

LESSON 9. SAND FORESTS, SAVANNAS, AND FLATWOODS

Wind blown sand deposits are relatively common in the northern half of Illinois accounting for about 5 percent of the land area of the state (Figure 9.1). Most occur on glacial outwash plains resulting from erosional events associated with Wisconsin glaciation. The most extensive are the Kankakee sand deposits of northeastern Illinois, the Illinois River sand deposits in the central part of the state, and the Green River Lowlands in northwestern Illinois. Other sand deposits are associated with the floodplain of the Mississippi River in northwestern Illinois, and the Chicago Lake Plain and beaches along Lake Michigan in northeastern Illinois.

The Kankakee sand deposits were formed about 14,500 years ago as glacial moraines were breached during a major re-advance of the Wisconsin Glacier. These glacial meltwaters were mostly discharged into the Kankakee River Valley creating the Kankakee Torrent. The Kankakee Valley could not accommodate this extensive flood and at the peak of the flow the water spread out over the surrounding uplands forming a series of large glacial lakes (Lake Watseka, Lake Wauponsee, Lake Pontiac, and Lake Ottawa). During this period glacial sands were deposited in these lakes. Large quantities of sand were removed during the Kankakee Torrent, but extensive deposits were left behind forming the Kankakee Sand Area Section of the Grand Prairie Natural Division.

The Illinois River sand deposits were also formed during the Kankakee Torrent. The outlet channel for the Kankakee Torrent was along the Illinois River Valley and the Torrent was entrenched in bedrock, moving rapidly and scouring broad areas of the bedrock. Below the Big Bend at present day Hennepin, Illinois, however, the Kankakee Torrent entered a wider and more easily eroded section of the Illinois River Valley. In this wider valley the Kankakee Torrent slowed and much of the gravels and sands being carried was deposited, particularly below present day Peoria (Figure 9.1). The broad terraces presently along the Illinois River Valley from Hennepin to Beardstown are mostly erosional surfaces of the Kankakee Torrent, and most are presently covered with sand and gravel deposits. These deposits in the southern half of Tazewell County, nearly all of Mason County, and parts of Cass, Morgan, and Scott counties, are the Illinois River Section of the Illinois River and Mississippi River Sand Areas Natural Division.

Another large sand deposit occurs in the Green River Lowland Section of the Grand Prairie Natural Division. These sand deposits cover the southern half of Whiteside County, most of the northern half of Henry County, and small parts of Bureau and Lee counties in extreme northwestern Illinois (Figure 9.1). Located just to the west of the terminal moraine of Wisconsin glaciation, extensive amounts of sand and gravel were deposited over the existing Illinoian till during intermittent warm periods of the Wisconsin Episode. These sands were reworked by wind creating numerous small sand dunes. Except for local “blowouts” these dunes were formed soon after the sand was exposed to wind action and most have long been stabilized in their present position by vegetation.

Many smaller sand deposits are scattered throughout the lowlands of the Mississippi River and its tributaries. Referred to as the Mississippi River Section of the Illinois River

and Mississippi River Sand Areas Natural Division these scattered deposits occur from Jo Daviess County south to Hancock County. Some of these deposits were formed when the glacial Lake Milan and Lake Cordova in Carroll, Henry, Rock Island and Whiteside counties drained. Others were deposited during flood events during the retreat of the Wisconsin Glacier when moraines and ice dams were breached and glacial lakes to the north of Illinois drained (Figure 9.1).



Figure 9.1. Major areas of wind-blown sand deposits in Illinois.

In northeast Illinois the sand deposits are mostly associated with the Lake Michigan Dunes Section and the Chicago Lake Plain Section of the Northeastern Morainal Division. This area is the most recently glaciated part of Illinois. The soils of the Chicago Lake Plain Section were derived from lakebed sediments deposited by glacial Lake Chicago which had an elevation about 4.6 meters higher than present Lake Michigan.

These sand deposits, commonly referred to as Parkland Sand or the Parkland Formation, consist of windblown sand in dunes and in sheet-like deposits between and bordering the dunes. The dunes are usually found on terraces along the major river valleys in the northern half of Illinois, and consist of medium-grained sands that are sorted by wind from the underlying glacial outwash. These sands were reworked by wind forming the characteristic dune and swale topography characteristic of these deposits. Dunes 6 to 12 meters high are common and occasional dunes exist that are 30 meters high. In the Mississippi River valley in northwestern Illinois the dunes have migrated onto the bluffs and uplands to the east of the terraces. Dunes were also common features on the beaches of glacial Lake Chicago.

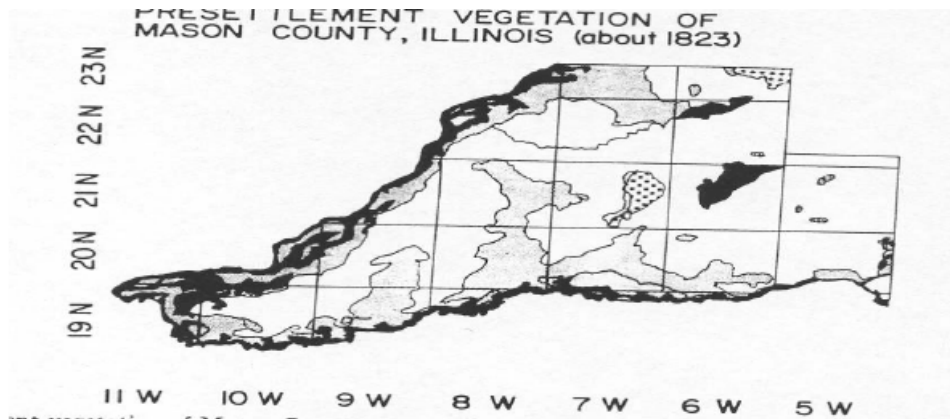
Dry habitats are characteristic of sand deposits, and the common associated species are those adapted to xeric conditions. Some of these open sands are desert-like with species of cactus being common. However, wet areas are also occasionally found, particularly where the water table is at or near the soil surface. As expected, plant communities of sand deposits are extremely diverse and include sand ponds, marshes and sedge meadows, prairies, savannas and woodlands, closed forests, and flatwoods. Some of the most comprehensive early work completed on the vegetation of Illinois sand deposits was undertaken in the early 1900s by Henry Allen Gleason, an ecologist and plant geographer at the Illinois Natural History Survey, and by Arthur G. Vestal, a botanist at the University of Illinois. These authors described the dominant plant communities of the sand deposits and discussed the animals associated with these deposits, particularly the insects.

Sand Forests

The Illinois Natural Areas Inventory (INAI) distinguished three categories of sand forests based upon moisture availability: dry sand forests, dry-mesic sand forests, and mesic sand forests. All three are associated with portions of the sand deposits where natural firebreaks have reduced fire frequency. Generally, the dry sand forests are restricted to the top and sides of dunes where the soil has very little humus and its water holding capacity is low. In these dry sand forests *Quercus velutina* (black oak) is the dominant overstory species while *Quercus marilandica* (blackjack oak) and *Carya texana* (black hickory) are the common subdominants. In contrast, dry-mesic sand forests have soils with more humus and higher soil moisture levels. On these sites *Quercus alba* (white oak) is common, sometimes exceeding the importance of black oak. Mesic sand forests are usually restricted to ravines and river terraces and support a broad range of mesic tree species, the most common being white oak, *Quercus rubra* (red oak), and *Acer saccharum* (sugar maple).

Dry sand forests are relatively common in the Illinois River sand deposits of Mason County. Based on Government Land Office (GLO) survey records sand prairie vegetation dominated this county in presettlement time occupying 67.7 percent of the land surface. Dry and sometimes dry-mesic savannas accounted for 14.4 percent of the area, dry and dry-mesic closed canopy sand forests for 13.3 percent, while marshes, swamps, and lakes accounted for the remainder. In the 1820s, when the county was surveyed, savannas and forested areas were on sand dunes or associated with rivers and streams (Figure 9.2). The

dominant trees recorded in the survey were shade-intolerant, fire-tolerant oaks and hickories. Black oak was the dominant species encountered by the GLO surveyors in both savanna, open, and closed forest. Black oak was also the common tree of the prairie where the surveyors recorded occasional individuals. Blackjack oak was also found on the prairie and was second in importance in the savanna, followed by hickories.



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Figure 9.2. Presettlement vegetation of Mason County, Illinois in about 1823. Clear areas represent prairie, stippled areas indicate forest, darkly shaded areas are ponds, lakes, and rivers, while small solid squares represent marshes.

The GLO surveyors recorded 21 species of trees in the presettlement closed canopy forests of Mason County. Many of these species were in low numbers, particularly the many fire-sensitive species like *Populus deltoides* (cottonwood), *Celtis occidentalis* (hackberry), *Platanus occidentalis* (sycamore), *Juglans nigra* (black walnut), *Cercis canadensis* (redbud), *Salix* spp. (willows), *Acer* spp. (maples), and *Fraxinus* spp. (ashes). These species were mostly encountered along the western edge of the county on the floodplains and terraces of the Illinois River. This natural firebreak prevented the prairie fires, driven by the westerly winds, from entering these forests. These forests only rarely burned.

In the savanna and open canopy forests, in contrast, tree species diversity was low and few mesic fire-sensitive species were encountered. The large number of small diameter individuals of black oak, blackjack oak, and hickories recorded in the GLO survey indicates that these dominant species were reproducing and that many individuals were entering the savanna and forest canopies. This indicated that in presettlement times these savanna and open canopy forest communities were relatively stable with the shadeintolerant, fire-insensitive species replacing themselves. This compositional stability was probably controlled by periodic fires that maintained the open habitat necessary for these species to reproduce and enter the canopy.

About 2 percent of Mason County was still forested (50 percent or more canopy cover) in 1969, compared with 27.7 percent at the time of the GLO survey. Most of the forests

were cleared for agriculture, particularly since the development of central pivot irrigation. The remaining forests were mostly associated with the rivers and streams, particularly the forests bordering the Illinois River that forms the western boundary of the county. A few nature preserves and natural area inventory sites in the Illinois River sand deposits contain forest communities with an overstory composition which was very similar to that recorded by the GLO surveyors. The forests, however, are probably different today compared to the early 1800s, mostly due to a reduced fire frequency followed by the total absence of fire in recent decades. This resulted in canopy closure and the subsequent woody invasion by native mesic species in the understory.

Presently, closed canopy forests are found in a few nature preserves and at Sand Ridge State Forest. Bishop's Woods Natural Area, a closed canopy forest at Sand Ridge State Forest, has the same overstory composition recorded by the GLO surveyors. This forest is a remnant of a much larger forest that occurred on stabilized sand dunes in northern Mason County before settlement by Europeans. Twenty-one woody species were encountered in the woods, 10 canopy trees and 11 understory trees and shrubs. Black oak dominated the canopy with an importance value (IV) of 144.9 (possible 200). This species accounted for 61 percent of the individuals, 84 percent of the basal area (m^2/ha), dominated all diameter classes, ranked second in seedlings, and fifth in saplings (Table 9.1). Black hickory, ranked second with an IV of 22.6, was well represented in the seedling, sapling, and lower diameter classes. Third in importance, blackjack oak had a clumped distribution and was common at the margins of small openings in the woods. Very few seedlings and saplings of this species were found. The remaining overstory and understory trees, as well as the nine species of shrubs encountered during the survey, were mostly fire-sensitive species that have survived in the woods because of low fire frequency.

The woody composition of Bishop's Woods is very similar to that reported for Barkhausen Woods in the southwestern corner of Mason County. Both were closed canopy forests on low dunes of Parkland Sand. In both the overstory was dominated by black oak, black hickory, and blackjack oak, with mesic species being uncommon in the understory (Table 9.1). Also, the stems/ha were nearly the same (237.9 for Barkhausen Woods, 247.5 for Bishop's Woods) as was the basal area (16.3 m^2/ha for Barkhausen Woods, 16.1 m^2/ha for Bishop's Woods). The major differences between the two woodlots were the importance of black hickory (IV of 22.6 in Bishop's Woods, 61.5 in Barkhausen Woods), and the absence of *Carya tomentosa* (mockernut hickory) from Barkhausen Woods. In both woods the larger trees maintained an open-grown appearance with low branches or branch-scars.

Both Bishop's Woods and Barkhausen Woods had a dense woody understory. Besides the many seedlings and saplings of black oak and black hickory there was a well developed shrub layer. *Toxicodendron radicans* (poison ivy), *Rhus aromatica* (fragrant sumac), *Zanthoxylum americanum* (prickly ash), and *Cornus racemosa* (gray dogwood) were the common species encountered at Bishop's Woods where shrubs averaged 26,488 stems/ha. Similar results were obtained at Barkhausen Woods where the shrubs averaged 9,235 stems/ha with poison ivy, gray dogwood, and *Rubus allegheniensis* (common

blackberry) the most common. Both woods are rarely subjected to ground fires. Neither woodlot had been burned in the recent past, which probably accounted for the relatively dense shrub layer.

Table 9.1. Density (#/ha), basal area (m²/ha), relative values, importance values, and average diameters (cm) of the tree species encountered at Bishop's Woods and Barkhausen Woods, Mason County, Illinois.

Species	Density (#/ha)	Basal Area (m ² /ha)	Rel. Den.	Rel. Dom.	I.V.	Average Diameter (cm)
Bishop's Woods						
black oak	150.1	13.5	60.7	84.2	144.9	30.8
black hickory	40.2	1.0	16.3	6.3	22.6	16.3
blackjack oak	23.9	0.8	9.7	5.3	15.0	19.9
mockernut hickory	19.9	0.5	8.0	2.9	10.9	15.8
black locust	6.8	0.1	2.7	0.6	3.3	13.6
wild black cherry	4.0	0.1	1.6	0.4	2.0	14.0
others (6 species)	2.6	0.1	1.0	0.3	1.3	
Totals	247.5	16.1	100.0	100.0	200.0	
Barkhausen Woods						
black oak	82.2	12.5	34.5	76.7	111.2	41.3
black hickory	109.6	2.5	46.2	15.3	61.5	15.9
blackjack oak	35.6	1.2	14.9	7.1	22.0	19.1
others (14 species)	10.5	0.1	4.4	0.9	5.3	
Totals	237.9	16.3	100.0	100.0	200.0	

Presently, management fires are used in some sand forests to keep the forest open and to reduce understory density. At the 590 hectare Sand Prairie-Scrub Oak Nature Preserve the forests have been subjected to numerous management burns and occasional wildfires since being purchased by the Illinois Department of Conservation in 1969. These management fires, along with drought conditions have allowed for the perpetuation of oak species. Black oak is reproducing on the site with numerous seedlings and saplings in the understory. Blackjack oak, in contrast, had a very low rate of reproduction with only a few seedlings and saplings encountered. This species is more common at the prairie/forest interface and in forest openings.

Besides top-killing, the woody understory fire also killed some of the forest trees, and with increased fire frequency more oaks were top-killed. Many of these top-killed individuals re-sprouted, resulting in numerous coppice (multiple-stemmed) individuals. In this preserve multiple-stemmed individuals were common and ranged from 70 to 96 multiple-stemmed trees/ha in the four areas of the preserve that were studied (Table 9.2). Coppice individuals averaged about two living stems per tree, although some had as

many as five living stems along with some dead-standing stems. Most coppice individuals were oaks, and most were fire-scarred near the base.

Table 9.2. Density (stems/ha), basal area (m²/ha), and average diameter of live coppice stems in four areas at Sand Prairie Scrub Oak Nature Preserve, Mason County, Illinois.

Area and Species	Coppice Trees (stems/ha)	Average Number of stems/tree	Basal Area (m ² /ha)	Average Diameter (cm)
AREA # 1				
black oak	76	1.84	5.936	22.6
Totals	76		5.936	
AREA # 2				
black oak	55	2.25	6.903	25.7
blackjack oak	15	2.27	1.026	19.3
Totals	70		7.929	
AREA # 3				
black oak	88	2.17	11.026	26.6
blackjack oak	6	2.17	0.354	18.2
black hickory	1	2.00	0.018	10.6
wild black cherry	1	2.00	0.018	10.7
Totals	96		11.416	
AREA # 4				
black oak	58	2.05	6.537	25.9
blackjack oak	12	2.00	0.894	21.3
Totals	70		7.431	

White and black oaks dominate dry-mesic sand forests. White oak may be the dominant overstory species in these forests but is usually exceeded in importance by black oak depending on past disturbances and moisture availability. White oak is well adapted to mesic habitats and is a common component of upland forests, open woodlands, savannas, prairie groves, and as scattered trees associated with mesic prairie. It is relatively resistant to fires due to its thick bark. In sand deposits white oak is restricted to moister habitats than black oak, commonly being restricted to lower slopes of dunes, in swales between dunes, and on terraces of rivers and streams.

Dry-mesic sand forests are not very common in any of the sand areas of the state, only a few of high natural quality have been found. In the Illinois River sand deposits dry-mesic forests were probably common in presettlement times on the terraces and low uplands along the west side of the Illinois River. A few remnants of this forest type still exist in the area. One that was recently surveyed is White Oak Creek Woods Natural Area located 6 km south of Havana, Illinois. Located on a sandy upland terrace of the Illinois River it was designated a high quality natural area by the Illinois Natural Areas Inventory. In this small woodlot 10 tree species were encountered that formed an overstory with an average of 180.4 stems/ha and an average basal area of 28.715 m²/ha (Table 9.3). White oak dominates the larger diameter classes with an IV of 144.2 (200 possible), and an average diameter of 53.4 cm. Some of the larger white oaks had an open-grown appearance with

large branches or branch scars within 4 meters of the ground. Black oak, also restricted to the larger diameter classes, was second in IV (12.7) and had an average diameter of 71.3 cm. Oak seedlings were common in the understory but few oak saplings were encountered.

Table 9.3 Density (#/ha), basal area (m²/ha), relative values, importance values, and average diameters (cm) of the tree species encountered at White Oak Creek Natural Area, Mason County, Illinois.

Species	Density (#/ha)	Basal Area (m ² /ha)	Rel. Den.	Rel. Dom.	I.V.	Average Diameter (cm)
white oak	105.6	24.577	58.6	85.6	144.2	53.4
black oak	6.5	2.611	3.6	9.1	12.7	71.3
wild black cherry	20.2	0.284	11.2	1.0	12.2	12.9
sassafras	18.2	0.466	10.0	1.6	11.6	14.1
black locust	11.7	0.240	6.5	0.8	7.3	15.6
white mulberry	8.5	0.094	4.7	0.4	5.1	11.8
Osage orange	4.3	0.322	2.4	1.1	3.5	28.0
American elm	3.2	0.098	1.8	0.4	2.2	18.2
hackberry	1.1	0.010	0.6	--	0.6	10.9
black walnut	1.1	0.013	0.6	--	0.6	12.3
Totals	180.4	28.715	100.0	100.0	200.0	

Although the forest of the White Oak Creek Natural Area was never clear-cut, it undoubtedly differs today compared to early settlement times. The present owner of the property recalled her great grandfather stating that it was possible to drive a wagon through the woods in the 1840s, an indication of the openness of the woods. Also mentioned was that some of the oaks were present as grubs which occurs when oaks are continually top-killed by frequent fires. The present appearance of White Oak Creek Woods compared to 150 years ago is probably due to a reduced fire frequency followed by a total absence of fire in recent decades. Oak densities in this presettlement landscape were dictated by fire frequency and intensity, ranging from low tree densities in savannas and woodlands that burned hot and frequent, to higher tree densities in closed forests where surface fires burned cooler and were less frequent.

In the Kankakee sand deposits dry-mesic and mesic sand forests were formerly abundant along most of the Kankakee and Iroquois rivers. Cutting, grazing, fragmentation, and fire suppression have resulted in the destruction of most of these once extensive forests. A few relatively large, but degraded dry-mesic forests are still available for study. At the Momence Wetlands Land and Water Reserve along the Kankakee River, a 31-hectare dry-mesic upland forest was examined in 1999. The overstory of this forest contained five species, of which three were common. Tree density averaged 252 stems/ha and basal area averaged 22.29 m²/ha. Black oak dominated all but the lower diameter classes, had an average diameter of 47.2 cm, and an IV of 109.0 (200 possible). White oak ranked second with an IV of 53.9, and was common in the smaller diameter classes, while *Prunus serotina* (wild black cherry) ranked third with an IV of 34.1 and dominated the 10-19 cm diameter class. Wild black cherry also dominated the seedling and sapling layer. Fire suppression is probably the reason for the dense understory and the presence of wild black cherry in the tree stratum.

Both dry-mesic and mesic sand forests are found at the nearby Iroquois Woods Nature Preserve. Located in the southern part of Kankakee County on the east side of the Iroquois River this 19-hectare preserve is the best old growth forest remnant along the Iroquois River and one of the better in the state. The dry-mesic sand forest is on a high terrace about 300 meters back from the river. White oak was the dominant canopy tree with an IV of 56.7 (200 possible) followed by *Ulmus americana* (American elm) with an IV of 31.0 and black oak with an IV of 30.3 (Table 9.4). Two distinct size groups of tree dominate the upland terrace. The oaks, white, black, and red, were found in the larger diameter classes with average diameters of 40.3, 55.3, and 52.2 cm dbh respectively. The remaining species of the high terrace were mostly in the smaller diameter classes with average diameters not exceeding 23 cm dbh (Table 9.4). These species were mostly fire-sensitive, shade-tolerant species, indicating that fire has rarely entered this forest. Many large clumps of the understory tree, *Asimina triloba* (pawpaw), were scattered through the upland terrace, another indication that fires were rare. This species is very fire-sensitive, and once established it produces numerous root suckers that form dense colonies.

Adjacent to the river, and on a lower terrace less than one meter above the dry-mesic forest is a mesic sand forest. This mesic forest was dominated by *Quercus rubra* (red oak), *Tilia americana* (basswood), *Ulmus rubra*, *Aesculus glabra* (Ohio buckeye), and *Quercus macrocarpa* (bur oak). Again, two distinct size groups were present, the oak occurred in the larger diameter classes with most of the remaining tree species in smaller diameter classes (Table 9.4). Also, most of the trees present were fire-sensitive, suggesting that fire was rare in this community.

Between the high and low terrace is an erosional channel of the Iroquois River. This shallow depression is rarely more than 20 cm below the elevation of the low terrace. Water accumulated in this depression for extended periods of time during the growing season probably accounts for the variation in the species composition found here. The woody species encountered in this depression were mostly the same as those encountered in the low and high terrace but their density differed. Though *Quercus bicolor* (swamp white oak) was rare in the low terrace, it dominated the depression. This species is common in swamps and marginally wet areas throughout most of Illinois where it may sometimes be the dominant species.

Sand Savannas

Savannas on fine textured, black loamy soil on glacial till are rare in Illinois and only a few degraded remnants are known to exist. Sand savannas, in contrast, are more common with a few high quality examples protected as nature preserves and in private ownership. Two categories of sand savannas are recognized by the INAI based on a moisture gradient: dry sand savanna with the tree layer dominated by black oak, and dry-mesic sand savanna with black oak and white oak the common trees present. Presently, the majority of the sand savannas in Illinois are found in the Kankakee sand deposits of Iroquois, Kankakee, Will, and Grundy counties in the northeastern part of the Illinois and adjacent Indiana (Figure 9.1). Most of the best quality sand savannas are located in the extreme northeastern corner of Iroquois County and adjacent Pembroke Township in Kankakee County.

Pembroke Township is situated at the edge of former glacial Lake Watseka. This lake drained about 14,500 years ago during the Kankakee Torrent leaving behind sandy beaches and near shore sand deposits. These sands were reworked by wind creating the dune and swale topography present today. When seen from the air many of these dunes are clustered together with broad open areas between these dune fields. The individual dunes have the typical crescent shape of actively moving dunes. Presently the areas between the dune fields are mostly cultivated and consist of Watseka and Maumee loam

Table 9.4. Density (#/ha), basal area (m²/ha), relative values, importance values, and average diameters (cm) of the tree species encountered at Iroquois Woods Nature Preserve, Kankakee County, Illinois.

Species	Density (#/ha)	Basal Area (m ² /ha)	Rel. Den.	Rel. Dom.	I.V.	Average Diameter (cm)
Low Terrace						
red oak	45.7	14.204	12.1	43.4	55.5	60.9
basswood	69.1	3.502	18.3	10.7	29.0	22.3
slippery elm	50.6	1.443	13.4	4.4	17.8	17.9
Ohio buckeye	42.3	1.403	11.2	4.3	15.5	18.1
bur oak	14.0	3.659	3.7	11.2	14.9	55.1
hackberry	35.7	1.747	9.4	5.3	14.7	21.0
sugar maple	34.6	1.214	9.1	3.7	12.8	18.6
American elm	35.7	1.048	9.4	3.2	12.6	18.0
black walnut	8.3	1.410	2.2	4.3	6.5	44.6
bitternut hickory	10.3	0.849	2.7	2.6	5.3	29.4
pawpaw	14.0	0.180	3.7	0.6	4.3	12.6
others (9 species)	17.8	2.075	4.8	6.3	11.1	
Totals	378.1	32.734	100.0	100.0	200.0	
Low Depression						
swamp white oak	50.0	14.171	13.6	47.9	61.5	58.2
basswood	116.0	4.121	31.6	13.9	45.5	19.1
American elm	131.0	2.786	36.0	9.4	45.4	15.7
bur oak	14.5	3.040	3.9	10.3	14.2	43.8
green ash	14.5	2.475	3.9	8.4	12.3	42.1
red oak	6.5	1.755	1.7	5.9	7.6	55.6
slippery elm	17.0	0.477	4.6	1.6	6.2	17.8
silver maple	5.5	0.337	1.5	1.1	2.6	25.1
others (7 species)	12.0	0.433	3.2	1.5	4.7	
Totals	367.0	29.595	100.0	100.0	200.0	
High Terrace						
white oak	79.0	11.281	19.3	37.4	56.7	40.3
American elm	100.1	1.959	24.5	6.5	31.0	14.9
black oak	28.3	7.019	7.0	23.3	30.3	55.3
wild black cherry	47.4	1.958	11.6	6.5	18.1	21.5
red oak	13.4	3.223	3.3	10.7	14.0	52.2
sugar maple	36.6	0.983	9.0	3.3	12.3	17.0
red ash	25.8	1.165	6.3	3.9	10.2	22.3
basswood	23.2	0.734	5.7	2.4	8.1	18.4
slippery elm	21.1	0.563	5.2	1.9	7.1	16.8
sassafras	20.7	0.574	5.1	1.9	7.0	18.1
others (6 species)	12.2	0.724	3.0	2.2	5.2	
Totals	407.8	30.183	100.0	100.0	200.0	

fine sand, and Gilford fine sandy loam. These poorly drained soils are derived from outwash sediments and are acidic, peaty sand with a brown to black surface horizon. The dune soils are mostly Oakville fine sand that developed from sandy sediments that are well drained and have a dark grayish brown surface horizon. The savanna and prairie vegetation of this sand deposit was established during the Hypsithermal period about 8,000 years ago.

The overstory vegetation of both dry and dry-mesic sand savanna communities was studied at the Iroquois County Conservation area and the adjacent Willow Slough Fish and Wildlife Area, Newton County, Indiana. At both sites the dry savanna dominated the upper dune slopes and ridges with black oak accounting for nearly all of the importance value. At the Iroquois County Conservation Area tree density varied from 144 to 151 stems/ha on two study sites; while at the Willow Slough Fish and Wildlife Area tree density varied from 230 to 232 stems/ha. This difference was due to the excessive number of individuals in the smaller diameter class and indicates that the savannas at Willow Slough Fish and Wildlife Area had not been burned recently. At the Iroquois County Conservation Area the two study sites had been burned every three years, while at the Willow Slough Fish and Wildlife Area fire had rarely been used in forest management. The dry-mesic sand savannas studied, in contrast, were located on the lower dunes slopes and swales between the dunes. Black and white oaks were important stand components with each species accounting for about half of the importance value.

During the past five years botanists from the Illinois Natural History Survey studied five of the better-quality natural areas in Pembroke Township. According the INAI all of the areas examined contained high quality “grade B” dry and dry-mesic sand savannas. All information available indicates that these wooded dunes have not been clear-cut though some trees were removed for firewood. Also, most of the region was open range at the turn of the century and was burned frequently to maintain open pasture. By the early 1950s most commercial grazing was stopped, and these savannas were only occasionally burned, usually the result of lightning strikes or arson. Though subjected to various disturbances, however, these areas still retain much of their original natural character and are similar in vegetation structure and composition to the sand communities when European settlers entered the region.

On the dry ridges and upper parts of the dunes in Pembroke Township black oak was dominant. On the lower dune slopes white oak was usually present in low numbers, but black oak still dominated the overstory. Tree density varied widely on the five study sites; from a low of 43 stems/ha to a high of 287 stems/ha (Table 9.5). Only three of the sites would be classified as savannas (Mt. Fraker Natural Area, Leesville East Natural Area, Sweet Fern Land and Water Reserve). The remaining two (Liebert Natural Area and Bently/Crawford-Jordon Natural Area) are sand forests with more than 80 percent canopy cover. Bently/Crawford-Jordon Natural Area had the highest basal area (13.7 m²/ha) as well as the highest density of white oak. Most of this forest was situated in a shallow depression while the low dunes to the north and south had a more open overstory

and were dominated by black oak. This dry-mesic sand forest was dominated by black oak, but white oak accounted for nearly 25 percent of the importance value.

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Table 9.5. Density (#/ha), basal area (m²/ha), relative values, importance values, and average diameters (cm) of the tree species encountered at five natural areas in Pembroke Township, Kankakee County, Illinois.

Species	Density (#/ha)	Basal Area (m ² /ha)	Rel. Den.	Rel. Dom.	I.V.	Average Diameter (cm)
Mt. Fraker						
black oak	43.3	4.125	100.0	100.0	200.0	34.6
Totals	43.3	4.125	100.0	100.0	200.0	
Leesville East						
black oak	59.1	5.168	79.8	81.2	161.0	31.9
white oak	6.6	1.026	9.0	16.1	25.1	40.3
pin oak	8.4	0.168	11.2	2.7	13.9	15.7
Totals	74.1	6.362	100.0	100.0	200.0	
Sweet Fern						
black oak	85.0	7.220	81.6	88.8	170.4	30.3
white oak	19.1	0.911	18.4	11.2	29.6	23.1
Totals	104.1	8.131	100.0	100.0	200.0	
Liebert						
black oak	140.9	6.271	83.3	85.4	168.7	22.3
white oak	28.3	1.074	16.7	14.6	31.3	21.2
Totals	169.2	7.345	100.0	100.0	200.0	
Bentley/Crawford Jordan						
black oak	208.4	11.017	72.5	80.6	153.1	25.2
white oak	79.2	2.652	27.5	19.4	46.9	19.9
Totals	287.6	13.669	100.0	100.0	200.0	

In all five natural areas the woody understory was very open and not very diverse with only 12 woody species commonly encountered (Table 9.6). Black oak accounted for most of the tree seedlings and saplings. Many were sprouts from old root crown, but one- and two-year-old seedlings were also common. Shrubs were also common, particularly in open parts of the savanna where *Rhus copallina* (dwarf sumac) and *Rhus glabra* (smooth sumac) were common. Relatively few large saplings or large shrubs were encountered which gave the sites a very open appearance.

The ground layer vegetation of the five study sites was extremely variable depending upon past disturbances, time since the last fire, and tree density. At most sites *Carex pensylvanica* (Pennsylvania sedge) and *Schizachyrium scoparium* (little bluestem) were the

most common species (Table 9.6). Most species observed were those typically associated with sand savanna and sand woodland communities. At Bentley/Crawford-Jordon Natural Area, a closed sand forest, many of the same species were present (Table 9.6). Here, however, *Helianthus divaricatus* (woodland sunflower) and *Rosa carolina* (pasture rose) were the dominant species, with Pennsylvania sedge and little bluestem third and fourth respectively in importance.

Table 9.6. Trees, shrubs, graminoids, and forbs commonly encountered in the five natural areas in Pembroke Township, Kankakee County, Illinois. The species in each group are mostly listed in order of importance. For the graminoids and forbs, only the most common species observed in the study quadrates are included.

Trees

Quercus velutina (black oak)
Quercus alba (white oak)
Quercus palustris (pin oak)
Sassafras albidum (sassafras)
Prunus serotina (wild black cherry)
Malus ioensis (Iowa crab apple)

Shrubs

Rhus copallina (winged sumac)
Rhus glabra (smooth sumac)
Rhus hirta (staghorn sumac)
Rosa carolina (Carolina rose)
Rubus allegheniensis (common blackberry)
Rubus flagellaris (common dewberry)
Amorpha canescens (leadplant)
Salix humilis (prairie willow)

Graminoids

Schizachyrium scoparium (little bluestem)
Carex pensylvanica (Pennsylvania sedge)
Dichanthelium villosissimum (hairy panic grass)
Koeleria macrantha (June grass)
Cyperus filiculmis (flatsedge)
Sporobolus cryptandrus (sand dropseed)
Poa pratensis (Kentucky bluegrass)
Sorghastrum nutans (Indian grass)

Forbs

Euphorbia corollata (flowering spurge)
Viola pedata (bird's-foot violet)
Chamaechaerista fasciculata (partridge pea)
Ionactis linarifolius (flax-leaved aster)
Asclepias verticillata (horsetail milkweed)
Solidago nemoralis (gray goldenrod)
Liatris astra (rough blazing-star)
Helianthemum canadense (frostweed)
Tephrosia virginiana (goat's-rue)

Lespedeza capitata (round-headed bush clover)
Chamaechrista nictitans (sensitive pea)
Helianthus divaricatus (woodland sunflower)
Smilacina racemosa (false Solomon's-seal)
Potentilla simplex (common cinquefoil)

Over the past 65 years there has been a decrease in fire frequency in the natural plant communities in the sand deposits of Pembroke Township. Originally natural fires and those set by early aborigines decreased the extent of woody invasion, while early settlers used fire to maintain open pasture. With the decrease in grazing in Illinois in the early 1950s, and the increase in home sites and agriculture, the number and intensity of extensive woodland fires dramatically decreased. Presently fires are rare, mostly being accidental or arson in origin. Based on the study of aerial photographs, there has been nearly a 50 percent increase in overstory cover in the study sites since 1939. Consequently, much of the original savanna vegetation became open woodlands, or in the case of some dry-mesic sand savannas, became open or closed forests.

Some natural areas and nature preserves in the Kankakee sand deposits are now occasionally burned, usually on a two- to four-year cycle. The reintroduction of fire has decreased the extent of woody encroachment, increased tree mortality, and decreased canopy cover. This should have a beneficial effect on the composition and structure of the ground layer vegetation. Overall, it should result in the increase in forb diversity and reduce the number of exotic species.

Sand Flatwoods

Sand flatwoods are rarely encountered, being restricted to the sand deposits of the Kankakee Sand Area and the Chicago Lake Plain. These flatwoods occur in depressions between dunes where the water table is at or near the surface of the ground for extended periods of time in the winter and spring. Sometimes water is present until mid-summer. The peaty soils are acidic and consist of fine sand loams with high concentrations of organic material.

In these depressions *Quercus palustris* (pin oak) is consistently the dominant species, usually accounting for 60 to 95 percent of the importance value (Table 9.7). White oak is commonly present in low numbers, usually occurring on slightly raised areas in the depressions. *Nyssa sylvatica* (black gum, sour gum) is generally present in low numbers. Three sand flatwoods in the Kankakee sand deposits have been studied. These sites are located at the Iroquois County Conservation Area, and at the Hooper Branch Nature Preserve, both in Iroquois County, Illinois, and at Willow Slough Fish and Wildlife Area in Newton County, Indiana (Table 9.7).

The largest of these flatwoods is located at Hooper Branch Nature Preserve where tree density averaged 302 stems/ha with a basal area of 25.7 m²/ha (Table 9.7). Pin oak dominated accounting for nearly 95 percent of the IV (188.6 of a possible 200). The only other overstory species present were black gum and white oak. The woody understory was open, only 35 saplings/ha were encountered. Woody seedlings, however, were

common and averaged 41,800 stems/ha; most being pin oak along with scattered individuals of *Sassafras albidum* (sassafras), *Ilex verticillata* (winterberry), *Vaccinium angustifolium* (low-bush blueberry), and various species of *Rubus* (blackberry, raspberry, and dewberry). The ground layer vegetation was sparse. Common ground layer species were *Carex stricta* (tussock sedge) and *Calamagrostis canadensis* (bluejoint grass). This flatwoods shows indications of past cutting and de-watering. Most of the overstory individuals were in the 20-39 cm diameter classes. This suggests that it had probably been cut in the 1950s before the land was purchased by the state. Also, coppice stems averaged 23 stems/ha, accounting for 13 percent of the total basal area/ha (3.2 m²/ha). The average diameter of 32.2 cm for pin oak suggests a relatively young community. Previous studies of flatwoods in the Kankakee sands obtained similar results with average diameters of 20.8 and 29.2 cm.

Table 9.7. Density (#/ha), basal area (m²/ha), relative values, importance values, and average diameters (cm) of the tree species encountered in sand flatwoods in the Kankakee sand deposits of Iroquois County in northeastern Illinois and adjacent Newton County, Indiana.

Area and Species	Density (#/ha)	Basal Area (m ² /ha)	Rel. Den.	Rel. Dom.	I.V.	Average Diameter (cm)
Willow Slough Fish and Wildlife Area						
pin oak	204	15.3	65.4	69.9	135.3	29.2
white oak	71	6.1	22.8	27.9	50.7	28.7
black gum	37	0.5	11.8	2.2	14.0	12.4
Totals	312	21.9	100.0	100.0	200.0	
Iroquois County Conservation Area						
pin oak	456	17.2	91.8	92.8	184.6	20.8
white oak	39	1.3	7.6	7.0	14.6	19.1
black gum	3	--	0.6	0.2	0.8	10.9
Totals	498	18.5	100.0	100.0	200.0	
Hooper Branch Nature Preserve						
pin oak	276	25.0	91.4	97.2	188.6	32.2
white oak	19	0.4	6.3	1.7	8.0	15.9
black gum	7	0.3	2.3	1.1	3.4	22.2
Totals	302	25.7	100.0	100.0	200.0	

Sand forests also occur on the sandy plains of the glacial Lake Chicago at the Jurgensen Nature Preserve and Thornton-Lansing Road Nature Preserve in Cook County. Pin oak is the dominant canopy species with sour gum also common. Other tree species encountered are *Quercus ellipsoidalis* (Hill's oak), *Acer saccharinum* (silver maple), American elm, and swamp white oak. These sand flatwoods are fairly large, up to 25 hectares, with the soil a mixture of peat and sandy loam. About one meter below the sand is an impervious layer of lake bottom clay.

These sand flatwoods, that are commonly called pin oak flatwoods, have an interesting and unique flora. The acidic soil and dense shade create a habitat that is rare in Illinois. *Vaccinium angustifolium* (low-bush blueberry) is sometimes common along with occasional scattered clumps of all three Illinois members of the fern genus *Osmunda*: *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), and *Osmunda regalis* (royal fern). Also, the carnivorous plant species *Drosera intermedia* (narrow-leaved sundew) is sometimes present. Soon after the flatwoods dries in late spring or early summer this species is occasionally found as a dense carpet over large sections of the flatwoods.