Stewart Lake County Park
Natural Communities
Vegetation Management Plan

February 2, 2022

1. Introduction

Over the course of the last 200 years, the natural vegetation and ecosystems of Dane County have been heavily altered by human activity (Figure 1). Beginning in the 1830s, a growing number of European settlers to the region brought significant changes to the land. Wildfires, which once swept across the land and shaped the vegetation, were extinguished by settlers or halted by farm fields and roads. Agriculture and livestock grazing damaged the soil and displaced native species. Furthermore, the introduction and spread of non-native, invasive species, has contributed to significant losses in biodiversity and creates obstacles to recovery. Today, global forces such as climate change further threaten the health of these lands and waters and the species that reside within this landscape. Through the science and practice of ecological restoration, a discipline with origins tracing back to the University of Wisconsin-Madison, Dane County Parks attempts to restore natural communities that have been heavily altered or lost due to anthropogenic forces.

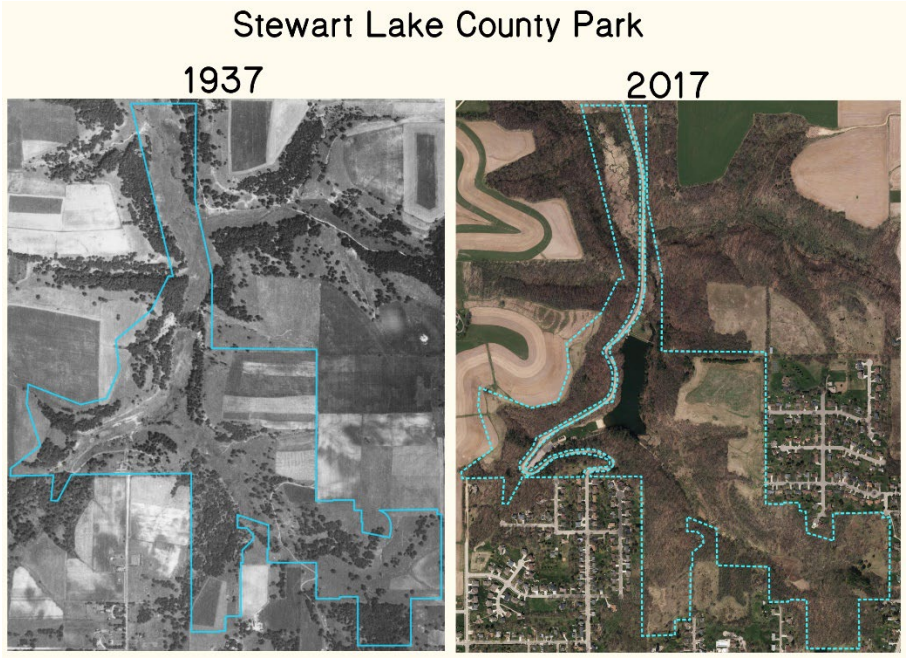


Figure 1. Change in vegetation at Stewart Lake County Park between 1937 and 2017.

A natural community is an assemblage of native plants, animals, and other organisms interacting with each other and their physical environment in a particular area. Around 100 natural communities have been identified across Wisconsin by the Department of Natural Resources (DNR) Natural Heritage Inventory. Environmental factors such as moisture, sunlight, soil type, temperature, and disturbance (e.g. flood or fire) determine which community prevails in a specific location. Natural communities exist in a mosaic across the landscape and repeat where similar environmental conditions exist. Changes in these environmental factors account for transitions from

one community to the next. For example, the north facing side of a hill is likely to be more sheltered from the sun and will therefore be cooler and retain more moisture as compared to the south facing side. As a result of these differing environmental conditions, natural communities are likely to be significantly different on opposing sides of the hill.

Vegetation goals and objectives for a particular location are informed by the target natural community for that site. If oak opening is determined to be suitable and attainable for a given location, vegetation management should promote species that comprise this community and deter or remove species that are not associated with this community. Invasive species are obvious priorities for removal. Less obvious, but also important, are native species that have encroached from other natural communities, likely due to fire suppression. Reintroducing appropriate species through direct planting or seeding, as well as replicating natural processes such as burning, are key to restoring desired natural communities.

The restoration and management of natural communities on Dane County lands requires a partnership between county staff and volunteers. County resources alone will never satisfy all stewardship needs required to maintain healthy natural communities. Likewise, volunteers are also limited in what they can do independently and require tools, training, and guidance to work successfully. However, when staff and volunteers work together in a coordinated partnership, there is unlimited potential to restore and enhance natural areas.

2. Public-Use Statement

Stewart Lake County Park borders the northern edge of Mount Horeb, WI and is used regularly by neighboring residents, the greater community, and visitors from across the region. As the very first park in the county system, Stewart has been a gathering place used by thousands of visitors since 1935.

The park contains a well-developed and extensive system of trails for dog walking, jogging, hiking, and snowshoeing. The lake offers a variety of water-based recreational opportunities including swimming, fishing, and canoeing/kayaking. Archery hunting for deer and turkey is permitted on a limited lottery permit basis. Wildlife viewing and nature study opportunities occur throughout the trail system and along the lake. A timber frame shelter hosts many events and parties including weddings.

Ecological restoration activities are conducted by volunteers, staff and Operation Fresh Start Conservation Crews, and include such tasks as tree and brush removal, brush pile burning, invasive weed control, prescribed burning, and seeding/planting. Demonstration gardens and plantings have been installed at multiple locations around the park to provide interpretive resources and education opportunities for park visitors.

Stewart Park also contains a system of sanitary lines that collect wastewater from Mount Horeb, which is then pumped via a lift station at the south end of the lake to the wastewater treatment plant. A series of stormwater basins also function to collect stormwater and remove sediment as rainfall flows through the park and into Stewart Lake from uphill neighborhoods.

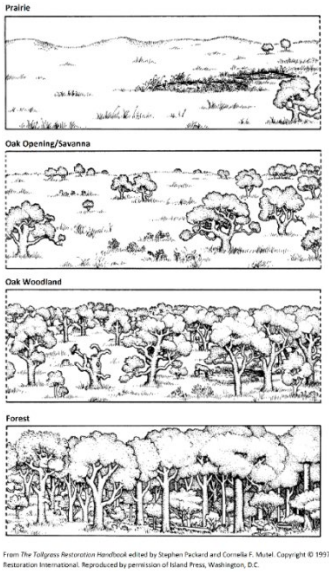
3. Broad vegetation goals, describing the desired physical/biological appearance

- Park will include a broad range of natural communities characteristic of the unglaciated driftless region of southwestern Wisconsin including:
    - Dry Prairie
    - Dry-Mesic Prairie
    - Wet-Mesic Prairie
    - Oak Opening/Savanna
    - Oak Woodland
    - Southern Sedge Meadow

Figure 2 contains images of prairie, oak opening/savanna, oak woodland, and forest community types. Figure 3 includes a map of target community locations within the park. Natural Community descriptions of each community can be found in Appendices 1-6.

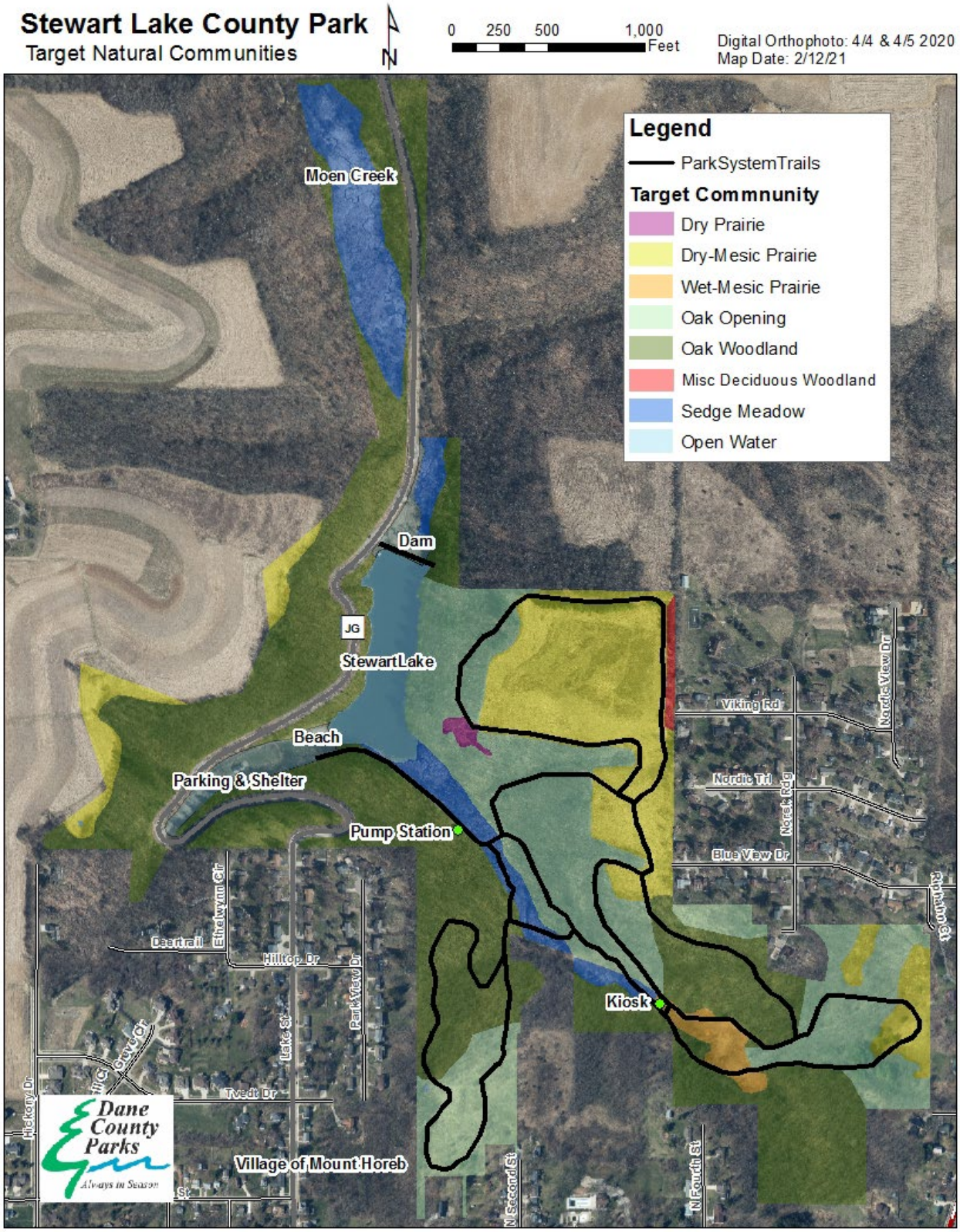
- Communities will transition naturally into each other providing a seamless landscape that is biologically diverse and offers a varied experience for the park user.
- Exotic/invasive species will be controlled through various methods. Table 2 lists common exotic/invasive species that occur at Stewart Lake County Park and recommended approaches to management.
- Vegetation will allow views of geologic features, underlying terrain, and water bodies and include designated scenic vistas occurring regularly throughout the park.
- Vegetation will assist in the management of stormwater runoff and prevention of soil erosion to protect geologic features, biological resources, and water quality.
- Vegetation will sequester carbon to mitigate against the harmful impacts of climate change.
- Vegetation will provide habitat for insects, pollinators, and all wildlife with a particular focus on Species of Greatest Conservation Need (SGCN) as determined by the Wisconsin Department of Natural Resources (DNR). Appendices 7-10 list high priority SGCN within each community.

2a.



2b.

Figure 2a. Sketches of prairie, oak opening/savanna, oak woodland, and forest community types.
Figure 2b. Oak Opening/Savanna at Pleasant Valley Conservancy in western Dane County.


Stewart Lake County Park
Target Natural Communities
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Legend
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Target Commnunity
Dry Prairie
Dry-Mesic Prairie
Wet-Mesic Prairie
Oak Opening
Oak Woodland
Misc Deciduous Woodland
Sedge Meadow
Open Water
Moen Creek
Dam
JG
StewartLake
Beach
Parking & Shelter
Pump Station
Kiosk
Viking Rd
Nordic View Dr
Nordic Trl
Norsk Rdg
Blue View Dr
Alphahorn St
Ethelwynn Cir
Deertrail
Hilltop Dr
Park View Dr
Lake St
Tvedt Dr
Hickory Dr
N Second St
N Fourth St
Dane County Parks
Always in Season
Village of Mount Horeb

Table 1. Summary of characteristic native plants and birds in oak opening/savanna, oak woodlands, and southern dry-mesic forest. (D=Dominant; SD=Sub-dominant, O=Occassional) Note: While Southern Dry-Mesic Forest is not a target community type it is included here for comparison.

Oak Savanna/Opening	***Oak Woodland***	***Southern Dry-Mesic Forest***
Wide-spaced oaks, at least 1 tree/acre but less than 50% canopy cover by trees	*Oak dominated, 50-95% canopy cover with partial shade tolerant flowers and grasses*	*Oak dominated, 95%+ canopy cover with shade tolerant flowers and ferns*
Characteristic Native Plants: • Bur oak (D) • White oak (D) • Black oak (SD) • Shagbark hickory (SD) • American hazelnut • New Jersey Tea • Lead plant • Big bluestem • Wild bergamot • Shooting stars **Characteristic Native Birds** • Eastern screech owl • Eastern bluebird • Orchard oriole • Northern bobwhite • Northern flicker • Red-headed woodpecker • Sharp-tailed grouse • Wood duck	**Characteristic Native Plants:** • White oak (D) • Bur oak (D) • Red oak (D) • Shagbark hickory (D) • Black Oak (SD) • Figwort giant hyssop • Poke milkweed • American bellflower • Purple Joe-pye-weed • Solomon's seal • Yellow pimpernel **Characteristic Native Birds** • Eastern bluebird • Orchard oriole • Great-crested flycatcher • Eastern wood pewee • Northern flicker • Red-bellied woodpecker • Red-headed woodpecker • Blue-gray gnatcatcher • Yellow-throated vireo	**Characteristic Native Plants:** • Red oak (D) • White oak (D) • Basswood (SD) • Shagbark hickory (SD) • Bitternut hickory (O) • Elms (O) • White Ash (O) • Black cherry • Jack-in-the-pulpit • Wild geranium • Large-flowered bellwort • Interrupted fern **Characteristic Native Birds** • Scarlet tanager • Eastern wood pewee • Great-crested flycatcher • Red-bellied woodpecker • Barred Owl • White-breasted nuthatch • Red-eyed vireo • Yellow-throated vireo • Ovenbird

4. Noteworthy resources and unique opportunities.

    - Multiple stands of mature open-grown bur and white oaks over 200 years old.
    - Stands of black walnut that could provide revenue for ecological restoration in the park.
    - Dry prairie remnants with rare and sensitive species that have declined significantly in the region.
    - Unique springs, streams, and wetland habitat which flows into Stewart Lake.
    - Multiple rock walls, ledges, and exposed bedrock.
    - Multiple scenic vistas and views of Blue Mounds and the surrounding driftless landscape.
    - Park is positioned at the transition of two ecological landscapes: the southwest savanna and western coulee & ridges.
    - Excellent wildlife viewing opportunities including woodland birds, mammals, and waterfowl.
    - Close proximity to the Village of Mount Horeb offers easy access for recreation and environmental education opportunities for students and community members.
    - Opportunities for wild foraging including berries and mushrooms.

5. Threats/concerns that may be impediments to success.

    - Encroachment of woody vegetation and invasive shrubs in all communities.
    - High prevalence of black walnut throughout the park, which releases juglones, a toxin poisonous to a wide variety of plants.
    - Obstruction of scenic vistas by tall woody vegetation and invasive shrubs.
    - Invasion of aggressive exotic herbaceous weeds in all communities including several species that are deeply entrenched and beyond the potential for eradication.
    - Declining health of mature oaks and poor natural recruitment of oaks in areas with dense invasive species, heavy shade, and deer herbivory.
    - Excessive soil nutrients in upland grassland restoration resulting in abundant weeds.
    - Potential expansion of unauthorized social trails resulting in damage to vegetation and soil erosion.
    - Stormwater management challenges and soil erosion resulting from steep topography and adjacent impervious surfaces.

6. Priority management recommendations

    <u>Management of vegetation and natural communities</u>

    - Cut, treat, pile, and burn invasive shrubs and trees that are not compatible with desired natural community. Table 1 summarizes desirable trees and other species and their relative dominance within each community. Table 2 lists recommended management approaches for common invasive species.
    - Timber harvesting should be considered as a method to reduce the abundance of non-compatible species and increase sunlight for oak regeneration.
    - Utilize fire as a management tool to suppress invasive weeds and woody growth and encourage recruitment of native vegetation. Fire should be used annually in the early stages. In maintenance stages, fire should be used 1-3 years for prairies and every 2-5 years for oak openings/savanna, oak woodlands, and sedge meadows.

- Stack and burn or remove brush, firewood, and storm damage (heavy fuels) from along trail sides to help ensure safe and effective breaks for prescribed burning. Heavy fuels toward the interior of the unit should also be reduced when possible.
- Control and suppress invasive species through multiple methods (e.g. hand weeding, selective herbicide applications, mowing/cutting, etc.). Care should be taken that control methods do not damage sensitive and rare vegetation. Any new species and infestations should be documented with the Great Lakes Early Detection app (GLEDN) or EDDmaps.
- Prioritize invasive weed control efforts by focusing on the protection of key resources and/or starting control on scattered individuals at the leading edge of the invasion and working in towards the most established part of the population.
- Scatter native seeds and plant appropriate trees, shrubs, or plants to increase diversity and habitat quality.

Table 2. Summary of management approaches for common exotic, invasive, or adventitious native species found at Stewart Lake County Park.

Management Approach	Species	Goal
Prevention	Leafy Spurge, Greater Celandine, Spotted Knapweed	Prevent introductions, monitor and detect early, respond quickly if discovered
Eradication	Bird's Foot Trefoil, Crown vetch, Burning Bush, Norway Maple	Treat all individuals; eliminate from park
Containment	Autumn Olive, Biennial thistles, Burdock, Bush Honeysuckles, Canada thistle, Buckthorns, Gray Dogwood, Multiflora Rose, Prickly Ash, Reed Canary Grass, Sumacs, Purple loosestrife, Sweet Clovers, White Mulberry, Wild Parsnip	Control wherever populations are found with greater attention to priority assets, travel corridors, and within focused project areas; treatment of all populations may not be realistic but impact can be minimized where efforts are focused.
Asset-based protection & long-term management	Dame's Rocket, Garlic Mustard, Japanese Hedge Parsley	Eradication impossible. Use gradual, indirect, and/or broad strokes techniques such as fire, biological control agents, or environmental manipulation to manage infestations.

Scenic vistas and geology

- Identify priority scenic vistas for park users to appreciate the geological significance of the park.
- Maintain scenic vistas by removing dense trees and brush species that are not core components of the desired natural community, especially invasive shrubs.

Management of stormwater and soil erosion

- Remove dense cover of invasive shrubs that prohibits the growth of low-growing native grasses and forbs, which act to slow runoff and limit erosion.
- Seed or plant low-growing native grasses and forbs where bare ground is exposed.

- Limit use of heavy equipment within 75ft of the shoreline when soil is not frozen.
- Ensure trail system is sustainable, minimizing stormwater channelization and soil erosion.

Wildlife habitat management

- Remove invasive trees and brush and invasive weeds to promote healthy and diverse natural communities.
- Seed or plant a diversity of native wildflowers to provide floral resources for pollinators.
- Protect snags and dead wood, where safe and appropriate, to promote species that require dead standing and fallen wood.
- Concentrate travel to designated areas, thereby limiting disturbance to wildlife.
- Appendices 7-10 summarize high priority Species of Greatest Conservation Need (SGCN) for Dry Prairie, Dry-Mesic Prairie, Oak Opening/Savanna, and Oak Woodland.

Ensuring safety to park users

- Designate and sign areas for berry picking and wild foraging where herbicides will not be used and vegetation is managed by other methods. Designated areas may change from year to year but should be identified with a sign.
- Volunteers should observe policies and procedures identified in the Dane County Parks Natural Areas Volunteer Handbook. Handbook contains guidance on many topics including use of herbicides, power tools, driving on trails, and working safely in groups.
- Lead volunteers should obtain Land Steward Certification as described in the Natural Areas Volunteer Handbook.

7. Coordination and approval of volunteer activities
    - Volunteer activities should be consistent with this Natural Communities Vegetation Management Plan.
    - Volunteers should observe policies and procedures identified in the Dane County Parks Natural Areas Volunteer Handbook.
    - Volunteers should develop a work plan every year in coordination with Dane County Parks Natural Areas staff, who will be responsible for review and approval. Plans outside of the scope of the work plan should be discussed with staff beforehand. Volunteers are encouraged to check in with staff regularly or when questions arise.

8. Implementation, methods, and site maintenance

A proposed cycle of vegetation management activities is provided in Table 3, detailing how projects will be completed and maintained. The table includes method of completing tasks, including equipment involved and entity completing the task.

Table 3. Proposed cycle of vegetation management activities

Activity	Timeframe	Entity	Method
Tree and shrub removal	October-March	Volunteers and/or staff	Volunteers and staff: chainsaw, brushcutter (spot treating stumps w/ herbicide); Staff: mowers, skid loader
Prescribed burning	March-May; August-November	Staff led, volunteer supported	Burn crew with fire-fighting equipment (hand tools, water cans, UTVs, trucks)
Weed control	April-July	Volunteers and/or staff	Volunteers: Shovels, brushcutters, small mowers, herbicides Staff: mowers, herbicides
Native Seed collection	August-October	Staff led, volunteer supported	Hand collect seed from several parks in the system during regular county parks hosted workdays
Seed processing and packaging	September-December	Staff led, volunteer supported	Clean, weigh, and package seed for planting in parks throughout the county
Planting seeds	November-March	Volunteers	Hand scatter seeds in project areas
Plant trees and shrubs	October-November; April-June	Volunteers	Plant county-grown or nursery purchased container plants
Water and maintain container plants	May-September	Volunteers	Provide water to container plants, maintain caging, remove weeds

References:

Wisconsin Department of Natural Resources. 2015. 2015-2025 Wisconsin Wildlife Action Plan. Madison, WI.

Wisconsin Department of Natural Resources. 2015. *The Ecological Landscapes of Wisconsin: An Assessment of Ecological Resources and a Guide to Planning Sustainable Management*. Wisconsin Department of Natural Resources PUB-SS-1131 2015, Madison.

Appendix 1. Dry Prairie Community Description (WDNR Ecological Landscapes of Wisconsin, 2015)

Dry Prairie (Global Rank G3G4; State Rank S3)

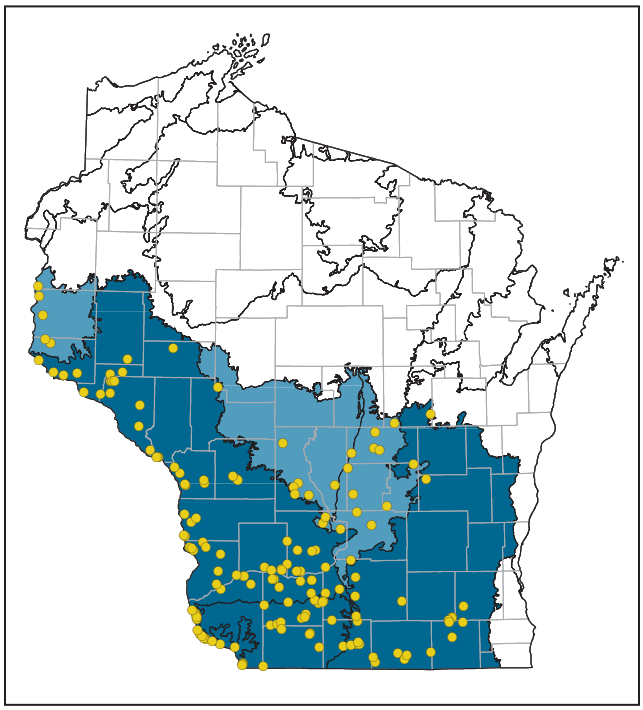
Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

Dry Prairie (also known as "goat prairie," "dry lime prairie," or "bluff prairie") is a native grassland community that is especially well represented on steep southwest-facing slopes in the Driftless Area of southwestern Wisconsin and neighboring states. The soils are often derived from loess of varying depth, though dolomite or sandstone bedrock may occur at or just beneath the surface. Along some of the major river valleys of western and southwestern Wisconsin bedrock outcroppings are prominent features that may form impressive cliffs tens of meters in height. These provide habitat for specialized plants as well as hunting, basking, and denning sites for herptiles. Rock fragments often occur on the prairie surface, in some areas aggregating into accumulations of talus. The severe environmental conditions on the steep, rocky, exposed bluffs are among the factors that have played a role in maintaining remnants of this formerly much more extensive prairie community despite many decades of fire suppression and the widespread agricultural and residential development throughout southern Wisconsin. Other prairie communities, such as those on sites with deep, productive soils and level or more subdued topography, have now been almost eliminated from the state's landscapes.

In the glaciated parts of Wisconsin, Dry Prairie occurs on gravelly, or sometimes sandy, knolls in the Kettle Moraine region of southeastern Wisconsin and along and near the St. Croix River on the Minnesota-Wisconsin border. More intensive vegetation sampling of Dry Prairies is needed in these areas as the occurrences may warrant recognition as subtypes. Irrespective of unanswered classification questions, Dry Prairies outside of the Driftless Area should be evaluated and included in state and regional prairie conservation plans.

Historically, Dry Prairie occurred within a vegetation mosaic that included other prairie communities, oak savanna, oak woodland, and oak forest. All of these communities are adapted to and somewhat dependent on periodic fire. Effective conservation of the entire suite of native plants and animals associated with Dry Prairie will require restoration of some of these adjoining plant communities, many of which are now severely overgrown with shrubs and sapling trees, or they've been converted to other land uses. The transition from open prairie to adjoining wooded habitats (often this is now dense forest rather than semi-open savanna or oak woodland) is often abrupt, and this may not provide for the needs of species requiring multiple habitats to complete their life cycles or allow for these dynamic entities to expand, contract, or shift their ranges as environmental conditions change.

Patch sizes for Dry Prairie are limited by physiographic factors, woody encroachment, and development. Typical stands sizes are small to moderate (single acres to tens of acres), and the prairie patches become increasingly isolated as bluffs are developed (often for residential use) and related infrastructure is installed. The deep draws and ravines separating the prairies are typically heavily wooded, creating barriers to dispersal for some organisms.



Locations of Dry Prairie in Wisconsin. The deeper hues shading the ecological landscape polygons indicate geographic areas of greatest abundance. An absence of color indicates that the community has not (yet) been documented in that ecological landscape. The dots indicate locations where a significant occurrence of this community is present, has been documented, and the data incorporated into the Natural Heritage Inventory database.

Community Description: Composition and Structure

The dominant grasses are of short to medium stature, usually less than one meter in height, and include little bluestem (*Schizachyrium scoparium*), side-oats grama (*Bouteloua curtipendula*), hairy grama (*B. hirsuta*), and prairie dropseed (*Sporobolus heterolepis*). Prairie satin grass (*Muhlenbergia cuspidata*) is abundant in some Dry Prairies on the Mississippi River bluffs along the state's western edge. Several panic grasses (*Dicanthelium* spp.) are widespread in and characteristic of dry prairie communities, though these are seldom, if ever, among the dominant graminoids. When present, tall grasses such as big blue-stem (*Andropogon gerardii*), yellow Indian grass (*Sorghastrum nutans*), and needle grass (*Stipa spartea*) tend to occupy slightly more moist habitats, either on the lower slopes or in draws.

Among the common or characteristic shrubs and forbs are lead-plant (*Amorpha canescens*), American pasqueflower

(*Anemone patens*), bird's-foot violet (*Viola pedata*), silky aster (*Symphyotrichum sericeum*), heath aster (*S. ericoides*), flowering spurge (*Euphorbia corollata*), purple prairie-clover (*Dalea purpurea*), cylindrical blazing-star (*Liatris cylindracea*), false boneset (*Kuhnia eupatorioides*), prairie coreopsis (*Coreopsis palmata*), upland white goldenrod (*Solidago ptarmicoides*), and gray goldenrod (*Solidago nemoralis*).

A number of rare plants and animals are strongly associated with the Dry Prairie community, which provides critical habitat for some of these species, especially among the invertebrates and herptiles. Rare herptiles include the six-lined racerunner (*Aspidoscelis sexlineata*), prairie ringnecked snake (*Diadophis punctate arnyi*), North American racer (*Coluber constrictor*), and timber rattlesnake (*Crotalus horridus*). Among the invertebrates, rare butterflies, moths, leafhoppers, and land snails have been documented in these habitats, including the globally rare ottoe skipper butterfly (*Hesperia ottoe*).

Rare or otherwise noteworthy vascular plants include Wilcox's panic grass (*Dichanthelium wilcoxianum*), ground-plum (*Astragalus crassicarpus*), prairie-turnip (*Pediomelum esculentum*), pale purple coneflower (*Echinacea pallida*), Carolina anemone (*Anemone caroliniana*), and silver bladder-pod (*Lesquerella ludoviciana*).

Conservation and Management Considerations

Brush encroachment due to successional changes in the absence of periodic fire and increased patch isolation as residential and agricultural uses increasingly dominate the adjoining lands above and below the steeper and rockier slopes are

Southwest-facing bluffs above the Mississippi River support an impressive series of dry prairies, one of the largest such concentrations in the Upper Midwest. Remnant oak forest, oak woodland, and oak savanna add ecological value to this exceptional natural features complex. Rush Creek State Natural Area, Crawford County, Western Coulees and Ridges Ecological landscape. Photo by Eric Epstein, Wisconsin DNR.

This series of fine dry prairies occupies south-facing bedrock bluffs not far from the Rush River. Wisconsin has exceptional representation of bluff (or "goat") prairies, which provide key habitat for numerous native plants, invertebrates, and herptiles. Photo by Eric Epstein, Wisconsin DNR.

The Hogback is a striking Driftless Area landform, a long curvilinear ridge with steep slopes rising from level croplands that now occupy an abandoned meander of the Kickapoo River. The knife-edged ridge is highly unusual in that it supports prairie vegetation on both its west and east slopes. This diverse prairie is inhabited by rare plants and animals. Shrub thickets and a potentially restorable oak savanna complement the prairie by providing habitat for additional species of conservation concern. Hogback Prairie State Natural Area, Crawford County, Western Coulees and Ridges Ecological Landscape. Photo by Thomas Meyer, Wisconsin DNR.

The upper, west-facing slopes of Battle Bluff support native prairie vegetation with very little encroachment of woody species. Battle Bluff State Natural Area, Vernon County, Western Coulees and Ridges Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

the greatest current threats. Appropriate management actions for Dry Prairie communities include the use of prescribed fire, mechanical removal of woody vegetation (shrubs, saplings, and small trees), and judicious application of herbicides to control unwanted plants, especially nonnative invasive species such as leafy spurge (*Euphorbia esula*) and spotted knapweed (*Centaurea biebersteinii*). Comprehensive planning and good communications among managers and with nearby landowners are essential to determine how, how often, when, and exactly where to use prescribed fire, ultimately the single most important management tool for restoration and maintenance of this prairie community. Paradoxically, not every species dependent on or strongly associated with dry prairie as a primary habitat (e.g., certain invertebrates) is adapted to survive the direct impacts of fire. Because of the small size and isolation of many of our best remnants, an investment of extra care in conservation design and implementation of management activities is warranted, especially when rare species are present. Controversies can be resolved (or at least clarified) via research and adaptive management, to the benefit of all stakeholders interested in the conservation of prairie ecosystems.

Other management issues include grazing, tree planting on or around prairie openings, and residential construction (wherein the prairie is likely to be destroyed and replaced with a monotypic lawn). The loss of sensitive species from isolated prairies (due to rarity, small population size, absence of a key pollinator, competition, unfavorably changing habitat conditions, and distance from a source population, etc.) is a significant threat at some sites, and this will only be effectively addressed by planning and monitoring, followed by appropriate management adjustments and actions.

A number of the largest and least disturbed Dry Prairie sites in the Driftless Area have been identified and designated for protection. Many are now under conservation management by public agencies, NGOs, and private individuals. Expansion and connection of patches of open prairie is possible at some locations and should be a management priority whenever possible. Where the opportunities exist, there is a great need to manage surrounding areas to restore and promote other terrestrial fire-dependent communities such as Sand Prairie, Dry-mesic Prairie, and oak-dominated savannas, woodlands, and forests.

From a global perspective, Wisconsin has an especially important role to play in the conservation of the Dry Prairie community. No other state in the Upper Midwest has equivalent conservation opportunities for this community and its associated vegetation mosaic. Most of the dry bluff prairies of the Upper Midwest occur within the Driftless Area, almost three-fourths of which is within Wisconsin. Southeastern Wisconsin's glaciated southern Kettle Moraine region contains a significant concentration of xeric gravel prairies embedded within a matrix of overgrown oak savanna. More detailed floristic studies are needed to determine whether or not these prairies should be recognized as distinct community types. Until then, conservationists and managers of public lands supporting Dry Prairie occurrences should consider their restoration and management wherever they occur.

Additional Information

For information on similar communities, see the descriptions for Sand Prairie, Dry-mesic Prairie, Dry Cliff, and Bedrock Glade. In the U.S. National Vegetation Classification, Dry Prairie corresponds most closely to CEGL002245 Little Bluestem - Sideoats Grama Bedrock Bluff Herbaceous Vegetation (Faber-Langendoen 2001).

Also see:
Anderson (1954)
Foote (1966)
Kraszewski and Waller (2008)
Steele and Hartman (2015a)
Steele and Hartman (2015b)
Theler (1997)
Thomson (1940)

FROM: Epstein, E.E. Natural communities, aquatic features, and selected habitats of Wisconsin. Chapter 7 *in The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management.* Wisconsin Department of Natural Resources, PUB-SS-1131H 2017, Madison.

For a list of terms used, please visit the **Glossary.**

For a reference list, please see the **Literature Cited.**

Appendix 2. Dry-Mesic Prairie Community Description (WDNR Ecological Landscapes of Wisconsin, 2015)

Dry-mesic Prairie (Global Rank G2G3; State Rank S2)

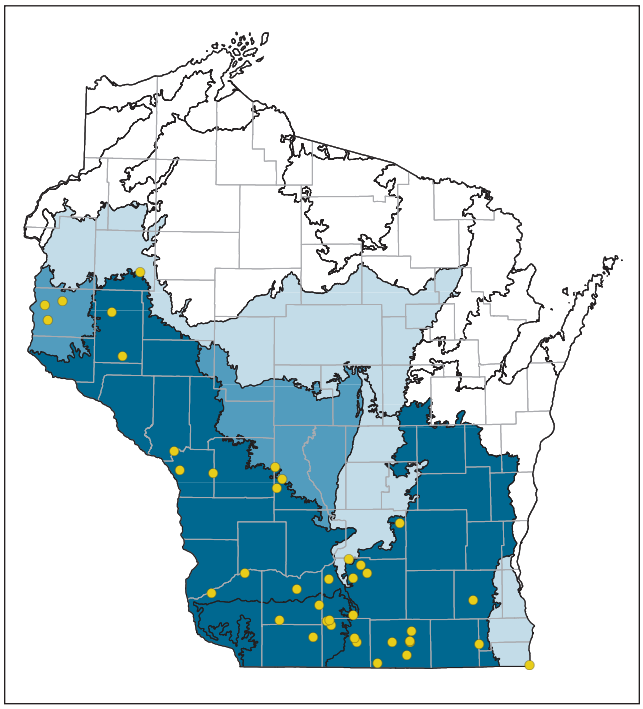
Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

Dry-mesic Prairie is a native grassland community that occurs south of the ecoclimatic Tension Zone. Along with the other tallgrass prairie communities, Dry-mesic Prairie has been almost eliminated from the Upper Midwest, and the remaining occurrences are mostly small and isolated, presenting difficult challenges for conservationists, planners, and site managers. Historical abundance is difficult to estimate for this natural community. Curtis (1959) estimated that ca 30% (or 630,000 acres) of Wisconsin's prairie cover was Dry-mesic Prairie before Euro-American settlement. Estimates of present abundance are less uncertain as only a few hundred acres of this rare natural community are known to persist across its statewide range.

In glaciated southeastern Wisconsin, the landforms supporting this community include outwash, extinct glacial lakebeds, and till plains. Several occurrences are known from drumlins and the lower slopes and bases of end and recessional moraines. Soils are generally somewhat sandy and include sandy loams, loamy sands, and fine sands. Nutrient levels are moderate to low. Dry-mesic Prairie is found on less droughty sites than Dry Prairie or Sand Prairie but supports some of the same species as those communities.

In the unglaciated Driftless Area of southwestern Wisconsin, Dry-mesic Prairie occurs on the lower slopes and at the bases of sandstone or dolomite bluffs and on sandy terraces flanking the large river floodplains. At a few locations, Dry-mesic Prairie has been found on large sandy or gravelly islands within river floodplains. In glaciated southeastern Wisconsin, Dry-mesic Prairie was most strongly associated with either coarse-textured end or recessional moraine or with sandy outwash.

Historically, Dry-mesic Prairie occurred with other native grasslands such as Dry and Mesic prairies and with other fire-dependent natural communities such as oak savanna and oak forest. On river terraces, the community mosaic within which Dry-mesic Prairie was embedded often included Sand Prairie and Oak Barrens or, more rarely, Pine Barrens.



Locations of Dry-mesic Prairie in Wisconsin. The deeper hues shading the ecological landscape polygons indicate geographic areas of greatest abundance. An absence of color indicates that the community has not (yet) been documented in that ecological landscape. The dots indicate locations where a significant occurrence of this community is present, has been documented, and the data incorporated into the Natural Heritage Inventory database.

Community Description: Composition and Structure

The dominant grasses are generally of tall or medium stature, with some representation by the shorter species. The most characteristic graminoids are big blue-stem (*Andropogon gerardii*), yellow Indian grass (*Sorghastrum nutans*), needle grass (*Stipa spartea*), prairie dropseed (*Sporobolus heterolepis*), and few-flowered panic grass (*Dichanthelium oligosanthes*). Grasses that are strongly to moderately associated with Dry-mesic Prairie include switch grass (*Panicum virgatum*), Canada wild-rye (*Elymus canadensis*), and several additional panic grasses (*Dicanthelium* spp.).

The forb component is more diverse in the dry-mesic than in the dry or mesic prairies and may include species that are associated with these other prairie communities. Prevalent forbs include sky-blue aster (*Symphyotrichum oolentangiense*), hoary puccoon (*Lithospermum canescens*), false boneset (*Kuhnia eupatorioides*), rough blazing-star (*Liatris aspera*), thimbleweed (*Anemone cylindrica*), whorled milkweed (*Asclepias verticillata*), purple prairie-clover (*Dalea purpurea*), stiff sunflower (*Helianthus pauciflorus*), grooved yellow flax (*Linum sulcatum*), prairie cinquefoil (*Potentilla arguta*), and gray goldenrod (*Solidago nemoralis*).

Among the numerous rare plants associated with Dry-mesic Prairie are the U.S. Threatened prairie bush-clover (*Lespedeza leptostachya*), clustered poppy mallow (*Callirhoe triangulata*), Hill's thistle (*Cirsium hillii*), field dodder (*Cuscuta pentagona*), pale purple coneflower (*Echinacea pallida*), cream gentian (*Gentiana alba*), American feverfew (*Parthenium integrifolium*), prairie-turnip (*Pediomelum esculentum*), pink milkwort (*Polygala incarnata*), rough rattlesnake-root (*Prenanthes aspera*), hairy wild petunia (*Ruellia humilis*), and white camas (*Zigadenus elegans* ssp. *glaucus*). Several of these species are globally rare (e.g., clustered poppy mallow, Hill's thistle, and prairie bush-clover), and some of the Wisconsin

populations are of especially high conservation significance because of large population size and high site viability.

Animals of conservation importance because of their rarity or strong association with this natural community include mammals, birds, reptiles, and invertebrates. Examples are American badger (*Taxidea taxus*), Franklin's ground squirrel (*Spermophilus franklinii*), plains pocket gopher (*Geomys bursarius*), Bobolink (*Dolichonyx oryzivorus*), Dickcissel (*Spiza americana*), Eastern Meadowlark (*Sturnella magna*), Henslow's Sparrow (*Ammodramus henslowii*), Northern Bobwhite (*Colinus virginianus*), Northern Harrier (*Circus cyaneus*), and Western Meadowlark (*Sturnella neglecta*), gophersnake (*Pituophis catenifer*), Blanding's turtle (*Emydoidea blandingii*), and the regal fritillary (*Speyeria idalia*).

As so many of the better quality Dry-mesic Prairie remnants are small or linear, many of the vertebrates mentioned are likely to persist only in prairies that occur within or adjacent to more extensive areas of compatibly managed herbaceous cover. The same may hold true for some of the specialized invertebrates, such as those that are highly dependent on one or a few plant species for their continued existence. Populations of such plants would have to be multiple, large, secure, or exist in close proximity to ensure that the loss of any single plant population would not lead to the subsequent loss of some animals as well.

Some native grassland species do make use of shrubs and thickets as nest sites, feeding areas, hunting perches, and song perches. These include rare species such as Loggerhead Shrike (*Lanius ludovicianus*), Bell's Vireo (*Vireo bellii*), and Northern Bobwhite.

Conservation and Management Considerations

Historically, Dry-mesic Prairie occurred with other native grasslands and oak savannas south of the Tension Zone. In common with all of the fertile and productive tallgrass prairie communities, Dry-mesic Prairie has been greatly reduced

This small but diverse prairie occurs on a west-facing slope between two sandy terraces bordering the Mississippi River. Important grasses are big blue-stem, little blue-stem, yellow Indian grass, and needle grass. A number of showy native forbs also occur here. Midway Prairie State Natural Area, La Crosse County, Western Coulees and Ridges Ecological Landscape. Photo by Thomas Meyer, Wisconsin DNR.

Dry-mesic prairie. Dane County, Western Coulees and Ridges Ecological Landscape. Photo by Thomas Meyer, Wisconsin DNR.

DNR biologist Cathy Bleser conducting surveys at extensive grassland composed of patches of dry-mesic prairie embedded within non-native, formerly pastured "surrogate grasslands" near Barneveld. Iowa County, Southwest Savanna Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

in extent due to conversion of former prairie to agricultural cropland, residential areas, or tree plantations. Prolonged exposure to heavy grazing generally favors nonnative plants.

Currently, many of the sites supporting Dry-mesic Prairie remnants occur within travel or utility corridors. Isolation of these remnants limits their ability to support area-sensitive species. Over time the loss of species with poor dispersal abilities is increasingly likely. Once a species is lost from a remnant, many of the grassland natives will have difficulty recolonizing isolated sites without active intervention.

Active management is required to maintain this community, including the use of prescribed fire, mechanical brush removal, and the judicious use of herbicides. Management is likely to be more successful where the remnants can be buffered and embedded within other managed grasslands and savannas. The proximity of extensive surrogate grasslands and open wetlands can help maintain populations of some area-sensitive prairie animals. At larger scales, especially, it may be more feasible to include important microsites such as rock outcrops, sandblows, springs, and seepage ponds.

Invasive herbs adversely affecting this community include Kentucky bluegrass (*Poa pratensis*), Canada bluegrass (*P. compressa*), smooth brome (*Bromus inermis*), Canada thistle (*Cirsium arvense*), white sweet-clover (*Melilotus albus*), and yellow sweet-clover (*M. officinalis*). Nonnative invasive shrubs include autumn olive (*Elaeagnus umbellata*), several Eurasian honeysuckles (especially *Lonicera tatarica*, *L. morrowii*, and the hybrid *Lonicera* x *bella*), common buckthorn (*Rhamnus cathartica*), and multiflora rose (*Rosa multiflora*). Woody natives can be problematic, especially sumacs (*Rhus* spp.), cherries (*Prunus* spp.), eastern red-cedar (*Juniperus virginiana*), and box elder (*Acer negundo*). Note that the total elimination of the shrub component is not necessarily desirable, especially for those large sites containing multiple grassland communities, complex topography, and natural firebreaks. Such decisions need to be made on a site-specific basis, especially when the shrubs are native, generally noninvasive, and provide food and cover for native wildlife. Examples are gray dogwood (*Cornus racemosa*), American plum (*Prunus americana*) and Canadian plum (*P. nigra*), native roses (*Rosa* spp.), and hawthorns (*Crataegus* spp.). At those sites where rare species such as Loggerhead Shrike, Bell's Vireo, and Northern Bobwhite still occur, management plans need to carefully weigh the pros and cons of retaining shrubs; they certainly should not be eliminated from native grassland situations everywhere.

Most Dry-mesic Prairie remnants occur in areas where agriculture is now the dominant land use. Remnants on some of the large river terraces, for example, along the Mississippi River, continue to be reduced in size, fragmented and isolated by center pivot irrigation-based agriculture and residential development, and encroached upon by invasive plants.

As the vast majority of the land within the range of this community is privately owned, partnerships with NGOs and individuals are essential to achieve effective conservation. The Prairie Enthusiasts, the Wisconsin Chapter of The Nature Conservancy, and the Mississippi Valley Conservancy are among the effective nongovernmental organizations working on the conservation of prairies in southern Wisconsin.

Additional Information

For additional Information, see the natural community descriptions for Dry Prairie, Mesic Prairie, Sand Prairie, Oak Openings, and Oak Barrens. In the "Selected Habitats" section of this chapter, refer to Surrogate Grasslands and Sand Barrens. The U.S. National Vegetation Classification community most closely resembling Wisconsin's Dry-mesic Prairie is CEGL002214 Midwest Dry-mesic Prairie (Faber-Langendoen 2001).

Also see:
Packard and Mutel (1997)

FROM: Epstein, E.E. Natural communities, aquatic features, and selected habitats of Wisconsin. Chapter 7 *in The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management*. Wisconsin Department of Natural Resources, PUB-SS-1131H 2017, Madison.

For a list of terms used, please visit the **Glossary.**

For a reference list, please see the **Literature Cited.**

Appendix 3. Wet-Mesic Prairie Community Description (WDNR Ecological Landscapes of Wisconsin, 2015)

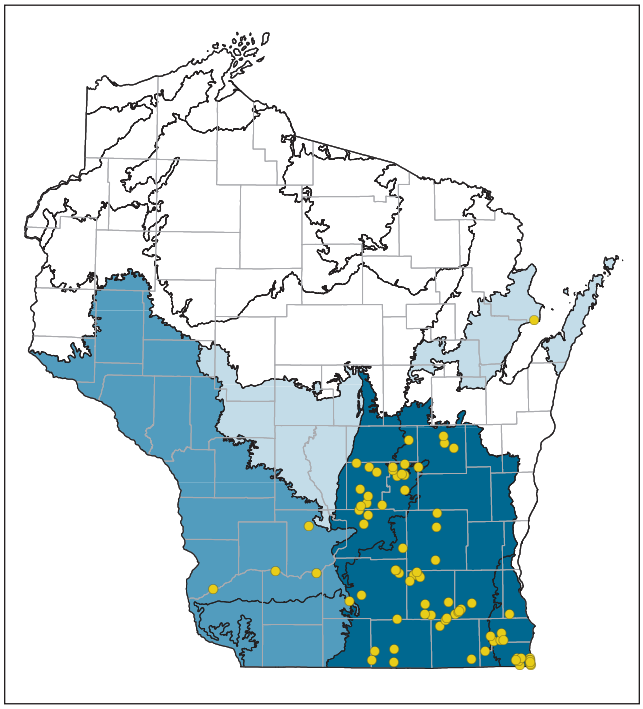
Wet-mesic Prairie (Global Rank G2; State Rank S2)

Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

In the Upper Midwest, the term tallgrass prairie encompasses Wisconsin's wet, wet-mesic, mesic, and dry-mesic prairie communities, all of which are dominated by grasses that can reach heights of one to two meters or more. Wet-mesic Prairie occurs mostly south of the Tension Zone on sites that are at least seasonally saturated. Historically it was most prevalent on poorly drained till plains and sometimes, in the southeastern part of the state, in glacial outwash channels where it occurred in vegetation mosaics composed of other tallgrass prairie communities, emergent marsh, sedge meadow, fen, shrub-carr, and oak savanna.

Wet-mesic and Wet Prairies occur on mineral soils; Calcareous Fen and some sedge meadows develop on peaty, organic soils. In Michigan, the transition from prairie to fen can be quite abrupt, due at least in part to this basic soil difference (Ryan O'Connor, Wisconsin DNR, personal communication, 2012).

All of the tallgrass types have been reduced by well over 99% of their historical abundance in Wisconsin and elsewhere in the Upper Midwest, primarily because of outright destruction and conversion of these fertile native grasslands to croplands and pasture. Many of the wet and wet-mesic sites have been drained by ditching and tiling, altering hydrology and severely impacting prairie composition and long-term stand viability. Wet-mesic Prairie is now globally rare and provides critical habitat for some of Wisconsin's rarest and most sensitive native plants and animals.



Locations of Wet-mesic Prairie in Wisconsin. The deeper hues shading the ecological landscape polygons indicate geographic areas of greatest abundance. An absence of color indicates that the community has not (yet) been documented in that ecological landscape. The dots indicate locations where a significant occurrence of this community is present, has been documented, and the data incorporated into the Natural Heritage Inventory database.

Community Description: Composition and Structure

The dominant tall grasses in Wet-mesic Prairie include big blue-stem (*Andropogon gerardii*), blue-joint grass (*Calamagrostis canadensis*), prairie cordgrass (*Spartina pectinata*), Canada wild-rye (*Elymus canadensis*), switch grass (*Panicum virgatum*), fringed brome (*Bromus ciliatus*), marsh muhly (*Muhlenbergia glomerata*), and sometimes, yellow Indian grass (*Sorghastrum nutans*). Sedges are well represented though seldom dominant in this community. Sedge species found in Wet-mesic Prairie include Bebb's sedge (*Carex bebbii*), Buxbaum's sedge (*C. buxbaumii*), common lake sedge (*C. lacustris*), tussock sedge (*C. stricta*), and rigid sedge (*C. tetanica*). For other possibilities, see Hipp (2008).

Forb composition is diverse and can be exceptionally showy, featuring species such as sky blue aster (*Symphyotrichum oolentangiensis*), eastern shooting-star (*Dodecatheon meadia*), saw-tooth sunflower (*Helianthus grosseserratus*), yellow star-grass (*Hypoxis hirsuta*), thick-spike blazing-star (*Liatris pycnostachya*), brook lobelia (*Lobelia kalmii*), prairie phlox (*Phlox pilosa*), Virginia mountain mint (*Pycnanthemum virginianum*), yellow coneflower (*Ratibida pinnata*), prairie dock (*Silphium terebinthinaceum*), stiff goldenrod (*Solidago rigida*), culver's-root (*Veronicastrum virginicum*), and golden alexanders (*Zizea aurea*). Among the pteridophytes likely to occur in Wet-mesic Prairie are sensitive fern (*Onoclea sensibilis*) and marsh fern (*Thelypteris palustris*).

Tree cover in Wet-mesic Prairie is very low, typically less than 10%. Shrub cover is also low and often deliberately reduced by management techniques involving the use of prescribed fire, mechanical brushing, or herbicides. Characteristic shrubs of this natural community are several dogwoods, willows, swamp rose (*Rosa palustris*), and sometimes shrubby cinquefoil (*Pentaphylloides floribunda*).

Some of Wisconsin's rarest plants are strongly associated with Wet-mesic Prairie. A few examples are the U.S. Threatened and Wisconsin Endangered prairie white-fringed orchid (*Platanthera leucophaea*), earleaf foxglove (*Agalinis auriculata*), wild hyacinth (*Camassia scilloides*), and hairy fimbristylis (*Fimbristylis puberula*). Other notable rare plants occurring in this community are prairie milkweed (*Asclepias sullivantii*), prairie Indian-plantain (*Arnoglossum plantagineum*), small white lady's-slipper (*Cypripedium candidum*), marsh blazing star (*Liatris spicata*), and white camas (*Zigadenus elegans* var. *glaucus*). For the current status of these and

other species mentioned here, see the Wisconsin Natural Heritage Working List (WDNR 2016c).

The Oklahoma grass pink (*Calopogon oklahomensis*) is known to have occurred in Wisconsin only from historical records. It may have occurred in tallgrass prairie and savanna complexes, which included Wet-mesic Prairie. More precise information on the habitat affinities of this taxon is ambiguous and not readily available.

Rare animals strongly or moderately associated with Wet-mesic Prairie are Franklin's ground squirrel (*Spermophilus franklinii*), Short-eared Owl (*Asio flammeus*), Northern Harrier (*Circus cyaneus*), Bobolink (*Dolichonyx oryzivorus*), LeConte's Sparrow (*Ammodramus leconteii*), eastern massasauga (*Sistrurus catenatus catenatus*), Butler's gartersnake (*Thamnophis butleri*), boreal chorus frog (*Pseudacris maculata*), and Blanding's turtle (*Emydoidea blandingii*). Among the numerous rare invertebrates occurring in good quality Wet-mesic Prairies are the Liatris borer moth (*Papaipema beeriana*), Silphium borer moth (*P. silphii*), and Poweshiek skipperling (*Oarisma poweshiek*).

Avoca is among the largest remaining prairies east of the Mississippi River. It is within the floodplain of the lower Wisconsin River and crossed by seasonally flooded braided streams channels. Topographic relief within this native grassland is estimated at only around 4 feet, yet this is enough to support a continuum of natural communities from inundated marshes in the lowest swales to dry-mesic prairie on the crests of the highest sandy ridges. A detailed vegetation map would be most useful here, and this dynamic site should be monitored carefully over the coming decades. Avoca Prairie State Natural Area, Iowa County, Western Coulees and Ridges Ecological Landscape. Photo by Thomas Meyer, Wisconsin DNR.

Conservation and Management Considerations

The major factors leading to the present rarity of Wet-mesic Prairie have been outright destruction, hydrological disruption via drainage (or more rarely, inundation), lack of periodic wildfire, prolonged grazing by confined livestock, and the colonization by and spread of invasive species. Wetland drainage has been extensive in many parts of southeastern

Several of the wet-mesic prairie remnants in the Scuppernong Basin of southeastern Wisconsin are composed of exceptionally rich assemblages of native grassland plants and animals. Kettle Moraine State Forest - South Unit, Waukesha County, Southeast Glacial Plains Ecological Landscape. Photo by Drew Feldkirchner, Wisconsin DNR.

Chiwaukee Prairie occurs on ridge-and-swale topography near Lake Michigan in the southeastern corner of Wisconsin. In addition to excellent examples of tallgrass prairie and fen communities, this site supports an exceptionally high diversity of native grassland plants, many of them now very rare. The dominant flowering forb in this photo, taken in spring, is eastern shooting-star. Chiwaukee Prairie State Natural Area, Kenosha County, Southern Lake Michigan Coastal Ecological Landscape. Photo by Thomas Meyer, Wisconsin DNR.

The owners/stewards of this privately-owned grassland south of Fort Atkinson have invested thousands of hours in management efforts to rehabilitate this formerly badly overgrown prairie. The work has paid off, and the site is now recognized as one of the best examples of this globally rare natural community in south central Wisconsin. Allen Creek Prairie, Jefferson County, Southeast Glacial Plains Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

Wisconsin and has led to type conversion (either to agricultural fields, or to shrub swamps or lowland hardwood forests) and dominance by invasive plants such as reed canary grass (*Phalaris arundinacea*).

Sediment and nutrient-laden runoff from agricultural fields, construction sites, residential areas, and roads affects prairie composition by favoring the growth of weedy plants such as nettles, thistles, ragweeds (*Ambrosia* spp.), and common burdock (*Arctium minus*) as well as highly invasive species such as reed canary grass. Several animal-dispersed shrubs, such as glossy buckthorn (*Rhamnus frangula*), common buckthorn (*R. cathartica*), and multiflora rose (*Rosa multiflora*), are also having negative impacts in Wet-mesic Prairies.

The Wet-mesic Prairies are greatly reduced from their historical abundance, but from a conservation perspective, the situation is less dire than for related upland tallgrass prairie communities such as Mesic and Dry-mesic Prairies, and more mesic oak savanna remnants. Good restoration opportunities for this globally rare, species-rich natural community are few (especially at the larger scales) but have been identified at locations such as the South Unit of the Kettle Moraine State Forest, within the extensive wetlands bordering the White and Puchyan rivers, and around Rush Lake in east central Wisconsin. More coordination and cooperation with land managing public agencies and NGOs in Illinois would have ecological and economic benefits for the extremely diverse and ecologically significant Chiwaukee Prairie-Illinois Beach complex. Along Lake Michigan, the core of the diverse natural community mosaic at Chiwaukee Prairie is a variant of Wet-mesic Prairie known and described in Michigan as Lakeplain Wet-mesic Prairie. In the Driftless Area, Wet-mesic Prairie is very rare, but good examples are known from the valley of the lower Wisconsin River, with Avoca Prairie (Iowa County) being especially important because of its size, overall condition, and functionally intact complex of associated natural communities.

Additional vegetation sampling and monitoring is needed for the community, focusing on those stands of especially good quality, undergoing restoration, and/or located in the Driftless Area.

Managers and others engaged in ecological restoration should consult Packard and Mutel (1997) and Henderson (1995), among others, when designing conservation plans for tallgrass prairies, including Wet-mesic Prairie. Maintenance of existing remnants will require active management, and expansion of small, isolated stands—where that's feasible—will involve restoration. There are a few stands of diverse Wet-mesic Prairie occurring within powerline or transportation rights-of way, but conserving these without some type of buffering from the impacts of local land uses will be very difficult.

Additional Information

For more information on similar vegetation, see the natural community descriptions for Wet Prairie, Mesic Prairie, Southern Sedge Meadow, Calcareous Fen, and Northern Sedge Meadow. The U.S. National Vegetation Classification type most closely corresponding to Wet-mesic Prairie is CEGL002024 Central Wet-mesic Tallgrass Prairie (Faber-Langendoen 2001). However, the Wisconsin type encompasses the extremely rare and diverse CEGL005095 Lakeplain Wet-mesic Prairie, which is not currently recognized as a separate entity in our state but appears to be a good fit for some of the native grasslands at Chiwaukee Prairie along Lake Michigan in southeastern Kenosha County.

FROM: Epstein, E.E. Natural communities, aquatic features, and selected habitats of Wisconsin. Chapter 7 *in The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management*. Wisconsin Department of Natural Resources, PUB-SS-1131H 2017, Madison.

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Appendix 4. Oak Opening/Savanna Community Description (WDNR Ecological Landscapes of Wisconsin, 2015)

Oak Opening (Global Rank G1; State Rank S1)

Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

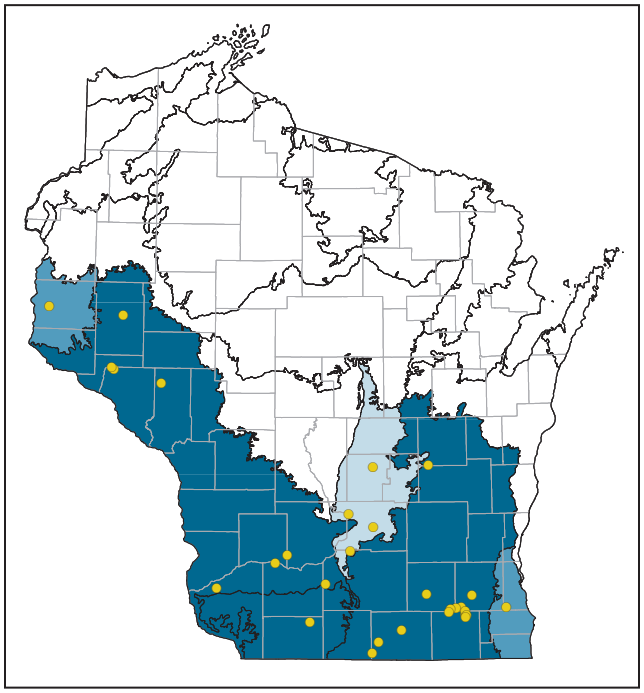
Historically, Oak Openings occurred on dry to wet-mesic sites across much of southern and western Wisconsin. Patch size and configuration varied greatly, and the community was found as isolated groves, in draws between ridges, on tongue-like peninsulas, on steep slopes partially protected by waterbodies or wetlands, and sometimes as extensive ecotonal areas separating open prairie from closed forest. According to the interpretations of Curtis (1959) and Finley (1976), Oak Openings covered approximately 5.5 million acres in southern Wisconsin at the time of the federal public land survey in the mid-19th century. Only the vast (and variable) Northern Mesic Forests in the northern part of the state were more extensive.

In 1959 Curtis wrote that "an oak savanna with an intact ground layer is the rarest plant community in Wisconsin today." This statement applies throughout the continental range of the type (Nuzzo 1986) and is even more apt now than it was a half century ago. Virtually all present conservation efforts to maintain and reestablish this type are restorations, wherein prescribed fire, mechanical removal of shrubs and saplings, mowing, and herbicides are employed to eliminate or control unwanted woody growth and invasive herbs and encourage suppressed native groundlayer plants. In some restoration efforts, it has been deemed necessary to reintroduce native plant species that have been lost.

As defined by Curtis (1959), Oak Openings are oak-dominated savanna communities in which there was at least one tree per acre but where total tree cover was less than 50%. However, he also noted that the "density (of trees) per acre was the most variable of all characteristics," a key point for managers and restoration planners. It's also worth noting that Oak Openings could grade seamlessly into communities still influenced by and ultimately dependent on periodic wildfire but characterized by increasing levels of canopy closure. A continuum of the fire-dependent "oak ecosystem" could grade from open and park-like oak openings, to a more closed oak woodland, and finally to closed canopy oak forest.

By 2012 wildfire suppression in much of the state had been policy for a century or more throughout the former range of these savannas. As a result, canopy cover is not by itself a useful criterion to define an Oak Opening, nor is it necessarily useful to identify a remnant. Multiple factors, such as the spacing and limb architecture of the dominant oaks, stand disturbance history, landscape position with respect to past fire behavior, and floristic associates (if they haven't been shaded or grazed into oblivion) are arguably of greater importance in identifying stands that have retained some savanna attributes and possess the highest restoration potential (Leach and Givnish 1998).

Few extant remnants are in good condition, and these are now mostly limited to dry, often steep, rocky or gravelly sites. Remnant condition is typically poor owing to explosive



Locations of Oak Opening communities in Wisconsin. The deeper hues shading the ecological landscape polygons indicate geographic areas of greatest abundance. An absence of color indicates that the community has not (yet) been documented in that ecological landscape. The dots indicate locations where a significant occurrence of this community is present, has been documented, and the data incorporated into the Natural Heritage Inventory database.

This morainal ridge in Waukesha County supports a remnant oak opening. The dominant trees are large open-grown bur oaks, with scattered white oak and shagbark hickory also present. A long history of grazing has maintained savanna structure, but the understory is now composed almost entirely of nonnative cool season grasses. Southeast Glacial Plains Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

increases in woody growth, the dominance of invasive plants, the past and present impacts of grazing, and removal of the large oaks for timber or firewood. Oak Openings on mesic sites were formerly abundant, but these have essentially been extirpated, not only from southern Wisconsin but from the entire midwestern range of the community. Lowland savannas (these would occur on alluvial river terraces above the true floodplain) are now extremely rare, and known remnants are weedy and/or badly overgrown with shrubs and saplings.

The loss of the Oak Openings has been primarily due to four factors: the implementation of widespread fire suppression policies leading to an increase in the abundance and cover of woody plants at the expense of the native herbs; conversion of lands supporting savannas to other uses and cover types; prolonged periods of heavy grazing, which maintained savanna structure but caused the decline or loss of many native floristic associates; and recent increases in the abundance of invasive plants.

Fragmentation and the great changes in the vegetation mosaic within which the Oak Openings historically occurred have undoubtedly been significant factors in this formerly abundant natural community's demise, but the absence of intact remnants and the destruction and outright loss of the associated tallgrass prairies make the Oak Openings difficult to describe with precision, let alone manage with accurately predicted outcomes.

Community Description: Composition and Structure

Bur oak (*Quercus macrocarpa*) was the dominant tree on many mesic and dry-mesic sites in southeastern Wisconsin, with white oak (*Q. alba*) a dominant or co-dominant in some stands. Black oak (*Quercus velutina*) and shagbark hickory (*Carya ovata*) were the most important associates. The bur oaks were capable of achieving great girth, and the spreading crowns were often wider than the trees were high. No other upper midwestern plant community featured this unique stand physiognomy.

Shrub cover is highly variable and is often based on the time elapsed since the last fire. Important members of the shrub layer include American hazelnut (*Corylus americana*), gray dogwood (*Cornus racemosa*), New Jersey tea (*Ceanothus americanus*), leadplant (*Amorpha cansescens*), and several native roses (*Rosa* spp.).

The herbaceous layer has the potential to support high floristic diversity as it may include plants associated with open oak woodlands, more densely canopied oak-dominated hardwood forests, and treeless prairies. Historically, representative herbs were big blue-stem (*Andropogon gerardii*), little blue-stem (*Schizachyrium scoparium*), needlegrass (*Stipa spartea*), Leiberg's panic grass (*Dichanthelium leibergii*), flowering spurge (*Euphorbia corollata*), wild bergamot (*Monarda fistulosa*), thimbleweed (*Anemone cylindrica*), American pasqueflower (*A. patens*), northern bedstraw (*Galium boreale*), bird's-foot violet (*Viola pedata*), eastern shooting-star (*Dodecatheon meadia*), Solomon's-seal (*Polygonatum biflorum*), early buttercup (*Ranunculus fascicularis*), and yellow-pimpernel (*Taenidia integerrima*). Diverse and colorful displays of composites, especially among the asters, sunflowers, and blazing stars, were noted by observers who encountered the Oak Openings prior to the widespread settlement of southern Wisconsin by Euro-American immigrants.

A relatively small number of plants and animals reach their optimal abundance in the somewhat ecotonal Oak Openings. Some of the better known examples include kitten-tails (*Besseya bullii*), yellow giant hyssop (*Agastache nepetoides*), cream gentian (*Gentiana alba*), smooth phlox (*Phlox glaberrima*), white camas (*Zigadenus elegans* var. *glaucus*), and purple milkweed (*Asclepias purpurascens*), all of which are now rare in Wisconsin. Among other plants that are known to occur in Oak Openings but that are either too rare to be useful as indicators of any particular community assemblage or structure, or which have been more strongly linked to other natural communities, are woolly milkweed (*Asclepias lanuginosa*), great Indian-plantain (*Arnoglossum reniforme*), wild hyacinth (*Camassia scilloides*), violet bush-clover (*Lespedeza violacea*), slender bush-clover (*L. virginica*), and one-flowered broom-rape (*Orobanche uniflora*).

One of the native plants adapted to the filtered shade and patchy canopy conditions of the oak opening is the globally rare kitten-tails. Photo by Robert H. Read, Wisconsin DNR.

Animals of conservation interest that have a substantial association with Oak Openings are Eastern Screech Owl (*Megascops asio*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Eastern Bluebird (*Sialia sialis*), and Orchard Oriole (*Icterus spurius*). Trees with cavities can be important maternity sites for bats and also provide cover for other species. In years when the acorn crop is heavy, species such as Wood Duck (*Aix sponsa*) and eastern fox squirrel (*Sciurus niger*) may be common.

Conservation and Management Considerations

Because of its current rarity and the highly degraded condition of most remnants, conservation of the globally imperiled Oak Openings will be almost entirely dependent on efforts to restore heavily disturbed examples, most of them with greatly impaired, diminished, or missing components of the community's characteristic composition, structure, and function.

Frequent fires of low intensity are appropriate prescriptions for this community once the maintenance stage has been achieved, but initially, mechanical removal of unwanted competing shrubs and trees, augmented by the judicious use of herbicides, are critical steps. Once the surplus woody growth has been brought under control (this may be more effectively accomplished in stages, rather than in a rapid, massive reduction of woody cover) and reestablishment of a native ground layer is underway, the reintroduction of periodic fire will be the single most important step taken in the restoration process. Stands undergoing restoration will need to be monitored closely to assess ongoing needs to control invasive species (which are now present in virtually all remnants, including managed stands), set back shrubs and saplings, and determine whether or not there is a need to reintroduce missing elements of the native ground layer, ideally from similar habitats nearby.

The list of problematic invasive plants in the degraded, weed-infested remnants is long and includes Canada thistle (*Cirsium arvense*), garlic mustard (*Alliaria petiolata*), spotted knapweed (*Centaurea biebersteinii*), black swallow-wort (*Vincetoxicum nigrum*), common buckthorn (*Rhamnus cathartica*), multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), and the Eurasian honeysuckles (especially *Lonicera tatarica* and the hybrid *Lonicera* x *bella*). Exotic cool season grasses often dominate the ground layer of stands with a long history of livestock grazing. Prevalent among these are Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*P. pratensis*), and smooth brome (*Bromus inermis*).

Native shrubs can become abundant in remnant Oak Openings, and managers may seek to control or even eradicate them from sites undergoing restoration. Examples include several of the sumacs (*Rhus* spp.), blackberries (*Rubus* spp.), and common prickly-ash (*Zanthoxylum americanum*).

Oak Opening restoration and management will likely be most successful where other natural communities belonging to the mosaic of fire-dependent vegetation comprising the oak ecosystem are also present (such as oak woodland and oak-dominated forest types) or where the Oak Opening remnant can be embedded within native or surrogate grasslands. Opportunities to accomplish this are best offered by sites in the Driftless Area in both the Western Coulees and Ridges and Southwest Savanna ecological landscapes. Unlike many of the remnants in southeastern and south central Wisconsin (the southern Kettle Moraine being the exception), the steep slopes, shallow soils, and rougher topography of the Driftless Area have retained areas with unplowed sod, which may harbor seeds and other propagules of native species but also the native microflora and fauna associated with the uncropped substrate.

Open-grown bur oaks dominate this remnant oak opening in western Waukesha County. Grazing has maintained savanna stand structure, but the understory is now dominated almost entirely by nonnative plants. Southeast Glacial Plains Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

The southern portion of southeastern Wisconsin's Kettle Moraine region is especially significant as savanna and prairie restoration activities have been occurring there for several decades, a substantial core of public lands well suited (really critical) to these activities exists, and public interest and support for doing work of this nature is high. Excellent partnerships have developed there between public agencies and NGOs (The Nature Conservancy, Waukesha County Land Trust, Friends of the Mukwonago River, and The Prairie Enthusiasts are just a few examples) as well as with many private individuals. Somewhat parallel situations exist in parts of the Driftless Area, though a majority of the public land base there is centered on the larger river corridors. At some of the sites undergoing restoration, the Oak Openings occur within a mosaic of vegetation types that included Wet-mesic Prairie, Southern Sedge Meadow, Calcareous Fen, and Emergent Marsh.

Among the subjects needing additional research are the importance of stand size and connectivity; variability in the spatial and temporal representation of mature trees; compositional differences across the community's Wisconsin range; demographics of the prevalent oak species; representation of native shrubs; the intensity, frequency, and timing of prescribed burns; and differentiating savannas (e.g., those from

which fire has been excluded for many decades) from oak woodland and oak forest. The significance and ecological roles of animals that had been present historically but that are now absent from the range of the Oak Openings such as elk (*Cervus canadensis*), Greater Prairie-chicken (*Tympanuchus cupido*), Sharp-tailed Grouse (*Tympanuchus phasianellus*), and Passenger Pigeon (*Ectopistes migratorius*) also need to be better understood. The Northern Bobwhite (*Colinus virginianus*) might be placed with this group of extirpated species as well.

Savannas on sandy or gravelly alluvium apparently existed on outwash terraces or islands within or in close proximity to several of the major river floodplains, especially in southwestern Wisconsin. To date, documentation of the composition, structure, and function of such alluvial savannas has been very limited, but this is an item that merits further investigation in the near future as good restoration opportunities may exist on some of the public lands bordering rivers such as the Mississippi, Wisconsin, Chippewa, Black, St. Croix, and others.

Wisconsin has a major role to play in the restoration and management of this globally imperiled natural community and is a legitimate focus of land management activities at appropriate sites scattered across southern and central Wisconsin.

Additional Information

For additional information, see the descriptions of Oak Woodland, Oak Barrens, Pine Barrens, Southern Dry Forest, Southern Dry-mesic Forest, Sand Prairie, Dry Prairie, Dry-mesic Prairie, and Mesic Prairie. In parts of southeastern Wisconsin, the descriptions of Wet-mesic Prairie, Southern Sedge Meadow, Calcareous Fen, and Emergent Marsh might also offer information of interest. The U.S. National Vegetation Classification (US NVC) type most closely corresponding to Wisconsin's Oak Openings is GEGL02020 North-central Bur Oak Openings (Faber-Langendoen 2001). The US NVC type CEGL005284 Chinquapin Oak Limestone – Dolomite Savanna is generally found farther south, e.g., in Missouri, but there is at least one good quality occurrence in Wisconsin on dolomite bluffs near the Mississippi River.

Michigan and Ontario have described CEGL005120 Lakeplain Wet-mesic Oak Openings. This extremely rare natural community is possible in the southeastern corner of Wisconsin and northeastern Illinois within the Chiwaukee Prairie-Illinois Beach complex. There is also at least one occurrence of a wet-mesic savanna in south central Wisconsin, south of Madison (obviously this stand would not fit the "lakeplain" concept). More study is needed to appropriately describe and classify this stand. The proposed state name is Wet-mesic (Alluvial) Swamp White Oak Savanna with a state rank of S1.

Also see:

Bowles and McBride (1998)
Brawn (2006)
Bray (1960)
Bronny (1989)
Haney and Apfelbaum (1990)
Haney and Apfelbaum (1994)
Henderson (2005)
Henderson and Epstein (1995)
Hujik (1995)
Kline (1997)
Leach and Ross (1995)
Leach and Givnish (1999)
Nuzzo (1986)
O'Connor et al. (2009)
Packard (1988)
Packard (1993)
Stout (1946)
WDNR (2010)
White (1986)

FROM: Epstein, E.E. Natural communities, aquatic features, and selected habitats of Wisconsin. Chapter 7 *in The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management*. Wisconsin Department of Natural Resources, PUB-SS-1131H 2017, Madison.

For a list of terms used, please visit the **Glossary.**

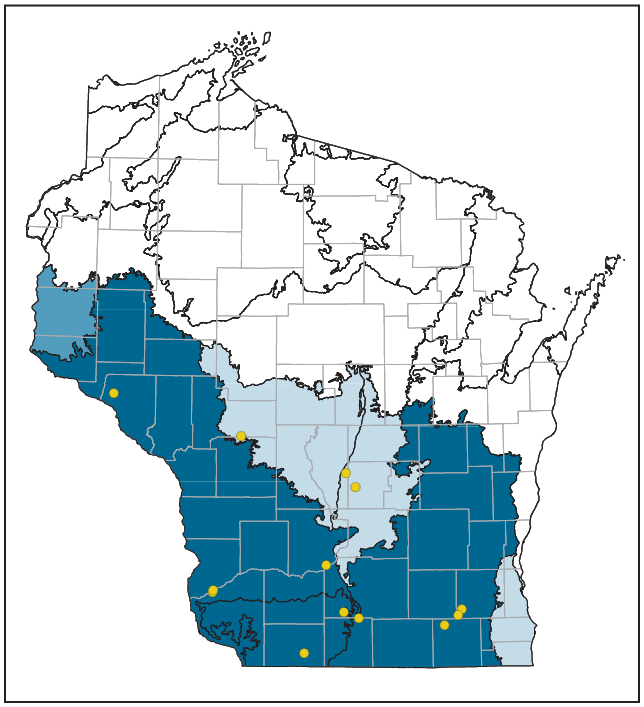
For a reference list, please see the **Literature Cited.**

Appendix 5. Oak Woodland Community Description (WDNR Ecological Landscapes of Wisconsin, 2015)

Oak Woodland (Global Rank GX; State Rank S1)

Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

Oak Woodland is an integral part of the fire-dependent oak ecosystem complex, which also includes oak-dominated savannas and forests. Structurally, canopy cover in Oak Woodland is greater than that characteristic of the true savanna communities such as the more open, sparsely timbered Oak Opening and somewhat less than or approaching the more densely canopied Southern Dry and Southern Dry-mesic Forests. Canopy cover in Oak Woodland exceeds 50% and may approach 100%. Though this community shares many attributes with savannas and dry forests, a key point in defining Oak Woodland is that the higher canopy cover in remnants or restored stands is not simply due to fire suppression and the subsequent proliferation of fire-sensitive woody species. Besides the higher density of trees and greater canopy cover, the trees in an Oak Woodland lack the short, large diameter boles prevalent in well-developed oak savanna, and the crowns do not exhibit a limb architecture characterized by widely spreading branches, nor will they necessarily have the same form as the narrow crowns entirely lacking the spreading upper limbs of an oak forest.



Locations of Oak Woodland communities in Wisconsin. The deeper hues shading the ecological landscape polygons indicate geographic areas of greatest abundance. An absence of color indicates that the community has not (yet) been documented in that ecological landscape. The dots indicate locations where a significant occurrence of this community is present, has been documented, and the data incorporated into the Natural Heritage Inventory database.

It is thought that frequent fires of low-intensity maintained the understory in an open condition, free of dense growths of shrubs and saplings. It is possible that browsing by large herbivores such as elk and white-tailed deer also played a role in maintaining open understory conditions in this type prior to settlement by Euro-Americans. Though little is known about the historical extent or composition of Oak Woodland, it appears that at least some of the characteristic understory plant species (certain legumes, composites, and grasses among them) may reach their greatest abundance here.

The historical range of this type would have basically coincided with the range of other Oak Savannas, especially Oak Openings and perhaps dry hardwood forests dominated by white oak, which occurred mostly south of the Tension Zone in the Central Sand Hills, Southeast Glacial Plains, Southwest Savanna, and Western Coulees and Ridges ecological landscapes.

Community Description: Composition and Structure

Because so few intact examples have been identified and even fewer described in detail, information on composition is somewhat speculative. The canopy dominants on dry-mesic, mesic, and some dry sites in southern Wisconsin are oaks, commonly including white oak (*Quercus alba*), bur oak (*Q. macrocarpa*), northern red oak (*Q. rubra*), and shagbark hickory (*Carya ovata*). Black oak (*Quercus velutina*) and/or northern pin oak

Oak woodland features high canopy closure, but the dominant oaks retain distinctive limb architecture, and the oaks' leaf mosaic allows more light to reach the ground than in stands being invaded by shade tolerant trees such as maples. Such stands are somewhat transitional between more open savannas and true forests. In some situations, they can be managed and maintained to help accommodate both forest interior animals and light-demanding understory plants that tolerate high filtered shade. Kettle Moraine State Forest – South Unit, Jefferson County, Southeast Glacial Plains Ecological Landscape. Photo by Drew Feldkirchner, Wisconsin DNR.

(*Q. ellipsoidalis*) would have been less common, and perhaps absent, on more mesic sites due to their shade intolerance and the competitive advantages some of the other oaks would have had in these environments.

The floristic associates documented by those collecting data that were later analyzed and presented in *The Vegetation of Wisconsin* (Curtis 1959) were compiled about seventy years ago. This was well after fire suppression policies had been widely implemented across the state, and therefore it is thought by some researchers that more of the understory plants representative of an Oak Woodland situation (higher canopy closure and less light reaching the surface) would still have been present and relatively easy to observe. Table VII-3 in Curtis (1959) (Appendix for Chapter 5, "Prevalent Groundlayer Species of Southern Dry Forest") would be worth taking a hard look at for clues to the composition of some oak woodlands during the mid-20th century.

Some members of the Oak Woodland flora are thought to belong to genera or families that are also common in other communities in the oak ecosystem group but represented by a different set of species (belonging to genera that include as members composites, grasses, legumes, mints, and snapdragons). Examples of species observed in and thought to be possibly representative of oak woodland environments include figwort giant hyssop (*Agastache scrophulariaefolia*), poke milkweed (*Asclepias exaltata*), American bellflower (*Campanula americana*), wood thistle (*Cirsium altissimum*), long-bracted green orchid (*Coeloglossum viride*), bracted tick-trefoil (*Desmodium cuspidatum*), purple Joe-Pye-weed (*Eupatorium purpureum*), bottlebrush grass (*Elymus hystrix*), forest bedstraw (*Galium circaezans*), broad-leaved panic grass (*Dichanthelium latifolium*), Solomon's-seal (*Polygonatum biflorum*), Short's aster (*Symphyotrichum shortii*), and yellow-pimpernel (*Taenidia integerrima*).

This white oak-red oak-black oak woodland has been "thinned from below," and several prescribed burns have reduced the heavy shade created by the previously dense understory of deciduous shrubs and saplings. Legumes, composites, and other light-demanding herbs are now thriving in the understory. Rush Creek State Natural Area, Crawford County, Western Coulees and Ridges Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

Mixed stand of white, black, and red oaks is now managed with prescribed fire to restore and maintain open understory conditions and allow for the habitat needs of the more light-demanding herbs. Oak woodland is an important part of the continuum of fire-dependent communities occurring in southern Wisconsin. Rush Creek State Natural Area, Crawford County, Western Coulees and Ridges Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

Understory plants associated with oak savannas such as large-flowered yellow false foxglove (*Aureolaria grandiflora*), wild lupine (*Lupinus perennis*), and starry campion (*Silene stellata*) are also of potential or even likely occurrence within some oak woodlands. Species more often found in oak forest situations such as rough-leaved sunflower (*Helianthus strumosus*) and black-seeded rice grass (*Oryzopsis racemosa*) may also occur in Oak Woodland. Keep in mind that light conditions and the degree of shading may vary considerably within different parts of an oak savanna, oak forest, or oak woodland.

Plant species of high conservation significance owing to rarity or for other reasons would probably overlap with those more often associated with Oak Openings, at least to some degree. Examples include great Indian-plantain (*Arnoglossum reniforme*), purple milkweed (*Asclepias purpurascens*), yellow giant hyssop (*Agastache nepetoides*), violet bush-clover (*Lespedeza violacea*), snowy campion (*Silene nivea*), hairy meadow parsnip (*Thaspium chapmanii*), purple meadow-parsnip (*T. trifoliatum*), and white camas (*Zigadenus elegans*).

Characteristic animals may include not only typical savanna associates such as the Orchard Oriole (*Icterus spurius*), Eastern Bluebird (*Sialia sialis*), Northern Flicker (*Colaptes auratus*), and the declining Red-headed Woodpecker (*Melanerpes erythrocephalus*) but also species more often associated with hardwood forests, such as Great-crested Flycatcher (*Myiarchus crinitus*), Eastern Wood-pewee (*Contopus virens*), Red-bellied Woodpecker (*Melanerpes carolinus*), Blue-gray Gnatcatcher (*Polioptila caerulea*), and Yellow-throated Vireo (*Vireo flavifrons*). Several area-sensitive forest interior birds, such as Cerulean Warbler (*Setophaga cerulean*), Hooded Warbler (*Setophaga citrina*), and Acadian Flycatcher (*Empidonax virescens*), have been documented in Oak Woodland during their breeding seasons. Where stand size is sufficient, community structure is appropriate, and where Oak Woodland adjoins extensive areas of dry-mesic or mesic hardwood forest, it may be possible to maintain populations of these species.

Conservation and Management Considerations

Oak Woodland occurred south of the Tension Zone where it most often occupied a position in the continuum of fire-dependent, fire-maintained natural communities between oak savannas and closed hardwood forests. In the absence of fire or other disturbances, the ground layer was quickly overtaken by shrubs and saplings, and characteristic forbs and grasses were either suppressed and reduced in vigor or disappeared altogether.

Among the numerous obstacles preventing or impeding the conservation and maintenance of Oak Woodland are fire exclusion, logging of the large canopy oaks, livestock grazing, leaf litter build-up, and an increase in shrubs, saplings, and small trees, especially infestations of species formerly excluded or suppressed because of their sensitivity to periodic fire. Colonization by highly invasive species, many of them nonnative, is also a significant problem for managers. The lack of basic information on this segment of fire dependent oak ecosystems is another problematic factor.

The conservation focus will be on restoration, as remnants are either overgrown with woody understory plants or have lost their most characteristic understory species due to periods of prolonged grazing or the proliferation of invasive plants. Among the benefits to be gained by restoring and maintaining oak woodland is a clearer understanding that many of the native plant species that are currently declining in unburned oak "forests" will ultimately be lost from many parts of southern Wisconsin. Managing proactively for Oak Woodland using prescribed fire could alleviate or forestall this situation, at least locally.

As community stability is inherently low (or nonexistent) in the absence of periodic fire, there is a significant lack of information on the fire regime needed to restore and maintain an understory composed of native herbs in the Oak Woodland community. As a practical consideration, identifying and mapping stands of Oak Woodland using remote sensing imagery alone would be difficult or impossible. Canopy cover alone is not a criterion that will permit the planner, researcher, or natural resource manager to delineate occurrences of Oak Woodland with much confidence.

There are several factors that will aid in the differentiation of Oak Woodland from other fire dependent oak-dominated communities, such as oak savanna or oak forest. Among the potentially important clues to consider are composition of both the canopy and understory, limb architecture of the canopy trees, position in the local landscape with respect to physical features and other plant communities (which are the sources for recolonization of lost or depleted plants and animals from nearby woodland remnants), and perhaps most critically, the amount of light that reaches the soil surface.

The Oak Woodland type is NOT meant to simply indicate an overgrown Oak Opening in need of crown thinning—though that could be an appropriate, even necessary, management action for stands where more mesophytic tree species such as red maple, cherries, ashes, or ironwood have become part of the canopy.

More field inventory is needed to better characterize the community and identify restorable sites, especially those that occupy strategic locations bordered by oak savanna and oak forest. Managers of landscapes in which oak ecosystems are prevalent may be excellent sources of information, especially in areas such as the southern Kettle Moraine in southeastern Wisconsin or at scattered locations within the Driftless Area where management to maintain and restore savannas is an ongoing activity. This may be especially true in the vicinity of rough terrain bordering big rivers where the full complement of southern Wisconsin's fire-dependent natural communities is either present or could potentially be restored to functionality. Ideally these sites will be situated so that they can be managed with prescribed fire and, as needed and appropriate, by other methods such as brushing, judicious cutting, and limited herbicide use.

A potentially significant advantage to managers and conservationists when recognizing and managing Oak Woodland is that it can bridge the gap between stands managed to maintain or restore open savanna conditions with low tree cover of 10% to 50% and closed canopy forest. At some sites, this may mimic historical conditions and at others provide habitat for at least some sensitive forest interior species (Cerulean Warbler would be one of those). It would also mitigate some of the negative impacts associated with "hard," high contrast edge (such as excessive white-tailed deer (*Odocoileus virginiana*) browse, increased rates of brood parasitism and predation, and more competition from already abundant edge-adapted species).

It is possible, even likely, that important variants of Oak Woodland occur on wet-mesic, mesic, and very dry sites. However, at this time there is a lack of data sufficient to allow for the adequate description of additional oak woodland communities. Stands on extremely dry, droughty, low nutrient sites with coarse textured soils in which the dominant oaks are mostly black oak or northern pin oak may experience somewhat different disturbance regimes (for example, more frequent, catastrophic, stand-replacing fires) and require other management approaches—especially on sites that historically supported open barrens communities. These were most often in the sand country of central Wisconsin and on the broad sandy terraces bordering major rivers in southwestern Wisconsin.

Additional Information

Information on related vegetation types can be found in the natural community descriptions in this chapter for Oak Openings, Oak Barrens, Southern Dry Forest, and Southern Dry-mesic Forest. The U.S. National Vegetation Classification type most closely resembling Oak Woodland on dry-mesic to mesic sites is CEGL002142 White Oak – Bur Oak – Northern Red Oak / American Hazelnut Woodland (Faber-Langendoen 2001). However, CEGL002134 Central Midwest White Oak – Mixed Oak Woodland, though described for areas south of Wisconsin, and a wet-mesic type CEGL002140 Burr Oak Bottomland Woodland may also fit some Wisconsin occurrences with a bit of modification.

Special thanks to Wisconsin DNR botanist Rich Henderson for shedding light on many of the unknowns and other difficulties associated with this often-ignored and somewhat nebulous segment of the fire-dependent oak ecosystem continuum.

Also see:

Bray (1958)
Delong and Hooper (1996)
Gilbert and Curtis (1953)
Grossman and Mladenoff (2007)
Leach and Ross (1995)
Packard (1993)
WDNR (2010)

FROM: Epstein, E.E. Natural communities, aquatic features, and selected habitats of Wisconsin. Chapter 7 *in The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management*. Wisconsin Department of Natural Resources, PUB-SS-1131H 2017, Madison.

For a list of terms used, please visit the **Glossary.**

For a reference list, please see the **Literature Cited.**

Appendix 6. Southern Sedge Meadow Community Description (WDNR Ecological Landscapes of Wisconsin, 2015)

Southern Sedge Meadow (Global Rank G4?; State Rank S3)

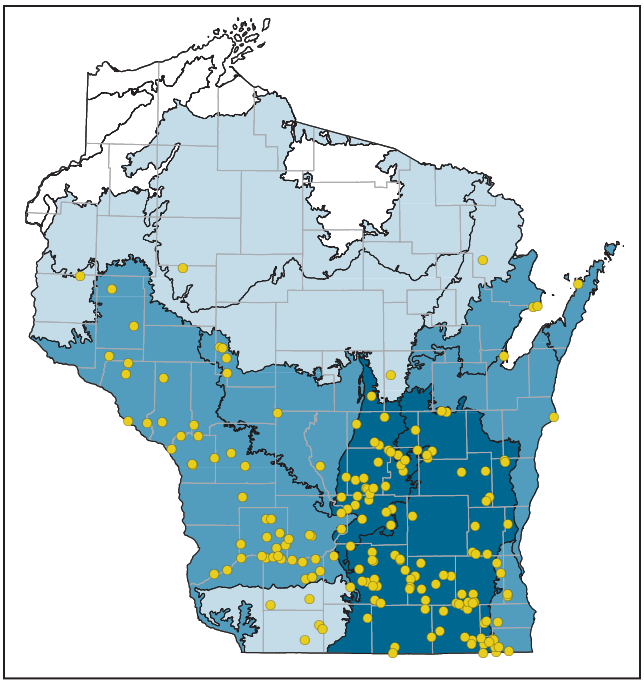
Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

Southern Sedge Meadow is an herb-dominated, minerotrophic wetland community that is most abundant south of the Tension Zone. Outliers are scattered across northern Wisconsin, but there the community is uncommon and of limited extent and supports fewer plant species of mostly southern distribution. Wisconsin's larger occurrences are situated in poorly drained glaciated terrain, especially on landforms such as till plain, lake plain, and outwash. Sedge Meadows are often associated with lake and stream margins. In southwestern Wisconsin's unglaciated Driftless Area, sedge meadows occur mostly along larger low gradient rivers and streams. Stands of Southern Sedge Meadow are also present along the upper reaches of some smaller Driftless Area streams, including headwaters areas, where groundwater seepage can be an important water source.

Soils are peats and mucks, which are usually alkaline, especially in regions of the state such as the southeast where the underlying glacial materials are calcareous, in contrast to the more acid peats and tills associated with the boggier habitats found throughout the north and within parts of central Wisconsin. Layers of marl or clay are sometimes present, and in some areas these help maintain saturated conditions throughout the growing season. In some locations sedge meadows have developed on mineral substrates, such as sands or clays, where the water table has remained high. Because they occupy some of the lowest elevations in a landscape, sites supporting sedge meadows may experience cold air drainage and fogs during the growing season and early fall frosts. The wet soils are slow to warm in the spring, retarding vegetation development.

The mosaic of wetland communities within which Southern Sedge Meadow occurred historically included marsh, fen, low prairie, shrub swamp, and lowland forest. Uplands adjoining Southern Sedge Meadow were vegetated with a mixture of prairie, savanna, woodland, and hardwood or mixed forest. Site hydrology, especially under the saturated or partially inundated water levels typically present in spring, is among the major factors that formerly maintained sedge meadow and prevented them from succeeding to communities dominated by woody vegetation. Another key disturbance factor was wildfire, which periodically burned the meadows along with nearby fire-adapted vegetation types such as prairies and savannas. Uplands bordering sedge meadows often supported fire-dependent vegetation such as mesic (tallgrass) prairie, oak savanna, oak woodland, and oak forest, and the fires that formerly maintained those communities sometimes burned the adjacent sedge meadows as well. Severe droughts, especially when prolonged for a period of years, also impacted sedge meadow by allowing for the establishment of shrubs and trees.

Much of the natural vegetation that historically bordered wetlands of all types in densely populated, heavily developed southeastern Wisconsin has been cleared and replaced by cropland, pasture, and residential or industrial areas. In parts of central Wisconsin, however, extensive areas of oak forest (much of it formerly savanna) are still prevalent on the uplands bordering wetlands. Where appropriate, and when not conflicting with other land management needs and goals, the reintroduction of fire would help to partially restore and maintain the mosaic of native communities formerly present in the region.



Locations of Southern Sedge Meadow in Wisconsin. The deeper hues shading the ecological landscape polygons indicate geographic areas of greatest abundance. An absence of color indicates that the community has not (yet) been documented in that ecological landscape. The dots indicate locations where a significant occurrence of this community is present, has been documented, and the data incorporated into the Natural Heritage Inventory database.

Many sedge meadows have been ditched or tiled in order to make them more suitable for agricultural uses; others have been inundated by dam and dike construction to enhance certain recreational activities or facilitate the passage of ships. In some areas, wetlands, including sedge meadows, were routinely filled or used as dumps.

Community Description: Composition and Structure

The dominant graminoid is most often tussock sedge (*Carex stricta*), a species that has tremendous influence on the structure and composition of Southern Sedge Meadow by providing microsites upon which other members of the community find suitable growing conditions. Other sedges common in or characteristic of this community are common lake sedge (*Carex lacustris*), water sedge (*C. aquatilis*),

Sartwell's sedge (*Carex sartwellii*), lesser panicled sedge (*C. diandra*), bristly sedge (*C. comosa*), and bottlebrush sedge (*C. hystericina*). Blue-joint grass (*Calamagrostis canadensis*) is a frequent associate and a co-dominant in some sedge meadows. Other grasses occurring in Southern Sedge Meadow are fringed brome (*Bromus ciliatus*), prairie cordgrass (*Spartina pectinata*), marsh muhly (*Muhlenbergia glomerata*), and fowl manna grass (*Glyceria striata*).

A diverse group of forbs is associated with Southern Sedge Meadow, including marsh bellflower (*Campanula aparinoides*), marsh fern (*Theypteris palustris*), tall meadow-rue (*Thalictrum dasycarpum*), sensitive fern (*Onoclea sensibilis*), northern water-horehound (*Lycopus uniflorus*), panicled aster (*Symphyotrichum lanceolatum*), shining-leaved aster (*S. firmum*), southern blue flag (*Iris virginica*), giant goldenrod (*Solidago gigantea*), spotted Joe-Pye-weed (*Eupatorium maculatum*), boneset (*E. perfoliatum*), great water dock (*Rumex orbiculatus*), marsh skullcap (*Scutellaria galericulata*), tufted loosestrife (*Lysimachia thyrsiflora*), purple-stem angelica (*Angelica atropurpurea*), meadow anemone (*Anemone canadensis*), turtlehead (*Chelone glabra*), swamp milkweed (*Asclepias incarnata*), swamp thistle (*Cirsium muticum*), brook lobelia (*Lobelia kalmii*), lesser purple fringed orchid (*Platanthera psycodes*), and Michigan lily (*Lilium michiganense*).

The complement of woody plants found in sedge meadows includes many shrubs that dominate or are common in Shrub-carr communities, such as red osier dogwood (*Cornus stolonifera*), silky dogwood (*C. amomum*), beaked willow (*Salix bebbiana*), pussy willow (*S. discolor*), sandbar willow (*S. exigua*), meadow willow (*S. petiolaris*), ninebark (*Physocarpus opulifolius*), nannyberry (*Viburnum lentago*), and white meadowsweet (*Spiraea alba*). Tree cover is low but may include seedlings and saplings of American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), and others deciduous species. The needle-leaved deciduous conifer tamarack (*Larix laricina*) is sometimes present.

Among the rare plants associated with Southern Sedge Meadow are snowy campion (*Silene nivea*), glade mallow (*Napaea dioica*), nodding rattlesnake-root (*Prenanthes crepidinea*), adder's tongue (*Ophioglossum pusillum*), and smooth-sheath sedge (*Carex laevivaginata*). Some of the more alkaline meadows, especially those that grade into or share groundwater sources with limy springs and/or rich (calcareous) fen vegetation, support specialists associated with open, high pH plant communities.

Animals of conservation concern inhabiting sedge meadows include American Bittern (*Botaurus lentiginosus*), Sandhill Crane (*Antigone canadensis*), Whooping Crane (*Grus americana*), Sedge Wren (*Cistothorus platensis*), Northern Harrier (*Circus cyaneus*), northern cricket frog (*Acris crepitans*), Blanding's turtle (*Emydoidea blandingii*), queensnake (*Regina septemvittata*), eastern massasauga (*Sistrurus catenatus catenatus*), western ribbon snake (*Thamnophis proximus*), Butler's garter snake (*T. butleri*), Baltimore checkerspot (*Euphydryas phaeton*), and Poweshiek skipperling (*Oarisma poweshiek*). Notable among the rare invertebrates that have been documented in Southern Sedge Meadow is the globally rare and U.S. Endangered Hines emerald dragonfly (*Somatochlora hineana*).

Conservation and Management Considerations

As with all wetland communities, protection of site hydrology and function are the paramount conservation concerns. Sedge meadows statewide, but especially in southern Wisconsin, have been ditched, drained, tiled, and grazed to expand areas of cropland and pasture or to create more suitable sites upon which to build homes, businesses, rights-of-way, and other infrastructure. In some areas, periodic wildfire historically played a key role in maintaining herb dominance and the open aspect of sedge meadows. Ditched or tiled stands in which the water table has been significantly lowered are either quickly converted to croplands or are invaded by woody plants, hastening succession to shrub swamp (usually Shrub-carr) or lowland hardwood forest.

Impoundments created by American beaver (*Castor canandensis*) activity can be problematic. While beaver dams may temporarily increase the local abundance of graminoid-dominated wetlands, they may take the place of riparian forests or shrub swamps, especially swamps composed of speckled alder (*Alnus incana*), bottomland hardwoods, or lowland conifers. It is desirable to have better basic information on the number, extent, and ecological impacts of these altered riparian areas. Where timber management is geared toward aspen production in or adjacent to stream corridors, beaver populations may quickly grow to levels that will affect wetlands by altering hydrology as flowing waters are converted to series of ponds and lakes.

Sedge meadows that have been subjected to prolonged periods of grazing by domestic livestock may be dominated by monotypic stands of reed canary grass (*Phalaris arundinacea*), a pernicious invasive that can also increase when sedge meadows receive excess sediment and nutrient runoff from surrounding

Tussock sedge and Canada bluejoint grass are the dominant graminoid plants in this sedge meadow bordering the White River in Green Lake County. Southeast Glacial Plains Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

Intact meadow of tussock sedge and Canada bluejoint grass borders this stretch of the White River in Green Lake County. Southeast Glacial Plains Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

uplands. The hooves of livestock can physically break down the sedge tussocks, reducing the availability of key microsites for other native plants and thereby diminishing overall floristic diversity (Werner and Zedler 2002). Grazing compacts soil in the hollows between sedge hummocks, altering drainage patterns and sometimes introducing weed propagules. This type of damage also makes it easier for shrubs to become established, eventually altering stand structure and shading out the more light-demanding native herbs. The absence of periodic wildfire, especially in situations where sedge meadows were integral parts of a vegetation mosaic of fire-dependent natural communities such as prairie, fen, and oak savanna, has also led to increases in woody cover. However, in stands damaged by past grazing, fire alone may not be sufficient to control invasive shrubs once they are established (Middleton 2002a, 2002b, 2004). In such cases, mechanical removal, chemical treatment, or other methods will warrant consideration.

In addition to reed canary grass, invasive plants that can alter, dominate, simplify, or otherwise degrade sedge meadows include common reed (*Phalaris australis*), narrow-leaved cat-tail (*Typha angustifolia*), hybrid cat-tail (*Typha* x *glauca*), and purple loosestrife (*Lythrum salicaria*). Exotic shrubs may also be problematic, especially common (*Rhamnus cathartica*) and glossy (*R. frangula*) buckthorns and Tartarian (*Lonicera tatarica)*, Asian fly (*L. morrowii*), and hybrid Bell's (*Lonicera* x *bella*) honeysuckles. Native shrubs such as dogwoods (*Cornus* spp.), ninebark (*Physocarpus opulifolius*), and white meadowsweet may also be serious problems in sedge meadows where the hydrology has been altered or fire has been excluded. Prolonged droughts can also accelerate the spread of woody species. Tree species capable of invading sedge meadows are American elm, box elder (*Acer negundo*), eastern cottonwood (*Populus deltoides*), quaking aspen (*P. tremuloides*), willows, (*Salix* spp.), and several ashes (*Fraxinus* spp.).

Protecting and, where needed, restoring wetland hydrology is the key to managing and maintaining diverse, functional sedge meadows. Appropriate management actions may include ditch filling, tile breakage, restoration of stream meanders, use of prescribed fire, cutting, and herbicides to limit the abundance of encroaching woody vegetation, modifying or eliminating dams that maintain artificially elevated water tables, and controlling the quantity and quality of runoff. Runoff carrying excessive amounts of silt, nutrients, herbicides, and pesticides is problematic and ultimately needs to be addressed at the source when possible, but the establishment of buffer areas between wetlands and adjacent croplands, heavily grazed pastures, construction sites, and residential developments can help lessen adverse impacts from these land uses.

Southern Sedge Meadow may grade into Emergent Marsh, Calcareous Fen, Wet-mesic Prairie, Wet Prairie, Tamarack (Rich) Swamp, or Shrub-carr. At some sites, individual wetland components of the vegetation mosaic around sedge meadows can be difficult to tease apart or delineate with precision. From a conservation perspective, the more important considerations are to identify those factors that are affecting and impacting the community, determining the habitat patch size and context needed by the plants and animals inhabiting the meadow and then incorporating that knowledge into development and implementation of a management and monitoring plan that is designed to effectively maintain the sedge meadow and the other communities occupying a given wetland—and the local watershed—over time. It would be useful to perform analyses designed to better assess the economic values provided to society by functional sedge meadows and other wetlands.

Additional Information and References

For related information, see the natural community descriptions for Northern Sedge Meadow, Emergent Marsh, Calcareous Fen, Wet Prairie, Wet-mesic Prairie, Shrub-carr, Alder Thicket, and Southern Hardwood Swamp. Southern Sedge Meadow corresponds most closely to the U.S. National Vegetation Classification type CEGL002258 Tussock Sedge - Sedge Species Herbaceous Vegetation (Faber-Langendoen 2001). Also, see "Beaver Meadow" in the "Other Selected Habitats" section of this document.

Also see:
Costello (1936)
Hipp (2008)
Kost and De Steven (2000)
Middleton (2002a)
Middleton (2002b)
Middleton (2004)
Peach and Zedler (2006)
Reuter (1986)
Van der Valk et al. (1999)
Werner and Zedler (2002)

FROM: Epstein, E.E.. Natural communities, aquatic features, and selected habitats of Wisconsin. Chapter 7 *in The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management.* Wisconsin Department of Natural Resources, PUB-SS-1131H 2017, Madison.

For a list of terms used, please visit the **Glossary.**

For a reference list, please see the **Literature Cited.**

Appendix 7. High Priority Species of Greatest Conservation Need (SGCN) for Dry Prairie in the Southwest Savanna and/or Western Coulee and Ridges (Wisconsin Wildlife Action Plan 2015)

Birds (11)	Herptiles (14)	Mammals (2)
Bell's Vireo Common Nighthawk Eastern Meadowlark Grasshopper Sparrow Lark Sparrow Loggerhead Shrike Northern Bobwhite Short-eared Owl Upland Sandpiper Vesper Sparrow Western Meadowlark	Blanding's Turtle Eastern Massasagua Gophersnake Lined Snake North American Racer Ornate Box Turtle Plains Gartersnake Prairie Ring-necked Snake Six-lined Racer Slender Grass Lizard Timber Rattlesnake Western Wormsnake Wood Turtle	Prairie Deer Mouse Prairie Vole
Terrestrial Insects (50) *Aflexia rubranura, Arphia conspersa, Arphia simplex, Atrytonopsis hianna, Attenuipyga vanduzeei, Bassareus lituratus, Brachypnoea convexa, Bruchomorpha extensa, Catocala abbreviatella, Catocala whitneyi, Chlosnye gorgone, Colapsis suggona, Cuerna sayi, Dichagyris reliqua, Dichromorpha viridis, Driotura robusta, Epeolus ainsliei, Eritettix simplex, Erythroneura carbonate, Fitchiella robertsonii, Glyptina brunnea, Hesperia ottoe, Herperotettis speciosus, Hesperotettix viridis, Kasendria kansiensis, Laevicephalus vannus, Melanoplus gladstoni, Melanoplus scudderi, Memnonia panzer, Mermiria bivittata, Myndus ovatus, Neolarra vigilans, Opeia obscura, Orphulella pelidna, Pachybrachis atomarius, Pachybrachis peccans, Paraphlepsius altus, Paraphlepsius maculosus, Paraphlepsius nebulosus, Polites origenes, Polyamia dilate, Prairiana cinerea, Prairiana kansana, Problema byssus, Rhynochomitra microrhina, Saxinis omogera, Schinia lucens, Speyeria idalia, Syrbula admirabilis, Triachus vacuus*		

Appendix 8. High Priority Species of Greatest Conservation Need (SGCN) for Dry-Mesic Prairie in the Southwest Savanna and/or Western Coulee and Ridges (Wisconsin Wildlife Action Plan 2015)

Birds (13)	Herptiles (3)	Mammals (4)
Bell's Vireo Bobolink Common Nighthawk Dickcissel Eastern Meadowlark Grasshopper Sparrow Henslow's Sparrow Loggerhead Shrike Northern Bobwhite Short-eared Owl Upland Sandpiper Vesper Sparrow Western Meadowlark	Blanding's turtle Lined Snake North American Racer	Big Brown Bat Eastern Pipistrelle Northern Long-eared Bat Woodland Vole
Terrestrial Insects (50) *Aflexia rubranura, Arphia conspersa, Arphia simplex, Atrytonopsis hianna, Attenuipyga vanduzeei, Bassareus lituratus, Brachypnoea convexa, Bruchomorpha extensa, Catocala abbreviatella, Catocala whitneyi, Chlosnye gorgone, Colapsis suggona, Cuerna sayi, Dichagyris reliqua, Dichromorpha viridis, Driotura robusta, Epeolus ainsliei, Eritettix simplex, Erythroneura carbonate, Fitchiella robertsonii, Glyptina brunnea, Hesperia ottoe, Herperotettis speciosus, Hesperotettix viridis, Kasendria kansiensis,*		

Laevicephalus vannus, Melanoplus gladstoni, Melanoplus scudderi, Memnonia panzer, Mermiria bivittata, Myndus ovatus, Neolarra vigilans, Opeia obscura, Orphulella pelidna, Pachybrachis atomarius, Pachybrachis peccans, Paraphlepsius altus, Paraphlepsius maculosus, Paraphlepsius nebulosus, Polites origenes, Polyamia dilate, Prairiana cinerea, Prairiana kansana, Problema byssus, Rhynochomitra microrhina, Saxinis omogera, Schinia lucens, Speyeria idalia, Syrbula admirabilis, Triachus vacuus

Appendix 9. High Priority Species of Greatest Conservation Need (SGCN) for Oak Opening in the Southwest Savanna and/or Western Coulee and Ridges (Wisconsin Wildlife Action Plan 2015)

Birds (7)	Herptiles (9)	Mammals (5)
Common Nighthawk Eastern Meadowlark Eastern Whip-poor-will Henslow's Sparrow Northern Bobwhite Red-headed Woodpecker Versper Sparrow	Blanding's Turtle Gopher Snake North American Racer Ornate Box Turtle Prairie Ring-necked Snake Six-lined Racerunner Slender Grass Lizard Timber Rattlesnake Wood Turtle	Big Brown Bat Eastern Pipistrelle Franklin's Ground Squirrel Little Brown Bat Woodland Vole
Terrestrial Insects (19) *Arphia simplex, Bruchomorpha extensa, Catocala whitneyi, Coelocephalapion decoloratum, Cryptocephalus cuneatus, Cuerna sayi, Dichromorpha viridis, Erythroneura carbonate, Hesperia metea, Hesperotettix speciosus, Lycaeides melissa samuelis, Melanoplus foedus, Pachybrachis atomarius, Paraphlepsius maculosus, Polyamia dilate, Prairiana angustens, Prairiana kansana, Speyeria idalia, Syrbula admirabilis*		

Appendix 10. High Priority Species of Greatest Conservation Need (SGCN) for Oak Woodland in the Southwest Savanna and/or Western Coulee and Ridges (Wisconsin Wildlife Action Plan 2015)

Birds (4)	Herptiles (6)	Mammals (5)
Cerulean Warbler Eastern Whip-poor-will Red-headed Woodpecker Worm-eating Warbler	Blanding's Turtle Gopher Snake Ornate Box Turtle Prairie Ring-necked Snake Timber Rattlesnake Wood Turtle	Big Brown Bat Eastern Pipistrelle Franklin's Ground Squirrel Northern Long-eared Bat Woodland Vole
Terrestrial Insects (3) *Hesperotettix speciosus, Melanoplus foedus*		