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WOODY VEGETATION SURVEY OF BEALL WOODS NATURE PRESERVE, WABASH COUNTY, ILLINOIS

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ABSTRACT. The Beall Woods Nature Preserve in Wabash County, Illinois contains the best remnant of the immense forest once associated with the Lower Wabash River Valley. The forest was studied in 1997 using 3 ha plots (100 m × 300 m) in each of six major forest cover types. The three upland forest cover types were sugar maple/oak/hickory (329 stems/ha, 26.23 m^2/ha), sugar maple/oak/ash (284.6 stems/ha, 29.51 m^2/ha), and sugar maple/ sweet gum/ash (263.2 stems/ha, 31.45 m^2/ha). Species composition within the floodplain forest cover types varied extensively as a result of minor variations in elevation. The three floodplain forest cover types were silver maple/pecan (209.3 stems/ha, 36.71 m^2/ha), hackberry/ sweet gum/kingnut hickory (282.5 stems/ha, 29.12 m^2/ha) and elm/sweet gum/oak (299.8 stems/ha, 29 m^2/ha). A greater diversity of tree species was present in upland forests as compared to the floodplain forests.

Keywords: Beall Woods Nature Preserve, forest structure, Illinois, old-growth forest, Wabash River

Since early studies by the American ornithologist Robert Ridgway (1872, 1882, 1883) the Lower Wabash Valley has been known for lowland forests with large trees (Davenport 1970; Huffman 1994). Most of this extensive forest has been destroyed, with the biggest and best remaining example being Beall Woods Nature Preserve (BWNP).

Acquired by the Illinois Department of Conservation in 1965, the area was dedicated as a nature preserve on 24 January 1966. The high quality of this forest and the many large forest trees, some of which are records for Illinois, are justification for the dedication (Beecher 1965; Peterson 1970; McFall & Karnes 1995; Esarey 1999). This old-growth forest has been subjected to some disturbance over the last 200 years, including grazing by hogs and cattle, hunting, and the removal of most of the black walnuts over 12 inches dbh (Ashby & Ozment 1967). The present study was undertaken to determine present structure and composition of the forest cover types and to determine changes since early studies.

METHODS

The vegetation of BWNP was studied between fall of 1996 and summer of 1997. The sites studied included three upland and three floodplain cover types described by Ashby & Ozment (1967). These sites were relatively large continuous tracts of timber characterized by distinct tree associations. Within each cover type the overstory was examined using 100 m by 300 m (3 ha) plots. Each plot was divided into 25 m × 25 m sub-plots for ease in study (48 in each plot). The plots were located as near as possible near the center-line through each cover type and the mid-line of each plot marked with permanent stakes (Fig. 1). Number, diameter and species identity of all living and dead-standing woody individuals, ≥ 10 cm dbh, were recorded for each sub-plot. From the living tree data, the density (stems/ha) in broad diameter classes, the basal area (m^2/ha), relative density, relative dominance, importance value (IV) and average diameter (cm) were calculated for each species. IV is the sum of the relative density and relative dominance (basal area) for each species (McIntosh 1957; Boggess 1964). From the dead-standing tree data the density and basal area were determined for each species.

The woody understory was sampled using nested circular plots 0.0001, 0.001 and 0.01 ha in size randomly located along line transects throughout each of the 3 ha plots. Two additional 0.0001 ha circular plots were lo-

Table 1.—Densities (stems/ha) in diameter classes (cm), basal areas (m^2/ha), relative density (rel. den.), relative dominance (rel. dom.), importance values (IV), and average diameters (cm) of the woody species in the upland forests cover types at Beall Woods Nature Preserve, Wabash County, Illinois.

Species	Diameter classes (cm)								Total #/ha	Basal area m^2/ha	Rel. den.	Rel. dom.	IV	Av. diam. (cm)
	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80+						
Sugar Maple/Oak/Hickory Forest														
Acer saccharum	76.0	25.7	5.3	2.0	0.7	0.3	—	—	110.0	3.42	33.4	13.0	46.4	18.1
Quercus alba	1.0	—	0.7	1.7	2.7	4.0	6.3	6.3	22.7	9.20	6.9	35.1	42.0	69.1
Carya ovata	2.7	3.7	10.0	8.0	4.7	1.3	0.7	—	31.1	4.24	9.4	16.2	25.6	39.6
Ostrya virginiana	35.7	–	—	—	—	—	—	—	35.7	0.44	10.8	1.7	12.5	12.8
Fraxinus pennsylvanica	7.3	4.0	1.7	0.3	0.7	1.7	0.7	0.3	16.7	1.71	5.1	6.5	11.6	29.8
Liquidambar styraciflua	3.7	4.0	4.7	2.7	1.0	0.3	0.3	—	16.7	1.60	5.1	6.1	11.2	32.4
Ulmus americana	19.0	4.0	—	—	—	—	—	—	23.0	0.49	7.0	1.9	8.9	15.9
Nyssa sylvatica	2.3	3.0	2.3	1.3	1.0	—	—	0.3	10.2	1.04	3.1	4.0	7.1	32.1
Quercus bicolor	—	—	0.3	0.7	0.7	1.3	1.0	0.3	4.3	1.33	1.3	5.1	6.4	60.9
Carya tomentosa	6.7	3.0	1.7	0.7	0.3	0.3	—	—	12.7	0.67	3.8	2.5	6.3	22.7
Sassafras albidum	4.7	3.7	1.0	0.7	—	—	—	—	10.1	0.47	3.0	1.8	4.8	22.8
Acer rubrum	6.0	1.0	—	0.7	—	—	—	—	7.7	0.26	2.3	1.0	3.3	14.0
Cornus florida	7.3	—	—	—	—	—	—	—	7.3	0.09	2.2	0.3	2.5	12.5
Others	13.3	4.7	1.3	0.7	0.3	0.3	1.0	—	21.6	1.27	6.6	4.8	11.4	—
Totals	185.7	56.8	29.0	19.5	12.1	9.5	10.0	7.2	329.8	26.23	100.0	100.0	200.0	
Sugar Maple/Oak/Ash Forest														
Acer saccharum	96.3	66.0	17.0	3.0	—	0.3	—	—	182.6	6.91	64.2	23.4	87.6	20.6
Quercus alba	—	—	1.3	2.3	2.3	4.0	4.3	4.3	18.5	7.12	6.5	24.1	30.6	67.2
Fraxinus pennsylvanica	2.0	0.3	0.3	0.3	1.7	1.7	2.0	2.3	10.6	3.46	3.7	11.7	15.4	58.8
Quercus rubra	—	—	0.3	—	1.7	0.7	1.7	1.3	5.7	2.65	2.0	9.0	11.0	73.5
Quercus velutina	—	—	0.3	0.7	0.3	0.3	0.7	3.0	5.3	2.59	1.9	8.8	10.7	76.1
Nyssa sylvatica	2.0	0.3	2.7	3.0	3.3	0.7	—	—	12.0	1.81	4.2	6.2	10.4	41.3
Carya tomentosa	2.7	3.0	1.3	1.3	1.0	0.7	—	—	10.0	0.97	3.5	3.3	6.8	31.4
Liquidambar styraciflua	1.3	1.3	1.7	2.0	1.0	0.3	—	—	7.6	0.93	2.7	3.2	5.9	36.6
Liriodendron tulipifera	0.7	0.7	—	—	0.3	—	0.3	1.0	3.0	1.04	1.1	3.5	4.6	55.3
Carya ovata	1.3	0.7	1.7	1.0	0.7	—	—	—	5.4	0.52	1.9	1.8	3.7	33.0
Others	14.0	3.3	3.0	2.7	0.3	0.3	—	0.3	23.9	1.51	8.3	5.0	13.3	—
Totals	120.3	75.6	29.6	16.3	12.6	9.0	9.0	12.2	284.6	29.51	100.0	100.0	200.0	
Sugar Maple/Sweet Gum/Ash Forest														
Acer saccharum	40.7	26.0	11.3	1.7	0.3	—	—	—	80.0	3.27	30.4	10.4	40.8	21.2
Liquidambar styraciflua	5.7	8.3	4.3	3.0	2.0	3.0	4.3	1.3	31.9	5.58	12.2	17.7	29.9	41.5

Table 1.—Continued.

Species	Diameter classes (cm) 10–19	20–29	30–39	40–49	50–59	60–69	70–79	80+	Total #/ha	Basal area m^2/ha	Rel. den.	Rel. dom.	IV	Av. diam. (cm)
Fraxinus pennsylvanica	4.7	2.7	1.0	1.7	1.7	1.7	3.0	5.3	21.8	6.56	8.2	20.9	29.1	53.9
Quercus alba	—	1.0	1.3	0.7	2.7	3.3	3.0	2.0	14.0	4.66	5.3	14.8	20.1	62.6
Liriodendron tulipifera	4.7	0.3	1.3	0.7	2.3	2.7	2.0	2.3	16.3	4.25	6.2	13.5	19.7	50.5
Nyssa sylvatica	4.7	2.0	2.7	1.0	1.3	0.3	—	—	12.0	1.04	4.6	3.3	7.9	29.5
Sassafras albidum	3.0	3.7	2.3	1.3	0.7	—	—	—	11.0	0.81	4.2	2.6	6.8	28.2
Cornus florida	13.7	0.3	—	—	—	—	—	—	14.0	0.21	5.3	0.7	6.0	13.5
Ulmus americana	6.0	3.0	1.0	0.3	—	—	—	—	10.3	0.36	3.9	1.1	5.0	19.4
Acer rubrum	1.3	0.3	1.3	—	0.7	0.7	—	0.7	5.0	0.96	1.9	3.1	5.0	41.7
Celtis occidentalis	7.0	2.7	0.3	0.3	—	—	—	—	10.3	0.28	3.9	0.9	4.8	17.1
Cercis canadensis	9.0	0.3	—	—	—	—	—	—	9.3	0.13	3.5	0.4	3.9	13.1
Others	15.3	3.0	1.4	2.7	1.3	0.6	1.0	2.0	27.3	3.34	10.4	10.6	21.0	—
Totals	115.8	53.6	28.2	13.4	13.0	12.3	13.3	13.6	263.2	31.45	100.0	100.0	200.0	

cated 6 m to the north and south of each nested plot center. Seedlings (≤ 50 cm tall) were tallied in the 0.0001 ha plots; small saplings (≥ 50 cm tall/≤2.5 cm dbh) were recorded in the 0.001 ha plots; while large saplings (2.5–9.9 cm dbh) were recorded in the 0.01 ha plots, and their densities (stems/ha) determined. A total of 48 sets of nested circular plots were located within each of the study areas, with an additional 96 seedling plots. Nomenclature follows Mohlenbrock (1986).

DESCRIPTION OF THE STUDY AREA

The BWNP is located in Beall Woods Conservation Area about 2 km east of Keensburg and about 8 km southwest of Mt. Carmel, Wabash County, Illinois (S11 T2S R13W) in the Bottomlands Section of the Wabash Border Division (Schwegman 1973). The preserve is divided by Coffee Creek and its tributary, Sugar Creek, both of which are greatly influenced by flooding from the Wabash River (Fig. 1). It is common in spring for flood water to reach the 400 foot (122 m) contour interval, flooding about half of the nearly 120 forested ha (about 300 acres) of BWNP.

Elevations at BWNP range from 115 m in the creek bottom to 140 m above sea level on the uplands. Bedrock beneath BWNP is the Bond Formation of the Pennsylvanian System and exposures of sandstone, shale, siltstone, and coal occur along Coffee Creek (Frankie et al. 1996). Bottomland soils are of the Haymond-Allison Association while upland soils are of the Alford-Iona Association (USDA 1964).

The climate of south-central Illinois is continental with cool winters, hot summers, and little or no water deficit in any season of the year (Page 1949; Fehrenbacher et al. 1967; Schwegman 1973). In Princeton, Indiana (20 km to the east), average precipitation is 116.8 cm, with the month of May having the highest average rainfall (13.36 cm). Mean average temperature in Princeton is 12.6° C with the hottest month being July (average of 25.1° C), and January the coldest (average of −1.8° C). The average number of frost-free days is 186.

Two previous studies have been published concerning the flora of BWNP. Lindsey (1962) conducted a survey of the overstory using ⅕ acre strips: 20 in the lowland forest and 25 in the upland forest. The densities, basal areas, relative values and importance values were

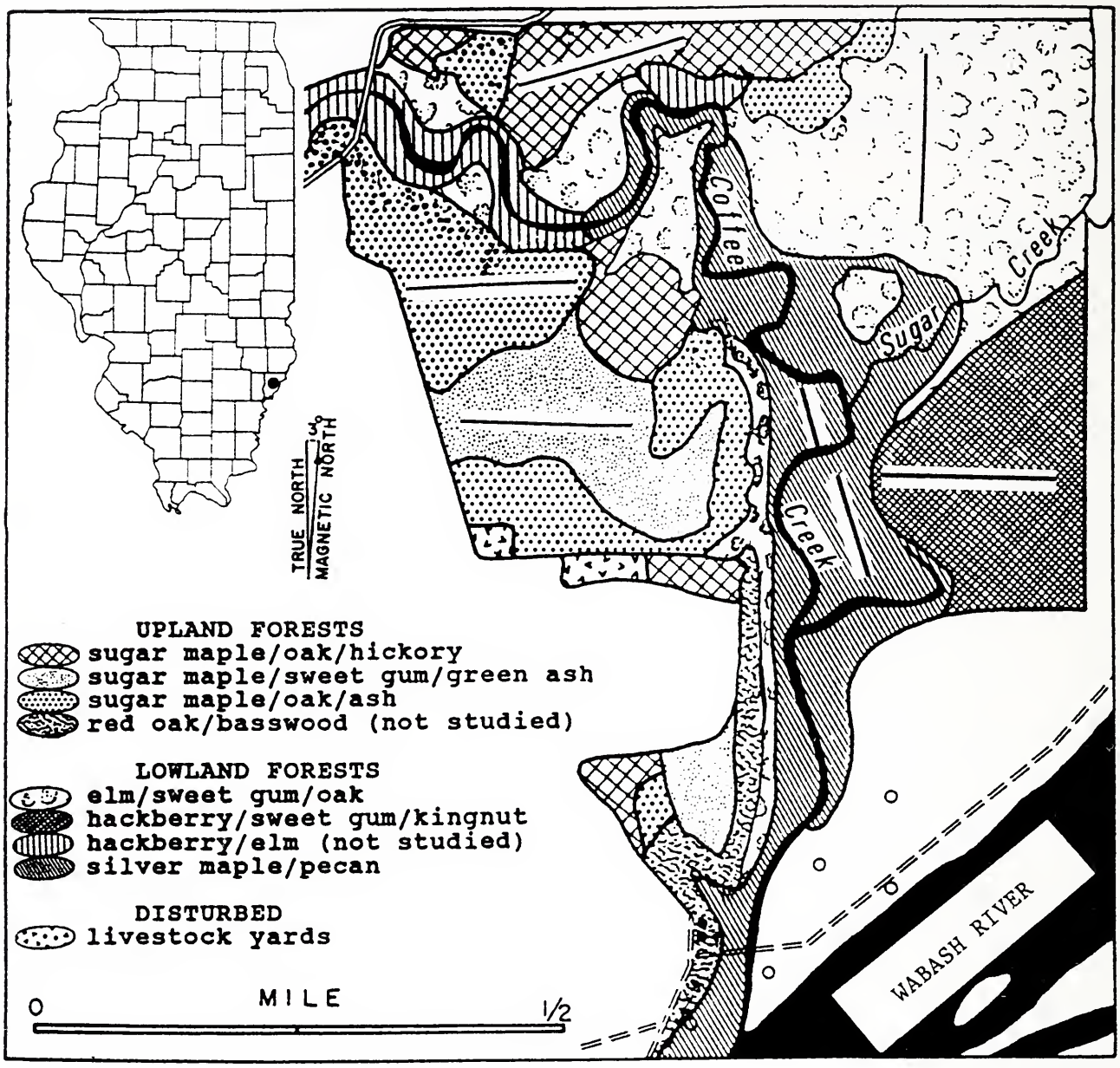

Figure 1.—Forest cover types of Beall Woods Nature Preserve, Wabash County, Illinois. The centerline of each plot in each of the six cover types is indicated by a black line. Modified from Ashby & Ozment (1967).

given for the tree species in each area. Ashby & Ozment (1967) prepared a checklist of vascular plant species and described eight forest cover types. Of the eight forest cover types, six are of considerable size and were sampled during the present study. Two forest cover types covered very small areas and were not sampled.

RESULTS

Woody vegetation of the upland forest.—The three upland forest cover types at Beall Woods are classified as dry-mesic to wet-mesic forests (White & Madany 1978). Open-grown trees are not common, indicating a closed canopy forest prior to European settlement.

Sugar maple/oak/hickory forest: (*Acer saccharum*/*Quercus* spp./*Carya* spp.). This cover type is best developed on the level and gently sloping ground north of Coffee Creek (Fig. 1). Tree density was 329.8 stems/ha with a basal area of 26.23 m^2/ha while 24 canopy and six understory tree species were encountered (Table 1). Numerous small diameter trees are common with more than 185 stem/ha in the 10–19 cm diameter class. Sugar maple ranked first with an IV of 46.4, and dominated the smaller diameter classes. *Quercus alba* (white oak) ranked second in IV, while *Carya ovata*

Table 2.—Densities (stems/ha) of the woody seedlings (≤50 cm tall), small saplings (>50 cm tall <2.5 cm dbh), and large saplings (2.5–9.9 cm dbh) in upland forests cover types at Beall Woods Nature Preserve, Wabash County, Illinois.

Species	Sugar Maple/ Oak/Hickory			Sugar Maple/Oak/Ash			Sugar Maple/ Sweet Gum/Ash		
		Saplings			Saplings			Saplings	
	Seedlings	Small	Large	Seedlings	Small	Large	Seedlings	Small	Large
Asimina triloba	1389	2208	100	972	2500	29	1250	4042	196
Nyssa sylvatica	1111	—	4	4583	292	4	—	—	4
Carya cordiformis	417	—	4	—	—	—	—	—	4
Sassafras albidum	278	—	—	—	—	—	—	—	—
Ostrya virginiana	—	125	133	—	42	13	—	—	4
Acer saccharum	—	42	238	417	42	121	—	42	125
Celtis occidentalis	—	42	17	139	42	4	139	—	21
Cornus florida	—	—	88	—	—	33	—	—	54
Ulmus americana	—	—	17	—	—	—	—	—	—
Fraxinus pennsylvanica	—	—	17	1111	42	8	278	—	8
Carya ovata	—	—	8	139	—	—	—	—	—
Carya tomentosa	—	—	4	—	—	—	—	—	—
Cercis canadensis	—	—	4	—	—	8	—	—	13
Acer negundo	—	—	4	—	—	—	—	—	8
Crataegus mollis	—	—	4	—	—	—	—	—	—
Prunus serotina	—	—	4	—	—	—	—	—	—
Ulmus rubra	—	—	—	139	42	17	—	—	29
Acer rubrum	—	—	—	—	—	—	—	—	17
Morus rubra	—	—	—	—	—	—	—	—	4
Acer saccharinum	—	—	—	—	—	—	—	—	4
Gymnocladus dioicus	—	—	—	—	—	—	—	—	4
Lindera benzoin	139	—	—	—	42	—	2917	1167	—
Elaeagnus umbellata	—	—	—	—	42	—	–	—	—
Totals	3334	2417	646	7500	3086	237	4584	5251	495

(shagbark hickory) ranked third. Remaining species were those commonly associated with mesic sites, with *Ostrya virginiana* (hop hornbeam) and *Cornus florida* (flowering dogwood) the common understory species. *Asimina triloba* (pawpaw) and *Nyssa sylvatica* (black gum) (mostly root sprouts), dominated the seedling layer, while pawpaw and sugar maple were the common saplings (Table 2). Density of dead-standing individuals was 18 stems/ha with a basal area of 2.68 m^2/ha. White oak had the highest mortality followed by *Sassafras albidum* (sassafras), *Ulmus americana* (American elm), and black gum.

Sugar maple/oak/ash forest: (*Acer saccharum/Quercus* spp./*Fraxinus* spp.). This cover type is found on moderately dissected lands mostly to the south of Coffee Creek. Tree density was 284.6 stems/ha with a basal area of 29.51 m^2/ha, while 24 canopy and three understory tree species were encountered (Table 1). Sugar maple dominated with an IV of 87.6, mostly due to stems in the 10–29 cm diameter classes. White oak ranked second followed by *Fraxinus pennsylvanica* (green ash) and red oak. Hickories were rare, as were hop hornbeam and flowering dogwood, distinguishing this cover type from the sugar maple/oak/hickory cover type. Black gum, green ash, and pawpaw dominated the seedling category, while pawpaw and sugar maple were the most important saplings (Table 2). Density of dead-standing individuals was 13 stems/ha with a basal area of 1.49 m^2/ha. Oaks accounted for 67% of the dead-standing basal area.

Sugar maple/sweet gum/ash forest: (*Acer saccharum/Liquidambar styraciflua/Fraxinus* spp.). Located in the flat area to the south of Coffee Creek, this cover type was designated the white oak/tulip tree cover type by Ashby & Ozment (1967). The area is flat, drainage is poor, with standing water common in win-

Table 3.—Densities (stems/ha) in diameter classes (cm), basal areas (m^2/ha), relative density (rel. den., relative dominance (rel. dom.), importance values (IV), and average diameters (cm) of the woody species in the lowland forest cover types at Beall Woods Nature Preserve, Wabash County, Illinois.

Species	Diameter classes (cm)								Total #/ha	Basal area m^2/ha	Rel. den.	Rel. dom.	IV	Av. diam. (cm)
	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80+						
Silver Maple/Pecan Forest														
Acer saccharinum	10.0	29.7	26.0	31.7	20.0	17.0	8.7	6.3	149.4	27.41	71.3	74.7	146.0	44.5
Carya illinoensis	—	—	—	0.7	2.7	2.0	3.0	2.7	11.1	4.59	5.3	12.5	17.8	71.1
Ulmus americana	15.7	6.0	2.7	1.3	—	—	0.3	—	26.0	1.19	12.4	3.2	15.6	21.6
Ulmus rubra	2.3	1.7	2.0	1.3	1.0	—	0.3	—	8.6	0.85	4.1	2.3	6.4	31.8
Platanus occidentalis	—	—	—	—	—	0.3	0.3	1.7	2.3	1.73	1.1	4.7	5.8	94.9
Celtis laevigata	6.0	0.7	0.3	—	—	—	—	—	7.0	0.16	3.3	0.4	3.7	16.3
Fraxinus pennsylvanica	0.7	0.7	0.3	0.3	—	0.3	—	0.7	3.0	0.61	1.4	1.7	3.1	43.2
Others	1.0	0.3	0.3	—	—	0.3	—	—	1.9	0.17	1.1	0.5	1.6	—
Totals	35.7	39.1	31.6	35.3	23.7	19.9	12.6	11.4	209.3	36.71	100.0	100.0	200.0	
Hackberry/Sweet Gum/Kingnut Hickory Forest														
Celtis occidentalis	55.0	33.7	10.0	2.3	0.3	0.3	0.7	0.3	102.6	4.60	36.3	15.8	52.1	21.5
Liquidambar styraciflua	—	0.3	0.3	1.7	2.7	3.0	3.7	5.0	16.7	6.73	5.9	23.1	29.0	69.5
Carya laciniosa	1.3	3.0	6.7	8.3	4.0	2.0	1.0	0.7	27.0	4.76	9.6	16.3	25.9	44.5
Acer saccharinum	5.7	3.3	4.3	4.0	4.0	2.3	0.7	0.7	25.0	3.60	8.8	12.3	21.1	38.5
Ulmus americana	30.3	10.0	2.0	1.0	0.7	—	—	—	44.0	1.48	15.6	5.1	20.7	18.9
Acer negundo	13.3	7.0	5.0	1.0	—	—	—	—	26.3	1.24	9.3	4.3	13.6	22.5
Gymyocladus dioicus	4.7	2.0	1.7	1.3	1.3	—	0.3	—	11.3	1.02	4.0	3.5	7.5	29.6
Quercus macrocarpa	—	—	—	—	0.3	—	—	1.7	2.0	1.49	0.7	5.1	5.8	95.5
Carya cordiformis	1.3	1.0	1.7	2.0	0.7	0.7	—	—	7.4	0.92	2.6	3.2	5.8	37.0
Celtis laevigata	9.0	1.7	—	0.3	—	0.3	—	—	11.3	0.40	4.0	1.4	5.4	18.4
Others	2.3	1.0	0.7	1.0	1.6	—	0.6	1.7	8.9	2.88	3.2	9.9	13.1	—
Totals	122.9	63.0	32.4	22.9	15.6	8.6	7.0	10.1	282.5	29.12	100.0	100.0	200.0	
Elm/Sweet Gum/Oak Forest														
Ulmus americana	61.0	20.7	3.3	3.0	0.3	—	—	—	88.3	2.82	29.6	9.7	39.3	18.5
Liquidambar styraciflua	2.7	3.3	4.0	4.0	2.3	4.7	2.3	3.7	27.0	6.87	9.0	23.7	32.7	51.5
Quercus shumardii	—	—	—	0.3	1.0	—	0.7	5.3	7.3	6.06	2.4	20.9	23.3	98.5
Carya laciniosa	1.0	5.3	5.3	5.3	3.7	2.7	—	—	23.3	3.37	7.8	11.6	19.4	40.7
Celtis occidentalis	29.3	8.3	1.7	—	—	—	—	—	39.3	1.00	13.1	3.4	16.5	16.6
Acer negundo	18.7	6.0	3.0	0.3	—	—	—	—	28.0	0.93	9.3	3.2	12.5	18.9

Table 3.—Continued

Species	Diameter classes (cm)								Total #/ha	Basal area m^2/ha	Rel. den.	Rel. dom.	IV	Av. diam. (cm)
	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80+						
Quercus macrocarpa	—	—	—	—	—	0.7	0.7	2.7	4.1	2.82	1.3	9.7	11.0	92.6
Celtis laevigata	16.0	3.3	1.3	—	—	—	—	—	20.6	0.48	6.9	1.7	8.6	16.2
Acer saccharinum	6.0	4.3	0.3	1.0	0.3	0.7	—	—	12.6	0.84	4.2	2.9	7.1	25.9
Fraxinus pennsylvanica	1.7	1.7	—	—	—	0.3	—	2.0	5.7	1.49	1.9	5.1	7.0	46.7
Asimina triloba	18.0	—	—	—	—	—	—	—	18.0	0.20	6.0	0.7	6.7	12.0
Others	14.3	4.0	3.4	0.9	1.4	1.0	—	0.6	25.6	2.12	8.5	7.4	15.9	—
Totals	168.7	56.9	22.3	14.8	9.0	10.1	3.7	14.3	299.8	29.00	100.0	100.0	200.0	

ter, spring, and also sometimes for a few days after summer rains. Tree density was 263.2 stems/ha with a basal area of 31.45 m^2/ha, while 25 canopy and five understory species were encountered (Table 1). Sugar maple dominated the lower diameter classes, ranked first in importance with an IV of 40.8, and had the highest density. Sweet gum and green ash ranked second and third in IV respectively, were well represented in most diameter classes, and had average diameters exceeding 40 cm. Pawpaw and *Lindera benzoin* (spicebush) dominated the seedling and small sapling categories, while pawpaw, sugar maple and American elm were the important large saplings (Table 2). Density of dead-standing individuals was 17 stems/ha with a basal area of 3.59 m^2/ha. A few large oaks and green ashes were responsible for the high basal area.

Woody vegetation of the lowland forest.—The lowland forest cover types at Beall Woods are classified as wet floodplain forest to mesic floodplain forest (White & Madany 1978). Here flooding determined species diversity, with fewer species entering the canopy and the woody understory where flooding is common.

Silver maple/pecan forest: (*Acer saccharinum/Carya illinoensis*). This wet floodplain forest cover type is common along both sides of Coffee Creek (Fig. 1). Flooding duration is three weeks to a month in early spring and additional floods of a week or more may occur during the growing season. Tree density was 209.3 stems/ha with a basal area of 36.71 m^2/ha, while 11 tree species were encountered (Table 3). Silver maple dominated (IV of 146), had the highest density (149.4 stems/ha), the most basal area (27.41 m^2/ha), and some individuals exceeded 125 cm dbh. Pecan and American elm were second and third in IV respectively. Understory trees were not common; *Celtis laevigata* (sugarberry) was the most numerous with 7 stems/ha. The understory was open with few saplings, while silver maple and green ash seedlings were occasionally encountered (Table 4). Density of dead-standing individuals was 15 stems/ha with a basal area of 2.08 m^2/ha. Silver maple accounted for over 80% of the dead stems and basal area. A few dead-standing *Betula nigra* (river birch) were present.

Hackberry/sweet gum/kingnut hickory forest: (*Celtis occidentalis/Liquidambar styraci-*

Table 4.—Densities (stems/ha) of the woody seedlings (≤50 cm tall), small saplings (>50 cm tall <2.5 cm dbh), and large saplings (2.5–9.9 cm dbh) in lowland forests cover types at Beall Woods Nature Preserve, Wabash County, Illinois.

	Silver Maple/Pecan			Hackberry/Sweet Gum/Kingnut Hickory			Elm/Sweet Gum/Oak		
		Saplings			Saplings			Saplings	
Species	Seedlings	Small	Large	Seedlings	Small	Large	Seedlings	Small	Large
Acer saccharinum	1528	—	—	—	—	4	—	—	—
Fraxinus pennsylvanica	556	417	4	139	83	4	—	—	4
Celtis laevigata	139	—	—	—	—	8	—	—	13
Asimina triloba	139	—	—	—	125	13	694	875	117
Celtis occidentalis	—	—	—	278	—	25	—	83	46
Gymnocladus dioicus	—	—	—	278	—	—	—	—	—
Quercus macrocarpa	—	—	—	139	—	—	—	—	—
Ulmus americana	—	—	—	—	—	4	—	—	71
Carya cordiformis	—	—	—	—	—	4	—	—	8
Acer negundo	—	—	—	—	—	4	139	—	8
Liquidambar styraciflua	—	—	—	—	—	—	—	42	—
Cercis canadensis	—	—	—	—	—	—	—	—	13
Carya laciniosa	—	—	—	—	—	—	—	—	4
Totals	2362	417	4	834	208	66	833	1000	284

flua/Carya laciniosa). This lowland forest is situated on a flat terrace about 1.5 m above the floodplain (Fig. 1). Tree density was 282.5 stems/ha and basal area was 29.12 m^2/ha, while 14 canopy and four understory species were encountered (Table 3). Hackberry dominated with an IV of 52.1 and 102.6 stems/ha with more than half in the 10–19 cm diameter class (Table 3). Sweet gum ranked second in IV (29.0) with most individuals in larger diameter classes and kingnut hickory ranked third with most individuals in intermediate diameter classes. Silver maple and American elm were also common forest components, both with IV's exceeding 20. Few saplings were encountered, while seedlings were rare with 834 stems/ha (Table 4). Density of dead-standing individuals was 25 stems/ha with a basal area of 3.01 m^2/ha. Hackberry and American elm accounted for more than 75% of dead-standing individuals while a few oaks and silver maple accounted for most of the dead-standing basal area.

Elm/sweet gum/oak forest: (*Ulmus* spp./*Liquidambar styraciflua*/*Quercus* spp.). Common on terraces along Coffee Creek, this wet-mesic floodplain forest occurs about 2.5 m above the floodplain. The terrain is flat, and floods are uncommon and of short duration. Tree density was 299.8 stems/ha with a basal area of 29.00 m^2/ha, while 16 canopy and three understory tree species were encountered (Table 3). American elm ranked first (IV of 39.3), dominated the lower diameter classes, had the highest density (88.3 stems/ha), but averaged only 18.5 cm dbh. Sweet gum, Shumard's oak, and kingnut hickory ranked second through fourth in importance, respectively. These species had much higher average diameters, and were well represented in larger diameter classes. Except for oaks, most remaining species were well represented in lower diameter classes, particularly *Acer negundo* (box elder), sugarberry, and pawpaw. The woody understory was not dense; pawpaw dominated all categories (Table 4). Density of dead-standing individuals was 21.3 stems/ha with a basal area of 4.10 m^2/ha. The oaks, particularly Shumard's and *Quercus macrocarpa* (bur oak), accounted for more than 80% of the basal area, but American elm accounted for 55% of the dead-standing individuals. Also, many large dead oaks were on the ground, the canopy gaps were being filled with American elm, hackberry, sugarberry and pawpaw.

DISCUSSION

Lindsey (1962) reported white oak as the leading dominant in upland forest at BWNP, and oaks in general accounted for 70% of the

basal area. At that time, sugar maple ranked second, mostly due to many small diameter individuals, while hickories as a group, ranked third in importance. Results reported by Lindsey (1962) are similar to those found in the sugar maple/oak/hickory cover type during the present study except sugar maple has replaced oak as first in importance. Increase in sugar maple is to be expected as it has increased dramatically in most Illinois forests during the past 30 years (Ebinger 1986; Ebinger & McClain 1991). This shade-tolerant, fire-sensitive species has been increasing in importance since European settlement due to anthropogenic reduction of fire frequency and a corresponding increase in canopy cover. This is a trend that has been observed in many Midwestern forest communities (Boggess 1964; Boggess & Bailey 1964; Boggess & Geis 1966; McClain & Ebinger 1968; Ebinger & McClain 1991; Roovers & Shifley 1997).

The upland forest at the BWNP are similar in floristic composition to some upland forests of the Southwestern Lowland Division and the South-Central Oak and Mixed Woods Division of southern Indiana (Lindsey et al. 1969). Many of the tree species found at BWNP are also listed for Hemmer Woods, in Gibson County, Indiana, but differ in their IV's (Lindsey et al. 1969). Also, Donaldson's Woods, in Lawrence County, Indiana has many of the woody species found in the uplands at BWNP, again differing in IV. One major exception is *Fagus grandifolia,* which is extremely rare at BWNP and one of the dominants in many woodlots in Indiana (Barton & Schmelz 1987).

Lindsey (1962) listed American elm as having the highest IV in the lowlands of the BWNP followed by Shumard's oak, sweet gum, bur oak and kingnut hickory. He referred to the area as an oak/gum/elm/hickory forest with Shumard's oak and sweet gum accounting for 40% of the basal area and with bur oak and American elm added accounted for 60% of the basal area. Silver maple, which was confined to lower elevations, ranked fifth in his study, while he reported few pecans.

The results of Lindsey (1962) are most similar to those found in the elm/sweet gum/oak forest cover type of the present study (Table 3). In both studies American elm had the highest IV, while sweet gum and oak species (Shumard's and bur) were also common, followed by kingnut hickory. It is likely most of the plots used by Lindsey (1962) were located in this cover type, species composition and structure are similar and tree density (281.7 stems/ha) was nearly identical with that found during the present study (299.8 stems/ha).

Results obtained during the present study for the silver maple/pecan forest cover type are similar to those reported by Lindsey et al. (1962) and Phillippe & Ebinger (1973) for other forest communities along the Wabash River. The floodplains and frontal flats of the Wabash River are dominated by silver maple, with the remaining species present determined by the extent of flooding and standing water.

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