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Secondary Vegetation and Successional Sequences Within Shawnee Lookout Park, Hamilton County, Ohio

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ABSTRACT

The vegetation of five secondary stands in Ohio ranging from 3 years to 120 years old were described using an abundance scale. Successional trends for the area were proposed. The stands represent early old-fields (*Aster ericoides, Ambrosia artemisifolia, Eupatorium serotinum,* and *Solidago* spp.) through more mature forest stages (*Acer saccharum, Carya cordiformis, C. ovata, Fraxinus americana, Prunus serotina, Quercus prinus,* and *Q. rubra*). The stands are located in southwestern Ohio near Cincinnati (Hamilton County). The stands studied are located close to one another in a protected area in Shawnee Lookout Park.

INTRODUCTION

Extensive cultivation and rapid population growth has greatly depleted the natural vegetation of southwestern Ohio, particularly in Hamilton County. Secondary old-fields are fairly common as fields are taken out of cultivation. Finding both young and more mature stands in proximity to each other is difficult. Shawnee Lookout Park is an important resource which provides a protected area for studying seral plant communities within Hamilton County. Our purposes were to describe the vegetation of different aged stands and to provide a prediction of successional trends in the park. These stands provide areas which can be studied on a long term basis since the park's long term plan calls for no development in the areas we studied and only the development of foot trails elsewhere.

Shawnee Lookout Park encompasses an area of 404 ha at the confluence of the Great Miami and Ohio Rivers in the southwest corner of Hamilton County, Ohio. The park is contained in the dissected portion of the Illinoian till plain in the Western Mesophytic Forest Region (Braun, 1950). The Hamilton County Park District obtained the land in 1968. Throughout the last century various fields and forests were abandoned from farming and lumbering, creating a number of different aged stands within the park.

METHODS AND DESCRIPTION OF STUDY AREA

During the late summer and autumn of 1977, this study was conducted to investigate the composition of the vegetation

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on different aged stands and to propose successional patterns within the park. Five sites representing five different aged stands were chosen. The history and ages of these stands were obtained through increment boring, examination of aerial photographs dating back to 1932, and conversation with Mr. Charles Winter, a nonagenarian who is an eighty year resident of the area. Species abundance in each stand was estimated for major canopy species according to the following scale: 5—very common, 4—common, 3—here and there, 2—uncommon, 1—rare, +-present (Oosting, 1956). Successional sequences

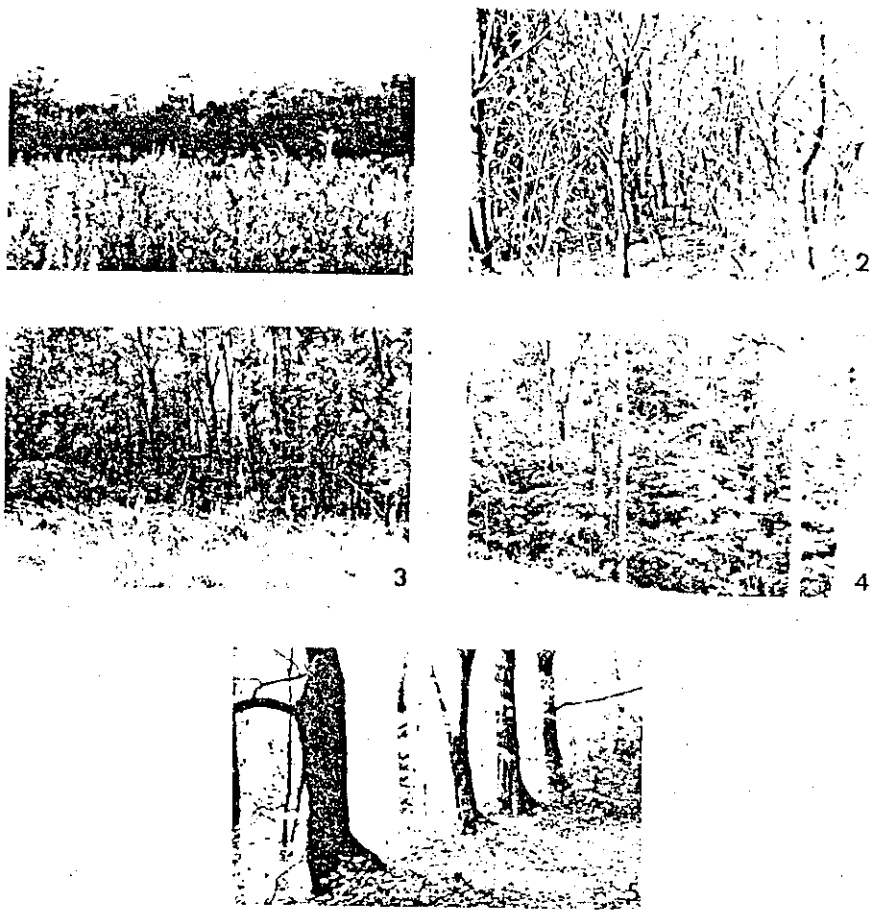

Figure 1. The five stands studied in Shawnee Lookout Park as members of two major successional sequences. Dominants of these stands are given in the text, and range from weedy (stand 1) to mixed mesophytic (stand 5).

were proposed based on a comparison of the dominants of the different aged stands and on successional sequences proposed by other workers on similar sites.

The five stands described ranged from a recently abandoned old-field (stand 1) to an oak-ash-maple forest (stand 5). Stand 1 was a 3-year old abandoned corn field which was cultivated until 1974. The park district had planted the corn annually since it obtained the land; it was left standing each year to supply deer food. Stand 2 was last used for a gas pipeline and was maintained by mowing until 1968 at which time it was abandoned. Stand 3 is an approximately 25-year old abandoned field. The fourth stand has not been disturbed for at least 80 years. The fifth stand, which is the most mature stand in the park, is over 120 years old.

The climate of the study area is basically continental, with a wide range in temperature (Climatological Data for the U.S., 1975). The mean annual temperature is 13.5° C, with monthly averages ranging from O° C in January to 24.5° C in July. Nearly 1/3 of the average annual precipitation of 100 cm occurs during the summer months. The growing season of the area averages approximately 198 days per year.

The physiographic types of the sites included in this study are level terraces, river bluffs, and drained, gently rolling uplands. The soils found upon these physiographic types are Negley loam, Cincinnati silt loam, and Eden silty clay loam, respectively (Soil Survey of Shawnee Lookout Park, 1977).

Stands 1, 2, and 3 are on level terraces and the soils are of Negley loam (Soil Survey of Shawnee Lookout Park, 1977). This deep, gently sloping, well-drained soil is found on very high dissected terraces of Kansan age. It is a highly productive woodland soil with moderate to rapid permeability, moderate available water capacity, and medium runoff. The surface layer is brown loam to about 15 cm. The subsoil which has an extremely acid reaction is silty clay loam to a depth of 150 cm.

Stand 4 is on a northeast slope, and the soil is Eden silty clay loam. It is a moderately deep, well-drained soil on uplands. The 15 cm surface layer is brown silty clay loam. The subsoil from 15 to 150 cm is light olive-brown silty clay and flaggy silty clay. Below 150 cm is weathered interbedded shale, siltstone, and sandstone with some clayey material.

Stand 5 is located on a level ridge top, and the soil is Cincinnati silt loam. This is a deep, strongly sloping, well-drained soil found on dissected areas of the Illinoian glacial till plain. The 15 cm surface layer is brown silt loam. The upper part of the subsoil is brown silty clay loam, the middle part is a brown clay loam fragipan and the lower part is dark yellowish brown clay loam. The fragipan in the middle part of the subsoil is a very dense, hard and brittle layer that is a restriction to both root and water penetration. This is a very highly productive woodland soil with moderate permeability above the fragipan and slow permeability below it. It has a medium to very high acid reaction, moderate available water capacity, and medium runoff.

RESULTS AND DISCUSSION

Stand Descriptions. The dominants of stand 1 were *Aster ericoides, Ambrosia artemisifolia, Eupatorium serotinum,* and *Solidago* spp. (Table 1). Figure 1 shows all five stands. Other common old-field weed species were also present in stand 1. *Fraxinus americana* and *Acer negundo* were the only two tree species present. The former was the most abundant, but neither species was as abundant as the weedy species.

Stand 2 was dominated by *Acer negundo.* Other tree species included *Juglans nigra, Prunus serotina, Robinia pseudo-acacia,* and *Ulmus rubra.* Woody pioneers in cleared areas included *Crataegus* spp., *Gleditsia tricanthos, Robinia pseudo-acacia,* and *Ulmus rubra* (Braun, 1916); we found all of these species in stands 2 and/or 3.

Stand 3 was dominated by *Fraxinus americana, Ulmus parviflora,* and *U. rubra. Ailanthus altissima* and *Crataegus* spp. were also important. Other species included *Acer negundo, Celtis occidentalis, Gleditsia tricanthos, Juglans nigra, Robinia pseudo-acacia,* and *Prunus serotina.*

Stand 4 was dominated by *Fraxinus americana* with important codominants including *Acer saccharum, Aesculus glabra, Celtis occidentalis, Prunus serotina,* and *Ulmus rubra.* The shrub layer consisted of *Asimina triloba, Cercis canadensis, Euonymous atropurpureus,* and *Lindera benzoin.*

The dominants of stand 5 included Acer saccharum, Carya cordiformis, C. ovata, Fraxinus americana, Prunus serotina,

ıble 1. Stand composition and species abundance based on the llowing scale: 5—very common (important constituent of the and), 4—common, 3—here and there, 2—uncommon, 1—rare, +—present. (Identification based on Braun, 1961; Weishaupt, 1971. Voucher specimens were deposited with the Miami University Herbarium.)

Species	Stand 1	2	3	4	5
erbs and Vines					
:hillea millefolium	2				
grostis alba	3				
mbrosia artemisifolia	5				
ster ericoides	4				
mpsis radicans	4				
rsium discolor	+				
nvolvulus sepium var. *repens*	3				
aucus carota	3				
esmodium canascens	2				
upatorium rugosum		3			
upatorium serontium	5				
eum virginianum		3			
enothera biennis	1				
hytolacca americana		3			
olidago graminifolia	4				
olidago odora	5				
ernonia fasciculata	2				
itis vulpina		3			
rees					
cer negundo	1	5	2	3	
cer saccharum				4	5
esculus glabra				4	3
lanthus altissima			4	3	
simina triloba				3	2
arya cordiformis				3	5
arya ovata				2	4
eltis occidentalis			2	5	2
ercis canadensis				4	3
rataegus spp.			4	3	
uonymus atropurpureus				3	
raxinus americana	3		4	5	4
raxinus quadrangulata				4	
leditsia tricanthos		2			
rhus vinera		2	+	3	2

Lindera benzoin			4	2
Platanus occidentalis			3	
Prunus serotina	1	2	4	5
Quercus macrocarpa			1	3
Quercus muehlenbergii				3
Quercus palustris				2
Quercus prinus			2	5
Quercus rubra			2	5
Robinia pseudo-acacia	2	+	1	
Tilia heterophylla			+	3
Ulmus parviflora		5		
Ulmus rubra	1	5	4	2

Quercus prinus, and *Q. rubra.* The shrub layer consisted of *Asimina triloba, Cercis canadensis,* and *Lindera benzoin.*

Successional Sequence. Figure 2 outlines the secondary successional sequences represented by the five stands surveyed. Although differences in successional pattern due to site differences (soils, history, or topography) are to be expected, elements common to all stands studied are a part of the successional sequences depicted here. Length of each stage as well as associated species are both site dependent, also.

Fraxinus americana and *Acer negundo* were the first woody species to invade stand 1, the three-year old abandoned corn field. Studies in the region around southwestern Ohio indicate that the invasion of trees into an abandoned field occurs in the second year after abandonment (Buell et al., 1971; Hopkins and Wilson, 1974). Obviously the invasion of woody species into a field is dependent on the availability of a nearby seed source (Bazzaz, 1968) and the type of dispersal unit. For species with wind dispersed fruits, such as *Acer negundo* and *Fraxinus americana,* a nearby seed source allows rapid colonization of these old-fields (Buell et al., 1971).

The history of the land utilization is different for stand 2 and is a factor affecting succession. Because the land was cleared but not cultivated it developed into an almost pure grove of *Acer negundo.* Braun (1916) states that there is often no indication of what direction succession will proceed in pure groves of trees. However, the presence of common early invaders (as shown in Table 1 and Figure 2) in our stand 2 indicates which direction succession will proceed.

Different ecological strategies of individual species deter-

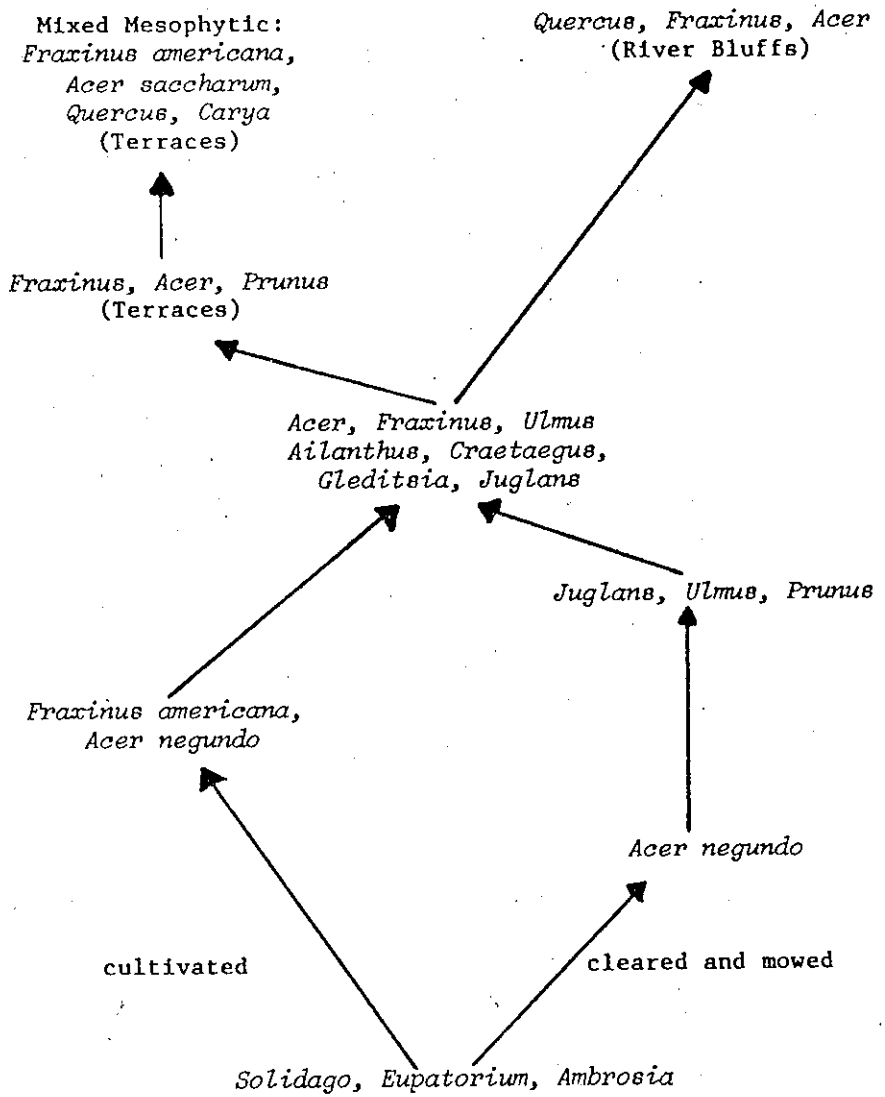

Figure 2. Proposed successional sequences for selected sites at Shawnee Lookout Park.

mine the successional sequence within the available physical framework. For example, *Prunus serotina*, a bird dispersed species, seldom appears before the third year after abandonment (Buell et al., 1971). Seedlings continue to appear for 10-12 years beyond that. In the 5 different aged stands that we studied, *P. serotina* first appeared in stand 2 and became steadily more abundant and important in the stands which were older. Both *P. serotina* and *Robinia pseudo-acacia* are early invaders which can increase in abundance as succession progresses by root sprouting as well as seedlings (Auclair, 1975; Braun, 1916). In our study area, *R. pseudo-acacia* does not seem to be increasing in older stands. *Juglans nigra* was scattered but uncommon in stands 2, 4, and 5, indicating it as a minor constituent of the canopy of forests in the park to the age of about 120 years. In stands in which it is abundant in southwestern Ohio, it becomes so about 20 years after abandonment (Otto, 1964; Small, 1972). The presence of *J. nigra* in stand 2 is probably due to the facts that it could get established while the stand was still being mowed, to the presence of a nearby seed source, and to the fact that it does appear in southwestern Ohio old-fields as early as 10 years after abandonment (Shontz, 1964).

While the important woody species in stands 1 and 2 are the same, the time progress for stand 1 will probably be slower due to the differences between cultivating and mowing. None of the herbaceous plants which is important in stand 1 is present in stand 2. This is not typical of abandoned cultivated fields in southwestern Ohio. Hopkins and Wilson (1974) found a nearby 10 year old old-field dominated by *Acer negundo, Prunus serotina,* and *Ulmus rubra* although *Aster ericoides, Solidago* spp., *Daucus carota, Oenothera biennis* were still characteristic herbaceous representatives. At 10 years after abandonment, stand 1 will probably resemble Hopkins and Wilson's 10 year old stand.

Stand 3 depicted typical vegetation for 25 year old fields in southwestern Ohio. Many of the species important in this stage entered the stand earlier, rose to prominence, but are not a part of mature communities in this region; these species included *Crataegus* spp., *Gleditsia tricanthos,* and *Acer negundo* (Braun, 1916; Otto, 1964; Shontz, 1964; Small, 1972). Although *Ulmus parviflora* was a dominant in this stand, the lack of seedlings indicates that its importance will decrease in the future. *Fraxinus americana* was a major species throughout the stages of succession on cultivated fields studied in the park. It is one of the dominants of the mature oak-ash-maple stands in the park, and is typical of Negley loam (Diehl, 1933). Stand 5 is an example of this forest and as such includes hickories as important species.