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The Southern-Mesic Forest of Southeastern Wisconsin: Species Composition and Community Structure

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Abstract: Forty-three remnants of the southern-mesic forest community were identified in the metropolitan Milwaukee, Wisconsin region. Historical and environmental descriptions, species composition and diversity and community structure are quantitatively presented for each structural layer (canopy, understory, shrub and groundlayer) of each stand.

A community dendrogram of 42 stands was developed. The dendrogram illustrated a continuum of dominance by sugar maple (*Acer saccharum* Marsh.), American beech (*Fagus grandifolia* Ehrh.) and basswood (*Tilia americana* L.). White ash (*Fraxinus americana* L.) was a vigorous, opportunistic competitor in the forest remnants. Responding to disturbance, it appears to be replacing the elms (*Ulmus spp.* L.) and may be considered a major component of all structural strata in the southern-mesic forest community.

Choke cherry (*Prunus virginiana* L.) was the most abundant and frequent species in the shrub stratum. Sugar maple and white ash were the most important tree species in the shrub layer. However, in general there was an inverse relationship between their respective importances in any given stand.

No exotic species were observed to persist in any strata under the closed canopy of the southern-mesic forest with the exception of the European orchid, helleborine (*Epipactis latifolia* (L.) Crantz.).

INTRODUCTION

Agricultural development and urbanization in the eastern United States has reduced and fragmented once-region-wide forest ecosystems into widely isolated woodlots. The remnant woodlots are embedded in an urban-agricultural system quite unlike the natural environment in which they originally developed. The fate of biota in such isolated "habitat islands" has become the focal point of recent research efforts (Forman and Elfstrom, 1975; Greller, 1975; Suhrweir and Tramer, 1976; Forman, et al., 1976; Whitcomb, et al., 1976). The maintenance, management and preservation of native communities and endangered species becomes more difficult as the natural systems become more limited and isolated.

The initial step in the preservation of regional biotic diversity is to obtain a quantified inventory of the community type in question. In the metropolitan Milwaukee, Wisconsin, the predominant forest vegetation was the beech-maple (Braun, 1950) or southern-mesic (Curtis, 1959) forest. Original and post-settlement vegetation had been described by Chamberlin (1877) and Bruncken (1900) and summarized by Shinners (1940). Although informative, these works remain qualitative. There have been few quantitative studies of the region's upland forest communities, most notably Whitford and Salamun's (1954) documentation of the continuum of upland forest types in Milwaukee County. Ward (1956) and Curtis (1959) examined only two sites each in the metropolitan region for their studies of the southern-mesic type.

In light of these facts, the objectives of this paper are to: 1) identify the persisting, remnant southern-mesic forests in the metropolitan Milwaukee region; 2) survey the remnant communities and document the plant species composition and community structure; and 3) summarize the phytosociologic relations for each site and the region.

STUDY AREA

The study was limited to metropolitan Milwaukee, an area of about 525km^2, including Milwaukee County, southern Ozaukee County, and the eastern portions of Waukesha and Washington Counties (Figure 1).

Climate

The metropolitan Milwaukee region has a continental climate influenced by major storm systems tracking across the upper Ohio River Valley followed by high pressure moving southeastward from Canada to dominate the regions weather (NOAA, 1974).

Lake Michigan creates local climatic modifications, especially when the water temperature differs considerably from the air temperature. Areas adjacent to the Lake are generally cooler in the summer and warmer in the winter. Milwaukee's annual temperature is 8.0°C (46.4°F) averaged over a 99-year period (NOAA, 1974). Average monthly temperatures range from -6.2°C (20.9°F) in January to 21.5°C (70.7°F) in July. The average annual precipitation is about 76.2cm (30 in) with about two-thirds falling during the frost-free season. The length of the average growing season near Lake Michigan in Milwaukee County is 180 days (Figure 2).

Summers are warm with intermittent periods of hot, humid weather. About 55% of the annual rainfall occurs between May and September. The average first freezing temperature is October 8th, but within 3-5km (2-3 mi) of the Lake, the freeze may be postponed for two weeks.

The change from fall to winter is often abrupt. Freezing of the ground usually begins late in November and lasts until early April. The average annual snowfall is about 107cm (42 in), but the range is from 28cm (11 in) to more than 254cm (100 in). A change of weather can be expected every 2-3 days from late fall through midspring. The prevailing winds are from the northwest from November through March. Modification of temperature caused by the lake

Figure 1. The towns of Milwaukee and Ozaukee County, Wisconsin.

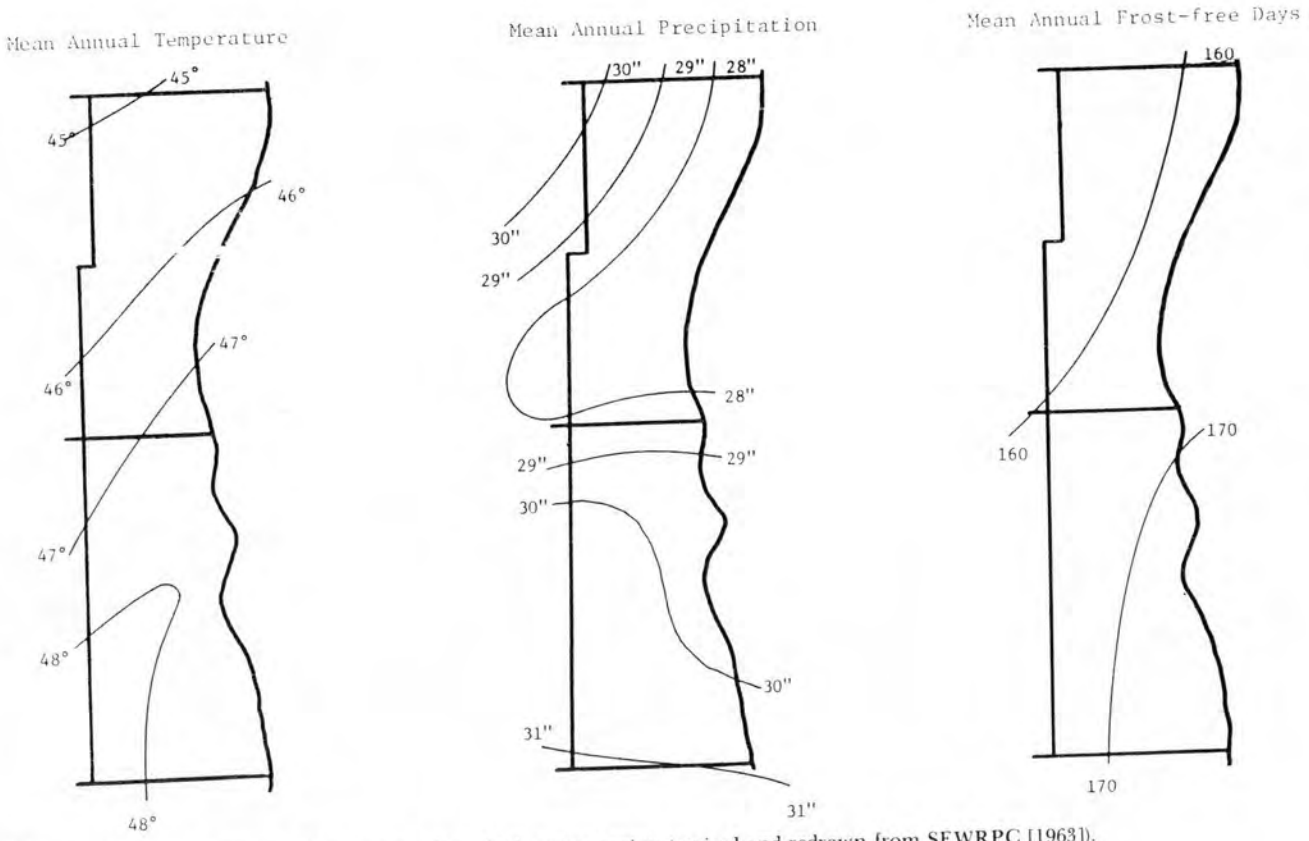

Figure 2. Climatic summary of the metropolitan Milwaukee region (revised and redrawn from SEWRPC [1963]).

is least during the winter season, although "lake effect" snow showers are frequent within a few kilometers of the shore.

The advance of spring is slow, consisting of alternating warm and cold periods. The effects of the Lake are most pronounced in the spring when a wind shift off the Lake can result in a drop in temperature of 5-8°C (10-15°F) in adjacent areas. The last freezing temperature averages May 8th, but within 3-5km of the Lake, it occurs up to two weeks earlier. Prevailing winds are from the northeast from April through June.

Physiography

Southeastern Wisconsin lies in the Great Lakes section of the Central Lowlands Province (Fenneman, 1938). The bedrock of the region is Milwaukee shale and Niagara dolomite (Figure 3A). The Niagara dolomite outcrops only occasionally in south-central Ozaukee County and northeastern Waukesha County. The entire study area lies just east of the sub-continental divide separating the Great Lakes - St. Lawrence drainage basin from the Mississippi River basin.

Glacial features of Wisconsin glaciation dominate the landscape. The retreat of the Cary substage 12-13,000 years B.P. is evidenced by a series of 2 to 3 parallel recessional moraines. Leverett (1899) and Alden (1918) referred to this zone 16-32 km (10-20 mi) wide along the Lake Michigan shoreline as the Lake Border Moraines. Drainage, poorly integrated and controlled by the moraines, is largely confined to the intervening troughs creating low, wet, marshy areas in which are found the rivers of the region: the Milwaukee, Root and Menominee (Fenneman, 1938; Thornbury, 1965). Generally, local relief is slight, but the northwestern portion of the study area is characterized by kettle and kame topography (Figure 3B).

Soils

The pattern of soil associations in southeastern Wisconsin is closely correlated with glacial features, primarily the end moraines and adjacent ground moraines. The Ozaukee-Morley-Mequon soil association occupies these morainic uplands, accounting for about 80 percent of the study area. The Ozaukee and Morley soils (Typic Hapludalfs) are well-drained to moderately well-drained and are characterized by moderately slow permeability and moderate fertility. The Mequon series (Udollic Ochraqualf) consists of somewhat poorly-drained, silty soils typically found near waterways, foot slopes and depressions. These soils are typical of most of Milwaukee County and southwestern Ozaukee County (USDA; 1970, 1971).

The Hochheim-Casco soil series (Typic Argiudoll and Typic Hapludalf) occur in the northwest corner of the study area in Ozaukee County. These soils are also formed in thin loess and loamy glacial material, but on ground moraines and outwash plains rather than recessional moraines. Also well-drained, these soils are characterized by moderate fertility and permeability.

Other soils series occur in the study area, but are not typical of the upland areas (Figure 3C).

Vegetation

The original and post-settlement vegetation of metropolitan Milwaukee has been described by several authors (Chamberlin, 1877; Shinners, 1940; Whitford and Salamun, 1954; Ward, 1956, Curtis, 1959). The region is unusual in that three major vegetation types (prairie, northern forest, and the southern forest - after Curtis, 1959) were originally present. The general pattern of presettlement vegetation in the study area can be described along a southwest-northeast axis (Figure 3D). Prairie entered the extreme southwestern corner of Milwaukee County. Scattered oak openings were present in association with the prairie. These stands graded into the southern xeric (oak-hickory) forest. Southern dry-mesic (maple-red oak) covered most of Milwaukee County (Shinners, 1940). The southern-mesic (beech-maple) forest was discontinuous primarily in the northeastern half of Milwaukee County and most of Ozaukee County. Patches of the southern xeric and southern lowland forest could be found interspersed on xeric and depressional sites respectively. Northern forest occurred in extreme eastern Ozaukee County and extended into northeastern Milwaukee County.

Only a small proportion of the two-county area was covered by prairie or northern forest. The greatest area was vegetated by southern mesic and dry-mesic forest. Schafer (1927) reports:

> "At Root River began the maple forest of southeastern Wisconsin, a dense growth of trees and underbrush which also covered Milwaukee County save about one-half of the town of Franklin, all of Ozaukee County, parts of Waukesha and Jefferson, all of Washington, most of Sheboygan and the eastern portions of Dodge, Fond du Lac and Calumet counties."

Composition of the southern forest was more complex than Schafer's term "maple forest" implied. Three major upland southern forest communities have been distinguished by Chamberlin (1877), Whitford (1951), and Curtis (1959). The different designations used can be easily related as shown below:

Chamberlin	Whitford	Curtis	Dominant Species
Oak Group	Oak-hickory	Southern xeric	*Quercus alba* *Q. velutina* *Q. macrocarpa* *Q. borealis*
Oak-Maple Group	Intermediate	Southern dry-mesic	*Quercus borealis* *Q. alba* *Tilia americana* *Acer saccharum*
Maple Group	Maple-basswood	Southern mesic	*Acer saccharum* *Tilia americana* *Fagus grandifolia* *Ulmus rubra* *Quercus borealis* *Ostrya virginiana*

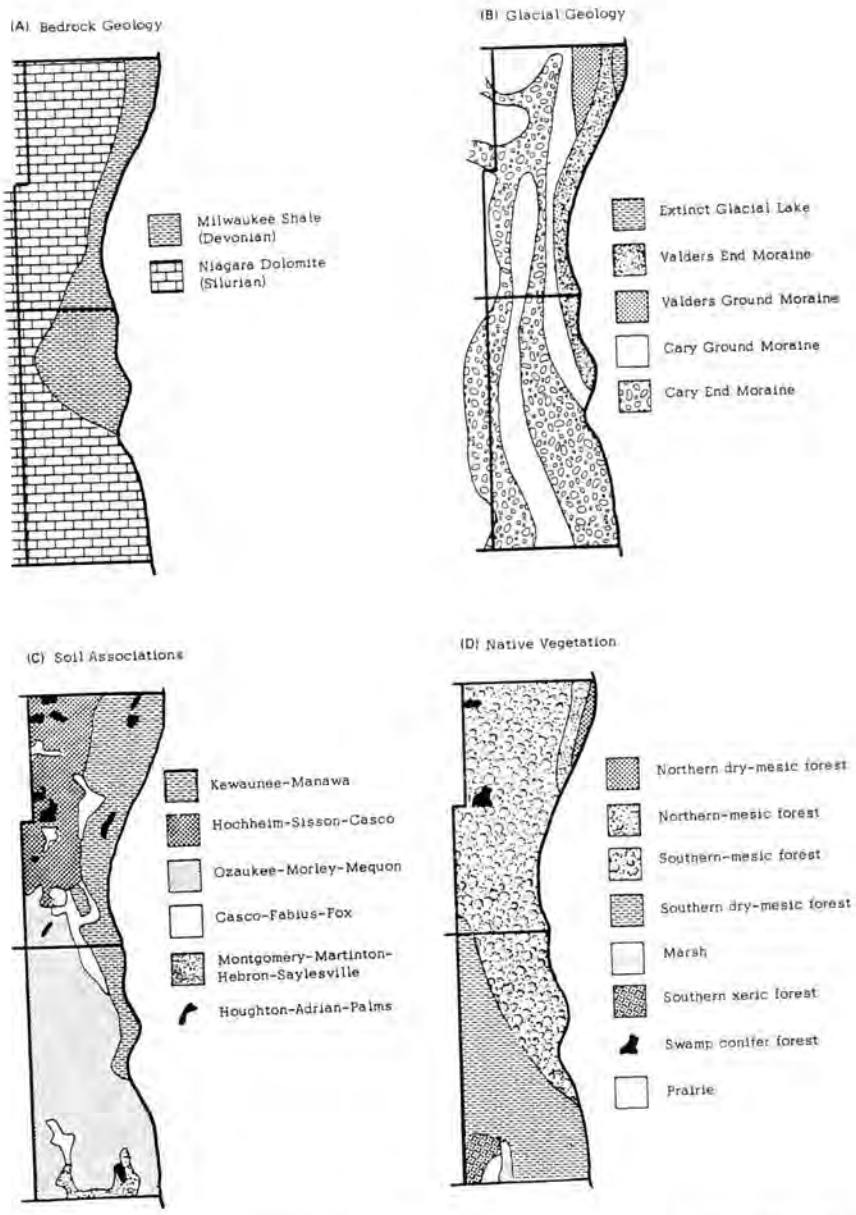

Figure 3. (A) Bedrock geology and (B) glacial geology of the metropolitan Milwaukee region, redrawn and revised from SEWRPC (1963). (C) The major soil associations of the metropolitan region, redrawn from USDA (1970, 1971). (D) The native vegetation of the metropolitan Milwaukee region, redrawn from Chamberlin (1873).

Chamberlin (1877) was probably the first to note that "no abrupt line of demarcation existed between" the communities. Detailed studies of the upland forests in southern Wisconsin by Curtis and McIntosh (1951) and Whitford and Salamun (1954) indicated a broad vegetational continuum in which one type graded to another.

History and Land Use

The fate of the once-regional forest can best be understood within the context of Milwaukee's historical development. Before European settlement, the resident and transient Indian population had little impact. The Public Land Survey of exterior lines for the area (township and range) was completed by 1836 (SEWRPC, 1970).

Early settlement was primarily by farmers. The process of clearing the virgin forest for agricultural use was the "labor of a generation" (Schafer, 1927). Settlers first came to the heavily forested region of Milwaukee and Ozaukee counties in the early 1830s. A large proportion of the settlers were without financial resources and depended upon their personal labor to make a living. Federal land sales were temporarily postponed in the Milwaukee land district in the mid-1830s and "squatting" was common. Timber was plentiful and homes, sheds and fences were constructed of materials cut in the course of clearing. Construction was completed with little or no outlay of cash and a few days of labor. The movement of settlers into the region, without competition from land speculators, was well underway by the spring of 1836. A territorial census taken in July assigned 2893 inhabitants to the original much larger Milwaukee County, which was established in 1834 (Schafer, 1927).

The opening of land for sale brought with it the threat that speculators could buy land claimed by the settlers. A series of claim rules and laws were conceived by a committee of settlers. These claim laws were adopted and enforced by the squatters in March, 1837 (Schafer, 1927), becoming the earliest basis of a land-use program in the region. Briefly, those rules stated:

1) A section (1 mi^2 of 640 acres) was the largest claim for which protection from speculators could be expected.

2) For claims larger than a half-section (320 acres), improvement of 15 acres within the first 6 months was required. The erection of a house and improvement of one-tenth of the entire claim must be completed within the first year.

3) If the claim was a half-section (320 acres), the claimant must have improved 10 acres within the first 6 months or 15 acres within a year. A house could be built in lieu of the last 5 acres.

4) The claimant of a quarter section (160 acres), the average claim, must within 6 months from the time of the claim, improve and cultivate a least 3 acres. At the end of a year, he must have a house on the land or have at least 6 acres improved.

The stricter requirements associated with larger claims were designed to discourage speculators and to restrain land seekers to an amount they could handle. During the great land sale of February and March 1839, nearly 500,000 acres were sold at $1.25 per acre.

The actual process of land selection by the settlers provides further insight into land use patterning. Since all the public lands were offered at a uniform price, cost was not a major factor. The usual criteria for homestead selection included:

1) Proximity to a spring or brook.

2) Proximity to a market, or a road to market for sale or produce.

3) Proximity to the lake ports for sale of fuel wood and forest products.

Another consideration was the general belief in the superiority of forested land over prairie land. The settlers wanted land which would produce large yields of wheat and other grains. The soils of the region were generally suitable except for some lowland areas and the narrow belt of heavy clay loam east of the Milwaukee River. In addition, it was a distinct advantage to have and maintain a woodlot for fuel and building materials. High, well-drained morainic ridges were used for roadways, a practice still evident in the region. Homesteads were located near the ridges.

A census in 1840 revealed 3345 persons within the present limits of Milwaukee County (established in 1846) and 343 persons residing in Ozaukee County (Schafer, 1927). The only town in Ozaukee County settled simultaneously with the towns of Milwaukee County was Mequon (Figure 1). Since it was near Milwaukee, Mequon was a significant part of the city's trade area. The more northerly towns of Cedarburg and Grafton were not settled until 1842-1845 (Schafer, 1927). Most of the upland areas in the Town of Saukville were settled by 1849 (Farley and Salamun, 1973). The towns of Fredonia and Belgium were not settled until still later, between 1846-1849. Ozaukee County, the smallest county in the state, was finally established in 1853.

Agriculture in the region was dependent upon corn, oats, and wheat. With those grains, potatoes and other root crops were grown for home use as well as for market. By 1860, over one-third of the land in Milwaukee County had been converted to plowfields with another third also in farm ownership (Whitford and Whitford, 1972). Wheat was the main cash crop from the time farming first started until about 1880. Much of the wheat was taken to Milwaukee for processing and shipment to other areas. The wheat monoculture soon depleted the upland soils, resulting in reduced yields and declining returns (USDA, 1971). After the Civil War, the malting industry began to develop resulting in diversification of crops to include barley and hops. After 1890, the popularity of these crops declined and gradually agriculture shifted to raising dairy cattle. By 1920, dairying had become the major agricultural pursuit (SEWRPC, 1963). The growing of oats, corn and hay again increased as feed was required for the dairy cattle. Grazing of woodlots was a common practice.

The trends in farming practice were related to industrial and urban growth. During the period when the settlers depended on agriculture for subsistence, industry in the region was limited to processing agricultural produce and milling of timber from the homesteads. Early Milwaukee was mainly a trading center. But, by 1834, a sawmill had been built (Shafer, 1927) and by 1840 a small iron foundry supplied local needs (SEWRPC, 1963). Sawmills and

grist mills were located along water courses. Speculators limited their efforts to claiming favorable sites along the Milwaukee River and Cedar Creek (Schafer, 1927). The mills were erected as needed by the settlers.

During the 1850s, railroads pushed into the state's interior and after the Civil War, the rail network was expanded. This provided greater accessibility to the developing ports of Milwaukee and Port Washington for the towns of the interior.

The major period of industrialization began around 1880. Milwaukee developed into a major city and port in the late 1880s. Much of the development can be traced directly to the skilled mechanics, metal workers and artisans who immigrated from Europe in this period (USDA, 1971).

The census of 1850 indicated that 31,077 persons resided in Milwaukee County. Between 1850 and 1860, the population more than doubled. Slow growth occurred between 1860-70, but with increasing industrialization, a five-fold increase occurred between 1860 and 1890. Then the growth rate declined somewhat, doubling between 1900 and 1930 (SEWRPC, 1972). By 1970, Milwaukee County reported 1,054,249 residents.

Ozaukee County had attained a population of 15,682 by 1860. Not directly involved in the industrialization experienced in Milwaukee County, the population remained relatively static for 80 years, only 18,985 persons resided in the county in 1940. However, by 1960, the population had more than doubled, reaching 38,441. The increase resulted partly from proximity to Milwaukee County, and probably partly the greater ability to commute provided by the automobile. By 1970, the population had expanded to 54,461 people.

For over 100 years, 1840 to 1950, urban growth and development occurred in a general outward expansion from the earlier established urban centers. But;

> "From 1950 to 1970 . . . a dramatic change occurred in this pattern of urban development in that large, scattered tracts of rural lands were subdivided for urban use, resulting in a highly dispersed, discontinuous, low-density development pattern, a pattern which has become known as "urban sprawl"." (SEWRPC, 1971).

The rapid population growth coupled with urban sprawl accounted for the conversion of more than 16,194ha (40,000a and 920 farms) of farmland to urban use in Milwaukee County between the late 1940s and 1959 (USDA, 1971). In 1964, only 10,393ha (25,670a) of farmland remained in Milwaukee County, a decrease of 22% in five years (USBC, 1964). The trend accelerated between 1964 and 1969 with only 7049ha (412a) remaining in farmland, a decrease of another 32%. The overall change during the decade, 1959 to 1969, was a 47% decrease in farmland with a 56% reduction of the number of farms. Woodland, including woodland pasture, averaged 8% of the County's farmland and showed an overall decrease of 25% in area between 1964 and 1969 (from 1944 to 1464a).

In Ozaukee County, the total land in farms was 43,808ha (108,205a) in 1964. About 9% was wooded and 43% of the woodlands were actively grazed (USDA, 1970). Ozaukee County experienced a 10% decrease in farmland be-

tween 1959 and 1969, while the number of farms decreased by nearly 23% over the same period.

In Ozaukee County, the woodlands remaining for study were generally privately owned. In Milwaukee County, most were part of the Milwaukee County Park system. The park system is the result of consolidation in 1937 of the City of Milwaukee Park Board (formed in 1889) and the Milwaukee County Park Commission (formed in 1907). Milwaukee County has one of the finest park and parkway systems in the country. In 1910, the County Park Commission started an active program of land acquisition and development. Urban expansion in the county eliminated many potential sites. With the premium placed on land in the metropolitan region, protection by the County Park Commission has been one of only a few guarantees against development. The remaining sites acrued added value for their open-space character in the heavily urbanized landscape (SEWRPC, 1965).

METHODS

Site Selection Criteria

The metropolitan Milwaukee region is especially suitable for a comparative study since topography, soils, and climate are relatively uniform. The forests include many widely dispersed woodlots within an urban and agricultural matrix.

The vegetation units selected were the southern mesic and the southern dry-mesic forest types described by Curtis (1959). These types are the present dominant upland vegetation in the region as they were in pre-settlement time, and represent the end points of regional upland succession. Baseline and modal characteristics for each type have been described (Curtis, 1959).

A narrow north-south band in which the climate is modified by Lake Michigan parallels the shoreline in Milwaukee and Ozaukee County. This climate is conducive to the maintenance of the southern-mesic forest. Likewise, the topography shows a general north-south orientation. These patterns defined the limits of the study area and subsequent stand selection.

Stand Selection

Stand selection was based on criteria from an associated study (Levenson, 1976). Criteria pertinent to this study were: 1) The woodlot must support the southern-mesic forest type (Curtis, 1959); 2) The woodlot should be a remnant of original upland vegetation, not a newly established stand; 3) The woodlot must include all structural vegetational zones, i.e., groundlayer, shrub layer, understory, and canopy; 4) There should be no evidence of recent major disturbance (grazing, burning or cutting); and 5) The woodlot should have existed as a discrete unit for a sufficient time to have develped a mature forest edge. Potential stands were identified by examining ASCS aerial photographs. The current status of each stand was verified by aerial and extensive ground reconnaissance. Each potential site was surveyed on foot before it was finally selected for study.

The 43 woodlots selected included a variety of sizes (ranging from 0.03 to 40 ha) existing in a variety of surroundings, urban to rural. Virtually all of the residual stands in the region display some disturbance. To be sure that southern-mesic forest was selected, only stands which contained sugar maple, whether in a mixture with beech, red oak or white ash, were chosen. Complete descriptions of each stand are included in the Appendix. Land use history of each stand was obtained by questioning owners, referring to earlier reports, and examining aerial photographs from the 1937 flights.

Field Sampling Methods

The vegetation of each island was sampled using the stratified-random line-strip method (modified from Lindsey, 1955). Groundlayer, shrub, understory and canopy strata were sampled contemporaneously using a series of nested rectangular plots (Figure 4).

Canopy and understory strata were sampled in 10 x 25m plots. All stems greater than 5m tall and 2.5cm diameter breast height (dbh) were recorded in 3 size categories: 2.5 - 5cm (1 - 2 in) dbh; 5 - 10.1cm (2 - 4 in) dbh; or, if over 10.2cm (4 in) dbh, by the exact diameter. Dead stems, recent windthrows, and stumps were also recorded. In most stands, 20 such plots were sampled, collectively totalling 0.5 ha.

The shrub layer was sampled in plots 2 x 12.5m beginning at the midpoint of each 10 x 25m plot. All woody species between 0.5 and 5m tall were recorded in the shrub strata. The number of stems of each species present was recorded for each plot. Twenty plots were sampled in most stands, collectively comprising an area of 0.05 ha.

The groundlayer was sampled using two $1m^2$plots nested at the midpoint and endpoint of each large 10 x 25m plot. Density of woody stems ($\leq$ 0.5m tall) and all herbaceous stems were recorded by species in each of 40 plots in each island. The groundlayer sample at each site totalled 0.004 ha. Thirty-one sites were sampled for summer groundlayer vegetation between June 15 and September 28, 1975. The study was begun when the canopy had closed completely and the spring ephemerals had largely disappeared. Because many of the groundlayer species form a stoloniferous network beneath the leaf litter and reproduce vegetatively, it was impractical to determine the extent of a single plant. Therefore, each stem that originated at ground level was considered an individual (Whitford, 1949).

Individuals of unknown species were collected for later identification. These vouchers were deposited in the University of Wisconsin-Milwaukee herbarium. Species nomenclature follows Gleason (1952).

Only the area bounded by the "edge trees" were sampled (Figure 5). Edge trees were defined as those trees exhibiting an asymmetrical bole. Characteristically, an edge tree displayed a considerable clear-length on the interior side of the bole (forest-grown side) and heavy branching to the outside (open-grown side). Vegetation to the outside of the edge trees was considered to be a different community and was not sampled.

It is important to realize that edge trees were not always present at the physical

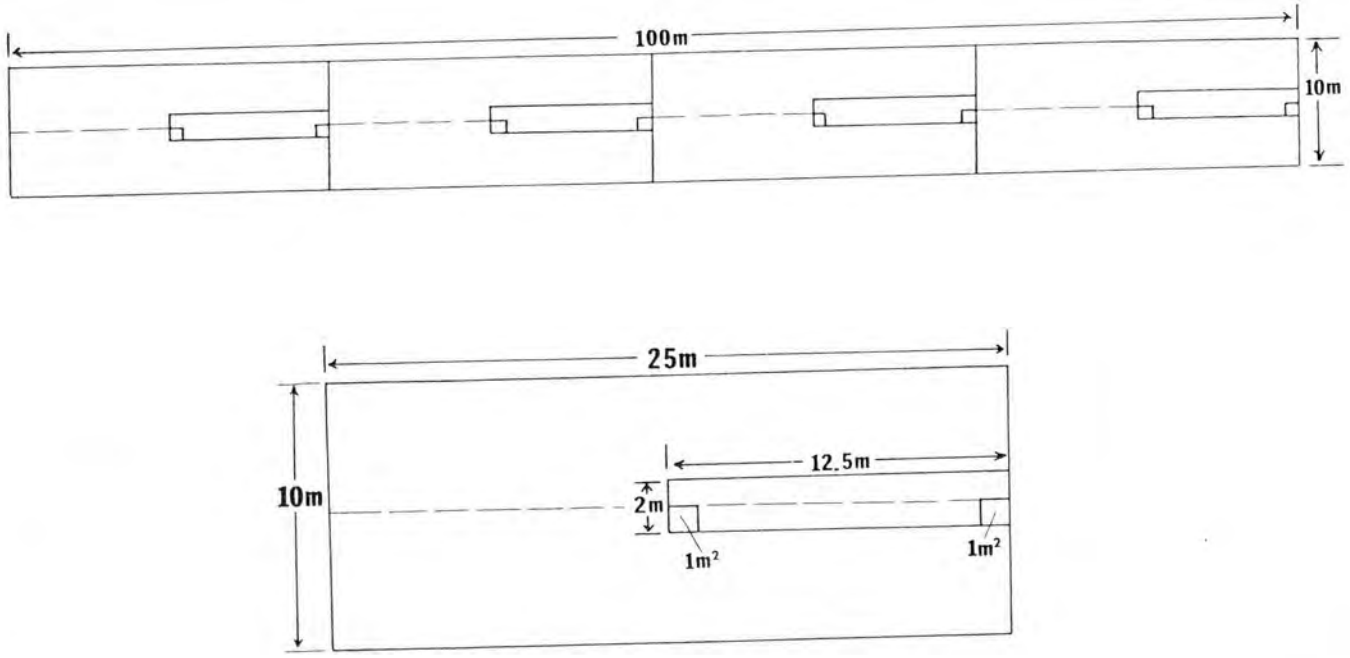

Figure 4. (A) Example of a line-strip, four plots in length, showing the arrangement of the nested plots. (B) Trees were sampled in the 10 x 25m plots, shrubs in the 2 x 12.5m plots and groundlayer vegetation in the $1m^2$ plots.

edge of the woodlot, but may have been some distance within the stand interior. The edge trees represent a critical boundary separating the edge community from the forest interior (Forman and Elfstrom, 1975; Levenson, 1976).

In each stand, line-strips were located systematically throughout the entire area, beginning in one corner approximately 10m inside the nearest edge trees. A 50m steel chain, divided into 12.5m intervals, was drawn along a compass heading perpendicular to the long axis of the stand. As many plots as possible were sampled in a line strip. After the width of the stand was traversed, and before reaching the far edge, a distance of 25m was measured at a right angle to the end of the last plot. A new line-strip was established and the chain pulled back in the opposite direction parallel to the first line-strip. This procedure was continued until the entire length of the stand has been sampled. For very large stands, more plots were sampled and line-strips were separated by a distance of 50m. This modification insured representative coverage and provided detail for the air photo analyses being conducted in an associated study. Stands approximately one hectare or less in size were full-tallied for the canopy and understory strata. In these smaller stands, shrub and groundlayer strata were sampled using the line-strip technique, but with only 15m separating the line-strips.

Data Analysis

Tables of species attributes were calculated for each structural stratum of each site (Appendix). Species density is recorded as the number of stems per hectare. Frequency is the percentage of plots in each stand in which the species occurred. Basal area was converted from the diameter breast height (dbh) to meters^2/hectare and recorded for each species in each stand. Relative density, relative frequency, and relative dominance were calculated, then averaged to obtain the importance value expressed as a percentage for each species (Lindsey, 1956). The shrub stratum and groundlayer importance values are the average of relative density and relative frequency only, since cover values were not measured. For any species, the importance value expresses the relative contribution of each species to the stratum as a percentage.

Comparisons between woodlots were made using an hierarchial cluster analysis (Ward, 1963; Veldman, 1967). Use of the technique results in the formation of an hierarchy of clusters of mutually excluded stands, each stand with species that are most similar to one another with respect to presence or absence and importance value (Ward, 1963). The procedure reduces the number of clusters n to n-1 in such a way as to minimize information loss. Without modifying clusters already formed, the procedure is repeated until the number of clusters are systematically reduced from n to 1 (Ward, 1963). With each grouping, an error index is provided, determined from the sum of within-group sums of squares. The analysis is based on the "no value" information contributed by species absent. The analysis was completed using a computer program prepared by Claflin and Ostapik (1975, UWM-CSD).

The Shannon Index (H') was used to calculate species diversity for each stand (Shannon and Weaver, 1949). This is expressed as $H' = -\Sigma P_i \ln P_i$, where P_i is the probability of sampling the ith species. Inherent to the Shannon

Figure 5. Edge trees were defined as those exhibiting an assymetrical hole. Characteristically, an edge tree displayed a considerable clear length on the interior (forest grown) side and lower branching accompanied by an overall lean of the hole to the outside (open grown) of the island.

Index are the components of species richness (variety) and equitability (numerical representation of species). The equitability (J') component was calculated separately using $J' = H'/H'_{max}$ where H'_{max} is the natural logarithm of the number of species (Pielou, 1966). The wide acceptance and use of the Shannon Index allows immediate comparison with other studies (Monk, 1967; Loucks, 1970; Johnson, et. al., 1976). Diversity was calculated for the canopy and understory stratum, the shrub stratum, and the groundlayer. In addition, the shrub, understory, and canopy data were corrected to density/hectare and recalculated as total woody diversity (stems $\geq$ 0.5m tall). The analysis was completed using a computer program developed by Zar (1968).

RESULTS AND DISCUSSION

Overstory Structure and Composition

Forty-three remnants of the upland southern mesic forest types were sampled in the metropolitan Milwaukee region between May 29th and October 13th, 1975 (Figure 6). Detailed descriptions of each site including locations, land-use history, soils information, and vegetation summaries are included in the Appendix. This section summarizes the composition, structure and variation of the local forest vegetation.

The southern-mesic forest community of southeastern Wisconsin is composed of a relatively few, shade tolerant woody species adapted to reproduction and growth in the mesic forest interior: sugar maple *(Acer saccharum)*, American beech *(Fagus grandifolia)*, ironwood *(Ostrya virginiana)*, and slippery elm *(Ulmus rubra)*. These species compose the basic community of the southern-mesic forest described by Curtis (1959). Additional species present in the community are typically less shade tolerant species such as white ash *(Fraxinus americana)*, red oak *(Quercus borealis)*, etc. (Table 1). Their presence is often the result of former disturbance and redevelopment through the mechanism of gap-phase reproduction (Watt, 1947; Bray, 1956). The destruction of a small segment, or several segments of the canopy as the result of selective cutting, disease, lightning or windthrow creates a local microclimate unlike that of the rest of the forest. Temperature and humidity ranges, light levels and soil conditions resulting from the canopy opening favor the establishment of less-tolerant, successional species in the gaps. Some of these individuals may mature to eventually reclose the canopy and re-establish the mesophytic conditions.

Disturbance, whether natural or man-induced, is a major variable controlling species composition and structure in the isolated woodlots. In the southern mesic forest " . . . it is clear that the degree of success of the intolerant trees and hence the degree of species mixture to be found in the forest is proportional to the chances for disturbance" (Curtis, 1959). In the agro-urban matrix of metropolitan Milwaukee, the forest islands owe their existence, isolation and composition primarily to man-induced disturbances. In a similar study in northwestern Ohio, Tramer and Suhrweir (1975) concluded that human interference was a major variable in affecting species richness patterns. Auclair and Cottam (1971) indicated that coupled with forest island isolation, heavy usage was the critical aspect of woodlot ecology. Frequent disturbance

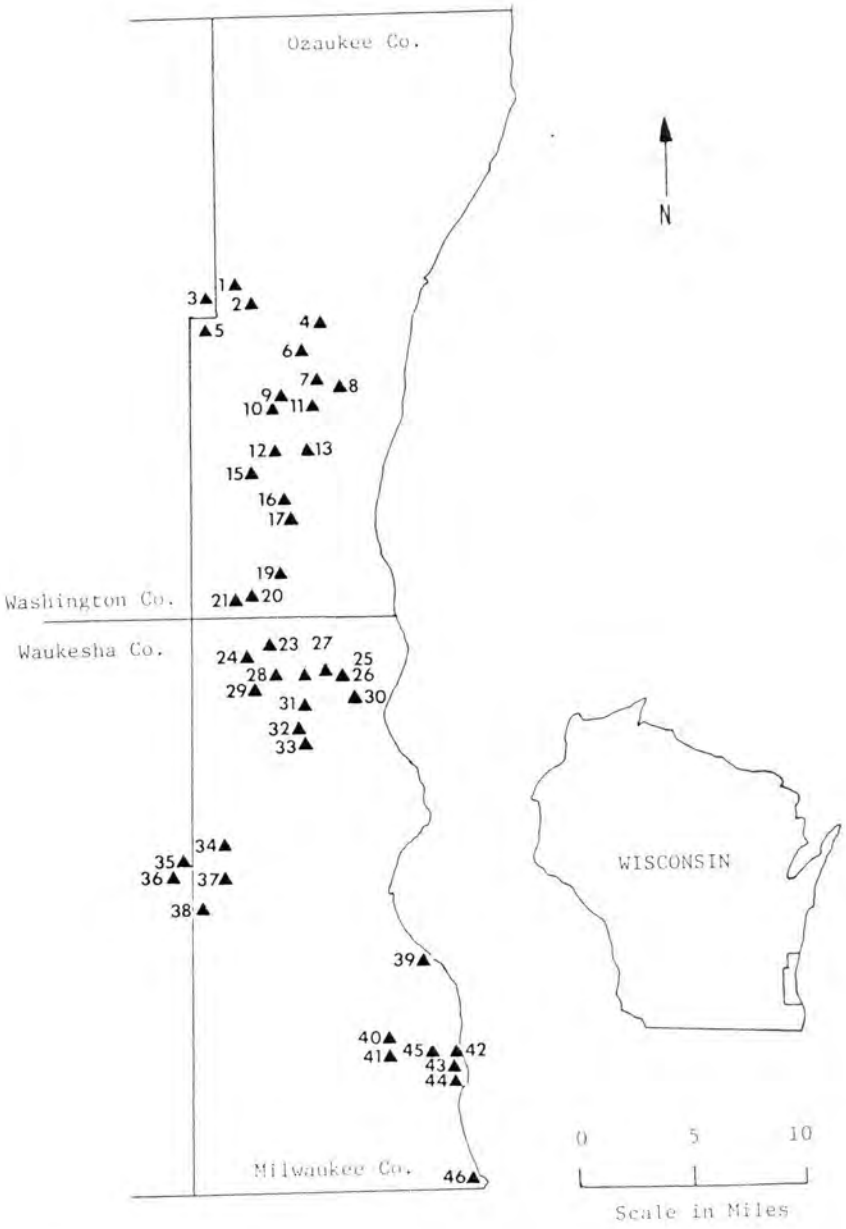

Figure 6. Map of the study area indicating the location of the 43 forested island woodlots in the metropolitan Milwaukee region.

results in a shift toward a more xeric habitat with greater light, greater transpiration stress and more variable temperature and moisture levels. The disturbed conditions destroy the mesic "stabilizing mechanisms" and favor species with pioneer tendencies, in contrast to more mesic species (Curtis, 1956; Auclair and Cottam, 1971).

The forest remnants ranged from dense, successional stands dominated by basswood (*Tilia americana*) with low basal area to old-growth stands dominated by sugar maple with a relatively high basal area. Stem density ($\geq$10.2 cm) ranged from 240-929 stems/ha with an average of 442 (179 trees/acre). The average basal area (stems $\geq$ 10.2cm) for the 43 forest islands was 29.8m^2/ha (130ft^2/acre), but ranged from 21.5-43.3m^2/ha (Table 2). The average basal area per hectare compares favorably with 26.9m^2/ha reportedly by Goff and Zedler (1968) for 125 forests in southern Wisconsin. Their values were from more xeric stands typically dominated by oaks (*Quercus* spp.) in the southcentral part of the state. They noted that " . . . in most cases, the basal area per acre is higher . . . " in the more mesophytic stands in which sugar maple is the leading dominant. Similar broad ranges of stand density and basal area are indicative of the structural variation found within the remnant forest islands of metropolitan Milwaukee.

Only woodlots which contained sugar maple were included in this study. American beech was limited in the study area since the region represents the western limit of its range. Beech was once present north and east of a line extending between the southeast and northwest corners of Milwaukee County (Whitford and Salamun, 1954; Ward, 1956). Using this distribution as a guide, beech was a potential component in all islands save the five in west-central Milwaukee County. However, in this study, I was examining the southern-mesic and dry-mesic forests as structural features upon the landscape. These features are acknowledged to represent not discrete communities, but rather a series of related communities responding to a comparable continuum of edaphic, geographic and climatic factors.

Sugar maple was dominant or co-dominant in 30 of the 43 upland islands. Dominance in thirteen sites was shared with American beech. Other co-dominants with sugar maple included red oak in nine sites, white ash in four sites, white oak (*Q. alba*) in two sites and basswood in one site. Basswood was the sole dominant in three woodlots and shared dominance with white ash, red oak and beech in two woodlots each.

Forest remnants in southwestern Milwaukee County were not sampled since they were more typical of the southern-xeric forest type. As a result, we examined a larger proportion of mesophytic sites than did Whitford and Salamun (1954). This is demonstrated by the overall greater combined importance values of sugar maple, beech and basswood (23%) with commensurate lower combined importance values of white oak and red oak (18%) in this study as compared to those of Whitford and Salamun. Of the 33 species in the canopy stratum, only sugar maple was present in all stands (Table 1). White ash was absent from only two stands and basswood and ironwood were each absent from five stands. Only nine species had a constancy value over 60%; i.e. the percent of islands in which the species occurred (Braun-Blanquet, 1928). Of the nine species with above 60% constancy, only one is primarily

bird disseminated. Six species may occasionally be spread by mammals and five are usually dispersed by wind. Only beech and basswood depend heavily on vegetative reproduction. Of the 14 species below 10% constancy, seven are spread by birds and/or mammals and seven are wind-dispersed. Of the 33 species, several are more typical of other forest types, six are pioneers or exotics and five species are normal components of the mature southern-mesic forest.

The dendrogram of the cluster analysis illustrates clearly the continuum nature of the vegetation (Figure 7). The dendrogram was based on species presence or absence, and if present, upon importance value. An error index, expressed as a percentage and scaled on the sum of within group sums of squares (81.4) was calculated for each cluster formation (Claflin and Ostipek, UWM-CSC). The leading dominants of the stands encompassed in a major cluster are appropriately indicated.

Nine species, in different proportions, dominated the 43 forest stands. Slippery elm, red maple *(Acer rubrum)* and black cherry *(Prunus serotina)* were co-dominants in only three sites, Sites 34, 8 and 2 respectively. The remaining 40 woodlots were dominated by nearly every possible combination of only six species; sugar maple, beech, white ash, basswood, red oak and white oak. The final three clusters of the dendrogram were sufficiently different to be recognized as major groups: Maple Group from the Maple and Beech Group and Basswood Group. The separation of the Maple Group from the Beech Group was the result of the dominant role played by beech. Interestingly, this separation is the same as that recognized by Chamberlin (1877) almost a century ago.

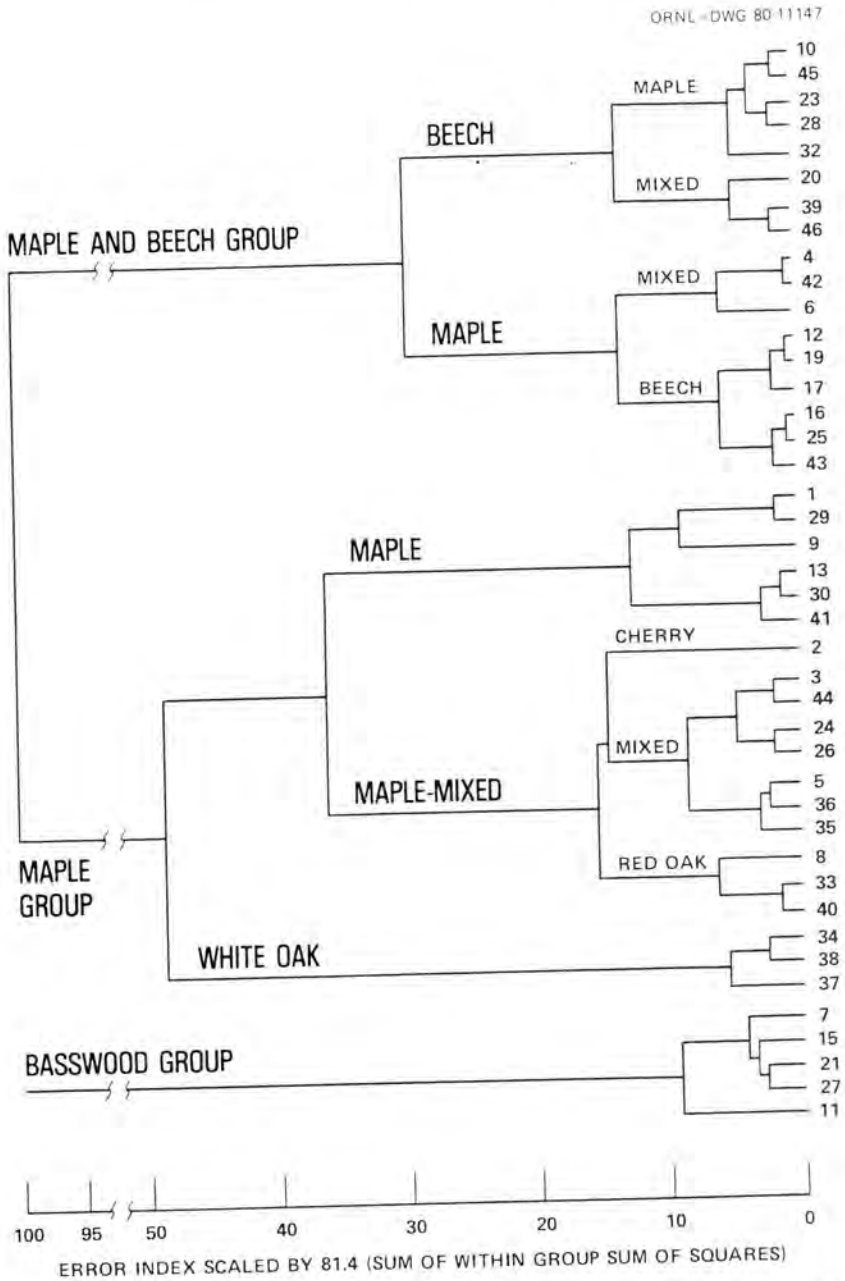

Figure 7. Dendrogram of the cluster analysis for the canopy stratum of the 42 islands based on the species composition and importance values of all species. The leading dominant of each major group is listed.

Table 1. Summary values for all canopy species occurring in 42 forest islands. (Site 31 was not included because of small sample size) Values for the mean density and mean basal area are based on only the stands in which the species was present. Importance value is the average of the sum of the relative values of frequency, density and dominance (Maximum = 100).

Species	Constancy	Mean (ha.)	Mean Basal Area (m^2/ha.)	Mean Importance Value
Acer saccharum Marsh.	100.0	118	7.76	26.24
Fagus grandifolia Ehrh.	76.7	98	5.76	15.32
Tilia americana L.	88.4	81	4.84	14.59
Quercus borealis Michx. f.	83.7	35	5.92	10.16
Fraxinus americana L.	95.3	38	2.95	9.34
Quercus alba L.	60.5	27	3.33	5.56
Ostrya virginiana (Mill.) K. Koch	88.4	33	.55	5.21
Prunus serotina Ehrh.	79.1	28	.84	3.83
Ulmus rubra Muhl.	72.1	15	.76	2.78
Acer rubrum L.	37.2	17	1.23	1.41
Carya cordiformis (Wang.) K. Koch	44.2	6	.22	.70
Crataegus succulenta Link.	30.2	10	.15	.66
Juglans cinerea L.	30.2	4	.49	.53
Carya ovata (Mill.) K. Koch	14.0	10	.54	.48
Betula papyrifera Marsh.	18.6	10	.62	.43
Ulmus americana L.	41.9	4	.13	.39
Fraxinus pennsylvanica Marsh.	23.3	8	.37	.38
Acer saccharinum L.	4.7	36	3.72	.35
Quercus macrocarpa Michx.	9.3	6	1.32	.33
Juglans nigra L.	7.0	11	1.87	.26

Table 1 continued

Species	Constancy	Mean Density (ha.)	Mean Basal Area (m^2/ha.)	Mean Importance Value
Fraxinus nigra Marsh.	11.6	9	.20	.21
Populus grandidentata Michx.	2.3	47	1.61	.13
Quercus bicolor Willd.	9.3	4	.35	.11
Amelanchier laevis Wieg.	11.6	3	.05	.10
Populus tremuloides Michx.	9.3	4	.14	.10
Catalpa speciosa Warder.	2.3	12	.80	.08
Acer negundo L.	4.7	6	.11	.07
Carpinus caroliniana Walt.	9.3	3	.04	.06
Betula lutea Michx. f.	4.7	3	.28	.04
Celtis occidentalis L.	2.3	4	.50	.03
Pyrus malus L.	4.7	3	.05	.03
Crataegus punctata Jacq.	2.3	2	.03	.02
Cornus alternifolia L. f.	2.3	1	.02	.02
Totals		442[a]	29.84[b]	99.95

[a] Mean density = 179 stems/acre

[b] Mean basal area = 130.04 ft^2/acre

Table 2. Island size and woody species richness for the canopy and shrub strata of the 43 forested islands. The canopy stratum includes all species greater than 5m tall and 2.5cm dbh. Density and basal area was calculated for stems greater than 10.2cm dbh. The shrub stratum includes all woody species from 0.5 to 5m tall. Total woody species are all woody species greater than 0.5m tall.

		Canopy Stratum			Shrub Stratum		
Site	Size (ha.)	Total Species	Density (ha.)	Basal Area (m^2/ha.)	Total Species	Density (ha.)	Total Woody Species
31	0.03	2	—	—	15	23,332	17
28	0.36	12	929	28.86	19	11,300	24
11	0.57	8	337	21.56	19	14,340	24
46	0.59	13	285	33.23	16	10,560	22
15	0.61	9	486	28.46	16	10,200	18
02	0.65	11	847	26.37	13	14,865	19
29	0.73	10	269	28.54	14	14,440	22
10	1.21	14	476	24.27	24	15,223	31
32	1.40	16	331	22.78	20	13,872	27
13	1.50	9	448	30.52	24	9,480	28
08	1.54	11	445	32.36	13	13,700	19
20	1.58	10	494	22.81	25	20,075	27
09	1.62	11	265	21.51	17	18,720	24
26	1.70	8	465	30.63	22	30,050	24
12	1.98	13	360	28.30	17	8,984	27
05	2.06	10	495	31.25	24	16,700	28
21	2.19	17	542	29.62	35	14,060	42
03	2.23	9	516	32.76	22	10,900	25
23	2.35	11	447	31.00	24	14,175	27
35	2.39	14	540	37.44	27	12,820	35
24	2.43	12	446	29.99	22	29,900	27
07	2.43	18	576	33.65	16	21,900	31

Site	Size (ha.)	Canopy Stratum: Total Species	Canopy Stratum: Density (ha.)	Canopy Stratum: Basal Area (m^2/ha.)	Shrub Stratum: Total Species	Shrub Stratum: Density (ha.)	Total Woody Species
25	2.47	15	506	29.49	25	18,200	33
27	2.51	16	684	29.52	23	23,360	32
43	2.83	10	326	33.79	14	13,420	20
19	2.91	14	478	30.13	23	15,600	31
33	3.12	17	358	25.68	26	28,540	34
42	3.24	13	304	28.42	13	6,260	25
44	3.97	15	436	43.30	8	21,080	21
30	4.09	13	366	33.49	18	23,520	28
41	4.13	12	358	32.03	11	10,058	20
17	4.25	8	464	31.10	21	18,960	23
37	4.49	11	330	31.44	20	18,800	28
34	5.47	11	240	22.49	19	23,360	28
06	6.48	7	356	27.22	18	16,180	19
16	7.21	12	550	32.00	13	21,420	20
40	7.81	11	416	36.12	20	16,040	24
45	7.93	12	276	31.04	17	12,050	21
39	11.46	15	474	33.02	16	14,380	24
04	14.53	7	398	31.94	19	12,317	21
38	18.34	11	366	31.07	16	12,200	25
36	21.05	12	348	29.80	26	21,100	27
01	39.96	13	524	24.30	18	18,057	21
Average		12	442	29.84	19	16,616	25
Standard Deviation		3	141	4.36	5	5,641	5

The Maple Group is composed of 20 stands in which sugar maple was present with a varity of co-dominants. Sugar maple occurred as the sole dominant in the "maple" cluster (6 stands) of the Maple Group. The "maple mixed" cluster is further divided in three units. The uppermost (Site 2), exists alone as it was dominated by black cherry with sugar maple in a sub-dominant role. The "mixed" cluster (7 stands) represents sugar maple with various combinations of co-dominants; red oak, white ash and white oak. The bottom "red oak" cluster is represented by three stands in which red oak was the leading dominant in co-dominance with species other than sugar maple. The final cluster of the Maple Group was composed of three stands with white oak as the leading dominant in combination with slippery elm, red oak and sugar maple respectively.

The Basswood Group was significantly different in composition and structure to remain separated from the other groups. Five islands occurred in this group which appeared successional in nature. Three were solely dominated by basswood (Sites 7, 11 and 15). In the other stands, basswood, red oak, and white ash shared dominance.

The relative contribution of white ash in the upland forests of the Milwaukee region has changed considerably in the last 24 years. Whitford and Salamun (1954) indicated that ash contributed an average importance value of 4.26% compared to 9.34% found in this study. The number of stands in which ash was present are comparable (95% in each study), but its relative contribution to the importance value has more than doubled. In stands common to both studies (Sites 30, 33, 37, 38 and 40), the increased contribution of white ash is evident as most of the other species have retained similar importance values over the past 24 years. Recent increases of importance value for white ash are reflected by the relatively high abundance in the smaller size classes throughout the metropolitan Milwaukee region (Appendix, Site Tables B). The success of ash may be partially explained by the demise of the elms *(Ulmus rubra* and *Ulmus americana)* caused by Dutch-elm disease *(Ceratocystis ulmi).* Elms, either one or both species, occurred in 86% of the stands 24 years ago and in 81% today, while the combined average importance value has dropped from 9.22% to 3.17%. Twenty-four years ago, slippery elm and American elm were more important than white ash in 17% and 41% of the stands respectively. Combined, they were more important than white ash in 68% of the sites. Today, slippery elm dominates ash in only 17% of the stands and American elm is dominant in none.

The replacement of elm by ash appears logical as the genera have similar ecological requirements. Auclair and Cottam (1971) further suggest that the two key factors in the process of compositional change in isolated woodlots are chance dispersal of species and catastrophe. The Dutch-elm disease catastrophe created conditions favorable for exploitation by ash. Cope (1948) reported that the wind-borne ash seeds can be dispersed as far as 137m. In addition, he reported that white ash is shade tolerant when young, capable of surviving with little growth under a full canopy at less than 3% full sunlight. Canopy openings formed by the death of elms, or other disturbance, create areas for localized secondary succession within the stand. When exposed to the full light, ash seedlings are capable of rapid growth (Guenther, 1951). White ash becomes less tolerant with increasing age. Ash has become a major com-

ponent of the second growth forests in our region.

The species composition and structure of the remnant forests is more readily understood when examined in light of relatively recent historical events and land use patterns throughout the region. The reduction of the regional forest complex over the past century did not preserve the full variety of environments and associated species of the original forest. Most fertile upland sites were converted to agriculture (Curtis, 1959) while the land remaining in forest was generally wet, stony, rough or otherwise undesirable for agriculture. My study was restricted to upland sites, but the numerous lowland species present in the stands suggest that many of these remaining upland sites may have been previously imperfectly drained upland depressions. The presence of the somewhat poorly drained Mequon silt loam in numerous sites further supports this position (Appendix). In addition, practically all of the forest land in Milwaukee County had been logged by 1870 (Whitford and Whitford, 1972). All stands of the region were probably selectively logged during the last century and some were clear-cut. Grazing of woodlots in southern Wisconsin was nearly a universal phenomena. Questioning of owners and neighbors of the study sites indicates, as closely as their memories served, that nearly all islands were grazed 35-45 years ago (1930-1940). This grazing was part of the major regional ecosystem disturbance during the drought and depression years of the 1930s. During the drought, forage crops were in limited supply and the woodlots were a source of inexpensive, emergency forage. The impact of grazing and soil compaction by the huge livestock population coupled with the drought was devastating to the mesic forest. Although grazing was largely terminated by the 1950s, the forest structure today is largely a result of natural recovery following that period.

Initial isolation and disturbance of the remnant stands occurred between 1850 and 1940. This time may at first seem relatively broad until put in the context of the relatively long-lived species with a high reproductive potential that are involved. Loucks (1970) suggested a successional cycle of 200-300 years for this forest type. Certainly, there are limits on how completely a forested tract can recovery from a major disturbance in only 50 to 75 years. The limits can be described by examining the forest structural features of size class distribution, basal area, density and species composition. In addition, increasing isolation of the stands affects the efficiency of transfer of species from one island to another (Curtis, 1956). Once a species is eliminated from a stand, it may not be possible for it to become re-established. Auclair and Cottam (1971) report that species which are bird-dispersed (*Prunus sp.* and *Celtis sp.*) hold a considerable edge over the animal- and wind dispersed species (*Quercus sp.*, *Carya sp.*, *Acer sp.*). They further report that the isolation of woodlots in southcentral Wisconsin has localized the distribution of sugar maple and is the major obstacle to the further successional development of the oak forest (*Quercus sp.*) to sugar maple-basswood (*Acer-Tilia*), the terminal forest type for the region.

Species diversity (H') was calculated for the canopy and understory strata (stems $\geq$ 2.5cm dbh) for all stands based on the Shannon Index (Table 3). Species diversity (H') of the forest islands ranged from 0.69 to 2.27 with an average of 1.76 + 0.94 S.D. These values compare favorably with those derived by Monk (1967) from Braun's (1950) work. Monk reported the average species

diversity for the beech-maple forest region was 1.64 and 1.40 for the oak-hickory forest (after conversion from $\log_2$ to ln). My values are slightly higher for two reasons: 1) we included all stems greater than 2.5cm dbh, while only stems greater than 10.2cm dbh were included in Monk's (1967) work; and 2) Braun (1950) included only the most typical and undisturbed examples of a forest type, whereas we examined a number of heavily disturbed and successional sites.

Table 3. Shannon Index of diversity (H') and equitability (J'), expressed as natural logarithms, for plant species in each vegetational stratum of the 43 upland forest islands.

Site	Canopy layer ($\geq$ 5m) H'	J'	Shrub layer (0.5-5m) H'	J'	Groundlayer ($<$ 0.5m) H'	J'	Total Woody Species ($\geq$ 0.5m) H'	J'
01	1.56	.59	2.02	.66	N/A	N/A	N/A	N/A
02	1.68	.70	.68	.27	N/A	N/A	1.15	.34
03	1.61	.67	2.51	.81	3.07	.84	2.81	.77
04	.87	.48	1.50	.53	N/A	N/A	1.70	.52
05	1.53	.66	1.78	.59	N/A	N/A	2.02	.57
06	.89	.64	1.40	.49	1.30	.43	1.51	.48
07	1.91	.67	1.55	.57	N/A	N/A	1.74	.50
08	1.92	.80	1.46	.57	N/A	N/A	1.77	.52
09	1.05	.40	1.35	.51	1.72	.52	1.49	.42
10	1.75	.63	1.93	.62	2.73	.72	2.21	.58
11	1.38	.52	1.49	.54	2.23	.69	1.70	.48
12	1.79	.66	1.57	.63	1.19	.34	1.94	.56
13	1.64	.68	1.97	.64	N/A	N/A	2.32	.64
15	1.53	.70	1.43	.52	N/A	N/A	1.71	.50
16	1.50	.60	1.35	.53	2.30	.68	1.52	.43
17	1.51	.66	1.40	.50	1.74	.58	1.60	.45
19	1.64	.62	1.91	.63	2.21	.66	2.19	.58
20	1.87	.73	2.34	.75	2.09	.59	2.53	.68
21	2.16	.71	2.54	.73	2.81	.74	2.81	.67
23	1.64	.68	2.09	.66	2.71	.72	2.24	.60
24	1.95	.74	2.21	.71	2.84	.78	2.36	.62
25	1.76	.64	1.28	.40	2.85	.76	1.49	.39
26	1.68	.81	1.34	.43	1.97	.63	1.44	.41
27	2.00	.66	2.14	.68	N/A	N/A	2.34	.58
28	1.73	.67	1.65	.57	N/A	N/A	2.21	.59
29	1.89	.79	1.52	.61	2.12	.63	1.67	.50
30	1.86	.66	.70	.25	2.15	.71	.85	.23
31	1.33	.83	1.97	.82	N/A	N/A	2.06	.73
32	1.85	.64	2.00	.68	2.25	.62	2.35	.60
33	2.22	.77	1.75	.54	2.51	.75	1.98	.49
34	1.85	.68	1.83	.63	2.93	.81	1.99	.53
35	1.41	.57	1.82	.63	N/A	N/A	2.09	.59

Table 3 continued

	Canopy layer (≥ 5m)		Shrub layer (0.5-5m)		Groundlayer (< 0.5m)		Total Woody Species (≥0.5m)	
	H'	J'	H'	J'	H'	J'	H'	J'
36	2.11	.78	1.69	.54	2.26	.63	1.87	.48
37	1.54	.58	1.61	.59	2.05	.74	1.83	.51
38	1.77	.63	1.83	.66	1.34	.44	2.15	.58
39	2.27	.80	1.31	.48	2.69	.74	1.61	.43
40	2.48	.86	1.06	.36	2.46	.71	1.35	.35
41	.69	.26	.79	.34	1.82	.69	1.17	.34
42	1.60	.55	1.16	.53	2.62	.81	1.55	.44
43	.99	.41	.62	.26	2.35	.68	.90	.27
44	1.49	.58	.12	.06	2.22	.65	.30	.09
45	1.98	.72	.97	.35	2.45	.71	1.17	.32
46	1.90	.70	1.35	.50	1.92	.52	1.65	.45
Mean	1.76		1.68		2.36		1.92	
S. D.	.94		.96		1.54		1.22	

Although disturbance and land-use histories of many of the islands are not known, several general statements can be made regarding species diversity (H') and equitability (J'). The diversity characteristics of forest communities are viewed by Loucks (1970) as "repeating waveform phenomena triggered by random perturbations" at intervals of 30-200+ years. He further suggested that peak species diversity in the mesic forest was achieved 100-200 years after secondary succession had been initiated when members of both the pioneer and stable communities were present. As intolerant species drop from the community with time, diversity declines. However, diversity is not only a function of species richness, but also a function of the numerical representation among the species; the equitability (J') component. The terminal forests of this region are dominated by sugar maple and beech. A high relative stem density of one or two species with only a few individuals each of numerous other species creates a low equitability component, and lowers the diversity index.

Species diversity of the canopy and understory strata of the 43 islands appear to conform to the model described by Loucks (1970), but a different scale is required. His random perturbations were large or widespread, and in the framework of a regional forest. Perturbations in the remnant woodlots may be much smaller in magnitude, i.e., windthrow, death by old age, vandalism, etc., but occur more frequently, locking the stand into a sub-climax cycle. Instead of widespread destruction of all species triggering extensive secondary succession as in Louck's (1970) model, the isolated woodlots suffer chiefly from localized disturbance with patches of successional species intermixed

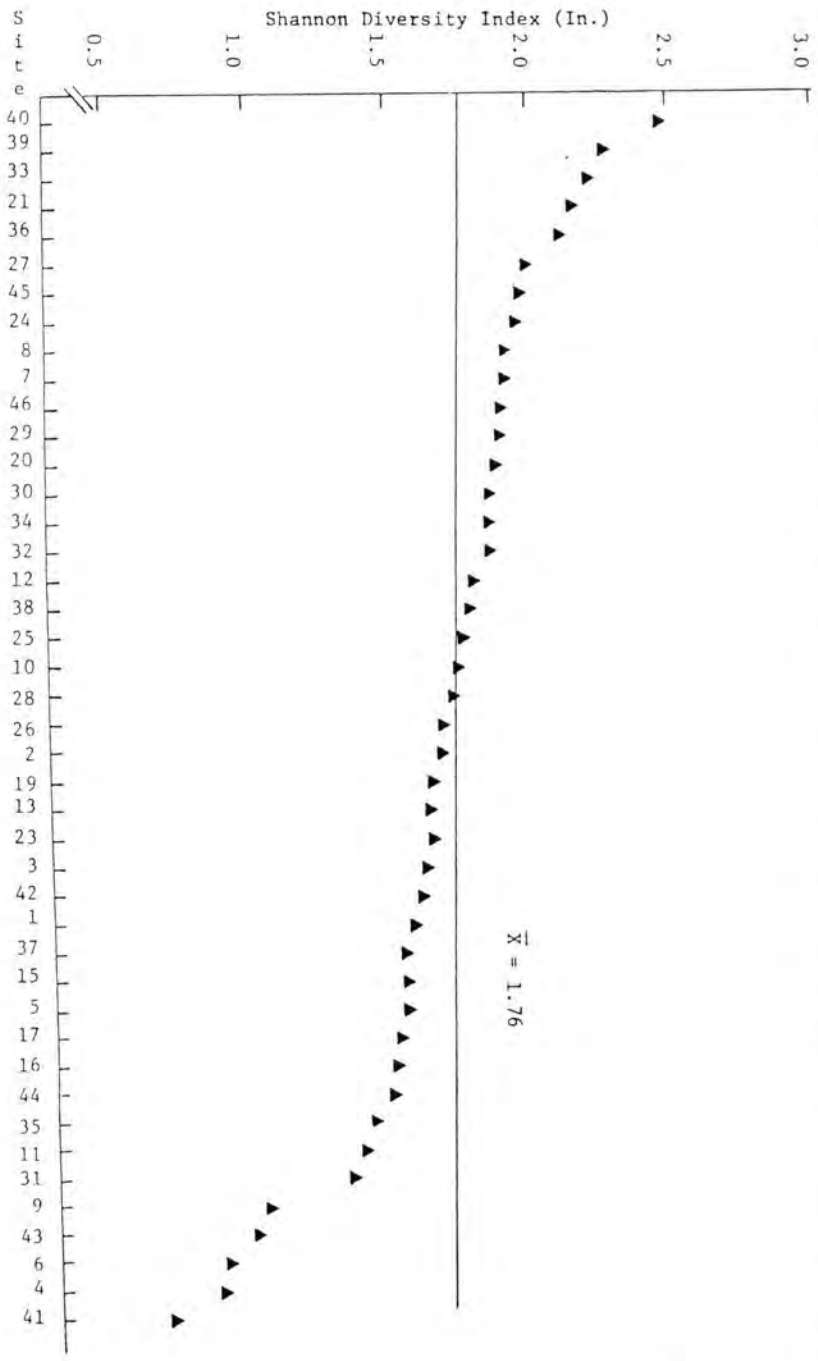

Figure 8. Shannon Diversity Indices (H') for the canopy and understory strata of the 43 forest islands expressed as natural logarithms.

among the older larger climax species. In this cycle, as in the broader scale regional one, extinctions of tolerant species become more likely as old individuals die. More disturbance patches result in a higher diversity index for the stand. Suhrweir and Tramer (1976) also interpret this phenomenon as maintaining species diversity near the peak of the wave-form. Frequent disturbance coupled with isolation prevent the islands from reaching the expected structure and composition of the terminal stage and result in the moderately high species diversity indices.

Species diversity (H') for the 43 forest islands was plotted in order of decreasing value (Figure 8). Thirty-three of the islands had values near the average, within a range from 1.33 to 1.98. Five islands fell considerably below the average and were well separated from the rest. Sites 4 and 41 had the lowest diversity indices of all, but appeared to be the best remaining examples of old-growth southern-mesic forest in southeastern Wisconsin. Both islands were dominated by sugar maple which comprised 67% and 86% of the stems (Sites 4 and 41 respectively) greater than 2.5cm dbh, thereby resulting in a relatively low equitability (J') component. But, the two sites were unlike in species richness. Site 4 only had six species in the canopy and understory strata, while Site 41 had 14 species. Equitability of species distribution far outweighed species richness. Sites 6, 9, and 43 were also dominated by sugar maple, but were clearly second growth and their low diversity index can be attributed to selective removal of species. Site 40, located only 0.25km from Site 41, had the greatest diversity index of the 43 forest islands (Table 3). The high diversity value was attributed to the equitable distribution of individuals between the species. As demonstrated elsewhere (Loucks, 1970), the self-perpetuating terminal forests of this region are less diverse than the later successional stages leading to them.

Shrub Stratum Composition and Structure

There were more woody species in the shrub stratum of the southern-mesic forest stands than in the canopy and understory strata. Sixty-six different woody species were found in the shrub stratum of the 43 forest islands (Table 4). Thirty-six species were considered true shrubs; species whose maximum potential height restricted them to the sub-canopy strata. The remaining 30 species had the potential of entering the canopy. Over all stands, an average of 19 species were encountered in the shrub layer, but actual numbers ranged from 8-35 species. In a similar study, Donselman (1973) also found 66 species in the shrub strata of 21 old-growth beech-maple forests in Indiana, Ohio and Michigan. He determined a stand average of 25 species per stand with a range from 15-32 species.

Stem density in the shrub layer varies greatly from stand to stand. Windthrow, tree mortality, ice storms and other disturbances create canopy openings which trigger successional responses. Auclair and Cottom (1971) found as many as 95,000 stems/ha in disturbed sites and as few as 40,100 stems/ha in relatively undisturbed forests in southcentral Wisconsin. Competition from the high densities of shrubs reduced seedling establishment of tree species. Donselman (1973), in his study of the shrub layer of the beech-maple association, found stem densities ranging from 5990 to 17,350 stems/ha with an

average of 9502. In this study, tree reproduction accounted for most of the species as well as the greatest stem density. Stem densities for the 43 study sites fell within the ranges of previous studies. Nearly 16,800 stems/ha (range 6300-30,100) were present in the shrub stratum (Table 2). This average density value appears representative of the shrub stratum for most stands, although locally higher or lower values may be obtained due to the chance location of plots under open or closed canopy. For example, dense clones of root sprouts may occur around the base of a beech tree or light from an opening in the canopy may support a blackberry patch or dense growth of white ash saplings. The use of "importance value" as an integrating expression which averages the relative density and relative frequency helps to reduce the quantitative effect of stem clumping.

Increased species richness and/or stem density did not necessarily indicate a large stand or a better substrate. Alternatively, these conditions denote a disturbed situation with successional species present. Environmental diversity, i.e., presence of microhabitats resulting from topographic variation, also exerts a direct effect on species richness (MacArthur and Wilson, 1967). Although the successional stage is probably a major factor, the level of local disturbance in the stand appears most important. The lowest shrub density was recorded in Site 42; a stand dominated by American beech and sugar maple. This stand, in Grant Park, is an excellent example of an old-growth beech-maple forest. Under the closed maple-beech canopy, few shrub species can reproduce and survive. Stem density was low in all sub-canopy layers. Heavy park usage and resultant compaction also contributed to the lack of seedling establishment. The highest density was found at Site 26 (Table 2). This stand was also dominated by sugar maple, but grazing by horses through the late 1960s maintained the site in a disturbed state with an incomplete canopy. The site was located on a xerophytic southwest facing slope. With the open canopy, compacted soil and xeric conditions, the leading dominant in the shrub stratum was choke cherry *(Prunus virginiana)*. We recorded 21,000 stems of choke cherry per hectare, over 3 times the average density for the species (Table 2) and 69% of all stems in the stand (Table 26C).

Sugar maple and spicebush *(Lindera benzoin)* were the most important species of the shrub layer in 21 old-growth beech-maple forests in Indiana, Ohio and Michigan (Donselman, 1973). Wild gooseberry *(Ribes missouriense)* and choke cherry were reported by Auclair and Cottam (1971) to be the most important species in the shrub layer of the southern-xeric forest of south-central-Wisconsin. And, according to Chamberlin (1877), the round-leaved dogwood *(Cornus rugosa)* "was the most conspicuous shrub" of the original southern-mesic forest. In this study, *C. rugosa* was not sampled in any of the 43 forests. The species was observed in the "edge flora" of a few stands of the Milwaukee County Park system, presumably placed there as part of an ornamental planting. Choke cherry and sugar maple were the dominant species of the shrub layer of the 43 woodlots in metropolitan Milwaukee. Choke cherry was sampled in all stands. Sugar maple and white ash were absent in only one stand. Choke cherry was dominant, or co-dominant in 95% of the stands. Sugar maple was the second dominant species followed by white ash. These three species accounted for 67% of all stems recorded. Dogberry *(Ribes cynosbati)* shared dominance in 24% of the stands and the hybrid honey-

suckle *(Lonicera bella)* in 14%. These shrubs, and choke cherry, bear fruit which is readily dispersed and preferred by birds. Curtis (1956) suggested that species with widely dispersed seeds were achieving unusually high levels of dominance in woodlots in central Wisconsin. Auclair and Cottam (1971) found that bird-dispersed species of shrubs had a higher potential for dispersal than mammal- and wind-dispersed types and were becoming more abundant in Wisconsin woodlots. In addition to long-range bird dispersal, they listed delayed seed germination and flexibility in seedbed requirements as other characteristics of opportunistic or colonizing plant species. Ideal conditions for invasion included the conversion of forests to isolated woodlots, ample light, and widespread disturbance.

Choke cherry was never observed to flower or set fruit in the interior of any of our stands. Apparently choke cherry seeds are dispersed from outside the woodlot to the inside. Thompson and Willson (1978) report avian frugivores, more typical of the forest interior, often forage in the forest edges where fruits are available. Subsequent return of the birds to the interior actively distributes propagules to the forest interior. The source may be no more distant than the edge community where choke cherry is ubiquitous and often observed with a heavy fruit set. The distribution of sweet cherry *(Prunus avium)* in a mature oak-hickory forest in New Jersey was reported by Wales (1972) to follow the same pattern. He found that the trees in gaps near the center of the stand were not large enough to produce seed, and assumed bird-dissemination of seed.

Urban woodlots in Delaware were found to contain a greater bird species richness and more territorial males than did most sample areas from homogeneous or interior habitats (Lineham, Jones and Longcore, 1967). They also reported that very dense bird populations with a large variety of species could be expected in urban woodlots 8ha or larger in size if an adequate shrub, understory, mature and dead standing trees, and wide vegetation edges were present. Presumably the concentrated avian use of the scattered, isolated woodlots and their edges is the cause of "immigration" of choke cherry propagules from the edge to the interior.

White ash achieved a high average importance value for the shrub stratum just as it had in the canopy. Ash averaged almost 1400 stems/ha in the shrub stratum and had more than twice the average density per hectare of black cherry *(Prunus serotina)*. While black cherry appears more successful in the dry-mesic forests (Auclair and Cottam, 1971), my data indicate that ash is more successful in the southern-mesic forest, although both act as opportunistic successional species responding to disturbances in the canopy.

In Donselman's work, the importance of American beech in the shrub layer resulted from its even distribution and high frequency in each stand throughout the region. Although vegetative reproduction was important, the ability of beech to reproduce by seed also contributed to its importance. In southeast Wisconsin, beech was found in the shrub layer in nearly 70% of the stands, but contributed significantly in only 5% of the stands. Beech saplings usually resulted from root sprouts. Stimulated by injury to the tree base or roots, high densities of root sprouts may occur, but sprouts may also form

where no injury is evident (Lutz, 1930; Rushmore, 1956). We found high densities of beech in the understory and shrub strata in woodlots with a history of grazing or cutting, e.g., Sites 12 and 28. The dispersal potential for beech is largely limited to the maximum lateral extent of their root system. Often several dozen sprouts may occur in a ring around a parent tree. Isolated populations of American beech in isolated woodlots run a finite risk of extinction. The ability of beech to produce a large mast crop of viable seed appears greatly limited in this region (Ward, 1956). Once beech is eliminated or lost from a stand, extinction is irrevocable since recolonization is highly improbable. This phenomena can be observed in Sites 15 and 12. Site 15 is totally devoid of beech whereas Site 12 is co-cominated by beech and the stands are separated by only 1km. Successive aerial photographs over the past 40 years indicate no major removal of trees. Beech has been unable to recolonize Site 15.

Only nine species in the shrub stratum were classified as exotics, i.e., not native to eastern North America. Of the nine, only three occurred in more than two stands. Bittersweet *(Solanum dulcamara)* and common buckthorn *(Rhamnus catharticus)* were present in 42% and 30% of the stands respectively. Bird-dispersal was suggested for both species as they produce multi-seeded berries and drupes. Both species appeared most successful in disturbed sites with wet-mesic conditions. Only the hybrid honeysuckle *(Lonicera bella)* achieved wide distribution, occurring in 58% of the sites, often with locally high densities. Honeysuckle qualifies as an opportunistic species, entering the forest in an opening or edge, prospering and finally declining as the canopy closes. Species reaching a stand will only be successful in colonization if suitable habitat requirements are present for them to complete their life cycles. No exotic shrubs or species not native to the southern-mesic forest appeared able to survive under the closed forest canopy.

Species diversity (H') of the shrub stratum averaged 1.68 + 0.96 S.D. (Table 3). This value is slightly lower than the H' value obtained for the canopy and understory strata. Intuitively, one would expect this relationship, bearing in mind the self-perpetrating qualities of the southern-mesic forest and the shade tolerant species capable of surviving, growing and reproducing under the closed canopy. In actual fact, shrub diversity was higher than canopy diversity in one-half of the stands, but ranged from 0.12 to 2.51 (Table 3), presumably a function of disturbance.

Site 44 had the lowest shrub species diversity of all stands sampled. Species richness was more than two standard deviations below the average with choke cherry making up more than 98% of a greater than average stem density (Table 44C). On the other hand, Site 3 had the greatest species diversity with slightly greater than average species richness, but no single dominant species (Table 3C). In general, the shrub flora of the stands reflected the disturbance history with varying degrees of species richness attributable to the balance of elements of both pioneer and terminal communities. Stands with a high species diversity in the shrub layer were characterized by mixed communities without dominants or with only weakly dominant species, i.e., low relative densities of choke cherry and/or sugar maple.

Table 4. Constancy, density and importance values for all species occurring in the shrub stratum of 43 forest islands. Values for the mean density per hectare are based on the stands in which the species was present. Importance value was the average of the sum of the relative values of density and frequency (Maximum = 100). Exotic species are indicated by (•).

Species	Constancy	Mean Density (ha.)	Mean Importance Value
Prunus virginiana L.	100.0	6863	30.28
Acer saccharum Marsh.	97.7	3012	16.64
Fraxinus americana L.	97.7	1391	10.18
Prunus serotina Ehrh.	90.7	615	6.35
Ribes cynosbati L.	74.4	1026	4.67
•*Lonicera bella* Zabel.	58.1	1273	4.19
Fagus grandifolia Ehrh.	69.8	472	3.47
Tilia americana L.	81.4	431	3.18
Ribes americanum Mill.	72.1	601	2.82
Ostrya virginiana (Mill.) K. Koch	65.1	197	1.51
Vitis riparia Michx.	58.1	214	1.42
Carya cordiformis (Wang.) K. Koch	62.8	127	1.30
Cornus stolonifera Michx.	25.6	1513	1.27
Viburnum lentago L.	53.5	315	1.22
Ulmus rubra Muhl.	58.1	138	1.04
Cornus racemosa Lam.	37.2	384	.99
Populus grandidentata Michx.	2.3	300	.99
Hamamelis virginiana L.	25.6	399	.76
Rubus occidentalis L.	44.2	173	.76
Viburnum opulus L.	20.9	708	.72
•*Solanum dulcamara* L.	41.9	244	.70
Zanthoxylum americanum Mill.	41.9	115	.70
Viburnum acerifolium L.	23.3	406	.62
Crataegus succulenta Link.	32.6	106	.48
Viburnum rafinesquianum Schult.	20.9	347	.47
Cornus alternifolia L. f.	25.6	177	.45
Menispermum canadense L.	25.6	359	.42
Dirca palustris L.	23.3	136	.42
Sambucus canadensis L.	20.9	76	.42
Fraxinus pennsylvanica Marsh.	9.3	167	.34
Quercus borealis Michx. f.	32.6	70	.34
•*Rhamnus catharticus* L.	30.2	69	.34
Crataegus punctata Jacq.	32.6	45	.29
Acer negundo L.	20.9	61	.22
Carpinus caroliniana Walt.	18.6	35	.17
Lonicera prolifera (Kirchner) Rehder)	14.0	132	.16
Amelanchier sp. L.	16.3	55	.14
Acer rubrum L.	18.6	38	.14

Table 4 continued

Species	Constancy	Mean Density (ha.)	Mean Importance Value
Sambucus pubens Michx.	7.0	247	.12
Parthenocissus quinquefolia (L.) Planch.	14.0	55	.12
•*Viburnum lantana* L.	4.7	163	.11
Fraxinus nigra Marsh.	7.0	87	.11
Euonymus atropurpureus Jacq.	4.7	293	.10
•*Rhamnus frangula* L.	4.7	173	.08
Ulmus americana L.	11.6	25	.07
Quercus macrocarpa Michx.	4.7	80	.06
Smilax hispida Muhl.	2.3	280	.05
Carya ovata (Mill.) K. Koch	4.7	95	.05
Juglans nigra L.	4.7	30	.04
Betula papyrifera Marsh.	2.3	100	.03
Acer saccharinum L.	2.3	120	.03
Juglans cinerea L.	2.3	63	.03
•*Forsythia suspensa* (Thunb.) Vahl.	2.3	120	.02
Ptelea trifolia L.	2.3	40	.02
Celtis occidentalis L.	4.7	44	.02
Rosa sp. L.	2.3	100	.02
Rhus radicans L.	4.7	20	.02
•*Berberis thunbergii* D.C.	2.3	150	.02
•*Euonymus alatus* (Thunb.) Sieg.	2.3	20	.01
Populus tremuloides Michx.	2.3	20	.01
Quercus alba L.	2.3	20	.01
Thuja occidentalis L.	2.3	25	.01
Rhus typhina L.	2.3	15	.01
Celastrus scandens L.	2.3	72	.01
Rubus hispidus L.	2.3	15	.01
•*Acer ginnala* Maxim.	2.3	40	.01
Total		16,627	100.

CONCLUSIONS

The species composition and community structure of the isolated woodlots is largely a function of disturbance, whether natural or human induced. Heavy utilization of the urban forest maintains a continual state of disturbance resulting in a high value for species richness. The increased species richness approaches the regional peak described by Loucks (1970) when a mix-

ture of intolerant and tolerant species co-exist. Further, the increased human disturbance retards stand redevelopment toward a terminal equilibrium (Suhrweir and Tramer, 1976). In rural areas, where the woodlots are under less human pressure and disturbances are more random, the woodlots can redevelop successionally resulting in the eventual loss of intolerant species and a lower overall species richness as the terminal community is reestablished.

In a related study (Levenson, 1976), I found the impact of disturbance to be a function of woodlot size. Very small woodlots, approximately 2 ha (5a) or less in size, functioned essentially as edge communities. Larger woodlots were more capable of sustaining random perturbations. The threshold size necessary for a southern-mesic woodlot to sustain random disturbance appears to be approximately 4 ha (10a). A major management priority for the preservation of the southern-mesic forest community is the protection of the larger (> 4ha), less disturbed woodlots. Only the larger stands have the potential to provide the once-regional southern-mesic environment. These larger stands may function as refugia for the rarer species requiring the southern-mesic habitat.

Retention of the smaller islands and fencerows is also desirable as these areas harbour a diverse mix of exotic, pioneer and terminal plant community components. In agreement with Forman, Galli and Leck (1976), the smaller areas function as "stepping stones" from which species can be reintroduced when local community equilibrium fluctuates (Sullivan and Shaffer, 1975). Using local ecotypes of upland trees and shrubs as street and yard plantings in the urban system could help to reduce inter-stand distance by providing seed sources. In rural areas, the retention of fencerows and other environmental corridors could provide the much-needed "stepping stones" for dispersal.

Top priority should be given research programs and management strategies for American beech *(Fagus grandifolia)*. Once eliminated from a stand, natural re-establishment is not possible. The small population of beech in some of the Milwaukee County Parks (Sites 30, 33 and 41) are presently in danger of extinction.

White ash is a vigorous, opportunistic competitor in the remnant forest stands of metropolitan Milwaukee. Responding to disturbance, it appears to be replacing the elms *(Ulmus sp.)* and may be considered a major component of all structural strata of the southern-mesic forest.

As reported earlier in New York (Peterson and McKenny, 1968) and in New England (Dowden, 1975), the European orchid, helleborine *(Epipactis latifolia)* appears to have become a successful, tolerant colonizer of the southern-mesic forest. No other exotic species were observed under the closed canopy.

Sugar maple seedling densities were often lower in the urban and heavily disturbed sites while white ash reached somewhat higher densities. Locally heavy rabbit browsing and unsuitable seedbed conditions for sugar maple have been suggested as responsible for its low numbers. Further investigation of this relationship is necessary as it has a direct bearing on the successional dynamics and future composition of the urban forest.

APPENDIX

Detailed descriptions of each site are provided in this section. Site location, land-use history, soils information and vegetation summaries are included for each forest remnant. The groundlayer vegetation of most sites was examined in detail by Hoehne (1977). Detailed studies for Site 01 were conducted for the canopy stratum by Dunnum (1972a) and the groundlayer by Powers (1977).

Pages and tables have been numbered to correspond to the numerical designation of each stand. For uniformity and to enhance ease of reference, each table has an alphabetical suffix:

A = Species composition and attributes of the canopy stratum.

B = Size-class distribution of the canopy species.

C = Species composition and attributes of the shrub stratum.

D = Species composition and attributes of the groundlayer.

Cedar-Sauk Forest

Site 01
Size: 39.96ha
Ozaukee County

Newburg Quadrangle
SE¼, Sec 30, T11N, R21E
University of Wisconsin-Milwaukee

The University of Wisconsin-Milwaukee field station is located in an area of kettle and kame topography disjunct from the major kettle moraine region to the northwest. Kettle and Kame topography, varying from 1 to 8km in width lies in a long crescent from southwest of West Bend, eastward along the north side of Cedar Creek and then northward along the west edge of the Cedarburg Bog towards Newburg (Matthiae, pers. comm.). The area is characterized by low, gravelly hills forested with southern-mesic forest, and by kettle holes or depressions occupied by bog or swamp forests.

The Cedar-Sauk forest is located on typical, complex kettle and kame topography. Low, gravelly hills with a maximum relief of 15m dip into kettle depressions on 35 percent slopes. The forest developed on the Hoccheim-Sisson-Casco soil complex (Typic Argiudoll and Typic Hapludalfs). Generally, the Hochheim soil makes up about 40% of the complex. The degree of slope determines the proportion of the other soils. Sisson fine sandy loam is predominant on the steeper (20-35 percent) slopes. Runoff is medium to rapid presenting a moderate to severe erosion hazard. The soils occupy no specific position on the landscape, but are closely intermixed on the slopes. The lower soil layers are usually stratified, but at different angles. Water usually follows a particular stratum downhill until it seeps or forms a wet spot on the surface (USDA, 1970).

The land-use history of this forest island was obtained from Dunnum (1972a) and Matthiae (pers. comm.). The northern 16ha of the upland forest had received the heaviest disturbance. That part of the island was part of a

small farm and was selectively logged for timber and firewood over many years. The last cutting for cull trees and firewood occurred during the winter of 1963-64 (Matthiae, pers. comm.), prior to acquisition by the Field Station in 1964. Numerous logging trails were still evident. The southern half of the island received little disturbance. The extreme southeastern 4ha of the southern 12ha was heavily logged with subsequent grazing which ended in the late 1930s (Matthiae, pers. comm.). Since then, little disturbance has occurred. In 1964, several large basswood *(Tilia americana)* were removed, but because of their poor quality, were sold for firewood.

The vegetation of the Cedar-Sauk forest was not sampled in this study. Dunnum (1972a) had sampled the entire island for canopy, understory, shrub and groundlayer vegetation. The entire stand was surveyed using a grid with north-south and east-west lines at 50m intervals. Square units, 0.25ha, were formed with a sample point located at each corner. Nested circular plots were sampled at each point. Trees and saplings were recorded in $100m^2$ plots, shrubs in $10m^2$ plots and groundlayer in $1m^2$ plots.

The upland forest was dominated by sugar maple *(Acer saccharum)* which comprised 41% of stems and 44% of the basal area (Table 01A). White ash *(Fraxinus americana)*, American beech *(Fagus grandifolia)* and basswood shared sub-dominance together accounting for 30% of the density and 39% of the basal area. Ironwood *(Ostrya virginiana)* had the second highest importance value as a result of high density of small stems.

The upland forest was not uniform in structure because of multiple ownership and different management strategies. Dunnum (1972b) found the northern portion had a higher stem density per acre and lower basal area per acre than the southern section. Table 01A combines the two areas, resulting in the somewhat higher than average stem density, but significantly lower than average basal area (Table 2). The sapling, shrub and groundlayer strata were described in detail in Dunnum (1972a, 1972b).

Table 01A. Stand attributes for the Cedar-Sauk Forest (Site 01), revised from Dunnum (1972a). Sample size: 64 plots (100m² circles) Sample date: Summer, 1971.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	215	N/A	10.69	40.98	36.88	44.00	40.62
Ostrya virginiana	96		1.53	18.31	14.38	6.29	12.99
Fraxinus americana	46		3.38	8.74	13.13	13.93	11.93
Fagus grandifolia	59		2.97	11.20	11.25	12.22	11.55
Tilia americana	52		3.03	9.84	7.50	12.48	9.94
Carya ovata	36		1.54	6.83	7.50	6.33	6.88
Ulmus rubra	9		.40	1.64	3.75	1.64	2.34
Quercus borealis	4		.35	.82	1.88	1.41	1.37
Acer rubrum	3		.17	.55	1.25	.72	.84
Ulmus americana	1		.08	.27	.62	.33	.40
Betula papyrifera	1		.07	.27	.62	.29	.39
Prunus serotina	1		.06	.27	.62	.25	.38
Populus tremuloides	1		.03	.27	.62	.10	.33
	524[a]		24.30[b]	99.99	100.00	99.99	99.96

a = 212 trees/acre
b 105.90 ft²/acre

Table 01**C**. Shrub composition for the Cedar-Sauk Forest. Sampled: Summer, 1971. Table revised from Dunnum (1972a).

Species	Density (ha.)	Relative Density	Relative Frequency	Importance Value
Acer saccharum	6513	35.11	24.37	29.74
Prunus virginiana	4453	24.00	7.56	15.78
Fraxinus americana	1848	9.95	13.86	11.90
Ribes cynosbati	1188	6.40	6.30	6.35
Fagus grandifolia	659	3.55	7.14	5.34
Ostrya virginiana	615	3.32	6.72	5.02
Carya cordiformis	301	1.77	6.72	4.24
Ulmus rubra	405	2.16	4.62	3.39
Prunus serotina	272	1.47	4.62	3.04
Zanthoxylum americanum	158	3.70	1.68	2.69
Sambucus pubens	442	2.39	2.10	2.24
Vitis riparia	301	1.62	2.52	2.07
Carya ovata	170	.92	2.52	1.72
Tilia americana	101	.54	2.52	1.53
Quercus borealis	101	.54	2.10	1.32
Cornus racemosa	329	1.62	.84	1.23
Viburnum lentago	57	.31	1.26	.78
Celastrus scandens	72	.32	.84	.61
Ulmus americana	42	.23	.84	.53
Rhus typhina	15	.08	.42	.25
Rubus hispidus	15	.08	.42	.25
TOTAL	18,057	100.14	99.97	100.02

Table 01**D**. Species composition, frequency and relative frequency in the groundlayer of Cedar-Sauk Forest (from Dunnum, 1972a).

Species	Freq.	% F	Species	Freq.	% F
Acer saccharum	50.75	12.82	*Parthenocissus vitacea*	7.25	1.83
Fagus grandifolia	10.15	2.56	*Amphicarpa bracteata*	5.80	1.46
Fraxinus americana	43.50	10.99	*Osmorhiza claytoni*	56.55	14.28
Tilia americana	5.80	1.46	*Hepatica acutiloba*	18.85	4.76
Ostrya virginiana	23.20	5.86	*Hepatica americana*	17.40	4.39
Quercus borealis	2.90	0.73	*Galium lanceolata*	2.90	0.73
Carya ovata	2.90	0.73	*Galium concinnum*	7.25	1.83
Ulmus rubra	30.45	7.69	*Galium triflorum*	2.90	0.73

Table 01D continued

Species	Freq.	%F	Species	Freq.	%F
Ulmus americana	5.80	1.46	*Viola pubescens*	17.40	4.39
Prunus serotina	4.35	1.10	*Actea alba*	1.45	0.37
Carya cordiformis	5.80	1.46	*Sanicula gregaria*	20.30	5.13
Prunus virginiana	5.80	1.46	*Smilax herbacea*	1.45	0.37
Vitis riparia	2.90	0.73	*Phryma leptostachya*	1.45	0.37
Viburnum lentago	1.45	0.37	*Geranium maculatum*	1.45	0.37
Ribes cynosbati	1.45	0.37	*Aster macrophyllus*	5.80	1.46
Cornus racemosa	1.45	0.37	*Carex laxiflora*	5.80	1.46
Celastrus scandens	1.45	0.37	*Epifagus virginiana*	2.90	0.73
Rhus radicans	1.45	0.37	Misc. Grasses & Sedges	24.24	6.23
Aralia nudicaulis	7.25	1.83			

Mud Lake Island

Site 02
Size: 0.65ha
Ozaukee County

Newburg Quadrangle
SW¼, SE¼, SW¼, Sec 29, T11N, R21E
University of Wisconsin-Milwaukee

The Mud Lake forest island was located on a small upland in the west-central portion of the Cedarburg Bog. The upland was created by crevasse filling or "pit filling" in the large Cedarburg Bog ice block (Matthiae, pers. comm.); a process not unlike that of kame formation. A crevasse or an eroded depression on the surface of the ice block filled with unsorted, glacial debris. When the block melted, the Cedarburg Bog basin was created with the pocket of debris left as an upland island. The forest developed on Casco loam soil (Typic Hapludalf). The soil is considered well drained and is typically formed in calcareous sand and gravel outwash (USDA, 1970). The island is surrounded by a narrow terrace supporting lowland hardwoods, and beyond by the northern swamp conifer forest of the bog.

The early land-use history of the island is unknown. The original forest on the island was clear-cut about 45 years ago (Matthiae, pers. comm.). Examination of the 1937 ASCS air photos indicated a brushy appearance with a few large trees around the periphery. The trees ringing the island were swamp hardwood species which probably became established during the period when the water level in the bog was reduced in an effort to drain the bog during the early 1900s (Farley and Salamun, 1973).

The island was sampled using twelve 10 x 12.5m plots. Young growth of black cherry *(Prunus serotina)* and sugar maple *(Acer saccharum)* were co-dominant and together accounted for 57% of the stems and 53% of the basal area (Table 02 **A**). A few American beech *(Fagus grandifolia)* were located outside the island edge trees on the island's terrace. That the present vegetation of the island was a result of recent successional processes can best be seen in the size

class distributions (Table 2 **B**). No individual tree on the upland exceeded 40cm (15.7in) dbh, with few exceeding 30cm (11.8in). Big-toothed aspen *(Populus grandidentata)* was represented by only a few relatively large individuals and that population appeared to be declining. Black cherry reproduction in the smaller size classes (2.5-10.1cm dbh) had dropped off significantly, while sugar maple comprised 70% of the stems. The structure was also typical of a young stand. Stem density was significantly higher, nearly three standard deviations, than the average but the basal area per hectare was somewhat lower than the average for 43 forest islands (Table 2). Species diversity (H') was near the average for the 43 islands sampled (Table 3).

Choke cherry *(Prunus virginiana)* totally dominated the shrub layer comprising 87% of the stems (Table 02 **C**). The only other species to occur in over half of the plots was sugar maple which accounted for only 4% of the stems recorded. Stem density per hectare was slightly below average, but species richness was significantly below the average for the 43 islands (Table 2). Species diversity (H') for the shrub layer was the lowest of all islands sampled, reflecting a combination of low species richness and low species equitability (J'); 87% of the stems were choke cherry.

The groundlayer was not sampled for the summer flora. No rare or endangered species were observed.

Table 02A. Stand attributes for Mud Lake Island (Site 02)
Sample size: 12 plots (10 x 12.5m) Sample Date: September 26, 1975

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Prunus serotina	306	92	7.99	36.22	22.92	30.31	29.82
Acer saccharum	180	83	6.00	21.26	20.83	22.75	21.61
Fraxinus americana	147	75	3.42	17.32	18.75	12.97	16.35
Tilia americana	73	50	3.53	8.66	12.50	13.37	11.51
Quercus borealis	40	25	2.63	4.72	6.25	9.97	6.98
Populus grandidentata	47	17	1.61	5.51	4.17	6.10	5.26
Ostrya virginiana	27	25	.32	3.15	6.25	1.22	3.54
Betula papyrifera	13	17	.24	1.57	4.17	.91	2.22
Carya cordiformis	7	8	.54	.79	2.08	2.06	1.64
Ulmus americana	7	8	.09	.79	2.08	.33	1.07
TOTAL	847[a]		26.37[b]	99.99	100.00	99.99	100.07

a = 343 trees/acre
b = 114.95 ft^2/acre

Table 02 **B**. Size class distribution for Mud Lake Island
Sample size: 0.15ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Tilia americana	1	6	2	2	2	2	2	1											18
Quercus borealis			1			2	2	1											6
Acer saccharum	50	36	11	3	6	6	1												113
Carya cordiformis							1												1
Fraxinus americana	2	5	8	10	3	1													29
Prunus serotina		3	14	18	12	2													49
Populus tremuloides				2	5														7
Betula papyrifera			1	1															2
Ulmus americana			1																1
Prunus virginiana	6	7																	13
Ostrya virginiana	1	5	4																
Total	60	62	42	36	28	13	6	2											

Table 02C. Shrub Composition for Mud Lake Island I Sampled 9/26/75

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	12865.	91.67	86.55	23.91	55.23
Acer saccharum	567.	83.33	3.81	21.74	12.78
Prunus serotina	267.	41.67	1.79	10.87	6.33
Fraxinus americana	200.	41.67	1.35	10.87	6.11
Populus grandidentata	300.	25.00	2.02	6.52	4.27
Carya cordiformis	167.	25.00	1.12	6.52	3.82
Ribes cynosbati	100.	25.00	.67	6.52	3.60
Viburnum acerifolium	133.	8.33	.90	2.17	1.54
Betula paperifera	100.	8.33	.67	2.17	1.42
Quercus borealis	67.	8.33	.45	2.17	1.31
Ostrya virginiana	33.	8.33	.22	2.17	1.20
Tilia americana	33.	8.33	.22	2.17	1.20
Lonicera prolifera	33.	8.33	.22	2.17	1.20
Total	14865.		100.00	100.00	100.00

Fechters Woods

Site 03
Size: 2.23ha
Washington County

Newburg Quadrangle
S½, NE¼, NE¼, Sec 36, T11N, R20E
Private Ownership

Fechters Woods was located near the crest of a kame with a gentle southwest and west slope, but an abrupt east-southeast face. The forest was developed on the well-drained Hochheim loam soil (Typic Argiudoll). This soil is usually located on upland slopes and formed in calcareous, loamy glacial till. The island was bounded on the west, north and east by various agricultural land uses. The south boundary was an orchard.

The land-use history of the island was obtained from Andrew Fechter. The island has been owned by the Fechter family for several generations. He reported that the woods had never been grazed. The island was last logged for choice, construction grade timber in 1949. Prior to that, light selective cutting occurred as timber was required through the years. During the spring of either 1932 or 1933, a tornado passed near the woods dropping a large water tank in the southwest corner of the woods. The area of damage was evident on the 1937 ASCS air photos and can still be seen today in the form of a dense growth of small ironwood sapplings (*Ostrya virginiana*).

The canopy and understory strata were sampled using twenty 10 x 12.5m plots. Red oak (*Quercus borealis*) and sugar maple (*Acer saccharum*) were co-

dominant in the canopy layer, accounting for 55% of the stems and 60% of the basal area (Table 03A). Although sugar maple comprised a third of the stems, red oak represented 39% of the basal area. American beech *(Fagus grandifolia)* was sub-dominant, accounting for 21% of the stems and restricted to the size classes less than 35cm (13.7 in) dbh (Table 03 **B**). In addition, beech was confined almost entirely to the east edge and the steeply sloping southeast corner. The size class distribution of the canopy species reflected the long history of selective cutting with no individuals greater than 60cm (23.6in) dbh and relatively few stems larger than 40cm (15.7in) dbh. The understory stratum (stems 2.5-10cm dbh) was dominated by sugar maple which accounted for 53% of the stems and occurred evenly throughout the island. Ironwood, with a patchy distribution, contributed another 30% of the stem density. Species richness was somewhat below the average in the canopy strata. Stem density and basal area per hectare were greater than the average for the 43 islands (Table 2), reflecting management through selective cutting. Species diversity (H') was slightly lower than average due to the reduced species richness.

No single species dominated the shrub layer of the island (Table 03 **C**). Choke cherry *(Prunus virginiana)* had the greatest stem density, but only accounted for 17% of the total. Species richness was somewhat greater than average, but nearly all species were typical components of the southern mesic forest. Only prickly-ash *(Zanthoxylum americanum)*, an indicator of disturbance, and forsythia *(Forsythia suspensa)*, an escaped exotic, were atypical members of the community. Surprisingly, the stem density per hectare was significantly below the average. Species diversity (H') was the second highest of the 43 islands sampled and was attributed to the relatively high equitability (J') component (Table 3).

Likewise, no single species dominated the groundlayer (Table 03 **D**). False Solomon's-seal *(Smilacina racemosa)* was the most numerous species but accounted for only 14% of the stems. Sugar maple was more evenly distributed and accounted for 11% of the importance value. Most species were typical of the southern-mesic ground flora, although a few were more typical of disturbed locations. The presence of wild sarsaparilla *(Aralia nudicaulis)* exemplifies the northern affinities of stands in the tension zone. Species diversity (H') was the highest of the 31 groundlayers sampled (Table 3). The high diversity was a function of the relatively high species richness coupled with a high equitability (J') component. No rare or endangered species were encountered.

Table 03 **A**. Stand attributes for Fechter's Woods (Site 03)
Sample size: 20 plots (10 x 12.5m) Sample Date: September 26, 1975

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Quercus borealis	112	70	12.71	21.71	25.00	38.80	28.50
Acer saccharum	172	80	6.92	33.33	28.57	21.11	27.67
Fagus grandifolia	108	50	4.66	20.93	17.86	14.21	17.67
Tilia americana	64	35	5.08	12.40	12.50	15.51	13.47
Fraxinus americana	28	20	2.88	5.43	7.14	8.79	7.12
Ostrya virginiana	24	15	.33	4.65	5.36	1.01	3.67
Acer rubrum	4	5	.13	.78	1.79	.41	.99
Amelanchier laevis	4	5	.05	.78	1.79	.16	.91
Totals	516[a]		32.76[b]	100.01	100.01	100.00	100.00

a = 209 trees acre
b = 142.77 ft^2 acre

Table 03 **B**. Size class distribution for Fechter's Woods
Sample size: 0.25ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Tilia americana		4	3	1	3	3	1	1	2	1		1							20
Quercus borealis			1		2	4	4	8	1	5	3								28
Acer saccharum	99	16	11	10	11	7		3		1									158
Fraxinus americana	10					1	3	2		1									17
Fagus grandifolia	8	1	2	9	9	2	5												36
Ostrya virginiana	59	7	5	1															72
Acer rubrum					1														1
Amelanchier laevis			1																1
Prunus serotina	9	2																	11
Ulmus rubra	1																		1
Carya cordiformis	1																		1
Totals	187	30	23	21	26	17	13	14	3	8	3		1						

Table 03**C**. Shrub composition for Fechters Woods sampled 9/26/75

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	1840.	60.00	16.88	9.02	12.95
Acer saccharum	1340.	85.00	12.29	12.78	12.54
Ostrya virginiana	1440.	75.00	13.21	11.28	12.24
Fraxinus americana	1000.	60.00	9.17	9.02	9.10
Fagus grandifolia	1300.	40.00	11.93	6.02	8.97
Ribes cynosbati	840.	60.00	7.71	9.02	8.36
Carya cordiformis	440.	65.00	4.04	9.77	6.91
Viburnum acerifolium	880.	35.00	8.07	5.26	6.67
Cornus racemosa	420.	30.00	3.85	4.51	4.18
Zanthoxylum americanum	160.	30.00	1.47	4.51	2.99
Dirca palustris	220.	20.00	2.02	3.01	2.51
Prunus serotina	220.	15.00	2.02	2.26	2.14
Smilax hispida	280.	10.00	2.57	1.50	2.04
Ulmus rubra	100.	15.00	.92	2.26	1.59
Quercus borealis	60.	10.00	.55	1.50	1.03
Vitis riparia	60.	10.00	.55	1.50	1.03
Ribes americanum	60.	10.00	.55	1.50	1.03
Tilia americana	40.	10.00	.37	1.50	.94
Hammemelis virginiana	40.	10.00	.37	1.50	.94
Forsythia suspensa	120.	5.00	1.10	.75	.93
Viburnum rafinesquianum	20.	5.00	.18	.75	.47
Lonicera prolifera	20.	5.00	.18	.75	.47
Total	10900.		100.00	100.00	100.00

Table 03**D**. Groundlayer for Fechters Woods sampled 9/26/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	11000.	35.00	10.26	12.73	11.49
Prunus virginiana	9500.	30.00	8.86	10.91	9.88
Fraxinus americana	6500.	30.00	6.06	10.91	8.48
Smilacina racemosa	15000.	7.50	13.99	2.73	8.36
Hepatica acutiloba	6250.	20.00	5.83	7.27	6.55
Carex blanda	10000.	2.50	9.32	.91	5.12
Quercus borealis	3000.	20.00	2.80	7.27	5.03
Caulophyllum thalictroides	6750.	5.00	6.29	1.82	4.06
Carex albursina	4500.	2.50	4.20	.91	2.55

Table 03 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Oxalis sp.	2250.	7.50	2.10	2.73	2.41
Allium tricoccum	2000.	7.50	1.86	2.73	2.30
Tilia americana	1000.	10.00	.93	3.64	2.28
Circaea quadrisulcata	2500.	5.00	2.33	1.82	2.07
Galium sp.	2500.	5.00	2.33	1.82	2.07
Potentilla simplex	3250.	2.50	3.03	.91	1.97
Viola pubescens	1250.	7.50	1.17	2.73	1.95
Viola eriocarpa	3000.	2.50	2.80	.91	1.85
Hystrix patula	1000.	7.50	.93	2.73	1.83
Geranium maculatum	1500.	5.00	1.40	1.82	1.61
Podophyllum peltatum	1500.	5.00	1.40	1.82	1.61
Polygonatum pubescens	1500.	5.00	1.40	1.82	1.61
Prenanthes altissima	1000.	5.00	.93	1.82	1.38
Epifagus virginiana	1750.	2.50	1.63	.91	1.27
Aster cordifolius	750.	5.00	.70	1.82	1.26
Carya cordiformis	750.	5.00	.70	1.82	1.26
Viburnum acerifolium	750.	5.00	.70	1.82	1.26
Dioscorea villosa	1000.	2.50	.93	.91	.92
Rhus radicans	1000.	2.50	.93	.91	.92
Aralia nudicaulis	750.	2.50	.70	.91	.80
Osmorhiza claytoni	750.	2.50	.70	.91	.80
Ribes cynosbati	750.	2.50	.70	.91	.80
Amphicarpa bracteata	500.	2.50	.47	.91	.69
Ostrya virginiana	500.	2.50	.47	.91	.69
Geum canadense	250.	2.50	.23	.91	.57
Parthenocissus quinquefolia	250.	2.50	.23	.91	.57
Phryma leptostachya	250.	2.50	.23	.91	.57
Solanum dulcamara	250.	2.50	.23	.91	.57
Viburnum lentago	250.	2.50	.23	.91	.57
Total	107250.		100.00	100.00	100.00

Kurtz Woods

Site 04
Size: 14.53ha
Qzaukee County

Cedarburg Quadrangle
SW¼, NE¼, Sec 1, T10N, R21E
Private Ownership

Kurtz Woods is located on a southward extension of Cary-age recessional moraine. The upland was characterized by a few small depressions and the presence of glacial erratics. A northwest-southeast trending ridge traversed the eastern third of the island with associated shallow ravines on either side. This rolling topography is typical of recessional moraines in this region with relief generally less than 10m. The forest was developed on the Hochheim-Sisson-Casco soil complex (Typic Argiudoll and Typic Hapludalfs). Generally, the Hochheim soil makes up about 40% of the complex. The degree of slope determines the proportion of the other soils. The Sisson fine sandy loam is predominant on the steeper (20-35 percent) slopes. Runoff is medium to rapid presenting a moderate to severe erosion hazard. The soils occupy no specific position on the landscape, but are closely intermixed on the slopes. The lower soil layers are usually stratified, but at different angles. Water usually follows a particular stratum downhill until it seeps or forms a wet spot on the surface (USDA, 1970).

The northwest, north, northeast, and south edges were bounded by agricultural uses. The southeast edge was bounded by successional and lowland forest. The southern third of the west edge was actively quarried for gravel.

Much of the land-use history of the island was obtained from the owner (Kurtz, pers. comm.). Most of the disturbance in the forest occurred about 50 years ago when a swath, approximately 50m wide along the length of the east edge, was logged for timber and firewood. The same section was grazed some 30-40 years ago. Examination of the 1937 ASCS air photos corroborated the cutting history. The remainder of the stand had a fully-closed, mature canopy and according to Mr. Kurtz received little or no disturbance.

The canopy and understory strata were sampled using thirty 10 x 12.5m plots. Sugar maple *(Acer saccharum)* and American beech *(Fagus grandifolia)* dominated the canopy layer combining to contribute 91% of the stems and 85% of the basal area (Table 04 **A**). Only four other species were sampled in the canopy layer, but red oak *(Quercus borealis)* and a single bitternut hickory *(Carya cordiformis)* were observed near the south end of the island. Examination of the size class distribution of the canopy trees indicates sugar maple and beech present in all classes up to 55cm (21.6in) dbh (Table 04 **B**). They reached their greatest densities between 25-40cm (9.9-15.7in) dbh. A few large beech and sugar maple reached 68cm and 81cm respectively. White ash *(Fraxinus americana)* and basswood *(Tilia americana)* were present in the medium size classes (35-60cm dbh), but were not effectively reproducing or present in the larger classes (Table 04 **C**). Elms *(Ulmus sp.)* were conspicuously absent. The understory was totally dominated by sugar maple, that species comprised 94% of the stems recorded. Ironwood *(Ostrya virginiana)* was noticeably absent as a major understory component. As expected for a fine old-growth beech-maple forest, stem density was somewhat below the average while basal area per hectare was greater than the average of the 43 forest islands

(Table 2). Species richness and species diversity (H') were significantly less than average (Table 3).

Sugar maple clearly dominated the shrub layer accounting for nearly 50% of the stems recorded (Table 04 **C**). Beech was sub-dominant, but occurred in 67% of the plots while accounting for only 18% of the stems. Although dominant in most of the stands in the region, choke cherry *(Prunus virginiana)* made a smaller contribution to the shrub strata of this old-growth forest. Unlike the canopy layer, the shrub strata had a near-average species richness and stem density (Table 2). However, species diversity (H') was below average. Nearly 50% of the stems were sugar maple, which created a low equitability (J') component (Table 3).

The groundlayer was not sampled for the summer flora. However, an unusually rich and diverse ground flora was observed. The rare and endangered golden-seal *(Hydrastis canadensis)* was observed in several widely separated clones. Both species of ginseng *(Panax quinquefolium* and *P. trifolium)* were also observed. A relatively dense clone of the vegetative form of an unidentified orchid was seen in one of the kettle-like depressions.

Table 04 **A**. Stand attributes for Kurtz Woods (Site 04)
Sample size: 30 plots (10 x 12.5m) Sample Date: October 10, 1975

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	184	90	14.33	46.31	48.21	44.85	46.40
Fagus grandifolia	176	63	12.81	44.30	33.93	40.12	39.45
Tilia americana	16	10	2.70	4.03	5.36	8.46	5.95
Fraxinus americana	8	10	1.57	2.01	5.36	4.91	4.09
Prunus serotina	11	10	.50	2.68	5.36	1.56	3.20
Ostrya virginiana	3	3	.03	.67	1.79	.10	.85
Totals	398[a]		31.94[b]	100.00	100.01	100.00	100.00

a = 161 trees acre
b = 139.19 ft^2 acre

Table 04 **B**. Size class distribution for Kurtz Woods
Sample size: 0.38ha.

Species	SIZE CLASS (centimeters)																	
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	**Total**
Acer saccharum	64	38	17	6	6	11	6	12	4	4	1		1			1			171
Fraxinus americana									1	1		1							3
Tilia americana								1	3		1	1							6
Fagus grandifolia	3	2	6	10	8	10	13	12	4	1	2								71
Prunus serotina					2	2													4
Ostrya virginiana		1	1																2
Totals	67	41	24	16	16	23	19	25	12	6	4	2	1			1			

Table 04C. Shrub composition for Kurtz Woods sampled 10/10/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	6092.	90.00	49.46	27.00	38.23
Fagus grandifolia	2253.	66.67	18.29	20.00	19.15
Prunus virginiana	16.00	33.33	12.99	10.00	11.49
Ribes cynosbati	12.93	40.00	10.50	12.00	11.25
Fraxinus americana	627.	26.67	5.09	8.00	6.54
Sambucus canadensis	187.	30.00	1.52	9.00	5.26
Prunus serotina	93.	6.67	.76	2.00	1.38
Ostrya virginiana	40.	6.67	.32	2.00	1.16
Ulmus americana	27.	6.67	.22	2.00	1.11
Crataegus punctata	13.	3.33	.11	1.00	.55
Dirca palustris	13.	3.33	.11	1.00	.55
Quercus borealis	13.	3.33	.11	1.00	.55
Cornus alternifolia	13.	3.33	.11	1.00	.55
Acer rubrum	13.	3.33	.11	1.00	.55
Viburnum acerifolium	13.	3.33	.11	1.00	.55
Tilia americana	13.	3.33	.11	1.00	.55
Ribes americanum	13.	3.33	.11	1.00	.55
Total	12317.		100.00	100.00	100.00

Martins Woods

Site 05
Size: 2.06ha
Ozaukee County

Five Corners Quadrangle
SW¼, SE¼, NW¼, Sec 6, T10N, R21E
Private Ownership

Martins Woods was located on a small hill overlain by Cary-age ground moraine. The hill is underlain by Niagara dolomite very close to the surface. Topographic relief within the stand was approximately 3m with the land sloping gently in all directions from the center. The forest developed on Hochheim loam (Typic Argiudoll). The soil is considered well drained and forms from calcareous, loamy glacial till on upland slopes (USDA, 1970). The island was bounded on the east by rural residences and mowed grass. The remaining edges were bounded by agricultural land.

The land-use history of the island is largely unknown. The remnants of a lime kiln were located not far from the woods. Examination of 1937 ASCS air photos indicated the island was then about the same size and shape as today. About 60% of the canopy appeared intact. A 25m swath along the length of the west edge appeared to have been cleared recently. The south and east edges had large openings in the canopy. Examination of the island indicated that most of the larger oaks (*Quercus sp.*) had an open-grown growth form. Al-

though the size class distribution indicates a highly disturbed stand (Table 05 **B**), it also suggests a woods in transition from oak to maple (Stearns, pers. comm.). The present owners have removed numerous dead and dying ironwood *(Ostrya virginiana)*.

The canopy and understory strata were sampled using sixteen 10 x 12.5m plots. Sugar maple *(Acer saccharum)*, by virtue of high densities, was the leading dominant while accounting for only 26% of the basal area (Table 05 **A**). Red oak *(Quercus borealis)* and white oak *(Q. alba)* combined to contribute 58% of the basal area, but only 20% of the stems. Typically, the oaks had an open-grown form. Canopy species richness was slightly below the average but the stem density and basal area per hectare were above average for the 43 islands sampled (Table 2).

Sugar maple and ironwood saplings dominated the understory (stems 2.5-10.1cm dbh) jointly contributing 90% of the stems (Table 05 **B**). Ironwood was suffering from an apparent high mortality rate. The initial population was at least 51% higher if the dead stems recorded were included. Back estimates would be risky, however, since the owners were actively removing dead and dying individuals. Species diversity (H') for the canopy and understory strata was somewhat below average (Table 3).

Choke cherry *(Prunus virginiana)* and sugar maple were co-dominant in the shrub layer, contributing 42% and 28% of the density respectively (Table 05 **C**). White ash *(Fraxinus americana)* was also widely distributed and accounted for 10% of the stems. Species richness was significantly higher than the average for the 43 islands (Table 2). The increased richness was attributable to several mesic species which survived the earlier disturbance, including witch-hazel *(Hamamelis virginiana)*, leatherwood *(Dirca palustris)*, and maple-leaved viburnum *(Viburnum acerifolium)*. However, honeysuckle *(Lonicera bella)*, prickly-ash *(Zanthoxylum americanum)* and hawthorn *(Crataegus punctata)* were left from, and were indicators of, former disturbance. The presence of white cedar *(Thuja occidentalis)* suggested an unexpected invasion from the Cedarburg bog a short distance to the north and poses an interesting dispersal problem. Species diversity (H') for the shrub layer was slightly above average even though the equitability (J') component was relatively low (Table 3).

The groundlayer was not sampled for the summer flora. No rare or endangered species were encountered.

Table 05 **A.** Stand attributes for Martin's Woods (Site 05)
Sample size: 16 plots (10 x 12.5m) Sample Date: October 4, 1975

Species	Density (ha.)	Frequency	Basal Area (M^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	185	75	8.00	37.37	24.00	25.60	28.99
Quercus borealis	55	56	10.09	11.11	18.00	32.29	20.47
Ostrya virginiana	110	69	1.48	22.22	22.00	4.73	16.32
Quercus alba	45	31	7.95	9.09	10.00	25.44	14.84
Tilia americana	30	25	1.53	6.06	8.00	4.89	6.32
Fraxinus americana	25	19	.73	5.05	6.00	2.35	4.47
Ulmus rubra	25	12	1.09	5.05	4.00	3.49	4.18
Fagus grandifolia	15	19	.32	3.03	6.00	1.03	3.35
Prunus serotina	5	6	.06	1.01	2.00	.19	1.07
Totals	495[a]		31.25[b]	99.99	100.00	100.01	100.01

a = 200 trees/acre
b = 136.23 ft^2/acre

Table 05 **B.** Size class distribution for Martins Woods
Sample size: 0.2 ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Quercus alba				1				2	2		2	1		1					9
Quercus borealis						1	1	1	2	2	1		3						11
Acer saccharum	27	29	9	9	6	4	7	1	1										93
Ulmus rubra			1	3					1										5
Tilia americana		2		2		4													8
Ostrya virginiana	15	30	18	4															67
Fraxinus americana	4	2	3			2													11
Fagus grandifolia			1	2															3
Prunus serotina	1		1																2
Carya cordiformis	2																		2
Totals	49	63	33	21	6	11	8	4	6	2	3	1	3	1					

Table 05 **C.** Shrub composition for Martins Woods Sampled 10/4/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	7075.	93.75	42.37	14.85	28.61
Acer saccharum	4625.	93.75	27.69	14.85	21.27
Fraxinus americana	1650.	81.25	9.88	12.87	11.38
Prunus serotina	500.	56.25	2.99	8.91	5.95
Viburnum acerifolium	375.	56.25	2.25	8.91	5.58
Viburnum rafinesquianum	625.	37.50	3.74	5.94	4.84
Hamamelis virginiana	275.	31.25	1.65	4.95	3.30
Ostrya virginiana	175.	31.25	1.05	4.95	3.00
Dirca palustris	175.	25.00	1.05	3.96	2.50
Tilia americana	150.	25.00	.90	3.96	2.43
Carya cordiformis	100.	25.00	.60	3.96	2.28
Ribes cynosbati	100.	18.75	.60	2.97	1.78
Fagus grandifolia	150.	12.50	.90	1.98	1.44
Lonicera prolifera	300.	6.25	1.80	.99	1.39
Lonicera bella	175.	6.25	1.05	.99	1.02
Viburnum lentago	75.	6.25	.45	.99	.72
Vitis riparia	75.	6.25	.45	.99	.72
Zanthoxylum americanum	50.	6.25	.30	.99	.64
Thuja occidentalis	25.	6.25	.15	.99	.57
Crataegus punctata	25.	6.25	.15	.99	.57
Total	16700.		100.00	100.00	100.00

Buckskin Bowman

Site 06 — Cedarburg Quadrangle
Size: 6.48ha — S-2/3, W½, SE¼, NE¼, Sec 11, T10N, R21E
Ozaukee County — Private Ownership

The forest was located at the base of a narrow branch of Cary-aged end moraine that sloped abruptly to the southwest onto ground moraine. Topographic relief within the island approached 10m. Stoniness characterized much of the forest floor. The forest was developed on Hochheim loam soil (Typic Argiudoll), a soil considered well drained and typical of upland ridges. Soil formation occurred in calcareous, loamy glacial till (USDA, 1970). The east edge of the island was bounded by a gravel pit. The remaining boundaries were in agricultural use.

Nothing was known of the island's history. Examination of the 1937 ASCS air photos indicated a tightly closed canopy of small-crowned trees; typical of a vigorous second-growth stand. The southeast edge of the island

appeared to have been disturbed resulting in an open canopy. Except for a relatively large sugar maple *(Acer saccharum)* and an American beech *(Fagus grandifolia)*, the size class distribution of the canopy trees was restricted to less than 55cm (21.6in) dbh (Table 06**B**), suggesting a heavy cutting, probably about the turn of the century.

The canopy and understory strata were sampled using twenty 10 x 12.5m plots. Sugar maple was the dominant species accounting for 64% of the stems and 67% of the basal area (Table 06**A**). American beech was sub-dominant comprising an additional 28% of the stems and 22% of the basal area. Sugar maple was present in all size classes to 55cm, but beech was only present to 35cm (13.7in) dbh (Table 06 **B**). Just four species were sampled in the canopy and understory, but a small specimen each of black cherry *(Prunus serotina)* and red and white oak *(Quercus borealis* and *Q. alba)* were observed.

Tree reproduction in the 2.5-10.1cm (1-3.9in) dbh size classes was almost non-existent (Table 06 **B**). Beech, in the form of root sprouts, and sugar maple were the only species present and relatively recent grazing may be indicated. Stem density and basal area per hectare were somewhat less than the average (Table 2). However, species richness and species diversity (H') were significantly below the average for the 43 islands sampled (Table 3).

The shrub layer was dominated by an even distribution of sugar maple saplings accounting for 63% of the stems and 43% of the importance value (Table 06 **C**). Sub-dominants included beech, which accounted for only 10% of the stems, and dogberry *(Ribes cynosbati)*, white ash *(Fraxinus americana)* and choke cherry *(Prunus virginiana)*, each of which contributed 6% of the stems. Species richness, stem density and species diversity (H') was only slightly below the average for the 43 islands (Table 3).

Sugar maple also dominated the groundlayer comprising 70% of the stems and occurred in 95% of the plots (Table 06 **D**). White ash was sub-dominant contributing only 10% of the stems. Most important, 60% of the species were woody, possibly indicating that the herbaceous species had been eliminated by grazing. Species richness and species diversity (H') were well below the average (Table 2). Species diversity was the second lowest of the 31 stands sampled (Table 3). No rare or endangered species were encountered.

Table 06**A**. Stand attributes for Buckskin Bowman (Site 06)
Sample size: 20 plots (10 x 12.5m) Sample Date: September 20, 1975

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	228	95	18.36	64.04	55.88	67.43	62.45
Fagus grandifolia	100	55	6.01	28.09	32.35	22.09	27.51
Fraxinus americana	20	15	2.30	5.62	8.82	8.46	7.63
Tilia americana	8	5	.55	2.25	2.94	2.02	2.40
Totals	356[a]		27.22[b]	100.00	99.99	100.00	99.99

a = 144 trees/acre
b = 118.64 ft^2/acre

Quercus borealis - 1 observed
Prunus serotina - 1 observed
Quercus alba - 1 observed

Table 06**B**. Size class distribution for Buckskin Bowman
Sample size: 0.25 ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Acer saccharum		5	7	10	4	10	9	5	7	3	1				1				62
Fagus grandifolia	6	1	1	6	9	5	2			1					1				32
Fraxinus americana							1	2	2										5
Tilia americana			1						1										2
Totals	6	6	9	16	13	15	11	7	10	4	1				2				

Table 06C. Shrub composition for Buckskin Bowman Woods Sampled 9/20/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	10160.	100.00	62.79	22.99	42.89
Fagus grandifolia	1580.	50.00	9.77	11.49	10.63
Ribes cynosbati	960.	60.00	5.93	13.79	9.86
Fraxinus americana	1020.	55.00	6.30	12.64	9.47
Prunus serotina	820.	55.00	5.07	12.64	8.86
Prunus virginiana	920.	40.00	5.69	9.20	7.44
Sambucus pubens	280.	10.00	1.73	2.30	2.01
Cornus alternifolia	120.	10.00	.74	2.30	1.52
Ulmus rubra	100.	10.00	.62	2.30	1.46
Ostrya virginiana	40.	10.00	.25	2.30	1.27
Zanthoxylum americanum	40.	5.00	.25	1.15	.70
Rubus occidentalis	40.	5.00	.25	1.15	.70
Crataegus punctata	20.	5.00	.12	1.15	.64
Amelanchier sp.	20.	5.00	.12	1.15	.64
Viburnum lentago	20.	5.00	.12	1.15	.64
Tilia americana	20.	5.00	.12	1.15	.64
Ribes americanum	20.	5.00	.12	1.15	.64
Total	16180.		100.00	100.00	100.00

Table 06D. Groundlayer for Buckskin Bowmen sampled 9/20/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	79750.	95.00	69.80	42.22	56.01
Fraxinus americana	11500.	35.00	10.07	15.56	12.81
Circaea quadrisulcata	6250.	15.00	5.47	6.67	6.07
Arisaema triphyllum	1500.	15.00	1.31	6.67	3.99
Prunus virginiana	1250.	10.00	1.09	4.44	2.77
Cornus alternifolia	2750.	5.00	2.41	2.22	2.31
Prunus serotina	1000.	7.50	.88	3.33	2.10
Parthenocissus quinquefolia	2250.	5.00	1.97	2.22	2.10
Ribes cynosbati	1750.	5.00	1.53	2.22	1.88
Fagus grandifolia	1000.	5.00	.88	2.22	1.55
Actea alba	500.	5.00	.44	2.22	1.33
Carex sp.	1500.	2.50	1.31	1.11	1.21
Aster cordifolius	500.	2.50	.44	1.11	.77
Carex albursina	500.	2.50	.44	1.11	.77
Lonicera bella	500.	2.50	.44	1.11	.77
Sambucus canadensis	500.	2.50	.44	1.11	.77
Tilia americana	500.	2.50	.44	1.11	.77
Allium tricoccum	250.	2.50	.22	1.11	.66
Sanguinaria canadensis	250.	2.50	.22	1.11	.66
Solanum dulcamara	250.	2.50	.22	1.11	.66
Total	114250.		100.00	100.00	100.00

Woodview School Woods

Site: 07
Size: 2.43ha
Ozaukee County

Cedarburg Quadrangle
W½, E½, NW¼, Sec 13, T10N, R21E
Grafton Public Schools

The forest island of Woodview School was located on an isolated outlier of kettle and kame topogrphy. Maximum relief within the island exceeded 15m. The majority of the forest was developed on Hochheim loam (Typic Argiudoll) formed on 6 to 12 percent slopes. Much of the soil surface layer had been eroded severely. The island was bounded on the east by an abandoned gravel pit, on the south by an elementary school and on the west by a highway. The north edge was in cropland.

The history of the stand was provided by Alfred Propp whose family had owned the site for three generations. The island was purchased in 1850 from the federal government and logged. The site was purchased by Propp's grandfather in 1854 who used it as pasture. In the spring of 1900, Propp's father replanted native trees and fenced the site. Except for maintenance cutting, no logging or grazing has occurred since. Examination of 1937 ASCS air photos indicated the presence of a relatively mature forest remnant of about 0.5ha near the southeast corner of the site.

The canopy and understory strata were sampled using twenty 10 x 12.5m plots. Basswood *(Tilia americana)* was the leading dominant accounting for 60% of the stems and 62% of the basal area (Table 07 **A**). The island had the highest species richness of the 43 islands sampled. Catalpa *(Catalpa speciosa)* and black locust *(Robinia pseudoacacia)* were present as was yellow birch *(Betula lutea)*. Stem density and basal area per hectare were significantly higher than the average (Table 2). As expected, species diversity (H') for the canopy and understory strata was somewhat above average, but reduced by the relatively low equitability (J') component; 50% of all stems recorded were basswood (Table 3). Cattalpa, black locust, eastern red cedar *(Juniperus virginiana)* and arbor vitae *(Thuja occidentalis)* were present but not reproducing. These species appeared to be unsuccessful in competition with the developing mesic forest. Only silver maple *(Acer saccharinum)* which was planted along the south side of the stand, was vigorous and established in the canopy layer.

The shrub layer was similar in composition to that of the native regional forests. Choke cherry *(Prunus virginiana)* was the dominant species, being evenly distributed and accounting for 47% of the stems (Table 07 **C**). Box elder *(Acer negundo)* and honeysuckle *(Lonicera bella)* were the only two species atypical of the shrub layer. The most surprising finding was the low contribution of black cherry *(Prunus serotina)* and sugar maple *(Acer saccharum)*. In a highly disturbed area, black cherry would have been expected to be very numerous (Auclair and Cottam, 1971). The low contribution of sugar maple is probably attributable to disturbance. This island provides evidence for stand recovery and presents opportunities to examine seed dispersal. Species richness and species diversity (H') were lower than the average for the 43 islands sampled (Table 3). Stem density per hectare was somewhat greater than average (Table 2).

The groundlayer was not sampled for the summer or the spring flora. No rare or endangered species were encountered.

Table 07 **A**. Stand attributes for Woodview School Woods (Site 07)
Sample size: 20 plots (10 x 12.5m) Sample Date: October 3, 1975

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Tilia americana	348	80	21.00	60.42	32.65	62.42	51.83
Acer saccharinum	64	20	6.15	11.11	8.16	18.28	12.52
Prunus serotina	48	25	2.00	8.33	10.20	5.93	8.15
Fraxinus americana	28	25	.85	4.86	10.20	2.53	5.86
Fagus grandifolia	24	15	.72	4.17	6.12	2.15	4.15
Catalpa speciosa	12	15	.80	2.08	6.12	2.36	3.52
Crataegus succulenta	12	15	.17	2.08	6.12	.50	2.90
Acer rubrum	8	10	.44	1.39	4.08	1.31	2.26
Ostrya virginiana	8	10	.28	1.39	4.08	.83	2.10
Acer negundo	8	10	.12	1.39	4.08	.36	1.94
Betula lutea	4	5	.52	.69	2.04	1.55	1.43
Quercus macrocarpa	4	5	.40	.69	2.04	1.18	1.30
Populus tremuloides	4	5	.16	.69	2.04	.49	1.07
Acer saccharum	4	5	.04	.69	2.04	.11	.95
Totals	576[a]		33.65[b]	99.98	99.97	100.00	99.98

a = 233 trees/acre
b = 146.64 ft^2/acre

Table 07**B**. Size class distribution for Woodview School
Sample size: 0.25ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Tilia americana	6	11	12	10	14	26	12	8	3			2							104
Acer saccharinum				1	1	2	3	5	2	2									16
Catalpa speciosa				2					1										3
Betula lutea									1										1
Quercus macrocarpa								1											1
Fagus grandifolia	2	2	2	3			1												10
Fraxinus americana	11	3	3	1	2	1													21
Prunus serotina	1			5	2	5													13
Ostrya virginiana	3	2	1			1													7
Acer rubrum					1	1													2
Populus tremuloides					1														1
Acer negundo	4	2	1	1															8
Acer saccharum	2	5	1																8
Crataegus succulenta		2	3																5
Ulmus rubra	2	1																	3
Crataegus punctata		2																	2
Prunus virginiana	4																		4
Totals	35	30	23	23	21	36	16	14	7	2		2							

Table 07**C**. Shrub composition for Woodview School sampled 10/3/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	10240.	100.00	46.76	18.69	32.72
Ribes americanum	5300.	80.00	24.20	14.95	19.58
Lonicera zbella	2520.	70.00	11.51	13.08	12.30
Fraxinus americana	1700.	70.00	7.76	13.08	10.42
Vitis riparia	560.	50.00	2.56	9.35	5.95
Tilia americana	280.	40.00	1.28	7.48	4.38
Acer negundo	240.	35.00	1.10	6.54	3.82
Rubus occidentalis	700.	15.00	3.20	2.80	3.00
Sambucus canadensis	120.	25.00	.55	4.67	2.61
Parthenocissus quinquefolia	80.	15.00	.37	2.80	1.58
Viburnum lentago	80.	15.00	.37	2.80	1.58
Rhamnus cathartica	20.	5.00	.09	.93	.51
Prunus serotina	20.	5.00	.09	.93	.51
Ribes cynosbati	20.	5.00	.09	.93	.51
Acer saccharum	20.	5.00	.09	.93	.51
Total	21900.		100.00	100.00	100.00

Grafton High School

Site 08
Size: 1.54ha
Ozaukee County

Cedarburg Quadrangle
W½, NE¼, NW¼, Sec 19 T10N, R22E
Grafton Public Schools

The stand at Grafton High School was the only island sampled that was east of the Milwaukee River on the Valders end moraine. This woods was located at the crest of a broad upland which sloped to the north and west. The level upland portion of the forest was developed on Kewaunee silt loam soil (Typic Hapludalf). The soil is well drained and typical of ridge crests. The soil formed in a reddish silty clay material, originally a lake-laid deposit, later redeposited by glacial action (USDA, 1970). The slopes of the island were an eroded Kewaunee silty clay loam, more typical of drainageways. The north and east boundaries were in cropland. The south and west boundaries were maintained in grassy lawn and athletic fields.

The early land-use history of the site is unknown. Mr. Ted Bielein, a previous owner said the stand had not been logged since at least 1930. Only dead trees have been removed since that date, however cattle had been allowed to graze in the woods until about 1956. Since that time, there has been little disturbance except for leisure and nature study use by the high school students. Examination of the 1937 ASCS air photos indicated heavy disturbance along the length of the west edge. Large, single trees existed through the southern third of the site, reflecting the grazing.

The canopy and understory strata were sampled using sixteen 10 x 12.5m plots. Red maple *(Acer rubrum)* red oak *(Quercus borealis)*, and sugar maple

(Acer saccharum) were co-dominant in the canopy contributing a combined 58% of the stems and 59% of the basal area (Table 08 **A**). The maples contributed 45% of the stems, but were restricted to the smaller size classes, less than 40cm (15.7in) dbh (Table 08 **B**). Red oak however, only contributed 13% of the stems but comprised 29% of the basal area. The presence of paper birch *(Betula papyrifera)* suggested the influence of the climatic tension zone in eastern Ozaukee County. Sixty-one percent of the stems recorded in the understory (stems 2.5-10.1cm dbh) were white ash*(Fraxinus americana)*. Stem density and basal area were above the average for the 43 islands (Table 2). Species richness and species diversity (H') were near the average (Table 3).

As in the understory, white ash also dominated the shrub layer. Ash was present in every plot comprising 51% of the stems (Table 08 **C**). Choke cherry *(Prunus virginiana)* was sub-dominant, making up an additional 24% of the stems. Despite the disturbance history, honeysuckle *(Lonicera bella)* was the only disturbance species present. The relatively dense growth of young maples in the canopy created a dark interior. As a result, a significantly lower than average species richness and stem density for the shrub layer (Table 2). Species diversity (H') was only slightly below the average for the 43 islands sampled (Table 3).

The groundlayer was not sampled for the summer flora. No rare or endangered species were observed.

Table 08A. Stand attributes for Grafton High School (Site 08)
Sample size: 16 plots (10 x 12.5m) Sample Date: October 3, 1975

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer rubrum	105	75	4.91	23.60	21.05	15.18	19.94
Quercus borealis	60	56	9.41	13.48	15.79	29.09	19.45
Acer saccharum	95	63	4.86	21.35	17.54	15.02	17.97
Quercus alba	30	38	5.94	6.74	10.53	18.35	11.87
Fagus grandifolia	65	38	2.03	14.61	10.53	6.26	10.47
Fraxinus americana	25	25	2.88	5.62	7.02	8.90	7.18
Betula papyrifera	20	19	1.03	4.49	5.26	3.19	4.31
Tilia americana	20	19	.50	4.49	5.26	1.55	3.77
Ostrya virginiana	15	13	.38	3.37	3.51	1.16	2.68
Carya ovata	10	13	.42	2.25	3.51	1.29	2.35
Totals	445[a]		32.36[b]	100.00	100.00	99.99	99.99

a = 180 trees/acre
b = 140.97 ft^2/acre

Table 08**B**. Size class distribution for Grafton High School
Sample size: 0.2ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Fraxinus americana	68	7	2					1		1		1							80
Quercus borealis	1			1				4	3		2	1	1						23
Quercus alba							1			2	2	1							6
Acer rubrum	5	3	4	4	4	5	1	3											29
Acer saccharum	6		1	4	6	2	5	1											25
Fagus grandifolia	2	1	4	2	5	1	1												16
Carya ovata	1		1			1													3
Betula lutea					2	2													4
Tilia americana	11	5	2		2														20
Ostrya virginiana	7	4		3															14
Prunus virginiana	1																		1
Totals	102	20	14	14	19	11	8	9	3	3	4	3	1						

Table 08**C**. Shrub composition for Grafton High School sampled 10/3/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	6975.	100.00	50.91	25.81	38.36
Prunus virginiana	3225.	75.00	23.54	19.35	21.45
Lonicera bella	1200.	68.75	8.76	17.74	13.25
Tilia americana	1025.	31.25	7.48	8.06	7.77
Acer saccharum	350.	43.75	2.55	11.29	6.92
Ribes americana	575.	18.75	4.20	4.84	4.52
Fagus grandifolia	100.	12.50	.73	3.23	1.98
Prunus serotina	100.	6.25	.73	1.61	1.17
Vitis riparia	50.	6.25	.36	1.61	.99
Viburnum lentago	25.	6.25	.18	1.61	.90
Rhamnus catharticus	25.	6.25	.18	1.61	.90
Rubus occidentalis	25.	6.25	.18	1.61	.90
Acer rubrum	25.	6.25	.18	1.61	.90
Total	13700.		100.00	100.00	100.00

R & R Excavating

Site 09
Size: 1.62ha
Ozaukee County

Cedarburg Quadrangle
W½, SE¼, NE¼, Sec 22, T10N, R21E
Private Ownership

The forest island was located at the crest of a broad, morainic upland of Cary age. Topographic relief within the stand was negligible. The forest was developed on Hochheim loam soil (Typic Argiudoll), a well-drained soil, formed in calcareous, loamy glacial till (USDA, 1970). The soil is typical of glacial ridges. The eastern half of the island was bounded by cultivated cropland and the western half by an active gravel quarry.

Little is known of the land-use history. Examination of 1937 ASCA air photos indicated the stand then covered 3.7ha. The west edge, a quarter-section line, was a fencerow with large-crowned trees. The major portion of the woods was composed of smaller-crowned trees with a tightly closed canopy of a second-growth forest. Size class distribution of canopy species corroborates the second growth nature of the stand (Table 09 **B**). Few stems exceeded the 55cm (21.6in) dbh size class except for the relatively few fast-growing basswood *(Tilia americana)* and white ash *(Fraxinus americana)*. Except for reduction size of the forest island, it appears there had been little disturbance in the past 40 years until recently, when the south edge of the island was removed, increasing light penetration far into the stand. A severe ice storm in the spring of 1976 devastated the canopy and will probably trigger rapid structural changes in the stand.

A full-census of the 1.62ha island was made to record the canopy and understory strata. Sugar maple *(Acer saccharum)* was the leading dominant accounting for 61% of the stems and 56% of the basal area (Table 09 **A**). Basswood was the sub-dominant, but added an additional 24% of the stems and 32% of the basal area. The stem density and basal area per hectare were significantly less than the average for the 43 forest islands (Table 2). The understory was totally dominated by sugar maple which accounted for 79% of the stems measuring 2.5-10.1cm dbh (Table 09 **B**). Species richness was near the average for the 43 islands, but species diversity (H') was well below the average (Table 3). The low species diversity is attributable to the large number of sugar maple stems creating a low equitability (J') component.

The shrub strata was dominated by sugar maple and choke cherry *(Prunus virginiana)* which, combined, contributed 84% of the stems recorded and 66% of the importance value (Table 09 **C**). Both species had an even distribution throughout the island, occuring in 95% of and 100% of the plots respectively. Species richness and stem density were near the average for the 43 islands sampled (Table 2). Species diversity (H') was somewhat below the average, again attributable to a relatively low equitability (J') component.

The groundlayer was co-dominated by basswood *(Tilia americana)* and sugar maple seedlings, which combined to contribute 63% of the stems and 54% of the importance value (Table 09 **D**). They were also the only two species of the 27 recorded in the groundlayer to occur in 50% or more of the plots. At least 25% of the species could be classified as successional, reflecting the removal of the south edge of the island. Species diversity (H') was the third lowest of the 31 islands sampled. No rare or endangered species were encountered.

Table 09 **A**. Stand attributes for R & R Excavating (Site 09)
Full Tally (1.62 ha) Sample Date: July 21, 1975

Species	Density	Basal Area (m^2/ha)	Relative Density	Relative Dominance	Importance Value
Acer saccharum	162	11.94	61.07	55.59	58.33
Tilia americana	64	6.95	24.24	32.35	28.30
Fraxinus americana	10	1.19	3.96	5.53	4.75
Fagus grandifolia	12	.66	4.43	3.08	3.76
Ulmus rubra	8	.16	5.03	.76	1.90
Prunus serotina	3	.11	1.17	.47	.82
Ulmus americana	2	.08	.70	.33	.52
Quercus borealis	1	.20	.23	.92	.58
Quercus alba	1	.12	.47	.52	.50
Fraxinus pennsylvanica	1	.09	.47	.41	.44
Ostrya virginiana	1	.01	.23	.05	.14
Totals	265[a]	21.51[b]	100.00	100.01	100.00

a = 107 trees/acre
b = 93.61 ft^2/acre

Table 09**B**. Size class distribution for R & R Excavating
Sample size: 1.62ha.

Species	SIZE CLASS (centimeters)																		Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Tilia americana		11	13	9	9	11	10	15	13	9	6	6	2		1				115
Acer saccharum	184	191	53	28	33	33	38	29	18	19	9	1	1						637
Fraxinus americana	34	31	3	3	1	1		1	3		3	1	1						82
Quercus borealis													1						1
Fagus grandifolia		2		4	5	5	3	2											21
Quercus alba							1	1											2
Fraxinus pennsylvanica						1	1												2
Ulmus americana		2	2					1											5
Prunus serotina		1	2	1	1		1												6
Ulmus rubra	4	9	6	3	4														26
Ostrya virginiana	2			1															3
Prunus virginiana		1																	1
Cornus alternifolia		1																	1
Amelanchier laevis	1																		1
Totals	225	249	79	49	53	51	55	48	34	28	18	8	5		1				

Table 09**C**. Shrub composition for R and R Excavating sampled 7/21/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	8460.	95.00	45.19	23.75	34.47
Prunus virginiana	7180.	100.00	38.35	25.00	31.68
Ribes cynosbati	800.	40.00	4.27	10.00	7.14
Fraxinus americana	340.	40.00	1.82	10.00	5.91
Carya cordiformis	160.	30.00	.85	7.50	4.18
Solanum dulcamara	600.	20.00	3.21	5.00	4.10
Ribes americanum	640.	10.00	3.42	2.50	2.96
Ulmus rubra	160.	20.00	.85	5.00	2.93
Prunus serotina	80.	10.00	.43	2.50	1.46
Dirca palustris	40.	10.00	.21	2.50	1.36
Viburnum lentago	40.	10.00	.21	2.50	1.36
Tilia americana	140.	5.00	.75	1.25	1.00
Fagus grandifolia	60.	5.00	.32	1.25	.79
Viburnum acerifolium	20.	5.00	.11	1.25	.68
Total	18720.		100.00	100.00	100.00

Table 09**D**. Groundlayer for R and R Excavating sampled 7/30/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Tilia americana	72250.	65.00	34.28	24.07	29.18
Acer saccharum	60000.	55.00	28.47	20.37	24.42
Circaea quadrisulcata	43500.	20.00	20.64	7.41	14.02
Fraxinus americana	6250.	32.50	2.97	12.04	7.50
Arisaema triphyllum	12250.	7.50	5.81	2.78	4.30
Parthenocissus quinquefolia	5000.	10.00	2.37	3.70	3.04
Smilacina racemosa	1750.	7.50	.83	2.78	1.80
Geum canadense	750.	7.50	.36	2.78	1.57
Maianthemum canadense	750.	7.50	.36	2.78	1.57
Ulmus rubra	750.	7.50	.36	2.78	1.57
Ribes cynosbati	1750.	5.00	.83	1.85	1.34
Solanum dulcamara	1250.	5.00	.59	1.85	1.22
Actea alba	750.	5.00	.36	1.85	1.10
Impatiens pallida	500.	2.50	.24	.93	.58
Allium tricoccum	250.	2.50	.12	.93	.52
Carex sp.	250.	2.50	.12	.93	.52
Cornus racemosa	250.	2.50	.12	.93	.52
Epilobium adenocaulon	250.	2.50	.12	.93	.52
Fagus grandifolia	250.	2.50	.12	.93	.52
Potentilla simplex	250.	2.50	.12	.93	.52

Table 09 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Quercus alba	250.	2.50	.12	.93	.52
Aster lateriflorus	250.	2.50	.12	.93	.52
Sonchus sp.	250.	2.50	.12	.93	.52
Trillium grandiflorum	250.	2.50	.12	.93	.52
Laportea canadensis	250.	2.50	.12	.93	.52
Viburnum lentago	250.	2.50	.12	.93	.52
Vitis sp.	250.	2.50	.12	.93	.52
Total	210750.		100.00	100.00	100.00

Cedarburg Woods

Site 10 — Cedarburg Quadrangle
Size: 1.21ha — W¾, NW¼, NW¼, SE¼, Sec 22, T10N, R21E
Ozaukee County — Private Ownership

The Cedarburg Woods exists on the broad upland of a Cary-aged end moraine. The stand is located on a gentle, southwest-facing slope. The forest is developed on Hochheim loam soil (Typic Argiudoll). The soil is classified as well drained and formed in calcareous, loamy glacial till. The island was bounded on the east by a gravel pit. The south boundary adjoins residential land areas, but the west and north edges are bounded by agricultural cropland. Fencerows extend from the northwest and southeast corners.

The island has experienced heavy and continuous disturbance for many years. Examination of 1937 ASCS air photos indicated an island of nearly 3.25ha. The canopy was irregular with a few large trees widely dispersed within a young, second growth stand. Approximately 1.6ha along the length of the east side appeared to have been clear cut within the past few years. Logging for timber and firewood continued until about 1956 (Kohlway, pers. comm.). There was no history of grazing on the tract. About this time, the sand and gravel operation began in the vicinity. Through a series of cuttings, the stand reached its present size. Groundwater from the gravel pit was piped into the eastern portion of the stand, further reducing the size of the upland community.

The canopy and understory strata were sampled using fifteen 10 x 12.5m plots. American beech *(Fagus grandifolia)* and sugar maple *(Acer saccharum)* dominated the canopy and, combined accounted for 62% of the stems and 75% of the basal area (Table 10 **A**). Sugar maple and basswood *(Tilia americana)* were the only two species to exceed 40cm (15.7in) dbh, and sugar maple actually reached its highest densities in the size classes between 40-55cm (15.8-21.6in) dbh (Table 10**B**). Stem density was somewhat higher than average.

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The Southern-Mesic Forest of Southeastern Wisconsin: Species Composition and Community Structure

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but the basal area per hectare was more than a standard deviation below the average for the 43 islands (Table 2). The forest structure and size class distribution reflected the history of cutting. Sugar maple and beech saplings accounted for 45% and 26% respectively of the stems 2.5-10.1cm dbh. Species richness and species diversity (H') were near the average for the 43 islands.

Sugar maple and choke cherry *(Prunus virginiana)* dominated the shrub layer accounting for 58% of the stems (Table 10**C**). Combining to contribute an additional 24% of the stems were white ash*(Fraxinus americana)* and American beech. Both of the latter species were evenly distributed throughout the stand. The somewhat higher than average species richness was composed of mesic species rather than the expected species indicators of disturbance. Species diversity (H') was near the average for the 43 islands (Table 3).

No single species dominated the groundlayer (Table 10 **D**). Enchanter's nightshade *(Circaea quadrisulcata)* and woodbine *(Parthenocissus quinquefolia)* had the greatest densities, combined equal to 41%. Both species were of patchy distribution which decreased their combined importance value to 30%. White ash was the most widely distributed species in the groundlayer, but accounted for only 9% of the stems. A total of 44 species were sampled in the groundlayer, the presence of several species was attributable to the heavy disturbance. The species richness and species diversity (H') were somewhat higher than the average for the 31 islands sampled. The rare golden-seal *(Hydrastis canadensis)* was sampled only once but reached locally high densities in other parts of the island. In addition, the yellow lady-slipper (probably *Cypripendium calceolus* L.) was reported present by the owner of the sand and gravel operation (Steiner, pers. comm.).

Table 10A. Stand attributes for Cedarburg Woods (Site 10)
Sample size: 15 plots (10 x 25m) Sample Date: September 8, 1975

Species	Density (ha.)	Frequency	Basal Area (m^2/ha)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Fagus grandifolia	216	100	8.58	45.51	23.81	35.37	34.90
Acer saccharum	80	93	9.67	16.85	22.22	39.83	26.30
Ostrya virginiana	72	47	1.29	15.17	11.11	5.31	10.53
Tilia americana	37	47	2.18	7.87	11.11	8.98	9.32
Prunus serotina	27	40	.85	5.62	9.52	3.49	6.21
Ulmus rubra	16	27	.82	3.37	6.35	3.40	4.30
Fraxinus americana	8	20	.44	1.69	4.76	1.81	2.75
Quercus alba	5	13	.08	1.12	3.17	.34	1.54
Amelanchier laevis	3	7	.09	.56	1.59	.39	.89
Ulmus americana	3	7	.09	.56	1.59	.39	.85
Fraxinus nigra	3	7	.08	.56	1.59	.32	.82
Quercus bicolor	3	7	.07	.56	1.59	.28	.81
Crataegus succulenta	3	7	.03	.56	1.59	.10	.75
Totals	476[a]		24.27[b]	100.00	100.00	100.01	100.00

a = 193 trees/acre
b = 105.75 ft^2/acre

Table 10**B**. Size class distribution for Cedarburg Sand & Gravel
Sample size: 0.38ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Acer saccharum	26	27	3	2	2	2	2	2	7	5	4	1							83
Tilia americana	2	3	3	2	3	1	2	2			1								19
Fagus grandifolia	12	19	17	18	25	10	7	4											112
Ulmus rubra	4	2		2	1	1	2												12
Fraxinus americana	3		1				2												6
Prunus serotina	1	1	1	3	6														12
Ostrya virginiana	4	8	15	11	1														39
Ulmus americana					1														1
Amelanchier laevis					1														1
Quercus alba			1	1															2
Quercus bicolor				1															1
Fraxinus nigra				1															1
Crataegus succulenta		3	1																4
Acer rubrum		2																	2
Hamamelis virginiana	1																		1
Carpinus caroliniana	1																		1
Totals	54	65	42	41	40	14	15	8	7	5	5	1							

Table 10**C**. Shrub composition for Cedarburg Sand and Gravel Sampled 9/8/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	4426.	100.00	29.07	17.65	23.36
Prunus virginiana	4372.	66.67	28.72	11.76	20.24
Fraxinus americana	2479.	86.67	16.29	15.29	15.79
Fagus grandifolia	1173.	80.00	7.71	14.12	10.91
Ribes americanum	666.	26.67	4.38	4.71	4.54
Tilia americana	133.	33.33	.88	5.88	3.38
Cornus racemosa	746.	6.67	4.90	1.18	3.04
Ribes cynosbati	267.	20.00	1.75	3.53	2.64
Hamamelis virginiana	160.	20.00	1.05	3.53	2.29
Vitis riparia	133.	20.00	.88	3.53	2.20
Prunus serotina	187.	13.33	1.23	2.35	1.79
Ulmus rubra	133.	13.33	.88	2.35	1.61
Ostrya virginiana	80.	13.33	.53	2.35	1.44
Viburnum lentago	53.	13.33	.35	2.35	1.35
Sambucus canadensis	27.	6.67	.18	1.18	.68
Parthenocissus quinquefolia	27.	6.67	.18	1.18	.68
Zanthoxylum americanum	27.	6.67	.18	1.18	.68
Carpinus caroliniana	27.	6.67	.18	1.18	.68
Dirca palustris	27.	6.67	.18	1.18	.68
Acer rubrum	27.	6.67	.18	1.18	.68
Carya cordiformis	27.	6.67	.18	1.18	.68
Viburnum acerifolium	27.	6.67	.18	1.18	.68
Total	15223.		100.00	100.00	100.00

Table 10**D**. Groundlayer for Cedarburg Sand and Gravel Sampled 9/8/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Circaea quadrisulcata	60999.	40.00	23.16	8.63	15.90
Parthenocissus quinquefolia	47333.	46.67	17.97	10.07	14.02
Fraxinus americana	24333.	73.33	9.24	15.83	12.53
Prunus virginiana	21000.	26.67	7.97	5.76	6.87
Geranium maculatum	19666.	23.33	7.47	5.04	6.25
Hydrophyllum virginianum	6333.	20.00	2.41	4.32	3.36
Podophyllum peltatum	10333.	10.00	3.92	2.16	3.04
Ulmus rubra	2333.	23.33	.89	5.04	2.96
Geum canadense	4333.	16.67	1.65	3.60	2.62
Cornus stolonifera	8667.	6.67	3.29	1.44	2.36
Tilia americana	2333.	16.67	.89	3.60	2.24
Smilacina racemosa	5000.	10.00	1.90	2.16	2.03
Aster lateriflorus	4667.	10.00	1.77	2.16	1.97

Table 10**D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Carex sp.	6667.	3.33	2.53	.72	1.63
Aster macrophyllus	4000.	6.67	1.52	1.44	1.48
Actea rubra	1667.	10.00	.63	2.16	1.40
Vitis sp.	1333.	10.00	.51	2.16	1.33
Athyrium filix-femina	4333.	3.33	1.65	.72	1.18
Carex blanda	4000.	3.33	1.52	.72	1.12
Prunus serotina	2000.	6.67	.76	1.44	1.10
Pyrola eliptica	3667.	3.33	1.39	.72	1.06
Maianthemum canadense	1333.	6.67	.51	1.44	.97
Viburnum acerifolium	1333.	6.67	.51	1.44	.97
Rhus radicans	1000.	6.67	.38	1.44	.91
Trillium grandiflorum	1000.	6.67	.38	1.44	.91
Acer rubrum	667.	6.67	.25	1.44	.85
Xanthium strumarium	2000.	3.33	.76	.72	.74
Ribes americanum	1667.	3.33	.63	.72	.68
Cryptotaenia canadensis	1000.	3.33	.38	.72	.55
Desmodium nudiflorum	1000.	3.33	.38	.72	.55
Ribes cynosbati	1000.	3.33	.38	.72	.55
Smilax herbacea	1000.	3.33	.38	.72	.55
Actea alba	667.	3.33	.25	.72	.49
Heracleum lanatum	667.	3.33	.25	.72	.49
Viburnum opulus	667.	3.33	.25	.72	.49
Viola cucullata	667.	3.33	.25	.72	.49
Acer nigrum	333.	3.33	.13	.72	.42
Fagus grandifolia	333.	3.33	.13	.72	.42
Hepatica acutiloba	333.	3.33	.13	.72	.42
Ostrya virginiana	333.	3.33	.13	.72	.42
Oxalis europaea	333.	3.33	.13	.72	.42
Smilax ecirrhata	333.	3.33	.13	.72	.42
Viola eriocarpa	333.	3.33	.13	.72	.42
Hydrastis canadensis	333.	3.33	.13	.72	.42
Total	263331.		100.00	100.00	100.00

Grafton Bank Woods

Site 11
Size: 0.57ha
Ozaukee County

Cedarburg Quadrangle
S½, SW¼, SW¼, SW¼, Sec 24, T10N, R21E
Private Ownership

The stand covers the crest and east and west-facing slopes of a kame-like glacial feature of Cary age. Topographic relief within the stand approaches 10m. The soil is eroded Hochheim loam soil (Typic Argiudoll), character-

ized as well drained since it is formed directly in calcareous, loamy glacial till. The site is bounded on the west by a roadway, and on the south by an asphalt parking lot. The north and east sides are bounded by old field communities. A fencerow extends from the northeast corner.

The land-use history of the island is unknown. Examination of 1937 ASCS air photos indicated the island was approximately 2.0ha in size. The canopy appeared tightly closed with small crowns; indicating a young, second-growth stand. Trees on the east side appeared larger, possibly reflecting moisture differences between east and west facing slopes. Size class distributions of canopy tree speices indicate few stems larger than 45cm (17.7in) dbh (Table 11 **B**). This may reflect heavy cutting, probably after the turn of the century. The stand has been reduced in size several times over the past decade with the installation of streets, utility right-of-way and parking lots. The stand is under heavy human pressure from a large apartment complex across the street. Numerous paths and holes have nearly eliminated the groundlayer. Saplings have been removed by local residents to landscape their property. A devastating ice storm in the spring of 1976 destroyed much of the canopy on the east-facing slope.

A full census of the canopy and understory strata was made of the 0.57ha island. Eight species were encountered in the canopy stratum. Basswood *(Tilia americana)* totally dominated the canopy accounting for 69% of the stems and 78% of the basal area (Table 11**A**). Sugar maple*(Acer saccharum)* and white ash were sub-dominants, each comprising an additional 14% of the density; together they account for 19% of the basal area. Both species were represented in the smaller size classes (Table 11 **B**). However, sugar maple represented 62% of the density in the size classes between 2.5-10.1cm dbh and ash only represented 2%. Although black cherry *(Prunus serotina)* was not recorded in the canopy, 17% of the stems in the understory layer were black cherry, illustrating the dispersal potential of that species. Stem density was below average, but basal area per hectare was nearly two standard deviations below the average of the 43 islands (Table 2). Similarly, species diversity (H') for the canopy and understory strata was also below average due to the relatively low equitability (J') component induced by the high densities of basswood and sugar maple (Table 3).

The shrub stratum was dominated by choke cherry *(Prunus virginiana)* which accounted for nearly half of the stems (Table 11 **C**). Sugar maple saplings comprised an additional 23% of the stems and both species enjoyed an even distribution in the stand. Black cherry was less successful and was present in only half the plots, making up only 3% of the stems. At least six of the 16 species recorded in the shrub stratum could be considered as disturbance indicators for the southern-mesic forest. Only one, box elder *(Acer negundo)* had wind-dispersed seeds; the remainder were bird- or animal-dispersed. Species richness, stem density and species diversity (H') were near the average for the 43 islands.

No single species dominated the groundlayer, but choke cherry occurred in 68% of the plots and accounted for 34% of the stems. White ash had about three times the density of sugar maple in the groundlayer and also a wider distribution (Table 11 **D**). A combination of soil erosion and heavy human usage cre-

ated a relatively bare forest floor and low stem density. Many of the species recorded in the groundlayer are more typical of old field communities. Black cherry seedlings were not observed in the groundlayer. Species diversity (H') was only slightly below the average for the 31 forest islands (Table 3). No rare or endangered species were encountered.

Table 11**A**. Stand attributes for Grafton Bank Woods (Site 11)
Full Tally (0.57ha.) Sample Date: August 21, 1975.

Species	Density	Basal Area (m^2/ha)	Relative Density	Relative Dominance	Importance Value
Tilia americana	233	16.75	69.27	77.67	73.47
Acer saccharum	47	2.36	14.06	10.93	12.50
Fraxinus americana	47	1.74	14.06	8.06	11.06
Quercus borealis	2	.30	.52	1.40	.96
Juglans cinerea	2	.18	.52	.85	.69
Quercus alba	2	.17	.52	.79	.66
Fraxinus pennsylvanica	2	.04	.52	.18	.35
Carya cordiformis	2	.02	.52	.11	.32
Totals	337[a]	21.56[b]	99.99	99.99	100.01

a = 136 trees/acre
b = 93.98 ft^2/acre

Table 11 **B**. Size class distribution for Grafton Bank Woods
Sample size: 0.57ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Tilia americana	15	17	8	11	29	27	24	19	10	1	4								165
Quercus borealis										1									1
Acer saccharum	115	32	7	6	2	4	6	1	1										174
Fraxinus americana	3	2	5	6	11	3	1	1											32
Juglans cinerea								1											1
Quercus alba								1											1
Fraxinus pennsylvanica		1		1															2
Carya cordiformis		1	1																2
Prunus serotina	32	8																	40
Crataegus succulenta	2	1																	3
Ostrya virginiana		3																	3
Crataegus punctata		2																	2
Celtis occidentalis	2																		2
Acer negundo	1																		1
Totals	170	67	21	24	42	34	31	23	11	2	4								

Table 11**C**. Shrub composition for Grafton Bank Woods Sampled 8/21/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	7060.	95.00	49.23	20.65	34.94
Acer saccharum	3340.	90.00	23.29	19.57	21.43
Ribes cynosbati	1820.	70.00	12.69	15.22	13.95
Fraxinus americana	740.	55.00	5.16	11.96	8.56
Prunus serotina	500.	50.00	3.49	10.87	7.18
Lonicera bella	460.	25.00	3.21	5.43	4.32
Tilia americana	180.	20.00	1.26	4.35	2.80
Viburnum lentago	80.	15.00	.56	3.26	1.91
Zanthoxylum americanum	20.	5.00	.14	1.09	.61
Quercus macrocarpa	20.	5.00	.14	1.09	.61
Crataegus succulenta	20.	5.00	.14	1.09	.61
Acer negundo	20.	5.00	.14	1.09	.61
Carya cordiformis	20.	5.00	.14	1.09	.61
Ulmus americana	20.	5.00	.14	1.09	.61
Crataegus punctata	20.	5.00	.14	1.09	.61
Ulmus rubra	20.	5.00	.14	1.09	.61
Total	14340.		100.00	100.00	100.00

Table 11**D**. Groundlayer for Grafton Bank sampled 8/21/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	41250.	67.50	33.81	23.89	28.85
Parthenocissus quinquefolia	18250.	27.50	14.96	9.73	12.35
Circaea quadrisulcata	22750.	10.00	18.65	3.54	11.09
Fraxinus americana	6500.	32.50	5.33	11.50	8.42
Smilacina racemosa	5500.	27.50	4.51	9.73	7.12
Ribes cynosbati	7500.	22.50	6.15	7.96	7.06
Viburnum lentago	3750.	12.50	3.07	4.42	3.75
Acer saccharum	2000.	12.50	1.64	4.42	3.03
Podophyllum peltatum	3500.	5.00	2.87	1.77	2.32
Caulophyllum thalictroides	1000.	10.00	.82	3.54	2.18
Tilia americana	1750.	7.50	1.43	2.65	2.04
Maianthemum canadense	1500.	5.00	1.23	1.77	1.50
Aster sp.	1250.	5.00	1.02	1.77	1.40
Geranium maculatum	500.	5.00	.41	1.77	1.09
Geum canadense	500.	5.00	.41	1.77	1.09
Trillium grandiflorum	1250.	2.50	1.02	.88	.95
Actea rubra	500.	2.50	.41	.88	.65
Actea alba	500.	2.50	.41	.88	.65
Oxalis sp.	500.	2.50	.41	.88	.65

Table 11 D continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Cirsium sp.	250.	2.50	.20	.88	.54
Lonicera prolifera	250.	2.50	.20	.88	.54
Lonicera xbella	250.	2.50	.20	.88	.54
Rhamnus catharticus	250.	2.50	.20	.88	.54
Taraxacum officinale	250.	2.50	.20	.88	.54
Viola pubescens	250.	2.50	.20	.88	.54
Vitis sp.	250.	2.50	.20	.88	.54
Total	122000.		100.00	100.00	100.00

Fox Farm Woods

Site 12
Size: 1.98ha
Ozaukee County

Five Corners Quadrangle
S2/3, SW¼, SW¼, NW¼, Sec 34, T10N, R21E
Private Ownership

The Fox Farm Woods is located on a broad upland of a Cary end moraine. The stand occupies a gentle northwest-facing slope with a maximum relief of about 7m. The upper portions of the forest are developed on Theresa silt loam soil (Typic Hapludalf). This soil is well-drained and typically formed on the uplands and side slopes of glacial ridges (USDA, 1970). The remainder of the forest is developed on Hochheim loam soil (Typic Argiudoll), a soil typically well drained and formed in calcareous, loamy glacial till with a very shallow silt cap (USDA, 1970). The island is bounded on the north and south edges by rural residences. The east is bounded by the grassy fields of an old fox farm and the west edge is bounded by a highway. A fenceline extends from the southeast corner of the stand and joins another forest island.

The early land-use history of the island is unknown. Examination of 1937 ASCS air photos indicates the island was then about the same size and shape. Numerous gaps occurred in the canopy and it appeared grazed. A previous owner corroborated the indications of cattle grazing which occurred between approximately 1935 and 1966 (Mrs. Ron Stephenson, pers. comm.). Additional evidence of grazing was provided by numerous giant puffballs *(Calvatia gigantea)*. Size class distribution of the canopy species suggest that the stand was recovering from a heavy cutting with few stems exceeding 45cm (17.7in) dbh (Table 12 **B**). The stand has been under a new ownership since 1967 and has been left undisturbed.

The canopy and understory strata were sampled using fifteen 10 x 12.5m plots. Sugar maple *(Acer saccharum)*, American beech *(Fagus grandifolia)*, and white ash *(Fraxinus americana)* dominated the stand accounting for 84% of the stems and 80% of the basal area (Table 12 **A**). The stand was characterized

as being relatively even-aged second growth. Stem density and basal area per hectare were somewhat less than the average for 43 islands (Table 2). This is particularly evident in the 10.2-25cm (4-9.9in) dbh size classes and attributable to the extended period of grazing (Table 12 **B**). Ironwood *(Ostrya virginiana)* and beech shared dominance in the understory (stems 2.5-10.1cm dbh) accounting for 38% and 34% of the stems, respectively. The relative success of beech saplings was attributed to root sprouts. Species richness and species diversity (H') were average for the 43 islands (Table 3).

The shrub stratum was dominated solely by the hybrid honeysuckle *(Lonicera bella)* which had wide distribution throughout the stand and accounted for 52% of the stems recorded (Table 12 **C**). This domination by a single species requires more investigation, but may bear a relationship to grazing (Stearns, pers. comm.). Choke cherry *(Prunus virginiana)* and American beech were sub-dominants that together contributed an additional 27% of the stems and 28% of the importance value. The species richness and species diversity (H') were both slightly below the average for the 43 islands sampled (Table 3). However, this site had the second lowest shrub density of all islands sampled (Table 2). This condition probably resulted from the extended period of grazing under a completely closed canopy.

The groundlayer was totally domonated by white ash seedlings which occurred in every plot and comprised 70% of the stems (Table 12 **D**). Sugar maple seedlings were also of relatively even distribution, but only accounted for 4% of the stems. The remaining 32 species were of wide distribution and low densities. Species diversity (H') was the lowest of the 31 stands sampled, reflecting the domination by ash with a low equitability (J') component; 70% of the stems were white ash. No rare or endangered species were encountered.

Table 12**A**. Stand attributes for Fox Farm Woods (Site 12)
Sample size: 15 plots (10 x 12.5m) Sample Date: September 7, 1975

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	112	87	11.48	31.11	27.08	40.59	32.93
Fagus grandifolia	117	80	7.34	32.59	25.00	25.93	27.84
Fraxinus americana	72	60	6.26	20.00	18.75	22.12	20.29
Tilia americana	21	27	1.15	5.93	8.33	4.05	6.10
Prunus serotina	16	13	.39	4.44	4.17	1.39	3.33
Juglans cinerea	5	13	1.09	1.48	4.17	3.84	3.16
Ulmus rubra	5	13	.33	1.48	4.17	1.16	2.27
Quercus alba	3	7	.14	.74	2.08	.51	1.11
Pyrus malus	3	7	.06	.74	2.08	.21	1.01
Ostrya virginiana	3	7	.03	.74	2.08	.10	.97
Amelanchier laevis	3	7	.03	.03	2.08	.10	.97
Totals	360[a]		28.30[b]	99.99	99.99	100.00	99.98

a = 146 trees/acre
b = 123.27 ft^2/acre

Table 12 **B**. Size class distribution for Fox Farm Woods
Sample size: 0.19ha.

Species	SIZE CLASS (centimeters)																		Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Juglans cinerea									1			1							2
Acer saccharum	8	10	4	1	1	5	8	8	10	2	3								60
Fraxinus americana		2	1	4	5	4	3	3	3	2	2								29
Fagus grandifolia	19	16	1	5	8	15	10	4		1									79
Tilia americana	1	2	4	1			1		2										11
Ulmus rubra			1					1											2
Quercus alba						1													1
Prunus serotina			2	2	2														6
Pyrus malus				1															1
Ostrya virginiana	28	11	1																40
Amelanchier laevis	1		1																2
Prunus virginiana	1	2																	3
Crataegus punctata		1																	1
Carya cordiformis	1																		1
Hamamelis virginiana	1																		1
Totals	60	44	15	14	16	25	22	16	16	5	5	1							

Table 12**C**. Shrub composition for Fox Farm Woods sampled 9/7/75

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Lonicera xbella	4639.	100.00	51.63	27.78	39.70
Prunus virginiana	1386.	60.00	15.43	16.67	16.05
Fagus grandifolia	1013.	46.67	11.28	12.96	12.12
Ribes cynosbati	587.	40.00	6.53	11.11	8.82
Acer saccharum	453.	40.00	5.04	11.11	8.08
Fraxinus americana	453.	26.67	5.04	7.41	6.23
Rubus occidentalis	240.	13.33	2.67	3.70	3.19
Amelanchier sp.	107.	6.67	1.19	1.85	1.52
Ulmus rubra	27.	6.67	.30	1.85	1.07
Ostrya virginiana	27.	6.67	.30	1.85	1.07
Solanum dulcamara	27.	6.67	.30	1.85	1.07
Cornus stolonifera	27.	6.67	.30	1.85	1.07
Total	8984.		100.00	100.00	100.00

Table 12**D** Groundlayer for Fox Farm Woods Sampled 9/7/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	395284.	100.00	69.93	24.46	47.19
Acer saccharum	25293.	76.47	4.47	18.71	11.59
Circaea quadrisulcata	65587.	26.47	11.60	6.47	9.04
Smilacina racemosa	20294.	35.29	3.59	8.63	6.11
Lonicera xbella	13529.	26.47	2.39	6.47	4.43
Fagus grandifolia	7059.	17.65	1.25	4.32	2.78
Carex albursina	7941.	8.82	1.40	2.16	1.78
Maianthemum canadense	10882.	5.88	1.93	1.44	1.68
Quercus borealis	1176.	11.76	.21	2.88	1.54
Ulmus rubra	1176.	8.82	.21	2.16	1.18
Carya cordiformis	882.	8.82	.16	2.16	1.16
Sanguinaria canadensis	2941.	5.88	.52	1.44	.98
Podophyllum peltatum	2059.	5.88	.36	1.44	.90
Solanum dulcamara	882.	5.88	.16	1.44	.80
Prunus serotina	588.	5.88	.10	1.44	.77
Tilia americana	588.	5.88	.10	1.44	.77
Potentilla simplex	1765.	2.94	.31	.72	.52
Caulophyllum thalictroides	1176.	2.94	.21	.72	.46
Hepatica acutiloba	1176.	2.94	.21	.72	.46
Geum canadense	588.	2.94	.10	.72	.41
Trillium grandiflorum	588.	2.94	.10	.72	.41
Arisaema triphyllum	294.	2.94	.05	.72	.39
Aster cordifolius	294.	2.94	.05	.72	.39
Cryptotaenia canadensis	294.	2.94	.05	.72	.39
Juglans cinerea	294.	2.94	.05	.72	.39

Table 12 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Osmorhiza claytoni	294.	2.94	.05	.72	.39
Ostrya virginiana	294.	2.94	.05	.72	.39
Prunus virginiana	294.	2.94	.05	.72	.39
Rhamnus catharticus	294.	2.94	.05	.72	.39
Solidago caesia	294.	2.94	.05	.72	.39
Ribes americanum	294.	2.94	.05	.72	.39
Smilax ecirrhata	294.	2.94	.05	.72	.39
Vitis sp.	294.	2.94	.05	.72	.39
Polygonatum pubescens	294.	2.94	.05	.72	.39
Total	565279.		100.00	100.00	100.00

Millers Woods

Site 13
Size: 1.50ha
Ozaukee County

Cedarburg Quadrangle
SW¼, SW¼, NE¼, Sec 35, T10N, R21E
Private Ownership

Millers Woods was located on the first terrace above the floodplain of Cedar Creek. On a moderately steep, northeast facing slope, the topographic relief from crest to bottom was approximately 12m (40ft). The forest was developed on Ritchy silt loam soil (Lithic Hapludalf), a soil formed partly in silt and partly in glacial drift over limestone bedrock less than 50cm (20in) below the surface (USDA, 1970). Rapid runoff and potentially serious erosion problems are the major limitations of the soil. The island was bounded on the east by Cedar Creek and on the north by the Cedarburg municipal sewage treatment plant. The western boundary was successional oil field and the southern edge was lowland forest.

Virtually nothing is known of the land-use history. Examination of ASCS air photos indicates the woods has not changed in size and shape since 1937. Some light disturbance was apparent near the hill crest in the 1937 photography. The canopy was closed with mature crowns. Few of the canopy species exceed 45cm (17.7in) dbh. However, mature red oaks *(Quercus borealis)* were numerous and achieved relatively large size. It appears that the stand was carefully and selectively cut for species other than red oak (Table 13 **B**). The remains of an old wagon trail running diagonally down to the creek are barely evident.

Canopy and understory were sampled using twenty 10 x 12.5m plots. Sugar maple *(Acer saccharum)* was the leading dominant by virtue of a high density of small stems. Sugar maple accounted for 71% of the stems and 46% of the basal area (Table 13 **A**). Red oak was probably the true dominant. Numerous large specimens (40-70cm dbh) represented 40% of the basal area but only 14% of

the density. American beech *(Fagus grandifolia)* was widely spaced in the stand. A few large specimens were present, but were not in the sample. The understory (stems 2.5-10.1cm dbh) was dominated by white ash *(Fraxinus americana)* which accounted for 62% of the stems recorded (Table 13**B**). Ash saplings were evenly distributed throughout the stand. The cool, moist northeast-facing slope harbored some relatively large paper-birch *(Betula papyrifera)*, more typical of the northern-mesic forest. Stem density and basal area per hectare was near the average for the 43 forest islands (Table 2). Species richness and species diversity (H') were below the average for the 43 islands (Table 3).

To a lesser extent, white ash was co-dominant in the shrub layer with choke cherry *(Prunus virginiana)*, together they accounted for 66% of the stems. They were also the only two species to occur in more than 40% of the plots (Table 13 **C**). Species richness was somewhat higher than average for the 43 islands. Species diversity (H') was also somewhat higher than average (Table 3). Stem density was the third lowest of all stands examined. This was partially explained by the low light levels created by the dense canopy and northeast-facing aspect of the slope.

The groundlayer was not sampled. The exotic orchid, helleborine *(Epipactis latifolia)* was present in small numbers. No rare or endangered species were observed.

Table 13**A**. Stand attributes for Miller's Woods (Site 13)
Sample size: 20 plots (10 x 12.5m) Sample Date: October 4, 1975

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	316	100	14.11	70.54	50.00	46.24	55.59
Quercus borealis	64	50	12.20	14.29	25.00	39.98	26.42
Fagus grandifolia	40	25	1.69	8.93	12.50	5.53	8.99
Betula papyrifera	12	10	.95	2.68	5.00	3.12	3.60
Fraxinus americana	4	5	.90	.89	2.50	2.93	2.11
Quercus alba	4	5	.49	.89	2.50	1.62	1.67
Ostrya virginiana	8	5	.18	1.79	2.50	.58	1.62
Totals	448[a]		30.52[b]	100.01	100.00	100.00	100.00

a = 181 trees/acre
b = 133.02 ft^2/acre

Table 13 **B**. Size class distribution for Miller's Woods
Sample size: 0.25ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Quercus borealis	1					1	1		4	3	3	2	1	1					17
Fraxinus americana	114	3									1								118
Acer saccharum	6	10	16	15	16	16	11	4	1										95
Betula papyrifera				1			1		1										3
Quercus alba								1											1
Fagus grandifolia	7	1	1	2	3	4													18
Ostrya virginiana	22	2		2															26
Acer rubrum	3	1																	4
Tilia americana	8																		8
Cornus alternifolia	10																		10
Amelanchier laevis	2																		2
Totals	173	17	17	20	19	21	13	5	6	3	4	2	1	1					

Table 13**C**. Shrub composition for Millers Woods

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	3640.	95.00	38.40	19.59	28.99
Prunus virginiana	2640.	90.00	27.85	18.56	23.20
Lonicera xbella	440.	40.00	4.64	8.25	6.44
Acer saccharum	480.	35.00	5.06	7.22	6.14
Ribes cynosbati	300.	30.00	3.16	6.19	4.68
Vitis riparia	200.	25.00	2.11	5.15	3.63
Lonicera prolifera	400.	10.00	4.22	2.06	3.14
Ribes americanum	300.	15.00	3.16	3.09	3.13
Tilia americana	140.	20.00	1.48	4.12	2.80
Ostrya virginiana	100.	20.00	1.05	4.12	2.59
Fagus grandifolia	100.	20.00	1.05	4.12	2.59
Viburnum lentago	100.	15.00	1.05	3.09	2.07
Cornus racemosa	160.	10.00	1.69	2.06	1.87
Prunus serotina	120.	10.00	1.27	2.06	1.66
Cornus stolonifera	120.	10.00	1.27	2.06	1.66
Cornus alternifolia	80.	10.00	.84	2.06	1.45
Zanthoxylum americanum	40.	5.00	.42	1.03	.73
Acer rubrum	40.	5.00	.42	1.03	.73
Amelanchier sp.	20.	5.00	.21	1.03	.62
Carya cordiformis	20.	5.00	.21	1.03	.62
Crataegus punctata	20.	5.00	.21	1.03	.62
Quercus borealis	20.	5.00	.21	1.03	.62
Total	9480.		100.00	100.00	100.00

Nieman Woods

Site 15
Size: 0.61ha
Ozaukee County

Five Corners Quadrangle
NE¼, NW¼, SE¼, NE¼, Sec 4, T9N, R21E
Private Ownership

Nieman Woods is located on an east-facing slope of a Cary-age end moraine. Maximum topographic relief is about 12m. A wet depression exists at the foot of the slope. The USDA soil survey (1970) indicates the woods is developed on an eroded Ozaukee silt loam soil (Typic Hapludalf), a soil typical of glacial moraines. Because of the slope (6-12%) and a relatively slow permeability of the eroded soil, runoff is rapid. Standing water was observed at the base of the slope during the spring. The north side of the island is bounded by an apple orchard, while croplands lie to the east, south and west. Extensive fencerows emerge from the northeast and northwest corners.

The land-use history is unknown. The 1937 ASCS air photos reveal a tight canopy of small crowns, indicating a vigorous second growth stand.

A full census of canopy and understory substantiates the second growth nature of the stand. No trees larger than 60cm (23.6in) dbh (Table 15**B**) were found. The canopy was totally dominated by basswood *(Tilia americana)*

which accounted for approximately 53% of the density and basal area (Table 15 **A**). The relatively high density of basswood resulted from many basswood clumps near the edges. Clump growth of basswood is probably a result of heavy logging, occurring about the turn of the century.

Sub-dominant species included white ash *(Fraxinus americana)* and red oak *(Quercus borealis)* which together accounted for 25% of the density and 38% of the basal area. Red oak was restricted to size classes greater than 20cm (8in) dbh, indicating little reproductive vigor (Table 15 **B**). White ash reached highest stem density in the 20-35cm dbh size classes. Conversion of the stand to mesic forest appears probable with sugar maple *(Acer saccharum)* and ironwood *(Ostrya virginiana)* comprising 52% and 26% of the stems 2.5-15cm (1.0-5.8in) dbh respectively.

The structural features of the canopy and understory strata included a stem density and basal area slightly greater than average (Table 2). Species richness and species diversity (H') were lower than the average (Table 3).

The shrub layer was dominated by choke cherry *(Prunus virginiana)* which accounted for 51% of the stems and occurred evenly throughout the island (Table 15 **C**). Dogberry *(Ribes cynosbati)* and white ash shared a sub-dominant role with 22% and 16% of the stem density respectively. Only one individual of black cherry *(Prunus serotina)* was sampled in this successional stand. Species richness was below average, but not significantly so when considering the size of the island. Species diversity (H') was also lower than average, a value attributable to 51% of the stems being of one species. A single specimen of black walnut *(Juglans nigra)* was found in the shrub layer. Considering the isolation of the stand and the absence of walnut in the canopy, this occurrence presents an interesting dispersal problem.

The groundlayer was not sampled but no rare or endangered species were observed.

Table 15 **A**. Stand attributes for Nieman Woods (Site 15)
Full Tally (0.61ha). Sample Date: September 6, 1975.

Species	Density	Basal Area (m^2/ha)	Relative Density	Relative Dominance	Importance Value
Tilia americana	260	15.10	53.56	53.07	53.32
Fraxinus americana	84	6.08	17.29	21.37	19.33
Quercus borealis	40	4.75	8.14	16.71	12.43
Acer saccharum	59	1.26	12.20	4.41	8.31
Ostrya virginiana	26	.40	5.42	1.40	3.41
Ulmus rubra	10	.56	2.08	1.97	2.00
Prunus serotina	2	.16	.34	.56	.45
Carya cordiformis	3	.07	.68	.23	46
Quercus alba	2	.08	.34	.27	.31
Totals	486[a]	28.46[b]	100.00	99.99	100.02

a = 197 trees/acre
b = 124.01 ft^2/acre

Table 15**B**. Size class distribution for Nieman Woods
Sample size: 0.61ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Tilia americana	4	16	12	23	35	46	28	8	4										178
Ulmus rubra		3	2	2		1					1								9
Quercus borealis					2	3	1	6	7	4	1								24
Fraxinus americana	1	1	3	5	9	12	10	5	5	1	1								53
Acer saccharum	21	55	23	7	4	1		1											102
Prunus serotina								1											1
Quercus alba					1														1
Ostrya virginiana	6	32	11	4	1														54
Carya cordiformis		1		2															3
Totals	32	108	51	43	52	63	39	21	16	5	3								

Table 15C. Shrub composition for Nieman Woods sampled 9/6/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	5160.	95.00	50.59	25.00	37.79
Ribes cynosbati	2240.	55.00	21.96	14.47	18.22
Fraxinus americana	1640.	75.00	16.08	19.74	17.91
Tilia americana	480.	40.00	4.71	10.53	7.62
Ulmus rubra	280.	40.00	2.75	10.53	6.64
Ostrya virginiana	60.	15.00	.59	3.95	2.27
Menispermum canadense	80.	10.00	.78	2.63	1.71
Acer saccharum	60.	10.00	.59	2.63	1.61
Lonicera xbella	40.	5.00	.39	1.32	.85
Ribes americanum	40.	5.00	.39	1.32	.85
Viburnum lentago	20.	5.00	.20	1.32	.76
Parthenocissus quinquefolia	20.	5.00	.20	1.32	.76
Carya cordiformis	20.	5.00	.20	1.32	.76
Sambucus canadensis	20.	5.00	.20	1.32	.76
Prunus serotina	20.	5.00	.20	1.32	.76
Juglans nigra	20.	5.00	.20	1.32	.76
Total	10200.		100.00	100.00	100.00

Mee Kwon Park

Site 16 — Cedarburg Quadrangle
Size: 7.21ha — SE¼, SW¼, NE¼, Sec 10, T9N, R21E
Ozaukee County — City of Mequon

Mee Kwon Park is located on a northwest-facing slope. Although the substrate is glacial till, an outcrop of Niagara dolomite occurs at the southwest edge of the stand. Nearly 12m of topographic relief exists within the stand. A steep, non-vegetated ravine runs diagonally out of the northwest edge of the island. The forest is developed on Ozaukee silt loam soil (Typic Hapludalf). The soil is typically well-drained and formed over glacial till. The forest is bounded on the north and east by grassy parkland. The south boundary is successional forest and the west boundary a steep (15m) roadcut along State Highway 57.

Much of the land-use history of the island is unknown. The island was owned by the Nieman family for approximately 100 years and was part of their large fox farm empire. The former owner reports that there had been no grazing or logging in the woods within the last 25 years and probably not since at least 1915 (Ed Nieman, pers. comm.). Examination of the 1937 ASCS air photos indicates a section near the center of the island, approximately 2.5ha in size, with a mature canopy. Surrounding this core, the remainder of the island appears to have been selectively logged since numerous small holes occurred in the canopy. Part of the fox farm encroached upon the woods in the

southeast corner and the remnants of a small gravel road, now overgrown, enters the east-central portion of the stand.

The canopy and understory strata were sampled using twenty 10 x 25m plots. Sugar maple *(Acer saccharum)* and American beech *(Fagus grandifolia)* dominated the canopy layer with a combined 74% of the stems, 57% of the basal area and 59% of the importance value (Table 16**A**.) Sugar maple and beech were present in all size classes to 45cm (17.7in) dbh with a conspicuous reduction in density in the larger size classes (Table 16**B**). The low density in the size classes greater than 45cm suggests a period of light cutting. Eighty four percent of the stems 2.5-10.1cm dbh were sugar maple and beech suggesting a trend back to mesic conditions. Stem density 10.2cm dbh was nearly a standard deviation greater than the average for the 43 islands (Table 2). The presence of a single, large hackberry *(Celtis occidentalis)* and a yellow birch *(Betula lutea)* provide excellent opportunities to examine intra-stand seed dispersal. Species richness was average and species diversity (H') for the 43 forest islands was slightly below average (Table 3). The lower species diversity for the canopy and understory strata can be attributed to a relatively low equitability (J') component; 77% of the stems recorded were either sugar maple or beech.

Only 13 species were sampled in the shrub layer, a number significantly below the average. Sugar maple and choke cherry *(Prunus virginiana)* dominated the shrub layer accounting for 81% of the stems sampled (Table 16**C**). As expected with a low species richness and equitability (J') component, species diversity (H') was lower than the average for the 43 forest islands (Table 3).

No single species dominated the groundlayer of Mee Kwon Park (Table 16 **D**). Five species shared 80% of the stems recorded, but only three species occurred in half or more of the plots. Sugar maple, choke cherry, and white ash comprised nearly 40% of the stems of the groundlayer. Species richness and species diversity (H') were near the average for the 31 islands sampled. No rare or endangered species were encountered.

Table 16A. Stand attributes for Mee Kwon Park (Site 16)
Sample size: 20 plots (10 x 25m) Sample Date: August 12, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	180	95	11.46	32.73	22.89	35.81	30.48
Fagus grandifolia	226	100	6.87	41.09	24.10	21.48	28.89
Tilia americana	30	55	3.68	5.45	13.25	11.50	10.07
Prunus serotina	52	50	2.21	9.45	12.05	6.90	9.47
Quercus borealis	20	30	4.72	3.64	7.23	14.76	8.54
Fraxinus americana	18	30	1.00	3.27	7.23	3.12	4.54
Ulmus rubra	6	15	.92	1.09	3.61	2.88	2.53
Ostrya virginiana	6	15	.14	1.09	3.61	.43	1.71
Ulmus americana	4	10	.27	.73	2.41	.84	1.33
Juglans cinerea	4	10	.23	.73	2.41	.72	1.29
Celtis occidentalis	4	5	.50	.73	1.20	1.56	1.16
Totals	550[a]		32.00[b]	100.00	99.99	100.00	100.01

a = 223 trees/acre
b = 139.47 ft^2/acre

Table 16**B**. Size class distribution for Mee Kwon Park
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Acer saccharum	28	31	25	7	13	18	11	7	5		1	1			2				149
Tilia americana	1	3	1		1	3	2	4	1	1	1				1				19
Ulmus rubra	1					1	1						1						4
Quercus borealis								1	1		2	5	1						10
Celtis occidentalis	1		1									1							3
Fagus grandifolia	6	16	35	40	23	10	5		1	1									136
Fraxinus americana	2	1	2	2	1	1	1		2										12
Prunus serotina	1		3	6	10	5	1	1											27
Ulmus americana					1		1												2
Juglans cinerea					1		1												2
Ostrya virginiana	1	3	1	1	1														7
Acer negundo		1																	1
Totals	41	55	68	56	51	38	23	12	10	2	4	7	2		3				

Table 16**C**. Shrub composition for Mee Kwon Park sampled 8/12/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	10360.	90.00	48.37	21.18	34.77
Prunus virginiana	6980.	95.00	32.59	22.35	27.47
Ribes cynosbati	1900.	45.00	8.87	10.59	9.73
Fraxinus americana	640.	50.00	2.99	11.76	7.38
Fagus grandifolia	600.	45.00	2.80	10.59	6.69
Prunus serotina	320.	45.00	1.49	10.59	6.04
Ribes americanum	220.	15.00	1.03	3.53	2.28
Ulmus rubra	40.	10.00	.19	2.35	1.27
Carya cordiformis	40.	10.00	.19	2.35	1.27
Solanum dulcamara	200.	5.00	.93	1.18	1.06
Viburnum opulus	60.	5.00	.28	1.18	.73
Cornus alternifolia	40.	5.00	.19	1.18	.68
Quercus borealis	20.	5.00	.09	1.18	.63
Total	21420.		100.00	100.00	100.00

Table 16**D**. Groundlayer for Mee Kwon Park sampled 8/12/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	35000.	70.00	12.90	18.67	15.78
Prunus virginiana	40750.	52.50	15.02	14.00	14.51
Circaea quadrisulcata	50500.	37.50	18.62	10.00	14.31
Fraxinus americana	29750.	52.50	10.97	14.00	12.48
Carex pensylvanica	60000.	10.00	22.12	2.67	12.39
Smilacina racemosa	5750.	17.50	2.12	4.67	3.39
Trillium grandiflorum	8750.	12.50	3.23	3.33	3.28
Allium tricoccum	3500.	17.50	1.29	4.67	2.98
Arisaema triphyllum	5500.	12.50	2.03	3.33	2.68
Ribes cynosbati	5250.	12.50	1.94	3.33	2.63
Ribes americanum	5250.	10.00	1.94	2.67	2.30
Vitis sp.	2000.	12.50	.74	3.33	2.04
Parthenocissus quinquefolia	8000.	2.50	2.95	.67	1.81
Fagus grandifolia	1000.	7.50	.37	2.00	1.18
Quercus borealis	750.	7.50	.28	2.00	1.14
Podophyllum peltatum	750.	5.00	.28	1.33	.80
Tilia americana	500.	5.00	.18	1.33	.76
Solidago caesia	2000.	2.50	.74	.67	.70
Carex albursina	1750.	2.50	.65	.67	.66
Cornus alternifolia	1000.	2.50	.37	.67	.52
Rhus radicans	750.	2.50	.28	.67	.47
Solanum dulcamara	750.	2.50	.28	.67	.47
Lonicera xbella	500.	2.50	.18	.67	.43

Table 16**D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Actea alba	250.	2.50	.09	.67	.38
Caulophyllum thalictroides	250.	2.50	.09	.67	.38
Geum canadense	250.	2.50	.09	.67	.38
Prunus serotina	250.	2.50	.09	.67	.38
Sanguinaria canadensis	250.	2.50	.09	.67	.38
Smilax ecirrhata	250.	2.50	.09	.67	.38
Total	271250.		100.00	100.00	100.00

Highland Woods

Site 17
Size: 4.25ha
Ozaukee County

Thiensville Quadrangle
N½, NE¼, NE¼, Sec 15, T9N, R21E
Private Ownership

Highland Woods was located on a narrow upland of a Cary end moraine. The major portion of the island occurred on the near-level upland, a small section on a gentle east-facing slope and nearly 20% of the stand on a moderate west-facing slope. The forest on the slopes was developed on Ozaukee silt loam soil (Typic Hapludalf). This soil is characterized by having a relatively shallow cap of silt over the glacial till. The near-level section of the stand was on Hochheim loam soil (Typic Argiudoll). Hochheim loam is formed in calcareous, loamy glacial till and is typically well drained (USDA, 1970). The soil is usually associated with glacial ridges. The island was bounded on the west and north by highways. The east boundary was a low, old field and the south was open, successional forest.

The land-use history of the forest is unknown. Former owners believe the island was never grazed, but the logging history is uncertain (Ed Nieman, pers. comm.). Examination of 1937 ASCS air photos indicates a closed, even-aged canopy, suggestive of a vigorous second growth stand. Size class distribution of the canopy species indicated none larger than 65cm (25.5in) dbh (Table 17**B**). Restriction of sugar maple *(Acer saccharum)* and American beech *(Fagus grandifolia)* to size classes less than 55cm (21.6in) dbh, with most less than 40cm (15.7in), is suggestive of nearly mature second growth stand which was probably selectively cut prior to the turn of the century.

The canopy and understory strata were sampled using twenty-five 10 x 25m plots. Sugar maple was the leading dominant accounting for 45% of the stems, 39% of the basal area, and 37% of the importance value (Table 17**A**). White ash *(Fraxinus americana)* and American beech were sub-dominants combining to comprise an additional 33% of the stems and 36% of the basal area. Continued maturation of the stand will occur as 80% of the stems 2.5-10.1cm dbh were beech and sugar maple. As expected for a vigorous, second growth stand, stem

density and basal area per hectare were slightly higher than the average. Species richness was somewhat lower than the average for the 43 forest islands (Table 2). As a result, species diversity (H') was also somewhat lower than the average, possibly reflecting the lack of recent disturbance (Table 3).

The shrub layer was dominated by choke cherry *(Prunus virginiana)* accounting for 57% of the stems and 40% of the importance value (Table 17 **C**). Sugar maple and white ash were sub-dominant making up an additional 25% of the density and 29% of the importance value. As in the canopy and understory strata, the species richness and species diversity (H') were somewhat lower than the average for the 43 forest islands (Table 3). The relatively low species richness is probably attributable to the low light intensity under the complete and dense canopy.

Similarly, only 20 species were recorded in the groundlayer of Highland Woods. The shade tolerant, mesophyllic Jack-in-the-pulpit *(Arisaema triphyllum)* dominated the groundlayer accounting for 48% of the stems (Table 17 **D**). White ash was the only other species to occur in more than half of the plots while contributing 19% of the stems. The remainder of the species were also shade tolerant suggesting that the canopy had been closed long enough to eliminate successional species. Locally high densities of the European orchid, helleborine *(Epipactis latifolia)* were common. Persistence of this species in the dark, southern-mesic forext suggests that it is capable of becoming a permanent member of the community. The relatively low species richness coupled with the domination of Jack-in-the-pulpit contributed to the lower than average species diversity (H') (Table 3). No rare or endangered species were encountered.

Table 17 **A**. Stand attributes for Highland Woods (Site 17)
Sample size: 25 plots (10 x 25m) Sample Date: May 29, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	210	100	12.10	45.17	27.78	38.90	37.28
Fraxinus americana	51	68	7.28	11.03	18.89	23.41	17.78
Fagus grandifolia	104	52	3.89	22.41	14.41	12.51	16.44
Tilia americana	22	28	2.55	4.83	7.78	8.21	6.94
Ulmus rubra	22	32	1.93	4.83	8.89	6.21	6.64
Prunus serotina	18	32	.99	3.79	8.89	3.18	5.29
Quercus borealis	11	24	1.81	2.41	6.67	5.82	4.97
Ostrya virginiana	24	20	.38	5.17	5.56	1.21	3.98
Ulmus americana	2	4	.17	.34	1.11	.55	.67
Totals	464[a]		31.10[b]	99.98	100.01	100.00	99.99

a = 188 trees/acre
b = 135.58 ft^2/acre

Table 17 **B**. Size class distribution for Highland Woods
Sample size: 0.63ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Tilia americana	4	8	3		2		1	2	1	3	1		1						26
Quercus borealis				1	1		1	1				2	1						6
Fraxinus americana					4	1	3	4	8	7	3	1	1						32
Ulmus rubra	1	6	2		3		5	1	1	1		1							21
Acer saccharum	65	64	21	17	29	21	21	13	3	1	3								258
Fagus grandifolia	18	22	18	17	19	4	5		1	2									106
Prunus serotina	1	2	2	4		1	3	1											14
Ulmus americana		2							1										3
Ostrya virginiana	10	5	9	6															30
Prunus virginiana	1	1																	2
Totals	100	110	55	45	58	26	37	24	16	14	7	4	3						

Table 17 Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	10832.	108.00	57.13	23.08	40.10
Acer saccharum	2560.	84.00	13.50	17.95	15.73
Fraxinus americana	2176.	68.00	11.48	14.53	13.00
Ribes cynosbati	1808.	48.00	9.54	10.26	9.90
Ribes americanum	752.	44.00	3.97	9.40	6.68
Fagus grandifolia	384.	32.00	2.03	6.84	4.43
Tilia americana	208.	28.00	1.10	5.98	3.54
Cornus racemosa	48.	12.00	.25	2.56	1.41
Carya cordiformis	32.	8.00	.17	1.71	.94
Acer negundo	32.	8.00	.17	1.71	.94
Crataegus succulenta	32.	4.00	.17	.85	.51
Vitis riparia	16.	4.00	.08	.85	.47
Ulmus americana	16.	4.00	.08	.85	.47
Solanum dulcamara	16.	4.00	.08	.85	.47
Prunus serotina	16.	4.00	.08	.85	.47
Ostrya virginiana	16.	4.00	.08	.85	.47
Cornus alternifolia	16.	4.00	.08	.85	.47
Total	18960.		100.00	100.00	100.00

Table 17**D**. Groundlayer for Highland Woods Sampled 6/25/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Arisaema triphyllum	134750.	60.00	48.04	20.69	34.36
Fraxinus americana	52000.	67.50	18.54	23.28	20.91
Circaea quadrisulcata	37000.	30.00	13.19	10.34	11.77
Smilacina racemosa	16750.	35.00	5.97	12.07	9.02
Prunus virginiana	22000.	25.00	7.84	8.62	8.23
Acer saccharum	2250.	17.50	.80	6.03	3.42
Fagus grandifolia	1500.	10.00	.53	3.45	1.99
Ribes cynosbati	4500.	5.00	1.60	1.72	1.66
Tilia americana	750.	7.50	.27	2.59	1.43
Podophyllum peltatum	2500.	5.00	.89	1.72	1.31
Carya cordiformis	500.	5.00	.18	1.72	.95
Caulophyllum thalictroides	1750.	2.50	.62	.86	.74
Rubus odoratus	1750.	2.50	.62	.86	.74
Epipactis latifolia	750.	2.50	.27	.86	.56
Allium tricoccum	500.	2.50	.18	.86	.52
Phlox divaricata	250.	2.50	.09	.86	.48
Actea alba	250.	2.50	.09	.86	.48
Cornus alternifolia	250.	2.50	.09	.86	.48
Ulmus rubra	250.	2.50	.09	.86	.48
Viburnum dentatum	250.	2.50	.09	.86	.48
Total	280500.		100.00	100.00	100.00

Garvey's Woods

Site 19
Size: 2.91ha
Ozaukee County

Thiensville Quadrangle
NE¼, NW¼, SE¼, SE¼, SW¼, NE¼,
Sec 27, T9N, R21E

Garvey's Woods is located near the base of a Cary end moraine. Topographic relief within the island does not exceed 4m, but the forest is effectively divided into two distinct sections. The northern two-thirds of the forest developed on Ozaukee silt loam soil (Typic Hapludalf). This soil is well-drained and occurs on glacial moraines formed in a silt cap less than 50cm (20in) over silty clay loam glacial till. The southern third of the forest is associated with a small, intermittent stream. The somewhat poorly drained Mequon silt loam (Udollic Ochraqualf) is typical of drainageways and depressions. Wetness is the major limitation of this soil and it is likely to pond in the spring and after heavy rains (USDA, 1970). The island is bounded on the north and east by grassy open fields. The south and west boundaries are cropland.

The land-use history of the site is not known. Size class distributions of the canopy tree species indicates a conspicuous reduction of stems in the classes greater than 45cm (17.7in) dbh Table 19**B**). The absence of larger individuals of red and white oak *(Quercus borealis* and *Q. alba),* American beech *(Fagus grandifolia)* and basswood *(Tilia americana)* strongly suggests some logging perhaps prior to the turn of the century. Vigorous reproduction of sugar maple *(Acer saccharum),* beech and ironwood *(Ostrya virginiana)* indicates the stand is recovering rapidly. There was no evidence of grazing. Examination of 1937 ASCS air photos indicates that the island was much the same as today. The southern third, the lowland area, appeared more open; perhaps in response to the drought of that period. The northern two-thirds had a dense, even canopy suggesting vigorous second growth. At approximately the same time, the woods was referred to locally as "ginseng woods" as a result of efforts to grow ginseng *(Panax sp.)* commercially in the woods (Arthur Garvey, pers. comm.).

The canopy and understory were sampled using twenty 10 x 25m plots. The canopy was dominated by a young growth of sugar maple which accounted for 37% of the stems and 38% of the basal area (Table 19 **A**). White ash and beech were sub-dominant and combined contributed another 40% of the stems and basal area. As might be expected of a vigorous second-growth stand, stem density and basal area were slightly higher than average for the 43 forest islands (Table 2). The understory (stems 2.5-10.1cm dbh) was strongly dominated by sugar maple and beech which together accounted for 73% of all stems recorded (Table 19 **B**). Species richness, even with the somewhat wet-mesic "habitat island" was slightly lower than average as was species diversity (H') (Table 3).

Conversely, the species richness and diversity (H') of the shrub layer were somewhat higher than the average (Table 3). Choke cherry *(Prunus virginiana)* was the most numerous and widely distributed species accounting for 39% of the stems (Table 19 **C**). Sugar maple and dogberry *(Ribes cynosbati)* were subdominant combining for an additional 32% of the stems. Two common components of the shrub and understory strata of the southern-mesic forest, the now relatively uncommon witch-hazel *(Hamamelis virginiana)* and leatherwood *(Dirca palustris),* were both present in this stand.

Twenty-nine species were sampled in the summer groundlayer. White ash seedlings were most numerous, accounting for 36% of the stems recorded (Table 19 **D**). Numerous successional species were present, further substantiating past disturbance. Even with the successional species and wet-mesic community, species diversity (H') was slightly lower than the average of the 31 islands sampled (Table 3). There was no remaining evidence of the attempted cultivation of ginseng. No rare or endangered species were encountered.

Table 19A. Stand attributes for Garvey Woods (Site 19)
Sample size: 20 plots (10 x 25m) Sample Date: July 16, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	176	85	11.46	36.82	22.67	38.04	32.51
Fagus grandifolia	112	95	5.35	23.43	25.33	17.77	22.18
Fraxinus americana	80	65	6.66	16.74	17.33	22.10	18.72
Tilia americana	40	40	2.46	8.37	10.67	8.15	9.06
Ulmus rubra	24	25	1.36	5.02	6.67	4.50	5.40
Prunus serotina	28	25	.96	5.86	6.67	3.19	5.24
Quercus borealis	4	10	.57	.84	2.67	1.91	1.81
Quercus alba	4	10	.40	.84	2.67	1.32	1.61
Carya cordiformis	6	10	.08	1.26	2.67	.25	1.39
Ulmus americana	2	5	.42	.42	1.33	1.40	1.05
Juglans cinerea	2	5	.41	.42	1.33	1.36	1.04
Totals	478[a]		30.13[b]	100.02	100.01	99.99	100.01

a = 194 trees/acre
b = 131.29 ft^2/acre

Table 19**B**. Size class distribution for Garvey Woods
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Fraxinus americana	3	3	7	2	7	5	8	5	2		2	1			1				46
Acer saccharum	152	49	19	12	9	13	17	8	3	4	1	1		1					289
Fagus grandifolia	24	23	15	11	6	12	6	3	2		1								103
Ulmus americana											1								1
Juglans cinerea											1								1
Quercus borealis	2						1			1	1								4
Prunus serotina	7	13	5	5	2	1				1									34
Quercus alba			1							1									2
Tilia americana	3	8	5	6		1	2	3	2	1									31
Ulmus rubra	1	6	2	1	4	2	1		2										19
Carya cordiformis	3	3	2	1															9
Ostrya virginiana	18	19																	37
Amelanchier laevis		1																	1
Crataegus succulenta	3																		3
Totals	216	125	56	38	28	34	35	19	11	7	7	2		1	1				

Table 19**C**. Shrub composition for Garvey Woods sampled 7/26/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	6160.	95.00	39.49	16.52	28.00
Acer saccharum	2340.	85.00	15.00	14.78	14.89
Ribes cynosbati	2660.	60.00	17.05	10.43	13.74
Ribes americanum	1680.	45.00	10.77	7.83	9.30
Fraxinus americana	460.	50.00	2.95	8.70	5.82
Prunus serotina	340.	40.00	2.18	6.96	4.57
Fagus grandifolia	680.	25.00	4.36	4.35	4.35
Carya cordiformis	260.	40.00	1.67	6.96	4.31
Vitis riparia	160.	20.00	1.03	3.48	2.25
Lonicera xbella	140.	15.00	.90	2.61	1.75
Hamamelis virginiana	120.	15.00	.77	2.61	1.69
Ostrya virginiana	80.	15.00	.51	2.61	1.56
Viburnum lentago	200.	10.00	1.28	1.74	1.51
Dirca palustris	60.	15.00	.38	2.61	1.50
Tilia americana	100.	10.00	.64	1.74	1.19
Ulmus rubra	60.	10.00	.38	1.74	1.06
Zanthoxylum americanum	20.	5.00	.13	.87	.50
Rubus occidentalis	20.	5.00	.13	.87	.50
Amelanchier sp.	20.	5.00	.13	.87	.50
Menispermum canadense	20.	5.00	.13	.87	.50
Cornus stolonifera	20.	5.00	.13	.87	.50
Total	15600.		100.00	100.00	100.00

Table 19**D**. Groundlayer for Garvey Woods sampled 7/31/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	82250.	90.00	35.61	23.53	29.57
Geranium maculatum	25500.	45.00	11.04	11.76	11.40
Prunus virginiana	20250.	47.50	8.77	12.42	10.59
Carex pensylvanica	34250.	15.00	14.83	3.92	9.37
Acer saccharum	7750.	30.00	3.35	7.84	5.60
Circaea quadrisulcata	18000.	10.00	7.79	2.61	5.20
Smilacina racemosa	6250.	22.50	2.71	5.88	4.29
Ribes cynosbati	8250.	17.50	3.57	4.58	4.07
Hydrophyllum virginianum	5250.	10.00	2.27	2.61	2.44
Arisaema triphyllum	4000.	10.00	1.73	2.61	2.17
Tilia americana	1500.	12.50	.65	3.27	1.96
Vitis sp.	2250.	10.00	.97	2.61	1.79
Podophyllum peltatum	1500.	10.00	.65	2.61	1.63
Agropyron smithii	3500.	5.00	1.52	1.31	1.41
Carex sp.	3250.	2.50	1.41	.65	1.03
Trillium grandiflorum	1500.	5.00	.65	1.31	.98

Table 19 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fagus grandifolia	750.	5.00	.32	1.31	.82
Crataegus punctata	500.	5.00	.22	1.31	.76
Smilax herbacea	500.	5.00	.22	1.31	.76
Ribes americanum	1000.	2.50	.43	.65	.54
Hamamelis virginiana	500.	2.50	.22	.65	.44
Prunus serotina	500.	2.50	.22	.65	.44
Solidago caesia	500.	2.50	.22	.65	.44
Allium tricoccum	250.	2.50	.11	.65	.38
Crataegus succulenta	250.	2.50	.11	.65	.38
Menispermum canadense	250.	2.50	.11	.65	.38
Ostrya virginiana	250.	2.50	.11	.65	.38
Sanguinaria canadensis	250.	2.50	.11	.65	.38
Ulmus rubra	250.	2.50	.11	.65	.38
Total	231000.		100.00	100.00	100.00

Genglers Woods

Site 20
Size: 1.58ha
Ozaukee County

Menomonee Falls Quadrangle
NE¼, NW¼, NW¼, SE½, Sec 33, T9N, R21E
Private Ownership

Genglers Woods is located at the crest of a Cary-aged end moraine. Topography slopes downward from the site in all directions. A small depression occurred at the northern end of the stand, but relief was neglible. Standing water was observed in the depression on several dates. The forest is developed on the well-drained Ozaukee silt loam soil (Typic Hapludalf). These soils are typical of glacial ridges in Ozaukee County. The island is bounded on the north and east by successional old fields. Cropfields exist on the south and west sides.

The early land-use history of the site is unknown. Examination of 1937 ASCS air photos indicates the island was then the same size and shape as it is today. A small trail entered the woods from the west. The canopy appeared very tight, possibly indicating a vigorous second-growth stand. Local residents had no recollection of grazing. The size class distribution of the canopy species suggests heavy logging since few individuals exceed 50cm (19.6in) dbh (Table 20 **B**). The stand appeared to be well on its way to recovery until numerous large elms *(Ulmus sp.)* were stricken with Dutch-elm disease. A confirmed tornado was recorded in the vicinity of the island during the spring of 1974. A sugar maple *(Acer saccharum)* and two basswood *(Tilia americana)* in the 80+ size classes were apparently uprooted.

The canopy and understory were sampled using fifteen 10 x 12.5m plots. Basswood and white ash *(Fraxinus americana)* were the leading dominants accounting for 44% of the stems, 64% of the basal area, and 51% of the importance value (Table 20 **A**). Sugar maple and American beech *(Fagus granifolia)* shared sub-dominant positions contributing a combined 37% of the density and 24% of the basal area. Basal area per hectare was significantly lower than that expected (Table 2). Part of the explanation lies in the large number of dead elms still standing and the recent windthrows. Successional processes have not had sufficient time to produce a high density of small stems. Future recovery is seen in the understory where sugar maple accounts for 34% of the stems between 2.5-10.1cm dbh and basswood makes up another 17% (Table 20 **B**). The species richness and diversity (H') were lower than the average for the 43 forest islands (Table 3).

Sugar maple, choke cherry *(Prunus virginiana)*, and basswood were the leading dominants of the shrub layer combining to comprise 48% of the stems and 41% of the importance value (Table 20 **C**). As might be expected in a disturbance situation, the stem density, species richness and species diversity (H') were all greater than the average for 43 stands (Table 3). Species richness was increased by the presence of several species more typical of wet-mesic communities.

The groundlayer was dominated by white ash comprising 45% of the stems and 33% of the importance value (Table 20 **D**). The only other species to occur in half or more of the plots was choke cherry which was second in importance. Nearly 68% of the species occurred in 5% or less of the plots. Several species recorded in the groundlayer are more typical of wet-mesic communities. Perhaps the relative positions of dominance of white ash, which can tolerate periodic flooding, and black cherry *(Prunus serotina)* which is intolerant of flooding (Lindsey, et al, 1961), is a function of moisture rather than succession. Overall species richness is less than average as was species diversity (H') due to a relatively low equitability (J') component (Table 3). No rare or endangered species were encountered.

Table 20**A**. Stand attributes for Gengler's Woods (Site 20)
Sample size: 15 plots (10 x 12.5m) Sample Date: September 24, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Tilia americana	133	67	7.58	26.88	23.26	33.23	27.79
Fraxinus americana	85	67	6.97	17.20	23.26	30.58	23.68
Fagus grandifolia	101	40	2.45	20.43	13.95	13.53	15.97
Acer saccharum	80	47	1.06	16.13	16.28	10.75	14.39
Ostrya virginiana	75	40	1.06	15.05	13.95	4.65	11.22
Quercus borealis	5	7	1.01	1.08	2.33	4.41	2.61
Acer rubrum	5	7	.24	1.08	2.33	1.48	1.63
Ulmus rubrum	5	7	.07	1.08	2.33	1.06	1.49
Crataegus succulenta	5	7	.07	1.08	2.33	.30	1.24
Totals	494[a]		22.81[b]	100.01	100.02	99.99	100.02

a = 201 trees/acre
b = 99.35 ft^2/acre

Table 20**B**. Size class distribution for Gengler's Woods
Sample size: 0.19ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Fraxinus americana	8		2	3	2	3	1	2	1	1				1					24
Quercus borealis										1									1
Tilia americana	14	3	5	1	6	6	3	3	1										42
Fagus grandifolia	7	2	5	7	4	2	1												28
Acer saccharum	18	11	6	1	5	3													44
Acer rubrum						1													1
Ulmus rubra					1														1
Ostrya virginiana	6	6	12	2															26
Crataegus succulenta	3		1																4
Crataegus punctata		4																	4
Prunus serotina	1																		1
Carya cordiformis	1																		1
Rhamnus catharticus	1																		1
Totals	59	26	31	14	18	15	5	5	2	2				1					

Table 20**C**. Shrub composition for Gengler's Woods sampled 8/27/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	3999.	100.00	19.92	13.04	16.48
Prunus virginiana	3226.	80.00	16.07	10.43	13.25
Tilia americana	2506.	80.00	12.48	10.43	11.46
Menispermum canadense	2906.	40.00	14.48	5.22	9.85
Ribes cynosbati	1946.	73.33	9.69	9.57	9.63
Fagus grandifolia	1253.	66.67	6.24	8.70	7.47
Fraxinus americana	1066.	73.33	5.31	9.57	7.44
Ostrya virginiana	1253.	60.00	6.24	7.83	7.03
Ulmus rubra	267.	33.33	1.33	4.35	2.84
Prunus serotina	187.	33.33	.93	4.35	2.64
Quercus borealis	293.	20.00	1.46	2.61	2.03
Fraxinus nigra	80.	20.00	.40	2.61	1.50
Solanum dulcamara	373.	6.67	1.86	.87	1.36
Carya cordiformis	133.	13.33	.66	1.74	1.20
Crataegus punctata	53.	13.33	.27	1.74	1.00
Lonicera xbella	160.	6.67	.80	.87	.83
Viburnum rafinesquianum	80.	6.67	.40	.87	.63
Vitis riparia	80.	6.67	.40	.87	.63
Crataegus succulenta	80.	6.67	.40	.87	.63
Ribes americanum	53.	6.67	.27	.87	.57
Celtis occidentalis	27.	6.67	.13	.87	.50
Zanthoxylum americanum	27.	6.67	.13	.87	.50
Rhamnus catharticus	27.	6.67	.13	.87	.50
Total	20075.		100.00	100.00	100.00

Table 20**D**. Groundlayer for Gengler's Woods sampled 8/27 and 9/27/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	90250.	85.00	45.07	21.22	33.15
Prunus virginiana	24000.	50.00	11.99	12.48	12.23
Carex pensylvanica	24000.	10.00	11.99	2.50	7.24
Smilacina racemosa	12750.	30.00	6.37	7.49	6.93
Tilia americana	4750.	42.50	2.37	10.61	6.49
Geranium maculatum	9250.	30.00	4.62	7.49	6.05
Acer saccharum	6500.	30.00	3.25	7.49	5.37
Fagus grandifolia	1750.	12.50	.87	3.12	2.00
Geum canadense	2500.	10.00	1.25	2.50	1.87
Maianthemum canadense	3000.	8.00	1.50	2.00	1.75
Hepatica acutiloba	3750.	5.00	1.87	1.25	1.56
Arisaema triphyllum	750.	7.50	.37	1.87	1.12
Rhamnus catharticus	2000.	5.00	1.00	1.25	1.12

Table 20 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Hydrophyllum virginianum	1500.	5.00	.75	1.25	1.00
Ribes cynosbati	1500.	5.00	.75	1.25	1.00
Menispermum canadense	1250.	5.00	.62	1.25	.94
Circaea quadrisulcata	750.	5.00	.37	1.25	.81
Smilax herbacea	750.	5.00	.37	1.25	.81
Ostrya virginiana	500.	5.00	.25	1.25	.75
Pilea pumila	500.	5.00	.25	1.25	.75
Smilax ecirrhata	500.	5.00	.25	1.25	.75
Solidago flexicaulis	500.	5.00	.25	1.25	.75
Trillium grandiflorum	1500.	2.50	.75	.62	.69
Hystrix patula	1250.	2.50	.62	.62	.62
Laportea canadensis	1000.	2.50	.50	.62	.56
Epifagus virginiana	750.	2.50	.37	.62	.50
Fragaria virginianum	500.	2.50	.25	.62	.44
Podophyllum peltatum	500.	2.50	.25	.62	.44
Vitis sp.	500.	2.50	.25	.62	.44
Actea alba	250.	2.50	.12	.62	.37
Allium tricoccum	250.	2.50	.12	.62	.37
Prunus serotina	250.	2.50	.12	.62	.37
Pyrola elliptica	250.	2.50	.12	.62	.37
Quercus borealis	250.	2.50	.12	.62	.37
Total	200250.		100.00	100.00	100.00

Stauss Woods

Site 21
Site: 2.19ha
Ozaukee County

Menomonee Falls Quadrangle
NE¼, NW¼, SW¼, Sec 33, T9N, R21E
Private Ownership

Stauss Woods is located on a gentle south-facing slope near the crest of an end moraine of Cary age. Topographic relief within the island is approximately 5m. Most of the forest is developed on a slope of eroded Ozaukee silt loam (Typic Hapludalf). The more level portions are less eroded. The soil is typical of glacial moraines and is well drained (USDA, 1970). The southern portion of the island contains a large depression in which standing water occurs for a large part of the growing season. A swamp forest exists in and around the depression in which an Ashkum silt loam (Typic Haplaquoll) has developed.

Little is known of the land-use history. About 1875, the stand was logged and the timber was used for pilings (Melvin Stauss, pers. comm.). Examination of the 1937 ASCS air photos indicates the island was then the same size and shape. The canopy appeared to be very tight suggesting vigorous second growth. A small open area appeared near the northwest corner. In recent years, only dead elms *(Ulmus sp.)* have been removed. There was no history of

grazing at this site. The island is entirely surrounded by cropland with fencerows extending from the southwest and southeast corners as well as from the center of the east edge.

The canopy and understory strata were sampled using twenty 10 x 25m plots. Basswood *(Tilia americana)* was the dominant canopy species accounting for 55% of the stems, 48% of the basal area and 42% of the importance value (Table 21 **A**). Red oak *(Quercus borealis)* was sub-dominant comprising 28% of the basal area but only accounted for 15% of the stems. The history of logging is corroborated by the size class distribution of the tree species (Table 21 **B**). Few trees exceeded 45cm (17.7in) dbh with none recorded over 55cm (21.6in). dbh. The canopy and understory strata had the highest species richness of the 43 sites sampled. Even with the great species richness, species diversity (H') was only the fourth highest because of reduced equitability (J'); 35% of the stems were basswood (Table 21 **B**). Much of the increased richness was due not only to the numerous successional species, but also to the wet-mesic species typical of the depressional community.

Similarly, the shrub layer had the greatest species richness, greatly exceeding the average (Table 2). Like the canopy layer, the increased species richness was the addition of successional species and wet-mesic species of the lowland community. Several exotic species also temporarily found a niche in the recovering southern-mesic forest. Choke cherry *(Prunus virginiana)* was the leading dominant accounting for 35% of the stems and 23% of the importance value (Table 21 **C**). Ironwood *(Ostrya virginiana)* and witch-hazel *(Hamamelis virginiana)* were next in importance. These two species were typical of the subcanopy layers of the southern-mesic forest and survived the period of logging.

Forty-five species were sampled in the groundlayer (Table 21 **D**). False Solomon's-seal *(Smilacina racemosa)* and poison ivy *(Rhus radicans)* were the most numerous species, but false Solomon's-seal and wild geranium *(Geranium maculatum)* were the most important species as they were the only to occur in over half of the plots. Sixty-two percent of the species occurred in 5% or less of the plots and were largely successional or exotic species. As a result of the high species richness and sparse distribution, species diversity (H') was considerably higher than the average of the 31 islands sampled (Table 3). No rare or endangered species were encountered.

Table 21 **A**. Stand attributes for Stauss Woods (Site 21)
Sample size: 20 plots (10 x 25m) Sample Date: September 5, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Tilia americana	300	100	14.16	55.35	23.26	47.76	42.12
Quercus borealis	82	82	8.27	15.13	12.79	27.90	18.61
Acer saccharum	30	50	1.03	5.54	11.63	3.48	6.88
Quercus alba	30	40	1.37	5.54	9.30	4.63	6.49
Acer rubrum	22	30	1.19	4.06	6.98	4.00	5.01
Prunus serotina	16	35	.73	2.95	8.14	2.48	4.52
Fagus grandifolia	14	20	.39	2.58	4.65	1.32	2.85
Fraxinus americana	8	15	.74	1.48	3.49	2.49	2.49
Fraxinus pennsylvanica	10	10	.85	1.85	2.33	2.87	2.35
Fraxinus nigra	8	20	.27	1.48	4.65	.90	2.34
Ostrya virginiana	6	15	.07	1.11	3.49	.28	1.63
Carya cordiformis	4	10	.23	.74	2.33	.79	1.29
Quercus bicolor	4	10	.20	.74	2.33	.68	1.25
Amelanchier laevis	4	10	.07	.74	2.33	.25	1.11
Crataegus succulenta	2	5	.03	.37	1.16	.11	.55
Carpinus caroliniana	2	5	.02	.37	1.16	.08	.54
Totals	542[a]		29.62[b]	99.98	100.02	100.02	100.03

a = 219 trees/acre
b = 129.20 ft^2/acre

Table 21 **B**. Size class distribution for Stauss Woods
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus borealis	6			2	7	4	7	9	7	2	3								47
Fraxinus americana	15	2			1	1		1		1									21
Tilia americana	31	31	17	25	48	32	20	5	3										212
Fraxinus pennsylvanica	5	1				1	3	1											11
Quercus alba			4	3	1	4	1	2											15
Acer rubrum	5	4		1	6	1	2	1											20
Acer saccharum	16	9	4	3	5	1	2												40
Prunus serotina	1			3	2	1	2												9
Quercus bicolor			1				1												2
Fagus grandifolia	1		3	1	2	1													8
Carya cordiformis		1				2													3
Fraxinus nigra			1	1	1	1													4
Amelanchier laevis			1	1															2
Ostrya virginiana	105	12	3																120
Carpinus caroliniana	8	4	1																13
Crataegus succulenta	3	3	1																7

Table 21 **B** continued

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Ulmus rubra	19	4																	23
Hamamelis virginiana	40	5																	45
Crataegus punctata		1																	1
Carya ovata	1																		1
Rhamnus catharticus	2																		2
Totals	258	77	36	40	73	49	38	19	10	3	3								

Table 21 **C**. Shrub composition for Stauss Woods sampled 9/5/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	4880.	85.00	34.71	11.04	22.87
Ostrya virginiana	880.	60.00	6.26	7.79	7.03
Hamamelis virginiana	1220.	40.00	8.68	5.19	6.94
Ribes cynosbati	860.	45.00	6.12	5.84	5.98
Crataegus succulenta	480.	60.00	3.41	7.79	5.60
Prunus serotina	480.	60.00	3.41	7.79	5.60
Tilia americana	620.	50.00	4.41	6.49	5.45
Cornus stolonifera	940.	15.00	6.69	1.95	4.32
Viburnum rafinesquianum	560.	35.00	3.98	4.55	4.26
Rubus occidentalis	580.	30.00	4.13	3.90	4.01
Fraxinus americana	300.	30.00	2.13	3.90	3.01
Acer saccharum	140.	35.00	1.00	4.55	2.77
Quercus borealis	180.	30.00	1.28	3.90	2.59
Solanum dulcamara	540.	5.00	3.84	.65	2.25
Ulmus rubra	220.	20.00	1.56	2.60	2.08
Lonicera xbella	140.	20.00	1.00	2.60	1.80
Zanthoxylum americanum	100.	20.00	.71	2.60	1.65
Crataegus punctata	140.	15.00	1.00	1.95	1.47
Dirca palustris	100.	15.00	.71	1.95	1.33
Viburnum lentago	120.	10.00	.85	1.30	1.08
Viburnum acerifolium	100.	10.00	.71	1.30	1.00
Rosa sp.	100.	10.00	.71	1.30	1.00
Amelanchier sp.	80.	10.00	.57	1.30	.93
Fagus grandifolia	60.	10.00	.43	1.30	.86
Carya cordiformis	40.	10.00	.28	1.30	.79
Vitis riparia	40.	10.00	.28	1.30	.79
Fraxinus nigra	40.	5.00	.28	.65	.47
Menispermum canadense	40.	5.00	.28	.65	.47
Lonicera prolifera	20.	5.00	.14	.65	.40
Rhamnus frangula	20.	5.00	.14	.65	.40
Rhus radicans	20.	5.00	.14	.65	.40
Parthenocissus quinquefolia	20.	5.00	.14	.65	.40
Total	14060.		100.00	100.00	100.00

Table 21 **D**. Groundlayer for Stauss Woods sampled 9/5/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Smilacina racemosa	33250.	67.50	18.37	16.36	17.37
Geranium maculatum	20750.	55.00	11.46	13.33	12.40
Prunus virginiana	13000.	35.00	7.18	8.48	7.83
Rhus radicans	22750.	10.00	12.57	2.42	7.50
Carex blanda	22000.	2.50	12.15	.61	6.38

Table 21 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus pennsylvanica	5500.	35.00	3.04	8.48	5.76
Carya cordiformis	11500.	15.00	6.35	3.64	4.99
Circaea quadrisulcata	7750.	7.50	4.28	1.82	3.05
Geum canadense	3750.	15.00	2.07	3.64	2.85
Aster macrophyllus	4500.	7.50	2.49	1.82	2.15
Acer saccharum	2250.	12.50	1.24	3.03	2.14
Aster shortii	3250.	10.00	1.80	2.42	2.11
Smilax herbacea	1750.	10.00	.97	2.42	1.70
Parthenocissus quinquefolia	3750.	5.00	2.07	1.21	1.64
Prenanthes altissima	1500.	10.00	.83	2.42	1.63
Rhamnus catharticus	3500.	5.00	1.93	1.21	1.57
Tilia americana	1000.	10.00	.55	2.42	1.49
Trillium grandiflorum	1000.	10.00	.55	2.42	1.49
Ulmus rubra	2000.	7.50	1.10	1.82	1.46
Graminеae	2250.	5.00	1.24	1.21	1.23
Ribes cynosbati	750.	7.50	.41	1.82	1.12
Rubus occidentalis	1250.	5.00	.69	1.21	.95
Apocynum androsaemifolium	500.	5.00	.28	1.21	.74
Smilax ecirrhata	500.	5.00	.28	1.21	.74
Viburnum rafinesquianum	500.	5.00	.28	1.21	.74
Carex pennsylvanica	1250.	2.50	.69	.61	.65
Dirca palustris	1250.	2.50	.69	.61	.65
Rosa sp.	1250.	2.50	.69	.61	.65
Viola cucullata	1250.	2.50	.69	.61	.65
Carex sp.	750.	2.50	.41	.61	.51
Fragaria virginianum	750.	2.50	.41	.61	.51
Erythronium americanum	500.	2.50	.28	.61	.44
Xanthium strumarium	500.	2.50	.28	.61	.44
Amphicarpa bracteata	250.	2.50	.14	.61	.37
Aralia nudicaulis	250.	2.50	.14	.61	.37
Arisaema triphyllum	250.	2.50	.14	.61	.37
Aster cordifolius	250.	2.50	.14	.61	.37
Cornus stolonifera	250.	2.50	.14	.61	.37
Crataegus succulenta	250.	2.50	.14	.61	.37
Hamamelis virginiana	250.	2.50	.14	.61	.37
Heracleum lanatum	250.	2.50	.14	.61	.37
Picea miriana	250.	2.50	.14	.61	.37
Rubus allegheniensis	250.	2.50	.14	.61	.37
Solanum dulcamara	250.	2.50	.14	.61	.37
Vitis sp.	250.	2.50	.14	.61	.37
Total	181000.		100.00	100.00	100.00

Convent Woods

Site 23
Size: 2.35ha
Milwaukee County

Menomonee Falls Quadrangle
SE¼, NE¼, Sec 9, T8N, R21E
Private Ownership

The woods of the Regina Mundi Convent is located on a broad, Cary aged, morainic upland. Topographic relief within the forest island is negligible. The forest is developed entirely on Ozaukee silt loam soil (Typic Hapludalf). The soil is well-drained and characteristic of morainic uplands.

The land-use history of the woods is largely unknown. The site was heavily disturbed in 1935 when a driveway and several buildings were constructed in and near the edge of the woods. Examination of 1937 ASCS air photos indicates the woods was the same general size and shape as present. The canopy appeared tightly closed, suggesting a second-growth forest. Size class information indicates a few trees larger than 45cm (17.7in) dbh (Table 23 **B**). However, a light selective logging is indicated by the presence of a few remnant large red oak *(Quercus borealis)*, white ash *(Fraxinus americana)* and sugar maple *(Acer saccharum)*. There was no evidence of grazing, and only dead trees have been removed from the woods since 1954. The island was bounded on the west by a road, the south by residences, and the east and north by open grasslands.

The canopy and understory were sampled using sixteen 10 x 25m plots. American beech *(Fraxinus grandifolia)* and sugar maple dominated the canopy layer accounting for 67% of the stems and 57% of the basal area (Table 23 **A**). Sub-dominants, basswood *(Tilia americana)* and white ash made up an additional 18% of the stems and 27% of the basal area. As in the canopy, the understory (stems 2.5-10.1cm) was dominated by sugar maple and beech which accounted for 72% of the stems recorded. Species richness and species diversity (H') were near the average for the 43 islands sampled (Table 3).

Choke cherry *(Prunus virginiana)* was the most numerous and widespread species in the shrub layer accounting for 27% of the importance value (Table 23 **C**). White ash and black cherry *(Prunus serotina)* were sub-dominant making up a combined 26% of the stem density and 25% of the importance value. Both species richness and diversity (H') for the shrub layer were higher than the average for the 43 islands. Interestingly, exotic species as well as relatively uncommon remnant species contributed to the increased diversity. Leatherwood *(Dirca palustris)* and witch-hazel *(Hamamelis virginiana)*, formerly common in this region, were both present at this site.

No single species dominated the groundlayer, but white ash was the most common and widely distributed (Table 23 **D**). A nearly complete groundcover of sedges was present along the west edge of the stand. A mature edge had not yet formed and increased light levels reached far into the interior of the island. This undoubtedly contributes to the increased species richness and species diversity (H') of the groundlayer of this island (Table 3). Although no rare or endangered species were encountered, it is noteworthy that this was the only site in the two-county study area in which wood betony *(Pedicularis canadensis)* was observed.

Table 23 **A**. Stand attributes for Regina Mundi Convent (Site 23)
Sample size: 16 plots (10 x 25m) Sample Date: August 13, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Fagus grandifolia	240	100	11.08	53.93	23.53	35.73	37.73
Acer saccharum	60	69	6.58	13.48	16.18	21.22	16.96
Fraxinus americana	40	56	4.90	8.99	13.24	15.80	12.68
Tilia americana	40	50	3.51	8.99	11.76	11.33	10.69
Quercus borealis	15	38	2.89	3.37	8.82	9.34	7.18
Ostrya virginiana	23	44	.39	5.06	10.29	1.26	5.54
Ulmus rubra	10	25	.83	2.25	5.88	2.69	3.61
Prunus serotina	10	25	.30	2.25	5.88	.96	3.03
Juglans cinerea	3	6	.43	.56	1.47	1.40	1.14
Carya cordiformis	3	6	.06	.56	1.47	.19	.74
Ulmus americana	3	6	.03	.56	1.47	.08	.70
Totals	447[a]		31.00[b]	100.00	99.99	100.00	100.00

a = 180 trees/acre
b = 135.08 ft^2/acre

Table 23 **B**. Size class distribution for Regina Mundi Cover
Sample size: 0.4ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus borealis	1						1	2	1		1					1			7
Fraxinus americana			1	2		2	2	2	4	1	1			1					16
Acer saccharum	9	3	3	2	2	2	2	2	6	1	2	2							36
Juglans cinerea										1									1
Fagus grandifolia	1	3	10	25	23	18	14	4	2										100
Tilia americana	6	5	1	1	1	3	3	4	3										27
Ulmus rubra				1			1	2											4
Prunus serotina	2		2		1	1													6
Ostrya virginiana		2	5	4															11
Carya cordiformis				1															1
Ulmus americana			1																1
Totals	19	13	23	36	27	26	23	16	16	3	4	2		1		1			

Table 23 **C**. Shrub composition for Convent Woods sampled 8/13/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	5575.	93.75	39.33	14.15	26.74
Fraxinus americana	2050.	87.50	14.46	13.21	13.83
Prunus serotina	1700.	68.75	11.99	10.38	11.19
Tilia americana	775.	75.00	5.47	11.32	8.39
Acer saccharum	900.	68.75	6.35	10.38	8.36
Lonicera xbella	1025.	43.75	7.23	6.60	6.92
Dirca palustris	525.	18.75	3.70	2.83	3.27
Rhamnus catharticus	225.	31.25	1.59	4.72	3.15
Fagus grandifolia	175.	25.00	1.23	3.77	2.50
Vitis riparia	125.	25.00	.88	3.77	2.33
Carya cordiformis	100.	25.00	.71	3.77	2.24
Ulmus rubra	225.	12.50	1.59	1.89	1.74
Rubus occidentalis	75.	12.50	.53	1.89	1.21
Sambucus canadensis	50.	12.50	.35	1.89	1.12
Berberis thunbergii	150.	6.25	1.06	.94	1.00
Ribes americanum	150.	6.25	1.06	.94	1.00
Hamamelis virginiana	125.	6.25	.88	.94	.91
Menispermum canadense	50.	6.25	.35	.94	.65
Acer negundo	50.	6.25	.35	.94	.65
Quercus borealis	25.	6.25	.18	.94	.56
Solanum dulcamara	25.	6.25	.18	.94	.56
Zanthoxylum americanum	25.	6.25	.18	.94	.56
Viburnum lentago	25.	6.25	.18	.94	.56
Cornus racemosa	25.	6.25	.18	.94	.56
Total	14175.		100.00	100.00	100.00

Table 23 **D**. Groundlayer for Convent Woods sampled 8/13/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	69999.	88.57	17.12	14.83	15.98
Carex pennsylvanica	84856.	25.71	20.75	4.31	12.53
Circaea quadrisulcata	51999.	14.29	12.72	2.39	7.56
Tilia americana	15714.	65.71	3.84	11.00	7.42
Smilacina racemosa	31714.	40.00	7.76	6.70	7.23
Prunus virginiana	26857.	40.00	6.57	6.70	6.63
Acer saccharum	9143.	37.14	2.24	6.22	4.23
Thalictrum dioicum	23428.	14.29	5.73	2.39	4.06
Hydrophyllum virginianum	8571.	17.14	2.10	2.87	2.48
Geranium maculatum	7428.	17.14	1.82	2.87	2.34
Rhamnus catharticus	3429.	22.86	.84	3.83	2.33
Ulmus rubra	3714.	20.00	.91	3.35	2.13
Aster macrophyllus	9428.	11.43	2.31	1.91	2.11

Table 23 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus serotina	5714.	14.29	1.40	2.39	1.89
Arisaema triphyllum	6571.	11.43	1.61	1.91	1.76
Ribes americanum	3714.	14.29	.91	2.39	1.65
Maianthemum canadense	5143.	11.43	1.26	1.91	1.59
Carex albursina	2857.	11.43	.70	1.91	1.31
Fagus grandifolia	2000.	11.43	.49	1.91	1.20
Carex interior	7143.	2.86	1.75	.48	1.11
Viola cucullata	4857.	5.71	1.19	.96	1.07
Eupatorium pupereum	4571.	5.71	1.12	.96	1.04
Lonicera xbella	2571.	8.57	.63	1.44	1.03
Geum canadense	2286.	8.57	.56	1.44	1.00
Quercus borealis	1143.	8.57	.28	1.44	.86
Actea alba	857.	8.57	.21	1.44	.82
Carya cordiformis	857.	8.57	.21	1.44	.82
Dioscorea villosa	3143.	2.86	.77	.48	.62
Oxalis europea	1143.	5.71	.28	.96	.62
Aralia racemosa	571.	5.71	.14	.96	.55
Hepatica acutiloba	1143.	2.86	.28	.48	.38
Podophyllum peltatum	1143.	2.86	.28	.48	.38
Solidago sp.	1143.	2.86	.28	.48	.38
Amphicarpa bracteata	857.	2.86	.21	.48	.34
Arabis canadensis	571.	2.86	.14	.48	.31
Dirca palustris	571.	2.86	.14	.48	.31
Acer negundo	286.	2.86	.07	.48	.27
Allium tricoccum	286.	2.86	.07	.48	.27
Ostrya virginiana	286.	2.86	.07	.48	.27
Rubus odoratus	286.	2.86	.07	.48	.27
Solanum dulcamara	286.	2.86	.07	.48	.27
Trillium grandiflorum	286.	2.86	.07	.48	.27
Xanthium strumarium	286.	2.86	.07	.48	.27
Total	408851.		100.00	100.00	100.00

Bradley Woods

Site 24
Size: 2.43ha
Milwaukee County

Menomonee Falls Quadrangle
N2/3, NE¼, SW¼, Sec 9, T8N, R21E
City of Mlwaukee

Bradley Woods is located on a southeast facing slope near the crest of a Cary end moraine. Topographic relief within the stand is approximately 10m. The forest is developed on Ozaukee silt loam soil (Typic Hapludalf) which is characterized as being well-drained and typical of morainic uplands. Small depressions in the southeast and northern sections of the island are typified by the somewhat poorly drained Mequon silt loam (Udollic Ochraqualf).

The land-use history of the island is largely unknown. About 50 years ago, the woods was grazed for a short time by cattle. At about the same time, elm *(Ulmus sp.)* trees were removed. Little disturbance has occurred in the woods for the past 50 years until just recently. Until at least the mid-1960s, the island was approximately 7.5ha (18.7a) in size and separated from another 5ha tract by only a powerline right-of-way. Development in the past few years has reduced the island by two-thirds through the construction of a railroad spur and factory. The present island is bounded on the west and north by cropland. The east is bounded by the railroad spur and powerline right-of-way, and the south by a new factory.

The canopy and understory strata were sampled using twenty 10 x 25m plots. Sugar maple *(Acer saccharum)* and American beech *(Fagus grandifolia)* dominated the island with 49% of the stem density, 55% of the basal area and 47% of the importance value (Table 24 **A**). Stem density and basal area per hectare were almost equal to the average for the 43 islands (Table 2). The size class distributions were indicative of an old-growth southern-mesic forest (Table 24 **B**). A reduced density of stems in the 45-55cm (17.8-21.6in) dbh size classes may indicate light selective cutting sometime in the past.

Species richness was below average, but species diversity (H') was brought above average by a moderately high equitability (J') (Table 3). The understory (stems 2.5-10.1cm dbh) was dominated by sugar maple, which comprised 37% of the stems. White ash *(Fraxinus americana)* and ironwood *(Ostrya virginiana)* contribute another 37% of the stems (Table 24 **B**).

Three species: sugar maple, choke cherry *(Prunus virginiana)*, and dogberry *(Ribes cynosbati)* accounted for 64% of the stems sampled in the shrub stratum (Table 24 **C**). Bradley Woods had the second densest shrub layer of the 43 islands sampled (Table 2). Both species richness and species diversity (H') for this island were well above the average for the 43 islands (Table 3). Only four of the 22 species sampled in the shrub layer possesses wind-dispersed seeds. Contributing to the increased density and diversity of stems between 0.5-5.0m tall were the numerous openings in the canopy created by the dead and dying elms. In addition, the spring seasons of 1973 and 1974 were both characterized by high winds. A number of large old trees were windthrown, further opening the canopy.

The leading dominants of the shrub layer also lead in the groundlayer, but no single species was dominant. Dogberry had the greatest stem density but was of

limited distribution (Table 24 **D**). Sugar maple had the widest distribution and the third highest density. Choke cherry was the third in importance. An upland mesic orchid, the showy orchid *(Orchis spectabilis)*, was numerous and widespread in the woods. Although not considered rare or endangered, this was the only southern-mesic stand in which it was encountered. The species richness and species diversity (H') were greater than the average for the 31 islands for the same reasons as for the shrub stratum (Table 3): No rare or endangered species were encountered.

I would highly recommend this site for preservation because it represents the only remaining old-growth beech-maple forest in northern Milwaukee County. Species composition and community structure of all vegetational strata are indicative of a community not found elsewhere in the County. The site is of sufficiently large size to provide nesting habitat for the larger raptors (i.e., red-tailed hawk). Numerous den-trees, standing and down, provide much needed habitat for mammals. The region is being rapidly developed into an industrial park. This is the last remaining woods in this immediate area. The spring flora was especially showy with a high species richness. As this land is already held by the City, it may be possible to have it preserved as a research area.

Table 24 **A**. Stand attributes for Bradley Woods (Site 24)
Sample size: 20 plots (10 x 25m) Sample Date: June 3, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	118	90	10.52	26.46	21.18	35.08	27.57
Fagus grandifolia	100	70	5.92	22.42	16.47	19.76	19.55
Tilia americana	44	45	5.37	9.87	10.59	17.90	12.79
Ostrya virginiana	68	60	1.37	15.25	14.12	4.56	11.31
Fraxinus americana	54	65	1.79	12.11	15.29	5.97	11.12
Quercus borealis	22	25	3.55	4.93	4.93	5.88	7.55
Ulmus rubra	20	30	.99	4.48	7.06	3.30	4.95
Prunus serotina	12	25	.32	2.69	5.88	1.07	3.21
Carya cordiformis	6	10	.11	1.35	2.35	.35	1.35
Ulmus americana	2	5	.05	.45	1.18	.17	.60
Totals	446[a]		29.99[b]	100.01	100.00	100.01	100.00

a = 180 trees/acre
b = 130.66ft^2/acre

Table 24 **B**. Size class distribution for Bradley Woods
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Acer saccharum	76	28	11	13	12	4	5	5	1			3		1	1	3			162
Quercus borealis	1				1	2		2	3			1	1		1				12
Fagus grandifolia	4	7	10	6	11	9	7	4	1	1				1					61
Tilia americana	5	12	1		1	2	6	3	3	3	1	2							39
Fraxinus americana	20	39	16	4	2	2		1	2										86
Ulmus rubra	8	6	3	1	2	1	2	1											24
Prunus serotina	10	8	1	3	2														24
Ostrya virginiana	20	25	12	18	4														79
Carya cordiformis	2	5	2	1															10
Ulmus americana				1															1
Prunus virginiana	2	1																	3
Crataegus succulenta		1																	1
Celtis occidentalis		1																	1
Acer rubrum	1																		1
Totals	149	133	56	47	35	20	20	16	10	4	1	6	1	2	2	3			

Table 24**C**. Shrub composition for Bradley Woods sampled 6/3/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	8700.	90.00	29.10	10.98	20.04
Prunus virginiana	6060.	95.00	20.27	11.59	15.93
Ribes cynosbati	4280.	95.00	14.31	11.59	12.95
Tilia americana	2400.	85.00	8.03	10.37	9.20
Fraxinus americana	1560.	70.00	5.22	8.54	6.88
Fagus grandifolia	1000.	55.00	3.34	6.71	5.03
Lonicera xbella	1300.	35.00	4.35	4.27	4.31
Zanthoxylum americanum	380.	45.00	1.27	5.49	3.38
Ribes americanum	700.	35.00	2.34	4.27	3.30
Viburnum rafinesquianum	1120.	20.00	3.75	2.44	3.09
Carya cordiformis	300.	30.00	1.00	3.66	2.33
Rubus occidentalis	420.	25.00	1.40	3.05	2.23
Viburnum lentago	220.	30.00	.74	3.66	2.20
Ulmus rubra	560.	20.00	1.87	2.44	2.16
Rhamnus catharticus	140.	20.00	.47	2.44	1.45
Prunus serotina	120.	15.00	.40	1.83	1.12
Dirca palustris	60.	15.00	.20	1.83	1.01
Menispermum canadense	380.	5.00	1.27	.61	.94
Crataegus succulenta	60.	10.00	.20	1.22	.71
Quercus borealis	40.	10.00	.13	1.22	.68
Crataegus punctata	40.	10.00	.13	1.22	.68
Celtis occidentalis	60.	5.00	.20	.61	.41
Total	29900.		100.00	100.00	100.00

Table 24**D**. Groundlayer for Bradley Woods sampled 6/26/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	21250.	82.50	10.16	18.33	14.24
Ribes cynosbati	31500.	35.00	15.05	7.78	11.42
Prunus virginiana	23250.	42.50	11.11	9.44	10.28
Fraxinus americana	15750.	42.50	7.53	9.44	8.49
Arisaema triphyllum	15250.	37.50	7.29	8.33	7.81
Smilacina racemosa	15500.	25.00	7.41	5.56	6.48
Carex pennsylvanica	20250.	10.00	9.68	2.22	5.95
Geranium maculatum	11500.	12.50	5.50	2.78	4.14
Circaea quadrisulcata	4500.	17.50	2.15	3.89	3.02
Tilia americana	3250.	17.50	1.55	3.89	2.72
Thalictrum dioicum	8750.	5.00	4.18	1.11	2.65
Hepatica acutiloba	7500.	2.50	3.58	.56	2.07
Carya cordiformis	2000.	12.50	.96	2.78	1.87

Table 24 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Ribes americanum	4500.	5.00	2.15	1.11	1.63
Ulmus rubra	1000.	10.00	.48	2.22	1.35
Carex albursina	3250.	5.00	1.55	1.11	1.33
Allium tricoccum	2000.	7.50	.96	1.67	1.31
Rubus occidentalis	1500.	7.50	.72	1.67	1.19
Fagus grandifolia	1250.	7.50	.60	1.67	1.13
Trillium grandiflorum	2250.	5.00	1.08	1.11	1.09
Actea alba	1000.	7.50	.48	1.67	1.07
Gramineae	3000.	2.50	1.43	.56	.99
Geum canadense	1250.	5.00	.60	1.11	.85
Maianthemum canadense	1250.	5.00	.60	1.11	.85
Viburnum rafinesquianum	750.	5.00	.36	1.11	.73
Crataegus sp.	500.	5.00	.24	1.11	.68
Cornus racemosa	1000.	2.50	.48	.56	.52
Lonicera xbella	1000.	2.50	.48	.56	.52
Fragaria virginianum	750.	2.50	.36	.56	.46
Solidago caesia	500.	2.50	.24	.56	.40
Vitis sp.	500.	2.50	.24	.56	.40
Aster shortii	250.	2.50	.12	.56	.34
Daucas carota	250.	2.50	.12	.56	.34
Dioscorea villosa	250.	2.50	.12	.56	.34
Ostrya virginiana	250.	2.50	.12	.56	.34
Plantago major	250.	2.50	.12	.56	.34
Prunus serotina	250.	2.50	.12	.56	.34
Sanicula gregaria	250.	2.50	.12	.56	.34
Total	209250.		100.00	100.00	100.00

Brown Deer Park

Site 25
Size: 2.47ha
Milwaukee County

Thiensville Quadrangle
SE¼, NE¼, NW¼, Sec 13, T8N, R21E
Milwaukee County Park Commission

The woods at Brown Deer Park was located on a near-level Cary-aged ground moraine. There is little relief within the stand except for two widely separated depressions. The level area is characterized by Ozaukee silt loam soil (Typic Hapludalf), a well-drained soil typical of morainic features. The depressions are somewhat poorly drained with Mequon silt loam soil (Udollic Ochraqualf). The island is bounded on all sides by the mowed grasslands of park recreation areas.

The land-use history of the forest island is unknown. It has been under the protection of the County Park Commission since 1928. Major disturbance

has been limited to removal of dead trees by the County. Vandalism plays a major role in the current forest dynamics as evidenced by numerous sapling stumps. The size class distrubition of the tree species suggests early disturbance (Table 25 **B**). The partial absence of trees over the 50cm size class may be indicative of selective logging some years ago.

The forest was sampled using twenty 10 x 25m plots, taking care to avoid the depressional "habitat islands". American beech *(Fagus grandifolia)* and sugar maple *(Acer saccharum)* were co-dominant, accounting for 68% of the stems and over 50% of the basal area (Table 25 **A**). The sub-dominants, basswood *(Tilia americana)* and red oak *(Quercus borealis)* made up an additional 28% of the basal area, but only 17% of the stems. Species richness and species diversity (H') for the canopy and understory strata were average for the 43 islands studied (Table 3). The understory (stems 2.5-10.1cm dbh) was dominated by sugar maple which accounted for 54% of the stems. American beech and ironwood *(Ostrya virginiana)* were responsible for another 35% of the stems. Overall, these three mesic tree species represented 89% of the stems recorded (Table 25 **B**).

Choke cherry *(Prunus virginiana)* dominated the shrub layer comprising 72% of the stems and 45% of the importance value (Table 25 **C**). Species richness was considerably higher than expected for the shrub layer. Five exotic species contributed to the increased richness along with the wet-mesic species associated with the depressional "habitat islands". Even with the increased species richness, species diversity (H') was well below the average for the 43 islands because of the reduced equitability (J') component (Table 3); i.e., 72% of the stems were included in a single species.

Conversely, the groundlayer had the third highest species diversity (H') and nearly the highest species richness (Table 25 **D**). No single species dominated the groundlayer; a factor which contributed to the high species equitability (J'). Choke cherry and skullcap *(Scutellaria lateriflora)* were the most numerous species, and the only two to exceed 10% of the density. Skullcap, however, was not a dominant species but reached a locally high density in a single plot near a depression. At least 25% of the species encountered in the groundlayer were more typical of successional old-field communities. No rare or endangered species were encountered.

Table 25**A**. Stand attributes for Brown Deer Park (Site 25)
Sample size: 20 plots (10 x 25m) Sample Date: July 24, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Fagus grandifolia	220	85	7.59	43.48	21.52	25.76	30.25
Acer saccharum	122	95	7.42	24.11	24.05	25.16	24.44
Tilia americana	56	60	4.66	11.08	15.19	15.81	14.03
Quercus borealis	30	40	3.55	5.93	10.13	12.03	9.36
Ulmus rubra	20	25	.84	3.95	6.33	2.84	4.37
Fraxinus americana	14	20	1.44	2.77	5.06	4.88	4.24
Acer rubrum	12	15	.81	2.37	3.80	2.75	2.97
Prunus serotina	10	15	.60	1.98	3.80	2.05	2.61
Quercus alba	4	10	1.25	.79	2.53	4.24	2.52
Quercus bicolor	4	5	.95	.79	1.27	3.21	1.76
Ulmus americana	4	10	.18	.79	2.53	.62	1.31
Ostrya virginiana	6	10	.06	1.19	2.53	.20	1.31
Fraxinus pennsylvanica	4	5	.14	.79	1.27	.46	.84
Totals	506[a]		29.49[b]	100.02	100.01	100.01	100.01

a = 205 trees/acre
b= 128.46 ft^2/acre

Table 25 **B**. Size class distribution for Brown Deer Park
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus bicolor			1													1			2
Quercus borealis			2	2		2	4		2			1	1		1				15
Quercus alba													2						2
Acer saccharum	31	31	17	11	5	10	5	7	1	1	3		1						123
Fraxinus americana	1	1	1		2		1	1		1			1						9
Tilia americana		2		3	9	1	3	7	2	3									30
Acer rubrum			1	2		1		1		1									6
Fagus grandifolia	2	20	23	38	28	14	4	2	1										132
Prunus serotina	5	1	2		1			2											11
Ulmus rubra			3		3	3	1												10
Ulmus americana					2														2
Fraxinus pennsylvanica					2														2
Ostrya virginiana		17	3																20
Amelanchier laevis		1																	1
Rhamnus catharticus	2																		2
Totals	41	73	53	56	52	31	18	20	6	5	3	1	5		1	1			

Table 25**C**. Shrub composition for Brown Deer Park sampled 7/24/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	13060.	100.00	71.76	18.18	44.97
Acer saccharum	1140.	70.00	6.26	12.73	9.50
Ribes americana	1100.	45.00	6.04	8.18	7.11
Viburnum opulus	480.	45.00	2.64	8.18	5.41
Fraxinus americana	460.	45.00	2.53	8.18	5.35
Prunus serotina	480.	40.00	2.64	7.27	4.96
Fagus grandifolia	280.	35.00	1.54	6.36	3.95
Fraxinus nigra	140.	25.00	.77	4.55	2.66
Viburnum lantana	100.	20.00	.55	3.64	2.09
Ulmus rubra	120.	15.00	.66	2.73	1.69
Rhamnus catharticus	100.	15.00	.55	2.73	1.64
Viburnum lentago	80.	15.00	.44	2.73	1.58
Cornus stolonifera	180.	10.00	.99	1.82	1.40
Lonicera xbella	160.	10.00	.88	1.82	1.35
Acer rubrum	80.	10.00	.44	1.82	1.13
Menispermum canadense	40.	10.00	.22	1.82	1.02
Solanum dulcamara	60.	5.00	.33	.91	.62
Crataegus punctata	20.	5.00	.11	.91	.51
Vitis riparia	20.	5.00	.11	.91	.51
Carpinus caroliniana	20.	5.00	.11	.91	.51
Ostrya virginiana	20.	5.00	.11	.91	.51
Tilia americana	20.	5.00	.11	.91	.51
Cornus alternifolia	20.	5.00	.11	.91	.51
Euonymus alatus	20.	5.00	.11	.91	.51
Total	18200.		100.00	100.00	100.00

Table 25**D**. Groundlayer for Brown Deer Park sampled 7/30/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	37500.	42.50	13.81	9.77	11.79
Scutellara lateriflora	50000.	2.50	18.42	.57	9.50
Geranium maculatum	23000.	32.50	8.47	7.47	7.97
Fraxinus americana	17500.	37.50	6.45	8.62	7.53
Smilacina racemosa	13500.	37.50	4.97	8.62	6.80
Circaea quadrisulcata	19250.	25.00	7.09	5.75	6.42
Hydrophyllum virginianum	19000.	15.00	7.00	3.45	5.22
Acer saccharum	7750.	32.50	2.85	7.47	5.16
Thalictrum dioicum	16250.	10.00	5.99	2.30	4.14
Rhamnus catharticus	8500.	20.00	3.13	4.60	3.86
Geum canadense	5250.	22.50	1.93	5.17	3.55

Table 25 D continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Ribes americanum	6750.	15.00	2.49	3.45	2.97
Cornus racemosa	6000.	12.50	2.21	2.87	2.54
Solidago caesia	6000.	12.50	2.21	2.87	2.54
Carex pennsylvanica	5750.	12.50	2.12	2.87	2.50
Trillium grandiflorum	3500.	10.00	1.29	2.30	1.79
Carex albursina	3500.	7.50	1.29	1.72	1.51
Actea alba	1500.	7.50	.55	1.72	1.14
Aster macrophyllus	3000.	5.00	1.10	1.15	1.13
Gramineae	2500.	5.00	.92	1.15	1.04
Maianthemum canadense	1750.	5.00	.64	1.15	.90
Allium tricoccum	1000.	5.00	.37	1.15	.76
Ulmus rubra	1000.	5.00	.37	1.15	.76
Arisaema triphyllum	750.	5.00	.28	1.15	.71
Fagus grandifolia	750.	5.00	.28	1.15	.71
Xanthium strumarium	750.	5.00	.28	1.15	.71
Potentilla simplex	2250.	2.50	.83	.57	.70
Carex sp.	1750.	2.50	.64	.57	.61
Fragaria virginianum	750.	2.50	.28	.57	.43
Plantago major	500.	2.50	.18	.57	.38
Poa pratensis	500.	2.50	.18	.57	.38
Prunus serotina	500.	2.50	.18	.57	.38
Silene cucubalus	500.	2.50	.18	.57	.38
Smilax herbacea	500.	2.50	.18	.57	.38
Viola cucullata	500.	2.50	.18	.57	.38
Carpinus caroliniana	250.	2.50	.09	.57	.33
Cryptotaenia canadensis	250.	2.50	.09	.57	.33
Erigeron annuus	250.	2.50	.09	.57	.33
Impatiens pallida	250.	2.50	.09	.57	.33
Quercus borealis	250.	2.50	.09	.57	.33
Solanum dulcamara	250.	2.50	.09	.57	.33
Taraxacum officinale	250.	2.50	.09	.57	.33
Total	271500.		100.00	100.00	100.00

Rangeline Woods

Site 26
Size: 1.70ha
Milwaukee County

Thiensville Quadrangle
NW¼, NW¼, SW¼, Sec 16, T8N, R22E
Private Ownership

Rangeline Woods is located on a southwest-facing slope on Cary-aged ground moraine. The forest island is developed on the well-drained Ozaukee silt loam soil (Typic Hapludalf). Typically, this soil is formed on the convex side slopes of glacial moraines (USDA, 1971).

Much of the early land use history of the site is unknown. Examination of 1963 ASCS air photos indicates the stand was 2.11ha (5.2a) in size and part of a horse boarding stable. The woods was actively grazed by horses until the late 1960s. The presence of relatively large red oaks *(Quercus borealis)* indicates the stand has existed for some time (Table 26 **B**). By mid-summer 1975, developers had begun to create a subdivision in and around the island. A north-south swath was cut through the island, bisecting and reducing it to 1.7ha (4.2a). The island was further developed and, at the time of this writing, the western half has three homes constructed within the woods.

The canopy and understory was sampled using sixteen 10 x 12.5m plots (eight in each remaining half). The island was dominated by sugar maple *(Acer saccharum)* which accounted for 40% of the density, 30% of the basal area, and 33% of the importance value (Table 26 **A**). The majority of sugar maple was in the smaller size classes suggesting the stand is recovering from prior logging (Table 26**B**). Red oak was subdominant accounting for another 30% of the basal area, but only 11% of the stems. Size class distributions reflect the recent period of grazing with very few stems between 2.5-10.1cm dbh. The absence of large individuals of white oak *(Quercus alba)* and American beech *(Fagus grandifolia)* may also be indicative of selective logging. Stem density and basal area per hectare were near the average for the 43 islands sampled. But species richness in the canopy stratum was well below the average (Table 2), however species diversity (H') was only slightly below the average because of the high equitability (J') component (Table 3).

The stem density per hectare in the shrub stratum was the highest of all 43 stands sampled. Choke cherry *(Prunus virginiana)* accounted for 69% of the stems and over 42% of the importance value (Table 26 **C**). Dogberry *(Ribes cynosbati)* was the only other species to represent more than 8% of the stems. Although species richness was higher than average (Table 2), species diversity (H') was low because of the low equitability (J') component; i.e., 69% of the individuals were one species (Table 3).

Likewise, choke cherry dominated the groundlayer accounting for 35% of the stems and 33% of the importance value (Table 26 **D**). White ash *(Fraxinus americana)* was sub-dominant, but represented only 16% of the stems. Although not dominant, the European orchid, helleborine *(Epipactis latifolia)* reached locally high densities. Species diversity (H') of the groundlayer was the sixth lowest of the 31 sites sampled (Table 3). No rare or endangered species were observed.

Table 26A. Stand attributes for Rangeline Woods (Site 26)
Sample size: 16 plots (10 x 12.5m) Sample Date: September 24, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	185	81	9.19	39.78	28.89	30.02	32.90
Quercus borealis	50	38	8.93	10.75	13.33	29.15	17.74
Ostrya virginiana	85	56	1.24	18.28	20.00	4.05	14.11
Fagus grandifolia	70	31	2.64	15.05	11.11	8.63	11.60
Tilia americana	40	31	3.92	8.60	11.11	12.79	10.83
Fraxinus americana	25	31	3.76	5.38	11.11	12.27	9.59
Ulmus rubra	5	6	.49	1.08	2.22	1.59	1.63
Quercus alba	5	6	.46	1.08	2.22	1.50	1.60
Totals	465[a]		30.63[b]	100.00	99.99	100.00	100.00

a = 188 trees/acre
b = 133.46 ft^2/acre

Table 26 **B**. Size class distribution for Rangeline Woods
Sample size: 0.2ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus borealis							1	3	1	3			1		1				10
Acer saccharum	1	4	9	8	7	6	4	1	1			1							42
Fraxinus americana	2	2						2	1	1	1								9
Tilia americana				1	4					2	1								8
Ulmus rubra								1											1
Fagus grandifolia	3		4	1	5	3	1												17
Quercus alba							1												1
Ostrya virginiana		3	12	5															20
Totals	6	9	25	15	16	9	7	7	3	6	2	1	1		1				

Table 26**C**. Shrub composition for Rangeline Woods sampled 9/24/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	20775.	100.00	69.13	15.53	42.33
Ribes cynosbati	2525.	50.00	8.40	7.77	8.08
Fraxinus americana	1025.	56.25	3.41	8.74	6.07
Ribes americanum	725.	56.25	2.41	8.74	5.58
Lonicera xbella	1375.	37.50	4.58	5.83	5.20
Acer saccharum	1075.	43.75	3.58	6.80	5.19
Vitis riparia	275.	56.25	.92	8.74	4.83
Cornus racemosa	525.	31.25	1.75	4.85	3.30
Rhamnus frangula	325.	31.25	1.08	4.85	2.97
Viburnum lantana	225.	31.25	.75	4.85	2.80
Tilia americana	175.	25.00	.58	3.88	2.23
Euonymus atropurpureus	125.	18.75	.42	2.91	1.66
Viburnum lentago	100.	18.75	.33	2.91	1.62
Fagus grandifolia	75.	18.75	.25	2.91	1.58
Rhamnus catharticus	75.	18.75	.25	2.91	1.58
Solanum dulcamara	350.	6.25	1.16	.97	1.07
Rubus occidentalis	50.	12.50	.17	1.94	1.05
Menispermum canadense	150.	6.25	.50	.97	.74
Ulmus rubra	25.	6.25	.08	.97	.53
Acer negundo	25.	6.25	.08	.97	.53
Prunus serotina	25.	6.25	.08	.97	.53
Ostrya virginiana	25.	6.25	.08	.97	.53
Total	30050.		100.00	100.00	100.00

Table 26**D**. Groundlayer for Rangeline Woods sampled 9/27/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	64000.	90.00	34.74	31.58	33.16
Fraxinus americana	29500.	62.50	16.01	21.93	18.97
Circaea quadrisulcata	22000.	20.00	11.94	7.02	9.48
Thalictrum dioicum	22500.	17.50	12.21	6.14	9.18
Carex pennsylvanica	26750.	7.50	14.52	2.63	8.57
Cornus racemosa	3500.	10.00	1.90	3.51	2.70
Acer saccharum	2000.	10.00	1.09	3.51	2.30
Geranium maculatum	1750.	10.00	.95	3.51	2.23
Vitis sp.	1250.	7.50	.68	2.63	1.66
Hydrophyllum virginianum	2000.	5.00	1.09	1.75	1.42
Euonymus atropurpureus	1250.	5.00	.68	1.75	1.22
Geum canadense	1000.	5.00	.54	1.75	1.15
Aster macrophyllus	500.	5.00	.27	1.75	1.01
Dioscorea villosa	500.	5.00	.27	1.75	1.01

Table 26 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Tilia americana	500.	5.00	.27	1.75	1.01
Gramineae	1500.	2.50	.81	.88	.85
Smilacina racemosa	1000.	2.50	.54	.88	.71
Ribes americanum	750.	2.50	.41	.88	.64
Epipactis latifolia	750.	2.50	.41	.88	.64
Menispermum canadense	500.	2.50	.27	.88	.57
Carex blanda	250.	2.50	.14	.88	.51
Caulophyllum thalictroides	250.	2.50	.14	.88	.51
Solidago flexicaulis	250.	2.50	.14	.88	.51
Total	184250.		100.00	100.00	100.00

Tripoli Country Club

Site 27
Size: 2.51ha.
Milwaukee County

Thiensville Quadrangle
NE¼, NW¼, SE¼, Sec 14, T8N, R21E
Private Ownership

The forest island of Tripoli Country Club is located on the north-facing slope and foot of a large morainic ridge. Maximum relief is about 9m (30ft). An eroded Ozaukee silt loam soil (Typic Hapludalf) occupies the upper slope. With part of the surface of this soil lost, runoff is increased and infiltration is reduced (USDA, 1971). A narrow band of somewhat poorly drained Mequon silt loam (Udollic Ochraqualf) exists at the base of the slope. Standing water was observed in this area and a "habitat island" of mature lowland forest persisted there.

Little of the early history of the forest island is known except that it was originally a farm woodlot. The presence of large, open-grown American beech *(Fagus grandifolia)* near the center and northern end of the island suggests that it must have been heavily logged, and even pastured, prior to purchase by the Tripoli Country Club in 1923. The woods has been left undisturbed for the past 52 years except for the removal of some fallen trees, according to Mr. James Bellfield, greenskeeper.

The canopy and understory strata were sampled using twenty 10 x 12.5m plots. Basswood *(Tilia americana)* was the leading dominant accounting for 51% of the stems, 32% of the basal area and over 37% of the importance value (Table 27 **A**). It should be noted, however, that basswood was restricted entirely to the size classes les than 35cm (13.7in) dbh, with 92% of the stems less than 25cm (9.8in) dbh (Table 27 **B**). The sub-dominants, white ash *(fraxinus americana)* and black cherry *(Prunus serotina)*, combined accounted for another 29% of the stems and 19% of the basal area, but were also restricted to the smaller size classes (Table 27 **B**). The near absence of trees in the larger size classes suggests the site was heavily logged around the turn of the century. Stem density ($\geq$ 10.2cm) was significantly greater than the average of the 43 islands (Table 2). This forest structure is typical of a young, second-growth stand. Species richness was greatly enhanced by the presence of the lowland species of the wet-mesic "habitat island." As a result, species diversity (H') for the canopy and understory strata was slightly higher than the average (Table 3).

The shrub layer was dominated by choke cherry *(Prunus virginiana)* accounting for nearly 35% of the stems and 24% of the importance value (Table 27 **C**). The shrub layer displayed a successional structure and composition resulting from heavy disturbance. Stem density of the shrub stratum was considerably higher than the average. Species richness was higher than average, but also attributable to the wet-mesic "habitat island" and its associated species. Similarly, species diversity (H') was somewhat higher than average (Table 3). Only five of the 23 species recorded had wind-dispersed seeds. The groundlayer was not sampled, but no rare or endangered species were encountered.

Table 27**A**. Stand attributes for Tripoli Country Club (Site 27)
Sample size: 20 plots (10 x 12.5m) Sample Date: October 6, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Tilia americana	352	90	9.56	51.46	28.13	32.37	37.32
Fraxinus americana	112	60	3.55	16.37	18.75	12.01	15.71
Prunus serotina	84	35	1.68	12.28	10.94	5.70	9.64
Fagus grandifolia	28	25	3.23	4.09	7.81	10.94	7.61
Quercus borealis	24	25	1.86	3.51	7.81	6.29	5.87
Acer saccharum	16	20	2.59	2.34	6.25	8.78	5.79
Fraxinus nigra	28	20	.52	4.09	6.25	1.77	4.04
Quercus alba	4	5	2.88	.58	1.56	9.75	3.96
Acer saccharinum	8	5	1.28	1.17	1.56	4.34	2.36
Quercus macrocarpa	4	5	1.24	.58	1.56	4.21	2.12
Acer rubrum	4	5	.72	.58	1.56	2.43	1.52
Quercus bicolor	4	5	.16	.58	1.56	.54	.89
Acer negundo	4	5	.09	.58	1.56	.30	.81
Carya cordiformis	4	5	.07	.58	1.56	.23	.79
Crataegus succulenta	4	5	.06	.58	1.56	.21	.78
Ulmus americana	4	5	.03	.58	1.56	.11	.75
Totals	684[a]		29.52[b]	99.95	99.98	99.98	99.97

a = 277 trees/acre
b = 128.73 ft^2/acre

Table 27 **B**. Size class distribution for Tripoli Country Club
Sample size: 0.25ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus alba		1															1		2
Quercus macrocarpa													1						1
Acer saccharum	3	2			1				2				1						9
Fagus grandifolia	4	6	2	1					1		3								17
Acer saccharinum	1							1			1								3
Acer rubrum										1									1
Quercus borealis	1		1			3			2										7
Fraxinus americana	1	3	4	13	9	1		1											32
Tilia americana	8	23	36	27	15	7	3												119
Prunus serotina	3	6	11	8	2														30
Fraxinus nigra		1	5	1	1														8
Quercus bicolor		1			1														2
Acer negundo				1															1
Ulmus americana	2	2	1																5
Crataegus succulenta	8	7	1																16
Carya cordiformis			1																1

Table 27 **B** continued

Species	SIZE CLASS (centimeters)																	
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	**Total**
Crataegus punctata	3	2																	5
Rhus typhina		1																	1
Carya ovata		1																	1
Rhamnus cathartica	1																		1
Vitis riparia	4																		4
Totals	39	56	62	51	29	11	3	2	5	1	4		2			1			

Table 27 **C**. Shrub composition for Tripoli Country Club Sampled 10/6/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	8060.	85.00	34.50	13.49	24.00
Ribes americanum	2520.	75.00	10.79	11.90	11.35
Prunus serotina	2500.	70.00	10.70	11.11	10.91
Acer saccharum	2380.	60.00	10.19	9.52	9.86
Fraxinus americana	1820.	65.00	7.79	10.32	9.05
Cornus racemosa	1360.	35.00	5.82	5.56	5.69
Vitis riparia	840.	45.00	3.60	7.14	5.37
Lonicera xbella	1200.	30.00	5.14	4.76	4.95
Solanum dulcamara	1540.	10.00	6.59	1.59	4.09
Tilia americana	440.	35.00	1.88	5.56	3.72
Viburnum lentago	160.	30.00	.68	4.76	2.72
Rhamnus catharticus	160.	20.00	.68	3.17	1.93
Rubus occidentalis	80.	15.00	.34	2.38	1.36
Crataegus succulenta	80.	10.00	.34	1.59	.96
Acer negundo	60.	5.00	.26	.79	.53
Parthenocissus quinquefolia	20.	5.00	.09	.79	.44
Carya cordiformis	20.	5.00	.09	.79	.44
Rhus radicans	20.	5.00	.09	.79	.44
Viburnum opulus	20.	5.00	.09	.79	.44
Ulmus americana	20.	5.00	.09	.79	.44
Viburnum rafinesquianum	20.	5.00	.09	.79	.44
Zanthoxylum americanum	20.	5.00	.09	.79	.44
Quercus borealis	20.	5.00	.09	.79	.44
Total	23360.		100.00	100.00	100.00

Brynwood Country Club

Site 28
Size: 0.36ha
Milwaukee County

Thiensville Quadrangle
NE¼, NE¼, SE¼, Sec 15, T8N, R21E
Private Ownership

The Brynwood Country Club island is located on the crest and southwest-facing slope of a small hill. Topographic relief of 6m (20ft) is great, when considering the small size of the island. The woods is developed on an eroded Ozaukee silt loam soil (Typic Hapludalf). The soil has lost part of its original surface layer resulting in a higher runoff and slower permeability (USDA, 1971).

Much of the land use history was obtained for the original greenskeeper, Mr. Les Verhaalen, Sr., now retired. The present island is a remnant of a much larger woods which was logged for basswood *(Tilia americana)* about 1909 and later for sugar maple *(Acer saccharum)* about 1914. There is no record of grazing and the richness of the spring flora indicates this. The golf course was constructed in 1928 creating the isolation and present small size of the island. The structure of the present forest is the result of over 60 years of recovery.

The canopy and understory strata were sampled in a full-census of the 0.36ha. American beech *(Fagus grandifolia)* was the leading dominant accounting for 38% of the stems and 42% of the basal area (Table 28 **A**). The stand was characterized by a very high stem density (over twice the expected number) and near-average basal area (Table 2). A few large sugar maples and beech were the only stems greater than 40cm (15.7in) dbh (Table 28 **B**). This structure is typical of a young, second-growth stand but is also the result of the relatively recent loss of 29 elms *(Ulmus rubra* and *U. americana)* greater than 10.2cm dbh in the site. The resultant opening of the canopy and the small size of the island combine to increase available light appreciably. The understory was relatively dense and dominated by mesic species. Sugar maple, beech and ironwood *(Ostrya virginiana)* accounted for 88% of the 421 stems recorded between 2.5-10.1cm dbh (Table 28 **B**). Species diversity (H') is near the average for the 43 forest islands (Table 3).

The shrub layer was dominated by choke cherry *(Prunus virginiana)* accounting for 53% of the stems and 36% of the importance value. White ash and sugar maple were sub-dominant combining for an additional 28% of the density and 31% of the importance value (Table 28 **C**). No other species accounted for over 5% of the stem density. Total stem density per hectare was well under the average for the 43 islands sampled. Species diversity (H') was near the average for the shrub stratum (Table 3).

The groundlayer was not sampled, but no rare or endangered species were observed.

Table 28 **A**. Stand attributes for Brynwood Country Club (Site 28)
Full Tally (0.36ha.) Sample Date: October 6, 1975.

Species	Density	Basal Area (m^2/ha)	Relative Density	Relative Dominance	Importance Value
Fagus grandifolia	357	12.21	38.36	42.32	40.34
Tilia americana	176	5.52	18.93	19.12	19.03
Ostrya virginiana	164	2.36	17.65	8.99	12.92
Acer saccharum	90	4.13	9.72	14.31	12.02
Fraxinus americana	55	2.15	5.88	7.46	6.67
Ulmus rubra	33	1.16	3.58	4.02	3.80
Ulmus americana	21	.60	2.30	2.08	2.19
Crataegus succulenta	10	.19	1.02	.66	.84
Carya cordiformis	5	.05	.51	.16	.34
Carpinus caroliniana	2	.04	.26	.12	.19
Amelanchier laevis	2	.02	.26	.08	.17
Totals	929[a]	28.86[b]	100.00	100.01	100.02

a = 376 trees/acre
b = 125.76 ft^2/acre

Table 28**B**. Size class distribution for Brynwood Country Club
Sample size: 0.36ha.

Species	SIZE CLASS (centimeters)																	
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	**Total**
Acer saccharum	129	66	19	8	2	2	4	1				1				1			233
Fagus grandifolia	36	48	42	47	37	13	5	2	3			1							234
Tilia americana	8	13	24	24	16	4	2	4											95
Ulmus rubra	1	3	5	2	4	1	1	1											20
Fraxinus americana	5	8	4	6	5	7		1											36
Ulmus americana		2	5	1	2		1												11
Prunus serotina	1		1	3	2														7
Ostrya virginiana	18	72	57	11	1														159
Crataegus succulenta		1	1	3															5
Carpinus caroliniana	5	3	1																9
Carya cordiformis		1	2																3
Amelanchier laevis			1																1
Crataegus punctata		1																	1
Totals	203	218	162	105	69	27	13	9	3			2				1			

Table 28C. Shrub composition for Brynwood Country Club Sampled 10/6/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	5940.	90.00	52.57	18.95	35.76
Fraxinus americana	1980.	80.00	17.52	16.84	17.18
Acer saccharum	1140.	85.00	10.09	17.89	13.99
Tilia americana	540.	55.00	4.78	11.58	8.18
Lonicera xbella	340.	25.00	3.01	5.26	4.14
Ribes cynosbati	340.	20.00	3.01	4.21	3.61
Dirca palustris	140.	25.00	1.24	5.26	3.25
Solanum dulcamara	220.	10.00	1.95	2.11	2.03
Rubus occidentalis	80.	15.00	.71	3.16	1.93
Zanthoxylum americanum	60.	15.00	.53	3.16	1.84
Ribes americanum	120.	10.00	1.06	2.11	1.58
Fagus grandifolia	80.	10.00	.71	2.11	1.41
Ostrya virginiana	40.	10.00	.35	2.11	1.23
Ulmus rubra	120.	5.00	1.06	1.05	1.06
Cornus stolonifera	80.	5.00	.71	1.05	.88
Carya cordiformis	40.	5.00	.35	1.05	.70
Crataegus succulenta	20.	5.00	.18	1.05	.61
Rhamnus catharticus	20.	5.00	.18	1.05	.61
Total	11300.		100.00	100.00	100.00

Haskell Noyes Park

Site 29 — Menomonee Falls Quadrangle
Size: 0.73ha — NE¼, NE¼, NW¼, Sec 21, T8N, R21E
Milwaukee County — Milwaukee County Park Commission

Haskell Noyes Park is located on the crest of a Cary-aged end moraine. Relief within the forest island is near-level except for a small, intermittent stream. The Southern-mesic forest is developed on Ozaukee silt loam soil (Typic Hapludalf). This soil is classified as being well-drained and formed over a calcareous silty clay loam glacial till on moraines. The somewhat poorly drained Mequon silt loam (Udollic Ochraqualf) was associated with the stream drainageway.

The wooded island of Haskell Noyes Park encompasses 11.2ha, but all except 0.73ha was young, second-growth forest. Edge trees clearly separated the old-growth section from the new growth. The land-use history of the forest island is unknown. It is obvious that the woods was originally part of a farm as the foundations are still evident just outside the southwest corner of the woods. It appeared that the old-growth island was at least partially protected from grazing by the presence of lines of edge trees with faint barbed wire scars. Trees with an open-growth form and dense sapling and shrub growth exist to the outside of the edge trees. Within the edge trees, large forest-grown trees typical of the southern-mesic forest form a complete canopy. In an effort to preserve the woods for future use as a nature study area, the Milwaukee County Park Commission fenced the perimeter of the entire island in 1968 (MCPC, 1972).

The fencing has done little to protect the site from indiscriminate vandals. Virtually all small saplings have been cut from the old-growth section. Two large American beech *(Fagus grandifolia)* were killed by girdling, creating a large opening in the canopy. During the 1975-76 winter, the groundlayer was burned, eliminating the litter layer and small woody stems.

The canopy and understory strata were sampled by a full-census of all stems within a 0.43ha area. Sugar maple *(Acer saccharum)* was the dominant species accounting for 46% of the stems and 49% of the basal area (Table 29 **A**). Sugar maple was present in all size classes up to 65cm (25.5in) dbh. A reduced density of stems in the 35-45cm (13.8-17.7in) dbh size classes for all species suggests a short period of grazing some time ago. The conspicuous lack of oaks *(Quercus sp.)* in all but the largest size classes may reflect a period of high-grade logging (Table 29 **B**).

Vandalism has reduced the understory to a very low density as evidenced by the number of small stumps. White ash *(Fraxinus americana)* and black cherry *(Prunus serotina)* were the most numerous species accounting for a combined 56% of the stems 2.5-10.1cm dbh. The hawthorns *(Crataegus punctata* and *C. succulenta)* make up an additional 27% of the stems (Table 29 **B**), further indicating possible former grazing.

The stem density per hectare in the canopy layer was significantly below the average for the 43 forest islands, but the basal are was near average (Table 2). As a result, the average size per tree was relatively large creating the false impression of an undisturbed situation. Species diversity (H') for the canopy and understory strata was slightly above average with a high equitability (J') component (Table 3).

White ash dominated the shrub layer comprising 44% of the stems and 34% of the importance value (Table 29 **C**). Choke cherry *(Prunus virginiana)* was subdominant accounting for 27% of the stems and 24% of the importance value. In view of the heavy disturbance, it is interesting to note that only three of the 12 species have wind-dispersed seeds. Species richness was well below average because of the moderate equitability (J') component (Table 3).

The groundlayer was co-dominated by false Solomon's-seal *(Smilacina racemosa)* and, as in the shrub layer, white ash. Together, they accounted for over 53% of the stems recorded and 44% of the importance value (Table 29 **D**). Examination of the groundlayer flora indicated a large component of successional, old field species. Species diversity (H') was near the average for the 31 stands examined (Table 3). No rare or endangered species were encountered.

Table 29 **A**. Stand attributes for Haskell Noyes Park (Site 29)
Full Tally (0.43 hectare) Sample Date: July 11, 1975.

Species	Density	Basal Area (m^2/ha)	Relative Density	Relative Dominance	Importance Value
Acer saccharum	123	13.86	45.69	48.55	37.12
Fraxinus americana	33	6.08	12.07	21.29	16.68

Table 29A continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Ostrya virginiana	49	1.13	18.10	3.96	11.03
Fagus grandifolia	21	2.20	7.76	7.71	7.73
Quercus alba	7	2.73	2.59	9.58	6.08
Crataegus succulenta	23	.37	8.62	1.29	4.96
Quercus borealis	2	1.24	.96	4.36	2.61
Prunus serotina	7	.53	2.59	1.85	2.22
Juglans cinerea	2	.22	.86	.77	.82
Ulmus rubra	2	.18	.86	.64	.75
Totals	269[a]	28.54[b]	100.00	100.00	100.00

a = 109 trees/acre
b = 124.38 ft²/acre

Table 29**B**. Size class distribution for Haskell Noyes Park
Sample size: 0.43ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus borealis																1			1
Quercus alba														2		1			3
Fraxinus americana	15	2			2		2			4	1	2	1	2					31
Acer saccharum	4	3	1	3	7	9	8	5	5	9	2	2	2						60
Prunus serotina	14	5	1		1					1									22
Fagus grandifolia					2	1	2	1	1	2									9
Ulmus rubra							1												1
Juglans cinerea							1												1
Ostrya virginiana	1	3	8	9	3	1													25
Crataegus succulenta		7	6	3	1														17
Crataegus punctata	2	8																	10
Totals	36	28	16	15	16	11	14	6	6	16	3	4	3	4		2			

Table 29**C**. Shrub composition for Haskell Noyes Park Sampled 7/11/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	6360.	100.00	44.04	23.81	33.93
Prunus virginiana	3920.	90.00	27.15	21.43	24.29
Prunus serotina	1580.	70.00	10.94	16.67	13.80
Ribes cynosbati	1600.	65.00	11.08	15.48	13.28
Acer saccharum	120.	25.00	.83	5.95	3.39
Rubus occidentalis	100.	15.00	.69	3.57	2.13
Vitis riparia	60.	15.00	.42	3.57	1.99
Cornus stolonifera	220.	10.00	1.52	2.38	1.95
Lonicera xbella	220.	10.00	1.52	2.38	1.95
Ribes americanum	120.	10.00	.83	2.38	1.61
Tilia americana	100.	5.00	.69	1.19	.94
Sambucus canadensis	40.	5.00	.28	1.19	.73
Total	14440.		100.00	100.00	100.00

Table 29**D**. Groundlayer for Haskell Noyes Park sampled 6/11/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Smilacina racemosa	133250.	90.00	31.32	16.67	23.99
Fraxinus americana	94000.	97.50	22.09	18.06	20.07
Circaea quadrisulcata	62750.	35.00	14.75	6.48	10.61
Acer saccharum	17250.	67.50	4.05	12.50	8.28
Ribes cynosbati	21000.	57.50	4.94	10.65	7.79
Prunus virginiana	23250.	52.50	5.46	9.72	7.59
Geranium maculatum	20250.	30.00	4.76	5.56	5.16
Trillium grandiflorum	17750.	12.50	4.17	2.31	3.24
Prunus serotina	5250.	15.00	1.23	2.78	2.01
Hydrophyllum virginianum	9250.	5.00	2.17	.93	1.55
Carex albursina	2500.	7.50	.59	1.39	.99
Geum canadense	1500.	7.50	.35	1.39	.87
Ulmus rubra	500.	7.50	.12	1.39	.75
Allium tricoccum	4000.	2.50	.94	.46	.70
Vitis sp.	2000.	5.00	.47	.93	.70
Solidago caesia	2000.	5.00	.47	.93	.70
Carex pennsylvanica	1500.	5.00	.35	.93	.64
Solidago flexicaulis	1250.	5.00	.29	.93	.61
Cornus stolonifera	1000.	5.00	.24	.93	.58
Fagus grandifolia	750.	5.00	.18	.93	.55
Potentilla simplex	1000.	2.50	.24	.46	.35
Fragaria virginianum	750.	2.50	.18	.46	.32

Table 29 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Aster cordifolius	750.	2.50	.18	.46	.32
Sambucus canadensis	500.	2.50	.12	.46	.29
Rubus occidentalis	500.	2.50	.12	.46	.29
Crataegus punctata	250.	2.50	.06	.46	.26
Tilia americana	250.	2.50	.06	.46	.26
Ribes americanum	250.	2.50	.06	.46	.26
Polygonatum pubescens	250.	2.50	.06	.46	.26
Total	425500.		100.00	100.00	100.00

Kletzsch Park

Site 30 — Thiensville Quadrangle
Size: 4.09ha — E½, NE¼, SE¼, Sec 19, T8N, R22E
Milwaukee County — Milwaukee County Park Commission

The forested island at Kletzsch Park exists on a small upland on the west side of the Milwaukee River above the floodplain. The floodplain and upland lie on an outwash plain. The topography slopes gently to the east-southeast. The forest is developed on Fox loam soil (Typic Hapludalf). Fox loam typically overlies sand and calcareous gravel outwash. As a result, it is well-drained and may be characterized as being slightly droughty (USDA, 1971).

The land-use history of the woods is unknown. Reputed Indian activity in the Park's vicinity prior to settlement is evidenced by an Indian mound and remnant furrows of a corn field (MCPC, 1972). The Park was also the site of a grist mill (Bender Mill) which was probably built in the late 1800s. Kletzsch Park, formerly known as Blatz Park, was established in 1918. Little or no logging has occurred since that time except for the removal of hazardous conditions.

The canopy and understory strata were sampled using twenty 10 x 25m plots. The canopy was co-dominated by sugar maple *(Acer saccharum)* and red oak *(Quercus borealis)* accounting for 79% of the density, 90% of the basal area, and 75% of the importance value (Table 30 **A**). Red oak was present in the 20-70cm (7.9-27.5in) dbh size classes representing the largest trees in the stand (Table 30 **B**). The relative absence of larger individuals suggests probable selective cutting, light in total amount. Twelve species were recorded in the canopy layer, the average for the 43 forest islands (Table 2).

The understory, stems 2.5-10.1cm dbh, was dominated by ironwood *(Ostrya virginiana)* and sugar maple accounting for 44% and 20% of the stem density, respectively. The species diversity (H') for the canopy and understory strata was only slightly above the average for the 43 forest islands (Table 3).

The shrub stratum was totally dominated by choke cherry *(Prunus virginiana)* with 86% of the stem density and 58% of the importance value (Table 30 **C**). No other species exceeded 5% of the stem density. White ash *(Fraxinus americana)* was the only other species to be distributed in over one-third of the plots. Stem density per hectare was over a standard deviation greater than the average for the 43 forest islands (Table 2). Species richness was only slightly below the average, but species diversity (H') was the fourth lowest of the 43 islands sampled (Table 3). With 86% of the stems occurring in a single species, the equitability component (J') was low.

Similarly, choke cherry was the leading dominant in the groundlayer accounting for nearly 27% of the stems and importance value. However, two herbaceous species, the false Solomon's seal *(Smilacina racemosa)* and Virginiana waterleaf *(Hydrophyllum virginianum)* accounted for an additional 38% of the stems. Although not sampled, helloborine *(Epipactus latifolia)* reached locally high densities in the stand and appears to have become a tolerant member of the southern-mesic forest. Groundlayer species diversity (H') was slightly below the average for the 31 islands sampled even though species richness was relatively low. No rare endangered species were encountered.

Table 30 **A**. Stand attributes for Kletzsch Park (Site 30)
Sample size: 20 plots (10 x 25m) Sample Date: July 23, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	208	95	15.63	56.83	31.67	46.68	45.06
Quercus borealis	82	75	14.34	22.40	25.00	42.82	30.07
Fraxinus americana	10	25	.83	2.73	8.33	2.49	4.52
Ostrya virginiana	16	25	.21	4.37	8.33	.63	4.44
Acer rubrum	12	15	1.09	3.28	5.00	3.24	3.84
Tilia americana	14	20	.21	3.83	6.67	.62	3.71
Prunus serotina	6	10	.16	1.64	3.33	.49	1.82
Juglans nigra	4	10	.24	1.09	3.33	.72	1.71
Ulmus americana	4	10	.07	1.09	3.33	.21	1.54
Betula papyrifera	6	5	.39	1.64	1.67	1.16	1.49
Quercus alba	2	5	.30	.55	1.67	.89	1.04
cornus alternifolia	1	5	.02	.55	1.67	.06	.76
Totals	366[a]		33.49[b]	100.00	100.00	100.01	100.00

a = 148 trees/acre
b = 145.91 ft^2/acre

Contributions in Biology and Geology

Number 41 August, 1981

The Southern-Mesic Forest of Southeastern Wisconsin: Species Composition and Community Structure

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MILWAUKEE PUBLIC MUSEUM

Table 30**B**. Size class distribution for Kletzsch Park
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus borealis		1			1	4	1	7	8	3	7	6	3	1					42
Acer saccharum	8	15	12	15	17	17	12	7	18	3	2		1						127
Acer rubrum	1				1		4			1									7
Fraxinus americana	2	1			2	1		2											8
Quercus alba									1										1
Betula papyrifera					1	1		1											3
Juglans nigra					1		1												2
Prunus serotina	3	2		2	1														8
Tilia americana		9	6		1														16
Ostrya virginiana	22	29	7	1															59
Ulmus americana	1	2	1	1															5
Cornus alternifolia	8		1																9
Carpinus caroliniana	1	1																	2
Hamamelis virginiana	1	4																	5
Crataegus succulenta		2																	2
Ulmus rubra	3																		3
Crataegus punctata	1																		1
Totals	51	66	27	19	25	23	18	15	29	7	9	6	4	1					

Table 30 **C**. Shrub composition for Kletzsch Park sampled 7/23/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	20160.	100.00	85.71	30.30	58.01
Fraxinus americana	320.	40.00	1.36	12.12	6.74
Cornus racemosa	1100.	25.00	4.68	7.58	6.13
Cornus alternifolia	800.	25.00	3.40	7.58	5.49
Acer saccharum	280.	30.00	1.19	9.09	5.14
Ribes americanum	340.	25.00	1.45	7.58	4.51
Vitis riparia	80.	20.00	.34	6.06	3.20
Ostrya virginiana	60.	10.00	.26	3.03	1.64
Prunus serotina	60.	10.00	.26	3.03	1.64
Tilia americana	40.	10.00	.17	3.03	1.60
Lonicera xbella	100.	5.00	.43	1.52	.97
Viburnum rafinesquianum	60.	5.00	.26	1.52	.89
Hamamelis virginiana	40.	5.00	.17	1.52	.84
Sambucus pubens	20.	5.00	.09	1.52	.80
Acer negundo	20.	5.00	.09	1.52	.80
Carpinus caroliniana	20.	5.00	.09	1.52	.80
Ribes cynosbati	20.	5.00	.09	1.52	.80
Total	23520.		100.00	100.00	100.00

Table 30 **D**. Groundlayer for Kletzsch Park sampled 7/29/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Imortance Value
Prunus virginiana	47000.	72.50	26.48	26.61	26.54
Smilacina racemosa	39750.	50.00	22.39	18.35	20.37
Hydrophyllum virginianum	27750.	15.00	15.63	5.50	10.57
Lonicera xbella	20250.	12.50	11.41	4.59	8.00
Circaea quadrisulcata	11000.	15.00	6.20	5.50	5.85
Maianthemum canadense	4500.	12.50	2.54	4.59	3.56
Podophyllum peltatum	4500.	12.50	2.54	4.59	3.56
Acer saccharum	2250.	15.00	1.27	5.50	3.39
Fraxinus americana	1500.	15.00	.85	5.50	3.17
Cornus racemosa	5500.	7.50	3.10	2.75	2.93
Trillium grandiflorum	2250.	10.00	1.27	3.67	2.47
Ribes americanum	2750.	7.50	1.55	2.75	2.15
Thalictrum dioicum	2000.	5.00	1.13	1.83	1.48
Parthenocissus quinquefolia	1750.	5.00	.99	1.83	1.41
Viburnum lentago	1250.	2.50	.70	.92	.81
Carex pennsylvanica	1000.	2.50	.56	.92	.74

Table 30 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Arabis canadense	750.	2.50	.42	.92	.67
Ariseama triphyllum	750.	2.50	.42	.92	.67
Carpinus caroliniana	500.	2.50	.28	.92	.60
Prenanthes alba	250.	2.50	.14	.92	.53
Sanguinaria canadensis	250.	2.50	.14	.92	.53
Total	177500.		100.00	100.00	100.00

Graceland Cemetery

Site 31
Size: 0.03ha
Milwaukee County

Milwaukee Quadrangle
SW¼, NW¼, SW¼, SE¼, Sec 23, T8N, R21E
Private Ownership

Graceland Cemetery was the smallest island examined. The woods was located in the extreme southwest corner of the cemetery. It was originally part of an 80-acre farm unit purchased by the cemetery around the turn of the century. The island is a remnant extension of an 8ha island which existed a short distance north until the summer of 1966. At that time, the larger island was reduced to only 3ha and finally completely cut by 1968. The woods had been grazed until the early 1920s by cows. Until the late 1930s, young tree saplings from the woods were used to landscape the cemetery (Vedder, 1967).

The remaining island is in a highly disturbed condition. It is bounded on the north and east by graded landfill. The south edge is bounded by residential properties and the west by the grassy banks of a channelized, intermittent stream. The soil is Mequon silt loam (Udollic Ochraqualf). Frequent human use has exposed the soil surface and caused it to become compacted.

A full census was made of the canopy and understory strata. Only nine trees greater than 10.2cm dbh were present (Table 31 **A**). Six of the trees were greater than 45cm (18in) dbh, suggesting that the island had existed for a considerable period. The largest individual was a basswood *(Tilia americana)* measuring 83.6cm (32.9in) dbh. The understory was composed of seven individuals of four species. Basswood and white ash *(Fraxinus americana)* accounted for five individuals. The opportunistic black cherry *(Prunus serotina)* and hawthorn *(Crataegus succulenta)* were present with one individual each (Table 31 **B**).

An abbreviated sample of the shrub layer was obtained by crossing two conventional sized plots. Eleven species were present with honeysuckle *(Lonicera bella)* sharing dominance with high bush cranberry *(Viburnum opulus)* and white ash (Table 31 **C**). Nine of the eleven species present in the shrub

layer have bird- or animal-dispersed seeds. Only ash and basswood are wind-dispersed. The absence of sugar maple *(Acer saccharum)* in the shrub and understory layers, even though the canopy is primarily maple, suggests the inability of sugar maple to successfully reproduce in an island of such small size where (1) mesic conditions have been lost; (2) the seedbed is compacted, and (3) competition from opportunistic species better adapted to the harsh conditions is too great.

The summer groundlayer was not sampled, but a floral list was compiled. Without tree reproduction, the species composition is more typical of an old field than of a southern-mesic forest:

Arabis laevigata (Muhl.) Poir.	Rock Cress
Arctium minus Schk.	Common Burdock
Aster sp. L.	Wild Aster
Aster macrophyllus L.	Wild Aster
Carex sp.	Sedge
Cirsium arvense (L.) Gaertn.	Canada Thistle
Fragaria virginiana Duchesne.	Strawberry
Geum canadense Jacq.	Avens
Maianthemum canadense Desf.	Wild lily-of-the-valley
Oxalis sp. L.	Wood Sorrel
Poa pratensis L.	Kentucky Blue Grass
Parthenocissus quinquefolia (L.) Planch.	Virginia Creeper
Potentilla simplex Michx.	Cinquefoil
Rhamnus catharticus L.	Buckthorn
Solidago canadensis L.	Canada Goldenrod
Taraxacum officinale Weber.	Common Dandelion
Viola pubescens Ait.	Downy Yellow Violet
Vitis riparia Michx.	Frost Grape
Vitis sp. L.	Grape

Table 31 **A**. Stand attributes for Graceland Cemetery (Site 31)
Full Tally (0.03ha) Sample Date: September 12, 1975.

Species	Density	Basal Area (m^2/ha.)	Relative Density	Relative Dominance	Importance Value
Acer saccharum	206	33.31	77.78	56.62	67.20
Tilia americana	59	25.52	22.22	43.38	32.80
Totals	265[a]	58.83[b]	100.00	100.00	

a = 107 trees/acre
b = 256.37 ft^2/acre

Table 31 **B**. Size class distribution for Graceland Cemetery
Sample size: 0.03ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Acer saccharum					1			2		1	2	1							7
Tilia americana	1	2											1			1			5
Fraxinus americana	2																		2
Prunus serotina	1																		1
Crataegus succulenta	1																		1
Totals	5	22			1			2		1	2	1	1			1			

Table 31 **C**. Shrub composition for Graceland Cemetery sampled 9/12/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Lonicera xbella	6666.	100.00	28.57	11.11	19.84
Viburnum opulus	4872.	100.00	20.88	11.11	16.00
Fraxinus americana	4102.	100.00	17.58	11.11	14.35
Viburnum lentago	2308.	100.00	9.89	11.11	10.50
Vitis riparia	1282.	100.00	5.49	11.11	8.30
Tilia americana	1282.	100.00	5.49	11.11	8.30
Prunus virginiana	1026.	100.00	4.40	11.11	7.75
Prunus serotina	769.	50.00	3.30	5.56	4.43
Cornus stolonifera	513.	50.00	2.20	5.56	3.88
Zanthoxylum americanum	256.	50.00	1.10	5.56	3.33
Carya cordiformis	256.	50.00	1.10	5.56	3.33
Total	23332.		100.00	100.00	100.00

US Army Reserve

Site 32
Size: 1.40ha
Milwaukee County

Thiensville Quadrangle
SW¼, SE¼, NW¼, Sec 26, T8N, R21E
Ownership under negotiation

The island was of triangular shape located at the junction of North 55th Street and the Milwaukee Road railroad tracks. Topographic relief within the stand is negligible. The stand is developed upon Mequon silt loam soil (Udollic Ochraqualf). This soil is somewhat poorly drained and typical of depressions and drainageways. Wetness is the major limitation of the soil (USDA, 1971).

The land-use history of the site is unknown, but the site was part of a farm woodlot prior to ownership by the Army. Examination of 1956 ASCS air photos indicates much disturbance near the woods, including roadways and a landfill. At that time, the woods was 1.4ha in size and occupied a circular area in the northwest corner of the tract with an extension paralleling the railroad tracks. The land was released by the federal government in 1969 and has since been the subject of ownership negotiations. Presently, the site is a nature preserve, and with successional forest growth it occupies a 4.21ha tract. Vandalism was very heavy.

The site was sampled using nineteen 10 x 12.5m plots within the 1.4ha older section. American beech *(Fagus grandifolia)* was the leading dominant accounting for 30% of the stems and 46% of the basal area (Table 32 **A**). There were few trees over 45cm (17.7in) dbh and none over 65cm (25.5in) (Table 32 **B**). The absence of large trees is suggestive of a heavy cutting or of complete regrowth following a clear-cut. Greatly reduced stem densitite in the 15-35cm

(5.9-13.7in) dbh size classes probably reflects a period of grazing. The opportunistic species, black cherry *(Prunus serotina)* and white ash *(Fraxinus americana)*, were sub-dominants accounting for 33% of the stems over 10.2cm, but only 6% of the basal area. They totally dominated the understory, comprising 76% of the stems recorded between 2.5-10.1cm dbh.

Stem density ($\geq$ 10.2cm dbh) was well below the average as was the basal area per hectare (Table 2). Sixteen species were recorded in the canopy stratum, third highest of all stands sampled. The high species richness was attributed to successional species typical of a disturbance site. Even with the increased species richness, species diversity (H') was only slightly above average (Table 3). A reduced equitability (J') component created by the high density of only a few species reduced the overall diversity expression.

Nineteen species were recorded in the shrub stratum. Choke cherry *(Prunus virginiana)* was the most numerous species accounting for 34% of the stem density and 26% of the importance value (Table 32 **C**). As in the understory, black cherry and white ash were sub-dominants, combining to account for 32% of the density and 33% of the importance value. Other mesic forest tree species were of limited numbers and distribution. Fifteen of the nineteen species recorded in the shrub layer possessed either animal- or bird-dispersed seeds. Stem density was below the average, but species diversity (H') was greater than the average (Table 3).

Thirty-eight species were recorded in the groundlayer. The false solomon's seal *(Smilacina racemosa)* was the most common species totaling 35% of the density and 26% of the importance value (Table 32 **D**). Choke cherry accounted for another 13% of the density and importance value. Sugar maple *(Acer saccharum)* appears to be achieving a moderate level of success and will probably increase in the future. The groundlayer was an unusual mix of forest and old field species (Table 32 **D**). Both groups are relicts of prior communities. Remnant species tolerant to the old-growth southern-mesic forest as *Epifagus virginiana* are in close association with strawberry *(Fragaria virginiana)* and sedges *(Carex pennsylvanica* and *C. albursina)* reflecting heavy disturbances in the canopy cover. The most important finding is the absence of any large sugar maple on a site where sugar maple should be dominant. Exotics including honeysuckle *(Lonicera bella)*, bittersweet *(Solanum dulcamara)*, and helleborine *(Epipactis latifolia)* contributed to the somewhat low species diversity (H') (Table 3). No rare or endangered species were encountered.

Table 32 **A**. Stand attributes for US Army Reserve (Site 32)
Sample size: 19 plots (10 x 12.5m) Sample Date: September 29, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Fagus grandifolia	101	58	10.47	30.38	22.92	45.99	33.10
Prunus serotina	67	32	.88	20.25	12.50	3.87	12.21
Fraxinus americana	42	32	.51	12.66	12.50	2.55	9.41
Juglans cinerea	17	21	1.14	5.06	8.33	5.00	6.13
Quercus alba	13	11	1.86	3.80	4.17	8.16	5.38
Quercus macrocarpa	8	11	1.90	2.53	4.17	8.37	5.02
Quercus borealis	13	11	1.51	3.80	4.17	6.63	4.87
Acer saccharum	13	11	1.31	3.80	4.17	5.74	4.57
Tilia americana	8	11	1.59	2.53	4.17	6.97	4.56
Carya ovata	8	11	.67	2.53	4.17	2.94	3.21
Carya cordiformis	13	11	.25	3.80	4.17	1.08	3.02
Ostrya virginiana	8	11	.18	2.53	4.17	.79	2.50
Ulmus rubra	8	11	.11	2.53	4.17	.46	2.39
Populus tremuloides	4	5	.20	1.27	2.08	.86	1.40
Crataegus succulenta	4	5	.14	1.27	2.08	.64	1.33
Ulmus americana	4	5	.06	1.27	2.08	.26	1.20
Totals	331[a]		22.78[b]	100.01	100.02	100.01	100.03

a = 134 trees/acre
b = 99.22 ft^2/acre

Table 32 **B**. Size class distribution for US Army Reserve
Sample size: 0.24ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus borealis	2			1	1								1						5
Quercus macrocarpa		2								1		1							4
Tilia americana	1	3						1				1							6
Quercus alba								2			1								3
Fagus grandifolia	4	3	1		2	1	4	9	6	1									31
Juglans cinerea		1		2				2											5
Acer saccharum						1		1	1										3
Carya ovata	1					1		1											3
Populus tremuloides					1														1
Carya cordiformis	15	6	2		1														24
Crataegus succulenta	4	1			1														6
Ostrya virginiana	4	5	1		1														11
Prunus serotina	57	26	14	2															99
Fraxinus americana	94	42	9	1															146
Ulmus rubra	4	8	2																14
Ulmus americana	2	1	1																4
Fraxinus pennsylvanica	1																		1
Crataegus punctata	1																		1
Totals	190	98	30	6	7	3	4	16	7	2	1	2	1						

Table 32 **C**. Shrub composition for US Army Reserve Woods sampled 10/3/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	4778.	8.95	34.45	17.71	26.08
Prunus serotina	2210.	8.95	15.93	17.71	16.82
Fraxinus americana	2252.	8.42	16.24	16.67	16.45
Lonicera xbella	1137.	5.79	8.19	11.46	9.83
Cornus racemosa	1305.	2.63	9.41	5.21	7.31
Carya cordiformis	484.	2.63	3.49	5.21	4.35
Rubus occidentalis	463.	2.11	3.34	4.17	3.75
Cornus stolonifera	505.	1.05	3.64	2.08	2.86
Crataegus succulenta	168.	1.58	1.21	3.13	2.17
Acer saccharum	84.	1.58	.61	3.13	1.87
Ribes americanum	147.	1.05	1.06	2.08	1.57
Fagus grandifolia	105.	1.05	.76	2.08	1.42
Juglans cinerea	63.	1.05	.46	2.08	1.27
Ulmus rubra	42.	1.05	.30	2.08	1.19
Ostrya virginiana	42.	.53	.30	1.04	.67
Crataegus punctata	21.	.53	.15	1.04	.60
Rhamnus catharticus	21.	.53	.15	1.04	.60
Vitis riparia	21.	.53	.15	.104	.60
Quercus borealis	21.	.53	.15	1.04	.60
Total	13872.		100.00	100.00	100.00

Table 32 **D**. Groundlayer for US Army Reserve sampled 9/28/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Smilacina racemosa	77750.	65.00	35.14	16.25	25.70
Prunus virginiana	28000.	55.00	12.66	13.75	13.20
Carex pennsylvanica	45250.	7.50	20.45	1.87	11.16
Acer saccharum	13500.	30.00	6.10	7.50	6.80
Fraxinus americana	3750.	32.50	1.69	8.12	4.91
Cornus racemosa	9000.	22.50	4.07	5.62	4.85
Carya cordiformis	4000.	25.00	1.81	6.25	4.03
Geum canadense	2500.	17.50	1.13	4.37	2.75
Fragaria virginianum	7250.	7.50	3.28	1.87	2.58
Lonicera xbella	4000.	10.00	1.81	2.50	2.15
Vitis sp.	1250.	10.00	.56	2.50	1.53
Carex blanda	2500.	7.50	1.13	1.87	1.50
Ulmus rubra	1000.	10.00	.45	2.50	1.48
Epipactis latifolia	2000.	7.50	.90	1.87	1.39
Prunus serotina	1750.	7.50	.79	1.87	1.33

Table 32 D continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Cornus stolonifera	1500.	7.50	.68	1.87	1.28
Viola pubescens	1500.	7.50	.68	1.87	1.28
Aster lateriflorus	2500.	5.00	1.13	1.25	1.19
Carya ovata	1000.	7.50	.45	1.87	1.16
Hydrophyllum virginianum	1500.	5.00	.68	1.25	.96
Crataegus punctata	500.	5.00	.23	1.25	.74
Fagus grandifolia	500.	5.00	.23	1.25	.74
Quercus alba	500.	5.00	.23	1.25	.74
Anemone virginiana	1750.	2.50	.79	.62	.71
Parthenocissus quinquefolia	1250.	2.50	.56	.62	.59
Circaea quadrisulcata	1000.	2.50	.45	.62	.54
Carex albursina	750.	2.50	.34	.62	.48
Geranium maculatum	500.	2.50	.23	.62	.43
Gramineae	500.	2.50	.23	.62	.43
Solamun dulcamara	500.	2.50	.23	.62	.43
Actea alba	250.	2.50	.11	.62	.37
Allium tricoccum	250.	2.50	.11	.62	.37
Epifagus virginiana	250.	2.50	.11	.62	.37
Oxalis sp.	250.	2.50	.11	.62	.37
Quercus borealis	250.	2.50	.11	.62	.37
Solidago flexicaulis	250.	2.50	.11	.62	.37
Solidago caesia	250.	2.50	.11	.62	.37
Tilia americana	250.	2.50	.11	.62	.37
Total	221250.		100.00	100.00	100.00

McGovern Park

Milwaukee Quadrangle
Size: 3.12ha
Milwaukee County

S½, NW¼, NE¼, Sec 35, T8N, R21E
Milwaukee County Park Commission

McGovern Park is located on near-level Cary-aged ground moraine. Topographic relief within the stand is limited to slight depressions. A detailed soil survey was not make of the park (USDA, 1971). Evaluation of soil patterns near the park suggest the woods is developed on Mequon silt loam (Udollic Ochraqualf). The soil is somewhat poorly drained and occurs typically along drainageways and in slight depressions (USDA, 1971). Wetness is the major soil limitation. The island was bounded on the south by a street; the remaining edges were bound by mowed park lawns.

The history of McGovern Park, formerly Silver Spring Park, is unknown. The large forest-grown white and red oaks *(Quercus alba* and *Q. borealis)*

in all size classes up to 80cm is evidence for the original nature of the vegetation (Table 33 **B**). The restriction of virtually all other species to size classes less than 45cm (17.7in) dbh suggests selective logging in the stand's history. The low stem density and basal area for the site also is indicative of high-grading (Table 33 **A**). The large density of hawthorns *(Crataegus succulenta* and *C. punctata)* coupled with the few stems in the 20-45cm size classes suggests an extended period of grazing. The selective logging and grazing must have occurred prior to the development of the park in 1907. Current heavy human use and abuse is evidenced by the numerous small trees which have been cut or sawed down. Numerous paths traverse the island greatly restricting the expanse of the groundlayer.

The canopy and understory strata were sampled using twenty 10 x 25m plots. Red oak and white oak combined to dominate the stand, accounting for 72% of the basal area and 41% of the importance value (Table 33 **A**). Red oak was the leading dominant contributing 47% of the basal area and 28% of the importance value. An additional 26% importance value was added by high relative density (38%) of small ($\leq$ 35cm dbh) basswood *(Tilia americana)* and white ash *(Fraxinus americana)* stems. The low importance of American beech *(Fagus grandifolia)* is probably due to the location at the western edge of the beech range. At this latitude, beech was not observed farther west.

The relatively high species richness of this island is probably attributable to the "habitat islands" of the several slight depressions. Lowland species occupied these micro-communities as evidenced by the last four species of Table 33 **A**). As might be expected, the species diversity (H') of McGovern Park was the second highest of the 43 islands studied (Table 3).

Comparison of our data with that obtained by Whitford and Salamun (1954) for 1951 indicates a number of changes. McGovern Park is the same as their stand number 17. The oaks dominated the stand 24 years ago as today, but with a combined decrease in importance of 6%; probably not significant. The proportion of red oak to white oak stayed the same; approximately 2:1. Numerous significant changes of relative dominance occurred between the other species. Slippery elm *(Ulmus rubra)* was the third leading dominant 24 years ago contributing 14% of the importance value. Today, Slippery elm contributed just 4% of the importance value; the result of the Dutch elm disease. Basswood and ironwood *(Ostrya virginiana)* more than doubled their relative dominance, while white ash only increased slightly.

One of the more striking differences is that of species richness, but the difference can be attributed to sampling method rather than successional change:

	Climax Adaptation Number	1951		1975	
		IV	CIV	IV	CIV
Quercus borealis	5.5	32.33	178	27.95	154
Quercus alba	3.5	14.67	51	13.43	47
Ulmus rubra	8.0	14.00	112	4.38	35
Fraxinus americana	6.5	9.33	61	11.75	71

Continued from page 171

	Climax Adaptation Number	1951 IV	1951 CIV	1975 IV	1975 CIV
Quercus macrocarpa	1.0	7.67	8	-	-
Acer saccharum	10.0	6.67	67	3.29	33
Tilia americana	7.5	6.00	45	14.47	109
Ostrya virginiana	8.5	5.33	45	8.75	74
Ulmus americana	7.5	1.33	10	.57	4
Carya ovata	4.5	-	-	3.67	17
Crataegus succulenta	-	-	-	3.05	-
Carya cordiformis	8.5	-	-	2.84	24
Prunus serotina	3.5	-	-	1.78	6
Fagus grandifolia	9.5	-	-	1.45	14
Carpinus caroliniana	8.0	-	-	1.12	9
Fraxinus pennsylvanica	-	-	-	.87	-
Fraxinus nigra	-	-	-	.56	-
Total		97.33	1731	99.93	1791

Only nine species were recorded 24 years ago, while we obtained 16 species. The chance of picking up the rare or widely distributed species is one of the advantages of the line-strip technique over the "random pairs" method used by Whitford and Salamun (1954). The difference in sampling method probably also accounts for the difference in the relative dominance of sugar maple *(Acer saccharum)*. When a "rare" species is recorded by the random pairs method, its relative density and dominance is usually over-estimated.

Red-osier dogwood *(Cornus stolonifera)* and choke cherry *(Prunus virginiana)* dominated the shrub layer combining for 69% of the stems and 48% of the importance value (Table 33 **C**). Although species richness was the third highest of the 43 islands examined, species diversity (H') was only slightly above average (Table 3). The equitability (J') component was lowered because the majority of the stems were shared by only two species. As in the canopy and understory strata, the species richness of the shrub stratum was also influenced by lowland species.

The groundlayer was co-dominated by grey dogwood *(Cornus racemosa)*, wild geranium *(Geranium maculatum)*, and choke cherry. The three species accounted for 53% of the stems and 46% of the importance value. As a result of no clear-cut dominant species (Table 33 **D**), the species diversity (H') was slightly greater than average even though species richness was less than average. No rare or endangered species were encountered.

Table 33**A**. Stand attributes for McGovern Park (Site 33)
Sample size: 20 plots (10 x 25m) Sample Date: July 17, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Quercus borealis	68	85	12.06	18.99	17.89	46.98	27.95
Tilia americana	76	75	1.64	21.23	15.79	6.40	14.47
Quercus alba	26	40	6.34	7.26	8.42	24.61	13.43
Fraxinus americana	60	65	1.24	16.76	13.68	4.81	11.75
Ostrya virginiana	50	45	.72	13.97	9.47	2.81	8.75
Ulmus rubra	12	25	1.16	3.35	5.26	4.53	4.38
Carya ovata	10	25	.78	2.79	5.26	3.03	3.69
Acer saccharum	10	20	.74	2.79	4.21	2.87	3.29
Crataegus succulenta	12	25	.14	3.35	5.26	.54	3.05
Carya cordiformis	12	20	.25	3.35	4.21	.97	2.84
Prunus serotina	6	15	.13	1.68	3.16	.51	1.78
Fagus grandifolia	4	10	.29	1.12	2.11	1.13	1.45
Carpinus caroliniana	4	10	.04	1.12	2.11	.14	1.12
Fraxinus pennsylvanica	4	5	.11	1.12	1.05	.43	.87
Ulmus americana	2	5	.02	.56	1.05	.09	.57
Fraxinus nigra	2	5	.02	.56	1.05	.09	.56
Totals	358[a]		25.68[b]	100.00	99.97	99.92	99.95

a = 145 trees/acre
b = 111.85 ft^2/acre

Table 33**B**. Size class distribution for McGovern Park
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus alba	5	11				1	1	1		3		3	3			2			29
Quercus borealis	10	7	6	2	1		1	3	1	4	5	3	4	2	2				51
Ulmus rubra	5	2	2			1		1	1		1								13
Acer saccharum	4	4	1				3		1										13
Fagus grandifolia			1						.										2
Carya ovata	2	4	1	1				2	1										11
Tilia americana	29	41	20	12	4	1	1												108
Fraxinus americana	73	52	16	10	1	2	1												155
Fraxinus pennsylvanica				1	1														2
Ostrya virginiana	58	64	19	5	1														147
Carya cordiformis	1	3	2	4															10
Prunus serotina		5	1	2															8
Crataegus succulenta	27	34	6																67
Ulmus americana	8	3	1																12
Carpinus caroliniana	3	5	2																10
Fraxinus nigra	1	1	1																3
Crataegus punctata	19	17																	36
Prunus virginiana	1	1																	2
Totals	246	254	79	37	8	5	7	7	5	7	6	6	7	2	2	2			

Table 33 **C**. Shrub composition for McGovern Park sampled 7/17/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Cornus stolonifera	11360.	90.00	39.80	12.68	26.24
Prunus virginiana	8460.	100.00	29.64	14.08	21.86
Fraxinus americana	2140.	100.00	7.50	14.08	10.79
Tilia americana	1520.	70.00	5.33	9.86	7.59
Viburnum lentago	2240.	50.00	7.85	7.04	7.45
Viburnum opulus	640.	40.00	2.24	5.63	3.94
Viburnum rafinesquianum	400.	40.00	1.40	5.63	3.52
Ulmus rubra	260.	40.00	.91	5.63	3.27
Ribes americanum	240.	25.00	.84	3.52	2.18
Quercus macrocarpa	140.	25.00	.49	3.52	2.01
Crataegus succulenta	80.	20.00	.28	2.82	1.55
Cornus racemosa	420.	10.00	1.47	1.41	1.44
Prunus serotina	100.	15.00	.35	2.11	1.23
Crataegus punctata	60.	15.00	.21	2.11	1.16
Solanum dulcamara	60.	10.00	.21	1.41	.81
Vitis riparia	60.	10.00	.21	1.41	.81
Rubus occidentalis	60.	10.00	.21	1.41	.81
Menispermum canadense	140.	5.00	.49	.70	.60
Ribes cynosbati	40.	5.00	.14	.70	.42
Lonicera prolifera	20.	5.00	.07	.70	.39
Ostrya virginiana	20.	5.00	.07	.70	.39
Carya cordiformis	20.	5.00	.07	.70	.39
Carya ovata	20.	5.00	.07	.70	.39
Hamamelis virginiana	20.	5.00	.07	.70	.39
Acer saccharum	20.	5.00	.07	.70	.39
Total	28540.		100.00	100.00	100.00

Table 33 **D**. Groundlayer for McGovern Park sampled 7/29/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Cornus racemosa	37000.	55.00	21.08	16.06	18.57
Geranium maculatum	30750.	42.50	17.52	12.41	14.97
Prunus virginiana	24500.	37.50	13.96	10.95	12.45
Hydrophyllum virginianum	20500.	10.00	11.68	2.92	7.30
Smilacina racemosa	8000.	30.00	4.56	8.76	6.66
Fraxinus americana	6750.	27.50	3.85	8.03	5.94
Circaea quadrisulcata	8500.	17.50	4.84	5.11	4.98
Viburnum rafinesquianum	2500.	17.50	1.42	5.11	3.27

Table 33 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Geum canadense	4750.	12.50	2.71	3.65	3.18
Carex pensylvanica	7000.	5.00	3.99	1.46	2.72
Viburnum lentago	3000.	12.50	1.71	3.65	2.68
Tilia americana	2750.	10.00	1.57	2.92	2.24
Quercus alba	3500.	7.50	1.99	2.19	2.09
Allium tricoccum	1500.	10.00	.85	2.92	1.89
Parthenocissus quinquefolia	3000.	5.00	1.71	1.46	1.58
Heracleum lanatum	2000.	5.00	1.14	1.46	1.30
Sanguinaria canadensis	1750.	5.00	1.00	1.46	1.23
Ribes americanum	1500.	5.00	.85	1.46	1.16
Potentilla simplex	500.	5.00	.28	1.46	.87
Asarum canadense	1750.	2.50	1.00	.73	.86
Rhus radicans	1750.	2.50	1.00	.73	.86
Carpinus caroliniana	500.	2.50	.28	.73	.51
Rubus occidentalis	500.	2.50	.28	.73	.51
Crataegus punctata	250.	2.50	.14	.73	.44
Fragaria virginianum	250.	2.50	.14	.73	.44
Solanum dulcamara	250.	2.50	.14	.73	.44
Thalictrum dioicum	250.	2.50	.14	.73	.44
Agrimonia gryposepala	250.	2.50	.14	.73	.44
Total	175500.		100.00	100.00	100.00

Underwood Parkway

Site 34
Size: 5.47ha
Milwaukee County

Wausatosa Quadrangle
NW¼, SW¼, Sec 20, T7N, R21E
Milwaukee County Park Commission

We examined the wooded region north of Watertown Plank Road at 108th Street known as Sholes Park or Underwood Parkway. The wooded island exists on a broad upland overlooking Underwood Creek. The woods is developed on the well-drained Ozaukee silt loam (Typic Hapludalf). This soil is typical of the slopes of glacial moraines and characterized as having moderately slow permeability (USDA, 1971).

The historical usage of the site has not been documented. At one time, this land was part of the County Farms and was grazed by cattle (MCPC, 1972). With subsequent conversion to parkland in 1935, the woods has been left to slowly recover. Save for a few paths, the island has been relatively undisturbed for 40 years. Girl and Boy Scouts presently use the site for nature study.

The canopy and understory vegetation was sampled using twenty 10 x 12.5m plots. White oak *(Quercus alba)* strongly dominated the stand account-

ing for 64% of the basal area and 46% of the stems and importance value (Table 34 **A**). White oak was present in the 25-60cm size classes (Table 34 **B**). Stem density per hectare was the lowest of all stands examined. The relatively large stem size/tree with few individuals in the size classes between 10.2-30cm (4-12in) dbh reflects the period of grazing. Very large individual trees were scattered throughout the stand. Most notable were several large red oaks *(Quercus borealis)* in the 90-100cm (35-40in) dbh size classes. A few large, open-grown sugar maples *(Acer saccharum)* were observed. American beech *(Fagus grandifolia)* was absent as this island is beyond the western range of the species in Milwaukee County.

The understory was dominated by white ash *(Fraxinus americana)* totaling 47% of the stems. The relative success of black cherry *(Prunus serotina)*, accounting for another 30% of the stems in this droughty site, is consistent with Auclair and Cottam's (1971) results for the southern-xeric forests of south-central Wisconsin. As expected following a period of grazing, hawthorns *(Crataegus succulenta* and *C. punctata)* represented nearly 13% of the stems between 2.5 and 10.1cm. Species diversity (H') was slightly greater than the average for the 43 islands sampled (Table 3).

The shrub layer was dominated by bird-dispersed species; choke cherry *(Prunus virginiana)*, honeysuckle *(Lonicera bella)*, and black cherry. These three species accounted for 67% of the stems and 56% of the importance value (Table 34 **C**). Only four other sites had a greater density of stems per hectare in the shrub layer. Importantly, the high stem density was relatively evenly distributed. Thickets or patches of shrubs in the southern-mesic forest are usually confined to areas of canopy disturbances, i.e., windthrows, lightning strikes, and openings. In this stand, with an estimated 70% canopy cover and only 240 stems/ha greater than 10.2cm, the shrub layer was uniformly and densely distributed. This site is the only one in which hop tree *(Ptelea trifoliata)* occurred.

The groundlayer was dominated by so single species (Table 34 **D**). Choke cherry stems and sedge *(Carex pennsylvanica)* clumps were most numerous. However, the sedge was of limited distribution reducing its contribution to the groundcover. White ash accounted for 10% of the importance value and 13% of the stems, but was distributed in less than one-half of the plots. This island had the second highest groundlayer species diversity (H') of the 31 islands sampled (Table 3). Although species richness was also moderately high (37 species), the lack of a clear-cut dominant and a high equitability (J') component influenced the high diversity.

An unusual species, the closed gentian (probably *Gentiana andrewsii* Griseb.) was observed near the margin of the woods. The presence of the large, old oaks and the gentian may be suggestive of a former oak opening at this site. No rare or endangered species were encountered. The spring flora was not sampled.

Table 34**A**. Stand attributes for Underwood Parkway (Site 34)
Sample size: 20 plots (10 x 12.5m) Sample Date: October 1, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Quercus alba	112	50	14.37	46.67	27.03	63.91	45.87
Ulmus rubra	32	35	.83	13.33	18.92	3.70	11.98
Acer saccharum	12	15	2.00	5.00	8.11	8.87	7.33
Acer rubrum	12	15	1.39	5.00	8.11	6.20	6.44
Prunus serotina	20	15	.27	8.33	8.11	1.19	5.88
Quercus macrocarpa	8	10	1.73	3.33	5.41	7.67	5.47
Quercus borealis	8	10	1.27	3.33	5.41	5.64	4.79
Fraxinus americana	16	10	.30	6.67	5.41	1.32	4.47
Ostrya virginiana	8	10	.18	3.33	5.41	.79	3.18
Crataegus succulenta	8	10	.09	3.33	5.41	.41	3.05
Populus tremuloides	4	5	.06	1.67	2.70	.28	1.55
Totals	240[a]		22.49[b]	99.99	100.03	99.98	100.01

a = 97 trees/acre
b = 97.99 ft^2/acre

Table 34**B**. Size class distribution for Underwood Parkway
Sample size: 0.25ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus macrocarpa								1					1						2
Quercus alba		1				3	6	5	7	5	1	1							29
Acer saccharum	3								2		1								6
Quercus borealis	2							1		1									4
Acer rubrum								3											3
Ulmus rubra	2		4	2	1		1												10
Fraxinus americana	62	13	3		1														79
Ostrya virginiana	3	2		2															7
Prunus serotina	36	11	4	1															52
Crataegus succulenta	8	11	2																21
Populus tremuloides		1	1																2
Ulmus americana		1																	1
Crataegus punctata	1																		1
Carya ovata	1																		1
Rhamnus catharticus	1																		1
Totals	119	40	14	5	2	3	7	10	9	6	2	1	1						

Table 34 **C**. Shrub composition for Shoals Parkway sampled 10/1/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	8240.	95.00	35.27	16.38	25.83
Lonicera xbella	5260.	75.00	22.52	12.93	17.72
Prunus serotina	2260.	90.00	9.67	15.52	12.60
Acer saccharum	2360.	60.00	10.10	10.34	10.22
Cornus stolonifera	2680.	50.00	11.47	8.62	10.05
Vitis riparia	700.	75.00	3.00	12.93	7.96
Ribes cynosbati	1100.	35.00	4.71	6.03	5.37
Zanthoxylum americanum	220.	25.00	.94	4.31	2.63
Ribes americanum	180.	15.00	.77	2.59	1.68
Acer saccharinum	120.	10.00	.51	1.72	1.12
Ptelea trifoliata	40.	10.00	.17	1.72	.95
Viburnum lentago	40.	10.00	.17	1.72	.95
Fraxinus pennsylvanica	60.	5.00	.26	.86	.56
Ostrya virginiana	20.	5.00	.09	.86	.47
Acer negundo	20.	5.00	.09	.86	.47
Populus tremuloides	20.	5.00	.09	.86	.47
Ulmus rubra	20.	5.00	.09	.86	.47
Rhamnus catharticus	20.	5.00	.09	.86	.47
Total	23360.		100.00	100.00	100.00

Table 34 **D**. Groundlayer for Shoals Parkway sampled 9/28/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	25000.	47.50	13.95	13.38	13.66
Fraxinus americana	13500.	45.00	7.53	12.68	10.10
Carex pensylvanica	23750.	5.00	13.25	1.41	7.33
Parthenocissus quinquefolia	13750.	17.50	7.67	4.93	6.30
Cornus stolonifera	11250.	20.00	6.28	5.63	5.95
Cornus racemosa	8500.	22.50	4.74	6.34	5.54
Vitis sp.	6750.	25.00	3.77	7.04	5.40
Circaea quadrisulcata	11500.	15.00	6.42	4.23	5.32
Lonicera prolifera	13000.	10.00	7.25	2.82	5.03
Acer saccharum	4000.	25.00	2.23	7.04	4.64
Gramineae	15000.	2.50	8.37	.70	4.54
Rubus occidentalis	4000.	15.00	2.23	4.23	3.23
Viola cucullata	3750.	10.00	2.09	2.82	2.45
Hydrophyllum virginianum	3750.	5.00	2.09	1.41	1.75
Geranium maculatum	2250.	7.50	1.26	2.11	1.68

Table 34 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Ribes cynosbati	2500.	5.00	1.39	1.41	1.40
Aster lateriflorus	1000.	7.50	.56	2.11	1.34
Geum canadense	750.	7.50	.42	2.11	1.27
Quercus alba	1250.	5.00	.70	1.41	1.05
Ribes americanum	1250.	5.00	.70	1.41	1.05
Solidago canadense	1250.	5.00	.70	1.41	1.05
Aster cordifolius	2000.	2.50	1.12	.70	.91
Thalictrum dioicum	2000.	2.50	1.12	.70	.91
Crataegus punctata	500.	5.00	.28	1.41	.84
Equisetum hyemale	500.	5.00	.28	1.41	.84
Ostrya virginiana	500.	5.00	.28	1.41	.84
Podophyllum peltatum	1250.	2.50	.70	.70	.70
Aster sp.	750.	2.50	.42	.70	.56
Fragaria virginiana	750.	2.50	.42	.70	.56
Trillium grandiflorum	750.	2.50	.42	.70	.56
Agrimony gryposepala	500.	2.50	.28	.70	.49
Oxalis sp.	500.	2.50	.28	.70	.49
Quercus borealis	500.	2.50	.28	.70	.49
Menispermum canadense	250.	2.50	.14	.70	.42
Ribes sp.	250.	2.50	.14	.70	.42
Smilacina racemosa	250.	2.50	.14	.70	.42
Viburnum acerifolium	250.	2.50	.14	.70	.42
Total	179250.		100.00	100.00	100.00

Pfauser's Woods

Site 35
Size: 2.39ha
Waukesha County

Wauwatosa Quadrangle
N½, NE¼, SW¼, Sec 25, T7N, R20E
Private Ownership

Pfauzer's Woods is located on a gentle east-facing slope of an end moraine. The woods is "sandwiched" behind residences on all sides. The island is rectangular in shape with the east-west axis approximately 4 times as long as the north-south axis. The island exists in a former natural drainageway and is developed on the somewhat poorly drained Mequon silt loam (Udollic Ochraqualf). Wetness is the major limitation of this soil for cultivation and is probably responsible for the preservation of the stand.

In a report to the Nature Conservancy in 1967, Professor Philip B. Whitford suggested the woods was essentially a virgin forest remnant. He based that statement on (1) the presence of several tree specis in all size and age classes

up to 30in dbh, (2) occurrence of black walnut *(Juglans nigra)*, usually one of the first species to be eliminated by selective cutting, in numerous size classes, and (3) absence of grassy openings and hawthorn thickets, indicators of grazing in this region.

The island was sampled using twenty 10 x 12.5m plots. Sugar maple *(Acer saccharum)* and red oak *(Quercus borealis)* dominated the island, accounting for a combined 55% of the stems and basal area and 50% of the importance value (Table 35 **A**). An examination of the size class distributions (Table 35 **B**) indicates that sugar maple was restricted to sizes less than 35cm (13.7in) dbh. High densities of young sugar maples led to its mathematical dominance, when in fact red oak was the dominant canopy species accounting for 42% of the basal area of the island. Except for a few individuals, red oak was present in the size classes from 50-85cm (19.7-33.4in) dbh. Relatively high densities of other young (10.1-35cm), mesic species contributed to a significantly higher than average stem density and basal area.

The presence of black walnut was noteworthy as it occurred in only two other stands, but was originally of widespread distribution throughout the forest type. The largest individual was 65.8cm (25.9in) dbh with several over 30cm (12in) dbh. Butternut *(Juglans cinerea)*, a close relative, was also present in similar size classes. This island was west of the range of American beech *(Fagus grandifolia)*.

The understory (stems 2.5-10.2cm dbh) was totally dominated by sugar maple, accounting for 86% of the stems recorded. Whitford (1967) reported 14 tree species in the woods, including the edges. We sampled 12 canopy and understory species in the island's interior. Even though species richness was relatively low because the high numbers of sugar maple influenced the equitability component (Table 3).

The shrub layer was dominated by sugar maple, choke cherry *(Prunus virginiana)*, and dogberry *(Ribes cynosbati)* which combined for 79% of the stems sampled and 68% of the importance value (Table 35 **C**). Of the 18 species sampled, only four possess wind-dispersed seeds. The others are either animal- or bird-dispersed. Species diversity (H') in the shrub layer was slightly higher than the average of the 43 islands (Table 3).

Neither the groundlayer nor the spring flora were sampled. A list of herbaceous species compiled by Whitford (1967) includes the following:

Actaea alba (L.) Mill.	White Baneberry
Actaea rubra (Ait.) Willd.	Red Baneberry
Agastache sp. Clayton	Giant Hyssop
Allium tricoccum Ait.	Wild Leek
Arisaema triphyllum (L.) Schott.	Jack-in-the-pulpit
Aster macrophyllus L.	Big-leaved Aster
Aster sagittifolius Willd.	Woodland Aster
Aster pilous (?) Willd.	Aster
Amphicarpa bracteata (L.) Fern.	Hog Peanut
Arabis laevigata (Muhl.) Poir.	Rock Cress
Carex sp. L. (2 species)	Sedge
Campanula americana L.	Tall Bellflower

Caulophyllum thalictroides (L.) Michx.	Blue Cohosh
Circaea quadrisulcata (Maxim) Franch.	Enchanter's Nightshade
Corallorhiza maculata Raf.	Coralroot orchid
Cryptotaenia canadensis (L.) DC	Honewort
Eupatorium purpureum L.	Joe-Pye Weed
Eupatorium rugosum Houtt.	White Snakeroot
Galium aparine L.	Bedstraw
Galium concinnum T&G	Smooth Bedstraw
Geranium maculatum L.	Wild geranium
Helianthus strumosus L. (?)	Sunflower
Heraclaum lanatum Michx.	Cow Parsnip
Hydrophyllum virginianum	Waterleaf
Hystrix patula Moench.	Bottlebrush Grass
Menispermum canadense L.	Moonseed
Osmorhiza claytoni (Michx.) Clarke	Sweet Cicley
Podophyllum peltatum L.	Mayapple
Polygonatum pubescens (Willd.) Pursh.	Solomon's seal
Prenanthes alba L.	Rattlesnake Root
Ranunculus septentrionalis Poir	Buttercup
Sanguinaria canadensis L.	Bloodroot
Scrophularia marilandica L.	Figwort
Smilacina racemosa (L.) Desf.	False Solomon's seal
Smilax ecirrhata (Engelm.) Wats.	Carrionflower
Solidago flexicaulis L.	Wide-leaved Goldenrod
Solidago ulmifolia Muhl.	Elm-leaved Goldenrod
Thalictrum dioicum L.	Early Meadowrue
Trillium grandiflorum (Michx.) Salisb.	Trillium
Urtica dioica L.	Wood Nettle
Viola pubescens Ait.	Downy yellow violet

Table 35**A**. Stand attributes for Pfauser's Woods (Site 35)
Sample size: 20 plots (10 x 12.5m) Sample Date: October 13, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	240	95	5.05	44.44	28.36	13.49	28.76
Quercus borealis	60	40	15.57	11.11	11.94	41.59	21.55
Ulmus rubra	64	50	3.85	11.85	14.93	10.27	12.35
Tilia americana	72	50	2.46	13.33	14.93	6.56	11.61
Juglans nigra	28	20	5.16	5.19	5.97	13.78	8.31
Fraxinus americana	32	30	3.18	5.93	8.96	8.51	7.80
Ostrya virginiana	28	30	.63	5.19	8.96	1.68	5.28
Carya cordiformis	8	10	.48	6.48	2.99	1.28	1.99
Juglans cinerea	4	5	.77	.74	1.49	2.05	1.43
Quercus alba	4	5	.29	.74	1.49	.78	1.00
Totals	540[a]		37.44[b]	100.0	100.02	99.99	100.01

a = 219 trees/acre
b = 163.13 ft^2/acre

Table 35**B**. Size class distribution for Pfauser's Woods.
Sample size: 0.25ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Quercus borealis				1				1	1		3	3	3	2		1			15
Juglans nigra							1	1	2		1	1		1					7
Ulmus rubra			4	1	4	3	2		1		1								16
Juglans cinerea										1									1
Fraxinus americana		2	1	2			1		2	2									10
Tilia americana	1	1	4	6	4	3	1												20
Acer saccharum	49	53	36	13	7	1	3												162
Quercus alba							1												1
Carya cordiformis	1	1		1				1											4
Ostrya virginiana		3	2	3	2														10
Prunus virginiana	4	1																	5
Cornus alternifolia	2																		2
Totals	57	61	47	27	17	7	9	3	6	3	5	4	3	3	1				

Table 35C. Shrub composition for Pfauzers Woods sampled 10/13/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	3880.	100.00	30.27	28.17	29.22
Prunus virginiana	3400.	50.00	26.52	14.08	20.30
Ribes cynosbati	2840.	55.00	22.15	15.49	18.82
Fraxinus americana	740.	45.00	5.77	12.68	9.22
Tilia americana	520.	25.00	4.06	7.04	5.55
Cornus alternifolia	140.	15.00	1.09	4.23	2.66
Euonymus atropurpureus	460.	5.00	3.59	1.41	2.50
Ulmus rubra	60.	10.00	.47	2.82	1.64
Cornus racemosa	220.	5.00	1.72	1.41	1.56
Parthenocissus quinquefolia	160.	5.00	1.25	1.41	1.33
Sambucus canadensis	120.	5.00	.94	1.41	1.17
Menispermum canadense	100.	5.00	.78	1.41	1.09
Prunus serotina	80.	5.00	.62	1.41	1.02
Solanum dulcamara	20.	5.00	.16	1.41	.78
Rhamnus catharticus	20.	5.00	.16	1.41	.78
Carya cordiformis	20.	5.00	.16	1.41	.78
Ostrya virginiana	20.	5.00	.16	1.41	.78
Lonicera xbella	20.	5.00	.16	1.41	.78
Total	12820.		100.00	100.00	100.00

Bishops Woods

Site 36
Size: 21.05ha
Waukesha County

Wauwatosa Quadrangle
SW¼, SW¼, Sec 25, T7N, R20E
Private Ownership

Bishops Woods was the second largest island studied. The stand was located on the east-facing side slope of a Cary aged moraine. The moraine slopes approximately 18m (60ft) in 0.4km (0.25mi) and represents the only significant change of relief within the stand. The major soil type is the well-drained Ozaukee silt loam (Typic Hapludalf) which typically occupies the convex side slopes of glacial moraines (USDA, 1971). This soil is characterized by moderately slow permeability and high available water capacity. A soil associated with three small intermittent stream beds was the somewhat poorly drained Mequon silt loam (Udollic Ochraqualf). This soil is also characterized by moderately slow permeability and a high available water capacity.

The land-use history of the site is not completely known. The woods was originally part of a farm owned by the Dousman family. During the mid-1800s, the Dousmans owned and operated a sawmill (Schumann, 1974). Prior to the turn of the century, there was some evidence of selective logging (Whitford, pers. comm.). The Archdiocese of Milwaukee purchased the woods in 1905. Disturbance since 1905 has been minimal. Up until 30 years ago, the eastern

portion of the stand was relatively open with new growth. Today, the relatively young growth is separated from the old growth section by well-developed edge trees. The western third of the forest had numerous large, but not old trees 30 years ago. Today, several individuals display open-grown characteristics. In the past 25 years, there has been no grazing or logging. Other disturbances, including footpaths and campsites occur throughout the stand. Urban pressures of development and size reduction are threatening the island.

The canopy and understory vegetation was sampled using twenty 10 x 12.5m plots. Sugar maple *(Acer saccharum)* was the dominant species accounting for 29% of the importance value. Sub-dominants, white ash *(Fraxinus americana)*, white oak *(Quercus alba)*, and red oak *(Q. borealis)* had nearly equal importance values, combined totaling over 43% of the importance value. These four species accounted for 87% of the basal area and nearly 70% of the stems (Table 36 **A**).

Sugar maple was present in nearly all size classes up to 75cm (Table 36 **B**). Red oak was present in the 40-60cm size classes, but was conspicuously absent in others. Similarly, white oak was present in the 20-50cm classes, but absent from the rest. The absence of oak reproduction in the smaller size classes is expected under the full canopy of sugar maple, but the absence of large individuals suggests selective logging of oaks some years ago. The restriction of basswood *(Tilia americana)* to specimens smaller than 35cm was peculiar as was the noticeable lack of black cherry *(Prunus serotina)*. Failure of those species may be attributable to the relative success of sugar maple and white ash. White ash was present in nearly all size classes up to 65cm (25.5in) dbh. Sugar maple, ironwood *(Ostrya virginiana)*, and white ash dominated the understory (stems 2.5-10.2cm dbh) accounting for 77% of the stems recorded. The tree components of the island appear to be progressing toward more mesic conditions. Species diversity (H') of the canopy and understory layers was the fifth highest of all stands examined (Table 3). The island was located west of the beech range.

Similarly, sugar maple dominated the shrub layer and accounted for 53% of the stems and 35% of the importance value (Table 36 **C**). The opportunistic white ash and choke cherry *(Prunus virginiana)* were sub-dominant and contributed another 23% to the importance value. The presence of prickly ash *(Zanthoxylum americanum)* and the hawthorns *(Crataegus punctata* and *C. succulenta)* sharing over 8% of the importance value suggests former grazing. Species diversity (H') of the shrub layer was 1.68; near the average for the shrub layer (Table 3).

The groundlayer was dominated by four mesic species: sugar maple, white ash, enchanter's nightshade *(Circaea quadrisulcata)*, and false Solomon's seal *(Smilacina racemosa)*. Combined, they accounted for 73% of the stems and 68% of the importance value (Table 36 **D**). A total of 37 species were recorded in the groundlayer, but no rare or endangered species were encountered. Species diversity (H') was slightly lower than the average for the groundlayer of 31 forest islands.

Table 36**A**. Stand attributes for Bishop's Woods (Site 36)
Sample size: 20 plots (20 x 12.5m) Sample Date: August 15, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	96	85	10.80	27.59	22.67	36.25	28.84
Fraxinus americana	54	55	4.76	15.52	14.67	15.98	15.39
Quercus alba	52	45	4.51	14.94	12.00	15.15	14.03
Quercus borealis	34	45	5.89	9.77	12.00	19.77	13.85
Ulmus rubra	32	35	.84	9.20	9.33	2.82	7.12
Tilia americana	24	30	.50	6.90	8.00	1.68	5.53
Carya cordiformis	24	15	.51	6.90	4.00	1.70	4.20
Ostrya virginiana	14	25	.20	4.02	6.67	.66	3.78
Juglans cinerea	8	15	.91	2.29	4.00	2.97	3.09
Acer rubrum	6	2	.77	1.72	4.00	2.58	2.77
Prunus serotina	2	5	.08	.57	1.33	.27	.72
Crataegus succulenta	2	5	.03	.57	1.33	.09	.66
Totals	348[a]		29.80[b]	99.99	100.00	100.00	99.98

a = 141 trees/acre
b = 129.79 ft^2/acre

Table 36**B**. Size class distribution for Bishops Woods
Sample size: 0.25ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Acer saccharum	48	11	5	3	1	4	8	10	6	5	4		1		1				107
Fraxinus americana	24	4	5	5	5	3	1	1		1	3	2	1						55
Quercus borealis		1					2		4	5	5	1							18
Acer rubrum	5	2				1	1					1							10
Quercus alba					3	7	6	7	2	1									26
Juglans cinerea				1				1	2										4
Tilia americana	9	5	7	3	1		1												26
Ulmus rubra	2	3	8	3	3	2													21
Carya cordiformis	2	5	5	4	3														17
Prunus serotina	3	1			1														5
Ostrya virginiana	30	33	6	1															70
Crataegus punctata	1		1																2
Cornus alternifolia	3																		3
Carpinus caroliniana	2																		2
Carya ovata	1																		1
Totals	130	65	37	20	17	17	19	19	14	12	12	4	2			1			

Table 36**C**. Shrub composition for Bishops Woods sampled 8/15/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	11200.	100.00	53.08	16.13	34.60
Fraxinus americana	2260.	90.00	10.71	14.52	12.61
Prunus virginiana	2320.	60.00	11.00	9.68	10.34
Viburnum acerifolium	2440.	30.00	11.56	4.84	8.20
Zanthoxylum americanum	400.	45.00	1.90	7.26	4.58
Carya cordiformis	320.	45.00	1.52	7.26	4.39
Cornus alternifolia	560.	25.00	2.65	4.03	3.34
Prunus serotina	240.	30.00	1.14	4.84	2.99
Tilia americana	160.	30.00	.76	4.84	2.80
Ribes cynosbati	140.	30.00	.66	4.84	2.75
Ostrya virginiana	100.	20.00	.47	3.23	1.85
Crataegus punctata	100.	20.00	.47	3.23	1.85
Crataegus succulenta	260.	15.00	1.23	2.42	1.83
Ulmus rubra	120.	15.00	.57	2.42	1.49
Quercus borealis	100.	15.00	.47	2.42	1.45
Amelanchier sp.	80.	10.00	.38	1.61	1.00
Juglans nigra	40.	10.00	.19	1.61	.90
Cornus racemosa	80.	5.00	.38	.81	.59
Acer rubrum	60.	5.00	.28	.81	.55
Menispermum canadense	40.	5.00	.19	.81	.50
Rubus occidentalis	40.	5.00	.19	.81	.50
Quercus alba	20.	5.00	.09	.81	.45
Carpinus caroliniana	20.	5.00	.09	.81	.45
Total	21100.		100.00	100.00	100.00

Table 36**D**. Groundlayer for Bishops Woods sampled 8/15/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	57500.	95.00	19.38	20.32	19.85
Circaea quadrisulcata	81750.	55.00	27.55	11.76	19.66
Fraxinus americana	34000.	82.50	11.46	17.65	14.55
Smilacina racemosa	44000.	60.00	14.83	12.83	13.83
Thalictrum diocum	20500.	2.50	6.91	.53	3.72
Prunus virginiana	11000.	15.00	3.71	3.21	3.46
Viburnum acerifolium	10000.	10.00	3.37	2.14	2.75
Ariseama triphyllum	5000.	15.00	1.68	3.21	2.45
Cornus alternifolia	6750.	10.00	2.27	2.14	2.21

Table 36 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Carya cordiformis	2750.	12.50	.93	2.67	1.80
Tilia americana	1250.	12.50	.42	2.67	1.55
Geranium maculatum	2250.	10.00	.76	2.14	1.45
Smilax herbacea	1250.	10.00	.42	2.14	1.28
Quercus borealis	750.	7.50	.25	1.60	.93
Acer rubrum	1750.	5.00	.59	1.07	.83
Trillium grandiflorum	1750.	5.00	.59	1.07	.83
Crataegus succulenta	1500.	5.00	.51	1.07	.79
Hydrophyllum virginianum	3000.	2.50	1.01	.53	.77
Desmodium nudiflorum	750.	5.00	.25	1.07	.66
Zanthoxylum americanum	750.	5.00	.25	1.07	.66
Cornus racemosa	2000.	2.50	.67	.53	.60
Gramineae	1250.	2.50	.42	.53	.48
Rhus radicans	1250.	2.50	.42	.53	.48
Ribes cynosbati	500.	2.50	.17	.53	.35
Euonymus atropurpureus	500.	2.50	.17	.53	.35
Actea rubra	250.	2.50	.08	.53	.31
Amphicarpa bracteata	250.	2.50	.08	.53	.31
Geum canadense	250.	2.50	.08	.53	.31
Lonicera xbella	250.	2.50	.08	.53	.31
Laportea canadensis	250.	2.50	.08	.53	.31
Ostrya virginiana	250.	2.50	.08	.53	.31
Prunus serotina	250.	2.50	.08	.53	.31
Quercus alba	250.	2.50	.08	.53	.31
Rubus occidentalis	250.	2.50	.08	.53	.31
Smilax ecirrhata	250.	2.50	.08	.53	.31
Trillium gleasoni	250.	2.50	.08	.53	.31
Vitis sp.	250.	2.50	.08	.53	.31
Total	296750.		100.00	100.00	100.00

Milwaukee County Zoological Gardens

Site 37 — Wauwatosa Quadrangle
Size: 4.49ha — S½, SW¼, Sec 29, T7N, R21E
Milwaukee County — Milwaukee County Park Commission

The woods at the Milwaukee County Zoo is located at the crest of a small upland sloping gently to the south-southeast. Topographic relief within the stand is less than 5m and is characterized by several small depressions. The forest island is developed entirely upon the well-drained Ozaukee silt loam (Typic Hapludalf). The soils are typical of glacial moraine side slopes underlain by a calcareous silty loam glacial till (USDA, 1971).

The land-use history of the tract prior to purchase by the Park Commission in 1958 and 1959 is unknown. Until the late 1950s, the forest island was approximately 18ha (45a) in size. Construction of the zoo buildings, trails, and animal facilities in the early 1960s trisected the island, but preserved the major portion intact. The presence of white oak *(Quercus alba)* in all size classes to 65cm (25.5in) dbh is indicative of the island's long-term presence. However, the few, large red oak *(Quercus borealis)* specimens and lack of basswood *(Tilia americana)* and white ash *(Fraxinus americana)* in the larger size classes is suggestive of selective logging (Table 37 **B**).

The canopy and understory strata were sampled using twenty 10 x 25m plots in the section bounded by the tour train tracks on the south and the main foot-trail to the north. The section south of the train tracks was within animal enclosures and was not sampled. The larger region to the north of the foot-trail also was not sampled. Much of it was successional in nature. A permanent deer yard and temporary cheetah run prevented access. Observations confirmed that the general forest structure of the enclosed sections either was the same or was heavily disturbed and unsuitable; i.e., the heavily browsed deer yard.

White oak and sugar maple *(Acer saccharum)* co-dominated the canopy stratum, combined contributing 69% of the importance value (Table 37 **A**). Also, the same two species accounted for 75% of the stems and 77% of the basal area with an even distribution throughout the stand. The understory (stems 2.5-10.1cm dbh) was clearly dominated by black cherry *(Prunus serotina)* which accounted for 55% of the stems (Table 37 **B**). The high density of black cherry saplings is consistent with Auclair and Cottam's (1971) work in the xeric stands of south-central Wisconsin. Sugar maple was sub-dominant making up 28% of the stem density. As expected, with the vast majority of stems represented by so few species, the species diversity (H') was lower than the average for the 43 forest islands (Table 3). American beech *(Fagus grandifolia)* was absent since this site is west of its natural range in Milwaukee County.

Comparison of our data with that reported by Whitford and Salamun (1954) for 1951 indicates little change. The Milwaukee County Zoo is the same as their Site Number 6:

	Climax Adaptation Number	1951		1975	
		IV	CIV	IV	CIV
Acer saccharum	10.0	37.67	377	33.92	339
Quercus alba	3.5	33.67	118	35.48	124
Quercus borealis	5.5	7.33	40	10.37	57
Acer rubrum	7.0	6.33	44	3.52	25
Ulmus rubra	8.0	4.67	37	1.53	12
Ostrya virginiana	8.5	3.00	26	1.45	12
Prunus serotina	3.5	2.33	8	7.47	26
Tilia americana	7.5	2.00	15	2.17	16

Continued

Species	Climax Adaptation Number	1951 IV	1951 CIV	1975 IV	1975 CIV
Fraxinus americana	6.5	2.00	13	3.38	22
Juglans nigra	6.5	1.33	9	-	-
Ulmus americana	7.5	-	-	.72	5
		100.33	2073	100.01	1914

Sugar maple and white oak dominated the stand 24 years ago, as today. Red oak also held a position similar to that of 24 years ago. The major difference lies in the relative contribution of the mesic red maple *(Acer rubrum)*, slippery elm *(Ulmus rubra)*, and ironwood *(Ostrya virginiana)*. Combined, they accounted for 14% of the importance value 24 years ago, but today contributed only 6.5%. The differences for red maple and ironwood may be attributable to variation in sampling. But the decrease in slippery elm was the result of Dutch elm disease and subsequent removal by the County. Several elm stumps are still present. Young black cherry, however, more than tripled its contribution in the last 24 years, accounting for 10% of the stems but less than 2% of the basal area. This would seem reasonable with the opening of the canopy as a result of the dying elms, plus the development of the grounds in the early 1960s.

The shrub layer was co-dominated by sugar maple and choke cherry *(Prunus virginiana)* and black cherry comprising 83% of the stems and 70% of the importance value (Table 37 **C**). It is interesting to note that the two cherry species combined to account for 43% of the stems and 41% of the importance value. Both were characterized by an even distribution. Species richness was below average as was the species diversity (H') (Table 3). Only four of the 15 species occurred in more than 25% of the plots. Four of the species were exotics; not native to the eastern United States. All exotics were of limited distribution and appeared to be declining. The Amur maple *(Acer ginnala)* was recorded only in this stand.

Only 16 species were recorded in the groundlayer. False Solomon's-seal *(Smilacina racemosa)* and choke cherry were the most numerous species, contributing 50% of the density and 45% of the importance value (Table 37 **D**). Sugar maple seedlings were third in importance, but accounted for less than 7% of the relative density. Each of the three species occurred in slightly over half of the plots. As a result, species diversity (H') of the groundlayer was well below the average of the 31 islands sampled (Table 3). No rare or endangered species were encountered. The spring flora was not sampled.

Table 37**A**. Stand attributes for Milwaukee Zoological Gardens (Site 37)
Sample size: 20 plots (10 x 25m) Sample Dates: July 25 and August 7, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Quercus alba	108	95	14.26	32.73	28.36	45.35	35.48
Acer saccharum	138	95	9.92	41.82	28.36	31.57	33.92
Quercus borealis	18	35	4.78	5.45	10.45	15.20	10.37
Prunus serotina	34	35	.53	10.30	10.45	1.67	7.47
Acer rubrum	8	20	.69	2.42	5.97	2.18	3.52
Fraxinus americana	8	15	1.01	2.42	4.48	3.23	3.38
Tilia americana	6	15	.07	1.82	4.48	.21	2.17
Ulmus rubra	4	10	.12	1.21	2.99	.40	1.53
Ostrya virginiana	4	10	.04	1.21	2.99	.14	1.45
Ulmus americana	2	5	.02	.61	1.49	.06	.72
Totals	330[a]		31.44[b]	99.99	100.02	100.02	100.01

a = 134 trees/acre
b = 137.00 ft^2/acre

Table 37**B**. Size class distribution for Milwaukee Zoological Gardens
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Fraxinus americana	29	6	2	1												1			39
Quercus borealis						1			1		2	1		2	2				9
Acer saccharum	50	49	18	6	11	7	3	10	8	2	2		2						168
Quercus alba				1	3	4	10	11	8	5	10	1	1						54
Acer rubrum	1				2			1	1										5
Prunus serotina	120	72	12	4		1													209
Ulmus rubra	1			1	1														3
Tilia americana	2	6	3																11
Ostrya virginiana	3	2	2																7
Ulmus americana		4	1																5
Populus deltoides		1																	1
Carya cordiformis	1																		1
Acer negundo	1																		1
Prunus virginiana	1																		1
Totals	209	140	38	13	17	13	13	22	18	7	14	2	3	2	2	1			

Table 37 **C**. Shrub composition for Milwaukee County Zoo Woods sampled 8/7/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	7520.	90.00	40.00	18.75	29.37
Prunus virginiana	5000.	90.00	26.60	18.75	22.67
Prunus serotina	3020.	95.00	16.06	19.79	17.93
Fraxinus americana	960.	80.00	5.11	16.67	10.89
Lonicera xbella	1140.	25.00	6.06	5.21	5.64
Ribes americanum	520.	25.00	2.77	5.21	3.99
Cornus racemosa	300.	15.00	1.60	3.13	2.36
Ulmus rubra	60.	15.00	.32	3.13	1.72
Vitis riparia	40.	10.00	.21	2.08	1.15
Tilia americana	40.	10.00	.21	2.08	1.15
Ribes cynosbati	60.	5.00	.32	1.04	.68
Acer ginnala	40.	5.00	.21	1.04	.63
Solanum dulcamara	40.	5.00	.21	1.04	.63
Rhamnus catharticus	40.	5.00	.21	1.04	.63
Acer rubrum	20.	5.00	.11	1.04	.57
Total	18800.		100.00	100.00	100.00

Table 37 **D**. Groundlayer for Milwaukee County Zoo sampled 8/7/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Smilacina racemosa	26889.	57.78	26.54	21.67	24.10
Prunus virginiana	24000.	51.11	23.68	19.17	21.43
Acer saccharum	8889.	57.78	8.77	21.67	15.22
Circaea quadrisulcata	15111.	15.56	14.91	5.83	10.37
Fraxinus americana	6667.	28.89	6.58	10.83	8.71
Ribes americanum	5333.	15.56	5.26	5.83	5.55
Podophyllum peltatum	6444.	6.67	6.36	2.50	4.43
Prunus serotina	2889.	11.11	2.85	4.17	3.51
Carex sp.	1556.	2.22	1.54	.83	1.18
Cornus racemosa	667.	4.44	.66	1.67	1.16
Acer rubrum	444.	4.44	.44	1.67	1.05
Arisaema triphyllum	667.	2.22	.66	.83	.75
Vitis sp.	667.	2.22	.66	.83	.75
Ulmus rubra	444.	2.22	.44	.83	.64
Carex sp.	444.	2.22	.44	.83	.64
Allium tricoccum	222.	2.22	.22	.83	.53
Total	101332.		100.00	100.00	100.00

Greenfield Park

Site 38 — Wauwatosa Quadrangle
Size: 18.34ha — E-2/3, S½, SW¼, Sec 6, T6N, R21E
Milwaukee County — Milwaukee County Park Commission

The forest island is part of the 113ha (278a) County Park. The first land purchase was made from the Bradley family in 1921. Additional purchases were made later. The woods is located on the east-facing side slope of an end moraine, near the base. The majority of the forest island is developed on eroded Ozaukee loam (Typic Hapludalf). With part of the original surface layer gone, the soil exhibits slow permeability and rapid runoff. A multi-branched, intermittent stream bed was located in the northern half of the island draining to the north-northeast. Mequon silt loam (Udollic Ochraqualf), a somewhat poorly drained, silty soil was associated with the stream bed. The island was bounded on the east by a park road. All other edges were adjacent to mowed park lawns.

The canopy and understory strata were sampled using twenty 10 x 25m plots. Sixteen species were present in the canopy and understory strata. The canopy was dominated by white oak *(Quercus alba)* and red oak *(Q. borealis)* combining to account for over 52% of the stems, 80% of the basal area, and aover 57% of the importance value (Table 38 **A**). The structure was typical of the southern dry-mesic forest described by Curtis (1959). The oaks were dominant in the larger size classes from 25-75cm (10-29in) dbh with little or no reproduction (Table 38 **B**). Very large individuals were also missing, suggesting some cutting some time ago, perhaps before the turn of the century. Species diversity (H') was near the average for the 43 islands sampled (Table 3).

Sugar maple *(Acer saccharum)* and ironwood *(Ostrya virginiana)* were subdominants, but combined only contributed 8% of the basal area. Both species were confined to the smaller size classes (Table 38 **B**). Sugar maple totally dominated the understory (stems 2.5-10.2cm) accounting for 54% of the stems. Ironwood and black cherry *(Prunus serotina)* accounted for another 22% and 19% respectively. The three species combined represented 95% of the stems recorded (Table 38 **B**). The strong reproductive success of sugar maple and ironwood, with a commensurate decrease of success of the oaks suggests that the stand is moving toward eventual maple domination. The relative success of black cherry in the understory is consistent with the results of Auclair and Cottam (1971) in the southern-xeric forests of south-central Wisconsin. The island is beyond the western range of American beech *(Fagus grandifolia)*.

Comparison of our data with that obtained by Whitford and Salamun (1954) in 1951 shows an interesting but expected trend. Greenfield Park is the same island as their stand number 4:

Species	Climax Adaptation Number (Curtis, 1959)	1951 IV	1951 CIV	1975 IV	1975 CIV
Quercus alba	3.5	46.67	163	36.20	127
Quercus borealis	5.5	11.00	61	21.21	117

Continued from page 197

Species	Climax Adaptation Number (Curtis, 1959)	1951 IV	1951 CIV	1975 IV	1975 CIV
Tilia americana	7.5	9.00	68	4.71	35
Acer saccharum	10.0	6.33	63	14.79	118
Ostrya virginiana	8.5	6.00	51	9.07	77
Fraxinus americana	6.5	5.33	35	2.58	17
Acer rubrum	7.0	4.67	33	4.85	34
Prunus serotina	3.5	4.00	14	4.85	17
Ulmus rubra	8.0	3.33	27	3.58	29
Crataegus (succulenta)	-	2.00	-	.57	-
Ulmus americana	7.5	1.00	8	.62	5
Carya cordiformis	8.5	1.00	9	-	-
Total		100.33	1596	99.99	1728

The oaks dominated the stand 24 years ago as today with 57% of the importance value, but their respective contributions have changed considerably. Instead of the near total domination by white oak 24 years ago, today red oak, a more mesic species (Curtis, 1959) has doubled its contribution. The relative contributions of basswood *(Tilia americana)* and white ash dropped significantly, but sugar maple and ironwood increased. The remainder of the species remained about the same, including the elms *(Ulmus rubra* and *U. americana)*. In summary, a change to a more mesophytic community has occurred in the last 24 years. The change was not great, illustrating the slow rate of change in transition from a southern dry-mesic forest to a southern-mesic forest. A recalculation of Whitford and Salamun's continuum index was necessary due to changes made by Curtis (1959) from his original climax adaptation numbers (Curtis and McIntosh, 1950).

Sixteen species were sampled in the shrub stratum (Table 38 **C**). Choke cherry dominated the stratum comprising 37% of the stems and 27% of the importance value. Sugar maple, black cherry, honeysuckle *(Lonicera bella)*, and white ash had similar importance values and accounted for an additional 54% of the stems and 58% of the importance value. Even with five species comprising the vast majority of stems, species diversity (H') for the shrub stratum was slightly higher than average (Table 3).

The groundlayer was clearly dominated by the false Solomon's seal *(Smilacina racemosa)* accounting for nearly 69% of the stems and over 50% of the importance value (Table 38 **D**). Large expanses of the forest floor had nearly complete coverage of dense stands of *S. racemosa*. Only one other species, white ash, exceeded 10% importance value. The remaining 19 species were widely distributed and few in number. The species diversity (H') was the third lowest of the 31 stands examined (Table 3). No rare or endangered species were observed.

Table 38**A**. Stand attributes for Greenfield Park (Site 38)
Sample size: 20 plots (10 x 25m) Sample Date: August 4, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Quercus alba	140	100	14.63	38.25	23.26	47.10	36.20
Quercus borealis	52	70	10.30	14.21	16.28	33.15	21.21
Acer saccharum	52	65	1.88	14.21	15.12	6.05	11.79
Ostrya virginiana	42	60	.55	11.48	13.95	1.77	9.07
Acer rubrum	18	25	1.19	4.92	5.81	3.82	4.85
Prunus serotina	18	35	.42	4.92	8.14	1.36	4.81
Tilia americana	18	25	1.05	4.92	5.81	3.39	4.71
Ulmus rubra	14	25	.34	3.83	5.81	1.09	3.58
Fraxinus americana	8	15	.64	2.19	3.49	2.05	2.58
Ulmus americana	2	5	.05	.55	1.16	.16	.62
Crataegus succulenta	2	5	.02	.55	1.16	.05	.57
Totals	366[a]		31.07[b]	100.03	99.99	99.99	99.99

a = 148 trees/acre
b = 135.38 ft^2/acre

Table 38**B**. Size class distribution for Greenfield Park
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	Total
Quercus borealis	1					3	2	2	3	1	8	2	3	1	1				27
Quercus alba				4	5	15	11	15	9	5	4	1	1						70
Fraxinus americana		1		1	1	1				1									5
Tilia americana		6	4	1			1	1	2										15
Prunus serotina	27	52	8						1										88
Acer saccharum	155	74	9	4	8	2	2	1											255
Acer rubrum		1	1	1		2	3	2											9
Ulmus rubra		3	2	4	1														10
Ostrya virginiana	64	31	19	2															116
Ulmus americana		1		1															2
Crataegus succulenta	1	1	1																3
Crataegus punctata		1																	1
Prunus virginiana		2																	2
Juglans cinerea		1																	1
Hamamelis virginiana		1																	1
Amelanchier laevis	1																		1
Totals	249	175	44	17	15	23	19	21	15	7	12	3	4	1	1				

Table 38**C**. Shrub composition for Greenfield Park sampled 8/4/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	4500.	75.00	36.89	17.24	27.06
Acer saccharum	1860.	85.00	15.25	19.54	17.39
Prunus serotina	1760.	75.00	14.43	17.24	15.83
Lonicera xbella	1900.	40.00	15.57	9.20	12.38
Fraxinus americana	1100.	65.00	9.02	14.94	11.98
Tilia americana	260.	20.00	2.13	4.60	3.36
Ribes americana	340.	10.00	2.79	2.30	2.54
Ostrya virginiana	80.	15.00	.66	3.45	2.05
Zanthothoxylum americanum	80.	10.00	.66	2.30	1.48
Cornus racemosa	80.	10.00	.66	2.30	1.48
Viburnum opulus	100.	5.00	.82	1.15	.98
Amelanchier sp.	40.	5.00	.33	1.15	.74
Rubus occidentalis	40.	5.00	.33	1.15	.74
Viburnum lentago	20.	5.00	.16	1.15	.66
Carya cordiformis	20.	5.00	.16	1.15	.66
Vitis riparia	20.	5.00	.16	1.15	.66
Total	12200.		100.00	100.00	100.00

Table 38 D. Groundlayer for Greenfield Park sampled 8/4/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Smilacina racemosa	166250.	92.50	68.70	31.90	50.30
Fraxinus americana	13000.	55.00	5.37	18.97	12.17
Prunus virginiana	12250.	32.50	5.06	11.21	8.13
Acer saccharum	7750.	25.00	3.20	8.62	5.91
Thalictrum dioicum	14500.	7.50	5.99	2.59	4.29
Circaea quadrisulcata	10000.	12.50	4.13	4.31	4.22
Geranium maculatum	3500.	12.50	1.45	4.31	2.88
Arisaema triphyllum	2750.	10.00	1.14	3.45	2.29
Prunus serotina	750.	7.50	.31	2.59	1.45
Hepatica acutiloba	4250.	2.50	1.76	.86	1.31
Trillium grandiflorum	1250.	5.00	.52	1.72	1.12
Tilia americana	500.	5.00	.21	1.72	.97
Parthenocissus quinquefolia	1250.	2.50	.52	.86	.69
Podophyllum peltatum	1250.	2.50	.52	.86	.69
Rubus occidentalis	750.	2.50	.31	.86	.59
Galium concinum	500.	2.50	.21	.86	.53
Lonicera xbella	500.	2.50	.21	.86	.53
Carya cordiformis	250.	2.50	.10	.86	.48

Table 38 D continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Sanguinaria canadensis	250.	2.50	.10	.86	.48
Smilax herbacea	250.	2.50	.10	.86	.48
Viburnum opulus	250.	2.50	.10	.86	.48
Total	242000.		100.00	100.00	100.00

St. Francis Seminary

Site 39
Size: 11.46ha
Milwaukee County

South Milwaukee Quadrangle
NE¼, SE¼, Sec 15, T6N, R22E
Private Ownership

St. Francis Seminary is located a short distance from Lake Michigan. The most distant portion of the woods is only 0.9km from the Lake shore. The southern-mesic forest is developed on a Cary end moraine of Wisconsin glaciation. A large, irregular depression exists near the center of the stand and accounts for approximately 25% of the entire wooded area. The depression is vegetated by lowland forest species. The soils for this site were not mapped (USDA, 1971). Judging from surrounding soil patterns and topography, the upland areas where the southern-mesic forest was developed were probably Morley silt loam (Typic Hapludalf). Blount silt loam (Aeric Ochraqualf) was probably present in the depressional areas. Blount silt loams are somewhat poorly drained soils of drainageways and depressions and present a ponding hazard (USDA, 1971).

The old-growth southern-mesic forest had been selectively logged over a century ago. According to Whitford and Whitford (1972), the stand was logged between 1849 and 1856 when a sawmill was erected to produce lumber to build the seminary. Selective cutting for firewood occurred in the forest until about 1900. No further cutting or grazing occurred in the island since at least 1924 (Fetterer, pers. comm.). However, heavy human and motorcycle use has expanded the numerous paths throughout the woods. As a result, the native groundlayer has become limited in extent. While sampling, one had the distinct impression that the largest trees existed along the paths. Once away from the paths, the size and quality of the trees declined noticeably. Perhaps the rationale of the selective cutting favored scenic woodland paths. The presence of the Lakeside electric power generating station 1.1km to the southeast may cause periodic air pollution problems within the stand.

Only the upland sections of the forest island were sampled using eighteen 10 x 25m plots. American beech *(Fagus grandifolia)*, basswood *(Tilia americana)* and sugar maple *(Acer saccharum)* co-dominated the stand. Combined, these three species accounted for 70% of the basal area and 58% of the importance value (Table 39 **A**). The high stem density and basal area reflects the second growth character of the stand. Continued recovery of the stand appears assured with sugar maple, white ash *(Fraxinus americana)*, and ironwood

(Ostrya virginiana) dominating the understory (stems 2.5-10.2cm dbh) and accounting for 55% of the stems (Table 39**B**). The depressional "habitat islands" (MacArthur and Wilson, 1967) contributed wet-mesic species and influenced species richness of the canopy layer. Seventeen species were present in the canopy and understory (Table 39 **B**). Species diversity (H') was the second highest of the 43 forest islands (Table 3).

Choke cherry *(Prunus virginiana)* dominated the shrub layer accounting for over 65% of the stems and 44% of the importance value (Table 39**C**). Because of the heavy domination by choke cherry, species diversity (H') was slightly below the average (Table 3). Similarly, stem density and species richness were also slightly below the average. Nine of the 15 species present in the shrub stratum were tree reproduction. Honeysuckle *(Lonicera bella)* was the only exotic species sampled and was of limited importance.

Thirty-eight species were sampled in the goundlayer. No species demonstrated clear-cut dominance. White ash and choke cherry had the greatest importance values, combined contributing 25% (Table 39 **D**). Reflecting the high relative disturbance, sedge *(Carex pennsylvanica)* reached the highest density. Other disturbance species present, but reaching much lower importance, were dogbane *(Apocynum androsaemifolium)*, and the exotics honeysuckle and hop clover *(Trifolium procumbens)*. Another exotic, helleborine *(Epipactis latifolia)*, reached locally high densities and may have become a tolerant and permanent member of the southern-mesic forest community. No rare or endangered species were observed.

Table 39 **A**. Stand attributes for St. Francis Seminary (Site 39)
Sample size: 18 plots (10 x 25m) Sample Date: June 18, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Fagus grandifolia	90	75	8.12	18.99	15.79	24.58	19.79
Tilia americana	110	85	5.42	23.21	17.89	16.41	19.17
Acer saccharum	54	75	9.42	11.39	15.79	28.53	18.57
Ostrya virginiana	84	75	1.52	17.72	15.79	4.60	12.70
Fraxinus pennsylvanica	40	30	1.35	8.43	6.32	4.07	6.27
Quercus borealis	18	15	3.76	3.80	3.16	11.38	6.11
Fraxinus americana	20	40	.90	4.22	8.42	2.74	5.13
Prunus serotina	24	30	.75	5.06	6.32	2.28	4.55
Ulmus rubra	8	10	.54	1.69	2.11	1.65	1.82
Crataegus succulenta	12	10	.14	2.53	2.11	.43	1.69
Fraxinus nigra	4	10	.13	.84	2.11	.39	1.11
Quercus alba	4	5	.46	.84	1.05	1.38	1.09
Carya cordiformis	2	5	.31	.42	1.05	.93	.80
Juglans cinerea	2	5	.16	.42	1.05	.50	.66
Carpinus caroliniana	2	5	.04	.42	1.05	.12	.53
Totals	474[a]		33.02[b]	99.98	100.01	99.99	99.99

a = 192 trees/acre
b = 143.87 ft^2/acre

Table 39 **B**. Size class distribution for St. Francis Seminary
Sample size: 0.45ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus borealis				1			1		2	2	1			1			1		9
Fagus grandifolia	5	9	8	10	6	4	3	2	3	2	2	2	2			1			45
Quercus alba								2											2
Acer saccharum	23	7	1	1			3	3	5	5	3	3	1	1	1				27
Tilia americana	8	12	16	8	11	9	5	3	1		1	1							55
Fraxinus americana	19	10	5	3						2									10
Ulmus rubra		1	1		1	1			1										4
Carya cordiformis		1							1										2
Prunus serotina	11	2	4	1	6	1													12
Juglans cinerea							1												1
Fraxinus pennsylvanica	1	1	4	6	7	2	1												20
Ostrya virginiana	18	21	23	16	2	1													42
Fraxinus nigra				1	1														2
Carpinus caroliniana	7	4		1															1
Crataegus succulenta	2	3	6																6
Hamamelis virginiana	4	7																	11
Viburnum lentago		1																	1
Totals	98	79	68	48	34	18	14	10	13	11	7	6	3	2	1	1	1		

Table 39 **C**. Shrub composition for St. Francis Seminary sampled 6/18/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	9400.	100.00	65.37	22.99	44.18
Acer saccharum	1420.	65.00	9.87	14.94	12.41
Fraxinus americana	700.	60.00	4.87	13.79	9.33
Viburnum lentago	1120.	40.00	7.79	9.20	8.49
Prunus serotina	860.	45.00	5.98	10.34	8.16
Tilia americana	300.	40.00	2.09	9.20	5.64
Fagus grandifolia	80.	20.00	.56	4.60	2.58
Carpinus caroliniana	100.	15.00	.70	3.45	2.07
Vitis riparia	80.	10.00	.56	2.30	1.43
Lonicera xbella	80.	10.00	.56	2.30	1.43
Ostrya virginiana	40.	10.00	.28	2.30	1.29
Viburnum opulus	140.	5.00	.97	1.15	1.06
Fraxinus pensylvanica	20.	5.00	.14	1.15	.64
Ribes americanum	20.	5.00	.14	1.15	.64
Ribes cynosbati	20.	5.00	.14	1.15	.64
Total	14380.		100.00	100.00	100.00

Table 39 **D**. Groundlayer for St. Francis Seminary sampled 6/18/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	55250.	62.50	15.35	12.50	13.92
Prunus virginiana	34500.	67.50	9.58	13.50	11.54
Carex pensylvanica	60000.	15.00	16.67	3.00	9.83
Acer saccharum	22250.	57.50	6.18	11.50	8.84
Solidago flexicaulis	40250.	30.00	11.18	6.00	8.59
Geranium maculatum	28000.	17.50	7.78	3.50	5.64
Podophyllum peltatum	14750.	30.00	4.10	6.00	5.05
Arisaema triphyllum	14250.	25.00	3.96	5.00	4.48
Hydrophyllum virginianum	18750.	10.00	5.21	2.00	3.60
Tilia americana	11250.	20.00	3.13	4.00	3.56
Circaea quadrisulcata	16250.	12.50	4.51	2.50	3.51
Aster macrophyllus	10750.	20.00	2.99	4.00	3.49
Solidago caesia	4000.	10.00	1.11	2.00	1.56
Sanguinaria canadensis	2000.	12.50	.56	2.50	1.53
Epipactis latifolia	1750.	12.50	.49	2.50	1.49
Maianthemum canadense	3250.	10.00	.90	2.00	1.45
Fagus grandifolia	3250.	7.50	.90	1.50	1.20
Epifagus virginiana	2750.	7.50	.76	1.50	1.13
Ostrya virginiana	1250.	7.50	.35	1.50	.92

Table 39**D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Viburnum rafinesquianum	1000.	7.50	.28	1.50	.89
Solanum dulcamara	2000.	5.00	.56	1.00	.78
Rubus odoratus	1750.	5.00	.49	1.00	.74
Viburnum lentago	1000.	5.00	.28	1.00	.64
Hamamelis virginiana	2750.	2.50	.76	.50	.63
Trifolium procumbens	750.	5.00	.21	1.00	.60
Carya cordiformis	500.	5.00	.14	1.00	.57
Carex albursina	1750.	2.50	.49	.50	.49
Lonicera xbella	1000.	2.50	.28	.50	.39
Allium tricoccum	500.	2.50	.14	.50	.32
Solidago sp.	500.	2.50	.14	.50	.32
Apocynum androsaemifolium	250.	2.50	.07	.50	.28
Erythronium americanum	250.	2.50	.07	.50	.28
Juglans cinerea	250.	2.50	.07	.50	.28
Prenanthes alba	250.	2.50	.07	.50	.28
Quercus borealis	250.	2.50	.07	.50	.28
Smilacina racemosa	250.	2.50	.07	.50	.28
Trillium grandiflorum	250.	2.50	.07	.50	.28
Vitis sp.	250.	2.50	.07	.50	.28
Total	360000.		100.00	100.00	100.00

Cudahy Woods (North)

Site 40
Size: 7.81ha
Milwaukee County

Greendale Quadrangle
N½, NE¼, NW¼, Sec 4, T5N, R22E
Milwaukee County Park Commission

Cudahy Woods (North) is a part of a larger, approximately 24ha (60a) tract recently acquired by the Milwaukee County Park Commission. The tract had been owned by the Cudahy family for nearly a century until presented to Milwaukee County in 1975. The northernmost portion of the site appears to have been heavily timbered and possibly grazed. Black cherry *(Prunus serotina)* and large hawthorns *(Crataegus sp.)* are numerous. Edge trees separating the island from this tract are present, but the edge is not mature. The east edge is bounded by a gravel road and the west by landfill and construction. An old overgrown road enters the woods from the west and terminates at the south edge. The southern edge grades into a lowland forest.

Cudahy Woods is located on a narrow upland sloping to the southeast. Several small ravines create mesic pockets with varied slope aspects. The woods is developed on an eroded Morley silt loam (Typic Hapludalf) (USDA, 1971); a further suggestion of earlier disturbance. This soil is highly susceptible to erosion. The soil is relatively impermeable and heavy precipitation will run off rather than soak in (USDA, 1971).

The site was sampled using a series of east-west line strips composed of twenty 10 x 25m plots. Red oak *(Quercus borealis)* and white oak *(Q. alba)* dominate the forest accounting for 72% of the basal area and 51% of the total importance value (Table 40**A**). The size class data indicate red oak dominating the largest classes ($\geq$ 40cm), white oak dominating the medium sizes (25-40cm dbh), and sugar maple *(Acer saccharum)* and ironwood *(Ostrya virginiana)* dominating the smaller classes and understory (Table 40 **B**). Subdominants in the understory include hornbeam *(Carpinus caroliniana)* and witch-hazel *(Hamamelis virginiana)*. Canopy and understory species diversity was the highest of all sites sampled (Table 3), an additional indication of disturbance.

The shrub layer was dominated by choke cherry *(Prunus virginiana)* which accounted for 73% of the stems and 51% of the importance value (Table 40**C**). The subdominant was witch-hazel, comprising only 12% of the stems and 13% of the importance value. The heavy domination by choke cherry seems to have reduced species diversity.

The groundlayer was co-dominated by white ash *(Fraxinus americana)* seedlings, wild geranium *(Geranium maculatum)* and false Solomon's-seal *(Smilacina racemosa)* which together included almost 47% of the importance value and 53% of the stems (Table 40 **D**). The European orchid *(Epipactis latifolia)* was widespread and common in the stand contributing over 1% to the importance value. No rare or endangered species were encountered.

Table 40 **A**. Stand attributes for Cudahy Woods - North (Site 40)
Sample size: 20 plots (10 x 25m) Sample Date: June 10, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Quercus borealis	110	80	17.58	26.44	16.67	48.66	30.59
Quercus alba	90	75	8.66	21.63	15.63	23.95	20.40
Acer saccharum	54	75	1.82	12.98	15.63	5.04	11.22
Fraxinus americana	34	60	2.88	8.17	12.50	7.99	9.55
Tilia americana	42	50	2.74	10.10	10.42	7.61	9.38
Ostrya virginiana	26	45	.34	6.25	9.38	.93	5.52
Fagus grandifolia	18	25	.82	4.33	5.21	2.27	3.94
Acer rubrum	12	20	.54	2.88	4.17	1.48	2.84
Prunus serotina	10	25	.22	2.40	5.21	.60	2.74
Carya ovata	14	15	.44	3.37	3.13	1.22	2.57
Ulmus rubra	6	10	.08	1.44	2.08	.24	1.25
Totals	416[a]		36.12[b]	99.99	100.03	99.99	100.00

a = 168 trees/acre
b = 157.39 ft^2/acre

Table 40**B**. Size class distribution for Cudahy Woods - North
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus borealis		1	4	3	2	1	2	8	10	10	6	2	2	3	2				56
Fraxinus americana	4	3	1	3	4	2	2	1	2	1			1						24
Quercus alba					6	12	10	10	2	1	3		1						45
Tilia americana	1	3	6	2	4	1	2	3	2			1							25
Acer saccharum	24	31	11	5	5	3	1	2											82
Fagus grandifolia	2	3	1	3	2	1	2												14
Acer rubrum	1	2		3	1	1	1												9
Prunus serotina	4	7	3		2														16
Carya ovata	1	1	2	1	4														9
Ostrya virginiana	20	20	11	2															53
Ulmus rubra	2	3	2	1															8
Crataegus succulenta	8	3																	11
Carya cordiformis	4	3																	7
Carpinus caroliniana	21	2																	23

Table 40 **B** continued

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Cornus alternifolia		1																	1
Hamamelis virginiana	20	8																	28
Prunus virginiana	1	1																	2
Amelanchier laevis	1	1																	2
Totals	114	93	41	23	30	21	20	24	16	12	9	3	4	3	2				

Table 40**C**. Shrub composition for Cudahy Woods-North sampled 6/10/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	11680.	100.00	72.82	29.41	51.11
Hamamelis virginiana	2320.	40.00	14.46	11.76	13.11
Fraxinus americana	420.	45.00	2.62	13.24	7.93
Acer saccharum	460.	40.00	2.87	11.76	7.32
Crataegus succulenta	100.	20.00	.62	5.88	3.25
Prunus serotina	280.	15.00	1.75	4.41	3.08
Viburnum rafinesquianum	240.	10.00	1.50	2.94	2.22
Rubus occidentalis	140.	10.00	.87	2.94	1.91
Carpinus caroliniana	60.	10.00	.37	2.94	1.66
Cornus alternifolia	60.	5.00	.37	1.47	.92
Viburnum lentago	60.	5.00	.37	1.47	.92
Acer rubrum	40.	5.00	.25	1.47	.86
Crataegus punctata	40.	5.00	.25	1.47	.86
Viburnum acerifolium	40.	5.00	.25	1.47	.86
Carya cordiformis	20.	5.00	.12	1.47	.80
Fagus grandifolia	20.	5.00	.12	1.47	.80
Quercus borealis	20.	5.00	.12	1.47	.80
Tilia americana	20.	5.00	.12	1.47	.80
Ulmus rubra	20.	5.00	.12	1.47	.80
Total	16040.		100.00	100.00	100.00

Table 40**D**. Groundlayer for Cudahy Woods-North sampled 6/25/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	44250.	75.00	16.83	15.54	16.18
Geranium maculatum	57000.	45.00	21.67	9.33	15.50
Smilacina racemosa	38500.	75.00	14.64	15.54	15.09
Prunus virginiana	28250.	52.50	10.74	10.88	10.81
Thalictrum dioicum	16250.	27.50	6.18	5.70	5.94
Allium tricoccum	12000.	27.50	4.56	5.70	5.13
Circaea quadrisulcata	18250.	15.00	6.94	3.11	5.02
Acer saccharum	5000.	25.00	1.90	5.18	3.54
Arisaema triphyllum	8000.	17.50	3.04	3.63	3.33
Trillium grandiflorum	5750.	12.50	2.19	2.59	2.39
Ribes cynosbati	8250.	2.50	3.14	.52	1.83
Actea rubra	1500.	10.00	.57	2.07	1.32
Epipactis latifolia	1250.	10.00	.48	2.07	1.27
Actea alba	1750.	7.50	.67	1.55	1.11

Table 40 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Carya cordiformis	1000.	7.50	.38	1.55	.97
Caulophyllum thalictroides	1000.	7.50	.38	1.55	.97
Crataegus succulenta	1000.	7.50	.38	1.55	.97
Hamamelis virginiana	750.	7.50	.29	1.55	.92
Tilia americana	750.	7.50	.29	1.55	.92
Viola pubescens	2000.	5.00	.76	1.04	.90
Parthenocissus quinquefolia	3000.	2.50	1.14	.52	.83
Erythronium americanum	1500.	5.00	.57	1.04	.80
Solidago caesia	1250.	5.00	.48	1.04	.76
Quercus borealis	500.	5.00	.19	1.04	.61
Fagus grandifolia	1000.	2.50	.38	.52	.45
Sanguinaria canadensis	1000.	2.50	.38	.52	.45
Viburnum rafinesquianum	750.	2.50	.29	.52	.40
Maianthemum canadense	500.	2.50	.19	.52	.35
Agrimonia gryposepala	250.	2.50	.10	.52	.31
Podophyllum peltatum	250.	2.50	.10	.52	.31
Smilax hispida	250.	2.50	.10	.52	.31
Viburnum acerifolium	250.	2.50	.10	.52	.31
Total	263000.		100.00	100.00	100.00

Cudahy Woods (South)

Site 41
Size: 4.13ha
Milwaukee County

Greendale Quadrangle
SE¼, NW¼, Sec 4, T5N, R22E
Milwaukee County Park Commission

Cudahy Woods (South) is a part of a larger, approximately 24ha (60a) tract recently acquired (1975) by the Milwaukee County Park Commission. The woods is an excellent old-growth maple woods; probably the finest example remaining in Milwaukee County. There is little evidence of any disturbance. The site had been owned by the Cudahy family for nearly a century. There is some history of selective cutting, but not extensive or recent (Salamun, pers. comm.). Only a few foot trails wind through the site. Edge trees are evident and large in size.

The site is bounded on the west by a small tract of young forest adjoined by single family residences. The remains of a fence and the mature edge trees accentuate the boundary. The southern boundary is agricultural land and the eastern is an old field maintained as such for the final approach to Mitchell Field. The northern boundary is lowland forest.

The tract is located on a broad upland gently sloping to the northeast. The forest is developed on Morley silt loam soil (Typic Hapludalf) which is

moderately well-drained and characterized by moderate fertility (USDA, 1971). The northern island boundary is marked not only by a different forest type, but also an abrupt soil change to Adrian muck (Terric Medisaprist).

The forest was sampled using line strips oriented on an east-west compass heading, separated by 25m. Thirty-five 10 x 25m plots totaling 0.87ha were used.

The forest was dominated by sugar maple *(Acer saccharum)*. Sugar maple accounted for 65% of the stems and 47% of the basal area and importance value (Table 41 **A**). The species was evenly distributed throughout the stand, occurring in all plots. Sugar maple dominated all size classes except those over 70cm (27.5in) dbh. Red oak *(Quercus borealis)* and white ash *(Fraxinus americana)* dominated the larger classes. Of the eleven species encountered, American beech *(Fagus grandifolia)* ranked fifth, accounting for 3.8% of the density, basal area and importance value. Beech distribution was limited to the north edge of the site. Several trees were dead and others appeared in poor health. Beech reproduction was sparse and occurred only as root sprouts. Only 0.6% of the stems between 2.5-10.0cm were beech, while 95% were sugar maple (Table 41 **B**). Canopy and understory diversity was the lowest of all sites examined (Table 3).

Sugar maple also dominated the shrub layer accounting for 69% of the stems (Table 41 **C**). Only 10 species were noted in the sample and as a result shrub layer diversity was the fourth lowest of all sites examined (Table 3).

White ash seedlings dominated the groundlayer. Sugar maple seedlings ranked second, combining with ash to account for 60% of the stem density and importance value (Table 41 **D**). However, on a density per hectare basis, only 0.04% of the ash seedlings are represented in the shrub layer, whereas 45% of the sugar maple seedlings are represented. The loss in ash between ground and shrub layers illustrates the relative shade tolerance of the two species with only the maple persisting.

Only 14 species were encountered in the summer groundlayer; 4 tree species, 1 shrub, 1 summer herb, and 8 shade-tolerant remnants of the spring flora. The relatively low species richness and stem density is characteristic of the old-growth southern-mesic forest. No rare or endangered species were encountered.

Table 41**A**. Stand attributes for Cudahy Woods-South (Site 41)
Sample size: 35 plots (10 x 25m) Sample Date: June 6, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	231	100.00	15.53	64.86	32.41	48.48	48.58
Quercus borealis	30	42.85	8.31	8.31	13.89	25.93	16.04
Fraxinus americana	30	45.71	4.24	8.31	14.81	13.23	12.12
Ulmus rubra	21	42.85	.90	5.75	13.89	2.80	7.48
Fagus grandifolia	14	11.43	1.23	3.83	3.70	3.84	3.79
Tilia americana	8	17.14	.77	2.24	5.56	2.42	3.41
Prunus serotina	10	20.00	.19	2.88	6.48	.60	3.32
Ostrya virginiana	5	11.43	.08	1.28	3.70	.25	1.74
Carya cordiformis	5	8.57	.08	1.28	2.78	.26	1.44
Quercus alba	2	5.71	.47	.64	1.85	1.47	1.32
Juglans cinerea	2	2.86	.23	.64	.93	.72	.76
Totals	358[a]		32.03[b]	100.02	100.00	100.00	100.00

a = 145 trees/acre
b = 139.65 ft^2/acre

Table 41 **B**. Size class distribution for Cudahy Woods-South
Sample size: 0.78ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Quercus borealis				1	1		1	2		1	1	6	4	3	4	1	1		26
Fraxinus americana	2	5	6	3		1		4	3	3	1	1		1		3			33
Fagus grandifolia	1	3	3	3	1	1		2		1					1				16
Acer saccharum	379	289	69	34	27	17	6	13	6	10	7	8	3	3					871
Quercus alba										1		1							2
Tilia americana		1	1	1	1		1		2		1								8
Ulmus rubra		7	7	3	3	2		1	2										25
Juglans cinerea							1	1											2
Prunus serotina	3	3	3	5	1														15
Ostrya virginiana		3	2	2															7
Carya cordiformis		1	2	2															4
Carpinus caroliniana		1																	1
Hamamelis virginiana		1																	1
Crataegus succulenta	1																		1
Totals	386	314	93	54	34	21	9	23	13	16	10	16	7	7	5	4	1		

Table 41 **C**. Shrub composition for Cudahy Woods South sampled 6/5/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	6938.	94.29	68.98	49.25	59.12
Prunus virginiana	2766.	60.00	27.50	31.34	29.42
Fagus grandifolia	103.	8.57	1.02	4.48	2.75
Ribes cynosbati	80.	8.57	.80	4.48	2.64
Rubus occidentalis	80.	5.71	.80	2.99	1.89
Hamamelis virginiana	34.	2.86	.34	1.49	.92
Solanum dulcamara	23.	2.86	.23	1.49	.86
Fraxinus americana	11.	2.86	.11	1.49	.80
Crataegus succulenta	11.	2.86	.11	1.49	.80
Carya cordiformis	11.	2.86	.11	1.49	.80
Total	10058.		100.00	100.00	100.00

Table 41 **D**. Groundlayer for Cudahy Woods South sampled 6/24/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fraxinus americana	30600.	62.00	40.26	32.29	36.28
Acer saccharum	15400.	52.00	20.26	27.08	23.67
Prunus virginiana	10400.	26.00	13.68	13.54	13.61
Arisaema triphyllum	4400.	20.00	5.79	10.42	8.10
Geranium maculatum	4400.	4.00	5.79	2.08	3.94
Hydrophyllum virginianum	4400.	2.00	5.79	1.04	3.42
Solidago caesia	2000.	6.00	2.63	3.13	2.88
Quercus borealis	600.	6.00	.79	3.13	1.96
Thalictrum dioicum	1200.	4.00	1.58	2.08	1.83
Caulophyllum thalictroides	800.	2.00	1.05	1.04	1.05
Podophyllum peltatum	800.	2.00	1.05	1.04	1.05
Smilacina racemosa	600.	2.00	.79	1.04	.92
Carya cordiformis	200.	2.00	.26	1.04	.65
Trillium gleasoni	200.	2.00	.26	1.04	.65
Total	76000.		100.00	100.00	100.00

Grant Park (old growth)

Site 42 — South Milwaukee Quadrangle
Size: 3.24ha — SW¼, NW¼, Sec 1, T5N, R22E
Milwaukee County — Milwaukee County Park Commission

Grant Park is a long strip paralleling Lake Michigan. Land was first purchased for the Park in 1910 with subsequent purchases until 1927 (MCPC, 1972).

This section has been set aside as a scenic nature area. The site was reputed to have the largest and oldest American beech *(Fagus grandifolia)* in the State. Unfortunately, the tree succumbed to old age and only a stump remains. However, a sugar maple *(Acer saccharum)* was observed measuring 101.3cm (39.9in) dbh. This individual must approach the State record for a forest-grown specimen.

Past record of disturbance is unclear. Lack of stumps indicated little or no timber removal, save for dead or fallen trees. Unfortunately, numerous footpaths and heavy human use have all but destroyed the goundlayer and much of the shrub and understory layers in most of the stand.

The stand is located on a north-facing slope which gently breaks to the west, north and northeast before dropping abruptly into ravines. The soil is a moderately well-drained Morley silt loam (Typic Hapludalf) characterized by moderately low permeability and moderate fertility (USDA, 1971). These soils are typical of the side slopes of ground moraines in the southeastern part of the County (USDA, 1971). The stand is bounded on the north and west by steep ravines 12-18m (40-60ft) deep. The south boundary is a park pavillion and the east a grassy area overlooking the Lake.

A 1.94ha (4.8a) section was full-censused for canopy and understory species.

The canopy was co-dominated by beech and sugar maple totaling 80.5% of the importance value (Table 42 **A**). Collectively, they accounted for 75% of the stems and 86% of the basal area. Eleven subordinate species made up the 19% importance. Sugar maple and beech also dominated the understory accounting for 89% of the stems. Worthy of note were three individuals of yellow birch *(Betula lutea)* located on the northeast edge of the site.

Comparison of our data with that obtained by Whitford and Salamun (1954) in 1951 shows interesting trends. This site is the same as their stand number 20:

Species	Climax Adaptation Number (Curtis, 1959)	1951 IV	1951 CIV	1975 IV	1975 CIV
Fagus grandifolia	9.5	55	522.5	45	427.5
Acer saccharum	10.0	23	230.0	36	360.0
Tilia americana	7.5	5	37.5	5	37.5
Prunus serotina	3.5	10	35.0	3	10.5
Ostrya virginiana	8.5	1	8.5	3	25.5
Fraxinus americana	6.5	3	19.5	3	19.5
Betula papyrifera	-	1	-	2	-
Fraxinus pennsylvanica	-	-	-	2	-
Quercus borealis	5.5	-	-	1	5.5
Betula lutea	-	-	-	1	-

Continued

Species	Climax Adaptation Number (Curtis, 1959)	1951 IV	1951 CIV	1975 IV	1975 CIV
Ulmus rubra	8.0	1	8.0	1	-
Juglans cinerea	7.5	1	7.5	1	-
Ulmus americana	7.5	-	-	1	-
Total		100	868.5	100	886.0
Continuum Index			2605.0		2658.0

A quick glance indicates that beech and black cherry have decreased in importance during the past 24 years while sugar maple and ironwood *(Ostrya virginiana)* have increased in their contribution to the stand. In all, not much change has occurred as would be expected in a stand at this stage of development. A recalculation of Whitford and Salamun's continuum index was necessary due to changes made by Curtis (1959) from his original climax adaptation numbers (Curtis and McIntosh, 1959). Further interpretation would be risky as two different sampling procedures were involved.

Of the sites sampled, the shrub layer in this stand was fifth lowest in diversity (Table 3). Only nine species were present. Choke cherry *(Prunus virginiana)* dominated the shrub layer, accounting for 61% of the stems of and 44% of the importance value (Table 42 **C**). Sugar maple was a sub-dominant comprising a quarter of the stems. Other species were widely distributed and few in number. Vandalism probably plays an important role in eliminating species and reducing stem density.

The groundlayer was co-dominated by Jack-in-the-pulpit *(Arisaema triphyllum)* and sugar maple (Table 42 **D**). Sub-dominants included green ash *(Fraxinus pennsylvanica)*, choke cherry, and broad-leaved goldenrod *(Solidago flexicaulis)*; the five species collectively accounting for 62% of the importance value. No rare or endangered species were encountered.

Table 42**A**. Stand attributes for Grant Park - Old Growth (Site 42)
Full Tally (1.94 ha.) Sample Date: June 10, 1975.

Species	Density	Basal Area (m^2/ha.)	Relative Density	Relative Dominance	Importance Value
Fagus grandifolia	102	15.83	33.56	55.72	44.64
Acer saccharum	125	8.67	41.19	30.52	35.86
Tilia americana	18	1.47	5.76	5.18	5.47
Prunus serotina	13	.55	4.24	1.92	3.08

Table 42 **A** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Ostrya virginiana	15	.20	4.92	.69	2.81
Fraxinus americana	12	.43	3.90	1.52	2.71
Betula papyrifera	8	.50	2.54	1.76	2.15
Fraxinus pennsylvanica	7	.41	2.20	1.43	1.82
Quercus borealis	2	.26	.68	.91	.80
Betula lutea	2	.03	.51	.12	.32
Ulmus rubra	1	.04	.17	.13	.15
Juglans cinerea	1	.02	.17	.09	.13
Ulmus americana	1	.01	.17	.03	.10
Totals	304[a]	28.42[b]	100.01	100.02	100.04

a = 123 trees/acre
b = 123.85 ft²/acre

Table 42**B**. Size class distribution for Grant Park - Old Growth
Sample size: 1.94ha.

Species	SIZE CLASS (centimeters)																	
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	**Total**
Acer saccharum	126	159	95	52	22	15	9	6	6	10	5	6	4	7	5			1	528
Fagus grandifolia	37	86	31	12	6	3	9	27	23	17	26	18	12	5	5	4			321
Tilia americana			6	8	6	4	1	3	1	1	1	1			1	1			34
Quercus borealis			1	1			1							1					4
Betula papyrifera				2	4	3	4	1	1										15
Prunus serotina	2	7	4	8	5	2	5	1											34
Fraxinus americana	13	16	12	1	5		4	1											52
Fraxinus pennsylvanica			2	1	2	3	4	1											13
Ulmus rubra							1												1
Juglans cinerea					1														1
Ostrya virginiana	24	61	24	5															114
Betula lutea		1	1	2															3
Ulmus americana		1	1																1
Prunus virginiana	16	7																	23
Carpinus caroliniana	1	3																	4
Hamamelis virginiana	3	1																	4
Fraxinus nigra	2	1																	3
Cornus alternifolia	1																		1
Totals	225	343	177	92	51	30	38	40	30	28	32	25	16	13	11	5		1	

Table 42**C**. Shrub composition for Grant Park - Old Growth sampled 7/10/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	3820.	65.00	61.02	27.66	44.34
Acer saccharum	1540.	75.00	24.60	31.91	28.26
Fagus grandifolia	280.	30.00	4.47	12.77	8.62
Fraxinus americana	220.	25.00	3.51	10.64	7.08
Sambucus canadensis	80.	15.00	1.28	6.38	3.83
Ribes americanum	180.	10.00	2.88	4.26	3.57
Cornus alternifolia	100.	5.00	1.60	2.13	1.86
Prunus serotina	20.	5.00	.32	2.13	1.22
Viburnum opulus	20.	5.00	.32	2.13	1.22
Total	6260.		100.00	100.00	100.00

Table 42 **D**. Groundlayer for Grant Park Old Growth sampled 7/10/75.

Species	Density Per ha.	Frequency	.elative Density	Relative Frequency	Importance Value
Arisaema triphyllum	21750.	97.50	11.25	20.63	15.94
Acer saccharum	24500.	77.50	12.68	16.40	14.54
Fraxinus pennsylvanica	17750.	62.50	9.18	13.23	11.21
Prunus virginiana	21250.	47.50	11.00	10.05	10.52
Solidago flexicaulis	29000.	22.50	15.01	4.76	9.88
Allium tricoccum	13000.	25.00	6.73	5.29	6.01
Aster cordifolius	13750.	10.00	7.12	2.12	4.62
Circaea quadrisulcata	14750.	7.50	7.63	1.59	4.61
Fagus grandifolia	4750.	27.50	2.46	5.82	4.14
Solidago caesia	7750.	7.50	4.01	1.59	2.80
Geum canadense	2500.	12.50	1.29	2.65	1.97
Viola cucullata	2500.	10.00	1.29	2.12	1.71
Ribes americanum	3250.	7.50	1.68	1.59	1.63
Pilea pumila	4000.	5.00	2.07	1.06	1.56
Actea alba	1500.	10.00	.78	2.12	1.45
Thalictrum dioicum	3500.	2.50	1.81	.53	1.17
Acer rubrum	1250.	7.50	.65	1.59	1.12
Prunus serotina	1250.	7.50	.65	1.59	1.12
Hydrophyllum virginianum	1500.	5.00	.78	1.06	.92
Sambucus canadensis	1250.	5.00	.65	1.06	.85
Vitis sp.	500.	5.00	.26	1.06	.66
Cornus alternifolia	1250.	2.50	.65	.53	.59
Caulophyllum thalictroides	250.	2.50	.13	.53	.33
Viburnum lentago	250.	2.50	.13	.53	.33
Viburnum opulus	250.	2.50	.13	.53	.33
Total	193250.		100.00	100.00	100.00

Grant Park (North)

Site 43
Size: 2.83ha
Milwaukee County

South Milwaukee Quadrangle
SE¼, SW¼, Sec 1, T5N, R22E
Milwaukee County

This tract is located in the northeast corner of the Grant Park golf course which opened in 1920 (MCPC, 1972). The woods has not been grazed or timbered at least since that time, save for the removal of dead trees for safety purposes. The several footpaths present are not heavily used.

The site is located on a gentle southeast facing slope adjacent to the bluff overlooking Lake Michigan. The forest is developed on the moderately well-drained Morley silt loam (Typic Hapludalf). The soil is typical of the side slopes of ground moraines in the southeastern part of the County (USDA, 1971). This soil is characterized by moderate fertility and moderately slow permeabiliby (USDA, 1971).

The woods is bounded on the north by an extensive lawn and on the west by a fence separating it from the Park maintenance facility. The south boundary is the golf course and the east is Park Drive and the Lake Michigan bluff.

The site was sampled using twenty 10 x 25m plots in line-strips oriented along a north-south compass heading. The total area sampled was 0.5ha.

The canopy layer was co-dominated by sugar maple *(Acer saccharum)* and American beech *(Fagus grandifolia)* comprising 59% of the importance value (Table 43 **A**). Basswood *(Tilia americana)* was third in importance adding nearly 19% more to the importance value. Seven other species, widely scattered in distribution, made up the remaining 22%. The canopy and understory species diversity (H') was the fourth lowest of all stands sampled (Table 3).

The size class distribution matched the typical rotated sigmoid curve described by Goff and West (1975) (Table 43**B**). Sugar maple totally dominated the understory. Of an estimated 636 stems per hectare between 2.5-10.0cm, sugar maple comprised 91%. It would appear the stand will continue toward stronger domination by sugar maple since other tree reproduction is almost lacking. The medium size classes were dominated by sugar maple, beech and basswood. The largest individuals were beech, sugar maple and a few white ash *(Fraxinus americana)*. Large individuals included red oak *(Quercus borealis)* measuring 94cm (37.0in) and a white ash measuring 81cm (31.9in) dbh.

Just as sugar maple dominated the understory, choke cherry dominated the shrub layer making up 62% of the importance value and 88% of the stems sampled (Table 43 **C**). As a result, this site had the second lowest species diversity (H') of all sites sampled (Table 3).

The groundlayer was co-dominated by Jack-in-the-pulpit *(Arisaema triphyllum)* and white ash (Table 43 **D**). Ash seedlings outnumbered sugar maple seedlings by over three times, suggesting again that ash can become established readily, but as indicated by its absence in the understory, the seedlings cannot survive at low light intensities. Species diversity (H') in the groundlayer was relatively high (Table 3), but no rare or endangered plants were encountered.

Table 43**A**. Stand attributes for Grant Park - North (Site 43)
Sample size: 20 plots (10 x 25m) Sample Date: August 1, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Acer saccharum	142	95	8.95	43.56	27.94	26.50	32.67
Fagus grandifolia	70	80	11.53	21.47	23.53	34.12	26.37
Tilia americana	62	55	6.94	19.02	16.18	20.53	18.58
Fraxinus americana	18	35	3.55	5.52	10.29	10.51	8.77
Prunus serotina	10	20	1.06	3.07	5.88	3.13	4.03
Carya cordiformis	8	20	.28	2.45	5.88	.82	3.05
Betula papyrifera	6	15	.89	1.84	4.41	2.64	2.96
Ostrya virginiana	6	10	.07	1.84	2.94	.21	1.66
Quercus borealis	2	5	.41	.61	1.47	1.20	1.09
Ulmus rubra	2	5	.11	.61	1.47	.36	.81
Totals	326[a]		33.79[b]	99.99	99.99	100.02	99.99

a = 132 trees/acre
b = 147.20 ft^2/acre

Table 43**B**. Size class distribution for Grant Park - North
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Acer saccharum	145	105	40	2	3	5	6		5	6	1	2				1			321
Fraxinus americana					1	1		1	1			4			1				9
Fagus grandifolia	5	5	4	2	1	1	3	3	3	6	1	6	2	3					45
Tilia americana	1				1	4	12	6	3	2	1	2							32
Quercus borealis											1								1
Prunus serotina	1	2				1	1	1		1									7
Betula papyrifera							1			2									3
Ulmus rubra						1													1
Carya cordiformis	1		1	1	2														5
Ostrya virginiana		4	3																7
Crataegus punctata	1																		1
Totals	154	116	48	5	8	13	23	11	12	17	4	14	2	3	1	1			

Table 43 **C**. Shrub composition for Grant Park - North sampled 8/1/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	11780.	95.00	87.78	36.54	62.16
Acer saccharum	400.	50.00	2.98	19.23	11.11
Ribes americanum	340.	20.00	2.53	7.69	5.11
Fraxinus americana	220.	20.00	1.64	7.69	4.67
Prunus serotina	160.	20.00	1.19	7.69	4.44
Tilia americana	140.	15.00	1.04	5.77	3.41
Solanum dulcamara	100.	15.00	.75	5.77	3.26
Sambucus canadensis	40.	10.00	.30	3.85	2.07
Fagus grandifolia	120.	5.00	.89	1.92	1.41
Acer negundo	80.	5.00	.60	1.92	1.26
Viburnum opulus	40.	5.00	.30	1.92	1.11
Total	13420.		100.00	100.00	100.00

Table 43 **D**. Groundlayer for Grant Park - North sampled 8/1/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Arisaema triphyllum	78750.	75.00	27.06	14.35	20.71
Fraxinus americana	56750.	85.00	19.50	16.27	17.88
Prunus virginiana	42250.	67.50	14.52	12.92	13.72
Acer saccharum	17750.	47.50	6.10	9.09	7.60
Maianthemum canadense	8000.	50.00	2.75	9.57	6.16
Allium tricoccum	14500.	35.00	4.98	6.70	5.84
Thalictrum dioicum	18250.	12.50	6.27	2.39	4.33
Circaea quadrisulcata	13250.	7.50	4.55	1.44	2.99
Fagus grandifolia	6250.	15.00	2.15	2.87	2.51
Prunus serotina	3000.	20.00	1.03	3.83	2.43
Podophyllum peltatum	6500.	10.00	2.23	1.91	2.07
Tilia americana	2250.	17.50	.77	3.35	2.06
Trillium grandiflorum	4750.	10.00	1.63	1.91	1.77
Actea alba	2250.	10.00	.77	1.91	1.34
Viburnum opulus	1500.	10.00	.52	1.91	1.21
Actea rubra	1500.	7.50	.52	1.44	.98
Ribes americanum	2500.	5.00	.86	.96	.91
Solidago flexicaulis	3250.	2.50	1.12	.48	.80
Agrimonia gryposepala	750.	5.00	.26	.96	.61
Cryptotaenia canadensis	1750.	2.50	.60	.48	.54
Viola eriocarpa	1250.	2.50	.43	.48	.45
Hydrophyllum virginianum	750.	2.50	.26	.48	.37
Pilea pumila	750.	2.50	.26	.48	.37

Table 43 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Fragaria virginiana	500.	2.50	.17	.48	.33
Viola cucullata	500.	2.50	.17	.48	.33
Acer negundo	250.	2.50	.09	.48	.28
Carex sp.	250.	2.50	.09	.48	.28
Caulophyllum thalictroides	250.	2.50	.09	.48	.28
Geum canadense	250.	2.50	.09	.48	.28
Solanum dulcamara	250.	2.50	.09	.48	.28
Ulmus rubra	250.	2.50	.09	.48	.28
Total	291000.		100.00	100.00	100.00

Grant Park (South)

Site 44 — South Milwaukee Quadrangle
Size: 3.97ha — NE¼, NW¼, Sec 12, T5N, R22E
Milwaukee County — Milwaukee County Park Commission

This section of Grant Park is about 100m south of Site 43. The two sites have a similar history in relation to the golf course. The topography and soil series is the same as Site 43.

The island is bordered on the north, west and south sides by the golf course. The east is also bordered by Park Drive and connected to the Grant Park (North) site by a row of roadside trees..In respect to vegetation, these sites appear discrete. Bird and animal studies would probably consider them as a single, large island.

This site is void of footpaths (except for an asphalt trail adjacent to the road). It appears to receive less usage than Site 43 as it is some distance from parking lots and has no commercial or recreational attractions.

This tract was sampled using east-west line strips totaling twenty 10 x 25m plots (0.5ha). The forest was co-dominated by red oak *(Quercus borealis)* and sugar maple *(Acer saccharum)* totaling 52% of the importance value (Table 44 **A**). White ash *(Fraxinus americana)* and American beech *(Fagus grandifolia)* added an additional 37% importance. Seven other species comprise the remaining 11%.

The dynamics of this stand are particularly interesting. The stem density (436/ha or 177/a) is high, as is the basal area (43.3m²/ha or 188.72ft²/a). This high basal area is probably the inadvertent result of former management and is comparable to most natural stands in the western mesophytic forest several hundred miles to the south (Braun, 1950; Jackson, 1975). White ash and red oak occupy the largest size classes from 35-80cm (13.8-31.5in) dbh (Table 44 **B**). On the other hand, the understory and smaller size classes to 30cm (12in) dbh are heavily dominated by sugar maple followed by beech. This is indica-

tive of a stand moving into the final stages of succession from former disturbance. Not sampled but observed were butternut *(Juglans cinerea)* and horse chestnut *(Aesculus hippocastenea)*.

The shrub layer is completely dominated by choke cherry *(Prunus virginiana)*. Choke cherry was evenly distributed throughout the stand making up 98% of all stems sampled and nearly 85% of the importance value (Table 44**C**). Somewhat perplexing is the very poor success sugar maple and beech are having in the shrub layer. Of all the sites sampled, this one shows the lowest species diversity (H') in the shrub layer (Table 3).

Choke cherry also dominated the groundlayer. Beech and sugar maple are barely represented with importance values 1.35 and 0.45 respectively (Table 44 **D**). A large clone of orange day lily *(Hemerocallis fulva)*, a native of Asia growing along the east edge suggested former disturbance. Although no rare or endangered species were encountered, a County record for *Dentaria diphylla* was established.

Table 44**A**. Stand attributes for Grant Park - South (Site 44)
Sample size: 20 plots (10 x 25m) Sample Date: August 6, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Quercus borealis	84	85	17.36	19.27	20.73	39.90	26.63
Acer saccharum	172	100	5.36	39.45	24.39	12.37	25.40
Fraxinus americana	68	65	13.52	15.60	15.85	31.22	20.89
Fagus grandifolia	76	85	3.83	17.43	20.73	8.83	15.66
Tilia americana	14	26	1.47	3.21	6.10	3.40	4.24
Carya cordiformis	6	15	.46	1.38	3.66	1.07	2.04
Carya ovata	6	10	.40	1.38	2.44	.93	1.58
Fraxinus pennsylvanica	4	10	.43	.92	2.44	.99	1.45
Prunus serotina	2	5	.22	.46	1.22	.51	.73
Ulmus rubra	2	5	.22	.46	1.22	.51	.73
Ostrya virginiana	2	5	.03	.46	1.22	.07	.58
Totals	436[a]		43.30[b]	100.02	100.00	99.80	99.93

a = 177 trees/acre
b = 188.72 ft^2/acre

Table 44**B**. Size class distribution for Grant Park - South
Sample size: 0.5ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5-5.0	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-85	85-95	95-105	
Fraxinus americana	1						2	7	7	5	3	4		5		1			35
Quercus borealis						1	4	4	4	8	5	9	2	2	3				42
Fagus grandifolia	3	1	5	8	8	8	6	2	1										42
Tilia americana							3	2	2										7
Fraxinus pennsylvanica						1			1										2
Acer saccharum	27	41	28	28	14	10	4	2											154
Carya cordiformis						2		1											3
Prunus serotina								1											1
Ulmus rubra								1											
Carya ovata				1			2												3
Ostrya virginiana		2	1																3
Amelanchier laevis		1																	1
Prunus virginiana	1																		1
Totals	32	45	34	37	22	22	21	20	15	13	8	13	2	7	3	1			

Table 44 **C**. Shrub composition for Grant Park - South sampled 8/6/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	20680.	100.00	98.10	71.43	84.77
Solanum dulcamara	80.	10.00	.38	7.14	3.76
Acer saccharum	40.	10.00	.19	7.14	3.67
Ribes americanum	180.	5.00	.85	3.57	2.21
Ribes cynosbati	60.	5.00	.28	3.57	1.93
Fagus grandifolia	20.	5.00	.09	3.57	1.83
Fraxinus americana	20.	5.00	.09	3.57	1.83
Total	21080.		100.00	100.00	100.00

Table 44 **D**. Groundlayer for Grant Park - South sampled 8/6/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	83750.	85.00	39.88	26.56	33.22
Hydrophyllum virginianum	24250.	17.50	11.55	5.47	8.51
Caulophyllum thalictroides	11750.	25.00	5.60	7.81	6.70
Fraxinus americana	8250.	30.00	3.93	9.38	6.65
Solidago flexicaulis	18000.	15.00	8.57	4.69	6.63
Smilacina racemosa	11250.	22.50	5.36	7.03	6.19
Podophyllum peltatum	10000.	20.00	4.76	6.25	5.51
Hemerocallis fulva	15250.	5.00	7.26	1.56	4.41
Arisaema triphyllum	3500.	10.00	1.67	3.13	2.40
Allium tricoccum	1750.	12.50	.83	3.91	2.37
Quercus borealis	1500.	10.00	.71	3.13	1.92
Solanum dulcamara	3750.	5.00	1.79	1.56	1.67
Actea alba	1250.	7.50	.60	2.34	1.47
Vitis sp.	1000.	7.50	.48	2.34	1.41
Fagus grandifolia	750.	7.50	.36	2.34	1.35
Geranium maculatum	3750.	2.50	1.79	.78	1.28
Aster cordifolius	3000.	2.50	1.43	.78	1.10
Viola eriocarpa	2750.	2.50	1.31	.78	1.05
Trillium grandiflora	500.	5.00	.24	1.56	.90
Ribes cynosbati	750.	2.50	.36	.78	.57
Actea rubra	500.	2.50	.24	.78	.51
Geum canadense	500.	2.50	.24	.78	.51
Osmorhiza claytoni	500.	2.50	.24	.78	.51
Acer saccharum	250.	2.50	.12	.78	.45
Prunus serotina	250.	2.50	.12	.78	.45
Sambucus canadensis	250.	2.50	.12	.78	.45

Table 44 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Sanguinaria canadensis	250.	2.50	.12	.78	.45
Thalictrum dioicum	250.	2.50	.12	.78	.45
Tilia americana	250.	2.50	.12	.78	.45
Viola cucullata	250.	2.50	.12	.78	.45
Total	210000.		100.00	100.00	100.00

Rawson Park

Site 45
Size: 7.93ha
Milwaukee County

South Milwaukee Quadrangle
W½, SW¼, Sec 2, T6N, R22E
Milwaukee County Park Commission

Rawson Park is an 11.7ha neighborhood park with a 7.93ha stand of native beech-maple forest. The Park was acquired between 1937 and 1942 (MCPC, 1972). Since then, only dead and dying trees have been removed for the safety of park visitors. The wooded island is bounded on the north and east by open land, the south by lawn and picnic area and on the west by South Milwaukee Senior High School.

The site is characterized by gentle rolling topography with a broad depression diagonally crossing the woods. The soils were Morley silt loam (Typic Hapludalf) which are moderately well to well-drained. Runoff is generally average or medium, but increases during heavy precipitation because the soil is not readily permeable (USDA, 1971). On several visits, we observed water ponded in the depressions.

Although the site has been protected from development, disturbance has been very heavy. Footpaths are numerous, wide, compacted and frequently used by off-road vehicles. Many small trees were broken, girdled or ripped out.

A total sample of 0.75ha was obtained using thirty 10 x 25m plots in line-strips. The line-strips were separated by 50m and were oriented along an east-west compass heading.

The canopy was dominated by American beech *(Fagus grandifolia)* and sugar maple *(Acer saccharum)* comprising 62% of the importance value (Table 45 **A**). Ten subordinate species made up the remaining 38%. The size class distributions for sugar maple and beech were similar, i.e., normal curves peaking in the 30-40cm (10-18in) classes (Table 45 **B**). Only a few large (> 20in) individuals of red oak *(Quercus borealis)*, white oak *(Quercus alba)* and white ash *(Fraxinus americana)* were present with none in the sapling sizes. A beech stump had a diameter of 102.6cm (40.4in).

The understory was dominated by beech, black cherry *(Prunus serotina)* and ironwood *(Ostrya virginiana)*. Beech was dominant in the understory because

of dense root sprouting. I think the relative success of black cherry and ironwood saplings may be attributed to the lack of sugar maple in the understory.

The shrub layer exhibited low species diversity (H') with only 16 species (Table 3). It was heavily dominated by choke cherry *(Prunus virginiana)* (Table 45 **C**). Beech and sugar maple shared a combined importance value of only 16% in the shrub layer.

The groundlayer was co-dominated by sugar maple, white ash, choke cherry, and Jack-in-the-pulpit *(Arisaema triphyllum)*, together comprising almost 58% of the importance value (Table 45 **D**). Twenty-seven lesser species made up the remaining 42%. The low frequency values for all species may be partially explained by the heavy visitor use and abuse. Species diversity (H') was slightly above the average for the 31 islands and attributable to the moderately high equitability (J') component (Table 3). We observed a large clone of Mayapple *(Podophyllum peltatum)* which had been entirely defoliated. Similar treatment in successive years could certainly eliminate the clone. Another partial explanation for low frequency values is the shade produced by the mature, closed canopy of the southern mesic forest. No rare or endangered species were encountered.

Table 45**A**. Stand attributes for Rawson Park (Site 45)
Sample size: 30 plots (10 x 25m) Sample Date: June 12, 1975.

Species	Density (ha.)	Frequency	Basal Area (m^2/ha.)	Relative Density	Relative Frequency	Relative Dominance	Importance Value
Fagus grandifolia	130	83.33	13.32	47.34	29.41	43.15	39.97
Acer saccharum	63	53.33	7.32	22.71	18.82	23.71	21.75
Ulmus rubra	23	33.33	1.70	8.21	11.76	5.51	8.49
Prunus serotina	17	23.33	.74	6.28	8.24	2.40	5.64
Fraxinus americana	8	16.67	2.35	2.90	5.88	7.60	5.46
Tilia americana	7	16.67	1.43	2.42	5.88	4.63	4.31
Quercus borealis	5	13.33	1.71	1.93	4.71	5.52	4.05
Quercus alba	5	10.00	1.44	1.93	3.53	4.67	3.38
Ostrya virginiana	9	16.67	.23	3.38	5.88	.74	3.33
Fraxinus pennsylvanica	3	6.67	.29	.97	2.35	.73	1.35
Carya cordiformis	3	6.67	.23	.97	2.35	.44	1.25
Juglans cinerea	3	3.33	.28	.97	1.18	.89	1.01
Totals	276[a]		31.04[b]	100.01	99.99	99.99	99.99

a = 112 trees/acre
b = 135.27 ft^2/acre

Table 45**B**. Size class distribution for Rawson Park
Sample size: 0.75ha.

Species	SIZE CLASS (centimeters)																	Total
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	
Fagus grandifolia	22	1	5	7	10	16	15	16	14	6	5	3				1			121
Quercus borealis	1	1	1											2		1			3
Quercus alba									1		1	1				1			4
Acer saccharum	8		1	2	2	7	11	4	10	5	3	1	1						55
Fraxinus americana											3		1	1	1				6
Tilia americana	8	11		1				1				1	1	1					24
Ulmus rubra	6	4	1	3	2	4	3	2	1	1									27
Prunus serotina	16	17	5		4	2		2											46
Fraxinus pennsylvanica	1	1				1		1											4
Juglans cinerea							1	1											2
Ostrya virginiana	16	3	3	2	2														26
Carya cordiformis				1			1												2
Crataegus succulenta	1	2																	3
Carpinus caroliniana	5																		5
Hamamelis virginiana	1																		1
Prunus virginiana	1																		1
Totals	86	40	16	16	20	30	31	27	25	12	13	6	3	4	1	3			

Table 45 **C**. Shrub Composition for Rawson Park sampled 6/12/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Prunus virginiana	9478.	96.67	78.65	25.89	52.27
Fagus grandifolia	613.	43.33	5.09	11.61	8.35
Prunus serotina	440.	46.67	3.65	12.50	8.08
Acer saccharum	387.	46.67	3.21	12.50	7.85
Fraxinus pennsylvanica	307.	40.00	2.54	10.71	6.63
Ribes americana	387.	26.67	3.21	7.14	5.18
Tilia americana	160.	23.33	1.33	6.25	3.79
Crataegus punctata	53.	10.00	.44	2.68	1.56
Hamamelis virginiana	40.	10.00	.33	2.68	1.51
Ostrya virginiana	40.	6.67	.33	1.79	1.06
Viburnum acerifolium	27.	6.67	.22	1.79	1.00
Crataegus succulenta	53.	3.33	.44	.89	.67
Fraxinus americana	27.	3.33	.22	.89	.56
Carpinus caroliniana	13.	3.33	.11	.89	.50
Ulmus rubra	13.	3.33	.11	.89	.50
Cornus racemosa	13.	3.33	.11	.89	.50
Total	12050.		100.00	100.00	100.00

Table 45 **D**. Groundlayer for Rawson Park Sampled 6/25/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	65750.	57.50	22.77	13.07	17.92
Fraxinus americana	44250.	72.50	15.32	16.48	15.90
Arisaema triphyllum	50000.	40.00	17.32	9.09	13.20
Prunus virginiana	26750.	52.50	9.26	11.93	10.60
Tilia americana	26000.	17.50	9.00	3.98	6.49
Thalictrum dioicum	16000.	15.00	5.54	3.41	4.48
Circaea quadrisulcata	6750.	22.50	2.34	5.11	3.73
Carya cordiformis	2750.	22.50	.95	5.11	3.03
Fagus grandifolia	3500.	20.00	1.21	4.55	2.88
Smilacina racemosa	7250.	12.50	2.51	2.84	2.68
Lonicera bella	6750.	12.50	2.34	2.84	2.59
Geranium maculatum	4250.	7.50	1.47	1.70	1.59
Podophyllum peltatum	3750.	7.50	1.30	1.70	1.50
Prunus serotina	3000.	7.50	1.04	1.70	1.37
Solidago caesia	1500.	7.50	.52	1.70	1.11
Ulmus rubra	1250.	7.50	.43	1.70	1.07
Viola sp.	2500.	5.00	.87	1.14	1.00
Sanicula gregaria	2000.	5.00	.69	1.14	.91

Table 45 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Pilea pumila	1750.	5.00	.61	1.14	.87
Rubus odoratus	3250.	2.50	1.13	.57	.85
Actea alba	1500.	5.00	.52	1.14	.83
Fraxinus pennsylvanica	1500.	5.00	.52	1.14	.83
Allium tricoccum	1000.	5.00	.35	1.14	.74
Solanum dulcamara	1000.	5.00	.35	1.14	.74
Quercus borealis	500.	5.00	.17	1.14	.65
Solidago flexicaulis	1750.	2.50	.61	.57	.59
Maianthemum canadense	1000.	2.50	.35	.57	.46
Hydrophyllum virginianum	500.	2.50	.17	.57	.37
Vitis sp.	500.	2.50	.17	.57	.37
Crataegus punctata	250.	2.50	.09	.57	.33
Potentilla simplex	250.	2.50	.09	.57	.33
Total	288750.		100.00	100.00	100.00

Oak Creek Power Plant

Site 46
Size: 0.59ha
Milwaukee County

Racine - North Quadrangle
S½, NE¼, Sec 36, T5N, R22E
Milwaukee Electric Power Company

This forested island is located on a general northeast facing slope within 0.5km of Lake Michigan. The actual island, only 0.59ha in size, is embedded in a larger successional stand of 4-5ha. The area studied was bordered on the south by a service road, the north by a railroad spur, and on the west by the extensive (4ha), dense stand of young basswood *(Tilia americana)*, hawthorn *(Crataegus sp.)* and black cherry *(Prunus serotina)*. The remnant of a former home site, now hidden in a dense growth of shrubs and pioneer trees, lies on the east edge. Ornamental plantings of pines, junipers, and paper birch are still evident.

Several large depressions occurred within the stand. Vegetation was closely correlated to relief. American beech *(Fagus grandifolia)* and basswood dominated the upland and ridges between the depressions. Butternut *(Juglans cinerea)* and ironwood *(Ostrya virginiana)* dominated the depressions. The entire stand is reported to be on moderately well to well-drained Morley silt loam soil (Typic Hapludalf) over calcareous silty clay loam glacial till (USDA, 1971). This soil is typically found on the slopes of ground moraines in the southeastern part of the County (USDA, 1971).

The entire 0.59ha was censused for canopy and understory trees. The stand was dominated by American beech and basswood with a combined importance value of 52% (Table 46 **A**). Ironwood and sugar maple *(Acer saccharum)* contributed an additional 33%. Nine other species made up the remaining 12% importance value.

Peculiar to this site were the numerous large ironwood trees. The largest individual was 32.3cm (12.7in) and the average size was 17cm (6.7in) dbh. Ironwood also dominated the understory vegetation, comprising 44% of the 244 stems measured between 2.5 and 10.0cm dbh. Large hawthorns *(Crataegus succulenta)* were distributed near the margins of the island, indicating an earlier edge. Remnants of barbed wire were evidenced as scars in the edge trees, further indicating that at some time grazing may have been excluded from the area.

The shrub layer had a relatively low species diversity (Table 3). Sugar maple saplings clearly dominated the layer. Sugar maple and choke cherry *(Prunus virginiana)* combined accounted for 80% of the stems and nearly 62% of the importance value (Table 46 **C**). Competition with sugar maple and choke cherry, coupled with a dense closed canopy, probably contributed to the low shrub success and diversity.

The groundlayer was dominated by sugar maple seedlings. This is one of only a few sites in which sugar maple dominated the groundlayer. Maple seedlings were evenly distributed throughout the island. Forty other species shared the remaining 63% importance value (Table 46 **D**). The patchy distribution and relatively high diversity of groundlayer species was enhanced by the wide range of environmental conditions created by the numerous depressions and varied aspects of slopes. Although no rare or endangered

species were encountered, the species present were typical of the ground flora of the beech-maple association (Levenson, 1973).

The spring flora was not sampled.

Table 46**A**. Stand attributes for Oak Creek Power Plant (Site 46)
Full Tally (0.59ha.) Sample Date: June 13, 1975.

Species	Density	Basal Area (m^2/ha.)	Relative Density	Relative Dominance	Importance Value
Fagus grandifolia	71	9.70	25.00	29.20	27.10
Tilia americana	51	10.73	17.86	32.30	25.08
Ostrya virginiana	86	2.16	30.36	6.49	18.43
Acer saccharum	25	6.99	8.93	21.05	14.99
Crataegus succulenta	29	.56	10.12	1.69	5.91
Quercus borealis	2	1.42	.59	4.27	2.43
Prunus serotina	5	.64	1.79	1.92	1.86
Juglans cinerea	5	.53	1.79	1.59	1.69
Betula papyrifera	3	.33	1.19	.98	1.09
Ulmus rubra	2	.09	.59	.28	.44
Fraxinus pennsylvanica	2	.03	.59	.09	.34
Pyrus malus	2	.03	.59	.09	.34
Carya cordiformis	2	.02	.59	.05	.32
Totals	285[a]	33.23[b]	99.99	100.00	100.02

a = 115 trees/acre
b = 144.72 ft^2/acre

Table 46**B**. Size class distribution for Oak Creek Power Plant
Sample size: 0.59ha.

Species	SIZE CLASS (centimeters)																	
	2.5–5.0	5–10	10–15	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–85	85–95	95–105	Total
Quercus borealis																		1	1
Tilia americana	2	16	5	3	2			2	1	1	5	2	1	3	2	2		1	48
Acer saccharum	29	7		1			1	2	1	1		1	1	1	4	2			51
Fagus grandifolia	17	2	1		5	2	5	8	9	6	1	3	1		1				61
Prunus serotina	12	11	1	1										1					26
Juglans cinerea				1				1		1									3
Betula papyrifera							1	1											2
Ostrya virginiana	54	54	22	16	9	3	1												159
Crataegus succulenta	1	8	10	5	1	1													26
Ulmus rubra		2				1													3
Fraxinus pennsylvanica	13	6		1															20
Pyrus malus		1	1																2
Carya cordiformis		1	1																2
Fraxinus americana	5	2																	7
Hamamelis virginiana	1																		1
Totals	134	110	41	28	17	7	8	14	11	9	6	6	3	5	7	4		2	

Table 46**C**. Shrub composition for Oak Creek Power Plant sampled 6/13/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	6380.	100.00	60.42	25.00	42.71
Prunus virginiana	2120.	70.00	20.08	17.50	18.79
Fagus grandifolia	740.	45.00	7.01	11.25	9.13
Fraxinus pensylvanica	280.	45.00	2.65	11.25	6.95
Prunus serotina	260.	45.00	2.46	11.25	6.86
Ostrya virginiana	160.	30.00	1.52	7.50	4.51
Carya cordiformis	60.	15.00	.57	3.75	2.16
Fraxinus americana	140.	10.00	1.33	2.50	1.91
Tilia americana	40.	10.00	.38	2.50	1.44
Solanum dulcamara	120.	5.00	1.14	1.25	1.19
Vitis riparia	80.	5.00	.76	1.25	1.00
Ribes cynosbati	60.	5.00	.57	1.25	.91
Rubus occidentalis	60.	5.00	.57	1.25	.91
Crataegus succulenta	40.	5.00	.38	1.25	.81
Carpinus caroliniana	20.	5.00	.19	1.25	.72
Total	10560.		100.00	100.00	100.00

Table 46**D**. Groundlayer for Oak Creek Power Plant sampled 8/5/75.

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Acer saccharum	155250.	95.00	54.52	19.00	36.76
Circaea quadrisulcata	38250.	20.00	13.43	4.00	8.72
Fraxinus americana	16250.	42.50	5.71	8.50	7.10
Fagus grandifolia	10000.	32.50	3.51	6.50	5.01
Prunus virginiana	7000.	35.00	2.46	7.00	4.73
Tilia americana	5000.	35.00	1.76	7.00	4.38
Vitis sp.	7500.	27.50	2.63	5.50	4.07
Allium tricoccum	5750.	20.00	2.02	4.00	3.01
Geranium maculatum	5500.	17.50	1.93	3.50	2.72
Sanguinaria canadensis	3000.	15.00	1.05	3.00	2.03
Arisaema triphyllum	2000.	15.00	.70	3.00	1.85
Osmorhiza claytoni	2000.	12.50	.70	2.50	1.60
Prunus serotina	1500.	12.50	.53	2.50	1.51
Pilea pumila	5750.	5.00	2.02	1.00	1.51
Carya cordiformis	1250.	12.50	.44	2.50	1.47
Podophyllum peltatum	2250.	7.50	.79	1.50	1.15
Aster sp.	2000.	7.50	.70	1.50	1.10
Solidago flexicaulis	1500.	7.50	.53	1.50	1.01
Geum canadense	1250.	7.50	.44	1.50	.97
Thalictrum dioicum	750.	7.50	.26	1.50	.88

Table 46 **D** continued

Species	Density Per ha.	Frequency	Relative Density	Relative Frequency	Importance Value
Ulmus rubra	750.	7.50	.26	1.50	.88
Xanthium strumarium	750.	5.00	.26	1.00	.63
Eupatorium rugosum	2000.	2.50	.70	.50	.60
Caulophyllum thalictroides	500.	5.00	.18	1.00	.59
Viola cucullata	500.	5.00	.18	1.00	.59
Ribes cynosbati	750.	2.50	.26	.50	.38
Solanum dulcamara	750.	2.50	.26	.50	.38
Carex blanda	500.	2.50	.18	.50	.34
Crataegus succulenta	500.	2.50	.18	.50	.34
Cryptotaenia canadensis	500.	2.50	.18	.50	.34
Gramineae	500.	2.50	.18	.50	.34
Hydrophyllum virginianum	500.	2.50	.18	.50	.34
Maianthemum canadense	500.	2.50	.18	.50	.34
Ostrya virginiana	250.	2.50	.09	.50	.29
Parthenocissus quinquefolia	250.	2.50	.09	.50	.29
Phryma leptostachya	250.	2.50	.09	.50	.29
Sanicula gregaria	250.	2.50	.09	.50	.29
Smilacina racemosa	250.	2.50	.09	.50	.29
Solidago caesia	250.	2.50	.09	.50	.29
Taraxacum officinale	250.	2.50	.09	.50	.29
Rosa sp.	250.	2.50	.09	.50	.29
Total	284750.		100.00	100.00	100.00

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