

VEGETATION SURVEY OF AN OAK-HICKORY MAPLE FOREST IN CLARK COUNTY, ILLINOIS

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ABSTRACT. — The present stand of the western-most part of Rocky Branch Nature Preserve, Clark County, Illinois, is composed of 136 stems per acre (above 4 inches d.b.h.) with a basal area of 99 square feet per acre. A total of 35 woody species are present on the site with white oak comprising half of the basal area and nearly one-third of the total individuals. Black oak, red oak, shagbark hickory, sugar maple, mockernut hickory, and bitternut hickory follow in order of Importance Value. Three broad cover types are recognized in the woodlot. The first area is a dry, relatively flat upland in which white oak has an Importance Value of over 100; the second is a mixed-hardwood region on the slopes and lowland areas where oaks, hickories, and sugar maple dominate, and the third is a sugar maple-dominated region on a steep north-facing hillside. The large number of saplings, seedlings, and small diameter trees of sugar maple indicates that its importance will increase in the woods.

The 130 acre Rocky Branch Nature Preserve is located about 6 miles northwest of Marshall in Clark County, Illinois. Because of the unique fauna and flora of this area, the Illinois Chapter of The Nature Conservancy purchased the tracks of land bordering parts of Rocky Branch Creek. This area is now under the trusteeship of Eastern Illinois University and is being maintained as a natural area for instructional and research purposes.

The woodlot represents the remnant of the typical forest associated with deep valleys of the Illinoian till of East-Central Illinois. The plants of the many sandstone walls,

which border the creek, and the vegetation, which occurs in the ravines and on the slopes, make this an extremely botanically interesting area. In these areas are numerous species of plants that are not common to this part of Illinois. Found here are such woody plants as beech (*Fagus grandiflora*), tulip tree (*Liriodendron tulipifera*), red maple (*Acer rubrum*), and maple-leaved viburnum (*Viburnum acerifolium*). Herbaceous species that are near the extreme edge of their range include three species of sphagnum

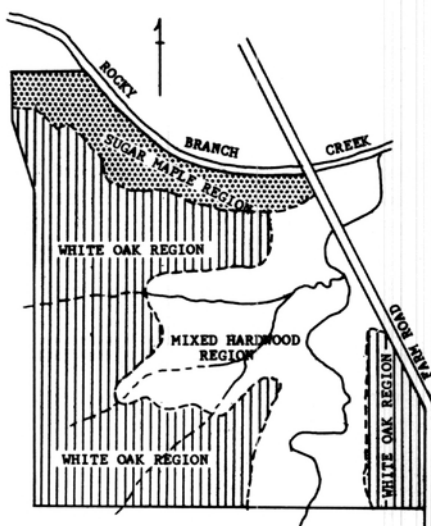


FIGURE 1. Map showing the distribution of the broad cover types in the western-most part of the Rocky Branch Nature Preserve.

moss (Arzeni, 1947), shining club moss (*Lycopodium lucidulum*), walking fern (*Camptosorus rhizophyllus*), partridge berry (*Mitchella repens*), beech drops (*Epifagus virginiana*), and bishop's cap (*Mitella diphylla*).

Prior to the acquisition of the land by The Nature Conservancy, the woods had been grazed to some extent and some timber had been cut. According to the local inhabitants, however, no extensive cutting has taken place since about 1900. A few stumps are still present in parts of the woods, indicating that more recent cutting has also occurred.

The only previous ecological work in the woodlot was conducted by Stover (1930), who completed a checklist of the plants and gave short descriptions of the plant associations that existed. The first complete inventory of the woody vegetation of the western part of this area was conducted in 1967, and the results are presented in this paper. The western-most section was studied since it represents the most mature and least disturbed part of the woods.

DESCRIPTION OF THE WOODLOT

The area studied in this survey was the western-most part of Rocky Branch Nature Preserve, consisting of a 16 acre woodlot located in the NE $\frac{1}{4}$, SE $\frac{1}{4}$ of Section 30, T12N, R12W, Clark County, Illinois. This woodlot is on Illinoian till, 5 miles to the south of the terminal moraine of the Wisconsin glacier. The topography of the area is quite diverse. The western part is a level to gently sloping upland while the remainder

of the woodlot is divided by ravines with gradually sloping sides to steep banks. The northern perimeter of the woods consists of outcroppings of sandstone and an accompanying severe bank overlooking Rocky Branch Creek. The west and south edges of the woodlot are limited by open fields, the east edge by a farm road, and have the usual edge vegetation of low shrubs and weed trees typical of fence rows. The overall relief is about 60 feet, the high point in the southwest corner being 645 feet above sea level.

METHOD OF STUDY

The woodlot was divided into 50 meter square quadrats and the number, size, and species of trees above 4 inches d.b.h. were recorded in each. The diameters were recorded to the nearest 1/10 of an inch. The Importance Value (IV) was then calculated from the actual data to provide a better basis of comparison of the various species. As used here, the determination of the IV follows the procedure outlined by McIntosh (1957) and later by Boggess (1964), in which the IV is the sum of the relative density

$$\frac{(\text{number of individuals of a species})}{(\text{number of individuals of all species})} \times 100$$

and of the relative dominance

$$\frac{(\text{basal area of a species})}{(\text{total basal area of all species})} \times 100.$$

Also, the IV was calculated for each quadrat to determine if different vegetation zones existed in the woods. Dead-standing and dead-downed trees also were measured and identified when possible. A record

was kept of the amount of coppice growth that existed in the woodlot, as well as the number and size of cut stumps.

In each 50 meter quadrat, four 1/100 and 1/1000 acre nested, circular plots were randomly located. The saplings (1 to 4 inches d.b.h.) were recorded on the larger plot and the seedlings on the smaller. The seedlings were divided into those under one foot in height and those over one foot in height but less than one inch in diameter.

The taxonomic nomenclature used in this paper follows that of Jones (1963).

RESULTS AND DISCUSSION

A total of 35 woody species were recorded on the woodlot. Of this total, 23 were canopy trees, 6 were understory trees, and 6 were woody shrubs and vines. The species encountered, with their density and frequency by height and diameter class, appear in Table 1. The 14 leading species encountered, with their relative values, average diameters, and number of individuals per acre in broad diameter classes are included in Table 2.

Three broad cover types are recognized in the area, based on the Importance Values of the leading species on each of the quadrats studied. Quadrats of similar composition were grouped together and the cover types were defined, based on the Importance Value level of white oak. The cover-type boundaries, shown in Figure 1, were smoothed by field observation.

White oak. The dry, relatively flat uplands on the west and south-

eastern edges of the woods are dominated by white oak which accounts for over 50 per cent of the total Importance Value of the areas (IV of 100 or more). Black oak and shagbark hickory are the most common associates and have higher Importance Values than any other secondary species. Red oak, mockernut hickory, bitternut hickory, black walnut, slippery elm, and white ash have high frequencies, while sugar maple and pignut hickory are present only about 50 per cent of the time. All eight of these species have very low Importance Values. In the southern part of the western upland area, no sugar maple occurs, but near the steep, northern slope its Importance Value is 15. Also, the frequency and density of saplings and seedlings of sugar maple and ironwood increase greatly in the northern part of this area.

Sugar maple. The steep, north-facing hillside which overlooks Rocky Branch Creek is dominated by sugar maple, red oak, and to a lesser extent, bitternut hickory, basswood, beech, and ironwood. Sugar maple comprised 20 to 40 per cent of the stand and its IV averages 70. Red oak is the second most important species with an IV of 35. Nearly all of the basswood, beech, and ironwood are restricted to this part of the woods, and bitternut hickory has a much higher Importance Value here than in the remainder of the woodlot. A few individuals of black walnut, mockernut hickory, slippery elm, and white ash occur here, but have very low Importance Values. Very little white and black oak occur in this cover type.

Mixed hardwood. The remainder

of the woods consists of gentle to relatively-steep slopes and lowland areas associated with the small stream and the few ravines that occur in the woodlot. White oak dominates this cover type with an average IV of about 65 and is first in Importance Value in all quadrats. Black oak, red oak, and shagbark hickory are the most common associates with Importance Values between 15 and 24. Black walnut, mockernut hickory, and bitternut hickory have high frequencies but low Importance Values, while sugar maple is more important here than in the upland areas. On some of the steeper northern and northwestern slopes of this area, a few beech occur and the amount of sugar maple increases. Associated with the small terraces near the stream are a few individuals of butternut, persimmon, slippery elm, red mulberry, and sassafras.

Of the aborescent species found at Rocky Branch, the oaks (white, black, and red) rank first, second, and third in importance, respectively, and comprise the most important species group in the woodlot. White oak, which has an IV of 80 in the woods, comprises half of the basal area and nearly one-third of the total individuals in the area studied. It exceeds the other species in all broad diameter classes except the 4- to 6-inch class. This species is the leading dominant in all of the sample quadrats except on the steep, north-facing slope adjacent to Rocky Branch Creek.

Both black and red oak have an IV of about 20 in the woodlot. Black oak usually ranks second to white oak in the uplands of the woodlot,

while red oak is more common on the slopes. Both species have poor size-class distributions, with the majority of the individuals occurring in the 7- to 12 and 13- to 24-inch classes. Neither species is well represented in the sapling and seedling classes and are more poorly represented than white oak. The average diameter of 15.2 for black oak and 13.1 for red oak qualify them as the largest species in the woodlot. The largest individual in the woods is a 34-inch black oak.

Shagbark, mockernut, bitternut, and pignut hickories rank third, fifth, sixth, and eighth in importance, respectively, and comprise the second most important species group in the natural area. Shagbark, mockernut, and bitternut hickories are well distributed throughout the woodlot with frequencies of 100 per cent, while pignut is much more restricted, occurring in only 56 per cent of the quadrats examined. All of the hickories have good size-class distribution with most of their individuals in the 4- to 6-inch class and decreasing upward. Bitternut hickory is the only species of this genus with individuals in the 25- to 36-inch class. Shagbark hickory exceeds all other species in the 4- to 6-inch diameter class with 65 per cent of the individuals in this class. This species ranks second to white oak in total individuals per acre.

Sugar maple ranks fifth in importance and is commonly associated with third-ranked red oak. The high importance of sugar maple is due to tree number rather than tree size, as 65 per cent of this species occur in the 4- to 6-inch diameter class. Although not found throughout the

woods, its high importance on the north-facing hillside adjacent to Rocky Branch Creek and its occurrence in the lowland and on the other slopes of the woods indicate the more mesic nature of this species. Sugar maple ranks first in the number of seedlings and saplings per acre, having more than twice the density as the next most important species. Ironwood, which occurs as an understory tree that is associated with sugar maple, ranks thirteenth in importance. This species has nearly the same distribution in the woodlot as sugar maple and ranks third in seedlings and fourth in saplings per acre. Similar association of ironwood and sugar maple was observed by Ebinger (1968) in Sargents Woods, located on the Shelbyville Moraine.

Black walnut, slippery elm, white ash, and sassafras are scattered throughout the stand, but have Importance Values less than 5. No saplings or seedlings of black walnut occurred in the sample plots and its poor size-class distribution indicates that this species will decrease in importance in the future. The remaining three species, slippery elm, white ash, and sassafras, have a much better size-class distribution with over half of their individuals in the 4- to 6-inch diameter class. White ash ranks second in seedlings per acre, but the small number of saplings and trees of this species indicates its poor survival value. Slippery elm, in contrast, ranks second in saplings per acre. Its importance in the woods will probably not increase, however, due to mortality from phloem necrosis and Dutch elm disease.

Beech (fourteenth in IV) has a very restricted distribution in the woods, being found only on relatively steep slopes with a northern or northwestern exposure. Seedlings and saplings of beech are also restricted to these areas. This mesic site preference and the small number of seedlings and saplings indicate that the importance of this species will probably not increase in the woodlot.

A total of 31 stumps, with a total basal area of 41 square feet, was found in the woods. Most of these had been cut from the upland areas on the west and east edges of the woodlot and it appears that most of the trees cut were species of oak. Coppice growth is not an important feature of the woodlot, but it may give an indication as to when the last major cutting took place. Less than 4 per cent of the trees were composed of two or more main stems and accounted for less than 5 per cent of the basal area of the stand. Increment borings of the coppice stems showed an average stem age of 62 years.

The number of dead-standing and dead-downed trees is not an important feature of the woodlot. The total mortality of all species is only 8.6 trees per acre with a basal area of 3.0 square feet per acre. Dead white oaks average 3.6 trees per acre with a basal area of 1.3 square feet per acre. Dead elms averaged 1.1 trees per acre with a basal area of 0.4 square feet per acre. This is extremely low, particularly when compared with woods on the Shelbyville Moraine and farther north. In Sargents Woods (Ebinger, 1968) and Baber Woods (McClain and Ebinger,

1968) located on the Shelbyville Moraine, dead elms averaged 3 to 5 trees per acre with a basal area of 1 to 2 square feet per acre. All other species had a mortality of less than 0.7 trees per acre and less than 0.5 square feet of basal area per acre.

White oak and the hickory species are reproducing fairly well in the woodlot and have good size-class distribution. This indicates that these species represent a relatively stable community and that their importance in the stand will continue. In contrast, black and red oak have poor size-class distribution and will probably decrease in importance as mortality occurs in the larger diameter classes.

The more mesic hardwoods, such as sugar maple, white ash, basswood, and beech, are more restricted in the woodlot and except for sugar maple are not making substantial advances in the dried upland. The amount of sugar maple found and its distribution are important features of the area. The large number of seedlings and saplings, the good size-class distribution, and the ability of sugar maple to take advantage of canopy openings that occur, indicate its increasing importance in the woods.

The number of sugar maple seedlings (4453 per acre) is almost as great as for all other tree species combined. This trend toward a more mesic woodland situation was observed by McClain and Ebinger (1968) and by Ebinger (1968) in other upland forests in East-Central Illinois.

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TABLE 1.—Density Per Acre and Frequency of Woody Species by Height or Diameter Class.
The species symbol will be used to identify species in subsequent tables and figures.

Scientific Name	Common Name	Sym- bol	Height Class			Diameter Class		
			Density		Frequency %	1'-4'		4' +
			<1'	>1'<1" dbh		<1'	Fre- quency %	
<i>Quercus alba</i> L.	White oak	WO.	109	31	9.4	5	4.7	45.75
<i>Quercus velutina</i> Lam.	Black oak	BO.	46	62	4.7			9.56
<i>Quercus rubra</i> L.	Red oak	RO.	15	62	1.6	2	1.6	10.44
<i>Carya onata</i> (Mill.)								
K. Koch	Shagbark hickory	SH.	15	47	1.6	16	14.1	13.75
<i>Acer saccharum</i> Marsh.	Sugar maple	SM.	3,781	672	62.4	131	56.3	10.81
<i>Carya tomentosa</i> (Poir.)								
Nutt.	Mockernut hickory	MH.	15	94	1.6	11	9.4	7.63
<i>Carya cordiformis</i> (Wang.)								
K. Koch	Bitternut hickory	BH.	171	62	12.5	14	14.1	6.94
<i>Juglans nigra</i> L.	Black walnut	BW.						4.44
<i>Carya glabra</i> (Mill.) Sweet.	Pignut hickory	PH.	125	62	12.5	14	12.5	5.31
<i>Ulmus rubra</i> Muhl.	Slippery elm	SE.	266	422	23.4	63	32.8	4.56
<i>Fraxinus americana</i> L.	White ash	WA.	1,922	125	48.4	16	12.5	3.06
<i>Sassafras albidum</i> (Nutt.)								
Nees.	Sassafras	Sa.	47	109	4.7			3.06
<i>Ostrya virginiana</i> (Mill.)								
K. Koch	Ironwood	Ir.	859	343	40.6	34	23.4	2.81
<i>Fagus grandifolia</i> Ehrh.	Beech	Be.		31	3.1	3	3.1	1.13
<i>Quercus imbricaria</i> Michx.	Shingle oak	SO.						1.44
<i>Prunus serotina</i> Ehrh.	Black cherry	BC.	234	171	15.6	2	1.6	1.63
<i>Tilia americana</i> L.	Basswood	Ba.						0.75
<i>Quercus palustris</i> Muench.	Pin oak	PO.						0.50
<i>Carpinus caroliniana</i> Walt.	Muscle tree	MT.	422	125	18.7	22	15.6	0.69
<i>Cornus florida</i> L.	Flowering dogwood	FD.	234	203	9.4	72	34.4	0.63

TABLE 1.—Density Per Acre and Frequency of Woody Species by Height or Diameter Class.
The species symbol will be used to identify species in subsequent tables and figures.
(Concluded)

Scientific Name	Common Name	Sym- bol	Height Class				Diameter Class			
			Density		Frequency %		1'-4'		4' +	
			<1'	>1'<1" dbh	Total	<1'	>1'<1" dbh	Density	Fre- quency %	Fre- quency %
<i>Morus rubra</i> L.	Red mulberry	RM...	15	15	30	1.6	1.6	8	7.8	25
<i>Nyssa sylvatica</i> Marsh.	Black gum	BG...						2	1.6	12
<i>Celtis occidentalis</i> L.	Hackberry	Ha...								25
<i>Ulmus americana</i> L.	American elm	AE...								12
<i>Juglans cinerea</i> L.	Butternut	Bu...								6
<i>Cercis canadensis</i> L.	Redbud	Re...	31	15	31	1.6	1.6			6
<i>Diospyros virginiana</i> L.	Persimmon	Pe...			15					6
<i>Platanus occidentalis</i> L.	Sycamore	Sy...								6
<i>Rhus radicans</i> L.	Poison ivy	PI...	1,500	828	2,328	18.7	17.2			
<i>Corylus americana</i> Walt.	Hazelnut	Hz...	78	158	236	4.7	6.3			
<i>Celastrus scandens</i> L.	Bittersweet	Bi...	453	187	640	18.7	10.9			
<i>Hydrangea arborescens</i> L.	Wild hydrangea	WH...	31	47	78	1.6	3.1			
<i>Amelanchier arborea</i> (Michx. f.) Fern.	Juneberry	Ju...	47		47	3.1				
<i>Sambucus canadensis</i> L.	Common elder	CE...	31	15	46	1.6	1.6			
<i>Crataegus margareta</i> Ashe.	Hawthorn	Hw...		62	62		4.7			
Total			10,447	3,948	14,395			415		136.52

TABLE 2. — Number of Trees, Basal Area per Acre, Importance Value Index and Average Diameter for Leading Dominants.

Species	4-6		7-12		13-24		25-36		Total		Percent Total		Av. Diam., In.
	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.	Rel. Den.	Rel. Dom.	I.V.I.
WO.....	7.00	1.19	17.69	10.15	20.19	32.18	0.88	3.50	45.76	47.02	33.52	47.40	80.92
BO.....	1.25	0.23	3.06	1.77	4.63	8.54	0.63	2.79	9.57	13.33	7.01	13.44	20.45
RO.....	2.56	0.39	2.69	1.38	4.81	8.46	0.38	1.68	10.44	11.91	7.65	12.01	19.66
SH.....	9.00	1.34	4.19	1.87	0.56	0.65	.....	.....	13.75	3.86	10.08	3.90	13.98
SM.....	6.06	0.88	3.18	1.52	1.44	2.13	0.13	0.43	10.81	4.96	7.92	5.01	12.93
MH.....	3.88	0.64	2.88	1.41	0.88	1.07	.....	.....	7.64	3.12	5.59	3.14	8.73
BH.....	3.25	0.51	3.00	1.47	0.63	1.02	0.06	0.34	6.94	3.34	5.08	3.38	8.46
BW.....	0.81	0.15	2.75	1.69	0.88	1.06	.....	.....	4.44	2.90	3.25	2.93	6.18
PH.....	2.36	0.37	2.50	1.19	0.44	0.55	.....	.....	5.30	2.11	3.89	2.14	6.03
SE.....	3.19	0.42	1.19	0.52	0.19	0.19	.....	.....	4.57	1.13	3.34	1.14	4.48
WA.....	1.88	0.27	1.06	0.49	0.13	0.15	.....	.....	3.07	0.91	2.24	0.92	3.16
Sa.....	2.25	0.31	0.75	0.28	0.06	0.15	.....	.....	3.06	0.74	2.24	0.75	2.99
IW.....	2.31	0.33	0.50	0.16	.....	.....	.....	.....	2.81	0.49	2.06	0.49	2.55
Be.....	0.50	0.06	0.31	0.20	0.25	0.45	0.06	0.35	1.12	1.06	0.82	1.07	1.89
Others.....	4.75	0.64	1.94	0.95	0.56	0.68	.....	.....	7.25	2.27	5.31	2.28	7.59
Total.....	51.05	7.73	47.69	25.05	35.65	57.28	2.14	9.09	136.53	99.15	100.00	100.00	200.00