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Woody Vegetation Survey of Bishop's Woods, a Sand Forest in Mason County, Illinois

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ABSTRACT

An inventory of the woody vegetation of a 6.5 ha section of a mesic sand forest in Mason County, Illinois, gave a stand composition of 247.5 stems/ha (above 10 cm dbh), and a basal area of 16.1 sq m/ha. A total of 21 woody species were present on the site with black oak comprising 84% of the basal area, 61% of the total individuals, and with an importance value (IV) of 144.9 (out of 200). Black hickory ranked second (IV of 22.6) accounting for 16% of the individuals and 6% of the basal area. Blackjack oak and mockernut hickory were third and fourth in importance with IV's of 15.0 and 10.9, respectively. Most of the overstory species were relatively evenly distributed throughout the woods except for blackjack oak which had a clumped distribution, being limited to the margins of small clearings.

INTRODUCTION

Few overstory inventories have been undertaken in the oak-hickory sand forests of Illinois. Rodgers and Anderson (1979), in a study of presettlement vegetation of McLean and Mason Counties, concluded that the closed forests associated with the sandy soils of this area were dominated by black oak, blackjack oak, and hickory species. Later, Adams and Anderson (1980), in studying the responses of forest species to a moisture gradient, concluded that blackjack oak and black

oak were the dominant forest species occurring on upland sandy sites, such as those located in Mason County. More recently, McDowell et al. (1983), in a study of several dry and dry-mesic sand savannahs in the Kankakee Sand Area Section (Schwegman 1973), concluded that black oaks, along with a few white oaks, dominate these northeastern Illinois sites.

The present study was conducted on a 6.5 ha tract of oak-hickory sand forest known as Bishop's Woods. This woods, located in the southern part of Sand Ridge State Forest, is approximately 2 miles west of Forest City, Mason County, Illinois (SE1/4 Sec 10, SW1/4 Sec 11, NW1/4 Sec 14, NE1/4 Sec 15, T22N, R7W). The study site is in the Illinois River Section, Illinois River and Mississippi River Sand Areas Natural Division (Schwegman, 1973), and represents a remnant of a much larger woods that occurred on stabilized sand dunes in Mason County before settlement by European man (Rodgers and Anderson, 1979). The present study was undertaken to determine the floristic composition and structure of this forest.

MATERIALS AND METHODS

During the summer of 1989, a 6.5 ha (16 acres) section of Bishop's Woods was surveyed. The area was divided into quadrats 25 m on a side (0.154 acres), and the number, size and species of all living and dead-standing trees (above 10 cm dbh) were recorded for each of the 104 quadrats. The relative dominance, relative density and importance value (IV) were then calculated for each species encountered. The procedure for IV determination follows that developed by McIntosh (1957) and later by Boggess (1964), which is the sum of the relative density and relative dominance. The average diameter, density (#/ha) in broad diameter classes, and basal area (sq m/ha) were also calculated for each species.

Nested circular plots 0.0001, 0.001, and 0.01 ha in size were randomly located in each of the 104 quadrats. In the 0.0001 ha plot seedlings <40 cm in height were recorded, in the 0.001 ha plot seedlings >40 cm in height but <2.5 cm dbh were recorded, and in the 0.01 ha plot saplings (2.5-10.0 cm dbh) were recorded and their densities (#/ha) determined. Nomenclature follows Mohlenbrock (1986).

Randomly located throughout the site five soil pits were dug to determine the depth of the A horizon. From each of these pits, soil samples were taken from both the A and B horizons for determination of soil texture and pH. Soil texture was determined using the Bouyoucos hydrometer method (Bouyoucos, 1962), while soil pH was obtained using a Corning pH meter, Model 7.

RESULTS AND DISCUSSION

A total of 21 woody species were recorded in the woodlot, 10 canopy trees and 11 understory trees and shrubs. The canopy species encountered, along with their densities in broad diameter classes and basal area per ha, relative values, IV's, and average diameters are listed in Table 1, while the understory shrubs, along with their densities (#/ha) appear in Table 2.

Canopy

Of the species encountered, *Quercus velutina* (black oak) ranks first in IV with the highest relative dominance and relative density. It accounts for 61% of the individuals, 84% of the basal area (sq m/ha), and is the dominant species throughout the woods. It dominants all diameter classes, with large numbers of individuals in the smaller diameter classes. It ranks second in the number of seedlings present, and fifth in saplings (Table 1).

Carya texana (black hickory) ranks second in the overstory with a IV of 22.6, is common throughout the woods, accounting for 16% of the individuals, and 6% of the basal area. It has a large number of individuals in the lower diameter classes, few large trees, and no individuals above 50 cm dbh. Also, it is well represented in the seedling and sapling categories (Table 1). The large number of seedlings, saplings, and smaller diameter trees of this species, suggests that black hickory will probably increase in importance in the future. This large number of small diameter individuals is possibly the result of the suppression of periodic fires which would cause high mortality in this thin barked species.

Quercus marilandica (blackjack oak) has an IV of 15.0, ranking third in importance, accounting for only 10% of the individuals, and 5% of the basal area. Blackjack oak has few individuals in the larger diameter classes, but is well represented by small diameter trees. Few seedlings and saplings of this species were encountered when compared with black oak and black hickory. Also, it has a clumped distribution in the woods, commonly being found at the margins of small openings. These openings are usually less then 1/4 ha in size, have a sand soil with little organic material, and are dominated by *Opuntia humifusa* (Raf.) Raf. (prickly pear) and other xeric, prairie species.

Carya tomentosa (mockernut hickory) ranks fourth in importance with a IV of 10.9, comprising 8% of the individuals, and only 3% of the basal area. The majority of the individuals of this species occur in the lower diameter classes, and it is relatively well represented in the seedling and sapling categories.

The other canopy species are of only minor importance in the woods with a combined IV of 6.6. *Robinia pseudoacacia* (black locust), with an IV of 3.3, is restricted to the lower diameter classes, and is mostly found in areas where past tree-falls have created canopy openings. *Prunus serotina* (black cherry) is also restricted to canopy openings, though it is well represented throughout the woods by numerous seedlings and saplings (Table 1). The remaining six species are only rarely encountered.

Coppice Growth

Multiple stemmed trees are common in the woodlot, averaging 10.2 coppice trees/ha, with an average of 22.5 stems/ha, and a basal area of 1.4 sq m/ha. Of the five species exhibiting coppice growth, black oak ranks first with 8.3 trees/ha,

an average of 2.2 stems/tree, and an average diameter for each stem of 29.6 cm dbh. Black oak accounts for 82% of all coppice trees, and 93% of their basal area. In contrast, blackjack oak averages 1.2 coppice trees/ha with each stem averaging 15.0 cm dbh. Other species with coppice individuals are black hickory, mockernut hickory and black locust. These three species are of minor importance in terms of coppice growth, since they account for only 6% of the coppice trees, and 4% of their basal area. The extent of coppice growth in these woods is probably due to past fires.

Tree Mortality

Tree mortality is a fairly high, averaging 28.5 dead standing trees/ha, with an average diameter of 28.2 cm dbh, and a basal area of 2.2 sq m/ha. Black oak, as expected, has the highest mortality with 24.1 dead trees/ha, and with an average diameter of 29.9 cm dbh. This species accounts for 85% of the dead trees, and 94% of their basal area. Blackjack oak has the second highest mortality with 3.7 dead trees/ha, and with an average diameter of 18.8 cm dbh. A few dead individuals of black hickory are also found in the woodlot.

Shrubs

Nine shrubs were encountered in the understory (Table 2). *Toxicodendron radicans* (poison ivy), *Rhus aromatica* (fragrant sumac), *Zanthoxylum americanum* (prickly ash), and *Cornus racemosa* (gray dogwood) are the most common, accounting for more than 80% of the stems in the dense understory. These species, as well most of the others encountered, are common in dry to dry-mesic forest areas. Fragrant sumac commonly forms dense, low thickets in more open parts of the woods, while prickly ash and gray dogwood are common under a dense overstory. Poison ivy probably reaches its maximum importance in mesic forested areas and, according to Adams and Anderson (1980) is the most numerous shrub in all forest types in central Illinois.

Soils

The soils of this woodlot are extremely sandy and acidic. The A horizon throughout the woodlot has a average depth of 8.0 (6.5-9.5) cm with an average pH of 5.1 (4.2-5.7), while the B horizon is also acidic with a pH of 4.8 (4.4-5.4), being slightly more acidic than the A horizon. Both the A and B horizons have similar soil texture with sand being the major component. The A horizon has an average soil texture of 88.8% sand, 3.3% silt and 7.9% clay, while the B horizon has an average soil texture of 91.1% sand, 2.1% silt and 6.8% clay. These results are similar to those of Adams and Anderson (1980) who reported that sites in the sand areas along the Illinois River have soils that varied in texture from 92-100% sand.

CONCLUSIONS

The results of this study tend to indicate that this forest is a relatively high quality example of the closed forests associated with the sand dunes of the Illinois River Sand Area Section. In a study of the presettlement vegetation of McLean and Mason Counties, Rodgers and Anderson (1979) concluded that the closed forests associated with the sand dunes in Mason County, were dominated by black oak (IV 118.31), blackjack oak (IV 18.35) and hickory spp. (IV 21.81). Their results are very similar to the IV's for black oak (144.9), blackjack oak (15.0), and black hickory (22.6) found in the present study. They also suggested that these closed forests seem to be fairly stable in composition, since the relatively shade-intolerant dominant species tend to reproduce themselves due to the lack of competition in extremely xeric conditions, and the periodic burns which keep the canopy open. The fact that black oak and black hickory have a large number of individuals in the lower diameter classes, and sufficient seedling and saplings for future replacement of veteran trees, tends to support these findings.

More recently, Adams and Anderson (1980) reported that upland sites on water-deposited, wind-worked sands along the Illinois River were dominated by blackjack oak and black oak with black hickory and mockernut hickory the third and fourth leading species in the upper canopy on xeric sites. These workers also found that the dominant saplings were black hickory (81.3 #/ha), black oak (40.0 #/ha), mockernut hickory (28.0 #/ha), and blackjack oak (27.3 #/ha), and that these four species, with the addition of black cherry, are the important species in the seedling stratum as well. The results of the present study are similar to those found by Adams and Anderson (1980) except that there were significantly more seedlings and saplings found. Adams and Anderson (1980) also suggest that the basal area of these xeric sites averages 17.7 sq m/ha. The average basal area found in the present study tends to support their findings, with 16.1 sq m/ha. Furthermore, Adams and Anderson (1980) suggested that these xeric sites are characterized by a few dominant tree species, resulting in low diversity, and that diversity increases in the seedling stratum due to the addition of three mesophytic species (hackberry, American elm and black cherry) that are not found in the tree or sapling stratum. During the present study two of these species were sometimes encountered, while black cherry was a common component of both the seedling and sapling layer.

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Table 1. Densities (#/ha), diameter classes, basal areas (sq m/ha), relative values, importance values and average diameters of the woody species in Bishop's Woods a mesic sand forest located near Forest City, Mason County, Illinois.

Species	Seedlings #/ha <40cm	Seedlings #/ha >40cm	Saplings #/ha	Diameter Classes(cm) #/ha 10-20	20-30	30-40	40-50	50+	Total	Basal Area	Rel. Den.	Rel. Dom.	I.V.	Av. Diam. (cm)
Quercus velutina Lam.	1250	375	46	36.9	47.2	32.2	18.9	14.9	150.1	13.5	60.7	84.2	144.9	30.8
Carya texana Buckl.	1346	1240	222	31.8	5.5	1.8	1.1	--	40.2	1.0	16.3	6.3	22.6	16.3
Quercus marilandica Muenchh.	192	19	6	13.7	8.3	1.5	.2	.2	23.9	.8	9.7	5.3	15.0	19.9
Carya tomentosa (Poir.) Nutt.	96	288	137	16.3	2.2	1.2	.2	--	19.9	.5	8.0	2.9	10.9	15.8
Robinia pseudoacacia L.	--	87	68	6.3	.5	--	--	--	6.8	.1	2.7	0.6	3.3	13.6
Prunus serotina Ehrh.	673	788	128	3.7	.3	--	--	--	4.0	.1	1.6	0.4	2.0	14.0
Others*	96	135	5	2.6	--	--	--	--	2.6	.1	1.0	0.3	1.3	--
Totals	3653	2932	612	111.3	64.0	36.7	20.4	15.1	247.5	16.1	100.0	100.0	200.0	

* Includes *Sassafras albidum* (Nutt.) Nees., *Ulmus americana* L., *Juglans nigra* L., *Celtis occidentalis* L., *Malus ionesis* (Wood) Britt., and *Juniperus virginiana* L.

Table 2. Density (#/ha) of the shrub species encountered in Bishop's Woods a mesic sand forest located near Forest City, Mason County, Illinois.

SPECIES	INDIVIDUALS PER HA
Toxicodendron radicans (L.) Kuntze.	7788
Rhus aromatica Ait.	7259
Zanthoxylum americanum Mill.	6144
Cornus racemosa Lam.	3990
Ribes missouriense Nutt.	442
Ptelea trifoloata L.	509
Prunus virginiana L.	212
Corylus americana Walt.	96
Amorpha canescens Pursh.	48
Total	26488