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A Study of Four River Birch Stands in Mason and Cass Counties, Illinois

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ABSTRACT

Four stands of *Betula nigra* L. (river birch) were surveyed in Mason and Cass Counties, Illinois. River birch was the dominant overstory species in each of the study areas, accounting for 83% to 92% of the basal area and 75% to 87% of the overstory individuals. Other species encountered included black oak, black cherry, black hickory, silver maple, American elm, sassafras and green ash. All sites studied were in shallow depressions underlain by acidic, sandy soils.

INTRODUCTION

Betula nigra (river birch) is a common woody species in eastern United States, occurring from southeastern New York, south to northwest Florida, and west to northeast Texas, Oklahoma, Missouri, Iowa, and Wisconsin (Little, 1971). Cribben and Ungar (1974) report that river birch forests are frequent along smaller streams and in poorly drained areas as far north as southeastern Ohio. They also found that its distribution is closely related to acid mine drainage into streams in these unglaciated areas. Braun (1943) states that river birch occur on more acid soils of Kentucky.

In Illinois, river birch occurs commonly in the southern, central and western parts of the state with very few collections from within the area of Wisconsin glaciation (Mohlenbrock and Ladd, 1978). In southern Illinois, Voight and Mohlenbrock (1964) reported that river birch occurs on poorly drained soils which are low in organic matter. Fritts and Kirkland (1960) found that river birch is

common along streams in Cumberland County, Illinois, which drain the more acid soils of the Illinoian age glacial deposits. They also reported that it is absent along streams which drain the more alkaline materials from the Wisconsin moraine to the north. Nearly pure stands of river birch are occasionally found in depressions in the Illinois River Section of the Illinois River and Mississippi River Sand Area Division (Schwegman, 1973). A study of these forests was undertaken to determine their floristic composition and to examine the soil conditions under which they presently exist.

METHODS

During the fall of 1988, four river birch stands were surveyed in Mason and Cass Counties, Illinois. Studied stands were divided into quadrats 25 m on a side (0.0625 ha) and the number, size, and species of all living and dead -standing trees above 10 cm dbh were recorded for each quadrat. At each site, the maximum number of quadrats were placed to completely survey the entire forest, leaving at least a 10 m buffer strip around the perimeter to eliminate edge effects. Relative density, relative dominance, and importance value (IV) were then calculated for each species in each of the areas sampled. The IV determination follows the procedure developed by McIntosh (1957), and later by Boggess (1964), and is the sum of the relative density and relative dominance. Also determined for each species was the density (stems/ha) and the basal area (sq m/ha) for each stand.

In each of the 25 x 25 m quadrats, nested circular plots, .0001 and .01 ha in size, were randomly located using a blind throw of a marker from the southwest corner of each quadrat. In the smaller plot, seedlings (less than 2.5 cm dbh) were recorded, while in the larger plot, saplings (2.5-10.0 cm dbh) were recorded and their densities (stems/ha) determined. Nomenclature follows Mohlenbrock (1975).

At each site, two soil pits were dug to determine the depth and soil texture of the A and B horizons, and the presence of a hardpan. Also, soil samples were then taken from the A and B horizons in odd-numbered 25 x 25 m quadrats for determination of pH. Soil samples were analyzed for pH using a Corning model 7 pH meter, while soil texture was determined (three replicates) using the Bouyoucos Hydrometer Method (Bouyoucos, 1962).

Listed below are the four river birch stands studied along with their general site and soil characteristics.

Kilbourne Site 1: This stand, which is about 1/8 ha in size, occurs in the southwest part of Mason County, Illinois, (NE1/4 Sec 35 T20N R9W) three miles west of the town of Kilbourne. This plant community is in a small depression between stabilized sand dunes on which the dominant vegetation is *Quercus velutina* (black oak). It occurs on Dune Sand (Smith et al., 1924) which was deposited during the melting of the Wisconsin glaciers and later re-worked by wind. This terrace soil type is low in organic material, and may have a plastic, impervious, mottled yellow clay hardpan.

Kilbourne Site 2: This stand is about 1/4 ha in size, and is located 200 m north of Site 1 (NE1/4 Sec 35 T20N R9W). It is located in a small depression between stabilized sand dunes on which the dominant vegetation is black oak. The soil is similar to that of Kilbourne site 1.

Matanzas Prairie Site: This stand is about 1 ha in size, and is located in the Matanzas Prairie Nature Preserve (N1/2 Sec 4 T20N R9W) 1 1/2 miles northeast of Bath, Mason County, Illinois. It is located in a drainage depression about 1/2 m lower than the wet prairie, occurring on Brown-Gray sandy loam on tight clay (Smith et al., 1924). This terrace soil is relatively low in organic material, and has a plastic, impervious, mottled yellow clay subsoil.

Bluff Springs Site: This stand, which is about 1 1/2 ha in size, is located in the west-central part of Cass County, Illinois, (NE1/4 Sec 34 T18N R11W) about two miles southeast of Bluff Springs. It is in a low area with the topography rising 2-4 m on the west and north side, and is bounded on the east and south by county roads. It occurs on Orio sandy loam (Smith et. al., 1947) which developed under grass vegetation on an old sandy river deposit. This terrace soil is relatively low in organic material, while the subsoil is a gray sandy clay heavily mottled with yellow and only slowly permeable to water.

RESULTS

At Kilbourne site 1, the number of overstory stems/ha is 504 while the basal area averages 18.9 sq m/ha (Table 1). The dominant overstory species is river birch with an IV of 176.7 (out of a possible 200), followed by black oak (IV of 18.5) and small numbers of *Carya tomentosa* (mockernut hickory), and *Ulmus americana* (American elm). The only dead-standing trees in the woodlot are river birch (16 stems/ha with an average diameter of 16.7 cm). A few black oak, *Carya texana* (black hickory), and river birch seedlings are present in the understory, while *Prunus serotina* (black cherry) and American elm saplings are also occasionally encountered. None, however are common, and the understory is open. The soil in this woodlot is extremely sandy and acidic. The A horizon has a pH of 5.3 and is 90% sand, while the B horizon has a pH of 5.7 and is 96% sand (Table 2).

At Kilbourne site 2, the number of overstory stems/ha is 448 while the basal area averages 19.67 sq m/ha (Table 1). River birch is the dominant overstory species with an IV of 168.4, followed by black oak (IV of 28.8), and a few *Quercus marilandica* (blackjack oak). Black oak, although not as abundant as river birch, shows a similar size class distribution. Dead-standing individuals include river birch (72 stems/ha with an average diameter of 12.5 cm) and black oak (40 stems/ha with an average diameter of 13.7 cm). No river birch seedlings or saplings were recorded at this site. In contrast, black oak, black hickory, and black cherry, were well represented in the seedling layer, with black and blackjack oaks the only species present in the sapling layer. The soil in this woodlot is extremely sandy and acidic. The A horizon has a pH of 5.3 and is 86% sand, while the B horizon has a pH of 4.8 and is 88% sand (Table 2).

At the Matanzas Prairie site, the number of overstory stems/ha is 579 while the basal area averages 24.04 sq m/ha (Table 2). The dominant overstory species is river birch (IV of 179.2), followed by green ash (IV of 10.8), *Acer saccharinum* (silver maple), American elm, *Sassafras albidum* (sassafras), *Diospyros virginiana* (persimmon), and *Platanus occidentalis* (sycamore). The only species with dead-standing individuals was river birch with 80 stems/ha and having an average diameter of 35.9 cm. At this site the understory is more diverse, and more than twice as dense as that found at the other three sites examined (15798 stems/ha). As is typical of the other sites, however, river birch is only of minor importance in the understory. American elm, *Fraxinus pennsylvanica* (green ash), sassafras, and the shrub *Rhamnus frangula* (glossy buckthorn) are common components of the seedlings layer along with smaller numbers of black cherry, *Quercus alba* (white oak), and *Morus rubra* (red mulberry). The sapling layer is dominated by American elm, green ash and glossy buckthorn, along with occasional individuals of river birch, sassafras, black cherry, and red mulberry. The soil in this woodlot is very sandy and either acidic or alkaline depending on the horizon (Table 2). The A horizon has a pH of 5.95 and is 68% sand, while the B horizon has a pH of 7.35 and is 78% sand.

At the Bluff Springs site, the number of overstory stems/ha is 616 while the basal area averages 20.77 sq m/ha (Table 1). River birch is the dominant tree (IV of 160.4), with silver maple second (IV of 36.7) and American elm (IV of 2.9) third. The only dead-standing trees in this woodlot are river birch (63 stems/ha with an average diameter 21.0 cm). Both silver maple and American elm are common components of the 10-20 cm diameter class, with only a few larger individuals encountered. No river birch seedlings or saplings were recorded at this site. In contrast, silver maple, American elm, sassafras, and black cherry are represented in the seedling layer, while silver maple and American elm dominate the sapling layer. The soil in this woodlot is sandy and acidic. The A horizon has a pH of 5.3 and is 68% sand, while the B horizon has a pH of 5.7 and is 72% sand (Table 2).

DISCUSSION

At all four sites, river birch dominates the sandy depressions in which the soil is fairly acidic (A horizon pH of 5.30-5.95). According to Cribben and Ungar (1974), these wet, acidic and sandy conditions are ideal for river birch to reach maturity. On the sites examined, river birch accounts for 83% to 92% of the basal area and 75% to 87% of the overstory individuals. It is abundant in the lower diameter classes on each site, which suggests that it will continue to be the dominant overstory species for the immediate future.

Although river birch is by far the dominant species on the sites studied, the subordinate and understory species are highly variable. Both Kilbourne sites support some xerophytic species (black oak, blackjack oak, black hickory), while the Matanzas Prairie and Bluff Springs sites support many mesophytic species. At the Kilbourne sites black hickory and black oak dominate the seedling strata while black oak ranks second in importance in the overstories. The high percentage of sand in the soil on these two sites (exceeding 86% in the A horizon) indicates a poorly developed, relatively thin A horizon (Table 2) which is

very low in organic material (Smith et al., 1924). In contrast, at the Matanzas Prairie and the Bluff Springs sites, most of the subordinate overstory and understory species are usually associated with mesophytic and hydrophytic conditions. At these two sites the A horizon is thicker, less sandy (Table 2), and higher in organic material (Smith et al., 1924, 1947).

At two of the sites (Kilbourne site 2 and Bluff Springs site) no river birch seedlings or saplings were recorded while at the other sites only a small number were encountered. At all of the sites, river birch saplings are not advancing into the lower diameter classes. At both Kilbourne sites, other species, such as the black oak, blackjack oak and black hickory, that are slightly more shade tolerant, could possibly increase in importance to the detriment of the extremely shade intolerant river birch. At the Bluff Springs site, even though the river birch is the dominant overstory species, American elm and silver maple appear to be the dominant understory species and will probably become more important in the future. At the Matanzas Prairie site, green ash will probably increase in importance since it is well represented in the seedling, sapling, and lower diameter classes. There is a drastic change in the soil pH at this site, ranging from 5.95 in the A horizon to 7.35 in the B horizon. Cribben and Ungar (1974) suggests that when the pH of the soil rises to neutral and beyond, river birch densities tend to decline.

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Table 1. Densities, basal areas, importance values and average diameters of the woody species in river birch stands located in Mason and Cass Counties, Illinois

Species	Seed-lings #/ha	Sap-lings #/ha	Density #/ha	Basal Area m^2/ha	I.V.	Av. Diam. (cm)
Kilbourne Site 1: (NE1/4 Sec 35 T20N R9W, Mason Co., IL)						
Betula nigra L.	500	--	440	16.88	176.7	21.5
Quercus velutina Lam.	2500	--	48	1.70	18.5	19.4
Carya tomentosa (Poir.) Nutt.	--	--	8	0.19	2.6	17.5
Ulmus americana L.	--	50	8	0.10	2.2	12.2
Carya texana Buckl.	1500	--	--	--	--	--
Prunus serotina Ehrh.	--	150	--	--	--	--
Totals	4500	200	504	18.87	200.0	--
Kilbourne Site 2: (NE1/4 Sec 35 T20N R9W, Mason Co., IL)						
Betula nigra L.	--	--	384	16.27	168.4	21.8
Quercus velutina Lam.	1750	75	56	3.21	28.8	24.4
Quercus marilandica Muenchh.	250	100	8	0.19	2.8	17.2
Carya texana Buckl.	1750	--	--	--	--	--
Prunus serotina Ehrh.	1500	--	--	--	--	--
Juglans nigra L.	250	--	--	--	--	--
Totals	5500	175	448	19.67	200.0	--
Matanzas Prairie Site: (N1/2 Sec 4 T20N R9W, Mason Co., IL)						
Betula nigra L.	--	50	504	22.13	179.2	22.6
Fraxinus pennsylvanica Marsh.	2833	133	37	1.05	10.8	18.3
Acer saccharinum L.	--	--	8	0.36	2.9	22.9
Ulmus americana L.	8000	1750	13	0.13	2.8	11.3
Sassafras albidum (Nutt.) Nees.	833	33	11	0.22	2.7	15.7
Diospyros virginiana L.	--	--	3	0.08	0.8	19.5
Platanus occidentalis L.	--	--	3	0.07	0.8	18.1
Prunus serotina Ehrh.	333	83	--	--	--	--
Quercus alba L.	167	--	--	--	--	--
Rhamnus frangula L.	1166	200	--	--	--	--
Morus rubra L.	167	50	--	--	--	--
Totals	13499	2299	579	24.04	200.0	--
Bluff Springs Site: (NE1/4 Sec 34 T18N R11W, Cass Co., IL)						
Betula nigra L.	--	--	461	17.77	160.4	20.7
Acer saccharinum L.	750	869	143	2.81	36.7	14.5
Ulmus americana L.	1438	219	12	0.19	2.9	13.0
Sassafras albidum (Nutt.) Nees.	188	--	--	--	--	--
Prunus serotina Ehrh.	63	--	--	--	--	--
Totals	2439	1088	616	20.77	200.0	--

Table 2. Soil texture, depth and pH of A horizon, B horizon, and depth of the hardpan for the soils in each of the river birch forests surveyed in Mason and Cass Counties, Illinois.

A HORIZON			B HORIZON		HARDPAN
Depth (cm)	pH	Soil Texture	pH	Soil Texture	Depth from surface (cm)
Kilbourne Site 1:					
13.0	5.30	90% Sand 7% Silt 3% Clay	5.70	96% Sand 4% Silt 0% Clay	absent
Kilbourne Site 2:					
20.0	5.30	86% Sand 10% Silt 4% Clay	5.80	88% Sand 8% Silt 4% Clay	60.0
Matanzas Prairie Site:					
36.0	5.95	68% Sand 22% Silt 10% Clay	7.35	78% Sand 18% Silt 4% Clay	56.0
Bluff Spring Site:					
24.0	5.30	68% Sand 19% Silt 13% Clay	5.70	72% Sand 19% Silt 9% Clay	absent