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A survey of the flora and vegetion of the Mayville Ledge Beech-Maple Woods State Natural Area

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Abstract

At least 132 vascular plant species were present in two relatively undisturbed woods in the Mayville Ledge Natural Area. The Plateau Woods was dominated by ironwood (*Ostrya virginiana*), American beech (*Fagus grandifolia*), and sugar maple (*Acer saccharum*), with a Continuum Index of 2535. Red oak (*Quercus rubra*), basswood (*Tilia americana*), and sugar maple were the most important trees of the Slope Woods, where the Continuum Index reached 2253. Sugar maple dominated the sapling and seedling layers of both stands. American beech was completely absent from the Slope, while red oak was limited to minor status on the Plateau. The Slope Woods had a richer herb composition, with nearly twice as many species and nearly twice the cover of the Plateau. The Slope appeared to be undergoing the greatest change in tree species composition, with sugar maple apparently replacing the dominant red oak.

Introduction

In 1988, the Bureau of Endangered Resources of the Wisconsin Department of Natural Resources began the State Natural Areas Baseline Data Acquisition Program in order to describe quantitatively, in a systematic fashion, each state Natural Area and to provide background data for monitoring future changes in the vegetation. In 1988 and 1989 I studied the Mayville Ledge Beech-Maple Woods (also known as Neda Woods) (Natural Area No. 143), located in eastern Dodge County along the Niagara escarpment (Fig. 1). The approximately 25 hectare site consists of a mixture of grazed and ungrazed woods (some with a history of selective logging), grassy openings, old fields, and small upland marshes. Lying along the south edge of the Tension Zone (Curtis 1959), it is in the Southeastern Mesic Forest and Oak Savanna Glaciated Plain. The presettlement vegetation of the region has been described as Southern Mesic Forest, dominated by sugar maple, basswood, elms, and white and red oaks (Neuenschwander 1957; Finley 1976). The site is significant, in part, because it contains American beech (*Fagus grandifolia*) and its parasite beech drops (*Epifagus virginiana*) at one of their most westerly locations in southern Wisconsin.

The "ledge" itself consists of a steep exposed segment of the Niagara escarpment, between 5 and 20 m high. The woods above the ledge ("Plateau Woods") are variable-aged; the least disturbed areas are located in the northern part of the site (T12N, R16E, SW1/4, SW1/4, S36) (Fig. 1). Soils here consist of a mixture of Dodge silt loam (2-6% and 0-2% slopes), Channahon silt loam 1-6%, and the Rodman-Casco complex (12-30%, eroded), with scattered glacial erratics (USDA, 1980). Directly west of this site, below the escarpment (Fig. 1), is a narrow wooded strip ("Slope Woods") located predominantly on the steep slope paralleling the escarpment face (T12N, R16E, W1/2,

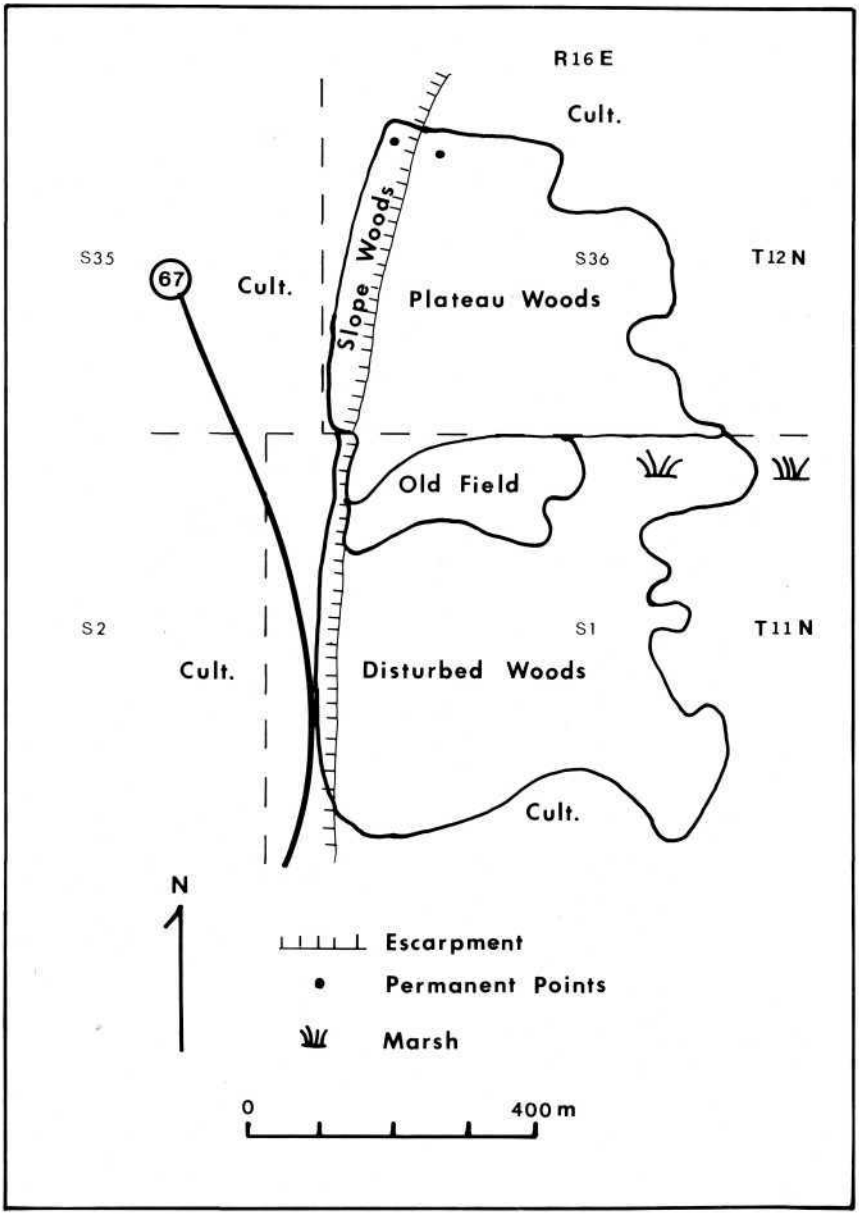

Fig. 1. Location of the study site in Dodge County, Wisconsin.

SW1/4, SW1/4, S1). The slope is ungrazed, with a rich complement of species. Substrate consists of rock outcrop, Niagara dolomite blocks, and soils of the Channahon complex (5-30% slopes).

The area was previously owned by U.S. Steel, but was never mined. It was donated to the UWM Field Station in 1976 and became a State Natural Area in August, 1978.

Methods

The sampling of the natural areas involved two procedures – the compilation of a complete list of all vascular plant species present in each area, and transect sampling of each area. The list included a qualitative ranking of species on an abundance scale ("abundant", "common", "occasional", or "rare"). Duplicate voucher specimens were collected for each species (exclusive of threatened or endangered species) and deposited in the herbaria of the Milwaukee Public Museum and the University of Wisconsin–Madison. These two tasks required trips to the site in spring, summer and fall to ensure that all species were noted.

Sampling followed the modified line transects of Lindsey (1956) and Levenson (1981). In each natural area, 20 nested rectangular quadrats were established along either east-west or north-south transects, depending on the long axis of the site. These plots were spaced so that they were approximately evenly distributed throughout the area. The initial transect and quadrat were established by entering each site 20 m perpendicular to the direction of the transect and then moving 25 m parallel to the transect, thus avoiding sampling the edge. By using two random digits, two further distances were measured off. This final position became the permanent point to be marked with a steel post, and was the beginning of the first quadrat, extending along the long axis of the woods. All distances and directions were recorded for future reference.

Each large quadrat was 25 m long and 10 m wide, with the transect running through the center. In these plots I recorded, by species, the diameters and numbers of trees and shrubs at least 10 cm dbh (including dead individuals), the number of saplings and shrubs between 2.5 cm and 9.9 cm dbh, the number of climbing woody vines, and any downed dead wood at least 30 cm dbh. Tree seedlings at least 1 m tall but less than 2.5 cm dbh were tallied in a 4 x 5 m plot at the beginning of each quadrat. Two 1 x 1 m plots were located in each large quadrat 2 m from the transect, one toward each end of the quadrat. These positions eliminated trampling. In the 1 x 1 m quadrats, I recorded numbers of tree seedlings less than 1 m tall, presence of herbaceous species, and an estimation of the percent of ground not covered by seedlings and herbs. The small plots were sampled both in spring and summer to record the presence of seasonal herbs.

The first 20 m of the transect tape was used to determine percent cover of small shrubs (i.e., less than 10 cm dbh), trailing vines, and bare ground. For each 2 dm segment, a species was noted as being present if any portion of the plant intercepted the line. The number of 2 dm segments intercepted was totaled and compared to the total transect length to calculate percent of relative cover. In addition, photographs were taken at the permanent point in the four cardinal directions. All data were deposited with the Bureau of Endangered Resources (DNR) in Madison.

Species attributes that were calculated included density (number of stems per unit area), frequency (the number of plots in which a species was found), and basal area for trees (determined by measuring diameter at breast height and converting to the area of the trunk). Each of these three values was relativized, and then averaged to give an importance value for each species per site.

The Continuum Index (CI) of Curtis (1959) is a synthetic scale that reflects a stand's composition relative to dominance by shade-tolerant species. It ranges from 300 to 3000 and is based on species importance values multiplied by species adaptation values (AV), which reflect the shade tolerance of species relative to sugar maple. Thus a pure stand of burr oak (AV=1.0) would have a CI of 300, while one composed entirely of sugar maple (AV=10.0) would have a CI of 3000.

Results and Discussion

I found a total of 132 vascular plant species in the Natural Area–92 in the plateau woods, 64 in the slope woods, and 20 in the upland marshes (Table 1). Nine of these species were non-natives, four found in each of the plateau and marsh, and one found on the slope. No endangered or threatened species were found.

From the initial inspection of the Natural Area, it was apparent that the two least disturbed and intact areas (i.e., the Plateau Woods and the Slope Woods) differed not only physically but also vegetationally. I therefore sampled the two areas separately. Fifteen plots were established in the Plateau Woods and five in the Slope Woods. The tree stratum of the Plateau was dominated by ironwood (*Ostrya virginiana*) and beech (*Fagus grandifolia*), followed by sugar maple (*Acer saccharum*), yellowbud hickory (*Carya cordiformis*), and slippery elm (*Ulmus rubra*) (Table 2). Red oak (*Quercus rubra*) was not tallied, and basswood (*Tilia americana*) was only of minor status. A Continuum Index of 2535 was calculated for this stand, classifying it as "mesic" (Curtis, 1959). The predominant trees of the Slope were *Quercus rubra*, *Tilia americana*, and *Acer saccharum*, which together accounted for almost 80% of combined percent importance. *Fagus grandifolia* was completely absent, and *Ostrya virginiana* was a minor species. The Continuum Index of 2253 was somewhat lower than that for the Plateau Woods, placing it in the "dry-mesic" category of Curtis (1959). While the overall stem densities of the two areas were similar, the basal area of the Slope was considerably greater than for the Plateau (38.50 m2/ha vs. 23.29 m2/ha).

In contrast to the overstory, the sapling strata of the two areas were very similar (Table 3). Both were dominated by *Acer saccharum* and *Ostrya virginiana*, while the primary difference again was the complete absence of *Fagus grandifolia* from the Slope, which instead had a relatively high complement of *Tilia americana* (18%). The sapling density of the Slope was much less (486 saplings/ha vs. 877/ha), but sapling Continuum Indexes were almost identical–2679 for the Slope and 2625 for the Plateau.

Acer saccharum completely dominated the tree seedling layer of both sites (Table 4), with *Fagus grandifolia* again found exclusively on the Plateau. The second-ranked seedling species on the Slope was *Ostrya virginiana*; its Importance Value of 24% was three times its importance on the Plateau. The Plateau stand had nearly twice the overall seedling density (7325 seedlings/ha vs. 3900/ha).

Table 1. List of vascular plant species found in three habitats of the Mayville Ledge Natural Area. Sampling dates: July 10, 1988; August 24, 1988; September 30, 1988; and May 17, 1989.

Asterisk denotes non-native species.
R = rare; O = occasional; C = common; A = abundant.

Species	Common Name	Plateau	Marsh	Slope
Woody Plants				
Acer negundo	box elder	O		
Acer saccharum	sugar maple	A		A
Carpinus caroliniana	American hornbeam	O		
Carya cordiformis	yellowbud hickory	C		O
Celastrus scandens	climbing bittersweet	O		
Celtis occidentalis	hackberry			R
Cornus alternifolia	pogoda dogwood	O		O
Crataegus sp.	hawthorn	R		
Hamamelis virginiana	witch hazel	D		
Ilex verticillata	black alder		R	
Juglans cinerea	butternut	R		
Lonicera canadensis	fly honeysuckle			O
Lonicera prolifera	grape honeysuckle	C		C
Ostrya virginiana	ironwood	A		C
Parthenocissus inserta	virginia creeper	C		C
Parthenocissus quinquefolia	virginia creeper	C		C
Populus grandidentata	large-toothed aspen	O		
Prunus serotina	black cherry	O		O
Prunus virginiana	chokecherry	A		A
Pyrus malus *	apple	R		
Quercus alba	white oak	O		
Quercus rubra	red oak	O		C
Rhus radicans	poison ivy	O		O
Ribes cynosbati	prickly gooseberry	A		C
Ribes missouriense	Missouri gooseberry	O		
Rosa sp.	rose	R		
Rubus occidentalis	black raspberry	O		
Sambucus canadensis	common elder	O		C
Staphylea trifolia	bladdernut			O
Symphoricarpos albus	snowberry	O		
Tilia americana	American basswood	C		A
Ulmus americana	American elm	C		O
Ulmus rubra	slippery elm	C		O
Viburnum acerifolium	maple-leaved viburnum	O		O
Viburnum lantana *	wayfaring tree			R
Viburnum lentago	nanny berry	C		
Viburnum opulus *	guelder rose	C		

Herbaceous Plants

Actaea pachypoda	white baneberry	C		O
Actaea rubra	red baneberry			C
Agrimonia gryposepala	agrimony	C		
Alisma plantago-aquatica	water plantain		C	
Allium tricoccum	wild leek	C		
Amphicarpa bracteata	hog peanut	O		O
Anemone quinquefolia	wood anemone	C		
Anemone virginiana	thimble weed	O		O
Apocynum androsaemifolium	dogbane	O		
Aquilegia canadensis	wild columbine	O		C
Arabis laevigata	smooth rock cress	O		
Arabis missouriensis	rock cress	R		
Aralia nudicaulis (cliff edge)	wild sarsaparilla		C	
Arisaema triphyllum	jack in the pulpit	C		
Asarum canadense	wild ginger	O		A
Aster lateriflorus	aster	C		
Aster prenanthoides	aster	O		
Aster sagittifolius	aster			O
Aster shortii	aster			O
Boehmeria cylindrica	false nettle		O	
Carex albursina	sedge	C		
Carex blanda	sedge	C		
Carex convoluta	sedge	C		
Carex lupulina	sedge		O	
Caulophyllum thalictroides	blue cohosh	O		O
Circaea lutetiana	enchanter's night shade	C	C	
Claytonia virginica	spring beauty	O		C
Cystopteris bulbifera	bulblet fern			C
Dicentra cucullaria	dutchman's breeches	O		C
Dryopteris spinulosa	spinulose wood fern			O
Echinochloa crusgalli *	barnyard grass		O	
Epifagus virginiana	beech drops	C		
Epilobium coloratum (roads)	willow herb	O		
Equisetum arvense	common horsetail		C	
Erysimum cheiranthoides	wormseed mustard			O
Erythronium albidum	white dog's tooth violet		O	
Eupatorium perfoliatum	boneset		O	
Eupatorium rugosum	white snakeroot	C		
Fagus grandifolia	American beech	A		
Fraxinus americana	white ash	C		O
Galium aparine	bedstraw	C		C
Galium concinnum	bedstraw	O		
Galium triflorum	sweet-scented bedstraw	O		
Geranium maculatum	white cranesbill	C		O
Geum canadense	geum	C		O
Glyceria striata	fowl meadow grass	C		O
Hackelia virginiana (roads)	stickseed	O		
Hepatica acutiloba	liverleaf	O		C

Hydrophyllum virginianum	water leaf	O		C
Hystrix patula	bottlebrush grass	O		O
Isopyrum biternatum	false rue anemone	C		A
Laportea canadensis	wood nettle			O
Leersia oryzoides	rice cutgrass		C	
Leonurus cardiaca *	common motherwort	O		
Lithospermum latifolium	gromwell	O		
Lobelia siphilitica	great lobelia		O	
Lycopus virginicus	water horehound		O	
Menispermum canadense	moonseed	O		
Mitella diphylla	coolwort	R		O
Onoclea sensibilis	sensitive fern		O	
Osmorhiza claytoni	sweet cicely			R
Parietaria pensylvanica	pellitory			O
Pellaea glabella	cliff brake			O
Phalaris arundinacea	reed canary grass		C	
Phryma leptostachya	lopseed	O		
Pilea pumila	richweed	C		
Podophyllum peltatum	may apple	C		O
Polygonum hydropiper *	common smartweed		C	
Polygonum persicaria *	lady's thumb		C	
Polymnia canadensis	leafcup			C
Ranunculus abortivus	buttercup	O		
Rumex crispus *	yellow dock		O	
Sanguinaria canadensis	bloodroot	O		O
Scirpus cyperinus	woolgrass		C	
Scirpus fluviatilis	river bulrush		O	
Sium suave	water parsnip		O	
Smilacina racemosa	false solomon's seal	C		C
Smilax ecirrhata	greenbriar	O		
Solanum dulcamara *	nightshade	C		C
Solidago flexicaulis	goldenrod			
Solidago ulmifolia	goldenrod	O		O
Symplocarpus foetidus	skunk cabbage	R		
Thalictrum dioicum	early meadow rue	A		C
Thelypteris palustris	marsh fern		O	
Trillium grandiflorum	common trillium	O		O
Triosteum aurantiacum	wild coffee	O		
Typha latifolia	broad-leaved cattail		C	
Uvularia grandiflora	large-flowered bellwort		O	
Verbena urticifolia (roads)	white vervain	O		
Viola canadensis	Canada violet			A
Viola eriocarpa	smooth yellow violet	O		
Viola sororia	wooly blue violet	C		
Vitis riparia	river bank grape	O		O
Xanthoxylum americanum	northern prickly ash	O		O
	Totals (132)	92	20	64
	Non-native (9)	4	4	1

Table 2. Stand attributes of trees found in the Mayville Ledge Natural Area. Separate statistics are reported for the Plateau Woods (Plt) (sample area 0.375 ha) and the Slope Woods (Slp) (sample area 0.128 ha). Density, frequency, basal area and importance value are presented as relative values in % of total. Sampled July 11-12, 1988.

	Density (%)		Frequency(%)		Basal Area(%)		Importance Value (%)	
Species	Slp	Plt	Slp	Plt	Slp	Plt	Slp	Plt
Ostrya virginiana	28.0	35.0	5.6	21.9	0.2	15.3	2.6	24.1
Fagus grandifolia		13.1		15.6		32.3		20.3
Acer saccharum	26.0	15.6	27.8	17.2	13.8	9.2	22.5	14.0
Carya cordiformis		15.6		14.1		10.4		13.4
Ulmus rubra	6.0	7.5	11.1	9.4	5.7	13.7	7.6	10.2
Fraxinus americana	2.0	6.2	5.6	9.4	1.7	4.9	3.1	6.8
Ulmus americana	6.0	2.5	11.1	6.2	8.2	2.0	8.4	3.6
Tilia americana	26.0	1.2	22.2	3.1	32.7	6.1	27.0	3.5
Quercus alba		1.9		1.6		5.0		2.8
Prunus serotina		1.2		1.6		0.9		1.2
Quercus rubra	32.0		16.7		37.6		28.8	

Slope Density = 400.0/ha
Plateau Density = 426.7/ha
Slope Basal Area = 38.50 m2/ha
Plateau Basal Area = 23.29 m2/ha
Slope Continuum Index = 2253
Plateau Continuum Index = 2535

Table 3. Stand attributes of saplings found in the Mayville Ledge Natural Area. Separate statistics are reported for the Plateau Woods (Plt) (sample area 0.375 ha) and the Slope Woods (Slp) (sample area 0.128 ha). Density, frequency and importance value are presented as relative values in % of total. Sampled July 12, 1988.

	Density (%)		Frequency(%)		Importance Value(%)	
Species	Slp	Plt	Slp	Plt	Slp	Plt
Acer saccharum	56.4	47.7	35.7	25.9	46.0	36.8
Ostrya virginiana	21.0	23.1	28.6	14.8	24.8	19.0
Fagus grandifolia		11.8		16.7		14.2
Carya cordiformis		6.4		18.5		12.4
Fraxinus americana		6.1		9.2		7.6
Prunus serotina		2.1		5.6		3.8
Ulmus americana	4.8	0.6	7.1	3.7	6.0	2.2
Tilia americana	14.5	0.9	21.4	1.8	18.0	1.4
Quercus rubra		0.6		1.8		1.2
Ulmus rubra	3.2	0.6	7.1	1.8	5.2	1.2

Slope Density = 486.3/ha
Plateau Density = 877.3/ha
Slope Continuum Index = 2679
Plateau Continuum Index = 2625

Table 4. Stand attributes of tree seedlings found in the Mayville Ledge Natural Area. Separate statistics are reported for the Plateau Woods (Plt) (sample area 0.04 ha) and the Slope Woods (Slp) (sample area 0.01 ha). Density, frequency and importance value are presented as relative values in % of total. Sampled July 11-12, 1988.

	Density (%)		Frequency(%)		Importance Value(%)	
Species	Slp	Plt	Slp	Plt	Slp	Plt
Acer saccharum	74.4	82.9	40.0	47.5	57.2	65.2
Fagus grandifolia		5.8		10.0		7.9
Ostrya virginiana	17.9	3.1	30.0	12.5	24.0	7.8
Prunus serotina		3.4		7.5		5.4
Fraxinus americana		2.0		7.5		4.8
Carya cordiformis	2.6	1.0	10.0	7.55	6.3	4.2
Tilia americana	2.6	1.4	10.0	5.00	6.3	3.2
Ulmus rubra	2.6	0.3	10.0	2.5	6.3	1.4

Slope Density = 3900/ha
Plateau Density = 7325/ha
Slope Continuum Index = 2782
Plateau Continuum Index = 2743

Table 5. Shrub and trailing vine cover of the Mayville Ledge Natural Area, based on the line-intercept method. Sampling dates: July 11-12, 1988.

Species	Plateau		Slope	
	Cover (%)	Relative Cover (%)	Cover (%)	Relative Cover (%)
Prunus virginiana	6.3	63.0	12.8	47.0
Ribes cynosbati	2.1	21.0	--	--
Parthenocissus quinquefolia	1.3	13.0	0.8	2.9
Cornus alternifolia	0.2	2.0	0.6	2.2
Sambucus canadensis	0.1	1.0	1.6	5.9
Parthenocissus inserta	--	--	5.6	20.6
Staphylea trifolia	--	--	5.0	18.4
Rubus occidentalis	--	--	0.6	2.2
Lonicera prolifera	--	--	0.2	0.7
Totals	10.0%	100.0%	27.2%	99.9%

Table 6. Relative frequency of occurrence (percent of occurrences of all species in all quadrats sampled) of herbaceous species found in the Mayville Ledge Natural Area. Data for Slope Woods based on 10, 1 m 2 plots and the data for Plateau Woods based on 30, 1 m2 plots. Sampling dates: July 12, 1988 and May 17, 1988.

	Slope		Plateau	
Species	Spring	Summer	Spring	Summer
Asarum canadense	11.8%	28.0%		
Dicentra cucullaria	11.8			
Hydrophyllum virginianum	11.8	4.0		
Smilacina racemosa	9.8	16.0	17.8%	10.0%
Thalictrum dioicum	9.8	16.0	3.6	3.3
Isopyrum biternatum	7.8			
Aster shortii	5.9	4.0		
Hepatica acutiloba	5.9	4.0		
Geranium maculatum	3.9	4.0		3.3
Mitella diphylla	3.9			
Trillium grandiflorum	3.9	4.0		
Anemone quinquefolia	2.0		7.1	
Claytonia virginica	2.0		3.6	
Erythronium albidum	2.0			
Galium aparine	2.0		7.1	
Polymnia canadensis	2.0	8.0		
Poaceae	2.0			
Viola canadensis	2.0			
Cystopteris bulbifera		8.0		
Laportea canadensis		4.0		
Arisaema triphyllum			46.4	46.7
Agrimonia gryposepala			3.6	
Allium tricoccum			3.6	
Carex spp.			3.6	3.3
Viola sororia			3.6	
Circaea lutetiana				16.7
Podophyllum peltatum				6.7
Epifagus virginiana				3.3
Geum canadense				3.3
Viola spp.				3.3
No. of species	18	11	10	10
Bare ground	44.5%	52.5%	96.1%	78.9%

Chokecherry (*Prunus virginiana*) was the major species of the shrub/vine layers of both sites (Table 5), with prickly gooseberry (*Ribes cynosbati*) and five-leaved virginia creeper (*Parthenocissus quinquefolia*) next in importance in the Plateau Woods, and virginia creeper (*Parthenocissus inserta*) and bladdernut (*Staphylea trifolia*) subdominants on the Slope. Overall, the Slope had nearly three times the total shrub cover of the Plateau Woods (27.2% vs. 10.0%).

Eighteen herbaceous species were found in the Slope Woods sample plots during the spring, as compared to 11 found in the same stand in the summer (Table 6). The percent of bare ground increased slightly from 44.5% in the spring to 52.5% in the summer. The most frequently encountered species in the spring were wild ginger (*Asarum canadense*), dutchman's breeches (*Dicentra cucullaria*), and water leaf (*Hydrophyllum virginianum*), followed by false soloman's seal (*Smilacina racemosa*) and early meadow rue (*Thalictrum dioicum*). By summer, *Asarum* was the clear dominant, followed by *Smilacina* and *Thalictrum*. The Plateau had fewer species (10) during both spring and summer; the most frequent at both times was jack in the pulpit (*Arisaema triphyllum*), which was completely absent from the slope. The second most frequent species on the Plateau was *Smilacina racemosa* during the spring, and enchanter's nightshade (*Circaea lutetiana*) during the summer. *Circaea lutetiana* was not found during the spring on the Plateau and was not found at all on the Slope. The percent of bare ground on the Plateau was high in the spring (96.1%), but diminished by summer (78.9%).

To examine compositional changes occurring within each site, I first considered size classes as "stands" and calculated Continuum Indexes (CI) for each. When graphed (Fig. 2), the Slope Woods show a consistent trend towards a higher CI in the smaller (and, therefore, younger) stems, thus indicating a more mesic future. By "more mesic", I mean greater dominance by shade-tolerant and shade-producing species (such as sugar maple) which will also result in a somewhat moister, cooler microclimate. The smaller size classes of the Plateau nearly coincide with those of the Slope. However, the largest class (not found in the Slope) presents a dramatic increase in CI.

Size classes plotted against log density show a curve approaching a straight line for the Plateau Woods (Fig. 3). This negative exponential curve is characteristic of the structure of undisturbed, uneven-aged forests in which there is survival of a significant number of subcanopy trees. In contrast, the Slope Woods graph reveals the rotated sigmoid curve typical of many small eastern deciduous forest stands, with a plateau in the middle classes (Goff and West, 1975; West et al., 1981). A curve of this form has been interpreted as indicating past disturbance (Schmelz and Lindsey, 1965), although others (e.g., Jones et al., 1981; West et al., 1981) have linked curves of this shape to vertical structure, understory-overstory interactions, and differences in species' life histories. Jones et al. (1981) have interpreted the initial steep slope (the young understory) of small individuals present in high densities as representing invasive species with high mortality rates. As a few of these stems mature into the overstory, the mortality rate decreases, producing the plateau in the curve. Finally, the larger stems (senescent upperstory) approaching maximum age show a higher mortality rate resulting from natural causes (windthrow or disease) or cutting. The origin of the even-aged, dominant red oaks remains debatable. They are possibly of post-fire origin. Fires driven

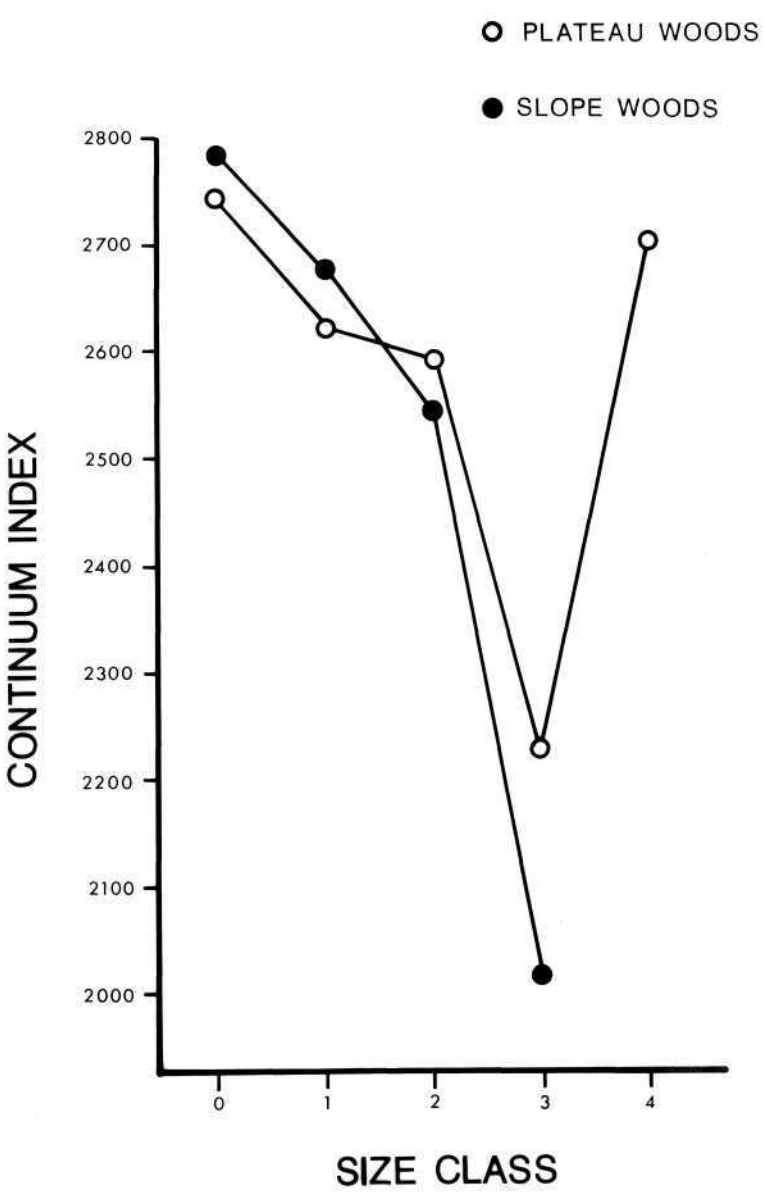

Fig. 2. Changes in Continuum Index by size class for the two Mayville sites. Size class 0: <2.5 cm dbh; 1: 2.5-9.9 cm dbh; 2: 10.0-29.9 cm dbh; 3: 30.0-49.9 cm dbh; 4: >50.0 cm dbh.

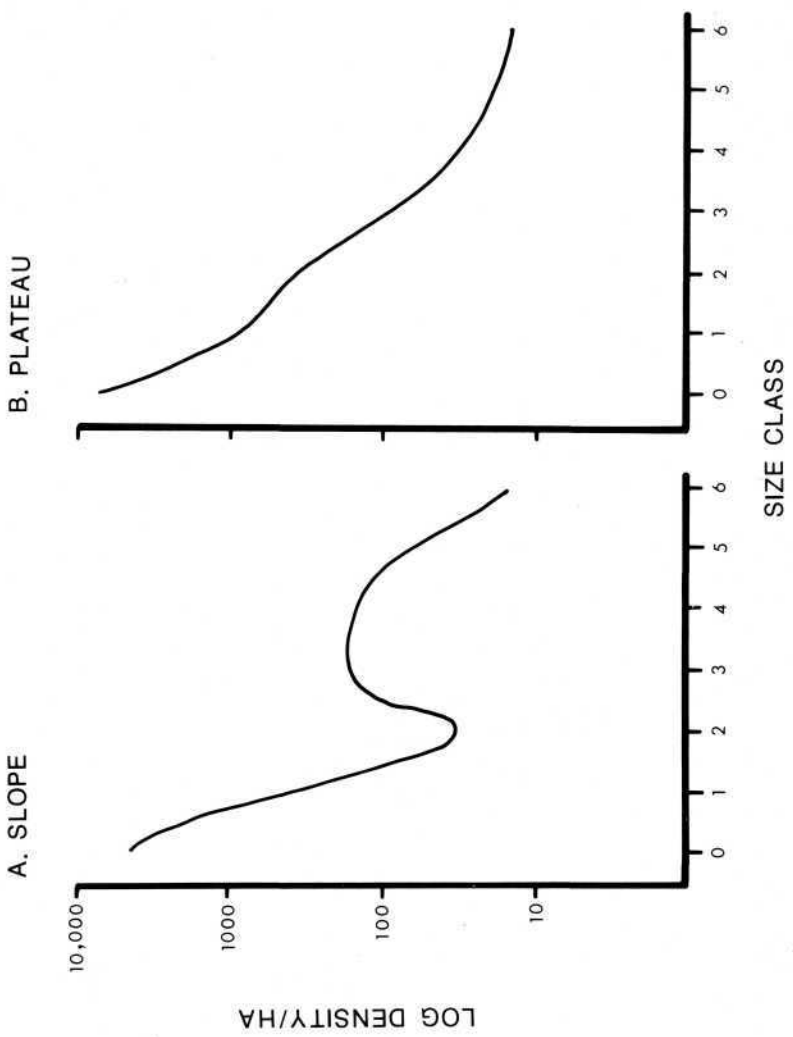

Fig. 3. Size class-log density profiles for all tree species in the two Mayville sites. Size class 0: <2.5 cm dbh; 1: 2.5-9.9 cm dbh; 2: 10.0-19.9 cm dbh; 3: 20.0-29.9 cm dbh; 4: 30.0-39.9 cm dbh; 5: 40.0-49-9.9 cm dbh; 6: >50.0 cm dbh.

eastward across the lowland would likely have been prevented from further advancement by the escarpment itself, but not before destroying much of the woody vegetation below, thus providing an opportunity for oak establishment.

To obtain a clearer picture of changes in species composition, I plotted relative densities by species in four size classes (Fig. 4). Changes appear to be occurring in both stands. Although ironwood (*Ostrya virginiana*) is, overall, the most important tree species in the Plateau Woods, it does not reach large tree size and actually only dominates the intermediate size classes. Beech (*Fagus grandifolia*), a dominant species in the larger size classes, is successfully replacing itself, and sugar maple (*Acer saccharum*) seems to be increasing in percent importance. Except for white oak (*Quercus alba*), all other species (white ash *Fraxinus americana*, *Ulmus rubra*, *Tilia americana*, and *Carya cordiformis*) are adequately represented in the smaller classes and should maintain themselves as subdominant canopy species in the future.

In contrast, in the Slope Woods red oak (*Quercus rubra*), the most important tree species, is apparently being replaced by sugar maple (*Acer saccharum*), while basswood (*Tilia americana*) should maintain its dominant position. Although American elm (*Ulmus americana*) is present in the smaller size classes, its presence as a canopy species is jeopardized by Dutch elm disease (as is, to a somewhat lesser extent, *U. rubra*), which would prevent young individuals from surviving long enough to enter the overstory.

Assuming protection from future disturbance, the results strongly suggest that the Slope forest will become increasingly mesic as the older oaks die and are replaced by sugar maple. The potential similarity of the Slope Woods to the Plateau Woods seems limited, though, since the thin, rocky soil should prevent beech from becoming established below the ledge, and ironwood shows no indication of increasing importance.

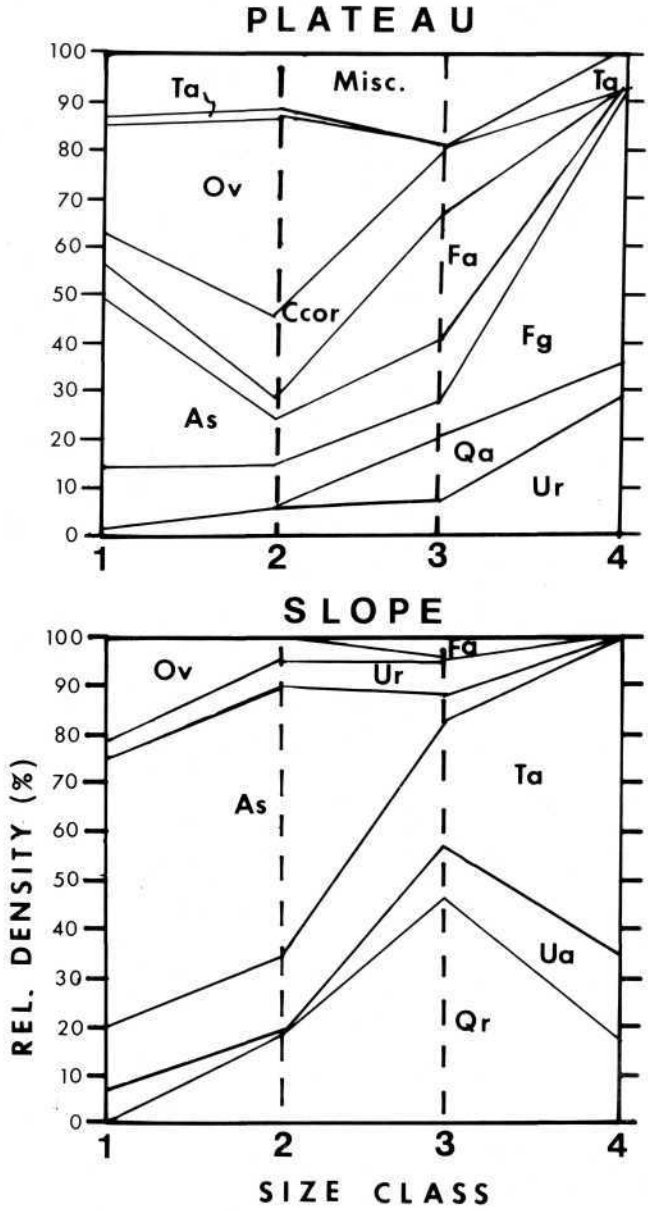

Fig. 4. Changes in relative densities of major tree species by size class found in the two Mayville sites. Size class 1: 2.5-9.9 cm dbh; 2: 10.0-29.9 cm dbh; 3: 30-44.9 cm dbh; 4: >45.0 cm dbh. Species codes: As = Acer saccharum; Ccor = Carya cordiformis; Fa = Fraxinus americana; Fg = Fagus grandifolia; Ov = Ostrya virginiana; Qa = Quercus alba; Qr = Quercus rubra; Ta = Tilia americana; Ua = Ulmus americana; Ur = Ulmus rubra.

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