

Hemmer Woods: An Outstanding Old-Growth Lowland Forest Remnant in Gibson County, Indiana

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Interest in old-growth forest stands and other little-disturbed remnants of original Indiana vegetation has been heightened by the current Indiana Natural Areas Survey. More commonly than not, areas that have escaped the major causes of disturbance are found by ecologists to be either extremely inaccessible or on marginal, rugged land that has precluded clearing. Hemmer Woods is a welcome exception. The Hemmer family has preserved this nearly level lowland forest remnant because of their love for large trees and quiet woods. The central purpose of this paper is to provide a detailed description of this remarkable old-growth forest stand before it is "developed" into one of the all-too-common land use patterns of the state.

Location and Description of the Area

Hemmer Woods is located about two miles southeast of the village of Mackey in extreme southeastern Gibson County. The area is in the Wabash Lowland Physiographic Province that was subjected to glaciation during the Illinoian Period. Smith Fork of Pigeon Creek, which is, in turn, tributary to the Ohio River, meanders through the entire length of the area. The least disturbed section of the woods comprises about 20 acres located principally in the North Half of the Northwest Quarter of the Southwest Quarter of Section 24, Township 3 South, Range 9 West. Another nearby wooded tract of about 70 acres is also owned by the Hemmers. This large stand has had slight disturbance by limited cutting several years ago. Although a description of the latter stand is not included in this paper, it should be the site of future ecological studies because it represents a gradual transition from the floodplain to the dry upland.

The study area is part of an alluvial deposit known locally as the "Buckskin Bottoms." The area has less than 10 ft of relief with the entire 20-acre stand lying between 410 and 420 ft above mean sea level. The soil type was mapped in the 1922 Gibson County Soil Survey Report as Waverly silt loam. It has a light gray surface horizon that is medium in organic content. Soil samples taken from six locations ranged from pH 6.0 to 6.2. The area was naturally poorly drained, owing to its flat surface, low position and gentle stream gradient. A deeply-dredged ditch located a few rods from the stand has lowered the water table until the section of the creek that is located within the stand remains very low or dry during most of the year. According to Mr. L. H. Hemmer, the ditch was dug in 1918, and prior to that, the creek retained a good flow of water all year.

No living trees have been removed, but dead individuals have been cut following lightening strikes or other natural mortality. A small

tornado struck the southern edge of the stand in 1916 and several wind-thrown and damaged trees were salvaged shortly thereafter. Mr. Hemmer states that there has been no fire in the stand during this century and grazing has been excluded since World War I or earlier. There is no present evidence of disturbance except for a very few stumps that remain from past cutting of dead trees. The area has been designated as a classified forest for about 20 years by the Indiana Division of Forestry.

Procedure

A full census was made by the usual full tally method for 11.33 acres centered in the main part of the stand. All stand edges were excluded. The major study section (600 ft square) is located in the main east-west part of the tract. A smaller contiguous section (roughly a 30°-60° triangle with a 400 ft base) was tallied in the northeastern part of the stand. Temporary markers will be replaced by permanent stakes at the plot corners. All trees over 4 inches dbh (diameter breast high) were measured to the nearest one tenth inch with diameter tapes and those 2.0 to 3.9 inches were counted and recorded by species. Tree heights were taken with an Abney level.

Since the area has quite uniform topography, the section tallied is treated as a single stand. The tally for one small segment of the stand which is located on slightly higher ground was recorded separately and is discussed later. Data are summarized in Tables 1 and 2. Stand attributes are those of Lindsey (2); species nomenclature for trees follows Little (5); and shrub and herb nomenclature follows Fernald (1). Common names of trees are used in the text for convenience in reading.

Stand Description

A total of 1,259 trees were tallied in the size classes greater than 4.0 inches. The 2.0 to 3.9-inch size class contained 789 individuals, including 28 vines which are omitted from the tables. As indicated in Table 1, the stand is of mixed lowland composition with several species sharing dominance. Thirty-two species were represented by individuals larger than 4 inches dbh, and eleven species had importance values of nearly 5% or greater. It is best characterized as a sweet gum—tulip-poplar—red maple—elm stand. The presence of tulip-poplar as one of the dominant species in this lowland stand is understandable when one considers that Ridgway (6) found the species growing to great proportions in the original forests of the fertile high bottoms of the southern Wabash River floodplain. The low gradient stream of this stand has probably never flooded extensively for lengthy periods, conditions similar to those on the Wabash high bottoms. Lindsey, *et al.* (4), failed to find tulip-poplar present in the Wabash floodplains, since complete clearing for agriculture had removed most of the suitable sites. Increased frequency and duration of flooding in recent decades undoubtedly has accelerated the loss of species such as tulip-poplar, which are relatively intolerant to inundation. Hemmer Woods has increased value as a

natural area since it is the only known example of floodplain forest in the state that includes such large tulip-poplar trees.

The size of individual trees and the great number of large trees are the most striking features of the stand (Table 2). Eleven species have a total of 74 individuals in the 30-inch or larger size classes, for an average of over six 30-inch plus stems per acre. Eighteen stems greater than 40 inches dbh fell within the study plot. At least three trees greater than 40 inches fell outside the plot, including a 48.3 inch sycamore. Three tulip-poplars exceeded 50 inches dbh; the largest, at 54.6 inches, may be the largest individual of that species in the state. Twelve species had representatives larger than 30 inches with sycamore 48.6 inches, white oak 44.0, sweet gum 40.7, green ash 37.4, red oak 36.5, American elm 35.9, red maple 34.4, hackberry 33.5, river birch 30.8 and swamp white oak 30.5. The stand is also noteworthy for large sassafras (nine over 20 inches) with the largest at 31.9. A great number of the larger trees have clear boles of 40 to 60 feet. The largest tulip-poplar measured 151 feet tall and 53 feet to the first limb. The larger tulip trees stand 20 to 30 feet taller than the general canopy level of about 120 feet. Another interesting feature is the large grove of very large paw paw trees. Twenty paw paw stems exceeded 4 inches dbh with two reaching 6.2 inches. These are among the largest forest grown paw paw trees that the author has measured.

The shrub stratum is dominated by *Lindera benzoin*, *Staphylea trifolia*, *Euonymus atropurpureus*, and *Smilax rotundifolia*. *Urtica procera* abounds in the herb layer, which could aid in the preservation of the area! Mr. Hemmer stated that the spring wildflower display is very showy, including large colonies of *Trillium gleasoni* and *Mertensia virginica*.

Effect of Drainage on Stand Composition

Although there is little relief within the area, there is remarkable ecological separation of species that are usually restricted to either upland or lowland sites. Along such a low gradient stream, three or four vertical feet alter the drainage and soil moisture patterns appreciably. Since several of the tally strips crossed the area at right angles to the stream, it was easy to note the gradual but definite species shift to species less tolerant of high water tables as the gentle topographic rise was topped. This helps explain the presence of shagbark and mockernut hickory, and black oak in the same stand with swamp white oak, sycamore, river birch, sweet gum, hackberry and shellbark hickory.

Another interesting moisture relationship is illustrated by a comparison between the species importance values of a small segment (approximately 1 acre) of the stand located on the highest small rise with importance values of the main stand. This small segment, on a gentle southwest-facing slope, had a combined importance value for the more typically upland oaks (white, red and black) and upland hickories (shagbark and mockernut) of 30.9% as compared to 11.6% for the same species in the remainder of the stand. A change in importance value of

TABLE 1. Stand Attributes, Hemmer Woods, Gibson County, Indiana, Based on trees 4" dbh and Greater. 11.33 Acres—Full Tally (Symbols are From Left, Density per Acre, Relative Density, Basal Acre per Acre, Relative Basal Area and Basal Area per Tree, Respectively).

Species	D ₂	D ₃	B ₂	B ₃	V ₃	BA/Tree
<i>Liquidambar styraciflua</i>	10.06	9.06	22.74	16.97	13.02	2.26
<i>Liriodendron tulipifera</i>	5.65	5.09	23.91	17.84	11.46	4.23
<i>Acer rubrum</i>	11.56	10.41	7.85	5.85	8.13	.68
<i>Ulmus americana</i>	12.18	10.97	5.33	3.98	7.48	.44
<i>Celtis occidentalis</i>	12.00	10.81	5.18	3.86	7.34	.43
<i>Ulmus rubra</i>	11.56	10.41	3.65	2.72	6.56	.32
<i>Sassafras albidum</i>	8.30	7.47	6.71	5.01	6.24	.81
<i>Platanus occidentalis</i>	2.82	2.54	11.69	8.72	5.63	4.14
<i>Carya ovata</i>	6.53	5.88	7.21	5.38	5.63	1.10
<i>Nyssa sylvatica</i>	6.88	6.20	6.19	4.62	5.41	.90
<i>Quercus alba</i>	2.21	1.99	9.77	7.29	4.64	4.43
<i>Fraxinus pennsylvanica</i>	3.27	2.94	5.23	3.90	3.42	1.60
<i>Fraxinus americana</i>	4.06	3.66	3.50	2.61	3.14	.86
<i>Quercus rubra</i>	1.24	1.11	4.48	3.34	2.23	3.62
<i>Carya laciniosa</i>	2.21	1.99	2.89	2.15	2.07	1.31
<i>Prunus serotina</i>	2.47	2.23	1.54	1.15	1.69	.62
<i>Betula nigra</i>	1.15	1.03	2.20	1.64	1.33	1.92

<i>Asimina triloba</i>	1.77	1.59	.25	.19	.89	.14
<i>Carya cordiformis</i>	.79	.72	1.15	.85	.78	1.44
<i>Cornus florida</i>	1.15	1.03	.14	.11	.57	.12
<i>Quercus bicolor</i>	.18	.16	.84	.63	.40	4.77
<i>Carya tomentosa</i>	.44	.40	.49	.36	.38	1.10
<i>Cercis canadensis</i>	.53	.48	.09	.06	.27	.16
<i>Diospyros virginiana</i>	.35	.32	.18	.14	.23	.51
<i>Morus rubra</i>	.44	.40	.07	.05	.23	.16
<i>Acer saccharum</i>	.35	.32	.15	.11	.22	.41
<i>Carpinus caroliniana</i>	.26	.23	.05	.03	.13	.18
<i>Juglans nigra</i>	.18	.16	.09	.07	.11	.51
<i>Quercus shumardii</i>	.09	.08	.18	.13	.11	1.99
<i>Quercus velutina</i>	.09	.08	.18	.13	.11	2.03
<i>Acer negundo</i>	.18	.16	.07	.05	.10	.37
<i>Juglans cinerea</i>	.09	.08	.09	.07	.07	1.03
Total	111.04		134.09			

nearly 20% for these species indicates much lower soil moisture levels on the slope. In addition, the only individual of the most xeric of the oak species present (black oak) was found on the same slope.

Other species with substantial shifts in importance in the slope segment include: a) increases on slope; slippery elm 6.3% to 12.3%, white ash 2.8% to 8.1%, wild cherry 1.4% to 6.0% and sassafras 5.9% to 10.4%; b) decreases on slope; sweet gum 14.0% to 3.8%, red maple 8.7% to 0.6%, American elm 7.9% to 2.4%, hackberry 7.6% to 3.8%, sycamore 6.0% to 0.0%, shellbark hickory 2.2% to 0.0% and river birch 1.5% to 0.0%. It is of interest that all species with increases in importance are more typical of upland stands, while all species with decreases in importance are typical of depressional or floodplain situations.

Of the five sugar maples larger than 4.0 inches, three were in the slope segment. Four of the sugar maples were in the 6-inch size class with the lone exception at 13.3 inches. One 4.9 inch sugar maple was found on a very slight rise along the creek and another at 6.6 inches occurred on higher ground near the south edge of the stand. Both of the 2-4 inch maples occurred on higher sites. Only a single red maple was found on the slope, as compared to an average of 12.7 red maples per acre in the remainder of the stand.

Future Changes in Composition

Perhaps the shift from red maple to sugar maple on the drier sites is a definitive change that portends a future trend within the stand toward species less typical of floodplains. This could indicate the beginning of a species shift in response to less hydric conditions following the lowering of the water table 50 years ago.

Inspection of the size class data in Table 2 reveals that several species seem to be shifting significantly in importance value. Both river birch and sycamore are restricted to the immediate vicinity of the creek bank and neither is reproducing. Although tulip-poplar has more general distribution throughout the stand, apparently it is not reproducing. One could assume that it will be maintained in canopy openings resulting from windthrow or death, since abundant seed sources are at hand. There are few tulip trees in the area disturbed by the tornado, however. Instead, other intolerant species such as sassafras, wild cherry, slippery elm, American elm and hackberry represent a larger percentage of the medium-sized stems in that area.

When ratios of the number of individuals smaller than 12 inches to the number of individuals greater than 12 inches are compared for several species, projected compositional changes become clearer. The three members of the Ulmaceae plus red maple have ratios greater than 3:1 and seem to be invading the stand rapidly. Wild cherry, ash, black gum, bitternut and shagbark hickory have ratios decreasing from 2:1 to ½:1 in the order listed. These species seem to be maintaining their position in the stand. River birch, sweet gum, tulip-poplar, white oak, shellbark hickory and sycamore have ratios less than 0.5:1 and appear

TABLE 2. Size Class Midpoints, Hemmer Woods, Gibson County, Indiana. 11.33 Acres—Full Tally.

Species	2-4"	6"	10"	14"	18"	22"	26"	30"	34"	38"	42"	44"	Total >4"	Total >2"
<i>Ulmus americana</i>	82	96	27	6	5	1	1	1	1				138	220
<i>Celtis occidentalis</i>	80	79	38	17		1			1				136	216
<i>Acer rubrum</i>	83	71	29	14	7	5	2	1	2				131	214
<i>Ulmus rubra</i>	128	94	28	7	2								131	259
<i>Liquidambar styraciflua</i>	14	17	8	19	16	22	20	8	3		1		114	128
<i>Sassafras albidum</i>	9	46	20	10	9	3	4	2					94	103
<i>Nyssa sylvatica</i>	28	17	23	24	9	5							78	106
<i>Carya ovata</i>	1	11	13	33	10	6	1						74	75
<i>Liriodendron tulipifera</i>		3	7	9	9	6	9	3	3	5	3	7	64	64
<i>Fraxinus americana</i>	72	22	8	6	4	4	2						46	118
<i>Fraxinus pensylvanica</i>	13	8	7	4	7	7	2	1		1			37	50
<i>Platanus occidentalis</i>			1	2	5	7	9	2	1	1	1	3	32	32
<i>Prunus serotina</i>	6	13	6	7	1	1							28	34
<i>Quercus alba</i>	1	3		2	1	3	2	6	4	2	1	1	25	26
<i>Carya laciniosa</i>	6	2	1				1						31	31
<i>Asimina triloba</i>	121	20		12	9								20	141
<i>Betula nigra</i>	1	1			2	2	3	4	1	1			14	15
<i>Cornus florida</i>			4	2	1	3	2	1					13	13
<i>Carya cordiformis</i>	5	2	1	1	3	1							9	14
<i>Cercis canadensis</i>	12	6											6	18
<i>Carya tomentosa</i>			1	3	1								5	5
<i>Morus rubra</i>	16	5											5	21
<i>Diospyros virginiana</i>													4	4
<i>Acer saccharum</i>	2	4	2	1									5	7
<i>Carpinus caroliniana</i>		3											3	3
<i>Quercus bicolor</i>								2					2	2
<i>Juglans nigra</i>	2		2										2	4
<i>Acer negundo</i>		1	1										2	2
<i>Quercus shumardii</i>					1								1	1
<i>Quercus velutina</i>					1								1	1
<i>Juglans cinerea</i>				1									1	1
Total	761	538	227	181	103	77	59	31	16	10	6	11	1259	2020

to be losing their share of stand dominance. The size distribution ratios are, at best, only indications of trends, since they do not completely account for differential survival rates among young trees of different species.

Since the number of standing dead trees per species gives some information about survival rates, all identifiable dead trees were measured and recorded. Overall, 4.4% of the total standing stems were dead. This appears to be a relatively low mortality rate until one considers that most small trees are largely sapwood which decays to a condition that precludes species identification in a very few years. Dead trees represented a substantial percentage of total standing stems for the following species: sassafras 12.1, black cherry 9.7, American elm 8.6, black gum 6.0, sweet gum 4.2 and slippery elm 3.0. American elm seems to be maintaining its position in the stand, since widespread mortality from elm diseases is not in evidence.

The stand does not appear to be at climax although largely undisturbed by man. Perhaps an equilibrium had been reached prior to drainage. Presently the composition shift appears to be favoring species typical of situations of medium soil moisture. Those species favoring very moist situations, such as river birch, sweet gum, shellbark hickory and sycamore, are apparently decreasing. Windthrow has probably helped retain intolerant species such as wild cherry, sassafras and tulip-poplar. It is of interest that no beech trees were found in any size class, although beech occurs quite commonly in surrounding stands. Perhaps the relatively recent invasion of sugar maple is the initial step toward a beech-maple dominated stand, and that beech invasion will follow suit in the future. Long term studies would be of interest here.

Comparison with Other Stands

Bottomland and depressional forests frequently have higher basal area per acre than most undisturbed upland stands which partially explains the moderately high (134 sq ft per acre) basal area in this stand. It is surpassed in basal area by only four of the old-growth stands reported by Schmelz and Lindsey (7). It has both higher basal area and lower density per acre than either Donaldson's Woods in Lawrence County or Cox Woods, Orange County, which are often considered to be the most impressive forests in the state (7). Beckville Woods in Montgomery County, which occupies a depressional Brookston silt loam soil, was found by Petty (personal communication) to have 135 sq ft per acre. A full tally of 21 acres of Kramer Woods along the Ohio River in Spencer County was found by Schmelz (personal communication) to have 128.5 sq ft per acre, but the stand density was much lower at 78.9 trees per acre. The mean diameter of trees in Hemmer Woods at 12.2 inches is about average for old-growth stands in the state, but Kramer Woods at 14.6 and Beall Woods at 14.2 (7) indicate a greater percentage of large trees.

When the numbers per size class were plotted on semi-log paper according to the method used by Schmelz and Lindsey (7) to analyze

disturbance in stands, the relationship approaches a straight line more closely than did any of the 19 stands that they studied. Slight plateaus in the 18 to 26-inch size classes and 42 to 50-inch size classes indicate only mild disturbance. The former plateau probably reflects the windthrow of 52 years ago.

Hemmer Woods has 18 of its 32 species in common with the Beall Woods bottomland stand which is located on the larger floodplain of the lower Wabash River (3), and 24 of its 32 species in common with Kramer Woods. Most important Beall Woods species absent from Hemmer Woods are bur oak, silver maple, and pin oak. Shumard's oak represented 13% of Beall Woods, but had only 0.11% importance in Hemmer Woods. Although pin oak is absent from the stand reported herein, it is abundant in medium size classes in the larger Hemmer Woods stand. Of the important species in Kramer Woods, only southern red oak, swamp chestnut oak and beech are absent here. Again, Shumard's oak is very important (23%) in Kramer Woods.

Coefficients of community, based on importance percentages, were calculated to compare the degree of similarity among the three bottomland stands. Hemmer Woods was 39.6% and 32.8% similar to Beall and Kramer Woods, respectively. Beall and Kramer Woods were 48.1% similar to one another. These values indicate that stands located on floodplains of larger rivers, within a given area, tend to be more similar structurally than are stands which are located on floodplains of large and small streams, respectively. Differences in the frequency and duration of flooding between large and small streams is undoubtedly a major factor influencing stand composition.

The only species of southern affinity in this stand are persimmon and Shumard's oak, although floodplains normally offer excellent migration corridors.

The extremely large trees, excellent size class distribution, rich species composition, high basal area and relatively low density combine to make Hemmer Woods one of the finest forests in Indiana. The area is certainly of the quality that should be preserved as part of the Natural Areas System of Indiana.

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