x	x	x	x	
Pteridium aquilinum		x	x				x	x	x	
Pycnanthemum virginianum		x	x	x		x	x	x	x	
Pyrola elliptica		x	x					x	x	
Ranunculus abortivus	x	x			x	x	x	x		
Ranunculus fascicularis		x	x					x	x	
Ranunculus hispidus v. nitidus	x	x		x	x				x	
Ranunculus recurvatus	x	x			x	x			x	
Ranunculus rhomboideus			x					x	x	
Ratibida pinnata		x	x	x	x	x	x	x	lp	
Rudbeckia hirta		x	x			x	x	x	lp	
Rudbeckia laciniata	x	x		x	x				x	
Rudbeckia subtomentosa ¹		x	x	x	x	x				
Rudbeckia triloba		x	x	x	x					
Sanguinaria canadensis	x	x					x	x		
Sanicula canadensis	x	x					x	x		
Sanicula gregaria	x	x				x	x	x		
Sanicula marilandica	x	x				x	x		x	
Sanicula trifoliata	x						x	x		
Scrophularia lanceolata		x				x	x	x		
Scrophularia marilandica	x	x				x	x	x		
Scutellaria leonardi		x	x					x	x	
Scutellaria ovata	x	x				x	x	x	x	
Scutellaria parvula v. parvula*		x	x					x	x	lp
Senecio aureus	x	x	x	x	x				x	
Senecio pauperculus			x					x	x	
Silene antirrhina		x	x					x	x	lp
Silene stellata ¹		x	x			x	x	x		
Silphium integrifolium ¹			x	x		x	x	x		
Silphium laciniatum			x			x	x	x		
Silphium perfoliatum		x	x	x		x	x	x	x	
Silphium terebinthinaceum ¹			x	x		x	x	x	x	
Sisyrinchium campestre		x	x			x	x	x	x	lp
Sium sauve			x	x		x				
Smilacina racemosa	x	x				x	x	x	lp	
Smilacina stellata	x	x	x			x	x	x	x	lp
Smilax ecirrhata	x	x					x	x	x	
Smilax herbacea ¹	x	x				x	x	x		
Solidago canadensis		x	x	x		x	x	x	lp	
Solidago flexicaulis	x	x					x	x	x	x
Solidago gigantea		x	x	x		x	x			x
Solidago hispida	x	x				x	x	x		
Solidago juncea		x	x				x	x	x	lp
Solidago missouriensis ¹			x			x	x	x	x	lp
Solidago nemoralis		x	x				x	x	x	lp
Solidago ptarmicoides ¹		x	x				x	x	x	lp

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¹ Species with restricted ranges in southern Wisconsin, as reported by Cochrane and Iltis (2000).

SH=Shade PS=Partial Shade SU=Full Sun W-M=Wet-Mesic D-M=Dry-Mesic Ca=Calcareous LP=Limestone Prairie

Oak Savanna/Oak Woodland Species List (Continued)

Species	Light			Soil			Ca		
	SH	PS	SU	Lowland	Upland	Dry			
				Wet	W-M	Mesic	D-M		
<i>Solidago riddellii</i> ¹			x	x	x			x	
<i>Solidago rigida</i>			x	x	x	x	x	lp	
<i>Solidago speciosa</i>		x	x			x	x	x	
<i>Solidago ulmifolia</i>	x	x				x	x	x	
<i>Spiranthes cernua</i>		x	x	x	x	x		x	
<i>Stachys palustris</i>			x	x	x				
<i>Taenidia integerrima</i>		x			x	x			
<i>Talinum rugospermum</i> ¹		x	x					x	
<i>Tephrosia virginiana</i>		x	x				x	x	
<i>Teucrium canadense</i>	x	x	x		x	x	x	x	
<i>Thalictrum dasycarpum</i>		x	x	x	x	x		x	
<i>Thaspium trifoliatum</i> ¹		x	x		x	x			
<i>Thelypteris palustris</i>	x	x	x	x	x			x	
<i>Tradescantia ohiensis</i>		x	x	x	x	x	x	lp	
<i>Trillium recurvatum</i> ¹	x	x				x	x		
<i>Triosteum aurantiacum</i>		x			x	x	x		
<i>Triosteum perfoliatum</i>		x			x	x	x	lp	
<i>Uvularia grandiflora</i>	x	x				x	x	x	
<i>Uvularia sessilifolia</i> ¹	x	x					x	x	
<i>Verbena hastata</i>		x	x	x	x				
<i>Verbena stricta</i>			x			x	x	x	lp
<i>Verbena urticifolia</i>		x	x	x	x	x			
<i>Vernonia fasciculata</i>			x	x	x	x			
<i>Veronicastrum virginicum</i>		x	x	x	x	x	x		
<i>Vicia americana</i>		x	x	x	x	x			
<i>Vicia caroliniana</i>	x	x				x	x	x	
<i>Viola adunca</i>		x	x				x	x	
<i>Viola cucullata</i>	x	x		x	x	x			
<i>Viola palmata</i> v. <i>pedatifida</i>		x	x			x	x	x	lp
<i>Viola pedata</i>		x	x			x	x	x	lp
<i>Viola sagittata</i>		x	x			x	x		
<i>Viola septentrionalis</i>	x	x				x	x	x	
<i>Viola sororia</i>		x	x			x	x	x	
<i>Zigadenus elegans</i>		x	x			x	x	x	x
<i>Zizia aptera</i> ¹		x	x			x	x	x	
<i>Zizia aurea</i>	x	x	x	x	x	x	x		
Shrubs									
<i>Amelanchier arborea</i>	x	x				x	x	x	
<i>Amelanchier laevis</i>	x	x				x	x	x	
<i>Amelanchier sanguinea</i>	x	x				x	x		
<i>Amorpha canescens</i>		x	x			x	x	x	lp
<i>Aronia melanocarpa</i>		x	x				x	x	lp
<i>Ceanothus americanus</i>		x	x			x	x	x	lp
<i>Ceanothus herbaceus</i> ¹		x					x	x	
<i>Celastrus scandens</i>	x	x				x	x	x	lp
<i>Clematis virginiana</i>	x	x	x	x	x				x
<i>Cornus amomum</i>	x	x		x	x				x

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SH = Shade PS = Partial Shade SU = Full Sun W-M = Wet-Mesic D-M = Dry-Mesic Ca = Calcareous LP = Limestone Prairie

Species	Light			Soil			Ca			
	SH	PS	SU	Lowland	Upland	Dry				
				Wet	W-M	Mesic	D-M			
<i>Cornus racemosa</i>		x	x	x	x	x	x	lp		
<i>Cornus sericea</i>		x	x	x	x	x		x		
<i>Corylus americana</i>	x	x		x	x	x	x	lp		
<i>Crataegus calpodendron</i>		x			x	x				
<i>Crataegus chrysoarpa</i>	x	x			x	x	x			
<i>Crataegus coccinea</i>		x	x			x	x			
<i>Crataegus crus-galli</i>		x				x	x	x	lp	
<i>Crataegus flabellata</i>	x	x				x	x	x		
<i>Crataegus mollis</i>	x	x	x	x	x	x			x	
<i>Diervilla lonicera</i>	x	x				x	x	x		
<i>Lonicera dioica</i>	x	x				x	x	x	x	
<i>Lonicera prolifera</i>	x	x				x	x	x	x	
<i>Menispermum canadense</i>	x	x		x	x	x				
<i>Parthenocissus quinquefolia</i>	x	x				x	x	x	lp	
<i>Parthenocissus vitacea</i>	x	x				x	x	x	x	
<i>Physocarpus opulifolius</i>		x	x	x	x		x	x	x	
<i>Potentilla fruticosa</i>		x	x	x	x					
<i>Prunus americana</i>	x	x	x			x	x	x		
<i>Prunus pensylvanica</i>		x	x					x	x	
<i>Prunus pumila</i>		x	x					x	x	x
<i>Pyrus ioensis</i>		x	x			x	x	x	x	lp
<i>Rhus aromatica</i> ¹		x	x					x	x	
<i>Rhus copallina</i> ¹	x	x						x	x	
<i>Rhus glabra</i>		x	x			x	x	x	x	lp
<i>Rhus typhina</i>		x	x					x	x	
<i>Ribes americanum</i>	x	x		x	x	x				x
<i>Ribes cynosbati</i>	x	x				x	x	x		
<i>Ribes missouriense</i>	x	x					x	x	x	
<i>Rosa blanda</i>		x	x	x	x	x		x	x	lp
<i>Rosa carolina</i>		x	x					x	x	lp
<i>Rosa setigera</i>		x	x			x	x	x	x	lp
<i>Rubus allegheniensis</i>	x	x				x	x	x	x	x
<i>Rubus flagellaris</i>		x	x					x	x	
<i>Rubus idaeus</i>	x	x				x	x	x	x	x
<i>Rubus occidentalis</i>	x	x						x	x	x
<i>Salix discolor</i>			x	x	x	x				
<i>Salix humilis</i> ¹		x	x	x	x	x	x	x		lp
<i>Sambucus canadensis</i>		x	x	x	x					
<i>Spirea alba</i>			x	x	x					
<i>Symphoricarpos occidentalis</i>		x	x				x	x	x	lp
<i>Toxicodendron radicans</i>	x	x	x	x	x	x	x	x	x	lp
<i>Viburnum lentago</i>	x	x		x	x	x				
<i>Viburnum rafinesquianum</i>	x	x					x	x	x	x
<i>Viburnum trilobum</i>	x	x				x	x			
<i>Vitis aestivalis</i>	x	x	x			x	x	x	x	
<i>Vitis riparia</i>	x	x	x	x	x	x	x	x	x	lp
<i>Zanthoxylum americanum</i>	x	x		x	x	x	x			lp