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ERIGENIA

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The Illinois Native Plant Society Journal

The Illinois Native Plant Society is dedicated to the preservation, conservation, and study of the native plants and vegetation of Illinois.

ERIGENIA is named for *Erigenia bulbosa* (Michx.) Nutt. (harbinger of spring), one of our earliest blooming woodland plants. The first issue was published in August, 1982.

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ERIGENIA STAFF

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COVER ILLUSTRATION

Photo of *Quercus alba,* white oak, at Jim Edgar Panther Creek State Fish and Wildlife Area, by Mike Tyner. Thanks to Guy Sternberg for technical assistance.

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VASCULAR FLORA OF THE VERMILION RIVER OBSERVATORY, VERMILION COUNTY, ILLINOIS

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ABSTRACT: The vascular flora of the Vermilion River Observatory, Vermilion County, Illinois, was studied during the 1996—1998 growing seasons. A total of 475 taxa were found: 13 ferns and fern allies, 5 gymnosperms, 120 monocots, and 337 dicots. Families with the largest number of taxa included Asteraceae with 67 taxa, Poaceae with 53 taxa, and Cyperaceae with 33 taxa, of which 29 were members of the genus *Carex*. Two Illinois threatened species were encountered on the site, *Carex communis* (fibrous-rooted sedge) and *C. willdenowii* (Willdenow's sedge). Three forest communities (south-facing mesic upland forest, north-facing mesic upland forest, dry-mesic upland forest) were surveyed, and density (stems/ha), basal area (m2/ha), importance value, and average diameter were determined for each overstory species. The dry-mesic upland forest was dominated by various species of oaks and hickories. The mesic forested hillsides were dominated by oak species along with a more mesic component of *Acer saccharum* (sugar maple) and *Fagus grandifolia* (American beech).

INTRODUCTION

The Vermilion River Observatory (VRO) is located in east-central Illinois, east-central Vermilion County, approximately 6.4 kilometers (4 miles) southeast of Danville, Illinois, and 1.9 kilometers (1.2 miles) west of Vermillion County, Indiana. Owned by the University of Illinois, the Department of Electrical and Computer Engineering administers the site. Originally the site was purchased in the late 1950s for the construction of a radio telescope. Large amounts of surrounding ground, farm fields and wooded ravines, were also purchased. The telescope was a 183 meters (600 feet)-long and 122 meters (400 feet)-wide giant radio telescope. It was built into a ravine where it was in use for cosmological studies from 1962 to 1967 (McVittie 1962). After the telescope was abandoned the land was retained by the university, much of the flat uplands being farmed, the remainder being used for research as coordinated through the Committee on Natural Areas. The VRO is 198 ha (490 ac) in size with about 26% or 52 ha (129 ac) presently being farmed and the remaining uplands in various stages of succession. The level uplands have all been variously disturbed either through heavy grazing of the forest or clearing of the land for hayfields, cropfields, and the construction of three buildings. The wooded ravines have been subjected to varying degrees of disturbance, particularly extensive cutting around the turn of the century and again in the 1950s, and probably grazed into the 1940s (fig. 1). The present study was undertaken to document the vascular flora of the site and to determine the composition and structure of the native plant communities present.

MATERIALS AND METHODS

At various times throughout the growing season, from spring of 1996 through fall of 1998, field trips were made to the VRO. During each trip voucher specimens were collected, habitat data for each taxon determined, and the plant communities delineated. The material collected was identified and deposited in the herbarium of the Illinois Natural History Survey (ILLS), Champaign, Illinois. Criteria for designating native and non-native taxa followed Fernald (1950), Steyermark (1963), Mohlenbrock (1986), and Gleason and Cronquist (1991).

During the summer of 1997, the forest communities were surveyed using randomly located circular plots 0.0405 ha in size. Six to eight plots were located as near as possible to the center line running through the long axis of each forest type (dry-mesic upland forests and two mesic upland forests, one on a north-facing hillside, the other on a south-facing hillside). In each plot all living and dead-standing woody individuals 10 cm dbh and above were identified and their diameters recorded. From the living-stem data the density (stems/ha), basal area (m2/ha), relative density, relative dominance, importance value (IV), and average diameter (cm) were calculated for each species. Determination of the IV follows the procedure used by McIntosh (1957), and is the sum of the relative density and relative dominance of a given species. The densities (stems/ha) of the woody understory species were determined using nested circular plots (0.0001, 0.001, and 0.01 ha) randomly located along transects through the study area. Two additional 0.0001 ha circular plots were located 6 m from each center along north/south compass directions. To determine the number of meters that quadrats were located right (odd-numbered meters) or left (even-numbered meters) from the transect, a random numbers table (single digit) was used. In the 0.0001 ha plots, tree seedlings (<50 cm tall) and all shrubs were counted. In 0.001 ha circular plots, small saplings (≥50 cm tall and <2.5 cm dbh) were counted and, in the 0.01 ha circular plots, large saplings (≥2.5 - <10 cm dbh) were counted. Nomenclature primarily follows Mohlenbrock (1986), Gleason and Cronquist (1991), and Flora of North America Editorial Committee (1993). The plant com-munities were designated using the community classes of White and Madany (1978).

DESCRIPTION OF THE STUDY AREA

The VRO is in the Vermilion River Section of the Wabash Border Division (Schwegman 1973). Located on the Wisconsin Till Plain, the VRO is about 70 km (43 mi) north of the terminal moraine. This very level region, exposed by the retreating glaciers, was dissected by rapid down cutting by the post-glacial river, leaving behind the entrenched Vermilion River and its tributaries. Presently, this section is characterized by rugged topography along the major streams surrounded by relatively flat uplands. The presettlement vegetation was mostly wet-mesic to dry-mesic forests in the ravines and dissected uplands, with mesic prairie, savanna, and open woodlands on the flat to gently rolling uplands (Public Land Survey 1834).

This approximately 198 ha (490 ac) property is situated 6.4 km (4 mi) southeast of Danville, Illinois (T19N, R11W, E1/2 Section 35, W1/2 Section 36, and T18N, R11W, NW1/4 NW1/4 Section 1). The elevation of the VRO ranges from 156 m (512 ft) at the mouth of Getz Ravine to 198 m (650 ft) above sea level at its highest point on the relatively flat uplands in the eastern regions of the property. Maximum relief is only 42 m (138 ft).

The climate of east-central Illinois is continental with cool winters, hot summers, and little or no water deficit at any season of the year (Page 1949, Fehrenbacher et al. 1967). In Danville, Illinois, the mean annual precipitation is 102.1 cm (40.2 in), the month of July having the highest rainfall with a mean of 11.3 cm (4.5 in). The mean annual temperature in Danville is 11.3°C (52.3°F). The hottest month is July with a mean of 24°C (75.2°C) and the coldest month is January with a mean of -3.8°C (25.1°F) (Midwestern Climate Center 1999). The number of frost-free days is 170 to 180.

RESULTS AND DISCUSSION

In this survey, we found 475 species and/or subspecific taxa within 280 genera and 96 families (Appendix). Of these 475 taxa, 77 (16.2%) were not native to Illinois. The fern, fern-allies, and gymnosperms were represented by 10 families, 15 genera, and 18 taxa of which four species (gymnosperms) were exotics planted at the VRO. All other exotics were naturalized. Among the angiosperms, monocots accounted for 12 families, 56 genera, and 120 taxa. Dicots accounted for 74 families, 209 genera, and 337 taxa. The genera represented by the most taxa were *Carex* with 29, *Solidago* with 9, and *Panicum* with 8. The families with the most species and/or subspecific taxa were Asteraceae (67), Poaceae (53), Cyperaceae (33), Rosaceae (24), Fabaceae (16), Scrophulariaceae (13), and Apiaceae (12).

The VRO natural plant community types have been subjected to varying degrees of disturbance, most occurring before the area was purchased by the University of Illinois for the construction of the radio telescope. Below is a description of each plant community. The results of a quantitative vegetation analysis is included for the mesic and dry-mesic upland forest (Figure 1).

Mesic Upland Forest

Two mesic upland forests were surveyed, both in the same steep-sided ravine with an east/west orientation. Mesic upland forest accounted for about 39% or 78 ha (194 ac) of the VRO. They occurred on well drained soils (Marseilles loam and Strawn silt loam) that were very steep (35 to 80 percent), moderately deep, and formed in loamy material and in underlying siltstone residuum (Wacker 1996).

On the mesic upland forested ravine, 14 tree species were tallied on the south-facing hillside with 316 stems/ha and a basal area of 23.45 m2/ha (table 1). *Quercus alba* was the dominant species with 84 stems/ha, an importance value (IV) of 55.4, an average diameter of 29.1 cm, and a majority of the individuals in the smaller diameter classes. *Quercus velutina*, with 58 stems/ha, ranked second in IV (40), and had few individuals in the 10 - 19 cm diameter class. Other common species included *Acer saccharum* with 60 stems/ha, *Q. rubra*, and *Fagus grandifolia*, all with IVs greater than 15. The large number of individuals in the smaller diameter classes indicates that this woods is recovering from past disturbances, particularly cutting. *Acer saccharum* dominates the understory with 51666 seedlings/ha, 3875 small saplings/ha, and 375 large saplings/ha (table 2). *Cornus florida* was second in abundance with 416 seedlings/ha, 1500 small saplings/ha, and 312 large saplings/ha. In comparison, other woody species were rarely encountered, but some *Quercus* spp. reproduction was still occurring. A few seedlings and saplings of *Ostrya virginiana* (hop hornbeam), *Quercus* spp., *Carya* spp., *Prunus serotina*, *Sassafras albidum*, and *Cercis canadensis* were tallied, but these were quite infrequent (table 2).

On the mesic forested ravine, 13 tree species were tallied on the north-facing hillside with 314 stems/ha and a basal area of 25.34 m2/ha (table 1). *Quercus rubra* was the dominant species with 64 stems/ha, an IV of 49.4, an average diameter of 36.1 cm, and was well represented in all diameter classes. *Acer saccharum*, which ranked second with 94 stems/ha, an IV of 46.2, dominated the smaller diameter classes, and had an average diameter of 20.9 cm. *Quercus alba*, which ranked third with 54 stems/ha, an IV of 44.5, was well represented in most diameter classes, and had an average diameter of 37.2 cm. *Fagus grandifolia* ranked fourth with 34 stems/ha, an IV of 22.9, was well represented in most diameter classes, and had an average diameter of 31.5 cm. All remaining species had IVs of less than 10, being minor components of the slope. In the understory, *A. saccharum* was the dominant overstory tree with 21250 stems/ha, 3000 small saplings/ha, and 487 large saplings/ha (table 2). *Cornus florida* was the most common understory tree with 1250 stems/ha, 500 small saplings/ha, and 212 large saplings/ha (table 2). Other species were relatively uncommon, with *Fraxinus americana*, *Fagus grandifolia*, and wild *Prunus serotina* of minor importance. A few seedlings and saplings of *Q. alba*, *Sassafras albidum*, *Ostrya virginiana*, *Liriodendron tulipifera*, and *Amelanchier arborea* were tallied, but these were quite rare (table 2). *Carex communis*, a state threatened herb, was occasional, where it grows on the steep slopes with *Polystichum acrostichoides* and *Carex virescens*.

Dry-mesic Upland Forest

The dry-mesic upland forest accounted for about 13% or 25 ha (62 ac) at the VRO. This community occurred on silt loam soils formed in loess and underlying loamy till and ranged from the well-drained Miami Series (5 to 12% slope) to the moderately well drained Xenia Series (1 to 5% slope) to the poorly drained Fincastle Series (0 to 2% slope) (Wacker 1996). The dry-mesic upland forest was characterized by a dominance of *Quercus* spp. and *Carya* spp. There were 11 tree species total with a total density of 515 stems/ha and a basal area of 27.52 m2/ha (table 1). *Quercus velutina* was dominant with 107 stems/ha, an IV of 54.3, an average diameter of 32.4 cm, and a majority of the individuals in the 20-29 and 30-39 cm diameter classes. *Carya tomentosa*, which ranked second in IV (43.9), dominated the lower diameter classes (< 30 cm) with 139 stems/ha. Other species with IV scores above 10 included *Q. alba* with an IV of 33.5, *C. ovata* with an IV of 33.2, and *C. glabra* with an IV of 23.2. Nearly 400 of the 515 stems/ha were < 30 cm dbh. The large number of individuals in the smaller diameter classes indicate that this woodlot is recovering from past disturbance, particularly cutting. The understory was dominated by *Acer saccharum* with 8889 seedlings/ha and 583 large saplings/ha (table 2). Other common understory species included *C. tomentosa*, *Q. velutina*, *Malus ioensis*, *Fraxinus americana*, *Cornus florida*, and *Prunus serotina*. *Carex willdenowii*, a state threatened herb, was infrequent here, where it grows on a dry ridge with *Dodecatheon meadia* and in a level open woods at the head of a ravine with *Liparis liliifolia* and *Carex jamesii*.

Seeps

This community is characterized by saturated soils caused by circumneutral groundwater flowing to the surface (White and Madany 1978). The seeps accounted for >1% or > 0.5 ha (>1 ac) at the VRO. Though frequent, the seeps were small and poorly developed. They generally occurred at the base of steep slopes in the mesic ravines. Dominant plants included *Acer saccharum*, *A. negundo*, *Cornus alternifolia*, *Impatiens biflora*, and *Pilea pumila*.

Cultural

The cultural communities accounted for about 48% or 95 ha (234 ac) of the VRO. The cultural communities are created and/or maintained by human disturbance. At the VRO the cultural community is represented by croplands, successional fields (former pastureland and orchards), developed land (giant telescope, roads, and buildings), a tree plantation, and four artificial ponds. The common taxa encountered here were introduced and native weedy species.

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Table 1 Densities (stems/ha), diameter classes, basal areas (m^2/ha), relative values, importance values and average diameters of the woody species in three forest types at the Vermilion River Observatory southeast of Danville, Vermilion County, Illinois.

Species	Diameter Classes (cm) 10-19	20-29	30-39	40-49	50+	Total stems/ha	Basal Area m^2/ha	Rel. Den.	Rel. Dom.	I.V.	Av. Diam. (cm)
Mesic Upland Forest (South-facing Hillside)											
Quercus alba	26.0	24.0	16.0	10.0	8.0	84.0	6.74	26.6	28.8	55.4	29.1
Quercus velutina	8.0	22.0	14.0	10.0	4.0	58.0	5.06	18.4	21.6	40.0	31.6
Acer saccharum	26.0	8.0	18.0	6.0	2.0	60.0	4.04	19.0	17.2	36.2	25.6
Quercus rubra	8.0	18.0	14.0	6.0	2.0	48.0	3.65	15.2	15.6	30.8	29.5
Fagus grandifolia	4.0	2.0	6.0	8.0	2.0	22.0	2.47	7.0	10.5	17.5	36.1
Carya ovata	6.0	2.0	4.0	--	--	12.0	0.44	3.8	1.9	5.7	19.9
Carya tomentosa	8.0	--	--	--	--	8.0	0.11	2.5	0.5	3.0	13.3
Sassafras albidum	8.0	--	--	--	--	8.0	0.12	2.5	0.5	3.0	13.9
Others (6 species)	6.0	6.0	2.0	2.0	--	16.0	0.82	5.0	3.4	8.4	--
Totals	100.0	82.0	74.0	42.0	18.0	316.0	23.45	100.0	100.0	200.0	--
Mesic Upland Forest (North-facing Hillside)											
Quercus rubra	10.0	12.0	12.0	20.0	10.0	64.0	7.33	20.4	29.0	49.4	36.1
Acer saccharum	58.0	20.0	6.0	6.0	4.0	94.0	4.15	29.9	16.3	46.2	20.9
Quercus alba	6.0	18.0	4.0	14.0	12.0	54.0	6.90	17.3	27.2	44.5	37.2
Fagus grandifolia	6.0	12.0	6.0	8.0	2.0	34.0	3.05	10.8	12.1	22.9	31.5
Quercus velutina	2.0	2.0	10.0	--	--	14.0	1.11	4.5	4.4	8.9	30.7
Carya ovata	4.0	6.0	4.0	--	--	14.0	0.71	4.5	2.8	7.3	24.7
Tilia americana	2.0	2.0	8.0	--	--	12.0	0.87	3.8	3.4	7.2	29.0
Sassafras albidum	8.0	--	--	2.0	--	10.0	0.40	3.2	1.6	4.8	19.4
Others (5 species)	10.0	4.0	4.0	--	--	18.0	0.82	5.6	3.2	8.8	--
Totals	106.0	76.0	54.0	50.0	28.0	314.0	25.34	100.0	100.0	200.0	--
Dry-mesic Upland Forest											
Quercus velutina	2.7	37.3	50.7	13.3	2.7	106.7	9.25	20.7	33.6	54.3	32.4
Carya tomentosa	80.0	58.7	2.7	--	--	141.4	4.49	27.6	16.3	43.9	19.3
Quercus alba	10.7	21.3	16.0	16.0	2.7	66.7	5.65	13.0	20.5	33.5	31.3
Carya ovata	50.7	37.3	10.7	--	--	98.7	3.85	19.2	14.0	33.2	21.2
Carya glabra	24.0	29.3	10.7	--	--	64.0	2.98	12.4	10.8	23.2	22.8
Others (6 species)	29.4	2.7	2.7	2.7	--	37.5	1.30	7.1	4.8	11.9	--
Totals	197.5	186.6	93.5	32.0	5.4	515.0	27.52	100.0	100.0	200.0	--

Table 2 Densities (stems/ha) of the woody seedlings (<50 cm tall), small saplings (≥50 cm tall <2.5 cm dbh), and large saplings (≥2.5 - <10 cm dbh) in three forest types at the Vermilion River Observatory, Vermilion County, Illinois.

Species	Seedlings	Small Saplings	Large Saplings
Mesic Upland Forest (South-facing Hillside)			
Acer saccharum	51666.7	3875.0	375.0
Fraxinus americana	1250.0	--	--
Fagus grandifolia	833.3	625.0	50.0
Cornus florida	416.7	1500.0	312.5
Ostrya virginiana	416.7	--	25.0
Quercus spp.	1250.1	--	12.5
Carya spp.	416.7	--	25.0
Prunus serotina	416.7	--	--
Sassafras albidum	416.7	--	--
Cercis canadensis	--	--	12.5
Totals	57083.6	6000.0	812.5
Mesic Upland Forest (North-facing Hillside)			
Acer saccharum	21250.0	3000.0	487.5
Fraxinus americana	4166.7	250.0	--
Cornus florida	1250.0	500.0	212.5
Fagus grandifolia	1250.0	750.0	37.5
Prunus serotina	1250.0	125.0	--
Quercus alba	1250.0	--	12.5
Sassafras albidum	416.7	--	12.5
Ostrya virginiana	416.7	--	12.5
Liriodendron tulipifera	416.7	--	--
Amelanchier arborea	--	--	25.0
Totals	31666.8	4625.0	800.0
Dry-mesic Upland Forest			
Acer saccharum	8888.9	333.3	583.3
Carya tomentosa	5000.0	--	33.3
Quercus velutina	3333.3	--	--
Malus ioensis	2222.2	--	--
Fraxinus americana	2222.2	--	--
Cornus florida	1666.7	333.3	116.7
Prunus serotina	1111.1	--	100.0
Fagus grandifolia	555.6	--	--
Ostrya virginiana	555.6	166.7	50.0
Ulmus rubra	--	--	16.7
Quercus alba	--	--	16.7
Carya ovata	--	--	16.7
Totals	25555.6	833.3	933.4

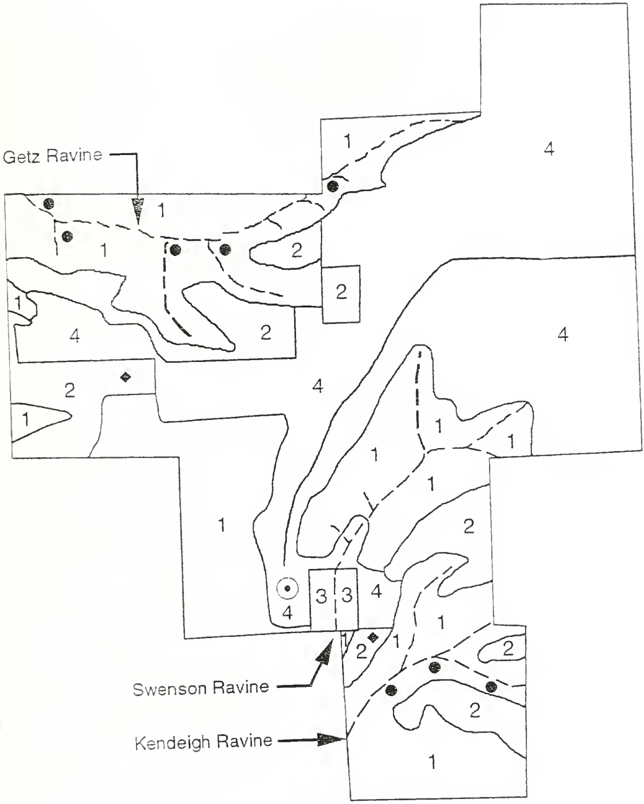

Figure 1. Natural communities and rare plant locations of Vermilion River Observatory, Vermilion County, Illinois.

1. mesic upland forest
2. dry-mesic upland forest
3. giant radio telescope
4. cultural communities

• *Carex communis*
◆ *Carex willdenowii*
⊙ biological station

APPENDIX

The vascular taxa encountered and vouchered at the Vermilion River Observatory are listed below by major groups, pteridophytes (ferns and fern allies) and spermatophytes (seed plants). The spermatophytes are further divided into gymnosperms (non-flowering seed plants) and angiosperms (flowering seed plants); the latter are divided into monocots and dicots. The families, genera, and species are alphabetically arranged within each group. Preceding the binomial, state threatened species are indicated by a T and non-native species are indicated by an asterisk (*). After the binomial and authority, the collecting numbers, preceded by the initial of the collector's name, are given (P for Loy R. Phillippe, H for Mary Harper.

PTERIDOPHYTES

ASPLENIACEAE

Asplenium platyneuron (Linnaeus) Britton, Sterns & Poggenburg: P 27637

DRYOPTERIDACEAE

Athyrium filix-femina (Linnaeus) Mertens var. *angustum* (Willdenow) G. Lawson: P 27906
Cystoperteris protrusa (Weatherby) Blasdell: P 27638
Deparia acrostichoides (Swartz) M. Kato: P 27586, P 28370
Polystichum acrostichoides (Michaux) Schott: P 27611

EQUISETACEAE

Equisetum arvense Linnaeus: P 27069, P 27118
Equisetum hyemale Linnaeus: P 27258

LYCOPODIACEAE

Diphasiastrum digitatum (Dillenius ex A. Braun) Holub: P 27066

OPHIOGLOSSACEAE

Botrychium dissectum Sprengel: P 28347
Botrychium virginianum (Linnaeus) Swartz: P 27265

OSMUNDACEAE

Osmunda claytoniana Linnaeus: P 27907

PTERIDACEAE

Adiantum pedatum Linnaeus: P 27612

THELYPTERIDACEAE

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Aureolaria flava (Linnaeus) Farwell: P29495
Collinsia verna Nuttall: P 27141
Gratiola neglecta Torrey: P 27589
Pedicularis canadensis Linnaeus: P 27132
Penstemon calycosus Small: P 28865
Scrophularia marilandica Linnaeus: P 28397
*_Verbascum blattaria_ Linnaeus: P 27870
*_Verbascum thapsus_ Linnaeus: P 27912
*_Veronica arvensis_ Linnaeus: P 27238
*_Veronica officinalis_ Linnaeus: P 27213
Veronica peregrina Linnaeus: P 29656
Veronicastrum virginicum (Linnaeus) Farwell: P 29468

SIMAROUBACEAE
*_Ailanthus altissima_ (Miller) Swingle: P 29187

SOLANACEAE
Physalis heterophylla Nees: P 28556
*_Physalis longifolia_ Nuttall: P 29193
Solanum carolinense Linnaeus: P 29191
Solanum ptycanthum Dunal: P 29190

STAPHYLEACEAE
Staphylea trifolia Linnaeus: P 27225

TILIACEAE
Tilia americana Linnaeus: P 29182

ULMACEAE
Celtis occidentalis Linnaeus: P 29483
Ulmus americana Linnaeus: P 27062
Ulmus rubra Muhlenberg: P 27063, P 27078

URTICACEAE
Boehmeria cylindrica (Linnaeus) Swartz: P 29297
Laportea canadensis (Linnaeus) Weddell: P 28383
Parietaria pensylvanica Muhlenberg: P 29664
Pilea pumila (Linnaeus) Gray: P 28375

VALERIANACEAE
Valeriana pauciflora Michaux: P 27227, P 27585

VERBENACEAE
Phryma leptostachya Linnaeus: P 27886
Verbena urticifolia Linnaeus: P 27877

VIOLACEAE
Hybanthus concolor (T.F. Forster) Sprengel: P 27372
Viola pratincola Greene: P 27120
Viola pubescens Aiton var. *eriocarpa* (Schwein) Russell: P 27126
**Viola rafinesquii* Greene: P 27239
Viola striata Aiton: P 27140
Viola triloba Schwein var. *triloba:* P27255

VITACEAE
Parthenocissus quinquefolia (Linnaeus) Planchon: P 29473
Vitis aestivalis Michaux: P 27587
Vitis riparia Michaux: P 27402

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THE VASCULAR FLORA AND VEGETATION OF ROBESON HILLS NATURE PRESERVE: AN OLD-GROWTH BEECH-MAPLE FOREST IN SOUTHEASTERN ILLINOIS

Bob Edgin[1]

ABSTRACT: The vascular flora of the 64 ha Robeson Hills Nature Preserve and Robeson Hills Land and Water Reserve (Lawrence County, Illinois) was studied during the 1999 and 2000 growing seasons. A total of 233 species and subspecific taxa, including the state-endangered *Iresine rhizomatosa* Standley (bloodleaf), were observed. Of that number, 10 were fern, fern allies, and gymnosperms, 38 monocots, and 185 dicots. Sampling was conducted using a stratified-random line-strip method. A total of 58 taxa were encountered during sampling. Among the overstory trees, *Acer saccharum* Marsh. (sugar maple) ranked first in importance value (IV = 39.9), accounting for 54.3% of all individuals encountered and 33.9% of the total basal area. Of the sugar maple encountered, 61.4% were < 30.0 cm dbh. *Fagus grandifolia* Ehrh. (beech) ranked second in importance value (IV = 18.2), being present in low numbers in all diameter classes. In the understory, sugar maple was the most abundant species in the large and intermediate sapling categories. *Asimina triloba* (L.) Dunal (pawpaw) was most abundant in the small sapling category. Beech was not represented well in large and intermediate sapling and groundlayer categories, but was present in moderate numbers in the small sapling category. *Hydrophyllum canadense* L. (Canada waterleaf) and *Laportea canadensis* (L.) Wedd. (stinging nettle) were the most abundant herbaceous species.

INTRODUCTION

At the time of European settlement about 61% of Illinois was covered with prairie, the flat to gently rolling areas in prairie and savanna, the more rugged terrain in woodland and forest vegetation (Kuchler 1964, Iverson et al. 1991, Ebinger 1997). In this rugged terrain, tree species composition often varied from one locality to another with oaks (*Quercus* spp.) and hickories (*Carya* spp.) being the common forest species on drier, mostly upland sites. Mesophytic species such as elm (*Ulmus* spp.), ash (*Fraxinus* spp.), and sugar maple (*Acer saccharum* Marsh.) were associated with the dissected ravines and narrow river floodplains (Braun 1950, Anderson 1983, Cowell and Jackson 2002). At the eastern edge of Illinois, particularly in the Wabash Border Natural Division, many of these forests contained American beech (*Fagus grandifolia* Ehrh.), tuliptree (*Liriodendron tulipifera* L.), sugar maple, and other tree species typically found in the forests to the east of Illinois (Schwegman 1973).

Beech-maple forests, which usually contained some species of oaks and hickories, reached the western limit of their range in east-central and southern Illinois. The few remaining examples of this forest type are primarily restricted to locations that have steep, deeply dissected ravine systems, narrow valleys, and narrow to broad ridges. These forest stands usually contain a beech-maple component with a rich herbaceous layer on the mesic slopes and an oak-hickory component on the ridges and more level uplands. Presently, few examples of this forest type remain in Illinois, and these remnants have been variously modified by past disturbance such as cutting and grazing, the lack of fire regime, and exotic species invasion.

Three examples of this community type located in the Wabash River Basin have been dedicated as Illinois Nature Preserves (McFall and Karnes 1995). The Robeson Hills Nature Preserve (RHNP) and Robeson Hills Land and Water Reserve contain one of these protected beech-maple forests. The objectives of the study were (1) to investigate the historical background of this forest, (2) to determine the composition and structure of the forest vegetation, (3) to analyze changes in the community composition that may have occurred since the forest was last studied in 1973, and (4) to establish permanent plots to more precisely monitor changes in the forest composition and structure.

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DESCRIPTION OF THE STUDY AREA

Robeson Hills Nature Preserve is located approximately 13 km east of Lawrenceville, Lawrence County, Illinois (Location 21, T3N, R10W). Located in the Wabash Border Natural Division, Robeson Hills is a strongly dissected 400 ha erosional remnant that rises some 30 m above the floodplain of the Wabash River (Schwegman 1973). The bedrock is Pennsylvanian-aged sandstone and shale that is overlain with thick deposits of loess.

The climate is continental, characterized by cold winters and hot, humid summers. Weather station records for Vincennes, Indiana, about 3.2 km from the preserve, reports the annual precipitation as 106.4 cm, which falls mostly as rain during the period of March to September (Weather.com). Average precipitation is highest during the month of May (11.2 cm) and lowest during February (6.6 cm). January is the coldest month, having a mean temperature of -3° C with an average high of 2° C and an average low -8° C. A record low of -31° C was recorded on December 23 and 24, 1989. July is the hottest month, having a mean temperature of 24° C with an average high 31° C and an average low of 18° C. A record high of 38° C was recorded on July 22, 1983, and June 26, 1988. The frost-free growing period averages 180 days per year (Fehrenbacher and Odell 1956).

Prior to European settlement, Robeson Hills was occupied by native Americans of the Archaic, Woodland, and Mississippian cultures for about 5000 years (Rillo 1978). Archeological evidence suggests that the Archaics were a semi-nomadic people who used the area primarily as a winter camp site. The Woodland Culture was a more settled culture with its people living in small villages and tending small gardens. The Mississippian culture was based on agriculture with its people living in large villages and honoring their deceased through burial in mounds.

Jean Baptiste Racine is believed to have been the first person of European descent to claim ownership of the hills, doing so in 1763. Toussaint Dubois purchased the hills in 1807 and sold them to William Robeson in 1877. The hills remained in the ownership of the descendants of William Robeson, until the north portion consisting of 218 ha (545 acres), was purchased by Vincennes University, Vincennes, Indiana, in 1964.

Vincennes University dedicated 48.6 ha of old-growth beech-maple forest as an Illinois nature preserve in 1972 (McFall and Karnes 1990). In 1996, the 7.3 ha Dark Hollow addition to the RHNP was dedicated and the 8.8 ha Robeson Hills Land and Water Reserve was registered in the Illinois Registry of Land and Water Reserves. These tracts, which total 64 ha (160 acres), are old growth beech-maple forest that have been subjected to relatively little human disturbance and will be subsequently referred to as Robeson Hills Nature Preserve. Beech and sugar maple predominate on the steep slopes, being replaced by tulip tree, *Celtis occidentalis* L. (hackberry), and *Platanus occidentalis* L. (sycamore) on the more gentle slopes. *Quercus alba* L. (white oak), *Quercus rubra* L. (red oak), and *Fraxinus americana* L. (white ash) are more common on the narrow, drier ridges.

MATERIALS AND METHODS

The vascular flora of Robeson Hills Nature Preserve was studied during the growing seasons of 1999 and 2000. During each trip, all new flowering or fruiting species encountered were collected, the specimens identified and deposited in the Stover-Ebinger Herbarium (EIU) of Eastern Illinois University, Charleston. Criteria for designating native and non-native taxa follow Gleason and Cronquist (1991) and Mohlenbrock (1986). All vascular plant taxa observed are presented in the Annotated Species List (Appendix I). Nomenclature follows Mohlenbrock (1986).

Sampling was conducted on June 29 and July 4, 2000, using the stratified-random line-strip method of Lindsay (1955) as modified by Donselman (1973), Levenson (1973), and Dunn (1978). Using this method, overstory trees, saplings, shrubs, and groundlayer strata were sampled simultaneously in nested rectangular plots positioned along transect lines.

Sample plots for the overstory trees (≥10.0 cm dbh) were delimited using a 100 m tape divided into 25 m sections. Overstory trees were sampled in 10 m x 25 m (0.025 ha) plots using a telescoping PVC pole 2.5 m long to determine the boundaries of the plots. All trees with centers that were located within two pole lengths (5 m) of either side of the tape were included in the sample. Aspect of the plot, taxon, and diameter were recorded for each individual located within the boundaries of each plot.

Large saplings (5.0 cm dbh—9.9 cm dbh), intermediate saplings (≥ 2.5 cm dbh; ≤ 4.9 cm dbh), small saplings (≥ 50.0 cm tall; ≤ 2.4 cm dbh), shrubs, and the groundlayer (woody seedlings <50.0 cm tall and all herbaceous taxa) were sampled in nested rectangular plots located at the zero, 25 m, 50 m, and 75 m mark of the tape. Aspect, taxa, and the number of individuals were recorded for all individuals that fell within one meter from the tape along a section 2.5 m long (0.00025 ha plot).

When all plots along the 100 m transect line were sampled, a section of 1/2" steel conduit marked "Edgin 2000" was driven at each end of the tape to facilitate the relocation of the transect line in future studies. A new 100 m transect line, laying a minimum of 25 m distant from the first line and perpendicular to the ravine was then established and the sampling procedures repeated. This process was replicated along ten 100 m transect lines, providing a total of 40 plots in each category.

Density (trees/ha), basal area (m^2/ha), frequency (%), relative density, relative dominance, relative frequency, importance value (relative density + relative dominance + relative frequency)/3 and average dbh (cm) were determined for each taxon of overstory tree. Density (stems/ha), frequency (%), relative density, relative frequency, and importance value (relative density + relative frequency)/2 was determined for each taxon in the small, intermediate, and large sapling, shrub, and groundlayer categories.

The Floristic Quality Index (FQI) was determined for the preserve using the coefficient of conservatism assigned to each taxon by Taft et al. (1997). The FQI is ostensibly a weighted index of the species richness (N), and is the arithmetic product of the average coefficient of conservatism (CC) and the square root of the species richness ($\sqrt{N}$) of an inventory site [$FQI = CC(\sqrt{N})$]. For relatively small areas that are fairly intensively studied floristically, the FQI gives a rapid means of comparison and an indication of the floristic integrity of the site.

RESULTS AND DISCUSSION

The flora of RHNP consisted of 233 species and subspecific taxa in 157 genera and 79 families. Of these taxa, 12 (5.2%) are not native to Illinois. The gymnosperms and pteridophytes were poorly represented, accounting for only 10 taxa (4.3% of all taxa) in 9 genera and 5 families. Among the angiosperms, monocots accounted for 38 species and subspecific taxa (16.3% of all taxa) in 24 genera and 8 families, while dicots accounted for 185 species and subspecific taxa (79.4% of all taxa) in 124 genera and 66 families. The families with the highest representation of taxa were the Asteraceae (25 taxa), Poaceae (10), Cyperaceae (10), Lamiaceae (9), Fagaceae (8), and Ranunculaceae (8). Genera with the highest representation were *Carex* (9), *Quercus* (7), *Carya* (5), and *Polygonum* (5). See Appendix I for a listing of the vascular taxa encountered.

Overstory Composition and Structure

Twenty taxa were encountered in the overstory sampling having a density of 186 trees/ha and a total basal area of 33.144 (m^2/ha) (Table 1). Sugar maple was the dominant tree species, having an importance value of 39.9. It had the highest frequency, occurring in 85.5% of all plots, accounted for 54.3% of all trees encountered, and 33.9% of the basal area (m^2/ha) (Table 1). It was present in all diameter classes, but was particularly abundant in the 10—39.9 cm diameter classes, accounting for 67.9% of the trees encountered in those classes. Sugar maple was the only tree species encountered in 7 of the 40 plots. Of those plots, four were located on northeast-facing slopes, two on southwest-facing slopes, and one on the east-facing slope of a narrow v-shaped valley.

Beech ranked second in importance value (IV=18.2), basal area, and frequency (Table 1). It occurred in 57.5% of the plots and was present in low numbers in all diameter classes. Hackberry (IV=6.4) was the only other taxon to be represented by more than 10 individuals and was most common in the smaller diameter classes.

Over time, a mature, undisturbed forest is expected to experience a slight decrease in tree density and a corresponding increase in total basal area average (Abrell and Jackson 1977, Poulson and Platt 1996, Shotola et al. 1992, Swanson and Vankat 2000). Over the past 27 years, the forest at RHNP has experienced a decrease in tree density (from 233 to 186 trees/ha) and a decrease in basal area (from 38.88 to 33.144 m^2/ha). Beech has experienced a decline in density, basal area and importance value, despite an increase in average tree diameter, while sugar maple has experienced an increase in importance value, basal area, and density. Since no permanent plots were established during the previous study, some variation in the data may be attributed to sampling error. However, it seems unlikely that such a dramatic shift in the composition of the forest could be attributed solely to this factor, and the even distribution of beech throughout all diameter classes would seem to eliminate the possibility of a catastrophic event.

The shift in the forest structure may be explained by the dynamic equilibrium that exists within mature beech-maple forests. Poulson and Platt (1996) found that beech has the competitive advantage over sugar maple during times of low treefall rates and small canopy gap formation. Sugar maple has the advantage during periods of multiple treefalls and large canopy gaps. Seven dead-standing trees, a few fallen trees, and several bowls created by rootballs of fallen trees were noted during the study. It is possible that the forest experienced a period of increased canopy gap formation after the previous study was conducted. The associated increase in understory light levels could have given the competitive edge to sugar maple, which is apically dominant and has a greater vertical growth potential than beech. This hypothesis is further supported by the presence of hackberry, a shade- sensitive species, in the smaller diameter classes and its absence from the larger diameter classes.

In the understory, sugar maple was the dominant species in the large sapling category, accounting for 51.6% of the individuals, and was encountered in plots on most aspects (Table 2). No beech were encountered in this category. Sugar maple was also dominant in the intermediate sapling category, where it occurred in 62.5% of the plots and represented 71.3% of the individuals encountered (Table 2).

Pawpaw was the dominant species in the small sapling category, occurring in 95.0% of the plots, and accounting for 80.6% of the individuals encountered (Table 2). Sugar maple and beech ranked second and third, respectively, in importance value, with beech being poorly represented.

With the exception of *Staphylea trifolia* L. (bladdernut), shrub density was very low (Table 3). Two non-native shrubs, *Euonymus alata* (Thunb.) Sieb. (winged wahoo) and *Rosa multiflora* Thunb. (multiflora rose), were occasionally encountered.

The abundance of sugar maple, combined with the relative lack of beech in the sapling layers, would indicate that sugar maple will continue to increase in importance if treefall and canopy gap formation occur at frequent intervals (Poulson and Platt 1996). However, beech could gain the competitive advantage if treefall and canopy gap formation rates decline and the light intensity in the understory decreases. Most other taxa are expected to remain as minor components of the forest.

In the groundlayer, 48 taxa were encountered. Of that number, 25 were herbaceous with *Hydrophyllum canadense* L. (Canada waterleaf), *Laportea canadensis* (L.) Wedd. (stinging nettle), *Asarum canadense* L. (wild ginger), *Cystopteris protrusa* (Weatherby) Blasd. (fragile fern), *Viola* spp. (violet) being the most abundant (Table 4). Sugar maple, white ash, pawpaw, *Prunus serotina* Ehrh. (wild black cherry), and *Ulmus rubra* Muhl. (red elm) were the most abundant woody seedlings, with pawpaw and red elm being present primarily as rootsprouts from more mature individuals.

The average coefficient of conservatism, when calculated for all taxa, was 3.72 and the FQI was 56.3. When calculated for native taxa only, the average coefficient of conservatism and FQI were 4.04 and 58.6, respectively. According to Taft et al. (1997), sites that have an FQI greater than 35 may be regionally noteworthy, while sites with an FQI greater than 45 are often of statewide significance.

<u>Slope Aspects</u>

Sufficient data were available to determine the characteristic taxa of the northeast- and southwest-facing slopes in the study area. General characteristics of these two areas are discussed below.

Northeast-Facing Slopes (16 plots)

In the overstory trees, sugar maple ranked first in importance value, occurred in 87.5% of the plots, and accounted for nearly 56% of the trees encountered and 42.4% of the basal area (Table 5). Beech ranked second in importance value and was present in 56.3% of the plots. Tulip tree was the only other tree with an importance value greater than 5. Sugar maple ranked first in importance value in the large and intermediate sapling categories and second in the small saplings. Pawpaw ranked second in the intermediate sapling and third in the small sapling category. Beech was poorly represented in all sapling categories. Stinging nettle, Canada waterleaf, wild ginger, fragile fern, and violet were the most abundant herbaceous taxa with sugar maple, bladdernut, white ash, winged wahoo, and wild black cherry being the most abundant woody seedlings.

Southwest-Facing Slope (14 plots)

Sugar maple ranked first in importance value among overstory trees (IV=37.6), occurred in 85.7% of the plots, and accounted for 52.9% of the trees encountered. Hackberry ranked second in importance, occurring in 35.7% of the plots. White oak and red oak were the only other trees encountered with an importance value greater than 10. Beech was not well represented, having an importance value of 4.3 and occurring in only 2 plots.

Sugar maple had the highest density among the large and intermediate saplings and ranked second in density in the small sapling category. Beech was not encountered in the large sapling category and was poorly represented in the intermediate and small sapling categories. Pawpaw had the highest density in the small sapling category. Winged wahoo was the only shrub taxon encountered.

Groundlayer plots located on southwest-facing slopes were the most diverse, with 38 taxa being encountered, and had the highest density. Canada waterleaf, fragile fern, wild ginger, violet, stinging nettle, *Arisaema triphyllum* (L.) Schott. (Jack-in-the-pulpit), clearweed, and *Hybanthus concolor* (T.F. Frost) Spreng. (green violet) each had an importance value greater than 5.0. Sugar maple, white ash, wild black cherry, and pawpaw were the most abundant woody seedlings.

<u>Endangered Species</u>

A population of *Iresine rhizomatosa* Standl. (bloodleaf) was encountered during the study. *I. rhizomatosa* is a dioecious, rhizomatous perennial with a restricted range in Illinois, being confined to the drainage basins of the Wabash and Ohio Rivers (Gleason and Cronquist 1991, Herkert 1991, Mohlenbrock 1986). Other populations of this species in Illinois are located in floodplain areas that receive periodic inundation at some point during the year. The population at Robeson Hills consisted of several hundred stems growing in a colony that occupied an area approximately 6 m x 12 m. The colony was unusual in that it was observed at an elevation of 155 m, well above the 125 m elevation of the 100-year floodplain.

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Table 1. Density (trees/ha) by diameter classes (cm), total density, basal area (m^2/ha), frequency (%), relative density, relative dominance, relative frequency, importance value, and average dbh are given for tree taxa encountered during sampling of Robeson Hills Nature Preserve, Lawrence County, Illinois. Also included is the density (trees/ha), importance value and average dbh per tree taxa from the 1973 study. (Dunn 1978).

Species	10.0 -19.9	20.0 -29.9	30.0 -39.9	40.0 -49.9	50.0 -59.9	60.0 -69.9	70.0 -79.9	80.0+	Total Density (#/ha)	Basal Area (m^2/ha)	Freq. (%)	Rel. Den.	Rel. Dom.	Rel. Freq.	IV	Avg. dbh	1973 Density (#/ha)	1973 IV	1973 Avg. dbh
Acer saccharum	34.0	28.0	10.0	5.0	7.0	11.0	5.0	1.0	101.0	11.229	85.5	54.3	33.9	31.4	39.9	37.4	59.0	17.8	33.8
Fagus grandifolia	2.0	3.0	5.0	3.0	4.0	3.0	3.0	3.0	26.0	5.982	57.5	14.0	18.0	22.5	18.2	54.1	77.0	31.1	47.6
Celtis occidentalis	4.0	1.0	2.0	2.0	2.0	- -	2.0	- -	13.0	1.424	20.0	7.0	4.3	7.8	6.4	39.1	2.0	1.2	54.1
Liriodendron tulipifera	- -	- -	1.0	1.0	- -	- -	- -	3.0	5.0	2.572	10.0	2.7	7.8	4.0	4.8	80.7	4.0	3.1	77.4
Quercus alba	- -	1.0	- -	1.0	2.0	- -	- -	2.0	6.0	2.043	7.5	3.2	6.1	2.9	4.1	65.8	9.0	5.8	68.6
Quercus rubra	- -	- -	- -	- -	- -	- -	- -	3.0	3.0	2.243	7.5	2.2	6.8	2.9	3.8	84.5	8.0	6.5	82.1
Platanus occidentalis	- -	- -	- -	- -	- -	- -	- -	3.0	3.0	2.310	7.5	1.6	7.0	2.9	3.8	99.0	1.0	0.6	56.4
Fraxinus americana	- -	- -	- -	1.0	1.0	1.0	1.0	1.0	5.0	1.810	7.5	2.7	5.5	2.9	3.7	67.7	4.0	2.3	55.3
Carya glabra	- -	1.0	- -	1.0	- -	1.0	- -	1.0	4.0	1.103	10.0	2.2	3.3	4.0	3.2	59.7	4.0	4.3	52.9
Juglans nigra	- -	- -	2.0	- -	1.0	- -	- -	- -	3.0	0.424	7.5	1.6	1.3	2.9	1.9	42.2	1.0	0.4	15.9
Carpinus caroliniana	4.0	- -	- -	- -	- -	- -	- -	- -	4.0	0.068	7.5	2.2	0.2	2.9	1.8	15.9	1.0	0.4	11.3
Ulmus americana	2.0	1.0	- -	- -	- -	- -	- -	- -	3.0	0.057	7.5	1.6	0.2	2.9	1.6	15.9	9.0	3.7	29.8
Fraxinus pennsylvanica	- -	- -	- -	- -	- -	2.0	- -	- -	2.0	0.598	5.0	1.1	1.8	2.0	1.6	61.8	1.0	0.6	51.7
Gymnocladus dioica	2.0	- -	- -	- -	- -	- -	- -	- -	2.0	0.041	5.0	1.1	0.1	2.0	1.1	15.9	3.0	1.7	54.1
Quercus macrocarpa	- -	- -	- -	- -	- -	- -	1.0	- -	1.0	0.434	2.5	0.5	1.3	1.0	0.9	74.0	1.0	0.6	51.7
Carya tomentosa	- -	- -	- -	- -	- -	1.0	- -	- -	1.0	0.345	2.5	0.5	1.0	1.0	0.8	66.8	1.0	0.5	11.8
Acer rubrum	- -	- -	- -	- -	- -	1.0	- -	- -	1.0	0.295	2.5	0.5	0.9	1.0	0.8	61.8	- -	- -	- -
Tilia americana	- -	- -	1.0	- -	- -	- -	- -	- -	1.0	0.112	2.5	0.5	0.3	1.0	0.6	37.4	6.0	2.4	45.1
Asimina triloba	1.0	- -	- -	- -	- -	- -	- -	- -	1.0	0.017	2.5	0.5	0.1	1.0	0.6	15.9	- -	- -	- -
Carya ovata	1.0	- -	- -	- -	- -	- -	- -	- -	1.0	0.037	2.5	0.5	0.1	1.0	0.5	19.9	16.0	6.7	35.6
Others (7 species)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	26.0	10.3	- -
Totals	50.0	35.0	21.0	14.0	17.0	20.0	12.0	17.0	186.0	33.144	- -	100.0	100.0	100.0	100.0	- -	233.0	100.	

Table 2. Density (stems/ha), frequency (%), relative density, relative frequency, and importance value for large saplings (≥ 5.0 cm dbh - 9.9 cm dbh), intermediate saplings (≥ 2.5 cm dbh - ≤4.9 cm dbh), and small saplings (≥50 cm tall - ≤2.4 cm dbh) encountered during sampling of Robeson Hills Woods Nature Preserve, Lawrence County, Illinois.

Large Saplings (5.0—9.9 cm dbh)					
	Density (stem/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
Acer saccharum	80	35.0	51.6	63.6	57.6
Prunus serotina	40	10.0	25.8	18.1	21.9
Carpinus caroliniana	20	5.0	12.9	9.1	11.0
Cornus florida	10	2.5	6.5	4.6	5.6
Carya cordiformis	5	2.5	3.2	4.6	3.9
Totals	155		100.0	100.0	100.0
Intermediate Saplings (2.5—4.9 cm dbh)					
Acer saccharum	225	62.5	71.3	65.8	68.5
Asimina triloba	45	17.5	14.3	18.4	16.4
Celtis occidentalis	15	5.0	4.8	5.3	5.0
Carpinus caroliniana	10	5.0	3.2	5.3	4.3
Fagus grandifolia	15	2.5	4.8	2.6	3.7
Tilia americana	5	2.5	1.6	2.6	2.1
Totals	315		100.0	100.0	100.0
Small Saplings (>50 cm tall - 2.4 cm dbh)					
Asimina triloba	4160	95.0	80.6	37.3	59.0
Acer saccharum	645	77.5	12.5	30.4	21.5
Fagus grandifolia	95	30.0	1.8	11.8	6.8
Celtis occidentalis	70	10.0	1.4	3.8	2.6
Tilia americana	25	10.0	0.5	3.8	2.2
Carya cordiformis	30	7.5	0.6	2.9	1.8
Ulmus rubra	50	5.0	1.0	2.0	1.5
Carpinus caroliniana	10	5.0	0.2	2.0	1.1
Fraxinus americana	15	5.0	0.3	2.0	1.1
Gymnocladus dioica	40	2.5	0.8	1.0	0.9
Liriodendron tulipifera	5	2.5	0.1	1.0	0.5
Carya glabra	5	2.5	0.1	1.0	0.5
Fraxinus americana	5	2.5	0.1	1.0	0.5
Totals	5155		100.0	100.0	100.0

Table 3. Density (stems/ha) arranged by aspect, total density (stems/ha), frequency (%), relative density, relative frequency, and importance value for shrubs encountered during sampling of Robeson Hills Woods Nature Preserve, Lawrence County, Illinois.

	Density (stem/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
Staphylea trifolia	295	5.0	85.6	18.2	51.9
Sambucus canadensis	15	7.5	4.3	27.2	15.8
Euonymus alata	15	5.0	4.3	18.2	11.3
Lindera benzoin	10	5.0	2.9	18.2	10.5
Rosa multiflora	10	5.0	2.9	18.2	10.5
Totals	345	27.5	100.0	100.0	100.0

Table 4. Density (stems/ha) arranged by aspect and total density (stems/ha), frequency (%), relative density, relative frequency, and importance value for ground layer taxa encountered during sampling of Robeson Hills Woods Nature Preserve, Lawrence County, Illinois.

Species	Total Density (stem/ha)	Freq. (%)	Rel. Den.	Rel. Freq.	IV
Hydrophyllum canadense	95100	72.5	28.55	10.0	19.4
Laportea canadensis	108700	40.0	32.63	5.5	19.2
Asarum canadense	28500	50.0	8.57	6.9	7.9
Cystopteris protrusa	25300	45.0	7.58	6.3	7.0
Acer saccharum	15100	60.0	4.54	8.3	6.4
Viola spp.	12000	45.0	3.61	6.3	5.0
Fraxinus americana	5900	57.5	1.78	7.9	4.9
Arisaema triphyllum	6800	37.5	2.05	5.1	3.6
Asimina triloba	3100	37.5	0.93	5.1	3.0
Prunus serotina	2900	32.5	0.87	4.5	2.7
Parthenocissus quinquefolius	2800	27.5	0.84	3.8	2.3
Phlox divaricatus	3100	22.5	0.93	3.1	2.0
Impatiens capensis	4100	15.0	1.23	2.1	1.7
Ulmus rubra	1400	20.0	0.42	2.7	1.6
Carya cordiformis	800	17.5	0.24	2.4	1.3
Polygonum virginianum	1600	12.5	0.48	1.7	1.1
Pilea pumila	4100	5.0	1.24	0.7	1.0
Quercus alba	600	12.5	0.18	1.7	1.0
Agrostis hyemalis	1300	10.0	0.39	1.4	0.9
Vitis spp.	500	10.0	0.15	1.4	0.8
Staphylea trifolia	1800	5.0	0.54	0.7	0.6
Liriodendron tulipifera	300	7.5	0.09	1.0	0.6
Solidago caesia	1900	5.0	0.27	0.7	0.5
Athyrium pycnocarpon	1100	5.0	0.33	0.7	0.5
Carex spp.	700	5.0	0.21	0.7	0.5
Others (23 taxa)	4500	72.5	1.35	9.3	4.5
Totals	334000		100.0	100.0	100.0

Table 5. Ranking of tree species by importance value for plots that occurred on 2 slope aspects at Robeson Hills Nature Preserve, Lawrence County, Illinois. The species listed are those with the 10 highest overall importance values throughout the preserve and are arranged in descending importance value. Ranking of the taxa by importance value for each slope is in parenthesis.

	Aspect			
Species	Northeast (16 plots)		Southwest (14 plots)	
Acer saccharum	43.8	(1)	37.6	(1)
Fagus grandifolia	19.7	(2)	4.3	(7)
Celtis occidentalis	2.9	(5)	11.9	(2)
Liriodendron tulipifera	11.8	(3)	---	---
Quercus alba	—	---	11.4	(3)
Quercus rubra	---	---	10.9	(4)
Platanus occidentalis	2.8	(6)	3.6	(8)
Fraxinus americana	2.6	(7)	8.3	(5)
Carya glabra	2.1	(8)	6.5	(6)
Juglans nigra	3.3	(4)	---	---

Appendix I

ANNOTATED SPECIES LIST

The vascular flora of Robeson Hills Nature Preserve and Land and Water Reserve is arranged alphabetically within each taxonomic group. Nonnative taxa are indicated by an asterisk (*). Collection numbers are those of Edgin.

PTERIDOPHYTA

ADIANTACEAE

Adiantum pedatum L.

ASPLENIACEAE

Asplenium platyneuron (L.) Oakes; E3355
Athyrium pycnocarpon (Spreng.) Tidestrom; E2041
Cystopteris protrusa (Weatherby) Blasd.; E2047
Polystichum acrostichoides (Mchx.) Schott.; E2066
Woodsia obtusa (Spreng,) Torrey; E3360

EQUISETACEAE

Equisetum arvense L.; E3357
Equisetum hyemale L. var. *affine* (Engelm.) A. A. Eaton; E3091

OPHIOGLOSSACEAE

Botrychium dissectum Spreng.; E3849
Botrychium dissectum Spreng. var. *obliguum* (Muhl.) Clute; E3848
Botrychium virginianum (L.) Sw.; E3352
Ophioglossum vulgatum L. var. *pseudopodum* (Blake) Farw.; E3356

GYMNOSPERMAE

CUPRESSACEAE

Juniperus virginiana L.; E3350

ANGIOSPERMAE

MONOCOTYLEDONAE

ARACEAE

Arisaema triphyllum (L.) Schott.; E2042
Arisaema dracontium (L.) Schott.; E5491

COMMELINACEAE

Tradescantia subaspera Ker.; E3056

CYPERACEAE

Carex albursina Sheldon; E2034
Carex blanda Dewey; E2072
Carex frankii Kunth; E3074
Carex grayi Carey; E3059
Carex grisea Wahl.; E3583
Carex jamesii Schwein.; E2024
Carex pensylvanica Lam. E3196
Carex rosea Willd.; E2065
Carex vulpinoidea Mchx.; E3582
Scirpus cyperinus (L.) Kunth; E5492

DIOSCOREACEAE

Dioscorea quaternata (Wait.) J. F. Gmel.; E3058

LILIACEAE

Erythronium albidum Nutt. E3194
Polygonatum commutatum (Schult.) A. Dietr.; E4981
Smilacina racemosa (L.) Desf; E3347
Trillium flexipes Raf.; E2027
Trillium recurvatum Beck; E2051
Trillium sessile L.; E2039
Uvularia grandiflora Sm.; E2029

ORCHIDACEAE

Aplectrum hyemale (Willd.) Nutt.; E3859
Galearis spectabilis (L.) Raf.
Liparis lilifolia (L.) Rich.; E4984
Spiranthes cernua (L.) Rich.; E3807

POACEAE

Bromus pubescens Muhl.; E3585
Cinna arundinacea L.; E3854
Diarrhena americana Beauv.; E3588
Elymus hystrix L.; E3046
Elymus villosus Muhl.; E3083
Elymus virginicus L.; E3066
Festuca obtusa Biehler; E3587
Glyceria striata (Lam.) Hitchc.; E3567
Leersia lenticularis Michx.; E5494
Leersia virginica Willd.; E3069A
Poa sylvestris Gray; E2073

SMILACACEAE

Smilax hispida Muhl.; E3082

DICOTYLEDONEAE

ACANTHACEAE
Ruellia strepens L.; E3096

ACERACEAE
Acer negundo L.; E3815
Acer saccharinum L.; E3823
Acer saccharum Marsh.; E2061

AMARANTHACEAE
Iresine rhizomatosa Standley; E3053

ANACARDIACEAE
Toxicodendron radicans (L.) Kuntze;E4982

ANNONACEAE
Asimina triloba (L.) Dunal; E2060

APIACEAE
Cryptotaenia canadensis (L.) DC.; E3081
**Daucus carota* L.; E5496
Erigenia bulbosa (Michx.) Nutt.;E5497
Osmorhiza claytonii (Michx.) Clarke; E5498
Osmorhiza longistylis (Toffey) DC.; E2046
Sanicula canadensis L.; E3577
Sanicula gregaria Bickn.; E3054

ARALIACEAE
Panax quinquefolius L.; E3575

ARISTOLOCHIACEAE
Asarum canadense L. var. *reflexum* (Bickn.) Robins.; E2045

ASTERACEAE
Aster pilosus Willd; E3822
Aster lateriflorus (L.) Britt.; E3845
Aster novae-angliae L.; E3852
Aster x *sagittifolius* Wedem.; E3863
Bidens aristosa Mchx.; E3868
Cirsium discolor (Muhl.) Spreng.; E3819
Elephantopus carolinianus Raeusch.; E3077
Erigeron annuus (L.) Pers.; E3055
Erigeron philadelphicus L.; E3351
Eupatorium coelestinum L.; E5499
Eupatorium purpureum L.; E3088
Eupatorium rugosum ffoutt.; E3075
Eupatorium serotinum Michx.; E3821
Helianthus strumosus L.; E3867
Lactuca floridana (L.) Gaertn.; E3834
Prenanthes altissima L.; E3813
Rudbeckia laciniata L.; E5500
Senecio glabellus L.; E4989
Solidago caesia L.; E3865
Solidago canadensis L.; E3850
Solidago flexicaulis L.; E3080
Solidago ulmifolia Muhl.; E3825
Verbesina alternifolia (L.) Britt.; E3094
Vernonia gigantea (Wait.) Trel.; E3851

BALSAMINACEAE
Impatiens capensis Meerb.; E3062
Impatiens pallida Nutt.; E3061

BERBERIDACEAE
**Berberis thunbergii* DC.; E3346
Podophyllum peltatum L.; E2036

BIGNONIACEAE
Campsis radicans (L.) Seem.; E3569

BORAGINACEAE
Hackelia virginiana (L.) I. M. Johnston; E3095
Mertensia virginica (L.) Pers.; E2031
Myosotis macrosperma Engelm.; E2069

BRASSICACEAE
Cardamine bulbosa (Schreb.) BSP.; E5502
Cardamine douglassii (Torr.) Britt.; E2044
**Cardamine hirsuta* L.:E2033
Dentaria laciniata Muhl.; E2053
**Rorippa sylvestris* (L.) K. Koch; E3574

CAESALPINIACEAE
Cercis canadensis L.; E2034
Gymnocladus dioica (L.) K. Koch; E3574

CAMPANULACEAE
Campanula americana L.; E3071
Lobelia inflata L.; E3808

CAPRIFOLIACEAE
**Lonicera japonica* Thunb., E3847
**Lonicera maackii* (Rupr.) Maxim., E3838
Sambucus canadensis L.; E3824
Symphoricarpos orbiculatus Moench.; E3841

CARYOPHYLLACEAE
Silene stellata (L.) Ait.; E3812
**Stellaria media* (L.) Vill.; E4985

CELASTRACEAE
**Euonymus alata* (Thunb.) Sieb.; E2071
Euonymus atropurpurea Jacq.; E3070
**Euonymus europaea* L.; E5504

CHENOPODIACEAE
Chenopodium album L.; E3860

CONVOLVULACEAE
Ipomoea pandurata (L.) G. F. W. Mey.; E5505

CORNACEAE
Cornus drummondii C. A. Mey.; E3833
Cornus florida L.; E3826

CORYLACEAE
Carpinus caroliniana Walt.; E3837
Corylus americana Walt.; E3831
Ostrya virginiana (Mill) K. Koch; E2070

EBENACEAE
Diospyros virginiana L.; E3827

ELAEAGNACEAE
**Elaeagnus umbellata* Thunb.; E3836

EUPHORBIACEAE
Acalypha rhomboidea Raf.; E3842

FABACEAE
Desmodium cusipidatum (Muhl.) Loud.; E5506
Desmodium nudiflorum (L.) DC.; E5507

FAGACEAE
Fagus grandifolia Ehrh.; E3855
Quercus alba L.; E3579
Quercus bicolor Willd.; E5508
Quercus macrocarpa Michx.; E5510
Quercus pagoda Raf; E3586
Quercus prinoides Wild. var. *acuminata* (Michx.) Gl.; E3067
Quercus rubra L.; E3811
Quercus velutina Lam.; E5509

GENTIANACEAE
Frasera carolinensis Walt.; E5511

GERANIACEAE
Geranium maculatum L.; E3348

HYDROPHYLLACEAE
Hydrophyllum appendiculatum Michx.; E4986
Hydrophyllum canadense L.; E3580
Hydrophyllum virginianum L.; E4986
Phacelia purshii Buckley

HYDRANGEACEAE
Hydrangea arborescens L.; E3578

HYPERICACEAE
Hypericum mutilum L.; E5515

JUGLANDACEAE
Carya cordiformis (Wang.) K. Koch ; E5516
Carya glabra (Mill.) Sweet; E3576
Carya ovata (Mill.) K. Koch; E5517
Carya tomentosa (Poir.) Nutt.; E5518
Juglans nigra L.; E 5519

LAMIACEAE
Agastache nepetoides (L.) Ktze.; E3060
Blephilia hirsuta (Pursh.) Benth., E3065, E3584
**Lamium purpureum* L. E3195
**Perilla frutescens* (L.) Britt; E3814
**Prunella vulgaris* L.; E3818
Scutellaria ovata var. *versicolor* (Nutt.) Fernald; E3049
Stachys tenuifolia Willd; E3063
Teucrium canadense L. var. *virginicum* (L.) Eat.; E3844

LAURACEAE
Lindera benzoin (L.) Blume; E30 51
Sassafras albidum (Nutt.) Nees; E3830

MAGNOLIACEAE
Liriodendron tulipifera L.; E3568

MENISPERMACEAE
Menispermum canadensis L.; E2068

MORACEAE
**Maclura pomifera* (Raf.) Schnieder; E5520
Morus rubra L.; E3866

NYSSACEAE
Nyssa sylvatica Marsh.; E5521

OLEACEAE
Fraxinus americana L.; E3856
Fraxinus pennsylvanica Marsh.; E3820

ONAGRACEAE
Circaea lutetiana Aschers. & Magnus spp. *canadensis* (L.) Aschers. & Magnus; E3571
Oenothera biennis L.; E3853

OROBANCHACEAE
Epifagus virginiana (L,) Bart.: E3857

OXALIDACEAE
Oxalis dillenii Jacq.; E3857
Oxalis stricta L.; E3573
Oxalis violacea L.; E5522

PAPAVERACEAE
Dicentra cucullaria (L.) Bernh.; E2048
Sanguinaria canadensis L.; E2030

PHRYMACEAE
Phryma leptostachya L.; E3093

PHYTOLACCACEAE
Phytolacca americana L.; E3084

PLATANACEAE
Platanus occidentalis L.; E3816

POLEMONIACEAE
Phlox divaricata L.; E2049
Phlox paniculata L.; E3064
Polemonium reptans L.; E2035

POLYGONACEAE
**Polygonum cespitosum* Blum var. *longisetum* (DeBruyn) Stewart; E3862
**Polygonum hydropiper* L.; E3085
Polygonum punctatum Ell.; E5523
Polygonum scandens L.; E3810
Polygonum virginianum L.; E3073

PORTULACACEAE
Claytonia virginica L.; E2054

RANUNCULACEAE
Actaea pachypoda Ell.; E3362
Anemone canadensis L.; E5524
Delphinium tricorne Michx.; E2052
Isopyrum biternatum (Raf.) T. & G.; E2038
Ranunculus abortivus L.; E4988
Ranunculus micranthus Nutt.; E2032
Ranunculus recurvatus Poir.; E3061
Ranunculus septentrionalis Poir.; E2028

ROSACEAE
Agrimonia pubescens Wallr.; E3068
Amelanchier arborea (Mchx. F.) Fern.; E5526
Geum canadense Jacq.; E3076
Geum vernum (Raf.) T. & G.; E2067
Prunus serotina Ehrh.; E3858
Rosa carolina L.; E5527
**Rosa multiflora* Thunb.; E2057

RUBIACEAE
Galium aparine L.; E3358
Galium circaezans Michx.; E3092
Galium concinnum T. & G.; E3089B
Galium triflorum Michx.; E3090

SALICACEAE
Populus deltoides Marsh.; E5741
Salix nigra Marsh.; E5740

SCROPHULARIACEAE
Mimulus alatus Ait.; E3069B

SIMAROUBACEAE
Ailanthus altissima (Mill.) Swingle; E3087

SOLANACEAE
Solanum ptycanthum Dunal.; E3048

STAPHYLACEAE
Staphylea trifolia L.; E3193

TILIACEAE
Tilia americana L.; E2058

ULMACEAE
Celtis laevigata Willd.; E3050
Celtis occidentalis L.; E3864
Ulmus americana L.; E3843
Ulmus rubra Muhl.; E3828

URTICACEAE
Boehmeria cylindrica (L.) Sw.; E3822
Laportea canadensis (L.) Wedd.; E3861
Pilea pumila (L.) Gray; E3079

VERBENACEAE
Verbena hastata L.
Verbena urticifolia L.; E3086

VIOLACEAE
Hybanthus concolor (T.F. Frost) Spreng.; E3047
Viola pratincola Greene; E3353
Viola pubescens var. *eriocarpa* (Schwein.) Russell; E2050
Viola sororia Willd.; E2040
Viola striata Ait.; E3354

VITACEAE
Ampelopsis cordata Michx.; E3566
Parthenocissus quinquefolia (L.) Planch.; E2055
Vitis aestivalis Michx.; E3829
Vitis vulpina L.; E3839

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TWENTY-YEAR WOODY VEGETATION CHANGES IN NORTHERN FLATWOODS AND MESIC FOREST AT RYERSON CONSERVATION AREA, LAKE COUNTY, ILLINOIS

Marlin Bowles[1], Michael Jones[2], Christopher Dunn[1], Jenny McBride[1], Charles Bushey[3], and Robbin Moran[4]

ABSTRACT: Conservationists are concerned that forest fragmentation and fire suppression are causing an increase in shade-tolerant species (e.g., maples) and a decline of fire-adapted oaks and associated species richness in midwestern forests. We tested whether such changes are occurring in flatwoods and mesic forest stands that were first sampled in 1975—1976 at the Ryerson Conservation Area in Lake County, Illinois. We re-sampled tree and shrub plots in these stands in 1997 and compared their changes over time. In 1976, the northern flatwoods was dominated by swamp white oak and white oak in large size classes, and by ash in small size classes. By 1977, these species had increased in stem numbers, resulting in a 23% increase in basal area. However, a large decline took place among mid-size oaks and shrub layer species over the 20-year period. Sugar maple dominated the mesic forest stand, where it increased in importance and now dominates all but the largest size class, which is oak-dominated. However, there was little gain in larger size classes, and basal area decreased 28%. Maples also increased in smaller size classes, whereas shrub layer species and mid-size class oaks and maples declined. Shrub layer stem density and species richness were much higher in flatwoods than in mesic forest, and a native species richness index also showed the northern flatwoods' groundlayer to be more than twice as rich as the mesic forest. Tree cores indicate that declining mid-size class trees arose in the late 1800s, while older age class oaks and maples predate settlement. The changes in flatwoods are apparently due to forest canopy maturation and canopy closure, a process that probably began with fire protection after European settlement. Decline of oaks in the mesic forest may be less closely linked with fire protection, and the increase in maple saplings might have been triggered by more recent loss of canopy elms. Over-browsing by eastern white-tailed deer could have enhanced the decline of shrubs in both stands. The trends of increasing ash and maples in these stands indicate that they will become less diverse unless management can restore canopy structure that will maintain shrub layer species and allow oak regeneration. Restoration goals and applied research are needed to guide recovery. Fire appears to be the principal tool, especially in flatwoods, but it may have positive and negative effects, and supplemental cutting of fire-resistant vegetation may be required.

INTRODUCTION AND PROBLEM

Replacement of fire-adapted oak (*Quercus*) species by shade-tolerant and fire-intolerant species such as sugar maple (*Acer saccharum*) is often characteristic of fire-protected midwestern forests (McIntosh 1957, Curtis 1959, Schlesinger 1976, Miceli et al. 1977, Lorimer 1985, Pallardy et al. 1991, Abrams 1992, Roovers and Shifley 1997). During this process, forest stand maturation and canopy closure decrease canopy light penetration, thereby preventing oak reproduction and lowering tree species diversity (Christensen 1977, Lorimer 1984, McGee 1986). These successional changes are thought to be occurring in oak forests of the Chicago region, but have not been well documented (Bowles et al. 2000). We tested for such changes in a northern flatwoods and a mesic forest stand at the Ryerson Conservation Area, Lake County, Illinois. These stands were identified and sampled by the Illinois Natural Areas Inventory (INAI) in 1976 and were found to represent old second-growth stand structure. The Ryerson mesic stand was also sampled independently in 1975, providing additional data. Our objectives were 1) to compare successional changes in these stands, 2) to describe the chronology and potential causes for the changes, and 3) to discuss management and restoration objectives.

STUDY AREAS

Landscape context

The Ryerson Conservation Area lies on the east side of the Des Plaines River, in Sec. 23, 25, and 26, T43N, R11E, and is located in the Western Morainal Section of the Morainal Natural Division (Swink and Wilhelm 1994). In this area in 1976, the Illinois Natural Areas Inventory (INAI) identified 329 acres of high-quality mesic floodplain forest, dry-mesic and mesic upland forest, and northern flatwoods. These forests were protected from eastward-moving prairie fires by the Des Plaines River, resulting in a transition from forest nearest the river to woodland, savanna and then prairie to the east (Figure 1). The

[1]The Morton Arboretum, Lisle, Illinois; [2]Christopher Burke Engineering, Rosemont, Illinois;
[3]Montana Prescribed Fire Services, Billings, Montana; [4]The New York Botanic Garden, Bronx, New York

frequency and intensity of presettlement fires that occurred across this gradient are poorly understood. The mesic floodplain was one of the most fire-protected forest habitats of the Chicago region, which allowed development of presettlement maple-basswood forest (Moran 1978), and the extent to which this forest may have burned is unknown.

Historic vegetation

Northern flatwoods occur on seasonally wet, impervious glacial till. This vegetation type is often dominated by swamp white oak (*Quercus bicolor*) and is thought to have been savanna or woodland prior to settlement (White and Madany 1978). The flatwoods stand at Ryerson was located in presettlement woodland (Figure 1), in which the Public Land Survey recorded "bur oak," "white oak," and "white ash" witness trees at a mean density of 52 trees/ha, and woody undergrowth of "elm," "white ash," "pin oak," and "hickory" (PLS data from east line of Sec. 25). In 1976, the INAI found the flatwoods stand at Ryerson dominated by *Q. bicolor,* with lower abundance of *Q. alba* and Hill's oak (*Q. ellipsoidalis*). Nomenclature follows Swink and Wilhelm (1994), which treats *Q. ellipsoidalis* as scarlet oak (*Q. coccinea*).

The Ryerson mesic stand occupies a river floodplain terrace in which the Public Land Survey recorded a single maple witness tree and undergrowth of "lynn" (basswood), "hickory" and "maple." Tree density could not be calculated because the tree was apparently located directly on the quarter corner (PLS data from north line of Sec. 25). In 1976, the stand was *Acer saccharum*-dominated with subdominance by red elm (*Ulmus rubra*) and red oak (*Quercus rubra*); however, a large amount of American elm (*U. americana*) was lost from the canopy of this stand in the 1960s due to Dutch elm disease (C. Bushey pers. obs.). The Ryerson Conservation Area was also grazed to some extent by horses and cattle in the past, and more recently, its ground layer vegetation has been severely impacted by browsing of eastern white-tailed deer (Anderson 1994). The area is managed by the Lake County Forest Preserve District.

METHODS

Historic data collection

In 1976, the INAI sampled the flatwoods and mesic stands with nested tree and shrub plots at 20 sampling points equally spaced along two randomly located transect lines (Table 1). These transects were not permanently marked, but their locations were traced on aerial photo overlays. Overstory tree sampling included tree species basal area (BA) with a 3-BA factor metric wedge prism, and a tally of trees > 1 dm dbh (diameter at 1.37 meter high) by 1-dm size class from circular 0.025 hectare plots. Woody understory sampling included density of shrubs and tree saplings > 1m high but < 1 dm dbh in ten circular 0.001 hectare plots at alternating sampling points. These methods compromise calculation of BA because wedge prism counts are biased toward larger trees, and dbh was recorded by size class rather than actual diameter.

In 1975, C. Bushey and R. Moran sampled the Ryerson mesic stand with 68 square 0.01-hectare ($100m^2$) plots (Table 1). Their sampling transects were not permanently marked, but locations were mapped. The sampling plots were equally spaced along one ~200-meter north-south transect and along three parallel ~350-meter east-west transects. Within each plot, all trees ≥ 10cm dbh were identified and measured for exact dbh. All tree saplings < 10 cm dbh in each plot were identified and placed in either 2.5 - < 6.2 cm dbh or 6.2 - < 10 cm dbh size classes.

Data collection in 1997

All new sampling transects were located as precisely as possible based on original maps and marked with conduit stakes. To resample using similar methods to the INAI, tree dbh was measured in each of the twenty 0.025 ha circular plots and assigned to 1-dm size classes. Shrub and sapling densities were recorded from all 20 sampling points in the 0.001 ha circular plots. We also sampled ground layer woody and herbaceous species presence and estimated their cover in 1 m^2 plots at each of the sampling points. Because of intergradation between bur oak (*Q. macrocarpa*) and *Q. bicolor* (Swink and Wilhelm 1994), and difficulty in separating immature *Fraxinus americana* and *F. pennsylvanica,* these species were combined into *Q. bicolor* and *Fraxinus* sp, respectively, for flatwoods data analysis. To replicate the data set collected by Bushey and Moran in the mesic stand in 1975, we sampled 68 circular 0.01-hectare plots (radius = 5.64 m) along the relocated transect lines. As in 1975, all trees ≥ 10 cm dbh were identified and measured for exact dbh within each plot, and saplings were placed in either 2.5 - < 6.2 cm dbh or ≥ 6.2—10 cm dbh size classes.

To establish tree cohort chronologies, tree cores were taken from *Quercus alba* and *Q. bicolor* in the flatwoods and from *Acer saccharum* and *Q. rubra* in the mesic stand. Because of limited numbers of smaller size class oaks, these species were supplemented with cores from similar habitats elsewhere in the Chicago region (Bowles et al. 2000).

Woody vegetation data analysis

For northern flatwoods, we compared our 1997 sampling data with the INAI 1976 data. Following Bowles et al. (2000), basal area was calculated by using the midpoint of each 1-dm size class in which a tree was tallied to estimate its stem radius (r) for the formula BA/ha = (πr^2) x (stems/ha). Importance values (IV) were calculated for each species as IV = ½ Σ (relative BA + relative density). Changes in structure were determined by comparing between years the BA and number of stems sampled by size class for all tree species. For shrub layer species, we compared the mean number of stems and species present per plot for each stand between 1976 and

1997 with t-tests. We also partitioned shrub layer species into three groups comparing true shrubs, understory trees, and tree saplings that represent potential canopy trees. We tested for proportional changes in stem densities among these species groups using Chi-square analysis in contingency tables.

For the mesic stand, we compared our 1997 data with the Bushey-Moran 0.01 ha plot data to determine change in tree species density, frequency, BA, and importance values, where IV = 1/3 Σ (relative density + relative frequency + relative BA). For these data, actual BA was calculated based on tree dbh values, where BA = (πr^2) x (stems/ha). We also used size class medians to estimate BA as a comparison with actual measures. We combined INAI and Bushey-Moran data for comparing changes in tree density by size class, providing the largest possible data set for this measure. For saplings, we compared temporal differences in stem densities in the 2.5 - < 6.2 cm dbh and the ≥ 6.2—10 cm dbh size classes. For shrub layer species, we compared the mean number of stems and species present per plot for each stand between 1976 and 1997 with t-tests.

Tree ring analysis

Ages of tree species based on tree ring counts were regressed against corresponding tree diameters (including bark), using linear regression and power functions. No oaks were available to provide ring counts for the 1 - < 2 dm size class. To compensate, one age-diameter correlate was randomly selected from the inner 5 cm core length of each core and added to the data set. Although bark thickness was not included, it would be negligible at this small size class. Power functions provided the best fit for *Quercus alba* and *Q. bicolor* in flatwoods, while linear regressions had the best fit for *Acer saccharum* and *Q. rubra* from mesic stands. More precise aging would require the number of years for trees to achieve tree-coring height under forest conditions. This is probably up to 10 years or more for oaks (G. Ware, pers. comm..) and longer for *A. saccharum*, which can persist in the shrub layer for at least 30 years (Hett 1971, Marks and Gardescu 1980).

Ground layer data analysis

For ground layer vegetation, frequencies and mean cover/m^2 were calculated, and species were ranked by their importance value, where IV = ½ Σ (relative frequency + relative cover), within the alien, graminoid, herbaceous, and woody species groups. We also calculated Species Richness Index (SRI) values for the flatwoods and mesic stands following Bowles et al. (2000). To derive the SRI, mean plot richness of all species ($\bar{x}$ R) was calculated by averaging the number of species per plot across all plots. The SRI is calculated as: [SRI = $\bar{x}$ R x *Ln*S], where *Ln*S = the natural logarithm of the total number of all species sampled. The Native Richness Index (NRI) uses mean plot richness of native species ($\bar{x}$ R_N), and is calculated as [NRI = $\bar{x}$ R_N x *Ln*NR] where *Ln*NR = natural logarithm of the total number of native species sampled. The difference between SRI and NRI reflects the Alien Component (AC) of species richness.

RESULTS

Northern flatwoods

Basal area in flatwoods increased from 20.5 to 26.6 m^2/ha (stand data are in Appendices). *Quercus bicolor*, the dominant species, increased in importance, whereas *Quercus alba* and *Q. coccinea* declined. Total stand density increased from 248 to 286 stems/ha, primarily due to a 100% increase in the smallest size class from *Fraxinus* sp., *F. nigra*, and *Ulmus americana*, as well as *Acer saccharum* and basswood (*Tilia americana*) (Figure 3). In contrast, stem numbers dropped in the 2 - < 4 dm size classes due, almost exclusively, to decline in *Quercus* species. In 1976, peak distributions occurred in the 2 - < 3 dm size class for *Q. alba* and the 3 - < 4 dm size class for *Q. bicolor* and *Q. coccinea*. Based on tree age-dbh regressions, these size classes correspond to cohorts that arose in about 1880—1890, with slower growth for *Q. alba* [age = 4.4839 * diam.$^{(.9114)}$] than for *Q. bicolor* [age = 2.8488 * diam.$^{(.9752)}$]. After 20 years, these cohorts appear to have shifted to larger size classes, with about 50% loss of stem numbers and essentially no recruitment in the smaller size class (Figure 3). This also resulted in a substantial shift in BA toward larger size classes (Figure 4). The oldest trees sampled in 1997 were *Q. bicolor* in the 8—9 dm size class that appears to have originated in about 1780.

In the flatwoods shrub layer, 15 species were sampled in 1976, with a density of 13,100 stems/ha. By 1997, stem density and species richness had declined significantly, with a proportionally greater decline in shrubs than trees (Figure 5). American hazelnut (*Corylus americana*), the dominant shrub, dropped 97% from 3700 stems/ha in 1976 to 100 stems/ha in 1997. Blue beech (*Carpinus caroliniana*), the most abundant small tree, dropped from 4100 to 2850 stems/ha, and saplings of *Fraxinus* sp and *Ulmus* sp dropped from 2000 to 300 stems/ha.

The flatwoods ground layer sample included 61 native species. *Potentilla simplex* was the most important species, followed in importance by *Geum canadensis, Galium aparine*, and *Carpinus caroliniana*. Native plot richness averaged 9.30 species, with a Native Richness Index of 33.38, and no alien species were sampled (Figure 6). Herbaceous species dominated the ground layer, but woody species accounted for 25% importance (Figure 6).

Mesic forest

Basal area in mesic forest at Ryerson decreased from 34.3 to 25.6 m^2/ha, with overall stand density dropping from 300 to 283.8 stems/ha. The estimate of BA based on size-class midpoints was in close agreement with BA calculated from actual dbh data, showing a 28.2% decline from 33.9 to 24.4 m^2/ha, which occurred across all but the two smallest size classes (Figure 4). *Acer saccharum*, the single dominant tree, declined in BA, but increased in IV as almost all other tree species declined in importance (Figure 2). *Ulmus rubra*, primarily an understory species, remained the second most important species, while *Quercus rubra*, a canopy species, remained the third most important species. *Fraxinus americana* was the fourth most important species in 1975, but dropped below *U. americana* and *Q. macrocarpa* in 1997 (Figure 2). Ten other species had minor contributions to IV in 1975 and 1997; among these species, *Carpinus caroliniana*, *Quercus coccinea*, *Q. alba*, and *Carya cordiformis* were not resampled in 1997.

Shifts in species importance corresponded to changes in size class distribution (Figure 7). Among all species, the greatest changes were an increase from 113 to 137 stems/ha in the 1 - < 2 dm size class and a drop from 69 to 32 stems/ha between 4 - < 6 dm. *Acer saccharum* made a large contribution to these changes by increasing to over 100 stems/ha in the smallest (1 - < 2 dm) size class and by dropping from 32 to 12 stems/ha in the 4 - < dm range. Based on age-dbh regression, the 4 - < 5 dm size class corresponds to a maple cohort that began in about 1875 (age = dbh * 2.234 + 0.55). The oldest maples, found in the 8—9 dm size class in 1997, may have originated in about 1807, or earlier if they had survived as suppressed saplings. *Quercus rubra*, the most abundant oak in the mesic stand, also had a peak size class distribution in the 4 - < 5 dm range, which corresponds to an origin of about 1870 (age = dbh * 1.74 + 26.7). The largest *Q. rubra* individuals, found in the 8—9 dm size class in 1997, probably originated in about 1822, while *Q. alba* and *Q. macrocarpa* individuals, which are infrequent, predate 1800 in origin. *Fraxinus americana* stems peaked in the 5 - < 6 dm size class and also declined, but not enough cores were available to age this cohort. In the subcanopy, *Ulmus rubra* declined in the 1 - < 2 dm size class, but increased in the 3 - < 4 dm size class. *Ulmus americana* was present only in the 1 - < 4 dm size class range in 1975, and dropped almost 50% in stems/ha by 1997.

Significant changes occurred in sapling and shrub layer plots between 1975 and 1997. Sapling stems increased from 17 to 313 stems/ha in the 0.25 – 5 < 6.2 cm size class and from 148 to > 500 stems/ha in the 0.62 - 1 dm size class (Table 2). *Acer saccharum* accounted for 90% or more of the stems in these two classes, whereas *Carpinus caroliniana*, black cherry (*Prunus serotina*), and *Ulmus rubra* disappeared from the plots in 1997. In shrub-layer plots, total density dropped from 7000 stems/ha in 1976 to 1527 stems/ha in 1997 (Figure 4), and mean stem density and plot species richness dropped significantly from 7.0 to 1.53 stems/plot and from 1.53 to 0.85 species/plot (Figure 5). Only three shrub layer species were sampled, with *A. saccharum* accounting for 97% of all stems in 1997. *Ulmus rubra*, the only other important shrub layer species, had 1400 stems/ha in 1976, but was not resampled in 1997.

In 1997, the mesic ground layer sample included 29 native species. *Acer saccharum* was the most important species, followed by *Allium tricoccum* var. *burdickii*, *Erythronium albidum*, and *Podophyllum peltatum*. *Alliaria petiolata* was the only alien species sampled. Plot richness of native species averaged 4.95 species, with a Native Richness Index of 16.67 (Figure 6). Herbaceous species dominated the ground layer, but woody species accounted for > 40% importance (Figure 6).

DISCUSSION

Processes of forest change

The deterioration in forest composition and structure at the Ryerson Conservation Area fits a stand maturation model for mixed maple-oak stands that includes lack of oak reproduction, loss of mid-size-class oaks, and replacement of oaks by shade-tolerant species (e.g., Christensen 1977, Abrams and Downs 1990, Oliver and Larson 1990, Abrams 1992). These changes occur because oaks are relatively shade-intolerant and establish after canopy-opening disturbances. Survivorship of oak seedlings and saplings then declines as canopies close (Lorimer 1983, Lorimer 1985, Crow 1988, Crow 1992). As a result, oak stands are unstable or transitional without recurring disturbance, and shift toward an internal canopy gap-phase process that favors shade-tolerant species and leads to mortality of mid-size-class oaks (Lorimer 1981, McCune and Cottam 1985, Abrams 1992). The decline in shrub layer species also appears to fit the same model. Many shrubs sprout after fire and are relatively shade-intolerant, preferring the open conditions of white oak stands, and decline with increasing BA (McIntosh 1957, Loucks and Schnur 1976). However, as discussed below, different factors may have caused stand deterioration in the flatwoods and mesic stands.

Chronology and causes of change

The changes in composition and structure of forest stands at Ryerson Conservation Area appear to reflect responses to changes in disturbance regimes that began in the 1800s. Chicago region oak forest stands are assumed to have been subject to frequent fires prior to settlement, with oak cohorts becoming established during periods without fire (Gleason 1913, McAndrews 1966, Moran 1978, Grimm 1983, 1984, Anderson 1991, Bowles et al. 1994). Burning declined after settlement in the mid 1800s, but was often replaced by human disturbance, including tree cutting and grazing, as well as occasional burning (e.g., Nowacki and Abrams 1997, Mendelson 1998). The peak size class distributions for oaks at Ryerson corresponds to the late 1800s, which suggests that burning or other disturbances were halted at that time, allowing establishment of oak cohorts in the flatwoods and mesic forest stands. Logging after the 1871 Chicago fire may have opened tree canopies and allowed establishment of oaks and maples.

The high degree of natural fire protection afforded to the mesic stand by its landscape position suggests that factors other than human-caused fire protection have contributed to its historic changes and current composition and structure. Nevertheless, these changes are at least indirectly linked to human causes such as the introduction of Dutch elm disease, over-grazing, and control of predators that has allowed deer herds to expand. For example, the loss of canopy *Ulmus americana* in the 1960s could have released the large cohort of sapling sugar maples, as well as the smaller red elm and black cherry. In Wisconsin, elm death promoted shrub growth in floodplain forests (Dunn 1986, 1987). However, previous grazing, as well as maple dominance, may have reduced the shrub layer and prevented a release after elm mortality. Recent changes in shrub layer structure and composition could also be related to over-browsing by deer, which winter-browse many shrubs and tree saplings and tend to prefer oaks and avoid maple (Strole and Anderson 1992). Stems and sprouts of blue beech are also heavily browsed by deer, which could have contributed to its decline in the understories of both stands, and its high importance in the flatwoods ground layer due to sprouting. The presence of old-growth oaks in the mesic stand may be evidence that some historic disturbances operated at scales larger than small canopy gaps, which favor maples (Canham 1985). Periodic fire could have been one of these factors. Another possibility is that the position of this stand on a floodplain terrace allows periodic flooding and ice-scouring that help maintain disturbance-adapted species such as oaks.

Projected changes and impacts

In northern flatwoods, the increase in BA and its gain in larger size classes indicate a trend toward old-growth structure. Because of the loss of mid-size class oaks and lack of oak reproduction, increasing ash and elm saplings appear poised to eventually enter the tree canopy. However, Dutch elm disease would prevent most elms from reaching canopy status, leaving ash species as future canopy replacements of oaks. The drop in shrub layer stem densities and species richness also indicates that the flatwoods shrub layer will become more monotypic with fewer shrubs and more tree saplings. Decline of hazel is particularly undesirable, as this shrub species dominated presettlement woody undergrowth and provides an important wildlife food source (Bowles et al. 1994, Bowles and Spravka 1994).

The structure and composition of the mesic stand are at a more advanced stage of maturation and development than the flatwoods because its landscape position on the fire-protected east side of the Des Plaines River allowed development of late-successional forest conditions (Moran 1978). However, recent changes mirror those that occurred in flatwoods, including a 20-year decline in mid-size class trees, an increase in shade-tolerant saplings (maples), and loss of shrub layer stem density and species richness. The drop in BA associated with its shift toward larger size classes may be due to replacement of larger oaks by smaller maples of similar ages. The increase in maple saplings indicates that this species should continue to replace oak, ash, and red elm and eventually replace old growth oaks as they are lost from the canopy. As in flatwoods, the shrub layer appears to be shifting toward dominance by few species; in this case, maples that will continue to add new cohorts to this stand.

Changing woody vegetation composition and structure may negatively affect animals and other plants. For example, shrub layers provide nesting habitat for forest interior songbirds (Whelan and Dilger 1992). Although we do not know if the decline in shrub layer stem densities at Ryerson has fallen below nesting thresholds for different bird species, a trend of continued decline should be of concern. Most plant species richness in forest stands occurs in the ground layer, in which richness decreases along a decreasing light gradient (Bowles and McBride 1998, Bowles et al. 2000). Although we lack data from 1976, a trend of decreasing ground-layer richness could have paralleled the decline in shrub-layer species, and might be more advanced in the mesic stand. For example, the 33.4 Native Richness Index value for the flatwoods exceeded index values for most Chicago region forest stands, which averaged 14.16 for maple stands, 22.58 for red oak stands, and 23.35 for white oak stands (Bowles et al. 2000). But the 16.7 NRI for the mesic stand was below that of most stands. The potential also exists for loss of a multitude of invertebrate species that would use declining understory species as obligate hosts.

MANAGEMENT ISSUES AND RECOMMENDATIONS

If maintaining biodiversity is a management objective of ecological restoration, it will be important to set appropriate restoration goals and alternatives. Although vegetation change is natural and expected (Pickett et al. 1992), restoration requires a context or reference system (Aronson et al. 1995), as well as implementation of processes needed to maintain the restored system. With respect to Ryerson, alternatives might include 1) returning composition and structure to a presettlement condition, 2) restoring historic (1975—1976) conditions, or 3) maintaining the composition and structure found in 1996 and preventing further species declines; each alternative will require restoration of fire to some degree as a system process. These potential targets involve tradeoffs and uncertainties. Presettlement conditions might be most desirable if we assume that they will maximize biodiversity, but we lack historic measures to set highly specific targets, and presettlement fire regimes are poorly known. The 1975—1976 data provide a more precise target for composition and structure; but they also represent a time frame under human influence, and it is unknown whether these conditions can be achieved or maintained. Maintaining current conditions may be most efficient, but involves a measurable loss of species richness that could be unacceptable to conservationists.

Once management goals are set, research will be needed to determine how woody species composition and structure can be managed and the effects of such management on other components of biodiversity. Because of the large amount of historic evidence for fire as a critical process in development and maintenance of oak forests (Crow 1988, Lorimer 1992, Abrams 1992), effects of fire must be a major component of a research strategy. As illustrated at Ryerson, landscape positions of forest stands determined the degree to which they were structured by fire and offer guidelines for the types of restoration management research they may require. The location of the Ryerson flatwoods in the woodland transition between forest and savanna, and its dominance by oaks, suggests tht fire was important in maintaining this stand, and that fire protection may have led to its recent structural changes. Therefore, fire will be critical for its management if restoration of early historic conditions are a goal.

The mesic forest location in a floodplain terrace and its dominance by old-growth maple indicate that fire would be a less important restoration tool for this stand, as it apparently owes its existence more to landscape fire protection than to fire (Moran 1978). Although the recent increase in maple saplings appears to have resulted from Dutch elm disease, a 1997 prescribed ground fire significantly reduced stem densities of seedling-size maples in this stand (Bowles et al. 2000). Thus, prescribed burning could be effective in reducing maples. Because of the presence of Dutch elm disease, it appears impossible to restore previous stand structure that included canopy elms. This suggests that novel management goals and multiple management tools may be needed for this stand.

Re-introducing fire may not reverse the canopy-level changes that appear to have caused losses of understory trees and shrubs. Therefore, we need to better understand how to manage canopy structure. This will entail numerous research questions. For example, at what scale do canopy gap dynamics in forest fragments maintain sufficient light levels for oak and shrub regeneration and for enhancing ground layer vegetation? Crow (1992) found that reduction of overstory and understory vegetation density increased survivorship and growth of *Q. rubra* seedlings relative to full canopy cover. Pubanz and Lorimer (1992) and Lorimer et al. (1994) found that reduction of canopy cover to 85% and removal of competing understory saplings enhanced oak seedling survivorship and growth, but suggested fire as a more natural alternative. Bowles and McBride (1998) found that canopy light controlled the distribution of graminoid and herbaceous ground layer vegetation in savanna, and recommended subcanopy thinning to restore ground layer structure. Also, what is the direct effect of differing fire frequencies and intensities on ground layer vegetation, and how does fire interact with reduced canopy cover to affect this vegetation? Luken and Shea (2000) found that burning an upland maple forest did not affect groundlayer richness, but did reduce maple stem densities of maple saplings. The ground fire that reduced maple densities at Ryerson still resulted in surviving maples at 1000—4000 stems/ha, which could allow significant maple recruitment (Bowles et al. 2000).

There are also important differences between presettlement fires and prescribed burns that have implications for management. Modern management fires do not occur in a landscape-scale presettlement context. As a result, they may not attain the intensity of large-scale fires, and may have different effects. Present-day fires can open seed beds that enhance establishment and spread of *Alliaria petiolata* (Anderson et al. 1996). Management fires may have severe negative effects on fire-sensitive organisms, and impacts of a variable fire regime on animals associated with forest vegetation are poorly known. This is particularly a concern in fragmented landscapes where many species have no fire refuge or source of recolonization after fire. Alternatives to fire may require artificial reduction of canopy cover by removal of sub-canopy trees and selective removal of larger maple saplings that would quickly fill canopy gaps created by management. Control of deer herds is apparently critical, as continued over-grazing may prevent recovery of woody and herbaceous species such as *Trillium grandiflorum* (Anderson 1994). These are difficult management decisions that should be tested by sound experimental approaches and more frequent monitoring than at 20-year intervals.

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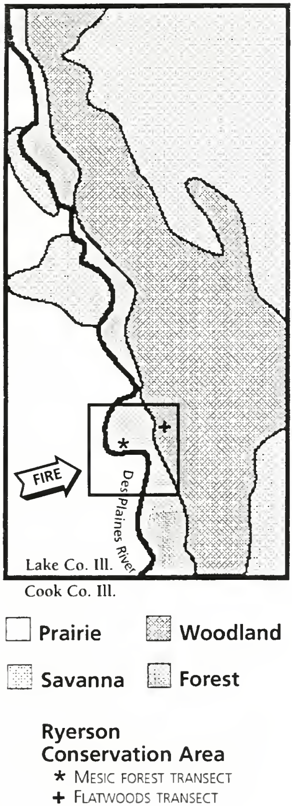
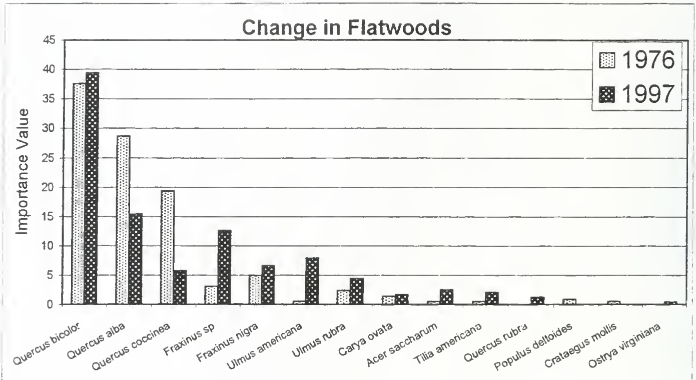


Figure 1) Landscape model for the pattern of presettlement savanna, woodland and forest in relation to the firebreak effect of the DesPlaines River in Lake County, Illinois (following Moran 1978). Arrow indicates direction of prairie fires driven by prevailing westerly winds. Inset is S26 (T43N, R11E) and shows, at Ryerson Conservation Area, the location of mesic forest (*) and flatwoods (+) transects within presettlement forest and woodland, respectively.



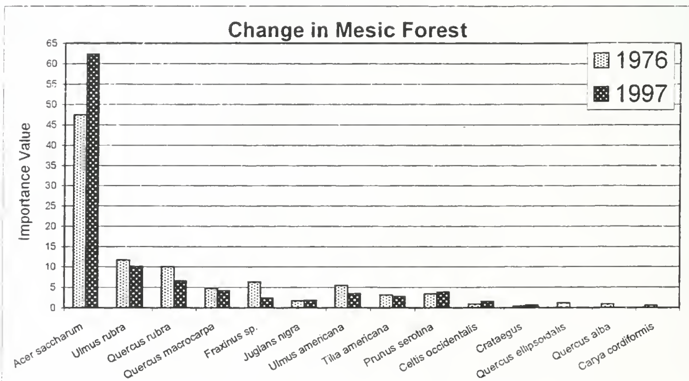


Figure 2) Importance values of tree species in 1975—1976 and in 1977 in flatwoods (upper) and in mesic forest (lower) at Ryerson Conservation Area.

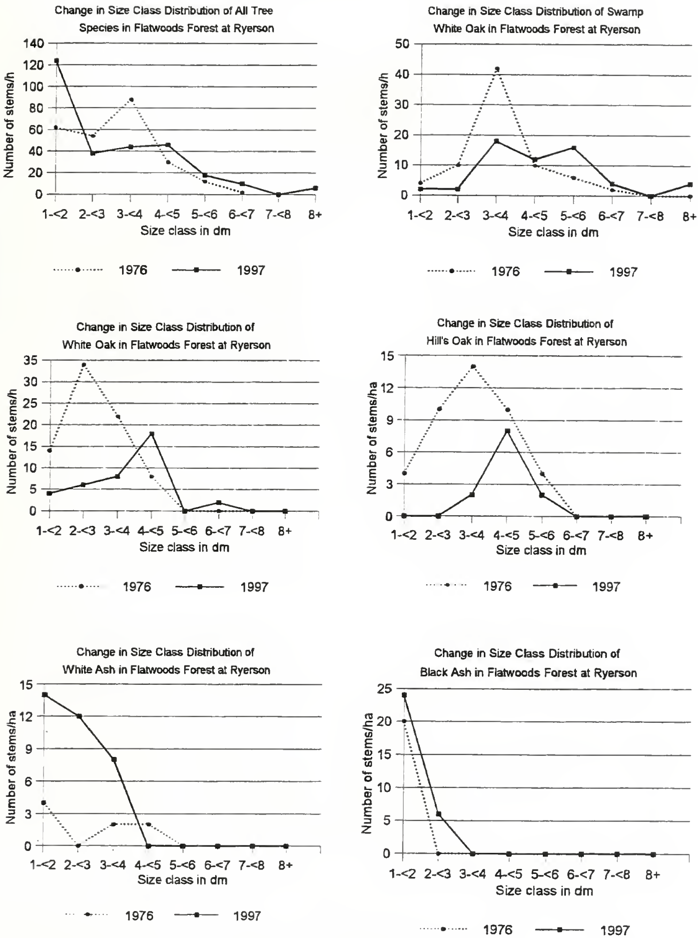
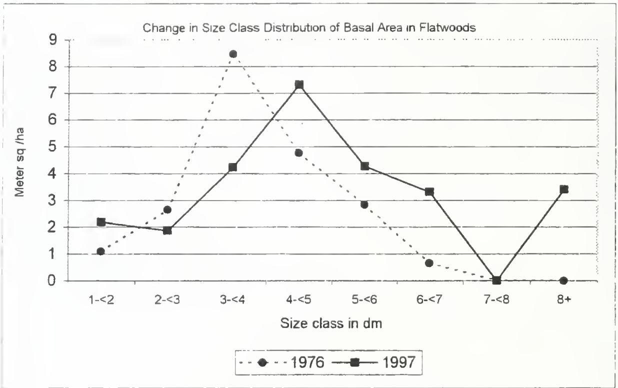


Figure 3) Temporal changes in size class distribution of all tree species and dominant tree species in flatwoods at Ryerson Conservation Area.



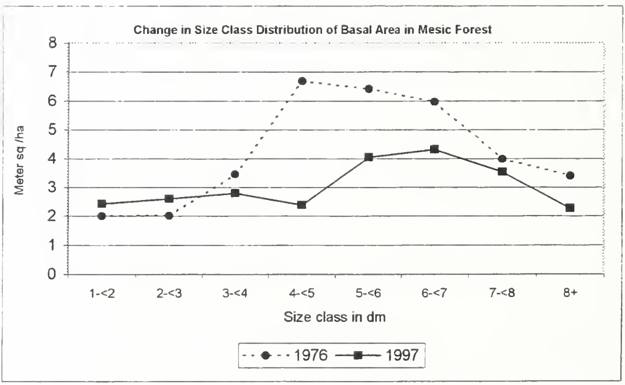
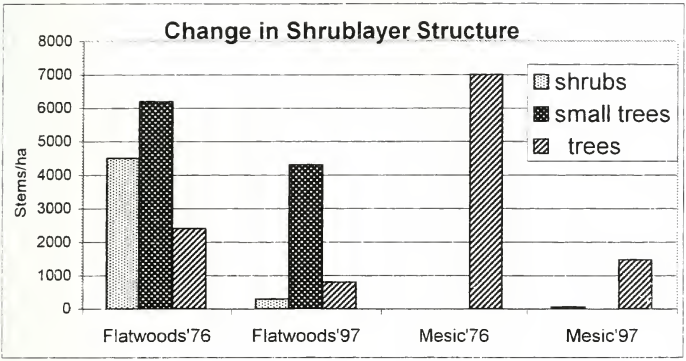


Figure 4) Temporal change and size class distribution of basal area in flatwoods (upper) and in mesic forest (lower) at Ryerson Conservation Area.



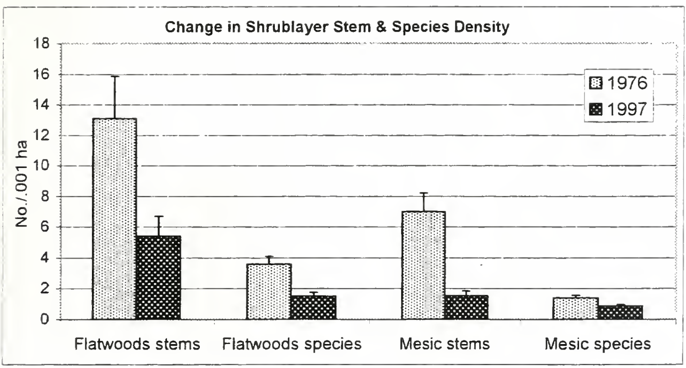
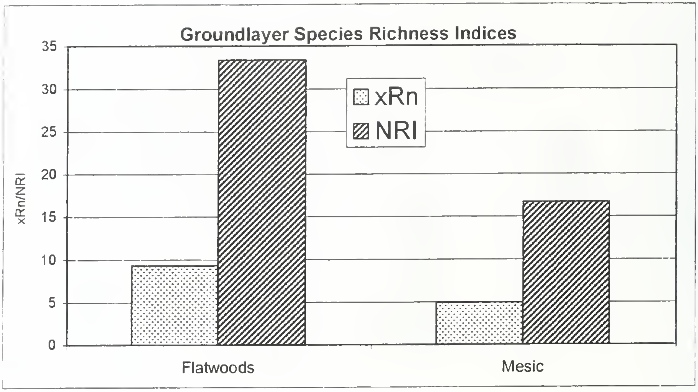


Figure 5) Temporal change in shrub layer structure (upper) and shrub layer stem density and species richness (lower) in flatwoods and mesic forest at Ryerson Conservation Area. Structure: flatwoods $P < 0.001$; mesic forest $P = 0.648$; density, all values $P < 0.01$.



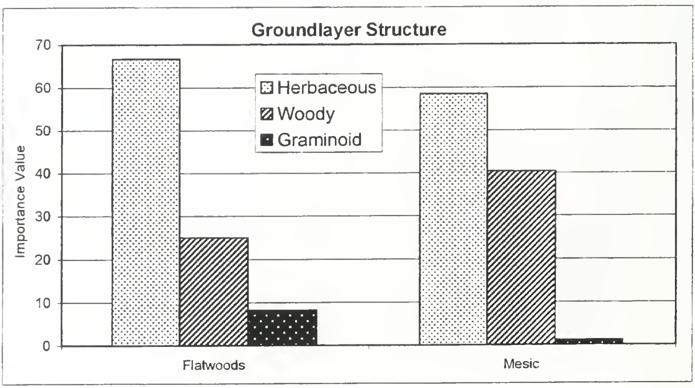


Figure 6) Groundlayer species richness (upper) and vegetation structure (lower) differed between flatwoods and mesic forest in 1997 at Ryerson Conservation Area. NRI = native richness index; xRn = mean plot richness of native species.

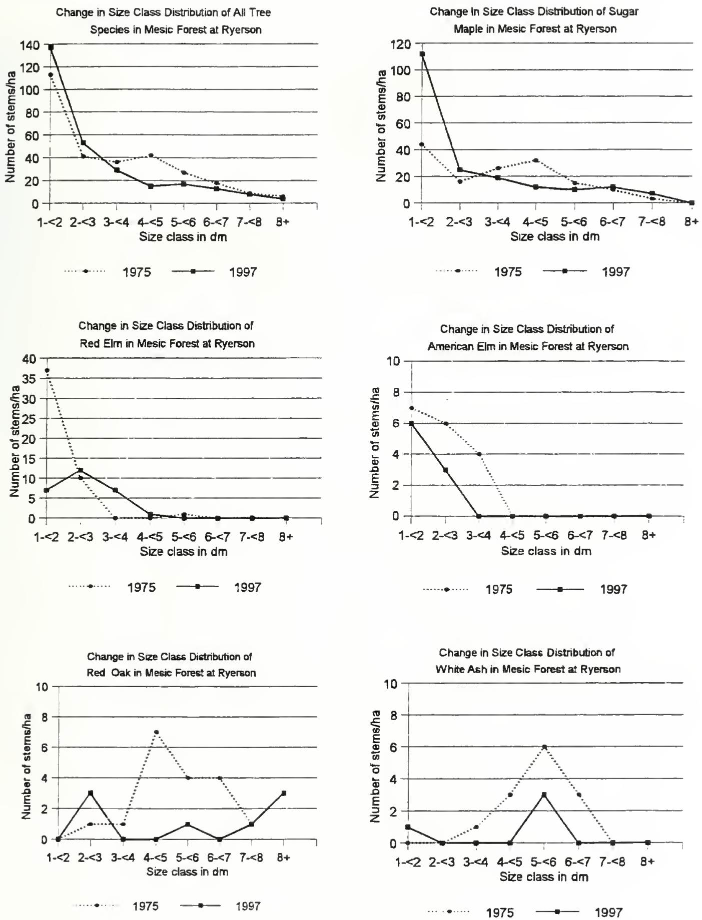


Figure 7) Twenty-year changes in size class distribution of all tree species and dominant tree species in mesic forest at Ryerson Conservation Area.

Table 1. Ryerson Conservation Area sampling methods used in 1975 by C. Bushey and R. Moran, and in 1976 by the Illinois Natural Areas Inventory field ecologists (K. Wilson and R. Moran).

Date	Vegetation type	Source
1975	Mesic upland forest	Bushey and Moran
1976	Mesic upland forest	Illinois Natural Areas Inventory
1976	Northern flatwoods	Illinois Natural Areas Inventory

Vegetation type	INAI (1976)	Bushey-Moran (1975)
Trees ≥ 1 dm dbh	20 plots (0.025 ha) 1 dm size class distribution wedge prism point samples	68 plots (0.01 ha) presence density dbh
Shrubs and trees < 1 dm dbh	10 plots (0.001 ha) presence density	68 plots (0.01 ha) presence density / 3.7 cm size class

Table 2. Temporal change in tree sapling stems/ha by size class (2.5 - < 6.2 cm and 6.2 - < 10 cm), based on 68 circular $100m^2$ (.01 ha) plots in mesic forest at Ryerson Conservation Area.

	0.25 - < 6.2 cm		**6.2 - < 10 cm**	
	1975	1977	1975	1997
Acer saccharum	14.71	307.35	107.35	475.0
Ulmus rubra	1.47	0	13.24	0
Carpinus caroliniana	0	0	8.82	0
Ulmus americana	1.47	2.94	5.88	18.0
Celtis occidentalis	0	0	4.41	1.47
Prunus serotina	0	0	2.94	0
Tilia americana	0	0	2.94	4.41
Crataegus spp	0	2.94	2.94	2.94
Carya cordiformis	0	0	0	1.47
Quercus macrocarpa	0	0	0	1.47
Ostrya virginiana	0	0	0	2.94
TOTAL	17.64	313.24	148.53	505.88

Appendix 1. Temporal change in tree species density, basal area, and Importance Values in flatwoods at Ryerson Conservation Area.

1976	**BA**	**RBA**	**Density**	**R. Den.**	**IV**
Quercus bicolor	8.95	43.66	78	31.45	37.56
Quercus alba	5.31	25.88	78	31.45	28.67
Quercus coccinea	4.45	21.70	42	16.94	19.32
Fraxinus americana	0.58	2.84	8	3.23	3.03
Fraxinus nigra	0.35	1.72	20	8.06	4.89
Ulmus americana	0.04	0.17	2	0.81	0.49
Ulmus rubra	0.30	1.46	8	3.23	2.34
Carya ovata	0.23	1.11	4	1.61	1.36
Acer saccharum	0.04	0.17	2	0.81	0.49
Tilia americana	0.04	0.17	2	0.81	0.49
Quercus rubra	0.00	0.00	0	0.00	0.00
Populus deltoides	0.19	0.94	2	0.81	0.87
Crataegus mollis	0.04	0.17	2	0.81	0.49
Ostrya virginiana	0.00	0.00	0	0.00	0.00
TOTAL	20.50	100.00	248	100.00	100.00

1997	**BA**	**RBA**	**Density**	**R. Den.**	**IV**
Quercus bicolor	14.46	54.36	70	24.48	39.42
Quercus alba	4.66	17.52	38	13.29	15.40
Quercus coccinea	1.94	7.29	12	4.20	5.74
Fraxinus americana	2.26	8.50	48	16.78	12.64
Fraxinus nigra	0.72	2.70	30	10.49	6.60
Ulmus americana	0.86	3.22	36	12.59	7.90
Ulmus rubra	0.85	3.19	16	5.59	4.39
Carya ovata	0.14	0.53	8	2.80	1.66
Acer saccharum	0.21	0.80	12	4.20	2.50
Tilia americana	0.18	0.66	10	3.50	2.08
Quercus rubra	0.29	1.09	4	1.40	1.25
Populus deltoides	0.00	0.00	0	0.00	0.00
Crataegus mollis	0.00	0.00	0	0.00	0.00
Ostrya virginiana	0.04	0.13	2	0.70	0.42
TOTAL	26.61	100.00	286	100.00	100.00

Appendix 2. Temporal change in tree species frequency, density, basal area and Importance Values in mesic forest at Ryerson Conservation Area.

1975	Freq.	Rel. Freq.	Dens/ha	Rel. Dens.	BA/ha	Rel. BA	IV
Acer saccharum	75.00	45.10	144.12	48.00	17.18	50.11	47.74
Ulmus rubra	25.00	15.00	48.53	16.20	1.29	3.78	11.66
Quercus rubra	14.70	8.80	23.53	7.80	4.68	13.64	10.08
Fraxinus sp.	10.30	6.20	13.24	4.40	2.81	8.19	6.26
Ulmus americana	13.20	7.90	17.65	5.90	0.91	2.66	5.49
Quercus macrocarpa	5.90	2.40	7.35	2.45	3.24	9.44	4.76
Tilia americana	7.35	4.40	11.76	3.90	0.43	1.24	3.18
Prunus serotina	4.40	2.65	14.71	4.90	0.88	2.57	3.37
Juglans nigra	2.90	1.70	4.41	1.50	0.69	2.02	1.74
Carpinus caroliniana	4.40	2.65	4.41	1.50	0.06	0.17	1.44
Populus deltoides	1.50	0.90	1.47	0.50	0.88	2.57	1.32
Quercus ellipsoidalis	1.50	0.90	1.47	0.50	0.71	2.06	1.15
Celtis occidentalis	2.90	1.70	2.94	1.00	0.03	0.09	0.93
Quercus alba	1.50	0.90	1.47	0.50	0.44	1.29	0.90
Carya cordiformis	1.50	0.90	1.47	0.50	0.04	0.13	0.51
Crataegus sp.	1.50	0.90	1.47	0.50	0.01	0.04	0.48
TOTAL	173.6	100.0	300.0	100.0	34.28	100.0	100.0

1997	Freq.	Rel. Freq.	Dens/ha	Rel. Dens.	BA/ha	Rel. BA	IV
Acer saccharum	91.18	54.39	198.53	69.95	16.04	62.70	62.34
Prunus serotina	10.29	6.14	10.29	3.63	0.44	1.72	3.83
Ulmus rubra	14.03	19.00	27.94	9.84	1.69	6.61	10.16
Ulmus americana	8.82	5.26	8.82	3.11	0.56	2.18	3.52
Crataegus sp.	1.47	0.88	2.94	1.04	0.03	0.11	0.68
Tilia americana	5.88	3.51	7.35	2.59	0.56	2.18	2.76
Quercus rubra	8.82	5.26	8.82	3.11	2.91	11.38	6.58
Fraxinus sp.	4.41	2.63	4.41	1.55	0.76	2.99	2.39
Celtis occidentalis	4.41	2.63	4.41	1.55	0.18	0.69	1.63
Quercus macrocarpa	5.88	3.51	7.35	2.59	1.66	6.49	4.20
Juglans nigra	2.94	1.75	2.94	1.04	0.75	2.93	1.91
TOTAL	158.13	100.0	208.82	100.0	25.38	100.0	100.0

Appendix 3. Temporal change in density per hectare of shrub layer species sampled in .001 ha plots in northern flatwoods and mesic forest in Ryerson Conservation Area.

	Northern flatwoods 1976	Northern flatwoods 1997	Mesic forest 1976	Mesic forest 1997
SHRUBS				
Cornus racemosa	400	50	---	---
Corylus americana	3,700	100	---	---
Menispermum canadense	300	0	---	---
Ribes missourienses	---	---	0	53
Viburnum prunifolium	0	150	---	---
Viburnum rafinesquianum	100	0	---	---
SMALL TREES				
Carpinus caroliniana	4,100	2,850	---	---
Crataegus pruinosa	1,200	0	---	---
Crataegus punctata	200	0	---	---
Crataegus sp.	0	150	---	---
Ilex verticillata	0	1,150	---	---
Ostrya virginiana	700	150	---	---
TREES				
Acer saccharum	100	250	5,600	1,474
Carya cordiformis	0	150	---	---
Carya ovata	100	0	---	---
Fraxinus americana	1,100	0	---	---
Fraxinus nigra	200	150	---	---
Fraxinus pennsylvanica	0	100	---	---
Prunus serotina	100	0	---	---
Quercus ellipsoidalis	100	0	---	---
Ulmus americana	0	100	---	---
Ulmus rubra	700	50	1,400	0
SUMMARY				
Shrub layer stems/ha	13,100	5,400	7,000	1,527
Shrubs	4,500	300	0	53
Small trees	6,200	4,300	0	0
Trees	2,400	800	7,000	1,474

Appendix 4. Frequency, cover, and importance values of northern flatwoods groundlayer vegetation at Ryerson Conservation Area.

	freq	mean cover	IV
HERBACEOUS			
Potentilla simplex	50.00	3.50	6.95
Geum canadensis	65.00	2.34	6.35
Galium aparine	15.00	4.35	6.11
Geranium maculatum	40.00	2.25	4.89
Impatiens sp.	35.00	2.45	4.86
Floerkea proserpinacoides	35.00	2.15	4.50
Polygonum punctatum	50.00	1.45	4.45
Claytonia virginica	45.00	0.75	3.33
Anemone quinquefolia	20.00	1.80	3.26
Galium sp.	20.00	0.90	2.17
Cardamine bulbosa	30.00	0.35	2.03
Arisaema triphyllum	20.00	0.65	1.87
Aster lateriflorus	25.00	0.35	1.77
Viola cucullata	15.00	0.60	1.54
Polygonum virginianum	20.00	0.20	1.32
Allium canadense	5.00	0.75	1.18
Prunella vulgaris	15.00	0.15	0.99
Ranunculus septentrionalis	10.00	0.20	0.78
Aster schreberi	5.00	0.40	0.76
Aster macrophyllus	5.00	0.40	0.76
Fragaria virginiana	10.00	0.15	0.72
Circaea lutetiana	10.00	0.10	0.66
Arisaema draconium	10.00	0.10	0.66
Trillium recurvatum	10.00	0.10	0.65
Arenaria lateriflora	5.00	0.10	0.39
Viola conspersa	5.00	0.10	0.39
Prenanthes sp.	5.00	0.10	0.39
Smilacina stellata	5.00	0.05	0.33
Smilax lasioneura	5.00	0.05	0.33
Asarum canadensis	5.00	0.05	0.33
Viola sp.	5.00	0.05	0.33
Unknown herb	5.00	0.05	0.33
Erythronium albidum	5.00	0.05	0.33
Epilobium coloratum	5.00	0.05	0.33
Oxalis stricta	5.00	0.05	0.33
Smilacina racemosa	5.00	0.05	0.33
Total			66.69

	freq	mean cover	IV
WOODY			
Carpinus caroliniana	30.00	3.45	5.82
Ilex verticillata	5.00	2.00	2.71
Rhus radicans	35.00	0.60	2.61
Lonicera prolifera	25.00	0.80	2.32
Rubus pubescens	15.00	1.05	2.09
Acer saccharum	15.00	0.65	1.60
Viburnum prunifolium	5.00	0.75	1.18
Crataegus sp.	15.00	0.20	1.05
Fraxinus sp.	15.00	0.14	0.98
Prunus viginiana	10.00	0.35	0.96
Parthenocissus sp.	5.00	0.50	0.88
Rubus occidentalis	5.00	0.25	0.57
Fraxinus americana	5.00	0.25	0.57
Quercus alba	5.00	0.10	0.39
Fraxinus nigra	5.00	0.05	0.33
Prunus serotina	5.00	0.05	0.33
Quercus bicolor	5.00	0.05	0.33
Quercus ellipsoidalis	5.00	0.05	0.33
total			25.04
GRAMINOID			
Cinna arundinacea	40.00	0.85	3.18
Carex gracillima	10.00	1.30	2.12
Carex blanda	15.00	0.15	0.99
Carex sp.	10.00	0.10	0.66
Glyceria striata	10.00	0.10	0.66
Carex sp. #2	5.00	0.05	0.33
Carex tribuloides	5.00	0.05	0.33
total			8.27

Plot species richness	9.30
Species richness index	72.64
Native plot species richness	9.30
Native richness index	72.64
Alien component	0

Appendix 5. Frequency, cover, and importance values of mesic forest groundlayer vegetation at Ryerson Conservation Area.

	freq	mean cover	IV
WOODY			
Acer saccharum	89.47	12.51	26.00
Fraxinus sp.	36.84	0.39	4.22
Prunus serotina	26.32	0.25	2.97
Ribes missourienses	15.79	0.79	2.66
Ulmus sp.	15.79	0.14	1.77
Prunus virginiana	5.26	0.74	1.53
Vitis riparia	5.26	0.05	0.60
Parthenocissus inserta	5.26	0.05	0.59
total			40.34
HERBACEOUS			
Allium burdickii	52.63	10.37	19.40
Erythronium albidum	57.89	3.36	10.37
Podophyllum peltatum	26.32	3.84	7.87
Circaea lutetiana	21.05	0.32	2.54
Geranium maculatum	15.79	0.42	2.15
Isopyrum biternatum	15.79	0.37	2.08
Arisaema triphyllum	15.79	0.26	1.94
Trillium grandiflorum	15.79	0.15	1.79
Cirsium sp.	10.53	0.09	1.18
Impatiens sp.	5.26	0.37	1.03
Polygonum virginianum	5.26	0.21	0.81
Anemone quinquefolia	5.26	0.16	0.74
Allium canadense	5.26	0.11	0.67
Smilacina racemosa	5.26	0.05	0.60
Dicentra cucullaria	5.26	0.05	0.60
Geum canadensis	5.26	0.05	0.60
Unknown seedling	5.26	0.05	0.59
Geum sp.	5.26	0.05	0.59
Trillium recurvatum	5.26	0.05	0.59
total			56.14
ALIENS			
Alliaria petiolata	5.26	1.32	2.32
GRAMINOID			
Carex sp.	5.26	0.05	0.60
Leersia virginica	5.26	0.05	0.60
total			1.20

Plot species richness	5.00
Species richness index	27.39
Native plot species richness	4.95
Native richness index	27.10
Alien component	0.29

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VEGETATION OF ALLISON PRAIRIE – A GRAVEL PRAIRIE RECONSTRUCTION IN LAWRENCE COUNTY, ILLINOIS

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ABSTRACT: The vascular flora of a 2 ha gravel prairie reconstruction in Lawrence County, Illinois, was studied during the growing season of 2001. Frequency (%), average cover (%), and importance value (IV = 200) of the taxa were determined using randomly located quadrats along a line transect. A total of 181 taxa were observed on the site: 1 fern, 1 gymnosperm, 49 monocots and 130 dicots, of which 16 were woody taxa and 49 introduced exotics. A total of 31 taxa were encountered in the sample plots. *Heterotheca camporum* (Greene) Shinners (golden aster) had the highest importance value (39.1), followed by *Sporobolus asper* (Michx.) Kunth. (northern dropseed), *Andropogon gerardii* Vitman (big bluestem), *Melilotus* sp. (sweet clover), *Opuntia humifusa* (Raf.) Raf. (prickly pear), and *Schizachyrium scoparium* (Michx.) Nash (little bluestem). The state endangered *Silene regia* Sims (royal catchfly) also occurs on the site.

INTRODUCTION

At the time of European settlement about 61% of Illinois was covered with prairie (Iverson et al. 1991). The most common were "black soil" prairies that covered extensive areas throughout the central part of the state, creating what was commonly referred to as the prairie peninsula (Transeau 1935, Schwegman 1973). Many other prairie community types were common in Illinois, including the prairies associated with the extensive loess and glacial-till deposits along major rivers (Evers 1955), and the prairies associated with extensive sand deposits on glacial out-wash from the Wisconsin glaciation. Other, less common prairie types occur in Illinois, including gravel, dolomite, and shrub prairies (White and Mandany 1978).

Gravel prairies are rarely encountered, being associated with valley train deposits along a few rivers and streams in central and northern Illinois. These gravel prairies are rare in the midwest, many having been destroyed by mining operations. Occurring on kames and eskers mostly in the Northeastern Morainal Division of Illinois, and on the slopes of gravel terraces along major rivers, few of the prairies have been studied. Fell and Fell (1956) listed the plant species and associations of a few gravel hill prairies along the Rock River in Winnebago County, while Post et al. (1985) examined three gravel hill prairies along Wea Creek, a tributary of the Wabash River in north-central Indiana. A few gravel prairies are dedicated Illinois nature preserves, but have not been studied in detail (McFall and Karnes 1995).

Historical records indicate that gravel prairies occurred in east-central Illinois, particularly along the Wabash River and its tributaries in theWabash Border Natural Division (Schwegman 1973). The northern part of this division was subjected to Wisconsin glaciation, while glacial melt water resulted in the formation of a broad floodplain and terrace deposits of sand and gravel in the southern part of the division. In some locations, gravelly clay loam and sandy loam soils developed on sand and gravel deposits that were at or near the surface (Fehrenbacher et al. 1967). Prairies developed on these soils of low water holding capacity. Government Land Office surveyors reported the existence of an extensive prairie, approximately 64 km^2, on the floodplain of the Wabash River in the northern part of Lawrence County, Illinois (Hutchison 1988, Edgin 1996). Most of this prairie was described as wet; however, the southeast portion of T4N R11W contained a nearly level, dry prairie with a thin gravelly soil. Following European settlement, these prairies were converted to agriculture production. Presently, small prairie remnants remain, mostly in cemeteries, along roadsides, and in railroad rights-of-way.

Because of these historical records, John E. Schwegman (retired, Illinois Department of Natural Resources) initiated a reconstruction of a gravel prairie in eastern Lawrence County in 1991. The purpose of this study is to determine

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the floristic composition and structure of this gravel prairie reconstruction. These data will enable the evaluation of the vegetational trends, and determine probable management goals for the future. The status of the state endangered *Silene regia* Sims (royal catchfly) on the prairie will also be discussed.

DESCRIPTION OF THE STUDY AREA

The 2 ha Allison Prairie reconstruction is located 10 km northeast of Lawrenceville, Lawrence County, Illinois (NE ¼, NW ¼, S 25, T4N, R11W). The project to reconstruct a gravel prairie typical of the Wabash Border Natural Division was initiated in May 1991 with the execution of a management agreement between the Illinois Department of Natural Resources (IDNR) and the Bi-State Airport Authority which owns the property. Prior to this agreement, a floristic survey of ten sand and gravel prairie remnants located near the study area was conducted in 1988, and 91 sand and gravel prairie taxa were found (Schwegman 1988, unpublished). Using this information, seeds and plants for the reconstruction were collected from remnant communities and sown or translocated to the north half of the study area in October 1991 and October 1993. Seeds from *Andropogon gerardii* Vitman (big bluestem), *Bouteloua curtipendula* (Michx.) Torr. (side-oats grama), *Schizachyrium scoparium* (Michx.) Nash (little bluestem), *Sorghastrum nutans* (L.) Nash (Indian grass), and *Sporobolus asper* (Michx.) Kunth. (northern dropseed) were planted in the north half of the study area using a no-till drill. Approximately 3,300 rootstocks obtained from the IDNR nursery were transplanted in the south half of the study area in May 1998.

Management practices include several brush removal efforts which were undertaken from 1993 to 2001 to eliminate *Ulmus pumila* L. (Siberian elm), *Celtis occidentalis* L. (hackberry), and *Lonicera maackii* (Rupr.) Maxim. (Amur honeysuckle) from the south half of the study area. Prescribed burning of the entire area was conducted in the spring of 1998, 2000, and 2001. Some gravel deposits had been removed from the north half of the study area several years prior to the initiation of the reconstruction effort.

The soils of the study area are Carmi loam (Fehrenbacher and Odell 1956). These terrace soils developed under grass on slopes of 0 to 4 %. The surface soil is a friable, 25 to 30 cm thick loam containing considerable coarse sand. The subsoil is about 60 cm thick and composed of yellowish brown clay loam to gravelly clay loam. Permeability to water is moderately rapid and gravel is found at a depth of 85 to 90 cm, making the soil somewhat droughty.

The climate is continental, characterized by humid, hot summers and cold winters. Weather station records for Vincennes, Indiana, about 10 km from the preserve, gives the annual precipitation as 111.5 cm, most of which falls as rain during the period of April to September. Average rainfall is highest during the month of May (11.2 cm) and lowest during February (6.6 cm). The average temperature for January is -0.7° C with an average maximum of 3.6° C and an average minimum of -5.5° C. The average temperature for July is 25.5° C with an average maximum of 31.1° C and an average minimum of 19.0° C. The frost-free growing period averages 180 days per year (Fehrenbacher and Odell 1956).

MATERIALS AND METHODS

Observations to determine the vascular flora of the site were conducted from April through September 2001. Voucher specimens were collected for each taxon and deposited in the herbarium of the Illinois Natural History Survey, Champaign, Illinois. Monitoring of the royal catchfly was conducted in late July or early August of 1998, 1999, and 2001. Nomenclature follows Mohlenbrock (1986). Designation of introduced taxa follows Mohlenbrock (1986) and Gleason and Cronquist (1991).

On September 25, one 50 meter long transect was randomly located in a north-south orientation in the north half of the study area. Along this transect, two 1 m^2 quadrats were randomly located at 1 meter intervals on alternating sides of the transect line. Quadrats located at odd numbered intervals were located on the east side of the transect line; quadrats located at even numbered intervals were located on the west side of the transect line. A random numbers table was used to determine the number of meters the quadrats were located from the transect line. Percent cover of each taxon was determined using the Daubenmire cover class system (Daubenmire 1959), as modified by Bailey and Poulton (1968). Only plants rooted within the frame of the quadrat were recorded. The modified cover scale is as follows: class 1 = 0—1%, class 2 = 1—5%, class 3 = 5—25%, class 4 = 26—50%, class 5 = 51—75%, class 6 = 76—95%, and class 7 = 96—100%. Importance value (IV) for ground cover taxa was determined by summing relative frequency and relative cover.

The Floristic Quality Index (FQI) was determined for the preserve using the coefficient of conservatism assigned to each taxon by Taft et al. (1997). The FQI is a weighted index of the species richness (N), and is the arithmetic product of the average coefficient of conservatism (CC) and the square root of the species richness (√N) of an inventory site [FQI = CC(√N)]. For relatively small areas that are fairly intensively studied floristically, the FQI gives a rapid means of comparison and an indication of the floristic integrity of the site.

RESULTS AND DISCUSSION

A total of 181 vascular plant taxa was observed during the growing season of 2001 (Appendix 1). Of these taxa, one was a fern, one was a gymnosperm, 49 were monocots in 5 families and 29 genera, and 130 were dicots in 41 families and 105 genera. Non-native taxa were rather common, 49 being found on the site, while 16 woody taxa were observed. The families with the largest number of taxa were the Poaceae with 30 taxa, the Asteraceae with 28 taxa and the Cyperaceae with 16 taxa.

Of the taxa found on the study site, 31 (17.3%) occurred in the quadrats (Table 1). Of these taxa, 11 were non-native and four were woody. *Heterotheca camporum* (Greene) Shinners (golden aster) was the dominant species (IV = 39.1), occurring in 96% of the quadrats and having the highest cover. Northern dropseed ranked second in importance value followed by big bluestem, *Melilotus* spp. (sweet clover), *Opuntia humifusa* (Raf.) Raf. (prickly pear), little bluestem, *Ambrosia artemissiifolia* L. (common ragweed), and *Tridens flavus* (L.) Hitchcock (purple top). These taxa were well distributed throughout the study area, with most occurring in at least 40% of the plots.

Sixteen taxa, including royal catchfly, were minor components of the prairie, occurring in only 1 plot (Table 1). Of that number, 2 were non-native taxa and 3 were woody. Another 16 taxa were sampled in less than 10% of the quadrats. Of those taxa, 6 were non-native and 1 was woody.

The floristic integrity of the prairie reconstruction, as measured using the FQI, was 26.8 with a mean Coefficient of Conservatism (CC) of 2.01 when all taxa were included in the calculation. When calculation included only the native taxa, the FQI was 32.2 with a CC of 2.9. The only taxon with a CC greater than 7 was *Silene regia* Sims (royal catchfly). Prairie reconstructions seldom have an FQI of 35 or higher without intensive management (Taft et al. 1997).

Another reason for this reconstruction was to provide a sanctuary for the Illinois endangered plant royal catchfly (Herkert 1991). This tap-rooted perennial with conspicuous crimson corollas was originally known from this part of the state, probably occurring in dry gravel prairies. Seeds from a local roadside population of royal catchfly were collected in the fall of 1992, and the resulting seedlings translocated to the site in October 1993. An additional 25 royal catchfly plants, grown from locally collected seed, were transplanted in the north half of study area in May 2000. Because of unusually dry soil conditions, it is very probable that none of these plants survived beyond a few weeks.

About half of the 25 royal catchfly plants translocated to the site in 1993 persist with 11, 13, and 10 plants being observed in 1998, 1999, and 2001, respectively. Since only the 1999 census was conducted during the peak flowering period, variation in population size can probably be attributed to sampling error rather than natural population fluctuations. A total of 36 stems were observed in 1998 (31 flowering), 64 in 1999 (37 flowering), and 53 in 2001 (42 flowering). The low number of stems observed during the 1998 growing season is probably due to unusually low precipitation during that growing season. Perforation of the seed capsules by insects was noted in every year of monitoring. This damage affected as many as 40% of the capsules in a given year and resulted in the loss of all seed production in those capsules.

Very little information is available concerning the flora of gravel prairies in Illinois. Along the Rock River in northern Illinois, Fell and Fell (1956) listed the consistent grasses on the gravel prairie crests as little bluestem, *Sporobolus heterolepis* (prairie dropseed), and side-oats grama. Big bluestem and Indian grass were restricted to draws and damp spots, while *Panicum virgatum* L. (switch grass) and *Stipa spartea* Trin. (porcupine grass) were even more limited in their distribution. To the northeast in Harrison County, Indiana, the gravel hill prairies have the visual aspect of mid-grass prairie (Post et al. 1985). Here the common grasses are side-oats grama, little bluestem, and porcupine grass, with big bluestem, prairie dropseed, and Indian grass present in more mesic areas.

Other than a few small prairie remnants in cemeteries and along rights-of-way, there is no information available on the floristic composition and structure of the dry gravel prairies in the lower Wabash Valley. As a result, the present management strategies are to remove woody invasive taxa, decrease the number of non-native herbaceous taxa, and increase the number and diversity of native prairie species that are commonly associated with mid-grass prairies on xeric sites in the midwest. It is hoped that the frequent use of fire will increase the abundance of the more xeric grass taxa and will also have a positive effect on the typical prairie forbs and shrubs that have been found in the area.

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Table 1. Frequency (%), cover (%), relative frequency, relative cover, and importance value of taxa encountered during sampling at the Allison Gravel Prairie Reconstruction, Lawrence County, Illinois.

Taxa	Freq. (%)	Average Cover	Rel. Freq.	Rel. Cover	IV
Heterotheca camporum	96.0	15.855	15.0	24.0	39.0
Sporobolus asper	74.0	12.870	11.6	19.5	31.1
Andropogon gerardii	43.0	7.270	6.7	11.0	17.7
Melilotus sp.	73.0	3.430	11.4	5.2	16.6
Opuntia humifusa	36.0	6.930	5.6	10.5	16.1
Schizachyrium scoparium	40.0	4.600	6.3	7.0	13.3
Ambrosia artemisiifolia	58.0	2.390	9.1	3.6	12.7
Tridens flavus	40.0	3.050	6.3	4.6	10.9
Sorghastrum nutans	32.0	3.460	5.0	5.2	10.2
Saponaria officinalis	28.0	2.765	4.4	4.2	8.6
Achillea millefolium	20.0	0.415	3.1	0.6	3.7
Artemisia absinthium	6.0	0.780	0.8	1.2	2.0
Erigeron annuus	9.0	0.295	1.4	0.4	1.8
Potentilla simplex	9.0	0.145	1.4	0.2	1.6
Bouteloua curtipendula	7.0	0.360	1.0	0.5	1.5
Others (16 taxa)		1.515	10.9	2.3	13.2
Totals			100.0	100.0	200.0

APPENDIX I

The vascular flora of Allison Gravel Prairie Reconstruction, Lawrence County, Illinois is arranged alphabetically within each taxonomic group. Introduced taxa are indicated by an asterisk (*). The binomial and authority are followed by the collection numbers of Garrard (G) and Edgin (E). A few taxa were observed but not collected because of their presence in low numbers or lack of flowers and/or fruits.

PTERIDOPHYTA

ASPLENIACEAE
Asplenium platyneuron (L.) Oakes; E5108

GYMNOSPERMAE

CUPRESSACEAE
Juniperus virginiana L.; G66

MONOCOTYLEDONAE

COMMELINACEAE
Tradescantia ohiensis Raf.; E4200

CYPERACEAE
Carex annectens Bickn.; E4205
Carex blanda Dewey; E4216
Carex cephalophora Willd.; E4248
Carex conjuncta Boott.; E3887
Carex cristatella Britt.; E4229
Carex festucacea Willd.; E4234
Carex frankii Kunth.; E4245
Carex gracilescens Steud.; E3886
Carex grayi Carey; E4244
Carex grisea Wahlenb.; E4214
Carex stipata Muhl.; E4228
Cyperus filiculmis Vahl.; E4801
Cyperus strigosus L.; E4840
Eleocharis obtusa (L.) R. & S.; G26
Scirpus georgianus Harper; E4224
Scirpus pendulus Muhl.; E4627

LILIACEAE
**Allium vineale* L.; E4207

POACEAE
Agropyron repens (L.) Beauv.; G61
Andropogon gerardii Vitman; E4596
Bouteloua curtipendula (Michx.) Torr.; E4599
Buchloe dactyloides (Nutt.) Engelm.; Observed
**Bromus commutatus* Schrad.; E4616
**Bromus inermis* Leyss.; E4588
**Bromus tectorum* L.; E3885
**Digitaria sanguinalis* (L.) Scop.; E4825
Elymus villosus Muhl.; E4805
Elymus virginicus L.; G16
Eragraotis spectabilis (Pursh.) Steud.; G2
**Festuca pratensis* Huds.; E4222
Hordeum pusillum Nutt.; E4232
Leersia oryzoides (L.) Swartz; G24
Muhlenbergia schreberi J. F. Gmel; E4583
Panicum capillare L.; E4832
Panicum dichotomiflorum Michx.; E4839
Panicum virgatum L.; G9
Paspalum laeve Michx.; G27
**Poa pratensis* L.; E3888
Schizachyrium scoparium (Michx.) Nash.; E4812
**Setaria faberi* Heerm.; E4600
Setaria glauca (L.) Beauv.; G97
**Setaria viridis* (L.) Beauv.; E4745
Sorghastrum nutans (L.) Nash; G20
Spartina pectinata Link; G30
Sphenopholis obtusata (Michx.) Schribn.; E4249
Sporobolus asper (Michx.) Kunth.; E4744
Sporobulus heterolepis (Gray) Gray; E4817
Tridens flavus (L.) Hitchcock; E4595

TYPHACEAE
Typha latifolia L.; E4617

DICOTYLEDONAE

ACANTHACEAE
Ruellia humilis Nutt.; G73

AMARANTHACEAE
Amaranthus albus L.; E4829

APIACEAE
Chaerophyllum procumbens (L.) Crantz.; E3883
Eryngium yuccifolium Michx.; E4586
Sanicula canadensis L.; E4225
**Torilis japonica* (Houtt.) DC.; G91

APOCYNACEAE
Apocynum cannabinum L.; G84

ASCLEPIADACEAE
Asclepias incarnata L.; G68
Asclepias syriaca L.; G85
Cynanchum laeve (Michx.) Pers.; E4597

ASTERACEAE
**Achillea millefolium* L.; E4624
Ambrosia artemisiifolia L.; E4604
Ambrosia trifida L.; E4822
**Artemisia absinthium* L.; E4831
Aster novae-angliae L.; E4826
Aster ontarionis Wieg.; E4833
Aster pilosus Willd.; E4808
Bidens bipinnata L.; E4814
Bidens frondosa L.; E4835
Brickellia eupatorioides (L.) Shinners; E4591
**Centaurea cyanus* L.; G12
Cirsium discolor (Muhl.) Spreng.; E4743
Conyza canadensis (L.) Cronq.; E4809
Echinacea pallida Nutt.; E4581
Erechtites hieracifolia (L.) Raf.; E4830
Erigeron annuus (L.) Pers.; E4199
Eupatorium serotinum Michx.; E4837
Euthamia graminifolia (L.) Salsb.; E4834
Helianthus strumosus L.; E4804
Heterotheca camporum (Greene) Shinners; E4193
**Lactuca serriola* L.; E4598
Liatris aspera Michx.; E4836
Liatris pycnostachya Michx.; E5110
Parthenium integrifolium L.; E4846
Senecio glabellus Poir.; E3882
Silphium terebinthinaceum Jacq.; E4812
Solidago canadensis L.; E4824
**Tragopogon dubius* Scop.; E4220

BIGNONIACEAE
Campsis radicans (L.) Seem.; E4594

BORAGINACEAE
**Buglossoides arvense* (L.) I. M. Johnston; E3877
Hackelia virginiana (L.) I. M. Johnston; E4827

BRASSICACEAE
**Barbarea vulgaris* R. Br.; E3869
**Capsella bursa-pastoris* (L.) Medic.; E4208
**Erysimum repandum* L.; E3880
**Lepidium campestre* (L.) R. Br.; E4215
Lepidium virginicum L.; E4201
**Thlaspi arvense* L.; E3879
**Thlaspi perfoliatum* L.; E3884

CACTACEAE
Opuntia humifusa (Raf.) Raf.; Observed

CAESALPINIACEAE
Cassia fasciculata Michx.; E4603
Cassia marilandica L.; E5112
Gleditsia triacanthos L.; Observed

CAMPANULACEAE
Campanula americana L.; E4579

CAPRIFOLIACEAE
**Lonicera japonica* Thunb.; E5113
**Lonicera maackii* (Rupr.) Maxim.; E4807

CARYOPHYLLACEAE
**Arenaria serpyllifolia* L.; E4230
**Dianthus armeria* L.; E4619
**Lychnis alba* Min.; E4221
**Saponaria officinalis* L.; E4209
Silene antirrhina L.; G63
Silene regia Sims; E4592
**Stellaria media* (L.) Vill.; E3874

CHENOPODIACEAE
Chenopodium album L.; E4828

CONVOLVULACEAE
**Convolvulus arvensis* L.; E4606
**Ipomoea hederacea* (L.) Jacq.; E4820
Ipomoea pandurata (L.) G.F.W. Mey.; E4620

CORNACEAE
Cornus drummondii C.A. Mey.; E4243
Cornus racemosa Lam.; E4802

EUPHORBIACEAE
Chamaesyce maculata (L.) Small; E4813
Croton capitatus Michx.; G35
Euphorbia corollata L.; E4607
Poinsettia dentata (Michx.) Kl. & Garcke; G17

FABACEAE
Dalea purpurea Vent.; E5114
Desmodium illinoense Gray; G72
**Kummerowia stipulacea* (Maxim.) Makino; E4849
Lespedeza capitata Michx.; E4800
**Medicago lupulina* L.; E4194
**Melilotus alba* Medic.; E4212
**Melilotus officinalis* (L.) Pallas; E4213

GERANIACEAE
Geranium carolinianum L.; E4821

LAMIACEAE
Agastche nepetoides (L.) Ktze.; E4823
**Lamium purpureum* L.; E3870
Lycopus americanus Muhl.; G65
Monarda fistulosa L.; G78
**Nepeta cataria* L.; E4237
Physostegia virginiana (L.) Benth.; E4843
Teucrium canadense L. var. *virginicum* (L.) Eat.; E4622

LYTHRACEACE
Rotala ramosior (L.) Kochne; G18

MALVACEAE
**Sida spinosa* L.; E4815

MIMOSACEAE
Desmanthus illinoensis (Michx.) MacM.; E4625

MORACEAE
Humulus lupulus L.; E4803
Morus rubra L.; E4587

NYCTAGINACEAE
**Mirabilis nyctaginea* (Michx.) MacM.; E4819

ONAGRACEAE
Oenothera biennis L.; E4601

OXALIDACEAE
Oxalis dillenii Jacq.; E4582

PHYTOLACCACEAE
Phytolacca americana L.; G44

PLANTAGINACEAE
**Plantago lanceolata* L.; E4580
Plantago virginica L.; G58

POLYGONACEAE
Polygonum pennsylvanicum L.; Observed
**Polygonum persicaria* L.; G92
**Polygonum convolvulus* L.; G38
**Rumex acetosella* L.; E3875
Rumex altissimus Wood.; E4197
**Rumex crispus* L.; E4195

ROSACEAE
Fragaria virginiana Duchesne; E4618
Geum canadense Jacq.; E4613
Geum vernum (Raf.) Torr.; E3876
**Potentilla norvegica* L.; E4612
**Potentilla recta* L.; G11
Potentilla simplex Michx.; Observed
Prunus serotina Ehrh.; Observed
**Rosa multiflora* Thunb.; G80
Rosa palustris Marsh.; G48
Rubus allegheniensis Porter; G81
Rubus pensylvanicus Poir.; E4236

RUBIACEAE
Galium aparine L.; E4233

SALICACEAE
Populus deltoides Marsh.; G70
Salix exigua Nutt.; G56

SCROPHULARIACEAE
Mimulus alatus Ait.; E4611
**Verbascum thaspus* L.; E4589
Veronica peregrina L.; Observed

SOLANACEAE
Physalis subglabrata Mack. & Bush; G29
Solanum carolinense L.; E4206
Solanum ptycanthum Dunal; E4239

ULMACEAE
Celtis occidentalis L.; E4810
**Ulmus pumila* L.; E4217

URTICACEAE
Parietaria pensylvanica Muhl.; E4241

VALERIANACEAE
Valerianella radiata (L) Dufr.; E4238

VERBENACEAE
Verbena stricta Vent.; G6

VITACEAE
Vitis aestivalis Michx.; E4818

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COMPOSITION AND STRUCTURE OF A POST OAK (*QUERCUS STELLATA*) WOODS IN HAMILTON COUNTY, ILLINOIS

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ABSTRACT: A woody vegetation survey of a small section of Cartway Woods was undertaken in 1997. Tree density averaged 395 trees/ha with a basal area of 23.75 m^2/ha. *Quercus stellata* Wang. (post oak) dominated the overstory with an importance value (IV) of 83.5 (200 possible), most individuals in the larger diameter classes. *Carya ovata* (Wang.) K. Koch ranked second with an IV of 46.0, most individuals in the 10—19 cm diameter class. Other species with IV exceeding 24 were *Carya tomentosa* (Nutt.) Nees and *Quercus velutina* Lam. Except for black oak, oak reproduction was poor, indicating that the closed canopy of this woodland favors the more shade-tolerant, fire-sensitive species. The large number of post oak with low branches and branch scars indicate that this woods was more open in the past. Numerous fire scars were present in cut stumps, indicating that fire was important in maintaining an open canopy in settlement times.

INTRODUCTION

Post oak (*Quercus stellata* Wang.) dominated forests were common throughout much of the Midwest from Ohio to Missouri, especially on the Illinoisan glacial till plain (Telford 1926, Braun 1950). Post oak forests occur on barrens with thin soil and exposed bedrock (Ebinger et al. 1994), as well as on flatwoods with heavy clay soils having a claypan near the surface (Coates et al. 1992, Taft et al. 1995). In areas with better drainage, post oak was usually associated with *Q. velutina* Lam. (black oak) and various species of hickory (*Carya* spp.). These post oak forests occur on more mesic sites having greater topographic relief without the edaphic and drainage properties of flatwoods. These forest types are not common in Illinois, and except for some observations by Telford (1926), have not been studied in detail.

Studies indicate that post oak upland forests were relatively open (Anderson and Anderson 1975, Ebinger and McClain 1991). At the time of European settlement, these open canopy forests were maintained by periodic fire (Williams 1989, Davies 1994, McClain and Elzinga 1994). With the cessation of landscape fires, woody plant encroachment resulted in canopy closure (Ebinger 1986, Ebinger and McClain 1991).

The study area is a small section of an extensive block of timber known as Cartway Woods due to the presence of an early 19th Century dirt road, or cartway. The woodlot was the best remaining example of the post oak forest that once was common in Hamilton County. Privately owned, the woodlot was marked for harvest before the authors were aware of the site. A selective timber harvest occurred in the fall of 1997 soon after the completion of our study. The study was undertaken to determine the structure and composition of this woodlot, and to determine the fire history of the site using fire scars data from the cut stumps.

DESCRIPTION OF THE STUDY AREA

Cartway Woods is located in Dahlgren Township, about 19 kms northwest of McLeansboro, Hamilton County, Illinois, in the Mt. Vernon Hill Country Section of the Southern Till Plain Natural Division (Schwegman 1973). Though mostly composed of forest and savanna in presettlement times, extensive prairie inclusions were present (Government Land Office Field Notes Vol. 76).

The woodlot studied is a dry mesic post oak woods about 8 ha in size (NE1/4 Sec 2 T4S R5E). The overall relief does not exceed 7 m, and ranges from 134 m to 141 m above sea level. The soils are Wynoose and Bluford silt loams, which are poorly drained soils that occur on broad, loess-covered till plains (Currie 1986). The climate is continental, characterized by humid, hot summers and cold winters. Average annual precipitation is 105 cm, with a record high of 157.5 cm in 1945 and a record low of 68.3 cm in 1936. The highest temperature on record is 114

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degrees F for July 14, 1936. During an average year, there are 51 days with temperatures greater than 90 degrees F, 104 days with temperatures less than 32 degrees F, and only four days of temperatures below zero. The frost-free growing period averages 184 days (Bryan and Wendland 1995).

METHODS

During the summer of 1997, a 4 ha section of the woodlot was divided into quadrats 25 m on a side. In each quadrat, all living and dead-standing woody individuals 10.0 cm dbh and above were identified to species and their diameters recorded. Living-stem density (stems/ha), basal area (m2/ha), relative density, relative dominance, importance value (IV), and average diameter (cm) were calculated for each species. Dead-standing stem density (stems/ha), basal area (m^2/ha), and average diameter were also determined for each species.

Woody understory composition and density (stems/ha) were determined using 0.0001, 0.001, and 0.01 ha nested circular plots randomly located at 20 meter intervals along line transects within the study area, two additional 0.0001 ha plots were located 7 m to the east and west of each center. In the 0.0001 ha plot, seedlings (≤50 cm tall) and all shrubs were counted; in the 0.001 ha circular plots, small saplings (>50 cm tall and ≤2.5 dbh) were recorded; and in the 0.01 ha circular plots, large saplings (2.6—9.9 cm dbh) were tallied. Nomenclature follows Mohlenbrock (1986).

During the spring of 1998, cross sections from 40 tree stumps were cut within 30 cm of ground level using a chain saw. These cross sections were prepared for counting using an electric hand planer followed by belt sanding using successively finer sanding grits. Each cross section was aged and fire scars identified to their year of occurrence.

RESULTS AND DISCUSSION

Tree density in the woodlot averaged 395 stems/ha with a basal area of 23.73 m^2/ha (Table 1). Of the 16 arborescent species encountered, post oak ranked first with an IV of 83.5, averaged 104 stems/ha, and accounted for more than 55% of the total basal area (13.54 m^2/ha). Few seedlings and no saplings of post oak were observed (Tables 1 and 2). Most of the large post oaks had an open-grown appearance with low branches or branch scars and broad open crowns. In a survey along two line transects, a total of 50 post oaks greater than 30 cm dbh were examined for lower branches or branch scars. Of these, 42 trees had branch scars or branches within 8 m of the ground; a few had branch scars as low as 1.5 m above the ground, while the average distance was 4 m.

Of the remaining oak taxa, black oak ranked fourth in IV (24.7), most individuals in the 10-19 cm diameter class, and with some seedlings and saplings present (Tables 1 and 2). Other oak species were not common; all had IVs below 3.0 and densities below 8 stems/ha.

Hickories were important components of the woodlot. *Carya ovata* (Mill.) K. Koch (shagbark hickory) and *C. tomentosa* (Poir.) Nutt. (mockernut hickory) ranked second and third in IV due to their high relative densities. They were well represented in the seedling, sapling, and small tree diameter classes (Tables 1 and 2).

The remaining woody species were not plentiful and none had an IV greater than 4.0 or a density greater than 13 stems/ha. Of these, some were common in the seedling and sapling categories, particularly *Sassafras albidum* (Nutt.) Nees (sassafras) and *Prunus serotina* Ehrh. (wild black cherry). The only understory trees present, *Cornus florida* L. (flowering dogwood) and *Morus rubra* L. (red mulberry) were not common (Table 2).

Tree mortality averaged 21.7 stems/ha with a basal area of 1.70 m^2/ha (Table 3). Post oak had the highest mortality, followed by black oak and shagbark hickory. The average diameter of the dead-standing post oak was 36.6 cm, with the largest individual being 75 cm dbh.

If the woodlot had not been cut, post oak would have continued its importance for the near future. However, the relatively few post oaks in the lower diameter classes, as well as the total absence of saplings, suggests that conditions were not favorable for the long term dominance of this taxon. The decrease in oak regeneration is occurring throughout the Midwest, probably due to fire suppression (Ebinger and McClain 1991). The resulting canopy closure favors the growth of shade-tolerant, fire-sensitive species that take advantage of canopy openings as veteran trees die.

Many of the stumps in the woodlot exceeded 200 years in age and contained scars from 101 separate fire events from 1776 to 1991. During this 215 year period there were two major fire intervals: one from 1776 to 1850 when 36 fires were recorded for an average of a fire every 2.08 years; and one from 1886 to 1991 with 65 fires for a fire frequency average of 1.63 years. There was no evidence of fire from 1851 to 1885.

The 101 fires produced 242 fire scars in the cross sections examined. Severe fires—those that scarred 10% or more of the cross sections examined—occurred in 1793, 1804, 1836, 1913, 1914, 1924, 1932, 1936, 1940, 1944, 1953, 1954, 1964, and 1983. Based on weather data from Mt. Vernon, Illinois, located 25 km northwest of the study site, below average precipitation characterized the years 1914, 1924, 1936, 1940, 1944, 1953, 1954 and 1964 (Bryan and Wendland 1995). This extensive fire history of the study site suggests that fire was important in maintaining the open condition of this forest at least until mid 1980s.

ACKNOWLEDGMENTS

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Table 1. Densities (stems/ha), diameter classes, basal areas (m^2/ha), relative values, importance values and average diameters of woody species in Cartway Woods, Hamilton County, Illinois.

	Diameter classes (cm)						Total	Basal area	Rel	Rel		Avg diam
	10-19	20-29	30-39	40-49	50-59	60-69	stems/ha	m^2/ha	dens	dom	IV	(cm)
Quercus stellata	7.3	25.0	24.8	25.0	16.0	6.3	104.4	13.54	26.5	57.0	83.5	38.4
Carya ovata	106.0	18.3	5.0	1.0	0.3	--	130.6	3.05	33.2	12.8	46.0	16.0
Carya tomentosa	47.3	15.8	5.5	1.8	0.5	--	70.9	2.40	18.0	10.1	28.1	18.9
Quercus velutina	28.3	7.0	3.3	1.3	3.3	3.3	46.5	3.09	11.7	13.0	24.7	24.2
Sassafras albidum	13.0	--	--	--	--	--	13.0	0.16	3.3	0.7	4.0	12.8
Carya glabra	0.8	1.0	1.5	1.8	0.3	--	5.4	0.53	1.3	2.2	3.5	33.9
Quercus rubra	5.8	1.8	0.3	--	--	--	7.9	0.18	2.0	0.8	2.8	16.7
Quercus alba	0.3	--	0.3	0.5	0.8	0.3	2.2	0.41	0.5	1.7	2.2	48.3
Prunus serotina	5.0	1.0	--	--	--	--	6.0	0.11	1.5	0.5	2.0	15.1
Others (7 species)	6.8	0.5	0.3	--	0.5	--	8.1	0.28	2.0	1.2	3.2	
Totals	220.6	70.4	41.0	31.4	21.7	9.9	395.0	23.75	100.0	100.0	200.0	

Table 2. Density (stems/ha) of the seedlings, small saplings, and large saplings in Cartway Woods, Hamilton County, Illinois.

Species	Seedlings (≤50 cm tall)	Small saplings (>50 cm tall/ ≤2.5 cm dbh)	Large saplings (2.6—9.9 cm dbh)
Sassafras albidum	1562.5	703.1	71.9
Prunus serotina	1250.0	343.8	6.3
Carya ovata	937.5	609.4	270.4
Carya tomentosa	781.3	296.9	143.8
Quercus velutina	781.3	328.1	35.9
Fraxinus pennsylvanica	312.5	296.9	7.9
Diospyros virginiana	312.5	93.8	17.2
Cornus florida	156.3	140.7	21.9
Quercus stellata	156.3	--	--
Quercus alba	156.3	31.3	4.7
Quercus imbricaria	156.3	31.3	4.7
Ulmus Americana	--	31.3	20.3
Quercus rubra	--	15.6	3.1
Morus rubra	--	--	6.3
Total	6562.8	2922.2	614.4

Table 3. Density (stems/ha), basal area (m^2/ha) and average diameter (cm) of the dead-standing trees in Cartway Woods, Hamilton County, Illinois.

Species	Density (stems/ha)	Basal area (m^2/ha)	Average diameter (cm)
Quercus stellata	10.8	1.28	36.6
Quercus velutina	4.3	0.26	23.1
Carya ovata	2.0	0.02	11.6
Carya tomentosa	1.0	0.09	30.9
Prunus serotina	1.5	0.03	17.2
Sassafras albidum	1.0	0.01	12.1
Others	1.1	0.01	--
Totals	21.7	1.70	

Illinois Flora Updates:
New Distribution Records and other Noteworthy Finds
by INPS Flora Update Committee

Illinois flora updates is a new feature in *Erigenia* and we hope it becomes a regular feature in subsequent issues. We propose this feature as a solution to several problems: 1) many new distribution records, especially county distribution records, are never published; 2) there have been rediscoveries of many species and populations considered rare or extirpated but not tracked by the Illinois Endangered Species Protection Board; 3) several non-native plant species are now spreading explosively across Illinois and parts of North America; and 4) no one individual in Illinois is tracking or verifying all new finds and rediscoveries. We hereby initiate this feature with the hope that it will act as a clearinghouse for new and updated information on the distribution of plants in Illinois, and thus stimulate further botanical discoveries and floristic work in Illinois.

The first published compilation of vascular plant distribution by county for Illinois was in 1955 (Jones and Fuller 1955), with added records in 1960 (Winterringer and Evers 1960). In the past, *Erigenia* has published updates (Mohlenbrock and Ladd 1983; Mohlenbrock 1985) to Distribution of Illinois Vascular Plants (Mohlenbrock and Ladd 1978). Recent works on the Illinois vascular flora have generally lacked precise information on species distribution (Mohlenbrock 2002) or deal with a limited region of Illinois (Swink and Wilhelm 1994) or one plant family (Lynn 2001). Recent publications in the Transactions of the Illinois State Academy of Science (Basinger 2001; Ketzner 1996; Wilm and Taft 1998e) have publicized species new to Illinois, but generally have omitted new distribution records of species previously known from the state. In few cases, recently published floristic studies require close reading to determine if any new distribution records were made!

At present, we want the updates to focus on vascular plants (flowering plants, conifers, ferns, and fern allies). This is the only group for which state-wide distribution data are widely available, primarily through the publications cited in the previous paragraph. We will also summarize publications elsewhere concerning additions to the Illinois flora, where pertinent collection data are included. We request that authors inform us of the new finds (after publication, of course) with relevant information. Given the current lack of stability in scientific names, we also propose to alert Illinois plant enthusiasts to published changes in these names. We will provide a citation and, if possible, a brief statement citing the reason for these changes.

We hope this feature will assist in tracking the spread of non-native plants. At present, many widespread exotics are under-recorded, and we encourage the collection of voucher specimens to document this spread. Among the under-collected exotics are two invasive shrubs, autumn-olive (*Elaeagnus umbellata*) and the Amur or red honeysuckle (*Lonicera maackii*); they may now be present in every county. We also need documentation for certain invasive species that are now just arriving in Illinois or will probably appear here within the near future, such as giant hogweed (*Heracleum mantegazzianum*) or mile-a-minute (*Polygonum perfoliatum*). As human-mediated climate and landscape change proceeds, this feature could become an invaluable resource for land managers and invasive species biologists.

We will only accept records that are based on voucher specimens deposited at an institutional herbarium. We strongly suggest the herbaria of the Illinois Natural History Survey (all Illinois plants) and Morton Arboretum (plants collected in northeastern Illinois) as appropriate places to deposit specimens. Their addresses are included below. Other herbaria that specialize in the Illinois flora include those at Illinois' universities and large colleges, museums (Field Museum and Illinois State Museum), and public gardens (Chicago Botanical Garden and Missouri Botanical Garden).

The only exception to the above restriction will be made for certain endangered, threatened, or otherwise rare species, for which an archival photograph should be presented to a herbarium as a voucher. Two good rules of thumb for vouchering rare herbaceous species are: 1) do not collect a specimen if the population is below twenty individuals; and 2) do not collect an entire plant unless the population is above fifty individuals (or stems). Hopefully, this will also prompt a more careful survey of the population and its environs for additional plants and will result in a more accurate population census. We also encourage all botanists (both professional and amateur) to limit collections of rare species to the minimal material needed to confirm the plant's identity. We will not publish sight records, aside from rediscoveries of previously verified populations belonging to species of conservation concern (listed as federal T&E, state E&T, FS sensitive species (USDA FS, on Midewin and Shawnee). All other records must be accompanied by a specimen or verifiable photograph.

When collecting known or potentially invasive species, carefully dispose of any viable seed not incorporated into the specimen; please do not unintentionally assist in the spread of exotics! We may question reports (even with vouchers) of certain cultivated plants reported as "new to Illinois" or "new to ________ County"; we don't want this feature to become a horticultural record for Illinois. Only genuine escapes and plants persisting long after cultivation (>40 years) at abandoned house sites and gardens should be considered part of the spontaneous flora. For supplementary opinions on the rationale and ethics involved in plant collecting, read Raviell (1982) and Stritch (1982). Be aware that wild plants belong to the landowner, and we recommend obtaining written permission before collecting on private land. It is illegal to collect in nature preserves and most other public lands without a permit.

There are several publications available on the proper methodology and equipment for collecting voucher specimens (Hill 1996; Oskins 1982; Robertson 1980; Smith 1971). These publications also include some sources of plant presses and other equipment, and the Internet is another source with on-line catalogs for plant collecting and herbarium supplies. Several textbooks on plant taxonomy and systematics also include information on making plant specimens.

All records *(not specimens)* should be mailed (hard copies or electronic mail) to:

Illinois Flora Updates
Erigenia Editor

4252 Humphrey Street
St. Louis, Missouri 63116
mvogt@accessus.net

The editor will forward the records to the INPS Flora Updates coordinator a few months before publication of Erigenia. The coordinator will work with botanists at the Illinois Natural History Survey and other institutions to confirm the significance of these reports. The coordinator will then organize the reports into a format suitable for Erigenia.

We recommend that all submissions should include the following information. If any of the fields below marked with an asterisk is omitted, we may refuse to publish the record.

- Scientific name*
- The identification manual or source of nomenclature being used* (Mohlenbrock 2002, Swink and Wilhelm 1994, Yatskievych 1999, or others)
- Common name
- Family
- County*
- Date of collection* (or sighting, for species of conservation concern)
- Collector's name*
- Collection number*
- Herbarium* where specimen or copy of photograph is deposited
- Accession number (from herbarium where specimen is deposited; we highly recommend including this number, if available)
- Locality information (legal location, township, state park, forest preserve, or national forest should be included; however, precise locality info will be omitted for rare plants or those vulnerable to unsustainable harvest, e.g., orchids, goldenseal, or ginseng).
- Habitat, can include associates.
- Comments on population size (especially if the species is of conservation concern).
- If the information is published in full elsewhere, please cite publication.*
- Significance – a brief statement or short paragraph discussing the importance of this find. Is this a new state record, a new county record, a major range extension, a rare species, the rediscovery of a historic specimen, or a rapidly spreading exotic? (If this discussion is lengthy, we will edit it.)
- Please indicate whether the plants are native or alien (non-native). Be aware that plants native in one part of Illinois may be escaping from cultivation in other regions (e.g., redbud).

Please include your telephone number, e-mail address, or postal address so the coordinator can contact you if any questions arise. At present, there will not be any page charges for publishing records.

Herbaria:

Dr. L. R. Phillippe, Herbarium Manager
Center for Biodiversity
Illinois Natural History Survey
607 East Peabody
Champaign IL 61820

Herbarium Curator
Research Department
The Morton Arboretum
Lisle IL 60532

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