WEEK 7. SAVANNAS

When the surveyors and settlers entered the glaciated lands north of the Shawnee Escarpment they found that closed and open canopy forests were the dominant vegetation of the vast Southern Till Plain Natural Division. Throughout the southern part of this region forest was the common vegetation type, though prairie openings were common, some being relatively large. Sometimes the transition from prairie to forest was abrupt, a wall of forest trees next to the prairie, but there was usually a gradual transition from forest to prairie. In leaving the forest, surveyors sometimes mentioned that the trees became scattered, the forest more open, and the understory "grassy" or "brushy." The trees of these openings commonly had an open-growth form, were scattered, but also had a clumped distribution. The surveyors commonly listed "hazelnut, briers, and vines" as the important plants of the understory. As they continued their surveys into central Illinois, prairie vegetation became more common, forest more restricted to rugged topography, and the transition between prairie and forest more diffuse.

When the surveyors and settlers entered central Illinois north of the terminal moraine of Wisconsin glaciation, they found open prairies some many miles across. This part of the state was subjected to Wisconsin glaciation that retreated from central Illinois about 18,000 years ago. Consequently the drainage systems were poorly developed; river valleys were shallow, the streams sluggish, and there were extensive poorly drained flat areas. Prairie swamps and marshes were common, and the surveyors recorded occasional shallow lakes and numerous small ponds called prairie potholes. Due to this wet soil, the lack of trees for lumber, and the harsh environment, settlers built their log cabins at the prairie/forest boundary, not on the prairie. With the establishment of railroads in the decade from 1850 to 1860, the prairies were rapidly settled.

In this recently glaciated land, commonly referred to as the Grand Prairie Division or black soil, tallgrass prairie of Illinois, prairies were the dominant vegetation. Closed canopy forests were found along the rivers and larger streams and other areas of rugged topography. Generally, between the forest and prairie there was a transition region where the forest "gave-way" to prairie. This transition could be relatively abrupt, or gradual, depending on topography, firebreaks, and prevailing winds. Called savannas or oak openings these transition zones covered extensive areas in the prairie peninsula. Many of the forests listed in the Government Land Office (GLO) survey notes were probably open woodlands and savannas, not forests.

Three savanna subclasses were defined by the Illinois Natural Areas Inventory (INAI): savanna, sand savanna, and barrens. Savannas were associated with black soil, tallgrass prairies and were further divided by moisture classes into dry-mesic savannas and mesic savannas based on soil moisture. Barrens are now considered as separate from savannas, occurring on different soils, and having a different developmental history. The so-called "barrens" or "brush prairies" many authors and some GLO surveyors described in the tallgrass prairie of the prairie peninsula are treated here as brush (or grub) savannas. The sand savanna communities are considered in a separate chapter.

Defining Savannas

The term savanna has been used to define a variety of plant communities found throughout the world in both temperate and tropical regions. Usually the term is used for a plant community composed of scattered trees that are associated with grasslands. In temperate regions it is generally defined as a community consisting of open-grown trees that are growing as scattered individuals or in small groves, with an herbaceous, primarily grassy ground layer. This definition is usually expanded to include plant communities that have a shrub layer within a grassy matrix in which the scattered trees may be reduced to

grubs, the result of frequent fires.

According to the INAI, savannas were generally considered to be communities with a grassy groundcover and an average tree canopy cover of less than 80 percent but greater than 10 percent. Savannas commonly had inclusions of shrubby areas and as a result the tree canopy could locally be greater or less than the above limits. Overall, areas with less than 10 percent canopy cover were considered prairie, areas with more than 80 percent cover were considered forest. The soils of the savannas were transitional between forest and prairie, were fine-textured, and derived from loess and glacial drift. Also, savannas had distinctive plant and animal associates and were maintained by fire in presettlement times.

The percentage of tree cover used to distinguish savanna from prairie and forests is arbitrary. Presently many ecologists consider that savanna communities have between 10 and 50 percent canopy cover, woodland have between 50 and 80 percent canopy cover, and forests have greater than 80 percent cover. Other classifications are also in common use. The Nature Conservancy considers savannas to have between 10 and 25 percent cover, with woodlands and forests more than 25 percent cover, and prairie with less than 10 percent. Sometime tree density is used to distinguish savanna, particularly if GLO survey data are being used to map vegetation types, with savanna having between 0.5 and 47 trees/ha. Probably the most realistic view is to define savannas as having more than one mature tree per acre (2.5 trees/ha), but less than 50 percent tree canopy cover. With less than 2.5 trees/ha the area is considered prairie, while forests would have more than 50 percent canopy cover. This means that if trees shade half of the ground area at noon in midsummer, the stand would be classified as a forest. No matter which classification is used, however, savannas represent part of a vegetation continuum between prairie and forest.

Origin of Midwest Savannas

The savannas of the Midwest occurred as a transitional region between the deciduous forests of the eastern United States and the prairies of the Great Plains to the west. This transitional zone occurred along the eastern edge of a large triangular-shaped grassland that extended from the Rocky Mountains east into the Midwest (Figure 7.1). This grassland becomes narrower to the east where it is referred to as the prairie peninsula that extends through most of Illinois into a part of northern Indiana and continued as a series of outliers in southern Michigan and central Ohio.

The rain shadow effect of the Rocky Mountains and the prevailing westerly winds resulted in a moisture gradient with low precipitation in the western part of the Great Plains that increased significantly to the east. Traditionally three major grasslands are recognized in this region. The western part of this immense grassland is dominated by short grass prairie where the grasses rarely exceed 45 cm in height. Farther toward the east, where more moisture is available, a mixed grass prairie association developed where the grasses grew to 2 meters tall. In the eastern portion of this grassland, which includes the prairie peninsula of Illinois, tallgrass prairie prevailed. Here the dominant grasses average between 2 and 3 meters in height. The increase in moisture from west to east created a climate that became progressively less suitable for growing grasses and more suitable for the growth of trees.

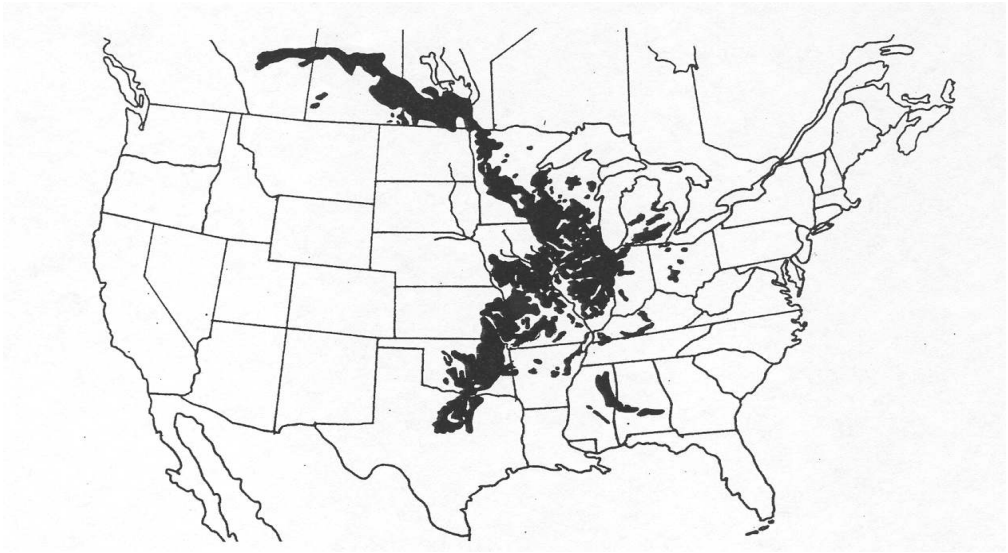

Figure 7.1. Distribution of the prairie-forest transition in North America.

The climate of the Great Plains is such that except for along some streams and other areas where water was available, trees could not survive. To the east in the prairie peninsula the vegetation was still dominated by grasses, though trees were common in areas of rough topography and along the major rivers and stream. Also, trees were encountered at the prairie/forest transition and prairie groves were scattered throughout the prairies. Just to the north and east of the prairie peninsula, however, forests prevailed though the precipitation was high enough in both regions to support trees.

The early work (1935) by Dr. Ernest N. Trauseau, a plant ecologist at the University of Illinois, revealed that the prairie peninsula has a lower mean precipitation/evaporation ratio than the adjacent forest regions to the north and east of the prairie peninsula. This suggests that the lower mean water balance in the prairie peninsula, when coupled with extreme drought conditions, could be lethal to trees. In drought years the amount of precipitation was commonly exceeded by the amount of water lost due to evaporation and run-off from the soils of the prairie peninsula. As a result, available moisture in the soil was less than what trees need for growth. This high water deficit, coupled with the lack of rainfall during the beginning of the growing season in April and May, would result in the death of many trees.

The savanna vegetation of the Midwest, particularly that of Illinois, shows the effect of this gradual increase in moisture availability. In this transition zone climatic conditions are variable with periodic droughts punctuated by periods of excessive moisture, and then periods when precipitation is sufficient during the summer month for tree growth and survival. Periodic droughts, that have occasionally been extremely severe in the prairie peninsula, have occurred even during historic times, the more recent being in 1913-14, and in the early 1930s. During these severe droughts many trees die, some from drought, others becoming susceptible to disease due to moisture stress. At the end of the 1913-1914 drought thousands of oaks bordering the Illinois prairies died, while hundreds of thousands of trees died in Iowa during the drought in the early 1930s. In eastern Nebraska 80 percent of the red oaks and basswoods within 25 km of the Missouri River died during the drought years in the early 1930s. In 1934 many trees in Trelease Woods, located in Champaign County, Illinois, began to lose their leaves in July, and some were killed by the drought.

Prairie grasses and forbs are better able to withstand drought than most trees. Though the above ground parts of these prairie plants are killed by low humidity and hot temperatures, the underground root systems are usually protected and commonly survive, sending up new shoots when conditions are more favorable for growth. Also, since soils recharge with moisture from the surface downward, soils that are not completely recharged due to a drought would have dry subsoil at the beginning of the growing season in April and May. This dry subsoil coupled with a dry spring would have a more detrimental effect on deep-rooted trees than on grasses with shallow root systems. Rains may not penetrate very deep into the soil, but the wetting of the surface soil supplies the water necessary for the growth of grasses, but not for the deep-rooted trees. To the east of the prairie peninsula the periods of occasional drought decreases, and the mean precipitation/evaporation ratio is higher. The more reliable, and slightly higher amount of reliable annual precipitation, favors tree growth, particularly during the summer months.

Fire and Savannas in the Prairie Peninsula

In presettlement times the northeastern border of the prairie peninsula was a broad mosaic of prairie, savanna, and forest that was primarily climatically induced but controlled by fire. These fires burned across the western prairies of the Great Plains as well as the prairie/forest transition of the prairie peninsula. Both natural fires, the result of lightning strikes, and those set by Native Americans and early European settlers repeatedly burned extensive areas of the Midwest. In many parts of the prairie peninsula these fires occurred yearly. Most fires occurred in the late fall, were set by Native Americans, and burned extensive areas, only being stopped by natural fire breaks such as water barriers or rough topography and wet weather.

Prairie grasses and forbs were mostly not affected by fire. The above ground parts of the prairie plants would be killed, but the perennial underground root systems were protected. Most trees, in contrast, were injured, and sometimes killed by a prairie fire, while recurring fires commonly killed many trees. These fires would top-kill most tree seedlings and many of the larger saplings and shrubs. Some of these top-killed individuals would re-sprout, but frequent recurring fires could result in a weakening of the root system and eventual death of many tree species. Generally the fire did not consume the larger trees. Instead the intense heat killed the phloem of the inner bark that transported nutrients and sometimes the sapwood (xylem), which transported water through the tree. By girdling the tree, the movement of food and water stopped and the tree soon died.

Fire frequency and intensity has had a major effect on the distribution and abundance of trees in the prairie peninsula. In years of normal precipitation fires in the closed canopy forests of the prairie peninsula rarely killed large trees, only affecting the woody understory and smaller diameter trees. In drought years, particularly on days with low humidity, high temperatures, high winds, and excessive fuel loads on the forest floor, crown fires could develop, killing many of the forest trees. Closed canopy forests rarely burned, however, except when located at the prairie/forest transition.

Most closed canopy forests were associated with areas of rough topography. Highly dissected landscapes do not carry fire well. Though fire moves up-slope quite readily due to rising convection air currents, these currents work against fires burning down-slope. Also, closed canopy forests create their own microclimate by slowing air movement, maintaining a high relative humidity, slowing the drying of accumulated litter, and lowering the air temperature within the forest. It is generally believed that these closed canopy forests in rugged terrain rarely burned, even in periods of extreme drought.

In the savanna and where closed forests occurred at the prairie/forest border, in contrast, fires were more destructive. Here the vigorous growth of grasses created a heavy fuel load of finely divided stems and leaves. The open nature of this fuel, along with low humidity, high temperatures, and wind resulted in very hot, fast moving fires. The trees of the savanna that were growing among the prairie grasses were sometimes top-killed during intense fires. When these fast moving, intense fires entered the closed forest at the prairie/forest boundary, they could top-kill trees for a considerable distance past the prairie boundary. The narrower bands of timber on the west side of rivers and other fire breaks in the prairie peninsula were the result of the prevailing westerly winds pushing these intense, fast moving fires into the forests. In presettlement Illinois the timber on the east side of a river was much broader than the band of timber to the west of the river. The recurring prairie fires were continually burning into these forests, killing many of the trees and increasing the extent of prairie. This pattern is obvious when the GLO survey plats are examined (Figure 7.2).

Prairie fires commonly killed isolated trees on the prairie and savanna. Mostly oaks, particularly *Quercus macrocarpa* (bur oak) and *Quecus alba* (white oak) were fire adapted, re-sprouting after being top-killed, and having a thick insulating bark that was commonly 4-6 cm thick. Also, oaks created their own firebreak. These large, open-grown trees with low branches created conditions unfavorable for the growth of prairie grasses and forbs beneath their crowns. As a result, shade-tolerant herbs grew under these trees, and did not create the high fuel loads commonly produced by prairie grasses. Also, leaf litter from these large oaks was generally blown away by the strong winds that were common on the open prairies and savannas. Commonly fires did not reach within 30 cm of the tree trunks, and the thick bark of these trees was sufficient to insulate the inner bark and sapwood from the heat of the fire.

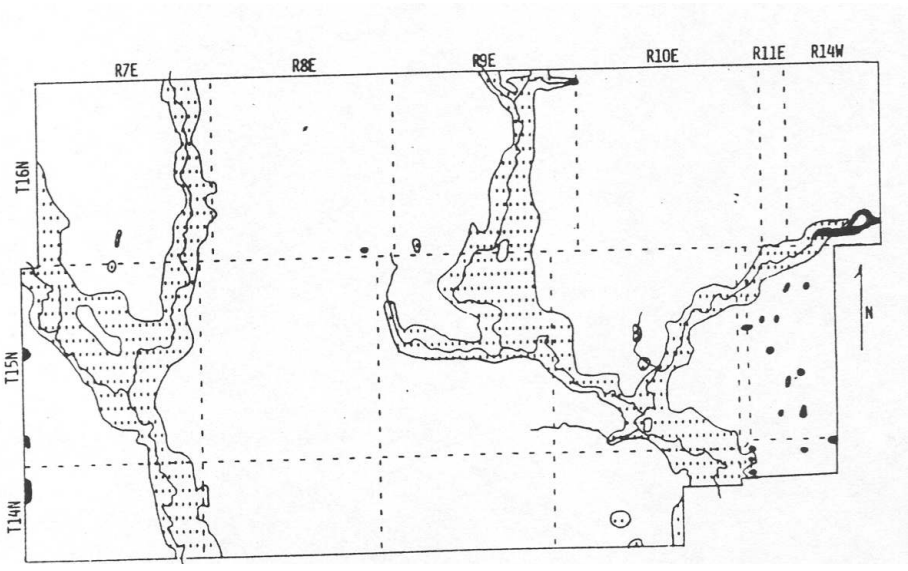

Figure 7.2. Presettlement vegetation of Douglas County, Illinois, showing the distribution of prairie and forest associated with the major drainage systems.

There are important differences between the presettlement fires and the management burns used to try and create and maintain open canopies in our present day nature preserves. Modern management fires, as well as the fires set by local farmers to maintain a grassy understory for grazing in the mid-1800s to about 1950, did not attain the

intensity, duration, and size of most presettlement fires. Most management fires in forests creep through the understory, top-killing woody seedlings and small saplings, but only occasionally injuring larger trees.

Structure and Composition of Savanna Vegetation

Savannas in presettlement time were widespread in North America, being distributed along the west coast in California and Oregon, and through the central portion of the United States. In both areas savannas were mostly a transitional community located between areas of forest and grassland or else they were isolated communities within forest or prairie. Generally considered to be a community consisting of large, open-growing trees scattered in grassland, the actual vegetation composition and structure of savannas is hard to determine, as few examples still exist. Essentially all of the original savannas of the Midwest have been lost due to agricultural activities, overgrazing, or fire suppression. At the present time savannas are considered one of the rarer natural vegetation types in the world.

At one time savannas occurred throughout Illinois except in the bottomlands of the Ohio and Wabash rivers in southern Illinois. Presently no detailed accounts have been found of savanna vegetation from near the time of European settlement. The majority of early information is available from two sources, causal accounts of travels and the GLO survey records. Accounts by travelers and early settlers generally mention the open, orchard-like, or park-like appearance of the savanna with scattered broad-crowned bur and white oaks with an understory of prairie species. GLO survey plats only distinguish forest and prairie. The distances of witness trees to the corner post in the GLO field notes, however, can be used to determine density (trees/ha) and therefore the presence of savanna vegetation.

The results of an age analysis of savanna trees suggests that recruitment of oaks into the savanna canopy is related to periodic events that may occur in northern Illinois and adjacent Wisconsin and Indiana only once in 35 to 100 years. In the small, degraded remnant oak savannas that still exist the oaks were commonly grouped into distinct age cohorts. This age distribution suggests that periodic, intense fires were interspersed with several years of low intensity fires or no fires. During these “windows” of opportunity, probably during wetter periods, fires were less common or less intense for 10 to 30 years. This allowed the grub sprouts to grow and to reach a size where they no longer would be top-killed by an average fire. In one study four cohorts of oaks were present in a degraded black soil savanna remnant in a Chicago suburb. The cohorts were 230-250 years old, 110-140 years old, 50-90 years old, and less than 25 years old when the study was done in 1990.

In 1946, Dr. A. B. Stout, of the New York Botanical Garden, published the following description of one of the few remaining bur oak openings in southern Wisconsin. “In this particular oak opening the trees are, I believe, all bur oaks (*Quercus macrocarpa* Michaux); but in some of the other oak openings of the area and especially on the belt of moraines there were trees of the white oak (*Quercus alba* L.). These oaks are all broad-topped and so spaced that seldom are the branches of two trees interlocked. Also they are rather uniform in size. There are no young trees or shrub growth anywhere in this grove nor has there been such growth here for at least one hundred years. Between the trees there is the firm turf of native grasses that has never been disturbed by cultivation. The entire area of this grove is almost level, as are the reaches of formerly prairie land that lie

adjacent. . . .“

The coming of European man into southern Wisconsin meant the demise of the savannas that Dr. Stout called oak openings. The land was fertile, there was sufficient timber for the immediate needs of the settlers, and the open stands of oak were so sparse that the trees were easily cleared. By the early 1900s the oak openings were converted into fields of corn, wheat, oats, and tobacco or were closed in with a growth of *Quercus velutina* (black oak), the result of fire suppression. By the time Dr. Stout wrote his article there existed only a few scattered remnants of the once numerous bur oak openings. Fifty years earlier the destruction of the savannas of Illinois was well underway.

Though most of the Midwest savannas were destroyed by agricultural practices, many “just grew into closed canopy forests”. All indications are that this was a rapid conversion, taking less than 30 years to complete. With the movement of European settlers into an area the yearly fires stopped. The numerous oak grubs that occurred in the understory were no longer burned back by the yearly fires. These grubs, with their massive root systems, had developed over many years in response to repeated fires. With fire suppression the basal sprouts from these grubs were able to continue growing, forming multiple-stemmed trees that soon filled in the canopy between the large open-grown bur oak. These overgrown savannas are occasionally found. On these sites a few old and gnarled oaks with their broad, open crown are scattered among numerous smaller diameter oaks with straight, long trunks, and narrow crowns. Remnants are still encountered, particularly in savanna areas that were settled in the late 1800s. In southern Wisconsin occasional oak forests still have these old savanna trees surrounded by forest grown trees.

Only a few degraded savanna remnants are known to exist in Illinois. No sizeable example of an intact deep-soil mesic savanna was located in Illinois by the INAI, and only one high-quality dry-mesic savanna covering 0.1 ha was identified. During the 1990s a few other degraded remnants were reported, but no large, intact, high quality savannas have been located. A few heavily degraded remnants have been studied which give some indication of the composition and structure of this very rare plant community.

One early savanna remnant is located at Wolf Road Prairie Nature Preserve in Cook County about 24 km west of Lake Michigan and near the northeastern boundary of the prairie peninsula. This 2-hectare savanna remnant persists on mesic silt loam soil because grazing was excluded and because it was frequently burned until about 1965. Presently this remnant has an open overstory canopy of mature bur oak and a dense 30-year-old subcanopy of bur oak and *Quercus ellipsoidalis* (Hill’s oak) that grew from oak grub sprouts after cessation of the annual fires in 1965. The ground layer in this degraded savanna remnant was dominated by shade-tolerant forest species that presumably have spread into the remnant during canopy closure. The mostly shade-intolerant prairie plants were restricted to the few remaining light gaps, and at the forest edge. Overall, species richness and the number of prairie species were highest at the highest light level while alien and forest species richness was highest under canopy shade.

As no high-quality savanna remnants are known from Illinois, little information is available concerning the ground layer species that were originally present in this community type. Available information, however, considers the savanna ground layer to be a mixture of prairie species and species adapted to shaded woodland and forest habitats. Since savannas represent a transition between prairie and forest, the ground layer species composition changes from open prairie to closed forest are gradual as individual species increase or decrease in abundance along a solar irradiance gradient. Numerous

factors other than light also effect this gradual shift in species composition, including soil depth and structure, soil disturbances, fire intensity and frequency, canopy extent and structure, plant species competition, plant/animal interactions, and many others.

The true dominants of savanna vegetation are the grasses, not the trees. The ground layer vegetation forms the community matrix in which the trees are the conspicuous, but only incidental members. In sunny parts of the savanna, prairie grasses dominated; *Andropogon gerardii* (big bluestem), *Sorghastrum nutans* (Indian grass), *Schizachyrium scoparium* (little

Table 7.1. Sites of occurrence and average frequency of ground layer species found in oak openings (savannas) in Wisconsin.

Species	Sites of Occurrence	Average Frequency
Amorpha canescens	79	33.8
Amphicarpaea bracteata	79	41.1
Andropogon gerardii	68	19.4
Anemone cylindrica	58	7.5
Antennaria neglecta	53	7.8
Apocynum androsaemifolium	68	19.5
Aquilegia canadensis	37	4.0
Aralia nudicaulis	42	8.0
Asclepias syriaca	37	1.3
Carex pensylvanica	32	8.4
Ceanothus americanus	63	10.3
Coreopsis palmata	63	14.4
Comandra umbellata	84	11.0
Cornus racemosa	79	21.8
Corylus americana	68	20.8
Dalea purpurea	63	12.7
Desmodium glutinosum	58	18.7
Dichanthelium leibergii	58	10.9
Euphorbia corollata	89	34.3
Fragaria virginiana	68	13.5
Galium boreale	79	33.2
Galium concinnum	42	12.1
Greranium maculatum	68	15.5
Helianthus laetiflorus	32	12.3
Helianthus occidentalis	37	5.3
Helianthus strumosus	47	13.3
Heliopsis helianthoides	42	22.1
Heterostipa spartea	58	8.5
Lespedeza capitata	47	7.9
Lithospermum canescens	68	14.6
Monarda fistulosa	84	23.1
Parthenocissus inserta	53	7.6
Phlox pilosa	42	3.0
Physalis virginiana	37	3.2
Poa pratensis	53	27.9
Polygonatum commutatum	53	3.8
Prenanthes alba	47	3.2

Pteridium aquilinum	37	5.9
Rhus glabra	53	8.4
Rosa sp.	84	22.5
Schizachyrium scoparium	58	12.2
Smilacina racemosa	79	12.1
Smilax herbacea	37	5.6
Toxicodendron radicans	58	12.5
Viola cucullata	42	5.8
Viola pedata	63	8.6
Vitis riparia	79	11.6

bluestem), *Panicum virgatum* (switch grass) and *Heterostipa spartea* (porcupine grass) being the most common. In shaded parts of the savanna the shade-tolerant woodland grasses and sedges became important, including *Agrostis hyemalis* (tickle grass), *Cinna arundinacea* (stout reed grass), *Diarrhena obovata* (beakgrass), *Elymus hystrix* (bottlebrush grass), various species of *Dichanthelium* (panic grass), *Carex pensylvanica* (Pennsylvania sedge), *Carex umbellate* (sedge), *Carex muhlenbergii* (Muhlenberg's sedge), and *Carex hirsutella* (hairy-leaved sedge). The prairie forbs also sort out to different habitats based on solar radiation, some species being adapted to full sunlight, others to lower light levels, and some to nearly complete shade. The woodland species associated with savannas were mostly shade-tolerant, and commonly found in areas where canopy cover was high.

Numerous species lists for Midwest savannas are available. Of these, a person who saw the "real thing" compiled the most comprehensive list. Dr. Samuel B. Mead, following 13 years of collecting and observations as he traveled his physician's rounds on horseback in then largely unsettled Hancock County, Illinois, published a list in 1846 in which he listed the plant species from various habitats. Barrens are one of the best-represented communities on his list and probably refer to the community type we now call savanna, and/or brush savanna. Though incomplete and probably giving too much importance to some species, it is a starting point for a comprehensive list of the savanna and/or brush savanna species of the Midwest. More recent lists are also available that give some indication of the abundance of the species in the ground layer of Midwest savannas. One list gives the prevalent ground layer species of the oak opening of southern Wisconsin (Table 7.1), while the second gives the common species found in eight silt loam pioneer cemetery savannas in northern Illinois and northwestern Indiana (Table 7.2).

Table 7.2. Percent occurrence of species occurring in eight silt loam pioneer cemetery savanna in northern Illinois and adjacent northwestern Indiana. Only species with a presence of 50% or greater are listed.

Species	Common Name	Percent Occurrence
Amorpha canescens	leadplant	50
Andropogon gerardii	big bluestem	88
Antennaria neglecta	pussy-toes	63
Antennaria plataginifolia	pussy-toes	63
Asclepias verticillata	horsetail milkweed	50
Aster ericoides	heath aster	50
Baptisia alba	white wild indigo	50
Carex bicknellii	Bicknell's sedge	63
Ceanothus americanus	New Jersey tea	63

Comandra umbellate	false toadflax	75
Desmodium canadense	hoary tick trefoil	50
Desmodium illinoense	Illinois tick trefoil	50
Dichanthelium acuminatum	panic grass	50
Dodecatheon meadia	shooting-star	50
Erigeron strigosus	daisy fleabane	75
Euphorbia corollata	flowering spurge	88
Fragaria virginiana	wild strawberry	50
Helianthus grosseserratus	sawtooth sunflower	50
Helianthus laetiflorus	hybrid sunflower	50
Heterostipa spartea	porcupine grass	50
Heuchera richardsonii	prairie alumroot	63
Hypoxis hirsute	yellow star grass	50
Lespedeza capitata	round-headed bush clover	75
Lithospermum canescens	hoary puccoon	50
Lobelia spicata	spiked lobelia	75
Monarda fistulosa	wild bergamont	100
Oligoneuron rigidum	stiff goldenrod	75
Oxalis violacea	purple oxalis	75
Parthenium integrifolium	American feaverfew	50
Pycnanthemum virginianum	common mountain mint	75
Ratibida pinnata	drooping coneflower	50
Rosa carolina	Carolina rose	88
Rudbeckia hirta	black-eyed susan	75
Salix humilis	prairie willow	50
Schizachyrium scoparium	little bluestem	75
Silphium integrifolium	rosinweed	88
Silphium terebinthinaceum	prairie dock	63
Sisyrinchium albidum	blue-eyed grass	75
Solidago juncea	early goldenrod	50
Sorghastrum nutans	Indian grass	100
Tradescantia ohiensis	Ohio spiderwort	63
Viola pratincola	common blue violet	63
Viola pedatifida	prairie violet	63

Brush Savannas

While surveying the prairie peninsula the GLO surveyors commonly reported brushy areas that they referred to as "barrens." Oak grubs dominated barrens and along with various shrubs sometimes formed impenetrable thickets, some more than a few km across. Important shrubs included *Corylus americana* (hazelnut), *Ceanothus americana* (New Jersey tea), *Prunus americana* (wild plum), *Zanthoxylum americanum* (prickly ash), *Rhus* spp. (sumacs), *Rubus* spp. (blackberries and raspberries), *Cornus* spp. (dogwoods), *Malus* spp. (crabapples), *Rosa* spp. (roses) and *Salix* spp. (willows). These so-called "barrens" contained many prairie grasses and forbs and are treated here as brush savannas since they occur on deep, black, silt loam soils derived from loess over glacial till.

Brush savannas were usually composed of thickets of oak grub and shrubs within a prairie matrix usually along with a few fairly dwarfed open-grown trees. These areas undoubtedly varied through both time and space, with the variations depending upon fire intensity and frequency. The same site, over a period of years may resemble: (1) a brush prairie with the prairie grasses and forbs hiding most of the oak grubs and shrubs, (2) a

brush savanna with the oak grubs and the taller shrubs overtopping the prairie grasses and forbs, (3) or an open savanna with a few scattered trees and the prairie grasses and forbs hiding the oak grubs and shrubs. Frequent fires would top-kill the oak grubs, intense fires would eliminate the few savanna trees, while less frequent, low intensity fires would allow the oak grubs and shrubs to survive forming the typical brush savanna.

Brush savannas were common in the prairie peninsula of Illinois, Wisconsin and Minnesota. Generally they existed as dense thickets of fire-stunted oaks and brush that from a distance were indistinguishable from the tallgrass prairie because the nearly annual fires continually top-killed the woody vegetation. According to the GLO survey records these brush savannas were most common on rolling to rough topography and along creeks in the prairie peninsula where the effects of fire were reduced. Also, brush savannas were found on the west sides of forests that were penetrated by fires driven by the prevailing westerly winds. Commonly the oak grubs were individuals *of Quercus imbricaria* (shingle oak), black oak, and Hill's oak since the relatively thin bark of these species probably facilitated top-killing by fire and resprouting.

Early travelers sometimes mention the occurrence of extensive brush thickets (now called brush savannas) that existed between the open trees of the savanna or prairie groves and the prairie. In Illinois, Iowa, and Nebraska this appears to have been relatively common, particularly around prairie groves. This brushy strip next to savannas and prairie groves was commonly composed of hazelnut and *Cornus racemosa* (gray dogwood). Hazelnut and dogwood were also the common shrubs of these brushy areas that were the "hazel thickets" mentioned by GLO surveyors. Early travelers and settlers of Illinois commonly wrote about brush prairies composed of "hazel roughs," "hazel ruff" or "hazel copses." Dr. Michael S. Bebb, an early botanist who lived in Fountaindale, Winnebago County, Illinois, collected many plants and published articles concerning the vegetation of northern Illinois and adjacent Wisconsin. In 1860 he mentioned the hazel undergrowth of the prairie extending for a mile or more into the prairie forming a "hazel ruff."

Very little information is available concerning the composition of the herbaceous vegetation of brush savannas. With no extant example, we must rely on the observations of the GLO field notes and the early writing of settlers and early travelers. A good start is Samuel B. Mead's list that was mentioned previously in this chapter. Other lists have also been proposed, but all contain many of the species listed by Samuel B. Mead in 1843. These brush savannas, however, must have had a high diversity of species since they existed in a variety of habitats and on diverse topographic conditions. There is evidence that at least 30 species of shrubs grew in brush savannas. Using many historical accounts from northern and central Illinois a list of 247 species was prepared for savanna communities. This list included 41 woody, 191 forbs, and 15 graminoid species.