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The effect of human disturbance on vegetation at the Wehr Nature Center in Whitnall Park

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THE EFFECT OF HUMAN DISTURBANCE ON VEGETATION AT THE WEHR NATURE CENTER IN WHITNALL PARK

During 1975 and 1976, I studied (Nowak, 1976) two woodlands at the Wehr Nature Center in Whitnall Park, Milwaukee County (Figure 1). My purpose was to document the vegetational changes brought about by human disturbance. The Wehr Woods, adjacent to the Wehr Nature Center Building, had been lumbered and grazed; while the woods along College Avenue is subjected to seasonal flooding, a result of road construction which had altered the drainage pattern.

In each woodland, a disturbed portion was compared with an adjacent, relatively undisturbed area. The heavily lumbered and grazed portion of the Wehr woods will be referred to as the "cutover area" and an adjacent uncut and ungrazed maple woods is designated the "mature area". The woods affected by ponding in spring and early summer along College Avenue will be referred to as "the flooded area" and the adjacent unflooded woods as the "non-flooded area".

METHODS

Quadrats were used to sample vegetation. The College Avenue woods, was too small to hold even a minimum number of plots. There, trees in the non-flooded area were sampled by the quarter method (Curtis and Cottam, 1962) while all trees were recorded in the smaller flooded area. Quadrats consisted of nested rectangular plots, 5 by 20 m for trees, 2 by 8 m for shrubs, and 0.4 by 2.5 m for herbs.

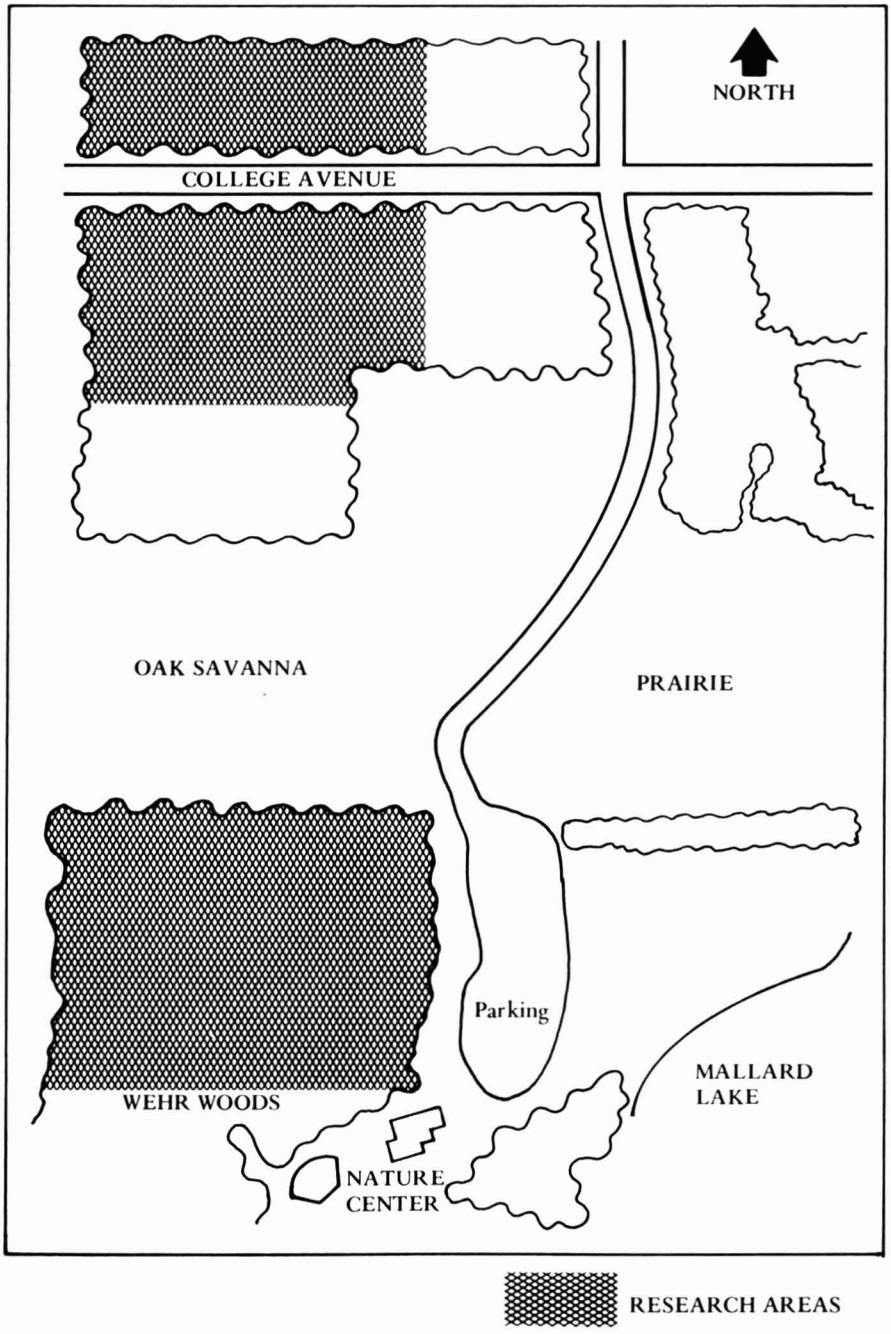
NORTH
COLLEGE AVENUE
OAK SAVANNA
PRAIRIE
Parking
WEHR WOODS
MALLARD
LAKE
NATURE
CENTER
RESEARCH AREAS

Fig. 1

Diameter at breast height (dbh) was recorded for all trees (woody stems over 4 in dbh) and saplings; the diameter of shrubs was measured at 15 cm (about 6 in) above ground. In the herb layer, species and percent cover were recorded. Nomenclature follows Gleason and Cronquist (1963).

DESCRIPTION OF THE AREA

The soils were formed on glacial drift of the Late Wisconsin stage (USDA, 1971). Soils of both the Wehr and the College Avenue woods belong to the Morley and Blount series. The descriptions that follow are based on a recent soil survey of Milwaukee and Waukesha Counties (USDA, 1971).

The Morley series consists of "well-drained and moderately well-drained silty soils over calcareous silty clay loam glacial till." The native vegetation was deciduous forest dominated by oaks and hickories.

The Blount series includes soils which were formed in a "thin layer of silt and in calcareous silty clay loam glacial till. They occur in drainageways and in slight depressions in the southern part of Milwaukee County." In the Wehr woods, this soil is associated with a small streambed which dissects the woods and in the College Avenue woods, the seasonal ponding occurs on this soil. The soil surveyors report that the native vegetation was a deciduous forest, mainly oak, hickory, and elm.

The woodlands studied were originally part of farmland owned by Timothy Doody, Hugo Koch, and August Powers. This land was purchased by the Milwaukee County Park Commission in 1929 and 1930 to increase the size of Whitnall Park (Park Land Acquisition Book, Milwaukee County Park Commission).

While the date of the last lumbering in the Wehr woods is unknown, it occurred before the Milwaukee County Park Commission purchase of the property in 1930. The western path through the Wehr woods is an old lumbering trail (Wehr Nature Center, Woodland Trail Guide).

College Avenue was originally an Indian trail, which later became a wagon trail according to Mr. John Voight, Director of the Boerner Botanical Gardens in Whitnall Park and a long-time resident of the area. As the road was gradually improved during the years the roadbed was raised, undoubtedly changing the drainage alongside the road.

RESULTS

Past human disturbance has greatly modified the species composition of the vegetation within the Wehr woods and the College Avenue woods as it has

	MATURE AREA				CUTOVER AREA			
	Rel Freq.	Rel Dens.	Rel Dom.	I.V.	Rel Freq.	Rel Dens.	Rel Dom.	I.V.
	Percentage				Percentage			
Acer saccharum	17.2	18.5	37.9	73.6	–	–	–	–
Carya cordiformis	5.2	4.3	0.7	10.2	–	–	–	–
Carya ovata	3.4	3.3	4.3	11.0	–	–	–	–
Crataegus spp.	–	–	–	–	30.6	42.2	28.4	101.2
Fraxinus americana	22.4	29.3	8.8	60.5	36.1	32.8	40.9	109.8
Juglans nigra	3.4	3.3	1.9	8.6	11.1	7.8	16.5	35.4
Ostrya virginiana	3.4	2.2	0.2	5.8	–	–	–	–
Prunus nigra	–	–	–	–	2.8	1.6	0.8	5.2
Prunus serotina	12.1	9.8	4.3	26.2	13.9	10.9	8.3	33.1
Quercus alba	5.2	4.2	7.4	16.9	–	–	–	–
Quercus borealis	3.4	2.2	1.7	7.3	–	–	–	–
Quercus macrocarpa	6.9	6.5	11.2	24.6	–	–	–	–
Quercus velutina	6.9	4.3	16.1	27.3	–	–	–	–
Tilia americana	–	–	–	–	2.8	1.6	1.4	5.8
Ulmus americana	–	–	–	–	2.8	3.1	3.8	9.7
Ulmus rubra	10.3	12.0	5.6	27.9	–	–	–	–

The mature area, with a basal area of 194 ft^2/acre had 184 stems/acre; the cutover area area with a basal area of 23 ft^2/acre had 128 stems/acre.

Table 1. Relative values of frequency, density, and dominance and importance value of trees in the mature and cutover areas of the Wehr woods.

	Flooded Area		Non-Flooded Area			
	Rel. Dens.	Rel Dom.	Rel Freq.	Rel Dens.	Rel Dom.	I.V.
	Percentage		Percentage			
Acer rubrum	–	–	3.0	2.5	2.7	8.2
Acer saccharum	–	–	7.0	5.0	9.9	21.9
Carya ovata	0.5	0.9	–	–	–	–
Crataegus spp.	–	–	2.0	1.3	0.2	3.5
Fraxinus americana	–	–	21.0	27.5	9.0	57.5
Fraxinus sp.	92.2	84.1	–	–	–	–
Juglans nigra	–	–	9.0	6.3	5.9	21.2
Ostrya virginia	–	–	3.0	2.5	0.6	6.1
Populus tremuloides	–	–	2.0	5.0	0.7	7.7
Prunus serctina	–	–	10.0	10.0	2.2	22.2
Quercus alba	1.4	9.3	10.0	7.5	20.6	38.1
Quercus borealis	–	–	17.0	17.5	45.4	79.9
Quercus macrocarpa	0.5	3.1	–	–	–	–
Tilia americana	–	–	7.0	7.5	1.7	16.2
Ulmus americana	5.5	2.5	–	–	–	–
Ulmus rubra	–	–	9.0	7.5	1.2	17.7

Table 2. Relative values of frequency, density, dominance and importance value of trees in the flooded and non-flooded areas of the College Avenue woods.

Table 3. Species richness[1] and diversity[2] in the mature and cutover sections of the Wehr woods

	MATURE AREA	CUTOVER AREA
Trees		
Species richness	12.0	7.0
Species diversity	3.07	2.04
Saplings		
Species richness	8.0	13.0
Species diversity	1.76	2.05
Shrubs		
Species richness	10.0	17.0
Species diversity	1.87	2.94
Herb species richness	15.0	28.0

[1] Number of species

[2] The Shannon-Wiener Diversity Index, sensitive to both the number of species and the distribution of individuals among species, was used to calculate these values.

elsewhere in Milwaukee County (Levenson, 1976). In the mature Wehr woods, sugar maple (*Acer saccharum*), white ash *(Fraxinus americana)*, and oaks *(Quercus* spp.) are the most important tree species. Hawthorns (*Crataegus* spp.) and white ash are most important in the cutover area (Table 1). In the College Avenue woods, red oak (*Quercus borealis)*, white ash, and white oak *(Quercus alba)* are important in the non-flooded area; white ash and green ash *(Fraxinus pennsylvanica)*, in the flooded area (Table 2). White ash is prominent in all areas, indicating adaptability to a variety of conditions. Sugar maple, a climax species, is important only in the mature area of the Wehr woods.

In addition to the effect of disturbance on the tree species, other changes in species composition are evident. The cutover area of the Wehr woods has an abundance of thorny and spiny species – plants that presumably survived the grazing or had invaded during that period. These include buckthorn *(Rhamnus catharticus)*, prickly ash *(Zanthoxylum americanum)*, Missouri gooseberry *(Ribes missouriense)*, common blackberry *Rubus allegheniensis)*, black raspberry *(Rubus occidentalis)*, wild crabapple *(Pyrus coronaria)*, in addition to the hawthorns. The flooded area of the College Avenue woods has many water-tolerant species such as red osier dogwood *(Cornus stolonifera)*, skullcap *(Scutellaria lateriflora)*, alder buckthorn (*Rhamnus Frangula*), and green ash.

Species richness and diversity have also been affected by disturbance. Species richness is simply the number of species. Species diversity, in my study,

was estimated by the Shannon-Wiener diversity index (Cox, 1972), which is sensitive to both the number of species and the distribution of individuals among species. Diversity values were not calculated for herbs.

The cutover area of the Wehr woods, in comparison with the mature area, had a greater species richness in all strata – herbs, shrubs, and saplings – with the exception of the tree stratum. Species diversity in the cutover area was also greater in the sapling and shrub stratum, but not in the tree stratum. The lumbering which occurred in the cutover section reduced the canopy allowing the invasion of pioneer species. The presence of both pre-disturbance and post-disturbance species accounts for the greater species richness and diversity in this area. The species richness and diversity in the flooded area of the College Avenue woods was far lower than that found in the other three areas studied (Table 3). Only a few species can survive the stress of protracted flooding.

These two woodlands provide examples of the effects of recent human disturbance on plant communities and can serve as useful teaching tools for environmental education at the Wehr Nature Center.

CONSIDERATIONS FOR THE FUTURE

In view of the effects of past human disturbance at the Wehr Nature Center, as quantified to some degree by this study, it seems reasonable to examine the future possibilities. Whitnall Park, which includes the Wehr Nature Center, may be considered as an "island" in an urban sea. A theory of island biogeography (MacArthur and Wilson, 1967) suggests that the species diversity of a given island is directly related to the area of the island. Diamond (1975) and others have applied this concept to national parks, which, like Whitnall Park, are isolated areas often surrounded by an urban or agricultural matrix (Kolata, 1974). They warn that park size should be planned to reduce species extinctions to a minimum and to provide sufficient area for predators and for rare species.

While my study did not attempt to predict changes based on island biogeography theory for Whitnall Park, it seems essential that the implications be studied thoroughly before permitting any construction, road improvement (including College Avenue), or other encroachment on the remaining vegetated areas in Whitnall Park. Such "improvements" would reduce the size of the biotic community within the park and may reduce species richness and diversity. Expansion of the park would be helpful in the preservation of the flora and fauna now present.

The maintenance of the biotic communities represented in Whitnall Park is important for their intrinsic value and equally important for their use as a living laboratory for the environmental education program of the Wehr Nature Center. In an ever-more urbanized society, it is essential that people have the

opportunity to leave the narrow paved paths of their everyday lives and rediscover the web of life within which all living organisms, including themselves, are inexorably bound. Urbanization has increased the need for the aesthetic experiences most readily associated with natural areas. Finally, the community of plants and animals within Whitnall Park is a repository of biological diversity – a naturally-maintained gene pool – which may provide seed for revegetation of nearby areas and which may be tapped for human benefit at some future date.

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