

***Quercus alba* (Fagaceae, White Oak) Dominated Sand Forest/Savanna, Illinois River Sand Deposits, Mason County, Illinois**

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ABSTRACT

Quercus alba (white oak), a dominant tree of mesic and wet-mesic forests in Illinois, is uncommon in the Illinois River sand deposits. In White Oak Creek Woods Natural Area in Mason County, *Q. alba* was the dominant overstory species. In this small woods 10 tree species were encountered with a density of 180.4 stems/ha and an average basal area of 28.715 m²/ha. Located on an upland terrace of the Illinois River, *Q. alba* dominated the overstory and accounted for more than 70% of the importance value. *Quercus velutina* (black oak), *Prunus serotina* (wild black cherry), and *Sassafras albidum* (sassafras) followed in IV and accounted for most of the remaining stems. No oak saplings were present in the natural area, probably the result of a closed canopy due to fire suppression.

Key words: degraded savanna, forest survey, Illinois River sand deposits

INTRODUCTION

Quercus alba L. (white oak), an important forest tree throughout the eastern United States, is common from Maine to Michigan and Minnesota south to eastern Texas and northern Florida (Gleason and Cronquist 1991). This species is a leading dominant of mesic and wet-mesic forests, woodlands, and savannas throughout the northern half of its range. In these communities *Q. alba* is commonly associated with *Q. velutina* Lam. (black oak), *Q. rubra* L. (red oak), and various species of *Carya* (hickories) (Braun 1950, Ebinger 1997, Tyrrell et al. 1998).

Quercus alba is well adapted to mesic habitats in Illinois; occurring in upland forests, open woodlands, savannas, prairie groves, and scattered trees associated with mesic prairies. Known from all Natural Divisions in Illinois, it is commonly listed as a component of many plant communities (Schwegman 1973, Mohlenbrock and Ladd 1978, White and Madany 1978). It is, however, not a very common component of sand area communities. Sand deposits account for nearly 5% of the land surface of Illinois and generally occur on

glacial outwash plains associated with erosional events of Wisconsinian glaciation in the northern half of the state (Schwegman 1973, Willman and Frye 1970, King 1981.)

Of the large sand deposits within Illinois, only the Kankakee Sand Area Section of the Grand Prairie Natural Division has communities in which *Quercus alba* is common (Schwegman 1973). *Quercus alba* is rare in the Illinois River Section of the Mississippi River and Illinois Rivers Sand Areas Natural Division. During an extended study of all dedicated nature preserves, *Q. alba* was not encountered. The authors know of only one forest community in the Mason County sand deposits in which *Q. alba* is a common overstory component. The purpose of this study was to determine the composition and structure of the overstory in this *Q. alba* dominated sand forest and compare the results with other sand forests in Illinois.

MATERIALS AND METHODS

Study Site

White Oak Creek Woods Natural Area is located in Mason County about 6 km south of Havana, Illinois (SE1/4 NW1/4 S23 T21N R9W). This site, about 2 ha in size, is located on a sandy upland terrace about 500 m west of the Illinois River immediately south of White Oak Creek. The soils are excessively drained Plainfield sand (Calsyn 1995), part of the dune and swale topography known as the Parkland Formation (Willman and Frye 1970).

Very little is known about the history of this small tract of timber. This area, as well as the land north of White Oak Creek, was designated a good quality dry sand forest by the Illinois Natural Areas Inventory (White 1978). Most trees of *Quercus alba* were selectively logged in the area north of White Oak Creek in 1980 (Lerczak 2000). Registered as an Illinois Natural Heritage Landmark since 1983, this dry mesic sand forest is now designated as the Speckman-Stelter Woods Land and Water Reserve by the Illinois Nature Preserves Commission (Lerczak 2000).

The climate of central Illinois is continental and characterized by hot, humid summers and cold winters. Mean annual precipitation is 98.0 cm with May having the highest rainfall (11.3 cm). Mean annual temperature is 10.8°C with the hottest month being July (average of 24.6°C), and the coldest January (average of -5.0°C). Frost-free days range from 140 to 206, with the average being 173 days (Havana, Illinois; Midwestern Regional Climate Center. 2007).

Data Collection and Analysis

During late summer of 2004, a 75 m by 125 m section of the 2 ha natural area was surveyed by dividing the area into 15 contiguous plots 25 m on a side. All living and dead-standing woody individuals ≥ 10.0 cm dbh were identified and their diameters recorded. From these data, living-stem density (stems/ha), basal area (m^2/ha), relative density, relative dominance, importance value (IV), and average diameter (cm) were calculated for each species. Determination of the IV follows the procedure used by McIntosh (1957), and is the sum of the relative density and relative dominance (basal area). Dead-standing density (stems/ha) and basal area (m^2/ha) were also determined.

Woody understory composition and density (stems/ha) were determined using nested circular plots 0.0001, 0.001, and 0.01 ha in size located at about 15 m intervals along line transects within the study area (n=20). Four additional 0.0001 ha circular plots were located 7 m from the center point of each of the 20 plot centers along cardinal compass directions (100 plots). In the 0.0001 ha plots woody seedlings (≤ 50 cm tall) were counted; in the 0.001 ha circular plots small saplings (>50 cm tall and <2.5 cm dbh) were calculated; and in the 0.01 ha circular plots large saplings (2.5- <10.0 cm dbh) were tallied.

RESULTS

Ten tree species were encountered forming an overstory with an average of 180.4 stems/ha and an average basal area of 28.715 m²/ha (Table 1). *Quercus alba* dominated the larger diameter classes with an IV of 144.2 (200 possible), and an average diameter of 53.4 cm. The larger individuals of *Q. alba* had an open-grown form with large branches or branch scars within 4 m 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. The remaining tree species were mostly in the 10-29 cm diameter classes. Dead-standing oaks averaged 11.7 stems/ha with an average basal area of 2.641 m²/ha.

The woody understory was sparse, being very open in most parts of the woods. The density of tree seedlings, shrubs and woody vines was high, totaling 19,000 individuals/ha, small saplings averaged 2,250 stems/ha, and large saplings totaled 1,370 stems/ha (Table 2). *Sassafras albidum* (Nutt.) Nees (sassafras) dominated the seedling and sapling categories with 4300 seedlings/ha, 1600 small saplings/ha, and 545 large saplings/ha. Oak seedlings were fairly common, but no oak saplings were present.

DISCUSSION

The forests of the Speckman-Stelter Woods Land and Water Reserve and surrounding land differ today compared to early settlement times. According to Lerczak (2000), Ms. Stelter, 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. It also was mentioned that many oaks were present as grubs, suggesting frequent fires (Taft 1997).

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 (Taft 1997). In pre-settlement time frequent fires maintained much of this dry-mesic to mesic oak cover type, particularly along the western edge of its range (Ebinger and McClain 1991, McClain and Elzinga 1994). In general, many oak species are well adapted to fire due to their thick bark and ability to reproduce by sprouts, giving them a competitive advantage in areas of high fire frequencies. Oak densities in this pre-settlement landscape was 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 (Anderson 1991, Abrams 1992).

The Illinois Natural Areas Inventory surveyed the vegetation of White Oak Creek Woods in 1976 (White 1978). Their field biologists considered the area a good quality old-growth dry sand forest due to a tree density of 292 stems/ha and a basal area of 25.4 m²/ha. Black oak was the dominant overstory species with 100 stems/ha and a basal area of 17.0 m²/ha. *Ulmus americana* L. (American elm), *Quercus alba*, and *Sassafras albidum* followed in importance. The area surveyed, however, was the area selectively logged in the 1980s north of White Oak Creek, not the small section south of White Oak Creek that was examined during the present survey.

No other forested areas in the Illinois River sand deposits of Mason County were found to contain more than just a few individuals of *Quercus alba*. All have been closed canopy dry sand forests on dune deposits where black oak and *Quercus marilandica* Muench. (blackjack oak) were the leading dominants along with a few hickory species in low numbers (Jenkins et al. 1991, Coates et al. 1992, McClain et al. 2002). One closed forest, Burton Woods, located on a terrace of Salt Creek in Mason County, was dominated by *Celtis occidentalis* L. (hackberry) and *Quercus macrocarpa* Michx. (bur oak) (McClain et al. 1993). *Quercus alba* was absent from this wet-mesic forest though many mesic species were present: *Gleditsia triacanthos* (honey locust), *Ulmus americana*, *Platanus occidentalis* L. (sycamore) *Ulmus rubra* Muhl. (slippery elm), *Juglans nigra* L. (black walnut), and *Quercus bicolor* Willd. (swamp white oak).

Rodgers and Anderson (1979) used Government Land Office survey records from 1821-1824 to determine the pre-settlement vegetation of Mason County. In all community types (prairie, savanna, open forest, and closed forest), black oak was the dominant woody species and usually accounted for more than half the IV (300). Blackjack oak was second in IV in open canopy communities (prairie and savanna) while in open and closed forests hickories and maples were second and third in importance. *Quercus alba* was not common, being occasionally recorded in savanna (IV of 14.05 out of 300), open forest (IV of 19.46 out of 300), and closed forests IV of 11.18 out of 300). These forests were mostly on the western edge of the county adjacent to the Illinois River and its backwater lakes where decreased fire frequency may have permitted the establishment of mesic to dry-mesic forests.

In the Kankakee Sand Area Section of the Grand Prairie Natural Division, *Quercus alba* occurs in dry-mesic sand savannas on the lower slopes of dunes and in the swales between the dunes (McDowell et al. 1983, Johnson and Ebinger 1992). On these sites the vegetation is a savanna with an understory of native prairie species (Johnson and Ebinger 1995). Management burns are used to maintain an open overstory in these sand savannas.

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Table 1. Density by diameter class (stems/ha), basal area (m^2/ha), relative density, relative dominance, importance value, and average diameter for the woody species at White Oak Creek Woods Natural Area, Mason County, Illinois.

Species	Diameter Classes (cm)						Total #/ha	Basal Area m^2/ha	Rel.Den.	Rel.Dom.	I.V.	Av.Diam (cm)
	10-19	20-29	30-39	40-49	50+	50+						
<i>Quercus alba</i>	--	--	11.7	29.9	64.0	105.6	24.577	58.6	85.6	144.2	53.4	
<i>Quercus velutina</i>	--	--	--	--	6.5	6.5	2.611	3.6	9.1	12.7	71.3	
<i>Prunus serotina</i>	18.1	2.1	--	--	--	20.2	0.284	11.2	1.0	12.2	12.9	
<i>Sassafras albidum</i>	17.1	--	--	--	1.1	18.2	0.466	10.0	1.6	11.6	14.1	
<i>Robinia pseudoacacia</i>	9.6	2.1	--	--	--	11.7	0.240	6.5	0.8	7.3	15.6	
<i>Morus alba</i>	8.5	--	--	--	--	8.5	0.094	4.7	0.4	5.1	11.8	
<i>Maclura pomifera</i>	2.1	--	1.1	1.1	--	4.3	0.322	2.4	1.1	3.5	28.0	
<i>Ulmus americana</i>	2.1	1.1	--	--	--	3.2	0.098	1.8	0.4	2.2	18.2	
<i>Celtis occidentalis</i>	1.1	--	--	--	--	1.1	0.010	0.6	--	0.6	10.9	
<i>Juglans nigra</i>	1.1	--	--	--	--	1.1	0.013	0.6	--	0.6	12.3	
Totals	59.7	5.3	12.8	31.0	71.6	180.4	28.715	100.0	100.0	200.0		

Table 2. Density (individuals/ha) of the woody understory species at White Oak Creek Woods Natural Area, Mason County, Illinois.

Species	Seedlings	Small Saplings	Large Saplings
<i>Sassafras albidum</i>	4300	1600	545
<i>Celtis occidentalis</i>	1700	100	25
<i>Quercus alba</i>	1100	--	--
<i>Quercus velutina</i>	800	--	--
<i>Carya texana</i>	300	200	95
<i>Ulmus americana</i>	300	--	15
<i>Prunus serotina</i>	200	100	375
<i>Morus alba</i>	100	--	45
<i>Cercis canadensis</i>	100	--	20
<i>Asimina triloba</i>	100	--	--
<i>Carya tomentosa</i>	--	50	--
<i>Ulmus rubra</i>	--	--	145
<i>Robinia pseudoacacia</i>	--	--	75
<i>Crataegus mollis</i>	--	--	5
<i>Tilia americana</i>	--	--	5
<i>Fraxinus lanceolata</i>	--	--	5
<i>Juglans nigra</i>	--	--	5
<i>Cornus drummondii</i>	200	200	10
<i>Toxicodendron radicans</i>	7700	--	--
<i>Rubus allegheniensis</i>	1200	--	--
<i>Ribes missouriense</i>	900	--	--
Totals	19000	2250	1370

