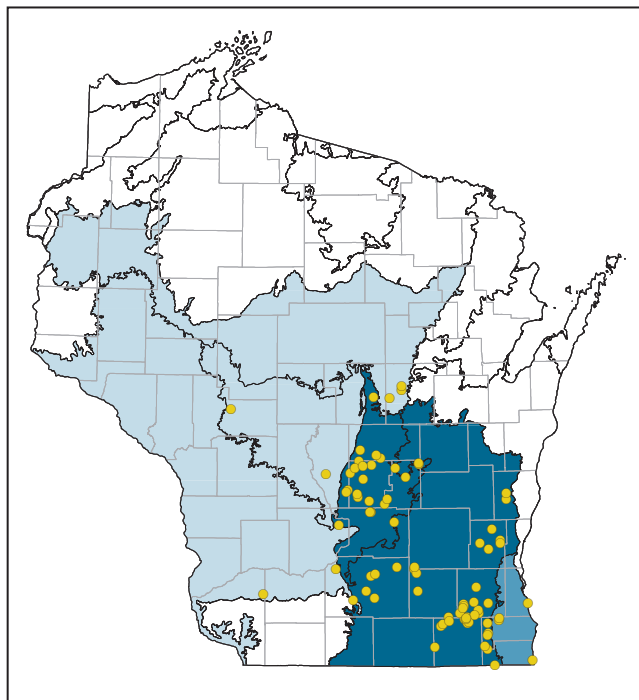


Calcareous Fen (Global Rank G3; State Rank S3)

Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

Calcareous fen is a highly minerotrophic wetland dependent on a constant internal flow of water rich in calcium or magnesium bicarbonates. The groundwater chemistry is strongly influenced by bedrock type and/or composition of glacial deposits. The majority of occurrences are south of the Tension Zone in glaciated areas underlain by calcareous till or bedrock. This calcareous substrate, whether derived from glacial material or bedrock, is the source of the calcium bicarbonates that give the Calcareous Fen its distinctive character. Fens may occur as peat mounds (created both by the accumulation of peat and artesian pressure), as seepage areas bordering calcareous headwaters streams, on the margins of alkaline drainage lakes, or on springy slopes from which alkaline groundwater is being actively discharged. “Hanging” or “perched” fens occur on slopes underlain by impervious substrates. The Calcareous Fen is a rare natural community in Wisconsin where it is concentrated and limited in distribution to a small number of ecological landscapes in the south, mostly within glaciated areas. The total extent of Calcareous Fens in Wisconsin doubtfully exceeds 1,000 acres, with very few of the individual occurrences more than 20 acres.



Locations of Calcareous Fen 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.

The saturated soils (very seldom inundated) are mucks, peats, or marls but may include areas or layers of mineral soils. Fens soils are typically circum-neutral to strongly alkaline (pH ranging from ca 6.6 to over 8.0) and rich on calcium bicarbonates. Peaty soils form when biomass accumulation exceeds the rate of decomposition.

Important microhabitats found within Calcareous Fen include marl flats, small pools, spring runs, and seepages. Each of these may support its own assemblage of associates, and these may include narrow, and sometimes rare, habitat specialists.

Calcareous Fens may occur as discrete patches of vegetation or as transitional areas that intergrade seamlessly with other native, nonforested lowland habitats found in southern Wisconsin such as Southern Sedge Meadow, Wet and Wet-mesic prairies, Shrub-carr, and Emergent Marsh. Some of southern Wisconsin's tamarack swamps support a component of the more shade tolerant fen plants, and some fens are, or were, associated with these outlying coniferous forests.

Wetland researchers have grouped Wisconsin's Calcareous Fens with “Temperate Zone Fens of the Glaciated Midwestern USA,” a region that includes parts of Ohio, northern Indiana, northern Illinois, Iowa, and southern Minnesota, southern Michigan, and southern Wisconsin (Amon et al. 2002).

The Southeast Glacial Plains Ecological Landscape contains an especially significant concentration of Calcareous Fens, but good examples are also known from the Central Sand Hills and Southern Lake Michigan Coastal ecological landscapes. A few Calcareous Fens have been reported from Wisconsin's Driftless Area in the Western Coulees and Ridges and Southwest Savanna ecological landscapes. To date these have not been adequately described or well documented, and the calcareous sedimentary rocks here are dolomites rather than limestones and therefore somewhat less soluble (compared to Iowa and Minnesota). In southwestern Minnesota, which was glaciated, fens are present, and these seem similar if not comparable to those in southeastern and south central Wisconsin.

Community Description: Composition and Structure

Descriptions of Calcareous Fen from elsewhere in its midwestern range generally describe them as herb-dominated communities; however, this is at least partially dependent on the type, frequency, and severity of natural disturbance, the mosaic of natural vegetation types present, and local effects of landform and waterbody.

Some of the more characteristic plant species in Calcareous Fen have restricted distributions and strong affinities for alkaline environments; others are more widely distributed and occur in many open wetland communities, including some that are most abundant well north of the Tension Zone.

Important graminoids for Calcareous Fens include sedges such as fen star sedge (*Carex sterilis*), prairie sedge (*C. prairiea*), water sedge (*C. aquatilis*), Buxbaum's sedge (*C. buxbaumii*), long-scaled tussock sedge (*C. haydenii*), broad-leaved woolly sedge (*C. pellita*), hard-stem bulrush (*Schoenoplectus acutus*), and the rare but sometimes locally abundant beaked spike-rush (*Eleocharis rostellata*). Prevalent grasses are marsh muhly (*Muhlenbergia glomerata*), big blue-stem (*Andropogon gerardii*), fringed brome (*Bromus ciliatus*), and tufted hairgrass (*Deschampsia cespitosa*). Others include prairie cord grass (*Spartina pectinata*) and fowl manna grass (*Glyceria striata*).

In addition to the graminoids mentioned above, forbs commonly found in—and that could be considered at least somewhat characteristic of—Calcareous Fen are Ohio goldenrod (*Solidago ohioensis*), Riddell's goldenrod (*S. riddellii*),



Calcareous fens occur in a variety of landscape settings, including spring-fed streambanks, shores of alkaline lakes, and on hillsides intersecting a perched water table. Pictured here is a good example of a mound fen, one of the rarest subtypes of calcareous fen. The mounds, composed mostly of peat, are caused by upwellings of calcareous groundwater. Marl is an accumulation of calcium and magnesium carbonates, which occurs around the groundwater discharge areas. The marl flats and the network of streams emanating from the mounds, provide microhabitats that support an unusual and specialized biota. Walworth County, Southeast Glacial Plains Ecological Landscape. Photo by Thomas Meyer, Wisconsin DNR.

fen grass-of-Parnassus (*Parnassia glauca*), brook lobelia (*Lobelia kalmii*), swamp-lousewort (*Pedicularis lanceolata*), edible valerian (*Valeriana edulis*), narrow-leaved loosestrife (*Lysimachia quadriflora*), swamp thistle (*Cirsium muticum*), Virginia mountain mint (*Pycnanthemum virginianum*), and purple-stem angelica (*Angelica atropurpurea*).

Herbs that are widespread in southern Wisconsin's open wetland communities but often common in fens are blue-joint grass (*Calamagrostis canadensis*), prairie cord grass (*Spartina pectinata*), fowl manna grass (*Glyceria striata*), tussock sedge (*Carex stricta*), marsh fern (*Thelypteris palustris*), boneset (*Eupatorium perfoliatum*), spotted Joe-Pye-weed (*E. maculatum*), tall meadow-rue (*Thalictrum dasycarpum*), marsh pea (*Lathyrus palustris*), northern blue flag (*Iris versicolor*), swamp milkweed (*Asclepias incarnata*), blue marsh violet (*Viola cucullata*), shining-leaved aster (*Symphyotrichum firmum*), paniced aster (*S. lanceolatum*), thick-spike blazing-star (*Liatris pycnostachya*), nodding lady's-tresses (*Spiranthes cernua*), and American water-horehound (*Lycopus americanus*).

Species associated with northern fens (there has been a long history in Wisconsin of calling virtually all open peatlands north of the Tension Zone "bogs" and applying that term to some of the southern fens as well if they support some of the species mentioned in this paragraph) include bogbean (*Menyanthes trifoliata*), northern bog goldenrod (*Solidago uliginosa*), twig-rush (*Cladium mariscoides*), rush aster (*Symphyotrichum boreale*), flat-top aster (*Doellingeria umbellatus*), and the very rare tufted bulrush (*Trichophorum cespitosus*). Woolly-fruit sedge (*Carex lasiocarpa*), one of the so-called wire-leaved sedges of "wiregrasses," is sometimes present, but this species is far more common and characteristic of open peatlands in northern Wisconsin where it is more widely distributed and is sometimes among the dominant plants. Insectivorous species are included with these species more often associated with northern peatlands and are represented by purple pitcher plant (*Sarrecenia purpurea*),



This wire-leaved sedge-dominated calcareous fen contains important microsites such as this alkaline pool. Numerous rare species have been documented here. Southeast Glacial Plains Ecological Landscape. Photo by Thomas Meyer, Wisconsin DNR.

northern bladderwort (*Utricularia intermedia*), and round-leaved sundew (*Drosera rotundifolia*).

Much of the information on the nonvascular plants of Wisconsin's Calcareous Fens, especially mosses and liverworts, is unpublished and difficult to access. In "southern" fens occurring within the glaciated parts of southern Minnesota, *Bryum*, *Campylium*, and *Drepanocladus* are among the important moss genera (MDNR 2005a). Some mosses collected from Calcareous Fens in Wisconsin include *Calliergon trifarium*, *Meesia uliginosa*, *Scorpidium scorpioides* (Christy 1982). D.M. Reed (1985) collected the following mosses from fen plots in southeastern Wisconsin: *Campylium stellatum*, *Cratoneuron commutatum*, *C. filicinum*, *Drepanocladus revolvens*, and *D. vernicosus*. Among the nonvascular plants, liverworts are also sometimes important community members in southern Wisconsin fens, but details were hard to come by.

Woody plants of low stature (less than 0.5 meters) such as shrubby cinquefoil (*Pentaphylloides floribunda*), sage-leaved willow (*Salix candida*), and Kalm's St. John's-wort (*Hypericum kalmianum*) are often present and may achieve high cover values, especially at sites from which fire has been excluded.

Trees and tall shrubs may invade Calcareous Fen, especially if fen hydrology and/or natural disturbance regimes have been altered by actions such as ditching, diking, or grazing or by the exclusion of fire. Tall shrubs inhabiting (or invading) Calcareous Fen include red osier dogwood (*Cornus stolonifera*), silky dogwood (*C. amomum*), ninebark (*Physocarpus opulifolius*), nannyberry (*Viburnum lentago*), and various willows (*Salix* spp.). Poison sumac (*Toxicodendron vernix*) and bog birch (*Betula pumila*) are common in some fens. Among the trees that are found in this community are quaking aspen (*Populus tremuloides*), American elm (*Ulmus americana*), and tamarack (*Larix laricina*).

Calcareous Fens are well known to botanists, ecologists, and plant-oriented naturalists for their diverse and unusual floristic content, which often includes rarities that are found at only a few sites or that rarely occur in other types of habitat. Rare or otherwise notable vascular plants found in this natural community include small white lady's-slipper (*Cypripedium candidum*), northern yellow lady's-slipper (*C. parviflorum* var. *makasin*), few-flowered spike-rush (*Eleocharis quinqueflora*), beaked spike-rush (*E. rostellata*), false asphodel (*Triantha glutinosa*), low nut-rush (*Scleria verticillata*), prairie straw sedge (*Carex suberecta*), lesser fringed gentian (*Gentianopsis procera*), hair beak-rush (*Rhynchospora capillacea*), mat muhly (*Muhlenbergia richardsonis*), cut-leaved water-parsnip (*Berula erecta*), Ohio goldenrod, common bog arrow-grass (*Triglochin maritima*), and slender bog arrow-grass (*T. palustris*). Several of these species grow primarily in microhabitats such as marl flats or spring runs, mentioned above in the "Overview" section.

Some of the characteristics offered in a functional Calcareous Fen that permit some of these specialists to persist in and even thrive in the fen environment include high levels of bicarbonates and sulfates, cold groundwater temperatures, and the nearly anoxic conditions associated with the peat soils.



The swamp metalmark is extremely rare in Wisconsin. It inhabits calcareous fens and a few other wetland communities that support its primary larval food plant, swamp thistle. Photo by William Bouton.

Rare or otherwise notable animals associated with Calcareous Fen are swamp metalmark (*Calephelis muticum*), liatris borer moth (*Papaipema beeriana*), Blanding's turtle (*Emydoidea blandingii*), and eastern massasauga (*Sistrurus catenatus*).

Conservation and Management Considerations

Effective conservation and management of fens requires a solid understanding of site-specific hydrology, especially when land uses and disturbances in the vicinity of water sources and recharge areas result in water diversions, water level fluctuations outside of the range of natural variation, or groundwater withdrawals. The source, chemical composition, and quantity of the water reaching the fen strongly influence the nature of the vegetation.

The key management consideration is the protection of site hydrology. A fen cut off from its internal source of carbonate-enriched water will lose its ability to support portions of its specialized biota. Restoration of previous hydrological disruptions such as channelization, ditching, tiling of adjoining croplands, dredging, and dam construction is necessary at some sites. American beaver (*Castor canadensis*) sometimes construct dams on spring runs or headwaters streams and can effectively convert the diverse fen habitats to more marshy environments that lack some or all of the fen specialists and may become dominated by a few species of tall graminoid plants such as cat-tails (*Typha* spp.) or the invasive common reed (*Phragmites australis*). Controlling aspen in the vicinity of fens is an important management option that can sometimes lessen or eliminate the need to actively remove beaver from outlet streams or spring runs.

Other important factors that can negatively impact fens include livestock grazing, which compacts the soil, destroys or otherwise alters the community structure of important microhabitats such as spring discharge areas and sedge tussocks, creates trails that channel water, and provides a means of spreading the propagules of invasive plants. Problematic

invasive plants at this time include glossy buckthorn (*Rhamnus frangula*), reed canary grass (*Phalaris arundinacea*), and common reed. Mining for marl formerly occurred in some southeastern Wisconsin fens, a practice that altered hydrology and destroyed much of the sensitive native vegetation.

The encroachment of herb-dominated open areas by woody species, including natives such as dogwoods (*Cornus* spp.) and quaking aspen, is a problem, and disturbances in the surrounding landscape that increase stand isolation and fragmentation while facilitating the spread of invasive species may also be serious problems. Impacts of these changes include limiting the suitability of fens to support animals, especially vertebrates that require extensive areas of open habitat, use multiple habitats to complete their life cycles, or depend upon seasonal dispersal to find suitable habitat in which to complete their life cycles. In the absence of periodic fire that co-occurred in the southern Wisconsin landscapes with fire-dependent communities such as prairies, sedge meadows, and oak savannas, the fens will likely become increasingly dominated by woody species, enter a shrub phase, and lose at least some of their light-demanding specialists.

Some reviewers felt that there was a “natural cycling” from herb to shrub to tree dominance and back in some Calcareous Fens (even in hydrologically intact occurrences), depending on the frequency and severity of natural disturbances such as fire and water level fluctuations. However, in the absence of active management, usually involving prescribed fire, cutting, and herbicide use, “modern succession” seems more unidirectional at this time, either toward shrub-carr or hardwood swamp or to marsh if flooding is prolonged or permanent and associated with water quality degradation. Many southern Wisconsin fens are now effectively separated from populations of species that are likely to be lost if local habitat changes (such as dense shade or strong competition) render growing conditions no longer suitable for some of the more sensitive fen biota. Soil studies from northern Wisconsin peatlands have shown alternating layers of moss, sedge, and woody peat, and this may also be the case at some Calcareous Fens in southern Wisconsin.

A potential threat to certain Calcareous Fens relates to recent changes in the wetland protection laws. Since, by definition, the water source maintaining Calcareous Fens is from the ground rather than over the surface, some hanging fens, or those situated in headwaters areas, could be considered “isolated” and lose the legal protection they had in the past (Bedford and Godwin 2003). The small size of many Calcareous Fens is another factor that makes them vulnerable on legal grounds. Even where Calcareous Fens have received a degree of legal protection, the recharge areas that sustain them are not protected.

Active management is often necessary to maintain the open conditions needed or favored by some of the more conservative plants and their associated invertebrates. As the

Calcareous Fen is a small patch community in Wisconsin, seldom exceeding 20 acres, management plans need to consider both the habitat requirements and disturbance sensitivities of the resident specialists. If fire-sensitive species are present, refugia should be designed for them within the fen during the site planning process, along with a monitoring plan to track population responses to management. Site isolation and destruction or degradation of the native grasslands within which many of the fens were historically embedded is a key factor when designing a viable management plan.

Development and implementation of a monitoring plan and the appropriate follow-up is essential when trying to determine both long-term and short-term impacts to species of high conservation concern, to the overall community, and to site hydrology due to management activities and land uses of the surrounding landscape.

Conservation significance of the Calcareous Fens has long been deemed high because of the rarity of the community and the large number of rare species that are dependent upon them. For many of the vertebrates, successful management will best be achieved by managing the fens as integral parts of natural community and habitat mosaics that include sedge meadow, prairie, surrogate grassland, oak savanna, and oak forest. Several sites in southern Wisconsin meet all or most of these parameters, including areas within the southern Kettle Moraine region, the Mukwonago River watershed, the White River-Puchyan Prairie area, and the Chiwaukee Prairie-Illinois Beach State Park complex.

Taxa in need of additional survey work include the invertebrates, mosses, and liverworts. The nonvascular plants can be important components of the organic soils (peats and mucks) and the living flora. Better documentation and status determination of the members of this group are desirable.

Additional Information

For information on similar or related natural communities, see the descriptions for Boreal (Rich) Fen, Poor Fen, Southern Sedge Meadow, Wet Prairie, Wet-mesic Prairie, Interdunal Wetland, Coastal Plain Marsh, Alvar, and Great Lakes Alkaline Rockshore. The U.S. National Vegetation Classification (US NVC) type most closely corresponding to our Calcareous Fen is CEG005139 Cinquefoil – Sedge Prairie Fen (Faber-Langendoen 2001). Several additional plant associations described in the US NVC are at least partial fits for Wisconsin’s Calcareous Fen.

Also see:

Amon et al. (2002)
Carpenter (1995)
Nekola (1994)
Nekola (2004)
Reed (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](#).