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Understory Survey at the Rocky Branch Nature Preserve, Clark County, Illinois

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ABSTRACT

The herbaceous plants and woody seedlings of the Rocky Branch Nature Preserve were studied during the growing seasons of 1987 and 1989 using 1/10 m^2 circular plots established along 25 m long transects. Densities in the mixed hardwood vegetation region averaged 32.3 (plants/m^2) during the spring survey of 1987, declining to 12.9 and 8.1 for the summer and fall surveys. In the white oak vegetation region, densities were 19.3 (plants/m^2) for the spring survey of 1987, decreasing to 9.2 and 4.6 during the summer and fall surveys. Densities decreased during the 1989 survey, in both vegetation regions to about two-thirds of those recorded for 1987, probably the result of extreme drought conditions in 1988. In the sugar maple vegetation region, located on a steep, north-facing hillside, the densities of herbaceous plants and woody seedlings were similar for both years, averaging 23.4 (plants/m^2) for the spring surveys, and decreasing to an average of 8.8 for both the summer and fall surveys.

INTRODUCTION

Rocky Branch Nature Preserve, located six miles northwest of Marshall, Clark County, Illinois, contains remnants of the forests typically associated with valleys of the Illinois till plain of the Southern Uplands Section, Wabash Border Natural Division (Schwegman, 1973). In this Section, oak forests include a mixture of beech, sugar maple, tulip tree, and other tree species typical of forests east of Illinois.

Due to its unique flora, land bordering parts of Rocky Branch Creek was purchased by the Illinois Chapter of The Nature Conservancy and placed under the trusteeship of Eastern Illinois University. Several vegetation studies have

been undertaken in the woodlot. Stover (1930) prepared a checklist of the plants in the preserve and described the plant associations, Arzeni (1947) prepared a checklist of the bryophytes, while Hellinga and Ebinger (1970) completed an inventory of the vascular plant species. The woody vegetation of the eastern section of the preserve was surveyed by Hughes and Ebinger (1973), and the western section was surveyed by Ebinger and Parker (1969) and Clapp and Ebinger (1988). The results of these past surveys indicate that the forests in the preserve have undergone major changes in species composition during the past twenty years. Most of these changes involve the explosive increase in sugar maple and a corresponding decrease in the importance of oak species.

This change in forest composition is probably causing changes in the herbaceous species in the woodlot due to excessive shading and changes in litter composition. The present study was undertaken to determine the existing floristic composition of the understory, since it is very possible that some management practices will be implemented to decrease the importance of sugar maple.

DESCRIPTION OF THE WOODLOT

The area studied, the western most portion of the Rocky Branch Nature Preserve, consists of a 6.5 ha woodlot located in the NE1/4, SE1/4 of Section 30, T12N, R12W, Clark County, Illinois. The topography varies from level to gently sloping uplands, to ravines with gradually sloping sides to steep banks, while sandstone outcrops and a steep hillside overlook Rocky Branch Creek at the northern edge. Overall relief is about 18 m with the high point being 195 m above mean sea level. Ebinger and Parker (1969) divided this woodlot into three vegetation regions based on woody overstory composition: a mixed hardwood region on the slopes and lowlands associated with the small streams and ravines, a white oak region on the relatively flat uplands, and a sugar maple region on the steep north-facing hillside.

METHODS AND MATERIALS

Herbaceous plants and the woody seedlings were surveyed during the growing seasons of 1987 and 1989. In spring, summer, and fall of each year, 24 north/south transects 25 m long were located randomly in the woodlot, eight in each of the three vegetation regions. The 1989 survey was conducted within three calendar days of the 1987 survey dates, and each line was started at the same location as in the 1987 survey. Along each transect, 1/10 m^2 circular plots were randomly located at 1 m intervals. A random numbers table was used to determine the number of meters the plots were placed to the east (odd numbered plots) or to the west (even numbered plots) of the transect. All herbaceous plants and woody seedlings were identified, counted, and their densities (plants/m^2) determined. These calculations were made for each species in the three vegetation regions for each season of 1987 and 1989. Nomenclature follows Mohlenbrock (1986).

RESULTS AND DISCUSSION

A total of 45 vascular plant species were found in the study plots of the mixed hardwood region, 29 in the white oak region, and 31 in the sugar maple region. These species are shown in Tables 1, 2, and 3, along with their densities for the spring, summer, and fall surveys in each region in 1987 and 1989.

Mixed Hardwood Vegetation Region

In this region, 32.3 plants/m^2 were recorded during the spring survey of 1987. *Dicentra cucullaria*, with an average density of 5.1 (plants/m^2), was the dominant species encountered (Table 1). Other important herbaceous species included *Galium concinnum*, *Podophyllum peltatum*, *Arisaema triphyllum*, *Cystopteris protrusa*, and *Carex* spp. During the summer survey of 1987 only 12.9 plants/m^2 were recorded. Of the herbaceous species, *Arisaema triphyllum* dominated with 1.5 plants/m^2, while the densities of all herbaceous species decreased from the spring survey, and only a few new species were encountered. Similar results were obtained in the fall survey with only 8.1 plants/m^2 (Table 1).

Of the species recorded in this region, nine were woody species. *Acer saccharum* (3.6 plants/m^2) was the dominant woody species encountered for the spring survey of 1987 (Table 1). Seedlings of *Ulmus rubra*, *Cornus florida*, *Prunus serotina*, *Ostrya virginiana*, and *Quercus alba* were also occasionally encountered. The density of most of these woody species remained fairly constant during the growing season, generally showing only a slight decline from the spring to fall survey.

The survey results for 1989 were very different from those of 1987. During the spring survey of 1989 total plant densities decreased to 19.6 plants/m^2, declining to 5.8 and 6.3 during the summer and fall surveys respectively. Overall, the densities decreased to about two-thirds of those recorded for 1987, and 9 species found in 1987 were not recorded in 1989. Also, the dominant spring species of 1987, *Dicentra cucullaria*, was noticeable absent in 1989. This pronounced decrease in densities in 1989 may be related to the drought conditions of 1988, resulting in the death of some understory species as well as a decrease in propagule production.

White Oak Vegetation Region

This region has a relatively low species diversity with only 29 taxa being recorded. During the spring survey of 1987, 19.3 plants/m^2 were recorded. *Arisaema triphyllum*, with a density of 6.9 plants/m^2, was the dominant species encountered (Table 2). Other important herbaceous species included *Podophyllum peltatum*, *Smilacina racemosa*, *Circaea lutetiana*, and *Arisaema dracontium*. During the summer survey the density decreased to 9.2 plants/m^2, while a further decline to 4.6 plants/m^2 was recorded during the fall survey.

Of the woody plant seedlings found in this region, only *Acer saccharum* and *Fraxinus* sp. exceeded one individual per m^2 during any of the surveys. During the fall survey of 1987, sugar maple averaged 1.3 plants/m2, while ash seedlings averaged 1.3 plants/m^2 during the summer survey of 1987 (Table 2).

The species densities for 1989 were much lower than those recorded for 1987. In the spring of 1989, 12.5 plants/m^2 were recorded, declining to 6.0 and 6.4 during the summer and fall surveys of that year, respectively. Though most of the same species were recorded for both years, their densities in 1989 were significantly lower, usually about two-thirds of the densities recorded for 1987. These dramatic decreases may be drought related.

Sugar Maple Vegetation Region

This area is located on the steep north-facing hillside at the northern edge of the woodlot. In this region, a density of 21.3 plants/m^2 was recorded during the spring survey of 1987, increasing to 25.6 in 1989. *Hepatica nobilis*, with a density of over 5.0 plants/m^2 in both years, was the dominant species (Table 3). *Arisaema triphyllum, Podophyllum peltatum, Polystichum acrostichoides*, and *Solidago caesia* were also commonly encountered. During the summer and fall surveys, many of the same species were found, but in lower numbers. Important woody species of this region were seedlings of sugar maple and a relatively large number of individuals of *Hydrangea arborescens*. Overall, similar results were obtained in both years, with slightly higher densities found in 1989.

At the present time, the herbaceous understory in most parts of this woods lacks the diversity and population size characteristic of many forests of east-central Illinois (Burns, 1986). This low diversity and density is probably the result of excessive shading and nutrient depletion created by a dense sapling population of *Acer saccharum*. Many of the herbaceous species of oak woodlands are not adapted to the reduced light intensities and, perhaps, the intensive competition associated with a sugar maple dominated forest. These species will probably disappear as the oak woods are converted to sugar maple forests. In this woods, sugar maple saplings and large seedlings virtually blanket the understory. As indicated by Clapp and Ebinger (1988) and Ebinger (1988) sugar maple dominates the lower diameter classes in this woods, while oaks are found mostly in the larger diameter classes. Also, sugar maple has a high gap-phase-replacement-potential, so as these larger oaks die, sugar maple will increase in importance. This will result in more shading of the herbaceous understory, further decreasing diversity and density of the herbaceous layer. It should also be noted that sugar maple has a compensation point of 3.4% of full sunlight, while oaks have a compensation point of approximately 13.6% (Burns, 1923). With such a low compensation point sugar maple is easily become established in the understory.

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Table 1. Density (plants/m^2) of the species found during the spring, summer, and fall surveys of a lowland forest dominated by mixed hardwoods at the Rocky Branch Nature Preserve, Clark County, Illinois.

SPECIES	SPRING		SUMMER		FALL	
	1987	1989	1987	1989	1987	1989
Dicentra cucullaria (L.) Bernh.	5.1	--	--	--	--	--
Galium concinnum Torr. & Gray.	4.1	0.1	0.6	--	1.7	0.4
Acer saccharum Marsh.	3.6	0.8	2.1	0.8	2.1	0.3
Podophyllum peltatum L.	2.8	4.4	0.6	0.2	0.4	--
Arisaema triphyllum (L.) Schott.	2.8	2.5	1.5	0.8	--	--
Parthenocissus quinquefolia (L.) Planch.	2.0	0.8	1.3	--	1.0	0.4
Cystopteris protrusa (Weatherby) Blasd.	1.5	2.3	1.2	1.4	--	0.4
Carex spp.	1.3	--	0.6	--	--	0.4
Hydrangea arborescens L.	1.0	1.1	0.8	0.1	0.7	0.3
Smilacina racemosa (L.) Desf.	0.8	0.9	0.3	--	0.2	0.1
Circaea lutetiana Aschers. & Magnus.	0.8	0.8	0.1	--	--	--
Impatiens capensis Meerb.	0.8	--	0.1	--	--	--
Ulmus rubra Muhl.	0.7	0.1	0.4	--	0.5	--
Dentaria laciniata Muhl.	0.7	0.1	--	--	--	--
Phlox divaricata L.	0.5	--	0.2	--	--	--
Galium aparine L.	0.5	--	--	--	--	--
Claytonia virginica L.	0.5	--	--	--	--	--
Uvularia grandiflora Sm.	0.4	--	0.2	--	0.1	--
Blephilia hirsuta (Pursh) Benth.	0.4	--	--	--	--	--
Cornus florida L.	0.4	0.3	0.3	0.3	0.4	0.6
Polystichum acrostichoides (Michx.) Schott.	0.3	0.3	0.7	--	--	0.1
Viola sororia Willd.	0.3	--	--	--	--	--
Prunus serotina Ehrh.	0.3	2.5	--	0.7	--	1.4
Toxicodendron radicans (L.) Kuntze.	0.2	0.3	0.1	--	0.1	0.3
Ostrya virginiana (Mill.) K. Koch.	0.2	0.8	0.1	0.3	0.1	0.4
Quercus alba L.	0.1	0.1	0.2	--	0.2	--
Dioscorea villosa L.	0.1	0.9	0.1	--	0.1	0.3
Pilea pumila (L.) Gray.	--	--	1.0	--	0.1	--
Phegopteris hexagonoptera (Michx.) Fee	--	--	0.1	0.2	0.1	0.1
Epifagus virginiana (L.) Bart.	--	--	--	--	--	0.5
Others	0.1	0.5	0.3	1.0	0.3	0.3
Totals	32.3	19.6	12.9	5.8	8.1	6.3

Table 2. Density (plants/m^2) of the species found during the spring, summer, and fall surveys of a wooded upland dominated by white oak at the Rocky Branch Nature Preserve, Clark County, Illinois.

SPECIES	SPRING		SUMMER		FALL	
	1987	1989	1987	1989	1987	1989
Arisaema triphyllum (L.) Schott.	6.9	6.1	3.5	1.2	--	--
Podophyllum peltatum L.	5.1	1.1	0.4	0.4	--	--
Smilacina racemosa (L.) Desf.	2.1	1.8	0.8	0.7	0.5	--
Circaea lutetiana Aschers. & Magnus.	1.2	0.2	--	--	--	--
Parthenocissus quinquefolia (L.) Planch.	0.7	0.6	0.8	--	0.4	0.9
Arisaema dracontium (L.) Schott.	0.7	0.4	0.6	0.4	--	--
Acer saccharum Marsh.	0.4	0.5	0.2	1.3	1.3	1.2
Viola sororia Willd.	0.4	0.1	--	--	--	--
Galium concinnum Torr. & Gray.	0.3	0.4	0.3	0.2	0.4	--
Claytonia virginica L.	0.2	--	--	--	--	--
Geranium maculatum L.	0.2	--	--	--	--	--
Quercus alba L.	0.2	--	0.2	0.4	0.2	--
Carex spp.	0.2	0.1	--	--	--	0.2
Smilax lasioneuron Hook.	0.1	--	0.4	--	0.1	0.1
Eupatorium rugosum Houtt.	0.1	--	--	0.2	--	--
Toxicodendron radicans (L.) Kuntze.	0.1	--	0.2	--	0.2	--
Ulmus rubra Muhl.	0.1	0.9	0.3	--	0.5	0.3
Prunus serotina Ehrh.	0.1	0.1	--	--	0.1	0.4
Fraxinus sp.	--	--	1.3	1.0	0.5	1.9
Uvularia grandiflora Sm.	--	--	0.1	--	0.1	0.2
Others	0.2	0.2	0.1	0.2	0.3	1.2
Totals	19.3	12.5	9.2	6.0	4.6	6.4

Table 3. Density (plants/m^2) of the species found during the spring, summer, and fall surveys of a north facing, wooded hillside dominated by sugar maple at the Rocky Branch Nature Preserve, Clark County, Illinois.

SPECIES	SPRING		SUMMER		FALL	
	1987	1989	1987	1989	1987	1989
Hepatica nobilis Mill.	5.2	5.3	1.2	0.7	2.1	2.9
Arisaema triphyllum (L.) Schott.	4.7	1.9	1.0	0.4	--	--
Podophyllum peltatum L.	3.1	0.9	0.2	1.4	--	--
Acer saccharum Marsh.	1.5	2.1	1.3	1.5	1.7	1.4
Polystichum acrostichoides (Michx.) Schott.	1.4	4.6	1.1	1.6	1.7	1.1
Solidago caesia L.	1.3	2.8	0.7	0.7	0.5	2.5
Hydrangea arborescens L.	1.0	1.8	0.7	0.6	0.4	1.0
Cystopteris protrusa (Weatherby) Blasd.	0.7	2.3	--	--	--	--
Smilacina racemosa (L.) Desf.	0.4	1.3	0.1	0.5	0.5	0.3
Fraxinus sp.	0.3	--	0.1	0.3	0.2	--
Toxicodendron radicans (L.) Kuntze.	0.3	--	--	--	--	--
Dicentra cucullaria (L.) Bernh.	0.3	--	--	--	--	--
Circaea lutetiana Aschers. & Magnus.	0.2	0.3	0.8	0.4	--	--
Ostrya virginiana (Mill.) K. Koch.	0.2	0.7	--	--	--	--
Cornus florida L.	0.1	0.4	0.3	--	0.6	--
Parthenocissus quinquefolia (L.) Planch.	--	0.6	0.8	--	--	0.3
Quercus alba L.	--	0.1	--	0.3	--	--
Aster drummondii Lindl.	--	--	--	0.3	--	--
Sanicula gregaria Bickn.	--	--	--	0.3	--	--
Others	0.6	0.5	--	0.4	--	0.5
Totals	21.3	25.6	8.3	9.4	7.7	10.0