NATURAL SYSTEMS OF WISCONSIN
Fall 2007

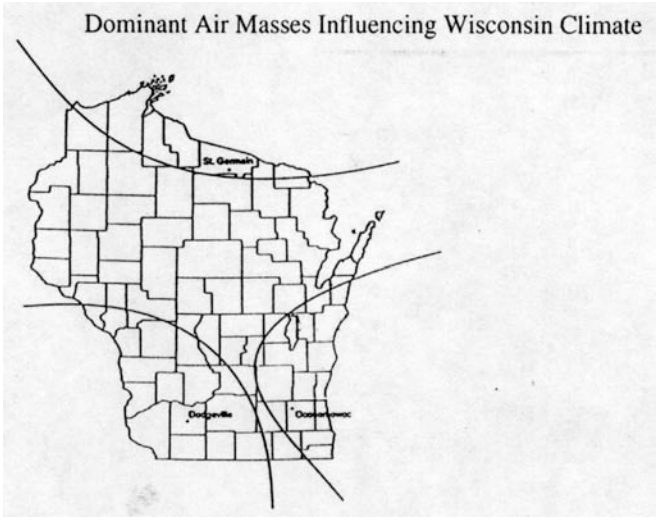
The pre-Euro-Yankee Wisconsin landscape had many diverse natural plant communities and associated groups of animals that were adapted to our variable, seasonal climate, and to the impacts (for example fire) of indigenous cultures. Most of the large tracts of native communities are gone now, but patches remain, some of which are protected under the State Natural Areas System, administered through the Department of Natural Resources.

The following description of the natural systems of Wisconsin is organized around the classification of Wisconsin plant communities developed in the 1950s by UW-Madison Botany Professor John Curtis and his students. The classification is based on: 1) botanical structure--the presence or absence of trees, the dominance of grasses, etc.; 2) geographic location, a designation which is in turn based on plant species range maps that create a "Tension Zone"; and 3) position along a moisture gradient. The techniques used to develop this classification -- ordinations-- represented pioneering efforts within ecology. Although several other classifications exist, the Curtis scheme is still widely used in whole or in part by conservationists and ecologists working in the state.

These notes are, of course, very incomplete. I hope they will give you at least a glimpse into the wonderful diversity of this part of the world. Use this summary as an introduction to the assigned readings from the Vegetation of Wisconsin (Curtis, 1959).

CLIMATE AND LANDFORMS

In order to understand the native plants and animals of Wisconsin, we need to become familiar with the regional climate and the shape of the land. Located in the interior of the world's second largest continent, Wisconsin's climate is primarily influenced by three large air masses: 1) arctic air from the north (often cold); 2) mild pacific air from the west (often dry; moisture is removed as the air mass passes over the Rocky Mountains); and 3) warm humid air from the Gulf of Mexico and the tropical Atlantic Ocean. The movement of these air masses influences daily temperatures and storm patterns. The pattern of movement creates geographical differences throughout the state.



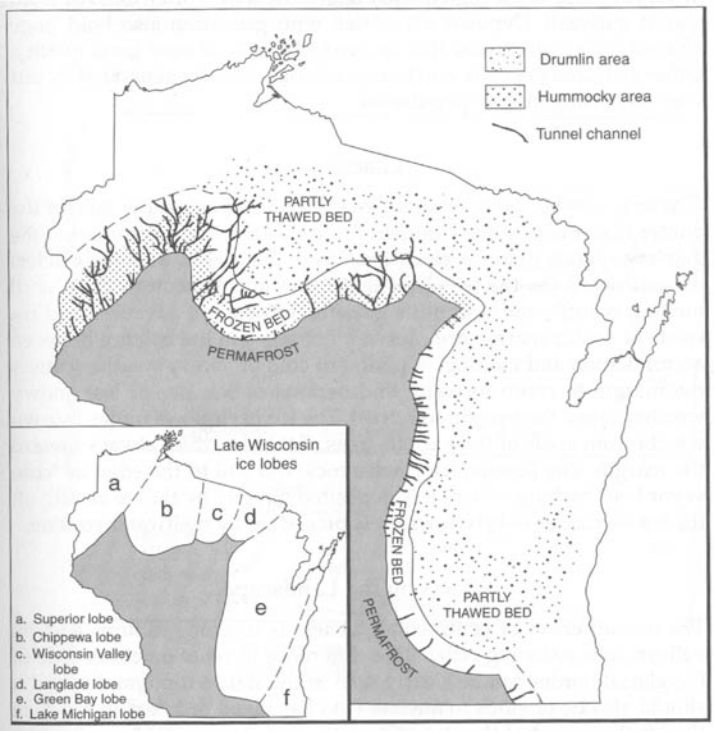
Taken and modified from Vale, Thomas R. 1997. "From End Moraines and Alfisols to White pines and Frigid Winters." In Wisconsin Land and Life. Robert C. Ostergren and Thomas R. Vale, editors. University of Wisconsin Press.

The climate exhibits strong seasonal patterns, with cold winters and warm summers. The climate is also quite variable from year to year, as shifts occur in the positions of the air masses. These changing conditions bring summer or winter drought years, short summers, mild winters, etc. The patterns remain difficult for people to predict, and the ability to respond to varying conditions appears to have been part of the evolutionary selection pressure on native plants and animals.

Late January is generally the coldest time of the year, with temperatures in northern Wisconsin being colder than those in the south, largely due to more frequent outbreaks of cold arctic air. The normal daily minimum temperature is between 0 and 5° F in northern Wisconsin and 5 to 10° F in the south. July and August are the warmest months, with temperatures in the lower 80s in the north to the 90s in the south. The tropical air masses that dominate in the summer also bring high humidity.

Precipitation occurs all year, with the driest months generally being January and February. In winter, precipitation is usually in the form of snow, with snowfall being more consistent and abundant in northern than in southern Wisconsin. Thunderstorms are frequent in spring, and especially in summer, often accompanied by high winds and hail. Tornado outbreaks are not uncommon. June is normally the wettest month.

The Wisconsin landscape is essentially a rolling plain, with few abrupt changes in elevation. Still, Wisconsin landforms, though not so dramatic as the mountains of the west, are quite varied, largely as the result of the multiple glaciations that have visited the area. The final ice advance entered the state approximately 23,000 years ago. There were 6 lobes of this "Wisconsin" glaciation that influenced most of the state with the exception of the southwestern corner—the "Driftless Region".



From: Mickelson, David M. 1997. "Wisconsin's Glacial Landscapes" pages 35-48 in Wisconsin Land and Life. Robert C. Ostergren and Thomas R. Vale, editors. University of Wisconsin Press.

The general effect of the glaciers was to erode hills and fill valleys, thus leveling the landscape. In the process, the glaciers left behind deposits of ground-up rock of various shapes and sizes. These deposits hold large amounts of ground water, afford structural stability, and buffer against floods. The glaciers also created numerous rather gentle landforms such as moraines, drumlins and eskers, and thousands of lakes. (Bascom and Observatory Hills as well as Madison's lakes are remnants of the last glaciation.)

The Driftless Area, in contrast, is a region of relatively steep stream-cut valleys or gorges. Natural lakes are absent, streams and rivers common. There may be a total of 300 feet of elevational difference between the top and bottom of a Driftless Area ridge and valley. The magnitude of this difference leads to only subtle changes in vegetation as a response to elevation. Of more importance are the microclimate differences attributable to degree of slope and slope aspect.

Map. 2. Driftless Area.

From Fassett, Norman C. 1976. Spring Flora of Wisconsin. University of Wisconsin Press

THE TENSION ZONE

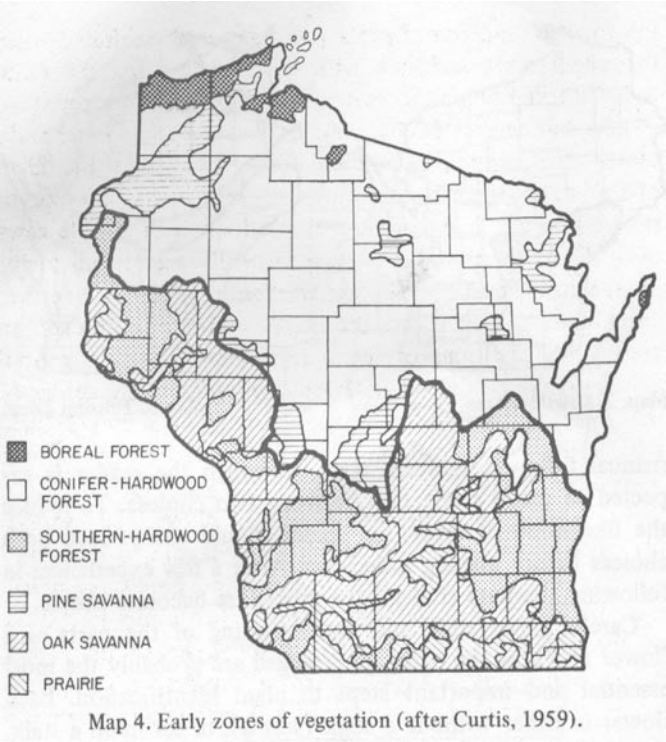
Botanists have long recognized that plant species are not uniformly distributed across Wisconsin. There are two sets of species, one found in the north, the other in the south, separated by a narrow band containing elements of each. This band--the "Tension Zone"-- is defined by the range limits of a number of species, and marks the northern limits of southern species and the southern limits of northern species. The band runs northwest to southeast, and is from 10 to 30 miles wide.

Map 3. Tension Zone.

From Fassett, Norman C. 1976. Spring Flora of Wisconsin. University of Wisconsin Press

The set of species found south of the Tension Zone is often referred to as the "prairie-forest" flora, and that found north of the zone the "northern hardwoods flora". There are also many species that range throughout the state.

As might be expected, the range limits of many animals also are shaped by the Tension Zone, and the shape of the band also correlates with several climatic factors. For example, areas of the state north of the Tension Zone have, on average, shorter growing seasons, and less total precipitation, but more precipitation in the form of snow than areas to the south.



Map 4. Early zones of vegetation (after Curtis, 1959).

From Fassett, Norman C. 1976. Spring Flora of Wisconsin. University of Wisconsin Press

A NOTE ABOUT THE ANIMALS

Prior to Euro-Yankee settlement, a great variety of birds, mammals, reptiles, and invertebrates inhabited Wisconsin. They were adapted to the structure of the native vegetation and to the seasonal climatic cycles that greatly influenced the availability of cover and food. Many animals moved between vegetation types, so it is often difficult to separate "forest species" from "grassland species" (of course, the same can be said for many plants, such as the wild strawberry!) Nevertheless, I have included notes about animals in some of the sections that follow, mostly to get you thinking about how their habits are shaped by the nature of the vegetation.

Many native animal species still remain; some, such as the white-tailed deer and the northern cardinal, have even increased in number. We have also added species, some of which have proven to be more desirable than others -- the English sparrow, the European starling, the zebra mussel. Because of active conservation efforts, we have managed to rescue species that had been on the decline for many years – the bald eagle, the timber wolf, the sandhill crane, and the prairie chicken. Sadly, however, we have lost quite a few. One of the most disturbing stories, at least to me, is that of the Passenger Pigeon (*Ectopistes migratorius*), which, of course is not only absent from Wisconsin, but is now extinct.

The passenger pigeon was similar to, but larger than a mourning dove. It had a slate-blue head and rump, a slate gray back and a wine red breast. Estimates in the 19th Century put its abundance at from 1 to 4 billion. There were reports of flocks that were so large that they darkened the sky as they passed.

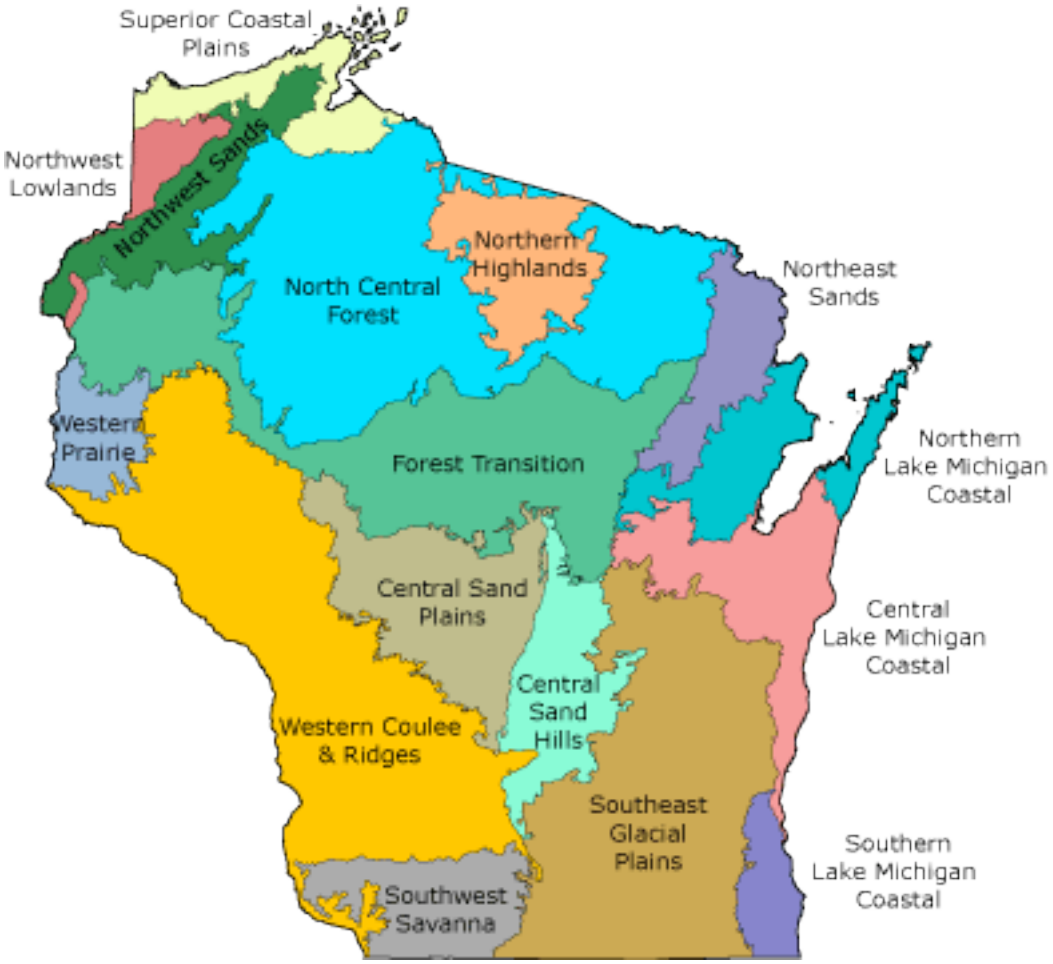
The birds were often summer residents of Wisconsin in years in which their preferred food crops—oak acorns and beechnuts – were abundant. They nested in large colonies, sometimes having 100 nests in a single tree. In the 1850s, the birds always appeared in the Madison area in February and March, on their way north from southern over-wintering spots. They moved through again in the fall.

The last wild pigeon known from Wisconsin was shot near Babcock in 1899. The last known individual, "Martha", died in the Cincinnati Zoo in 1914 at the age of 29.

http://www.jcanu.hpg.ig.com.br/history/h4sep/h4sep01.html

ECOLOGICAL LANDSCAPES

Before going on to describe the major plant communities of Wisconsin, it is useful to recognize a set of geographical regions, designated by the Wisconsin Department of Natural Resources, based in large part on the vegetation and landform patterns described above. There are 16 separate regions. This classification ties Wisconsin's natural systems to particular spatial locations, and links sets of communities together into ecological landscapes.



http://www.dnr.state.wi.us/landscapes/

MAJOR COMMUNITIES OF SOUTHERN WISCONSIN -- THE PRAIRIE/FOREST PROVINCE

In presettlement times, the area south of the Tension Zone was a complex mosaic of grasslands, forests, savannas, and wetlands. The boundaries between these communities blended together and changed over time, influenced by drought cycles, and by the frequency of wildfires, many of which were apparently set by the resident American Indians. The drier the climate, and the more frequent the fires, the greater was the extent of the grasslands and savannas.

Forests

Forests are communities that are dominated by mature trees forming closed stands (more than 50% canopy cover). In southern Wisconsin, the trees are deciduous hardwoods. In many ways, the canopy trees shape the forest environment: influencing the amount of light that reaches the forest floor; the wind and humidity levels of the interior; and the fertility of the soil. The forests often contain three distinct vertical layers: 1) the canopy, consisting of the mature trees; 2) the midstory, formed of shrubs, vines and tree saplings;

and 3) the understory, with herbs, ferns, sedges, grasses, vines, and tree and shrub seedlings.

Seasonal cycles are evident. Due to the combination of changing sun angles and the seasonal loss of leaves, most light reaches the forest floor in March and April, and then again in October. In spring, the forest greens-up from the bottom, starting with the herbs on the forest floor, and ending with the canopy. Many of the wildflowers bloom before the canopy leafs out. Similarly, the trees and shrubs often bloom and set fruit before their leaves emerge. This allows wind-pollinated species to expose their flowers directly to the wind and presents the flowers of insect and bird – pollinated species more visibly to their pollinators. The spring expansion of leaves and flowers often requires a certain number of warm days. The string can be interrupted by cold weather and the count resumed with the next warm front. By midsummer, in many tree and shrub species, the buds for next year have been formed. In early fall, the plants prepare for dormancy. Growth ceases and starches and fats are stored. Nutrients are transferred from leaves to storage places in the roots and other tissues. The chlorophyll in the leaves breaks down, making photosynthetic accessory pigments visible, thus producing fall color. Finally, the leaves fall to ground, forming a layer of litter. Decomposition of the litter will take place, beginning the following spring, releasing any nutrients that remain in the fallen leaves.

There are three main forest types: the **mesic**, **xeric**, and **wet forests**.

<u>Southern Mesic Forests:</u>

The major trees of the mesic forests of southern Wisconsin include sugar maple, basswood, slippery elm, ironwood, and, in the eastern part of the state, American beech. These form a dense canopy that casts a deep shade over the interior in mid-summer such that midstory shrubs are very sparse. Most of the canopy species reproduce in the shade, thus maintaining their presence in the community for many generations, barring disturbance.

The understory herbs are predominantly spring bloomers. One of the most distinctive sets of these wildflowers are the **spring ephemerals**--species that grow very rapidly in early spring, frequently while snow is still melting, and bloom, set seed and go dormant in the few weeks before the leaves come out on the trees. Spring ephemerals include trout lily, spring beauty, toothwort, Dutchman's breeches, and false rue anemone. Other mesic forest wildflowers are adapted to growing in the deep shade. These include bloodroot, wild ginger, hepatica, and trillium. These, too, bloom in the spring.

Toothwort

Trillium

The mesic forests formed about 9.8% of the total land area of the state in presettlement times, and occurred in islands protected from wildfires in counties near Lake Michigan, in the Driftless Area, and in the present Green, Grant, and Sauk counties.

Southern Xeric Forests

Xeric forests were relatively uncommon in presettlement times, covering less than 4% of the total land area and occupying sandy soils, thin soils, and/or the south and west slopes of hills. Oaks – bur, red, and white—and shagbark hickory dominate these communities. Because the canopy created by these species is quite open, xeric forests may have an abundance of shrubs and vines creating a dense midstory (especially in the absence of fire). Prominent shrub species include dogwood, viburnum, red and black raspberries, blackberry, and hazelnut. The understory herbs include more species that bloom in late spring and summer and many species that produce nuts and berries. Characteristic species include lopseed, wild geranium, Solomon's plume, and Virginia waterleaf.

Ground fires influenced the character of the understory. Frequent fires resulted in an abundance of sedges and grasses; less frequent burns led to more shrubs and herbs.

Wild Geranium

Virginia Waterleaf

False Solomon's Seal

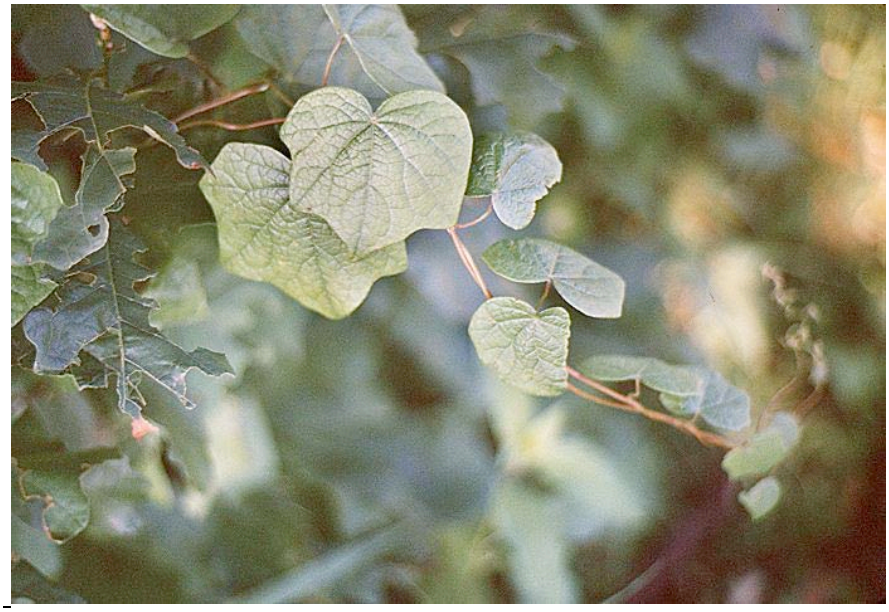
Southern Wet Forests

The major type of wet forest in southern Wisconsin is the floodplain forest, found along the banks of the major rivers -- the Mississippi, the Wisconsin, the Fox, the Sugar, etc. The dominant trees, including silver maples, American elm, green ash, cottonwood, river birch, black willow, and swamp white oak, form a loose canopy that lets in enough light to support a tall, lush herbaceous understory that is well-supplied with nutrients carried in by the spring floods. Among the more prominent species are nettles, the green dragon, woods phlox, and Virginia bluebells, as well as numerous sedges. Midstory shrubs are sparse -- perhaps because floodwaters are damaging to the stems -- but vines such as poison ivy, Virginia creeper, greenbriar, and carrion flower are abundant.

Because much of the ground is covered by water in the spring, the understory starts growing relatively late and many species bloom in summer. In addition, the roots of the trees are adapted to survive for long periods without access to oxygen. This feature makes floodplain species popular in urban landscaping where compacted soils also restrict oxygen in the soil.

Although floodplain forests have always occupied a rather small proportion of the land area of the state, they are an important factor in water quality management.

Green Dragon



Moonseed Vine

Forest Animals:

The birds, mammals, reptiles, and invertebrates of Wisconsin's deciduous forests are adapted to the structure created by the dominance of trees and to seasonal climatic cycles that greatly influence the availability of cover and food. Trees provide nest and den sites, food sources, and perches. Many animals nest in trunk or branch cavities. Some create the cavities themselves—woodpeckers and chickadees – others use natural cavities or old woodpecker holes. Others build nests of twigs, leaves, etc. that are supported by tree branches -- squirrels, for example. Many animals have the ability to climb trees in search of food or cover – the black bear, white-footed mouse, tree frogs, and the black rat snake are examples. Ground burrowing animals are also common (chipmunks). Relatively few animals build nests on the ground surface – the ovenbird is one exception. Dead wood (branches, twigs, trunks), collectively referred to as coarse woody debris, provides habitat for a number of animals.

The seasonal cycles of the vegetation have a strong influence on the habits of the animals. The flush of new leaves produced by the trees in the spring provides an abundance of food for caterpillars and leafhoppers. As the leaves "harden" and become less palatable, this food becomes less available for the foliage - eaters in summer, and disappears in the fall as the leaves drop to the forest floor. The litter so produced, in turn, provides an abundance of energy for the multitude of soil organisms—millipedes, fungi, bacteria. The insect populations supported by the spring and summer foliage are themselves an abundant energy source for nesting birds, many of which leave the forests in the fall as the insect populations decline with the advent of cold temperatures.

Summer fruits are often full of sugar and provide much needed energy to nesting species. Fall fruits often contain less sugar and more fat, just in time to provide fuel for the fall migrants. In late summer, look for the "foliar flags" which signal the availability of ripe fruit. Some species such as Virginia creeper and sumac display fall color before the trees and other shrubs do. The bright fall coloration attracts the attention of passing birds and animals that then feed on the fruit and thus disperse the seeds.

Some examples of forest animals include: wood turtle, spotted salamander, gray tree frog, wood duck, ruffed grouse, red-shouldered hawk, barred owl, eastern peewee, white-breasted nuthatch, wood thrush, red-eyed vireo, ovenbird, scarlet tanager, short-tail shrew, eastern chipmunk, gray squirrel, flying squirrel, white-footed mouse, gray fox, and the passenger pigeon (extinct).

Gray Squirrel 

Nuthatch

Forest-Edge Animals:

Many species lived along the edges of the forests and/or in savanna settings (see below). One reason for this distribution is probably because the species made use of several habitats—nesting in trees, but foraging in grasslands. Many of these "edge" species have adapted well to our human dominated landscape. Cardinals and indigo buntings may have originally inhabited openings in the forest. The flicker, blue jay, and northern oriole may have been savanna birds. Some of the forest-edge mammals include the eastern mole, the short-tailed shrew, the eastern cottontail rabbit, the woodchuck (groundhog), the fox squirrel, the red fox, and the white-tailed deer.

Savanna (Barrens)

Savannas, consisting of scattered trees in a matrix of grasses and herbs, were one of the most widespread communities in presettlement times; now, they are considered to be among the rarest, particularly those dominated by bur oaks. Much of the southern half of the state was a tapestry of savanna, woods and prairie, with the boundaries between these communities shifting with patterns of drought and fire.

The dominant tree species of southern Wisconsin savannas were oaks-- especially the fire-resistant bur oak. These existed as single specimens with low-growing branches, or in groves forming canopies of less than 50% cover. The understory was prairie-like in areas with little cover, and woods-like within the groves.

Savannas occupied many soil types from sands to loams. The sandy - soil savannas are sometimes referred to as “barrens”, because of their relative unsuitability for traditional agriculture.

One of the reasons that savannas are rare today is that the cessation of wildfires brought about with European settlement caused many of them to grow up into woods. Many others disappeared under the plow.

Prairie

Prairies are communities with less than one mature tree per acre and with more than one-half of their biomass contributed by grasses. Growing among the grasses are many species of non-grassy herbs known by the collective name of "**forbs**".

Brown-Eyed Susan

Prairie plants are adapted to drought, wind and fire. Much of the biomass of the community is contained beneath the soil in extensive root systems.

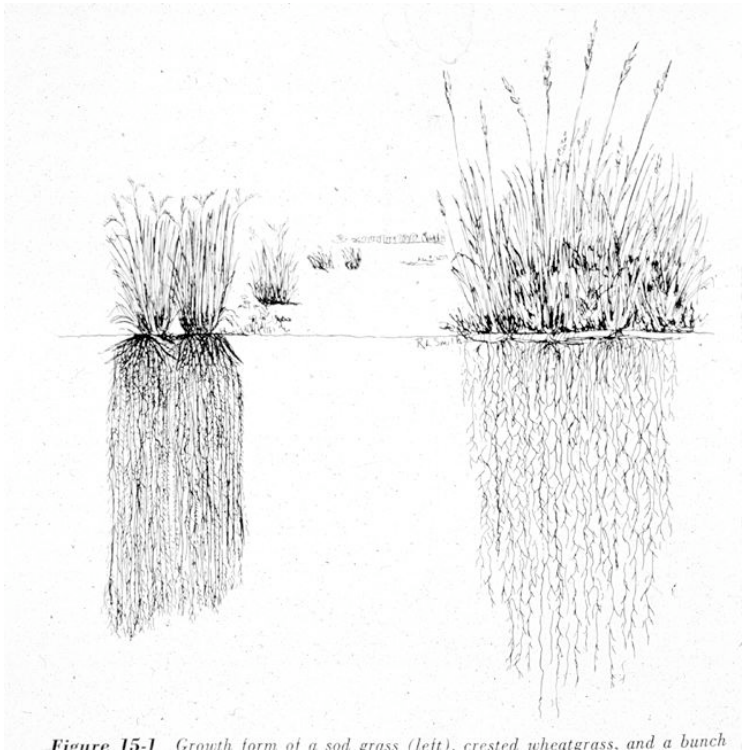


Figure 15-1 Growth form of a sod grass (left), crested wheatgrass, and a bunch

One of the striking adaptations of the grasses is to have the growing points of their leaves located at the base rather than at the tip. These "intercalary meristems" allow the plants to be able to easily replace tissue lost to grazing or to fire.

Grass leaves are narrow, an adaptationwhich prevents overheating by the sun and reduces wind resistance. The leaves are held vertically; in a habitat in which .light is plentiful, many vertical leaves allow large photosynthetic surface area without shading neighbors. One estimate is that 1 acre of prairie may contain 5 – 10 acres of leaf surface.

Grass leaves contain silica, a feature which helps deter grazing. The flowers of the grasses are wind pollinated, and the fruits are dry, compact, with high nutrient content

Forbs often have small leaves, thick leaves, and hairy leaves and stems. Adaptations which reduce heat load, water loss, help resist wind, and deter grazing.

As in the forests, the seasons strongly influence plant behavior. The plants become dormant in late fall, and the above ground parts die back. A distinct vertical structure develops as the plants start growing from the ground surface in spring, with some early-blooming species such as violets, remaining small and others, such as big bluestem, eventually reaching 10 feet in height. Something is in bloom and or fruit all of the growing season. Prairies have both cool season (C3) and warm season (C4) plants. Cool season species are photosynthetically active in spring and fall but relatively inactive in the heat of the summer. Warm season species start growth late in the spring (May) and are most active in the heat of mid-summer.

There are three major types of prairie in southern Wisconsin -- **mesic**, **xeric**, and **wet**.

Mesic Prairie

The mesic prairie occupied large patches of southern Wisconsin in presettlement times, forming the deep, rich agricultural soils that have been the foundation of much of our agriculture. In the vicinity of Madison there were two huge mesic prairies-- the Rock and the Arlington. The land was flat to gently rolling. There are only small patches left, often in cemeteries, on railroad rights-of way, or on roadsides. The mesic prairies were dominated by the tallest of our prairie grasses, big bluestem, as well as Indian grass. Prominent forbs included smooth aster, wild indigo, rattlesnake master, blazing star, yellow coneflower, black-eyed Susan, flowering spurge, and compass plant. The mesic prairie has a dense sod; with most of the soil surface and much of the profile occupied by plants.

Xeric Prairie

The xeric prairie occupies either the sandy soils of the central part of the state or the thin, rocky soils of limestone hills. The vegetation cover is less than that of the mesic prairie, and the plants often reach no more than 2 or 3 feet in height. Prominent species include

little bluestem and side-oats grama grasses, and forbs such as pasque flower, puccoon, bird's foot violet and silky aster.

Wet Prairie

Wet prairies are found in the flood plains of rivers and in other wet soil locations. This community is intermediate in cover and height. Leading species include blue-joint grass, slough grass, New England aster, bottle gentian, and Kansas gayfeather.

Prairie Animals

The abundance of grasses, the absence of woody tissue above ground, especially in the winter, and the relatively unimpeded sun and wind all contribute to shaping the adaptations of the animals that inhabited Wisconsin's prairies.

The prairies contained a wide variety of grass-eaters. Among the most noticeable were the large mammals such as bison. These mammals moved in large herds – herding is an anti-predator device—following the growth of grasses. The ruminant habit, in which animals store partially eaten grass in one section of the stomach from which it is later regurgitated and chewed further is also an adaptation which allows them to "eat and run" when necessary.

The prairie is also home to a wide variety of grasshoppers, insects with a relatively large volume relative to the surface area that helps prevent water loss and with a strong flying ability to help cope with the winds.

Many grassland species nest on the ground or in underground burrows, others produce young that quickly gain the ability to walk and run. Many species have brown and white-striped protective coloration.

Some of the birds, most notably the prairie chicken, stage elaborate courtship displays on the ground in early spring before the vegetation commences growth. Others use grass stalks as song perches.

The lack of plant and snow cover in winter makes conditions difficult for many species. Most of the birds migrate out. Many small mammals hibernate. Others such as the badger do not hibernate, but stay underground for long periods.

Examples of prairie animals include: ornate box turtle, glass lizard, garter snake, bull snake, upland sandpiper, prairie chicken, red-tailed hawk, horned lark, meadowlark, bobolink, dickcissel, brown-headed cowbird, thirteen-lined ground squirrel, Franklin's ground squirrel, deer mouse, meadow vole, timber wolf, and badger.

Marsh and Sedge Meadow

In addition to wet forests and wet prairies, southern Wisconsin has several other wetland communities. The most prominent of these are the sedge meadow and marsh.

Sedge meadow:

Sedge meadows are open communities (no mature trees) in which more than half the dominance is contributed by sedges rather than by grasses. The ground may be flooded in spring or after heavy summer rains, but typically it lies just above the permanent water table. Characteristic species include tussock sedge, joe-pye weed, boneset, meadow rue, and angelica. These communities are often recognized by the hummocks formed by the tussock sedges. These plants build up mounds of soil with layers of their roots. The long roots reach down to the water table when water levels are low in mid-summer, and the shorter, surface roots on the mounds are able to obtain oxygen when water levels are high.

Marsh:

Marshes are dominated by "emergent aquatics" -- species that are rooted under water, but which have stems and leaves rising above the surface. Cattails, reeds, and rushes predominate, with irises, arrowleaf, and several other species also being important. Marshes are typically found at the edges of ponds and lakes. These communities are very important for providing wildlife habitat, as well as acting as a filter for floodwaters.

Wetland Animals:

Many animals visit wetlands during all or part of the year. The marshes surrounding ponds and lakes are particularly important habitats for waterfowl, fish, and many invertebrates. Some characteristic species are rails, bitterns, ducks, the marsh wren, the red-winged blackbird, and the swamp sparrow. Sandhill cranes nest in marshes and feed in the surrounding uplands. Muskrats and minks are also common.

Sandhill crane, Campus Natural Areas

MAJOR COMMUNITIES OF NORTHERN WISCONSIN

Forests dominated the presettlement vegetation north of the Tension Zone, but this region also contained extensive tracts of open communities, including grasslands and bogs. One of the most noticeable differences between the vegetation of the north and that of southern Wisconsin is the prominence of evergreen conifer species in the north--particularly, white, red, and jack pine and hemlock.

Botanists have long speculated about why evergreen coniferous trees dominate in some areas and deciduous angiosperm trees in others. One line of reasoning concerns the advantages and disadvantages of the deciduous habit in a climate featuring seasonal water stress. The idea is that the seasonal loss of leaves is good for avoiding moisture stress in winter, and that doing so allows the trees to maintain broad leaves during the seasons in which conditions are favorable, thus allowing maximum photosynthetic light capture and gas exchange. The cost, of course, is the loss of energy and nutrients when the leaves are dropped. Evergreen conifers, on the other hand, better conserve nutrients and energy, as they do not need to replace all of their leaves each year. Evergreens can also have an extended growing season, as they can photosynthesize at any time in which the conditions are favorable. One cost is that in order to adapt to seasonal water stress, leaves are xeromorphic and less efficient in capturing energy and gas exchange. In Wisconsin, the climate north of the Tension Zone is such that a continuous snow cover often reduces water stress. In the south, snow cover is often absent. In addition, many of the soils in the north are poor in nutrients, a fact that also may tip the balance in favor of the evergreen conifers.

Forests

Northern Mesic Forests:

As is the case in southern Wisconsin, mesic forests in the north contain an abundance of sugar maple, but hemlock is of almost equal importance. Yellow birch also is an important component of this community. Some forest stands contain an even mix of both maple and hemlock; either one or the other dominates. The maple stands are very similar in composition to those of the south, having an abundance of spring ephemerals (with species related to, but not the same as, those in southern mesic forests), and a sparse midstory. The very deep shade cast year-around by the canopy in hemlock stands leads to a very sparse midstory and understory. Often, the only groundlayer that is found in these hemlock woods are patches of ferns in small openings between the trees.

There were large, contiguous stands of mesic forest in the north before Euro-Yankee settlement, and this was by far the largest community in Wisconsin. A few isolated relic stands can be found on steep north-facing slopes in southern parts of the state--for example in the Driftless Area of Iowa, Grant and Richland counties.

Northern Xeric Forest:

The northern dry forests are dominated by pine. The driest sites--those with sandy soils, for example, have jack pine. The more dry-mesic areas have red pine, mixed with red oak, red maple, and white pine. The evergreen trees that dominate these forests cast some shade all year, but the canopy is not dense, similar to the situation in the deciduous dry forests of the south. There is often a well-developed shrub layer, with species such as beaked hazelnut, dogwood, and dwarf honeysuckle. The understory contains a fair number of species with evergreen leaves -- pipsissewa, trailing arbutus, and wintergreen are examples. Other common herbs include gay wings, bunchberry, Canada mayflower, and starflower.

Gay Wings

Northern Wet Forests:

The most characteristic northern wet forests are the tamarack/black spruce bog forests, the white cedar/balsam fir conifer swamps, and the black ash/yellow birch hardwood swamps. These are found on low-lying ground in lakebeds and along river floodplains.

The bog forests may range from pure tamarack to pure black spruce; usually, the tamaracks are found in areas near an open bog mat, whereas the spruces are found on slightly higher ground. Tamaracks are conifers, but they are also deciduous, turning a golden yellow in the fall, and loosing their needles in winter. The spruces have dark foliage, with a distinctive spire shape.

Cedar swamps are very visually complex communities, with leaning trunks, a ground surface covered with mosses, and numerous herbs and ferns comprising the understory.

Cedar Swamp

Savannas

Northern savannas (Pine Barrens) have jack pine as the dominant tree, with some Hill's oak also present. The ground layer has numerous grasses, forbs, and shrubs, with bracken fern, blueberries, and sweet fern being among the more distinctive species. Pine Barrens are found on sandy soils.

Bogs

One of the most important wetland communities in northern Wisconsin is the bog. Bogs have soils primarily formed of peat, and are dominated by mosses--particularly *Sphagnum* sp. -- sedges and a set of shrubs and herbs that are adapted to grow in this specialized environment. Bogs generally are slow to warm up in the spring, thus leading to drought-like conditions for the plants. Their tops lose water in the warm spring sun while their roots are in frozen soil with little access to water. Nitrogen availability is also low in bogs, in part due to a low pH created by the sphagnum. One of the most important sets of shrubs is the "ericads"-- a family including bog rosemary, leatherleaf, bog laurel, and Labrador tea. Among the dominant herbs are insectivorous species such as sundew and pitcher plant.

Long Beech Fern

Big Leaf Aster

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Robbins, Samuel D., Jr. 1991. Wisconsin Birdlife University of Wisconsin Press.

Wisconsin Land and Life. 1997. Robert C. Ostergren and Thomas R. Vale, editors. University of Wisconsin Press.

Web Sites:

Check List of the Vascular Plants of Wisconsin
http://www.botany.wisc.edu/wisflora/

The Virtual Foliage home Page
http://botit.botany.wisc.edu/

Wisconsin Endangered Resources Program
http://www.dnr.state.wi.us/org/land/er/

The Prairie Enthusiasts
http://www.theprairieenthusiasts.org/

The Wisconsin Chapter of the Nature Conservancy
http://nature.org/wherewework/northamerica/states/wisconsin/

Ecological Landscapes of Wisconsin
http://www.dnr.state.wi.us/landscapes/

Illustrations:

Photos on pages 13, 16, the bottom of 18, , 21, 22, and 27 come from Dr. Virginia Kline's Teaching Collection, available on the Web under the Virtual Foliage Web Site listed above.

All other photos are by Evelyn Howell.

The sources for all other illustrations are found in the text.