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Bob Edgin
Illinois Nature Preserve Commission

Gordon C. Tucker
Eastern Illinois University, gctucker@eiu.edu

John E. Ebinger
Eastern Illinois University

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Bob Edgin

Illinois Nature Preserves Commission
Springfield, Illinois 62701, U.S.A.

Gordon C. Tucker[1] and John E. Ebinger

Department of Biological Sciences
Eastern Illinois University
Charleston, Illinois 61920, U.S.A.

ABSTRACT

American Beech Woods Nature Preserve is located on Illinoian till in the Wabash Border Division of eastern Illinois. The plant life of this 8 ha site was examined during the 1999–2001 growing seasons. We documented a total of 207 vascular plant species in 148 genera of 71 families (10 pteridophytes, 1 gymnosperm, 49 monocots, and 147 dicots). We also sampled the vegetation using a stratified-random line-strip method. Tree density averaged 249 trees/ha with a basal area of 22.91 m^2/ha. *Fagus grandifolia* Ehrh. (American beech) was the dominant tree species with 63 trees/ha, a basal area of 7.34 m^2/ha, and an importance value 26.1 (possible 100). *Acer saccharum* Marsh. (sugar maple) ranked second in importance value (IV = 15.7) with most individuals in the 10–19.9 cm diameter class. *Quercus velutina* Lam. (black oak) and *Carya glabra* (Mill.) Sweet (pignut hickory) were the only other overstory trees with an importance value greater than 10. In comparison with an earlier study in 1973, the site has experienced a decrease in both tree density (399 trees/ha vs. 249 trees/ha) and basal area (33.35 m^2/ha vs. 22.91 m^2/ha).

RESUMEN

La Reserva Natural de Haya Americana esta ubicada en terreno Illinois en la frontera del Rio Wabash en Illinois oriental. La flora del bosque que mide 8 hectáreas fue examinada durante la temporada de crecimiento en los años 1999–2001. Hemos identificado 207 especies de plantas vasculares que incluyen 148 géneros de 71 familias distintas: 10 pteridófitas, una gimnosperma, 49 monocotitedóneas, y 147 dicotiledóneas. Muestreamos la vegetación usando el método de línea-franja aleatoria. La densidad promedia era 249 árboles por hectárea con una área basal de 22.91 m2/ha. *Fagus grandifolia* Ehrh. (haya) era la especie de árbol dominante. Había 63 árboles por hectárea con una área basal de 7.32 m^2/ha y un valor de importancia de 26.1 (posibilidad de 100). *Acer saccharum* (arce de azúcar) tenía una importancia secundaria con un valor de importancia de 15.7. La mayoría de los individuos pertenecían a la clase de tamaño entre 10–19.9 cm. *Quercus velutina* Lam. (roble negro) y *Carya glabra* Mill. (nuez de cerdo) eran los únicos árboles que tenían un valor de importancia de más de 10. En comparación con el estudio de 1973 el bosque ha sufrido una perdida de densidad (399 árboles por ha v. 249 árboles por ha) y área basal (33.35 m^2/ ha v. 22.91 m^2/ha.)

INTRODUCTION

At the beginning of extensive European settlement (ca. 1800), about 61% of Illinois was prairie and savanna. The remainder, mostly the more rugged terrain, was woodland and forest (Küchler 1964; Anderson 1970; Iverson et al. 1991; Ebinger 1997). In such areas of rugged terrain, tree species composition varied

[1]Corresponding author; cfgct@eiu.edu.

locally with oaks (*Quercus* spp.) and hickories (*Carya* spp.) being the common forest species on drier mostly upland sites. Mesophytic species such as elm (*Ulmus* spp.), ash (*Fraxinus* spp.), and sugar maple (*Acer saccharum* Marsh.) were associated with the dissected ravines and narrow river floodplains (Braun 1950; Anderson 1983; Cowell & Jackson 2002). At the eastern edge of Illinois, particularly in the Wabash Border Natural Division, many of these forests contained American beech (*Fagus grandifolia* Ehrh.), tulip tree (*Liriodendron tulipifera* L.), and other tree species typically found in forests to the east of Illinois (Schwegman 1973). American beech has a wide range comparable to that of other major Eastern Deciduous Forest trees.

Beech-maple forests usually included some species of oaks and hickories and reached the western limit of their range in east-central and southern Illinois. In Illinois, the few remaining examples of this community type are associated with steep, deeply dissected ravine systems, narrow valleys, and narrow to broad ridges. The beech-maple component has a rich herbaceous layer on the mesic slopes and an oak-hickory component on the ridges and more level uplands. These remnants have been variously disturbed by logging, grazing, and exotic species invasion.

Three examples of this forest community located in the Wabash River Valley have been dedicated as Illinois Nature Preserves (McFall & Karnes 1995). Occurrences of American beech in this region have enhanced significance as these populations represent the western edge of the range of a wide ranging eastern North American species. The American Beech Woods Nature Preserve contains one of these protected beech-maple forests. The objectives of our study were to document the vascular flora; to determine the composition and structure of the woody and herbaceous vegetation; and to analyze changes in the forest composition that occurred since the forest was last studied in 1973.

DESCRIPTION OF THE STUDY AREA

The American Beech Woods Nature Preserve, dedicated as a nature preserve in 1985, is located in Lincoln Trail State Park (Fig. 1), about 5 km south of Marshall, Clark County, Illinois (SE/4, NW/4, S2, T10N, R12W; 39°20'30"N, 87°42'45"W). Located in the Southern Upland Section of the Wabash Border Natural Division about 15 km from the Indiana state line, the preserve is situated on Illinoian glacial till about 20 km south of the terminal moraine of Wisconsin glaciation (Schwegman 1973). The preserve, about 8 ha in size, has rugged topography, ranging in elevation from 167 m at the edge of Lincoln Trail Lake to 190 m at the highest point. Topographic features include steep-sided ravines, valley walls of various slope aspects, and narrow ridges. The western boundary of the preserve follows the shoreline of Lincoln Trail Lake. Presently most of the preserve is high quality, old second growth, mesic and dry-mesic upland forest (White & Madany 1978). Based on the original Government Land Office survey records

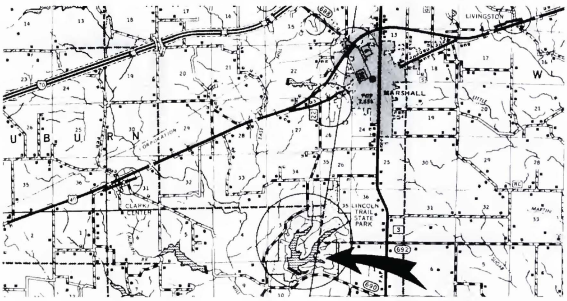

Fig. 1. The location of Clark County in eastern Illinois, and the location of American Beech Woods Nature Preserve in Lincoln Trail State Park, S of Marshall, Illinois (courtesy of the Illinois Nature Preserves Commission).

at the Illinois State Archives in Springfield (Hutchison 1988), the woods still retains many of the species present prior to settlement by Europeans.

The overstory of the preserve was sampled in 1973 as part of an extensive study that examined the structure and composition of beech-maple forests in Illinois, Indiana, Michigan, and Wisconsin (Dunn 1978). Two prescribed burns (Nov 1993 and Dec 1998) have been conducted in the preserve, while seedlings and saplings of sugar maples have been removed recently from the flat uplands and ridgetops.

The soils of the ridgetops are Stoy silt loam, a somewhat poorly drained soil that formed in loess underlain by Illinoian glacial till (Awalt 1979). Soils of the wooded slopes and drainages are Hickory loam, a well-drained soil that developed in Illinoian glacial till. These soils overlay bedrock composed of Pennsylvanian shale and sandstone (Dunn 1978).

The climate is continental, characterized by hot, humid summers and cold winters. Weather station records for Marshall, Illinois, about 6 km north of the preserve, indicate that the area receives an average annual precipitation of 104 cm which falls mostly as rain during the period of April through September (Weather.com 2002). January is the coldest month with an average high temperature of 1° C and an average low temperature -8° C. The record high for the month was 27° C on January 9, 1932 and the record low was -31° C on January 18, 1930. July is the hottest month with an average high temperature of 31° C and an average low of 17° C. The record high for the month was 43° C on July 14, 1936 and the record low was 7° C on July 1, 1937 (weather.com 2002).

MATERIALS AND METHODS

The area was visited numerous times during the 1999, 2000, and 2001 growing seasons. During each trip, all new flowering or fruiting species encountered were collected, the specimens identified, and deposited in the Stover-Ebinger Herbarium (EIU) of Eastern Illinois University, Charleston. Native status and nomenclature follows Mohlenbrock (2002). All vascular plant taxa observed are enumerated in the Annotated Species List (Appendix I).

Vegetation sampling to determine quantitative abundance of woody and herbaceous species was conducted on August 29 and 30, 2000. We employed the stratified-random line-strip method of Lindsay (1955) as modified by Donselman (1973), Levenson (1973), and Dunn (1978). Using this method, overstory trees, saplings, shrubs, and ground layer strata were sampled simultaneously in rectangular plots positioned along transect lines.

Sample plots for the overstory trees (≥10.0 cm dbh) were delimited using a 100 m tape divided into 25 m sections. Overstory trees were sampled in 10 m × 25 m (0.025 ha) with four located along each transect. All trees whose centers were located within the plots were included in the sample. Aspect of the plot, species, and diameter at breast height (dbh) were recorded for each individual located within the boundaries of each plot. Large saplings (5.0 cm dbh – 9.9 cm dbh), intermediate saplings (≥2.5 cm dbh; ≤ 4.9 cm dbh), small saplings (≥ 50.0 cm tall; ≤ 2.4 cm dbh), shrubs, and the groundlayer (woody seedlings <50.0 cm tall and all herbaceous taxa) were sampled in rectangular plots located at the zero, 25 m, 50 m, and 75 m mark of the tape. Aspect, species, and the number of individuals were recorded for all vascular plants in each category that fell within one meter from the tape along a section 2.5 m long (0.00025 ha plot).

When all plots along the 100 m transect line were sampled, a section of 1/2" steel conduit marked "Edgin 2000" was driven at each end of the tape to facilitate the relocation of the transect line for future studies. A new 100 m transect line, located a minimum of 25 m distant from the first line and perpendicular to the ravine was then established and the sampling procedures repeated. This process was replicated along ten 100 m transect lines providing a total of 40 plots in each category.

Density (trees/ha), basal area (m^2/ha), frequency (%), relative density, relative dominance, relative frequency, importance value (relative density + relative dominance + relative frequency/3) and average basal area were determined for each species in the overstory tree stratum. Density (stems/ha), frequency (%), relative density, relative frequency, and importance value (relative density + relative frequency/2) were determined for each species in the small, intermediate, and large sapling, shrub, and ground layer strata.

The Floristic Quality Index (FQI) of the site was determined using the Coefficient of Conservatism (CC) assigned to each species by Taft et al. (1997). The

CC for each species in the Illinois flora was determined by assigning an integer from 0 to 10 for each species based on its tolerance to disturbance and its fidelity to habitat integrity. The FQI is a weighted index of species richness (N = number of species present), and is the arithmetic product of the average Coefficient of Conservatism (C-Value = the average of all species CC's) multiplied by the square root of the species richness ($\sqrt{N}$): FQI = C-Value ($\sqrt{N}$). Therefore the FQI indicates the level of habitat degradation and provides an assessment of the quality of each tract based on the taxa present. It is particularly useful when combined with quadrat-based sampling methods and provides a way of making quantitative comparisons among sites. The Sørenson Coefficient of Community (Sørenson 1948) was used to determine the similarity of the ground layer vegetation on the different slope aspects in the study area. The index is calculated as $2c/(a + b + 2c)$, where a is the number of species unique to sample a, b is the number of species unique to sample b, and c is the number of species shared by both samples (Small & McCarthy 2001).

RESULTS AND DISCUSSION

Overstory and woody understory composition and structure.—During the sampling of the overstory, a total of 17 tree species was encountered, including two understory species having little chance of reaching the canopy; seven additional tree species were found elsewhere on the preserve, i.e., outside the sampling transects, accounting for a total of 24 species. Overall tree density was 249.0 trees/ha and total basal area was 22.91 m^2/ha. American beech ranked first in basal area, relative density, relative dominance, and importance value (Table 1). It was the most frequently encountered species, occurred in 70% of the plots, and was evenly distributed throughout most diameter classes. Sugar maple ranked second in importance value and relative density and third in basal area. It occurred in 57.5 % of the plots and was most abundant in the smaller diameter classes with 63% of the individuals encountered being in the 10–19.9 cm diameter class. *Quercus velutina* Lam. (black oak) (IV = 11.7) and *Carya glabra* (Mill.) Sweet (pignut hickory) (IV = 10.0) were the only other taxa encountered with importance values greater than 10. Black oak was most abundant in the medium and large diameter classes while pignut hickory was most abundant in the smaller diameter classes.

Of the remaining overstory trees, tulip tree was the only species to be represented in most diameter classes, being present in low numbers in all but the largest diameter class (Table 1). *Carya ovata* (Mill.) K. Koch (shagbark hickory) was present only in the smaller diameter classes with no individuals over 39.9 cm dbh being encountered. *Carya tomentosa* (Poir. ex Lam.) Nutt. (mockernut hickory) was present in low numbers in the small and medium diameter classes while *Quercus alba* L. (white oak) was present only in the medium diameter

TABLE 1. Density (#/ha) by diameter classes (cm), total density (#/ha), basal area (m^2/ha), frequency (%), relative density, relative dominance, relative frequency, importance value, and average dbh are given for tree taxa encountered during sampling of American Beech Woods Nature Preserve, Clark County, Illinois. Also included is the importance value and average dbh per tree taxa from the 1973 study (Dunn 1978).

	10.0 -19.9	20.0 -29.9	30.0 -39.9	40.0 -49.9	50.0 -59.9	60.0 -69.9	70.0 -79.9	80.0+	Total Density (#/ha)	Basal Area (m^2/ha)	Freq. (%)	Rel. Den.	Rel. Dom.	Rel. Freq.	IV	Avg. Basal Area/ tree	1973 IV	1973 Basal Area/ tree
Fagus grandifolia	16.0	12.0	12.0	10.0	8.0	4.0	--	1.0	63.0	7.34	70.0	25.3	32.0	21.1	26.1	0.12	25.9	0.09
Acer saccharum	29.0	6.0	4.0	5.0	--	2.0	--	--	46.0	2.59	57.5	18.5	11.3	17.3	15.7	0.06	15.5	0.06
Quercus velutina	--	4.0	9.0	6.0	2.0	3.0	1.0	--	25.0	3.72	30.0	10.0	16.2	9.0	11.7	0.15	7.3	0.13
Carya glabra	12.0	7.0	8.0	2.0	1.0	--	--	--	30.0	1.87	32.5	12.1	8.2	9.8	10.0	0.06	4.3	0.08
Liriodendron tulipifera	3.0	3.0	4.0	2.0	1.0	1.0	1.0	--	15.0	1.80	25.0	6.0	7.9	7.5	7.1	0.12	5.4	0.18
Carya ovata	11.0	9.0	4.0	--	--	--	--	--	24.0	0.95	25.0	9.6	4.1	7.5	7.1	0.04	0.8	0.02
Carya tomentosa	4.0	2.0	2.0	3.0	1.0	1.0	--	--	13.0	1.02	20.0	5.2	4.5	6.0	5.2	0.08	4.1	0.06
Quercus alba	--	--	4.0	1.0	1.0	1.0	--	--	7.0	1.12	17.5	2.9	4.9	5.3	4.4	0.16	11.0	0.11
Quercus rubra	--	--	--	--	1.0	1.0	--	1.0	3.0	1.06	10.0	1.2	4.6	3.0	2.9	0.36	8.2	0.14
Ulmus americana	6.0	1.0	--	--	--	--	--	--	7.0	0.13	10.0	2.8	0.6	3.0	2.1	0.02	0.4	0.03
Fraxinus pennsylvanica	--	1.0	--	2.0	--	--	--	--	3.0	0.44	7.5	1.2	1.9	2.2	1.8	0.15	0.7	0.11
Nyssa sylvatica	--	--	3.0	--	--	--	--	--	3.0	0.29	7.5	1.2	1.3	2.2	1.6	0.10	6.2	0.04
Ulmus rubra	1.0	1.0	--	1.0	--	--	--	--	3.0	0.22	7.5	1.2	1.0	2.2	1.5	0.08	--	--
Sassafras albidum	3.0	--	--	--	--	--	--	--	3.0	0.04	5.0	1.2	0.2	1.5	1.0	0.01	0.7	0.09
Acer rubrum	--	--	--	--	1.0	1.0	--	--	2.0	0.23	2.5	0.4	1.0	0.8	0.9	0.23	--	--
Juglans nigra	--	--	1.0	--	--	--	--	--	1.0	0.08	2.5	0.4	0.3	0.8	0.5	0.09	--	--
Cornus florida	1.0	--	--	--	--	--	--	--	1.0	0.01	2.5	0.4	0.0	0.8	0.4	0.01	0.8	0.01
Others (7 taxa)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.7	--
Totals	86.0	46.0	51.0	32.0	16.0	14.0	2.0	2.0	249.0	22.91		100.0	100.0	100.0	100.0		100.0	

classes. Of the remaining trees, most were present as widely scattered individuals with two, *Sassafras albidum* (Nutt.) Nees (sassafras) and *Cornus florida* L. (flowering dogwood) being understory trees.

The overall tree density declined from 399.0 trees/ha in 1973 to 249.0 trees/ha in this study (Dunn 1978) (Table 1). Total basal area also decreased from 33.35 m^2/ha in 1973 to 22.91 m^2/ha in 2000. However, the importance values for American beech, sugar maple, and most other species were very similar to those reported in the previous study. The importance value of shagbark hickory was considerably higher in the present study while those of white oak and red oak were considerably lower.

Seven species having a combined importance of 8.7 in the 1973 study were not encountered during the sampling in this study. Of those species, *Carya cordiformis* (Wang.) Koch (bitternut hickory) and *Fraxinus americana* L. (white ash) had IV's totaling 1.5 in the 1973 study. *Amelanchier arborea* (Michx. f.) Fernald (shadbush), *Carpinus caroliniana* Walt. (musclewood), and *Ostrya virginiana* (Mill.) K. Koch (ironwood) are understory trees that had a combined importance value of 4.8 in the 1973 study. Since no permanent transects were established in the previous study, these changes may be more reflective of sampling error rather than changes in the composition of the forest stand. *Tilia americana* L. (basswood) (IV = 2.4 in 1973) was encountered neither during the sampling, nor the site visits and appears to have been extirpated from the preserve.

In the understory, sugar maple and American beech ranked first and second, respectively in all three sapling categories. Of the remaining understory trees, only flowering dogwood and ironwood were present in all of the sapling categories (Table 2). Hickories were not common in the understory and no oaks were encountered.

A total of 26 dead-standing saplings were encountered in 11 plots. These stems were all in the medium and small sapling categories and occurred in plots located on ridgetops or slopes with an east, west, or southwest aspect. Of 26 stems encountered, 19 appeared to have been top-killed by fire (14 sugar maple, two ironwood, two American beech, and one hickory). Seven dead-standing dogwood saplings were encountered, but it was not clear as to whether these individuals were dead as a result of fire or anthracnose.

Hydrangea arborescens L. (wild hydrangea) and *Lonicera maackii* (Rupr.) Maxim. (bush honeysuckle) were the only shrub taxa encountered. Wild hydrangea was present in one plot located in a creek bottom while one bush honeysuckle shrub was encountered in a plot with a north-facing aspect.

Groundlayer composition and structure.—A total of 70 taxa was encountered in the groundlayer (Table 3). The *Carex* spp. (sedges) as a group ranked first in importance value (IV = 8.8) and occurred in 50% of the plots. *Pilea pumila* (L.) A. Gray (clearweed) ranked second in importance value, being most abundant in plots that occurred in creek bottoms and on the northeast-facing slopes. *Sanicula*

TABLE 2. Density (stems/ha) arranged by aspect, total density (#/ha), frequency (% of plots in which each taxon was observed), relative density, relative frequency, and importance value for large saplings (≥5.0 cm dbh–9.9 cm dbh), intermediate saplings (≥ 2.5 cm dbh–< 5.0 cm dbh), and small saplings (>50 cm tall–2.5 cm dbh) encountered during sampling of American Beech Woods Nature Preserve, Clark County, Illinois.

	Aspect									All plots				
						Large Saplings (5–10cm dbh)								
	Crk. Bot.	SW	Ridge top	N	W	E	S	NE	SE	Total Density (#/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
Acer saccharum	- -	114	66	198	- -	400	400	- -	- -	130	17.5	65.0	46.7	55.9
Fagus grandifolia	57	- -	- -	66	80	- -	- -	- -	- -	30	7.5	15.0	20.0	17.5
Carpinus caroliniana	114	- -	- -	- -	- -	- -	- -	- -	- -	20	5.0	10.0	13.3	11.7
Cornus florida	- -	57	- -	- -	- -	- -	- -	- -	- -	10	5.0	5.0	13.3	9.1
Carya ovata	- -	- -	- -	- -	- -	- -	- -	- -	- -	10	2.5	5.0	6.7	5.8
Totals	171	171	66	264	80	400	400	- -	- -	200		100.0	100.0	100.0
						Intermediate Saplings (2.5–4.9 cm dbh)								
Acer saccharum	228	- -	198	132	- -	400	133	800	400	200	30.0	52.6	46.3	49.4
Fagus grandifolia	57	160	66	198	160	- -	266	- -	400	120	22.5	31.7	34.6	33.2
Cornus florida	- -	- -	132	- -	80	- -	- -	- -	- -	30	5.0	7.9	7.7	7.8
Carpinus caroliniana	- -	- -	- -	- -	80	- -	- -	- -	- -	10	2.5	2.6	3.8	3.2
Ulmus rubra	- -	- -	- -	- -	- -	80	- -	- -	- -	10	2.5	2.6	3.8	3.2
Carya ovata	- -	80	- -	- -	- -	- -	- -	- -	- -	10	2.5	2.6	3.8	3.2
Totals	285	240	396	330	320	480	399	800	800	380		100.0	100.0	100.0
						Small Saplings (>50 cm tall–2.4 cm dbh)								
Acer saccharum	513	720	462	924	- -	80	266	3200	800	600	47.5	43.4	31.1	37.3
Fagus grandifolia	456	320	66	330	320	- -	133	200	- -	240	37.5	17.4	24.5	20.9
Ostrya virginiana	- -	- -	- -	528	80	- -	- -	400	400	120	12.5	8.7	8.2	8.5
Ulmus rubra	114	80	- -	66	- -	- -	- -	800	- -	90	15.0	6.5	9.9	8.2
Cornus florida	57	80	198	66	80	- -	- -	- -	- -	70	15.0	5.1	9.9	7.5
Asimina triloba	- -	- -	- -	- -	- -	1280	- -	- -	- -	160	2.5	11.6	1.6	6.6

TABLE 2. continued

	Aspect									All plots				
	Small Saplings (>50 cm tall–2.4 cm dbh)													
	Crk. Bot.	SW	Ridge top	N	W	E	S	NE	SE	Total Density (#/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
Carpinus caroliniana	57	--	--	--	80	--	--	--	--	20	5.0	1.5	3.4	2.5
Fraxinus pennsylvanica	57	--	--	66	--	--	--	--	--	20	5.0	1.5	3.4	2.5
Prunus serotina	--	--	--	--	--	--	--	400	--	20	2.5	1.5	1.6	1.6
Liriodendron tulipifera	--	--	--	--	--	--	--	200	--	10	2.5	0.7	1.6	1.1
Morus rubra	--	--	--	--	--	--	--	200	--	10	2.5	0.7	1.6	1.1
Sassafras albidum	--	--	--	66	--	--	--	--	--	10	2.5	0.7	1.6	1.1
Fraxinus americana	--	--	--	66	--	--	--	--	--	10	2.5	0.7	1.6	1.1
Totals	1254	1200	726	2112	560	1360	399	5400	1200	1380		100.0	100.0	100.0

TABLE 3. Density (#/ha) arranged by aspect, total density (#/ha), frequency (% of plots in which each taxon was observed), relative density, relative frequency, and importance value for groundlayer taxa including woody species (<50 cm tall) encountered during sampling of American Beech Woods Nature Preserve, Clark County, Illinois.

	Aspect									All plots				
	Crk. Bot.	SW	Ridge top	N	W	E	S	NE	SE	Density (#/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
Carex spp.	9324	2880	25974	13320	1332	--	6660	2000	--	14100	50.0	10.4	7.2	8.8
Pilea pumila	46620	--	1998	1332	--	--	333	70000	--	14600	22.5	10.8	3.3	7.0
Sanicula spp.	1332	--	2664	666	22644	800	4662	28000	--	10500	30.0	7.7	4.3	6.0
Asarum canadensis	--	--	--	87246	--	800	4662	--	--	14600	7.5	10.8	1.1	5.9
Viola sororia	11988	800	10656	666	4995	4000	1998	1400	--	7800	35.0	5.7	5.1	5.4
Liriodendron tulipifera	888	7200	1998	3996	999	800	7326	--	--	4500	35.0	3.3	5.1	4.2
Solidago caesia	--	8800	7992	9324	333	--	333	18000	--	4800	32.5	3.5	4.7	4.1
Impatiens capensis	11544	--	--	6660	2664	--	333	2000	--	4600	20.0	3.4	2.9	3.1

TABLE 3. continued

	Aspect									All plots				
	Crk. Bot.	SW	Ridge top	N	W	E	S	NE	SE	Density (#/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
Acer saccharum	1332	1600	7326	1998	333	3200	333	-	- -	2500	30.0	1.8	4.3	3.0
Polystichum acrostichoides	1332	1600	666	1332	- -	- -	333	8000	16000	1700	27.5	1.3	4.0	2.7
Sassafras albidum	- -	8800	4662	- -	333	1600	333	- -	- -	2200	22.5	1.6	3.3	2.5
Parthenocissus quinquefolius	1776	3200	666	6660	- -	1600	- -	- -	- -	2200	20.0	1.6	2.9	2.3
Arisaema triphyllum	444	4800	1998	- -	- -	12000	333	- -	- -	2600	17.5	1.9	2.5	2.2
Ageratina altissima	2664	- -	7326	666	- -	800	- -	2000	- -	2000	20.0	1.5	2.9	2.2
Leersia virginica	20424	- -	- -	- -	- -	- -	- -	- -	- -	4600	7.5	3.3	1.0	2.1
Antenoron virginianum	11544	- -	- -	- -	999	- -	- -	2000	- -	4000	10.0	2.9	1.4	2.1
Phryma leptostachya	1776	800	666	- -	1332	- -	- -	32000	- -	2600	15.0	1.9	2.2	2.1
Galium concinnum	444	- -	1332	- -	333	- -	333	40000	- -	2500	15.0	1.8	2.2	2.0
Ulmus rubra	444	800	2664	- -	- -	3200	666	- -	- -	1200	20.0	0.9	2.9	1.9
Fraxinus americana	888	800	2664	- -	- -	- -	333	2000	- -	900	20.0	0.7	2.9	1.8
Osmorhiza claytonii	1332	- -	666	330	- -	5600	- -	- -	- -	1600	15.0	1.2	2.2	1.7
Laportea canadensis	8436	2400	- -	- -	- -	1600	- -	- -	- -	2400	7.5	1.8	1.1	1.4
Prunus serotina	- -	- -	1998	3330	- -	- -	1332	- -	- -	900	12.5	0.7	1.8	1.3
Aster spp.	888	- -	666	- -	- -	800	- -	2000	- -	600	15.0	0.4	2.2	1.3
Carya spp.	- -	3200	3996	- -	- -	- -	- -	- -	- -	1000	12.5	0.7	1.8	1.3
Equisetum arvense	12432	- -	- -	1332	- -	- -	- -	- -	- -	2800	2.5	2.0	0.4	1.2
Vitis aestivalis	- -	- -	- -	666	- -	- -	8325	- -	- -	2500	2.5	1.8	0.4	1.1
Oxalis spp.	9768	- -	- -	- -	- -	- -	- -	- -	- -	2200	5.0	1.6	0.7	1.1
Galium circaezans	- -	- -	4662	- -	999	- -	- -	2000	- -	1100	7.5	0.8	1.1	1.0
Hepatica acutiloba	- -	- -	- -	- -	- -	- -	- -	- -	8000	1800	5.0	1.3	0.7	1.0
Muhlenbergia spp.	- -	- -	7326	- -	2331	- -	- -	- -	- -	1800	5.0	1.3	0.7	1.0
Cornus florida	- -	- -	666	- -	- -	- -	- -	- -	- -	100	2.5	0.1	0.4	0.3
Others (39 taxa)	12876	16000	7992	7326	3996	12800	5661	3200	800	12800	140.0	9.5	20.3	14.9
Totals	170496	63680	109224	146850	43623	49600	44289	214600	24800	136100		100.0	100.0	100.0

TABLE 4. Ranking of tree species by importance value for plots that occurred on 9 slope aspects at American Beech Woods Nature Preserve, Clark County, Illinois. The species listed are those with the 10 highest overall importance values throughout the preserve and are arranged by descending importance value. Ranking by importance value for each aspect is in parentheses.

	Aspect					All plots		
Species	Creek Bottom (7 plots)	Southwest (7 plots)	Ridge top (5 plots)	North (5 plots)	South & Southeast (5 plots)	West (4 plots)	East (4 plots)	Northeast (3 plots)
Fagus grandifolia	28.3 (1)	33.9 (1)	10.0 (5)	30.2 (1)	20.4 (2)	26.7 (1)	33.3 (1)	53.7 (1)
Acer saccharum	17.7 (3)	19.2 (2)	5.4 (7)	16.9 (2)	4.5 (10)	27.2 (2)	15.3 (3)	20.2 (2)
Quercus velutina	—	12.2 (3)	26.5 (1)	6.8 (5)	13.8 (3)	12.1 (3)	—	12.7 (4)
Carya glabra	—	6.8 (6)	23.9 (2)	15.0 (3)	4.8 (9)	9.2 (4)	—	—
Liriodendron tulipifera	28.1 (2)	6.8 (5)	—	5.6 (6)	10.2 (4)	6.3 (5)	—	—
Carya ovata	—	4.0 (7)	8.4 (6)	4.9 (8)	22.0 (1)	9.2 (6)	12.7 (4)	—
Carya tomentosa	5.9 (6)	2.3 (9)	10.3 (4)	—	6.2 (6)	—	4.7 (8)	13.4 (3)
Quercus alba	—	—	10.7 (3)	4.7 (9)	5.9 (7)	—	16.4 (2)	—
Quercus rubra	—	7.2 (4)	—	10.7 (4)	—	—	—	—
Sassafras albidum	2.8 (8)	—	—	—	—	4.5 (7)	—	—

TABLE 5. Sørenson Index for groundlayer taxa encountered during sampling of American Beech Woods Nature Preserve, Clark County, Illinois.

	Creek Bottom (30 taxa)	Southwest (20 taxa)	Ridge top (27 taxa)	North (23 taxa)	West (20 taxa)	East (18 taxa)	South (25 taxa)	Northeast (18 taxa)
Southwest	44.0							
Ridge top	56.1	63.8						
North	49.1	32.6	52.0					
West	36.0	40.0	55.3	41.9				
East	45.8	42.1	48.9	39.0	26.3			
South	43.6	48.9	53.8	50.0	44.4	46.5		
Northeast	50.0	31.6	57.8	39.0	47.4	22.2	41.9	
Southeast (3 species)	6.1	8.7	6.7	15.4	8.7	0	7.1	9.5

spp. (snakeroot), *Asarum canadense* L. (wild ginger) and *Viola sororia* Willd. (woolly blue violet) were the only other herbaceous taxa with IV's greater than five. Snakeroot was most abundant in plots that had a west and northeast aspect while wild ginger was most common on the north-facing slopes. Woolly blue violet was present in low to moderate numbers in most plots. Tulip tree, sugar maple, and sassafras were the most commonly encountered tree seedlings. Oak seedlings were rare with only one seedling being encountered on a north-facing slope.

Slope aspects.—Among the overstory trees, American beech ranked first in importance value in plots located on most slope aspects (Table 4). It ranked second in plots with a south or southeast aspect and fifth in plots that occurred on ridge tops. Sugar maple ranked second in importance value in plots having a southwest, north, west, or northeast aspect. Black oak ranked first in plots that occurred on the ridge tops, but no higher than third on the remaining aspects. White oak ranked second and third in plots with an easterly aspect and on the ridge tops, respectively, but was only a minor component or was absent from plots occurring on the remaining aspects. Red oak ranked fourth in plots with a southwest or north aspect and was not encountered in the remaining plots. Among the hickories, shagbark hickory ranked first in plots with a south or southeast aspect while pignut hickory ranked second in plots that occurred on the ridge tops.

The plots located on the ridgetops and the southwest-facing slopes had greatest similarity (63.8% Sørenson Coefficient of Community, Sørenson 1948) (Table 5). Plots located on the southeast-facing slopes were considerably dissimilar to plots located on other slope aspects having Sørenson Coefficient of Community percentages that ranged from 0 to 15.4. These low values may be attributed to the low number of plots with southeast aspects (1) and the low species richness of the plot (3). Most other plots had similarity indices that ranged from 36.1% and 57.8%.

During the study, we observed 207 vascular plant taxa in the study area: 11 ferns, fern allies, and gymnosperms, 49 monocots, and 147 dicots. Of that number, 23 (11.1%) had a Coefficient of Conservatism (CC) of seven or greater and 10 (4.8%) were non-native taxa. The average CC, when calculated for all taxa, was 3.88 and the FQI was 55.8. When calculated for native taxa only, the average CC and FQI were 4.04 and 57.0, respectively. Sites that have an FQI greater than 35 are considered regionally noteworthy, while sites with an FQI greater than 45 are defined as statewide-significant natural areas (Taft et al. 1997).

The composition of American Beech Woods is similar to other beech-maple forests in Illinois and Indiana, having American beech and sugar maple as co-dominants on the mesic slopes with oaks and hickories predominating on the drier slopes or more level uplands (Ebinger 1997; Cowell & Jackson 2002). The decline in overall tree density and total basal area in this preserve is typical of many similar forest stands in the region (Petty & Lindsey 1961; Lindsey &

Schmelz 1964; Barton & Schmelz 1987). Oak density declines as mature individuals die while shade-intolerant and successional species such as tulip tree, ash, and sassafras, persist as minor components because of gap-phase disturbances (Cowell & Jackson 2002).

APPENDIX 1

Vascular flora of American Beech Woods Nature Preserve, Lincoln Trail State Park, Clark County, Illinois arranged alphabetically by taxonomic group. Nomenclature follows Mohlenbrock (2002). Collection numbers with the T prefix are those of Tucker; while the E prefix indicates specimens collected by Ebinger. All specimens were deposited in the Stover-Ebinger Herbarium at Eastern Illinois University, Charleston, Illinois, with some duplicates at ILLS. Taxa preceded by an asterisk (*) are non-native.

FERNS AND FERN ALLIES

ADIANTACEAE

Adiantum pedatum L. T11770

ASPLENIACEAE

Asplenium platyneuron (L.) Oakes E29720
Cystopteris protrusa (Blasd.) Weatherby T11750
Polystichum acrostichoides (Michx.) Schott E29605

EQUISETACEAE

Equisetum arvense L. T11736

OPHIOGLOSSACEAE

Botrychium dissectum Spreng. var. *dissectum* E29719
Botrychium dissectum Spreng. var. *obliquum* (Muhl.) Clute E30427
Botrychium virginianum (L.) Sw. E29501
Ophioglossum vulgatum L. E29889

THELYPTERIDACEAE

Phegopteris hexagonoptera (Michx.) Fée E29604

GYMNOSPERMS

CUPRESSACEAE

Juniperus virginiana L. E29890

DICOTYLEDONS

ACERACEAE

Acer saccharum Marsh. E2989
Acer rubrum L. (Observed)

ANACARDIACEAE

Toxicodendron radicans (L.) Kuntze E30232

ANNONACEAE

Asimina triloba (L.) Dunal E30430

APIACEAE

Cicuta maculata L. T 11739
Cryptotaenia canadensis (L.) DC. T11738
Osmorhiza claytonii (Michx.) Clarke T11752
Sanicula canadensis L. var. *canadensis* T11744
Sanicula odorata (Raf.) Pryer & Phillippe E29622

ARALIACEAE

Aralia racemosa L. E30157
Panax quinquefolius L. E29892

ARISTOLOCHIACEAE

Aristolochia serpentaria L. E29618
Asarum canadense L. E29497

ASTERACEAE

Ageratina altissima (L.) R.M. King & H. Robins. E30158
Antennaria plantaginifolia (L.) Richards. E29500
Arnoglossum atriplicifolium (L.) H. Robins. E30233
Aster lateriflorus (L.) Britt. E30437
Aster sagittifolius Wedem. ex Willd. E30438
Aster shortii Lindl. E30436
Erechtites hieracifolia (L.) Raf. E30439
Erigeron annuus (L.) Pers. T11742
Erigeron philadelphicus L. T12047
Eupatorium sessilifolium L. var. *brittonianum* Porter E30159
Euthamia graminifolia (L.) Nutt. ex Cass. E30293
Helianthus divaricatus L. E30160
Hieracium gronovii L. E30235
Krigia biflora (Walt.) Blake T12041
Lactuca canadensis L. E30236

Prenanthes altissima L. E30440
Senecio glabellus Poir. E29608
Senecio obovatus Muhl. T12044
Solidago caesia L. E30442
Solidago canadensis L. E30294
Solidago nemoralis Aiton E30443
Solidago ulmifolia Muhl. ex Willd. E30237

BALSAMINACEAE
Impatiens capensis Meerb. E30161

BERBERIDACEAE
Podophyllum peltatum L. E29487

CORYLACEAE
Carpinus caroliniana Walt. var. *virginiana* (Marsh.) Fernald T11775
Corylus americana Walt. E29895
Ostrya virginiana (Mill.) K. Koch E29897

BORAGINACEAE
Cynoglossum virginianum L. E29620
Hackelia virginiana (L.) I.M. Johnst. E29894

BRASSICACEAE
Dentaria laciniata Muhl. E29490

CAESALPINIACEAE
Cercis canadensis L. T11765

CAMPANULACEAE
Campanulastrum americanum (L.) Small E30162
Lobelia inflata L. T11782
Lobelia siphilitica L. E30295

CAPRIFOLIACEAE
**Lonicera maackii* (Rupr.) Maxim. E29610
Sambucus canadensis L. T 11756
Symphoricarpos orbiculatus Moench E30164
Viburnum prunifolium L. E29898

CARYOPHYLLACEAE
Silene stellata (L.) Aiton E30165

CORNACEAE
Cornus florida L. E29726

EBENACEAE
Diospyros virginiana L. E29900

ELAEAGNACEAE
**Elaeagnus angustifolia* L. T11773

EUPHORBIACEAE
Acalypha rhomboidea Raf. E30238

FABACEAE
Amphicarpaea bracteata (L.) Rickett & Stafleu E30299
Desmodium nudiflorum (L.) DC. T11741
Desmodium paniculatum (L.) DC. E30298
**Robinia pseudoacacia* L. E29901

FAGACEAE
Fagus grandifolia Ehrh. T12051
Quercus alba L. E29727
Quercus imbricaria Michx. E30296
Quercus palustris Muenchh E30433
Quercus rubra L. E30434
Quercus velutina Lam. T12305

GENTIANACEAE
Frasera caroliniensis Walt. E29904

GERANIACEAE
Geranium maculatum L. E29492

HAMAMELIDACEAE
Liquidambar styraciflua L. E30239

HYDRANGEACEAE
Hydrangea arborescens L. E29903

HYDROPHYLLACEAE
Hydrophyllum virginianum L. E30168

HYPERICACEAE
Hypericum punctatum Lam. T11776

JUGLANDACEAE
Carya cordiformis (Wangenh.) K. Koch E30431
Carya glabra (Mill.) Sweet E30301
Carya ovata (Mill.) K. Koch E30432
Carya tomentosa (Poir.) Nutt. E30300
Juglans nigra L. E30241

LAMIACEAE
Collinsonia canadensis L. E30242
Lycopus virginicus L. E30302
Monarda bradburiana Beck E29617
**Prunella vulgaris* L. T11771
Pycnanthemum tenuifolium Schrad. E29905
Scutellaria incana Biehl. E29906
Teucrium canadense L. T11735

LAURACEAE
Sassafras albidum (Nutt.) Nees T11759
Lindera benzoin (L.) Blume T11764

MAGNOLIACEAE
Liriodendron tulipifera L. E29728

MENISPERMACEAE
Menispermum canadense L. E29615

MORACEAE
Morus rubra L. E30169

NYSSACEAE
Nyssa sylvatica Marsh. E29908

OLEACEAE
Fraxinus americana L. E29729
Fraxinus pennsylvanica Marsh. E30435
**Ligustrum vulgare* L. E29730

ONAGRACEAE
Circaea lutetiana L. ssp. *canadensis* (L.) Aschers. & Magnus E29910

OROBANCHACEAE
Conopholis americana (L.) Wallr. E29619

OXALIDACEAE
Oxalis stricta L. E29624
Oxalis violacea L. E29625

PAPAVERACEAE
Sanguinaria canadensis L. E29498

PHRYMACEAE
Phryma leptostachya L. T11760

PHYTOLACCACEAE
Phytolacca americana L. E29911

POLEMONIACEAE
Phlox divaricata L. spp. *laphamii* (Wood) Wherry T12045
Polemonium reptans L. E29731

POLYGONACEAE
Persicaria punctata (Elliott) Small E30303
Antenoron virginianum (L.) Roberty & Vautier E30170
**Rumex crispus* L. T11767

PORTULACACEAE
Claytonia virginica L. E29488

RANUNCULACEAE
Actaea pachypoda Elliott E29616
Hepatica acutiloba DC. E29496
Ranunculus abortivus L. E29495
Ranunculus recurvatus Poir. T12046
Ranunculus septentrionalis Poir. E29494
Thalictrum dioicum L. T12034

ROSACEAE
Agrimonia gryposepala Wallr. E30173
Agrimonia parviflora Soland. ex Aiton E30243
Agrimonia pubescens Wallr. E30172
Amelanchier arborea (Michx. fil.) Fernald T12050
Geum canadense Jacq. T11761
Geum vernum (Raf.) Torrey & A. Gray E29629
Potentilla simplex Michx. E29630
Prunus serotina Ehrh. E29631
**Rosa multiflora* Thunb. ex Murr. E29628
Rubus allegheniensis Porter ex L.H. Bailey E29634
Rubus flagellaris Willd. E29632
Rubus occidentalis L. T11777
Rubus pensilvanicus Poir. ex Lam. T11732

RUBIACEAE
Cephalanthus occidentalis L. T11734
Galium aparine L. E29489
Galium circaezans Michx. T11740
Galium concinnum Torrey & A. Gray E29733
Galium triflorum Michx. T11743
Houstonia purpurea L. E29732

SAXIFRAGACEAE
Penthorum sedoides L. E30244

SCROPHULARIACEAE
Mimulus alatus Aiton T11774
Pedicularis canadensis L. E29735
Scrophularia marilandica L. E30174

ULMACEAE
Ulmus americana L. T11737
Ulmus rubra Muhl. T11768

URTICACEAE
Boehmeria cylindrica (L.) Sw. E30247
Laportea canadensis (L.) Wedd. E30246
Parietaria pensylvanica Muhl. ex Willd. E29915
Pilea pumila (L.) A. Gray E30304

VERBENACEAE
Verbena urticifolia L. E29917

VIOLACEAE
Viola palmata L. E29503
Viola pratincola Greene E29502
Viola sororia Willd. E29623

VITACEAE
Parthenocissus quinquefolia (L.) Planch. E30248
Vitis aestivalis Michx. E30305

MONOCOTYLEDONS

ALISMACEAE
Alisma triviale Pursh T11733

ARACEAE
Arisaema dracontium (L.) Schott E29626
Arisaema triphyllum (L.) Schott T12043

COMMELINACEAE
Tradescantia subaspera Ker T12033
Tradescantia virginiana L. E29505

CYPERACEAE
Carex albicans Willd. E29510
Carex blanda Dewey E29511
Carex cephalophora Muhl. ex Willd E29637
Carex glaucodea Tuckerm. E30176
Carex gracilescens Steudel T12039
Carex hirsutella Mack. E29927
Carex hirtifolia Mack. T12048
Carex lurida Wahl. T11762
Carex pensylvanica Lam. E29509
Carex rosea Schk. ex Willd. T12037
Scirpus georgianus Harper T11763

DIOSCOREACEAE
Dioscorea quaternata (Walt.) J.F. Gmel. E29925

JUNCACEAE
Juncus tenuis Willd. T11772
Luzula multiflora (Retz.) Lej. T11753

LILIACEAE
Allium tricoccum Aiton E29508
Smilacina racemosa (L.) Desf. E29611
Trillium recurvatum Beck E29507
Uvularia grandiflora Sm. E29612

ORCHIDACEAE
Corallorhiza odontorhiza (Willd.) Nutt. (Observed)
Galearis spectabilis (L.) Raf. E29926
Liparis liliifolia (L.) Rich. E30307

POACEAE
**Agrostis gigantea* Roth T11766
Agrostis hyemalis (Walt.) BSP. E30230
Brachyelytrum erectum (Schreb.) Beauv. E29918
Bromus pubescens Muhl. T11751
Cinna arundinacea L. E30177
Danthonia spicata (L.) Roem. & Schult. E29721
Dichanthelium boscii (Poir.) Gould & Clark T11748
Dichanthelium clandestinum (L.) Gould T11757
Dichanthelium dichotomum (L.) Gould E29723
Dichanthelium lindheimeri (Nash) Gould T11746
Dichanthelium microcarpon (Muhl.) Mohlenbr. T11747
Elymus hystrix L. E29922
Elymus villosus Muhl. E29921
Elymus virginicus L. E30178
**Festuca arundinacea* Schreb. T11780
Festuca subverticillata (Pers.) Alekseev T12036
Glyceria striata (Lam.) Hitchc. T11754
Leersia virginica Willd. E29923
Muhlenbergia schreberi J.F. Gmel. E30429
Muhlenbergia sobolifera (Muhl.) Trin. E30179
**Poa compressa* L. E30306
Poa sylvestris A. Gray T12049

SMILACACEAE
Smilax tamnoides L. var. *hispida* (Muhl.) Fernald E30180

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