# *THE ARBORETUM'S EAST WOODS:* ARE THEY FOREVER?

"Who could deny the beauty of the East Woods of the Morton Arboretum, particularly in spring, when the spring flowers have flushed into full bloom; or in fall when the deep oranges and yellows of the sugar maple trees cast their glow onto the forest floor? Yet, for all their beauty, much recent research from the Arboretum and the region at large suggests that these comely woods may indeed be hiding the seeds and seedlings of their own destruction." Marion T. Hall, 1988.

By Gerould Wilhelm

## INTRODUCTION

By the mid-1970's it was becoming evident that the oaks in the East Woods of the Morton Arboretum were dying. Older staff members of the Arboretum noted that the woodland wild flowers were disappearing. Oak wilt, a fungal disease, was identified in many of the trees. The recent introduction of a massive expressway to the south of the woods evoked thoughts of the potential effects of acid rain and other aerial pollutants. It is certain that these factors have been and are having an impact on the ecology of our remnant wooded natural areas. But there is reason to believe that additional ecological forces are contributing profoundly not only to the oak decline, but even to the collapse of the entire ecosystem of which they are a part.

During this same period, it was noted that not only are the oaks dying, they are not regenerating. The younger trees in the woods are hard maples, lindens, ashes, and hornbeams. The clear impression is that, even as the oaks are waning, other trees are waxing, a process which suggests either that there is an ecological succession occurring in which one set of trees is replacing another, or that the current concentrations of aerially induced pollutants are selective in their effect on woody plants, or both. It is now apparent, however, that we must examine a process which began long before the coming of toll roads and urbanization if we are to understand fundamentally the nature of our East Woods. What we see there today bears absolutely no resemblance to the scene as it was witnessed prior to settlement.

The science of ecology did not really exist until the late 1800's, so disciplined descriptions of the land are wholly lacking. We do, however, have general impressions of our region from some early travelers who wrote, from the perspective of Northeasterners, of its strange and awesome beauty. They wrote of a land, our land, whose character tested their ability to describe it.

> "The view from this mound . . . beggars all description. An ocean of prairie surrounds the spectator whose vision is not limited to less than thirty or forty miles. This great sea of verdure is interspersed with delightfully varying undulations, like the vast waves of the ocean, and every here and there, sinking in the hollows or cresting the swells, appears spots of trees, as if planted by the hand of art for the purpose of ornamenting this naturally splendid scene." W. R. Smith, 1837.

> "This county (Rock County, Wisconsin) is about equally divided between prairie and oak openings. . . . Groves are interspersed through the prairies at intervals besides which, points of openings jut into the prairie at different places, thus rendering the outlines of the prairie unequal, and at the same time bringing wood and timber within a short distance to all its settlers; in fact, few men on the prairies live more than three miles from timber."
> Guernsey & Willard, 1856.

"The country was what is termed 'rolling,' from some fancied resemblance to the surface of the ocean, when it is just undulating with a long 'groundswell.' Although wooded, it was not, as the American forest is wont to grow, with tall straight trees towering toward the light, but with intervals between the low oaks that were scattered profusely over the view, and with much of that air of negligence that one is apt to see in grounds, where art is made to assume the character of nature. The trees, with very few exceptions, were what is called the 'burr-oak,' . . . and the spaces between them, always irregular, and often of singular beauty, have obtained the name of 'openings,' . . . These woods, so peculiar to certain districts of (the) country, are not altogether without some variety, though possessing a general character of sameness. . . . In places they stand with a regularity resembling that of an orchard; then, again, they are more scattered and less formal, while breadths of the land are occasionally seen in which they stand in copses, with vacant spaces, that bear no small affinity to artificial lawns, being covered with verdure. The grasses are supposed to be owing to the fires lighted periodically by the Indians in order to clear their hunting-grounds." F. Cooper, 1812.

A century and a half later, John T. Curtis studied early descriptions of the southern Wisconsin landscape and concluded in his *Vegetation of Wisconsin*, 1959:

". . . the oak openings quickly change to closed oak forest in the absence of fire, so any area which has been protected has long since lost its savanna qualities."

Clearly, if we are to understand the Arboretum's East Woods, we must perceive it in a context much broader than the modern era. What we see today in our East Woods, or any other genuine natural area remnants, is the current end point in a process which has been unfolding for millennia. In these woods lies an unbroken genealogy; indeed, they represent a community which for ten thousand years has adapted itself to this part of the globe. If they are to live for another ten thousand years we must know why there has been such a dramatic change in their character in recent years.

## EAST WOODS SAMPLING METHODS

In order to document and characterize the changes which are occurring in the East Woods, thirteen one-acre permanent plots were established in the woods east of the Maple Collection. They were laid out in July of 1979, and each of their four corners were marked by an orange permanent pipe. On each pipe, an aluminum sign was attached to indicate the plot number and the relative location. During winter of the same year, each tree 4" dbh (diameter at breast height) and larger was measured and identified in each plot. From these data, the density (number of stems) and dominance (basal area) of each tree species were calculated and their importance values expressed in relative terms; this sampling was repeated in the spring of 1985, the woods having developed through five growing seasons. Partial results of these two surveys are shown in Tables 1 and 2, page 56.

Table 1 shows the growth and decline of principal forest trees of the Morton Arboretum's East Woods from 1980 to 1985. Measurements are expressed in percent increases or decreases in square inches of basal area per acre. Plots 2, 3, and 12 have been omitted from the table, inasmuch as they were clear cut about 1920. Column A is an average for all 10 non-cutover plots.

Table 2 gives the changes in relative importance of forest trees in the Arboretum's East Woods during this same 5-year period. Importance values, therefore, were calculated by multiplying the density of each species by its total basal area and relativized to 100. Again, data on plots 2, 3, and 12 have been omitted. Column A is an average for all 10 non-cutover plots. Data values rendered in bold face type represent decreases in relative importance. The "t" indicates importance values less

than 0.5.

In addition to the sampling, permanent photo stations were established at each corner pipe. From each of these stations, photographs were produced from a stabilized camera aimed at the center of the plot. Plate 1 (page 57) is an example pair of pictures. Both pictures were taken during the winter season, the sequel taken at the same time of year, five growing seasons later.

## RESULTS

The results of the five-year plot study were in part expected and in part surprising. In each plot the basal area of canopy-aged sugar maples increased at an average rate of about 6% per year, or 33% over the five-year period. This rate is rather dramatic in view of the fact that both red oak and white oak showed marked declines.

These data suggest that the woody composition of the woods is changing at a readily perceptible rate. Such changes appear to have been going on for quite some time. In 1840, the original land surveyors described an area just 200 feet from Acre Plot #9:

> "White Oak 24 inches in diameter, and one 12 inches; land all rich first rate soil, timber principally Bur and White Oak."

Generally, these land surveyors summarized King's Grove (the Arboretum's East Woods) as timbered principally with bur and white oak, with "Hazel and Hickory undergrowth." In 1985 Plot #9 registered the following relative importance values for forest trees:

> Sugar maple (68), linden (18), white oak (7), red oak (6), and white ash (1).

**Table 1. Percent Changes in Basal Area from 1980 to 1985.**

| | Plots | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **13** | **A** |
| Sugar Maple | 150 | 31 | 6 | 10 | 28 | 20 | 15 | 31 | 14 | 27 | 33 |
| Red Oak | –1 | –26 | 0 | –17 | –14 | 0 | –5 | –6 | –2 | –2 | –7 |
| White Oak | –1 | | 5 | –30 | –23 | 1 | 1 | –17 | 0 | –15 | –8 |

**Table 2. Changes in Relative Importance from 1980 to 1985.**

| | Plots | | | | | | | | | | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **13** | **A** | |
| Sugar Maple | t | 87 | 97 | 94 | 37 | 88 | 58 | 28 | 31 | 74 | 59 | 1980 |
| | t | 93 | 97 | 97 | 56 | 93 | 68 | 35 | 38 | 83 | 66 | 1985 |
| Red Oak | 19 | 1 | t | 2 | 43 | 2 | 8 | 28 | 63 | 8 | 17 | 1980 |
| | **15** | **t** | t | **1** | **25** | 2 | **6** | **24** | **57** | **6** | **14** | 1985 |
| White Oak | 66 | | 1 | 1 | 5 | 1 | 7 | 1 | 2 | 13 | 10 | 1980 |
| | **57** | | 1 | 1 | **2** | 1 | 7 | **t** | 2 | **7** | **8** | 1985 |
| Linden | t | 1 | t | 1 | 5 | 1 | 26 | 38 | 3 | 1 | 8 | 1980 |
| | t | **t** | t | **t** | **4** | **t** | **18** | 38 | 3 | 1 | **6** | 1985 |
| White Ash | 1 | 1 | t | 2 | 8 | 5 | 1 | 3 | t | 2 | 2 | 1980 |
| | 1 | 1 | t | **1** | 9 | **4** | 1 | **1** | t | **1** | 2 | 1985 |

**Plate 1.** *Above:* Picture of plot #8 taken in winter of 1980 from its northeast corner; note the clean appearance of the forest floor. *Below:* The same area after five growing seasons; note the ground clutter and dead standing trees.

For all trees, these importance values reflect a change of 10% over the values registered in 1979. Sugar maple itself increased in importance at a rate of 3.4% per year in Plot #9. Though there is no way of verifying whether this rate has been constant over time, if it has been, sugar maple would have taken about 125 years (from first appearance of a 4" tree) to attain its current importance; if it continues to increase at this rate, sugar maple will dominate wholly by 1996. For all ten non-cutover plots, the average yearly increase is 2.8%; at this rate, it would take 150 years for sugar maple to attain an importance of 66% and would place the beginning of the trend around 1835—the time of settlement. By the year 2000, our East Woods could be dominated fully by sugar maple. Some critical questions now are laid before us.

Does this recent, ongoing change reflect a "normal" succession from oak forest to maple forest? Or has there been a fundamental change in the post-settlement ecology of our biome? Have ecologists been looking only at the behavior of trees and failing to understand the forest?

## DISCUSSION

In attempting to understand the changes which we are observing in the 1980's, it is important to consider the nature of the East Woods plant community and the biotic and abiotic factors which govern vegetational development within it. It is important to accept the idea that there is no other place like ours on the earth's surface, and that our native vegetation once reflected this local uniqueness.

The Morton Arboretum is located on a continent in the north temperate climes, immediately west of a great fresh-water lake, remote from, but more or less in the rain shadow of, a vast mountain range. Our moisture comes at irregular intervals, largely from the Gulf of Mexico a thousand miles to the south. In the summer months, the temperatures approach 100 degrees Fahrenheit and we are exposed to hot, dry, desiccating winds from out of the west; in the winter, our temperatures plummet to sub-zero, sometimes for extended periods and often without an insulating blanket of snow. Moraines and outwash plains of wet alkaline tills were left here scarcely 15 thousand years ago by glaciers which for ages ground the Niagaran dolomitic bedrock. We are not the Shenandoah Valley, the Cumberland Plateau, Door County, or anywhere else in the world other than northeastern Illinois. Obvious as this may seem, a failure to keep it in mind, I believe, has crippled our ability to relate general ecological concepts to site-specific situations, and to natural lands in general.

When the first settlers arrived here in the early 1830's from New England and the northeastern states, what they saw inspired feelings of awe; the scene was so unfamiliar, so outside of their experience as to be almost indescribable. Some of them, nevertheless, put their impressions on paper:

> "In some instances, prairies are found stretching for miles around, without a tree or shrub, so level as scarcely to present a single undulation; in others, those called 'rolling prairies,' appears in undulation upon undulation, as far as the eye can reach presenting a view of peculiar sublimity, especially to the beholder for the first time. It seems when in verdure, a real troubled ocean, wave upon wave, rolls before you, ever varying, ever swelling; even the breezes play around to heighten the illusion . . . a fac-simile [sic!] of sublimity, which no miniature imitation can approach."
>
> Lieutenant D. Ruggles, 1835.

Early accounts are replete with descriptions of fires set by Indians in the presettlement landscape. According to the original land survey accounts, that portion of the Arboretum between the DuPage River and the East Woods was tall grass prairie. Such prairies were capable of producing intense fires. An early anonymous writer

waxed almost poetic in this account from 1828.

> "How shall I describe the sublime spectacle that then presented itself? I have seen the old Atlantic in his fury, a thunderstorm in the Alps, and the cataracts of Niagara; but nothing could be compared to what I saw at this moment. The line of flame rushed through the long grass with tremendous violence, and a noise like thunder; . . . The wind, which even previously had been high, was increased by the blaze which it fanned; and with such vehemence did it drive along the flames, that . . . It passed me like a whirlwind, and with a fury I shall never forget." Curtis, 1959

The East Woods, however, was timbered and the grasses beneath were no doubt much shorter. The fires in this area were quite different, perhaps more like George Catlin, the famous painter, described in 1842:

> "The prairies burning form some of the most beautiful scenes that are to be witnessed in this country . . . Over the elevated lands and prairie bluffs, where the grass is thin and short, the fire slowly creeps with a feeble flame, which one can easily step over; where the wild animals often rest in their lairs until the flames almost burn their noses, when they will reluctantly rise, and leap over it, and trot off amongst the cinders . . . These scenes at night become indescribably beautiful, when their flames are seen at many miles distance, creeping over the sides and tops of the bluffs, appearing to be sparkling and brilliant chains of liquid fire . . . hanging suspended in graceful festoons from the skies".

Such were the descriptions of our landscape as the settlers began to arrive. It is what they saw, immense open prairies, rolling, swelling, punctuated here and there by groves of "scattering timber" and "grassy woods." In the many swales and vast low prairies the land was unendurably wet and stretched on that way for miles. The tall, verdant grasses produced tremendous fuels for the prairie fires. Wooden plank roads that would float on the mud were constructed in the late 1840's; top dollar was paid for white oak timbers which were of suitable size to build them. Is it any wonder that most of our older white oaks date back to the time of settlement—those young ones which were too small to be cut into planks?

The oaks grew in groves, largely on the morainic rises in DuPage County on soils which were somewhat better drained than those of the low prairies and where the surface material had become more weathered and leached over thousands of years. The grasses and sedges that grew on them were low in stature. The fires these species produced were low, much gentler events, not the roiling conflagrations produced by the "tall grass." The trees that grew in these groves were open-grown, with wide-spreading branches, and they appeared in stands as dense as, perhaps, 50 trees per acre to as scarce as only single individuals.

In describing these presettlement timbers, accounts of early writers point out the importance of fire in maintaining the oak openings.

> ". . . magnificent oak-openings over the whole region except at the margins of the many lakelets and streams where maples, birches, lindens and willows flowered, . . . on the crests of the loftiest hills where the vegetation was sparse, and on a few patches of prairie . . . with their rank grasses swaying in the summer winds like the waters of the sea, and annually involved in the great fires which swept over the whole of the country, keeping it clear of shrubbery and underbrush, though not injuring the noble oaks which shaded the greater portions of the country." Theron Haight, 1907.

> "A large crop of grasses and other plants, annuals and perennials, grow [in these oak openings], many of which are gay flowered; these formed a thick coat for the devouring fires that ran over the country in former times, and caused much of its openings character. . . . The only trees that could withstand the fires were those so covered with an incombustible cork that the heat of the prairie fires could not penetrate to and destroy the cambium. The oaks, hickories, and some poplars could alone do this." J.G. Knapp, 1871.

In 1888, Dr. Joseph Mudd recalled and described the original vegetation of a timbered prairie as he had seen it years earlier. Then, he contrasted it with what he saw in his own time. He wrote one hundred years ago:

> "... When the county was first settled there was no under brush or small timber such as now exists. The timbered lands were open, the trees standing so far apart that the hunters could see deer at a distance from one to five hundred yards. The entire surface of the country was then covered with a rank growth of vegetation, consisting of the native grasses and wild flowers, which gave to the landscape, especially in the timbered lands, a much more beautiful appearance than it now has. Annually, after this rank growth of vegetation became frosted, dead and dry, the Indians set fire to it, and burned it from the entire surface of the country."

It should be apparent that these trees of the timbered prairies must, in fact, be viewed as prairie plants, for amongst them grew another two hundred species along with whose roots they shared the rhizosphere. These trees, while magnificent, easy to identify, and comely in stature, are no more or less significant to the systems in which they grew than the recondite but yet ubiquitous sprigs and tillers of Pennsylvania sedge (*Carex pensylvanica*) which, with yet other species, comprised the turf below. This turf, which fueled the fires and whose physiognomy controlled fire intensity, comprised a matrix within which our native flora, including the trees, once thrived.

The landscape just described is wholly and completely different from that found farther east, yet much of what we think we know about Illinois' "forest" ecology is derived either from studies in eastern forests or in post-settlement stands as they manifest themselves after a century of disturbance and eclectic management. An understanding of a plant community in which 99% of its native floristic elements has been ignored must be incomplete; further, if the understanding of the 1% [trees] is based upon data derived from their behavior in other biomes or out of context, then should we not regard this understanding with some circumspection?

We must change our perspective and accept the fact that our biome and our individual plant communities are different from all others on earth. We can then analyze what we observe in northern Illinois in a Midwestern context, to recognize that the earth's surface was diversely populated, to appreciate that the position of continents on the earth's face and their geomorphology all have had profound effects on vegetational structure and ecology, to accept that the whole world was not destined to "climax" in sugar maple. We must be open-minded and not unwilling to question that which has been taken as fact; with the view in mind that we want to understand our natural systems well enough to preserve our portion of what little remains of the earth's living richness.

## THEN and NOW and . . . , a THEORY

What has happened to the "large crops of grasses" and "gay-flowered" ground covers that once bedecked our prairie savannas, our oak timbers? Now one only can imagine the landscape as it might have been.

Early in the spring, before the leaves emerged from the trees, in soils soggy from winter snow melt and cold spring rains, there awakened in our timbered lands those delicate species which now are known locally as the "woodland wild flowers." Red and white trilliums, all manner of anemones, hepaticas, spring beauty, waterleafs, and numerous others flushed profusely. Their roots proliferating, respiring, drawing upon the water, acidified the rhizosphere and ameliorated the wetness—even as the precocious fibrous roots of the oaks, inextricably enmeshed with those of the

ground cover species, began the growth which would sustain the trees during the inevitable dry periods of summer.

A month or so later, as the leaves of the oaks and hickories emerged, the older leaves and stems of the vernal flush already had begun their decay in the moist, newly warmed soils of late spring. The resultant nutrient availability is as if timed precisely to coincide with the period of rapid growth in the trees. The gilled and pored mushrooms [ectomycorrhizal fungi] appeared copiously, their hyphae coupled and connected in a healthy commensal relationship with the vascular plants.

Spring bloomers also include the sedges, but their vegetative growth comes somewhat later, persists green through the moist periods, and begins to brown during dry periods. Their coarse leaves are slow to decompose; rather, like their grassland counterparts, they endure and insulate the soil from water loss due to evaporation; their stomates draw tight and soil water is conserved during drought periods. These upland sedges once formed the matrix within which hundreds of other species grew, each with different growing and flowering periods, different vegetative morphologies, and different decomposition relationships.

From the earliest harbingers of spring to the coarsest die-hards of fall, there was achieved a nutrient relationship, a water balance, and a rhizosphere milieu to which our oaks became long-accustomed. A gentle fire in spring or fall returned to the soil even the hard-stemmed asters and goldenrods, rendering the system able to start anew each year; a system tuned, adapted, and steeled to the stresses of the biome. It was a system composed of species conservative to the conditions, species which through eons of natural adaptations, or ecological "learning", "knew" how to live together under these conditions.

The conditions, however, changed profoundly at the time of settlement. Fires stopped, timbers were cut, ground cover was severely over-grazed, and topsoils became compacted. Remnant timbers became heavily over-stocked with trees of similar age; soil water relations became disrupted by ditching, tiling, and a drastically different evapotranspiration scenario.

Along with these changes of condition, there came a new set of plants which for millennia had become highly adapted to the kinds of things that agricultural, sedentary man does to land. These are the plants which followed European man and his agriculture and technology to the New World; this immigrant flora has supplanted the native flora nearly or quite as completely as we have supplanted North America's aboriginal culture.

Those species once restricted to the timbered prairies and savannas yielded long ago, and left only weakened skeletons, the trees, of a system once unique, rich, and alive, with a time-honored knowledge of this land. This knowledge is now all but forgotten, scattered in the genomes of what few remnant populations of native species are still with us in disconnected locations.

Most of what remains of our prairie timbers consists of dense growths of dying, even-aged oak. Their understories are either saplings of linden and maple or infested by Eurasian shrubs. In some instances, there remains yet a "spring flora" which appears before the canopy leaves arrive, but this soon is replaced by naked, black lightless ground vulnerable to erosion and evaporation. Our timbers in summer and fall are empty lifeless woods, a condition which has passed for more than half a century as a "successional stage" toward a beech/maple "climax."

Ecologists have preferred, it seems, to view the timbered prairies of the Midwest as some sort of enormous "gap phase" in incipiently mesophytic forest, the progress of which toward beech/maple

"climax" merely has been frustrated. Our curious tendency to regard only the trees, when thinking of forest or timber management, ironically in time may render our timbered lands oakless. Even the empty hollow maple stands, as the lifeless earth around their roots erodes away, may be replaced by disclimaxed thickets of Old World shrubs and weedy short-lived trees. The rhizosphere below, once rich with life, will pass to emptiness, or to domination by Virginia creeper, poison ivy, enchanter's nightshade, or garlic mustard.

The loss of our native flora and its accumulated knowledge of the biome will be lamented by our posterity. Essays on our lack of understanding will discourse wistfully, sanctimoniously on what once was but cannot be retrieved. Once our flora and its attendant fauna, indeed the system, is gone and its knowledge "forgotten", words will be only words; and the words of the ancient poet cannot be exaggerated:

> The moving finger writes,
> and having writ moves on,
> Nor all your piety nor wit
> shall lure it back to cancel half a line,
> Nor all your tears wash out a word of it.
> Omar Khayyam, *The Rubaiyat*

At this point in time, sufficient remnants of our natural systems remain such that I believe this bleak scenario can be avoided, that we can become better able to understand these ecosystems. We must, however, do what is necessary to preserve and manage properly these remnant systems. I believe that in so doing, we can learn to reestablish critical aspects of our biome which have been so neglected for the last 150 years. Enough remains that we can rehabilitate and propagate it, and in the process, become, ourselves, more in tune with the unique land on which we live.

One of the missions of the Morton Arboretum is to preserve not only individual species, but also the remnant ecosystems of which they were a part. These systems, with their array of pollinators and soil microorganisms, and their inherent stability, facilitate population gene flow necessary for the long-term survival of our native flora. With a revised understanding of our timbered lands, we look forward now, as part of our ongoing research efforts, to the development of management and restoration strategies which will optimize the survival of existing remnant ecosystems in the Morton Arboretum and in the region.

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