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Vegetation Survey of Floodplain Forests Along the Wabash River

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Vegetation Survey of Floodplain Forests along the Wabash River

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VEGETATION SURVEY OF FLOODPLAIN FORESTS ALONG THE WABASH RIVER

Introduction

The Wabash River extends for 475 miles from Mercer County, Ohio, to where it joins the Ohio River about halfway between Mt. Vernon, Indiana, and Shawneetown, Illinois. From a point about 15 miles below Terre Haute, Indiana, until it joins the Ohio River, the Wabash River forms the boundary between Illinois and Indiana. This river and its tributaries drain an area of 33,100 square miles, of which 24,218 are in central Indiana, 8,563 in eastern Illinois, and 319 in Ohio (Lindsey et al, 1961). Frequently in late winter and early spring most of the bottomlands are inundated. During periods of dry weather in late summer and early fall the Wabash often lowers with some of its minor tributaries becoming intermittent.

The Wabash River basin was subjected to two major stages of glaciation. The Illinoian ice sheet, which receded about 250,000 years ago, extended southward to the Shawneetown Ridge (Voigt and Mohlenbrock, 1964) covering the entire basin with the exception of some hilly regions in the south. Later, the Wisconsin Glacier, which receded about 11,000 years ago, moved into this basin from the northeast and extended southward and westward to a position along a line from Peoria through Decatur, Shelbyville, Charleston, and Paris in Illinois and Terre Haute,

Greencastle, Martinsville, Columbus, and Greensburg in Indiana.

Approximately 80% of the Wabash River basin has been covered by the Illinoian or Wisconsin Glaciers. A somewhat rough topography over-ridden by enormous ice masses was filled and leveled by the material carried or pushed ahead, forming a plain of glacial construction. This resulted in the deposition of glacial material or till in varying thicknesses, the filling of preglacial drainage systems, and a change in the gradient of many streams. The glacial deposits which average about 100 feet in depth (Wayne, 1956), now form the rich agricultural lands that drain into the Wabash and its tributaries.

The lowland area along the Wabash River below Terre Haute, Indiana, and above Russellville, Illinois, was the area of study. This region is a major portion of the northern half of the Wabash Lowland. It consists of an area of rather level land that is subjected to many floods due to the heavy drainage load of the Wabash River (Voigt and Mohlenbrock, 1964). The characteristically flat floodplain forests may be narrow strips of trees or large wooded areas depending on the location of the more elevated terraces formed by older drainage systems.

At one time the lowland areas along the Wabash River were covered by forests. Presently much of this area has been cleared for agricultural purposes. Many of the remaining lowland forests have been grazed to some extent and nearly all have been subjected to cutting.

Location of Woodlots Investigated

The Wabash River is continually changing course and as a result of the denuding and depositing, a series of plant habitat types are created. The active floodplains which are subjected to this periodic flooding and change are referred to as "first bottoms" by Putnam (1951). Those areas with an almost continous stand of water due to their formation by an abandoned meander are referred to as swamp forests. These active floodplain areas are generally forested and represent a region where flooding is a major controlling environmental factor. Former streams and shallow depressions represent most of the variation in elevation. A hillside or terrace normally represents the end of the floodplain and a natural transition to the more upland forest vegetation.

The areas surveyed for this study are located in the section of the Middle Wabash River Basin that includes Clark and Crawford counties in Illinois and Sullivan County in Indiana. The regions of study ranged from 2.77 to 6.16 acres with a total of 30.5 acres being surveyed. Those wooded areas which represented the most mature and least disturbed forests were chosen and a total of seven forests were surveyed (Figure 1). These areas were:

First Bottom Forests

Area 1. Located 3.5 miles east of Walnut Prairie in the NW¼ SE¼ of Section 2, T9N, R11W, Clark County, Illinois. This area which was surveyed on 26 May, 1971, totaled 6.16 acres,

and was located farther north than any of the other areas.

Area 2. Located 1.5 miles northeast of York in the NE¼ NE¼ of Section 34, T9N, R11W, Clark County, Illinois. This area totaled 4.31 acres and was surveyed on 12 May, 1971.

Area 3. Located between two drainage ditches near their connection to the river about one mile southeast of Palestine in the NW¼ SE¼ of Section 1, T6N, R11W, Crawford County, Illinois. The area totaled 2.77 acres and was surveyed on 5 June, 1971.

Area 4. Located in the NE¼ SW¼ of Section 33, T6N, R10W, Crawford County, Illinois. The area was 2.5 miles northeast of Heathsville between a drainage ditch and the Wabash River, totaled 6.16 acres, and was surveyed on 10 June, 1971.

Area 5. Located within a curve of the river about 2.5 miles southeast of Heathsville in the NE¼ NW¼ of Section 20, T5N, R10W, Crawford County, Illinois. This area was surveyed on 18 June, 1971, totaled 3.70 acres, and was farther south than any of the other forests.

Area 6. Located approximately 3 miles north of Hutsonville in the SE¼ NW¼ of Section 8, T8N, R11W, Crawford County, Illinois. This area totaled 3.70 acres and was surveyed on 9 June, 1972.

Area 7. Located in the NE¼ NE¼ of Section 1, T7N, R11W, Sullivan County, Indiana. This forest was approximately 1.5 miles north of Merom, Indiana, and 0.5 miles east of the Wabash River. The area totaled 3.70 acres and was surveyed on 23 June, 1972.

Method of Study

The woodlots were divided into 25 meter square quadrats and the number, size, and species of trees above 4 inches diameter at breast height (d.b.h.) were recorded for each. All the living and dead-standing trees were identified and measured to the nearest 1/10 of an inch. The dead-downed trees were not recorded since they could have been carried in during periods of flooding. Relative density, relative dominance, relative frequency, and Importance Value (McIntosh, 1957) were calculated from the data to provide a basis for comparison of the various species and areas. The Importance Value (IV) is the sum of the relative density, relative dominance, and relative frequency.

$$\text{Relative density} = \frac{\text{number of individuals of a species}}{\text{number of individuals of all species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{basal area of a species}}{\text{basal area of all species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{number of plots of occurrence of a species}}{\text{total plots of occurrence of all species}} \times 100$$

Comparison of the species was made by recording the number of saplings (1 to 4 inches d.b.h.), the number of seedlings over two feet but less than one inch in diameter, and the number of seedlings under two feet in the areas surveyed. The number of seedlings over two feet and the number of saplings were determined by making a total count of the number present in the quadrats. A hoop 1/4 of a meter in size was randomly thrown twice in each

quadrat to determine the abundance of seedlings under two feet. First year seedlings were not included in this count.

Herbaceous species growing in the study areas were collected and identified and deposited in the Eastern Illinois University Herbarium. The abundance of these species was determined by using a modification of the procedure used by Acocks (1953). An average distance between the individuals of the same species was estimated by measuring and observing the distance between plants and the abundance of each species was determined by comparing this distance with the following scale:

Average Distance between Plants	Abundance Category
3 in. - 1 ft.	abundant
1 ft. - 3 ft.	common
3 ft. - 12 ft.	frequent
12 ft. - 50 ft.	occasional
50 ft.	rare

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

Results and Discussion

A rather complete study of the vegetation and environment of the Wabash River was done by Lindsey, Petty, Sterling, and VanAsdall (1961). Their results showed Salix nigra, Acer saccharinum, Ulmus americana, and Populus deltoides to be the more important species of the first bottom stands. Fraxinus

lanceolata, Acer negundo, Celtis occidentalis, Platanus occidentalis, and Gleditsia triacanthos were also mentioned as being found in the first bottoms but were of lesser importance. In their study, which included vegetation and environment of the Wabash and Tippecanoe Rivers, they were concerned with hydrogeology and edaphic conditions, habitats near the river level, effects of flooding, 56 forest stands at various terrace levels, climatic factors, and species range limits. Their paper was somewhat generalized to include this much material while this paper is a complete study limited to the first bottom forests and swamp forests of the Wabash River.

According to Crites and Ebinger (1969) Acer saccharinum, Populus deltoides, Acer negundo, Salix nigra, Ulmus rubra, Platanus occidentalis, and Fraxinus americana were found to be the most important species along the Embarrass River in east-central Illinois. (These results were similar to those of this study) except for the presence of Fraxinus americana and Ulmus rubra and the high IV of Acer negundo. Fraxinus lanceolata and Ulmus americana were found in the first bottoms along the Wabash River but not Fraxinus americana and Ulmus rubra. In most instances Acer negundo had an IV above 50 in the Embarrass floodplains but it only averaged an IV of 12.8 along the Wabash.

The study of swamps along the Wabash River is limited to the paper by Lindsey, Sterling, Petty, and VanAsdall (1961). They discuss the cypress swamps below Mt. Carmel, Illinois, and above the Ohio River. The more important trees in these areas

were Taxodium distichum, Acer saccharinum, Fraxinus lanceolata, Carya illinoensis, Betula nigra, and Salix nigra.

First Bottom Forests

A total of thirteen woody species were recorded in the five first bottom forests studied. Of this total, Acer saccharinum and Populus deltoides were the most important. Fraxinus lanceolata and Acer negundo were next in importance followed by Ulmus americana, Salix nigra, Carya illinoensis, and Carya laciniosa. These eight species with their relative values, number of trees and basal area per acre by diameter class, total number of trees and basal area per acre, and average diameter in inches were recorded in Table 1. The remaining species found in the first bottom forests but of little importance were Morus rubra, Celtis occidentalis, Platanus occidentalis, Juglans nigra, and Catalpa speciosa. These trees were listed as "others" in the tables because of their low IV. The average number of seedlings less than two feet, seedlings over two feet, and saplings per acre in these forests were recorded in Table 3.

Acer saccharinum had the greatest IV in all the first bottom forests and usually the relative frequency, relative density, and relative dominance of this tree was the highest. This species always had a relative density of 68.5 or higher and comprised 47% or more of the total IV of the areas (IV of 141 or greater). It was usually represented in all diameter classes even though the average diameter was usually lower than that of the other trees.

Due to the frequent cutting of the floodplain forests, this tree showed coppice growth with many of the trees having 2-6 main stems. The saplings of Acer saccharinum were usually more frequent than other saplings, and seedlings of this species were also quite abundant. Seedlings of Acer saccharinum under two feet in height were very common and were scattered throughout the entire floodplain woods. Larger seedlings were also common but normally seedlings of Ulmus americana over two feet in height were more common.

Populus deltoides ranked second in IV in most of the first bottom forests due to the age and location of the areas studied. Those areas nearer the river contained more trees of this species. As one moved farther from the river there was a gradual decline in the IV of this species and an increase in the importance of other trees such as Acer saccharinum. In the areas surveyed Populus deltoides had an average diameter that was greater than that of most of the other tree species with the majority being in the 13-24 inch diameter class. It had a low relative density in comparison to the relative frequency and relative dominance and ranked second in IV in Areas 1, 2, and 4 and third in Area 5. Area 3 was lacking Populus deltoides. This was probably due to the fact that this area was located farther from the river than the other first bottom forests. The only saplings or seedlings of this species observed were growing near the river bank where there were fewer tall trees and more sunlight. Nearly all the surviving trees of this species were as tall or

taller than the surrounding trees due to this species lack of shade tolerance. This fact was made more obvious by the total absence of any saplings or seedlings within the surveyed forests.

Salix nigra ranked third in IV in Areas 1, 2, and 4 and sixth in Area 3 but was absent in Area 5. The IV of this tree and Populus deltoides can be used to determine the age or successional development of the stands. On the newly developed first bottom stands such as Areas 1, 2, and 4 there were more Salix nigra and Populus deltoides present and on the areas farther from the Wabash River there was a shift toward species which were less water tolerant and more shade tolerant. The unimportance of Salix nigra and the lack of Populus deltoides in Area 5 shows that this stand is gradually shifting from first bottoms to the less frequently flooded second bottoms. Salix nigra was normally found growing near the river. Only the tall trees of this species were able to survive within the wooded areas and no saplings or seedlings were found. Saplings and seedlings of Salix nigra were only observed near the river growing in association with Salix interior which was common along the banks of the Wabash River.

Fraxinus lanceolata ranked second in IV in Area 3 and fourth in Area 4 but was absent or of little importance in the other first bottom areas surveyed. This species made up around 17% of the total IV of Area 3 with the largest number of these trees being in the 7-12 inch diameter class. This area was not as flat

as most of the other first bottom areas. A gradual hillside or terrace was near one side of this stand and a depression possibly caused by a former stream was in one corner. This variation in elevation possibly increased the importance of Fraxinus lanceolata and other species such as Ulmus americana, Carya illinoensis, and Carya laciniosa. Saplings and seedlings of Fraxinus lanceolata were uncommon except in Area 3. This species comprised approximately 30% of the total number of seedlings under two feet and 65% of the seedlings over two feet in Area 3. The trees and the saplings and seedlings of Fraxinus lanceolata did not seem to be associated with any special regions but were found scattered throughout the forest.

Acer negundo ranked second in IV in Area 5 and fourth in Areas 1 and 2 but was absent in Areas 3 and 4. Most of the trees of this species were in the 7-12 inch diameter class and they made up 13% of the total IV of Area 5 due to their high relative frequency. Since trees that grow in the first bottoms along the Wabash are subjected to extensive damage during flooding and frequent fluctuations in stream flow, the numbers of those trees frequently found in floodplains but not capable of withstanding the excess flooding and saturated soil may be limited in number (Lindsey et al, 1961). This may explain why very few saplings or seedlings of Acer negundo were found in the first bottom forests.

Ulmus americana ranked third in Area 3 and fourth in Area 5 but was absent or of little importance in the other first

bottom areas. As a tree this species was of little importance in the first bottoms but seedlings over two feet were abundant in all the stands with an average of 51 per acre. Saplings of Ulmus americana averaged approximately 10 per acre ranking second only to Acer saccharinum. The majority of the Ulmus americana were in the 4-6 inch diameter class and this lack of larger trees shows doubt there will ever be a succession to this species. Phloem necrosis and Dutch Elm disease would also continue to limit its importance in the first bottom forests.

The remaining species were uncommon and of little importance in any of the first bottom forests. Carya illinoensis and Carya laciniosa did rank fourth and fifth in IV in Area 3 but were absent in the other first bottom areas. These two trees as well as Celtis occidentalis, Morus rubra, Juglans nigra, Platanus occidentalis, and Catalpa speciosa were often associated with drier areas such as the second bottom forests. Celtis occidentalis and Morus rubra were of some importance because of the numbers of their seedlings over two feet found in first bottom stands. A few saplings of these species were found but none of the areas surveyed showed the trees to be of much importance.

The first bottom forests surveyed contained 4,267 living trees and 376 dead ones for a total of 4,643 trees. There was a total of 3,906 Acer saccharinum with 298 being dead-standing trees. Of the 556 Populus deltoides 38 were dead, as were 25 of the 41 Salix nigra. Ten of the 65 Fraxinus lanceolata and and 3 of the 27 Ulmus americana were dead-standing trees. There

were 45 Acer negundo and 3 Carya laciniosa with each having only one dead-standing tree present in the 23.1 acres of first bottom forests surveyed. An average of 69.9% dead-standing Salix nigra and only 7.6% dead-standing Acer saccharinum shows the succession from those shade intolerant species usually found near the river bank to the more shade tolerant species frequently found in the first bottom stands.

Woody vines were quite abundant in the floodplains and a number of shrubs were also of importance. The shrubs included Sambucus canadensis, Cephalanthus occidentalis, Forestiera acuminata, and Rhus radicans while the common vines were Menispermum canadense and Smilax hispida. On more open sites were found vines of Campsis radicans, Vitis aestivalis, Vitis cinerea, Vitis riparia, Parthenocissus quinquefolia, and Celastrus scandens. A common shrub that aided in the deposition of silt and debris along the Wabash River and the eventual development of the first bottom forests was Salix interior.

The most important herbaceous species of the first bottom forests included Leersia virginica, Boehmeria cylindrica, and Laportea canadensis. Leersia virginica covered most all regions and was usually associated with patches or large stands of Boehmeria cylindrica or Laportea canadensis. Plants such as Aster ontarionis and Sicyos angulatus were seen scattered throughout the forests and stands of Pilea pumila, Tradescantia subaspera, or Saururus cernuus were normally growing in the moist regions. Most other herbaceous plants were rare and could

only be found by careful observation of the open areas or drier regions of the surveyed forests.

Swamp Forests

A total of nine woody species were recorded in the two swamp forests surveyed. Of this total, Acer saccharinum and Fraxinus lanceolata were the most important. Populus deltoides and Quercus bicolor were next in importance followed by Carya illinoensis and Betula nigra. The remaining species found in the swamp forests but of little importance were Ulmus americana, Quercus palustris, and Gleditsia triacanthos. These nine species with their relative values, number of trees and basal area per acre by diameter class, total number of trees and basal area per acre, and average diameter in inches were recorded in Table 2. The average number of seedlings less than two feet, seedlings over two feet, and saplings per acre were recorded in Table 4.

Acer saccharinum and Fraxinus lanceolata made up over 70% of the total IV of both swamp forests (Areas 6 & 7). Acer saccharinum was the most important species with 52.5% of the total IV in Area 6 and 56.8% in Area 7. Due to its high relative frequency, Fraxinus lanceolata made up 19.8% of the total IV in Area 6 and 26.3% in Area 7. A buttress base was an obvious characteristic of this species in the swamp forests. The number of seedlings and saplings of these two species shows that they will continue to be the most important species.

Populus deltoides ranked third in IV in Area 6 and Quercus bicolor ranked third in Area 7. Neither of these two species

were of much importance in the other swamp forest. The lack of any seedlings or saplings or smaller trees of Populus deltoides showed this tree would eventually be of little importance while this did not seem to be true with Quercus bicolor.

Carya illinoensis and Betula nigra were next in importance in the swamp forests with most of the trees of both species being in the 7-12 or 13-24 inch diameter classes. Carya illinoensis was found scattered through both swamp forests while Betula nigra was only in Area 6. Neither of these two trees were well represented by sapling or seedling growth.

The swamp forests contained 989 living trees and 87 dead ones for a total of 1076 trees. Approximately 8.7% of the Acer saccharinum, 8.9% of the Populus deltoides, and 10.2% of the Fraxinus lanceolata were dead-standing trees. In contrast to the low percentage of death in these three species, a total of 20.0% of the Betula nigra and 28.5% of the Ulmus americana were dead-standing trees.

Woody vines and shrubs were quite abundant in the swamp forests. The most important shrubs were Cephalanthus occidentalis, Forestiera acuminata, and Rhus radicans. Cephalanthus occidentalis was the most important shrub with an average of 274.9 per acre found scattered throughout the forest. Forestiera acuminata normally grew in the wet areas of the forest and Rhus radicans in the drier areas. Rhus radicans was often found growing as a vine on many of the trees. Other vines within the swamp forests were Menispermum canadense and Campsis radicans.

The number of herbaceous plant species was limited in the swamp woods by the extremely wet conditions. The most abundant herbaceous plant was Pilea pumila. Others usually found in these forests were Saururus cernuus, Leersia virginica, and Boehmeria cylindrica.

Summary

This paper presents an ecological study of the floodplain forests within the Wabash River system. Woody and herbaceous vegetation surveys were made of five first bottom forests totaling 23.1 acres and two swamp forests totaling 7.4 acres. A comparison was made of the plants that would grow in these regions including the trees, shrubs, woody vines, and herbs.

Acer saccharinum, Populus deltoides, Fraxinus lanceolata, Acer negundo, Ulmus americana, and Salix nigra were found to be of most importance in the first bottoms. The sapling and seedling growth of these trees showed the first bottom forests were becoming drier. As Acer saccharinum, Fraxinus lanceolata, Acer negundo, and Ulmus americana were reproducing within the first bottoms, the water tolerant pioneer species such as Salix nigra and Populus deltoides were no longer producing seedlings within the forests.

Acer saccharinum, Fraxinus lanceolata, Populus deltoides, Quercus bicolor, Carya illinoensis, and Betula nigra were the most important trees of the swamp forests. Sapling and seedling growth showed that Acer saccharinum and Fraxinus lanceolata would remain the most important species unless the environmental conditions change and these areas become drier.

Major factors controlling growth of the shrubs, woody vines, and herbaceous plants were the tolerance of the plants to shade and excess water. Within the first bottom forests were shrubs of Sambucus canadensis and Cephalanthus occidentalis, vines of Menispermum canadense and Smilax hispida, and herbaceous plants such as Leersia virginica and Boehmeria cylindrica. Others that were found were usually growing in open areas or near the edges of the woods. Within the swamp forests were shrubs of Cephalanthus occidentalis and Forestiera acuminata, vines of Menispermum canadense and Campsis radicans, and herbaceous plants such as Pilea pumila and Saururus cernuus. Others that were found were usually growing in the drier regions.

Annotated Checklist of Herbaceous Plants Collected from the Bottomland Forests of the Wabash River

This list includes the herbaceous plants most often observed during the surveying of the seven floodplain forests. In this list are 66 herbaceous plants including 56 dicots and 10 monocots. The general distribution, occurrence, and collecting number follow each species. All specimens were collected by P. Phillippe and are deposited in the herbarium at Eastern Illinois University.

Acanthaceae

Dianthera americana L. - Moist, open areas; rare. #252

Ruellia strepens L. - Openings in Areas One and Three; rare. #222

Amaranthaceae

Iresine rhizomatosa Standl. - Openings in Area Three; rare. #332

Araceae

Arisaema dracontium (L.) Schott. - Drier, shaded regions; rare. #197

Balsaminaceae

Impatiens biflora Walt. - Scattered throughout Areas One and Three; occasional. #261

Impatiens pallida Nutt. - Found in Area Three; rare. #260

Campanulaceae

Campanula americana L. - Drier, open areas; rare. #259

Chenopodiaceae

Chenopodium album L. - Least shaded areas; rare. #366

Commelinaceae

Commelina communis L. - Small colonies in shaded areas; rare. #322

Tradescantia subaspera Ker. - Moist, shaded areas; locally abundant. #325

Compositae

Ambrosia trifida L. - Open areas; locally common. #296

Aster ontarionis Wieg. - Throughout the first bottom forests; frequent to locally common. #340

Aster simplex Willd. - In the more open areas; rare. #330

Erigeron annuus (L.) Pers. - Open regions in Areas One and Three; rare. #397

Eupatorium rugosum Houtt. - Drier, less shaded locations; rare. #339

Rudbeckia laciniata L. - Open areas of the first bottom forests; rare. #328

Senecio glabellus Poir. - Scattered through most of the surveyed forests; occasional. #229

Verbesina alternifolia (L.) Britt. - Drier regions of Area Three; rare. #343

Vernonia altissima Nutt. - Scattered through Area Three; rare. #326

Convolvulaceae

Cuscuta gronovii Willd. - Parasite on various plants in Areas Three and Six; rare. #265

Ipomoea pandurata (L.) G.F.W. Mey. - Open areas; rare. #281

Ipomoea purpurea (L.) Roth. - Drier, open areas; rare. #323

Cruciferae

Iodanthus pinnatifidus (Michx.) Steud. - Scattered through first bottom forests; rare. #192

Rorippa islandica (Oeder) Borbas. - In open areas; rare. #216

Rorippa sessiliflora (Nutt.) Hitchc. - Openings in Areas One and Three; rare. #396

Cucurbitaceae

Sicyos angulatus L. - Scattered through shaded areas; occasional to locally abundant. #275

Cyperaceae

Carex grayii Carey. - Lower, wet areas; rare. #262

Gramineae

Cinna arundinacea L. - In the more open areas; rare. #344

Elymus virginicus L. - Scattered through the first bottom woods; rare. #239

Leersia lenticularis Michx. - Growing in the more swampy regions; rare. #320

Leersia virginica Willd. - Throughout the bottomland forests; abundant. #274

Muhlenbergia frondosa (Poir.) Fern - Drier, open areas; rare. #368

Iridaceae

Iris shrevei Small. - One small colony in open region of Area Two; rare. #225

Labiatae

Glecoma hederacea L. - Open areas; rare. #308

Lycopus virginicus L. - Usually in wet, open areas; rare. #309

Physostegia speciosa Sweet. - Open areas; rare. #336

Scutellaria lateriflora L. - Mostly in the open, drier areas; rare. #334

Stachys tenuifolia Willd. - Scattered through most of the forests; rare. #246

Teucrium canadense L. - Open areas; rare. #263

Onagraceae

Circaea latifolia Hill. - Moist, shaded areas; rare. #284

Oxalidaceae

Oxalis stricta L. - Openings of Area Three; rare. #227

Phytolaccaceae

Phytolacca americana L. - In the least shaded areas; rare. #279

Polygonaceae

Polygonum hydropiper L. - Scattered through most of the floodplain forests; rare. #317

Polygonum pensylvanicum L. - Moist ground of open areas; rare. #256

Polygonum scandens L. - Openings in the floodplain woods; rare. #342

Polygonum virginianum L. - Scattered through most of the surveyed areas; rare. #321.

Rumex altissimus Wood. - More open regions; rare. #198

Rumex crispus L. - More open regions; rare. #233

Rumex verticillatus L. - Wet areas; rare. #401

Primulaceae

Lysimachia ciliata L. - Open, drier areas; rare. #232

Lysimachia nummularia L. - Patches in wet areas; rare. #226

Ranunculaceae

Ranunculus abortivus L. - Scattered through wet, shaded areas; rare. #203

Ranunculus septentrionalis Poir. - Scattered through wet, shaded areas; rare. #351

Rosaceae

Geum canadense Jacq. - Drier, more open regions; rare. #244

Rubiaceae

Galium aparine L. - By openings or near edges of the surveyed woods; rare. #191

Saururaceae

Saururus cernuus L. - Lower, wet areas; locally abundant. #235

Scrophulariaceae

Chelone obliqua L. - Drier regions of Area Three; rare. #341

Mimulus ringens L. - In shaded, moist areas; rare. #337

Solanaceae

Physalis subglabrata Mack. & Bush. - Found only on moist soil of Area Six; rare. #290

Solanum nigrum L. - Open areas; rare. #269

Umbelliferae

Cryptotaenia canadensis (L.) DC. - Scattered throughout the forests; rare. #202

Sanicula gregaria Bickn. - Scattered through the first bottom forests; rare. Observed

Urticaceae

Boehmeria cylindrica (L.) Sw. - Scattered through most areas; abundant to locally common. #236

Laportea canadensis (L.) Gaud. - Found throughout most floodplain areas; common to locally abundant. #324

Pilea pumila (L.) A. Gray. - In the moist areas of the floodplain forests; frequent to locally abundant. Observed

Urtica gracilis Ait. - Scattered through the first bottom forests; rare. Observed

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Figure 1.— Map showing the location of the surveyed forests along the Wabash River. The numbers represent the forest areas that were surveyed. One inch equals approximately eight miles.

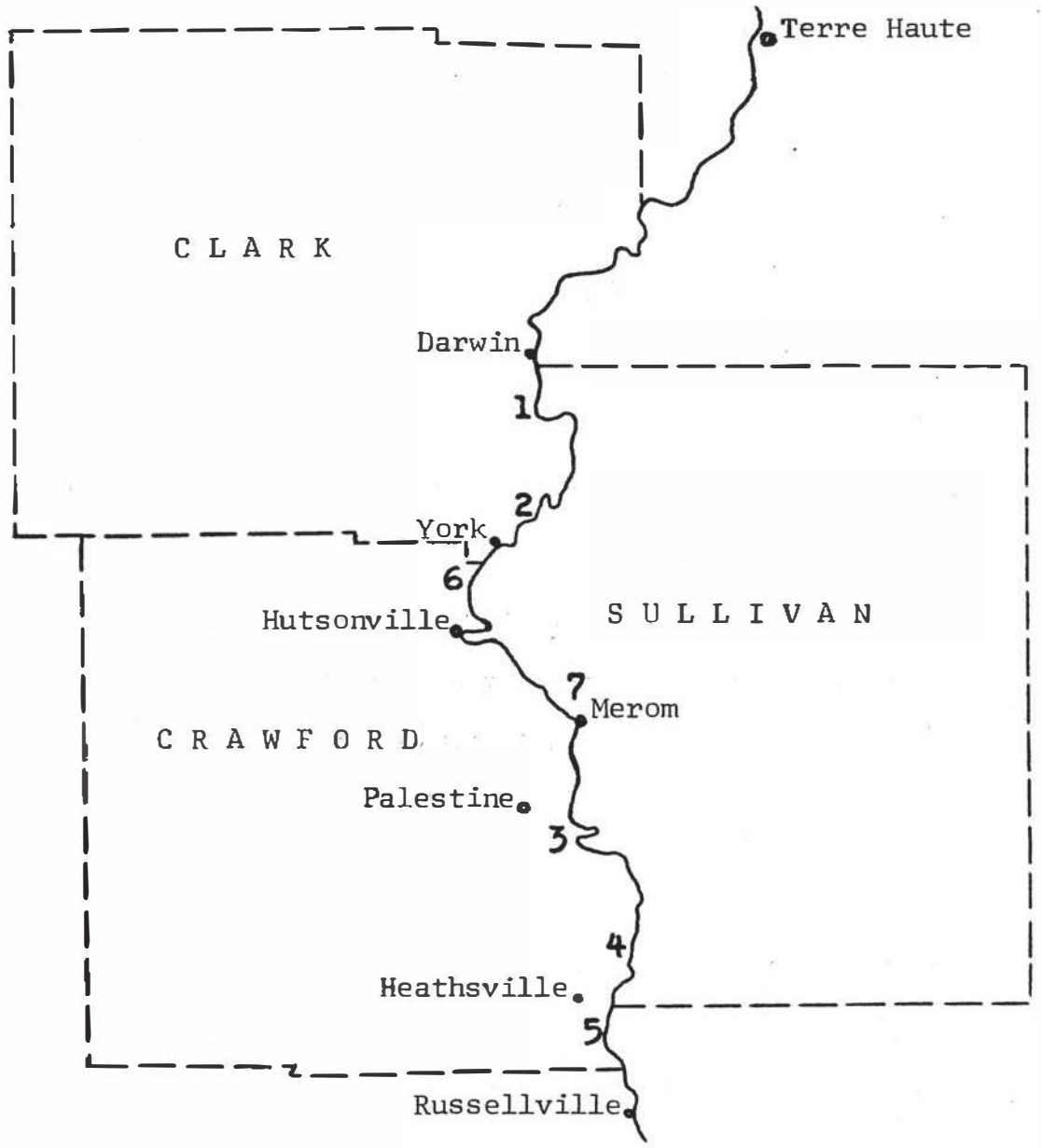

Table 1.—Number of Trees, Basal Area Per Acre, Relative Values, and Average Diameters for the Woody Vegetation of the First Bottom Forests Surveyed along the Wabash River.

Species by Area	Number of Trees and Basal Area Per Acre by Diameter Class										Relative Values				Av. Diam. in.
	4-6		7-12		13-24		25+		Total						
	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.	Rel. Freq.	Rel. Den.	Rel. Dom.	I.V.	
Area 1 (Sect. 2 T9N R11W)															
Acer saccharinum.....	46.9	7.6	77.4	39.9	14.8	18.5	...	...	139.1	66.0	50.0	81.4	53.1	184.5	8.7
Populus deltoides.....	....	...	5.5	3.5	23.7	48.0	1.1	5.0	30.3	56.5	40.0	17.8	45.5	103.3	17.9
Salix nigra.....	....	...	0.2	0.1	0.5	0.9	...	...	0.7	1.0	5.0	0.4	0.8	6.2	16.7
Acer negundo.....	....	...	0.5	0.2	0.2	0.5	...	...	0.7	0.7	5.0	0.4	0.6	6.0	13.2
Totals.....	46.9	7.6	83.6	43.7	39.2	67.9	1.1	5.0	170.8	124.2	100.0	100.0	100.0	300.0	....
Area 2 (Sect. 34 T9N R11W)															
Acer saccharinum.....	74.0	12.8	78.4	35.4	8.8	10.4	...	...	161.2	58.6	38.4	68.7	36.0	143.1	7.7
Populus deltoides.....	0.7	0.1	16.7	11.1	48.2	81.1	1.9	7.8	67.5	100.1	37.0	28.7	61.5	127.2	15.9
Salix nigra.....	...	...	....	....	2.1	3.2	...	...	2.1	3.2	6.8	0.9	2.0	9.7	16.4
Acer negundo.....	0.2	...	0.2	0.1	...	...	...	...	0.4	0.1	2.7	0.2	0.1	3.0	7.7
Others.....	2.1	0.4	1.4	0.5	...	...	...	...	3.5	0.9	15.1	1.5	0.4	17.0	...
Totals.....	77.0	13.3	96.7	47.1	59.1	94.7	1.9	7.8	234.7	162.9	100.0	100.0	100.0	300.0	...
Area 3 (Sect. 1 T6N R11W)															
Acer saccharinum.....	12.6	2.2	97.8	59.2	55.6	74.4	...	...	166.0	135.8	40.9	86.0	85.0	211.9	11.8
Fraxinus lanceolata...	4.3	0.9	8.7	4.9	5.1	8.3	0.4	1.8	18.5	15.9	31.8	9.5	10.0	51.3	11.5
Ulmus americana.....	4.0	0.7	1.4	0.9	1.4	2.0	...	...	6.8	3.6	18.2	3.5	2.2	23.9	8.7
Carya illinoensis.....	...	...	0.4	0.2	...	...	0.4	1.7	0.8	1.9	4.5	0.4	1.2	6.1	20.0
Carya laciniosa.....	...	...	...	...	0.4	0.6	0.4	1.4	0.8	2.0	2.3	0.4	1.3	4.0	22.3
Salix nigra.....	...	...	...	...	0.4	0.6	...	...	0.4	0.6	2.3	0.2	0.3	2.8	16.9
Totals.....	20.9	3.8	108.3	65.2	62.9	85.9	1.2	4.9	193.3	159.8	100.0	100.0	100.0	300.0	....

Table 1.— (Continued)

Species by Area	Number of Trees and Basal Area Per Acre by Diameter Class										Relative Values				Av. Diam. in.
	4-6		7-12		13-24		25+		Total						
	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A	No.	B.A.	Rel. Freq.	Rel. Den.	Rel. Dom.	I.V.	
Area 4 (Sect. 33 T6N R10W)															
Acer saccharinum.....	30.7	5.3	100.8	58.7	57.8	77.7	1.6	9.0	190.9	150.7	75.4	97.1	93.3	265.8	11.3
Populus deltoides.....	....	...	0.3	0.2	4.4	9.2	0.2	0.6	4.9	10.0	17.0	2.5	6.2	25.7	19.0
Salix nigra.....	....	...	...	...	0.3	0.6	...	...	0.3	0.6	3.8	0.2	0.4	4.4	18.2
Fraxinus lanceolata...	....	...	0.5	0.2	...	...	...	...	0.5	0.2	3.8	0.2	0.1	4.1	9.5
Totals.....	30.7	5.3	101.6	59.1	62.5	87.5	1.8	9.6	196.6	161.5	100.0	100.0	100.0	300.0	....
Area 5 (Sect. 20 T5N R10W)															
Acer saccharinum.....	16.2	2.8	52.2	30.1	43.3	61.1	1.9	9.3	113.6	103.3	48.0	88.5	89.5	226.0	12.0
Acer negundo.....	3.2	0.5	4.9	2.6	2.2	2.5	...	...	10.3	5.6	28.0	8.0	4.8	40.8	9.3
Populus deltoides.....	...	...	...	...	2.7	5.5	...	...	2.7	5.5	12.0	2.1	4.8	18.9	19.3
Ulmus americana.....	0.3	...	0.5	0.3	...	...	...	...	0.8	0.3	6.0	0.6	0.3	6.9	8.5
Others	0.3	...	0.6	0.2	0.3	0.4	...	...	1.2	0.6	6.0	0.8	0.6	7.4	...
Totals	20.0	3.3	58.2	33.2	48.5	69.5	1.9	9.3	128.6	115.3	100.0	100.0	100.0	300.0	...

Table 2.—Number of Trees, Basal Area Per Acre, Relative Values, and Average Diameters for the Woody Vegetation of the Swamp Forests Surveyed along the Wabash River.

Species by Area	Number of Trees and Basal Area Per Acre by Diameter Class										Relative Values				Av. Diam. in.
	4-6		7-12		13-24		25+		Total						
	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.	Rel. Freq	Rel. Den.	Rel. Dom.	I.V.	
Area 6 (Sect. 8 T8N R11W)															
Acer saccharinum.....	43.6	7.4	63.9	32.1	21.4	33.3	0.8	3.9	129.7	76.7	33.3	70.2	54.1	157.6	9.5
Fraxinus lanceolata....	12.7	2.2	16.5	8.9	3.8	4.4	...	...	33.0	15.5	30.6	17.9	11.0	59.5	8.7
Populus deltoides.....	....	...	0.8	0.6	8.1	16.8	4.9	23.3	13.8	40.7	22.2	7.5	28.7	58.4	22.4
Betula nigra.....	0.3	0.1	3.0	1.8	3.2	4.3	...	....	6.5	6.2	8.3	3.6	4.3	16.2	12.7
Carya illinoensis.....	...	...	0.5	0.2	0.5	0.8	...	....	1.0	1.0	2.8	0.6	0.8	4.2	13.0
Quercus palustris.....	...	...	...	...	...	...	0.3	1.4	0.3	1.4	1.4	0.1	1.0	2.5	31.1
Gleditsia triacanthos..	...	...	0.3	0.2	...	...	...	...	0.3	0.2	1.4	0.1	0.1	1.6	11.0
Totals.....	56.6	9.7	85.0	43.8	37.0	59.6	6.0	28.6	184.6	141.7	100.0	100.0	100.0	300.0	....
Area 7 (Sect. 1 T7N R11W)															
Acer saccharinum.....	0.8	0.1	10.0	6.8	34.9	65.3	5.7	32.8	51.4	105.0	35.9	61.9	72.5	170.3	18.2
Fraxinus lanceolata....	1.9	0.3	5.1	2.6	14.6	25.9	...	....	21.6	28.8	32.8	26.1	19.9	78.8	14.8
Quercus bicolor.....	1.6	0.3	2.2	0.9	1.4	2.8	0.8	2.8	6.0	6.8	15.6	7.2	4.8	27.6	12.7
Carya illinoensis.....	...	...	0.8	0.4	1.6	2.5	...	...	2.4	2.9	7.8	2.9	2.0	12.7	14.0
Ulmus americana.....	0.8	0.1	0.3	0.2	0.3	0.5	...	...	1.4	0.8	6.3	1.6	0.4	8.3	8.4
Populus deltoides.....	...	...	...	...	0.3	0.6	...	...	0.3	0.6	1.6	0.3	0.4	2.3	20.6
Totals.....	5.1	0.8	18.4	10.9	53.1	97.6	6.5	35.6	83.1	144.9	100.0	100.0	100.0	300.0	....

Table 3.—Average Number of Seedlings and Saplings Per Acre in the Five Floodplain Forests Studied, and the Average Per Acre for All Areas Combined.

Species	Average Number of Seedlings Per Acre (<2′)						Average Number of Seedlings Per Acre (>2′ but<1″ d.b.h.)						Average Number of Saplings Per Acre (1-4″ d.b.h.)					
	Area 1	Area 2	Area 3	Area 4	Area 5	Av. All Areas	Area 1	Area 2	Area 3	Area 4	Area 5	Av. All Areas	Area 1	Area 2	Area 3	Area 4	Area 5	Av. All Areas
Acer saccharinum.	31,768	27,753	8,547	18,008	672	17,350	58.1	25.5	12.3	2.9	10.3	21.8	69.2	31.3	4.0	4.5	8.4	23.5
Ulmus americana...	.....	575	.....	.....	....	115	78.2	32.0	119.1	11.5	14.3	51.0	16.4	1.4	7.2	1.3	21.1	9.5
Morus rubra.....	.....	.....	.....	.....	....	.....	11.7	0.9	7.9	1.5	5.9	5.6	8.1	2.6	....	....	5.4	3.2
Celtis occidentalis	.....	.....	.....	.....	....	.....	7.0	7.0	114.8	3.6	8.1	28.1	0.3	0.2	1.4	....	3.0	1.0
Acer negundo.....	.....	.....	.....	.....	....	.....	.....	....	1.1	0.2	3.0	0.9	....	0.2	....	....	2.2	0.5
Fraxinus lanceolata..	.....	.....	3,148	.....	....	630	0.5	....	480.5	....	....	96.2	0.3	....	0.4	....	....	0.1
Others.....	.....	.....	.....	.....	....	.....	0.6	1.2	17.7	7.1	1.4	5.6	....	0.2	3.2	1.3	0.8	1.1
Totals.	31,768	28,328	11,695	18,008	672	18,095	156.1	66.6	753.4	26.8	43.0	209.2	94.3	35.9	16.2	7.1	40.9	38.9

Table 4.—Average Number of Seedlings and Saplings Per Acre in The Two Swamp Forests Studied, and The Average Per Acre for All Areas Combined.

Species	Average Number of Seedlings Per Acre (<2′)			Average Number of Seedlings Per Acre (>2′ but <1″ d.b.h.)			Average Number of Saplings Per Acre (1-4″ d.b.h.)		
	Area 6	Area 7	Av. All Areas	Area 6	Area 7	Av. All Areas	Area 6	Area 7	Av. All Areas
Acer saccharinum	45,864	3,372	24,618	71.7	167.5	119.6	11.4	51.1	31.3
Fraxinus lanceolata	3,372	7,756	5,564	266.0	18.9	142.5	3.0	0.3	1.7
Ulmus americana	.....	674	337	1.4	82.3	41.9	.....	18.4	9.2
Celtis occidentalis	.....	.....	.....	14.9	16.8	15.9	0.3	0.3	0.3
Carya illinoensis	.....	337	168	.....	1.4	0.7	.....	.....	.....
Quercus bicolor	.....	.....	.....	.....	0.5	0.3	.....	.....	.....
Betula nigra	.....	.....	.....	1.9	.....	1.0	.....	.....	.....
Populus deltoides	.....	.....	.....	.....	.....	.....	0.3	.....	0.2
Salix nigra	.....	.....	.....	.....	0.3	0.2	.....	.....	.....
Morus rubra	.....	.....	.....	1.4	.....	0.7	.....	.....	.....
Cephalanthus occidentalis	.....	.....	.....	128.5	274.9	201.7	.....	.....	.....
Foresteria acuminata	.....	.....	.....	34.6	0.5	17.6	0.3	0.8	0.6
Totals	49,236	12,139	30,687	520.4	563.1	542.1	15.3	70.9	43.3