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FOREST COMMUNITIES AND TREE SPECIES OF THE LOWER WABASH RIVER BASIN

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ABSTRACT. The nature of presettlement forests of the Lower Wabash River basin, as documented by the naturalist Robert Ridgway, is presented. Comparisons are made between the composition of the original forest with present-day stands on various floodplain soils. Brief descriptions are given for representative forest stands within the study area, as related to topographic position and/or susceptibility to flooding. Eight natural areas are listed where remnants of original vegetation may be observed. Fifteen tree species that typify southwestern Indiana are described briefly.

Keywords: Floodplain vegetation, forest communities, Lower Wabash Valley, presettlement forests, Robert Ridgway, tree species of Indiana

Some of the most impressive presettlement forest stands of the Eastern Deciduous Forest Biome grew along the southern reaches of the Wabash River, its major tributaries, and associated lowlands (Petty & Jackson 1966). Here during the 1870s and 1880s, naturalist Robert Ridgway (1872, 1882) measured and photographed a number of individual trees that exceeded 150 ft (45 m) in height, and regularly reached diameters 6 feet (1.8 m) or greater on the fertile soils of that region. Forest stands remaining in southwestern Indiana today differ greatly from the vast original wilderness, not only in areal extent, but also in species composition, and in the size of trees present.

Statewide, Indiana forests contain approximately 100 native species that routinely reach tree size at maturity. Of these, 78 species can be found within the Southwestern Lowlands and the Southern Bottomlands Natural Regions of southwestern Indiana (Jackson 2004). A few of these species are unique in their occurrence (in Indiana) to these regions, are of special interest ecologically or taxonomically, or are at or near their northern range limit in that area of Indiana. Nomenclature for tree species follows Gleason & Cronquist (1991).

NATURE OF THE ORIGINAL FOREST AND RECORD TREES

From early reliable accounts (Ridgway 1882; DenUyl 1958; Lindsey et al. 1961) of the nature and grandeur of the forests of the Lower Wabash River Valley, it is doubtful that more magnificent stands of hardwood trees occurred anywhere in the Eastern Deciduous Forest Biome. The height, girth, and density of trees growing there were seldom exceeded even in the moist cove forests of the southern Appalachian Mountains (Jackson unpubl. data). Considering that the Wabash River drains some of the finest glaciated landscape of midwestern U.S., it is understandable that the deep, fertile, well-drained soils, with constant moisture available, would produce an original forest which now seems improbable to many people.

The early naturalist Robert Ridgway, who grew up in the Lower Wabash Valley, and who spent extended periods there during the 1870s and 1880s photographing (e.g., Figs. 1, 2) and measuring trees, described the area and its forest: ". . . from a little below Vincennes (Indiana) to near New Harmony (Illinois), an exceedingly heavy virgin forest, some of the heaviest hardwood forest I have seen—as I have twice visited the Tropics (Central America)—covered almost the entire flood plain of the Wabash on the Indiana side. If the forest is viewed from a high bluff, it presents the appearance of a compact, level sea of green, apparently almost endless, but bounded by the line of wooded bluffs three to seven miles back from the river. . . . My estimate was that the tree top line of the virgin forest along the Lower Wabash . . . may have been as much as 120 feet. It was remarkably uniform, forming

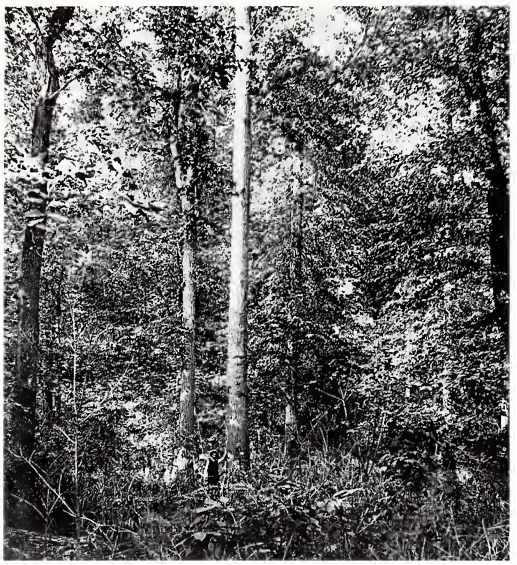

Figure 1.—View (July 1890) of pin oak (*Quercus palustris* Muenchh.) in the Wabash Bottoms, 4 or 5 miles (7–9 km) south of Vincennes, Indiana. (Robert Ridgway photo)

a practically straight level line, with only here and there the dome-shaped top of some species which grew larger than most others (usually a sycamore, pecan, or tulip tree), lifted above the general level." (Ridgway 1872)

Ridgway's actual measurements of height of trees still living, and those he observed as recently cut, substantiated his earlier estimates. His careful measurements of the heights by triangulation and lengths of actual felled trees allowed him to determine the average tree-top level at 130 feet (40 m), and that "by no means infrequent monarchs attained a height of more than 180 feet (55 m), and that the tallest sycamores and tulip trees approached 200 feet (60 m) in height." (Ridgway 1872)

Ridgway's diameter measurements were equally impressive. Bald cypress (*Taxodium distichum* (L.) Rich.) stems that were recently cut were 9–10 feet (2.7–3 m) across, whereas some harvested earlier exceeded the dimensions of any stumps, or those still standing (Ridgway 1876). Other trees measured by Ridgway included a sycamore (*Platanus occidentalis* L.) in Gibson County located nearly opposite Mt. Carmel, Illinois, at 15 feet (4.6 m) diameter at 10 feet (3 m) above ground, whose height as measured by dendrometer was "probably the tallest tree east of California," in Ridgway's (1882) words. He also stated that, "In the same half mile square, I measured, on this same day, twelve sycamores which averaged near 8 feet (average girth of 23½ feet) in diameter and 127 feet spread of top." Additionally, four tulip trees (*Liriodendron tulipifera* L.) within a single photograph taken in 1888 by Ridgway ranged from 5–7 feet (1.5–2.1 m) dbh each. (The term dbh, stands for diameter at breast height, the forester's term for the standard height measurement for trees, i.e., at 54 inches or 1.37 m above ground.) A Shumard's red oak (*Quercus shumardii* Buckley) below the White River mouth was 6 feet (1.8 m) in diameter at 12 feet (3.7 m) high (Figure 2). Within 100 yards (90 m) of the above oak were two black walnuts (*Juglans nigra* L.), each 6 feet (1.8 m) in diameter above the butt swell.

Lindsey et al. (1961) recorded an 81.5 inches (2.1 m) in diameter standing bald cypress in Little Cypress Swamp in Knox County that they speculated to be the largest living tree in Indiana at that time. Other large individual trees (> 48 inches or 1.2 m dbh) that they recorded along the Wabash River in Indiana during their field study which lasted from 1955–1959 were: silver maple (*Acer saccharinum* L.) 72.2, 70.5 and 63.0 inches (1.8, 1.8 and 1.6 m); hackberry (*Celtis occidentalis* L.) 69.1 inches (1.8 m); cottonwood (*Populus deltoides* Marshall) 67.1 inches (1.7 m); black willow (*Salix nigra* Marshall) 67.3 and 64.3 inches (1.7 and 1.6 m); northern red oak (*Quercus rubra* L.) 56.0 inches (1.4 m); and pin and bur oak (*Quercus palustris* Muenchh. and (*Q. macrocarpa* Michx.) 50.0 inches (1.3 m). In their 1961 study, Lindsey et al. did not record tulip tree as present on floodplain sites in recent times, but apparently the species was common there on well-drained soils, and reached record sizes in Ridgway's day (DenUyl 1958). Almost all well-drained sites have now been cleared and are in agricultural production.

In the low-ground section of Hemmer Woods in Gibson County, tulip tree still occurs in record sizes. In an 11.3 acre (4.6 ha) full census, Jackson (1969a, b) recorded three tulip trees that exceeded 50 inches (1.3 m) dbh, 10 over 40 inches (1.0 m), and 20 greater than 30 inches (0.8 m). Twelve species in the stand had a total of 61 stems > 30 inches dbh,

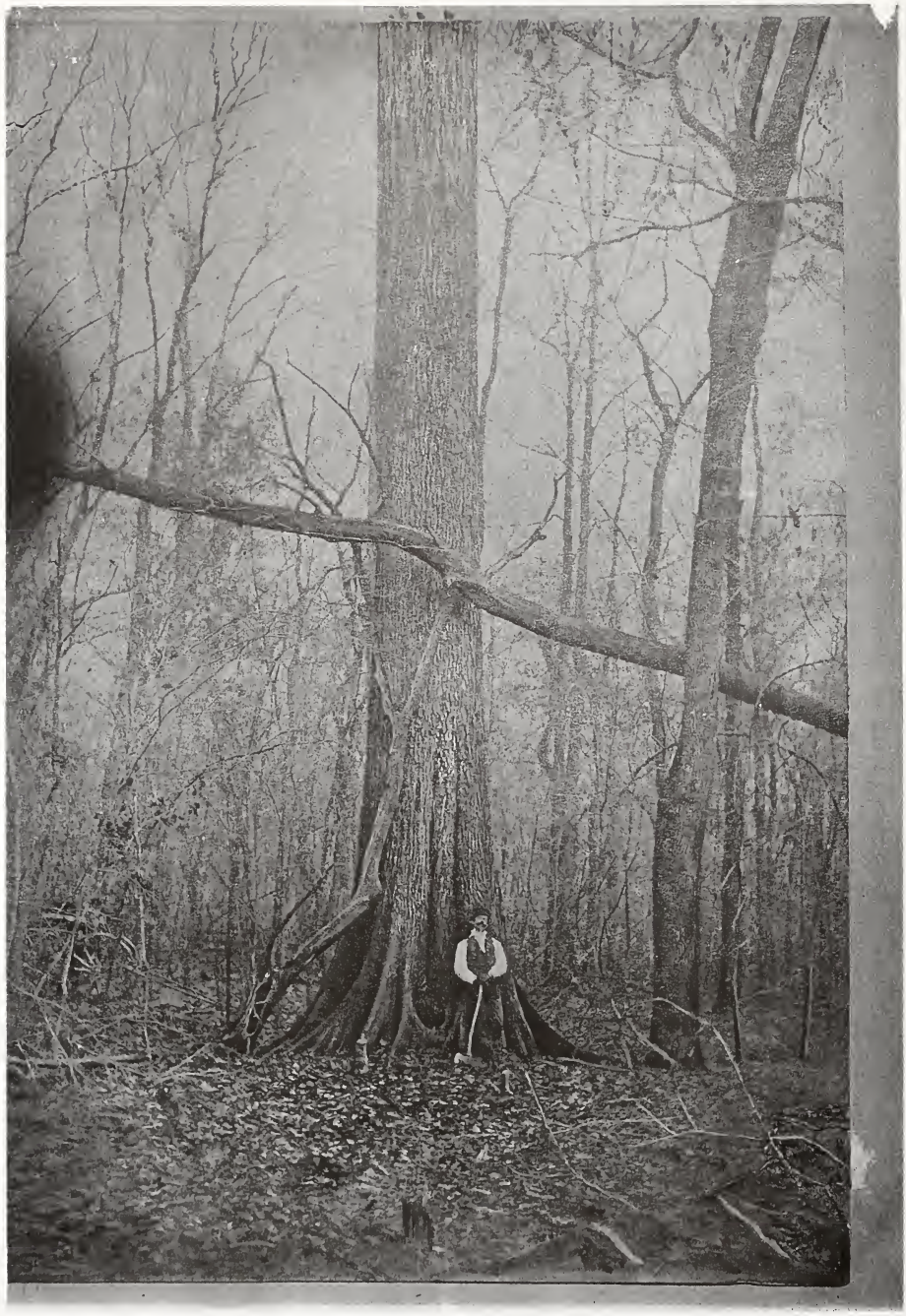

Figure 2.—Shumard's Red Oak (*Quercus shumardii* Buckley) in the original forest of the Wabash Bottoms. Tree is 6 feet (1.8 m) dbh, 12 feet (3.6 m) at base. (Robert Ridgway photo, date unknown)

or 5.4/acre. The largest tulip tree at 54.6 inches or 1.4 m dbh in 1969, may be the largest forest-grown tulip tree in the State of Indiana. At 151 feet (46 m) tall and 53 feet (16 m) clear length, it rivals the height of those forest giants of Ridgway's day. Overall, Hemmer Woods is remarkable in having 32 species above 10 cm in diameter, with an interesting mix of both hydric and mesic species represented. Tulip tree and sweet gum (*Liquidam-*

bar styraciflua L.) dominate the stand at a combined importance value of 25%.

FOREST CHANGES FROM PRESETTLEMENT TIME TO PRESENT

Not only has the essentially unbroken presettlement forest been reduced by clearing to a remnant of its former grandeur, major changes have also occurred in the species present, and in forest composition generally.

The Wabash River is most unusual in that its overall flow patterns remain essentially unmodified by major structural changes such as construction of large reservoirs, channelization, dredging, and the like. As such, it is one of the largest and longest essentially free-flowing rivers of North America south of Canada. However, forest clearing, artificial drainage of agricultural land, destruction of wetlands, and extensive paved surfaces within the watershed, have greatly increased runoff rates and all have contributed to increased frequency, height, and duration of floods during the past two centuries. Such changes in the flooding regime are likely the primary cause of the definite shifts in the species composition of forests of the Lower Wabash Valley since presettlement time.

Two important ecological studies examined the composition of presettlement forests within the region. Dr. William Crankshaw, a long-term professor of ecology at Ball State University, examined the nature of edaphic controls of tree distribution in the presettlement forests south of the Late Wisconsinan glacial boundary, as his Ph.D. research at Purdue University (Crankshaw 1964; Crankshaw et al. 1965). His study included data on more than 60,000 trees that the General Land Office (GLO) surveyors selected as bearing or witness trees to mark section corners during the original survey of land now comprising southern Indiana.

Crankshaw constructed stand tables of tree species present on all major soil types represented on floodplain, terrace, and upland landforms within the region. He found American beech (*Fagus grandifolia* Ehrh.) to be present on six widespread floodplain soil series (Eel, Gesesee, Morganfield, Pope, Ross, and Shoals), ranging from 7–33% of stand importance on different soils; sugar maple to be present on four soil series (Eel, Genesee, Pope, and Ross), at 7–20% importance; and tulip tree on three (Eel, Morganfield, and Pope), at 5–7% importance. White oak (*Quercus alba* L.) was also present at 13% on the Eel soil series. Combined, beech, sugar maple, and tulip tree represented 46% of the stand importance on Eel silt loam soils; while beech and sugar maple totaled 48% on Genesee loam soils. None of these mesic to dry-mesic tree species is found on floodplain soils within the Wabash River valley today (Lindsey et al. 1961). Changes in the flooding regime during the past 200 years are believed to be the primary cause of their exclusion from these sites today.

Ellen Donselman's (1975) Master's thesis at Indiana State University contained a comparison of forest composition of Vigo County, as based on the 1814 GLO land survey, with data obtained from sampling 14 of the best remaining contemporary stands within the county during the 1974 field season. Her analysis centered on comparing the two samplings separated by 160 years, by dividing the county physiographically into floodplain, terrace, upland slope, and upland flat units. Each unit for each time period was considered as a separate forest stand.

The floodplain comparison for the two time periods is especially revealing. In 1814, of a 345-tree sample, beech, sugar maple, and tulip tree collectively comprised 14% of stand importance, with white oak and black oak combined representing another 20%. Silver maple was present in 1814 at only 4%; cottonwood was not listed by the GLO surveyors. In the 1974 sampling of remaining floodplain stands, beech, sugar maple, tulip tree, and the two oak species were absent, whereas silver maple and cottonwood combined totaled 60% of stand importance. Again, differences in forest composition during the intervening 160 years are believed to have resulted primarily from changes in the flooding regime.

That tulip trees still occur in all size classes in the bottomland stand at Hemmer Woods (Jackson 1969b) represents a somewhat different situation. First, the creek that runs through Hemmer Woods is small, strongly meandering, and carries a relatively small water volume following most rains. Any overflow that occurs is likely shallow and of short duration. Further, a drainage ditch cut across adjacent farmland in years past has lowered the water table several feet below the general

land surface. Also, the larger tulip trees likely began growth in the presettlement forest (or during the early years of Indiana's history), and continue to survive. Additionally, the presence of tulip trees in all size classes from 4 inches (10 cm) upward to > 50+ inches (1.3 m) dbh (Jackson 1969b), suggests that tulip tree regeneration has been occurring without interruption in Hemmer Woods since presettlement time.

Changes in the terrace communities of Vigo County were almost equally revealing. The major terrace system in Vigo County (where much of the City of Terre Haute is located) is mainly underlain by sands and gravels that were deposited during the Pleistocene by the Maumee Torrent, a deluge that drained much of glacial Lake Maumee when a moraine near Fort Wayne was breached by flood waters. Since these terrace soils are relatively dry, they supported prairie vegetation, for the most part. However, in the forest stands that did occur on the terrace in 1814, beech and sugar maple represented 13% of a 227-tree sampling by the surveyors, and tulip tree was not recorded. Oak and hickory species combined totaled 58% of stand importance. Donselman's 1974 sample revealed that beech and sugar maple each represented < 1% of the stands, tulip tree 8%, whereas oak and hickory combined were similar in importance to 1814 at 52% (Donselman 1975).

Figure 3.—The Southern Bottomlands Natural Region of Indiana. (Graphic from *The Natural Heritage of Indiana* 1997)

PRESENT FOREST COMMUNITIES TYPICAL OF SOUTHWESTERN INDIANA NATURAL REGIONS

Forested areas found today in the two natural regions of southwestern Indiana are largely present on flood-prone lands, river margins, sites with high water tables at or near the surface (at least seasonally), or on other tracts unsuited for agriculture or development. Although both glaciated and unglaciated landscapes are represented in far southwestern Indiana, glaciation there occurred long ago, and apparently has little effect on present forest composition (Lindsey et al. 1961). Instead, the impact of southerly weather systems originating over the Gulf of Mexico, and their attendant extension up the Mississippi, Ohio, and Wabash river valleys, is far more influential in extending the northward range of a number of tree species with southern affinities (Lindsey et al. 1961; Abrell 1997), some of which are described below.

The nature of forest stands is strongly influenced also, by subtle changes in elevation, hence by the frequency, height, and duration of flooding, and by notable differences in moisture conditions of the soils (Lindsey et al. 1961). The deeper sloughs and swamps of the Southern Bottomlands Natural Region (Fig. 3) of far southwestern Indiana that hold standing water throughout the year, or nearly so, range from essentially pure stands of bald cypress, to stands mixed with silver maple, river birch (*Betula nigra* L.), pecan (*Carya illinoensis* (Wangenh.) K. Koch), swamp cottonwood (*Populus heterophylla* L.), sugarberry (*Celtis laevigata* Willd.), and locally, water locust (*Gleditsia aquatica* Marshall), or pumpkin ash (*Fraxinus profunda* (Bush) Bush). Joining this forest mosaic at sites with prolonged, but not continuous, standing water, are communities of such characteristic species as silver maple,

cottonwood, sycamore, green ash (*Fraxinus pennsylvanica* Marshall), overcup oak (*Quercus lyrata* Walter), pecan, shellbark hickory (*Carya laciniosa* (Michx. f.) Loudon), sugarberry, and black willow. Slightly better-drained sites may be dominated by swamp white (*Quercus bicolor* Willd.), swamp chestnut (*Q. michauxii* Nutt.), Shumard's red, and bur oaks, along with shellbark hickory, hackberry, American elm (*Ulmus americana* L.), or, locally, green hawthorn (*Crataegus viridis* L.), or Kentucky coffee tree (*Gymnocladus dioica* (L.) K. Koch). Flatwoods, at slightly higher elevations, but still poorly drained—often internally—may have prolonged periods of standing water, and contain post (*Quercus stellata* Wangenh.), cherrybark (*Q. pagoda* Raf.), and pin oaks, plus sometimes sweet gum (*Liquidambar styraciflua* L.), green ash, and American elm (Abrell 1997).

A distinctive non-arborescent plant species strongly characteristic of this natural region is giant cane (*Arundinaria gigantea* (Walter) Chapman), a bamboo that grows on very fertile soils. These "cane breaks," which were once very extensive, are now almost entirely converted to agriculture. Also present are such shrubs as swamp privet (*Forestiera acuminata* (Michx.) Poiret), catbird grape (*Vitis palmata* M. Vahl.), and woolly pipe vine (*Aristolochia tomentosa* Sims); and such showy herbs as spider lily (*Hymenocallis caroliniana* (L.) Herbert) and featherfoil (*Hottonia inflata* Elliott). Characteristic vertebrates include the swamp rabbit (*Sylvilagus aquaticus* (Bachman), (very rare in Indiana), plus such reptilian species that are rare in Indiana as the eastern mud turtle (*Kinosternon subrubrum subrubrum* (Lacepede)), and the cottonmouth moccasin (*Agkistrodon piscivorus leucostoma* (Troost)) (Abrell 1997).

The Southwestern Lowlands Natural Region parallels the Wabash River from the Ohio River north to the Wisconsinan glacial boundary in Vigo and Clay counties (Fig. 4). Standing at higher elevations, and generally much better drained than the preceding natural region, the plant communities are quite different. The southern section, which was shaped and leveled early on by Illinoian glaciation, is characterized by black ash (*Fraxinus nigra* Marshall) swamps in the lowest-lying areas, alternating with poorly-drained flatwoods which contain pin and shingle (*Quercus imbricaria* Michx.) oak, and shagbark hickory (*Carya ovata* (Miller) K. Koch), red (*Acer rubrum* L.) and silver maple, hackberry, and green ash (Hedge 1997).

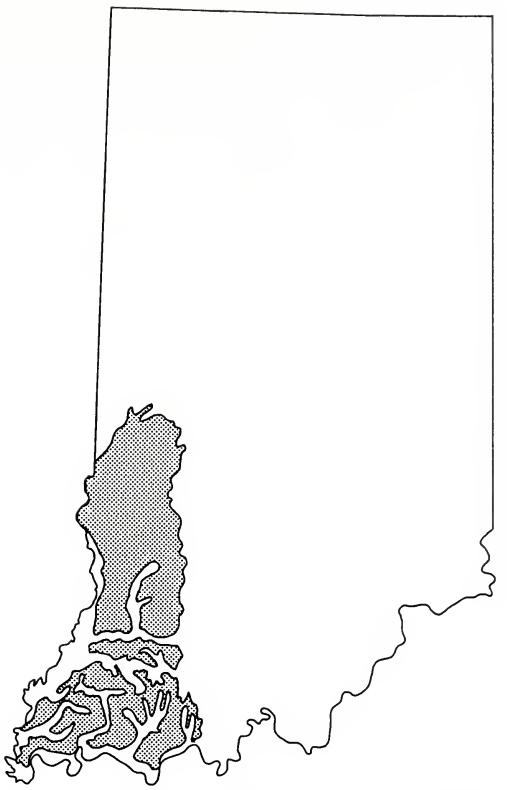

Figure 4.—The Southwestern Lowlands Natural Region of Indiana. (Graphic from *The Natural Heritage of Indiana* 1997).

The southernmost section beyond the reach of glaciation has a mix of forested and non-forested communities, ranging from marsh to seep spring to sandstone cliffs, as topography changes markedly throughout the section. The flatwoods here are different in that a mix of prairie grasses and forbs intermingles with southern bottomland trees such as cherrybark, Shumard's red, swamp white, and pin oaks, along with shellbark hickory, sweet and black (*Nyssa sylvatica* Marshall) gum, and green ash (Hedge 1997).

Largely from Vincennes northward to Terre Haute is a narrow band of scattered sand ridges and dunes formed by aeolian sands that were blown eastward by westerly winds from the poorly-vegetated Wabash River floodplain at the close of the Pleistocene (Petty & Jack-

son 1966). This section had primarily prairie and barrens vegetation along with a scatter of black (*Quercus velutina* Lam.) and blackjack (*Q. marilandica* Muenchh.) oaks. A small remnant of sand prairie is protected at Little Bluestem Prairie Nature Preserve in Vigo County north of Terre Haute (Strait & Jackson 1986). On sites less steep, and with improved soil moisture, oak-hickory forest, dominated by white, red (*Q. rubra* L.), and black oak, along with shagbark and pignut (*Carya glabra* (Miller) Sweet) hickory, was more prevalent (Hedge 1997).

NATURAL AREAS OF THE LOWER WABASH VALLEY THAT CONTAIN REMNANTS OF ORIGINAL VEGETATION

Relatively few high quality remnants of original vegetation have escaped the pervasive clearing and development that has systematically altered the majority of the Indiana landscape during the past two centuries. The highly fertile soils of the Wabash Valley, and the transportation advantages of the river itself, have resulted in greater changes in this region, than those that occurred in some other parts of the State.

Seven natural areas in Indiana, plus one in Illinois are listed below. (Information excerpted largely from INDR Nature Preserves Directory 1995).

1. Ashumbala Nature Preserve (Vanderburgh and Warrick counties): 63 acres (25.5 ha). Contains one of the longest and least-modified stretches of Ohio River Floodplain Forest in Indiana. The trees are mostly silver maple, cottonwood, and black willow, plus green hawthorn and swamp cottonwood also present.
2. Flesher Woods Nature Preserve (Vigo County): 36 acres (14.6 ha). High quality floodplain forest of predominately silver maple, green ash, shellbark hickory, pecan, and bur oak. Probably the least-disturbed floodplain forest in Vigo County.
3. Goose Pond Cypress Slough Nature Preserve (Posey County): 60 acres (24.3 ha). A portion of a three-mile (4.8 km) long cypress slough that contains mostly a bald cypress-green ash-silver maple forest community.
4. Hemmer Woods Nature Preserve (Gibson County): 73 acres (29.6 ha). A Registered National Natural Landmark. Contains both upland oak-hickory forest, plus a very high quality bottomland stand dominated by tulip tree, sweet gum, sycamore, red maple, and elm (Jackson 1969a, b).
5. Little Bluestem Prairie Nature Preserve (Vigo County): 8+ acres (3.3 ha). Likely the only sand prairie remaining in Indiana. Dominated by little bluestem grass (*Schizachyriun scoparium* (Michx.) Nash)), and other herbs, along with a scatter of black oak (Strait & Jackson).
6. Twin Swamps Nature Preserve (Posey County): At 598 acres (242 ha), it is one of Indiana's largest nature preserves, and contains a swamp cottonwood-bald cypress-overcup oak community. The preserve has a boardwalk for visitor enjoyment of the high-quality swamp forest, the herb featherfoil, plus such sought-after birds as prothonotary warblers.
7. Wesselman Woods Nature Preserve (Vanderburgh County): 197 acres (79.8 ha). A Registered National Natural Landmark. This nearly-flat forest of exceptional quality is dominated by sweet gum and tulip tree, along with Shumard's red and pin oak, green ash, and red maple (Lindsey et al. 1969). The preserve has a fine nature center.
8. Beall Woods State Park (Wabash County, Illinois): 280 acres (113.4 ha). This excellent remnant of original forest has both upland and bottomland segregates. The lowland stand, which occurs on both sides of Sugar Creek where it joins the Wabash River, has 31 tree species present, led by Shumard's red and bur oak, sweet gum, American elm, shellbark hickory, and silver maple. Lindsey (1962) listed this stand as having the highest basal area of any midwestern forest then known.

SOUTHWESTERN TREE SPECIES OF SPECIAL INTEREST

(abridged from Jackson 2004)

Bald cypress (*Taxodium distichum* (L.) Rich): Characteristic of deep swamps, sloughs, oxbows, and slough-like creeks, usually with standing water much of the year. Occurred naturally in only five counties of far southwestern Indiana. Now widely planted.

Sweet gum (*Liquidambar styraciflua* L.): Widespread in wet bottomland forests and flatwoods throughout the Lower Wabash River basin from Parke and Vigo counties southward to the Ohio River. Widely planted as an ornamental.

Sugarberry (*Celtis laevigata* Willd.): Often found in swampy woods of low-lying sites, streamsides, and flooded bottomlands from Sullivan Couny south to the Ohio River. Occasional on moist slopes or uplands.

Pecan (*Carya illinoensis* (Wangenh.) K. Koch): Occurs on fertile, moist soils of bottomlands along the Wabash, White, and Ohio rivers, and their tributary streams, from Fountain and Vermillion counties southward in Indiana and adjacent Illinois.

Swamp cottonwood (*Populus heterophylla* L.): Found in deep swamps, low wet woods, and on waterlogged soils in southwestern Indiana from Vigo and Clay counties southward to the Ohio River. Also widely scattered in northern Indiana.

Overcup Oak (*Quercus lyrata* Walter): Occurs on very wet sites on floodplains, and in forested swamps, and sloughs of southwestern Indiana from Sullivan County southward. Very tolerant of extended flooding.

Swamp chestnut oak (*Q. michauxii* Nutt.): Found in low wet woods, and some streambottom forests of far southwestern Indiana, from Knox and Daviess counties south to the Ohio River. Formerly called cow oak by the pioneers.

Cherrybark oak: (*Q. pagoda* Raf.): Mainly in bottomland forests or swamps, and on flats along streams (occasionally on dry sites) of a seven-county area of far southwestern Indiana. Sold as red oak for timber.

Post oak (*Q. stellata* Wangenh.): Usually found on poor soils—from wet, spring-ponded flatwoods to dry woods on steep slopes. Species is ecologically bi-modal, with wet and dry mesic segregates represented. Occurs from Greene County south.

Southern red oak (*Q. falcata* Michx.): Typically on dry, poor upland ridges, but sometimes also in flatwoods and bottomland forests from Knox and Daviess counties southward, in our area of interest. Sold as red oak as timber.

Water locust (*Gleditsia aquatica* Marshall): Known only from Knox, Gibson, and Posey counties in Indiana, and in adjacent Illinois. Occurs only in low swampy woods with roots frequently submerged for several months each year.

Green hawthorn (*Crataegus viridis* L.): Usually occurs in low wet woods, or along stream banks. Known from only five counties in far southwestern Indiana.

Winged elm (*Ulmus alata* Michx.): Occurs typically on dry ridges, bluffs, and in old fields, but occasionally in low woods. Confined to a several county area from Knox and Daviess counties southward in our region of Indiana.

Persimmon (*Diospyros virginiana* L.). Generally widespread in the southern half of Indiana from Vermillion and Parke counties south continuously to the Ohio River. Usually in clearings, old fields, and fence rows; occasionally in more mature forests. Very widely planted.

Pale hickory (*Carya pallida* (Ashe) Engler & Graebner): Rarely encountered and endangered in Indiana and apparently confined (usually) to fine sandy soils of Knox, Daviess, and Posey counties.

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